Flight Crew Operating Manual

FCOM

A310

Volume 1

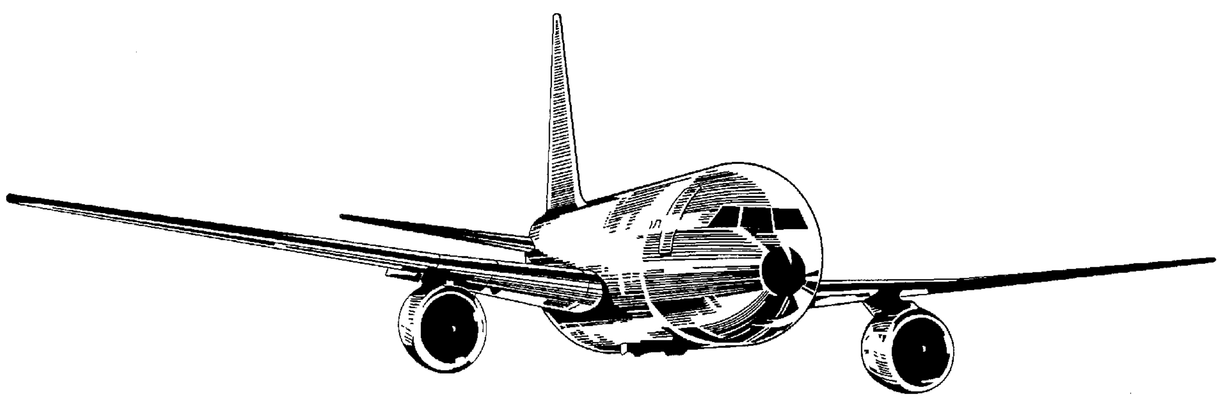
AIRBUS

AIRBUS TRAINING

A310

SIMULATOR

A310



FLIGHT CREW OPERATING MANUAL

AI/V-F 4000

SIMU S4 for training only 1PM

R *Note* : – *Chapter 1.21 is not published for SPERRY FMS.*
R – *Chapter 1.20 is not published for SMITHS FMS.*

COMMENTS - QUESTIONS - SUGGESTIONS

All manual holders and users are encouraged to forward their questions and suggestions regarding the Flight Crew Operating Manual.
Any questions with respect to use of this manual or information contained herein shall be directed to :

R AIRBUS – BP 33
1 ROND POINT MAURICE BELLONTE
31707 BLAGNAC CEDEX - FRANCE
TELEX TLSBI7X or 530526F
R FAX : 33/5.61.93.29.68
R ATTN. Flight Operations Support - STLW

FOR TECHNICAL OR PROCEDURAL CONTENT

R AIRBUS - BP 33
1 ROND POINT MAURICE BELLONTE
31707 BLAGNAC CEDEX – FRANCE
TELEX TLSBP7X or 530526F
FAX : 33/5.61.93.28.06
R ATTN. Technical Documentation Services – SDC

FOR PRINTING AND DISTRIBUTION

GENERAL

The purpose of this letter of transmittal is to provide some general information on the revision. It is used also in order to highlight the main changes introduced with the revision (additionally, each page revised contains its own highlight as listed in subchapter 1.00.02).

R ## MAIN TOPICS OF REVISION 39

R **CONFIGURATION MANAGEMENT AND NEW**
R **MODIFICATIONS**

R This revision is mainly issued for aircraft configuration
R management purposes, and to incorporate new system
R modifications.

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FOREWORD

This manual is complementary to the approved Flight Manual. While every endeavour is made to ensure that the data contained herein and that in the Flight Manual are in agreement, in the event of disagreement the Flight Manual is the final authority.

CONTENT

The Flight Crew Operating Manual is the support documentation for flight crew operations.

The Flight Crew Operating Manual provides operating crews with the technical, procedural and performance characteristics of the A310 aircraft to ensure a safe and efficient operation during normal and/or abnormal/emergency situations on ground and in flight.

However, the Flight Crew Operating Manual is not intended to provide basic jet aircraft piloting techniques or information that are considered as basic airmanship for trained flight crews familiar with that type of aircraft and with its general handling characteristics.

The Flight Crew Operating Manual is intended :

– to be used directly as flight crew operating manual or to be the basis for elaboration of the relevant parts of the "crew manual" by the operations department of the operator in accordance with applicable requirements.
– to be used as a flight crew training manual (initial and refresher). However, the Flight Crew Operating Manual is not intended to be used for teaching basic piloting skills.

The contents are divided into two volumes :

– Vol. 1 : SYSTEMS DESCRIPTION
  Volume 1 contains description of the aircraft and the systems.
– Vol. 2 : PROCEDURES AND PERFORMANCE.
  Volume 2 contains operating and performance information plus loading data.

The material included in this volume has been extracted from the Flight Manual as far as the certified parts are concerned.

If any of the procedures or performance data contained in Vol. 2 are not in agreement with the Flight Manual, the latter will supersede.

Airline experience and flight test inputs have been taken into account.

R ## CAUTIONS AND NOTES

CAUTION

R Text of the CAUTION

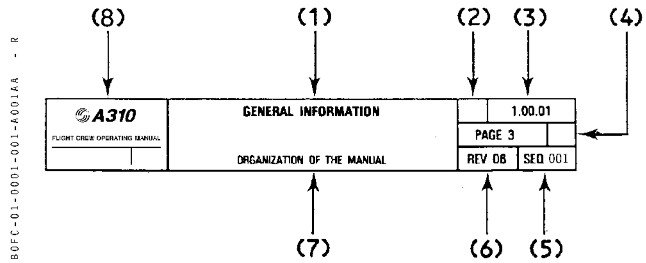
R Used to precise certain procedures or to avoid a misusing.

R *Note : Text of the Note.*

R Used to underline the corresponding point or to give a
R supplementary information.

PAGINATION

TOP OF THE PAGE



(1) Chapter title

(2) Blank space

(3) FCOM Volume/Chapter/Section number

(4) Page number followed by L which indicates weights are given in pounds. If there is no indication, the page is valid for both pounds and tons.

When a new page must be inserted between two existing pages, a suffix letter is added to the page number.

Ex. : Page 24-A must be inserted between page 24 and page 25.

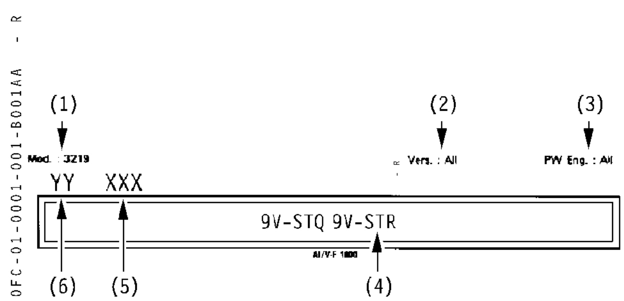
(5) Sequence number :
It allows an easier management of the pages for Airbus Industrie and allows to enter the List of Effective Pages. It may be used by each manual holder to simplify manuals updating.

(6) Number of the revision.

(7) Section title.

(8) Airbus logo or Airline logo.

BOTTOM OF THE PAGE



(1) This zone contains :
– either, applicable modification (MOD) or/and modification proposal (MP) number(s) (validation criteria).
– or, a « Code » number (ex : 0029) (validation criteria) when a combination of various modifications applies.
A table of correspondence between « Code » numbers and MOD/MP number(s) is given in this chapter 1.00.25.

(2) Indicates page specific to the particular aircraft version (validation criteria). When there is no indication or ALL indication, the page is valid for all versions restricted by others validation criteria.

(3) Indicates page specific to type of engine installed (validation criteria). When there is no indication or ALL indication, the page is valid for all engines, restricted by others validation criteria.

(4) This zone is used for listing operator's aircraft MSN or tail number if this option has been taken.

(5) Airline three-letter abbreviation (e.g.XXX) if page only applicable to XXX airline.

(6) The two letter abbreviation (e.g. YY) indicates a specific page written to comply with local regulations, eg :
- AA : for Australian regulations
- UK : for C.A.A. regulations
- US : for F.A.A. regulations.

REVISIONS

NORMAL REVISIONS

Issued periodically to cover non-urgent corrections, changes or/and to add new data.
They are accompanied by filing instructions and an updated List of Effective Pages including customized pages.
R Highlights are also provided to give background information
R on the changes introduced with the revision.
R A normal revision record sheet is provided at the front
R of each volume.
R In addition, a « List of MOD/MP affecting the manual »
R is provided, giving a simple explanation of the technical
R content of each MOD/MP incorporated and their validity
R per aircraft.
R
R

TEMPORARY REVISIONS

Printed on yellow paper, issued to cover urgent matters arising between normal revisions, they are accompanied by filing instructions.
R

The applicability of each temporary revision is given on the customized List of Effective Temporary Revisions (LETR) issued with each new temporary revision.

INTERMEDIATE REVISIONS

Intermediate revisions of the FCOM/QRH are used when the need occurs to :

- supply the contractual allocation of manuals to a new operator between two normal revisions
- validate aircraft configuration changes by retrofit of Airbus Service Bulletins between two normal revisions (on request of the operator)
- validate fleet composition changes (new aircraft) between two normal revisions.

EXAMPLE

A suffix letter after the revision number indicates an intermediate revision, between two normal revisions, e.g., 023A issued between normal revisions 023 and 024. R

This service allows Airbus Operators to use at any time up-to-date manuals. It is quicker than issuing a Temporary Revision and allows direct replacement in the manuals of only the affected white pages instead of inserting yellow pages.

INCORPORATION OF SERVICE BULLETINS IN THE FCOM

When a Service Bulletin has been accomplished on one or more aircraft of the operators fleet, and notified to AIRBUS, all affected manuals will reflect the new aircraft configuration at the next revision. If judged necessary by AIRBUS, or requested by the operator, a "Temporary Revision" will be issued between normal revisions.

R

HOW TO INSERT A REVISION

GENERAL

FCOM and checklists are customized in such a way to allow an airline to elaborate :
- either, an envelope airline manual (available in a library)
- or, an airplane manual valid for a particular airplane (on board of this airplane).

Two documents added to each revision allow this work :

- the « Filing instructions »
- the « List of Effective Pages – LEP ».

FILING INSTRUCTIONS

Use the filing instructions as follows :

- REMOVE : The page must be removed. It may be replaced by a new page if associated with an "INSERT" instruction. If not, the page is cancelled.
- INSERT : The page must be inserted. If not associated with a "REMOVE" instruction, the page is new for the operator fleet and does not replace an existing one.

The column "NOTE" indicates the reason for change. It states "EFFECTIVITY CHANGE ONLY" if the page is only revised due to effectivity change and not due to technical content.

LIST OF EFFECTIVE PAGES (LEP)

The manual after revision must comply with the LEP, which lists all the pages that are in the manual. The new pages are indicated by "N" and the revised pages by "R".

BEST WAY TO GET UPDATED DOCUMENTATION

The best way, for an airline, to be sure getting, regularly, correct updated documentation is to advise :

AIRBUS
BP 33
31707 BLAGNAC CEDEX
FRANCE

Telex : TLSBP7X or 530526F

FAX : (33) 5.61.93.28.06

ATTN : Customer Service Directorate – Technical Documentation Services (SDC).
R or via e-mail at : sb.reporting@airbus.com

as soon as any Airbus Service Bulletin is completely performed on any airplane.

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THIS TABLE GIVES, FOR EACH AIRCRAFT INCLUDED IN THE MANUAL, THE CROSS REFERENCE BETWEEN :

- THE MANUFACTURING SERIAL NUMBER (MSN) WHICH APPEARS IN THE LIST OF EFFECTIVE PAGES
- THE REGISTRATION NUMBER OF THE AIRCRAFT AS KNOWN BY AIRBUS INDUSTRIE.

MSN	REGISTRATION
0596	SIMU-S4104

V	CH	SEC	PAGE	SEQ	REV	VALIDATION CRITERIA / REASONS OF CHANGE
1	10	70	001	001	REV031	STD OR M:(4803+5884)
						- INCORPORATION OF MOD 05884
1	19	10	001	200	REV037	M:11320=11364=12044=12045
						- INCORPORATION OF MOD 11320 - INCORPORATION OF MOD 11364
1	20	52	001	100	REV037	M:6789
						- INCORPORATION OF MOD 06789
1	20	66	002	100	REV037	M:6789
						- INCORPORATION OF MOD 06789
1	20	71	002	100	REV037	M:6789
						- INCORPORATION OF MOD 06789
1	20	71	004	100	REV037	M:6789
						- INCORPORATION OF MOD 06789
1	20	71	005	110	REV037	M:4801+6789
						- INCORPORATION OF MOD 06789
1	20	71	008	100	REV037	M:6789
						- INCORPORATION OF MOD 06789
1	20	71	009	100	REV037	M:6789
						- INCORPORATION OF MOD 06789
1	20	73	020	100	REV037	M:6789
						- INCORPORATION OF MOD 06789

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
						----------EFFECTIVITY----------	
1		00	00	001	001	REV038	CONTENTS
1		00	00	002	001	REV035	COMMENTS
						ALL	
1		00	00	003	001	REV039	LETTER OF TRANSMITTAL
1		00	00	004	001	REV038	
						ALL	
1		00	01	001	001	REV038	ORGANIZATION OF THE MANUAL
1		00	01	002	001	REV035	ORGANIZATION OF THE MANUAL
						ALL	
1		00	01	003	001	REV038	ORGANIZATION OF THE MANUAL
1		00	01	004	001	REV034	
						ALL	
1		00	02	CRT	001	REV039	CROSS REFERENCE TABLE
						ALL	
1		00	02	HL	001	REV039	HIGHLIGHTS
						ALL	
1		00	02	LEP	001	REV039	LIST OF EFFECTIVE PAGES
						ALL	
1		00	02	LOM	001	REV039	LIST OF MOD/MP/SB
						ALL	
1		00	03	001	001	REV039	LIST OF NORMAL REVISIONS
1		00	03	002	001	REV038	LIST OF NORMAL REVISIONS
						ALL	
1		00	04	000-LTR	001		LIST OF TEMPORARY REVISIONS
						ALL	
1		00	04	001	001	REV033	LIST OF TEMPORARY REVISIONS
1		00	04	002	001	REV033	LIST OF TEMPORARY REVISIONS
						ALL	
1		00	05	001	001	REV038	
1		00	05	002	001	REV038	
						ALL	
1		00	05	003	001	REV038	
1		00	05	004	001	REV038	
						ALL	
1		00	05	005	001	REV038	
1		00	05	006	001	REV038	
						ALL	
1		00	06	001	001	REV025	
1		00	06	002	001	REV020	
						ALL	
1		00	25	001	001	REV039	LIST OF CODES
1		00	25	002	001	REV039	LIST OF CODES
						ALL	
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1		00	25	004	001	REV039	LIST OF CODES
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1		00	25	005	001	REV039	LIST OF CODES
1		00	25	006	001	REV039	LIST OF CODES
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1		00	25	007	001	REV039	LIST OF CODES
1		00	25	008	001	REV039	LIST OF CODES
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1		00	25	009	001	REV039	LIST OF CODES
1		00	25	010	001	REV039	LIST OF CODES
						ALL	
1		00	25	011	001	REV039	LIST OF CODES
1		00	25	012	001	REV039	LIST OF CODES
						ALL	
1		00	25	013	001	REV039	LIST OF CODES
1		00	25	014	001	REV039	LIST OF CODES
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1		01	00	002	001	REV036	
						ALL	
1		01	10	001	001	REV028	
1		01	10	002	010	REV023	MOD 4863 ALL-PW
						ALL	

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
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1		01	10	003	020	REV014	MOD 4863
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1		01	10	005-6	001	REV008	ALL/ALL
						ALL	
1		01	20	001	105	REV030	M:4803
1		01	20	002	025	REV013	MOD 4803
						ALL	
1		01	20	003	001	REV030	
1		01	20	004	025	REV013	MOD 4803
						ALL	
1		01	30	001	110	REV036	M:12557
1		01	30	002	001	REV036	
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1		01	35	002	100	REV037	CODE 0201
						ALL	
1		01	35	003	100	REV037	CODE 0201
1		01	35	004	100	REV038	CODE 0201
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1		01	38	001	310	REV036	M:5051+5448+5725
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1		01	40	001	001	REV028	
1		01	40	002	001	REV020	
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1		01	40	003	010	REV033	M:3004
1		01	40	004	001	REV024	
						ALL	
1		01	40	005	020	REV021	MOD 4803
1		01	40	006	020	REV026	MOD.4803
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1		01	40	007	200	REV036	M:4803+12557
1		01	40	008	040	REV026	MOD.4803+5051
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1		01	40	009	001	MAR1983	
1		01	40	010	010	REV026	MOD.3004
						ALL	
1		01	40	011-12	001	REV030	
						ALL	
1		01	50	001-2	030	REV013	MOD 4803
						ALL	
1		02	00	001-2	001	REV014	
						ALL	
1		02	10	001	001	REV019	
1		02	10	002	050	REV033	M:2989+3881
						ALL	
1		02	20	001	001	REV028	
1		02	20	002	020	REV017	MOD 2989
						ALL	
1		02	20	003	020	REV033	M:5289
1		02	20	004	040	REV016	MOD 3881+6334
						ALL	
1		02	20	005	001	REV008	ALL/ALL
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1		02	20	009	001	REV020	
1		02	20	010	400	REV034	M:2989+5289+6106+6444
						ALL	
1		02	20	011	020	REV012	MOD 2989 ALL/ALL
1		02	20	012	001	MAR1983	
						ALL	
1		02	20	013	001	REV028	
1		02	20	014	050	REV025	MOD.2989+6041
						ALL	

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----	----------EFFECTIVITY----------
	1	02	20	015-16	025	REV013	MOD 5051	ALL
	1	02	30	001	040	REV035	M:3881+4765	
	1	02	30	002	100	REV030	MOD:3881=5282 OR (3881+5282)	ALL
	1	02	30	003	100	REV030	MOD:3881=5282 OR (3881+5282)	
	1	02	30	004	050	REV011	MOD 3881+4765	ALL
	1	02	30	005	020	REV008	MOD 3881	
	1	02	30	006	040	REV007	MOD 3881+4765	ALL
	1	02	30	007	020	REV030	MOD:3881 OR (3881+5282)	
	1	02	30	008	200	REV035	M:3881+5448	ALL
	1	02	30	009	200	REV036	M:3881+4765	
	1	02	30	010	020	REV028	MOD 3881	ALL
	1	02	30	011-12	030	REV017	MOD 3881+5051	ALL
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	1	02	40	004	001	REV017	CODE 0240G	ALL
	1	02	40	005	001	REV008	ALL/ALL	
	1	02	40	006	025	REV017	MOD 5051	ALL
	1	02	50	001-2	205	REV037	M:2989+3881	ALL
	1	03	00	001	001	REV030		
	1	03	00	002	230	REV032	M:(5051+MPS5063)=(5051+6523)	ALL
	1	03	10	001	100	REV033	MPS5063 OR M:6523	
	1	03	10	002	100	REV031	MPS 5063 OR MOD 6523	ALL
	1	03	10	003	001	REV030		
	1	03	10	004	001	REV031		ALL
	1	03	10	005	105	REV031	MPS5063 OR 6523	
	1	03	10	006	001	REV031		ALL
	1	03	11	001	100	REV039	M:11899=11900=(11899+11900)	
	1	03	11	002	001	REV031		ALL
	1	03	11	003	001	REV030		
	1	03	11	004	001	REV031		ALL
	1	03	12	001	001	REV032		
	1	03	12	002	110	REV030	MOD:6036	ALL
	1	03	12	003	001	REV031		
	1	03	12	004	001	REV037		ALL
	1	03	12	005	001	REV031		
	1	03	12	006	001	REV030		ALL
	1	03	12	007	001	REV031		
	1	03	12	008	100	REV031	MPS5063 OR M:6523	ALL
	1	03	12	009	001	REV031		
	1	03	12	010	001	REV031		ALL
	1	03	13	001	100	REV030	MPS5063 OR M:6523	
	1	03	13	002	100	REV039	M:7187	ALL
	1	03	13	003	100	REV039	M:11899=11900=(11899+11900)	
	1	03	13	004	100	REV039	M:11899=11900=(11899+11900)	ALL
	1	03	20	001	100	REV036	MPS5063 OR M:6523	
	1	03	20	002	100	REV031	MPS5063 OR M:6523	ALL
	1	03	20	003	100	REV031	MPS5063 OR M:6523	
	1	03	20	004	001	REV031		ALL
	1	03	21	001	001	REV032		
	1	03	21	002	001	REV031		ALL
	1	03	22	001	210	REV035	CODE 0045	
	1	03	22	002	001	REV031		ALL
	1	03	23	001	001	REV039	CODE 0250	
	1	03	23	002	001	REV030		ALL
	1	03	24	001	100	REV031	MP S5063 OR M:6523	
	1	03	24	002	001	REV031		ALL
	1	03	25	001	110	REV032	MPS5063 OR M:6523/PW 4000	
	1	03	25	002	001	REV031		ALL
	1	03	26	001	210	REV030	M:5051+6523 = MP S5063+5051	
	1	03	26	002	001	REV031		ALL
	1	03	30	001	001	REV031		
	1	03	30	002	001	REV030		ALL
	1	03	30	003	001	REV031		
	1	03	30	004	001	REV031		ALL
	1	03	31	001	001	REV031	STD OR M:5051+6415	
	1	03	31	002	100	REV031	M:5051	ALL
	1	03	32	001	001	REV032		
	1	03	32	002	001	REV030		ALL
	1	03	33	001	100	REV031	M:11442	
	1	03	33	002	200	REV039	CODE 0258	ALL
	1	03	33	003	100	REV031	M:11454	
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	1	03	41	001	100	REV031	M:7187	
	1	03	41	002	100	REV030	MOD : 6036	ALL
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	1	03	41	004	001	REV031		ALL
	1	03	42	001	100	REV034	M:11899=11900	
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	1	03	42	003	120	REV034	M:11899=11900	
	1	03	42	004	100	REV034	M:11899=11900	ALL
	1	03	43	001	001	REV031		
	1	03	43	002	120	REV031	M:6036	ALL
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	1	03	43	004	001	REV031		ALL
	1	03	44	001	001	REV030		
	1	03	44	002	001	REV030		ALL
	1	03	44	003	001	REV030		
	1	03	44	004	001	REV030		ALL

M	V	CH	SEC	PAGE	SEQ	REV	VALIDATION CRITERIA
M	V	CH	SEC	PAGE	SEQ	REV / EFFECTIVITY	VALIDATION CRITERIA
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	1	03	45	002	001	REV031	
						ALL	
	1	03	46	001	001	REV030	
	1	03	46	002	001	REV031	
						ALL	
	1	03	47	001	001	REV030	
	1	03	47	002	001	REV030	
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	1	03	49	002	001	REV030	
						ALL	
	1	03	50	001	001	REV031	
	1	03	50	002	001	REV032	
						ALL	
	1	03	50	003	001	REV030	
	1	03	50	004	001	REV031	
						ALL	
	1	03	50	005	100	REV031	M:5051
	1	03	50	006	001	REV036	
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	1	03	51	001	001	REV033	
	1	03	51	002	001	REV032	
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	1	03	52	001	001	REV038	
	1	03	52	002	001	REV031	
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	1	03	52	003	001	REV030	
	1	03	52	004	001	REV038	
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	1	03	60	001	001	REV030	
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	1	04	10	002	001	REV010	ALL/ALL
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	1	04	10	003-4	001	REV008	ALL/ALL
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	1	04	20	002	001	REV008	ALL/ALL
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	1	04	30	001	001	REV008	ALL/ALL
	1	04	30	002	001	REV034	
						ALL	
	1	04	40	001	001	REV008	ALL/ALL
	1	04	40	002	001	REV019	
						ALL	
	1	04	50	001	001	REV027	
	1	04	50	002	001	REV008	ALL/ALL
						ALL	
	1	04	60	001	000	REV019	
	1	04	60	002	000	REV029	
						ALL	
	1	04	70	001	025	REV018	MOD 4540
	1	04	70	002	001	REV029	
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	1	04	80	001	001	REV029	
	1	04	80	002	001	REV029	
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	1	04	80	003-4	020	REV019	MOD 5051
						ALL	

M	V	CH	SEC	PAGE	SEQ	REV	VALIDATION CRITERIA
M	V	CH	SEC	PAGE	SEQ	REV / EFFECTIVITY	VALIDATION CRITERIA
	1	04	90	001	001	REV029	
	1	04	90	002	001	REV014	
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	1	05	00	001	001	REV032	
	1	05	00	002	100	REV032	M:4803
						ALL	
	1	05	00	003	001	REV032	
	1	05	00	004	001	REV032	
						ALL	
	1	05	10	001	001	REV032	
	1	05	10	002	001	REV032	
						ALL	
	1	05	20	001	110	REV035	M:5910=(5910/UR)
	1	05	20	002	001	REV032	
						ALL	
	1	05	20	003	001	REV032	
	1	05	20	004	001	REV034	
						ALL	
	1	05	20	005	001	REV038	
	1	05	20	006	001	REV032	
						ALL	
	1	05	30	001	001	REV032	
	1	05	30	002	001	REV032	
						ALL	
	1	05	30	003	001	REV032	
	1	05	30	004	001	REV032	
						ALL	
	1	05	40	001	001	REV032	
	1	05	40	002	100	REV032	M: 4803
						ALL	
	1	05	40	003	001	REV037	
	1	05	40	004	001	REV032	
						ALL	
	1	05	50	001	001	REV032	
	1	05	50	002	100	REV032	M:4803
						ALL	
	1	05	50	003	001	REV032	
	1	05	50	004	001	REV032	
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	1	05	60	001	001	REV032	
	1	05	60	002	001	REV032	
						ALL	
	1	05	70	001	001	REV036	
	1	05	70	002	001	REV037	
						ALL	
	1	06	00	001	001	REV030	
	1	06	00	002	105	REV030	MOD 5911
						ALL	
	1	06	10	001	100	REV032	M:5911
	1	06	10	002	100	REV034	M:5911
						ALL	
	1	06	20	001	001	REV031	
	1	06	20	002	001	REV030	
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	1	06	21	001	001	REV031	
	1	06	21	002	001	REV030	
						ALL	
	1	06	30	001	001	REV031	
	1	06	30	002	001	REV031	
						ALL	
	1	06	30	003	001	REV030	
	1	06	30	004	001	REV031	
						ALL	
	1	06	30	005	001	REV031	
	1	06	30	006	001	REV031	
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	1	06	30	007	001	REV031	
	1	06	30	008	001	REV031	
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M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
1		06	31	001	001	REV031	
1		06	31	002	001	REV031	
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1		06	31	003	105	REV030	MOD 5911 OR(4705 + 5911)
1		06	31	004	001	REV031	
						ALL	
1		06	32	001	001	REV031	
1		06	32	002	001	REV031	
						ALL	
1		06	32	003	100	REV038	M:5051
1		06	32	004	001	REV030	
						ALL	
1		06	33	001	100	REV033	M:5911
1		06	33	002	001	REV030	
						ALL	
1		06	40	001	001	REV034	
1		06	40	002	200	REV031	MOD 5911 + 7770
						ALL	
1		06	41	001	001	REV030	
1		06	41	002	001	REV030	
						ALL	
1		06	41	003	001	REV031	
1		06	41	004	001	REV030	
						ALL	
1		06	42	001	001	REV031	
1		06	42	002	100	REV030	MOD 5051
						ALL	
1		06	50	001	100	REV031	MOD 5911
1		06	50	002	100	REV033	M:5911
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1		06	51	001	100	REV030	MOD 5911
1		06	51	002	001	REV030	
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1		06	60	001	100	REV032	M:5911
1		06	60	002	001	REV030	
						ALL	
1		07	00	001-2	001	REV011	
						ALL	
1		07	10	001	200	REV036	M:4803+12557
1		07	10	002	045	REV028	MOD 4803+5414
						ALL	
1		07	10	003	000	REV008	
1		07	10	004	000	REV008	
						ALL	
1		07	20	001	210	REV033	M:(2965+8199)=(2965+10991)
1		07	20	002	030	REV017	MOD 4803
						ALL	
1		07	20	003	001	REV008	
1		07	20	004	001	REV020	
						ALL	
1		07	20	005	001	REV038	
1		07	20	006	001	REV036	
						ALL	
1		07	30	001	035	REV013	MOD 2994+4803
1		07	30	002	001	REV009	
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1		07	30	003	035	REV013	MOD.2994+4803
1		07	30	004	035	REV013	MOD 2994+4803
						ALL	
1		07	40	001-2	001	REV030	
						ALL	
1		08	00	001-2	001	REV020	
						ALL	
1		08	10	001	050	REV038	PW ALL
1		08	10	002	001	REV016	
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1		08	10	003	001	REV029	
1		08	10	004	001	REV034	
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M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
1		08	10	005	020	REV016	MOD 5051
1		08	10	006	001	REV008	
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1		08	10	007-8	100	REV033	M:5051
						ALL	
1		08	20	001	001	REV027	
1		08	20	002	001	REV016	
						ALL	
1		08	20	003	001	REV008	
1		08	20	004	001	REV029	
						ALL	
1		08	20	005	020	REV016	MOD 5051
1		08	20	006	001	REV014	
						ALL	
1		08	20	007-8	020	REV026	MOD 5051
						ALL	
1		08	30	001	040	REV010	MOD 2254+2989
1		08	30	002	040	REV008	MOD 2254+2989
						ALL	
1		08	30	003	020	REV014	MOD 2254
1		08	30	004	001	REV008	
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1		08	30	005	020	REV016	MOD 2254
1		08	30	006	020	REV019	MOD 2254
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1		08	30	007	050	REV017	MOD 2254+5051
1		08	30	008	001	REV008	
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1		08	40	001	001	REV008	
1		08	40	002	001	REV026	
						ALL	
1		08	40	003	002	REV014	
1		08	40	004	002	REV008	
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1		08	40	005-6	020	REV017	MOD 5051
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1		08	60	001	100	REV021	MOD 2254+5051
1		08	60	002	001	REV020	
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1		09	00	001	001	REV030	
1		09	00	002	001	REV030	
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1		09	10	001	001	REV032	
1		09	10	002	001	REV030	
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1		09	11	001	001	REV030	
1		09	11	002	001	REV031	
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1		09	12	001	200	REV035	CODE 0084
1		09	12	002	001	REV034	
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1		09	12	003	001	REV036	
1		09	12	004	200	REV035	CODE 0084
						ALL	
1		09	13	001	100	REV030	M:5330
1		09	13	002	001	REV038	
						ALL	
1		09	14	001	200	REV036	MOD 5408+11442
1		09	14	002	001	REV030	
						ALL	
1		09	15	001	100	REV031	M:5330
1		09	15	002	001	REV030	
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1		09	16	001	001	REV030	
1		09	16	002	001	REV031	
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1		09	20	001	100	REV030	M:5904
1		09	20	002	001	REV031	
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M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
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1 09 21	001	100	REV037	M:4803
1 09 21	002	001	REV037	
			ALL	
1 09 22	001	001	REV030	
			ALL	
1 09 23	001	001	REV030	
1 09 23	002	100	REV030	MOD 11442
			ALL	
1 09 24	001	001	REV036	
1 09 24	002	100	REV039	M:5224
			ALL	
1 09 25	001	001	REV030	
1 09 25	002	001	REV031	
			ALL	
1 09 30	001	001	REV035	
1 09 30	002	001	REV030	
			ALL	
1 09 40	001	100	REV030	M:5051
1 09 40	002	100	REV030	M:5051
			ALL	
1 09 40	003	100	REV030	M:5051
1 09 40	004	100	REV030	M:5051
			ALL	
1 09 40	005	100	REV030	M:5051
1 09 40	006	100	REV030	M:5051
			ALL	
1 09 50	001	220	REV030	M:4801+5051 PW 4000
1 09 50	002	105	REV030	M:5051
			ALL	
1 09 51	001	210	REV032	M:4801+5051 PW 4000
1 09 51	002	001	REV031	
			ALL	
1 10 00	001	001	REV030	
1 10 00	002	001	REV030	
			ALL	
1 10 00	003	001	REV030	
1 10 00	004	110	REV030	MOD:8601OR10107OR(8601+10107
			ALL	
1 10 10	001	001	REV030	
			ALL	
1 10 11	001	001	REV030	
1 10 11	002	001	REV030	
			ALL	
1 10 12	001	101	REV037	M:12291 OR(5846+11123+12291)
1 10 12	002	100	REV031	MPS5063 OR M:6523
			ALL	
1 10 12	003	110	REV030	MOD : 5735
1 10 12	004	001	REV031	
			ALL	
1 10 13	001	100	REV031	M:5051
1 10 13	002	100	REV030	M:5051
			ALL	
1 10 20	001	001	REV031	
1 10 20	002	001	REV031	
			ALL	
1 10 21	001	001	REV030	
1 10 21	002	101	REV037	M:12291
			ALL	
1 10 22	001	001	REV031	
1 10 22	002	100	REV037	CODE 0157
			ALL	
1 10 22	003	001	REV036	
1 10 22	004	001	REV030	
			ALL	
1 10 22	005	001	REV030	
1 10 22	006	001	REV031	
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M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
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1 10 23	001	001	REV030	
1 10 23	002	001	REV031	
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1 10 24	001	001	REV031	
1 10 24	002	001	REV030	
			ALL	
1 10 24	003	001	REV031	
1 10 24	004	001	REV036	
			ALL	
1 10 25	001	001	REV032	
1 10 25	002	001	REV031	
			ALL	
1 10 26	001	001	REV031	
1 10 26	002	001	REV031	
			ALL	
1 10 27	001	001	REV031	
1 10 27	002	001	REV031	
			ALL	
1 10 27	003	001	REV031	
1 10 27	004	001	REV031	
			ALL	
1 10 28	001	205	REV039	M:5051+7985
1 10 28	002	001	REV031	
			ALL	
1 10 29	001	100	REV030	M:5051
1 10 29	002	001	REV031	
			ALL	
1 10 30	001	001	REV031	
1 10 30	002	001	REV031	
			ALL	
1 10 31	001	001	REV038	
1 10 31	002	001	REV038	
			ALL	
1 10 40	001	001	REV030	
1 10 40	002	001	REV031	
			ALL	
1 10 41	001	001	REV034	
1 10 41	002	100	REV036	M:4024
			ALL	
1 10 42	001	100	REV030	M:5051
1 10 42	002	001	REV031	
			ALL	
1 10 50	001	103	REV030	M:10107 OR (8601+10107)
1 10 50	002	001	REV031	
			ALL	
1 10 51	001	100	REV030	M:5051
1 10 51	002	001	REV031	
			ALL	
1 10 55	001	001	REV030	
1 10 55	002	001	REV030	
			ALL	
1 10 56	001	100	REV037	CODE 0225
1 10 56	002	200	REV038	CODE 0233
			ALL	
1 10 57	001	100	REV037	CODE 0225
1 10 57	002	110	REV037	CODE:0218
			ALL	
1 10 57	003	100	REV037	CODE 0227
1 10 57	004	115	REV038	CODE:0234
			ALL	
1 10 58	001	300	REV036	CODE 0197
1 10 58	002	105	REV032	M: 11351
			ALL	
1 10 60	001	001	REV030	
1 10 60	002	001	REV030	
			ALL	
1 10 61	001	001	REV030	
1 10 61	002	001	REV031	
			ALL	

M	V	CH	SEC	---PAGE--	SEQ-	--REV-- / ---EFFECTIVITY---	-----VALIDATION CRITERIA----
1	10	62		001	100	REV030	M:3832
1	10	62		002	100	REV030	M:3221
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1	10	70		001	001	REV031	STD OR M:(4803+5884)
1	10	70		002	001	REV031	
						ALL	
1	10	71		001	001	REV031	
1	10	71		002	001	REV030	
						ALL	
1	10	72		001	001	REV030	
1	10	72		002	001	REV031	
						ALL	
1	10	73		001	001	REV032	
1	10	73		002	001	REV031	
						ALL	
1	10	74		001	001	REV031	
1	10	74		002	001	REV030	
						ALL	
1	10	75		001	001	REV031	STD OR M:(5846+11123)
1	10	75		002	001	REV031	
						ALL	
1	10	76		001	001	REV030	
1	10	76		002	001	REV031	
						ALL	
1	10	77		001	001	REV030	
1	10	77		002	001	REV030	
						ALL	
1	10	78		001	001	REV030	
1	10	78		002	001	REV031	
						ALL	
1	10	80		001	115	REV033	CODE:0002
1	10	80		002	115	REV033	CODE:0037
						ALL	
1	10	81		001	100	REV033	CODE:0042
1	10	81		002	110	REV039	CODE 0042
						ALL	
1	10	81		003	110	REV033	CODE:0044
1	10	81		004	100	REV033	CODE 0065
						ALL	
1	10	81		005	100	REV033	CODE 0065
1	10	81		006	100	REV033	CODE 0065
						ALL	
1	10	82		001	103	REV036	M:11894
1	10	82		002	325	REV037	M:4803+5697+6234
						ALL	
1	10	82		003	100	REV037	CODE:0208
1	10	82		004	100	REV033	CODE 0064
						ALL	
1	10	83		001	100	REV033	CODE 0065
1	10	83		002	100	REV033	CODE 0065
						ALL	
1	10	90		001	001	REV030	STD OR FDX
1	10	90		002	001	REV030	
						ALL	
1	10	90		003	001	REV030	
1	10	90		004	001	REV030	
						ALL	
1	10	91		001	001	REV030	
1	10	91		002	105	REV030	M:S5063=6523 OR (S5063+6523)
						ALL	
1	10	92		001	200	REV030	M:3732+6445=6119+6445
1	10	92		002	100	REV030	M:3732=6119
						ALL	
1	10	93		001	001	REV031	
1	10	93		002	001	REV031	
						ALL	
1	10	94		001	001	REV032	
1	10	94		002	001	REV030	
						ALL	
1	10	94		003	001	REV030	
1	10	94		004	001	REV031	
						ALL	
1	10	95		001	001	REV030	
1	10	95		002	001	REV031	
						ALL	
1	11	00		001	001	REV031	
1	11	00		002	220	REV037	M:4801+5875=4801+5875+6875
						ALL	
1	11	10		001	100	REV036	MOD 4801
1	11	10		002	001	REV030	
						ALL	
1	11	11		001	310	REV034	M:4801+4917+5027
1	11	11		002	001	REV030	
						ALL	
1	11	20		001	200	REV030	MOD 4801 + 5875
1	11	20		002	100	REV032	M:4801
						ALL	
1	11	30		001	001	REV030	
1	11	30		002	001	REV030	
						ALL	
1	11	40		001	100	REV034	M:4917
1	11	40		002	200	REV037	M:4801+5562
						ALL	
1	11	40		003	001	REV036	
1	11	40		004	001	REV031	
						ALL	
1	11	40		005	300	REV034	M:4801+6368+8648
1	11	40		006	001	REV031	
						ALL	
1	11	41		001	100	REV034	M:4917
1	11	41		002	001	REV030	
						ALL	
1	11	42		001	001	REV031	
1	11	42		002	240	REV031	MOD 6843 + 6845
						ALL	
1	11	43		001	100	REV036	M:4801=(4801+7576)
1	11	43		002	100	REV034	M:5051
						ALL	
1	11	43		003	300	REV037	M:5051+5562+6519
1	11	43		004	001	REV031	
						ALL	
1	11	50		001	120	REV030	M:4801=6875 OR (4801+6875)
1	11	50		002	001	REV030	
						ALL	
1	11	51		001	210	REV036	M:4801+6605
1	11	51		002	001	REV030	
						ALL	
1	11	52		001	200	REV036	(4801+5051)=(4801+5051+7576)
1	11	52		002	001	REV030	
						ALL	
1	11	60		001	205	REV033	M:4801+5027
1	11	60		002	001	REV036	
						ALL	
1	11	60		003	200	REV030	M:(3028+4801)=(4801+5027)
1	11	60		004	001	REV030	
						ALL	
1	11	61		001	140	REV032	M:4801 OR (4801+6702+11756)
1	11	61		002	140	REV032	M:4801 OR (4801+6702+11756)
						ALL	
1	11	61		003	001	REV030	
1	11	61		004	001	REV030	
						ALL	
1	11	62		001	001	REV037	
1	11	62		002	001	REV030	
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1	11	70		001	100	REV032	M:4801
1	11	70		002	201	REV032	M:4801+6813
						ALL	

M V	CH	SEC	---PAGE--	SEQ-	--REV-- / ----------EFFECTIVITY----------	-----VALIDATION CRITERIA----
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1	11	70	004	100	REV034	M:4801
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1	11	70	005	100	REV032	M:4801
1	11	70	006	100	REV032	M:4801
					ALL	
1	11	70	007	100	REV032	M:4801
1	11	70	008	100	REV032	M:4801
					ALL	
1	11	71	001	100	REV030	MOD 4801
1	11	71	002	100	REV030	MOD 4801
					ALL	
1	11	71	003	200	REV030	MOD 4801 + 6497
1	11	71	004	100	REV030	MOD 4801
					ALL	
1	11	71	005	100	REV030	MOD 4801
1	11	71	006	100	REV031	M:4801
					ALL	
1	11	72	001	100	REV030	MOD 4801
1	11	72	002	100	REV037	M:4801
					ALL	
1	11	73	001	220	REV036	CODE 0167
1	11	73	002	100	REV031	MOD 4801
					ALL	
1	11	80	001	103	REV030	M:4801
1	11	80	002	001	REV030	
					ALL	
1	12	00	001-2	001	REV014	
					ALL	
1	12	10	001	001	REV024	
1	12	10	002	001	REV020	
					ALL	
1	12	10	003	001	REV028	
1	12	10	004	110	REV037	M:5911
					ALL	
1	12	10	005	001	REV008	ALL/ALL
1	12	10	006	050	REV037	MOD 4803
					ALL	
1	12	10	007	020	REV037	M:4691
1	12	10	008	200	REV037	M:4803+7378
					ALL	
1	12	10	009	001	REV028	
1	12	10	010	020	REV029	MOD 5051
					ALL	
1	12	10	011	100	REV037	MOD 5051
1	12	10	012	001	REV037	
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1	12	20	001-2	001	REV014	
					ALL	
1	13	00	001-2	000	REV014	
					ALL	
1	13	10	001-2	000	REV019	
					ALL	
1	13	20	001	000	REV028	
1	13	20	002	000	MAR1983	
					ALL	
1	13	20	003	100	REV032	M:5910
1	13	20	004	000	REV008	ALL/ALL
					ALL	
1	13	20	005-6	020	REV013	MOD 5051
					ALL	
1	13	30	002	500	REV026	CODE 1330I
					ALL	
1	13	30	003-4	500	REV026	CODE 1330J
					ALL	
1	13	40	001	000	REV008	ALL/ALL
1	13	40	002	000	REV028	
					ALL	
1	13	40	003-4	020	REV028	MOD 5051
					ALL	
1	13	50	001	000	REV008	ALL/ALL-PW
1	13	50	002	000	REV011	ALL/ALL-PW
					ALL	
1	13	50	003-4	020	REV023	MOD 5051 ALL-PW
					ALL	
1	13	60	001	001	REV028	
1	13	60	002	000	REV038	
					ALL	
1	13	70	001	060	REV016	MOD 2753+5051+5381
1	13	70	002	030	REV013	MOD 2753+5381
					ALL	
1	13	70	003-4	200	REV030	CODE 0094
					ALL	
1	13	80	001	000	REV014	
1	13	80	002	010	REV034	M:2753
					ALL	
1	14	00	001-2	000	REV014	
					ALL	
1	14	10	001-2	000	REV026	
					ALL	
1	14	20	001	000	REV008	
1	14	20	002	000	REV008	
					ALL	
1	14	20	003	000	REV008	
1	14	20	004	001	REV033	
					ALL	
1	14	20	005	000	MAR1983	
1	14	20	006	000	MAR1983	
					ALL	
1	14	20	007	000	REV025	
1	14	20	008	000	REV008	
					ALL	
1	14	20	009-10	020	REV022	MOD 5051
					ALL	
1	14	30	001	000	MAR1983	
1	14	30	002	110	REV027	MOD:5910
					ALL	
1	14	30	003-4	020	REV020	MOD 4803
					ALL	
1	14	40	001	050	REV028	CODE 0023
1	14	40	002	000	REV021	
					ALL	
1	14	40	003	001	REV034	
1	14	40	004	001	REV034	
					ALL	
1	14	40	005	300	REV028	CODE 0025
1	14	40	006	200	REV038	M:MP S7212+5443
					ALL	
1	14	40	007	410	REV031	CODE 0026
1	14	40	008	005	REV028	CODE 0027
					ALL	
1	14	40	009	060	REV028	CODE 0077
1	14	40	010	001	REV028	CODE 0028
					ALL	
1	14	50	001-2	000	REV028	CODE:0029
					ALL	
1	15	00	001	001	REV034	
1	15	00	002	105	REV030	M:4672
					ALL	
1	15	10	001	001	REV033	
1	15	10	002	001	REV031	
					ALL	
1	15	11	001	100	REV036	M:4672
1	15	11	002	100	REV036	CODE 0018
					ALL	

M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
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1 15 11	003	100	REV030	M:4672
1 15 11	004	100	REV030	M: 4672
			ALL	
1 15 12	001	100	REV031	M:4672
1 15 12	002	001	REV031	
			ALL	
1 15 13	001	110	REV031	CODE 0082
1 15 13	002	001	REV031	
			ALL	
1 15 20	001	001	REV034	
1 15 20	002	001	REV036	
			ALL	
1 15 21	001	001	REV031	
1 15 21	002	001	REV031	
			ALL	
1 15 22	001	001	REV031	
1 15 22	002	100	REV036	M:2962
			ALL	
1 15 22	003	100	REV033	CODE 0173
1 15 22	004	001	REV031	
			ALL	
1 15 23	001	001	REV031	STD = M:11702
1 15 23	002	001	REV030	
			ALL	
1 15 24	001	001	REV037	
1 15 24	002	001	REV030	
			ALL	
1 15 24	003	001	REV030	
1 15 24	004	001	REV031	
			ALL	
1 15 24	005	001	REV031	
1 15 24	006	001	REV030	
			ALL	
1 15 25	001	001	REV030	STD OR M:11702
1 15 25	002	001	REV031	
			ALL	
1 15 30	001	001	REV034	
1 15 30	002	001	REV030	
			ALL	
1 15 31	001	001	REV030	
1 15 31	002	001	REV030	
			ALL	
1 15 31	003	001	REV031	
1 15 31	004	001	REV037	
			ALL	
1 15 40	001	001	REV038	
1 15 40	002	001	REV030	
			ALL	
1 15 40	003	001	REV030	
1 15 40	004	001	REV031	
			ALL	
1 15 41	001	001	REV030	
1 15 41	002	001	REV031	
			ALL	
1 15 41	003	001	REV031	
1 15 41	004	001	REV031	
			ALL	
1 15 50	001	115	REV031	M:2962
1 15 50	002	001	REV031	
			ALL	
1 15 51	001	001	REV030	
1 15 51	002	100	REV030	MOD:2962
			ALL	
1 15 51	003	105	REV030	M:2962
1 15 51	004	001	REV031	
			ALL	
1 15 60	001	001	REV031	
1 15 60	002	001	REV031	
			ALL	

M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
			----------EFFECTIVITY----------	
1 15 61	001	001	REV031	
1 15 61	002	001	REV031	
			ALL	
1 15 70	001	103	REV035	M:8541
1 15 70	002	001	REV030	
			ALL	
1 15 71	001	001	REV030	
1 15 71	002	001	REV030	
			ALL	
1 15 72	001	001	REV030	
1 15 72	002	001	REV030	
			ALL	
1 15 73	001	100	REV030	MOD:4803
1 15 73	002	001	REV031	
			ALL	
1 16 00	001-2	001	REV014	
			ALL	
1 16 10	001	070	REV026	CODE 1610A
1 16 10	002	020	MAR1983	ALL-PW
			ALL	
1 16 10	003-4	150	REV030	M:3881/PW ALL
			ALL	
1 16 20	001	200	REV028	MOD 5146+6007
1 16 20	002	005	REV028	CODE 0130/ALL PW
			ALL	
1 16 20	003	320	REV028	MOD 5051+5146+6007+7460
1 16 20	004	001	REV028	
			ALL	
1 16 20	005-6	020	REV025	ALL PW
			ALL	
1 16 30	001	001	REV028	
1 16 30	002	001	REV008	ALL/ALL
			ALL	
1 16 30	003-4	001	REV028	
			ALL	
1 16 40	001	001	REV019	
1 16 40	002	001	REV008	ALL/ALL
			ALL	
1 16 40	003	001	REV011	ALL/ALL
1 16 40	004	001	MAR1983	
			ALL	
1 16 50	001-2	001	REV008	ALL/ALL
			ALL	
1 16 60	001	200	REV028	MOD 5146+5448+7259
1 16 60	002	110	REV030	M:7259 ENG:ALL
			ALL	
1 16 60	003-4	020	REV028	MOD 5051
			ALL	
1 16 70	001	001	REV014	
1 16 70	002	001	REV019	
			ALL	
1 17 00	001-2	020	REV014	ALL-PW
			ALL	
1 17 10	001	030	REV026	CODE 1710A
1 17 10	002	030	REV024	PW 4000
			ALL	
1 17 10	003-4	100	REV037	MOD.7380/PW 4152
			ALL	
1 17 20	001	030	REV030	CODE 0114
1 17 20	002	030	REV029	PW 4000
			ALL	
1 17 20	003	180	REV030	CODE 0133
1 17 20	004	050	REV026	CODE 1720H
			ALL	
1 17 20	005	035	REV024	PW 4000
1 17 20	006	050	REV024	PW 4000
			ALL	

M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
			----------EFFECTIVITY----------	
1 17 20	007	040	REV026	CODE 1720H
1 17 20	008	035	REV031	CODE 0128 PW 4000
			ALL	
1 17 30	001	030	REV028	PW 4000
1 17 30	002	030	REV024	PW 4000
			ALL	
1 17 30	003	040	REV028	PW 4000
1 17 30	004	080	REV030	MOD.5051+5448+7259/PW 4000
			ALL	
1 17 30	005-6	040	REV024	MOD.5051/PW 4000
			ALL	
1 17 40	001	025	REV024	CODE 1740A/PW 4000
1 17 40	002	030	REV024	PW 4000
			ALL	
1 17 40	003	120	REV024	MOD.5051/PW 4000
1 17 40	004	030	REV024	PW 4000
			ALL	
1 17 50	001	130	REV033	M:12262/PW 4000
1 17 50	002	020	REV016	ALL-PW
			ALL	
1 17 50	003	130	REV033	M:12262/PW 4000
1 17 50	004	030	REV024	PW 4000
			ALL	
1 17 50	005-6	070	REV026	MOD.5051/PW 4000
			ALL	
1 17 60	001	045	REV024	CODE 1760B/PW 4000
1 17 60	002	050	REV033	CODE 0008/PW 4000
			ALL	
1 17 60	003-4	120	REV024	MOD.6334/PW 4000
			ALL	
1 17 70	001	100	REV024	MOD.7380/PW 4000
1 17 70	002	030	REV024	PW 4000
			ALL	
1 17 70	003	030	REV024	PW 4000
1 17 70	004	047	REV032	PW 4152
			ALL	
1 17 70	005	040	REV020	PW 4152
1 17 70	006	100	REV024	MOD.5051+5448/PW 4000
			ALL	
1 17 70	007-8	120	REV024	MOD.5051+5725/PW 4000
			ALL	
1 17 80	001	050	REV026	CODE 1780C
1 17 80	002	030	REV024	PW 4000
			ALL	
1 17 80	003	030	REV024	PW 4000
1 17 80	004	030	REV024	PW 4000
			ALL	
1 17 80	005	020	REV036	PW
1 17 80	006	030	REV036	PW 4000
			ALL	
1 17 80	007-8	040	REV024	MOD.5051/PW 4000
			ALL	
1 17 90	001-2	030	REV024	PW 4000
			ALL	
1 18 00	001	001	REV031	
1 18 00	002	100	REV036	M:5051
			ALL	
1 18 10	001	001	REV036	
1 18 10	002	001	REV031	
			ALL	
1 18 20	001	103	REV036	M:5051
1 18 20	002	100	REV031	M:5051
			ALL	
1 18 30	001	001	REV035	
1 18 30	002	100	REV031	M:5051
			ALL	

M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
M V CH SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
			----------EFFECTIVITY----------	
1 18 30	003	001	REV037	
1 18 30	004	100	REV030	M:6269
			ALL	
1 18 30	005	100	REV031	M:5051
1 18 30	006	001	REV036	
			ALL	
1 18 30	007	200	REV039	M:4801+5051
1 18 30	008	100	REV030	M:5051
			ALL	
1 18 40	001	100	REV039	M:5051
1 18 40	002	001	REV030	
			ALL	
1 18 40	003	100	REV039	M:5051
1 18 40	004	001	REV031	
			ALL	
1 18 40	005	001	REV031	
1 18 40	006	120	REV031	M:2989 PW ALL
			ALL	
1 18 50	001	100	REV030	M:5051
1 18 50	002	130	REV037	CODE 0220/PW OR GE80C2
			ALL	
1 18 50	003	001	REV030	
1 18 50	004	001	REV030	
			ALL	
1 18 50	005	001	REV030	
1 18 50	006	001	REV030	
			ALL	
1 18 60	001	001	REV031	
			ALL	
1 18 70	001	001	REV030	
1 18 70	002	001	REV030	
			ALL	
1 18 70	003	001	REV031	
1 18 70	004	001	REV032	
			ALL	
1 18 70	005	001	REV030	
			ALL	
1 18 71	001	100	REV031	M:5051
1 18 71	002	001	REV031	
			ALL	
1 18 72	001	100	REV031	M:5051
1 18 72	002	100	REV031	M:5051
			ALL	
1 18 80	001	100	REV030	M:5051
1 18 80	002	100	REV031	M:5051
			ALL	
1 18 80	003	100	REV031	M:5051
1 18 80	004	100	REV031	M:3781
			ALL	
1 18 80	005	001	REV031	
1 18 80	006	001	REV031	
			ALL	
1 18 80	007	100	REV031	M:5051
1 18 80	008	100	REV030	M:5051
			ALL	
1 19 10	001	200	REV037	M:11320=11364=12044=12045
1 19 10	002	200	REV037	M:11320=11364=12044=12045
			ALL	
1 19 20	001	001	REV037	
1 19 20	002	001	REV037	
			ALL	
1 19 20	003	001	REV037	
1 19 20	004	001	REV037	
			ALL	
1 19 30	001	001	REV037	
1 19 30	002	001	REV037	
			ALL	
1 20 11	001	100	REV037	M:6789
1 20 11	002	100	REV037	M:6789
			ALL	

M V CH SEC	---PAGE--	SEQ-	--REV-- ----------EFFECTIVITY----------	-----VALIDATION CRITERIA----
1 20 11	003	100	REV037	M:6789
1 20 11	004	100	REV037	M:6789
			ALL	
1 20 12	001	001	REV037	
1 20 12	002	001	REV037	
			ALL	
1 20 13	001	001	REV037	
1 20 13	002	001	REV037	
			ALL	
1 20 14	001	010	REV037	M:4801
1 20 14	002	001	REV037	
			ALL	
1 20 15	001	001	REV037	
1 20 15	002	001	REV037	
			ALL	
1 20 21	001	001	REV037	
1 20 21	002	001	REV037	
			ALL	
1 20 21	003	001	REV037	
1 20 21	004	001	REV037	
			ALL	
1 20 22	001	001	REV037	
1 20 22	002	001	REV037	
			ALL	
1 20 23	001	001	REV038	
1 20 23	002	200	REV037	M:11320=11364=12044=12045
			ALL	
1 20 23	003	001	REV037	
1 20 23	004	200	REV037	M:11320=11364=12044=12045
			ALL	
1 20 24	001	001	REV037	
1 20 24	002	001	REV037	
			ALL	
1 20 31	001	100	REV037	M:11320=11364=12044=12045
1 20 31	002	001	REV037	
			ALL	
1 20 32	001	100	REV037	M:11320=11364=12044=12045
1 20 32	002	100	REV037	M:11320=11364=12044=12045
			ALL	
1 20 32	003	001	REV037	
1 20 32	004	100	REV037	M:11320=11364=12044=12045
			ALL	
1 20 33	001	100	REV037	M:11320=11364=12044=12045
1 20 33	002	001	REV037	
			ALL	
1 20 41	001	001	REV037	
1 20 41	002	001	REV037	
			ALL	
1 20 42	001	100	REV037	M:6789
1 20 42	002	100	REV037	M:6789
			ALL	
1 20 51	001	100	REV037	M:6789
1 20 51	002	100	REV037	M:6789
			ALL	
1 20 52	001	100	REV037	M:6789
1 20 52	002	001	REV037	
			ALL	
1 20 53	001	100	REV037	M:6789
1 20 53	002	100	REV037	M:6789
			ALL	
1 20 53	003	300	REV037	M:11320=11364=12044=12045
1 20 53	004	001	REV037	
			ALL	
1 20 54	001	100	REV037	M:6789
1 20 54	002	100	REV037	M:6789
			ALL	
1 20 54	003	100	REV037	M:6789
1 20 54	004	100	REV037	M:6789
			ALL	
1 20 54	005	100	REV037	M:6789
1 20 54	006	100	REV037	M:6789
			ALL	
1 20 54	007	100	REV037	M:6789
1 20 54	008	100	REV037	M:6789
			ALL	
1 20 55	001	100	REV037	M:6789
1 20 55	002	100	REV037	M:6789
			ALL	
1 20 55	003	100	REV037	M:6789
1 20 55	004	100	REV037	M:6789
			ALL	
1 20 55	005	100	REV037	M:6789
1 20 55	006	100	REV037	M:6789
			ALL	
1 20 55	007	100	REV037	M:6789
1 20 55	008	100	REV037	M:6789
			ALL	
1 20 61	001	100	REV037	M:6789
1 20 61	002	001	REV037	
			ALL	
1 20 62	001	001	REV037	
1 20 62	002	001	REV037	
			ALL	
1 20 62	003	100	REV037	M:6789
1 20 62	004	100	REV037	M:6789
			ALL	
1 20 63	001	001	REV037	
1 20 63	002	001	REV037	
			ALL	
1 20 63	003	001	REV037	
1 20 63	004	001	REV037	
			ALL	
1 20 64	001	001	REV037	
1 20 64	002	100	REV037	M:6789
			ALL	
1 20 64	003	200	REV037	M:11320=11364=12044=12045
1 20 64	004	200	REV037	M:11320=11364=12044=12045
			ALL	
1 20 65	001	200	REV037	M:11320=11364=12044=12045
1 20 65	002	001	REV037	
			ALL	
1 20 66	001	110	REV037	M:4801+6789
1 20 66	002	100	REV037	M:6789
			ALL	
1 20 66	003	001	REV037	
1 20 66	004	200	REV037	M:11320=11364=12044=12045
			ALL	
1 20 66	005	300	REV037	M:11320=11364=12044=12045
1 20 66	006	110	REV037	M:4801+6789
			ALL	
1 20 71	001	100	REV037	M:6789
1 20 71	002	100	REV037	M:6789
			ALL	
1 20 71	003	001	REV037	
1 20 71	004	100	REV037	M:6789
			ALL	
1 20 71	005	110	REV037	M:4801+6789
1 20 71	006	200	REV036	M:4801+6789
			ALL	
1 20 71	007	001	REV037	
1 20 71	008	100	REV037	M:6789
			ALL	
1 20 71	009	100	REV037	M:6789
1 20 71	010	100	REV037	M:6789
			ALL	
1 20 72	001	100	REV037	M:6789
1 20 72	002	100	REV037	M:6789
			ALL	

M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
M	V	CH	SEC	---PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA----
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1		20	72	003	100	REV037	M:6789
1		20	72	004	100	REV037	M:6789
						ALL	
1		20	72	005	100	REV037	M:6789
1		20	72	006	100	REV037	M:6789
						ALL	
1		20	72	007	001	REV037	
1		20	72	008	100	REV037	M:6789
						ALL	
1		20	72	009	100	REV037	M:6789
1		20	72	010	100	REV037	M:6789
						ALL	
1		20	72	011	100	REV037	M:6789
1		20	72	012	100	REV037	M:6789
						ALL	
1		20	72	013	100	REV037	M:6789
1		20	72	014	100	REV037	M:6789
						ALL	
1		20	72	015	001	REV037	
1		20	72	016	001	REV037	
						ALL	
1		20	73	001	200	REV037	M:11320=11364=12044=12045
1		20	73	002	100	REV037	M:11320=11364=12044=12045
						ALL	
1		20	73	003	001	REV037	
1		20	73	004	001	REV037	
						ALL	
1		20	73	005	100	REV037	M:11320=11364=12044=12045
1		20	73	006	200	REV037	M:11320=11364=12044=12045
						ALL	
1		20	73	007	100	REV037	M:6789
1		20	73	008	300	REV037	M:11320=11364=12044=12045
						ALL	
1		20	73	009	100	REV037	M:6789
1		20	73	010	001	REV037	
						ALL	
1		20	73	011	300	REV037	M:11320=11364=12044=12045
1		20	73	012	100	REV037	M:6789
						ALL	
1		20	73	013	001	REV037	
1		20	73	014	100	REV037	M:6789
						ALL	
1		20	73	015	100	REV037	M:6789
1		20	73	016	100	REV037	M:6789
						ALL	
1		20	73	017	300	REV037	M:11320=11364=12044=12045
1		20	73	018	100	REV037	M:6789
						ALL	
1		20	73	019	100	REV037	M:6789
1		20	73	020	100	REV037	M:6789
						ALL	
1		20	73	021	100	REV037	M:6789
1		20	73	022	100	REV037	MOD:6789
						ALL	
1		20	73	023	100	REV037	MOD:6789
1		20	73	024	100	REV037	MOD:6789
						ALL	
1		20	73	025	100	REV037	MOD:6789
1		20	73	026	100	REV037	MOD:6789
						ALL	
1		20	73	027	100	REV037	MOD:6789
1		20	73	028	100	REV037	MOD : 6789
						ALL	
1		20	74	001	200	REV037	M:11320=11364=12044=12045
1		20	74	002	200	REV037	MOD:11320=11364=12044=12045
						ALL	
1		20	74	003	200	REV037	CODE 0231
1		20	74	004	110	REV037	M:4801+6789
						ALL	
1		20	74	005	200	REV037	M:11320=11364=12044=12045
1		20	74	006	100	REV037	M:6789
						ALL	
1		20	75	001	200	REV037	M:11320=11364=12044=12045
1		20	75	002	200	REV037	M:11320=11364=12044=12045
						ALL	
1		20	75	003	100	REV037	M:6789
1		20	75	004	100	REV037	M:6789
						ALL	
1		20	75	005	100	REV037	M:11320=11364=12044=12045
1		20	75	006	100	REV037	M:11320=11364=12044=12045
						ALL	
1		20	76	001	200	REV037	M:11320=11364=12044=12045
1		20	76	002	200	REV037	M:11320=11364=12044=12045
						ALL	
1		20	76	003	100	REV037	M:11320=11364=12044=12045
1		20	76	004	100	REV037	M:11320=11364=12044=12045
						ALL	
1		20	76	005	200	REV037	M:11320=11364=12044=12045
1		20	76	006	001	REV037	
						ALL	
1		20	76	007	001	REV037	
1		20	76	008	100	REV037	M:11320=11364=12044=12045
						ALL	
1		20	76	009	100	REV037	M:11320=11364=12044=12045
1		20	76	010	100	REV037	M:11320=11364=12044=12045
						ALL	
1		20	76	011	100	REV037	M:11320=11364=12044=12045
1		20	76	012	100	REV037	M:11320=11364=12044=12045
						ALL	
1		20	76	013	001	REV037	
1		20	76	014	100	REV037	M:11320=11364=12044=12045
						ALL	
1		20	77	001	001	REV037	
1		20	77	002	001	REV037	
						ALL	

M V T	REV	MOD	MP	SB	TITLE	VALIDITY
.	036	......	S7212	....	LANDING GEAR - MODIFY PARKING BRAKE PRESSURE LIMITER	ALL
.	036	2254	......	....	FIRE DETECTION - DOUBLE THE NUMBER OF AM- BIENT SMOKE DETECTORS	ALL
.	036	2753	......	....	INSTALL AN EXTERIOR ICING WARNING SYSTEM	ALL
.	036	2962	......	....	INSTALL 2ND ARINC 712 ADF SYSTEM	ALL
.	036	2965	......	....	OXYGEN - FLIGHT CREW SYSTEM - INCREASE CAPACITY OF CYLINDER	ALL
.	036	2989	......	....	FWD CARGO COMPARTMENT - ADD VENTILATION AND HEATING	ALL
.	036	2994	......	....	PASSENGER COMPARTMENT - INSTALL AN EMERGENCY EVAC-ALERT SYSTEM - KSSU CONFIGURATION	ALL
.	036	3004	......	....	INSTALL HONEYWELL STROBE LIGHTS	ALL
.	036	3221	......	....	INSTALL A JAEGER METRIC ALTIMETER	ALL
.	036	3721	......	....	INSTALL FANS FOR MESSIER BRAKES	ALL
.	036	3732	......	....	NAVIGATION - PROVIDE AUTOMATIC RADIO ALTITUDE CALL OUT ON LANDING	ALL
.	036	3781	......	....	INSTALL A TIRE PRESSURE INDICATING SYSTEM	ALL
.	036	3832	......	....	STANDBY ALTIMETER - CUT OFF THE SUPPLY FOR THE VIBRATOR ON GROUND	ALL

M V T	REV	MOD SB	MP	TITLE	VALIDITY
.	036	3881	......	CABIN PRESSURE CONTROL SYSTEM - INTRODUCE NEW PRESSURE REGULATING SYSTEM COMPONENTS	ALL
.	036	4024	......	INSTRUMENTS - ECAM - INTRODUCE NEW DESIGN FOR ALTITUDE ALERT WARNING	ALL
.	036	4504	......	NAVIGATION - PROVIDE FMC SWITCHING FOR EFIS DISPLAY	ALL
.	036	4540	......	APU - PROVIDE AUTOMATIC APU SHUTDOWN WHEN SELECTING BATTERIES "OFF"	ALL
.	036	4672	......	NAVIGATION - INSTALL 3 HONEYWELL IRS	ALL
.	036	4691	......	HYDRAULIC POWER - GREEN ELECTRIC PUMP CONTROL - MODIFY TYPE OF PUSH-BUTTON SWITCH	ALL
.	036	4765	......	AIR CONDITIONING - DELETE THE CABIN DEPRESSURIZATION MECHANICAL ASSEMBLY	ALL
.	036	4801	......	FUEL - INSTALL TRIM TANK SYSTEM	ALL
.	036	4803	......	EQUIPMENT/FURNISHINGS - FLIGHT COMPARTMENT - MODIFY DESIGN	ALL
.	036	4857	......	EXHAUST - IMPROVE THE SELECTION LOGIC OF THE FLIGHT IDLE	ALL
.	036	4863	......	WINGS - INTRODUCE NEW WING TIP	ALL
.	036	4917	......	FUEL - FEED SYSTEM - CENTER TANK - DELETE ISOLATION VALVE	ALL

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M
V REV   MOD  MP        TITLE
T          SB                              VALIDITY


. 036   5027  ......  FUEL - ADD REFUEL/DEFUEL COUPLINGS TO
     ...........       LH WING
                             ALL

. 036   5051  ......  INDICATING/RECORDING SYSTEMS - ECAM -
     ...........       DELETE WLDP
                             ALL

. 036   5146  ......  PNEUMATIC - BLEED AIR - MODIFY OVERHEAT
     ...........       DETECTION
                             ALL

. 036   5224  ......  FLAP CONTROLS - SLAT AND FLAP CONTROL
     ...........       SYSTEM - MODIFY INPUT CONTROL
                             ALL

. 036   5289  ......  AIR CONDITIONING - MAX COOL PUSHBUTTON
     ...........       SWITCH - MODIFY LEGEND AND WIRING
                             ALL

. 036   5330  ......  FLIGHT CONTROLS - AILERONS - REDUCE
     ...........       DROOP TRAVEL TO 6.6  -
                             ALL

. 036   5381  ......  ICE & RAIN PROTECTION - INHIBIT ICE
     ...........       DETECTION SYSTEM ON GROUND
                             ALL

. 036   5388  ......  STARTING - MODIFY IGNITER POWER SUPPLY
     ...........             ALL

. 036   5408  ......  FLIGHTS CONTROLS - RUDDER CONTROLS -
     ...........       REDUCE RUDDER DEFLECTION FROM 5  TO
                       3.5  IN HIGHT SPEED FLIGHT -
                             ALL

. 036   5414  ......  OXYGEN - FLIGHT COMPARTMENT - RELOCATE
     ...........       PORTABLE OXYGEN EQUIPMENT
                             ALL

. 036   5443  ......  LANDING GEAR - REPLACE STEEL BRAKES BY
     ...........       CARBON BRAKES AND ASSOCIATED WHEELS -
                             ALL
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MVT	REV	MOD / SB	MP	TITLE / VALIDITY
.	036	5448	......	INDICATING/RECORDING SYSTEMS - ECAM - MODIFY SGU SOFTWARE ALL
.	036	5562	......	FUEL - MODIFY FEED SYSTEM LOGIC DURING TAXI/TAKE OFF PHASE ALL
.	036	5697	......	NAVIGATION - GPWS - IMPROVE FUNCTION ALL
.	036	5725	......	INDICATING/RECORDING SYSTEMS - FLIGHT WARNIN COMPUTER - INTRODUCE L12 BATCH IMPROVEMENT ALL
.	036	5735	......	NAVIGATION - DISPLAY FMS WIND DATA ON EFIS ALL
.	036	5875	......	FUEL - INSTALL FUEL TEMPERATURE INDICATION SYSTEM ALL
.	036	5884	......	NAVIGATION - RELOCATE EFIS TRANSFER SWITCH ALL
.	036	5904	......	FLIGHT CONTROLS - JAMMING DETECTION SYSTEM - MODIFY JAMMING DETECTION UNIT ALL
.	036	5910	......	ELECTRICAL POWER - INSTALL SYSTEM PROVISION FOR INSTALLATION OF AN AC/DC STANDBY GENERAT HYDRO-ELECTRICAL UNIT ALL
.	036	5911	......	ELECTRICAL POWER - INSTALL AN AC/DC STANDBY GENERATION HYDRO ELECTRICAL UNIT ALL
.	036	5917	......	AIRBORNE AUXILLIARY POWER - STARTING - EXTEND RELIGHT ALTITUDE ALL
.	037	5918	......	FUSELAGE - APU AIR INTAKE - INSTALL FIXED DIVERTER AND MODIFY FLUID BARRIERS ALL

M V T	REV	MOD MP SB	TITLE VALIDITY
.	037	5944	GENERAL - CERTIFY AIRCRAFT FOLLOWING F.A.A. REQUIREMENTS (AS PART) ALL
.	039	5994	POWER PLANT - INSTALL P.& W. ENGINES 4152 - (ST7 ONLY) ALL
.	036	6007	PNEUMATIC - ENGINE BLEED AIR SUPPLY SYSTEM - MODIFY TRIGGERING THRESHOLD OF BLEED VALVE FAULT WARNING ALL
.	036	6036	AUTO FLIGHT - REPLACE FCO ALL
.	036	6041	INDICATING/RECORDING SYSTEMS - ECAM - INTRODUCE NEW SGU SOFTWARE ALL
.	036	6106	AIR CONDITIONING - MODIFY PACK DISCHARGE TEMPERATURE LOW LIMIT IN MAX COOL MODE ALL
.	036	6119	NAVIGATION - ACTIVATE AUTOMATIC RADIO ALTITU CALL-OUT ON FWC ALL
.	036	6120	PNEUMATIC - ENGINE BLEED AIR SUPPLY SYSTEM - INCREASE MINIMUM ENGINE IDLE ALL
.	036	6233	LANDING GEAR - INSTALL A320 GOODYEAR CARBON BRAKES AND RELATED WHEELS ALL
.	036	6234	NAVIGATION - GPWS - INSTALL FLAP SELECTOR SWITCH ALL
.	036	6269	INDICATING/RECORDING SYSTEMS - MODIFY ECAM SGU SOFTWARE ALL

M V T	REV	MOD / SB	MP	TITLE / VALIDITY
.	036	6334	......	AIR CONDITIONING - AIR CONDITIONING PACK CLOSING SIGNAL - MODIFY WIRING ALL
.	036	6354	......	AUTO FLIGHT - AFS - INTRODUCE FAC CERTI- FICATION STANDARD FOR ST7 ALL
.	036	6368	......	FUEL - FUEL PUMP SYSTEM - MODIFY ELECTRICAL POWER SUPPLY ALL
.	036	6384	......	INDICATING/RECORDING SYSTEMS - ECAM - MODIFY SGU SOFTWARE ALL
.	036	6444	......	AIR CONDITIONING - DELETE MAX COOL OFF MESSAGE ON ECAM DISPLAY UNIT ALL
.	036	6445	......	INDICATING/RECORDING SYSTEMS - ECAM - INTRODUCE FWC SOFTWARE S4 ALL
.	036	6497	......	FUEL - FUEL PUMP SYSTEM - MODIFY TRANSFER VALVE POWER SUPPLY ALL
.	036	6519	......	FUEL - MODIFY CENTER TANK PUMP CONTROL SYSTEM ALL
.	036	6523	......	AUTO FLIGHT - INSTALL A SECOND TCC ALL
.	036	6605	......	FUEL - FQI SYSTEM - INTRODUCE MODIFIED COMPUTER ON A310-300 A/C ALL
.	036	6789	......	NAVIGATION - SPERRY FMS - INTRODUCE I7-2 SOFTWARE ALL
.	036	6813	......	INDICATING/RECORDING SYSTEMS - CGCC - INTRODUCE M3 SOFTWARE ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	036	6843	......	FUEL - CHANGE INNER TANK FUEL PUMP LP FAULT INDICATION ALL
.	036	6845	......	FUEL - OVERCOME INNER TANK NUISANCE ECAM WARNINGS ALL
.	036	6875	......	FUEL - INTRODUCE NEW STANDARD INDICATOR ALL
.	036	6908	......	NAVIGATION - MODIFY EFIS SGU ALL
.	036	7171	......	AUTO FLIGHT - FAC - INTRODUCE NEW EQUIPMENT - ALL
.	036	7187	......	AUTO FLIGHT - GENERAL - INSTALL COMPONENTS WITH AIRBORNE WINDSHEAR WARNING SYSTEM CAPACITY ALL
.	036	7258	......	AUTO FLIGHT - FAC - MODIFY SOFTWARE ALL
.	036	7259	......	INDICATING/RECORDING SYSTEMS - ECAM - MODIFY SGU SOFTWARE ALL
.	036	7307	......	NAVIGATION - EFIS - MODIFY SGU SOFTWARE ALL
.	036	7378	......	HYDRAULIC POWER - REPLACE RESERVOIR HYDRAULI FLUID QUANTITY INDICATORS. ALL
.	036	7380	......	ENGINE FUEL AND CONTROL - P.W 4000 ENGINE - REPLACE FADEC. ALL
.	037	7460	......	PNEUMATIC - OPTIMIZE ENGINE BLEED AIR SUPPLY SYSTEM ALL

M V T	REV	MOD MP SB	TITLE	VALIDITY
.	036	7763	NAVIGATION - ATC - INSTALL ATC MODE/S -	ALL
.	036	7770	ELECTRICAL POWER - MODIFY CONTACTOR DC TIE LOGIC -	ALL
.	036	7985	AUTO/FLIGHT - ACTIVATE WINDSHEAR FUNCTION -	ALL
.	036	8065	ENGINE/FUEL AND CONTROL - PW 4000 ENGINE - REPLACE FUEL HP VALVE CONTROL SYSTEM -	ALL
.	036	8199	OXYGEN - PAX COMPARTMENT - PROVIDE OXYGEN SUPPLY FOR 22 MIN.	ALL
.	036	8364	AUTO FLIGHT - FAC - MODIFY SOFTWARE.	ALL
.	036	8541	NAVIGATION - INSTALL BFE FOR BB1 VERSION -	ALL
.	036	8601	NAVIGATION - INSTALL TCAS II COMPLETE PROVISIONS -	ALL
.	036	8616	NAVIGATION - INSTALL BENDIX TCAS II - (A310) -	ALL
.	036	8648	ELECTRICAL POWER - MODIFY ESSENTIAL BUSBAR DISTRIBUTION -	ALL
.	036	8671	NAVIGATION - INSTALL ATC/TCAS CONTROL BOX BENDIX -	ALL
.	036	10107	NAVIGATION - MODIFY TCAS/VSI SOFTWARE (SEXTANT) -	ALL

M V T	REV	MOD MP SB	TITLE	VALIDITY
.	036	10356	NAVIGATION - INSTALL A BENDIX DUAL ATC/TCAS CONTROL UNIT -	ALL
.	036	10928	NAVIGATION - INSTALL BENDIX TCAS II UPGRADED WITH CHANGE 6.04A -	ALL
.	036	10963	LANDING GEAR - WHEELS AND BRAKES - DEACTIVATE TPIS -	ALL
.	036	11047	NAVIGATION - INSTALL BENDIX TCAS II WITH DATA LOADER FUNCTION UPGRADED WITH CHANGE 6,04A -	ALL
.	039	11320	NAVIGATION - MODIFY FMS FOR GPS C1 CAPABILITY -	ALL
.	036	11351	NAVIGATION - ATC/TCAS-INSTALL SEXTANT ATC/TCAS CONTROL PANEL (P/N C12404 BA02)	ALL
.	039	11364	NAVIGATION - FMS - MODIFY HONEYWELL AFMS FOR PW ENGINES	ALL
.	036	11442	FLIGHT CONTROLS - INHIBIT RUDDER TRIM CONTROL WITH YAW AUTO PILOT ENGAGED	ALL
.	036	11454	AUTO FLIGHT - AUTO PILOT - PROVIDE PITCH DISCONNECTION BY STICK-FORCE APPLICATION IN ALL FLIGHT PHASES	ALL
.	037	11893	NAVIGATION - EGPWS - INSTALL ENHANCED GROUND PROXIMITY WARNING COMPUTER (NEW SPEC.) (SFE)	ALL

M V T	REV	MOD	MP SB	TITLE / VALIDITY
.	037	11894	....	NAVIGATON - EGPWS - ACTIVATE ENHANCED FUNCTIONS OF EGPWS ALL
.	036	11900	....	AUTO FLIGHT-AUTOPILOT/FLIGHT DIRECTOR- INTRODUCE A310-A300/600 STANDARD P/N B 470ADM ALL
.	036	12025	....	NAVIGATION - TCAS - INSTALL ALLIED SIGNAL COMPUTER P/N 066-50000-2220 (WITH CHANGE 7.0) (WITH DATA LOADER) ALL
.	039	12045	....	NAVIGATION - FMS - CORRECT FMS "GPS STANDARD" (PW ENGINES) ALL
.	036	12262	....	EXHAUST-THRUST REVERSER SYSTEM CONTROL - IMPLEMENT A THIRD LINE OF DEFENCE - (PROPULSION SYSTEM PART) - PW 4000 ALL
.	036	12277	....	AUTO-FLIGHT-ELECTRIC PITCH TRIM-REPLACE OLD FAC SOFTWARE BY NEW ONE WITH "THETA TRIM" FUNCTION ALL
.	037	12291	....	NAVIGATION - EFIS - INSTALL NEW SGU - EFIS E21 STANDARD ALL
.	037	12557	....	DOORS - FIXED INTERIOR DOORS IN PAX COMPARTMENT - INSTALL ELECTRICAL COCKPIT DOOR RELEASE (SHORT COCKPIT) ALL

REVISION NUMBER	ISSUE DATE	DATE FILED	INITIALS
04	FEB 83		
05	MAR 83		
06	JUL 83		
07	DEC 83		
08	MAY 84		
09	JUL 84		
10	NOV 84		
11	MAR 85		
12	MAY 85		
13	OCT 85		
14	MAR 86		
15	JUN 86		
16	DEC 86		
17	FEB 87		
18	JUN 87		
19	JAN 88		
20	JUL 88		
21	FEB 89		
22	AUG 89		
23	MAR 90		

REVISION NUMBER	ISSUE DATE	DATE FILED	INITIALS	
24	FEB 91			
25	JAN 92			
26	JUL 93			
27	FEB 94			
28	OCT 95			
29	OCT 96			
30	MAY 98			
31	JUN 98			
32	APR 99			
33	APR 00			
34	MAY 01			
35	MAY 02			
36	JAN 04			
37	NOV 05			
38	DEC 06			
39	OCT 07			R

Note : The next normal revision 40 is scheduled in 2009. R

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M	TR NO	-DATE-- -----------TITLE----------- / ----------EFFECTIVITY----------	M	TR NO	-DATE-- -----------TITLE----------- / ----------EFFECTIVITY----------
	181-1	JAN2008 TR APPLICABLE TO ALL			

This Temporary Revision has been issued after REV N° 39.

Remove this TR only when instructed to do so by the FILING INSTRUCTIONS TEMPORARY REVISIONS and the LIST OF EFFECTIVE TEMPORARY REVISIONS.

VALIDITY : All aircraft fitted with MOD 11454 and 11899 or MOD 11454 and 11900 or MOD 11454 and 11899 and 11900.

SUBJECT : AUTOPILOT
Actuator override

REASONS FOR ISSUE : This TR is issued to correct the term "declutched" which was not adapted to describe AP actuator override functioning.

INSTRUCTIONS :

Insert the following pages in the FCOM Vol 1 and update the RECORD OF TEMPORARY REVISIONS.

TR N° 181-1 page 1 of 2 after the LIST OF EFFECTIVE TEMPORARY REVISION (LETR) in 1.00.04
TR N° 181-1 page 2 of 2 facing 1.03.33 page 2

R Refer to the "List of effective temporary revisions" listing for effective TR issued after the current normal revision. This
R listing is automatically sent and updated with each new TR.

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When a cockpit item or cockpit panel engraving is used to define a control or indicator, it is printed in BLOCK LETTERS.

A : Amber, Ampere
ABNORM : Abnormal
ABSORB : Absorber
ABV : Above
AC : Alternating Current
A/C : Aircraft
R ACARS : Aircraft Communication Addressing and Reporting
R System
ACCEL : Accelerate
ACCU : Accumulator
R ACP : Audio Control Panel
ACQ : Acquire
ACT : Active
ACTVT : Activate
ADC : Air Data Computer
ADF : Automatic Direction Finder
ADI : Attitude Director Indicator
R ADM : Air Data Module
ADS : Air Data System
ADV : Advisory
AFS : Automatic Flight System
AFT : Rear part
AHP : Anti Hijacking Panel
AHRS : Attitude and Heading Reference System
AIDS : Aircraft Integrated Data System
AIL : Aileron
AIR COND : Air Conditioning
ALIGN : Alignment
ALPHA (α) : Angle of Attack
ALT : Altitude
ALTM : Altimeter
ALTN : Alternate
AMP : Ampere
AMPL : Amplifier
ANN : Annunciator
ANT : Antenna
R AoA : Angle-of-Attack
AP : Auto-Pilot
APPR : Approach
APU : Auxiliary Power Unit
ARND : Around
ARPT : Airport
ARTF : Artificial
AS : Airspeed
ASA : All Speed Aileron
ASAP : As Soon As Possible
ASD : Accelerate Stop Distance
A/SKID : Anti Skid
ASI : Air Speed Indicator
ASSY : Assembly
A/STAB : Auto Stabilizer
ASYM : Asymmetrical
ATC : Air Traffic Control
ATE : Automatic Test Equipment
A/THR : Automatic Thrust
ATS : Auto-Throttle System
ATT : Attitude
ATTND : Attendant
AUTO : Automatic
AUTO LAND : Automatic Landing
AUX : Auxiliary
AVAIL : Available
AVNCS : Avionics
AWY : Airway

B : Blue
BARO : Barometric
BAT : Battery
B/B : Back Beam
BCC : Battery Charge Controller R
BFO : Beat Frequency Oscillator
BITE : Built-in Test Equipment
BLW : Below
BRG : Bearing
BRK : Brake
BRT : Bright
BTL : Bottle

C : Centigrade, Cyan, Cold, Closed
CAB : Cabin
CAB PRESS : Cabin Pressurization
CAL : Calibration
CAPT : Captain
CAS : Calibrated Airspeed
CAT : Category
C/B : Circuit Breaker
CCU : Calibration Control Unit R
CCW : Counter Clock Wise
CDI : Course Deviation Indicator R
CDLS : Cockpit Door Locking System R
CDP : Compressor Discharge Pressure
CDU : Control and Display Unit
CFIT : Controlled Flight Into Terrain R
CG : Center of Gravity
CGCC : Center of gravity Control Computer R
CHAN : Channel
CHG : Change
CKD : Checked
CKPT : Cockpit
C/L : Check List
CL : Climb
CLR : Clear
CM : Crew Member
CMD : Command
CMM : Calibration Memory Module R
CMPTR : Computer
CNTOR : Contactor
CO : Company
COM : Communication
COMPT : Compartment
COND : Conditioning
CONFIG : Configuration
CONT : Continuous
COOL : Cooling, Cooler
CPLR : Coupler
CR : Cruise
CRC : Continuous Repetitive Chime
CRS : Course
CRT : Cathode Ray Tube
CSD : Constant Speed Drive
CSTR : Constraint
CTL : Control
CTR : Center
CU : Control Unit
CVR : Cockpit Voice Recorder
CW : Clock Wise
CWS : Control Wheel Steering

DA : Drift Angle
DAR : Digital AIDS Recorder
DB : Decibel
DC : Direct Current
D/D : Engine Out Drift Down Point
DDRMI : Digital distance and Radio Magnetic Indicator
DEC : Declination
DECEL : Decelerate
DECR : Decrease
DEF : Definition
DELTA P : Differential Pressure
DES : Descent
DEST : Destination
DET : Detection
DEV : Deviation
DFA : Delayed Flap Approach
DFDAU : Digital Flight Data Acquisition Unit
DFDAMU : Digital Flight Data Acquisition Management
R Unit
DFDR : Digital Flight Data Recorder
DFIDU : Dual Function Interactive Display Unit
DG : Directional GYRO
DH : Decision Height
DIFF : Differential
DIR : Direction
DISC : Disconnect
DISCH : Discharged
DIS-IN : Discrete Inputs
DIST : Distance
DME : Distance Measuring Equipment
DMU : Data Management Unit
DN : Down
DOW : Dry Operating Weight
DR : Dead Reckonning
DSPL : Display
DSRTK : Desired Track
DTG : Distance To Go
DU : Display Unit

E : East
EC : Engine Control
ECAM : Electronic Centralised Aircraft Monitoring
ECB : Electronic Control Box (APU)
ECON : Economic
ECP : ECAM Control Panel
EEC : Engine Electronic Computer
EFCU : Electronic Flight Control Unit
EFIS : Electronic Flight Instrument System
R EGPWC : Enhanced Ground Proximity Warning Computer
R EGPWS : Enhanced Ground Proximity Warning System
EGT : Exhaust Gas Temperature
ELEC : Electrical
ELEV : Elevator
ELV : Elevation
EMER : Emergency
END : Endurance
ENG : Engine
ENGR : Engineer
EO : Engine Out
EPR : Engine Pressure Ratio
EPR.D : EPR.Descent
EPR.L : EPR.Latch
EQPT : Equipment
ESS : Essential
EST : Estimated
ETA : Estimated Time of Arrival
ETE : Estimated Time en Route
ETP : Equal Time Point
EVAC : Evacuation
EXC : Excitation
EXCESS : Excessive
EXP : Expansion
EXT : Exterior, External, Extension
EXTING : Extinguish
EXTRACT : Extraction

FAC : Flight Augmentation Computer
FADEC : Full Authority Digital Engine Control R
FAF : Final Approach Fix
FAIL : Failed, Failure
FAR : Federal Aviation Regulations
FCC : Flight Control Computer
F/CTL : Flight Control
FCPI : Flight Control Position Ind.
FCU : Flight Control Unit, Fuel Control Unit
FD : Flight Director
FDAU : Flight Data Acquisition Unit
FDEP : Flight Data Entry Panel
F/E : Flight Engineer
FF : Fuel Flow
FFCC : Forward Facing Crew Concept
FIG : Figure
FIM : Fault Isolation Monitor
FL : Flight Level
FLC : Feel and Limitation Computer
FLEX : Flexible
FLP : Flap
FLT : Flight
FLXTO : Flexible Take Off
FMA : Flight Mode Annunciator
FMC : Flight Management Computer
FMCS : Flight Management Computer System
FMS : Flight Management System
F/O : First Officer
FOB : Fuel on Board
FPA : Flight Path Angle
F-PLN : Flight Plan
FPR : Flight Path Reference R
FPT : Flight Path Target
FPV : Flight Path Vector
FQ : Fuel Quantity
FQI : Fuel Quantity Indicating R
FRQ : Frequency
FRT : Front
F/S : Fast, Slow
FT : Foot, Feet
FT/MN : Feet per Minute
FU : Fuel Used
FWC : Flight Warning Computer
FWD : Forward
FWS : Flight Warning System

G : Green, Gyro, Earth, Acceleration
GA : Go Around
GCU : Generator Control Unit
GEN : Generator
GMT : Greenwitch Mean Time
GND : Ground
GPCU : Ground Power Control Unit
GPS : Global Positioning System R
GPWS : Ground Proximity Warning System
GRP : Geographic Reference Point
GRVTY : Gravity

	GRP	: Geographic Reference Point
	GRVTY	: Gravity
	GS	: Ground Speed
	G/S	: Glide Slope
	GW	: Gross Weight
	H	: Hour, Hot
	HDG	: Heading
	HDG/S	: Heading Selected
	HDL	: Handle
	HF	: High Frequency
	HI	: High
	HIL	: Hold Item List
	HLD	: Hold
R	HMC	: Hydromechanical control
	HP	: High Pressure
	HSI	: Horizontal Situation Indicator
	HYD	: Hydraulic
	HZ	: Hertz
	I	: Inertial
	I/P	: Intercept Profile
	IAF	: Initial Approach Fix
	IAS	: Indicated Airspeed
R	ICAO	: International Civil Aviation Organization
	IDENT	: Identification
	IDG	: Integrated Drive Generator
	IFR	: Instrument Flight Rules
	ILS	: Instrument Landing System
	IMM	: Immediate
R	IN	: Inch
	INB	: Inbound
	INBD	: Inboard
	INCR	: Increase, Increment
	IND	: Indicator
	INFO	: Information
	INHG	: Inches of Mercury
	INHI	: Inhibit
	INIT	: Initialisation
	INOP	: Inoperative
	INR	: Inner
	INS	: Inertial Navigation System
	INST	: Instrument
	INT(PH)	: Interphone
	INTCP	: Intercept
	INV	: Inverter
	I/O	: Input/Output
	IP	: Intermediate Pressure
	IRS	: Inertial Reference System
	ISA	: International Standard Atmosphere
	ISB	: Inter System bus
	ISDU	: Inertial Sensor Display Unit
	ISOL	: Isolation
R	IVS	: Inertial Vertical Speed
	JAM	: Jammed, Jamming
	KG	: Kilogram
	KRUG	: Kruger
	KT	: Knot
	L	: Left, Litre, Length
	LAND	: Landing
	LAT	: Latitude, Lateral
	LAT REV	: Lateral Revise
	LAV	: Lavatory

LB	: Pound	
LD	: Left Display, Load	
LDG	: Landing	
LE	: Log Entry	
L/G	: Landing Gear	
LH	: Left Hand	
LIM	: Limitation	
LIS	: Localizer Inertial Smoothing	
LL	: Latitude/Longitude	
LLS	: Left Line Select Key	
LNG	: Long	
LO	: Low	
LOC	: Localizer	
LOGO	: Logogram	
LONG	: Longitude	
LO SPD AIL	: Low Speed Ailerons	
LP	: Low Pressure	
LRU	: Line Replaceable Unit	
LS	: Line Select Key	
LS.AIL/LSA	: Low Speed Aileron	
LSDS	: Lavatory Smoke Detector System	R
LT	: Light	
LVL	: Level	
LVL/CH	: Level Change	
LW	: Landing Weight	
M	: Mach, Meter	
MAA	: Mountainous Approach Area	R
MAC	: Mean Aerodynamic Chord	
MAG	: Magnetic	
MAINT	: Maintenance	
MAN	: Manual	
MAP	: Ground Mapping	
MASI	: Mach and Airspeed Indicator	
MAX	: Maximum	
MB	: Millibar	
MCR	: Maximum Cruise	
MCT	: Maximum Continuous Thrust	
MCU	: Modular Concept Unit	
MDA	: Minimum Descent Altitude	
MEA	: Minimum En Route Altitude	
MEC	: Mechanical Engine Control	R
MECH	: Mechanic	
MEL	: Minimum Equipment List	
MFA	: Memorized Fault Annunciator	
MI	: Magnetic Indicator	
MIC	: Microphone	
MID	: Middle	
MIDU	: Multi-Input Interactive Display Unit	
MIN	: Minimum	
MKR	: Marker (radio Beacon)	
MLS	: Microwave Landing System	
MLW	: Maximum Landing Weight	
MMO	: Maximum Operating Mach	
MMR	: Multi Mode Receiver	
MN	: Minute	
MOT	: Motor	
MSA	: Minimum Safe Altitude	
MSG	: Message	
MSL	: Mean Sea Level	
MSU	: Mode Selector Unit (IRS)	
MTBF	: Mean Time Between Failure	
MTOW	: Maximum Take off Weight	
MTOGW	: Maximum Take off Gross Weight	
MTP	: Maintenance and Test Panel	

MWP	: Master Warning Panel	
MWS	: Master Warning System	
MZFW	: Maximum Zero Fuel Weight	
N1.D	: N1 Descent	
N1.L	: N1 Latch	
N	: North	
NAC	: Nacelle	
NAV	: Navigation	
NAVAID	: Navigation Aid	
ND	: Navigation Display	
NDB	: Non Directional Beacon	
NM	: Nautical Mile	
NORM	: Normal	
N/P	: Next Page	
NW	: Nose Wheel	
O	: Open	
OAT	: Outside Air Temperature	
OBSVR	: Observer	
OFF R	: OFF-RESET	
OFST	: Offset	
OK	: Correct	
OP	: Operational	
OPER	: Operative	
OPP	: Opposite	
OPS	: Operations	
OPT	: Optimum	
OUT	: Outlet	
OUTB	: Outbound	
OUTR	: Outer	
OVBD	: Overboard	
OVHD	: Overhead	
OVHT	: Overheat	
OVRD	: Override	
OXY	: Oxygen	
PA	: Passenger Address, Public Address	
P.ALT	: Profile Altitude	
P.CLB	: Profile Climb	
P.DES	: Profile Descent	
PED	: Pedestal	
PERF	: Performance	
P.EPR	: Profile EPR	
PFD	: Primary Flight Display	
P.MACH	: Profile Mach	
PMC	: Power Management Computer	
PMR	: Performance and Maintenance Recorder	
P.N1	: Profile N1	
PNEU	: Pneumatic System	
PNL	: Panel	
POS	: Position	
PPOS	: Present Position	
PR	: Pressure	
PRED	: Prediction	
PRE FLT	: Pre Flight	
PRESS	: Pressurisation, Pressure	
PREV	: Previous	
PROC	: Procedure	
PROC T	: Procedure Turn	
PROF	: Profile	
PROG	: Progress	
PSI	: Pounds Per Square Inch	
PSIG	: Pound Per Square Inch Gage	
P.SPD	: Profile Speed	
PT	: Point	
PTR	: Printer, Push to Reset	
PTT	: Push to Test, Push to Talk	
PTU	: Power Transfer Unit	
PURS	: Purser	
PWR	: Power	
PWS	: Predictive Windshear System	R
QAR	: Quick Access Recorder	
QFE	: Field Elevation Atmosphere Pressure	
QFU	: Runway Heading	
QNE	: Sea Level Standard Atmosphere Pressure (1013 Hpa)	
QNH	: Sea Level Atmosphere Pressure	
QT	: Quart (US)	
QTY	: Quantity	
R	: Right, Red, Release, Reset	
RA	: Radio Altitude	
RAD	: Radio	
RAT	: Ram Air Turbine	
RC	: Repetitive Chime	
RCCU	: Remote Calibration Control Unit	R
RCDR	: Recorder	
RCL	: Recall	
RD	: Right Display	
RED	: Reduction	
REF	: Reference	
REG	: Regulator	
REL	: Release	
RET	: Retract	
RETRD	: Retracted	
REV	: Reverse	
RH	: Right Hand	
R/I	: Radio/Inertial	
RLS	: Right Line Select Key	
RLY	: Relay	
RMI	: Radio Magnetic Indicator	
RNG	: Range	
RPLNT	: Repellent	
RPM	: Revolution Per Minute	
RPTG	: Repeating, Reporting	
RQRD	: Required	
RSV	: Reserves	
RSVR	: Reservoir	
RTE	: Route	
RUD	: Rudder	
RVSM	: Reduced Vertical Separation Minimum	R
RWY	: Runway	
S	: South,Second	
SAT	: Static Air Temperature	
SC	: Single Chime	
S/C	: Step Climb	
SD	: System Display	
S/D	: Step Descent	
SDAC	: System Data Analog Converter	
SDCU	: Smoke Detector Control Unit	R
SEC	: Secondary	
SEL	: Selector	
SENS	: Sensitivity	
SFCC	: Slat Flap Control Computer	
SFPI	: Slats/Flaps Position Ind.	
SGU	: Symbol Generator Unit	
SHLD	: Shield	
SHT	: Short	

	SI	: Slip Indicator
	SID	: Standard Instrument Departure
	SIM	: Simulation
	SLT	: Slat
	SPD	: Speed
	SPD/M	: Speed/Mach
	SPLR	: Spoiler
	SRS	: Speed Reference System
	SSC	: Single Stroke Chime
	SSG	: Single Stroke Gong
	STAB	: Stabilizer
	STAR	: Standard Terminal Arrival Route
	STAT	: Static
	STBY	: Stand-by
	STD	: Standard
	STRG	: Steering
	STS	: Status
	SURF	: Surface
	SVCE	: Service
	SW	: Switch
	SYNC	: Synchronise
	SYS	: System
	T	: True, Turn
	TACT	: Tactical
R	TAD	: Terrain Awareness and Display
	TAS	: True Air Speed
	TAT	: Total Air Temperature
	T/C	: Top of Climb
R	TCAS	: Traffic Collision Avoidance System
R	T2CAS	: Terrain and Traffic Collision Avoidance System
	TCC	: Thrust Control Computer
R	TCF	: Terrain Clearance Floor
	T/D	: Top of Descent
	TEMP	: Temperature
	TFR	: Transfer
	TGT	: Target
	THR	: Thrust, Throttle
	TK	: Tank
	TKE	: Track Angle Error
R	TLA	: Throttle Lever Angle
	TMR	: Timer
	T.O	: Take Off
	TO/APPR	: Take Off-Approach
	TOD	: Take Off Distance
	TOR	: Take Off Run
	TOGA	: Take Off-Go Around
	TOGW	: Take Off Gross Weight
	T-P	: Turn Point
	TR	: Transformer Rectifier, Turn Radius
	T-R	: Transmitter-Receiver
	TRANS	: Transition
	TRANSF	: Transfer
	TRK	: Track
	TROPO	: Tropopause
	TRP	: Thrust Rating Panel
	TRU	: True
	TRV	: Travel
	TTG	: Time to Go
	TURB	: Turbulence, Turbine
	TOW	: Take Off Weight
R	UDC	: Upper Deck Cargo
	U/FLOOR	: Under Floor
	UNLK	: Unlock

V	: Volt	
V1	: Takeoff decision speed	R
V2	: Takeoff climb speed	R
VA	: Design Manœuvering Speed	
VAR	: Variation	
VDEV	: Vertical Deviation	
VDP	: Visual Descent Point	R
VEL	: Velocity	
VENT	: Ventilation	
VERT REV	: Vertical Revise	
VFE	: Maximum Flap Extended Speed	
VFTO	: Final Take Off Velocity	
VHF	: Very High Frequency	
VIB	: Vibration	
V/L	: VOR/Localizer	
VLE	: Landing Gear Extended Speed	
VLO	: Landing Gear Operating Speed	
VLS	: Lowest Selectable speed	R
VM	: Manœuvring Speed	
VMCA	: Minimum Control Speed Air	
VMCG	: Minimum Control Speed Ground	
VMIN	: Minimum Operating Speed	
VMO	: Maximum Operating Speed	
VOR	: VHF OMNI Directional Range	
VOR.D	: VOR.DME	
VR	: Rotation Speed	
VREF	: Landing Reference Speed (1.3 VS CONFIG : 30°/40°)	
VS	: Stall Speed	
V/S	: Vertical Speed	
VSI	: Vertical Speed Indicator	
W	: White, West, Weight	
WARN	: Warning	
WBS	: Weight and Balance System	R
WGD	: Windshield Guidance Display	
WLDP	: Warning Light Display Panel	
WPT	: Waypoint	
WTB	: Wing Tip Brake	
WR	: Weather Radar	
WT	: Weight	
WX	: Weather Mode	
X	: Cross	
XFEED	: Cross Feed	
XFR	: Transfer	
XMTR	: Transmitter	
XPDR	: Transponder	R
XTK	: Cross Track Error	
Y	: Yellow	
ZFCG	: Zero Fuel Center Gravity	R
ZFW	: Zero Fuel Weight	
ZP	: Pressure Altitude	

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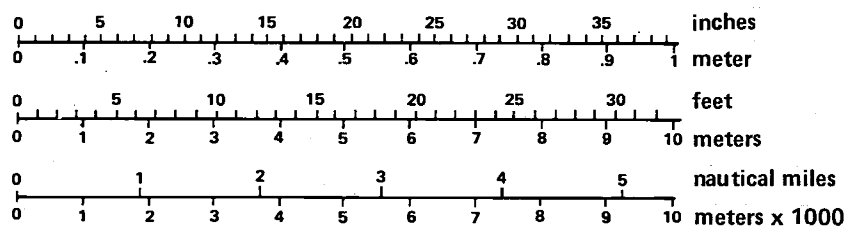
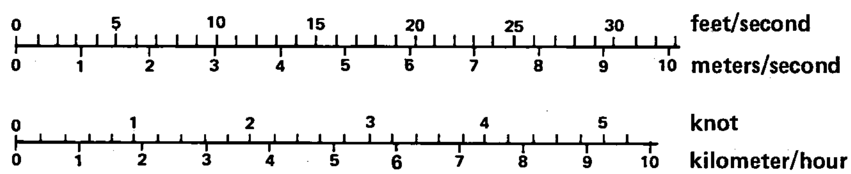
	METRIC → US	US → METRIC
LENGTH	1 milimeter (mm) = .0394 inch (in) 1 meter (m) = 3.281 feet (ft) 1 meter (m) = 1.094 yard (yd) 1 kilometer (km) = .540 nautical mile (nm)	1 inch (in) = 25.4 millimeter (mm) 1 foot (ft) = .3048 meter (m) 1 yard (yd) = .914 meter (m) 1 nautical mile (nm) = 1.852 kilometer (km)

B0FC-01-0006-001-A001AA - R



	METRIC → US	US → METRIC
SPEED	1 meter/second (m/s) = 3.281 Feet/second (ft/s) 1 kilometer/hour (km/h) = .540 knot (kt)	1 foot/second (ft/s) = .3048 meter/second (m/s) 1 knot (kt) = 1.852 kilometer/hour (km/h)

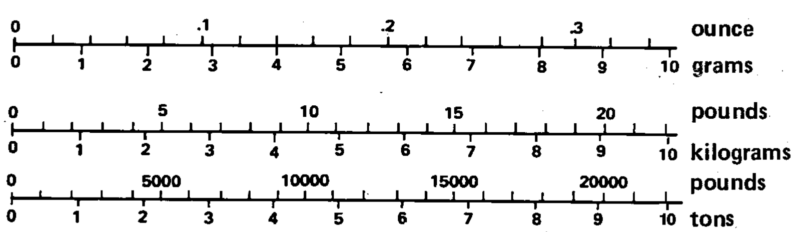
B0FC-01-0006-001-B001AA - R



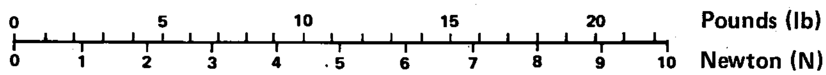
R
R

	METRIC → US	US → METRIC
WEIGHT	1 gram (g) = 0.0353 ounce (oz) 1 kilogram (kg) = 2.2046 pounds (lb) 1 ton (t) = 2204.6 pounds (lb)	1 ounce (oz) = 28.35 grams (g) 1 pound (lb) = .4536 kilogram (kg) 1 pound (lb) = .0004536 ton (t)

B0FC-01-0006-001-C001AA - R

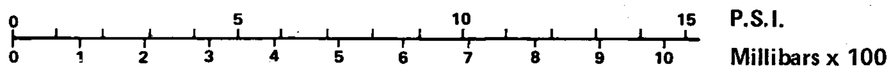


	METRIC → US	US → METRIC
FORCE	1 Newton (N) = .2248 pounds (lb) 1 deca Newton (daN) = 2.248 pounds (lb)	1 pound (lb) = 4.448 Newtons (N) 1 pound (lb) = .4448 deca Newton (daN)



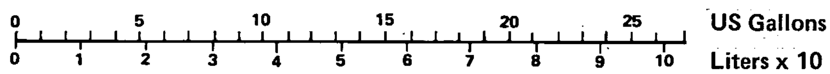
FB1.0006.002-AA.001.6A

	METRIC → US	US → METRIC
PRESSURE	1 bar = 14.505 pounds per square inch (P.S.I.) 1 millibar (mbar) = .0145 P.S.I.	1 pound per square inch (P.S.I.) = .0689 bar 1 P.S.I. = 68.92 millibars (mbar)



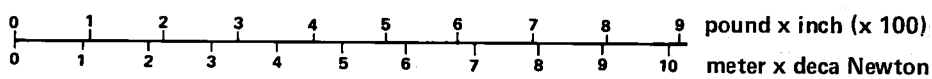
FB1.0006.002-AA.001.6B

	METRIC → US	US → METRIC
VOLUME	1 liter (l) = .2642 U.S. Gallons 1 cubic meter (m3) = 264.2 U.S. Gallons	1 US Gallon = 3.785 liters (l) 1 US Gallon = .003785 cubic meter (m3)



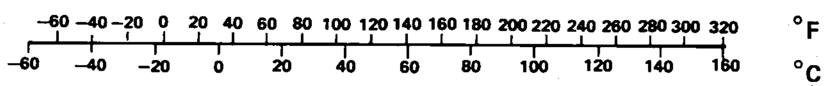
FB1.0006.002-AA.001.6C

	METRIC → US	US → METRIC
MOMENTUM	1 meter x deca Newton (m.daN) = 88.50 pound x inch (lb.in)	1 pound x inch (lb.in) = .0113 meter x deca Newton (mdaN)



FB1.0006.002-AA.001.6D

	METRIC → US	US → METRIC
R TEMPERATURE	$t\,(°C) = \frac{5}{9}\left\{t(°F) - 32\right\}$	$t\,(°F) = \frac{9}{5}\,t\,(°C) + 32$



FB1.0006.002-AA.001.6E

	CODE	DESIGNATION
	0001	STD or Mod : 5051 + 6415
R	0002	Mod : 11893 or 12161 or 12523 or (5697 + 11893) or (5697 + 12161) or (5913 + 11893) or (5913 + 12161) or (10416 + 11893) or (10416 + 12161) or (11893 + 12255) or (12161 + 12255) or (4628 + 5697 + 11893) or (4628 + 5697 + 12161) or (5697 + 5896 + 11893) or (5697 + 5896 + 12161) or (5697 + 6234 + 11893) or (5913 + 10416 + 11893) or (5913 + 10416 + 12161) or (5213 + 5697 + 5896 + 11893) or (5213 + 5697 + 5896 + 12161) or (5697 + 5896 + 5913 + 11893) or (5697 + 5896 + 5913 + 12161) or (5697 + 5896 + 12161 + 12255) or (5697 + 5896 + 7288 + 11893) or (5697 + 5896 + 7288 + 12161) or (5697 + 5896 + 8960 + 11893) or (5697 + 5896 + 8960 + 12161) or (5697 + 5896 + 8960 + 12523) or (5697 + 5896 + 10416 + 11893) or (5697 + 5896 + 10416 + 12161) (5697 + 10416 + 12161 + 12255) or (5896 + 5913 + 6234 + 11893) or (5896 + 5913 + 6234 + 12161) " or (5896 + 5913 + 6352 + 11893) or (5896 + 5913 + 6352 + 12161) or (5697 + 5896 + 5913 + 6234 + 11893) or (5697 + 5896 + 5913 + 6234 + 12161) or (5697 + 5896 + 5913 + 7288 + 11893) or (5697 + 5896 + 5913 + 7288 + 12161) or (5697 + 5896 + 5913 + 8960 + 11893) or (5697 + 5896 + 5913 + 8960 + 12161) or (5697 + 5896 + 5913 + 10416 + 11893) or (5697 + 5896 + 5913 + 10416 + 12161) or (5697 + 5896 + 6234 + 8960 + 11893) or (5697 + 5896 + 6234 + 8960 + 12161) or (5697 + 5896 + 7288 + 12161 + 12255) or (5697 + 5896 + 8960 + 12161 + 12255) or (5697 + 5896 + 10416 + 12161 + 12255) or (5896 + 5913 + 6234 + 8960 + 11893) or (5896 + 5913 + 6234 + 8960 + 12161) or (5697 + 5896 + 5913 + 6234 + 10416 + 11893) or (5697 + 5896 + 5913 + 6234 + 10416 + 12161) or (5697 + 5896 + 5913 + 6234 + 12161 + 12255) or (5697 + 5896 + 5913 + 7288 + 8960 + 11893) or (5697 + 5896 + 5913 + 7288 + 8960 + 12161) or (5697 + 5896 + 6234 + 8960 + 12161 + 12255) or (5697 + 5896 + 8960 + 12161 + 12255 + 12523)
	0003	Mod : 8616 or 10664 or 10734 or 11021 or 11403
	0004	Mod : (6334 + 10645) or (5388 + 6334 + 10645) or (5388 + 6334 + 6792 + 10645)
	0005	Mod : (3347 + 4000 + 7483) or (3347 + 4000 + 5119 + 5713 +7483)
	0006	Mod : (4000 + 7483) or (4000 + 5119 + 5713 + 7483)
	0007	Mod : (5544 + 8279) or (5544 + 8279 + 10002)
	0008	Mod : 6334 or (5388 + 6334) or (5388 + 6334 + 6792)
	0009	Mod : (4863 + 8616) or (4863 + 11021) or (4863 + 7763 + 8616) or (4863 + 7763 + 10664) or (4863 + 7763 + 11021) or (4863 + 7763 + 11403)
	0010	Mod : (5146 + 6007) or (5051 + 5146 + 6007 + 6415)
	0011	STD or Mod : 10938 or (10734 + 10938 + 11351)
	0012	Mod : (6515 + 7563 + 10002) or (5544 + 6515 + 7563 + 10002)
	0013	Mod : 8616 or 10664 or 10734 or 11021 or 11403 or (10938 + 11021)
	0014	Mod : (4801 + 6789 + 11320) or (4801 + 6789 + 11364) or (4801 + 6789 + 8976 + 11320) or (4801 + 6789 + 8977 + 11364)
	0015	Mod : (4917 + 6919 + 8339) or (4917 + 6919 + 8339 + 10083)
	0016	Mod : (12557 + 12785) or (12715 + 12785) or (12557 + 12693 + 12785)
	0017	Mod : 11320 or 11364 or (6789 + 11320) or (8976 + 11320)
	0018	Mod : 4672 or (4672 + 10113) or (4672 + 10113 + 10595)
	0019	Mod : (4801 + 6919) or (4801 + 6702 + 6919 + 11756)
	0020	Mod : (4801 + 6919 + 7467) or (4801 + 6702 + 6919 + 8720 + 11756)
	0021	Mod : (4917 + 6919 + 10751) or (4917 + 6919 + 8339 + 10751) or (4917 + 6919 + 10083 + 10751) or (4917 + 6919 + 8339 + 10083 + 10751)
	0022	Mod : 4801 + 4917 + 5027 + 6919 + 7467 + 8341
	0023	Mod : (MP S7212 + 3721) or (MP S7212 + 3721 + 3781 + 10963)
R	0024	STD or Mod : 3781 + 10963
	0025	Mod : (3721 + 3781 + 10963) or (3781 + 4180 + 10963) or (3781 + 6645 + 10963)
	0026	Mod : (3721 + 3781 + 5443 + 10963) or (3781 + 6233 + 6645 + 10963)

	CODE	DESIGNATION
	0027	Mod : 5443 or 6233 or (3219 + 12480) or (5443 + 6591) or (3781 + 5443 + 10963) or (3781 + 6233 + 10963) or (3781 + 5443 + 6591 + 10963)
	0028	STD or Mod : 5051 or (3781 + 5051 + 10963)
R	0029	STD or Mod : 3781 + 10963
	0030	Mod : 11893 or 12161 or 12523 or (5213 + 11893) or (5213 + 12161) or (7288 + 11893) or (7288 + 12161)
	0031	Mod : 4801 or (4801 + 6875) or (4801 + 7576) or (4801 + 6875 + 7576)
	0032	Mod : (4801 + 6875 + 6919 + 7576 + 8339) or (4801 + 6875 + 6919 + 7576 + 8339 + 10083)
	0033	Mod : 4801 + 5875 + 6875 + 6919 + 7467 + 7576
	0034	Mod : (4801 + 5875 + 6875 + 6919 + 7576 + 8339) or (4801 + 5875 + 6875 + 6919 + 7576 + 10083) or (4801 + 5875 + 6875 + 6919 + 7576 + 8339 + 10083)
	0035	Mod : (4801 + 6875 + 6919 + 7467 + 7576 + 8341) or (4801 + 6875 + 6919 + 7467 + 7576 + 8339 + 8341)
	0036	Mod : (4801 + 5875 + 6875 + 6919 + 7467 + 7576 + 8341) or (4801 + 5875 + 6875 + 6919 + 7467 + 7576 + 8339 + 8341) or (4801 + 5875 + 6875 + 6919 + 7467 + 7576 + 8339 + 8341 + 10083)
R	0037	Mod : 11893 or 12161 or 12523 or (5697 + 11893) or (5697 + 12161) or (5697 + 12523) or (5913 + 11893) or (5913 + 12161) or (11893 + 12255) or (12161 + 12255) or (4628 + 5697 + 11893) or (4628 + 5697 + 12161) or (5213 + 5697 + 11893) or (5213 + 5697 + 12161) or (5697 + 5913 + 11893) or (5697 + 5913 + 12161) or (5697 + 6234 + 11893) or (5697 + 6234 + 12161) or (5697 + 7288 + 11893) or (5697 + 7288 + 12161) or (5697 + 12161 + 12255) or (5913 + 6234 + 11893) or (5913 + 6234 + 12161) or (5913 + 6352 + 11893) or (5913 + 6352 + 12161) or (5697 + 5913 + 6234 + 11893) or (5697 + 5913 + 6234 + 12161) or (5697 + 5913 + 7288 + 11893) or (5697 + 5913 + 7288 + 12161) or (5697 + 6234 + 12161 + 12255) or (5697 + 7288 + 12161 + 12255) or (5697 + 12161 + 12255 + 12523) or (5697 + 5913 + 6234 + 12161 + 12255)
	0038	Mod : 4801 + 5875 + 6919 + 7467 + 8679 or MSN 421, 422
	0039	Mod : 6919 + 7467 + 8341 + 10751 or MSN 421, 422
	0040	Mod : 4801 + 5875 + 6536 + 6875 + 6919 + 7576 + 8339 + 10083
	0041	Mod : (6845 + 7467) or (6845 + 6919 + 10083) or MSN 421,422
R	0042	Mod : 11893 or 12161 or 12523 or (5697 + 11893) or (5697 + 12161) or (4209 + 5697 + 11893) or (4209 + 5697 + 12161) or (4209 + 5913 + 11893) or (4209 + 5913 + 12161) or (5697 + 5913 + 11893) or (5697 + 5913 + 12161) or (5697 + 6234 + 11893) or (5697 + 8960 + 11893) or (5697 + 8960 + 12161) or (5697 + 8960 + 12523) or (4209 + 5913 + 6234 + 11893) or (4209 + 5913 + 6234 + 12161) or (4209 + 5913 + 6352 + 11893) or (4209 + 5913 + 6352 + 12161) or (5697 + 5913 + 6234 + 11893) or (5697 + 5913 + 6234 + 12161) or or (5697 + 5913 + 8960 + 11893) or (5697 + 5913 + 8960 + 12161) or (5697 + 6234 + 8960 + 11893) or (5697 + 6234 + 8960 + 12161) or (5697 + 8960 + 12161 + 12523) or (4209 + 5697 + 5913 + 6234 + 11893) or (4209 + 5697 + 5913 + 6234 +12161) or (11893 or 12161/FDX)
	0043	Mod : (6845 + 6919 + 7467) or (6845 + 6919 + 7467 + 10083)
R	0044	Mod : 11893 or 12161 or 12523 or (4209 + 11893) or (4209 + 12161) or (5697 + 11893) or (5697 + 12161) or (4209 + 5697 + 11893) or (4209 + 5697 + 12161) or (5697 + 5913 + 12161) or (5697 + 6234 + 11893) or (5697 + 6234 + 12161) or (5697 + 8960 + 11893) or (5697 + 8960 + 12161) or (4209 + 5913 + 6234 + 11893) or (4209 + 5913 + 6234 + 12161) or (4209 + 5913 + 6352 + 11893) or (4209 + 5913 + 6352 + 12161) or (5697 + 5913 + 6234 + 12161) or (5697 + 5913 + 8960 + 11893) or (5697 + 5913 + 8960 + 12161) or (5697 + 6234 + 8960 + 11893) or (5697 + 6234 + 8960 + 12161) or (5697 + 8960 + 12161 + 12523) or (4209 + 5697 + 5913 + 6234 + 11893) or (4209 + 5697 + 5913 + 6234 + 12161) or (11893 or 12161/FDX)
	0045	Mod : (MP S5063 + 12291) or (6523 + 12291)
	0046	Mod : (5051 + 5562 + 6919 + 10862) or (5051 + 5562 + 6919 + 7467 + 10862)
	0047	Mod : 4801 + 5051 + 6919 + 7467 + 7576 + 8867

	CODE	DESIGNATION
	0048	Mod : (4801 + 6789 + 8976) or (4801 + 6789 + 8977)
	0049	Mod : 6919 + 7467 + 8341 + 10869) or MSN 421, 422
	0050	Mod : (4801 + 6789 + 8976) or (4801 + 6789 + 8977)
	0051	Mod : (3028 + 3482 + 6644) or (3482 + 5027 + 6644) or (5027 + 6644 + 6702)
	0052	Mod : (5697 + 5896 + 5913) or (5896 + 5913 + 6234) or (5896 + 5913 + 6352) or (5697 + 5896 + 5913 + 6234)
	0053	Mod : (5213 + 5697 + 5896) or (5697 + 5896 + 7288)
	0054	Mod : (4939 + MP S5063 + 12291) or (4939 + 6523 + 12291)
	0055	Mod : (3028 + 4801 + 6919) or (4801 + 5027 + 6919)
	0056	Mod : (5697 + 5896 + 8960) or (5697 + 5896 + 10416) or (5697 + 5896 + 6234 + 8960)
	0057	Mod : 10416 or (5913 + 10416) or (5697 + 5896 + 5913 + 8960) or (5697 + 5896 + 5913 + 10416) or (5896 + 5913 + 6234 + 8960) or (5697 + 5896 + 5913 + 6234 + 10416)
	0058	Mod : 5051 + 5562 + 6919 + 7467 or MSN 421, 422
	0059	Mod : 4801 + 6919 + 7468 + 7576 or MSN 421, 422
	0060	Mod : 4801 + 5051 + 6919 + 7467 + 7576 or MSN 421, 422
	0061	Mod : (3028 + 4801 + 6919 + 7467) or (4801 + 5027 + 6919 + 7467)
	0062	Mod : (3028 + 4801 + 6919 + 7467 + 8341) or (4801 + 5027 + 6919 + 7467 + 8341)
	0063	Mod : (4801 + 8341) or (4801 + 6919 + 7467 + 8341)
R	0064	Mod : 5213 or 7288 or 11893 or 12161 or 12523
R	0065	Mod : 11893 or 12161 or 12523 or (12161 + 12523)
	0066	Mod : (4917 + 6919 + 7467 + 8341 + 10751) or (4917 + 6919 + 7467 + 8339 + 8341 + 10751) or (4917 + 6919 + 7467 + 8339 + 8341 + 10083 + 10751)
	0067	Mod : (5697 + 5913) or (5697 + 5913 + 6234)
	0068	Mod : (3347 + 5051) or (3347 + 5051 + 5119 + 5713)
	0069	Mod : 5051 + MP S7103/GE 80C2A2/A8
	0070	STD or Mod : 5448 or (5051 + 5448 + 6415)
	0071	Mod : (5448 + 7259) or (5051 + 5448 + 6415 + 7259)
	0072	Mod : 5448 or (5051 + 5448 + 6415)
	0073	Mod : MP S5063 or 6523 or (MP S5063 + 5051 + 6415) or (5051 + 6415 + 6523)
R	0074	STD or Mod : 10938 or (8601 + 10938) or (10107 + 10938)
	0075	Mod : (6789 + 8976 + 11320) or (6789 + 8977 + 11364)
	0076	Mod : (5146 + 6007 + 7460) or (5051 + 5146 + 6007 + 6415 + 7460)
	0077	Mod : (3721 + 5051 + 5443) or (3721 + 5051 + 6233) or (5051 + 5443 + 6645) or (5051 + 6233 + 6645)
R	0078	STD or Mod : 4863 or 7763 or (4003 + 7763) or (4863 + 7763) or (4863 + 7763 + 8616) or (4863 + 7763 + 10664) or (4863 + 7763 + 11021) / FDX
	0079	Mod : 7536 or (3781 + 7536 + 10963)
	0080	STD or Mod : 5455 or 5725 or (5455 + 5725)
	0081	Mod : 10113 or (4672 + 10113) or (10113 + 10595) or (4672 + 10113 + 10595)
	0082	Mod : 5051 or (5051 + MP S5063) or (5051 + 6523)
	0083	Mod : (6845 + 6919) or (6845 + 7467) or MSN 421,422
	0084	Mod : (8364 + 12277) or (7258 + 8364 + 12277)

	CODE	DESIGNATION
	0085	MSN : 539, 542
	0086	Mod : (MP S8559 + 6789) or (MP S8559 + 8976) or (MP S8559 + 8977) or (MP S8559 + 6789 + 8976) or (MP S8559 + 6789 + 8977)
	0087	Mod : (11853 + 12062) or (12062 + 12161) or (12062 + 12523) or (5213 + 12062 + 12161) or (7288 + 11893 + 12062) or (7288 + 12062 + 12161)
R	0088	Mod : STD or 3588 or 5051 or (2753 + 5051) or (3588 + 5197) or (2753 + 5051 + 5381) or (2753 + 5051 + 6305) or (2753 + 5051 + 5381 + 6305)
	0089	Mod : (4801 + 6919 + 7576) or (4801 + 6384 + 6919 + 7576)
	0090	Mod : (6175 + 10107) or (6175 + 8601 + 10107)
	0091	Mod : (3803 + 4431 + 4803) or (3803 + 4803 + 7469)
	0092	Mod : 6365 or (5917 + 5918) or (5918 + 6365) or (5917 + 5918 + 6365) or (5918 + 6299 + 6365) or (5917 + 5918 + 6299 + 6365)
	0093	Mod : 6305 or (2753 + 6305) or (2753 + 5051 + 6305) or (2753 + 5381 + 6305)
	0094	Mod : (2753 + 5051) or (2753 + 5381) or (2753 + 5051 + 5381)
	0095	Mod : (5913 + 6234) or (5913 + 6352) or (5697 + 5913 + 6234)
	0096	Mod : (4803 + 5697 + 5896) or (4209 + 4661 + 4803 + 5697 + 5896)
	0097	Mod : (4209 + 4661 + 5896 + 6352) or (4803 + 5697 + 5896 + 6234) or (4209 + 4661 + 4803 + 5896 + 6234) or (4209 + 4661 + 4803 + 5697 + 5896 + 6234)
	0098	Mod : (4801 + 10806) or (4801 + 6813 + 7405 + 10806)
	0099	Mod : (5051 + MP S5063 + 6175) or (5051 + 6175 + 6523)
	0100	Mod : (5544 + 6812 + 7563 + 10002) or (5544 + 6934 + 7563 + 10002) or (5544 + 6515 + 6812 + 7563 + 10002) or (5544 + 6515 + 6934 + 7563 + 10002)
	0101	Mod : 6810 or (6515 + 6810)
	0102	Mod : 6812 or (6515 + 6812)
	0103	Mod : 6934 or (6515 + 6934)
	0104	Mod : (7536 + 11190) or (3781 + 7536 + 10963 + 11190)
	0105	MSN : 318, 331
	0106	Mod : (S5063 + 4939 + 5051) or (4939 + 5051 + 6523)
R	0107	Mod : STD or 2753 or 3588 or (2753 + 5381) or (2753 + 6305) or (3588 + 5197) or (2753 + 5381 + 6305)
	0108	Mod : 10928 or 11047 or (8616 + 10928) or (8616 + 11047) or (10664 + 11049) or (10734 + 11046) or (10928 + 11021)
	0109	Mod : (4209 + 5913 + 6234) or (4209 + 5913 + 6352) or (4209 + 5697 + 5913 + 6234)
	0110	Mod : (5697 + 8960) or (5697 + 5913 + 8960) or (5697 + 6234 + 8960) or FDX
	0111	Mod : (4431 + 11320) or (4431 + 11364) or (4431 + 12044) or (4431 + 12045)
	0112	Mod : (5051 + 5574)/PW 4D1 or (5051 + 5574 + 7259)
	0113	Mod : 5574/PW 4D1 or (5574 + 7259) or (5051 + 5574 + 6415)/PW 4D1
	0114	PW 4000 or Mod : (5051 + 6120/PW 4152/4156A) or (5051 + 6415/PW 4000) or (5051 + 6120 + 7075/PW 4152)
	0115	GE ALL or Mod : 5051/GE or (5051 + 6415/GE)
	0116	Mod : (6120 + 7075) or (5051 + 6120 + 7075)
	0117	PW 7R4 or Mod : 5051/PW 4E1 or (5051 + 6415/PW 4E1)
	0118	STD or Mod : 11702 or (5735 + 11702) or (5735 + 6908 + 7307 + 11702)

	CODE	DESIGNATION
	0119	Mod : (3721 + 3781 + 5443 + 6297 + 7441) or (3781 + 5443 + 6297 + 6645 + 7441) or (3781 + 6233 + 6297 + 6645 + 7441)
	0120	Mod : (3721 + 3781 + 5443 + 6297) or (3781 + 6233 + 6297 + 6645)
	0121	Mod : 11338 or 11339 or 12361 or (11338 + 11339)
	0122	Mod : (8601 + 8616) or (8601 + 10664) or (8601 + 10734) or (8601 + 8603 + 8616)
R	0123	Mod : 6214 or (6214 + 12691) or (6214 + 12710) or (6214 + 12691 + 12710) or (6214 + 12691 + 13073)
	0124	Mod : 11021 or 11403 or (8395 + 8616) or (8395 + 10664) or (8395 + 10734) or (8616 + 8671) or (8671 + 10664) or (8671 + 10734) or (10356 + 11403) or (10938 + 11021) or (8395 + 8601 + 8616) or (8395 + 8601 + 10664) or (8601 + 8616 + 8671) or (8601 + 8671 + 10734)
	0125	Mod : 11800 or 11952 or 12267 or (11952 + 12267)
	0126	Mod : 12025 or 12034 or 12043 or 12094 or 12339 or 12354 or (8616 + 12025) or (8616 + 12034) or (10734 + 12043) or (11403 + 12034) or (8616 + 12025 + 12034) or (10938 + 11021 + 12034)
	0127	Mod : (8616 + 10661) or (10661 + 10664) or (10661 + 10734) or (8601 + 10661 + 10664) or (8527 + 8601 + 10661 + 10664)
	0128	Mod : 5051 or (5051 + 5574) or (5051 + 7259) or (5051 + 5574 + 7259)
	0129	Mod : 12025 or 12034 or 12043 or 12094 or 12339 or 12354 or (8616 + 12025) or (8616 + 12034) or (11021 + 12034) or (11403 + 12034) or (8616 + 10928 + 12025) or (8616 + 10928 + 12034) or (8616 + 11047 + 12025) or (10734 + 11046 + 12043) or (10928 + 11021 + 12034) or (8616 + 10928 + 12025 + 12034)
	0130	STD or Mod : (5146 + 6007)
R	0131	STD or Mod : 7259 or (5051 + 6415)
	0132	Mod : 7555/PW 4000 or (5358 + 7555/PW 4000)
	0133	Mod : 8065/PW 4000 or (6120 + 8065/PW 4152) or (4857 + 6120 + 8065/PW 4000) or (4857 + 6120 + 7075 + 8065/PW 4152)
	0134	Mod : 6789 or 8977 or (6789 + 8976) or (6789 + 8977) or (3791 + 6662 + 8977) or (6789 + 8976 + 8977)
R	0135	Mod : 5443 or 6233 or (5443 + 6591) or (5443 + 6233 + 10963)
	0136	Mod : (8616 + 11351) or (10664 + 11351) or (10734 + 11351) or (11021 + 11351)
	0137	Mod : 6789 or 8976 or (6789 + 8976) or (6789 + 8977)
R	0138	Mod : (5051 + 5443) or (5051 + 6233) or (3219 + 5051 + 6591) or (5051 + 5443 + 6233) or (5051 + 5443 + 6591)
	0139	Mod : (6789 + 11320) or (8976 + 11320) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364)
	0140	MSN 288, 303, 313, 333, 339, 342, 343, 345, 346
	0141	Mod : 2989 + 5289 + 6106 + 6444 + 6583 + 7407
R	0142	STD OR FDX
R	0143	Mod : 5051 or (5051 + 6415) or (5051 + 7259)
	0144	Mod : 6789 or 8976 or 8977 or (6789 + 8976) or (6789 + 8977) or (6789 + 11320) or (6789 + 11364) or (3791 + 6662 + 8977) or (6789 + 8976 + 8977) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364) or (3791 + 6662 + 8977 + 11364) or (6789 + 8976 + 8977 + 11320 + 11364)
	0145	Mod : (6789 + 11320) or (6789 + 11364) or (8977 + 11364) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364)
	0146	Mod : 6789 or 8976 or 8977 or (6789 + 8976) or (6789 + 8977)
	0147	Mod : 8976 or 8977 or (6789 + 8976) or (8976 + 8977)
	0148	Mod : (4801 + 6789 + 8976 + 12248) or (4801 + 6789 + 8976 + 11320 + 12248)
R	0149	(MSN 425, 441, 444, 482) or (MSN 425, 441, 444, 482 / Mod : 4000 + 5119 + 5713 + 7483)

	CODE	DESIGNATION
R	0150	Mod : (3504 + 6383) or (3504 + 5051 + 6383) or (3504 + 5051 + 6383 + 6415)
	0151	Mod : (6919 + 7467) or (6919 + 7467 + 8341)
	0152	Mod : 8339 or (6919 + 8339) or (6919 + 10083) or (6919 + 8339 + 10083)
	0153	Mod : 8976 or 8977 or (6789 + 8976) or (6789 + 8977)
	0154	Mod : 11320 or 11364 or (6789 + 11320) or (6789 + 8976 + 11320)
	0155	Mod : 12248 or (6789 + 12248) or (3791 + 8977 + 12248) or (6789 + 8977 + 12248) or (8977 + 11364 + 12248)
	0156	Mod : (MP S8559 + 7032) or (MP S8559 + 8976) or (MP S8559 + 8977)
R	0157	Mod : 6354 or 7258 or 8364 or 8427 or (7171 + 7187)
	0158	Mod : (4939 + MP S5063) or (4939 + 6523) or (4939 + 5051 + MP S5063 + 6415)
	0159	Mod : (4801 + 11592 + 12085) or (4801 + 10610 + 11592)
	0160	Mod : (4801 + 12085 + 12248) or (4801 + 10610 + 12248)
	0161	Mod : (7032 + MP S8559) or (8976 + MP S8559) or (8977 + MP S8559)
	0162	Mod : (10610 + 12454) or (10610 + 12455) or (12085 + 12454) or (12085 + 12455)
R	0163	Mod : (4003 + 12557) or (FDX + 12557) or (FDX + 4003 + 12557)
	0164	Mod : (10167 + 10664) or (10167 + 10734) or (10167 + 11021) or (8601 + 10167 + 10734)
	0165	Mod : 5448 or (5051 + 5448 + 6415)
R	0166	STD or Mod : 5388 or (5388 + 6334) or (5388 + 6334 + 6792)
	0167	Mod : (4801 + 6384) or (4801 + 7576) or (4801 + 6384 + 7576)
	0168	Mod : (4801 + 6919 + 7467 + 7576) or (4801 + 6384 + 6919 + 7467 + 7576)
R	0169	Mod : 4801 + 5051 + 6919 + 7576
	0170	MSN 316, 318, 331
	0171	Mod : (3781 + 5443) or (3781 + 6233) or (3219 + 3781 + 6591) or (3219 + 3781 + 12480) or (3219+3781+6591+12480)
	0172	Mod : (3219 + 3721 + 5051) or (3219 + 4180 + 5051)
	0173	Mod : 5735 or 6908 or 7307 or (5735 + 7307) or (6908 + 7307) or (5735 + 6908 + 7307)
	0174	Mod : (11592 + 11702) or (11702 + 12248) or (6908 + 7307 + 11592 + 11702)
	0175	Mod : 11893 or 12161 or 12523 or (5697 + 11893) or (5697 + 12161) or (4209 + 5697 + 11893) or (4209 + 5697 + 12161) or (4209 + 5913 + 11893) or (4209 + 5913 + 12161) or (5697 + 5913 + 11893) or (5697 + 5913 + 12161) or (5697 + 6234 + 11893) or (5697 + 8960 + 11893) or (5697 + 8960 + 12161) or (5697 + 8960 + 12523) or (4209 + 5913 + 6234 + 11893) or (4209 + 5913 + 6234 + 12161) or (4209 + 5913 + 6352 + 11893) or (4209 + 5913 + 6352 + 12161) or (5697 + 5913 + 6234 + 11893) or (5697 + 5913 + 6234 + 12161) or (5697 + 5913 + 8960 + 11893) or (5697 + 5913 + 8960 + 12161) or (5697 + 6234 + 8960 + 11893) or (5697 + 6234 + 8960 + 12161) or (4209 + 5697 + 5913 + 6234 + 11893) or (4209 + 5697 + 5913 + 6234 +12161) or (11893 or 12161/FDX)
R	0176	Mod : 4003 or FDX or (FDX + 4003) or MSN 425, 441, 444, 482, 434, 484, 522, 523
	0177	Mod : 12693 or 12715 or (3456 + 12693) or (3456 + 12715) or (12557 + 12693)
	0178	Mod : (4801 + 6789 + 12248) or (4801 + 6789 + 8976 + 11320 + 12248) or (4801+ 6789 + 8977 + 11364 + 11592) or (4801 + 6789 + 8976 + 8977 + 11320 + 11364)
	0179	Mod : (5448 + 5455 + 5725) or (5051 + 5448 + 5455 + 5725 + 6415)
	0180	Mod : 12248 or (6789 + 12248) or (6789 + 8976 + 12248) or (6789 + 8977 + 12248) or (8977 + 11364 + 12248) or (3791 + 6662 + 8977 +12248) or (6789 + 8976 + 11320 + 11592) or (6789 + 8976 + 11320 + 12248) or (6789 + 8977 + 11364 + 11592)
	0181	MSN 378, 434, 445, 484, 490, 491, 522, 523, 531, 550, 551, 672

CODE	DESIGNATION
0182	Mod : 12248 or (6789 + 11364) or (6789 + 12248) or (6789 + 8976 + 12248) or (6789 + 8977 + 12248) or (8977 + 11364 + 12248) or (3791 + 6662 + 8977 + 12248) or (6789 + 8976 + 11320 + 11592) or (6789 + 8976 + 11320 + 12248) or (6789 + 8977 + 11364 + 11592) or (6789 + 8976 + 8977 + 11320 + 11364)
0183	Mod : (3791 + 8977) or (6789 + 11320) or (6789 + 11364) or (8976 + 11320) or (8977 + 11364) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364) or (6789 + 8976 + 8977 + 11320 + 11364)
0184	Mod : (MP S8559 + 6789 + 8976 + 11320) or (MP S8559 + 6789 + 8976 + 8977 + 11320 + 11364)
0185	Mod : (MP S8559 + 6789 + 11320) or (MP S8559 + 6789 + 11320 + 11364)
0186	Mod : (6789 + 11320) or (6789 + 11364) or (8976 + 11320) or (8977 + 11364) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364) or (6789 + 8976 + 8977 + 11320 + 11364)
0187	Mod : 12248 or (6789 + 12248) or (3791+ 8977 + 12248) or (6789 + 8976 + 12248) or (6789 + 8977 + 12248) or (8977 + 11364 + 12248) or (6789 + 8976 + 11320 + 11592) or (6789 + 8976 + 11320 + 12248) or (6789 + 8977 + 11364 + 11592)
0188	Mod : 11320 or 11364 or (6789 + 11320) or (6789 + 11364) or (8977 + 11364) or (6789 + 8976 + 11320) or (6789 + 8977 +11364) or (6789 + 8976 + 8977 + 11320 + 11364)
0189	Mod : 11592 or 12248 or (6789 + 12248) or (3791 + 8977 + 12248) or (6789 + 8976 + 12248) or (6789 + 8977 + 12248) or (8977 + 11364 + 12248) or (6789 + 8976 + 11320 + 12248) or (6789 + 8977 + 11364 + 11592)
0190	Mod : (6789 + 11320) or (6789 + 11364) or (8976 + 11320) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364) or (6789 + 8976 + 8977 + 11320 + 11364)
0191	Mod : 6789 or 8976 or 8977 or (6789 + 8976) or (6789 + 8977) or (3791 + 6662 + 8977)
0192	Mod : (6789 + 11320) or (6789 + 11364) or (8976 + 11320) or (8977 + 11364) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364) or (6789 + 8976 + 8977 + 11320 + 11364)
0193	Mod : (6789 + 11320) or (6789 + 11364) or (8976 + 11320) or (8977 + 11364) or (6789 + 8976 + 11320) or (6789 + 8977 + 11364)
0194	Mod : 12248 or (6789 + 12248) or (3791 + 8977 + 12248) or (6789 + 8976 + 12248) or (6789 + 8977 + 12248) or (8977 + 11364 + 12248) or (6789 + 8976 + 11320 + 11592) or (6789 + 8976 + 11320 + 12248) or (6789 + 8977 + 11364 + 11592)
0195	Mod : 12248 or (6789 + 11364) or (6789 + 12248) or (3791 + 8977 + 12248) or (6789 + 8976 + 12248) or (6789 + 8977 + 12248) or (8977 + 11364 + 12248) or (6789 + 8976 + 11320 + 11592) or (6789 + 8976 + 11320 + 12248) or (6789 + 8977 + 11364 + 11592)
0196	Mod : (8527 + 8616) or (8527 + 10664) or (8527 + 10734) or (8527 + 8601 + 8616) or (8527 + 8601 + 10664) or (8527 + 8601 + 10734) or (8527 + 10938 + 11021)
R 0197	Mod : (8527 + 10664 + 11351) or (8601 + 8616 + 11351) or (8601 + 10664 + 11351) or (8601 + 10734 + 11351) or (8527 + 8601 + 8616 + 11351) or (10734 + 10938 + 11021 + 11351) or (8601 + 8616 + 8671 + 10356 + 11351)
0198	Mod : (MP S8559 + 10610) or (MP S8559 + 12085)
0199	Mod : (11592 + 12085) or (12248 + 12085) or (11592 + 10610) or (12248 + 10610)
0200	Mod : (10610 + 11320) or (10610 + 11364) or (10610 + 12044) or (10610 + 12045) or (11320 + 12085) or (11364 + 12085) or (12044 + 12085) or (12045 + 12085)
0201	Mod : 12557 or 12715 or 12693 or (12557 + 12693)
0202	Mod : 12671 or (12557 + 12671) or (12557 + 12671 + 12693)
0203	Mod : (10610 + 11592) or (10610 + 12016) or (10610 + 12248) or (11592 + 12085) or (12016 + 12085) or (12085 + 12248)
0204	Mod : (10610 + 12016) or (10610 + 12248) or (12016 + 12085) or (12085 + 12248)
0205	Mod : (4801 + 10610 + 12016) or (4801 + 10610 + 12248) or (4801 + 12016 + 12085) or (4801 + 12085 + 12248)
0206	Mod : (11409 + 11592) or (11409 + 12016) or (11409 + 12248)

	CODE	DESIGNATION
R	0207	Mod : (11893 + 12062) or (12062 + 12161) or (12062 + 12523) or (5213 + 12062 + 12161) or (12062 + 12161 + 12523)
	0208	Mod : 11893 or 12161 or 12523 or (5213 + 11893) or (5213 + 12161)
R	0209	STD or Mod : 11702 or (5735 + 11702) or (6908 + 11702) or (7307 + 11702) or (5735 + 6908 + 11702) or (5735 + 7307 + 11702) or (6908 + 7307 + 11702) or (5735 + 6908 + 7307 + 11702) or (5735 + 6908 + 7307 + 12248)
	0210	Mod : (11592 + 11702) or (11702 + 12248) or (6908 + 7307 + 11592 + 11702) or (6908 + 7307 + 11702 + 12248)
	0211	Mod : (5735 + 12248) or (6908 + 12248) or (7307 + 12248) or (6908 + 7307 + 11592) or (6908 + 7307 + 12248) or (5735 + 6908 + 7307 + 12248)
	0212	Mod : 8616 or 10664 or 10734 or 11021 or 11403 or (10734 + 11021) or MSN 421, 422
	0213	Mod : (5697 + 5896 + 5913 + 7288) or (5697 + 5896 + 7288 + 12255)
	0214	Mod : (5697 + 5913 + 7288) or (5697 + 5913 + 12255)
	0215	Mod : (5697 + 5896 + 5913) or (5896 + 5913 + 6234) or (5896 + 5913 + 6352) or (5697 + 5913 + 12255) or (5697 + 5896 + 5913 + 6234)
	0216	Mod : (8616 + 11351) or (10664 + 11351) or (10734 + 11351) or (11021 + 11351) or (10734 + 10938 + 11021 + 11351)
	0217	Mod : (2989 + 3448 + 6205) or (2989 + 3448 + 5289 + 6205 + 6444)
	0218	Mod : 12025 or 12034 or 12043 or 12094 or 12339 or 12354 or (8616 + 12025) or (8616 + 12034) or (10664 + 12339) or (10734 + 12043) or (11403 + 12034) or (8616 + 12025 + 12034) or (10938 + 11021 + 12025) or (10938 + 11021 + 12034) or (11403 + 12025 + 12034) or (10734 + 10938 + 11021 + 12025)
R	0219	Mod : (5213 + 5697 + 5896 + 12972) or (5697 + 5896 + 7288 + 12972) or (5697 + 5896 + 7288 + 12255 + 12972)
	0220	Mod : 5875 or 5944 or (5875 + 5944)
R	0221	Mod : (11592 + 11702) or (11702 + 12248) or (5735 + 11702 + 12248) or (6908 + 11702 + 12248) or (6908 + 7307 + 11592 + 11702) or (6908 + 7307 + 11702 + 12248) or (5735 + 6908 + 7307 + 11702 + 12248)
	0222	Mod : (5875 + 12132) or (5944 + 12132) or (5875 + 5944 + 12132)
	0223	Mod : (5875 + 12691) or (5944 + 12691) or (5875 + 5944 + 12691)
R	0225	Mod : 8616 or 10664 or 10734 or 11021 or 11403 or 12339 or 12354 or (10664 + 12339) or (10938 + 11021) or (10734 + 10938 + 11021) or (8616 + MSN 421, 422)
R	0226	Mod : 8616 or 10664 or 10734 or 11021 or 11403 or 12339 or 12354 or (10664 + 12339) or (10938 + 11021) or (11351 + 12339) or (10664 + 11351 + 12339)
	0227	Mod : 8616 or 10664 or 10734 or 11021 or 11403 or 12339 or 12354 or (10664 + 12339) or (10734 + 11021) or MSN 421, 422
	0228	Mod : 12025 or 12034 or 12043 or 12094 or 12339 or 12354 or (8616 + 12025) or (8616 + 12034) or (11021 + 12034) or (11049 + 12354) or (11403 + 12034) or (8616 + 10928 + 12025) or (8616 + 10928 + 12034) or (8616 + 11047 + 12025) or (10664 + 11049 + 12339) or (10734 + 11046 + 12043) or (10928 + 11021 + 12025) or (10928 + 11021 + 12034) or (8616 + 10928 + 11047 + 12025) or (8616 + 10928 + 12025 + 12034)
	0229	Mod : (11592 + 12454) or (11592 + 12455) or (12016 + 12454) or (12016 + 12455) or (12248 + 12454) or (12248 + 12455)
	0230	Mod : (4803 + 12785) or (4803 + 12557 + 12785)
	0231	Mod : 11320 or 11364 or 12044 or 12045 or MSN 316
	0232	PW 4156A or Mod : 7380/PW 4156A
R	0233	Mod : (8616 + 11351) or (10664 + 11351) or (10734 + 11351) or (11021 + 11351) or (10664 + 12339 + 12972) or (10664 + 11351 + 12339 + 12972) or (10734 + 10938 + 11021 + 11351)

	CODE	DESIGNATION
R	0234	Mod : 12025 or 12034 or 12043 or 12094 or 12354 or (8616 + 12025) or (8616 + 12034) or (11021 + 12034) or (11049 + 12354) or (11403 + 12034) or (8616 + 10928 + 12025) or (8616 + 10928 + 12034) or (8616 + 11047 + 12025) or (10734 + 11046 + 12043) or (10928 + 11021 + 12025) or (10928 + 11021 + 12034) or (11403 + 12025 + 12034) or (8616 + 10928 + 11047 + 12025) or (8616 + 10928 + 12025 + 12034) or (10734 + 10928 + 11021 + 11046 + 12025)
R	0235	Mod : 5875 or MSN 434, 484, 522, 523
R	0236	STD or Mod : 4863 + 7763 + 8616
R	0237	STD or Mod : 4863 or (4863 + 7763 + 8616)
R	0238	STD or Mod : 4863/MSN 445,490,491,531
R	0239	STD or Mod : (3244 + 4366) or (3244 + 4776) or (4803 + 5353)
R	0240	Mod : 3244 or (3244 + 4366)
R	0241	Mod : 6240 + 12557
R	0242	Mod : 8357 + 11415
R	0243	Mod : 5735 + 6908 + 7307 + 11702 + 12248
R	0244	STD or Mod : 5574 or FDX / PW 4000
R	0245	Mod : (5051 + 5455) or (5051 + 5448 + 5455) or (5051 + 5448 + 5455 + 5725) or (5051 + 5448 + 5455 + 5725 + 6415)
R	0246	Mod : (5051 + 5448 + 5455 + 5725)
R	0247	STD or Mod : 6515 or 6810 or 6812 or 6934 or (6515 + 6812)
R	0248	STD or Mod : (3004 + 3731) or (3004 + 3731 + 7229)
R	0249	STD or Mod : 7563 or 10002 or (5544 + 7563) or (5544 + 10002) or (7563 + 10002) or (5544 + 6515 + 7563) or (5544 + 6812 + 7563) or (5544 + 7563 + 10002) or (6515 + 7563 + 10002) or (5544 + 6515 + 6812 + 7563) or (5544 + 6934 + 7563 + 10002)
R	0250	STD or Mod :12134 or 12291 or (12134 + 12291) or (12144 + 12291)
R	0251	STD or Mod : 4803 or (4803 + 12557) or (4803 + 12785)
R	0252	STD or Mod : 3731 or (3731 + 7229)
R	0253	STD or Mod : 5544 or (5544 + 10002)
R	0254	Mod : (MP S5063 + 12291) or (6523 + 12291) or (6523 + 12134 + 12291) or (6523 + 12144 + 12291)
R	0255	Mod : 3791 or (3791 + 12291) or (3791 + 12134 + 12291)
R	0256	Mod : 5051 or (5051 + 12134) or (5051 + 12291) or (5051 + 12134 + 12291)
R	0257	Mod (5051 + MP S5063) or (5051 + 6523) or (MP S5063 + 12291) or (5051 + MP S5063 + 12291) or (5051 + 6523 + 12134) or (5051 + 6523 + 12291) or (5051 + 6523 + 12134 + 12291) or (5051 + 6523 + 12144 + 12291)
R	0258	Mod : (11454 + 11899) or (11454 + 11900) or (11454 + 11899 + 11900)
R	0259	STD or Mod : 2989 or (2989 + 3448)
R	0260	Mod : 3881 or (2989 + 3881) or (2989 + 3448 + 3881)
R	0261	Mod : 2989 + 3881
R	0262	Mod : (2989 + 3881) or (2989 + 3448 + 3881)
R	0263	Mod : 2989 or (2989 + 3448)
R	0264	Mod : 3881 + 6334
R	0265	Mod : 3881+ 6334
R	0266	STD or Mod : 2989 or (2989 + 3448) or (2989 + 6723) or (2989 + 3448 + 6723) or (2989 + 3448 + 7367)
R	0267	STD or Mod : (5289 + 6444) or (5289 + 6205 + 6444) or (2989 + 5289 + 6205 + 6444)

	CODE	DESIGNATION
R	0268	Mod : 3448 or (2989 + 3448 + 5289 + 6205 + 6444)
R	0269	STD or Mod : (5289 + 6444) or (5289 + 6106 + 6444) or (2989 + 5289 + 6205 + 6444) or (5289 + 6106 + 6205 + 6444) or (2989 + 5289 + 6106 + 6205 + 6444) or (2989 + 5289 + 6106 + 6205 + 6444 + 7407)
R	0270	Mod : 2989 + 5289 + 6106 + 6444 / MSN 550,551
R	0271	STD or Mod : 3448
R	0272	STD or Mod : 2989 or 6041 or (2989 + 6041)
R	0273	Mod : 3448 or (2989 + 3448 + 6041) or (2989 + 3448 + 6041 + 7270)
R	0274	Mod : 2989 + 6041 / MSN 425,441,444,482
R	0275	Mod : (2989 + 6041) or (2989 + 3448 + 6041)
R	0276	Mod : 5051 or (3448 + 5051) / MSN 434,484,522,523
R	0277	STD or Mod : 4000 or (3347 + 4000) or (4000 + 5119) or (3347 + 4000 + 5119) or (4000 + 5119 + 5713)
R	0278	STD or Mod : (4000 + 7483) or (3347 + 4000 + 7483) or (4000 + 5119 + 7483) or (3347 + 4000 + 5119 + 7483) or (4000 + 5119 + 5713 + 7483)
R	0279	Mod : 4943 + 5119 + 5713
R	0280	STD or Mod : (2989 + 4000) or (3347 + 4000) or (3881 + 4000) or (2989 + 3881 + 4000) or (3347 + 3881 + 4000) or (2989 + 3347 + 3881 + 4000)
R	0281	Mod : 2989 + 3881 + 4000
R	0282	Mod : 11338 or 11339 or 12361 or (11338 + 11339) or (11338 + 11339 + 12361)
R	0283	STD or Mod : 4284 or 4803 or (4284 + 4900)
R	0284	Mod : 4803 + 12557
R	0285	Mod : 4803 or (4803 + 12557)
R	0286	STD or Mod : 3244 or (3087 + 3244) or (3244 + 4284) or (3244 + 4366) or (4803 + 5414) or (3087 + 3244 + 4366) or (3244 + 3422 + 4366) or (4803 + 5414 + 7273)
R	0287	Mod : 2965 or (2965 + 3422) or (2965 + 10991)
R	0288	STD or Mod : 3406 or 4776 or 4803 or (3406 + 4803) or (4803 + 6647)
R	0289	Mod : 4801 + 6605 + 6919
R	0290	STD or Mod : 2994 or 4803 or (2994 + 4803) or (3737 + 5184)
R	0291	Mod : 4803
R	0292	Mod : 3737 + 4803 + 5184
R	0293	Mod : (11338 + 11339) or (11338 + 11339 + 12361)
R	0294	Mod : 11338 or 11339 or 12361 or (11338 + 11339 + 12361)
R	0295	Mod : (4801 + 6644) or (4801 + MSN 421, 422)
R	0296	Mod : 4801 + 5027 + 6644 + 6702
R	0298	Mod : 4801 + 6702 + 6919 + 11756
R	0299	Mod : (4801 + 5875 + 6875 + 6919 + 7467 + 7576) or (4801 + 5875 + 6875 + 6919 + 7467 + 7576 + 10083)
R	0300	Mod : (4801 + 5875 + 6875 + 6919 + 7576 + 8339 + 10083) or (4801 + 5875 + 6536 + 6875 + 6919 + 7576 + 8339 + 10083)
R	0301	Mod : (4801 + 6919 + 7467) or (MSN 421, 422 + 4801)
R	0302	Mod : 4801 + 6875 + 6919 + 7576
R	0303	Mod : 4801 + 6919

	CODE	DESIGNATION
R	0304	Mod : 4801 + 4917 + 5027 + 6919
R	0305	Mod : 4801 + 5875 + 6919
R	0306	Mod : (4917 + 6919 + 7467 + 10751) or (4917 + 6919 + 7467 + 10083 + 10751)
R	0307	Mod : 4917 + 6919 + 8339 + 10083 + 10751
R	0308	Mod : 6919 + 8339 + 10751
R	0309	Mod : 6919 or 8339 or (6919 + 8339) or (6919 + 10869) or (8339 + 10869) or (6919 + 8339 + 10869)
R	0310	Mod : (6919 + 7467) or (6919 + 7467 + 10869)
R	0311	Mod : 6919 + 8339 + 10869
R	0312	Mod : 6845 + 6919 + 10083
R	0313	Mod : 5051 + 5562 + 6919
R	0314	Mod : 6845 or (MSN 421) or (MSN 422 + 6845)
R	0315	Mod : 4801 + 6919 + 7576
R	0316	Mod : 4801 + 6813 + 7405 + 10806
R	0317	Mod : 4801 + 10806
R	0320	Mod : (4801 + 6919 + 7576) or (4801 + 6384 + 6919 + 7576)
R	0321	Mod : 4801 + 6384 + 6919 + 7576
R	0322	Mod : (4801 + 5875) or (4801 + 5875 + 6875) or (4801 + 5875 + 7576) or (4801 + 5875 + 6875 + 7576)
R	0323	Mod : (4801 + 5875 + 6536 + 6875) or (4801 + 5875 + 6536 + 6875 + 7576)
R	0324	Mod : 5697 + 5896 + 8960 + 12161 + 12255 + 12523 + 12784 + 13209
R	0325	Mod : 5697 + 12161 + 12255 + 12523 + 12784 + 13209
R	0326	Mod : 5697 + 8960 + 12161 + 12523 + 12784
R	0327	Mod : 12161 + 12523 + 13095 + 13174 + 13209
R	0328	Mod : 12972 or (5697 + 12972) or (5697 + 12972 + FDX)
R	0329	Mod : 7483 or (5051 + 7483) or (2254 + 5051 + 7483)
R	0330	Mod : 2254 + 5051 + 7483
R	0331	Mod : (13095 + 13174) or (12161 + 12523 + 13095 + 13174)
R	0332	Mod : 2254 or 2989 or (2254 + 2989) or (2254 + 2989 + 4003-D3025)
R	0333	STD or Mod : FDX or (FDX + 3968) or (FDX + 4358)
R	0334	Mod : (3732 + 6445) or (6119 + 6445) or (3732 + 6119 + 6445)
R	0335	Mod : 3732 or 6119 or (3732 + 6119)
R	0336	Mod : 8616 + 10928 + 12025 + 12034
R	0337	Mod : (4943 + 5119) or (4943 + 5430) or (3347 + 4943 + 5119) or (3347 + 4943 + 5430) or (4943 + 4979 + 5430) or (4943 + 5119 + 5713) or (3347 + 4943 + 4979 + 5430)
R	0338	Mod : 12161 + 12523 + 12784 + 13095 + 13174 + 13209
R	0339	Mod : 5846 or (4803 + 5846) or (4803 + 5846 + 5884)
R	0340	Mod : (10610 + 13173) or (10610 + 13214) or (12085 + 13173) or (12085 + 13214)
R	0341	Mod : (MPS8559 + 10610 + 13173) or (MPS8559 + 10610 + 13214) or (MPS8559 + 12085 + 13173) or (MPS8559 + 12085 + 13214)
R	0342	Mod : (10610 + 12454 + 13173) or (10610 + 12455 + 13214) or (12085 + 12454 + 13173) or (12085 + 12455 + 13214)

CODE	DESIGNATION
0220B	STD or Mod : 6444 or (5289 + 6444)
0220C	Mod : (2989 + 3448) or (2989 + 3448 + 5289 + 6444)
0220D	Mod : 2989 or (2989 + 6444) or (2989 + 5289 + 6444)
0220F	Mod : 2989 + 3448 + 6041 + 7270
0230A	Mod : 3881 or (3881 + 5051 + 6415)
0240B	Mod : 4943 or (4943 + 5430) or (4943 + 4979 + 5430) or (4943 + 5119 + 5713)
0240C	Mod : (3347 + 4943) or (3347 + 4943 + 5430) or (3347 + 4943 + 4979 + 5430) or (3347 + 4943 + 5119 + 5713)
0240E	Mod : 4000 or (4000 + 5119 + 5713)
0240F	Mod : (3347 + 4000) or (3347 + 4000 + 5119 + 5713)
0240G	STD or Mod : 5119 + 5713
0240H	STD or Mod : 5051 + 5119 + 5713 + 6415
0410B	Mod : (6299 + 6365) or (5917 + 5918 + 6299)
0480A	STD or Mod : 5051 + 6415
0730B	Mod : (3737 + 5184) or (3737 + 4803 + 5184)
0800A	Mod : 6794 or 7019 or 7122 or 7402 or 7787
0810A	STD or Mod : 5051 + 6415
0820A	STD or Mod : 5051 + 6415
0830A	Mod : 2254 or (2254 + 5051 + 6415)
0830B	STD or Mod : 5051 + 6415
0830C	Mod : 8009 or 8099 or (8009 + 8099)
0830D	Mod : (2254 + 8009) or (2254 + 8099) or (2254 + 8009 + 8099)
0840A	STD or Mod : 5051 + 6415
0850A	Mod : 6794 or 7122 or 7402 or 7787
0850B	Mod : (5051 + 6794) or (5051 + 7019) or (5051 + 7122) or (5051 + 7402) or (5051 + 7787)
1210A	STD or Mod : 5051 + 6415
1320A	STD or Mod : 5051 + 6415
1330A	Mod : 5358 or (5051 + 5358 + 6415)
1330B	Mod : 4854 or (4854 + 5051 + 6415)
1330C	STD or Mod : 5051 + 6415
1330E	STD or Mod : 4854
1330F	Mod : 5358 or (4854 + 5358) or (4854 + 5051 + 5358 + 6415)
1330G	Mod : (5051 + 5358) or (4854 + 5051 + 5358)
1330H	Mod : (4854 + 5051) or (4854 + 5051 + 5358)
1330I	STD or Mod : 5358/PW 4000
1330J	STD or Mod : 5051 or (5051 + 5358)/PW 4000
1350A	STD or Mod : 5051 + 6415
1370A	STD or Mod : 3588 + 5197
1370B	Mod : 6305 or (2753 + 6305) or (2753 + 5381 + 6305)
1370C	STD or Mod: 5051 or (3588 + 5197)
1420A	STD or Mod : 5051 + 6415

CODE	DESIGNATION
1440A	STD or Mod : 5051 + 6415
1440B	Mod : 3781 or (3781 + 5051 + 6415)
1440D	Mod : (3721 + 3781) or (3781 + 4180) or (3781 + 6645)
1440E	Mod : 3721 or 4180 or 6645
1440N	Mod : (3781 + 5443 + 6536) or (3781 + 6233 + 6536)
1440S	Mod : (5051 + 5443) or (5051 + 6233) or (3219 + 5051 + 6591) or (5051 + 5443 + 6591)
1440T	Mod : (3721 + 3781 + MP S 7212) or (3781+ 6645 + MP S 7212)
1610A	STD or Mod : 5358/PW 4000
1620B	Mod : 5146 or (5051 + 5146 + 6415)
1620C	Mod : (5146 + 7460) or (5051 + 5146 + 6415 + 7460)
1710A	STD or Mod : 5358/PW 4000
1710B	PW 4156A or Mod : 7380/PW 4156A
1720G	STD or Mod : 4857 or 6120
1720H	STD Mod : 5574/PW 4000
1740A	STD or Mod : 5358
1740B	STD or Mod : 5051 + 6415
1740C	GE 80A3 or Mod : 6383/GE 80A3
1740D	STD or Mod : 6383
1740E	GE 80A3 or Mod : 6383/GE 80A3 or 6383/GE 80C2A2 or 6383/GE 80C2A8
1740F	Mod : 3504 + 5051 + 6383/PW 7R4
1740G	STD Mod : 6383/PW 7R4
1750A	STD or Mod : 5051 + 6415
1760B	Mod : 6334 or (5388 + 6334) or (5388 + 6334 + 6792)
1760C	STD or Mod : (5388 + 6792)
1770B	STD or Mod : 5448 or (5051 + 5448 + 6415)
1770D	STD or Mod : 5725 or (5051 + 5725 + 6415)
1770F	Mod : 5725 or (5051 + 5725 + 6415)
1780A	Mod : 4145 or 6039
1780B	STD or Mod : 5051 + 6415
1780C	STD or Mod : 6039/PW 4000
1790A	Mod : 6383 or (4290 + 6383/PW 7R4)
1900A	Mod : (3791 + 6622) or (3791 + 6967)
1910A	Mod : (3791 + 6622) or (3791 + 6967)
1910B	Mod : (6789 + 8976) or (6789 + 8977) or (3791 + 6662 + 8977) or (6789 + 8976 + 8977)
1910C	Mod : 8976 or 8977
1910D	Mod : (4801 + 8976) or (4801 + 8977) or (4801 + 6789 + 8976) or (4801 + 6789 + 8977)
1920A	Mod : (3791 + 6662) or (3791 + 6967)
1920B	Mod : (6789 + 8976) or (6789 + 8977) or (3791 + 6662 + 8977) or (6789 + 8976 + 8977)
1920C	Mod : 8976 or 8977
1930A	Mod : (3791 + 6662) or (3791 + 6967)

CODE	DESIGNATION
1940A	Mod : (6789 + 8976) or (6789 + 8977) or (6789 + 8976 + 8977)
1940B	Mod : 8976 or 8977 or (6789 + 8976) or (6789 + 8977)
1940P	Mod : 6789 or (4801 + 6789)
9006	Mod : 2254 + 2989 + 4003 D 3025
9007	Mod : 2989 + 3448 + 5289

Mod : 12557 or 12715

LEFT BLANK INTENTIONALLY

INTRODUCTION

The A 310 is a wide body monoplane transport powered by two turbofan engines. The fuselage has a circular cross section and is pressurized throughout except, nose cone, tail cone, landing gear bays and air conditioning compartments.

In the cockpit, accommodation is provided for two (or three) operating crew members and two observers.

Passenger seating layout may be varied to suit operating requirements up to the certificated maximum
R of 275 seats.

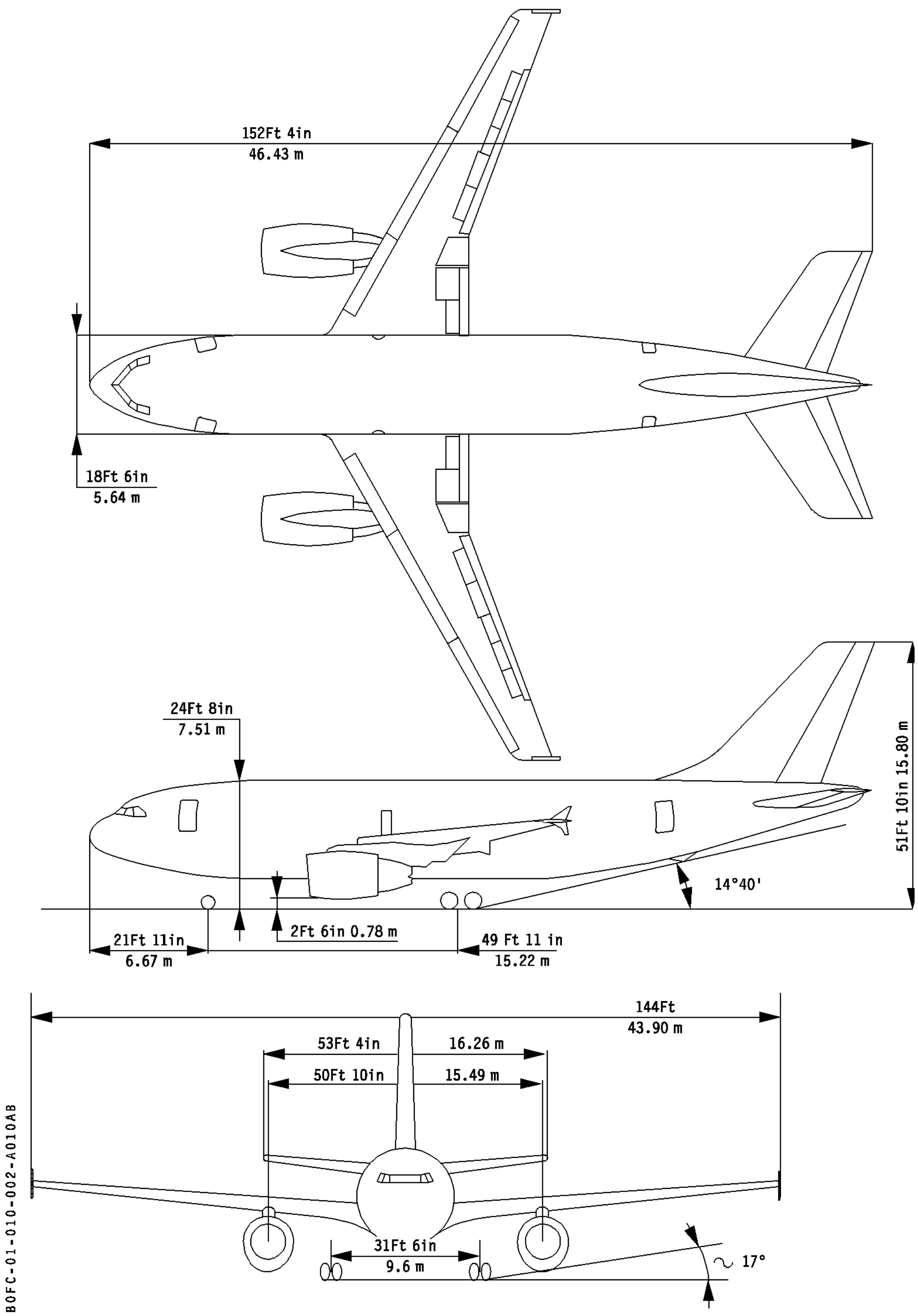
SCOPE

This manual covers all types of A 310.
For weight and performance refer to the appropriate chapter in Volume 2 « Procedures and Performance » of the FCOM.

GENERAL ARRANGEMENT

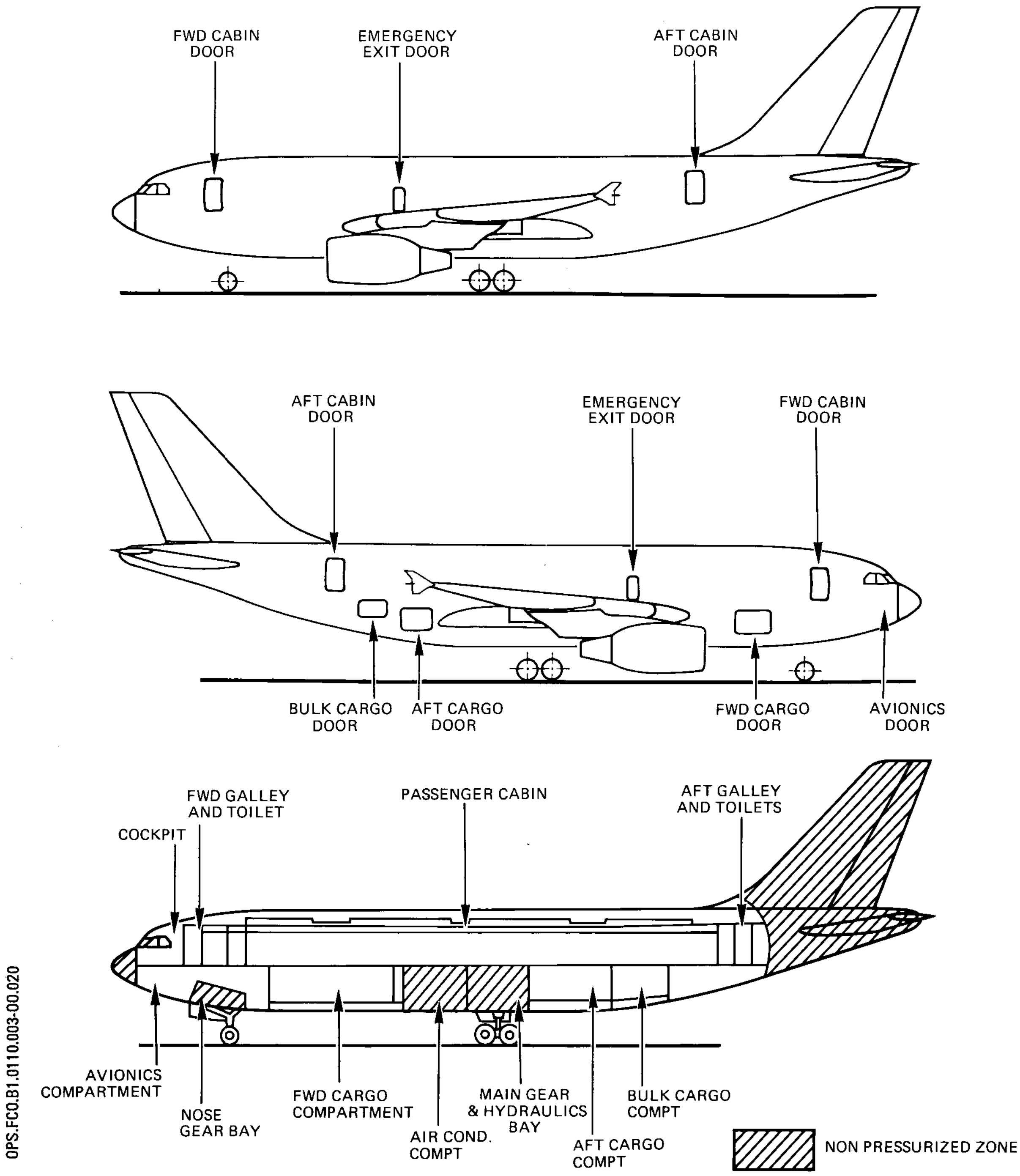
Overall dimensions of the aircraft, nomenclature of major components and compartments, location of antennas and turning capability on the ground are shown in the figures of this subchapter.

AIRCRAFT DIMENSIONS



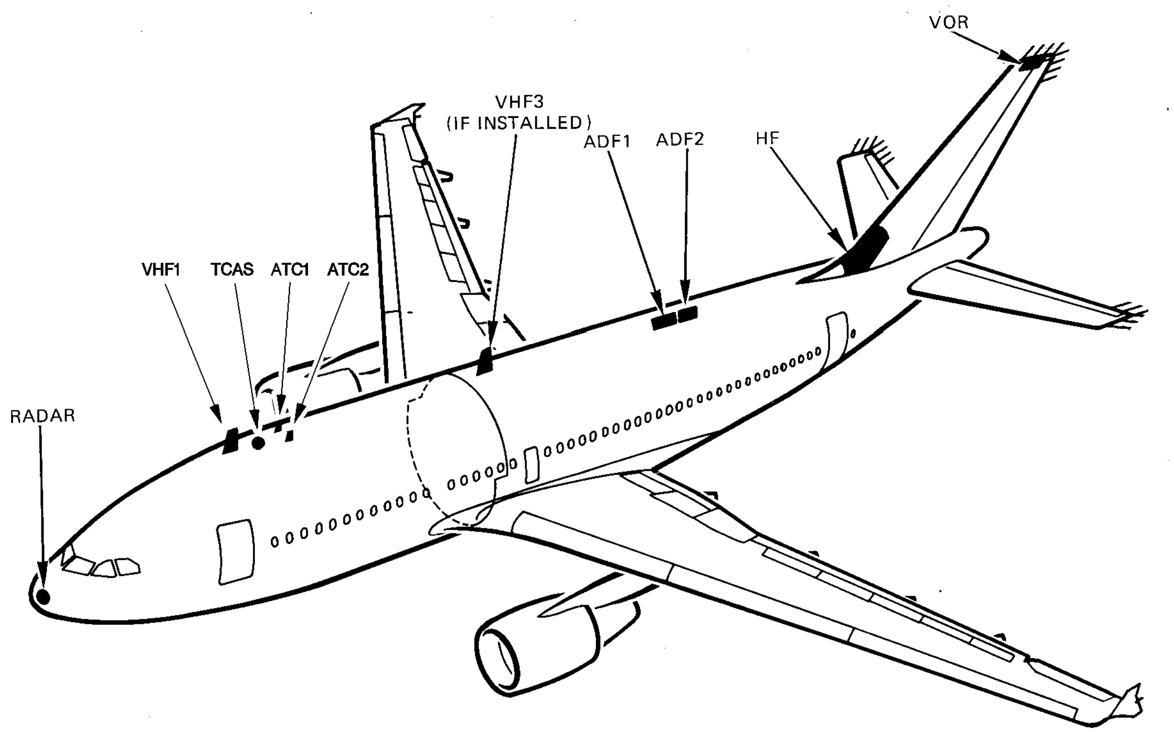
R

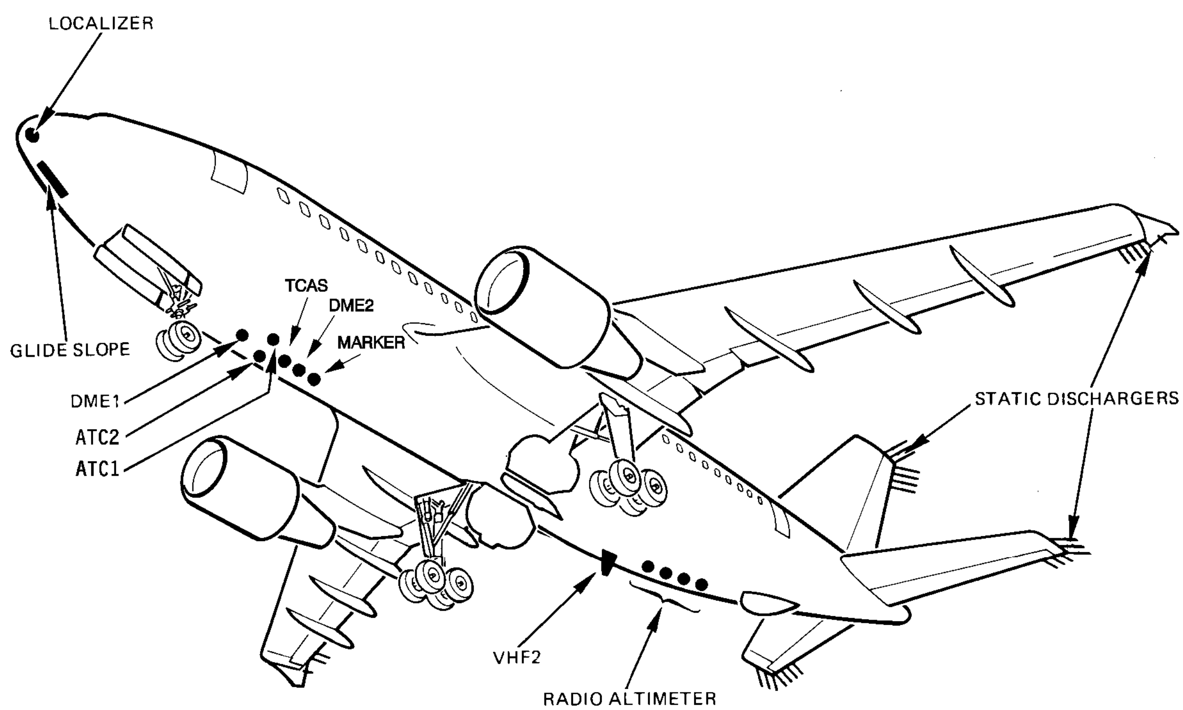
Mod. : 4863 PW Eng. : All


FWD CABIN DOOR
EMERGENCY EXIT DOOR
AFT CABIN DOOR
AFT CABIN DOOR
EMERGENCY EXIT DOOR
FWD CABIN DOOR
BULK CARGO DOOR
AFT CARGO DOOR
FWD CARGO DOOR
AVIONICS DOOR
FWD GALLEY AND TOILET
PASSENGER CABIN
AFT GALLEY AND TOILETS
COCKPIT
AVIONICS COMPARTMENT
NOSE GEAR BAY
FWD CARGO COMPARTMENT
AIR COND. COMPT
MAIN GEAR & HYDRAULICS BAY
AFT CARGO COMPT
BULK CARGO COMPT
NON PRESSURIZED ZONE
OPS.FCO.B1.0110.003-00.020

Mod. : 4863

ANTENNAS LOCATION





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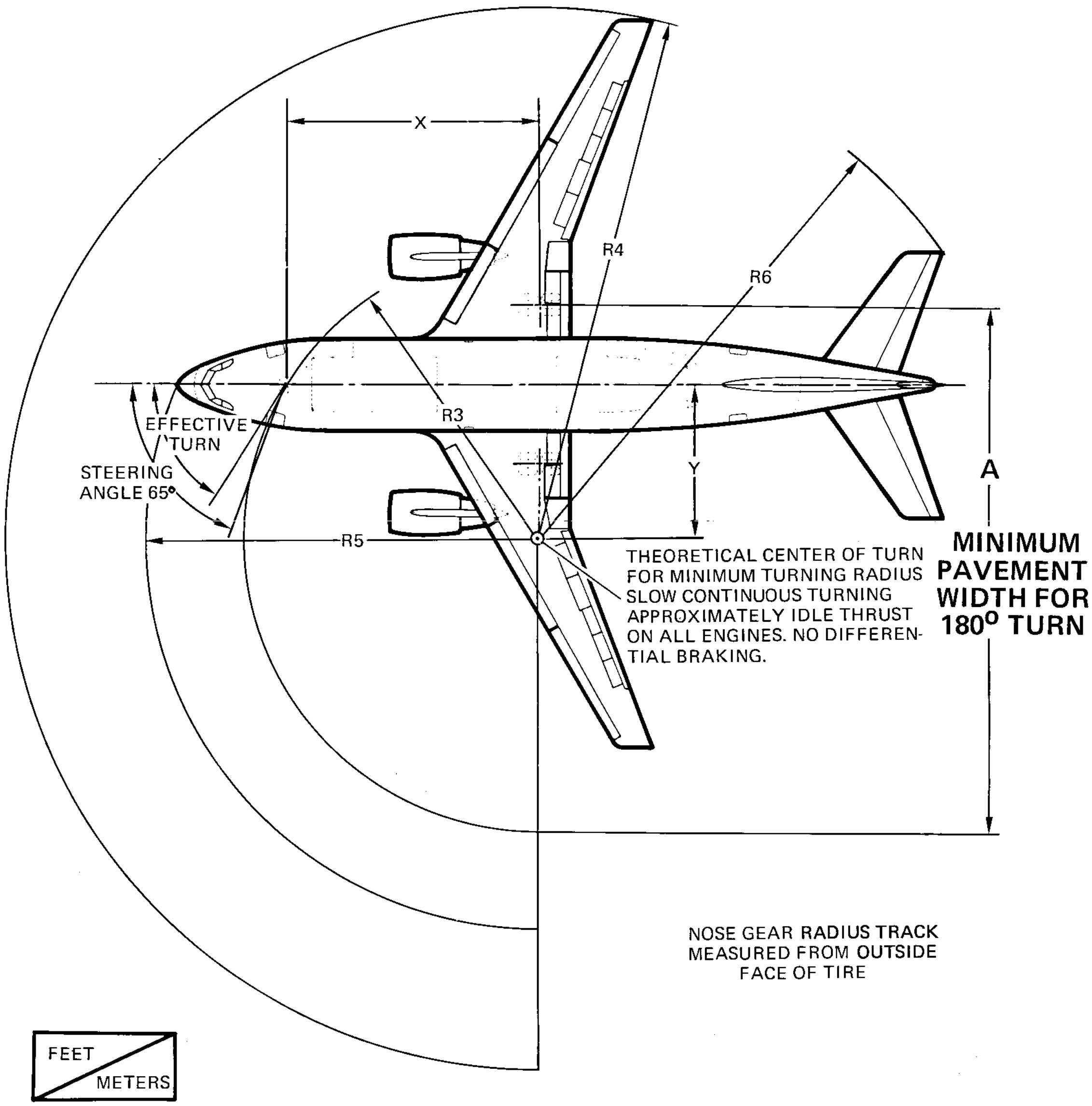
Code : 0009

MINIMUM TURNING RADIUS



A/C CG	EFFECTIVE TURN ANG	X	Y	A	R3	R4	R5	R6
FWD 18 %	60°2	50.89 15.51	28.77 8.77	105.42 32.13	58.63 17.87	103.25 31.47	77.37 23.58	97.77 29.80
AFT 35 %	55°8	50.89 15.51	34.16 10.41	113.69 34.65	61.52 18.75	108.17 32.97	79.53 24.24	100.92 30.76

OPS.FCO.B1.0110.005-06.001

Vers. : All Eng. : All

GENERAL

All aircraft and systems controls, required for the conduct of flight, are arranged in such a way that the crew positions are forward facing and all crew members can monitor instruments and systems.

The concentration of the systems controls on the overhead panel was achieved by extensive employment of pushbutton type switches, directly installed in the systems synoptic.

Status and failure indications are integrated into the pushbutton switches. Pushbutton switch positions and illuminated indications are based on a general concept with the « light out » condition for normal continuous operation as the basic rule.

Few exceptions excluded, the illumination of a light indicates a failure condition or an abnormal pushbutton switch selection. Whenever possible the failure warning is integrated into that pushbutton switch which has to be operated for corrective action.

If the failure warning is not integrated into the pushbutton switch, the warning is adjacent to the pushbutton switch for corrective action.

The installations on the lateral panel are intended for ground use and maintenance action only.

For the comfort, convenience and safety of the crew, various furnishings are fitted in the cockpit as shown in the figure EQUIPMENT AND STORAGES.

PRINCIPLES FOR PUSHBUTTON SWITCHES WITH INTEGRATED INDICATIONS

COLOR OF LIGHT	INDICATION
No light illuminated, except flow bars	Normal basic operation.
BLUE	Temporarily required system in normal operation.
GREEN	Back-up or alternate system selected.
WHITE	P/B Switch selection other than normal basic operation.
AMBER	Caution indication.
RED	Alert indication.

POSITION	BASIC FUNCTION
In (pressed)	ON, AUTO, NORM, OPEN
Out (released)	OFF, MAN, ALTN, SHUT

Note : *Some pushbuttons or lights are provided with two dots which indicate there is no bulb in corresponding part.*

SEATS

– The Captain and F/O seats are mounted each on a base secured to the floor on each side of the center pedestal.

  They are mechanically or electrically adjustable to a different extent :
  . Horizontal (longitude-lateral)
  . Vertical
  . Backrest reclining
  . Thigh support

– Operation of the mechanical controls overrides the electrical function.

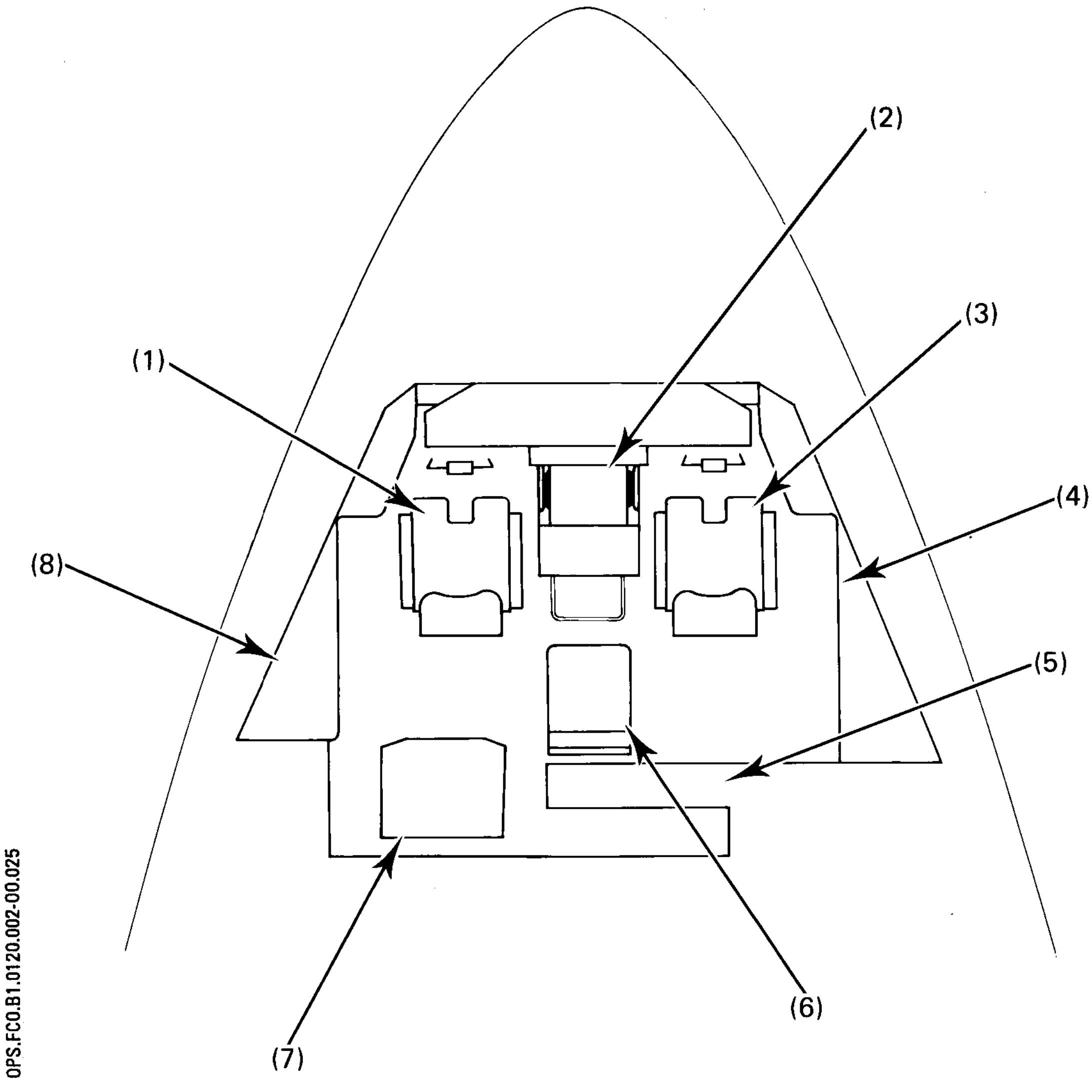
– The crew seats are equipped with adjustable folding armrests. The inboard and outboard armrests of Captain and F/O seats fold behind the backrests. R

– The third occupant seat is a folding seat attached on the rear panel behind the center pedestal.

– The crew seats, except the folding seat, are equipped with full harness including an inertial reel with locking handle for the shoulder harness. The folding seats are equipped with static lap belt.

Mod. : 4803

COCKPIT LAYOUT



(1) Captain Seat

(2) Center Pedestal

(3) F/O Seat

(4) RH Lateral Console

(5) Maintenance Panel

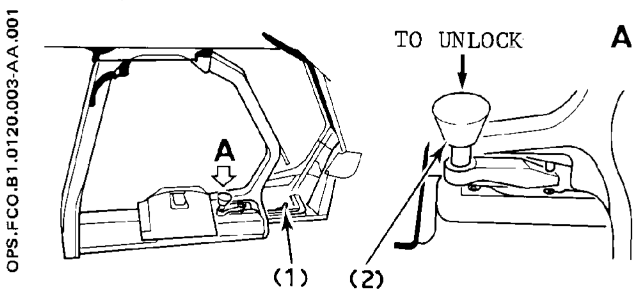
(6) Third Occupant Folding Seat

(7) Avionics Compartment Access Hatch

(8) LH Lateral Console

Mod. : 4803

A. SLIDING WINDOW



(1) Unlocking Pin

- **Front position** :
  Between closed and one-third open position, the window is free to move in the forward and aft directions.
  Forward movement of window is prevented when window is more than one third open.
- **Aft position**:
  Window open lock is disengaged for window closing.

(2) Control Handle

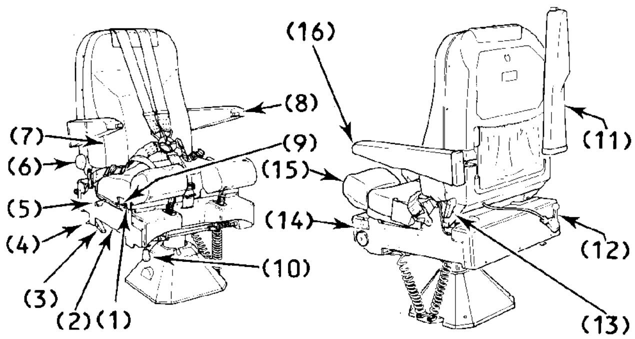
- **Pressed** :
  Handle unlocked for window opening.
- **Pulling** :
  Window is opened.
- **Pushing** :
  Window is closed.

Operation

When the window is closed and locked, the handle is in the front position. Pressing the handle unlocks it and allows to pull it rearward. By this action the handle pivots inward then rearward. The window unlocks and slides inward and rearward. After approximately one third of the window travel the open lock engages, preventing forward movement of window.

Before closure, when the window is more than one third of travel open, the unlocking pin, which is embedded in the window sill, must be set to the aft position to unlock the window for forward travel. Pushing the control handle then closes the window. When passing the one third open position the unlocking pin automatically trips to the front position. When reaching the end of the window travel, pushing the handle further forward results in pivoting of handle lever inward, then forward. By this action the window is moved outward and is locked. At the end of the lever travel the handle lock will engage.

B. CAPTAIN AND F/O SEATS



The captain and f/o seats movements, are achieved by means of mechanical or electrical controls.

To mechanically adjust a seat, lift the respective control handle. This unlocks the seat and it may be moved to the desired position. Releasing the control handle returns it to the springloaded locked position. To lower an armrest pull the armsrest control forward for unlocking and move armrest downward. Release armrest control when desired position is reached, it returns to the springloaded locked position.

For electrical adjustment press respective adjustment control switch in the desired direction. Release switch when the desired position is reached. The switch will return to the springloaded neutral position.

(1) Horizontal adjustment electrical control.

(2) Horizontal adjustment position indicator.

(3) Horizontal adjustment mechanical control.

(4) Vertical adjustment mechanical control.

(5) Tilting backrest control.

(6) Lower lateral cushion vertical position control.

(7) Adjustable lower lateral cushion.

(8) Armrest vertical adjustment control.

(9) Vertical adjustment electrical control.

(10) Thigh rest position and compression adjustment.

(11) Folding and stowable inboard armrest.

(12) Inertial reel locking control.

(13) Lower lateral cushion horizontal position control.

(14) Vertical adjustment indicator.

(15) Retractable thigh rests.

(16) Folding and stowable outboard armrest. R

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Mod. : 4803

CABIN DOORS

Four type « A » (two abreast) outward and forward opening plug-type doors are provided, two on each side of the fuselage. They are normally manually operated, with hydraulic damping towards the end of the opening travel.

In an emergency, the doors are opened (from the inside only) pneumatically and an escape slide installed on the door is automatically released and inflated (if armed). If opened under emergency conditions, the door cannot be closed without some maintenance action.
Opening the door from the outside disarms the escape slide release mechanisms.

The pneumatic opening system is « one-shot », requiring maintenance action after use.

EMERGENCY EXITS

- Cockpit

The two sliding windows in the cockpit are designed as emergency exits for the flight crew. Two centrifugally braked descent devices are installed above each window.

- Cabin

On each side of the cabin a type « 1 » or « 3 » outward opening emergency exit door is provided for use in case of emergency evacuation in addition to the regular cabin doors. They are also equipped with escape slides.

CARGO COMPARTMENT DOORS

Three cargo compartment doors are located on the right side of the fuselage below the cabin floor.

The FWD and AFT cargo doors are dimensioned to suit standard A1 and A2 containers and open outwards and upwards. These two main cargo doors are hydraulically operated by the YELLOW hydraulic system. Locking and unlocking is performed mechanically.

For normal operation hydraulic pressure is provided by yellow electrical pump operation. In case of pump failure the system may be pressurized by a handpump installed in the RH main gear and hydraulics bay. The handpump lever is stowed on the aft wall close to the pump. Both doors can be opened from the exterior only.

The BULK cargo door is smaller than the main cargo doors. It opens inward and upward. The door is operated mechanically from both sides, the interior and the exterior.

Note : *For cargo doors operation and controls refer to CARGO LOADING MANUAL.*

AVIONICS COMPARTMENT ACCESS

An inward opening, manually operated, hinged door gives external access to the avionics compartment in the lower fuselage forward of the nose landing gear bay. A ladder is stowed inside the compartment adjacent to this door, which may be operated from the interior as well as the exterior.

This compartment is also accessible from the cockpit through a hatch in the floor behind the Captain seat. A ladder is fixed in the avionics compartment for access from the cockpit.

INTERNAL DOORS

- Cockpit

A reinforced flight compartment door is installed in the cockpit.
It has a security system to prevent unauthorized entry to the flight deck.
For a further description and operation, refer to the following pages of this chapter.

- Cargo Compartments

Man-sized doors are provided between the FWD cargo compartment and the avionics compartment and between the AFT cargo compartment and the BULK cargo compartment.

Mod : 12557

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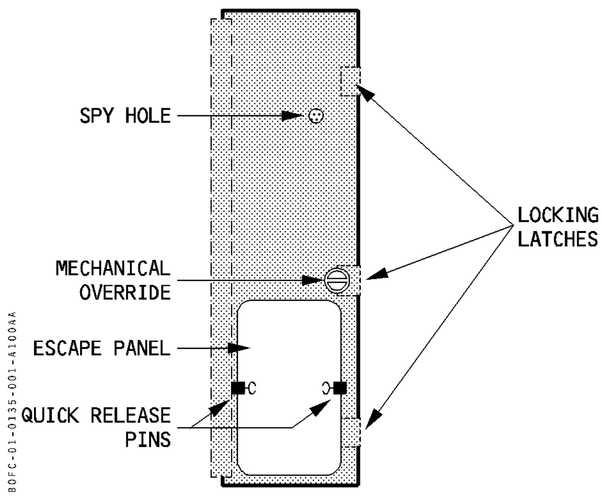
INTERNAL DOORS

- Cockpit

A forward-opening hinge door separates the cockpit from the passenger compartment. It is equipped with a Cockpit Door Locking System (CDLS). The door is equipped with electrical locking latches and a mechanical override handle, which are both controlled by the cockpit crew only. When the cockpit crew does not respond to requests for entry, the door can also be unlocked by the cabin crew, by entering an emergency code on the keypad. The keypad is installed on the door post behind the cockpit door. The door is bullet proof and fully compliant with rapid decompression requirements.

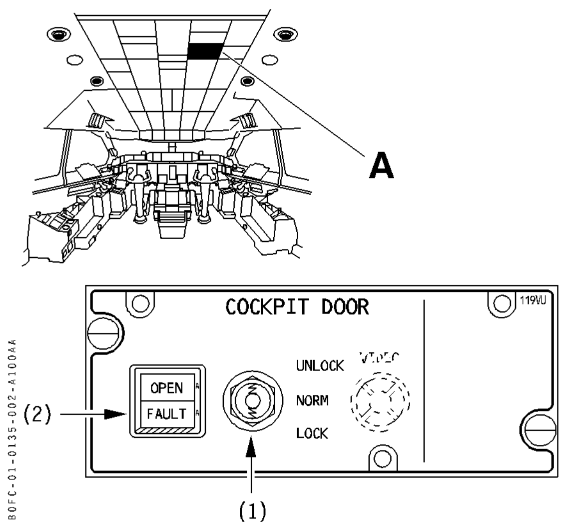


Note 1 : The escape panel enables the flight crew to evacuate the cockpit, in case of an emergency when the door is jammed or stuck. This panel can only be removed from the cockpit side by pulling the quick release pins, and kicking it open.

Note 2 : In case of an electrical supply failure the door is automatically unlocked.

Note 3 : The mechanical override handle is a standard door handle (cockpit side only) that unlocks the door, regardless of the status of the Cockpit Door Locking System (CDLS), even if the CDLS is faulty.

Mod : 12557 or (3456 + 12557)



A. COCKPIT DOOR CONTROL PANEL

The secured cockpit door opening is controlled by the toggle switch, of the COCKPIT DOOR PANEL located on the overhead panel.

(1) COCKPIT DOOR toggle switch

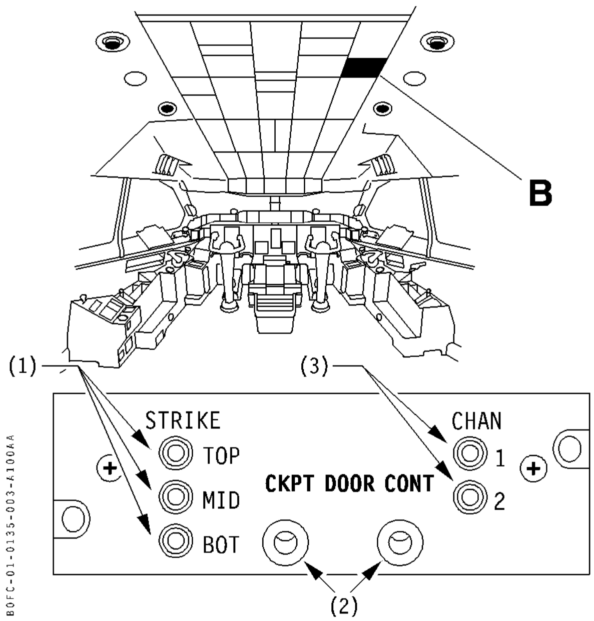
- UNLOCK : This position is used to enable the cabin crewmember to open the door. The switch must be pulled and maintained in this position until the door is fully open.
- NORM : Springloaded neutral position. All latches are locked, only emergency access is possible for the cabin crew.
- LOCK : Once the switch has been moved to this position, the door remains locked and emergency access is inhibited, the buzzer and the keypad are inhibited for a preselected time (5 to 20 minutes).

Note 1 : If the LOCK position has not been used by the pilot, for at least, 5 to 20 minutes, the cabin crew is able to request an emergency access to open the cockpit door.

Note 2 : The UNLOCK position overrides and resets any previous selection.

(2) COCKPIT DOOR light

- OPEN steady (amber) : The door is not fully locked.
- OPEN flashes (amber) : The cabin crew has started an emergency access procedure. If no reaction, the door will unlock at the end of the adjustable time delay (5 to 120 sec).
- FAULT (amber) : When a system failure has been identified (e.g. : latch, pressure sensors, control unit).
  The inoperative item can be identified by checking the STRIKE and CHAN status lights on the CKPT DOOR CONT panel.



B. CKPT DOOR CONT Panel

The Cockpit Door Locking System control panel is located on the overhead panel.

(1) STRIKE status lights

Light extinguished : the corresponding (TOP, MID or BOT) locking latch is operative.
Light illuminated : the corresponding (TOP, MID, or BOT) locking latch is faulty.

(2) Pressure sensor

Two redundant differential pressure sensors enable to detect rapid pressure variation in the cockpit in order to command simultaneous opening of all latches when a defined pressure drop is detected.

(3) Pressure sensor status lights

Light extinguished : the corresponding (CHAN 1 or CHAN 2) pressure sensor is operative.
Light illuminated : the corresponding (CHAN 1 or CHAN 2) pressure sensor is faulty.

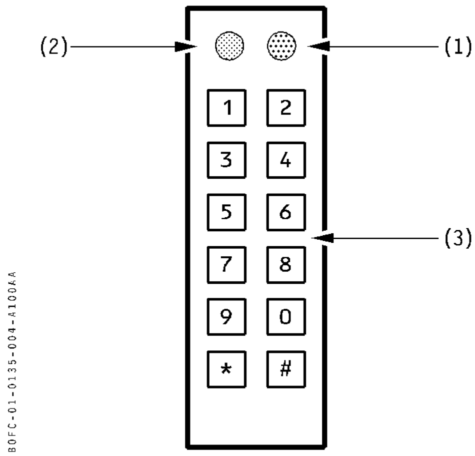
Note : These indicators enable the crew to identify the faulty item when the Fault indicator light on the COCKPIT DOOR Panel is illuminated.

R Code : 0201

C. ELECTRICAL LOCKING SYSTEM

KEYPAD

The keypad is used by the cabin crew to request pilots to open the door or to perform an emergency access. It is installed at the door post (cabin side).



(1) Unlocked door indicator

– GREEN : The door has been unlocked by the flight crew, or automatically (during 5 seconds) when no flight crew action has been performed during the delay, following an emergency access request. The door can be pushed open.

– GREEN flashes : An emergency request to enter the cockpit has been made ; the buzzer will sound continuously in the cockpit, but no action has yet been taken by the flight crew.

(2) Locked door indicator

– RED : The flight crew has denied the access request, and the door remains locked.

(3) Digital keypad

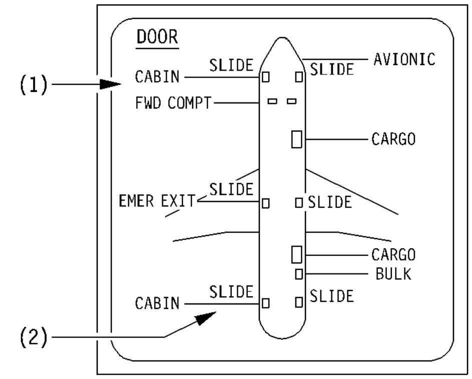
The keypad is used to sound the buzzer in the cockpit for one to nine seconds, by entering a zero to seven-digit code, as programmed by the airline, followed by the "#" key.

It is also used to enter the two to seven-digit emergency code , followed by the "#" key, when the flight crew does not respond.

Note : During the Annunciator lamp test, the CDLS keypad will be "operational" and the system will operate in the following inhibited manner : R
- *The CDLS control unit will register the entry codes entering and the keypad RED/ GREEN LEDs will stay on, as long as the Annunciator lamp test is active.* R
- *If normal entry code is pressed : the buzzer will not sound until the light test is complete.* R
- *If emergency entry code is pressed : timing will proceed to the point of unlocking the strikes and the cockpit buzzer/LED feedback will be inoperative.* R

Code : 0201

SYSTEM DISPLAY

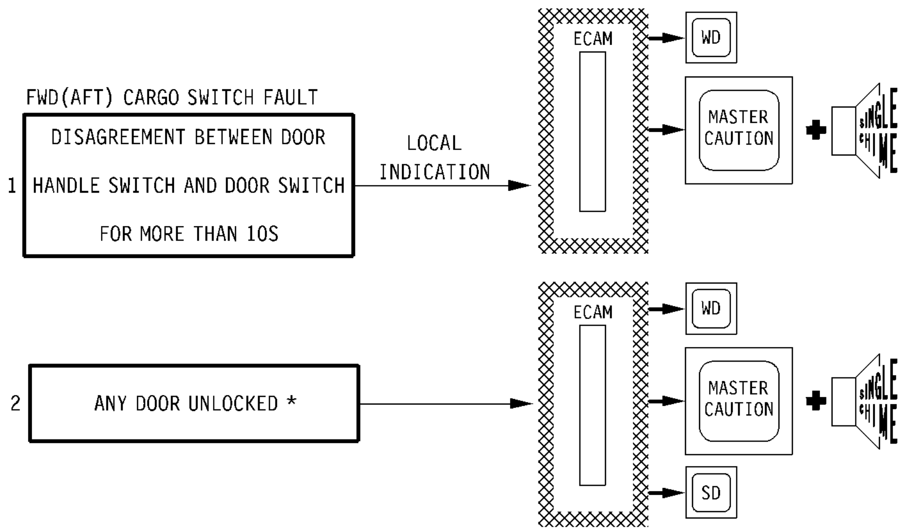


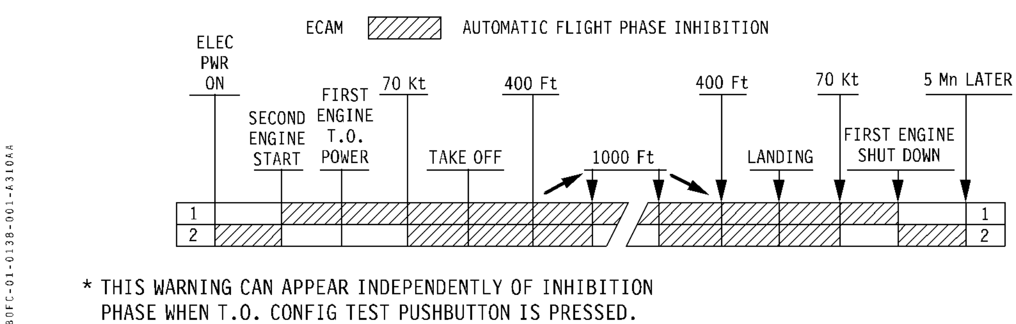
(1) Door Locked/Not Locked Indication

- **Door Locked** : The associated rectangle perimeter is green and the name of the door is displayed white.
- **Door Not Locked** : The associated rectangle surface and the name of the door are amber.

(2) Emergency Escape Slide Selection Indication

- **SLIDE** : The white indication appears when emergency escape slide is not disarmed.





* THIS WARNING CAN APPEAR INDEPENDENTLY OF INHIBITION PHASE WHEN T.O. CONFIG TEST PUSHBUTTON IS PRESSED.

Mod. : 5051 + 5448 + 5725

GENERAL

For aircraft lighting different systems are installed.

Controlled from the cockpit :
– Cockpit Lighting
– Annunciators lighting
– Cabin SIGNS Lighting
– Emergency Lighting
– EXTERIOR Lighting

Controlled from the pursers panel :

– Cabin Lighting
– Emergency Lighting

COCKPIT LIGHTING

The cockpit is provided with integral instrument lighting and instrument panel lightplates.

For illumination of instrument panels fluorescent tubes and incandescent spot lights are installed. Work surfaces and side consoles are illuminated by incandescent spot lights and flood lights.

The intensity of all panel lighting can be adjusted. A STORM switch is provided to override the intensity selection. For general cockpit illumination dimmable DOME lights are installed. When electrical power is supplied by batteries, only one DOME light will illuminate.

The avionics compartment is provided with an individual lighting system. If in automatic mode it illuminates on the ground and extinguishes during flight.

ANNUNCIATOR LIGHTING

All the annunciator lights in the cockpit can be adjusted depending on ANN LT « TEST/BRT/DIM » switch position on the overhead panel.

Lights dimming is ensured by an electronic box.

– On instruments panel dimming depends on cockpit luminosity measured by a photo cell.
– On overhead panel and pedestal the lights are dimmed to a fixed level.

An annunciator light test is provided to verify cockpit annunciator bulbes operating.
The test can be made by selecting TEST position on ANN LT « TEST/BRT/DIM » switch and by visually checking all lights illumination.

It also can be made automatically by depressing, AUTO TEST pb switch.
The test is ensured by an electronic box located in lateral panel which illuminates in a predetermined order the light to detect the faulty bulbes.

CABIN SIGNS LIGHTING

Throughout the cabin FASTEN YOUR SEAT BELTS signs illuminate if the SEAT BELTS switch is selected to ON or in the event of an excessive depressurization. The RETURN TO YOUR SEAT signs in the lavatories illuminate with the FASTEN YOUR SEAT BELTS signs. The NO SMOKING and the EXIT signs throughout the cabin illuminate if the NO SMOKING switch is selected to ON or, if AUTO is selected when the landing gear is extended. In the event of an excessive depressurization the NO R
SMOKING and the EXIT signs illuminate regardless of switch position.

Illumination of any cabin sign is accompanied by a low tone chime in the cabin.

CABIN LIGHTING

For normal cabin lighting fluorescent lights, lighting strips and passenger reading lights are installed.

Cabin lighting control is from the pursers panel. For the event of normal cabin lighting failure a minimum lighting system is provided for cabin and lavatories. (Refer to Emergency Lighting).

EXTERIOR LIGHTING

The exterior lighting includes the following systems : STROBE, BEACON, RWY TURN OFF, NAV and LOGO, NOSE, LAND, WING.

– Two (or three) STROBE lights are installed in each wing R
tip. Theyflash white and are used as supplemental recognition lights.

– BEACON lights are two red anticollision lights, one on the upper and one on the lower center fuselage.
– RWY TURN OFF lights are located on each side of the fuselage nose section. They are used during ground operation for lateral area illumination.
– NAV lights are located on each wing tip. The red (LH) and the green (RH) lights in the leading edge and the white lights in the trailing edge contain two bulbes each. LOGO lights are installed in the upper surface of each horizontal stabilizer to illuminate the company logo on the vertical stabilizer.
– NOSE lights are two reflectors attached to the nose gear strut. Dual filaments permit the selection of high intensity for takeoff and low intensity for taxiing.

- LAND lights are located below each wing, installed in a flap fairing. They illuminate only when fully extended.
- WING lights are provided on both sides of the fuselage. On each side two reflectors are installed, one to illuminate the engine air intake, the other to illuminate the wing leading edge. They are used primarily to detect ice accretion.

EMERGENCY LIGHTING

The emergency lighting includes EXIT signs, cabin ceiling lights and escape slide lighting. The electrical power
R supply is 28 VDC from the DC ESS BUS or, 6 VDC from integral batteries in emergency power supply units.

The batteries are charged from the 115 VAC NORM BUS. The battery capacity provides approximately 12 minutes of light illumination.

EXIT signs and cabin ceiling lights automatically illuminate :

- when the NO SMOKING switch is selected ON or AUTO with the landing gear extended.

or

- if the EMER EXIT LT selector is selected to ON

or

- automatically if the EMER EXIT LT selector is at ARM
R and the 28 VDC DC NORM BUS power supply fails,

or

- if the EMER pushbutton on the pursers panel is pressed.

or

- in case of excessive cabin decompression

The escape slide lights are equipped with an integral lighting system. The escape slide lights illuminate automatically when the slide is deployed.

EXTERIOR LIGHTING

R
R
R
R
R
R
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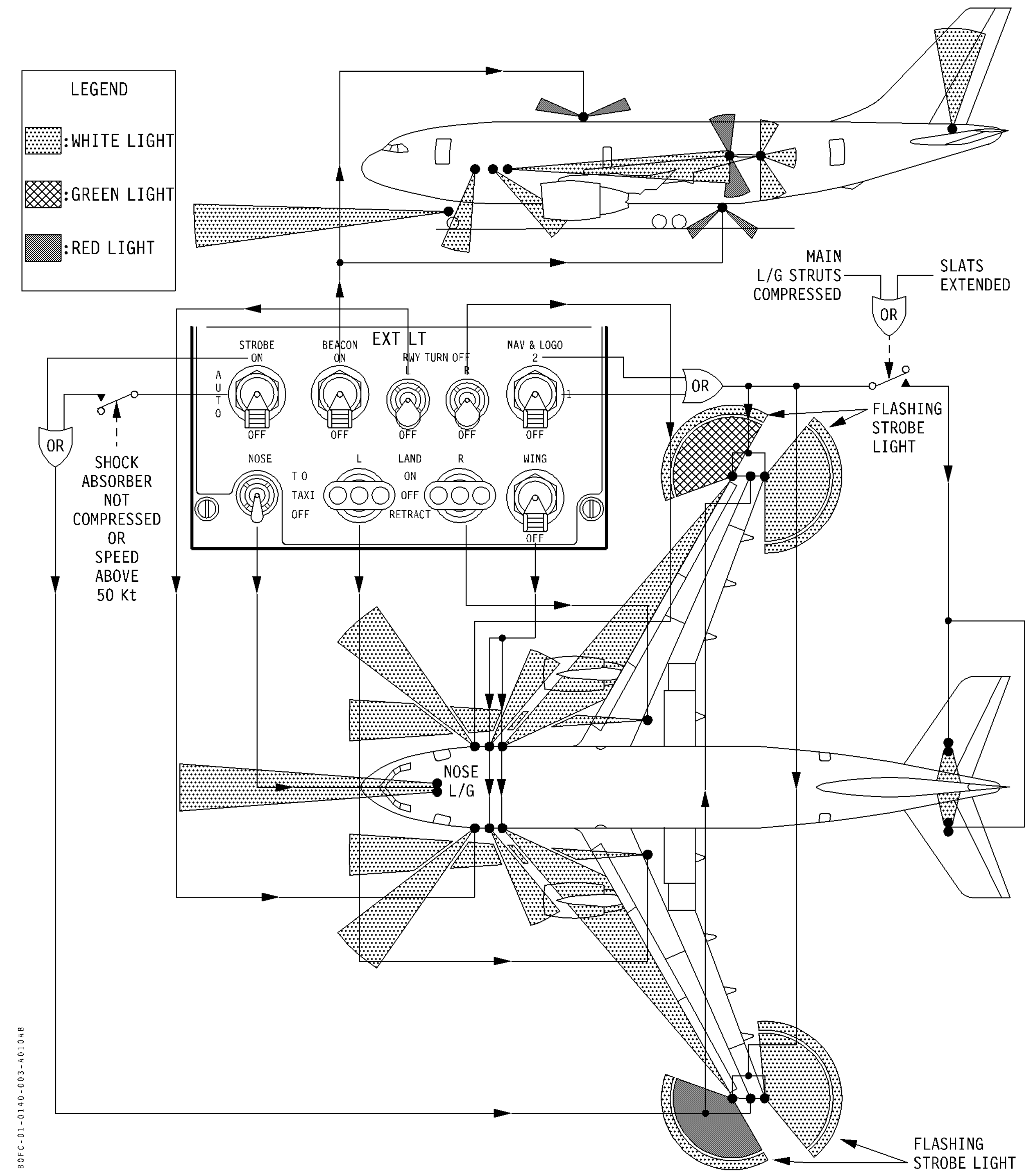
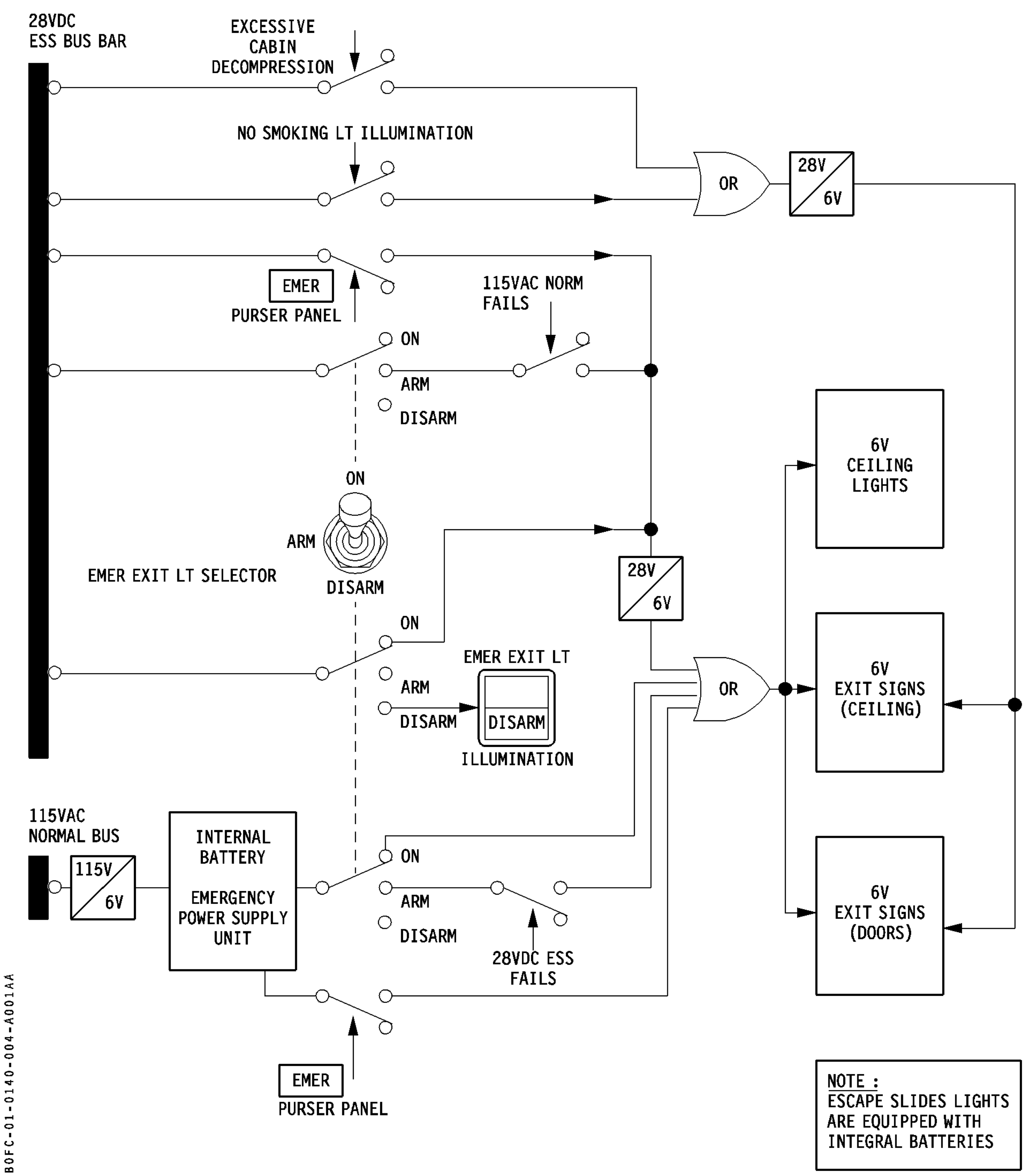
R
R



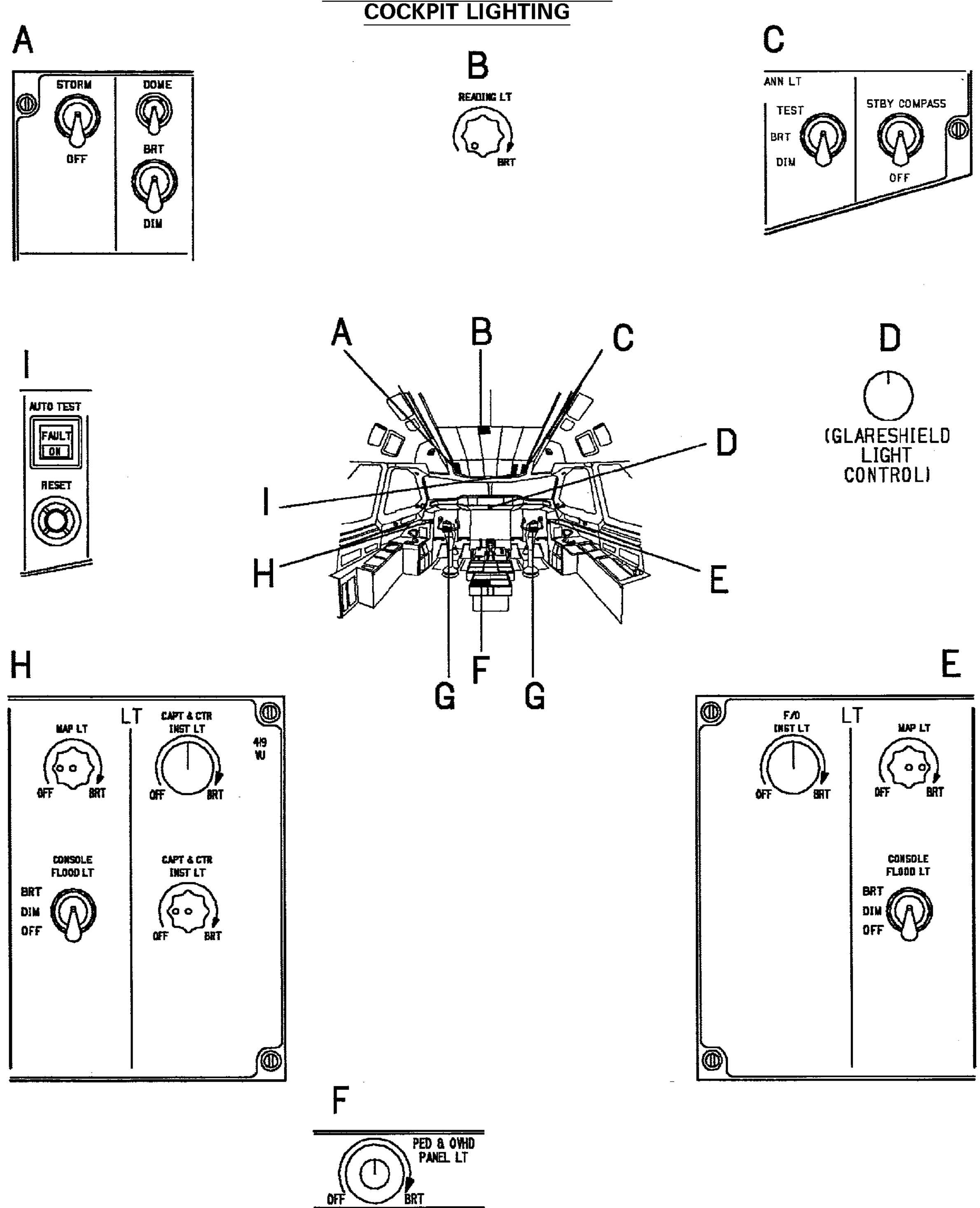
Mod. : 3004

EMERGENCY LIGHTING



NOTE :
ESCAPE SLIDES LIGHTS
ARE EQUIPPED WITH
INTEGRAL BATTERIES

LOCATION OF CONTROLS I
COCKPIT LIGHTING



R
R

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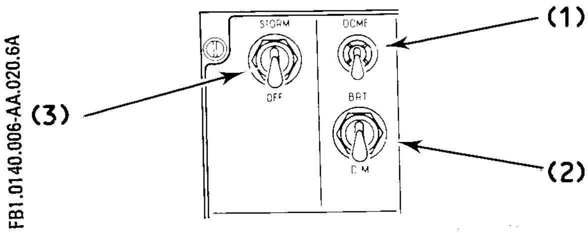
Mod. : 4803

A. COCKPIT LT PANEL



(1) DOME Switch

- **DOME** :
  All dome lights are illuminated.
- **Off** :
  All dome lights are off.

(2) DIM Switch

- **BRT** :
  Dome lights are on with maximum intensity.
- **DIM** :
  Dome lights are dimmed.

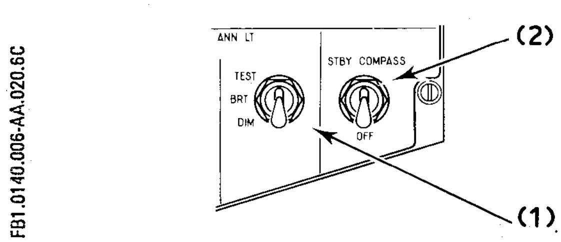
(3) STORM Switch

- **STORM** :
  Fluorescent tubes and flood lights are on with maximum intensity
- **OFF** :
  R Fluorescent tubes are off. Flood lights are on and intensity is controlled from flood rheostat.

B. OVERHEAD PANEL READING LT KNOB

The Knob selects activation and intensity of the overhead panel reading light.
All others reading lights in the flight compartment are controlled and regulated by rotation of the spot light.

C. ANN LT and STBY COMPASS PANEL



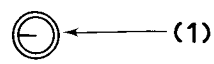
(1) ANN LT Selector

- **TEST** :
  All cockpit annunciator lights will come on bright.
  The windshear warning (if installed) is triggered. R
- **BRT** :
  Annunciator lights are illuminate bright.
- **DIM** :
  Annunciator lights brightness :
  - on Captain, F/O and center instrument panel is controlled by photo cells,
  - on overhead panel, center pedestal and glareshield is dimmed,

(2) STBY COMPASS Switch

- **STBY COMPASS** :
  Integral lighting of standby compass comes on.
- **OFF** :
  Lighting is off

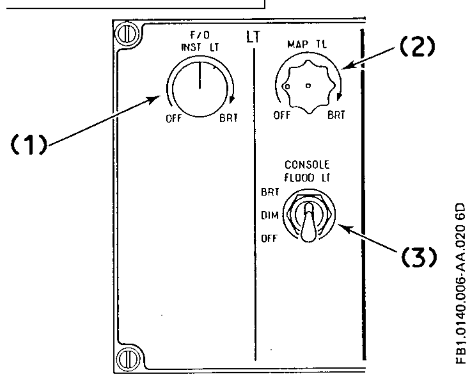
D. GLARESHIELD LIGHTING CONTROL



(1) Glareshield Lighting knob

Knob rotation controls the windows and pb switches integrated lighting of the glareshield panel.

E. F/O LT PANEL



(1) F/O INST LT Knob

Instrument integral lighting intensity on F/O instrument panel is controlled from OFF to BRT.

(2) MAP LT Knob

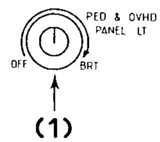
- **OFF** : Map table light is off.
- **BRT** : Map table light is on and regulated in intensity.

(3) CONSOLE FLOOD LT Switch

- **BRT** : F/O console lights illuminate with maximum intensity.
- **DIM** : Console lights are dimmed.
- **OFF** : Console lights are off.

Mod. : 4803

F. PED and OVHD PANEL LT CONTROL :



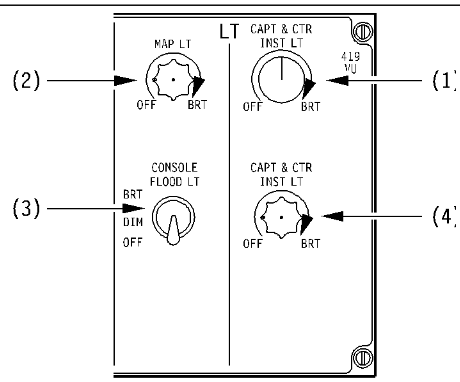
(1) PED & OVHD PANEL LT knob

Center panel and overhead panel integral instrument lighting intensity is controlled from OFF to BRT.

G. CHART HOLDER

CAPT and F/O chart holder lights are controlled by knob located on the chart holder.

H. CAPTAIN AND CENTER LIGHT PANEL



(1) CAPT and CTR INST LT knob

Instrument integral lighting intensity on CAPT and CTR instrument panels is controlled from OFF to BRT.

(2) MAP LT Knob

- **OFF** : Map table light is off.
- **BRT** : Map table light is on and regulated in intensity.

(3) CONSOLE FLOOD LT switch

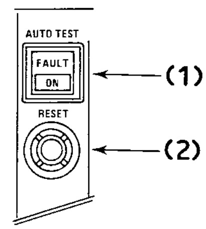
- **BRT** : Captain console lights illuminate with maximum intensity.
- **DIM** : Console lights are dimmed.
- **OFF** : Console lights are off.

(4) MAIN INST PNL FLOOD LT knob

- **OFF** : Main instrument panel lights are extinguished.
- **BRT** : Main instrument panel lights are illuminated and regulated in intensity.

Mod. : 4803 + 12557

I. AUTO TEST PANEL



The annunciator light test is used to verify cockpit annunciator bulbes operating.

(1) AUTO TEST pushbutton switch

- **Normal** (Released-out) : Automatic test is not operating.
- **ON** (Pressed in and magnetically held) : The ON light illuminates white.
  The automatic test sequence is in progress. All lights are illuminated and extinguished in a predeterminated order.
  The ON light extinguishes and the switch pops out at the end of the sequence if there is no faulty bulb.
- **FAULT** (Pressed in) : During the test sequence, if there is a faulty bulb, the FAULT light illuminates amber, the test sequence stops and all the lights around the faulty one flash.

Note : *During the test sequence all digital displays indicate « 888... » (except FQI digital displays during refueling).*
Following light bulbs cannot be automatically tested. During the test sequence these lights illumination have to be visually checked :

- *OVERHEAD PANEL : Mode selector units*
  fire handles
  Inertial system display unit
  Fuel quantity indicator LO LVL lights
  ENG TRIM
  COCKPIT DOOR R
  "OPEN FAULT" light R
  CKPT DOOR CONT R
  panel lights R
- *MAIN INSTRUMENT PANEL : Altimeters*
  L/G control lever
  TRP mode selector keys.
  Slats/Flaps position indicator
- *GLARESHIELD : Flight control unit*
  EFIS control panel
  AUTO LAND Lights

– *PEDESTAL : FMC - Control display units*
ECAM CTL panel
ATC control unit
VHF control unit
ADF1 control unit

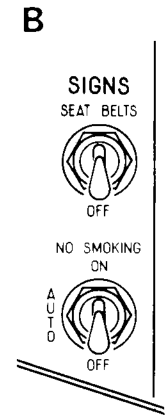
R *Note : This test triggers the windshear warning if*
R *installed.*

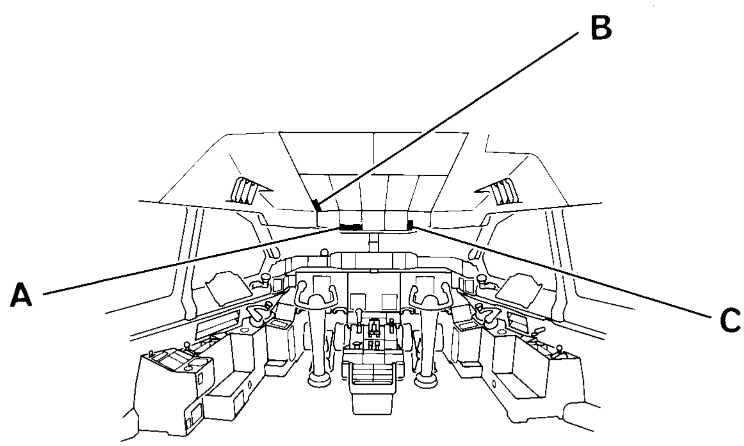
(2) RESET Pushbutton

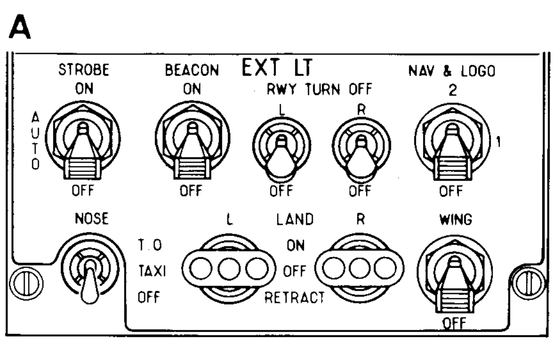
When pressed after a sequence interruption due to a faulty bulb detection, the automatic sequence re-starts.

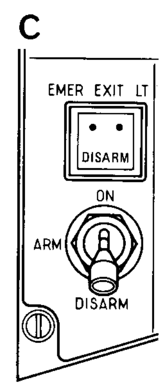
Mod. : 4803 + 5051

LOCATION OF CONTROLS II
EXTERIOR AND CABIN SIGN LIGHTING









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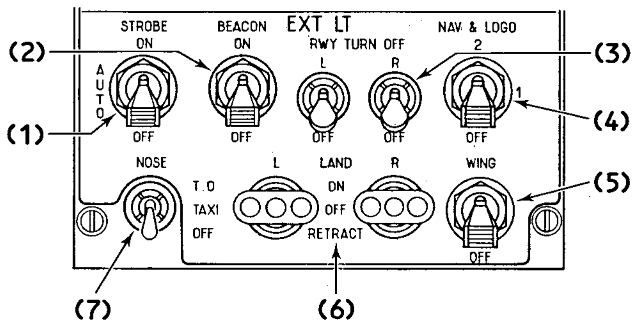
A. EXT LT PANEL :



(1) STROBE Selector

- **ON** : Strobe lights, two on the leading and one on the trailing edge of each wingtip, flash white.
- **AUTO** : Strobe lights are automatically switched on when the shock absorber is not compressed or when the speed is above 50 kt.
- **OFF** : All lights are off.

(2) BEACON Switch

- **ON** : Two anticollision lights, one on top and one on the bottom of the center fuselage flash.
- **OFF** : All lights are off.

(3) L and R RWY TURN OFF Switches

R Each RWY TURN OFF light, left and right, is controlled by an individual switch.

- **ON** : Two lights, one on each side of the forward fuselage, are activated to illuminate sideways, especially taxiway intersections for turning off.
- **OFF** : Lights are off.

(4) NAV and LOGO Selector

- **1** : Circuit for first set of navigation and logo lights is activated.
R One colored navigation light in the leading edge of each wingtip and one white light in the trailing edge,
R are steadily illuminated.
On each horizontal stabilizer a light is activated to illuminate the logo on each side of the vertical stabilizer when the main landing gear struts are compressed or slats are extended.
- **2** : Circuit for second set of navigation and logo lights is activated.
- **OFF** : All lights are off.

(5) WING Switch

- **ON** : On each side of the fuselage two lights are activated to illuminate the wing leading edge and the engine air intake.
- **OFF** : Lights are off.

(6) L and R LAND Selectors

Each landing light, left and right, is controlled by an individual selector.

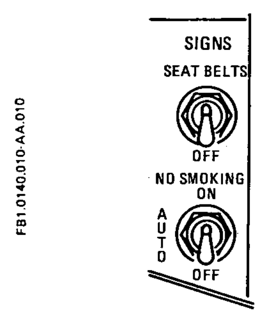
- **ON** : The related landing light is extended and comes on automatically when fully extended.
- **OFF** : The related landing light is extended but off.
- **RETRACT** : The related light is retracted and off.

(7) NOSE Selector

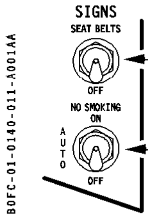
- **T.O.** : Two lights attached to the nose gear strut come on at high intensity.
- **TAXI** : Lights come on at low intensity.
- **OFF** : Lights are off.

Note : Lights automatically go off, when the landing gear is retracted.

B. SIGNS PANEL :



Note : RETURN TO YOUR SEAT, NO SMOKING and EXIT signs throughout the cabin and lavatories illuminate automatically regardless of switch positions when cabin altitude exceeds 11,300 ± 500 Ft and MAN PRESS is not selected on the CABIN PRESS PANEL. R R R



(1) SEAT BELTS Switch

- **ON**

  FASTEN YOUR SEAT BELTS signs in cabin and RETURN
R TO YOUR SEAT signs in lavatories illuminate associated with low tone gong upon illumination.

- **OFF**

  Signs are off. Low tone gong sounds upon extinction.

(2) NO SMOKING Selector

- **ON**

R NO SMOKING and EXIT signs in cabin illuminate associated with low tone gong upon illumination.

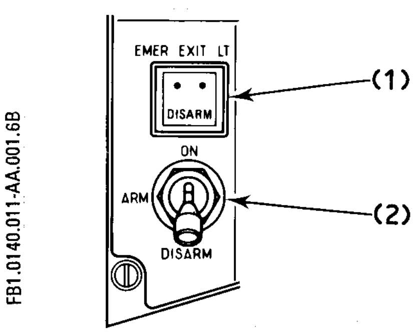
- **AUTO**

R NO SMOKING and EXIT signs in cabin illuminate when
R landing gear is extended and extinguish when landing gear is retracted. Low tone gong sounds upon illumination and extinction of the lights.

- **OFF**

  Signs are off. Low gong sounds upon extinction.

C. EMER EXIT LT PANEL



(1) DISARM Light

- **DISARM**

R Light illuminates amber, when the EMER EXIT LT selector is selected DISARM.
R If EMERG pushbutton switch on pursers panel is pressed
R the DISARM light extinguishes.

(2) EMER EXIT LT Selector

The selector is locked in each position. Before moving it must be slightly pulled.

- **ON**

  Ceiling lights, EXIT signs and floor path markings are illuminated.

- **ARM**

  Ceiling lights, EXIT signs and floor path markings will illuminate automatically if either AC normal bus or DC ESS bus are lost.

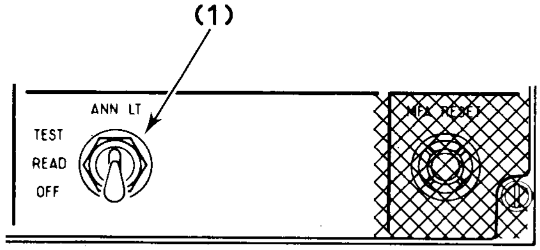
- **DISARM**

  Automatic illumination of ceiling lights, EXIT signs and floor path markings following power failure is deactivated.

Note : *The ceiling lights, EXIT signs and floor path markings can be illuminated independently from the purser panel.*

A. ANN LT PANEL :

FB1.0150.001-AA.030.6A

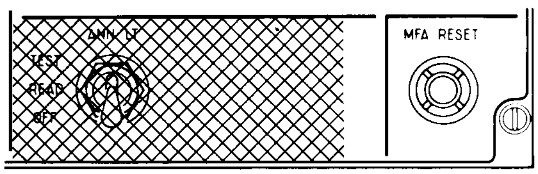


(1) ANN LT Selector

- **TEST** : All annunciator lights come on on lateral panel.
- **READ** : When activated, annunciator lights come on.
- **OFF** : All annunciator lights are off.

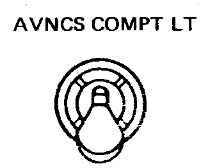
B. MFA's RESET P/B SWITCH

FB1.0150.001-AA.030.6B



When the MFA's RESET pb switch are pressed, all Memorized Fault Annunciators for each system included in the corresponding section of the lateral panel go off.

C. AVNCS COMPT LT SWITCH



FB1.0150.001-AA.030.6C

The switch is situated near the avionics compartment access patch. It controls the avionics compartment lighting.

Mod. : 4803

The air conditioning and pressurization systems maintain the air in the pressurized compartments at the desired level of pressure, temperature and freshness.

R Bleed air is cooled, conditioned and distributed to the individual compartments (flight compartment, passenger compartment, avionics compartment and cargo compartments) and then discharged overboard through outflow valves (pressure regulating valves) and fixed vent holes. A part of the cabin air is recirculated.

The required bleed air for the system is supplied either by engine compressors or APU or a high pressure ground air supply unit. (See chapter 16 – Pneumatic).

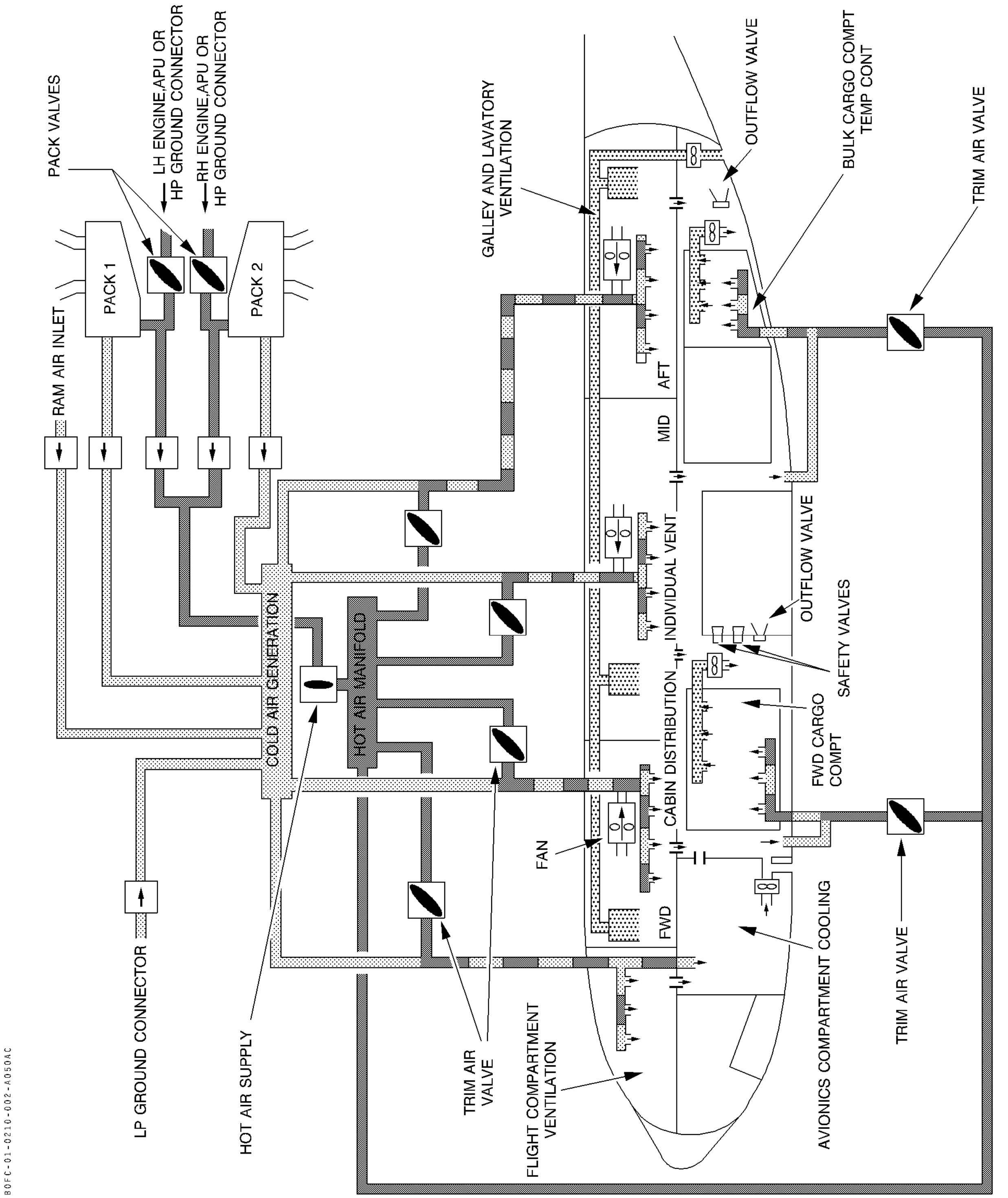
R R R *Note : it is recommended not to use external HP air for conditioning due to possible refrigeration pack contamination.*

Conditioned air can also be supplied directly to the cabin air distribution system by a low pressure ground connection.

A ram air inlet is also provided for fresh air ventilation, in flight when the air conditioning systems are not operating.

Pressure and pressure variations in the pressurized compartments are controlled automatically by adjusting the outflow valves.

The underfloor air is used for ventilation of the electronics racks, in the cargo compartment heating and ventilation systems, and for general ventilation of other underfloor areas inside the pressurized fuselage.



Mod. : 2989 + 3881

GENERAL

The bleed air supplied to the air conditioning system is hot compressed air processed through two air conditioning packs which regulate air flow and temperature as required. This cooled regulated air is then fed to a cold air manifold.

A part of the unconditioned hot air is tapped upstream of the two packs, just downstream of the pack valve and directly fed to a hot air manifold, through a single hot air supply valve.

The air supplied to the pressurized compartments is temperature controlled by mixing, for each compartment, cold air with hot air from the two manifolds.

AIR CONDITIONING PACKS

Each pack includes :

– *A pack valve* which is a pneumatically operated, electrically controlled butterfly valve, delivers air to the pack, and in normal operation, regulates an approximately constant volumetric airflow.

R Two levels of air flow are available :
R Normal flow and Econ flow (68 % of normal flow).
R Selection of Econ flow in cruise reduces the quantity of
R bleed air required, thus resulting in a fuel saving. On
R ground, or in single pack operation, selection of Econ flow
R has no effect, normal flow will continue.

Note : The information « ECON FLOW SELECTED » is displayed on the ECAM MEMO page.

In the absence of air pressure, and independently from any electrical supply, the pack valve is spring-loaded closed. It remains open in the absence of electrical supply, provided it is pneumatically supplied.

– *A refrigeration unit,* consisting of a compressor, a turbine and a fan mounted on a common shaft, and an air to air heat exchanger located between the compressor and turbine. The energy provided by the expansion of the air in the turbine is used mainly to cool the air already cooled in the heat exchanger, and to drive the compressor and fan.

Fusible plugs and thermostats at the compressor outlet and turbine inlet, protect the system in case of excessive temperature.

– *A turbine bypass valve* which admits more or less flow through the turbine.

– *A water separator* collecting small droplets of water, after separation from the air by inertia in a coalescer : this water is then sprayed through an injector at the inlet of the air to air heat exchanger cooling side.

– *A cooling airflow system* to modulate the precooled flow of the conditioning air in the heat exchanger. The cooling air inlet is closed by a deflect door during the takeoff and landing phases, and is open during flight and on the ground. The cooling air outlet is equipped with a modulation flap which is linked to the turbine bypass valve and modulates the flow of R cooling air as required.

– *An emergency ram air inlet* located forward of the air conditioning pack 1 cooling air inlet, provides for ventilation of the pressurized fuselage with ram air. The opening of the ram air inlet is only authorised in flight when the cabin differential pressure is lower than 1 PSI.

TEMPERATURE CONTROL

The system is designed to regulate and limit :
– The temperature of the air discharged from the packs.
– The temperature of the air supplied to the different compartments (or zones).

The temperature control is automatic, relative to the temperature selection on the COMPT TEMP overhead panel for the four zones : COCKPIT, FWD CABIN, MID CABIN and AFT CABIN.

To establish the required temperature (pack outlet temperature and zone ambient temperature), the amount of added hot air, mixed with cool air, is varied through the four trim air valves.

Pack temperature control system

Each pack discharge temperature is controlled by a temperature controller associated with the pack outlet temperature transmitter and a demand signal from the APU and pack temperature demand controller. The pack discharge temperature is adjusted according to a predetermined sequence to open or close the temperature control valve and the associated flap modulating the heat exchanger cooling air.

In automatic mode, the pack temperature controller :

– limits the pack discharge temperature,
– modulates the pack discharge temperature according to the zone ambient temperature demands.

With both packs operating :
– if, of all zones, the flight compartment demands the lowest temperature :
  Pack 1 temperature is controlled by the flight compartment
  Pack 2 temperature is controlled by that of the cabin zones (one of three) demanding the lowest temperature,
– if, of all zones, a cabin zone demands the lowest temperature :
  Pack 1 and 2 temperatures are controlled by that zone.

With one pack only operating :
– pack temperature is controlled by the zone demanding the lowest temperature.

In case of failure of the automatic control, manual control can be selected by means of the PACK MODE SEL pushbutton switch, on the PACK TEMP overhead panel.

Maximum cooling is obtained by fully closing the turbine bypass valve and fully opening the heat exchanger cooling air modulation flap.

Flight compartment and cabin temperature control system

The flight compartment and the three cabin zones are each provided with an independent temperature control system, capable of automatic or manual operation.

In automatic control, the compartment temperature controller receives inputs from the zone inlet and zone ambient temperature control sensors, signals from the APU and pack temperature demand controller and from the COMPT TEMP selectors.

The controller modulates the trim air valve, which mixes hot air with cold air to obtain the required air temperature.

The hot air comes from the LH and RH hot air manifolds, through a single hot air supply valve, regulating at 4 PSI over the cabin pressure.

The compartment temperature controller limits the maximum duct inlet temperature to 74^{0} C, with an overheat protection rated at 88^{0} C, causing the hot airsupply valve to close.

In case of automatic control failure, the zone temperatures may be manually controlled by direct operation of the trim air valves and manual adjustment of the pack discharge temperatures, using controls provided on the overhead panel.

COMPARTMENT AIR DISTRIBUTION

Air distribution through the pressurized fuselage is provided for :
– Delivering conditioned air to the main compartments : i.e. flight compartment and cabin, with an air recirculation system.
– Heating the cargo compartments.
– Ventilating and cooling different parts of the aircraft (See chapt. 02.40).

Flight compartment air distribution

The air distribution ducting delivers air through the following points :
– below the windshield panels, from the ceiling at the rear of the compartment and at floor level, on the LH side, where air is flow controllable by manual controls,
– to each crew member (4) through individual air outlets, flow controllable in quantity and direction.

Air is then extracted by differential pressure and distributed to the underfloor compartments, through the circuit breaker panel and orifices at floor level.

Cabin air distribution

Cabin air distribution system is divided into three main compartments, each one supplied from the hot and cold manifolds, by separate pipework routed between the cabin skin and sidewall panels. Then the air is distributed above the lateral overhead stowage compartments and doors.

A part of the air is recirculated by three electrical fans (one in each zone) situated above the ceiling panel in the cabin axis.

Air is then extracted near the floor level, next to the cabin sidewall panels, over full cabin length and directed to the underfloor compartments, where it is used for cooling the avionics compartment and ventilating the cargo compartments.

BULK AND FWD CARGO COMPARTMENT TEMPERATURE CONTROL R

The cargo compartment temperature control uses airflow from the cabin for ventilating the cargo compartment. The heating system includes :
– The ventilation system.
– The temperature control system.

In the ventilation system, the mixed air enters the compartment at floor level, on the LH side, and is equally distributed over the full compartment length. On the opposite side, and in the aircraft centerline, the air is extracted, near the compartment ceiling, by an electrical fan, and is exhausted under the compartment itself, thus providing temperature control of the compartment floor, and also, of the compartment sidewall panels using a part of the air evacuated from the cabin. R

In the event of a smoke warning, the cargo compartment is automatically isolated by closure of the isolation valve.

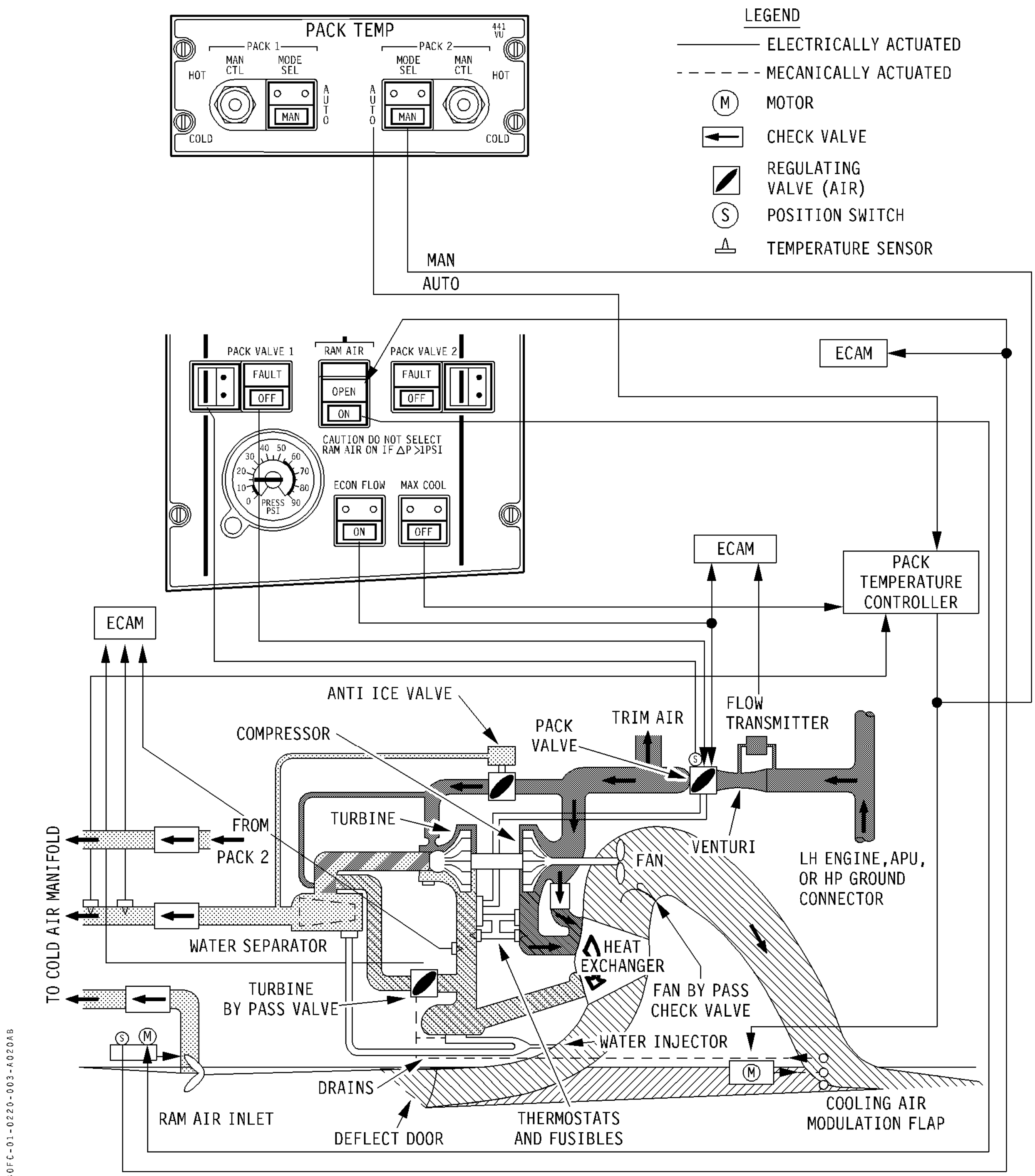
The compartment temperature control system includes for each cargo compartment, a temperature controller, a trim air valve, a zone inlet temperature sensor, a zone temperature control sensor, and an overheat thermal switch in the compartment inlet duct.

In automatic control, the controller, associated with the sensors and the selector regulates the compartment temperature to the selected level, by modulating the hot air supply through the trim air valve, with limitation of the maximum temperature of the blown air by closing the hot air valve in the event of overheat.

In case of automatic control failure, manual control can be achieved by acting directly on the trim air valve.

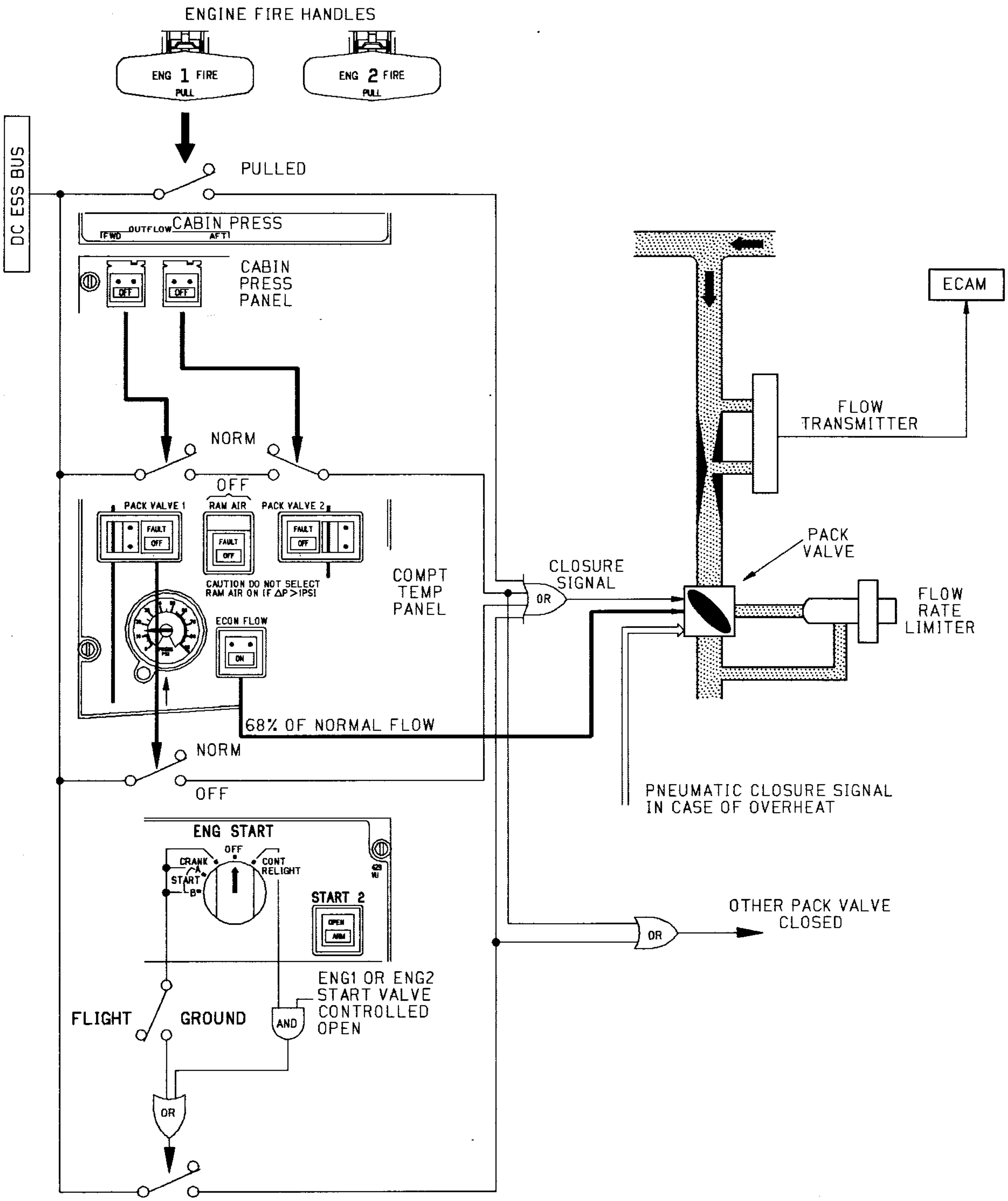
Mod. : 2989

AIR CONDITIONING PACK



Mod. : 5289

PACK VALVE CONTROL LOGIC



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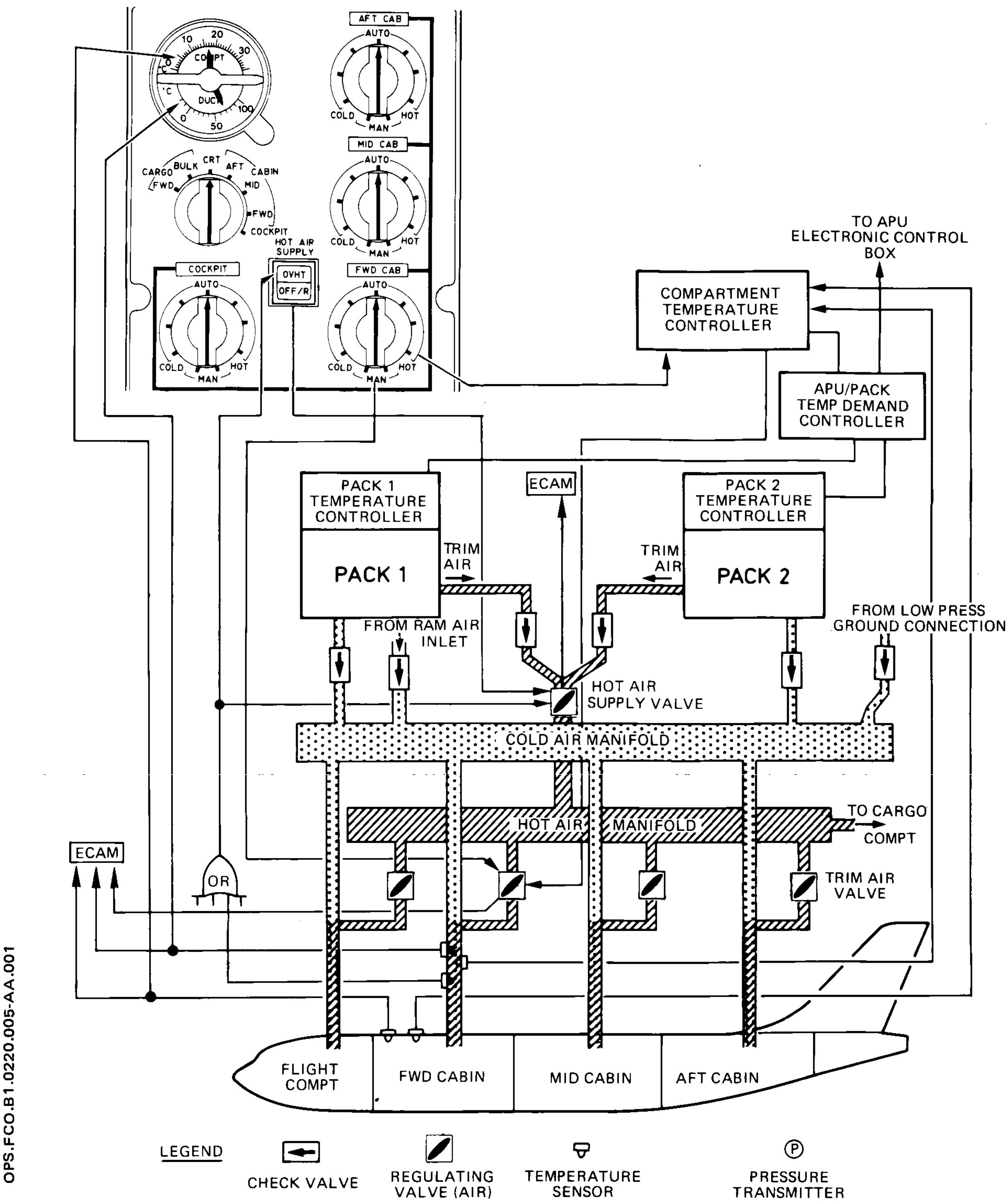
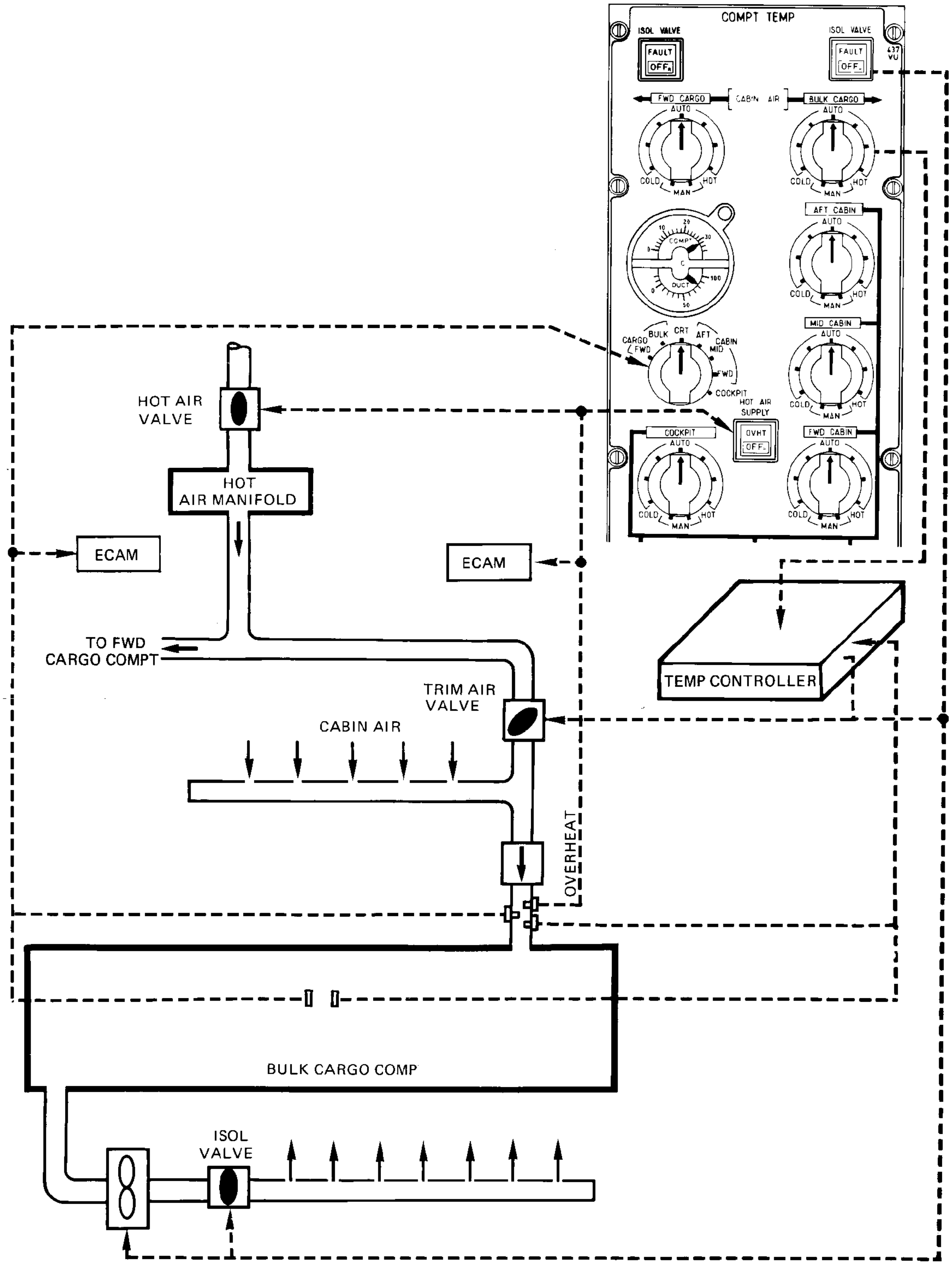
Mod. : 3881 + 6334

COMPT AIR DISTRIBUTION AND TEMP CONTROL



Vers. : All Eng. : All

BULK CARGO COMPT HEATING



R

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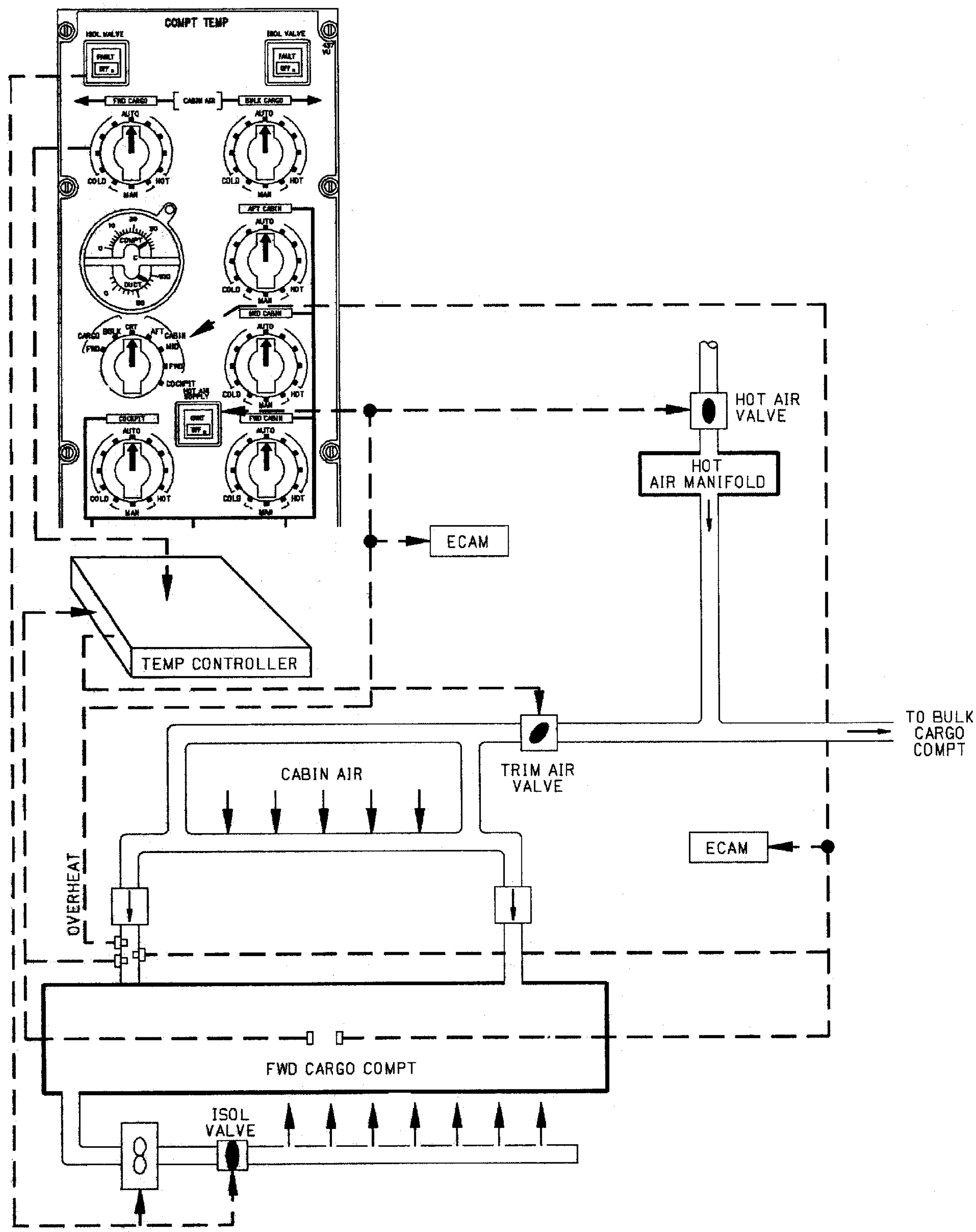
Mod. : 2989

FORWARD CARGO COMPT HEATING



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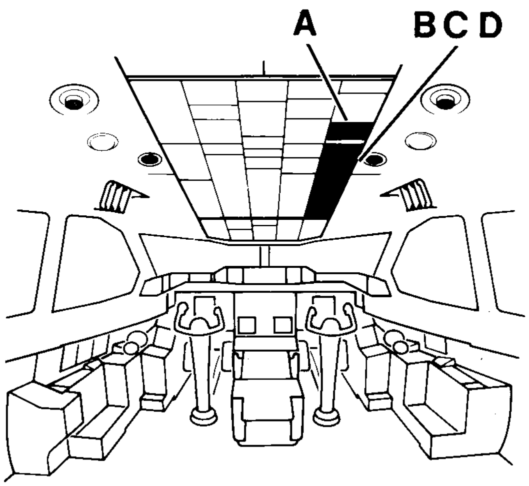
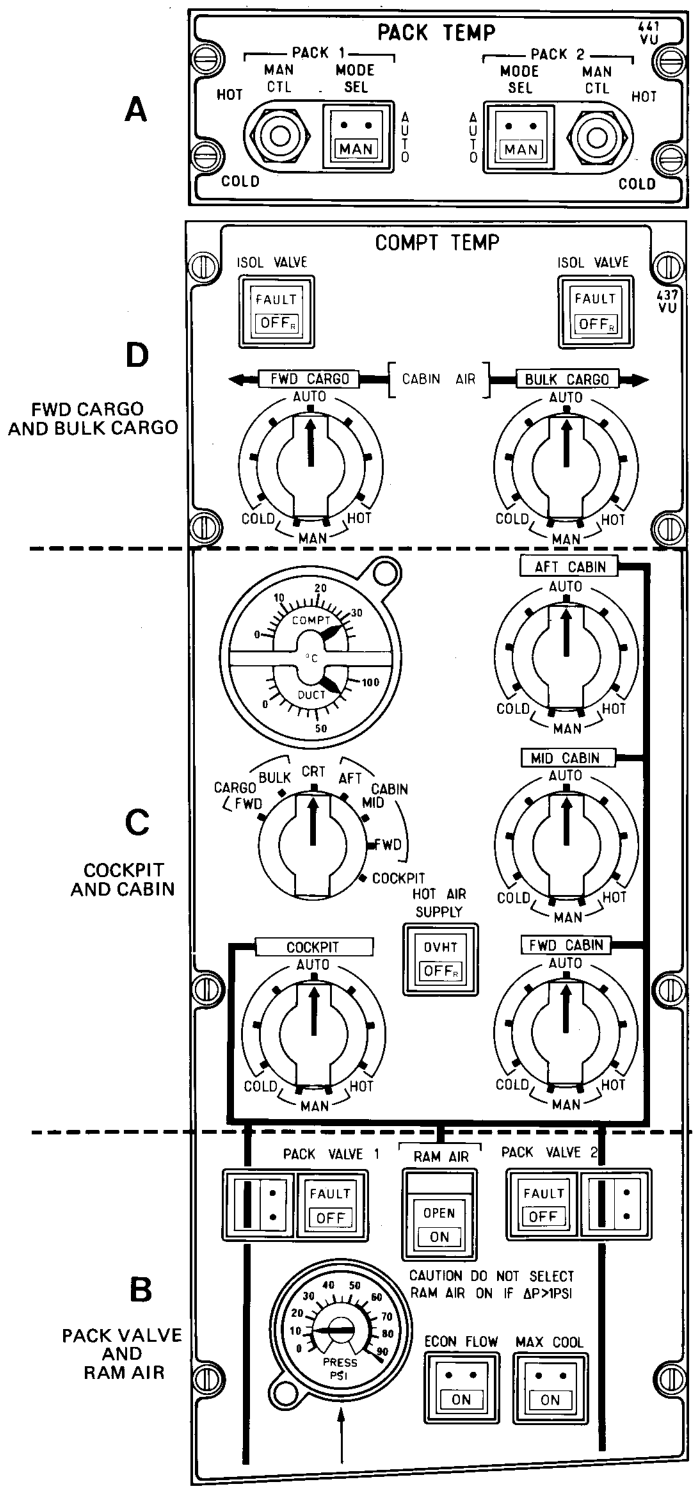
Mod. : 2989

LOCATION OF CONTROLS





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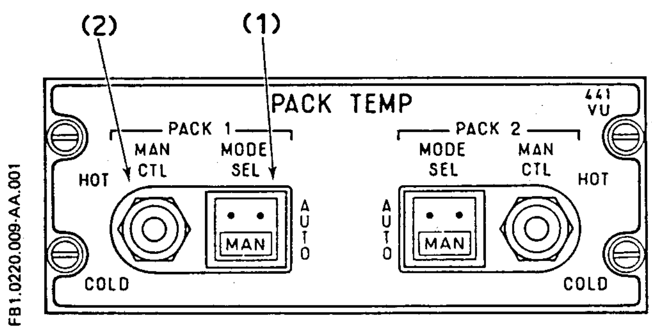
R Code : 0220D

A. PACK TEMP PANEL



(1) PACK 1 (PACK 2) MODE SEL Pushbutton Switch

Pack temperature control mode (operation of turbine by pass valve and cooling air modulation flap) is selected by P/B switch operation.

- **AUTO (P/B switch pressed – in)**

  Pack discharge temperature is automatically controlled
R between –7° C and 63° C, according to the
R compartment demands as processed by the APU and
R pack temperature demand controller.

R - **MAN (P/B switch released – out)**

R MAN light comes on white, pack discharge temperature
R is manually controlled by adjustment of the turbine
R by pass valve through the pack discharge COLD/HOT
  selector.

(2) Pack Discharge COLD/HOT Selector

When the respective PACK MODE SEL P/B switch is selected MAN, turbine by pass valve is adjusted by selector operation.
The switch is spring-loaded to neutral.

- **COLD**

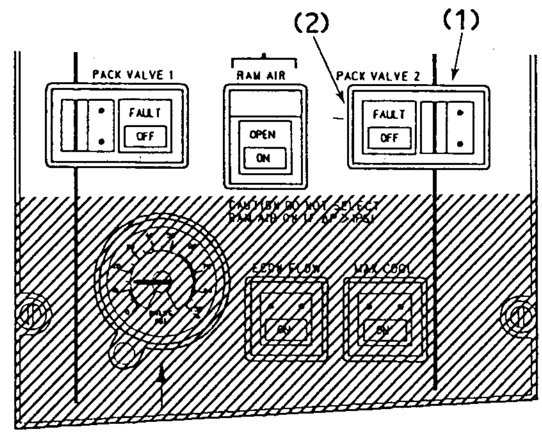
  Turbine by pass valve closes, pack discharge temperature decreases.

- **HOT**

  Turbine by pass valve opens, pack discharge temperature increases.

B. COMPT TEMP PANEL

– Pack valve and RAM air



(1) PACK VALVE Indicator

Flowbar on : valve is open.
Flowbar off : valve is closed.

(2) PACK VALVE 1 (2) Pushbutton Switches

Select automatic operation or manual closure of the respective pack valve.

- **Auto (P/B switch pressed – in)**

  Valve is pneumatically controlled.
  The valve is electrically closed when
  - the ENG FIRE handle is pulled,
  - CABIN PRESS OUTFLOW VALVE P/B switches are selected OFF
  - the ENG START selector is on CONT RELIGHT position and one of the two START valves is controlled open.

  The valve is pneumatically closed, when overheat occurs at compressor outlet or turbine inlet exceeding the limit of the fusible plugs. The valve is closed by spring force, if it is not supplied with pneumatic pressure.

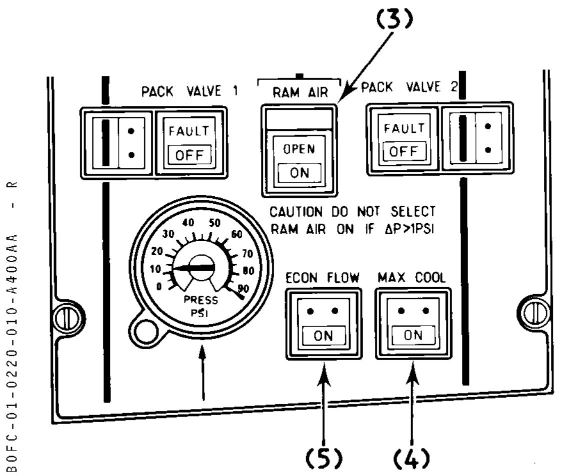
- **OFF (P/B switch released – out)**

  The valve is electrically closed. The OFF light comes on white.

- **FAULT**

  Illuminates amber, when the position of the pack valve
  disagrees with the commanded position. R
  If the FAULT light remains on for more than 5 sec., R
  the ECAM system is activated.

  Momentary illumination occurs, when valve is in transit.



(3) RAM AIR Pushbutton Switch (guarded)

Controls the ram air inlet which supplies ambient air to the cold air manifold, if required.

- **ON (pushbutton switch depressed – in)**

  ON light comes on white.
  The ram air inlet will open, provided both CABIN PRESS OUTFLOW VALVES pushbutton switches are not selected OFF.
R When cabin pressure is in AUTO mode, the FWD and
R AFT outflow valves will open simultaneously to permit
R unrestricted ventilation.

- **OPEN**

  Will come on green, when the ram air inlet is fully open.

- **Off (pushbutton switch released – out)**

  The ram air inlet closes. The FWD and AFT outflow valves return to normal regulation.

(4) MAX COOL Pushbutton Switch

- **ON (pushbutton switch pressed – in)**

  ON light comes on blue.
  Pack discharge temperature lower limit is decreased from + 4° C to – 7° C.

(5) ECON FLOW Pushbutton Switch

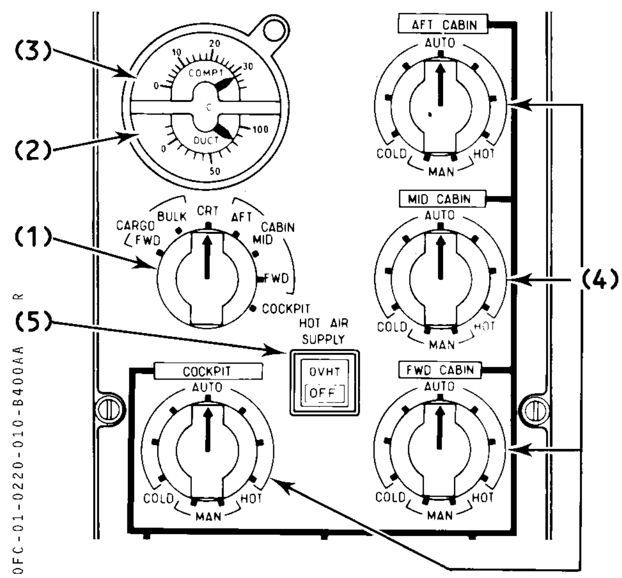
- **ON (pushbutton switch pressed – in)**

  ON light comes on blue.
  In flight, pack valves are controlled automatically to give 68 % of normal flow (economic flow).

Note : the indication « ECON FLOW SELECTED » is displayed on the MEMO page.

C. COMPT TEMP PANEL

– Cockpit and cabin



(1) COMPT/DUCT Temp Selector %

Selects the zone for which temperature (COMPT and DUCT) reading is desired on COMPT/DUCT indicator. On the CRT position indications are displayed on ECAM. When an other position is selected, temperature indications are replaced by amber XX.

(2) DUCT Indicator

For the selected compartment the temperature of the conditioned air before leaving the duct is indicated in ° C. The duct temperature is automatically limited to max. 74° C in AUTO mode.

(3) COMPT Indicator

The air temperature in the selected compartment is indicated in ° C.

Mod. : 2989 + 5289 + 6106 + 6444

(4) COMPT TEMP Selectors

For the related compartment the temperature is either automatically controlled to a level relative to the selector position or is manually selected by direct operation of the trim air valve through the selector.

- **AUTO**

  In this range the compartment temperature is automatically controlled between COLD 18° C and HOT 30° C relative to the selector position. In the center position AUTO the temperature is controlled to 24° C. The pack discharge temperature is automatically controlled via the APU and pack temperature demand controller to suit the demand.

- **MAN**

  When a selector is turned to the bottom quadrant, it is spring-loaded to the center MAN position. The temperature is manually controlled.
  COLD – Trim air valve closes.
  HOT – Trim air valve opens.

  To obtain the desired compartment temperature it may be necessary to manually adjust PACK TEMP.

(5) HOT AIR SUPPLY Pushbutton Switch

Controls the supply of hot air to the hot air manifold by activating the hot air supply valve. The hot air manifold pressure is controlled to 4 PSI above compartment pressure.

- **ON**

  (P/B switch pressed –in) : Valve operates automatically, hot air is supplied and regulated.
  If an overheat condition is detected in one of the compartment or cargo ducts, the valve is automatically closed and latched.

- **OFF/R**

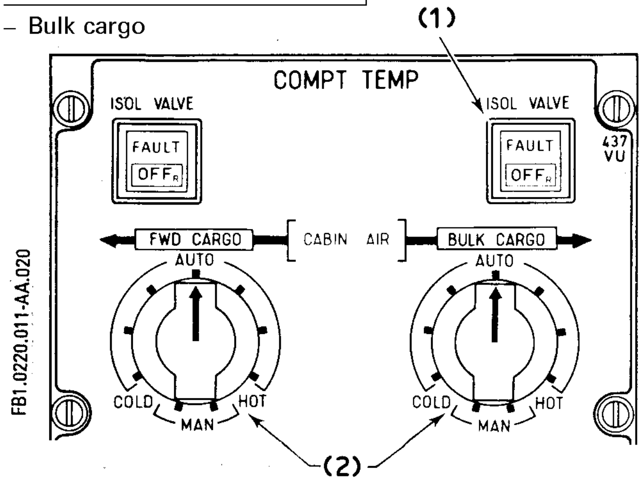
  (P/B switch released – out) : OFF/R light comes on white, valve closes.
  Overheat circuit is reset.

- **OVHT** :

  Light comes on amber associated with ECAM activation, when temperature in one of the compartment ducts exceeds 88° C. The hot air supply valve closes automatically. After selecting the HOT AIR SUPPLY P/B switch OFF/R the light will go off, when the duct temperature drops below 88° C.

D. COMPT TEMP PANEL

– Bulk cargo



(1) ISOL VALVE Pushbutton Switch

Operates the isolation valve and the fan for the air extraction from the cargo compartment.

- **ON**

  (P/B switch pressed – in) : The valve is open and the fan runs.
  If smoke is detected in the cargo compartment, the isolation valve and the trim air valve will automatically close.

- **OFF/R**

  (P/B switch released – out) : The isolation valve closes, the fan stops operating and the trim air valve closes. R
  OFF/R light comes on white. Smoke detection circuit is reset.

- **FAULT**

  The light comes on amber when disagreement between P/B switch selection and isolation valve position exists.

(2) BULK CARGO Temperature Selector

The cargo compartment air is automatically heated to a level relative to the selector position. The heating can be manually controlled by direct operation of the trim air valve through the selector, if required.

- **AUTO**

  Automatic heating relative to selector position from COLD 5° C up to HOT 25° C approximately.

- **MAN**

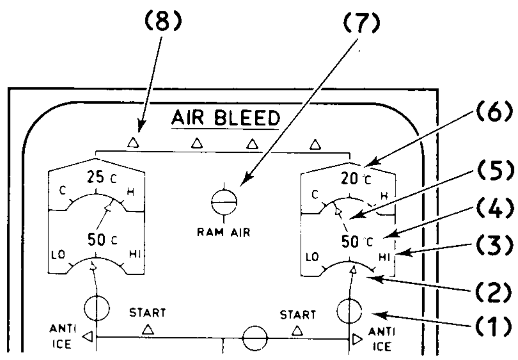
  When the selector is turned to the bottom quadrant, it is spring-loaded to the center MAN position.
  Heating control is manual.
  COLD – Trim air valve closes.
  HOT – Trim air valve opens.

LEFT INTENTIONALLY BLANK

SYSTEM DISPLAY

AIR BLEED

OPS.FCO.B1.0220.013-AA.001



(1) Pack Valve Position Indication

⦶	Green	Pack valve is open
⊖	Amber	Pack valve is closed

(2) Pack Flow Indication

Index comes on green in normal operation. It comes on
R amber when the pack flow is below a preset value.

(3) Pack Symbol Indication

In normal operation, pack symbols come on white. They come on amber when pack valve is closed, and engine START not selected.

(4) Turbine Inlet Temperature Indication

Turbine inlet temperature indication comes on green in normal operation. Indication comes on amber when T° ⩾ 120° C and flashes when T° ⩾ 95° C.

(5) Pack Temperature Control Valve Position Indication

Indication comes on green. C = cold, valve closed and H = hot, valve fully open.

(6) Pack Discharge Temperature Indication

Indication comes on green ; it comes on amber when T° ⩽ – 18° C.

(7) Ram Air Inlet Valve Indication

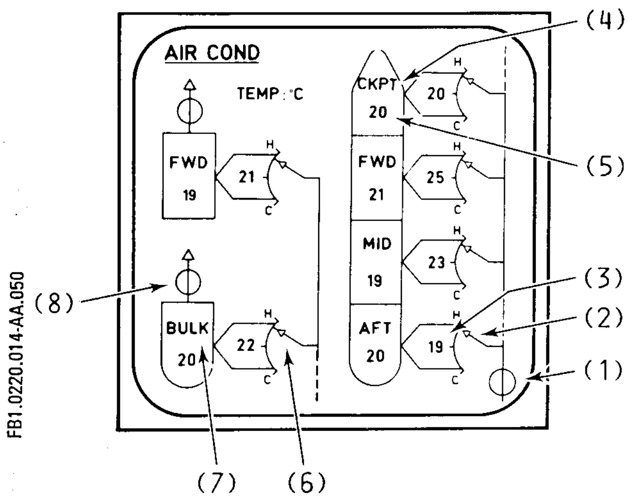
⦶	Green	Ram air inlet is open
⊖	Green	Ram air inlet is closed

(8) Cold Air Duct Supply Indication

Indication comes on green ; it comes on amber when no cold air is supplied.

SYSTEM DISPLAY

– AIR COND



(1) Hot Air Supply Valve Position Indication

⦶	Green	Hot air supply valve is open
⊖	Amber	Hot air supply valve is closed

(2) Trim Air Valve Position Indication

Indication comes on green.
H = hot, valve 100 % open.
C = cold, valve fully closed.
Indication comes on amber when hot air supply valve is closed.

(3) Cabin/Cargo Duct Temperature Indication

Indication comes on green ; it comes on amber when duct $T^{\circ} \geqslant 88^{\circ}$ C.

(4) Zone indication

AFT, MID, FWD and CKPT indications come on white. They come on amber when duct temperature of concerned zone is $\geqslant 88^{\circ}$ C.

R *Note : Same indication is given on the CRUISE page.*

(5) Zone Ambient Air Temperature Indication

Indication comes on green for each zone.

Note : Same indication is given on the CRUISE page.

(6) Cargo Compartment Trim Air Valve Indication

Indication comes on green.
H = hot, valve 100 % open.
C = cold, valve fully closed.
Indication comes on amber when cargo hot air valve is closed.

(7) Cargo Compartment Ambient Air Temperature Indication

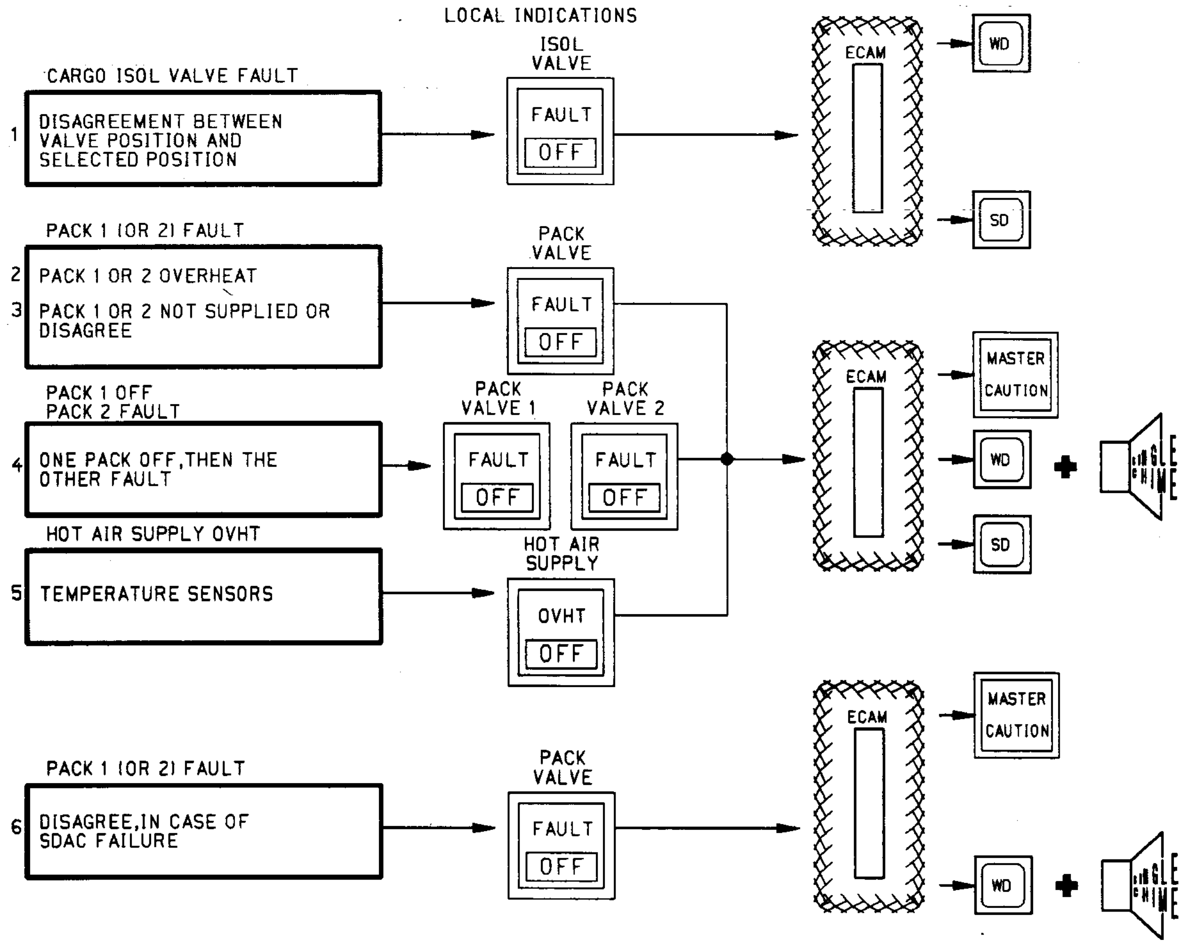
Indication comes on green.

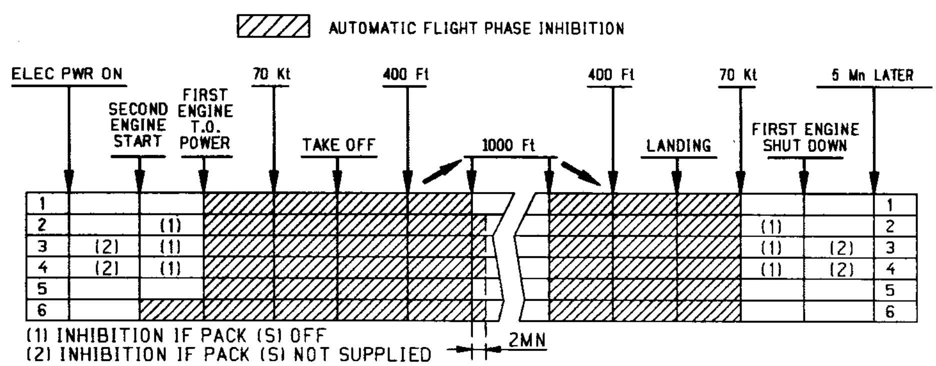
(8) Isolation Valve Indication

⦶	Green	Isolation valve is open
⊖	Amber	Isolation valve is closed

Mod. : 2989 + 6041

WARNING LOGIC





PLN.FCO.B1.0220.015-16.025

Mod. : 5051

GENERAL

Cabin pressure and rate of change control system is composed of :

– two independent automatic control systems,

– one manual control system.

They control two electrical regulating valves (outflow valves).
Two pneumatically operated safety valves are provided to avoid over or under pressure.

The two automatic systems will alternately operate.
Change over occurs automatically in case of failure of one system and before each flight.

AUTOMATIC CONTROLLER

Based upon information from the LANDING ELEVATION selector, the RATE LIMIT selector and the Captain or F/O altimeter setting, the automatic controller generates signals for positioning of outflow valves during all phases of flight. The other parameters used for signal computation are cabin pressure, aircraft static pressure, cabin pressure rate of change and static pressure rate of change.

The controller contains a computation circuit for determining theoretical cabin altitude relative to existing pressure altitude, taking into account the maximum performance of the aircraft (rate of climb, max. altitude).
The control tendency is to adjust the actual cabin altitude towards either the theoretical cabin altitude or the landing elevation altitude selecting the higher of the two.

MANUAL OPERATION R

The manual control of the aircraft pressurization is performed R
by selecting ON the MAN PRESS pushbutton switch and R
then action on the V/S CTL switch. When in manual mode R
the movement of the outflow valves is significantly slower R
than in automatic mode, and there is no automatic R
depressurization of the aircraft upon landing. R

OUTFLOW VALVES

One of them is located forward of the air conditioning bay, the other one, aft of the bulk cargo compartment.
Each valve is operated by three electric motors, which are independently controlled by one of the two automatic systems or the manual system.
Each outflow valve can be closed from the overhead panel, where its position is displayed.

Note : In some ABNORMAL/EMERGENCY procedures R
where evacuation is requested, the RAM AIR is R
selected ON to open OUTFLOW valves. When the R
pressurization system is being operated in the R
manual mode, the RAM AIR switch does not R
control the OUTFLOW valves and does not depressurize R
the aircraft. R

Mod : 3881 + 4765

PRESSURE CONTROL

Preflight

Since the pressure control is fully automatic, the crew action is reduced to setting the LANDING ELEVATION selector and to checking the indications and switch settings on the CABIN PRESS panel.

Prepressurization

Before takeoff, in the following configuration :

– aircraft on the ground (landing gear shock absorbers compressed)

– two engines running (oil pressure normal)

– one throttle control lever beyond 22°.

The automatic system, operating the regulating valves ensure the cabin pressurization at a rate of – 500 ft/mn until the cabin ΔP reaches 0.22 PSI.

15 seconds after takeoff (shock absorbers extended), prepressurization signals are cancelled, normal pressure control is started through the active system.

Inflight Regulation

– Generally :

The cabin altitude is regulated towards the theoretical cabin pressure altitude determined by the controller, or to the landing field elevation, whichever is the higher.

The △P increases with the increase of pressure altitude up to the operating ceiling.

When the theoretical altitude is higher than the landing elevation, the rate of change is the lowest of the two following values :

– RATE theoretical

– RATE limit (selected on the RATE LIMIT selector)

When the landing elevation is higher than the theoretical altitude the rate of change is the RATE limit.

In the particular case of :
– landing elevation selected before takeoff is lower than T.O. elevation and
– the rate of climb of the aircraft is lower than 750 ft/mn for more than 1 minute,
the cabin altitude starts decreasing in order to reach either the selected landing elevation or the theoretical cabin altitude (whichever is higher) with a rate of change of 500 ft/mn.
When the T.O. altitude is reached by the theoretical cabin altitude, the system works as in the general case.

Depressurization

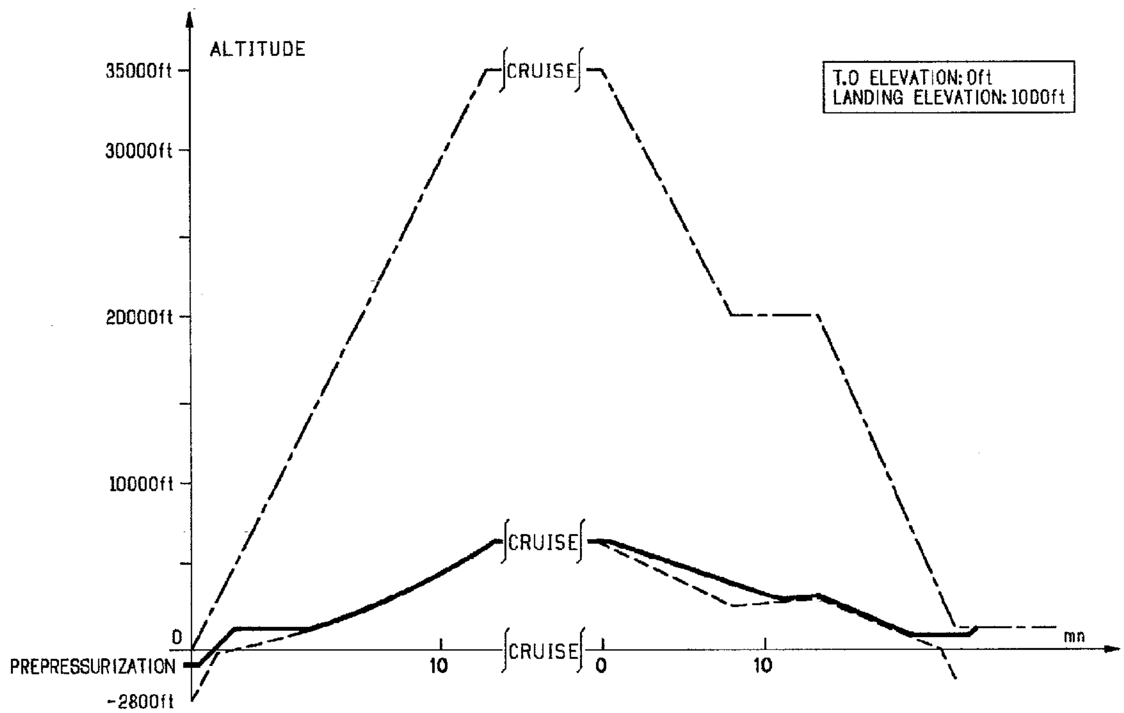
After touchdown, when the depressurization signal – L/G shock absorbers compressed, both throttle levers at idle – is received by the controllers, the cabin is depressurized by the active system at a rate of 500 ft/mn. 45 seconds after touchdown both outflow valves will completely open for full depressurization.

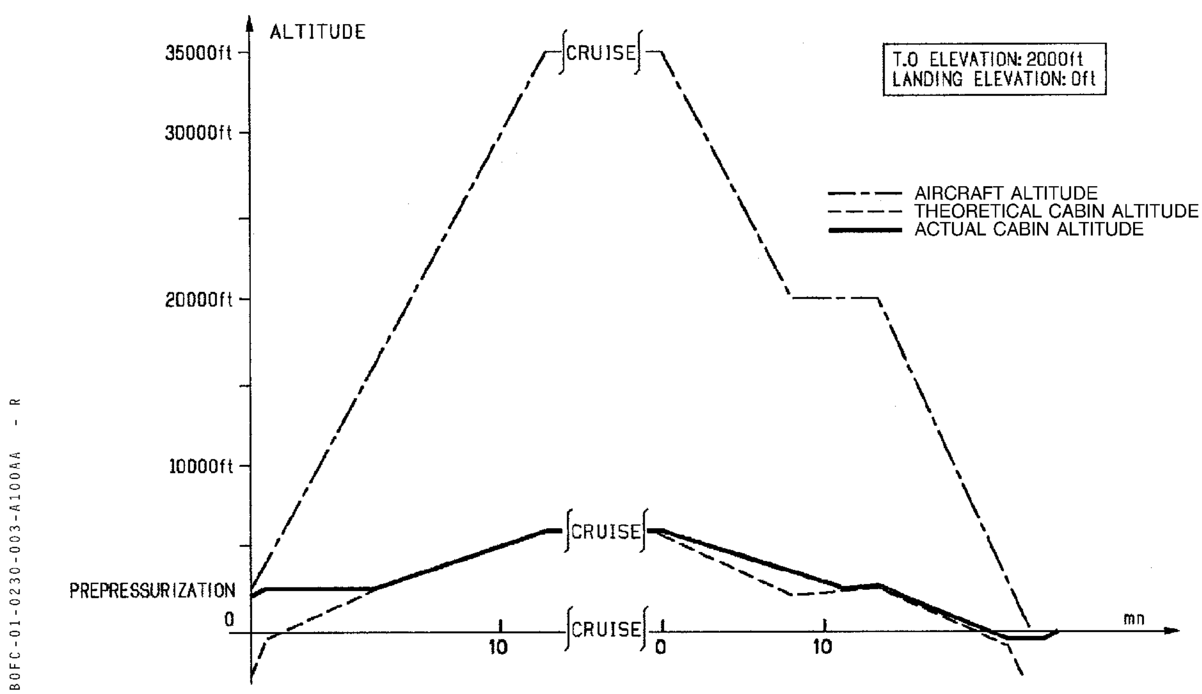
RATE LIMIT SETTING

CABIN ALTITUDE	SELECTOR POSITION			
	MIN	**NORM**	HI	MAX
Increase	+ 170 ft/mn	+ 850 ft/mn	+ 1130 ft/mn	+ 1670 ft/mn
Decrease	— 70 ft/mn	— 350 ft/mn	— 470 ft/mn	— 1170 ft/mn

Mod : 3881 or 5282 or (3881 + 5282)

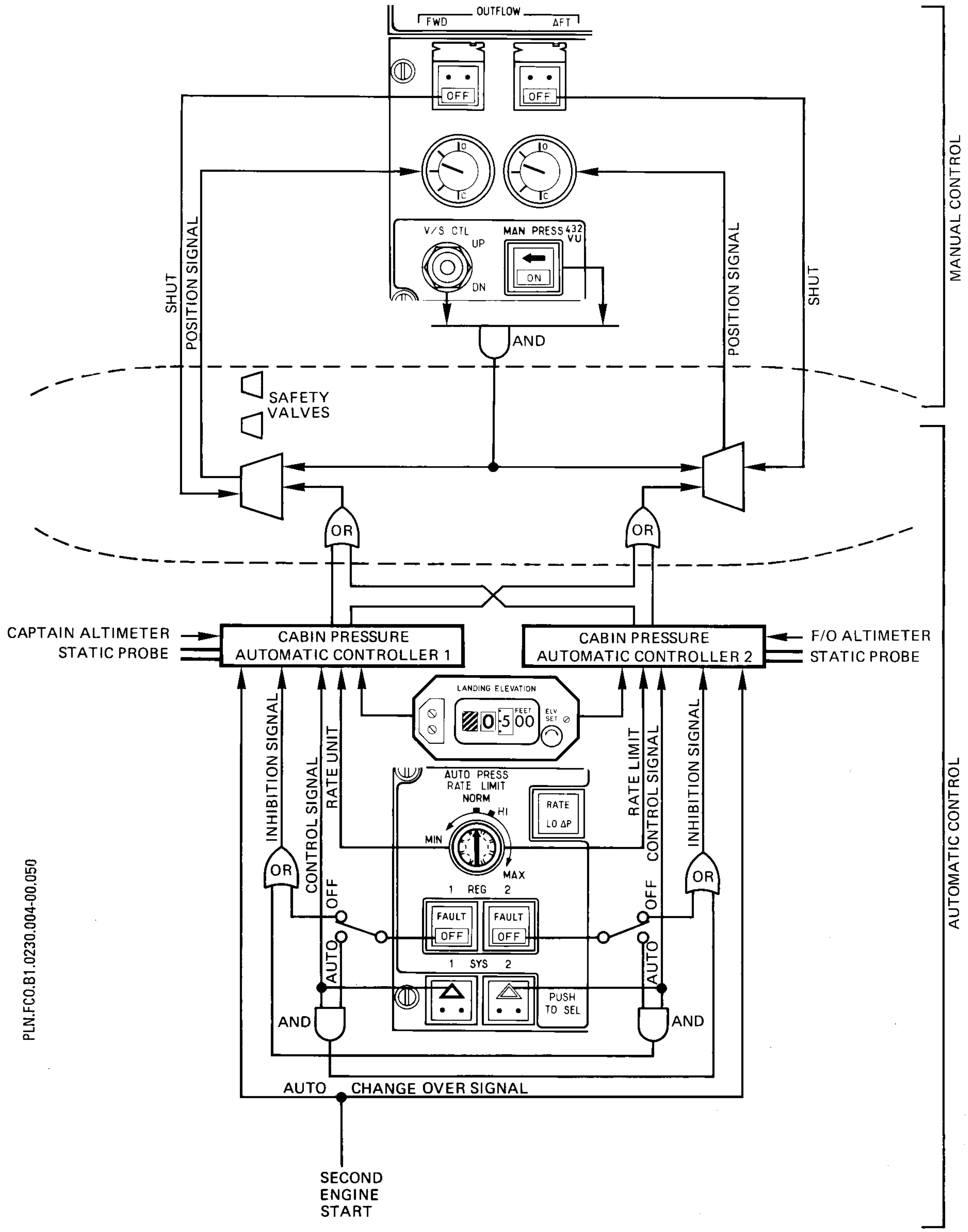
TYPICAL CABIN ALTITUDE PATTERNS





Mod : 3881 or 5282 or (3881 + 5282)

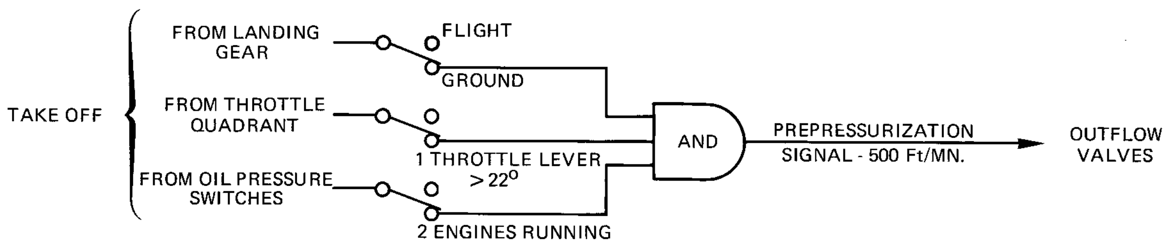
PRESSURIZATION CONTROL LOGIC



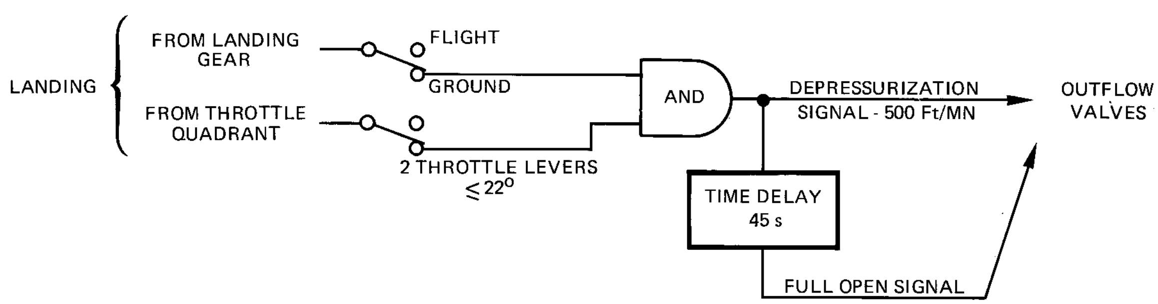
R
R

Mod. : 3881 + 4765 Vers. : All Eng. : All

PREPRESSURIZATION LOGIC

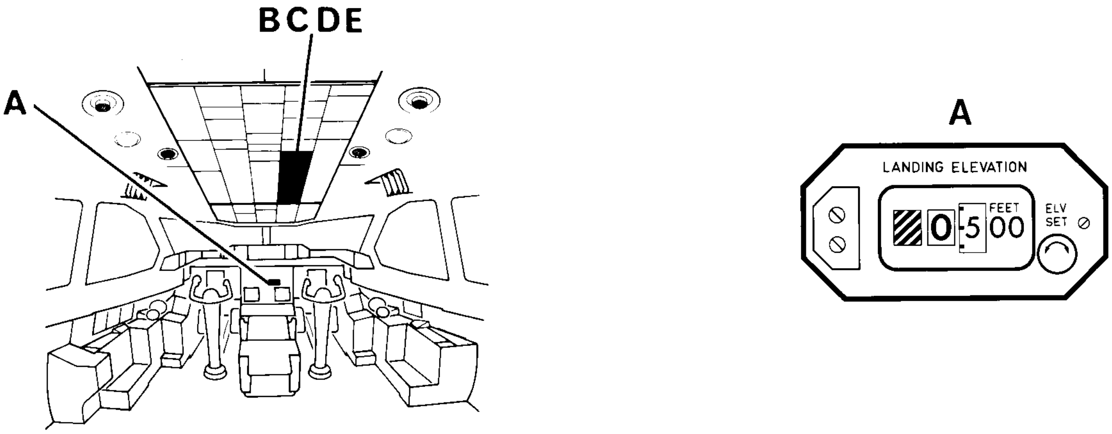


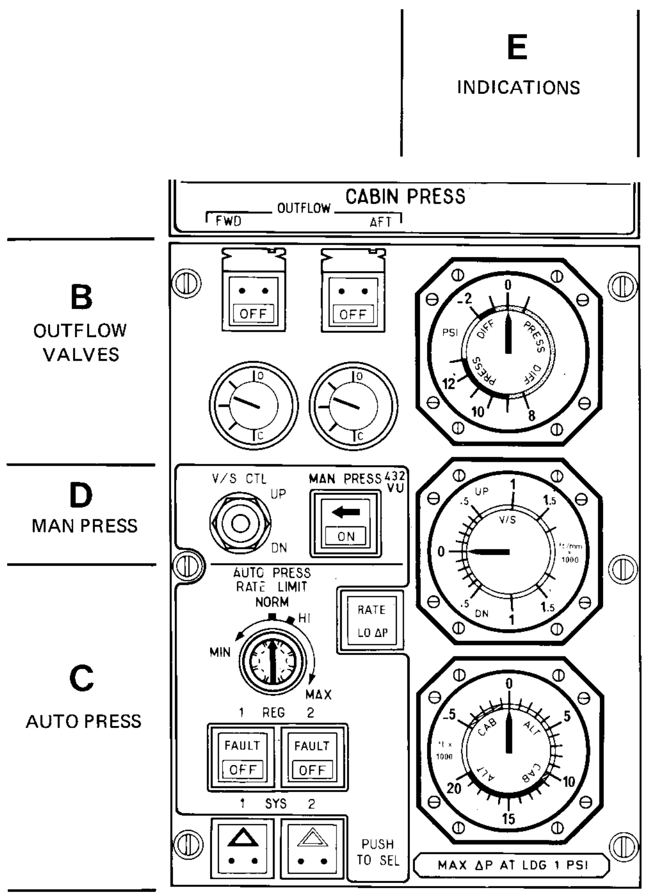
DEPRESSURIZATION LOGIC



PLN.FCO.B1.0230.005-00.020

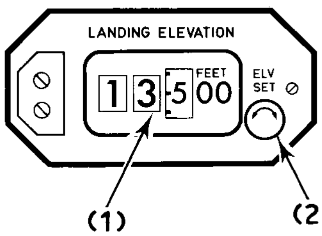
LOCATION OF CONTROLS





OPS.FCO.B1.0230.006-00.040

A. LANDING ELEVATION SELECTOR



FB1.0230.007-AA.020.6A

(1) LANDING ELEVATION Counter

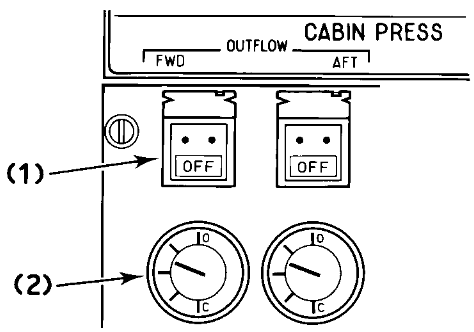
The setting of the landing elevation is displayed in hundreds, thousands and tenthousand feet.

(2) ELV SET Knob

The rotation of the knob sets the landing elevation.

B. CABIN PRESS PANEL

– Outflow Valves.



FB1.0230.007-AA.020.6B

(1) OUTFLOW Pushbutton Switches (guarded)

The pushbutton switches are operated to close the related valves if required. When both pushbutton switches are selected OFF, (used for ditching), the two outflow valves, the two pack valves, the overboard extract valve, the ram air inlet, and the safety valves are controlled closed.

- **Normal (Pushbutton Switch pressed-in)**

  The valve is controlled by the operating control system.

- **OFF (Pushbutton Switch released out)**

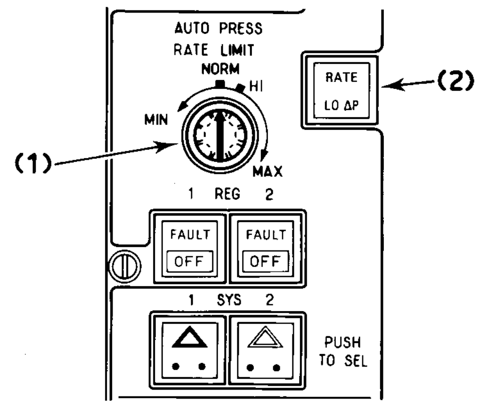
  The light illuminates.
  The valve is closed.

(2) OUTFLOW VALVE position indicator :

Indicates the outflow valve position.

C. CABIN PRESS PANEL

– Auto Press



FB1.0230.007-AA.020.6C

(1) RATE LIMIT Selector

Selects the limiting rate of change in cabin altitude to any value between MIN and MAX.

- **MIN**
  Rate of change limits + 170 ft/mn and – 70 ft/mn.
- **NORM**
  Rate of change limits + 850 ft/mn and – 350 ft/mn.
- **HI**
  Rate of change limits + 1 130 ft/mn and – 470 ft/mn.
- **MAX**
  Rate of change limits + 1 670 ft/mn and – 1 170 ft/mn.

(2) RATE/LO ΔP Lights

- **RATE**

  The light illuminates blue to indicate the AUTO PRESS/ RATE LIMIT selector is not in NORM position.

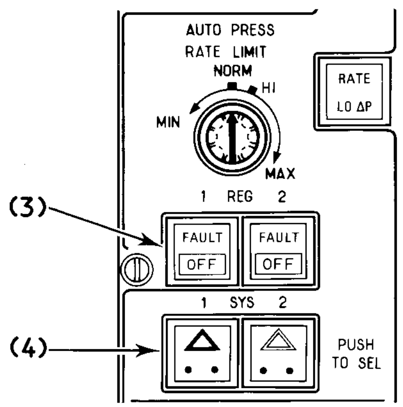
- **LO ΔP**

  The light illuminates amber, when following conditions are reached :

  1) Differential pressure below 0.7 PSI
  2) Aircraft rate of descent above 2 000 ft/mn
  3) CAB ALT greater than selected altitude plus 1 500 ft.

R Mod. : 3881 or (3881 + 5282)

B0FC-01-0230-008-A200AA - R



(3) REG 1 (2) Pushbutton Switches

Operated to confirm the disconnection between the system controller output and the associated outflow valve torque motor.

- **Normal (P/B switch pressed-in)** :
  The system controller output 1 (or 2) is connected to the outflow valve torque motors provided the green triangle integrated into the SYS 1 (or 2) P/B switch is on.
  The pressure control system 1 (or 2) ensures pressure control.
- **OFF (P/B switch released-out)** :
  The system 1 (or 2) is no longer operative. There is an automatic transfer to the system 2 (or 1) and the triangle integrated into the SYS 2 (or 1) P/B switch comes on green. The OFF light comes on white.
  Note : *When both regulators are on OFF position, the message « CAB PRESS MAN CTL » is displayed on MEMO page.*
- **FAULT** :
  The light comes on amber in the event of :
  system 1 (or 2) control failure.
  An automatic transfer to the system 2 (or 1) is performed.
  Illumination of the FAULT light is associated with ECAM activation.
  The light goes off when the REG 1 (or 2) P/B switch is selected OFF.

(4) SYS 1 and SYS 2/PUSH TO SEL Momentary Action Pushbutton Switches

If SYS 1 (SYS 2) P/B switch is momentarily pressed, this allows to select manually the active system for pressurization control provided the associated REG P/B switch is pressed-in (Normal) and the integrated FAULT light is off.

The triangle integrated into the selected P/B switch comes on green to indicate that the associated system is operative. The activation of a system deactivates automatically the other.

The transfer from one system to the other is automatic :

– after second engine start.

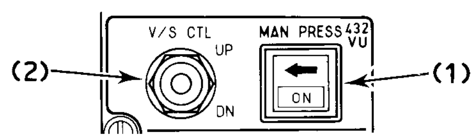
– if the associated REG P/B switch is selected OFF.

– if the associated REG FAULT light comes on.

D. CABIN PRESS PANEL

– Man Press

B0FC-01-0230-008-B200AA - R



(1) MAN PRESS Pushbutton Switch

The P/B switch selects the manual operation mode of the pressure regulating valves.

- **ON (P/B switch pressed-in)** :
  The ON light comes on green and the arrow comes on amber to indicate that the V/S CTL switch is operative and controls the operation of the regulating valves by activating the motors in manual mode.
  Automatic regulation, pressurization and depressurization R
  is no longer available. R
- **Off (P/B switch released-out)** :
  The V/S CTL switch is inoperative as long as the arrow is not on.
- **Arrow** :
  The arrow comes on amber when :
  – Both OFF lights integrated into REG 1 and REG 2 P/B switches are on,
  – or the MAN PRESS P/B switch is selected ON
  The V/S CTL is operative.

Note : *In this configuration, EXCESS CAB ALT warning and cabin pressure indication on ECAM display are lost.*

(2) V/S CTL Switch

The switch controls the regulating valve position by activating the motors in manual mode when the amber arrow is ON.

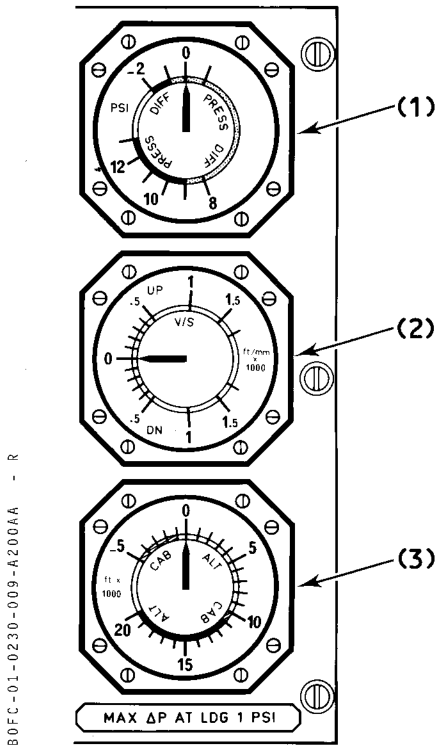
The switch is spring-loaded to neutral.

- **UP** : The valves move towards open position.
- **DN** : The valves move towards closed position.

Mod. : 3881 + 5448

E. CABIN PRESS PANEL

– Indications



(1) Cabin DIFF PRESS Indicator

Indicates the differential pressure between cabin and static pressure. From – 2 to 1 and from 8 to 13 the scale is graduated in PSI for reading of limiting values.

(2) Cabin V/S Indicator

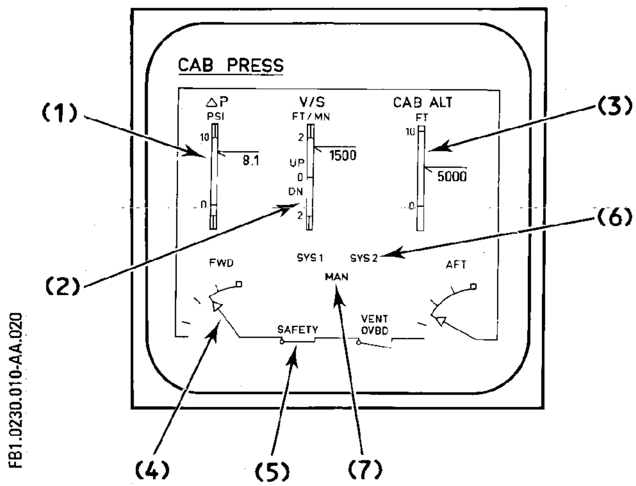
Indicates the direction and the rate of change of cabin altitude in ft/min.

(3) Cabin Altimeter

Indicates the cabin pressure altitude based on ISA pressure
R 1 013 mb. The tolerance with the ECAM CAB ALT indication
R can reach +/– 790 ft.

Mod. : 3881 + 4765

SYSTEM DISPLAY



(1) Cabin Differential Pressure Indication

Indication comes on green. It flashes when ΔP ⩾ 8.6 PSI.
Indication comes on amber when ΔP ⩽ – 1 PSI or ΔP ⩾ 10 PSI.

(2) Cabin Vertical Speed Indication

Indication comes on green. It flashes when V/S ⩾ selected V/S + 50 %.
Indication comes on amber when V/S ⩽ – 2 000 ft/mn or V/S ⩾ 2 000 ft/mn.

(3) Cabin Altitude Indication

Indication comes on green.
Indication comes on red when cabin altitude is above 10,000 ft.

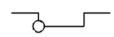
Note : This information is given on the CRUISE page in a digital form.

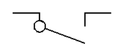
(4) FWD (or AFT) Regulating valve position indication

The indication is given in percent.
If flashes when the difference between the two regulating valve is greater than 40 %.
If becomes amber above 95 %.

(5) Safety valve position indication :

R

 : the two safety valves are not open.

 : one at least of the two safety valves is open. R
R

(6) SYS 1 (or 2) indication :

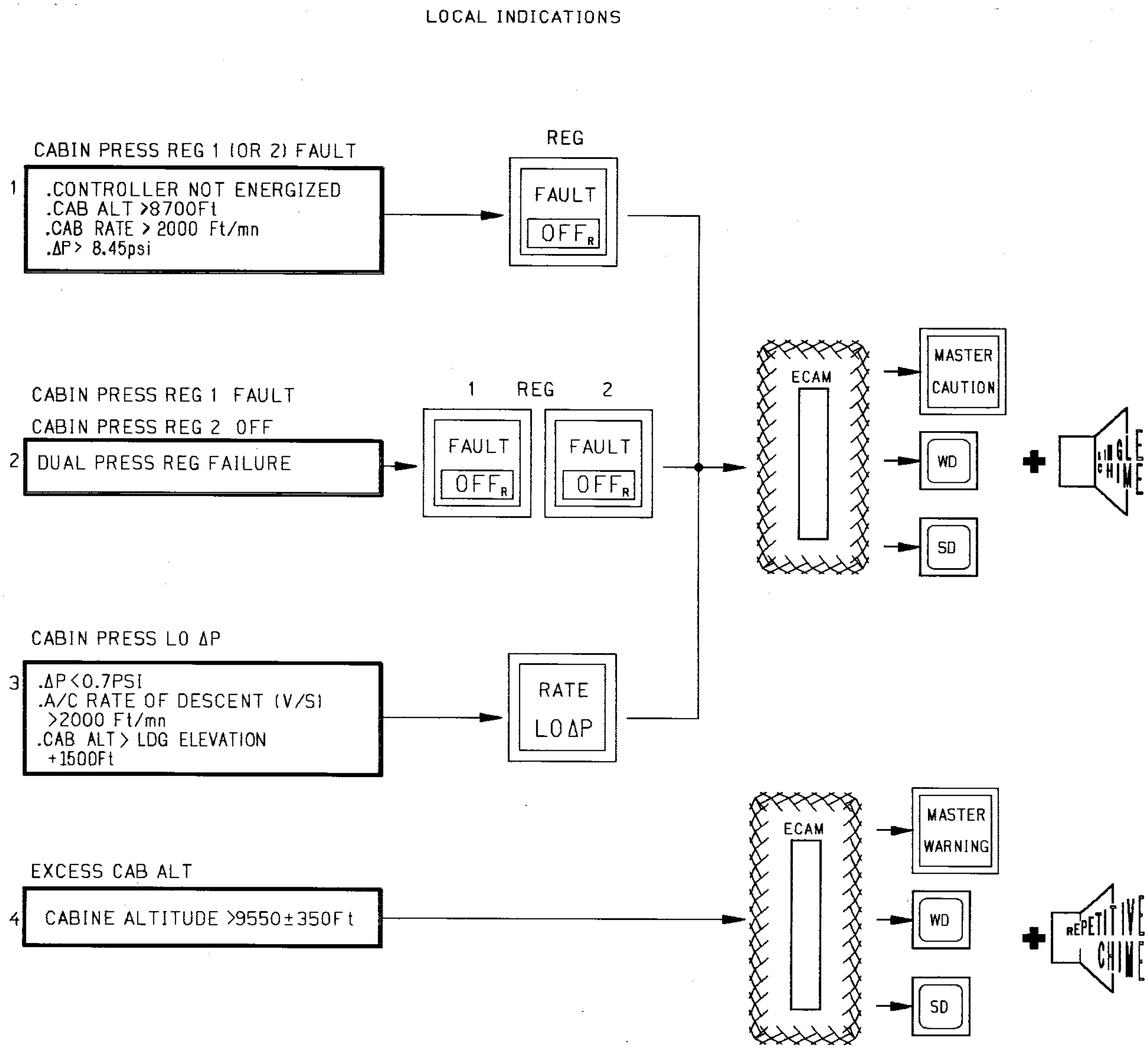
The indication is
– green when the system is NOT FAULT and ACTIVE,
– amber when the system is FAULT or OFF,
– suppressed when the system is ON and NOT FAULT but NOT ACTIVE.

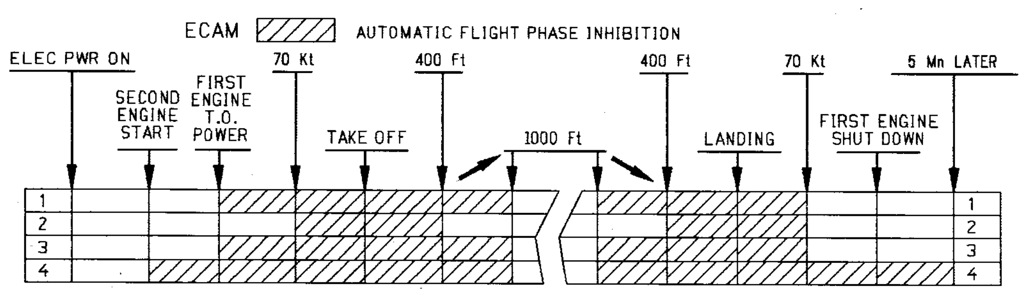
(7) MAN indication (white)

Displayed when the two automatic systems are FAULT or OFF.

Mod. : 3881

WARNING LOGIC





OPS.FCO.B1.0230.011-AB.030

Mod. : 3881 + 5051

GENERAL

Electric and electronic equipment as well as lavatories and galleys are ventilated by an ambient/air conditioning mixed airflow, which is, most of the time, blown by a fan, upstream of the equipment and then, extracted by, either the cabin differential pressure or a fan.

ELECTRIC AND ELECTRONIC EQUIPMENT VENTILATION

Avionics compartment ventilation is provided :

- for most of the main equipment racks, the radar transceiver, the IRS, the main instrument panels, the center pedestal and the overhead panel, by across or around the equipment, and extraction via appropriate outlet.
- for the radar indicators and the FCU panel, by air only.
- for the circuit breaker panel and various components located under the floor, by extraction of ambient air.

BLOWERS

Two blowers are installed to provide for ventilation airflow. Only one blower is operating at a given time. The air used for blower ventilation is taken from the underfloor area, below the flight compartment.

On the ground without air conditioning :

Exterior air entering through the open avionics compartment door.

On the ground with air conditioning on and in flight :

Air coming from the flight compartment and cabin. Supplementary ventilation is provided by fresh air supplied from a tapping in the flight compartment air duct.

The suction air for the blowers is silenced and passed through a dust separator and a filter.
The blowers operate at two different speeds.

The blower operation is fully automatic ; switch over between the two blowers is automatically achieved at each engine start.

BATTERY VENTILATION

The battery fan ensures sufficient ventilation when the normal ventilation flow induced by cabin differential pressure is less than 1 PSI.

EXTRACTION CIRCUIT

The air extracted from the avionics compartment is entirely ducted through the ventilated zones towards, either the three-position overboard valve or the inboard valve.

The air is extracted by a fan which runs in the same conditions as the blowers.

In normal use, the three-position overboard valve and the inboard valve function automatically :

On the ground, engines not running :

The three-position overboard valve is fully open.
The inboard valve is closed.

In flight, or on ground engines running :

The three-position overboard valve is fully closed.
The inboard valve is open.

When the avionics compartment ventilation airflow is not sufficient, the three-position overboard valve can be partially opened.

LAVATORY AND GALLEY VENTILATION

Individual ventilation in each lavatory and galley is provided from the main air distribution system through outlets which are adjustable in direction and flowrate.

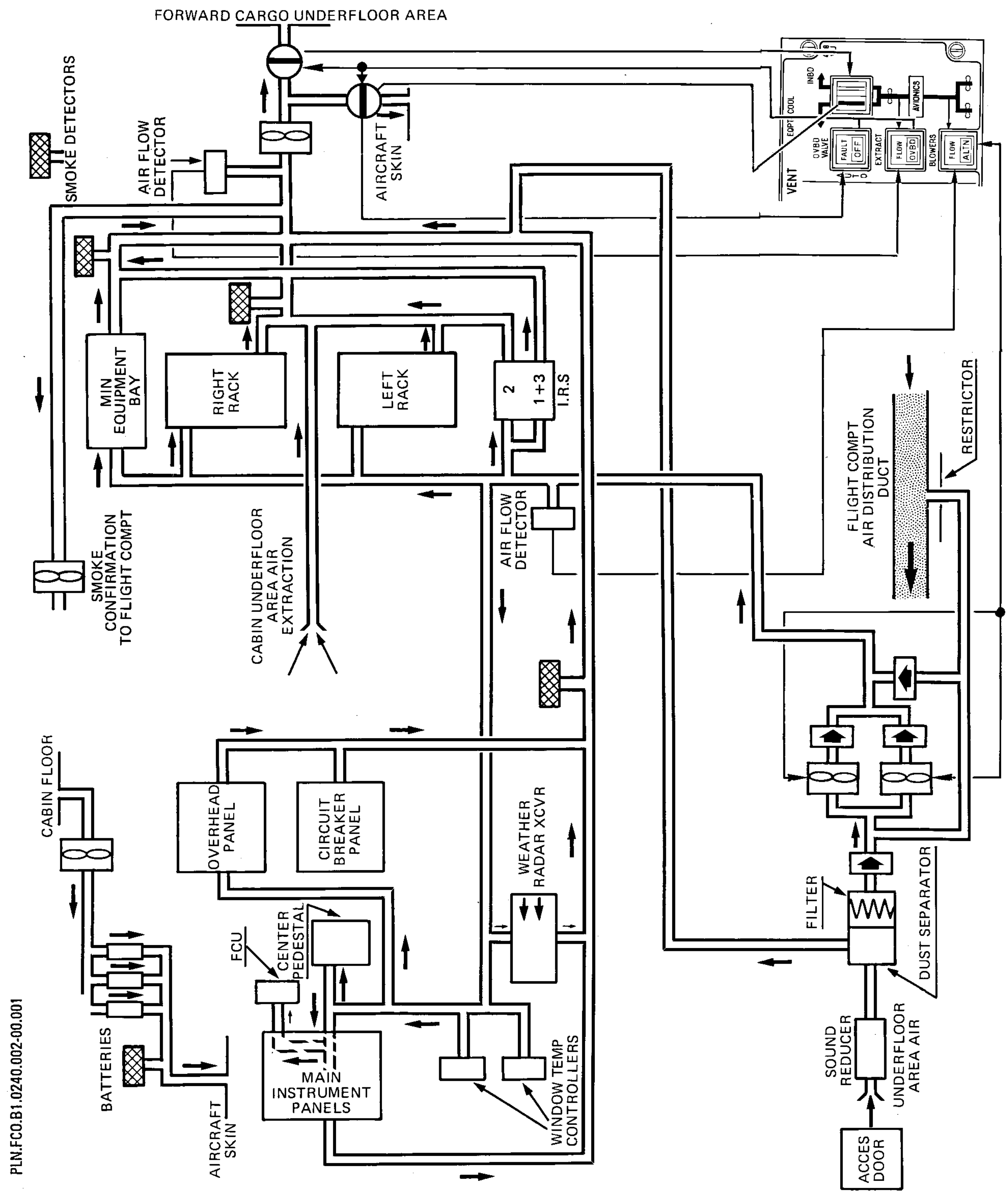
Normal ventilation of the lavatories and galleys is provided from the ambient air in the cabin with extraction through the lavatories and toilet bowls, and over the galleys to the cabin ceiling, then directly overboard via a venturi.

VENTILATION OF OTHER UNDERFLOOR AREAS

Ventilation of other underfloor areas, such as the areas over the wing box, and aft of the bulk cargo compartment is provided by exhausted cabin air. There are no systems, as such, to force ventilate this area.

The aft cargo compartment has no forced ventilation or heating system. However, natural ventilation through flaps in the flexible wall between this compartment and the bulk cargo compartment, is possible.

AVIONICS VENTILATION LAYOUT

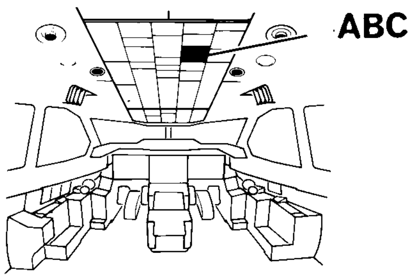


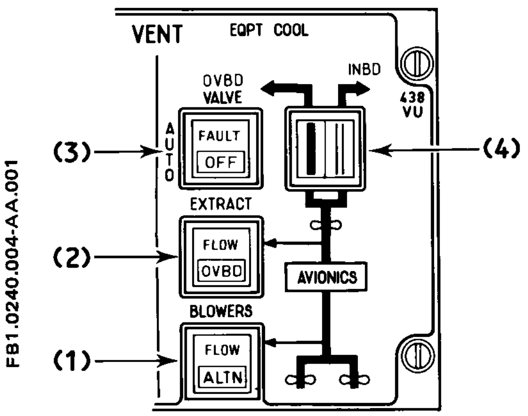
Vers. : All

Eng. : All

A. VENT PANEL

– Eqpt Cool





(1) BLOWERS Pushbutton Switch

Enables to select manually the active blower.

- **Normal (P/BSwitch Pressed-in)**

  One of the two blowers is continuously running. The transfer from one blower to the other is automatic at
  R each first engine start.

- **ALTN (P/B Switch Released-out)**

  Confirms the activation of the other blower after an automatic transfer due to a failure. Further retransfer, automatic or manual, is inhibited. The ALTN light comes on white.

- **FLOW**

  The light is triggered by an airflow detector in the blower ventilation duct. The detector has two levels, which correspond to the two blower speeds.

  The FLOW light comes on amber when the airflow in the blower duct is not sufficient for the actual demand. When the P/B switch is in normal position an automatic transfer is performed to the other blower.

  Illumination of the FLOW light is accompanied by ECAM activation, and on ground, by an external horn.

  The FOW light goes off after confirmation of automatic transfer by selecting the BLOWERS P/B switch ALTN.

(2) EXTRACT Pushbutton Switch

Controls the three-positions overboard valve and inboard valve operation according to :

– the ground or flight configuration of the aircraft
– the OVBD VALVE P/B switch position.

- **Normal (P/B Switch Pressed-in)**

  The extraction fan runs continuously and has two levels of speed depending on the flight or ground configuration.
  The OVBD VALVE P/B switch is normally selected AUTO.

  On the ground (engines not running)

  The three positions overboard valve is fully open.
  The inboard valve is fully closed.

  In flight (or on ground engines running)

  The three positions overboard valve is fully closed.
  The inboard valve is fully open.

- **OVBD (P/B Switch Released-out)**

  The three positions overboard valve is partially open.
  The OVBD light comes on white.
  The INBD valve is fully closed.
  The extract fan runs at low speed.

- **FLOW**

  The light is triggered by an airflow detector in the extraction fan duct. The detector has two levels which correspond to the two fan speeds.

  The FLOW light comes on amber to indicate the airflow in the fan duct is not sufficient for the actual demand.

  Illumination of the FLOW light is accompanied by ECAM activation.

  The FLOW light goes off when the airflow is sufficient.

(3) OVBD VALVE Pushbutton Switch

The switch is operated to close the three positions overboard valve if required. In normal configuration the switch is selected AUTO.

- **AUTO (P/B Switch Pressed-in)**

  The three positions overboard valve position depends on the EXTRACT P/B switch position.

- **OFF (P/B Switch Released-out)**

  The three positions overboard valve is closed. The OFF light comes on white.

Code : 0240G

- **FAULT**

The light comes on amber to indicate the three
R positions overboard valve remains open after engine
R starting.

Illumination of the FAULT light is accompanied by ECAM activation.

The FAULT light goes off when the OVBD VALVE P/B
R switch is selected OFF, provided the three positions
R overboard valve is closed.

(4) OVBD VALVE/INBD Annunciator

The double indication annunciator displays the path taken by the extraction airflow.

- **OVBD VALVE Flowbar On, (INBD Flowbar Off)**

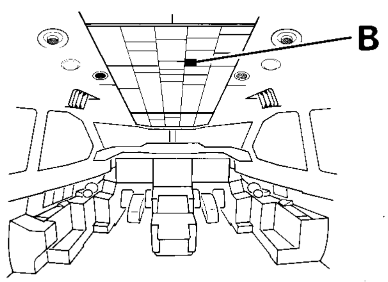
The airflow goes directly overboard through the three
R positions overboard valve which is fully or partially
R open.

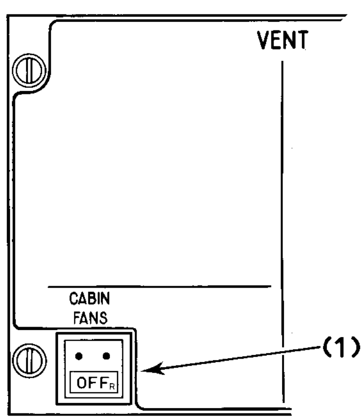
- **INBD Flowbar On (OVBD VALVE Flowbar Off)**

The airflow goes directly in the cargo compartment
R through the inboard valve.

B. VENT PANEL

– Cabin Fan





FB1.0240.005-AA.001

(1) CABIN FANS Pushbutton Switch

Controls the activation of fans which allow a part of the cabin air to be recirculated.

- **On (P/B Switch Pressed-in)**

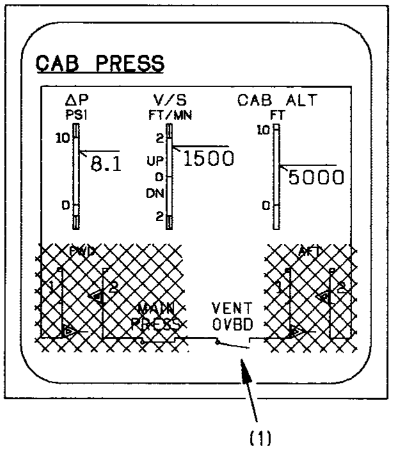
The fans are running and the cabin air is recirculated.

- **OFF/R (P/B Switch Released-out)**

The fans are stopped. The OFF/R light comes on white.

Vers. : All Eng. : All

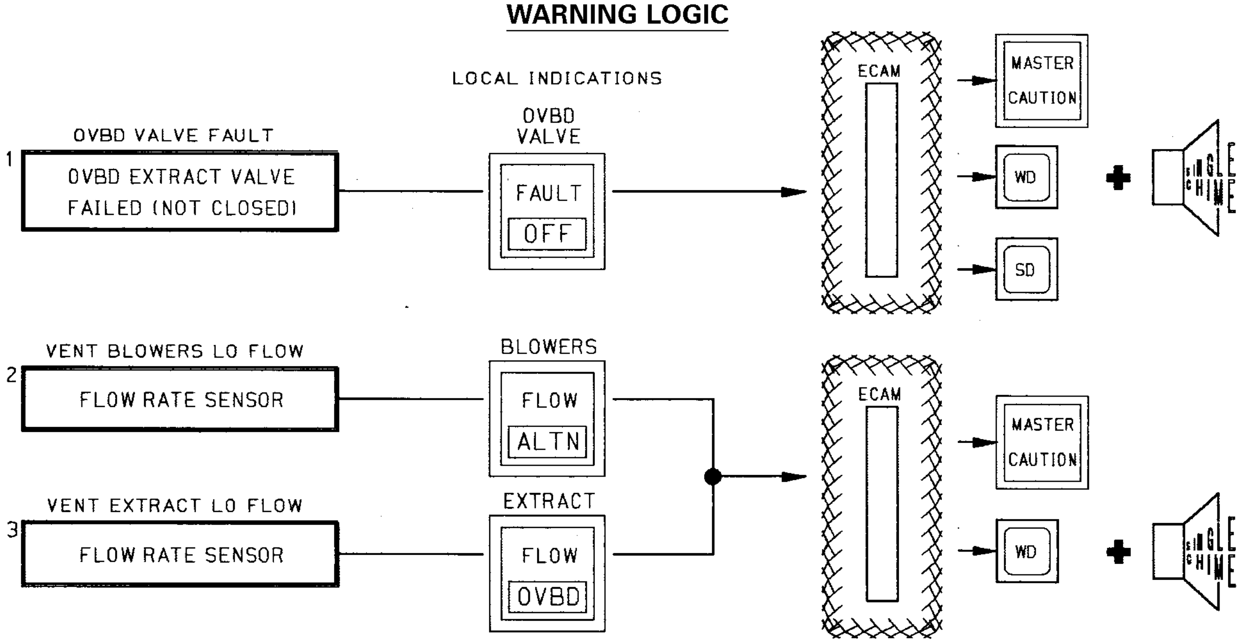
SYSTEM DISPLAY

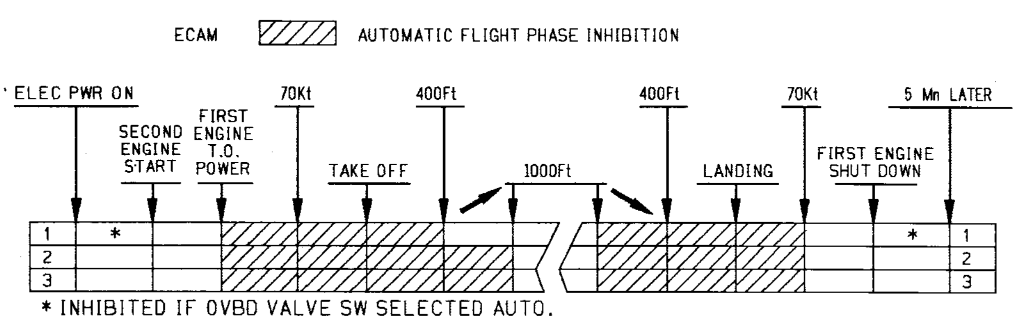


(1) VENT OVBD Indication

VENT OVBD	White	OVBD valve is fully closed
	Green	
VENT OVBD	White	OVBD valve is partially open
	Green	
VENT OVBD	White on ground amber in flight	OVBD valve is fully open
	Green on ground amber in flight	

WARNING LOGIC

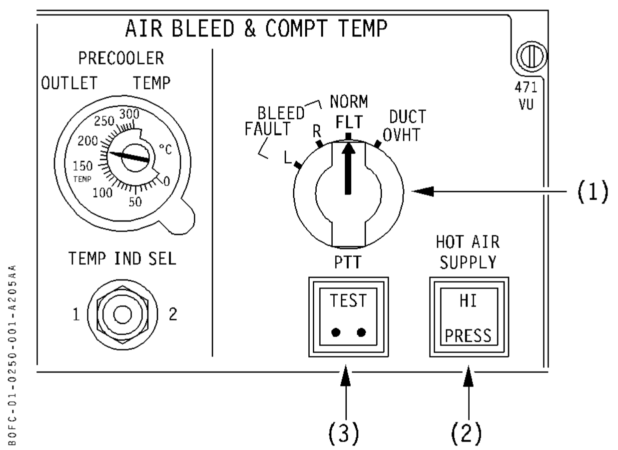




OPS.FCO.B1.0240.006-AA.025

Mod. : 5051

A. AIR BLEED AND COMPT TEMP PANEL



(1) AIR BLEED AND COMPT TEMP Test Selector Switch

Connects the PTT pushbutton switch to the warning circuits for test of overheat warning and automatic closure of the hot air supply valve.

(2) HOT AIR SUPPLY memorized fault annunciator (MFA)

Illuminates on white, when the pressure in the hot air duct exceeds 12.5 PSI for one minute or more.

(3) PTT Pushbutton Switch

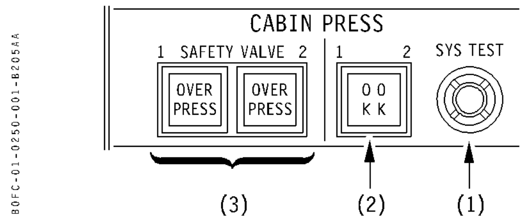
- **TEST**

  The light illuminates white, when the test selector switch is not in NORM FLT position.

- **Pressed and held**

  A simulated overheat signal is generated to test the selected overheat warning circuit. After test, systems must be reset.

B. CABIN PRESS PANEL



(1) SYS TEST Pushbutton Switch

The pressurization systems are tested one at a time as selected by the SYS 1 or SYS 2/PUSH TO SEL pushbutton switch on the CABIN PRESS panel.

When the pushbutton switch is pressed and held, the active system is tested :

– Respective OK light illuminates white if :
  . Electrical circuit integrity of controller, valves and aircraft is satisfactory.
  . All warning (ECAM) are satisfactory.

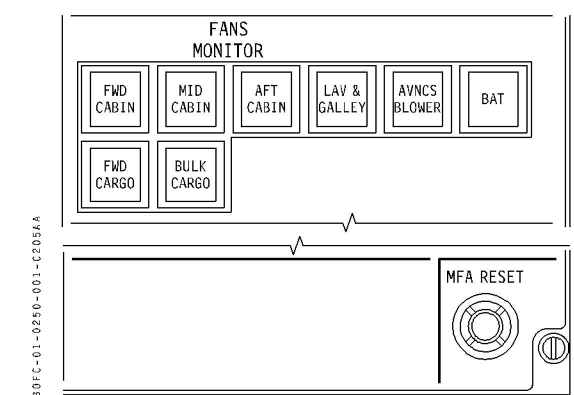
(2) SYS 1/ SYS 2/OK Annunciator

The light of the active system illuminates, when SYS TEST pushbutton switch is pressed, to indicate successful test.

(3) SAFETY VALVES OVER PRESS lights

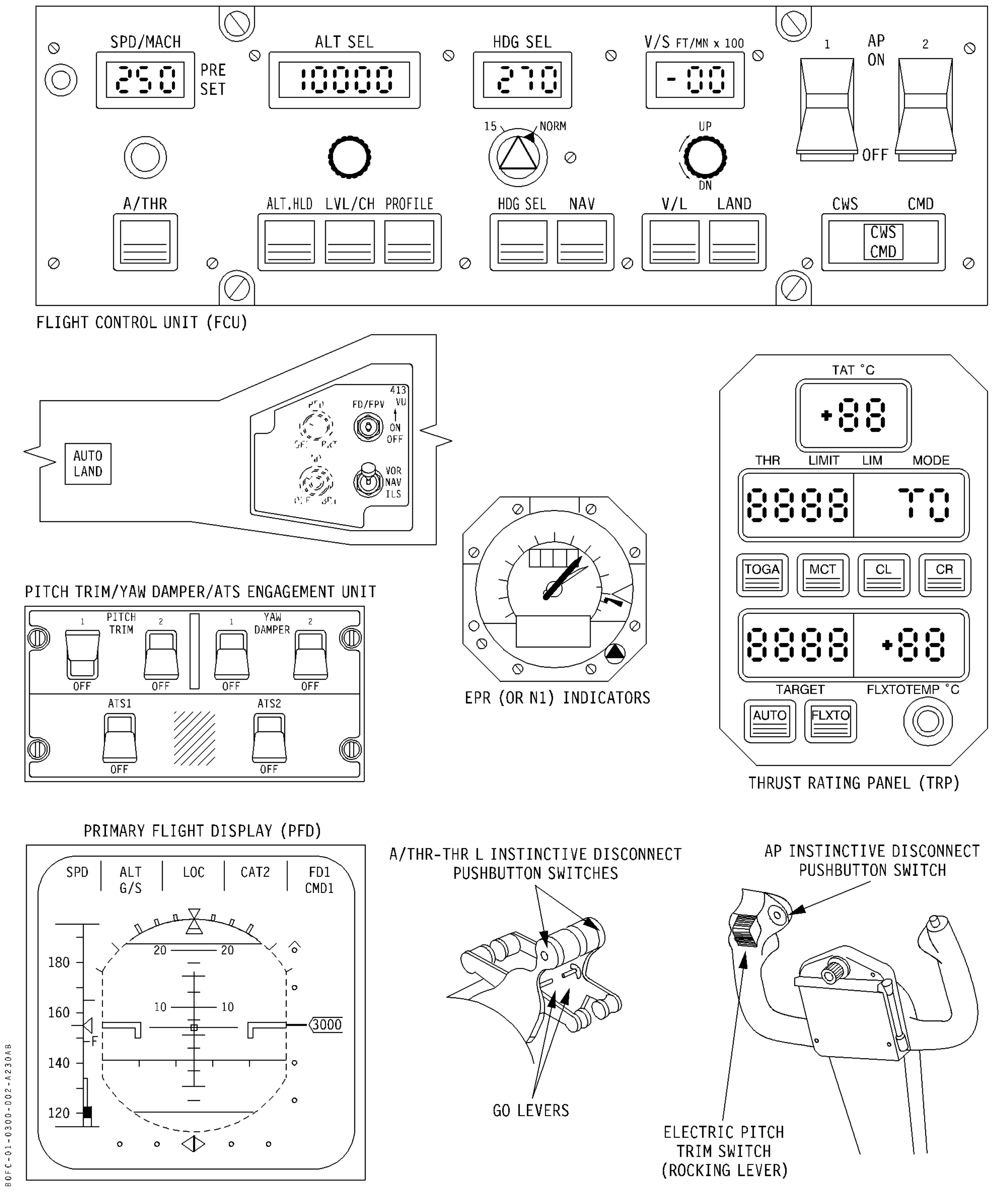
The light illuminates when the valve opens.

C. FANS MONITOR PANEL



The memorized fault annunciators (MFAs) illuminate in case of functional failure of the corresponding fan, i.e : cabin recirculation fans, lavatory and galley fan, avionics blowers, forward and bulk cargo fans.
MFA's extinguish off when MFA RESET pushbutton switch is pressed.

Mod : 2989 + 3881



R
R

MAIN

SYSTEM CONTROLS

AND DISPLAYS

Mod : (MP S5063 + 5051) or (Mod : 5051 + 6523)

GENERAL

- The Automatic Flight System (AFS) can be used:
  R – for guidance only, in manual flying (FD only) or
  R in control wheel steering (AP engaged in CWS mode),

  or

  – for automatic control of the selected flight path
  R targets (AP engaged in CMD mode).
- The AFS fully integrates the Auto Pilot/Flight Director functions (AP/FD) and the Auto Throttle functions (A/THR).
- **At any time, the pilot can select the desired level of automation, revert to the AP/FD basic modes or to manual flying.**
- The AFS is designed to :
  - control the aircraft on the selected flight path (AP/FD vertical and lateral guidance),
  - control the aircraft speed (AP/FD or A/THR),
  - control the engine thrust (A/THR).
- Pilot inputs to the AFS are performed via :
  - the Flight Control Unit (FCU),
  - the FMS CDU,
  - the Thrust Rating Panel (TRP),
  - the throttle Go-levers,
  - the control column, control wheel and rudder pedals, when the AP is engaged in CWS mode.
- The AFS consists of :
  - 2 Flight Directors (FD 1 and FD 2),
  - 2 Autopilots (AP 1 and AP 2),
  - 2 Autothrottle Systems (ATS 1 and ATS 2).
- The AFS includes the following computers :
  - 2 Flight Control Computers (FCC) :
    - FCC1 for AP1/FD1,
    - FCC2 for AP2/FD2.
  - 2 Thrust Control Computers (TCC) to :
    - compute the engine thrust limit for any flight phase,
    - control the associated Autothrottle System.
  - 2 Flight Augmentation Computers (FAC),
  - 2 Yaw Dampers (see chapter 1.09),
  - 2 Pitch Trim (see chapter 1.09).
- The AFS integrates peripheral data from the :
  - FCC, TCC, FAC, FCU, TRP,
  - FMS Control Display Unit (CDU),
  - Flight Management Computer (FMC),
  - IRS, ADC, VOR, ILS, Radio Altimeters,
  - Throttle Lever Angle (TLA) position and Go-levers,
  - ATS and AP instinctive disconnect pushbuttons switches,
  - engines,
  - Slats Flaps Control Computer (SFCC, for slats/flaps position),
  - Electronic Flight Control Unit (EFCU, for control wheel position),
  - landing gear position detectors (for the ground/flight condition).

AFS COMPUTER REDUNDANCY

- The AFS computers are duplicated in order to provide the required level of system redundancy.
- Each computer consists of two independent processing channels (command and monitor channels) assuring all the functions dedicated to the computer.
- The computations performed by the command and monitor channels are permanently compared.

  In case of disagreement between the two channels, the affected function or computer is disabled before it may affect the aircraft guidance.
- In operational terms, such a self-monitored system is referred to as being **Fail Passive**.
- For precision approach and go-around, as soon as the second AP is engaged, if the active system fails, the seconds system takes over automatically.

MP S5063 or Mod : 6523

R • In operational terms, this system redundancy provides a **Fail Operational** capability.

ELECTRIC POWER SUPPLY

• AFS computers are electrically supplied :

– temporarily :

• at aircraft power-up, for computer self test,

• when performing the annunciator lights test,

– continuously :

• when one PITCH TRIM lever is in the engaged position,

R or

• when one engine is started.

• The AFS computers are electrically supplied, as follows :

	AC	DC
FCC 1	AC ESS BUS	DC ESS BUS
FCC 2	AC BUS 2	DC NORM BUS
FCU		DC ESS BUS DC NORM BUS
TCC 1	AC BUS 1	DC NORM BUS
TCC 2	AC BUS 1 AC BUS 2	DC ESS BUS

• AFS power supply is cut off when both engines are shut down (both PITCH TRIM levers disengaged).

AFS ARCHITECTURE

• The main design principles of the AFS architecture are :

– the AFS fully integrates the Auto Pilot/Flight Director (AP/FD) and the Auto Throttle (A/THR) functions,

R – for each AP/FD mode, an A/THR mode is
R automatically associated (paired).

– the AP/FD can be used without the A/THR (i.e. with manual thrust setting).

– the A/THR can be used in manual flying.

– the AFS operates in response to the pilot selections.

however, in some cases, the AFS operates automatically according to built-in protection features (refer to section 1.03.13 AFS PROTECTIONS and to the MODE REVERSION paragraph in the description of each individual AP/FD mode).

– pilot selections and peripheral data are processed together to provide :

• guidance orders in pitch and roll, (FD bars),

• aircraft speed control,

• engine thrust control.

– AP/FD modes are armed or engaged either manually by the pilot (selections on FCU) or automatically (Go-levers activation, mode transitions or mode reversions).

– ATS modes are automatically selected in accordance with the engaged AP/FD vertical mode.

– the crew can monitor the AP/FD and ATS modes status on the Flight Mode Annunciator (FMA) which is displayed in the upper part of each PFD (Primary Flight Display).

– the engaged FD modes do not change upon AP engagement (transition from manual flying using the FD) and disengagement (reversion to manual flying using the FD).

– AP/FD1 and AP/FD2 work in parallel and provide guidance orders which are represented by the FD bars position. FD1 is displayed on PFD 1 and FD2 on PFD2.

– the FD guidance orders (FD bars commands) can be executed :

• manually by the pilot with AP OFF or with AP engaged in CWS mode (Control Wheel Steering) mode,

• automatically by the AP if engaged in CMD (Command) mode.

– at any time, the pilot can revert to manual thrust control by pressing the ATS instinctive disconnect pushbutton on either throttle lever and to manual flying by pressing the AP instinctive disconnect pushbutton on the control wheel.

Mod : (MP S5063) or (Mod : 6523)

– AP engagement conditions include all the FD engagement conditions plus specific additional conditions.

In case of loss of any engagement condition due to an equipment failure :

• if the FD1 (2) is lost, the AP1 (2) is lost consequently,

• if the AP1 (2) is lost, the FD1 (2) may remain engaged (for example, in case of loss of the green hydraulic system, the AP1 is lost but the FD1 remains operative).

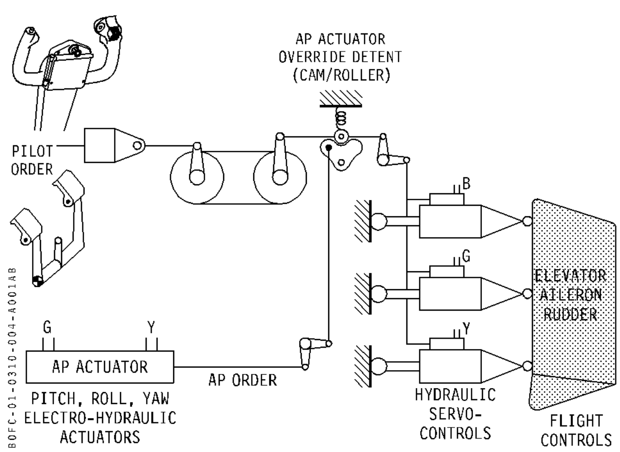
AFS – PILOT INTERFACE

- The cockpit equipments associated to the use of the AFS are :

R – PITCH TRIM/YAW DAMPER/ATS engagement unit,
  – Flight Control Unit (FCU),
  – Primary Flight Display (PFD) including :
    - Flight Mode Annunciator (FMA),
    - FD bars.
  – AP instinctive disconnect pushbuttons,
  – ATS instinctive disconnect pushbuttons,
  – Go-levers,
  – Thrust Rating Panel (TRP) and EPR/N1 indicators,
  – FD/FPV switches,
  – VOR/NAV/ILS selectors,
  – ILS control panel,
  – local warnings.

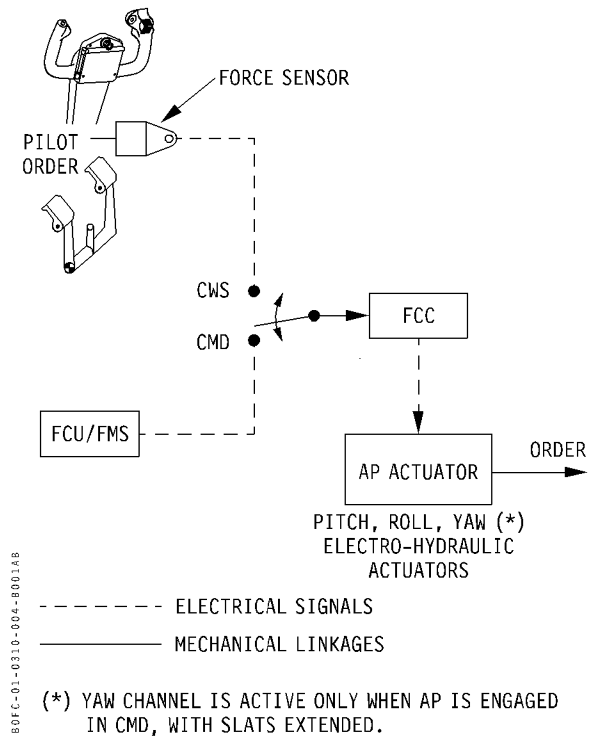
AP CONNECTION TO FLIGHT CONTROLS

- The primary flight controls are actuated by hydraulic servo controls which are commanded either mechanically in manual flying or by the AP actuators if the AP is engaged.



- With the AP engaged (in CMD or CWS), the AP electro-hydraulic actuators are electrically commanded via the FCC.

  The AP yaw actuator is active only when the AP is engaged in CMD and slats are extended.



- The AP electro-hydraulic actuators are hydraulically powered as follows :
  – AP1 actuators : Green hydraulic system.
  – AP2 actuators : Yellow hydraulic system.

- When flight controls are commanded by AP actuators, feedback movement is provided to the control column, control wheel and rudder pedals.

- Each AP actuator is fitted with a safety detent device (cam/roller), which provides the possibility to override the actuator in case of an AP hardover (illustration to be considered for education purposes only, it does not reflect the actual hardware).

Note : Refer to chapter 1.09 - FLIGHT CONTROL for general schematics.

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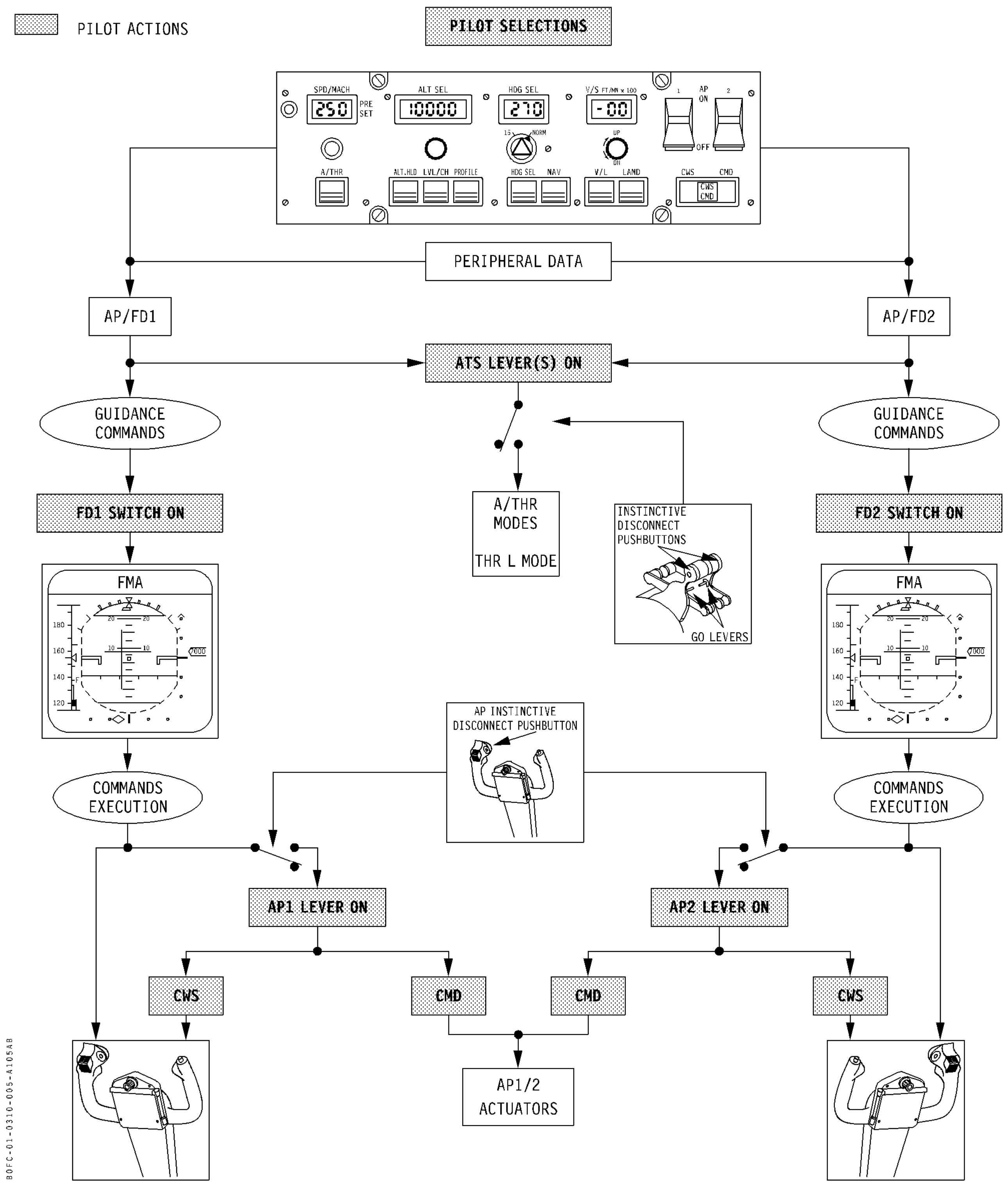
R
R



Mod : (MP S5063) or (Mod 6523)

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AFS MODES

- The AFS guidance associates :
  - AP/FD vertical and lateral modes,
  - a paired A/THR mode.
- For landing and go-around, the AP/FD uses combined modes which associate a vertical mode and a paired lateral mode.
- The selection of the AP/FD modes is performed on the FCU, the status of the corresponding vertical and lateral modes, as well as of the associated A/THR mode, is indicated on the Flight Mode Annunciator (FMA) located in the upper part of the Primary Flight Display (PFD).

AP/FD BASIC MODES

- The basic vertical mode of the AP/FD is the V/S mode.

  Upon engagement, the V/S mode maintains the current aircraft vertical speed.
- The basic lateral mode of the AP/FD is the HDG mode.

  Upon engagement, the HDG mode maintains the current aircraft heading.
- At AFS computer power-up, the FD engages the basic modes.

ENGAGED VERSUS ARMED MODES

- Some AP/FD modes can be armed before being engaged. ATS modes can only be engaged.
- A mode is **armed,** following a manual or automatic selection, until the conditions for engagement are met.

  During the arming phase, the mode is displayed in blue in the second or third line of the FMA.
- A mode is **engaged** when it is used by the AFS.

  When engaged, the mode is displayed in green in the first line of the FMA.

  An automatic transition from **armed** to **engaged** occurs when the required engagement conditions are met (e.g. : glide slope capture in approach, transition from G/S blue to GS* green).

MODE TRANSITIONS

- A mode transition is a manual or automatic change-over from one mode to another mode which occurs as the result of :
  - a pilot action (e.g. : mode selection on FCU),

  or
  - a prior pilot selection involving several modes in sequence (e.g. : in altitude capture, the vertical mode changes from SPD to ALT* then to ALT)

MODE REVERSIONS

- A mode reversion is a manual or automatic change-over from one mode to another mode which occurs as the result of :
  - a pilot action (e.g. intentional disengagement of a mode, by pressing the corresponding pushbutton switch on the FCU, thus resulting in a manual reversion to the associated basic mode),

  or
  - a system built-in condition (e.g. automatic LVL/CH to V/S mode reversion),

  or
  - a failure or temporary loss of the engaged mode.
- Reversions due to the failure or temporary loss of the engaged mode are indicated by the flashing of the associated FD bar and by the FMA annunciation (reversion to the associated basic mode, i.e. V/S or HDG).

Note : Mode transitions and reversions are described, for each individual AP/FD and A/THR mode, in the respective description and operation section.

R Mod : 11899 or 11900 or (11899 + 11900)

AP/FD VERTICAL MODE AND A/THR MODE PAIRING

- The engagement of an AP/FD vertical mode automatically engages the associated A/THR mode, provided the A/THR is engaged, e.g. :
  - Upon engagement of the AP/FD V/S mode, the A/THR SPD mode engages :
    - AP/FD adjusts the pitch attitude (using the elevator) to maintain the selected V/S and,
    - A/THR adjusts the engine thrust to maintain the selected speed.
  - In Level Change (LVL/CH), the AP/FD SPD mode engages and the A/THR THR mode (in climb) or RETARD mode (in descent) engages :
    - AP/FD adjusts the pitch attitude (using the elevator) to maintain the selected speed.
    - A/THR maintains the engine thrust limit (in climb) or idle (in descent),

ATS MODES

The ATS and A/THR can be engaged in the following modes :

FMA indications	Mode	Mode function
MAN THR *(Amber)*	Manual Thrust	ATS is armed but no A/THR mode is engaged, throttle levers must be set manually.
THR	Thrust	Maintains the Thrust Limit (THR LIM) as selected and displayed on the TRP.
THR *(Blue)*	Thrust Armed	Autothrottle system is declutched during takeoff, but remains armed in order to reclutch after takeoff (refer to section 1.03.23 A/THR THR mode).
SPD	Speed	Maintains the selected speed.
MACH	Mach	Maintains the selected Mach number.
P.THR	Profile Thrust	Maintains the Thrust Limit/Target Thrust directed by the FMS, as indicated on the TRP (TRP in AUTO).
P.SPD	Profile Speed	Maintains the target speed directed by the FMS.
RETARD	Retard	Reduces throttle levers to 5° throttle lever angle (TLA), then the Autothrottle system declutches (A/THR blue).
A/THR *(Blue)*	A/THR Armed	Autothrottle system is declutched but remains armed in order to reclutch at level-off.
R **THR L**	Thrust Latch	Sets and maintains the Thrust Limit (THR LIM), as selected and displayed on the TRP, following the activation of the angle-of-attack protection (alpha-floor).

AP/FD VERTICAL/LATERAL/COMBINED MODES

- The AP/FD can be engaged in the following modes :

VERTICAL modes

FMA Indication	Mode	Mode function	Associated A/THR mode
V/S	Vertical Speed	Acquires and maintains the selected V/S.	**SPD or MACH**
SRS	Speed Reference System	Maintains a reference speed for takeoff or go-around.	**THR**
SPD	Speed	Maintains the selected speed.	**THR (climb)** **RETARD (descent)**
MACH	Mach	Maintains the selected Mach number.	**THR (climb)** **RETARD (descent)**
ALT *(Blue)*	Altitude hold Armed	Arming phase of ALT mode.	***In accordance with the engaged vertical mode***
ALT*	Altitude hold Capture	Capture phase of ALT mode.	**SPD or MACH**
ALT	Altitude hold	Maintains the selected altitude.	**SPD or MACH**
G/S *(Blue)*	G/S Armed	Arming phase of GS mode.	***In accordance with the engaged vertical mode***
GS*	G/S Capture	Capture phase of GS mode.	**SPD**
GS	G/S Track	Tracks the Glideslope beam.	**SPD**
P.CLB *(Blue)*	Profile Climb Armed	Arming phase of P.CLB mode.	***In accordance with the engaged Pitch mode.***
P.CLB	Profile Climb	In PROFILE mode, maintains the climb speed and path directed by the FMS.	**P.THR**
P.ALT	Profile Altitude hold	In PROFILE mode, maintains the selected altitude.	**P.SPD**
P. DES *(Blue)*	Profile Descent Armed	Arming phase of P. DES mode.	***In accordance with the engaged vertical mode***
P.DES	Profile Descent	In PROFILE mode, maintains the descent speed, flight path or vertical speed directed by the FMS.	**P.THR** **then** **RETARD or P.SPD**

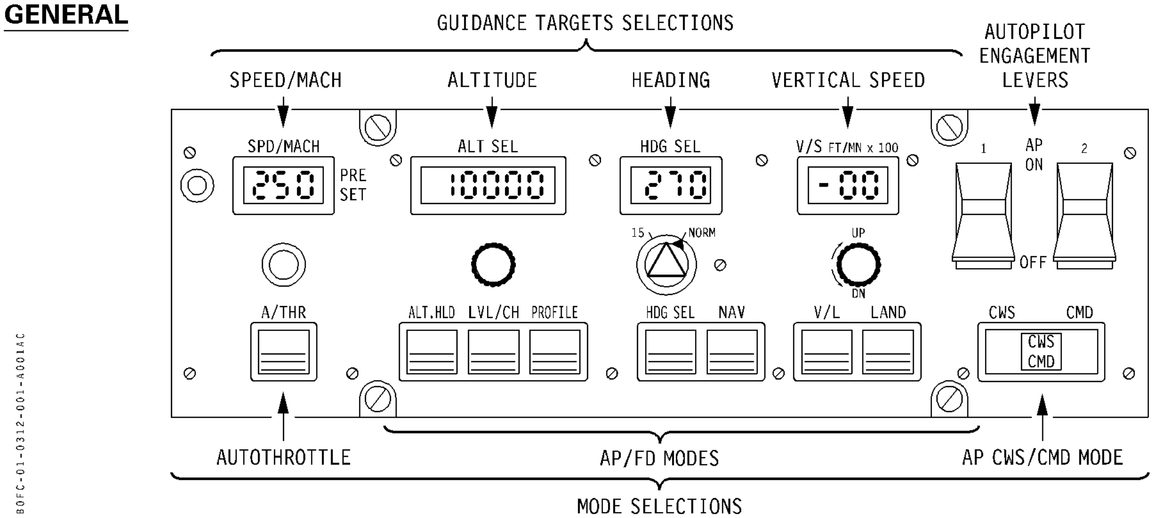
LATERAL modes

FMA Indication	Mode	Mode function
HDG	Heading	Maintains the present aircraft heading.
R **HDG/S** *(Blue)*	Heading Select Armed	Arming phase of HDG/S mode (only when HDG/S is armed for take-off).
HDG/S	Heading Select	Acquires and maintains the selected heading.
RWY	Runway	Tracks the selected localizer course to maintain the runway centerline during takeoff up to 30 ft (then NAV, HDG/S or HDG engages automatically). R
NAV *(Blue)*	Navigation Armed	Arming phase of NAV mode.
NAV	Navigation	Maintains the FMS F-PLN track.
VOR *(Blue)*	VOR Armed	Arming phase of VOR mode.
VOR*	VOR Capture	Capture of the selected VOR radial/course.
VOR	VOR Track	Tracks the selected VOR radial/course.
LOC *(Blue)*	Localizer Armed	Arming phase of LOC mode.
LOC*	Localizer Capture	Capture phase of LOC mode.
LOC	Localizer Track	Tracks the selected Localizer course.

COMBINED modes

FMA Indication	Mode	Mode function	Associated A/THR mode
LAND	Land Track	Localizer and glideslope tracking below 400 ft RA.	**SPD**
FLARE	Flare	Flare and runway alignment guidance.	**SPD then RETARD**
ROLL OUT	Rollout	Derotation and roll out guidance.	**MAN THR**
GO AROUND	Go Around	Go-around guidance, using SRS and HDG modes.	**THR**

GENERAL



- The FCU is the main interface between the flight crew and the AFS in order to :
  - engage the A/THR and the AP,
  - engage AP/FD modes,
  - select guidance target values.

BASIC PRINCIPLES

Arming/engagement :

- A mode can be armed or engaged by pressing the corresponding pushbutton switch or (for LVL/CH, HDG SEL and V/S modes only) by pulling the corresponding selector knob.

Disarming/disengagement :

- If a mode is armed or engaged, pressing its pushbutton switch a second time disarms or disengages the mode.
  A mode cannot be disengaged by pulling the corresponding setting knob a second time.

  Engaging a new mode disengages the mode which was previously engaged.

Selector knobs :

- Turning a selector knob clockwise increases the
R target value and turning anticlockwise decreases
R the target value.

Pushbutton switches :

- The pushbutton switches control the corresponding mode.

  The pushbutton switches include three green bars which illuminate green when the corresponding mode is engaged.

- Disengaging a mode by pressing the related pushbutton switch causes a reversion to the corresponding basic mode :
  - if the vertical mode is disengaged, V/S engages,
  - if the lateral mode is disengaged, HDG engages.

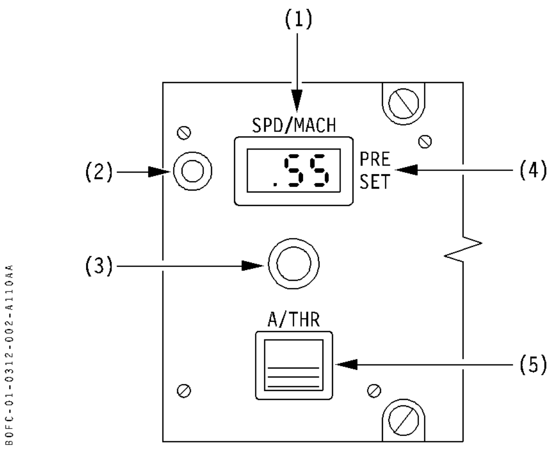
FCU INITIALIZATION

- During cockpit preparation, when the FCU is electrically supplied (by engaging either pitch trim lever) all windows, except SPD/MACH, are initialized in accordance with the present aircraft parameters (e.g. : 100 kt, 500 ft, 350°, 00 ft/min).

  Note 1 : 100 kt is the minimum value for the SPD/MACH display window.

  Note 2 : If aircraft data are missing or invalid, the displayed data are 100 kt, 5000 ft, 000° and "- - -" in the V/S display window.

FCU DESCRIPTION



(1) SPD/MACH window

- Displays the target or pre set speed/Mach number.
- When PRE SET light is extinguished, the target speed/Mach (used by either A/THR or AP/FD) is displayed. When PRE SET light is illuminated, the pre-set speed/Mach is displayed.
- "---" is displayed when PROFILE mode is engaged.

Note 1 : Range of displayed values :
- *SPD : 100 kt to 399 kt IAS*
- *MACH : .01 to .99*

Note 2 : The target speed (selected by the pilot or computed by the FMS, when in PROFILE mode) is also displayed on the PFD speed scale.

(2) SPD/MACH switch-over button

- Pressing the SPD/MACH switch over pushbutton switches the SPD/MACH display from the selected SPD to the present MACH or from the selected MACH to the present SPD.
- At 25,400 ft an automatic switching occurs from SPD to MACH in climb and from MACH to SPD in descent.
- If a SPD or MACH has been PRE SET, the automatic SPD/MACH switching occurs at the corresponding airspeed/Mach number cross-over altitude.

(3) SPD/MACH selector knob

- Turning the SPD/MACH setting knob selects the Speed/Mach target value (1 kt/0.01 Mach per click).
- The SPD/MACH selection is confirmed by cross-checking the blue index on the Primary Flight Display (PFD) speed scale.
- Pressing the knob illuminates the PRE SET light, and allows a speed or Mach to be preset. If PRE SET is already illuminated, pressing the knob again cancels the preset speed/Mach (PRE SET light extinguishes).

  (Refer to section 1.03.40 for description and operation of the PRE SET function).
- Pulling the knob while PROFILE mode is engaged, causes a manual reversion to selected modes :
  - if in level flight, PROFILE mode disengages and SPD mode (A/THR) and ALT mode (AP/FD) engage. The speed/Mach window synchronizes on the present aircraft speed or Mach.
  - if in climb or descent, PROFILE mode disengages and LVL/CH engages. The speed/Mach window synchronizes on the present aircraft speed/Mach.

(4) PRE SET light

- The PRE SET light illuminates when SPD/MACH setting knob is pressed. The speed or Mach set in the SPD/MACH window is the preset value (not the active speed or Mach)

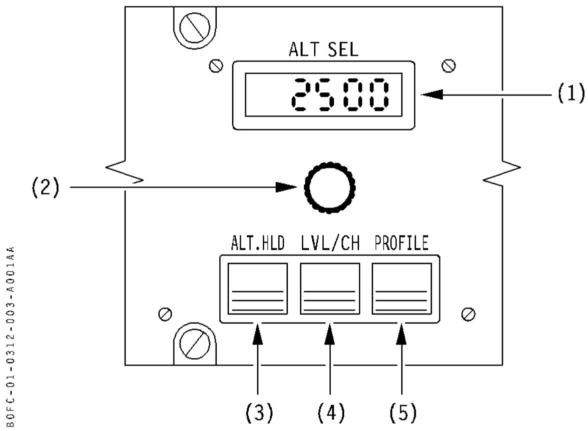
  (Refer to section 1.03.40 for description and operation of the PRE SET function).

(5) A/THR pushbutton switch

- Pressing the A/THR pushbutton switch engages or disengages the A/THR.

  (Refer to section 1.03.23 for description and operation of the A/THR mode).
- The three green bars illuminate when the A/THR is engaged.

Mod : 6036



(1) ALT SEL window

- Displays the selected target altitude.

(2) ALT SEL selector knob

- Pressing the knob changes the altitude setting increment per click from 1000 ft to 100 ft.

  Pressing the knob a second time reverts to 1000 ft increment.

- Turning the ALT SEL selector knob selects the altitude target value.

- The ALT SEL selection is confirmed by cross-checking the blue target altitude on the Primary Flight Display (PFD) altitude scale.

- Pulling the knob, if a new target altitude is selected in the ALT SEL window, results in the following :
  – LVL/CH engages,
  – If in PROFILE mode, a climb or descent is initiated,
  – If already in LVL/CH or PROFILE climb or descent, pulling this knob has no effect.

(3) ALT. HLD pushbutton switch

- Pressing the ALT. HLD pushbutton switch engages
R an immediate level-off (ALT green on FMA).

  (Refer to section 1.03.44 for description and operation of the ALT.HLD / ALT mode).

(4) LVL/CH pushbutton switch

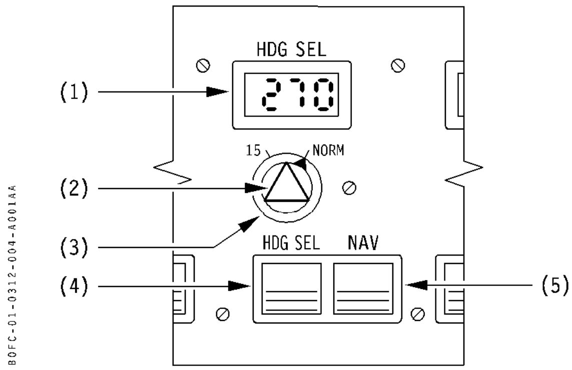
- Pressing the LVL/CH pushbutton switch engages or disengages the LVL/CH mode.

  (Refer to section 1.03.43 for description and operation of the LVL/CH mode).

(5) PROFILE pushbutton switch

- Pressing the PROFILE pushbutton switch engages or disengages the PROFILE mode.

  (Refer to section 1.03.52 for description and operation of the PROFILE mode).



(1) HDG SEL window

- Displays the selected target heading.

(2) HDG SEL selector knob (inner knob)

- Pushing the HDG SEL selector, if HDG/S mode is not engaged, synchronizes the heading in the HDG SEL window with the present aircraft heading.

  If HDG/S mode is already engaged, pushing the selector knob has no effect.

- Pulling the knob, if HDG/S is not engaged, engages the HDG/S mode. If HDG/S mode is already engaged, pulling the knob has no effect.

- Turning the knob selects the desired target heading (1° per click)

- The HDG/S mode engagement is confirmed by the FMA annunciation (HDG/S green) and by the illumination of the HDG SEL pushbutton on the FCU.

- The HDG SELection is confirmed by cross-checking the position of the blue index (or the blue heading value) on the Navigation Display (ND) heading scale.

(3) Bank Angle Limit selector (outer knob)

- The outer knob selects the bank angle limit :

R   – NORM position : the bank angle is limited to 25°
R   in HDG/S mode and in VOR mode.

  – 15 position : the bank angle is limited to 15° (this limitation is active only in HDG/S and VOR modes).

(4) HDG SEL pushbutton switch

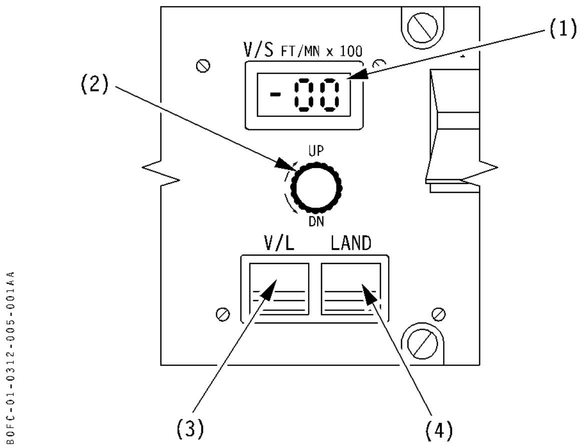
- Pressing the HDG SEL pushbutton switch engages or disengages the HDG/S mode.

  (Refer to section 1.03.46 for description and operation of the HDG/S mode).

(5) NAV pushbutton switch

- Pressing the NAV pushbutton switch engages or disengages the NAV mode.

  (Refer to section 1.03.53 for description and operation of the NAV mode).



(1) V/S window

- Display the selected vertical speed target.
- " - - - " is displayed if V/S mode is not engaged.

(2) V/S selector knob

- Turning the V/S selector knob selects the desired vertical speed target (100 ft/mn per click).
- Pushing the knob has no effect.
- Pulling the knob engages the V/S mode. If V/S mode is already engaged, pulling the knob has no effect.

  (Refer to section 1.03.42 for description and operation of the V/S mode)
- If the V/S mode is not engaged, turning this knob initially synchronizes the displayed V/S with the present aircraft V/S, but does not engage the V/S mode.

  If the V/S mode is not engaged by pulling the V/S knob or by deselecting the engaged vertical mode within 10 seconds, the displayed V/S is cleared from the V/S window.

(3) V/L pushbutton switch

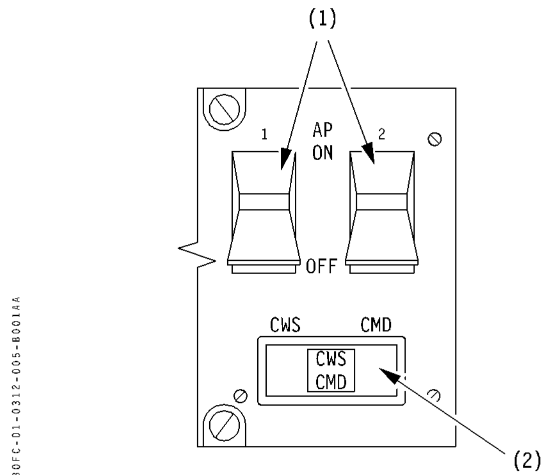
- Pressing the V/L pushbutton switch arms or engages VOR or LOC mode.

  (Refer to section 1.03.47 and 1.03.48 for description and operation of the V/L mode)

(4) LAND pushbutton switch

- Pressing the LAND pushbutton switch arms or engages the GS and LOC modes for an ILS approach.

  (Refer to section 1.03.50 for description and operation of the LAND mode).



(1) AP engagement levers

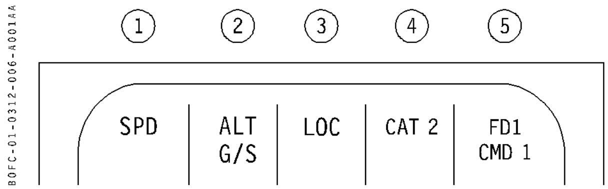
- Setting an AP engagement lever to ON allows to engage the corresponding AP, provided the AP engagement conditions are met.
  - ON : AP is engaged.
  - OFF : AP is disengaged.
- Only one AP lever can be engaged at a time, except when LAND mode is armed on the FCU or in GO AROUND mode, then both AP can be engaged simultaneously in CMD. R

(2) AP CWS/CMD switch-over pushbutton

- Pressing the AP CWS/CMD pushbutton switches the AP from CWS to CMD mode or from CMD to CWS. The corresponding light (CWS or CMD) illuminates to indicate the selected mode.

FLIGHT MODE ANNUNCIATOR (FMA)

FMA design principle and display :



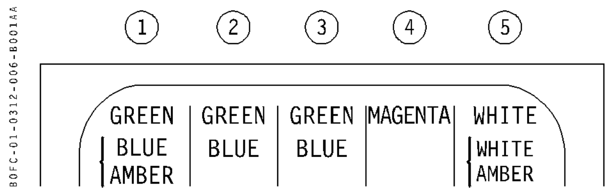
- The FMA is the main interface between the flight crew and the AFS in order to :
  - confirm the engagement of the selected A/THR and AP/FD modes (together with the illumination of the corresponding pushbutton switch on the FCU),
  - confirm, at any time, the status of the A/THR and AP/FD modes (e.g. in order to identify and callout any mode transition or reversion).
- Together with the FCU, the FMA provides feedback to the flight crew regarding the AFS operation :
  - flight crew **inputs** to AFS : **FCU** (and FMS CDU when in PROFILE / NAV mode),
  - AFS **feedback** to flight crew : **FMA** (together with other **PFD** and **ND** data).
- The FMA is divided into 5 separate columns :
  - column 1 : **ATS modes,**
  - column 2 : **AP/FD vertical modes,**
  - column 3 : **AP/FD lateral modes,**
  - column 4 : **Category of the landing capability**:
    CAT1 / CAT2 / CAT3
  - column 5 : **FD engagement status** :
    FD1 / FD2 (first line)

    AP mode engagement status :

    CMD1 / CMD2 / DUAL / CWS1 / CWS2 (Second line).
  - AP/FD **combined modes** are displayed in columns 2 and 3, used as a single column.

FMA colour codes :

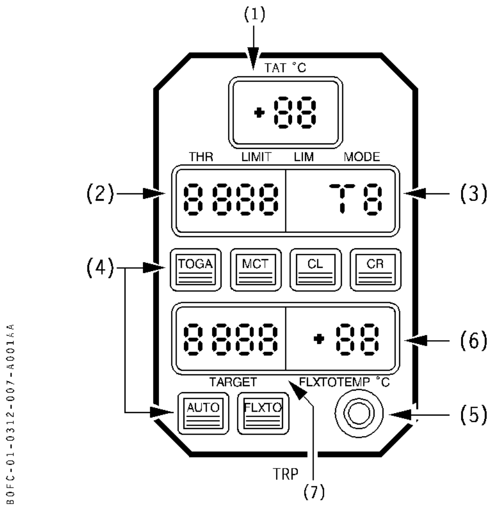
- The following colour codes are used to indicate the status of the AP/FD and A/THR modes, on the FMA :



In column 1, second line, blue is used for THR and A/THR and amber is used for MAN THR.

In column 5, second line, white is used for CMD1 / CMD2 / DUAL and amber for CWS1 / CWS 2.

THRUST RATING PANEL (TRP)



(1) TAT (Total Air Temperature) window

- Displays the TAT.
- Dashes are displayed in case of TAT computation failure.

(2) THR LIMIT window

- Displays the thrust limit value for the mode displayed in the LIM MODE window.
- The value is N1 (GE engine) or EPR (PW engine).
- Dashes are displayed in case of :
  - thrust limit computation failure,
  - TRP failure.

(3) LIM MODE window

- Displays the thrust limit mode selected either manually or automatically :
  - TOGA, MCT, CL or CR.

(4) Thrust limit mode selection keys

- Pressing a key selects the corresponding thrust limit mode.
- When a key is pressed, the three bars illuminate green.
- The selection of a new mode deselects the mode which was previously selected.

(5) FLX TO TEMP selector knob

- Turning the FLX TO TEMP selector knob selects a flexible temperature (assumed temperature) for reduced takeoff thrust (1°C per click).
- If a FLEX TO TEMP lower than the TAT is selected, the TARGET window becomes dashed.

(6) FLX TO TEMP °C window

- Indicates the selected flexible temperature (in °C).

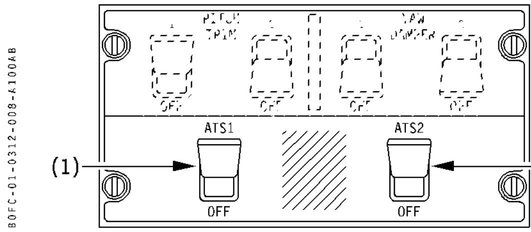
(7) TARGET window

- Displays the thrust target value.
- The displayed value is expressed in terms of N1 (GE engine) or EPR (PW engine) and depends on the flight phase and mode selection, as summarized hereafter :

TARGET window	Condition
FLX TO thrust	For takeoff, if FLX TO key is pressed and a FLX TO TEMP (greater than TAT) is selected
Thrust limit (as in THR LIMIT window)	A/THR engaged in THR mode A/THR not engaged and AP/FD in LVL/CH climb or SRS
Blank	A/THR engaged in SPD/ MACH mode A/THR is declutched
I-L-	In LVL/CH descent, in conjunction with RETARD mode engagement. In PROFILE descent, if FMS requires idle thrust
FMS target thrust	In PROFILE climb or descent
Dashes (- - - -)	In PROFILE cruise If a FLEX TO TEMP lower than TAT is selected

R

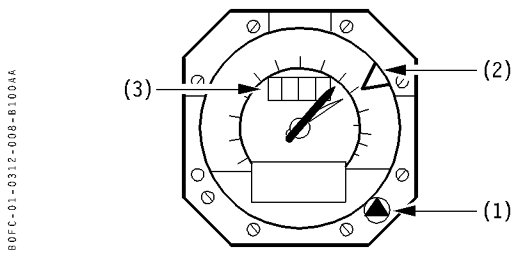
ATS PANEL



(1) ATS arming levers

- Up : The Autothrottle system (ATS) is armed.
  Lever remains latched up as long as ATS arming conditions are met.
- OFF : ATS is disarmed. Autothrottle functions are not available (including Alpha floor protection).

N1 (GE) or EPR (PW) INDICATORS



R *Note : For detailed description of the N1 (EPR)*
R *indicator, refer to the section 1.17.70 - POWER*
R *PLANT - INDICATING.*

(1) Thrust limit selector knob

- Pressed in : normal position.
- Pulling and turning the knob selects manually the desired thrust limit value (if no TRP data is available).

(2) Thrust limit index (orange bug)

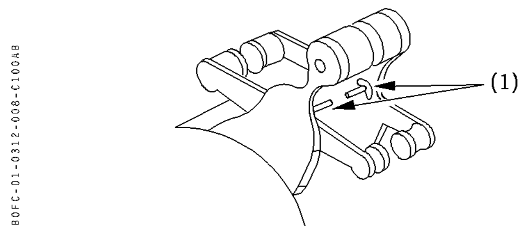
- Indicates the THR LIMIT value displayed on the TRP or manually selected by the selector knob.

  Note : In automatic mode (knob pressed in), the orange index is driven directly by the TCC and indicates zero in case of TCC failure.

(3) Digital thrust limit indication

- Displays the thrust limit value only if the thrust limit is manually selected by pulling and turning the selector knob (1).
- In automatic mode (selector knob pressed), the counter is blank (covered).

THROTTLE LEVERS



(1) Go-levers

- Go-levers are located under and between the throttle levers,
  - With slats extended, triggering either go-lever results in the following :
    - **on ground (take-off initiation)** : R

      AP/FD engages in SRS mode for vertical guidance and in RWY, HDG/S or HDG (depending on crew selection) for lateral guidance.

      A/THR engages in THR mode.
    - **in flight** :

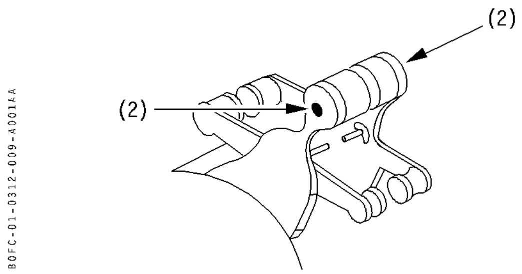
      AP/FD engages in GO AROUND mode (combined mode associating the SRS mode for vertical guidance and the HDG mode for lateral guidance).

      A/THR engages in THR mode.
  - With slats retracted in flight, triggering either go-lever engages the THR L mode but does not change the engaged AP/FD vertical and lateral modes.

    Note : If the A/THR - THR mode is engaged, triggering the go-levers has no effect.

MP S5063 or Mod : 6523

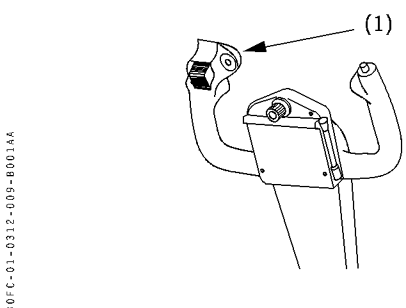
THROTTLE LEVERS (Cont'd)



R **(2) A/THR or THR L instinctive disconnect pushbuttons**

- Pressing either one of the two red pushbutton switches disengages the A/THR or the THR L mode , if engaged.

CONTROL WHEEL



(1) AP instinctive disconnect pushbutton

- Pressing the AP instinctive disconnect pushbutton, on either control wheel, disengages the autopilot, if engaged.
- Pressing either AP instinctive disconnect pushbutton a second time cancels the AP disconnect warnings.

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ANGLE-OF-ATTACK, SELECTED SPEED AND THRUST LIMIT PROTECTION

- The level of protection provided by the ATS-A/THR is summarized in the following table :

ATS LEVERS	A/THR	FMA	PROTECTION LEVEL
Disarmed	–	blank	No protection
Armed (*)	Disengaged	MAN THR	Alpha-Floor protection
Armed (*) (*) at least one lever armed	Engaged	A/THR blue THR, SPD P.THR, P.SPD RETARD	Alpha-Floor protection Selected speed protection Thrust limit protection

Alpha-Floor protection

- If the aircraft angle-of-attack exceeds a given value (as defined in the table hereafter), the ATS Thrust Latch mode engages (THR L annunciation on the FMA) in order to automatically apply to the thrust limit (THR LIMIT), as selected on the TRP (unless the THR mode is already engaged).
- The Alpha-Floor protection is activated at an angle-of-attack which depends on the Slats/Flaps lever position :

S/F LEVER	ANGLE-OF-ATTACK
0/0	8°5
15/0, 15/15, 20/20	14°5
30/40	11°5

- The activation of the Alpha-Floor protection is not accompanied by an AP/FD nose down order (the engaged AP/FD vertical mode remains engaged with the associated pitch command).

  Crew action is necessary for pitch attitude recovery.
- Alpha Floor protection is available provided :
  - one ATS lever is armed,
  - the altitude is above 100 ft RA.
- The THR L mode can be disengaged by pressing either ATS instinctive disconnect pushbutton (refer to section 1.03.24 for description and operation of the THR L mode).

speed protection

- The speed protection is available, whenever a target speed is selected, to protect the aircraft against underspeed or overspeed :
  - **underspeed** : if a speed lower than V_{LS} is selected on the FCU, the AFS maintains V_{LS},
  - **overspeed** : if a speed higher than V_{MAX} is selected on the FCU, the AFS maintains V_{MAX},
- The FCU speed selection protection is available provided one ATS lever is armed and :
  - the FD is followed manually (AP OFF or engaged in CWS mode),

    or
  - the AP is engaged in CMD.

Thrust limit protection

- If the Thrust Limit Computation is available, the A/THR automatically limits the engine thrust to the thrust limit (THR LIMIT) value corresponding to the LIM MODE selected on the TRP.
- If the Thrust Limit Computation is not available (e.g. TCC failed), provided the N1 (GE engines)/ EPR (PW engines) limit is manually set on the N1/EPR indicators, the thrust limit protection remains available in A/THR SPD/MACH mode.

(MP S5063) or (Mod : 6523)

WINDSHEAR WARNING AND GUIDANCE

- The windshear detection system is operative :
  - at takeoff and go-around : from the ground up
R to 1300 ft RA,
R – in approach : from 1300 ft RA down to 50 ft RA.
- If a windshear is detected, the windshear warning is triggered.
- If the slats are extended, when either go-lever is triggered, the AP/FD provides a specific vertical guidance (FD pitch bar command) for recovery.
- The windshear warnings consists in :
  - a red "WINDSHEAR" warning displayed in the sky part of the PFD (for 15 seconds minimum),
  - a voice "WINDSHEAR" warning repeated three times.

Note 1 : *Windshear warnings can be tested by the ANN LT "TEST" or "AUTO TEST".*

Note 2 : *When windshear warnings are triggered, GPWS warnings are inhibited.*

- The AP/FD vertical guidance (in SRS or GO AROUND mode progressively adopts the following survival strategy :
  - control of airspeed (selected speed + 10 kt) as long as a positive vertical speed is maintained,
  - control of altitude as long as airspeed is above stick-shaker speed,
  - control of speed above stick-shaker speed as long as required.

During recovery, a 21.5° maximum pitch attitude target may be commanded (instead of 17.5° in normal conditions).

Note 1 : *Refer to PROCEDURES AND TECHNIQUES chapter 2.02.13 for additional procedural information.*

AP AUTOMATIC DISENGAGEMENT

- When engaged in CMD, the AP automatically disengages if a force greater than a given value is applied on the control wheel in pitch (i.e. in an attempt to override the AP operation in pitch).
- For detailed information regarding the following functions and safety features, refer to the section 1.03.33, AUTOPILOT - CMD mode :
  - Supervisory Control Wheel Operation,
  - AP actuator override,
  - AP automatic disengagement.

Mod : 7187

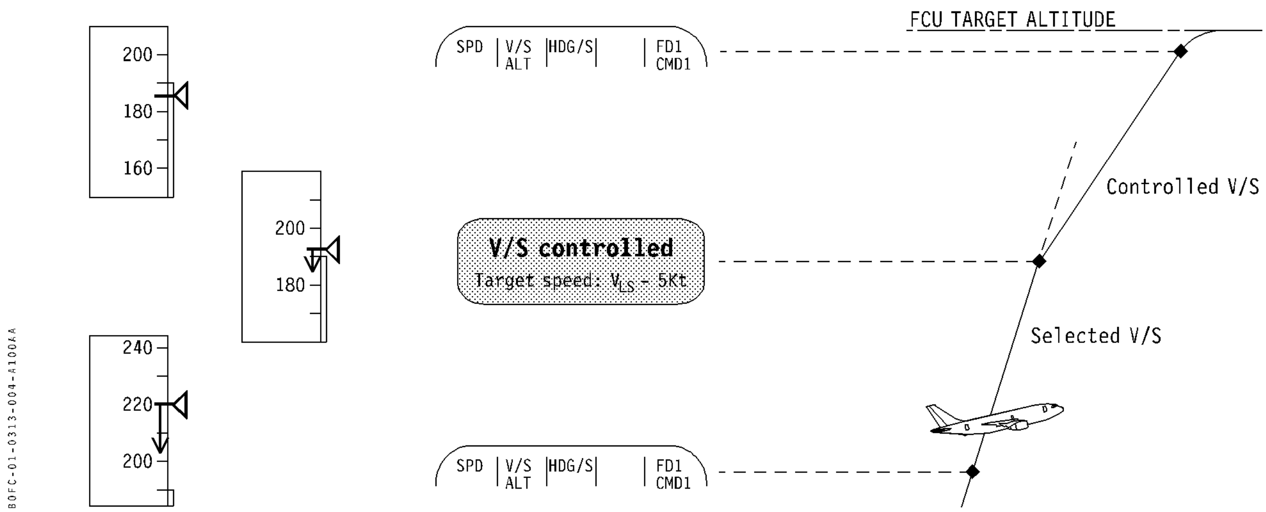
SPEED PROTECTION IN V/S, LVL/CH, ALT* OR PROFILE MODES

- With the AP/FD engaged in V/S, LVL/CH, ALT*, or PROFILE modes the speed protection protects the aircraft against :
  - **underspeed** in climb with a target speed down to VLS – 5 kt.
  - **overspeed** in descent with target speed up to VMAX + 4 kt.
- The authority of the guidance in the protection has been increased to ensure a better protection against a too large speed excursion out of the normal flight envelope (in case of high headwind or tail wind gradients, for example).
- The guidance system authority is limited to a level off. This means that if the thrust available is too low to maintain a vertical speed in climb at VLS – 5 kt, the aircraft will stop climbing, but will not descend to maintain the speed. Thus, the speed will slowly decrease.
  Similarly, if the requested vertical speed cannot be maintained due to high speed, the aircraft will reduce the vertical speed to maintain VMAX+4kt. This may lead to a level off.
- If the target speed of VLS – 5 kt cannot be maintained, the autopilot will disconnect at VLS – 10 kt. Before AP disconnection, the speed protection has been effective during several seconds and has contributed to reduce the pitch attitude and the deceleration rate. The aircraft is then at a reasonable pitch attitude with a slow deceleration rate and is easy to recover manually.

Note : *When flying manually, the flight director gives orders to follow the speed protection guidance. The crew reaction must be firmer than in normal flight, without being aggressive as the expected g-load variation can go up to 0.3 g. If the crew reaction is too smooth the overspeed warning or the stick shaker may be activated.*

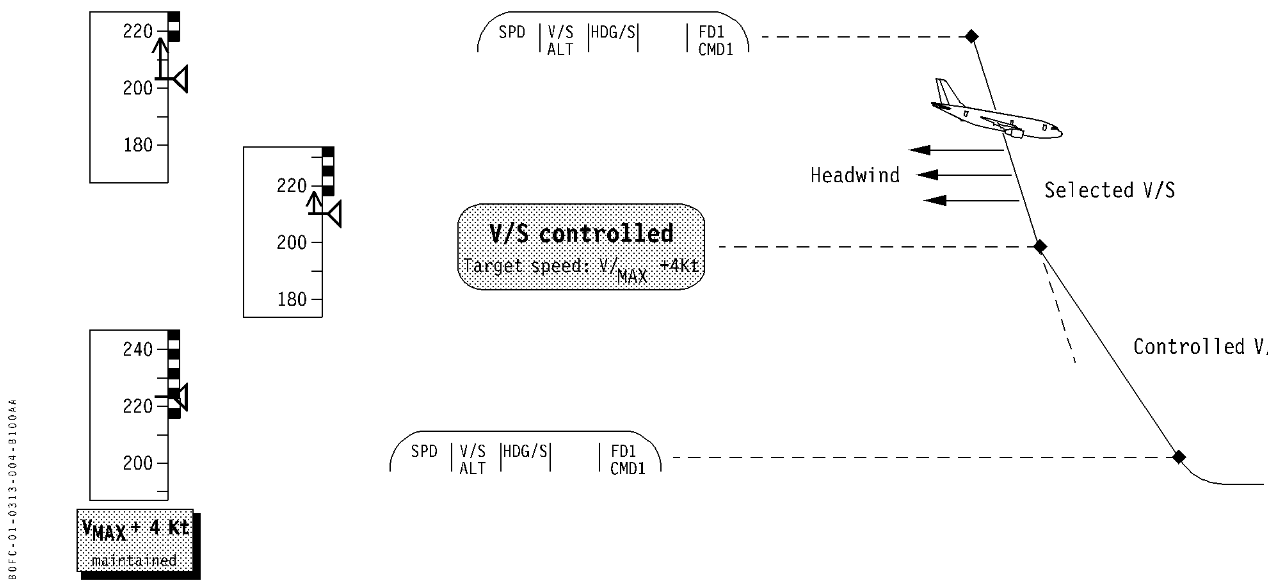
R Mod : 11899 or 11900 or (11899 + 11900)

• Example of excessive V/S target with V/S mode engaged :



At low speed, in ALT* or V/S mode, if the AFS cannot maintain the requested vertical speed (selected V/S), the aircraft will depart from the commanded trajectory as the AP/FD gives orders to maintain a vertical speed (controlled V/S) which avoid flying below VLS – 5kt.

• Example of headwind in approach with V/S mode engaged :



If the AFS cannot maintain the requested vertical speed, the AP/FD will avoid speed or Mach overshoot in case of high acceleration (strong headwind).

Note : *When reaching VMAX, the target speed guidance value is about the same as the overspeed warning. The overspeed warning may be activated when stabilized on the guidance target speed or in case of turbulence.*

R Mod : 11899 or 11900 or (11899 + 11900)

FUNCTION

- The Auto Throttle System (ATS) provides the following functions :
  - Computation (TCC) and display (TRP) of the thrust limit for the selected limit mode,
  - Autothrust (A/THR) to acquire and maintain :
    - a selected speed or Mach number, or
    - a selected thrust limit or target thrust, or
    - the idle thrust.
  - Angle-of-Attack protection (α-floor protection) by applying automatically the thrust limit corresponding to the limit mode selected on the TRP (Thrust Latch mode – THR L).

ENGAGEMENT AND OPERATION

- Provided the ATS is electrically supplied, the TCC computes the thrust limit for each thrust limit mode.
- The ATS is armed by arming the ATS engage lever.

  The ATS levers can be armed provided :
  - TCC 1 (for ATS 1) and TCC 2 (for ATS 2) are operative,
  - At least 1 FAC is operative,
  - At least 1 ADC is operative.
- Provided the ATS is armed, the THR L protection is available and the A/THR can be engaged.
- When A/THR is engaged, the engine thrust is automatically controlled (as a function of the active AP/FD mode).
- When A/THR is not engaged, the engine thrust must be manually controlled (as directed by the amber MAN THR annunciation on the FMA).

FMA INDICATIONS

- The ATS mode status is displayed in the first column of the FMA.

ATS CONNECTION TO THROTTLE LEVERS

- The ATS system consists of :
  - a computation (TCC) and display (TRP) part, in order to compute and display the applicable thrust limit or thrust target,
  - a driving part in order to move the throttle levers which, in turn, transmit the thrust command to the engines.
- The ATS driving part consists of the following electro-mechanical components :
  - a single electrical servo-motor (ATS actuator),
  - two coupling units (clutches).
- With any A/THR mode or with THR L mode engaged, both throttle levers are driven at a constant speed rate.

  The throttle levers speed rate (in ° / second) depends on the flight phase and AP / FD mode as follows :
  - In GO AROUND (whether engaged in flight or after touchdown) or with THR L mode engaged : R
    8° / second,
  - In any other mode : 3° / second.
- As soon as the thrust command is reached, the ATS either declutches the coupling units or stops the actuator, as follows :
  - **At takeoff :**
    - In order to enable each engine to reach the required takeoff thrust the ATS actuator operates until both engines have reached the takeoff thrust.
    - Coupling units are declutched individually, when the associated engine reaches the takeoff thrust.
    - When both engines have reached the takeoff thrust or at 100 kt at the latest, both coupling units are declutched.
    - The ATS declutch is annunciated on the FMA (THR blue).

(MP S5063) or (Mod : 6523)

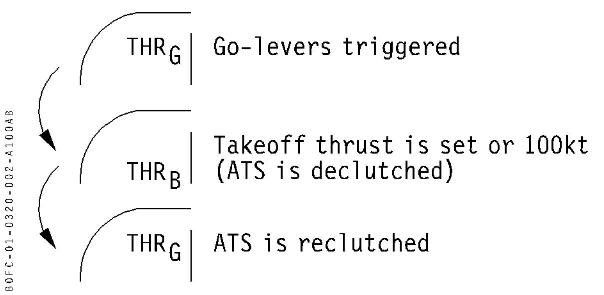
- The ATS is reclutched (both coupling units reclutched) when either :

  * the landing gear is selected UP,

  or

  * a new THR LIMIT mode is selected on the TRP.

- The FMA modes transition sequence is as follows :



- The ATS declutch during the takeoff phase is intended to prevent any uncommanded thrust change during the takeoff roll and initial climb.

– **In flight** :

R • During climb (A/THR - THR or P.THR mode) or cruise (A/THR - SPD or P.SPD mode), the coupling units remain clutched but the ATS

R actuator stops operating as soon as the leading engine reaches the thrust target.

The above operating logic applies to a thrust increase as well as to a thrust reduction.

- In LVL CH descent (A/THR – RETARD mode), the ATS coupling units are declutched simultaneously when idle is set (A/THR blue annunciation on FMA).

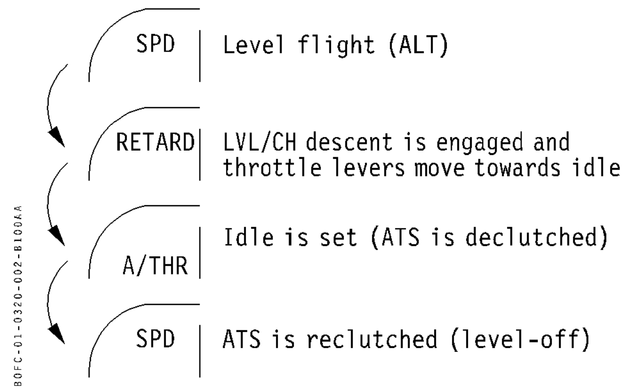
  The ATS coupling units are reclutched when either :

  – reaching the selected altitude, (ALT* mode engagement),

  or

  – another vertical mode is selected.

The FMA modes transitions sequence is as follows :



- With A/THR engaged in any mode or with THR L mode engaged (e.g. following the activation R
  of the angle-of-attack protection), when moving R
  either throttle lever manually :

  – the autothrottle coupling unit temporarily declutches to enable manual throttle lever adjustment (e. g. in case of thrust asymmetry requiring a throttle stagger),

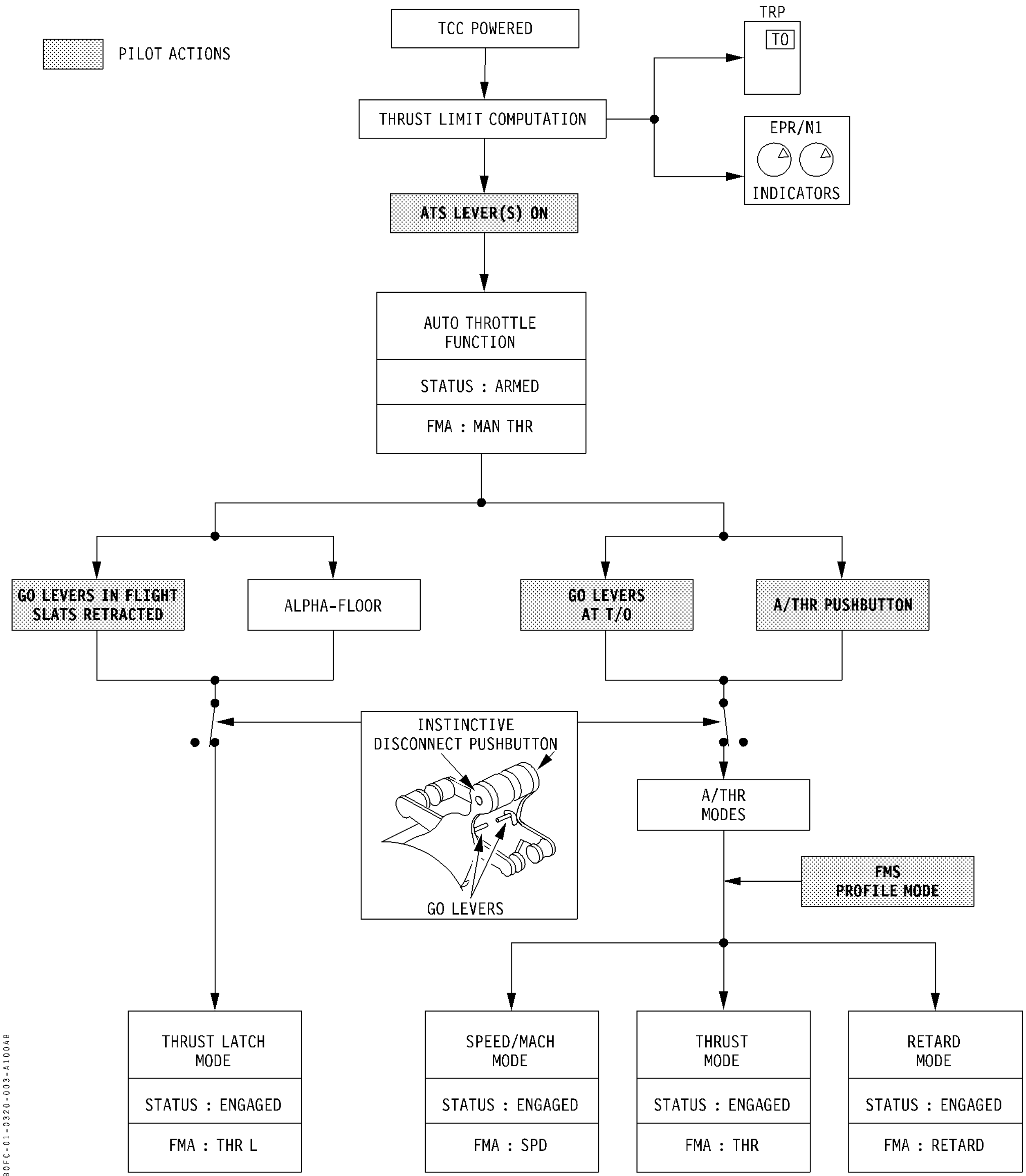
  – when the throttle lever is released, the autothrottle coupling unit reclutches,

  – the resulting throttle stagger, if any, is maintained.

(MP S5063) or (Mod : 6523)

R

R



MP S5063 or Mod : 6523

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THRUST LIMIT COMPUTATION

- The thrust limit value for the thrust limit mode selected on the TRP is computed by the TCC in N1 (for GE engine) or EPR (for PW engine). The value is displayed on the TRP THR LIMIT window as well as on the N1 or EPR indicators (amber bug).

  Note : Refer to section 1.03.12 for description of TRP and N1/EPR indicators.

- The thrust limit is computed for all flight phases and is permanently displayed.
- The following thrust limit modes can be selected on the TRP :
  - TOGA : Take-Off/Go-Around thrust,
  - MCT : Maximum Continuous Thrust
  - CL : Maximum Climb thrust,
  - CR : Maximum Cruise thrust,
  - FLX TO : Flexible (reduced) Take-Off thrust,
  - AUTO : FMS selects the Thrust Limit mode (MCT, CL or CR) and Target Thrust.
- When the TCC/TRP are initially powered, the TOGA mode is automatically selected.
- The Thrust Limit for the selected mode is continuously computed, and will change as conditions require (airspeed, temperature, altitude, etc...).
- To compute the thrust limit, the TCC uses data from the ADC (e.g. : altitude, speed/Mach, TAT) and bleed air status (e.g. : anti-ice valves open or closed, packs on or off).

THRUST LIMIT SELECTION :

Illuminated key	LIM MODE	Manual selection	Automatic selection
TOGA	TO	On ground only, by pressing the TOGA key.	On ground when aircraft is electrically powered.
FLX TO	TO	On ground only, by pressing the FLX TO key.	Not applicable.
TOGA	GA	In flight, by pressing the TOGA key.	In flight, when S/F lever is moved from 0/0 to 15/0.
MCT/CL/CR	MCT/CL/CR	By pressing MCT, CL or CR key.	Not applicable.
R AUTO	MCT/CL/CR	Not applicable	When PROFILE mode engages, if altitude is greater than 1500 ft RA.
R AUTO	GA	Not applicable	In flight, upon slats extension, if at least 1 AP/FD is engaged in PROFILE mode.

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FUNCTION

- The A/THR :
  - acquires and maintains the selected thrust limit or thrust target,
  - acquires and maintains the selected speed or Mach number,
  - retards the throttles to idle during initial descent.
- The A/THR controls the engine thrust in response to inputs from the FCU or FMS.

ENGAGEMENT AND OPERATION

R
- Provided one ATS lever is armed, the A/THR can be engaged :
  - manually, by pressing the A/THR pushbutton switch,

  or
  - automatically, at takeoff or for go-around by triggering either Go-lever.

On the ground, it is not possible to engage the A/THR by pressing the A/THR pushbutton switch.

- The A/THR can be engaged in :
  - THR mode,
  - SPD/MACH mode,
  - RETARD mode.
- When the A/THR is engaged, the A/THR pushbutton switch illuminates and the engaged A/THR mode is displayed on the FMA.

DISENGAGEMENT

- A/THR disengages (but ATS1 and ATS2 remain armed) :
  - **in flight** :
    - when the A/THR pushbutton switch is pressed,

    or
    - when pressing either instinctive disconnect pushbutton,

    or
    - when THR L mode engages, following the activation of the angle-of-attack protection.
  - **on the ground** :
    - when the ground spoilers are extended (at landing or in case of rejected takeoff),

    or
    - when one engine is in reverse thrust,

    or
    - when both engines are at idle, unless GA mode is engaged,

    or
    - if MCT, CL, or CR mode is selected on the TRP, with IAS below 60 kt.
- When the A/THR is disengaged, the thrust must be manually controlled.

  MAN THR is annunciated in amber on the FMA, for crew awareness.

  MAN THR is first flashing until the instinctive disconnect pushbutton is pressed (except on the ground where the flashing is inhibited), using R
  A/THR disconnection signal from TCC1. R

  Note : *If TCC1 is inoperative, MAN THR will keep* R
  flashing for the remaining of the flight. R

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THRUST MODE

FUNCTION

- The thrust mode acquires and maintains :
  - the thrust limit selected on the TRP (THR mode), or
  - the FLEX TO target thrust (THR mode), or
  - the target thrust computed by the FMS (P. THR mode).
- In THR (P.THR) mode, the A/THR acquires and maintains the THR LIMIT (TARGET) displayed on the TRP.

  The speed target selected on the FCU (managed by the FMS) is maintained by the AP/FD by adjusting the pitch attitude, using the elevators.

ENGAGEMENT AND OPERATION

- The THR mode automatically engages with the AP/FD SRS, SPD (LVL/CH climb) and GO AROUND modes.
- The P.THR mode automatically engages with the AP/FD PROFILE mode (P.CLB and initial phase of P.DES).
- In flight, in THR mode, the A/THR compares the thrust limit or target thrust with the engine which exhibits the higher thrust. When this engine reaches the target thrust, both throttle levers stop moving.

CAUTION

In case of a throttle lever jamming, whenever the ATS commands a thrust change, only the free throttle lever moves leading to a thrust asymmetry and to a possible flight path deviation.

- When a thrust reduction is commanded, the ATS commands the free throttle lever to retard, until the idle position (in the worst case).
- When a thrust increase is commanded, the ATS commands the free throttle lever to advance until the target thrust is reached.

Cont'd

Cont'd

Should such a throttle levers and thrust asymmetry be observed, the A/THR must be disconnected (using the instinctive disconnect pushbutton switch) and symmetric thrust must be restored manually.

Refer to the THROTTLE (LEVER) JAM procedure for detailed procedural recommendations.

SPEED/MACH MODE

FUNCTION

- The speed/Mach mode acquires and maintains :
  - the speed or Mach number target selected on the FCU (SPD or MACH mode), or,
  - the target speed or Mach number computed by the FMS (P.SPD mode).

ENGAGEMENT AND OPERATION

- SPD/MACH mode automatically engages and disengages in association with AP/FD V/S, ALT, GS or LAND mode.

  P.SPD mode automatically engages and disengages in association with AP/FD PROFILE mode (P.ALT).
- If a speed is selected on the FCU with the SPD mode engaged, pressing the SPD/MACH switch-over pushbutton causes the present Mach to be displayed.

  The engaged mode also changes to MACH.

  Switch-over from Mach to speed is also possible.
- With AP/FD OFF (e.g. manual flying using FPV), the A/THR can be engaged but only in SPD/MACH mode.

R Code : 0250

RETARD MODE

FUNCTION

- The RETARD mode retards the throttle levers to idle (5° throttle lever angle).

ENGAGEMENT AND OPERATION

- The RETARD mode engages :
  - in LVL/CH descent, until the throttles levers reach the idle position (then the ATS coupling units are declutched and A/THR blue is annunciated on the FMA),
  - in FLARE mode (at 30 ft),
  - in PROFILE descent (P.DES).

Note : In PROFILE descent, RETARD green remains displayed as long as idle thrust is required.

Note : When RETARD is engaged with LVL/CH or PROFILE, the throttles can be manually stopped at any desired intermediate position.

- When the throttle levers reach idle, or if levers are manually stopped while retarding, RETARD mode disengages and the ATS declutches (A/THR blue on the FMA).

FUNCTION

- The Thrust Latch (THR L) mode acquires and maintains the thrust limit (THR LIMIT) selected on the TRP.
- R R The THR L mode is primarily associated with the activation of the angle-of-attack protection (Alpha-Floor).

ENGAGEMENT AND OPERATION

- R R Provided that one ATS lever is armed, the THR L mode automatically engages either,
  - R if the Alpha-Floor protection is activated,

  or

  - if the go-levers are triggered in flight, with slats retracted.

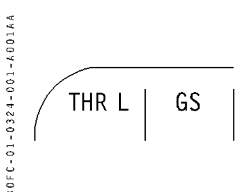
  Note : if slats are extended, triggering the Go-levers engages the AP/FD – GO AROUND mode and the A/THR – THR mode.

- THR L engagement is not possible if the A/THR is engaged in THR mode (indeed, the thrust limit is already commanded and set).
- THR L engagement :
  - R **does not change the engaged AP/FD vertical mode** (i.e. no angle-of-attack and speed recovery vertical guidance is associated to the THR L mode),

  and

  - **disengages the A/THR**.

- THR L engagement is indicated on the FMA :



- R R THR L is green and **steady** if THR L is engaged by the **Alpha-Floor protection**, and flashes when the aircraft exits the Alpha-Floor condition.
- R R THR L is green and **flashing** if THR L is engaged by the in-flight activation of **go-levers** with slats retracted.

(MP S5063) or (Mod : 6523)

DISENGAGEMENT

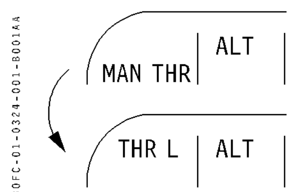
- THR L can be disengaged :
  - by pressing either ATS instinctive disconnect pushbutton (A/THR can then be re-engaged, when desired),

  or

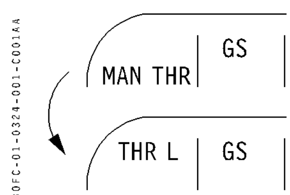
  - by pressing the A/THR pushbutton (to re-engage A/THR).

MODE TRANSITIONS

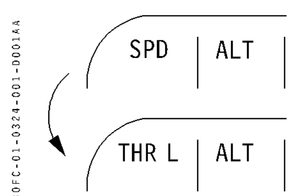
- Depending on the flight phase, the following typical mode transitions can be observed :
  - in level flight with manual thrust, if alpha-floor is activated :



  - in glide slope tracking with manual thrust, if alpha-floor is activated :



  - if go-levers are activated with slats retracted :



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EQUIPMENT LOST	ATS ARMED, A/THR or THR L ENGAGED
Engine 1 or 2	No effect.
R FADEC (MODE FAULT)	Both ATS disarm and cannot be re-armed.
R THROTTLE FAULT (loss of both throttle lever angle signals).	Both ATS disarm and cannot be re-armed.
ADC 1	Both ATS disarm. ADC 2 takes over automatically and both ATS can be re-armed.
ADC 1 and 2	Both ATS disarm, re-arming is not possible.
FAC 1 or 2	No effect.
FAC 1 and 2	Both ATS disarm, re-arming is not possible.
Radio Altitude 1 and 2	A/THR RETARD mode does not engage at 30 ft for flare.
R FCU	Both ATS disarm. ATS re-arming is possible. ATS can be re-armed, but no mode can be re-engaged.
R FMC 1 or 2	R Both ATS disarm upon AP/FD disengagement if the master FMC fails. ATS can be re-armed.

EQUIPMENT LOST	ATS ARMED	
	A/THR in SPD/MACH mode	• A/THR in THR mode, or • THR L engaged
R IRS 1	R ATS 1 disarms if SPD/MACH is engaged. R Re-arming is possible.	No effect.
R IRS 2	R ATS 2 disarms if SPD/MACH is engaged. R Re-arming is not possible.	No effect.
TRP	No effect.	ATS disarms.
TCC 1 (2) – Thrust limit computation	No effect.	ATS disarms.

(MP S5063) or (Mod : 6523)　　PW Eng. : 4000

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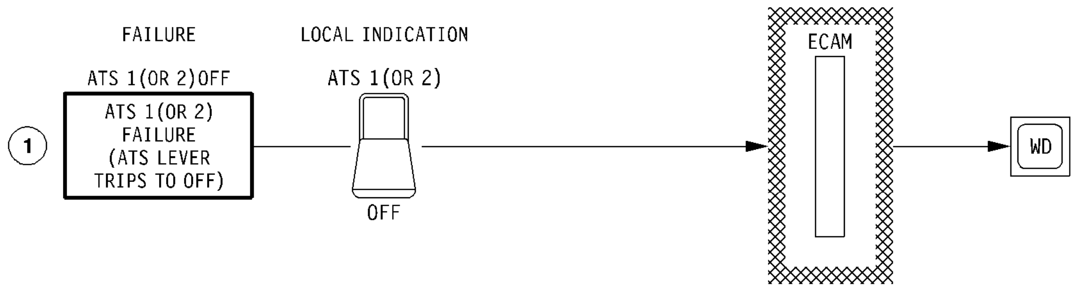
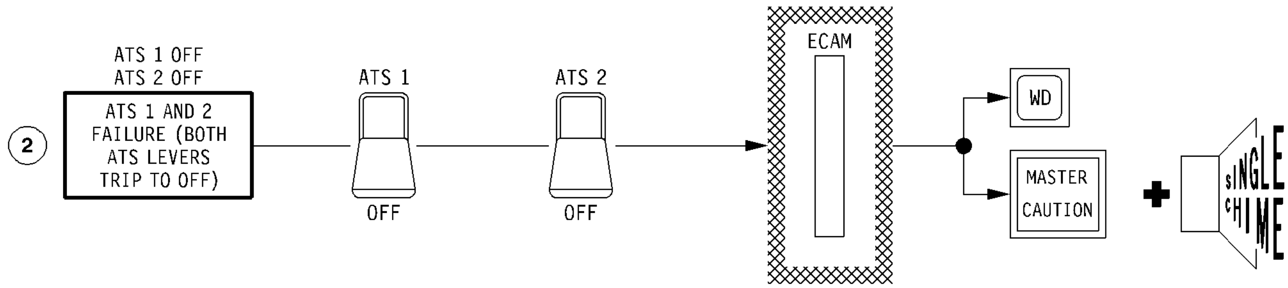
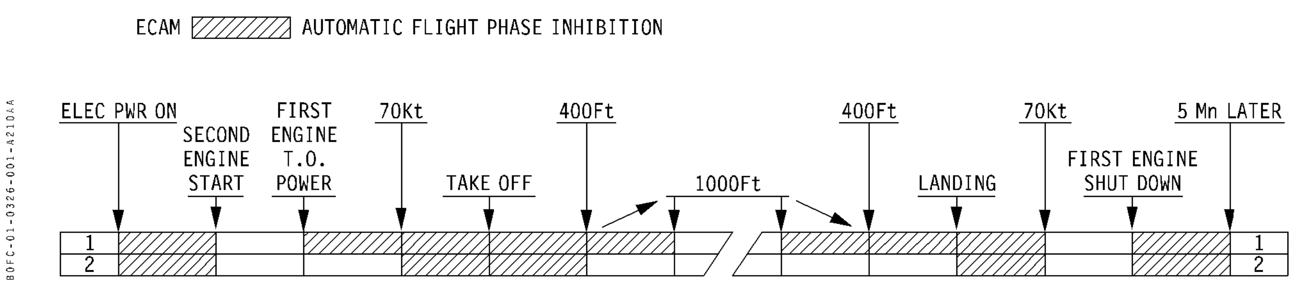
WARNING LOGIC







Mod : (5051 + 6523) or (MP S5063 + 5051)

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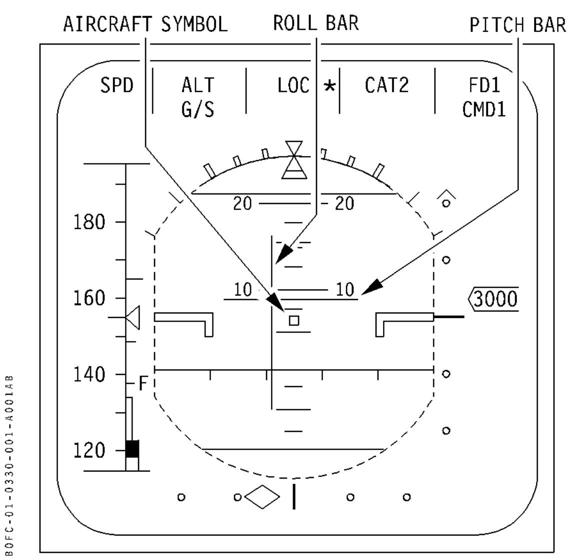
FUNCTION

- The Flight Director (FD) provides vertical and lateral guidance in manual flying as well as with an AP engaged in CWS.

OPERATION

- The FD includes :
  - the pitch command bar (horizontal bar),
  - the roll command bar (vertical bar).
- Pitch and roll bar positions indicate the pitch and R roll **corrections** to be applied to acquire and maintain the selected or computed flight path.



- When a bar is centered on the aircraft symbol, there is no more correction to be applied on this axis.
- If the FD bars are not followed on purpose, it is recommended to switch OFF both FD.

CAUTION

In LVL/CH descent, if a level-off is performed before capturing the target altitude (pitch bar not followed), the ATS remains declutched with thrust set at idle. R

A pilot action is then required for thrust setting (engagement of ALT mode or manual thrust control).

FD ENGAGEMENT CONDITIONS

- The FD 1 and 2 are engaged and displayed on the PFD provided the following conditions are met :

FD 1	FD 2
– FD/FPV 1 switch ON	– FD/FPV 2 switch ON
– FCC 1 operative	– FCC 2 operative
– ADC 1 operative	– ADC 2 operative
– FAC 1 or 2 operative	– FAC 1 or 2 operative
– IRS 1 and (2 or 3) operative	– IRS 2 and (1 or 3) operative
– FCU operative	– FCU operative
– Landing gear data available	– Landing gear data available

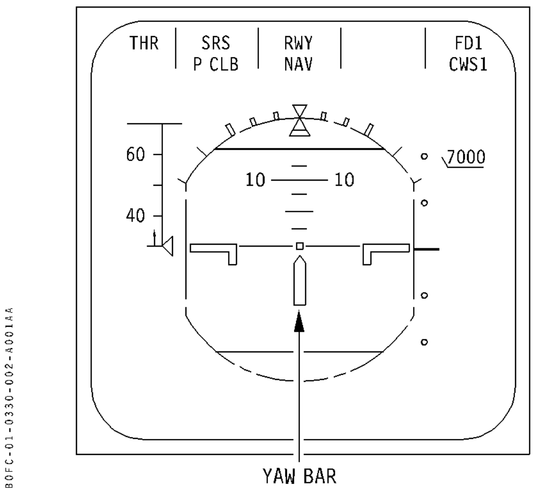
- On the ground, FDs initially engage in the basic modes (V/S and HDG).

FD BARS DISPLAY

- FD bars can be cleared from the PFD display :
  - by switching the FD/FPV to OFF,
  - by selecting the FPV display.
- With no AP engaged or with AP engaged in CWS, if FD bars are cleared or if FPV is selected : R
  - the A/THR can be used in SPD mode only,
  - on the FMA, columns 2 and 3 are blank.
- With AP engaged in CMD, if FD bars are cleared R or if FPV is selected, the FMA does not change. R

YAW BAR

- A yaw bar (vertical arrow) is automatically displayed instead of the FD roll bar :
  - at takeoff when the RWY mode engages,
  - at landing in FLARE mode, when passing 30 ft, and in ROLL OUT mode.



- The guidance provided by the yaw bar depends on the flight phase (AP/FD lateral mode) as follows :
  - at takeoff (RWY mode) : guidance along the runway center line up to 30 ft, using the LOC signal,
  - at landing (FLARE mode) : guidance for alignement with the runway center line.
  - during ROLL OUT mode : guidance to recover (as required) and keep the runway centerline.

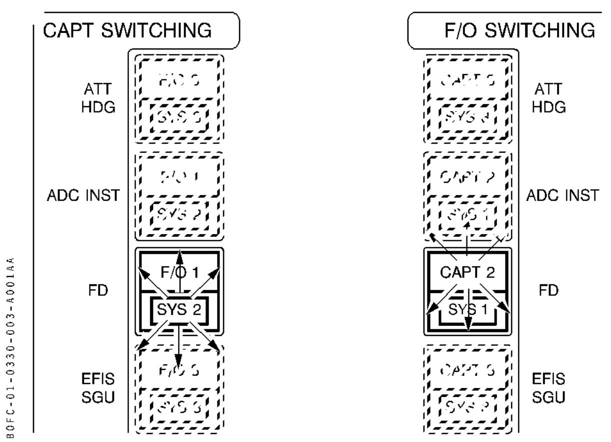
  Refer to section 1.03.50 - LAND MODE for detailed information on the FLARE and ROLL OUT guidance.

FD FAILURE

- If any of the FD display conditions is lost (except the FD/FPV switch position), the associated FD disengages, and :
  - The affected FD bars disappear,
  - A red "FD 1" (or 2) message appears on the sky of the affected PFD.
- At the time of the FD failure, the associated FMA is :
  - cleared, if no AP is engaged,
  - cleared, if the associated AP was engaged (this AP disengages simultaneously),
  - not affected, if the AP opposite to the failed FD is engaged (for example, FD 1 failed with AP 2 engaged).

FD SWITCHING

- In case of FD failure, the remaining FD orders can be displayed on both PFD simultaneously.
- In case of FD 1(2) failure, the FD 2(1) orders can
R be displayed on the affected side by pressing the FD pushbutton switch on the CAPT (F/O) SWITCHING panel.
- For example, in case of FD 1 failure, when the CAPT FD pushbutton switch is pressed :
  – SYS 2 illuminates white on the CAPT SWITCHING panel and,
  – CAPT/2 illuminates green on the F/O SWITCHING panel (this notifies the F/O that the captain is sharing FD 2).



– FD 2 commands are now displayed on both the F/O and CAPT PFD,

– ″FD 2″ (white) is displayed on both FMA,

– the red ″FD 1″ message is cleared from the CAPT PFD.

Note 1 : The initial configuration can be recovered by pressing the CAPT FD pushbutton switch a second time.

Note 2 : It is not possible to cross-display the FD commands : if the Captain has selected FD SYS 2, the F/O cannot select SYS 1 simultaneously.

Likewise, the CAPT cannot select FD SYS 2 if the F/O has already selected SYS 1.

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FUNCTION

- The Autopilot (AP) can be engaged in two different modes :
  - Control Wheel Steering (CWS),

  or
  - Command (CMD).
- In CWS mode, the pilot manually flies the aircraft and controls the pitch and roll flight controls through the AP actuators.

  The rudder is directly controlled by the pilot.

  The vertical and lateral guidance is provided by the FD bars.
- In CMD mode, the AP takes full automatic control of the aircraft in pitch, roll and yaw to follow the selected flight path. The yaw (rudder) is only controlled with slats extended.

ENGAGEMENT CONDITIONS

R
- The AP can be engaged in CWS or CMD provided the following conditions are met :

AP 1	AP 2
– flight/ground signal available	– flight/ground signal available
– Aircraft airborne since at least 4 s (*)	– Aircraft airborne since at least 4 s (*)
– Bank angle ⩽ 45°	– Bank angle ⩽ 45°
– FCC 1 operative	– FCC 2 operative
– FCU operative	– FCU operative
– Pitch, Roll, Yaw (*) AP actuators available	– Pitch, Roll, Yaw (*) AP actuators available
– ADC 1 operative	– ADC 2 operative
– FAC 1 or 2 operative	– FAC 1 or 2 operative
– IRS 1 and (2 or 3) operative	– IRS 2 and (1 or 3) operative
– Pitch Trim 1 or 2 engaged	– Pitch Trim 1 or 2 engaged
– Yaw Damper 1 or 2 engaged	– Yaw Damper 1 or 2 engaged
– Hydraulics : green and (blue or yellow) systems operative	– Hydraulics : yellow system operative

R R R R R R R R R R R R R R R R R R R R R R

(*) conditions not necessary for CWS mode.

STD or Mod : 5051 + 6415

- On the ground, with engines running, only CWS mode can be engaged.

  When selected in flight, the AP directly engages in CMD mode. To engage the CWS mode, the CWS/CMD switch-over pushbutton must be pressed. R R

  The pushbutton must be pressed a second time to revert to CMD mode.
- In CWS, only one AP can be engaged at a time.

  In CMD, two APs can be engaged in approach (after selection of LAND mode on FCU) and in go-around.
- If one AP is engaged, the engagement of the second AP disengages the first engaged AP (except in CMD after selection of LAND mode on the FCU or in GO AROUND mode).
- In case of AP change-over, the vertical and lateral modes engaged with the first AP remain engaged for the other AP.

DISENGAGEMENT CONDITIONS

- The AP can be manually disengaged by **pressing the AP instinctive disconnect pushbutton** (if both AP are engaged, both AP disengage simultaneously).

  It is also possible to disengage the AP by setting the associated AP lever to the OFF position.

- When engaged in CMD, the AP automatically disengages if a force greater than a defined threshold is applied in pitch on the control column (refer to section 1.03.33 – AP AUTOMATIC DISENGAGEMENT).

- The AP automatically disengages if any engagement condition is lost, except for the 45°-bank-angle condition.

- Disengagement of the AP simultaneously triggers :
  - the AP OFF warning on the PFD,
  - the aural warning (CAVALRY CHARGE).
  - the flashing of the two red AUTO LAND warning lights, if LAND green is annunciated on FMA and altitude is below 200 ft RA.

  Visual and aural warnings can be cancelled by pressing either AP instinctive disconnect pushbutton.

  Note : At the time of the AP disengagement, the modes engaged for AP guidance remain engaged for FD guidance.

Mod : 5051

OPERATION

- The Control Wheel Steering (CWS) mode enables manual flying through the AP (i.e. through the Flight Control Computer – FCC – and the AP pitch and roll actuators).

  Yaw control is not concerned by CWS operation.

- When the AP is engaged in CWS, the present aircraft pitch attitude and bank angle are maintained.

- The aircraft pitch attitude and bank angle can be changed by pilot inputs on the control column and control wheel.

  When CWS inputs are released, the new pitch attitude and bank angle are maintained.

- The CWS mode can be used for :
  - take-off and departure maneuvering,
  - approach and landing.

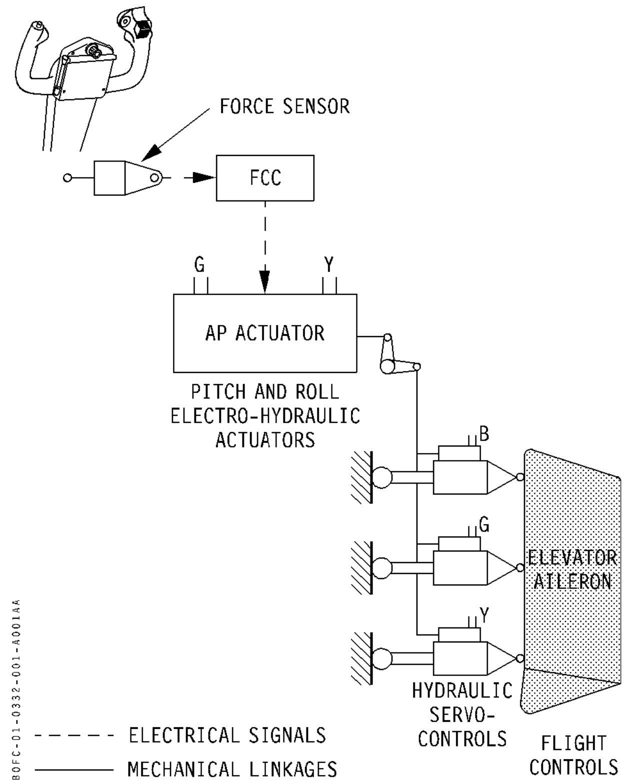
- In CWS mode, the FD orders must be followed by the pilot in order to acquire and maintain the selected flight path and targets.

- In CWS mode, the THS is controled by the Electric Trim (rocking levers) or by the Autotrim (refer to chapter 1.09.13 – PITCH CONTROL) as follows :
  - aircraft on the **ground** :
    - the Electric Trim is active,
    - the Autotrim is inhibited.
  - aircraft in **flight** :
    - the Electric Trim is active,
    - the Autotrim is active 5 seconds after liftoff, but is inhibited whenever the Electric Trim (rocking levers) is used.

R

    - **the Electric Trim has always priority over the Autotrim.**

- The inputs on the control column and control wheel are sensed by force sensors (dynamometric rods), processed by the FCC and transmitted to the AP pitch and roll actuators.



R

- In CWS mode, the control column and control wheel displacement reflects the deflection of the associated flight control surfaces (i.e. the result of the pilot input).

- In CWS mode, the Alpha trim protection is available (in clean configuration) as soon as a pitch force is applied on the control column and detected by the force sensors.

ENGAGEMENT

- The CWS mode can be used from brakes release to the complete aircraft stop at landing.
- The CWS mode is optimized for takeoff and arrival maneuvering, in cruise the use of CMD mode is recommended.
- The CWS mode can be engaged :
  - on the ground, by engaging one AP (the AP engages automatically in CWS mode),

  or

  - in flight, with AP engaged in CMD, by pressing the CWS/CMD switch-over pushbutton on the FCU.
- The engagement of the CWS mode is confirmed by the FMA annunciation (CWS 1 or 2) and by the illumination of the CWS light on the CWS/CMD switch-over pushbutton on the FCU.
- When in CWS mode, the second AP cannot be engaged.

DISENGAGEMENT

- The CWS mode can be disengaged by :
  - pressing the CWS/CMD switch-over pushbutton to engage the CMD mode,

  or

  - pressing the AP instinctive disconnect pushbutton on the control wheel to disengage the AP.
- In CWS, there is no automatic disengagement by stick force on the control column or control wheel (in CWS mode, the pilot cannot work against the AP but works through the AP).

OPERATION

- At AP engagement in CMD :
  - the present flight control deflections are initially maintained and then smoothly corrected to achieve the selected flight path.
  - if the associated FD is displayed, the AP engages in the same modes as the FD.
  - If the associated FD is not displayed, the AP engages in the basic modes (V/S and HDG).
- In CMD, with aircraft stabilised, the FD bars (if displayed) are centered on the aircraft position symbol.
- In CMD mode,
  - the Electric Trim is inhibited,
  - the Autotrim only is available.
- With both AP engaged (i.e. when LAND mode is armed on the FCU or in GO-AROUND mode), the selection of another vertical or lateral mode causes the disengagement of the AP2, except below 400 ft RA with LAND green annunciated on FMA (below 400 ft RA, LAND mode is latched).

YAW CONTROL

- In CMD, the AP controls the rudder only when the slats are extended. In straight flight, the AP commands the rudder deflection to obtain and maintain a zero aileron deflection (control wheel in neutral position).
- At AP engagement, the present rudder deflection is initially maintained by the AP.
- At slats retraction, the rudder is smoothly returned to neutral (in 10 seconds, then the AP yaw actuator declutches).
- At CMD mode disengagement (AP disengagement or CWS mode selection), the AP yaw actuator immediately declutches.
- In case of engine failure, with SRS or GO AROUND mode engaged, the yaw damper immediately reacts to compensate the lateral asymmetry. R

  The AP yaw actuator takes over to achieve a zero R aileron deflection.
- If the engine failure occurs with AP engaged (the rudder trim is normally set at 0), the AP stabilizes the aircraft with the rudder. At slats retraction, the pilot must maintain the rudder deflection and trim R the aircraft manually with the rudder trim.

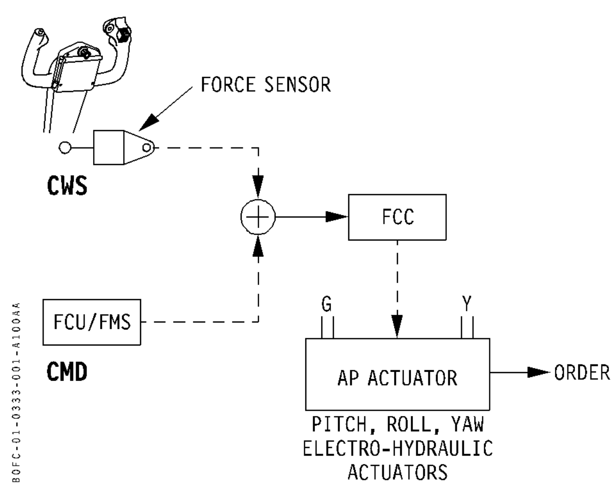
SUPERVISORY CONTROL WHEEL OPERATION

- The Supervisory Control Wheel Operation enables the pilot to manually assist the Autopilot in capturing a LOC or GS beam or in capturing or R tracking a VOR radial.
- The Supervisory Control Wheel Operation is available with the following modes :

Vertical mode	Lateral modes
GS*	VOR*/VOR LOC*

- The Supervisory Control Wheel Operation combines the orders and characteristics of the CMD and CWS modes.

  By smooth inputs on the control column and control wheel, the pilot can temporarily adjust the flight path of the aircraft.



Mod : 11442

- When the Supervisory Control Wheel Operation is available or used :
  - CMD remains displayed on the FMA and
  - CMD light remains illuminated on the FCU,
  - there is no indication of the CWS mode engagement on the FMA and FCU.

AP ACTUATOR OVERRIDE

- Roll and yaw AP actuators can be overridden in order to allow the pilot to regain manual control of the associated flight control surface in the event of an AP actuator malfunction or hardover.
- The AP actuator override capability is provided by a cam / roller detent fitted on the output shaft of each AP actuator.
- The cam / roller detent operation is illustrated on the opposite page (the illustration is to be considered for educational purposes only, it does not reflect the actual hardware arrangement).
- Overriding the AP pitch actuator is not possible.

  Any attempt to override the AP in pitch results in the **automatic disengagement** of the AP before or when reaching the break-out threshold of the AP pitch actuator override detent.
- The AP roll or yaw actuator is overridden if a force greater than the following value is applied on the control wheel or rudder pedals :
  - in roll : 15 kg / 33 lb.
  - in yaw : 65 kg / 143 lb.
- Whenever an AP actuator is overridden, the actuator is declutched from the flight control mechanical control system (through the detent device).

  The associated flight control surface is then mechanically controlled by the pilot by applying a force higher than in manual flying but lower than the override break-out force.

AP AUTOMATIC DISENGAGEMENT

- The AP automatically disengages if a force greater than the following values is applied in pitch on the control column :
  - **below 400 ft** :
    - with LAND green or GO AROUND mode annunciated on the FMA :
      * 20 kg / 45 lb nose-down,
      * 46 kg / 100 lb nose-up.
    - with any other vertical mode (e.g. V/S or GS green) annunciated on the FMA :
      * 15 kg / 33 lb nose-down or nose-up.
  - **above 400 ft** :
    - with GO AROUND or any other vertical mode annunciated on the FMA :
      * 15 kg / 33 lb nose-down or nose-up.
- The AP automatically disengages if the pitch trim motion is stopped by holding the pitch trim wheel.
- The AP automatically disengages if a speed lower than V_{LS} – 10 kt is reached except when the following modes are annunciated on the FMA :
  - LAND green

  or
  - SRS.

R Code : 0258

- When the Supervisory Control Wheel Operation is available or used :
  - CMD remains displayed on the FMA and
  - CMD light remains illuminated on the FCU,
  - there is no indication of the CWS mode engagement on the FMA and FCU.

AP ACTUATOR OVERRIDE

NO CHANGE

R R R • Whenever an AP actuator is overridden, the torque limiter is shifted from the flight control system through the detent device.

The associated flight control surface is then mechanically controlled by the pilot by applying a force higher than in manual flying but lower than the override break-out force.

NO CHANGE

AP ACTUATOR OVERRIDE

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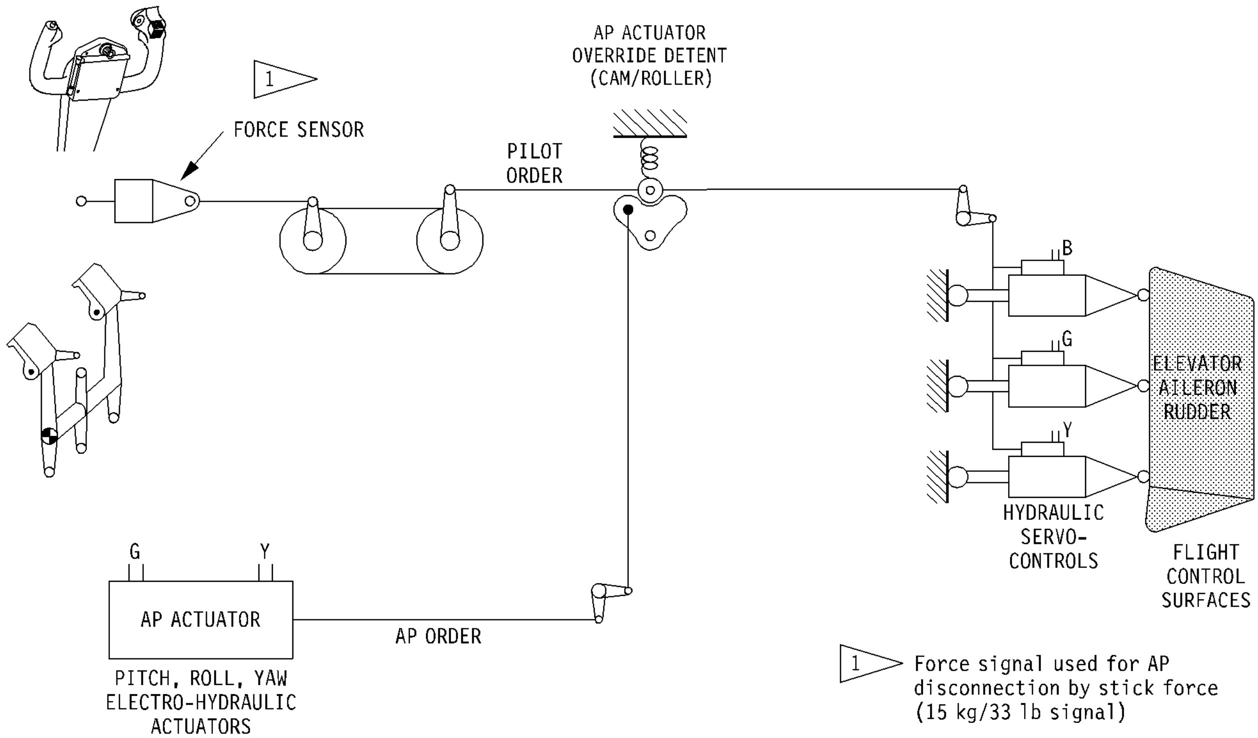
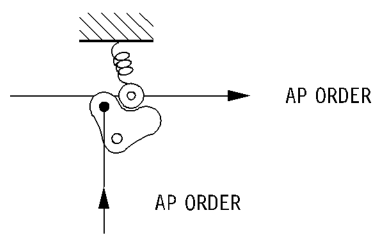
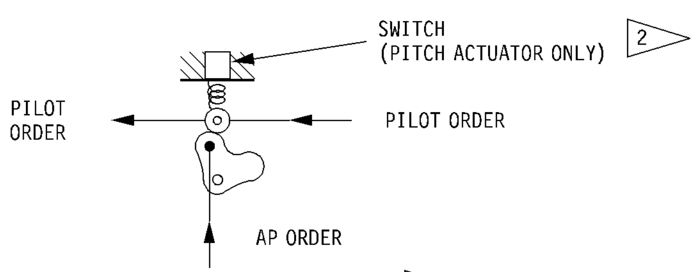


1 Force signal used for AP disconnection by stick force (15 kg/33 lb signal)

AP IN CMD
NORMAL OPERATION



AP IN CMD
AP ACTUATOR OVERRIDE



2 Switch signal used for AP disconnection by pitch actuator override (20 kg/45 lb nose-down, 46 kg/100 lb nose-up signals)

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Mod : 11454

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FUNCTION

- The PRE SET feature allows the pilot to pre-select a speed or Mach number which will become the next target speed or Mach.

  Note : PRE SET is not available in PROFILE mode.

PRESETTING A SPEED OR MACH :

- A speed or Mach can be preset by :
  - Pushing the SPD/MACH setting knob.

    The PRE SET light illuminates (to indicate that the value displayed in the SPD/MACH window is a PRE SET value).
  - Setting the desired preset speed or Mach in the SPD/MACH window.

  Note : On the ground (i.e. during the cockpit preparation) the PRE SET function is operative only if the altitude selected on the FCU (ALT SEL window) is greater than the aircraft present altitude.

ACTIVATION OF THE PRE SET SPEED OR MACH

- The preset speed or Mach becomes the active target speed or Mach when either :
  - LVL/CH or ALT mode is selected, or
  - at ALT* engagement.
- For a speed to Mach intercept :
  - If a Mach is preset while climbing in SPD mode the preset Mach becomes the target Mach at the speed/Mach crossover altitude.
    MACH mode engages.
- For a Mach to speed intercept :
  - If a speed is preset while descending in MACH mode, the preset speed becomes the target speed at the Mach/speed crossover altitude. R
    SPD mode engages.

PRE SET DE-ACTIVATION

- The PRE SET speed/Mach can be de-activated at any time by pushing the SPD/MACH setting knob a second time.

  The PRE SET light extinguishes and the active target speed (or Mach) is displayed in the SPD/MACH window.

PRE SET activation after takeoff at LVL/CH selection :

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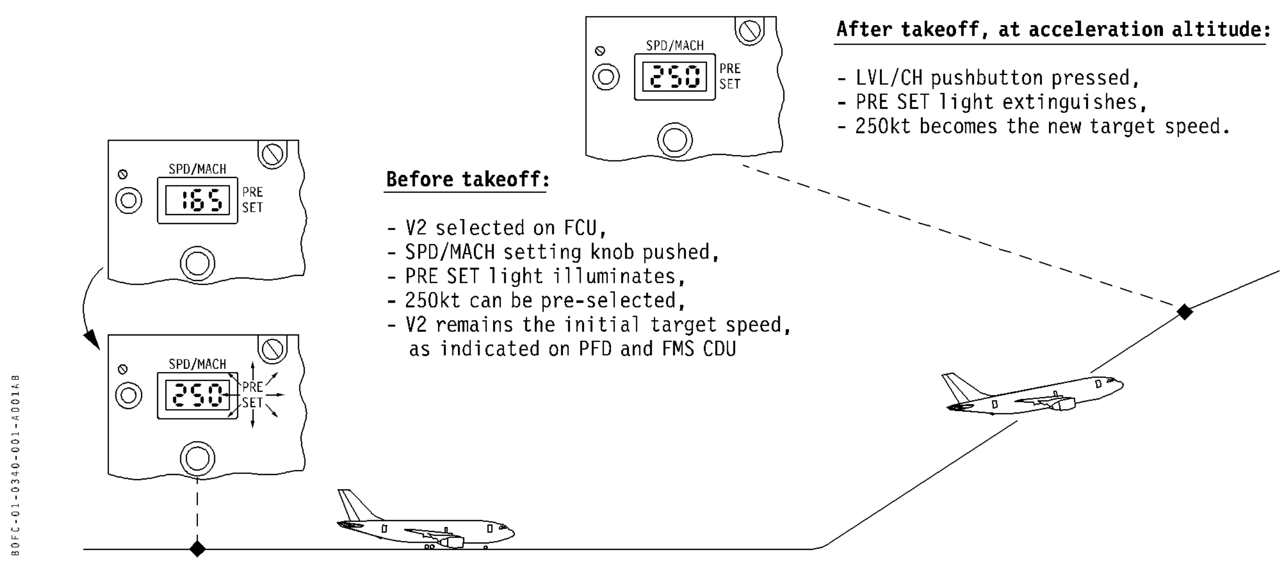
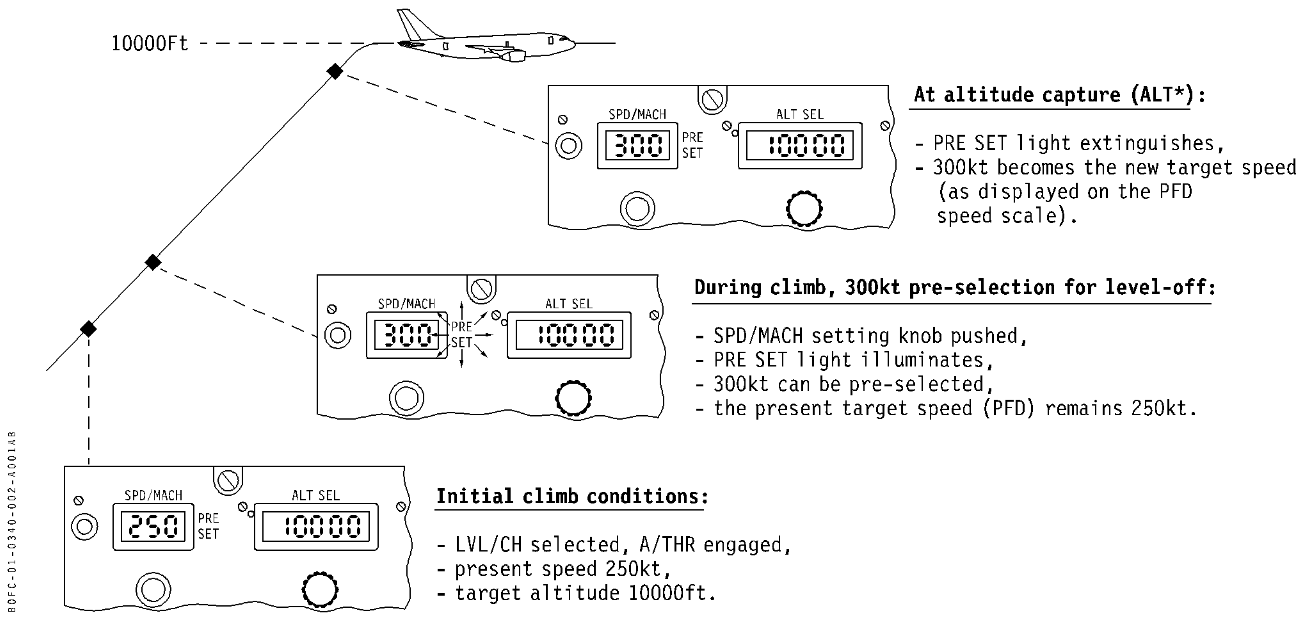


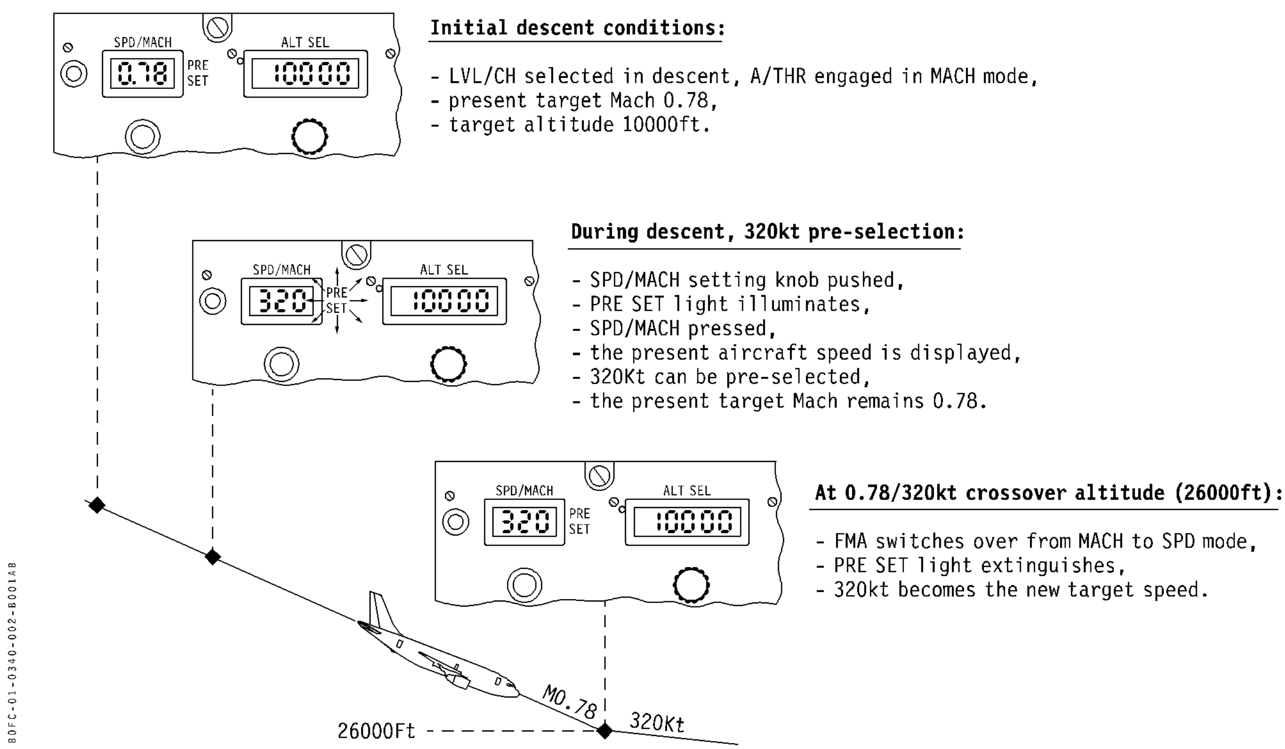
PRE SET activation at altitude capture (ALT*) :

R



PRE SET activation to intercept a SPD from a MACH :

R



COMBINED MODES FOR TAKEOFF

- For takeoff the AFS combines an A/THR, a vertical and a lateral AP/FD mode, as follows :
  - A/THR mode : THR mode,
  - Vertical AP/FD mode : SRS mode,
  - Lateral AP/FD mode : RWY, HDG/S or HDG mode.

  Note : *SRS is also the vertical guidance mode in GO AROUND mode.*

ENGAGEMENT CONDITIONS OF TAKEOFF MODES

- AFS takeoff modes are :
  - available on ground with :
    - no AP engaged, but at least one FD engaged, R

    or

    - at least one FD engaged and one AP in CWS mode,
  - and engages when either go-lever is triggered, provided : R
    - slats are extended at 15° or more.

SRS MODE (Speed Reference System)

- The SRS mode acquires and maintains :
  - With 2 engines operating :
    - The FCU selected speed + 10 kt (the selected speed is V2 at takeoff and VAPP in Go-around).
  - With 1 engine inoperative :
    - The FCU selected speed or the existing speed at the time of the engine failure, whichever is higher.
- After triggering the go-levers, the pitch bar is set at 10° nose-up. During rotation, the bar moves toward the SRS pitch target.
- The SRS guidance law includes :
  - a pitch attitude guidance limit in order not to exceed an 18° pitch attitude,
  - a vertical speed protection to ensure a minimum 100 ft/mn rate of climb. R

  Note : *At low aircraft weight, low airfield elevation and/or low OAT (high thrust/weight ratios) the AP/FD may momentarily exceed the 18° target before establishing a stabilised pitch attitude.*
- The SRS mode remains engaged until :
  - ALT* mode engagement or ALT. HLD mode selection, in case of low altitude level-off,

  or

  - LVL/CH mode selection,

  or

  - PROFILE mode engagement,

  or

  - V/S mode selection.
- If windshear is detected, the SRS mode provides pitch guidance as described above, until V/S reaches zero, then the following survival strategy is adopted :
  - A slightly positive V/S is maintained until speed decreases to slightly above Vss,
  - then, speed is maintained slightly above Vss, allowing an altitude loss as required to maintain Vss.

  Note : *In windshear conditions the pitch attitude guidance target may be significantly greater than that expected for a normal takeoff.*

RWY MODE (Runway)

- In RWY mode, a yaw bar replaces the FD roll bar for lateral guidance on the localizer centerline. (refer to section 1.03.30 - FLIGHT DIRECTOR).
- RWY mode is available provided the runway ILS frequency and course are selected and signals are valid.
- The RWY mode engages if the aircraft heading is less than 10° away from the selected ILS/LOC course when the go-levers are triggered. R

  When the RWY mode is engaged, if the aircraft heading departs by more than 40° from the selected ILS/LOC course, the RWY mode disengages. R

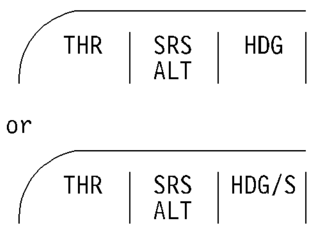
Mod : 7187

OPERATION :

- When either Go-lever is triggered, and provided the ATS is armed :
  - if the departure ILS or LOC frequency and course are selected, the FMA annunciation is :

B0FC-01-0341-002-A100AA

  - if the departure ILS or LOC frequency and course are not selected, the FMA annunciation is :



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Note 1 : *ALT mode is armed in readiness to capture the initial selected altitude.*

Note 2 : *HDG/S or NAV mode can be armed before takeoff and will automatically engage at 30 ft.*

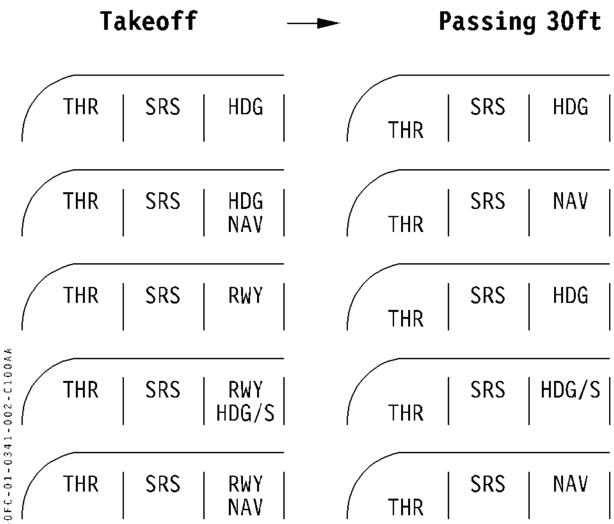
Note 3 : *If HDG mode is engaged for takeoff, the FD roll bar remains centered while on ground. After lift-off, the FD roll bar provides guidance to maintain the present aircraft heading.*

- RWY mode automatically disengages at 30 ft. The Yaw bar is replaced by the roll bar.
- When the SRS mode disengages, the SPD/MACH window synchronizes on the **current aircraft speed** if the current speed is higher than the selected target speed (i.e. V2 or VAPP), **except** if a PRE SET speed has been selected.
- For thrust control during takeoff, refer to chapter 1.03.20 – ATS CONNECTION TO THROTTLE LEVERS.

LATERAL MODE TRANSITION AT 30 FT

- At 30 ft, depending on the lateral mode selected and armed at takeoff, the typical automatic lateral mode transitions are presented hereafter (before landing gear retraction and A/THR reclutch) :

  Note : *the A/THR mode transition occurs during the takeoff roll.*



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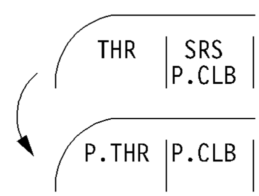
VERTICAL MODE TRANSITIONS

- Depending on the vertical mode armed for takeoff, the automatic vertical mode and A/THR mode transitions sequence is as follows :
  - at thrust reduction altitude, if PROFILE is armed :



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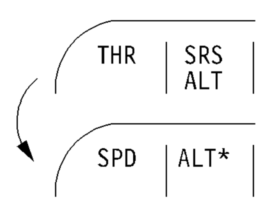
  - at altitude capture (i.e. low altitude level-off) :



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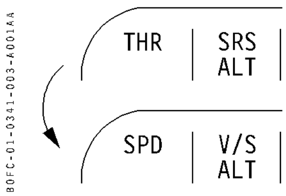
Mod : 6036

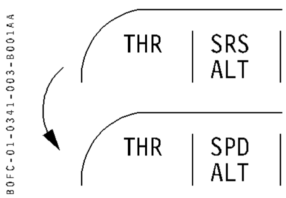
- A manual mode transition can be initiated by selecting another vertical mode.

  The possible mode transition sequences are :

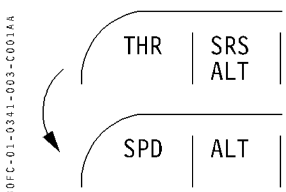
  – If V/S mode is selected :



  – If LVL/CH mode is selected :



  – If ALT. HLD mode is selected :



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FUNCTION

- The Vertical Speed mode (V/S) or Level Change mode (LVL/CH) can be used for climb or descent.
- V/S is the basic vertical mode of the AP/FD.
- The V/S mode allows to climb or descent while maintaining :
  - a selected V/S,
  - the selected speed (A/THR in SPD or MACH mode).
- If the selected target speed and V/S cannot be maintained simultaneously, **maintaining the target V/S has priority**, until speed protection controls V/S.

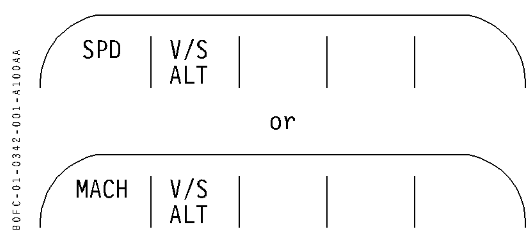
ENGAGEMENT

- V/S mode can be engaged by :
  - setting a new altitude target, then
  - pulling the V/S knob (this synchronizes the vertical speed window on the present aircraft vertical speed), then
  - setting the desired vertical speed.

  It is also possible to set the desired vertical speed before pulling the V/S knob.
- V/S speed mode engagement is confirmed by the FMA annunciation.
- V/S mode engages automatically :
  - on the ground, at the AFS power up,
  - when an FD is selected ON while no AP is engaged or no FD is displayed,
  - if an AP is engaged in CMD while its associated FD is not displayed or not operative,
  - if any engaged vertical mode (ALT. HLD, LVL/CH, PROFILE) is disengaged by pressing its associated pushbutton a second time.
  - if LAND mode is deselected, between GS* and LAND green on FMA (refer to 1.03.50 LAND MODE - MODE REVERSION).
  - when the AP/FD re-engages following an AP/FD temporary disengagement (both FD bars flash for 10 seconds).

OPERATION

- It is recommended to use V/S mode for step climb or descent of 2000 ft or less.
- At V/S mode engagement, the AP/FD synchronizes on the present vertical speed and acquires the selected V/S.
- In V/S mode, the AP/FD adjusts the pitch to maintain the vertical speed and the A/THR adjusts the engine thrust to maintain the speed.
- To maintain the selected V/S, the speed may :
  - decrease down to VLS – 5 kt, in climb,
  - increase up to VMAX + 4 kt, in descent.
- V/S mode engagement arms the ALT mode to capture the selected altitude.
- In V/S mode, the FMA annunciation is :

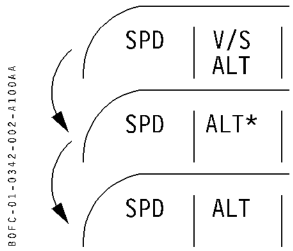


- While in V/S mode, the selected target altitude, speed and vertical speed can be changed at any time.
- In approach, V/S mode can be engaged with a negative vertical speed while the selected altitude is above the present aircraft altitude (e.g. descent from the Final Descent Point to the MDA, during a non-precision approach).

R Mod : 11899 or 11900

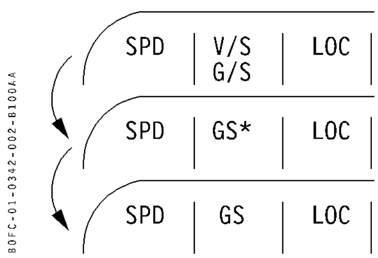
MODE TRANSITIONS

- When capturing the target altitude, the automatic mode transition sequence is :



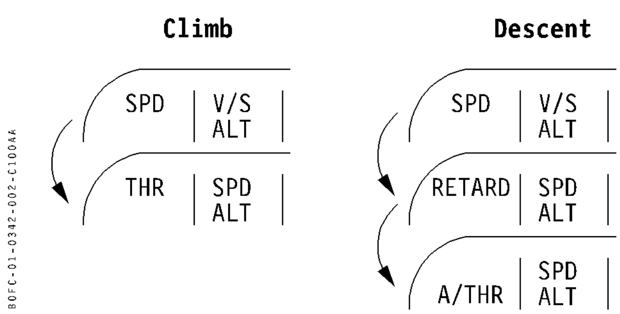
Note : If the FCU target altitude is within 100 ft of the present aircraft altitude when V/S mode is selected, V/S will initially engage but immediately disengages because ALT engages.*

- In approach, with LAND mode selected on FCU, when capturing the glide slope from above, the automatic mode transition sequence is :

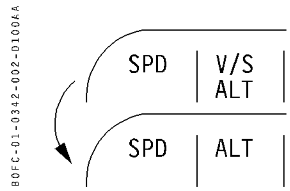


- A manual mode transition can be initiated by the pilot by selecting another vertical mode. The transition sequence is :

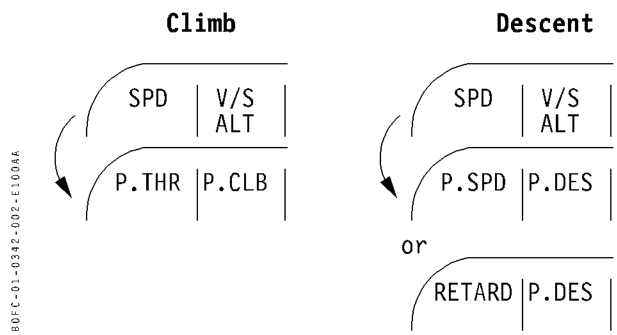
  – If LVL/CH mode is selected :



  – If ALT. HLD mode is selected :



  – If PROFILE mode is selected :



R Mod : 11899 or 11900

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(SPEED PROTECTION INSTALLED)

R Mod : 11899 or 11900

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R Mod : 11899 or 11900

FUNCTION

R • The LVL/CH mode enables to climb or descend at :
  – the selected target speed (AP/FD in SPD or MACH mode),
  – with the engine power set at the thrust limit for climb (A/THR in THR mode with CL or CR thrust limit selected on the TRP) or at idle for descent (RETARD mode).

ENGAGEMENT

• LVL/CH climb or descent can be engaged by :
  – Selecting a new altitude and,
  – Pushing the LVL/CH pushbutton or pulling the ALT SEL knob.

• LVL/CH climb engages if the selected altitude is above the present aircraft altitude and LVL/CH descent engages if the selected altitude is below the present aircraft altitude.

  LVL/CH engages only if the selected altitude and the aircraft present altitude differ by 250 ft or more.

• LVL/CH engagement is confirmed by the FMA annunciation and by the illumination of the LVL/CH pushbutton.

• In climb or descent with PROFILE mode engaged, a manual reversion to LVL/CH mode can be performed by pulling the SPD/MACH setting knob.

  The SPD/MACH window synchronizes on the present aircraft speed.

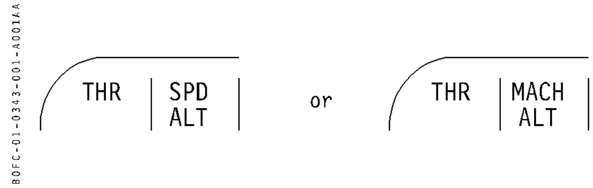
OPERATION

• It is recommended to use LVL/CH for step climb or descent exceeding 2000 ft.

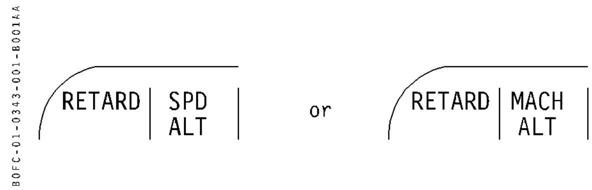
• In LVL/CH, the AP/FD maintains the selected target speed by adjusting the pitch.

• LVL/CH engagement arms the ALT mode (in readiness to capture the new selected altitude).

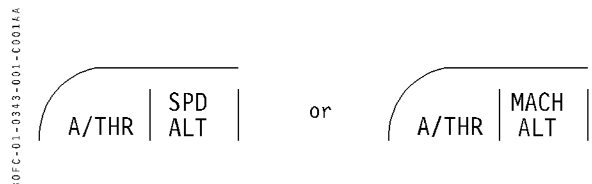
• In LVL/CH climb, the FMA annunciation is :



• In LVL/CH descent, the FMA annunciation is initially :



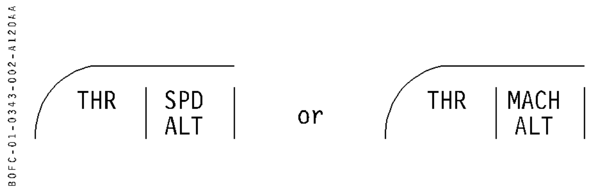
The A/THR commands idle thrust. When idle thrust is set, the FMA annunciation changes to :



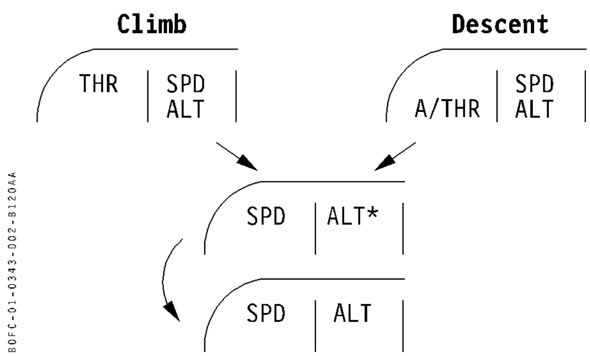
• While in LVL/CH :
  – The selected target altitude and speed/Mach can be changed at any time.
  – If the target speed/Mach is below V_{LS} or above V_{MAX}/M_{MO}, the AFS maintains Vls or V_{MAX}/M_{MO}.

MODE TRANSITIONS

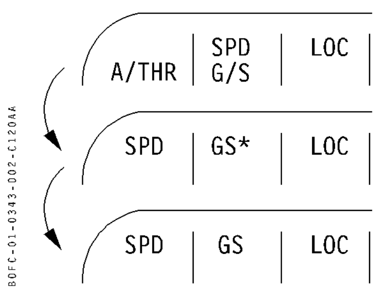
- The transition from SPD to MACH or from MACH to SPD occurs :
  - at the Speed/Mach crossover altitude,
R if PRE SET has been activated,
  - at 25,400 ft if PRE SET is not activated.



- When capturing the selected target altitude, the automatic mode transition sequence is :

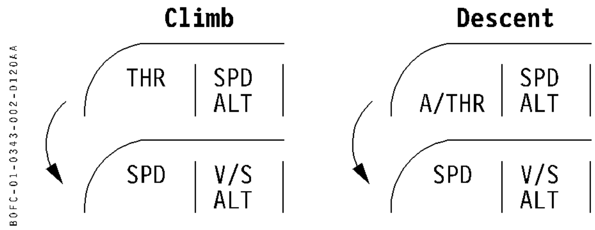


- In approach, with LAND mode armed on the FCU, when capturing the glide slope, the automatic mode transition sequence is :

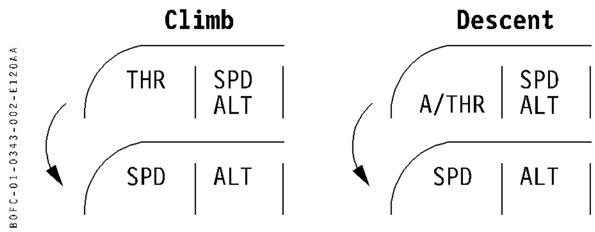


- A manual mode transition can be initiated by selecting another vertical mode.

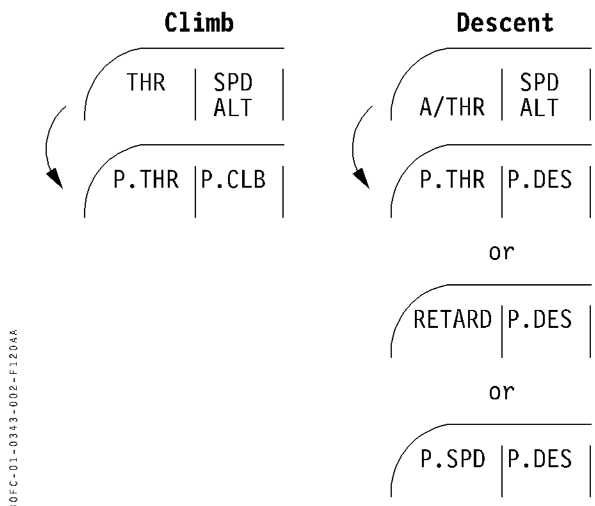
  The possible transition sequences are as follows :
  - If V/S mode is selected :



  - If ALT. HLD mode is selected :



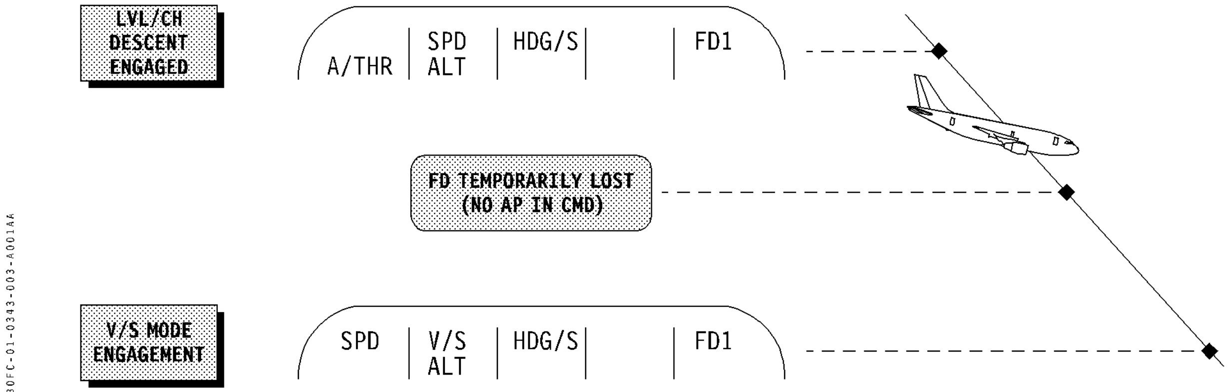
  - If PROFILE mode is selected :



Mod : 6036

MODE REVERSIONS

- In LVL/CH climb or descent, a manual mode reversion to V/S mode can be initiated by pressing the illuminated LVL/CH pushbutton.
- In LVL/CH (climb or descent), an automatic mode reversion to V/S mode occurs if no AP is engaged in CMD and the FD is temporarily lost. V/S mode engages after FD recovery.



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FUNCTION

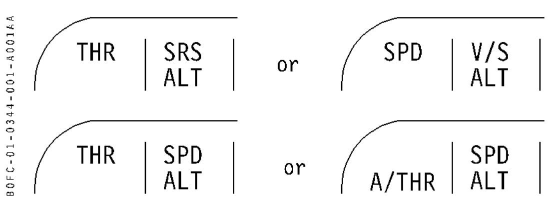
- The altitude (ALT) mode captures and maintains an altitude which is :
  - the FCU selected altitude in climb or descent, or
  - the immediate level-off altitude if the ALT. HLD pushbutton is pressed during climb or descent.
- During altitude capture and hold, the A/THR adjusts the engine thrust to maintain the selected speed (A/THR in SPD or MACH mode), provided that the A/THR was previously engaged.

ENGAGEMENT

- The altitude mode has three successive phases to capture and maintain a selected altitude :
  - arming phase (ALT blue on FMA),
  - capture phase (ALT* green on FMA),
  - hold phase (ALT green on FMA).

Arming phase

- ALT mode arms automatically when :
  - a climb or a descent mode is engaged (SRS or V/S mode engaged or LVL/CH or GO AROUND selected), and
  - a target altitude is set.
- The FMA annunciation is :

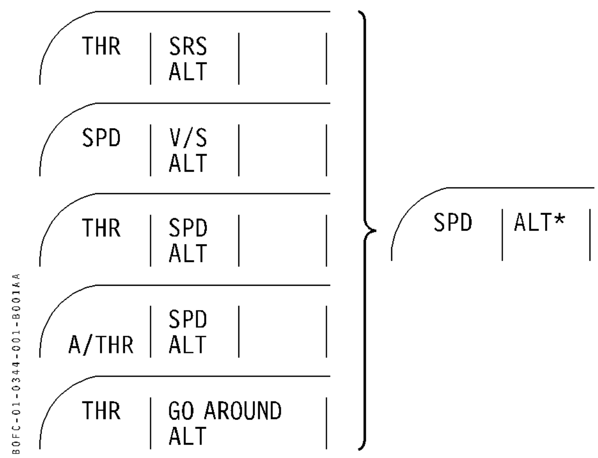


Altitude Capture phase

- ALT* mode automatically engages when the aircraft is in the capture range of the selected target altitude.

  The capture range varies depending on the aircraft vertical speed (the capture range increases with increasing vertical speed).

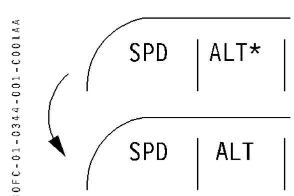
  For example, in LVL/CH with 2000 ft/mn vertical speed, ALT* engages approximately 700 ft before the selected altitude.
- ALT* mode engagement is confirmed by the FMA and by the illumination of the ALT. HLD pushbutton.
- The FMA transition sequence is :



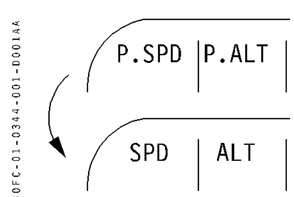
- On the FCU, the LVL/CH pushbutton extinguishes and the ALT. HLD pushbutton illuminates.

Altitude hold phase

- ALT mode engages when the aircraft reaches the selected altitude.
- ALT mode engagement is confirmed by the FMA.
- The FMA transition sequence is :

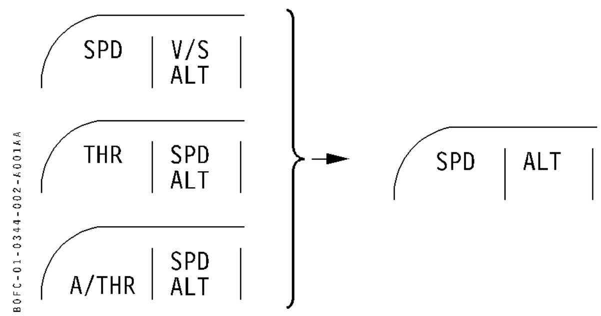


- In cruise, with PROFILE mode engaged (P. ALT), a manual reversion to the ALT mode can be performed by pulling the SPD/MACH knob.



IMMEDIATE LEVEL-OFF IN CLIMB OR DESCENT

- In climb or descent, an immediate level-off can be performed by pressing the ALT. HLD pushbutton.
- The AP/FD engages directly in ALT mode (the altitude capture phase is suppressed).
- The FMA transition sequence is :



OPERATION

- When ALT is armed or engaged, the selected target altitude can be changed at any time.

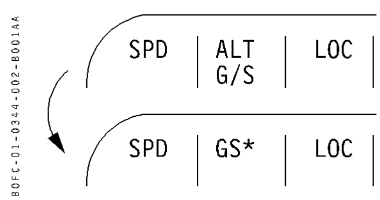
  Depending on when the new altitude selection is performed, the system operates as follows :

  – If the target altitude is changed while ALT is armed (ALT blue) :
    • the aircraft climbs or descends towards the new selected target altitude.
  – If the target altitude is changed during capture phase (ALT* green) :
    • If the new target altitude is within the capture range , ALT* remains engaged and the new altitude is captured.
    • If the new target altitude is beyond the capture range, an automatic reversion from ALT* to V/S mode occurs (refer to MODE REVERSION paragraph).
  – If the target altitude is changed during the altitude hold phase (ALT green) :
    • ALT remains engaged. The AP/FD will not climb or descend to the new selected target altitude until another vertical mode (i.e. : V/S, LVL/CH, P.CLB or P.DES) is selected.

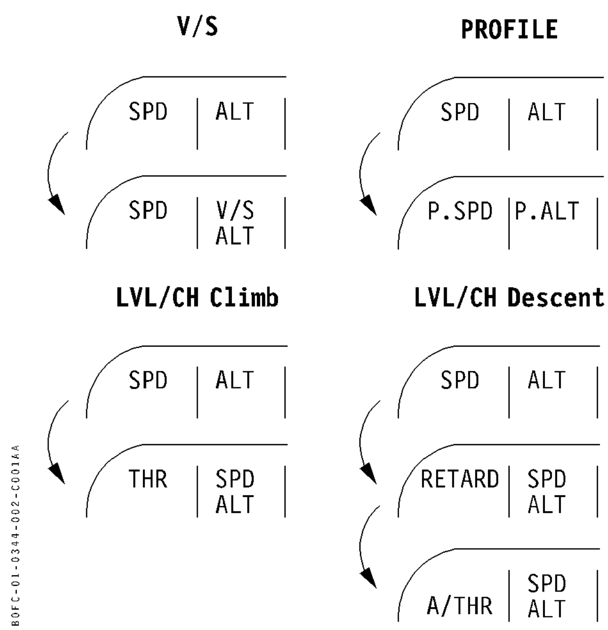
- If flying manually in ALT mode with only the FD displayed, and an AP is then engaged in CMD :
  – if the current altitude is within 250 ft of the selected target altitude, the AP/FD will capture and hold the target altitude (ALT* then ALT mode),
  – if the current altitude is more than 250 ft away from the target altitude, the AP/FD will maintain the current altitude.

MODE TRANSITIONS

- In approach, with LAND mode selected on FCU, when capturing the glide slope, the automatic mode transition sequence is :

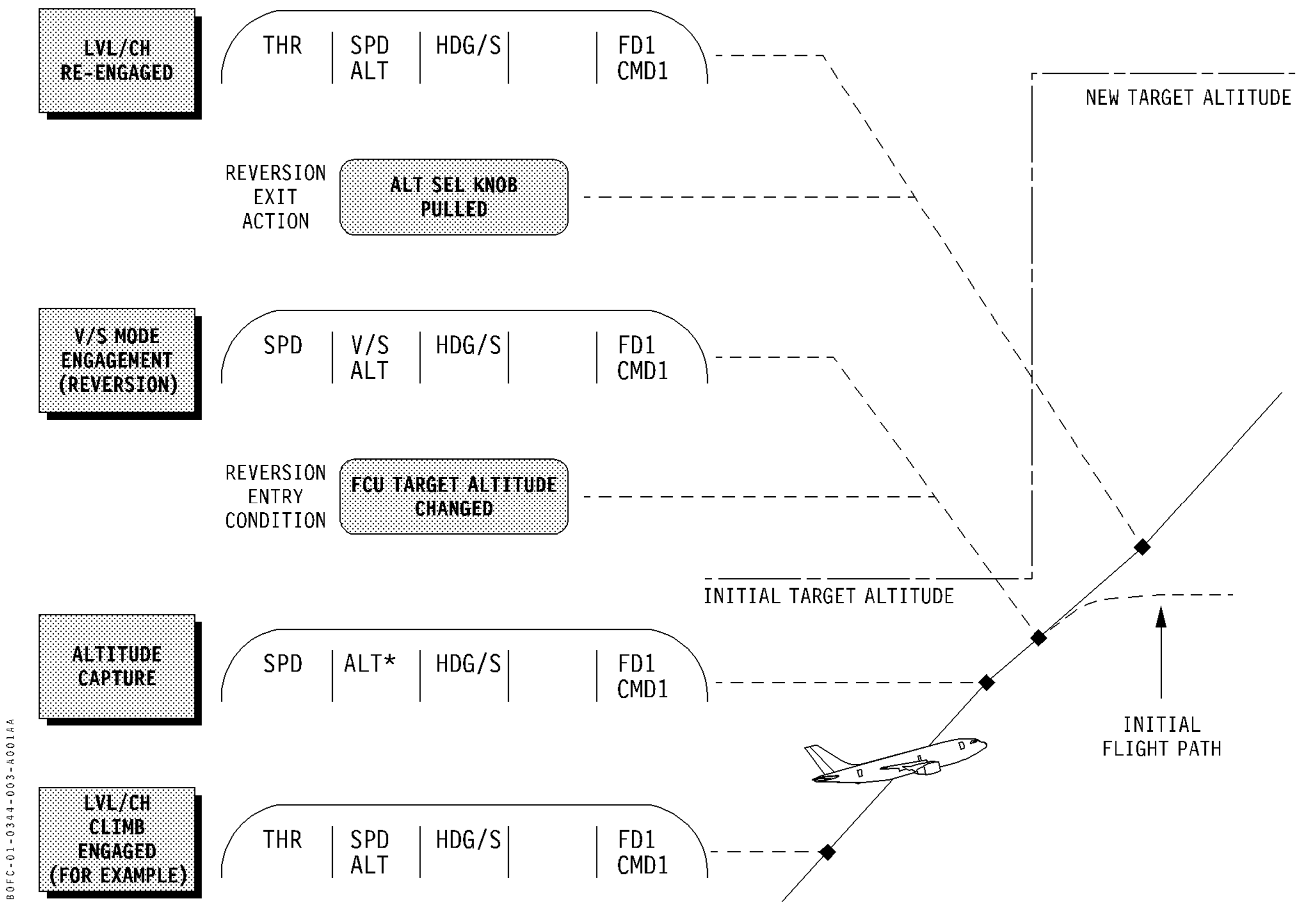


- A manual mode transition can be initiated by selecting another vertical mode, such as V/S, LVL/CH or PROFILE :



MODE REVERSIONS

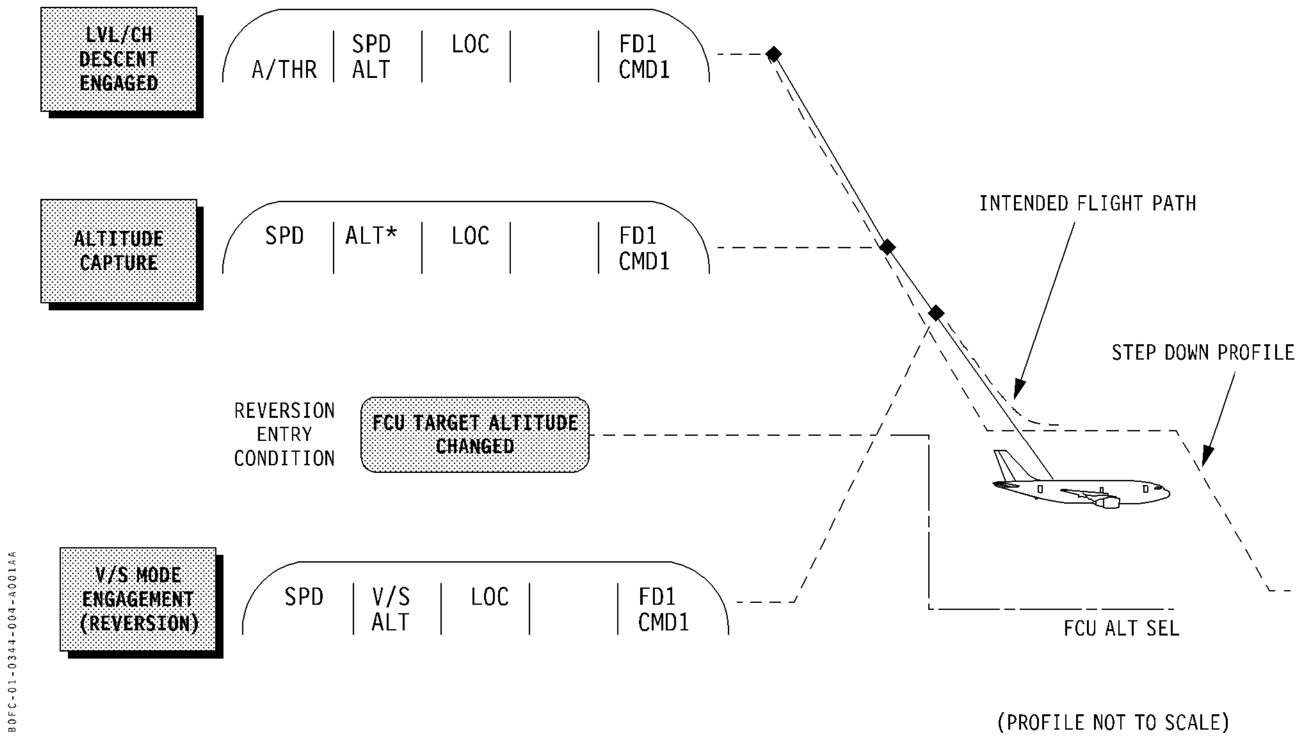
- In ALT* or ALT mode, a mode reversion to V/S occurs if the illuminated ALT. HLD pushbutton is pressed.
- In ALT* mode, an automatic mode reversion from LVL/CH to V/S occurs if :
  - the target altitude is changed (e.g. if the aircraft has been cleared to a higher (altitude), and
  - the aircraft is out of the capture range of the new target altitude, and
  - the ALT SEL knob is not pulled.



- Following the mode reversion :
  - the aircraft maintains the present aircraft vertical speed,
  - the FD pitch bar flashes for 10 seconds,
  - ALT is armed again (ALT blue),
  - ALT. HLD pushbutton extinguishes.
- The V/S mode remains engaged until the ALT SEL knob is pulled or until the LVL/CH pushbutton is pressed (re-engagement of the LVL/CH mode).

MODE REVERSIONS (Cont'd)

- A similar automatic mode reversion from LVL/CH to V/S occurs in descent or during a step-down approach if the target altitude is changed while in ALT* (e.g. if the aircraft has been already cleared to a lower altitude, and the change of FCU target altitude to the next step-down altitude is expedited while still in ALT*) :



FUNCTION

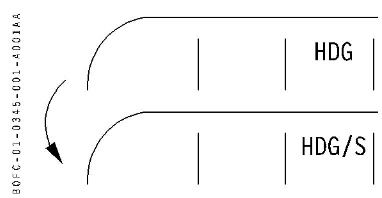
- The Heading (HDG) mode is the basic lateral mode of the AP/FD.
- HDG mode maintains the present aircraft heading at mode engagement.
- When HDG engages, if the present aircraft bank angle is :
  - less than 5°, the HDG mode maintains the present aircraft heading,
  - more than 5°, the AP/FD levels the wings, then maintains the heading which is achieved when the bank angle passes 5°.

ENGAGEMENT AND OPERATION

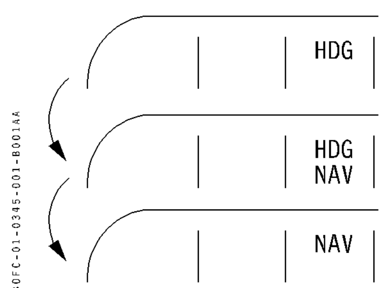
- There is no pushbutton to engage HDG Mode.
- HDG mode engages :
  - On the ground, at AFS power up,
  - When an FD is selected ON with no AP engaged or no FD displayed.
  - If an AP is engaged in CMD while its associated FD is not displayed.
  - If NAV mode is selected after LOC*.
  - If any other lateral mode (HDG/S, VOR or LOC) is disengaged by pressing its associated pushbutton a second time.
  - If LAND is deselected, between LOC* and LAND green on FMA (refer to section 1.03.50 LAND MODE - MODE REVERSIONS).
  - When the AP/FD re-engages following an AP/FD temporary disengagement (both FD bars flash for 10 seconds).
  - When GO AROUND mode engages (but HDG green is not indicated on the FMA).
- The HDG mode engagement is indicated on the FMA only (no indication on the FCU).

MODE TRANSITIONS

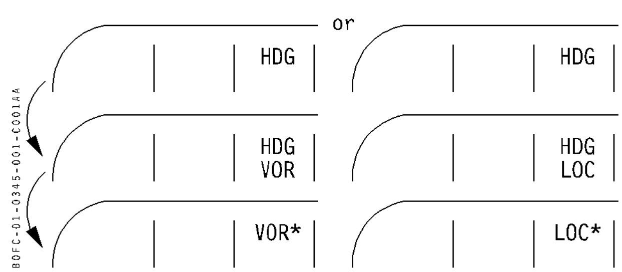
- A manual mode transition from HDG to another lateral mode occurs when the pilot selects any lateral mode on the FCU. The FMA transition sequence is as follows :
  - If HDG SEL mode is selected :



  - If NAV mode is selected :



  - If V/L mode (VOR or LOC mode) is selected :



  - If LAND mode is selected, the transition with LOC mode is the same as when LOC mode is selected by pressing the V/L pushbutton.
- An automatic mode transition occurs from HDG to NAV, at 30 ft, if NAV is armed for takeoff.

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FUNCTION

- The Heading Select mode (HDG/S) acquires and maintains the selected heading.

ENGAGEMENT AND OPERATION

- HDG/S mode can be engaged by :
  - pulling the HDG SEL knob, or
  - pressing the HDG SEL pushbutton.
- HDG/S can be engaged using the recommended **Push-Pull-Turn** technique :
  - **Push** the HDG SEL knob to synchronize the HDG SEL window on the present aircraft heading, then
  - **Pull** the HDG SEL knob to engage the HDG/S mode, then
  - **Turn** the HDG SEL knob, in the direction of the desired turn, to select the desired heading.

    The heading selection is confirmed by cross-checking the blue index on the Navigation Display (ND) heading scale.

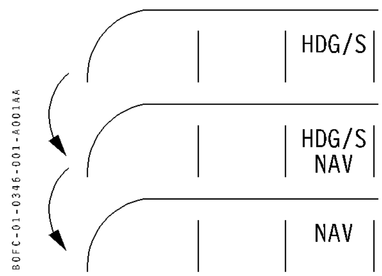
Note : *With HDG/S engaged, the aircraft turns in the same direction the HDG SEL knob is turned (even if a turn of more than 180° is selected).*

This design feature and the above operating technique avoids the possibility of initiating turns in the unintended direction.

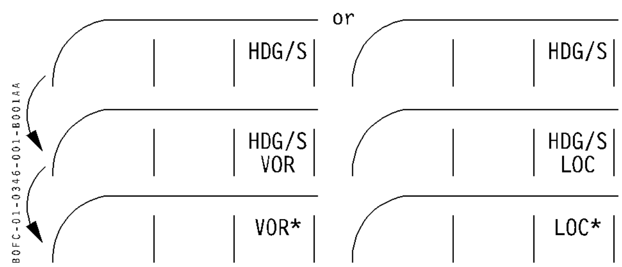
- If the HDG SEL window is not synchronized on the present aircraft heading or if the desired heading is selected before engaging the HDG/S mode, when HDG/S engages, the aircraft turns in the shortest direction towards the selected heading.
- HDG/S mode engagement is indicated on the FMA and on the FCU by the illumination of the HDG SEL pushbutton.
- While in HDG/S mode, the heading can be changed at any time by selecting the desired heading.
- Before takeoff, if RWY mode is used, HDG/S mode may be armed for climb out.

MODE TRANSITIONS

- A manual mode transition from HDG/S to another lateral mode occurs when the pilot selects any lateral mode on the FCU. The FMA transition sequence is as follows :
  - If NAV mode is selected :



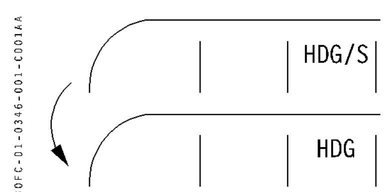
  - If V/L mode (VOR or LOC mode) is selected :



  - When LAND is selected, the transition with LOC mode is the same as when LOC mode is selected by pressing the V/L pushbutton.

MODE REVERSION

- A manual mode reversion from HDG/S to HDG (basic lateral mode) occurs if the pilot presses the HDG SEL pushbutton a second time.



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FUNCTION

- The VOR mode captures and tracks a selected VOR radial/course.
- The VOR mode is to be used for enroute navigation only.
- For capturing and tracking the final approach course of a VOR or VOR-DME approach, the HDG SEL mode must be used together with VOR or VOR-DME raw data.
- The HDG SEL mode and VOR/VOR-DME raw data should also be used to capture and track a VOR radial/course whenever slats are extended and the distance to the VOR is less than 30 nm.

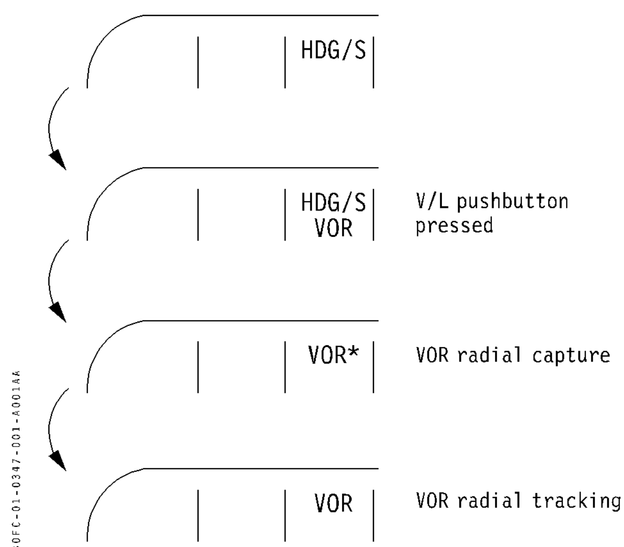
ENGAGEMENT AND OPERATION

- VOR mode has three successive phases to capture and track a selected VOR radial :
  - – arming phase (VOR blue on FMA)
  - – capture phase (VOR* green on FMA)
  - – tracking phase (VOR green on FMA).
- VOR mode can be armed by pressing the V/L (VOR/LOC) pushbutton in the following configurations :
  - – both FD are displayed (no AP engaged) and :
    - both VOR/NAV/ILS switches are in VOR, or one in VOR and the other in NAV,
    - VOR frequency/course are set on both VOR control panels.
  - – one AP in CMD and :
    - the onside VOR/NAV/ILS switch is in VOR,
    - VOR frequency/course are set on the onside VOR control panel (at least).
- It is not possible to engage VOR mode if LAND mode is selected on FCU.
- When VOR mode is armed, the AP/FD uses the support of another lateral mode to guide the aircraft towards the capture point of the VOR radial. This mode can be HDG, HDG/S or NAV.
- For correct capture of the VOR radial/course, the intercept angle must not exceed :
  - – 90°, if the distance to the VOR station is higher than 30 NM,
  - – 30°, if the distance to the VOR station is less than 30 NM.
- VOR mode automatically engages the radial capture phase (VOR*) when the aircraft is in the capture range of the VOR radial.

  VOR mode automatically engages the radial tracking phase (VOR) when the aircraft reaches the selected VOR radial.
- In VOR* and VOR modes, the AP Supervisory Override function is available.
- In VOR mode, the bank angle is limited at 25° with the HDG SEL outer knob in the NORM position, or at 15° with the knob in the 15 position.

  These bank angle limitations are valid in manual flying following FD orders or with the AP engaged in CMD.
- VOR mode arming and engagement is indicated by the FMA annunciation and by the illumination of the V/L pushbutton.

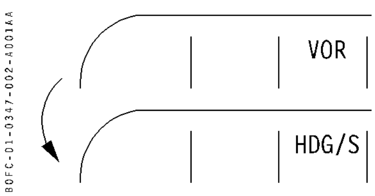
  A typical FMA transition sequence is :



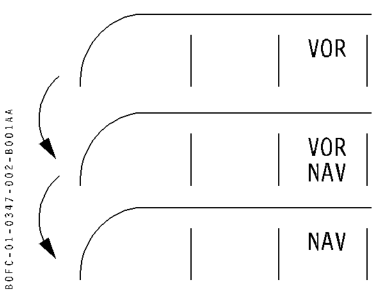
- If one VOR receiver fails while in the arming phase (VOR blue on FMA), the VOR mode disarms on the affected side.
- If one VOR receiver fails while in the capture (VOR*) or tracking (VOR green) phase :
  - If the onside AP/FD is engaged, the AP/FD disengages,
  - If the opposite AP/FD is engaged, the AP/FD remains engaged in VOR mode.

MODE TRANSITIONS

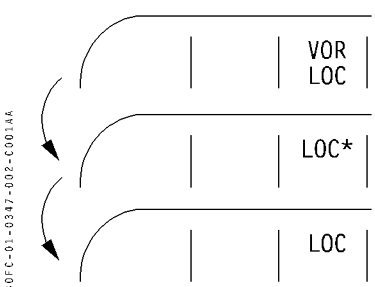
- A manual mode transition can be initiated by selecting another lateral mode. The FMA transition sequence is as follows :
  - If HDG/S mode is selected :



  - If NAV mode is selected :

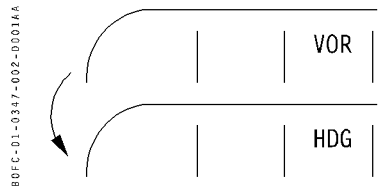


  - If LAND mode is selected :



MODE REVERSIONS

- A manual mode reversion from VOR to HDG (basic lateral mode) occurs if the V/L pushbutton is pressed a second time.



- If a go-around is initiated while in VOR* or VOR mode, GO AROUND mode engages using HDG mode for the lateral guidance.

  Note : in GO AROUND mode, HDG is not indicated on the FMA.

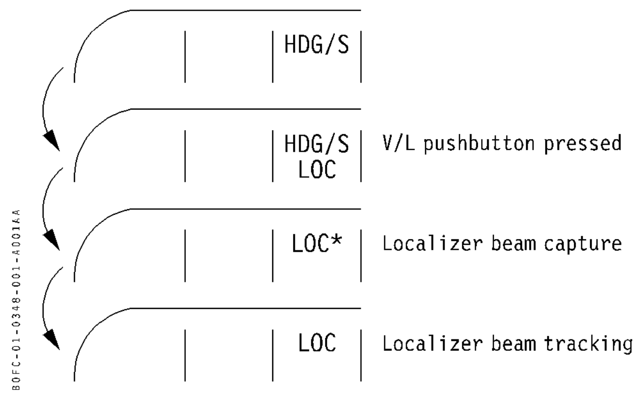
FUNCTION

- The LOC (localizer) mode captures and tracks a localizer beam.
- LOC mode can be used for localizer-only approaches, or if the ILS glideslope is out of service or unreliable.

ENGAGEMENT AND OPERATION

- LOC mode has three successive phases to capture and track a localizer beam :
  - arming phase (LOC blue on FMA)
  - capture phase (LOC* green on FMA)
  - tracking phase (LOC green on FMA)
- LOC mode can be armed by pressing the V/L (VOR/LOC) pushbutton while in the following configurations :
  - both FD are displayed (no AP engaged) and :
    - at least one VOR/NAV/ILS switch is in the ILS position,
    - the ILS or LOC frequency and course are set on the ILS control panel.
  - one AP in CMD and :
    - the onside VOR/NAV/ILS switch is in the ILS position,
    - the ILS or LOC frequency and course are set on the ILS control panel.
- LOC mode automatically arms when LAND pushbutton is pressed provided an ILS frequency and a course have been set on the ILS control panel (refer to APPROACH AND LANDING – LAND mode).
- When LOC mode is armed, the AP/FD uses the support of another lateral mode to guide the aircraft towards the capture point of the localizer beam. This mode can be HDG, HDG/S or NAV.
- LOC mode automatically engages the capture phase (LOC*) when the aircraft is in the capture range of the localizer beam.
- LOC mode automatically engages the tracking phase (LOC green) when the aircraft reaches the localizer beam.
- In LOC* mode, the AP Supervisory Override function is available.
- LOC arming and engagement is confirmed by the illumination of the V/L pushbutton, and by the FMA.

  A typical FMA transition sequence is :



Note 1 : *During the localizer capture phase (LOC*) the bank angle can reach 30°, irrespective of the bank angle limit selector position.*

Note 2 : *The maximum intercept angle for capturing a localizer is 115°.*

Note 3 : *If one ILS receiver (or LOC channel) fails while in the arming phase (LOC blue on FMA), the LOC mode disarms on the affected side.*

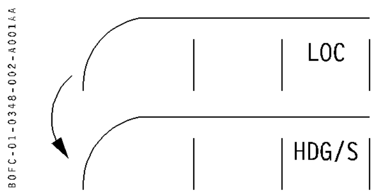
If one ILS receiver (or LOC channel) fails while in the capture (LOC) or tracking (LOC green) phase :*

- *If the onside AP/FD is engaged, the AP/FD disengages,*
- *If the opposite AP/FD is engaged, the AP/FD remains engaged in LOC mode.*

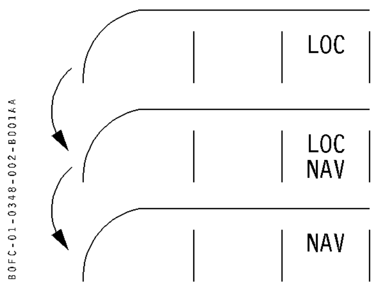
Note 4 : *If the on-ground localizer transmitter fails while in LOC* or LOC mode (no signal received by both aircraft ILS receivers), the LOC scale and FD roll bar flash on both PFD.*

MODE TRANSITIONS

- A manual mode transition can be initiated by the pilot by selecting another lateral mode. The FMA transition sequence is as follows :
  - If HDG/S mode is selected :

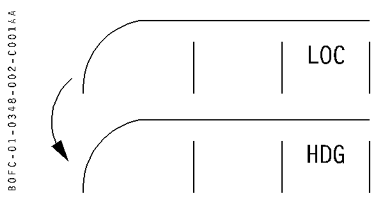


  - If NAV mode is selected :



MODE REVERSIONS

- A manual mode reversion from LOC to HDG (basic lateral mode) occurs if the V/L pushbutton switch is pressed a second time.



- A manual mode reversion from LOC to HDG occurs when LAND mode is selected and the pilot :
  - presses the LAND pushbutton switch,
  - or selects another vertical mode.

- If a go-around is initiated while in LOC* or LOC mode, GO AROUND mode engages using HDG mode for the lateral guidance.

  Note : in GO AROUND mode, HDG is not indicated on the FMA.

LOC BACK COURSE APPROACH

- The LOC mode cannot be used to fly a back-course ILS or LOC approach.
- During a LOC BACK CRS approach, the FD guidance or the AP guidance (if engaged in CMD mode) is reversed.
- A LOC BACK CRS approach can be conducted with the AP in CMD but using the HDG SEL and V/S modes.
- During a LOC BLACK CRS approach, the LOC deviation must be monitored on the ND only (in ROSE or ARC mode).

VOR/LOC MODE SELECTION LOGIC

- The V/L pushbutton controls the engagement of the VOR and LOC modes.
- Whether VOR or LOC mode arms/engages depends on the position of the two VOR/NAV/ILS switches, and on which FD and AP are engaged (refer to the tables 1, 2 and 3 below for details).

TABLE 1

- This table is applicable :
  - if both FD are displayed (no AP engaged) and LAND mode is not selected on FCU,
  - or if both AP are engaged in CMD and GO AROUND mode is engaged.
- If VOR/NAV/ILS switches are not in the same positions, VOR mode has priority over NAV mode, and LOC mode has priority over VOR and NAV modes.
- VOR or LOC mode arming/engagement when the V/L pushbutton is pressed is as follows :

VOR/NAV/ILS switch position		Mode	Remark
One side	Other side		
VOR	VOR	VOR	See Note 1
VOR	NAV	VOR	VOR arms on both PFD
VOR	ILS	LOC	See Note 2
NAV	NAV	No effect	
NAV	ILS	LOC	LOC arms on both PFD
ILS	ILS	LOC	

Note 1 : Once VOR mode is armed or engaged, if either VOR/NAV/ILS switch is changed from VOR to ILS, the associated FD will disengage (FD bars are cleared and the red FD warning is displayed).

Note 2 : The FD associated with the VOR/NAV/ILS switch which is in the VOR position disengages (FD bars are cleared and the red FD warning is displayed). This FD re-engages after its VOR/NAV/ILS switch is set to ILS or NAV.

Note 3 : If VOR or LOC mode is selected when both AP are in CMD in GO AROUND mode, AP2 disengages.

TABLE 2

- This table is applicable if :
  - one AP is engaged in CMD,
  - and both FD are displayed.
- Priority is given to the VOR/NAV/ILS switch associated with the engaged AP.
- VOR or LOC mode arming/engagement when the V/L pushbutton is pressed is as follows :

VOR/NAV/ILS switch position		Mode	Remark
Side of engaged AP	Other side		
VOR	VOR	VOR	
VOR	NAV	VOR	
VOR	ILS	VOR	See Note 1
NAV	VOR	No effect	
NAV	NAV	No effect	
NAV	ILS	No effect	
ILS	VOR	LOC	See Note 2
ILS	NAV	LOC	
ILS	ILS	LOC	

Note 1 : When VOR mode engages, if one VOR/NAV/ILS switch is in the ILS position, the onside FD disengages and will re-engage after the switch is set in the VOR position.

Note 2 : When LOC mode engages, if one VOR/NAV/ILS switch is in the VOR position, the onside FD disengages and will re-engage after the switch is set in the ILS position.

Note 3 : VOR mode does not engage if LAND mode is selected on FCU.

TABLE 3

- This table is applicable if LAND mode is selected on FCU and :
  - both AP are engaged in CMD,
  - and/or both FD are displayed.
- LOC mode arming/engagement when the V/L pushbutton is pressed is as follows :

Note : VOR mode cannot be engaged under the above conditions.

VOR/NAV/ILS switch position		Mode	Remark
One side	Other side		
ILS	ILS	LOC	See Note 1
ILS	VOR	LOC	See Note 2
ILS	NAV	LOC	See Note 3
NAV	NAV	No effect	
NAV	VOR	No effect	
VOR	VOR	No effect	

Note 1 : AP2 disengages but FD2 remains engaged (in LOC mode).

AP/FD1 remain engaged (in LOC mode).

Note 2 : The AP/FD associated with the VOR/NAV/ILS switch set to VOR disengages.

Note 3 : The AP/FD associated with the VOR/NAV/ILS switch set to NAV remains engaged (in LOC mode).

FUNCTION

- The LAND mode selection on the FCU provides vertical and lateral guidance during an ILS approach to capture and track the localizer and glide slope beams.

- In the final phase of the approach, the LAND mode provides flare and alignment guidance (FLARE mode) and roll out guidance (ROLL OUT mode) for automatic landing and roll out.

- The A/THR mode associated with the LAND mode is the SPD mode.

- The LAND mode selection :
  - arms simultaneously then engages a vertical mode (GS) and a lateral mode (LOC) for capturing and tracking the ILS beam,
  - engages successively combined (vertical and lateral) modes (LAND, FLARE and ROLL OUT) for the final approach and landing.

ENGAGEMENT AND OPERATION

- During approach, LAND mode can be selected by pressing the LAND pushbutton provided :
  - Radio Altitude (RA) is above 400 ft.
  - an ILS frequency and course have been set on the ILS control panel (irrespective of the VOR/NAV/ILS switch position).

- LAND mode selection is indicated by the FMA annunciation (G/S blue and LOC blue) and by the illumination of the LAND pushbutton.

- When LAND pushbutton is pressed, GS and LOC modes arm and start their respective capture phases when within their respective capture ranges.

- Selecting the VOR/NAV/ILS switch to ILS allows to display on the onside PFD and ND the LOC and GS deviation indexes.

  If the VOR/NAV/ILS switch has been left in VOR or NAV when LAND mode is selected, an amber "ILS" message flashes on the onside PFD (to remind the crew member to set the VOR/NAV/ILS switch in the ILS position).

- Once LAND mode has been armed, both AP can be engaged in CMD. R

Note 1 : With LAND mode armed and one AP engaged in CMD, the DC bus tie contactor (connecting the DC NORM BUS and the DC ESS BUS) automatically opens in order to assure an independent electrical power supplies for the AP/FD 1 and 2. R

In case of DC bus tie contactor failure to open, the landing capability does not change from CAT 2 to CAT 3 after the engagement of the second AP (but no audio alert is provided). R

Note 2 : Below 700 ft AGL, the ILS frequency and course selector knobs are disabled.

Note 3 : If FPV is used for the approach, FD bars automatically replace the FPV when FLARE mode engages or if a go-around is initiated.

- If LAND is deselected by pressing the pushbutton a second time, the FD bars flash during 10s.

MODES ASSOCIATED WITH LAND MODE

LOC mode

Refer to section 1.03.48 for LOC mode description.

GLIDE SLOPE (GS) mode

- The GS mode captures and tracks the ILS glide slope.

- GS mode has three successive phases :
  - arming phase (G/S blue on FMA),
  - capture phase (GS* green on FMA),
  - tracking phase (GS green on FMA).

- GS mode arming and engagement is indicated on the FMA only.

- When GS mode is armed, the AP/FD uses the support of a pilot-selected vertical mode to guide the aircraft towards the capture point of the glide slope beam. This intercept mode can be V/S, LVL/CH, ALT or PROFILE.

- GS mode automatically engages the capture phase (GS*) when the aircraft is in the capture range of the glide slope and engages the tracking phase (GS green) when the aircraft is stabilized on the glide slope.
- **GS* can engage only if LOC* or LOC green is engaged**
- In GS* mode, the AP Supervisory Control Wheel Operation is available.
- The A/THR mode associated to the GS mode is SPD.

LAND mode (LAND green on FMA)

- LAND mode is a combined mode which engages at 400 ft AGL or below provided GS and LOC modes are engaged in tracking phase (GS and LOC green on FMA).

  The guidance in LAND green mode is similar to GS green and LOC green.
- Once engaged, LAND mode is latched and cannot be disengaged except by engaging the GO AROUND mode.
- LAND mode engagement is indicated on the FMA only (LAND green).
- For safety reasons, in LAND mode, all FCU controls are inhibited except :
  - the SPD selector knob,
  - the AP engagement levers (to engage the second AP in CMD, if desired),
  - the CWS/CMD switch-over pushbutton.

R *Note : Switching from CMD to CWS is possible*
R *only when one AP is engaged.*

- The A/THR mode associated to the LAND mode is SPD.

FLARE mode

- The FLARE mode is a combined mode which provides :
  - vertical guidance for flare and touchdown (using a flare control law defined in terms of vertical speed).
  - lateral guidance for the alignment of the aircraft with the runway center line (by comparing the aircraft magnetic heading provided by the IRS with the runway heading / course selected on the ILS control box).

  Note : In cross-wind conditions, the aircraft is maintained wings level (i.e. without side-slip but with a crab angle).
- FLARE mode typically engages at 50 ft RA (the FLARE mode engagement is adjusted as a function of the aircraft vertical speed). Engagement is indicated on the FMA (FLARE green).
- In manual landing, at 30 ft RA, the FD roll bar is replaced by the yaw bar.
- The A/THR mode associated to the FLARE mode is initially SPD, then RETARD at 30 ft RA.

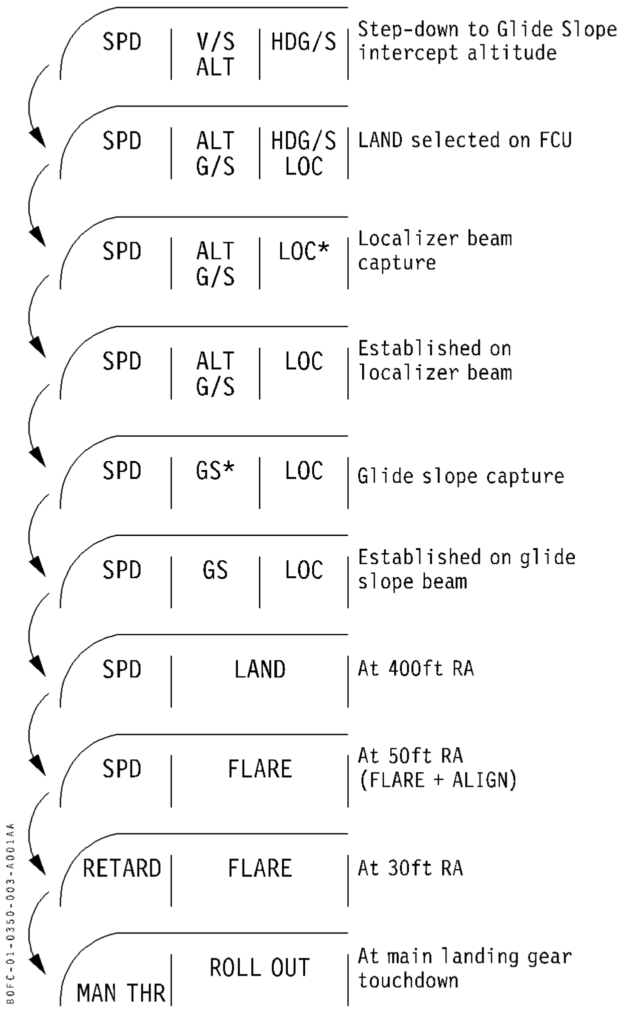
ROLL OUT mode

- The ROLL OUT mode is a combined mode which provides :
  - Lateral guidance for tracking of the runway centerline (using the IRS magnetic heading, the runway heading / course selected on the ILS control box, the yaw rate and the localizer deviation),
  - vertical guidance for lowering the nose landing gear (derotation).
- ROLL OUT mode engages at main landing gear touchdown and is annunciated on the FMA.
- When ROLL OUT mode engages, the A/THR disengages (MAN THR on FMA).
- The ROLL OUT mode remains active until the aircraft complete stop.
- On the ground during taxi-in, the ROLL OUT mode remains displayed on the FMA as long as the FD is displayed.

  The ROLL OUT mode disengages if a go-around is initiated after touchdown or, at the latest, when takeoff modes are engaged.

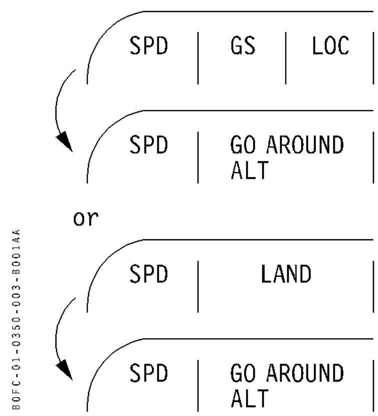
MODE TRANSITIONS

- During approach and landing, the typical automatic mode transitions sequence is as follows :



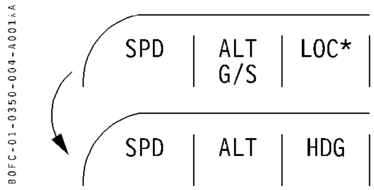
- With GS and LOC modes armed, both modes can be simultaneously disarmed by :
  - pressing the LAND pushbutton switch again (the support modes remain engaged),
  - selecting either another vertical mode or another lateral mode,
  - selecting GO AROUND mode (i.e. by triggering either go-lever).

- At any time of the approach, the pilot can engage the GO AROUND mode (SRS/HDG guidance), the corresponding FMA transition sequences are as follows :

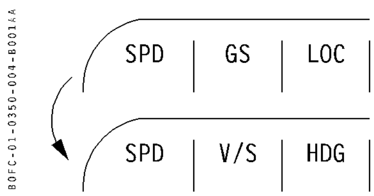


MODE REVERSIONS

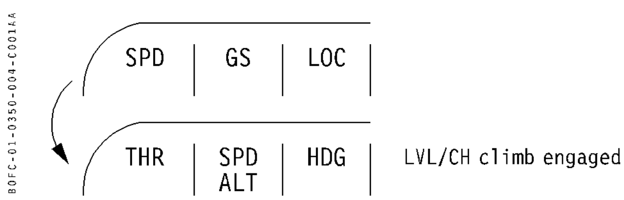
- Following LOC* engagement and before LAND green mode engagement, a manual mode reversion can be performed by :
  – pressing the LAND pushbutton a second time :
    - LOC* or LOC disengages and HDG engages (basic mode).
    - if G/S is armed, G/S disarms (the vertical support mode remains engaged).



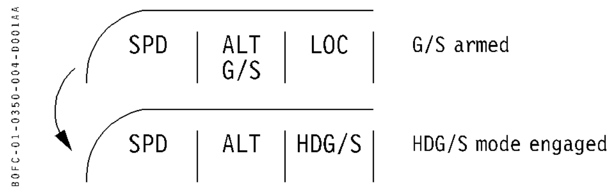
    - if GS* or GS is engaged, GS disengages and V/S engages (basic mode).



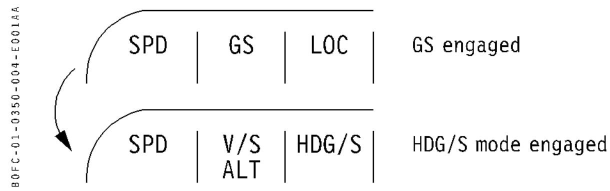
R – selecting another **vertical mode** :
    - the vertical mode engages,
    - a lateral mode reversion to HDG mode occurs.



  – selecting another **lateral** mode : R
    - the lateral mode engages,
    - if G/S is armed, G/S disarms (LAND pushbutton switch extinguishes)



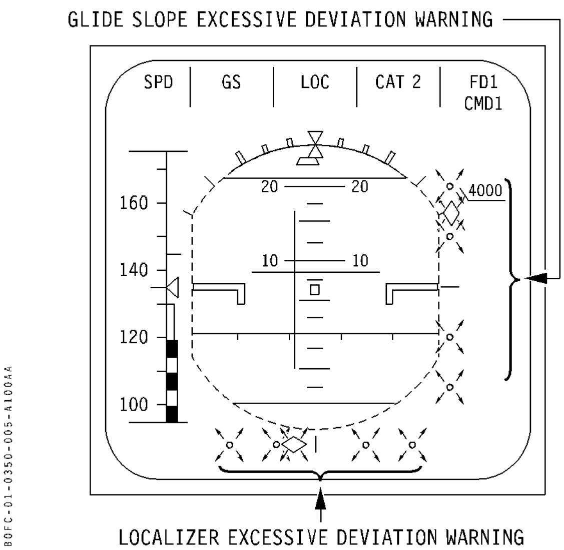
    - if GS* or GS is engaged, a vertical mode reversion occurs to V/S mode.



- An automatic mode reversion to basic modes (V/S and HDG) occurs if both radio altimeters fail or if both ILS receivers fail.

WARNINGS

Excessive deviation from localizer or glide slope



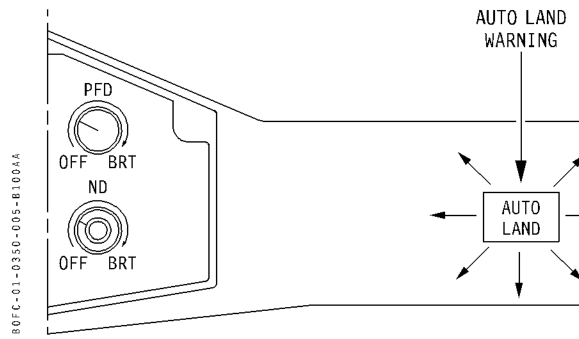
- If the VOR/NAV/ILS switch is in the ILS position, the PFD/ND glide slope and/or localizer index and scale flash to warn the crew of excessive localizer or glide slope deviation :
  - The LOC excessive deviation warning (flashing LOC index and scale on PFD and ND) is triggered, above 15 ft RA, if LOC deviation exceeds 1/3 dot.
  - The G/S excessive deviation warning (flashing G/S index and scale on PFD and ND) is triggered, above 100 ft RA, if G/S deviation exceeds 1 dot.

  The above warnings are triggered only in LOC green or GS green phases, with CAT 2 or CAT 3 landing capability indicated on FMA.

- In either GS or LOC tracking phase (GS green or LOC green on FMA),the ILS transmitter (ground station) failure is annunciated as follows :
  - localizer transmitter failure :
    - LOC excessive deviation warning and flashing FD roll bar, and
    - AUTO LAND warning, if below 200 ft RA.
  - glide slope transmitter failure :
    - G/S excessive deviation warning and flashing FD pitch bar, and
    - AUTO LAND warning, if below 200 ft RA.

AUTO LAND Warning

- The AUTO LAND warning consists of two red AUTO LAND lights flashing on the glareshield panel.



- The warning is triggered simultaneously with one of the following conditions :
  - GS and/or LOC excessive deviation warning,
  - AP OFF warning,
  - long flare (aircraft not on the ground 15 seconds after passing 50 ft RA),
  - a difference greater than 15 ft is detected between the Radio Altimeters 1 and 2.
- The warning is triggered, below 200 ft RA, only in LAND green mode with CAT 2 or CAT 3 landing category capability.
- The AUTO LAND warning can be cancelled by :
  - triggering either Go-lever (i.e. initiating a Go-Around), or
  - pressing the AP instinctive disconnect pushbutton twice (the first action disengages the AP, the second action cancels the AP OFF and AUTO LAND warnings).

Warning test

- LOC and G/S excessive deviation warnings and both AUTO LAND warning lights can be tested by pressing either AUTO LAND light.

Mod : 5051

Landing capability downgrade

- If the landing capacity category is downgraded (CAT 3 downgraded to CAT 2 or CAT 2 downgraded to CAT 1 or in case of loss of CAT 1 capability) an audio triple-click warning sounds.

LANDING CAPABILITY

- When LAND mode is selected on FCU, a landing capability category (CAT 1, CAT 2 or CAT 3) determined by the status of the aircraft's equipment, is displayed in the fourth column of the FMA.

- In addition to the arming conditions for LAND mode, the following table lists the equipment and systems which must be operational for respective landing capability categories :

Capability → / Equipment ↓	CAT 1	CAT 2	CAT 3
AP/FD	1 FD or 1 AP in CMD	1 AP in CMD	2 AP in CMD + 1 FD
A/THR			Engaged in SPD mode
ILS receiver	N°1 for FD 1 N°2 for FD 2	N°1 and N°2	N°1 and N°2
PFD (Primary Flight Display)	N°1 for FD 1 N°2 for FD 2	N°1 and N°2	N°1 and N°2
IRS (Inertial Reference System)	N°1 and (N°2 or 3) for FD 1 N°2 and (N°1 or 3) for FD 2	N°1 and (N° 2 or 3) for AP 1 N°2 and (N°1 or 3) for AP 2	N° 1 and N°2 and N°3
Radio Altimeters	N° 1 for FD 1 N° 2 for FD 2	N° 1 for AP 1 N° 2 for AP 2	N°1 and N°2
Hydraulic Systems		G and (B or Y) for AP 1 Y only for AP 2	G and B and Y
Electrical Power	GEN1 or GEN2 or APU GEN	GEN1 or GEN2 or APU GEN	2 GEN (GEN1 or GEN2 or APU GEN)
Yaw Damper		N°1 or N°2	N°1 and N°2
R Pitch Trim		N°1 or N°2	N°1 and N°2
FWC (Flight Warning Computer)		N°1 for AP 1 N°2 for AP 2	N°1 and N°2

- Below 100 ft RA, the CAT 3 landing capability is latched.

  The disconnection of one AP or the loss of the A/THR – SPD mode, or the loss of any required equipment, does not cause a downgrading of the landing capability category.

FAULT ACCOMODATION/REVERSION

- If one ILS or Radio Altimeter receiver fails, the onside AP/FD disengages. The other AP/FD remains engaged in LAND mode.

  The same logic applies for any equipment failure which causes the loss of the ROLL OUT mode.

- If both Radio Altimeters or both ILS receivers fail, LAND mode disengages (reversion to basic V/S and HDG modes), both AP disengage (AP OFF warning), FD bars flash for 10 seconds and the landing capability downgrade warning (triple-click) is triggered.

  The same logic applies for any failure which causes the disengagement of both AP/FD.

- In GS green or LOC green mode (tracking phase), the non-reception of the glide slope or localizer signal causes :
  - the activation of the glide slope or localizer excessive deviation warning,
  - the flashing of the pitch or roll FD bar,
  - the AUTO LAND warning activation (if below 200 ft RA).

- If the DC BUS Tie Contactor fails to open (no AP1 and AP2 electrical power segregation), the second AP can be engaged but the landing capability category will be CAT2 only.

FUNCTION

- The GO AROUND mode is a combined mode that provides vertical and lateral guidance for go-around :
  - The vertical guidance mode is SRS.
  - The lateral guidance mode is HDG.

On the FMA, GO AROUND is displayed, but SRS and HDG are not.

  Note : *For SRS mode, refer to section 1.03.41-TAKEOFF MODES*

- The A/THR mode associated to the GO AROUND mode is THR.

ENGAGEMENT AND OPERATION

- GO AROUND mode is engaged by triggering the Go-levers :
  - If the Go-levers are triggered in flight :
    - GO AROUND mode engages provided the SLATS/FLAPS handle is in the 15/0 position (or more extended).
    - If a GO AROUND is initiated with the AP engaged in CMD and the aircraft touches down during the go-around maneuver, the AP remains engaged in CMD and GO AROUND mode.
  - If the Go-levers are triggered within 30 seconds after touchdown :
    - following a manual landing, GO AROUND mode engages,
    - following an automatic landing, GO AROUND mode does not engage.
  - If the Go-levers are triggered more than 30 seconds after touchdown (with slats at 15° or more), TAKEOFF modes activate, and the AP disengages (if engaged).

Note : *If Go-levers are triggered in flight with the slats/flaps lever in 0/0 position, the ATS Thrust Latch mode (THR L on FMA) engages but the AP/FD guidance does not change.*

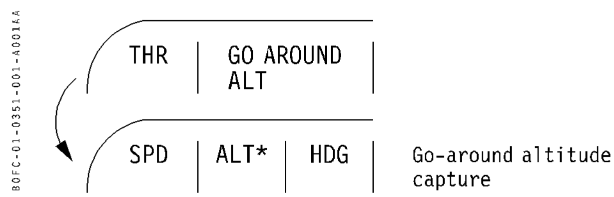
- GO AROUND mode engagement is indicated on the FMA only.
- If both AP were in CMD for the approach, both stay engaged during the go-around, as long as GO AROUND mode remains engaged.

Note 1 : *The GA thrust limit on the TRP is automatically selected when slats are selected to 15/0, and at least one AP/FD is engaged.*

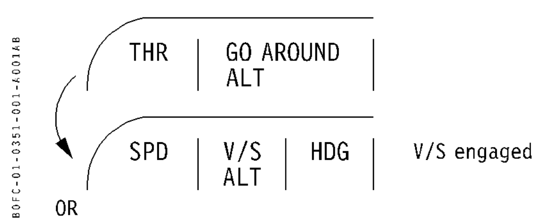
Note 2 : *If the FPV is displayed on the PFD when GO AROUND mode engages, it is automatically replaced by the FD bars.*

MODE TRANSITIONS

- An automatic mode transition occurs (GO AROUND mode disengages) when the aircraft reaches the go-around altitude. Altitude capture (ALT*) and HDG mode engage.



- When GO AROUND mode disengages, AP2 disengages if both AP were engaged.
- A manual mode transition occurs if a **new vertical mode** is engaged (V/S, ALT, LVL/CH, ALT* or R
  PROFILE when in NAV) : R
  - GO AROUND mode disengages,
  - the selected vertical mode engages,
  - the HDG mode is annunciated on the FMA (but was already engaged for the go-around lateral guidance),
  - the A/THR mode associated with the selected vertical mode engages.



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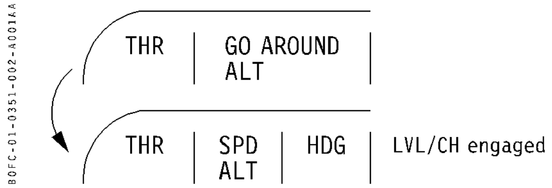
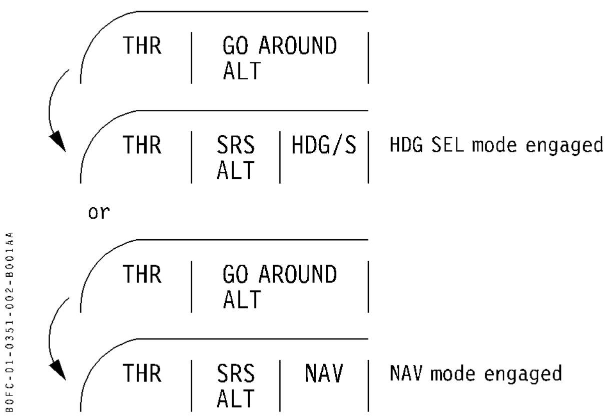


- A manual mode transition occurs if a **new lateral**
R **mode** is engaged (HDG SEL, NAV) :
  - GO AROUND mode disengages,
  - the SRS mode is annunciated on the FMA (but was already engaged for the go-around vertical guidance),
  - the selected lateral mode engages,
  - the A/THR THR mode remains engaged.



R *Note : The V/L and LAND modes must not be used*
R *to manually disengage the GO AROUND*
R *mode.*

FUNCTION

- The PROFILE mode couples the Flight Management System (FMS) to the AP/FD and to the A/THR (AUTO mode on TRP) for vertical guidance along the FMS vertical flight plan (F-PLN).
- In PROFILE mode, the vertical guidance orders and the thrust are computed by the Flight Management Computer (FMC) and executed by :
  - the AP/FD (P.CLB, P.ALT, P.DES modes) for maintaining the required speed, altitude, flight path or vertical speed,
  - the A/THR (P.THR, P.SPD, RETARD modes) for maintaining the required thrust or speed.
- The PROFILE mode may be used without the A/THR being engaged (i.e. with MAN THR setting).

ENGAGEMENT AND OPERATION

- The PROFILE mode can be armed (at takeoff) or engaged at any time by pressing the PROFILE pushbutton.
- When PROFILE mode is armed at takeoff (P.CLB blue on FMA), PROFILE (P.THR / P.CBL green on FMA) automatically engages at the thrust reduction altitude (i.e. at 1500 ft AGL or higher, as set in the FMS TAKEOFF page).
- If not initially armed, PROFILE mode can be manually engaged after passing the thrust reduction altitude at any time during climb (P.CLB on FMA), cruise (P.ALT on FMA) and descent (P.DES on FMA).
- When PROFILE mode is engaged, altitude changes are initiated by setting the new cleared altitude on the FCU, and by pulling the ALT SEL knob.
- When PROFILE mode engages,
  - the SPD/MACH window is dashed (speed/Mach is controlled by the FMS, the FMS target speed is indicated on the PFD speed scale by the blue index),
  - the TRP AUTO key illuminates (TRP thrust limit is controlled by the FMS).
  - In climb or descent the TRP TARGET window displays the FMS-computed target thrust.
- The A/THR modes associated to the PROFILE mode are :
  - P.THR in climb and for descent initiation, to maintain the target thrust commanded the FMS,
  - P.SPD in cruise to maintain the target speed commanded by the FMS or in descent if speed or altitude constraints have to be achieved,
  - RETARD during idle descent.
- PROFILE mode arming/engagement is indicated on the FMA and by the illumination of the PROFILE pushbutton switch.
- The operating envelope of the PROFILE mode is from 1500 ft AGL at takeoff to :
  - GS capture (GS*), for a precision approach,

  or

  - the Final Approach Fix (FAF) or the Final Descent Point, for non-precision approach.
- **PROFILE mode is not allowed for use on final approach (i.e. after the FAF or the Final Descent Point or 1000 ft AGL, whichever is earlier).**
- In PROFILE mode, the speed is controlled to remain between V_{LS} (Green Dot, if in ECON mode) and below V_{MAX} provided speed brakes are retracted at the end of descent. R R

DISENGAGEMENT

- The PROFILE mode is disengaged by pulling the SPD/MACH knob (SPD/MACH window synchronizes on the present aircraft speed).

  Pulling the SPD/MACH knob results in a manual reversion from **managed modes** to **selected modes** :
  - LVL/CH mode in climb or descent,
  - ALT mode in level flight.
- The SPD knob can then be turned to select the desired target speed.

MODES TRANSITIONS

- The automatic mode transitions sequence over a complete flight conducted in PROFILE mode, is as follows :

Thrust mode	Vertical mode	
MAN THR	V/S P.CLB	PROFILE armed during taxi (A/THR not engaged)
THR	SRS P.CLB	Go-levers triggered for takeoff
P.THR	P.CLB	PROFILE engagement (at thrust reduction altitude), AUTO engages on TRP
P.SPD	P.CLB	Entering level-off altitude capture
P.SPD	P.ALT	Reaching level-off altitude
P.SPD	P.ALT P.DES	Before TOD, target altitude selected and ALT SEL knob pulled. P. DES flashes during 30s before reaching TOD.
P.SPD	P.DES	Passing Top-of-Descent (TOD)
P.THR	P.DES	Initial descent
RETARD	P.DES	In descent at idle (no constraint)
P.SPD	P.DES	In descent according to FMS speed or altitude constraint
P.SPD	P.ALT G/S	G/S intercept
SPD	GS*	GS capture PROFILE mode disengages

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- The altitude capture range (automatic transition from P.THR / P.CLB to P.SPD / P.CLB) varies depending on the aircraft vertical speed (the capture range increases with increasing vertical speed).

  In PROFILE climb with 2000 ft/mn vertical speed, the capture phase is initiated approximately 300 ft before the selected altitude.

- A manual mode transition can be initiated by selecting another vertical mode, the transition sequence is as follows :
  - If V/S mode is selected by pulling the V/S knob :

CLIMB		**DESCENT**	
P.THR	P.CLB	RETARD	P.DES
SPD	V/S ALT	SPD	V/S ALT

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  - If LVL/CH mode is selected by :
    - pulling the SPD/MACH knob in climb or descent,
    - or by pressing the LVL/CH pushbutton.

CLIMB		**DESCENT**	
P.THR	P.CLB	P.THR	P.DES
THR	SPD ALT	RETARD	SPD ALT
		A/THR	SPD ALT

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  - If ALT HLD mode is selected by :
    - pulling the SPD/MACH knob in level flight,
    - or by pressing the ALT.HLD pushbutton.

P.SPD	P.ALT
SPD	ALT

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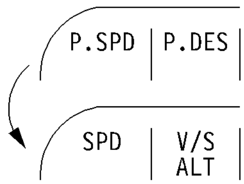
MODE REVERSIONS

- A manual mode reversion from PROFILE to V/S (basic vertical mode) can be performed by pressing the PROFILE pushbuton.

  The FMA mode reversion sequence is as follows :



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- In descent, automatic reversions from RETARD / P.DES to P.SPD / P.DES or from P.PSD / PDES to RETARD / P.DES occur when speed or altitude constraints have to be met or if the airspeed is below or above defined guidance limits.

- In P.DES mode, depending on the prevailing constraint or condition, the vertical guidance :

  – maintains the computed flight path (Path),

  or

  – maintains the computed target speed (SPD),

  or

  – maintains the present aircraft vertical speed (V/S).

  In the FMA illustrations provided hereafter, (Path), (V/S) or (SPD) indicates the applicable guidance - but is not displayed on the FMA.

- An automatic reversion from RETARD / P.DES to P.SPD / P.DES occurs if :

  – an ALT CSTR must be met,

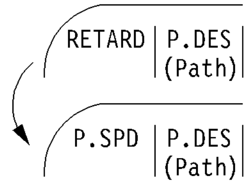
  – a SPD CSTR must be met,

  – IAS is greater than the target speed + 20 kt,

  – IAS is lower than the target speed – 20 kt,

  – IAS is lower than Green Dot – 10 kt.

  The FMA mode reversion sequence is as follows :



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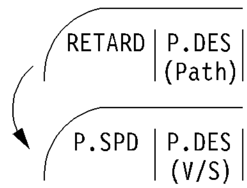
- An automatic mode reversion from RETARD / P.DES to P.SPD / P.DES occurs if a revision of the F-PLN is performed (as temporarily, the FMS cannot refer to any flight profile reference for flight path guidance) :



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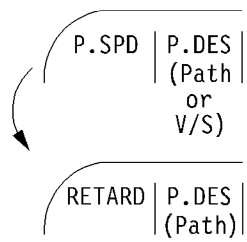
- When the conditions requiring a tight speed control (P.SPD mode) no longer exist, an automatic reversion from P.SPD / P.DES to RETARD / P.DES occurs :



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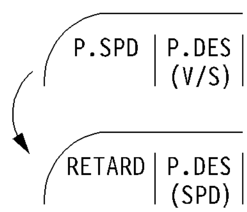
- An automatic reversion from P.SPD / P.DES to RETARD / P.DES occurs if the airspeed exceed VMO – 5 kt, when in IMM DES :



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- A similar automatic reversion from P.SPD / P.DES to RETARD / P.DES occurs if :

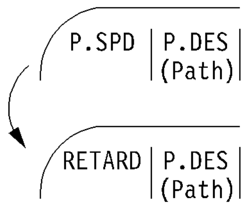
  – IAS is greater than the target speed + 15 kt,

  or

  – IAS is greater than VMAX – 2 kt

R or

R – Speed brakes extended



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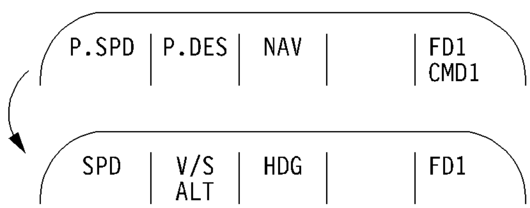
- An automatic mode reversion from PROFILE to V/S mode occurs if the FMC associated to the engaged AP fails.

  The AP disengages, the FD remains engaged in V/S mode.



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FUNCTION

- The NAV mode couples the Flight Management System (FMS) to the AP/FD for lateral guidance along the FMS lateral flight plan (F-PLN).

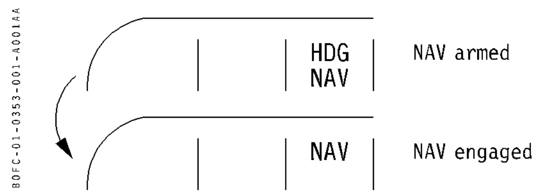
ENGAGEMENT AND OPERATION

- The NAV mode can be armed or engaged (NAV blue or NAV green on FMA) by pressing the NAV pushbutton.
- If the NAV mode is armed for takeoff, NAV automatically engages when passing 30 ft AGL.
- If not armed before takeoff, NAV mode can be manually engaged after passing 30 ft at any time, provided there is an active leg in the FMS F-PLN.
- In flight, when the NAV pushbutton is pressed :
  - NAV immediately engages if the aircraft is within the capture band of the active leg (i.e. if R the present aircraft track is within 10 nm from the FMS active F-PLN leg),
  - NAV arms if the present aircraft track is more than 10 nm away from the active leg, then NAV engages when the aircraft enters the capture band of the active F-PLN leg.
- When NAV is armed (NAV blue on the FMA), the AP/FD uses the support of another lateral mode (HDG, RWY, HDG/S or VOR) to guide the aircraft towards the capture band of the active F-PLN leg.

  At the capture point, NAV mode engages (NAV green on FMA) and the aircraft is guided towards the active F-PLN leg with a 45° intercept angle.
- When NAV mode is engaged, the HDG SEL window displays the last manually selected heading.
- To capture or maintain the FMS course in NAV mode, the bank angle is determined by the FMS regardless of the position of the Bank Angle Limit selector.

Note : With NAV mode engaged or disengaged, it is always possible to view the FMS flight plan course, and the aircraft's position relative to this course, on the ND, by selecting MAP or PLAN on the EFIS control panel. R

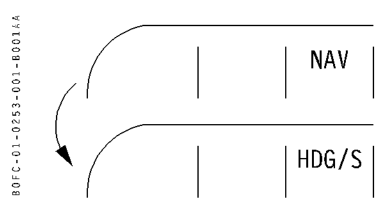
- NAV mode arming and engagement is annunciated on the FMA and is indicated on the FCU by the illumination of the NAV pushbutton switch.



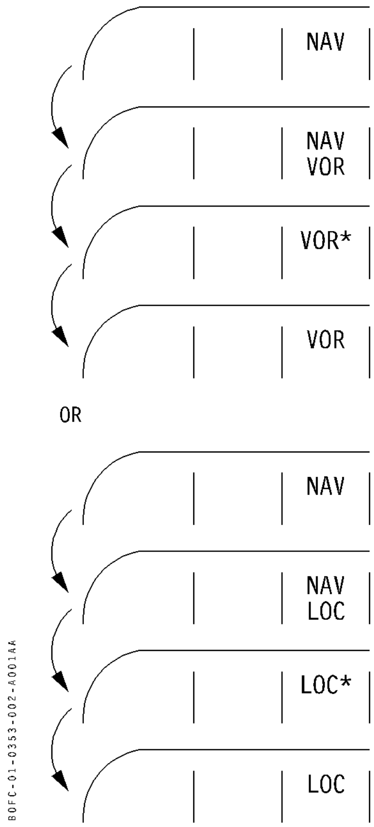
- The operating envelope of the NAV mode is from 30 ft AGL at takeoff to :
  - LOC capture (LOC*) for a precision (ILS) approach or for a LOC-only approach,
  - MDA-MDH for other types of non-precision approaches.

MODE TRANSITIONS

- A manual mode transition can be initiated by selecting another lateral mode, the transition sequence is as follows :
  - If HDG/S mode is selected :

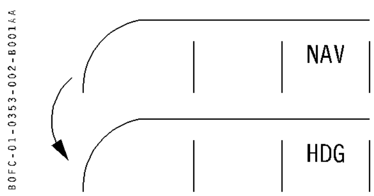


– If V/L (VOR/LOC) mode is selected :



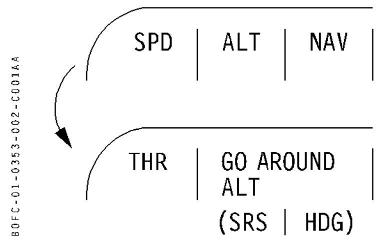
MODE REVERSIONS

- A manual mode reversion from NAV mode to HDG mode (basic lateral mode) occurs if the NAV pushbutton is pressed a second time.



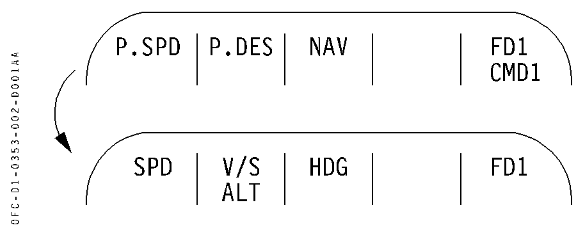
- When in NAV mode, if a given heading has to be maintained (e.g. upon ATC request) a manual reversion from NAV mode to HDG/S mode can be performed by using the Push-Pull-Turn technique (refer to section 1.03.46 - HEADING SELECT MODE)

- An automatic mode reversion from NAV mode to HDG mode occurs if a go-around is initiated, however HDG is not indicated on FMA :



- An automatic mode reversion from NAV mode to HDG mode occurs if the FMC associated to the engaged AP fails.

  The AP disengages, the FD remains engaged in HDG mode.



TO BE ISSUED LATER

LEFT BLANK INTENTIONALLY

GENERAL

The auxiliary power unit is a self-contained unit which makes the aircraft independent of external pneumatic and electrical power supply.

- **On ground** :

  Provides bleed air for starting the engines and to supply
R the air conditioning system of the aircraft.
  Provides electrical power to supply the aircraft network.

- **During Takeoff** :

  Supply of bleed air for air conditioning and wing anti-icing, in this way avoiding engine thrust reduction caused by use of engine bleed air, if optimum aircraft performance is required.

- **In Flight** :

  Provision of back-up power for :
  – electrical system (below 41,000 ft)
  – air conditioning (below 20,000 ft)
  – wing anti-incing (below 20,000 ft).

For APU start and operation only electrical power (batteries, AC emer inverter), and fuel supply at positive pressure are required.

Under normal conditions APU starting is permitted throughout the operating speed range up to 41,000 ft pressure altitude.

APU starting on battery only, is permitted up to 20,000 ft.

The APU fuel consumption with bleed air extracted and generator under load may be averaged at 200 kg/h on ground. In flight consumption is lower than consumption on the ground.

APU RUNNING indication is displayed on the ECAM MEMO page.

APU ENGINE

The basic element of the APU is the gas turbine which delivers mechanical shaft power for driving the accessory gearbox and produces bleed air for engine starting and for pneumatic system supply.

It consists of three main components :

– The power section has a two-stage centrifugal compressor driven by a three-stage axial turbine governed to a constant speed by variation of fuel flow which is controlled by the fuel control unit (FCU) and the electronic control box (ECB).

– The load compressor has a single-stage centrifugal compressor directly driven by the power section and delivers bleed air to the aircraft pneumatic system, controlled by modulating inlet guide vanes.

– The accessory gearbox is directly driven by the power section and carries the fuel control unit, lubrication pumps, AC generator, cooling air fan and starter motor.

AIR INTAKE SYSTEM

The air intake system, consisting of the air intake, diffuser and elbow, ducts the external air to compressor inlet.

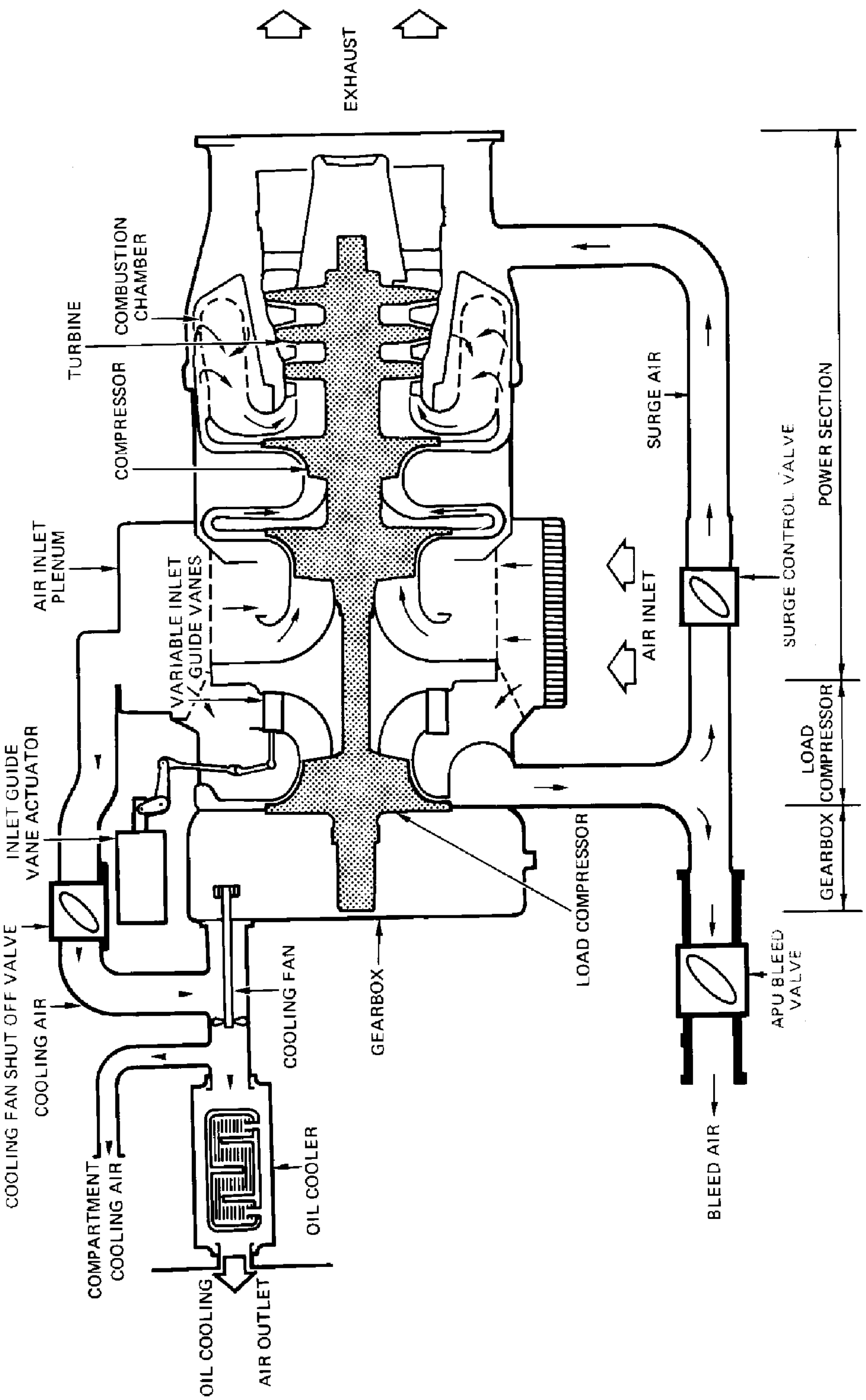
An electrically operated flap, is automatically controlled by the landing gear position :

– on ground, with the landing gear down and locked, the flap is in the retracted position, the air intake is fully open, R

– air intake flap is closed during flight when the APU is not being used.

Code : 0092

APU ENGINE



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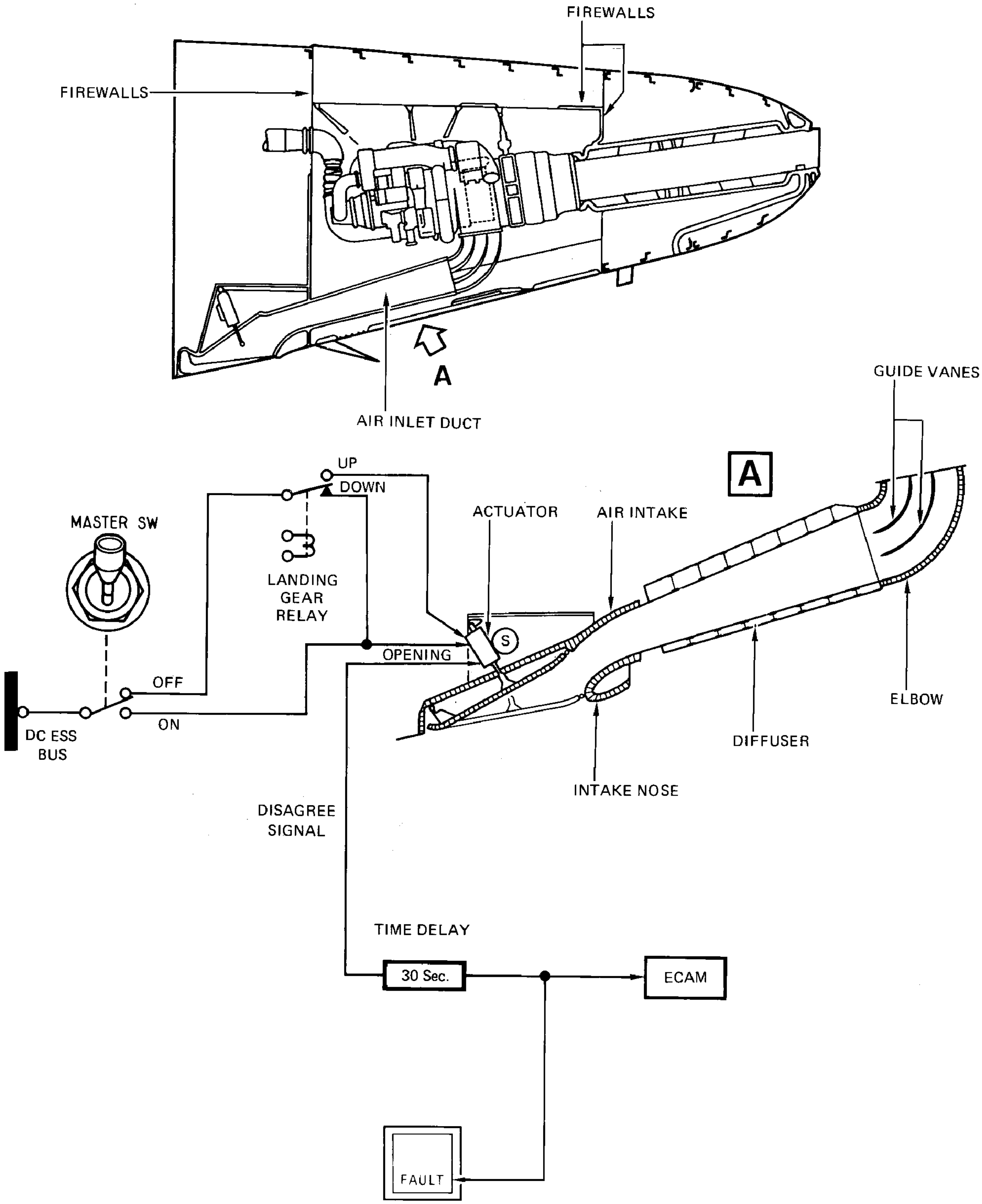
Vers. : All Eng. : All

APU ENGINE – AIR INTAKE



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Vers. : All Eng. : All

GENERAL

Normal fuel supply for the APU is from the left wing tanks. To use fuel from the right wing tanks the crossfeed valve must be opened.

The required positive pressure for the APU is available via tank or APU fuel pump.

Fuel flow to the APU is controlled normally by the isolation valve. In case of fire, the fuel supply is interrupted by the fire shut-off valve additionally.

FUEL FEED

A Centrifugal LP pump, installed in the crossfeed line, is electrically supplied by the AC EMER BUS.

When the APU MASTER SW is selected to ON and :

– **FUEL PUMP** pushbutton switch is selected AUTO,

  The pump is activated automatically when the pressure in the supply line is below 22 PSI. When the tank pumps are operating, the APU pump will not operate since tank pump pressure output exceeds 22 PSI.

– **FUEL PUMP** pushbutton switch is OVRD,

  The pump is continuously in operation.

An isolation valve is installed downstream of the LP pump. When the APU is not in operation the valve is closed to prevent the fuel line from being pressurized.

A fire shut-off valve upstream of APU compartment firewall is controlled by the APU FIRE handle (overhead panel) and, on ground by the automatic APU fire extinguishing system. The valve position is indicated by the LP VALVES APU indication on the fuel panel.

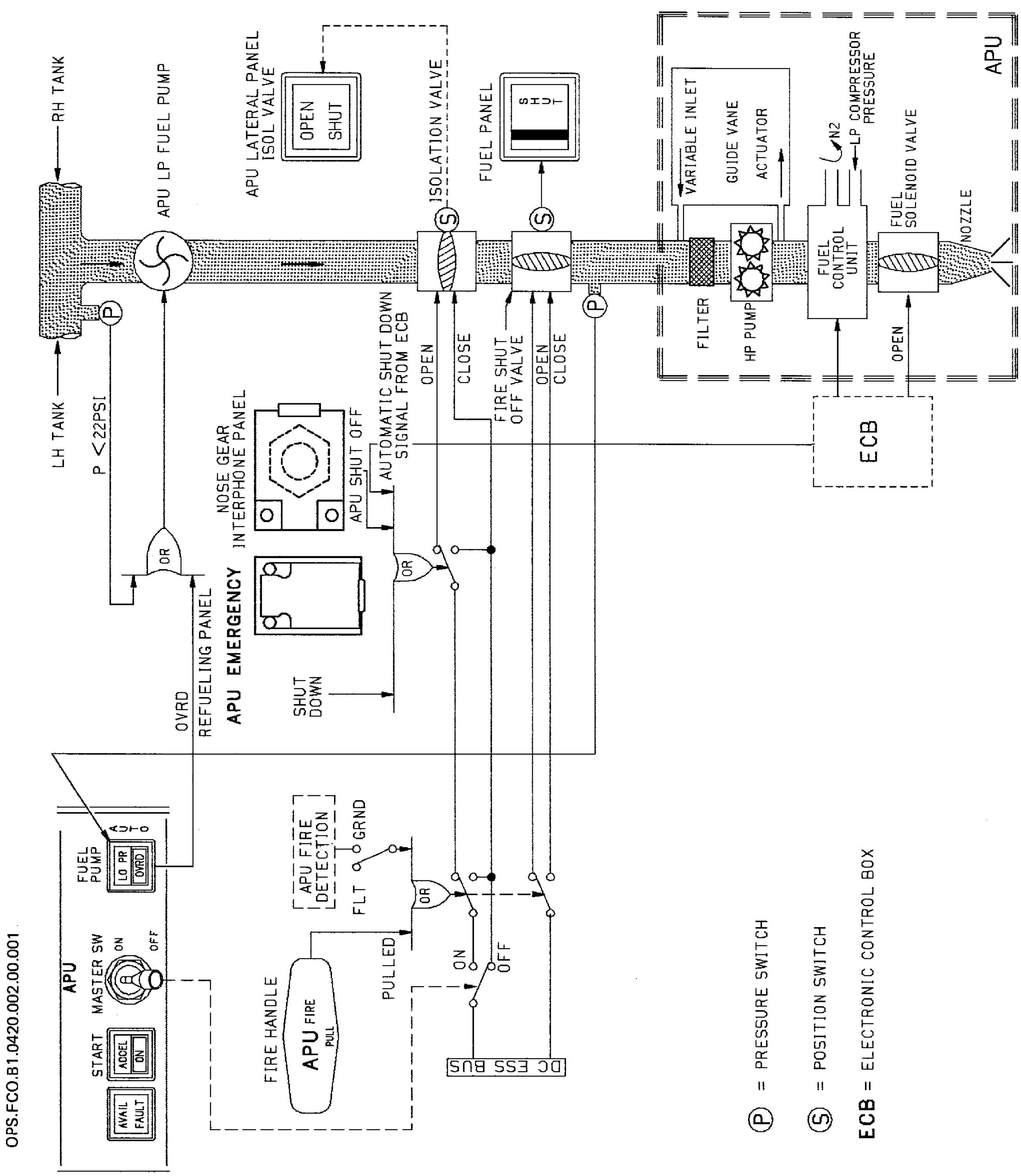
The LO PR light in the FUEL PUMP pushbutton switch on the APU panel comes on when the pressure switch downstream the fire shut-off valve senses the fuel pressure below 6 PSI.

APU FUEL CONTROL

High pressure fuel is delivered to the fuel control by the HP pump driven by the accessory gearbox. The fuel control unit operates hydromechanically.

To allow the proper amount of fuel in each operating condition mechanical, pneumatic and electronic signals are processed by the fuel control unit. The metered fuel is injected into the combustor through two manifolds, each with nine atomizing nozzles.

FUEL SYSTEM



Vers. : All Eng. : All

The APU utilizes an integral independent lubrication system for lubrication and cooling the APU, accessory gearbox and oil cooled generator.

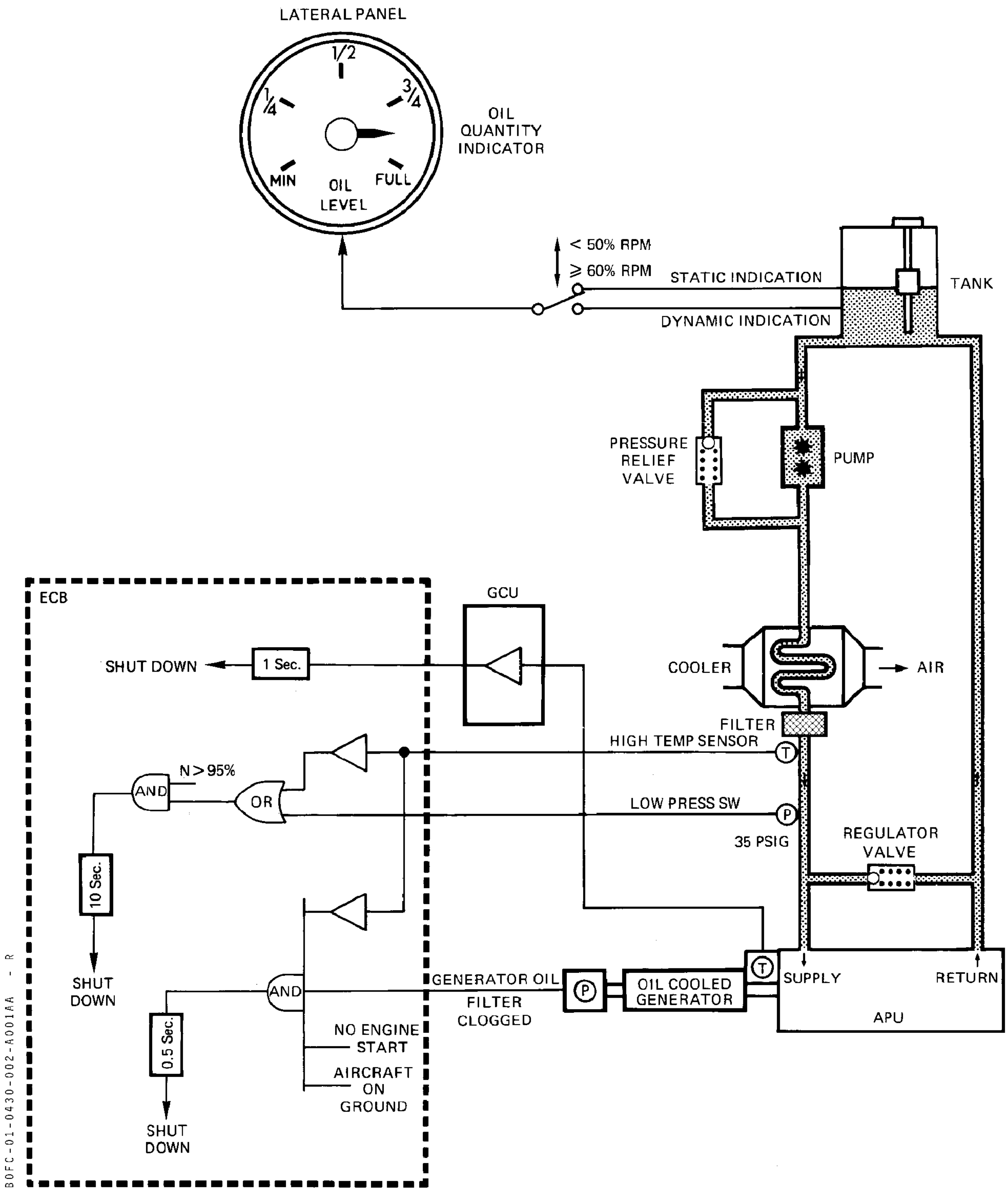
The oil level indicating system consists of an oil level transmitter and indicator. The transmitter is installed into the sump oil level. The indicator is installed on lateral panel and provides an indication of oil level from MIN to FULL divided into four quarters.

Because, during APU running, the oil level in the sump will be less than when the APU is not running, the transmitter has a dynamic and a static operating mode, provided by à 60 % relay.

OIL SYSTEM

R

R



The fully automatic bleed air system supplies and controls air bleed from the load compressor for the pneumatic system.

The APU bleed air system is separated from the aircraft pneumatic system by a bleed check valve and the APU load control valve, which is a shut-off butterfly valve, spring loaded normally closed when the APU is inoperative, pneumatically powered and controlled by the electronic control box and the APU bleed control switch.

The amount of air supplied by the APU, in accordance with aircraft system demand is determined by the inlet guide vanes position.

The position is in response to an electrical voltage signal from the electronic control box. For extensive bleed air demand during main engine start and wing de-icing the APU speed increases.

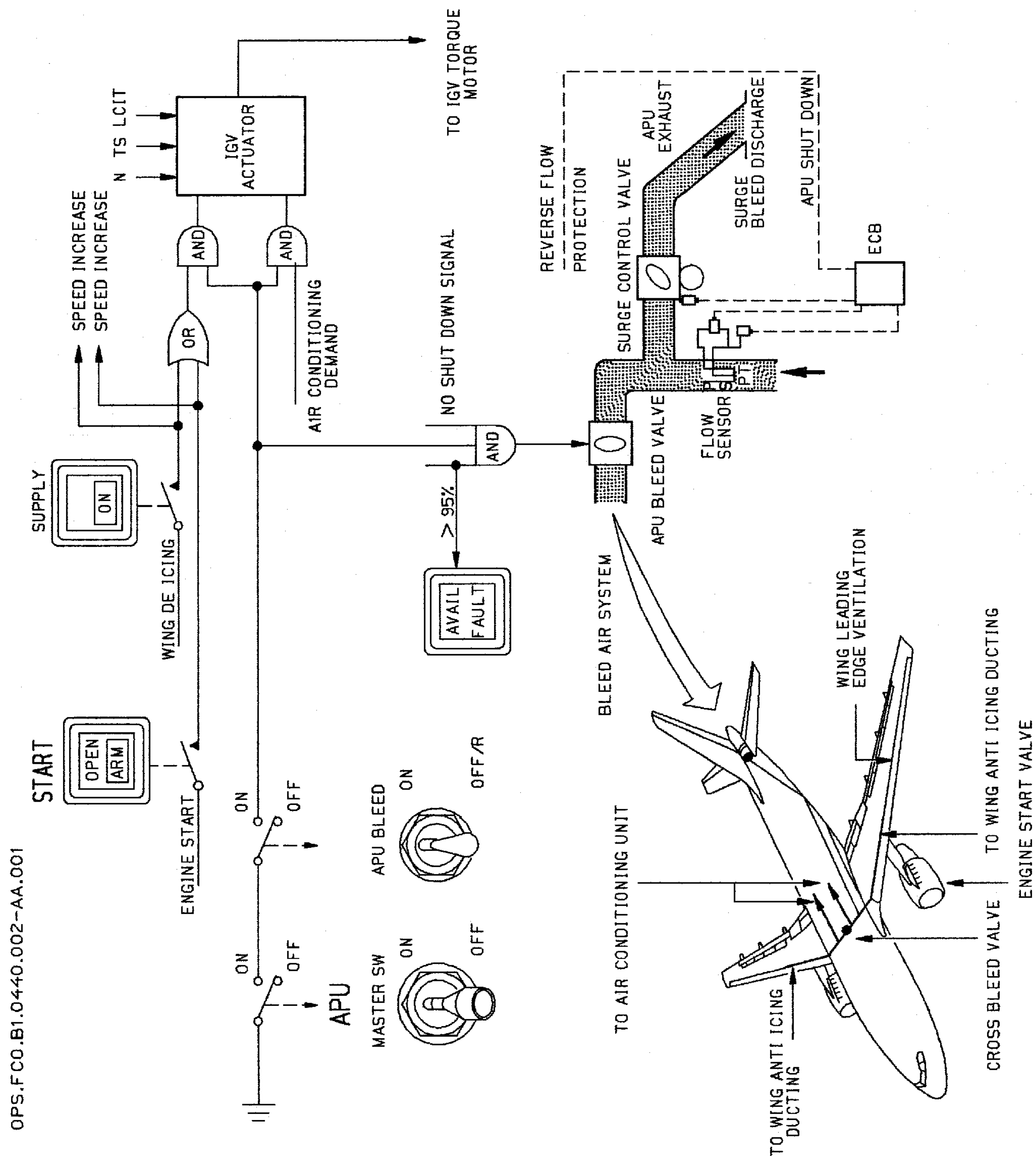
The speed is controlled by the electronic control box. A surge valve, installed between the compressor and the APU load control valve, ensures that sufficient air is diverted from the load compressor to maintain an adequate surge margin.

Surge air flow is discharged in the tailpipe. A load compressor inlet temperature sensor monitors the compressor inlet temperature as a means of sensing reverse flow.

An increase of temperature, as a result of reverse flow, will initiate an APU shut down to protect the unit against damage.
Additionally the bleed air system will be monitored via the system CRT.

BLEED AIR SYSTEM

R
R
R



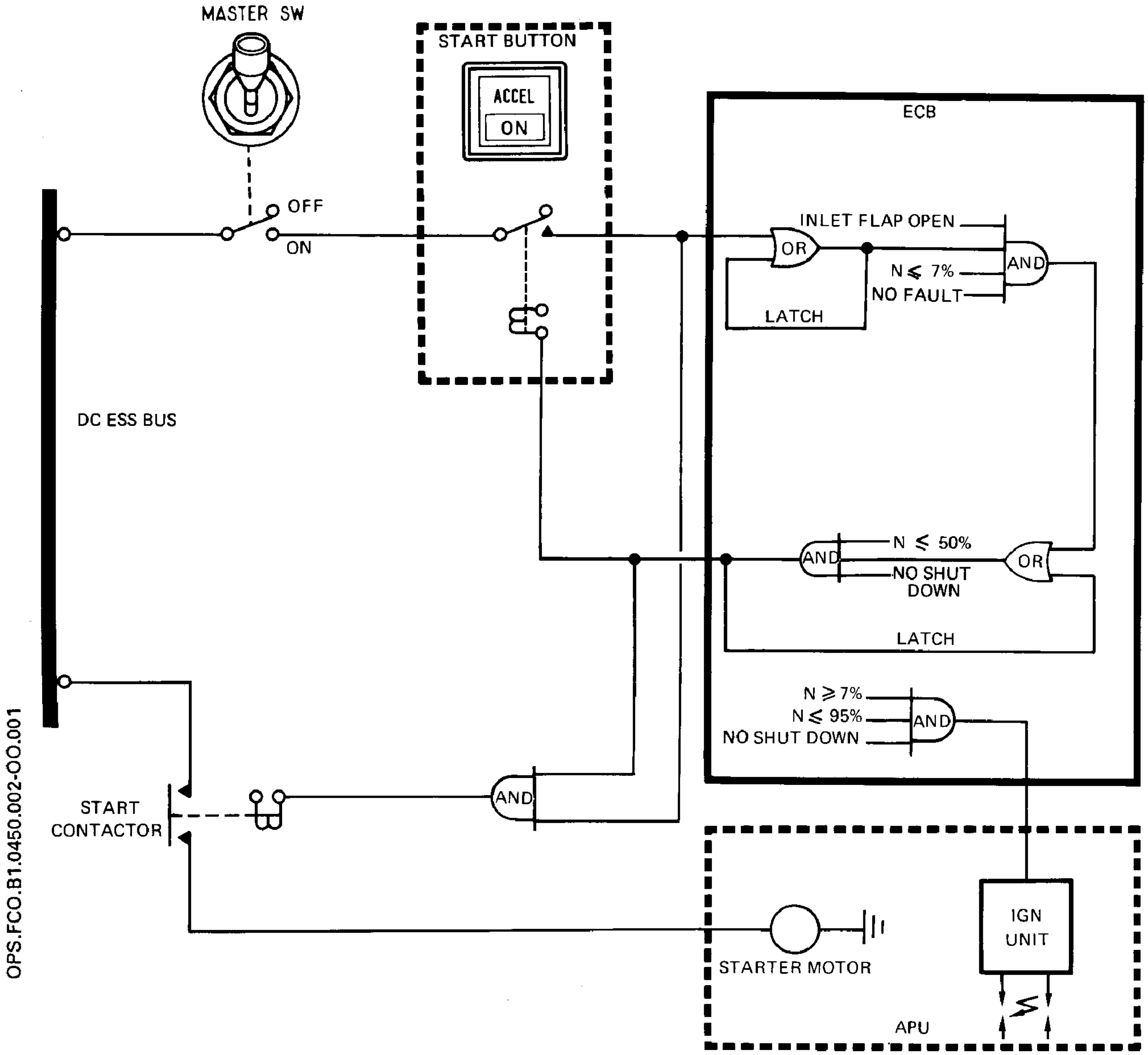
R With landing gear DOWN, the APU air intake flap is
R continuously opened.
R – Select APU MASTER switch ON :
R • with landing gear UP, APU air intake flap opens.
R • APU FUEL PUMP pushbutton switch LO PR light is off.
R – Press the APU START pushbutton switch to initiate the automatic start sequence :

Then the automatic start sequence begins :

- The white ON light in the START pushbutton switch comes on.
- The start output of the ECB energizes the starter motor
- When 7 % rpm are reached
  - the blue integrated ACCEL light comes on
  - the ECB energizes the igniters, and initiates the fuel supply.
- At 50 % rpm :
  - the starter motor is switching off
  - the START p/b switch drops out and the white ON light goes off.
- The APU continues to accelerate up to the normal regulated speed.
- At 95 % rpm :
  - the blue AVAIL light comes on
  - the blue ACCEL light goes off.

Note : *The start is inhibited as long as the air intake flap is closed.*
After an AUTO shutdown the MASTER switch has to be selected OFF then ON for resetting before a new start attempt.

STARTING SYSTEM



Vers. : All Eng. : All

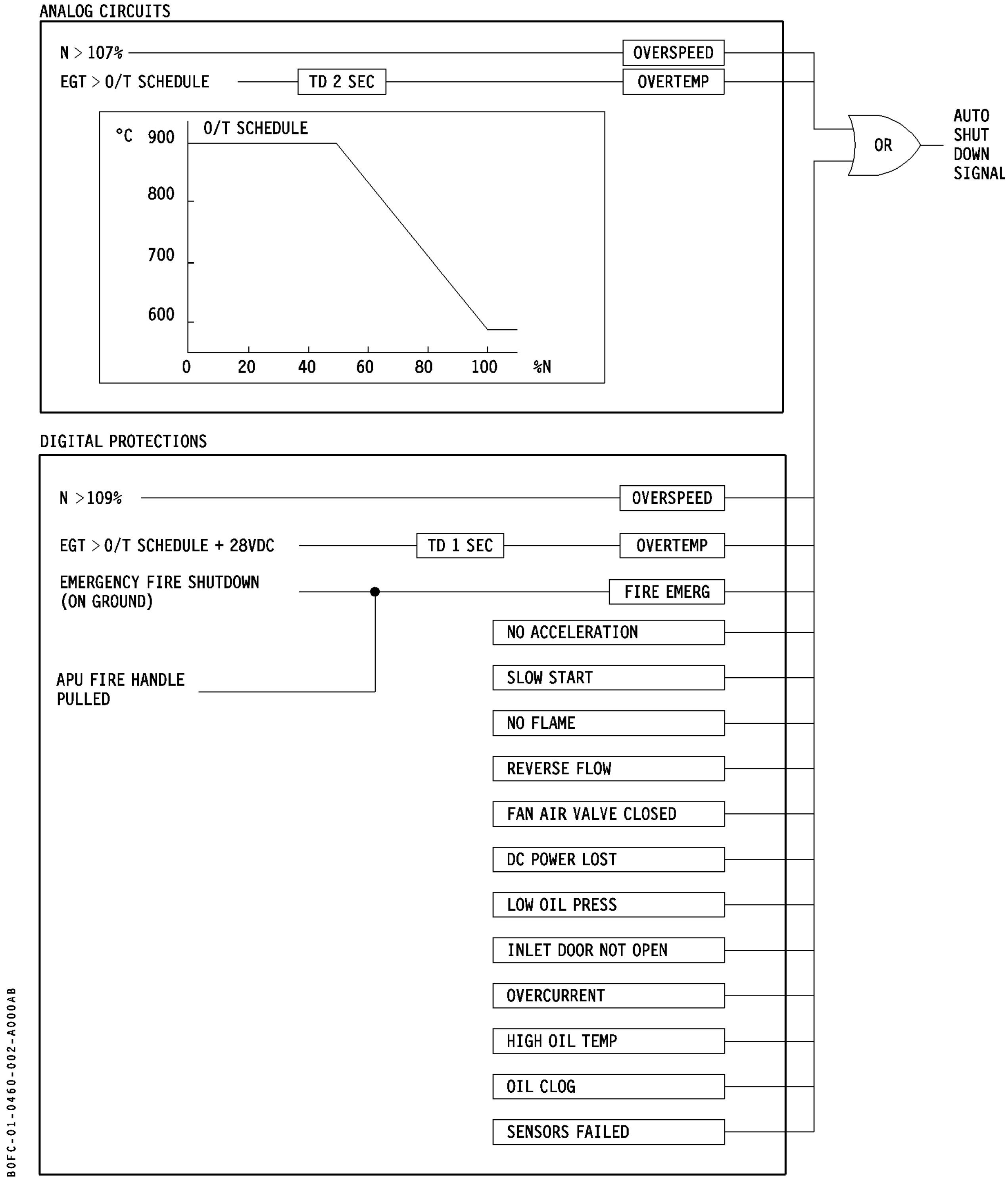
R The electronic control box (ECB) is primarily a full authority digital electronic APU-controller that performs the bulk of the APU system logic for all modes of engine operation including self-testing, shutdown protection and continuous monitoring of essential APU parameters as follows :

- Sequence of start
- Monitoring of start
- Monitoring of speed (RPM)
- Monitoring of operating temperature (EGT)
- Sequence of stopping
- Automatic stop
- Monitoring of bleed air

Speed is monitored according to bleed air demand :

DEMAND	CONDITION	% RPM
NO LOAD	APU BLEED SWITCH OFF/RESET	100 %
ENGINE START (MES)	START P/B SWITCH SELECTED ON	101.4 %
AIR COND	APU BLEED SWITCH SELECTED ON	100 %
WING ANTI-ICE	WING ANTI-ICE SUPPLY P/B SWITCH SELECTED ON	102.5 %

AUTO SHUT DOWN LOGIC



R
R

To permit APU ground operation without constant supervision provisions for automatic fire extinguishing are installed.

If an APU fire is detected by the fire detection circuits, simultaneously :

– the cockpit APU fire warnings, a red light on the nose gear interphone panel and a horn in the nose gear bay are activated,

– the automatic APU shutdown is initiated,

– the fuel fire shut-off valve closes.

– the isolation valve closes.

After 10 seconds delay :

– the fire extinguisher bottle is discharged.

The automatic shutdown is confirmed and the external horn is silenced by :

– pressing the APU EMERGENCY SHUTDOWN pushbutton on the Refuel/defuel panel, or

– pressing the APU SHUT-OFF pushbutton on the nose gear interphone panel, or

– pulling the APU FIRE handle on the overhead panel (will also silence CRC).

The remaining visual and aural warnings are cancelled when the fire is extinguished.

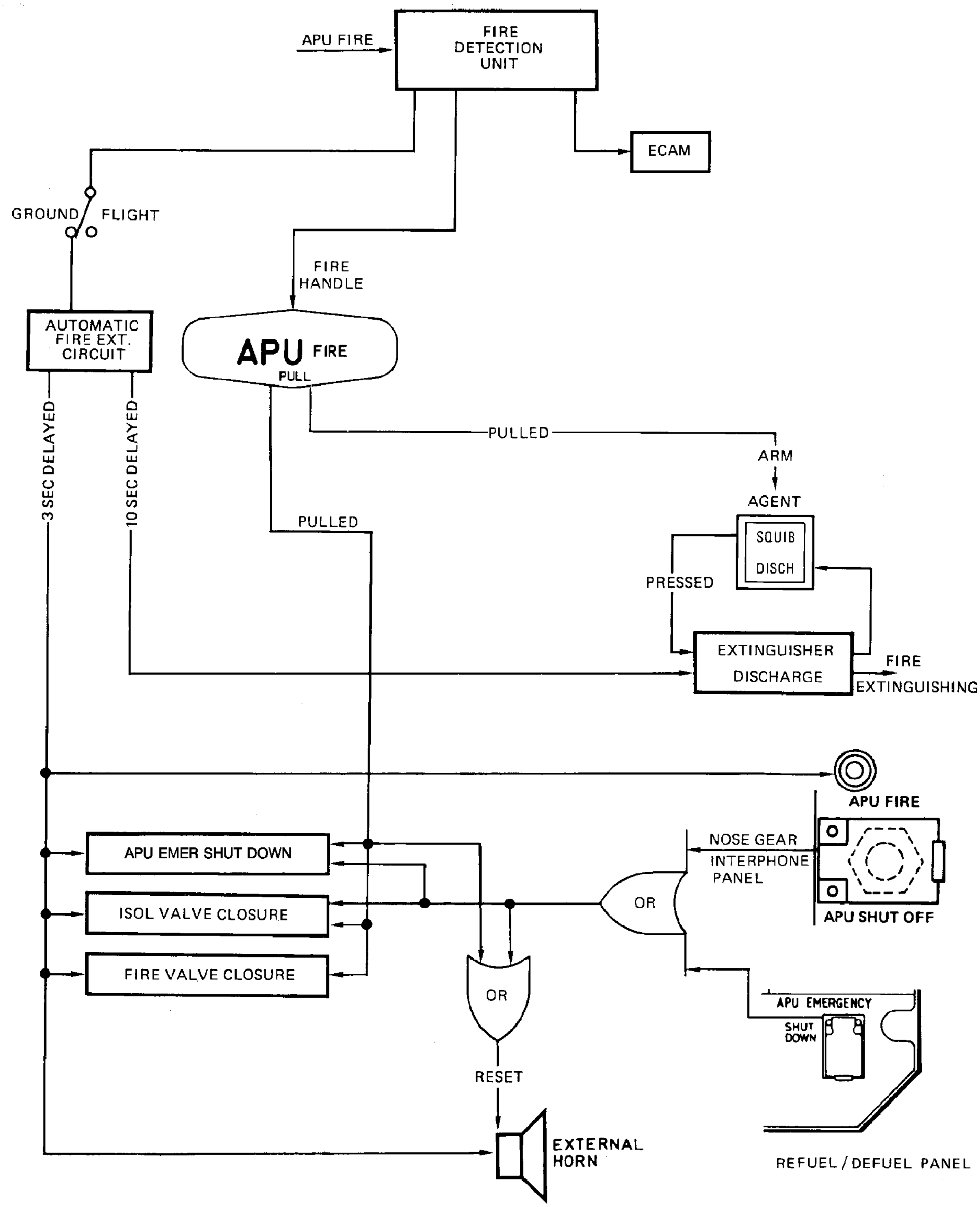
The pushbutton on the refuel/defuel panel and the pushbutton on the nose gear interphone panel also serve for APU shutdown from the exterior in other emergencies, if required.

Note : As soon as the DC ESS BUS is no more energized, the APU is shutdown. R

Mod. : 4540

GROUND OPERATION SAFETY DEVICE CONTROL LOGIC

R
R



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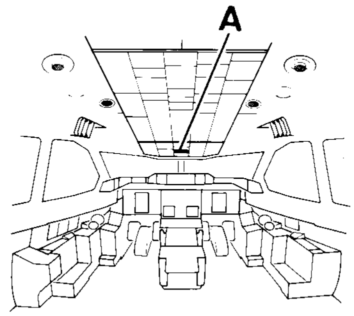
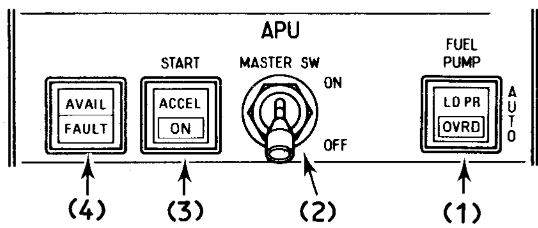
A. APU PANEL





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(1) FUEL PUMP Pushbutton-Switch

Selects the operation mode of the LP fuel pump.

- **AUTO (P/B switch pressed in)**

  The LP fuel pump operates automatically when the fuel pressure upstream of the pump is below 22 PSI provided that MASTER SW is selected ON and AC EMER BUS is supplied.

- **LO PR**

  The light comes on amber accompanied by ECAM when the APU MASTER SW is selected ON and the APU fuel pressure is below 6 PSI.

- **OVRD (P/B switch released out)**

  The LP fuel pump operates continuously provided that AC EMER BUS is supplied and MASTER SW is selected ON. OVRD white light comes on.

(2) MASTER SW

Controls basic power supply for APU starting, control and protection.

- **ON**

  Control and protection systems are energized. The fuel isolation valve opens, the LP fuel pump is armed or activated.
  The starting system is armed.
  In flight if gear is up the air intake flap opens.

Note : *When MASTER SW is selected ON and RPM > 95 % the indication APU RUNNING is displayed on the MEMO page of the warning display.*

- **OFF**

  APU is shutdown. (If the APU bleed valve was open when selecting OFF, the shutdown is delayed for 60 seconds to allow for a cooling period).
  The fuel isolation valve closes. LP fuel pump, starting control and protection systems are de-energized.

  When gear is up the air intake flap closes after 60 seconds when the RPM is below 7 %.

Note : *When selected OFF, shutdown is performed as an overheat signal then, EGT overlimit is displayed on ECAM.*

(3) START Pushbutton-switch

Initiates the starting sequence if the MASTER SW is selected ON.

- **ON (P/B switch pressed in.)**

  The starting sequence is initiated provided that the air intake flap is open. The ON light comes on white.
  The P/B switch remains latched. It is automatically released between 38 and 55 % RPM and the white ON R
  light extinguishes.

- **OFF (P/B switch released out)**

  Starting sequence is not initiated.

- **ACCEL**

  The light comes on blue when 7 % RPM are reached. It R
  extinguishes when 95 % RPM. R

(4) AVAIL/FAULT Lights

- **AVAIL** :

  The light comes on blue when the RPM reaches 95 % (the APU is ready to load).

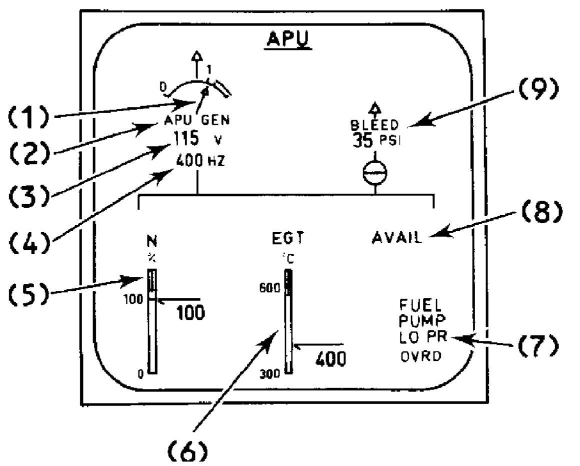
- **FAULT**

  The light comes on amber accompanied by ECAM when :

  . RPM is below 7 % and the air intake flap is not open within 30 seconds.

  . An APU automatic shutdown occurs, except when it is initiated by the MASTER SW.

SYSTEM DISPLAY



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(1) APU GEN Load Indication (green)

The APU GEN load is given in percent.
Above 110 %, the indication becomes amber.

The indication is replaced by a triangle (white) when the APU MASTER SW is selected OFF.

(2) APU GEN Indication (white)

The indication becomes amber when APU GEN P/B
R switch is selected OFF/R with the APU MASTER SW
R selected ON.

(3) APU GEN Voltage Indication (green)

R The APU GEN Voltage is displayed when the APU MASTER
R switch is ON.

Below 110 V the indication becomes amber.

Above 120 V the indication becomes amber.

The indication is replaced by OFF (white) when APU GEN P/B switch is selected OFF/R.

R

(4) APU GEN Frequency Indication (green)

The APU GEN frequency is displayed in Hertz when the R
APU MASTER switch is on and APU GEN pushbutton R
selected ON. R

Below 390 Hz the indication becomes amber.

Above 416 Hz the indication becomes amber.

R

(5) APU N% Indication (green)

The APU speed (RPM) is displayed in percent on a vertical scale.

Above 107 % the indication becomes amber.

(6) APU EGT Indication (green)

The APU Exhaust Gas Temperature is displayed in ° C on R
a vertical scale.

Above 540° C the indication flashes.

Above 585° C the indication becomes amber.

Note : *When the APU MASTER SW is selected OFF, the APU shut down is performed via the auto-shut down circuit for test purpose, and a full scale EGT deviation is momentarily displayed, independently of the real EGT value.*

(7) APU FUEL PUMP Indication (white)

- FUEL LO PR PUMP (amber) is displayed when a fuel low pressure is detected. R
- FUEL PUMP OVRD (green) is displayed when FUEL PUMP pushbutton switch is selected OVRD. R
- There is no indication displayed in normal operation or when APU MASTER SW is selected OFF.

(8) AVAIL indication (cyan)

The indication comes on when APU RPM is greater than 95 % and APU MASTER SW is selected ON.

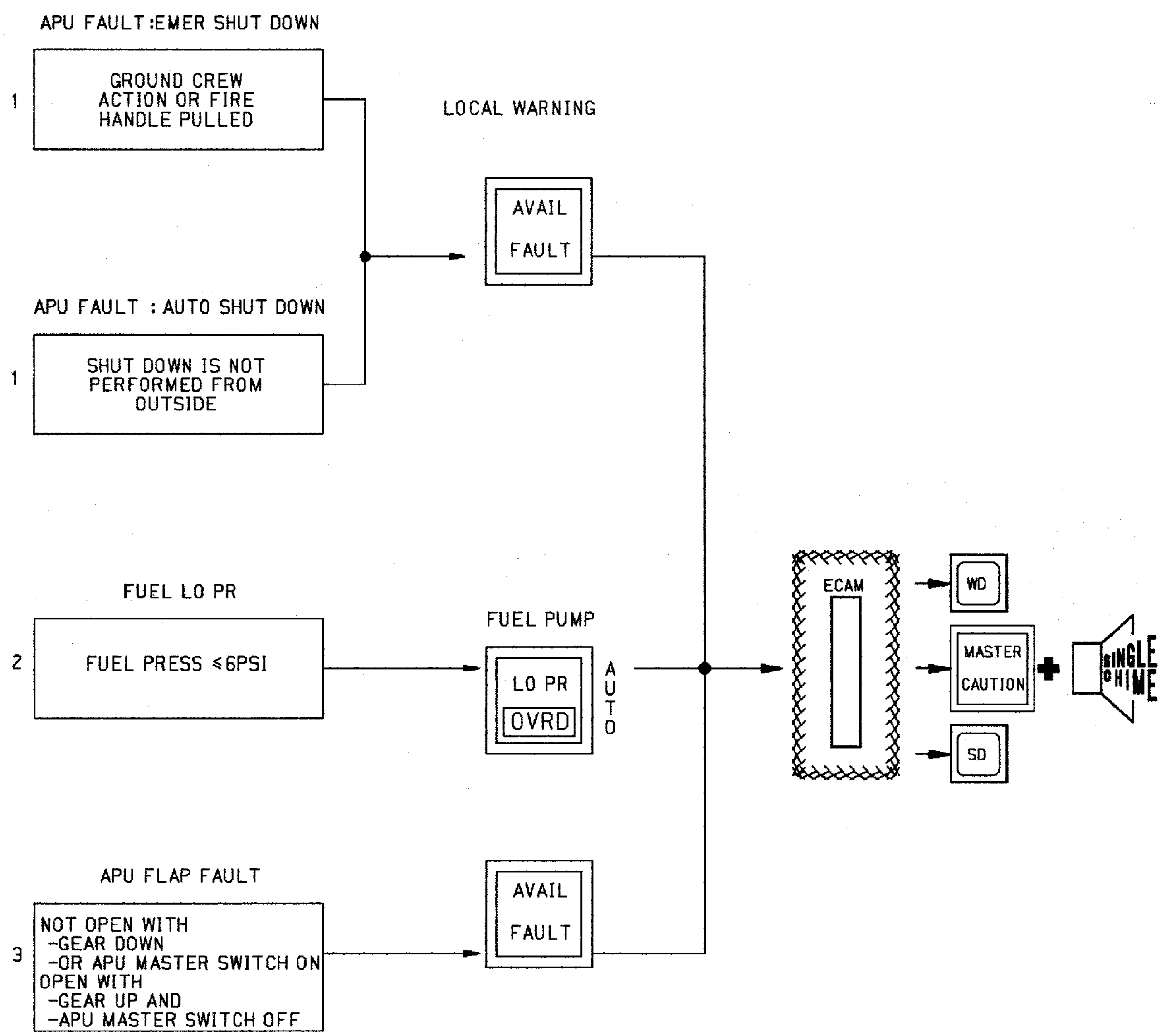
(9) APU BLEED Pressure indication (green)

The APU BLEED pressure is displayed in PSI when the R
APU BLEED valve is open. R

Above 57 PSI the indication becomes amber.

R

WARNING LOGIC



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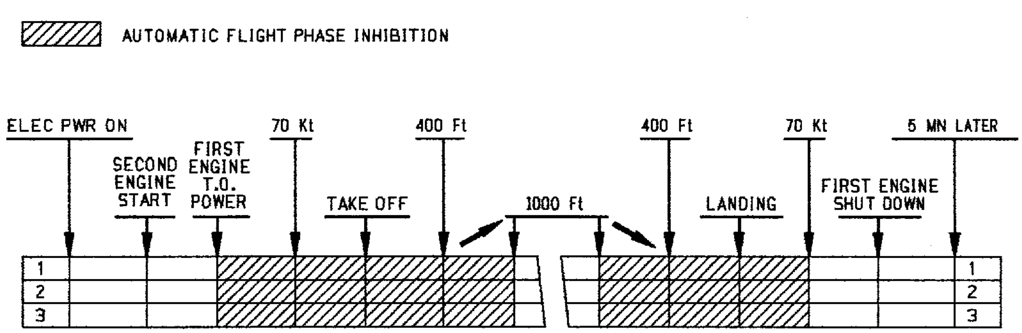

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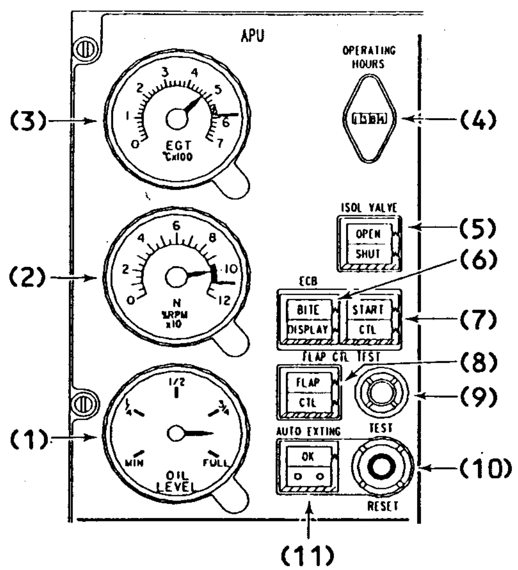
Mod. : 5051

A. APU PANEL

MAINTENANCE PANEL



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(1) OIL QTY Indication

R Indicates the oil level.

(2) RPM Indication

The RPM is indicated in percent of nominal speed. Active when MASTER SW is selected ON, de-activated 60 sec. after the APU speed is below 7 % RPM.

(3) EGT Indication

Exhaust gas temperature at turbine exit is indicated in °C. Active when MASTER SW is selected ON, de-activated 60 sec. after the APU speed is below 7 % RPM.

R

(4) OPERATING HOURS

The indicator totalizes the APU operating time when above 95 % RPM.

(5) ISOL VALVE Indication

Position of the fuel supply isolation valve is indicated by OPEN or SHUT white lights.

(6) ECB – BITE DISPLAY M.F.A.

Indicates ECB faults leading to an APU automatic shutdown. R

(7) START CTL M.F.A.

Indicates start contactor failures. R

(8) FLAP CTL M.F.A.

Indicates air intake flap malfunctions. R

(9) FLAP CTL TEST Pushbutton

When pressed in for 30 sec. checks air intake flap sequence.

(10) AUTO EXTING TEST RESET Switch

Test is to be performed on ground only.

- **TEST**

  Switch must be held during test. MASTER SW must be selected ON.
  APU FIRE warning, auto extinguishing and shutdown circuits are tested. Sequence duration is 10 seconds.
  The OK white light comes on to indicate a successful test.
  Note : If in operation, the APU shutdowns.

- **RESET**

  Test circuit is reset.

- **Neutral**

  Test circuit not energized.

(11) AUTO EXTING – OK Light

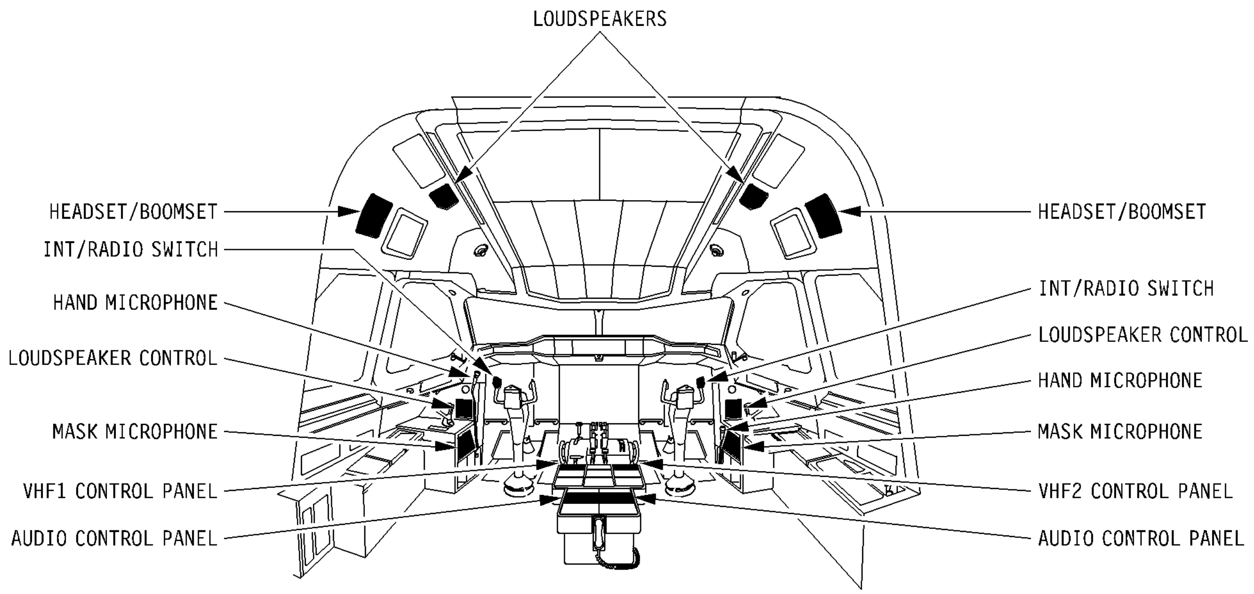
Comes on white when auto extinguishing sequence is completed and test result is positive.

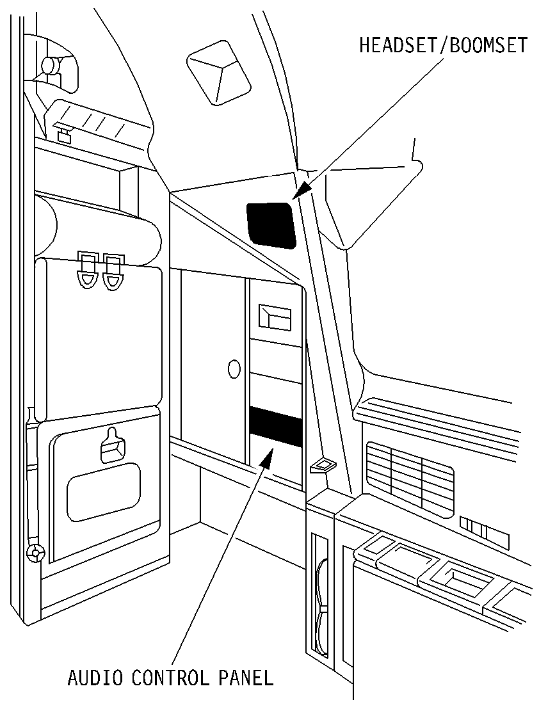
EXTERNAL CONTROLS

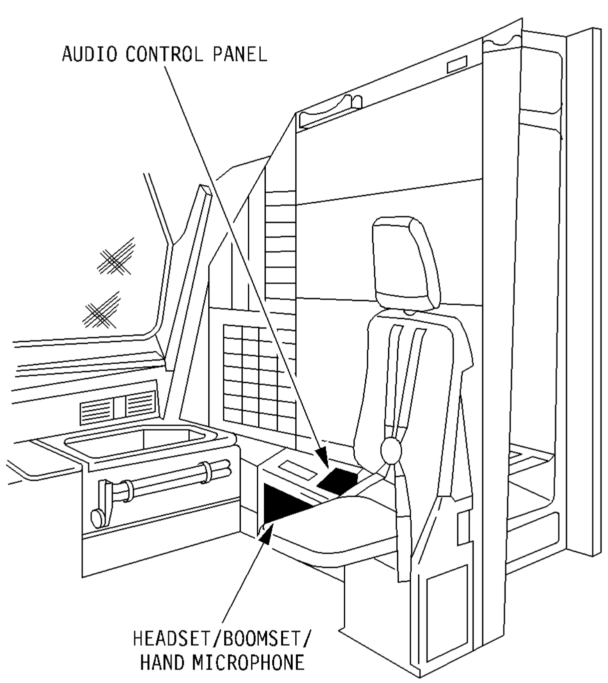
The APU external controls are provided for exterior fire
R warning and emergency shutdown (See FIRE
R PROTECTION Chapter).

Note : *The objective of this chapter is to provide a general presentation of the communication system installed on A310 aircraft.*

The schematics and panels contained in this chapter illustrate a typical aircraft configuration and may not reflect exactly the configuration of your aircraft.







(Typical configuration)

Mod : 4803

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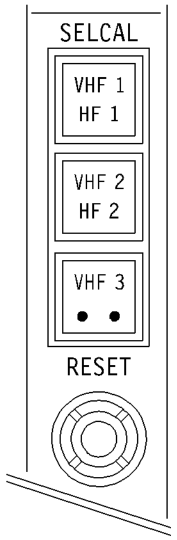
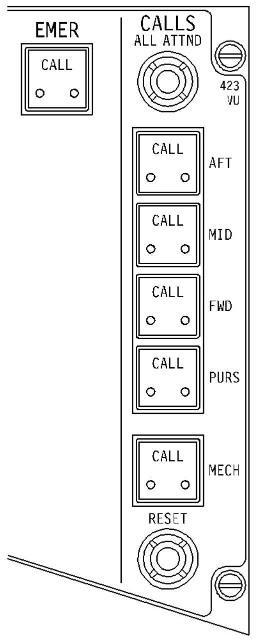
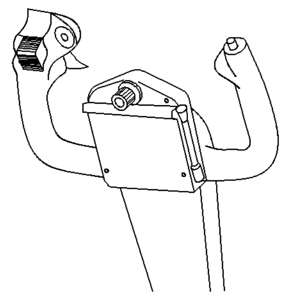


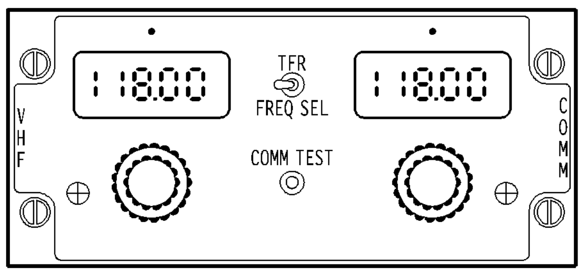
SELCAL PANEL



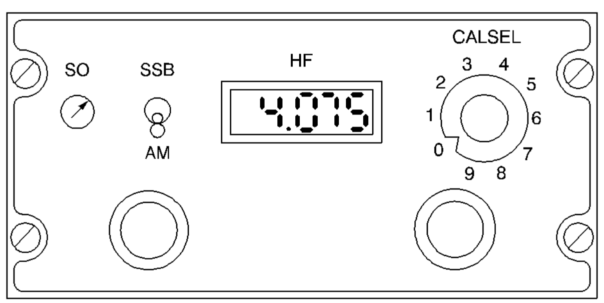
CALLS PANEL



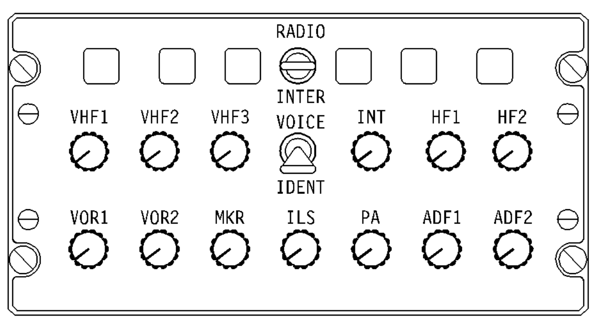
CONTROL WHEEL INT/RAD SWITCH



VHF CONTROL PANEL



HF CONTROL PANEL



AUDIO CONTROL PANEL

(Typical configuration)

- The aircraft communication system consists of :
  - the radio communication system, including :
    - VHF radio communication system,
    - HF radio communication system,
    - SELCAL system.
  - the interphone system, including :
    - flight interphone system,
    - service interphone and call system.
  - the audio integrating system,
  - the passenger address system.

RADIO COMMUNICATION SYSTEM

- The radio communication system enables air communications between :
  - the aircraft and the ground, or
  - the aircraft and other aircraft.
- Each radio communication system consists of specific antennas located on the fuselage (refer to the chapter ″Aircraft general″).

FLIGHT INTERPHONE SYSTEM

- The flight interphone system enables communication between :
  - both pilots,
  - pilots and the ground mechanic,
  - pilots and the avionics bay.

SERVICE INTERPHONE SYSTEM

- The service interphone system enables telephone communications between :
  - cabin attendants,
  - cabin attendants and flight crew,
  - cabin attendants and ground service crew,
  - flight crew and ground service crew,
  - ground service crew members.

PASSENGER ADDRESS SYSTEM

- The passenger address system enables the flight crew and the cabin attendants to make announcements to the passengers.

AUDIO INTEGRATING SYSTEM

- The audio integrating system enables the management of all audio signals (in emission or reception) provided by the radio communication system, the radio navigation system and the interphone system.
- The audio integrating system consists of :
  - three Audio Control Panels (ACP),
  - jack panels,
  - loudspeakers in the cockpit,
  - PTT switches on the control wheel.

LEFT BLANK INTENTIONALLY

VHF SYSTEM

- The VHF system (Very High Frequency) is used for short distance communications between the aircraft and the ground or other aircraft.
- Each VHF system consists of its own :
  - VHF control panel,
  - VHF transceiver,
  - VHF antenna.
- VHF1 is dedicated to the Captain.
- VHF2 is dedicated to the First Officer.
- A third VHF system can be installed.
- VHF systems operate in a frequency range from 118.00 MHz to 136.975 MHz with a frequency spacing of 25 kHz.
- VHF1 is electrically supplied from the DC ESS BUS.
- VHF2 (and VHF3, if installed) system is electrically supplied from the DC NORM BUS.

HF SYSTEM

- The HF system (High Frequency) is used for long distance communications between the aircraft and the ground or other aircraft.
- One or two HF systems are installed on the aircraft.
- Each HF system consists of its own :
  - HF control panel,
  - HF transceiver.
- The HF antenna is common to all HF systems.
- HF systems operate in a frequency range from 2.000 MHz to 29.999 MHz.

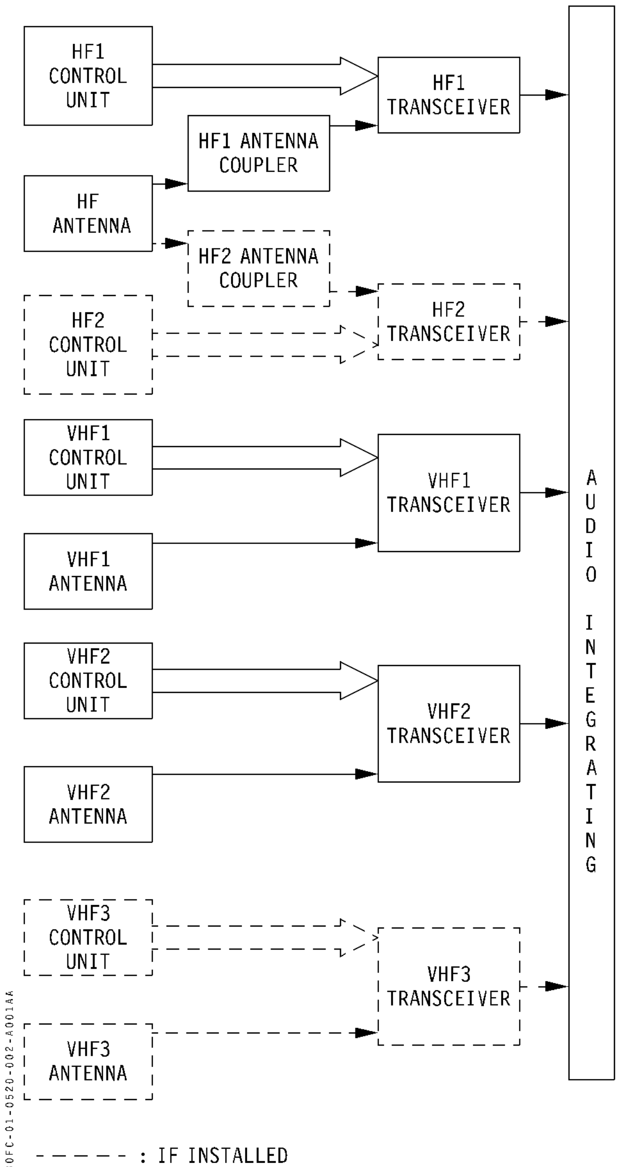
R • HF1 is electrically supplied from the AC ESS BUS.
R HF2 is electrically supplied from the AC BUS 2.

SELCAL SYSTEM

- The SELCAL system (SELective CALling) enables the flight crew to select only the calls that are addressed to them.
- The SELCAL system provides visual and aural indications when a radio communication is received.
- When the SELCAL system is activated, all HF and VHF systems are operative.
- The SELCAL system is electrically supplied from the DC NORM BUS.

Mod : 5910 or (5910/UR)

RADIO COMMUNICATION DIAGRAM



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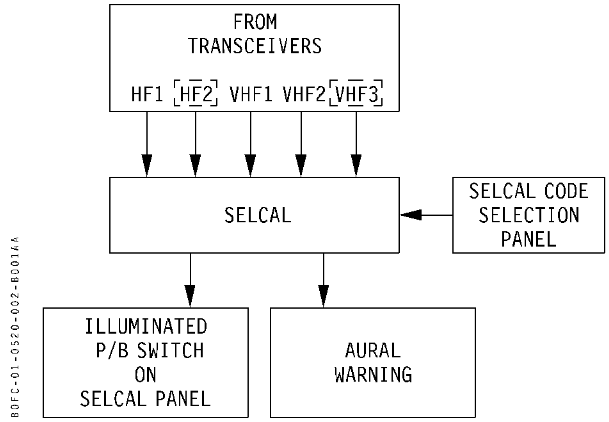
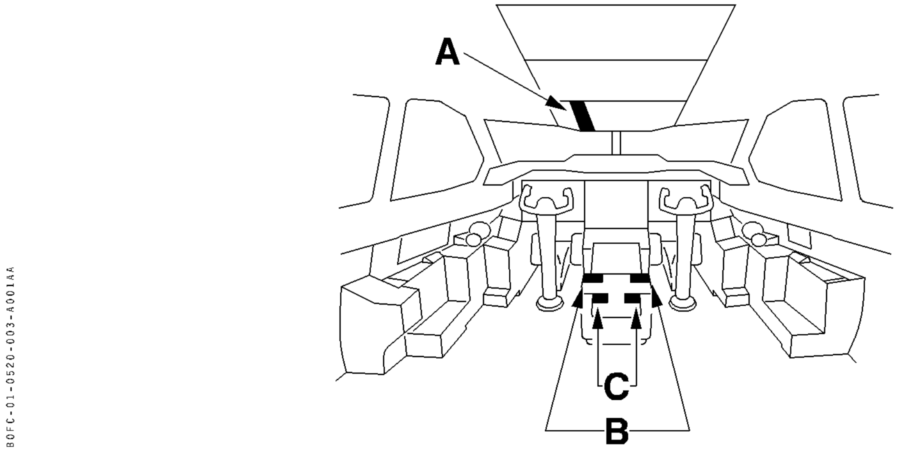
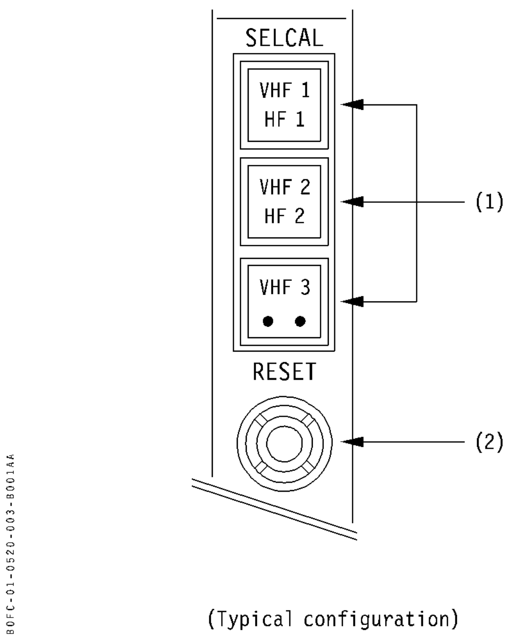
SELCAL DIAGRAM



LOCATION OF CONTROL PANELS



A. SELCAL CONTROL PANEL



(Typical configuration)

(1) VHF / HF lights

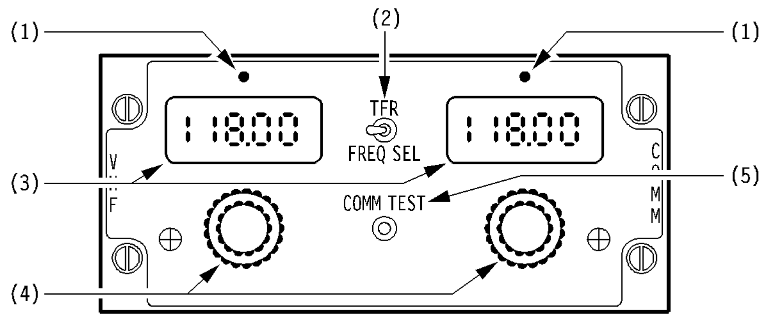
- The SELCAL light of a system illuminates blue when a selective call is received on this system.

(2) RESET pushbutton switch

- The RESET pushbutton switch cancels the audio and visual signals associated with a SELCAL.

Note : The RESET pushbutton switch must be pressed each time a SELCAL has been received to re–arm the SELCAL system.

B. VHF CONTROL PANEL



(Typical configuration)

(1) VHF selection lights

- One light illuminates at once to indicate which frequency ("active" frequency) is used for the radio communications on the relevant VHF system.

(2) TFR switch

- The TFR switch enables the selection of either left or right frequency as the active frequency, which is used for the radio communications on the relevant VHF system.

(3) VHF frequency display windows

- Displays the selected frequency in MHz.

(4) VHF frequency rotary selectors

- The rotary selectors enable the selection of the frequency in the relative upper window. The rotary selectors consist of two knobs :
  – The outer knob enables to select MHz (i.e. 2 nd and 3 rd digits).
  – The inner knob enables to select kHz (i.e. 4 th and 5 th digits).

R *Note : Some interferences may occur if selected*
R *frequencies are less than :*
R *. 2 MHz between VHF1 and VHF2*
R *. 2 MHz between VHF2 and VHF3*
R *. 6 MHz between VHF1 and VHF3*

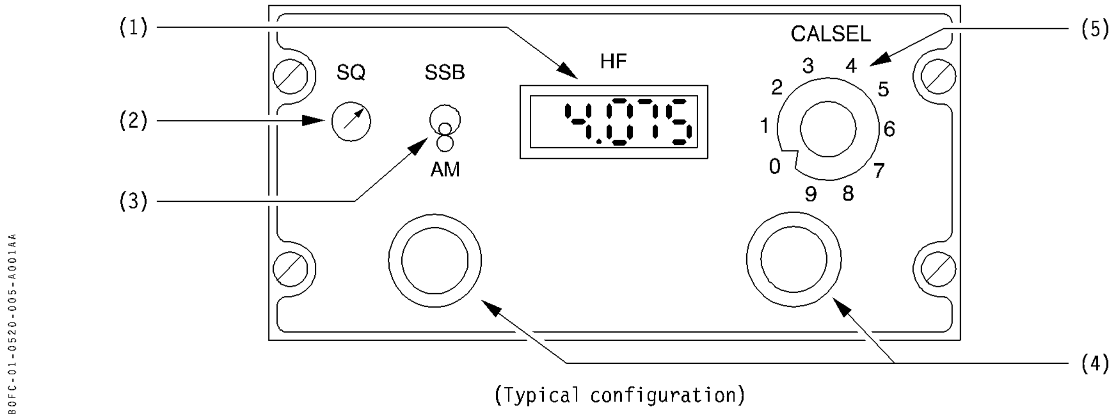
(5) COMM TEST pushbutton switch

- The COMM TEST pushbutton switch enables the test of the VHF communications.

Note : If installed, the VHF3 control panel can be equipped with a VOICE/DATA pushbutton switch that enables the selection of the VOICE mode or DATA mode (for ACARS purposes).

The VHF3 control panel can be installed at the rear of either the center pedestal or the overhead panel.

C. HF CONTROL PANEL



(Typical configuration)

(1) HF frequency window

- Displays the selected HF frequency in MHz.

(2) SQ rotary selector

- The SQ rotary selector enables the pilots to adjust the receiver squelch threshold.

R **(3) AM/SSB (or USB) Mode Selector**

R – SSB : Used for communications with single side
R band stations that transmit on the upper
R side band. Receptions of all stations operating
R on AM is still possible.

R – AM : Conventional HF communications (double
R side band). Used for communications with
R stations whose transmissions are amplitude
R modulated.

(4) HF frequency rotary selectors

- Two rotary selectors enable the selection of the frequency displayed in the window. Each rotary selector consists of two concentric knobs.
  - On the left,
    - the outer knob enables the selection of tens and units of MHz,
    - the inner knob enables the selection of tenths of MHz.
  - On the right,
    - the outer knob enables the selection of hundredths of MHz,
    - the inner knob enables the selection of thousandths of MHz.

(5) CALSEL ROTARY SELECTOR

- The nine positions of the CALSEL rotary selector enable the selection of a CALSEL code.
- The transmission command is obtained by pulling the rotary selector.

LEFT BLANK INTENTIONALLY

GENERAL

- The flight interphone system enables telephone communications between :
  - crew members,
  - crew members and the ground mechanic from the ground power receptacle housing or the avionics bay.
- The flight interphone system consists of :
  - jacks for the connection of the full face oxygen masks and headsets,
  - jacks for the connection of the ground service telephones.
- The flight interphone system is electrically supplied from the DC ESS BUS.

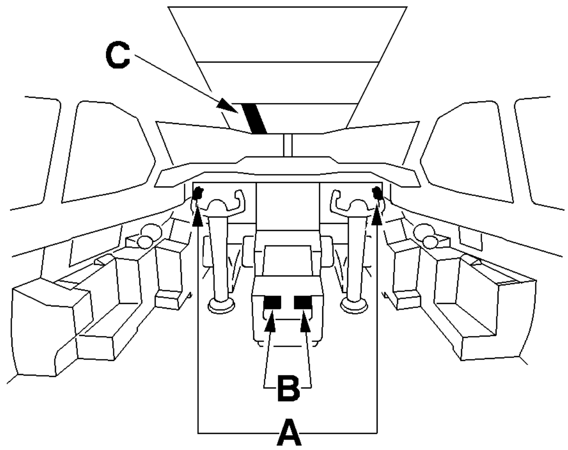
GROUND CREW CALL SYTEM

- The ground crew call system :
  - alerts the flight crew of a call coming from the ground mechanic through aural and visual indications,
  - alerts the ground mechanic of a call from the flight crew.
- The ground crew call system consists of :
  - a COCKPIT CALL light on the nose gear interphone box and an external horn for the ground mechanic,
  - A MECH CALL pushbutton switch and a reset pushbutton switch located on the overhead panel for the flight crew.

OPERATION

- The flight interphone mode is selected by a pilot if :
  - For the transmission,
    - the INT/RAD switch located on the on−side ACP (Audio Control Panel) is selected to the INT position, or
    - the INT/RAD switch located on the outboard horn of the on−side control wheel is selected to the forward position, or
    - the INT/RAD switch on the ACP is selected to the RAD position and the INT transmission key on the ACP (if installed) is pressed.
  - For the reception,
    - the INT reception knob must be released and the volume adjusted.
- In flight interphone mode, communications are established between connected stations.

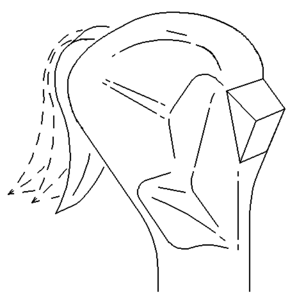
LOCATION OF CONTROLS



BOFC-01-0530-002-A001AA

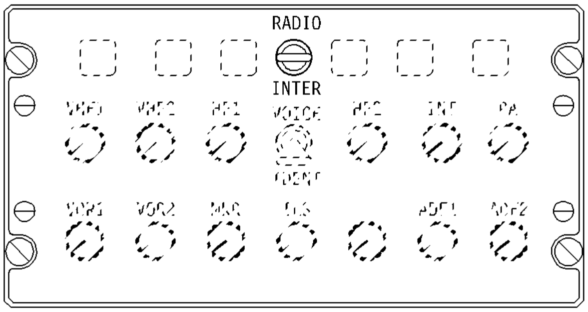
(Typical configuration)

A. INT / RAD PTT SWITCH


BOFC-01-0530-002-B001AA

- The INT/RAD PTT switch located on each control wheel enables the selection of the transmission mode.
- This switch is operative only when associated with the boom or mask mike.
- The switch has three positions :
  - Forward position :
    - The forward position enables communications through the flight interphone system.
    - For reception of the communications, the INT reception knob on the ACP (Audio Control Panel) must be released.
  - Center position (springloaded position) :
    - In this neutral position, no transmission is possible except with the hand microphones.
  - Aft position :
    - The aft position enables communications through the radio system which is selected for transmission on the ACP.

B. AUDIO CONTROL PANEL



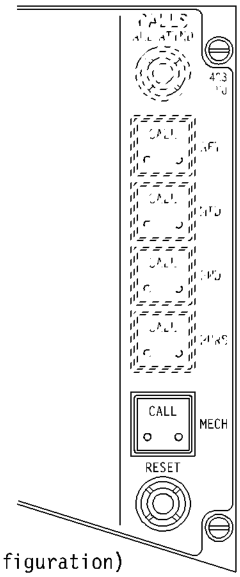
B0FC-01-05-30-003-A001AA

(Typical configuration)

INTER / RADIO SWITCH (if installed)

- The INTER / RADIO switch on the ACP has the same functions as the INT / RAD PTT switch on the control wheel.
- This switch is operative only when associated with the boom or mask mike.
- This switch has three positions :
  - INTER position :
    - The INTER position enables communications through the flight interphone system.
    - For reception of the communications, the INT reception knob on the ACP must be released.
  - Center position (springloaded position) :
    - In this neutral position, no transmission is possible except with the hand microphones.
  - RADIO position :
    - The RADIO position enables communications through the radio system which is selected for transmission on the ACP.

C. MECH CALL PUSHBUTTON SWITCH ON CALLS PANEL



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(Typical configuration)

- Pressing the MECH pushbutton switch enables the flight crew to call the ground mechanic.
- When the MECH pushbutton switch is pressed, the COCKPIT CALL light located on the nose gear interphone panel illuminates associated with an external horn signal.
- The CALL light illuminates blue, associated with an audio signal (buzzer), when the ground mechanic requests the communication.
- The RESET pushbutton switch cancels the MECH CALL light and the associated audio signal.

LEFT BLANK INTENTIONALLY

GENERAL

- The service interphone system consists of:
  - a cabin interphone system,
  - a ground service interphone system,
  - a call system.
- The service interphone is electrically supplied from the DC ESS BUS.

CABIN INTERPHONE

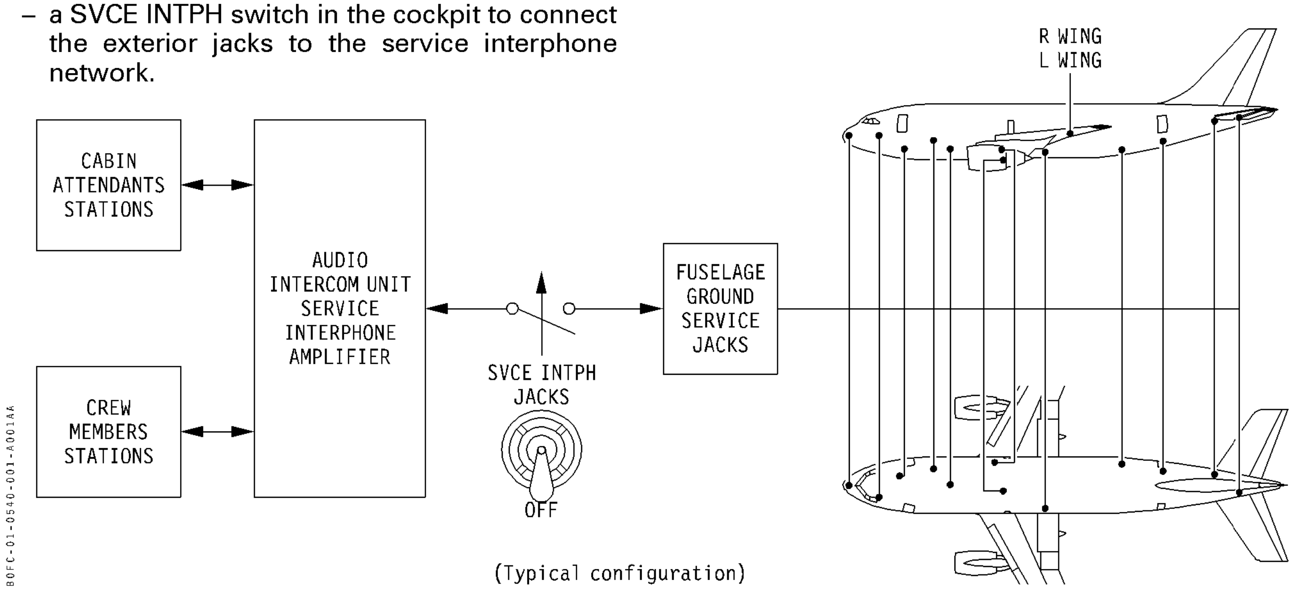
- The cabin interphone system enables telephone communications between :
  - cabin attendants,
  - cabin attendants and flight crew.

GROUND SERVICE INTERPHONE

- The ground service interphone system enables telephone communications between :
  - flight crew and ground crew stations,
  - ground crew stations and cabin attendants.
- The ground service interphone system consists of :
  - a network of jacks located all around the aircraft where the ground crew can connect to communicate with the personnel onboard.
  - a SVCE INTPH switch in the cockpit to connect the exterior jacks to the service interphone network.

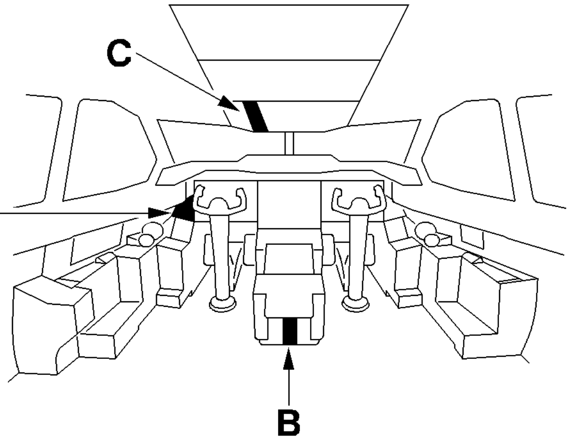
CALL SYSTEM

- The call system :
  - alerts the crew of a call coming from the cabin attendants through aural and visual indications,
  - alerts the cabin attendants of a call coming from the flight crew.
- The call system consists of :
  - a CALLS panel on the overhead panel for the flight crew,
  - CALL lights and pushbutton switches on the interphone panels for the cabin crew.
  - audio signals in the cockpit and the cabin.



(Typical configuration)

LOCATION OF CONTROLS



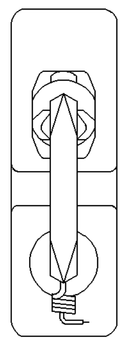
(Typical configuration)

A. SVCE INTPH SWITCH

(Typical configuration)

- When the SVCE INTPH switch is placed in the JACKS position, the maintenance jacks located all around the aircraft are connected to the service interphone system, when the aircraft is on the ground.

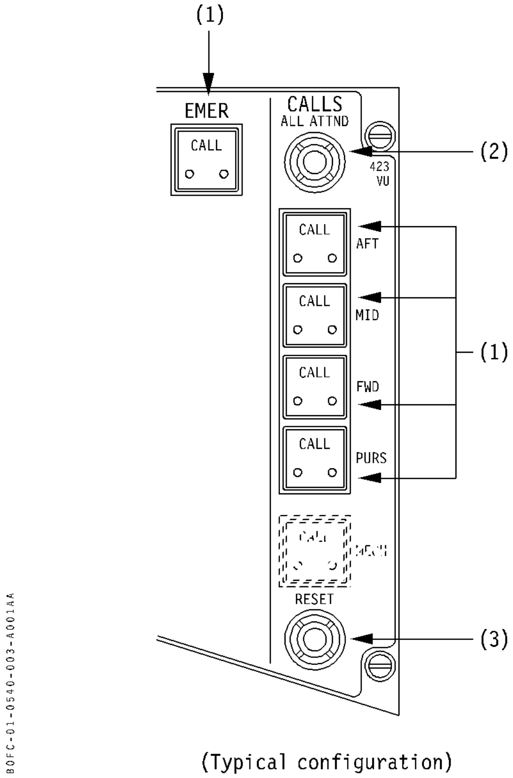
B. PILOT'S HANDSET



- The pilot's handset can be used for :
  - the cabin service interphone,
  - the ground service interphone,
  - the passenger address.
- To establish the communication through the service interphone system, the handset must be lifted from the cradle.
- To establish the communication through the ground service interphone system, the handset must be lifted from the cradle while maintaining the SVCE INTPH switch in the JACKS position.
- The communication is interrupted when the handset is replaced in the cradle.

Mod : 4803

C. CALLS PANEL



(Typical configuration)

(1) CALL pushbutton switches

- Pressing a CALL pushbutton switch enables the flight crew to call the respective cabin attendant station.
- The cabin attendant is alerted by the illumination of the blue CAPT light and the activation of an audio signal (high/low chime).
- The CALL light illuminates blue, associated with an audio signal (buzzer), when the communication is requested from the respective attendant station.

(2) ALL ATTND pushbutton switch

- The ALL ATTND pushbutton switch enables to call all the cabin attendants at the same time.

(3) RESET pushbutton switch

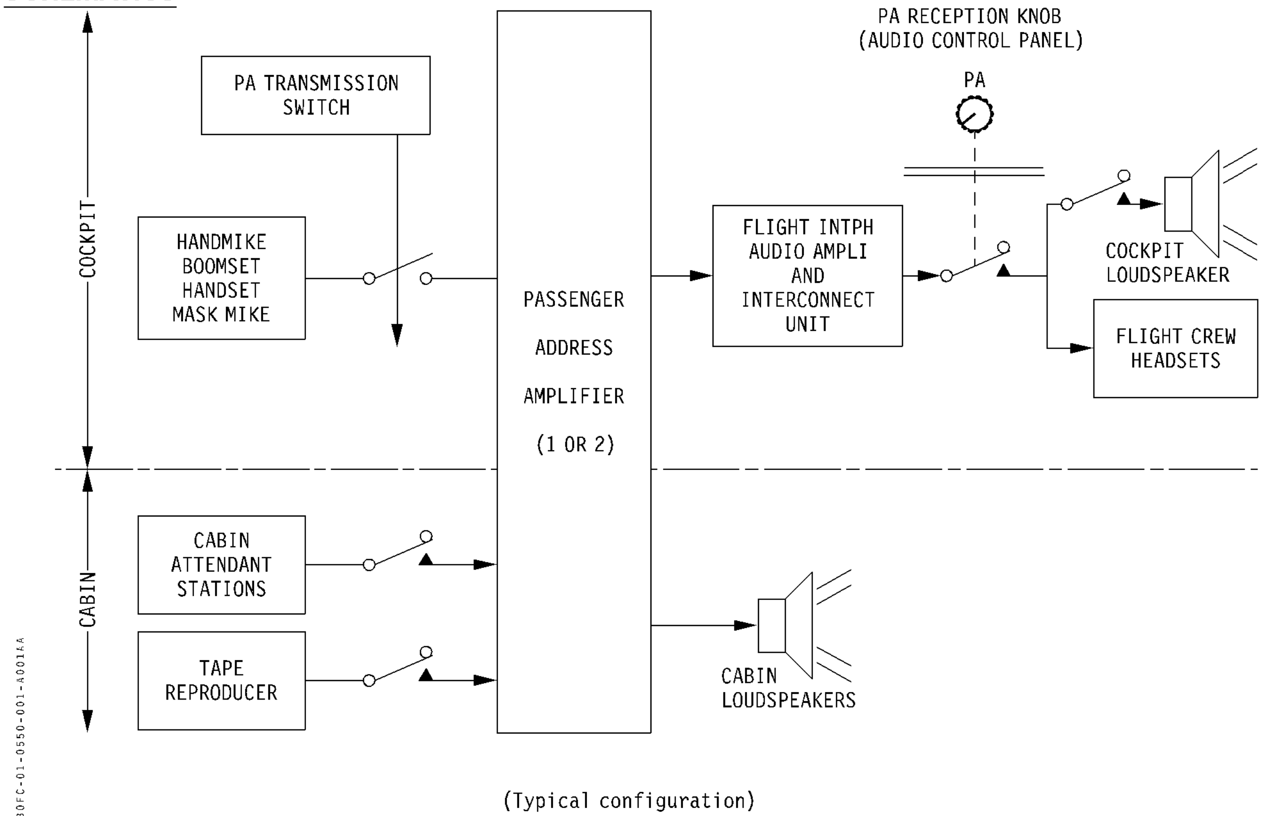
- The RESET pushbutton switch cancels any call which has been initiated by the captain. R R
- When the crew has noticed the call request, they must cancel the visual and audio signals by pressing the RESET pushbutton switch.

LEFT BLANK INTENTIONALLY

GENERAL

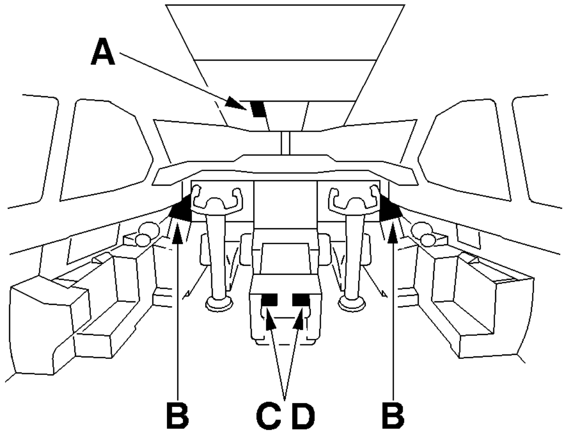
- The PA (Passenger Address) system allows the flight crew and the cabin attendants to make announcements to the passengers.
- The PA system consists of :
  - a PA reception knob on the ACP (Audio Control Panel),
  - if installed :
    - a PA transmission pushbutton switch located on the ACP,
  - or, if installed :
    - a PA transmission pushbutton switch located on the overhead panel,
    - an EMER PA transmission switch located on each lateral console (for passenger announcements through the mask microphone).
- The PA system is electrically supplied from the DC ESS BUS.
- The PA announcements are broadcast by the loudspeakers throughout the cabin.

SCHEMATICS



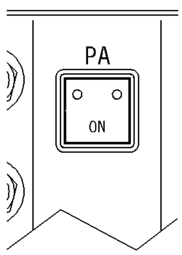
(Typical configuration)

LOCATION OF CONTROLS



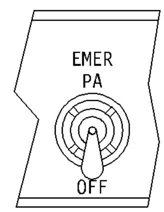
(Typical configuration)

A. PA PUSHBUTTON SWITCH (if installed)



- Pressing the PA pushbutton switch enables the flight crew to connect to the passenger address system and to make announcements through the hand, boomset or handset microphones.
- The PA pushbutton switch is fitted with a ON light which illuminates blue to indicate the connection to the passenger address system.

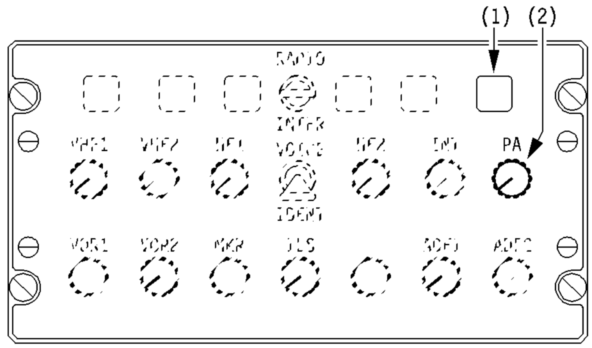
B. EMER PA SWITCH (if installed)



- Maintaining the EMER PA switch to the EMER PA position enables the flight crew to make announcements through the oxygen mask microphone.
- The switch is springloaded to the OFF position where the mask microphone is disconnected from the passenger address system.

Mod : 4803

C. AUDIO CONTROL PANEL



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(Typical configuration)

(1) PA transmission pushbutton switch (if installed)

- The PA transmission pushbutton switch is located on the ACP (Audio Control Panel).
- Pressing the PA pushbutton switch enables the flight cew to connect to the passenger address system and to make announcements through the dedicated mikes.
- The PA transmission pushbutton switch is equipped with a light which illuminates green to indicate the connection.

(2) PA reception knob

- The PA reception knob is located on the ACP.
- Pressing the PA reception knob enables the connection of the headsets and loudspeakers in the cockpit to the passenger address system.
- The PA reception knob is equipped with a white light which illuminates to indicate the connection.
- The volume is adjusted by rotating the knob.

LEFT BLANK INTENTIONALLY

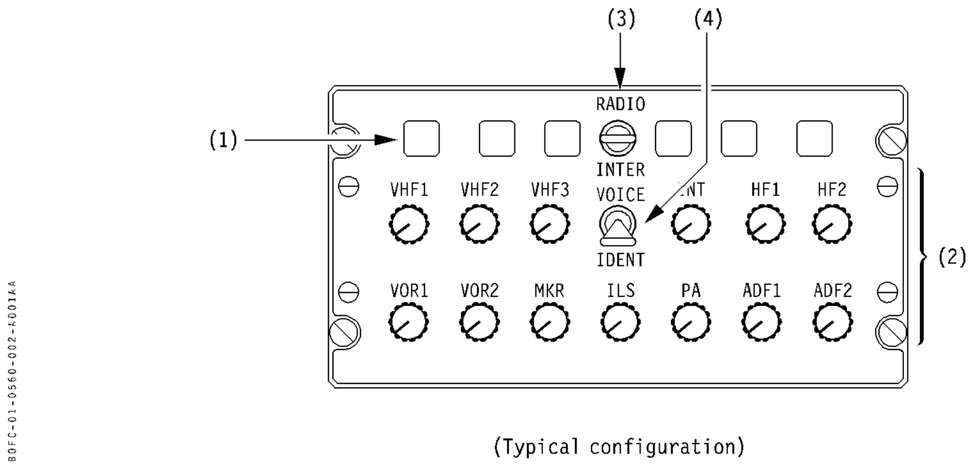
GENERAL

- The audio integrating system enables,
  - for the radio navigation systems :
    - the selection of a radio navigation system in reception to check its identification signal.
  - for the radio communication systems,
    - the connection to the flight interphone system,
    - the connection to the service interphone system,
    - the connection to the passenger address system,
    - the selection of radio communication systems for transmission or reception,
    - the management of all audio signals (activation, de−activation, volume).
- The audio integrating system essentially consists of :
  - three ACP (Audio Control Panel),
  - jack panels,
  - loudspeakers,
  - mask microphones,
  - hand microphones,
  - headsets,
  - boomsets,
  - two control wheel PTT switches.

OPERATION

- The hand microphones, handsets and boomsets are connected to the jack panels located close to the respective stowage boxes.
- In transmission mode, the audio integrating system collects and directs the various station microphone inputs to the communication system selected by the flight crew.
- In reception mode, the audio integrating system collects and directs the audio outputs to the various stations.
- The flight crew selects the radio communication systems for transmission or reception (with the adjustment of the volume) through the ACP.
- The transmission of radio signals or flight interphone signals is performed through the control wheel PTT switches, or the INT/RAD switch on the ACP (if installed).

AUDIO CONTROL PANEL



(Typical configuration)

(1) TRANSMISSION pushbutton switches

- Pressing a transmission pushbutton switch enables the selection of the corresponding communication system for transmission.
- Each pushbutton switch is equipped with an integrated light that illuminates to indicate which system is used for transmission.

Note : Only one system can be selected at a time.

(2) RECEPTION knobs

- Releasing a reception knob enables the selection of the corresponding communication system for reception.
- Each reception knob is equipped with an integrated light that illuminates white to indicate which systems are used in reception.
- Rotating the knob enables the adjustment of the volume.

(3) RADIO / INTER switch

- The INTER / RADIO switch on the ACP (Audio Control Panel) has the same function as the INT / RAD PTT switch on the control wheel.
- This switch is operative only when associated with the boom or mask mike.
- This switch has three positions :
  - INTER position :
    - The INTER position enables communications through the flight interphone system.
    - For reception of the communications, the INT reception knob must be released.
  - Center position (springloaded position) :
    - In this neutral position, no transmission is possible except with the hand microphones.
  - RADIO position :
    - The RADIO position enables communications through the radio system which is selected on the ACP for transmission.

(4) VOICE / IDENT switch

- This switch has two positions :
  - In the VOICE position, the identification signals from the radio navigation stations are filtered out. Only the voice messages are received.
  - In the IDENT position, both voice and identification signals are received.

The ACARS system is an optional equipment not installed on all aircraft.
This system is customized to meet the requirements of each airline so that many different configurations exist.
This chapter provides a general presentation of the ACARS system.

GENERAL

- The ACARS (Aircraft Communication Addressing and Reporting System) is a data link system which enables the exchange of data and messages between an aircraft and a ground based operation station, over an ARINC VHF radio network.
- A message from the aircraft to the ground is called a downlink.
- A message from the ground to the aircraft is called an uplink.

DESCRIPTION

- The airborne ACARS system consists of :
  - a MU (Management Unit), located in the avionics compartment, which processes the ACARS uplinks and downlinks.
  - a CDU (Control Display Unit), installed at the rear of the pedestal, which provides the interface between the flight crew and the ACARS system.
  - an ACARS control panel, consisting of a pushbutton switch and, other switches depending on the aircraft configuration (selection from the pilot, selection from the FMS,...).

ACARS OPTIONAL INTERFACES

- Depending on the aircraft definition, the following interfaces may be connected to the ACARS system :
  - the ACARS printer,
  - the VHF3 control panel,
  - the FMS (Flight Management System),
  - the DFDAU (Digital Flight Data Acquisition Unit),
  - a cabin system.

ACARS PRINTER

- The printer provides a printout of the data collected by the MU. A printer advisory light (if installed) alerts the crew when an uplink is being printed.

VHF3 CONTROL PANEL (if installed)

- The VHF3 can be used in VOICE mode. This enables the flight crew to select the VHF3 in case of VHF1 and VHF2 failure.
- The advisory VHF3 VOICE displayed on the ACARS CDU indicates that the VHF3 is operating in VOICE mode. In this case, no data link communications can be established.

Note : *If ACARS is installed, do not use the VHF3 for communications with the ATC, except if the VHF1 and VHF2 are both inoperative.*

In this case, push the VHF 3 VOICE ONLY pushbutton (if installed) or pull the ACARS circuit breakers. R R

FMS

- The ACARS system can be connected to the FMS in order to provide,
  - for uplinks :
    - flight plan update,
    - predicted wind data,
    - takeoff data
  - for downlinks :
    - position reports
- In this configuration, a switch is located on the ACARS control panel to select the FMS associated to the ACARS functions (FMS1 or FMS2).
- Refer to the FMS chapter (1.19) for more detailed information on the ACARS/FMS interface.

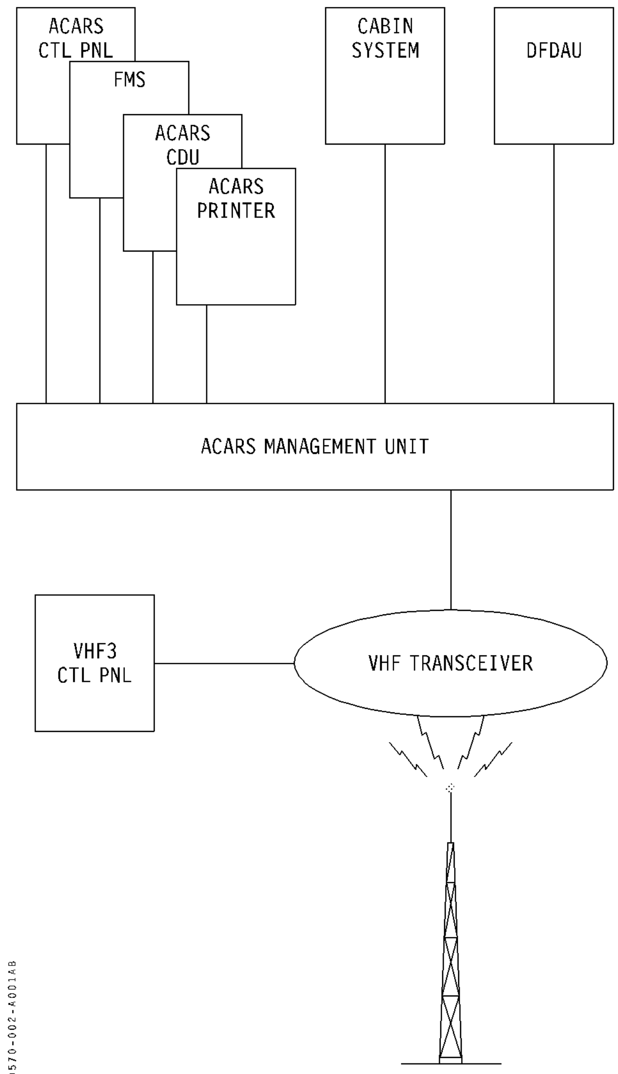
DFDAU

- The DFDAU enables the AIDS (Aircraft Integrated Data System) to be reported to the ground through downlinks.

CABIN SYSTEM

- The interface with the cabin system enables the report of cabin data through downlinks and the reception by the cabin of ground information.

SCHEMATICS



(Typical configuration)

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FUNCTIONS

- The main functions of the ACARS system, provided through the ACARS Control and Display Unit, are described hereafter :

Initialization

- The initialization of the ACARS system is performed by entering specific flight data such as :
  - crew identification,
  - flight number,
  - departure airport,
  - destination airport.

Link test

- Test of the VHF connection with the ground.

VOICE/DATA mode

- Selection of the VHF mode.

Engine data

- Report of engine parameters.

ETA page

- Display and revision of the Estimated Time of arrival.

Diversion report

- Report of diversion information.

GMT auto update

- This function enables the update of the airborne GMT from the ground.

Weather request

- The flight crew can request data about the weather.

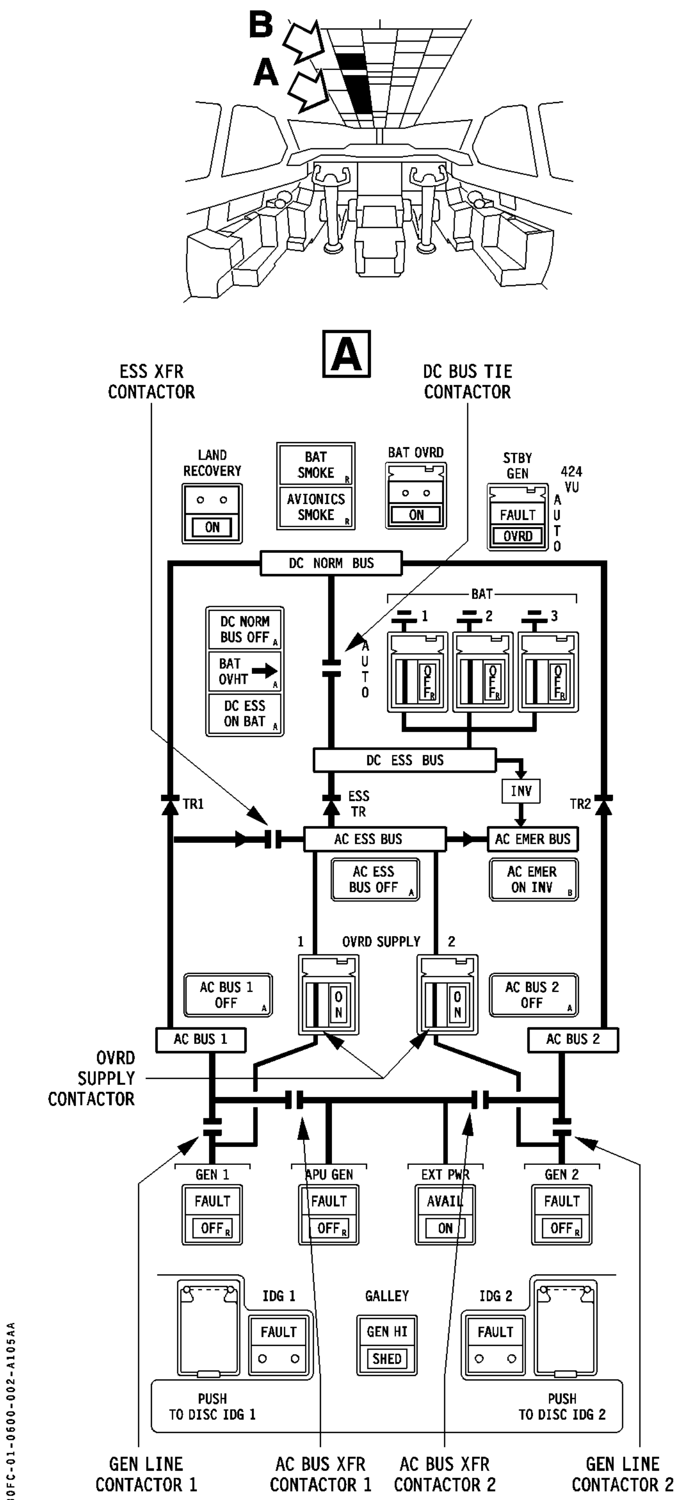
OOOI times (OUT – OFF – ON – IN events) : R

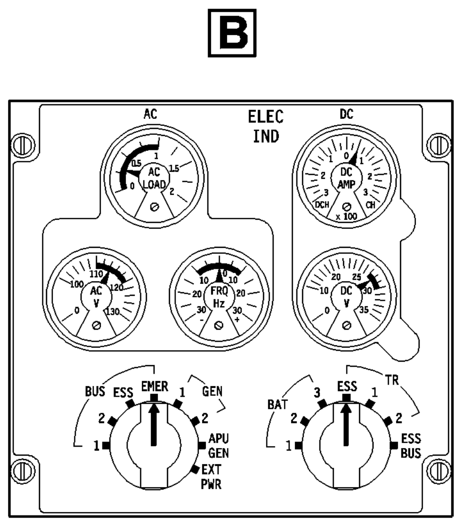
- The OUT–OFF–ON–IN times are the GMT times at which the aircraft is OUT of the gate, OFF the ground, back ON the ground and IN the gate.

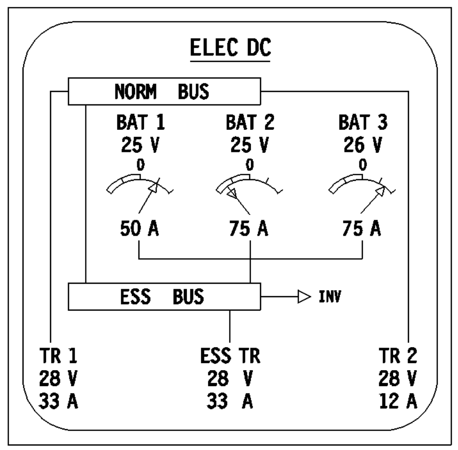
Free text

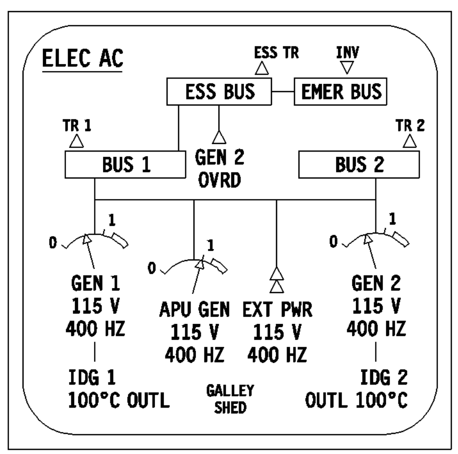
- Free messages can be sent to the ground.

Note : Other functions depending on the aircraft configuration can be provided.









MAIN

SYSTEM CONTROLS

AND DISPLAYS

Mod : 5911

GENERAL (Refer to PULL-OUT PAGE)

AC electrical system

- The AC electrical system is normally powered by two engine driven generators.

R • There are four AC bus:
  - AC BUS 1 and 2,
  - AC ESS BUS,
  - AC EMER BUS.

- The AC electrical system can also be powered by the APU generator on the ground and in-flight, or by external power on the ground.

R • The AC EMER BUS can be supplied by the batteries via a static inverter under abnormal conditions.

DC electrical system

- The DC electrical system is normally powered by the AC electrical system through three identical Transformer Rectifiers (TR).
- There are two DC buses :
  - DC NORM BUS,
  - DC ESS BUS.
- The DC ESS BUS is powered either by the batteries or by the AC ESS BUS through an ESSential Transformer Rectifier.

Emergency electrical power

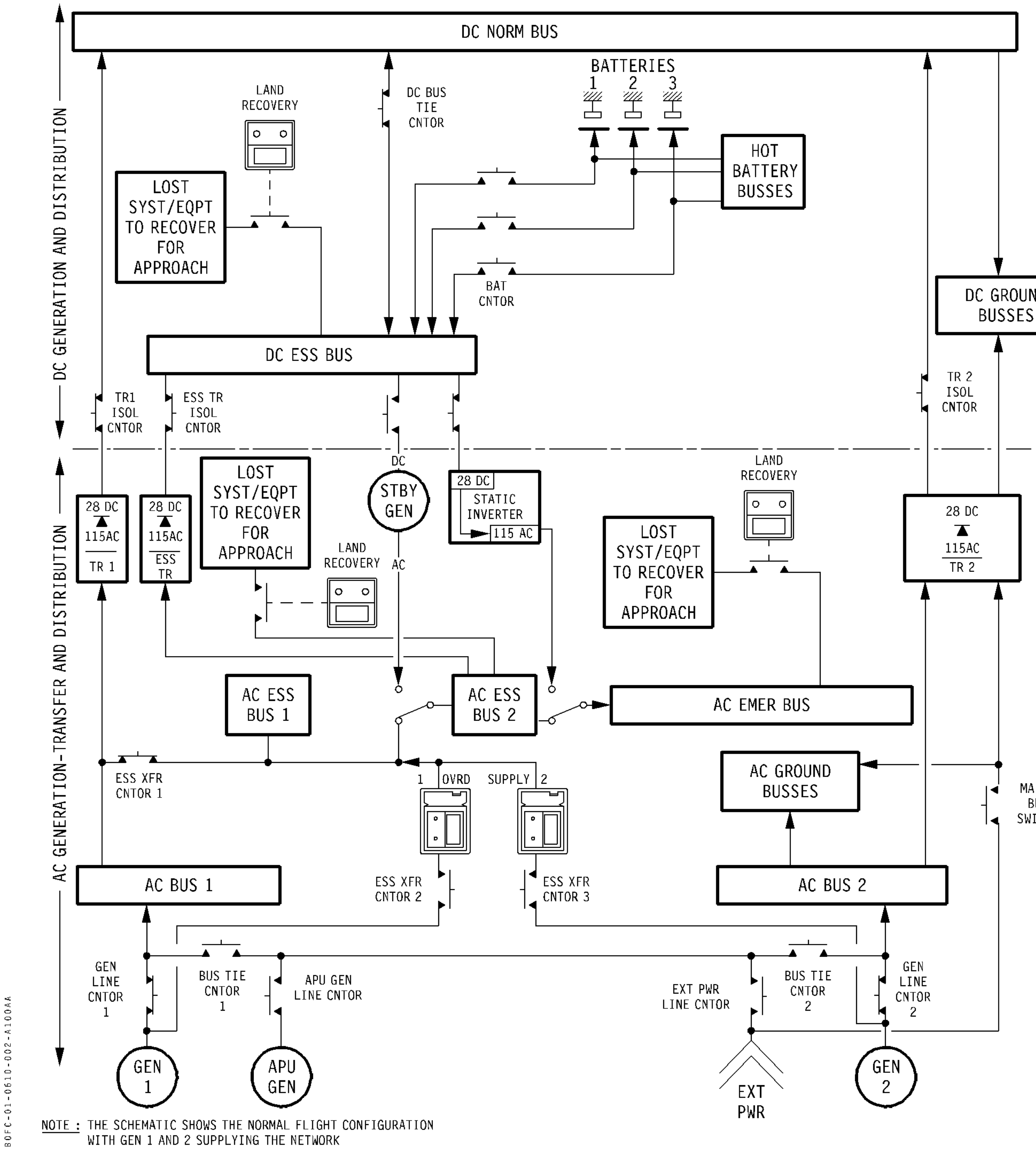
- Emergency power can be achieve by an AC / DC
R Stand by Generator which supplies :
  - the DC ESS BUS,
  - a part of the AC ESS BUS,
  - the AC EMER BUS.

Controls

- All controls, lights and indicators are located on the overhead panel, except Maintenance check switches which are located on the Maintenance panel.

Mod : 5911

AC - DC ELECTRICAL DISTRIBUTION



NOTE : THE SCHEMATIC SHOWS THE NORMAL FLIGHT CONFIGURATION WITH GEN 1 AND 2 SUPPLYING THE NETWORK

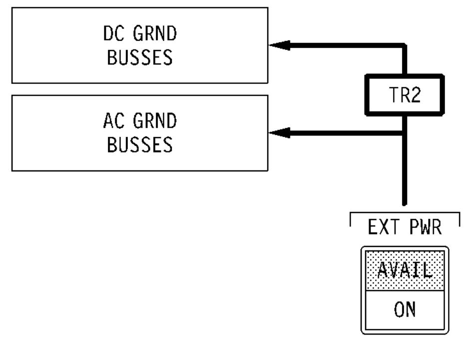
Mod : 5911

GENERAL

- An external power receptacle, located aft of the nose gear, allows connection of a 3-phase 115/200 V 400 Hz Ground Power Unit.
- The Ground Power Control Unit (GPCU) automatically opens the external power line contactor in case of :
  - Overvoltage or undervoltage,
  - Overfrequency or underfrequency,
  - Missing phase or out-of-phase.
- When both the APU GEN and EXT PWR are available at the same time, EXT PWR has priority to supply the aircraft.
- GEN 1 and GEN 2 have priority over the APU GEN and EXT PWR to supply the aircraft.

EXTERNAL POWER SUPPLY OF GROUND BUSSES

- On ground, when only ground services are required, the AC and DC GRND busses can be supplied directly from the external power source without supplying any of the other AC or DC busses.



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- This configuration is selected through the MAINT BUS switch.
- This switch allows power to be supplied only to the AC and DC GRND BUSses by simply connecting a Ground Power Unit to the aircraft's external power receptacle.

Note : *The cockpit EXT PWR pushbutton switch does not need to be selected ON to do this, so no access to the cockpit is needed for this operation.*

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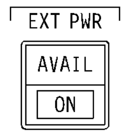
EXT PWR PUSHBUTTON SWITCH

R



R

- When a Ground Power Unit is connected to the aircraft, this pushbutton switch controls its connection to the aircraft electrical system.

■ **AVAIL**

– The AVAIL light illuminates green when :

- External AC Ground Power Unit is plugged-in,
- Ground Power Unit EXT PWR parameters are within limits,
- The external power line contactor is open.

■ **Pressed and released**

– If the green AVAIL light was illuminated (External power plugged-in but not on line) :

- If the Ground Power Unit's electrical parameters are normal, the external power line contactor closes.

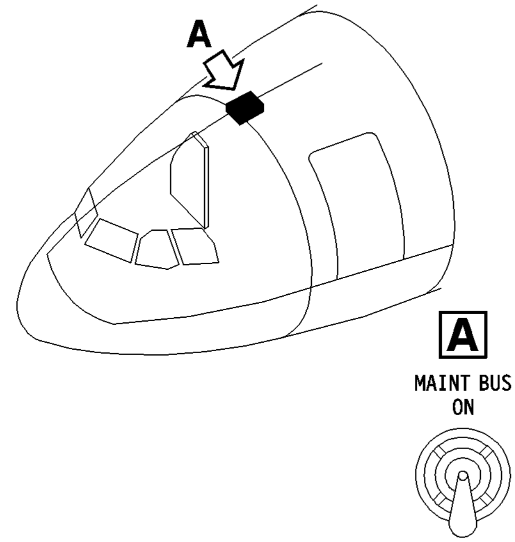
R This connects the EXT PWR to the AC BUS 1 and AC BUS 2.

R
- The ON light illuminates blue and the green AVAIL light extinguishes.

– If the blue EXT PWR ON light was illuminated (EXT PWR on line) :

- The external power line contactor opens, disconnecting the Ground Power Unit from the aircraft electrical system.
- The AVAIL light illuminates (assuming external power electrical parameters are normal) and the ON light extinguishes.

MAINT BUS Switch :



- When selected ON, the MAINT BUS toggle switch R
located on the FWD Cabin Circuit Brakers Panel (on the ceiling panel just aft of the cockpit door) routes the AC power directly from a Ground R
Power Unit to the AC GRND BUSses, and through TR2 to the DC GRND BUSses.

■ **ON**

– If the EXT PWR AVAIL light is illuminated, the toggle switch is magnetically latched ON.

– Lighting, cargo doors operation, cargo loading and refueling systems are powered (as well as the AC/DC outlets in the cabin).

■ **Off**

– If the aircraft electrical system is not powered, the ground service busbars are not energized.

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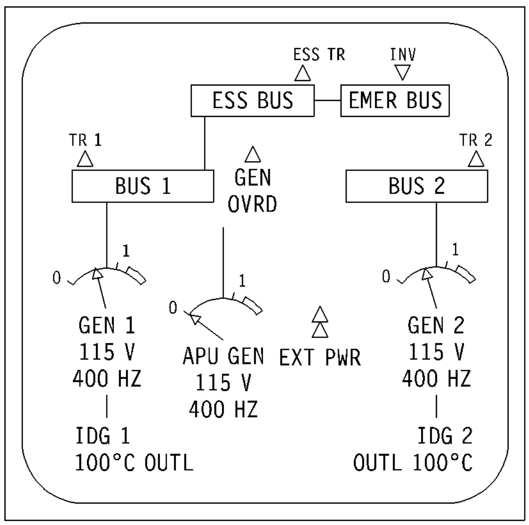
NORMAL AC POWER SUPPLY

- Normal aircraft electrical power is supplied by two AC Generators, driven by the engines via a Constant Speed Drive unit (CSD).
- The combination of the engine Generator and of its Constant Speed Drive is actually a single unit called an Integrated Drive Generator (IDG).
- Under normal circumstances, each generator supplies its associated AC bus (IDG 1 supplies AC BUS 1, IDG 2 supplies AC BUS 2) :



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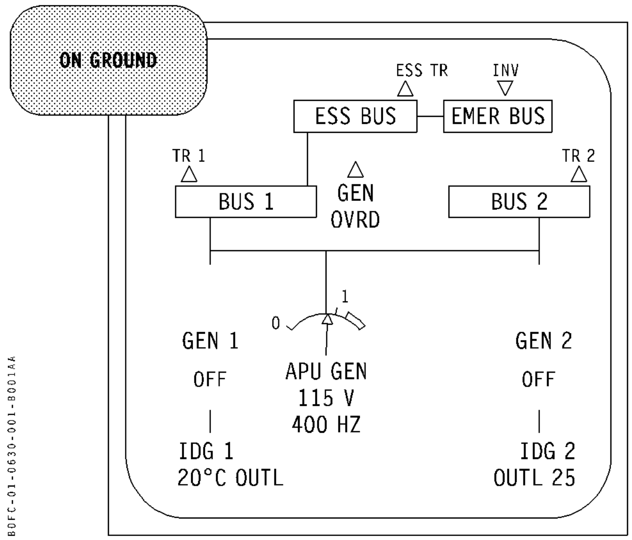
- A third generator is driven by the Auxiliary Power Unit (APU).
  - APU GEN can be used on ground to supply the aircraft electrical network when engines are not running.



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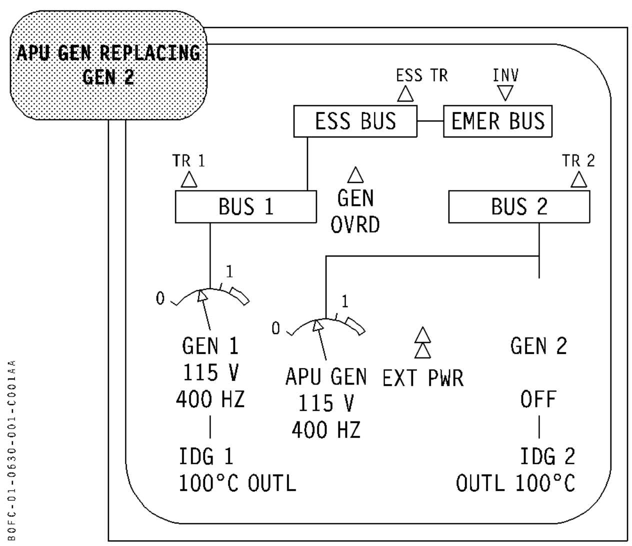
  - APU GEN can also be used in flight to replace a failed engine GEN.



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AC POWER GENERATION

INTEGRATED DRIVE GENERATORS (IDG)

- The two Integrated-Drive Generators (IDG) convert the engine accessory gearbox variable speed into a constant rotation speed for the generators.
  - IDG oil temperature and pressure are monitored by ECAM.
- If an IDG fails, the IDG can be disconnected from the engine gearbox by pressing the corresponding guarded PUSH TO DISC IDG pushbutton switch, on the ELEC PWR overhead panel.
  - Once disconnected, an IDG can only be reset on the ground with the engine shut down.

GEN 1, GEN 2 AND APU GEN

- Either engine-driven generator and the APU-driven generator are AC generators rated at 90KVA, 115V and 400Hz.
- Anyone of the three generators is capable of supplying the electrical network for the entire aircraft electrical requirements, except the MAIN galley (See GALLEY description).
- One generator can supply both AC BUS 1 and 2, however AC BUS 1 (2) can be supplied by only one GEN at a time.
- The generators cannot supply the same bus simultaneously, however if a generator is lost, power transfer is automatic.

GENERATOR CONTROL UNITS (GCU)

- Each generator is controlled by a dedicated Generator Control Unit (GCU), which :
  - regulates the generator's voltage, and
  - controls the generator connecting to or disconnecting from the AC electrical network, and
  - protects the generator and electrical network against the following fault condition :

FAULT	GCU ACTION
Overvoltage Undervoltage Overfrequency Underfrequency	Generator is controlled off-line with automatic AC BUS transfer. (AC BUS XFR contactors close)
Differential faults :	
– on generator	Generator is controlled off-line with automatic AC BUS transfer. (AC BUS XFR contactors close)
– on associated AC BUS	Generator is controlled off-line. AC BUS XFR line not activated. (AC BUS XFR contactor does not close). Associated AC BUS is lost.
Incorrect phase sequence	Generator is controlled off-line with automatic AC BUS transfer. (AC BUS XFR contactors close)
Overcurrent	GEN HI light illuminates.

EXTERNAL POWER

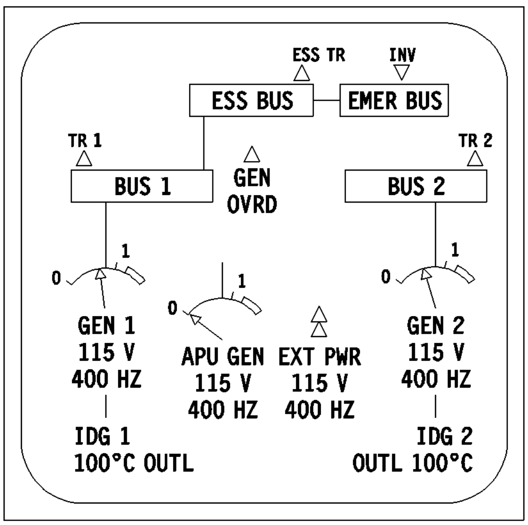
- An External Power unit can be connected aft of the nose landing gear.
- External power can supply the entire aircraft electrical network.

EMERGENCY INVERTER

- In case of loss of the AC ESS BUS, an Emergency Inverter (static inverter) converts the DC ESS BUS 28VDC power into a single-phase 115V/400Hz AC backup power to supply the AC EMER BUS.

AC POWER DISTRIBUTION AND TRANSFER

- The aircraft AC electrical distribution network consists of four main busses :
  - AC BUS 1, normally supplied by GEN 1
  - AC BUS 2, normally supplied by GEN 2
  - AC ESS BUS, normally supplied by AC BUS 1, and
  - AC EMER BUS, normally supplied from AC ESS BUS



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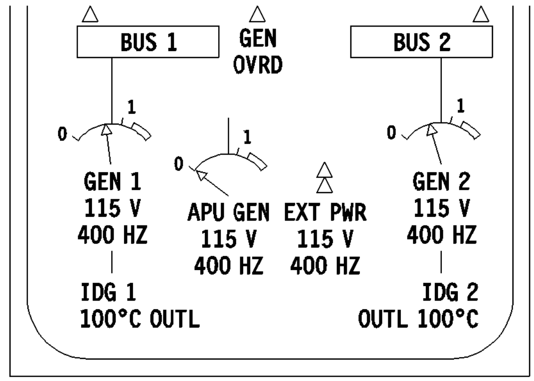
Note : Each of the four main AC Busses also has step-down transformers to provide 26 V AC power to sub-busses.

- If the normal power source for a bus is not available, automatic switching to an alternate power source occurs through the AC BUS XFR line.

AC BUS 1 and 2

- AC BUS's 1 and 2 are 3-phase busses, normally powered by their respective generator.



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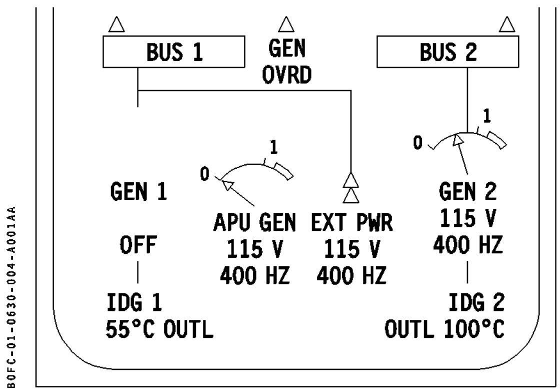
AC BUS transfer line - Power supply management

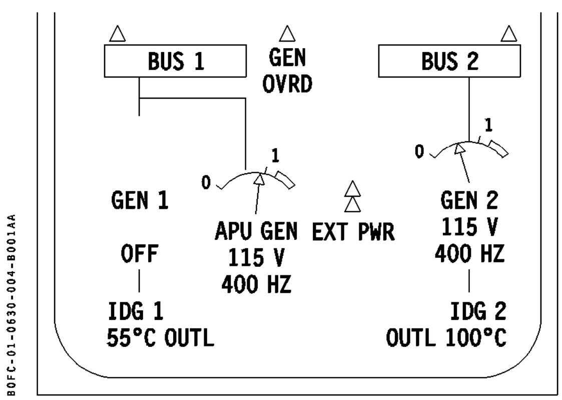
- If an Engine-Driven Generator is not available, the related AC BUS will be automatically switched to an alternate power supply source as follows :

  – If EXT PWR is available (On ground and EXT PWR light ON) the related bus will be connected to EXT PWR.

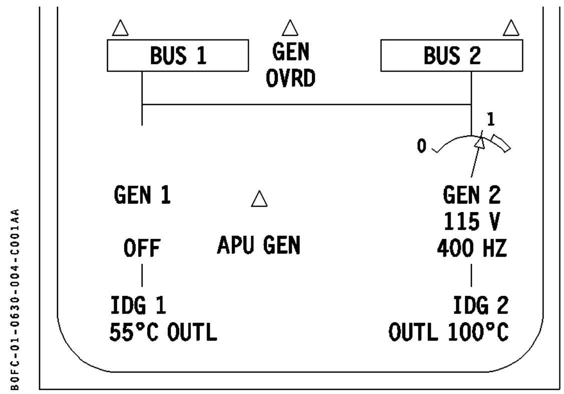


Note : If both the APU GEN and EXT PWR are available, EXT PWR has priority over the APU GEN.

  – If EXT PWR is not ON or in flight, the bus will be switched to the APU GEN (if available).

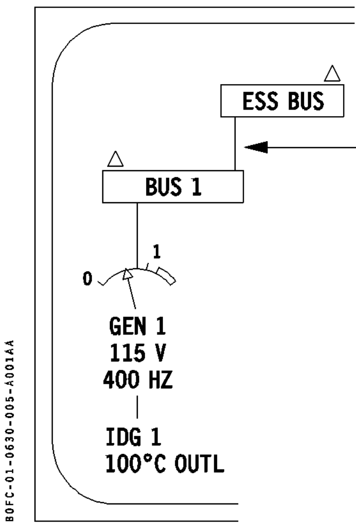


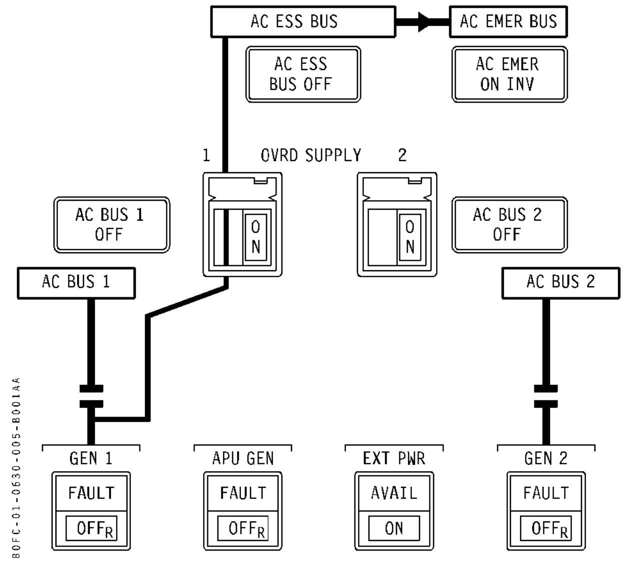
– Finally, if the APU GEN is not available, the bus will receive power from the opposite Engine-Driven Generator (GEN 2 for AC BUS 1, or GEN 1 for AC BUS 2) :



AC ESS BUS

- The AC ESS BUS is a 3-phase bus, normally supplied by the AC BUS 1 through an Essential Transfer Contactor (ETC).





SINGLE OVRD SUPPLY - AC ESS BUS RECOVERY

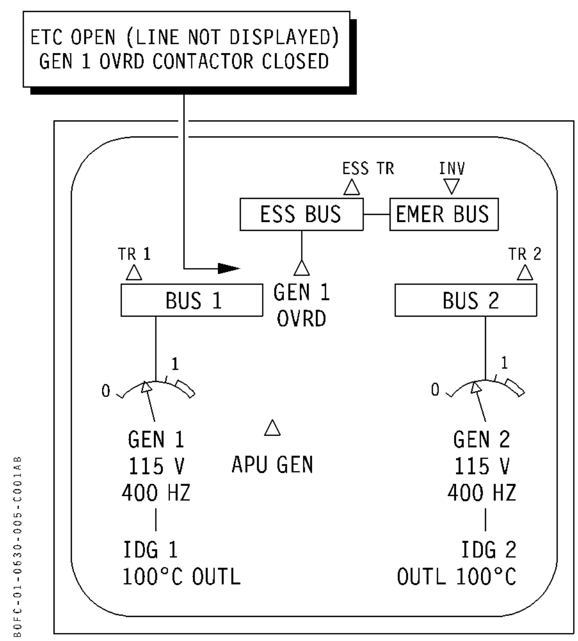
- If the AC ESS BUS is lost due to the loss of the AC BUS 1 or due to the failure of the Essential Transfer Contactor :

  – **If GEN 1 available** :

    • the guarded OVRD SUPPLY 1 pushbutton switch must be selected ON.

      * the OVRD SUPPLY 1 ON light (white) and the green flowbar illuminate.

      * the AC ESS BUS is now supplied directly from the GEN 1.



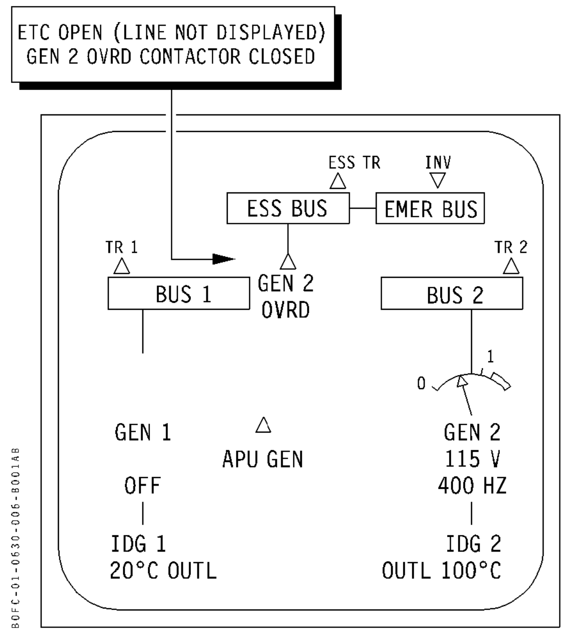
SINGLE OVRD SUPPLY - AC ESS BUS RECOVERY (Cont'd)

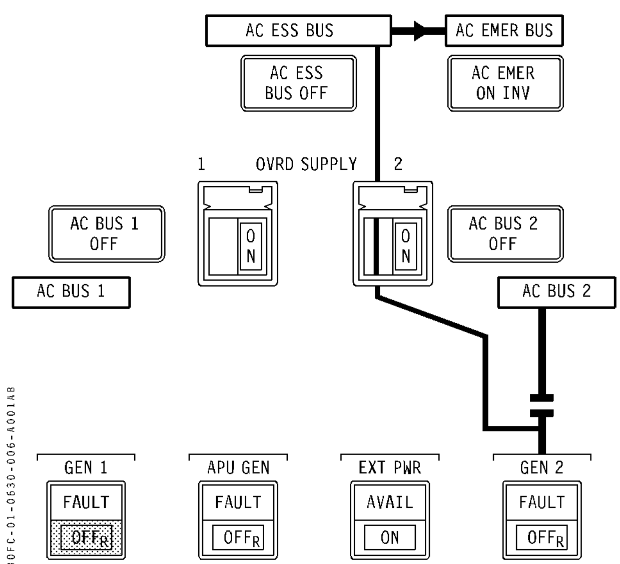
– **If GEN 1 is not available** :

- the guarded OVRD SUPPLY 2 pushbutton switch must be selected ON instead of OVRD SUPPLY 1.
  * the OVRD SUPPLY 2 ON light (white) and the green flowbar illuminate.
  * the AC ESS BUS is now supplied directly from the GEN 2.

– **If GEN 1 failure while in OVRD SUPPLY 1** :

- Before selecting the OVRD SUPPLY 2 pushbutton switch to ON, the OVRD SUPPLY 1 must be deselected (pushbutton released).
- Should the OVRD SUPPLY 2 be selected first, resulting in a DUAL OVRD SUPPLY condition, all normal AC and DC busses (AC BUS 1, AC BUS 2 and DC NORM BUS) would be shed.
- In this configuration, only the AC ESS BUS, AC EMER BUS and DC ESS BUS would remain supplied (refer to paragraph DUAL OVRD SUPPLY–AVIONICS SMOKE DRILL, hereafter).



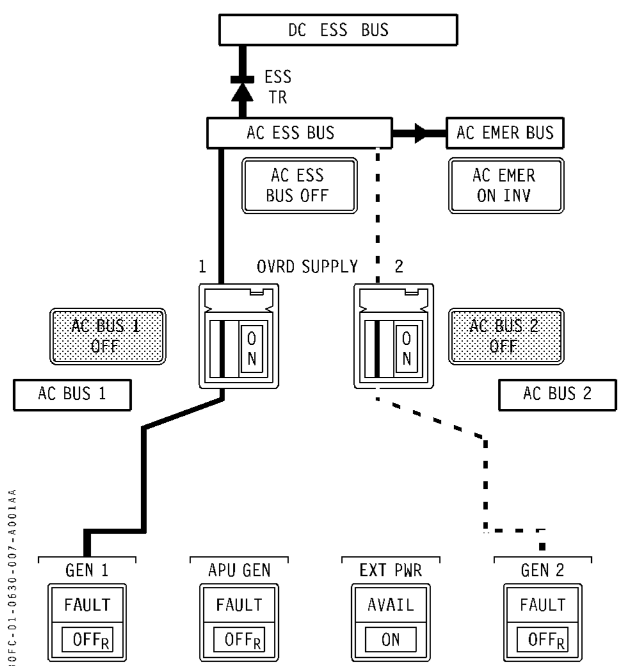


DUAL OVRD SUPPLY - AVIONICS SMOKE DRILL

- If AVIONICS SMOKE is detected, the AVIONICS SMOKE light located on the overhead ELEC PWR panel illuminates.
- The AVIONICS SMOKE procedure (refer to procedure) calls for pressing both OVRD SUPPLY pushbutton switches :
  - both OVRD SUPPLY ON lights illuminate white.
- Provided the APU GEN is not on line, the Generator Line Contactor 1 and 2 and the Essential Transfer Contactor open in order to shed :
  - the AC BUS 1,
  - the AC BUS 2, and
  - the DC NORM BUS.

Note 1 : *This removes power from the smoke source.*

Note 2 : *The GEN 1 supplies the AC ESS BUS. The GEN 2 is in Standby.*

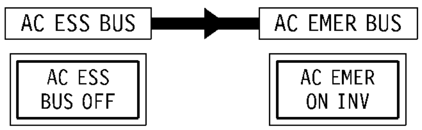


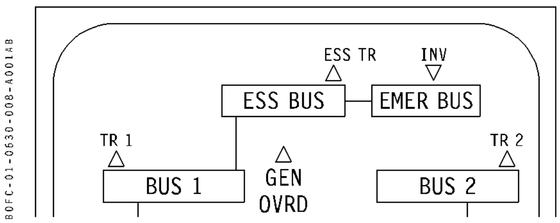
- The ESSential distribution network (AC ESS BUS, AC EMER BUS and DC ESS BUS) remains supplied :
  - If GEN 1 is operating :
    - the OVRD SUPPLY contactor 1 closes and its green flowbar illuminates.
    - the AC ESS BUS is supplied directly by the GEN 1.
    - the OVRD SUPPLY contactor 2 remains open.
  - If GEN 1 supply is lost, at any time, the OVRD SUPPLY contactor 2 closes and the GEN 2 supplies the ESSential network.

    (OVRD SUPPLY 1 flowbar extinguishes and OVRD SUPPLY 2 flowbar illuminates).

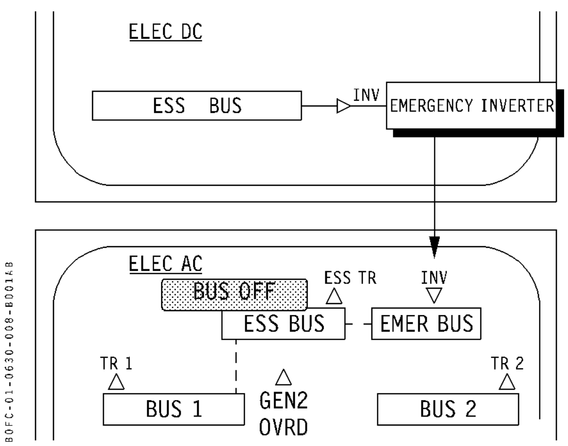
AC EMER BUS

- The AC EMER BUS is a single-phase bus, normally supplied from the AC ESS BUS :

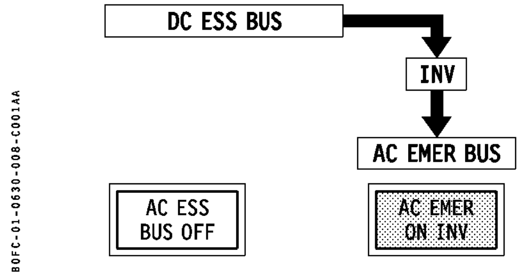




- If AC ESS OFF light illuminated, the AC EMER BUS is automatically supplied by the Emergency Inverter from the DC ESS BUS :

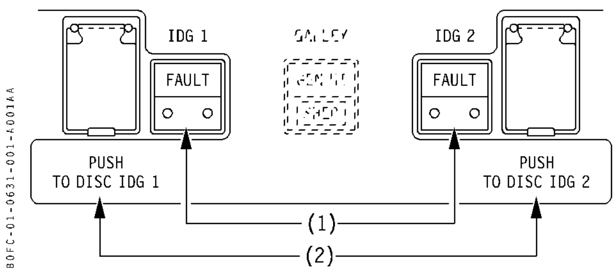


- When the Emergency Inverter is operating, the blue AC EMER ON INV light illuminates :



A. ELEC PWR PANEL (see PULL-OUT PAGE)

Integrated Drive Generators (IDG)



(1) IDG 1 (2) FAULT :

- The amber IDG FAULT light illuminates in case of:
  - IDG oil overheat, or
  - IDG low oil pressure

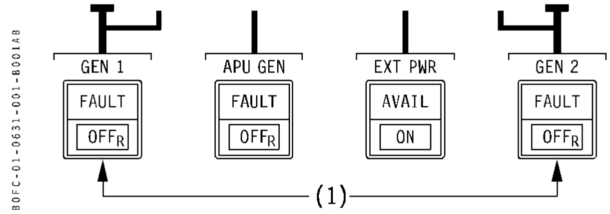
(2) IDG 1 (2) disconnection pushbutton switch :

- The guarded pushbutton switch controls the IDG 1 (or 2) disconnection from the engine accessory drive gear box.
- Pressing the pushbutton switch disconnects the IDG from its drive shaft.
  - Once disconnected, the IDG can only be reset on ground, with the engine stopped.

CAUTION

- The IDG must not be disconnected while engine is shut down or below ground idle (for example : IDG disconnect is not authorized on a windmilling engine)
- To avoid damaging the disengagement mechanism, the pushbutton switch must not be held for more than three seconds.

Engine Generators



(1) GEN 1 (2) pushbutton switches :

- These pushbutton switches control :
  - Generator operation and connection to the network by opening / closing the associated Generator Line Contactor, or
  - Resetting / rearming of the GCU's protection system after a fault has occured.

■ **ON (no light - pushbutton switch pressed-in)**

- The generator is selected and the Generator Line Contactor closes if the generator's parameters (phase sequence, frequency and voltage) are normal.

■ **FAULT (amber)**

- The Generator Line Contactor has opened due to activation of GCU's protections. The generator must be set to OFF.

Note : The activation of GCU protection may results from a transient condition. Resetting the GEN OFF/R then on may be successful in recovering the affected GEN.

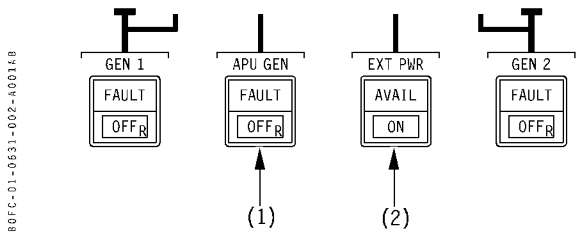
Note : In the following cases the Generator Line Contactor is open without GEN FAULT illumination :

- *Selecting GEN pushbutton switch OFF/R,*
- *or selecting both OVRD SUPPLY pushbutton switches ON (Smoke Drill).*

■ **OFF/R (white - pushbutton switch released - out)**

- The generator is cut off, and the Generator Line Contactor is opened.
- This also resets / rearms the GCU fault protection system (except for differential faults, as the protection system must be rearmed on the GCU itself by maintenance action).

ELEC PWR PANEL (continued)



(1) APU GEN pushbutton switch :

- This pushbutton switch controls :
  - APU Generator operation and connection to the network, or
  - Resetting / rearming of the APU GCU's protection system after a fault has occurred.

■ **ON (no light - pushbutton switch pressed-in)**
- The APU GEN is selected and energized if the generator's parameters (phase sequence frequency and voltage) are normal.

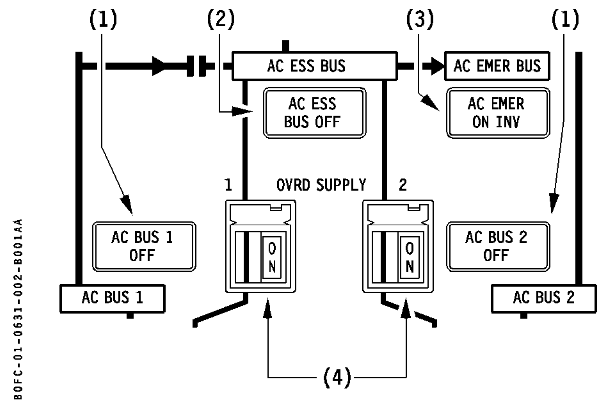
■ **FAULT (amber)**
- The generator must be set to OFF.

Note : The APU may be isolated (GLC open) without an APU GEN FAULT light if :
- *APU GEN pushbutton switch is OFF/R, or*
- *APU is not running.*

■ **OFF/R (white : pushbutton switch released-out)**
- The generator is cut off and disconnected from the network.
- This also resets / rearms the GCU fault protection system (except for differential faults, as the protection system must be rearmed by action on the GCU itself by maintenance action).

(2) EXT PWR pushbutton switch :

- (Refer to section 1.06.21 – EXTERNAL POWER CONTROLS AND INDICATORS).



(1) AC BUS 1 (or 2) OFF light :

- The amber AC BUS 1 (or 2) OFF light illuminates when the associated AC BUS is not supplied.

(2) AC ESS BUS OFF light :

- The amber AC ESS BUS OFF light illuminates when the AC ESS BUS is not supplied.

(3) AC EMER ON INV light :

- The blue AC EMER ON INV light illuminates when AC EMER BUS is powered from DC ESS BUS via the Static Inverter.

(4) OVRD SUPPLY 1 (2) pushbutton switch :

Refer to section 1.06.30 – OVRD SUPPLY - AC ESS BUS RECOVERY and OVRD SUPPLY - AVIONICS SMOKE DRILL.

ELEC PWR PANEL (continued)

(1) GALLEY pushbutton switch :

(See PULL-OUT page)

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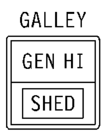


- The Galley pushbutton switch controls power to the MAIN and SECONDARY groups of galley equipment busses.
- If a generator becomes overloaded this pushbutton switch must be pressed to shed both galley busses and reduce the load.

■ **ON (no light - pushbutton switch pressed-in)**

– Power supply to the galley busses is automatic:
  - With two generators on line : both MAIN and SECONDARY galley busses are supplied.
  - If only one generator is on line : The Main galley bus is automatically shed (no light illuminates to indicate this condition).

Exception : Both galley busses can be powered by the APU generator alone when on the ground.

■ **GEN HI (amber)**

– Illuminates if any generator load is over the white arc for more than 15 sec.
  - If on ground with only the APU GEN on line, the switch trips to automatically shed both galley busses - SHED light illuminates.
  - Any other time a generator overloads, the GEN HI light only illuminates but the pushbutton switch does not trip automatically : the GALLEY pushbutton switch must be manually pressed to shed the galley busses - SHED light illuminates.

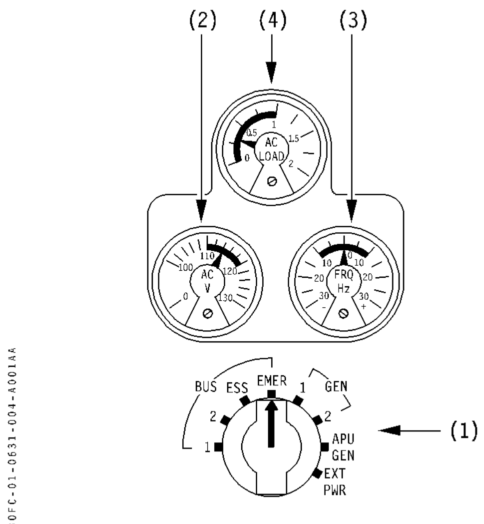
■ **SHED (white - pushbutton switch released - out)**

– Both MAIN and SECONDARY galley busses are not supplied.

– Pushbutton switch only trips out automatically in case of APU generator overload on ground.

Mod : 5911 or (4705 + 5911)

B. AC ELECTRICAL INDICATOR PANEL (SEE PULL-OUT PAGE)



(1) Rotary Selector for AC voltage (V), frequency (FRQHz) and LOAD indicators :

- This rotary selector selects which AC BUS or power source is displayed on the AC voltage (V), frequency (FRQHz) and LOAD indicators (2, 3 and 4).
- BUS positions :
  - AC Voltage and Frequency (no LOAD indication) of the selected AC BUS (AC BUS 1, AC BUS 2, AC ESS BUS or AC EMER BUS), are displayed on the corresponding Indicators.
- GEN 1 - GEN 2 - APU GEN - EXT PWR positions :
  - AC Voltage, Frequency and LOAD of the selected Generator (GEN 1, GEN 2, or APU GEN) are displayed on the corresponding Indicators.
  - For EXT PWR, only Voltage and Frequency (no LOAD) are displayed.

(2) AC voltage (V) Indicator :

- Indicates the voltage of the selected AC BUS or power source.
- Normal reading is within the white arc.

(3) AC frequency (FRQ Hz) Indicator :

- Indicates frequency of the selected AC BUS or power source.
- Normal reading is within the white arc.

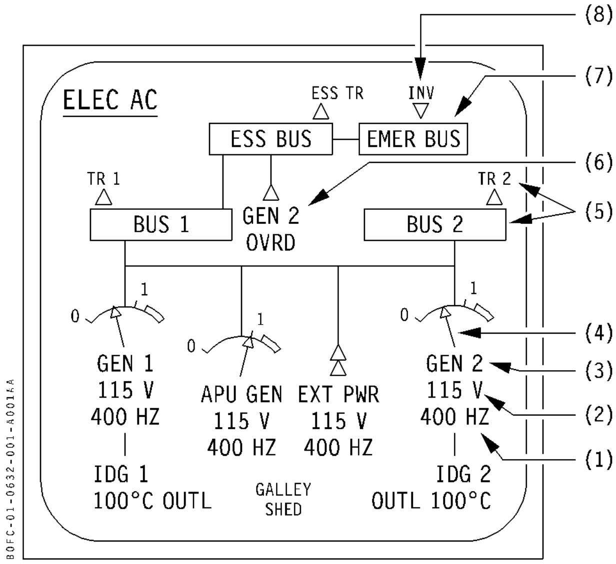
(4) AC LOAD Indicator :

- Displays the LOAD of the selected generator.
- Indicates from 0 to 200 % of the rated 90 KVA load (0.5 = 50 % rated load, 1 = 100 % rated load).
- Normal reading is within the white arc.

Note : *If a BUS or EXT PWR is selected, the LOAD indication will be zero.*

Note : *Except as mentioned before, only the phase selected on the lateral panel PHASE SEL (A-B-C) rotary selector is displayed on the AC voltage / frequency / load indicators.*

SYSTEM DISPLAY



(1) Generator Frequency Indication :

– Green when normal operation

– Amber if frequency is below 390Hz or above 410Hz.

– Not displayed when the GEN pushbutton switch is selected OFF/R.

(2) Generator Voltage Indication :

– Green when normal operation

– Amber if voltage is below 110V or above 120V.

– A white OFF indication replaces the voltage indication when the GEN pushbutton switch is selected OFF/R.

(3) GEN 1 (or 2) legend :

– White when normal operation

– Amber when the GEN pushbutton switch is selected OFF/R.

(4) Generator Load Indication :

– Green when normal operation

– Amber if load exceeds 110 % (1.1 on indicator).

– Not displayed if GEN pushbutton switch is selected OFF/R.

(5) BUS an TR Indications (AC BUS 1, AC BUS 2 and AC ESS BUS) :

- When the bus is powered :
  – TR indication is white.
  – BUS symbol is green.
- When the bus is not powered :
  – TR and BUS indications are amber

(6) GEN 1 (or 2) OVRD Indication :

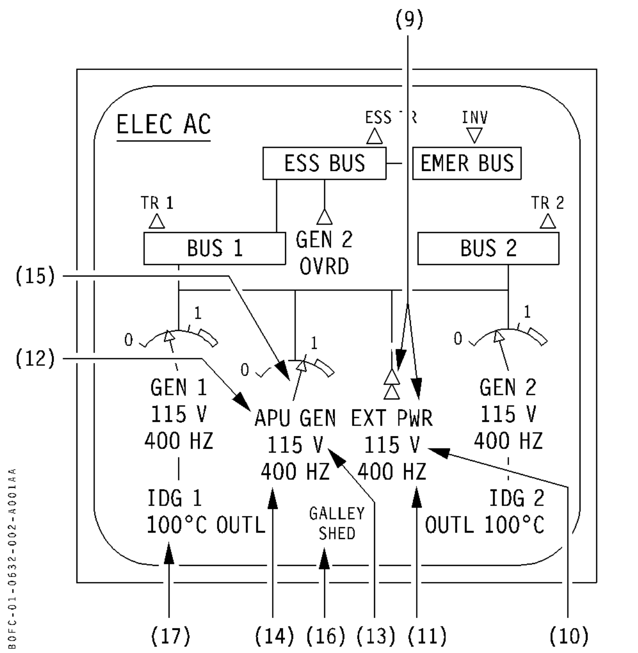
- White GEN 1 (or 2) OVRD indicates which OVRD SUPPLY contactor is closed.
- With both OVRD SUPPLY pushbutton switches selected OFF, only GEN OVRD is displayed (GEN 1 or 2 are not displayed).

(7) EMER BUS Symbol :

- Always displayed in green, whether bus is supplied or not.

(8) Emergency Inverter (INV) Indication :

- Always displayed in white, with Inverter supplying or not.



(9) EXT PWR legend and symbols :

These indications are only displayed on ground, and are not displayed in flight.

(10) EXT PWR Voltage Indication :

- Green when normal operation
- Amber if voltage below 110V or above 120V.
- Not displayed if voltage below 50V.

(11) EXT PWR Frequency Indication :

- Green when normal operation
- Amber if frequency below 390Hz or above 410Hz.
- Not displayed if voltage below 50V.

(12) APU GEN legend :

- Green when normal operation
- Turns amber if the APU GEN pushbutton switch is OFF/R while the APU MASTER SWITCH is ON.

(13) APU GEN Voltage Indication :

- Green when normal operation
- Amber if voltage below 110V or above 120V.
- A white OFF indication replaces the voltage indication when the APU GEN pushbutton switch is selected OFF/R.
- No indication displayed when the APU MASTER SWITCH is OFF.

(14) APU GEN Frequency Indication :

- Green when normal operation
- Turns amber below 390Hz or above 410Hz.

No indication displayed when :

- APU GEN pushbutton switch is selected OFF/R, or
- APU MASTER SWITCH is OFF.

(15) APU GEN Load :

- Green when normal operation
- Amber when load exceeds 110% (1.1 on dial)

A white triangle replaces the load indication when :

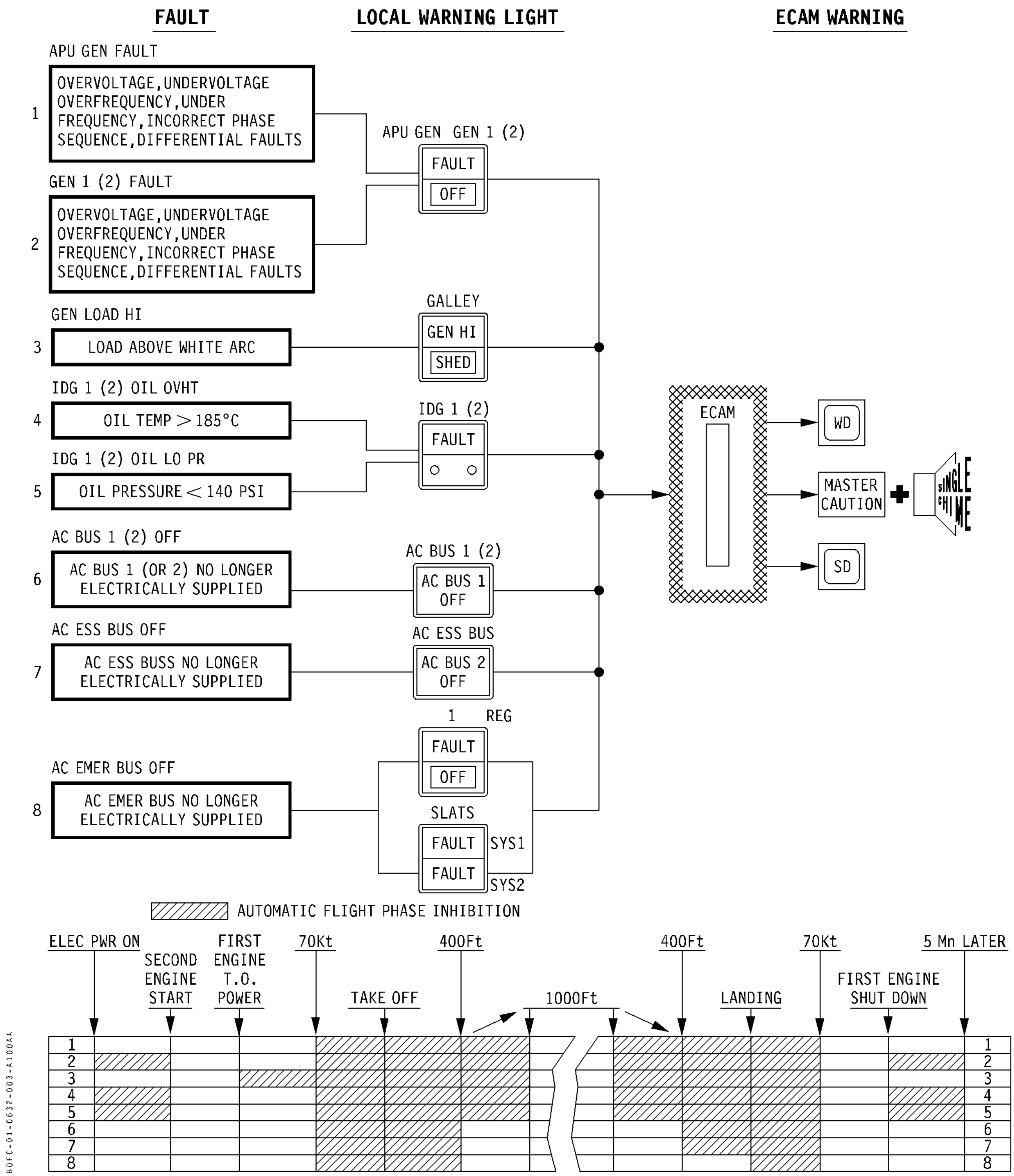
- APU GEN pushbutton switch is OFF/R, or
- APU MASTER SWITCH is OFF.

(16) GALLEY SHED legend :

White GALLEY SHED indication is displayed when both Main and Secondary Galley Busses are shed.

(17) IDG 1 (or 2) Outlet Oil Temperature Indication :

- Green when normal operation
- Flashes when temperature between 142° C and 185° C.
- Amber if temperature above 185° C.


FAULT
LOCAL WARNING LIGHT
ECAM WARNING
APU GEN FAULT
1 OVERVOLTAGE,UNDERVOLTAGE OVERFREQUENCY,UNDER FREQUENCY,INCORRECT PHASE SEQUENCE,DIFFERENTIAL FAULTS
GEN 1 (2) FAULT
2 OVERVOLTAGE,UNDERVOLTAGE OVERFREQUENCY,UNDER FREQUENCY,INCORRECT PHASE SEQUENCE,DIFFERENTIAL FAULTS
APU GEN GEN 1 (2)
FAULT
OFF
GEN LOAD HI
3 LOAD ABOVE WHITE ARC
GALLEY
GEN HI
SHED
IDG 1 (2) OIL OVHT
4 OIL TEMP > 185°C
IDG 1 (2) OIL LO PR
5 OIL PRESSURE < 140 PSI
IDG 1 (2)
FAULT
ECAM
WD
MASTER CAUTION
SINGLE CHIME
SD
AC BUS 1 (2) OFF
6 AC BUS 1 (OR 2) NO LONGER ELECTRICALLY SUPPLIED
AC BUS 1 (2)
AC BUS 1 OFF
AC ESS BUS OFF
7 AC ESS BUSS NO LONGER ELECTRICALLY SUPPLIED
AC ESS BUS
AC BUS 2 OFF
1 REG
FAULT
OFF
AC EMER BUS OFF
8 AC EMER BUS NO LONGER ELECTRICALLY SUPPLIED
SLATS
FAULT SYS1
FAULT SYS2
AUTOMATIC FLIGHT PHASE INHIBITION
ELEC PWR ON
SECOND ENGINE START
FIRST ENGINE T.O. POWER
70Kt
TAKE OFF
400Ft
1000Ft
400Ft
LANDING
70Kt
FIRST ENGINE SHUT DOWN
5 Mn LATER
1 2 3 4 5 6 7 8
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Mod : 5051

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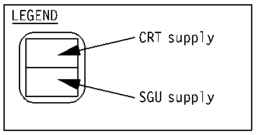
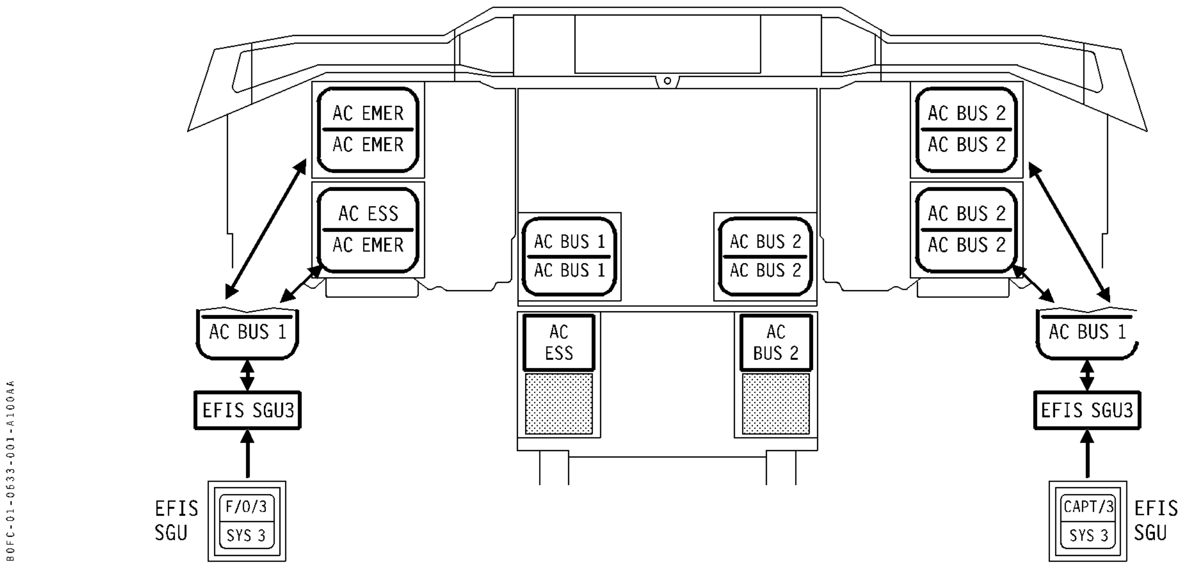

LEGEND
CRT supply
SGU supply


AC EMER
AC EMER
AC ESS
AC EMER
AC BUS 1
AC BUS 1
AC BUS 2
AC BUS 2
AC BUS 2
AC BUS 2
AC BUS 2
AC BUS 2
AC BUS 1
AC BUS 1
AC ESS
AC BUS 2
EFIS SGU3
EFIS SGU3
EFIS SGU
F/O/3
SYS 3
CAPT/3
SYS 3
EFIS SGU
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R Mod : 5911

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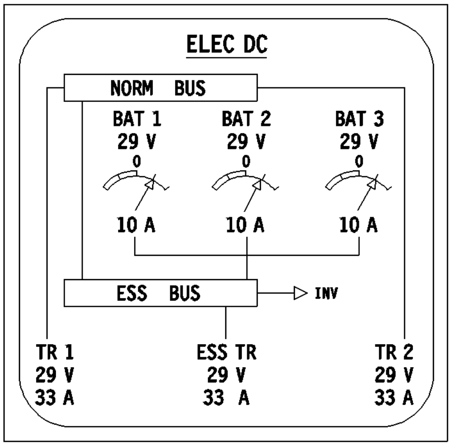
NORMAL DC POWER SUPPLY

- DC power is generated from the main AC sources by three Transformer Rectifier (TR) units, which convert the AC power to DC and step the voltage down to 28 V DC :



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- Two of the TRs supply the DC NORM BUS and the third TR supplies the DC ESS BUS.
- Each TR is rated at 150 A.

DC POWER GENERATION

- DC power is provided by three Transformer Rectifiers (TR) and three Batteries.

TRANSFORMER RECTIFIER (TR) UNIT

- The TRs convert 115 V/ 400 Hz AC power from the AC BUS 1, AC BUS 2 and the AC ESS BUS into 28V DC power.
- When electrically supplied by the associated AC BUS, each TR delivers up to 150 A of DC power through a TR line contactor.
- The TR line contactors open in case of :
  - Reverse current (from DC to AC), or
  - TR overheat.

BATTERIES

- The three 25 A/h batteries are contained in fire−proof boxes in the underfloor avionics compartment.
- Each battery's line contactor is operated by an automatic Battery Charge Controller (BCC).
- The BCC main functions are to :
  - connect the batteries to the DC ESS BUS, (for emergency power supply) if DC ESS BUS voltage drops.
  - control battery charging,
  - protect the battery from impending battery overheats during charging,
  - With LAND mode armed on FCU and both AP engaged, the BCC connects the batteries to the DC ESS BUS to increase the reliability of the autopilot's power supply for CAT III operations (Refer to section 1.03.50 – AFS – LAND MODE).
- Each battery is permanently connected to an associated Hot Battery Bus (located upstream of the battery line contactor).
- With all batteries OFF, the following equipment are still powered by the Hot Battery Busses :
  - Clocks,
  - Engine and cargo fire extinguisher squibs, R
  - Refuelling system (if the REFUEL / DEFUEL Panel PWR SUPPLY guarded toggle switch is set to BAT position),
  - IRS 1 (or 3 if the CAPT ATT HDG pushbutton switch is pressed).

DC POWER DISTRIBUTION

- There are two main 28V DC busses :
  - The DC NORM BUS, and
  - The DC ESS BUS.

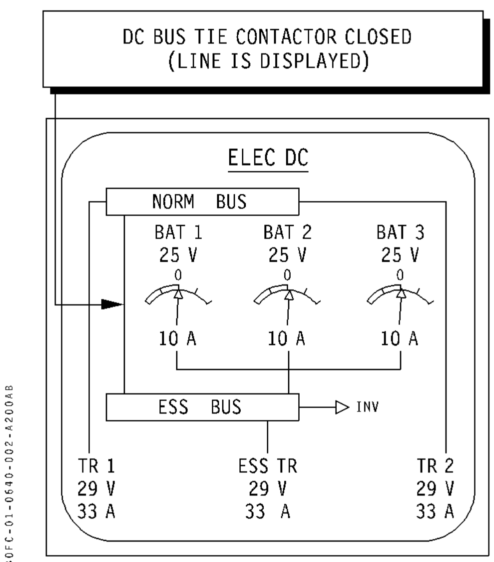
DC NORM BUS Power Supply

- The DC NORM BUS is supplied by Transformer Rectifiers (TR 1 and TR2).

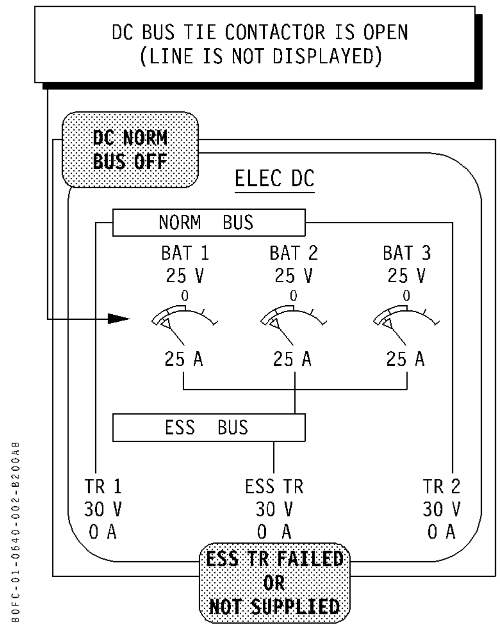
Note : TR2 is also used when supplying the AC and DC GRND / FLIGHT busses directly from EXT PWR.

DC ESS Bus Power Supply

- The DC ESS BUS is supplied from :
  - The ESS TR, and
  - The DC NORM BUS, through the DC Bus Tie Contactor which closes as soon as the aircraft network is electrically supplied (except when supplied by EXT PWR).



- If supply from the DC NORM BUS and ESS TR is lost, the DC ESS BUS is supplied by the Stand-by Generator or by the batteries :



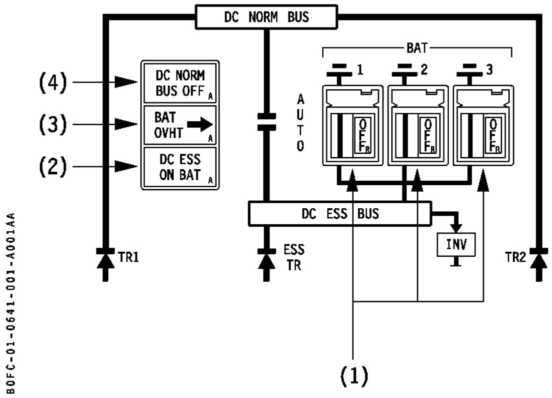
DC BUS TIE CONTACTOR

- The DC Bus Tie Contactor, connecting the DC NORM BUS with the DC ESS BUS, opens automatically :
  - If AC BUS 1 OFF and AC BUS 2 OFF (to prevent any battery from supplying the DC NORM BUS),

    Note : This condition occurs in case of loss of all generators, or as a result of performing the AVIONICS SMOKE procedure.
  - If a reverse current is detected from the DC ESS BUS to the DC NORM BUS.
  - When LAND mode is armed on FCU and both AP are engaged. The opening of the DC Bus Tie Contactor segregates the electrical power supply for AP1 and AP2 to increase the AP reliability during CAT III operations.

Mod : 5911 + 7770

A. ELEC PWR PANEL



(1) BAT 1 (or 2 or 3) pushbutton switches :

- These pushbuttons control operation of the corresponding Battery Charge Controller :

■ **AUTO (No light – Pushbutton switch pressed–in)**

– The Battery Charge Controller automatically operates its line contactor to connect/disconnect the battery to / from the DC ESS BUS.

  • When the Battery Charge Controller closes the line contactor, the green flowbar illuminates, indicating that the battery is connected to DC ESS BUS.

  • When the Battery Charge Controller has opened the line contactor, and the battery is disconnected from DC ESS BUS, the flowbar extinguishes.

– The Battery Charge Controllers connect the batteries to DC ESS BUS :

  • To assist APU starting (when APU Master switch is set to ON).

  • For back–up power if DC ESS BUS voltage falls below 25 V.

  • When the battery requires charging.

  • When two APs are engaged in LAND mode

– Otherwise, when fully charged the batteries are disconnected from the DC ESS BUS.

■ **OFF/R (white – pushbutton switch released–out)**

– The Battery Charge Controller unit is not operating and the battery line contactor is open. The Battery Charge Controller fault detection circuit is reset/rearmed.

– The flowbar extinguishes to show that the battery is disconnected from DC ESS BUS.

Note : Regardless of the BAT pushbutton switch position, if BAT OVRD pushbutton switch is selected ON, the battery is forced to connect to the DC ESS BUS and the flowbar illuminates, (even with its pushbutton switch is set to OFF).

(2) DC ESS ON BAT Light :

- This light illuminates amber when the DC ESS BUS is powered only by the batteries.

Note : When supplied by batteries only, DC ESS BUS will be powered for a limited time (refer to QRH procedure).

(3) BAT OVHT Light :

- This light illuminates amber when any battery's charge rate shows characteristics of a battery overheat.

- The associated Battery Charge Controller automatically disconnects the affected battery.

- The BAT OVHT light extinguishes when the affected battery's pushbutton switch is selected OFF/R.

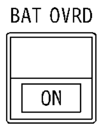
Note : This light is inhibited when the BAT OVRD pushbutton switch is ON.

(4) DC NORM BUS OFF :

- This light illuminates amber when the DC NORM BUS is not supplied.

ELEC PWR PANEL (continued)

(1) BAT OVRD pushbutton switch :



- The pushbutton switch overrides the Battery Charge Controller and the BAT pushbutton switch position and forces all three batteries to connect to the DC ESS BUS, even if the BAT pushbutton switches are set to OFF.

Note : This switch is used as directed by ECAM or QRH.

■ **ON (White – Pushbutton switch pressed–in)**
- All batteries are connected to the DC ESS BUS.
- Battery overheat detection is inhibited.

■ **Off (No light – pushbutton switch released out)**
- The BAT Line Contactors are controlled by the BAT pushbutton switches and by the Battery Charge Controllers.

(2) LAND RECOVERY pushbutton switch :

- In case of loss of DC NORM BUS, following the application of the SMOKE DRILL or in case of flight on BAT only, several systems and equipment used for approach and landing are lost.

  Pressing the LAND RECOVERY pushbutton switch enables to switch over the electrical power of these systems and equipment to the AC ESS BUS, AC EMER BUS and DC ESS BUS.

■ **Off (No light –pushbutton switch released out)**
- Normal position.

■ **ON (White – pushbutton switch pressed–in)**
- The systems equipment listed hereafter are recovered.

- The following systems/equipment are recovered by selecting LAND RECOVERY :
  - SLATS (one slats motor recovered)
  - FLAPS (one flaps motor recovered)
  - SPOILERS and SPEEDBRAKES (1, 4, 6, and 7 recovered),
  - GROUND SPOILER CONTROL (using spoilers 1, 4, 6, and 7),
  - ANTI–SKID (NORM recovered).
- LAND RECOVERY is used in the following procedures, as directed by the ECAM or QRH :
  - DC NORM BUS OFF,
  - LOSS OF BOTH ENG GENERATORS,
  - FLIGHT ON BAT ONLY,
  - AVIONICS SMOKE.

(3) AVIONICS SMOKE light :

- The AVIONIC SMOKE light illuminates red when smoke is detected in the ventilation duct from :
  - Cockpit instrument or overhead panels,
  - Circuit breakers panel,
  - Weather radar transceiver,
  - Electronic racks or IRS 2,
  - Underfloor area equipment.
- The illumination of the AVIONICS SMOKE light is accompanied by ECAM activation.

(4) BAT SMOKE light :

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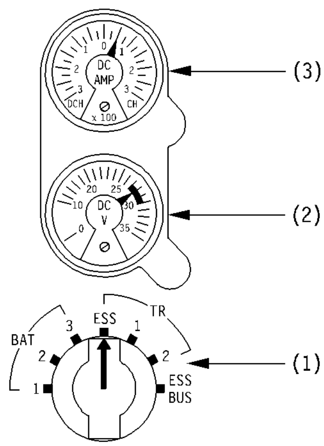
- The BAT SMOKE light illuminates red when smoke is detected in the battery ventilation duct.
- The illumination of the BAT SMOKE light is accompanied by ECAM activation.

B. DC ELEC IND PANEL



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(1) DC (V/AMP) Selector :

- Used to select the DC power source to be displayed on the DC V and DC AMP indicators.

  Note : *If any of the three BAT or any of the three TR is selected, both current (AMP) and voltage (V) are displayed.*

  If the ESS BUS is selected, only voltage (V) is displayed.

(2) DC voltage (V) Indicator :

- Displays the voltage of the DC power source selected by the rotary selector.
- Normal readings are :
  - for a battery without load : 25 to 28 V
  - for a battery under−load : 23 to 28 V
  - for a TR unit : 27 to 30 V (white arc).

(3) DC current (AMP) Indicator :

- Displays the charge (CH) or discharge (DCH) current of the DC power source selected by the rotary selector.
- The maximum continuous DC AMP indication for a TR is 150 A.

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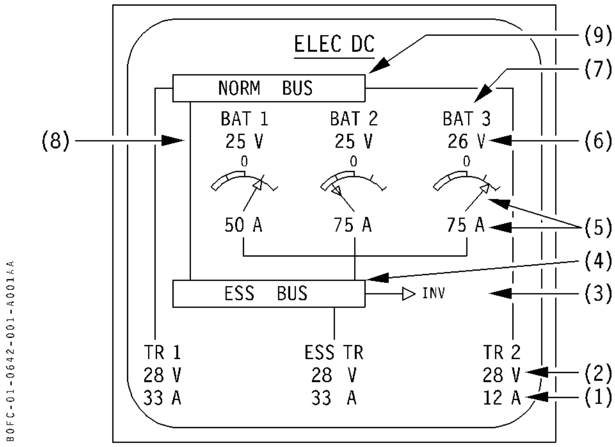
SYSTEM DISPLAY



(1) TR Current indication :

- Always green but flashes when the current is below 6A.

(2) TR Voltage indication :

- Normally green but illuminates amber when the voltage is below 25 V or above 31 V.

(3) INV indication :

- The indication is white when the Emergency Inverter is supplying the AC EMER BUS.

(4) ESS BUS symbol :

- Normally green but illuminates amber when the DC ESS BUS is not powered.

(5) Digital / Analog Battery Current indications :

- Normally green but illuminates amber with a reverse arrow when the reverse current is below 5A.
- A white OFF replaces these indications when the associated BAT pushbutton switch is selected to OFF/R and the battery line contactor is open.

(6) Battery Voltage indication :

- Normally green but illuminates amber when the voltage is below 25 V or above 31 V.

(7) BAT indication :

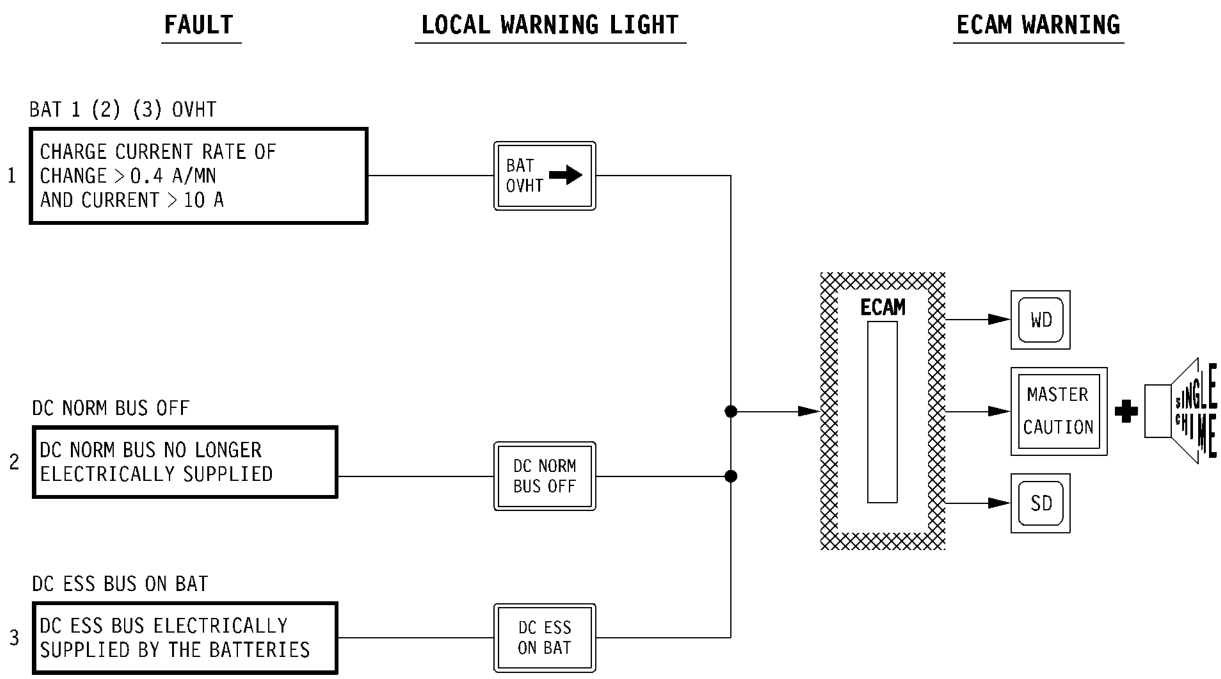
- Illuminates white when the BAT pushbutton switch is set to AUTO.
- Illuminates amber when the BAT pushbutton switch is selected to OFF/R.

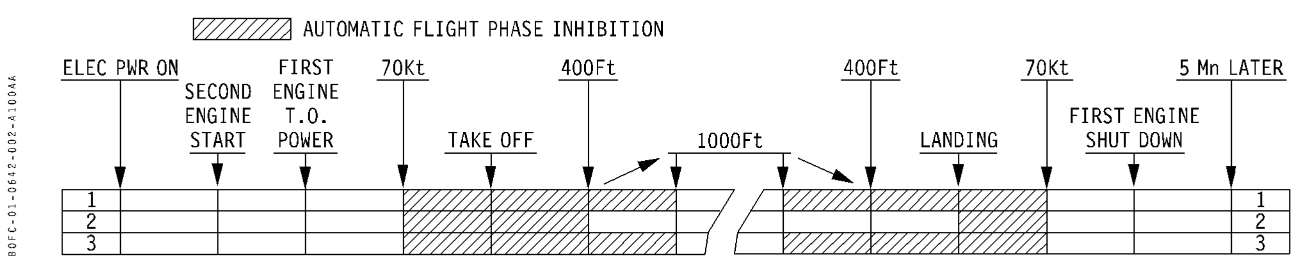
(8) DC Bus Tie Contactor line :

- Green when the DC Bus Tie contactor is closed.
- Not displayed when the DC Bus Tie contactor is open.

(9) NORM BUS symbol :

- The symbol is green when the DC NORM BUS is supplied, and is amber when the DC NORM BUS is not supplied.


FAULT
LOCAL WARNING LIGHT
ECAM WARNING
BAT 1 (2) (3) OVHT
1
CHARGE CURRENT RATE OF CHANGE > 0.4 A/MN AND CURRENT > 10 A
BAT OVHT
DC NORM BUS OFF
2
DC NORM BUS NO LONGER ELECTRICALLY SUPPLIED
DC NORM BUS OFF
DC ESS BUS ON BAT
3
DC ESS BUS ELECTRICALLY SUPPLIED BY THE BATTERIES
DC ESS ON BAT
ECAM
WD
MASTER CAUTION
SINGLE CHIME
SD


AUTOMATIC FLIGHT PHASE INHIBITION
ELEC PWR ON
SECOND ENGINE START
FIRST ENGINE T.O. POWER
70Kt
TAKE OFF
400Ft
1000Ft
400Ft
LANDING
70Kt
FIRST ENGINE SHUT DOWN
5 Mn LATER
1
2
3
1
2
3
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Mod : 5051

GENERATION

GENERATOR

- AC/DC stand–by generation is achieved by a constant speed–hydraulically driven STBY GEN powered by the green hydraulic system.

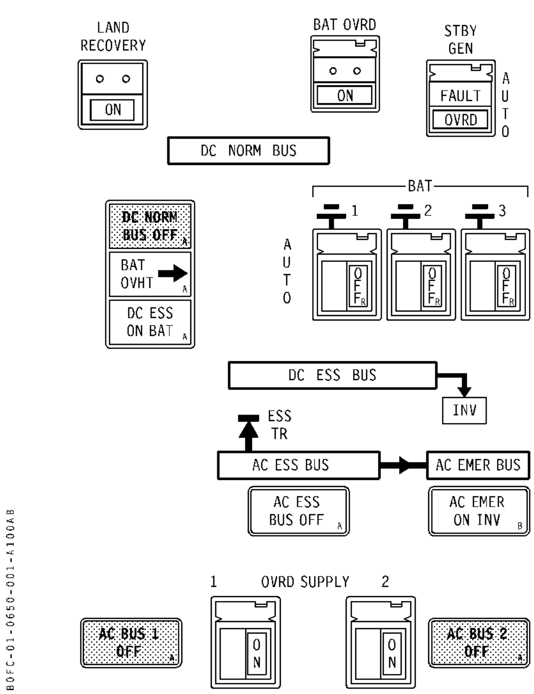
- The generator is rated at :
  - AC output : 5 kVA, 115 V, 400 Hz.
  - DC output : 50 A, 28 V (24 to 30 V).

GENERATOR CONTROL UNIT (GCU)

- The STDBY GEN is associated with a dedicated generator Control Unit (GCU) which provides AC voltage and frequency regulation and protection against the following faults :

FAULTS	EFFECTS
Under voltage (AC + DC)	AC and DC stand–by line contactors open
Under frequency (AC)	Generator is de–energized

DISTRIBUTION



- When the starting and feeding conditions (described on page 2) are met, the STBY GEN supplies :
  - a part of the AC ESS BUS (AC ESS BUS 2),
  - the AC EMER BUS,
  - the DC ESS BUS.

AC ESS BUS 2

- The AC ESS BUS 2 is a part of the AC ESS BUS and is normally supplied by the AC BUS 1, through the Essential Transfer Contactor and a two–direction contactor.

- Should STBY AC power feeding conditions be met, the two–direction contactor automatic switching :
  - will split the connection between AC ESS BUS 1 and AC ESS BUS 2, and AC BUS 1, and
  - will establish the connection between the AC output of the STBY GEN and AC ESS BUS2 provided the BAT OVRD guarded pushbutton switch is not selected ON.

AC EMER BUS

(Refer to section 1.06.60 – EMERGENCY AC AND DC POWER SUPPLY).

DC ESS BUS

- The DC ESS BUS is normally supplied by :
  - the DC NORM BUS through a DC Bus Tie contactor,
  - and the AC ESS BUS 2 through the ESS TR.

- When STBY DC power feeding conditions are met (see DC power feeding conditions paragraph further), the DC ESS BUS is supplied :
  - either by the DC output of the STBY GEN, provided the BAT OVRD pushbutton switch or the LAND RECOVERY pushbutton switch is not selected ON,
  - or by the batteries, if the BAT OVRD pushbutton switch is selected ON, (the STBY GEN is then deactivated).

Mod : 5911

STBY GEN STARTING AND FEEDING CONDITIONS

- The STBY GEN operation is confirmed by :
  - AC EMER ON INV light extinguished,
  - DC ESS ON BAT light extinguished,
  - FUEL X-FEED in-line.

STARTING WITHOUT FEEDING

- The STBY GEN starts to run provided the following conditions are met :
  - DC NORM BUS is OFF, and
  - R the Generator Line Contactor 2 is opened, and
  - BAT OVRD pushbutton switch is not selected ON, and
  - DC ESS ON BAT light illuminated, and
  - green hydraulic power is available, and
  - aircraft is in flight.

AC POWER FEEDING

- When feeding conditions are met :
  - no FAULT detected by the STBY GEN generator control unit, and
  - AC STBY power available,

    the AC STBY contactor closes, and STBY GEN AC power supplies the AC ESS BUS (AC ESS BUS 2) and the AC EMER BUS.

DC POWER FEEDING

- When feeding conditions are met :
  - no FAULT detected by the STBY GEN generator control unit, and
  - DC STBY power available, and
  - no APU start attempt, and
  - LAND RECOVERY pushbutton switch is not selected ON,

  the DC STBY contactor closes, and STBY GEN DC power supplies the DC ESS BUS.

- After an automatic starting of the STBY GEN in flight (for example in case of LOSS OF BOTH ENGINE GENERATORS), the two starting conditions DC ESS ON BAT and aircraft in flight are replaced by a STBY GEN operating condition (in order to maintain STBY GEN operation for the remainder of the flight).

  This maintains the STBY GEN operation although the DC ESS BUS is no longer supplied by the batteries.

- APU GEN has priority over STBY GEN to supply the electrical network, when GEN 1 and GEN 2 are lost.

- DC ESS BUS is momentarily disconnected from the STBY GEN during APU start to enable APU starting on batteries and prevent tripping of STBY GEN during APU start.

STBY GEN OVRD MODE

- The OVRD procedure is used if the STBY GEN fails to start automatically.

- Either in flight or on ground, the STBY GEN can be forced to run as soon as the following conditions are met :
  - BAT OVRD pushbutton switch is not selected ON, and
  - green hydraulic power is available.

- AC ESS BUS 2, AC EMER BUS, and DC ESS BUS electrical supply by the STBY GEN is achieved in the same way as with the STBY GEN pushbutton switch selected AUTO.

- If a the forced starting has been initiated :
  - in flight, the STBY GEN operation will continue after landing,
  - on ground, the STBY GEN operation will be limited to two minutes (ground test).

Mod : 5911

STBY GEN PUSHBUTTON SWITCH

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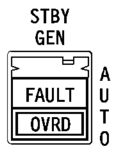

- The STBY GEN pushbutton switch enables the STBY GEN to be started as soon as starting conditions (refer to section 1.06.50) are met.

- Automatic operation of the STBY GEN is not controlled by the STBY GEN pushbutton switch.

■ **AUTO (pushbutton switch released out-normal position)**

– Automatic starting of the STBY GEN is performed provided the automatic starting conditions are met. Refer to section 1.06.50 – STBY GEN STARTING AND FEEDING CONDITIONS

– Automatic starting is inhibited on ground.

■ **OVRD (pushbutton switch pressed–in)**

– The OVRD light illuminates white to indicate that the pushbutton switch is pressed–in.

– The STBY GEN is forced to connect :

- in flight : permanently,
- on ground : for a 2-minute test period.

■ **FAULT**

– The FAULT light illuminates amber when :

- an undervoltage or underfrequency is detected by the GCU, or
- an defect is detected in the AC stand–by line contactor logic.

Mod : 5911

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EMERGENCY AC and DC POWER SUPPLY

R • Emergency power is provided either by :

R – an AC/DC STBY GEN (See AC AND DC STAND-BY POWER section) which supplies power to :

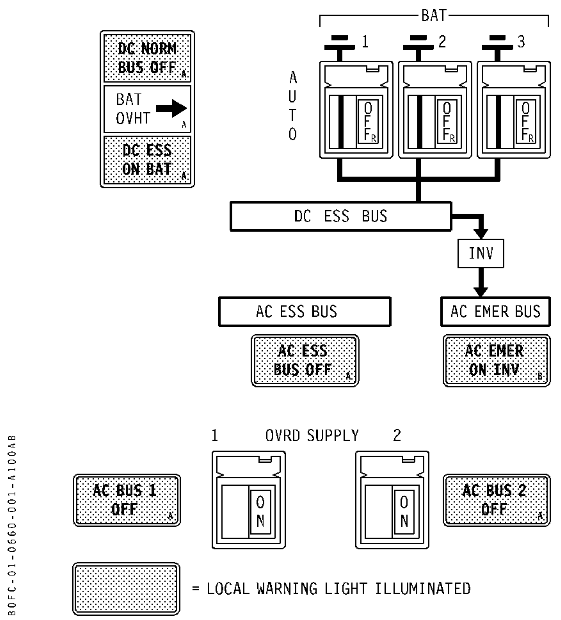
- the DC ESS BUS,
- a part of the AC ESS BUS,

R • the AC EMER BUS,

R or

R – three batteries which supply power to :

- the DC ESS BUS,
- the AC EMER BUS (via the emergency inverter) :



R

• The emergency electrical system is designed to cover cases when no aircraft generator is available (i.e. loss of both engine generators, APU or APU GEN not available and failure of the STBY GEN to come on line).

The aircraft is in the FLIGHT ON BAT ONLY configuration.

Mod : 5911

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The aircraft is equipped with fire-fighting, oxygen, first aid, emergency evacuation and emergency lighting equipment. All these items are placed throughout the cabin, readily available for use in emergency.

The emergency evacuation signal system is installed to provide crew and passengers with visual and audio warning if emergency evacuation is required.

The emergency lighting system provides aircraft illumination, when all other electrical power sources are no longer available.

COCKPIT

Each crew station is provided with :

– life vest,

– smoke goggles,

– flashlight,

– quick-donning oxygen mask, supplied with gaseous oxygen from one rechargeable storage bottle.

A portable fire extinguisher and a portable oxygen bottle are attached to the cockpit bulkhead in which the full face oxygen mask is stowed.

A fire axe is attached to the RH front vertical wall.

In addition are fitted :

– a portable fire extinguisher stowed on the LH side console,

– a fire axe attached on the coat stowage

– four evacuation devices – centrifugally roller braked tapes– are installed, two above each sliding window,

– asbestos gloves

– either a portable oxygen bottle with a full face oxygen mask, either a smoke hood or both equipments, stowed on the RH side console.

R An escape panel in the door between cabin and cockpit, can be forced open into the cabin, if required in an emergency.

CABIN

The emergency equipment is strategically distributed throughout the cabin and stowed adjacent to the cabin crew member stations.

It contains :

– portable fire extinguishers with full-face masks,

– portable oxygen bottles with continuous flow masks, additionally first aid masks and demonstration masks,

– emergency locator beacons,

– megaphones,

– first aid kits,

– crash axes,

– life vests,

– oxygen supply for passengers and cabin crew,

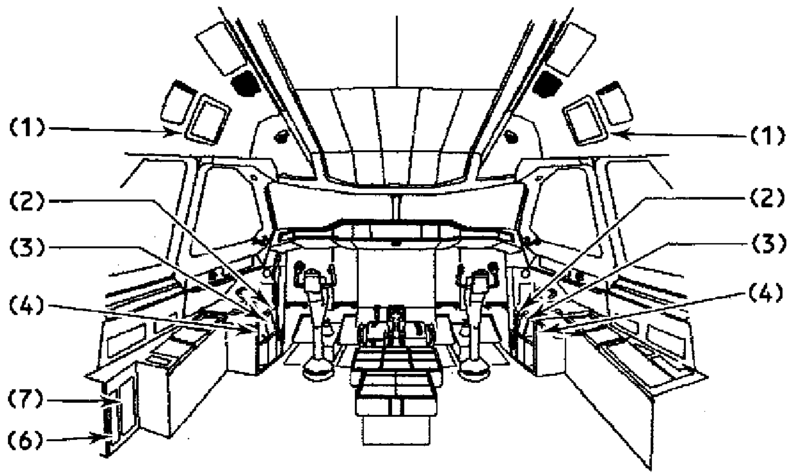
– escape slides.

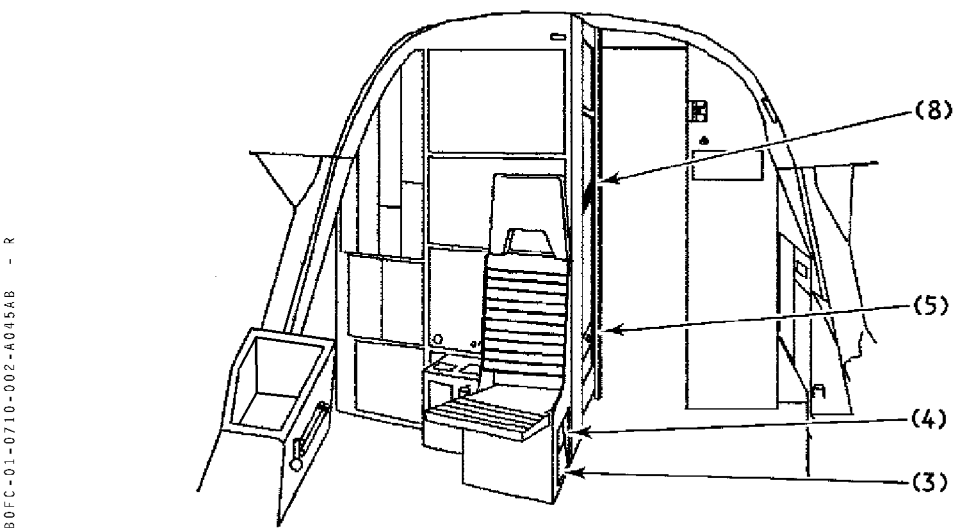
Life vests are stowed at each cabin crew station and under each passenger seat. Infant and demonstration life vests are stowed separately.
Oxygen supply for passengers and cabin crew is provided by solid state oxygen generators with drop-out masks. They are located above the passenger seats, at cabin crew stations, in lavatories and in galley areas.

For emergency evacuation the four passenger/crew doors are fitted with double escape slides, the two emergency exit doors with single escape slides. When armed, deployment and inflation are automatic when the door is opened. Upon deployment the slides are illuminated by built-in lighting.

Mod. : 4803 + 12557

COCKPIT EMERGENCY EQUIPMENTS





(1) Evacuation Device Handles (2+2)

(2) Flashlights (2)

R **(3)** Quick-donning oxygen Masks (3)

(4) Smoke Goggles (3)

Note : For other crew members life vests are stowed in the back of the seats.

(5) Portable oxygen bottle and full face oxygen mask and/or smoke hood R R

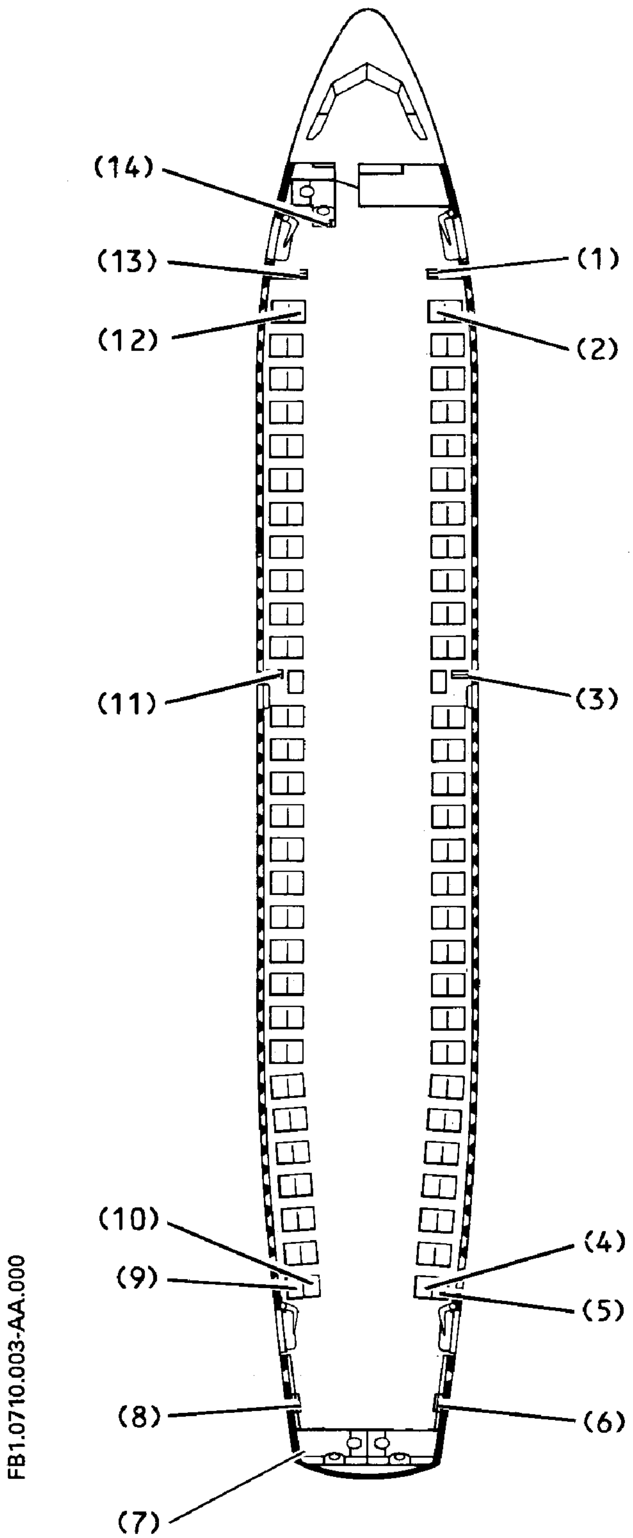
(6) Asbestos Gloves

(7) Portable Fire Extinguisher (Halon)

(8) Axe

Mod. : 4803 + 5414

CABIN EMERGENCY EQUIPEMENT LOCATION (TYPICAL)



(1) Attendant Life jacket. Portable oxygen. Oxygen mask. Full face smoke mask. Flashlight. Demonstration unit (in stowage).

(2) First aid kit (in overhead stowage).

(3) Attendant Life jacket. Flashlight. Demonstration unit (in stowage). Manual release tools.

(4) First aid kit (in overhead stowage).

(5) Portable oxygen. Oxygen mask. Full face smoke mask.

(6) Attendant Life jacket. Flashlight.

(7) Fire extinguisher.

(8) Attendant life jacket. Flashlight.

(9) Portable oxygen bottle. Smoke mask. Oxygen mask.

(10) Emergency radio beacon. Megaphone (in overhead stowage).
5 children life jackets (in overhead stowage).

(11) Attendant Life jacket. Demonstration unit (in stowage). Flashlight. Extinguisher.

(12) Emergency radio beacon. (in overhead stowage) Megaphone.
5 children life jackets (in overhead stowage)

(13) Attendant Life jacket. Portable oxygen. Oxygen mask. Smoke mask. Flashlight. Demonstration unit and Manual release tools (in stowage).

(14) Attendant Life Jacket. Portable oxygen. Oxygen mask. Smoke mask. Fire extinguisher. Flashlight.

Vers. : All   Eng. : All

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The oxygen systems are a pressure – breathing diluter – demand type system for the flight crew and a modular chemically – generating system with automatic drop-out masks for passengers and cabin crew.

Portable bottles are provided in the cockpit and in the cabin for crew mobility and for dispensing first aid oxygen.

CREW OXYGEN SYSTEM

A high pressure cylinder of 3,255 liters (115 cu feet) capacity, supplies oxygen to the distribution system. Nominal charging pressure is 1,850 psi, reduced to 78 ± 8 PSI in the distribution system.

Overpressure downstream and upstream of the pressure reducer causes oxygen to be vented overboard through discharge ports.

The quick donning masks are stowed in readily-accessible containers adjacent to each crew member seat. The mask harness inflates automatically when the mask is pulled out of the container, and it can easily be done with one hand. A mask-mounted diluter demand regulator provides dilution and emergency pressure control.

With the dilution control in the N (normal) position the mask is supplied with a mixture of oxygen and ambient air up to a Cabin altitude of 35,000 feet and 100 % oxygen above 35,000 feet.

In the 100 % position, undiluted oxygen is supplied. The emergency pressure control position provides positive pressure, when selected.

Storage (high) and distribution (low) system pressures are indicated on the CREW OXYGEN section of the overhead panel.

PASSENGERS OXYGEN SYSTEM

Modular oxygen generating and dispensing units are located above the passenger seats, in the lavatories at each galley and at each cabin crew station.

Each unit contains a sodium chlorate oxygen generator and 2, 3, 4 or 5 oro-nasal masks with reservoir bags.

The drop-out masks are presented automatically if the
R cabin altitude exceeds 14,000 ft (+ 0, – 500 ft). The automatic control can be overriden by the flight crew. When the masks are displayed, taped instructions are automatically announced over the passenger address system.

Electrical power, which operates the unit door latches, is automatically interrupted after 30 seconds. Oxygen generation is initiated by a lanyard when a mask is pulled toward the passenger seat and continues until the generator is exhausted approximately 22 minutes.

During oxygen generation the generator casing can reach a temperature of 93° C (200° F). Once activated, generators must be replaced.

Control and indication devices are installed in the PASSENGER OXYGEN section of the overhead panel.

FLIGHT CREW PORTABLE OXYGEN SYSTEM

The flight crew portable system ensures the protection of flight crew members in case of :

– smoke or noxious gas emissions
– cabin pressure altitude loss.

It consists of **either** :

– A smoke hood : ensuring the eyes and respiration system protection of one flight crew member when fighting a fire. It furnishes an effective time of use of 15 mn.

or :

– A portable oxygen cylinder fitted with a gauge indicating the cylinder pressure, and a high pressure relief valve.

A rotating type ON/OFF valve controls the oxygen flow. 100 % oxygen is supplied, on demand. The unit capability is 15 mn at 8000 ft.

A full face mask is connected to the cylinder.
Its user can communicate with other flight crew members by using the communication extension adapter which is stowed with the mask.
The adapter has one input to connect the mask and a dual output for connection in the flight compartment or in the avionics compartment :

. in the flight compartment the full face smoke mask connector has to be plugged-in into either crew member quick donning oxygen box after disconnection of the fixed oxygen mask.

. in the avionics compartment the connector (jack) has to be plugged-in into the FLIGHT ANTI SMOKE MASK interphone jack panel located on the left part of the nose gear well.

In case of fixed oxygen system failure, the quick donning mask can be disconnected from its oxygen supply, then connected to the portable cylinder via the oxygen adapter extension stowed in the housing near the portable cylinder.
Oxygen is then supplied as from the fixed oxygen system. The unit capability is then :

. 10 mn of descent with 100 % oxygen.

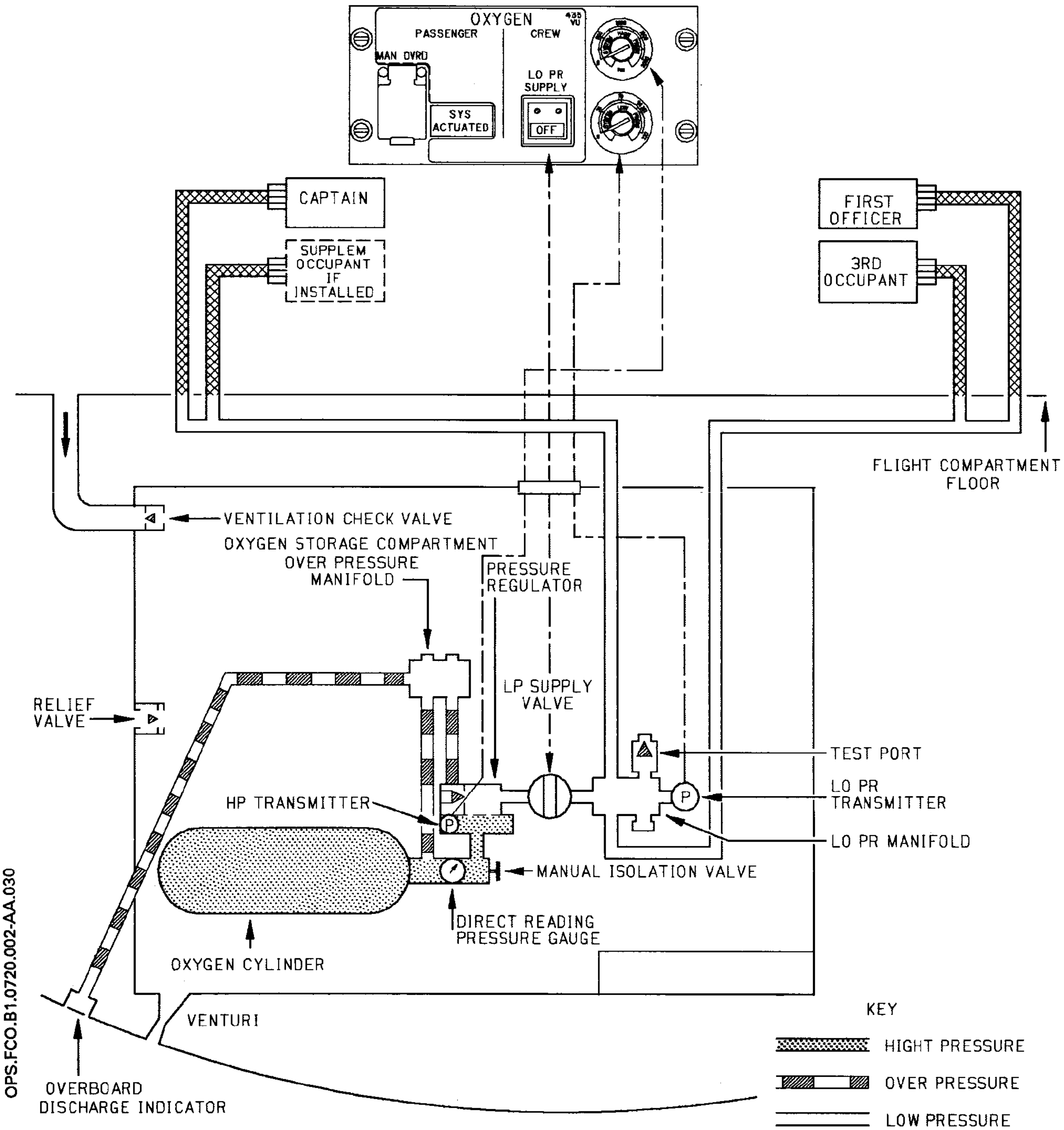
. 90 mn of flight continuation between 10000 and 15000 ft.

Or both.

Mod : (2965 + 8199) or (2965 + 10991)

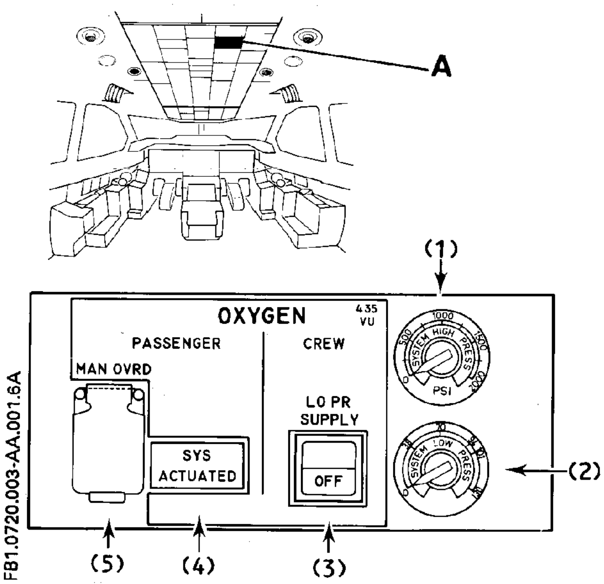
CREW OXYGEN

R
R
R
R
R
R
R
R



Mod. : 4803

A. CREW/PASSENGER OXYGEN PANELS



(1) SYSTEM HIGH PRESS Indicator :

Oxygen bottle pressure is displayed in PSI.
The scale is marked by a red arc from 0 to 85 PSI and by a green arc from 85 to 2,025 PSI.

(2) SYSTEM LOW PRESS Indicator :

Oxygen pressure downstream of the pressure regulator is indicated on a scale marked at 38, 70, 94, 101 PSI and by coloured arcs.

- **Red arcs** : from 0 to 38 PSI and from 101 to 130 PSI
- **Amber arcs** : from 38 to 70 PSI and from 94 to 101 PSI
- **Green arc** : from 70 to 94 PSI.

When the LO PR SUPPLY PB-switch is selected ON the pointer should be in the green arc.

(3) LO PR SUPPLY PB-Switch :

The PB-switch controls the low pressure supply solenoïd valve.

- **ON** (PB-switch pressed-in) : The valve is opened, low pressure oxygen is supplied to the oxygen masks.
- **OFF** (PB-switch released-out) : The valve is closed. The OFF light comes on white.

(4) SYS ACTUATED Light

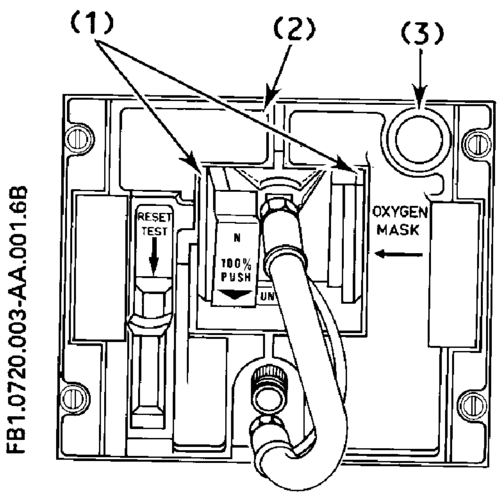
The light comes on green when oxygen generator/masks unit door opening relays are activated.

(5) MAN OVRD Pushbutton

The pushbutton is guarded in the normal position.

- **Normal** : Oxygen generator/masks unit doors open automatically when cabin altitude exceeds 14,000 ft (+ 0, – 500). R
- **MAN OVRD** : When pressed, the oxygen generator/masks unit doors open.

B. CREW OXYGEN MASK



(1) Red clips

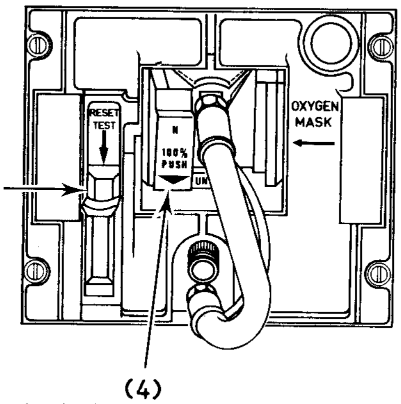
Squeezing the red clips, unlocks to two-flap door, and authorizes harness inflation.

(2) LH flap

Opening the LH flap results in opening the supply valve by actionning the control slide.
The valve remains open when the flap is closed again. The valve can be closed by returning the mask to the stowage or moving the control slide downward.

(3) Blinker

Flashes when oxygen is flowing.



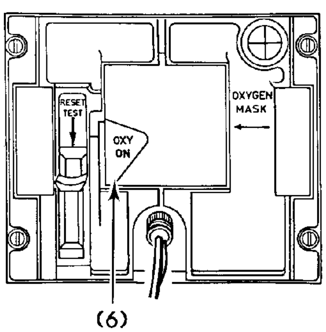
FB1.0720.004-AA.001.6A

(4) N / 100 % Selector

- **100 %** : The mask delivers 100 % oxygen. The system is automatically locked in this position.
- **N** : The mask delivers dilued oxygen when the cabine altitude is below 35,000 ft and 100 % oxygen above 35,000 ft. This configuration is obtained by acting simultaneously UNLOCK lever and the N / 100 % selector.

(5) RESET/TEST control slide

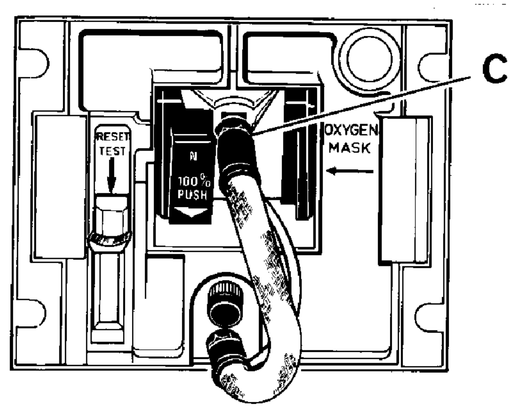
Authorizes testing of blinker operation, regulator supply, system sealing downstream of the valve, regulator sealing, and operating.

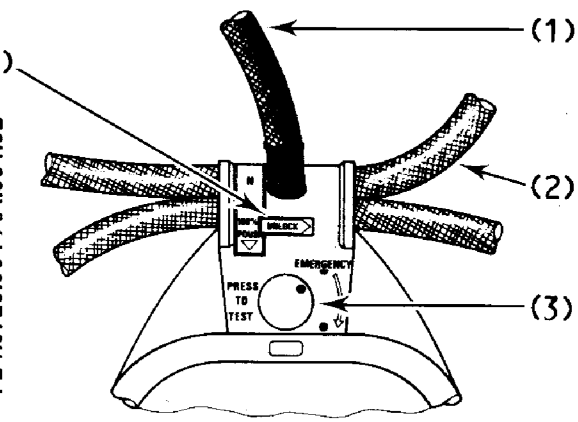


FB1.0720.004-AA.001.6C

(6) OXY.ON flag

Appears on the right of the LH flap when oxygen is supplied.





FB1.0720.004-AA.001.6B

C. UNDERSIDE OF REGULATOR

(1) Oxygen Supply Hose

(2) Inflation Harness

(3) EMERGENCY pressure Selector

- **When pressed** : a momentary overpressure is generated.
- **When turned** in the arrow direction : a permanent overpressure is generated.
  This overpressure is lower than 3 mbars.

Note : Do not use this selector in « N » configuration due to large variations of the dilution rate. R R

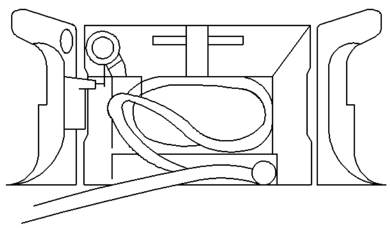
(4) UNLOCK Lever

Locks N / 100 % lever at 100 % position.
When pressed the lever is released.

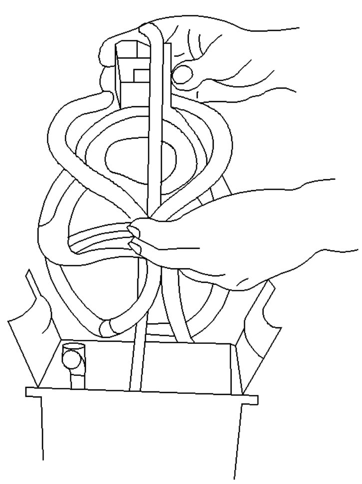
MASK STOWAGE

In order not to damage the mask hose, the proper stowage procedure is as follows :

1 - COIL THE HOSE, AND PLACE IT IN THE BOTTOM OF THE STOWAGE BOX.

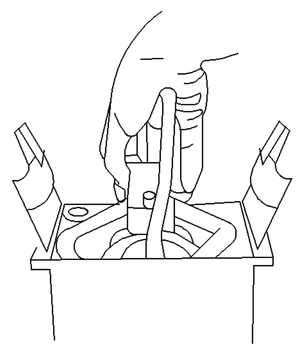


2 - POSITION THE REMAINING HOSE IN THE MIDDLE OF THE MASK.
- FOLD THE TWO HARNESS PORTIONS TOGETHER.

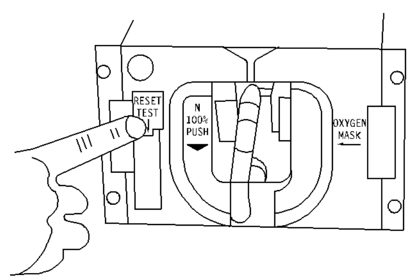


3 - PLACE THE MASK IN THE STOWAGE BOX.
- MAKE SURE THE MASK REGULATOR IS FULLY SEATED AGAINST THE STOP IN THE STOWAGE BOX.

CAUTION
NEVER STORE THE MASK WITH FOLDED HARNESS IN THE MASK FACE PART. R R



4 - CLOSE THE DOORS, THEN FULLY PRESS THE "RESET TEST" BUTTON.
- ONCE THE "RESET TEST" BUTTON IS RELEASED, CHECK THAT THE "OXY ON" FLAG COMPLETELY DISAPPEARS.
- PRESS THE EMERGENCY PRESSURE SELECTOR, AND CHECK THAT THE BLINKER REMAINS BLACK.



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LEFT BLANK INTENTIONALLY

EVAC SIGNAL SYSTEM

An EVAC SIGNAL system is utilized for visual and audio alert in case of impending emergency evacuation of the aircraft. Warning lights are installed on the overhead panel (in the flight compartment) on the purser panel and on the attendant panels at the LH aft cabin door.
Audio signal generators are installed on the maintenance panel in the flight compartment, at the purser station and at the LH aft cabin door.
The flashing red light and horn, can be initiated from the cockpit or, if the system is armed, from the purser station

The system is powered by 28 VDC from the DC ESS BUS. EVAC SIGNAL controls are on the EVAC SIGNAL section of the overhead panel and on the purser panel.

COCKPIT EVACUATION DEVICES

Four escape lines are installed in the cockpit, two above each sliding window. They are provided for escape through the sliding windows and lowering to the ground.

The 10 m steel tapes are spooled on centrifugal roller brakes. One end of each tape is attached to the aircraft structure, the other is fitted with a grab handle. The brakes progressively reduce the descent speed of the user
to approximately 11 ft/sec.

To facilitate the evacuation of the cockpit, the cockpit/cabin door, which normally opens into the cockpit, can be forced open into the cabin.

CABIN EVACUATION DEVICES

Dual lane inflatable escape slides are installed at the four cabin doors and single lane escape slides are installed at the two emergency exit doors.

The escape slides are stowed in containers which are attached to the inboard side of each door. When the slide arming lever is in the ARMED position, the slide is connected to the floor brackets at both sides of the doors.

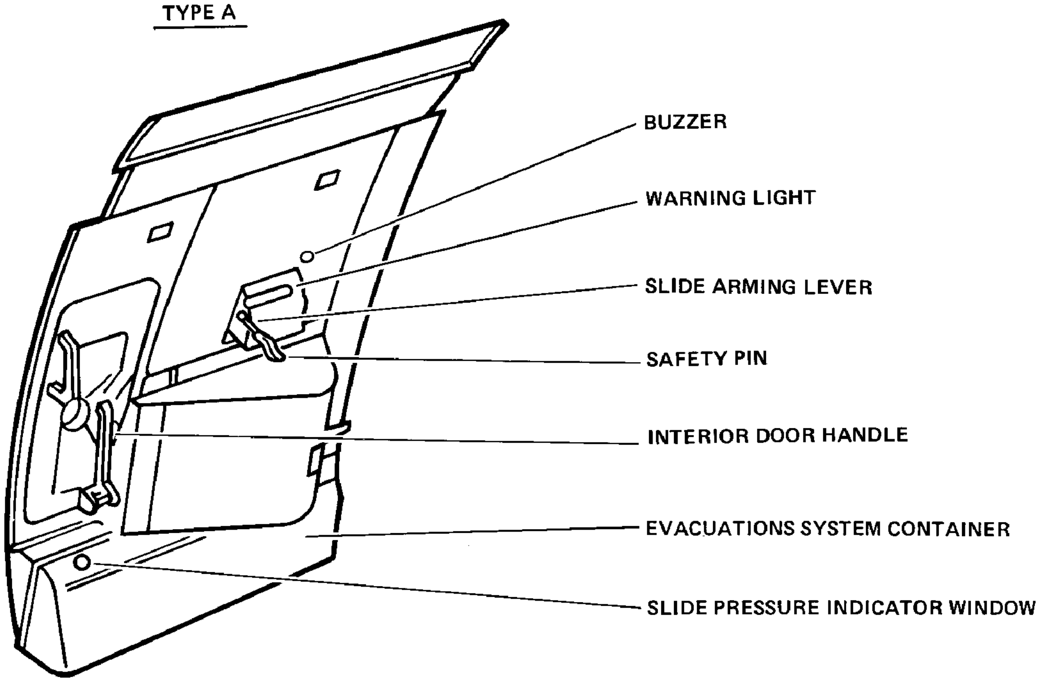
When subsequently the door is opened, the container opens and the slide is expelled by an ejector bag. Then automatic inflation and deployment occurs by actuation of the main CO_2 bottle. If the bottle fails to discharge automatically, it can be actuated manually.

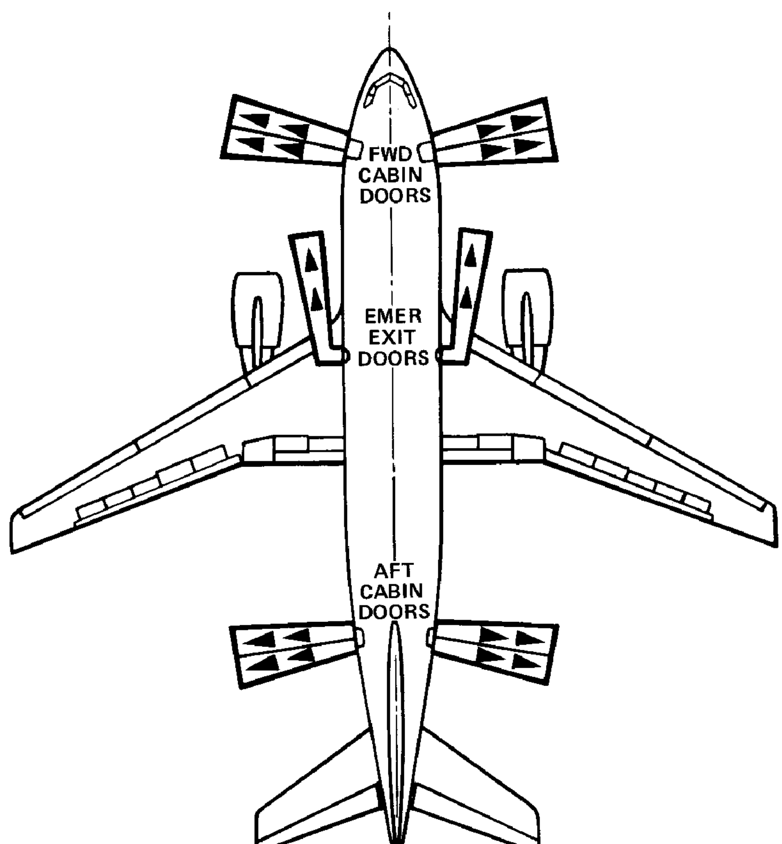
The main CO_2 bottle pressure is indicated on a pressure indicator, visible through a window in the container.

To prevent inadvertent slide deployment a warning system is fitted. If an attempt is made to open any door or emergency exit (on that door), the slide armed warning light flashes red and the buzzer emits a high intermittent tone.

PASSENGER CABIN EVACUATION

TYPE A



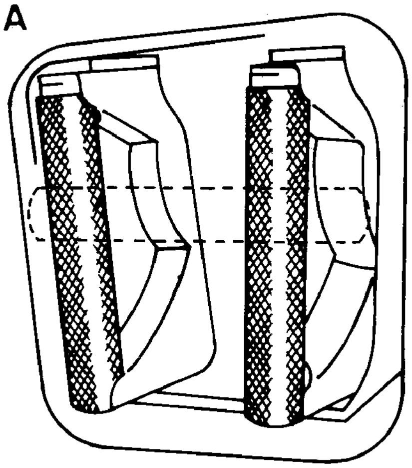


PLN.FCO.B1.0730.002-OO.001

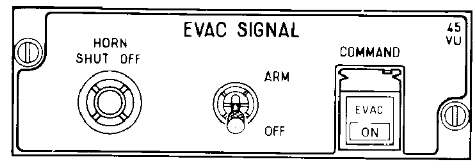
Vers. : All Eng. : All

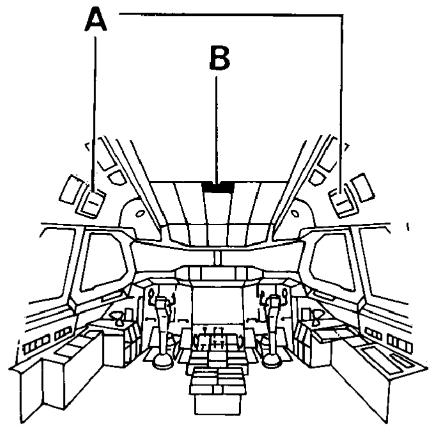
LOCATION OF CONTROLS

A



B





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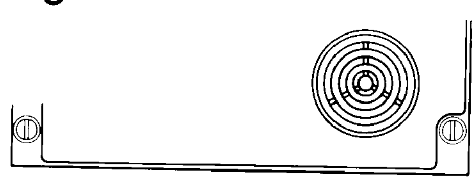


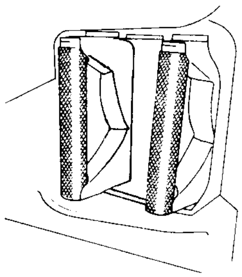
(MAINTENANCE PANEL)

OPS.FCO.B1.0730.003-OO.035

Mod. : 2994 + 4803

A. EVACUATION DEVICES HANDLES

FB1.0730.004-AA.035.6A



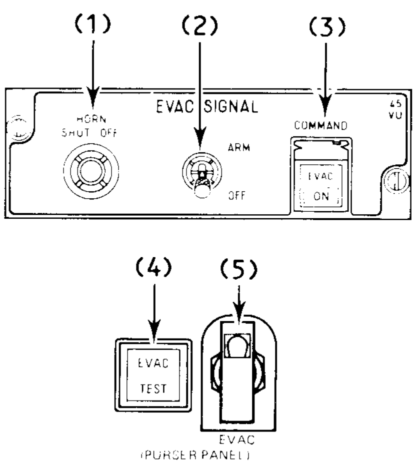
The handles are guarded by a removal cover.

Any handle can be used for emergency evacuation through either sliding window and subsequent lowering to the ground.

For escape grasp the handle with one hand, back out of the open sliding window holding the rear frame member with the other hand then, with both hands holding the handle, jump clear of the fuselage.

B. EVAC SIGNAL PANEL

FB1.0730.004-AA.035.6B



The EVAC controls on the purser panel is interconnected with the EVAC SIGNAL panel, in the cockpit.

(1) HORN SHUT OFF Pushbutton

When pressed, the audio warning in the cockpit is silenced, EVAC light continues to flash.

(2) EVAC SIGNAL Switch

- **ARM** :
  Evacuation signal can be activated from cockpit or from the purser panel.
- **OFF** :
  Evacuation signal can only be activated from the cockpit.

(3) COMMAND pb-Switch

- **Normal** : **(pb released out)**
  No evacuation signal.
- **EVAC** : **(pb released out the light flashes red)**
  Evacuation signal has been activated from the purser panel.
- **ON** : **(pb pressed)**
  The light illuminates.
  The EVAC light flashes red.
  Evacuation signal has been activated from the cockpit.

(4) EVAC TEST Pushbutton (purser panel)

the light flashes red when

– the pushbutton is pressed for bulb test.

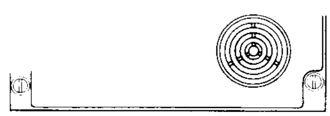
– or the evacuation signal is activated from the cockpit or the purser panel.

(5) EVAC Switch (purser panel)

If the EVAC SIGNAL selector is selected ARM :
When selected ON, the evacuation signal is activated.

If the EVAC SIGNAL selector is selected OFF :
When selected ON, an audio warning (buzzer) is activated in the cockpit.

C. AUDIO SIGNAL GENERATOR



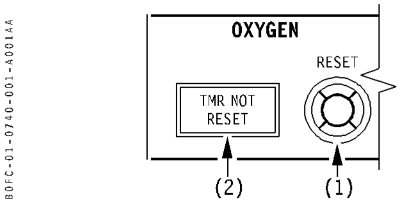
(MAINTENANCE PANEL)

FB1.0730.004-AA.035.6C

Activated from the cockpit COMMAND pb switch or from the purser panel.

Mod. : 2994 + 4803

A. OXYGEN PANEL



(1) RESET Pushbutton

When pressed, the control circuit is rearmed.
TIMER NOT RESET and SYS ACTUATED lights extinguish and PA relay is de-energized.

(2) TIMER NOT RESET Light

The light comes on blue 30 seconds after oxygen generator/masks unit door opening relays have been activated (automatically or manually).

FIRE PROTECTION

Each engine is equipped with a fire detection system which consists of

– two identical detection loops (A and B) mounted in parallel.

– and, a fire detection control unit

Each detection loop consists of three separate sensing elements located in the pylon-nacelle and engine core section.

When a sensing element is subject to heat, a signal is transmitted to a warning system, as soon as a preset level of temperature is reached.

A break in a loop will not affect the warning system therefore fire protection is maintained provided associated LOOP pushbutton switch is selected OFF. However the test will indicate a loop failure.

FIRE AND LOOP WARNINGS

When the fire detection control unit generates a fire or a fault signal related to one or both loops, warnings appear in the cockpit to alert the crew.

The engine fire warning system generates two different warnings.

– the FIRE warning (Red)
– the LOOP warning (Amber)

FIRE WARNING

The FIRE warning appears when the fire detection control unit generates :

. A fire signal related to both loops A and B, or

. A fire signal related to the loop A or B when only the respective pushbutton switch LOOP A or LOOP B is selected On, or

. A fault signal related to both loop A and loop B, provided both pushbutton switches LOOP A and LOOP B are selected On.

The FIRE warning devices are :

. The corresponding ENG FIRE handle

. The corresponding red fire warning light with the inscription HP VALVE integrated into the ENG FUEL lever when selected ON,

. Both LOOP lights (or one if only one LOOP pushbutton switch is selected On) on the ENG FIRE panel.

. The ECAM

LOOP WARNING

The LOOP warning appears when the fire detection control unit generates :

. A fault signal related to only one loop with both LOOP pushbutton switches selected ON.

. A fault signal related to one loop with the other LOOP pushbutton switch selected OFF.

The LOOP warning devices are :

. The LOOP A (or LOOP B) lights on the ENG FIRE panel.

. The ECAM (for FAULT signal only)

FIRE EXTINGUISHING SYSTEM

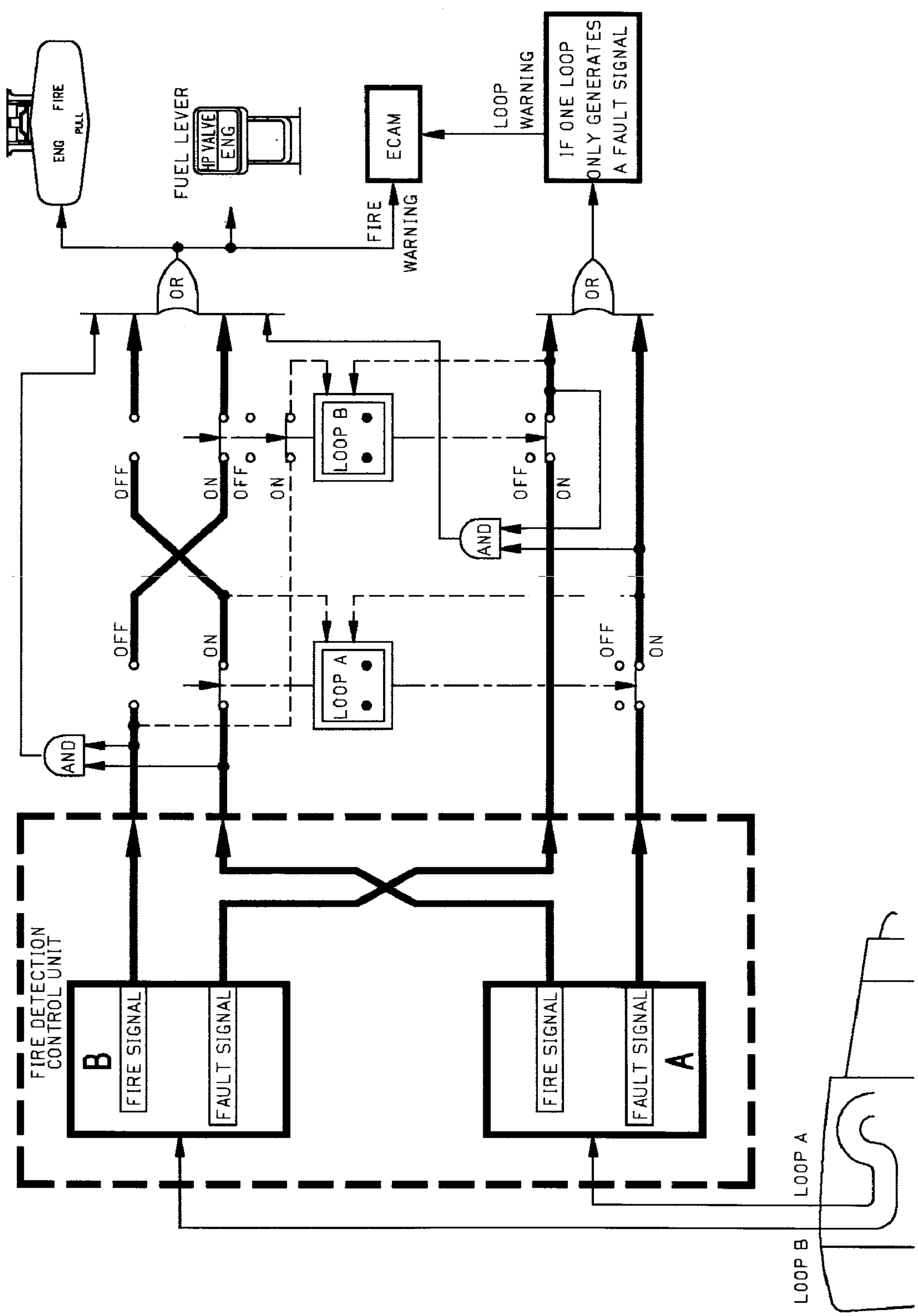
Each engine is equipped with a fire extinguishing system consisting of two extinguisher bottles for each engine. The bottles are located in the engine pylon.

Dual squibs are installed in the discharge heads on each bottle.

For fire extinction, the squibs are ignited by pressing the corresponding AGENT pushbutton located on the ENG FIRE panel.

PW Eng. : All R

FIRE AND LOOP WARNINGS



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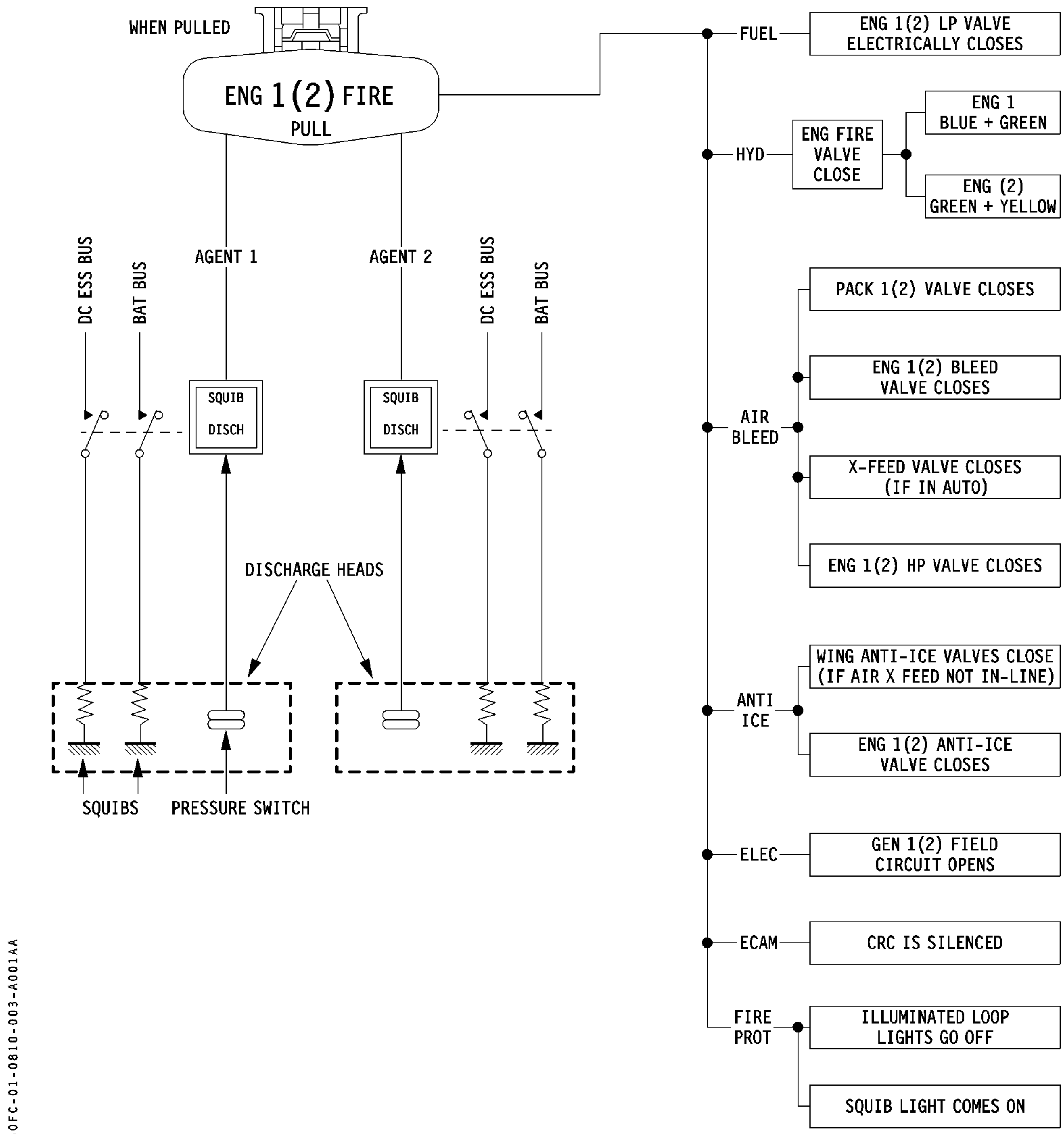
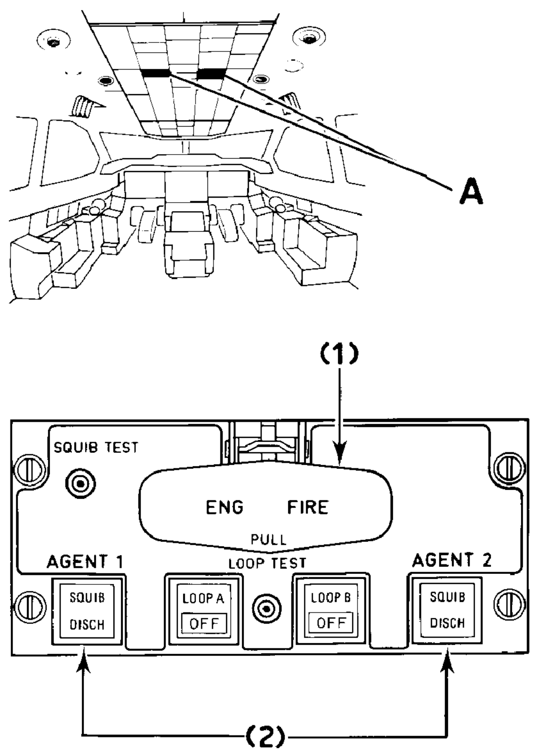
FIRE EXTINGUISHING SYSTEM

R
R
R
R



A. ENG 1 (2) FIRE PANEL



FB1.0810.004-AA.001

Two identical ENG FIRE panels with fire handles are provided for control of fire detection and extinction.
One panel controls ENG 1, the other controls ENG 2.

Both systems are energized when DC ESS BUS is powered. Electrical power for fire extinguishing operation is always available from batteries.

(1) ENG 1 (2) FIRE Handle

The ENG FIRE handles have two positions. An ENG 1 (2) FIRE warning light is integrated into the handles.

- **In**

  Normal position, mechanically locked.

- **Pulled**

  Pulling the handle electrically causes for the respective engine.

. FUEL	ENG LP VALVE closure
. HYD	ENG FIRE VALVE closure
. AIR BLEED	ENG HP VALVE closure ENG BLEED VALVE closure X FEED VALVE closure (if X FEED mode switch in AUTO)
. COMPT TEMP	PACK VALVE closure
. ANTI ICE	WING ANTI ICE VALVES (both sides) closure, if X FEED VALVE is closed. R R
. ELEC PWR	GEN deactivation
. CRC	Silencing and LOOP light extinction, SQUIB light illumination.
. ENG ANTI-ICE	Valve will close due to loss of pneumatic supply. The FAULT light comes on.

- **ENG 1 (2) FIRE**

  The light comes on red independently of handle position, as long as the respective engine fire warning is activated.

  It goes off when the temperature, detected by the loops drops below warning threshold.

  Illumination of the ENG 1 (2) FIRE light is accompanied by ECAM activation, illumination of the HP VALVE light on the ENG 1 (2) FUEL lever (if selected ON) and illumination of LOOP A and B amber light (if associated switch is selected ON).

(2) AGENT 1 (2) Pushbutton

The pushbutton controls the ignition of squibs and resultant discharge of fire extinguisher bottle.
The pushbutton is activated only when the related ENG FIRE handle is pulled.

- **Momentarily Pressed**

  With ENG FIRE handle pulled, the squibs are ignited for bottle discharge.

- **Released**

  The squibs circuit is de-energized.

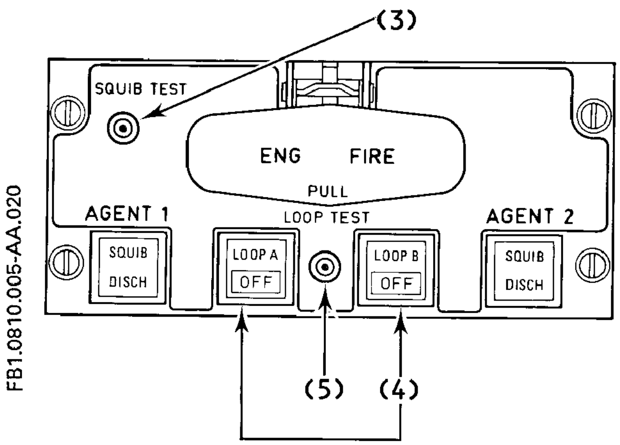
- **SQUIB**

  The light comes on white when the ENG FIRE handle is pulled to facilitate identification of the AGENT pushbutton to be activated.

  During SQUIB TEST, the light comes on to indicate successful test.

- **DISCH**

  The light comes on amber when the related fire extinguisher bottle is depressurized after discharge.



(3) SQUIB TEST Pushbutton

The pushbutton controls the test of the squibs in the discharge heads and their electrical circuits.

When pressed with the respective ENG FIRE handle in normal position, the two SQUIB lights come on if squibs and circuits are operative.

(4) LOOP A (B) Pushbutton Switch

The pushbutton switch allows to activate aural and visual warnings when a fire (FIRE) or fault (LOOP) signal is generated by the fire detection control unit for the related loop.

- **On (P/B-Switch Pressed-in)**
  Aural and visual warnings are activated when a fire or a fault signal is generated by the fire detection control unit.
- **OFF (P/B Switch Released-out)**
  Aural and visual warnings are inhibited for the related loop. The OFF light comes on white.
- **LOOP A(B)**
  The light comes on amber when the associated pushbutton switch is selected On, and a fire or a fault signal is generated by the fire detection control unit.

  The light goes off when the respective ENG FIRE handle is pulled.

  During LOOP TEST, the light comes on to indicate successful test.

Note : The engine FIRE warning is also activated when :

R *. both pushbutton switches LOOP A and LOOP B*
R *are selected OFF and, the fire detection control*
R *unit generates a fire signal related to both loop A*
R *and loop B, or*

R *. both pushbutton switches LOOP A and LOOP B*
R *are selected On, and the fire detection control*
R *unit generates a fault signal related to both*
R *loop A and loop B.*

Mod. : 5051

(5) LOOP TEST Pushbutton

The pushbutton controls the test of :

. both fire detection loops

. ENG FIRE and LOOP local warnings

with ECAM activation.

Both pushbutton switches LOOP A and LOOP B must be selected On, and the respective ENG FIRE handle must be in Normal position for complete system test.

- **Pressed and Held**

  LOOP and ENG FIRE warnings are tested in sequence. A successful test result in the following indications.
  - LOOP A light comes on
  - ECAM is momentarily activated (MASTER CAUTION light comes on and goes off associated with SSC).

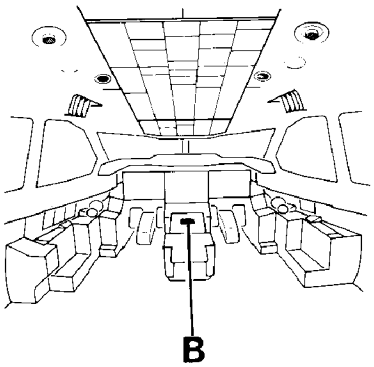
. After a few seconds :
  - LOOP A light remains on
  - LOOP B light comes on
  - ENG FIRE light integrated into the ENG FIRE handle comes on
  - HP VALVE light on the ENG FUEL lever comes on if the lever is selected ON.
  - ECAM is activated (MASTER WARNING light comes on and flashes associated with CRC).

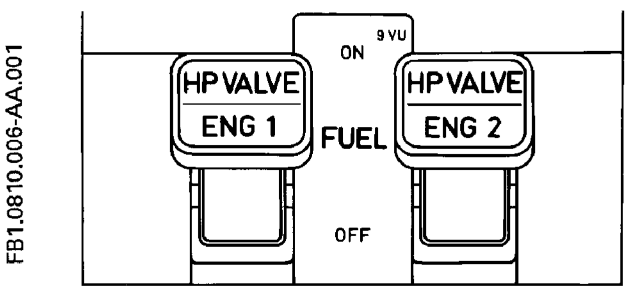
- **Released**

  Fire warnings are cancelled :
  - LOOP B light remains on
  - ECAM is momentarily activated (MASTER CAUTION light comes on and goes off associated with SSC).

. After a few seconds :
  - LOOP B light goes off

B. ENG 1(2) FUEL FIRE WARNING





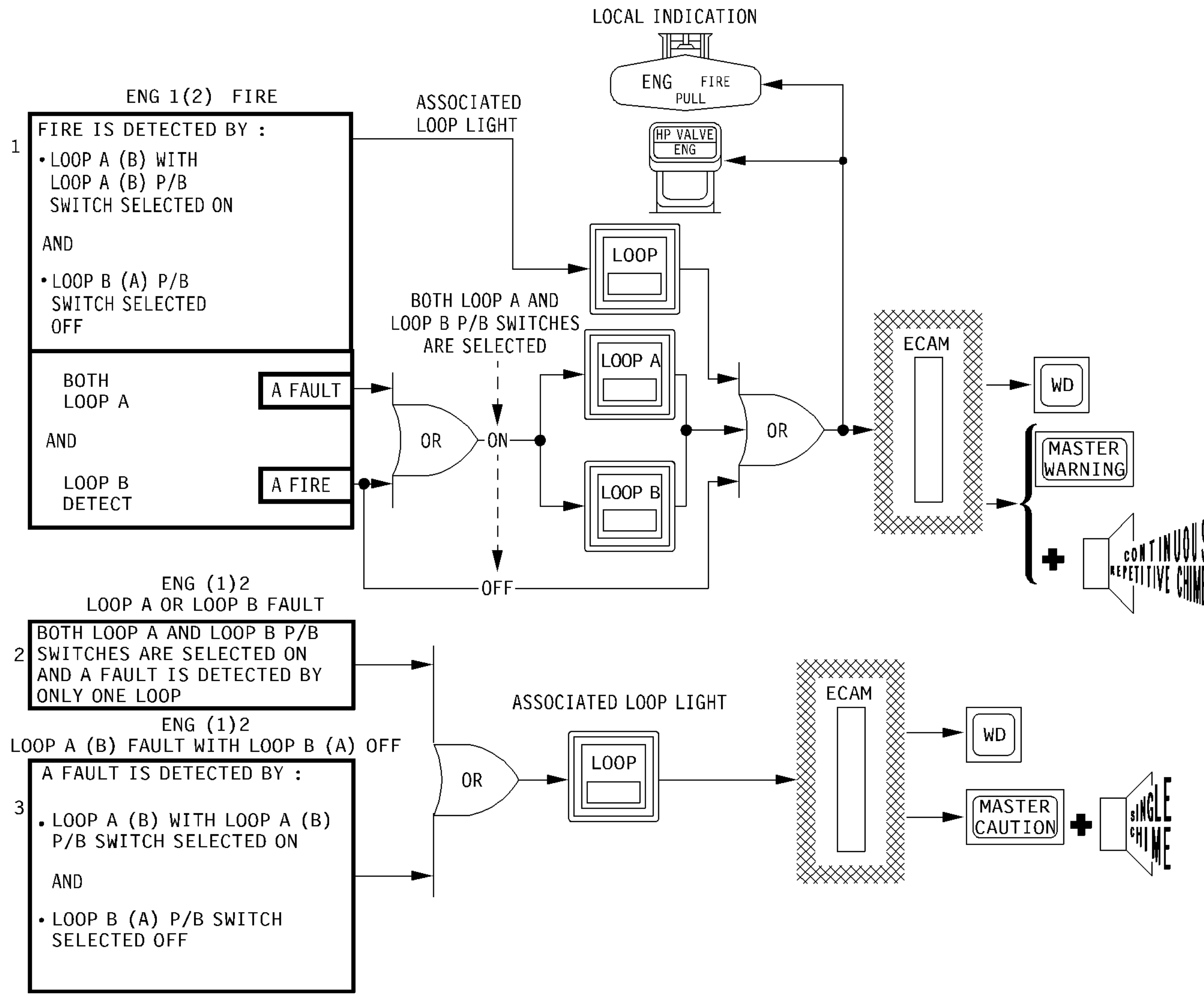
The ENG 1 (2) FUEL lever controls the HP shutoff valve.

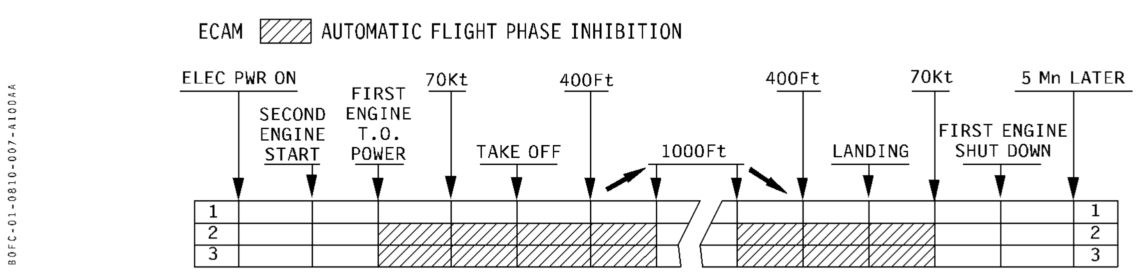
A red warning light with the inscription HP VALVE is integrated into the lever handle.

The light comes on red and HP VALVE is readable when an engine fire signal is generated as long as the ENG 1(2) FUEL LEVER is selected ON.

Illumination of the light is inhibited when the ENG 1(2) FUEL LEVER is selected OFF.

FIRE AND LOOP WARNINGS





Mod. : 5051

FIRE DETECTION

The APU is equipped with a fire detection system which consists of :

– two identical detection loops (A and B) mounted in parallel

– and, a fire detection control unit.

Each detection loop consists of one sensing element located in the APU compartment.

When a sensing element is subject to heat, a signal is transmitted to a warning system, as soon as a preset level of temperature is reached.

A break in a loop will not affect the warning system therefore fire protection is maintained. However the test will indicate a loop failure.

FIRE AND LOOP WARNINGS

When the fire detection control unit generates a fire or a fault signal related to one or both loops, warnings appear in the cockpit to alert the crew.

The APU fire warning system generates two different warnings :

– The FIRE warning (Red)

– The LOOP warning (Amber)

FIRE WARNING

The FIRE warning appears when the fire detection control unit generates :

. A fire signal related to both loops A and B or

. A fire signal related to the loop A or B when only the respective pushbutton switch LOOP A or LOOP B is selected On, or

. A fault signal related to both loop A and loop B provided both pushbutton switches LOOP A and LOOP B are selected On.

The FIRE warning devices are :

. The APU FIRE handle

. Both LOOP lights (or one if only one LOOP pushbutton switch is selected On) on the APU FIRE panel.

. The ECAM

LOOP WARNING

The LOOP warning appears when the fire detection control unit generates :

. A fire signal related to only one loop with both pushbutton switches LOOP A and LOOP B selected On, or

. A fault signal related to only one loop.

The LOOP warning devices are :

. The LOOP A (or LOOP B) lights on the APU FIRE panel.

. The ECAM (for FAULT signal only) R

When the aircraft is on ground additional warnings are triggered in the event of an APU fire :

. The APU FIRE light on the nose gear interphone panel, and

. An APU FIRE external horn located in the nose gear bay.

and APU shut down and extinguishing sequences are initiated automatically.

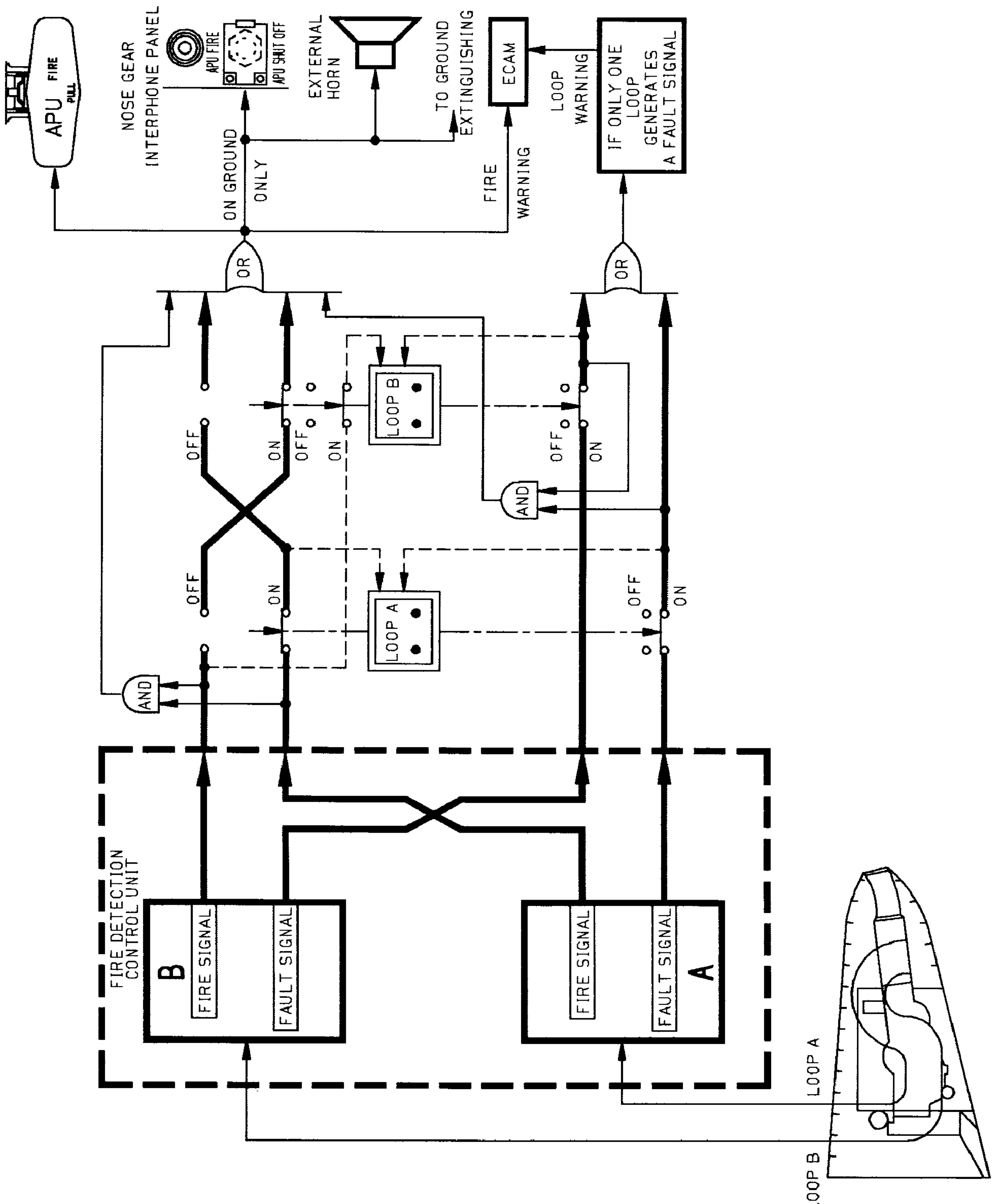
FIRE EXTINGUISHING SYSTEM

The APU is equipped with a fire extinguishing system consisting of one extinguisher bottle.
The bottle is located adjacent to the forward firewall of the APU compartment.

Dual squibs are installed in the discharge heads on the bottle.

For fire extinction the squibs are ignited by pressing the AGENT pushbutton located on the APU FIRE panel.

FIRE AND LOOP WARNINGS



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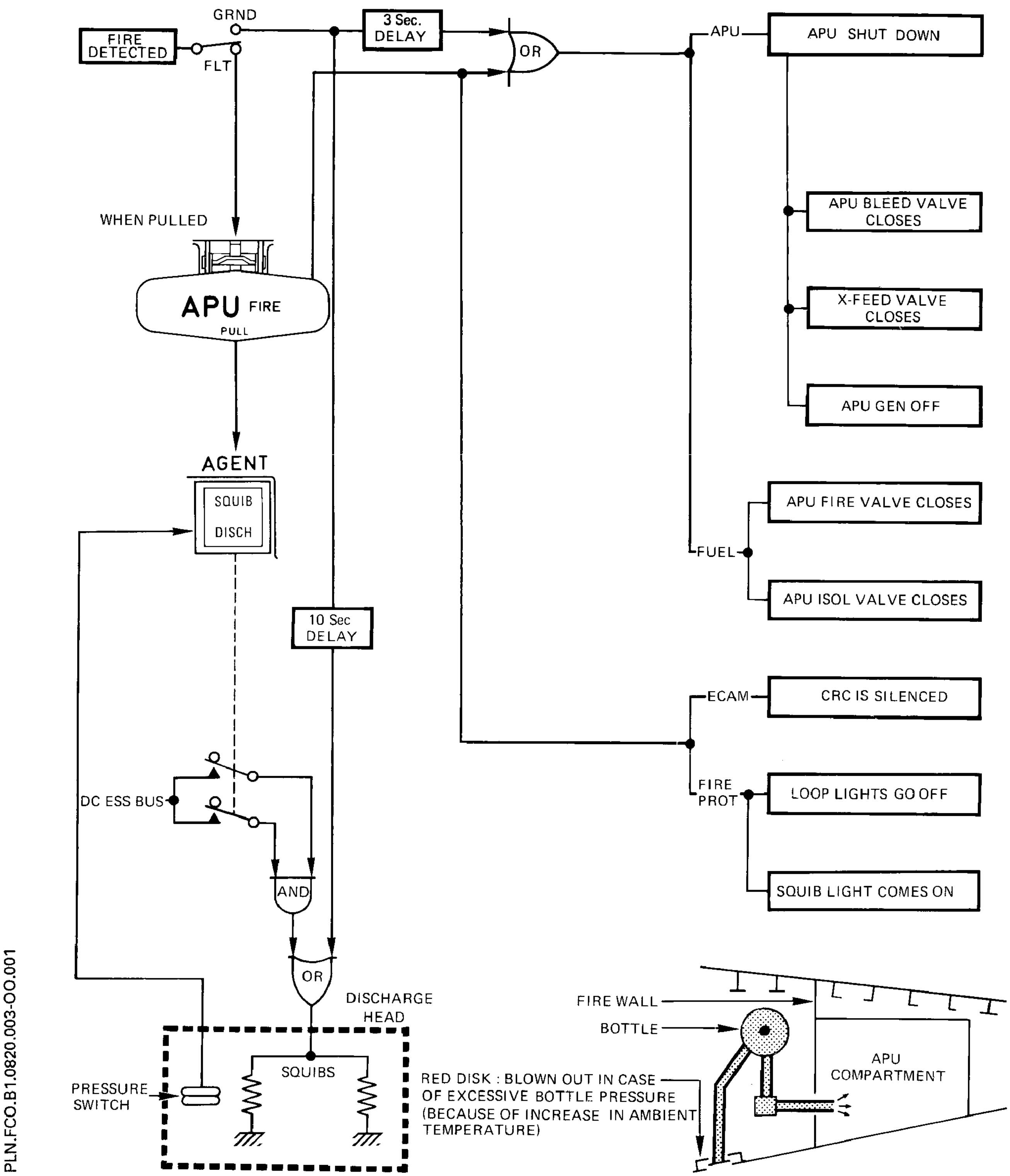
FIRE EXTINGUISHING SYSTEM



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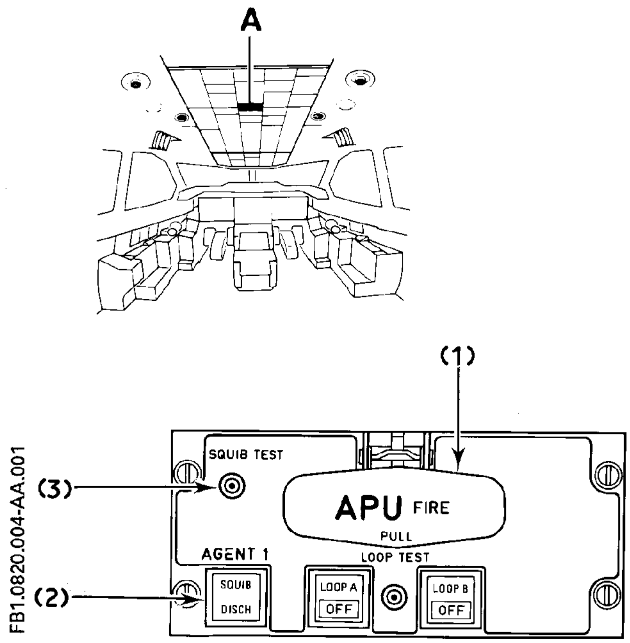
A. APU FIRE PANEL



The APU FIRE panel with a fire handle is provided for control of fire detection and extinction.

The system is energized when DC ESS BUS is powered. Warnings, test, and functions are similar to ENG FIRE panel but appropriate to the APU.

(1) APU FIRE Handle

The APU FIRE handle has two positions. An APU FIRE warning light is integrated into the handle.

- **In**

  Normal position, mechanically locked.

- **Pulled**

  Pulling the handle electrically causes :

R . APU emergency shutdown

. APU BLEED VALVE closure

. BLEED AIR X FEED VALVE closure (if X FEED mode switch in AUTO)

. APU GEN cut off

. FUEL APU FIRE VALVE closure

. APU ISOL VALVE (Fuel) closure

. CRC silencing and LOOP light extinction, SQUIB light illumination.

- **APU FIRE**

  The light comes on red independently of handle position as long as the fire warning is activated.

  It goes off when the temperature detected by the loops drops below warning threshold.

  Illumination of the APU FIRE light is accompanied by ECAM activation and by illumination of LOOP A(B) amber light if associated switch is selected ON.

(2) AGENT Pushbutton

The pushbutton controls the ignition of squibs and resultant discharge of fire extinguisher bottle.

The pushbutton is activated only when the APU FIRE handle is pulled.

- **Momentarily pressed**

  With APU FIRE handle pulled, the squibs are ignited for bottle discharge.

- **Released**

  The squibs circuit is de-energized.

- **SQUIB**

  The light comes on white when the APU FIRE handle is pulled to facilitate identification of the AGENT pushbutton to be activated.

  During SQUIB TEST, the light comes on to indicate successful test.

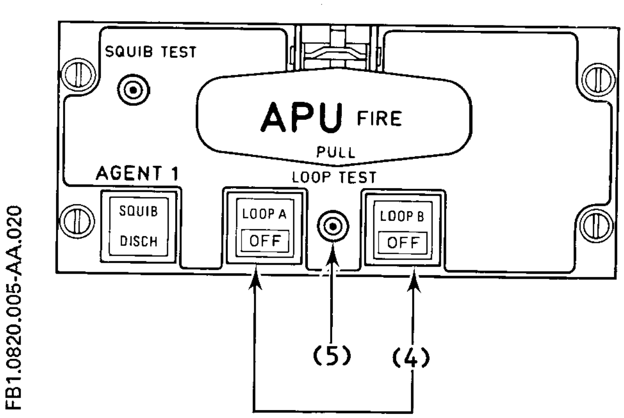
- **DISCH**

  The light comes on amber when the fire extinguisher bottle is depressurized after discharge.

(3) SQUIB TEST Pushbutton

The pushbutton controls the test of the squibs in the discharge head and their electrical circuit.

When pressed with the APU FIRE handle in normal position, the SQUIB light comes on if squibs and circuit are operative.



(4) LOOP A (B) Pushbutton Switch

The pushbutton switch allows to activate aural and visual warnings when a fire (FIRE) or fault (LOOP) signal is generated by the fire detection control unit for the related loop.

- **On (P/B Switch Pressed-in)**

  Aural and visual warnings are activated when a fire or a fault signal is generated by the fire detection control unit.

- **OFF (P/B Switch Released-out)**

  Aural and visual warnings are inhibited for the related loop. The OFF light comes on white.

- **LOOP A (B)**

  The light comes on amber when the associated pushbutton switch is selected On, and a fire or a fault signal is generated by the fire detection control unit.

  The light goes off when the APU FIRE handle is pulled. During LOOP TEST, the light comes on to indicate successful test.

Note : The APU FIRE warning is also activated when :

R *. both pushbutton switches LOOP A and LOOP B*
R *are selected OFF and, the fire detection control*
R *unit generates a fire signal related to both loop A*
R *and loop B, or*

R *. both pushbutton switches LOOP A and LOOP B*
R *are selected On, and the fire detection control*
R *unit generates a fault signal related to both*
R *loop A and loop B.*

(5) LOOP TEST Pushbutton

The pushbutton controls the test of :

. both fire detection loops

. APU FIRE and LOOP local warnings

with ECAM activation

Both pushbutton switches LOOP A and LOOP B must be selected On, and the APU FIRE handle must be in Normal position for complete system test.

- **Pressed and Held**

  LOOP and APU FIRE warnings are tested in sequence. A successful test results in the following indications :

  – LOOP A light comes on
  – ECAM is momentarily activated (MASTER CAUTION light comes on and goes off associated with SSC).

. After a few seconds :

  – LOOP A light remains on
  – LOOP B light comes on
  – APU FIRE light integrated into the APU FIRE handle comes on
  – ECAM is activated (MASTER WARNING light comes on and flashes associated with CRC).

- **Released**

  Fire warnings are cancelled

  – LOOP B light remains on
  – ECAM is momentarily activated (MASTER CAUTION light comes on and goes off associated with SSC).

. After a few seconds :

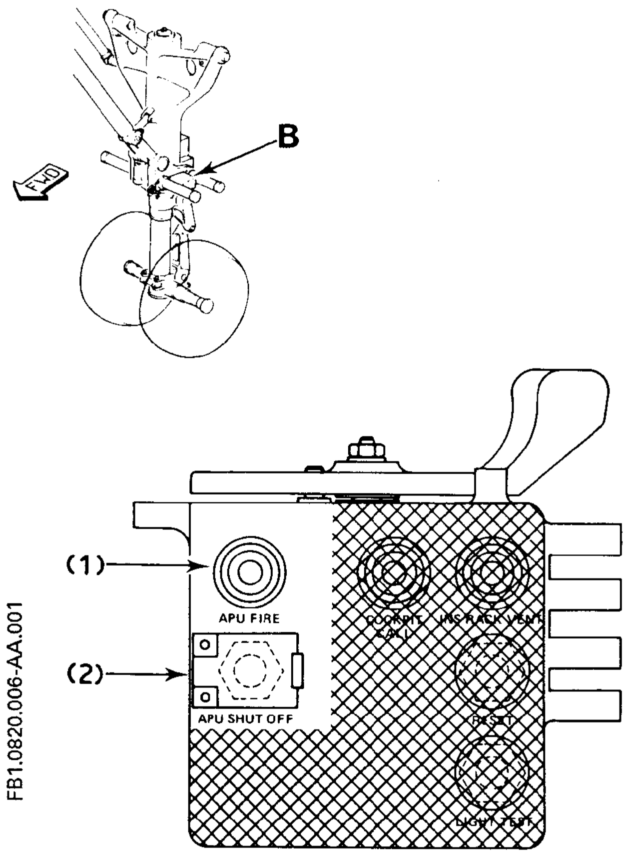
  – LOOP B light goes off

Note : During LOOP TEST the APU fire external warnings (APU FIRE light on the nose gear interphone panel and external horn) are inhibited.

Mod. : 5051

B. EXTERNAL CONTROLS

R – Nose gear interphone panel



On ground only, an additional external warning is provided in the event of an APU FIRE.

(1) APU FIRE Light

The APU FIRE light comes on red, accompanied by an external horn warning when an APU fire is detected.

The APU fire extinguisher will automatically discharge 10 seconds after the fire warning appearance.

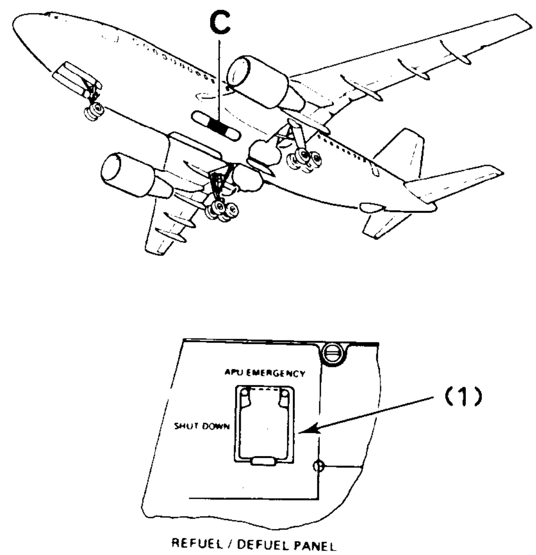
The light will go off after extinction of the fire.

(2) APU SHUT OFF Pushbutton

The pushbutton is guarded by a flap. When pressed in the event of an APU fire the automatic shutdown is confirmed and the external horn warning is silenced.

C. EXTERNAL CONTROLS R

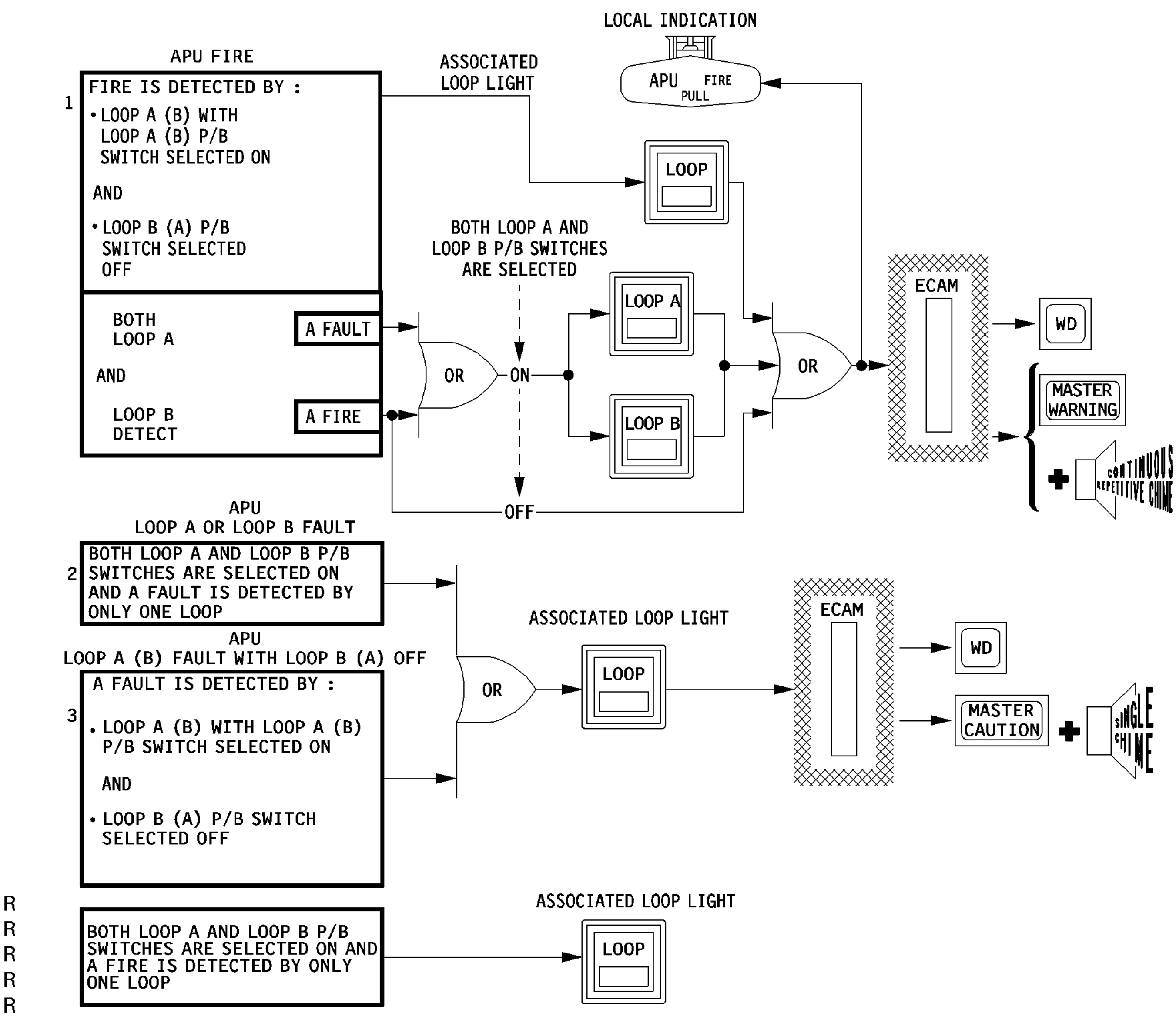
– Refuel/defuel panel

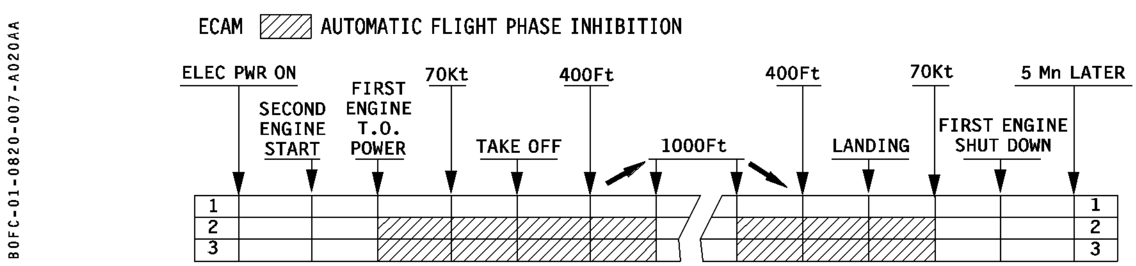


(1) APU EMERGENCY SHUTDOWN Pushbutton R

The pushbutton is guarded by a flap. When pressed, in the event of an APU fire, shutdown is initiated or automatic shutdown is confirmed and the external horn warning is silenced. R

FIRE AND LOOP WARNINGS





Mod. : 5051

SMOKE DETECTION

The cargo compartments smoke detection system comprises ten smoke detectors.

. 2 detectors (LOOP A) plus 2 detectors (LOOP B) installed in the FWD cargo compartment ceiling

. 2 detectors (LOOP A) plus 2 detectors (LOOP B) installed in the AFT cargo compartment ceiling

. 1 detector (LOOP A) plus 1 detector (LOOP B) installed in the BULK cargo compartment ceiling.

When smoke is detected in the BULK or AFT cargo compartment,

. the hot air flow to the BULK cargo compartment is cut off by closure of the associated trim air valve.

. the isolation valve located in the extraction duct of the BULK cargo compartment closes and the associated extraction fan is deactivated.

When smoke is detected in the FWD cargo compartment.

. the hot air flow to the FWD cargo compartment is cut off by closure of the associated trim air valve.

. the isolation valve located in the extraction duct of the FWD cargo compartment closes and the associated extraction fan is deactivited.

SMOKE WARNINGS

When a smoke signal is generated by one or both loops, warnings appear in the cockpit to alert the crew.

The cargo compartment smoke warning system generates two different warnings :

– the SMOKE warning (Red)

– the LOOP warning (Amber)

SMOKE WARNING

The SMOKE warning appears when :

– A smoke signal is generated by both loops A and B, or

– A smoke signal is generated by the selected loop A or B when only a single loop is selected On, on the CARGO COMPT SMOKE DET panel.

The smoke warning devices are :

– The corresponding SMOKE light

– Both associated LOOP lights (or one if only one loop pushbutton switch is selected On).

– The ECAM

FIRE EXTINGUISHING SYSTEM

The FWD, AFT and BULK cargo compartments are protected by a fire extinguishing system.

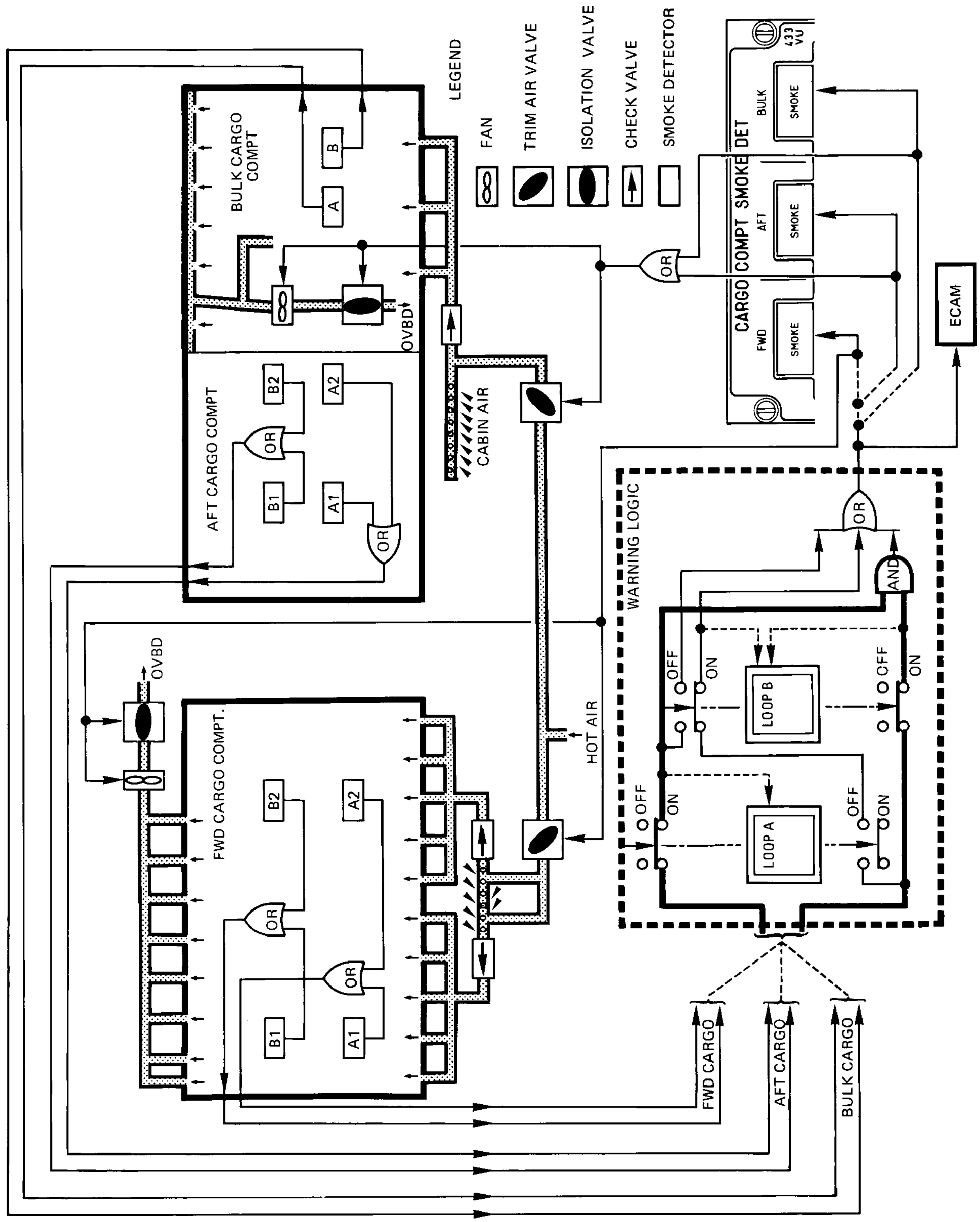
The extinguishing nozzles of FWD, AFT and BULK cargo compartments are supplied by two bottles. Each bottle has two discharge heads with squibs, one squib for the FWD and one squib for the AFT and BULK cargo compartments.

For fire extinction, the squibs for the respective compartment is ignited by selecting the appropriate AGENT switch AGENT 1.

The second bottle is available to maintain the required concentration of extinguishant should the remaining duration of the flight exceed 60 minutes.

The DISCH AGENT 2 light on the CARGO COMPT SMOKE DET panel comes on 60 minutes after AGENT 1 has been discharged. Then the second bottle is discharged by selecting the AGENT switch AGENT 2. R

SMOKE AND LOOP WARNINGS



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FIRE EXTINGUISHING SYSTEM

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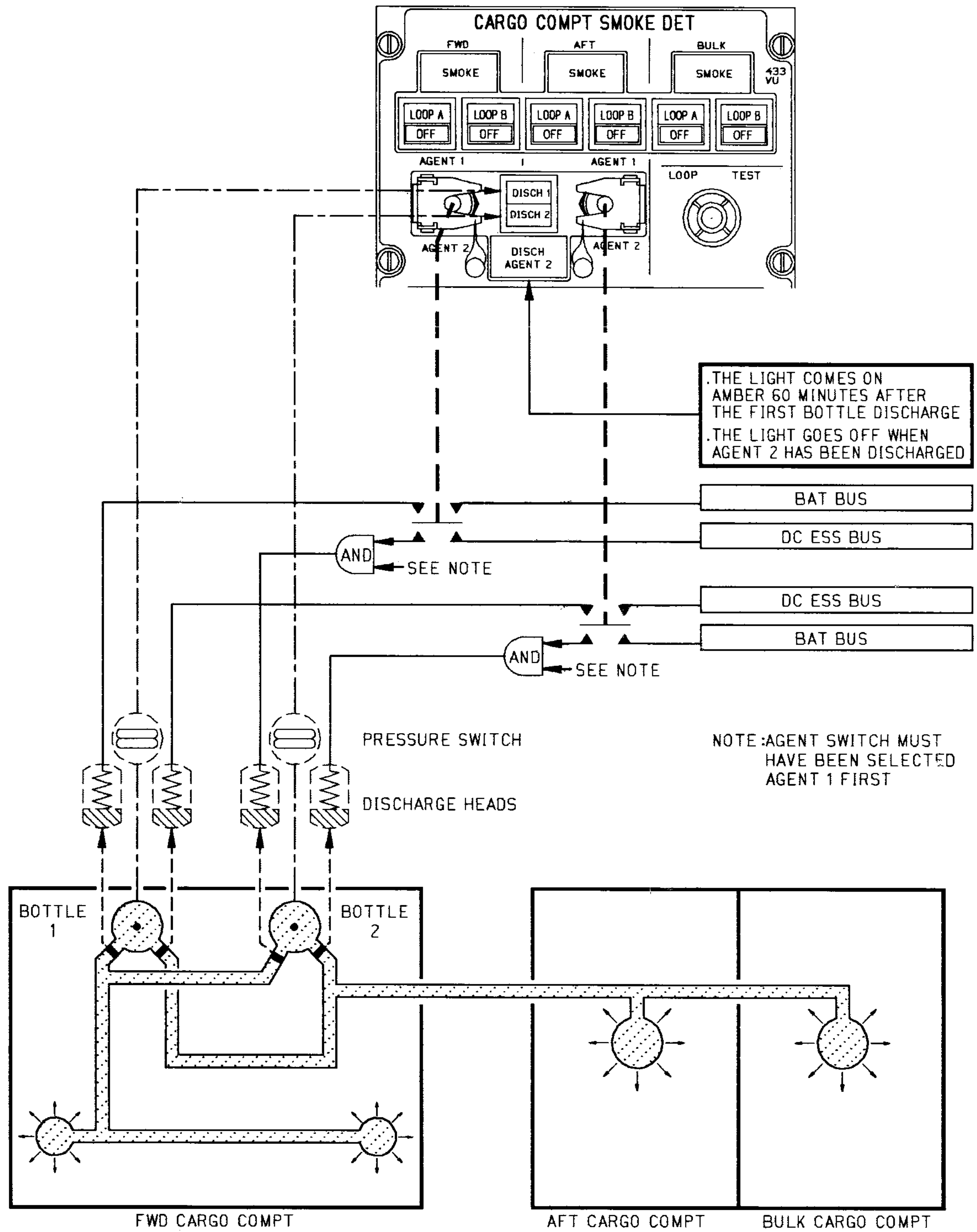

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Mod. : 2254

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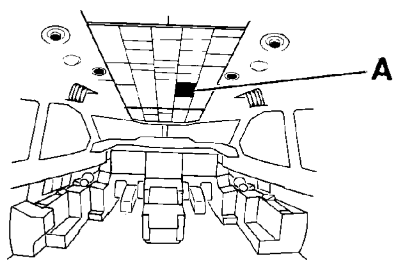
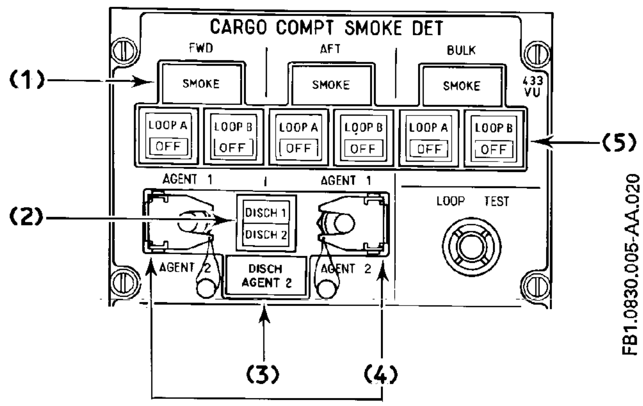
A. CARGO COMPT SMOKE DET PANEL





The CARGO COMPT SMOKE DET panel contains SMOKE warnings and fire extinguishing controls for the cargo compartments.

(1) FWD, AFT and BULK Cargo Compartments SMOKE Lights

A SMOKE light comes on red when smoke is detected in the respective cargo compartment.

Illumination of a SMOKE light is accompanied by ECAM activation.

(2) DISCH 1, DISCH 2 Lights

A light comes on amber when corresponding bottle is discharged.

The light gœs off only when empty bottle has been replaced.

(3) DISCH AGENT 2 Light

The light comes on amber accompanied by ECAM activation 60 minutes after discharge of the first fire extinguisher bottle (AGENT 1) for either the FWD or the AFT cargo compartment. R R

They serve as a reminder to discharge the second fire extinguisher bottle to maintain the necessary agent concentration in the concerned compartment. R

The light gœs off and warnings are cancelled when the second fire extinguisher bottle (AGENT 2) has been discharged. R

(4) FWD, AFT and BULK Cargo Compartments AGENT Switches

Both switches are guarded and lock-wired. They control the ignition of squibs and resultant discharge of the fire extinguisher bottle to the respective compartment.

- **AGENT 1**

  The squib of bottle 1 is ignited for discharge to the respective compartment (FWD or AFT and BULK)

- **AGENT 2**

  The squib of bottle 2 is ignited for discharge to the respective compartment (FWD or AFT and BULK) if the AGENT switch has been selected AGENT 1 first.

- **Neutral**

  Squibs are de-energized.

(5) FWD, AFT and BULK Cargo Compartment LOOP A (or B) Pushbutton Switch

The pushbutton switch controls the activation of the related smoke detection loop for each cargo compartment.

- **On (P/B Switch Pressed-in)**

  The loop is activated for smoke detection.

- **OFF (P/B Switch Released-out)**

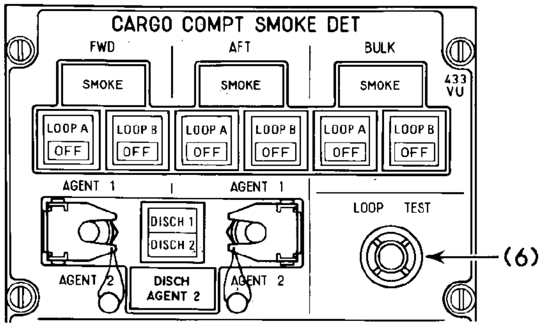
  The loop is deactivated. The OFF light comes on white.

- **LOOP A(B)**

  The light comes on amber when the active loop generates a warning signal.

  During LOOP TEST, the light comes on to indicate successful test.

Mod. : 2254



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(6) LOOP TEST Pushbutton :

When pressed, a test of one or both fire detection loops is activated depending on LOOP A and LOOP B pushbutton switches selection.

- **Test : LOOP A and LOOP B**

  With both loops activated a successful test is indicated by illumination of :

  . LOOP A and LOOP B lights

  . SMOKE light on the CARGO COMPT SMOKE DET panel.

R . FAULT light integrated in the ISOL VALVE pushbutton
R switch (see Air Conditioning chapter).

  and ECAM activation (inhibited from 2nd engine start on, to 1st engine shutdown).

- **Test : LOOP A or LOOP B**

  With LOOP B (OR A) pushbutton switch selected OFF, a successful test is indicated by illumination of :

  . LOOP A (or LOOP B) light

  . SMOKE light on the CARGO COMPT SMOKE DET panel.

R . FAULT light integrated in the ISOL VALVE pushbutton
R switch (see Air Conditioning chapter).

  and ECAM activation (inhibited from 2nd engine start on, to 1st engine shutdown).

Note : After test, the associated isolation valve has to be reset by action on the ISOL VALVE pushbutton switch (See Air Conditioning chapter).

Mod. : 2254

SMOKE AND LOOP WARNINGS

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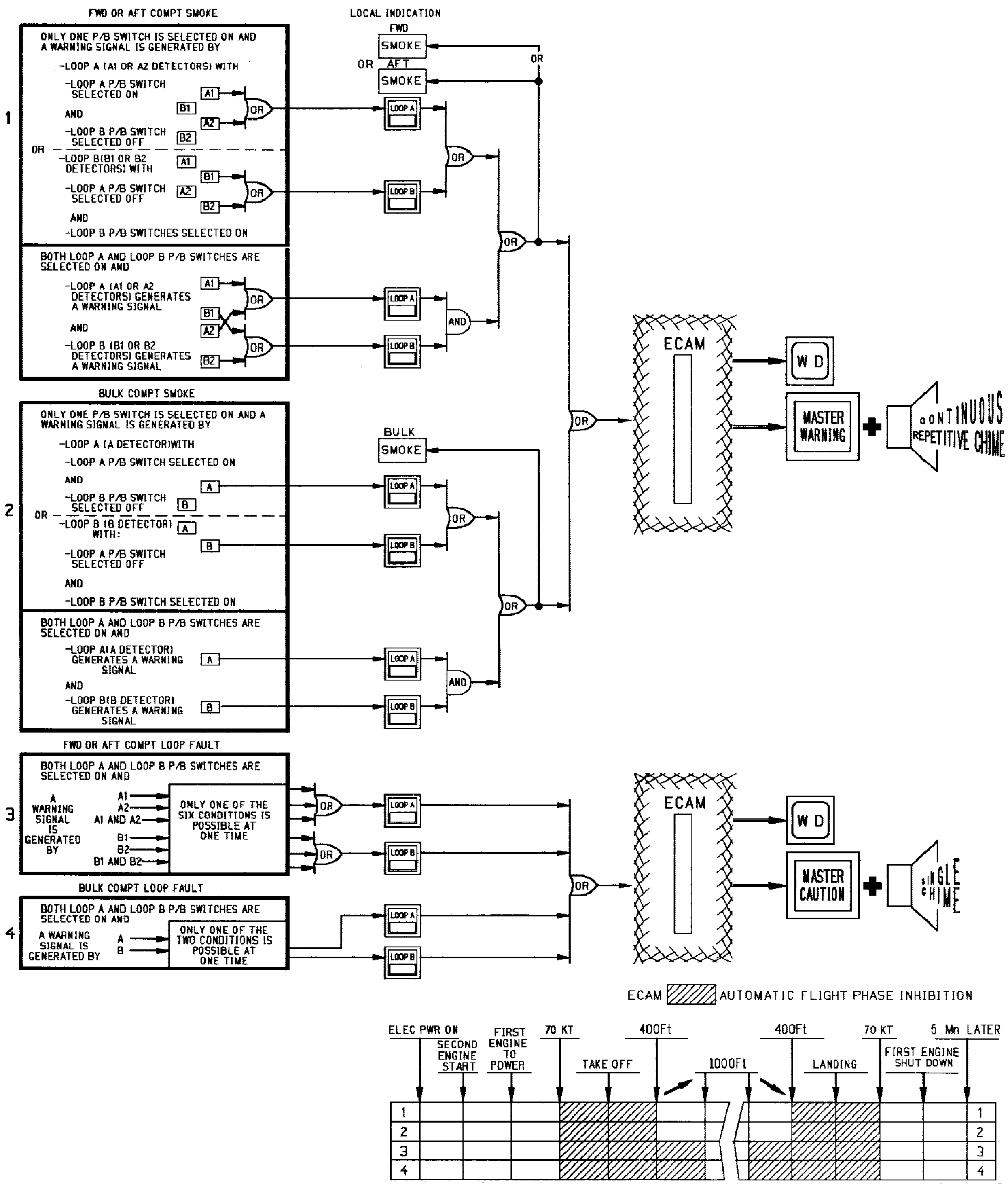

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Note : DISCH AGENT 2 light illumination causes ECAM activation (MASTER CAUTION light comes on, accompanied by a single chime). It is not a SMOKE warning but a reminder to discharge the second fire extinguisher bottle.

Mod. : 2254 + 5051

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The electrical smoke detection system comprises four independant detection systems.

Detectors are installed in the ventilation ducts of :

. Batteries

. Main avionics compartment

. Cockpit instrument panels

. Minimum equipment bay.

to detect the presence of combustion gases.

A fan installed in the avionics compartment provides olfactory confirmation of smoke via a sniffer located at the F/O's side console.

Each detector triggers a SMOKE light on the ELEC PWR panel and ECAM activation.

The SMOKE light for minimum equipment bay is located on the MIN EQPT BAY CIRCUIT BREAKERS panel on the aft part of the overhead panel.

SMOKE WARNINGS

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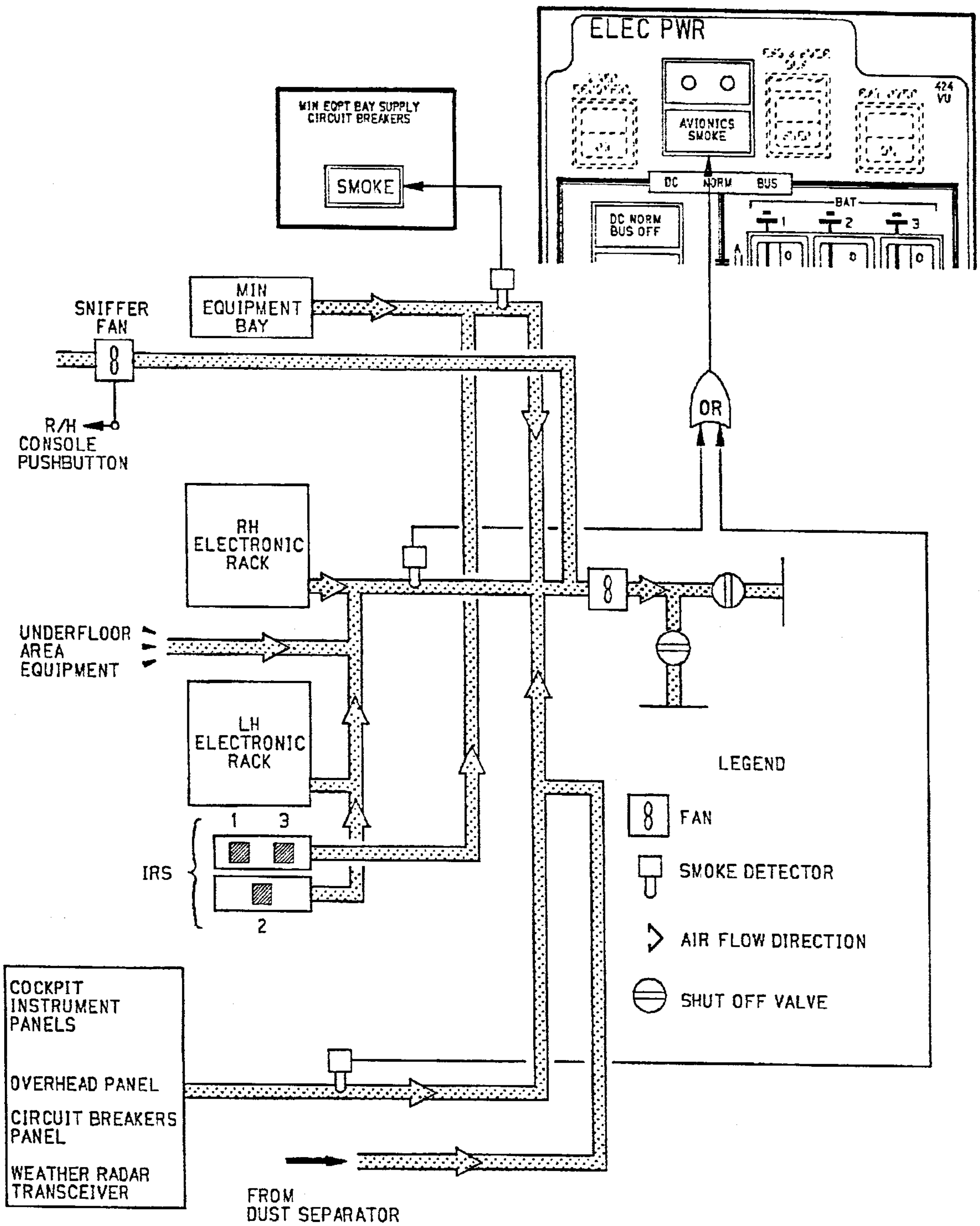

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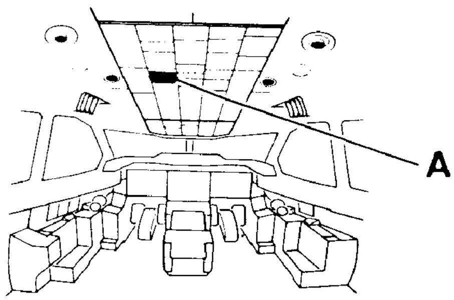
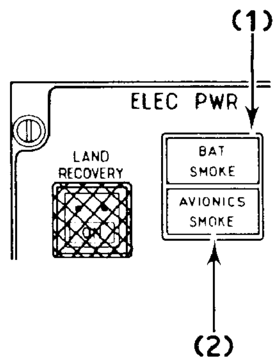
A. SMOKE LIGHTS ON ELEC PWR PANEL





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(1) BAT SMOKE Light

The BAT SMOKE light comes on red when smoke is detected in the batteries ventilation duct.

Illumination of the BAT SMOKE light is accompanied by ECAM activation.

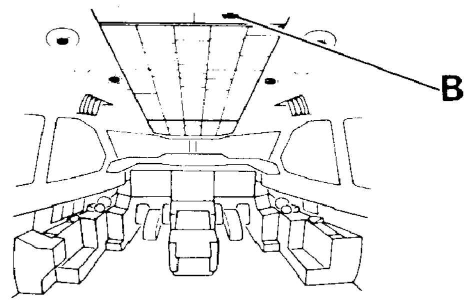
(2) AVIONICS SMOKE Light

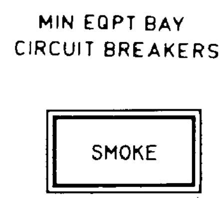
The AVIONICS SMOKE light comes on red when smoke is detected in the ventilation duct from :

- Cockpit instrument panels
- Overhead panel
- Circuit breakers panel
- Weather radar transceiver
- Electronic racks
- IRS 2
- Underfloor area equipment

Illumination of the AVIONICS SMOKE light is accompanied by ECAM activation.

B. MINIMUM EQUIPMENT BAY SMOKE



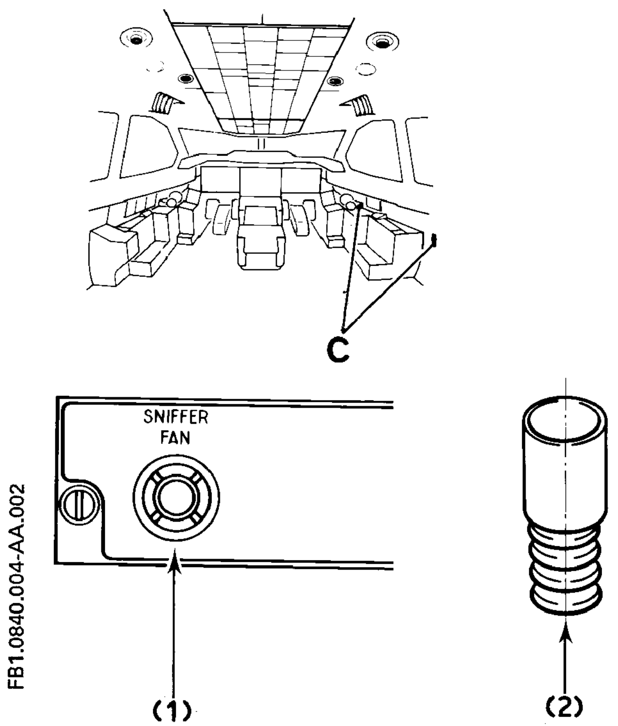


The SMOKE light located in the MIN EQPT BAY CIRCUIT BREAKERS section of the overhead circuit breaker panel comes on red when smoke is detected in the ventilation duct from the minimum equipment bay.

Illumination of the SMOKE light is accompanied by ECAM activation.

R

C. SNIFFER FAN CONTROLS



A fan located in the duct from the avionics compartment provides olfactory confirmation of smoke via a sniffer tube.

(1) SNIFFER FAN Pushbutton

- **Pressed and Held**

  The fan is activated and blows air through the sniffer duct.

- **Released**

  The fan is deactivated

(2) Sniffer Tube

The movable tube is provided for olfactory confirmation of smoke in air from the avionics compartment, extracted by the sniffer fan.

SMOKE WARNINGS

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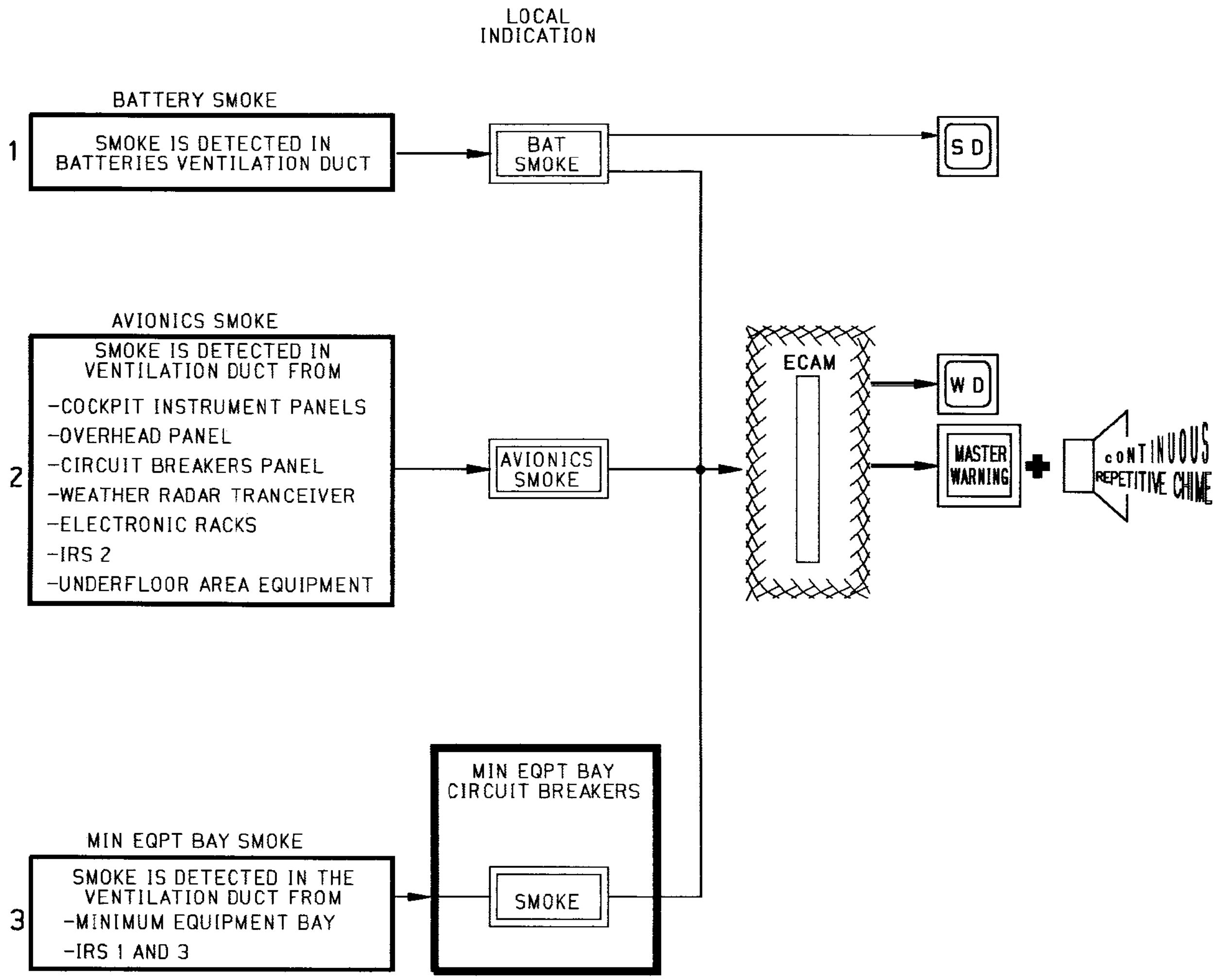
R



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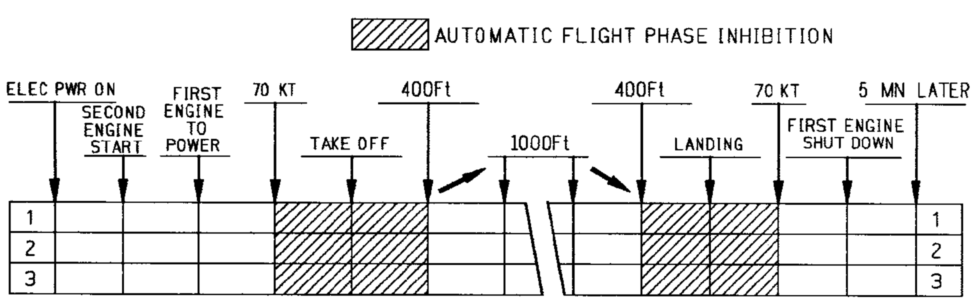
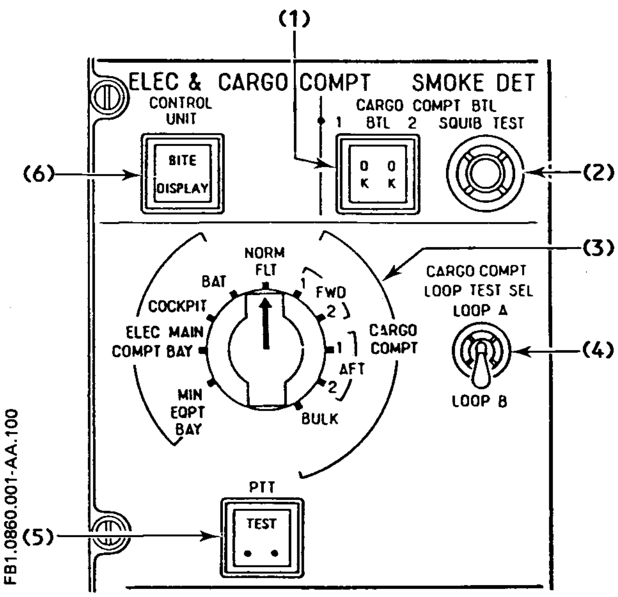


Mod. : 5051

A. ELEC and CARGO COMPT SMOKE DET PANEL



Controls the test of the electrical and cargo compartment smoke detection systems (detectors and circuit).

(1) BTL 1 (2) OK Lights

The lights BTL 1 and BTL 2 come on white, while SQUIB TEST pushbutton is pressed, when the corresponding squib in the bottle is operative.

(2) SQUIB TEST Pushbutton

When pressed and held the squibs in the discharge heads are tested simultaneously.

(3) Smoke Test Selector

Selects smoke detection system to be tested. 9 positions correspond to 14 smoke detectors.

. 5 (A detectors if the CARGO COMPT LOOP TEST SEL switch is selected LOOP A).

. 5 (B detectors if the CARGO COMPT LOOP TEST SEL switch is selected LOOP B).

. 4 in ventilation ducts from electrical bay.
The NORM FLT position deactivates the test functions, the TEST light in the PTT pushbutton is off.

(4) CARGO COMPT LOOP TEST SEL Switch

Selects the type of detectors and circuits to be tested

- **LOOP A**

  A detectors and circuits are tested

- **LOOP B**

  B detectors and circuits are tested

(5) PTT Pushbutton

The pushbutton initiates the test of the selected smoke detection system.

- **Pressed and Held**

  The test sequence is activated. It is successful if :

  . Corresponding local LOOP A (LOOP B) light comes on

  . Corresponding local SMOKE light comes on

  . MASTER WARNING light comes on associated with RC.

Note : ISOL VALVE FAULT light comes on on COMPT TEMP panel and must be reset after test.

- **Released**

  The test sequence is deactived

- **TEST**

  The light comes on white when the smoke test selector is in any test position and not selected NORM FLT.

(6) CONTROL UNIT Light

The BITE DISPLAY light comes on white and remains on if a smoke detection system fails.

Mod. : 2254 + 5051

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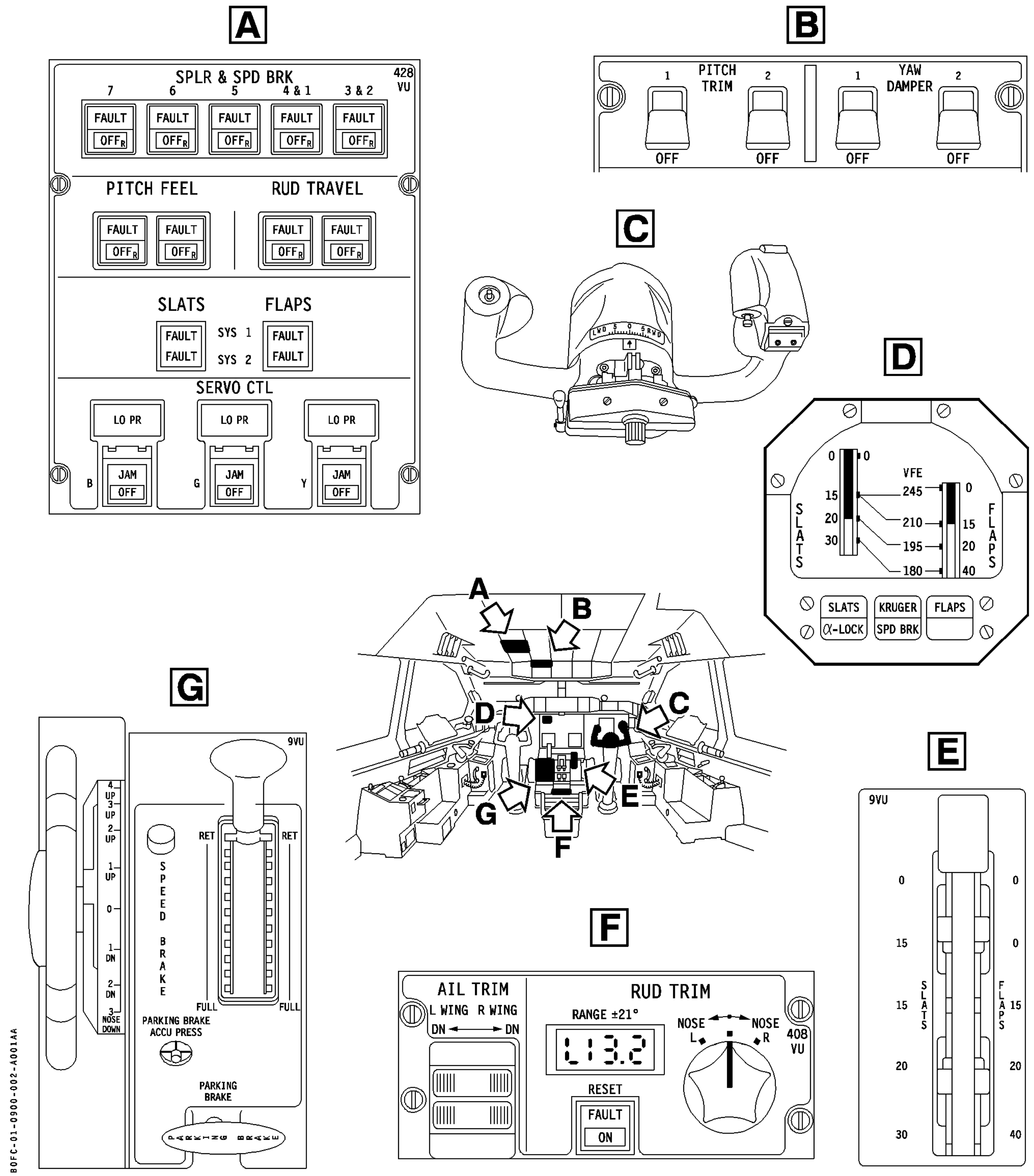


MAIN

SYSTEM CONTROLS

AND DISPLAYS

- Control of the aircraft is achieved by:
  - primary flight controls, and
  - secondary flight controls.

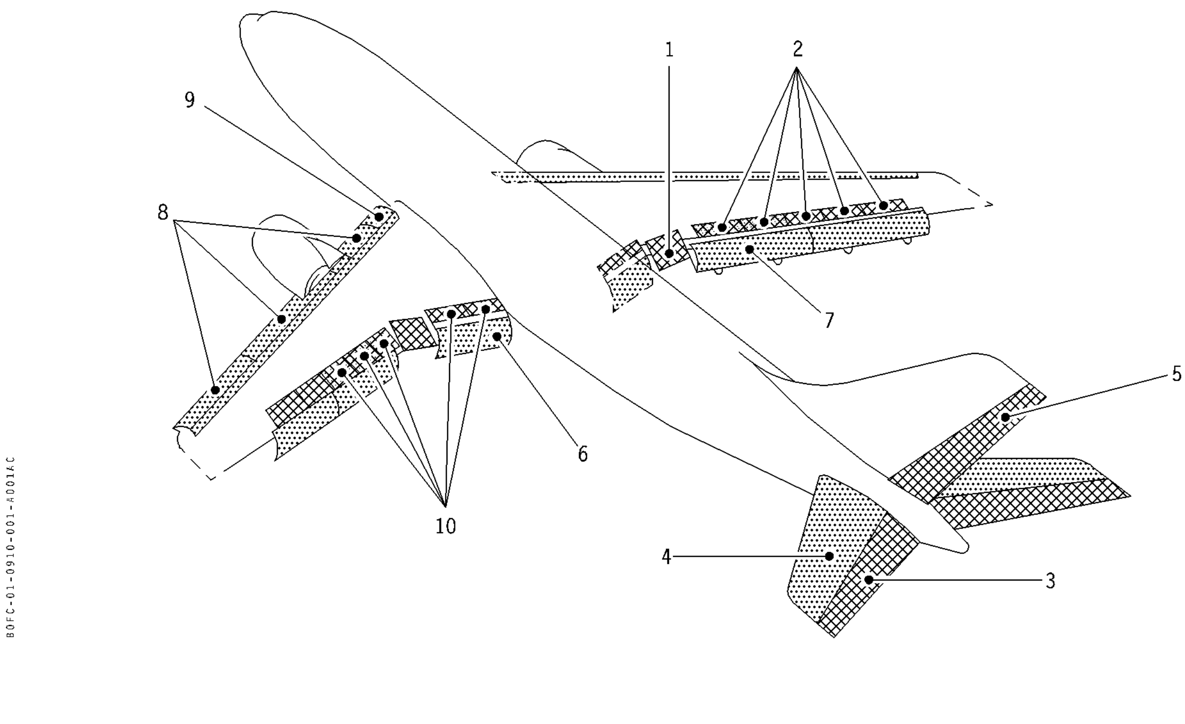
PRIMARY CONTROLS

- The primary flight controls are mechanically controlled and hydraulically actuated.
- The primary flight controls ensure **flight path control** and include:
  - **pitch control**, using:
    - the elevators **(3)**, which are hinged to the Trimmable Horizontal Stabilizer, and
    - the Trimmable Horizontal Stabilizer (THS) **(4)** which provides Pitch Trim.
  - **roll control**, using:
    - 1 aileron **(1)** per wing, and
    - the 5 outboard spoilers (Nos. 3 to 7) on each upper wing surface, as roll spoilers. **(2)**
  - **yaw control**, using a single rudder **(5)**.

SECONDARY CONTROLS

- The secondary flight controls are **lift and drag augmenting** devices and includes:
  - **flaps**: there are one double slotted inboard flap **(6)** and one single slotted outboard flap **(7)**.
  - **slats**: there are three slat sections per wing (inner, center and outer) **(8)**. Associated with the slats a Kruger flap **(9)** is located on the leading edge of each wing, inboard of the inner slat section.
  - **spoilers**: there are 7 spoilers (Nos. 1 to 7) on each upper wing surface which are used as speed brakes **(10)**, roll spoilers **(2)** or ground spoilers for lift dumping (all 7 surfaces).

R
R
R



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SERVO CONTROLS

- All flight controls surfaces are operated by hydraulically powered servo-actuators (linear movement) or servo-motors (rotary movement).

  Note : *For simplicity in the following, "actuator" will be used for "servo-actuator", and "motor" for "servo-motor".*

- The THS and Slats/Flaps motors are fitted with pressure-off brakes, which prevent flight controls from moving when the hydraulic pressure to the motor is shut off.
- Each actuator and motor is supplied by one of the three independent hydraulic systems.
- Hydraulic supply to the flight controls is designed with sufficient redundancy so that, with two hydraulic systems depressurized, the remaining hydraulic system can provide safe aircraft control throughout the entire flight envelope.
- Control of the elevator, aileron and rudder actuators (and back-up manual control of the THS motors) is via mechanical linkages from the pilots' controls. (mechanical control-hydraulic actuation)
- Slats/flaps, spoilers, rudder trim and aileron trim actuators are electrically controlled.
- When an AP is engaged, the AP actuators are clutched, and control the rudder, the ailerons and the elevators mechanical linkages (refer AFS chapter 1.03 for AP description and operation).
- In case of jamming of aileron, elevator or rudder actuator, or THS motor, a JAM warning is triggered.

  Note : *The JAM warning does not mean that the affected flight control is completely jammed, but simply means that one actuator of this flight control surface is not responding to control inputs.*

- A servo control (SERVO CTL) shutoff valve can be selected OFF to depressurize the associated servo control manifold, which in turn depressurizes the affected actuator or motor.
- The flight controls supply by respective hydraulic systems is :

BLUE	GREEN	YELLOW
Ailerons	Ailerons	Ailerons
Elevators	Elevators THS Pitch feel 1	Elevators THS Pitch feel 2
Rudder Yaw damper 1	Rudder	Rudder Yaw damper 2
Slats system 1	Slats system 2 Flaps system 2 Kruger Ailerons droop	Flaps system 1
Spoilers 2, 3, 7	Spoiler 5	Spoilers 1, 4, 6,
	AP 1	AP 2

- A priority valve in each hydraulic system closes when the pressure drops below approximately 1900 PSI in order to preserve the continued operation of the primary flight controls.

  The following flight controls are depressurized by the closing of the associated priority valve :

  – Blue : slats system 1.

  – Green : flap system 2, slat system 2, Kruger flaps and aileron droop system.

  – Yellow : flap system 1 and THS yellow motor.

- **Safety devices** :

  To preserve the green hydraulic system from a massive fluid loss in the event of a major structural damage, two hydraulic safety valves (also referred to as hydraulic fuses) are installed :

  – up-stream of the kruger flaps actuators (to protect the green hydraulic system in case of an engine rotor burst),

  – up-stream of the rudder green system actuator.

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- Pitch is controlled by the elevators and the Trimmable Horizontal Stabilizer (THS).
- The left and right elevators are connected by a coupling/uncoupling unit.

ELEVATORS

- Each elevator is controlled by the 3 hydraulic systems via 3 actuators, commanded by cable control runs from the Captain and First Officer control columns.
- If an elevator control run jams in flight (except for takeoff) the THS is used for pitch control.
- For takeoff, the elevator uncoupling/coupling sequence is as follows :
  - the elevator uncoupling unit (controlled by the Electrical Flight Control Unit, EFCU) uncouples the 2 elevators from 30 kt to 195 kt.
  - 2 bellcranks and detents connecting the front and rear ends of the 2 control runs (see diagram) allow the 2 control runs to be uncoupled so that, in case of elevator control jamming, the pilots can control the other elevator (overriding the detent requires a force of approximately 50 kg / 110 lbs).
  - above 195 kt, the unit recouples the elevators to prevent inflight asymmetric deflection of elevators.
- 2 independent artificial Pitch Feel systems, controlled by the Feel and Limitation Computers (FLC), provide increasing pitch control feel above 125 kt (high speed mode). The force increases progressively according to speed, Mach and THS position. Below 125 kt (low speed mode), the artificial pitch feel is a constant spring force.

  One system is active, the other is in stand-by.

  Each system uses its own hydraulic actuator (SYS 1 Green/SYS 2 Yellow).

  If both systems fail, the mechanism automatically returns to the low speed position, assisted by a spring (light elevator forces).

  If the system does not return to low speed mode, a warning of high speed mode operation is triggered when flaps reach 20°.
- The autopilot pitch actuator is connected to the linkage next to the left elevator. When one or both AP are engaged, the AP actuator drives the elevators.
- Stall warning is provided by electrical stick shakers fitted on the control columns (FWC activated).

PITCH TRIM

- Pitch trim is provided by the Trimmable Horizontal Stabilizer (THS). Mechanical stops are set at 3° nose down and 14° nose up.
- The THS is operated by two independent hydraulic motors (green and yellow hydraulic systems).
- The THS can be commanded:
  - by the electric trim using either trim switches (rocking levers) located on the control wheels,

  or
  - manually, by turning either trim wheel on the center pedestal,

  or
  - automatically, by the autopilot (Autotrim function),

  or
  - automatically, by the Flight Augmentation Computer (FAC) :
    - **Speed trim** (active above 200 kt) and Mach trim (active above MN 0.7) :
      - * **Nose up** order to optimize the longitudinal stability and handling qualities.
      - * The speed trim is available with the AP OFF, in CWS or in CMD
    - **Alpha trim** (active at high angle of attack, and high Mach number) :
      - * **Nose down** order to increase the pull-up stick force and prevent reaching an excessive angle-of-attack.
      - * The Alpha trim is available in clean configuration with the AP OFF, or AP in CWS and speedbrake lever in the retracted position.
    - **Stall trim** (active at high angle of attack and low speed).
      - * **Nose down** order to assist the stall recovery
      - * The stall trim is available in slats/flaps :
        . in slats/flaps 20/20 and 30/40
        . with AP OFF or AP in CMD or in CWS.
    - **Theta trim** (active at high pitch rate and low speed)
      - * Nose down order to ease the control of the pitch rate and attitude and prevent pitch from exceeding 30° (specially during go around)
      - * The theta trim is available with AP OFF, pitch above 10° and speed below 180 kts/M.37

Code : 0084

- The electric pitch trim inputs on rocking levers are inhibited when the AP is engaged in CMD (in case of an out-of-trim condition being experienced with the AP engaged in CMD, the AP must be first disconnected - using the AP instinctive disconnect pushbutton on the control wheel - before re-trimming the aircraft manually using the electric trim rocking levers.
- The Autotrim orders are inhibited :
  - at take-off, if the landing gear is still extended 60 seconds after rotation,
  - when landing gear is down locked during approach,
  - during 5 seconds following the engagement of the GO AROUND mode, in order to take account of the nose up pitching effect of the increasing engine thrust.
- Electric pitch trim commands (rocking lever inputs) and Autotrim commands (AP pitch trim orders) are processed by two pitch trim systems, provided the PITCH TRIM 1 and PITCH TRIM 2 levers are engaged.

  The THS position is indicated on the pitch trim wheel scale.
- In normal operation PITCH TRIM 1 is operating, and PITCH TRIM 2 is in standby.

R - The manual pitch trim (wheel and THS) runs approximately 5 time faster at low aircraft speed than at high speed.

R The Autotrim speed depends on the flaps
R configuration (pitch trim runs faster when flaps
R are extended).

Pitch trim safety devices

- Electric and automatic pitch trim commands can be overridden manually using the pitch trim control wheel.

  Overriding the electric trim and Autotrim by using the pitch trim control wheel results in the automatic disengagement of both pitch trim systems (both PITCH TRIM levers trip to OFF).
- When the pitch trim is controlled by the electric trim (i.e either rocking lever), the THS automatically stops before reaching the mechanical stops (3° nose down and 14° nose up).
- When using the electric trim switches, if the THS runs for more than 1 second, an audio "Whooler" sounds to alert the pilots.
- If CM1 and CM2's electric trim switches (rocking levers) are held in opposite directions, trimming action stops.
- Each electric trim rocking lever actuates two switches. If switches provide contradictory orders both pitch trim systems disengage.

Pitch trim engagement conditions

- Pitch Trim lever can be engaged if:
  - power supply is available,
  - associated Flight Augmentation Computer (FAC) is operative,
  - associated Air Data Computer (ADC) is operative, if flaps are retracted,
  - associated THS motor is operative.
- For in-flight re-engagement, in addition to the above conditions and if slats are retracted, at least two Angle-of-Attack sensors must be operative.

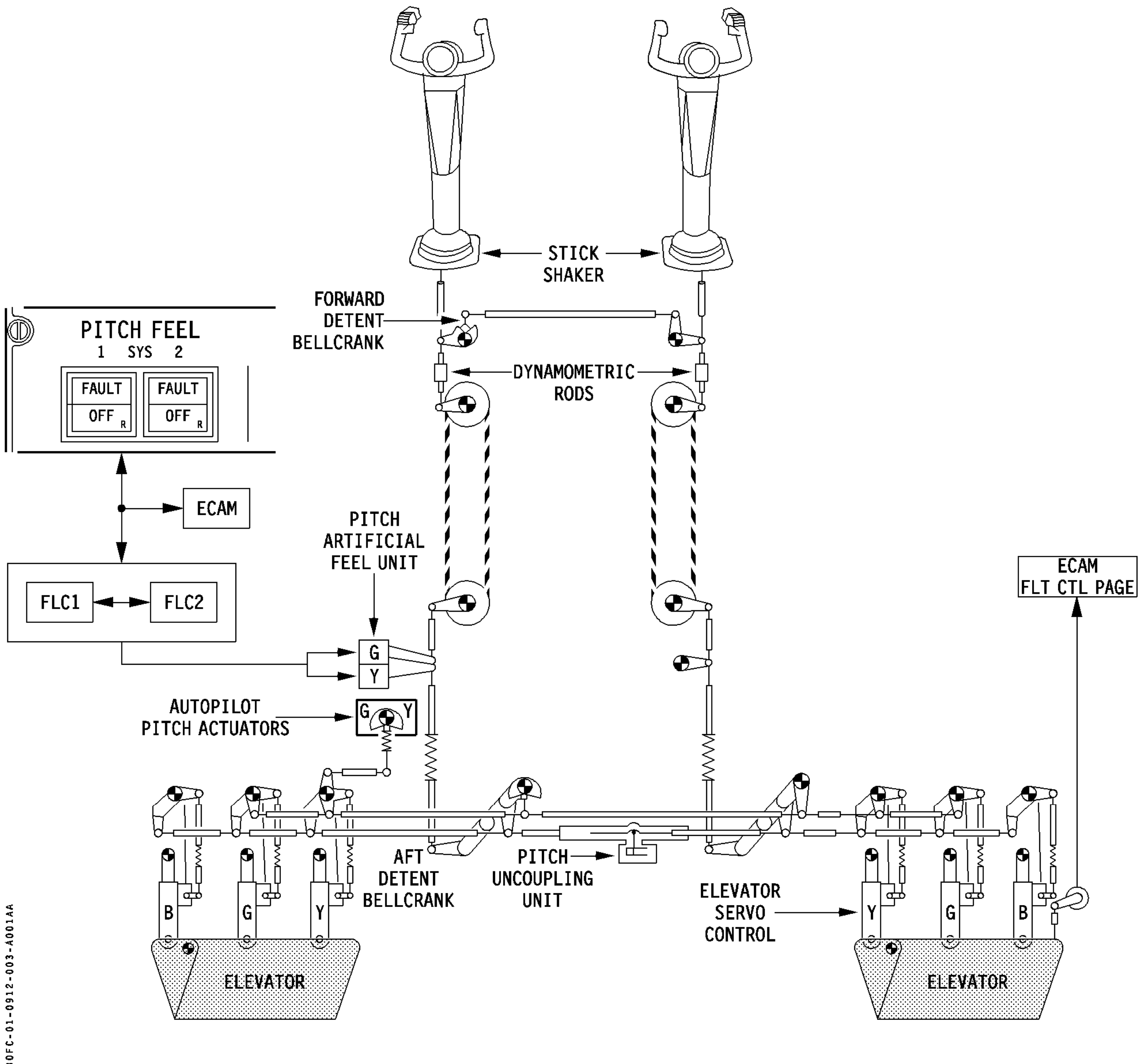
Pitch trim disengagement conditions

- If any pitch trim engagement condition is lost, the corresponding PITCH TRIM lever trips to OFF.

  ECAM warning is activated.

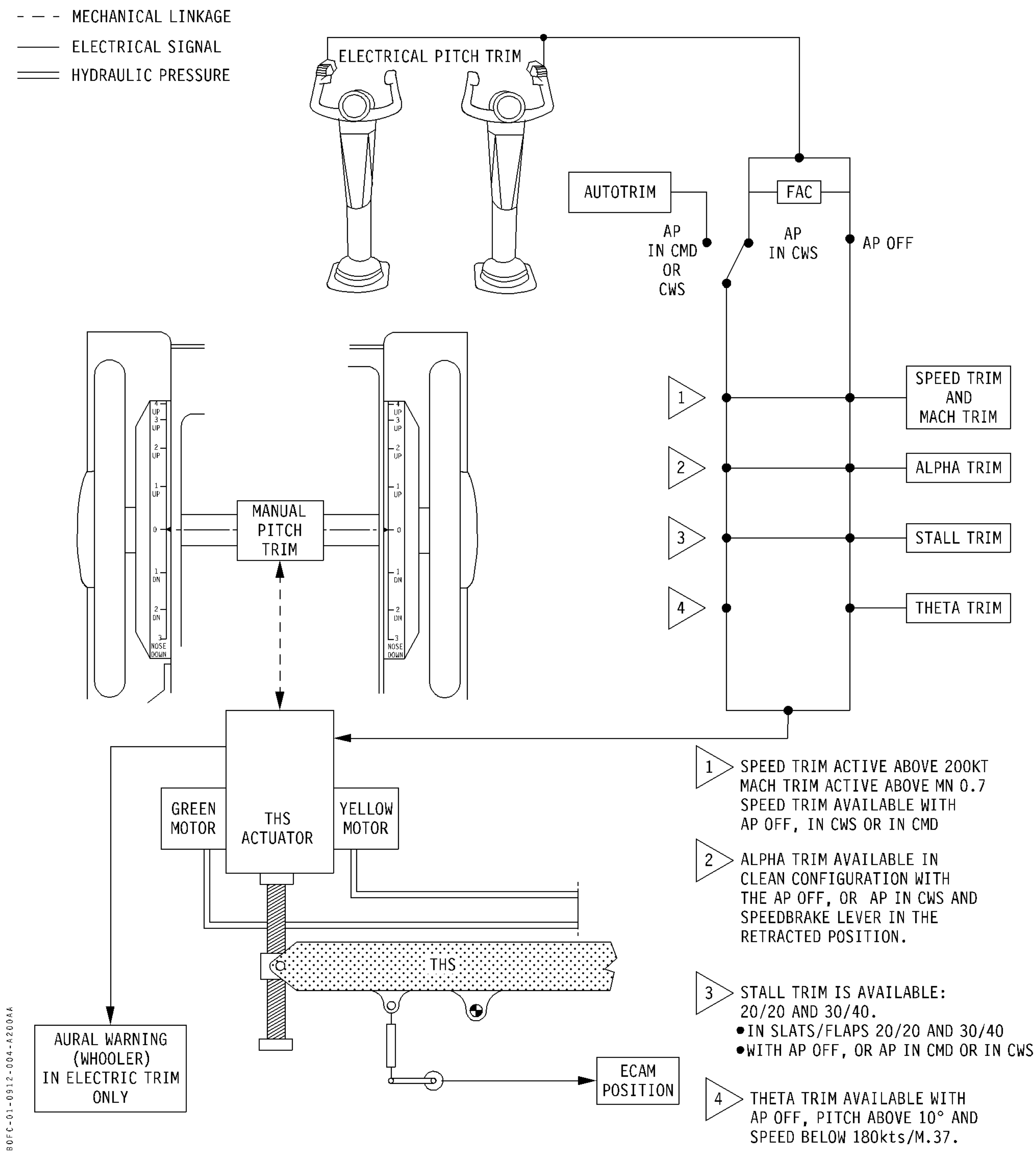
  The remaining pitch trim system continues to operate normally.

PITCH CONTROL



R *Note :* *The elevator trailing edge might appear to be low when observed from the ground. This is expected*
R *behavior when the hydraulics are switched off and the servo actuators can no longer hold the weight*
R *of the elevator surface.*

PITCH TRIM CONTROL



Code : 0084

ROLL CONTROLS

- The roll control on each wing is achieved by :
  - one aileron, powered by 3 actuators, and
  - 5 roll spoilers (Nos. 3 to 7), each one powered by 1 actuator.
- Pilot inputs on the control wheel are sent to the aileron actuators via dual parallel mechanical control systems (control runs) providing fail- safe operation.
- Roll spoilers are used for roll control only if the control wheel is moved beyond a given threshold.
- An artificial feel load which is proportional to the control wheel deflection is provided by a spring rod.
- If one control run jams, the associated control wheel is jammed. The other control run can be operated provided a given force (in the order of 16 kg/35 lbs) is applied on the associated control wheel. This action compresses the spring strut connecting the two control wheels (see diagram).

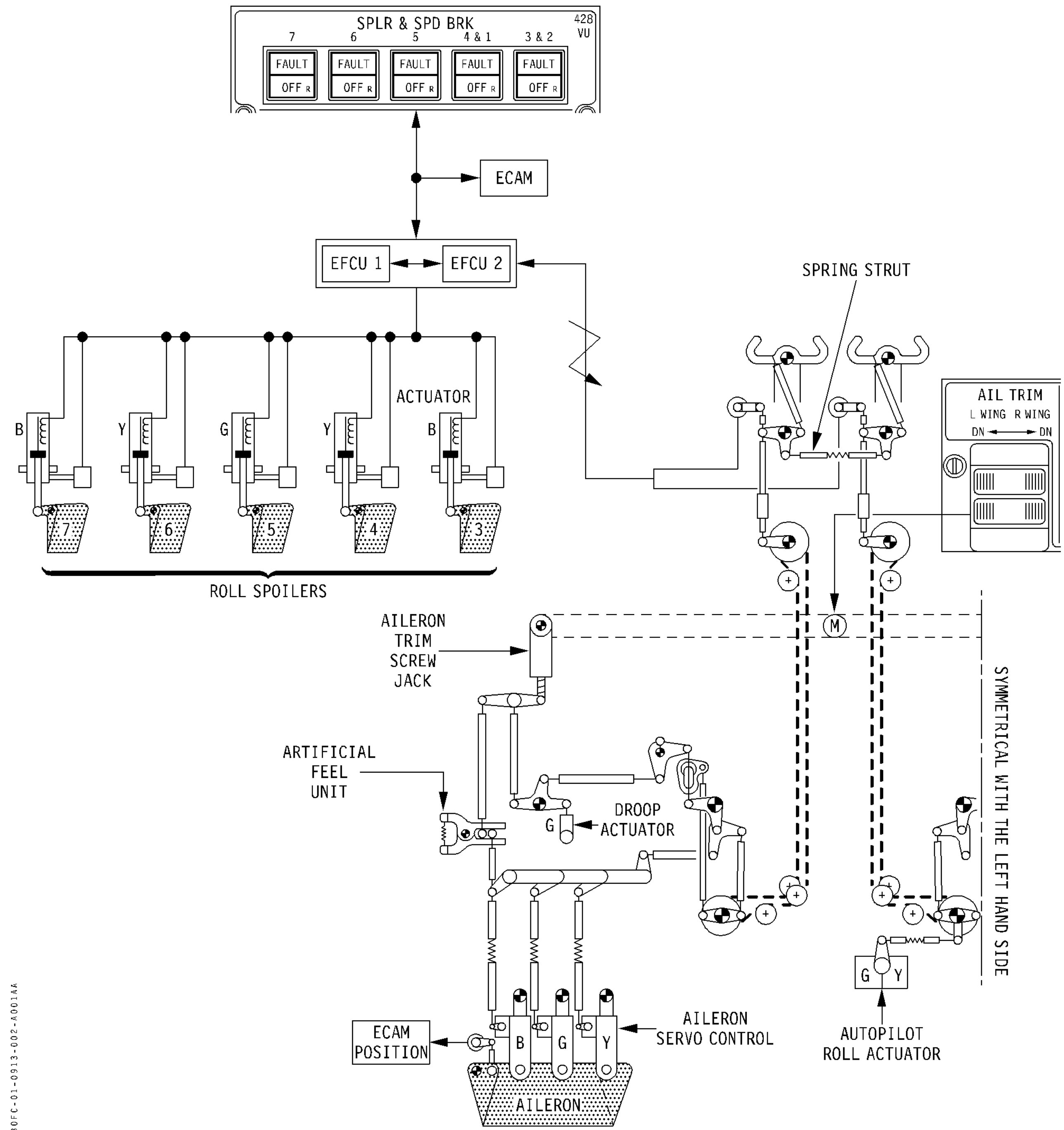
  The aileron on the unjammed side still operates.

  Roll spoiler control is degraded, so that:
  - if Crew Member (CM) 1 control run jams, CM2 controls roll spoilers 4 and 5.
  - if CM2 control run jams, CM1 controls roll spoilers 3, 6 and 7.
- To improve the aerodynamic characteristics with slats extended, the ailerons droop downwards by approximately 7° (aileron authority is unchanged).
- An aileron trim enables to trim the aircraft in wing-level condition using the aileron trim switches (rocking levers).

  Aileron trim is indicated on a scale on top of each control wheel.
- Roll spoilers are electrically controlled by the EFCU.

Mod : 5330

ROLL CONTROL



R

Note : The aileron trailing edge might appear to be low (or asymmetrical compared to the other side) when observed from the ground. This is expected behavior when the hydraulics are switched off and the servo actuators can no longer hold the weight of the aileron surface.

RUDDER CONTROL

- The rudder is controlled by 3 actuators, which are commanded by a single cable run from the rudder pedals.

  Rudder artificial feel is provided by a spring-loaded rod.

- Additional inputs to the rudder come from:
  - the rudder trim, and
  - the 2 yaw dampers.

- Rudder trim is operated by an electric motor.
  - Rudder trim inputs are inhibited when the AP yaw channel is active (i.e. when the AP is engaged in CMD and slats are extended).

- During cruise, it is recommended to trim the aircraft to achieve a Zero Control Wheel deflection.

  The resulting rudder trim deflection should not exceed 1.5 unit NOSE L or NOSE R.

- 2 independent Rudder Travel Limiting Systems (RUD TRAVEL), controlled by the Feel and Limitation Computers (FLC), progressively decrease the maximum
R rudder travel as a function of speed :
R – at or below 165 kt, maximum rudder travel is
R ± 30° (low speed range),
R – at VMO, maximum rudder travel is about ± 4°
R (high speed range).

  If both systems fail, whatever the aircraft speed, the mechanism automatically returns to the low speed position (± 30° rudder travel available).

  If the system does not return to the low speed position, an ECAM warning (indicating that the rudder travel limiting system is jammed in the high speed range) is activated when flaps are at 20° or more.

  In normal operation, RUD TRAVEL SYS 1 is active and SYS 2 is in standby.

- On the ground, the rudder pedals are linked to the nose wheel steering.

YAW DAMPER

- The yaw damper ensures the following functions:
  - dutch roll damping,
  - turn coordination which becomes active if sufficient control wheel deflection is applied except if :
    - AP is engaged in CMD, or
    - flaps are extended to 40°, or
    - a stall warning is detected.
  - yaw compensation in case of engine failure, provided the AP is engaged in CMD with SRS (takeoff) or GO AROUND mode annunciated on FMA.

- Yaw damper command is transmitted to the rudder but there is no deflection feedback sent to the rudder pedals.

- There are two yaw damper systems. In normal operation, yaw damper 1 is operative and yaw damper 2 is in standby.

- Each system is engaged by its respective yaw damper lever on the overhead panel.

- If both EFCU fail, both yaw dampers remain engaged but turn coordination is inhibited.

Yaw damper engagement :

- YAW DAMPER lever can be engaged if :
  - power supply is available,
  - associated FAC is operative,
  - associated ADC is operative (condition required only if flaps are retracted),
  - IRS 1 and (2 or 3) is operative for YD 1,
  - IRS 2 and (1 or 3) is operative for YD 2,
  - blue hydraulic system is pressurized, for YD 1,
  - yellow hydraulic system is pressurized, for YD 2.

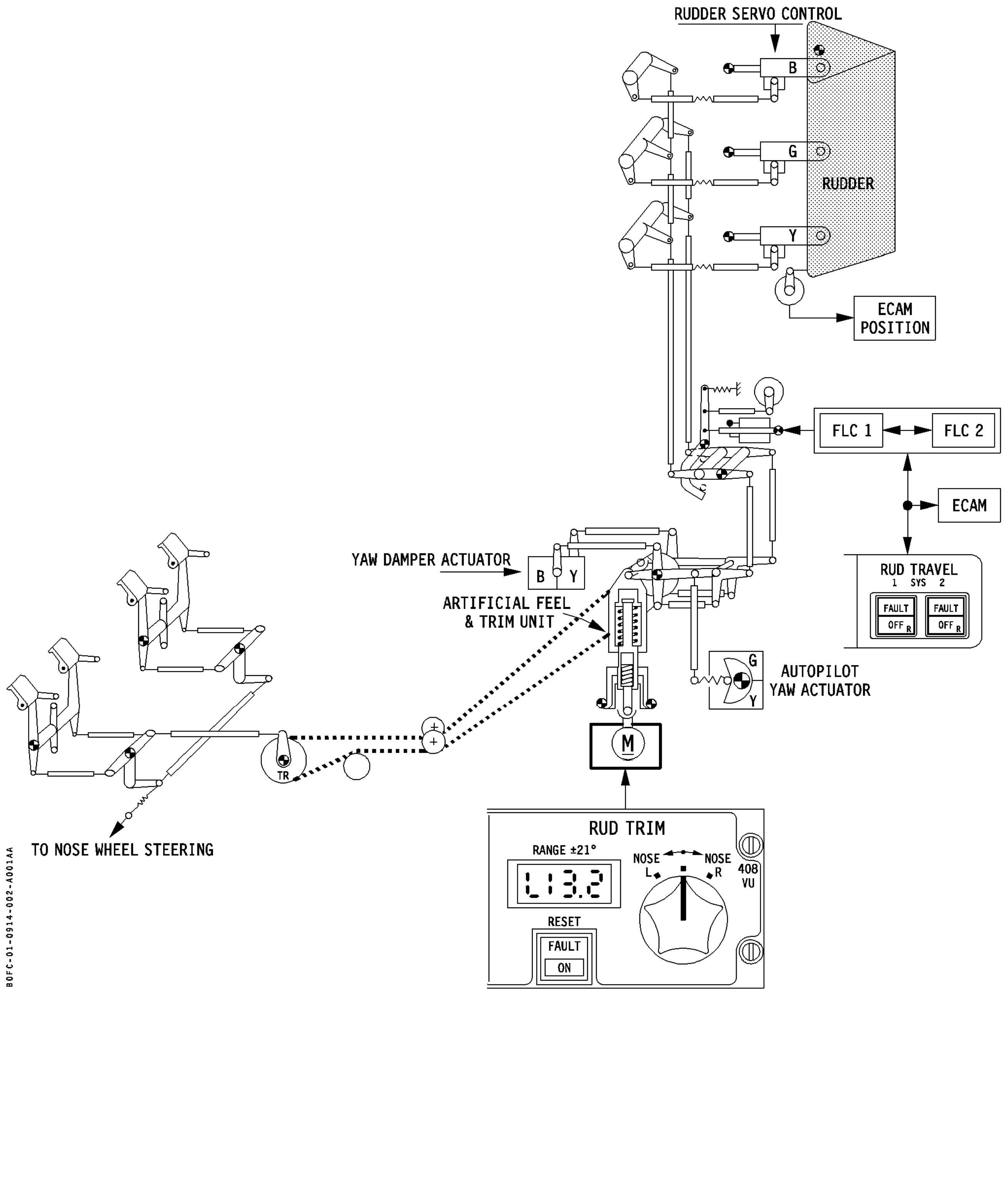
Note : on ground, hydraulic power is not necessary for yaw damper engagement.

Yaw damper disengagement :

- If any of the engagement conditions are lost, the respective YAW DAMPER engagement lever trips to OFF accompanied by ECAM activation.

Mod : 5408 + 11442

YAW CONTROL


RUDDER SERVO CONTROL
B
G
Y
RUDDER
ECAM
POSITION
FLC 1
FLC 2
ECAM
RUD TRAVEL
1 SYS 2
FAULT
OFF R
FAULT
OFF R
YAW DAMPER ACTUATOR
B
Y
ARTIFICIAL FEEL
& TRIM UNIT
AUTOPILOT
YAW ACTUATOR
G
Y
M
TR
TO NOSE WHEEL STEERING
RUD TRIM
RANGE ±21°
L13.2
NOSE
L
NOSE
R
408
VU
RESET
FAULT
ON
B0FC-01-0914-002-A001AA

GENERAL

- The 5-position SLATS/FLAPS control lever, located on the right side of the center pedestal, electrically controls the slat and flap operation.

  Four slat positions can be selected (0° , 15°, 20° and 30°).

  Four flap positions can be selected (0°, 15°, 20° and 40°).

- There are 5 selectable SLATS/FLAPS positions: 0/0, 15/0, 15/15, 20/20, 30/40.

- The slats and flaps are electrically controlled by two identical Slats Flaps Control Computers (SFCC). Each SFCC includes one slats and one flaps control channel (SYS 1 and SYS 2).

- Ths SLATS/FLAPS SYS 1 and SYS 2 are electrically and hydraulically supplied as follows :

	Hydraulic	Electric
SLATS SYS1	B	AC EMER BUS
SYS2	G	AC BUS 2
FLAPS SYS1	Y	AC ESS BUS (*ACEMERBUS)
SYS2	G	AC BUS 2

Note 1 : with only one hydraulic system pressurized, slats or flaps move at half speed.

Note 2 : (*), with LAND RECOVERY selected ON.

SLATS

- There are three retractable slat sections per wing, driven by screwjack mechanisms.

- The screwjack mechanisms are equipped with torque limiters to stop the system in case of excessive torque, in order to prevent system damage (slats jamming).

  In case of torque limiter engagement, slats operation may be recovered by cycling the slats/flaps lever. The jamming may also clear by itself, without crew action.

  The screwjacks are driven through a torque shaft by two independent hydraulic motors. These motors have pressure-off brakes which stop the slat motion when hydraulic pressure drops.

- A wing tip brake is fitted at the end of the torque shafts to stop the slat motion in case of detected slat asymmetry (slats stuck).

- To improve lift, a Kruger flap is fitted on each wing, between the inner slat and the fuselage.

- An aileron droop system is installed to improve aerodynamic characteristics with the slats extended.

  When slats are extended to 15°, the Kruger flaps extend and the ailerons droop by approximately 7°.

Alpha-lock protection

- If slats are selected to the 0/0 position while the angle-of-attack is higher than 9°, the slat retraction is limited to 15° , and the Kruger flaps and aileron droop remain extended (Alpha-lock protection is inhibited below 60 kt).

  If the slats/flaps lever is in the 0/0 position, once the AoA is below 9°, the slats, Kruger flaps and aileron droop retract automatically.

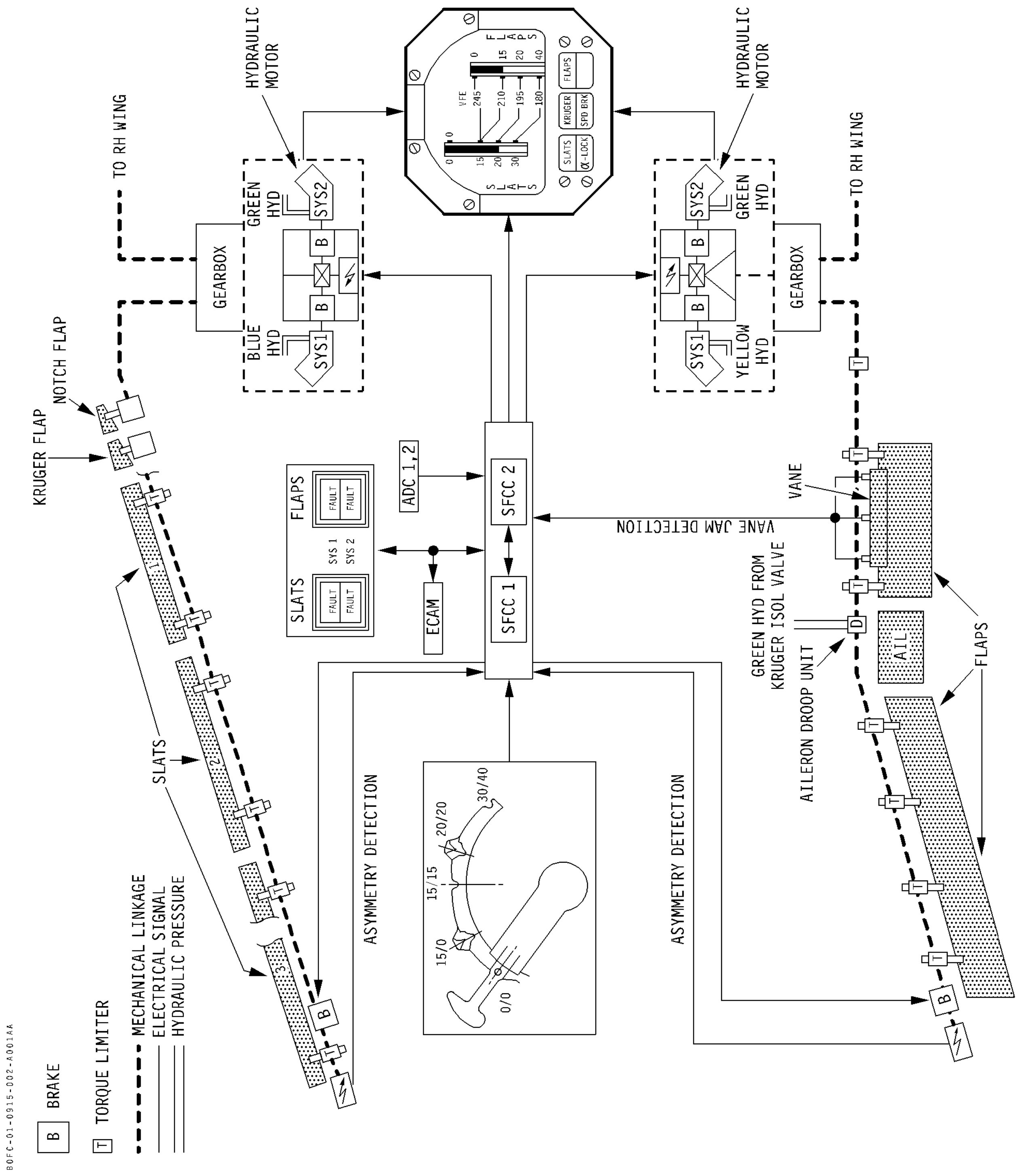
  The activation of the Alpha-lock protection is indicated on the Slat/Flap Position Indicator (SFPI) by the illumination of the blue α-LOCK light.

FLAPS

- There are two retractable flap sections per wing driven by screwjack mechanisms.

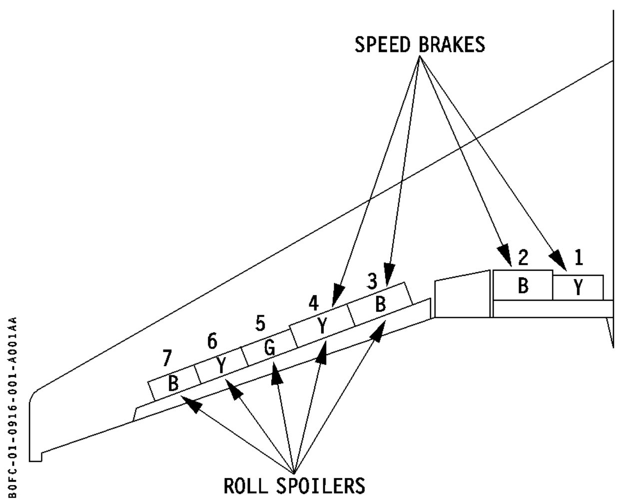
  The flaps mechanism is identical to the slats one.

Mod : 5330


HYDRAULIC MOTOR
TO RH WING
GEARBOX
GREEN HYD
BLUE HYD
YELLOW HYD
SYS1
SYS2
B
NOTCH FLAP
KRUGER FLAP
SLATS
FLAPS
FAULT
SYS 1
SYS 2
ADC 1,2
SFCC 1
SFCC 2
ECAM
VANE
VANE JAM DETECTION
GREEN HYD FROM KRUGER ISOL VALVE
AILERON DROOP UNIT
AIL
ASYMMETRY DETECTION
0/0
15/0
15/15
20/20
30/40
VFE
245
210
195
180
KRUGER
SPD BRK
α-LOCK
B BRAKE
T TORQUE LIMITER
MECHANICAL LINKAGE
ELECTRICAL SIGNAL
HYDRAULIC PRESSURE
B0FC-01-0915-002-A001AA

GENERAL

- There are 7 spoilers per wing which are electrically controlled and hydraulically actuated. In flight, some act as speed brakes, some act as roll spoilers. On the ground, all spoilers are used as ground spoilers.
- Each spoiler is powered by one actuator supplied by the Blue, Green or Yellow hydraulic system.



SPEED BRAKES

- The 4 inner spoilers (No 1 to 4) of each wing are used as speed brakes. Speedbrakes are operated by the SPEED BRAKE lever located on the left side of the center pedestal. Eleven positions can be selected from RET (retracted) to FULL (full extension).
- When extended, a "SPEED BRAKES EXTENDED" message is displayed on the ECAM MEMO page and the SPD BRK light illuminates blue on the SFPI.

ROLL SPOILERS

- The 5 outer spoilers (No 3 to 7) are used as roll spoilers.
- The roll spoilers automatically extend, in accordance with the control wheel deflection.

GROUND SPOILERS

- On the ground, all 7 spoilers can be automatically extended as ground spoilers.
- Ground spoilers are armed for take-off or landing by pulling the SPEED BRAKE lever.
- The ground spoilers automatically extend when the following conditions are met :
  - – ground spoilers are armed (SPEED BRAKE lever in RET position and pulled upward into the arming detent) and main landing gear compressed,

    or

    at least on thrust reverser selected,

  and

  - – both throttle levers are at idle,

  and

  - – wheel speed of main landing gear aft wheels is greater than 85 kt.

  Note : *In case of aborted take off below 85 kt, ground spoilers do not deploy.*

- If conditions for the automatic extension of the ground spoilers are not met (e.g. in case of jamming of one throttle lever out of the idle position), the speed brakes can be manually extended (spoilers 1 to 4 only with normal speed brake in-flight deflection).
- The ground spoilers deflection is higher than the maximum speed brake deflection.
- Ground spoilers can be retracted after landing:
  - – if armed, by pushing the speedbrake handle down out of the arming detent, or
  - – if not armed, by advancing at least one throttle above idle.

  Note : *In case of aircraft bouncing, the ground spoilers will remain extended provided both throttle levers are maintained at idle, and the other arming conditions are still met.*

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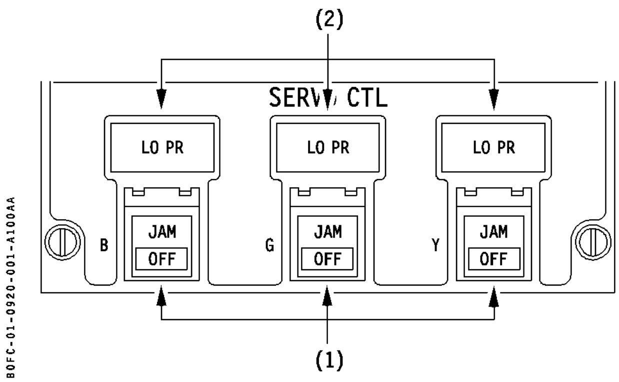
SERVO CONTROL PANEL



(1) SERVO CTL shutoff valves pushbutton switches

These guarded pushbutton switches control the servo control shutoff valves for the Blue (B), Green (G) and Yellow (Y) servo control manifolds.

- **Normal** (pushbutton switch pressed-in):
  - The corresponding (B, G or Y) servo control shutoff valve is open, and hydraulic pressure is supplied to the servo control manifold users when the associated hydraulic system is pressurized.
- **JAM** (amber):
  - The JAM light illuminates in case of jamming of the hydraulic control valve of any rudder, elevator or aileron actuator or in case of jamming of one of the pilot valves of the THS actuator.
  - Jamming detection is inhibited if the associated hydraulic system is depressurized.
- **OFF** (white: pushbutton switch released-out):
  - The associated servo shutoff valve closes, shutting off hydraulic pressure supply to the corresponding users.
  - The associated JAM warning is inhibited.
  - The amber LO PR light for the associated servo control manifold confirms that the valve has closed.

- **Safety device :**

  To prevent the inadvertent closing of all three servo control shutoff valves, only two valves can be closed simultaneously.

  If all three servo control shutoff valve pushbuttons are mistakenly selected OFF, when the third pushbutton is selected OFF, all three servo control shutoff valves automatically re-open.

  Note : the servo control shutoff valve position is shown on the ECAM HYD page.

(2) SERVO CTL manifolds LO PR lights

The amber LO PR lights illuminate if the hydraulic pressure in the associated servo control manifold drops below 1450 PSI.

Mod : 5904

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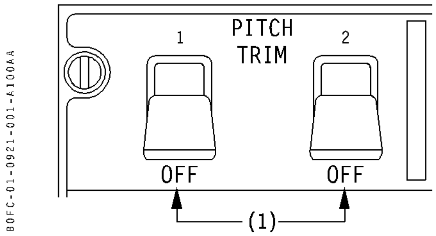
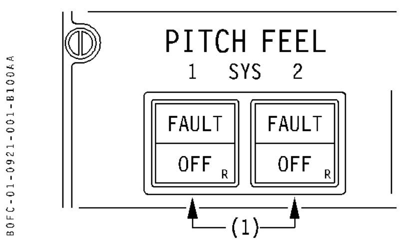
PITCH TRIM LEVERS



(1) PITCH TRIM engagement levers

- **Up** : pitch trim 1 (or 2) is engaged and operative.
- **OFF** : pitch trim 1 (or 2) is not engaged.

PITCH FEEL CONTROL PANEL



(1) PITCH FEEL pushbutton switches

The pushbutton switches control the two Pitch Artificial Feel systems.

- **Normal** (pushbutton switch pressed-in):

  The associated system is engaged.

- **FAULT** (amber):

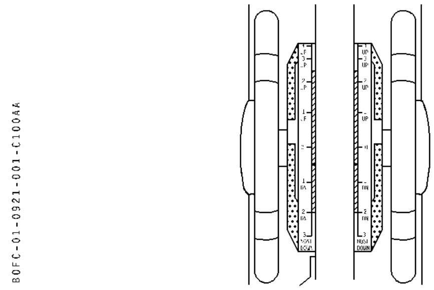
  Illuminates if a failure is detected with the pushbutton switch in normal position.

  ECAM warning is activated.

- **OFF/R** (white: pushbutton switch released-out): The system is disengaged. The monitoring circuits are reset.

> If both pitch feel systems have been selected OFF, but both FAULT lights illuminate again when flaps reach 20° or more, the Pitch Feel system is in high speed mode. High elevator forces may be expected for approach and landing.

PITCH TRIM WHEELS



- The pitch trim wheel provides mechanical feedback of THS movement and position. The THS position (in degrees) is indicated on the trim wheel scale.

  On production aircraft, the situation is as follow : R

	NOSE UP	NOSE DOWN	
SMALL RANGE	– 0.5	+ 0.5	R
LARGE RANGE	– 2	+ 0.5	R

The green band indicates the normal THS position for takeoff (the takeoff trim range provides a THS setting to have the aircraft trimmed for the second segment climb at approximately 1.3 Vs with two engines operative).

The white band provides additional indications regarding the THS position (typically illustrated on the sketch) :

– the small white band indicates the normal trim setting corresponding to a mean CG in cruise.

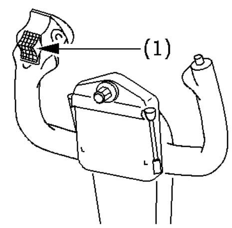
– the large white band indicates the possible trim setting within the whole CG range during climb, cruise and descent.

Therefore, usual operation leads to a trim setting in cruise inside the small band (provided actual CG is controlled by CGCC). R

- If manually operated by the pilot, the wheel mechanically controls the THS. When the manual trim wheel is used to override an electrical trim order, both PITCH TRIM levers drop.

R

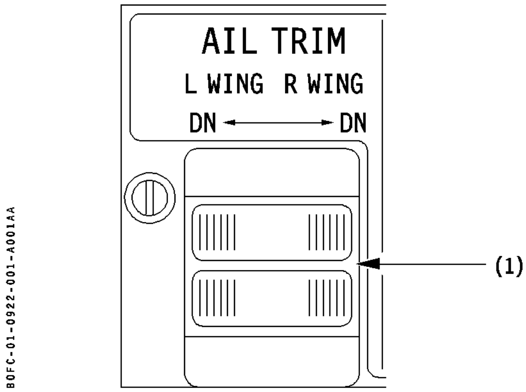
Mod : 4803



ELECTRICAL PITCH TRIM SWITCH (ROCKING LEVER)

- Pushing the electrical pitch trim switch (1) (rocking lever) forward trims the aircraft nose down, while backward movement of the switch trims the aircraft nose up. When the switch is released, it is spring-loaded to neutral.

AILERON TRIM PANEL

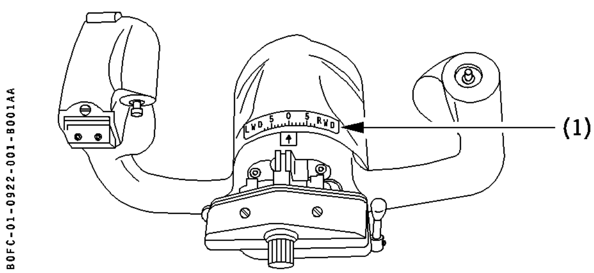


(1) AIL TRIM switches

- Aileron trim control is electrically powered via this split-switch.

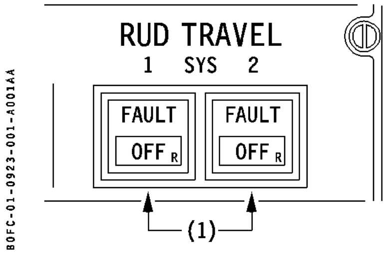
  To operate the aileron trim, both switches must be simultaneously held in the same direction (L WING DN or R WING DN).

AILERON TRIM SCALE



- The amount of aileron trim applied can be read on a scale (1) on top of each control column.
- The scale is marked in 1° increments from 7° LWD (Left Wing Down) to 7° RWD (Right Wing Down).

RUD TRAVEL CONTROL PANEL



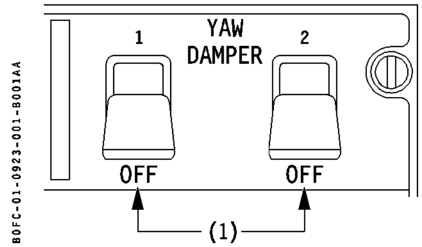
(1) RUDDER TRAVEL pushbutton switches

The pushbutton switches control the two Rudder Travel Limiting systems.

- **Normal** (pushbutton switch pressed-in):
  – The associated system is engaged.
- **FAULT** (amber):
  – Illuminates if a failure is detected with the pushbutton switch in normal position.
  – ECAM warning is activated.
- **OFF/R** (white: pushbutton switch released-out):
  – The associated system is disengaged. The monitoring circuits are reset.

> If both RUD TRAVEL systems have been selected OFF, but both FAULT lights illuminate again when flaps reach 20° or more, the RUD TRAVEL system is in the high speed configuration.
>
> The maximum cross-wind capability is reduced, a reduced maximum cross-wind limitation for landing is applicable (as directed by the ECAM procedure).

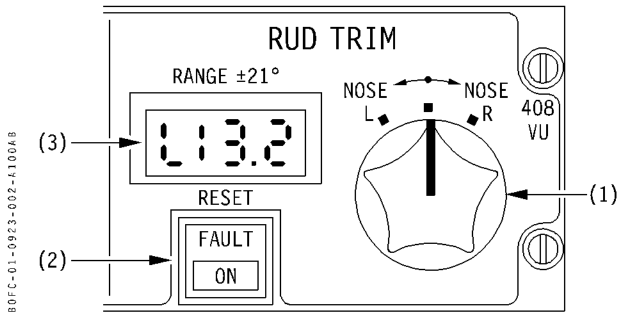
YAW DAMPER LEVERS



(1) YAW DAMPER engagement levers

- **Up** : yaw damper 1 (or 2) is engaged and operative.
- **OFF** : yaw damper 1 (or 2) is not engaged.

RUD TRIM PANEL



(1) RUDDER TRIM selector knob

- **NOSE L or NOSE R** :
  – Rudder trim is applied in the same direction as the selector knob.
  – Rudder trim travel range is ± 21° (or as limited by the rudder travel limiting system).

Note : Rudder trim inputs are inhibited when the AP yaw channel is active (i.e. when the AP is engaged in CMD and slats are extended).

- **Neutral** :
  – the selector knob is springloaded to the neutral (center) position.

(2) RESET pushbutton switch

Pressing this pushbutton switch automatically resets the rudder trim to zero.

- **ON** (white: pushbutton switch pressed-in) :
  – Rudder trim is being reset to neutral.
  – The pushbutton switch is latched while the rudder trim is being reset to zero, and is released out automatically when reset is complete.
  – The reset to zero can be stopped by pressing again the pushbutton switch. The pushbutton switch unlatches, and the ON light extinguishes.

- **FAULT** (amber) :
  – Automatic reset function has failed.
  – Manual reset using the selector knob must be performed.

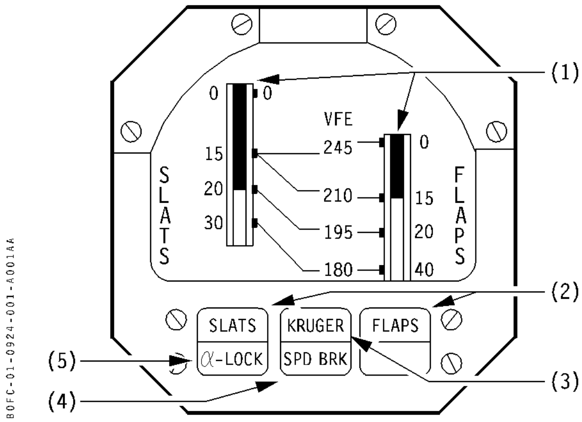
- **Normal** (pushbutton switch released-out) :
  – The reset action has stopped automatically or manually. The ON light extinguishes.

(3) RUD TRIM position indicator

Displays digital indication of the rudder trim direction (L or R) and deflection (0° to 21°).

Mod : 11442

SLATS / FLAPS POSITION INDICATOR



(1) SLATS / FLAPS position indicator strips

Slats and flaps position is shown by white strips moving up and down the SLAT and FLAPS scales.

The corresponding VFE (speed limit) is displayed opposite each selectable position.

Note : In case of loss slats/flaps position indication, slats/flaps position can be checked through the cabin windows identified by a black triangle sticker (▲).

(2) SLATS / FLAPS lights

Illuminate amber when the associated system is locked out. In case of detected slats or flaps asymmetry, system recovery is not possible in flight.

(3) KRUGER light

Illuminates amber if the Kruger flap has not retracted within 10s of selecting slats retraction, or has not extended within 10s after extending slats.

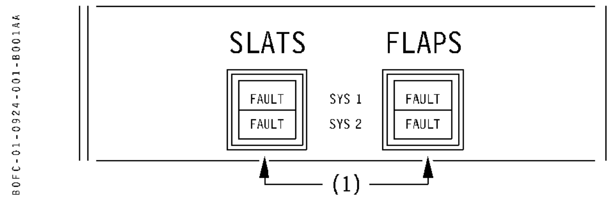
(4) SPD BRK light

The SPD BRK (speedbrake) light illuminates blue anytime the speedbrake lever is out of the retract (RET) position.

(5) α-LOCK light

Flashes blue to indicate that the Alpha-lock protection is active.

SLATS / FLAPS CONTROL PANEL



(1) SLATS (or FLAPS) FAULT lights

- One FAULT light illuminates to indicate a fault on slats or flaps SYS 1 or SYS 2. Then, normal operation is achieved through remaining system. R

- In case of insufficient hydraulic supply conditions (too low flow available) when the slats and/or flaps are extending or retracting, the associated FAULT light(s) on the overhead panel may flash until the selected configuration is reached, and then extinguishes. R

- Both SLATS or both FLAPS FAULT lights, illuminate together if slats (or flaps) movement stops due to a system jamming (torque limiter engagement).

  Note : The SFPI SLATS or FLAPS light does not illuminate in this case.

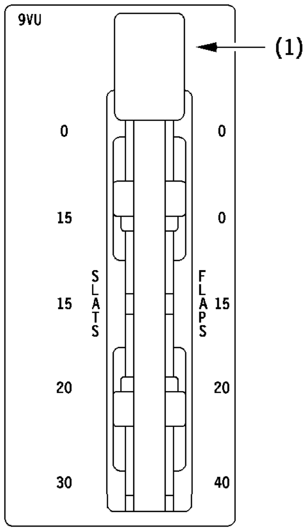
  If the jamming is cleared, the slats or flaps will move to the position commanded by the lever.

- Illumination of both SLATS, or both FLAPS FAULT lights, together with the SFPI SLATS or FLAPS light indicates that an asymmetry has been detected in the associated system.

  In this case, the affected slats or flaps system is locked out by the wing tip brakes and cannot be recovered in flight.

- The four SLATS and FLAPS FAULT lights illuminate if the control lever remains between two notches for more than 10s.

SLATS / FLAPS CONTROLS



B0FC-01-0924-002-A100AA

(1) SLATS / FLAPS control lever

- The lever controls the operation of the slats/flaps.
R The Kruger flaps are automatically extended when the slats are extended.

- The 5 gated positions select the following configurations :

Slats/Flaps lever position	Kruger flaps
0/0	Retracted
15/0	Extended
15/15	Extended
20/20	Extended
30/40	Extended

- To move the slats/flaps lever, the lever must be lifted out of its detent.

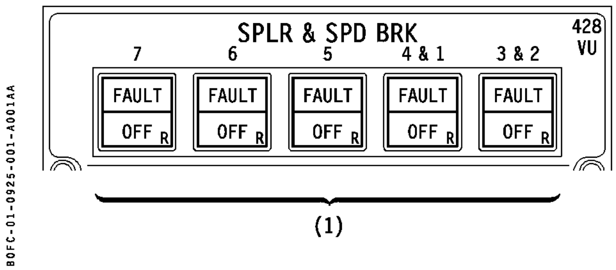
- A blocking bulk is installed at notch 15/0 and 20/20 to prevent moving the lever straight through these positions.

- When selecting the slats/flaps, the lever must be placed in one of the 5 selectable notches. **It is not possible to select intermediate slats or flaps positions.**

  If the lever is placed between 2 notches, the slats/flaps move to the setting corresponding to the previous notch position.

Mod : 5224

SPLR AND SPD BRK CONTROL PANEL



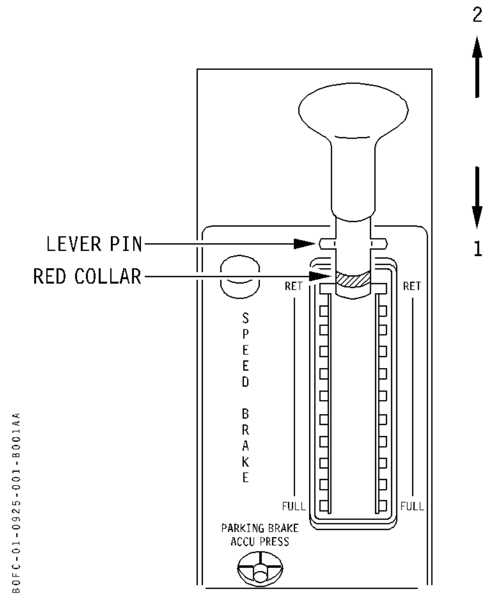
(1) SPLR & SPD BRK pushbutton switches

Each pushbutton switch controls one or two spoilers.

- **On** (pushbutton switch pressed-in):
  - The corresponding spoiler control system is activated.
- **FAULT** (amber):
  - When a spoiler pushbutton switch is On, the FAULT light illuminates if a failure is detected. The associated spoiler(s) is deactivated.

    ECAM warning is activated.
- **OFF/R** (white: pushbutton switch released-out):
  - the corresponding spoiler(s) is deactivated and the monitoring system is reset.
  - if hydraulic pressure is available, the actuators are pressurized in retracted position.

SPEED BRAKE / GROUND SPOILERS LEVER



- When pushed down (1) and manually moved the SPEED BRAKE lever controls speed brake extension to any of the eleven positions from fully retracted (RET) to fully extended (FULL).
- When pulled up from the fully retracted position (2), the lever arms the ground spoilers for automatic deployment.
- The SPEED BRAKE lever does not move in case of automatic extension of the roll spoilers or ground spoilers.
- When the ground spoilers are armed, observing or feeling the lever pin position and/or observing the red collar located on the handle shaft allows to visually identify the lever position.

  Note : *The lever cannot be pulled aft to deploy speed brakes when the ground spoilers are armed.*

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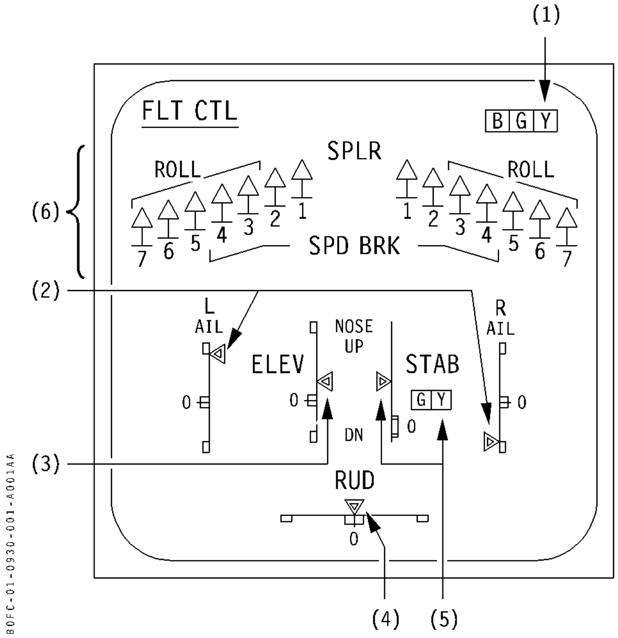
ECAM FLT CTL PAGE



(1) B, G, Y, symbols

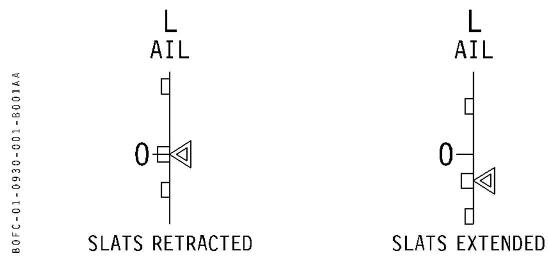
- Each available system on the flight controls and trimmable horizontal stabilizer is indicated by a green symbol.
- In case of servo control low pressure detection, the corresponding symbols become amber.

(2) AIL, (3) ELEV and (4) RUD position indication

- A white scale covering the full travel range is provided for each flight control surface.
- An index indicating the actual position of the surface moves along the scale.
- Boxes, located at each end of the travel range and
R in the neutral position, represent the indication tolerance for the respective positions.

R Full travel or neutral position is shown when the
R index is in the box or on the line of the box.

- The aileron zero position and endboxes are shifted downwards when slats are extended (to indicate the **aileron droop** position).



(5) STAB position indication and hydraulic power

- THS (STAB) position is indicated by white scale R
and index covering the full travel range. R
- The 2 hydraulic systems (G and Y) powering the THS are indicated by green symbols that become amber when low pressure is detected.

(6) ROLL SPLR, SPD BRK and GND SPLR position indication

—	Green	Surface is retracted
—	Amber	Surface is retracted but a failure exists
	Green	Surface is deflected by more than 2°
3	Amber	Surface is extended but a failure is detected by the EFCU
	Pulsing Green	Surfaces is extended, on ground and speed is greater than 70 kt

Note : The spoilers position indication is also provided on the ECAM WHEEL page.

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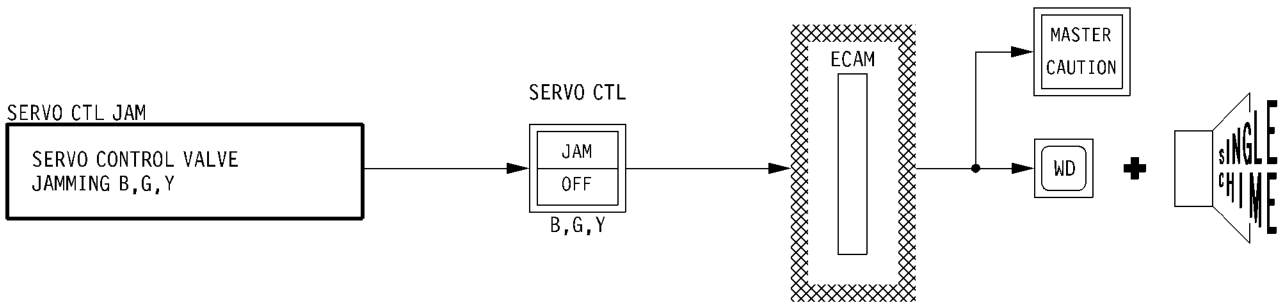
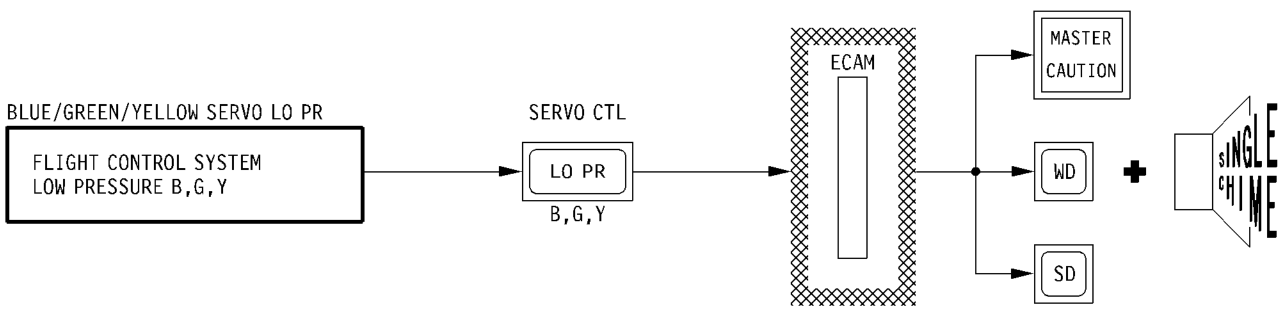
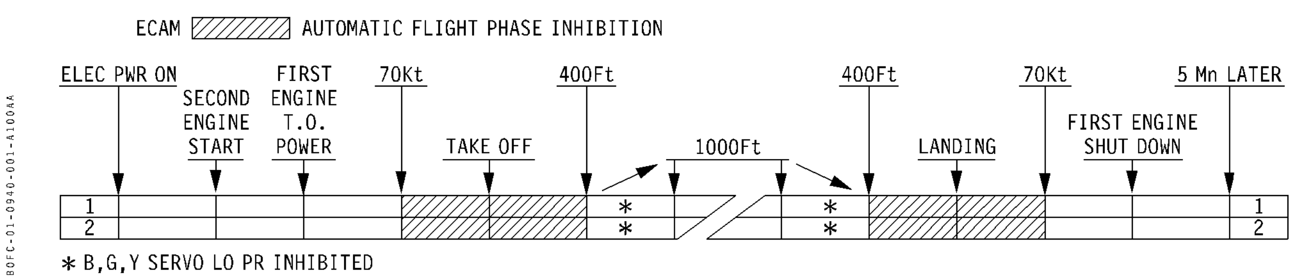
WARNING LOGIC



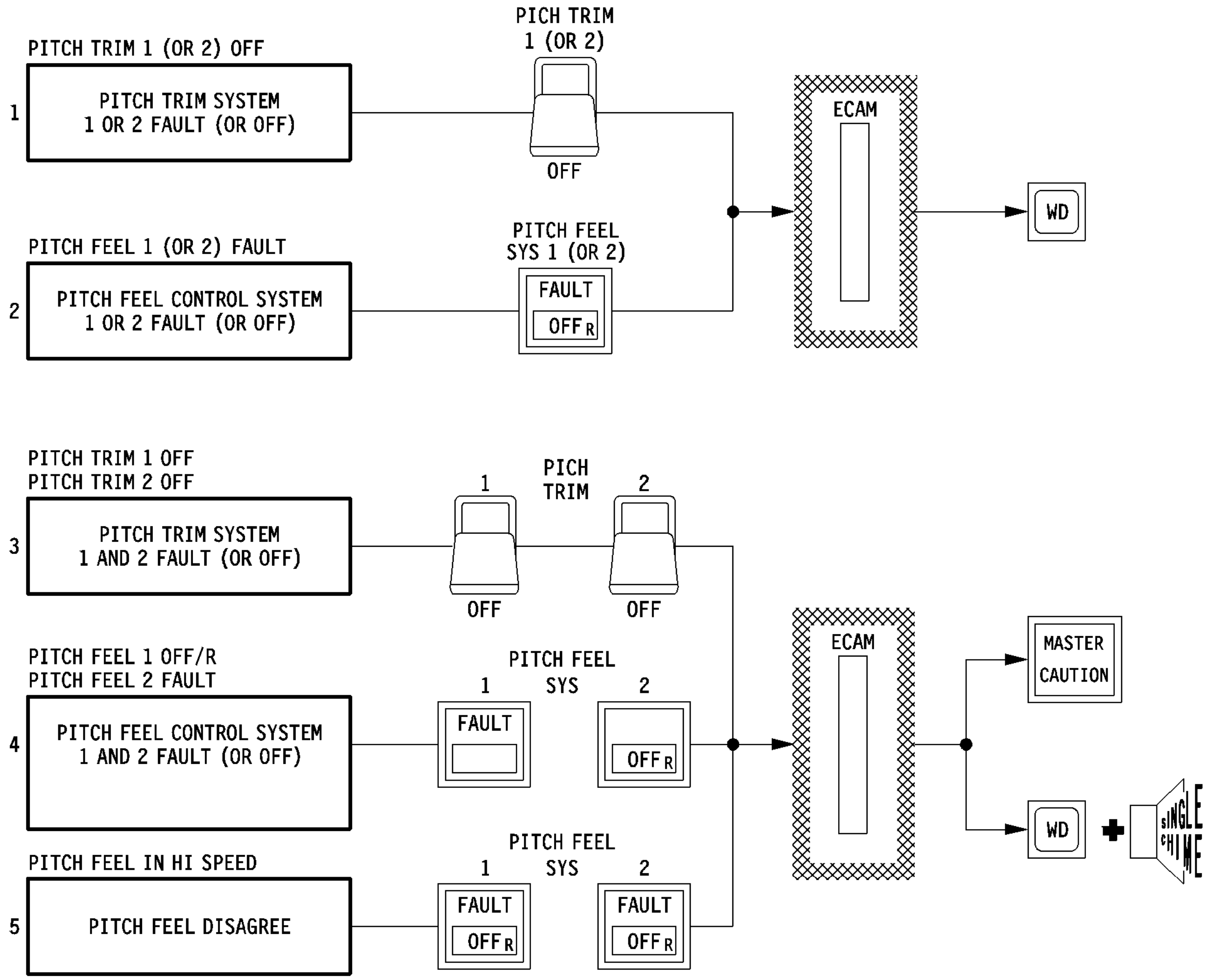
AFTER SELECTING SERVO CTL PUSHBUTTON SWITCH TO OFF

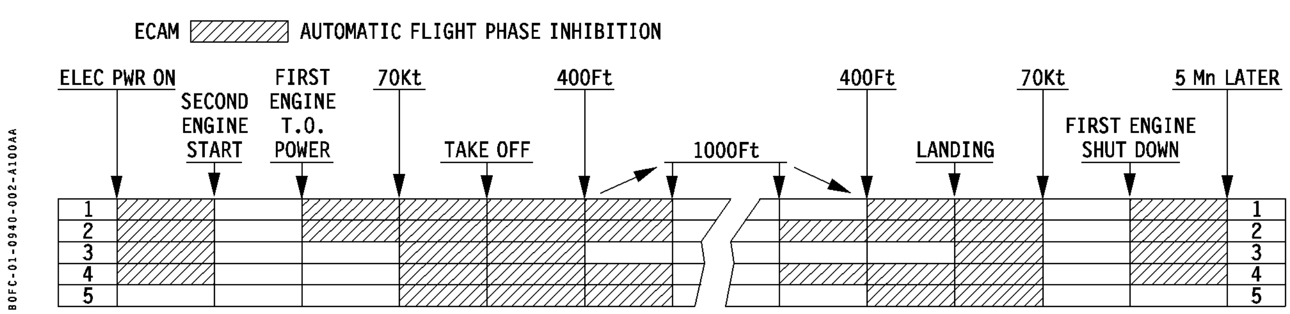




Mod : 5051

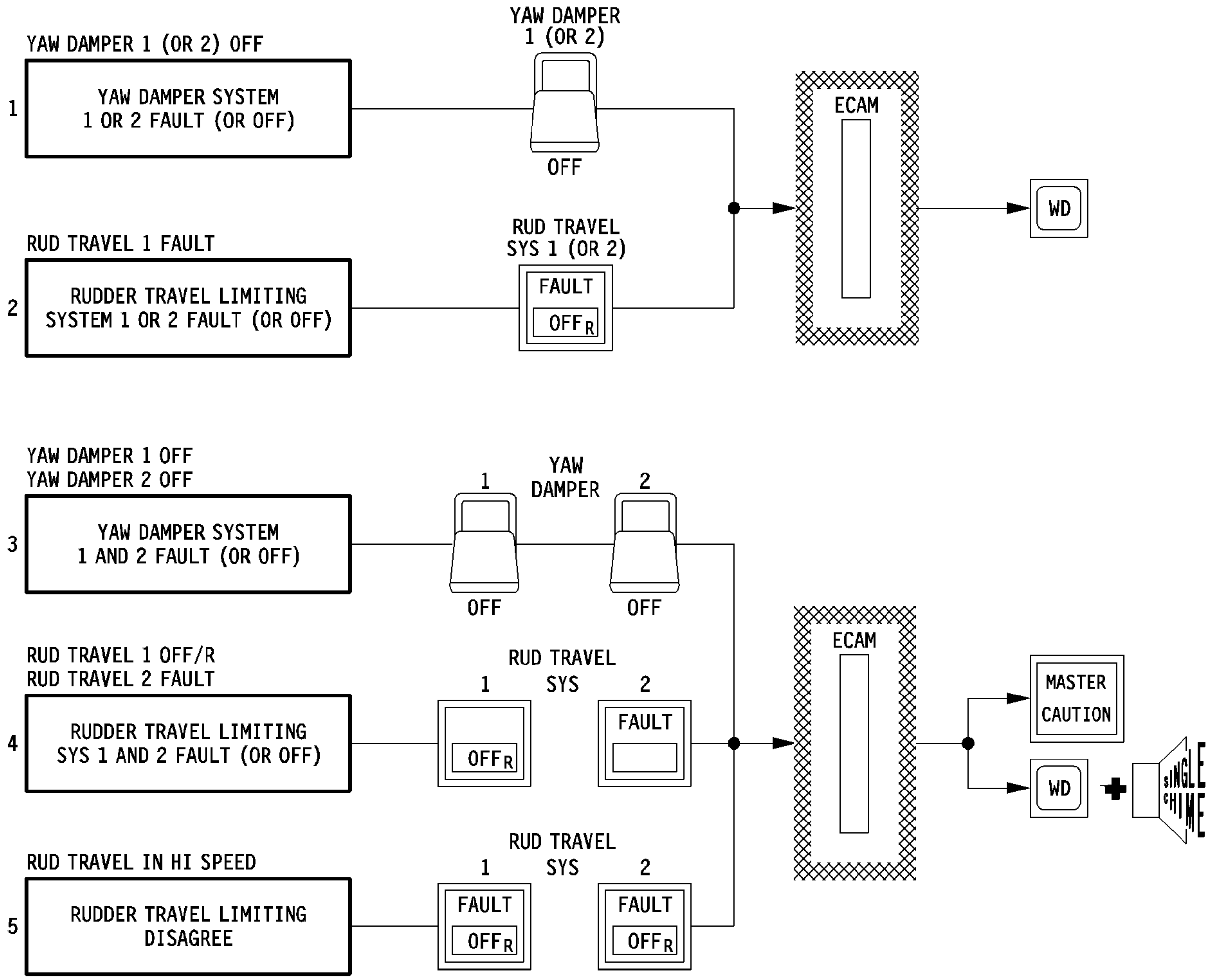
WARNING LOGIC

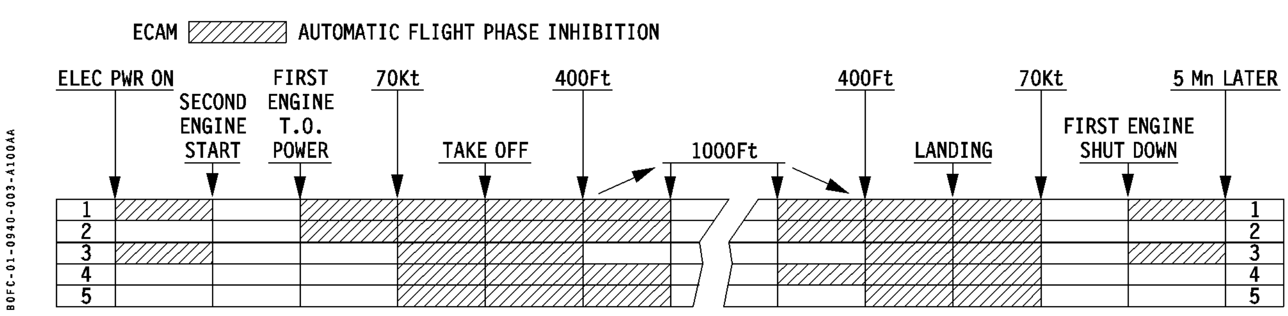




Mod : 5051

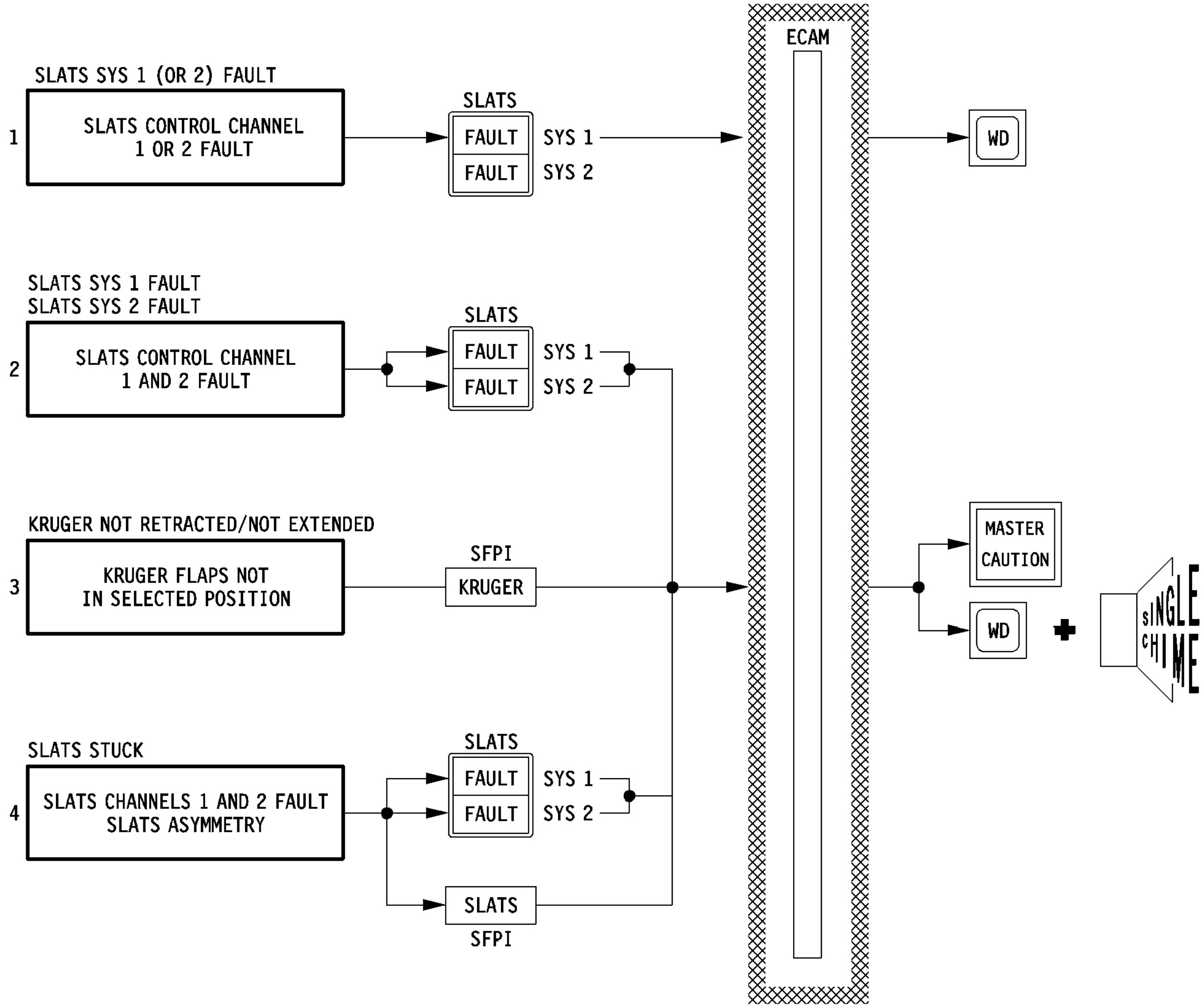
WARNING LOGIC

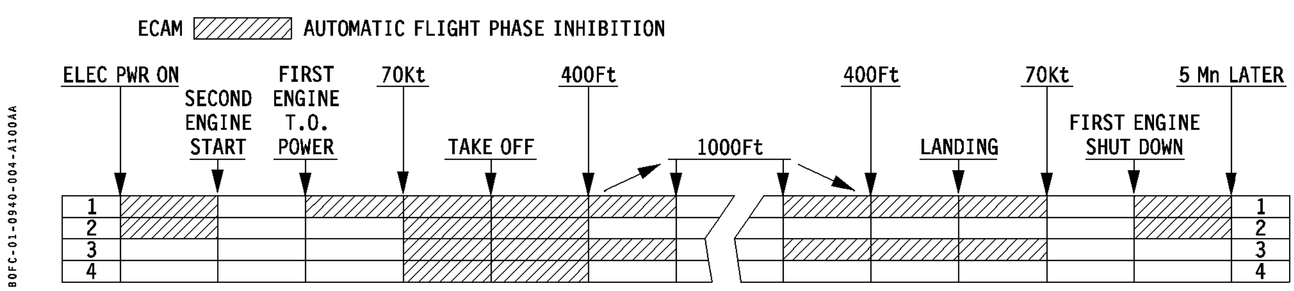




Mod : 5051

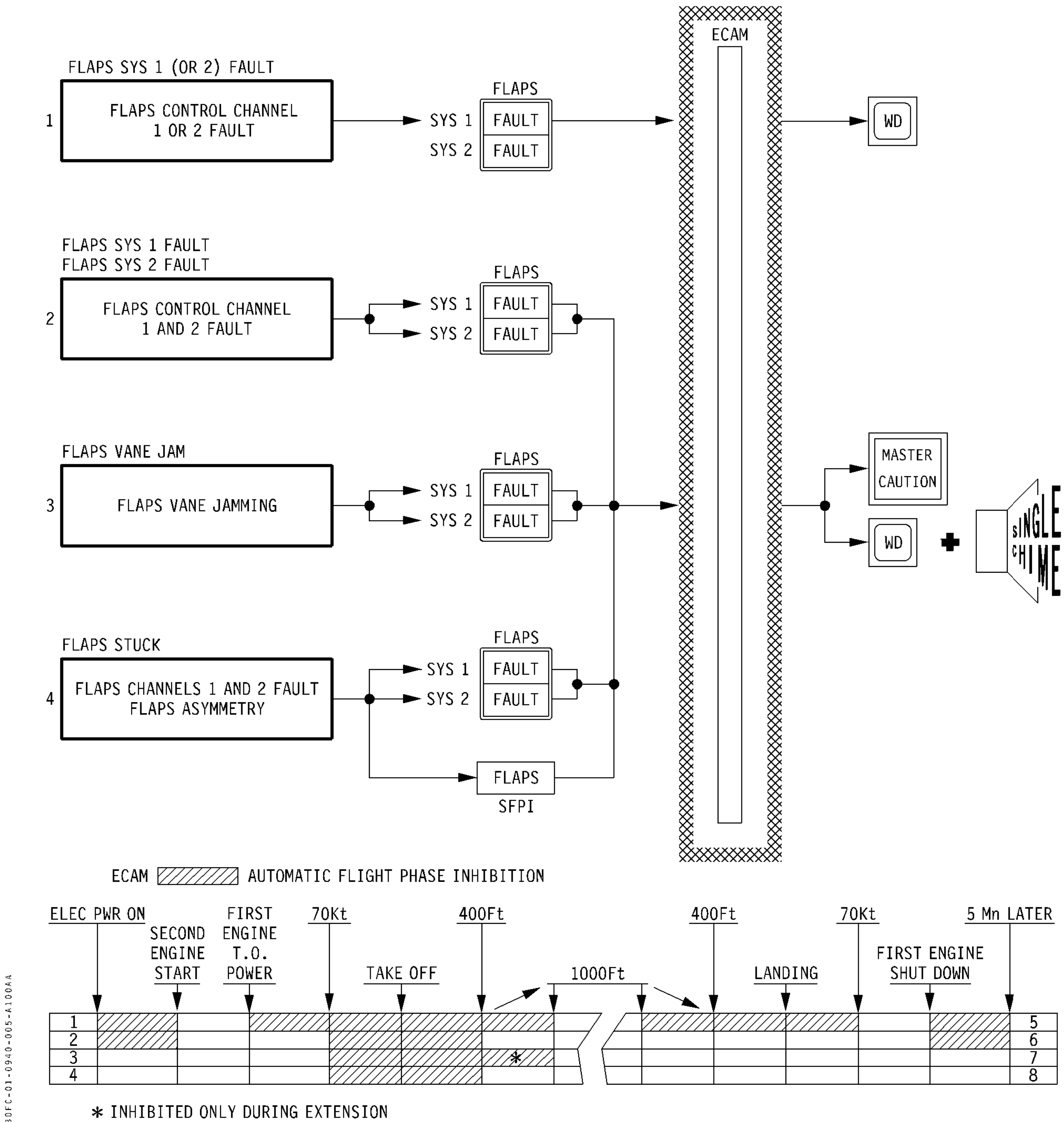
WARNING LOGIC





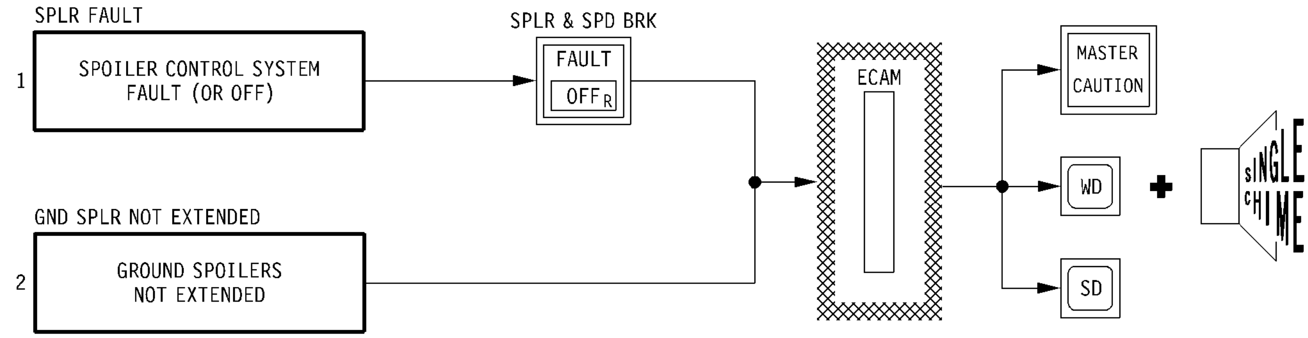
Mod : 5051

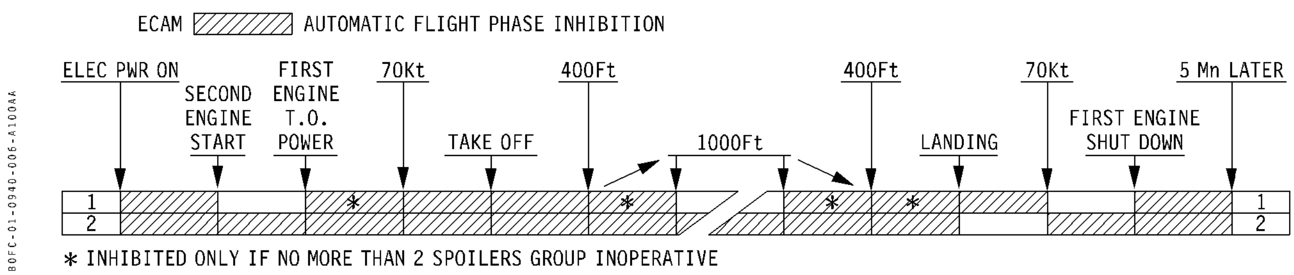
WARNING LOGIC



Mod : 5051

WARNING LOGIC

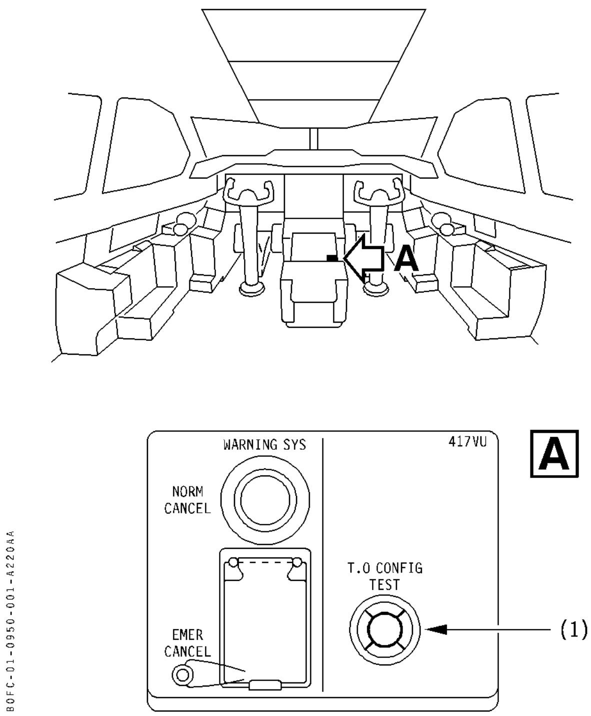




* INHIBITED ONLY IF NO MORE THAN 2 SPOILERS GROUP INOPERATIVE

Mod : 5051

T.O CONFIG TEST



(1) T.O CONFIG TEST pushbutton

- Pressing and holding the T.O CONFIG TEST pushbutton activate the takeoff configuration test.
- The T.O CONFIG TEST is active from the electrical power up until takeoff thrust is reached by at least one engine.
- The test result is indicated as follows :
  - If the aircraft is in a normal configuration for takeoff, the message NORM FOR T.O is displayed on the ECAM MEMO page.
  - If the aircaft is not in a normal configuration for take-off, the warnings described in the section 1.09.51 are activated, as applicable.
- The warnings are cancelled when the T.O CONFIG TEST pushbutton is released.

- The T.O CONFIG TEST monitors the correct configuration of the following flight controls and systems :
  - **horizontal stabilizer (STAB TRIM)** :
    - If the STAB TRIM setting is not in the takeoff range (2.3° DN to 3.5° NU), the MASTER WARNING lights illuminate, accompanied by the Continuous Repetitive Chime (CRC) and ECAM activation.
  - **slats and flaps** :
    - If slats or flaps are not in an approved takeoff configuration, the MASTER WARNING lights illuminate, accompanied by the CRC and ECAM activation.
    - The position of the kruger flaps is not monitored by the T.O CONFIG TEST.
  - **speed brakes and ground spoilers** :
    - If the speedbrakes or ground spoilers are extended, the blue SPD BRK light illuminates on the SFPI, accompanied by the illumination of the MASTER WARNING lights and by the CRC and ECAM activation
  - **doors** :
    - If any door (as monitored by the ECAM DOOR page) is not locked, the associated warning is recalled (i.e. the MASTER CAUTION lights illuminate accompanied by the Single Chime (SC) and ECAM activation).
  - **brakes temperature** :
    - If the temperature of any brake exceed the BRK HOT warning level, the associated warning is recalled (i.e. the MASTER CAUTION lights illuminate accompanied by the Single Chime (SC) and ECAM activation).
  - **probe heating** :
    - If the CAPT (or F/O or STBY) PROBE HEAT pushbutton switch is in the OFF position, the ANTI ICE lights illuminate amber on the WLDP accompanied by the Single Chime (SC) and ECAM activation.
  - **engine oil temperature** :
    - If the engine OIL TEMP is below 50°C, the MASTER CAUTION lights illuminate accompagnied by the Single Chime (SC) and ECAM activation.

TAKE-OFF WARNING

- The take-off warning monitors the correct configuration of the flight controls and systems, when a least one engine has reached take-off power, in order to ensure that flight controls and systems have been correctly selected (as required) following the T.O CONFIG TEST.

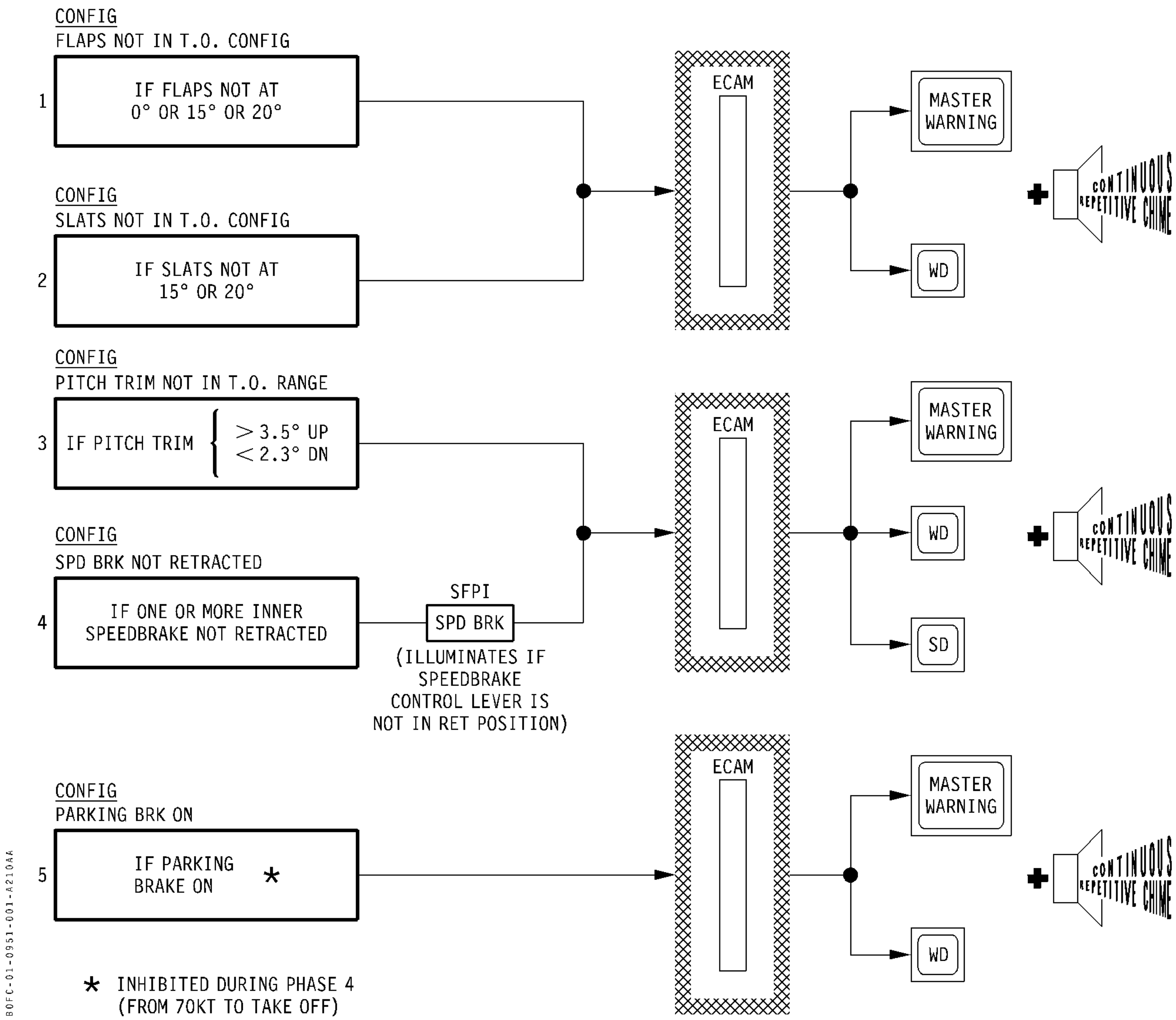
  If a flight control surface or system is not in the correct configuration for take-off, the associated local warning (as applicable) illuminates accompanied by the Continuous Repetitive Chime (CRC) and ECAM activation.

- In addition, the position of the PARKING BRAKE handle is also monitored.

  If the handle is not in the released position, the MASTER WARNING lights illuminate accompanied by the Continuous Repetive Chime (CRC) and ECAM activation.

Mod : 5051

WARNING LOGIC



R *Note : The following warnings are recalled by pressing the T.O. CONFIG TEST :*
R *– PROBES HEAT OFF*
R *– BRK TEMP HI*
R *– DOOR NOT CLOSED*
R *– ENG OIL TEMP LO*

Note : . The conditions 1 thru 4 are monitored by the T.O CONFIG TEST.
. The conditions 1 thru 5 are monitored by the T.O WARNING.

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GROUND PROXIMITY WARNING SYSTEM

MISCELLANEOUS

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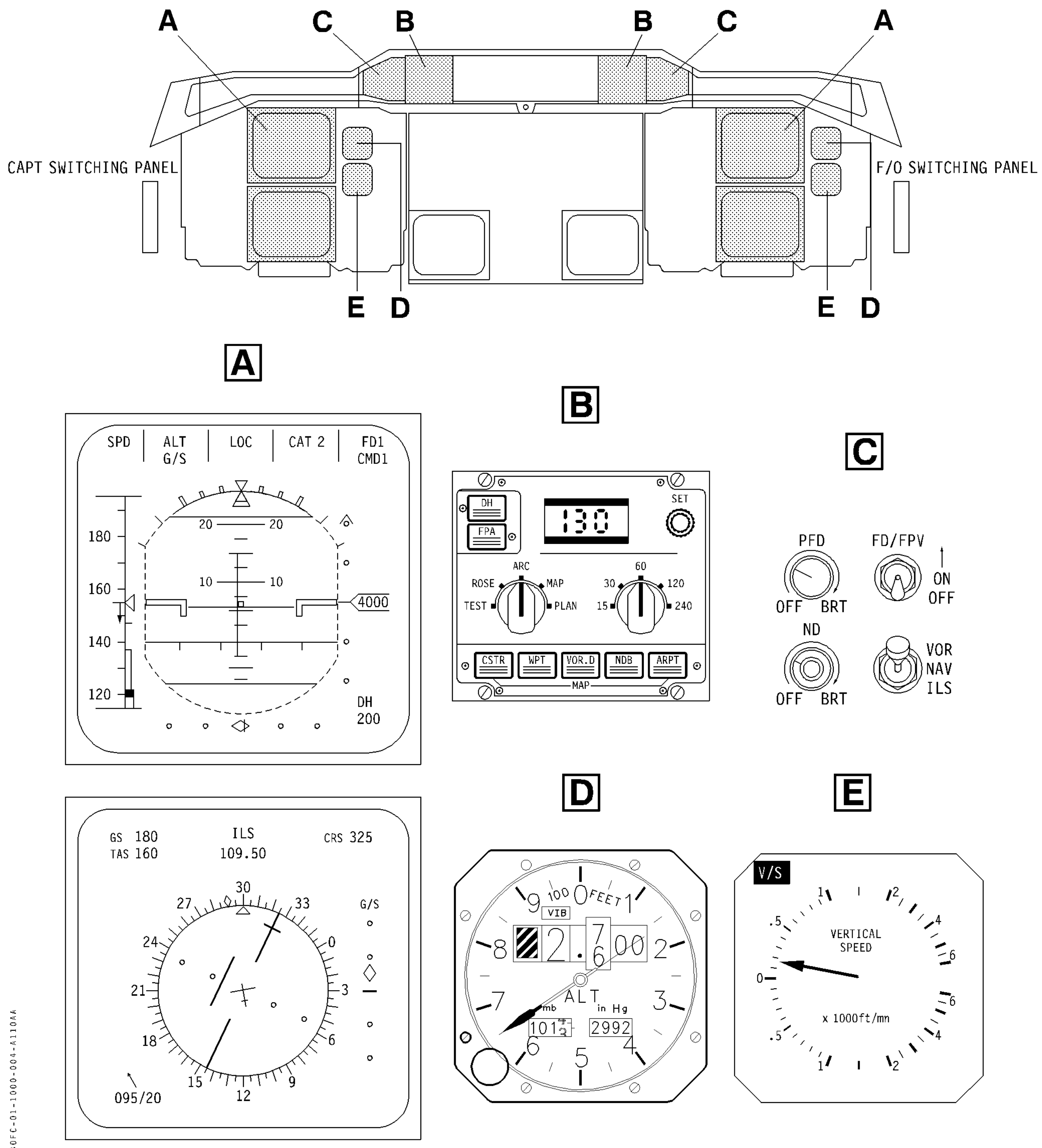


MAIN

SYSTEM CONTROLS

AND DISPLAYS

Mod : 8601 or 10107 or (8601 + 10107)

FLIGHT INSTRUMENTS

- The flight instruments includes the following equipment :
  - Electronic Flight Instruments System (EFIS), which includes :
    - the Primary Flight Display (PFD), and
    - the Navigation Display (ND) (refer to the section 1.15.20 for description and operation of the Navigation Display – ND),
  - Main Altimeters,
  - Vertical Speed Indicators,
  - Standby Airspeed Indicator,
  - Standby Artificial Horizon,
  - Standby Altimeter.

DATA SOURCES

- The flight instruments use two types of data from two different sources :
  - Airspeed, altitude and temperature data provided by three independent Air Data Systems :
    - two main systems (CAPT and F/O), and
    - one standby system.
  - Attitude data and inertial data provided by three independent Inertial Reference Systems (IRS).

Main Air Data Systems

- There are two independent main Air Data Systems. Each system includes one Air Data Computer (ADC).
  - ADC 1 primarily supplies the Captain's (CAPT) instruments,
  - ADC 2 primarily supplies the First Officer's (F/O) instruments.

  Note : *If one ADC fails, the remaining ADC can supply both CAPT and F/O instruments.*

  Switching is accomplished using the ADC INST pushbutton switch on the CAPT and F/O SWITCHING panels.

- Each ADC receives environmental data from :
  - One pitot probe for total air pressure,
  - Two static ports for static air pressure,
  - One temperature probe for Total Air Temperature,
  - One alpha probe for Angle-of-Attack.

  Note 1 : *The probes and ports are located on the lower left and right hand side of the forward fuselage and are electrically anti-iced.*

  Note 2 : *PROBE HEAT controls are located on the overhead panel (refer to chapter 1.13 – ICE AND RAIN PROTECTION).*

- The following ADC data are displayed on the Captain's and First Officer's flight instruments :
  - Airspeed on the Primary Flight Display (PFD) speed scales,
  - Altitude on the Main Altimeters and on the PFD Vertical Deviation scales,
  - Vertical Speed on both Vertical Speed Indicators,
  - True Air Speed (TAS) on both Navigation Displays (ND).

- Static Air Temperature (SAT) and Total Air Temperature (TAT) are displayed as follows :
  - SAT on the ECAM CRUISE page,
  - TAT on the ECAM MEMO page and on the Thrust Rating Panel (TRP).

Note 1 : *SAT and TAT are supplied by ADC 1. If ADC 1 fails, SAT and TAT are automatically supplied by ADC 2.*

Note 2 : *The TRP displays the TAT supplied by the Thrust Control Computer (TCC).*

Standby Air Data System

- If both ADC fail, the standby Air Data System provides attitude, airspeed and altitude information on the following instruments :
  - One standby artificial horizon,
  - One (or two, if installed) standby altimeters,
  - Two standby airspeed indicators.

- Standby Air Data System information is not processed by a computer.
  - The standby airspeed indicators and altimeter(s) are strictly pitot-static instruments requiring no electrical power for their primary operation.
  - The standby horizon is supplied by DC ESS BUS.

- The standby system receives data from :
  - One dedicated pitot probe,
  - Two dedicated static ports.

- Additionally, an electrically heated standby alpha probe, located on the right hand side of the fuselage, provides Angle-of-Attack data for the Flight Augmentation Computers (FAC 1 and FAC 2).

Inertial Reference Systems (IRS)

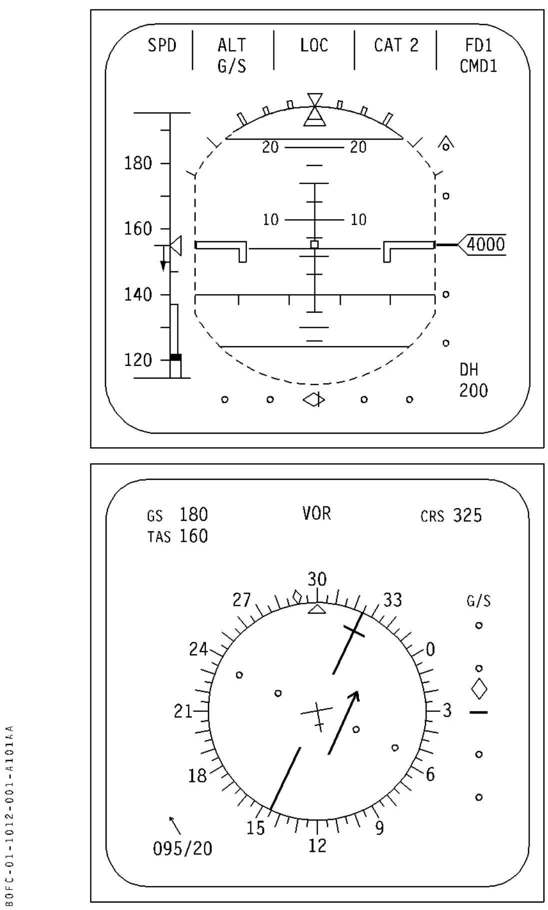
- The Inertial Reference Systems (IRS) primarily provide :
  - Attitude data to the PFD,
  - Heading data to the ND (refer to the chapter 1.15 – NAVIGATION).
- There are three independent Inertial Reference Systems (refer to the sections 1.15.10 thru 1.15.13 for description and operation of the Inertial Reference System) :
  - IRS 1 primarily supplies the Captain's (CAPT) instruments,
  - IRS 2 primarily supplies the First Officer's (F/O) instruments,
  - IRS 3 is in standby.

Note 1 : If either IRS 1 or IRS 2 fails, the attitude and heading data supply can be switched to the IRS 3.

Switching is accomplished using the ATT HDG pushbutton switch on the CAPT and F/O SWITCHING panel.

ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS)

- The Electronic Flight Instrument System (EFIS) provides the flight crew with most of the data needed for flight path and navigation control.
- The EFIS data are displayed on four Cathode Ray Tubes (CRT) :
  - Two Primary Flight Displays (PFD),
  - Two Navigation Displays (ND).
- PFD and ND are displayed as follows :
  - upper CRT : PFD,
  - lower CRT : ND.

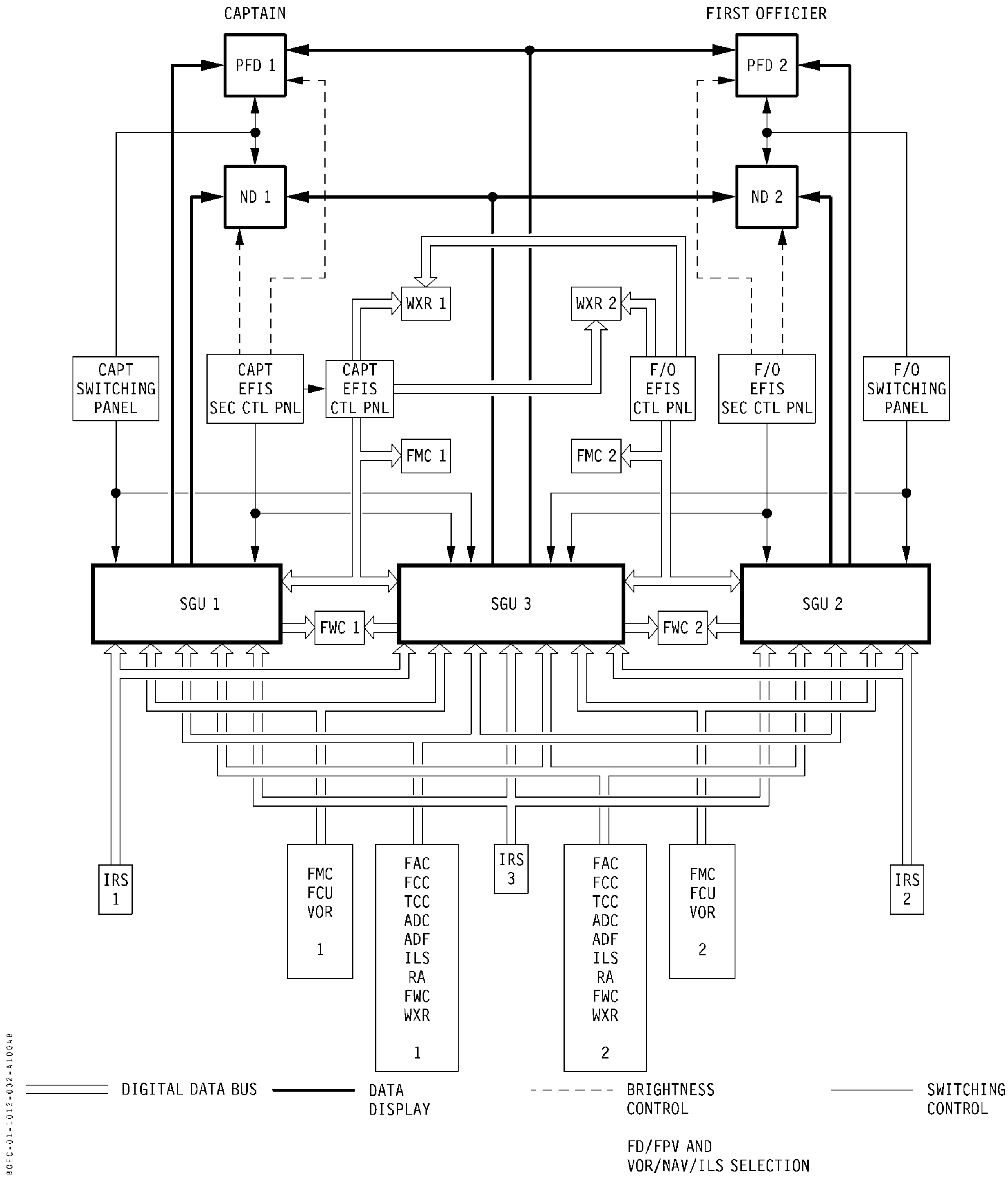


- PFD and ND are controlled by :
  - One EFIS control panel and one secondary control panel located on the glareshield,
  - A SWITCHING panel located beside the main instrument panel.
- Information displayed on the PFD and ND is generated by three Symbol Generator Units (SGU):
  - SGU 1 normally supplies the CAPT's PFD and ND,
  - SGU 2 normally supplies the F/O's PFD and ND,
  - SGU 3 is in standby.

  Note : *If either SGU 1 or SGU 2 fails, it can be replaced by SGU 3 (see EFIS SGU SWITCHING).*
- In case of SGU failure, the associated displays become black with a diagonal white line. R
- In case of CRT failure, the associated display become totally blank.
- A PFD/ND XFR pushbutton switch enables switching over the PFD and ND displays between the upper and lower CRT.

Mod : 12291 or (5846 + 11123 + 12291)

R



Mod : MPS 5063 or 6523

DATA SOURCES AND INPUTS TO EFIS SGU's

- The following table recalls the data sources and inputs received by the EFIS SGU's for display on the PFD and ND.

SOURCE	PFD	ND
IRS	– Pitch– Roll– Magnetic heading – Side-slip – Flight path vector (drift angle and slope)	– Magnetic heading – Magnetic track – Ground speed
ADC	– Baro altitude – Mach – Computed airspeed	– TAS
FCC	– AP modes – Landing capability – FD bard	
TCC	– ATS modes	
FAC	– V_{SS} – V_{LS} – F – S – Green dot speed – V_{max} – Speed trend	
FCU	– Selected speed – Selected altitude – Selected heading	– Selected heading
VOR	– Selected course (for flight path reference)	– Selected course – VOR deviation – TO/FROM indication
ILS	– G/S and LOC deviations – Runway heading (for flight path reference)	– G/S and LOC deviations – Runway heading
RA	– Radio height – H < DH warning	
ADF		– ADF 1 and 2
FWC	– CHECK ATT warning	– CHECK HDG warning
EFIS CTL PNL	– Flight path reference slope (FPA) – DH	– WR range
WR		– WR image
FMC	– DME ILS – V_1 – FMS target speed	– Flight plan – Wind

Mod : 5735

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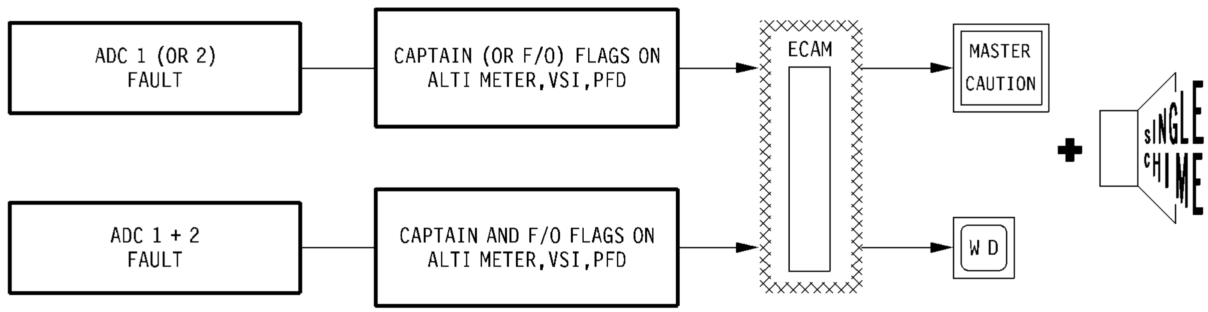
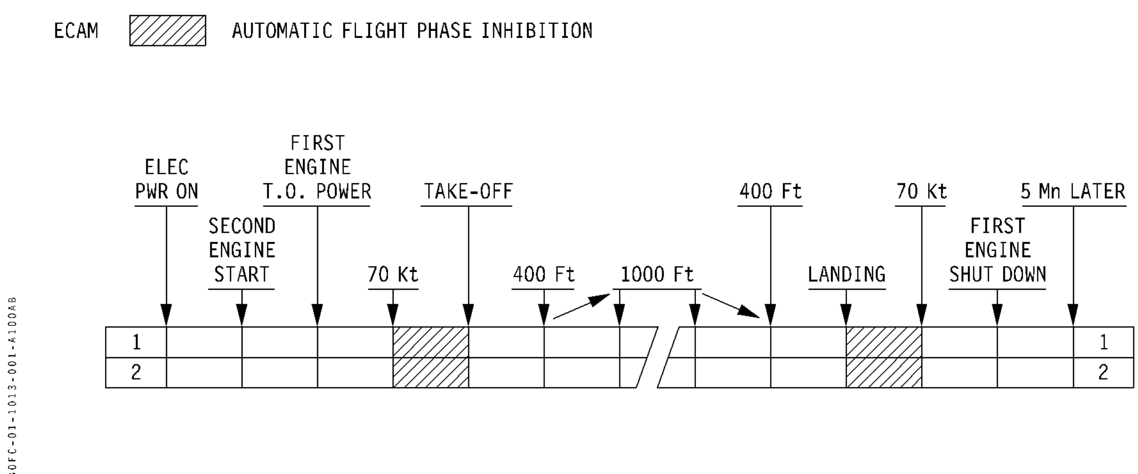
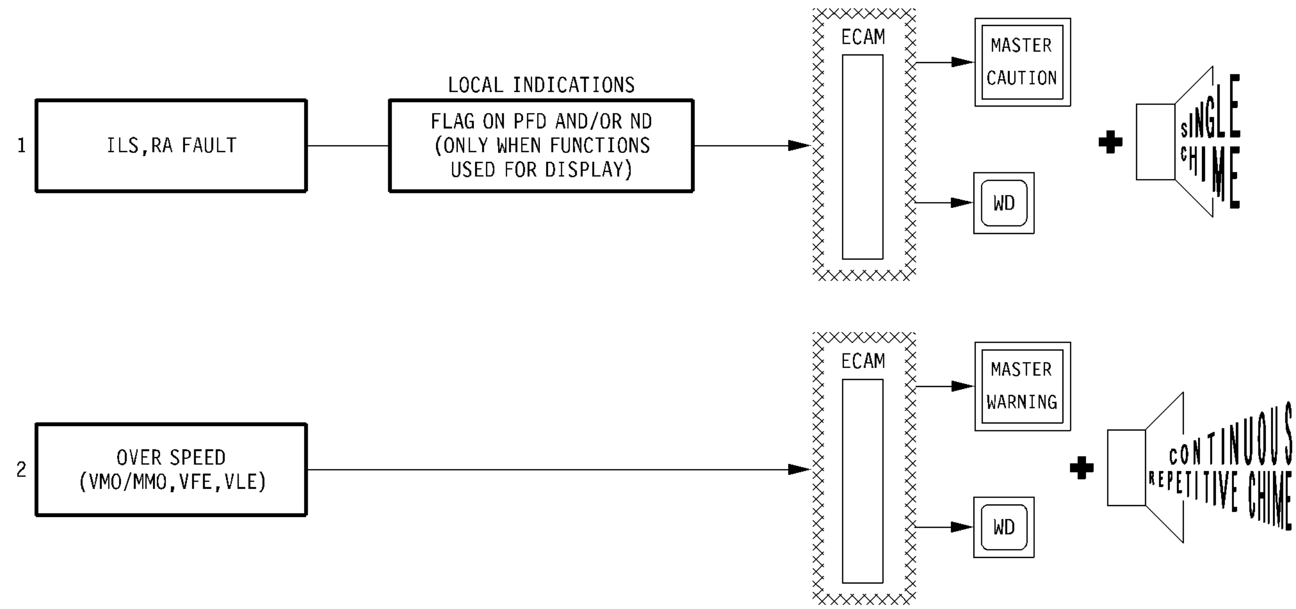
FAULT | **LOCAL WARNINGS** | **ECAM RESPONSE**

R 1
R 2

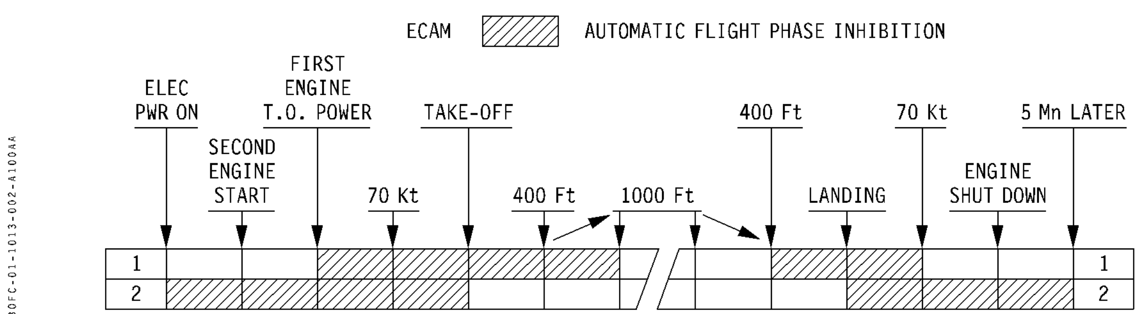




Mod : 5051

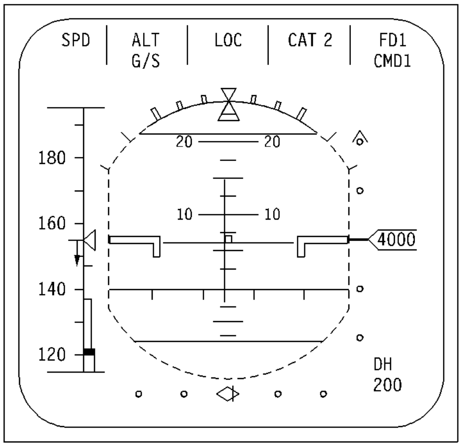


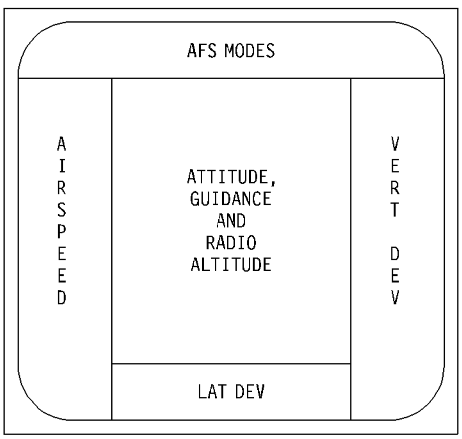
NOTE: MAINTENANCE ACTIONS ARE ONLY REQUIRED WHEN COMPLETE OVER SPEED WARNING HAS BEEN TRIGGERED (ECAM DISPLAY+ AURAL WARNING)



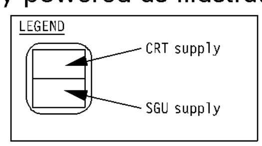
Mod : 5051

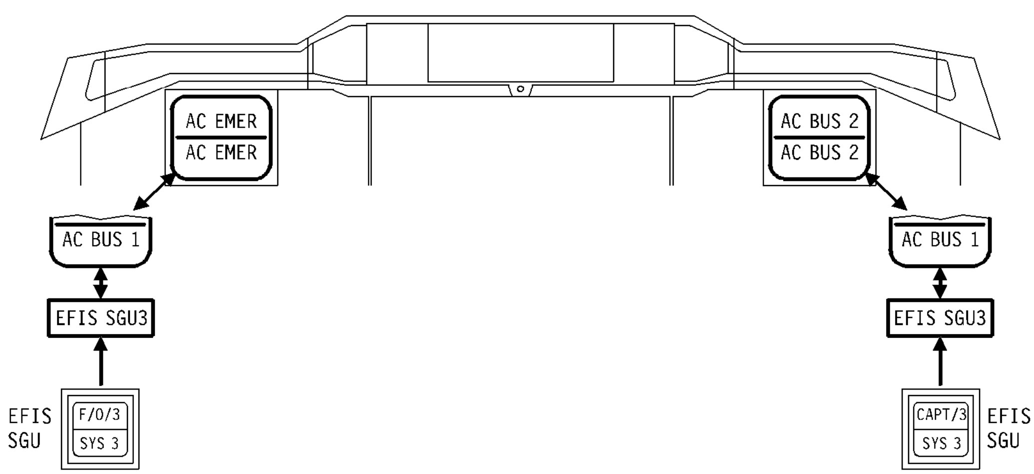
PRIMARY FLIGHT DISPLAY (PFD)





- The Primary Flight Display (PFD) provides the following information in five separate areas :
  - Auto Flight System (AFS) modes on the Flight Mode Annunciator (FMA),
  - Airspeed (selected speed, IAS, speed trend arrow, green dot speed or S speed or F speed, VLS, VSS).
  - Attitude (pitch, roll and heading scales), guidance (Flight Director) and Radio Altitude,
  - Vertical deviation from selected altitude or glide slope,
  - Lateral deviation from a localizer beam, if selected.
- If a failure affects information which is displayed on the PFD, the affected information is blanked.
  - In most cases a red failure message replaces the affected information.
  - The red failure message first flashes for a few seconds in order to attract the crew's attention.
  - The red failure message then remains steady as long as the fault exists, or until a backup source is selected to replace the affected system.
  - Some failure modes are associated with ECAM warning activation.
- The CAPT and F/O PFD CRT's and SGU's are electrically powered as illustrated hereafter :





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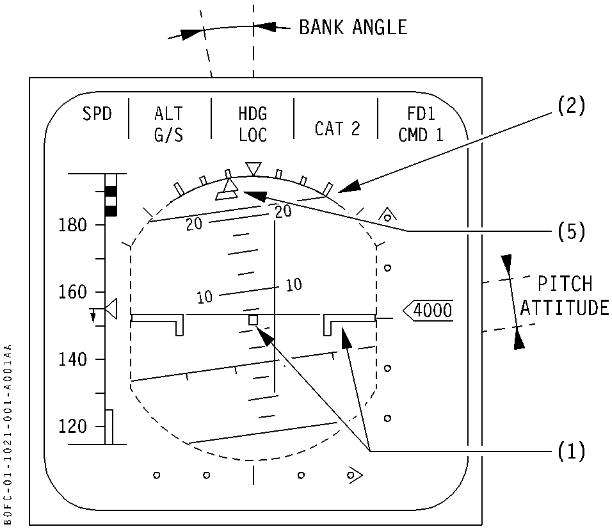
ATTITUDE DATA DISPLAY



- The aircraft attitude is indicated in the center area of the PFD in a conventional Attitude Director Indicator (ADI) presentation.
  - The distance between the aircraft symbol and the horizon indicates the aircraft pitch attitude.
  - The angle between the aircraft symbol and the horizon indicates the aircraft bank angle.
  - The sky is colored blue, and the earth is brown.

(1) Fixed Aircraft Symbol

- Black, outlined in yellow.

(2) Bank Angle Scale

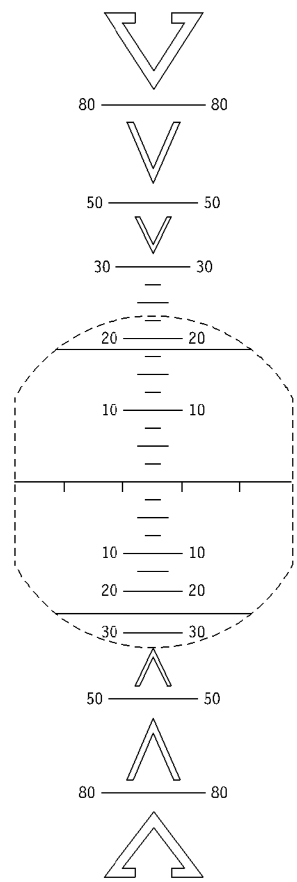
- White scale graduated at 0, 10, 20, 30, 45 and 60° of bank angle.
- The 0 position is marked by a yellow triangle (sky pointer).

(3) Roll Pointer

- A yellow pointer rolls with the aircraft and points at the bank angle on the bank angle scale.

(4) Pitch Scale

- The pitch scale is white, and is graduated in :
  - 2.5° increments between 0° and 30° nose up and between 0° and 10° nose down,
  - 5° increments between 10° and 20° nose down,
  - 10° increments between 20° and 30° nose down.
- In case of excessive nose up or nose down pitch attitude, red V's indicate the direction to the nearest horizon.
- On ground, the nose down scale is not displayed.



(5) Turn Coordination Indicator (side-slip index)

- Below the roll pointer a yellow trapezoid-shaped box indicates the aircraft side-slip.
- The trapezoid replace the conventional side-slip ball :
  - When the trapezoid is centered under the roll pointer, the aircraft is in coordinated flight (no side-slip).
  - If the box is located to one side of the roll pointer, more rudder input is required on that side to cancel the side-slip.

UNUSUAL ATTITUDES

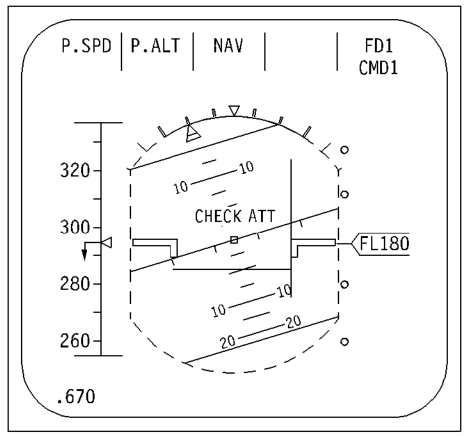
- In order to attract the flight crew attention in case of excessive pitch attitude or bank angle, the PFD display is decluterred in order to display only the information necessary for the recovery of a usual pitch and/or roll attitude.
- **Excessive bank angle** :
  - If the bank angle exceeds 45°, the following information only remain displayed :
    - pitch and roll attitudes,
    - speed,
    - heading,
    - FPV (if selected),

    all other information are cleared from display.
  - The PFD display returns to normal when the bank angle decreases below 40°.
- **Excessive pitch attitudes** :
  - If the pitch attitude exceeds 25° nose up or 13° nose down, the following information only remain displayed :
    - pitch and roll attitudes,
    - speed,
    - heading,
    - FPV (if selected),

    all other information are cleared from display.
  - The PFD display returns to normal when the pitch attitude decreases below 22° nose up or increases above 10° nose down.
- In case of excessive pitch or roll rate, a red ”CHECK ATT” message is displayed on the PFD. R

DISPLAY IN FAILURE CASES

- If IRS pitch or roll data is lost, the entire attitude sphere is erased and is replaced by a red ”ATT” message (refer to section 1.10.71 – IRS SWITCHING).
- If there is a difference of more than 4° in pitch or roll between the two PFD a red ”CHECK ATT” message is displayed on both PFD.



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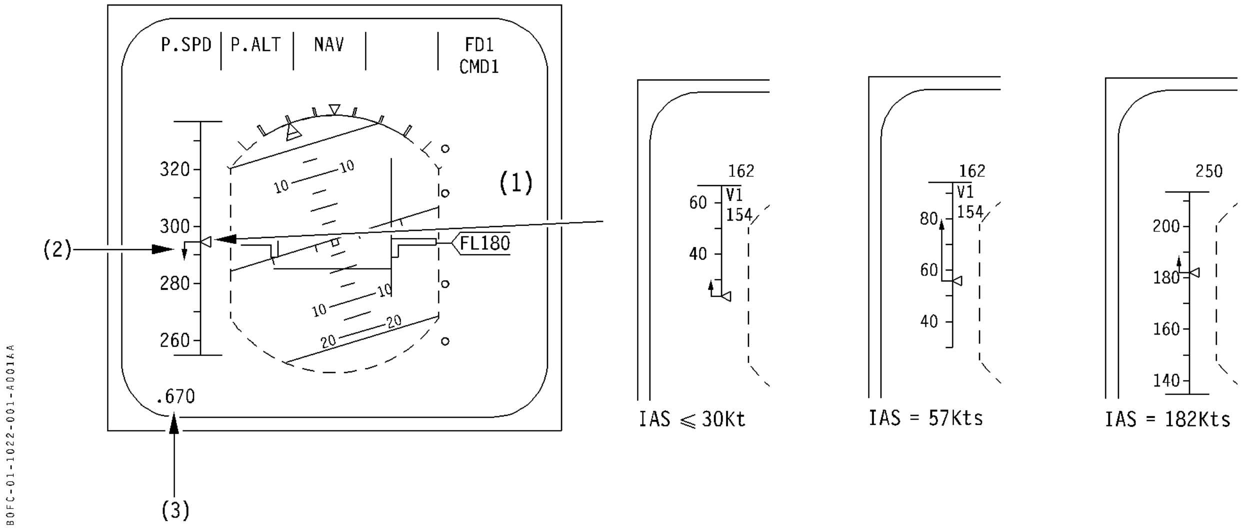
Mod : 12291

AIRSPEED SCALE



(1) Airspeed Scale and Symbol

- The speed scale is displayed on the left side of the PFD.
- The speed scale has graduated marks every 10 kt and numbers for every 20 kt.
- The maximum visible range of the scale is 80 kt.
- Airspeed computed by the Air Data Computer is
R indicated on the speed scale by a yellow triangular pointer.

(2) Speed Trend

- The speed trend, which is displayed as a yellow arrow starting from the speed symbol, is representative of the aircraft present acceleration.
- The end of the arrow indicates the speed which will be reached within 10 seconds if the present rate of acceleration or deceleration is maintained.

Note : The arrow is displayed if greater than 2 kt/10 seconds and is cleared if lower than 1 kt/10 seconds.

- The speed trend data is supplied by the Flight Augmentation Computer (FAC).
- In case of FAC failure, the speed trend arrow is cleared from display.

(3) Mach Number

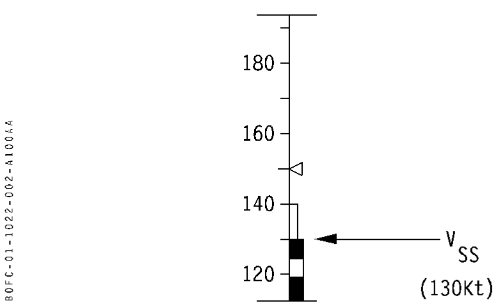
- Mach number is displayed when MN value is greater than 0.5, and is cleared from display when MN value decreases below 0.45.
- If Mach number data is lost, a red MACH flag is displayed.

LIMIT SPEEDS AND MANEUVERING SPEEDS

- Five seconds after lift-off, each Flight Augmentation Computer (FAC) provides the following speeds on the PFD speed scale :
  - Limit speeds :
    - VSS : Stick Shaker speed,
    - VLS : Lowest Selectable speed,
    - VMAX : Maximum selectable speed.
  - Maneuvering speeds :
    - F : Minimum Flaps retraction speed, or maneuvering speed with flaps 20.
    - S : Minimum Slats retraction speed, or maneuvering speed with slats 15.
    - O : Green Dot - Single engine operating speed, or clean maneuvering speed.

LIMIT SPEEDS

- **VSS – Stick Shaker Speed** :
  - The Stick Shaker speed VSS is displayed as a red and black strip at the bottom of the speed scale.

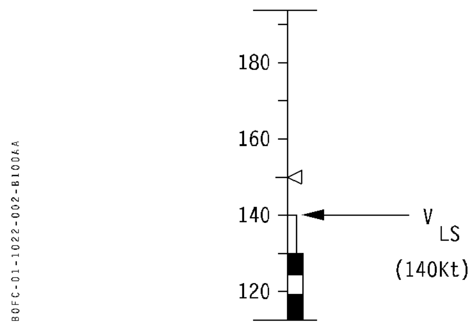


  - The stick shaker speed VSS is the IAS at which the Stick Shaker will be activated for the prevailing gross weight and configuration.
  - The VSS value varies with the g-load factor.
  - The Stick Shaker activation is solely based on the aircraft angle of attack :
R • approximately 10° in clean configuration,
R • approximately 17.5° in other configurations.

Note 1 : The actual stick shaker warning is triggered by the Flight Warning Computer (FWC) and is independent from the VSS value computed by the FAC.

Note 2 : A difference may exist between the VSS indication and the actual IAS at which the stick shaker is activated.

- **VLS – Lowest Selectable Speed** :



  - The Lowest Selectable speed VLS is displayed as an amber strip above VSS on the speed scale.
  - VLS is the lower limit of the flight envelope.
  - For take-off : VLS = 1.2 × Vs.
  - After take-off, as soon as flaps or slats configuration is changed : VLS = 1.3 × Vs.
  - Above 25,000 ft, VLS provides a 0.3 g margin above Mach buffet.
  - During configuration changes, VLS progressively changes to reflect the actual configuration.

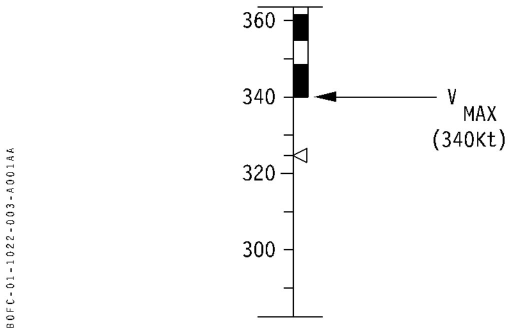
    Note : In order to offer a speed margin relative to VFE, VLS is limited to VFE – 20 kt, based on the VFE corresponding to the slats/flaps lever position.

    Note : At speedbrakes extension, VLS becomes equal to :
    . Green dot – 1 kt in clean configuration,
    . S – 1 kt in 15/0 configuration,
    . F – 1 kt in 15/15 and 20/20 configuration.

    In case of abnormal configuration, configuration increments may be required to correct the VLS.
  - In the final landing configuration, VLS = VREF.
  - At touchdown VLS returns to the take-off value (1.2×Vs).

LIMIT SPEEDS (continued)

- **VMAX – Maximum Selectable Speed :**



– The Maximum selectable speed is displayed as a red and black strip at top of speed scale.

– VMAX represents the following :

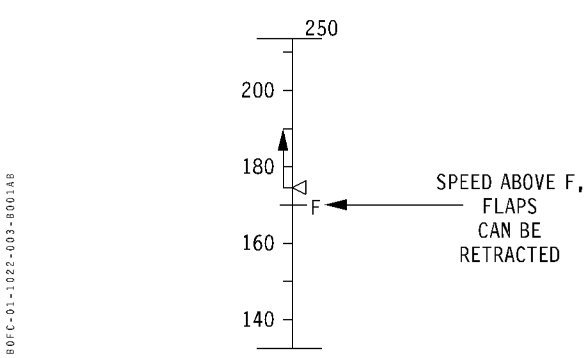
  - MMO or VMO (Maximum Operating speeds) in clean configuration.
  - VFE (Maximum speed Flaps/slats Extended) when slats or flaps are extended.
  - VLE (Maximum speed Landing gear Extended), when landing gear is extended.

R *Note 1 : The VFE displayed on the PFD depends*
R *on the S/F lever position.*

R *Note 2 : The VMAX exceedance warning triggered*
R *by the FWC is based on the actual*
R *aircraft configuration and is independent*
R *of the VFE value displayed on the*
R *PFD.*

MANEUVERING SPEEDS

- **F – Minimum Flaps Retraction Speed :**



– The minimum Flaps retraction speed F is displayed as a green "-F" on the speed scale.

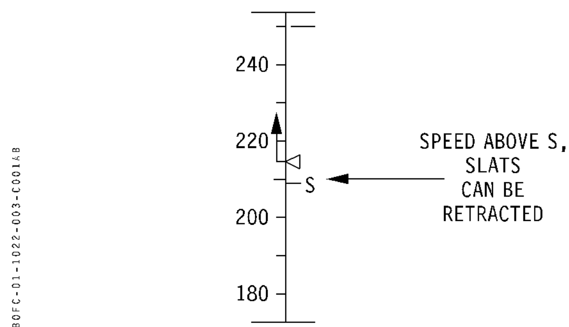
– F is displayed when the SLAT/FLAP lever is in the 15/15 or 20/20 positions.

– The flaps must only be retracted when the speed is above F-speed.

– F = 1.25 × stall speed of the slats 15 / flaps 0 configuration.

– F is also the approach maneuvering speed in Flaps 20 configuration (i.e. F = 1.4 to 1.5 × stall speed in 20/20 configuration).

- **S – Minimum Slats Retraction Speed :**



R

– The minimum Slats retraction speed is displayed as a green "-S" on the speed scale.

– S is displayed when the SLAT/FLAP lever is in the 15/0 position.

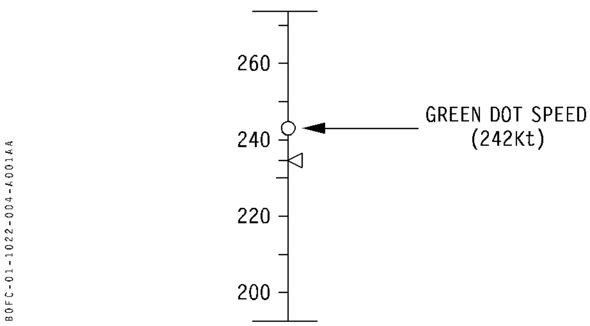
– The slats must only be retracted when the speed is above S-speed.

– S = 1.25 × Stall speed of the clean configuration.

– S is also the maneuvering speed in Slats 15 configuration (i.e. S = 1.4 to 1.5 × stall speed in 15/0 configuration).

MANEUVERING SPEEDS (continued)

- **O – Green Dot - Single Engine Operating Speed**



– The Single Engine Operating Speed "Green Dot" is displayed as a green dot "o" on the speed scale.

– Green Dot speed is only displayed in clean configuration.

– Green Dot speed is the speed which provides the best climb gradient in clean configuration. Green dot is also the best Lift / Drag ratio speed.

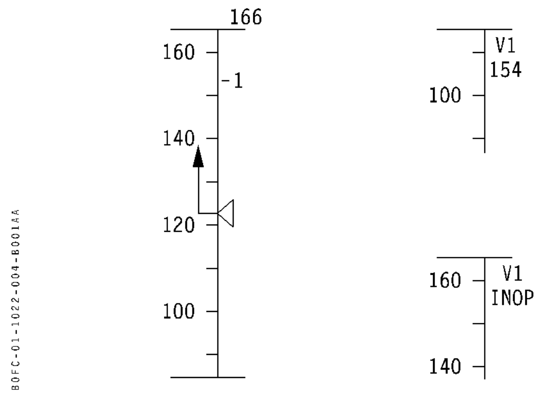
Green Dot is mainly used as the :

- maneuvering speed in clean configuration
- optimum engine out climb speed,
- optimum single engine driftdown speed,
- optimum climb gradient speed,
- maximum endurance speed for holding patterns.

– Green Dot speed is computed by the FAC, based on the aircraft weight and altitude.

Note 1 : The Green Dot speed displayed on the PFD speed scale is computed by the FAC. It may be up to 10 kt above the Green Dot speed computed by the FMC and displayed on the CDU.

V1 – Decision Speed :

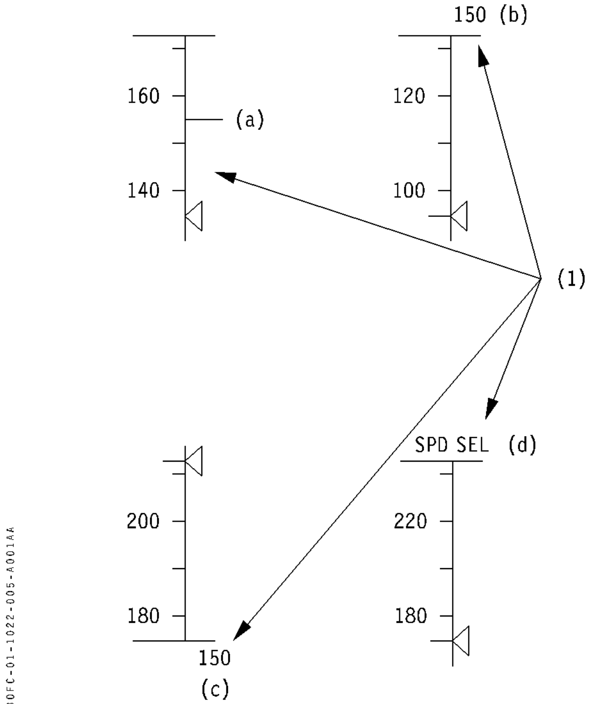


- The decision speed V1 is displayed as a blue "-1" on the speed scale.
- When V1 is out of the displayed range, it is displayed (e.g. V1 154) at the top of the speed scale.
- V1 is manually entered by the crew on the Flight Management System (FMS) CDU during cockpit preparation.
- V1 is not displayed after take-off.
- If V1 data is lost a red V1 INOP flag is displayed.

V2 – Second segment safe speed :

- The second segment safe speed target is entered in the FCU SPD/MACH window.
- As long as V2 is out of scale, the V2 speed is indicated at the top of the speed scale.
- Within the scale range, V2 is indicated by the blue target speed index (blue line).

TARGET SPEED



(1) Selected Target Speed

- The target speed is :

  – the speed selected and displayed on the FCU,

  or

  – the target speed computed by the FMC when PROFILE mode is engaged.

- The target speed is represented by a blue index which moves along the speed scale - item (a).

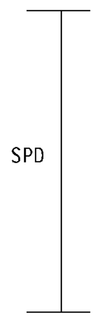
- When out of the indication range, the target speed is displayed either above - item (b) - or below - item (c) - the speed scale.

- In case of failure of the FCU or SFCC, a red SPD SEL message is displayed - item (d).

INDICATION IN CASE OF ADC FAILURE

- In normal operation, ADC 1 supplies PFD 1 and ADC 2 supplies PFD 2.
- If the ADC speed data is lost, all speed information is blanked.

  The speed scale turns red and a red SPD message is displayed.



BOFC-01-1022-006-A001AA

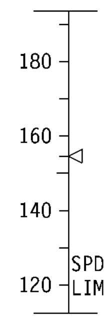
- Airspeed information can be recovered by switching to the operative ADC.

  Switching is accomplished using the ADC INST
R pushbutton switch on the CAPT (F/O) SWITCHING panel (refer to section 1.10.72 – ADC AND FAC SWITCHING).

INDICATION IN CASE OF FAC FAILURE

- In normal operation, FAC 1 supplies PFD 1 and FAC 2 supplies PFD 2.
- In case of FAC failure, all the speeds (Speed trend, V_{LS}, V_{SS}, V_{MAX}, F, S and Green Dot) are cleared from the associated PFD.

  A red SPD LIM message is displayed at the bottom of the speed scale.



BOFC-01-1022-006-B001AA

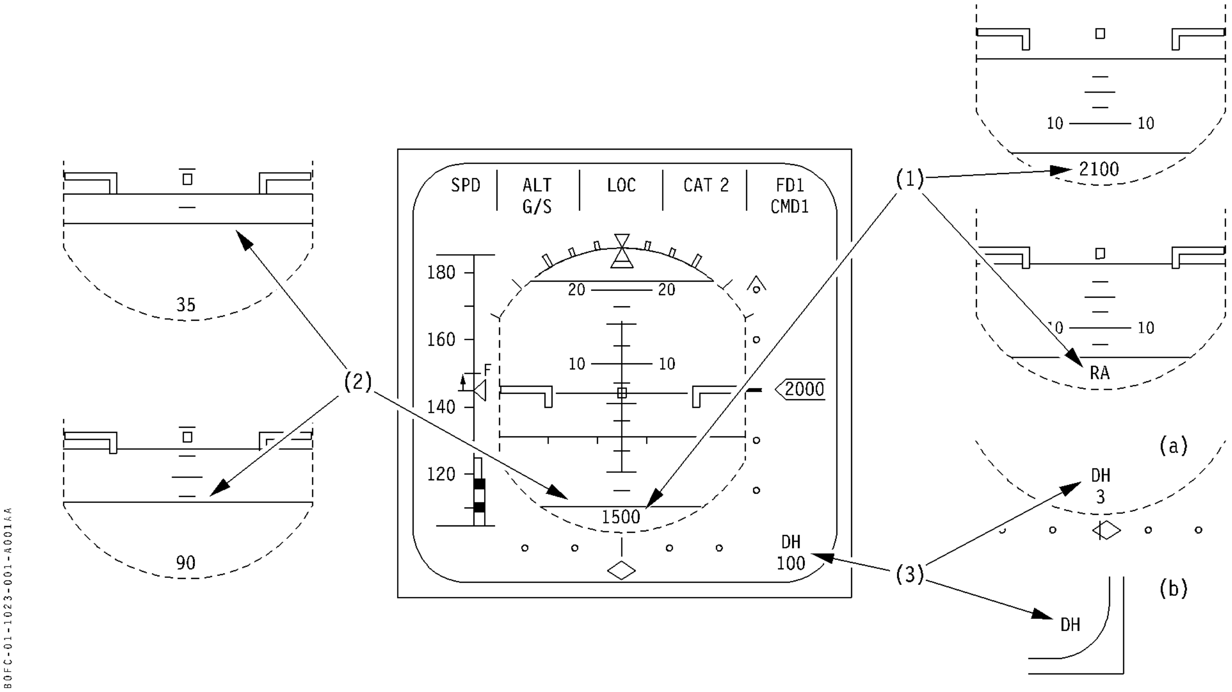
- Limit speeds and maneuvering speeds can be recovered by switching to the operative FAC.

  Switching is accomplished using the ADC INST pushbutton switch on the CAPT (F/O) SWITCHING panel (refer to section 1.10.72 – ADC AND FAC SWITCHING).

Note : The SPD LIM message is also displayed in case of loss of :

- *a Slats/Flaps Control Computer (SFCC) (or if the SLAT/FLAP control lever position is lost),*
- *an Angle-of-Attack (AoA) sensor,*
- *an Inertial Reference System (IRS).*

RADIO ALTITUDE



(1) Digital Radio Altitude (RA)

- Radio Altitude is displayed when the aircraft is below 2500 ft RA.
- The size and color of the RA indication depend on the Radio Altitude (RA) :
  - Above 1000 ft RA, small green digits,
  - Below 1000 ft RA, large green digits,
  - RA indication becomes amber at 100 ft above the Decision Height.
- The RA indication is displayed in steps as follows :
  - Above 50 ft RA : 10 ft steps,
  - Between 5 and 50 ft RA : 5 ft steps,
  - Below 5 ft RA : 1 ft steps.
- If both Radio Altimeters fail, when slats are extended, a red RA message replaces the Radio Altimeter data.

(2) Radio Altitude Line

- During final approach the lower white line moves up towards the horizon line to give a visual indication of approaching ground level.
- The distance between the horizon line and the RA line decreases progressively with decreasing radio altitude (at touchdown, the RA line and the horizon line merge as a single line).

(3) Decision Height (DH)

- The Decision Height set on the primary EFIS control panel is displayed in blue when the Radio Altitude is displayed.
- When the Radio Altitude is lower than the set Decision Height, an amber DH message, is displayed above the RA - item (a).
- If DH information is lost, DH value is cleared and a red DH message replaces the DH - item (b).

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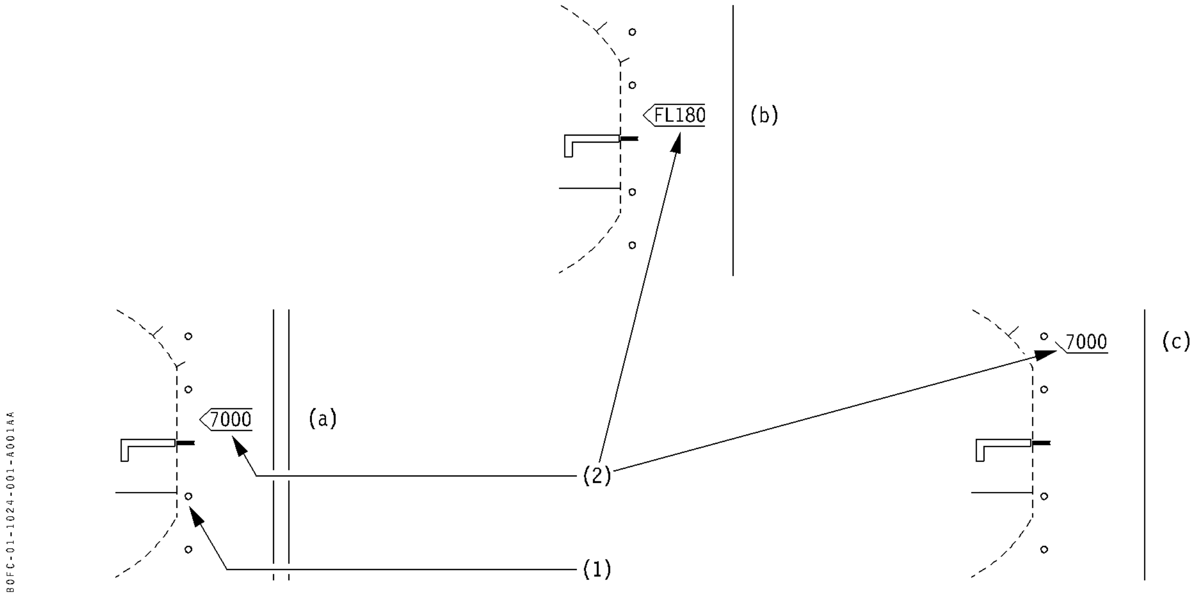
ALTITUDE DEVIATION



(1) Altitude Deviation Scale

- The vertical deviation scale is displayed in white and indicates the altitude deviation from the altitude selected on the Flight Control Unit (FCU) :
  – Each dot represents 500 ft.
  – The maximum deviation displayed is ± 1 000 ft.

(2) Selected Altitude Index

- The altitude selected on the FCU is shown in blue in a white index.
- The index moves up or down to reflect the difference between the aircraft actual altitude and the target altitude selected on the FCU.
- The value in the index box is either:
  – an altitude in ft - item (a) - if the altimeter BARO set knob is pushed to set the local QNH or QFE, R

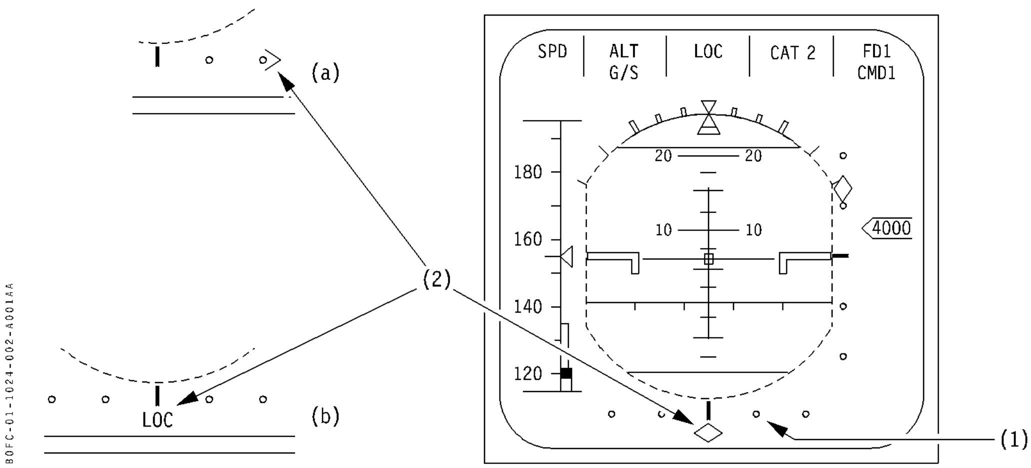
  or

  – a Flight Level - item (b) - if the altimeter BARO set knob is pulled to set STD.
- When the deviation from the selected altitude is more than 1 000 ft, only half of the selected altitude index reaches is displayed at the top or bottom of the PFD - item (c).
- If the altitude data is lost, the index is cleared from display.

ILS DEVIATION INFORMATION

- When the VOR/NAV/ILS switch on the EFIS control panel is placed in the ILS position, the following ILS deviation information is presented on the associated PFD.

LATERAL DEVIATION



(1) Localizer Deviation Scale

- The localizer deviation scale is displayed as four white dots and a yellow center bar.

  It is displayed at the bottom of the PFD deviation only when the VOR/NAV/ILS switch is in the ILS position.

- A one-dot deviation represents approximately :
  - at 4 nm (typical OM) : 180 m (600 ft),
  - at 0.5 nm (typical MM) : 70 m (230 ft),
  - at runway threshold : 50 m (175 ft).

(2) Localizer Deviation Index

- The localizer deviation index (pink diamond) is displayed when a localizer signal is received and the VOR/NAV/ILS switch is in the ILS position.

- When the index is outside of the deviation scale, only half a diamond is displayed - item (a).

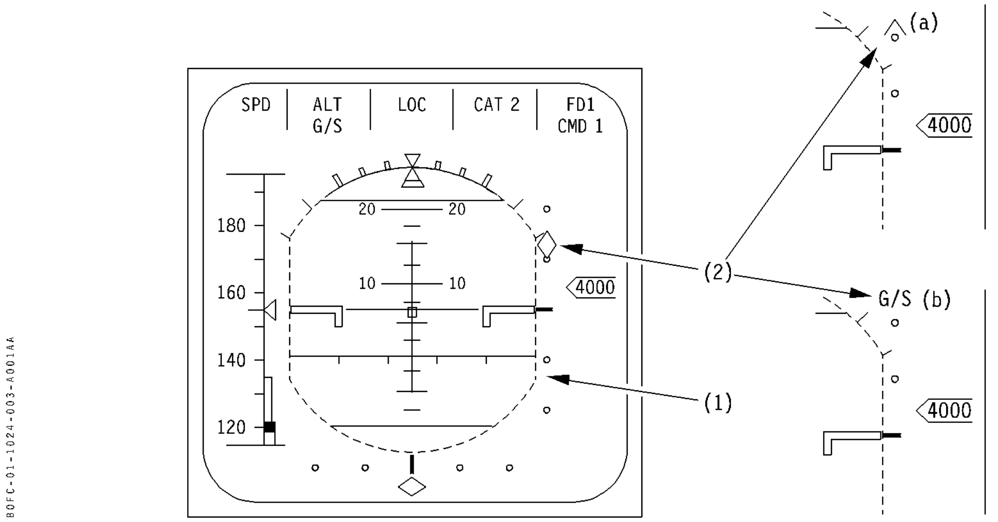
- If the localizer on-board receiver fails, the index is cleared and a red LOC message is displayed under the scale - item (b).

- With LAND mode engaged in LOC track phase (LOC green on FMA), an excessive LOC deviation (greater than 1/3 dot) is indicated by the flashing of the LOC index and scale.

  The LOC excessive deviation warning is activated only if CAT2 or CAT3 landing capability is indicated on FMA.

- If the localizer ground transmitter fails during the capture (LOC*) or track phase (LOC green) of LOC mode, the FD roll bar and localizer deviation scales flash on both PFD, and the deviation index is cleared from display.

VERTICAL DEVIATION



(1) Vertical (G/S) Deviation Scale

- The ILS vertical (Glide Slope) deviation scale is displayed as four white dots and a yellow center bar.
- The Glide Slope deviation index is displayed on the vertical deviation scale when the VOR/NAV/ILS switch is in ILS position.
- A two dot deviation represents approximately a 0.7° deviation for a 3° glide slope.

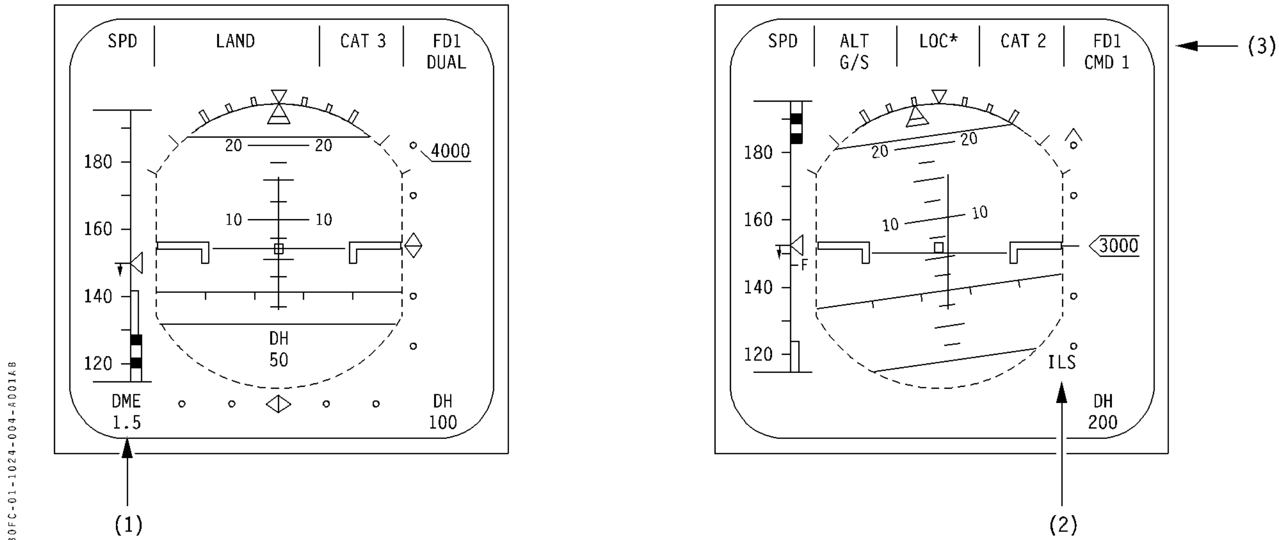
  This deviation represents approximately 75 ft at 1 nm from the runway touchdown zone.

(2) Glide Slope Deviation Index

- The glide slope deviation index (pink diamond) is displayed when a glide slope signal is received and the VOR/NAV/ILS switch is in the ILS position.
- When the deviation is outside of the deviation scale, only half a diamond is displayed - item (a).
- With LAND mode engaged in GS track phase (GS green on FMA), an excessive GS deviation (greater than 1 dot) is indicated by the flashing of the GS index and scale.

  The GS excessive deviation warning is activated only if CAT 2 or CAT 3 landing capability is indicated on FMA. R
- If the glide slope on-board receiver fails, the index is cleared and a red G/S message is displayed above the deviation scale - item (b).
- If the glide slope ground transmitter fails during the capture (GS*) or track phase (GS green) of G/S mode, the FD pitch bar and vertical deviation scales flash on both PFD, and the deviation index is cleared from display.

OTHER ILS INFORMATION



(1) ILS DME

- During approach, the ILS/DME is autotuned by the FMS and the ILS/DME distance is displayed in the lower left corner of both PFD if :
  - the ILS/DME frequency is set on the ILS control panel

  and

R – the ILS/DME is within 30 NM of the aircraft

R and

  - the VOR/NAV/ILS switch is in the ILS position,

  and

  - Mach number is below 0.45 (Mach number not displayed on PFD).

R *Note : if there are more than one possible ILS/DME*
R *on the selected frequency, the FMS will*
R *check the ILS approach in the F-PLN and*
R *display the corresponding DME distance. If*
R *no ILS approach is entered in the F-PLN, then*
R *the FMS cannot choose which DME to display,*
R *and no DME distance will be displayed.*

(2) ILS Reminder

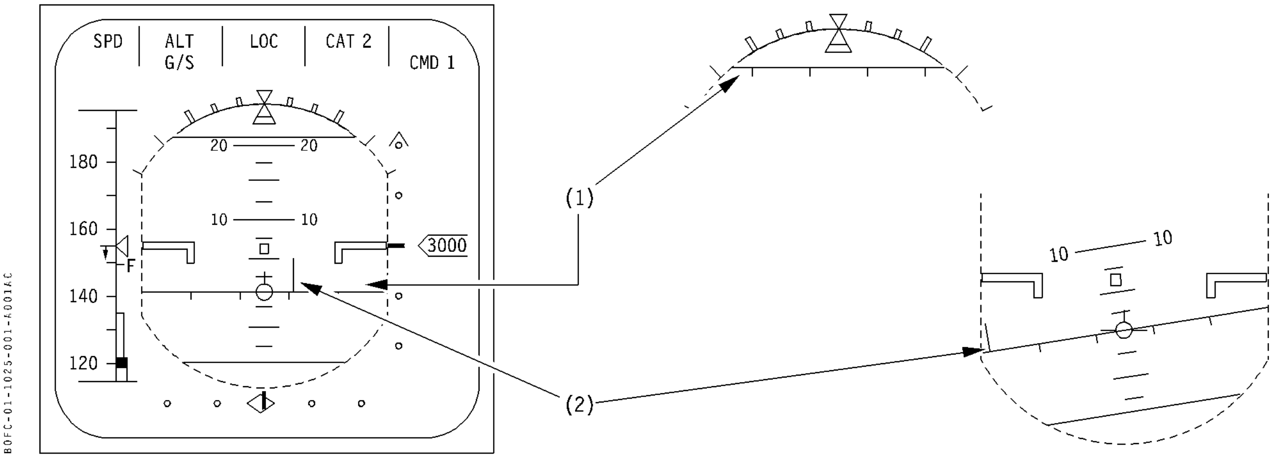
- The ILS reminder flashes amber if :
  - LAND mode is armed (G/S blue, LOC blue) or engaged (LOC green), and
  - The onside VOR/NAV/ILS switch is not in the ILS position.
- The purpose of the ILS reminder is to direct the pilot to set the VOR/NAV/ILS switch in the ILS position.

(3) Flight Mode Annunciator (FMA) Indications

- When LAND mode is armed, "G/S" and "LOC" are displayed in blue in the second line of the FMA.
- "GS*" and "LOC*" are displayed in green in the first line of the FMA during the capture of the glide slope and localizer beams.
- "GS" and "LOC" are displayed in green in the first line of the FMA when tracking the glide slope and localizer beams.

HEADING DATA

R



R

(1) Heading Scale

- A heading scale (graduated in 10° increments) which moves as the aircraft turns, is provided on the PFD horizon line.

R
- In case of excessive nose up or nose down pitch attitudes, the horizon line is out-of-view, but the heading scale remains visible at the bottom or at the top of the display.

(2) Selected Heading

- When the Flight Path Vector (FPV) is displayed (FPV/FD switch in the FPV position) the heading selected on the FCU is indicated by a blue vertical line on the heading scale.

  Refer to section 1.10.27 for description of the Flight Path Vector (FPV).

- If the selected heading is out of the display range, the symbol remains against the stop on the corresponding side of the heading scale.

- If IRS heading information is lost, the heading scale and symbol (as well as the FPV) are cleared from display.

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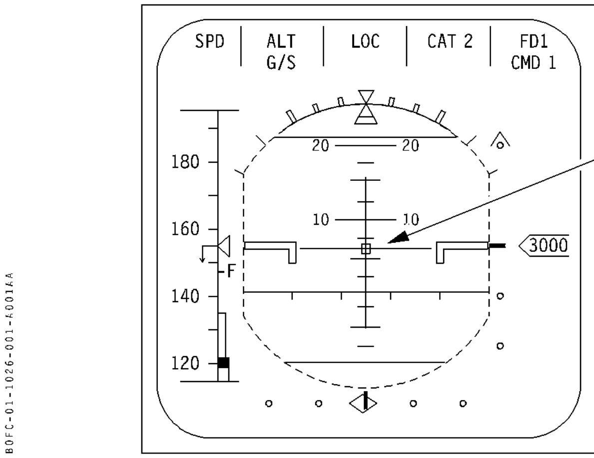
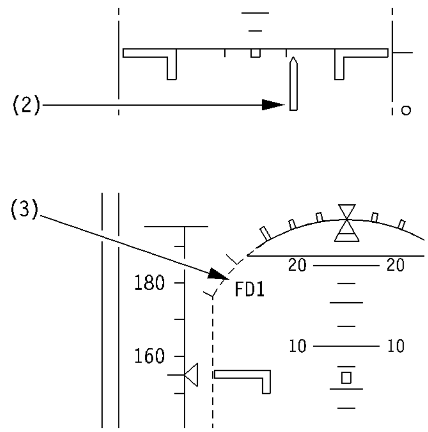
FLIGHT DIRECTOR DISPLAY

R





(1) FD Command Bars

- The Flight Director (FD) is displayed using the FD/FPV toggle switch located on the EFIS secondary control panel.
- When FD is selected, the green pitch and roll command bars are displayed.
- If the AP/FD reverts to the basic V/S and/or HDG modes, the FD bars flash for five seconds.

R R • For detailed description of the FD, refer to chapter 1.03.30 – AUTOFLIGHT SYSTEM – FLIGHT DIRECTOR.

(2) FD Yaw Bar

- For take-off (in RWY mode) and during landing (in FLARE and ROLL OUT modes), the roll bar is replaced by a yellow yaw bar which provides steering commands to the localizer centerline.

(3) FD Failure Message

- In case of FD failure, the command bars are cleared from display and a red FD1 (or FD2 depending on which FD is displayed) message is displayed.

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GENERAL

- The Flight Path Vector (FPV) symbol indicates the actual inertial trajectory of the aircraft, in terms of :
  - Flight Path Angle (FPA),
  - Track or Course (CRS).
- The Flight Path Reference (FPR) symbol indicates the intended trajectory. The FPR can be set in order to provide :
  - a Flight Path Angle (FPA) reference,
  - a Track or Course (CRS) reference.
- The FPV/FPR provide assistance to the flight crew to fly a trajectory following a desired FPA and CRS.
- The FPV/FPR can be used :
  - in manual flying, by keeping the FPV on the FPR,
  - with AP engaged in CMD, with V/S and HDG SEL modes :
    - as a monitoring means by the PNF,

    or
    - as a reference for both the PF and PNF.
- The FPV/FPR can be used under the following circumstances :
  - to conduct a non-precision (non-ILS) approach with a constant slope final descent from the FAF (or final descent point) down to the Visual Descent Point (VDP),
  - to conduct visual approaches (monitoring of flight path angle and drift correction),
  - to perform visual patterns,
  - in case of loss of both FMS,
  - in case of unreliable airspeed indication.
- The following features and design characteristics of the FPV/FPR must be highlighted :
  - The FPV/FPR are not linked to any navaid.
  - The FPV indicates the actual inertial trajectory (velocity vector) of the aircraft.
  - The FPR is an index indicating the intended

Rreference trajectory.

  - The FPV/FPR do not provide correction commands and do not constitute a flight director.
  - The use of the FPV/FPR must be associated with the use of navaid(s) raw data for monitoring.
  - The FPV/FPR cannot be coupled to the AP.
  - The AP can be used in CMD with :
    - V/S mode to adjust and maintain the FPV on the FPR,
    - HDG SEL mode to adjust and maintain the FPV on the reference CRS (or track).

(1) Flight Path Vector (FPV)

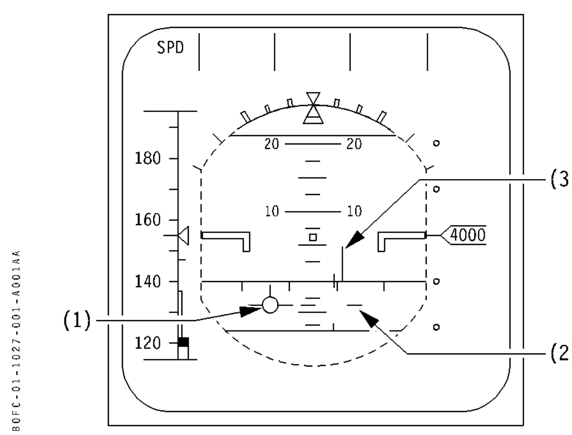
- The Flight Path Vector symbol is displayed by using FD/FPV toggle switch located on the EFIS secondary control panel.
- The FPV simultaneously displays the aircraft's vertical and lateral inertial trajectory.

(2) Flight Path Reference (FPR)

- The FPR is used as a reference for the FPV.
- The FPR is displayed by :
  - Selecting the FPV using the FD/FPV switch, and
  - Pressing the FPA key on the EFIS control panel.

(3) Selected Heading

- Refer to section 1.10.25 – HEADING.



FLIGHT PATH VECTOR (FPV)

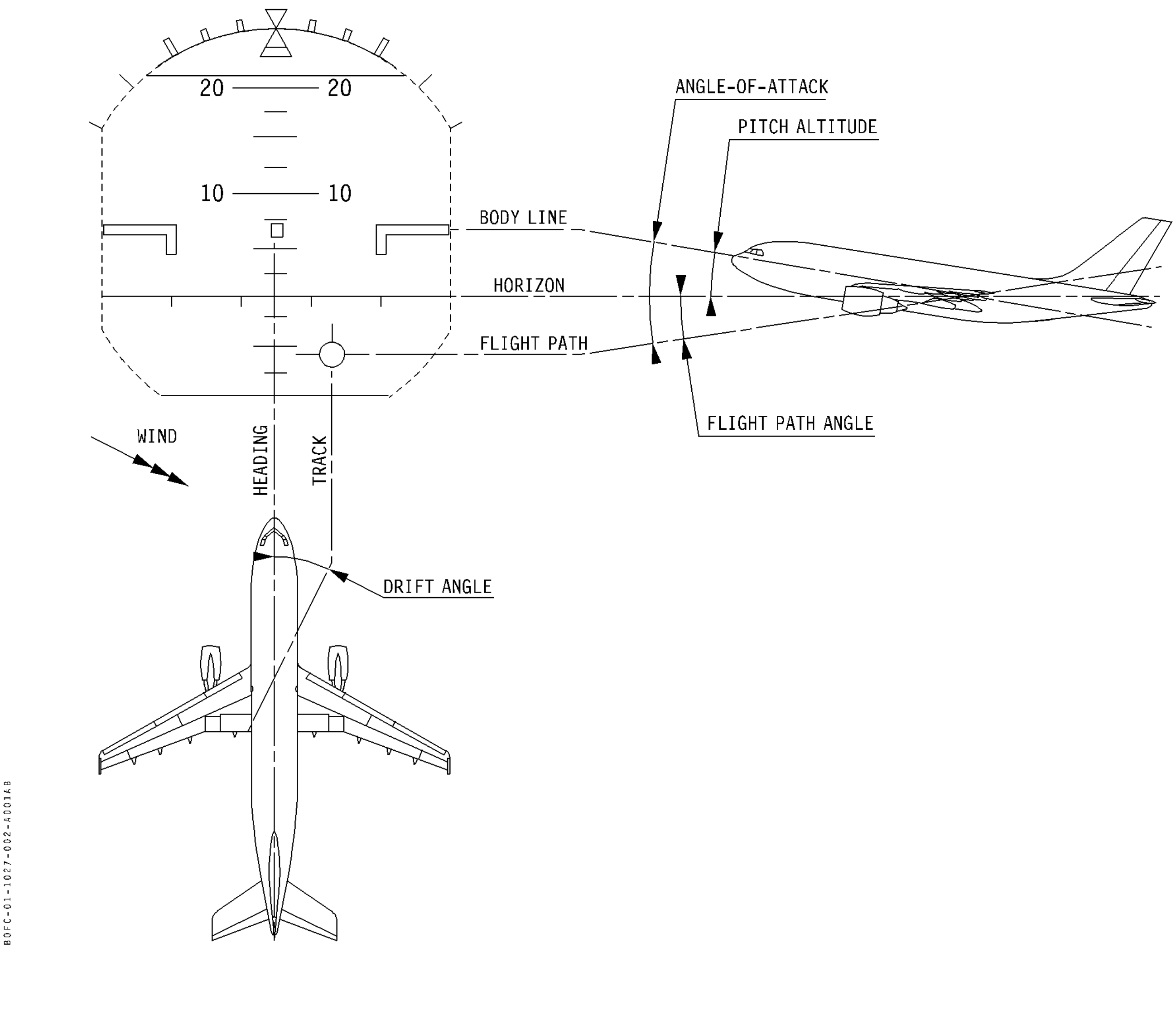
R • The vertical distance between the FPV and the
R horizon line represents the Flight Path Angle.

R • The lateral distance between the FPV and the
R nose of the aircraft symbol represents the drift
R angle.

• The vertical distance between the FPV and the nose of the aircraft symbol indicates the Angle-of-Attack (AoA).

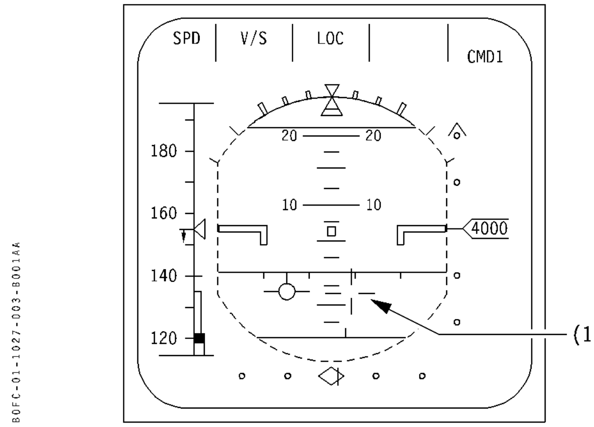
The AoA information can be used (in addition to pitch and thrust) in case of unreliable airspeed or loss of airspeed indication.

• In case of failure, the FPV symbol is cleared from display and a red FPV flag appears below the right wing of the aircraft symbol.

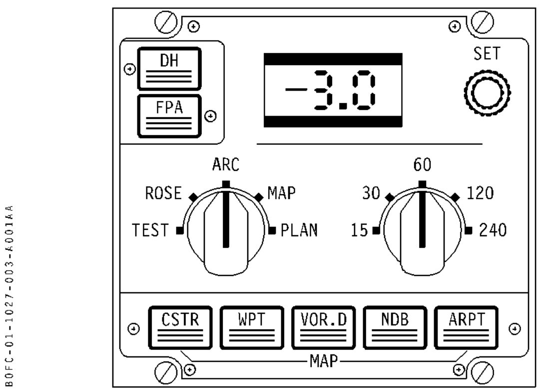


FLIGHT PATH REFERENCE (FPR)

- The Flight Path Reference (FPR) symbol (1) can be set to provide :
  - a flight path angle (FPA) reference,
  - a track/course (CRS) reference.



Flight Path Angle (FPA)



- Selecting the FPA pushbutton switch when the FPV is displayed on the PFD will display the Flight Path Reference (FPR) for use with the FPV.
- When selected, the FPA pushbutton switch light illuminates.

  If the pushbutton is pressed a second time, the display returns to dashes.
- The FPR symbol is positioned vertically by turning the SET knob :
  - Clockwise rotation raises the FPR,
  - Counterclockwise rotation lowers the FPR.
- The numbers displayed in the window when FPA is pressed are in degrees and tenths of a degree (from – 9.9° to + 9.9° by 0.1° increments).

Course/Track (CRS)

- The lateral position of the FPR is set on a fixed course or track, which depends on the position of the VOR/NAV/ILS switch, located on the secondary EFIS control panel.
- If the switch is in :
  - the VOR position : the FPR is set on the course selected on the VOR control panel.
  - the ILS position : the FPR is set on the course selected on the ILS control panel.
- By setting the FPR to a desired FPA (using the FPA SET knob), and a desired track (by setting a course on either the VOR or ILS control panel), the FPR can be used as a reference for the FPV to enable the pilot to maintain a desired flight path or to monitor the actual flight path relative to a desired FPA and track.
- If the course selected is out of display range, half of the FPR is presented against the side of the attitude display.

CAUTION

When using the FPV and FPR together for course and glide path control during an approach, raw data must be used to ensure that the aircraft is on course and on the published vertical profile.

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AFS Flight Mode Annunciator (FMA)

- Annunciation of AFS modes is provided at the top of the PFD, on the FMA.

  Refer to section 1.03.12 – AFS PILOT INTERFACE– FLIGHT MODE ANNUNCIATOR for detailed description of the FMA.

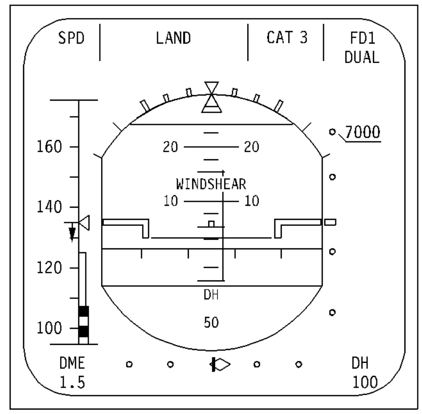
Special Message Display

- In certain conditions (refer to chapter 1.19 FLIGHT MANAGEMENT SYSTEM), specific amber messages are flashing to direct the crew to take specific actions.

- These messages are :
  - MORE DRAG,
  - DECELERATE.

WINDSHEAR Alert

- If windshear conditions are detected by the FAC, the following warnings are activated :
  - Red "WINDSHEAR" message in the center of the PFD,
  - Audio WINDSHEAR warning given three times over the loudspeaker.



- This detection and warning system is available :
  - During takeoff, from lift-off up to 1 300 ft Radio Altitude, R
  - During approach, from 1 300 ft down to 50 ft Radio Altitude, R
  - For go-around, up to 1 300 ft Radio Altitude. R

  The associated guidance function is available provided one AP or FD is engaged.

- Failures of the WINDSHEAR detection system are indicated on the ECAM as soon as slats are extended (except during lift-off up to 1 300 ft). R

  In this case :
  - Single chime audio signal is generated.
  - The MASTER CAUTION light illuminates.
  - The WINDSHEAR ALERT NOT AVAIL message is displayed on the left ECAM CRT.

Note : *On ground, with engines shut down and at least one PFD supplied, the windshear alert can be tested by triggering the annunciator lights test.*

Mod : 5051 + 7985

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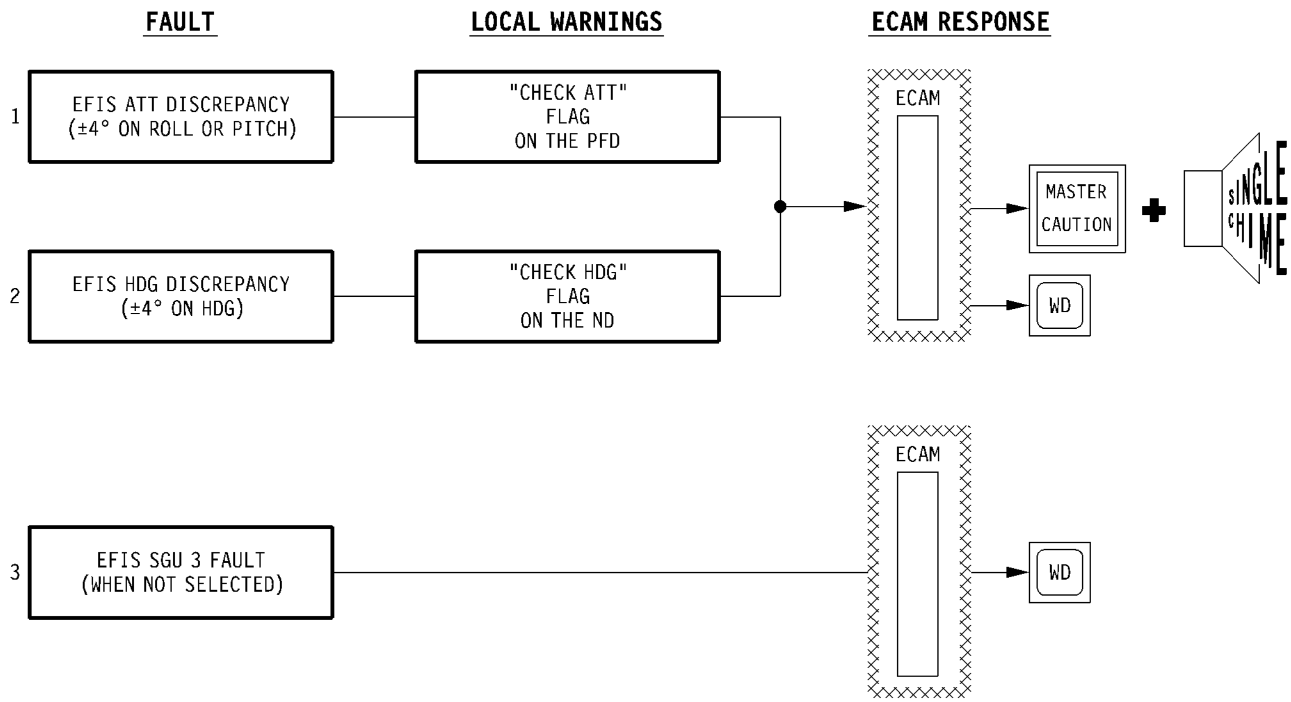
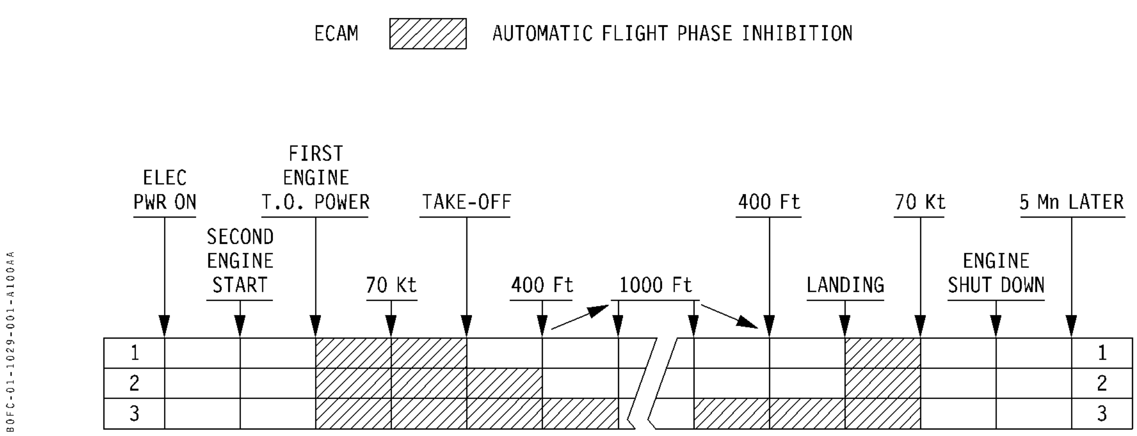

FAULT
LOCAL WARNINGS
ECAM RESPONSE
1
EFIS ATT DISCREPANCY (±4° ON ROLL OR PITCH)
"CHECK ATT" FLAG ON THE PFD
2
EFIS HDG DISCREPANCY (±4° ON HDG)
"CHECK HDG" FLAG ON THE ND
ECAM
MASTER CAUTION
SINGLE CHIME
WD
3
EFIS SGU 3 FAULT (WHEN NOT SELECTED)
ECAM
WD


ECAM
AUTOMATIC FLIGHT PHASE INHIBITION
ELEC PWR ON
SECOND ENGINE START
FIRST ENGINE T.O. POWER
70 Kt
TAKE-OFF
400 Ft
1000 Ft
400 Ft
LANDING
70 Kt
ENGINE SHUT DOWN
5 Mn LATER
1
2
3
B0FC-01-1029-001-A100AA

Mod : 5051

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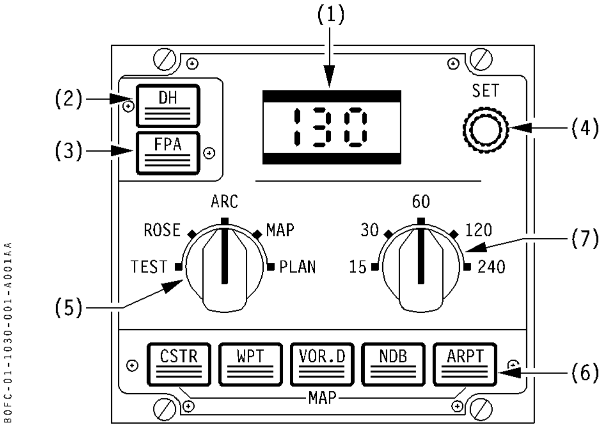
EFIS CONTROLS PANEL



PFD CONTROLS

(1) DH/FPA Display Window

- Decision Height (in ft) is displayed if the DH pushbutton switch is pressed-in.

R *Note : A Radio Altimeter DH is to be set for CAT II and CAT III ILS approach only.*

For CAT I ILS approaches, a barometric DH (DA) is set on the altimeter.

For non-ILS approaches, a barometric MDH (MDA) is set on the altimeter.

- Flight Path Angle (FPA) value is displayed (in degrees) if the FPA pushbutton switch is pressed-in.
- If neither pushbutton switch is pressed-in, dashes are displayed.

(2) DH Pushbutton Switch

- The Decision Height (DH) can be entered, for the Radio Altitude DH automatic callout system, by pressing this pushbutton switch. When selected, the pushbutton switch light illuminates. Another press cancels this, and the display returns to dashes.

(3) FPA Pushbutton Switch

- Refer to section 1.10.27 for description and operation of the FPV and FPR (FPA and CRS).

(4) SET Knob

- When the FPA or DH pushbutton switches are selected, this knob is used to set the DH or FPA to the desired value.
  - The DH value is adjustable in increments of 5 ft from – 5 ft to 995 ft.
  - The FPA value is adjustable in increments of 0.1° from – 9.9° to + 9.9°.

ND CONTROLS

(5) Mode Selector

(6) Display Options (in MAP or PLAN mode only)

(7) Range Selector

Note : Descriptions of the ND mode selector, of the MAP and PLAN modes display options and of the range selector can be found in section 1.15.21 NAVIGATION SYSTEMS – ND – CONTROLS AND INDICATORS.

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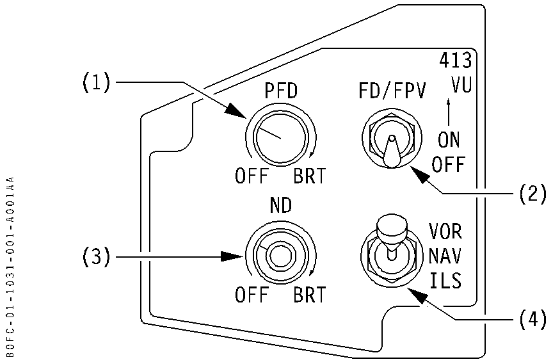
SECONDARY EFIS CONTROL PANEL



(1) PFD Brightness

- The knob controls the brightness of the PFD (upper CRT).
- If the knob is turned OFF while the ND is still on, the PFD display is automatically transferred to the lower CRT (ND display is no more available).

Note : *The brightness of the PFD and ND displays is automatically adjusted for small changes in ambient lighting conditions.*

(2) FD/FPV Switch

- This 3-position switch selects either Flight Director bars or the Flight Path Vector for display on the PFD.

■ **OFF**

– FD bars and FPV symbols are cleared from the PFD.

■ **ON**

– The PFD displays either the FD bars or the Flight Path Vector (FPV).

Note : *Depending on IRU standard, the display logic may not show the FPV on ground.* R R

■ ↑ **(upper position)**

– When the switch is pressed up to this position and released (it is springloaded back to ON), the display switches from FD bars to FPV, or from FPV to FD bars.

Note : *Depending on IRU standard, the display logic may not show the FPV on ground.* R R

- If the FPV is selected, **the FD bars replace automatically the FPV** as soon as the following modes engage :
  - TAKE-OFF (THR/SRS), by pressing go-levers,
  - GO AROUND, by pressing go-levers,
  - LAND during ALIGN (FLARE) or ROLL OUT phases.

(3) ND Brightness Knob

(4) VOR/NAV/ILS Switch

Note : *Refer to section 1.15.21 for the description of the ND brightness knob and VOR/NAV/ILS switch.*

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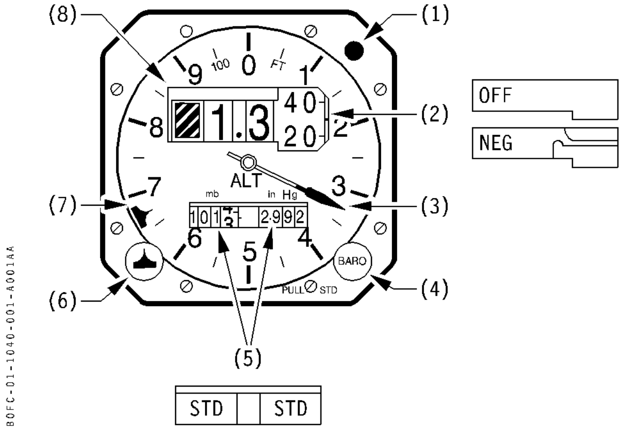
ALTIMETERS



(1) Altitude Alert Light

- The light illuminates amber when an Altitude Alert warning is triggered.

(2) Altitude Counter

- The digital counter indicates ten-thousands, thousands, hundreds and twenty-foot increments.
  - A black and white striped flag covers the ten-thousands digit when altitude is below 10 000 ft.
  - A black NEG flag covers the counter if the altitude is below zero.
  - A red OFF flag covers the counter for ADC failure, indicator failure or power supply failure.

(3) Altitude Pointer

- Each revolution of pointer equals 1000 ft altitude change.

(4) BARO Set Knob

- The knob is to set barometric pressure reference in millibars (mb) and in inches of mercury (inHg) :

■ **Pressed-in**

- Turning the BARO set knob allows to set the altimeters to the QNH or QFE pressure setting. When supplied from the onside ADC, the altimeter reading is corrected accordingly.

Note : If the ADC/INST pushbutton switch has been pressed to receive offside ADC data, the altimeter reading remains corrected by its own BARO set reference.

■ **Pulled-out**

- Pulling the BARO set knob automatically sets the altimeters to the standard altimeter setting (1013 mb or 29.92 inHg). The BARO set counters are now covered by grey "STD" flags.

(5) Baro Set Counters

- Two counters, one indicates barometric pressure in millibars (745 to 1050 mb), and the other in inches of mercury (22 to 31 inHg) display pressure as selected and set with the BARO set knob.
- Two grey "STD" flags cover these counters when BARO Set knob is pulled.

(6) Altitude Index Set Knob

- This knob is used to set the orange altitude index bug.

Note : The altitude index is used to set the barometric DH (DA) for a CAT I ILS approach or the barometric MDH (MDA) for a non-ILS approach.

(7) Altitude Index

- The orange altimeter bug may be set, with the altitude index set knob, to any position on the analog dial to mark certain critical altitudes (e.g. : CAT I DA/DH, MDA/MDH, acceleration altitude,...).

(8) Analog Altitude Dial

- The dial is graduated from 0 to 1000, in 50 ft increments.
- The 100 ft graduations are numbered from 0 to 9.

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GENERAL

- Altitude alerts are provided by the FWC, based on comparison of the indicated altitude against the Flight Control Unit (FCU) selected altitude (ALT SEL).
- When each FWC determines that an alert is required it illuminates its associated altimeter's amber warning light and, in certain cases, provides a C-chord audio alert through the cockpit loudspeakers.
- Altitude alert is inhibited when the following conditions are fulfilled :
  - in G/S track or,
  - in G/S capture or,
  - in LAND track or,
  - with slats extended and L/G lever down or,
  - the FCU ALT SEL rotary selector is turning or,
  - conditions 1, described hereafter, are fulfilled :

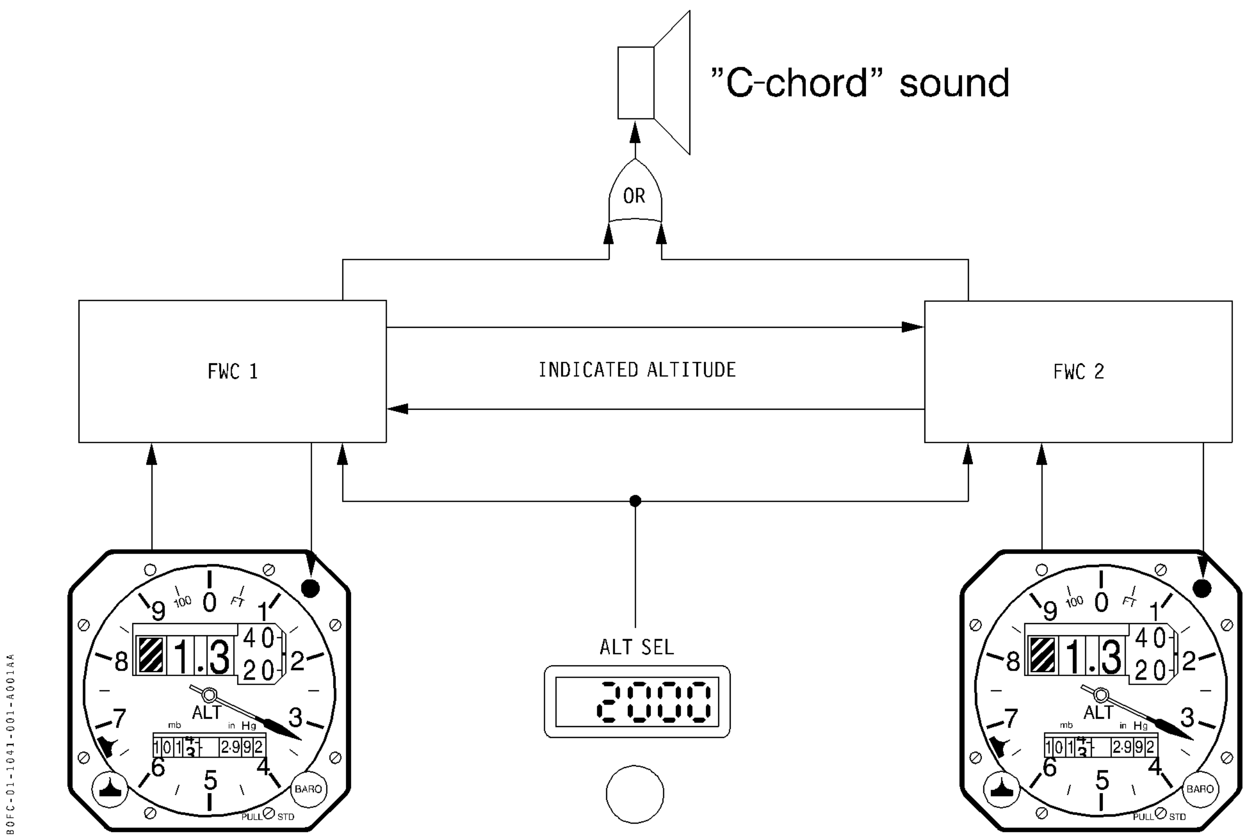
Conditions 1 :

Profile mode is engaged and AP is engaged in CMD or FD is engaged and conditions 2, described below, are fulfilled.

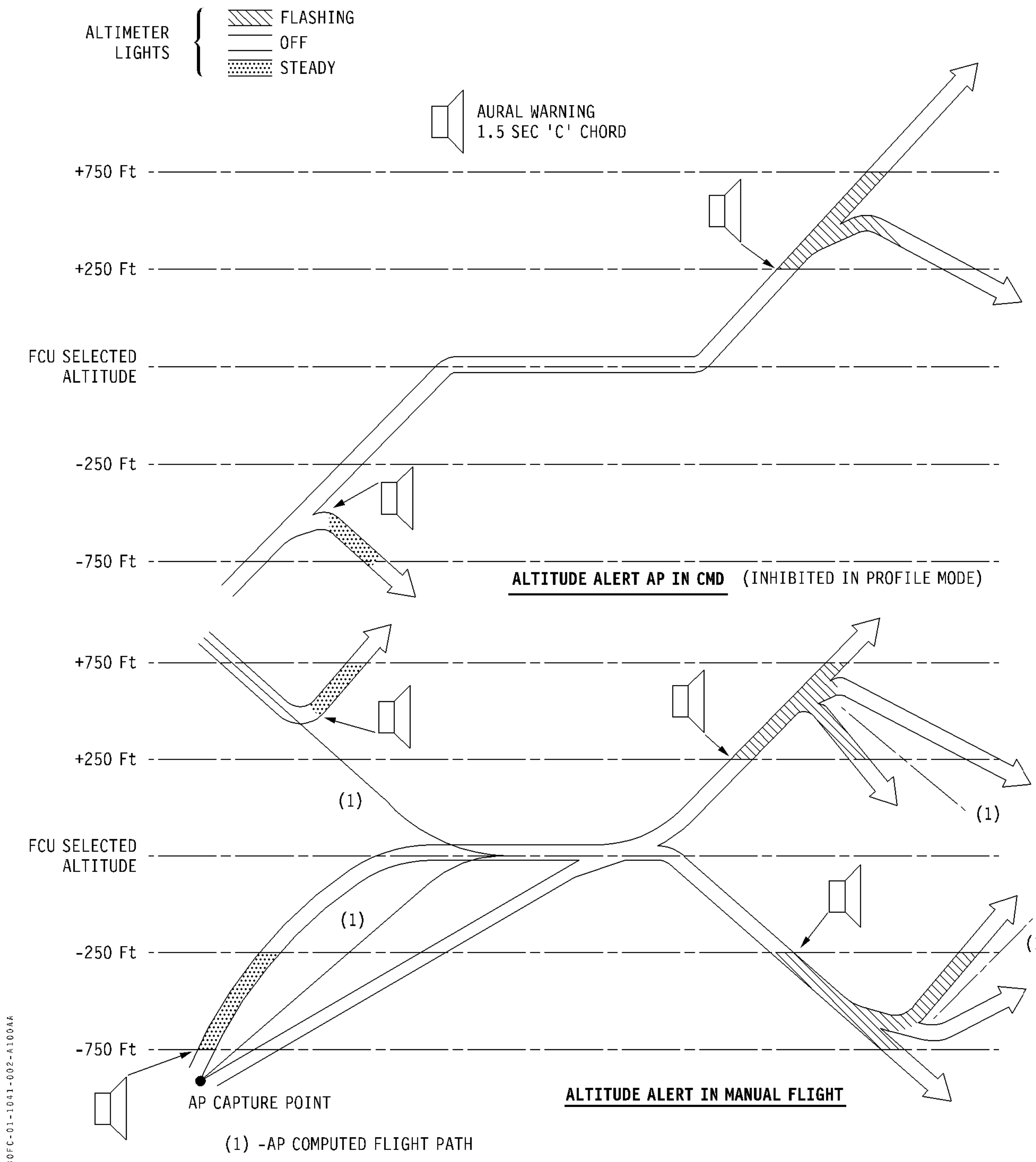
Conditions 2 :

FMC is in APPR phase and MDA is valid.

The above logic features general inhibitions, however they are completed by local inhibitions such as "When AP engaged and reaching the selected altitude" as described in the schematic on page 2.



ALTITUDE ALERT LOGIC



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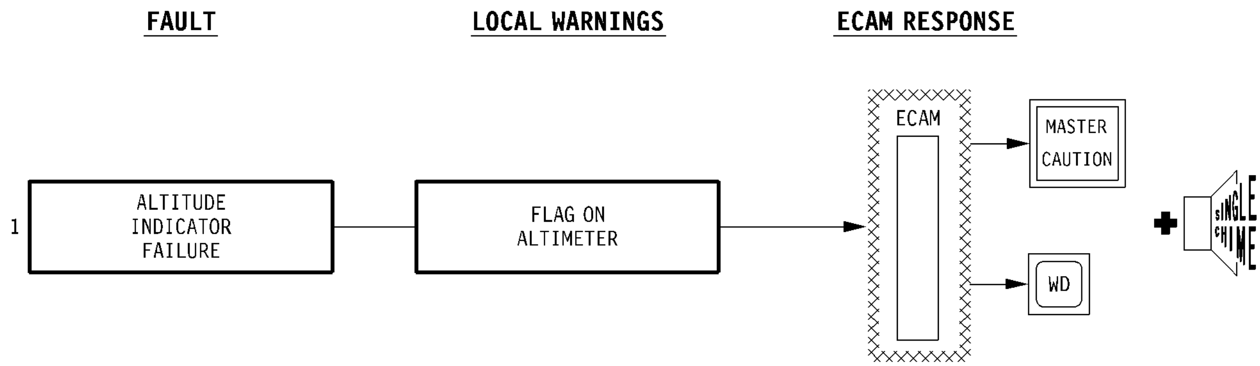
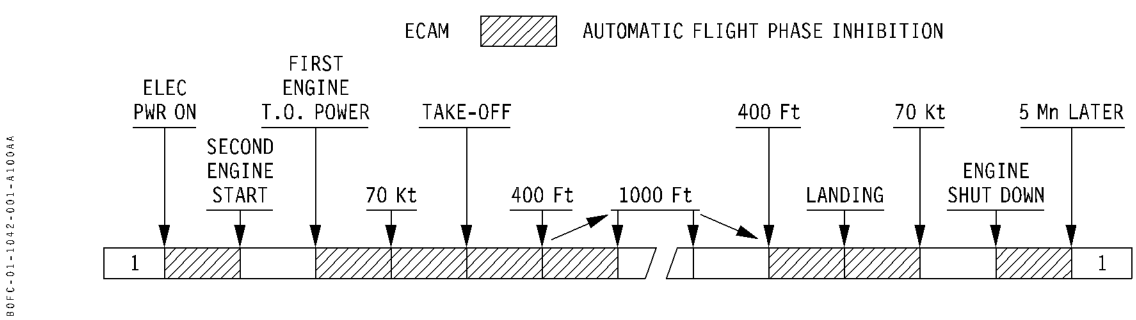
Mod : 4024


FAULT
LOCAL WARNINGS
ECAM RESPONSE
1
ALTITUDE INDICATOR FAILURE
FLAG ON ALTIMETER
ECAM
MASTER CAUTION
WD
SINGLE CHIME


ECAM
AUTOMATIC FLIGHT PHASE INHIBITION
ELEC PWR ON
SECOND ENGINE START
FIRST ENGINE T.O. POWER
70 Kt
TAKE-OFF
400 Ft
1000 Ft
400 Ft
LANDING
70 Kt
ENGINE SHUT DOWN
5 Mn LATER
1
1
B0FC-01-1042-001-A100AA

Mod : 5051

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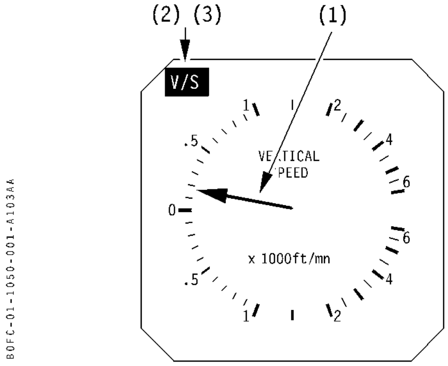
VERTICAL SPEED INDICATOR (VSI)



- The Vertical Speed Indicators (VSI) display the aircraft vertical speed in thousands of feet per minute.
  - The primary source of Vertical Speed (V/S) indication is the IRS. An automatic switch over to ADC occurs when an anomaly is detected on the Inertial Vertical Speed (IVS).
  - In normal operation, the VSI repeats the IVS data provided by the IRS. However, the IRS inputs are filtered by a barometric information for the stabilization of V/S indication.
  - If IRS input is lost, the VSI will continuously operate on ADC only (the indicated vertical speed then has a time ″lag″).
  - If ADC data is lost the VSI will operate on IRS data for only 30 seconds.

(1) Vertical Speed pointer

- Indicates rates of climb or descent between ± 6 000 ft/min.
- Scale increments :
  - 0 to ± 1 000 ft/min : 100 ft/min
  - ± 1 000 ft/min to ± 6 000 ft/min : 500 ft/min
- Display accuracy is ± 30 ft/min or 2 % of the actual value.

(2) IVS Flag

- The amber ″IVS″ flag is displayed in case of loss of the IRS Vertical Speed data.
- Automatic switching occurs to ADC data.

Mod : 10107 or (8601 + 10107)

(3) V/S Flag

- The red ″V/S″ flag is displayed when the indicator is inoperative.

Note : *In case of ADC failure, the VSI displays IVS for 30 seconds.*

Then the OFF flag appears and the pointer returns to 0 (unless the offside ADC is selected using the ADC/INST pushbutton switch).

Once the OFF flag appears, if onside ADC data is regained (or offside ADC data is selected by switching) it will take two minutes before V/S information is displayed again.

- In this case, the pointer is cleared from the display.

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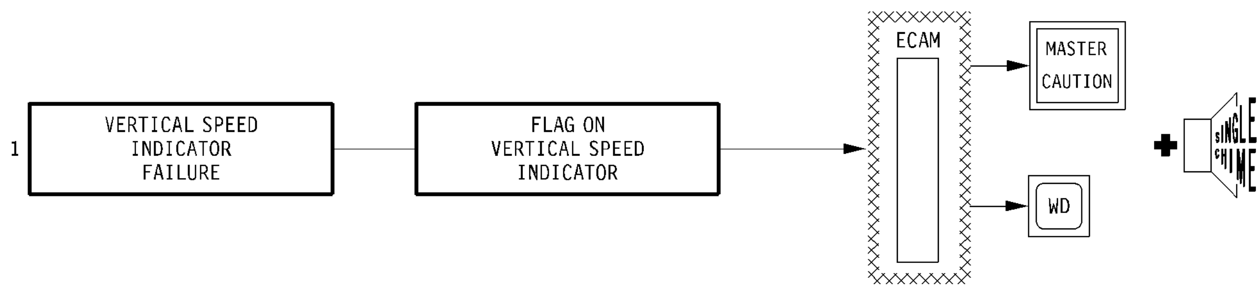
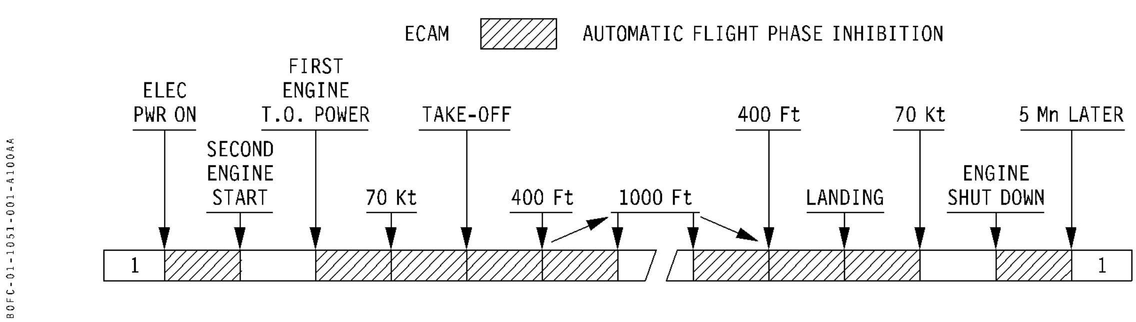

FAULT
LOCAL WARNINGS
ECAM RESPONSE
1
VERTICAL SPEED
INDICATOR
FAILURE
FLAG ON
VERTICAL SPEED
INDICATOR
ECAM
MASTER
CAUTION
WD
SINGLE
CHIME


ECAM
AUTOMATIC FLIGHT PHASE INHIBITION
ELEC
PWR ON
SECOND
ENGINE
START
FIRST
ENGINE
T.O. POWER
70 Kt
TAKE-OFF
400 Ft
1000 Ft
400 Ft
LANDING
70 Kt
ENGINE
SHUT DOWN
5 Mn LATER
1
1
B0FC-01-1051-001-A100AA

Mod : 5051

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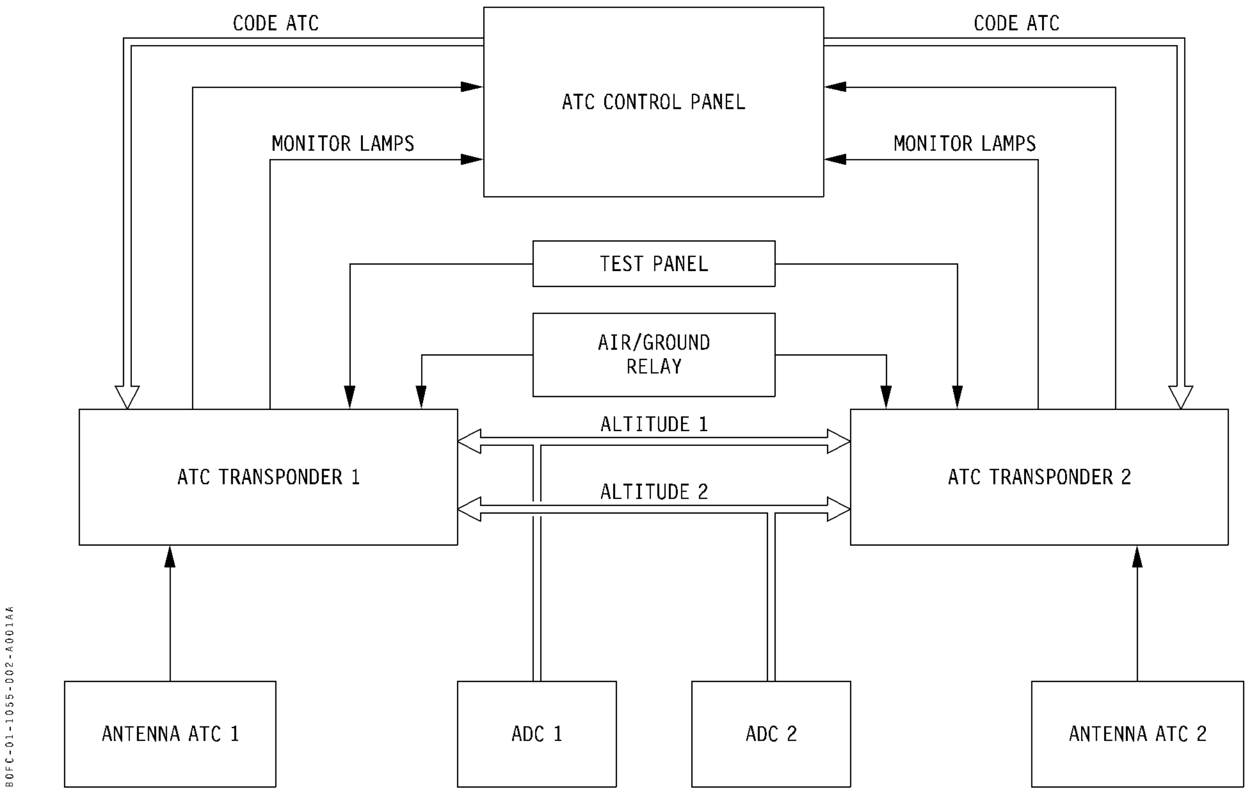
GENERAL

- The ATC (Air Traffic Control) Transponder (Transmitter/responder) enables the encoding and display of one or several of the following data on the ATC radar scope :
  - coded aircraft symbol,
  - flight number or aircraft registration,
  - flight level,
  - climb descent or level flight symbol,
  - ground speed,
  - alert messages (squawk codes 7500, 7600, 7700).
- Whenever ground radar beam hits the aircraft, the onboard ATC transponder transmits a reply.
- There are two interrogation modes :
  - Mode which transmits a selectable code number for aircraft identification.
  - Mode which transmits the aircraft's flight altitude.
- Two transponders are installed (SYS 1 or SYS 2), and are controlled by a common control panel on the center pedestal.
- Only one transponder is operating while the other is in stand-by.
- ADC 1 and 2 provide altitude information to their respective transponder.
- Transponder 1 is supplied by the AC EMER BUS, and transponder 2 is supplied by the AC BUS 2.
- Transponder faults are indicated on the control panel.
- The ATC control panel includes the following controls and indications :
  - A switch to activate the selected transponder.
  - A switch to select transponder 1 or 2.
  - A switch to activate the altitude reporting.
  - Fault and reply indication lights.
  - A display window and rotary selector knobs, for selection and display of the assigned transponder code.
  - An IDENT pushbutton switch.

Note 1 : The ATC transponder system can be tested using ATC pushbutton switch on the AVIONICS SYST TEST panel.

Note 2 : At high aircraft pitch attitudes the transponder's transmission of ATC information can be lost.

SYSTEM INTERFACE

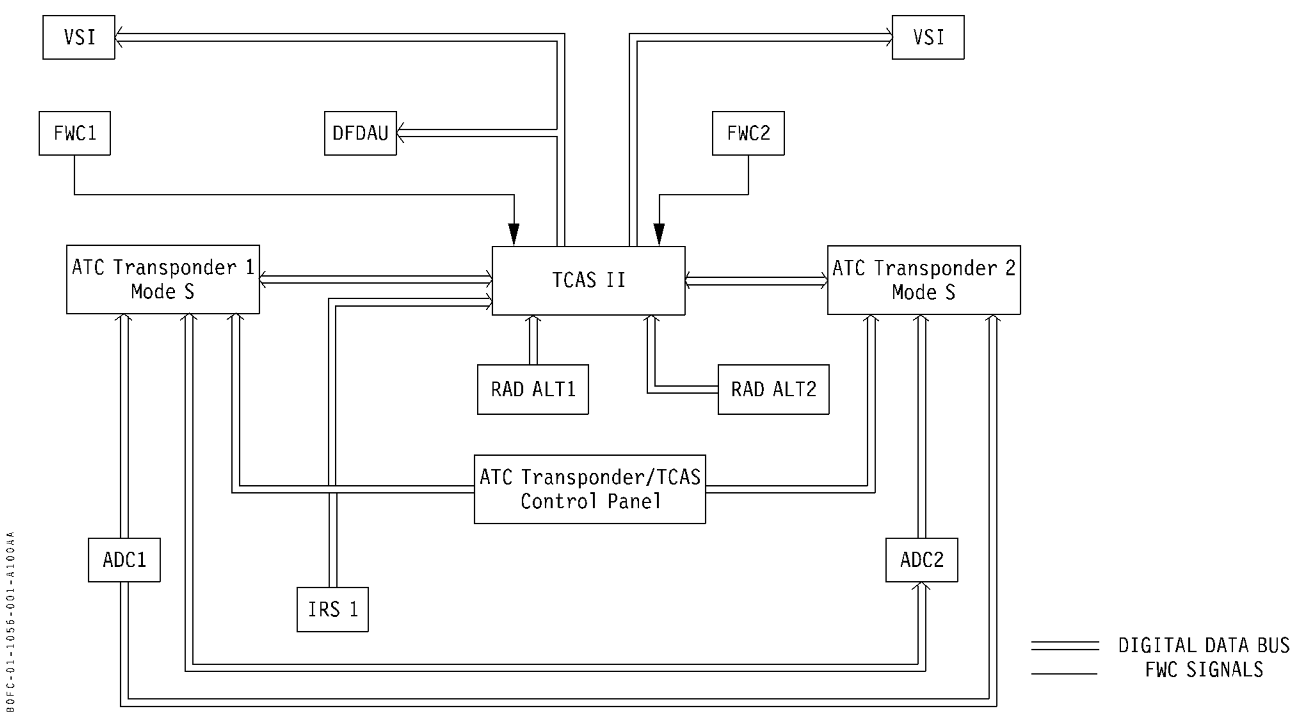


GENERAL

- The Traffic and Collision Avoidance System (TCAS) is a back-up and supplement to the separation services provided by the ground based Air Traffic Control (ATC).
- The TCAS preserves the ATC separation by :
  - tracking of the nearby aircraft equipped with mode A, mode C or mode S transponders,
  - evaluating the potential for separation conflicts,
  - providing Traffic Advisory (TA) alerts and display,
  - providing Resolution Advisory (RA) alerts and associated guidance for evasive maneuver (vertical speed target for evasive action in the vertical plane).

SYSTEM COMPONENTS AND INTERFACES

- The system consists of :
  - a computer which :
    - performs airspace surveillance,
    - track nearby intruder(s),
    - generates traffic information for display,
    - assesses the potential for separation conflicts,
    - generates resolution guidance for display,
    - activates audio messages,
  - two omnidirectional antennas,
  - two mode S ATC Transponders and a combined ATC Transponder / TCAS control panel,
  - two modified Vertical Speed Indicators (VSI) to display TCAS information and guidance.



R Code : 0225

PRINCIPLE

- The system is designed to protect a volume of airspace around the TCAS equipped aircraft. The TCAS detects the presence of nearby intruder aircraft equipped with mode A, mode C or mode S ATC Transponders.
- From an intruder transponder replies, the TCAS computes the following information :
  - distance between the aircraft and the intruder,
  - relative bearing to the intruder,
  - altitude and vertical speed of the intruder (if intruder reports altitude),
  - closing rate between the intruder and the aircraft.
- Using these data the TCAS predicts the time to, and the separation at, the intruders closest point of approach.
- If the TCAS predicts that an intruder will violate a first protection envelope, a Traffic Advisory (TA) is generated to alert the flight crew that a closing traffic is in the vicinity.
- If the intruder continues to converge and violate a second protection envelope, a Resolution Advisory (RA) is generated together with vertical speed guidance in order to maintain a safe vertical separation between the aircraft and the intruder.
- Due to the limitation of the display, only 8 intruders can be represented in a volume of + 2700 ft/ – 9900 ft or – 2700 ft/+ 9900 ft relative to the aircraft altitude and 6 nm range.

INTRUDER CLASSIFICATION

OTHER

- Any intruder which is between 9 900 ft and 1 200 ft above or below the aircraft altitude and within 6 nm range.

PROXIMATE ADVISORY (PA)

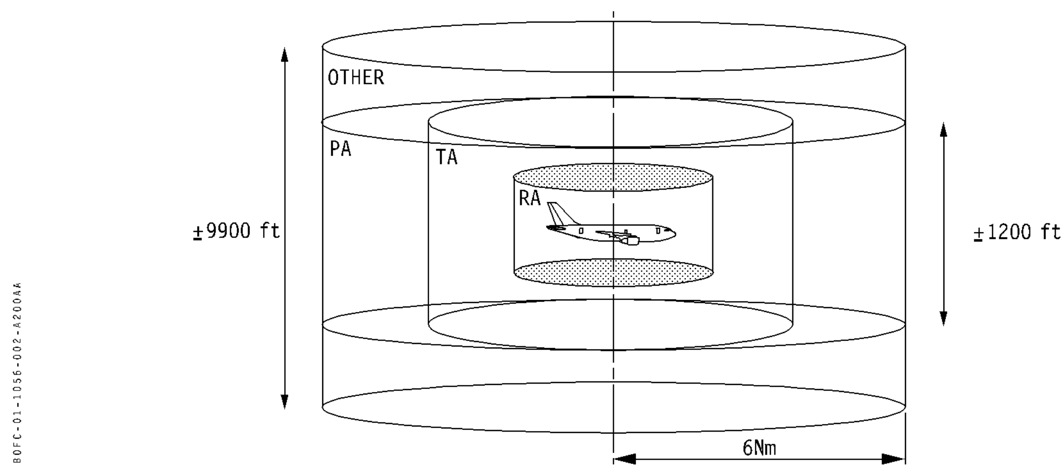
- Any intruder which is within ± 1 200 ft and within 6 nm range.
- It is not considered as a threat.

TRAFFIC ADVISORY (TA)

- The intruder is considered to be a potential threat and approximately 40 seconds from the closest point of approach.
- "TRAFFIC, TRAFFIC" audio message is activated.

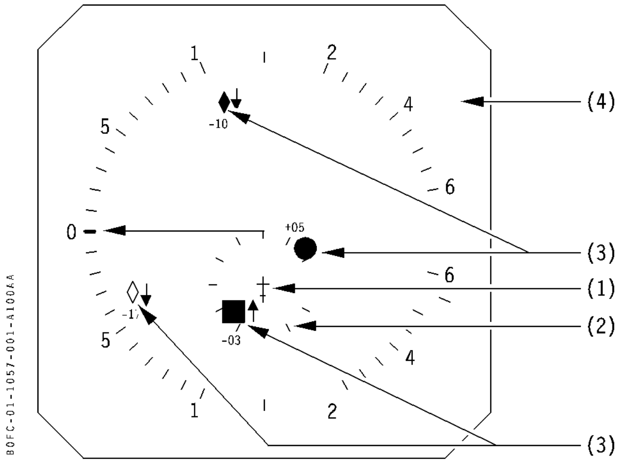
RESOLUTION ADVISORY (RA)

- The intruder is predicted to be a collision threat and approximately 25 seconds from the closest point of approach.
- An appropriate audio message is triggered and a vertical speed target range is displayed on the VSI as guidance to conduct the evasive maneuver.



R Code : 0233

INFORMATION DISPLAYED ON THE VSI



(1) Own Aircraft Symbol

(2) 2 nm Scale

- It corresponds to a 2 nm scale around the own aircraft position.

(3) Intruder Symbols

- Form and color :
  - RA : filled-in red square,
  - TA : filled-in yellow circle,
  - PA : filled-in cyan diamond,
  - OTHER : unfilled cyan diamond.
- A + (-) indicates that the intruder is above (below) the own aircraft.
- The two digits indicate the relative altitude of the intruder rounded to the nearest one hundred feet.

  When the intruder is above (below) own aircraft, the digits are above (below) the intruder symbol.
- The arrows indicate that the intruder is climbing (↑) or descending (↓), at a rate of at least 500 ft/min.

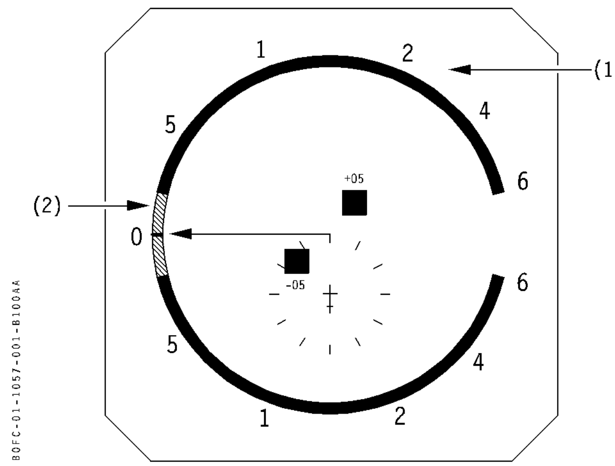
(4) VSI Scale

- See VERTICAL SPEED INDICATOR in this chapter.

PREVENTIVE AND CORRECTIVE RESOLUTION ADVISORIES

- Resolution advisories alert the flight crew to a vertical maneuver that :
  - must be avoided (preventive advisory), or
  - must be performed (corrective advisory),

  in order to prevent a separation conflict or a possible mid air collision.



(1) Red Arc(s)

- Whenever a TA or RA alert is generated, a red arc is displayed on the VSI.
  - TA : the red arc indicates the vertical speed range to be avoided and advises the flight crew against a change in the vertical flight path (preventive advisory).
  - RA : the red arc indicates the vertical speed range which, if penetrated, would result in a separation conflict or a possible collision.

(2) Green Arc

- When a RA alert is generated, a green arc is displayed on the VSI to indicate that a change in the present flight path is required and to provide the vertical speed range to be achieved during the evasive maneuver (corrective advisory).

R Code : 0225

ADVISORY MESSAGES

- TA / RA alerts are accompanied by one of the following messages :

"TRAFFIC, TRAFFIC"

- TA alert.

"CLIMB, CLIMB"

- Climb at the V/S indicated by the green arc on the VSI.

"CLIMB, CROSSING, CLIMB" (twice)

- Same as above. Indicates that the aircraft will cross through intruder altitude.

"INCREASE CLIMB" (twice)

- Triggered after CLIMB message if the aircraft V/S is not sufficient to achieve a safe vertical separation, increase the V/S as indicated on the VSI by the green arc.

"ADJUST VERTICAL SPEED, ADJUST"

- Adjust V/S as indicated on the VSI by the green arc, reducing climb speed or descent speed as appropriate.

"DESCEND, DESCEND"

- Descend at the V/S indicated by the green arc on the VSI.

"DESCEND, CROSSING, DESCEND" (twice)

- Same as above. Indicates that the aircraft will cross through intruder altitude.

"INCREASE DESCENT" (twice)

- Triggered after DESCENT message if the aircraft V/S is not sufficient to achieve safe vertical separation, increase the V/S as indicated on the VSI by the green arc.

"CLIMB, CLIMB NOW" (twice)

- Triggered after DESCEND message if the intruder trajectory has changed.

"DESCEND, DESCEND NOW" (twice)

- Triggered after CLIMB message if the intruder trajectory has changed.

"MONITOR VERTICAL SPEED"

- Ensure that V/S remains outside the red area (preventive advisory).

- Triggered only once if leaving from a previous corrective resolution advisory.

"MAINTAIN VERTICAL SPEED, MAINTAIN"

- Indicates a non -crossing advisory type, maintain V/S indicated by the green arc on the VSI.

"MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN"

- Indicates an altitude crossing advisory type, maintain V/S indicated by the green arc on the VSI.

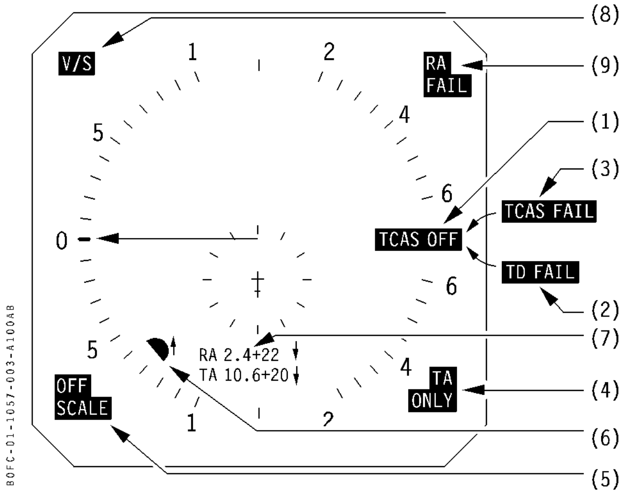
"CLEAR OF CONFLICT"

- Range is increasing and separation id adequate.

- The pilot can return to assigned clearance.

R Code : 0218

FLAG DISPLAYED ON THE VSI



(1) TCAS OFF Message

- This message is displayed in white when the TCAS mode selector is in the STBY position.

(2) TD FAIL Message

- This message is displayed in yellow in case of failure in the Traffic Display (TD) function.
- When this flag is displayed, no traffic is displayed.

(3) TCAS FAIL Message

- This message is displayed in yellow if the TCAS
R computer or the TCAS system fails, or if both
R radio altimeters fail.

(4) TA ONLY Message

- This message is displayed when the TCAS mode selector is in the TA position.
- The message is white during normal operation, and yellow when one or more TA are displayed.

(5) OFF SCALE Message

- This message is displayed in white when the TCAS computer is tracking RA or TA intruders that are beyond the display range.

(6) Intruder Off Scale

- Half of the appropriate symbol is displayed at the edge of the display area in the direction of the traffic bearing.
- Data and vertical trend arrows can be off scale.

(7) No-bearing Intruders

- When bearing data is not available, positioning the intruder symbol is not possible. However a message for RA and TA (two maximum) is displayed.
- The message is displayed in red (RA), yellow (TA) or white (PA).
- In the above example, the two non-bearing messages indicate the following traffics:
  - RA, 2.4 nm, 2200 ft above aircraft level, descending.
  - TA, 10.6 nm, 2000 ft above aircraft level, descending.

(8) V/S Message

- Refer to VERTICAL SPEED INDICATOR section.

(9) RA FAIL Message

- This message is displayed in yellow when the indicator has an internal failure associated with one or the following functions:
  - Resolution Advisory,
  - Vertical Speed.

Note : When the red flag V/S is displayed, the flag RA FAIL is displayed.

R Code : 0227

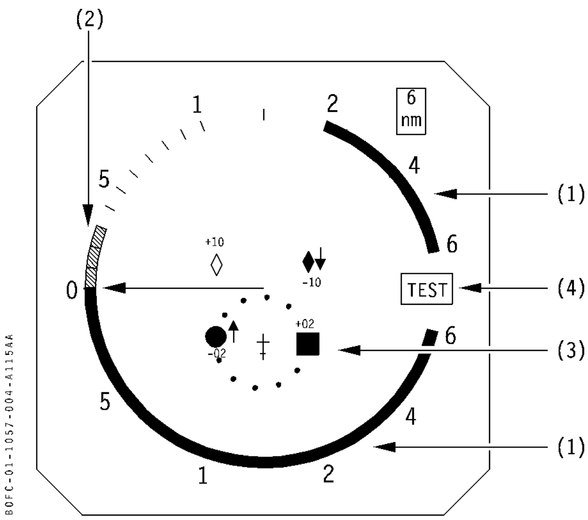
TEST FUNCTION
(Maintenance purposes)

- To check the correct operation of the TCAS, press the ATC transponder TCAS pushbutton switch installed on the maintenance panel.

  This test can also be performed by the TEST pushbutton switch located on the ATC/TCAS control panel (if installed).

- At the end of the sequence test, the system generates an audio message :
  – TCAS SYSTEM TEST OK, or
  – TCAS SYSTEM TEST FAIL.

- The auto test controls the main functions of the TCAS computer and displays on the VSI :



(1) Red Arc (Vertical Speed Range)

(2) Green Arc (Vertical Speed Range)

(3) Intruder Data

- Four intruders are displayed as indicated on the schematic above.

(4) Test Message

INHIBITIONS

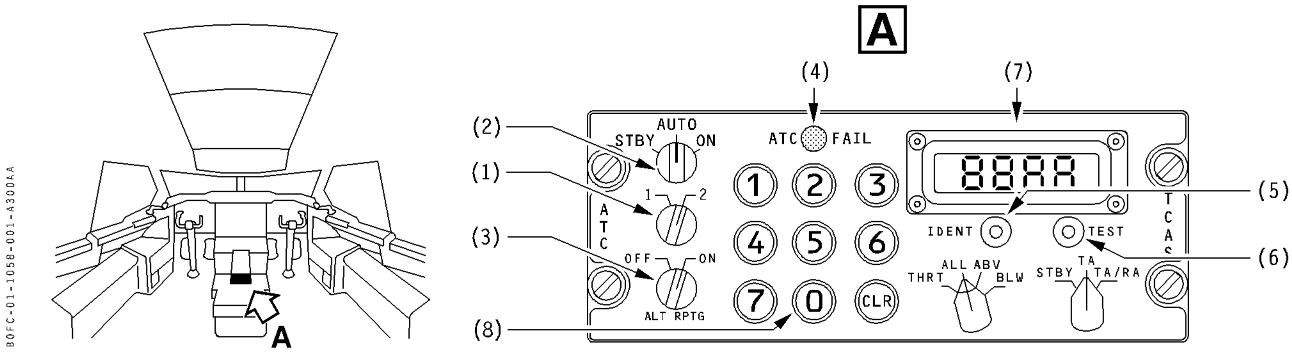
- Some advisories are inhibited depending on the aircraft altitude :
  – Below 1100 ft AGL in climb and 900 ft AGL in descent, all RA displays and aural messages are inhibited.
  – Below 600 ft in climb and 400 ft in descent, all TA aural messages are inhibited.
  – TCAS systematically eliminates responses from aircraft at an altitude below 400 ft in climb, and below 260 ft in descent when its own altitude is below 1700 ft Above Ground Level (AGL).
  – Below 1000 ft AGL in descent, RA ”DESCEND” message is inhibited.
  – Below 1200 ft AGL in climb, RA ”DESCEND” message is inhibited.
  – Below 1450 ft AGL in descent, RA ”INCREASE DESCENT” message is inhibited.
  – Below 1650 ft AGL in climb, RA ”INCREASE DESCENT” message is inhibited.

Note : Windshear, stall and GPWS messages have priority over TCAS messages.

R Code : 0234

ATC / TCAS CONTROL PANEL

- ATC and TCAS use a common control panel.



ATC PART

(1) SYS 1/2 Selector

- Selects the desired ATC transponder (1 or 2).

(2) STBY/AUTO/ON Selector

- **STBY**
  - The selected ATC transponder is electrically supplied but not operating.
- **AUTO**
  - In flight, selected ATC transponder operates.
  - On ground, modes A and C replies are inhibited, only mode S data link transmissions are operative.
- **ON**
  - The selected ATC transponder operates.

(3) ALT RPTG Selector

R
- **ON**
  - Altitude reporting is active.
- **OFF**
  - There is no altitude data transmission.
  - TCAS is inoperative.

(4) ATC FAIL Light

- Illuminates in case of failure of the selected ATC transponder.

(5) IDENT Pushbutton Switch

- When pressed, identification signal is transmitted.

(6) TEST Pushbutton Switch

- Initiates the ATC/TCAS test sequence.

(7) Code Display

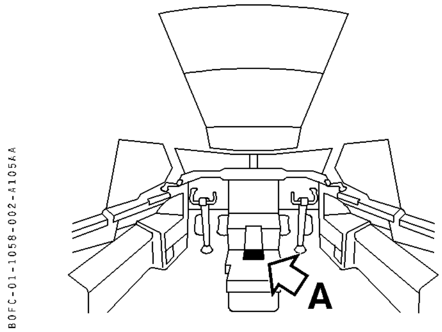
- Displays the assigned or selected code.

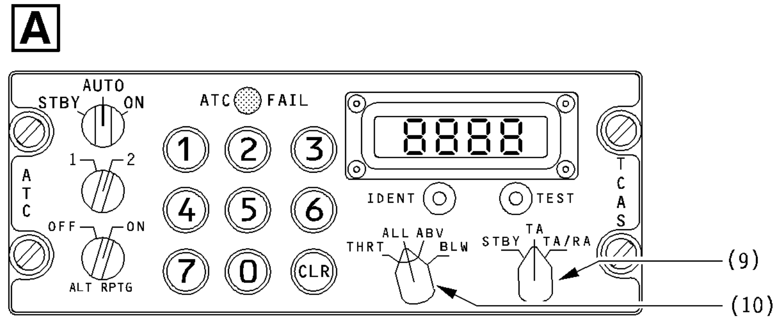
(8) ATC Code Selection Keys

- Used for entering a new code and/or clearing the display code.

Code : 0197

ATC / TCAS CONTROL PANEL (continued)





TCAS PART

(9) STBY / TA / TA/RA Selector

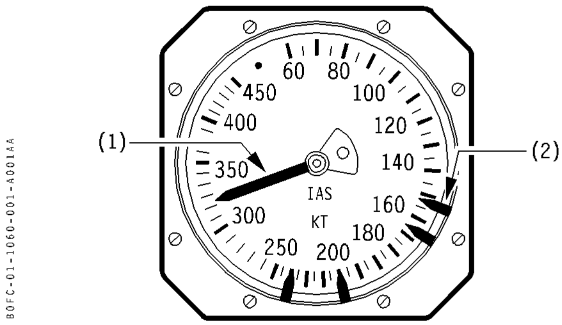
- **TA/RA**
  - If ATC transponder and ALT RPTG switches are in ON position, all TCAS functions are operable.
- **TA**
  - If ATC transponder switch is in ON position, only the Traffic Advisory TA function is active.
- **STBY**
  - TCAS is inoperative.

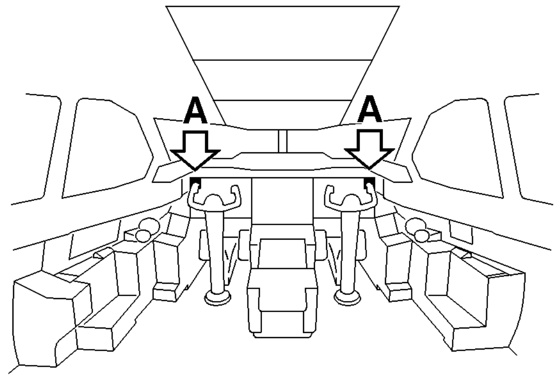
(10) THRT/ALL/ABV/BLW Selector

- **THRT**
  - If selected, the display is in THREAT TRAFFIC configuration. OTHER and PA intruders are only displayed if a RA or a TA is already displayed.
- **ALL**
  - ALL traffic configuration is full time displayed.
- **ABV**
  - Allows to display the intruders flying from 2 700 ft below to 9 900 ft above the aircraft altitude.
- **BLW**
  - Allows to display the intruders flying from 9 900 ft below to 2 700 ft above the aircraft altitude.

Mod : 11351

A. STANDBY AIRSPEED INDICATORS





- The Standby Airspeed Indicators (ASI) are directly supplied with standby static and standby pitot pressures.

- Standby ASI do not require electrical power.

(1) Airspeed Pointer

- Pointer indicates the airspeed on a graduated scale from 60 to 450 kt.

- When the aircraft is stopped (no headwind), pointer should be aligned with the white dot.

(2) Airspeed Index Bugs

- Theses moveable bugs are provided for marking speed references (V_R, V_2, Green Dot, V_{REF}, etc...).

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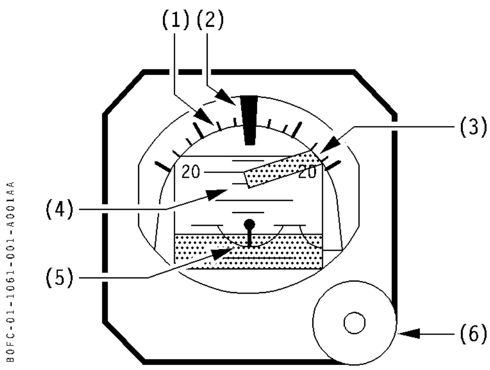
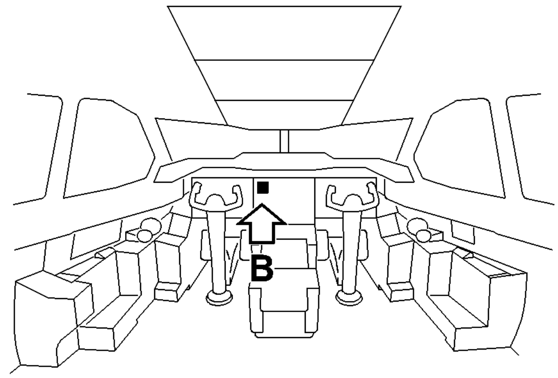
B. STANDBY ARTIFICIAL HORIZON





- The Standby Horizon is supplied anytime the DC ESS BUS is supplied (even on battery power only) and provides backup attitude reference in the event of loss PFD attitude reference.

(1) Bank Angle Scale

- The roll scale is graduated in 10° increments from 10° to 60°.

(2) Roll Pointer

- A pointer rolls with the aircraft and points at the bank angle on the bank angle scale.

(3) Flag

- A red flag is displayed in case of instrument failure or loss of electrical power supply.

(4) Pitch Scale

- The aircraft pitch attitude is indicated by reference to the aircraft symbol.

(5) Aircraft Reference

- The aircraft symbol is fixed.

(6) Caging Knob

- When pulled, the gyro is erected, leveling and centering the horizon.

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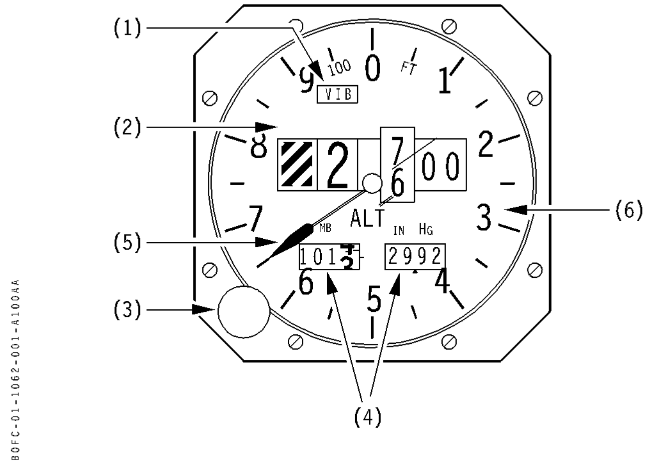
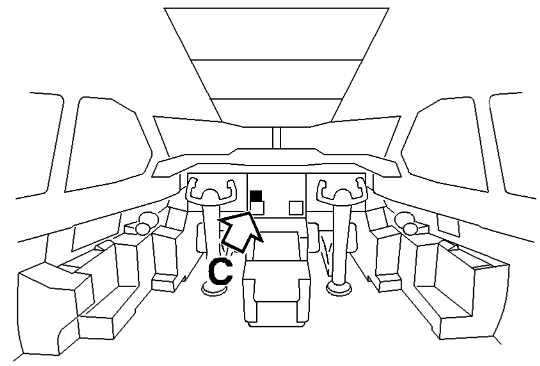
C. **STANDBY ALTIMETER**





- The standby altimeter provides backup altimeter reference in case of failure of the Main Altimeter. No electrical power is required for its operation (except for the internal vibrator).
- It is supplied from the standby pitot-static system.
- An internal vibrator minimizes the effect of mechanical friction to ensure a smooth pointer movement.
- The vibrator operates only in flight.

(1) VIB Flag

- The amber VIB flag appears in case of failure of the internal vibrator, and when the aircraft is on ground.
- The standby altimeter can still be used, but altitude pointer movement can be jerky.

(2) Altitude Counter

- The digital counter indicates ten thousands, thousands and hundreds of feet.
- A white and black striped flag masks the ten thousands indication when below 10 000 ft.
- A red and white striped flag masks the ten thousands indication when altitude is negative.

(3) Baroset Knob

- Sets barometric pressure reference in the millibars (mb) and inches of mercury (inHg) windows.

(4) Baroset Windows

- Two windows indicate the barometric pressure reference set with the Baroset knob, one in millibars (745 to 1 050 mb) and the other in inches of mercury (22 to 31 inHg).

(5) Analog Altitude Pointer

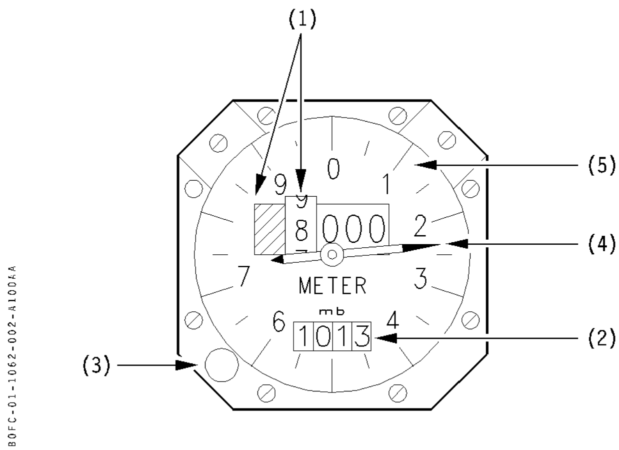
- One pointer revolution equals 1 000 ft of altitude change.

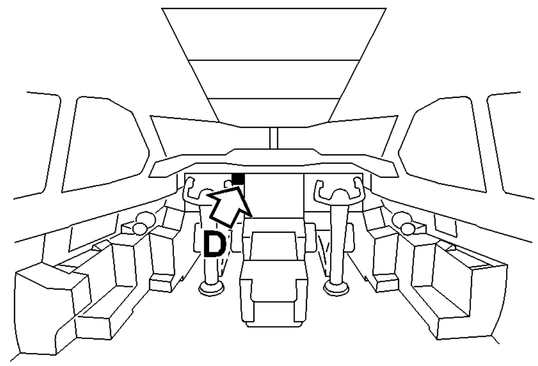
(6) Altitude Dial Scale

- The dial is graduated from 0 to 1 000 in 50 ft increments.
- The 100 ft graduations are numbered 0 to 9.

Mod : 3832

D. STANDBY METRIC ALTIMETER





- The standby metric altimeter is supplied from the standby pitot-static system.

(1) Altitude Counter

- The digital counter indicates ten thousands and thousands of meters.
- A white and black striped flag masks the ten thousands indication when below 10 000 m.
- A red and white striped flag masks the ten thousands indication when altitude is negative.

(2) Baroset Windows

- The window indicate the barometric pressure reference set with the Baroset knob in millibars (870 to 1 050 mb).

(3) Baroset Knob

- Sets barometric pressure reference in millibars (mb).

(4) Analog Altitude Pointer

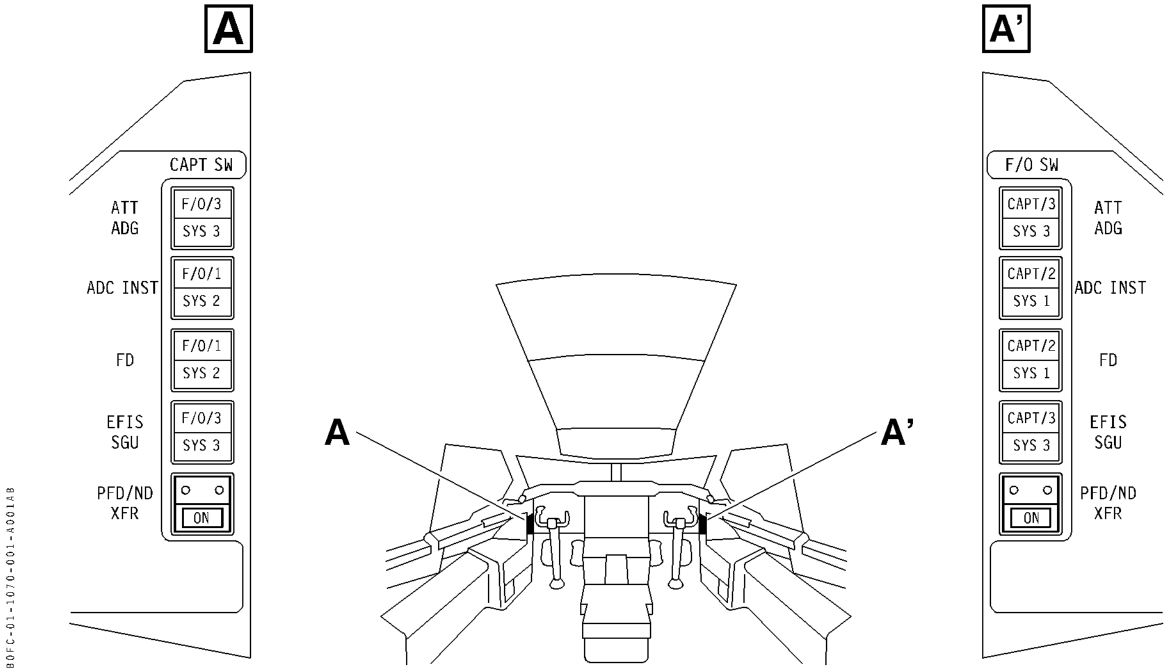
- One pointer revolution equals 1 000 m of altitude change.

(5) Altitude Dial Scale

- The dial is graduated from 0 to 1 000 in 50 m increments.
- The 100 m graduations are numbered 0 to 9.

Mod : 3221

CAPT AND F/O SWITCHING PANELS



- In case of loss of the primary data source, flight instruments can be switched to an alternate source (SYS 3) or share the data of the opposite primary source (SYS 2 for CAPT switching, SYS 1 for F/O switching).

R
- The switching is performed by pressing the associated pushbutton switch on the affected side SWITCHING panel.

ATT HDG Pushbutton Switch

R
- Enables to switch from the primary IRS source (IRS 1 for CAPT, IRS 2 for F/O) to standby IRS 3, for recovery of ATT and HDG data.

ADC INST Pushbutton Switch

R R
- Enables to share the other pilot's ADC and FAC data, for recovery of speed, altitude and speed limits information.

FD Pushbutton Switch

- Enables to share the other pilot's FCC, for recovery of the FD bars and guidance. R

EFIS SGU Pushbutton Switch

- Enables to switch from the primary SGU source (SGU 1 for CAPT, SGU 2 for F/O) to standby SGU 3, for recovery of PFD/ND displays. R

PFD/ND XFR Pushbutton Switch

- Enables to transfer the PFD display on the lower CRT and the ND display on the top CRT, for recovery of PFD or ND display in case of CRT failure, or for convenience. R R

STD or Mod : (4803 + 5884)

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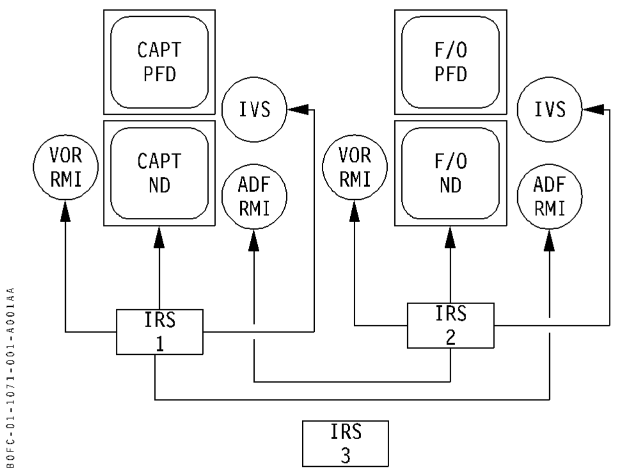
NORMAL OPERATION

- The IRS provides the flight instruments with inertial reference information and attitude.

- In the normal configuration IRS 1 supplies the CAPT's instruments, IRS 2 supplies the F/O's instruments.

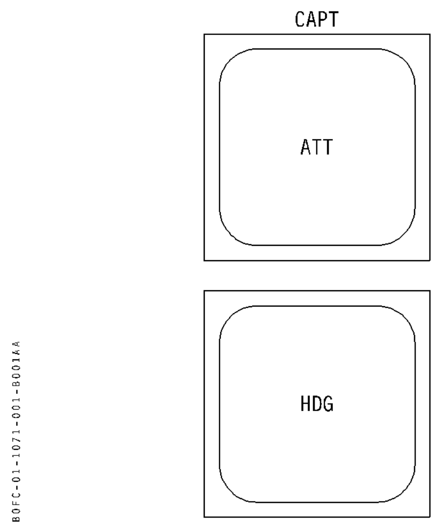
  IRS 3 is in standby and is available as an alternate source.



R • As illustrated above to enable cross-checking of
R heading references, each ADF RMMI displays the
R heading information from the opposite side.

IRS FAILURE

- The following example illustrates the loss of the IRS 1 :



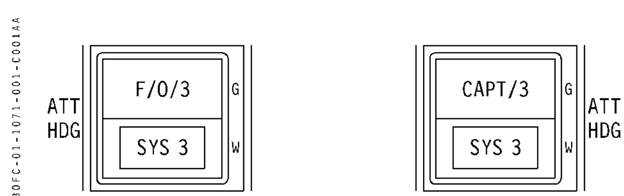
– A red ATT message is displayed on CAPT PFD,

– A red HDG message is displayed on CAPT ND.

Note : *IRS failure also causes the loss of Inertial Vertical Speed (IVS) on affected VSI and of heading references on the associated VOR RMI.*

IRS RECOVERY

- In case of IRS failure, the affected crew member can recover the attitude and heading data from the IRS3 by pressing the ATT HDG pushbutton on the SWITCHING panel :



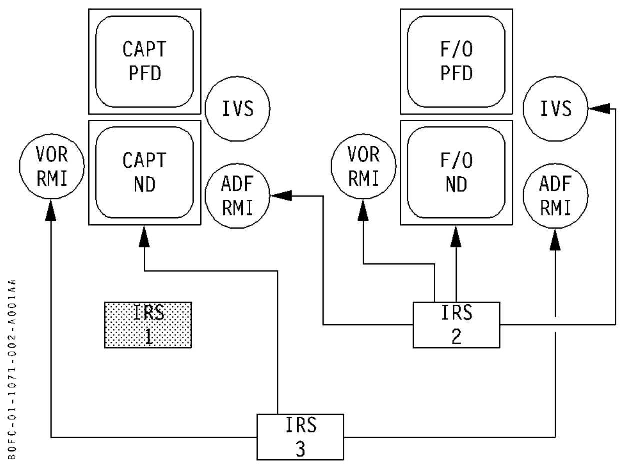
IRS SWITCHING PRIORITY

- The CAPT has priority over selection of IRS 3. Once the CAPT has selected IRS 3 by pressing his ATT HDG pushbutton switch, the F/O cannot select IRS 3.
- Likewise, if the F/O has selected IRS 3, and then the CAPT presses his own ATT HDG pushbutton switch, the CAPT will take over IRS 3, and the F/O's selection of IRS 3 will be cancelled.

IRS DATA RECOVERY

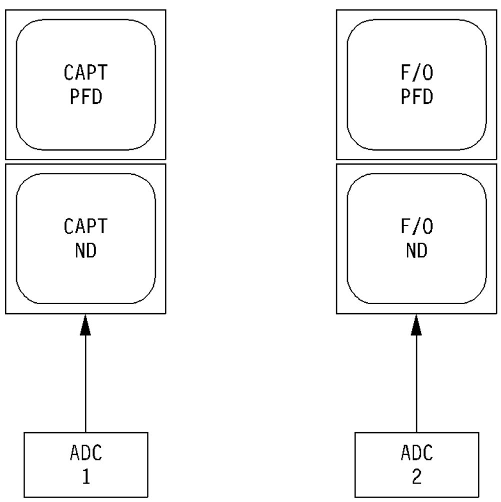
- To recover information from IRS 3, press CAPT ATT HDG pushbutton switch :
  - "SYS 3" illuminates on CAPT ATT HDG pushbutton switch to confirm that IRS 3 is in use.
  - "CAPT/3" illuminates on F/O ATT HDG pushbutton switch to notify the F/O that the CAPT is using IRS 3.
- IRS 3 now supplies the CAPT's flight instruments and F/O's ADF RMI.

Note : In this case CAPT, vertical speed indicator is supplied by the ADC only.



NORMAL OPERATION

- The Air Data Computers (ADC) provide the flight instruments with airspeed, altitude and vertical speed information.
- The Flight Augmentation Computers (FAC) provide the speed limits (V_{SS}, V_{LS}, F, S, Green Dot and V_{MAX}) and speed trend for presentation on the PFD speed scale.
- In the normal configuration ADC 1 supplies the CAPT's instruments and ADC 2 supplies the F/O's instruments.



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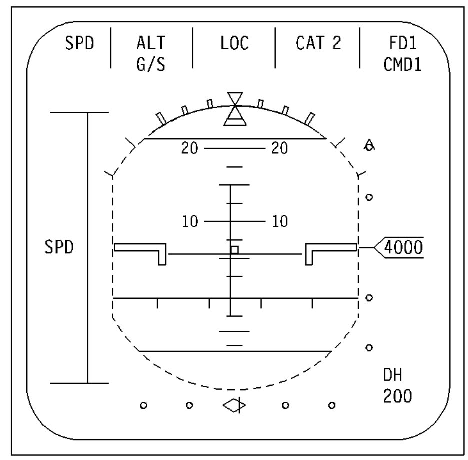
ADC FAILURE

- The following example illustrates the loss of the ADC 1 :
  – A red SPD message replaces speed scale on CAPT PFD.



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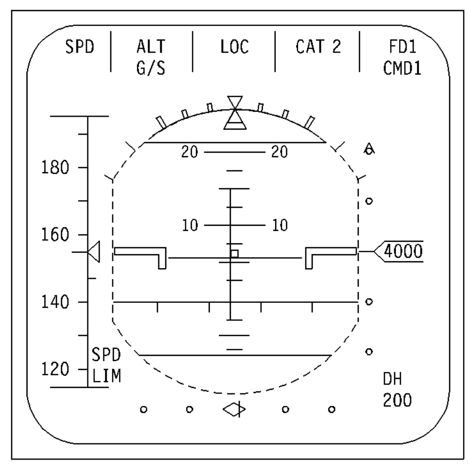
Note : FAC failure causes the loss of the speed limits and the speed trend on the PFD speed scale accompanied by a red SPD LIM message at the bottom of the speed scale.



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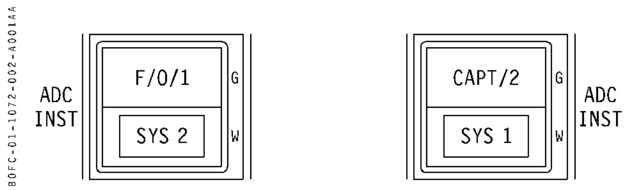
ADC DATA RECOVERY

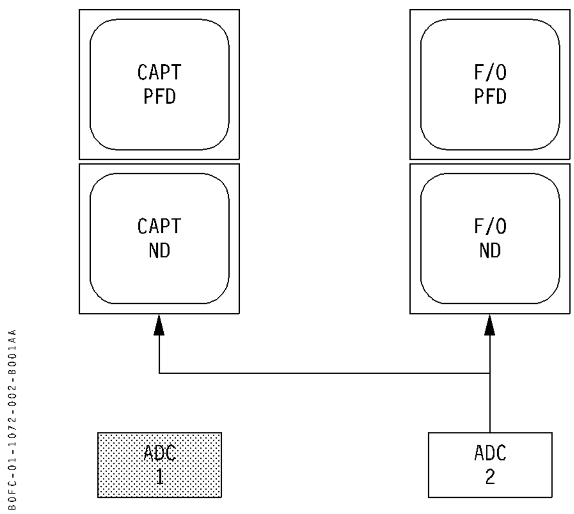
- In case of ADC failure, the affected crew member can share the data from the opposite ADC by pressing the ADC INST pushbutton on the SWITCHING panel :



  – "SYS 2" illuminates on CAPT ADC INST pushbutton switch to confirm that ADC 2 and FAC 2 are in use .

  – "CAPT/2" illuminates on F/O ATT HDG pushbutton switch to notify the F/O that the CAPT is sharing F/O's ADC and FAC.

- ADC 2 now provides data to both pilots' EFIS.

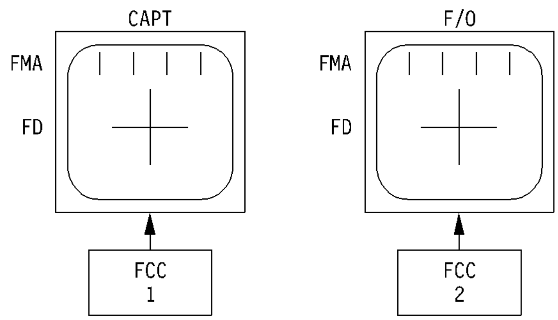


Note : Simultaneous cross supply (CAPT instruments from ADC 2/FAC 2 and F/O instruments from ADC 1/FAC 1) is not possible.

Note : In the above single-ADC configuration, the CAPT and F/O PFD speed scales reflect the same speed information, any speed cross-check must be performed against the standby airspeed indicator.

NORMAL OPERATION

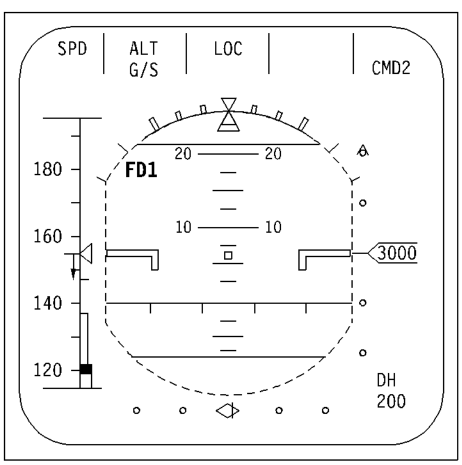
- The Flight Control Computers (FCC) supply the Flight Director bars commands and autoflight system (AP/FD-A/THR) Flight Mode Annunciator (FMA) operating modes.
- In the normal configuration FCC 1 supplies the CAPT's FD and FMA and FCC 2 supplies the F/O FD and FMA.



FD FAILURE

- The following example illustrates the loss of the
R FCC 1 (with an autopilot engaged in CMD) :
  - A red FD1 message is displayed on CAPT PFD.

R

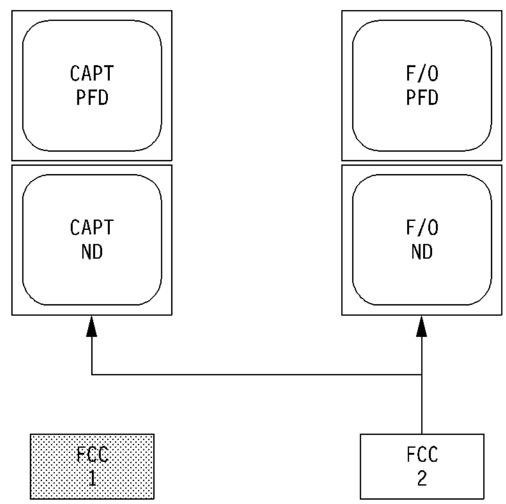


FD RECOVERY

- In case of FD failure, the affected crew member can share the data from the opposite FD receiver by pressing the FD pushbutton on the SWITCHING panel :

  - "SYS 2" illuminates on CAPT FD pushbutton switch to confirm that FD 2 is in use.
  - "CAPT/2" illuminates on F/O FD pushbutton switch to notify the F/O that the CAPT is sharing F/O's FCC.

- FCC 2 now provides data to both pilot PFD's.



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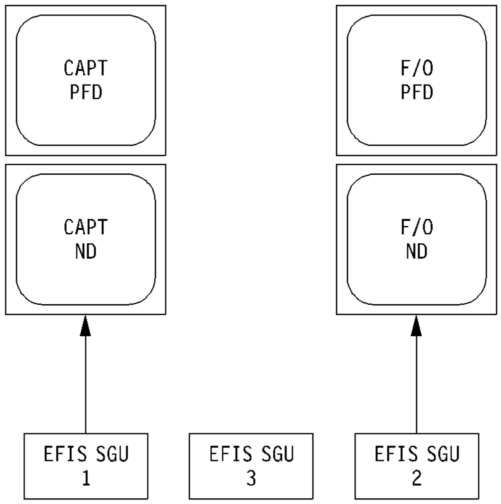
NORMAL OPERATION

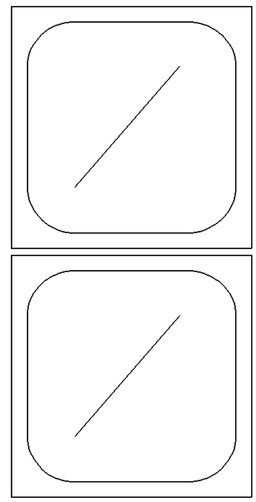
- The EFIS Symbol Generator Units (SGU) generate the pictures which are presented on the PFD and ND.
- In the normal configuration EFIS SGU 1 supplies the CAPT's PFD and ND, EFIS SGU 2 supplies the F/O's PFD.
- SGU 3 is in standby and is available as an alternate source.



B0FC-01-1074-001-A001AA

EFIS SGU FAILURE

- The following example illustrates the loss of the EFIS SGU 1 :
  - White diagonal lines are displayed on both Cathodic Ray Tubes (CRT).



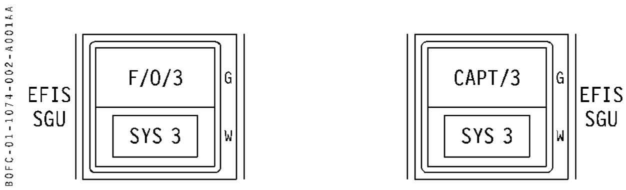
B0FC-01-1074-001-B001AB

EFIS SGU SWITCHING PRIORITY

- The CAPT has priority over selection of EFIS SGU 3. Once the CAPT has selected EFIS SGU 3 by pressing his EFIS SGU pushbutton switch, the F/O cannot select EFIS SGU 3.
- Likewise, if the F/O has selected EFIS SGU 3, and then the CAPT presses his own EFIS SGU pushbutton switch, the CAPT will take over EFIS SGU 3, and the F/O's selection of SGU 3 will be cancelled.

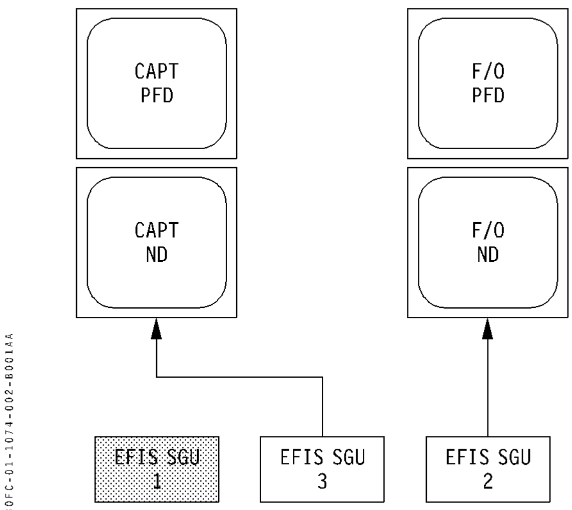
EFIS SGU RECOVERY

- In case of EFIS SGU failure, the affected crew member can share the data from the SGU3 by pressing the EFIS SGU pushbutton on the SWITCHING panel :



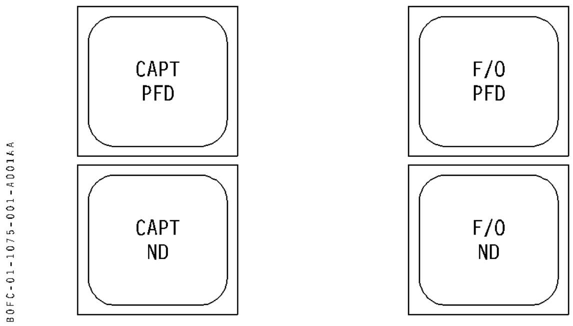
  – "SYS 3" illuminates on CAPT EFIS SGU pushbutton switch to confirm that SGU 3 is in use.
  – "CAPT/3" illuminates on F/O EFIS SGU pushbutton switch to notify the F/O that the CAPT is using SGU 3.

- EFIS SGU 3 now supplies the CAPT's EFIS.



NORMAL OPERATION

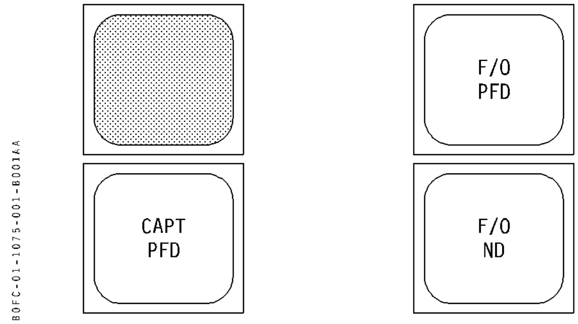
- In the normal configuration the PFD is displayed on the upper Cathodic Ray Tube (CRT) and the ND is displayed on the lower CRT.



- If desired, the PFD can be displayed on the lower CRT by pressing the PFD/ND XFR pushbutton switch.

CRT FAILURE

- The following example illustrates the loss of the CAPT's upper CRT :
  - the CAPT upper CRT is completely blank or fails to display data correctly.



CRT RECOVERY

- The affected display (PFD or ND) can be presented on the remaining CRT by using the PFD/ND XFR pushbutton switch.

- The affected display can be also transfered to the other CRT by switching the affected display to OFF.

- The PFD is now displayed on the CAPT's lower CRT.

STD or Mod : (5846 + 11123)

LEFT BLANK INTENTIONALLY

Not applicable

LEFT BLANK INTENTIONALLY

Not applicable

Not applicable

Not applicable

LEFT BLANK INTENTIONALLY

GENERAL

- The Enhanced Ground Proximity Warning System (EGPWS) includes :
  - one EGPWS computer,
  - two GPWS-G/S warning light/pushbutton switches on the Captain and First Officer's instrument panels,
  - one GPWS FAULT light and a GPWS selector switch on the CAPT SWITCHING panel,
  - one TERR MODE light/pushbutton switch on the CAPT SWITCHING panel,
  - two TERR light/pushbutton switches on the left side of each Navigation Display,
  - an audio warning system.
- The EGPWS provides visual and audio synthetic voice warnings to alert the flight crew about potential terrain conflicts.
- The basic GPWS warning modes are :
  - Mode 1 : excessive sink rate,
  - Mode 2 : excessive terrain closure rate,
  - Mode 3 : descent after take-off,
  - Mode 4 : inadvertent proximity to terrain,
  - Mode 5 : descent below ILS glide slope.

Note : Mode 5 is active only when a valid ILS glide slope signal is being received. Mode 5 warnings are inhibited for ILS "Back Course".

- The enhanced functions are :
  - A Terrain Awareness and Display (TAD) function which can predict a potential conflict with terrain ahead of the aircraft and display terrain data on the ND.
  - A Terrain Clearance Floor (TCF) function which alerts the flight crew of excessive terrain closure during approach.
- Visual alerts (on Captain and F/O's GPWS-G/S warning lights and ND) :
  - Modes 1 to 4 : red "GPWS" lights illuminate,
  - Mode 5 : amber "G/S" lights illuminate,
  - TAD : red "GPWS" lights illuminate and the appropriate colour is displayed on the ND
  - TCF : both red "GPWS" and amber "G/S" lights illuminate.
- Audio warnings : specific synthetic voice phrases are given for each individual alert.
- All EGPWS audio warnings can be cancelled with the EMER AUDIO CANCEL switch.
- A 3-position (NORM - FLAP OVRD - OFF) GPWS selector switch is located on the Captain's instrument panel.
  - If landing with flaps 20 or less, selecting FLAP OVRD inhibits the "TOO LOW FLAPS" warnings (mode 4B).
  - Modes 1 to 5 alerts can be inhibited by selecting the switch to the OFF position.
    Enhanced functions are not inhibited.
  - When the selector switch is in the FLAP OVRD position, the GPWS OVRD light illuminates.
- Illumination of the amber GPWS FAULT light on the CAPT SWITCHING panel indicates GPWS mode 1 to 5 failure.
- A TERR MODE pushbutton switch, when released, inhibits TAD and TCF functions.
  The white OFF light illuminates.
- A TERR MODE FAULT light indicates a failure of TAD and/or TCF functions.
- Captain and F/O TERR pushbutton switches allow the crew to select or deselect terrain data display on the onside ND, only in ARC or MAP mode.
  The ON ND green light illuminates.

  Note 1 : If a CAUTION or a WARNING alert is triggered, and there is no PREDICTIVE WINDSHEAR warning, terrain data is automatically displayed on the ND and the ON ND light illuminates.

R Code : 0002

Note 2 : The terrain data display is characterized by the message TERR on the left side of the ND and the TILT value is forced at "+ 00.0".

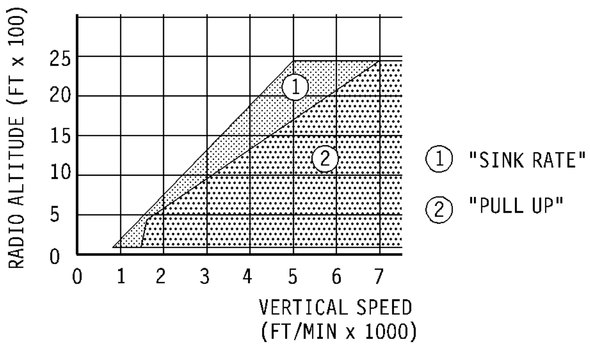
R
- The EGPWS can be tested on ground by pressing either the Captain or the F/O's GPWS-G/S pushbutton switch.
- Mode 5 (below glide slope) warnings can be momentarily inhibited (for example, for a non-precision approach) by pressing the G/S MODE pushbutton switch.
- A GPWS LANDING SLATS/FLAPS switch is used to inform the EGPWS of the selected landing configuration.
- All EGPWS alerts are inhibited if the stall warning or windshear warning (if installed) is activated.
- The EGPWS is electrically supplied from the AC BUS 1.

Note 1 : Several airports around the world have terrain located on their approach or departure flight path which penetrates the standard EGPWS warning profiles. When operating to/from these airports, the IRS position is used to modify the warning profile and avoid nuisance warnings.

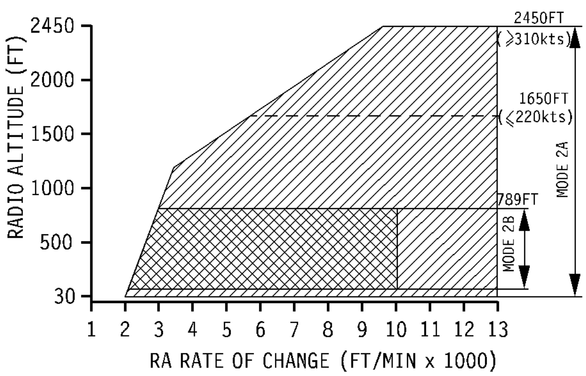
Note 2 : EGPWS processes information from ADC 1, ILS 1, IRS 1, FMC 1, Radio Altimeter 1, SFCC 1 and SFCC 2, SYS 2 nose gear down lock sensor, stick shakers 1 and 2, PWS 1 and 2, CAPT and F/O EFIS CP.

R Code : 0037

MODE 1:EXCESSIVE SINK RATE



MODE 2:EXCESSIVE TERRAIN CLOSURE RATE



MODE 2A - FLAPS 20 OR LESS, OR 40 OR LESS (*)

"TERRAIN TERRAIN" THEN CONTINUOUS "PULL UP"UNTIL THE A/C DEPARTS FROM THE WARNING ENVELOPE. AFTER BOUNDARY IS DEPARTED "TERRAIN" WILL PERSIST AS LONG AS IN THE WARNING AREA AND A 300 FT BARO ALTITUDE GAIN IS NOT OBTAINED.

(*) DEPENDING ON THE GPWS LANDING FLAPS SWITCH POSITION

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MODE 2B

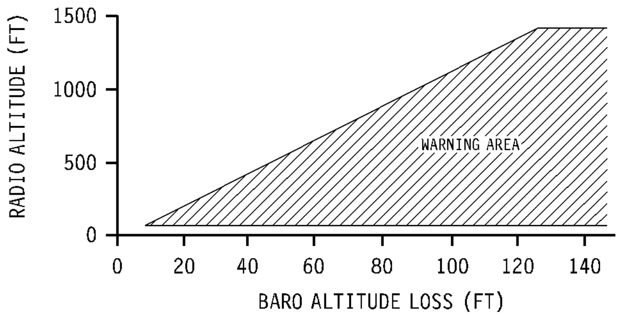
- Lowering the flaps to the landing position automatically switches the EGPWS to Mode 2B. The lower part of the Mode 2B boundary is controlled as a function of Radio Altitude and Altitude Rate when Flaps are in full landing configuration.

- Mode 2B is also selected when the aircraft is performing an ILS approach and the Glideslope and Localizer deviations are less than 2 dots. In this case the lower boundary is controlled only as a function of Radio Altitude (and no RA + Altitude Rate), having a constant lower cutoff of 30 feet AGL. When the Flaps are selected to landing configuration on the ILS Glideslope beam, the lower boundary is activated.

- Inside the envelope boundary conditions, the message is ″TERRAIN, TERRAIN″ followed by ″PULL UP″ if the condition persists (and white gear up). With both gear and flaps down, only ″TERRAIN, TERRAIN, TERRAIN″ is used.

R Code : 0042

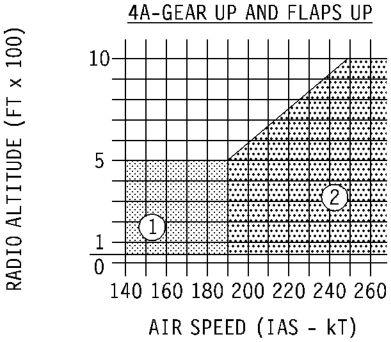
MODE 3:DESCENT AFTER TAKE-OFF



IF A DESCENT IS MADE DURING THE INITIAL TAKE-OFF CLIMB, OR DURING A GO AROUND A REPEATED "DON'T SINK" AURAL ALERT IS GENERATED.

MODE 4:INADVERTENT PROXIMITY TO TERRAIN

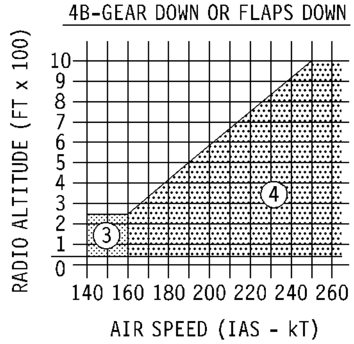
4A-GEAR UP AND FLAPS UP



1 "TOO LOW GEAR"

2 "TOO LOW TERRAIN"

4B-GEAR DOWN OR FLAPS DOWN

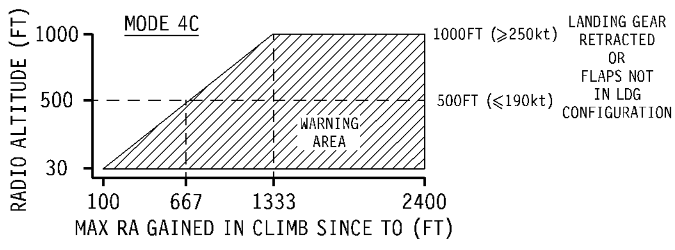


3 "TOO LOW FLAPS" (IF FLAPS NOT IN LANDING CONFIGURATION *) OR "TOO LOW GEAR" (IF GEAR NOT EXTENDED) R

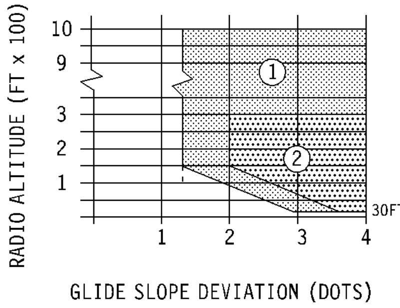
4 "TOO LOW TERRAIN"

(*) DEPENDING ON THE GPWS LANDING SLATS/FLAPS SWITCH POSITION (if installed).

MODE 5:DESCENT BELOW GLIDE SLOPE



MODE 4C IS PROVIDED TO PREVENT INADVERTANT CONTROLLED FLIGHT INTO TERRAIN DURING TAKE OFF AND CLIMB. PENETRATION OF THE BOUNDARY GENERATES THE ILLUMINATION OF THE GPWS LIGHTS AND A REPEATED AURAL WARNING "TOO LOW TERRAIN".

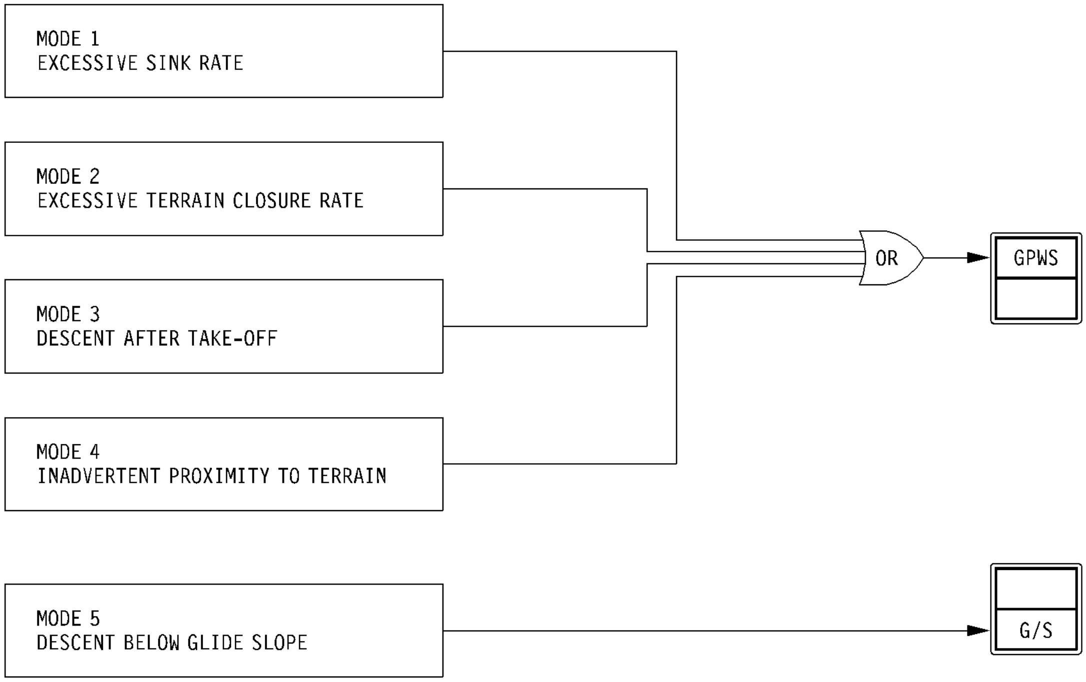


1 "GLIDE SLOPE" SOFT ALERT

2 "GLIDE SLOPE" HARD ALERT (INCREASED LEVEL)

BOFC-01-1081-002-A110AA

Code : 0042



WARNING PRIORITIES

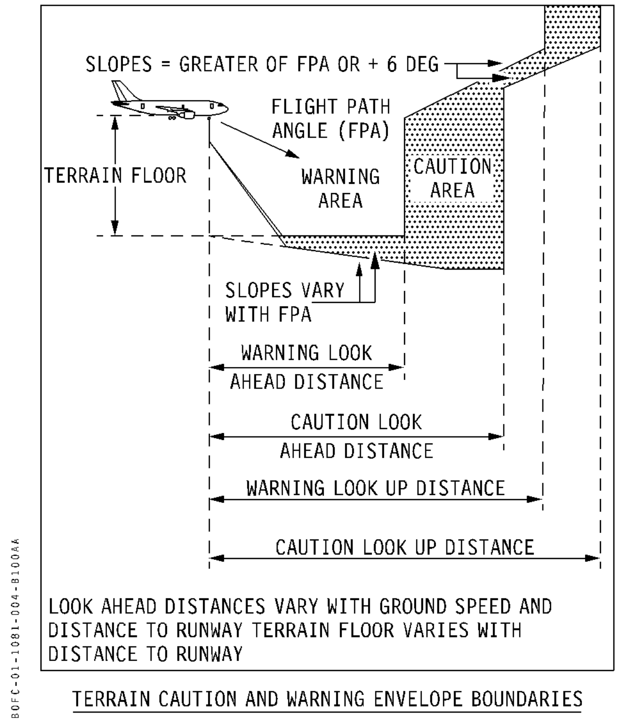
1 - PULL UP
2 - TERRAIN
3 - TOO LOW TERRAIN
4 - TOO LOW GEAR
5 - TOO LOW FLAPS
6 - SINK RATE
7 - DON'T SINK
8 - GLIDE SLOPE

80FC-01-1081-003-A110AA

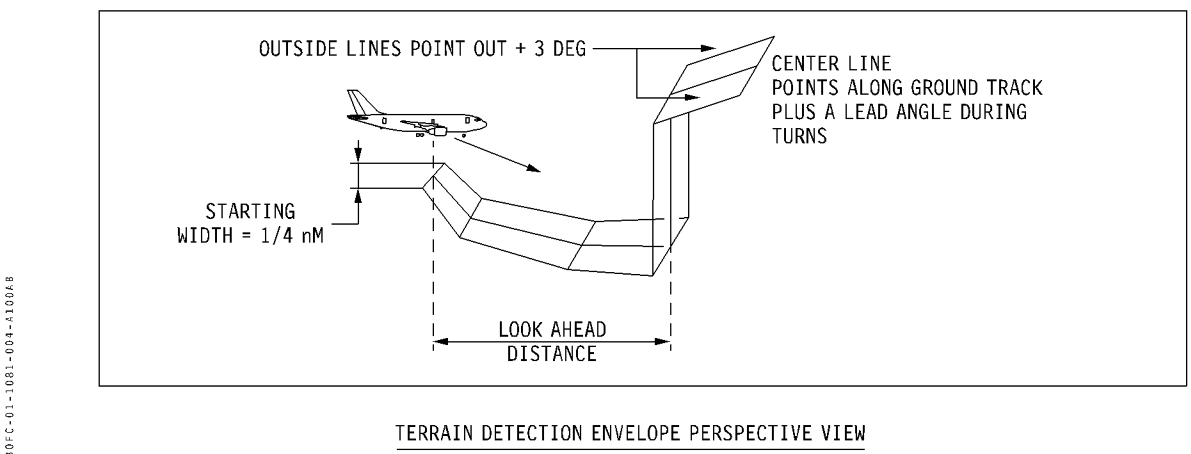
R Code : 0044

TERRAIN CAUTION AND WARNING ENVELOPES

- The EGPWS continuously computes two envelopes ahead of the aircraft :
  - the first one corresponds to a CAUTION alert,
  - the second one corresponds to a WARNING alert.
- Both envelopes are calculated as a function of :
  - the aircraft altitude,
  - the ground speed,
  - the turn rate.
- Both envelopes are defined by :
  - a look-ahead distance,
  - an altitude offset below the aircraft
  - a lateral distance on either side of the aircraft.
- Both envelopes are :
  - vertically aligned with the aircraft flight path,
  - horizontally aligned with the aircraft ground track.
- The look-ahead distance is computed as a function of the aircraft ground speed so that :
  - the CAUTION alert is activated between 40 and 60 seconds before the predicted conflict,
  - the WARNING alert is activated between 20 and 30 seconds before the predicted conflict.



TERRAIN CAUTION AND WARNING ENVELOPE BOUNDARIES

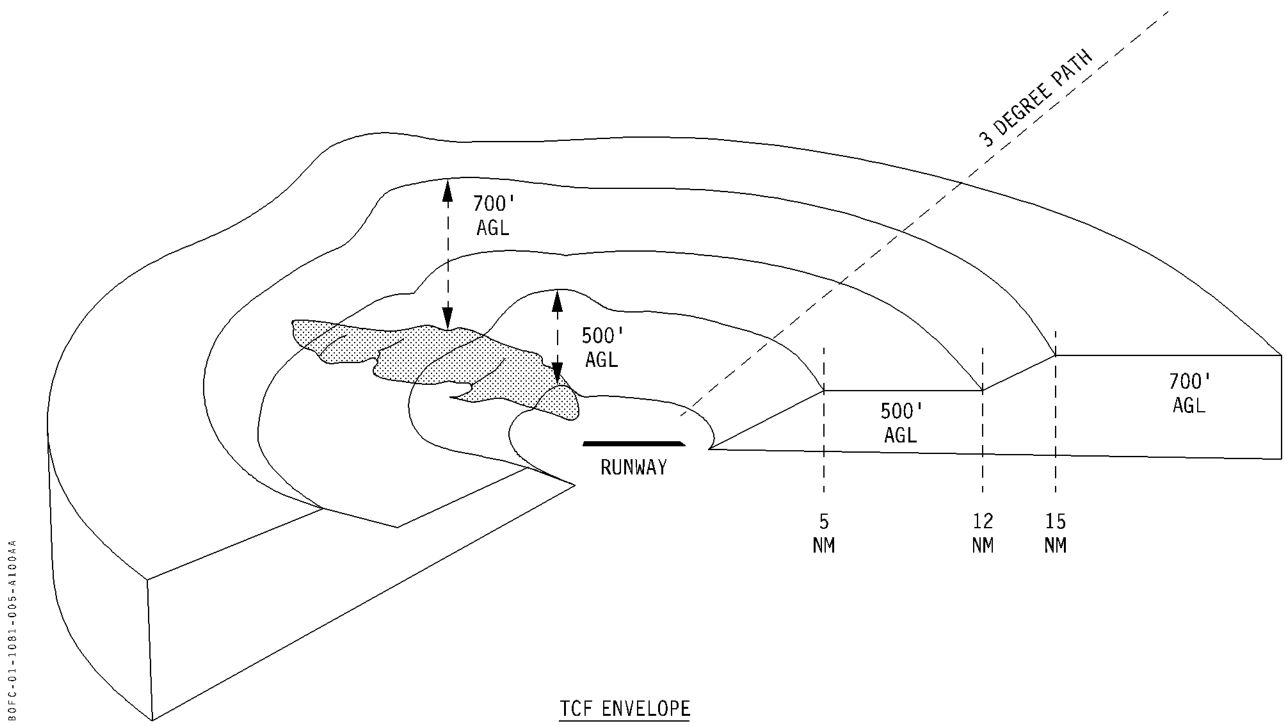


TERRAIN DETECTION ENVELOPE PERSPECTIVE VIEW

R Code : 0065

TERRAIN CLEARANCE FLOOR

- The EGPWS computes a Terrain Clearance Floor (TCF) which is an envelope surounding the nearest runway.
- The TCF is active during the take-off, cruise and final approach flight phases.
- The TCF is based on the radio altitude and may generate an alert as a fonction of the barometric altitude or the radio altitude in case of a barometric altitude discrepancy.



TCF ENVELOPE

R Code : 0065

TERRAIN CAUTION ALERT

- If the CAUTION envelope conflicts with terrain in the EGPWS database, a CAUTION alert is activated.
- The CAUTION alert consists of :
  - a vocal message TERRAIN AHEAD, repeated every 7 seconds until conditions disappear,
  - the illumination of the GPWS red light,
  - the display of TERR amber and a solid yellow area in front of the aircraft symbol on the ND (refer to 1.10.83 page 1)

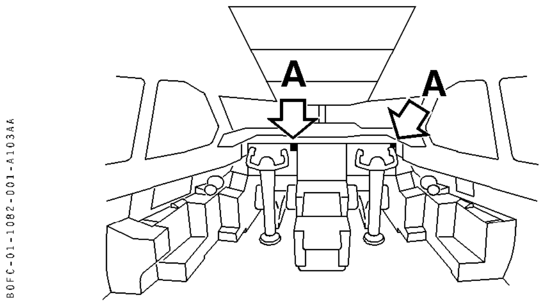
TERRAIN WARNING ALERT

- If the WARNING envelope conflicts with terrain in the EGPWS database, a WARNING alert is activated.
- The WARNING alert consists of :
  - a vocal message TERRAIN AHEAD, PULL UP repeated continuously until conditions disappear,
  - the illumination of the GPWS red light,
  - the display of TERR red and a solid red area in front of the aircraft symbol on the ND (refer to 1.10.83 page 1).

TERRAIN CLEARANCE FLOOR ALERT

- If the aircraft radio or barometric altitude conflicts with the TCF, a TCF alert is activated.
- The TCF alert consists of :
  - a vocal message TOO LOW TERRAIN, activated at first TCF penetration and repeated each time the radio altitude decreases by 20 %.
  - the illumination of both GPWS red light and G/S amber light.
- The TCF alert is activated even if the aircraft is in a landing configuration.
- The TCF alert is inhibited below a radio altitude of 30 ft.

R Code : 0065



A. GPWS-G/S Pushbutton Switches

- Each of these two identical pushbutton switches on the Captain and F/O's instrument panels include a GPWS and G/S warning light.

■ **GPWS light (red)**

– Illuminates when any warnings for modes 1 through 4 are activated.

– The associated voice warning is simultaneously generated.

■ **G/S light (amber)**

– Illuminates when a below glide slope alert (mode 5) is activated.

– The associated ″GLIDE SLOPE″ voice warning is generated simultaneously.

■ **Pressed on ground**

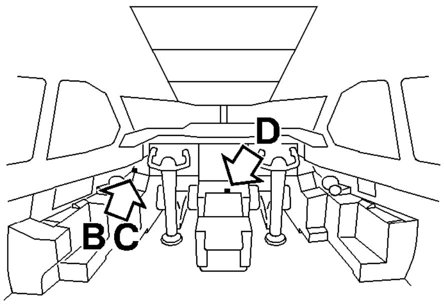
– If pressed momentarily :

- The self test warning is generated (self test is not available in flight with EGPWS).
  – Amber GPWS ″FAULT″ light illuminates on CAPT SWITCHING panel.
  – Amber TERR MODE ″FAULT″ light illuminates.
  – Amber ″G/S″ warning light illuminates on Captain and F/O's GPWS - G/S switches, with one ″GLIDE SLOPE″ voice warning.
  – Amber G/S warning light extinguishes.
  – Red ″GPWS″ warning light illuminates on Captain and F/O's GPWS - G/S switches with one ″PULL UP″ voice warning.
  – The ″TERRAIN AHEAD PULL UP″ aural warning comes on.
  – The test pattern is shown on ND and ″ON ND″ legend on both TERR pushbuttons illuminates.
  – ″GPWS″ warning lights extinguishes.
  – Test pattern (on both NDs) goes out of view.
  – ″ON ND″ legend on TERR pushbuttons extinguishes.
  – ″FAULT″ lights of GPWS and TERR MODE extinguish.

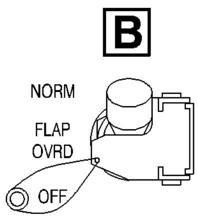
– If pressed for more than 5 seconds the full EGPWS self test is generated :

- Amber GPWS ″FAULT″ light illuminates on CAPT SWITCHING panel.
- On Captain and F/O's GPWS - G/S switches :
  – amber ″G/S″ warning light illuminates then extinguishes,
  – red ″GPWS″ warning light illuminates then extinguishes.
- During the self test sequence, all voice warnings are generated as follows :
  – all the warnings described in 1.10.81 p3.
- The GPWS amber ″FAULT″ light extinguishes.

Mod : 11894



B. GPWS Selector Switch



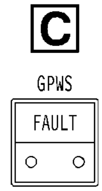
- This switch is guarded and lockwired in the NORM position.

■ **NORM**
- All GPWS warnings are available.

■ **FLAP OVRD**
- This position can be selected if landing with less than full flaps.
- FLAP OVRD inhibits nuisance "TOO LOW FLAPS" warning (Mode 4) if an approach is intentionally flown with less than full flaps.

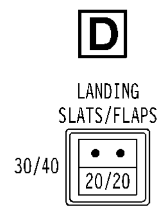
■ **OFF**
- Selected in case of GPWS malfunction.
- All warnings are inhibited.
- FAULT light illuminates.

C. GPWS Warning Light



- FAULT illuminates amber when a GPWS malfunction exists.
- When illuminated, all GPWS warnings are inhibited.

D. GPWS LANDING SLATS/FLAPS Switch

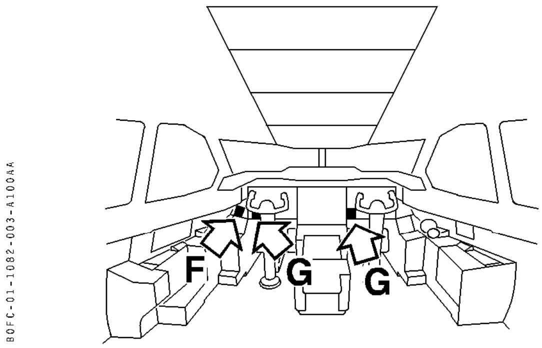


- When the landing gear shock absorbers are compressed, the switch automatically trips down to the 30/40 position.

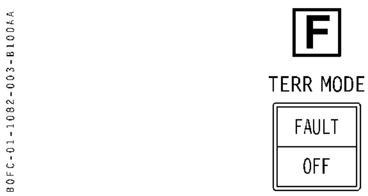
■ **20/20**
- The warnings in mode 4 are inhibited for flaps 20 or more.

■ **30/40**
- The warnings in mode 4 are inhibited for flaps 40.

Mod : 4803 + 5697 + 6234



F. EGPWS TERR MODE Pushbutton Switch



- This switch located on the Captain's switching panel includes one FAULT and one OFF lights.

■ **Pressed**

– The enhanced functions (TAD and TCF) are available.

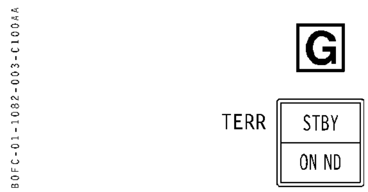
■ **Depressed**

– The enhanced functions (TAD and TCF) are inhibited.

– The OFF light illuminates.

- The FAULT light illuminates when a malfunction exists in the enhanced functions (TAD or TCF).

G. EGPWS TERR momentary Pushbutton Switches



- Pressing one TERR momentary pushbutton switch, located on the left side of each ND, enables the selection/deselection of the terrain display on the onside (only in ARC or MAP mode).

- The ON ND light illuminates green when terrain data is displayed on the onside ND.

- The STBY light illuminates blue when terrain data is not available from EGPWC.

R Code : 0208

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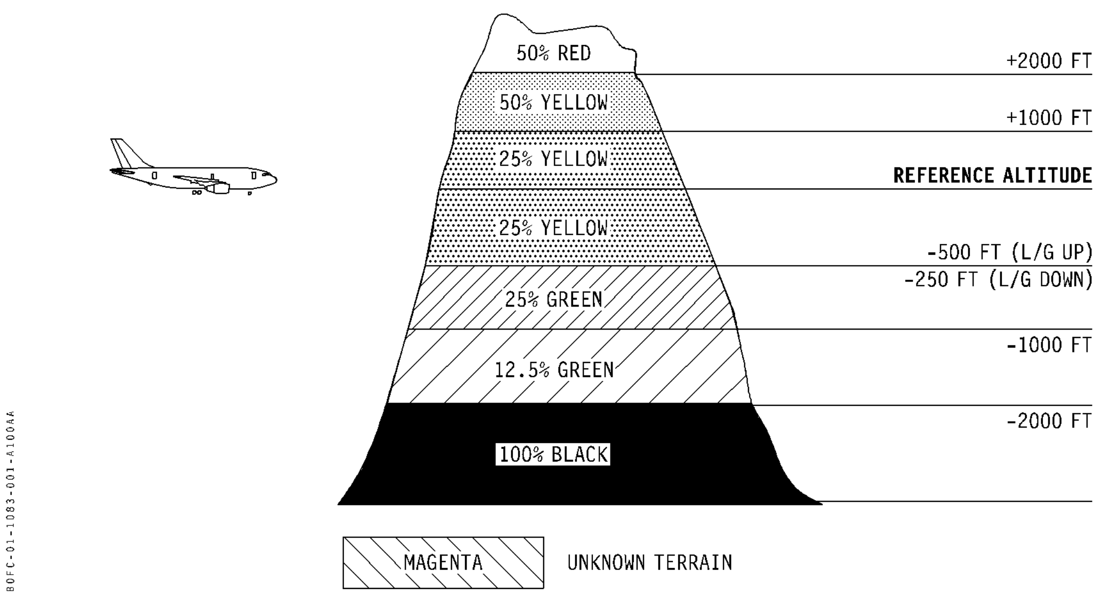
R Code : 0064

TERRAIN DISPLAY ON THE NAVIGATION DISPLAY

- The EGPWS generates a display of the terrain ahead of the aircraft with an indication of the potential conflicts.
- The terrain is displayed independently on each Captain or First Officer's ND, in ARC or MAP mode.
- The terrain is displayed on one ND if :
  - The onside TERR ON ND pushbutton switch is pressed in the ON ND position, or
  - A CAUTION or WARNING alert is activated,

  and no WINDSHEAR alert is activated.
- The terrain is displayed in a weather radar display format and replaces the weather radar display.
- The terrain display is distinguished from the weather radar display by the TERR message on the left side of the ND and the TILT value forced at "+00.0".
- The terrain data is displayed on the ND with reference to a code of colors and textures, which indicates the threat of the terrain (refer to the graph below).



R Code : 0065

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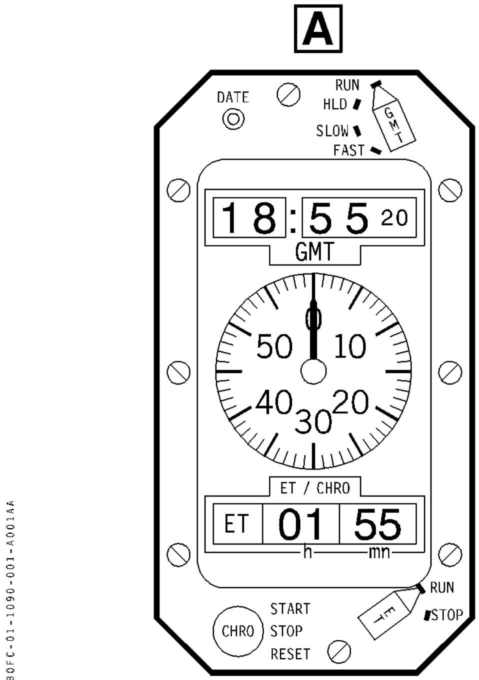
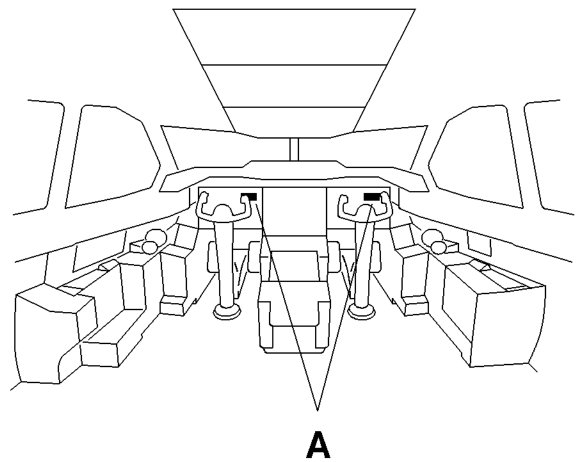
R Code : 0065

GENERAL

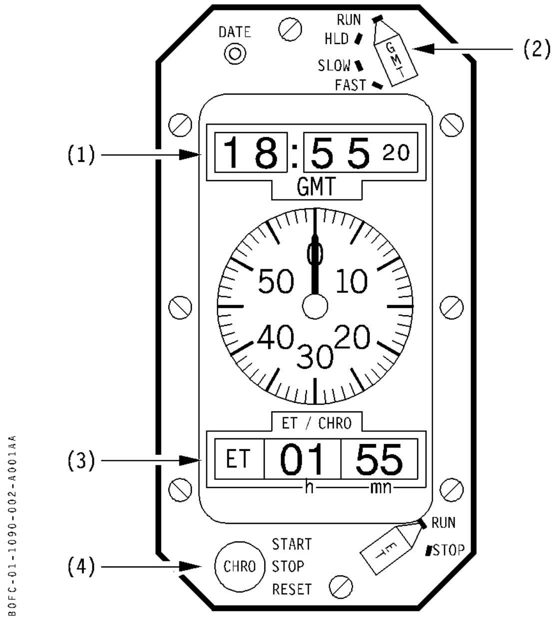




- A clock is available on each main instrument panel.
- Each of these two clocks has a remote pushbutton switch on the control wheel to operate the Stopwatch (CHRO) function.
- Captain's clock provides GMT data for FMC 1 and the F/O's clock provides GMT output for the Digital Flight Data Recorder and FMC 2.
- Each clock is supplied by two electrical power supply circuits, one of which is direct from the aircraft batteries to allow clocks continued operation when the aircraft is parked without any electrical power supply.

STD or FDX

OPERATIONAL DESCRIPTION



(1) GMT Window

- Displays hours, minutes and every 10 seconds.

(2) GMT Selector

- This 4-position switch is used to set GMT.

■ **FAST**

– Sets the hours.

– Sets GMT month if DATE pushbutton switch is pressed and held.

■ **SLOW**

– Set the minutes.

– Sets GMT day if DATE pushbutton switch is pressed and held.

■ **HLD (Hold)**

– Used to stop the GMT clock (for example to synchronize clock with GMT time reference).

■ **RUN**

– The GMT clock runs continuously.

– When the clock has been set, this is the normal position of this switch.

Note : To move out of the RUN position, the GMT selector must be pressed in before it can be turned.

(3) ET (Elapsed Time) Counter

- Displays hours and minutes elapsed since the Elapsed Time (ET) switch was placed in ET.

Note : When the stopwatch (CHRO) is in use, this counter is covered by the CHRO counter but Elapsed Time recording continues uninterrupted.

(4) CHRO (stopwatch) Pushbutton Switch

- When ET is displayed (as in (3) in the above clock illustration), the stopwatch is not running.

- Pressing the CHRO pushbutton switch (or the remote pushbutton switch on the control yoke) starts the stopwatch.

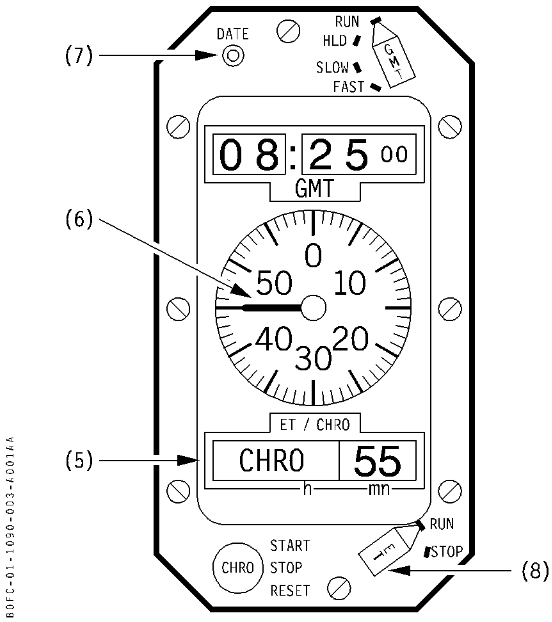
- A display of whole minutes elapsed since starting the stopwatch appears, masking the ET counter, and the sweep second hand indicates seconds (see (5) and (6) in the clock illustration on next page).

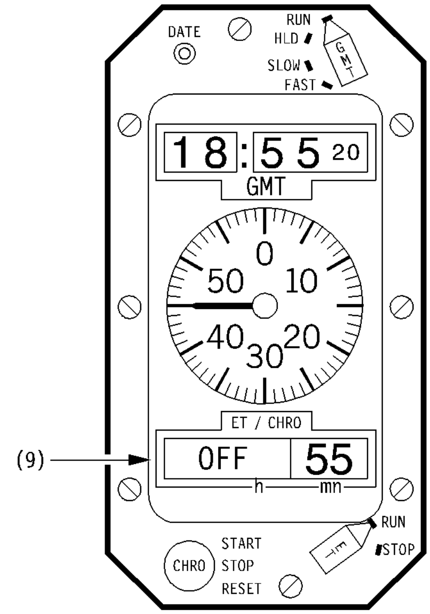
Note : While the stopwatch is running, the ET counter continues to run, but is simply masked by the CHRO display.

- A second press stops the stopwatch (see (9) in the clock illustration next page).

- A third press resets the stopwatch to zero as in the clock illustration above. The ET counter is uncovered.

OPERATIONAL DESCRIPTION (continued)





(5) CHRO (stopwatch) Counter

- When stopwatch is in use, "CHRO" flag is displayed with whole minutes elapsed since stopwatch was started (if ET switch is in RUN position, the ET counter is masked but still running).

(6) Stopwatch Sweep Second Hand

- When stopwatch is in use, the sweep second hand counts the seconds elapsed since the last whole minute.

(7) DATE Pushbutton Switch

- This pushbutton is held pressed and used with the GMT selector to set the GMT month and day.
  - GMT counter now displays the month in the left window and the day in the right one.
  - The GMT selector is then used to set the date as described in (2) above.

(8) ET Switch

■ **STOP**

– ET counter stops.

■ **RUN**

– ET counter is reset to zero and starts counting the Elapsed Time.

(9) OFF Flag

- In case of loss of electrical power supply, all indications are frozen and the OFF flag appears.
- When clock is repowered, all clock functions operate normally again.

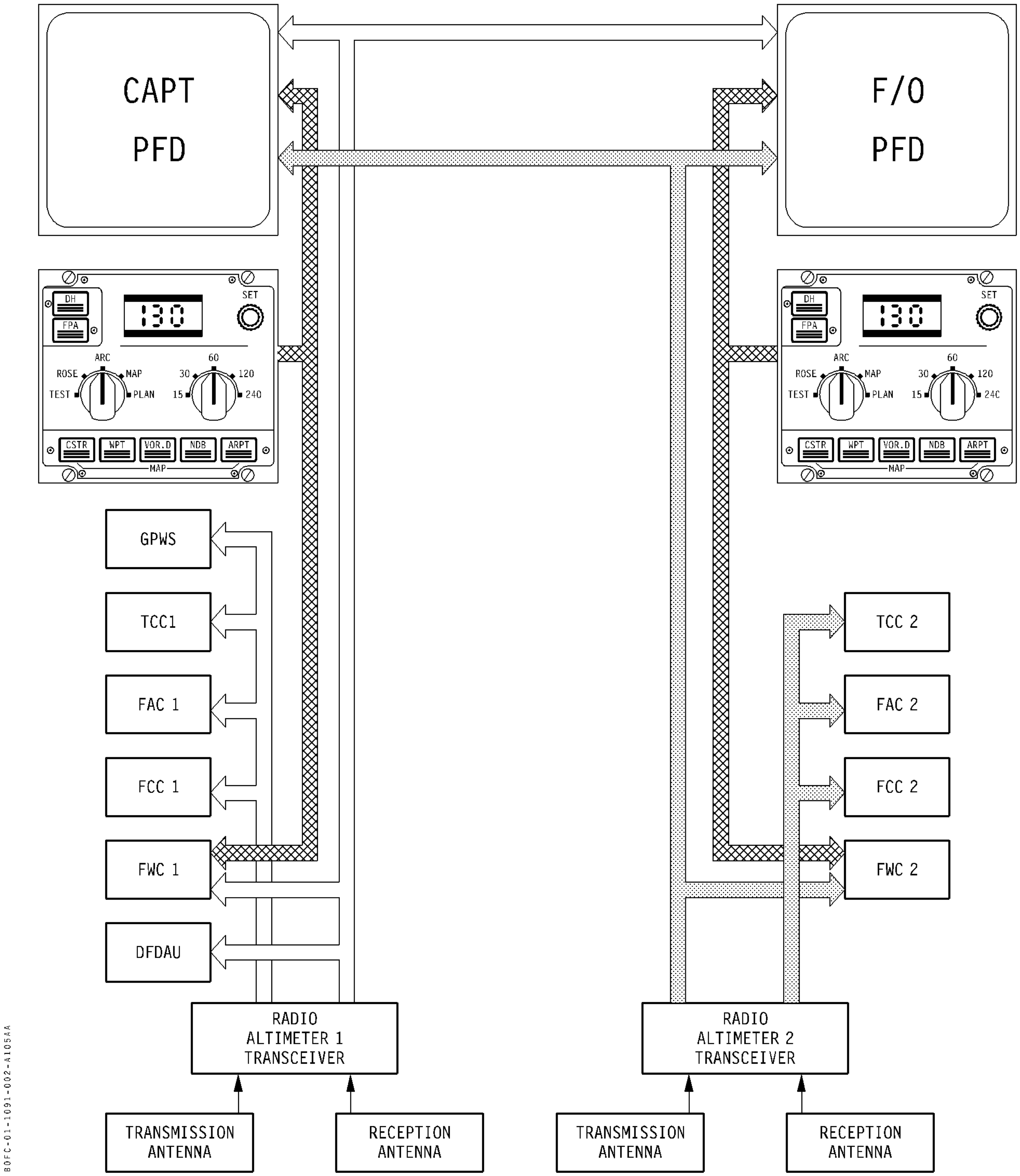
CLOCK SETTING TECHNIQUE

- A clock setting can be performed if required, for example in case of aircraft battery replacement or power loss.
  - With left hand press the DATE pushbutton switch. With right hand rotate GMT selector to FAST to set GMT month.
  - When the GMT month is set, rotate immediately the selector to SLOW to set GMT day.
  - When the GMT day is set, rotate immediately the selector to HOLD.
  - Release the DATE pushbutton switch.
  - Rotate the GMT selector to FAST, set GMT hour (24 hours format).
  - When GMT hour is set, immediately rotate the selector to SLOW until the GMT minutes are set.
  - Immediately rotate the selector to HLD and wait for GMT time reference (hack).
  - When GMT reference agrees with the time set, rotate the selector to RUN.

GENERAL

- Two Radio Altimeters are installed, and operate when below 2500 ft Radio Altitude (RA).
- The RA, which is displayed on each pilot's PFD, reflects the height of the main landing gear wheels above the ground (irrespective of the landing gear position).
  - Radio Altimeter 1 data are normally displayed on the CAPT's PFD. If Radio Altimeter 1 fails, the CAPT's PFD automatically displays data from Radio Altimeter 2.
  - Likewise, Radio Altimeter 2 data are normally displayed on the F/O's PFD. If Radio Altimeter 2 fails, the F/O's PFD automatically displays data from Radio Altimeter 1.
- The Radio Altimeters' antennae are located under the aft cargo compartment (see AIRCRAFT GENERAL chapter).
- RA information is displayed on the PFD (refer to section 1.10.23 PRIMARY FLIGHT DISPLAY – RADIO ALTITUDE).
- The RA Decision Height is set on the CAPT's and F/O's EFIS control panels (refer to section 1.10.30 – PRIMARY CONTROL PANEL description).
- The loss of one or both RA and the effect on aircraft systems is described in the individual description of each affected system.

SYSTEM ARRANGEMENT



Mod : S5063 or 6523 or (S5063 + 6523)

GENERAL

- The automatic call out system, integrated in the FWC, generates synthetic voice call outs when the Radio Altitude is below 400 ft.

DESCRIPTION

- The following automatic altitude call outs are provided :

Radio height (ft)	Call out
400	FOUR HUNDRED
300	THREE HUNDRED
200	TWO HUNDRED
100	ONE HUNDRED
50	FIFTY
40	FORTY
30	THIRTY
20	TWENTY
10	TEN
5	FIVE
DH + 100	HUNDRED ABOVE
DH	MINIMUM

- Call outs are inhibited during take-off.

  The system is activate only after an aircraft descent has been detected.

- After one of the above call outs have been given, if the next succeeding level is not passed within a certain time, the system announces the intermediate radio height. This time depends on the radio height :

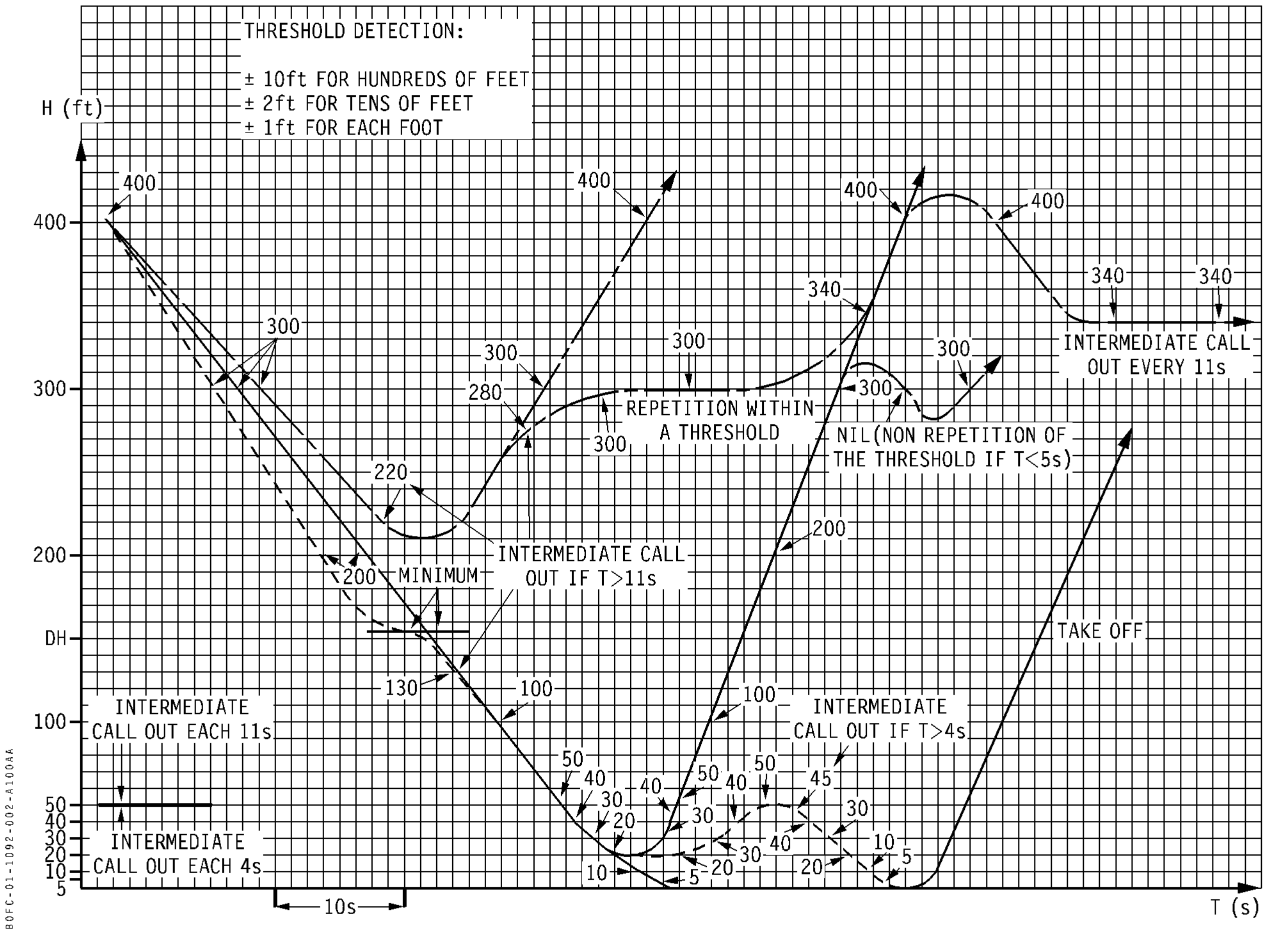
Radio Height	Time	Intermediate call out
Between 400 ft and 100 ft	11 s	radio height in 10 ft interval rounded to the lower.
Between 100 ft and 50 ft	11 s	radio height not rounded
Below 50 ft	4 s	radio height not rounded

- When reaching the Decision Height (DH) selected on the EFIS primary control panels, "MINIMUM" is announced.

Note : *If two different DH are selected on the two EFIS primary control panels, "MINIMUM" will be announced twice.*

Mod : (3732 + 6445) or (6119 + 6445)

CALL OUT CONFIGURATIONS



Mod : 3732 or 6119

STALL WARNING

R • A dual stall warning system, activated by the Flight Warning Computer (FWC), provides audio (Cricket) and stick shaker warnings in case of impending stall.

Note : A stick shaker is installed on each control column.

R • Stall warning activation depends on the AoA and slats configuration.

The stall warning is activated :

– If the AoA exceeds 10° in clean configuration,

or

– If the AoA exceeds 17.5° with slats extended.

• AoA is sensed by two electrically heated alpha probes (one on each side of the forward fuselage).

• Slats position is transmitted to the two FWC.

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GENERAL

- The aircraft is equipped with a Cockpit Voice Recorder (CVR) and an Aircraft Integrated Data System, which are automatically supplied from the first engine start until five minutes after the last engine shutdown.

- With engines shut down the CVR and DFDR can be selected ON manually.

COCKPIT VOICE RECORDER (CVR)

- The CVR is designed to :
  - Record the last 30 minutes of cockpit conversation and aural warnings (closed-loop recording).
  - Record the following on four different channels:
    - Radio conversations (received and transmitted),
    - Communications and conversations between crew members,
    - Aural warnings,
    - Announcements made by crew members.

- The CVR system is made up of :
  - A recorder in a crashproof box (installed in the aft fuselage),
  - A microphone located at the base of the overhead panel,
  - A control panel on the overhead panel.

R The CVR system also uses the flight crew and the
R passenger address microphones.

- The CVR is supplied from the AC EMER BUS.

Note : *One reason why batteries are selected OFF prior to the flight crew evacuation is to stop the CVR and prevent the erasure of potentially important data.*

AIRCRAFT INTEGRATED DATA SYSTEM

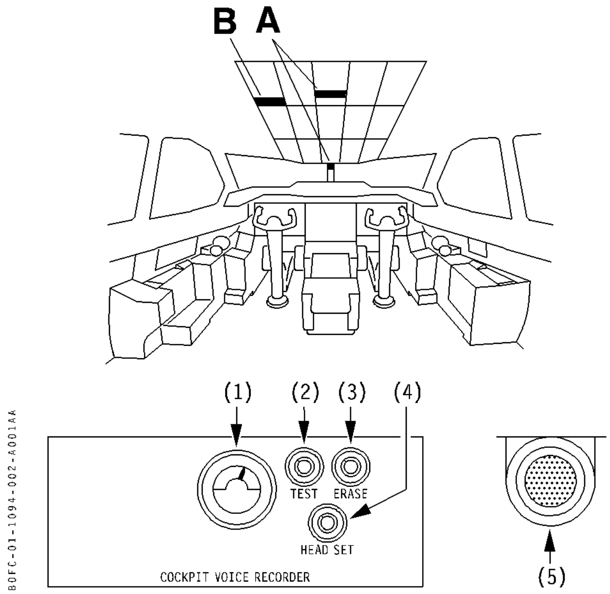
- The Aircraft Integrated Data System records many flight parameters which are collected and converted by a Digital Flight Data Acquisition Unit (DFDAU).

- This data is recorded by a Digital Flight Data Recorder (DFDR), which is encased in a shock and heat-resistant enclosure.

  Its storage capacity is 25 hours.

- An AIDS EVENT pushbutton switch is provided to record special events.

A. COCKPIT VOICE RECORDER Panel



(1) Monitor Indicator

- For use during test only. Movement of the pointer in the white band indicates that all channels are operative.

(2) TEST Pushbutton Switch

- When pressed and held the test is activated.
  - The pointer moves in pulses to indicate that all channels are recording properly.
  - If a headset is plugged into the HEAD SET jack, the test may be heard as low frequency signal.

(3) ERASE Pushbutton Switch

- Allows fast erasing of tape recordings.
  - Landing gear struts must be compressed with parking brake set.
  - While erasing, a low frequency signal may be heard in the headset.

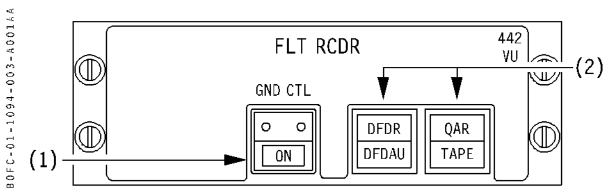
(4) HEAD SET Jack

- When a headset is plugged into the jack, the following can be heard :
  - Cockpit sounds picked up by the microphone,
  - Test tone when TEST pushbutton switch is pressed,
  - The erase tone when ERASE pushbutton switch is pressed.

(5) Area Microphone

- Picks up cockpit conversations and warning sounds.

B. FLT RCDR Panel



(1) GND CTL Pushbutton Switch

- The GND CTL pushbutton switch may be used when engines are shut down to select the CVR, DFDR and QAR (Quick Access Recorder) ON or off.

■ **Normal (pushbutton switch released-out)**

– CVR, DFDR and QAR are automatically powered from first engine start until five minutes after both engines are shutdown.

■ **ON (blue - pushbutton switch pressed-in)**

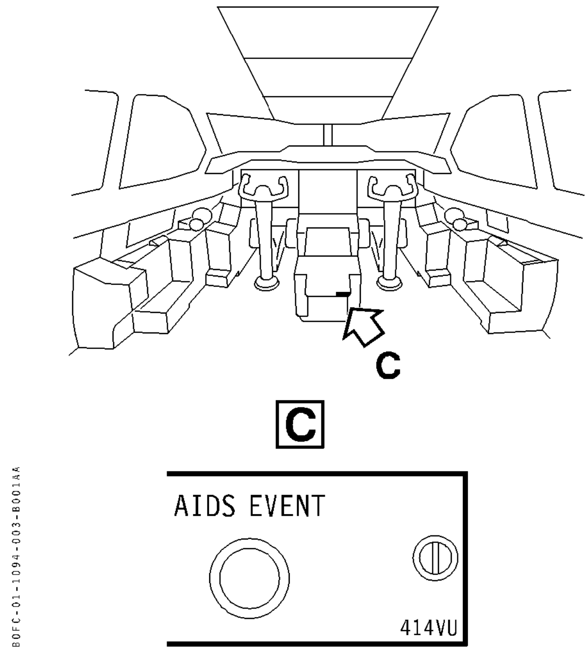
– The CVR, DFDR and QAR are powered.

– When the first engine is started, the ON light extinguishes.

(2) Fault Annunciator Lights

- Four amber annunciator lights are provided :
  – DFDAU (Digital Flight Data Acquisition Unit),
  – DFDR (Digital Flight Data Recorder),
  – QAR (Quick Access Recorder),
  – TAPE (tape supply low).
- Respective annunciator illuminates when a fault is detected in the corresponding unit or during test.
- DFDR illuminates when Aircraft Integrated Data System is not supplied.

C. AIDS EVENT Pushbutton Switch

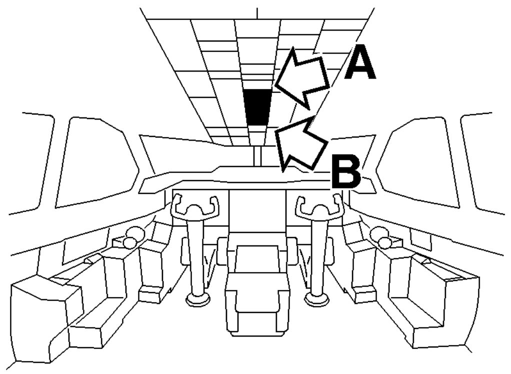


- When the AIDS EVENT pushbutton switch is pressed, an Event Mark is recorded on the DFDR tape.

LEFT BLANK INTENTIONALLY

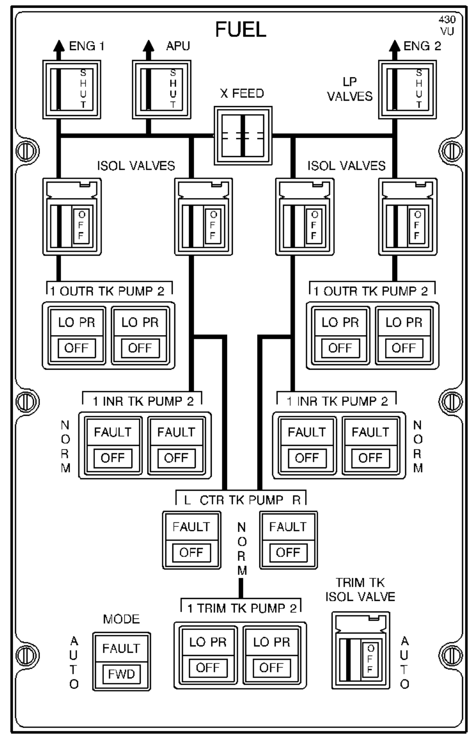
WEIGHT AND BALANCE SYSTEM is not installed.

LEFT BLANK INTENTIONALLY



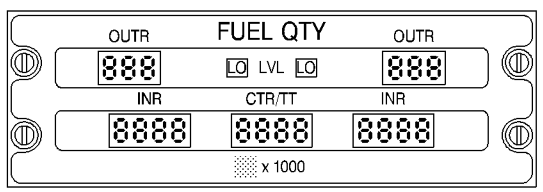
A

FUEL PANEL

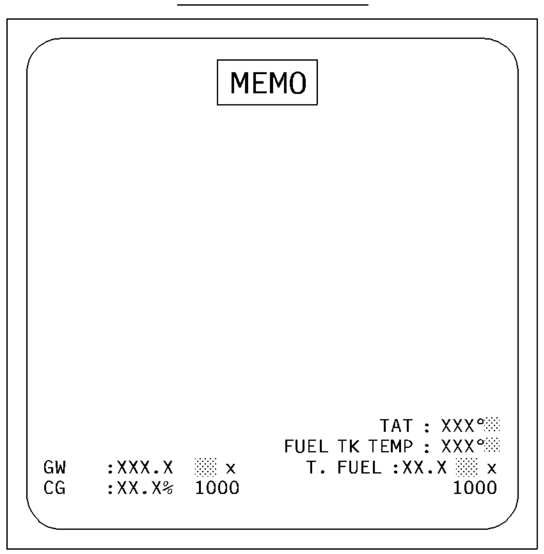


B

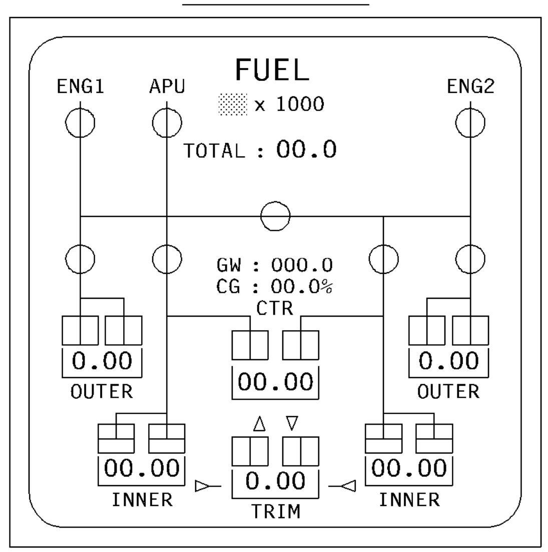
FUEL QUANTITY INDICATOR



ECAM MEMO PAGE



ECAM FUEL PAGE



MAIN

SYSTEM CONTROLS

AND DISPLAYS

Mod : (4801 + 5875) or (4801 + 5875 + 6875) R

- The fuel system includes:
  - Five wing tanks with two fuel pumps per tank, and a tank vent system,
  - A tail trim tank fitted with two transfer pumps,
  - An automatic fuel feed system for engines and APU,
  - A Fuel Quantity Indicating (FQI) System with a dedicated indicator and ECAM system display,
  - A pressure Refuel/Defuel system, and associated system controls and indicators.
- All fuel is stored in :
  - two outer and two inner wing tanks,
  - one center tank.
  - and one tail Trim tank.
- The wing tanks supply the engine on their respective side. The center tank supplies both engines simultaneously.
  APU fuel is supplied from the left side of the crossfeed manifold.
- The engines and APU may be crossfed from any tank.
- Wing loading and Center of Gravity considerations, require fuel to be used in the following order :
  - center tank,

  then
  - inner tanks,

  then
  - from outer tanks.
- The fuel feed sequence is automatically controlled by a Fuel Autofeed system.
- Manual control of the fuel feed sequence is possible.
- Low pressure fuel supply to the engines and APU may be cut off by three electrically controlled fuel fire shutoff valves (one for each engine and the APU). These valves close when their respective Fire handle is pulled.
- Supply from the outer (OUTR TK) or inner (INR TK) / center (CTR TK) tanks may also be shut off by electrically controlled Isolation valves (ISOL VALVES guarded pushbutton switches).
- Refueling and defueling is possible using :
  - External power supply, or
  - APU power, or
  - Battery power only, or
  - External power plugged in (AVAIL but not ON) R
    and MAINT BUS switch ON. R
- Fuel transfers between wing and center tank are possible on ground only (the TRANSFer VALVE control switch is located on the REFUEL DEFUEL panel).

Mod : 4801

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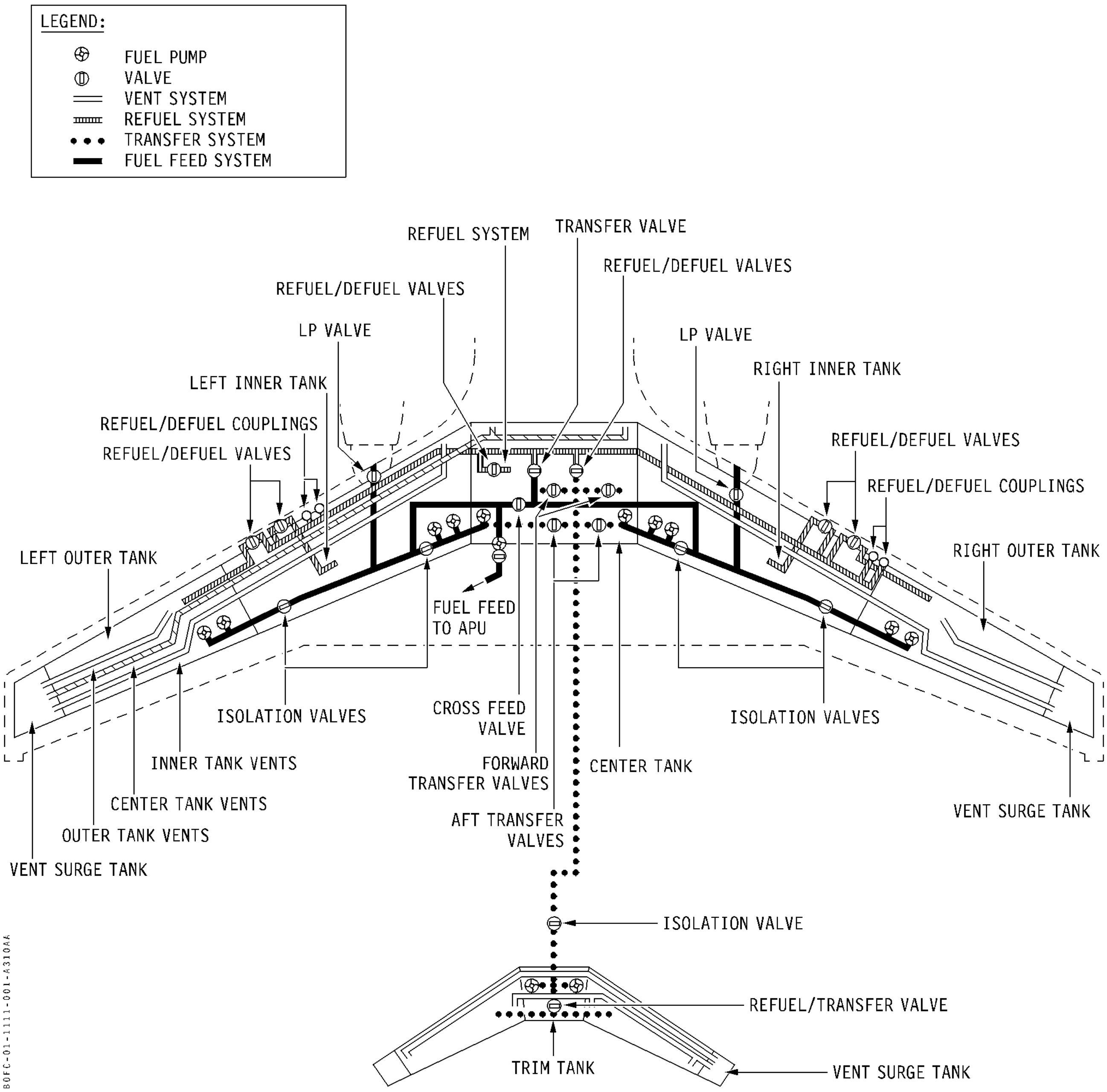

R Mod : 4801 + 4917 + 5027

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GENERAL

- The tanks are baffled to minimize fuel movement in the tank.
- Water drain valves are provided to remove accumulated water from the tanks.
- Extra volume in each tank allows some thermal fuel expansion to occur without causing fuel spillage.
- A water drain / scavenge system in the outer tanks enables water to be drawn into the engine feed system and consumed.
- A temperature sensor is located in the outer left fuel tank. The fuel tank temperature is displayed on the ECAM MEMO page (Refer to ECAM chapter, section 1.18.50 – MEMO page).

TANK CAPACITY

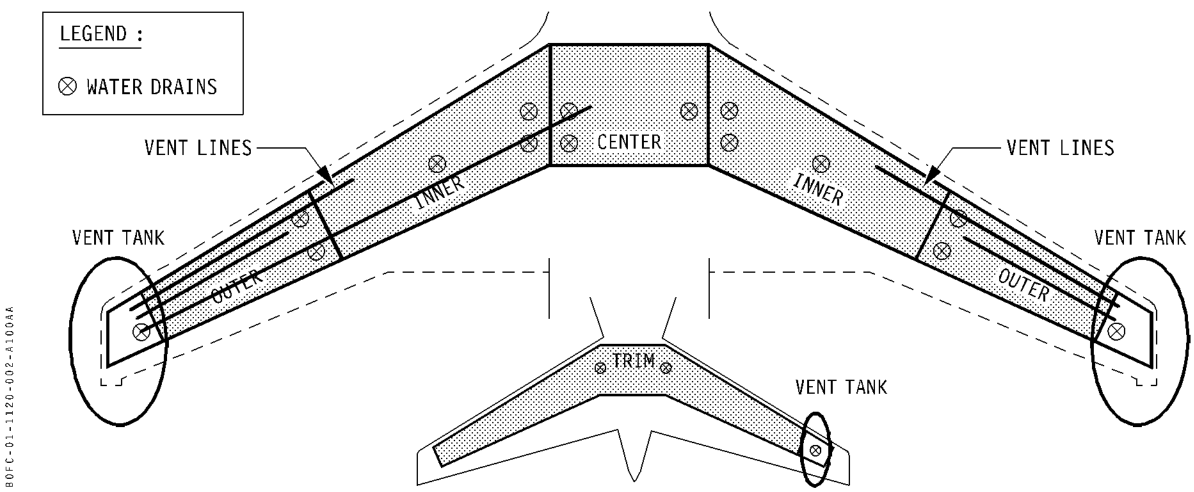
USABLE FUEL						
		OUTR	**INR**	**CTR**	**TRIM**	**TOTAL**
Volume	**l**	3,700	13,950	19,640	6,150	61,090
	US Gal	987	3,685	5,189	1,625	16,140
Weight-kg (0,8 kg/l)		2,960	11,160	15,712	4,920	48,872
Weight-lbs (6,68 lbs/US Gal)		6,525	24,605	34,642	10,848	107,750

Mod : 4801 + 5875

VENT / SURGE SYSTEM

- A Vent/surge tank is located at the tip of each wing, and at the RH tip of the horizontal stabilizer
- The volume of each wing vent tank is 190 liters (50 U.S. Gal.).
  - The volume of the tail vent tank is 120 liters
R (32 U.S Gal).
- The vent system prevents tank overpressure during refueling.
- The vent tanks provide additional thermal expansion space for fuel from the five main tanks.
  - Each inner and outer tank is connected to the vent tank located in its respective wing.
  - The center tank is connected to the left wing vent tank.
  - The trim tank vents into its own vent tank.
- In flight, these tanks are pressurized by ram air through flush NACA intake scoops on the underside of the wings.
  - This provides positive differential air pressure in the tanks whatever the aircraft attitude.
- Fuel in the vent surge tank siphons back to the associated inner wing tank when the fuel level in this tank drops.
- The vent tank will overflow overboard if it becomes full.
- Additional overpressure protection for each inner, center and vent surge tank is provided in the form of carbon safety discs which rupture if the tank becomes :
  - overpressurized. (for example during climb or refueling)
  - or underpressurized (for example during descent)

  Note : Fuel loss is limited should this occur.



Mod : 4801

ADDITIONAL CENTER TANK(S) NOT INSTALLED

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GENERAL

- Each main fuel tank is fitted with two electrical fuel booster pumps (TK PUMPs).
- From the fuel tanks, fuel is supplied through four isolation valves (ISOL VALVES) to the left and right sides of the fuel crossfeed line.
- Four non-return valves between the ISOL VALVES and the fuel feed line prevent reverse flow of fuel from the fuel feed line to the tanks.
- The usual fuel feed sequence starts from the CTR TK, followed by the INR TK, and finally by the OUTR TK but the fuel feed sequence may be manually controlled, as required.

FUEL PUMPS

- Any one pump can supply one engine at maximum thrust.
- The INR and CTR TK pump pressure is higher than the OUTR TK pump pressure to ensure that the CTR TK and INR TK supply fuel before the OUTR TK.

  Note : At high altitude, if using hot JP4 (JET B), CTR TK pump delivery pressure may momentarily drop below OUTR TK pump pressure, leading to a decrease in outer tank quantity.
- CTR and INR TK pumps operation is automatically controlled by the Fuel Autofeed.
- OUTR TK pumps operation is only manual: When an OUTR TK pump's pushbutton switch is pressed in, the associated pump operates continuously.

ISOLATION VALVES

- Four electrical ISOL VALVES can be used to shut off fuel supply from their respective fuel tank(s).

  ISOL VALVES are manually controlled by guarded pushbutton switches on the overhead panel.
- OUTER TANK ISOL VALVES :

  Closing an outer tank ISOL VALVE isolates the associated OUTR TK from the fuel feed line.
- INR TK ISOL VALVES :

  The L INR TK pump, or the R INR TK pump can be isolated from the fuel feed line by closing the associated ISOL VALVE.

Note : The CTR TK cannot be isolated by itself.

CROSSFEED VALVE

- An electrical fuel crossfeed valve separates or connects the left and right sides of the fuel crossfeed line.
- For redundancy, the crossfeed valve is operated by two motors.
- Opening the crossfeed valve allows an engine or the APU to be supplied from the opposite side of the fuel crossfeed line.

LOW PRESSURE (LP) FUEL/FIRE SHUTOFF VALVES

- Pulling an ENG or APU's FIRE handle (or an APU FIRE auto-shutdown) electrically closes the associated fuel LP VALVE to shut off the fuel supply to the respective engine or to the APU's.
- The three fuel LP VALVES are located in each engines pylon and in the APU fuel supply line.
- Each engine fuel LP VALVE is operated by two motors.

  The APU LP VALVE is operated by only one motor.

Mod : 4917

FUEL AUTOFEED MODE

- The fuel Autofeed mode automatically controls the INR TK and CTR TK PUMPs in accordance with the automatic fuel feed sequence.

Activation :

- To activate the Autofeed mode, at least one PUMP pushbutton switch for each INR TK and CTR TK must be pressed into the NORM position.
- Once Autofeed mode is activated, Autofeed mode remains active as long as at least one INR TK
R PUMP in each INR TK and one CTR TK PUMP remain selected (i.e. pushbutton switch in NORM position).

  Note : *This enables to apply the FUEL X FEED IN FLIGHT procedure (for example, for fuel balancing or in case of single engine operation) without deactivating the Fuel Autofeed mode.*

Automatic fuel feed sequence

- If the CTR TK contains fuel, the CTR TK PUMPs are activated, and the INR TK PUMPs are stopped.
- At first engine start, the CTR TK is feeding during 3 minutes (if not empty), then the INR TKs are feeding.
- After take-off, at slat retraction, CTR TK feeds again until the fuel level uncovers the calibration sensor (approximately 1000 kg/2200 lbs fuel remaining).
- 30 seconds after the CTR TK calibration sensor is dry, the CTR TK PUMPs are stopped and the INR TK PUMPs are activated.
  - If the fuel level in the CTR TK reaches again the calibration sensor level (for example as a result of forward fuel transfer from the Trim Tank), the INR TK PUMPs stop and the CTR TK PUMPs are re-activated.
  - This process is repeated until the fuel quantity in either INR TK reaches the low level sensor.
- 3 minutes after reaching the INR TK low level, INR TK PUMPs are stopped and CTR TK is feeding.
- 30 seconds after the CTR TK low level is reached, the CTR TK PUMPs are stopped.
- With all CTR TK PUMPs and INR TK PUMPs stopped the OUTR TKs supply fuel to the engines.
- If during descent, CTR TK is feeding (following forward fuel transfer from TRIM TK), 3 minutes after slats extension CTR TK pumps are stopped and fuel feed is transferred to :
  - INR TKs, if not empty,
  - OUTR TKs, if INR TK are empty.

  This fuel feed configuration is maintained until engine shutdown.

Deactivation :

- The fuel Autofeed mode can be deactivated by :
  - selecting all four INR TK PUMP pushbutton switches OFF,

  or
  - selecting both CTR TK PUMP pushbutton switches OFF.

  Note 1 : *The OUTR TK PUMPs are not controlled by the Autofeed mode, the OUTR TK PUMPs constantly operate whenever their respective pushbutton switches are pressed in.*

  However the OUTR TK PUMPs cannot supply fuel to the fuel feed line until CTR TK PUMPs and INR TK PUMPs pressure drops below 17 psi.

  Note 2 : *In Autofeed mode, the INR TK PUMPs and CTR TK PUMPs are not activated simultaneously.*

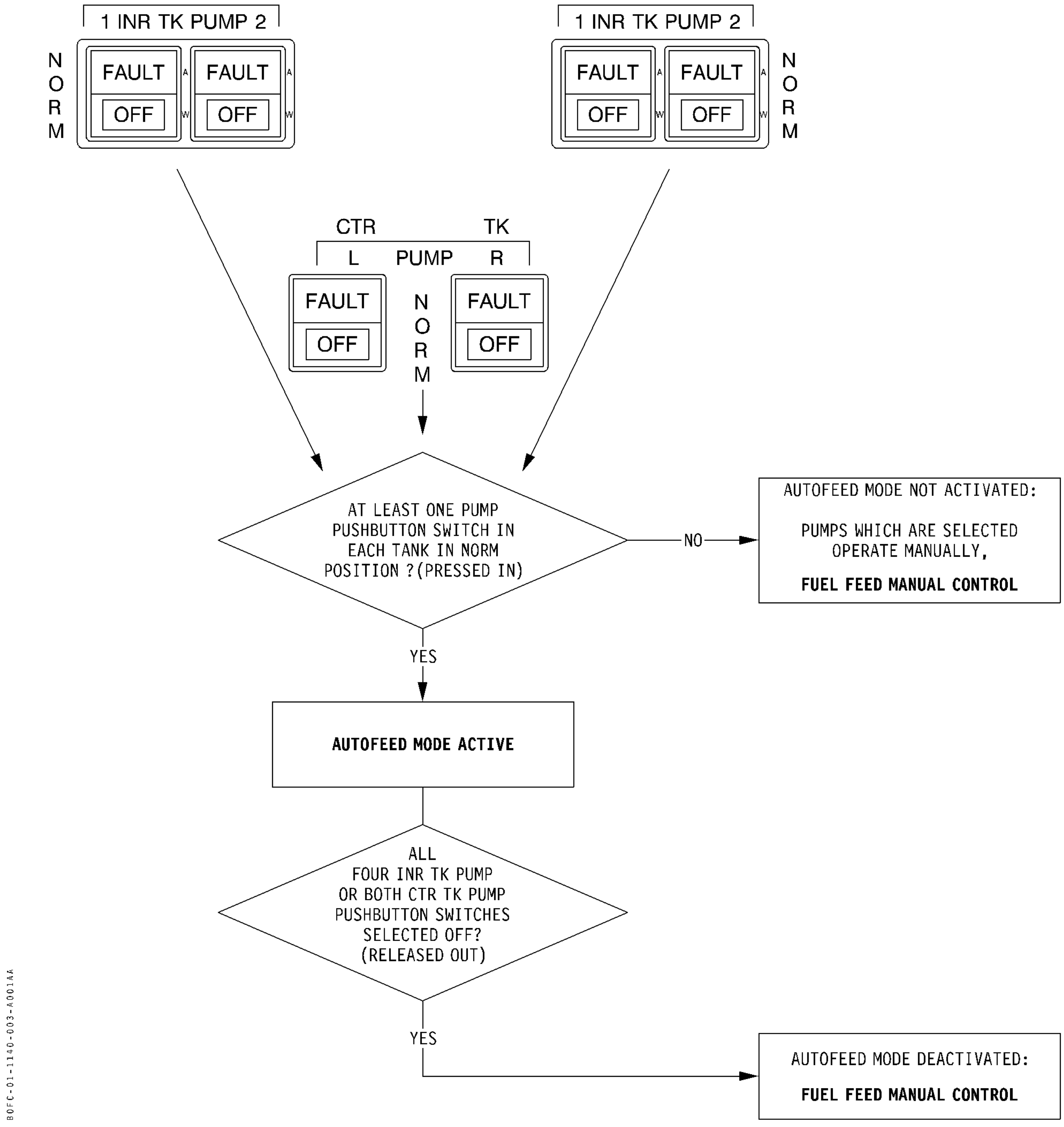
FUEL FEED MANUAL CONTROL

- When the Autofeed mode is deactivated, fuel pump operation can be manually controlled, using the respective PUMP pushbutton switches, in accordance with the corresponding QRH (Quick Reference Handbook) procedure.

Mod : 4801 + 5562

FUEL AUTOFEED MODE ACTIVATION LOGIC

R



FUEL AUTOFEED MODE FAULTS

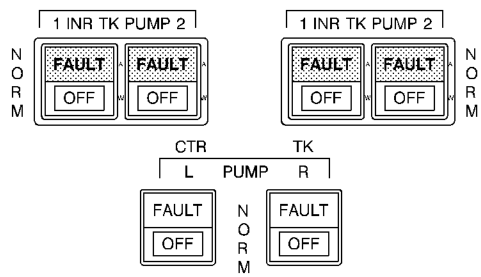
- If the Autofeed sequence does not operate correctly, an AUTO FUEL FEED FAULT is detected and PUMP FAULT lights illuminate on the overhead panel to indicate which pumps must be selected OFF in order to revert to the FUEL FEED MAN CTL mode.

- **All four INR TK PUMP FAULT lights illuminate** :

  – If both CTR TK PUMPs are not running when commanded to run,

  or

  – If an INR TK PUMP is running when commanded to stop.



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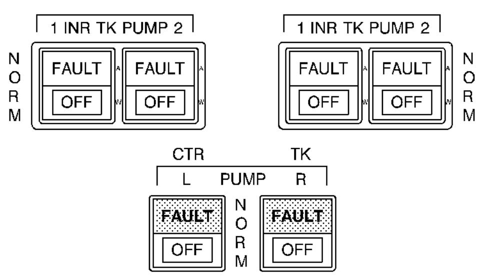
- Switching all four INR TK PUMPs to OFF deactivates the Autofeed mode and enables the CTR TK PUMPs to be operated manually.

- **Both CTR TK PUMP FAULT lights illuminate** :

  – If INR TK PUMPs are not running when commanded to run,

  or

  – If a CTR TK PUMP is still running when commanded to stop.



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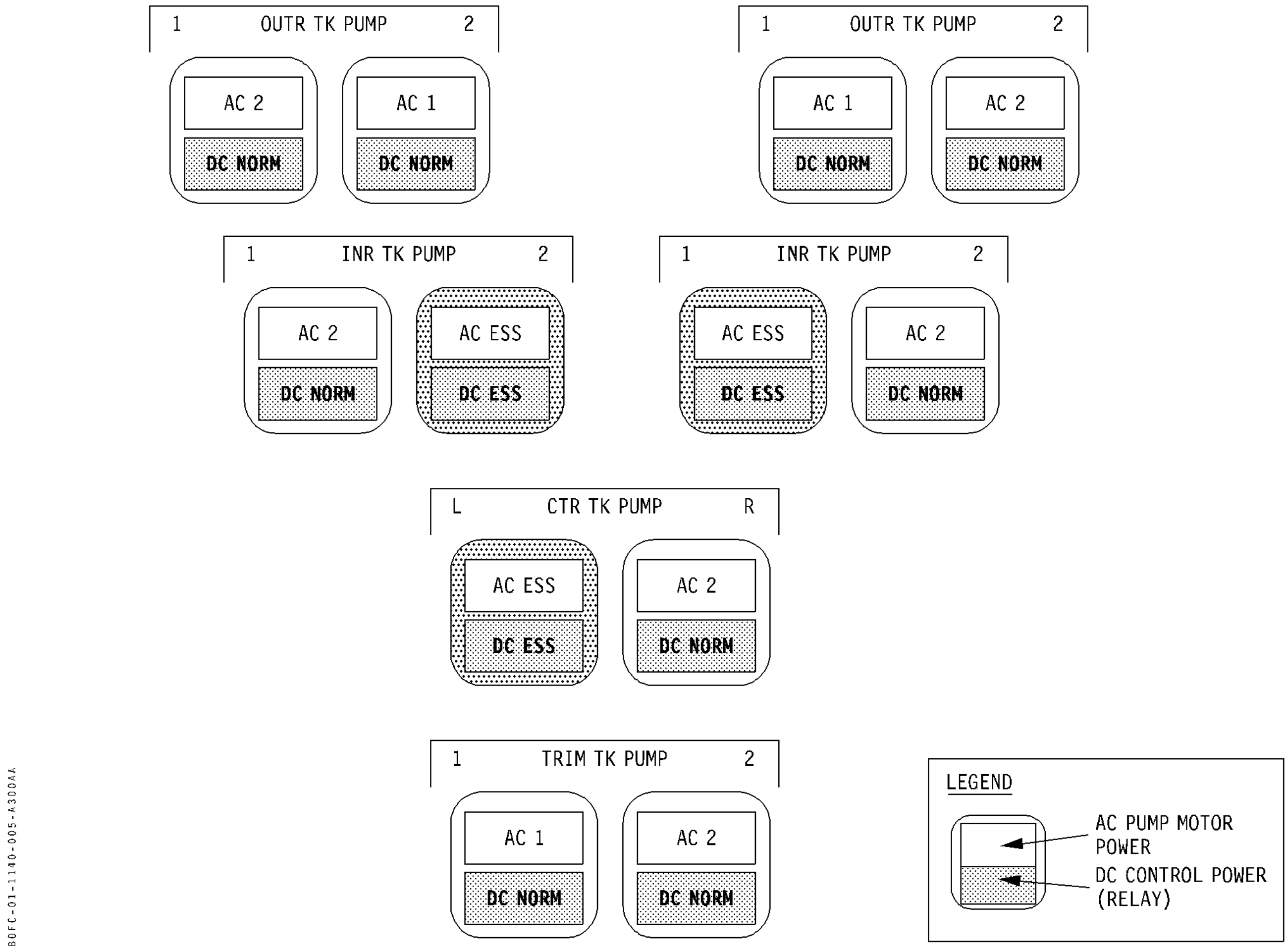
- Switching both CTR TK PUMPs to OFF deactivates the Autofeed mode and enables the INR TK PUMPs to be operated manually.

FUEL PUMP POWER SUPPLY



AVIONICS SMOKE DRILL :

- If the SMOKE DRILL procedure is applied, the only pumps still supplied are the L INR TK PUMP 2, R INR TK PUMP 1 and L CTR TK PUMP (DC ESS and AC ESS remain supplied in the SMOKE DRILL configuration). They are supplied one at a time with the following priority order :
  INR TK 2L, INR TK 1R, CTR TK L.

AC BUS FAILURE :

- The loss of one AC BUS does not affect fuel feed because at least one pump in each tank remains supplied, and Autofeed remains active.

DC BUS FAILURE :

- The loss of DC NORM (ESS) BUS results in the loss of the associated pumps.
- If DC NORM (ESS) BUS is lost, the AC contactor opens and the associated fuel pumps are lost without indication on the pushbutton switches.

BATTERY ONLY :

- On BAT ONLY supply , all fuel pumps are lost. (3 phase AC power is required to operate the pump motor).

  Fuel gravity feeding procedure must be applied.

Mod : 4801 + 6368 + 8648

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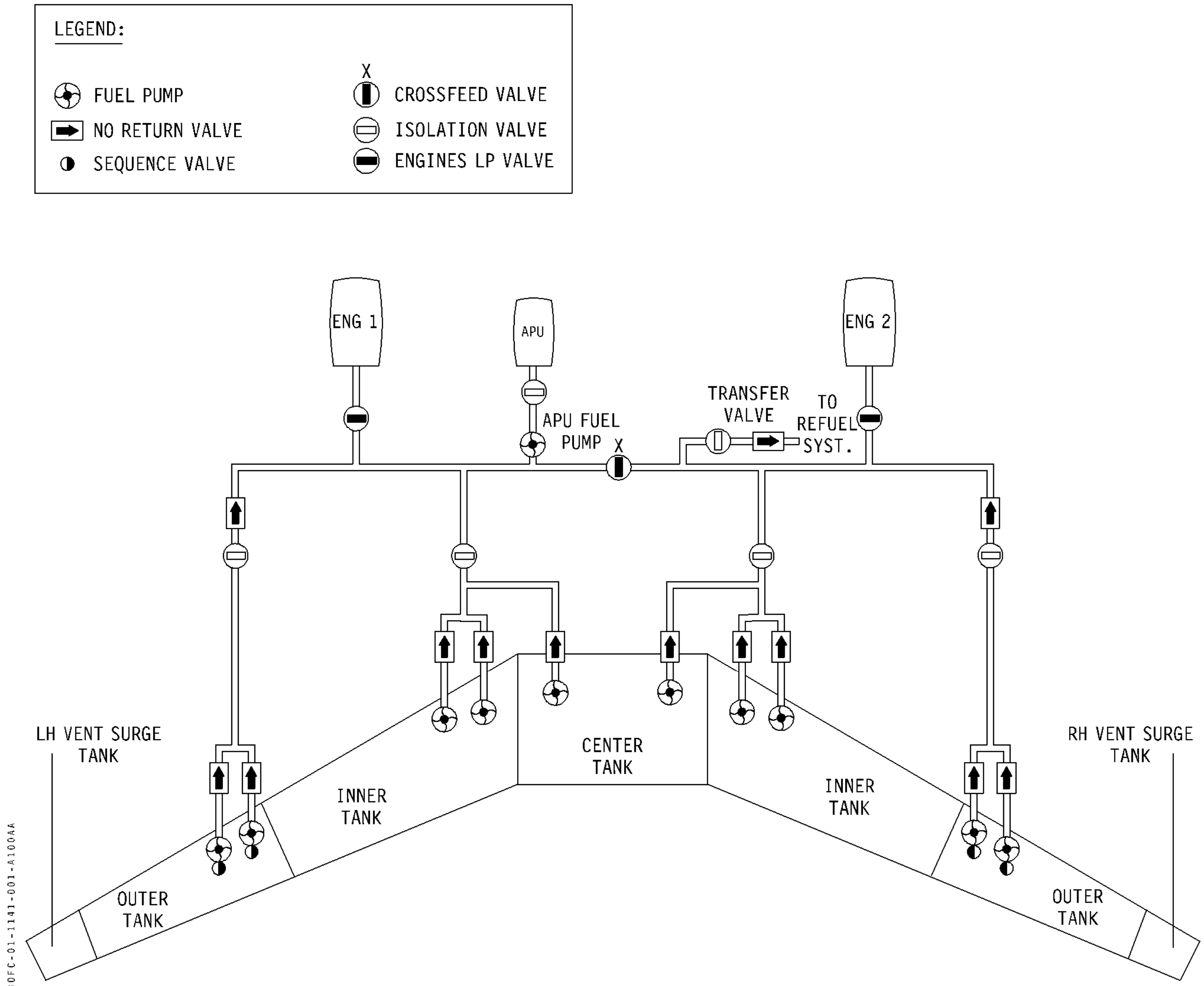
SYSTEMS DIAGRAM



R

R

R

R Mod : 4917

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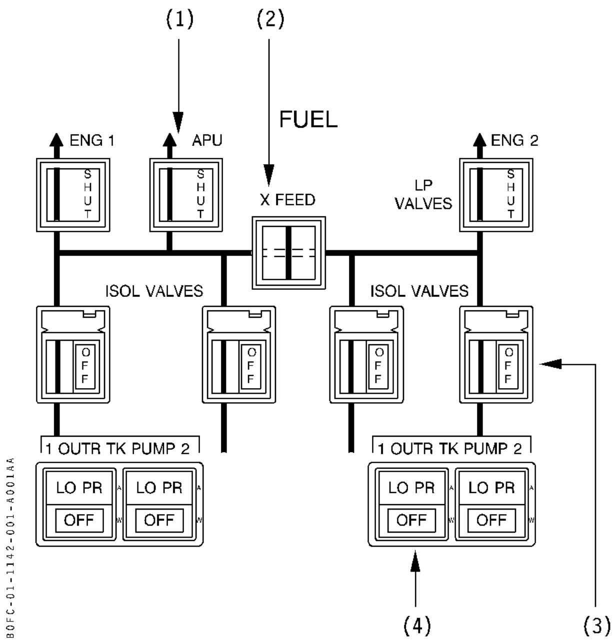
FUEL PANEL (see Pull-out page)



(1) ENG 1, APU, ENG 2 LP VALVES Annunciators :

- The annunciators display the position of the associated FUEL LP VALVE (fire shutoff valve)

■ **Green Flowbar illuminated**

– Valve is open.

■ **SHUT** (Amber)

– Valve is closed (FIRE handle pulled).

(2) X FEED Valve pushbutton switch :

- Controls the position of the fuel crossfeed valve.

  The pushbutton switch includes two green position indicating flowbars (in-line and cross-line).

■ **Cross-line flowbar illuminated**
(Pushbutton switch released-out)

– Valve is closed.

■ **In-line flowbar illuminated.**
(Pushbutton switch pressed in)

– Valve is open.

(3) ISOL VALVES pushbutton switches :

- These four guarded pushbutton switches control the position of the related tank ISOL VALVES.

  Note : The inner tank ISOL VALVES also shut off fuel supply from the respective CTR TK PUMP'S.

■ **Green Flowbar illuminated**
(Pushbutton switch pressed in)

– Valve is open.

Note : The flowbar flashes when the valve position disagrees with the pushbutton switch selection (for example during valve transit).

■ **OFF** (White : Pushbutton switch released out)

– Valve is closed.

(4) OUTR TK PUMP pushbutton switches :

- Each of the four pushbutton switches controls an OUTR TK PUMP.

■ **No light** : (Pushbutton switch pressed in)

– Pump operates continuously.

– Fuel is supplied from the outer tank only when inner and center tank pumps pressure drops.

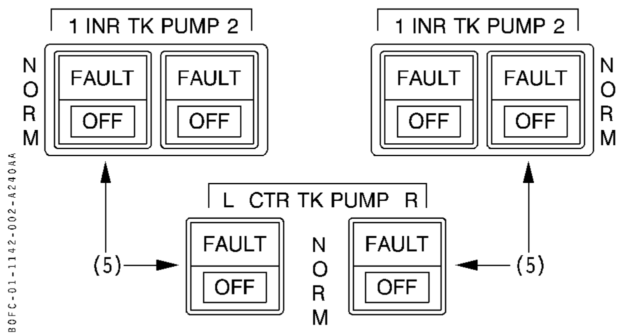
■ **LO PR** (Amber : Pushbutton switch pressed in)

– Illuminates in case of pump low pressure due to pump failure or fuel starvation.

Note : The LO PR light is inhibited when the pump is switched OFF.

■ **OFF** (White : Pushbutton switch released out)

– Pump is deactivated.



(5) INR TK/PUMP and CTR TK/PUMP Pushbutton switches.

- These pushbutton switches control the selection of the FUEL FEED MANUAL CONTROL or FUEL AUTO FEED modes.
  - If at least one PUMP in each TK is selected to NORM, the FUEL AUTO FEED mode is activated.
  - If all four INR TK PUMPS or both CTR TK PUMPs are selected OFF, the FUEL AUTO FEED mode is de-activated (i.e. FUEL FEED MANUAL CONTROL is required).

■ **NORM (Pushbutton switch pressed in)**

- In FUEL AUTO FEED mode, the pump operates according to the FUEL AUTO FEED mode logic.
- In FUEL FEED MANUAL CONTROL mode, the pump operates continuously.

■ **FAULT (Amber : Pushbutton switch pressed in)**

- The illumination of a single pump FAULT light indicates a pump low pressure.
- The simultaneous illumination of both CTR TK PUMP FAULT lights, or of all four INR TK PUMP FAULT lights, indicates a failure of the FUEL AUTO FEED mode (refer to section 1.11.42 – FUEL AUTO FEED SYSTEM FAULTS).

Note : The pump FAULT light is inhibited when the pushbutton switch is selected OFF.

■ **OFF (White : Pushbutton switch released out)**

- The pump does not operate.

Note 1 : When one of the two CTR TANK pumps is running the indication « CTR TANK FEEDING » is given on the ECAM MEMO page.

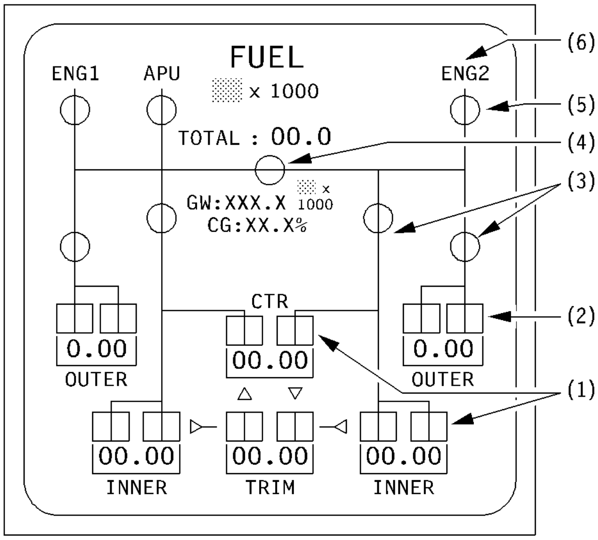
Note 2 : Switching from CTR to INR tanks feeding may occur prematurely during climb due to pitch angle.

Note 3 : If INNER tanks are empty before refuelling and if only OUTER and INNER tanks are refuelled, INNER TK pumps will not start for 30s after pumps selected NORM. This indication does not signify a fault nor does it require any action.

Mod : 6843 + 6845

SYSTEM DISPLAY

R



(1)- INNER (OR CENTER) TANK PUMP

(G) : PUMP ON AND NORMAL FUEL PRESSURE

LO (A) : PUMP ON AND LOW PRESSURE

(A) : PUMP PUSHBUTTON SWITCH SELECTED OFF

(G) : PUMP PUSHBUTTON SWITCH SELECTED ON, BUT PUMP NOT RUNNING

(2)- OUTER TANK PUMP

(G) : PUMP ON AND NORMAL FUEL PRESSURE

LO (A) : PUMP ON AND LOW PRESSURE

(A) : PUMP OFF

(3)- INNER AND OUTER TANK ISOLATION VALVE

(G) : VALVE OPEN

(A) : VALVE OPEN WHITOUT FUEL PRESSURE

(A) : VALVE CLOSED

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(4)- X FEED VALVE

(G) : VALVE OPEN

(A) : VALVE OPEN WITHOUT FUEL PRESSURE

(G) : VALVE CLOSED

(5)- LP VALVE (FIRE VALVE)

(G) : VALVE OPEN

(A) : VALVE OPEN WITHOUT FUEL PRESSURE

(A) : VALVE CLOSED

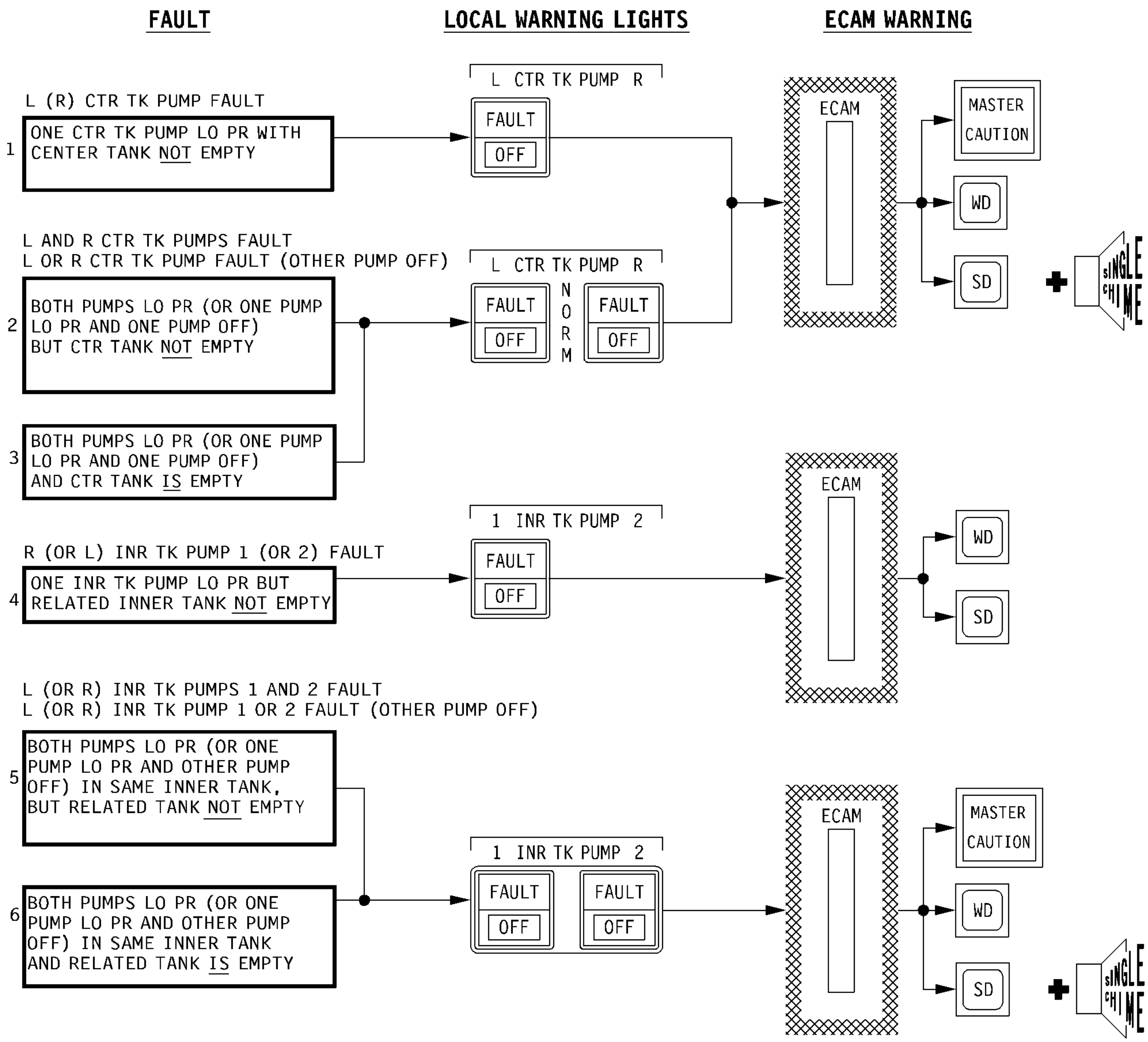
(6)- ENG 2(W)

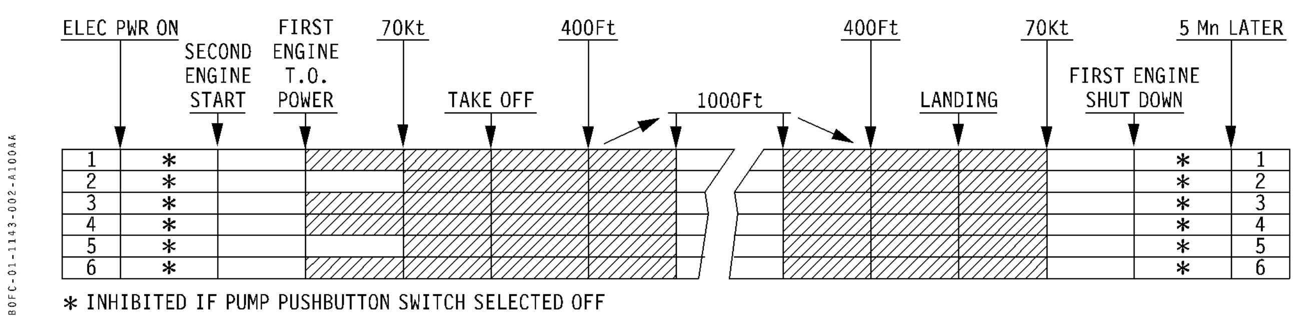
(A) WHEN NO FUEL PRESSURE

Note : Fuel feed lines are not displayed in case of DC NORM BUS OFF, but fuel feed system is not affected.

Mod : 4801 or (4801 + 7576)

R
R

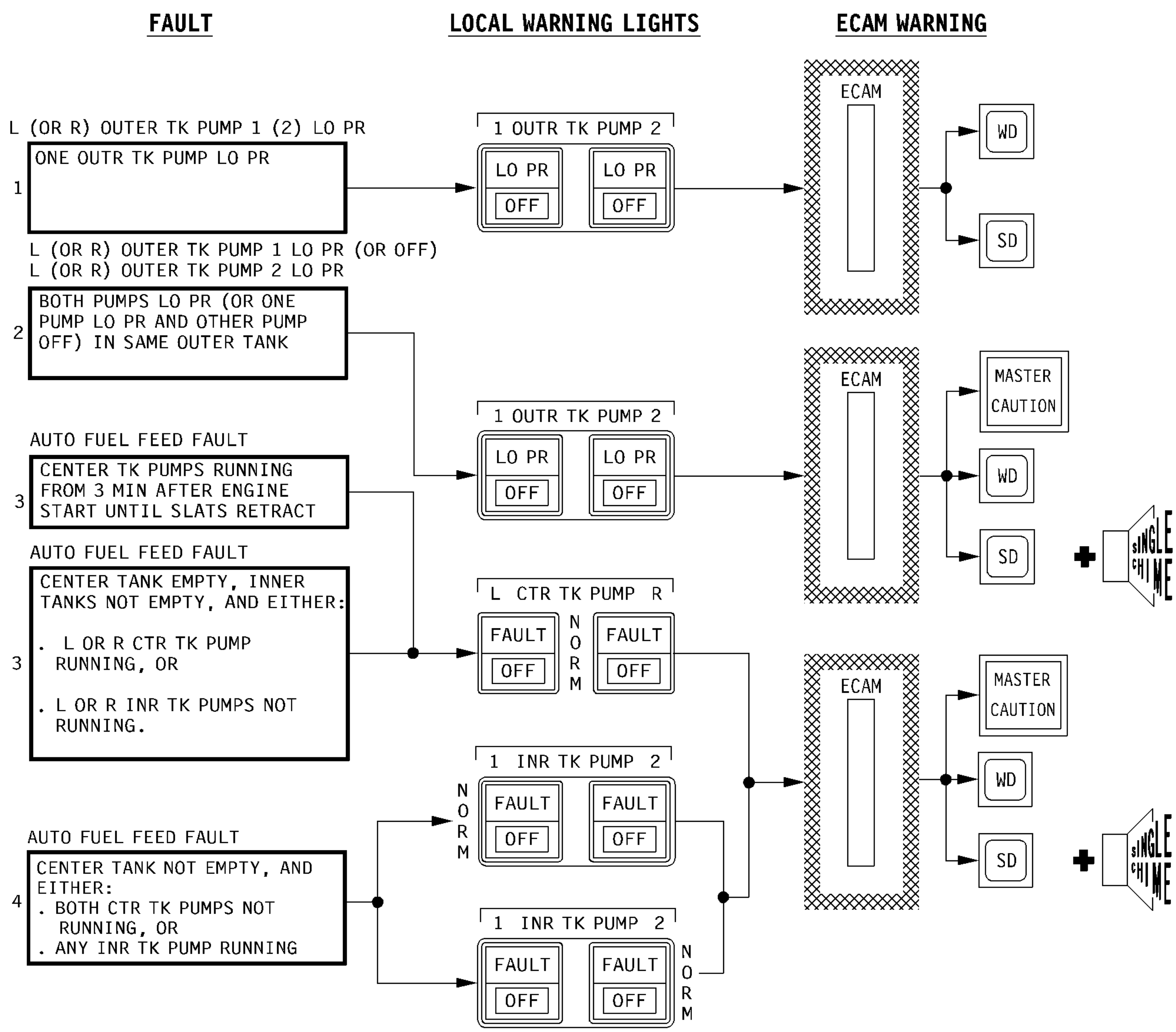


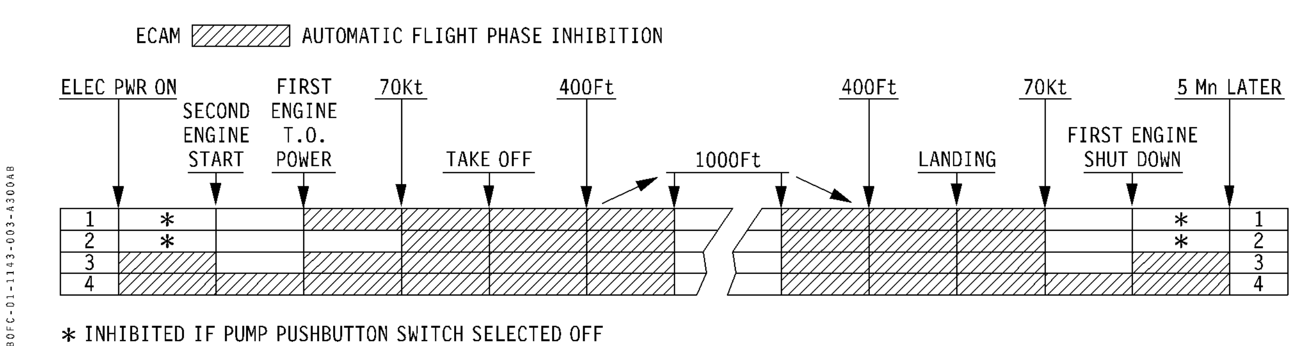


* INHIBITED IF PUMP PUSHBUTTON SWITCH SELECTED OFF

Mod : 5051

R
R
R
R





* INHIBITED IF PUMP PUSHBUTTON SWITCH SELECTED OFF

Mod : 5051 + 5562 + 6519

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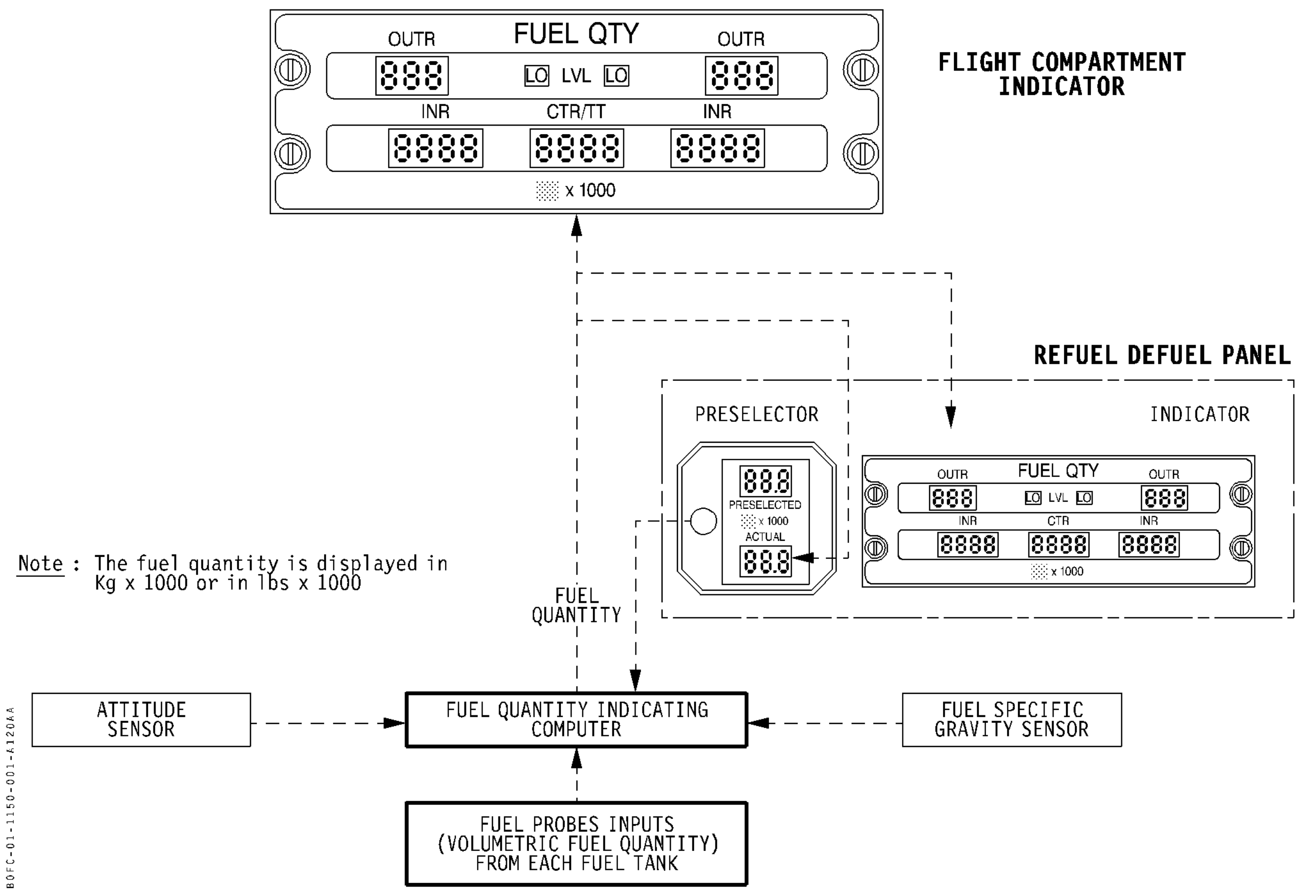
GENERAL

- Each tank has several fuel quantity probes.
- Volumetric fuel quantity information from tank probes is processed by a Fuel Quantity Indicating (FQI) computer, and adjusted using data from :
  - A fuel specific gravity sensor, (called a Cadensicon), which samples fuel during refueling to provide the specific gravity (SG),
  - An attitude sensor which provides pitch attitude and bank angles, and
  - A compensator probe in each tank which senses the dielectric characteristic of the fuel in the tank.
- Calculated tank fuel quantities are displayed on ECAM Fuel Page, on the FUEL QTY indicators on the overhead panel and on the REFUEL DEFUEL panel.
- The CTR/TT value is the sum of the Center and Trim Tank fuel quantity.

  Note : *When installed, the Additional Center Tanks fuel quantities are added to the CTR/TT value.*
- T. FUEL (Kg x 1000 (lbs x 1000) total fuel) indication is always presented at the bottom right side of the ECAM MEMO page.
- This fuel quantity information is also used during refueling to close the refuel valves when a preselected fuel quantity is reached.
- Magnetic fuel quantity indicators are installed in the bottom of each fuel tank to provide manual back-up for measuring tank fuel quantity on the ground (for example when there is no electrical power on the aircraft or when the FQI of a tank has failed).



Mod : 4801 or 6875 or (4801 + 6875)

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FUEL QTY INDICATOR (See PULL-OUT PAGE)

(1) OUTR, INR, and CTR/TT Tank FUEL QTY Indicators :

- The FUEL QTY Indicator (FQI) displays the calculated fuel quantity in each tank (lb × 1000 or kg × 1000) to within ± 10 kg (lb) per tank.

  The CTR/TT display indicates the sum of CTR TK and TT fuel quantities.

- A dash (–) may be displayed instead of the last digit of an indicator due to minor computational degradation. This dash indicates that the quantity indication accuracy is degraded to within ± 100 kg (lb) of the associated tank capacity. When it occurs, the quantity indication accuracy is fully serviceable.

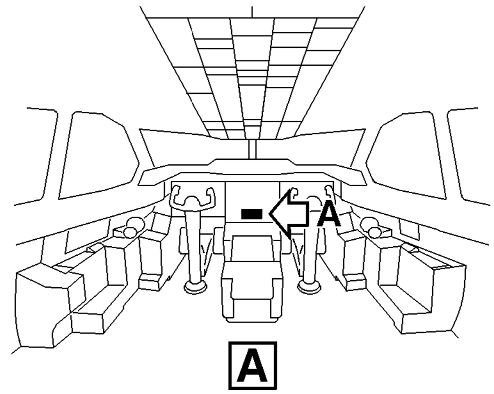
- In case of failure of the fuel specific gravity sensor, the code LA (Lower Accuracy) is displayed during the annunciator light test.

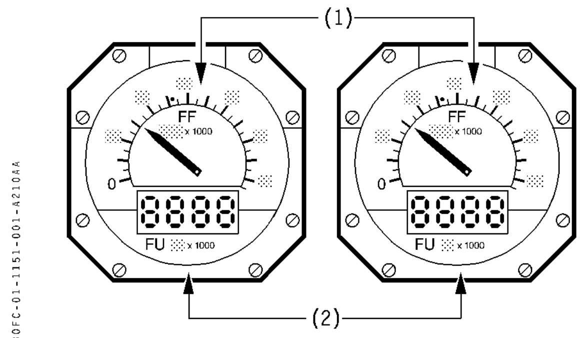
(2) OUTR Tank LO LVL Warning Lights :

- The LO LVL light illuminates red, with ECAM activation, when the fuel remaining in the associated OUTR TK is between 800 kg (1800 lb) and 1000 kg (2250 lb).

  Note : During pitch attitude changes, or if decelerating, the LO LVL lights may illuminate at a higher fuel quantity.

FF/FU INDICATORS





- A Fuel Flow (FF) / Fuel Used (FU) indicator is provided for each engine.

(1) FF indication :

- The engine fuel flow is indicated by a pointer. The scale is graduated in thousands of kg/h (lb/h).

(2) FU Counter :

- The total Fuel Used by the engine is digitally indicated in thousands of kg (lb).

- The FU indication is reset to 0 when the engine is started, on the ground only, when start valve opens.

Mod : 4801 + 6605

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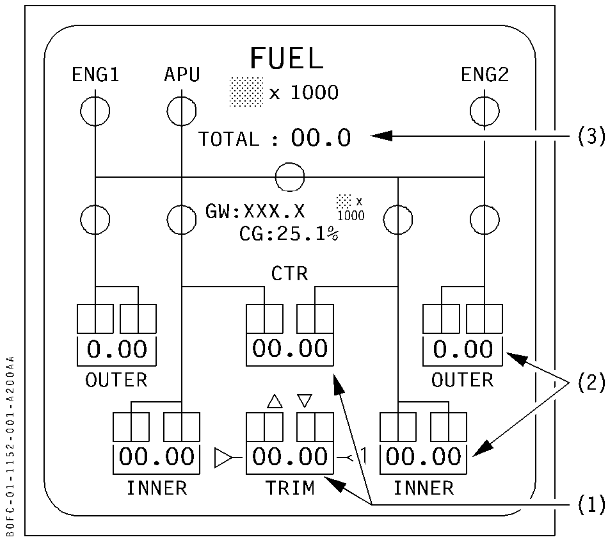
ECAM SYSTEM DISPLAY

R



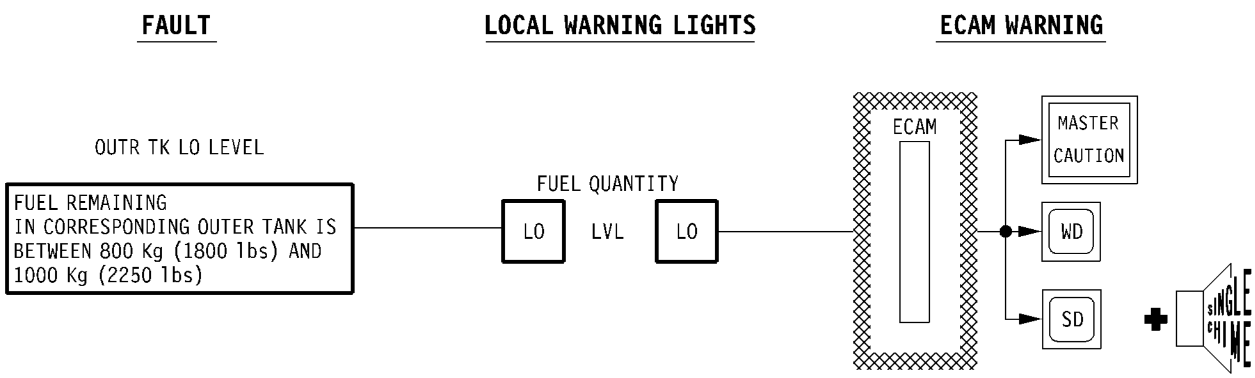
(1) CTR AND TRIM tank fuel quantity (G)

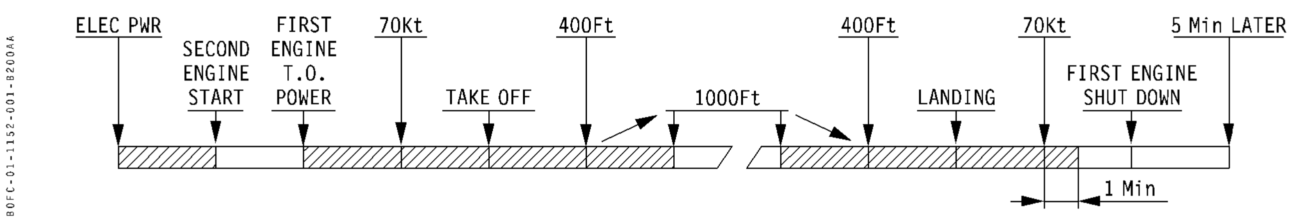
(2) OUTER and INNER tank fuel quantity (G)

- When fuel imbalance between the wing tanks exceeds 3000 kg (6700 lbs), the fuel quantity indications on the heavy side flash.

(3) TOTAL fuel quantity (G)

ECAM WARNING LOGIC





Mod : (4801 + 5051) or (4801 + 5051 + 7576)

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GENERAL

- Refueling and defueling is controlled from a REFUEL DEFUEL panel located on the lower right side of the fuselage near the air conditioning pack outlet.
- Two standard REFUEL DEFUEL couplings are mounted under each wing, outboard of the engine.
- The REFUEL DEFUEL VALVES are electrically commanded and they open by fuel muscle pressure.
  - REFUEL DEFUEL VALVES have mechanical controls to allow them to be manually opened if electrical power is not available

Note : *To purge the REFUEL DEFUEL manifold after refueling, when the L INR TK PUMP 1 and/or the R INR TK PUMP 2 are turned on, a drain valve opens to drain fuel trapped in the REFUEL DEFUEL line into the respective inner tank.*

If either of these pumps are operated during refueling or defueling, fuel will enter the respective inner tank through this drain valve, resulting in loading more fuel than preselected. This can lead to fuel spillage when the inner tanks are full.

AUTOMATIC PRESSURE REFUELING

- A fuel quantity preselector on the REFUEL DEFUEL panel is used to preset the desired fuel load.
- The required fuel load is distributed with the
R following priority : outer, inner, then center and
R trim tanks.
- The automatic refueling sequence simultaneously refuel all tank requiring fuel (based on above refuel priority).
- Tank refueling is automatically stopped by the FQI when the preset quantity is reached.
- As a backup of the automatic system, refueling may be manually controlled by placing each tank's REFUEL DEFUEL VALVES switch to OPEN or SHUT as required.
- Complete main tanks refueling takes approximately 25 minutes depending on refuel pressure. (Maximum fuel pressure is 50 PSI)
- Each tank has a high level sensor which closes the tank's REFUEL DEFUEL VALVE when the fuel level reaches the sensor.
- The center tank has a pressure relief valve which automatically opens when the REFUEL DEFUEL panel door is open. This valve allows excess center tank fuel to overflow into the right inner tank if the center tank overfills.
- If this valve is not open, it is not possible to refuel or defuel the center tank.

ALTERNATE GRAVITY REFUELING

- The individual wing tanks may also be gravity refueled by removing fuel caps on top of the wings.
- To refuel the center tank in this manner, the fuel transfer procedure must be applied.

Mod : 4801 + 5027

FUEL TRANSFER

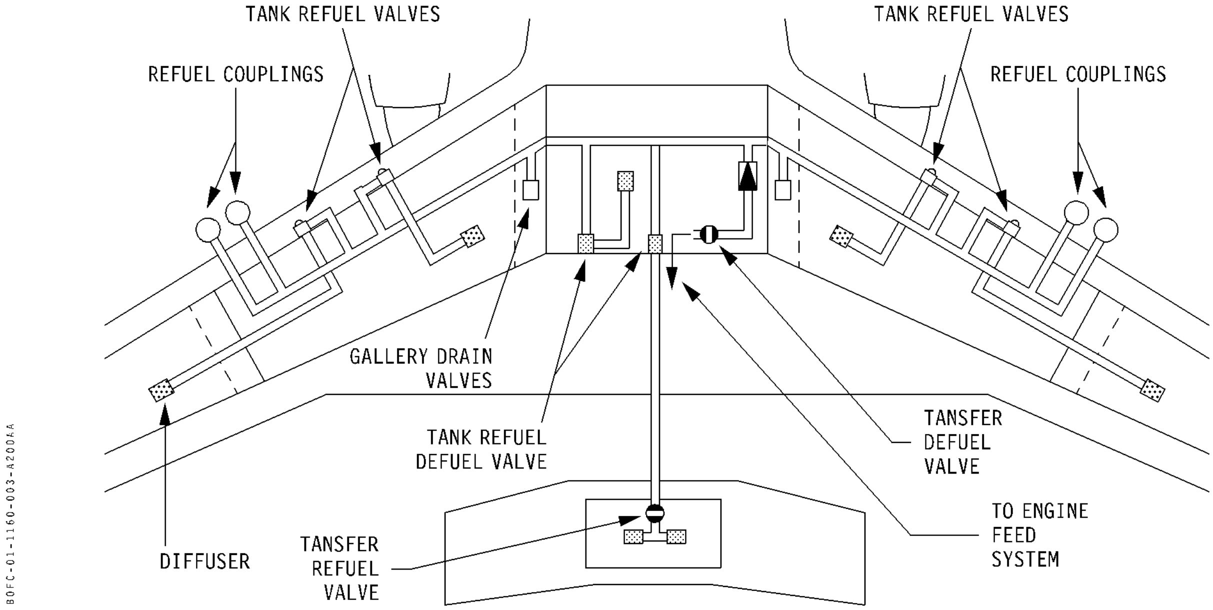
- Fuel transfer between main tanks is possible on the ground only.
  - On the REFUEL DEFUEL panel :
    - The TRANSF VALVE guarded toggle switch must be in the OPEN position.
    - The REFUEL DEFUEL VALVES guarded toggle switches of all tanks except the receiving tank must be in the SHUT position.
    - The REFUEL DEFUEL VALVES guarded toggle switch of any receiving tank must be in the OPEN position.
  - The supplying TK PUMP's must be operating.
- Fuel is pumped from the supplying tank into the fuel crossfeed line.
- From the crossfeed line, fuel goes through the TRANSF VALVE into the refuel/defuel line.
- From the refuel/defuel line, fuel enters the receiving tank through the associated REFUEL VALVE.

R *Note :* *If less than 400 kg (880 lb) is transferred to*
R *the right inner tank, a dash will be displayed*
R *on the last digit of both inner tanks FQI.*

POWER SUPPLY FOR REFUELING/DEFUELING

- When the REFUEL DEFUEL panel door is open, refueling electrical power can be obtained from three sources :
  - APU GEN or EXT PWR ON.
  - Aircraft not powered but :
    - EXT PWR plugged (AVAIL but not ON), and
    - MAINT BUS switch ON.
  - Aircraft not powered but :
    - REFUEL DEFUEL panel PWR SUPPLY switch in the BAT position.

Note : The aircraft Battery 1 supplies the DC Fueling Bus only (not the DC ESS BUS) and supplies the AC Fueling Bus through the Emergency Inverter.



Mod : (3028 + 4801) or (4801 + 5027)

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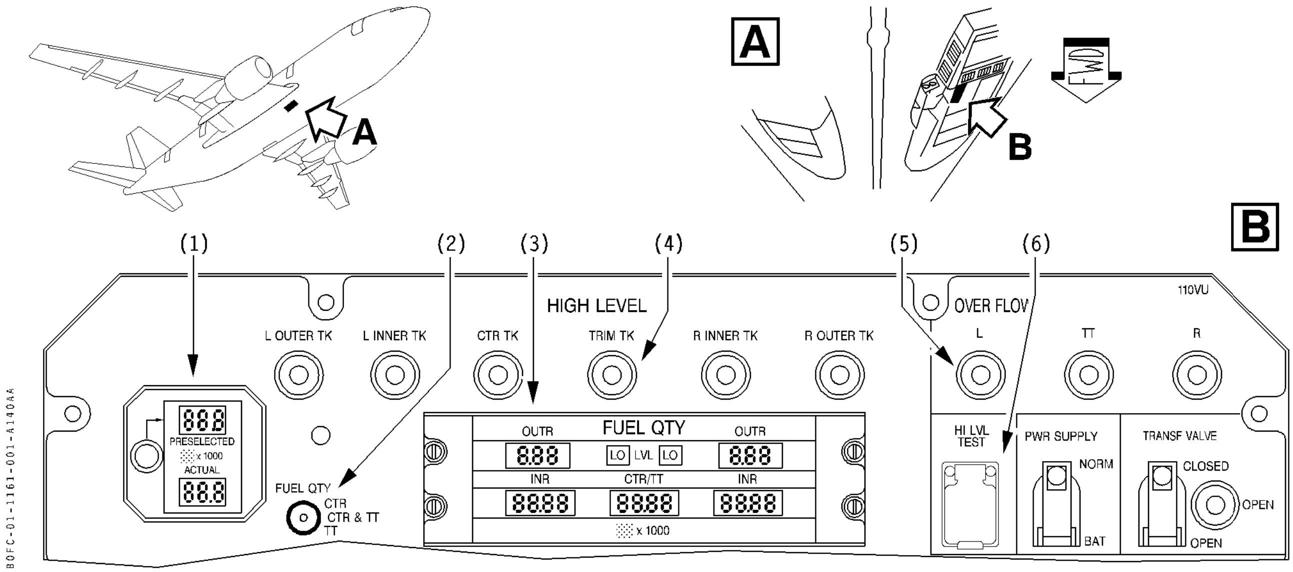
A. REFUEL/DEFUEL PANEL



(1) Fuel Quantity Preselector :

- PRESELECTED fuel quantity knob and display :
  - The total fuel quantity for automatic refueling is set using this preselector.
  - The display indicates the total fuel quantity preselected, in thousands of kg (lbs).
  - The PULL-TO-SET knob must be pulled and then turned to preselect the desired quantity.
- ACTUAL fuel quantity display :
  - Indicates the actual fuel quantity in thousands of kg (lbs).

(2) FUEL QTY Switch

- Enables to select on the FUEL QTY indicator , the fuel quantity indication of the CTR TK or TRIM TK or CTR & TRIM TK.

(3) FUEL QTY Indicator :

- Same indicator as used on the cockpit overhead panel.

  Note : CTR/TT indication depends on the position of the FUEL QTY switch (2).

(4) HIGH LEVEL Indicator Lights (Blue) :

- Illuminates when fuel level reaches the associated tank's high level sensor.
  - The corresponding REFUEL DEFUEL VALVE closes automatically, unless the MODE SELECTOR switch is set to DEFUEL.
  - Pressing the light illuminates the light (to test the light bulb).

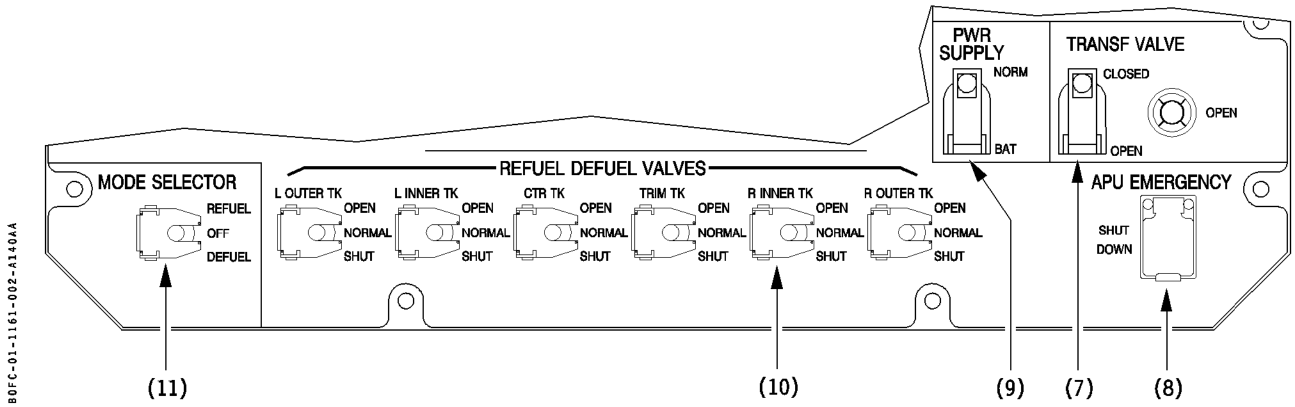
(5) L and R and TT OVERFLOW Warning Lights :

- Illuminates amber when the overflow sensor in the related vent surge tank is wet.
- Pressing the light illuminates the light (to test the light bulb).

(6) HI LVL TEST Pushbutton Switch :

- Pressing this pushbutton tests the high level and overflow sensors :
  - The test is successful when all HIGH LEVEL lights and all three OVERFLOW lights illuminate.
- The fuel quantity indications are also tested :
  - The test is successful if 8's are displayed in all positions of the FUEL QTY indicator, and on the PRESELECTED and ACTUAL quantity displays.

R Mod : 4801 or (4801 + 6702 + 11756)



(7) TRANSF VALVE guarded toggle switch :

- This switch controls the Defuel Transfer Valve that connects the fuel crossfeed and the REFUEL DEFUEL lines.

■ **OPEN** : The valve is open, fuel can be transferred or defuelled. The OPEN white light is illuminated.

■ **CLOSE** : Normal position, valve closed.

(8) APU EMERGENCY SHUT DOWN pushbutton switch (momentary action guarded) :

- Pressing this pushbutton switch shuts down the APU (normally used in case of fuel spillage).

(9) PWR SUPPLY guarded toggle switch :

- This toggle switch controls the REFUEL DEFUEL system power supply mode.

■ **NORM** : System can be powered by external power or the APU generator.

■ **BAT** : System is powered by BAT 1 and by the emergency inverter.

(10) REFUEL DEFUEL VALVES guarded toggle switches :

- These toggle switches control the REFUEL DEFUEL VALVES for each individual tank.

  Switches are guarded in the NORMAL position, which is the position used for automatic refueling.

Note : *For manual REFUEL : TRIM TK valve will not open unless CTR TK valve is also selected OPEN or both INNER TK high level sensors are wet.*

For DEFUEL, with fuel in TRIM TK, CTR TK cannot be defuelled unless TRIM TK is also selected.

(11) MODE SELECTOR guarded toggle switch :

- Controls the activation of the automatic refueling system or the operation of the REFUEL DEFUEL VALVES toggle switches.

Note : *Automatic refueling may not be successfully completed if any REFUEL DEFUEL VALVES toggle switch is not in the NORMAL position.*

R Mod : 4801 or (4801 + 6702 + 11756)

MODE SELECTOR switch position	**REFUEL DEFUEL VALVES switch position**		
	OPEN	**NORMAL**	**SHUT**
REFUEL	• REFUEL DEFUEL VALVE opens until the corresponding high level sensor is wet.	• REFUEL DEFUEL VALVE is operated by the automatic refueling system • The valve will close if its high level sensor is wet, or if signaled to close by the FQI.	• REFUEL DEFUEL VALVE is closed.
OFF	• REFUEL DEFUEL VALVES are closed and the REFUEL DEFUEL VALVES toggle switches are inoperative.		
DEFUEL	• REFUEL DEFUEL VALVE is open.		• REFUEL DEFUEL VALVE is closed.

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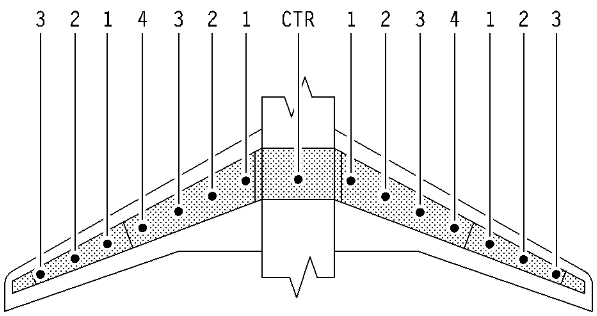
GENERAL

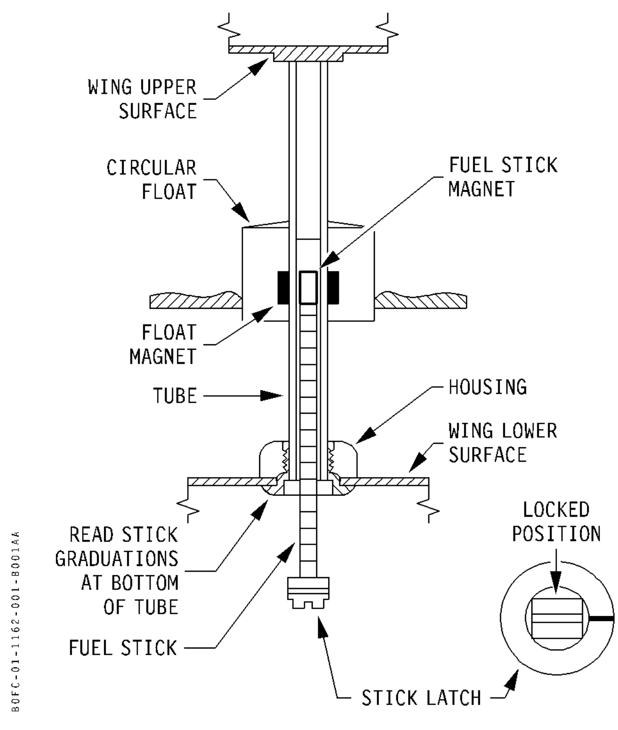
- The system is made up of:
  - Manual Magnetic fuel sticks for measurement of fuel depth in each tank, and
  - An attitude indicator to measure the aircraft pitch attitude and roll angle.
  - These two values are used to determine the actual fuel quantity based on the fuel quantity charts and on the specific gravity of the fuel.



MANUAL MAGNETIC FUEL STICKS

- Location:
  - 3 in each outer tank, R
  - 4 in each inner tank, R
  - 1 in the center tank.
  - 1 in the trim tank (if installed) R
- When the stick is unlocked, the fuel stick can be slowly pulled down.
- When the fuel stick is stopped by the float magnet, fuel depth can be read on the stick's scale.

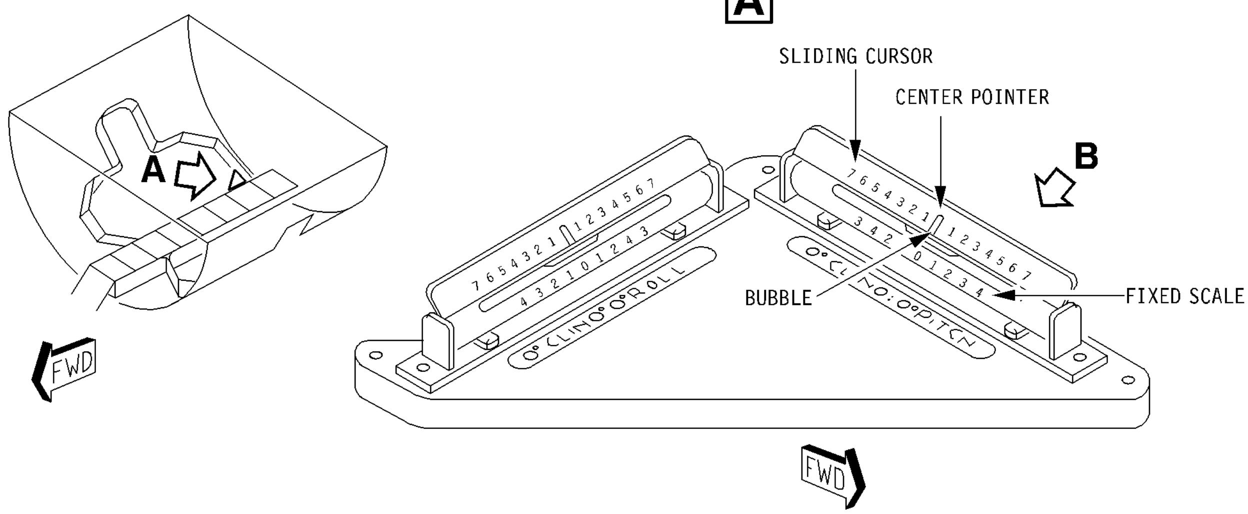
Note : *Do not use excessive force when pulling the fuel stick down, as this will pull the fuel stick past the float magnet and allow the fuel stick to hit its lower mechanical stop.*



ATTITUDE INDICATOR

- The attitude indicator located in the main landing gear bay has 2 level-type gauges.
- Each level gauge is fitted with :
  - a scale to measure the pitch attitude or roll angle, and
  - a sliding cursor scale.
- Determination of aircraft attitude :
  - The sliding cursor (1) is manually positioned over the center of the bubble.
  - The center pointer of the sliding cursor (2) indicates the aircraft pitch attitude (or roll angle) on the fixed scale (for example 1° 5 nose up on the picture).

A



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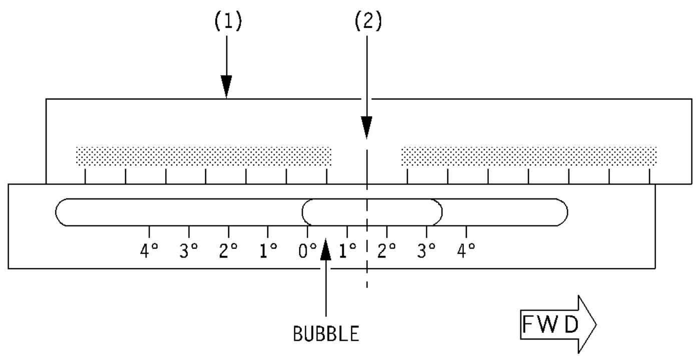


BOFC-01-1162-002-A001AA

GENERAL

- The Trim tank system is installed in order to :
  - Increase the fuel tank capacity.
  - Decrease the fuel consumption by reducing drag during cruise, by maintaining the aircraft Center of Gravity (CG) close to the certified aft limit.
- To maintain the CG target, fuel is transferred aft from the Center or Inner tanks to the Trim tank, or forward from the Trim tank to the Center tank.
  - Aft transfer is controlled by the Center of Gravity Control Computer (CGCC).
  - Forward transfer is controlled by the CGCC, or can be manually selected on the fuel panel.
- An independent monitoring of the CG is provided by the FWC, and is based on the THS position.

  It signals to the CGCC if the CG is to far aft and provides ECAM warnings.

CGCC FUNCTIONS

The CGCC has three main functions.

- The CGCC computes the aircraft CG and Gross Weight (GW) which are displayed on the ECAM.

  The CG and GW calculation is based on :
  - Zero Fuel CG (ZFCG) and Zero Fuel Weight (ZFW) entered by the crew on the FMS CDU.
  - Fuel quantity in each tank provided by the FQI.
  - Aircraft pitch angle provided by the IRS.
- Monitoring the aircraft CG and maintaining the CG target.
- Controlling fuel transfer to and from the Trim tank in order to maintain the CG target.

  This function is only active if at least one TRIM TK PUMP pushbutton switch is selected ON, and the MODE selector is in the AUTO position.

CGCC MODES

The CGCC has three modes of operation.

Normal Mode

- The CG control is fully automatic and maintains the CG close to the target.

Alternate Mode

- CG control is fully automatic, but fuel aft transfers are stopped.
- Fuel in the Trim tank will automatically be transfered forward in steps.
- An ECAM status message is displayed :

  FUEL TRIM TANK AFT XFR NOT AVAIL
- No crew action is required.

Fault Mode

- The automatic CG control is lost, and crew must manually transfer the Trim tank fuel forward.
- An ECAM caution is displayed :

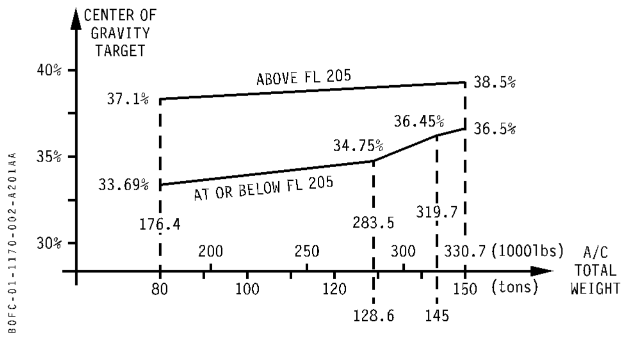
  FUEL TRIM TANK SYS FAULT

  PROC TRIM TANK SYS FAULT
- The crew must apply the TRIM TK SYS FAULT QRH procedure.

Mod : 4801

CG TARGET

- CG target (computed by the CGCC) depends on the aircraft Gross Weight, as illustrated hereafter :



- In case of manual FWD transfer in flight (for more than 10 seconds) or in case of degraded accuracy of FQI data, the CG target is shifted 1.5 % more forward.

Note : A STATUS message is displayed on the ECAM.

C.G. CONTROL

When the slats are retracted after take-off, the TRIM TK ISOL VALVE automatically opens to allow fuel transfers to or from the trim tank as controlled by the CGCC.

In climb below FL 205

- No aft tranfer will occur. Forward transfer will occur if the CG moves beyond the aft target due to fuel burn.

Flight above FL 205

- Automatic aft and forward transfers will be controlled by the CGCC in order to maintain the C.G. within 0.5 % forward of the C.G. target.
- If the CG target cannot initially be reached due to a full trim tank, C.G. control is interrupted and resumed automatically once the C.G. target is reached by fuel consumption.
- Once the inner tanks are empty, the C.G. target is no longer maintained and the CGCC controls forward transfers to maintain the center tank between 500 kg (1100 lb) and 1000 kg (2200 lb) until the trim tank is empty.

Descent below FL 200

- When descending below FL 200, the CGCC initiates a fast forward transfer in order to empty the trim tank. If the forward C.G. limit is reached , or center tank becomes full, forward transfer is suspended.
- When the landing gear is down, the TRIM TK ISOL VALVE will automatically close and to prevent any further fuel transfer.

Note : If the whole flight is performed below FL 205, the CG will be controlled between 33.6 % and 36.5 % depending on the aircraft Gross Weight and no automatic forward transfer will be initiated before landing.
In this case the crew must check the trim tank quantity prior to descent and select TRIM TK MODE to FWD to manually transfer the trim tank fuel forward prior to landing. It is permitted to land with up to 2000 kg (4400 lb) in the trim tank.

Mod : 4801 + 6813

FUEL TRANSFER SYSTEM

- The trim tank transfer pipe connects the trim tank to the engine feed gallery and refuel gallery.
- At the trim tank the pipe is isolated by the TRIM TK ISOL VALVE.
- This valve is automatically controlled :
  - On ground, it will be closed, except when the refuel panel is powered.
  - In flight the TRIM TK ISOL VALVE opens at SLATS retraction and closes again at landing gear extension. The TRIM TK ISOL VALVE will also open whenever TRIM TK MODE is selected FWD.
- The TRIM TK ISOL VALVE can also be manually selected closed, using its guarded pushbutton switch. The manual selection of the TRIM TK ISOL VALVE should not be used in flight.

Aft Transfer

- Fuel is supplied from the center or inner tanks, dependent on the autofeed control system.
- The transfer is controlled by the CGCC through two AFT TRANSFER VALVES which will be opened separately by the CGCC if inner tank fuel imbalance is more than 200 kg (440 lbs).
- Manual aft transfer is not possible.
- Aft transfer rate is approx 150 kg/min (330 lbs/min).

Forward Transfer

- FWD transfer is only possible from trim tank to center tank.
- The CGCC activates the trim tank pumps and opens the FORWARD TRANSFER VALVE (plus the AUXILIARY FORWARD TRANSFER VALVE for fast forward transfer).
- If this automatic mode is not available, fuel can be manually transferred forward, by selecting FWD on the TRIM TK MODE pushbutton switch.

  In this case, the trim tank pumps are activated and the FORWARD TRANSFER VALVE and the AUXILIARY FORWARD TRANSFER VALVE open (fast forward transfer).
  - FWD mode must be deselected and trim tank pumps turned off once the trim tank is empty.
- Forward transfer can also be performed by gravity.

Transfer Rates

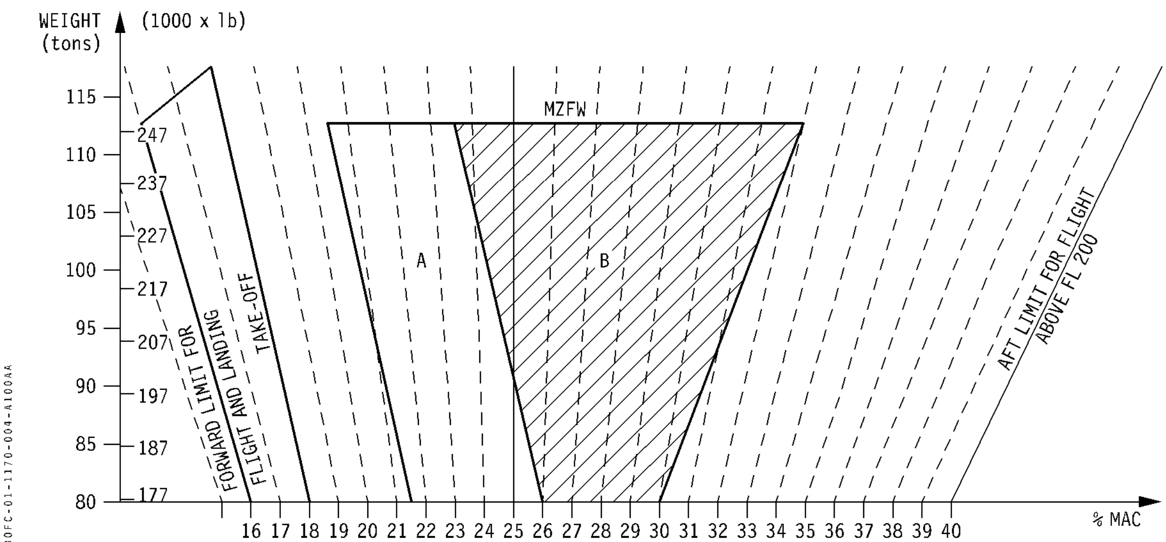
TRANSFER	TRANSFER RATE
AFT	150 kg/min (330 lb/min)
Automatic FWD	120 kg/min (265 lb/min)
Fast FWD	450 kg/min (990 lb/min)
Manual FWD	450 kg/min (990 lb/min)
Gravity FWD in cruise	100 kg/min (220 lb/min)
Gravity FWD in descent	125 kg/min (275 lb/min)

Mod : 4801

FORWARD TRANSFER FUNCTIONS

FAILURE	ZFCG in Zone A	ZFCG in Zone B
TYPE 1	Two-step fuel transfer : – 3 tons (6 600 lb) transferred from TRIM TK to CTR TK – Remaining TRIM TK fuel is transferred as soon as Inner tank pumps are running.	One step transfer : – Whole TRIM TK fuel is transferred to CTR TK as soon as failure is detected.
TYPE 2	Two-step fuel transfer : – When CTR TK fuel decreases below 12.4 tons (27 300 lb), 3 tons (6 600 lb) are transferred from TRIM TK to CTR TK. – Remaining TRIM TK fuel is transferred as soon as INR TK PUMPS are running.	Multiple-step transfer : – First transfer is initiated as soon as failure is detected. – When CTR TK fuel quantity increases above 15.4 tons (34 000 lb), transfer is stopped. – When CTR TK fuel quantity decreases below 14.4 tons (31 700 lb), transfer is resumed until fuel quantity in CTR TK reaches 15.4 tons (34 000 lb). – The process is repeated until TRIM TK is empty.

ZFCG Zones :



R TYPICAL GRAPH

Mod : 4801

CGCC ALTERNATE MODE

- Some failures cause the CGCC to enter in **alternate mode.**
- This mode only controls the forward transfer to ensure that the CG is maintained within safe limits, and prevents a CTR TK overfilling.
- With the following failures, the alternate mode initiates a **normal forward transfer** (alternate mode 1) :
  - Both ADC fail,
  - Both Fuel Flow indicators fail,
  - FQI fails,
  - FQI/CGCC monitor discrepancy,
  - Restart after power down (at least 200 ms) in flight,
  - One CTR TK PUMP fails during aft transfer,
  - Both pumps within one inner tank fail during aft transfer,
  - One OUTR TK below 2500 kg (5500 lb) and trim tank above 200 kg (440 lb).
- With the following failures, the alternate mode initiates a **fast forward transfer** (alternate mode 2) :
  - Refuel transfer valve fails to open or to close,
  - FWD transfer control valve fails to open or to close,
  - FWD auxiliary transfer valve fails to open or to close,
  - One aft transfer valve fails to open or to close,
  - Both Trim tank pumps fail.

Note 1 : The message :

FUEL TRIM TANK AFT XFR NOT AVAIL is displayed on the left ECAM CRT.

Note 2 : Fuel is automatically transferred forward from the Trim tank in steps. No crew action is required.

Mod : 4801

CGCC FAULT MODE

- The following conditions cause the CGCC to enter the **FAULT mode** with no automatic forward fuel transfer :
  - CGCC internal failure,
  - No initial ZFW or ZFCG after take off,
  - CG aft of target CG above FL 200,
  - Detected failure during manual operation,
  - Detected transfer system faults during alternate mode 1,
  - Detected FQI faults during alternate mode 2,
  - No transfer if FWD transfer commanded,
  - Undetected jamming of transfer control or auxiliary transfer valve.

Note 1 : The message :

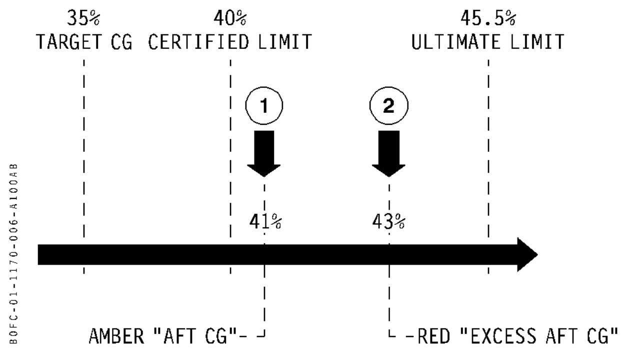
FUEL TRIM TANK SYSTEM FAULT is displayed on the left ECAM CRT.

MANUAL MODE

- The CGCC can be overridden by selecting manually FWD transfer on the MODE pushbutton switch.
- A fast forward transfer is initiated regardless of CGCC commands and of the CTR TK high levels signals.
- The CGCC automatic functions can be resumed if AUTO is selected again on the MODE pushbutton switch.

INDEPENDENT AFT CG MONITOR

- An Aft CG monitoring is provided in order to prevent from an undetected failure of the CGCC.
- The monitoring is independent from the CGCC and is performed by the FWC, considering the position of the trimmable horizontal stabilizer.
- The independent AFT CG monitor has two alert thresholds as shown in the following graph :



(1) AFT CG : 41 %

- An amber caution AFT CENTER OF GRAVITY is displayed on the left ECAM CRT if the CG exceeds 41 %.

(2) EXCESS AFT CG : 43 %

- A red warning EXCESS AFT CG is displayed on the left ECAM CRT if the CG exceeds 43 %.

Mod : 4801

ZFW AND ZFCG MONITORING

- On ground, the CGCC monitors the ZFW and the ZFCG received from the FMS.
- An ECAM caution is generated in the following cases :
  - If the difference between values received from FMS 1 and FMS 2 exceed a certain tolerance (in case of FMS independent operation).
  - If only one FMS is operative, the CGCC accepts the first entry of the ZFW but the next change in ZFW or ZFCG will lead to the display of ZFW or ZFCG DISAGREE message (as there is no possibility of cross check with the other FMS).

Note : The ECAM message is :

FUEL ZFW or ZFCG DISAGREE

PROC TRIM TK SYS INIT

- The flight crew must follow the TRIM TK SYS INIT procedure.
- If there is still a discrepancy, the CG control system should not be used and Trim tank pumps selected OFF.

Mod : 4801

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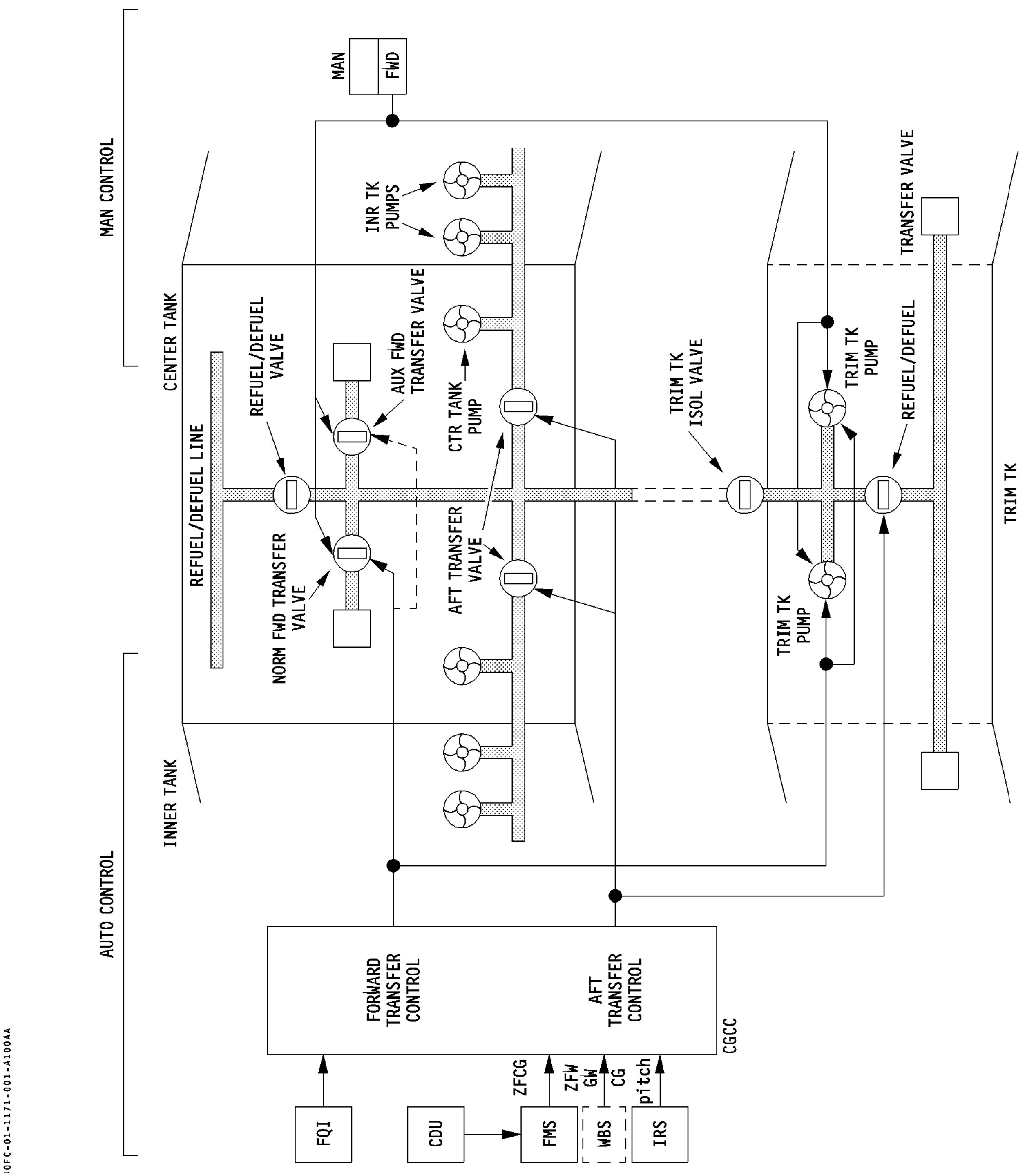
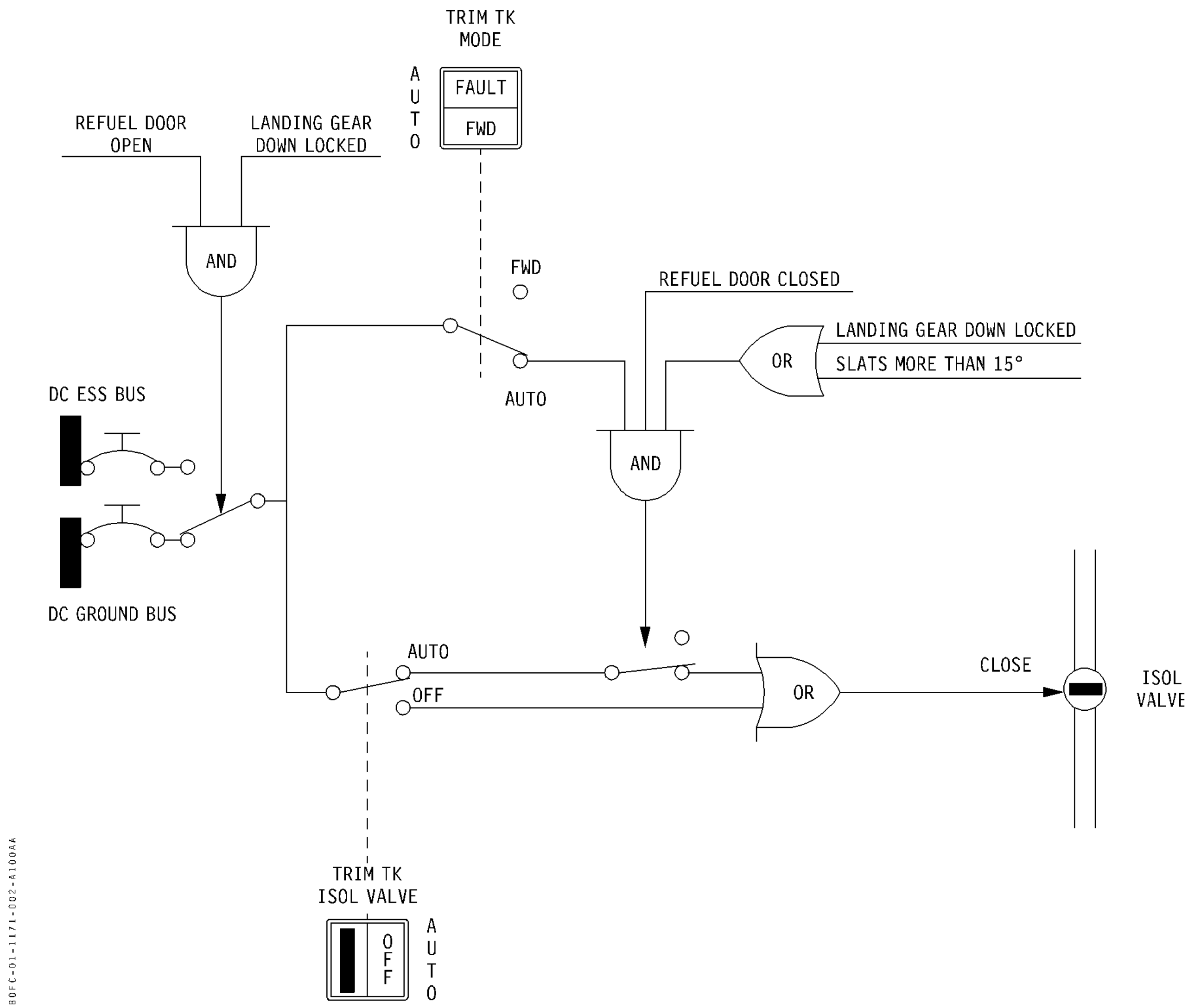
Mod : 4801

GENERAL



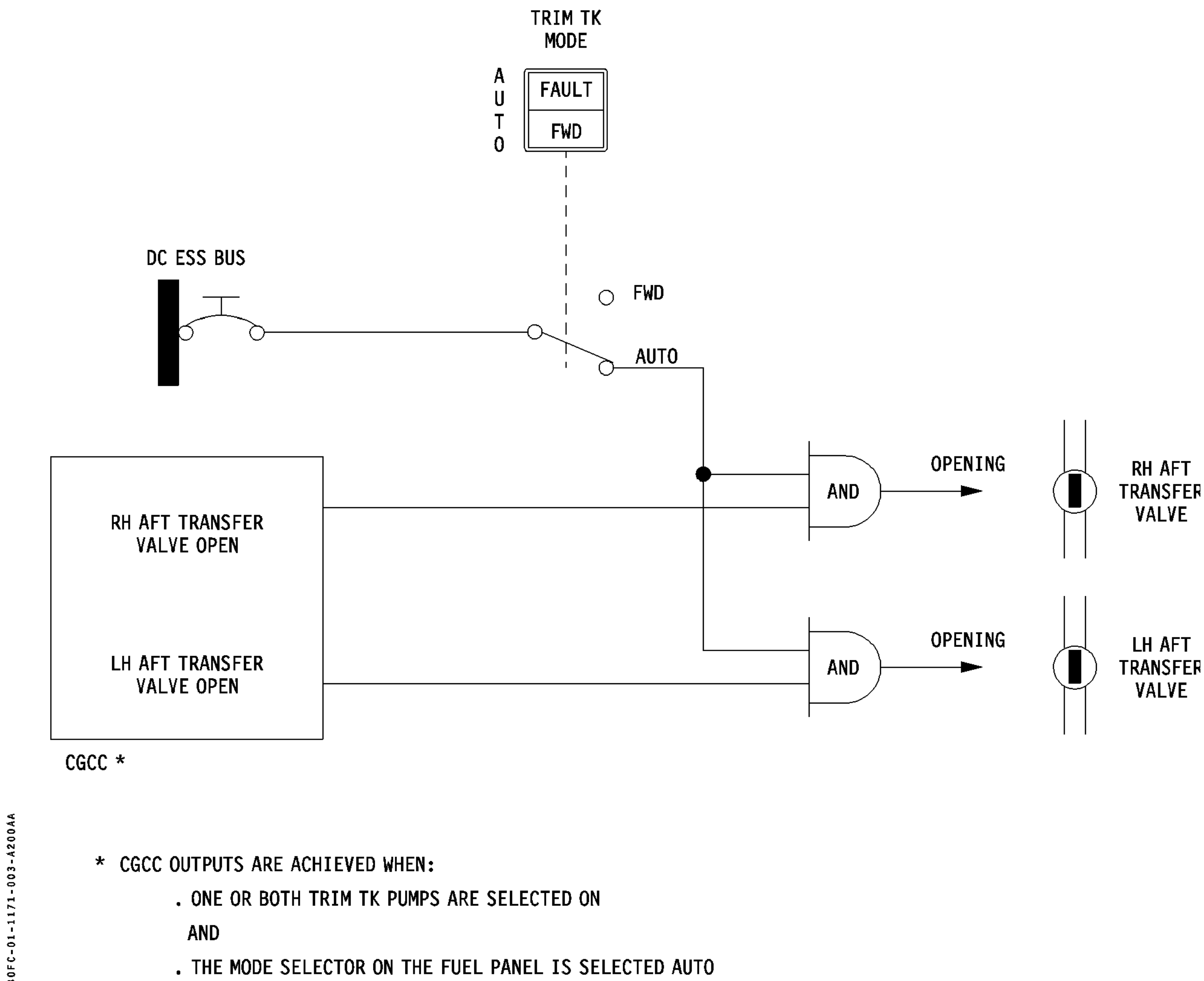
Mod. : 4801

ISOL VALVE CLOSURE



Mod. : 4801

AFT TRANSFER



* CGCC OUTPUTS ARE ACHIEVED WHEN:

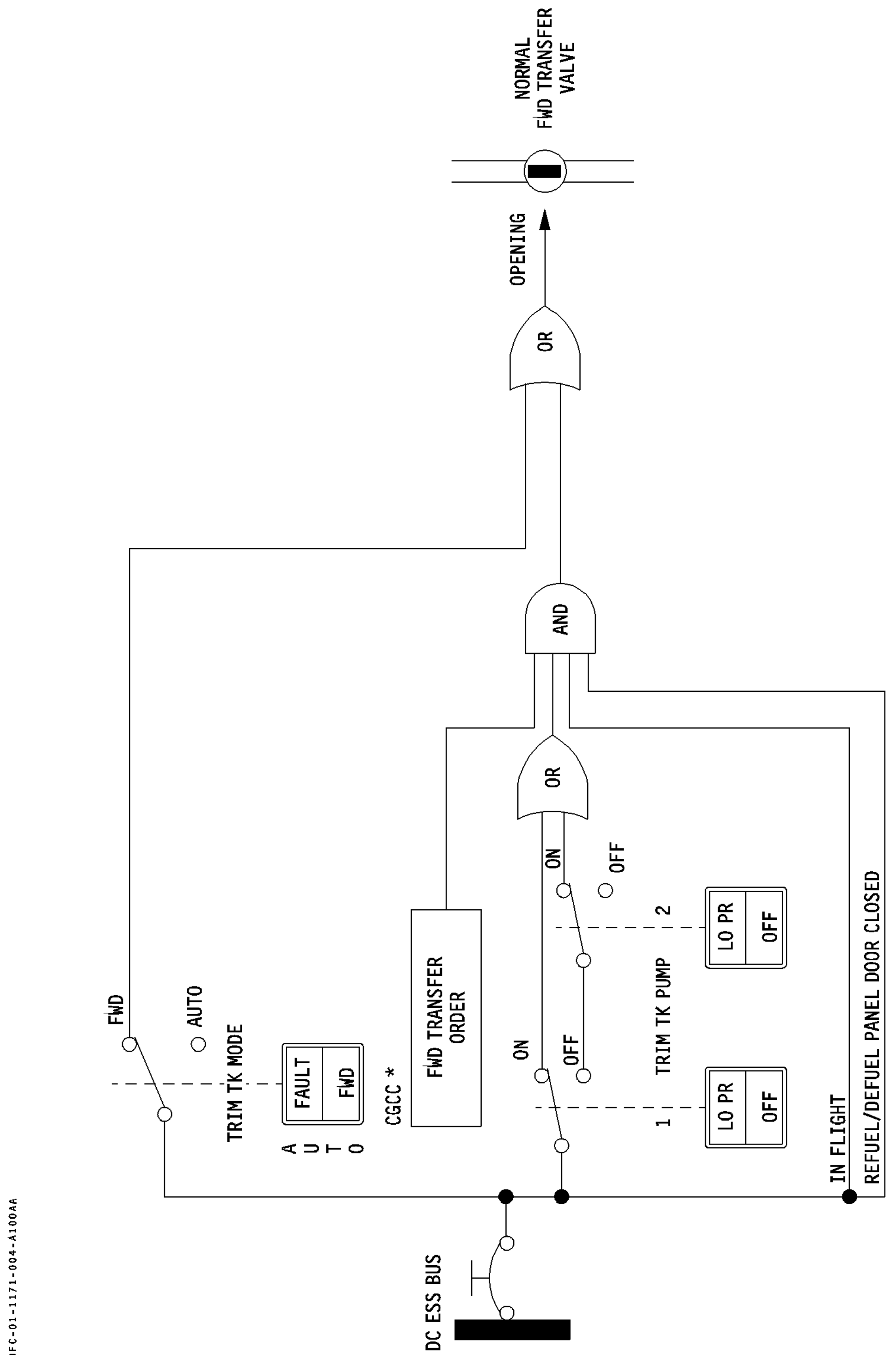
. ONE OR BOTH TRIM TK PUMPS ARE SELECTED ON

AND

. THE MODE SELECTOR ON THE FUEL PANEL IS SELECTED AUTO

Mod. : 4801 + 6497

NORMAL FORWARD TRANSFER VALVE



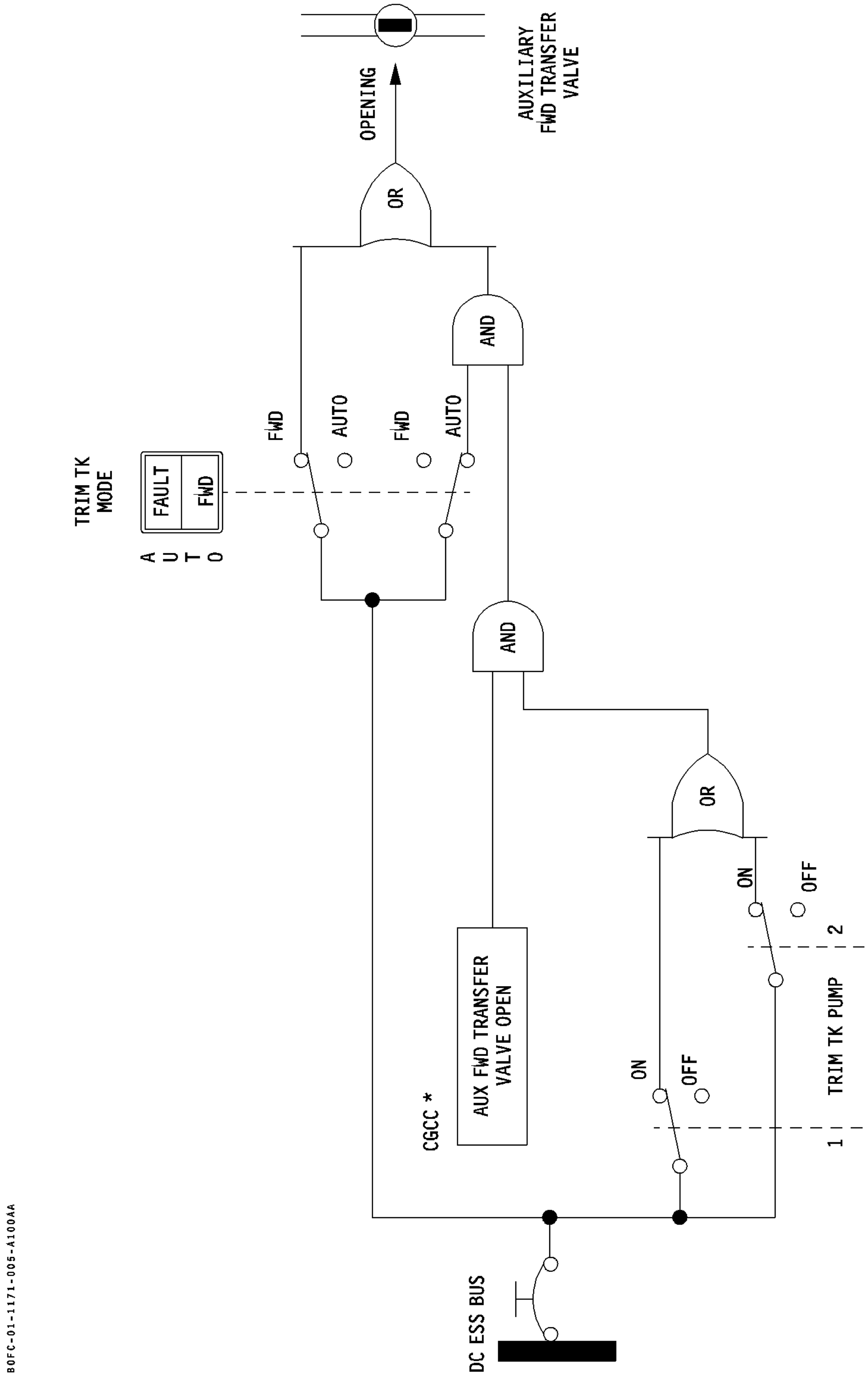
* CGCC OUTPUTS ARE ACHIEVED WHEN:
- . ONE OR BOTH TRIM TK PUMPS ARE SELECTED ON

AND

- . THE MODE SELECTOR ON THE FUEL PANEL IS SELECTED AUTO

Mod. : 4801

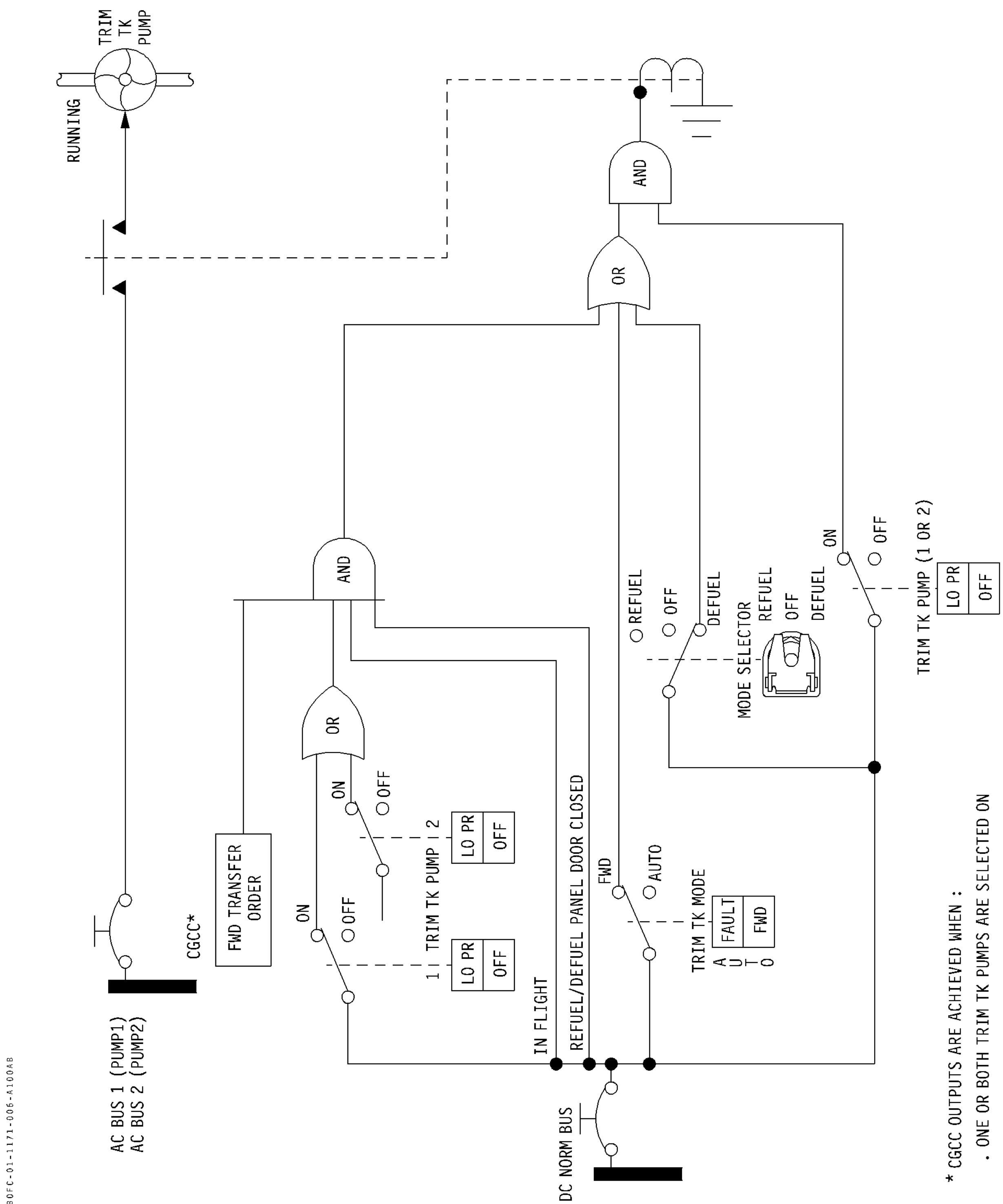
AUXILIARY FORWARD TRANSFER VALVE



* CGCC OUTPUTS ARE ACHIEVED WHEN:
. ONE OR BOTH TRIM TK PUMPS ARE SELECTED ON
AND
. THE MODE SELECTOR ON THE FUEL PANEL IS SELECTED AUTO

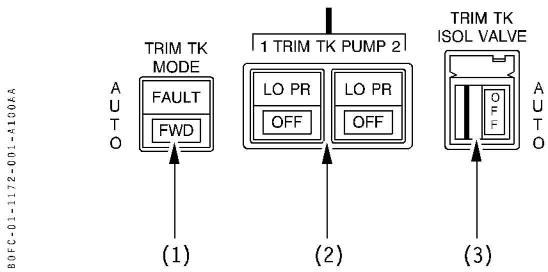
Mod. : 4801

TRIM TANK PUMPS



* CGCC OUTPUTS ARE ACHIEVED WHEN :
. ONE OR BOTH TRIM TK PUMPS ARE SELECTED ON
AND
. THE MODE SELECTOR ON THE FUEL PANEL IS SELECTED AUTO

Mod. : 4801



(1) TRIM TK MODE Pushbutton Switch

■ **AUTO**

- In flight, CG is automatically controlled by the CGCC (provided one TRIM TK PUMP at least is selected ON and the TRIM TK ISOL VALVE pushbutton switch is not selected OFF).

■ **FAULT light**

- Illuminates amber when :
  - The CGCC detects a TRIM TK system fault.
  - An AFT CG or EXCESS AFT CG warning occurs.
  - TRIM TK ISOL VALVE is not open with gear up and slats retracted.
  - TRIM TK PUMPS 1+2 LO PR and TRIM TK not empty, for more than 40 sec.

■ **FWD**

- When the pushbutton switch is pressed the FWD light illuminates white.
- Fuel is transfered forward, provided that the TRIM TK ISOL VALVE pushbutton switch is selected to AUTO.
- Both the Forward Transfer Valve and Auxiliary Forward Transfer Valve open.
- TRIM TK PUMPS (if selected) are activated, otherwise the transfer is performed by gravity.

(2) TRIM TK PUMP 1 (or 2) Pushbutton Switch

■ **Normal position**

- The PUMPS are activated according to the CGCC logic or if the TRIM TK MODE pusbutton switch is selected FWD.
- CGCC control is enabled if at least one TRIM TK PUMP is selected.

■ **LO PR**

- Illuminates amber if a low pressure is detected at the pump outlet.

■ **OFF**

- The light illuminates white.
- The PUMP cannot be activated by the CGCC.
- If both pumps are OFF, CGCC control is disabled.
- No automatic transfers will occur, CGCC monitoring and warnings are still available.
- Manual FWD transfer is available.

(3) TRIM TK ISOL VALVE Pushbutton Switch

■ **AUTO**

- The valve is OPEN or SHUT depending on its logic.

■ **OFF**

- The light illuminates white.
- The valve is closed.

■ **Flow bar (green)**

- In line when the valve is open.
- Flashing during the valve transit.

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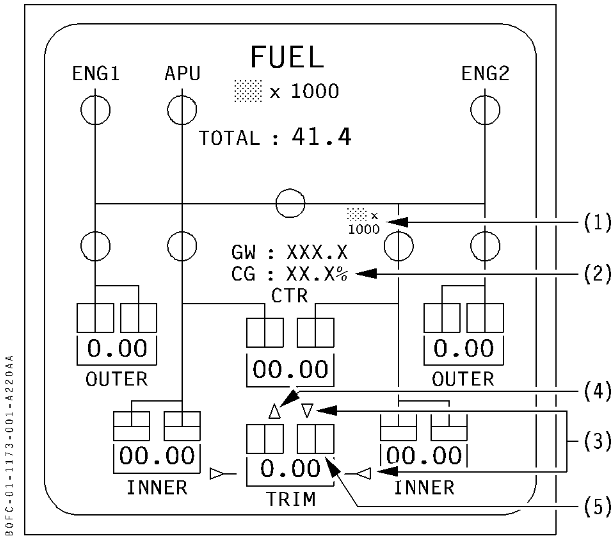
Mod : 4801



(1) Gross weight indication (Green)

R In KG x 1000 (or lbs x 1000)

(2) CG indication (Green)

- Green when CG is between 18.5 % and 39.5 %,
- Amber if CG exceeds 40 % or is more forwad than 18 %.

(3) Transfer indication from CTR or INR tank to TRIM tank

▼ (G) : AFT transfer
▽ (A) : AFT transfer FAULT or not allowed

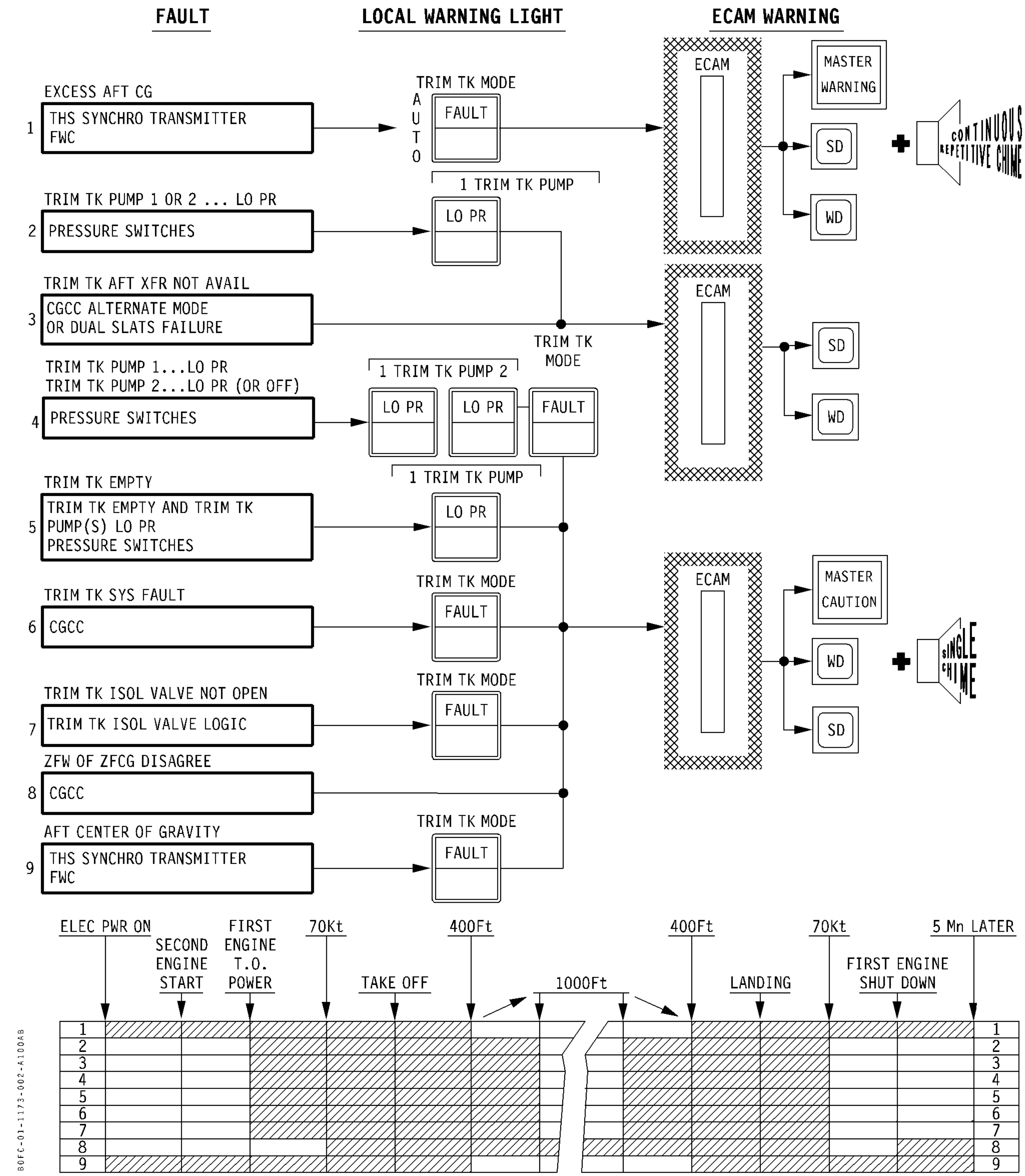
(4) Transfer indication from TRIM tank to CTR tank

R ▲ (G) : FWD transfer
△ (A) : FWD transfer FAULT

(5) TRIM tank pumps

◫ (G) : pump ON and normal fuel pressure
LO (A) : pump ON and LOW pressure
⊟ (A) : pump selected OFF
⊟ (G) : pump selected NORM but not running.

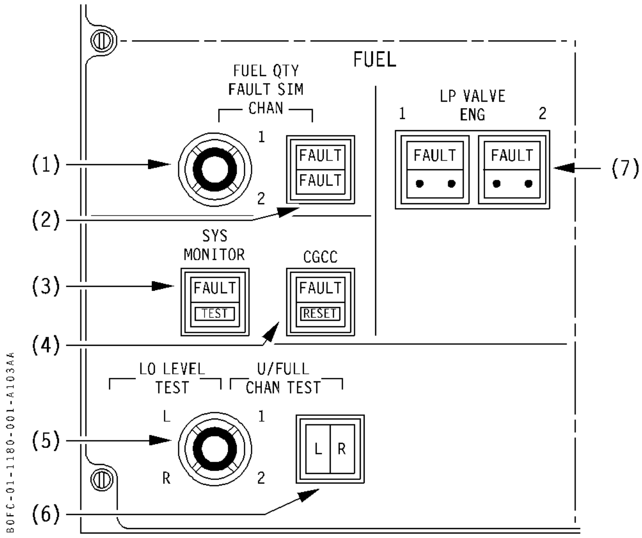
R Code : 0167


FAULT
LOCAL WARNING LIGHT
ECAM WARNING
1 EXCESS AFT CG
THS SYNCHRO TRANSMITTER FWC
2 TRIM TK PUMP 1 OR 2 ... LO PR
PRESSURE SWITCHES
3 TRIM TK AFT XFR NOT AVAIL
CGCC ALTERNATE MODE OR DUAL SLATS FAILURE
4 TRIM TK PUMP 1...LO PR
TRIM TK PUMP 2...LO PR (OR OFF)
PRESSURE SWITCHES
5 TRIM TK EMPTY
TRIM TK EMPTY AND TRIM TK PUMP(S) LO PR PRESSURE SWITCHES
6 TRIM TK SYS FAULT
CGCC
7 TRIM TK ISOL VALVE NOT OPEN
TRIM TK ISOL VALVE LOGIC
8 ZFW OF ZFCG DISAGREE
CGCC
9 AFT CENTER OF GRAVITY
THS SYNCHRO TRANSMITTER FWC
TRIM TK MODE
AUTO
FAULT
1 TRIM TK PUMP
LO PR
TRIM TK MODE
1 TRIM TK PUMP 2
LO PR
LO PR
FAULT
1 TRIM TK PUMP
LO PR
TRIM TK MODE
FAULT
TRIM TK MODE
FAULT
TRIM TK MODE
FAULT
ECAM
MASTER WARNING
SD
WD
CONTINUOUS REPETITIVE CHIME
ECAM
SD
WD
ECAM
MASTER CAUTION
WD
SD
SINGLE CHIME
ELEC PWR ON
SECOND ENGINE START
FIRST ENGINE T.O. POWER
70Kt
TAKE OFF
400Ft
1000Ft
400Ft
LANDING
70Kt
FIRST ENGINE SHUT DOWN
5 Mn LATER
1 2 3 4 5 6 7 8 9
BOFC-01-1173-002-A100AB

R

Mod : 4801

A. FUEL QTY



(1) FUEL QUANTITY FAULT SIM Selector

■ **UP**

– A failure is simulated in the channel 1 of the FQI.

■ **Neutral**

– No failure simulated.

■ **DOWN**

– A failure is simulated in the channel 2 of the FQI.

(2) FAULT SIM Indicator

• Each FAULT light illuminates when a failure is detected in the corresponding channel of the FQI.

(3) SYS MONITOR Pushbutton Switch

■ **Normal (pushbutton switch released-out)**

– No test performed.

■ **TEST (pushbutton switch depressed-in)**

– The light illuminates white. FUEL QTY indicator displays a code indicating the detected failure.

■ **FAULT**

– The light illuminates white if a failure is detected by the incorporated BITE.

(4) CGCC FAULT light

• Illuminates white if a CGCC fault is detected.

Note : A reset of CGCC is only possible if the CGCC bite has been read.

(5) LO LVL and U/FULL CHAN TEST Selector

■ **UP**

– LH LO LVL sensor and U/FULL channel 1 sensors are tested.

■ **Neutral**

– No sensor tested.

■ **DOWN**

– RH LO LVL sensor and U/FULL channel 2 sensors are tested.

(6) U/FULL CHAN TEST Light (if installed)

• L (or R) light illuminates when the test of the LH (or RH) sensor of the selected channel is positive, or when the respective OUTER TK fuel quantity is below 2000 kg (4400 lbs).

(7) LP VALVE ENG 1 (2) FAULT Light

• Illuminates in case of failure of one of the two contactors of the corresponding FIRE HANDLE.

Mod : 4801

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GENERAL

The aircraft has three completely independent hydraulic systems, which operate simultaneously. They are designated BLUE, GREEN, YELLOW.

Each system is supplied from its own hydraulic reservoir. There are no provisions for routing of hydraulic fluid from one system to the other.

Four identical, engine driven hydraulic pumps, 2 on each engine, pressurize the systems with a delivery pressure of 3,000 PSI :

- GREEN 2 pumps, one on each engine,
- BLUE 1 pump on engine 1,
- YELLOW 1 pump on engine 2.

Two non-reversible power transfer units are installed to provide for power transfer without fluid exchange, from the GREEN system to the BLUE or to the YELLOW system. They are required in case of power generation failure (e.g. in case of engine failure or engine pump failure) and also for ground testing.

If the engine driven pumps are not available, hydraulic power may also be generated by :

- Two electric pumps in the GREEN system (primarily intended for ground testing).
- One electric pump in the YELLOW system to pressurize the brake accumulators (Parking/ALTN-OFF brakes) if required, or to operate the main cargo compartment doors.
- A ram air turbine (RAT) driven pump in the YELLOW system to supply emergency hydraulic power.
- A hand pump in the YELLOW system to operate the main cargo compartment doors when the YELLOW electric pump is not available.

Hydraulic power is fed directly to the servo controls manifolds and then to the high pressure manifolds, which are permanently linked. The servo control manifolds supply the primary flight controls, spoilers and wing tip brakes through a servo controls selector valve.

The high pressure manifolds are equipped with a
R priority valve which isolates slat, flap, gear, krueger and nose gear steering operating systems, when the pressure has dropped below 1,885 PSI which gives priority to Flight Controls.
(See chapter FLIGHT CONTROLS for detailed information).

In the event of engine fire the engine driven pumps are isolated from their hydraulic reservoirs by the FIRE VALVES. When an ENG FIRE handle is pulled, the respective valves close. In the yellow system, the FIRE valve closes also in case of LO LVL.
The position of the FIRE VALVES is indicated on the lateral panel.

RESERVOIRS

The hydraulic fluid reservoirs, are of different capacities for each individual system. The low level for each is 5 ltr (1,3 US gal).

- GREEN On the rear wall of the main gear and hydraulics bay, normal filling level 17 ltr (4,5 US gal)
- BLUE Inside the LH wing root, normal filling level 12 ltr (3,2 US gal)
- YELLOW Inside the RH wing root, normal filling level 18.5 ltr (4,9 US gal)

The YELLOW reservoir will retain a fluid reserve of 3 ltr (0,8 US gal), which is strictly for RAT operation.

To avoid pump cavitation, all reservoirs are automatically pressurized to 50 PSI by engine bleed air, APU bleed air or by a ground air supply.
Individual replenishing is possible from the GREEN system ground service panel.

Each reservoir is provided with :

- an electrical, float type quantity transmitter,
- a pneumatic pressure switch for low air pressure warning,
- a temperature switch in the return line for high temperature warning,
- a compartment feature ensures positive fluid supply to the pumps during negative « g » conditions of up to 20 seconds.
- a direct reading level indicator.

ENGINE DRIVEN PUMPS

Two variable displacement pumps are installed on the accessory gearbox of each engine :

- Engine 1 : one green and one blue system pump.
- Engine 2 : one green and one yellow system pump.

They are identical and of the self-regulating multipiston type. The nominal output flow of 136 ltr/min (35,9 USgal/min) is delivered at a pressure of 3000 PSI.

A solenoid operated dump valve in each pump allows depressurization of the pump in case of pump or related system failure. Each valve is controlled by the corresponding PUMPS pushbutton switch on the HYD PWR section of the overhead panel.

FIRE VALVES, which are shutoff valves on the suction side of each pump, isolate the hydraulic fluid supply to the pump, when the respective ENG FIRE handle is pulled.

ELECTRIC PUMPS

The GREEN system is provided with two identical soft-compensated and self-regulating hydraulic pumps, driven by AC motors.

The nominal output flow is as follows :

- 0 ltr/min : 3,000 PSI
- 23 ltr/min (6 US gal/min) : 2,830 PSI
- 36 ltr/min (9,5 US gal/min) : 1,670 PSI

Both pumps are controlled simultaneously by a pushbutton switch on the HYD PWR section of the overhead panel. When operated, the complete GREEN system is pressurized. Electrical power supply for the AC motors is from AC BUS 1 and AC BUS 2 respectively.

The YELLOW system is provided with a self-regulating hydraulic pump, which is driven by an AC motor. The nominal output flow of 6 ltr/min (1,6 US gal/min) is delivered at 2 850 PSI. The pump is controlled by the PARKING BRAKE ACCU PRESS pushbutton on the center pedestal, near the PARKING BRAKE control handle, and by the OPEN/CLOSE selectors located adjacent to the main cargo compartment doors.

Pressurization of the complete YELLOW system by the electric pump is prevented by manifold check valves. When the PARKING BRAKE ACCU PRESS pushbutton is operated or when an OPEN/CLOSE cargo door selection is made, the parking ALTN-OFF brakes accumulators, and the main cargo compartment door operation circuit only are pressurized.

RAM AIR TURBINE (RAT)

The RAT consists of a self-regulating hydraulic pump driven by a constant speed propeller. It is connected to the YELLOW system and will pressurize it when extended into the airstream.

The nominal output flow is 45 ltr/min (11,9 US gal/min) delivered at a pressure of 2,800 PSI, provided the airspeed is **140 Kts** or more.

The RAT unit is fixed to an extendable leg. Stowed in a compartment in the lower right wing root adjacent to the RH main gear and hydraulics compartment. Two RAT handles are installed, one on each side console.

Operation of either handle mechanically unlocks the RAT. It extends by springforce, simultaneously opening the compartment doors. In the down position it is mechanically locked and cannot be retracted. It can only be restowed on the ground.

The RAT is used to supply emergency hydraulic power for aircraft control, if two or all hydraulic systems have failed, or in case of dual engine flame out.

The RAT may be deployed throughout the whole flight envelope, the response time (time between release and the appearance of nominal pressure) is less than 6.5 seconds.

POWER TRANSFER UNITS (PTU)

Two identical PTU are provided, one between the GREEN and BLUE systems, the other between the GREEN and YELLOW systems.

Each PTU consists of an hydraulic motor driven by GREEN hydraulic pressure, and an hydraulic pump in the receiving system. Motor and pump are connected by a drive shaft.

Each motor has an electrovalve which controls pressurized GREEN hydraulic supply to the motor, the GREEN pressure being generated by the engine pump or the green electric pumps.

The nominal output of the pump in the BLUE or in the YELLOW system is 90 ltr/min (23,8 US gal/min) at a pressure of 2,500 PSI ; with no flow demand the pressure is 3,000 PSI. Each motor in the GREEN system requires 111 ltr/min (29,3 US gal/min) at 3000 PSI to produce the nominal pump output. Only one PTU may be operated at a time.

Each PTU is controlled by a pushbutton switch on the HYD PWR section of the overhead panel, which operates the motor electrovalve. A PTU may be used in flight in case of hydraulic power generation failure in the BLUE or the YELLOW system. On ground, with the GREEN system pressurized by both electric pumps, they are used to pressurize the BLUE or the YELLOW system for maintenance purpose.

Electrical power for both PTU solenoïd valves is from the 28 DC normal bus.

HAND PUMP

A hand pump is installed on the aft wall of the RH main gear and hydraulics compartment. It is not accessible in flight. During ground operation it may be used to operate the main cargo compartment doors, if the YELLOW electric pump is not available. Only the cargo compartment door section of the YELLOW system is pressurized by the hand pump. R

The hand pump lever is stowed on the aft wall close to the pump.

GROUND SERVICE PANELS

For each system a ground service panel is provided with delivery, suction and reservoir depressurization connectors.

For reservoir pressurization a common air pressure connector is fitted on the blue system service panel.

For reservoir replenishing a common connector, reservoir selector and reservoirs hydraulic quantity repeated indicator is situated on the green service panel.

HIGH PRESSURE MANIFOLD EQUIPMENT

Each high pressure manifold is equipped with :

- one pressure switch
- two pressure transmitters,
- an overpressure relief/manual relief valve (manual relief on ground only).
- a priority valve.

The YELLOW system manifold is also fitted with two Parking/ALTN-OFF braking accumulators and is therefore additionally equipped with :

– an overpressure relief valve (for the brake accumulator system)

– one common pressure transmitter for both brake accumulators

The pressure switches signal low pressure, at the HP manifold to the ECAM system (SYS LO PR warning).
The pressure transmitters signal the manifold pressure to the ECAM system.
Braking accumulator pressure is indicated separately by the ACCU PRESS indicator on the center instrument panel.

The overpressure relief valves open to the return lines, if system pressure exceeds 3,440 PSI. On ground they can be opened manually by pressing a pushbutton on the valve, if system depressurization is required.

The priority valve is used to cut off hydraulic power to heavy load users in the event of low hydraulic pressure thus ensuring, priority to the servo controls. They close when the downstream pressure drops to 1 885 PSI.

SERVO CONTROL MANIFOLD EQUIPMENT

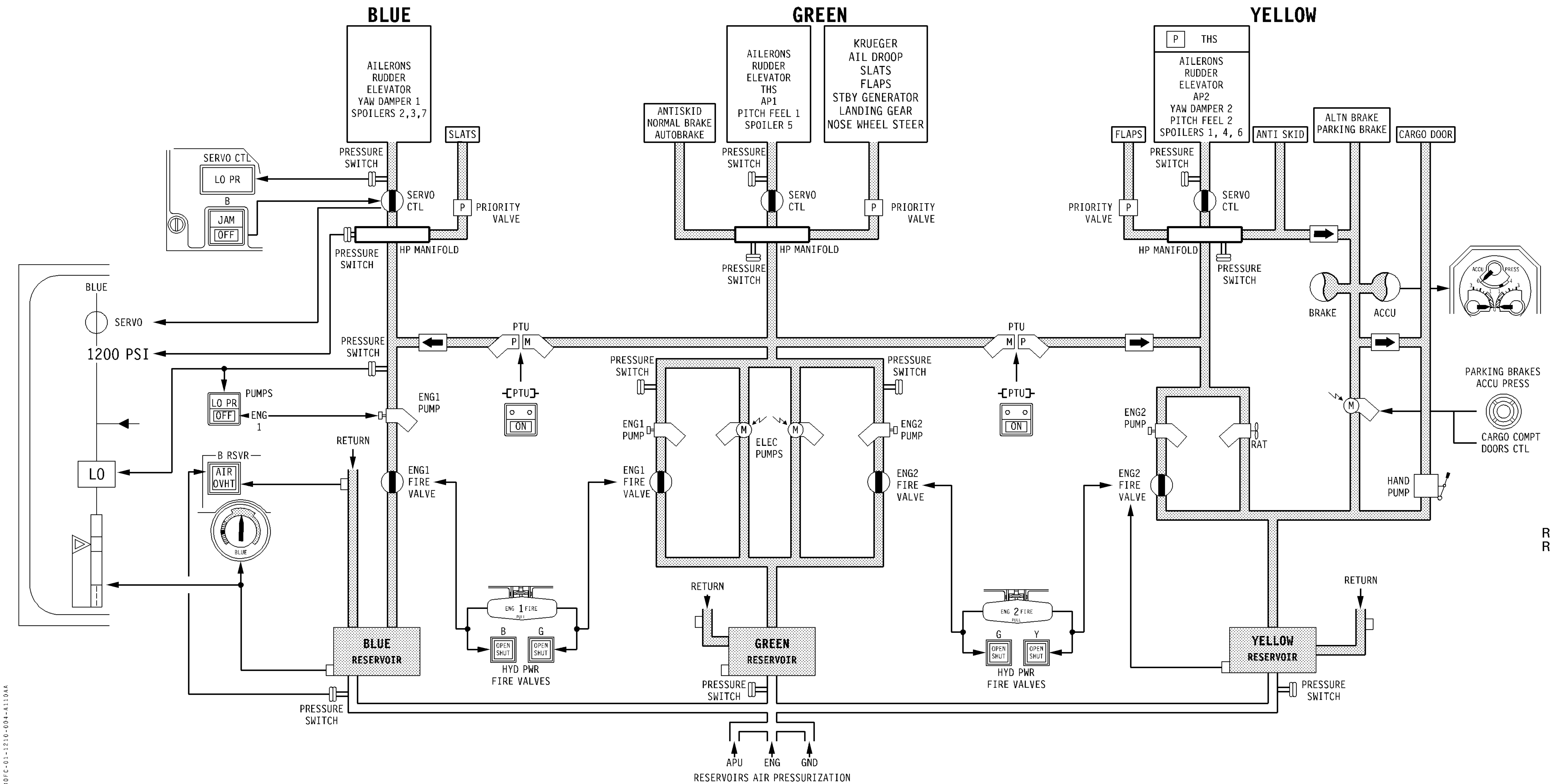
Each servo control manifold is equipped with :

– one pressure switch

R – one servo control selector valve

The pressure switches signal low pressure downstream of the servo manifold to the ECAM system (SERVO LO PR warning).
The servo control selector valve is used to isolate the respective hydraulic system in the event of a control surface servo jam or fluid loss.

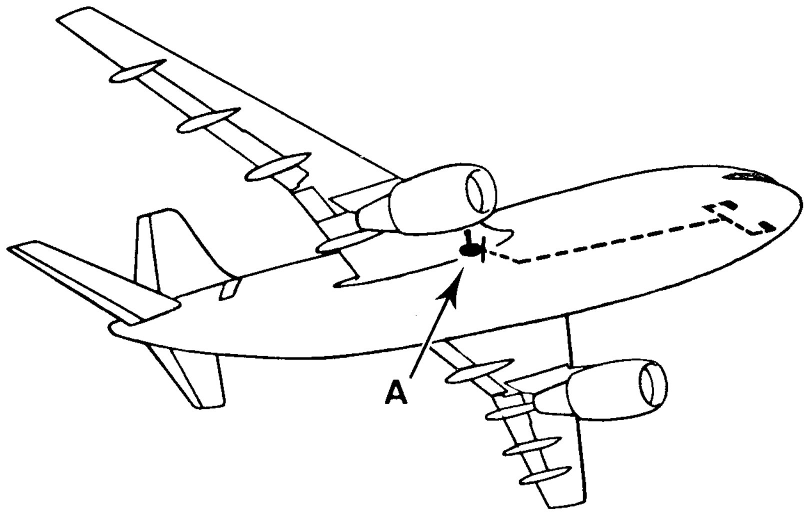
SYSTEMS ARRANGEMENT

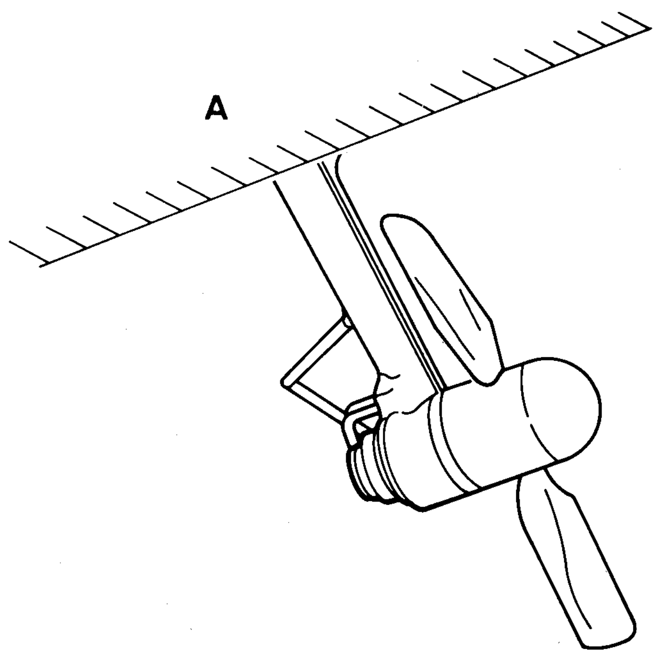


R
R

Mod : 5911

RAM AIR TURBINE

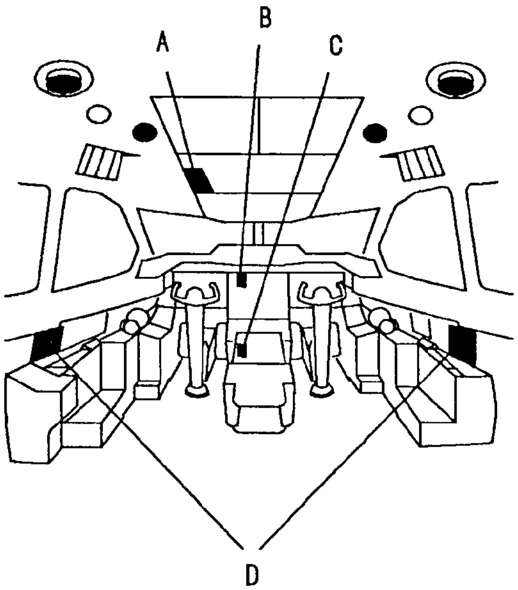




FB1.1210.005-AA.001

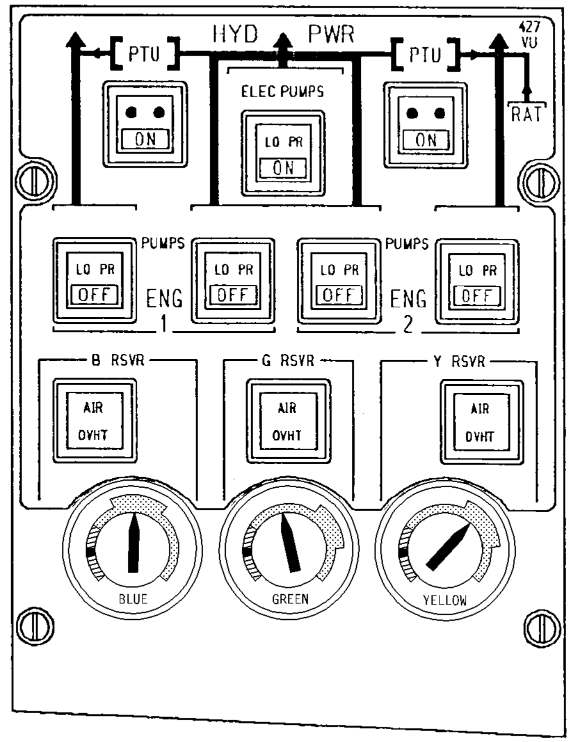
Vers. : All   Eng. : All

LOCATION OF CONTROLS

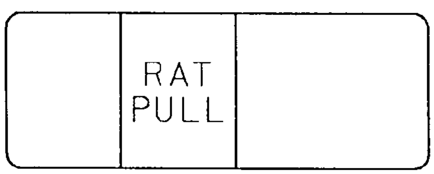


R
R
R

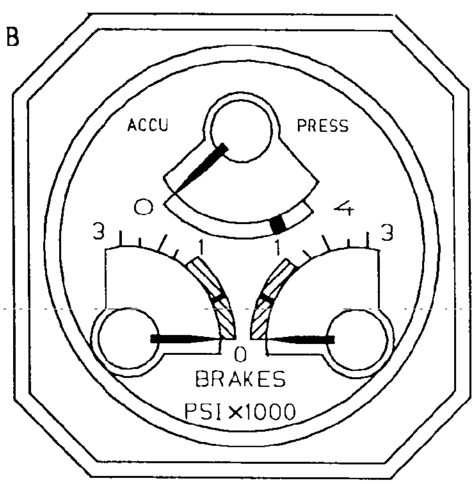
A



D



B



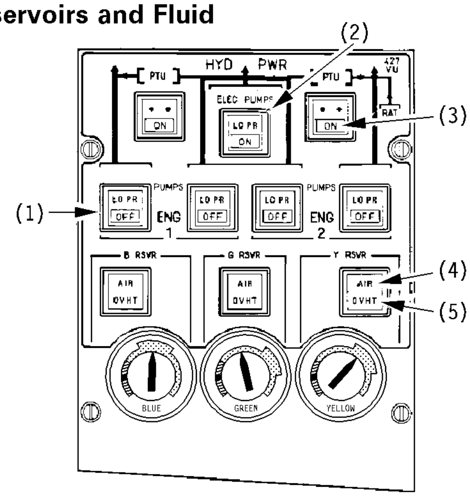
C

B0FC-01-1210-006-A050AA - R

Mod. : 4803

A. HYD PWR PANEL

– **Reservoirs and Fluid**



R
R
R

(1) PUMPS ENG, 1, B and G/ENG 2, G and Y Pushbutton Switches

Control activation and deactivation of engine pumps by operating the respective pump pressure dump valve.

- **On (PB-Switch pressed - in, magnetically latched)**

  Pump set for power generation

- **OFF (PB - Switch pressed - out)**

  OFF light comes on white.
  Power generation stops.
  Lubrication and cooling of pump continues. An OFF selection activates the ECAM system (LO PR light goes out, if OFF selected following LO PR warning).

- **LO PR**

  The light comes on amber, if - with the respective PUMPS switch selected ON - pump delivery pressure decreases below 1,800 PSI.

  The light goes off, when the pressure increases above 2,200 PSI.

  Illumination of the LO PR light is accompanied by ECAM activation.

(2) ELEC PUMPS Pushbutton Switch

Controls simultaneously the operation of both electric pumps in the GREEN system. A LO PR and an ON indication are integrated in the pushbutton switch.

- **ON (PB-Switch pressed - in)**

  ON light comes on WHITE. Electric pumps are activated. One pump operates immediately, the second starts with a 3 seconds delay.

- **Off (PB-Switch released - out)**

  ON light is off. Both pumps are deactivated.

- **LO PR**

  The light comes on amber if – with ELEC PUMPS switch selected ON – the total delivery pressure of both pumps is below 1 740 PSI with an increasing pressure and below 1 450 PSI with a decreasing pressure.

  Illumination of the LO PR light is accompanied by ECAM activation.

Note : The switch trips out as soon as the DC NORM BUS is not supplied.

(3) PTU Pushbutton Switches

Control the power transfer without fluid exchange from GREEN to BLUE and/or from GREEN to YELLOW systems respectively.

- **ON (PB-Switch pressed - in)**

  ON light comes on green, PTU operation is started, power transfer operates as long as GREEN system pressure is available.

- **Off (Switch released - out)**

  ON light is off. Supply for PTU motor is shut off. Power transfer stops.

(4) AIR Lights

Come on amber associated with ECAM if the respective reservoir air pressure drops below 22 PSI. The lights will go off when the pressure increases to 25 PSI or more.

Note : Reservoirs should maintain air pressure approximately at normal level for 12 hours after shutdown of pressure supply source.

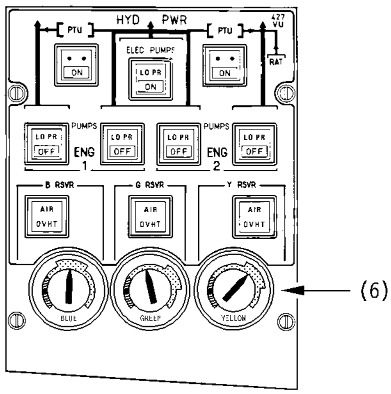
AIR lights may come on under negative-g conditions.

(5) OVHT Lights

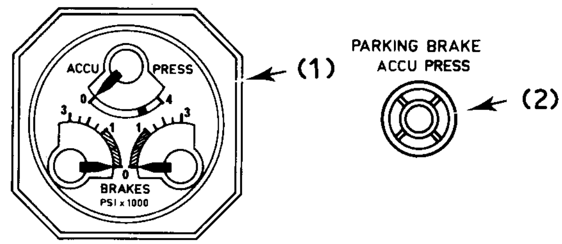
Come on amber, associated with ECAM if the return hydraulic fluid temperature at the entry of the respective reservoir is 95° C or more.
GREEN and YELLOW OVHT lights are inhibited in case of THS control valve jamming detection.

Mod : 4691

B. ACCU PRESS CONTROLS



B0FC-01-1210-008-A200AA - R



B0FC-01-1210-008-B200AA - R

(6) Reservoir Quantity Indicators - BLUE, GREEN, YELLOW

Indicate the fluid level in the respective hydraulic reservoir. If an indicator is not electrically supplied, the pointer may move to any position without warning.

Note : *Green reservoir level may fluctuate in flight due to thermal expansion, insufficient system bleeding or landing gear retraction.*

- **Green Arc**
  Normal usable range of hydraulic fluid.
- **Upper small green Arc**
  On ground, with reservoir pneumatically pressurized and hydraulic system depressurized.
  . Pointer within upper small green arc indicates normal fluid level in reservoir.
  . Pointer at max. limit of upper small green arc indicates max. normal fluid level in reservoir.
  . Pointer at min. limit of upper small green arc indicates min. normal fluid level in reservoir.
  R In case of extreme OAT :
  R . For OAT below – 10°C, the pointer may be below the upper small green arc down to two needles width. This indicates a normal fluid level in reservoir.
  R . For OAT above 20°C, the pointer may be above the upper small green arc up to two needles width. This indicates a normal fluid level in reservoir.
- **Yellow Arc with Red Dot**
  . Pointer within yellow arc indicates abnormal fluid level in reservoir. When pointer drops to, or below red dot, warning system is activated.

(1) ACCU PRESS Indicator

Indicates accumulator pressure of the two brake accumulators in the YELLOW system, available for ALTN/OFF and for parking brakes. Pressure indication is in PSI X 1000. Sufficient pressure for PARKING BRAKE is maintained by the accumulator for approx. 12 hrs.

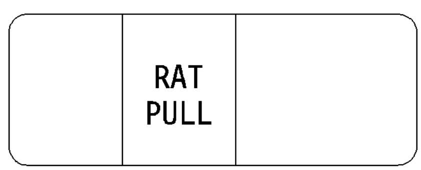
(2) PARKING BRAKE ACCU PRESS Pushbutton

Controls the electric pump in the YELLOW system, to operate it for recharging of brake accumulators to 3,000 PSI.

- **Pressed**
  Electric pump is activated. Pressure is self-regulated to 3,000 PSI.
- **Released**
  Electric pump is deactivated.

Note : *The yellow system hand pump cannot be used for recharging the brake accumulators.*

C. HYD RAM AIR TURBINE HANDLES



B0FC-01-1210-008-C200AA - R

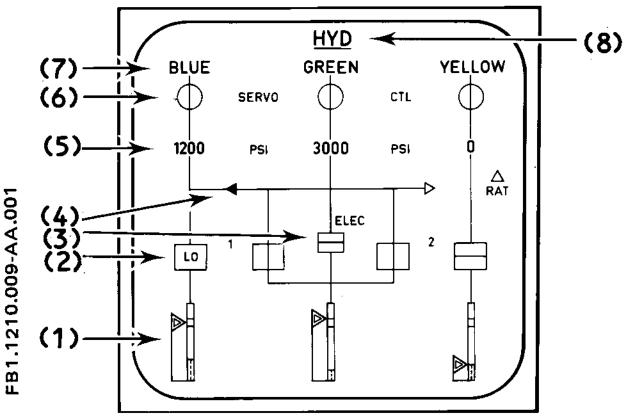
The ram air turbine can only be extended by operation of either handle, located on LH and RH side console.

For extension put fingers into the groove and pull.

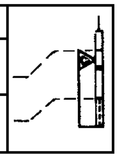
Note : *The ram air turbine can be retracted and restowed on the ground only.*

Mod. : 4803 + 7378

SYSTEM DISPLAY



(1) Reservoir level Indication :

	BLUE	GREEN	YELLOW	
Normal Filing	12 ltr 3,2us gal	17 ltr 4,5us gal	18.5 ltr 4,9 us gal	
LO LEVEL Warning	5 ltr 1,3us gal	5 ltr 1,3us gal	5 ltr 1,3 us gal	
	↔	↔	↔	

The lower part of the reservoir level indication and the triangle become amber when the fluid level is lower or equal to 5 ltr (1,3 US gal).

(2) Engine Driven Pump Control and Low Pressure Indication :

	Green	The pump is selected on and : – the fluid pressure > 2 200 PSI (if the pressure is increasing) – or the fluid pressure > **1 800** PSI (if the pressure is decreasing)
LO	Amber	The pump is selected on and : – the fluid pressure < 2 200 PSI (if the pressure is increasing) – or the fluid pressure < **1 800** PSI (if the pressure is decreasing)
	Amber	The pump is selected OFF

(3) Electric Pumps Control and Low Pressure Indications

	Green	The pumps are selected ON and : – the fluid pressure > 1 740 PSI (if the pressure is increasing) – or the fluid pressure > **1 450** PSI (if the pressure is decreasing)
LO	Amber	The pumps are selected ON and : – the fluid pressure < 1 740 PSI (if the pressure is increasing) – or the fluid pressure < **1 450** PSI (if the pressure is decreasing)
	Green	The pumps are selected OFF

(4) Power Transfer Units Control :

On the figure :
the GREEN/BLUE PTU is selected ON
the GREEN/YELLOW PTU is selected Off

(5) High Pressure Manifold Indication :

The pressure indication becomes amber when the pressure ⩽ 1450 PSI
Note : A fixed white RAT indication is displayed.

(6) SERVO CTL selector Valves Position Indication : R

	Green	The SERVO CTL selector valve is open	R
	Amber	The servo CTL selector valve is open and pressure ⩽ 1450 PSI	R
	Amber	The SERVO CTL selector valve is closed	R R

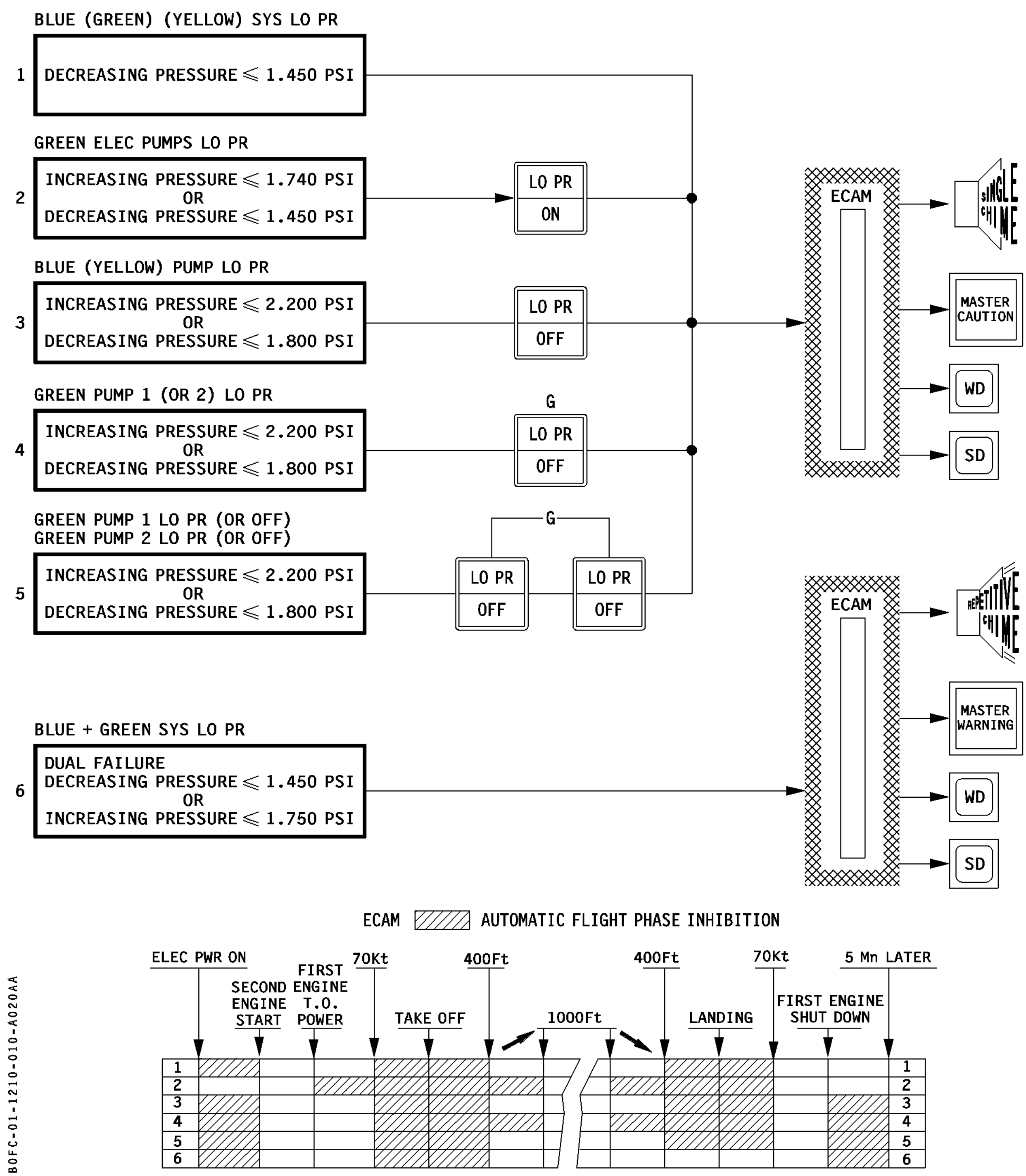
(7) System Name Indication :

The indication is white	The associated pressure > 1 740 PSI (if the pressure is increasing) or the associated pressure > **1 450** PSI (if the pressure is decreasing)
The indication is amber	The associated pressure < 1 740 PSI (if the pressure is increasing) or the associated pressure < **1 450** PSI (if the pressure is decreasing)

(8) HYD Indication :

The HYD indication is white when the HYD display has been called manualy.
The HYD indication is amber when the HYD page is displayed automatically following a warning.

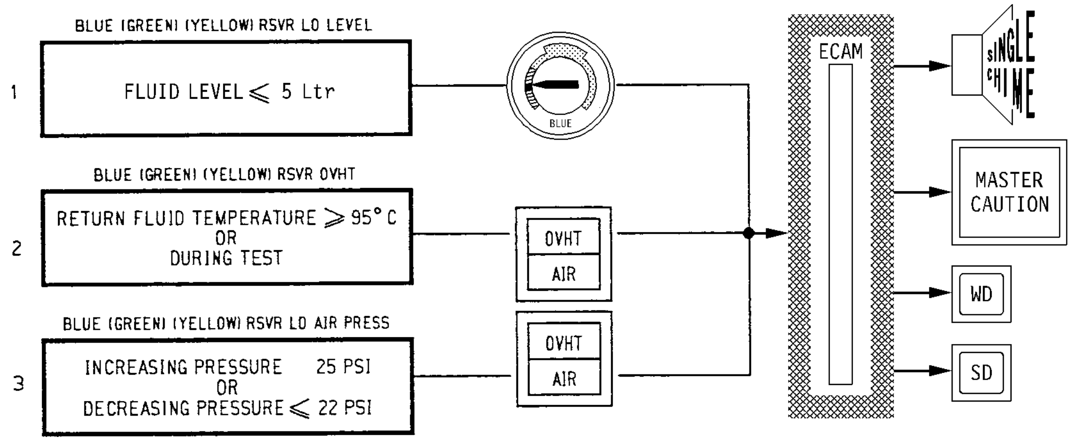
WARNING LOGIC

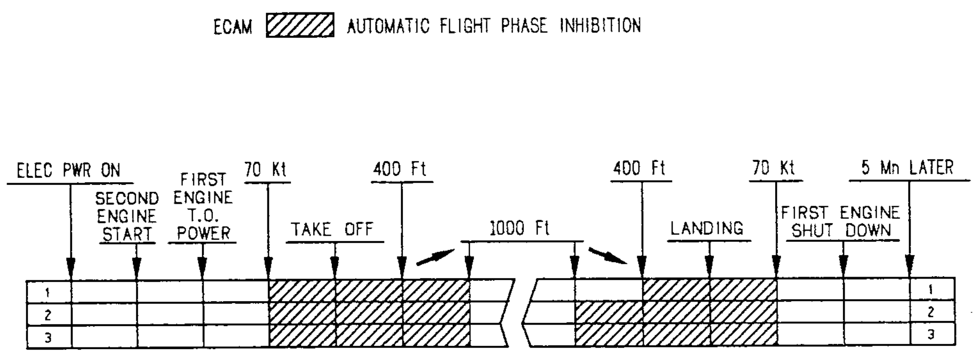


Mod : 5051

WARNING LOGIC

R
R
R
R





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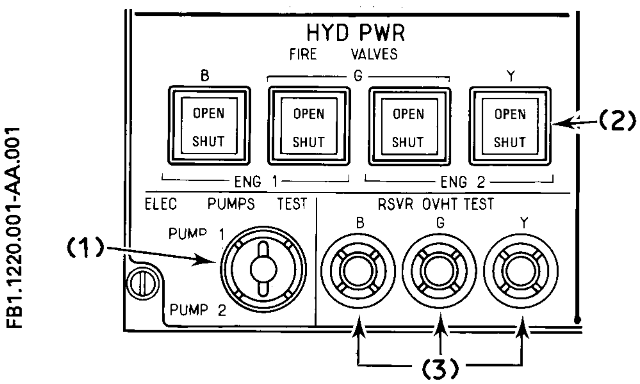
Mod. : 5051

INTENTIONALLY LEFT BLANK

A – HYD PWR PANEL



(1) ELEC PUMPS TEST Selector

The selector controls the individual test of the electric pumps in the GREEN system. The selector is springloaded to neutral.

For test, the ELEC PUMPS pushbutton switch on the HYD PWR section of the overhead panel must be selected ON, the ON light on, the LO PR light off.

- **PUMP 1**
  Pump 2 is deactivated by interruption of its electrical supply.
  Pump 1 only is operating.
- **PUMP 2**
  Pump 1 is deactivated by interruption of its electrical supply.
  Pump 2 only is operating.
- **Neutral**
  Both pumps are connected to the electrical supply.

The test of each pump is successful, if the LO PR light in the ELEC PUMPS pushbutton switch does not come on, and the indication on the G PRESS indicator reads approximately 3,000 PSI.

(2) FIRE VALVES ENG 1, B and G / ENG 2, G and Y Lights

When the ANN LT selector, on the lateral panel, is set to READ, the FIRE VALVES lights indicate the position of the respective FIRE VALVE, which is controlled by the corresponding ENG FIRE handle.

Note : In the yellow system, the valve closes also in case of LO LVL.

- **OPEN**
  Light comes on white, indicating the valve is fully open.
- **SHUT**
  Light comes on white, indicating the valve is fully closed.

(3) RSVR OVHT TEST B, G, Y Pushbuttons

Permit test of hydraulic fluid overheat warning for the individual reservoirs, BLUE, GREEN, YELLOW.

- **Pressed**
  An overheat signal is simulated in the corresponding overheat detection circuit.
  If test successful, the respective OVHT light on the HYD PWR section of the overhead panel will come on accompanied by ECAM activation.
- **Released**
  The overheat signal and the warnings are cancelled.

The ice and rain protection system permits aircraft operation without restriction by icing conditions or heavy rain.

Aircraft ice protection is provided by heating of critical areas using hot air or electrical power.

Hot air heated areas :

- Part of center and outer slats of each wing,
- Engine air intakes.

Electrical heated areas :

- Front windshields for ice protection, side windows for defogging,
- Probes, pitot tubes and static ports,
- Waste water drain masts.

For hot air heating the engines supply bleed air. APU bleed air may be used as an alternate source for wing anti-ice. For electrical heating the power is supplied by AC BUS 1,
R AC BUS 2, DC NORM BUS and DC ESS BUS.

Rain removal from the front windshields is achieved by windshield wipers and, in heavy rain only, by the rain repellent fluid system.

Ice protection for the wings is ensured by heating of the leading edges of center slats (outer half) and outer slats (full length). Hot air, supplied by engines or APU (up to 20 000 ft) is ducted in each wing, from the fixed leading edge supply duct into the outer slat through a telescopic tube.
Then the air is distributed along this slat by a piccolo tube, and also into the center slat piccolo tube, by a flexible connection across the slats gap. At last, the air, after having heated the concerned slats, exhaust overboard through vent holes distributed along the slat rear skin.

Each wing is equipped with two anti-ice solenoid controlled, pneumatically operated shutoff valves, normal and alternate, arranged in parallel.

– With engine bleed air supply, only one valve is active, as selected,
– With APU bleed air supply, both valves are active regardless of mode selection.

A flow limiting restrictor is fitted downstream of each valve.

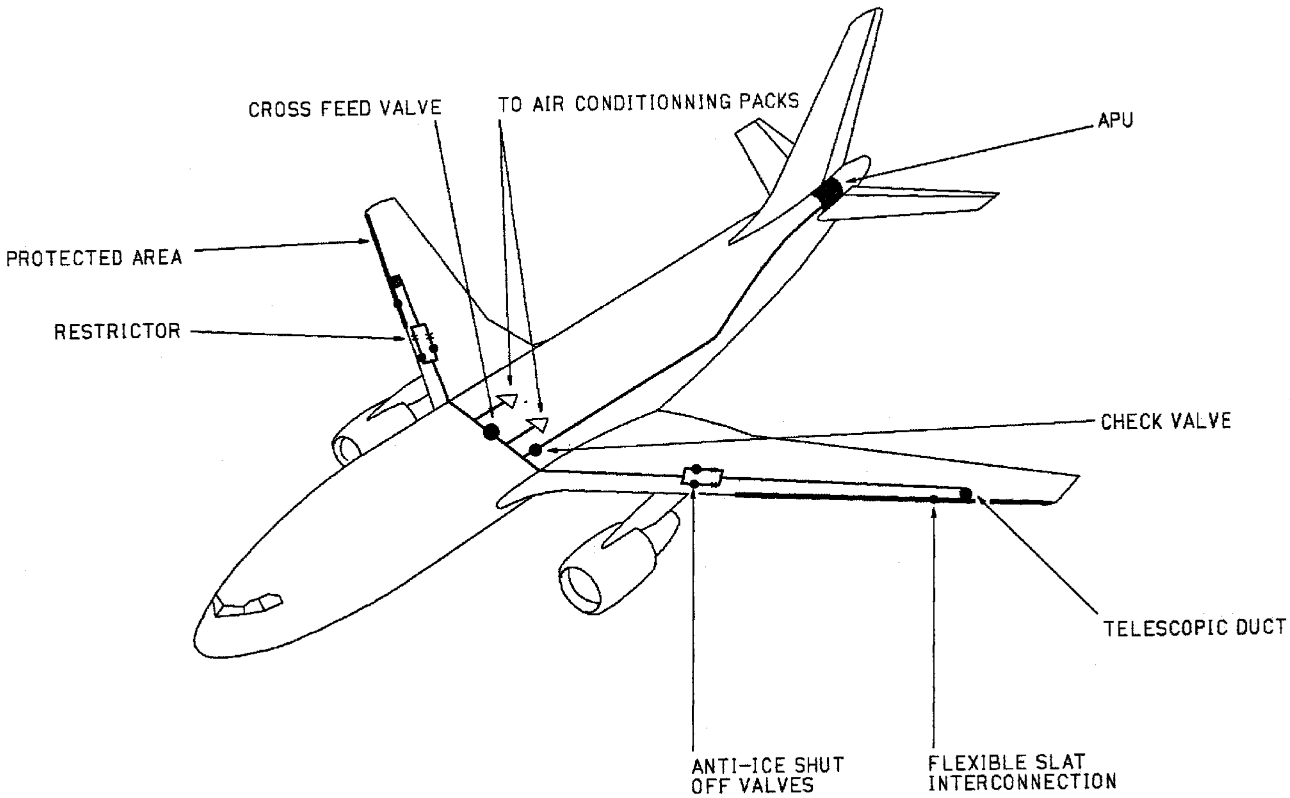
When WING ANTI-ICE SUPPLY is switched ON, a signal is passed to the pneumatic system which increases the hot air temperature at the precooler outlet (227° C instead of 177° C), and if operating on APU bleed air, the APU flow will be increased.

If during operation on engine bleed air an anti-ice valve fails to open, the other valve can be selected for operation. Without electrical or pneumatic supply the valves are springloaded closed.

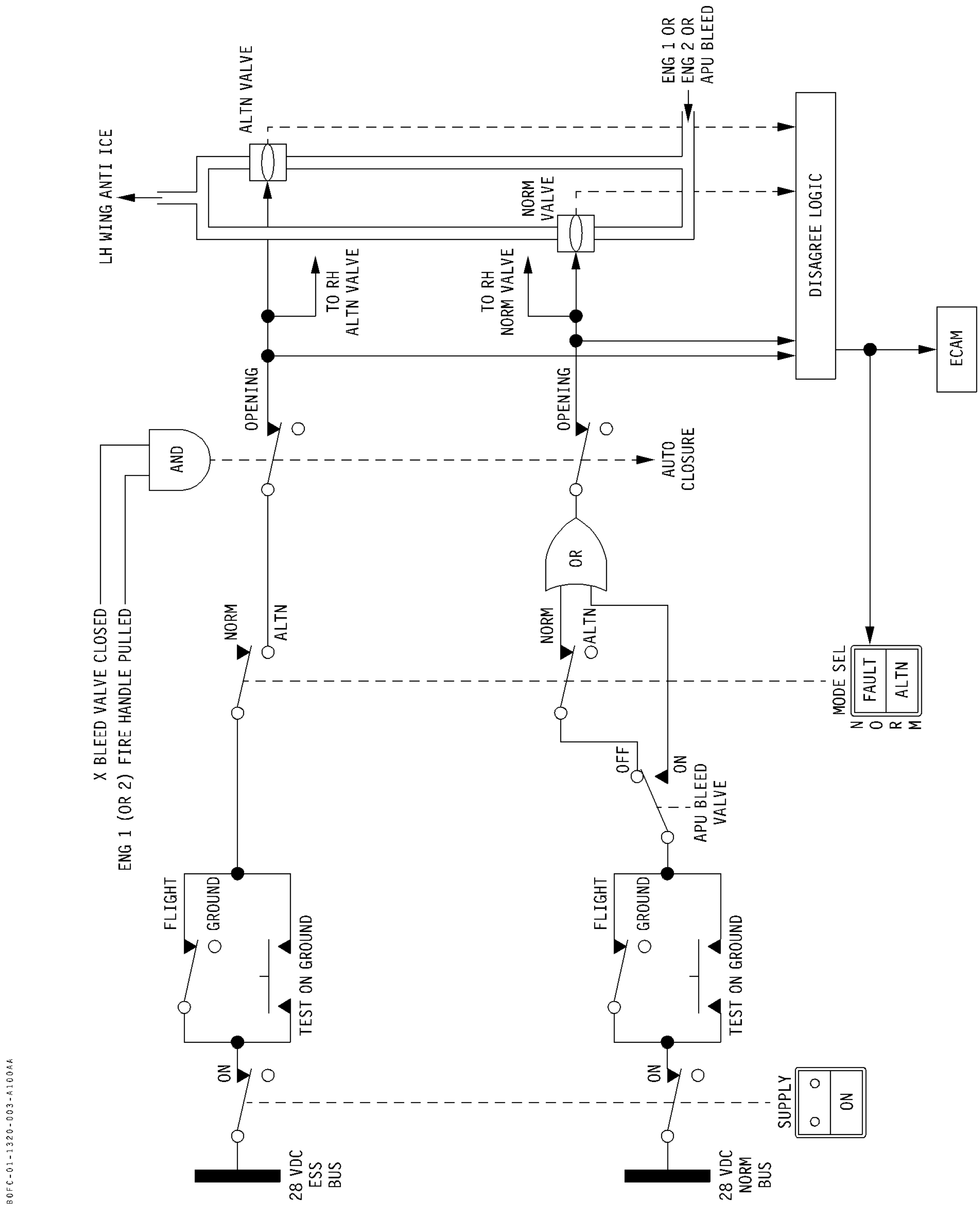
The wing anti-ice valves will close automatically if :

– an engine FIRE handle is pulled while the AIR BLEED X-FEED valve is closed,
– the main landing gear struts are compressed (weight on wheels),
– air bleed supply pressure < 10 psi R
– On the ground, if the wing anti-ice system is selected ON, overheating of the slat structure is prevented by means of a time delay relay which limits the valve opening time to 10 seconds during the test operation.

GENERAL ARRANGEMENT



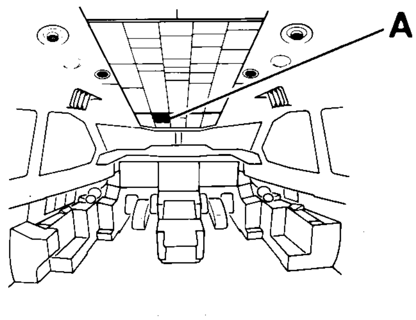
ARRANGEMENT AND LOGIC

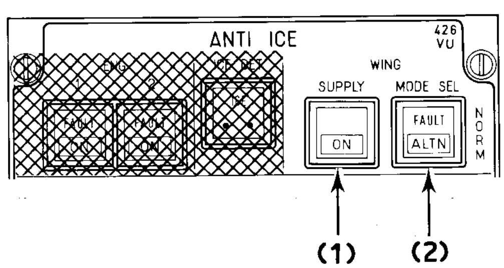


Mod : 5910

A. ANTI ICE PANEL

– Wing





FB1.1320.004-AA.000

(1) ANTI ICE WING SUPPLY Pushbutton Switch

Controls wing anti-ice system simultaneously on left and right side.

- **ON (P/B Switch Pressed – in)**

  The ON light comes on blue.

  – With Engine Bleed Air Supply :

  Two wing anti-ice valves open, as selected with MODE SEL switch NORM or ALTN, one on left and one on right side.

  – With APU Bleed Air Supply :

  All four wing anti-ice valves open.

  Note : The indication WING ANTI ICE ON is displayed on ECAM MEMO page.

  Note : When bleed air is supplied by the engines and when the TCC is operating, the opening of an anti-ice valve causes automatically a reduction of thrust limit indication.

- **OFF (P/B Swich Released – out)**

  Wing anti-ice valves close, the ON light goes off.

(2) ANTI ICE MODE SEL Switch

Controls the selection of the active wing anti-ice valves, when engine bleed air supply is used.

- **NORM (P/B Switch Pressed –in)**

  The normal valve on each side is selected for operation.

- **ALTN (P/B Switch Released – out)**

  the ALTN light comes on white. The alternate valve on each side is selected for operation.

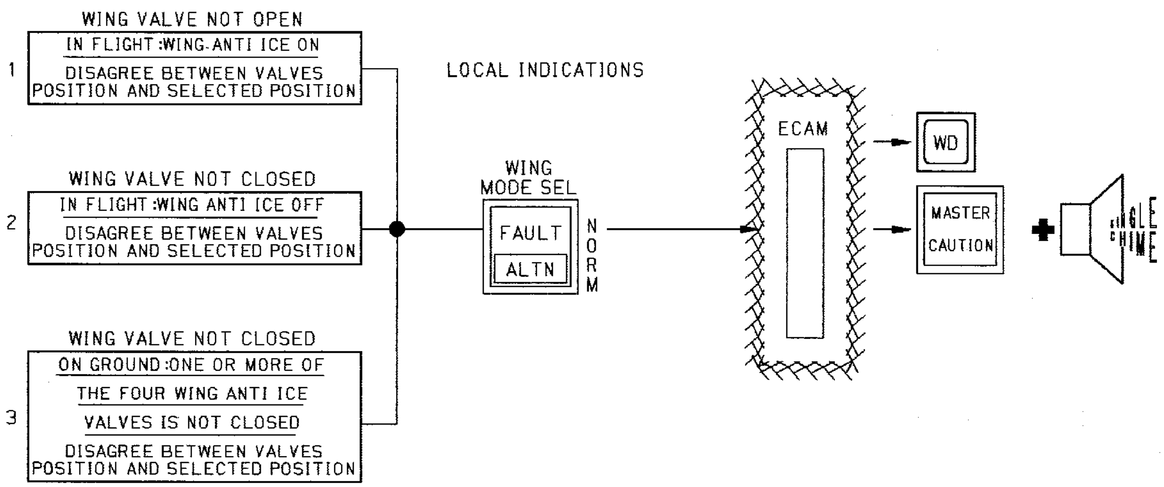
- **FAULT**

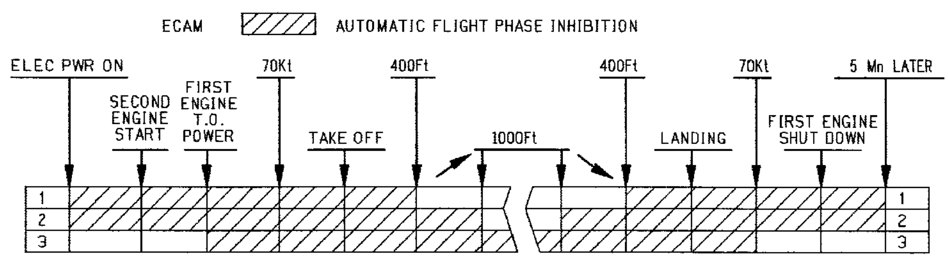
  The light comes on amber, if any wing anti-ice valve position does not agree with the scheduled position (as defined by the switch selection or by the overriding automatic command).

  The FAULT light comes on momentarily during wing anti-ice valve travel for opening or closure.
  If it comes on for more than 5 seconds, the ECAM system is activated.

Vers. : All Eng. : All

WARNING LOGIC



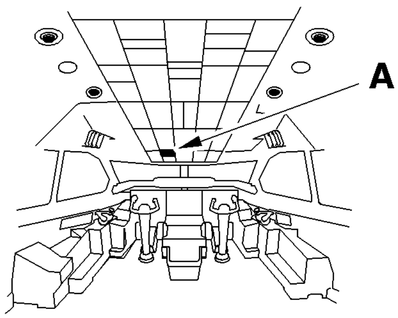


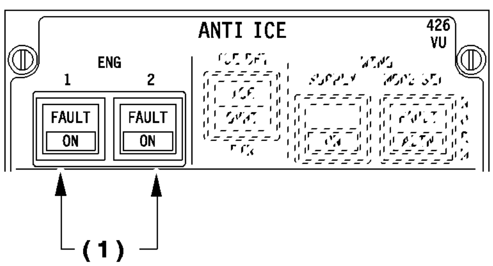
OPS.FCO.B1.1320.005-06.020

Mod. : 5051

A. ANTI ICE PANEL

– Eng





B0FC-011330-002-A500AA

(1) ENG 1 or ENG 2 P/B Switch

Controls engine anti-ice system for the related engine 1 or 2.

- **ON (P/B Switch Pressed-in)**

  The ON light comes on blue when anti-ice valve opens. The indication ENG ANTI ICE is given on the ECAM MEMO page.

- **off (P/B Switch Released-out)**

  The ON light goes off. The valve closes.

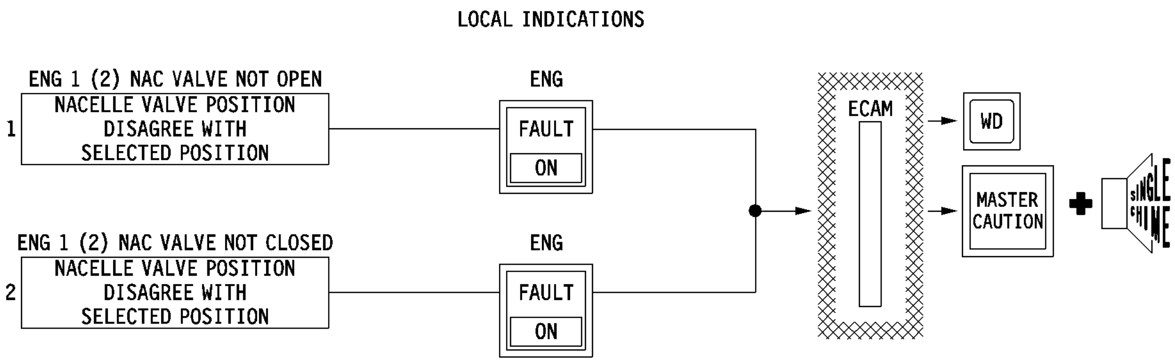
- **FAULT**

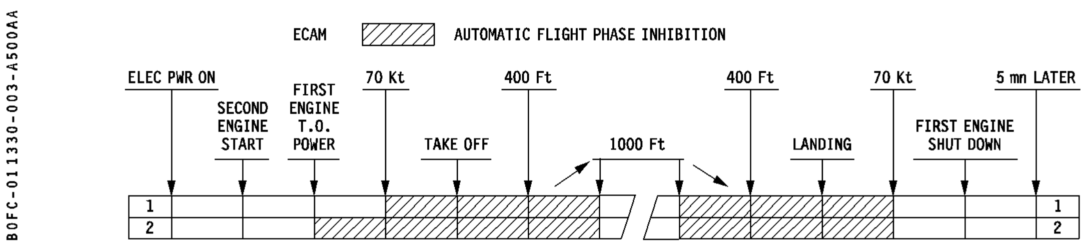
  The light comes on amber, if valve position does not agree with P/B switch selection.

  The FAULT light comes on momentarily during valve transit. If it remains on for more than 3 seconds the ECAM system is activated.

R Code : 1330I

WARNING LOGIC





R Code : 1330J

The cockpit windows are electrically heated ; the front windshields for ice protection and defogging, the side windows for defogging only.

Two anti-ice regulators control the front windshield temperatures to 35 °C/42 °C. A temperature sensor in each windshiedl signals the actual temperature to the related regulator, which accordingly activates or deactivates the heating power supply from regulator control to the heating elements of windshield and side windows.

Side window heat is not temperature controlled.

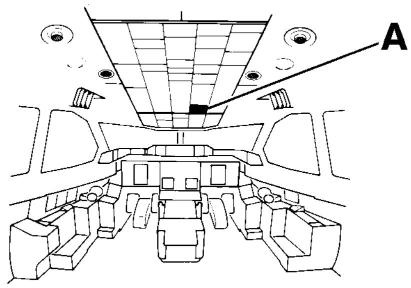
A regulated failure results in illuminating the FAULT lt on the WINDOW HEAT panel.

Front windshields are heated on two heating power levels. Low heating power is used on the ground. High heating power is used in flight.

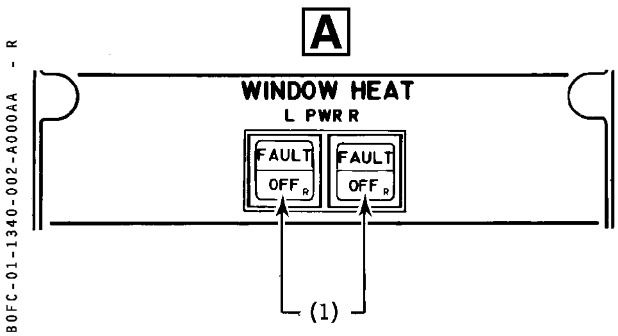
Window heat failure warnings are provided by two FAULT indications and the ECAM activation.

On the lateral panel devices for testing the heating power supply an for testing the protection and warning circuits are installed.

A. WINDOW HEAT PANEL



R



(1) PWR L or R P/B Switch

Controls activation of window heat system left or right side.

- **ON (P/B switch pressed-in) :**

  Power is supplied to anti-ice regulator. Heating elements in the panes are supplied, front and side windows are heated.

- **OFF/R (P/B switch released-out) :**

  OFF/R light illuminates white. Window heat system is deactivated.

- **FAULT :**

  The light illuminates amber if the related window heat system has failed. Heating power is disconnected and disconnection latched in the event of :

  – Front windshield temperature is less than — 60 °C or greater than + 60 °C

  – Failure of sensing or regulative circuit

  – Loss of 28VDC supply to regulator

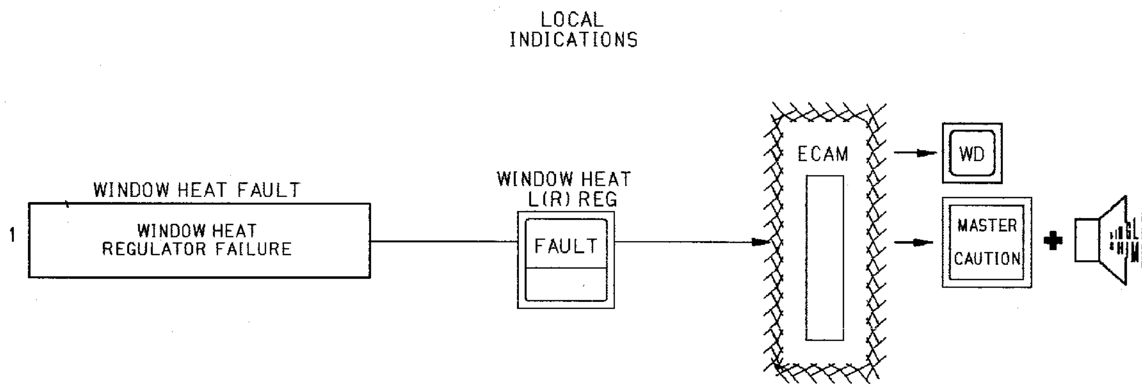
  The FAULT light will extinguish after :

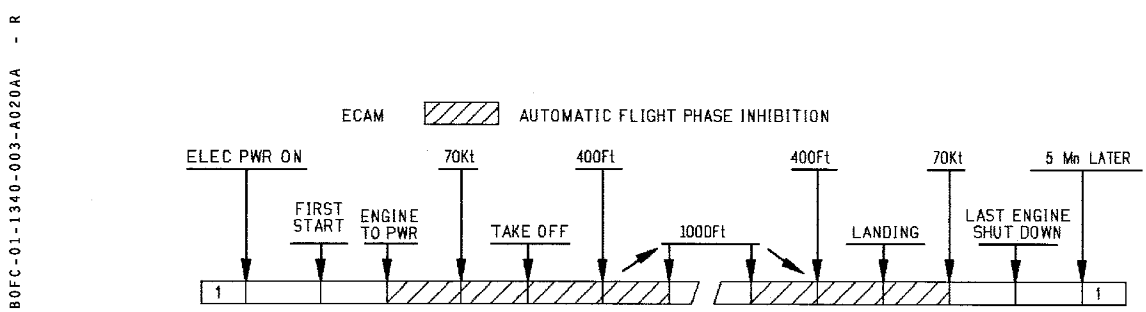
  – Recovery of 28VDC supply to anti ice regulator.

  – Selection of PWR P/B swith to OFF/R.

  Illumination of the FAULT light is accompanied by ECAM activation.

WARNING LOGIC





Mod. : 5051

To prevent the formation of ice on air data sensors
R electrical probe heating is provided for

- Pitot tubes
- Static Ports
- Alpha (angle of attack-α) probes
- EPR (compressor inlet total pressure – PT2) probes
- TAT (total air temperature) probes.

The system is arranged in three independant channels (CPT/FO/STBY).
Pitot tubes have two heating levels. Change over occurs automatically from low heating level on the ground to high heating level in flight.

Two parts of alpha probes are heated (case and vane).

Only failure of vane heating will be indicated to crew.

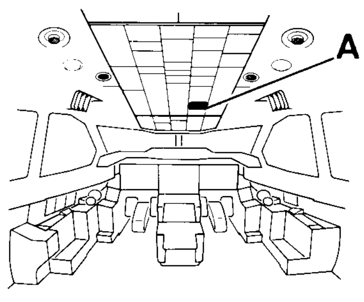
The TAT probes are not heated on the ground to avoid erroneous indications.

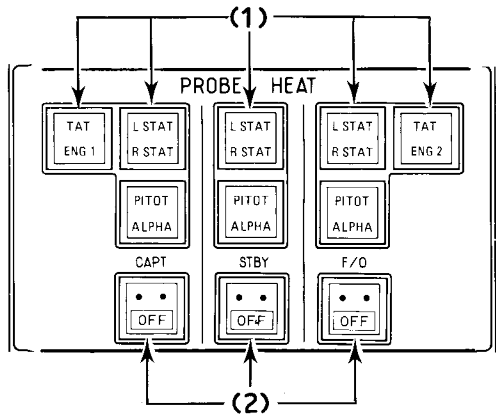
The TAT probe light will not illuminate on the ground even with system ON.

If probe heat is not selected ON or if any failure or discrepancy of probe heating occurs, the respective PROBE HEAT lights on the overhead panel will illuminate.

A. PROBE HEAT PANEL

FB1.1350.002-AA.000





(1) TAT, ENG 1 or 2, L or R STAT, PITOT, ALPHA Lights

Lights come on amber, if

– respective probe heat circuit not selected On,

– probe heating supply failed,

– probe heating control failed :

. If a PITOT light comes on on ground, in addition to the above causes the system may be in the high heating mode due to failure of switchover.

. If a PITOT light comes on in flight, in addition to the above causes the system may be in the low heating mode due to failure of switchover.

Illumination of a PROBE HEAT light is accompanied by ECAM activation.

R *Note : The TAT light remains off when switched ON*
R *on ground although the probe is not heated.*

(2) CPT, F/O, STBY P/B Switches

Control the activation of probe heating of their respective circuits.

- **ON (P/B Switch Pressed-in)**

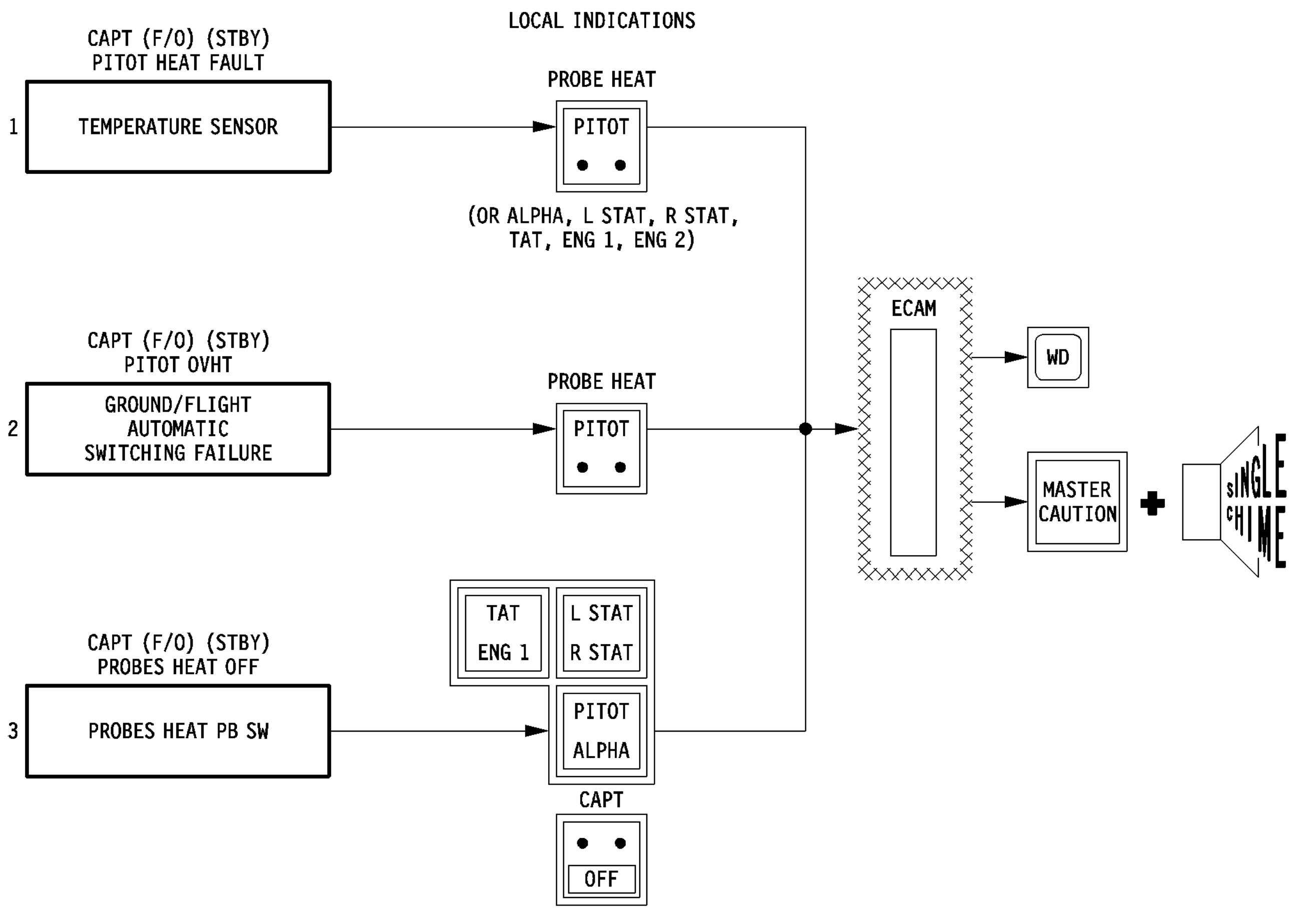
  Probe heating is activated. Respective PROBE HEAT lights will extinguish.

- **OFF (P/B Switch Released-out)**

  The OFF light comes on white. Probe heating is deactivated. Respective PROBE HEAT lights come on amber.

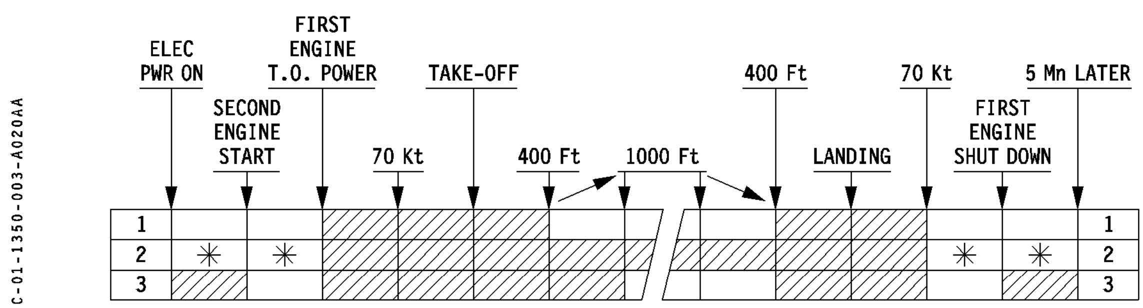
Vers. : All PW Eng. : All

WARNING LOGIC



ECAM ▨ AUTOMATIC FLIGHT PHASE INHIBITION

R
R
R
R
R



✳ INHIBITED DURING 2 MN EACH TIME T.O. CONFIG TEST P/B SW IS PRESSED

Mod. : 5051 PW Eng. : All

Rain removal from front windshields is provided by two wipers. Each wiper is driven by a two – speed electric motor. They are controlled by two WIPER selectors on the overhead panel, one for the captain, and one for the F/O.

The system has a parking position of the wiperblade with the scraper, just lifted from the window face, to avoid accumulation of sand and scratching of the glass.

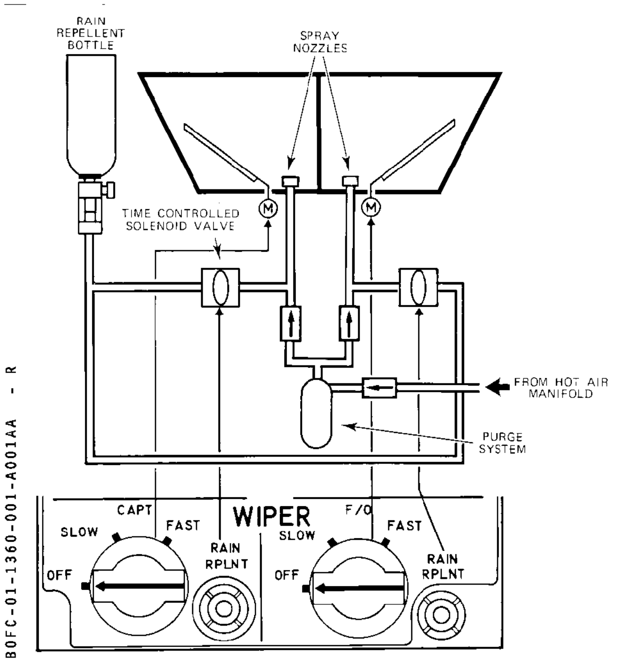
The rain repellent system is provided as an aid to improve visibility through front windshields in heavy rain. It includes a pressurized bottle, which supplies rain repellent fluid through two time-controlled solenoïd valves to the spray nozzles, and two pushbuttons for operation, one for each side. Timing devices limit the amount of rain repellent fluid for one application cycle.

The system is automatically purged by air from the hot air manifold.

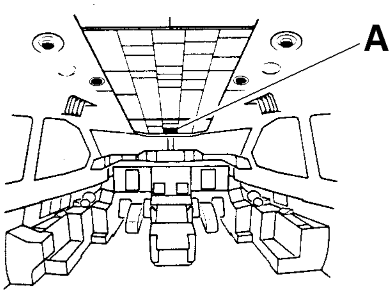
CAUTION

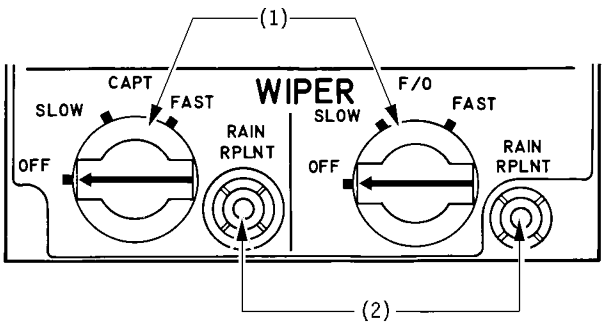
Rain repellent fluid contains a highly TOXIC substance. This is scented similar to orange peel, or lemon. If a similar smell is noticed in the cockpit a rain repellent leak may be suspected. The SMOKE/TOXIC FUMES REMOVAL procedure should be followed. R R R R R R

ARRANGEMENT



A. WIPER PANEL





B0FC-01-1360-002-A000AA - R

(1) CAPT – F/O WIPER Rotary Selectors

The rotary selectors control the windshield wipers on each side.

- **FAST**
  Wipers operate at 150 cycles/min.
- **SLOW**
  Wipers operate at 75 cycles/min.
- **OFF**
  Wiper operation stops in parking position, wipers are out of view.

(2) CAPT or F/O RAIN RPLNT Pushbutton

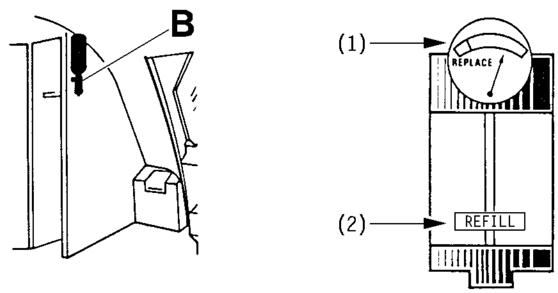
Controls the application of rain repellent fluid to the respective front windshield.

When pressed, the timer applies a measured quantity of fluid. To repeat the cycle, the pushbutton must be released, then pressed again.

CAUTION

R Rain repellent must not be used as windshield
R washer, and never be applied to a dry windshield.

B. RAIN REPELLENT BOTTLE



B0FC-01-1360-002-B000AA - R

The pressurized bottle is installed on the LH rear cockpit wall.

(1) Pressure Indicator

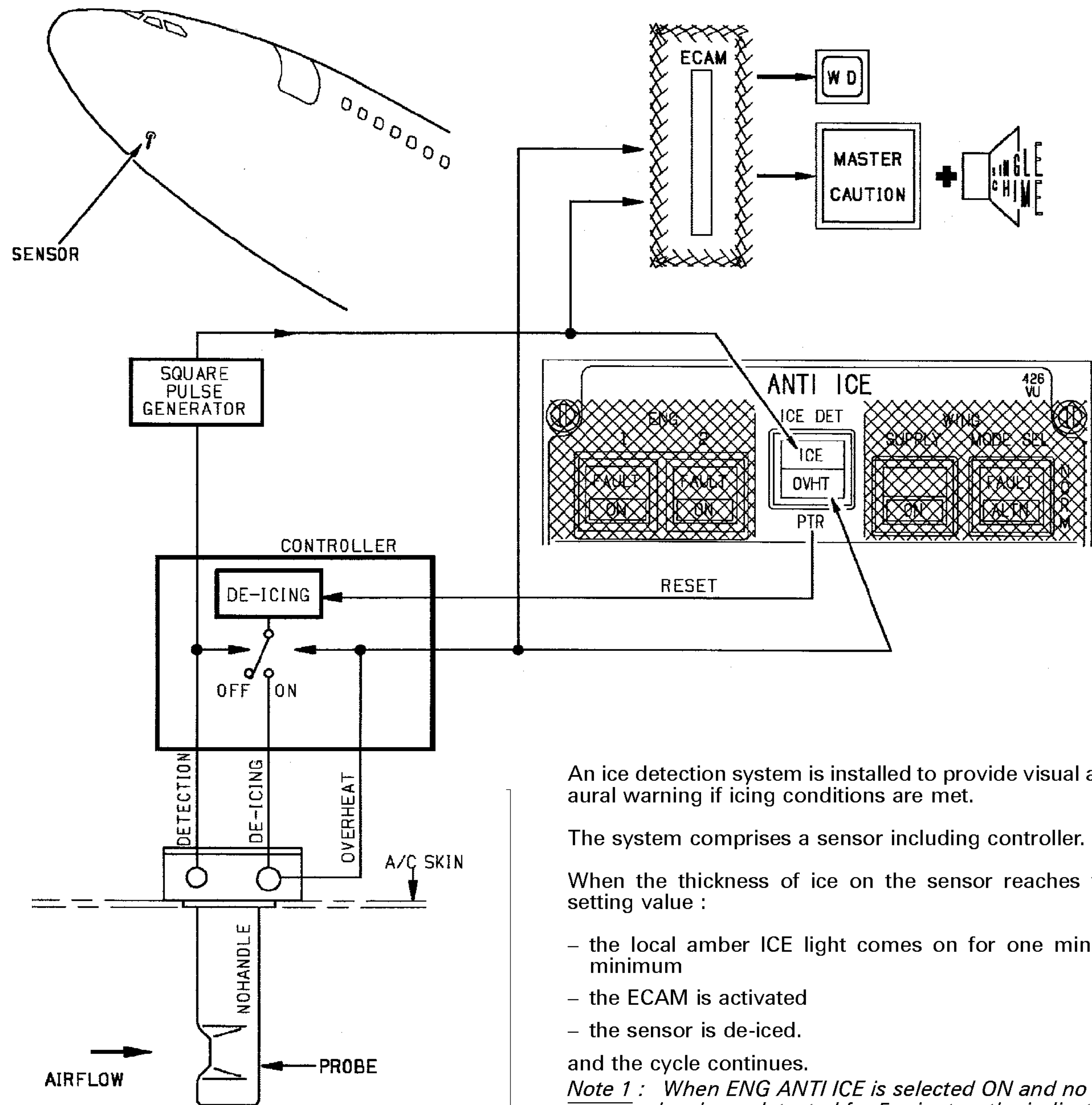
Indicates the nitrogen pressure in the bottle.

- **Green band**
  Pressure is sufficient.
- **Yellow band**
  Pressure is low, bottle should be replaced.

(2) Quantity Indicator

If the REFILL float is in view, the bottle should be replaced.

AUTOMATIC DETECTION SYSTEM



OPS.FCO.B1.1370.001-AA.060

An ice detection system is installed to provide visual and aural warning if icing conditions are met.

The system comprises a sensor including controller.

When the thickness of ice on the sensor reaches the setting value :

- the local amber ICE light comes on for one minute minimum
- the ECAM is activated
- the sensor is de-iced.

and the cycle continues.

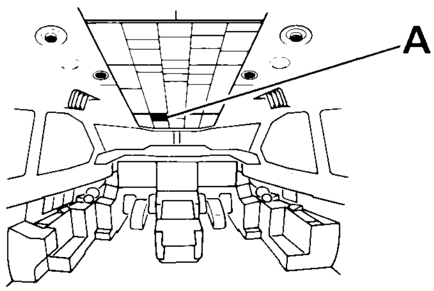
Note 1 : When ENG ANTI ICE is selected ON and no ice has been detected for 5 minutes, the indication ENG ANTI ICE ON on ECAM MEMO page flashes. This informs the crew of the necessity of checking icing conditions.

Note 2 : The ice detection system is inhibited on ground.

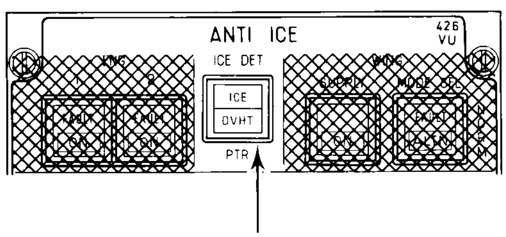
Mod. : 2753 + 5051 + 5381

A. ANTI ICE PANEL

– Ice Det



FB1.1370.002-AA.030



(1)

(1) PTR Pushbutton

The pushbutton allows to reset the de-icing system of the sensor after on overheat detection.

- **Momentarily Pressed**

  The de-icing system of the sensor is reseted after an overheat detection.

- **ICE**

  The light comes on amber during one minute minimum when the thickness of ice accretion on the sensor
R reaches a setting value, provided the aircraft is in flight.

  Simultaneously, the sensor is de-iced by heating. When it is fully de-iced, the sensor is ready to detect other ice condition.

  Illumination of the ICE light is accompanied by ECAM activation.

- **OVHT**

  The light comes on amber when an overheat is detected in the heating element.

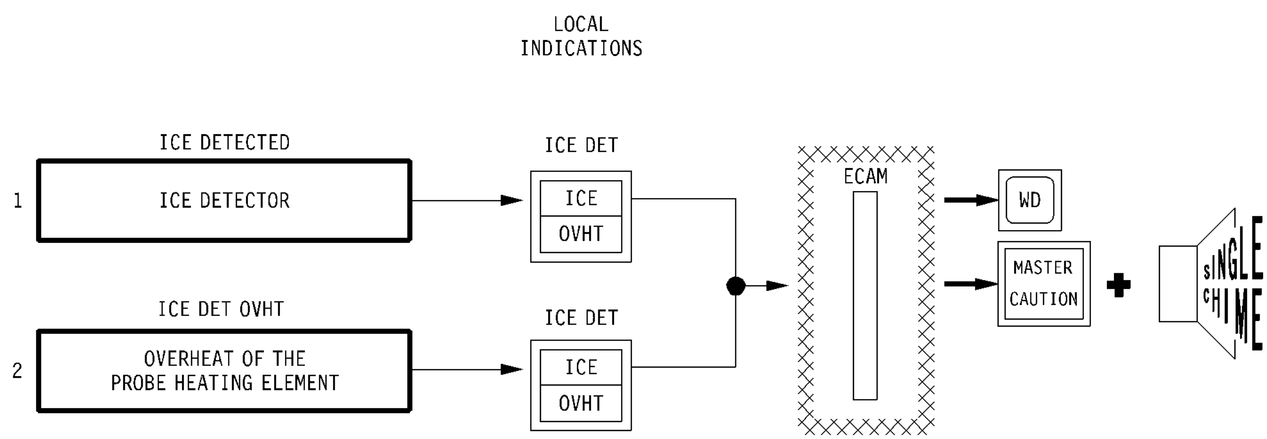
  The sensor de-icing system is then automatically cut-out.

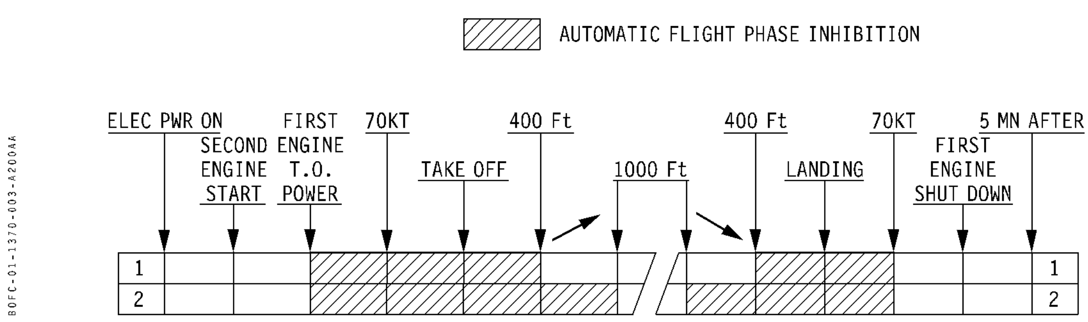
  Illumination of the OVHT light is accompanied by ECAM activation.

  The light gœs off when the overheat condition disappears.

Mod. : 2753 + 5381

WARNING LOGIC

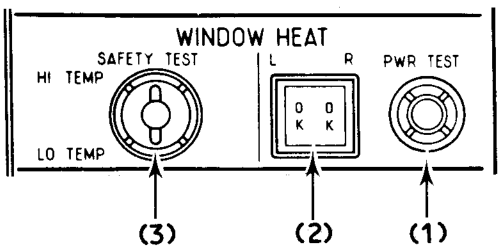




Code : 0094

A. WINDOW HEAT PANEL

FB1.1380.001-AA.000



(1) PWR TEST Pushbutton

Activates test of heating power supply to front windshields and side windows, simultaneously for both sides.

Before test the PWR P/B switches on the overhead panel must be selected ON.

When the pushbutton is pressed, the TEST OK lights will come on if the heating power supply is satisfactory. The duration of test is limited by a time relay to 10 seconds.

(2) OK Lights

The lights come on white during PWR TEST to indicate satisfactory condition of window heat power supply.

(3) SAFETY TEST Selector

Controls test of temperature control and warning circuits. Before test the PWR P/B switches on the overhead panel must be selected ON. The SAFETY TEST selector is springloaded to neutral (center position).

- **HI TEMP**

  Front windshield temperature in excess of 60 ° C is simulated.
  – Both FAULT lights come on on the overhead panel,
  – Heating power supply is disconnected,
  – ECAM is activated

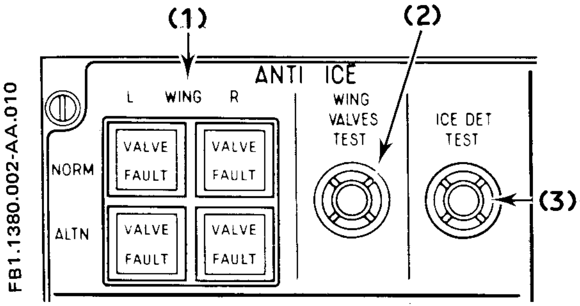
- **Neutral**

  Test circuit is de-energized. To cancel the warnings and to reset the system the PWR P/B switches must be selected OFF/R after test.

- **LO TEMP**

  Front windshield temperature in excess of – 60 ° C is simulated. Indications will be identical to test in TEMP HI position.

B. ANTI ICE PANEL



(1) WING VALVE FAULT Lights

For each wing anti-ice valve a light is provided for monitoring of valve operation. A failure is indicated after 3 seconds (Maintenance information only).

(2) WING VALVES TEST Pushbutton

The wing anti-ice system can be tested on the ground, with or without bleed air supply. Extent of test and the resulting indications differ respectively.

Before test the ANTI ICE WING SUPPLY P/B switch must be selected ON, the ON light on, no ANTI-ICE warnings activated,

- **Pressed and Held**

  System is tested for 10 seconds,

  – *With Bleed Air Supply*

  Wing anti-ice valves are induced to open ;
  all four when on APU bleed air,
  one of each side when on engine bleed air.

  The ANTI ICE WING FAULT light comes on during valve transit, then goes off.

  If it remains on during the 10 seconds test period, one of the four valves has failed to open. If it remains on after the 10 seconds test period has elapsed, one of the valves has failed to close, with activation of the ECAM system.

  After 3 seconds a failure to open or to close results in illumination of the corresponding WING VALVE FAULT light (if ANN LT switch is selected READ).

  – *Without Bleed Air Supply*

  Valves do not open. Only failure warnings are tested, as selected NORM or ALTN.
  R The ANTI ICE WING FAULT light must come on for the duration of the test with activation of the ECAM system.

- **Released**

  Test circuit is de-energized
  After successful test the ANTI-ICE light and FAULT light must be off.

(3) ICE DET TEST Pushbutton.

- **Pressed and Held**

  An ice detection is simulated by procuring an equivalent tension to the controller

  The ICE light comes on ANTI ICE panel accompanied by ecam activation to indicate positive test.

- **Released**

  Test circuit is de-energized.

Mod. : 2753

The landing gear consists of a forward retracting nose gear and two inboard retracting main gears. They are hydraulically operated. Gear doors enclose the landing gear bays. Each main gear assembly has an hydraulic/nitrogen shock absorber, and is equipped with a four wheel, twin bogie. Each main wheel is fitted with wheel brakes with anti skid.

A pitch damper on each bogie beam damps the movement and ensures return to neutral position, when
R the landing gear is free of the runway surface.
A visual indicating device is fitted to each pitch damper and in case of abnormal low pressure a red pin is in view.

The two-wheel nose gear assembly includes an hydraulic/nitrogen shock strut and a nose wheel steering system.

All gear doors open during landing gear transit.
The hydraulically operated doors close each time the landing gear is fully retracted or extended. The doors, which are fitted to the landing gear struts are mechanically operated by the gear and close at the end of gear retraction.

Landing gear controls and indicators are located in the cockpit on the center instrument panel and the overhead panel.
For gravity extension in case of hydraulic or electrical power supply failure, a hand crank is stowed in the RH side console and a protected fitting is provided in the cockpit floor.

Mechanical means for visual confirmation of landing gear down and locked are installed in each wing and on the nose gear strut.

A tail skid is provided to prevent or limit structural damage to the aft aircraft structure in case of takeoff or landing with excessive nose-up attitude.

NORMAL EXTENSION AND RETRACTION

System description :

Landing gear normal extension and retraction are controlled through a 3 – latched – position lever located on the center instrument panel.
Power is supplied by Green hydraulic system.

The gear electrovalve is controlled by the landing gear lever. It distributes green pressure, to retraction or extension line.

The door sequence valves are controlled by the gear uplock mechanisms and allow door opening or closing.

The gear sequence valves are controlled by the door open
position and allow gear extension or retraction.

Sequence principle :

Gear retraction (or extension) :

- The landing gear lever is selected UP (or DOWN).
- The gear electrovalve supplies retraction (or extension) line with green pressure.
- The doors are unlocked.
- The door sequence valves allow door opening by actuators.
- When the doors are fully open, their actuators remain pressurized open and the gear sequence valves open, which results in :
  – gear unlocking,
  – gear retraction (or extension) by actuators.
- When fully retracted (or extended), the gears are locked
  and actuators no more pressurized.
- The door sequence valves allow door closing by actuators.
- When fully closed, the doors are locked and their actuators remain pressurized closed.
- The landing gear lever is selected Neutral.
- The gear electrovalve connects extension and retraction lines to reservoir return.

LANDING GEAR GRAVITY FALL EXTENSION

In the event of normal extension system failure the landing gear can be extended mechanically from the flight compartment by means of a crank handle.

Rotation of the handle controls the following sequence of events :

– Shut off of high pressure supply and connection to reservoir return upstream of the sequence valves

– Connection of actuating cylinder retraction chambers to reservoir return

– Door uplock release

– Gear uplock release

The landing gear extends under gravity action. Downlocking is assisted by locking springs for the main gear and aerodynamic forces for the nose gear. The gear doors remain open.

A procedure is provided for restoring the landing gear to normal operating condition to enable gear retraction after a gravity extension during training flights.

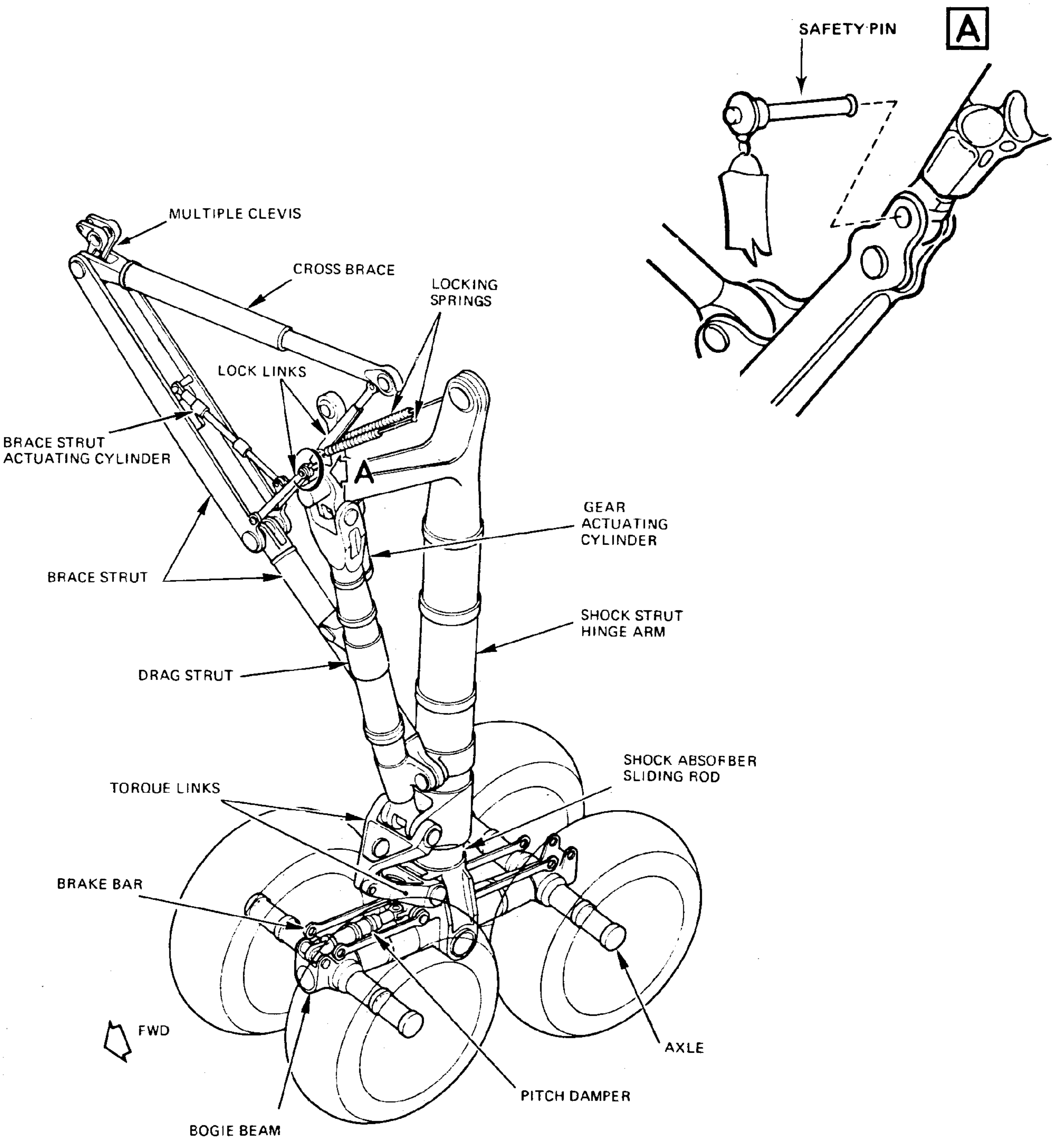
LANDING GEAR DOOR GROUND OPENING

For maintenance reasons, each gear door can be opened separately by means of a lever located near the door.

Operating of the lever isolates the door closing line, interconnects the actuating cylinder chambers and releases the door uplock, the door free falls to open position.

When the lever is returned to CLOSED position, door closure is achieved under Green hydraulic pressure with the landing gear normal control lever in DOWN position.

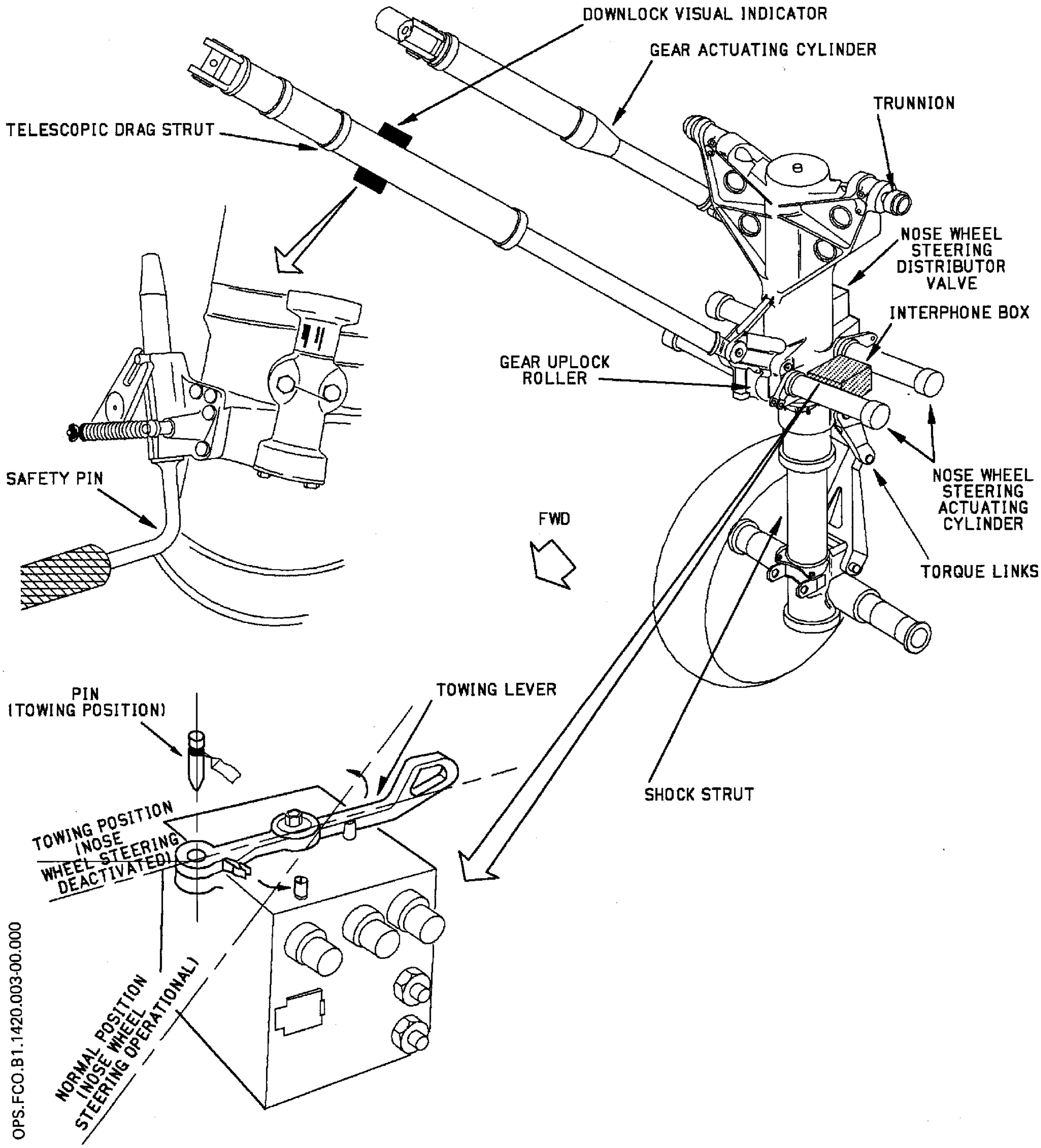
MAIN LANDING GEAR



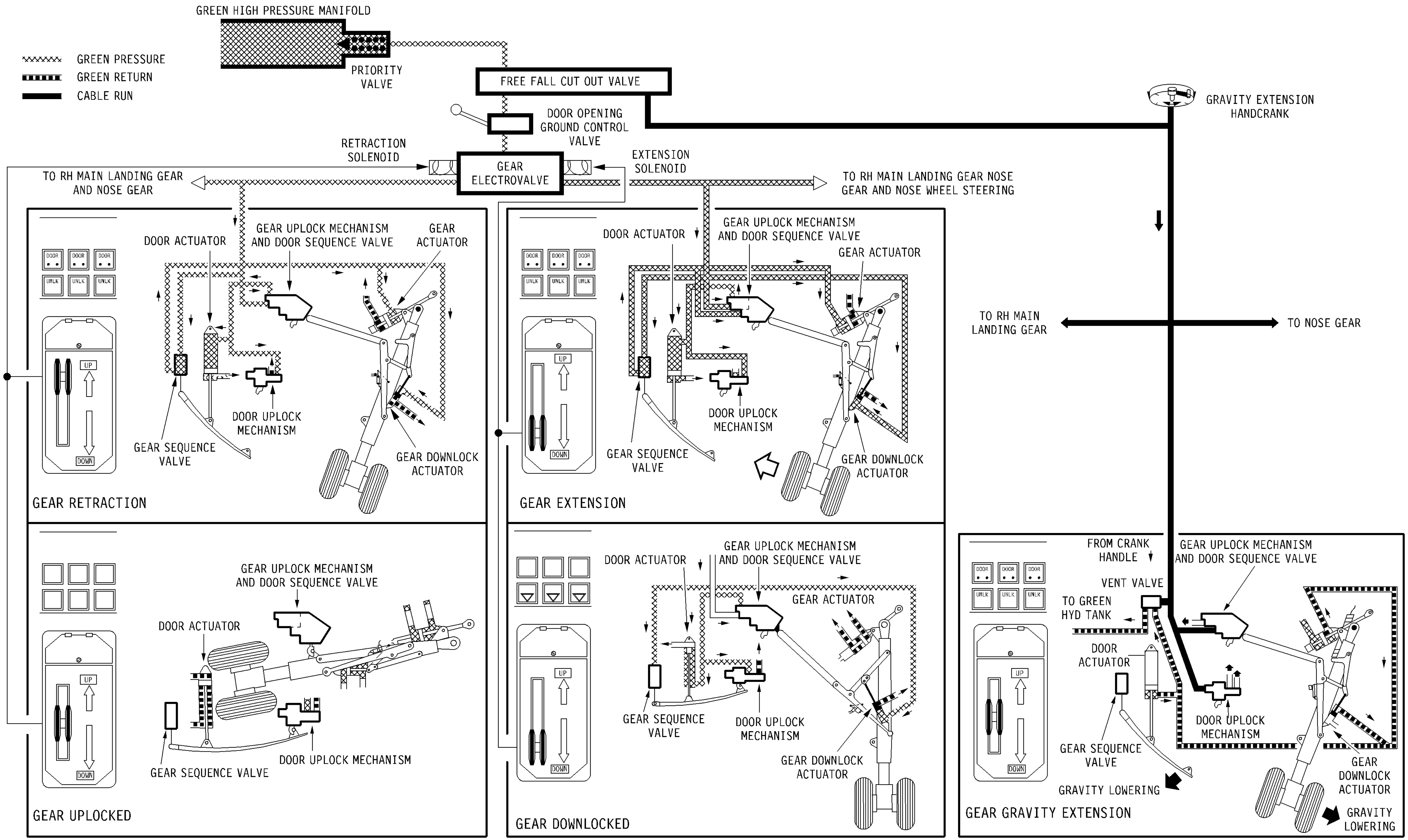
OPS.FCO.B1.1420.002-AA.000

Vers. : All Eng. : All

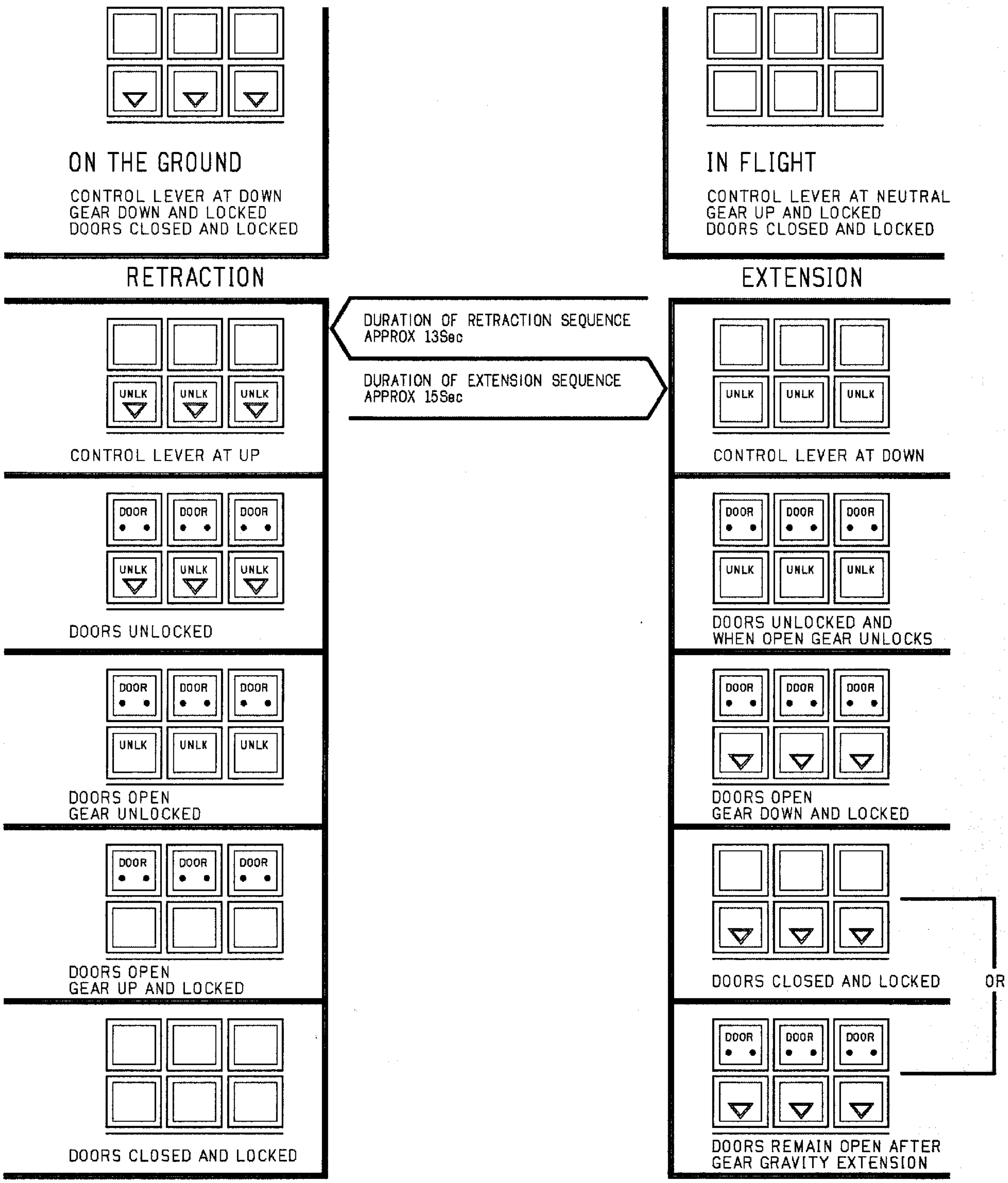
NOSE LANDING GEAR



LANDING GEAR OPERATION SYSTEM



LANDING GEAR OPERATION SEQUENCES



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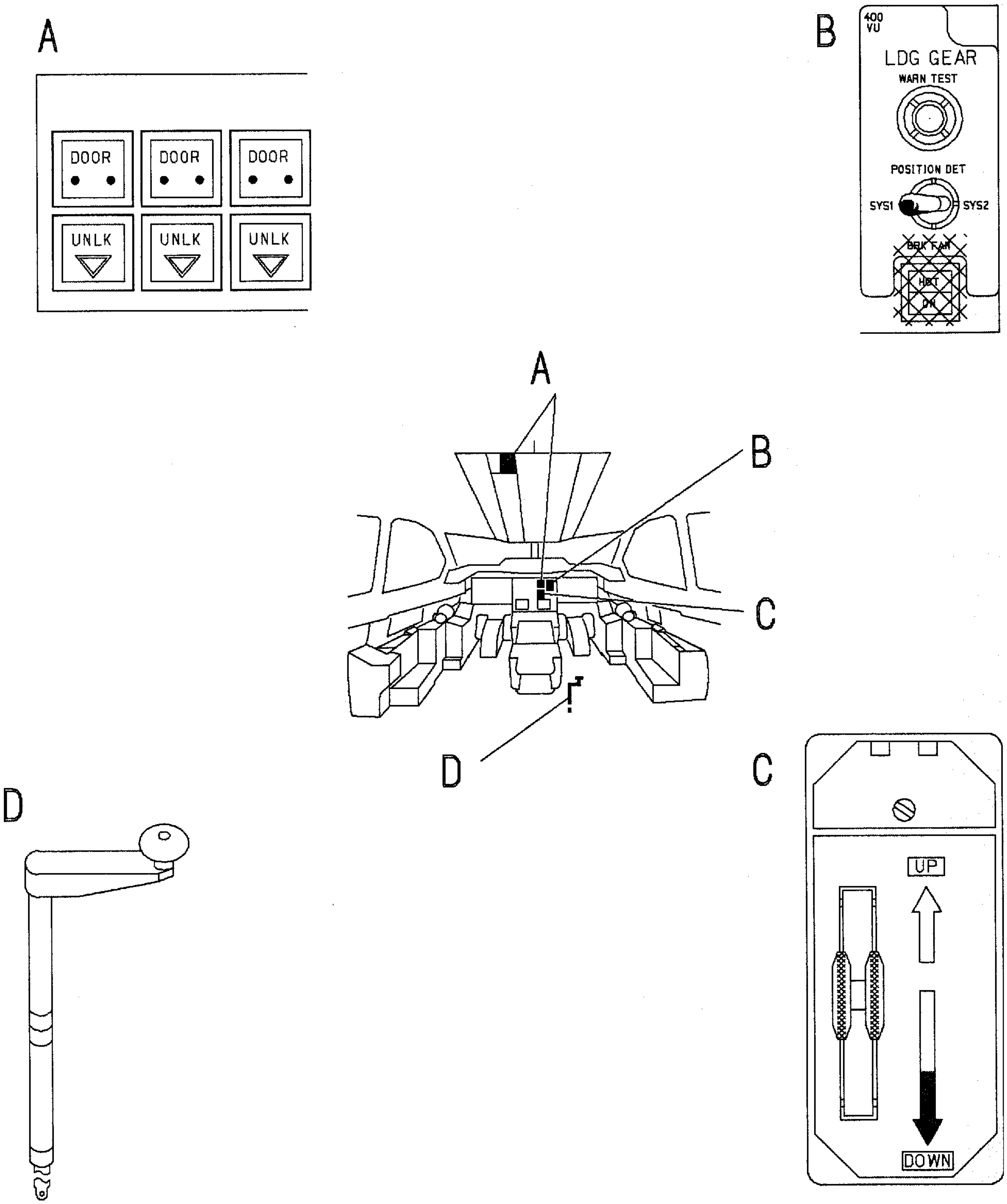
LOCATION OF CONTROLS

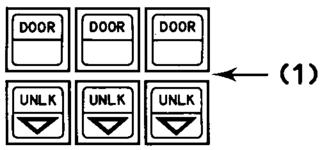


OPS.FCO.B1.1420.006-00.000

A. LANDING GEAR INDICATING UNITS

Two independent gear/door position indicators are provided.

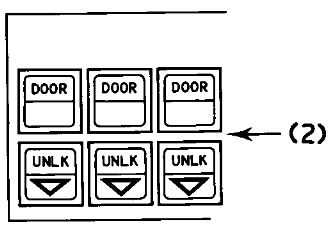
FB1.1420.007-AA.000.6A



(1) Overhead panel indicator,

energized by NORM ELEC PWR, connected to SYS 2 microswitches and proximity detectors.

FB1.1420.007-AA.000.6B

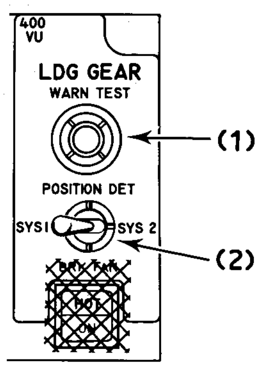


(2) Center instrument panel indicator,

energized by EMER ELEC PWR, connected to SYS 1 microswitches and proximity detectors.
. DOOR amber light = door not uplocked
. UNLK red light = gear not locked in selected position (or
R gear not uplocked with control lever in Neutral position).
. ▽ Green light = gear down locked

B. LDG GEAR PANEL

FB1.1420.007-AA.000.6C



(1) WARN TEST Pushbutton switch :

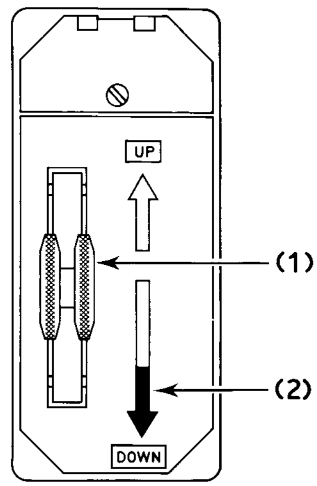
Controls the test of the gear not down and locked warning. When depressed the DOWN arrow illuminates associated with ECAM activation.

(2) POSITION DET SYS switch :

The active detection system for gear not locked down warning and for interlock safety system is determined by selector positioning.

C. LANDING GEAR LEVER PANEL

FB1.1420.007-AA.000.6D



(1) Landing gear control lever

The lever must be pulled prior to selecting one of the three possible positions. The lever controls Green hydraulic supply for normal operation.

UP : The landing gear is retracted.
- An interlock mechanism prevents unsafe retraction by locking the lever when gear position proximity detectors of selected SYS (1 or 2) are not in flight configuration :
  . 3 shock absorbers extended
  . nose wheel centered
  . 2 bogie beams aligned.
- During door opening only, anti skid is deactivated and main gear wheels are braked automatically.
- At end of nose gear retraction travel, nose wheels are mechanically braked.

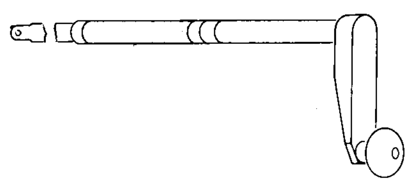
Neutral – Normal flight position. Hydraulic pressure to landing gear circuit is cut off.

DOWN – The landing gear is extended and the system remains pressurized.

(2) Red arrow

Illuminated red if the landing gear is not down and locked while the aircraft is in approach or landing configuration. Illumination of red arrow is associated with ECAM activation.

D. GRAVITY EXTENSION HANDCRANK



FB1.1420.008-AA.000.6A

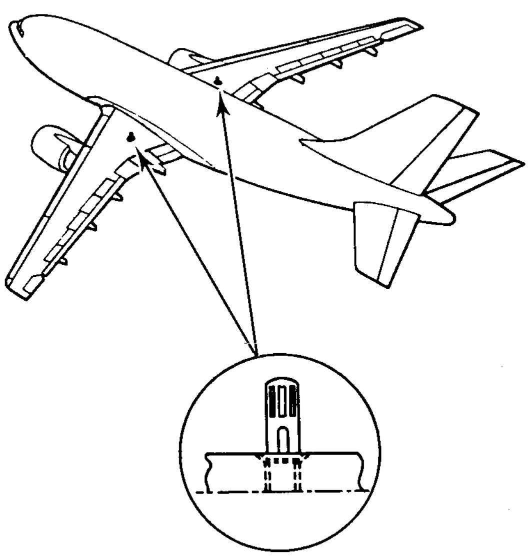
Stowed in the RH side console. For GRAVITY extension the handle must be inserted in a protected flight compartment floor fitting aft of the center pedestal on RH side, then rotated clockwise.

Green hydraulic pressure is first isolated. Then, all chambers are connected to the Green reservoir. At 17.5 turns, doors unlock. At 19.5 turns gears unlock, free fall and downlock assisted by aerodynamic forces (nose L/G) and spring assistance (main L/G). Doors will remain opened until flight or ground reconditioning.

E. VISUAL DOWN LOCK INDICATORS

MAIN GEAR Indicator

A red pin appears on each wing upper skin (above the gear bay) when the associated main gear is downlocked. It is visible from the cabin.



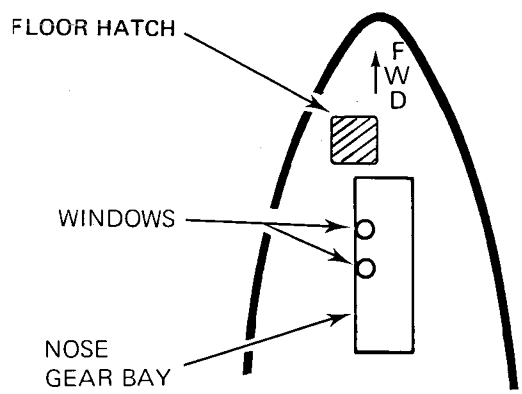
FB1.1420.008-AA.000.6B

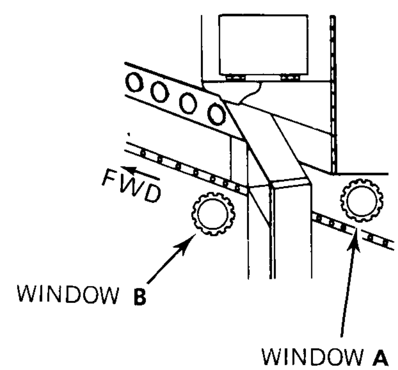
NOSE GEAR Indicator :

Two windows located in the avionics compartment on nose gear bay LH side :

– **WINDOW A** : for viewing a green mechanical indicator located on the telescopic drag strut.

– **WINDOW B** : for lighting the mechanical indicator by means of a flash light.

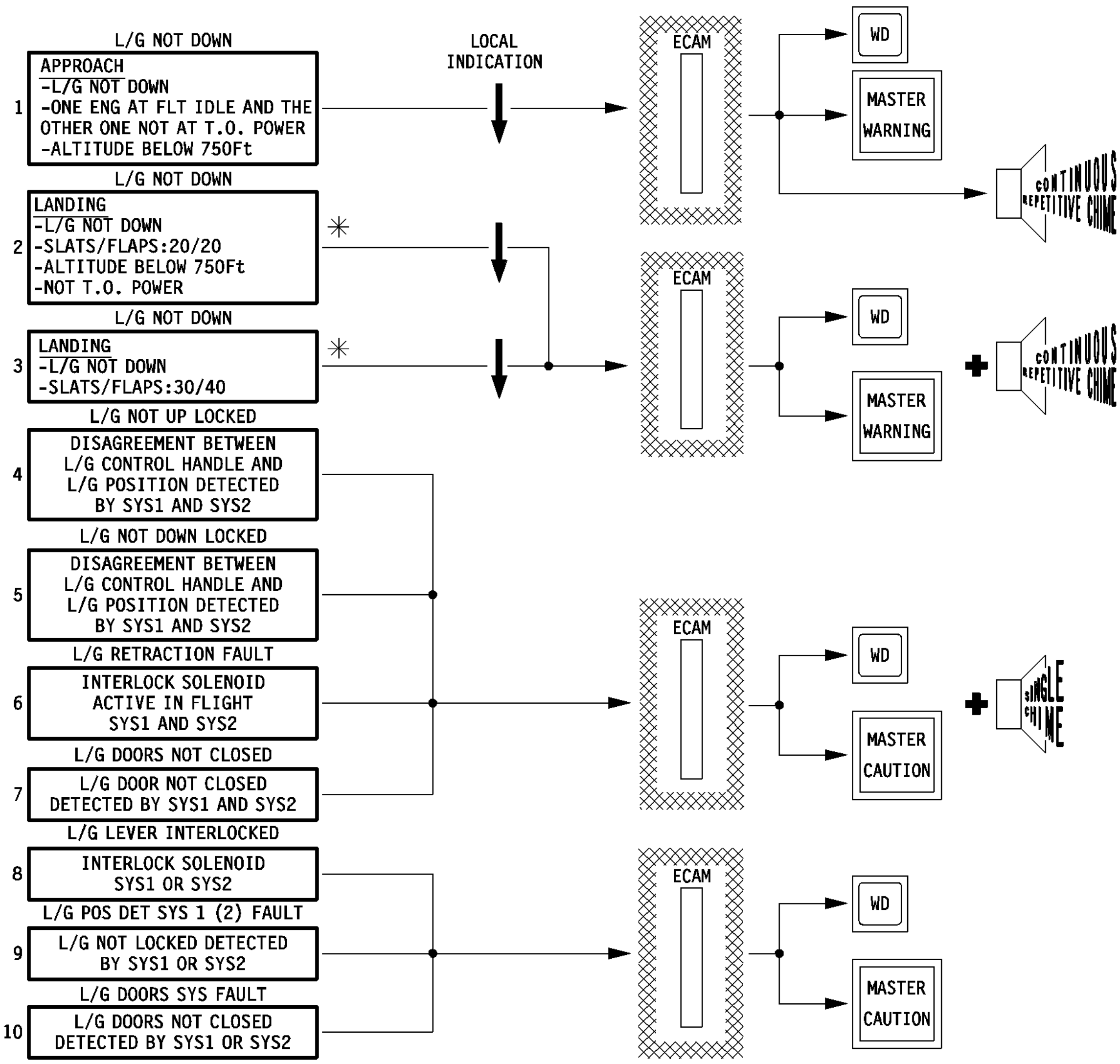


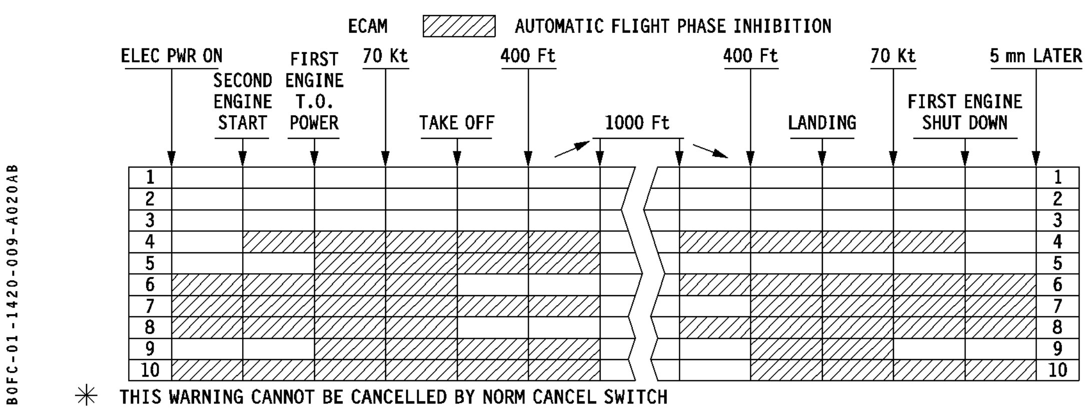


FB1.1420.008-AA.000.6C

Vers. : All Eng. : All

WARNING LOGIC





✳ THIS WARNING CANNOT BE CANCELLED BY NORM CANCEL SWITCH

Mod. : 5051

Nose wheel steering is possible by means of a servo mechanism mechanically controlled from the flight compartment and powered by Green hydraulic pressure tapped from the landing gear extension system via a selector valve. The selector valve shuts off pressure to the steering system when the shock absorbers are extended, during ground towing or when the engines are shut down.

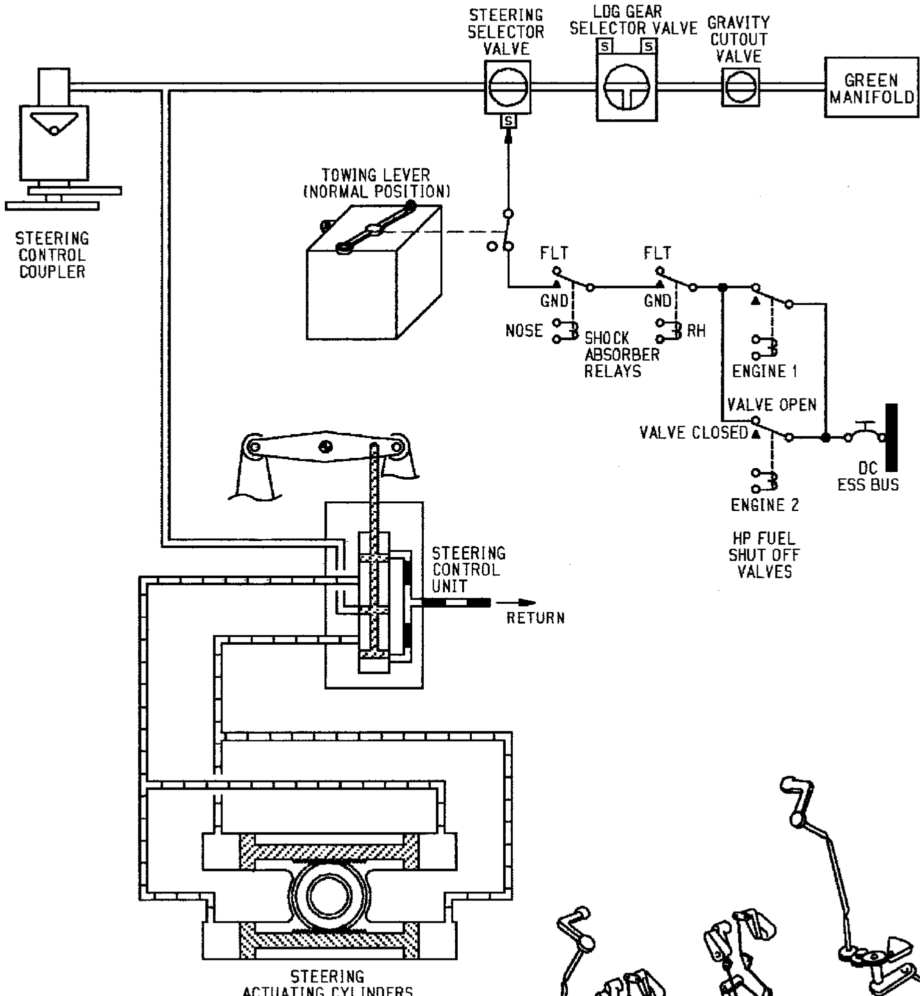
A towing lever on the interphone box enables the steering system to be deactivated for towing purposes. Nose wheel deflection of ± 95° is possible in this configuration.

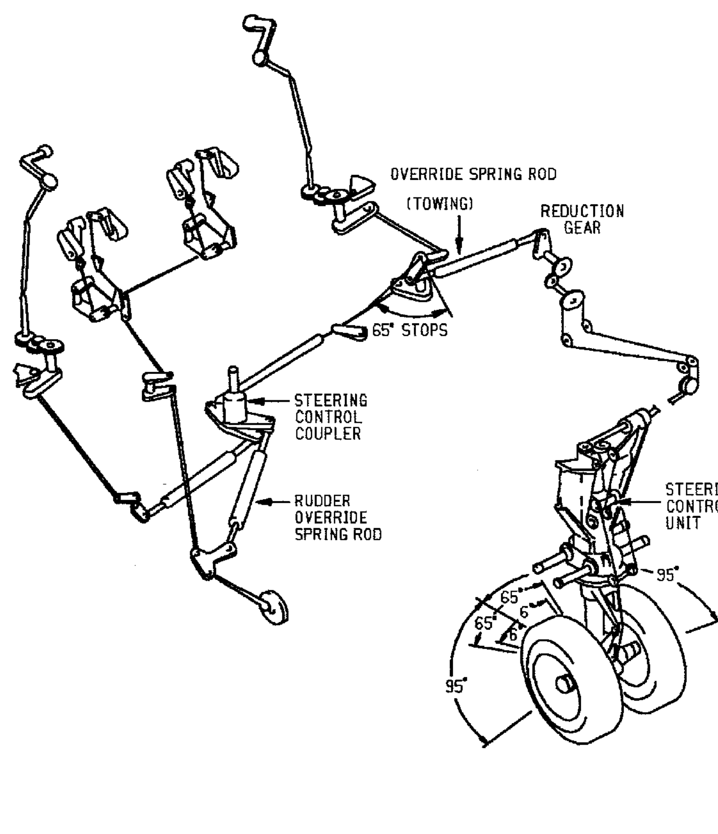
Independent control is achieved using either of the steering control handwheels located on each side of the flight compartment. Maximum nose wheel steering angle is then ± 65°.

A non reversible connection with the rudder pedals is achieved by means of a hydro mechanic coupler and enables nose wheel steering limited to ± 6° during high speed ground roll.

An internal cam mechanism returns the wheels to centered position after take off.

In the absence of Green hydraulic pressure the aircraft can be guided using the Alternate differential braking system.

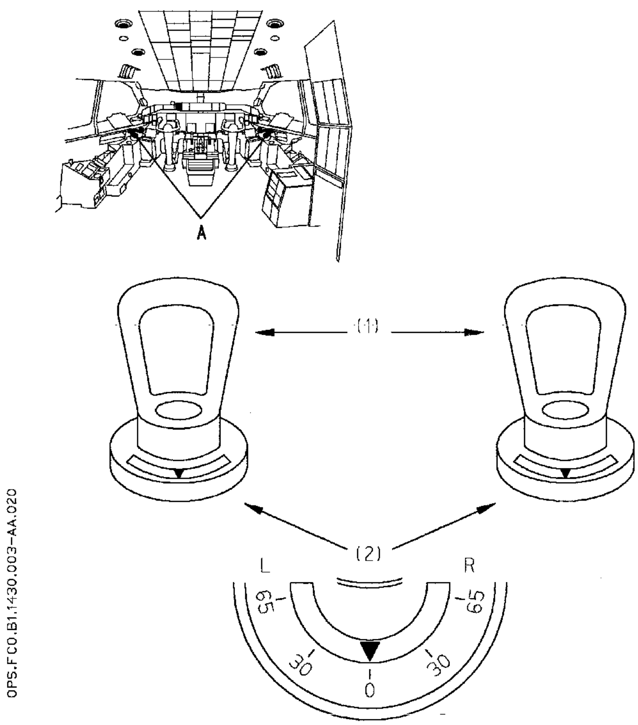




B0FC-01-1430-002-A110AA - R

Mod. : 5910

A. STEERING HANDWHEELS



(1) Steering Handwheels

The steering handwheels are interconnected and control the nose wheel steering angle up to 65° in either direction. When nose wheel steering is operated by rudder pedals (up to 6° either direction) the steering handwheels rotate accordingly.

- Clockwise : Steering to the right
- Counter clockwise : Steering to the left

(2) Steering Index

The index at each steering wheel indicates the steering angle in °, up to 65° to either side – (LH or RH).

Note : Nose wheel steering is self centering after lift-off.

Mod. : 4803

WHEELS AND BRAKES

The eight main gear wheels are equipped with multidisc brakes each operated by two independently supplied sets of pistons ; one set supplied by the green hydraulic system, the other by the Yellow hydraulic system assisted by two brake accumulators.

Each brake is equipped with an automatic adjuster, wear indicator and temperature sensor.

The wheels are fitted with tubeless tires.

The nose gear wheels are braked by brake bands at the end of the gear retraction cycle.

The main gear wheels are fitted with fusible plugs which protect against tire and wheel burst in the event of overheat.

Fans to speed up brake cooling are available.

ANTI SKID SYSTEM

The anti skid system is based on the comparison of the rotational speed of the nose and main gear wheels. It provides maximum braking efficiency, by maintaining the wheels at the limit of an impending skid, thus preventing the wheels from locking and protecting the tires. Brake release orders are sent to the eight Normal, and to the four Alternate servovalves as well as to the ECAM system which provides CRT display of the released brakes.

The three position NORM/ON, ALTN/ON, ALTN/OFF switch on the center instrument panel serves to switch from the Green system to the Yellow system in the event of partial failure of the anti skid system or to test the Yellow system (ALTN/ON) and if necessary to deactivate the anti skid system (ALTN/OFF).

BRAKING MODES

Four braking modes are available depending on the hydraulic supply systems and the position of the BRK/A/SKID switch and the PARKING BRAKE control handle.

(1) Normal braking

Control is electrical and achieved either :

- via the pedals on the ground
- or automatically :
  . On the ground by the auto brake system.
  . In flight, at the beginning of the gear retraction cycle.

Normal brake pressure is not indicated. A BRK FAIL, light alerts the flight crew in the event of failures.

(2) Alternate braking with anti skid

Automatic switching between the Green and Yellow systems is achieved by a reversible hydraulic selector.

Control is achieved solely via the pedals. The orders are transmitted by an auxiliary low pressure hydraulic system. The pressure delivered to the LH and RH brakes is indicated on a Yellow pressure triple indicator located on the center instrument panel. The anti skid system and associated indicating are operative.

(3) Alternate braking without anti skid

The anti skid regulation is deactived :

- electrically (BRK/A/SKID switch in ALTN/OFF position or power supply failure)
- or hydraulically if the brakes are supplied by the brake accumulators only, or when the parking brake handle is pulled.
  Hydraulical deactivation is achieved by closing the yellow return line.
  Switching between the yellow high pressure system and the accumulators is automatic and reversible.

The accumulators, the pressure of which is read on the brake Yellow pressure triple indicator, can be recharged by pressing the ACCU PRESS pushbutton switch controlling the Yellow electric pump. The accumulators are dimensioned to supply at least seven full brake applications.

(4) Parking braking

Operating the PARKING BRAKE control handle deactivates the other braking modes and the antiskid system and supplies the brakes with yellow high pressure or accumulator pressure limited at 2100 psi. The return lines are shut off to ensure an autonomy of at least 12 hours. The TO CONFIG warning alerts the flight crew if the PARKING BRAKE control handle is in the on (applied) position and one engine at take off power setting.

R Code : 0023

AUTO BRAKE

This system serves to reduce the delay in braking in the event of an acceleration – stop (MAX mode) or limit the deceleration upon landing to a preselected value.

System arming :

The flight crew arms the system by pressing the LO, MED or MAX pushbutton switch, provided all following arming conditions are met :

– Landing gear lever selected DOWN or NEUTRAL.

R – BRK/A/SKID selector at NORM/ON

– BRK FAIL light off.

– Green pressure avalaible.

– No failure on AUTO BRK system.

– Pressure transducers and master valves normally operating.

R Note : *If parking brake is ON, the system could be*
R *armed regardless of BRK/A/SKID selector ; but*
R *it will be automatically disarmed, at parking*
R *brake OFF selection, if BRK/A/SKID selector is*
R *not at NORM/ON position.*

System activation :

Braking is inititiated by the ground spoiler extension command. Consequently, in the event of an acceleration-stop, if the deceleration is initiated with the speed below 85 Kts, the automatic braking will not be operative because the ground spoilers will not be extended.

System disarming :

The system is disarmed by :

– releasing the pushbutton switch or,
– the loss of one or more of the arming conditions or,
– applying sufficient force to the pedals (provided the ground spoilers are commanded extended).

(This force is : in MAX mode : 25 dN on two pedals
in LO or MED mode : 18 dN on one pedal or
15 dN on two pedals).

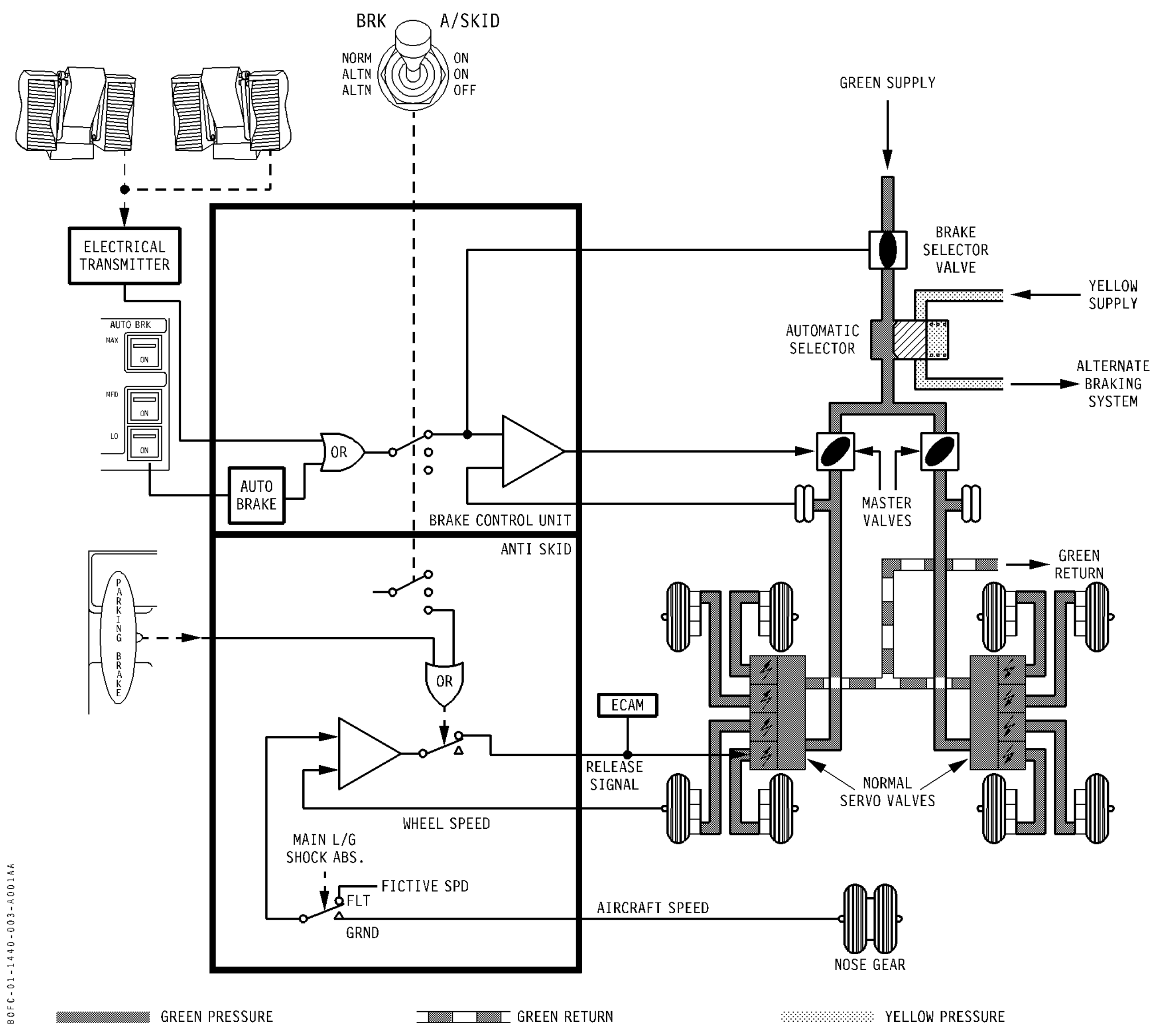
BRAKE TEMPERATURE SYSTEM

The system serves to measure the temperature at each of the eight brakes, provides temperature readout on the R ECAM CRT display unit, generates an overheat warning.

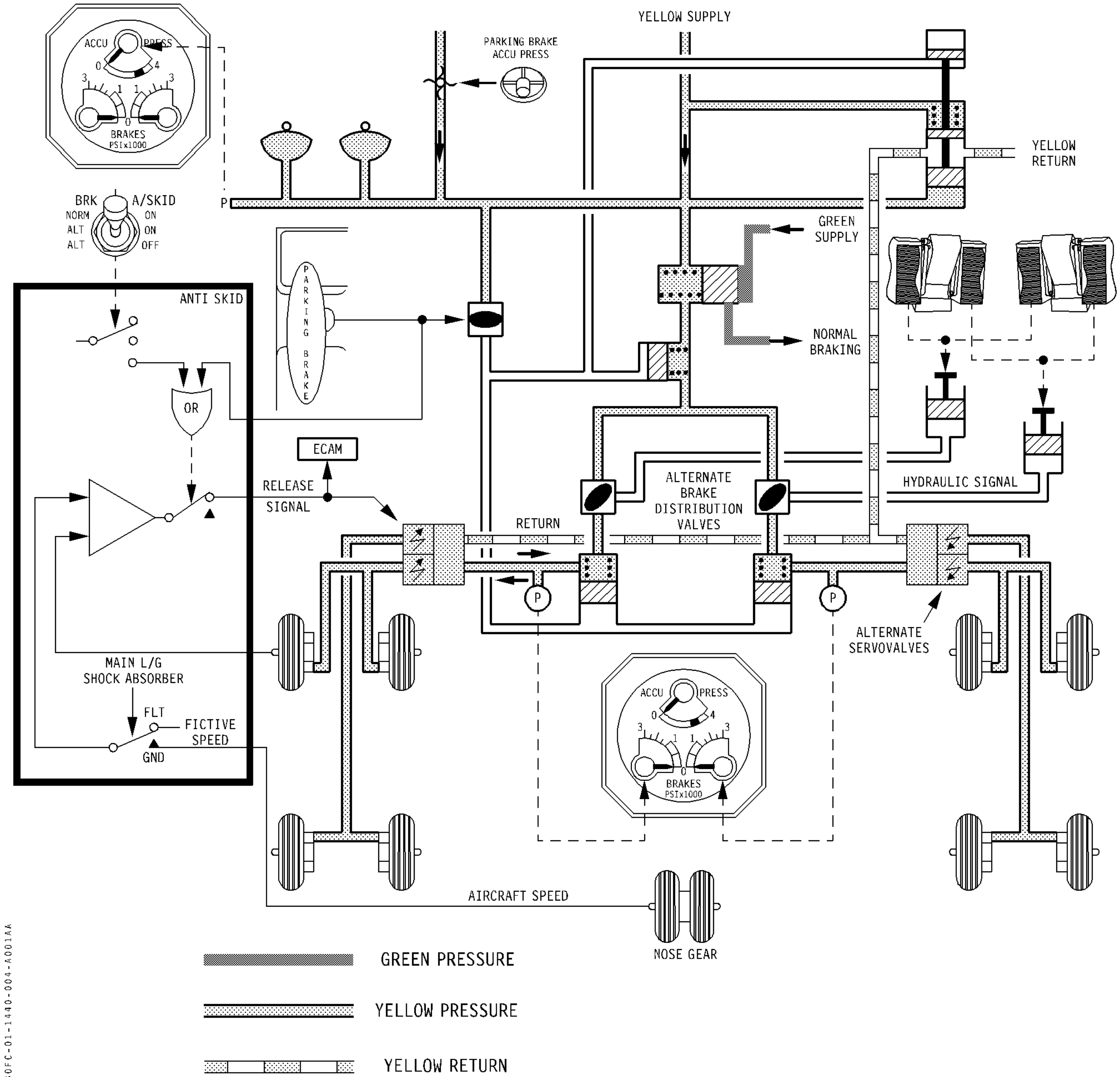
NORMAL BRAKING SYSTEM

R

R



ALTERNATE BRAKING SYSTEM

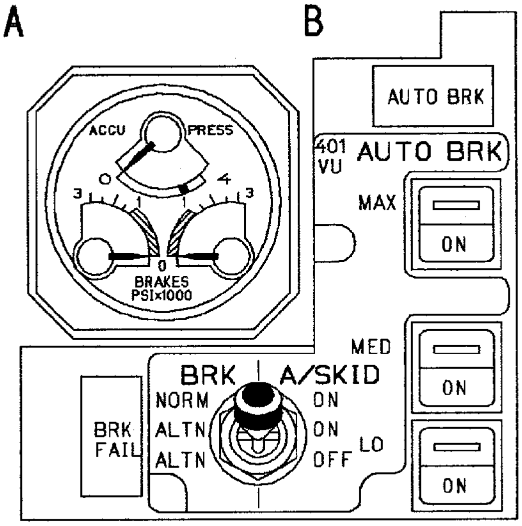


R

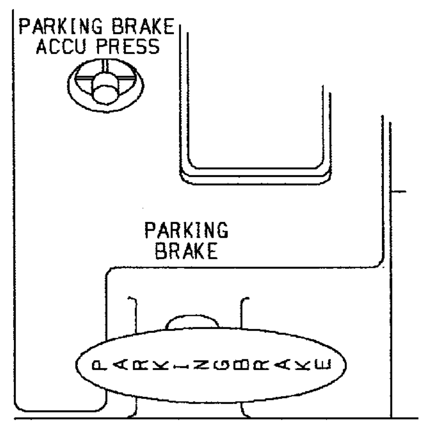
R

LOCATION OF CONTROLS

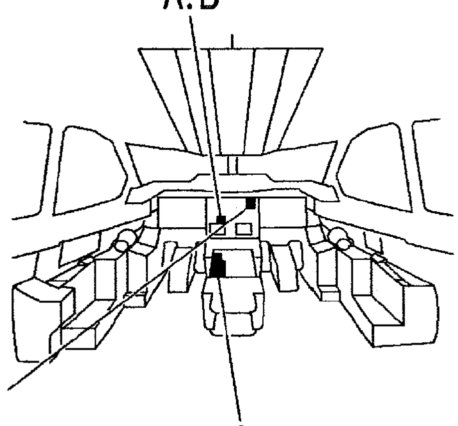
A B



C

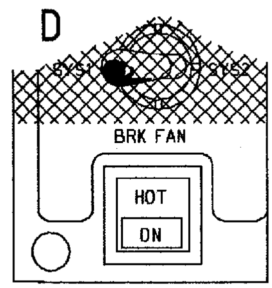


A.B



D C

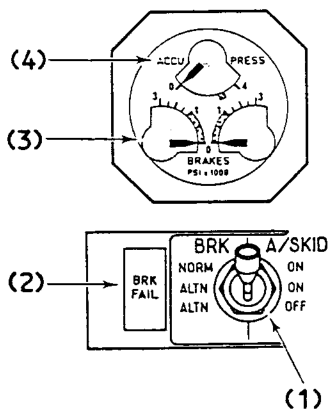
D



BOFC-01-1440-005-A300AA - R

Code : 0025

A. NORMAL/ALTERNATE SELECTION AND INDICATING



B0FC-01-1440-006-A200AA - R

(1) BRK/A/SKID switch

- **NORM/ON** :

  Anti skid is controlled via 8 servovalves provided that Green hydraulic pressure is available. Control is electrical with no pressure indication.

  If Green pressure drops, Yellow hydraulic pressure takes over automatically with dual BRAKES pressure indication (3) ; anti skid is still operative.

- **ALTN/ON** :

  Yellow hydraulic pressure is delivered to separate sets of brake pistons via separate servovalves. Control is hydraulic with BRAKES pressure indication (3) ; anti skid is operative.

- **ALTN/OFF** :

  Same as for ALTN/ON but anti skid system is deactivated.

(2) BRK FAIL light

The light comes on amber in flight, associated with ECAM activation, when :

– with gear up or down
  · BRK/A/SKID is selected ALTN/OFF
  or
  · one of several REL indications on the ECAM are off
– during gear retraction, if the braking pressure is lower than 290 psi.

(3) BRAKE Pressure Indication :

Indicates yellow pressure delivered to LH and RH brakes measured up-stream of ALTN servovalve.

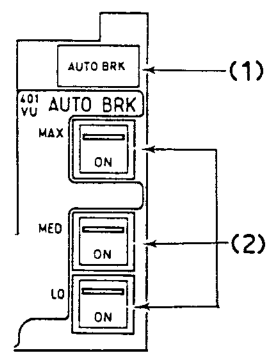
. normal Parking Brake pressure is about 2100 psi.
. the scale is marked by green arc from 0 psi to 1,000 psi.

Note : *Indicated pressure up to one needle width can be considered as zero.* R R

(4) ACCU PRESS Indication :

. normal pressure is between 2,800 and 3,200 psi (green zone).

B. AUTO BRK PANEL



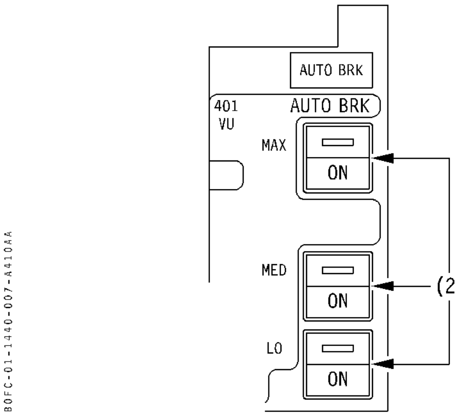
B0FC-01-1440-006-B200AA - R

The panel contains the controls and indications for arming or disarming and indications for operation of the autobrake system.

(1) AUTO BRK Light

The AUTO BRK light flashes amber for 10 sec when the AUTO BRK system is disarmed except when disarming is due to LDG GEAR CTL lever Selected UP or AUTO BRK pushbutton switch released.

MP : S7212 + Mod : 5443



(2) MAX, MED, LO Pushbutton Switches

The pushbutton switches control the arming of the system with several deceleration rates.

Autobrake system is activated when armed and ground spoiler deployment order is present.

The selectable deceleration rates are,
MAX : maximum braking pressure
MED : approximately 3.00 m/s^2
LO : approximately 1.70 m/s^2

MAX mode is normally selected for takeoff.
In the event of an aborted takeoff, maximum pressure is sent to the brakes as soon as ground spoiler deployment order is present.

MED and LO modes are normally selected for landing.
When LO is selected, progressive pressure is sent to the brakes 8 seconds after the ground spoiler deployment order

When the ground spoilers are retracted
– either, automatically by application of forward thrust
– or, manually by action on the SPEEDBRAKE lever the autobrake system will be disarmed.

- **ON (P/B Switch pressed-in)**

  The ON light illuminates blue to indicate positive arming. The light extinguishes when actual aircraft deceleration corresponds to the selected deceleration rate.

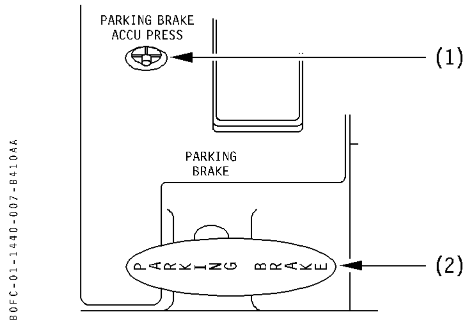
- **Off (P/B Switch released-out)**

  The autobrake system is deactivated for the associated mode.

- **Bar**

  The bar integrated in the upper part of the pushbutton switch illuminates green when actual aircraft deceleration corresponds to the selected deceleration rate.

C. PARKING BRAKE/ACCU PRESS PUSHBUTTON and PARKING BRAKE HANDLE



(1) PARKING BRAKE ACCU PRESS Pushbutton

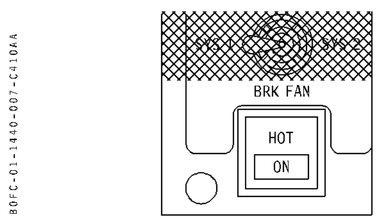
As long as pushbutton is pressed, the self regulating electric pump is activated and delivers 6 l/mn max under 3,000 psi to charge the brake accumulators.

(2) PARKING BRAKE handle

Pull handle and turn clockwise to apply parking brake. Application of the parking brake deactivates NORM and ALTN modes.

Note : The indication « PARKING BRAKE ON » is displayed on the ECAM MEMO page.

D. BRK FAN PUSHBUTTON SWITCH



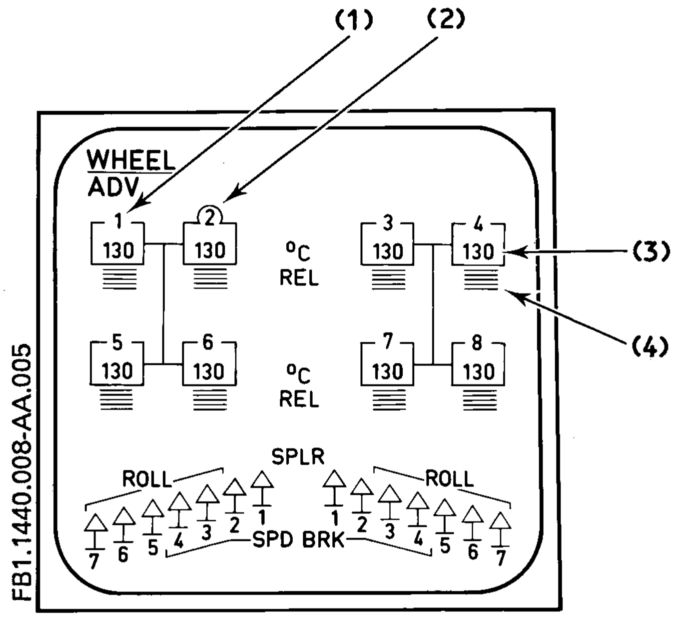
The pushbutton switch controls the operation of all brake fans simultaneously.
It is effective only when the landing gear is downlocked. R

- **ON (P/B Switch pressed-in)**
  The ON light illuminates green, brake fans are activated.
- **Off (P/B Switch released-out)**
  The ON light is off, brake fans are deactivated.
- **HOT**
  The light illuminates amber when the temperature of any brake exceeds 300° C and extinguishes when temperature decreases below 280° C ± 5.
  The light remains effective after landing gear retraction. Illumination of the HOT light is associated with ECAM activation.

Code : 0026

SYSTEM DISPLAY

BRAKE SYSTEM PAGE



(1) Wheel identification number (white) :

Becomes amber when the corresponding brake temperature is above 300 °C.

(2) Arc around wheel identification number (green) :

Comes on around the number of the hottest wheel, only if the corresponding brake temperature is above 100 °C. It becomes amber, if the corresponding brake temperature is above 300 °C.

(3) Brake temperature (green) :

The indication becomes amber when it is greater or equal to 300 °C.

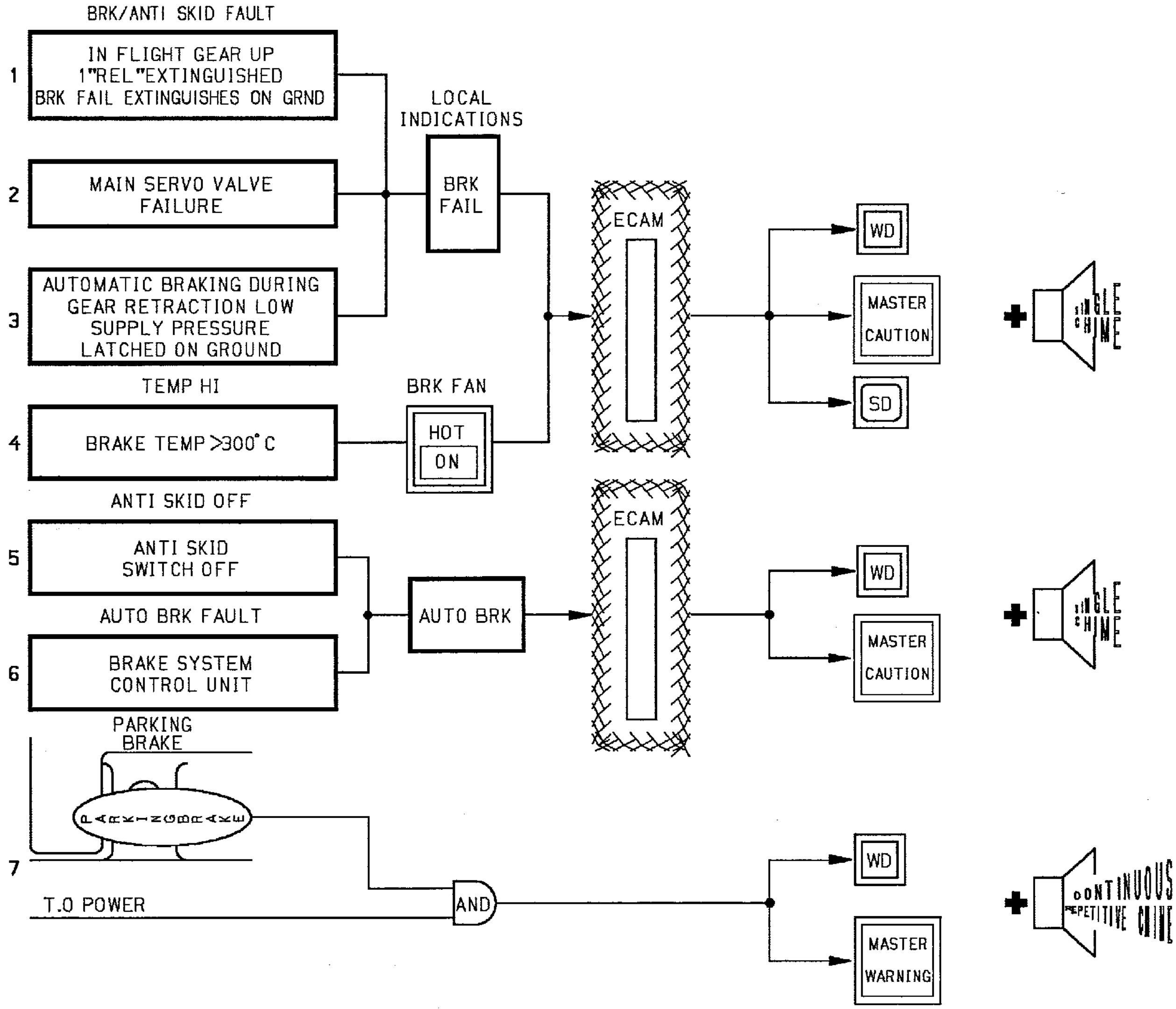
Note : Amber colour disappears as soon as temperature is below 300° C although the amber light remains on, on the LDG GEAR panel down to 280° C ± 5.

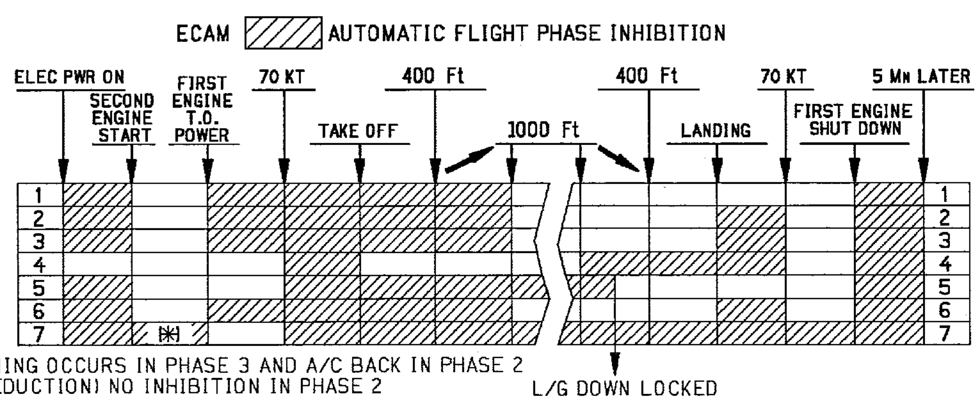
(4) Brake release indicator (green) :

Comes on, in flight when anti skid valid. After touch down, disappears and reappears, depending on anti skid release signal to the brakes.
Disappears when the aircraft is stopped.

R Code : 0027

WARNING LOGIC





(*) IF WARNING OCCURS IN PHASE 3 AND A/C BACK IN PHASE 2 (THR REDUCTION) NO INHIBITION IN PHASE 2

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R Code : 0077

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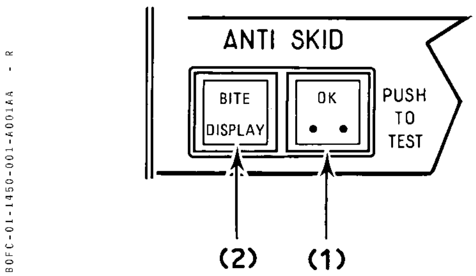
A. ANTI SKID PANEL



(1) ANTI SKID OK TEST pb

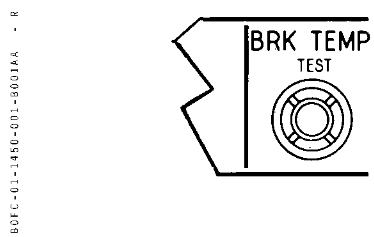
- **Neutral (Released-out-springloaded position).**
  Test circuit is not energized.
- **TEST (Pushed-in)**
  Test circuit is energized
  A speed of nose and main wheels is simulated. If the anti-skid system is operative, all the « REL » indications and the OK light illuminates. In case of failure, the BITE DISPLAY light illuminates.

(2) BITE DISPLAY Light

The BITE DISPLAY light comes on white and remains on if any fault is detected on normal braking electrical control and the anti skid system.

The coded failure is indicated on the face of the brake system control unit located in the avionics compartment.

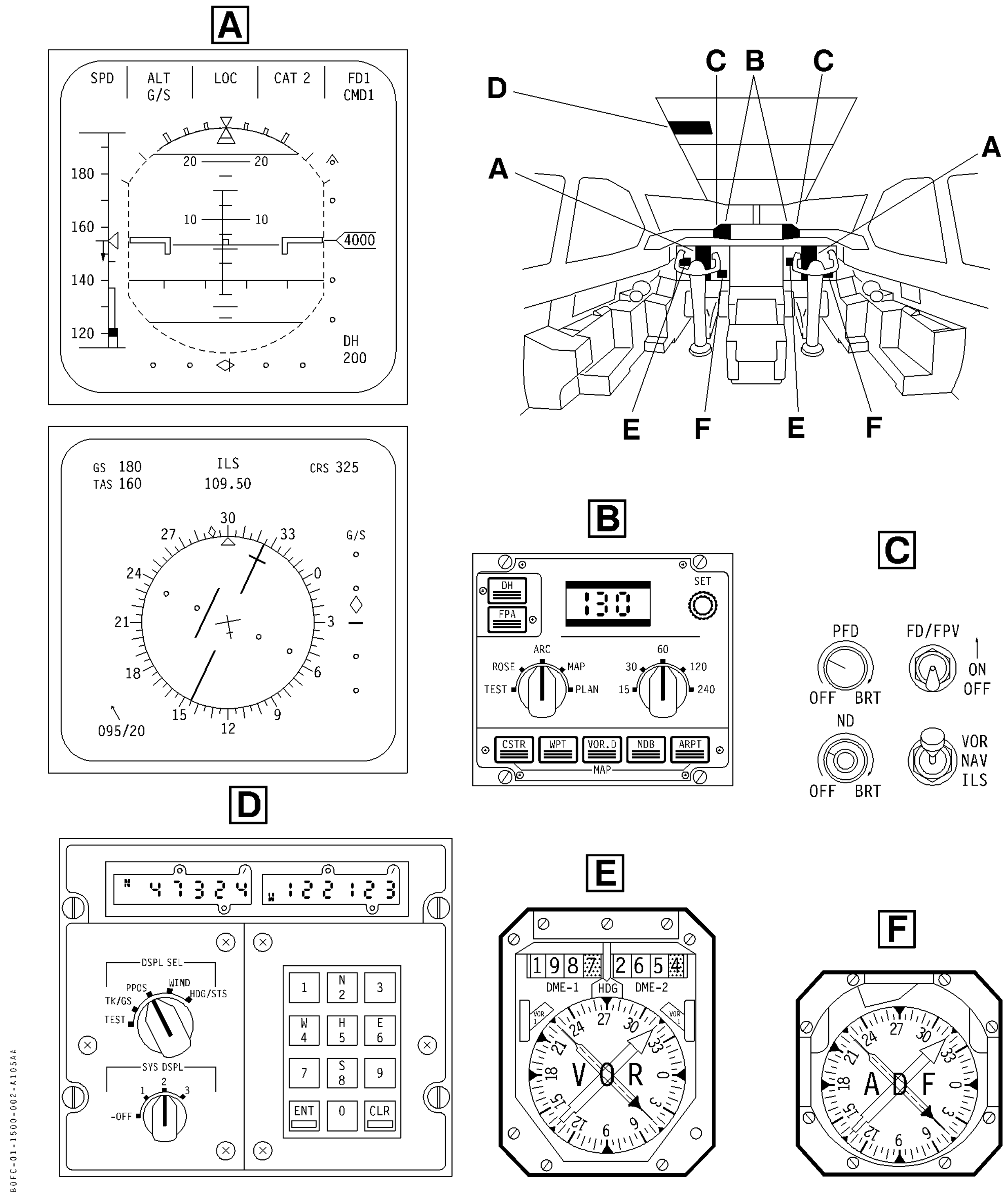
B. BRK TEMP TEST PUSHBUTTON



When the pusbutton is pressed and held, a temperature equalled to 70° C (steel brakes) or 100°C (carbon brakes) plus the warning threshold plus the actual brake temperature, is simulated.

The BRK HOT light comes on amber accompanied by ECAM activation to indicate positive test.

R Code : 0029



MAIN

SYSTEM CONTROLS

AND DISPLAYS

Mod : 4672

GENERAL

- Attitude and heading information is provided by three Inertial Reference Systems (IRS) and a standby system, which includes a standby horizon and a standby compass.
- The IRS provide information to the other aircraft systems, such as attitude, heading, aircraft speed, position, track and wind.
- Each IRS consists of :
  - an IRU (Inertial Reference Unit) located in the avionics bay, and
  - a MSU (Mode Selector Unit) located on the overhead panel.
- Each IRU includes a computer and the following sensors :
  - three LASER gyros, to measure the pitch, roll and yaw angles as well as the pitch/roll/yaw rates

  and

  - three accelerometers, to measure longitudinal, vertical and lateral accelerations.
- The IRU are operated from their respective MSU.
- Additionally, a single ISDU (Inertial Sensor Display Unit) on the overhead panel can be used to enter or display information to or from any of the three IRS.
- For initialization and alignment, the IRS require parking position coordinates, usually entered from the FMS CDU, but which can be alternatively entered on the ISDU (see FMS chapter).
- If IRS 1 or 2 fail, IRS 3 can be selected to replace the lost attitude and heading information for the Captain's or F/O's flight instruments (see FLIGHT INSTRUMENTS chapter).

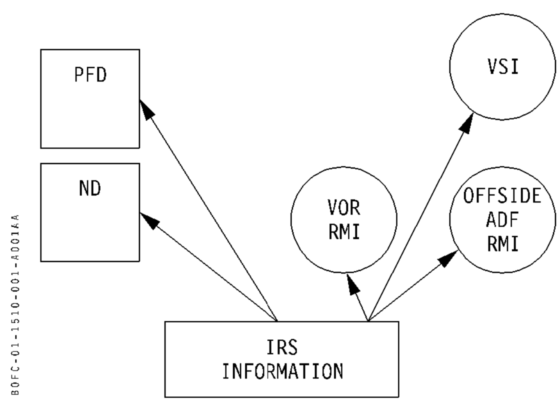
POWER SUPPLY

- During alignment, the IRS initially operate on aircraft batteries power for five seconds to ensure operation of the backup DC Power system. When this check is complete, IRS switch over to their normal source of power :
  - IRS 1 is supplied by AC EMER BUS.
  - IRS 2 is supplied by AC BUS 2.
  - IRS 3 is supplied by AC ESS BUS.
- Standby power supply (if normal AC power source is lost) :
  - IRS 1 will receive power from aircraft battery 1, until battery 1 is depleted.
  - IRS 2 and 3 will be supplied by their respective aircraft batteries (battery 2 for IRS 2, battery 3 for IRS 3) for 30 seconds. R

  Note : *If the IRS 3 has been already selected by the Captain or if the IRS 3 is selected within 30 seconds (ATT HDG switching), it will remain supplied until its DC power source is depleted.*

IRS INFORMATION DISPLAY

- IRS information is displayed on the EFIS Primary Flight Display (PFD) and Navigation Display (ND), the Vertical Speed Indicator (VSI), and the ADF and VOR/DME RMI.



Note : *For detailed description of the PFD, ND and VSI, refer to the chapter 1.10-FLIGHT INSTRUMENTS.*

IRS inputs to the Primary Flight Displays (PFD)

- The IRS provide the PFD with pitch, roll and heading information as well as lateral acceleration (sideslip indication).

- Additionally, the IRS provide information for the Flight Path Vector (FPV) symbol.

Note : A more detailed description of PFD is provided in the FLIGHT INSTRUMENTS chapter.

IRS inputs to the Navigation Displays (ND)

- IRS provides the ND with magnetic heading, ground track, ground speed and wind data.

Note : A more detailed description of the ND is provided in the section 1.15.20 thru 1.15.25.

IRS inputs to the VOR/DME RMI

- The CAPT's VOR/DME RMI displays heading information from IRS 1 (or 3 if ATT HDG switching pushbutton switch is selected).

- The F/O's VOR/DME RMI displays heading information from IRS 2 (or 3 if ATT HDG switching pushbutton switch is selected).

Note : For more information see VOR/DME system.

IRS inputs to the ADF RMI

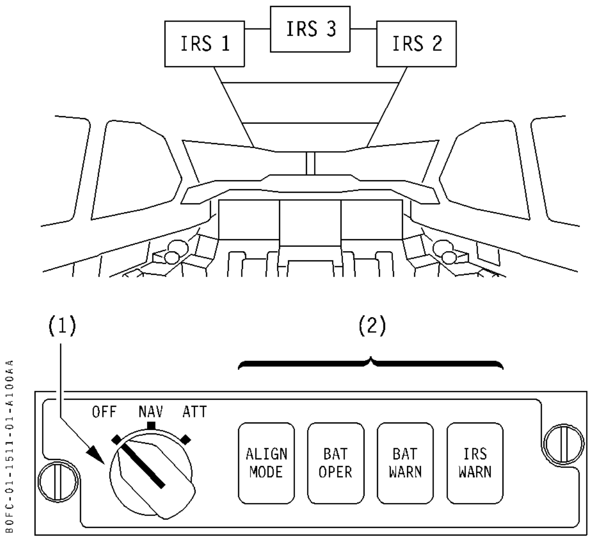
- The CAPT's ADF RMI displays heading information from the F/O's primary heading source (IRS 2, or 3 if F/O ATT/HDG switching has been selected).

- The F/O's ADF RMI displays heading information from the CAPT's primary heading source (IRS 1, or 3 if CAPT ATT/ HDG switching has been selected).

Note : This enables each pilot to compare his primary heading information (ND and VOR/DME RMI) against the other pilot's heading information (ADF RMI).

MODE SELECTOR UNIT (MSU)

The three MSU are located on the overhead panel.



(1) Mode Selector

- **OFF**
  - The IRS is not energized.
- **NAV**
  - Normal operating mode, the IRS provides all attitude, heading, navigation and trajectory information.
- **ATT**
  - Emergency mode.
  - ATT mode only provides attitude and heading information.
  - Magnetic heading must be manually entered on the ISDU, and regularly updated by the crew.
  - Navigation information such as present position, ground speed, wind and FPV are lost.

Note : *ATT is selected by the crew if a partial system failure or an electrical power loss prevent the use of the NAV mode.*

(2) Warning Annunciator Lights (amber)

- **ALIGN MODE**
  - Illuminates once DC power supply check is complete (5 seconds after system power-up), or when a rapid re-alignment is performed, to indicate that alignment has started.
  - If present position has been entered, this light extinguishes 10 minutes later when the alignment is complete.
  - It flashes to indicate an alignment discrepancy, an excessive aircraft motion or if present position has not been entered at the completion of the 10 minutes alignment time.

Note : *"IRS IN ALIGN" message is displayed on the ECAM MEMO page when any IRS is in the ALIGN mode.*

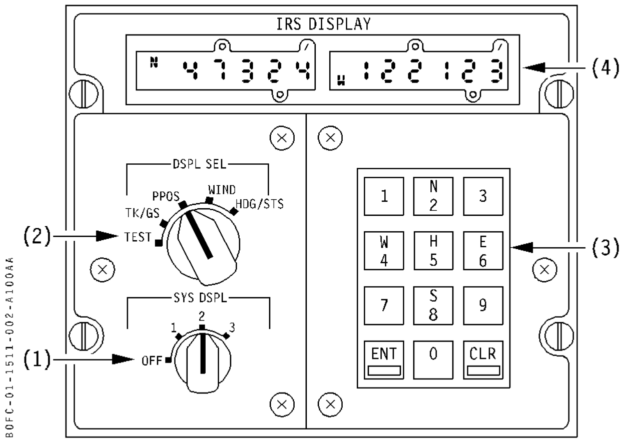
- **BAT OPER**
  - Indicates that the IRS is being supplied by its respective aircraft battery.

Note : *This light illuminates for 5 seconds at the start of the alignment, when the backup DC power supply is being tested.*

- **BAT WARN**
  - Indicates that the voltage of the associated aircraft battery is below 18 V even if IRS does not attempt to operate on battery.
- **IRS WARN**
  - Illuminates further to a complete IRS failure, or flashes to indicate either that ATT mode must be selected or that there is an ISDU failure (STATUS code must be checked to determine which failure case has occured).

Mod : 4672

INERTIAL SENSOR DISPLAY UNIT (ISDU)



- The ISDU is connected to all three Inertial Reference Unit (IRU). The ISDU provides an alternate means of displaying the IRS main navigation data, or entering the present position coordinates for IRS alignment.

Note : These operations are normally performed using the Flight Management System.

(1) SYS DSPL (Display) Selector

■ **OFF**

– The ISDU is not energized.

■ **1, 2 or 3**

– IRS 1, 2 or 3 is selected for data display on the ISDU, or for present position (alignment) or magnetic heading entry (ATT mode) using the ISDU keyboard.

(2) DSPL (Display) SELector

■ **PPOS**

– The present position (latitude and longitude) of selected the IRS is displayed.

Note : This position is also selected to enter the present position coordinates for alignment.

■ **TK/GS**

– True Track (TK) and Ground Speed (GS) information, from the selected IRS is displayed.

■ **WIND**

– True wind direction and speed, computed by the selected IRS, are displayed. R

■ **HDG/STS**

– True Heading (HDG) and any STATUS code (as applicable) are displayed.

Note 1 : During alignment, the display indicates the applicable STS code and the number of minutes remaining until the alignment is complete. If several STS codes are applicable, codes are displayed in turn for two seconds.

Note 2 : When ATT mode has been selected on any MSU, HDG/STS and the affected IRS (1, 2 or 3) must be selected to enter the magnetic heading, using the keyboard.

■ **TEST**

– Illuminates all digits on the ISDU display, and the ENT and CLR key lights for test.

(3) ISDU Keyboard

- Present position (and the magnetic heading, if ATT mode has been selected) are entered using this keypad.

Note : If entering magnetic heading, the "H" key must be pressed first.

(4) ISDU Display

- Depending on the position of the DSPL selector, the ISDU display indicates :
  - True Track and Ground Speed, or
  - Present position, or
  - True Heading and status codes.
- The following codes can be displayed when the DSPL selector is in the HDG/STS position :
  - 01 REMOVE IRU (for maintenance),
  - 02 DELAYED MAINTenance,
  - 03 ENTER POSition,
  - 04 SELECT ATT mode (IRS NAV failure),
  - 05 EXCESSIVE MOTION (during alignment),
  - 06 SWITCH ADC (switch to other ADC),
  - 07 CHECK C/B (check circuit breaker),
  - 08 REMOVE ISDU (for maintenance),
  - 09 ENTER MAGNETIC HEADING

Mod : 4672

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Mod : 4672

ALIGNMENT

- The IRS operation begins when the alignment is complete. If the present position coordinates have been entered, this takes place at least 10 minutes after the system was powered by placing the MSU selector from OFF to NAV.

Note : *The IRS can not be able to align in NAV mode at latitudes above 70° N. Therefore, the IRS should be kept operating during stops above 70° N.*

- 10 minutes after NAV mode have been selected, ALIGN MODE flashes unless present position has been entered.

- If excessive motion is detected during alignment, the system restarts the entire 10 minutes alignment cycle automatically once the motion stops.

- During the alignment, the IRS compares the crew-entered latitude to its own internally calculated latitude. If the difference between the two latitudes exceeds 0.5° (30 minutes of arc), the MSU ALIGN MODE light flashes to indicate latitude entry error.

  A new latitude must be entered before alignment can continue.

- During a stopover, when IRS is already operating in NAV mode, a rapid IRS re-alignment can be performed in 3 minutes by placing each MSU mode selector in OFF position for less than 5 seconds (the remaining time in seconds is indicated on the left display of the ISDU), and then back to NAV position.

  The present position must then be entered through the FMS or ISDU to complete the rapid re-alignment.

INITIALIZATION

- When the MSU selector is placed in NAV position, the MSU BAT OPER warning light illuminates for the first 5 seconds as the system performs tests.

- After this test period, the MSU ALIGN annunciator light illuminates. The crew can now initialize the IRS by entering the aircraft's present position in one of two ways :
  – Standard method : entry from the FMS CDU (see FMS chapter).
  – Alternate method : manual insertion from the ISDU.

- To manually enter the Present Position on the ISDU :
  – Select any IRS on the ISDU SYS selector (e.g.: IRS 1 - all other IRS will receive the coordinates simultaneously).
  – Select PPOS on the ISDU DSPL selector.
  – Enter latitude and longitude (it does not matter which data is entered first).
    - Latitude is entered by first pressing N or S. The ENT and CLR keys now illuminate green.

      Note : *If any other key than N, S, E or W is pressed first, the CLR key illuminates to indicate that an entry error has been made.*
    - Then enter the five digits corresponding to the latitude in degrees, minutes and tenths of minute (e.g. : 41° 37.6' would be entered as 41376). The latitude value is displayed on the left display.
    - Press ENT to load the data.
  – Longitude is entered similarly. First press E or W, and then the 6 digits (e.g. : 1° 22.9' would be entered as 001229). The longitude value will appear on the right display.
  – Press ENT to load the data.

- In ATT mode, a magnetic heading can be entered. With the DSPL selector in HDG/STS position, press the "H" key, then enter the four digits of the magnetic heading in degrees and tenths of a degree (e.g. : 032° would be entered on the ISDU keyboard as then 0320).

Note : – *Both AC and DC power must be available to fully align the IRS in NAV mode (DC for standby power check, then AC for normal operation).*
– *IRS 1, IRS 2, IRS 3 pushbutton switches located on the maintenance panel allow to test the three IRS.*

Mod : 4672

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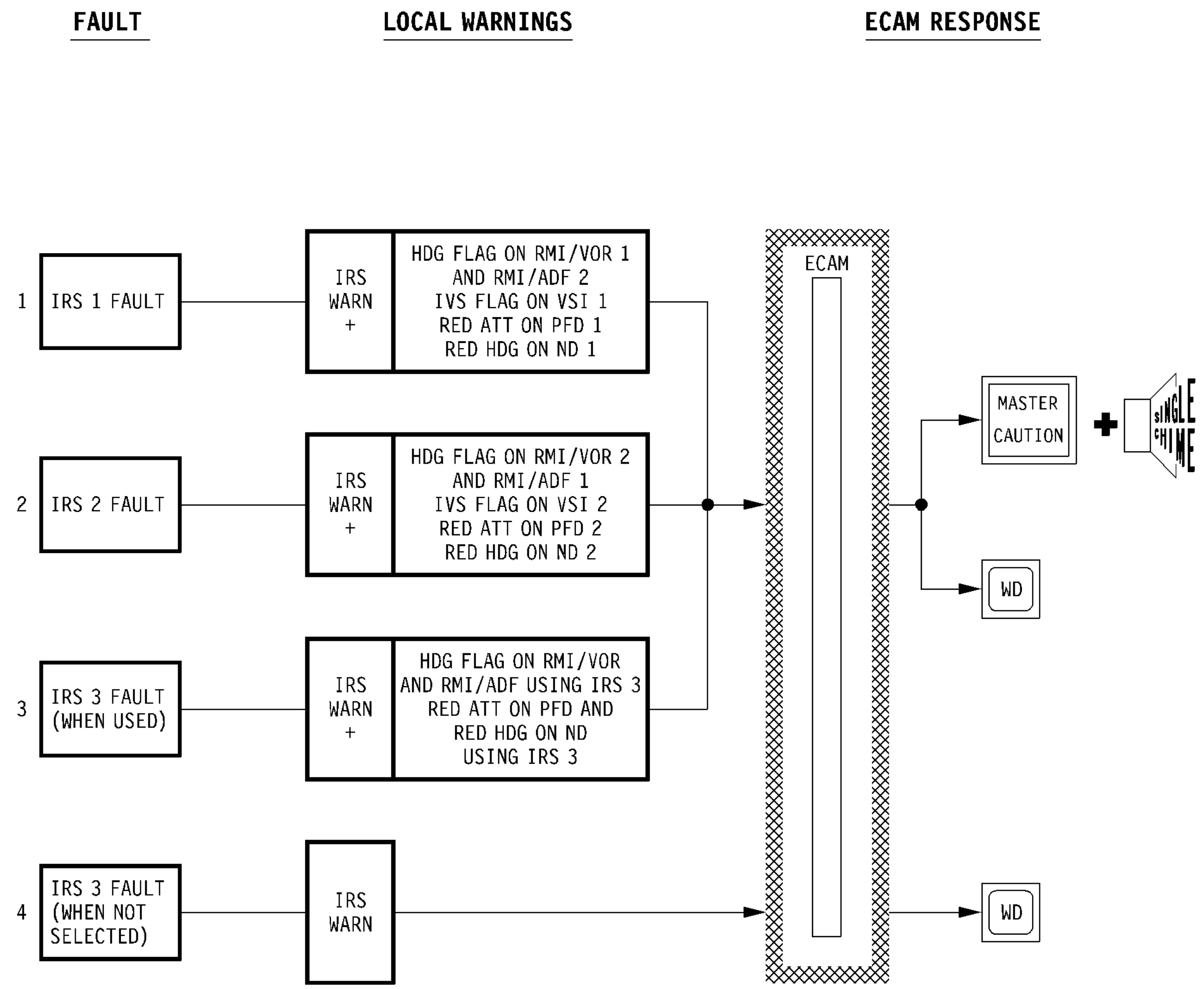
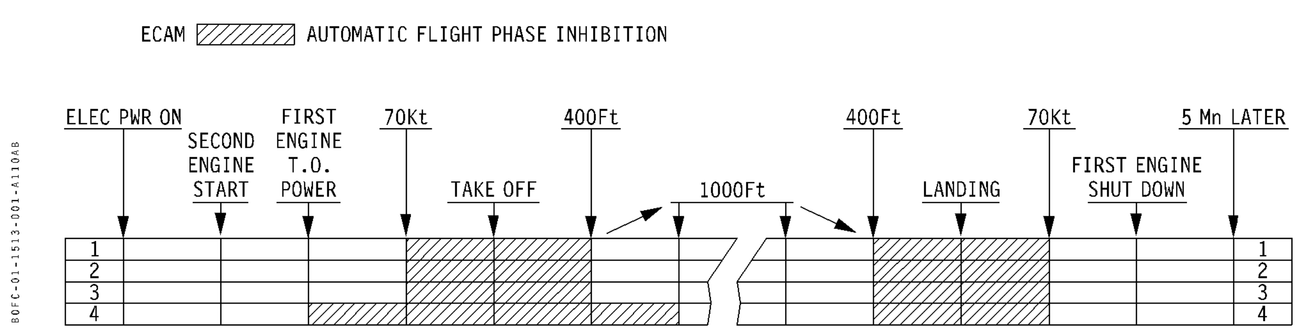

FAULT
LOCAL WARNINGS
ECAM RESPONSE
1 IRS 1 FAULT
IRS WARN +
HDG FLAG ON RMI/VOR 1 AND RMI/ADF 2 IVS FLAG ON VSI 1 RED ATT ON PFD 1 RED HDG ON ND 1
2 IRS 2 FAULT
IRS WARN +
HDG FLAG ON RMI/VOR 2 AND RMI/ADF 1 IVS FLAG ON VSI 2 RED ATT ON PFD 2 RED HDG ON ND 2
3 IRS 3 FAULT (WHEN USED)
IRS WARN +
HDG FLAG ON RMI/VOR AND RMI/ADF USING IRS 3 RED ATT ON PFD AND RED HDG ON ND USING IRS 3
4 IRS 3 FAULT (WHEN NOT SELECTED)
IRS WARN
ECAM
MASTER CAUTION
SINGLE CHIME
WD
WD


ECAM AUTOMATIC FLIGHT PHASE INHIBITION
ELEC PWR ON
SECOND ENGINE START
FIRST ENGINE T.O. POWER
70Kt
TAKE OFF
400Ft
1000Ft
400Ft
LANDING
70Kt
FIRST ENGINE SHUT DOWN
5 Mn LATER
1
2
3
4
B0FC-01-1513-001-A110AB

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GENERAL

- The Navigation Display (ND), normally presented on the lower EFIS Cathode Ray Tube (CRT), provides information related to both the lateral and vertical navigation.

- Several types of ND displays can be selected on the EFIS control panel : ROSE, ARC, MAP or PLAN.

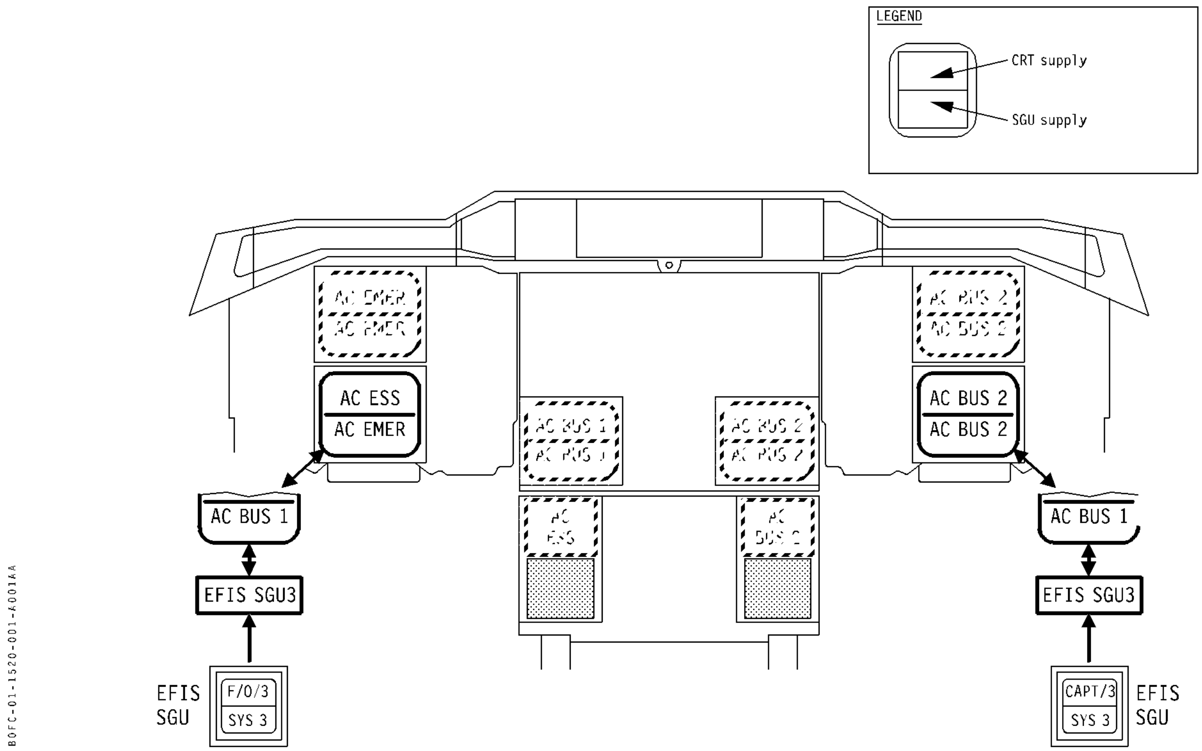
- If a system failure affects an information provided on the ND, this information is cleared from the display.

- In some cases, a red warning message is displayed on the ND to indicate the information being affected.

<u>Note</u> : – *When changing the ND mode, the message "MODE CHANGE" is displayed until the new mode is available.*

– *When changing ND range, the message "RANGE CHANGE" is displayed until the new range is available.*

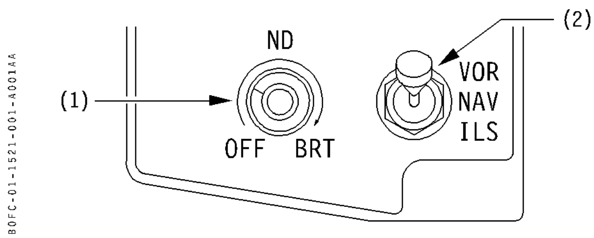
- The CAPT and F/O ND CRT's and SGU's are electrically supplied as illustrated hereafter :



DATA SOURCES AND INPUTS TO EFIS SGU's

Refer to 1.10.12 page 3.

EFIS SECONDARY CONTROL PANEL



(1) ND Brightness

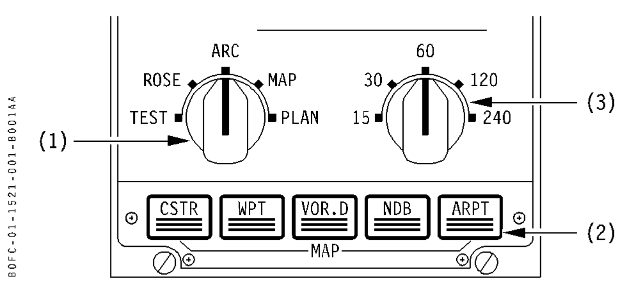
- The inner knob controls the brightness of the ND (lower CRT).
- The ND is turned off when this knob is set to OFF.
- The outer knob controls the brightness of the radar image on the ND (in MAP and ARC modes only).

(2) VOR/NAV/ILS Switch

- If the ND is in ROSE or ARC modes, the switch selects whether the VOR or ILS course and deviation are displayed.
- In NAV or ILS position, the VOR is autotuned by the FMS for VOR/DME position updating.

Note : *NAV should only be selected when MAP or PLAN modes are displayed. In ROSE or ARC modes, VOR or ILS should be selected.*

EFIS PRIMARY CONTROL PANEL



(1) Mode Selector

- The selector is used to set the ND display to TEST, ROSE, ARC, MAP or PLAN mode.

Note : *Placing the EFIS mode selector in TEST simulates an attitude difference greater than 4° , resulting in the activation and display of a "CHK ATT" message on the PFD.*

(2) Display Options (in MAP or PLAN mode only)

- When in ND MAP or PLAN display modes, the following FMS information can be viewed on the ND by pressing one of the five pushbutton switches:
  - CSTR (Constraints),
  - WPT (Waypoints),
  - VOR.D (VOR/DME),
  - NDB (Non Directional Beacons),
  - ARPT (Airports).
- Pressing any of these pushbutton switches displays the indicated navigational information on the ND, illuminates the associated pushbutton switch light and cancels any of the other four options which may have been previous selected.

  A second push cancels the option and extinguishes the pushbutton switch light.
- If any of the five options is being displayed in MAP or PLAN, and then ROSE or ARC mode is selected, the option remains selected, but will not be displayed until MAP or PLAN mode is selected again.

(3) Range Selector

- In ARC, MAP or PLAN mode the crew can select any of five ND viewing ranges: 15, 30, 60, 120 or 240 nm.

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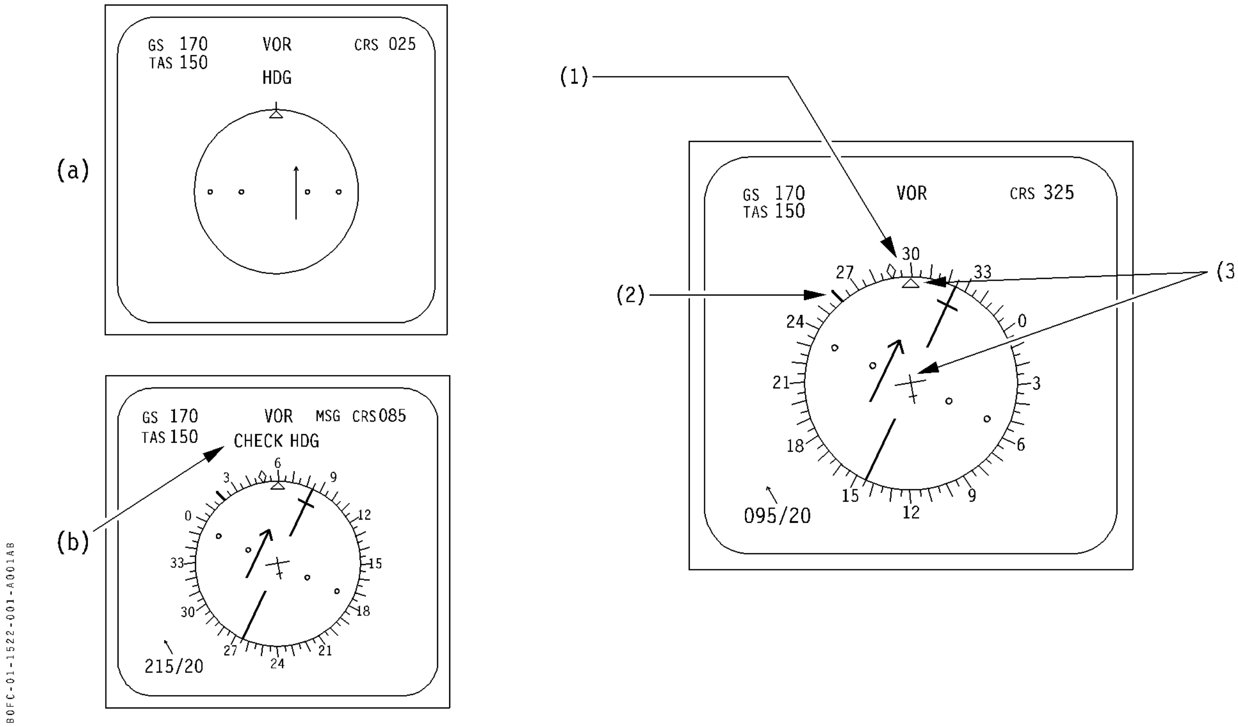
ROSE MODE



- ROSE mode presents an HSI-like display on the ND, that is to say a magnetic heading compass rose with a selected VOR or ILS course line and a Course Deviation Indicator (CDI) .

- ROSE mode is used to display VOR, ILS and NDB information (raw navaid data).

- Additional information such as magnetic track, True Airspeed (TAS), Ground Speed (GS) and wind information is also presented.

(1) Aircraft Heading

- The aircraft's magnetic heading is indicated by reading the position of the yellow triangular lubber line against the white compass rose (graduated in 5° increments).

- If IRS heading information is lost, the compass rose is cleared from display and a red "HDG" message is displayed at the top of the ND - item (a).

- If a difference greater than 4° is detected between the Captain and F/O's heading sources, a red "CHECK HDG" message is displayed on both ND item (b).

(2) Selected Heading

- The heading selected on the Flight Control Unit HDG SEL window is indicated on the heading scale with a blue index line.

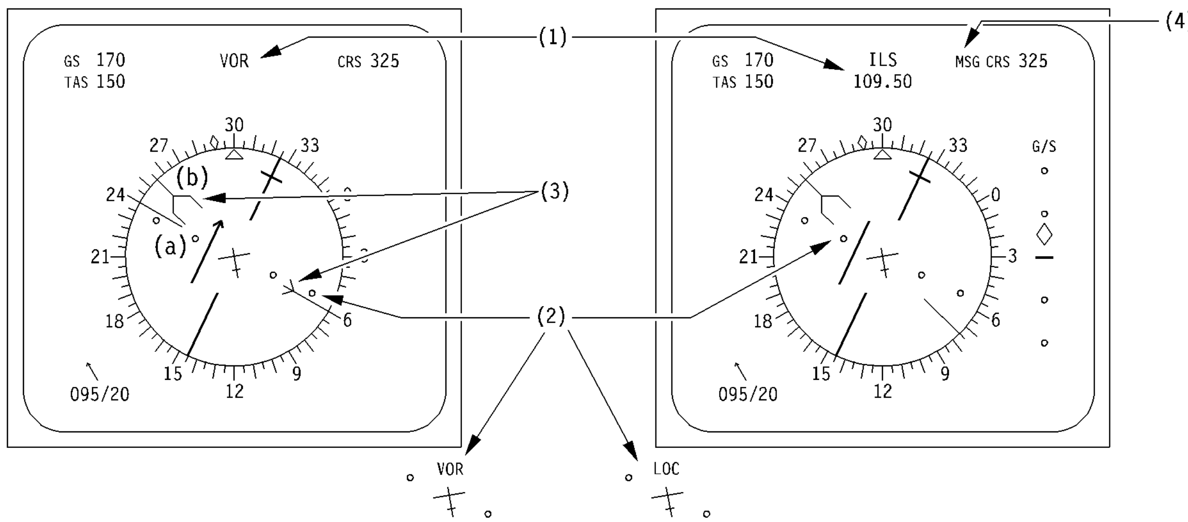
(3) Magnetic Track

- The orientation of the yellow aircraft symbol indicates the magnetic track computed by the IRS.

- If IRS track information is not available, the yellow aircraft symbol is replaced by a yellow circle.

- The magnetic track is also indicated by a green diamond-shape symbol on the compass rose (only with EFIS SGU standard E13 or subsequent).

ROSE MODE (continued)



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(1) ILS or VOR mode

- If the VOR/NAV/ILS selector is in the VOR position, "VOR" is displayed in blue.

  If ILS is selected, "ILS" is displayed in blue.

  The ILS frequency is also displayed in blue (only with EFIS SGU standard E13 or subsequent).

- When NAV is selected, no information is displayed.

(2) Lateral Deviation Scale and CDI

- This white scale is marked with **two dots** on each side of the selected course centerline.

- The deviation from the selected course is indicated by the displacement of the CDI. CDI display depends on the position of the VOR/NAV/ILS switch :
  - **VOR** : the CDI is blue and features an arrow-head (TO-FROM indication). Each dot represents a 5° deviation from selected course.
  - **ILS** : the CDI is magenta. In case of excessive deviation from the localizer (**two dots**), both the CDI and the scale flash.
  - **NAV** : the selected course and CDI are not displayed.

- The maximum displacement of the CDI is two dots. Beyond this point the CDI remains against the second dot.

- The CDI is not displayed until a VOR or ILS signal is received.

- If the LOC or VOR receiver fails, the CDI is cleared from the display and a red "LOC" (or "VOR") message is displayed in the center of the compass rose.

(3) ADF Bearing Information

- When receiving ADF bearing information, this information is presented on the ND as follows :
  - A thin magenta pointer indicates the bearing to the ADF station selected on ADF1 control panel via the transfer (TFR) switch - item (a). R
  - A wide green pointer indicates the bearing to the ADF station selected on ADF2 control panel via the transfer (TFR) switch - item (b). R

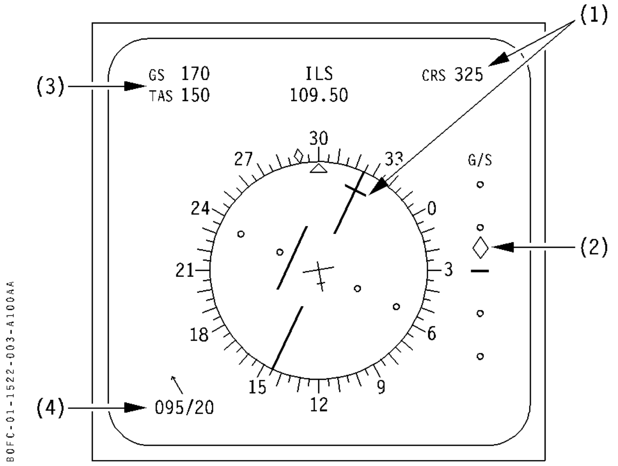
- If ADF 1 or 2 receivers fail, or if ADF information is lost, the corresponding pointer is cleared. R

(4) FMS Messages

- Whenever a message is displayed in the FMS CDU scratchpad, an amber MSG attention – getter is displayed.

Mod : 2962

ROSE MODE (continued)

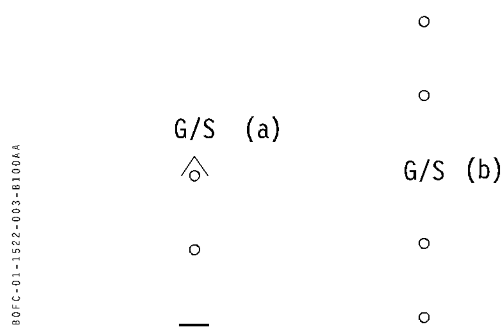


(1) Selected VOR or ILS Course

- The course information displayed on the ND depends on the position of the VOR/NAV/ILS switch :
  - VOR :
    - the course set on the VOR control panel and the CDI are both displayed in blue,
    - the TO/FROM indication is provided by the arrow at the end of the CDI.
  - ILS :
    - the localizer course set on the ILS control panel is displayed in blue,
    - the CDI is displayed in magenta (pink),
    - the frequency set on the ILS control panel is displayed above the compass rose.
  - NAV :
    - the selected course line, the CDI and the digital selected course information are cleared from the ND.

(2) G/S Vertical Deviation Scale and Index

- The vertical deviation scale and index diamond are displayed only in ILS mode.
- This scale indicates glide slope deviation.
- In case of excessive deviation from the glide slope (one dot), both the diamond index and the scale flash.
- The diamond index is not displayed until an ILS signal is received.



- Item (a) – When more than two dots from the glide slope, the diamond index remains against the second dot (and only an half of the diamond shaped index is displayed).
- Item (b) – If the glide slope receiver fails, the diamond index is cleared and a red "G/S" flag is displayed in the center of the scale.

(3) Ground Speed and True Airspeed

- Ground Speed (GS) and True Airspeed (TAS) are displayed in green in the upper left hand corner.
- If this data is not available, the digital value is replaced by dashed lines.

(4) Wind

- The FMS-computed wind direction and velocity is displayed in green in the lower left corner. R
- The digits indicate the true wind direction and speed.
- The pointer indicates the true wind direction. R
- In case of FMC failure the digits and pointer are cleared from the display.

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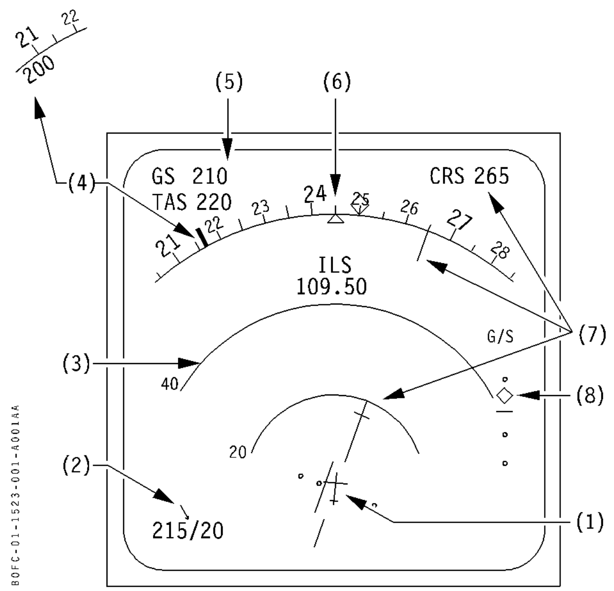
ARC MODE



- ARC mode displays selected VOR or ILS course information (raw navaid data) with a heading scale (± 40° from the present aircraft heading).
- Weather radar information is available in ARC mode.
- Additional information such as magnetic track, TAS, GS and wind information is also presented.

Note : ADF information cannot be displayed in ARC mode.

(1) Magnetic Track

- Same as ROSE mode.

(2) Wind

- Same as ROSE mode.

(3) Range Arcs

- Using the range selector on the EFIS primary control panel, the crew can select any of five maximum viewing ranges : 15, 30, 60, 120 or 240 nm.
- The three arcs display 1/3 of, 2/3 of and the full maximum range selected (for example, if the EFIS range selector is set at 60 nm range, the first arc is 20 nm from the aircraft, the second arc is at 40 nm, and the third arc-heading scale-indicates 60 nm).

(4) Selected Heading Index

- Same as ROSE mode, except that when the selected heading is off the scale (more than 40° from the aircraft heading) the selected heading is displayed as a digital number on the corresponding side of the scale.

(5) Ground Speed and True Airspeed

- Same as ROSE mode.

(6) Heading Scale

- Same as ROSE mode, except that the digital heading values are enlarged every 30° .

(7) Selected Course / Course Line / CDI

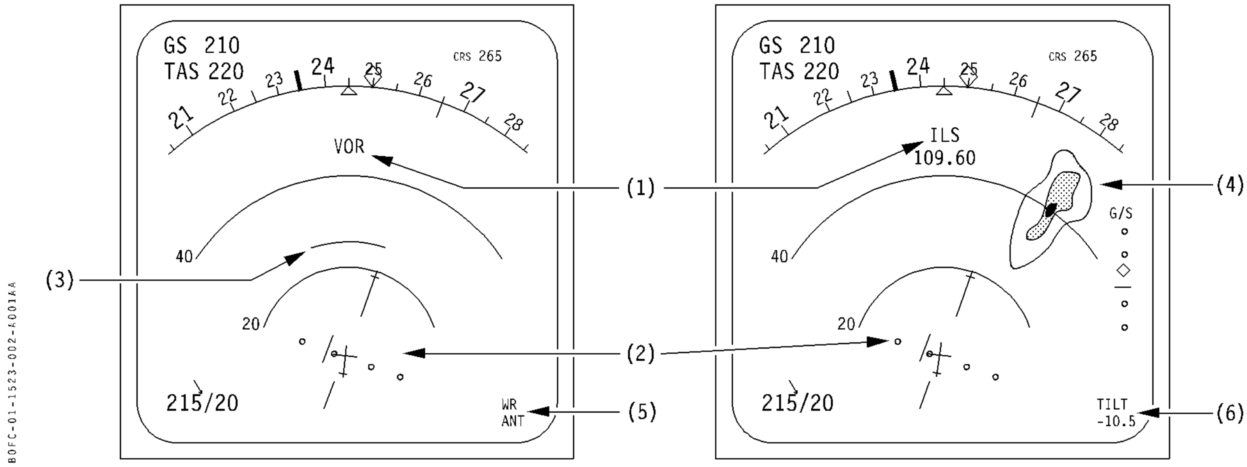
- Same as ROSE mode.

(8) G/S Vertical Deviation Scale and Index

- Same as ROSE mode.

STD or Mod : 11702

ARC MODE (continued)



(1) ILS or VOR Mode

- Same as ROSE mode.

(2) Lateral Deviation Scale and CDI

- Same as ROSE mode.

(3) Altitude Intercept Arc

- This small yellow arc indicates the point where the aircraft will reach the altitude selected on the Flight Control Unit if the present flight path is maintained.

Note : This arc is cleared when the aircraft is within 500 ft of the selected altitude.

(4) Weather Radar Returns

- If the radar is operating, and the ND radar brightness knob on the EFIS secondary control panel is correctly adjusted, radar returns are displayed on the ND.

  The radar image is displayed in accordance with the range selected for the arcs display.

- The radar echoes are displayed in different colors depending on the intensity of the precipitation.

(5) Radar Failure Messages

- Weather Radar failure messages are displayed in the lower right corner of the ND.

- Radar failures that cause the loss of the radar image are displayed in red.

- Radar failures that do not cause loss of the radar image are displayed in amber.

- When TEST is selected on the radar control panel, a test pattern is displayed and the amber message "WR TEST" is displayed.

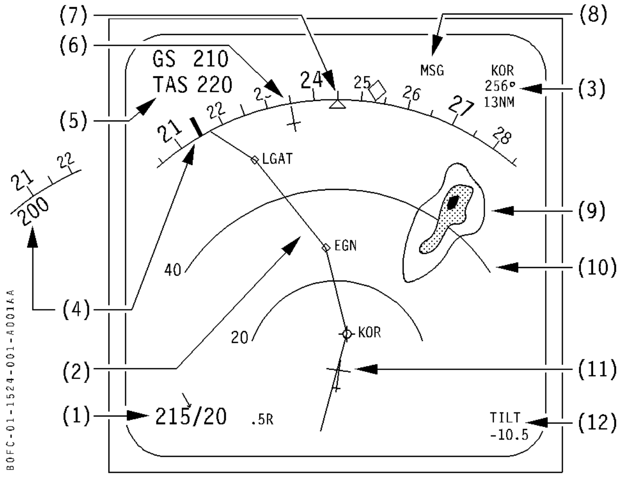
(6) TILT Value

- The tilt value set on the radar control panel is displayed in blue in the lower right part of the ND (+ is up, - is down, displayed in 0.5° intervals).

- If a radar failure is detected, the TILT information display is replaced by the applicable failure message.

Note : For more information, see WEATHER RADAR in this chapter.

MAP MODE



- MAP mode is similar to the ARC mode but illustrates the aircraft position relative to the FMS flight plan.
- Weather radar information is available in MAP mode.
- Additional information such as magnetic track, TAS, GS, and wind information is also presented.

Note : *Raw VOR, ADF, and ILS navaid data information can not be displayed in MAP mode.*

(1) Wind

- Same as ROSE and ARC modes.

(2) Flight Plan

- The FMS flight plan route ahead of the aircraft is displayed on the ND, and moves as the aircraft progresses along.
- The flight plan is displayed in accordance with the range selected for the arcs display.

(3) Next Waypoint

- The name of the next waypoint, and its bearing and distance are displayed in green in the upper right corner of the ND.

(4) Selected Heading

- Same as ARC mode.

(5) Ground Speed and True Airspeed

- Same as ROSE and ARC modes.

(6) ILS Course

- When the VOR/NAV/ILS switch is in ILS position, a blue index line is displayed on the heading scale, to recall the selected ILS course.
- When the ILS course is beyond the displayed heading range, this index line is not displayed.

(7) Heading Scale and Selected Heading Index Line

- Same as ARC mode.

(8) FMS Messages

- Same as ROSE mode.

(9) Weather Radar Returns

- Same as ARC mode.

(10) Range Arcs

- Same as ARC mode.

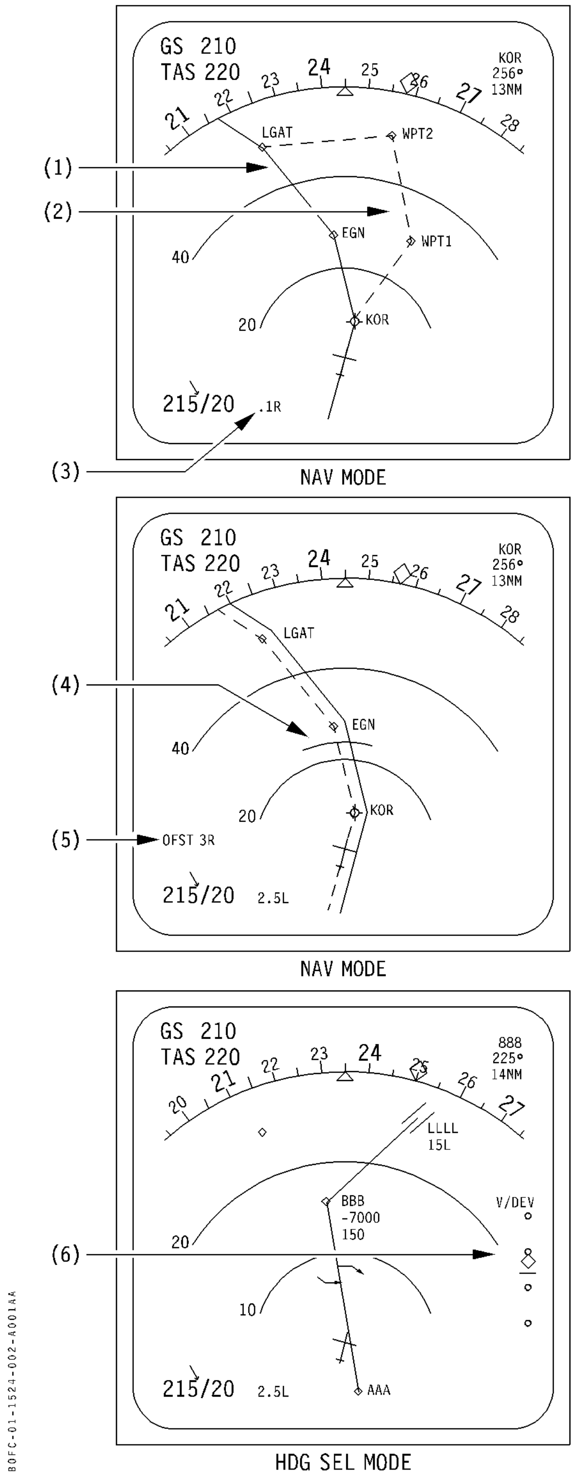
(11) Magnetic Track and Aircraft Symbol

- Same as ROSE and ARC modes.

(12) Tilt or Radar Failure Messages

- Same as ARC mode.

MAP MODE (continued)



(1) Active Flight Plan

- The active route being flown by the aircraft is displayed as a solid white line.

(2) Secondary Flight Plan

- The secondary flight plan is displayed in yellow dashes only if one of the pages associated to the SEC F-PLN function is displayed on the onside FMS CDU.

(3) Lateral Course Deviation

- The number of nm right (R) or left (L) of the flight plan course is displayed.

(4) Yellow Altitude Intercept Arc

- Same as ARC mode, but it is not displayed when PROFILE mode is engaged.

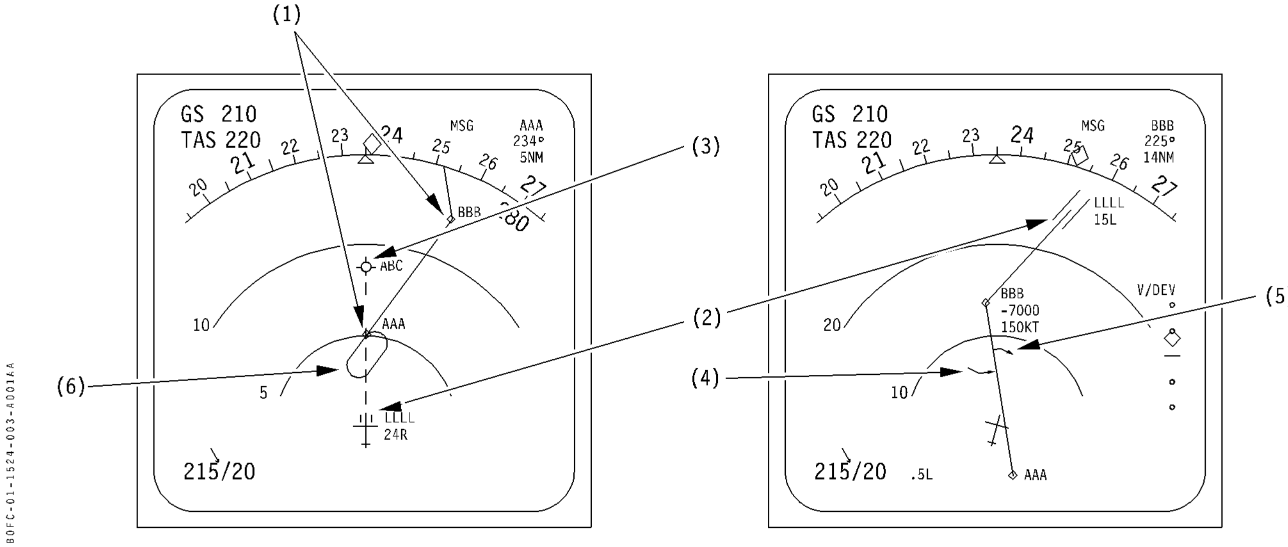
(5) Offset Course

- When a parallel offset course is selected on the FMS CDU, the offset course becomes the active flight plan (solid white line). The original flight plan is displayed as a white dashed line.
- The offset value is displayed as "OFST XX R" (or L) where XX is the offset distance in nm, and L or R indicates whether the offset is left or right of the original flight plan course.

(6) Vertical Deviation (V/DEV)

- Indicates deviation from the FMS-computed glide path (only for non-precision approaches when a MDA has been set in the FMS).
- Each dot represents 200 ft deviation.

MAP MODE (continued)



(1) FMS Flight Plan Waypoints

- Waypoints on the FMS flight plan route are displayed as diamond-shaped symbols together with the waypoint identifiers.
- The next waypoint is green, all others are white.

(2) Departure and Destination Airports

- Departure and destination airports are automatically displayed when within the display range.
- The display depends on the range selected and on the runway indication (refer to page 6).
- When the runway is indicated, the four letter ICAO airport identifier and the two digit runway identifier are displayed.

Note : *With a scale of 15 or 30 nm, if an FMS flight plan discontinuity exists between the flight plan and the runway, a 14 nm extended on-track line is displayed as a white dashed line to assist manual interception of the final approach course.*

(3) Tuned Navaid

- VOR/DME stations auto-tuned by the FMS, and displayed on the VOR RMI, are displayed in blue.

(4) Altitude Intercept Point

- In PROFILE mode, the point on the flight plan where the altitude (or FL) selected on the Flight Control Unit will be reached is indicated as a blue arrow symbol.

Note : *This symbol is cleared when the aircraft is within 100 ft of the selected altitude.*

(5) Top of Descent (T/D)

- The point where idle power descent from cruise altitude should be started is displayed as a white arrow shaped symbol.
- If an intermediate step down altitude (or FL) has been selected, the point at which the step down altitude (or FL) must be left to continue an idle descent is displayed with the same symbol, but in blue.

(6) Holding Patterns and Procedure Turns Symbols

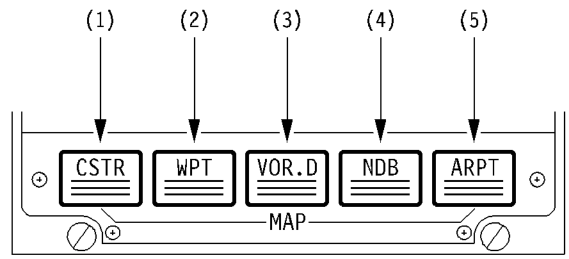
- Holding patterns and procedure turns symbols are displayed only if they are on the active flight plan.
- The display depends on the range selected (see page 6).

Optional Map Symbols

- The flight crew can display additional information on the MAP display with the five pushbutton switches on the bottom of the primary EFIS control panel (CSTR, WPT, VOR.D, NDB, ARPT).

- Only one of the five pushbutton switches can be selected at a time.

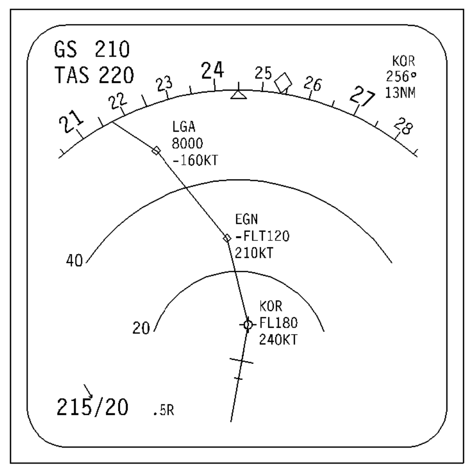
- The selected information is displayed in magenta on the ND.



(1) CSTR (Constraints) Pushbutton Switch

- Any altitude, speed or time constraints stored in the FMS database for active flight plan waypoints are displayed next to the concerned waypoints.

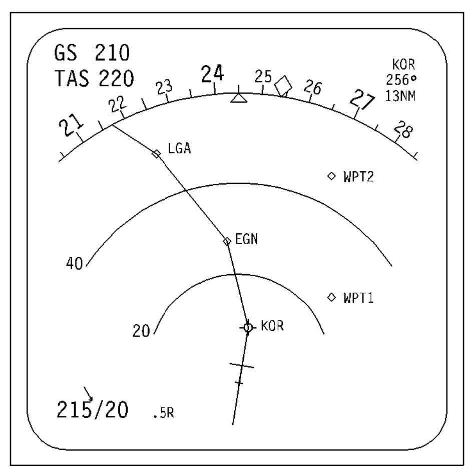
- Examples :
  - KOR waypoint : the aircraft must be at FL 180 and at 240 kt.
  - EGN waypoint : the aircraft must be at FL 120 or below and at 210 kt.
  - LGA waypoint : the aircraft must be at 8000 ft and at 160 kt or less.



CSTR SELECTED

(2) WPT (Waypoints) Pushbutton Switch

- Displays all waypoints within the selected ND range which are not in the active flight plan.



WPT SELECTED

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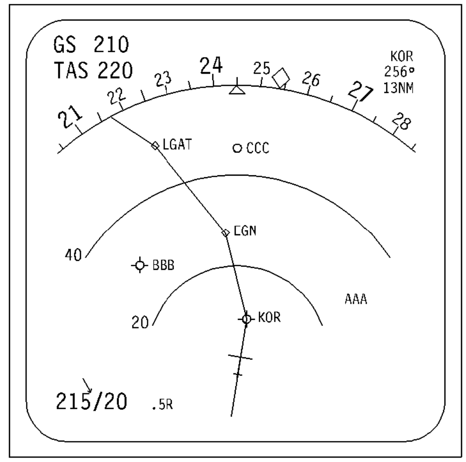
Optional Map Symbols (continued)

(3) VOR.D Pushbutton Switch

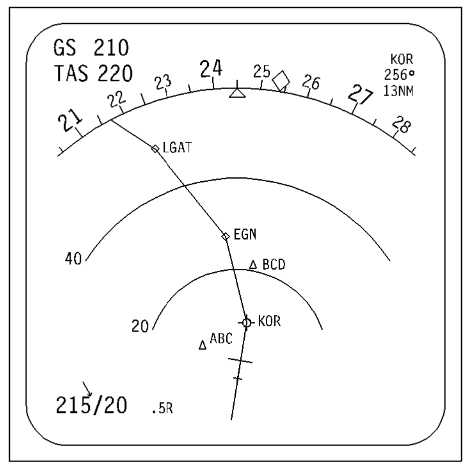
- VOR, DME or VOR/DME which are within the selected range (but not presented on the RMI) are displayed.



VOR.D SELECTED

(4) NDB Pushbutton Switch

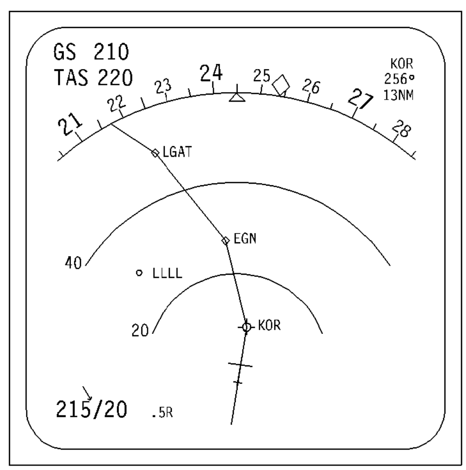
- NDB which are within the selected range are displayed.



NDB SELECTED

(5) ARPT Pushbutton Switch

- Airports which are not in the active flight plan, but are within the selected range, are displayed.



ARPT SELECTED

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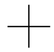
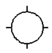
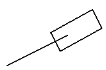
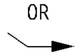
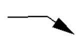
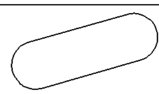
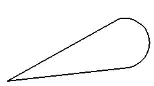
Map Display Symbols

ITEM	SYMBOLS	RANGE SELECTED	COLOR
WAYPOINT	 ABC	ALL	WHITE OR GREEN IF TO WAYPOINT
VOR DME VOR/DME	 BCD  CDE  DEF	ALL	MAGENTA OR BLUE WHEN TUNED MAGENTA OR BLUE WHEN TUNED MAGENTA OR BLUE WHEN TUNED
NDB	 EFG	ALL	MAGENTA
AIRPORTS	 LSGG	ALL	MAGENTA OR WHITE FOR ORIGIN AND DESTINATION
	 LSGG 33R	60,120 OR 240 NM	MAGENTA OR WHITE FOR ORIGIN AND DESTINATION
	 LSGG 33R	15 OR 30 NM	MAGENTA OR WHITE FOR ORIGIN AND DESTINATION
ALTITUDE INTERCEPT POINT TOP OF DESCENT	 OR  	ALL	BLUE WHITE
HOLDING PATTERN	RIGHT  OR  LEFT	60,120 OR 240 NM	WHITE
		15 OR 30 NM	WHITE OR BLUE OR AMBER
PROCEDURE TURN	RIGHT  OR  LEFT	60,120 OR 240 NM	WHITE
		15 OR 30 NM	WHITE OR BLUE OR AMBER

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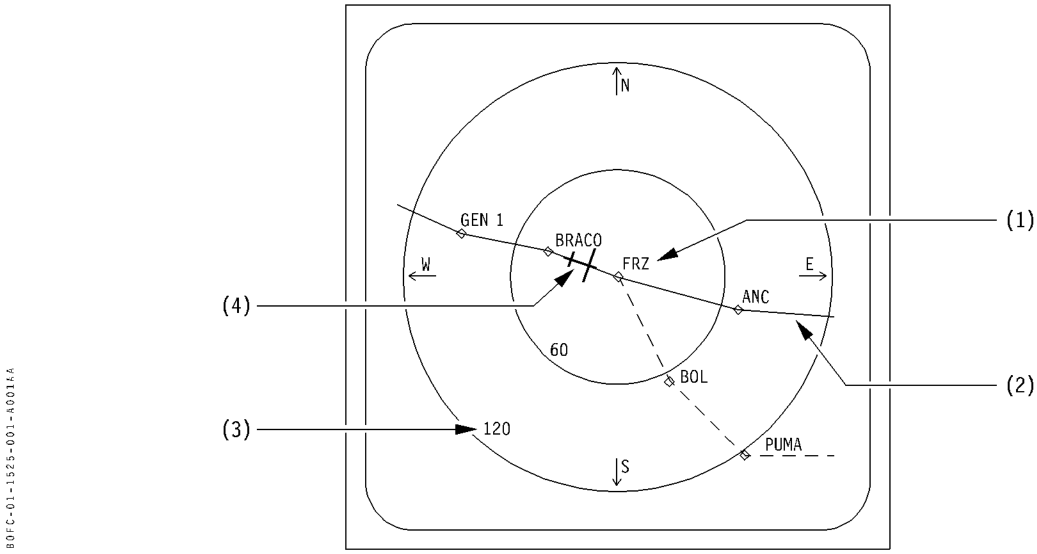
PLAN MODE



- PLAN mode is primarily used to review the FMS flight plan, and to view changes being made to the flight plan.
- PLAN mode is not intended for use as a primary inflight navigation reference.
- PLAN mode displays the aircraft position on the FMS flight plan course on a display which is always oriented so that North is up.
- The following information is not available in PLAN mode :
  – Weather radar, magnetic track, TAS, GS, wind information and BRG/DIST to next WPT.
  – VOR, ADF, and ILS navaid data information.
- In case of failure of the associated FMS, the message ”PLAN NOT AVAIL” is displayed and the flight plan is erased.

(1) Reference Waypoint

- When scrolling the FMS F-PLN for review, the point in the center of the PLAN display is always the second waypoint indicated on the FMS F-PLN page (TO WPT).

(2) Flight Plan

- Same as in MAP mode, except that the flight plan is presented in a ”North up” orientation.
- Symbols are the same as in MAP mode.

(3) Range Scale and Rings

- Same as ARC or MAP mode except that the range selected is the diameter of the PLAN circle.

  For example, if 240 nm range is selected, the distance from the center of the display to the outer ring is 120 nm, and the inner ring range is 60 nm (total diameter of the PLAN circle is 240 nm).

(4) True Track and Aircraft Position

- The yellow aircraft symbol points at the aircraft’s true track, and indicates the position of the aircraft relative to the FMS flight plan course.
- If the IRS track information is lost, the yellow aircraft symbol is replaced by a yellow circle.

STD or Mod : 11702

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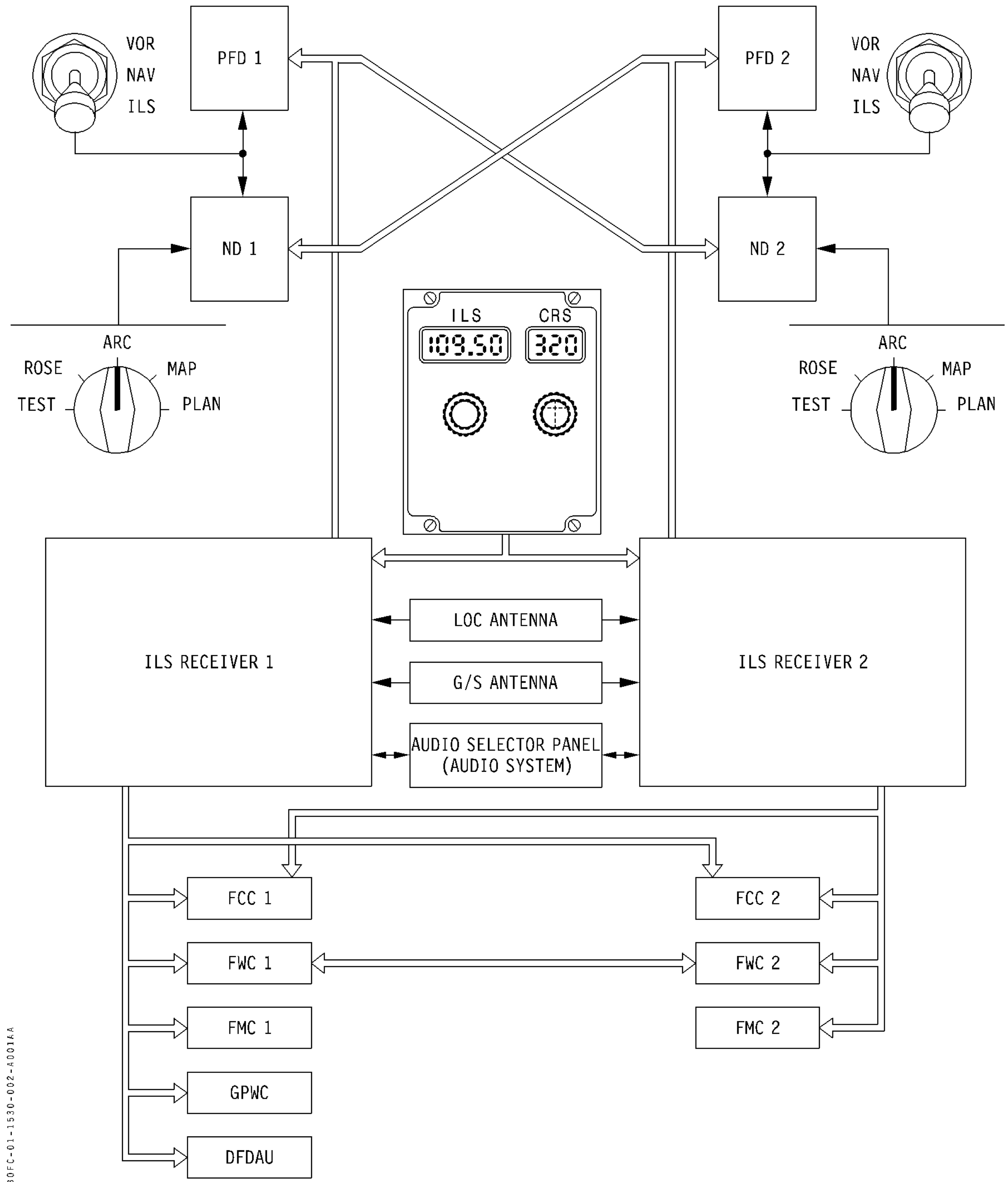
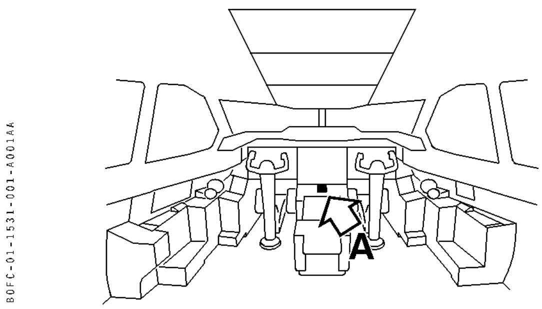
GENERAL

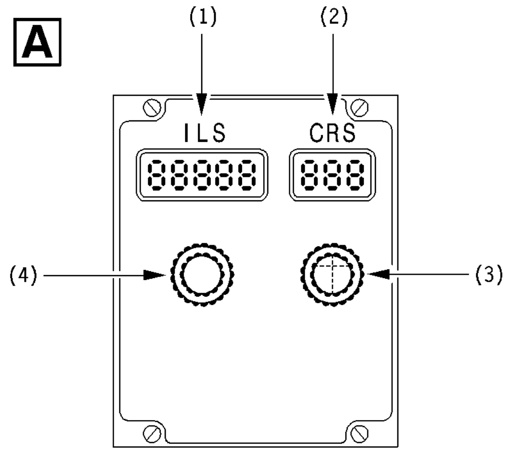
- The Instrument Landing System (ILS) provides guidance for the capture and tracking of the ILS glide slope (G/S) and localizer (LOC) beams.
- Two ILS receivers are installed. Both receivers are controlled by a single ILS control panel on the center pedestal.
- Both receivers use one localizer antenna in the radome and one glide slope antenna under the flight compartment (refer to chapter 1.01.).
- The ILS is tuned by setting the LOC frequency and CRS on the ILS control panel.

  Setting the LOC frequency automatically tune the paired G/S frequency.
- Glide slope and localizer deviations are displayed on the PFD and ND :
  - With the captain's VOR/NAV/ILS switch in ILS position, the captain's PFD displays information from ILS 1 receiver and captain's ND displays information from ILS 2 receiver.
  - Similarly, with the first officer's VOR/NAV/ILS switch in ILS position, the first officer's PFD displays information from ILS 2 receiver and R first officer's ND displays information from ILS 1 receiver.
- ILS failure indications are displayed on the PFD and ND :
  - If the localizer and/or glide slope receiver(s) fail, a red "LOC" and/or "G/S" warning is displayed on the localizer and/or glide slope deviation scale when the associated VOR/NAV/ILS switch is in ILS position.
- If both ILS receivers fail when LAND mode is armed or engaged, the AP/FD reverts to basic V/S and HDG modes.
- ILS audio signals can be monitored by selecting the ILS reception knob on the audio selector panels.
- ILS 1 is supplied by the AC EMER BUS, and ILS 2 is supplied by the AC BUS 2.
- The ILS receivers can be tested with the ILS 1 and 2 TEST pushbutton switches on the lateral maintenance panel.


VOR
NAV
ILS
PFD 1
PFD 2
ND 1
ND 2
ARC
ROSE
MAP
TEST
PLAN
ILS
CRS
109.50
320
ILS RECEIVER 1
ILS RECEIVER 2
LOC ANTENNA
G/S ANTENNA
AUDIO SELECTOR PANEL
(AUDIO SYSTEM)
FCC 1
FCC 2
FWC 1
FWC 2
FMC 1
FMC 2
GPWC
DFDAU
B0FC-01-1530-002-A001AA

ILS CONTROL PANEL





(1) ILS Frequency Display

- Displays the selected ILS frequency (from 108.10 to 111.95 MHz).

(2) Localizer Course Display

- Displays selected runway course (from 0° to 359°).

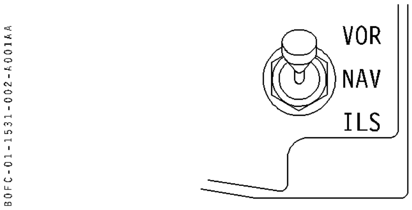
(3) Localizer Course Selector Knob

- This knob is used to set the desired ILS localizer course.
- The selected course is displayed on the ND in ROSE, ARC, or MAP modes, when the VOR/NAV/ILS switch is in ILS position.

(4) ILS Frequency Selector Knob

- This knob is used to set the desired ILS frequency (localizer frequency).
- The outer knob sets the whole units of MHz, and the inner knob is used to set the hundredths of MHz in 0.05 MHz increments.
- Below 700 ft with at least one AP engaged, tuning of the ILS receiver is inhibited, even if the control panel setting is changed.

VOR/NAV/ILS SWITCH

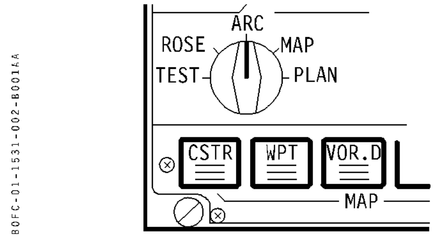


- The VOR/NAV/ILS switches are located on each pilot's secondary EFIS control panel.
- ILS position must be selected to display ILS information on the PFD and ND.

  G/S and LOC scales and deviation index are displayed as follows :

	ND ROSE or ARC modes	PFD
G/S scale	Displayed if switch in ILS position	Always displayed (vertical deviation scale)
LOC scale	Displayed if switch in ILS position	Displayed if switch in ILS position
G/S deviation index	Displayed if switch in ILS position and ILS signal received	Displayed if switch in ILS position and ILS signal received
LOC deviation index	CDI displayed if switch in ILS position and ILS signal received	Displayed if switch in ILS position and ILS signal received

ND MODE SELECTOR

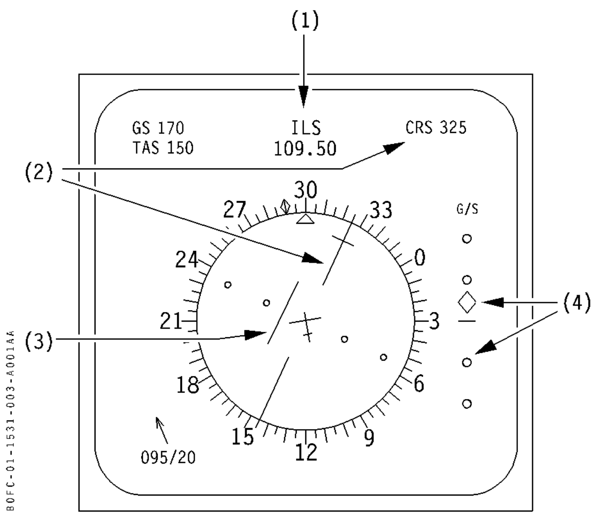


- These selectors are located on each pilot's EFIS control panel.
- To display ILS information on the associated ND :
  - ROSE or ARC must be selected, and
  - the associated VOR/NAV/ILS switch must be in ILS position.
- In MAP mode, the localizer course is displayed on the ND heading scale.

<u>Note</u> : *See ROSE, ARC and MAP mode descriptions in this chapter for more information.*

ND ILS INDICATIONS

ROSE MODE



(1) ILS Mode

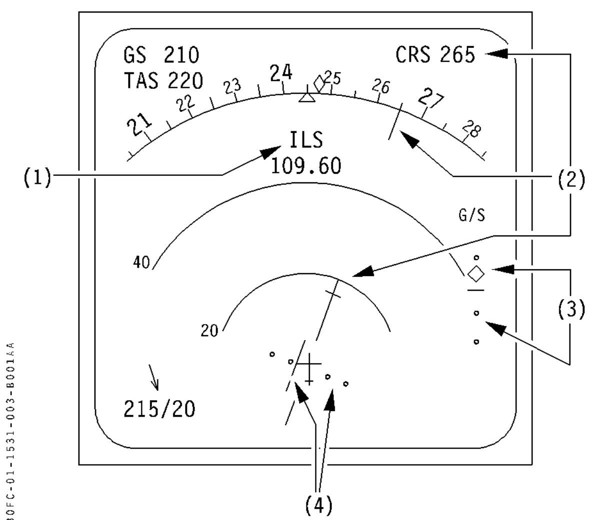
(2) Selected ILS Course

(3) LOC CDI and Scale

(4) G/S Deviation Index and Scale

Note : For detailed description, refer to section 1.15.22 - ROSE MODE.

ARC MODE



(1) ILS Mode

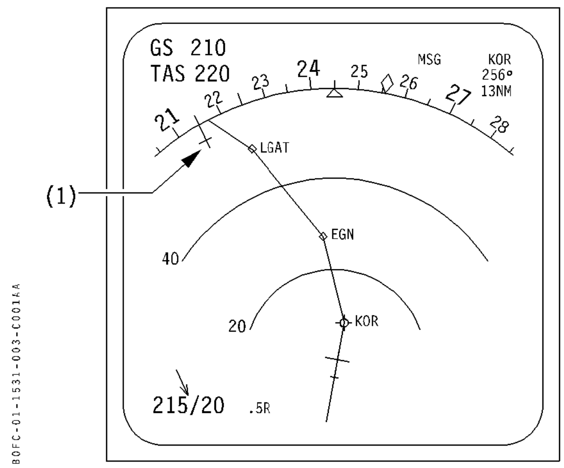
(2) Selected ILS Course

(3) G/S Deviation Index Scale

(4) LOC CDI and Scale

Note : For detailed description, refer to section 1.15.23 - ARC MODE.

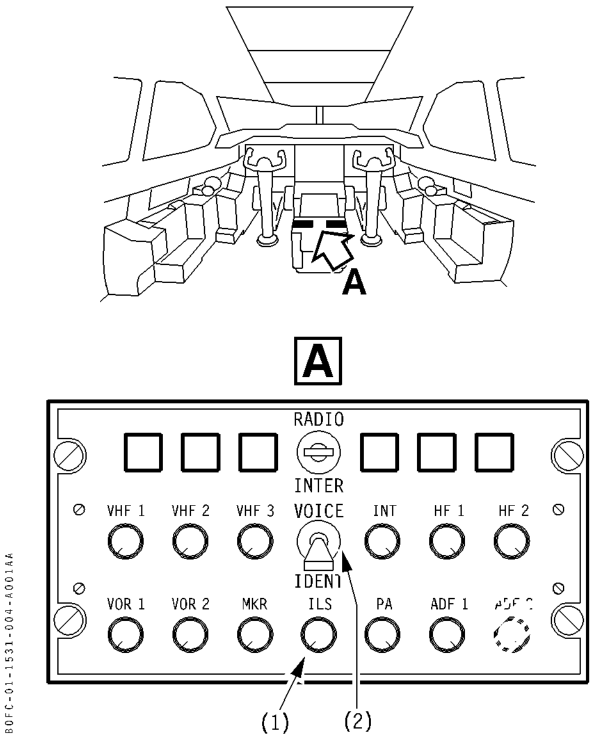
MAP MODE



(1) Selected Course

Note : For detailed description, refer to section 1.15.24 - MAP MODE.

ILS AUDIO SELECTION



(1) ILS Ident Reception Knob

- On each audio selector panel, an ILS pushbutton switch is provided for reception of audio signals through the ILS receivers.

■ **Pressed then released**

– The pushbutton switch illuminates white.

■ **Rotate**

– The rotation of the pushbutton switch adjusts the audio volume.

■ **Pressed again**

– The pushbutton switch remains in.

The light extinguishes.

(2) VOICE/IDENT Switch

■ **VOICE**

– Only voice is received and Morse code is filtered out.

■ **IDENT**

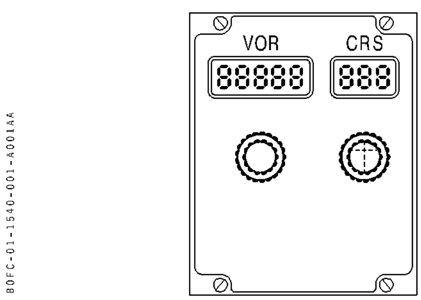
– Both Morse code and voice are audible. R

GENERAL

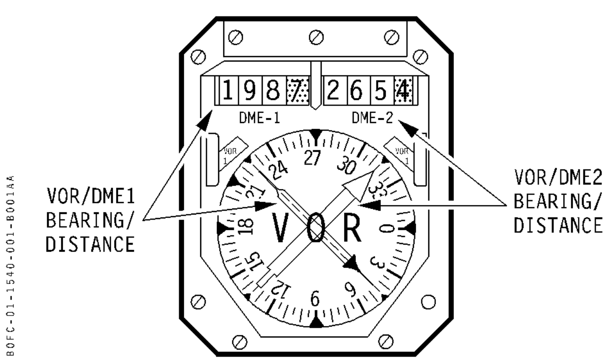
- Two VOR/DME systems and one Marker Beacon system are installed on the aircraft.
- The two VOR share one common antenna,located at the top of the fin.
- Each DME and MARKER beacon receivers have their own individual antennas, located aft of the nose landing gear.
- The VOR/DME are automatically powered when their supplying electrical buses are powered.
- Audio signals for identification of a VOR or DME station, or marker beacon, can be heard by selecting the VOR/DME or MKR pushbutton switches on the audio selector panels.

VOR

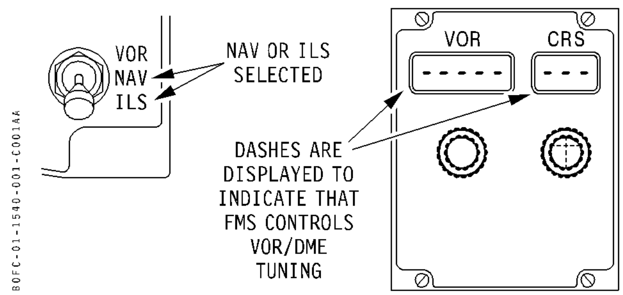
- Each VOR receiver has a VOR/DME control panel located at the front of the center pedestal.



- VOR 1 and 2 raw data are displayed on both the Captain and first officer's VOR/DME RMI.



- VOR information can also be displayed on the ND in ROSE or ARC modes.
  – Normally VOR 1 supplies the Captain's ND and VOR 2 supplies the first officer's ND.
- If the VOR/NAV/ILS switch on the secondary EFIS control panel is in the NAV or ILS position, the associated VOR/DME can be :
  – Autotuned by the associated FMS. Dashes are displayed on the related VOR control panel. The VOR control panel cannot be used to make VOR/DME frequency selections.

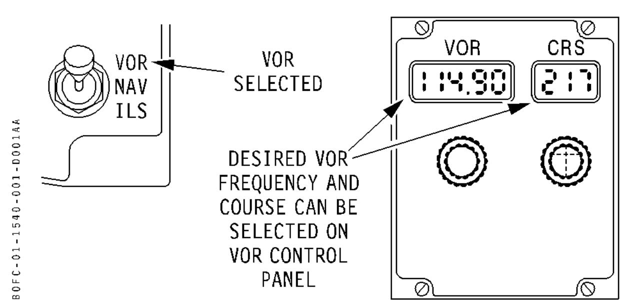


  – Remotely tuned by selecting the VOR/DME frequency on the FMS PROGRESS page. R

  <u>Note</u> : *When a VOR/DME is manually tuned on the FMS PROG page or if the VOR/NAV/ILS switch is left in the VOR position, the FMS uses the manually tuned VOR-DME for position update as long as possible.*

  If auto-tuning is not reselected on the PROG page or if the VOR/NAV/ILS switch is not repositioned to NAV, downgrading of the FMS navigation accurracy will occur.

- If the VOR/NAV/ILS switch is in VOR position, the associated VOR/DME receiver is manually tuned R by setting the desired frequency on the associated VOR control panel.



VOR (continued)

- VOR frequencies can be selected from 108.00 to 117.95 MHz (0.05 MHz spacing).
- VOR failure is indicated by red warning flags on the VOR/DME RMI and ND.

Note : VOR/DME information is also supplied to the associated FMC and FCC.

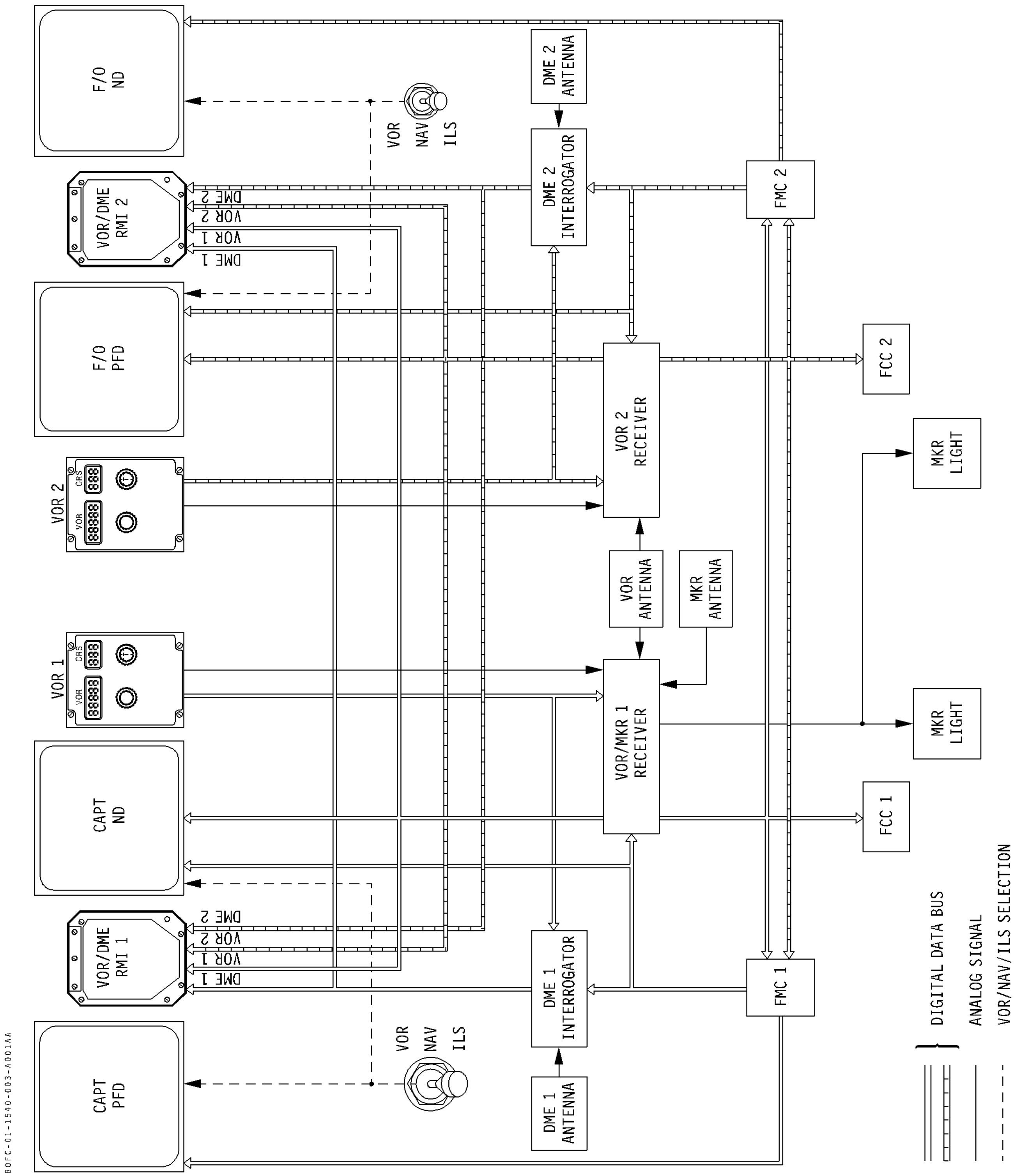
- VOR 1 is supplied by the AC EMER BUS, and VOR 2 is supplied by the AC BUS 2.
- Both VOR/DME systems and the Marker system can be tested by the VOR/MKR 1 and 2 TEST pushbutton switches on the AVIONICS SYS TEST section of the maintenance panel.

DME

- The DME frequency associated with a VOR/DME station is automatically set by selecting the VOR frequency.
- If the selected VOR station is DME-equipped, the slant range distance to the station is displayed on both VOR/DME RMI.
- During approach, the ILS/DME is autotuned by the FMS and the ILS/DME distance is displayed in the lower left corner of both PFD.
- DME failure is indicated by flags covering the DME windows on the VOR/DME RMI.
- DME 1 is supplied by the AC ESS BUS, and DME 2 is supplied by the AC BUS 2.
- Both DME receivers can be tested with the DME 1 and DME 2 TEST pushbutton switches on the AVIONICS SYS TEST section of the maintenance panel.

MARKER BEACONS

- Outer, middle and inner or airway marker beacon signals are received and processed by a marker beacon receiver for visual and audio annunciation of beacon overfly.
- Beacon overfly is indicated by two MKR lights on the Captain and first officer's instrument panels and by an audio signal in the loudspeakers.
- Marker beacon receiver is supplied by the AC EMER BUS, and indicator lights are supplied by the DC NORM BUS.
- The Marker system is automatically tested when the VOR 1 is tested.


F/O ND
DME 2 ANTENNA
VOR NAV ILS
DME 2 INTERROGATOR
FMC 2
VOR/DME RMI 2
DME 2
VOR 2
VOR 1
DME 1
F/O PFD
VOR 2 RECEIVER
FCC 2
MKR LIGHT
VOR 2
CRS
VOR
VOR ANTENNA
MKR ANTENNA
VOR 1
VOR/MKR 1 RECEIVER
MKR LIGHT
CAPT ND
FCC 1
VOR/DME RMI 1
DME 1 INTERROGATOR
FMC 1
CAPT PFD
DME 1 ANTENNA
DIGITAL DATA BUS
ANALOG SIGNAL
VOR/NAV/ILS SELECTION
B0FC-01-1540-003-A001AA

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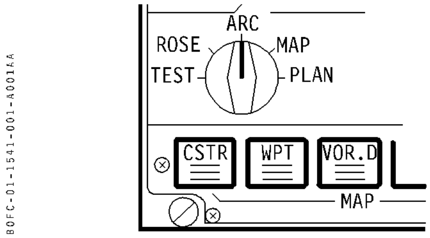
ND MODE SELECTOR



Note : The following description of the EFIS mode selectors only covers how they affect the VOR system. For more information refer to the FLIGHT INSTRUMENTS chapter.

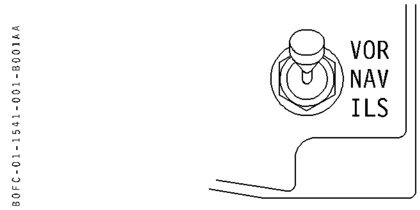
- These selectors located on the primary EFIS control panels, are used to select the associated ND's display mode.
- In ROSE or ARC, the related ND displays VOR information, if available.

IMPORTANT

In ROSE or ARC, the associated VOR/NAV/ILS switch must be placed in the VOR or ILS positions, as applicable.

If ROSE or ARC is selected, but the VOR/NAV/ILS switch is left in NAV position, no specific navaid information is displayed on the ND.

VOR/NAV/ILS SWITCH



- The VOR/NAV/ILS switches are located on the Captain and F/O's secondary EFIS control panels.
- Each switch position controls :
  - VOR or ILS information displayed on the PFD/ND.
  - Autotuning/manual tuning or remote tuning of the associated VOR control panel.

■ **VOR**

- The associated VOR control panel can be manually tuned.
- In ROSE or ARC modes, VOR data is displayed on the associated ND and VOR RMI.

■ **NAV**

- The associated VOR is autotuned by the onside FMS (dashes are displayed in the windows of the VOR control panel).

IMPORTANT

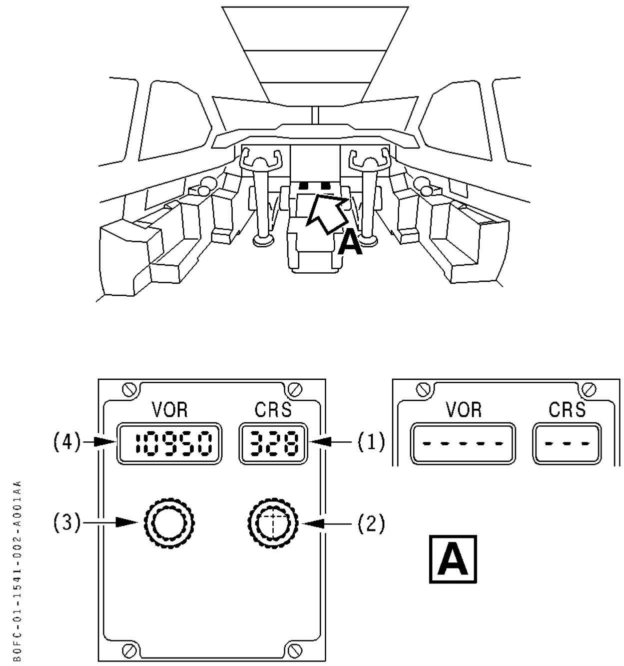
With the VOR/NAV/ILS switch in NAV position, the ND mode selector must be placed in the MAP position.

If ROSE or ARC mode is selected, no specific navaid information is displayed on the ND.

■ **ILS**

- The associated VOR is autotuned by the onside FMS (dashes are displayed in windows of the VOR control panel).
- In ROSE or ARC mode, ILS raw data is displayed on the associated PFD and ND.
- In MAP or PLAN mode, ILS raw data is displayed on the associated PFD. The associated ND displays only the selected ILS localizer course with no deviation data.

VOR/DME CONTROL PANEL



- The following VOR controls and indicators are operative only if the VOR/NAV/ILS switch is in the VOR position.

(1) CRS Window

- The selected VOR course (from 0 to 359) is displayed.

Note : *With the VOR/NAV/ILS switch in NAV or ILS, dashes are displayed to indicate that the VOR/DME receiver is being autotuned by the associated FMS.*

(2) CRS Selector Knob

- The desired VOR course can be selected by turning the knob. The selected course is displayed in the CRS window.
- Pressing this knob automatically changes the displayed VOR course to its reciprocal course.

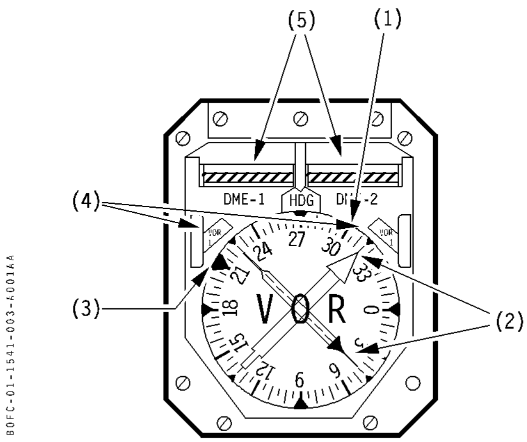
(3) VOR/DME Frequency Selector Knob

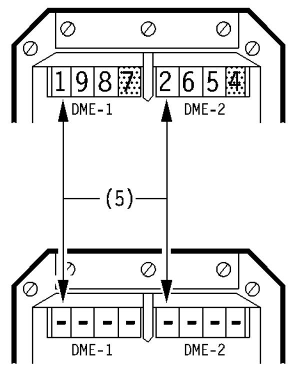
- The desired VOR/DME frequency can be set.
  - The outer knob sets whole MHz,
  - The inner knob sets decimal MHz fractions.

(4) VOR/DME Frequency Window

- The selected VOR/DME frequency is displayed.
- When the VOR/NAV/ILS switch is in the NAV or ILS position, dashes are displayed in the window.

VOR/DME RMI





(1) Compass Rose

- The rotating compass rose, graduated in 5° increments, indicates the aircraft magnetic heading.
- Heading information is provided :
  - for the Captain's RMI, by the IRS 1 (IRS 3 if Captain has pressed ATT/HDG pushbutton switch).
  - for the F/O's RMI, by the IRS 2 (IRS 3 if F/O has pressed ATT/HDG pushbutton switch).

(2) VOR 1 and 2 Pointers

- The thin dashed red pointer indicates magnetic bearing to VOR 1.
- The wide green pointer indicates magnetic bearing to VOR 2.
- When the VOR signal is not received, the associated pointer is set to the 3 o'clock position.
- If electrical supply is lost, or if the RMI fails internally, the pointer is frozen in the last position and the associated VOR flag appears - see (4).

(3) Selected Heading Index

- This orange bug indicates the heading selected on the FCU HDG SEL window.
- In case of failure, the orange index is set to the 6 o'clock position.

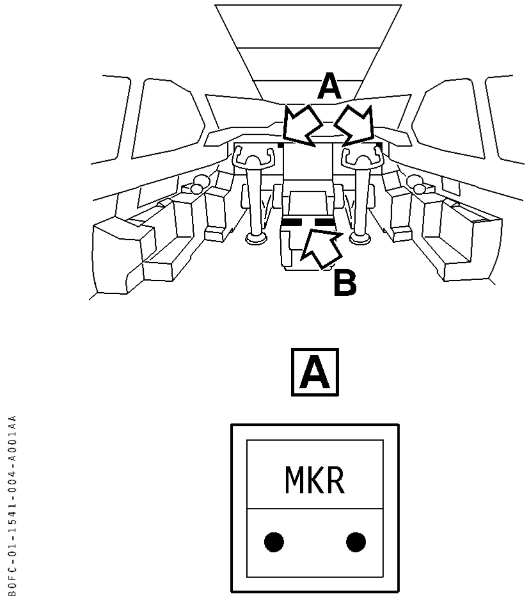
(4) VOR 1 and 2 Flags

- An amber VOR 1 or VOR 2 flag appears in case of failure of the respective VOR.
- Both VOR flags also appear whenever the HDG flag appears (heading information lost).

(5) DME 1 and DME 2 Counters

- The distance to the VOR/DME station tuned on VOR 1 or VOR 2 is displayed in the associated DME-1 or DME-2 window.
- If DME data is not available, white dashes appear in the window.
- In case of failure of the DME indication, an amber and white striped flag covers the affected window.

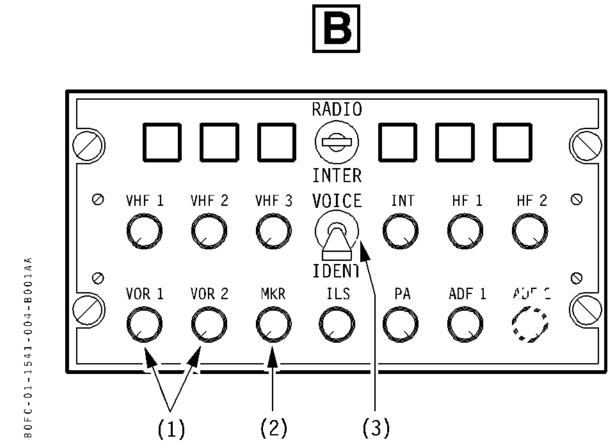
A. MARKER BEACON LIGHTS



- MRK lights on the Captain and F/O's instrument panels illuminate when signal reception indicates the overfly of an outer, middle or inner (or airway) marker beacon.
- Illumination of this light is accompanied by an audio signal :
  - Outer marker : a 400 Hz audio tone sounds,
  - Middle marker : a 1 300 Hz audio tone sounds,
  - Inner or Airway marker : a 3 000 Hz audio tone sounds.
- The MRK lights can be tested by pressing the light pushbutton.

Note : The MRK lights also illuminate when VOR 1 is tested from the maintenance panel.

B. VOR/DME/MARKER AUDIO SELECTION



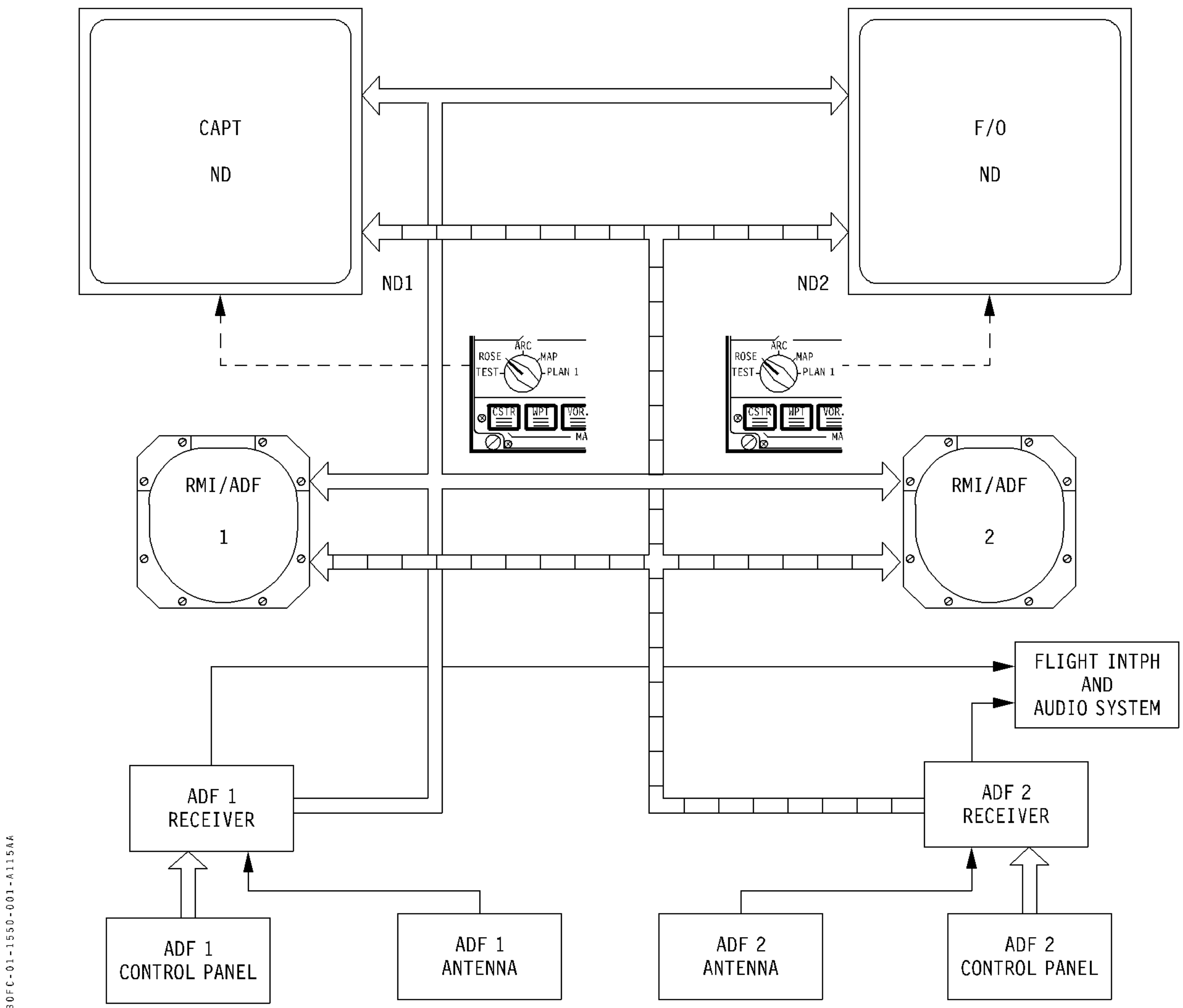
(1) VOR/DME 1 and 2 Audio Reception Knob

(2) MARKER Audio Reception Knob

(3) VOICE/IDENT Switch

Note : For more information regarding operation and use of the audio selector panel controls, refer to the chapter 1.05 - COMMUNICATIONS.

- The aircraft is equipped with two ADF system which provides relative bearing indications to the selected NDB or broadcast stations.
- The ADF receiver frequency range is from 190 to 1750 kHz.
- ADF antennas are located on the top of the fuselage, forward of the fin.
- Both ADF bearings are displayed on the Captain and F/O's ADF RMI
- ADF bearings are also available on the ND in ROSE mode.
- Two frequencies can be set on the ADF control panel. Only one of the frequencies is active at a time. The other frequency can be set for later use.
- ADF audio signals can be monitored on the flight interphone or audio system using the controls on the audio selector panels.
- ADF failure warning is provided by amber ADF 1 or ADF 2 flags on the ADF RMI.
- The ADF is automatically powered when its supplying bus is powered.
- ADF 1 is supplied by the AC ESS BUS, and ADF 2 is supplied by the AC BUS 2.



Mod : 2962

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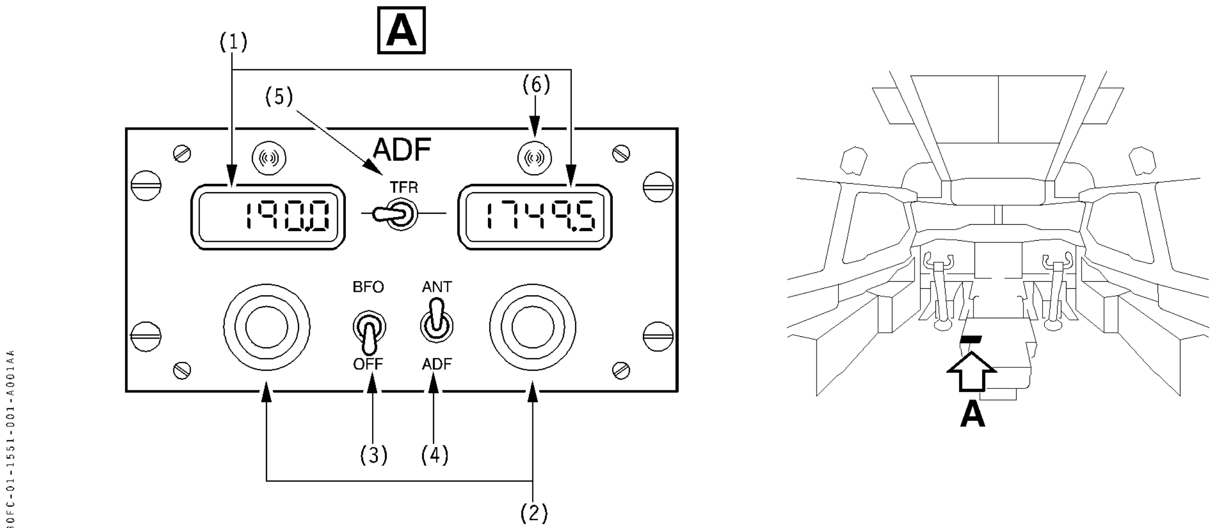
ADF CONTROL PANELS

- NDB frequencies can be set on the ADF control panel.



(1) Frequency Windows

- The selected NDB frequencies are displayed in two windows.

(2) Frequency Selectors Knobs

- The frequency selector knobs consist of three parts:
  - The inner knob sets the decimals and units of kHz.
  - The middle knob sets the tens of KHz.
  - The outer knob sets the hundreds of KHz.

(3) BFO/OFF Switch

■ **BFO**
- Used to receive the audio signal for beacon identification.

■ **OFF**
- The BFO is de-activated.

(4) ANT/ADF Switch

■ **ANT**
- Used if only reception of audio without direction finding.

■ **ADF**
- Normal operation.

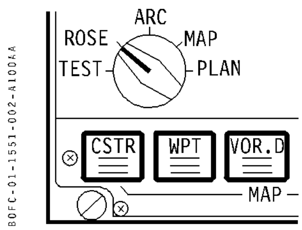
(5) TRF Switch

- Allows to switch-over from the selected NDB 1 (2) to the selected NDB 2 (1).

(6) Transfer Lights

- Illuminates to indicate the selected frequency used to tune the ADF receiver.

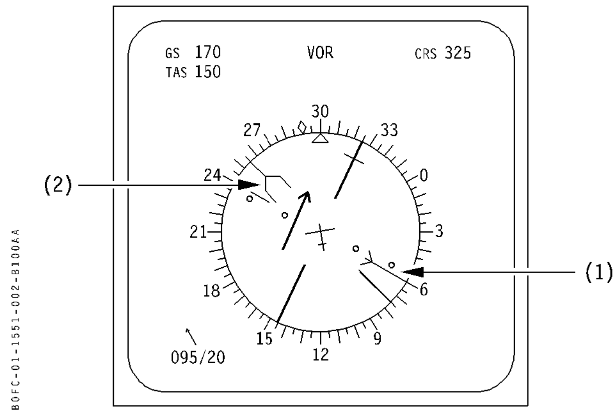
ND MODE SELECTOR



- To display ADF information on the ND, the selector must be in the ROSE position.
- This selector is located on the primary EFIS control panel.

ADF INDICATIONS ON ND

- In ROSE mode, the following ADF information is displayed on the associated ND :



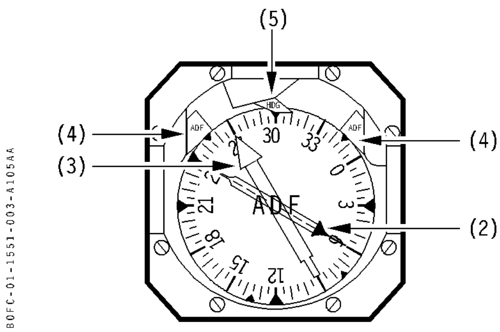
(1) ADF 1 Bearing

(2) ADF 2 Bearing

Note : For more information on the display of the ADF bearing on the ND in ROSE mode, refer to section 1.15.22 – NAVIGATION DISPLAY – ROSE MODE.

Mod : 2962

ADF RMI



- The Captain and first officer's RMI are identical.

(1) Compass Rose

- The rotating compass rose, graduated in 5° increments, indicates the aircraft magnetic heading.
- Heading information is provided :
  - For the Captain's ADF RMI, by the IRS that is supplying the first officer's ND and VOR RMI (usually IRS 2).
  - For the first officer's ADF RMI, by the IRS that is supplying the Captain's ND and VOR RMI (usually IRS 1).

(2, 3) ADF Pointers

- The thin dashed pointer (2) is active when the TRF switch is on the left hand position.
- The wide pointer (3) is active when the TRF switch is on the right hand position.
- The unused pointer is set to the 3 o'clock position.

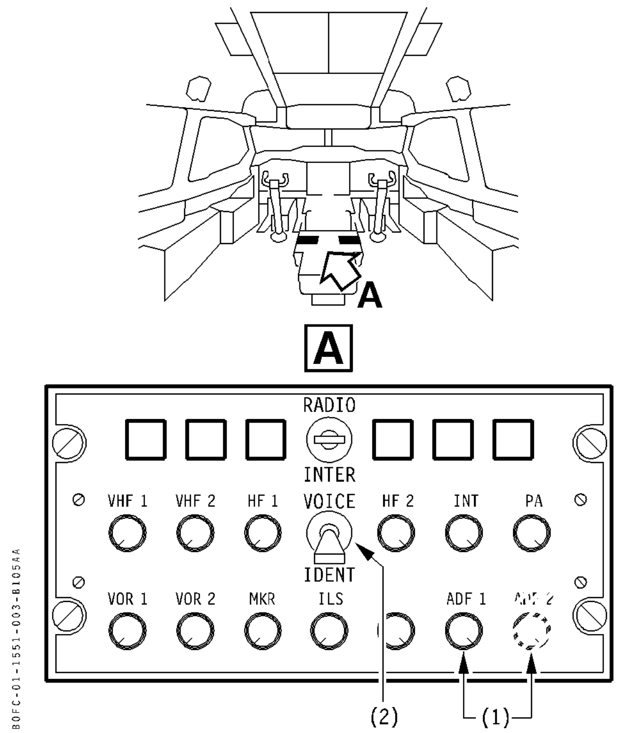
(4) ADF 1 Flag

- A red ADF 1 flag appears in case of failure of the ADF.

(5) HDG Flag

- The red HDG flag is displayed when :
  - IRS heading information is lost, or
  - RMI power supply is lost, or
  - RMI heading indication fails.

ADF AUDIO SELECTION



(1) ADF 1 and ADF 2 Audio Reception Knobs

(2) VOICE/IDENT Switch

Note : *For more information regarding the operation and use of the audio selector panel controls, refer to the chapter 1.05 – COMMUNICATIONS.*

Mod : 2962

LEFT BLANK INTENTIONALLY

LEFT BLANK INTENTIONALLY

LEFT BLANK INTENTIONALLY

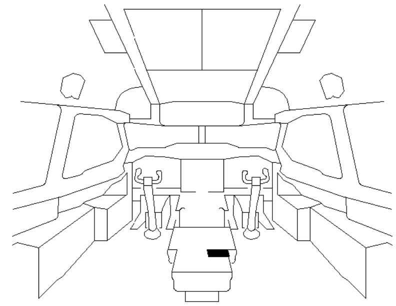
LEFT BLANK INTENTIONALLY

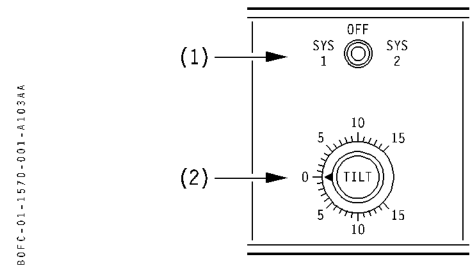
LEFT BLANK INTENTIONALLY

GENERAL

- The weather radar system provides the crew with a colored visual display of precipitation levels for ranges up to 240 nm ahead of the aircraft, and 60° either side of the aircraft heading.
- The weather radar can also be used as a navigation aid to provide information as to the type of terrain being flown over (mountain, cities, sea, etc...).
- The radar beam can be tilted ±15° above or below the aircraft's body line, using the TILT knob located on the weather radar control panel.
- All weather radar image and ground mapping are overlaid on the ND display, only in ARC and MAP modes.
- Before operating the radar system, maintain a minimum safety distance of 16.4 ft (5 meters) between the aircraft and :
  – any obstacle within 90° from the front of the aircraft,
  – any personnel within 135° from the front of the aircraft.
- Ensure that the radar is not operated within 200 ft (60 m) of any refueling operation, or in the vicinity of flammable or explosive liquids.

WEATHER RADAR CONTROL PANEL





(1) SYS Switch

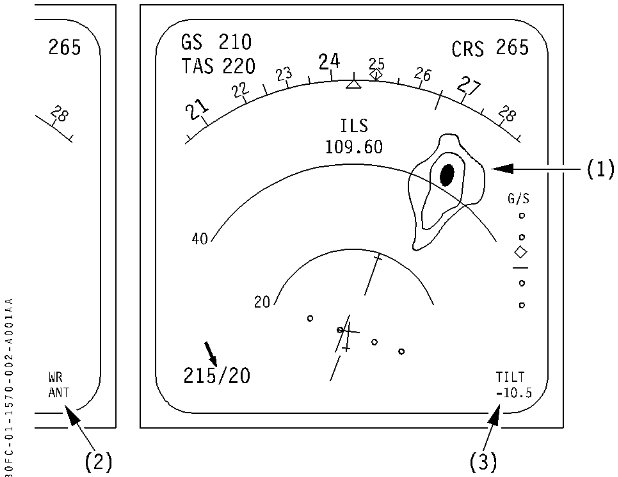
- This switch selects the system to be active.

(2) TILT Knob

- Allows manual control of the antenna tilt from 15° DN to 15° UP.

Mod : 8541

WEATHER RADAR IMAGE



(1) Weather Radar Image

- A radar image is displayed on the ND as soon as the radar is operating, and the ND radar brightness knob is turned up (outer part of the ND brightness knob, located on the EFIS secondary control panel).
- Radar echoes are displayed in different colors depending on precipitation intensity :
  - Green indicates low intensity.
  - Yellow indicates moderate intensity.
  - Red indicates heavy intensity.
- The colors which are displayed on the ground map display also depend on return intensity : black (calm water), then green (ground), then amber (cities, mountains).

(2) Tilt

- Antenna tilt is displayed in the lower right corner of the ND if no radar failure message is present (+ indicates up, - indicates down, calibrated in 0.5° intervals).

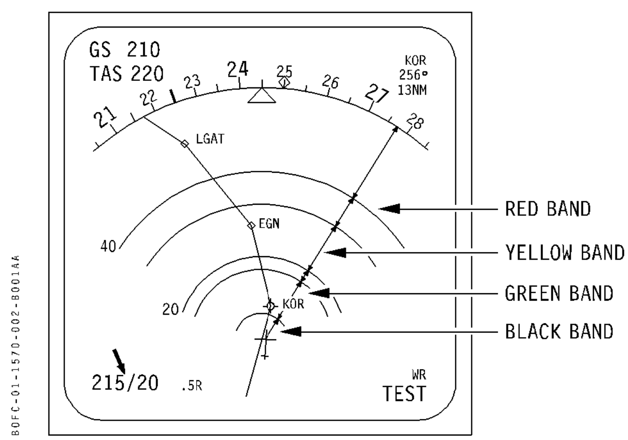
(3) Radar Failure Messages

- The following weather radar failure messages can be displayed in the lower right corner of the ND.

MESSAGE	COLOR	CAUSE	CONSEQUENCE
WR TR	RED	TRANSCEIVER FAILURE	LOSS OF IMAGE
WR ANT	RED	ANTENNA FAILURE	
WR CTL	RED	CONTROL UNIT FAILURE	
WR RNG	RED	INCORRECT RANGE COMPARISON	
WR WEAK	AMBER	INCORRECT CALIBRATION	IMAGE NOT FOUND
WR ATT	AMBER	ATTITUDE FAILURE	
WR STAB	AMBER	LOSS OF ANTENNA STABILIZATION	
WR TEST	AMBER	TEST MODE	TEST IMAGE

Note : If several weather radar failures occur simultaneously, only the most important one is displayed.

- When TEST is activated on the weather radar control panel, the following special test pattern is displayed if no failure is detected.



Reserved

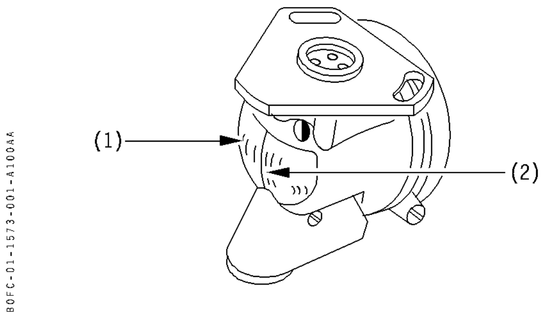
Reserved

Reserved

Reserved

STANDBY COMPASS

- The standby compass is a magnetic compass rose which freely rotates inside a liquid-filled compass bowl.
- A deviation card (reflecting the compass swing calibration) is fitted above the compass.



- When not used, the standby compass can be retracted upwards in its stowed position.

(1) Compass Rose

- The rotating magnetic compass card rose is graduated every 10°.

(2) Lubber Line

- The magnetic heading is read under the lubber line.

Mod : 4803

LEFT BLANK INTENTIONALLY

The pneumatic system consists of all the systems designed to supply air to the various aircraft systems, zones or engines, with associated control, monitoring and indicating components.

The pneumatic system supplies high pressure air for :

- Engine starting.
- Air conditioning and pressurization.
- Hydraulic reservoir pressurization (on ground or in an emergency).
- Wing anti-icing.
- Potable water tank pressurization.

Compressed air is obtained from three sources :

. High pressure air is bled from the engine compressors at the IP and HP stages. The bleed air is pressure regulated and precooled, using fan air ;

. The APU compressor ;

. One or two HP ground air supply units.

The pneumatic system includes :

. The temperature and pressure regulation systems of air bled from the HP stages of the engine compressor, located in the nacelles and pylons.

. The APU bleed air supply and crossbleed (crossfeed) systems, mainly located in the mid and aft fuselage.

. The ground compressed air supply system provided to supply the systems from distribution HP ground air supply units through ground connectors.

Monitoring of the pneumatic system operation and failure detection is achieved by :

. pressure and temperature indications of air supplied by the system (overhead panel, lateral panel, L and R ECAM display units).

. protection against overheat, due to possible leakage around the hot air ducts.

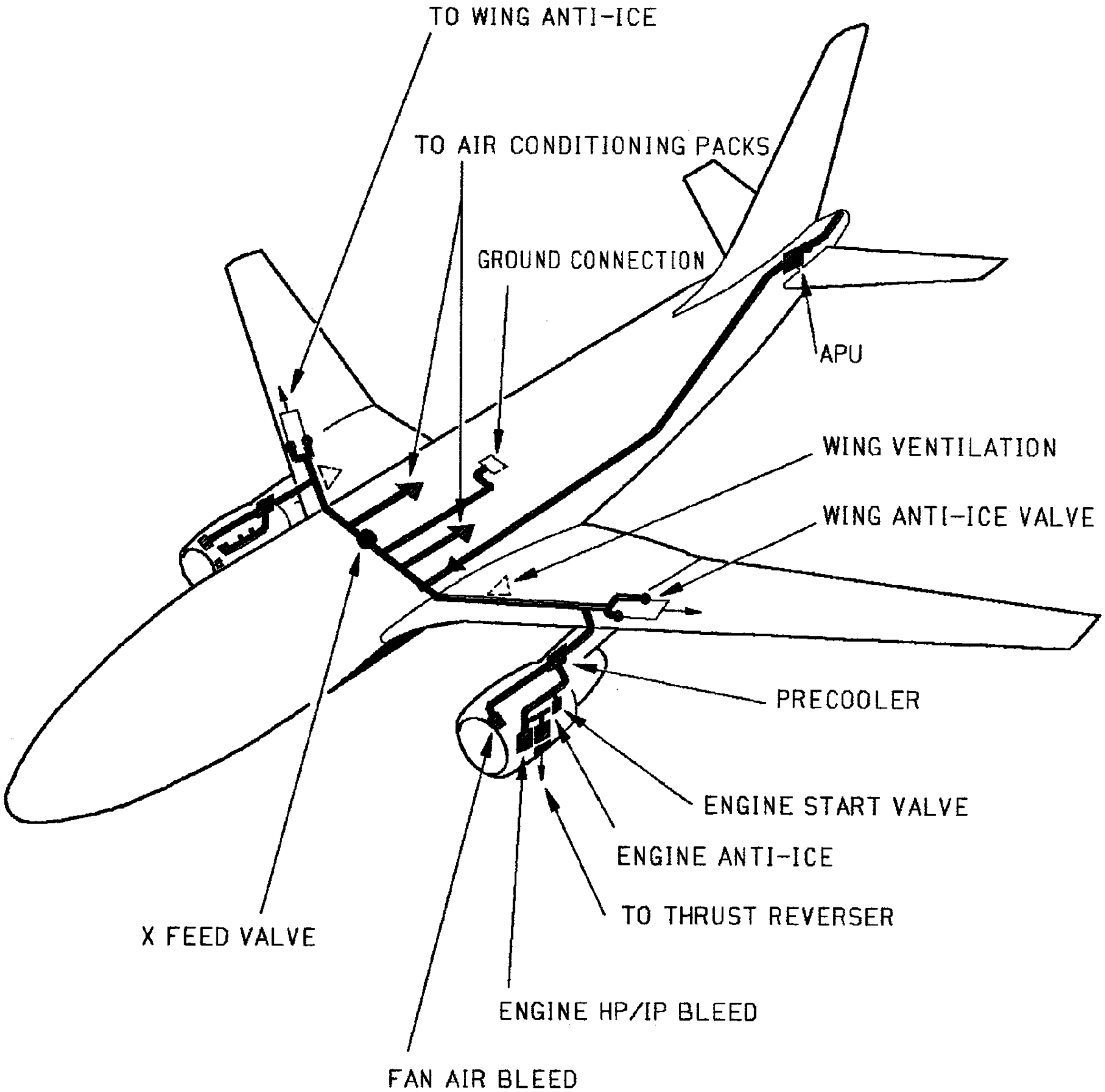
Two independent systems bleed air directly from each engine to supply :

. the thrust reverser.

. the engine air intake ice protection system

R Code : 1610A

AIR SUPPLY SYSTEM



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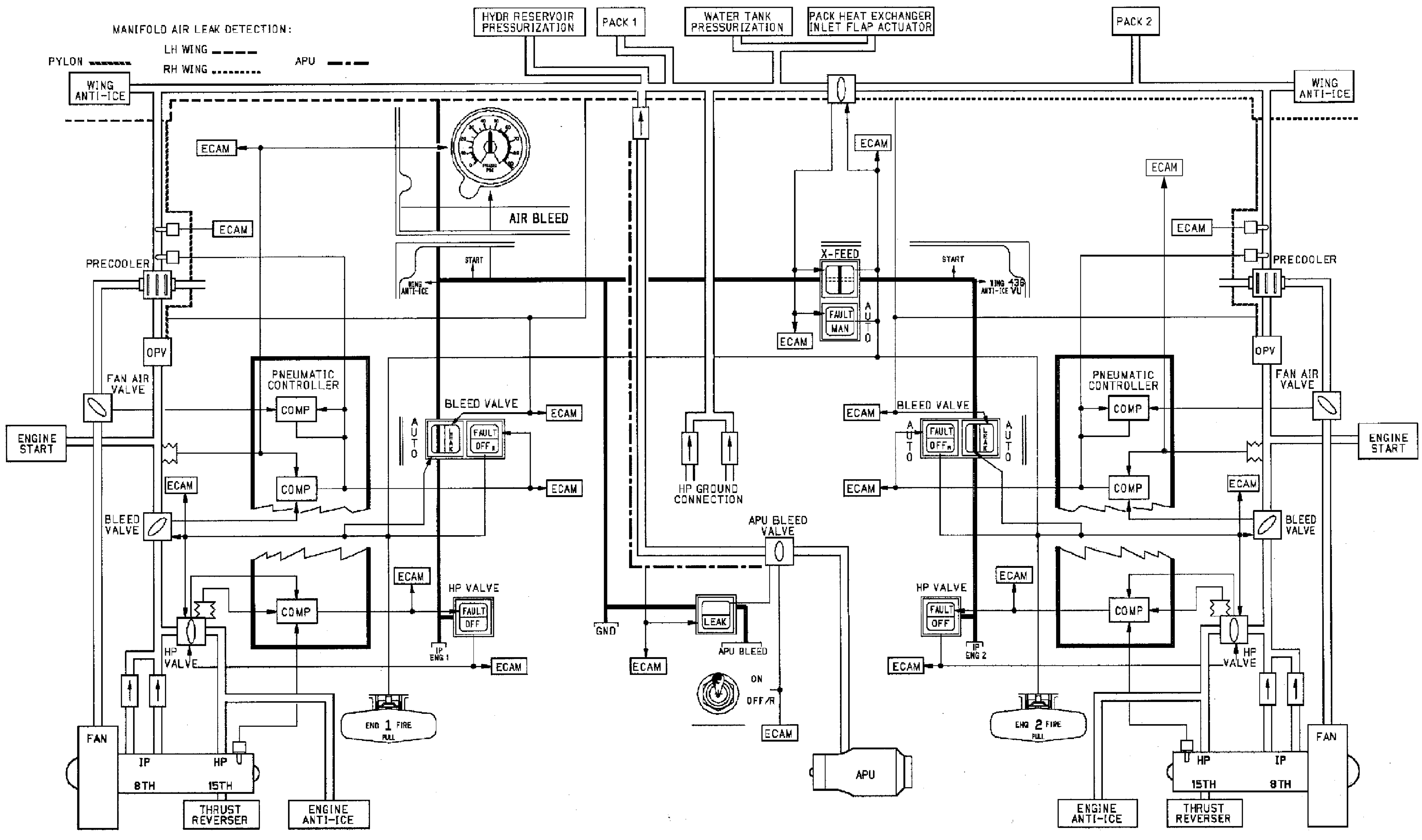
PW Eng. : All

GENERAL SCHEMATICS

R



Mod : 3881 PW Eng. : All

GENERAL

The system is designed to :

– control the supply of bleed air from the engine using IP bleed air, plus HP bleed air when required,

– regulate bleed air pressure,

– regulate bleed air temperature.

AIR BLEED SELECTION

Air is generally bled from an intermediate stage of the engine HP compressor (IP stage) to minimize engine pressure losses.
During low engine speeds, when the pressure from the IP stage is low, air is automatically bled from the last compressor stage (HP stage), particularly during descent, with engines at idle.

Supply of HP bleed air is provided by a pneumatically operated, electrically controlled butterfly valve, called the HP valve.

When the HP valve is closed, air is directly bled from the IP stage through IP bleed air check valves.

When the HP valve is open, the HP stage pressure is higher than the IP bleed pressure and thus closes the check valves ; air is therefore bled from HP stage only.

The HP valve pneumatic operation is controlled by two solenoids which allow opening of the HP valve up to different pressures depending on whether wing anti-ice is selected or not. In normal automatic operation the HP valve is :

– Pneumatically opened when the bleed pressure is below that required.

– Electrically closed if the HP bleed temperature or pressure exceed preset values.

PRESSURE REGULATION AND LIMITATION

Downstream of the junction of the IP and HP bleed air supply is a pneumatically operated electrically controlled butterfly valve called the Bleed Valve, which acts as a shutoff and pressure regulating valve.

The bleed valve regulates the bleed air pressure supplied to the aircraft at 46 PSI, provided the supply pressure is sufficient.

The bleed valve automatically closes in the following cases :

. pneumatic controller fault

. overheat at the precooler outlet,

. bleed leak detection,

. failure of pressure regulation,

. failure of temperature regulation at the precooler outlet,

. actuation of the associated ENG FIRE handle,

. APU bleed valve open.

In the absence of air pressure, the valve is spring-loaded closed independently from electrical power supply.

An overpressure valve installed at the pylon duct inlet protects the system against overpressure.

TEMPERATURE REGULATION AND LIMITATION

Under stabilized conditions, the system limits temperature downstream of the Bleed Valve by means of an air to air heat exchanger called the Precooler. It uses cold air from the engine fan supplied via the Fan Air Valve.

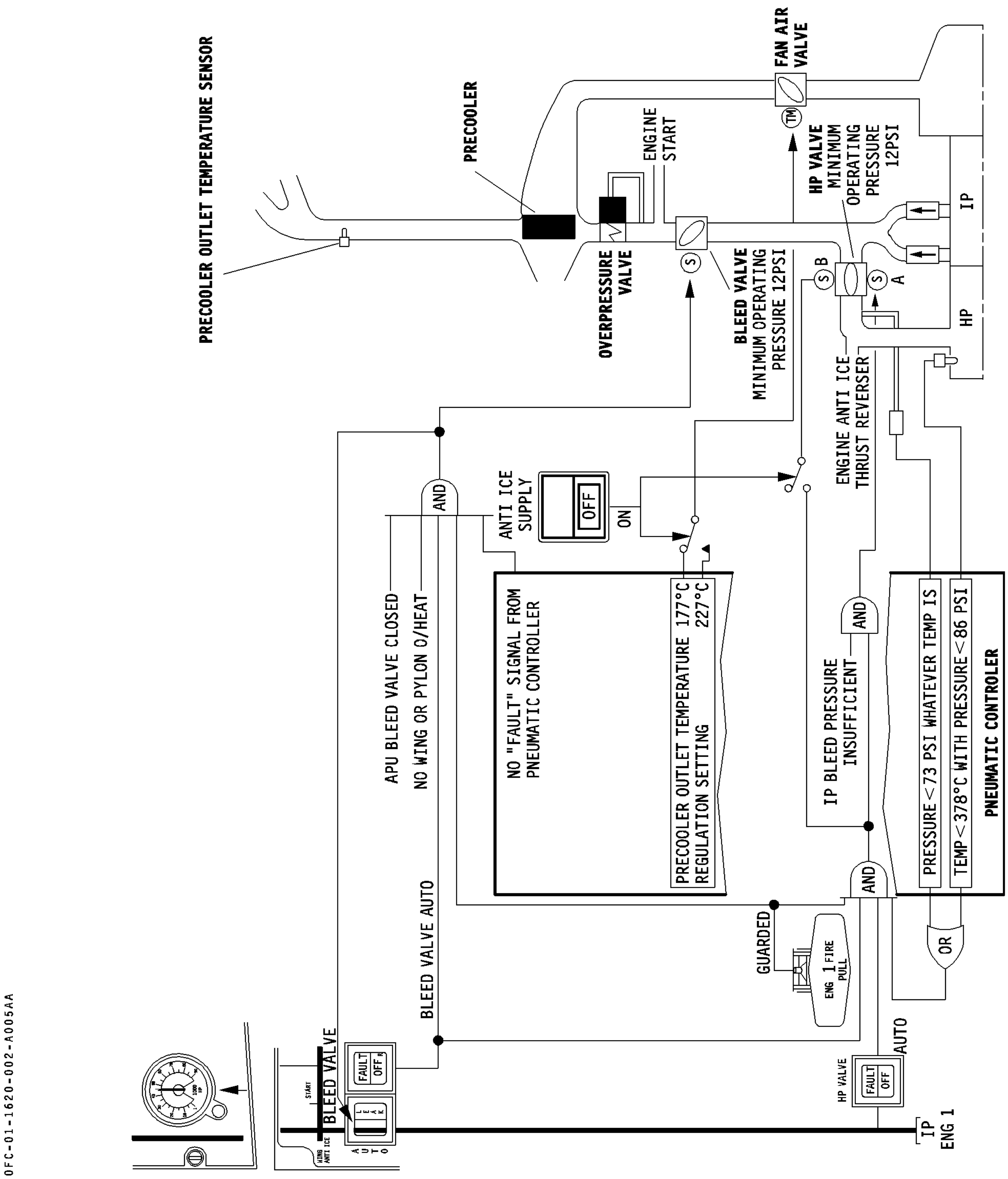
This is a butterfly valve pneumatically operated and electrically controlled by the pneumatic controller. In the absence of air pressure, the valve is spring loaded closed independently from electrical power supply.

A sensor measuring the precooler outlet temperature is connected to the pneumatic controller. This temperature is used to control the Fan Air Valve operation, regulating the precooler outlet temperature and also to provide a precooler overheat warning as follows :

. The normal precooler outlet temperature regulation is around 177°C, this setting is increased to 227°C in flight with wing anti-ice ON.

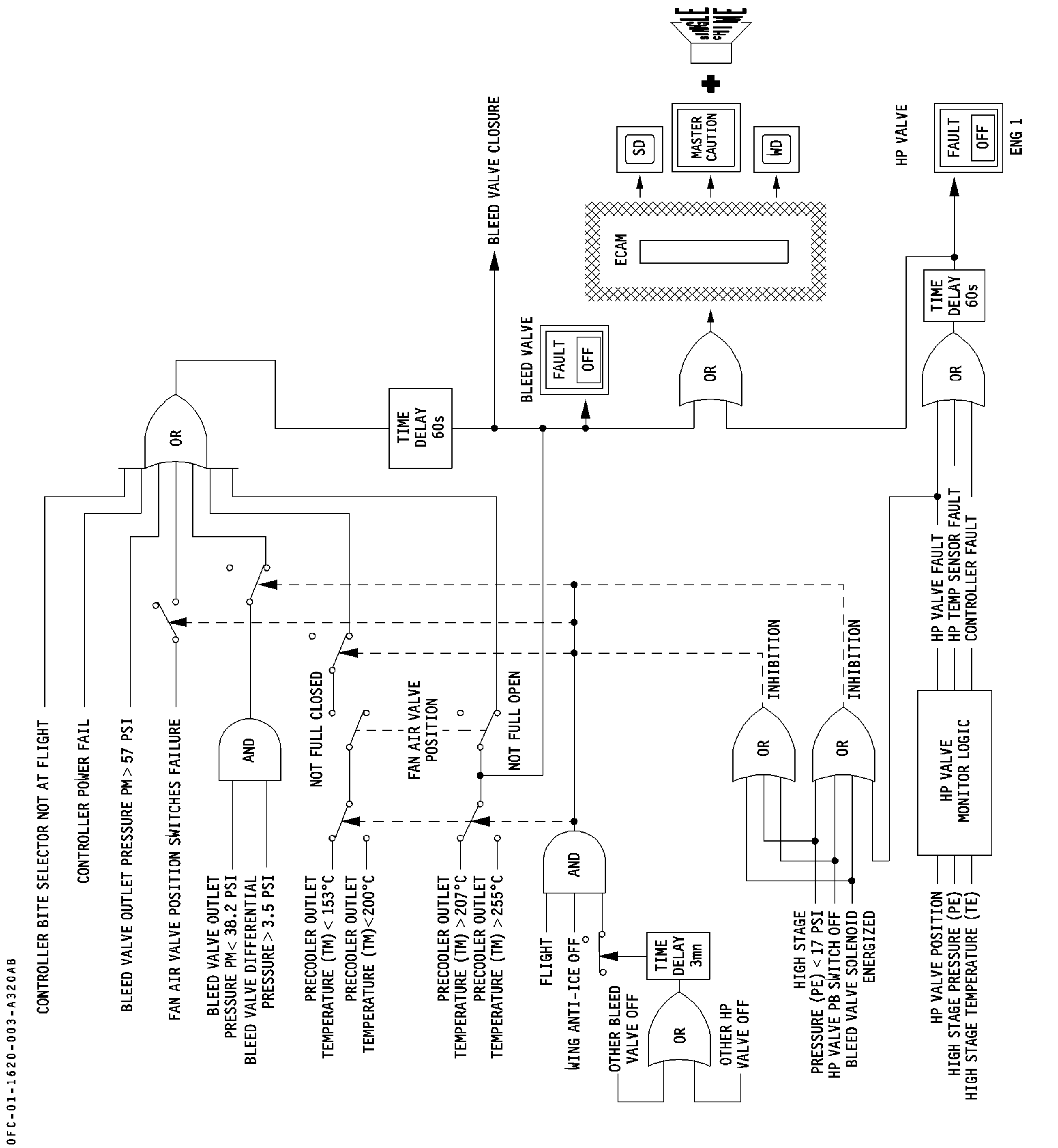
. The normal precooler overheat detection is set at 207°C, this setting is increased to 255°C, in flight with wing anti-ice ON, or the other engine BLEED VALVE selected OFF.

GENERAL SCHEMATICS



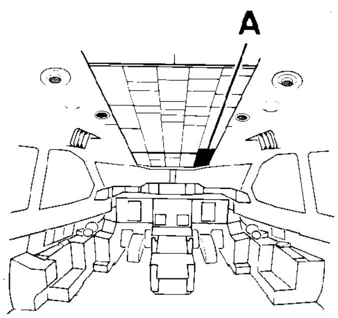
WARNING LOGIC

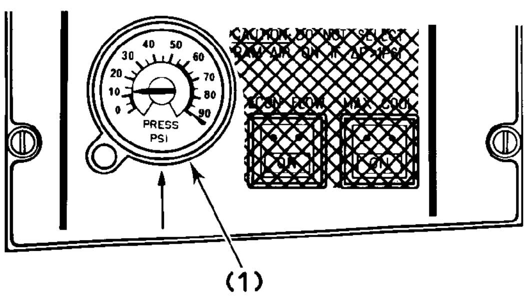
R
R
R
R



Mod. : 5051 + 5146 + 6007 + 7460

A. AIR BLEED PANEL





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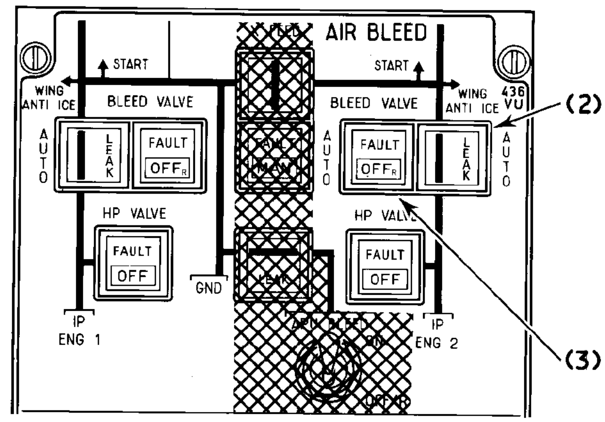


(1) PRESS Indicator

The indicator shows the pneumatic pressure at the ENG 1 bleed valve outlet.
The normal pressure ranges between 30 and 50 PSI.

(2) BLEED VALVE Annunciator

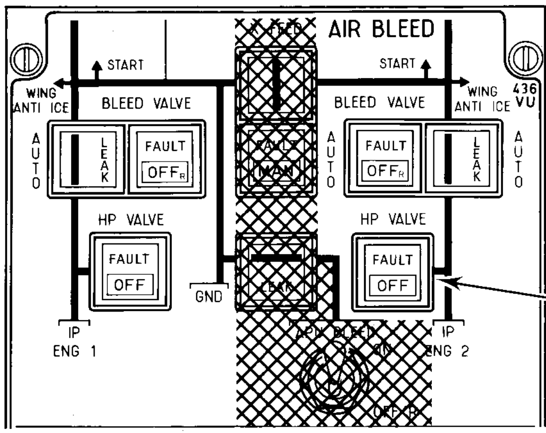
- **Flowbar** :
  . In line, green : the ENG 1 (2) bleed valve is controlled open.
  . Off : the ENG 1 (2) bleed valve is controlled closed.
- **LEAK** :
  The light comes on amber accompanied by ECAM activation when ambient overheat, due to leak, is detected by the related loops in wing or pylon.
  The associated bleed valve closes automatically.

(3) BLEED VALVE Pushbutton Switch

It controls operation of the associated engine bleed valve. A FAULT and an OFF/R light are integrated in the P/B switch.

- **AUTO (P/B switch pressed-in)** :
  Flowbar integrated in the BLEED VALVE annunciator is in line when the valve is controlled open. The valve operates automatically. It opens and regulates pressure R
  provided the APU BLEED valve is closed. R
  The bleed valve is automatically latched after automatic closure in the event of leakage or failure, and the flowbar goes off.
- **OFF/R (P/B switch released-out)** :
  Flowbar is off, the OFF/R light comes on white.
  The bleed valve and the HP valve are closed, bleed valve latching is reset : R
- **FAULT** :
  The light comes on amber accompanied by ECAM activation when :
  . Bleed valve temperature or pressure regulation fails.
  R
  . Overheat at the precooler outlet. R
  R
  . Pneumatic controller fault R
  . Fan air valve not at commanded position. R

  FAULT light remains on as long as overheat prevails.



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(4) HP VALVE Pushbutton Switch

It controls the engine HP valve for HP stage air supply. An OFF and a FAULT indication are integrated in the P/B switch.

- **AUTO (P/B switch pressed-in) :**

  The valve is automatically open provided the related BLEED VALVE P/B switch is selected AUTO (pressed-in).

  The HP valve remains open as long as :

  . With ANTI ICE WING SUPPLY P/B switch selected OFF : The HP stage pressure is lower than 86 PSI.

  . With ANTI ICE WING SUPPLY P/B switch selected ON : The HP stage pressure is lower than 141 PSI.

  . The HP stage temperature is lower than 378 ◦ C with
R pressure higher than 73 PSI.

The HP valve automatically closes when :

. BLEED VALVE P/B switch is released – out to OFF/R.

. Respective ENG FIRE handle is pulled.

- **OFF (P/B switch released-out) :**

  The valve is closed and the OFF light comes on white.

- **FAULT :**

  The light comes on amber accompanied by ECAM activation when :

  . The HP valve position does not agree with automatic command or P/B switch position.

  . The HP valve fails (does not automatically close).

  . The temperature sensors fail.

GENERAL

R The APU Bleed and Cross Bleed system is designed to :

- Supply the air conditioning system and, the wing anti ice system with air bled from the Auxiliary Power Unit (APU).
- R – Allow crossfeed between the LH and RH air bleeds.
- R – Supply air for engine start.
- Pressurize hydraulic reservoirs when LH engine air bleed is not available.

APU BLEED AIR SUPPLY

R Air supply from the APU is available on the ground and in flight up to a maximum authorized altitude of 20,000 ft.

APU air bleed is controlled by an APU bleed valve which is an integral part of the APU.
R

R The APU bleed valve is a pneumatically operated, electrically controlled butterfly valve.
In the absence of air pressure, the valve is spring-loaded
R closed.

The valve is automatically controlled closed when :

. APU compressor speed lower than 95 %

. reverse flow in APU air bleed ducting sensed by an airflow sensor associated with a built-in pressure switch

R . an APU bleed leak or LH bleed leak is detected

R A check valve located near the crossfeed duct prevents
R reverse bleed flow into the APU bleed duct.

R When the APU bleed valve is open, the engine bleed
R valves are automatically closed and APU output performance
R is modified and adapted to meet associated air system requirements (air conditioning, wing anti ice, engine starting).

CROSSFEED

The crossfeed valve installed on the crossfeed duct is designed to isolate or interconnect both air bleed systems.
The crossfeed valve is an electrically controlled, shutoff valve.

For safety reasons, the valve is equipped with two electric motors which can both actuate the butterfly in the opening and closing directions : one motor is used in automatic mode, the other one in manual mode.
Each motor includes a brake system which locks the butterfly in its actual position when power supply is cut off.

The valve can be selected open or closed using the XFEED R
pushbutton, after XFEED mode MAN is selected. R
In normal automatic operation, the crossfeed valve is R
controlled to the same position as the APU bleed valve, i.e. :
Closed : when the APU bleed valve is closed and bleed is R
supplied by the engines

Open : when the APU bleed valve is open. R

The Crossfeed Valve is also closed when : R

- Either ENG FIRE handle is pulled R
- LH, RH or APU bleed LEAK is detected. R

GROUND COMPRESSED AIR SUPPLY SYSTEM

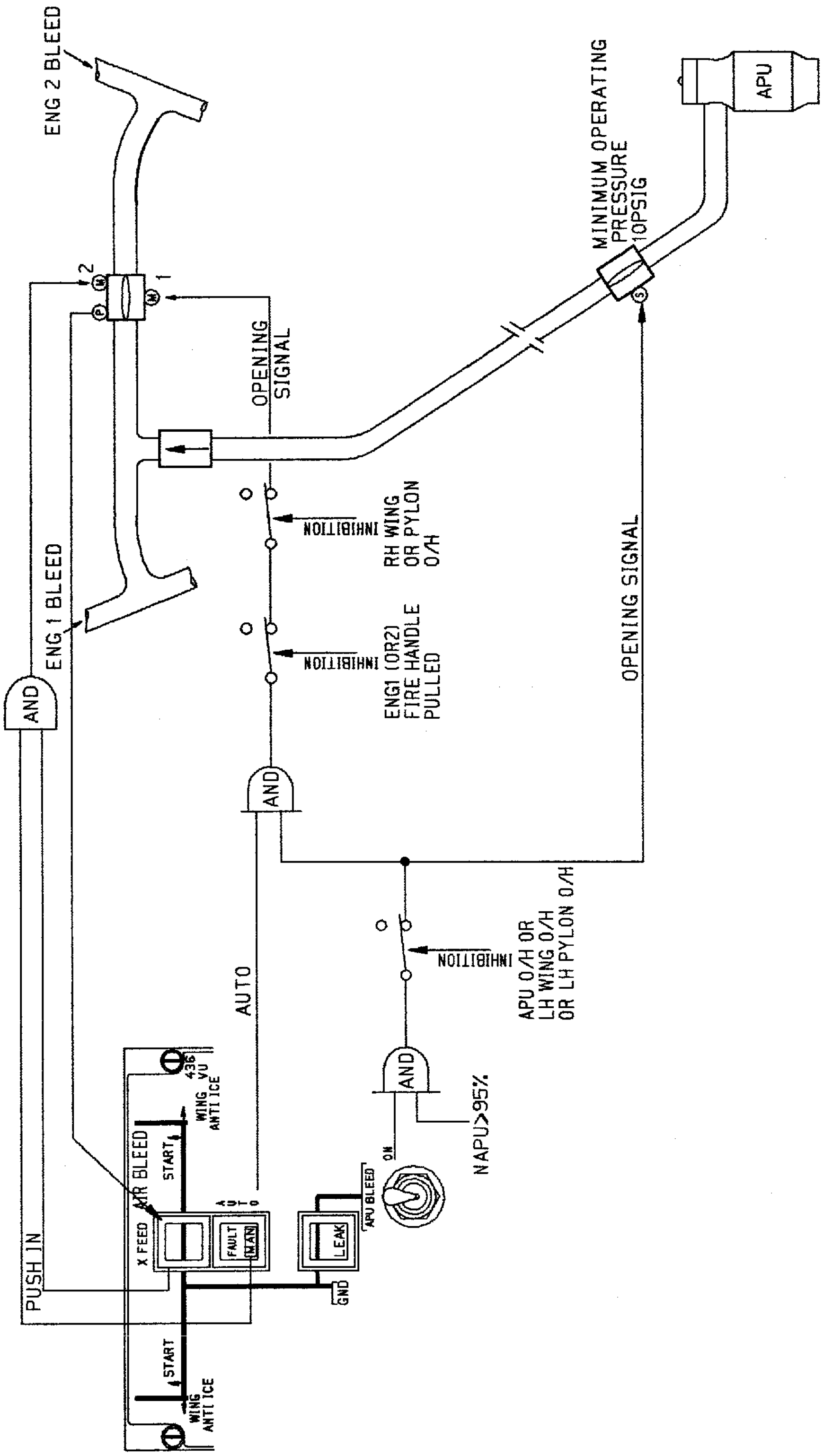
On the ground, the aircraft bleed system can be supplied by HP ground air supply units.

This allows : R

- supply to the air conditioning packs (not recommended R
  due to possible pack contamination) R
- engine starting
- hydraulic reservoir pressurization.

Air supply is achieved through two HP ground connectors located in the RH air conditioning pack cooling air inlet.

GENERAL SCHEMATICS



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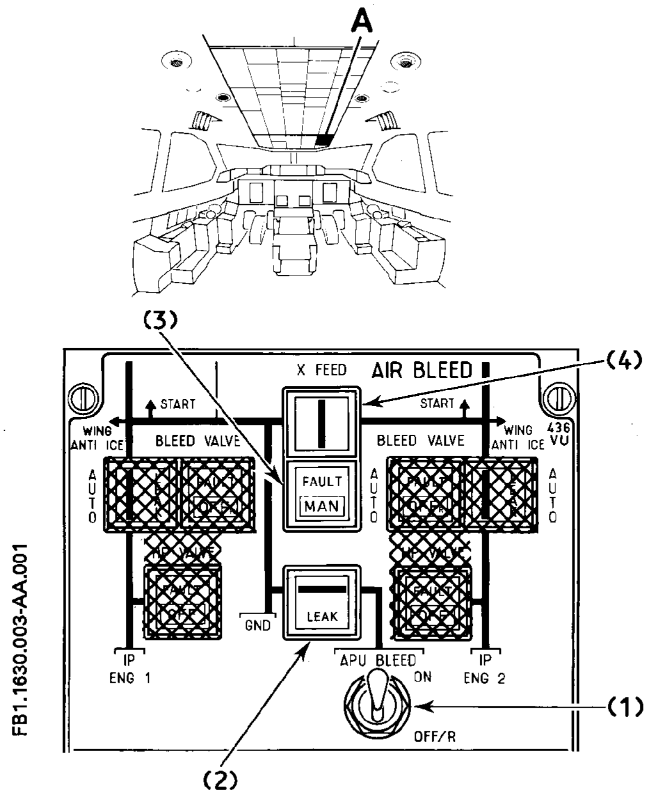
Vers. : All Eng. : All

A. AIR BLEED PANEL



(1) APU BLEED Switch

The switch controls the operation of the APU bleed valve.

R ▪ **ON** :

. Crossfeed valve opens if X FEED Mode P/B switch selected AUTO.

R . APU bleed valve opens and engine 1 and 2 bleed
R valves close, provided that the APU RPM is above
R 95 % and no APU or LH bleed leak is detected.

▪ **OFF/R** :

APU bleed valve closes and the automatic monitoring system is reset.

(2) APU BLEED VALVE Annunciator :

▪ **Flowbar** :

Comes on to indicate the position of the APU bleed valve.
In line : the valve is open
Off : the valve is closed.

▪ **LEAK** :

Comes on amber accompanied by ECAM activation, when overheat is detected by the loops in APU pneumatic duct.

(3) X FEED Mode Pushbutton Switch

The P/B switch selects the operating mode, automatic or manual, of the crossfeed valve.

▪ **AUTO (P/B switch pressed-in)** :

Valve operates automatically actuated by electric motor 1.
The crossfeed valve is open when air is bled from the APU.
The crossfeed valve is closed when :

– air is bled from engines 1 and 2
– ENG 1 (2) FIRE handle is pulled
– APU FIRE handle is pulled
– overheat is detected in APU or LH (RH) wing or LH (RH) pylon ducts.

▪ **MAN (P/B switch released-out)** :

The MAN light comes on white. The crossfeed valve is operated manually by pressing the X FEED flowbar pushbutton switch which activates electric motor 2.

▪ **FAULT** :

The light comes on accompanied by ECAM activation when crossfeed valve position disagrees with automatic selected position.

Note : The FAULT light comes on without ECAM activation during valve transit in automatic mode.

(4) X FEED Valve position Pushbutton Switch

In AUTO mode the selection of the X FEED valve position P/B switch is without any effect on valve positioning and related indication.

In MAN mode :

▪ **Pressed-in** :

The X FEED valve is manually opened

▪ **Released-out** :

The X FEED valve is manually closed.
The integrated green flowbar displays valve position.

▪ **In line** :

The valve is open (automatically or manually)

▪ **Cross line** :

The valve is closed (automatically or manually)

GENERAL

This continuous monitoring system is designed to detect, by means of detection loops, any ambient overheat, to protect the structures and components in the vicinity of the hot air ducts in the fuselage, pylons and wings, on which leaks or bursts may possibly occur.

The sensing elements comprise a central lead (nickel wire) embedded in an insulating material and are integrated in an inconel tube connected to aircraft ground.

Each sensing element is permanently subjected to the temperature of the compartment it protects : for any temperature higher than a preset value and applied to a small length of the element, the resistance of the eutectic mixture rapidly decreases and the central lead is grounded ; this results in an overheat signal transmitted from an overheat detection controller which triggers, illumination of annunciator lights and closing of the valve (s) associated with the affected system.

The sensing elements are tied to form a single or double loop. The detection loops are installed in the following aircraft areas.

ENGINE PYLON MONITORING AREA

Each LH and RH engine pylon is provided with a continuous overheat monitoring system, more particularly located at the outlet of the pylon ventilation duct.

The system is designed as a single loop and the overheat signal is triggered at 204 ° C ± 12 ° C.

WINGS AND FUSELAGE CENTER SECTION MONITORING AREA

The aircraft is divided into two zones, LH and RH, independently from the sensing element routing through the wings and the fuselage center section.

The separation is made at level of the crossfeed valve.

Each zone is provided with a continuous overheat monitoring system comprising twin loops, in order to eliminate spurious warnings.

The overheat signal is triggered at 124 ° C ± 7 ° C.

The sensing elements are routed :
- through each wing along the front web of the wing spar box.
- through the fuselage center section, in line with orifices drilled in the duct double shroud.

FUSELAGE AFT SECTION AND APU MONITORING AREA

Hot air supply system from the APU comprises a single detection loop, running from the check valve near the crossfeed duct to the APU compartment (excluding the associated fire zone).

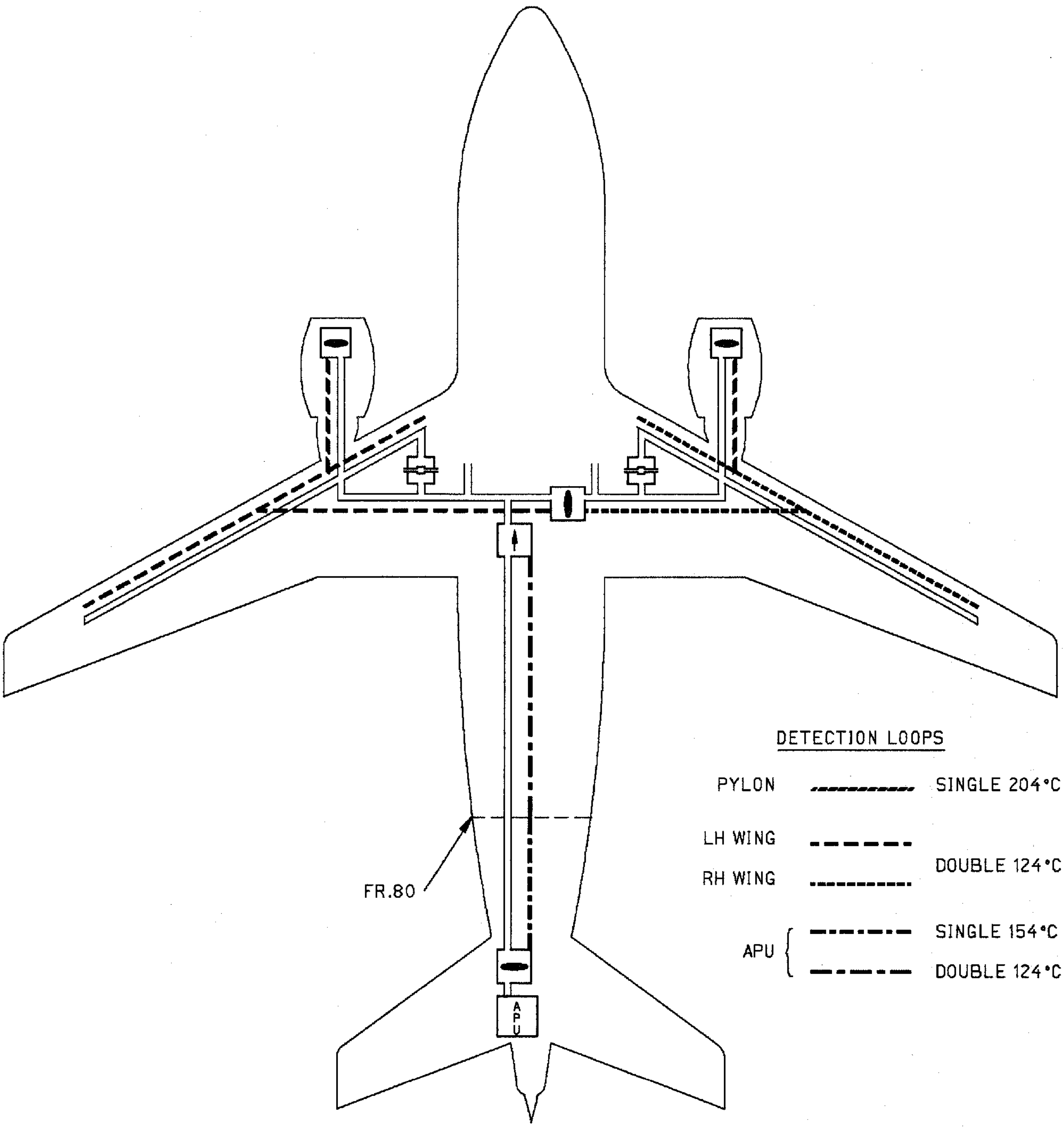
Overheat signal triggered at :
(T_d = temperature detection)
T_d = 124 ° C ± 7 ° C between the check valve and FR80
T_d = 154 ° C ± 9 ° C between FR80 and the APU compartment.

In the event of overheat, the corresponding amber LEAK light comes on on the overhead panel and the ECAM system is activated.

This light remains on as long as the overheat condition prevails. But the valves affected by overheat (s) are spring loaded closed and the circuits must be reset to open the valves when the overheat condition has disappeared.

Moreover, in the event of pylon or wing overheat, WING/or PYLON / LEAK memorized fault annunciator (MFA) comes on on the lateral panel and remains on even after the overheat condition has disappeared ; this facilitates fault isolation after aircraft landing.

DETECTION LOOPS



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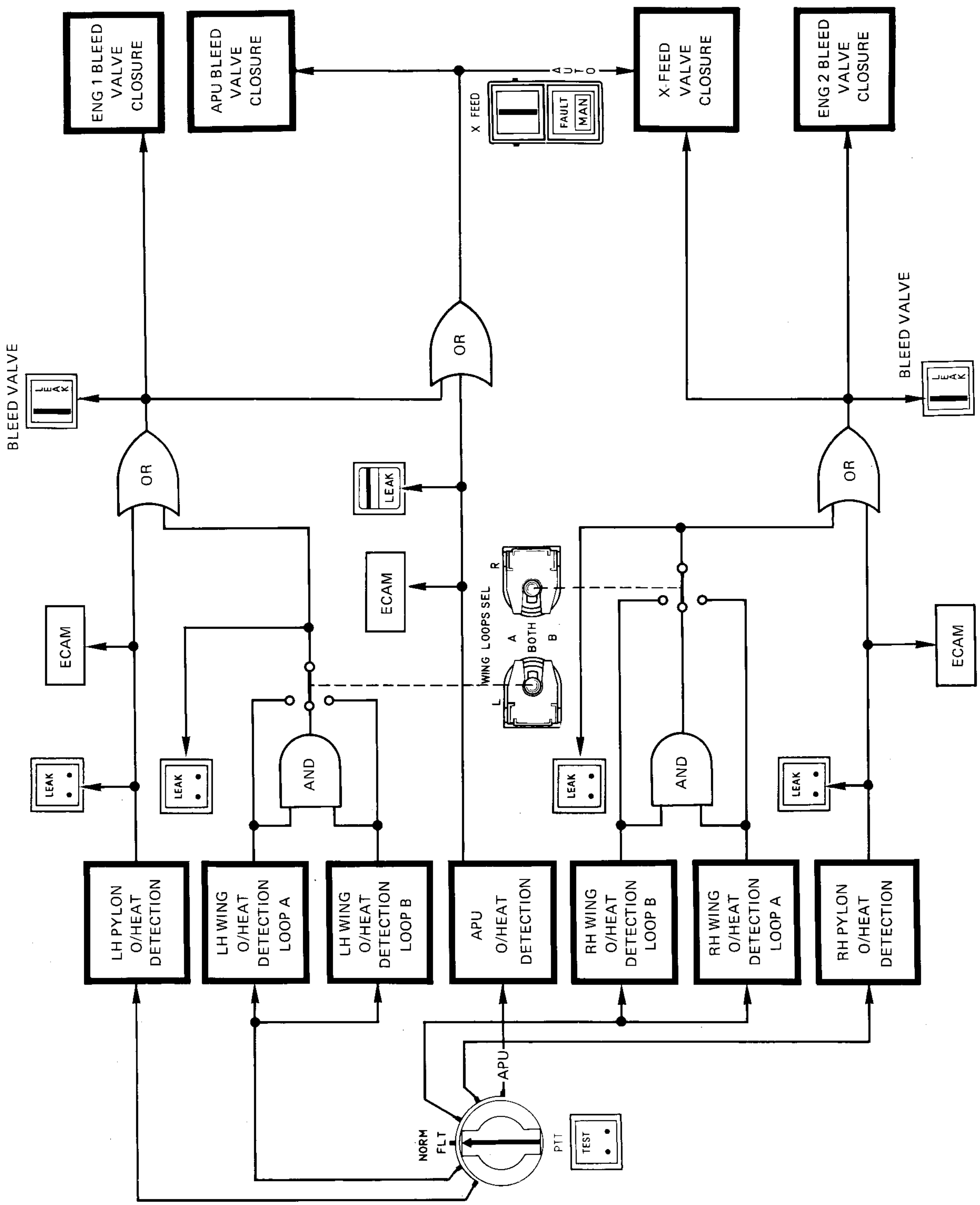
Vers. : All Eng. : All

LOGIC DIAGRAM

R
R
R
R
R



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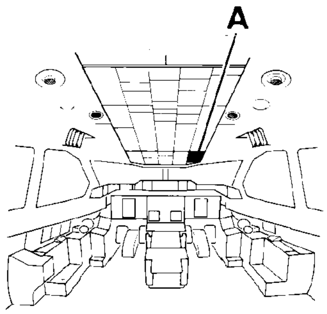
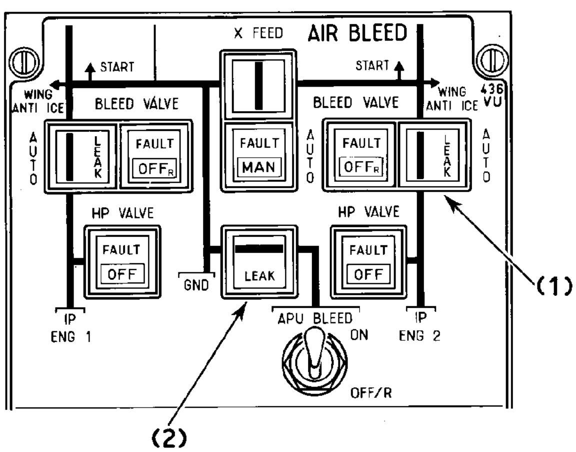
Vers. : All Eng. : All

A. AIR BLEED PANEL





FB1.1640.004-AA.001

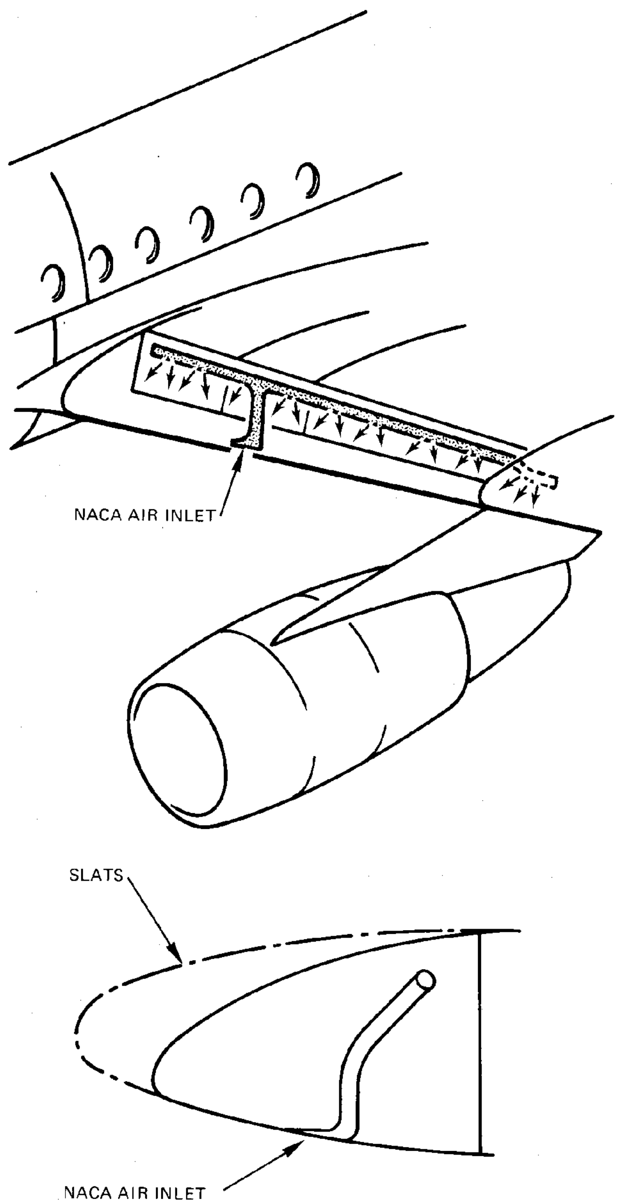
(1) BLEED VALVE Annunciator

The LEAK light comes on amber accompanied by ECAM activation when ambient overheat, due to leak, is detected by the related loops in wing or pylon. The associated bleed valve closes automatically.

(2) APU BLEED VALVE Annunciator :

The LEAK light comes on amber accompanied by ECAM activation when overheat is detected by the loops in APU pneumatic ducts.

Ventilation of the wing leading edge section, located between the engine pylon and the fuselage, is ensured, in flight only by a NACA type ram air inlet circulating ram air and supplying a picollo tube for distribution of air to the spar box in which the air bleed ducts are located.
No monitoring or manual control is provided.



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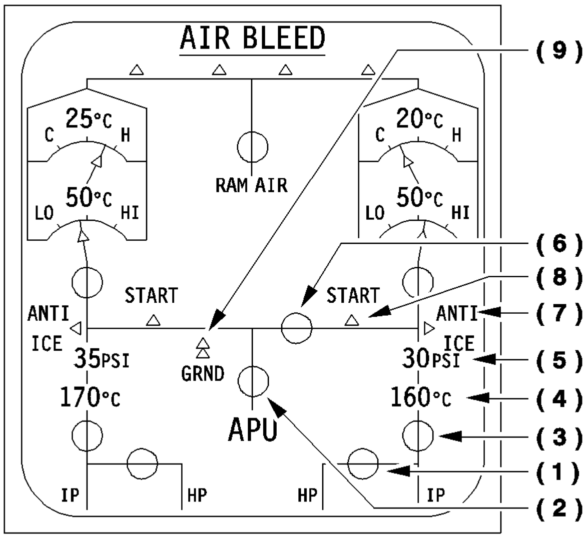
PNEUMATIC SYSTEM DISPLAY



(1) HP Valve Position Indication

⊖	Green	The HP valve is open
⦶	Green	The HP valve is closed automatically
⦶	Amber	The HP valve is closed : – The HP VALVE P/B switch is selected OFF.

Note : After engine shut down, the valve may be shown open.
This indication has to be disregarded.

(2) APU Bleed Valve Position Indication :

⦶	Green	Only displayed if APU MASTER SW is in ON position, the APU bleed valve is open.
⊖	Amber	Only displayed if APU MASTER SW is in ON position, the APU bleed valve is closed.
△	White	Replaces valve indication when APU MASTER SW is in OFF position

(3) Bleed Valve Position Indication :

⦶	Green	The bleed valve is controlled open
⊖	Amber	The bleed valve is controlled closed.

(4) Precooler Temperature Indication :

The temperature indication becomes amber when
- the temperature ⩾ 255° C with WING ANTI ICE selected ON or one BLEED VALVE OFF.
- the temperature ⩾ 207° C with WING ANTI ICE selected OFF and both BLEED VALVES ON.

(5) Precooler Pressure Indication :

The pressure indication becomes amber when the pressure ⩽ 8 PSI or ⩾ 57 PSI.
Engine 1 indication is replaced by amber "XX" if the R
associated input signal is lost. R

(6) Crossfeed Valve Position Indication :

⊖	Green	The crossfeed valve is open.
⦶	Green	The crossfeed valve is closed.

(7) Wing Anti Ice Indication :

ANTI ICE	White	ANTI ICE indication is only displayed when WING SUPPLY P/B-switch is selected ON.

(8) Engine Start Indication :

START	White	START indication is only displayed when START A, START B or CRANK is selected on the ignition selector.

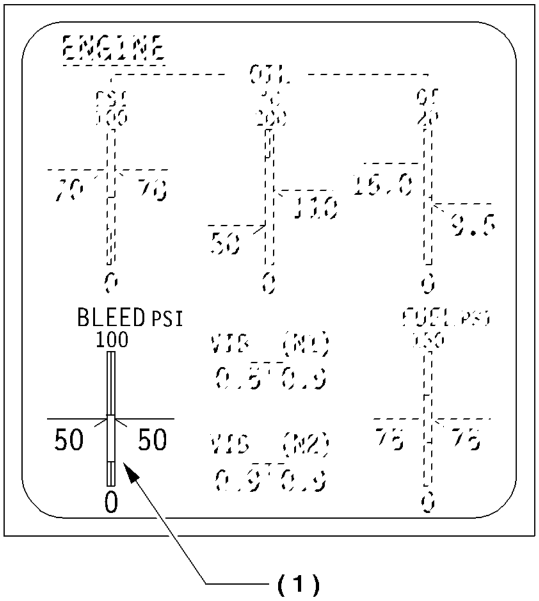
(9) Ground Supply Indication :

The ground supply indication is not displayed in flight.

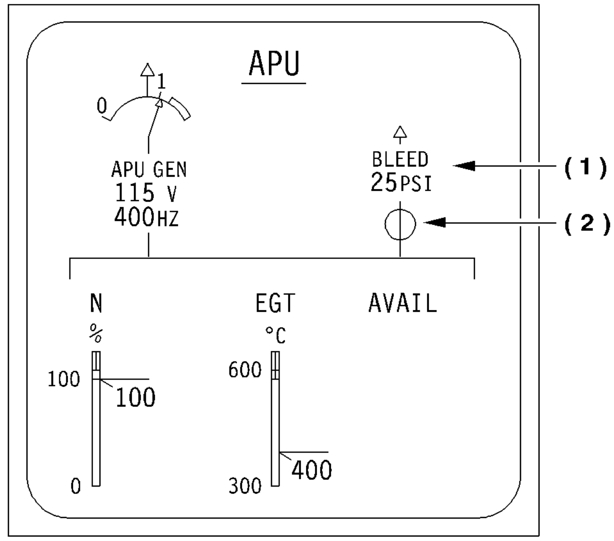
GRND	White	The ground supply indication is displayed independently of ground supply connection.

Mod. : 5146 + 5448 + 7259

ENGINE START PAGE



APU PAGE



BOFC-01-1660-002-A110AA

(1) BLEED pressure indication :

The indication is green

– becomes amber when the pressure is :

R ● lower than 8 PSI during engine start
or
R ● greater than 57 PSI.

R *Note : Indication is replaced by "XX" in amber in case*
R *of loss of electrical power supply.*

(1) APU BLEED Pressure Indication

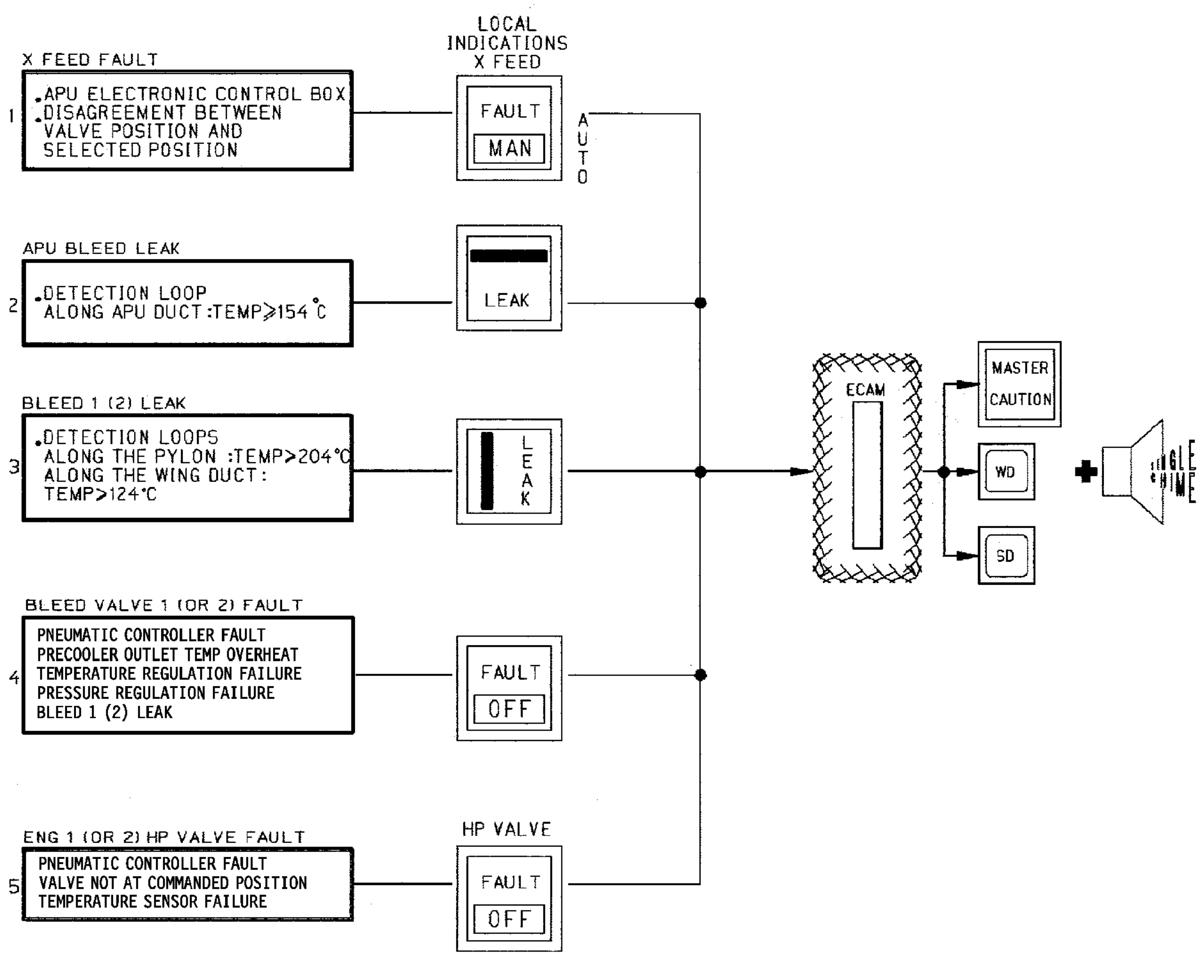
The indication is green.

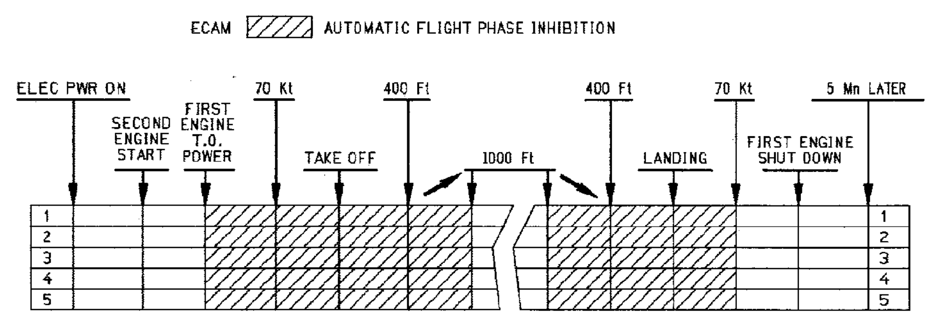
There is no indication displayed when the APU BLEED valve is closed.

(2) Bleed Valve Position Indication :

⌽	Green	APU BLEED valve open
⊖	Green	APU BLEED valve closed

WARNING LOGIC





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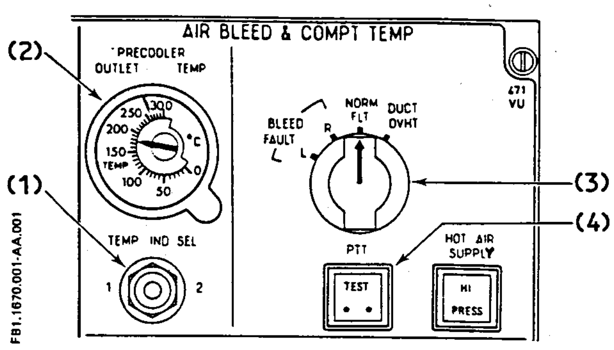
Mod. : 5051

A. AIR BLEED and COMPT TEMP PANEL



(1) TEMP IND SEL Switch :

The selector switch controls the display of precooler outlet temperature on the PRECOOLER OUTLET TEMP indicator.

– **1** Precooler outlet temperature of ENG 1 is displayed.

– **2** Precooler outlet temperature of ENG 2 is displayed.

(2) PRECOOLER OUTLET TEMP Indicator :

The temperature at the selected ENG 1 or ENG 2 precooler outlet is indicated in °C.
Normal operating temperature is between 160 °C and 240 °C.

(3) AIR BLEED and COMPT TEMP TEST ROTARY SELECTOR :

The selector activates the PTT P/B switch and connects it to the respective BLEED FAULT or DUCT OVHT warning circuit.

(4) PTT Pushbutton Switch :

A TEST indication is integrated in the PTT (Press To Test) P/B switch. The P/B switch initiates the test of the selected warning circuit.

- **TEST**

  The light comes on white when the AIR BLEED and COMPT TEMP TEST rotary selector is placed in a test position.
  The light is off with test selector in NORM FLT position.

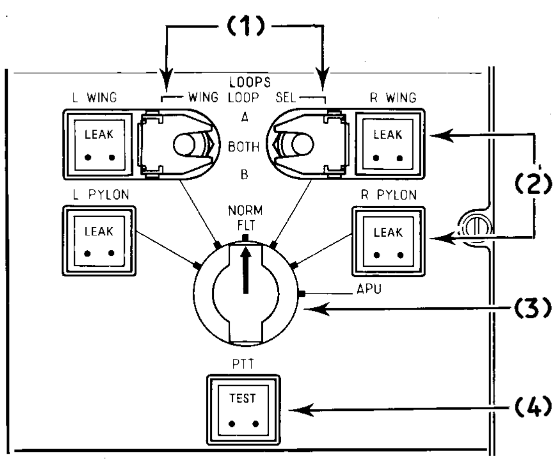
- **Pressed and held**

  The selected circuit is tested.
  After a BLEED FAULT L (R) test, the corresponding BLEED VALVE P/B switch must be selected OFF/R to reset the detection circuits.

- **Released**

  Test circuit is deactivated.

B. LOOPS PANEL



FB1.1670.002-AA.001

(1) L/R WING LOOP SEL Switches :

Switches control the selection of wing loops for ground test.

The wing loops can be tested separately for ground test
R or one loop can be isolated if unreliable.

- **BOTH**

  (Normal guarded position) : Signal from both loops A and B required to trigger LEAK warning.

- **A or B**

  During test or in the event of loop failure, warning is triggered by the selected loop A or B.

(2) L (R) WING/PYLON LEAK Memorized Fault Annunciator (MFA) :

R Comes on white when the corresponding overheat is detected.

Annunciator remains on after overheat has disappeared to facilitate fault location on the ground. MFA goes off when MFA RESET P/B switch is pressed.

(3) Loop Test Rotary Selector :

Activates the PTT P/B switch and connects it to the selected loops in wing, APU or pylon pneumatic ducts for test.

The test may be performed with APU bleed air supply or with engine bleed air supply or without bleed air supply.

- **NORM FLT**

  Normal operating position. Test function is deactivated.

- **L (R) WING**

  The selected loops (A, B or BOTH) detection circuit in the LH (RH) wing pneumatic ducts and the LEAK warning electrical circuits are connected.
  Warnings are activated when PTT P/B switch is pressed.
  The TEST light in the PTT P/B switch comes on white.

- **APU**

  The loops detection circuit in the APU pneumatic ducts and the LEAK warning electrical circuit are connected.
  Warnings are activated when PTT P/B switch is pressed.
  The TEST light in the PTT P/B switch comes on white.

- **L (R) PYLON**

  The loops detection circuit in the LH (RH) pylon pneumatic ducts and the LEAK warning electrical circuit are connected.
  Warnings are activated when PTT P/B switch is pressed.
  The TEST light in the PTT P/B switch comes on white.

(4) PTT Pushbutton Switch

The P/B switch activates the test of the loop detection circuit selected by the test selector switch. A TEST indication is integrated in the P/B switch.

- **Pressed and held**

  The selected system is tested.

  If the test is successful :

  – Associated MFA comes on white
  – Associated LEAK light on overhead panel comes on accompanied by ECAM activation.
  – LO PR light of ANTI ICE/WING/SUPPLY P/B switch comes on on overhead panel.

- **Released**

  The loop detection circuit test is no longer activated and corresponding warnings are cancelled.

- **TEST**

  The light comes on white when the test rotary selector is placed in a circuit test position. It is off when the test selector switch is in NORM FLT position.

PW Eng. : All

R The PW 4000 is a dual rotor, axial flow turbofan with a compression ratio of approximately 29.7 to 1. The engine has a fan air to primary air bypass ratio of 4.8 to 1.

LOW PRESSURE COMPRESSOR / TURBINE (LP)

The low speed rotor (N1) consists of one fan stage and four compressor stages driven by four low pressure turbine stages.

The exterior surface of the low pressure turbine case is cooled with engine fan discharge air to control turbine tip clearance.

HIGH PRESSURE COMPRESSOR / TURBINE (HP)

The high pressure compressor (N2) is composed of eleven stages and is driven by two high pressure turbine stages.

Variable stator vanes, automatically positioned by an hydraulic actuator are incorporated in the first four stages to provide optimum efficiency and stability.

BLEED AIR OFF-TAKES

For defining bleed air off-takes locations, LP and HP compressor stages are identified 1 thru 15, starting from the Fan stage.

Bleed ports are provided between the LP and HP compressors (station 2.5) and after the 9th stage of HP compressor to assist in maintaining overall compressor section stability.

The rotor heating control system controls the flows of the 9th stage compressor bleed air to the interior of the HP compressor rotor.

Twelfth stage compressor bleed air is used to provide regulated cooling air for the HP turbine (blades and vanes).

The HP turbine case is cooled like the LP turbine case.

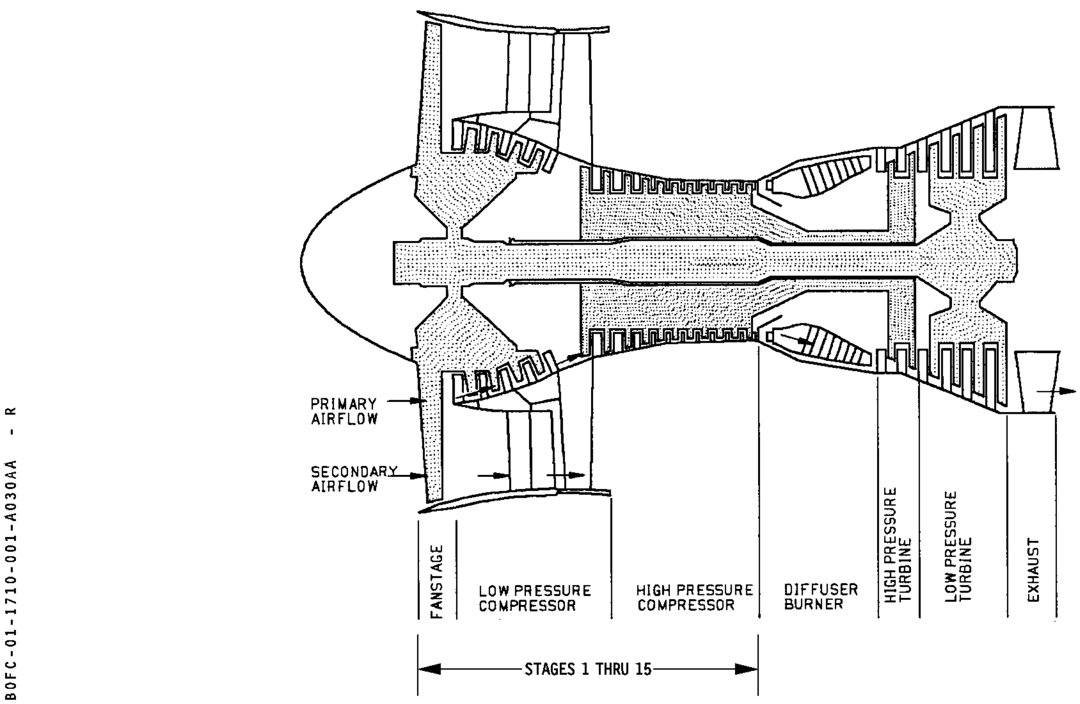
In addition the HP compressor provides eighth and fifteenth stage bleed air pneumatic requirements.

COMBUSTION CHAMBER

An annular diffuser combustion chamber is fitted with 24 dual aerating fuel injectors. Two igniter plugs are also located in this module.

ACCESSORY GEARBOX

The accessory gearbox is located at the rear of the HP compressor case, and contains mount pads for accessories required for air frame use.



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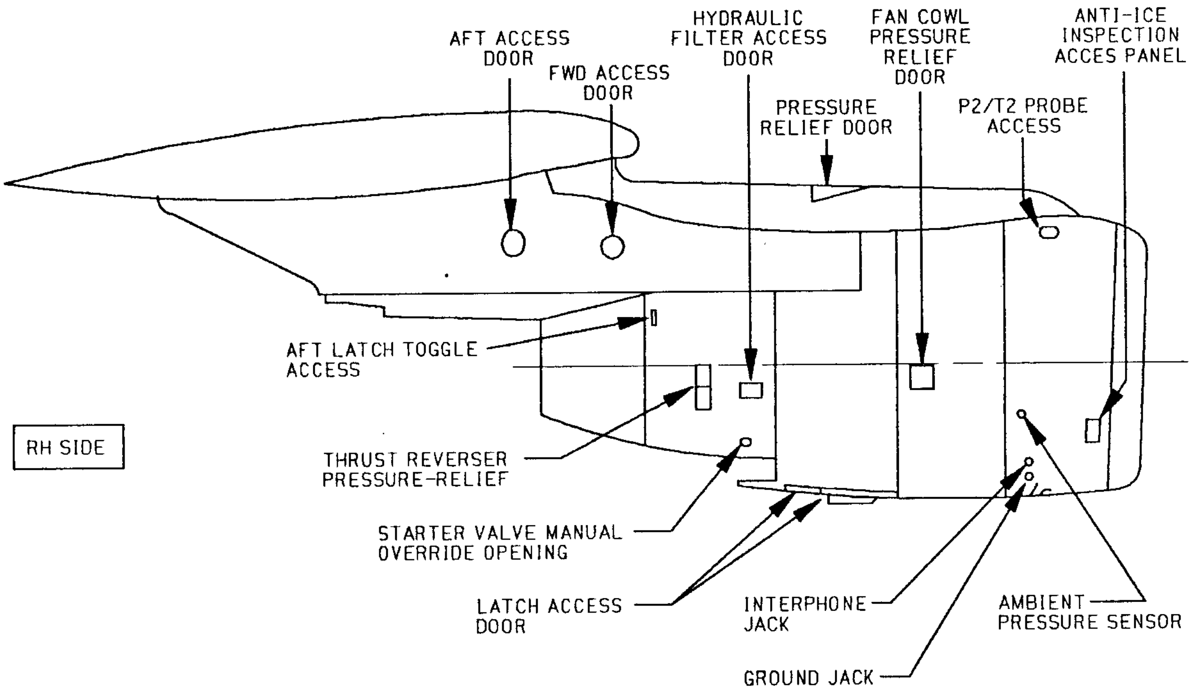
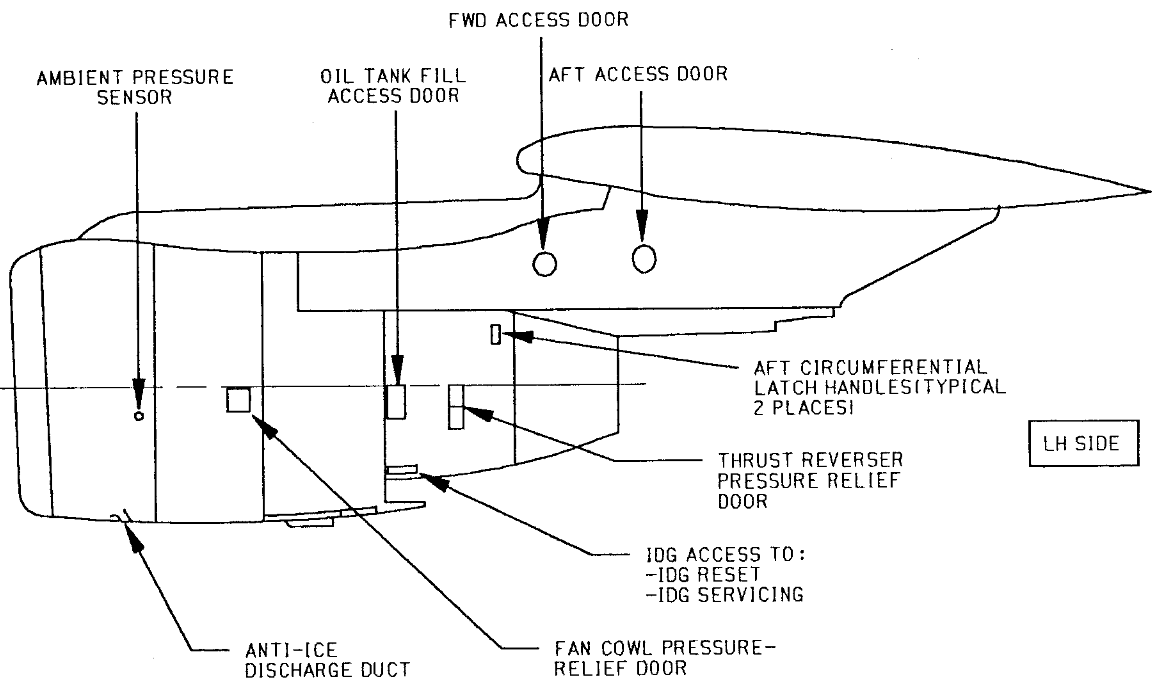
NACELLES AND PYLONS





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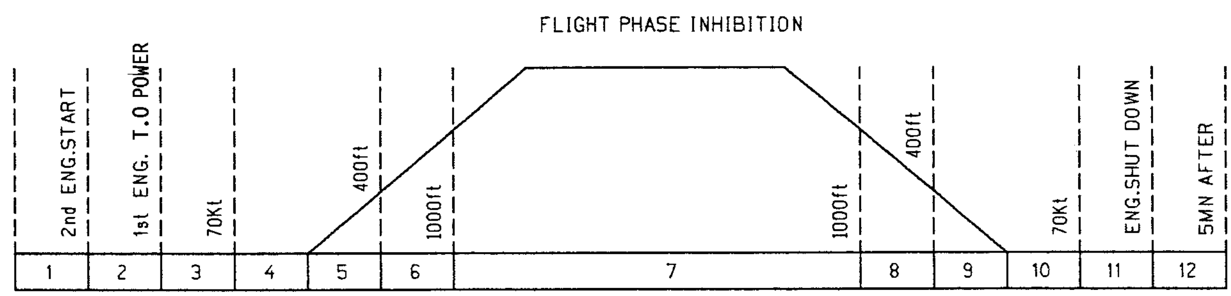
R

PW Eng. : 4000

ECAM Indications and Warnings

Warning Eng 1/Eng 2	Source	Warn Threshold	Warn Sound	Warn Light	Flt Phases Inhibition
Oil Lo Press	Pressure switch	⩽ 70 PSI	CRC	MW	4
Oil Filter Clog	Pressure switch	△P ⩾ 50 PSI	SC	MC	4, 5, 9, 10
Over Limit N1	Indicator	⩾ 111,4 %	SC	MC	4, 9, 10
Over Limit N2	Indicator	⩾ 104 %	SC	MC	4, 9, 10
Over Limit EGT	Indicator	⩾ 625°C	SC	MC	4, 9, 10
Fuel Filter Clog	Pressure switch	△P ⩾ 5.5 PSI	SC	MC	4, 5, 9, 10
Eng. shut down	HP fuel Lever + Fire Handle	–	SC	MC	–
Oil Temp HI	SDAC-FADEC	⩾ 163°C + 20 Min or ⩾ 177°C	SC	MC	4, 5, 6, 8, 9
R Reverse Unlk	Switches	–	SC	MC	1, 2, 4, 5, 10, 11, 12
R	FADEC	–	SC	MC	1, 2, 10, 11, 12
EPR Mode Fault	FADEC	–	SC	MC	4, 5, 6
Over speed Det.	FADEC	–	SC	MC	–
Oil Temp Low	FADEC	⩽ 50°C	SC	MC	1, 4 to 10, 12
Eng. Fail	FADEC	–	SC	MC	Not during shut down or start
Throttle Fault LV (Last Value)	FADEC	–	SC	MC	2, 3, 4, 5
Throttle Fault IDLE	FADEC	–	SC	MC	–
FADEC Channel A and B Fault	FADEC	–	SC	MC	4 to 10
Engine below IDLE	FADEC	–	SC	MC	–
Engine at IDLE	FADEC	–	SC	MC	–
Engine N1 Mode	FADEC	–	–	–	1, 4, 5, 10, 12
FADEC MINOR FAULT	FADEC	–	–	–	2 to 10
FADEC OVHT	FADEC	⩾ 105°C	SC	MC	1, 4, 5, 6, 12

SC : Single Chime
CRC : Repetitive Chime
MW : Master Warning
MC : Master Caution



B0FC-01-1710-003-A100AA - R

Mod. : 7380 PW Eng. : 4152

SYSTEM GENERAL

Fuel is supplied from tank booster pumps via the LP shutoff valve to the engine fuel pumps. The fuel passes through a centrifugal stage of the fuel pump, then into IDG and engine fuel/oil coolers and fuel filter, before going into a single gear stage pump.

The requisite quantity of fuel for combustion is metered within the Fuel Metering Unit, excess fuel being returned to pump interstage.

The Fuel Metering Unit responds to commands received from the Full Authority Digital Engine Control (FADEC).

From this Fuel Metering Unit, which contains as well the HP FUEL shut off valve, the fuel flows through the fuel flowmeter, the fuel divider valve and then through 8 manifolds to 24 injectors.

FUEL HEATING

Ice formation in the fuel system is prevented by heating the fuel before it passes through the fuel filter and Fuel Metering Unit. The heat absorbed in fuel/oil heat exchangers provides cooling for the engine and IDG oil supplies. When fuel temperature exceeds 127° C (260° F), the engine oil flow to the fuel/oil heat exchanger is bypassed.

FUEL FILTER

The fuel filter protects the engine fuel system from damage. In case of filter clogging, a bypass valve will open if the pressure drop across the filter is greater than 9 psi. When the pressure drop across the filter reaches 5.5 psi, the FUEL CLOG amber warning is triggered, associated with ECAM activation.

PUMP UNIT

The centrifugal pump boosts fuel pressure to a maximum pressure 320 psi above aircraft fuel supply pressure.

The main gear stage supplies high pressure fuel to Fuel Metering Unit.

FUEL CONTROL

The fuel control includes the Full Authority Digital Engine Control (FADEC) and the Fuel Metering Unit.

The FADEC system operates in response to the pilot command thrust settings as transmitted by the throttle lever position.

Engine fuel flow is commanded to establish the engine pressure ratio (EPR) corresponding to the commanded power setting.

The control laws used in scheduling fuel flow also consider acceleration and deceleration response, transient and, steady state stability requirements and engine protection.

The Fuel Metering Unit incorporates the fuel shut off function, a maximum fuel flow stop and a minimum fuel flow stop.

FUEL DISTRIBUTION

The fuel flow transmitter measures the fuel mass flow from the Fuel Metering Unit for indication of fuel flow rate and fuel used.

The fuel divider valve subdivides scheduled engine fuel flow from the fuel metering unit equally to eight fuel manifolds, each of which in turn feeds three fuel injectors.

IDLE CONTROL

General

. The PW4000, features a multiple idle concept as follows :
  - modulated minimum idle ;
  - flight/approach idle.

Modulated Minimum Idle

. The modulated minimum idle is meant to assure three requirements :
  * prevent the IDG's from dropping off-line : minimum N2 concept,
  * preventing the engine from flaming-out : minimum fuel ratio concept,
  * assuring the bleed requirements for air conditioning, engine anti-ice and wing de-ice : minimum burner pressure concept.

. The minimum idle value is driven by the highest of the three above requirements.

. The minimum idle is a function of the altitude.

Flight/Approach Idle :

. The flight/approach idle concept is meant to assure the engine acceleration requirements for Go-Around.

. The flight/approach idle is selected when the following conditions are met :
  * aircraft in flight,
  * slats extended. (lever position).

. The flight/approach idle is a function of the altitude and total temperature Tt2.

Selection of flight/approach idle

. When selecting the approach idle, at slats extension, the amount of N1 and N2 increase will be a function of the minimum idle level prevailing at the time of the selection.

Code : 0114

OVERSPEED PROTECTION

Each channel of the FADEC incorporates an overspeed detection and protection.

The overspeed protection features two levels of N1 and N2 speeds protection, as follows :

- N1 and N2 redlines limiting function (N1 and N2 topping loops) :
  - This function is part of the normal engine control loops and will not allow the N1 and N2 to exceed their respective redlines.
  - The topping loops apply a fuel cut-back as soon as the associated red line limit is reached. A slight overshoot may exist before the N1 (respectively N2) is controlled on its limit.
- Overspeed protection :
  - Should the above N1 and/or N2 topping loops fail to control the N1 (N2) on the applicable limit, a second line of defence is available and will be activated if the red line is exceeded by approximately 5 %.
  - The overspeed protection is not a software control law but a wired logic activating the overspeed solenoid of the FMU and reducing the fuel flow to a preset MIN FLOW value.
  - In flight, the MIN FLOW does not permit to sustain idle operation and will result in a sub-idle operation or in an engine flame out.

Both the N1 (N2) redlines limiting function (topping loops) and the overspeed protection are available in both EPR and N1 modes.

FUEL INDICATING

- Fuel pressure :

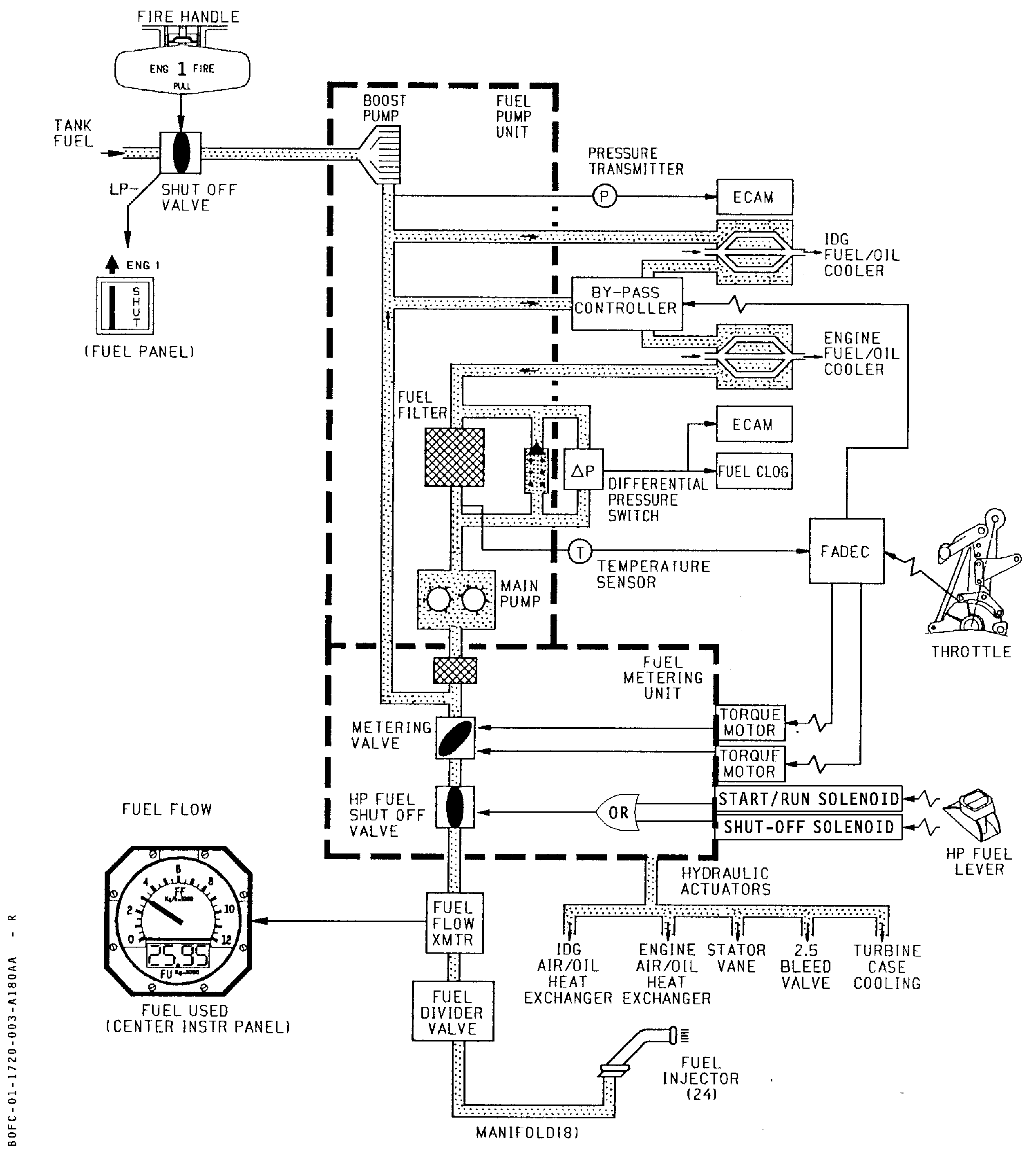
  A pressure tapping, provided at the engine pump interstage level supplies a transmitter which delivers an electrical signal to the SDAC which processes it to display the fuel pressure on ECAM.

- fuel flow/fuel used :

  The fuel flow transmitter is located in the fuel line upstream of the fuel divider valve. This transmitter is a fluid driven rotor referencing to a turbine sensitive to fluid angular momentum.
  This rotor produces a pulsed signal whose frequency is proportional to mass flow. The pulsed signal is processed to provide information to an indicator of fuel flow.
  Fuel used is calculated and displayed as an integration of fuel flow.

PW Eng. : 4000

SYSTEM GENERAL



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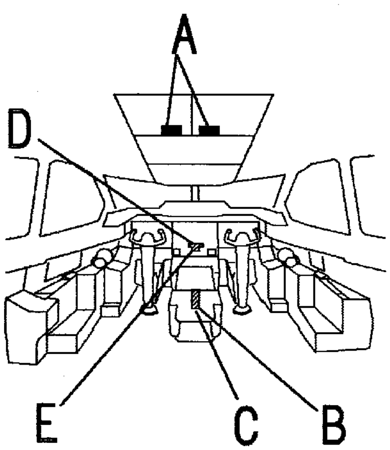
LOCATION OF CONTROLS



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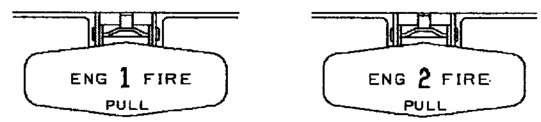

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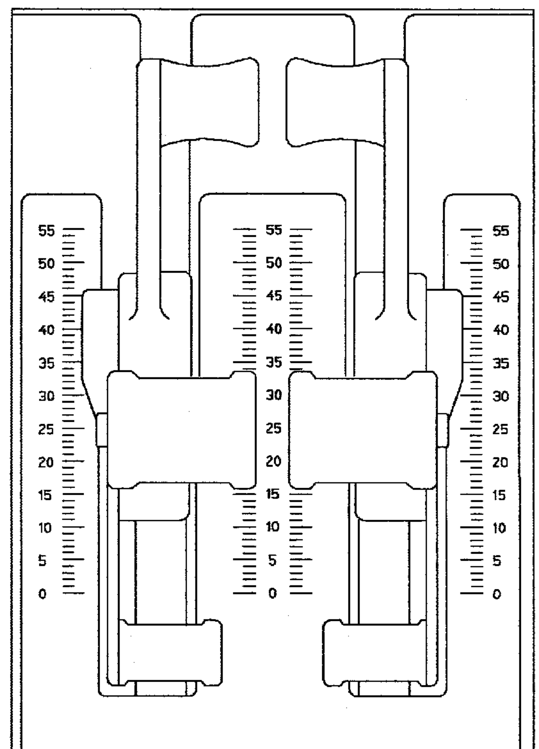

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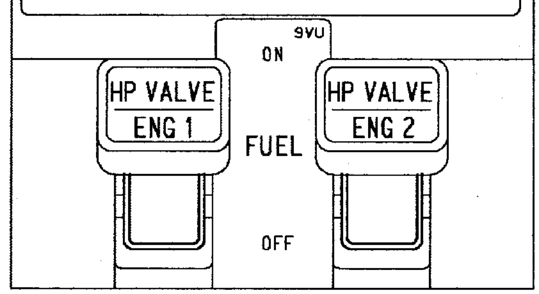

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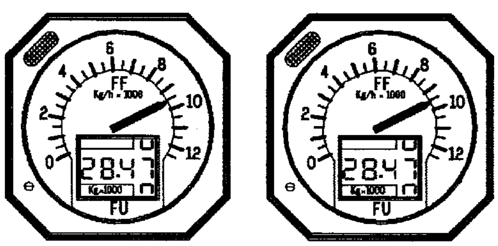

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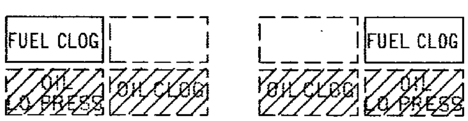

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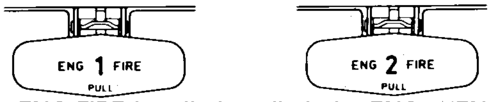
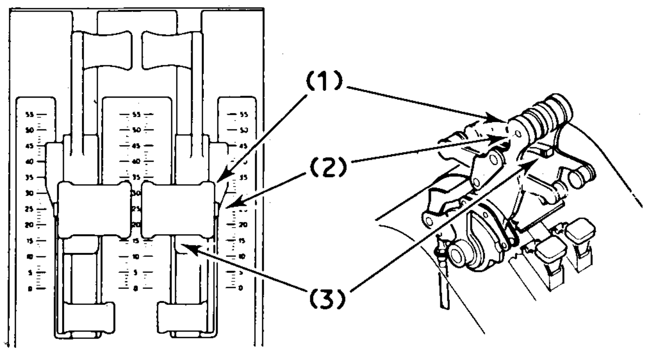
A. ENG FIRE HANDLES



When an ENG FIRE handle is pulled, the ENG 1 (ENG 2) LP SHUT OFF VALVE closes (FUEL).
For detailed information on other resulting actions refer to chapter FIRE PROTECTION.

B. THROTTLE LEVERS



FB1.1720.006-AA.050.6A

(1) Throttle Levers

Operation of throttle levers controls the related fuel control units and FADEC to obtain the desired thrust from idle to maximum – I.E., throttle lever position commands power setting.
Change over from flight idle to ground idle occurs automatically in the fuel metering unit without throttle lever movement.

(2) Autothrottle Instinctive Disconnect Pushbutton

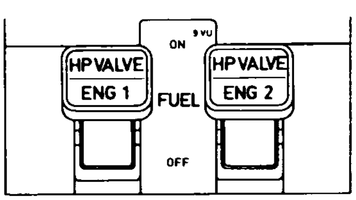
When depressed the autothrottle system is disconnected. Thrust setting must be performed manually.
For detailed information refer to chapter AUTO-FLIGHT SYSTEM.

(3) Go Levers

Actuation of go levers engages the autothrottle system in the THRUST mode, on ground for takeoff and during landing approach for go-around.
For detailed information refer to chapter AUTO-FLIGHT SYSTEM.

C. ENG FUEL LEVERS

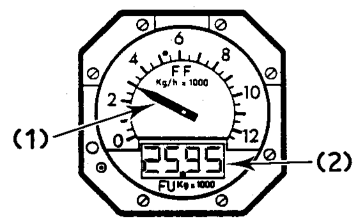
FB1.1720.006-AA.050.6B



The ENG 1/ENG 2 FUEL levers control the HP fuel shutoff valves in the fuel metering units and the ignition activation. A red fire warning light with the indication HP valve is integrated into the lever handle.

- **ON**
  HP valves open, admitting fuel to fuel manifolds and injectors.
  Ignition is activated as preselected and scheduled.
- **OFF**
  HP valves closed. Ignition is deactivated.
- **HP VALVE**
  The light illuminates red and HP valve is readable in case of :
  . Engine fire as long as the ENG FUEL lever is in ON position.
  . or, disagree between the lever and the actual valve position.

D. FUEL FLOW/FUEL USED INDICATOR



FB1.1720.006-AA.050.6C

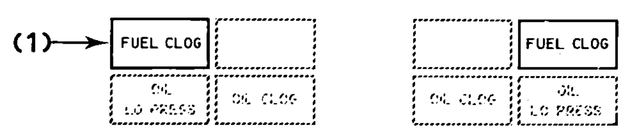
(1) Pointer

Indicates the fuel flow rate in kg/h × 1000.

(2) Digital indicator

Displays fuel used in kg × 1000.
The reset of the fuel used indicator is obtained automatically when the « START » p/b is depressed (on ground only).

E. FUEL CLOG WARNING



FB1.1720.006-AA.050.6D

(1) FUEL CLOG lt. :

Comes on amber associated with ECAM, when the differential pressure in the filter exceeds 5.5 ± .7 psi by increasing value and extinguishes when the differential pressure decreases below 3.5 ± 1psi.

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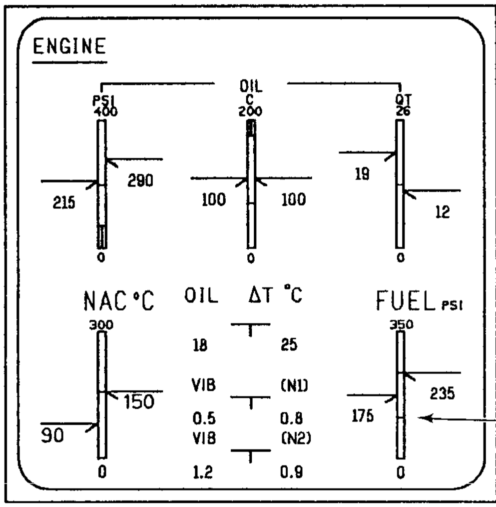
Code : 1720H

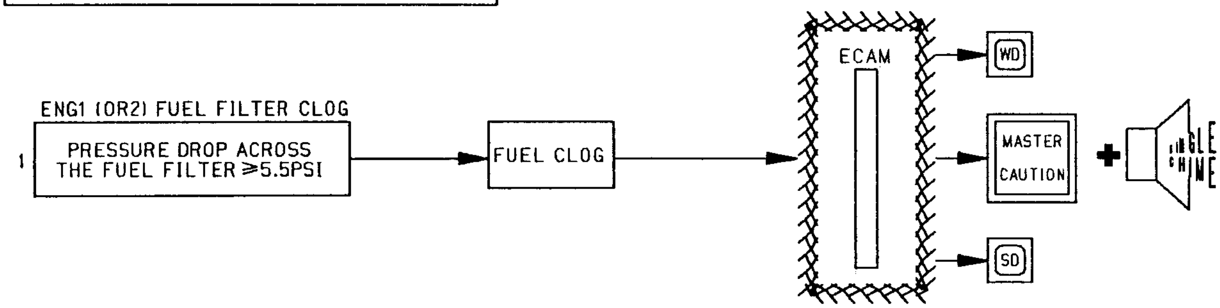
SYSTEM DISPLAY – ENGINE PAGE

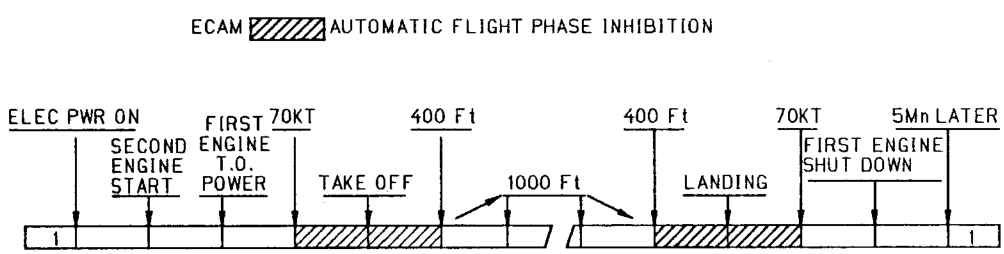


(1) FUEL Pressure Indication (green)

The FUEL pressure, measured at fuel pump interstage, is displayed on an analog scale graduated from 0 to 350 psi.

Note : Same indication is provided on the ENGINE START PAGE.





B0FC-01-1720-008-A035AA - R

SYSTEM GENERAL

The engine oil system provides the lubrication and cooling of engine and accessory gearbox bearings and gears.
The self-contained engine oil system consists of :

- Supply circuit, distributing oil to lubricated points and areas.
- Scavenge circuit, recovering oil after lubrication and returning it to the oil tank.

The main components of the oil system are :
- an oil tank,
- an oil pressure pump with associated filter, and bypass valve
- an air/oil heat exchanger with a bypass valve,
- a fuel/oil heat exchanger with a bypass valve,
- a temperature bypass valve,
- scavenge pumps,
- a deoiler and a deaerator.

SUPPLY CIRCUIT

The oil tank has a maximum oil capacity of 34,4 quarts (8.6 gallons or 36,77 liters).

From the oil tank, the single stage oil pressure pump forces oil through the main filter. If the pressure drop across the filter goes above 50 psi, the « OIL CLOG » light illuminates on the center pedestal associated with ECAM.
The oil by-pass is set to open at 90 psi.

The oil is then passed through an air/oil cooler and through a fuel/oil cooler. Pressure tappings at fuel/oil cooler outlet are used to detect high or low oil pressure conditions. Acceptable limits for oil temperature are between 163 ° C and 177 ° C for less than 20mn, or 177 ° C in transient conditions.
The FADEC commands the temperature bypass valve, which causes engine oil to bypass the fuel/oil cooler.

SCAVENGE CIRCUIT

Oil is returned to the oil tank by the scavenge circuit.
Oil collecting in the main bearing compartments and gearboxes is returned to the oil tank by use of individual scavenge pumps.
At the inlet of each pump is a chip detector.
The scavenge oil passes through a deaerator to remove the entraine air.

INDICATING

- oil quantity

  A transmitter located in the oil tank, sends an analog signal to the indicator. A recopy of the indicator is sent to the SDAC, where it is processed to be displayed on ECAM.

- oil pressure :

  A pressure tapping is provided at the fuel/oil cooler outlet, this pressure is sensed by a transmitter supplying a signal to the indicator and to the SDAC which processes it to display the oil pressure on ECAM

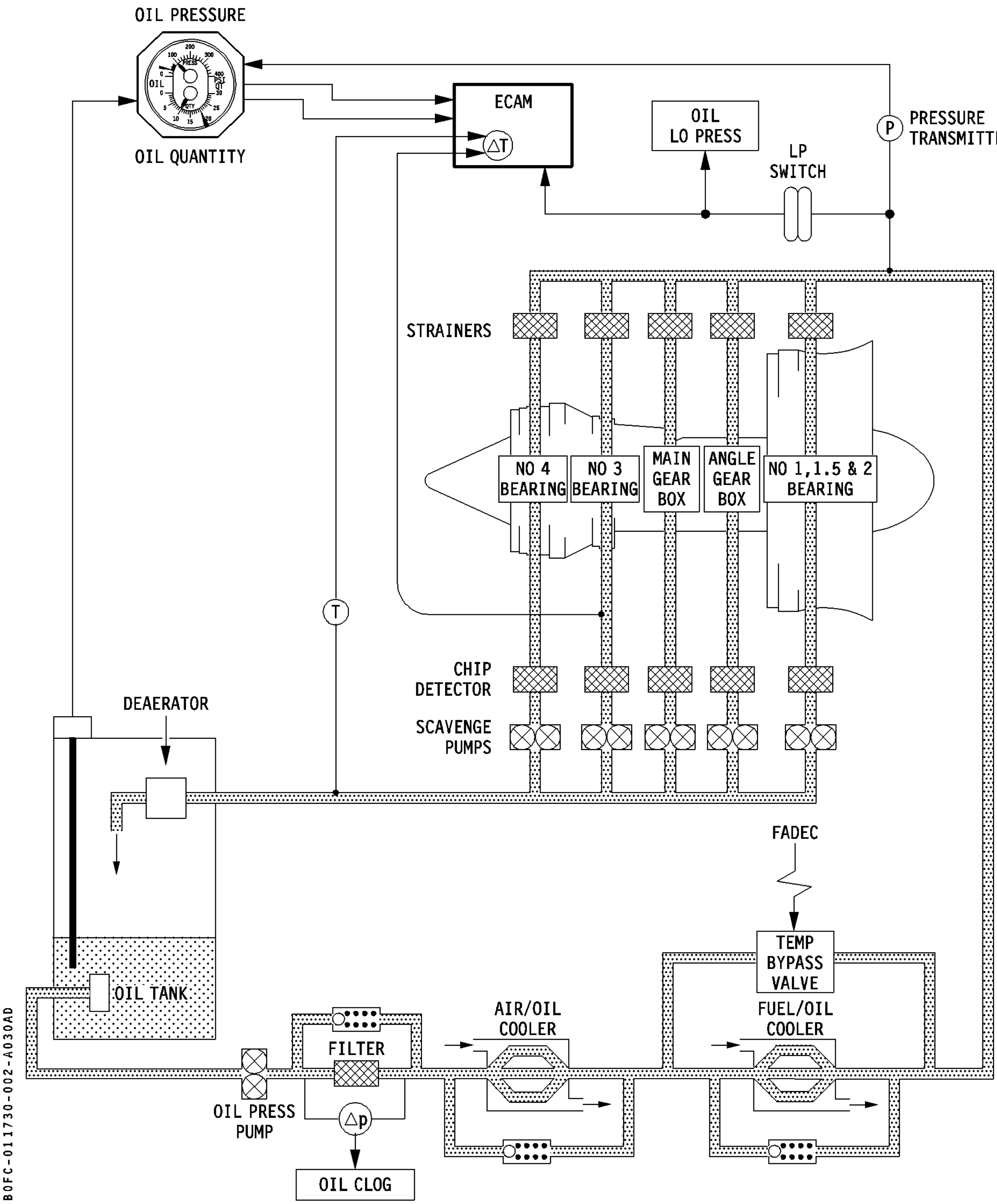
- oil temperature :

  Two immersed resistance probes are installed, one at the outlet of the n ° 3 bearing compartment and one on the scavenge line out of the engine.
  The probes resistance varies linearly with temperature.
  These signals are used by the SDAC and the SGU to generate digital signals displayed on the ECAM.

R

PW Eng. : 4000

SYSTEM GENERAL



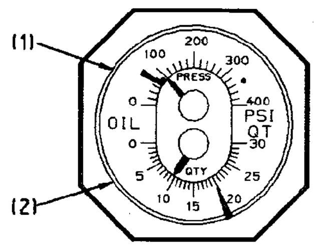
R

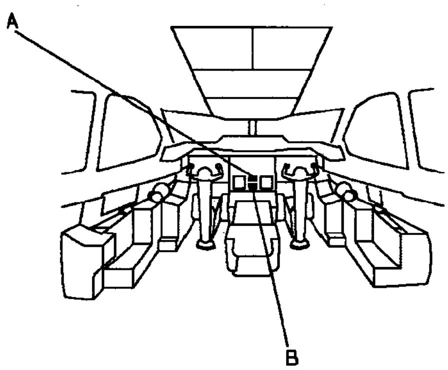
PW Eng. : 4000

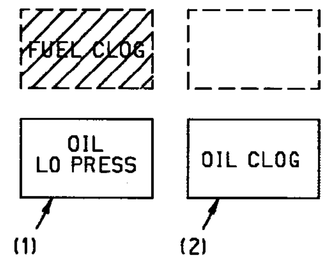
A. OIL QUANTITY AND PRESSURE INDICATOR

B. OIL WARNING

FB1.1730.003-AA.040







(1) Oil Pressure Indicator

Displays oil pressure of corresponding engine.
A red line indicates minimum oil pressure (70 PSI).

(2) Oil Quantity Indicator

Displays oil quantity in quarts (graduated from 0 to 30, effective range 0 to 26).
A white bug allows oil consumption to be monitored.

Note :
- *After engine start, the oil distribution to various engine parts results in a decrease in the indicated oil quantity (phenomenon known as the "oil gulping" effect).*
- *Compared to the pre-start indicated oil quantity, the following typical decrease in oil quantity readings can be observed :*
  – Idle operation : 6 to 8 quarts
R *– Flight operation : 9 to 14 quarts.*

(1) OIL LO PRESS lt.

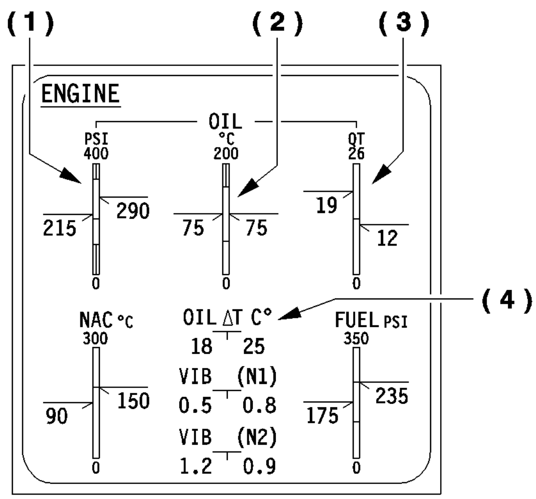
Comes on red, associated with ECAM, when the oil pressure reaches 70 psi ± 3 (decreasing pressure). It extinguishes when the pressure reaches 80 psi ± 3 (increasing pressure).
Inhibited when HP fuel valve lever on OFF position.

(2) OIL CLOG lt.

Comes on amber, associated with ECAM, when oil filter differential pressure exceeds 50 ± 2 psi by increasing value. It extinguishes when the differential pressure decreases below 40 psi ± 2.

SYSTEM DISPLAY – ENGINE PAGE

R



(1) Oil Pressure (green)

Oil pressure, (measured at the fuel / oil cooler outlet) is displayed on a linear scale from 0 to 400 psi.
It flashes when the pressure is $\leqslant$ 75 psi.
It becomes red when the pressure is 70 PSI or less.

Note : Engine 1 indication is replaced by amber "XX" if the associated input signal is lost.
Engine 2 indication drops to 0 if the associated input signal is lost.

(2) Oil Temperature (green)

Oil temperature, (measured on the scavenge line) is displayed on a linear scale from 0 to 200° C.
Above 163 C the indication flashes (green). Above 177° C, the indication becomes amber.

Note : Same indication is given on the CRUISE PAGE.

(3) Oil Quantity (green)

Oil quantity is displayed on a linear scale from 0 to 26 US quarts. Below 4 QTS the indication flashes.

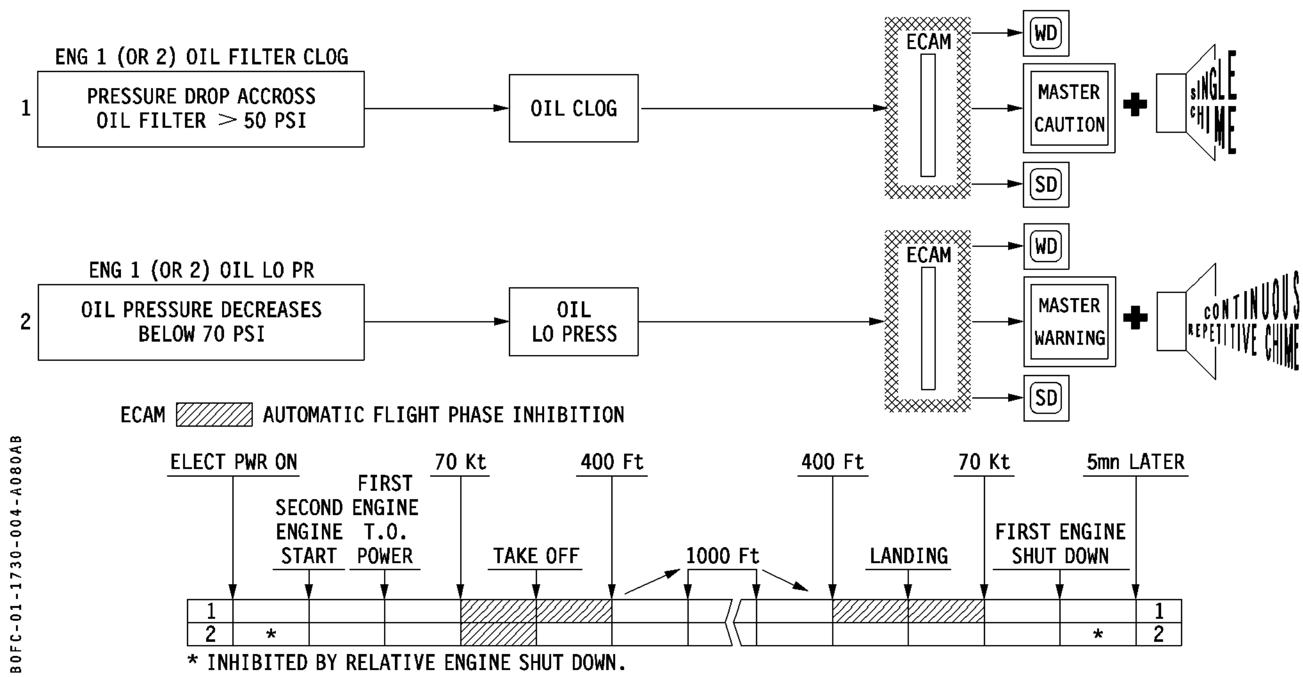
Note : Indication is replaced by amber "XX" if the associated input signal is lost.

(4) Oil Delta Temperature (green)

Oil Delta Temperature (measured between the oil outlet temp of the n° 3 bearing compartment and scavenge oil out of the engine) is displayed in digital format.
Above 44° C the indication flashes.

Note : All above indications are given on the ENG START PAGE.

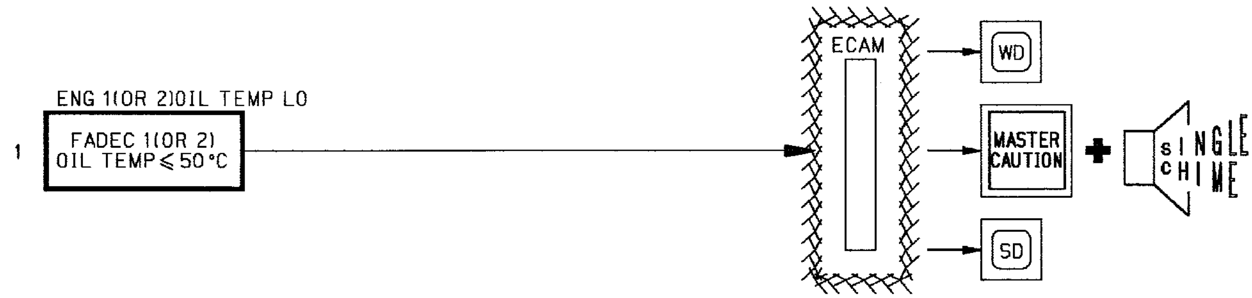
WARNING LOGIC

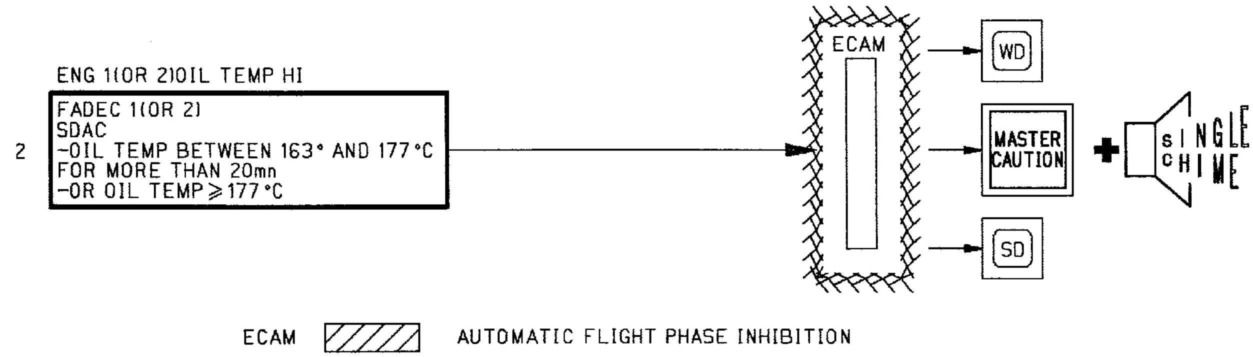


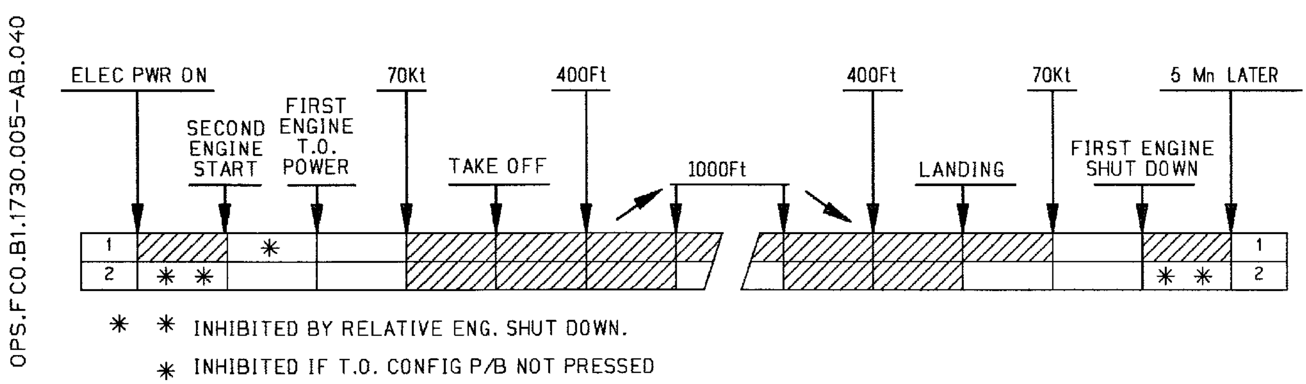
Mod. : 5051 + 5448 + 7259

PW Eng. : 4000

WARNING LOGIC (CONT'D)







R Mod. : 5051 PW Eng. : 4000

SYSTEM GENERAL

Bleed air is provided for three separate systems :
- Engine service,
- Engine surge protection,
- Airframe service.

TURBINE CASE COOLING

The exterior surface of the HP and LP turbine cases are cooled with engine fan discharge air to control turbine tip clearance. The Turbine Case Cooling Actuator position is scheduled as a function of altitude and high rotor speed (N2) by the Full Authority Digital Engine Control (FADEC).

Note : *In the event of an electrical or pneumatic failure, the system is design to fail safe in the closed position so that no fan air is discharged on the turbine cases.*

HP TURBINE COOLING

12th stage HP compressor air is used for internal cooling of HP turbine blades and vanes.

ENGINE SURGE PROTECTION

Bleed ports are provided between the LP and HP compressors (Station 2.5) and after the 9th stage of the HP compressor to assist in maintaining overall compressor section stability during transients and steady state operation. The bleeds are scheduled as a function of Thrust Lever Angle, LP rotor speed (N1), HP rotor speed (N2), Mach number, engine inlet total temperature (T2) and altitude by the FADEC.

The two 9th stage Compressor Stability Bleeds are used to facilitate engine starting.
The bleeds are controlled as a function of HP rotor speed (N2) and engine inlet total temperature (T2) by the FADEC.

VARIABLE STATOR VANE SYSTEM

The variable Stator Vane system positions the compressor variable vanes to the angles necessary to provide optimum compressor efficiency at all engine speeds.
Fuel pressure is used as the hydraulic power to operate the stator vane actuator.
The FADEC controls this system as a function of LP rotor speed, HP rotor speed and engine inlet total temperature.

ROTOR HEAT CONTROL MANAGEMENT

The Rotor Heat Control system controls air flow to the interior of the HP compressor rotor. The flow of 9th stage compressor air to the rotor interior is controlled as a function of HP rotor speed (N2) and altitude by the FADEC.

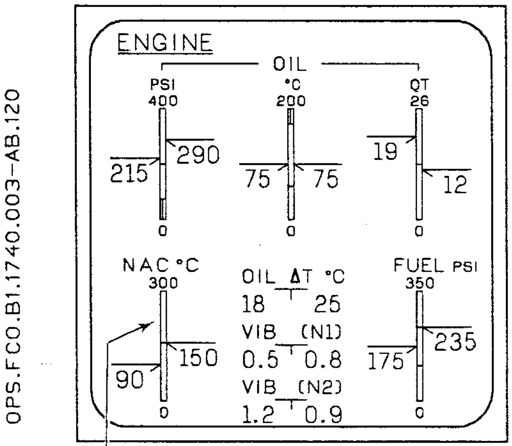
INDICATING

- *Nacelle Temperature Indicator*

  Nacelle temperature is provided by sensing elements which generate a signal to the SDAC. This signal is processed to be displayed on the ECAM except during starting when it is replaced by bleed pressure.

LEFT INTENTIONALLY BLANK

SYSTEM DISPLAY – ENGINE PAGE



(1)

(1) Nacelle temperature (green)

The nacelle temperature is displayed on a vertical scale, in ° C.
Above 230° C, the indication flashes.

LEFT INTENTIONALLY BLANK

Reverse thrust is obtained by reversing the fan airstream. It can be used on ground only and is controlled from the cockpit by operation of the reverse thrust control levers.

The FADEC interfaces with the Thrust Reverse System to provide Thrust limiting during any reverser transition. It maintains engine power setting at idle as long as the reverser is in transition or in case of inadvertent deployment or stowage.

In case of an uncommanded thrust reverser deployment, two safety features are available :

– An auto-restow function which immediately opens the pressure regulating and shut off valve to pressurize the thrust reverser system and restow the reverser as soon as any reverser sleeve leaves the stow position.
– Automatic fuel cut back to idle as soon as the sleeve deployment is detected by the FADEC.

The thrust reverser system employs a two position (stowed/deployed) pneumatically actuated translating sleeve/cascade/blocker door type reverser.

Pneumatic power for thrust reverser operation is provided by 15th stage HP compressor bleed air.

When reverse thrust is selected the locks of each reverser master actuator are released and both translating sleeves on the engine are moved aft on tracks by the airmotor and the actuators, exposing the fixed position cascade. Simutaneaously, twelve blocker doors are extended into the fan air stream to block the normal fan air flow path.

With the blocker doors deployed, the fan air flow is directed outboard through the fixed cascades which deflect the flow in an outward and forward direction.

After receipt of a reverser stow signal from the reverse thrust control lever, the translating sleeves, with attached blocker doors, move forward to cover the cascades resulting in the normal forward thrust fan air flow and cowl configuration.

For indication of reverser status « REV » (reverser deployed) and a « REV UNLK » (reverser unlocked) lights for each engine are provided on the center instrument panel.

OPERATING SEQUENCE

The translating sleeves are held in the stowed position by a brake in the pneumatic drive unit, which prevents air motor rotation and resulting reverser translation.
Normally the brake release chamber is depressurized and in addition, the brake is spring-loaded in the brake applied position.

A system secondary locking function is incorporated into each reverser master actuator. The master actuator locks function only in the reverser stowed position. The pressure regulating and shutoff valve and the rotary valve are closed. The system is vented.

In addition, an independent electrically controlled locking device is fitted on the reverser system.
One lock is fitted on each sleeve. Locks are commanded by a dedicated aircraft wiring independent from the other reverser controls.

When scheduled operating conditions for reverse thrust are met – aircraft on ground/throttle levers at idle – the reverse thrust control lever is unlocked and can command the thrust reverses operation.

Compressed air is routed to the rotary valve :
– to the latch operating valve in order to unlatch the air motor
and
– to the latch actuators in order to unlatch the translating sleeves.
Unlatching of any of the three latches will cause the « REV UNLK » light to come on.

The electrical locks are released to permit reverser operation when all conditions are met :
– throttle lever selected to the reverse position, and
– aircraft on ground.

The translating sleeves are driven to the deployed position by the air motor and flexshafts, uncovering the cascade vanes and rotating the blocker doors into the fan air duct.

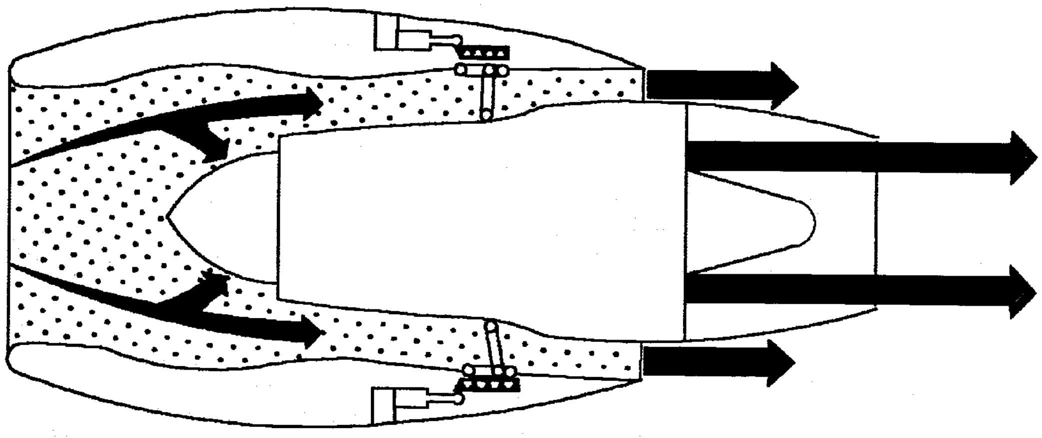
The FADEC restricts engine power to idle while the reverser travels from the stowed position to a position beyond the null thrust point. From this point the FADEC allows a progressive increase in engine power. Once the reverser is 90 % or more deployed, the FADEC schedules power in accordance with the reverse thrust control levers setting.

When both translating sleeves are accurately stopped in the deployed position, electrical signals are sent by the reverser to activate the « REV » green light, while the « REV UNLK » light is switched off.

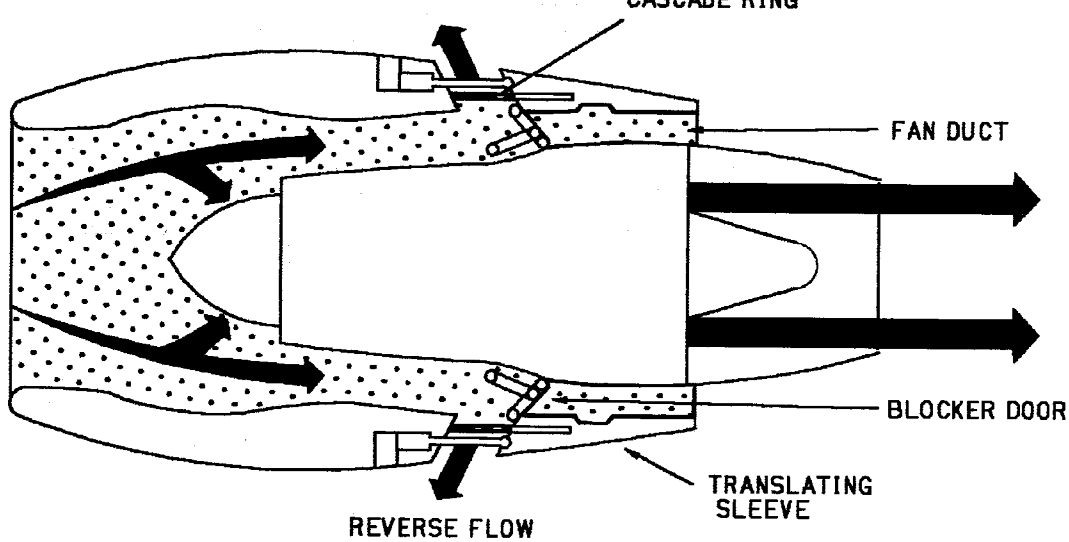
To terminate reverse thrust operation the reverse thrust control lever is placed in the forward thrust position (Forward full down). The translating sleeves are driven to the stowed position, rotating the blocker doors back into their recesses and covering the cascade vanes. They are latched at the end of travel.

During stowage the « REV » light goes off and the « REV UNLK » light comes on until the three latches are engaged and both stow switches signal the stowed position.

In normal reverser stow operation, the FADEC restricts engine power to idle while the reverser travels from the deployed position to a position less than the null thrust point. From this point the FADEC allows, a progressive increase in engine power if the throttle levers are in the forward region. Once the reverser is less than 10 % deployed, the FADEC will schedule forward thrust in accordance with the thrust control levers setting.



STOWED (VIEW LOOKING DOWN)

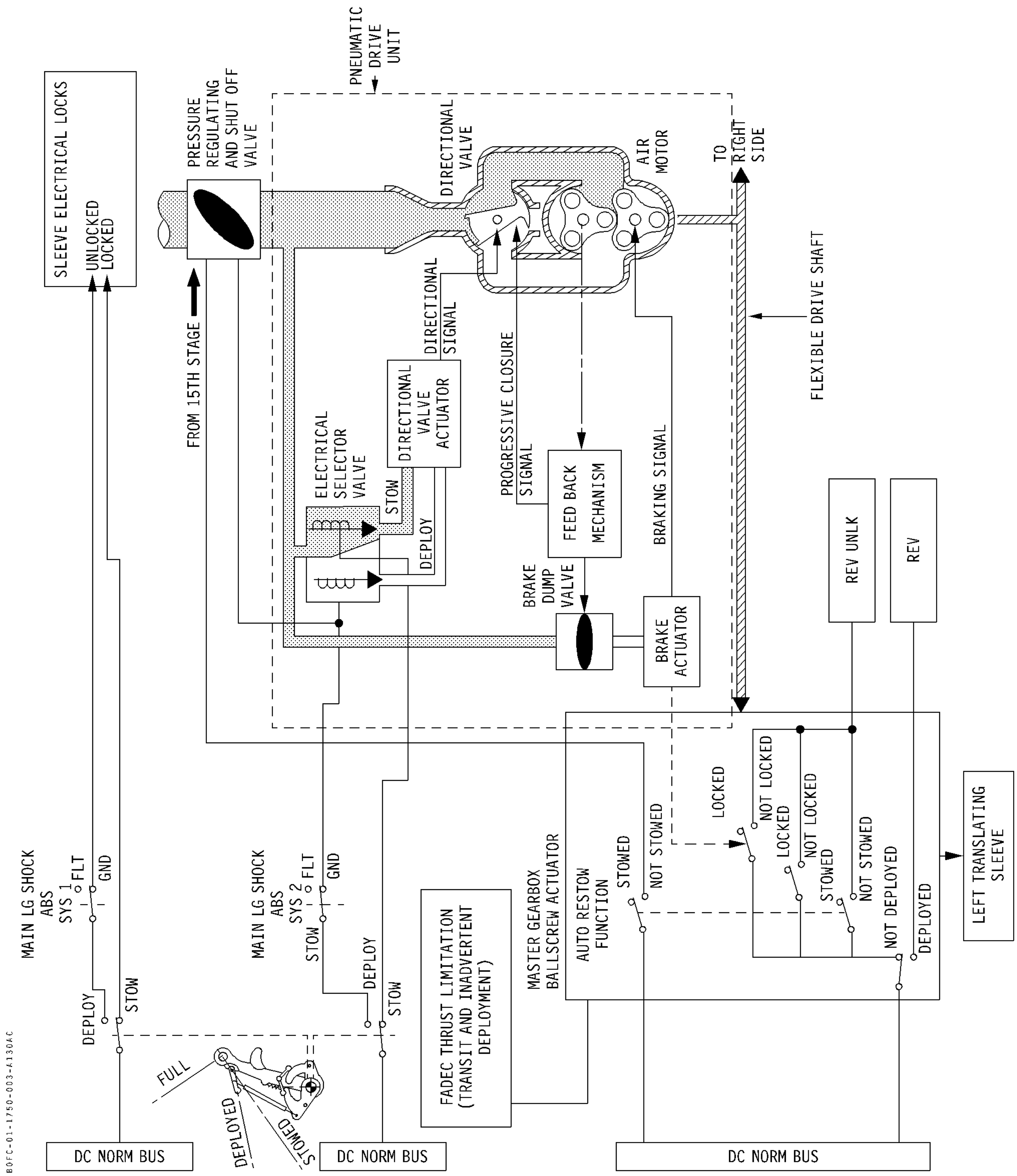


DEPLOYED (VIEW LOOKING DOWN)

OPS.FCO.B1.1750.002-AA.020

PW Eng. : All

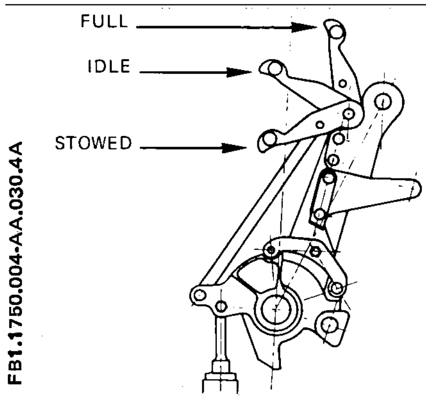
SYSTEM GENERAL



Mod : 12262

PW Eng. : 4000

A. REVERSE THRUST CONTROL LEVERS



When the throttle levers are not at idle, the reverse thrust control levers are mechanically locked in the stowed position. A movement of the levers when the aircraft is not on ground, is ineffective.

When throttle levers are at idle an action on the unlocked reverse thrust control levers is possible to command the thrust reversers operation.
A « hard point » is incorporated in the throttle linkage to indicate to the crew the reverse idle position.

In this position, with main landing gear struts compressed :

- translating sleeves move rearward,
- REV UNLK lights come on.
- The FADEC logic maintains an approach idle.

For reverse thrust application the reverse thrust control lever is pulled rearward as required. The FADEC restricts engine power to idle while the sleeves travel from the stowed position to a position beyond the null thrust point, then it allows a progressive increase in engine power.

Once the translating sleeves are 90 % deployed :

- REV lights come on,
- REV UNLK lights go off.
- The FADEC schedules power in accordance with the throttle levers position.

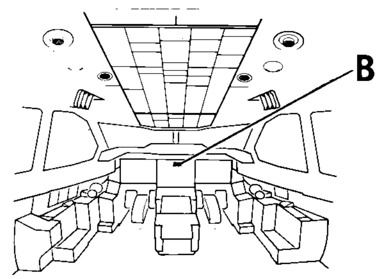
For stowage of thrust reversers the levers are moved forward then pushed down. During translating sleeve travel,

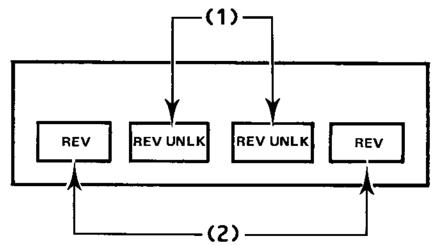
- REV lights go off,
- REV UNLK lights come on.
- the FADEC restricts engine power to idle.

When the translating sleeves are in the stowed position and the thrust reverser system is latched, the REV UNLK lights go off.

Note : *The FADEC will restrict the power to idle, if thrust reversers are not stowed, whatever the position of reverse thrust control lever is.*

B. THRUST REVERSER LIGHTS





The thrust reverser lights indicate the operation status of the thrust reverser systems. When all lights are off, the translating sleeves are in the stowed position, the systems are latched.

(1) REV UNLK Lights

A light comes on amber when,

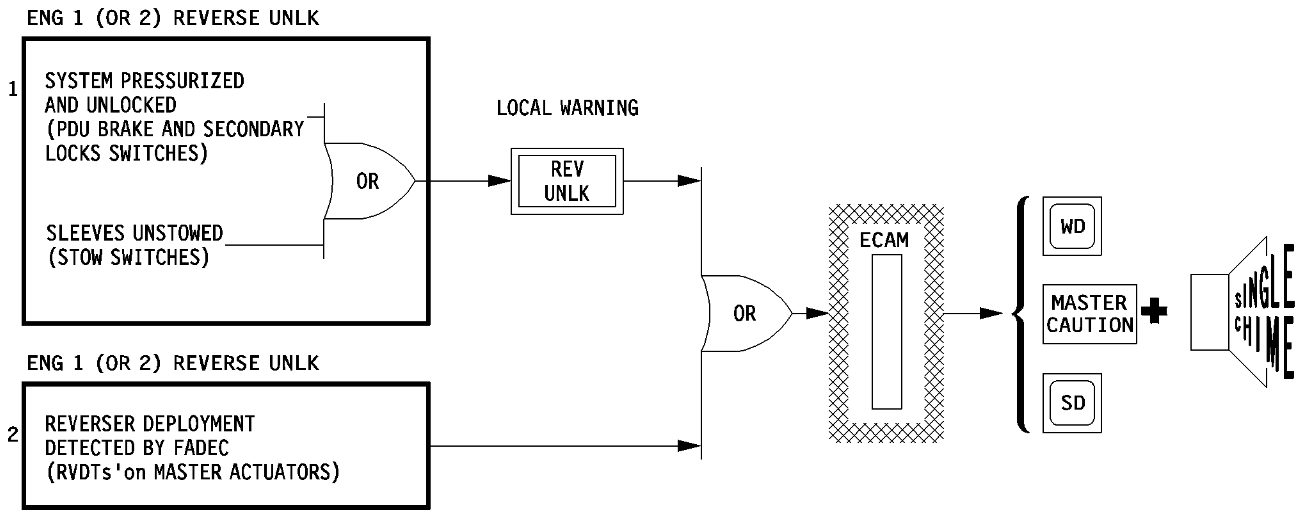
- the related thrust reverser system is unlatched
- the translating sleeves travel between the stowed position and 90 % of their travel or vice versa.

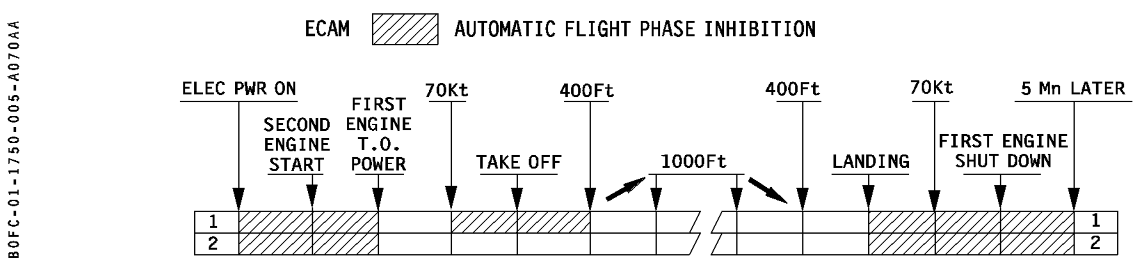
(2) REV Light

A light comes on green when,

- the translating sleeves of the related thrust reverser system are beyond 90 % of their travel.

WARNING LOGIC





Mod. : 5051

PW Eng. : 4000

ENGINE IGNITION SYSTEM

The ignition system initiates or sustains combustion of the fuel / air mixture in the annular combustion chamber.

The system consists of two physically and electrically independent indentical circuits.

Each system (A or B) is composed of :

– A high energy ignition exciter,
– An exciter-to-igniter plug lead,
– An igniter plug.

A system is electrically supplied by AC normal bus, B system is electrically supplied by the AC emergency busbar.

Monitoring of ignition system is done from the ENG panel on the overhead panel. An ignition selector allows the crew to select either one or both systems, as required, provided that the corresponding HP fuel lever is in ON position. The switching is as follows :

– With IGNITION selector in OFF or CRANK position no ignition system is powered for any engine, the OFF position is the normal position while CRANK is used for wet or dry motoring.
– With IGNITION selector in START A position, A systems for engine 1 and 2 are activated, provided that the corresponding HP fuel lever is in ON position and N2 below 45 %.
– With IGNITION selector in START B position and the same conditions as above, B systems for engine 1 and 2 are activated.
– With IGNITION selector in CONT RELIGHT position, both A and B systems of each engine are activated, provided that the HP fuel lever is in ON position. Selection of continuous relight is recommended every time the operating conditions can cause an engine flame out and for inflight relight. But to prolong the service life of the ignition system components, it is recommended to limit the usage of continuous relight. The CONT RELIGHT position is indicated on the MEMO page of the ECAM system.

ENGINE STARTING SYSTEM

Each engine is equipped with an air turbine starter and a start valve. The starter drives the HP rotor for engine starting or for ventilation. The start valve admits air supplied by the pneumatic system to operate the starter, whereas the pneumatic power source can be :

– Either an external ground power unit
– or the APU
– or the other operating engine (via the pneumatic cross bleed valve).

The start valve is opened when the related « START » switch is depressed, provided that the IGNITION selector has been set. The start valve open position is indicated by the blue light « OPEN » in the related « START » switch.

When the FUEL LEVER is selected « ON » ignition and fuel flow is initiated, and the engine continues to accelerate (provided that the ignition selector position is A, B or CONT RELIGHT).

When N2 reaches 45 %, the start valve will be commanded to close, and the starter disengaged.
Latest the engine reaches ground idle, the start valve will be fully closed.

On ground, as long as the IGNITION selector position is START A, START B or CRANK, the pack valves are closed.
In flight, pack valves are closed only when a start valve is open.
This situation is indicated to the crew by the ARM lights, which extinguish during starting sequence but illuminate again when both engine N2 are above 45 %.
If the selector position is CONT RELIGHT, the pack valves are closed by the latching of one of the two START pushbuttons. In this case, each ARM light is illuminated when the relevant N2 is lower than 45 % (except if the relevant start valve is controlled open).

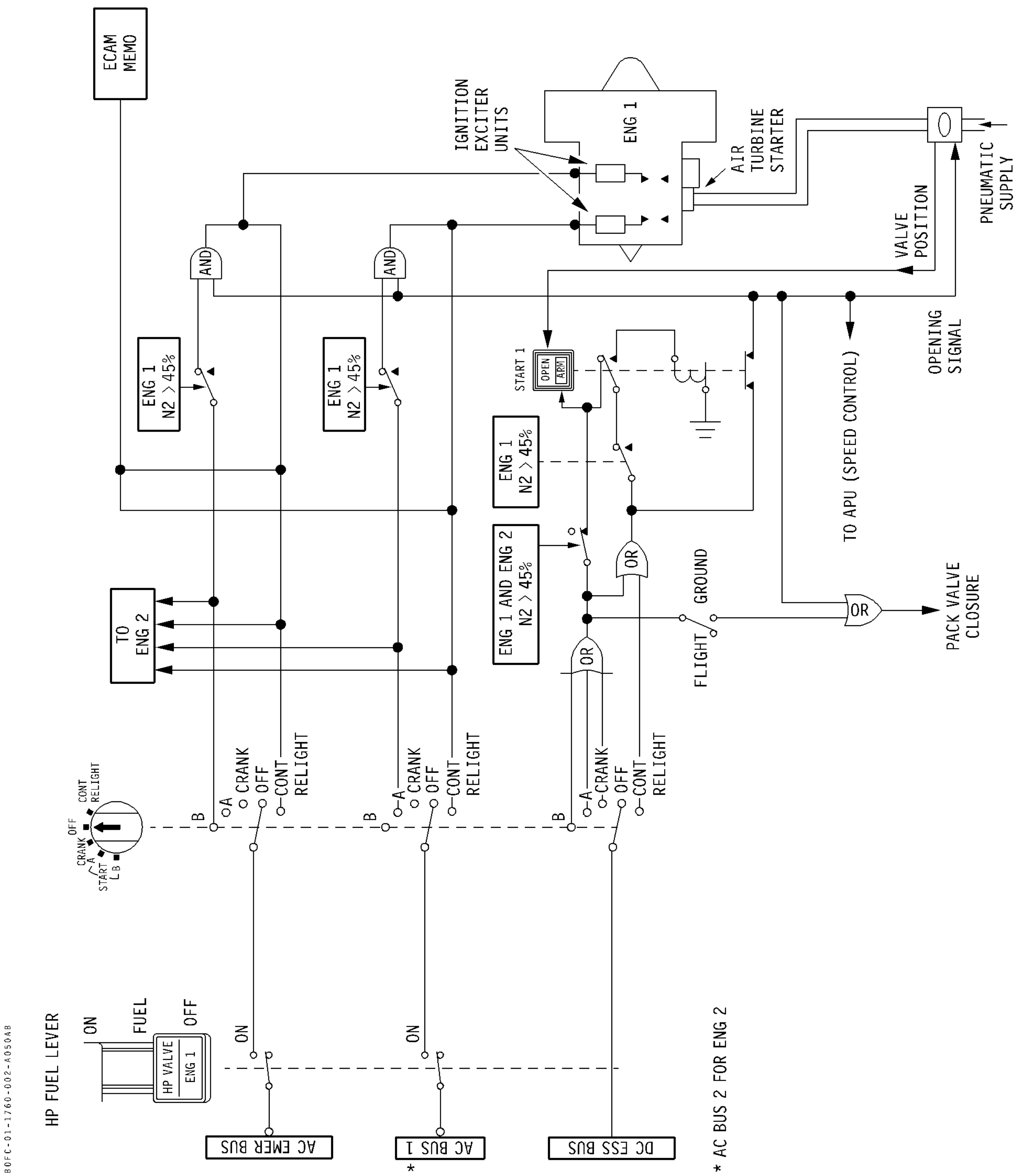
In case of latching failure, the START button can be manually maintained depressed.
On the ground, the start valve can be manually operated in case of start valve solenoid failure.
Starting air pressure indication is provided by the « PRESS » indicator on the air bleed section of the overhead panel.

The FADEC schedules operation of the Compressor Stability Bleed Valves to aid starting and schedules fuel flow during an engine start.

STARTING SEQUENCE

	START 1 (2) PB SWITCH	Ignition	Start valve	Pack valves	Remarks
IGNITION SELECTOR Start A or Start B	ARM illuminates	off	closed	closed on ground, open in flight	Authorizes START 1, START 2 pb sw LATCHING
ENG START ON	pb sw latched, OPEN illuminated, ARM extinguished	off	open	closed	– APU accelerates – N2 increases
FUEL LEVER ON	ditto	on	open	closed	Fuel flow
N2 45 %	ARM illuminated (if both engine N2 above 45 %)	off	start to close	closed on ground, start to open in flight	
Engine AT G.I.	OPEN extinguished	off	closed	closed on ground, open in flight	
IGNITION SELECTOR OFF OR	pb sw trips ARM extinguished	off	closed	open	
CONT RELIGHT	ditto	on	closed	open	

SYSTEM GENERAL

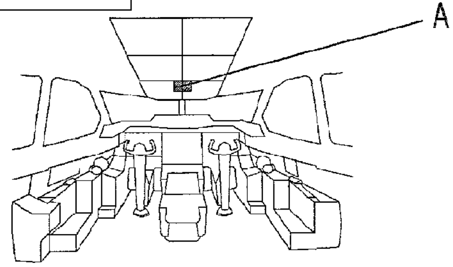


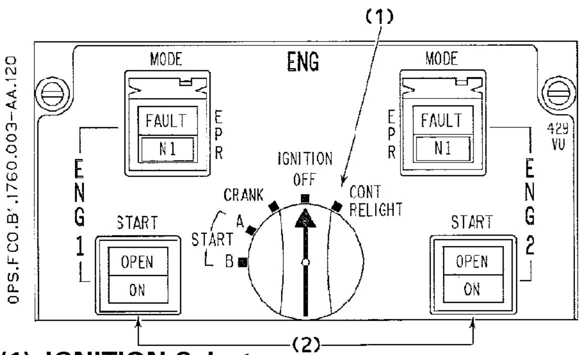
R

Code : 0008

PW Eng. : 4000

A. ENG PANEL





(1) IGNITION Selector

The setting of the IGNITION selector is a precondition for the activation of the starting or motoring sequence, and selects the ignition mode. The START switches will only be magnetically latched, when the IGNITION selector is in an appropriate position.
On ground, if the IGNITION selector is on START A, START B or CRANK position, the pack valves are controlled closed.

- **CRANK** : Ignition inhibited, START switches latching authorized. Engine can be ventilated.
  Note : After an unsuccessful start attempt on ground, the selector is set to CRANK position to inhibit ignition. Engine to be ventilated to evacuate fuel vapors.

- **START A (B)** : Ignition circuit A (B) selected. START switches latching authorized. The white « ARM » light illuminates on each « START » switch.
  Ignition is energized when the ENG FUEL lever is set to ON in the starting sequence. Ignition is automatically deactivated, when N2 reaches 45 %.

- **CONT RELIGHT** : Ignition circuits A and B selected for continuous ignition, which is energized as long as the ENG FUEL lever is in ON position.
  If an engine is below 45 % N2, the relevant START switch latching is authorized and related ARM light illuminates.

- **OFF** : Ignition circuits de-energized. Starting sequence disarmed or interrupted.
  If START switches were latched, they automatically trip.

(2) START pb switches

- No light (switch released-out) latching inhibited.

- **ARM light** (switch released-out) illuminates white before starting sequence when :
  The IGNITION selector is not in OFF position. The switch can be latched.

- **OPEN light** (switch depressed-in) illuminates blue :
  The starting sequence of the relevant engine is initiated by opening its start valve. The switch trips when the start valve is controlled closed, i.e., when N2 is above 45 %. The light extinguishes when the start valve is fully closed.

- **ARM light** (switch released-out) illuminates after starting sequence when :

  . The IGNITION selector is on START A, START B or CRANK position and both engine N2 are 45 %. (Both ARM lights illuminate then together).

  or

  . The IGNITION selector is on CONT RELIGHT position and the relevant N2 is lower than 45 %.
  This indicates the starting sequence of the relevant engine was not successfull.

Note : With start valve OPEN, pressing and releasing out the pb switch closes the selected start valve and allows pack valves re-opening (regardless of the achieved N2 during start sequence). R R R R

EPR indication :

The primary parameter for engine thrust control is the actual Engine Pressure Ratio (EPR). This is the ratio of turbine discharge total pressure (PT4.95) to compressor inlet total pressure (PT2).
The two PT4.95 probes are manifolded together to give an averaged PT4.95.
This pressure is routed along the engine to a PT4.95 inlet port on the FADEC.
In the fan inlet, at top dead center, a combined PT2/TT2, probe measures the fan inlet total pressure PT2. This pneumatic signal is routed to the PT2 inlet port of the FADEC.
These pneumatic signals are sensed by pressure transducers which convert them into frequency signals.
These signals are processed internally by the FADEC to provide, a digital signal proportionnal to actual EPR : PT4.95/PT2.
Two signals are supplied to the EPR indicator, by both channels of the FADEC. A logic is implemented in the indicator to select the source of information.

EGT indication :

The total temperature of the Low Pressure discharge gas flow (TT4.95) is indicated as exhaust gas temperature (EGT). A thermocouple is fitted in each of the four TT4.95 probes. Readings from the thermocouples are collected at a common junction box, and averaged.
The averaged signals are provided to both channels of the FADEC.
These signals are processed by the FADEC to give two digital signals proportional to the EGT, to the indicator.
A logic is implemented in the indicator to select the source of information.

Note : *The EGT indication is not available when FADEC is not power supplied, i.e :*
- *During engine start, between action on START push-button until engine reaches 5 % N2,*
- *5 minutes after the 2nd engine shutdown.*

RPM indicating :

The rotational speeds of LP rotor (N1) and HP rotor (N2) are indicated as percentage of defined nominal RPM values.

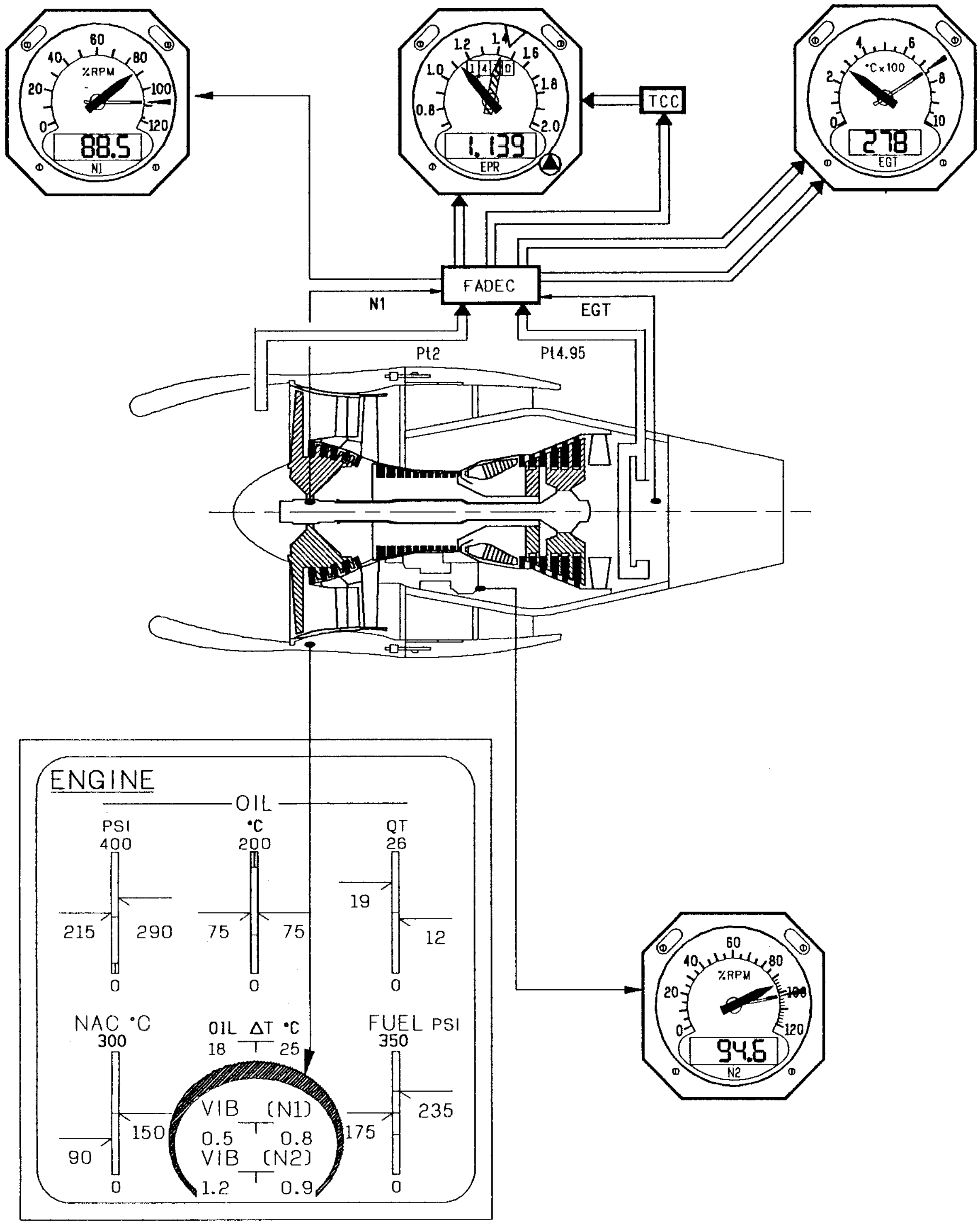
N1 :
A sensor, installed on the fan case generates a frequency signal proportional to the fan blade passage. This signal is sent to each channel of the FADEC. Channel B analog output is sent to the N1 indicator (100 % N1 = 3 600 RPM).

N2 :
The HP rotor speed is provided by the FADEC Permanent Magnet. Alternator (PMA), mounted on the accessory gearbox, through a dedicated winding.
The signal is directly sent to the N2 indicator (100 % N2 = 9 900 RPM).

Vibration monitoring

An accelerometer is fitted on the fan case and senses the vibrations induced by both Low and High rotor assemblies. The signal is transmitted by coaxial cable to an amplifier located in the electronics bay.
This amplifier also receives both N1 and N2 signals coming from the relevant transducers. These speed signals are used to set the central frequencies of narrow band filters which process the accelerometer signal and give two analog signals to be used by the SDAC as input for the ECAM display.

ENGINE INDICATING

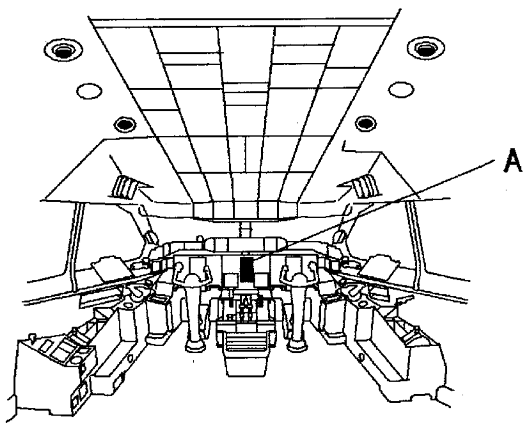


OPS.FCO.B1.1770.002-AB.030

R

PW Eng. : 4000

LOCATION OF CONTROLS



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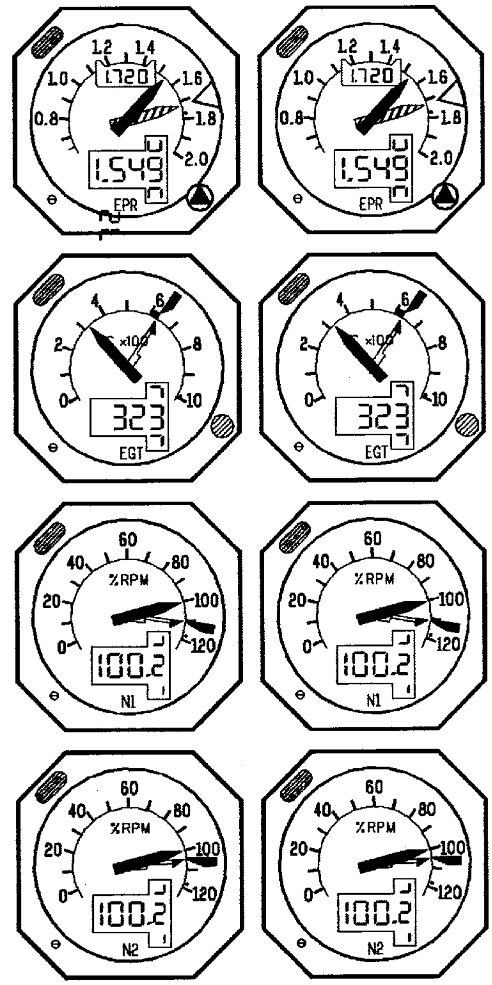

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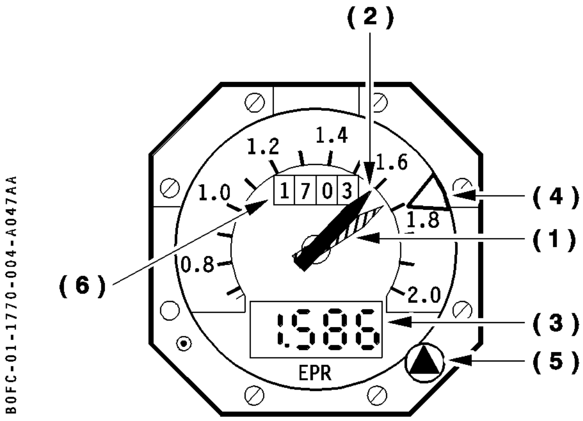
EPR INDICATOR



(1) EPR command pointer :

EPR command (TLA position) is displayed by a black and white pointer.

(2) Actual EPR pointer :

Actual EPR is displayed by a white pointer.

(3) Lower digital counter :

Actual EPR is displayed.

(4) EPR LIMIT index :

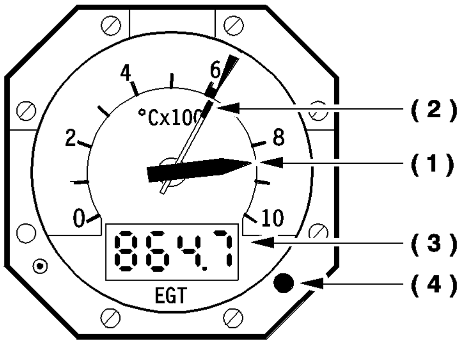
EPR limit is indicated by the yellow bug.

In manual mode, the bug is controlled by the index Mode Selector Knob (5), which is pulled out.
In this case EPR limit is displayed in digital format by the upper counter (6).

In automatic mode, the bug is controlled by the TCC. The knob is pressed in and the upper counter is blank.

Notes : – *In case of electrical power supply failure, EPR command pointer and EPR limit index remain in last position ; EPR actual pointer is at the lowest value (0.65), the counter is blank.*
– *In case of signal failure both pointers show the lowest value (0.65).*
– *In case of EPR limit signal loss the code AF (Auto Fail) is displayed on the upper counter (6).*

EGT INDICATOR



The analog scale is marked by a yellow arc from 600°C to the limit temperature and a red radial at limit temperature (625°C).

(1) Pointer :

Displays EGT (Shows the lowest value in case of electrical power supply failure or signal failure).

(2) Overtemperature pointer :

Normally on the red radial, indicates the maximum EGT obtained in case of overtemperature.
It is reset by pressing the MAX pointer reset pushbutton on the maintenance panel.

(3) Digital counter :

Displays EGT.

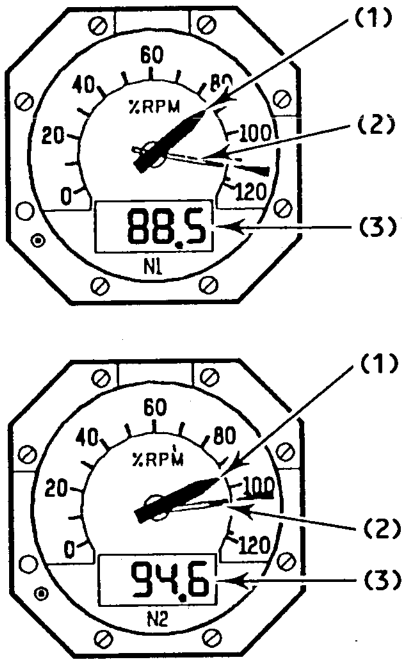
(4) Warning light :

Illuminates amber, associated with ECAM, when EGT reaches 625°C.

Note : Due to the design of the EGT indication system, the warning light may illuminate starting from 621°C. R R R

PW Eng. : 4152

N1 – N2 INDICATORS



FB1.1770.005-AA.040

The scale is marked by a red radial at 111.4 % for N1
104 % for N2

(1) Pointer

Indicates N1 (N2).

(2) Overspeed pointer

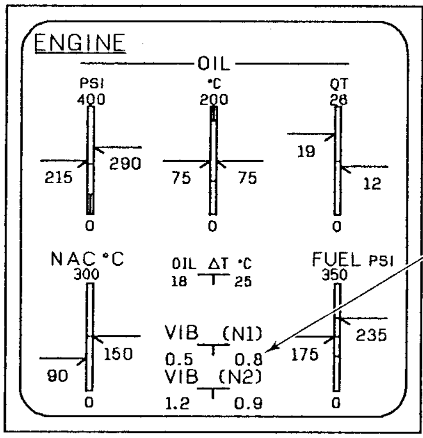
Normally on the red line, indicates the maximum value obtained on case of overspeed. It is reset by pressing the MAX pointer reset button on the maintenance panel.
In case of N1 or N2 overspeed, the ECAM is activated.

(3) Digital counter

Displays N1 (N2).

PW Eng. : 4152

SYSTEM DISPLAY – ENGINE PAGE



(1) Vibration Indication (green) :

The engine vibration is displayed with two digital values from 1 to 10.

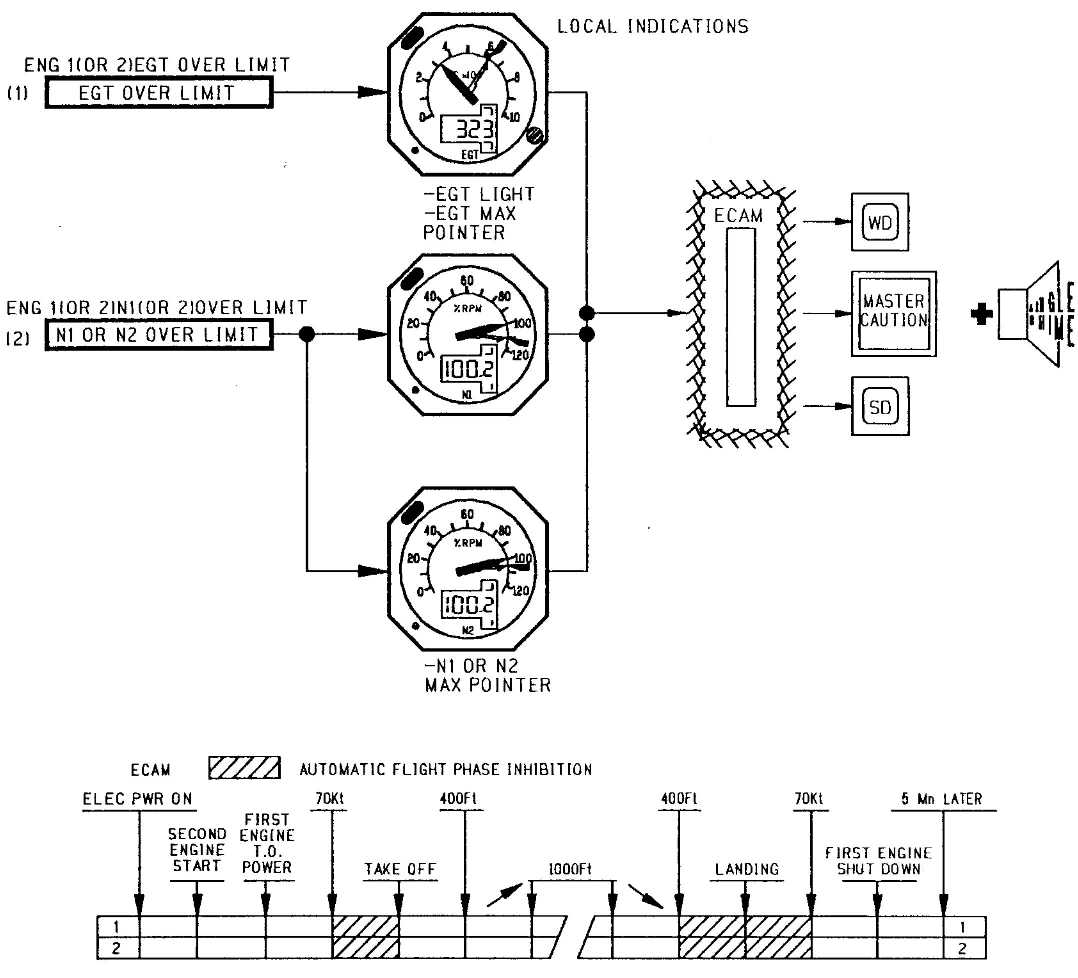
– N1 VIB : value sensed by the N1 tracking filter. Above 3, the indication flashes.

– N2 VIB : value sensed by the N2 tracking filter. Above 5, the indication flashes.

10 corresponds to a velocity of deplacement of 6 in./s

Note : Same indication is displayed on the ENG START PAGE, and on the CRUISE PAGE.

WARNING LOGIC



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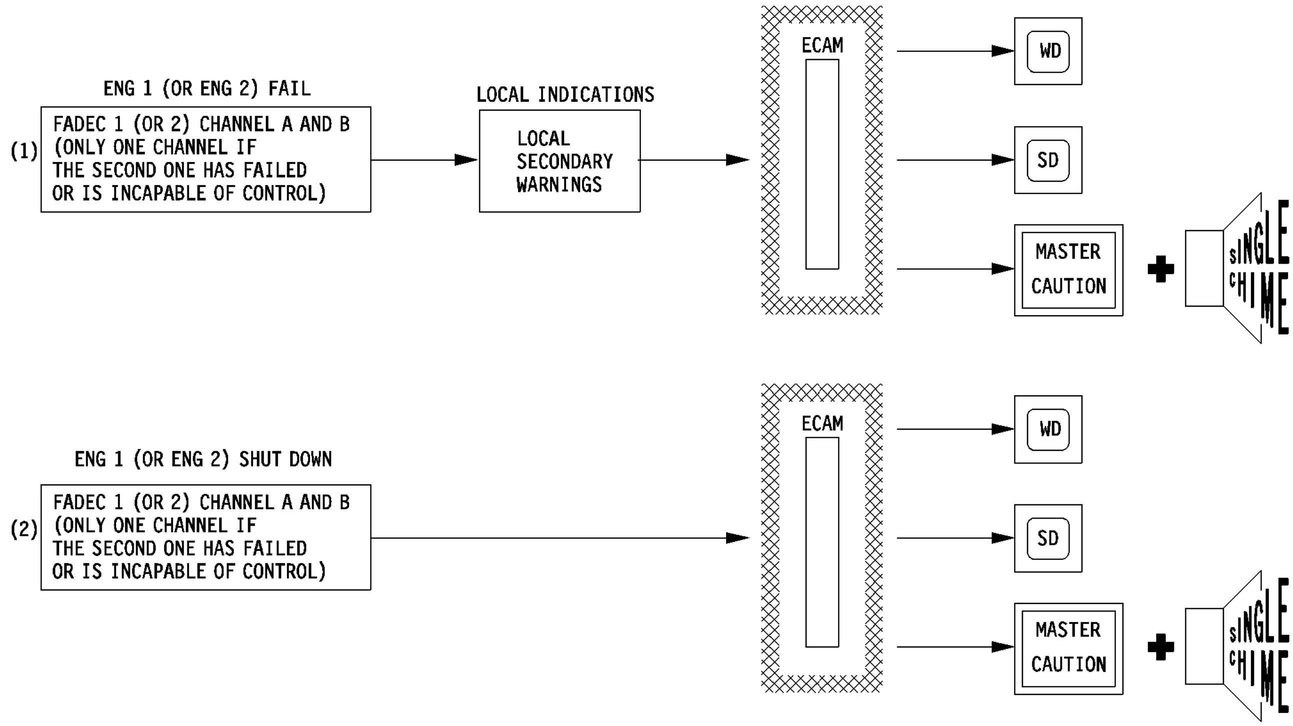
R Mod. : 5051 + 5448 PW Eng. : 4000

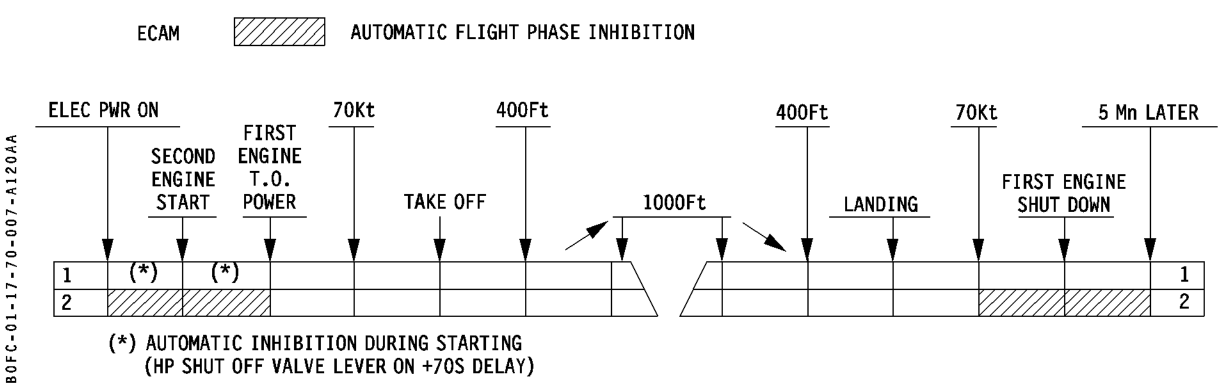
WARNING LOGIC

R
R R R R R R R R R R R R



R

R R R R



R Mod. : 5051 + 5725 PW Eng. : 4000

THRUST CONTROL COMPUTER

The TCC is included in the Automatic Flight System.
It computes the EPR limit according to the mode selected on the TRP, and takes into account the following parameters : Altitude, Mach number, Total Air Temperature, anti-ice and airbleed conditions.
TCC displays this EPR limit on the TRP, and sets the limit bug on the EPR indicators.
The autothrottle is controlled by TCC signals.
When it has been armed and A/THR is selected on the FCU, the following modes are available :

- a SPEED/MACH mode (allowing acquisition and then holding of the reference value).
- a THRUST mode (slaving the EPR to the EPR limit computed by the TCC, or to the EPR target given by FMC),
- a RETARD mode (which commands the throttle retraction on idle position).

FULL AUTHORITY DIGITAL ENGINE CONTROL (FADEC)

The FADEC is a fan case mounted air cooled and vibration isolated control system.
The FADEC assembly includes two independent control channels (A and B). Each channel has its own inputs, outputs and power supply, but data are crosstalked between the two channels for comparison and redundancy.

The FADEC is electrically supplied by a dedicated dual-output Permanent Magnet Alternator (PMA) mounted on the accessory gearbox. In addition two aircraft generated 28 Volt DC inputs are provided to each channel, one is used to power various solenoïds, the other is used to power the FADEC for test purpose when the engine is not running.

The FADEC provides :

- basic engine control functions (starting, idle, acceleration, deceleration, stability and thrust control).
- optimized engine efficiency (anti-surge bleeds, variable stator vanes, compressor clearance control, automatic turbine rotor clearance control, cooling airflow).
- engine accessory control (heat exchanger valves).
- engine protection (critical speed and pressure limiting,
R thrust limiting, and overboost protection, surge detection,
R accomodation and recovery).
- maintenance information.

It ensures also its self testing.

The FADEC system is able to work without any aircraft data or signal, including power supply, with the exception of the throttle lever position necessary to modulate the thrust.

Code : 1780C

Self test and fault isolation

The FADEC system can accommodate both single and multiple failures with no loss in performance or operational capability. This is possible by use of redundancy in all critical functions, by detection of hardware and software faults, by validation test of each input and by logic which accommodates detected faults by reconfiguring the system to use redundant features.

Modes characteristics

Each channel of the FADEC has two control modes.

The primary control mode normally used is the EPR mode. In this control mode the FADEC contains all the engine thrust setting curves to provide automatic thrust ratings. In case of inability for the system (after failure) to control in primary control mode, an alternate mode is used : N1 mode. This mode is non rating mode with the power setting done manually.

Thrust management and rating control.

According to the Thrust Lever Angle (TLA) signal coming from the throttle lever, the FADEC computes the EPR CMD, based on T2, altitude, Mach number, and air conditioning and anti-icing bleeds status.

On the other hand the FADEC ensures slaving of EPR actual to EPR CMD by modulating fuel flow.

An EPR modifier assures a consistent thrust/EPR relationship.

OPERATING

The system includes two loops :

– a loop for the determination of EPR CMD,
– a loop for the slaving of actual EPR to EPR CMD.

Determination of EPR CMD :

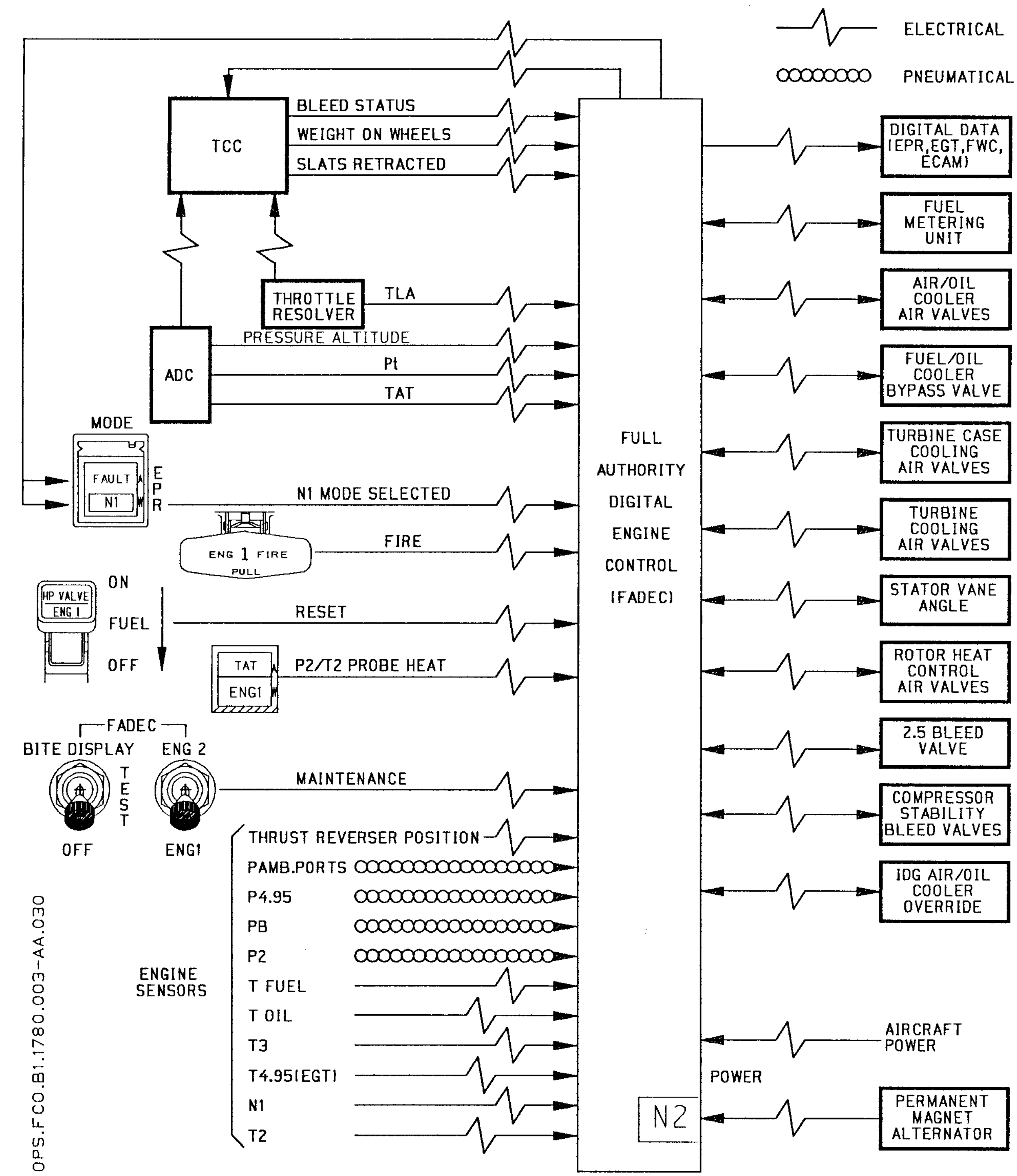
– TCC computes the EPR limit according to the mode selected on the TRP and external conditions.
– The throttle lever is set by the TCC.
– The FADEC receives the TLA from a resolver.
– The FADEC computes the EPR CMD according to the TLA and external conditions.
– The FADEC sends the EPR CMD signal to the TCC as a feedback.
– The TCC actuates the throttle levers, according to the difference between EPR CMD and EPR limit.

Note : When speed mode is selected, the TCC receives a selected speed signal, and an actual speed signal.
It computes a speed difference value, which is translated in EPR difference value.

Slaving of actual EPR to EPR CMD

– The FADEC receives TLA from the throttle lever.
– The FADEC controls the fuel flow, through the Fuel Metering Unit.
– The actual EPR obtained is computed by the FADEC, which receives PT4.95 and PT2.
– The FADEC compares actual EPR and EPR CMD.
– The FADEC actuates the torque motor in the Fuel Metering Unit to obtain actual EPR = EPR CMD.

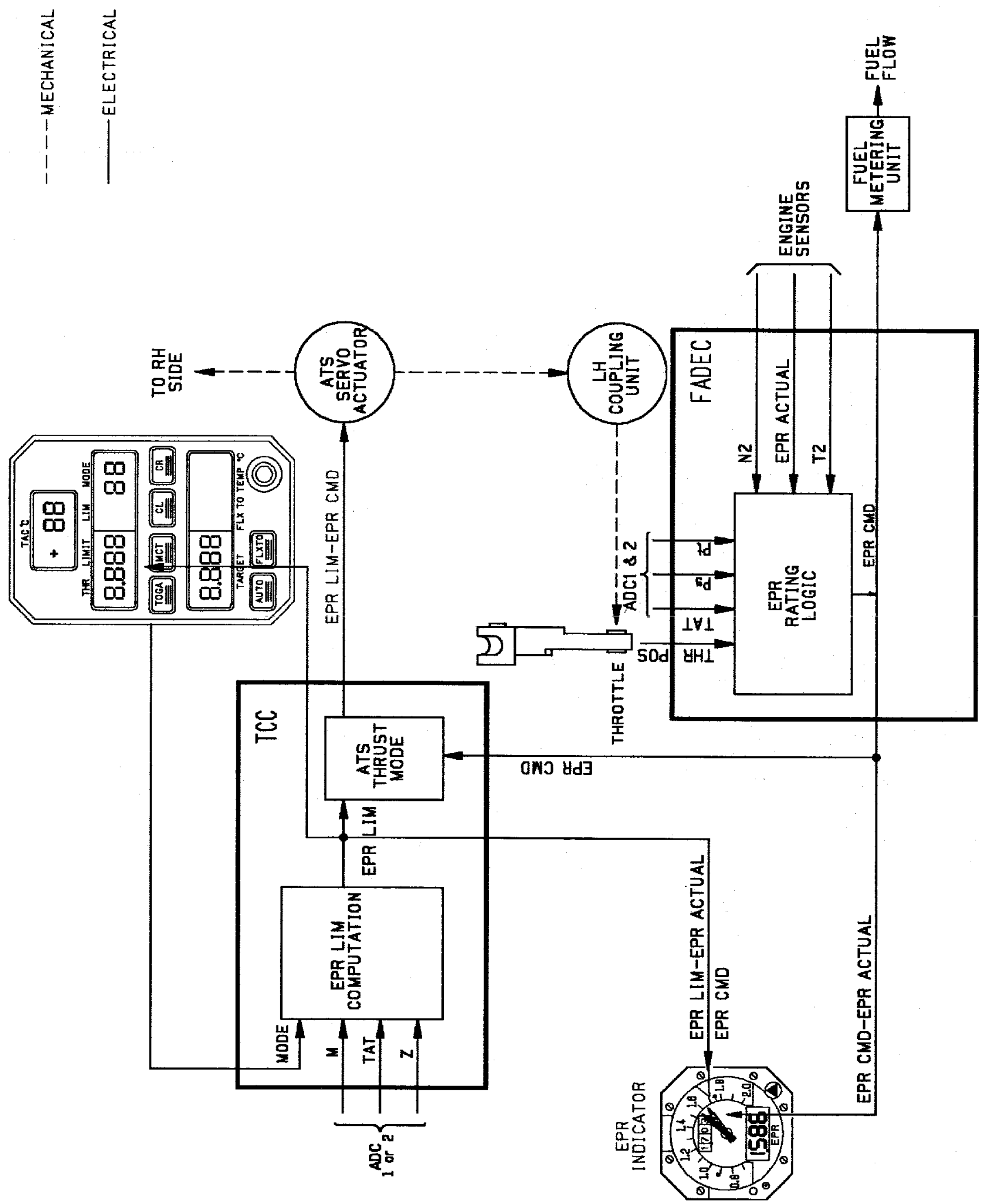
FADEC INTERFACE



R

PW Eng. : 4000

THRUST COMPUTATION BLOCK DIAGRAM



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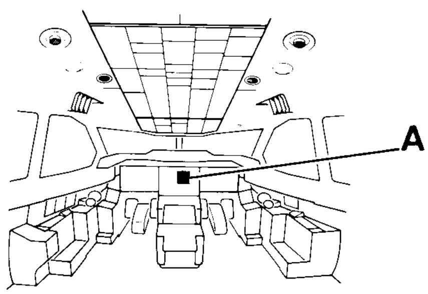
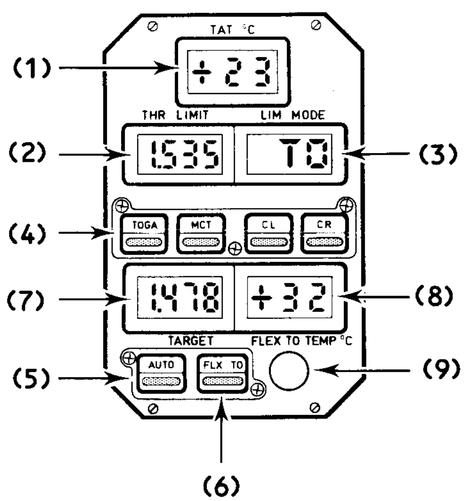
PW Eng. : 4000

A. THRUST RATING PANEL (TRP)





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(1) The TAT (Total Air Temperature) display :

Shows the value normally transmitted by the armed TCC, and directly taken from ADC 2 data bus in case of TCC failure.

(2) THR LIMIT display

The limit thrust corresponding to the selected mode is displayed. The only exception is when FLEX TO is selected. In this case MAX TO thrust is displayed in the
R THR LIMIT window, TO in the LIMIT MODE window and FLEX TO in the TARGET window.

(3) LIM MODE display :

Indicates the limit mode :

- TO, R
- GA, R
- CL,
- CR,
- MCT,

Manually controlled by the crew by pressing one of the five keys (4) and (6).
Automatically controlled by the FMC when the AUTO key (5) has been selected.

(4) (5) (6) Mode selector keys :

The keys are springloaded to return to the neutral position and a second action has no effect.
When a switch is pressed, three stripes come on and a signal is sent to the TCC.

(7) THR TARGET display

If PROFILE mode is not engaged, the limit thrust displayed in the THR LIMIT window is recopied (except for FLEX TO as explained above) if THRUST mode is active in the ATS.

Nothing is displayed if SPD/MACH mode is active in the ATS. I-L is displayed if throttles are on idle in descent with LVL/CH mode.

If PROFILE is engaged, TARGET THRUST calculated by the FMC is displayed whatever the mode is (P THR or SPD/P MACH). I-L is displayed if idle thrust is requested by the FMC.

(8) The FLX TO temperature display

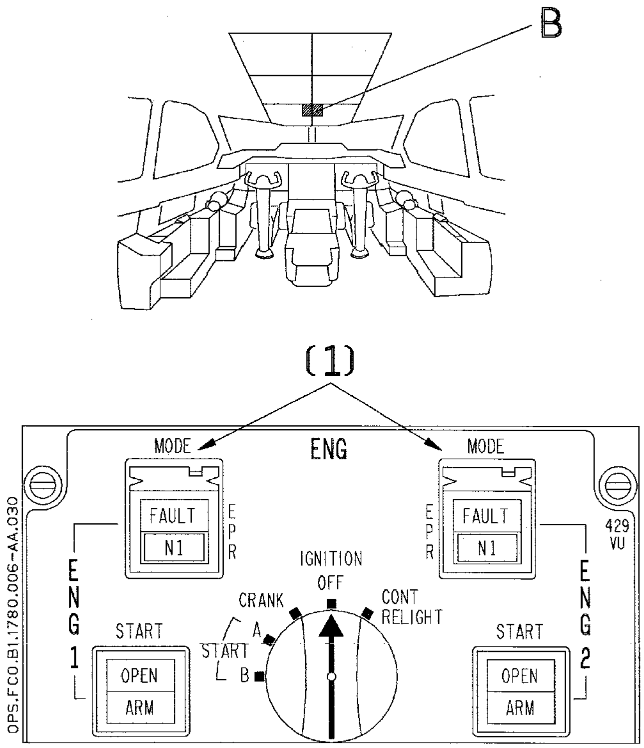
Indicates the temperature selected with the knob (9).

(9) The FLX TO temperature knob

Is equipped with a notch mechanism with 32 clicks per turn each click corresponding to 1 ∘ C.
This selected temperature is transmitted to the TCC.
Any selection of a FLX TO value lower than the TAT value results in « --- » in the FLX TO display.

PW Eng. : All

B. MODE SELECTOR



(1) MODE SELECTOR pb switch (guarded)

- **Normal (pb switch is out)**

  FAULT and N1 extinguished. The FADEC controls the engine in EPR mode.

- **FAULT**

  The light illuminates in amber accompanied by an ECAM warning.
  The FADEC has reverted to N1 mode due to its inability to control the engine in primary mode EPR. This automatic reversion is smooth, thrust is maintained and parameters are unchanged. This smooth transfer is known as a "lock-up" logic. R

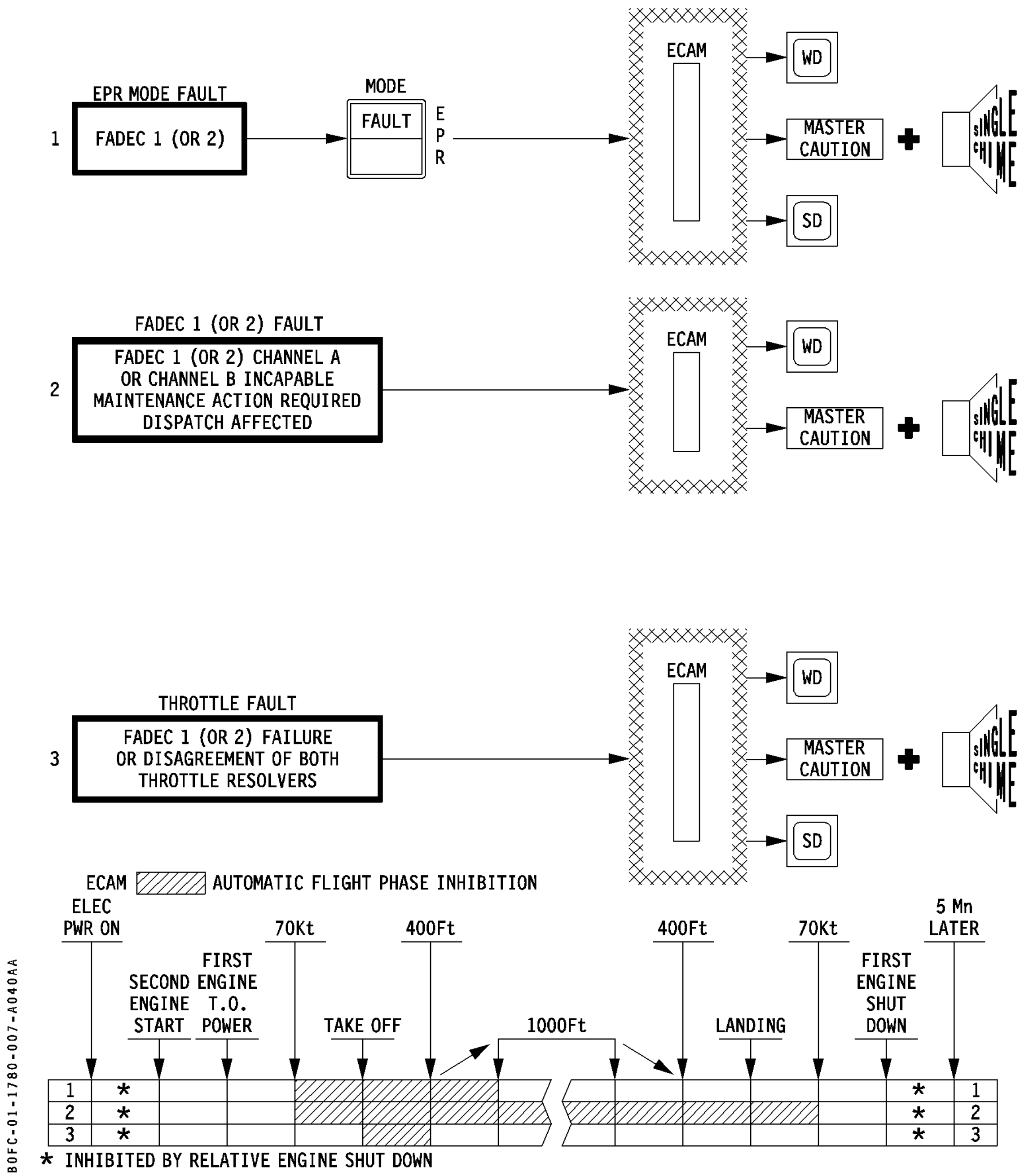
- **N1 (pb switch pressed-in)**

  The light illuminates in white.
  Alternate control mode N1 selected.
  Upon manual selection of N1 mode after automatic reversion, the "locked-up" logic is removed and the N1 schedule is followed. R

PW Eng. : 4000

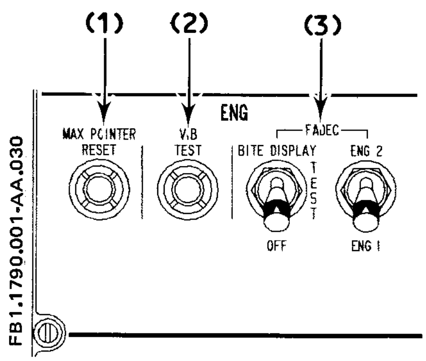
WARNING LOGIC

R



R Mod. : 5051 PW Eng. : 4000

A. MAX POINTER RESET-TEST SWITCHES



(1) MAX POINTER RESET Push-button

Push-button is used to reset the overlimit needles to the red lines for N1, N2, EGT of both engines.

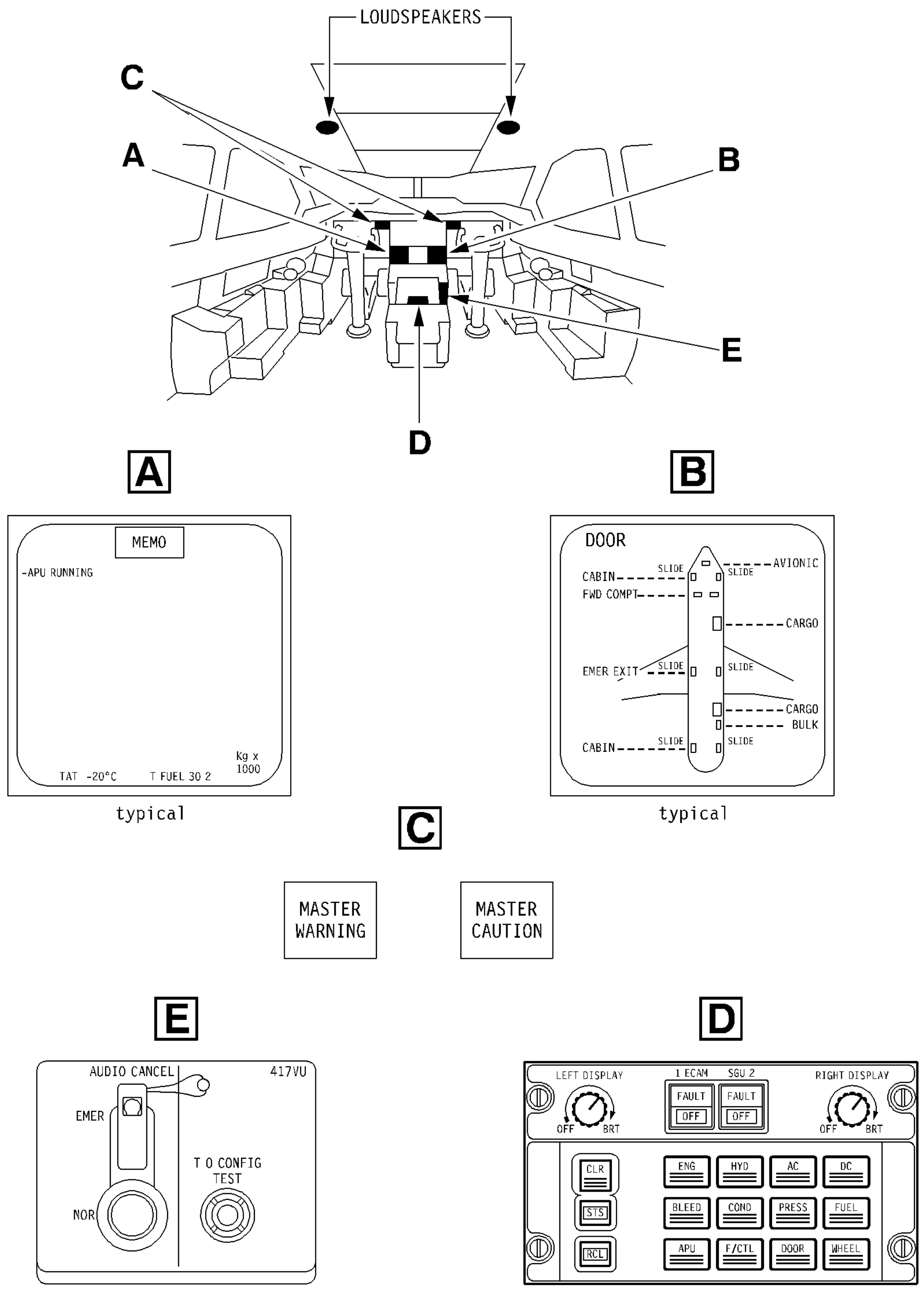
(2) VIB TEST Push-button

The push-button, is used on ground to test the vibration system.
When activated, the engine page will be displayed on the system CRT and both VIB (N1) (N2) indication show 8 for both engines.

(3) FADEC SWITCHES

On ground it is possible :

- to test the FADEC of each engine (TEST position) when initiated the test allows display on the ECAM system of parametric data, status and maintenance words from the two channels of the selected FADEC.
- to display on the ECAM the maintenance words encoded from the non-volatile memory (BITE DISPLAY position)



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MAIN

SYSTEM CONTROLS

AND DISPLAYS

R

Mod : 5051

GENERAL

- The Electronic Centralized Aircraft Monitor (ECAM) provides :
  - Audio warnings for failures and other conditions requiring crew action/attention.
  - Automatic analysis of aircraft systems failures and required procedures.
  - Systems information and procedures on two display units.
- The ECAM minimizes the need for the crew to frequently scan the system panels :
  - Monitoring of temporarily used items is performed on the MEMO page.
  - Routine system monitoring is performed by checking the System Display (system pages).

    A system page is available for each of the main aircraft systems. The most suitable system page for the actual flight phase is automatically displayed.
  - The ECAM constantly monitors system parameters to provide early notification to the crew if any monitored parameter drifts out of its normal range (Advisory mode).
- Processing of aircraft sytems data by the ECAM system is fully automatic.

ECAM DISPLAYS

- The ECAM interfaces with the flight crew via the following procedure-related and system-related pages :
  - **MEMO page :**

    The MEMO page recalls the list of systems which are selected for temporary use.

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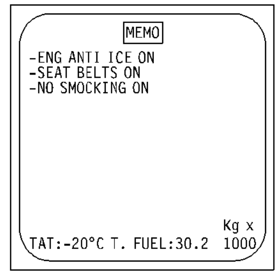

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  - **Warning page :**

    The warning page displays the list of required actions and information related to system failures :

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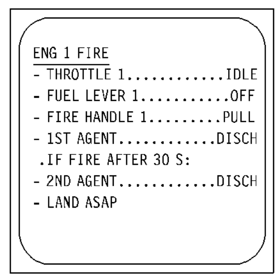

  - **STATUS page :**

    The STATUS page provides additional information, cross-reference to the QRH procedures and systems status reminder :

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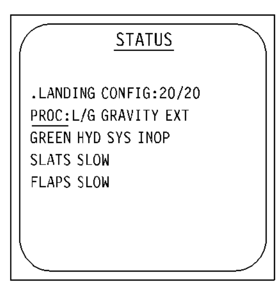
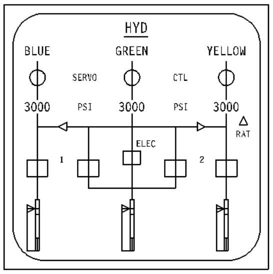


– **System page :**

System pages provide schematics of each of the
R major aircraft systems. System pages are displayed
automatically or can be manually selected :



80FC-01-1810-002-A001AB

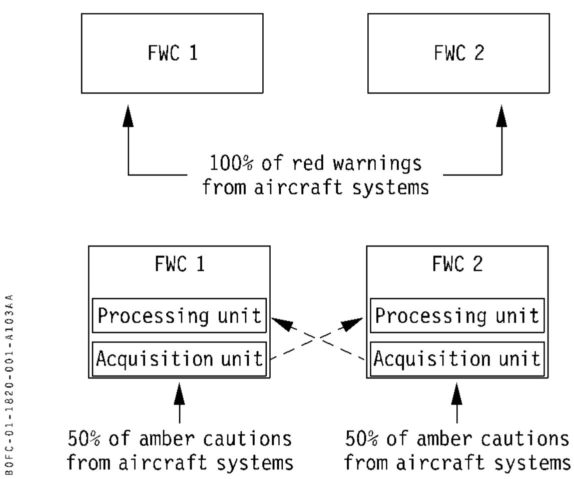
FLIGHT WARNING COMPUTERS (FWC)

- The ECAM system is driven by two Flight Warning Computers (FWC).

  Each FWC acquires and processes the aircraft systems data and generates the warning indications and system status data.

- The two FWC also activates :
  - Audio warnings,
  - The MASTER CAUTION and MASTER WARNING lights,
  - The stick shaker,
  - Autoflight System warnings.

- Each FWC has the capability to acquire
  - 100 % of the red warnings (emergency conditions),
  - 50 % of the amber cautions (abnormal conditions).



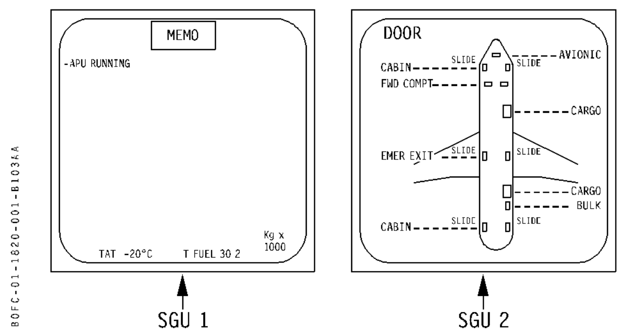
- A cross-talk data bus enables each FWC to process the 50 % amber cautions acquired by the second FWC.

- The loss of one FWC :
  - does not affect the red warnings,
  - affects part of the amber cautions (local warning lights, as applicable, are not affected).

ECAM SYMBOL GENERATOR UNITS (SGU)

- 2 Symbol Generator Units (SGU) process the output data from the FWC, System Data Analog/Digital Converter (SDAC), ADC and Fuel Quantity Indication System (FQI) for presentation on ECAM.

  The SGU'S also process the output data of optional equipment (as applicable) for display of the related information on ECAM.
  - SGU 1 drives the left CRT and SGU 2 drives the right CRT :



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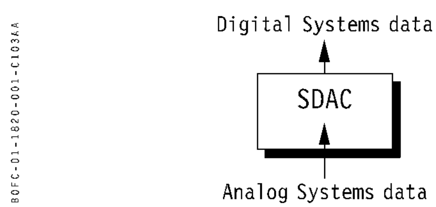
SYSTEM DATA ANALOG-TO-DIGITAL CONVERTER (SDAC)

- The SDAC converts analog aircraft sensor data to the digital format required by the two FWC and other onboard computers.



- The SDAC provides digital information for the system pages, action feedback for the warning pages, and information for the MEMO page.

Mod : 5051

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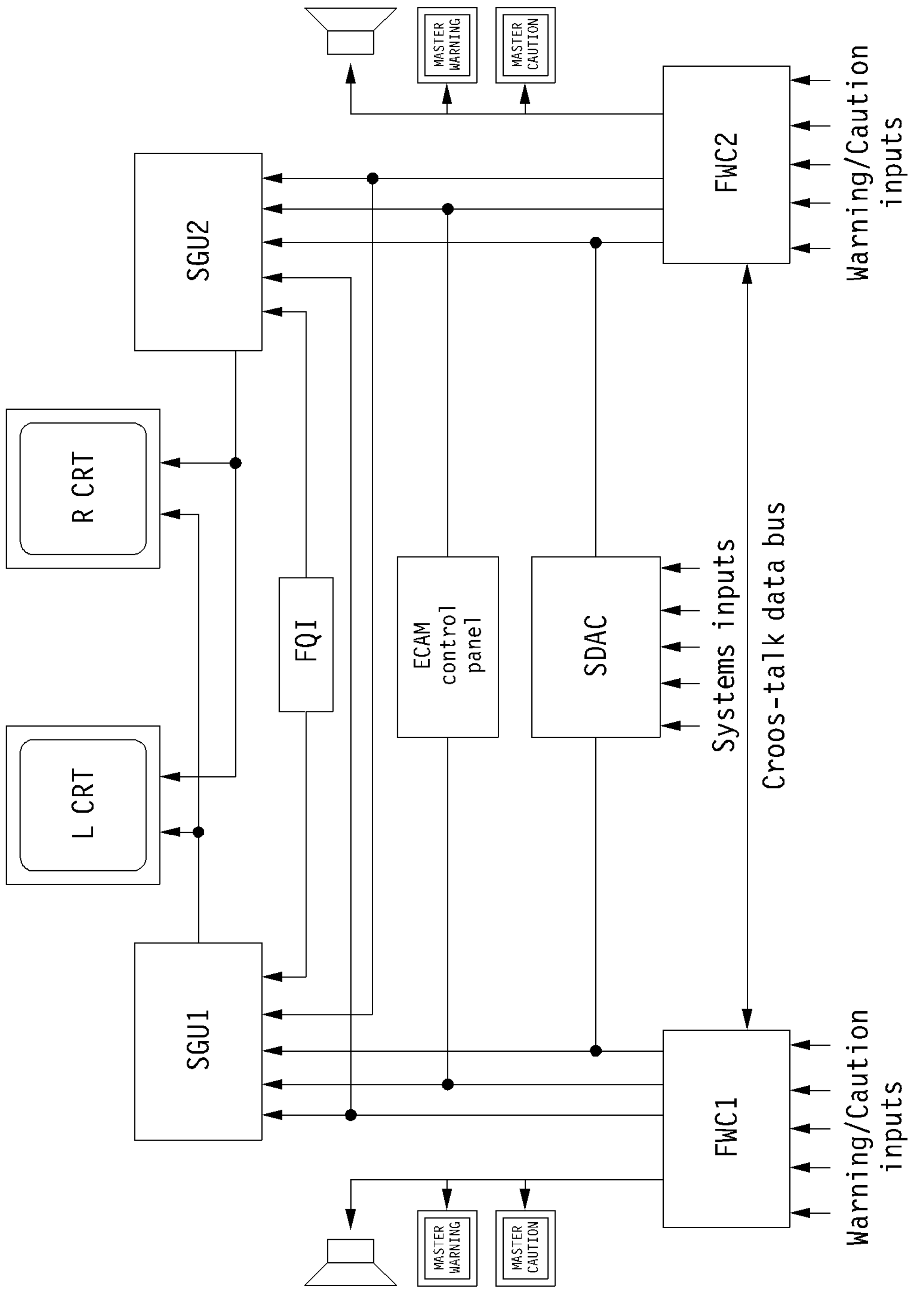

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Mod : 5051

WARNING LEVELS

- ECAM messages are divided into four levels, as follows :

RED WARNINGS

- Red warnings are associated with emergency conditions, and are identified by a red local warning light and by a Continuous Repetitive Chime (CRC), or other specific audio warnings.
- Immediate crew action must be initiated.

AMBER CAUTIONS

- Amber cautions are associated with abnormal conditions, and are identified by an amber warning light and a Single Chime (SC) audio warning.
- Immediate crew action is not required.
R However, time and situation permitting, these
R cautions should be considered without delay to
R prevent any further degradation of the affected
R system.

AMBER ALERTS

- Amber alerts correspond to conditions which only require crew monitoring, and are identified by an amber local warning light with no audio alert.
- Amber alerts are provided primarily for failures which cause the loss of system redundancy.

INFORMATION

- Additional information is provided in blue, green or white.

PRIORITY RULES

- Red Warnings have priority over Amber Cautions, which in turn have priority over Amber Alerts.
- Messages are ranked by importance so that, if more than one malfunction occur at the same time, the most important information is presented first.

PRIMARY FAILURES

- A **primary failure** is an equipment failure which results in the loss of one or more additional equipment or system.

  For example, the loss of ADC 1 is a **primary failure,** resulting in the loss of :

  – PITCH TRIM 1,

  – YAW DAMPER 1,

  – AP 1,

  – ADC information on captain's instruments.

SECONDARY FAILURES

- **Secondary failures** are caused by **primary failures**.
- In the above example, the loss of PITCH TRIM 1, YAW DAMPER 1, AP 1, and of ADC information on the captain's instruments are secondary failures caused by the primary failure of the ADC 1.

INDEPENDENT FAILURES

- An independent failure affects an isolated piece of equipment or system without affecting other equipment (e.g. : a fuel TK PUMP LO PR alone).

ECAM CRT COLOR CODES

- The following colors are used on the ECAM CRTs :

Color	Left CRT	Right CRT
Red (R)	• Emergency	• Emergency
Amber (A)	• Anormals • No action feedback	• Abnormals • "XX" Flags
Cyan (B) (Blue)	• Actions to be taken by crew • Limitations to be applied by crew (Speed increments, Landing Distance factors) • QRH procedures to be applied, in addition to ECAM actions. crew	• Units (°C, PSI, ...)
White (W)	• Actions completed *(action feedback)*	• Titles of manually selected system pages • ADV (advisories) • General inscriptions
Green (G)	General Information	• System parameters in normal ranges
Magenta (M) (Purple)	On MEMO page : • TO or LDG INHIB message • STATUS message	• Not Used

COCKPIT PANEL LIGHTS

LOCAL WARNINGS

- The annunciator lights on the cockpit systems panels are called **local indications** or **local warning** lights.
- Local warning lights provide independent indications of system failures/faults.

  Local warning lights are activated directly by the affected equipment and remain available when the associated ECAM warning is inhibited or if the ECAM system is partially or totally inoperative.

LIGHTS OUT CONCEPT

- In normal, operation, all local indication lights are extinguished except green flowbars and digital fuel quantity indications.
- The following colors are used for the cockpit annunciator lights :

	COLOR	MEANING	
WARNING	**Red**	Emergency condition requiring immediate crew action	R R
CAUTION	**Amber**	Abnormal condition not requiring immediate crew action.	R
INFORMATION	**Green**	Normal system operation	
	Blue	Normal but temporary use of a system (e.g. : APU AVAIL)	
	White	Switch is not in normal position (e.g. OFF, ALTN)	

Mod : 5051

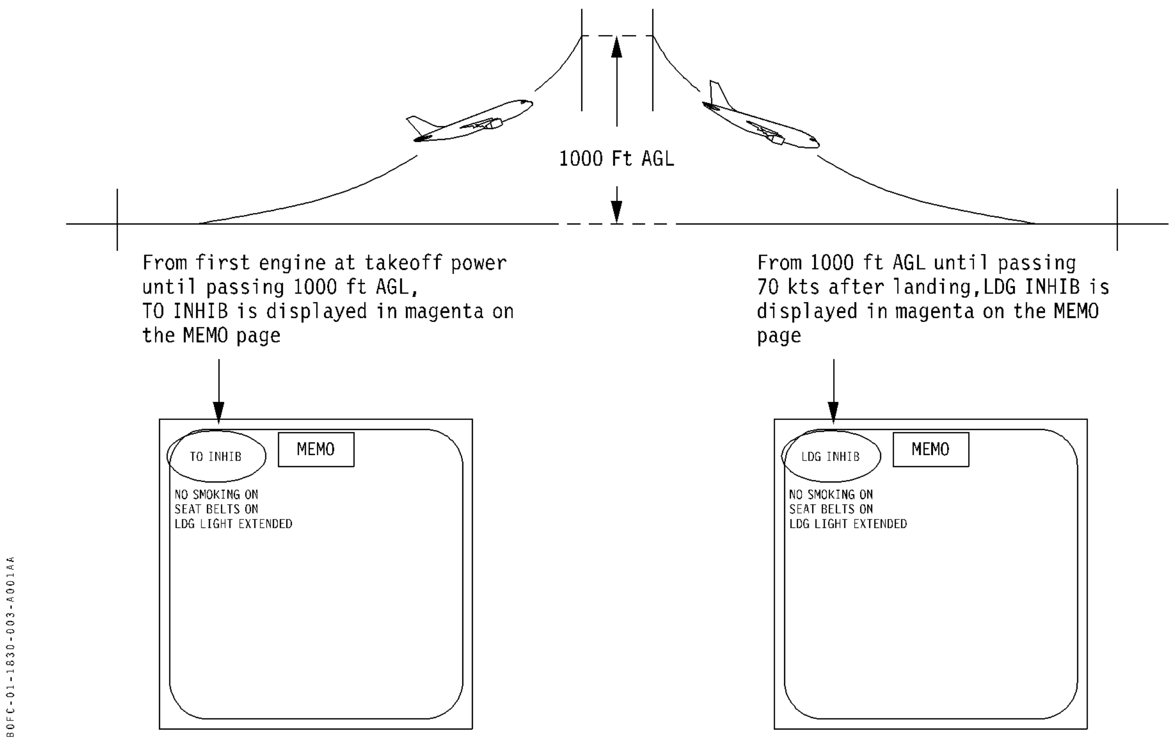
ECAM WARNINGS INHIBITION

- To prevent the activation of ECAM warnings during critical flight phases (unless otherwise warranted), most ECAM warnings are inhibited :
  - during takeoff and landing,
  - in accordance with a flight-phase-related inhibition, defined for each individual warning.

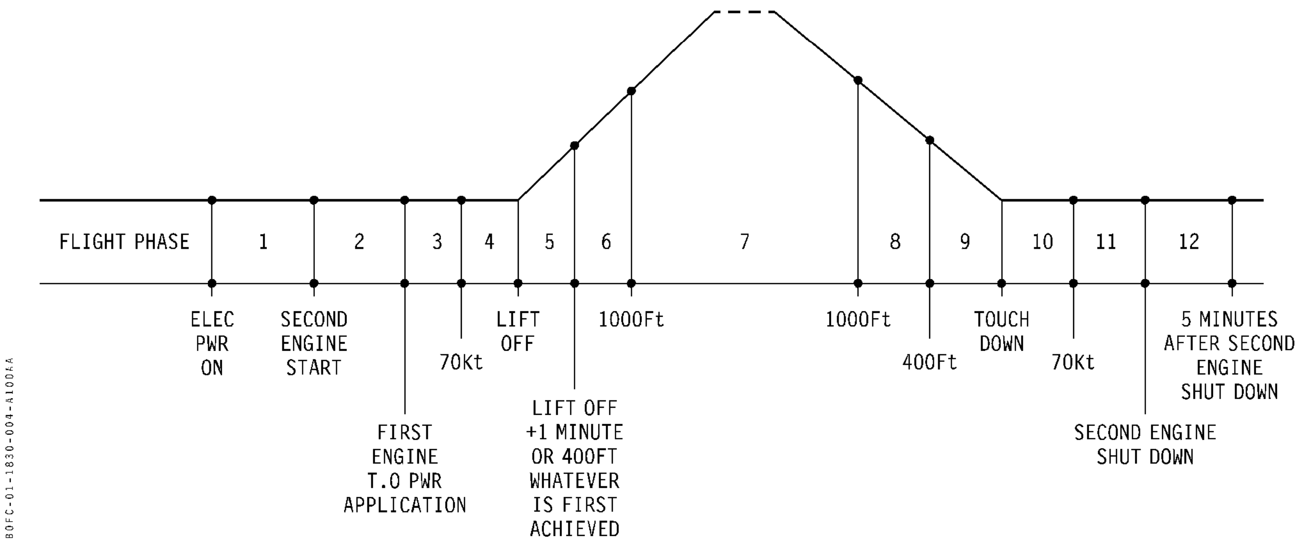
R • Some ECAM warnings are never inhibited (refer
R to the ECAM WARNING LOGIC page of each
R individual system description) (e.g. : Engine
R Fire) :

- The warning inhibition can be cancelled by pressing the RCL pushbutton on the ECAM Control Panel. This enables the ECAM warning pages and audio warnings to be available until the end of the R
  present flight phase. R

- When TO or LDG INHIB (inhibition) is active, if a warning is still being inhibited 60 seconds after the malfunction occurred, the warning inhibition is automatically cancelled.



- The following typical flight profile identifies 12 flight phases used to define the flight-phase-related inhibition of ECAM warnings.



Mod : 6269

ECAM WARNING OR CAUTION PRESENTATION

- When a system malfunction is detected by one FWC, the ECAM system simultaneously generates three types of warnings :

  – **Audio warning** :

  An audio alert sounds in the cockpit loudspeakers to attract the flight crew's attention :

  - Single Chime (SC) for abnormal conditions (cautions),
  - Continuous Repetitive Chime (CRC) for emergency conditions (warnings).

R R *Note : For amber alerts which only results in the loss of system redundancy (e.g. : loss of only one Pitch Trim system) no audio warning is generated.*

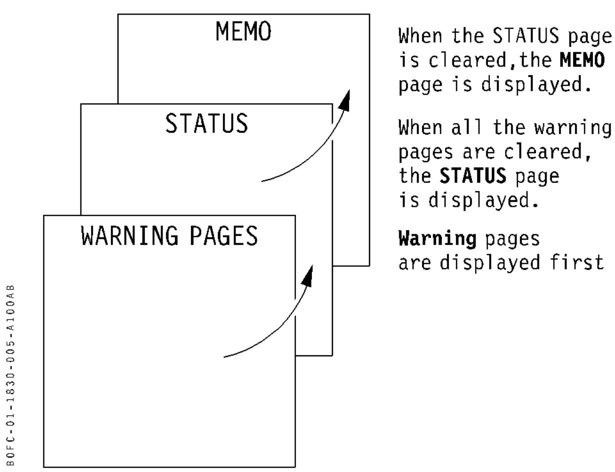
  – **MASTER WARNING and MASTER CAUTION lights** :

  - The relevant light illuminates to provide visual confirmation of the abnormal or emergency condition.

  – **CRT** information :

  - Required ECAM actions, ranked by priority, and STATUS information are displayed on the left hand CRT :

R



  - System pages associated with the warning pages are displayed on the right hand CRT.

Note : The system page must should be checked to confirm that the warning is correct and, after completion of ECAM actions, to review the resulting system condition.

Note : Warning and Caution presentations have priority over all other CRT displays. However, after the Warning or Caution is displayed, any system page can be manually selected.

SUMMARY

	Type of Warning	Where
1	**Audio alert** : • CRC for Emergencies (red warnings) • Single Chime for Cautions (amber cautions)	Cockpit Loudspeakers
2	**CRT Information** : • Warning and STATUS pages • Affected System pages	LH ECAM CRT RH ECAM CRT
3	**Visual alerts**	MASTER WARNING and MASTER CAUTION lights

WARNING PAGES

- General :

  – The title of a warning page is consistent with the title of the associated Quick Reference Handbook (QRH) section where the QRH procedure is located.

  Note : If the warning page displays a "HYD" procedure, refer to in the "HYD" section of the QRH to review the associated QRH procedure.

  – Wording and abbreviations used on warning pages are consistent with the overhead panel.

CREW COORDINATION

- When all ECAM actions under a particular warning page title are completed, the CLR pushbutton must be pressed but, only after cross-checking with the PF (refer to the introductions of FCOM chapters 2.04.10 – Emergency procedures – and 2.05.10 – Abnormal procedures – for crew coordination procedures). R

ADDITIONAL WARNING PAGES

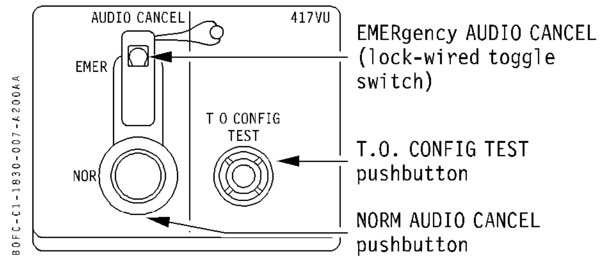
- After the first warning page has been cleared, the subsequent pages display the procedures related to additional failures, if any.
- If a warning is cleared while being displayed, the associated warning page is also cleared (e.g. if an ENGINE FIRE warning is cleared by setting the throttle lever to idle, the ENGINE FIRE warning page is cleared from the LH CRT).

USE OF QUICK REFERENCE HANDBOOK (QRH) PROCEDURES R

- Refer to QRH 0.01 and 0.02. R

T.O. CONFIGURATION TEST AND T.O. WARNING

- Refer to the section 1.09.50 for detailed description of the T.O. CONFIG test and T.O. warning.



AUDIO WARNINGS

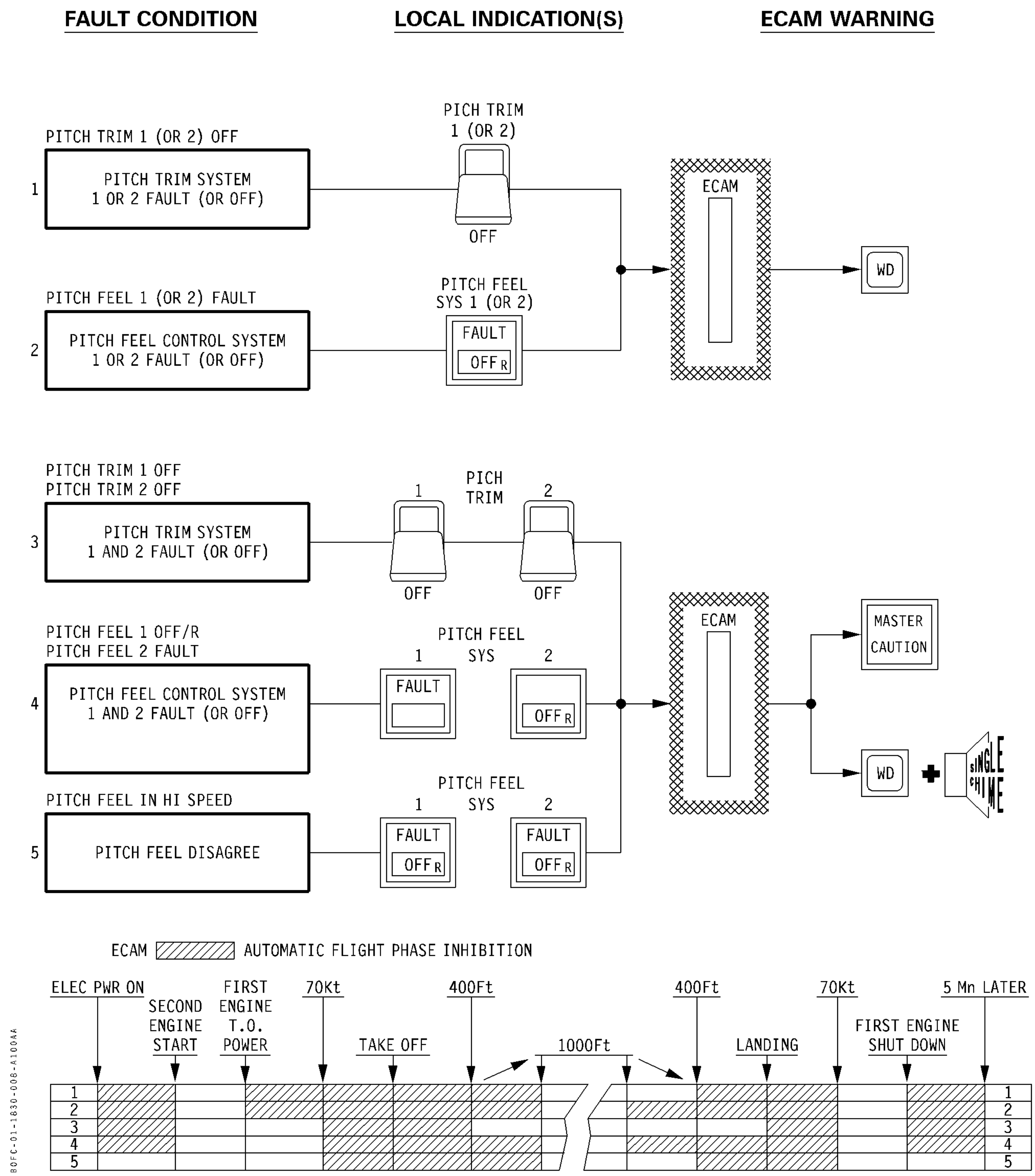
- Several types of audio warnings are provided :

AUDIO WARNING	ACTIVATED BY :	CANCELLED BY :
Single Chime (SC)	• Amber cautions	• No cancel required
Continuous Repetitive Chime (CRC)	• Red warnings • Engine/APU Fire • Cargo/Electrical Smoke • Gear Not Down : * During Approach * During Landing • TO Configuration • Overspeed • Excess AFT CG	• NORM audio cancel pushbutton • NORM audio cancel pushbutton or pulling associated FIRE handle • NORM audio cancel pushbutton * NORM audio cancel pushbutton * Corrective action or EMER audio cancel • Corrective action or EMER audio cancel • Corrective action or EMER audio cancel • Corrective action or EMER audio cancel
Stick Shaker/"Cricket"	• Stall Warning	• Corrective action or EMER audio cancel
"C" Chord	• Altitude Alert	• Corrective action or EMER audio cancel
"Whooler"	• THS moving *(only with AP not in CMD)*	• Stopping pitch trim input
Triple "Click"	• Change of Landing Capability Category	• No cancel required
Tea Kettle (or Auto Callouts)	• Decision Height	• NORM audio cancel push-button or auto
Cavalry Charge *(every 3 seconds till cancelled)*	• Autopilot Disconnect	• Pressing AP instinctive disconnect push-button at least 1 second.
Selcal buzzer *(On 1 sec, Off 1 sec ...)*	• Selective Calling alert	• NORM audio cancel pushbutton
Continuous buzzer	• Cabin Call	• No cancel required
TCAS ADVISORY MESSAGES	• TCAS	• Corrective action or EMER audio cancel
GPWS or EGPWS aural warnings	• GPWS or EGPWS	• Corrective action or EMER audio panel

Mod : 4801 + 5051

WARNING LOGIC

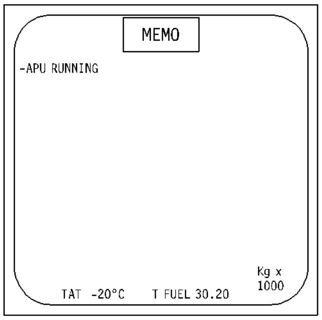
- The following schematics provides a typical warning logic, as illustrated in the description of each individual system.



Mod : 5051

ECAM DISPLAY UNITS (CRTs)

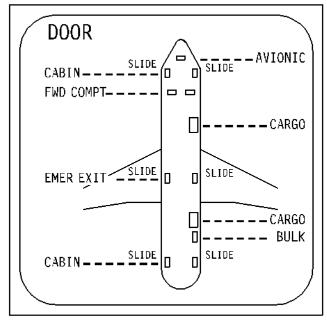
LEFT CRT



B0FC-01-1840-001-A100AA

- The left CRT displays :
  - Red/Amber warning pages, or
  - The STATUS or MEMO page.

RIGHT CRT



- The right CRT displays system pages.

MASTER LIGHTS

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(1) Red Warning flashing light (pushbutton)

- Require immediate crew action.
- In the event of a red warning, pressing the MASTER WARNING light extinguishes both MASTER WARNING lights and cancels the aural warning
R except for some red warnings, which can be
R cancelled by the use of AUDIO CANCEL pushbutton.

  This action has no effect on CRT messages.

(2) Amber Warning lights (pushbutton)

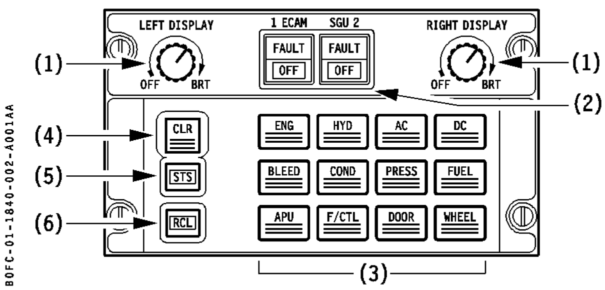
- Action may be delayed, as required.
- In the even of an amber caution pressing either MASTER CAUTION light extinguishes both MASTER CAUTION lights and cancels the aural warning.

  This action has no effect on CRT messages.

Mod : 5051

ECAM CONTROL PANEL

- The ECAM control panel enables the crew to :
  - Switch ECAM CRTs on or OFF and to adjust the ECAM CRT brightness,
  - Manually select system pages,
  - Manually select the STATUS page,
  - Clear warning pages with the CLR push-button,
  - Review the completed warning pages using the RCL (Recall) push-button,
  - Switch the Symbol Generator Units (SGUs) On or OFF.



(1) Brightness adjustment knobs

- Used to switch On/OFF and adjust the brightness of each CRT display.

(2) Symbol Generator Unit (SGU) pushbutton

- Amber FAULT light illuminates if an SGU failure is detected.
- Pressing the affected push-button turns off the associated SGU. FAULT extinguishes and the white OFF light illuminates.
- Both CRT's are then driven by the remaining SGU.

(3) System pages selection keys

- Pressed to manually select a system page for review on the right CRT.

  When a key is pressed, the key illuminates white.
- A manually selected system page can be deselected by pressing its illuminated pushbutton a second time.
- In single CRT mode (i.e. with one CRT failed), system pages can only be manually selected when the MEMO page is displayed. (All warning pages and the STATUS page must have been cleared first).
- If a warning or advisory occurs, the associated system page automatically replaces any manually selected page.

(4) CLR (Clear) pushbutton

- Illuminates white when a warning page or the STATUS page is displayed.
- Each press clears one warning page or the STATUS page from the display.
- Extinguishes when the MEMO page is displayed (No more warning pages or STATUS pages remaining).

(5) STS (Status) pushbutton

- When the MEMO page is displayed, pressing the STS pushbutton enables to manually select the STATUS page.
- If the STS pushbutton is pressed when no STATUS message exists, a STATUS NORMAL message is displayed.
- STATUS messages are not automatically displayed before the second engine start or after the first engine shutdown.
- If a warning occurs while the STATUS page is displayed, the applicable warning page replaces the STATUS page.

(6) RCL (Recall) pushbutton warning

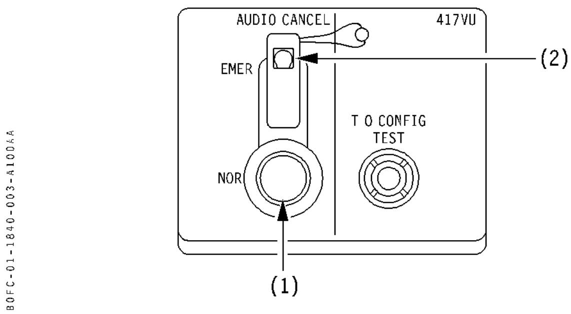
- Pressing this pushbutton displays, in sequence, all the warning pages that have been cleared.
- If the RCL pushbutton is pressed when no failures exist, a NORMAL message appears.
- Pressing the RCL pushbutton also cancels the ECAM warning inhibition until the end of the present flight phase.

  This enables the ECAM to activate visual and audio warnings for malfunctions which are inhibited in the present phase of flight.

AUDIO CANCEL PANEL

- An audio interface provides audio alerts through the aircraft loudspeakers.
- Audio warnings can be cancelled using :
  - The NORM audio cancel pushbutton,

  or
  - The safety-wired EMER audio cancel switch.



(1) NORM AUDIO CANCEL Pushbutton

Pressing the NORM AUDIO CANCEL pushbutton cancels the audio warnings.
However, the following listed audio warnings cannot be cancelled by this pushbutton :

R • LANDING GEAR NOT DOWN (during landing)
- TO. CONFIG
- OVERSPEED
- STALL
- TCAS
- GPWS or EGPWS
- ALTITUDE ALERT
- STAB IN MOTION

Note : *The listed audio warnings can be cancelled by use of the EMER AUDIO CANCEL pushbutton except for the STAB IN MOTION warning, which is cancelled by stopping the Pitch Trim Wheel.*

Mod : 5051

(2) EMER AUDIO CANCEL WARNING SYS pushbutton

- This safety wired and guarded switch can be used to cancel all audio red warnings which cannot be canceled using the NORM CANCEL pushbutton and which produce an operational nuisance.
- When EMER AUDIO CANCEL function has been used, the related red aural warning inhibition is automatically canceled when related warning failure condition disappears.
  Then if same warning activation conditions reappears, the red aural warning is triggered again.
- The EMER CANCEL ON message appears on ECAM when EMER AUDIO CANCEL switch is used and no ECAM warning activated.

CAUTION

If a failure occurs while the Emer Cancel push button is pressed, the associated audio warning (red warning) or the associated audio warning and ECAM warning (amber warning) will not be triggered.

- When EMER AUDIO CANCEL switch is pressed and maintained, ECAM messages are displayed to indicate which specific warning have been cancelled (e.g. APU FIRE WARNING CANCELLED).
- Cancellation can be removed by pressing the RCL pushbutton on the ECAM control panel for more than 3 seconds.
- Cancellation is automatically reset when the electric power is initially applied to the aircraft, or after the first engine shutdown.

MANUAL SELECTION OF SYSTEM PAGES :

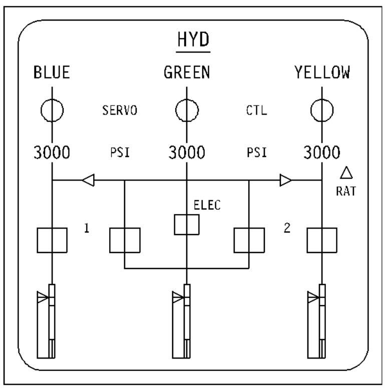
- Any system page (except the CRUISE page) can be displayed on the right CRT by pressing the associated key on the ECAM control panel.

  The selected key illuminates.

- If an advisory or system failure occurs when a system page is manually displayed, the page related to the system affected by the advisory or failure automatically replaces the selected system page.

SYSTEM DISPLAY

R - The selected system page is displayed on the right ECAM CRT.



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SYSTEM PAGES

- The following system pages can be selected by pressing the corresponding key on the ECAM control panel :

Key	Page Title	Description
ENG	ENGINE	Engine secondary parameters
HYD	HYD	Hydraulic power generation and distribution
AC	ELEC-AC	AC electrical power generation and distribution
DC	ELEC-DC	DC electrical power generation and distribution
BLEED	AIR BLEED	Bleed valves and air conditioning packs parameter
COND	AIR COND	Valves positions, ducts and compartments temperatures
PRESS	CAB PRESS	Valves positions, cabin differential pressure, vertical speed and altitude
FUEL	FUEL	Fuel pumps, feed lines and valves status
APU	APU	APU, APU GEN and APU BLEED parameters
F/CTL	FLT CTL	Flight controls hydraulic supply and position
DOOR	DOOR	Doors and slides status
WHEEL	WHEEL	Brakes and ground spoilers information

- The following flight phase related system page is also available :
  - ENG START :
    - The ENG START is similar to the ENG page, but the lower left indicating scale is replaced by a BLEED pressure indication.

SYSTEM DISPLAY INDICATIONS

- When in their normal ranges all digital values and analog indications are green. When an indication reaches its warning level, the associated analog pointer and digital value become amber (abnormals) or red (emergencies).
- In case of loss of sensor electrical power or loss of signal, the associated indication is replaced by an amber "XX".

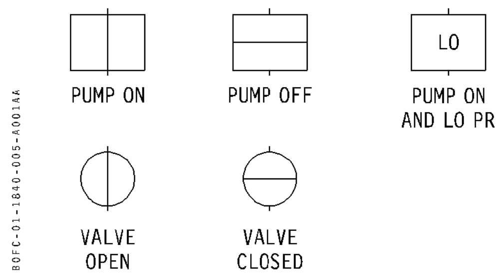
Note 1 : All units (e.g. : °C, PSI, V, Hz, etc...) are displayed in cyan.

Note 2 : System page titles :

When a system page is displayed automatically (except by advisories) the page title is green.

If a system page is manually selected, or displayed by an advisory, its title is white.

PUMP and VALVE SYMBOLS

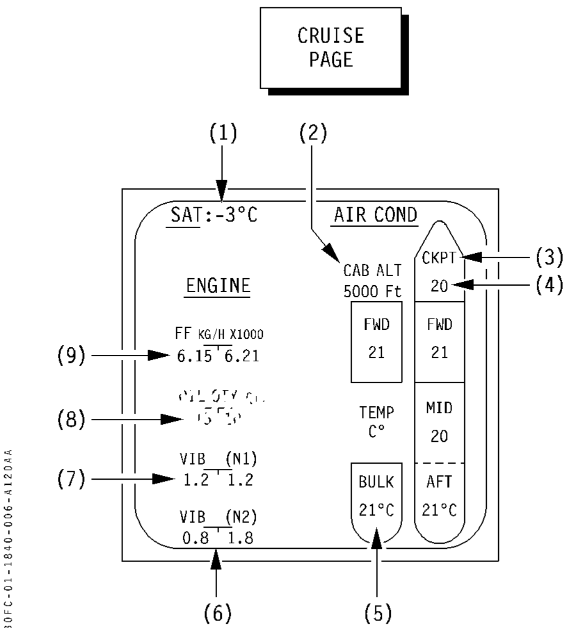


SYSTEM PAGE COLOR CODING

CONDITION	COLOR USED
In use	Green
Unusable	Amber
Not in use	Not shown
Off	Whire
Normal	Green
Abnormal	Amber
Emergency	Red

CRUISE PAGE

- The CRUISE page is automatically displayed when in clean configuration or when both throttle levers are retarded below takeoff power, if no other system page is displayed.



(1) STATIC AIR TEMPERATURE

(2) CABIN ALTITUDE

(3) ZONE NAME

(4) ZONE TEMPERATURE

(5) BULK CARGO COMPARTMENT TEMP

(6) ENGINE N2 VIBRATION

(7) ENGINE N1 VIBRATION

(8) OIL QUANTITY

(9) FUEL FLOW

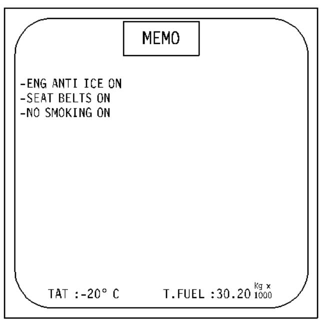
NORMAL DISPLAY MODE

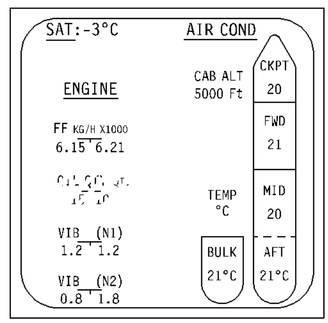
- When both ECAM CRT's are operating and :
  - no warning is activated,
  - no advisory is activated,
  - no system page is manually selected,

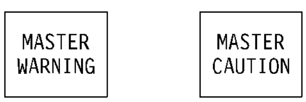
  the ECAM operates in the flight-phase-related mode.

- The MEMO page is displayed on the left CRT to recall the list of systems which have been selected (and are normally operated only temporarily).

- The right CRT displays the flight-phase-related system page (for exemple the CRUISE page, as illustrated hereafter).







MASTER WARNING and MASTER CAUTION lights are extinguished

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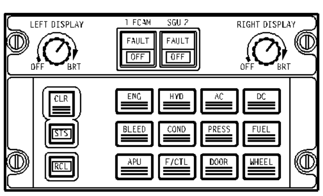


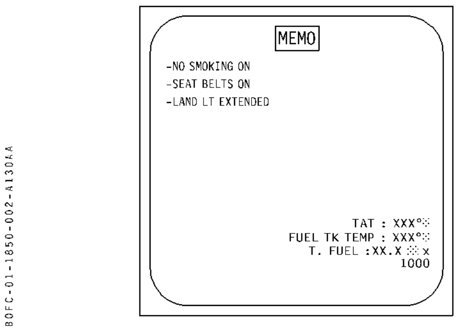
All lights on the ECAM control Panel are extinguished.

Mod : 5051

MEMO PAGE

- The MEMO page is the basic display of the left ECAM CRT.

MEMO PAGE



- This page lists the systems or functions which have been selected for temporary use.
- The MEMO page is displayed when :
  - No warning page is displayed, and
  - The STATUS page is not displayed.

Note : *If a warning page is displayed, when it is cleared, if no STATUS page message exist, the MEMO page is displayed. If there is a STATUS page, the MEMO page will be displayed when the STATUS page is cleared.*

- The MEMO page always displays :
  - The TAT,
  - The Total fuel quantity (T. FUEL),
  - A magenta STATUS message is displayed in the upper right corner if there are messages on the STATUS page,
  - A magenta TO INHIB or LDG INHIB message is displayed in the upper left corner during takeoff and landing phases. This indicates that most non-critical ECAM warnings are being inhibited.

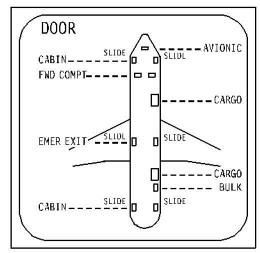
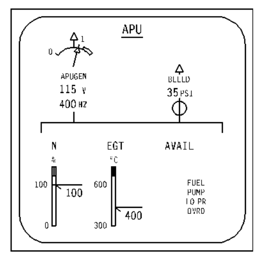
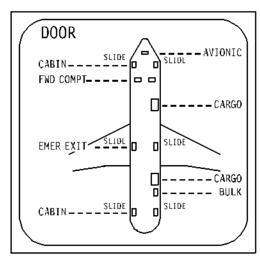
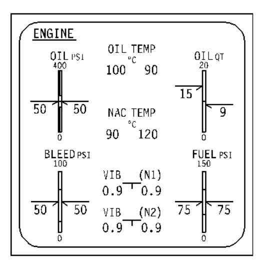
- The messages displayed on the MEMO page are listed here after:
  - CAB PRESS MAN CTL (only with electrical pressurization system, per Mod 3881),
  - IRS IN ALIGN,
  - TAT IN FREQUENT ICING RANGE, R
  - ENG ANTI ICE ON,
  - WING ANTI ICE ON,
  - APU RUNNING,
  - CONTINUOUS RELIGHT ON,
  - SEAT BELTS ON,
  - NO SMOKING ON,
  - FUEL FEED MAN CTL,
  - CTR TANK FEEDING,
  - FUEL X FEED,
  - PARKING BRAKE ON,
  - EXT PWR CONNECTED,
  - SPD BRAKES EXTENDED (flashes if throttles above IDLE),
  - LDG LIGHT EXTENDED,
  - ECON FLOW SELECTED,
  - FWD/BULK CARGO COOLING ON, if Mod 3448 installed.

MEMO PAGE (Cont'd)

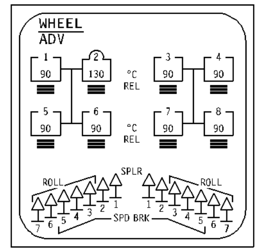
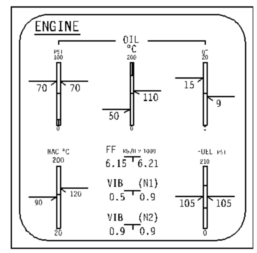
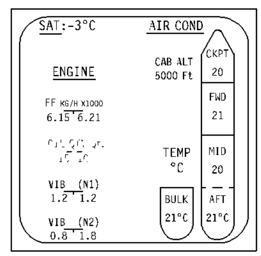
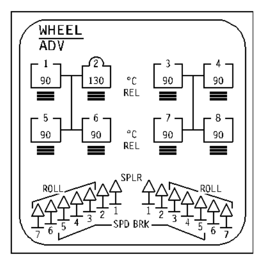
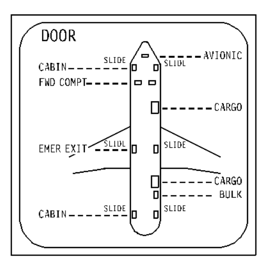
- T. FUEL : XX.X Kg (Lbs) × 1000 (lower right corner of the CRT),
- TAT : XXX°C (°F) (lower right corner of the CRT),
- GW : XXX.XX Kg (Lbs) × 1000 (right bottom of the CRT), only if Mod 4801 fitted,
- CG : XX.X % (left bottom of the CRT), only if Mod 4801 or Mod 4541 fitted,
- TOW : XXX.XX Kg (Lbs) × 1000 (right bottom of the CRT), only if Mod 4541 fitted,
- FUEL TEMP : XXX°C (°F) (right bottom of the CRT), only if Mod 5875 fitted,
- ZFW : XXX.X Kg (Lbs) × 1000, only if 6536 fitted,
- ZFCG : XX.X %, only if 6536 fitted.

FLIGHT-PHASE-RELATED PAGES

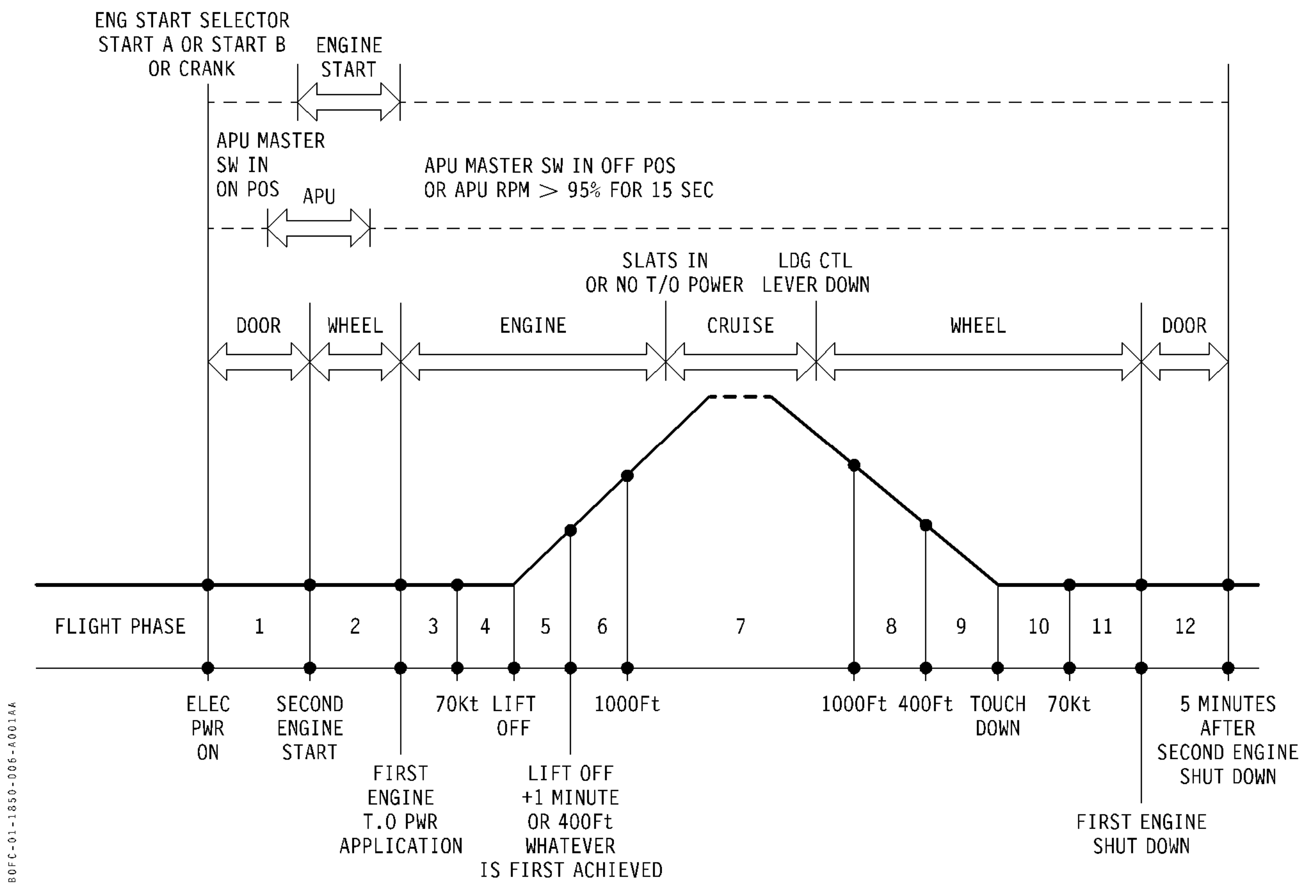
Note : the system pages illustrated here after are "typical" and may not reflect customer options or modifications.

PHASE OF FLIGHT	SYSTEM PAGE	FLIGHT-PHASE-RELATED PAGES
From electric power on until first engine start	DOOR page *To monitor door status*	B0FC-01-1850-004-A001AA 
From APU master switch ON until 15 seconds after APU reaches 95 % N.	APU page *To monitor APU start*	B0FC-01-1850-004-B001AA 
15 seconds after APU has reached 95 % N	DOOR page to monitor slides arming status	B0FC-01-1850-004-C001AA 
When START selector is placed in START A, B or CRANK position	ENGINE START page *(same as ENGINE page but with a BLEED pressure indication).*	B0FC-01-1850-004-D001AA 

FLIGHT-PHASE-RELATED PAGES (Cont'd)

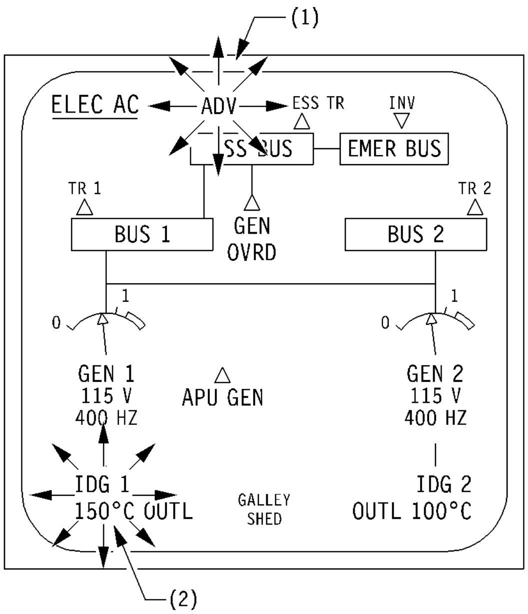
PHASE OF FLIGHT	SYSTEM PAGE	FLIGHT-PHASE-RELATED PAGES
After both engines have been started and the START selector is selected back to OFF	WHEEL page *To monitor brake temps during taxi out*	B0FC-01-1850-005-A001AA 
When throttle levers are advanced for takeoff	ENGINE page *To monitor engine parameters during takeoff*	B0FC-01-1850-005-B001AA 
After takeoff, when slats are retracted or when both throttle levers are retarded below T.O. power	CRUISE page *To monitor main engine parameters, Cabin altitude, cabin and cargo compartments temperature*	B0FC-01-1850-005-C001AA 
When landing gear handle is selected down	WHEEL page *To monitor brake anti-skid release signals, brakes temperature and grounds spoilers deployment*	B0FC-01-1850-005-D001AA 
At first engine shutdown	DOOR page *To monitor doors and slides status*	B0FC-01-1850-005-E001AA 

- The following typical flight profile summarizes the flight phases defined for :
  - the system display flight-phase-related mode,
  - the warnings flight-phase inhibition.



GENERAL

- If a system parameter is trending out of its normal range, but has not reached its warning threshold, the ECAM activates the Advisory mode.
- The activation of the Advisory mode results in the automatic display of the system page related to the affected system and parameter.
- No audio warning is associated with the Advisory mode.
- The activation of the Advisory mode is inhibited on the ground, and until slats have been retracted after takeoff.



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(1) ADV (Advisory) message

- An attention-getter message (ADV) is displayed after the system page title and flashes white until the page is deselected, by pressing the associated key on the ECAM control panel.
- The affected parameter is still displayed in green but is pulsing.

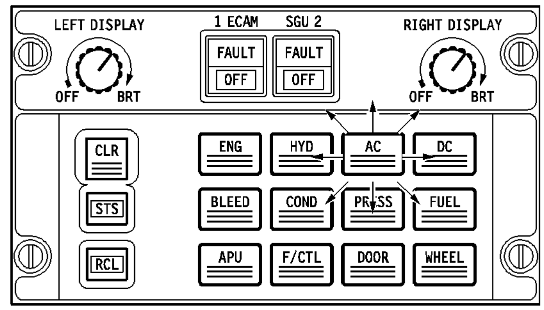
- On the ECAM control panel, the associated system key illuminates.

  Pressing the key cancels the Advisory mode display :

  – the system key extinguishes,

  – the system display reverts to the flight-phase-related page.

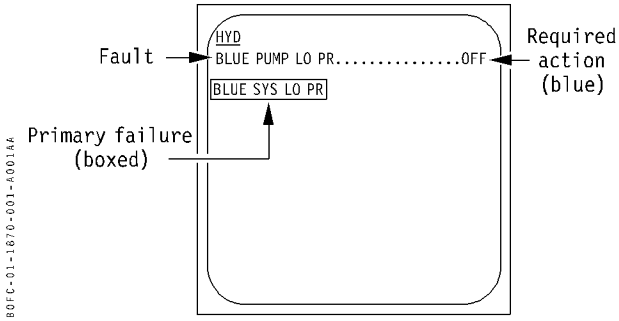
B0FC-01-1860-001-B001AA



WARNING PAGE PRESENTATION

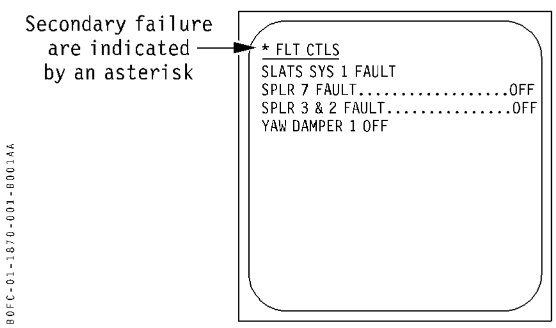
PRIMARY FAILURES

- The name of the primary failure is boxed.



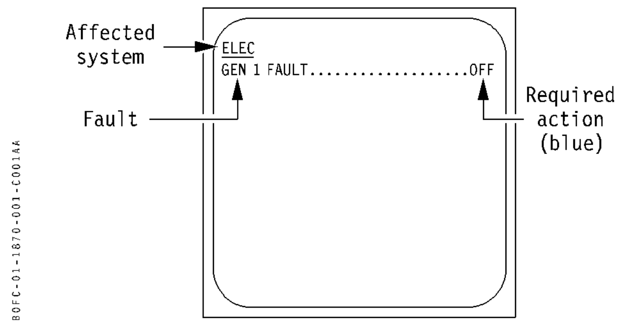
SECONDARY FAILURES

- The title of the system affected by secondary failures is identified with an asterisk.

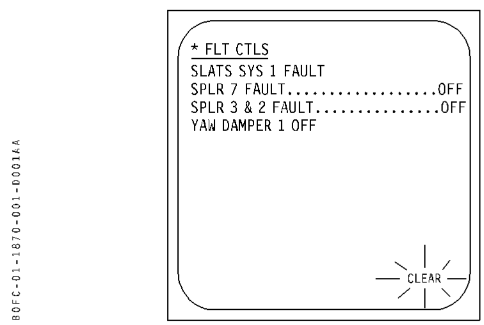


INDEPENDENT FAILURES

- Independent failure are displayed without asterisk or boxed items.



- If an independent failure occurs while secondary failures are displayed, a flashing green CLEAR message is displayed at the bottom of the warning page if there is not enough space on the CRT to display the new warning :



- When the CLR pushbutton is pressed on the ECAM control panel, the new warning is displayed on the next warning page.

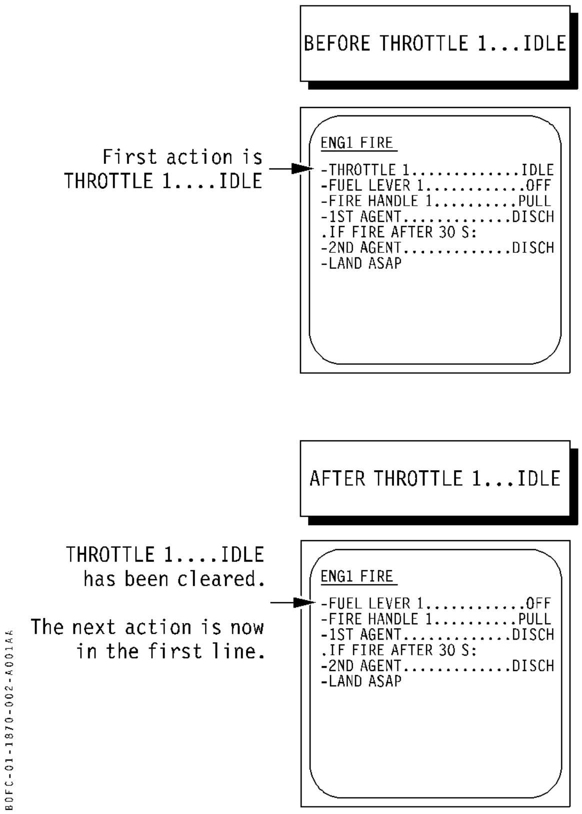
ACTION FEEDBACK

- When a blue ECAM action is performed, the action feedback is displayed on the warning page to confirm that the action is complete.

Note : Action feedback is largely generated by the SDAC. Thus, if the SDAC is lost (component failure or loss of AC BUS 1) most action feedback is lost.

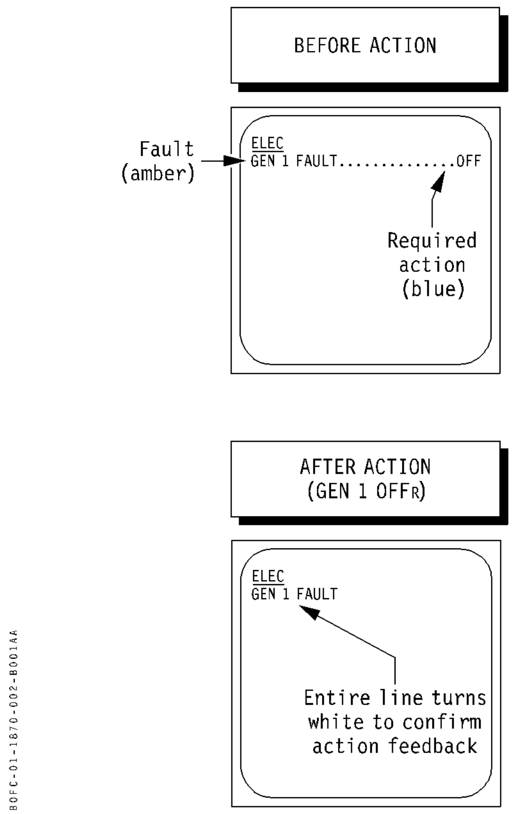
RED WARNINGS

- When an ECAM action is performed, the associated line disappears :



AMBER CAUTIONS

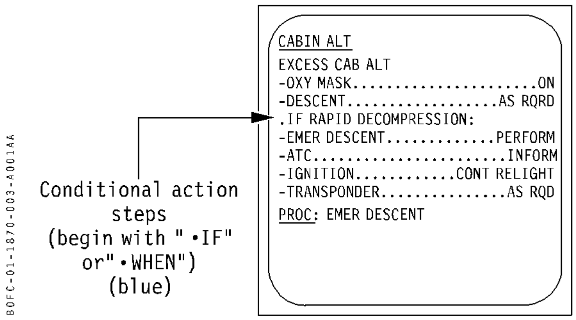
- For amber cautions, when the action is performed, the line turns white :



- If a system which has been set to OFF/R is successfully reset, the affected warning page is cleared from the warning display and the MEMO or STATUS page is displayed.

CONDITIONAL ACTIONS

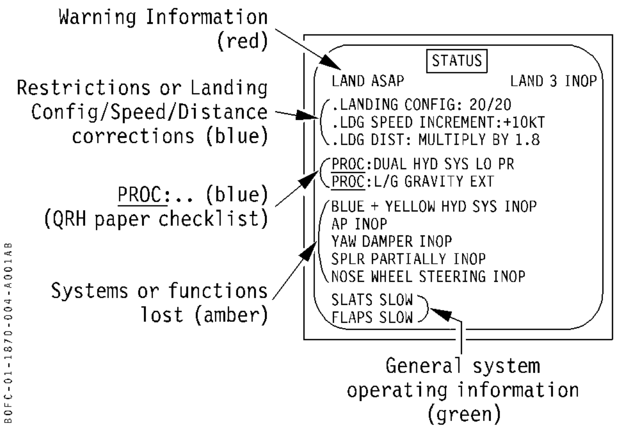
- Some warning pages include **conditional** action steps (e.g. : IF RAPID DECOMPRESSION, in the EXCESS CAB ALT procedure) which require the crew to decide whether to perform the related action(s) or not :



Note : There is no action feedback for conditional action steps. Whether the actions are performed or not, the corresponding action lines remain displayed in blue.

STATUS PAGE

- The STATUS page is displayed after all warning pages are cleared to provide a summary of the aircraft's condition :
- The following example relates to a DUAL HYD BLUE + YELLOW SYS LO PR (i.e. GREEN remaining) condition.



- The STATUS page provides the following information or references :
  - LAND ASAP message, if applicable,
  - Landing Category capability downgrade, if applicable,
  - Speed and altitude limitations,
  - Configuration recommendations, landing speed increments and landing distance multiplication factors,
  - Emergency or Abnormal procedures which require reference to a QRH Procedure (PROC : - - - - -),
  - Systems / functions lost or degraded,
  - Additional information related to systems operation.

- The STATUS page is displayed :
  - **Automatically** :

    When all warning pages have been cleared from the warning display.

    Note 1 : *If there are no STATUS messages, this page is skipped, and the MEMO page is displayed directly.*

    Note 2 : *From flight phase 1 to 5 and from flight phase 9 to 12, the STATUS page is skipped when a warning page is cleared, and the MEMO page is displayed directly.* R R

  - **Manually** :

    From the MEMO page, the STATUS page can be displayed by pressing the STS pushbutton.

    When the STATUS page has been manually selected the CRL pushbutton must be pressed to return to the MEMO page.

    Note : *If there are no status messages, NORMAL is displayed on the STATUS page as long as the STS pushbutton is pressed. When released, the MEMO page is displayed.*

SYSTEM DISPLAY

- When in their normal ranges all digital values and analog indications are green. When an indication reaches its warning level, the associated analog pointer and digital value become amber (abnormals) or red (emergencies).
- In case of loss of sensor electrical power or loss of signal, the associated indication is replaced by an amber ”XX”.

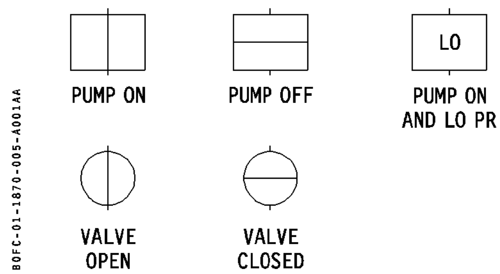
Note 1 : *All units (e.g. : °C, PSI, V, Hz, etc...) are displayed in cyan.*

Note 2 : *System page titles :*

When a system page is displayed automatically (except by advisories) the page title is green.

If a system page is manually selected, or displayed by an advisory, its title is white.

PUMP and VALVE SYMBOLS



SYSTEM PAGE COLOR CODING

CONDITION	COLOR USED
In use	Green
Unusable	Amber
Not in use	Not shown
Off	White
Normal	Green
Abnormal	Amber
Emergency	Red

ECAM SEQUENCE FOR INDEPENDENT FAILURES :

	L CRT	R CRT	
1) When warning is detected:	. Applicable (red or amber) warning page is displayed	Associated system page is displayed	MASTER lights: Applicable light illuminates flashing.* ECAM Control Panel: CLR pushbutton illuminates Local Warning light: FAULT light is illuminated Audio Warning is activated*
2) When crew performs required actions:	Action feedback is indicated on warning page: . amber warning page: action step line turns white . red warning page: Line is cleared from display	System page provides confirmation on the results of ECAM actions	MASTER lights extinguished ECAM Control Panel: CLR pushbutton is still illuminated Local Warning: extinguished Audio Warning: Cancelled
3) When crew presses CLR pushbutton on ECAM control panel to clear the warning page:	STATUS page is displayed . Required QRH procedures are listed . Applicable limitations/ restritions are provided	The flight-phase-related system page is displayed	MASTER lights: extinguished ECAM Control Panel: CLR pusbutton still illuminated if information on STATUS page Local Warning light: extinguished Audio Warning: Cancelled
4) When crew presses CLR pushbutton on ECAM control panel to clear the STATUS page:	MEMO page is displayed	No Change	MASTER light: extinguished ECAM Control Panel: CLR light extinguishes Local Warning light: extinguished Audio Warning: Cancelled
5) If the ECAM control panel RCL pushbutton is pressed to review the warning page procedures:	Warning pages are displayed in the same order as originally activated	Associated system pages are displayed in sequence with warning pages	MASTER lights: Applicable lights remain extinguished ECAM Control Panel: CLR pushbutton illuminates Local Warning light: is extinguished unless failure is still present Audio Warning: cancelled

R

R

B0FC-01-1871-001-A100AB

Note : If a warning page is automatically cleared when the corrective actions are performed (e.g. : resetting a tripped Yaw Damper lever), the associated WLDP and CLR lights extinguish.

** Until either MASTER light is pressed.*

Mod : 5051

LEFT BLANK INTENTIONALLY

ECAM SEQUENCE FOR PRIMARY AND SECONDARY FAILURES :

	L CRT	R CRT	
1)When warning is detected:	. Applicable primary (red or amber) warning page is displayed	Associated system page is displayed	MASTER lights: Applicable lights illuminate flashing* ECAM Control Panel: CLR pushbutton illuminates Local Warning light: Primary and Secondary FAULT lights illuminate Audio Warning is activated*
2)When crew performs required actions for primary failure:	Action feedback is indicated on warning page .red warning pages: line is cleared from display .amber WD pages: action step line turns white	System page provides confirmation on the results of ECAM actions	MASTER lights: the light remain extinguished ECAM Control Panel: CLR pushbutton is still illuminated Local Warning light: Primary FAULT light extinguished/Secondary FAULT light illuminated, Audio Warning: Cancelled
3)When crew presses CLR pushbutton to clear primary warning page:	Applicable secondary (red or amber)warning page(s) are displayed	System page associated with the first secondary warning page is displayed	MASTER lights: the lights remain extinguished ECAM Control Panel: CLR pushbutton is still illuminated Local Warning light: Primary FAULT light extinguished/Secondary FAULT light illuminated, Audio Warning: Cancelled
4) When crew performs required actions for secondary failure(s):	Action feedback is indicated on warning page: . amber warning pages: action step line turns white	System page provides confirmation on the results of ECAM actions	MASTER lights: the lights are extinguished ECAM Control Panel: CLR pushbutton is still illuminated Local Warning lights: extinguished Audio Warning: Cancelled
5) When crew presses CLR pushbutton to clear secondary warning pages (until STATUS page is displayed)	. Other secondary Warning pages are displayed until the STATUS page is reached. . Required QRH procedures (PROC:) are indicated . Applicable limitations/ restritions are listed	System pages associated with other secondary warning pages are displayed until STATUS page is displayed on warning display, then the flight-phase related system page is displayed	MASTER lights: extinguished ECAM Control Panel: CLR pushbutton is still illuminated if information on STATUS page Local Warning lights: extinguished Audio Warning: Cancelled

BOFC-01-1872-001-A100AA

* Until either MASTER light is pressed.

Mod : 5051

R **ORDER OF EVENTS and INDICATIONS FOR PRIMARY AND SECONDARY FAILURES (continued)** :

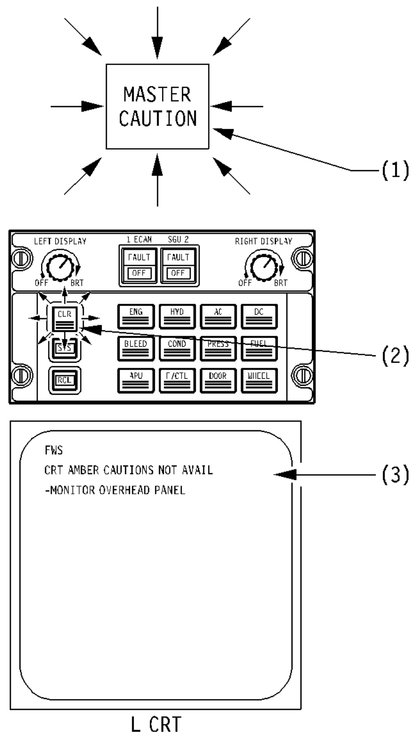
	L CRT	R CRT	
6)When crew presses CLR pushbutton onECAM control panel to clear the STATUS page:	MEMO page is displayed	No Change	MASTER lights: lights remain extinguished ECAM Control Panel: CLR light extinguishes Local Warning lights: extinguished Audio Warning: Cancelled
7)if the ECAM control panel RCL pb is pressed to review the WD pages:	Warning pages are redisplayed in the same order as originally displayed.	Associated system pages are displayed in sequence with warning pages	MASTER light: Applicable lights illuminate ECAM Control Panel: CLR pushbutton illuminates Local Warning lights: illuminate if failures are still present Audio Warning: cancelled

R

BOFC-01-1872-002-A100AB

Mod : 5051

SINGLE FWC LOSS



Note : The loss of one FWC can be caused by the loss of the AC BUS 2 or the AC EMER Bus.

- If one FWC is lost :
  - ECAM cannot provide warning pages for any Amber Cautions/Alerts,
  - The remaining FWC can still activate the MASTER CAUTION warning for part of amber faults.
  - red warnings are not affected as all red warning signals are received by both FWCs.
  - MASTER CAUTION light illuminates (1),
  - CLR pushbutton illuminates (2),
  - The lost amber cautions may only be identified by monitoring the local indications on the systems panels (3).

  Note : Some types of action feedback are lost.

- The MASTER CAUTION light is cancelled by pressing the pushbutton.
- When the CRL pushbutton is pressed :
  - The CLR pushbutton light extinguishes (4),
- The warning pages displays the message :

  FWS AMBER FAULT . . . . MONITOR SYS

  above the MEMO page (5).

  For all amber cautions, no ECAM warning page is available on the left CRT.

  The paper check-list (QRH) must be used, in conjunction with local indications.

  The ECAM message :

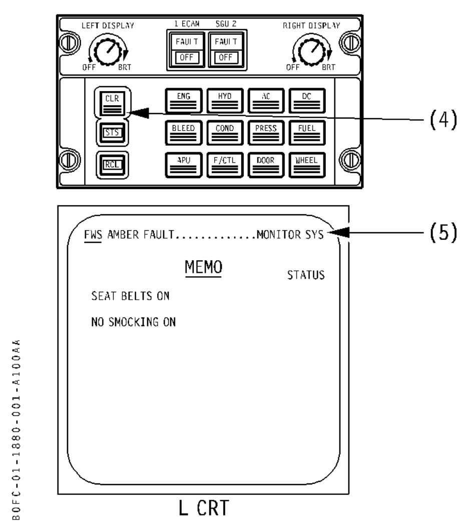
  FWS **AMBER** FAULT . . . . MONITOR SYS

  indicates the loss of a single FWC.

  Should the message subsequently become :

  FWS FAULT . . . . MONITOR SYS,

  this would indicate the loss of the second FWC (and the loss of all ECAM and audio warnings).



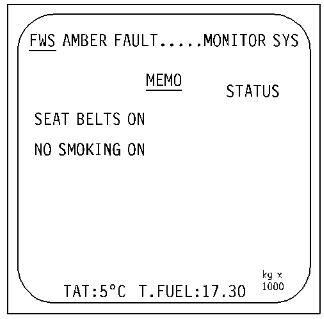
Mod : 5051

LOSS OF BOTH FWC

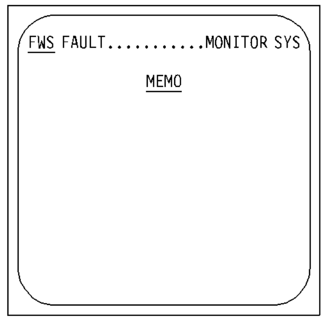
- If the second FWC is lost (e.g. loss of AC BUS 2 and AC EMER BUS or loss of one bus and loss of the non-related FWC), the only indication is that the word "AMBER" is cleared from the MEMO page message.

R
- MASTER CAUTION light illuminates.
- The warning page displays the message :
  FWS FAULT . . . . MONITOR SYS
- **No ECAM warnings are available.**

R
- **No audio, or CRT warnings are available.**
- **Overhead panel and other local indications must be scanned more frequently.**



Loss of a single FWC



Loss of both FWC

80FC-01-1880-002-A100AB

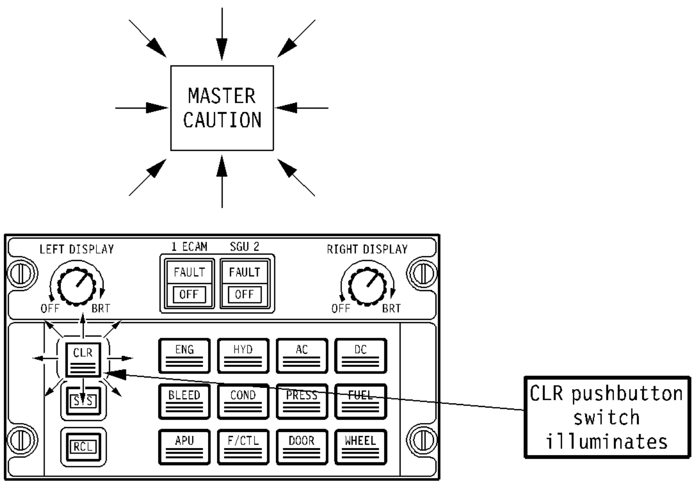
SUMMARY OF EFFECTS OF SINGLE AND DUAL FWC LOSS

	AMBER WARNINGS	RED WARNINGS
ONE FWC LOST	• All amber warning pages are lost. • Paper checklists (QRH) must be used for amber cautions and alerts. • **50 % of ECAM amber warnings are lost** (Only local indications are available). R • For the remaining 50 % ECAM amber warnings, only the Audio Chime warnings are available (no warning page).	• No effect, except that action feedback may be lost.
BOTH FWC LOST	• All ECAM warnings are lost. • Local warning lights must be monitored. • All red and amber warning pages are lost. • No Audio warning or MASTER CAUTION/WARNING light is available. • QRH procedures must be used for all fault conditions.	

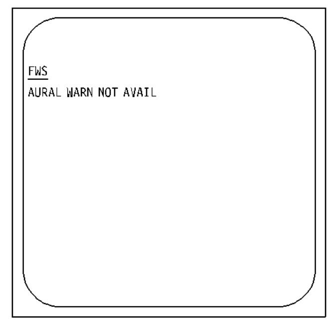
Mod : 5051

FWC 1 AND 2 - AUDIO MODULE FAILURE

- If case of loss of the FWC audio modules no aural warnings are available.
- The MASTER CAUTION light illuminates.

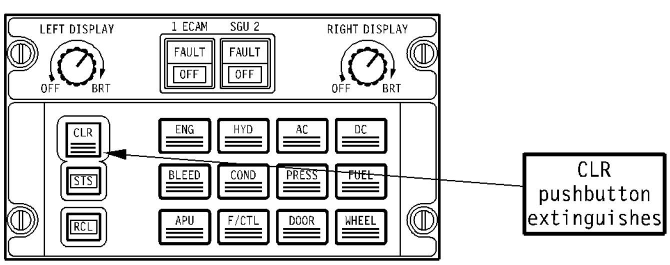


BOFC-01-1880-003-A100AA



L CRT

- The associated warning page is displayed on the left CRT.
- The MASTER CAUTION lights extinguish when either light is pressed.
- This warning is cleared by pressing the CLR pushbutton :



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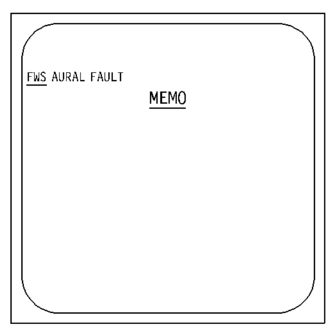


L CRT

R • The left CRT displays the message :

FWS AURAL FAULT

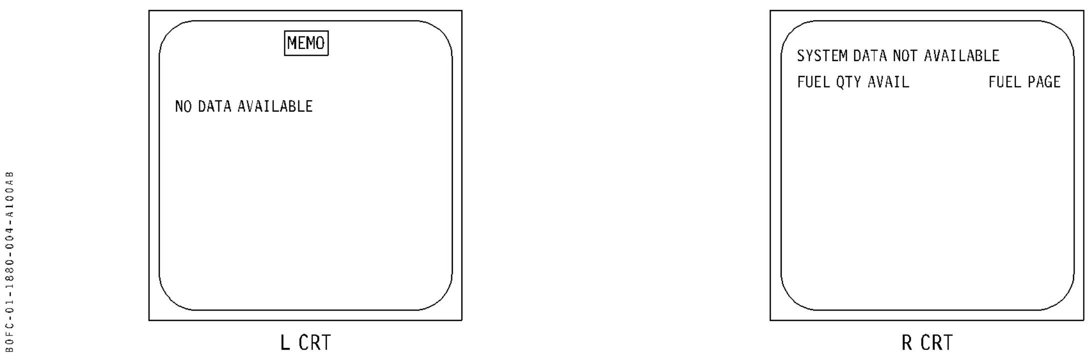
above the MEMO page.

Mod : 5051

LOSS OF SYSTEM DATA ANALOG-DIGITAL CONVERTER (SDAC)

- In case of SDAC failure, or loss of electrical power (AC BUS 1/AC ESS BUS), the following ECAM functions are lost :
  - MEMO page messages,
  - Most ECAM action feedback,
  - R All system pages (except FUEL QTY on the FUEL page and indications on WHEEL page),
  - Some STATUS messages are also lost.
- With no aircraft system failures :
  - Messages on MEMO page and on system display indicate that data are lost (except Fuel Quantity on FUEL page).

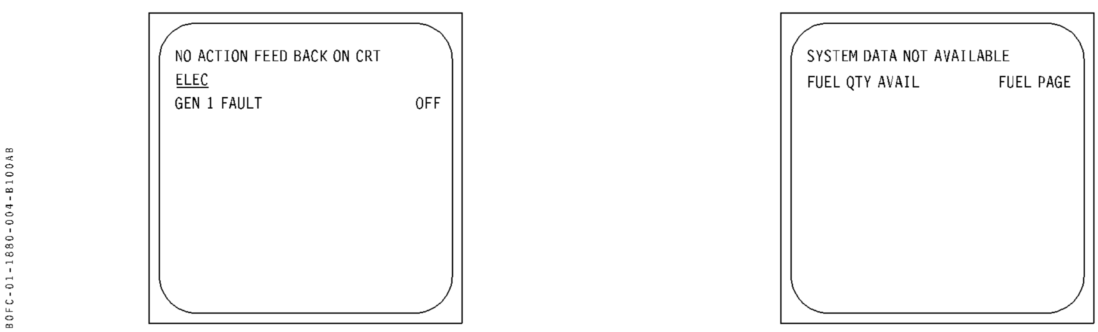
R



- If an aircraft sytem failure occurs (e.g. : GEN FAULT) :

  The associated warning page is displayed, but action feedback is not provided, the message NO ACTION FEED BACK ON CRT indicates that action feedback will not be displayed when action steps are performed.

R

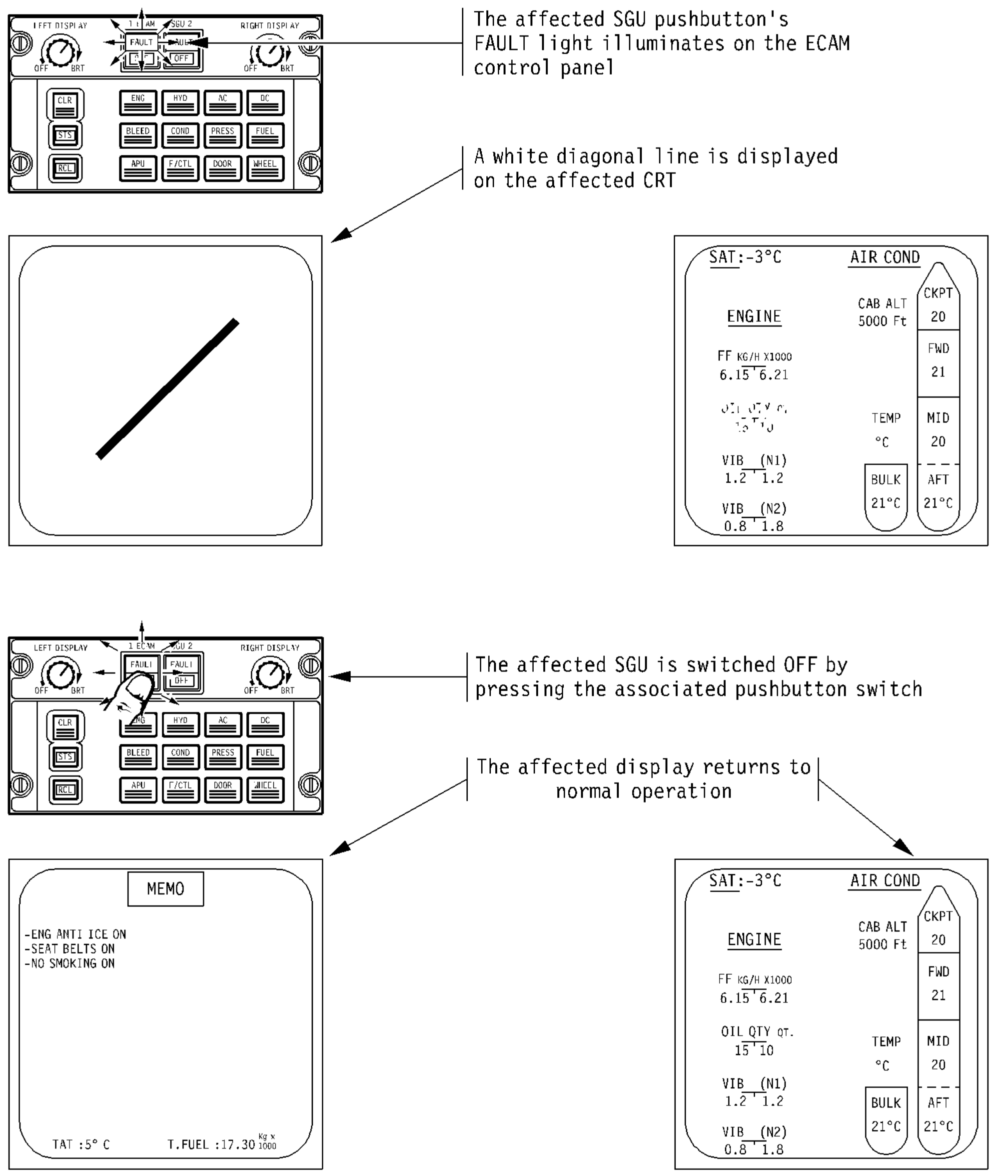


Mod : 3781

LOSS OF SYMBOL GENERATOR UNIT (SGU)

- If case of an ECAM SGU failure or loss of electrical power (AC BUS 1 OFF for SGU 1 and AC BUS 2 OFF for SGU 2), the associated SGU FAULT light illuminates on the ECAM control panel, and a white diagonal line is displayed on the affected CRT.

R



B0FC-01-1880-005-A001AB

- After the affected SGU is switched OFF, the ECAM CRTs return to normal operation (the remaining SGU
R supplies both CRTs).

LOSS OF A SINGLE CRT

R • In case of CRT failure or loss of electrical power (L CRT – AC BUS 1, R CRT – AC BUS 2) the display is blanked.

• The affected CRT must be switched OFF.

• The remaining CRT then provides all normal functions, as follows.

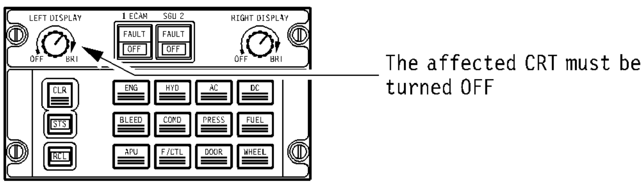
• With no warnings or cautions present, the MEMO page is display on the operative CRT :

  – All system pages can be manually selected (except the CRUISE page).

• If an ECAM warning or caution occurs, the warning pages replace the MEMO page on the operative CRT :

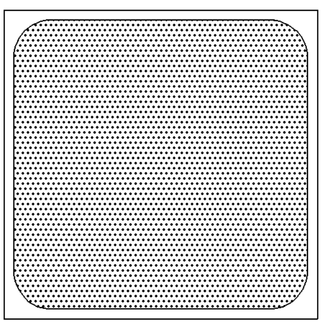
  – the related system page can be selected after clearing all the warning pages and the STATUS page,

  – after reviewing the system page, pressing the CLR pushbutton redisplays the first warning page.

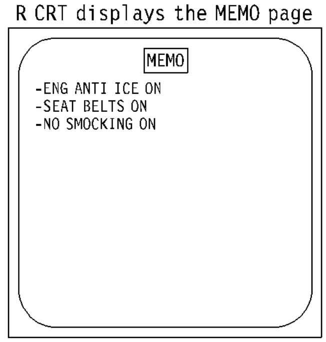


• **WITHOUT AIRCRAFT SYSTEM FAILURE:**

L CRT OFF

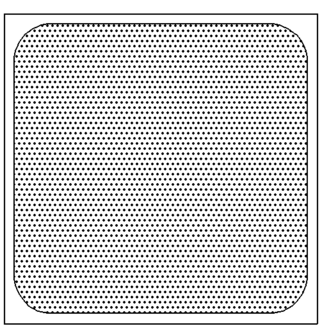
R 

R CRT displays the MEMO page

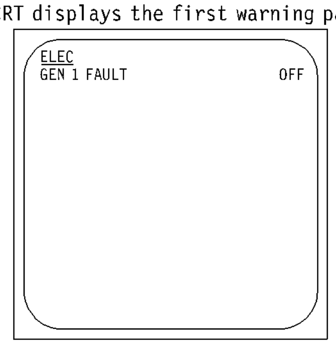


• **WITH AN AIRCRAFT SYSTEM FAILURE:**

L CRT OFF

R 

R CRT displays the first warning page

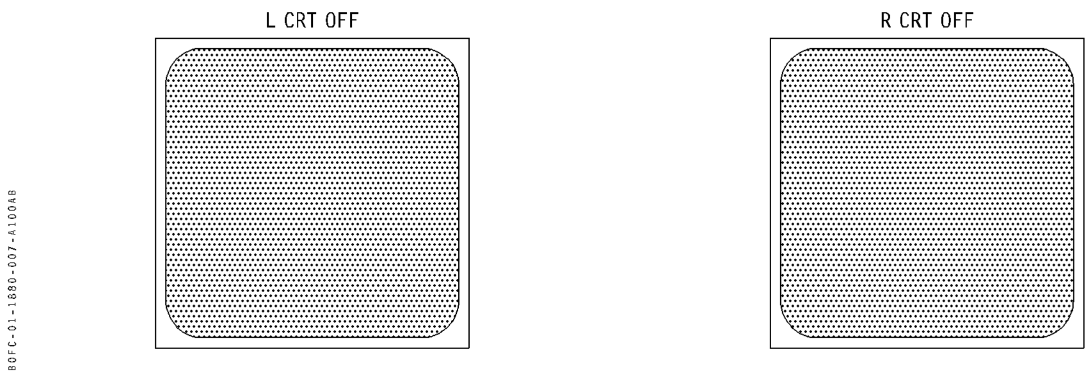


BOFC-01-1880-006-A001AB

LOSS OF BOTH ECAM CRTs

- In case of double CRTs failure or loss of electrical power supply (e.g. AVIONICS SMOKE drill or FLIGHT ON BAT ONLY), the ECAM still provides :
  - Audio warnings, and
  - MASTER CAUTION/WARNING lights and local warnings.

R



Mod : 5051

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Mod : 5051

Mod : 11320 or 11364 or 12044 or 12045

Mod : 11320 or 11364 or 12044 or 12045

ACCELERATION ALTITUDE

Altitude at which acceleration to initial climb speed is initiated as slats/flaps are retracted.

ACTIVE FLIGHT PLAN

Route between an origin and destination, as defined by the pilot in the FMC. May also be referred to as the ACTIVE PRIMARY FLIGHT PLAN.

ALTITUDE CONSTRAINT

Altitude crossing restriction.

AUTO FLIGHT SYSTEM (AFS)

Comprises the Flight Augmentation Computer (FAC), Thrust Control Computer (TCC), Flight Control Computer (FCC), and the Flight Control Unit (FCU).

COMPANY ROUTE

A route comprising the entire route, with the exception of the destination STAR, between the origin/destination, including cost index, and cruise flight level.

CONSTRAINT

Altitude, speed or time restriction in the flight plan entered by the pilots through the CDU.

COST INDEX

Factor representing the cost of operating the aircraft divided by the cost of fuel.

CONTROL DISPLAY UNIT

Main interface between the crew and the FMC. There are two identical CDUs, located on each side of the pedestal, in front of the throttle levers.

CROSSTALK

Communication of information between the two Flight Management Computers.

DATABASE

Navigation and performance-related informations stored in the non-volatile memory of the Flight Management Computer.

DATA FIELD

A data line on the CDU where specific information is displayed or entered.

DEFAULT

Data, from the FMC, that is automatically displayed when no previous entries have been made, or when entered data is manually cleared.

DISCONTINUITY

A break in the lateral flight plan where two successive path terminations (waypoints/navaids) are disconnected.

EXTRA FUEL

Fuel carried on board in addition of all requested reserves.

ECONOMY CLIMB

An IAS/Mach schedule which results in minimum operating cost per mile.

FIGURE OF MERIT

Number assigned to each navaid (VOR, DME, VOR/DME, ILS) indicating the maximum distance at which it can be tuned.

FIX

A reference waypoint from which an approach or maneuver procedure is begun (i.e., Final Approach Fix).

HOLD

Abbreviation for ″holding pattern″.

LEG

Portion of the flight plan between two navigation points.

LINE SELECT KEYS (LS KEYS)

There are two rows of six Line Selection keys which are respectively located on the left and right sides of the CDU. LS keys are associated with data fields on the CDU screen.

MAXIMUM ALTITUDE

A computed value which considers thrust limitations, speed envelope constraints, and load factor margins.

MAXIMUM CLIMB

A speed-altitude schedule which results in a maximum climb flight path angle.

MAXIMUM ENDURANCE

A speed target which results in best lift over drag ratio.

NAVAID

A VHF radio station that is used to determine aircraft position.

ONSIDE

The Captain's CDU is the onside CDU of the FMC1 and the First Officer's CDU is the onside CDU of the FMC2.

OPTIMUM ALTITUDE

Altitude at which performance factors of fuel, time, and cost are optimized according to the current strategic cruise mode.

PERFORMANCE OPTIMIZATION

Determination of speed/altitudes schedules which will minimize cost, fuel consumption or elapsed time.

PROMPT

Symbol displayed on the CDU, adjacent to a line select key, to select data (<or>), or modify the active flight plan (*).

PSEUDO WAYPOINT

Point inserted into the Primary Flight Plan reflecting a change in the vertical profile.

REMOTE TUNED STATION

A station which identifier has been manually selected by the crew on the CDU, but which frequency has been automatically tuned by the FMC (AUTOTUNE function).

SCRATCHPAD

Specific field, located on the bottom line of the CDU screen, where all characters typed by the crew on the CDU keyboard are displayed. The scratchpad also displays all messages generated by the FMS.

SCROLLING

Moving up or down a page which is too long to be entirely displayed on the CDU screen. Scrolling is achieved through dedicated keys which move the page one line up or down.

SITUATIONAL MODES (IMM DES, DECEL, IMM CLB, and ENGOUT DRIFTDOWN)

Allow the pilot to deviate from the vertical profile without necessitating a vertical flight plan change. These modes are either manually or automatically engaged.

SPEED CONSTRAINT

Refers to an airspeed restriction at a specified point.

STEP ALTITUDE POINT

Predicted point of the route where the cruise altitude is changed.

STRATEGIC MODE

Vertical performance parameters affecting all phases of a flight.

TACTICAL MODE

Vertical performance parameters affecting only the current flight phase.

THRUST REDUCTION ALTITUDE

Altitude where takeoff thrust is reduced to climb thrust.

WAYPOINT

A geographically-fixed position, along the route of flight, either contained within the database or defined by the pilot.

WRITE/INSERT

Entering data in a CDU data field from the keyboard requires two actions :

write :
Type a text on the CDU keyboard. This text is displayed in the scratchpad.

insert :
Transfer this text from the scratchpad to a data field (and so to both FMCs) by pressing the corresponding LS key.

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A	Autotune
ACARS	Aircraft Communication Addressing and Reporting System
ACCEL	Accelerate
ACT	Active
ADC	Air Data Computer
AFS	Automatic Flight System
AIDS	Aircraft Integrated Data System
ALT	Altitude
ALTN	Alternate
AP	Autopilot
APPR	Approach
ARPT	Airport
A/THR	Automatic Thrust
ATS	Autothrottle System
AWY	Airway
BRG	Bearing
BRT	Bright
CAS	Calibrated Airspeed
CDU	Control and Display Unit
CG	Center of Gravity
CGCC	Center of Gravity Control Computer
CLB	Climb
CLR	Clear
CONFIG	Configuration
CO RTE	Company Route
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CSTR	Constraint
CWS	Control Wheel Steering
DECEL	Decelerate
DES	Descent
DEST	Destination
DFA	Delayed Flap Approach
DIR	Direct
DIR TO	Direct To
DISCON	Discontinuity (F-PLN)
DIST	Distance
DME	Distance Measuring Equipment
DR	Dead Reckoning
DSPY	Display
ECAM	Electronic Centralized Aircraft Monitoring
ECON	Economy
EFIS	Electronic Flight Instrument System
EFOB	Estimated Fuel On Board
ELV	Elevation
ENG	Engine
EO	Engine Out
EOSID	Engine Out SID
ETA	Estimated Time of Arrival
ETE	Estimated Time En-route
FAC	Flight Augmentation Computer
FAF	Final Approach Fix
FCU	Flight Control Unit
FD	Flight Director
FF	Fuel Flow
FIG	Figure
FL	Flight Level
FLT	Flight
FMA	Flight Mode Annunciator
FMC	Flight Management Computer
FMS	Flight Management System
FOB	Fuel on Board
F-PLN	Flight Plan
FSO	Flaps, Slats, VFTO (Green Dot)
FQ	Fuel Quantity
FREQ	Frequency
G/S	Glide slope
GS	Ground Speed
GW	Gross Weight
HDG	Heading
I	Inertial
IAF	Initial Approach Fix
IAS	Indicated Airspeed
IDENT	Identifier
IMM	Immediate
INB	Inbound
INIT	Initialisation
INOP	Inoperative
INTCP	Intercept
I/P	Intercept Profile
IRS	Inertial Reference System
ISDU	Inertial Sensor Display Unit

L	Left
LAT	Latitude
LAT REV	Lateral Revision
LIM	Limit
LOC	Localizer
LONG	Longitude
LS key	Line Select key
LW	Landing Weight
M	Manual Tune
MAX CLB	Maximum Climb
MAX DES	Maximum Descent
MAX END	Maximum Endurance
MCT	Maximum Continuous Thrust
MIN	Minimum
MLW	Maximum Landing Weight
MMO	Maximum Operating Mach
MSG	Message
MTOGW	Maximum Takeoff Gross Weight
MZFW	Maximum Zero Fuel Weight
NAV	Navigation
ND	Navigation Display
NM	Nautical Miles
OAT	Outside Air Temperature
OFST	Offset
OPT	Optimum
OUTB	Outbound
P/B	Pushbutton
P/B/D	Place/Bearing/Distance
P/D	Place/Distance
PERF	Performance
PFD	Primary Flight Display
PPOS	Present Position
PRED	Prediction
PREV	Previous
PROC T	Procedure Turn
PROG	Progress
R	Remote Tune, Right
RED	Reduction
REF	Reference
REPR	Repressurization
REV	Revision
RMI	Radio Magnetic Indicator
RNAV	Area Navigation
RSV	Reserve
RTE	Route
RWY	Runway
S/C	Step Climb
S/D	Step Descent
SEC	Secondary
SEL	Select
SID	Standard Instrument Departure
SPD	Speed
SRS	Speed Reference System
STAR	Standard Terminal Arrival Route
TACT	Tactical
T/C	Top of Climb
TCC	Thrust Control Computer
T/D	Top of Descent
TEMP	Temperature
THR	Thrust, Throttle
TO	Takeoff
TOGA	Takeoff/Go Around
TOGW	Takeoff Gross Weight
TP	Turning Point
TRANS	Transition
TROPO	Tropopause
TRP	Thrust Rating Panel
UTC	Universal Time Coordinated
VAPP	Approach Speed
VDEV	Vertical Deviation
VERT	Vertical
VREF	Landing Reference Speed
V/S	Vertical Speed
WPT	Waypoint
ZFW	Zero Fuel Weight
ZFWCG	Zero Fuel Weight Center of Gravity

1 – PURPOSE

- The purpose of the Flight Management System is to provide a complete automation of all the navigation and flight management tasks.

- It reduces cockpit workload, improves efficiency and eliminates many routine operations normally performed by the pilots.

2 – SUMMARY OF FMS FUNCTIONS

- The following functions are listed according to flight phases. They are described in detail in chapter 2.02.19 ″Procedures and Techniques″ - FMS.

2.1 – ON GROUND (PRE-FLIGHT PHASE)

2.1.1 – Initialization and Flight Plan definition

- The two FMCs must be initialized. This can be done on either CDU. Thanks to the crosstalk between both FMCs, all entries will be received by both FMS. Initialization consists of :

  – Defining a Flight Plan (F-PLN)
  The route to be flown is inserted on the CDU ″INIT PAGE A″ by entering an airport pair of a Company Route identifier.

  The FMS then extracts the necessary data from its database and assembles the F-PLN.

  The F-PLN can also be defined waypoint by waypoint.
  The crew can display this F-PLN both on the CDU (by calling ″F-PLN″ page) and on the ND (by calling MAP or PLAN mode).

  – Aligning the IRSs
  This is done through INIT page A by pressing a dedicated key. This sends LAT/LONG associated to the DEPARTURE airport to the IRSs.

  – Entering weight data
    - Insert one weight among ZFW, TOGW on INIT page B
    - Insert also BLOCK fuel to get flight planning computation on ground before engine start
    - Insert Temperature (TEMP) and WIND forecasts at waypoints (WPT) on INIT page B or VERT REV page B (vertical revisions)

    Fuel predictions are now available on FUEL PRED page.

  – Inserting a cruise FL.

2.1.2 – F-PLN revisions

- F-PLN lateral revisions
The F-PLN directly extracted from the database can be revised by inserting (through the F-PLN ″LATERAL REVISION″ page) terminal area procedures (RWY/SID at departure and RWY/STAR at destination), new AIRWAYS, HOLDING procedures, etc...

  F-PLN can also be modified directly on ″F-PLN″ page by inserting NEW WAYPOINTS.

- F-PLN vertical revisions
On ″VERT REV″ pages :
  – Constraints at WPT : Time, Altitude, Speed/Mach
  – Temperature and wind forecasts at WPT
  – Step climb or descent with estimated savings or losses.

2.1.3 – Takeoff data on the ″TAKEOFF″ page

- V1 and VR must be entered on the CDU ″TAKEOFF″ page.
V2 is copied from the value selected on the FCU.
F, S, O are calculated and displayed if the BLOCK fuel has been entered.
Thrust reduction and acceleration altitudes are displayed, with and without ENGINE OUT. They are defaulted but may be changed if necessary.

Mod : 6789

2.1.4 – Secondary F-PLN definition

- A second F-PLN may be defined in a similar way on the SEC INDEX page for different purposes :
  - To prepare takeoff or approach on a different runway.
  - To prepare an in-flight turnback after takeoff.
  - To prepare a diversion to an en-route alternate.
  - For in-flight reclearance purpose.
- As the SEC F-PLN is not automatically erased after landing, it can be used :
  - To prepare the F-PLN for the next flight.
  - For training patterns.

2.2 – IN FLIGHT

2.2.1 – Aircraft position calculation

- The FMS is a navigation system with multiple sensors including IRS and radio navaid receivers.
- The FMC computes a MIX IRS position using the signal of the IRSs. The FMC updates its position with the best available sensor : DME/DME or VOR/DME.
- The radio stations (VOR/DME) required for updating are automatically tuned by the FMCs.
- This allows the FMS :
  - to carry out leg switching each time the aircraft crosses a waypoint.
  - to present on the ND the flight plan with respect to the instantaneous aircraft position.

2.2.2 – Coupling to the AFS

- Lateral steering commands are sent to the AFS provided NAV mode has been engaged.
- Vertical steering commands and thrust target are sent to the AFS, provided PROFILE mode has been engaged.
- The FMS will provide advisory information about the flight from takeoff to landing but will be coupled to AFS only from beginning of climb to approach.
- The FMS still provides advisory information when AFS is not coupled.

2.2.3 – F-PLN revisions

- Waypoints of the F-PLN are automatically sequenced as the flight progresses.
- Lateral and vertical revisions can be made on the Flight Plan.
- All the revisions can be viewed at the same time on the CDU ″F-PLN″ page and on the ND if MAP or PLAN mode is selected.
- The lateral revision page is also used to enter a STAR and an approach.

2.2.4. – Strategic and tactical performance modes

- The FMS optimizes the flight path according to the strategic mode selected.
  The strategic mode can be changed during flight.
- Besides the strategic mode, a tactical mode may be selected to be flown during the active flight phase only.

2.2.5 – Performance and fuel predictions

- Time predictions at certain waypoints and fuel prediction at destination airport can be viewed on the ″F-PLN″ page and the ″FUEL PREDICTION″ page.
- They are updated, as the flight progresses, to take into account F-PLN revisions, actual value of certain parameters (ground speed, cruise wind/ temperature).
- Time and fuel predictions are also influenced by the strategic or tactical mode selected.

Mod : 6789

2.2.6 – Other functions

- Engine out function
  When an engine failure occurs, the FMS detects it and asks for a confirmation :
  - to fly an engine out SID (EOSID) if the aircraft is before the splitting point.
  - to fly an ENG OUT drift down procedure.
- Activation of a step climb or descent
  The step can be made at a computed optimum point or a waypoint chosen by the crew. Fuel and time savings or losses are displayed.
- Activation of the alternate F-PLN
- Insertion of a descent wind profile
- Approach data insertion and computation :
  - landing configuration
  - VAPP display
  - wind correction insertion
  - predicted LANDING WEIGHT
  - O, F, S, calculation and display
  - MDA insertion
  - GO-AROUND data (as TAKEOFF)
  - Informations on waypoints and navaids used by the FMS are available when the "REFERENCE" page is called.
    New waypoints or new navaids (in addition of those existing in the database) can be defined.
  - The five closest airports can be displayed, with bearing and distance indications
  - Status of the sensors used by the FMS can be known by calling the "REFERENCE" page.

2.3 – AT LANDING

- The active F-PLN is cleared when the landing gear is compressed and both fuel flows are less than 200 kg/h.
- The secondary F-PLN is not cleared and can be activated as necessary.

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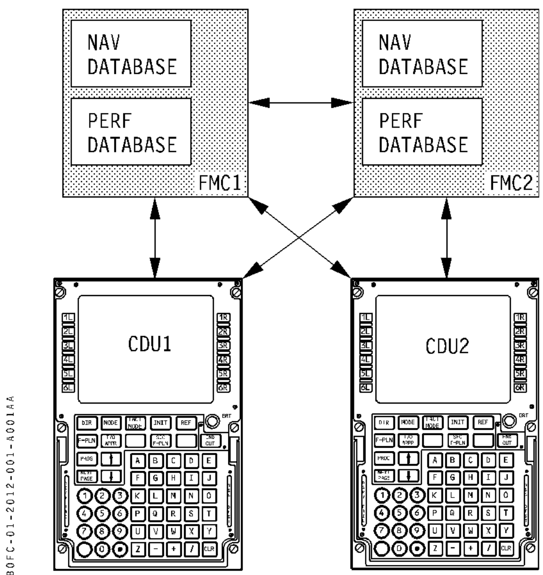
1 - FMS ARCHITECTURE

- The Flight Management System (FMS) consists of :
  - Two Flight Management Computers (FMCs)
  - Two Control Display Units (CDUs). One for each pilot. The CDUs represent the main interface between the flight crew and the FMCs.
- Each FMC works independently but each input entered through a CDU is transmitted to both FMCs.
- The FMCs communicate together through a crosstalk bus.



2 – FMC INTERNAL ORGANIZATION

- Each FMC uses for its computations :
  - the performance database

  and/or
  - the navigation database.

2.1 – PERFORMANCE DATABASE

- The performance database contains :
  - the aircraft aerodynamic data,
  - the engine data.
- It is used for all the performance computations, including aircraft position determination.The airline does not have access to this database.

2.2 – NAVIGATION DATABASE

- The navigation database contains :
  - Ground navigation aids ("navaids") : VOR, VOR/DME, VORTAC, DME, TACAN, ILS.

    Each navaid is defined by its :
    - identifier (4 characters maximum)
    - latitude, longitude,
    - frequency,
    - magnetic variation,
    - class (VOR, VOR/DME...),
    - figure of merit (company defined),
    - elevation (for DME and ILS),
    - course referenced to magnetic North (for LOC),
    - category (for ILS : CAT 1, 2 or 3).
  - Waypoints :

    Each waypoint is defined by its :
    - identifier (5 characters maximum),
    - latitude and longitude,
    - type (en route, terminal, or both).
  - Airways :

    Each airway is defined by its :
    - identifier (5 characters maximum),
    - list of fixes (waypoints, navaids, or airports that compose the airway).
  - Airports :

    Each airport is defined by its :
    - identifier (ICAO code),
    - latitude and longitude,
    - elevation,
    - association alternate airport (optional).

– Runways :

Each runway is defined by its :

- identifier (airport, number, left/right/center),
- center line bearing (QFU),
- threshold latitude and longitude,
- length,
- threshold elevation.

– Airport procedures :

Each procedure is defined by its :

- type (SID, EOSID, STAR, ILS, RNAV),
- airport ICAO identifier,
- applicable runways,
- path,
- termination.

– Company routes :

Each company route is defined by its :

- identifier (10 characters maximum),
- origin airport,
- destination airport,
- via code (SID, airway, direct, STAR, profile descent, approach),
- cruise altitude (optional),
- cost index (optional).

- All these data are proper to each company and cover only a defined geographic area, depending on the routes operated by the company.

- In addition, the crew can create and manually insert
20 navaids and 20 waypoints (or airports) in the FMC database. These points can be anywhere in the world.

- The crew can also modify or cancel some elements of the database, for the current flight only.

3 – SECONDARY NAVIGATION DATABASE

- A second navigation database, with another period of validity can be loaded.

- If the period of validity of the secondary database is correct, the crew can select it to make it the active database.

- Switching the database will erase the flight plan.

4 – NAVIGATION DATABASE UPDATE

- The navigation database must be updated every 28 days.

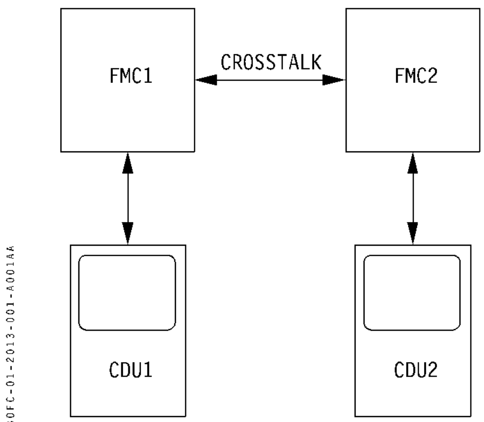
- Two different databases are always available and can be accessed through the CDU.

- The update of the navigation database is performed on the ground through a data loader, in about 5 min for each FMC.

- There are two FMS modes of operation :
  - The DUAL mode of operation, which is the normal mode
  - The INDEPENDENT mode of operation : each FMC is controlled by its associated CDU.

1 – DUAL MODE

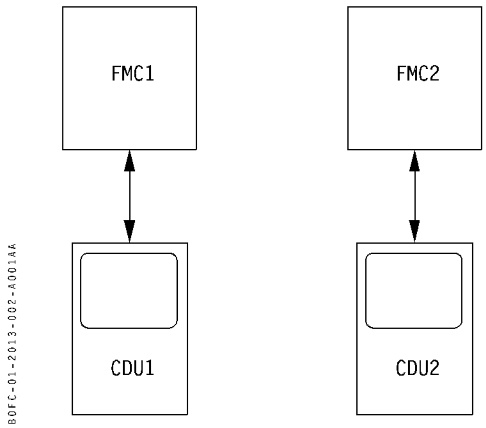
- This is the normal mode. The two FMCs are synchronized : each performs its own computations and exchanges data with the other through a crosstalk bus.



- One FMC is the master, the other the slave, so that the master FMC manages the critical functions and sends orders to the slave FMC.
- The main functions (controlled by the master FMC) are :
  - the sequencing of a waypoint (change of leg in the flight plan)
  - determination of the order in which insertions made on both CDUs will be processed.
  - the initiation of data comparison :
    - comparison of the flight plan
    - comparison of the aircraft position
    - comparison of the FCU status and GMT.
- The master FMC is determined by the AP or FD which is engaged :
  - If one AP is engaged, the related FMC is master
  - If two APs are engaged, FMC1 (captain's side) is master
  - If no AP is engaged and :
    - the FD1 is engaged (even if FD2 is also engaged), FMC1 is master
    - the FD2 is engaged, and FD1 is not, then FMC2 is master
  - If no AP or FD is engaged, the first FMC which is powered up is master.
- CDUs operating in DUAL mode of operation :
  - Both CDUs can display separate pages.
  - All data inserted into any CDU is transferred to both FMCs and to all peripherals.
  - Any data insertion into FMS can be made on any of the two CDUs. It will be taken into account by both FMCs and will appear on the corresponding CDU page.
  - Messages are only cleared within the onside FMC when cleared on the CDU.
- In DUAL mode, the aircraft position, the gross weight and the target CAS airspeed are computed independently by each FMC. The results are compared and any discrepancy is announced to the crew.

2 – INDEPENDENT MODE

- In this mode, each FMC operates independently and processes only its onside CDU inputs.

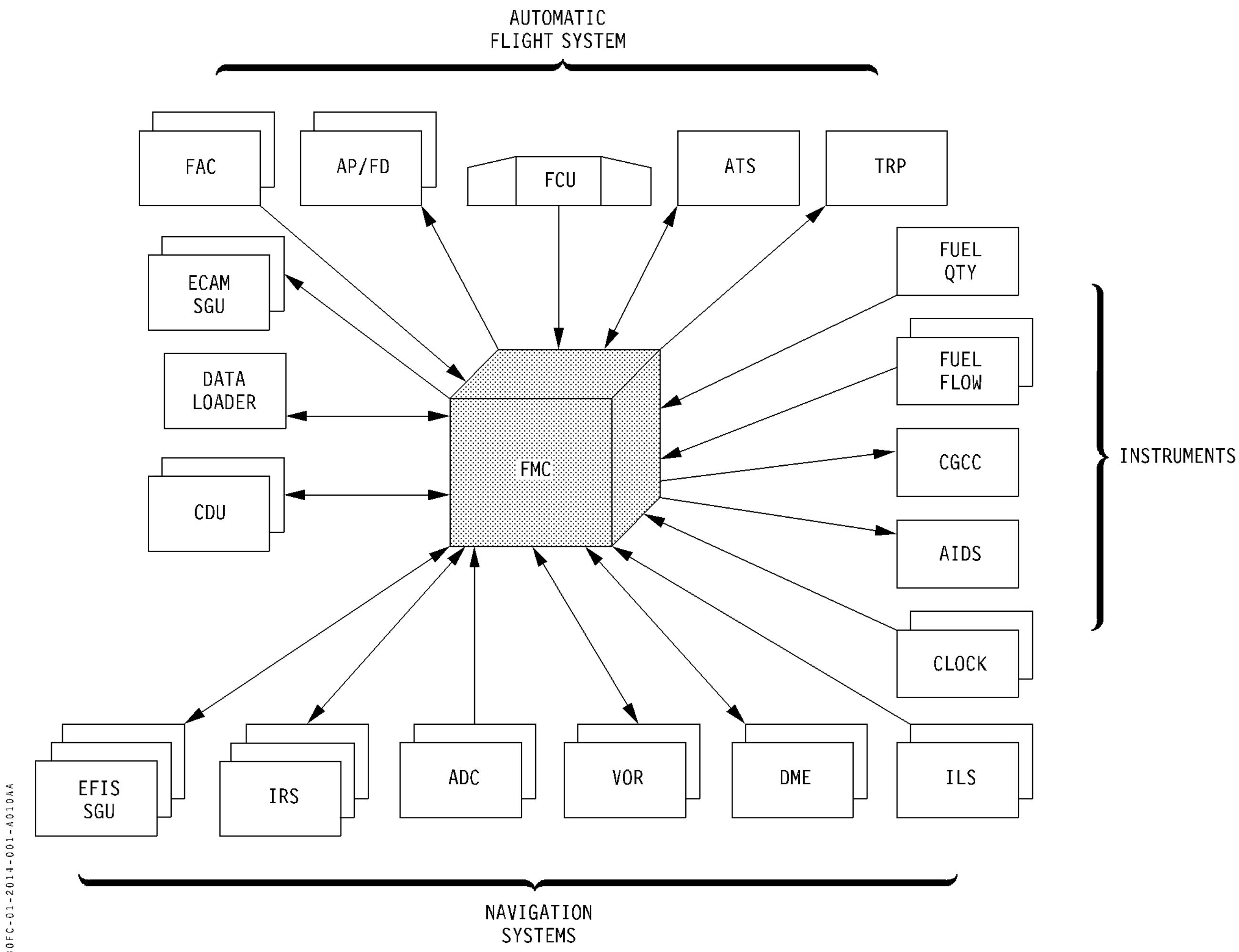


- The FMS reverts to the INDEPENDENT mode of operation if there is a discrepancy between certain parameters : see chapter 2.05.34 for more details.

- When the FMC reverts to the INDEPENDENT mode, the message "INDEPENDENT OPERATION" is displayed on both CDUs.

- The system can return to the DUAL mode only after one FMC is shutdown for more than 10 seconds. It is possible in flight.

- The FMS is interfaced with the Auto Flight System, the Navigation systems, the Flight Instruments, and several other computers, as shown on the diagram below.



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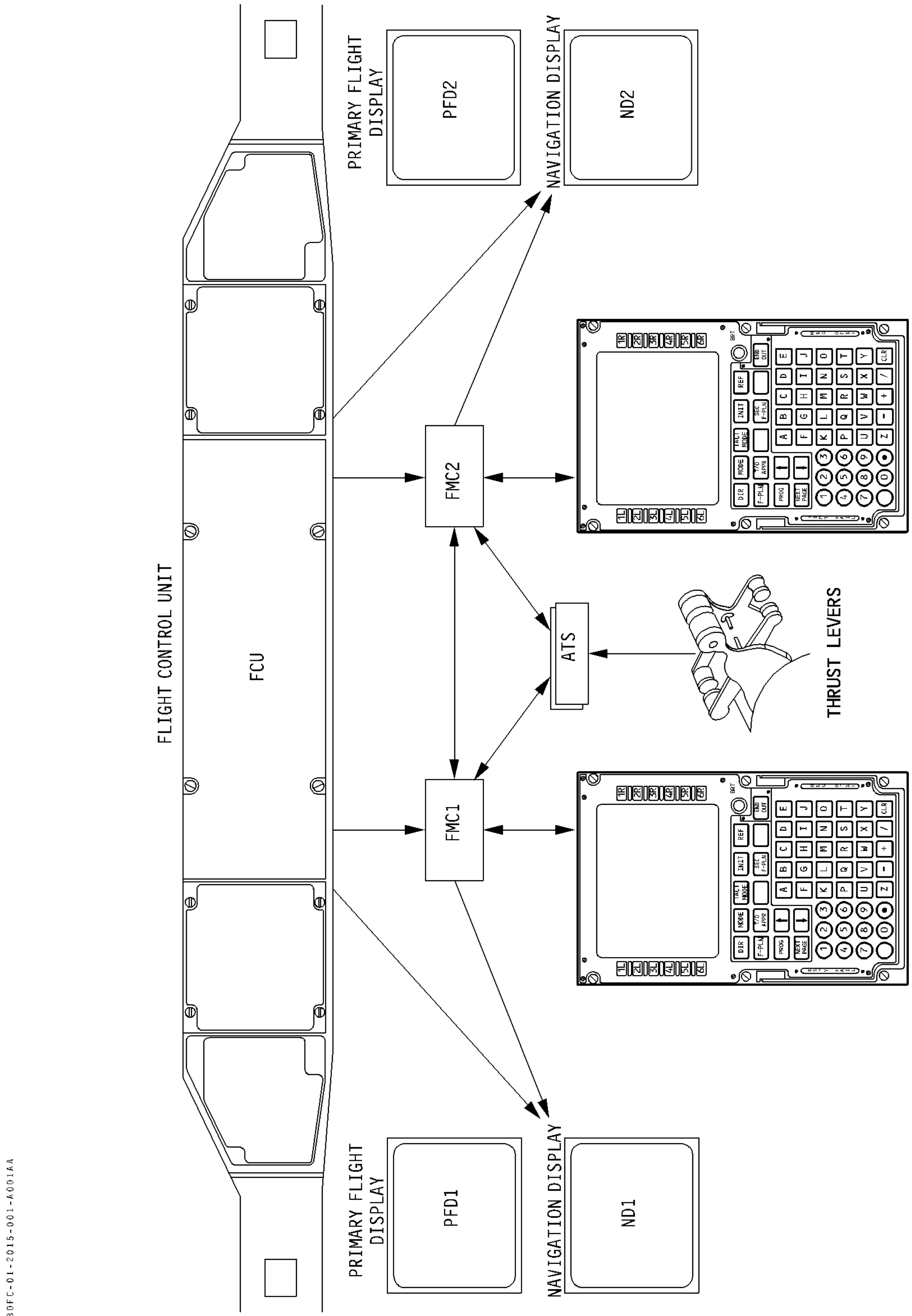
- Crew interface with FMC



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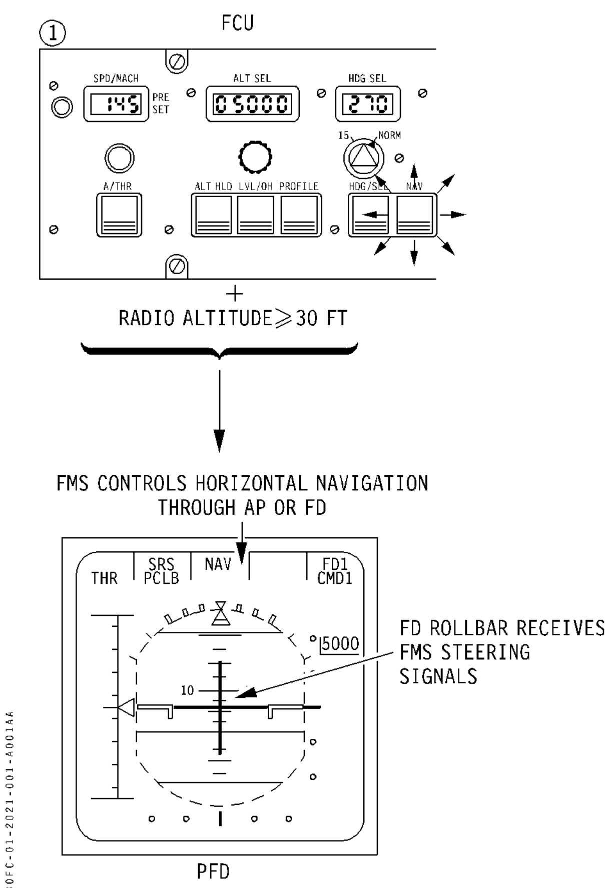
The FMS can be coupled to the AFS in three modes, with different levels of automation :

NAV, PROFILE and AUTO modes.

1 – NAV MODE

- The NAV mode allows to couple the FMS to the AP/FD in lateral axis, so that the FMS automatically controls the lateral navigation (from 30 ft to LOC capture).
  Parameters of this lateral navigation are defined and entered into the FMS flight plan through the CDU.

1 - NAV ENGAGEMENT



2 – PROFILE MODE

- The PROFILE mode allows to couple the FMS to the AP/FD in longitudinal axis and to the ATS, so that the FMS automatically controls the VERTICAL PROFILE (altitude, speed, thrust and time), from THR RED ALT to G/S capture.
- In PROFILE mode, the vertical guidance orders and the thrust are computed by the Flight Management Computer (FMC) and executed by :
  - the AP/FD (P.CLB, P.ALT, P.DES modes) for maintaining the required speed, altitude, flight path or vertical speed.
  - the A/THR (P.THR, P.SPD, RETARD modes) for maintaining the required thrust or speed.

CAUTION

PROFILE mode is not allowed for use on final approach.

- Parameters of this vertical profile are defined and entered into the FMS flight plan through the CDU.

  Note : *1. Coupling to the ATS (for speed or thrust control) is effective if, in addition, A/THR function has been engaged.*

  2. PROFILE engagement automatically activates AUTO mode on TRP (Thrust Rating Panel).

- The PROFILE mode may be used without the A/THR being engaged (i.e. with MAN THR setting).
- The main rules in FMS vertical guidance of the aircraft are :
  - Altitude acquisition by FMS is always limited by altitude selected on the FCU (clearance altitude).
  - During cruise phase, the FMS holds the clearance altitude within a band of ± 50 ft (soft hold) in order to minimize throttle activity.
  - If the FCU selected altitude is greater than the CRZ FL (entered on CDU "INIT" page) the FMS automatically changes this CRZ FL into the FCU altitude.
  - The FMS cannot command an altitude change without at least two "positive" actions of the crew. This means that the pilot must :
    - select the new altitude on the FCU (ALT knob).
    - pull the ALT knob to allow the altitude change.

  See chapter 1.03.52 for more details.

3 – AUTO MODE

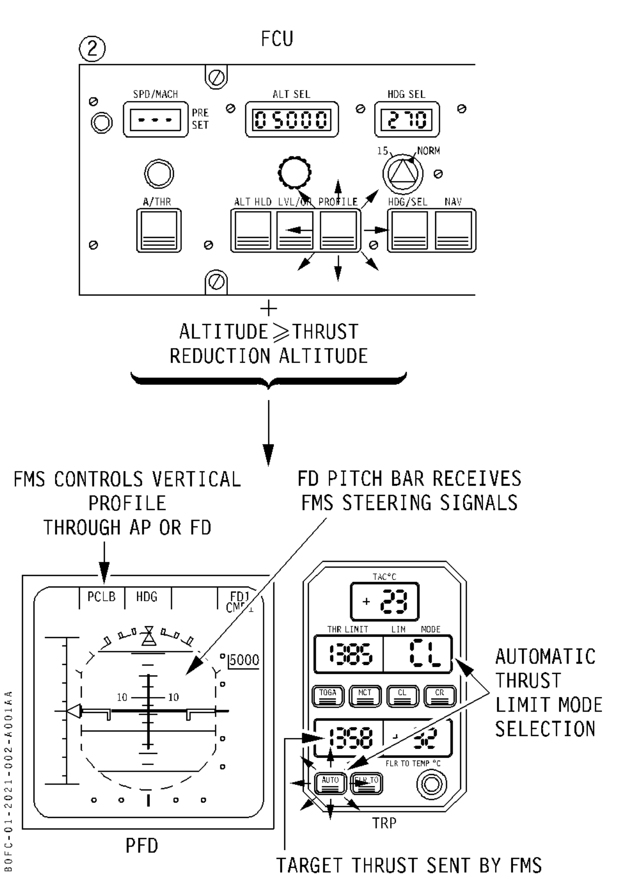
- The AUTO mode enables to couple the FMS to the Thrust Rating Panel : the FMS automatically selects the thrust limit mode and displays the target thrust on the TRP.
- AUTO can be manually selected on the TRP (independently of NAV or PROFILE engagement). It is automatically selected when PROFILE is engaged.

Note : When AUTO is engaged with PROFILE, it is no longer possible to manually disengage it on TRP. When PROFILE is disengaged, AUTO remains engaged. But it can be disengaged by selecting another mode on the TRP.

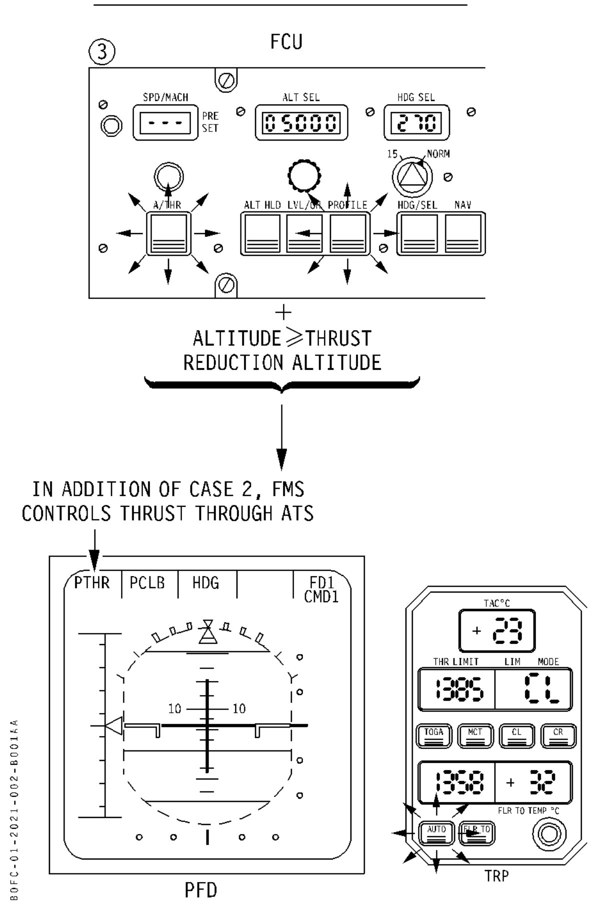
- The limit thrust mode selection is made by the FMS, but the corresponding limit thrust (displayed in the THR LIMIT window of the TRP) is still calculated by the TCC (Thrust Control Computer).
- In addition, when PROFILE is engaged, a target thrust is calculated by the FMS and displayed on the TRP. This target thrust, which cannot be greater than the limit thrust displayed at the same time, will be maintained by the ATS.
- When the PROFILE or AUTO mode is selected, the A/THR pushbutton illuminates on the FCU.

See chapter 1.03.21 for more details.

2 - PROFILE ENGAGEMENT - WITHOUT A/THR



3 - PROFILE ENGAGEMENT - WITH A/THR



4 – FMC FAILURE

- An FMC failure causes disengagement of NAV and PROFILE modes on the side where the FMC has failed.
  Moreover, if PROFILE or NAV mode is in active phase, AP/FD disengages.
  On the other side AP/FD remains engaged in PROFILE and NAV modes.

- Refer to chapter 1.03.52 : AP/FD profile mode for modes transitions and modes reversions.

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1 – INFORMATION SENT FROM FMC TO EFIS

- Each FMC is linked to its onside PFD and ND.
  The FMC sends the following information :
  - to the PFD :
    - DME distance of ILS selected on the ILS control panel
    - V_1
    - FMS target speed
    - FMS modes on FMA.

    See chapter 1.10.24 for more details.
  - to the ND :
    - Flight Plan.
    - Others FMS data : refer to chapter 1.15

2 – FMC FAILURE

- If an FMC fails, the onside CDU is no longer usable, and there is no more display on the onside ND and PFD coming from the FMC, except :
  - on the onside PFD : mode indication on the FMA
  - on the onside ND in MAP mode : "MAP NOT AVAILABLE" is displayed.

  Note : *If the onside VOR/NAV/ILS switch is in VOR position, VOR/DME indications are recovered on the onside RMIs if a frequency and course are selected on the corresponding VOR control panel.*

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1 – INERTIAL REFERENCE SYSTEM (IRS)

1.1 – FUNCTION

- In normal use, each of the 3 IRS sends an inertial aircraft position to each FMC.
- With these 3 positions, the FMC computes a triple mix inertial position.

  The FMS position is calculated using radio position, determining a bias between the triple mix IRS
R position and the FMS position. See chapter 1.20.32 for details.

1.2 – IRS ALIGNMENT

- Before departure, the IRSs must be aligned. This can be performed in two ways :
  - align the IRS through the FMS. This is done through the INIT page. See chapter 1.20.71.
  - align the IRS through the ISDU (Inertial System Display Unit) located on overhead panel. See chapter 1.15.12.

2 – VOR/DME/ILS : CHOICE OF NAVAID FOR DISPLAY ON NDs

- The navaid selected for display depends on the position of the VOR/NAV/ILS switches. Each VOR/NAV/ILS switch corresponds to its onside VOR and ILS control panels, RMI, PFD and ND.

2.1 – VOR/NAV/ILS SWITCH ON NAV OR ILS POSITION : AUTOTUNE FUNCTION

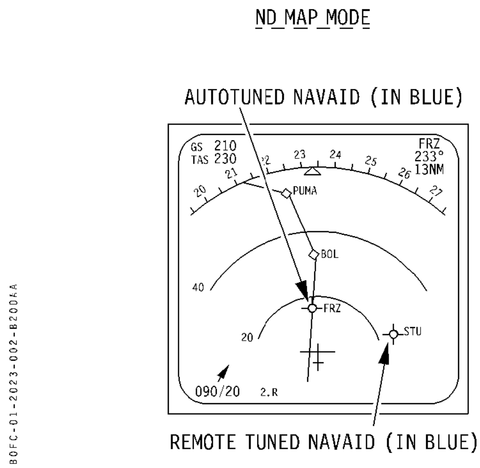
- Each FMC tunes a navaid (normally the same for the two FMCs) which is used for display on both RMIs, both NDs and on the CDU PROGRESS page.
- When the AUTOTUNE function is active, dashes are displayed on the VOR control panel
- The chosen navaid will be one of the following types of navaids, listed here in order of priority :

  1) The pilot selected navaid (VOR, DME, VORTAC or VOR/DME) on the PROGRESS page. This navaid is also called remote tuned navaid. It will remain on display as long as it is not manually cleared or changed.

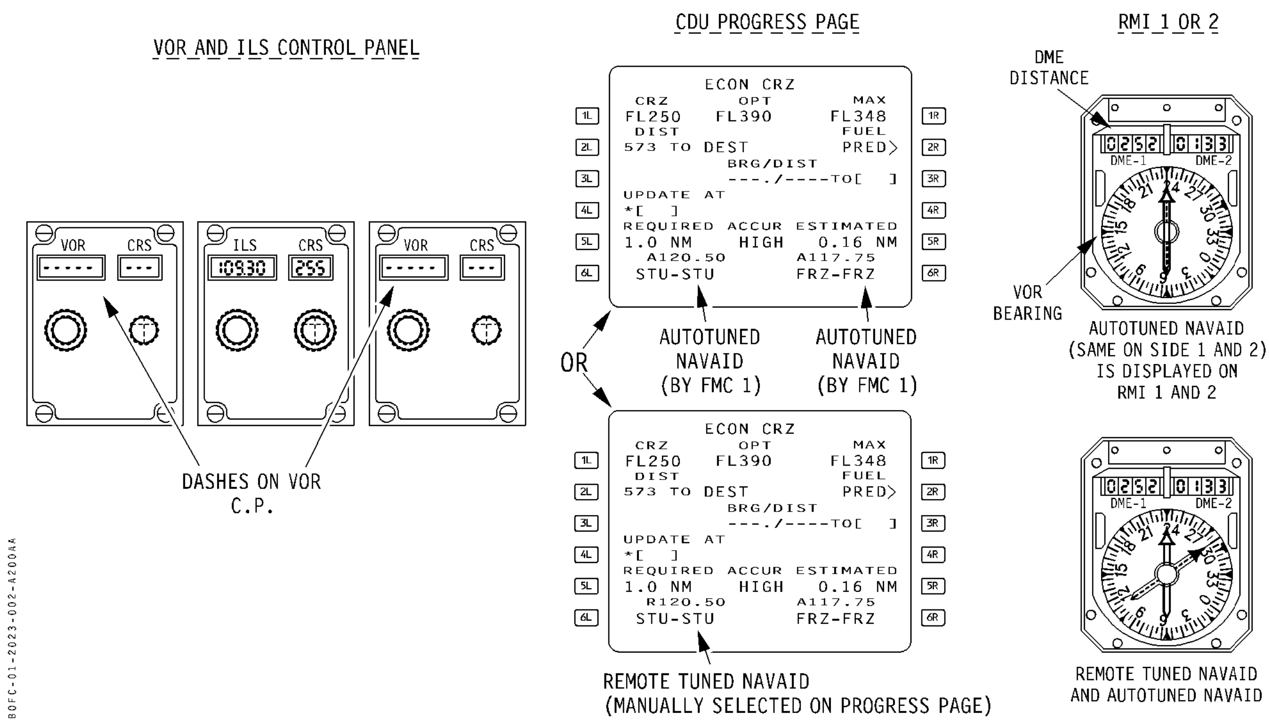
     Note : *This navaid must, however, belong to the database, or must have been defined through the REFERENCE pages.*

  2) The VOR/DME used for position updating (when there are not 2 DMEs available but only one VOR/DME).
  3) The specified navaid requested (by the FMC itself) in a terminal area procedure.
  4) The VOR "TO" (next VOR or VOR/DME or VORTAC along the F-PLN) if it is within figure of merit.
  5) The VOR "FROM" (last VOR or VOR/DME or VORTAC along the F-PLN) if it is within figure of merit.
  6) The VOR (or VOR/DME or VORTAC) downpath in the F-PLN and within figure of merit.
  7) Any VOR (or VOR/DME or VORTAC) OFF the route but within figure of merit.

- If there is no available navaid among the 7 types of above described navaids, the message "NO DISPLAYED NAVAID" is displayed.
- All these types of displayed navaids appear with an A (for AUTOTUNED) on the PROGRESS page. The remote tuned navaid (pilot selected) appears with an R.
- The displayed navaid(s) can be identified on the audio selector panel.
- When a remote tuned navaid has been selected and the FMC needs a type 2 or 3 navaid, the message TUNE AAA-FFF.FF (where AAA is the navaid identifier and FFF.FF is the frequency) is displayed to ask the crew to select that navaid on the PROGRESS page.

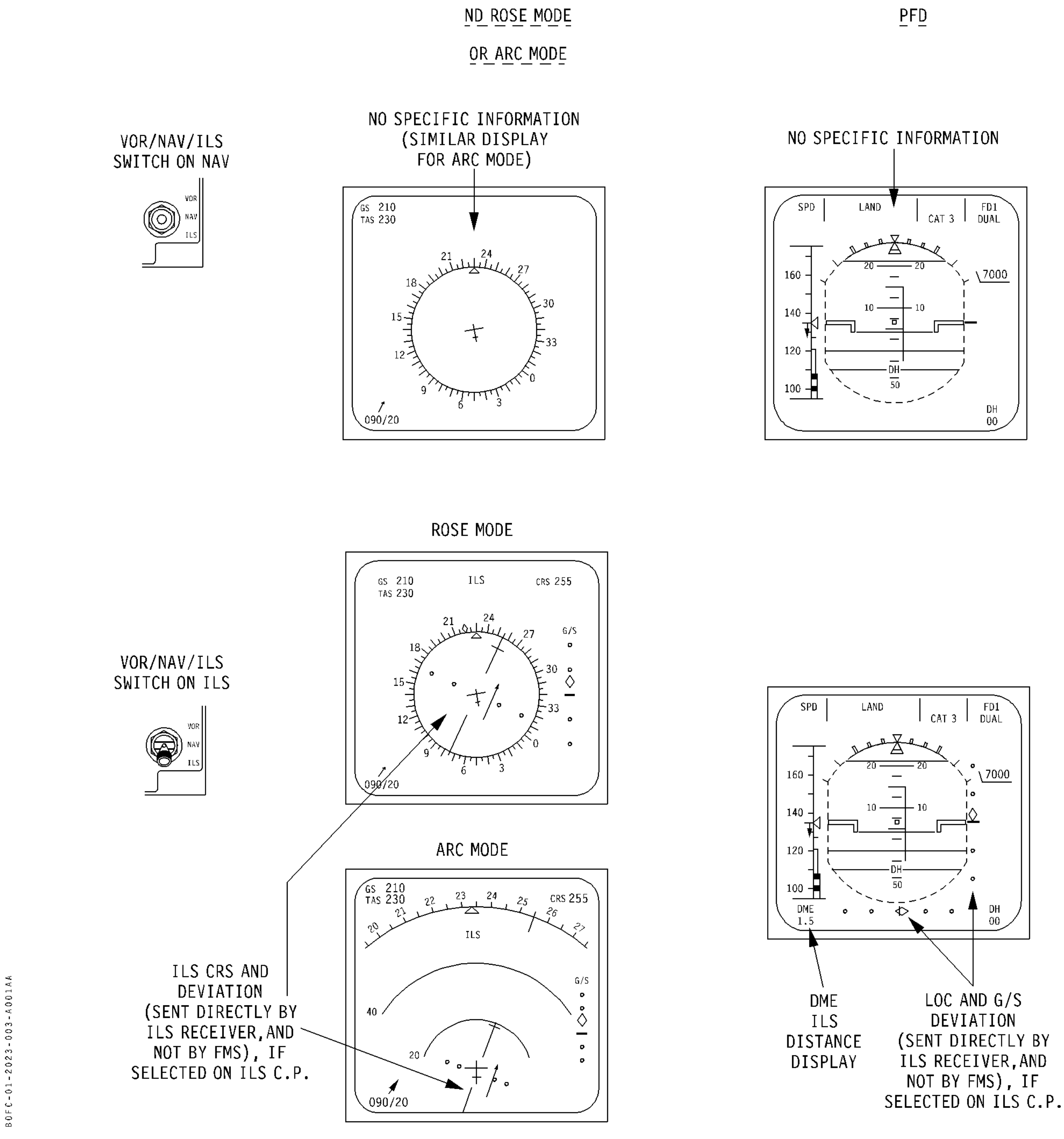


BOTH VOR/NAV/ILS SWITCHES ON NAV



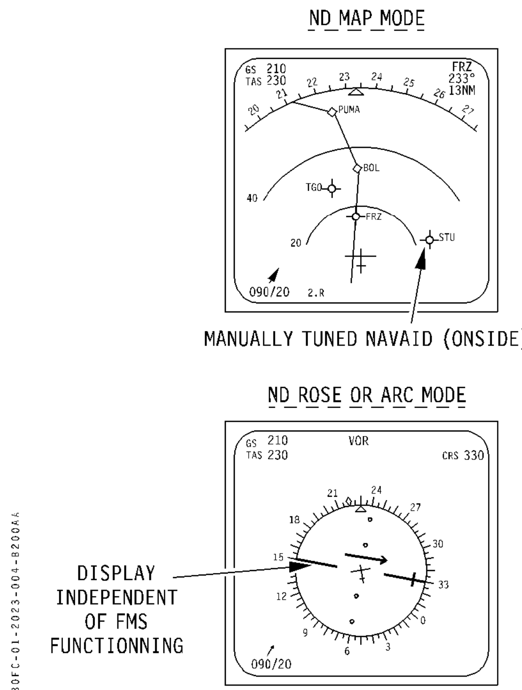
Mod : 11320 or 11364 or 12044 or 12045

DISPLAY WHEN VOR/NAV/ILS SWITCH IS IN NAV OR ILS POSITION

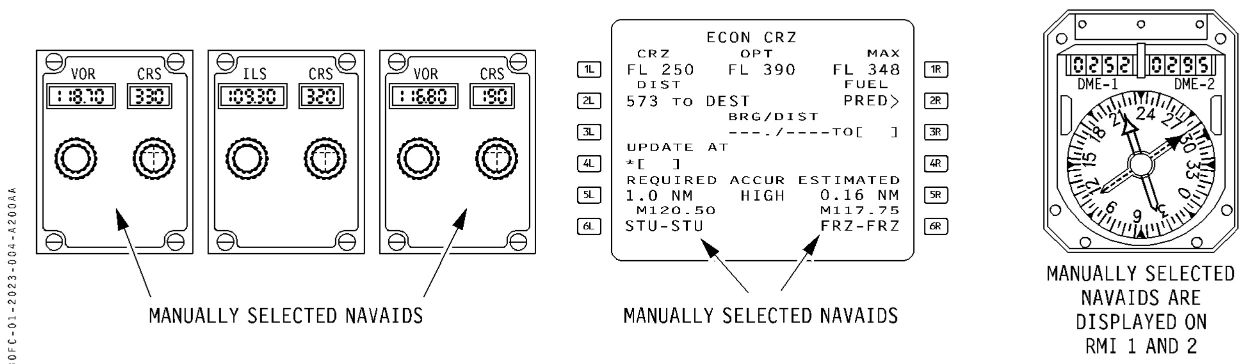


2.2 – VOR/NAV/ILS SWITCH ON VOR POSITION

- On the side where the VOR/NAV/ILS switch is in VOR position, a VOR indication will be displayed, if a station has been manually selected on the onside VOR control panel, and VOR signal is received.
- The selected frequency will be displayed on the PROGRESS page with a M before (for manually tuned).
- If a VOR/NAV/ILS switch is in VOR position, the ILS/DME distance cannot be displayed on the onside PFD. However if the ILS/DME frequency is selected on the VOR CONTROL PANEL then the DME distance will be displayed on the RMIs.
- When both VOR/NAV/ILS switches are in VOR position, no FMS radio update is possible.



BOTH VOR/NAV/ILS SWITCHES ON VOR



Mod : 11320 or 11364 or 12044 or 12045

1 – INTERFACE WITH ADS (AIR DATA SYSTEM)

- The function of this interface is to give to each FMC, the PRESSURE ALTITUDE, MACH, CAS, TAS, TAT, and SAT informations.
- In normal use ADC 1 feeds FMC 1.
  ADC 2 feeds FMC 2.
  But each ADC (Air Data Computer) feeds both FMCs in case of one ADC failure.

2 – INTERFACE WITH CLOCKS

- Greenwich Mean Time (GMT) is used by the FMCs for display on the CDU and prediction calculations.
- There are separate clocks for each FMC :
  Clock 1 feeds FMC 1 and clock 2 feeds FMC 2.
- But in case of one clock failure, the corresponding FMC will receive information from the other clock through the FMC cross talk.

3 – INTERFACE WITH AIDS (AIRCRAFT INTEGRATED DATA SYSTEM)

- Both FMCs send to AIDS the flight number, the date, the center of gravity, the identification of database selected by the pilot, the present position coordinates, the time from PPOS to next WPT and the coded data inserted via AIDS page.

4 – INTERFACE WITH DATA LOADER

- This interface allows updating of the FMC navigation database. This is performed through connectors located on the lateral panel in the cockpit.

5 – INTERFACE WITH FACs (FLIGHT AUGMENTATION COMPUTER)

- The function of this interface is to give to each FMC :
  - VLS (Lowest Selectable Speed) and VMAX (Maximum Selectable Speed) calculated by the FAC.
    The FMC will not command a speed greater than VMAX or lower than VLS.
  - SLATS/FLAPS position for performance and vertical guidance.
- In normal use FAC 1 feeds FMC 1 and FAC 2 feeds FMC 2.
  But in case of a FAC failure, the corresponding FMC can receive information from the other FAC through the FMC crosstalk.

6 – INTERFACE WITH FUEL FLOW AND FUEL QUANTITY SENSORS

- This interface allows the FMC to calculate the FOB (Fuel on Board). The FMC uses at the same time the information coming from FUEL FLOW (FF) sensors and FUEL QUANTITY (FQ) sensors to compute a precise FOB value.
- If a FF sensor has failed, the FMC will calculate the FOB with FQ sensor.
  If the FQ sensor has failed, the FMC will calculate the FOB with FF sensors provided a fuel quantity information is available when the failure occurs. If not, a FOB value has to be inserted.
- If the failure is not detected by the FMC, it is possible, through FUEL PREDICTION page, to manually deselect either of these sensors.
  See FUEL PREDICTION page in chapter 1.20.74.

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1 – ESTIMATED POSITION ERROR

- The Estimated Position Error (EPE) is a value which represents an estimation of the FMS position accuracy.
- The EPE depends on the current navigation mode. It is permanently computed by the FMS.
  - When in INERTIAL ONLY navigation mode, the EPE increases continuously according to the IRS drift model.
  - When in RADIO/INERTIAL navigation mode, the FMS computes an EPE which represents the achievable accuracy according to the radio beacons which are tuned.
  - If the aircraft position is invalid, either in flight or on the ground, the EPE is set to 17 NM.
- EPE initialization :
  - At power up, the EPE is initialized to 17 NM.
  - After IRS alignment, manual update on the ground or takeoff update, the EPE is set to 0.28 NM.
  - After a manual update in flight, the EPE is set to 4 NM.
- The EPE is displayed on the PROGRESS page under the label "ESTIMATED".

2 – REQUIRED NAVIGATION ACCURACY

- Depending on the flight area overflown (en route, terminal or approach), the FMS computes a default value for the required navigation accuracy.
- The default values are :
  - en route area : 3.41 NM
  - terminal area : 2.07 NM
  - approach area : 0.36 NM (DME/DME or ILS/DME update)
    0.61 NM (VOR/DME update)
  - flight area : Required Navigation Performance (RNP)
- The required navigation accuracy is displayed on the PROGRESS page under the label "REQUIRED". These figures are defaulted values and can be modified by the crew.

3 – CLASS OF NAVIGATION ACCURACY

- The class of navigation accuracy (ACCUR) is HIGH (or LOW), if the Estimated Position Error is lower (or greater) than the required navigation accuracy :
  - If the EPE does not exceed the appropriate criteria, accuracy is HIGH.
  - If the EPE exceeds the appropriate criteria, accuracy is LOW.
- REQUIRED, ACCUR and ESTIMATED are permanently displayed.
- When the class of navigation accuracy is upgraded from LOW to HIGH or downgraded from HIGH to LOW, a message is displayed on the CDU scratchpad with a reminder on the NDs.

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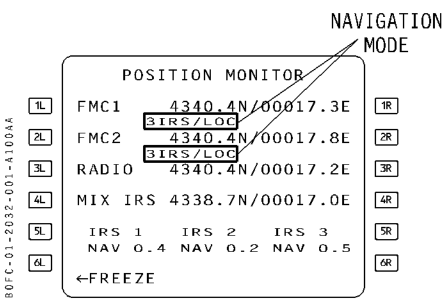
1 – FMC POSITION

- Each FMC computes its own aircraft position, called "FM position", from an IRS position, and a computed radio position.
- Signals from the three IRUs are used to compute an inertial position, and signals from VOR, DME, and ILS facilities compute a radio position, provide navigation updates, and takeoff/approach guidance.
- The FMS selects the most accurate position considering the estimated accuracy and integrity of each positioning equipment.

2 – NAVIGATION MODES

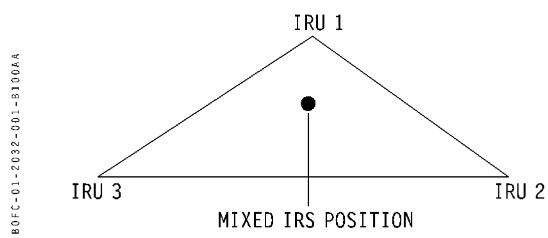
- The navigation mode for each FMC is displayed on the POSITION MONITOR page.
- The possible navigation modes are :
  - 3 IRS, 1 IRS
  - 3 IRS/VOR, 1 IRS/VOR, 3 IRS/LOC, 1 IRS/LOC
  - 3 IRS/DME/DME, 1 IRS/DME/DME, 3 IRS/VOR/DME, 1 IRS/VOR/DME.



3 – IRS POSITION

3.1 – POSITION COMPUTATION

- The three IRUs are initialized, on the ground, either through the CDU or on the ISDU. See 1.15.12 or 1.20.71.
- If done through the CDU, departure coordinates are automatically specified by the selection of a route or an airport of origin. Coordinates from database may be further adjusted manually through the CDU to conform to a specific gate position : the information is sent to the three IRUs.
- After the initialization process, each FMC uses the three IRU positions to compute a mean position called the mixed IRS position.



- Each FMC uses the IRS position as its own position until the thrust levers are advanced and the go-levers are triggered at takeoff. At this time the FMC position is updated to the runway threshold position stored in the database. The difference between the IRS position and the FMC threshold position is called the takeoff bias. This computed difference is then added to subsequent FMC positions.

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- If one IRS position becomes invalid (ATT mode or failed), the mixed IRS position becomes the position of one of the two remaining IRSs with the following priority order :
  - onside IRS (e.g. IRS 1 for FMS 1),
  - IRS 3,
  - opposite-side IRS (e.g. IRS 2 for FMS 1).

3.2 – POSITION UPDATE IN 3 IRS MODE

- The 3 IRS navigation mode is used when no reliable radio facilities are available, and at least one IRS is in the NAV mode supplying valid position and ground speed velocity data.
- The bias existing between the radio position and the inertial position, at the time transition to the 3 IRS mode occurs, is frozen at the current value until the radio position data becomes available again.

4 – RADIO POSITION

- The FMC computes a radio position from :
  - DME/DME,
  - VOR/DME

  in this order of priority.
- The radio position is used for FMC position updating, and the original takeoff bias is no longer used in the computation.

4.1 – CHOICE OF NAVAID

4.1.1. – Automatic tuning

- Navaids are automatically tuned by the FMC, based on the accuracy level criteria. Autotuning can only occur if the VOR/NAV/ILS switches are selected to either NAV or ILS.
- Autotuning is also indicated by dashes displayed on the VOR control panels.
- Navaids selected by the FMC for autotuning, are indicated by the letter "A" (AUTO) preceding the frequency in line 6 of the PROGRESS page.
- Each FMC builds up a list of 20 navaids which can be found within 300 NM around the aircraft, from the database or from the list of navaids entered by the crew on the NEW NAVAIDS page. Station selection is then based on the figure of merit, or range capability, of that particular station.

  Figure of merit : 0 = 40NM
  : 1 = 70NM
  : 2 = 130NM
  : 3 = 250NM

- The FMC autotunes :
  - VOR and DME for display.
  - DME for navigational computation.

  The FMC does not autotune the ILS.
- However as a consequence of the navaid selection criteria, navaids may be tuned but not currently being used for FMS position computation.
- To be autotuned, a navaid must not have been deselected by the crew.

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- These navaid types, in the order of their tuning priority are :
  - Navaids in the specified procedure (SID, STAR, etc.)
  - TO waypoint navaid
  - FROM waypoint navaid
  - Any other downpath navaid
  - Nearest navaid

4.1.2 – Manual/Remote tuning

- Manual tuning may be accomplished in two ways :
  - By manually selecting the desired frequency on the VOR Control Panel – the VOR/NAV/ILS switch must be in VOR position. A manually tuned frequency is preceded by the letter ″M″ (MANUAL) on the PROGRESS page.
    - If only one VOR/NAV/ILS switch is in VOR position, the onside FMC will use the available navaids from the other FMC (through the crosstalk between FMCs).
    - If both VOR/NAV/ILS switches are in VOR position, but one or two navaids (DME, TACAN or colocated DME or TACAN) have been manually selected on VOR control panel, each FMC will use them for position update (if within figure of merit).
      In this case there is no more AUTOTUNE function, the necessary navaids must be manually selected by the crew.

      Note : *If only one navaid is selected it must be a VOR/DME or VORTAC, otherwise the FMCs revert to inertial navigation.*
    - If both VOR/NAV/ILS switches are in VOR position and no usable navaid is within figure of merit (even if navaids are selected on VOR control panel), each FMC reverts to inertial navigation (I is displayed on PROGRESS page).

      Note : *In the two last cases, if a procedure requires a navaid, the message ″TUNE AAA-FFF.FF″ (where AAA is the NAVAID identifier and FFF.FF is the frequency) is displayed to ask the crew to select that navaid on the VOR control panel.*
  - On the PROGRESS page, by writing the desired frequency or identifier in the scratchpad and transferring it into the appropriate field on line 6. This method is referred to as remote tuning and is indicated by the letter ″R″ (REMOTE) preceding the frequency on line 6 of the PROGRESS page.

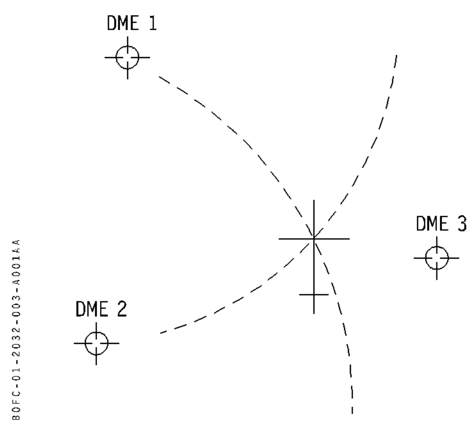
Both AUTO and REMOTE tuning require the navaid be contained in the database or defined by the pilot, otherwise the scratchpad message
″NOT IN DATA BASE″
is displayed. Manual tuning however, does not require that the navaid be contained in the database.

4.2 – POSITION COMPUTATION

- Priority is given to the DME/DME mode of navigation when two DME distances are found to be available and suitable.

4.2.1 – Radio position computed with DME/DME

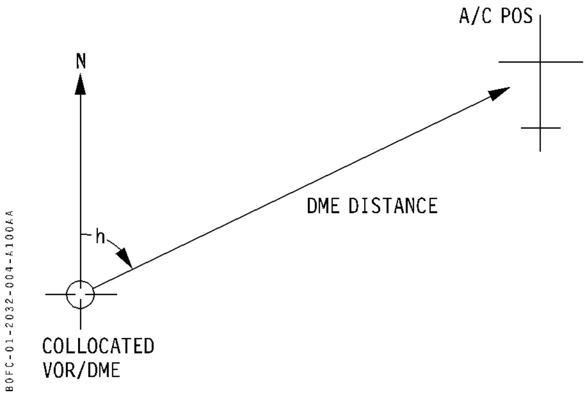
- The FMC searches around the aircraft present position, until at least two DMEs are located which provide the highest accuracy level and are within the figure of merit, as defined in the database.
  Ideally, one DME would be located directly ahead, and the other abeam. Since this is not always the case, the best available DMEs are selected.
  The fact that a station is within range does not necessarily mean it will be used.
- However, the pilot may tune any desired station.



4.2.2 – Radio position computed with VOR/DME

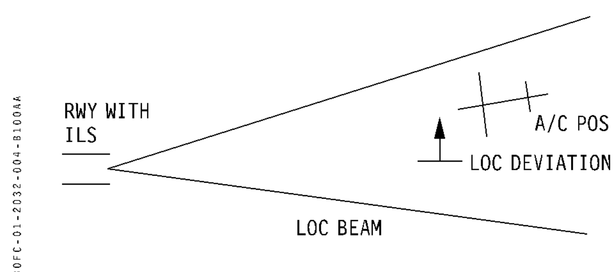
- If two separate DMEs are not available, the FMC uses an available collocated VOR/DME.

- The VOR/DME navaid will also be acceptable only if, and as long as, the total bearing/distance error for the given VOR/DME is lower than the present IRS estimated position error (EPE).



4.2.3 – Radio position computed with ILS (approach only)

- The localizer is used, in approach, to provide an additional cross-track position correction, using the center beam deviation, to eliminate any existing error between the FMC position and the center of the localizer beam, if no course correction is applied.



Mod : 11320 or 11364 or 12044 or 12045

1 – NAVIGATION MESSAGES

- A few messages concerning aircraft position or mode of navigation are displayed on the CDU scratchpad. Except for the ″AIRCRAFT POSITION INVALID″ message, the ″MSG″ amber display will appear on the Navigation Display for these messages. These messages and their meaning are briefly described hereafter :

  – ″**IRS ONLY NAVIGATION**″ : displayed only when navigation mode has been INERTIAL ONLY for more than 10 minutes or if navigation mode is INERTIAL ONLY when aircraft transitions from cruise to descent or approach while being in en-route area. It is displayed at once when navigation mode transitions from GP(IR)S/INERTIAL or RADIO/INERTIAL to INERTIAL while being in terminal area.

  – ″**VERIFY AIRCRAFT POSITION**″ : displayed when there is a difference or more than 12 NM between the IRS position and the radio position ; it is then left to the pilot to resolve the discrepancy between both positions.

  – ″**FMC POSITION MISMATCH**″ : displayed when the positions computed by both FMS differ by more than 0.5 NM if GP (IR)S mode is active, 5 NM otherwise.

  – ″**AIRCRAFT POSITION INVALID**″ : displayed when aircraft position becomes invalid (inertial position or aircraft velocity invalid), while a Direct To or Holding at present position is pending.

  – ″**NAV ACCUR DOWNGRAD**″ : displayed when navigation accuracy is downgraded from HIGH to LOW ; time delay : 10 sec.

  – ″**NAV ACCUR UPGRAD**″ : displayed when navigation accuracy is upgraded from LOW to HIGH ; time delay : 10 sec.

2 – RADIO TUNING MESSAGES

- The following messages are used to help the crew solve conflicts between manual and automatic tuning rules :

  – ″**TUNE BBB FFF.FF**″ : this message warns the crew that navaid which ident is BBB and frequency is FFF.FF is requested for autotuning either as the specified navaid (for VOR) or for position computation (VOR/DME navaid) while another navaid has been manually entered.

  – ″**REF NAVAID DESELECTED**″ : this message is displayed when the VOR/DME or VORTAC navaid required for autotuning as the specified navaid has been deselected by the crew.

  – ″**REF NAVAID UNTUNABLE**″ : this message is displayed when the VOR/DME or VORTAC navaid required for autotuning as the specified navaid fails the DME distance test or the VOR bearing test while the aircraft is found outside the zone of confusion.

Mod : 11320 or 11364 or 12044 or 12045

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- Two types of performance modes are available for selection at the option of the pilot :
  - the strategic modes allow modification of performance parameters for all remaining flight phases,
  - the tactical modes impact only the current flight phase.
- If no changes are made to either mode, the FMC assumes the ECON performance mode. This mode is based on the value of the cost index.
- The cost index is the ratio between the flight time and the fuel consumption.

1 – STRATEGIC MODES

- In all strategic modes the lowest target speed is either : V_{fto} (GREEN DOT) in the clean configuration or minimum maneuvering speed for the flap setting (F or S speed). The highest speed is the lower of Vmo – 10 kts/340 kts CAS/ or Mmo – 0.02 (or VFE or VLE).
- Pilot inputs necessary for this calculation are CRZ ALT and CI (cost index).
- Three options are proposed as strategic modes, to be applied throughout the flight :

1.1 – ECON

- Economy is the default mode of the FMC. It is based on the cost index defined by the airline or specified by the pilot, and represents the optimization of minimum fuel and minimum time.

1.2 – MIN FUEL

- The minimum fuel mode corresponds to a cost index equal to zero, and computes the optimum speeds required for minimum fuel consumption for the route to be flown.

1.3 – MIN TIME

- The minimum time mode corresponds to a cost index of 999, and provides the maximum speed possible within the confines of the flight envelope, except below 10 000 ft where 250 kt is the maximum allowed (this value can be changed).

2 – TACTICAL MODES

- A tactical mode is applied to the current flight phase only. It allows to revert from the current strategic mode to a mode specifically proposed for the flight phase.

Flight phase	Climb	Cruise	Descent
Tactical modes proposed	MAX CLB	MAX END	MAX DES
	SPD		
	Current strategic mode		

- In all tactical modes except SPD mode, the target speed is limited to GREEN DOT (or F or S) as lowest value and 340 Kt (or VFE or VLE) or VMO – 10 or MMO – 0.02 whichever is the lowest as maximum value.
  Below SPD LIM ALT (defaulted to 10 000 ft), it is always limited to SPD LIM (defaulted to 250 kt) as maximum value.
- Once a tactical mode is selected it is active until the end of the present flight phase, unless another mode is selected on TACTICAL MODE page. At the end of the present flight phase, the selected strategic mode is automatically re-activated.

2.1 – MAX CLB

- The MAX CLB mode provides the maximum angle of climb. The target speed becomes GREEN DOT (or F or S if not in clean configuration).

2.2 – SPD

- The SPD mode allows the pilot to directly control the aircraft speed. In TACTICAL SPD mode, the aircraft speed is limited to V_{LS} as lowest value and V_{MO} (or VFE or VLE) as max value, although pilot entries are allowed within [0.3, 0.84] range of Mach and [75 Kt, 360 Kt] range of speed.

2.3 – MAX END

- The MAX END (maximum endurance) mode maximizes the time-per-fuel ratio (minimum fuel flow). The corresponding target speed is that speed which provides maximum lift-over-drag ratio (approximately GREEN DOT).

2.4 – MAX DES

- The MAX DES mode provides maximum angle of descent. The target speed is MMO – 0.02 or 340 kt or VMO – 10 whichever is the lowest (or VFE or VLE).

1 – OVERVIEW

- The ENGINE OUT function allows to activate an ENGINE OUT guidance mode which optimizes aircraft performance (target speed value around green dot) and engine thrust (Max Continuous limit) provided PROFILE mode is engaged.
  At takeoff, it allows to guide the aircraft along an ENGINE OUT SID (EOSID) lateral and vertical path.
- The ENGINE OUT function is accessed by pressing the ENG OUT function key on the CDU, or if the TCC detects an engine failure :
  - if the aircraft is at takeoff, before the diversion point between the SID and the EOSID, or if an EOSID has been defined : the message « CONFIRM – EOSID – CLEAR »
    proposing 2 prompts, is automatically displayed on F-PLN page A.
  - if the aircraft is anywhere after the diversion point between the SID and the EOSID. (if any) : the message « COMFIRM – ENG OUT – CLEAR », proposing 2 prompts, is automatically displayed on PROGRESS page.
- One of the prompts « CONFIRM » or « CLEAR » must be pressed otherwise they will remain displayed indefinitely.
  Pressing CLEAR erases the message. Pressing CONFIRM activates specific ENG OUT performance computations.

2 – ENGINE OUT GUIDANCE RULES AT TAKEOFF

- Before PROFILE engagement : no ENGINE OUT function. PROFILE can be engaged only above EO ACCEL ALT and over green dot.
- The EO ACCEL ALT (engine out acceleration altitude) is coded in the database. It is defaulted to 1500 ft AGL and can be modified. See TAKEOFF page description in chapter 1.20.71.
- If ENGINE OUT is confirmed and the altitude is above EO ACCEL ALT, the target speed is green dot.
- Until EO THR RED ALT and green dot are both reached, there is no change in the thrust management. After EO THR RED ALT and green dot are both reached there is an automatic selection of MAX CONTINUOUS THRUST as soon as an engine failure is detected or the prompt CONFIRM ENG OUT is pressed.

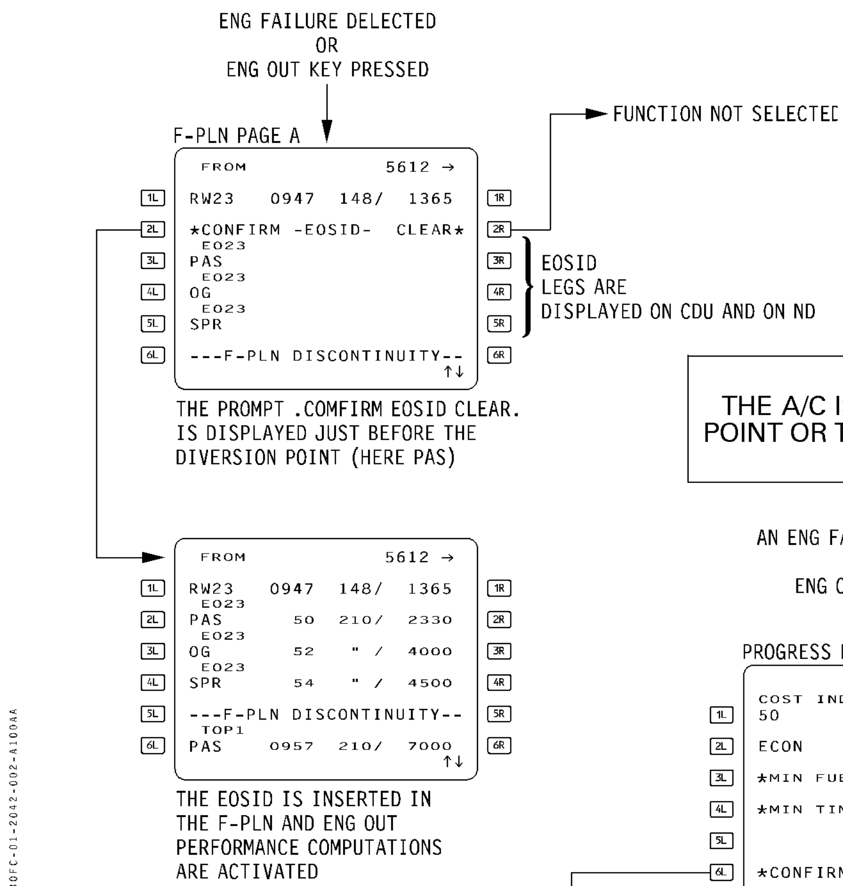
3 – ENGINE OUT GUIDANCE RULES AFTER TAKEOFF AND DURING CRUISE

- Below the EO MAX ALT (displayed on PROGRESS page) :
  The ECON mode is selected but this mode corresponds to a MIN FUEL mode. The corresponding speed and thrust are targeted upon the flight level.
- Above the EO MAX ALT :
  The target thrust is MCT.The speed reduces so as to maintain FCU ALT. As soon as FCU is lowered the FMC initiates a DRIFT DOWN at green dot. When reaching FCU ALT the MIN FUEL speed/thrust are targeted if the FCU ALT is set lower or equal to EO MAX ALT.

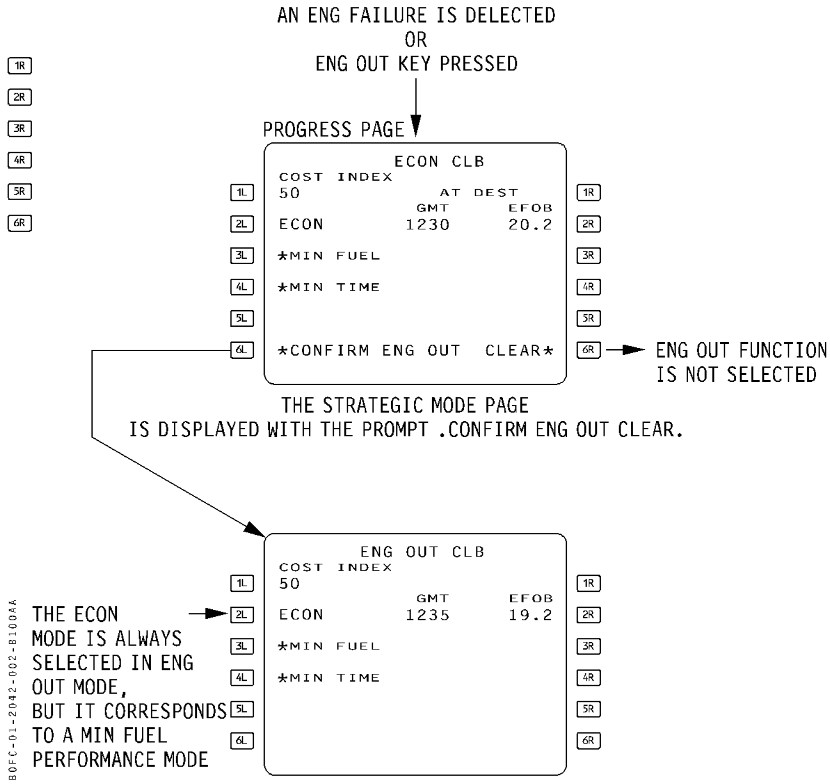
Note : EO MAX ALT refers to the net ceiling, and should not be used to conduct the diversion.

Mod : 6789

FIRST CASE
AN EOSID HAS ALREADY BEEN DEFINED IN THE F-PLN AND THE A/C IS BEFORE THE EOSID DIVERSION POINT



SECOND CASE
THE A/C IS BEYOND THE EOSID DIVERSION POINT OR THERE IS NO EOSID DEFINED IN THE F-PLN



Mod : 6789

- For flight planning, the pilot inserts into the FMS via the CDU :
  - the intended lateral trajectory (lateral flight plan)
  - the intended vertical trajectory, which is a speed and altitude profile (vertical flight plan)
- The system must have this information in order to compute performance and guidance commands.

1 – ACTIVE AND SECONDARY FLIGHT PLANS

- The FMS can contain two different flight plans :
  - the ACTIVE flight plan, which is the basis for :
    - lateral and vertical guidance
    - CDU and ND display
    - radio navigation autotuning
    - performance predictions
    - fuel planning
  - the SECONDARY flight plan which the pilot may use :
    - when an alternate takeoff runway is probable
    - to plan a diversion
    - to prepare the next flight
    - to compare predictions or evaluations.
- Each flight plan is composed of the same elements :
  - the primary flight plan, from origin to destination and missed approach
  - the alternate flight plan, from destination to alternate destination.

1.1 – ENTERING A FLIGHT PLAN

- The pilot uses the CDU to insert flight plans into the FMS :
  - a lateral flight plan that defines the intended horizontal flight path
  - a vertical flight plan that defines the intended speed and altitude profile for the aircraft to follow while flying the lateral flight plan.

  Note : *The flight planning function is available for both the active and secondary flight plans.*
- The pilot may then modify the flight plan on the ground or in flight, by making lateral and vertical revisions.
- The secondary flight plan can be made the copy of the active flight plan if it is created using the COPY ACTIVE function.
- The secondary flight plan can become the active flight plan by selecting the ACTIVATE SEC function on the SEC INDEX page (see chapter 1.20.79).

1.2 – SEQUENCING OF THE SEC F-PLN

- Sequencing of the SEC F-PLN occurs at the same time as the ACTIVE F-PLN if the current leg of the ACTIVE F-PLN is identical to the first leg of SEC F-PLN.
- If at any time after a copy is made, a flight plan revision occurs so that the first leg of the SEC F-PLN and the current leg of the ACTIVE F-PLN are no longer the same, all SEC F-PLN leg sequencing ceases.
- If conditions for secondary flight plan sequencing exist at DONE phase, then the SEC F-PLN reverts to its initial default state of PPOS followed by an END OF F-PLN.

Mod : 6789

1.3 – PREDICTIONS IN THE SEC F-PLN

- For predictions to be calculated in the SEC F-PLN, the following conditions must be met for both the ACTIVE F-PLN and SEC F-PLN :
  - during preflight, the origin airports must be the same,
  - during takeoff or climb, the vertical profiles must be the same,
  - during cruise, the cruise flight levels must be identical,
  - during any flight phase, the SEC F-PLN must be created by a COPY ACTIVE and the first leg of the SEC F-PLN must be identical to the active leg of the F-PLN.
- Predictions are not available when descent or approach is the active phase.
- The following items are modifications that may be made specifically to the secondary flight plan :
  - Speed constraint/limit
  - Altitude constraint
  - Cruise flight level (preflight phase only)
  - Forecast wind/temperatures
  - Cost index
  - Strategic mode
- Any of these modifications will cause the secondary flight plan predictions to be recalculated.

2 – TEMPORARY FLIGHT PLAN

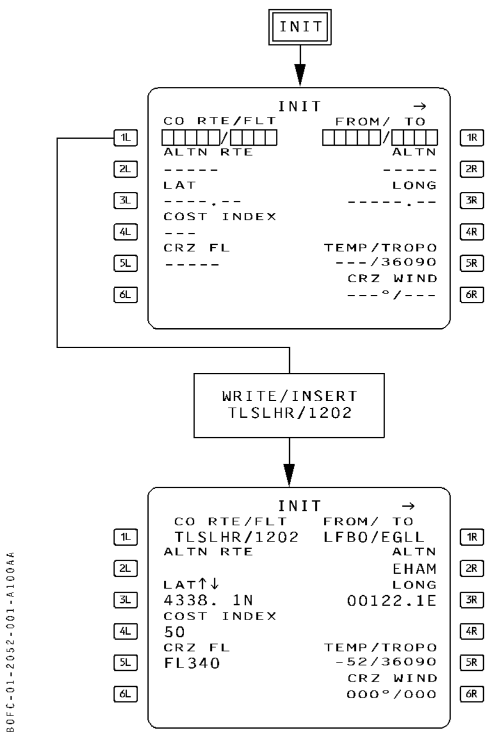
- The purpose of the temporary flight plan is to allow the pilot to check a revision on the CDU and EFIS ND before inserting the changes into the active flight plan. It is a copy of the active flight plan that has been changed according to the pilot revision.
- While it is displayed the aircraft will continue to follow the original active flight plan.
- As long as there is a temporary flight plan, the pilot cannot make revisions on the secondary flight plan.
- No predictions are computed or displayed on the pages of the temporary flight plan.

Mod : 6789

- There are three ways to define the route :
  - It is a company route, it is in the database,and it is known by the crew : they enter the name of the company route
    or
  - It is a company route and it is in the database, but the crew does not know it is there : they enter an airport pair
    or
  - There is no company route between the two airports.

1 - ENTERING A CO RTE

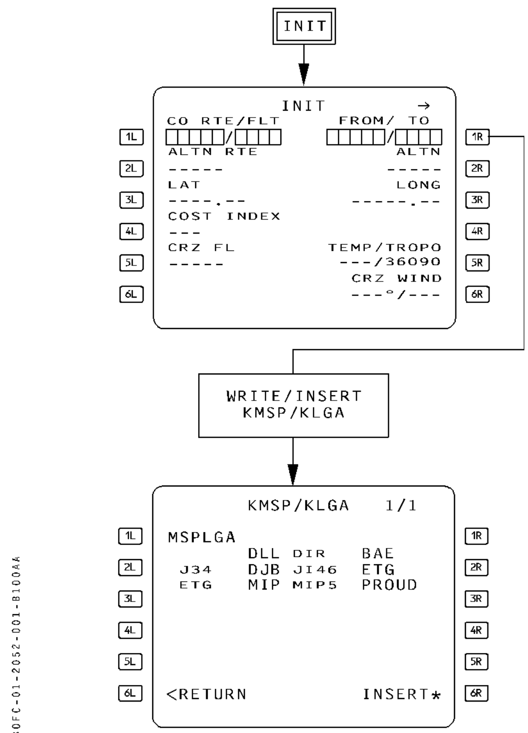
- The pilot enters the name of the CO RTE and the flight number into the 1L field of the INIT A page. This action enters all the elements of the flight plan. The database usually includes an alternate route associated with the destination.



2 - ENTERING AN AIRPORT PAIR

2.1 - It is a CO RTE in the database

- The pilot enters an airport pair in the 1R field. The ROUTE SELECTION page appears automatically and allows the crew to review all stored routes between the two airports before selecting one of them.



2.2 - It is not a CO RTE in the database

- The pilot enters the airport pair in the 1R field. The ROUTE SELECTION page appears and displays "NONE".
  The entire flight plan must be constructed manually.

Mod : 6789

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1 – LATERAL F-PLN STRUCTURE

1.1 – OVERVIEW

- The lateral F-PLN is made of a serie of legs, each one consisting of an elementary path generally terminated by a FIXED WAYPOINT or a PSEUDO-WPT.

  The complete structure of a F-PLN is as follows :

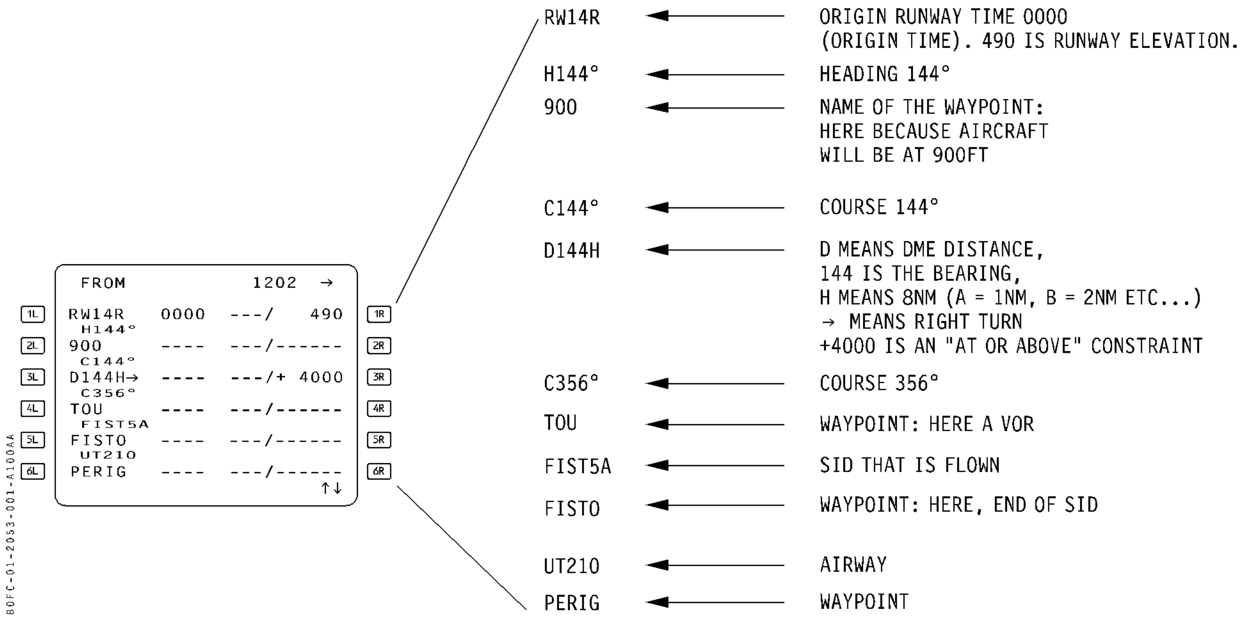
  PRIMARY F - PLN:
  - ORIGIN
  - PRIMARY ROUTE LEGS
  - DESTINATION
  - MISSED APPROACH LEGS

  ALTERNATE F-PLN:
  - ALTERNATE ORIGIN=PRIMARY DESTINATION
  - ALTERNATE ROUTE LEGS
  - ALTERNATE DESTINATION
  - ALTERNATE MISSED APPROACH LEGS

  The alternate F-PLN is not mandatory.

- During flight, the FMS sequences the F-PLN : when passing a WPT, the CDU display automatically slews so the « FROM » WPT is removed, the « TO » WPT becomes the « FROM » WPT, and the « NEXT » becomes the « TO » WPT.

  Slewing also occurs when the aircraft passes the bissectrix of the FROM leg and the NEXT leg, if the aircraft is not on the lateral flight path.



Mod : 6789

1.2 – LATERAL F-PLN LEGS

- A leg is composed of :
– a path (displayed in the LABEL line in small font)
– a termination (displayed in the data line in LARGE FONT)
- Access to LAT REV or VERT REV pages from a waypoint allows to make a LATERAL or a VERTICAL REVISION at this waypoint.

CDU Display	Path / terminator	Comments	Access to LAT REV	Access to VERT REV
(1) WPT	Direct to a fixed WPT Fixed WPT to fixed WPT	When first line is blank, a direct leg is assumed.	Yes	Yes
CXXX° WPT	Course to a fixed WPT	XXX is the defined course.	Yes	Yes
(1) AWY WPT	Direct to a fixed WPT fixed WPT to fixed WPT part of a AIRWAY, SID, STAR	If defined as part of a terminal area procedure or airway, that procedure name is displayed.	Yes	Yes
(1) LLNN	Direct to a fixed WPT fixed WPT to fixed WPT	The waypoint was a LAT / LONG input by the pilot. NN is the defined waypoint sequence number.	Yes	Yes
(1) PBDNN	Direct to a fixed WPT fixed WPT to fixed WPT	Place / Bearing / Distance waypoint defined by pilot. NN is the defined waypoint sequence number.	Yes	Yes
DD NAV WPT	DME Arc. to a fixed WPT	DD is the distance of the arc. NAV is the navaid the arc is defined from. WPT is the terminating waypoint.	Yes	Yes
HOLD L (4) HHHHH	Holding to an altitude in climb	L is direction of bank (L-left, R-right) HHHHH - terminating altitude	Yes	Yes
HOLD L (1) CXXX WPT	Holding with a manual termination at a fixed WPT or at PPOS (Turning Point)	XXX is the inbound course to the holding pattern fix. L is direction of bank (L-left, R-right). WPT is the holding pattern fix which may be a fixed waypoint or T-P.	Yes	Yes (3)
HOLD L WPT	Holding to a fixed WPT (one round only) It is a turning procedure for arrivals.	L is direction of bank (L-left, R-right).	Yes	Yes
PROCT (1)(2) MANUAL	Procedure Turn with a Manual Termination	Previous waypoint is where the turn is started.	Yes (2)	Yes
PROC T INTCPT	Procedure Turn to an intercept path	Previous waypoint is where the turn is done.	No	Yes
HXXX° (4) HHHHH	Heading to an altitude	XXX is heading HHHHH - terminating altitude	Yes	Yes
HXXX° WPTRRR	Heading to a VOR radial	XXX is heading. RRR is Radial from WPT.	Yes	Yes
HXXX° NAV / DD	Heading to a DME distance	XXX is heading - NAV is DME station. DD is DME distance.	Yes	Yes
HXXX° INTCPT	Heading to an intercept path	XXX is heading. The following leg defines the intercept termination.	Yes	Yes
HXXX° MANUAL	Heading with a Manual Termination	XXX is heading.	Yes	Yes
(4) WPTXXX HHHHH	Course from a fixed WPT to an altitude	XXX is course from the previous waypoint. HHHHH is terminating altitude. WPT is the first three characters of the ident of the fixed waypoint from which the course is defined.	Yes	Yes
WPTXXX MANUAL	Course from a fixed WPT with a Manual Termination	XXX is the course. The course is from the previous waypoint. WPT is the first three characters of the ident of the fixed waypoint from which the course is defined.	Yes	Yes
LABEL HHHHH	Conditional altitude termination. A conditional leg is possible with : Course to fixed WPT Fixed WPT to fixed WPT Heading to a VOR radial Heading to a DME distance.	HHHHH is the conditional altitude termination. It is followed by a conditional leg. If the altitude is reached before the conditional termination, the next leg is switched, otherwise, the whole conditional leg is flown.	No	Yes
T-P	Fixed waypoint Turn Point	Displayed when a DIRECT TO or HOLD at present position is executed. This is a fixed waypoint at the LAT/LONG when the DIR TO or HOLD were inserted.	Yes	Yes
PPOS	Present Position	Displayed as the FROM waypoint if the aircraft is in an discontinuity and does not meet the criteria for activation on the next leg.	Yes	Yes

Notes : (1) These legs may be inserted by the pilot through the CDU. All other legs can only be entered from the database.
(2) If the Procedure Turn with manual termination leg is the TO waypoint, access to LAT REV will not be allowed.
(3) Access from WPT only.
(4) Altitude terminations may be displayed as flight-level (FLHHH) or altitude (HHHHH).

Mod : 6789

2 – LATERAL F-PLN REVISIONS

- Lateral revisions are changes made in the lateral flight plan, from a specific point called the revise point, which may be any waypoint in the flight plan, including the FROM waypoint (expressed as PPOS) and F-PLN DISCONTINUITY (expressed as DISCON).
- The lateral revision page is displayed automatically when any left key is pressed on a F-PLN page. The waypoint next to the pressed key forms the title of the LAT REV page.
- Revisions made on these pages affect only the downpath flight plan ; all flight plan legs that occur up to and including the revise point remain intact.
- Should the revise point become the FROM waypoint while a lateral revision is being defined, the lateral revision is erased and the display reverts to the F-PLN page.
- Lateral revisions cause all predictions to be recalculated ; dashes are displayed while new values are calculated.
- There are five general categories of lateral revisions :
  - Waypoint insertion/deletion directly on F-PLN A and B pages.
  - From the flight plan pages through the LAT REV function.
  - The DIRECT TO function on the flight plan pages.
  - The Along Track Offset waypoint entered on the LAT REV page (only if LAT REV at FROM waypoint).
  - SID revisions are normally done only at the ORIGIN waypoint, and STAR revisions done only at the last en-route waypoint.

2.1 – LATERAL REVISION FUNCTIONS

- The Lateral Revision page allows the following functions :
  - SID/RWY selection (in PREFLIGHT phase only)
  - STAR/RWY selection
  - AIRWAY selection
  - HOLD : insertion of a holding pattern and modification of the associated parameters
  - VIA/GOTO definition and stringing of waypoints along a common airway to a termination point along that airway.
  - PROC-T : insertion of a procedure turn
  - NEW WPT : insertion of a new waypoint directly in the flight plan.
  - CO RTE : allows a flight plan revision by designating a prestored company route from an enroute revise point.
  - NEW RTE TO : used to define a new destination for the FMC.
  - ENABLE ALTERNATE : used to activate the alternate flight plan if an alternate destination has been specified on the INIT A page.

See chapter 1.20.73 for Lateral Revision page description.

2.2 – F-PLN DISCONTINUITY - PURPOSE/CLEARING

- Sometimes no leg is defined between two WPTs (after a revision of the F-PLN or because no leg is defined in the database). In this case « ... F-PLN DISCONTINUITY... » is displayed between these two WPT.
- Concerning predictions, the FMS assumes that the aircraft will fly a direct leg between the two waypoints that define the discontinuity.
- When the aircraft enters a flight plan discontinuity, the NAV mode automatically switches to the HDG mode and the AP disconnects.
- After passing a WPT followed by a F-PLN DISCONTINUITY, the FROM WPT becomes PPOS (aircraft present position). The first leg following the discontinuity will be an initial fix (IF).
- A F-PLN DISCONTINUITY can be cleared (see chapter 1.20.72).

Mod : 11320 or 11364 or 12044 or 12045

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1 – VERTICAL F-PLN STRUCTURE

1.1 – OVERVIEW

- The vertical F-PLN is divided into vertical flight sub-phases. Each sub-phase contains flight parameters such as altitude, airspeed (CAS), flight path angle, and time. These parameters may be imposed by constraints along the flight plan and / or computed to optimize the overall flight performance.
- The vertical F-PLN profile depends on :
  - the strategic mode selected for the whole flight (ECON, MIN FUEL, or MIN TIME), and
  - the tactical mode selected for the current flight phase.

1.2 – CONSTRAINTS

- Constraints are related to a specified waypoint. Constraints can apply to :
  - time,
  - speed,
  - altitude :
    - at,
    - at or above,
    - at or below, or
    - between altitudes (from the Data Base only)
- The departure and destination airports are considered as "at altitude" constraints (the runway altitude, if defined, or the airport altitude).
- When the F-PLN does not contain any altitude constraint (thus, there is no destination airport), except the SPD LIMIT altitudes, the vertical profile is called "OPEN PROFILE". The FMC only computes the optimum present performance. There is no optimization on the long term (no predictions). There is no computed vertical path.
- When a destination airport has been defined in the F-PLN, the FMS computes a vertical path taking into account the lateral path, the constraints, the predicted winds and temperature, the aircraft weight, the performance mode, and the cost index. The result is a closed-loop profile that the FMS updates continually in flight.
- When there is a F-PLN discontinuity, the FMS assumes a direct leg through this discontinuity to compute predictions beyond the discontinuity.

1.3 – STRUCTURE

- The general structure of a vertical F-PLN is described hereafter :

F-PLN	VERTICAL PATH
PREFLIGHT	
TAKEOFF	
PRIMARY CLIMB	Thrust reduction altitude (THR RED) Acceleration altitude (ACC ALT) Climb constraints (CLB CSTR) Climb speed limit (SPD LIM) Top of climb
PRIMARY CRUISE	Cruise altitude (CRZ ALT) Cruise constraints (Speed or time) Step climb or descent (S/C, S/D) Top of descent
PRIMARY DESCENT	Descent constraints (DES CSTR) Descent speed limit (SPD LIM) Approach constraints (APPR CSTR)
PRIMARY GO-AROUND	Missed approach constraints
ALTERNATE F-PLN	Same as above except that there is no : THR RED, ACC ALT, STEP CLB, STEP DES
DONE	On the ground, after both engine shutdowns.

Mod : 6789

1.4 – REMARKS

- The flight crew may define an Engine Out (EO) THR RED altitude and an EO ACC altitude (default values : 1500 ft). Both altitudes are used in case of an engine failure.

- There can be only one STEP in the F-PLN (CRZ phase only).

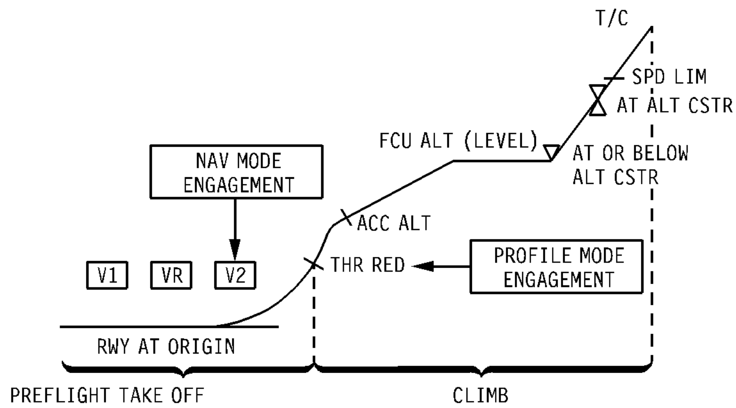
- The lateral guidance starts with the engagement of the NAV mode (at 30 ft if previously armed) and ends at LOC capture (for precision approaches).

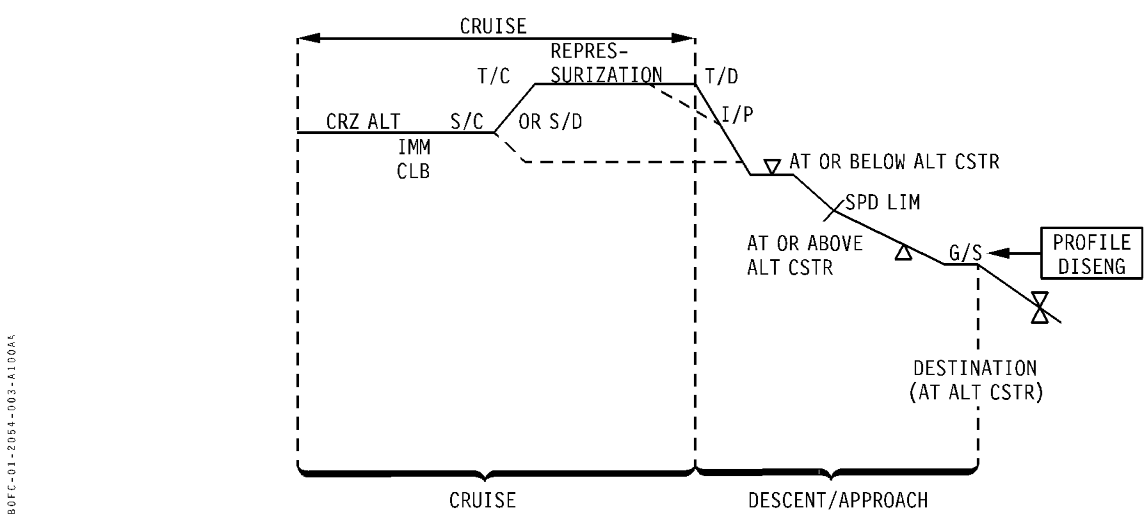
- The vertical guidance starts with the engagement of the PROFILE mode (at THR RED altitude) and ends at G/S capture (for precision approaches). For non-precision approaches, the PROFILE mode must be deselected no later than 1000 ft on approach.

- When the aircraft performs a go-around, the FMS deletes all constraints from PPOS to the first point of the go-around.

Mod : 6789

1.5 – VERTICAL F-PLN PROFILE EXAMPLE





Mod : 6789

1.6 – VERTICAL F-PLN PSEUDO-WAYPOINTS

- As for the LATERAL F-PLN, the VERTICAL F-PLN is composed of flight sub-phases each one terminated by a specific point.
- These points are called pseudo-waypoints as they are not related to the LATERAL F-PLN.
- All pseudo-WPT are displayed in LARGE FONT between brackets.
  They are never displayed as a « FROM » WPT.
- The table below gives all pseudo-WPT which may be encountered in the F-PLN with the possibility to make VERTICAL revisions from them or to delete them with the CLR function (no LATERAL revisions can be made on a pseudo-waypoint).

CDU Display and corresponding ND display	Pseudo Waypoint	Definition	Access to VERT REV	CLR Function Available
[I / P] no ND display	Intercept Descent Path	Displayed at the point where the aircraft will intercept the predefined vertical path when aircraft is doing an immediate descent.	No	No
[T / D] white on ND	Top of Descent	Inserted into the flight plan at the point where the FMC calculates the aircraft should start its descent.	Yes	No
(1) [S / C] no ND display	Step Climb Point	Inserted into the flight plan at the point where the pilot has inserted a step climb (when the step climb will begin).	No	Yes
(1) [S / D] white on ND	Step Descent Point	Inserted into the flight plan at the point where the pilot has inserted a step descent (when the step descent will begin).	No	Yes
[T / C] blue on ND	Top of Climb displayed on ND like a LEVEL point if FCU = CRZAlt or STEP Alt	Inserted into the flight plan at the point where the FMC calculates the aircraft will reach the cruise altitude or step altitude if a step climb.	Yes	No
(1) [LEVEL] in CLB, blue in DES, blue	FCU Altitude displayed on ND in amber if the FCU setting will make the aircraft to miss an ALT constraint	Inserted into the flight plan at the point where the aircraft will next intercept the FCU altitude. If the FCU altitude is the cruise altitude, LEVEL is the T / C.	No	No
(1) [HHHHH] no ND display	Altitude intercept Point	HHHHH is the altitude entered by the pilot in the PRED TO field of the TACT MODE page for CLB or DES phase. It is inserted into the F-PLN where the FMC predicts the aircraft will cross the altitude. This pseudo-WPT will not be displayed if the altitude is the same as the cruise altitude, speed limit altitude, FCU Alt.	No	No
SPD (1) [LIM] no ND display	Speed Limit	The speed and altitude are displayed as constraints on the right half of the F-PLN Page A. This is an altitude related speed limit associated with airspace the aircraft is in. The speed limit is inserted into the flight plan at the point where the aircraft will cross the speed limit altitude.	Yes	Yes

(1) The pseudo-WPT may be inserted or modified by the pilot via the CDU.

Mod : 6789

2 - VERTICAL REVISIONS

- Vertical revisions are changes made to the flight plan which have an immediate or downpath (future) affect on the active flight plan vertical profile. This vertical profile represents the desired aircraft trajectory, thrust settings, and speeds along the vertical path of the flight plan.

- The two vertical revision pages are accessed from F-PLN A and F-PLN B pages and are displayed when a right LS key is pressed adjacent to the desired waypoint on either flight plan page.

- Vertical revisions to the flight plan can be made at any point along the route of flight.

- The following revisions to the vertical profile may be made :
  - Altitude and time constraints
  - Speed limits and climb, cruise, or descent speeds
  - Altitude steps
  - Temperature and wind revisions.

- Entry of a vertical revision causes a complete recalculation of the vertical flight plan profile and invalidates all previous performance predictions. Due to the FMS computation time, during climb or descent, no vertical revision should be performed at less than 1000 ft from the level off altitude.

- Vertical revisions may be made to the primary, secondary, and alternate flight plans. The method to accomplish these revisions is identical in all three cases ; however, changes that may affect the active situation are not allowed in either the secondary or alternate flight plans.

2.1 – TIME AND ALTITUDE CONSTRAINTS

2.1.1 – Time Constraint

- A time constraint is defined as a time requirement to be met at a specified waypoint in the lateral flight plan. Based on the performance predictions of the vertical profile, the FMC adjusts the speed target during the cruise flight phase to meet the desired time constraint.

- Time constraints may be entered at any fixed waypoint in the primary flight plan, from the vertical revision page, except under the following conditions :
  - ENG OUT mode is active
  - no valid clock data
  - active lateral leg is a holding pattern or procedure turn
  - a STEP is in the primary flight plan
  - a destination is not defined in the primary flight plan
  - a missed approach is being flown

- Time constraints are automatically deleted from the flight plan for the following reasons :
  - when the aircraft becomes airborne
  - when a second time constraint is entered into the flight plan
  - activation of the ENG OUT mode
  - loss of valid clock data
  - the active leg has a manual termination

- A time constraint may be seen as being a pilot-defined ETA for a specified waypoint or destination.

2.1.2 – Thrust Reduction Altitude

- In addition to being the lowest altitude at which the PROFILE mode may be engaged, the thrust reduction altitude defines the vertical location at which the FMS commands the TCC to reduce the pilot-defined Takeoff/ Flex Takeoff thrust limit to the FMS thrust limit.

2.1.3 – Acceleration Altitude

- The acceleration altitude defines the vertical location at which the FMS can command an acceleration to the desired climb speed, (e.g. 250 kt below 10000 ft).

Mod : 6789

2.1.4 – Altitude Constraint

- Three types of altitude constraints may be entered into the flight plan :
  - AT
  - AT OR BELOW
  - AT OR ABOVE
- All may be manually entered by the pilot, or a database specified procedure may automatically enter one.
- Altitude constraints must be :
  - above the origin airport for CLB PHASE
  - above the present altitude for a climb constraint
  - below the present altitude for a descent constraint
  - above the destination airport for DES and APPR phase.

  If the altitude constraint does not conform to required criteria, it is rejected by the FMC.
- As with SPD constraints, altitude constraints may either be inserted directly into the flight plan, by writing the data in the scratchpad for transfer into the desired data field, or by vertical revision at the desired waypoint.
- An altitude constraint entry at the T/C pseudo-waypoint redefines the CRZ ALT in the FMC, in the same way as entry of a new CRZ ALT on the PROG PAGE. In this case, the new altitude is not a constraint, but a new cruise altitude.

  In a similar manner, an altitude constraint entry higher than the CRZ ALT defined in the FMC causes the CRZ ALT to be redefined to the new altitude.

2.2 – SPEED LIMITS AND CONSTRAINTS

2.2.1 – Speed Constraint

- Speed constraints restrict the IAS of the aircraft at a specified waypoint along the lateral flight plan. During takeoff, climb, and cruise flight phases, IAS is limited to a value equal to, or less than the specified constraint, until the waypoint specifying the constraint has been sequenced.
- In the descent and approach flight phases, IAS is also limited to a value equal to, or less than the speed at the last specified constraint and is retained when subsequent waypoints are sequenced unless further constrained, or the flight phase transitions to go-around, climb, or cruise.
- Speed constraints may be entered manually, or automatically by procedure from the NAV database (e.g. a specified speed at a STAR waypoint). In the latter case the constraint is automatically inserted in the F-PLN when the approach procedure is selected from the STAR list.

2.2.2 – Speed Limit

- Speed limit is an altitude related restriction on aircraft IAS (e.g. 250 kt/10000 ft). The speed target is determined at or below the specified altitude and is limited to the maximum defined speed.
- Different speed limits may be specified for the CLIMB and DESCENT flight phases.
- With PROFILE engaged and the aircraft below the speed limit altitude, the CDU scratchpad message "SPD LIM EXCEEDED",
  is displayed if the IAS exceeds the specified limit by more than 15 kt. The message automatically clears when the speed returns to within 5 kt of that specified.
- Manual clearing via the CLR key on the CDU is available at any time. This action causes the speed limit to revert to the default value specified in the database, and the displayed value is in small font.

Mod : 6789

2.3 – STEP ALTITUDE/PREDICTION

- A downpath altitude step may be seen as a form of altitude constraint, to satisfy an ATC request, or as a normal part of the flight plan.

- There are two possibilities for altitude steps, STEP CLB and STEP DES. The STEP CLB segment is active during the CRZ flight phase, and when the following conditions exist :
  - PROFILE is engaged
  - the STEP CLB pseudo waypoint is a part of the active F-PLN
  - the STEP point has been sequenced on the lateral F-PLN
  - actual aircraft altitude is below the FCU clearance altitude
  - ENG OUT Drift Down situational mode is not active.

- The STEP DES segment is active when the following conditions exist :
  - PROFILE is engaged
  - The STEP DES pseudo waypoint is a part of the active F-PLN
  - The STEP point has been sequenced on the lateral F-PLN
  - Actual aircraft altitude is above the FCU clearance altitude
  - ENG OUT Drift Down situational mode is not active.

- The point along the lateral flight plan at which the climb or descent is to occur, called the STEP point, is the point at which the vertical flight plan changes from one cruise altitude to another cruise altitude.

- The STEP point is indicated on the F-PLN pages and the ND by the pseudo waypoints S/C (STEP CLB) and S/D (STEP DES).

- Prior to executing an altitude step, the crew has the option to view the predictions associated with it on the STEP PRED page, to determine if such action is interesting in terms of time or fuel savings.

2.4 – WIND/TEMPERATURE REVISIONS

- Wind/Temperature computations along the route are based on pilot input and actual winds/temps from the FMC at PPOS.
  Wind input is used for ground speed, fuel consumption, and optimum altitude predictions.
  Temperature input is used to calculate TAS, thrust settings, optimum altitudes, etc.

- The FMC places the winds/temps into three categories :
  - entered : winds/temps entered by the pilot
  - forecast : winds/temps based on linear interpolation between wind/temp entries
  - predicted : winds/temps that are a combination of the forecast and actual wind/temp at PPOS.

  The pilot-entered wind value format is Direction/Velocity and is referenced to true north. Entry may be made on any one of five CDU pages :

  - INIT A : enter the forecast wind at top of climb (T/C) in the cruise wind field
  - F-PLN B : enter the forecast winds for each waypoint along the route
  - VERT REV B : entry is the same as F-PLN B above

Mod : 6789

– STEP PRED : enter PPOS wind at the STEP altitude on the STEP PRED page
– DES FORECAST : enter winds on at altitudes for the descent flight phase, and enter the destination surface wind from ATIS. Entry of the destination wind allows the FMC to provide predicted wind values for the descent phase without further pilot input.

- The climb wind forecast is divided into two segments as follows :

  – Below 10 000 ft, the vertical profile forecasts are determined by linear interpolation between the wind at the origin airport and the T/C wind at 10 000 ft.
  – Above 10 000 ft, the vertical profile forecasts are determined by the constant value of the T/C wind.

- If T/C wind and the origin wind are not entered by the pilot, the values default to zero, and wind values at all waypoints along the route of flight correspond to the T/C wind value derived from the FMC.

- En-route flight planning changes, which cause recalculation of the predictions, also cause a new wind profile to be calculated, using the actual wind at aircraft PPOS and projecting the profile forward from that position to the destination.

- The descent wind forecast profile is dependent on the winds entered on the DES FORECAST page. If no wind entry is made, the descent forecast profile consists of thefollowing :

  – Above 10 000 ft, the wind forecast is a constant value equal to the wind at T/D

  – Below 10 000 ft, the wind forecast is determined by linear interpolation between the cruise wind at 10 000 ft and the destination airport surface wind.

  If a destination wind is not entered, a zero wind velocity at destination is used for predictions.

- The temperature along the route of flight may be entered in degrees centigrade and is used to modify ISA values to correspond with actual conditions to improve predictions. Temperature entries may be made on the following CDU pages :

  – INIT A : enter a T/C temperature in the cruise temperature field
  – F-PLN B : enter forecast temperatures at origin, destination, all en-route waypoints, T/C, and T/D pseudo-waypoints.
  – VERT REV B : entries are the same as for F-PLN B page above.

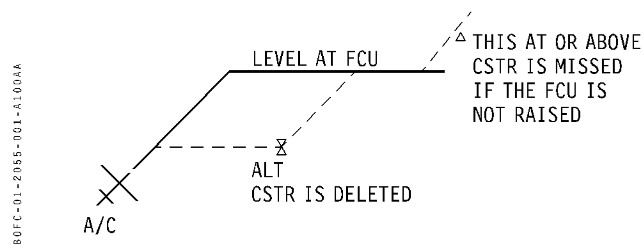
Mod : 6789

1 – GENERAL RULES

- The FMS controls the aircraft through the AFS. Lateral guidance is provided through the NAV mode.
  Vertical guidance is provided through the PROFILE mode in accordance with the altitude selected on the FCU (FCU ALT) :
  - The FMS will never control climb (descent) segments above (below) the FCU ALT.
  - When P-ALT is active meaning that the FMS holds the FCU ALT, a new FCU ALT may be sent to the FMS by dialing this new altitude on the FCU and pulling the ALT KNOB. Pulling means that the aircraft is authorized to leave the level but the immediate altitude change is not systematically performed as it is done in normal AFS use : it depends on the vertical flight plan of the FMS.
  - When P-ALT is not active, pulling the knob is not necessary to send a new FCU ALT to the FMS.
- The FMS computes a target altitude, a target speed and a target thrust for each flight phase. The vertical control logic is based on these targets : the FMS gives the AFS the vertical commands needed to reach and then to hold these targets. The suitable AFS/ATS profile flight mode (P.CLB, P.DES, P.ALT, P.THR, P.SPD, RETARD) will be engaged.
- During the whole flight, a target speed is computed for each flight phase upon the selected strategic or tactical performance mode and cruise FL. In ECON mode, the target speed is computed using the cost index. A speed constraint becomes the target speed when it is near to be reached.

2 – CLIMB PHASE

- The FMS controls speed on elevator with max climb thrust according to the selected performance mode : for instance green dot at max climb thrust in MAX CLIMB.
- P.THR (ATS) and P.CLB (similar to the AFS SPEED mode) are engaged.
- Aircraft levels off when an AT or an AT OR BELOW altitude constraint is encountered. The climb segment is resumed after passing the constrained waypoint.
- During climb, the target altitude is the FCU ALT. Aircraft levels off at this target altitude. Thus a constraint may be missed (and a message displayed) if the FCU ALT is not raised soon enough at the altitude constraint.
  In this case all ALT constraints between aircraft and FCU altitude are deleted.



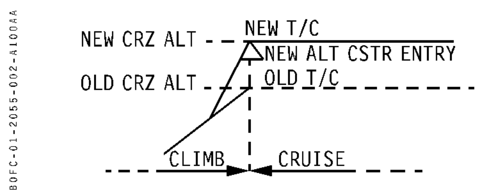
Mod : 6789

3 – CRUISE PHASE OR LEVEL SEGMENTS

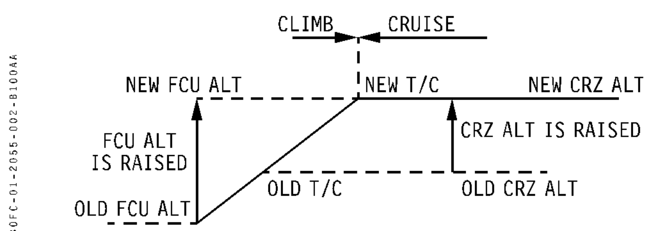
- The FMS controls the altitude on elevator, the speed being controlled with the autothrottle.
- P.SPD (ATS) and P.ALT (AFS) are engaged.
- in ENG OUT, MCT is selected, thus P.THR is engaged.

3.1 – CRUISE ALTITUDE (CRZ ALT)

- It is defined during preflight by the Company Route stored in the database or by the pilot on the CDU. It may be changed.
- If, in flight, an ALT constraint is entered above the defined CRZ ALT, CRZ ALT will be automatically moved up to this entered ALT CSTR, even if it is an AT OR BELOW CSTR. The message « NEW CRZ ALT HHHHH » is displayed.



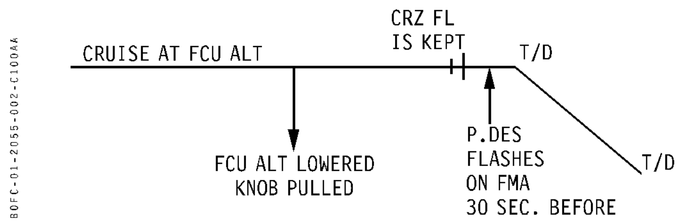
- The CRZ ALT is moved up to the FCU ALT when a higher FCU ALT is dialed except when a STEP CLIMB has been defined in the F-PLN or during the preflight phase.



- The FMS holds the CRZ ALT until the top of descent (T/D) is reached. The FCU ALT may be dialed down (and the knob pulled) to the future altitude before the T/D.

3.2 – CRZ FL KEPT AFTER AN FCU ALT CHANGE

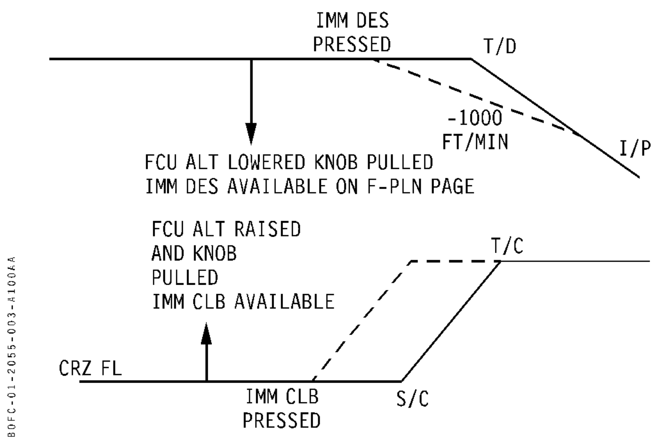
- There are some situations, in the cruise phase, where the aircraft stays at the CRZ FL after an FCU ALT change, even if this altitude change has been authorized by pulling the knob. These situations occur when the altitude change was preplanned :
  - Altitude change before the Top of Descent (T/D)
  - Altitude change before the step climb or descent point (S/C or S/D)
  - PROFILE being engaged.
- As soon as the knob is pulled P.DES or P.CLB is armed (blue on FMA). At the pseudo-waypoint there will be an altitude change with no pilot action as this altitude change was preplanned. In order to advise the crew of this altitude change with no action, P.CLB or P.DES armed on FMA will flash 30 sec before reaching the pseudo-WPT.



- In addition, as soon as the FCU ALT KNOB is pulled, the command IMM DES or IMM CLB will be available on the F-PLN page allowing to go immediatly to the FCU ALT without waiting for the pseudo-waypoint.

4 – IMMEDIATE CLIMB/IMMEDIATE DESCENT

- The IMM CLB or IMM DES commands are activated by pressing the key adjacent to the corresponding prompt displayed on F-PLN page.



- For descent, an INTERCEPT POINT (I/P) is computed where the descent path at – 1000 ft/min should intercept the previously computed descent path.
- the FMS controls the vertical speed on elevator (defaulted to – 1000 ft/mn), the speed being controlled with the autothrottle.
- P.SPD (ATS), P.DES (AFS) are engaged.
- If VMO – 5 kt is exceeded, throttles are retarded to idle, speed is controlled with autopilot and vertical speed is not controlled anymore.

5 – STEP CLIMB - STEP DESCENT

- In both STEP CLB and STEP DES, the AFS commands the vertical guidance path target, speed target, vertical speed target, thrust target, and control mode, with PROFILE engaged, as follows :
  - The CRZ FL is the vertical guidance path target.
  - Speed target is defined according to the following priority :
    - if TACT SPD mode is active the speed target is the defined tactical speed entry
    - if a HOLD is active or is to become active within 3 minutes, with a heading leg to a manual termination (HM) (e.g. IMM EXIT), the speed target is the pilot entered Holding Speed. If a pilot-entered Holding Speed has not been specified, then target speed is MAX ENDurance
    - the speed target is the SPD defined in the performance mode choses.
  - The vertical speed target in descent is –1000 ft/min or the pilot-defined vertical speed on the FCU, until the IAS reaches the limiting speed as defined on the TACT MODE page.
  - The vertical guidance thrust target is maximum climb thrust in climb and idle thrust in descent.
  - The vertical guidance control mode is speed on thrust or speed on elevator, or combinations of each, to maintain the selected IAS or vertical speed.

Mod : 6789

- After the step altitude is inserted into the F-PLN, the FCU must be changed in accordance with the new CRZ ALT to affect the desired altitude change when the step point is reached.

- Thirty seconds prior to the STEP point, providing the FCU and the STEP ALT are the same, P-CLB will flash on the PFD FMA indicating to the pilot that a STEP is about to occur at the STEP point without any further action.

- After a STEP has been inserted into the F-PLN and the FCU ALT has been changed accordingly, if the FCU ALT is repositioned to the present CRZ ALT prior to the STEP point, the STEP is automatically canceled, and the CRZ ALT reverts to the present altitude.

- If the FCU was not changed in accordance with the altitude STEP, then upon reaching the STEP point, the STEP is automatically deleted and the scratchpad message
  "CHECK ALTITUDES"
  is displayed.

- When ALT is the engaged mode in the FMA, changing the FCU altitude to the STEP altitude has no effect on aircraft altitude until the STEP point is reached. At that time, level change occurs and P-CLB or P-DES modes engage.

6 – DESCENT/APPROACH PHASE

- The FMS controls the vertical path on elevator and P.DES (AFS) is engaged. There is no specific target altitude.

- If there are no speed constraints, thrust is full idle. Just before RETARD, P.THR is engaged during the transition between cruise level and descent path in order to control speed from cruise speed to descent speed.

- The vertical deviations from the precomputed path are displayed on the PROGRESS page and on the ND.

- A repressurization segment may be performed by pressing the command IMM DES on the F-PLN page.
  This action should be done XX nm before the top of descent, XX being given by the message
  "REPR XX NM BFR T/D"
  displayed after the FCU has been lowered.

- If the present speed is greater than target speed + 20 in RETARD mode or + 15 kt in P.SPD mode or VMAX – 2 kt, whichever is the lowest,
  "MORE DRAG"
  flashes on the PFD, asking the pilot to extend airbrakes (use half).
  ATS reverts to RETARD if it was in P.SPD.

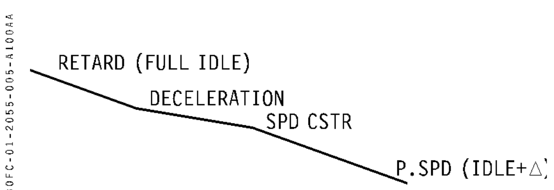
- If the aircraft is above the descent path, it will be controlled by the FMS at the descent speed target + 20 kt or 290 kt, whichever is the highest, in order to recapture the path from above.

- If the airbrakes are extended and the present speed falls below the target speed – 10 kt,
  "LESS DRAG"
  is displayed on the CDU, asking the pilot to retracts airbrakes (half).

- If anti-ice is ON, half airbrakes should be extended in addition to the previous requirements.

Mod : 6789

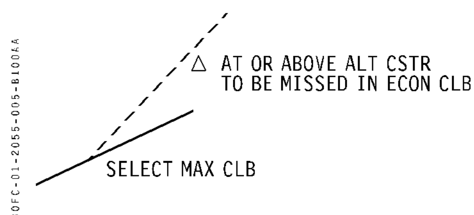
- All deceleration segments are performed in P.SPD at – 1000 ft min, or at – 500 ft min if it is not enough. It is the case for instance at the SPD LIM, or any other SPD constraint, or in the final deceleration before approach phase.
- Aircraft levels off when an AT or an AT OR ABOVE altitude constraint is encountered. The descent is resumed after passing the constrained waypoint.
- If during a revision of the flight plan, the descent path is recomputed, the guidance reverts to vertical speed on elevator and speed on thrust, V/S and SPD being the values at the revision. PROFILE mode is thus disengaged.
- Below the speed limit altitude, a descent path flown at 250 kt with an IDLE + Δ thrust is computed. The Δ thrust is used to facilitate the speed control with autothrottle. This is called SPEED REVERSION. The speed reversion is performed in P.SPD ATS mode and there is a tight speed control
  The speed reversion may occur before reaching the SPD LIM altitude each time the aircraft speed falls below a threshold from the descent speed, or if a speed constraint is encountered, or at any F-PLN revision. When a tight speed control is not needed anymore, ATS reverts to RETARD.



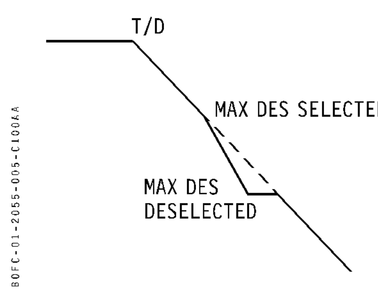
- Approach phase :
  – Based on the inserted flight plan route and wind profile the FMS computes the point where the aircraft should decelerate.
  – At this point the target speed falls to VAPP = VREF + 5 + wind correction, and the deceleration is performed at – 1000 ft/min (500 ft/min if necessary) or at the FCU alt (this assumes A/THR is engaged for landing).

7 – VERTICAL PATH DEVIATIONS

- If for any reason the aircraft does not or cannot follow the computed path, the FMS will respond in the following way, if PROFILE is engaged :
  – if a constraint cannot be met, an amber FCU level off symbol is displayed on NDs. Moreover, in climb, a message will be displayed in the CDU scratchpad.
  – if a time constraint will not be met in the present performance mode, the FMS will not stay at the speed computed for this mode and the CSTR indication will be displayed on the PROGRESS page.
  – if an altitude constraint will not be met in the present mode, the pilot must manually change the mode.

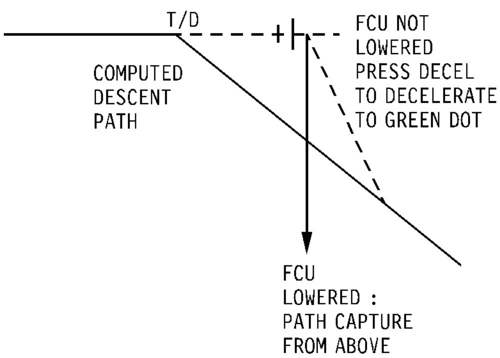


- During descent :
  – The vertical deviations are displayed on the PROGRESS page and on ND scale. Airbrakes should be extended or retracted as explained above.
  – If the MAX DES mode is activated, the descent rate is increased until the lowest of MMO – 0.02/VMO-10/340 kt is reached. As soon as MAX DES is deselected a level off will be ordered until the descent path is recovered.



Mod : 6789

– If the FCU is not lowered at the top of descent (because the ATC clearance is not yet given for instance), the FMS will not switch to the DES phase and will propose to decelerate to green dot. A DECEL prompt will be displayed on the F-PLN page to allow the deceleration by pressing the prompt. As soon as the FCU is lowered, the aircraft is controlled to recapture the computed descent path from above :
  – at descent target speed + 20 kt or 290 kt, whichever is the greatest above 10 000 ft.
  – at descent target speed + 20 kt or 250 kt whichever is the lowest below 10 000 ft.



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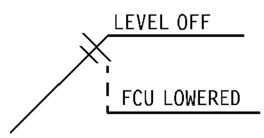
8 – ALTITUDE CONFLICTS

There cannot be descent segments during the climb phase and climb segments during the descent phase. If, in climb, FCU ALT is lowered below present aircraft altitude, there is an altitude conflict :
"CHECK ALTITUDES"
message is displayed. The FMS orders a level off. The conflict must be resolved, or PROFILE mode disengaged, to leave the level.



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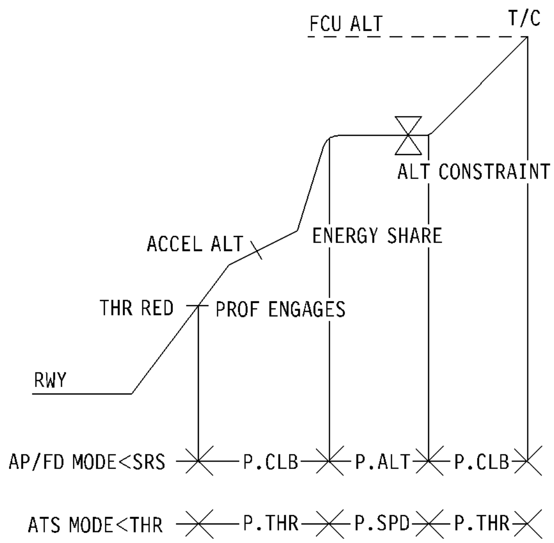
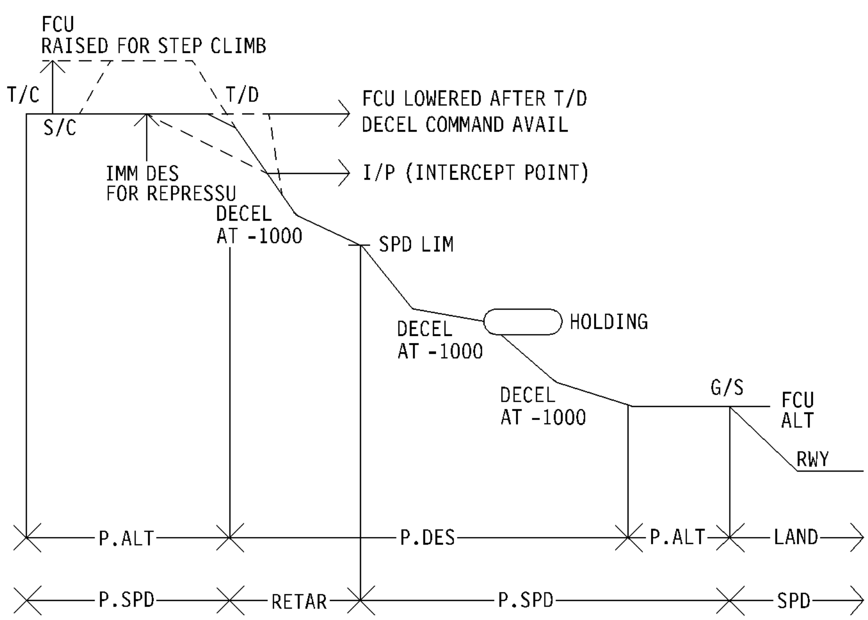
Mod : 6789

9 – GUIDANCE ALONG THE VERTICAL FLIGHT PLAN





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- The CDU is the primary pilot interface with the FMC, and is mainly used for long-term (strategic) actions such as flight plan construction, flight plan monitoring and revision, insertions of weights, temperature and wind entries, and performance data initialization. Short-term (tactical) actions, altitude steps, speed selections, etc., are also entered on the CDU.

- This interface allows the pilot to control the lateral and vertical elements of the flight plan.

- Lateral functions
  - NAV (aircraft position)
  - Navaid tuning (auto and manual)
  - IRS alignment
  - Flight plan initialization and modification
  - Lateral flight plan display
  - Lateral guidance

- Vertical functions
  - Vertical profile
  - Constraints (time, altitude, and speed)
  - Wind and temperature revision
  - Step climb or descent
  - Predictions (fuel, time, altitudes)

Mod : 6789

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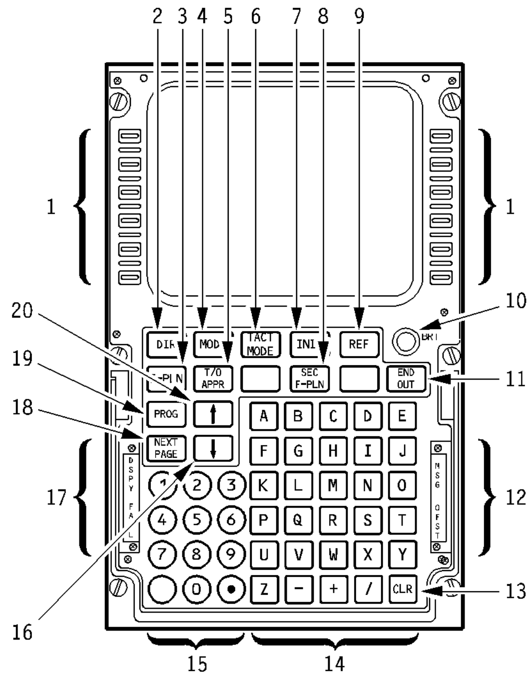
- The CDU keyboard provides a full alphanumeric keyboard combined with mode, function, data entry, slew keys, and advisory annunciators. The keyboard also contains two integral light sensors and a manual knob to control display brightness.



1. LINE SELECT KEYS
2. DIRECT KEY
3. FLIGHT PLAN KEY
4. MODE KEY
5. TAKEOFF/APPROACH KEY
6. TACTICAL MODE KEY
7. INITIALIZATION KEY
8. SECONDARY FLIGHT PLAN KEY
9. REFERENCE INDEX KEY
10. BRIGHTNESS KNOB
11. ENGINE OUT KEY
12. ANNUNCIATOR-MESSAGE, OFFSET
13. CLEAR KEY
14. ALPHA KEYS
15. NUMERIC KEYS
16. SLEW DOWN KEY
17. ANNUNCIATOR-DISPLAY, FAIL
18. NEXT PAGE KEY
19. PROGRESS KEY
20. SLEW UP KEY

B0FC-01-2062-001-A001AA

1 – SCREEN

- The display screen has 14 lines with 24 characters per line. The page format is partitioned into four areas.

1.1 – TITLE FIELD

- This field is the top line of the display. It identifies the page in view and what additional pages of a set are available.

1.2 – LEFT FIELD

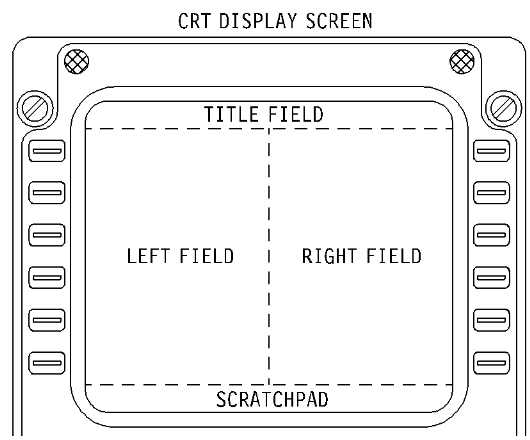
- This field is composed of six pairs of lines, eleven characters per line. It extends from the left side of the screen to the center. The operator has access to one line of each pair through a Line Select key (LS key) on the left side. A line pair comprises a label line and a data line.

1.3 – RIGHT FIELD

- This field is similar to the left field, extending from the center of the screen to the right side. Operator access is available by a LS keys on the right side.

1.4 – SCRATCHPAD

- This field is the bottom line of the screen. Typed alphanumeric characters and FMC generated messages are displayed on this line. The scratchpads for the two CDUs operate independently for data entry. The scratchpad accepts entries up to 22 characters. The last two character spaces are reserved for vertical slew indicators.



B0FC-01-2062-001-B001AA

2 – LINE SELECT KEYS

- The line select keys (LS key) are twelve keys, six on each side of the screen, aligned with the data fields.
- Pressing a line select key may display a new page or insert data from the scratchpad into selected line and field.

Note : Throughout this chapter, line select keys are denominated as follows :
– LS key 1L for the left upper line select key, then LS key 2L, 3L, 4L, 5L, 6L.
– LS key 1R for the right upper line select key, then LS key 2R, 3R, 4R, 5R, 6R.

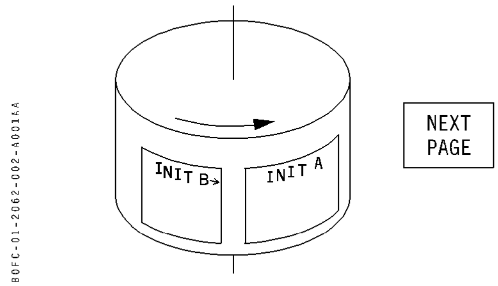
3 – ALPHANUMERIC KEYS

- These keys enable the operator to enter numerals and alphabetic characters into the scratchpad successively from left to right. Alpha and numeric keys may be entered together as required.
- The slash key (/) is included as part of the alpha keys and is used to separate pairs of entries in the same field. For example, airspeed and Mach (280/.720), wind direction and velocity (104/100), or airspeed and altitude (250/10000).
- The trailing entry of a pair is generally preceded by the slash if entered by itself. The leading entry may be followed by the slash but is not required if entered by itself.

4 – FUNCTION KEYS

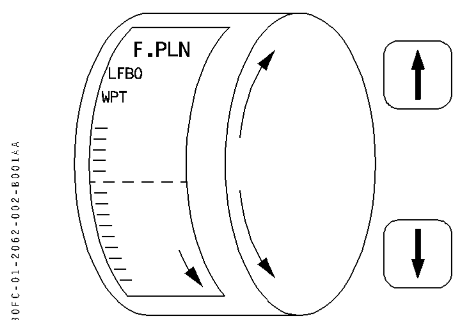
4.1 – NEXT PAGE key

- Provides access to additional pages of a set when another page is required to complete display of data. This capability is indicated by a horizontal arrow on the title line.
- The NEXT PAGE function is closed loop ; that is, it wraps around from the last page to the first page.



4.2 – VERTICAL SLEW keys : ↑ and ↓

- For pages longer than the available space on the screen vertical slewing is used to scroll the display up or down.
- These two keys are also used for incrementing (or decrementing) data (lat/long) in particular data fields.
- Vertical slew capability is indicated by arrows in the last two right hand spaces of the scratchpad. Simultaneous display of up and down arrows indicate upward and downward scroll capability.



4.3 – CLR key

- The CLR key is used to clear messages and data from the scratchpad or an individual data field.

5 – MODE KEYS

5.1 – DIR KEY

- Accesses the DIR TO page and allows the crew to initiate the DIRECT TO function by manual entry of a fixed waypoint, or line selection of a fixed waypoint in the active primary F-PLN only.

5.2 – MODE KEY

- Allows access to the MODE page, which displays the strategic performance modes. Changes made on this page effect performance in all the flight phases.

5-3 – TACT MODE KEY

- Allows access to the current flight phase page (climb, cruise, etc.). Changes made to the strategic modes on this page effect performance only in the current flight phase.

5.4 – INIT KEY

- Pressing this key will bring the INIT A page to the display on the ground only. The crew can define various initialization parameters including active F-PLN data and IRS alignment.

5.5 – REF KEY

- Accesses the REFERENCE INDEX page, which allows further access to reference pages concerning to aircraft configuration, stored and defined waypoints, navaids, maintenance, and other user systems.

5.6 – FPLN KEY

- Provides access to a leg by leg description of the active route. The data includes a listing of real and pseudo waypoints, estimated times of arrival, air speed/altitude constraints, distances between legs, and magnetic courses between legs.

5.7 – TO/APPR KEY

- Accesses the TAKEOFF or APPROACH page, as appropriate, on which takeoff or approach parameters are displayed and/or inserted depending on the flight phase.

5.8 – SEC FPLN KEY

- When pressed, displays the SEC INDEX page. The SEC INDEX page allows access to, and functions related to, the secondary flight plan. These functions include copying into, deleting, and activating the secondary flight plan. The SEC INIT pages and all secondary performance pages are accessible from this page.

5.9 – ENG OUT KEY

- Has no specific page associated with it however, pressing it can cause display of an EOSID, if available, or display of the MODE page with EO prompts.

5.10 – PROG KEY

- Pressing the PROG key displays dynamic flight information about the active flight plan including : CRZ FL, present position, distance to destination, etc.

6 – BRIGHTNESS KNOB

- The brightness knob allows the operator to manually increase or decrease the brightness of the CDU display. The back lighted key illumination is controlled by a remote flight deck control. Annunciators are controlled by the master bright-dim-test system.

7 – ANNUNCIATORS

- There are four annunciators, two on each side.

7.1 – DSPY (TOP LEFT)

- Illuminates when the flight plan has been slewed and/or the display does not indicate the active situation in the FMC.

Mod : 6789

7.2 – FAIL (BOTTOM LEFT)

- Indicates the CDU has failed. The screen is blank, except for the message FMC FAIL.

7.3 – MSG (TOP RIGHT)

- Illuminates when a scratchpad message is being displayed or when a message is waiting in the queue.

7.4 – OFST (BOTTOM RIGHT)

- Illuminates when a parallel offset is active.

Mod : 6789

1 – SPECIAL SYMBOLS

→ : THERE ARE SEVERAL PAGES ASSOCIATED TO THE PAGE DISPLAYED. PRESS NEXT PAGE KEY TO DISPLAY THEM.

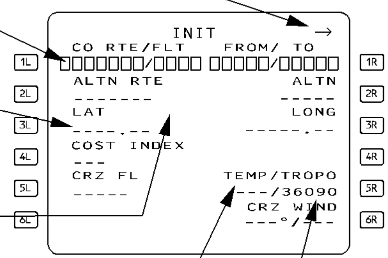
□□□□□ : DATA ENTRY IS MANDATORY HERE FOR ALLOWING THE FMC TO PERFORM ALL THE FUNCTIONS AVAILABLE ON THIS PAGE.

----- : THIS DATA WILL BE COMPUTED BY THE FMC IF IT HAS ENOUGH INFORMATION IT MAY ALSO BE CHANGED BY THE CREW.

↑↓ : WHEN THESE ARROWS ARE BESIDES A LABEL LINE, IT IS POSSIBLE TO INCREASE OR DECREASE THE VALUE DISPLAYED BELOW BY PRESSING ↑ OR ↓ KEYS ON THE KEYBOARD.

LABEL LINE

DATALINE OR DATA FIELD

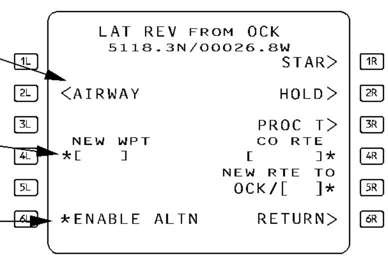


INIT PAGE A

<OR> : MEANS THAT AN OTHER PAGE MAY BE ACCESSED BY PRESSING THE ADJACENT LS KEY.HERE THE PAGE TO BE ACCESSED IS AIRWAY PAGE.

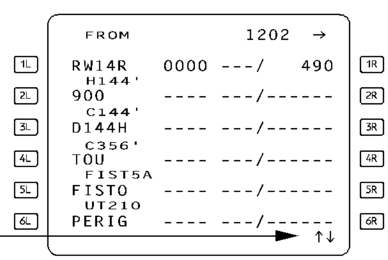
[ ] : A DATA INSERTION MAY BE MADE

* : INDICATES THAT PRESSING THE ADJACENT LS KEY WILL ACTIVATE THE FUNCTION.



LAT REV PAGE

↑↓ : SCROLLING IS AVAILABLE BY PRESSING ↑OR ↓ KEYS ON THE KEYBOARD. THE PAGE IS NOT LARGE ENOUGH TO DISPLAY THE WHOLE INFORMATION.



F-PLN PAGE A

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2 – SMALL OR LARGE FONT

- There are two sizes of fonts on the pages. Generally, all data on the data field (line adjacent to LS key) are displayed in LARGE font, and data on the label line (line above the data field) are displayed in small font.
- However the following are exceptions :
  - Data with predetermined value or FMS predicted value which can be changed by the crew are displayed in small font unless the crew has changed it (this applies, in particular, for INIT and F-PLN pages).
  - If two data entries are dependent upon each other (such as fuel and percentage for Route Reserve), the independent data are displayed in large font and the dependent data in small font.
  - Constraints (on F-PLN page) or active mode (on MODE page for example) are displayed in large font.

3 – TYPES OF DISPLAYED WAYPOINTS

- Waypoints are displayed on :
  - F-PLN pages A and B
  - F-PLN revision pages
  - DIR TO page
  - PROGRESS page
  - WAYPOINT and NEW WAYPOINT pages
- Waypoints can be of different types :
  - The FIXED waypoints (geographically defined) may be navaids or airports.
  - The PSEUDO waypoints (vertical occurrences) may be a top of climb, step climb, top of descent, FCU Level, speed limit, or intercept point.
- The PPOS is the present aircraft position.
- Waypoints are displayed with :
  - 4 or 5 letters, for en route fixed waypoints,
  - 4 letters, for airports (ICAO code),
  - 3 letters, for navaids,
  - LL03 for the 3rd pilot-defined waypoint entered through its lat/long,
  - PBD 02 for the 2nd pilot-defined waypoint entered through its place/bearing/distance,
  - PD 06 for the 6th pilot-defined waypoint entered through its place/distance.

4 – INSERTION OF DATA INTO FMC

- The data must first be written in the scratchpad by pressing the desired alphanumeric keys.
  Then data is moved from the scratchpad into the correct data field by pressing the adjacent LS key (this action clears the scratchpad).
- In case of error (format, acceptability...) the FMC displays an error message in the scratchpad.
  To correct the data the crew must first clear the message from the scratchpad. The incorrect data will reappear in the scratchpad and the crew will then correct the data or clear it out.
  If the scratchpad is already occupied by another message, there is no need to clear it. Any alphanumeric entry erases the message.
- Display in the scratchpad is maintained after a page change made by a mode key, or the NEXT PAGE key, or an LS key.
- In case of a double data field like temp/tropo (temperature and altitude of the troposphere) for instance :
  To insert a TEMP value, write/insert the value.
  To insert a TROPO value, write/insert the value preceded by a slash (/), e.g. /35000.

5 – CLEARING SCRATCHPAD AND DATA FIELDS

- To clear the scratchpad, press the CLR key. One press clears the last entered character, a continuous press of 2 seconds clears all the scratchpad.

- To clear a data field, when the scratchpad is empty, press the CLR key. CLR appears in the scratchpad.
  Then press the LS key adjacent to the data field. This clears this data, and erases CLR in the scratchpad.

- When a data field is cleared :
  - If the data field is filled with a predetermined value or a FMC calculated value, the data reverts to this value.
  - If the data field is a leg in the flight plan, that leg is deleted from the flight plan.

6 – AUTOMATIC CLEARING OF DATA AT END OF FLIGHT

- On ground when both fuel flow indications are lower than 200 kg/h :
  - F-PLN (WPTs, predictions, etc.) is cleared.
  - all variables, concerning the active F-PLN, that use predetermined values will be reset to the predetermined value.
  - all variables, concerning the active F-PLN, that have been inserted by the crew (for example ZFW on INIT page B) or calculated by the FMC (for example TRIP/TIME on INIT page B) are cleared to allow insertion of new values.
  - secondary F-PLN and variables concerning the secondary F-PLN are not cleared unless it has been defined by the COPY ACTIVE flight plan function (primary F-PLN copied into the secondary F-PLN).

    Note : If a change in the primary F-PLN is introduced after a COPY ACTIVE, then the secondary F-PLN is not cleared.

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- The various messages that the FMC displays on the CDU for pilot information appear in the scratchpad.

- There are two types of messages : class I and class II. The class II messages are the most important, they inform the pilot of a given situation or prompt a pilot action.

  Note : *When a class II message is displayed in the scratchpad, MSG annunciator illuminates on the CDU and MSG is displayed on the ND.*

1 – MESSAGE DISPLAY LOGIC

- If the scratchpad is occupied by an alphanumeric entry (made by the crew), when a class II message should be displayed, the message is not displayed but MSG light illuminates on the CDU and on ND. Upon clearing of the alphanumeric entry, the message appears.
  A class I message cannot be stored it is displayed in the scratchpad and the alphanumeric entry is stored until the message is removed.

- If there is more than one class II message, the last one received will be displayed. The others (5 maximum) will be stored in a stack. Upon clearing the last message, the previous one will be displayed.

- Alphanumeric entry is always possible and this :

  – erases class I messages (such as « FORMAT ERROR »)

  – stores class II messages in a stack until scratchpad is freed. In this case, MSG light illuminates on the CDU and ND.

2 – MESSAGE CLEARING LOGIC

- Any message except PLEASE WAIT can be cleared by pressing CLR key, even if the action corresponding to the message has not been done.

- Most class II messages are automatically cleared when they no longer apply.

- Class I messages are automatically cleared either by entering data into the scratchpad or by changing the page.

3 – MESSAGE LIST

LIST OF MESSAGES	MEANING	CLASS	AUTO CLEAR
1. AAAAA OUT OF RANGE AAAAA = BLOCK, ZFW, TOGW, GW	Displayed when the calculated dependent weights (ZFW, BLOCK or TOGW) exceed the minimum or maximum allowed.	II	YES
2. AAAA ERROR WPTXX ± NNNN AAAA : Time, speed, or altitude WPT01 : Constrained waypoint ± NNNN : error at the waypoint in minutes, knots, or feet. + : too late, fast or high – : too early, slow or low	A time, speed or altitude constraint will not be matched. The message gives the mismatch value. This message is not given during descent.	II	YES
3. A / C POSITION INVALID	Displayed when the HOLD or DIR TO pages are displayed and the aircraft position becomes invalid. In these cases the display returns to F-PLN page.	I	YES
4. A / C STATUS MISMATCH	Comparison of some idents found wrong (like NAV database serial number) during dual system initialization	II	
5. ALIGN IRS	Request to align IRS.	II	YES
6. ALT CSTR ABOVE MAX FLT	The altitude constraint inserted will not be possible.	II	YES
7. ALTN F-PLN CLEARED	The alternate F-PLN is cleared due to a memory capacity limit in order to give priority to the active F-PLN	I	YES
8. BUTTON PUSHES IGNORED	The FMC cannot process all the button pushes performed by the pilot especially during computations	I	NO
9. CANCELLING OFFSET	A parallel offset is presently flown and will be cancelled by guidance at the next leg.	II	YES
10. CHECK ALT CSTR AT WPT 01 (WPT01 name of the constrained WPT)	When an inconsistent CSTR is inserted (e.g. during CLB a CSTR is inserted below the present aircraft ALT)	I	YES
11. CHECK ALTITUDES	When there is an altitude conflict between FCU, CRZ level, ALT constraints.	II	YES
12. CHECK DATA BASE CYCLE	Displayed if date on the AIDS page is not within the effectivity of the active database.	II	
13. CLB ALT CSTR DELETED	When the ALTN F-PLN is enabled early before destination. There will not be a CLB phase for the Alternate thus all its CLB ALT CSTR are deleted.	II	YES
14. CLOCKS DO NOT MATCH	GMT difference between the 2 clocks greater than 2 mn.	II	YES
15. CLOCKS INVALID	The message is displayed if the clocks are invalids. In this case all time predictions are expressed in elapsed time from takeoff.	II	YES
16. CRZ ALT INVALID	When the FMS transitions to descent phase before reaching the CRZ ALT	II	YES
17. CRZ FL ABOVE MAX FL	When the crew inserts a CRZ FL above MAX FL	II	YES
18. DEAD RECKONING NAV	Dead Reckoning Position update mode is active.	II	YES
19. DEFAULT STATE ASSUMED	The initialization phase of the FMS is aborted	II	YES
20. DISCONTINUITY AHEAD	When NAV is engaged, the next leg being a discontinuity, the leg switching will occur in less than 30 seconds.	II	YES
21. ENTRY OUT OF RANGE	The pilot entry is not within the range given for the data entry.	I	YES
22. FORMAT ERROR	Incorrect format, type or field width of the entry.	I	YES
23. FMC POSITION MISMATCH	This message is displayed on CDU when the positions computed by both FMS differ by more than 0.5 NM if GPS mode is active, 5 NM otherwise.	II	YES
23a. FMC UNAVAILABLE			
24. F-PLN FULL	The flight plan revision causes a flight plan capacity overflow.	I	YES

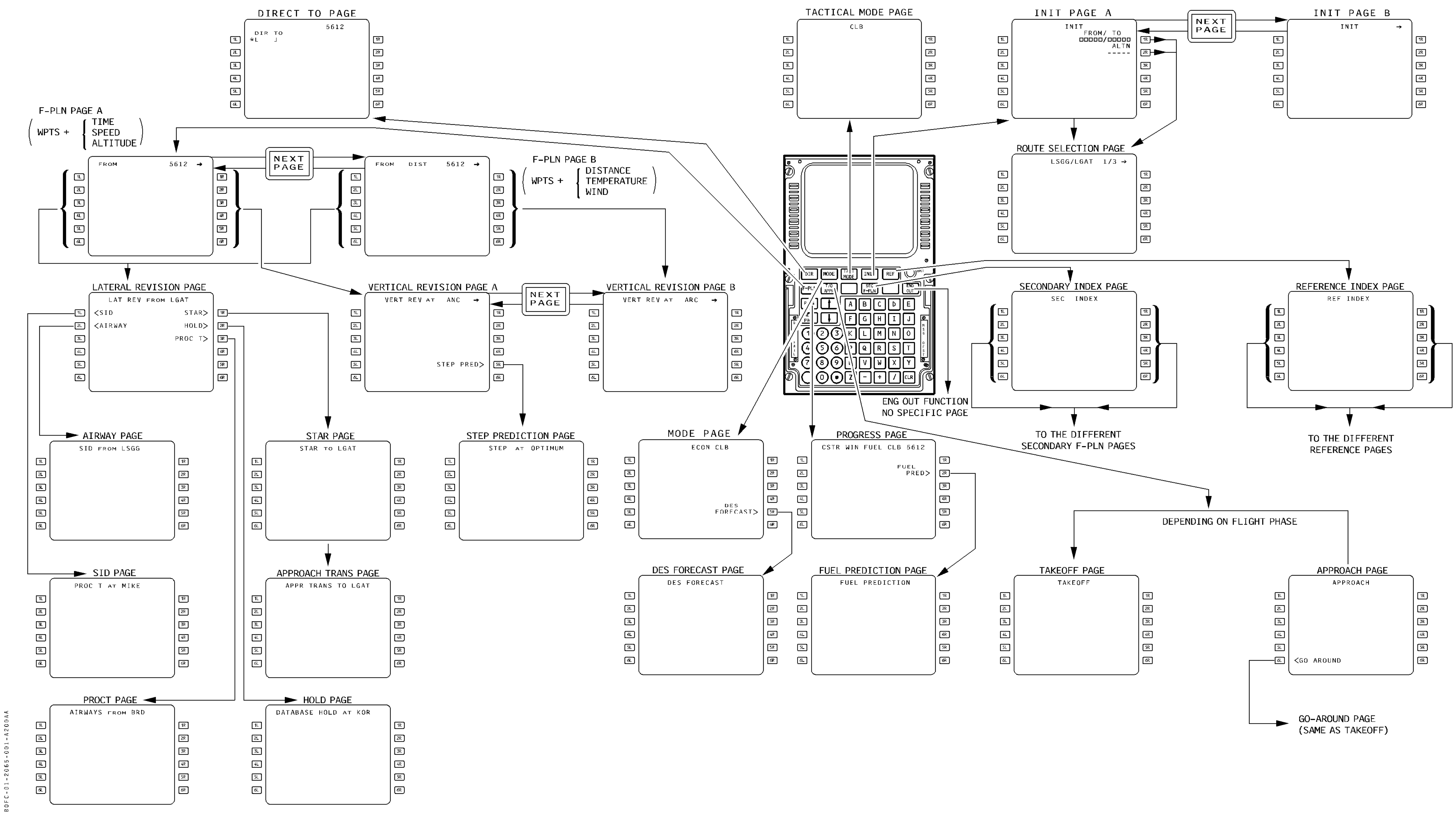
Mod : 6789

LIST OF MESSAGES	MEANING	CLASS	AUTO CLEAR
25. F-PLN STEP REMOVED	A step previously inserted is removed when the FCU is not correctly dialed or when the waypoint at which the step is referenced is deleted.	II	YES
26. F-PLN WPT/NAV RETAINED	Displayed when attempting to delete a navaid or waypoint which is a waypoint in the F-PLN. The deletion is not possible in this case.	I	YES
27. GROSS WEIGHT MISMATCH	There is a difference of 1 ton between the two FMC gross weight computation	II	YES
28. INDEPENDENT OPERATION	The system is in the independent mode of operation when FMCs computations and orders become different.	II	YES
29. INITIALIZE COST INDEX 30. INIT CRZ FL	Request for a CRZ ALT or COST INDEX entry if it is not defined at engine start	II	YES
31. INITIALIZE WEIGHTS	Request to enter ZFW or FUEL QUANTITY.	II	YES
32. IRS ONLY NAVIGATION	The accuracy class has been degraded to Inertial 10 mn before (2 mn in Terminal area : 50 NM from destination). .		
33. LIST OF TWENTY IN USE	Displayed when a new waypoint is entered while there are already 20 waypoints defined and all defined waypoints belong to the flight plan.	I	YES
34. MDA DELETED	When one of the following conditions for MDA insertion is not met : – DES phase – non ILS approach selected – DEST RWY selected and not preceeded by a discontinuity	II	YES
35. NAV ACCUR DOWNGRAD	Displayed when navigation accuracy is downgraded from HIGH to LOW. Time delay : 10 sec.	II	YES
36. NAV ACCUR UPGRAD	Displayed when navigation accuracy is upgraded from LOW to HIGH. Time delay : 10 sec.	II	YES
37. NEW CRZ ALT – HHHHH (HHHHH : newly assigned value for CRZ ALT)	Displayed when the cruise altitude has been automatically modified (e.g. insertion of an ALT CSTR above CRZ level, or FCU raised above previous CRZ ALT)	I	YES
38. NO DESTINATION	No destination has been defined and the FMS cannot perform some predictions and commands.	I	NO
39. NOT ALLOWED	Displayed when the pilot performs a not allowed action.	I	YES
40. NOT IN DATA BASE	The identifier of the entry is not in the database.	I	YES
41. PLEASE WAIT	Action on any CDU button is not accepted until the resynchronization of the FMCs is finished.	II	YES
42. RADIO ONLY NAVIGATION	No IRS position is available.	II	YES
43. REF NAVAID DESELECTED (CDU)	This message is displayed when the VOR/DME or VORTAC navaid required for autotuning as the specified navaid has been deselected by the crew.	II	YES
44. REF NAVAID UNTUNABLE (CDU)	This message is displayed when the VOR/DME or VORTAC navaid required for autotuning as the specified navaid fails the DME distance test or the VOR bearing test while the aircraft is found outside the zone of confusion.	II	YES

Mod : 11320 or 11364 or 12044 or 12045

LIST OF MESSAGES	MEANING	CLASS	AUTO CLEAR
45. REPR XXX NM BEFORE T/D	Displayed in CRZ phase when more time for cabin repressurization is needed compared at the time necessary for A/C descent	II	YES
46. SEC F-PLN CLEARED	Indicates that SEC F-PLN has been cleared due to memory capacity limit in order to give priority to active F-PLN and ALTN F-PLN.	I	YES
47. STEP PRED AVAILABLE	Informs the crew that the computations have ended. The pilot can go to the STEP PRED page to see them and to insert the step into the F-PLN.	II	YES
48. SPD LIM EXCEEDED	When the speed limit (defaulted to 250 kt) is exceeded below the reference altitude (defaulted to 10 000 ft)	II	YES
49. TIME CSTR REMOVED	A time constraint is automatically removed from the F-PLN following ENG OUT lateral revision, loss of clocks, other TIME CSTR insertion.	II	YES
50. TUNE AAA – FFF.FF (AAA : the navaid required to compute radio position FFF.FF : frequency of the navaid)	Request the crew to select a specific navaid on the PROGRESS page.	II	YES
51. USING COST INDEX – NNN (NNN : value of cost index)	No cost index having been entered by pilot, the cost index is predetermined to the last flight value.	I	YES
52. USING LDG CONFIG 30/40	30/40 is the defaulted landing config and is required for DFA approaches. If DFA is selected after another config has been selected then the FMS reverts automatically to the 30/40 config and this message is displayed.	II	YES
53 . VERIFY AIRCRAFT POSITION	It is displayed when there is a difference of more than 12 NM between the IRS position and the radio position ; it is then left to the pilot to resolve the discrepancy between both positions.	II	YES

Mod : 11320 or 11364 or 12044 or 12045



Mod : 11320 or 11364 or 12044 or 12045

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The following list gives all the data the pilot may enter on the CDU.

Also provided are the related acceptable format, acceptable range, units of entry and the CDU pages on which the data can be entered. Units of measure are pin program dependent at the airline's option (English or Metric).

The following codes are used to indicate various data formats :
A – Alphabetic entry
N – Numeric entry
X – Alphanumeric entry
≤/≥ – Below or equal to/above or equal to

DATA NAME	FORMAT	RANGE (X is input)	UNITS	DISPLAY PAGE
ACCEL ALT	+NNNNN If + or – is not input, + assumed ; leading zeros may be omitted.	Ref Alt +3000' ≤Thr Red Alt ≤Accel Alt ≤Max Cert Alt Pinable Ref Alt +1500'	ft (MSL)	TAKEOFF GO-AROUND
AIDS DATA	NNNNNN where N is an octal character (07).	N/A	N/A	AIDS
ALT	NNNN or NNNNN (leading zeros must be included).	Max Alt = 35000-41000 by S.N. Entry is rounded to the nearest 10 feet.	ft (MSL)	F-PLN A VERT REV A SEC F-PLN A
ALTN FUEL	See BLOCK	See BLOCK	See BLOCK	INIT B HOLD
ALTN RTE	Same as CO RTE	Same as CO RTE	N/A	INIT A
ALT/WIND	ALT or Flight Level/NNN/NNN	See ALT or FLIGHT LEVEL.	ft (MSL)/ degrees/	DES FORECAST SEC DES
FORECAST				
	NNN – leading zero not necessary. An entry of WIND DIR = 360 is displayed as 0.	Entry must be greater than destination elevation. WIND DIR 0-360 WIND VEL 0-200	kt	
ARPT	AAAA	If AAAA is not in data base file, "NOT IN DATA BASE" message is displayed.		INIT A LAT REV FUEL PREDICTION F-PLN A and B SEC F-PLN A and B WAYPOINT DIR TO
BLOCK fuel	NN.N (KG) or NNN.N (LBS); leading zeros may be omitted.	0-65.5 Tonnes	Thousands of kg or thousands of pounds, respectively.	INIT B
CLASS (navaid)	AAAAAA (refer to range for exact inputs allowed)	VOR DME VORDME VORTAC LOC NDB ILSDME	N/A	NEW NAVAID

Mod : 4801 + 6789

DATA NAME	FORMAT	RANGE (X is input)	UNITS	DISPLAY PAGE
CO RTE	XXXXXXX	If CO RTE is not in the NAV data base, "NOT IN DATA BASE" message is displayed.	N/A	LAT REV INIT A
CO RTE/FLT	See CO RTE and FLT. May be entered as : CO RTE/FLT CO RTE/FLT CO RTE may be entered alone as XXXXXXX. FLT may be entered alone as /NNNN or both may be entered as XXXXXXX/XXXX.	If CO RTE is not in the NAV data base, "NOT IN DATA BASE" message is displayed. FLT: 09999	N/A	INIT A
COST INDEX	NNN KG and LBS. May be entered as 1-3 digits ; leading zeros may be omitted.	0-999	(Ratio) See Section 3.1.2.4	INIT A MODE SEC MODE
CRS	Same as INB CRS	Same as INB CRS	degrees	NEW WAYPOINT
CRZ FL	Must be entered as FLIGHT LEVEL	See FLIGHT LEVEL	hundreds of ft (MSL)	INIT A and B SEC INDEX PROGRESS
CRZ WIND	See WIND	See WIND	See WIND	INIT A FUEL PRED SEC FUEL
DAY/MONTH	DD/MM where DD is day of month and MM is month of year. Leading zeros may be omitted but will be displayed.	DD:1-31 MM:1-12	N/A	AIDS
DIST	NN.N (leading and trailing zeros may be omitted).	0-99.9 in.1 NM increments	NM	HOLD
ELV	±NNNN if + or – is not input, assume +; leading zeros may be omitted.	–1000 to + 20470	ft (MSL)	NEW NAVAID NEW WAYPOINT
EO ACCEL ALT	Same as ACCEL ALT	MAX ALT = 41000 ft (MSL) Entry is rounded to the nearest 10 feet.	ft (MSL)	TAKEOFF GO-AROUND
EO THR RED ALT	Same as ACCEL ALT	MAX ALT = 41000 ft (MSL) Entry is rounded to the nearest 10 feet.	ft (MSL)	TAKEOFF GO-AROUND
FF + FQ Sensors	One or both may be entered. Both : /FF + FQ or /FQEFF Fuel Flow: /FF Fuel Quantity : /FQ	N/A	N/A	FUEL PRED
FIG OF MERIT	N	0-3	N/A	NEW NAVAID
FLIGHT LEVEL	FLNNN or NNN Leading zeros on NNN may be omitted.	NNN has range of MAX ALT to = 41000.	hundreds of ft (MSL)	F-PLN A and B PROGRESS VERT REV A INIT A and B SEC INDEX SEC F-PLN A SEC F-PLN B ALONG TRK OFST STEP PRED

Mod : 6789

DATA NAME	FORMAT	RANGE (X is input)	UNITS	DISPLAY PAGE
FLP RETR	Same as SPD	Same as SPD	kt (CAS)	TAKEOFF APPR GO-AROUND
FLT	/NNNN	0-9999	N/A	INIT A
FOB	NN.NN KG or NNN.NN LBS; leading zeros may be omitted.	See BLOCK	See BLOCK	FUEL PRED
FREQ	NNN.NN	108.00 – 117.95	MHz	NEW NAVAID
FROM/TO	AAAAA/AAAAA	AAAAA must be in data base or message, "NOT IN DATA BASE" is displayed.	N/A	INIT A
FINAL/TIME	FINAL (see BLOCK), TIME (see GMT)	See BLOCK and GMT	See BLOCK and GMT	INIT B HOLD FUEL PRED SEC FUEL PRED
GMT	HHMM where : HH are hours and MM are minutes. Leading zeros may be omitted. 1 or 2 digit entry is interpreted as minutes.	HH: 0-23 MM: 0-59	hours minutes	FUEL PRED MODE TACT MODE
INB CRS	NNN Leading zeros may be omitted. An entry of 360 is displayed as 0.	0-360	degrees	PROC T HOLD
INB DIST	Same as DIST	0-99.9, see range on OUTB CRS for PROC T restriction.	NM	PROC T
LAT	DDMM.MB or BDDMM.M DD = degrees MM.M = minutes B = direction. Leading zeros may be omitted but the direction (B) is required. Latitude is displayed as DDMM.MB.	B: N or S 0 ≤ DD ≤ 90 0 ≤ MM.M ≤ 59.9	degrees minutes tenths of minutes	INIT A
LAT/LONG	LAT/LONG Same as LAT and LONG except both must be entered with "/" in between.	Same as LAT and LONG	Same as LAT and LONG	PROGRESS F-PLN A and B NEW WAYPOINT NEW NAVAID SEC F-PLN A and B DIR TO LAT REV
LENGTH	NNNN Meters or NNNNN Feet; leading zeros may be omitted.	1000-8000 meters	Meters or feet, respectively	NEW WAYPOINT
LONG	DDDMM.MB or BDDDMM.M DDD = degrees MM.M = minutes B = direction. Leading zeros may be omitted but the direction (B) is required. Longitude is displayed as DDDMM.MB.	B: E or W 0 ≤ DDD ≤ 180 0 ≤ MM.M ≤59.9	degrees minutes tenths of minutes	INIT A
MACH	.NN The decimal point is necessary. Trailing zeros are not necessary.	.3 to .84	MACH number	TACT MODE (CLB or DES)
MACH/SPD	MACH and SPD must be entered with "/" in between (see MACH and SPD formats).	Same as MACH and SPD	Same as MACH and	TACT MODE (CLB or DES) SPD

DATA NAME	FORMAT	RANGE (X is input)	UNITS	DISPLAY PAGE
MDA	±NNNN If + or – is not input, assume E; leading eros may be omitted.	– 1000 to + 8000	ft (MSL)	APPR
NAVAID	XXXX	Any alpha numeric ; if entry not found in the data base NAVAID file, message ″NOT IN DATA BASE″ is displayed.	N/A	PROG NEW NAVAID NAVAID WAYPOINT F-PLN A and B LAT REV SEC F-PLN A and B DIR TO
OFST	NNB or BNN NN = offset NN = distance B = direction Leading zero on distance may be omitted. OFST will always be displayed as BNN.	B: L or R 1 ≤ NN ≤ 99	NM	LAT REV at FROM waypoint
OUTB CRS	Same as INB CRS. An entry of 360 is displayed as 0.	0-360 Selected course must be ≤ 90° of aircraft heading or message, ″ENTRY OUT OF RANGE″ is displayed.	degrees	PROC T
PERF FACTOR	N.N (leading or trailing zero may be omitted).	– 9.9 to 9.9	Percent (%)	A/C STATUS
PLACE/BRG/DIST	PLACE can be any data base ARPT, NAVAID or WAYPOINT. BRG must be a 3-digit entry. Decimal place may be omitted. An entry of BRG = 360.0 is displayed as 0.0. DIST is NNN.N Leading zeros may be omitted ; all 3 parameters must be entered with ″/″ in between.	PLACE – if not in data base, message ″NOT IN DATA BASE″ is displayed. BRG 000-360.0 DIST – 0-999.9	BRG – degrees DIST-NM	F-PLN A and B SEC F-PLN A and B LAT REV NEW WAYPOINT PROGRESS
PLACE/DIST	PLACE – Any navaid, waypoint, airport, or runway in the data base. DIST – ±NN.N If + or – is not input, assume +; leading zeros may be omitted.	PLACE – if not in data base, message ″NOT IN DATA BASE″ is displayed. – 99.9 to + 99.9 in .1 NM increments.	NM	F-PLN A and B SEC F-PLN A and B
PRED TO	Same as ALT or FLIGHT LEVEL	See ALT and FLIGHT LEVEL. In CLB: Entry must be greater that present aircraft altitude. In DES : Entry must be less than present aircraft altitude	See ALT and FLIGHT LEVEL	CLB DES
RTE RSV	May be entered as fuel or percentage of trip fuel but not both. FUEL – N.N for KG and LBS % – enter /N.N where the trailing N and decimal point may be omitted	FUEL – See Para 6.3 %: 0-9.9	Thousands of kg or thousands of pounds and %.	INIT B HOLD FUEL PRED SEC FUEL PRED

Mod : 11320 or 11364 or 12044 or 12045

DATA NAME	FORMAT	RANGE (X is input)	UNITS	DISPLAY PAGE
RWY	AAAANND where: AAAA is the ICAO identifier of the airport. NN is runway number (2 digits must be entered). D is runway suffix. D is L or R if there is more than one runway with the same number at the airport. D is not included unless there is more than one runway with the same number at AAAA.			F-PLN A and B
RWY (ACARS)	AANNDII AA is 'RW'. AA is an optional portion of the entry. NN is runway number 00-36 (2 digits must be entered). D is runway suffix (see RWY above). D is an optional portion of the entry. On the Takeoff page, II is an optional portion of the entry. II may be composed of any alphanumeric characters, except 0. On the ACARS page entry of II is not allowed.			ACARS, TAKEOFF
SLT RETR	Same as SPD	Same as SPD	kt (CAS)	TAKEOFF APPR GO-AROUND
SPD	NNN (must be 3 numerics)	85-Vmo	kt (CAS)	F-PLN A SEC F-PLN A VERT REV A
SPD LIM	SSS/NNNNN SSS is a speed (see SPD for rules). NNNNN is an ALT or FLIGHT LEVEL (see ALT and FLIGHT LEVEL). SPD and ALT must be entered with "/" in between.	SSS same as SPD.NNNNN must be ≤ 41000.	kt/ft (MSL)	F-PLN A SEC F-PLN A VERT REV A and B
SPD/MACH	See MACH/SPD	Same as MACH and SPD	Same as MACH and SPD	CLB TACT MODE
STATION DEC	NND where : NN is the declination and D is the direction. Leading zeros may be omitted. D is not required for an entry of zero declination.	NN: 01-99 D: E or W	degrees	NEW NAVAID
STEP TO ALTITUDE	Same as FLIGHT LEVEL	Same as FLIGHT LEVEL except that entries must be within ±8000 feet of CRZ FL.	See FLIGHT LEVEL	STEP PRED
STEP TO WIND	Same as WIND DIR/MAG	Same as WIND	Same as WIND	STEP PRED

Mod : 11320 or 11364 or 12044 or 12045

DATA NAME	FORMAT	RANGE (X is input)	UNITS	DISPLAY PAGE
TAXI	N.N-KG NN.N-LBS	0 to 5.0 Kg. 0 to 11 lbs. Leading or trailing zeros may be omitted.	See BLOCK	INIT B
TEMP	±NN If no sign, assume +.		degrees centrigrade	F-PLN B SEC F-PLN B VERT REV B INIT A FUEL PRED SEC FUEL PRED
THR RED ALT	See ACCEL ALT	Ref Alt +1500' ≤ Thr Red Alt ≤ Accel Alt ≤ Max Cert Alt	ft (MSL)	TAKEOFF GO-AROUND
TIME	N.N	0-9.9	minutes	HOLD
TOGW and GW	NNN.N for KG and LBS leading and trailing zeros may be omitted.	60.0 to 255.0	See BLOCK	INIT B (TOGW) FUEL PRED (GW)
TROPO	Same as ACCEL ALT	Same as ACCEL ALT	ft	INIT A FUEL PRED SEC FUEL PRED
WIND	NNN/NNN Both must be entered ; leading zeros may be omitted.	Direction : 0-360 Magnitude : 0-200	degrees kts	F-PLN B SEC F-PLN B VERT REV B DES FORECAST SEC DES
FORECAST				
	WIND DIR = 360 is displayed as 0.			
WIND CORR	NN Leading zeros may be omitted.	0-30	kts	APPROACH
V/S	±NNNN Leading zeros may be omitted	– 6000 to + 6000	ft/minute	F-PLN A F-PLN B
V1	Same as SPD	Same as SPD	kts (CAS)	TAKEOFF
VFTO	Same as SPD	Same as SPD	kts (CAS)	TAKEOFF APPR GO-AROUND
VR	Same as SPD	Same as SPD	kts (CAS)	TAKEOFF
WAYPOINT	XXXXX – may be from 1-5 characters for waypoint. Acceptable as waypoint IDENT : ARPT RWY NAVAID WAYPOINT. For F-PLN A and B, SEC F-PLN A and B, LAT REV pages and LAT/LONG, PLACE/BRG/DIST may be entered to define a waypoint.	Must be in NAV data base unless LAT/LONG or PLACE/BRG/DIST; if not in data base, message "NOT IN DATA BASE" is displayed	N/A	WAYPOINT NEW WAYPOINT F-PLN A and B SEC F-PLN A and B LAT REV PROGRESS DIR TO
ZFW	NNN.N for KG and LBS. Leading and trailing zeros may be omitted	60.0 to 190.0	See BLOCK	INIT B
ZFWCG	NN.N	10.0 to 40.0	% MAC	INIT B FUEL PRED

Mod : 4801 + 6789

1 – A/C STATUS PAGE

1.1 – PURPOSE

- The purpose of the AIRCRAFT STATUS page is to display the performance and navigation database parameters for which the particular FMS is configured.

  Title Line – Aircraft model and series

  1L : Engine type.

  2L : Effective period of the active navigation database.

  2R : Customer code, cycle date, and sequence number of the database.

  3L : Effective period of the second navigation database.

  4L : FMC program reference number.

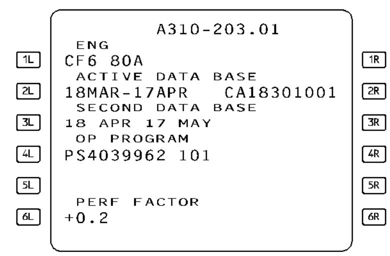
  6L : Performance Factor – a number with a range of + or – 9.9, reflecting the A/C performance status, a measure of aircraft/ engine efficiency from nominal, on which all FMC performance and prediction calculations are based. For example, a positive PERF FACTOR effectively decreases the entered cost index and increases the predicted fuel flow.
  It is defaulted to zero but may be changed by writing/inserting the new value in line 6L.
  This value should not be changed by the crew.

1.2 – ACCESS

- Automatically when power is first applied to the FMS.
- Manually, at any moment, through REF INDEX page.
- Automatically after landing when fuel flow is lower than 200 kg/h.

1.3 – DATABASE SELECTION

- The second navigation database may be activated by pressing LS key 3L. This action causes the two effective periods to change positions on the page. The active navigation database effective period is always displayed in LARGE font.
- Changing databases, on the ground or in flight, erases all previously entered data including flight plans. In flight, depending on mode engagement, this action can also cause the A/P to disengage.



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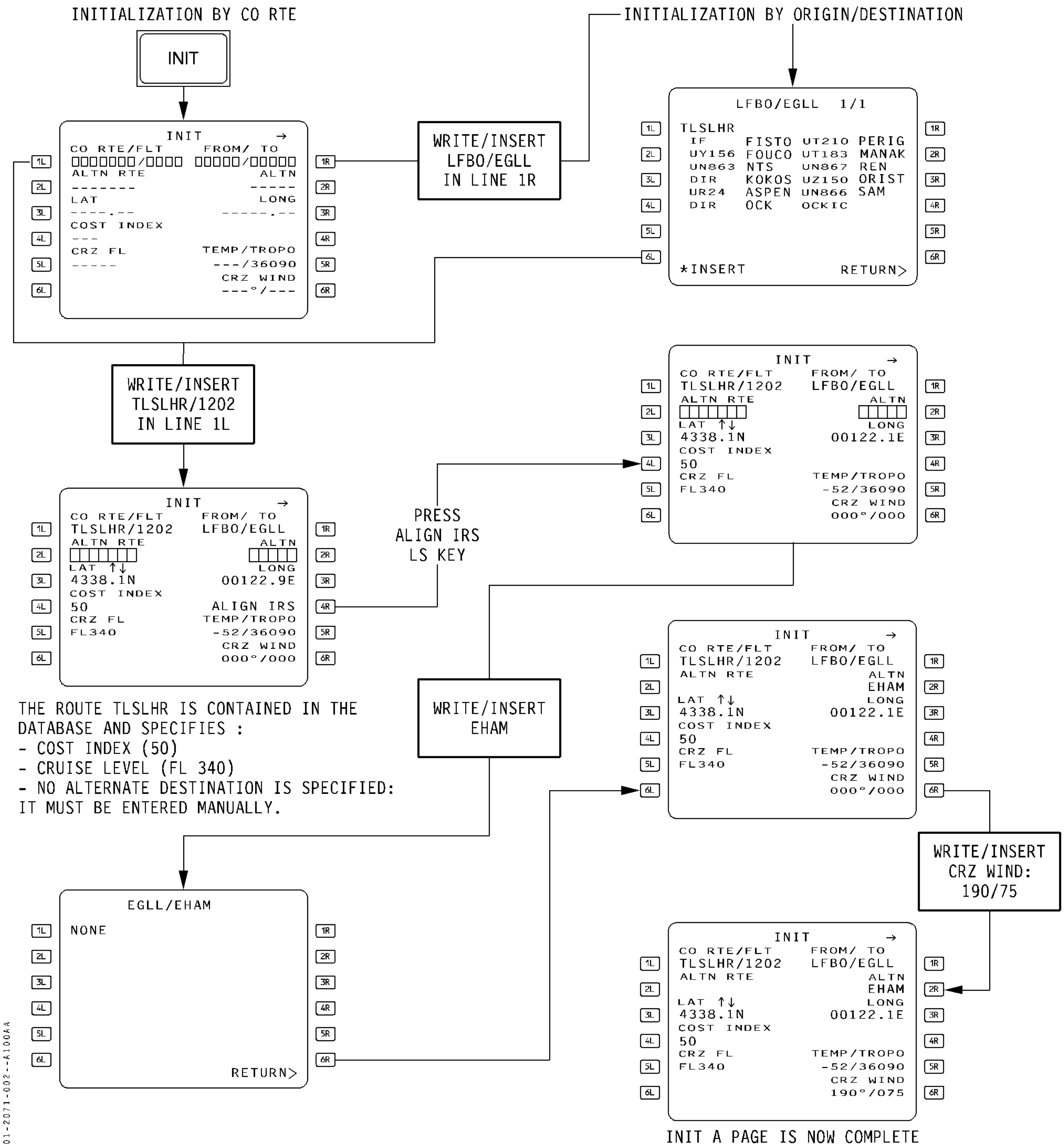
INIT PAGE A



THE ROUTE TLSLHR IS CONTAINED IN THE DATABASE AND SPECIFIES :
- COST INDEX (50)
- CRUISE LEVEL (FL 340)
- NO ALTERNATE DESTINATION IS SPECIFIED: IT MUST BE ENTERED MANUALLY.

NOTE: RTE SELECTION PAGE IS ONLY DISPLAYED AFTER SELECTION OF THE CITY PAIR.

80FC-01-2071-002--A100AA

Mod : 6789

2 – INIT PAGES

2.1 – PURPOSE

- There are two initialization pages, INIT A and INIT B. Both contain data that is pertinent to the flight and which must be inserted to allow the FMS to function. They allow to choose a route, make IRS alignment and enter weight data for flight planning computation.

2.2 – ACCESS

- Pressing INIT key on CDU, provided aircraft is on ground, displays INIT page A. INIT page B will then be displayed by pressing NEXT PAGE key on CDU. INIT pages cannot be accessed in flight.

  Note : *At first engine start, INIT page B is replaced by FUEL PREDICTION page (see PROGRESS page description)*
  At takeoff, INIT page A is replaced by F-PLN page A.

2.3 – INIT PAGE A

- This page allows the crew to initialize the cost index, define the origin/destination, or company route, cruise flight level, cruise wind, etc. It provides access to the INIT B page.

2.3.1 – Route definition

- **By the Company Route identifier :**
  The crew directly inserts a Company route (CO RTE) via the scratchpad in line 1L.

  Note : *If RUNWAY, SID, STAR are part of CO RTE stored in the database, they will be inserted into F-PLN as predetermined data, but can be changed through SID and STAR pages.*

- **By Origin/Destination identifiers :**
  - First case :
    The crew wants to define a route simply by specifying origin and destination (from Toulouse to London Heathrow for example) :
    LFBO/EGLL must be written/inserted in line 1 R.
    The FMC proposes all the routes between LFBO and EGLL contained in the database and the first one is automatically displayed on the RTE SELECTION PAGE. The others, if any, may be accessed by pressing the NEXT PAGE key.
    The crew selects the route, which is displayed on the RTE SELECTION page, by pressing the prompt INSERT in line 6 L.

    The INIT PAGE A is displayed again with all the selected route informations.

  - Second case :
    There is no route between LFBO and EGLL in the database or the crew does not want to select any of the routes proposed. NONE is displayed on the RTE SELECTION page.
    RETURN in line 6 R must be pressed.
    The INIT PAGE A is displayed again only with the origin/destination chosen. The entire F-PLN must then be defined by inserting desired WPTs in the F-PLN page.
    The origin/destination may be over written on INIT PAGE A if the crew wants to change it.

  Note : *When a CO RTE or FROM / TO entry is made, the date from the clock input is checked for agreement with the selected database cycle.*
  « CHECK DATA BASE CYCLE » message is displayed in case of disagreement.

2.3.2 – Other data entries

- **ALTN RTE / ALTN**

  ALTN is automatically filled if an alternate destination is specified in the database by the CO RTE selected.
  The ALTN RTE is not filled and must be selected via the RTE SELECTION page, accessed by pressing LS key 2R.
  If no ALTN is specified by the CO RTE, it must be written/inserted only after the primary destination is defined.
  If a CO RTE between PRIMARY DEST and ALTN DEST is defined in the database, it may be selected as an ALTN RTE via the RTE SELECTION page. If not, it must be constructed WPT by WPT in the F-PLN.

- **LAT/LONG**

  This field is filled (with latitude and longitude of origin airport) when CO RTE or FROM/TO is entered.
  Lat/long can be changed by entering a new value via the scratchpad or by using the SLEW keys (↑ or ↓) to increment or decrement the values.
  Pressing LS key 3R will move the slew symbol from LAT to LONG allowing to modify the longitude.

- **COST INDEX, CRZ FL**

  Are automatically filled if stored with the CO RTE in the database but may be manually overwritten.
  If they are not given, they should be manually inserted otherwise predictions will not be computed and a message will be displayed at engine start.
  When they are manually entered they are displayed in LARGE font.
  The CRZ FL entry is not limited by the computed MAX FL (1.2 g buffet). If CRZ FL is above MAX FL a message is displayed.

- **FLT NUMBER**

  The flight number must be inserted.

- **CRZ TEMP/TROPO, CRZ WIND, DIRECTION/ VELOCITY**

  – CRZ TEMP/TROPO is predetermined to ISA TEMP/36090.
    CRZ TEMP appears only when CRZ FL is entered.

  – CRZ WIND is predetermined to 000°/000 kts. It appears only when CRZ FL is entered.

  All these data except TROPO can be manually changed by the crew.

2.3.3 – IRS alignment

- Provided at least one MSU (IRS Mode Selector Unit) is on NAV, ALIGN IRS prompt appears on INIT PAGE as soon as LAT/LONG data field has been filled.

- Pressing LS key 4R sends lat/long to the IRS, initiates final IRS alignment and erases ALIGN IRS prompt.

- ALIGN IRS prompt appears again if a new lat/long is entered on INIT page A when alignment is not ended (ALIGN MODE lights on MSUs still on).
  In this case LS key 4R must be pressed again to allow final alignment. This can be a rapid realignment procedure.

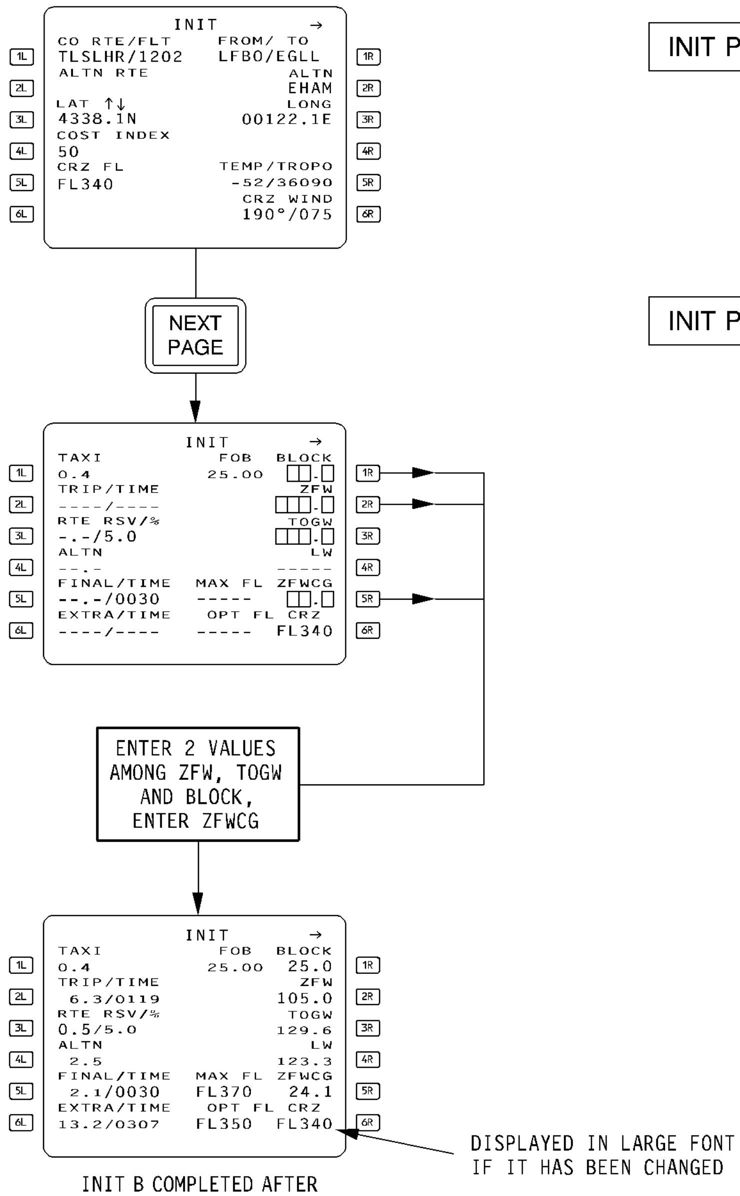
- ALIGN IRS message will appear in the scratchpad if a page change is made when ALIGN IRS prompt is still in 4R line.

See procedure in chapter 2.03.06/2.03.56.

Mod : 6789

INIT PAGE A

INIT PAGE B



INIT B COMPLETED AFTER FUEL PLANNING CALCULATIONS (ABOUT ONE MINUTE)

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Mod : 4801 + 6789

2.4 – INIT PAGE B

The INIT page B allows the crew to initialize performance related parameters, which in turn generate all performance predictions : weights, CG, cruise altitudes, etc.

The crew may also use this page for fuel planning. An assessment may be made by changing and/or eliminating the displayed values, and noting the resulting fuel requirements as adjustments are made : alternate fuel, holding fuel, required reserves, etc.

Note : Predictions are only as precise as the completeness and accuracy of the data loaded into the FMS. Complete routing from departure runway, SID, cruise, steps, descent, STARs, approach type, landing runway, and winds (takeoff, climb, cruise, descent, and landing) must be entered or updated, when precise planning data is required.

2.4.1 – Weight data entry

BLOCK, ZFW, TOGW

- Two of these three values (Total fuel in the aircraft at the gate, Zero Fuel Weight, aircraft Gross Weight at runway origin) must be entered to allow the FMC to make computation of the flight planning before engine start.
- The third value is deduced.
- If no flight planning is needed only ZFW or TOGW may be inserted.

  TOGW is calculated as BLOCK + ZFW – TAXI (fuel used between the gate and the RWY).

  Note : 1. After first engine start, if weight has not been entered, the message : INITIALIZE WEIGHTS is displayed.
  2. As soon as the second engine is running BLOCK value is automatically replaced by FOB value.

2.4.2 – Center of gravity entry

ZFWCG

ZFWCG must be entered by the pilot. If it has not been entered at engine start, the scratchpad displays : "INITIALIZE ZFWCG".
This message is automatically cleared when ZFWCG is entered. ZFWCG is cleared at the transition to the DONE flight phase.

2.4.3 – Default values

TAXI

Taxi fuel is a database derived default value. This amount may be modified by the pilot.

RTE RSV %

Is expressed in weight and percentage of trip fuel. The percentage is defaulted to a value defined in the database and the RTE RSV weight is displayed once the trip fuel value has been calculated.

If the calculated RTE RSV weight exceeds the bounds defined in the database by the airline policy, the RTE RSV weight takes the value of the bound and is displayed in LARGE FONT. The percentage is then displayed in small font.

The crew may alter these values but only one at a time. The changed value is displayed in LARGE FONT, provided it is not limited by the bounds of the database. If the RTE RSV is entered, the percentage is deduced and displayed in small font. If the percentage is entered, the RTE RSV is dashed.

2.4.4 – Computed values

TRIP/TIME

Is calculated and displayed after the aircraft weight and a F-PLN have been entered.

ALTN

The ALTN trip fuel weight is calculated and displayed once an ALTN DEST has been defined. The crew may change this value.

Mod : 4801 + 6789

- **FINAL/TIME**

  Computed holding fuel/time over ALTN DEST at 1500 ft with the MAX ENDURANCE performance mode. If there is no alternate, the hold is at the PRIMARY DEST. Time is defaulted to a value defined in the database. One value at a time may be changed (displayed in LARGE FONT), the other is deduced (displayed in small font).

- **EXTRA/TIME**

  Extra fuel at 1500 ft and extra time to hold at ALTN DEST.

  EXTRA is computed as BLOCK – TAXI – TRIP – RSV – ALTN – FINAL.

  Note : *Any change to data field 1L, 3L, 4L, 5L restarts fuel planning calculations.*

- **OPT FL, MAX FL**

  Are calculated as soon as weights are inserted. They cannot be changed.
  For ECON and MIN FUEL, the OPT FL is the altitude with the lowest cost function value. Cruise Mach is then deduced.
  For MIN TIME, it is the altitude for which ground speed is maximized.

2.4.5 – Other displayed values

- **CRZ FL**

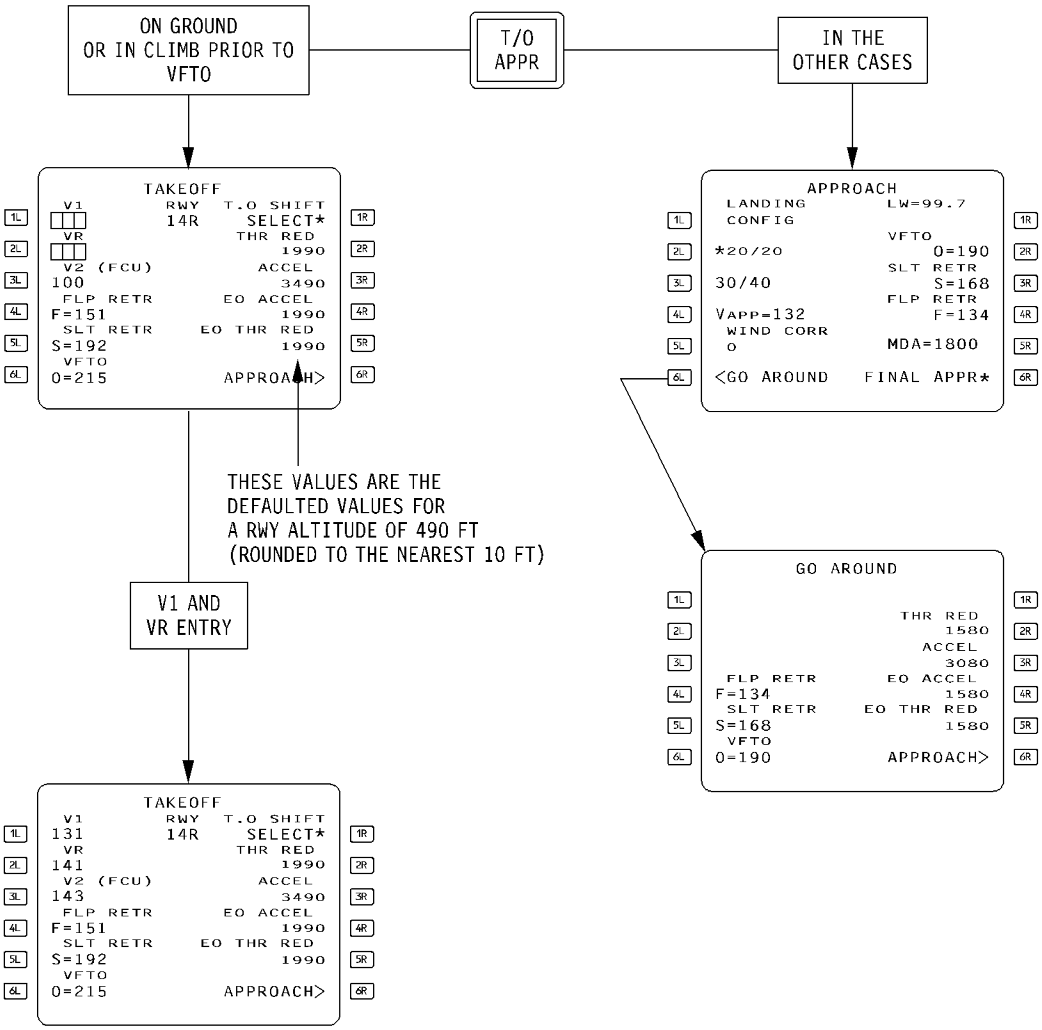
  Cruise flight level is displayed, same as on INIT A and can be changed by the crew.

- **MZFW, MTOGW**

  Displayed only when an entry leads to exceed one of the max values.

  Note : *Any entry change made on this page will cause the FMC to calculate again the fuel and time predictions.*

TAKEOFF AND APPROACH PAGES



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Mod : 6789

3 – TAKEOFF PAGE

3.1 – PURPOSE

- Displays parameters of special interest to the crew during takeoff phase.

3.2 – ACCESS

- By pressing TO/APPR (Takeoff/Approach) key on the CDU, if the aircraft is on ground or in climb prior to VFTO (Green Dot).

3.3 – PARAMETERS

- V1 and VR : must be written/inserted by the pilot (via the scratchpad) for reference purpose and, for V1, display on the PFD.
- V2 comes from the FCU (SPD/MACH display window).
- F (Minimum Flap Retraction Speed) ; S (Minimum Slat Retraction Speed) ; O (Final Take Off Speed) : are computed by the FMS as a function of weight but may be changed by the pilot.
- RWY : runway at origin airport (here RWY 14R) is displayed if previously entered via SID page.
- THR RED (Thrust Reduction Altitude) is predetermined at 1500 ft above the runway.
- ACCEL (Acceleration Altitude) is predetermined at 3000 ft above the runway.
- EO THR RED (Engine Out Thrust Reduction Altitude) and EO ACCEL (Engine Out Acceleration Altitude) are predetermined at 1500 ft above the runway.
- All these data can be manually changed. It is possible to revert these values to the default values by clearing them. The FMCs will always allow or set these values in order to have :
  THR RED ⩽ ACCEL
  EO ACCEL ⩽ EO THR RED
  The values displayed are altitudes QNH.
- T.O SHIFT pressing LS key 1R next to « TO SHIFT SELECT* » inserts a 970 m shift from the RWY threshold position. This is used for automatic updating of the FMS navigation at takeoff. « SELECT* » is then replaced by « ACTIVE ».
  Shift distance is automatically cleared if LS key 1 R (next to « TO SHIFT ACTIVE » prompt) is pressed again or if the RWY is changed.
- Pilot entries are allowed only while in PREFLIGHT phase.

  Note : *At the THR RED, PROFILE mode engages, if it has previously been armed. This couples FMS to AP / FD (for vertical guidance) and to ATS (for THRUST control).*

- APPR
  Pressing this prompt on line 6R allows access to the APPROACH page.
  This prompt is not displayed when there is no primary DEST in the F-PLN.

Mod : 6789

4 – APPROACH PAGE

4.1 – PURPOSE

- Allows to display and enter data needed for final approach computation : select a landing configuration, enter an MDA (Minimum Descent Altitude), display computed aircraft speeds and provide access to the GO-AROUND page.

4.2 – ACCESS

- By pressing TO/APPR key on the CDU, when the aircraft is in the CLB, CRZ, DES or APPR phase and if there is a primary DEST in the active F-PLN.
- By pressing the APPR prompt on the TAKEOFF page.

4.3 – DATA FIELDS

- LANDING CONFIG title line for landing configurations displayed on lines 2L and 3L.
  It is possible to select a landing configuration by pressing the corresponding left LS key. The selected configuration is displayed in LARGE FONT. The default configuration is 30/40.
  It is not allowed to select 20/20 configuration if DFA mode is armed or engaged.
  If 20/20 is selected and DFA is then armed or engaged, message « SELECT 30/40 » is displayed.
- V APP (CAS) : calculated by the FMC upon expected LW and wind correction. Cannot be changed.
- WIND CORR : defaulted to 0 but may be changed by the crew. Used for V APP calculation (V APP = V REF + 5 kt + WIND CORR).
- GO AROUND prompt is displayed during CRZ, DES, APP phases.
  Allows access to GO AROUND page (similar to TAKEOFF page).
- LW is the predicted landing weight. Cannot be changed.
- O, F, S speeds are computed in CAS as for TAKEOFF page but may be changed by the crew. It is possible to revert to the calculated value by pressing the corresponding right LS key.

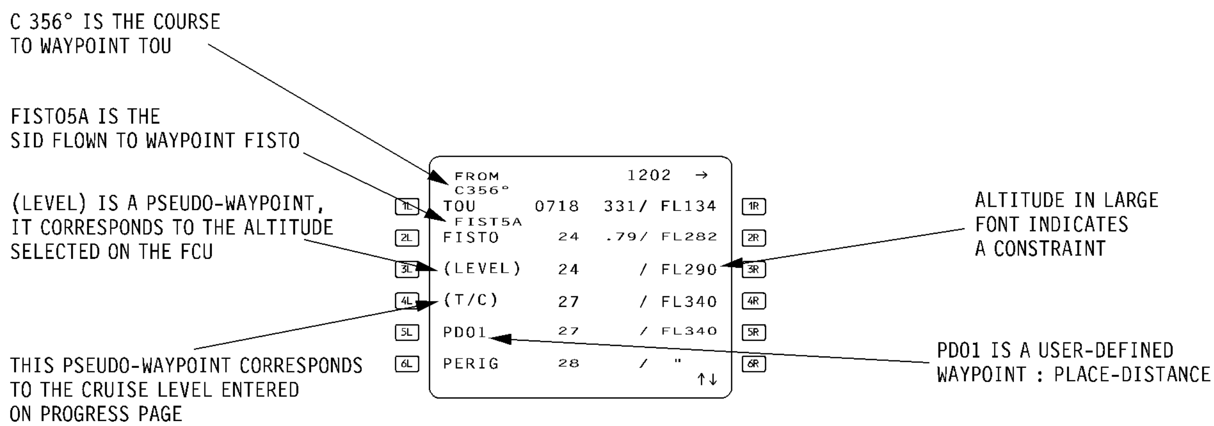
CAUTION

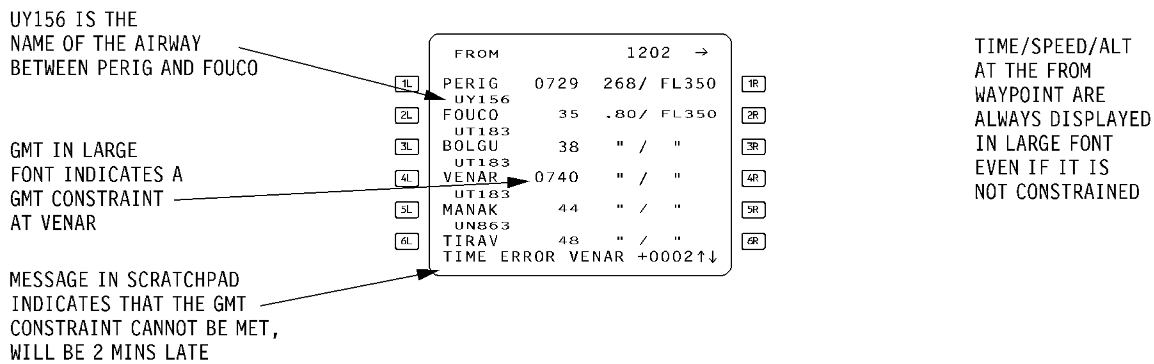
In case of FMS "LAT ONLY" configuration O, S and F values are not valid. They must be manually entered by the crew.

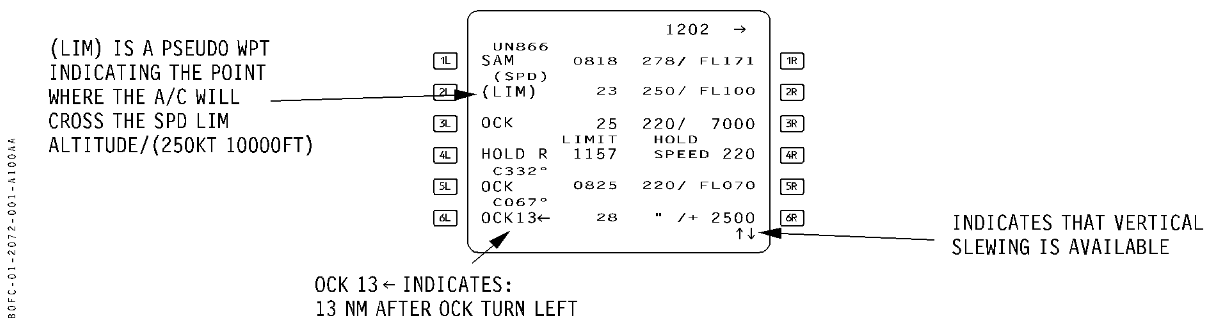
- MDA (Minimum Descent Altitude) : an MDA entry is allowed here during DES or APPR phases if a non ILS approach is selected, and if a runway with no discontinuity is in the F-PLN. MDA must be entered in feet above the Mean Sea Level.
- FINAL APPR : this prompt is displayed after MDA is entered. FINAL APPR would be pressed to allow the aircraft to descend below the FCU ALT (as the LAND pushbutton versus FCU ALT).
  This function was designed to use the PROFILE mode in final approach (see chapter 2.02.19).

Mod : 6789

F-PLN PAGE A







Mod : 6789

1 – ACTIVE FLIGHT PLAN : F-PLN PAGES

1.1 – PURPOSE

- There are two active flight plan pages, F-PLN A and F-PLN B.
- Before takeoff or in flight, they allow the crew to view the lateral and vertical elements of the flight plan in the order in which they occur, for planning purposes, and revision as desired. Each F-PLN page is capable of displaying up to six waypoints or navaids. Additional waypoints/navaids may be brought into view by vertical slewing, until the closed loop flight plan returns to the origin airport.

  Note : *If both ACTIVE and SEC F-PLNs are used, each may hold a maximum of approximately 65 waypoints. If only the ACTIVE Flight Plan is used, approximately 96 waypoints may be entered.*

1.2 – ACCESS

- Access to the F-PLN A page is via the F-PLN key on the CDU. When on the F-PLN A page, access to the F-PLN B page is provided through the NEXT PAGE key.

1.3 – DISPLAY RULES

- When F-PLN page is first displayed (by pressing F-PLN key), the FROM waypoint (last crossed fixed WPT in flight or departure airport on ground) is displayed at the TOP of the page, followed by all WPTs which constitute the F-PLN.
- The TO WPT is the first fixed waypoint after the FROM WPT. The NEXT WPT is the first fixed waypoint after the TO WPT.
- Only six waypoints can be listed on the F-PLN page at one time. To view the entire flight plan, the vertical slew up (↑) or slew down (↓) key must be used. Each press scrolls the display 1 waypoint. Holding the slew key down scrolls one waypoint per second.
- The F-PLN page is automatically slewed (in order to switch to the next F-PLN leg) when the aircraft crosses the TO waypoint if the FROM waypoint is at the top of the page. Automatic slewing occurs also when the aircraft crosses the bissectrix of the FROM leg and the NEXT leg if aircraft is not on the lateral path.
- Vertical slewing particularity for F-PLN :
  All the WPTs before the FROM WPT are erased. A WPT is erased each time the aircraft crosses a new WPT.
  This means that when FROM WPT is displayed in line 1 and slew down (↓) key is pressed, « END OF F-PLN » appears in line 1.

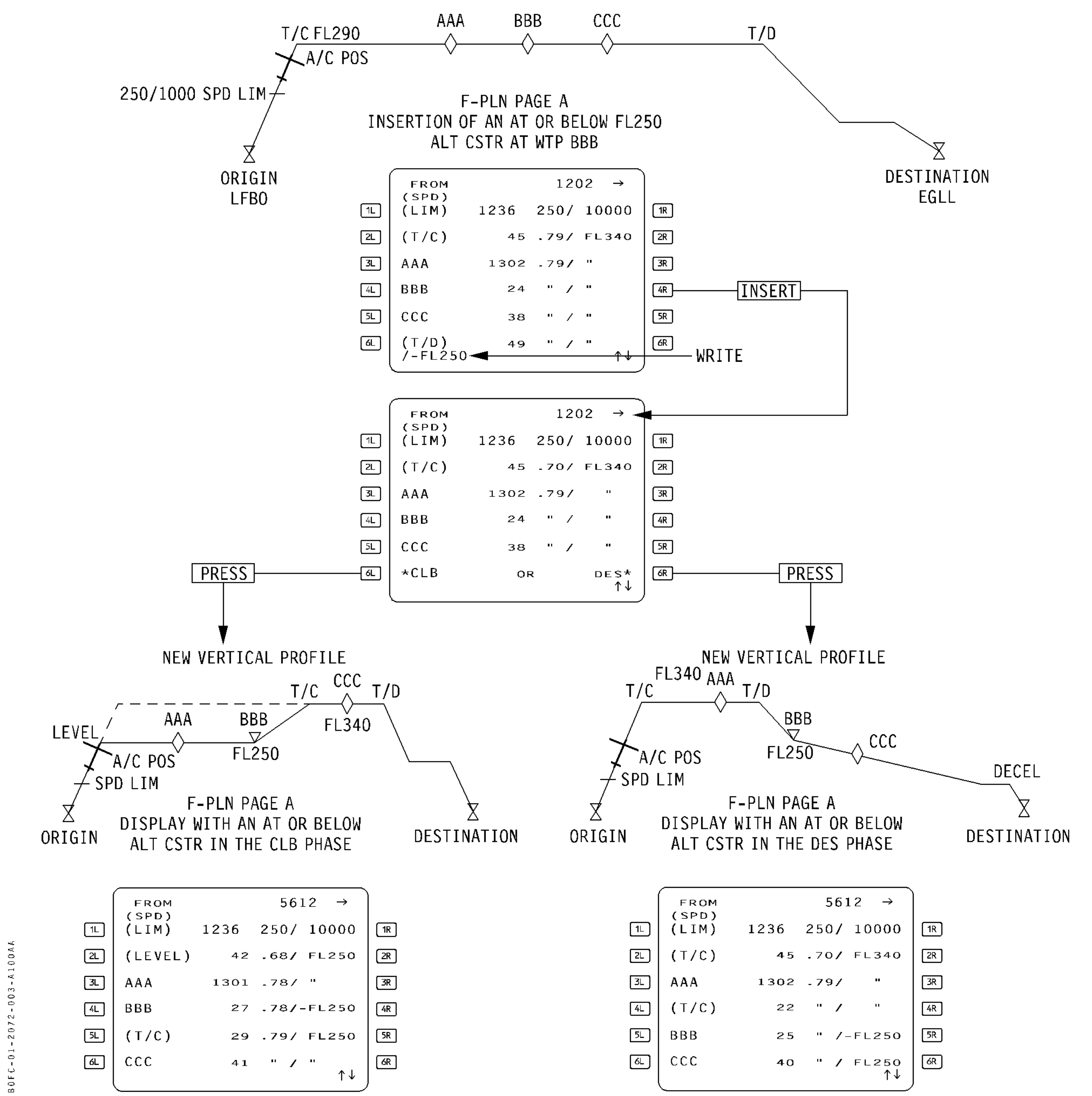
1.4 – F-PLN PAGE A

1.4.1 – Displays

- For each waypoint, the following data is displayed :
  - Its identification (see chapter 1.20.62-3 for types of waypoint)
  - The leg identifier. The leg can be a direct leg (no indication) an airway (like UG 20), a procedure (a SID, a STAR, a HOLDING...). See chapter 1.20.53.
  - Time at waypoint (GMT) when available.
  - Speed in CAS or mach at each WPT.
    Mach is displayed instead of CAS if it is greater than M. 65. It is V1 for the origin airport (V1 has been inserted on the TAKEOFF page).
  - Altitude in QNH or FL at each WPT.
    Display in QNH is used below the transition altitude, FL above. Guidance is made at QNH or FL depending only on the baro setting whatever is the display.
  - The flight path angle (displayed above altitude) if stored in the database with an approach.
  - A pseudo-waypoint is contained in brackets : see chapter 1.20.54 for pseudo-waypoints description.

Mod : 6789

F-PLN PAGE A : ALT CSTR INSERTION



Mod : 6789

1.4.2 – Constraints

- Time, speed and altitude are predicted by the FMCs, but they can be constrained by the crew during flight or defined by the database. Constraints are displayed in LARGE FONT. They are also displayed on ND without the CSTR option for the TO WPT.

- The ALT constraint can be
  - AT Altitude
  - AT or BELOW Altitude (with a minus sign)
  - AT or ABOVE Altitude (with a plus sign)
  - a window (AT or BELOW and AT or ABOVE).
    In this case, the lower altitude is normally displayed, but the upper altitude will be displayed instead if it is predicted to constrain the aircraft path.
    A window can only be defined from the database and not by the crew.

- If an altitude CSTR cannot be met, a message displays the difference between the predicted altitude and the constraint altitude if the difference is greater than 200 ft.
  See also vertical revisions in chapter 1.19.54.

1.4.3 – Speed/altitude constraints insertion and deletion

- All SPD/ALT CSTR inserted by the crew or by procedure are displayed in LARGE FONT.

- **Insertion procedure**
  - Write desired SPD and/or ALT in the scratchpad
  - Insert the constraint by pressing the right LS key besides the constrained WPT.

- **Insertion rules**
  - The SPD must be inserted as a CAS in knots and not as a Mach
  - The ALT must be inserted with a + sign if it is an AT OR ABOVE CSTR, a – sign if it is an AT OR BELOW CSTR, and without any sign if it is an AT CSTR.
  - The ALT may be inserted either in feet (referenced to the baro setting) or in Flight Level.
  - The pseudo-waypoint SPD LIM may also be modified or cleared on F-PLN page A.

- **Deletion of constraints procedures**
  Two ways of deleting constraints are provided :
  - ALT CSTR in climb between aircraft and FCU ALT are erased :
    - as soon as FCU ALT is raised if the aircraft is climbing
    - when FCU ALT knob is pulled if the aircraft is in level
  - Press the CLR key then press the right LS key besides the CSTR to be deleted.

- **Deletion rules**
  - If there is a SPD/ALT CSTR at a WPT, both SPD and ALT CSTR are deleted.
  - If only one CSTR has to be deleted at a WPT this deletion must be done on VERT PAGE A
  - All CSTR (defined by the crew or by the database) can be deleted.

Mod : 6789

1.5 – F-PLN PAGE B

1.5.1 – Displays

- For each waypoint, the following data is displayed :
  - Identification of waypoint and route identifier (as in Page A).
  - Distance between waypoints (between FROM and TO waypoints, actual distance between aircraft present position and TO waypoint is displayed).
  - The course between the waypoint displayed in line 2 and the waypoint displayed in line 3 : so even when vertical slew is used, course remains displayed between second and third line.
  - Temperature at the FROM WPT is the actual memorized temperature at this point.
  - Wind predictions based on pilot entries.
    Wind at the FROM WPT is the actual memorized wind at this point.
    Wind direction is referenced to true north.

  Note : Temperature and wind direction and magnitude can be changed by the crew :
  - *directly on F-PLN page B at each WPT within the CRZ segment after the T/C and T/D have been calculated.*
  - *on VERT REV Page B.*
  - *on STEP PRED Page. The wind will be the CRZ wind at the new altitude.*
  - *on INIT Page A. The wind and temperature will be cruise values.*
  - *on DES FORECAST Page in order to define the descent wind profile.*

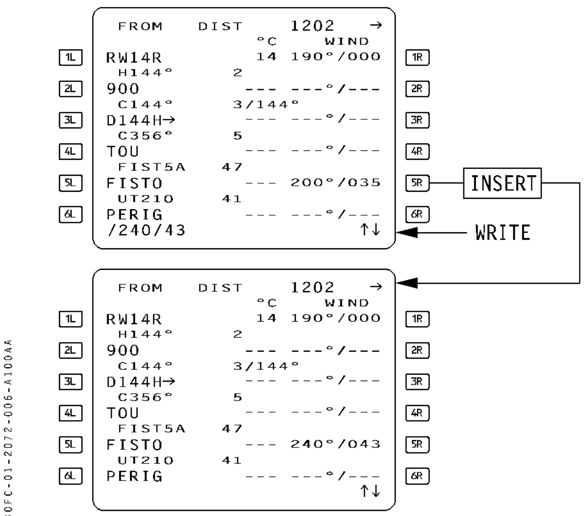
- Example of entries :
  TEMP/WIND DIR/WIND MAGN : Enter both temperature and wind
  TEMP : Enter TEMP only
  WIND DIR/WIND MAGN : Enter WIND only (with a slash preceding)
  Pilot entries are displayed in LARGE FONT.

1.5.2 – Temperature and Wind forecasts insertion and deletion

- All TEMP/WIND forecasts at a WPT inserted by the crew are displayed in LARGE FONT.
- These forecasts are used by wind and temperature models in order to establish wind and temperature predictions throughout the F-PLN, and thus to optimize the flight-planning.
- **TEMP/WIND insertion**
  - Write TEMP/WIND direction/wind magnitude
  - Insert by pressing the right LS key beside the considered WPT
- **TEMP insertion only**
  - Write TEMP in the scratchpad
  - Insert
- **WIND insertion**
  - Write/WIND direction/magnitude
  - Insert
- **Insertion rules**
  - WIND direction is referenced to the true North
  - Entries are allowed only at ORIGIN, DEST, T/C, T/D and fixed WPT between T/C and T/D.
    If T/C and T/D are not calculated, entry is allowed at any fixed WPT.
  - Entries are not allowed for not fixed WPT (except T/C, T/D), EOSID WPT, CLB WPT, DES WPT.
  - For DES WPT forecasts, entries are allowed on the DES FORECAST PAGE.
  - CLB wind profile is computed by interpolation between ORIGIN and T/C.
- **Deletion**
  - Press the CLR key
  - Press the right LS key beside the forecast to be cleared

Mod : 6789

- **Deletion rules**
  - Deletion on F-PLN page B clears TEMP and WIND forecast simultaneously
- **Example : WIND changed at FISTO**



1.6 – SITUATIONAL COMMANDS

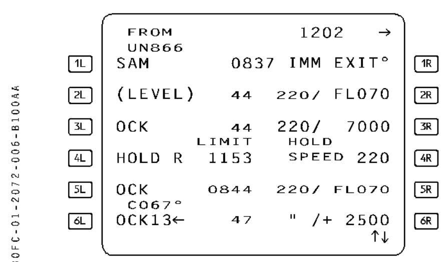
- The situational commands will be displayed in line 1R (label and data lines are used) on the F-PLN page A or B, even if the page has been vertically slewed.
- PROFILE mode must be engaged before any of the situational commands will be displayed (except for IMM EXIT and RESUME HOLD).
  NAV mode is not mandatory.
- Pressing the LS key 1R, when the situational command is displayed, activates the command.
- A table of what may appear follows :

SITUATIONAL COMMAND	WHEN DISPLAYED ON « F-PLN PAGE A OR B »	RESULT OF LS KEY 1R PUSH
IMM EXIT*	When the active leg is a holding (see HOLD page)	Makes the aircraft go directly to the FIX WPT and leave the HOLDING.
RESUME HOLD *	When IMM EXIT is selected	Cancels IMM EXIT and makes the aircraft re insert the HOLDING.
DECEL *	When the aircraft has passed the T/D (Top of Descent) and the FCU ALT is not yet lowered	Makes the aircraft to de-celerate until GREEN DOT from the FAC in order to keep the aircraft as near the descent path as possible.
IMM CLB *	When a step has been inserted in the flight plan and the FCU ALT raised above the present CRZ ALT	Makes the aircraft to climb at the step altitude immediatly.
IMM DES *	When the aircraft is prior a preplanned descent and the FCU ALT has been lowered	Makes the aircraft to descent immediatly without waiting for the T/D. The descent is made at a constant rate until the aircraft reaches the previous descent path.
V/S = -NNNN Where : NNNN is selected vertical speed displayed in large font	When IMM DES mode is active and the IMM EXIT prompt is not displayed	NNNN defaults to 1000 ft/min but may be changed via the scratchpad. Use of CLR key reverts to default value.

Note : IMM CLB and IMM DES have priority for display over IMM EXIT or RESUME HOLD. If the formers are selected, the latters will be displayed if there are available.

- **Example of a situational command**

  Here « IMM EXIT* » on F-PLN page A.



Mod : 6789

1.7 – MARKERS

- They are displayed on F-PLN, SEC F-PLN and DIR TO pages.

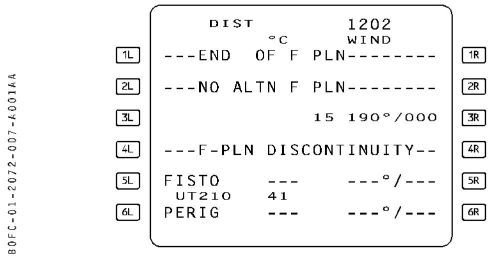
- The different markers can be displayed in any line. They are :

  --- F-PLN DISCONTINUITY --- : indicates a discontinuity in the F-PLN

  --- END OF F-PLN --- : indicates end of active or secondary F-PLN

  --- NO ALTN F-PLN --- : indicates there is no alternate F-PLN

  --- END OF ALTN F-PLN --- : indicates the end of the ALTN-F-PLN



1.8 – WAYPOINT INSERTION/DELETION, DISCONTINUITY DELETION

1.8.1 – Waypoint insertion on F-PLN page A or B

- **Actions to do**
  - Write the WPT in the scratchpad
    - by its identifier (when it is in the database or if it has been defined via the NEW WAYPOINT page).
    - by its lat/long (e.g. : 4512.3N/305.1E or N4512.3/E305.1). In this case the WPT will be considered as a new WPT and will appear in the F-PLN pages as for instance LL 05 if it is the fifth WPT defined by lat/long.
    - by its place/bearing/distance (e.g. TOU/350/32). As for the previous case the WPT will appear as PBD 04 if it is the fourth WPT defined by PBD.
    - by its place/distance (e.g. : TOU/32). The WPT is inserted on the path 32 NM after TOU (TOU/– 32 : inserted 32 NM before TOU). The WPT will appear as PD 03 if it is the third WPT defined by PD.
    - AIRPORTS identifiers are composed of 4 letters.
    - RWY thresholds are written as LFBO14 R for example.
  - Insert the WPT in the F-PLN by pressing the left LS key adjacent to the insertion line.

- **WPT insertion rules**
  - The new WPT must be a fixed WPT.
  - The new WPT cannot be inserted as the « FROM » WPT (if this is attempted, « NOT ALLOWED » message will appear), but can be inserted after a DISCONTINUITY.
  - The new WPT cannot be inserted after a manual terminated leg.
  - A direct leg is strung between the previous waypoint and the new waypoint.
  - A discontinuity follows the new waypoint unless the new WPT is a downpath WPT.
    If the new WPT, given by its IDENTIFIER is a downpath part of the F-PLN and if there are constraints at this WPT, they remain after the revision. All WPT between the old and the new position are deleted.
  - If the new WPT is inserted at the « TO » WPT line and if the « FROM » WPT is PPOS (present position), a DISCONTINUITY is inserted between PPOS and the new WPT.
  - After a discontinuity, predictions are made assuming a direct leg through the DISCONTINUITY.

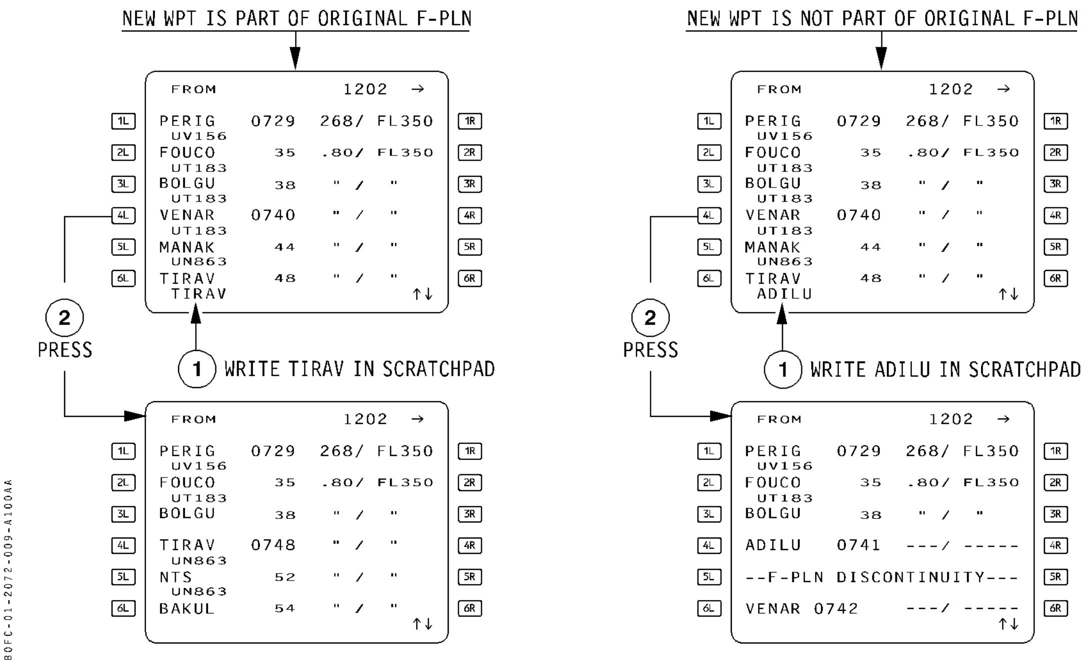
1.8.2 – Waypoint/discontinuity deletion on F-PLN page A or B

- **Actions to do**
  - Press CLR key on CDU (CLR is displayed in scratchpad).
  - Press left LS key where the WPT or the DISCONTINUITY has to be deleted.

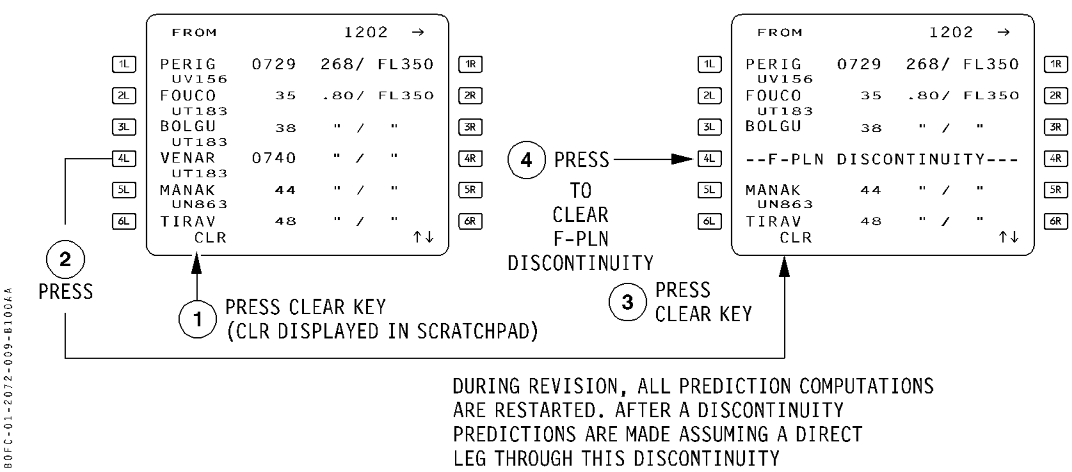
- **Deletion rules**
  - A WPT deletion creates a F-PLN discontinuity.
  - A direct leg is strung between previous and next WPT in the F-PLN after DISCONTINUITY deletion.
  - ORIGIN, or « FROM » waypoint cannot be cleared, if NAV is engaged.
  - If the « TO » waypoint is cleared, T-P (Turning Point) becomes the FROM WPT.
  - If aircraft position is invalid, clearing « TO » waypoint is not allowed.

Mod : 6789

WAYPOINT INSERTION



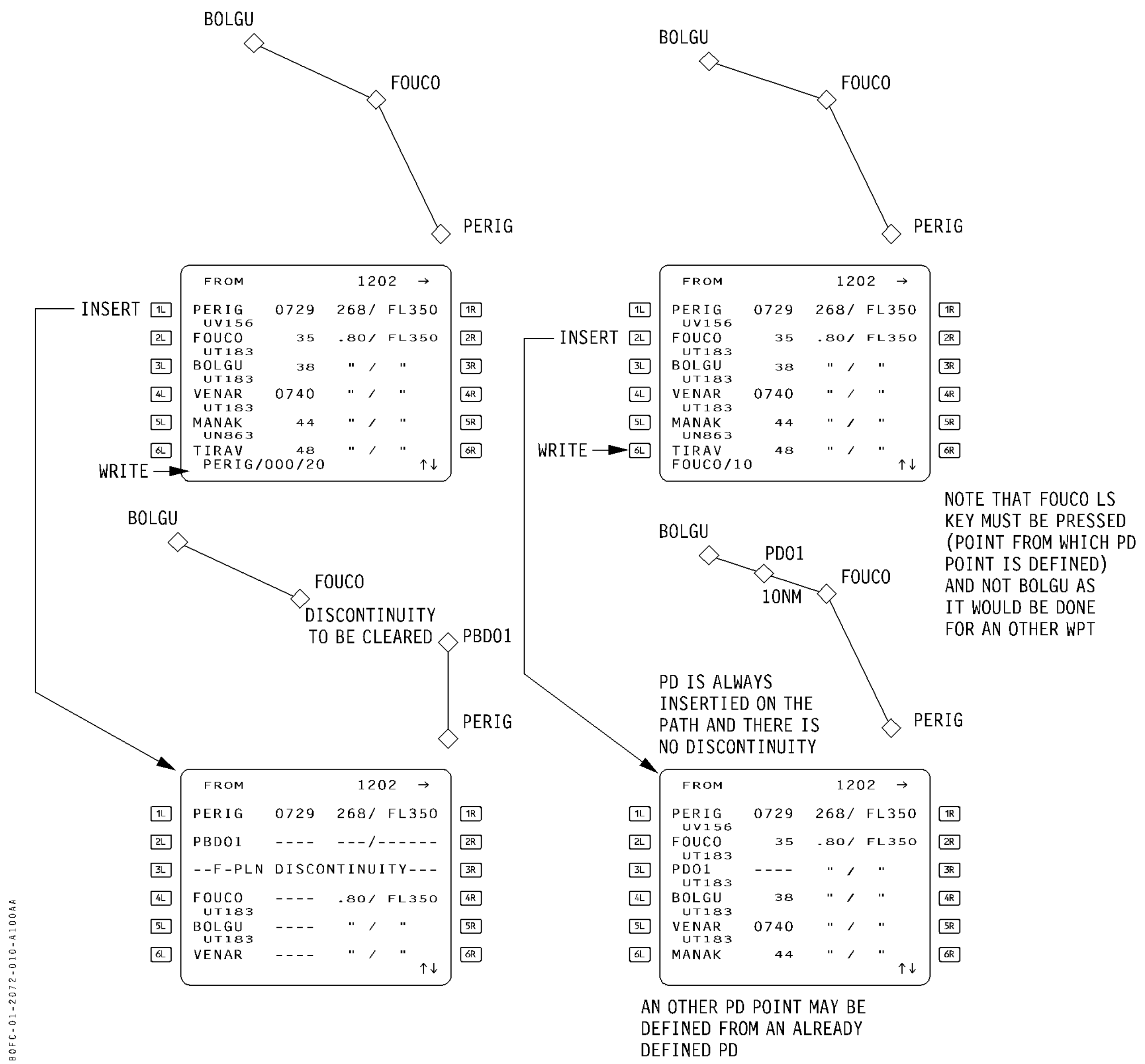
WAYPOINT DELETION



DURING REVISION, ALL PREDICTION COMPUTATIONS
ARE RESTARTED. AFTER A DISCONTINUITY
PREDICTIONS ARE MADE ASSUMING A DIRECT
LEG THROUGH THIS DISCONTINUITY

Mod : 6789

PD POINT INSERTION



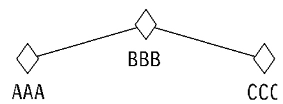
Mod : 6789

1.9 – ALONG TRACK OFFSET DEFINITION ON F-PLN PAGES

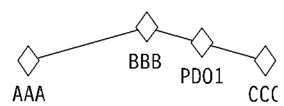
- **Definition of the PD WPT**

  There is no specific ALONG TRACK OFFSET function but it is possible to perform an ALONG TRACK OFFSET by making a lateral revision on a specific WPT, called PD, defined by PLACE/DISTANCE (see WPT insertion)

  – lateral F-PLN before inserting a PD WPT :



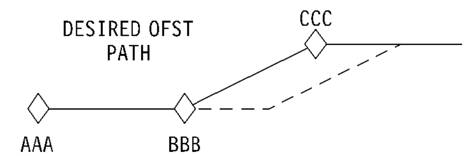
  – insert for example BBB/12 on the F-PLN page A or B :



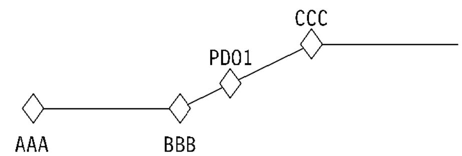
  The first PD WPT PD 01 will be inserted 12 NM after BBB on the lateral and vertical path.
  Distance may be preceeded by a minus sign to insert the PD point before its defining PLACE.

- **Insertion of an along track offset with an altitude constraint**

  – vertical path before ALONG TRK OFST :

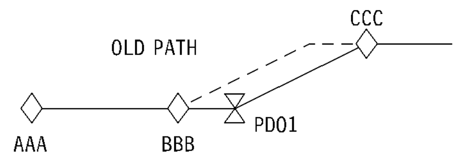


  – insert PD WPT :



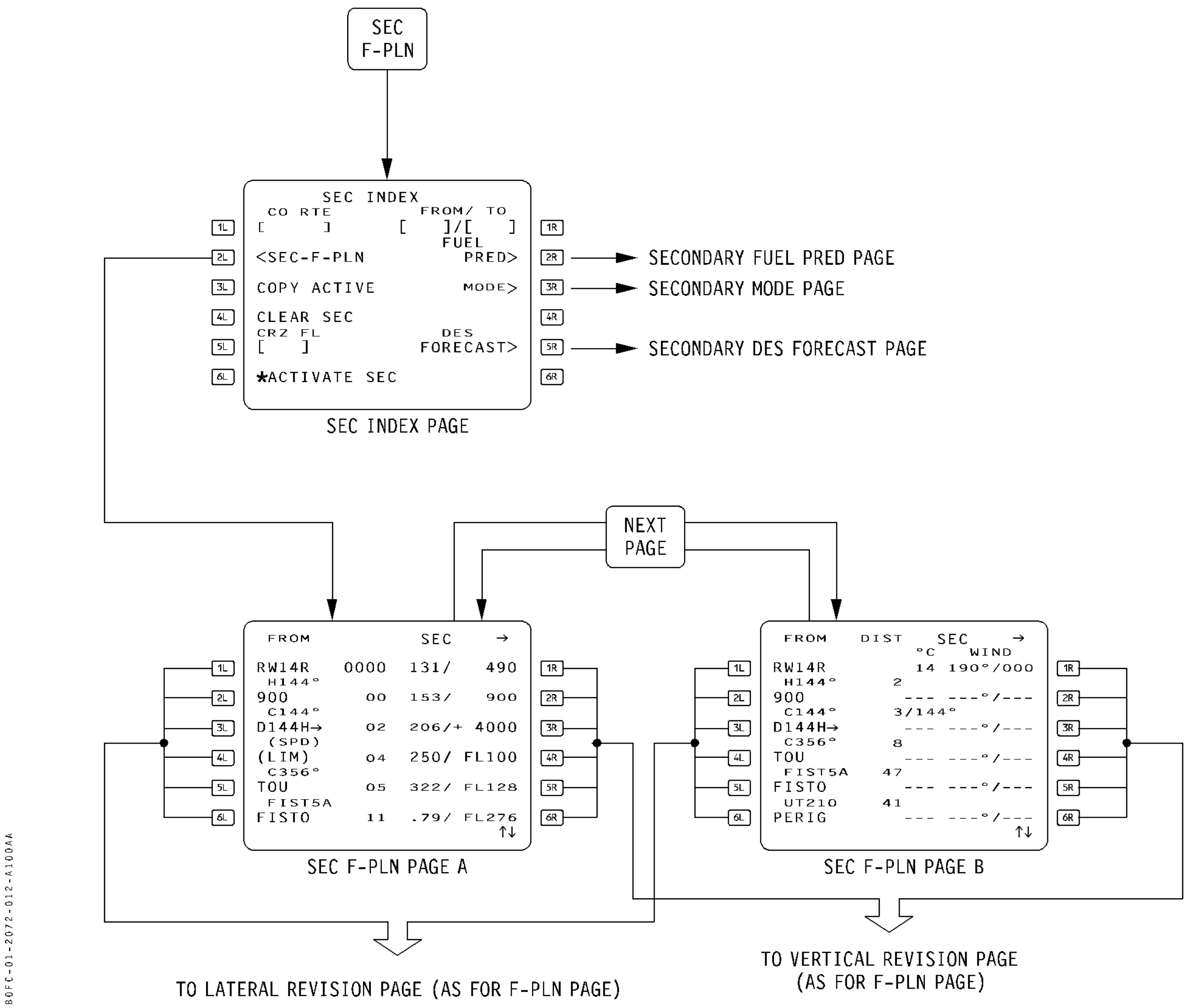
  – insert an ALT constraint at PD 01

  – vertical F-PLN after construction of the along track offset



Mod : 6789

SEC F-PLN PAGES



Mod : 6789

2 – SECONDARY FLIGHT PLAN : SEC INDEX PAGE

2.1 – PURPOSE

- Allows, through SEC INDEX page to :
  - Define a SECONDARY F-PLN without changing anything in the ACTIVE F-PLN.
  - Modify an already defined SECONDARY F-PLN.
  - Activate the SECONDARY F-PLN (in this case, defined SEC F-PLN is displayed both on F-PLN and SEC F-PLN pages. Active F-PLN is erased.
  - Clear the defined SECONDARY F-PLN.

2.2 – ACCESS

- By pressing SEC F-PLN key on CDU. This gives access to SEC INDEX page which then gives access to the different SEC F-PLN pages.

Note : As soon as SEC F-PLN key pressed, « DSPY » light illuminates on CDU.

2.3 – OPERATIONAL USE

- The two main cases where SEC F-PLN function is used are :
  - In case of a RECLEARANCE.

    In this case SEC F-PLN must be defined by using « COPY ACTIVE » function, otherwise there are no performance predictions and consequently no possibility to apply the RECLEARANCE procedure.
  - In case of TRAINING, in order to activate a new F-PLN, or to activate several times the same F-PLN at touch down.

    In this case SEC F-PLN must be defined by using « CO RTE » or « FROM/TO » function on SEC INDEX page, otherwise leg switching (deletion of the previous leg at each time the aircraft crosses a WPT) occurs in the SEC F-PLN. This means that SEC F-PLN may be partially or totally erased at the end of the first pattern and consequently unusable for a second pattern.
    See chapter 1.20.51 for active and secondary flight plan descriptions.

2.4 – FUNCTIONS ON SEC INDEX PAGE

Note : CLEAR SEC, CRZ FL and ACTIVATE SEC prompts are displayed on SEC INDEX page only if there is at least one WPT in the secondary F-PLN.

- **CO RTE or FROM/TO**

  Same function as the same prompts on INIT page A. They allow to define a SECONDARY F-PLN by entering a CO RTE number or an ORIGIN/DESTINATION.

  Then any revision of the SEC F-PLN is possible by calling SEC F-PLN page.

  When SEC F-PLN is created this way, there is no leg switching (see definition in « COPY ACTIVE ») for the SEC F-PLN.

  Note : CO RTE and FROM/TO fields are also filled when a SEC F-PLN is created by using « COPY ACTIVE ».

- **COPY ACTIVE**

  Allows to copy everything from the active F-PLN into the secondary F-PLN. This deletes whatever was in the secondary F-PLN but does not alter the active F-PLN. This also transfers the performance modes of the active F-PLN and displays the SEC F-PLN page A.

  Then any revision of the SEC F-PLN is possible by calling SEC F-PLN page.

  When SEC F-PLN is created this way, leg switching (deletion of the previous leg at each time the aircraft crosses a WPT) and predictions occur for SEC F-PLN (as for ACTIVE F-PLN) as long as the two F-PLNs are common.

  If the SEC-F-PLN has not been activated before the diversion point, activation is no longer possible with NAV mode engaged, there is no more leg switching and no predictions for the SEC F-PLN.

  However SEC F-PLN activation is always possible with NAV mode disengaged.

Mod : 6789

CAUTION

The RECLEARANCE must be made before the diversion point.
If the PRIMARY F-PLN is laterally revised before the diversion point, these revisions are not reproduced on the SEC F-PLN. Thus the SEC F-PLN is not useable anymore. Moreover if the primary F-PLN is revised vertically (CRZ FL change for instance), the SEC F-PLN is not revised accordingly and no more predictions are provided. Consequently COPY ACTIVE should be made just before activating the SEC F-PLN.

- **SEC F-PLN**

  Allows access to SEC F-PLN page A and B and to revise it with the same procedures (direct revisions, LAT REV, VERT REV) as those used for the ACTIVE F-PLN, except that EOSIDs are not available.

- **CLEAR SEC**
  - Clears all that is in the secondary F-PLN.
  - A cleared SEC F-PLN page will contain PPOS followed by a DISCONTINUITY and the «END OF F-PLN» marker.

- **CRZ FL**
  - Allows to select (by entry via the scratchpad) the cruise flight level of the SEC F-PLN, as soon as a CO RTE or a FROM TO has been entered.
  - If the SEC F-PLN is copied from the active F-PLN, the active cruise level is also copied but may be altered. Set the SEC CRZ FL equal to the primary CRZ FL to get predictions

- **ACTIVATE SEC**

  Allows to activate the secondary F-PLN and display the active F-PLN page A (which was previously the SEC F-PLN page A).

  <u>Note</u> : *Previous ACTIVE F-PLN is erased and defined SEC F-PLN is displayed both on F-PLN and SEC F-PLN pages.*

ACTIVATION is not always possible, several cases have to be considered :

- SEC F-PLN has been constructed from a COPY of the ACTIVE F-PLN and NAV mode is engaged :

  As long as the two F-PLNs are common, « ACTIVATE SEC » prompt is displayed and so ACTIVATION is possible. But from the point where the two F-PLNs diverge, ACTIVATE SEC prompt disappears and so ACTIVATION is no longer possible.

- SEC F-PLN has been constructed by using « FROM/TO » or « CO RTE » function and NAV mode is engaged. « ACTIVATE SEC » prompt is never displayed and so ACTIVATION is not possible.

  <u>Note</u> : *This is true even if, as described above, ACTIVE and SEC F-PLNs have a common part.*

- NAV mode is disengaged :
  « ACTIVATE SEC » prompt is always displayed whatever the way of SEC F-PLN construction. So ACTIVATION is always possible.

- **FUEL PRED**

  Allows access to SEC FUEL PRED page.
  GW, FOB, EXTRA TIME, TROPO cannot be changed.

- **MODE**

  Allows access to the SEC MODE page for the selection of a strategic mode, and to display predictions (GMT and FUEL at secondary destination).

- **DES FORECAST**

  Allows to access the SEC DES FORECAST page.

Mod : 6789

- **DISPLAY ON ND (MAP or PLAN mode)**
  - The SEC F-PLN is displayed on the ND (MAP or PLAN mode) only if one of the pages associated to the SEC F-PLN function is displayed on the onside FMS CDU.
  - When ND is in MAP mode :

    The ACTIVE and SECONDARY F-PLNs are displayed at the same time.
    The ACTIVE F-PLN is displayed in full line and the SEC F-PLN (parts not common with the ACTIVE F-PLN) is displayed in dashed line.
  - When ND is in PLAN mode :
    - If SEC F-PLN has been constucted from a COPY of the ACTIVE F-PLN, then both ACTIVE and SEC F-PLNs are displayed

      The ACTIVE F-PLN is displayed in full line and the SEC F-PLN (parts not common with the ACTIVE F-PLN) is displayed in dashed line.

      But as soon as the aircraft has reached the point where the two F-PLNs diverge, only the SEC F-PLN is displayed in dashed line.
    - If SEC F-PLN has been constructed by using « FROM/TO » or « CO RTE » function only, the SEC F-PLN is displayed in dashed line (even the common parts with the ACTIVE F-PLN).

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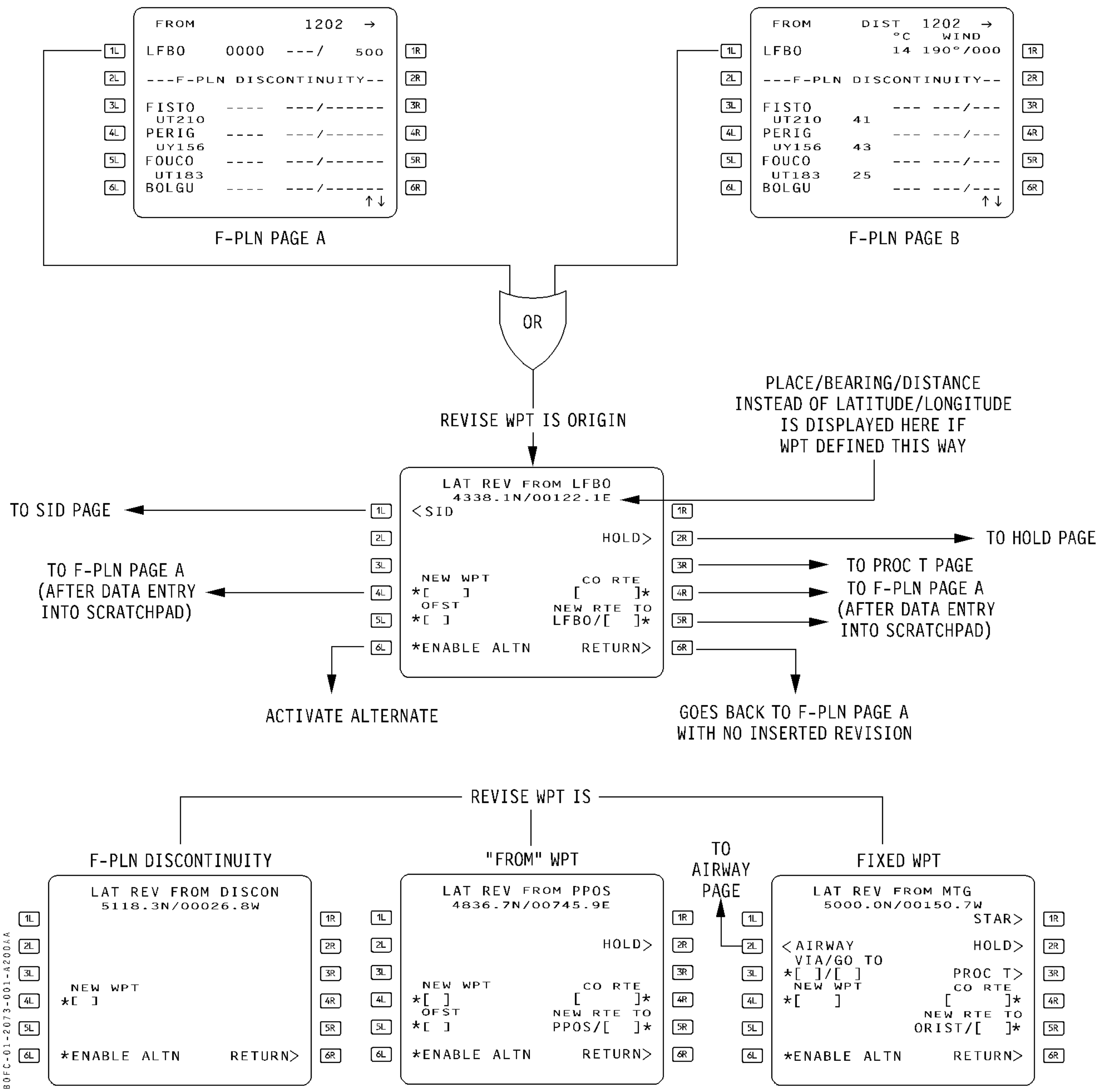
LAT REV PAGE



Mod : 11320 or 11364 or 12044 or 12045

1 – LATERAL REVISION PAGES

- Several lateral revisions can be made on the flight plan :
  - Inserting or deleting waypoints directly on F-PLN page A or B.
  - Using the LAT REV page.
  - Using the « DIRECT TO » page through the « DIR » key.
- The following rules apply to make any lateral revision :
  - the FMC does not automatically insert legs into the F-PLN to bridge discontinuities. The insertion of legs is a direct result of a pilot revision action.
  - revisions of the F-PLN are generally inserted immediately upon receipt of information, except for the EOSID revision which is presented on the F-PLN but may be deleted if necessary.
  - all revisions are from the revise waypoint. Therefore the lateral revision affects only the downpath F-PLN, and all legs in the original F-PLN up to the revise waypoint remain intact. Because of this rule, SID revision should be done at ORIGIN and STAR revision at last en-route waypoint.
  - any lateral revision causes the predictions to be fully recomputed. During the computation, dashes are displayed.
  - another consequence is that if the revise WPT becomes the FROM WPT after a lateral leg sequencing during the revision, this revision is aborted and CDU display reverts to the F-PLN page.

1.1. – LAT REV PAGE

1.1.1 – Purpose

- Depending on the REVISE POINT, allows to :
  - insert a NEW WPT, a new company route (CO RTE) or a new destination (NEW RTE TO), or an OFFSET, enable the ALTN F-PLN,
  - insert a SID, a STAR, an AIRWAY, a HOLDING or a PROCEDURE TURN (PROC T) through pages accessed from the LAT REV page.

1.1.2. – Access

- From F-PLN page A or B by pressing a left LS key next to a WPT, provided the WPT is not a marker (except F-PLN DISCONTINUITY marker).

1.1.3. – Display rules

- Revise WPT is the origin airport :
  Title displays the origin identifier with its lat/long. All prompts (SID, AIRWAY, etc.) are displayed except STAR.
- Revise WPT is a fixed WPT of the F-PLN other than the origin, the destination or a FROM WPT :
  Title displays the WPT identifier with its lat/long or its place/bearing/distance. All prompts are displayed except SID.
  STAR is displayed if in addition, a destination airport has been defined.
- Revise WPT is the destination airport :
  Title displays the destination identifier with its lat/long. All prompts are displayed except SID, STAR and AIRWAY.
  However, if a DIRECT TO DESTINATION has been previously inserted, STAR and AIRWAY prompts are available on LAT REV FROM DESTINATION page.
- Revise WPT is the FROM WPT :
  TITLE displays LAT REV FROM PPOS with lat/long of the present position. All prompts except SID, STAR and AIRWAY are displayed.

Mod : 11320 or 11364 or 12044 or 12045

- Revise WPT is the F-PLN DISCONTINUITY marker : Title displays LAT REV FROM DISCON. Only NEW WPT prompt is displayed.

1.1.4 – Inserting a new waypoint

- Allows flight crew to insert a DIRECT LEG to the new WPT, after the REVISE POINT into the F-PLN.

- **Actions to do**
  - Write the WPT in the scratchpad by its identifier (if WPT in the database or defined via REFERENCE pages) or lat/long (ex. : 4512.3N/00305.1E) or place/bearing/distance (ex. : TOU/350/32).
  - Press LS key 4L (next to NEW WPT). Display returns to F-PLN page with the NEW WPT inserted.

  Note : 1. *RWY THRESHOLDS are identified as LFBO14R.*
  2. *When a WPT is entered by its lat/long, it is considered as a new DEFINED WPT (see REFERENCE pages) and it appears as LL 05, for example, on F-PLN page (05 means it is the fifth DEFINED WPT).*
  Likewise a WPT entered by its place/bearing/distance appears as PBD 06, for example (sixth DEFINED WPT).

- **NEW WPT insertion rules into the F-PLN**

  A direct leg is strung between REVISE POINT and inserted NEW WPT, but a discontinuity follows the NEW WPT (unless the NEW WPT is a downpath WPT).

1.1.5 – ENABLE ALTN function (LS key 6L)

- By pressing the LS key 6L, the alternate F-PLN is activated.

- The destination airport is no more considered as an airport but only as a waypoint (a STAR insertion cannot be made).

- The alternate is considered as the new destination and a new airport is inserted to be the alternate of the new destination.

- The ALTN CRZ FL is defaulted to 220 if there are less than 200 NM to the ALTN airport and FL 310 otherwise.

1.1.6 – Changing route

1.1.6.1 – CO RTE data field (LS key 4R)

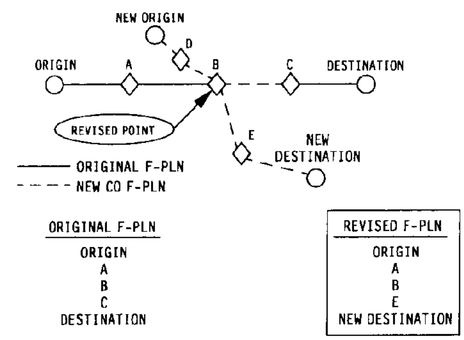
- Allows to change the destination using a stored CO RTE.

- **Action to do :**
  - Write CO RTE number in the scratchpad.
  - Press LS key 4R (next to CO RTE). Display returns to F-PLN page with the new CO RTE inserted.

- **CO RTE insertion rules into the F-PLN :**
  - All waypoints downpath of the revise point in the original F-PLN (including original DESTINATION) are deleted.
  - COST INDEX and CRZ ALT of the new CO RTE are not used.
  - The whole CO RTE is inserted and WPTs not needed must be manually deleted.

CO RTE INSERTION (ON LAT REV PAGE)

REVISED POINT BELONGS TO THE NEW CO RTE



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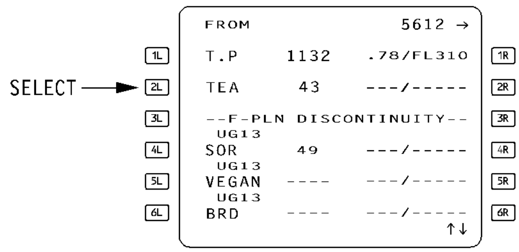
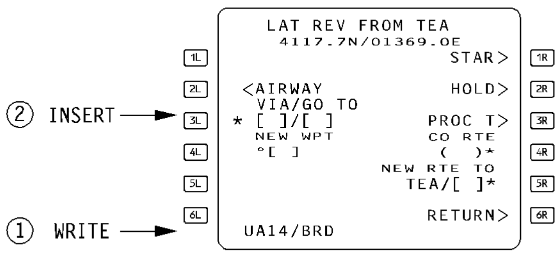
REVISED POINT DOES NOT BELONG TO THE NEW CO RTE

F-PLN PAGE A

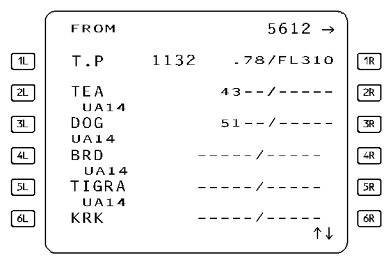


. PRESS KEY ADJACENT TO THE REVISE POINT



① . WRITE AIRWAY AND ENDING WAYPOINT THE SCRATCHPAD

② . INSERT INTO THE VIA/GO TO



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F-PLN PAGE A

1.1.6.2 – New RTE TO data field (LS key 5R)

- Allows flight crew to change the DESTINATION with no associated CO RTE.
- **Actions to do :**
  - Write new airport in scratchpad.
  - Press LS key 5R (next to NEW RTE TO) – Display returns to F-PLN page with the new DESTINATION inserted.
- **NEW RTE TO insertion rules into the F-PLN :**
  - All waypoints downpath from the revise point in the original F-PLN are deleted (including missed approach).
  - A DISCONTINUITY is inserted between revise point and new destination.
  - The route must be built WPT by WPT.

1.1.7 - Accessing other pages

- LS key 1L SID :

  Display the SID page when pressed. This prompt is only displayed when the flight phase is PREFLIGHT, the origin airport is defined in the flight plan, and the revise point is the origin airport. This prompt is not displayed if the origin waypoint is a pilot-defined runway or the origin for the alternate flight plan.

- LS key 1R STAR :

  Provides access to the STAR page. This prompt is displayed whenever a destination airport has been defined, and the revise point is any waypoint other than the FROM waypoint.

- LS key 2L AIRWAY :

  When pressed access is provided to the AIRWAY page, to allow selection of any airway segment associated with that aypoint. This prompt is displayed when the revise point is a fixed waypoint, except when it is a pilot-defined or pilot created (waypoint, navaid, runway, or airport).

- LS key 2R HOLD :

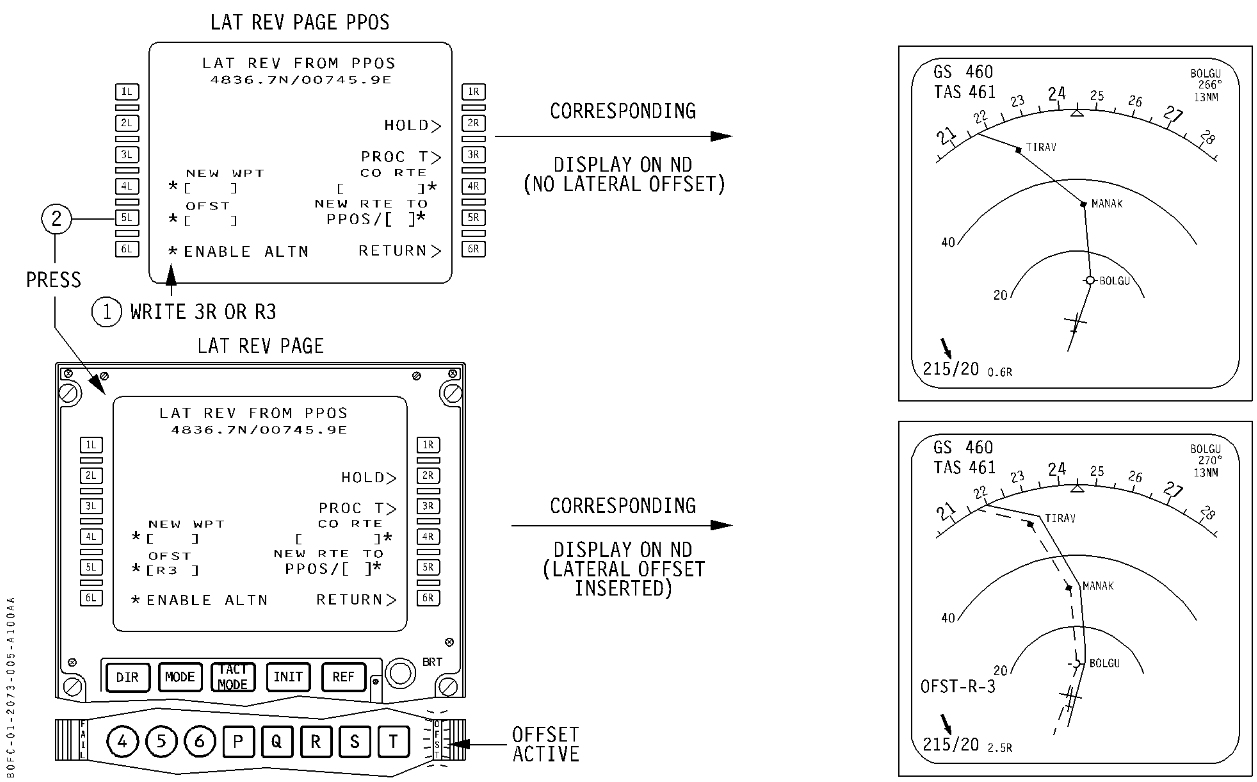
  This function is used to insert a holding pattern with a manual termination leg into the flight plan, or modify the parameters of an already existing holding pattern.

- LS key 3R PROC T :

  Provides access to the procedure turn page. This prompt is displayed only if the revise point is a fixed waypoint, or is the manual termination of a procedure turn leg that is not active. This pormpt is not displayed if the revise point is the FROM waypoint, or the manual termination point of an active procedure turn leg.

1.1.8 – Inserting an offset : OFST function (LS key 5L)

- Allows to insert a lateral offset into the active F-PLN.
- **Actions to do :**
  - Write/insert in line 5L : NNL (or LNN) for a left offset ; or NNR (or RNN) for a right offset (where NN is the offset distance in NM).
  - The lateral offset is immediately activated.
- **Insertion rules**
  - OFST is only displayed if the lateral revision is selected at the FROM WPT.
  - An offset can be inserted only if active leg and next leg are defined by fixed WPTs, or are courses to fixed WPTs, or active leg is a DIR TO.
  - An offset cannot be inserted if the aircraft distance to a next leg which does not match the above rule (e.g. a holding) is too short. This is also true if the next leg termination is the DESTINATION RWY.
  - An offset is cancelled when approaching a next leg which does not match the above rule (e.g. a holding). Message « CANCELLING OFFSET » is displayed 1.3 NM before the cancellation.
  - If an offset already exists it is displayed in line 5L but can be changed.
  - The offset is cleared by pressing CLR key then LS key 5L.
- **Corresponding display on ND (in MAP or PLAN mode)**
  - Original F-PLN is represented in a dashed line.
  - OFFSET F-PLN is represented in a full line.
  - OFFSET distance is indicated in the lower left hand corner of the ND.
  - BEARING and DISTANCE to the NON-OFFSET WAYPOINT is displayed in the upper right hand corner of the ND.



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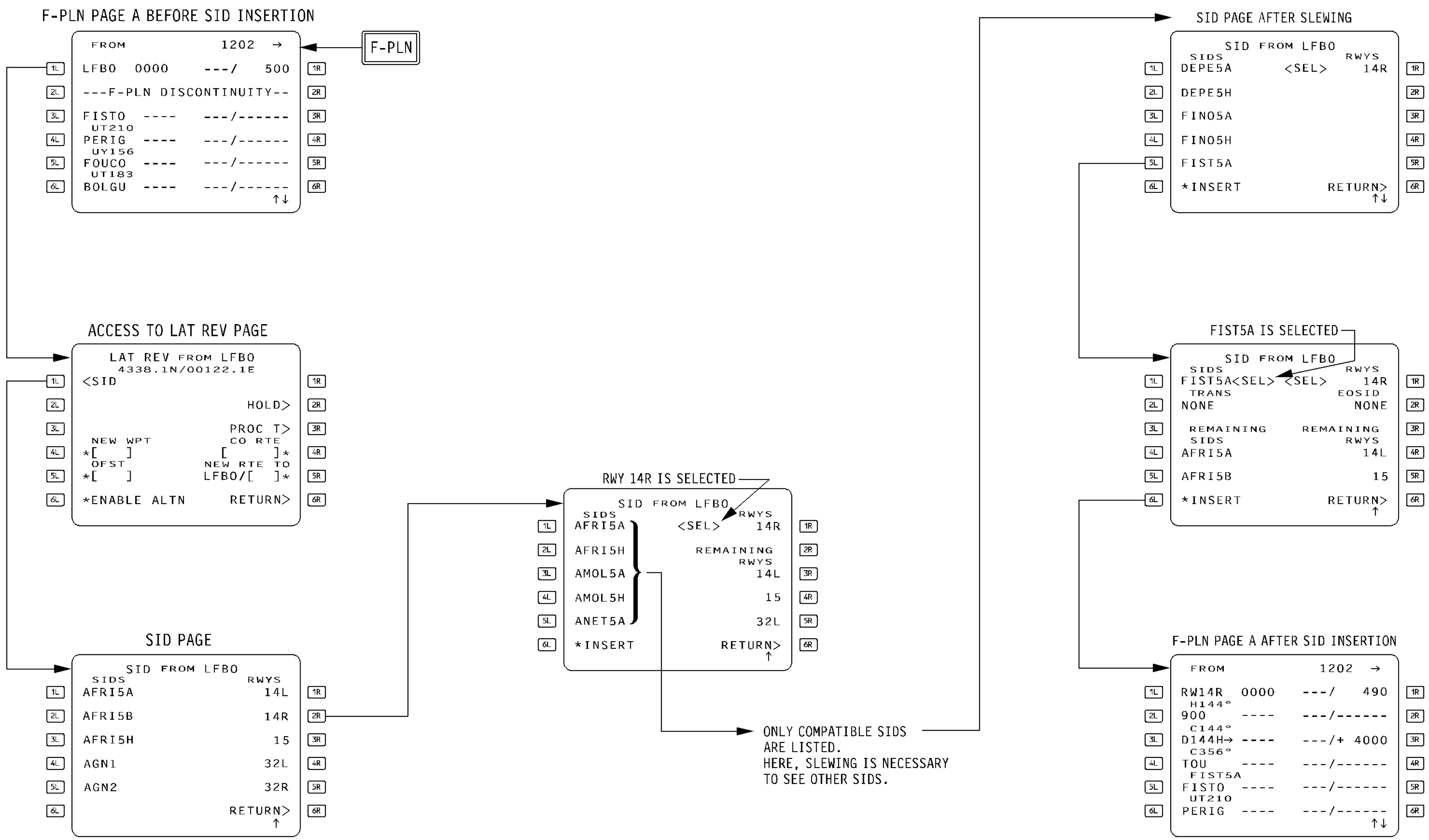
SID PAGE



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Mod : 11320 or 11364 or 12044 or 12045

1.2 – SID PAGE

1.2.1 – Purpose

- Allows to define a departure procedure from the ORIGIN airport by selecting a RWY and, if available, a SID and a TRANS between the SID and the en-route part of the F-PLN.

1.2.2 – Access

- By pressing SID (LS key 1L) on LAT REV page accessed from the origin during preflight phase.

1.2.3 – Actions to do

- See the adjacent figure.

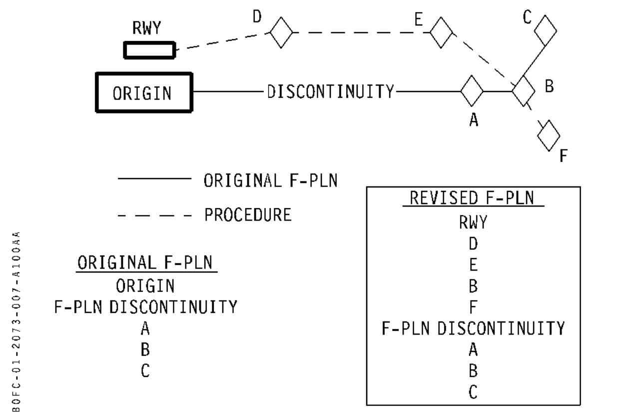
Notes :
1. *A selected SID, RWY or TRANS is indicated by « SEL » displayed next to it. « SEL » appears also when previous departure has been selected and the SID page is accessed again.*
2. *If no SID or TRANS exists, NONE is displayed in the corresponding data field.*
3. *A selected SID can be erased by using the CLR function. The selected SID en-route transition is also cleared.*
4. *A selected SID can be erased by using the CLR function. The selected SID en-route transition is also cleared.*

1.2.4 – Note on some WPTs and legs contained in a SID

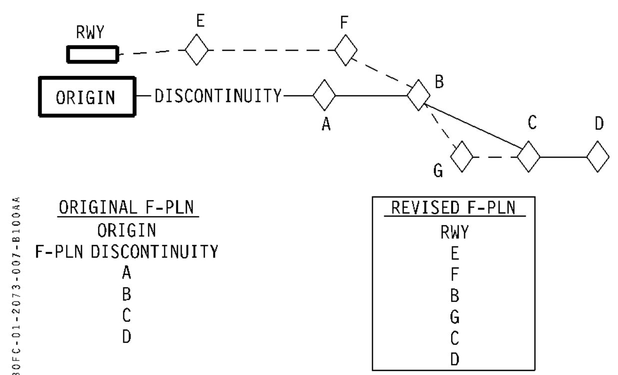
- SIDs and STARs are often composed of complex legs which use, for instance intersections with VOR radials, altitude interceptions, or air mass defined waypoints. Such a SID (or a STAR) cannot be manually constructed.
  It can be defined only by the database. It may also be difficult to revise it.
  The FMS prevents the crew from making bad lateral revisions of a SID, STAR or more generally any F-PLN which uses special legs.
- Therefore a WPT like TOU/08 cannot be called from the database (cannot be called on « WAYPOINT » page for example) because this WPT is the termination of a heading leg and so no associate coordinates (lat/long or place/brg/dist) exist for this WPT.

1.2.5 – Procedure insertion rules into the F-PLN

- **Ending WPT of the procedure not identical to a downpath WPT in original F-PLN**
  A discontinuity (---F-PLN DISCONTINUITY---) will be displayed between the ending WPT in the procedure and the first fixed WPT following the origin airport in the original F-PLN.



- **Ending WPT of the procedure identical to a downpath WPT in original F-PLN**
  All the WPTs of the original F-PLN between the origin airport and the identical downpath WPT are deleted.

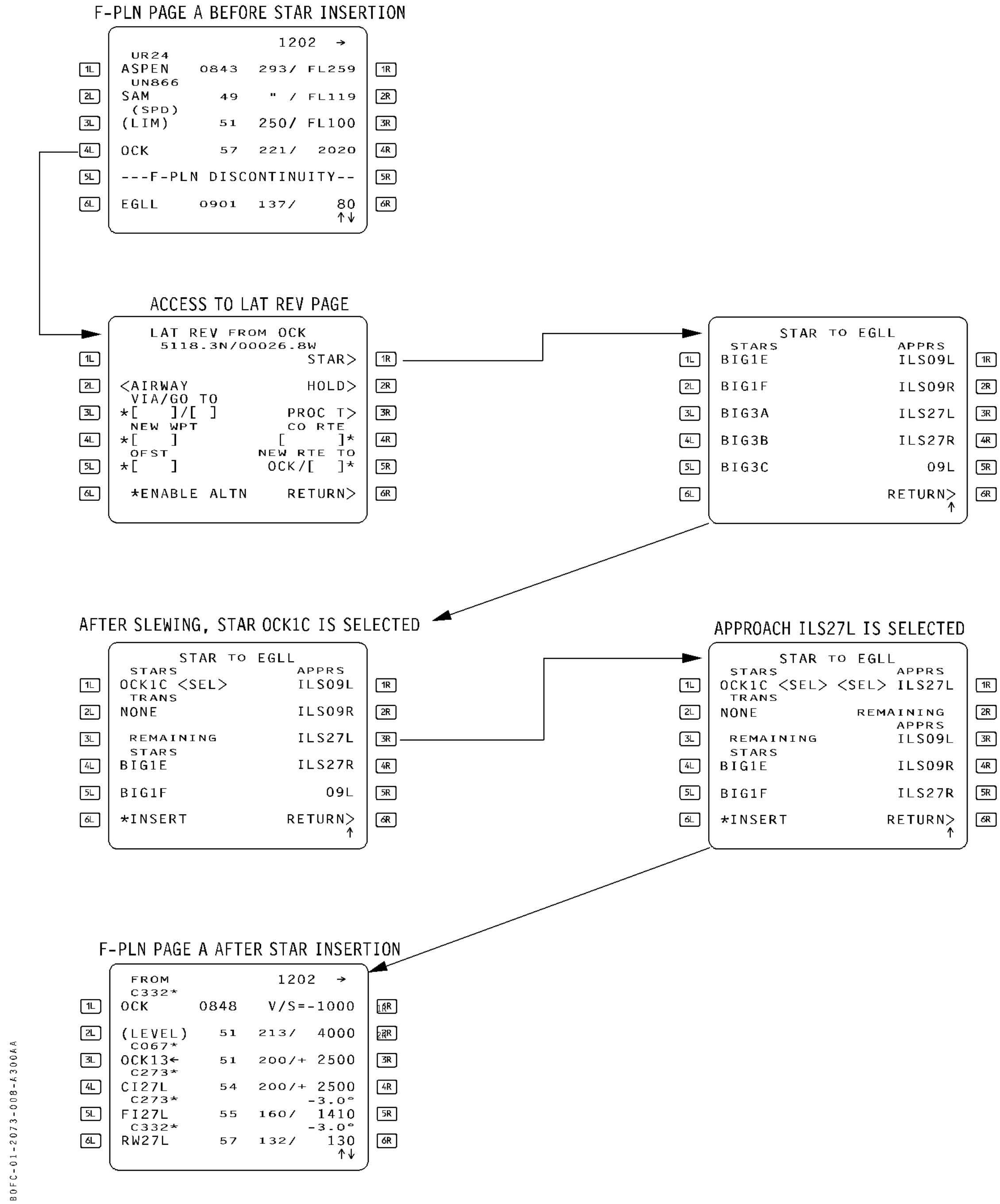


1.2.6. – Departure procedure change

- A selected RWY, SID or TRANS (either manually, or predetermined, if stored with CO RTE in the database) can be changed by pressing the LS key adjacent to an alternative one in the remaining list.
- If a RWY is selected which is not compatible with the previously selected SID, the selected SID and the en-route TRANS are automatically cleared.

Mod : 6789

STAR INSERTION



Mod : 11320 or 11364 or 12044 or 12045

1.3 – STAR PAGE

1.3.1 – Purpose

- Allows to define an arrival procedure to the DESTINATION airport by selecting an APPR (or only a RWY) and, if available, a STAR, an en-route Transition (TRANS) between the STAR and the en-route part of the F-PLN, and an approach Transition (APPR TRANS page) between the STAR and approach.
  If no STAR has been inserted in the F-PLN the default approach consists of a level off at 1500 ft followed by a final descent with a 1.7° angle.

1.3.2 – Access

- By pressing STAR (LS key 1R) on LAT REV page.

1.3.3 – Actions to do

- Select a STAR (or an APPROACH first). This causes APPR list to be modified so that compatible APPRs are first listed followed by remaining APPRs. Likewise, the STAR list is modified if an APPR (or runway only) is selected first.

- Select an APPR (or a RWY only).
  The approaches are displayed as :
  ILS 20 : for ILS approach on runway 20
  RNV 20 : for RNAV approach on runway 20
  VOR 20 : for VOR approach on runway 20
  NDB 20 : for NDB approach on runway 20
  20 : for runway 20

- Select an en-route TRANS (possible only when a STAR has been selected) if there is one.

- Press LS key 6L (next to INSERT). Display returns to F-PLN page with the selected procedure inserted except if an approach TRANS must be defined by the crew. In this case, APPR TRANS page is displayed.
  Possible approach transitions are displayed on the right side of the page from line 2R, under the label TRANS.
  Pressing LS key next to the chosen APPR TRANS inserts it into the F-PLN and makes the display return to F-PLN page. Pressing LS key 6R (next to RETURN) returns the display to the F-PLN page with the STAR- APPROACH directly strung.

Mod : 6789

Note : 1. *A selected STAR, APPR or TRANS is indicated by « SEL » being displayed next to it.*
« SEL » appears also when a previous arrival has been selected and the STAR page is accessed again.

2. *If no STAR or TRANS exists, NONE is displayed in the corresponding data field prompt.*

3. *A selected STAR, can be erased by using the CLR key. The selected STAR en-route transition is also cleared.*

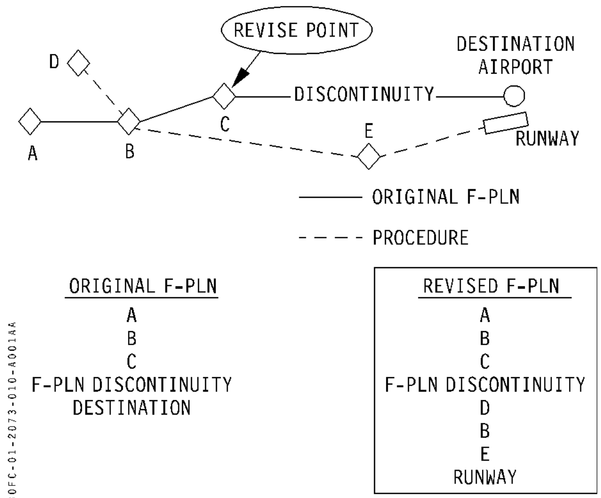
1.3.4 – Note on certain WPTs contained in a STAR

- A WPT like INTCPT cannot be found in the database (cannot be called on « WAYPOINT » page for example) because this WPT is the termination of a heading leg, and so no associate coordinates (lat/long or place/brg/dist) exist for this WPT.

1.3.5 – Procedure insertion rules into the F-PLN

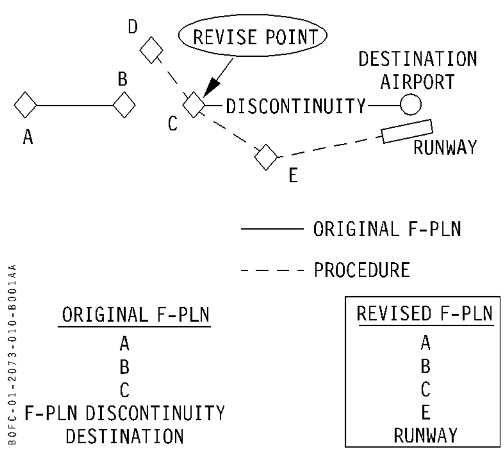
- If an approach is selected, the missed approach legs stored with that approach are automatically selected and strung into the F-PLN.
- All waypoints in the original flight plan beyond the revise point are deleted (except the destination).
- **Revise WPT not identical to a WPT in the procedure**

  A discontinuity (---F-PLN DISCONTINUITY---) will be displayed between the REVISE WPT and the first WPT in the procedure.



- **Revise WPT identical to a WPT in the procedure**

  There is no discontinuity, but all the WPTs in the procedure before the REVISE WPT are deleted.



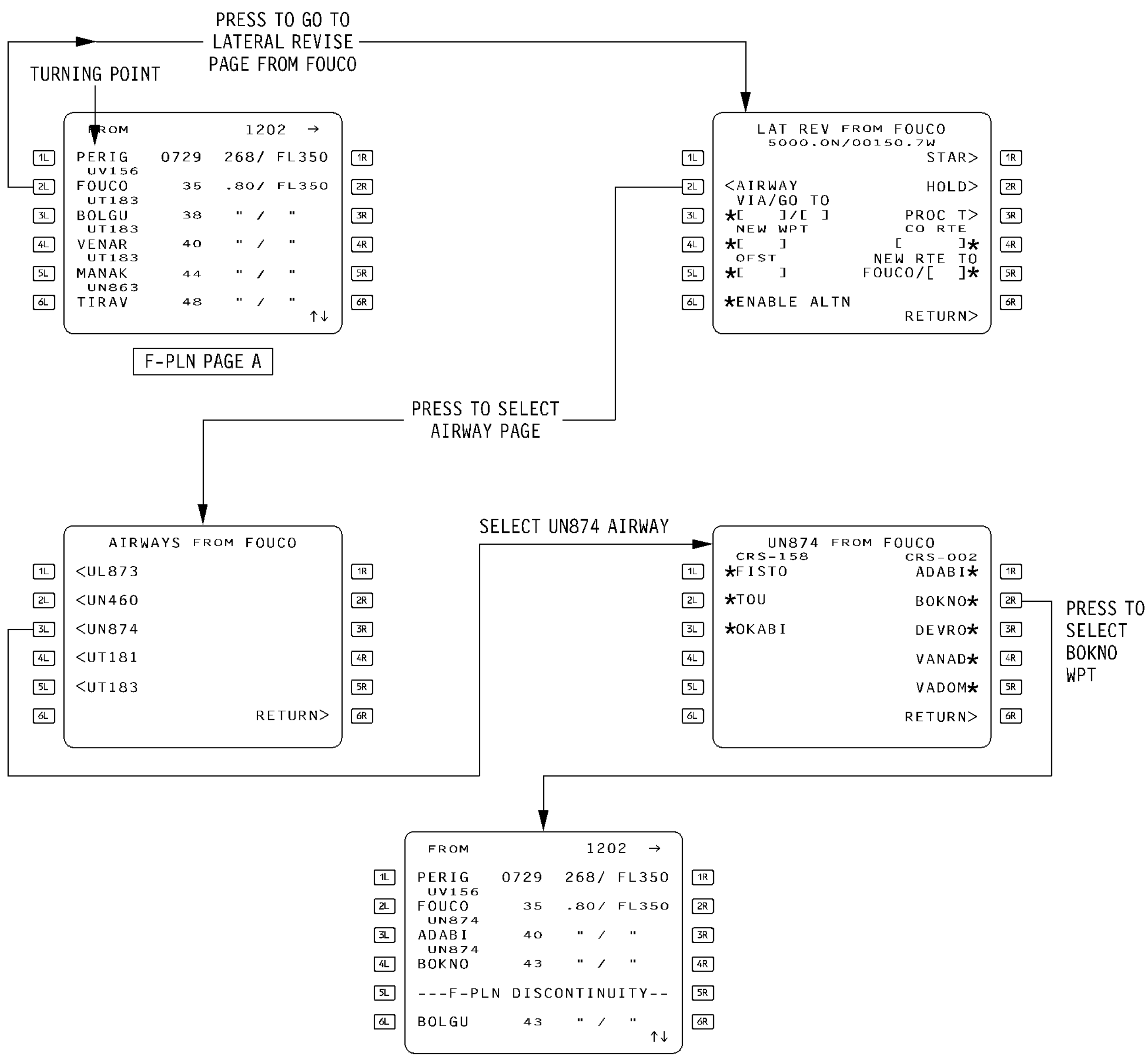
1.3.6 – Operational consequence

- Because of these rules, revise WPT should be at the same time last en-route WPT and first WPT in the procedure.
- This will allow insertion of the complete procedure without any discontinuity.

1.3.7 – Arrival procedure change

- A selected STAR, APPR or TRANS (either manually or predetermined if stored with CO RTE in the database) can be changed by pressing the LS key adjacent to an alternative one in the remaining list.
- If an APPR is selected which is not compatible with the previously selected STAR, the selected STAR is automatically cleared.

AIRWAY PAGE



F-PLN PAGE A

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1.4 – AIRWAY PAGE

CAUTION

The revise WPT may be the FROM WPT. In this case the aircraft may not be on the revised F-PLN (if NAV mode is engaged, the FMS will make the aircraft return to the path).

1.4.1 – Purpose

- Allows to select an airway or a part of an airway from the revise point.

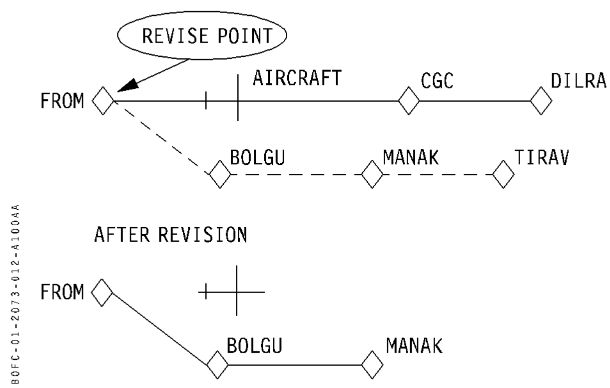
1.4.2 – Access

- By pressing AIRWAY LS key on LAT REV page.

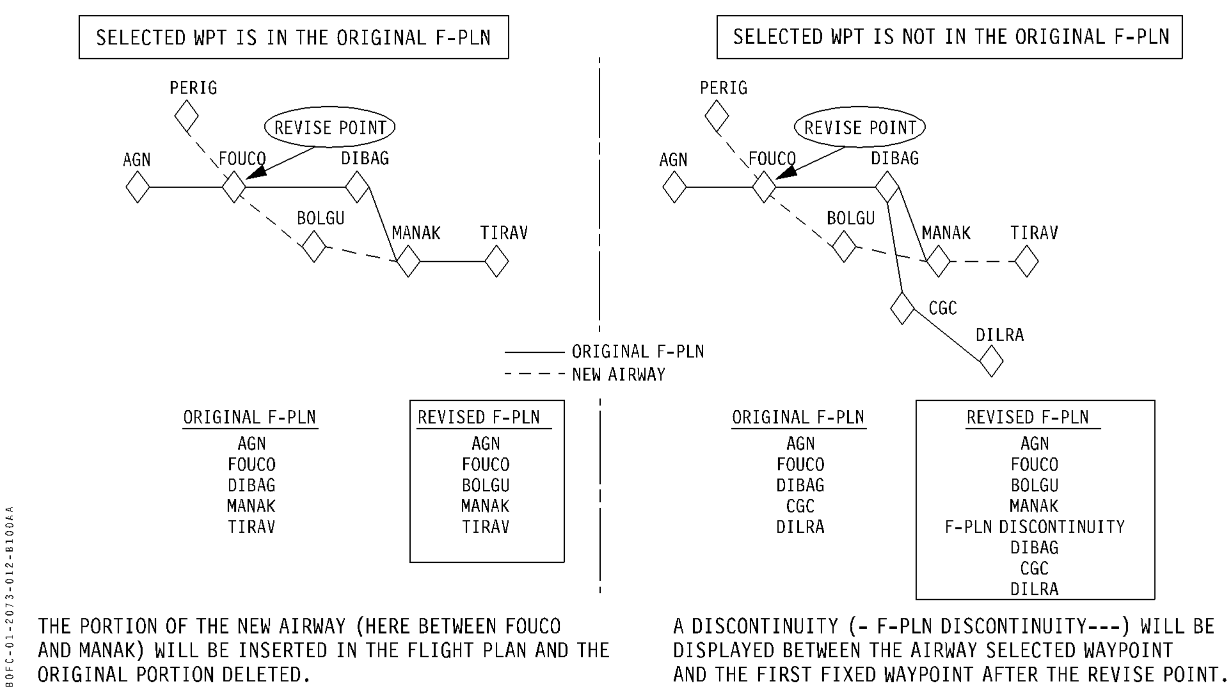
1.4.3 – Actions to do

- Select an airway among those which includes the REVISE POINT. If there are more than 6 airways, vertical slewing is available.
- Select an ending WPT on the chosen airway (here BRD). If there are more than 6 WPTs on the airway, vertical slewing is available.

Note : Selection of a WPT inserts the portion of airway comprised between the REVISE POINT and the ending WPT and also returns the display to F-PLN page.



1.4.4 – Airway insertion rules into the F-PLN



Mod : 6789

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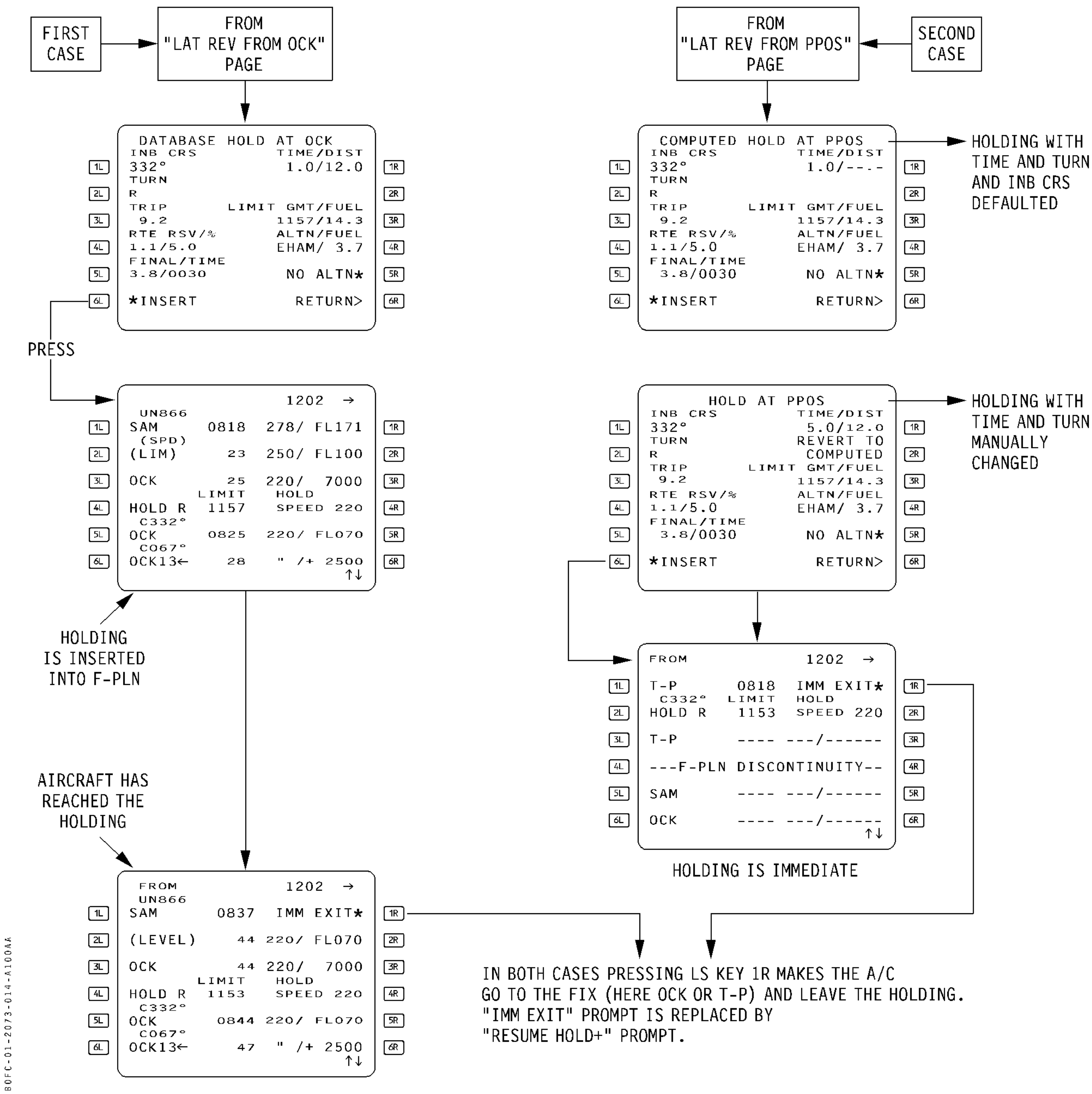
HOLD PAGE



Mod : 6789

1.5 – HOLD PAGE

1.5.1 – Purpose

- Allows to : insert or modify a HOLDING PATTERN with manual termination into the F-PLN at a given WPT or at PPOS.

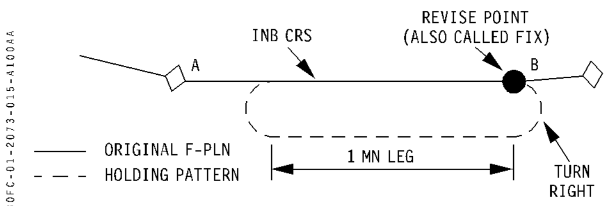
1.5.2 – Access

- By pressing HOLD LS key on LAT REV page.

1.5.3 – Actions to do

- Write/insert, if necessary, new INB CRS, TURN and TIME (or DISTANCE) instead of the existing ones (case of an already existing holding at the revise point) or instead of the predetermined ones (case where no holding exists at the revise point).
- Press LS key 6L (next to INSERT). Display returns to F-PLN page with the defined HOLDING inserted.

1.5.4 – Holding pattern definition



- Format of the title is :
  - « DATABASE HOLD AT » when a holding is already defined in database at the revise point
  - « COMPUTED HOLD AT » when there is no holding in the database at the revise point.
  - « HOLD AT » when the database parameters or the default holding parameters have been manually changed by the crew.

- Default holding parameters are :
  - Inbound Course (INB CRS) : inbound course to the holding fix from preceding WPT (or present track if the revise point is the present position – PPOS – point).
  - Turn direction (TURN) : right (R).
  - Leg time/distance (TIME/DIST) : above 14000 ft a 1.5 min leg., below 14000 ft a 1.0 min leg. Distance (DIST) is then computed by the FMC. Altitude of the holding is the predicted altitude at the revise point.
  - All predetermined parameters can be changed. For TIME/DIST only one at a time can be changed. The other is deduced using predicted ground speed. The ground speed is computed upon the predicted holding CAS.
  - Holding airspeed : before entering the holding, the predicted speed is MAX END of the clean configuration. After entering the holding the speed is MAX END of the actual configuration and is upper limited by ICAO speeds :
    - 210 kt between 0 and FL 60
    - 220 kt between FL 60 and FL 140
    - 240 kt between FL 140 and FL 240.

    The holding begins 3 min before reaching the fix. The speed may be manually changed on F-PLN page A.
- If one holding parameter has been changed, prompt « REVERT TO DATABASE » or « REVERT TO COMPUTED » is displayed (line 2R). Pressing the adjacent LS key returns to previous defined holding.

1.5.5 – Display on EFIS

- If the holding belongs to the next or active leg and the selected range on ND is 15 or 30 NM, the normal HOLDING PATTERN is displayed.
  The holding pattern size is function of the present aircraft speed when crossing the holding fix.
  In all other cases only a symbol (curved arrow) is displayed.

Mod : 6789

1.5.6 – Holding insertion

- After insertion, any holding definition or change becomes effective at the next overfly of the holding fix WPT. Holding at PPOS is immediatly activated when INSERT prompt is pressed and the aircraft position at this moment becomes the holding fix WPT.

1.5.7 – Fuel situation on HOLD page

- TRIP is the calculated trip fuel from the holding fix WPT to the destination.
- RTE RSV/% is expressed in weight/percentage of trip fuel. The display and entry rules are as defined for the INIT B page.
- FINAL/TIME is the hold fuel/time. The displays and entry rules are as defined for INIT B page.
- LIMIT GMT/FUEL is the time by which the hold must be exited and the fuel available for the hold such that reserves requirements are met. Modifications are NOT ALLOWED as these are calculated values. Because they are limit values, they are displayed in LARGE FONT.
- ALTN/FUEL is the ALTN destination and trip fuel. Any F-PLN revision updates these values but it is not possible to change ALTN destination here. The alternate trip fuel is calculated but may be manually changed.
- NO ALTN prompt is displayed when an ALTN exists in the F-PLN and the revise WPT is in the primary portion of the F-PLN (before DEST). Pressing this prompt deletes ALTN DEST and ALTN F-PLN and sets ALTN fuel to zero.

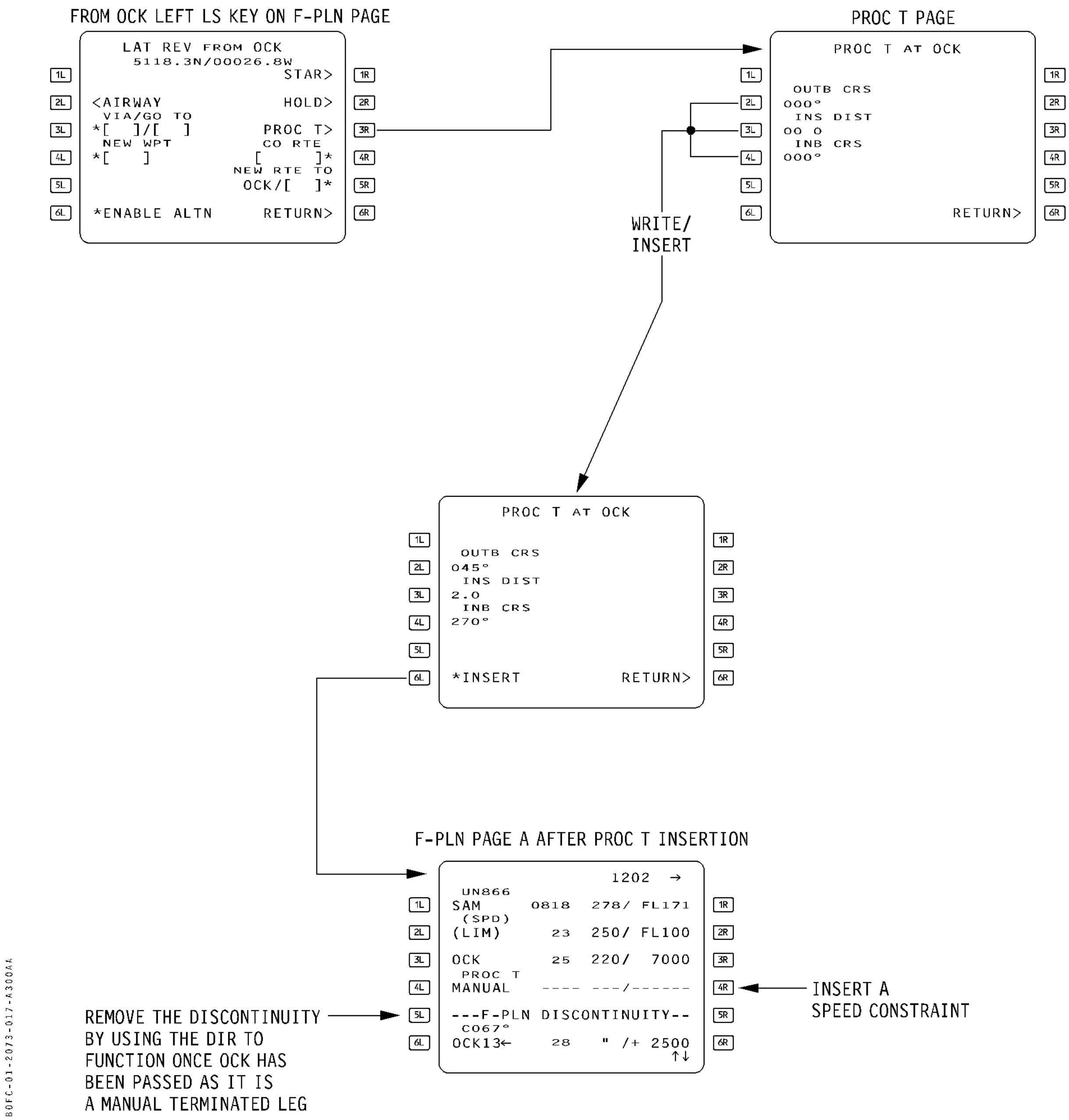
1.5.8 – F-PLN after holding insertion

- Holding patterns are not taken in account in the F-PLN predictions until 3 min before reaching the holding fix.
- « IMM EXIT » prompt appears when aircraft begins to decelerate but is replaced by « RESUME HOLD » prompt allowing reinsertion of the same holding pattern if IMM EXIT has been pressed.
  If LS key 1R is pressed again, the prompt is replaced by « IMM EXIT ».
  Otherwise, it disappears once the next leg is active.
- Holding pattern can be deleted from the F-PLN by pressing CLEAR key then left LS KEY next to HOLD line or next to FIX after HOLD.

Note : When the holding is made at PPOS (present position), a discontinuity follows the holding.

Mod : 6789

PROC T PAGE



Mod : 11320 or 11364 or 12044 or 12045

1.6 – PROC T (PROCEDURE TURN) PAGE

1.6.1 – Purpose

- Inserting or modifying a procedure turn into F-PLN at the revise point.

1.6.2 – Access

- By pressing PROC T LS key on LAT REV Page.

1.6.3 – Actions to do

- Write/insert the following three parameters :
  - OUTB CRS : outbound course from revise point
  - INB DIST : distance of inbound leg
  - INB CRS : inbound course to revise point
- Press LS KEY 6L (next to INSERT).
  Display returns to F-PLN page with the PROCEDURE TURN inserted.

Note : 1. *OUTB CRS and INB CRS are referenced to magnetic north.*

2. *PROC T cannot be accessed if the revise WPT is the FROM WPT.*

3. *If a PROC T already exists at the revise point, the defining parameters will be displayed in line 2L, 3L and 4L, but can be changed.*

CAUTION

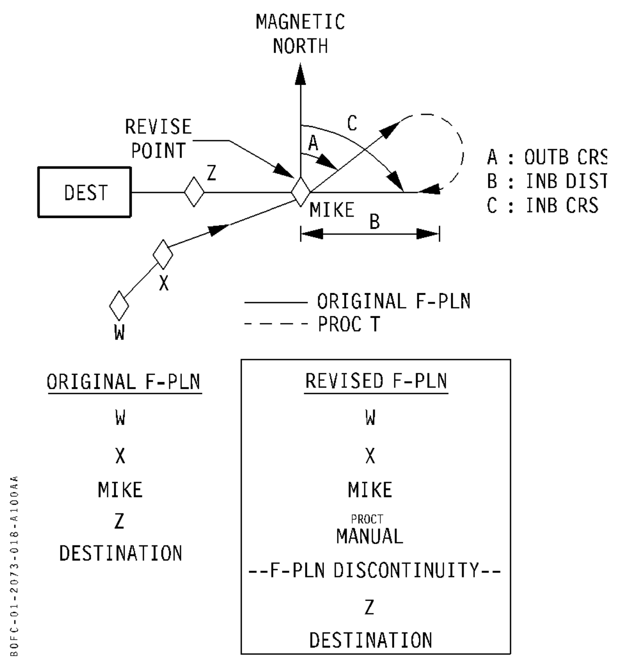
The new parameters will be inserted into the F-PLN only when LS key 6L is pressed again. Once the PROC T is inserted in the F-PLN it is necessary to insert a speed constraint at the turning point otherwise the aircraft may not be able to perform the turn.

1.6.4 – Display on EFIS

- If the PROCEDURE TURN belongs to the next or active leg and the selected range on ND is 15 , 30 or 60NM, the normal PROCEDURE TURN pattern is displayed.
- In all other cases only a symbol (curved arrow) is displayed.

1.6.5 – PROC T insertion rules into the F-PLN

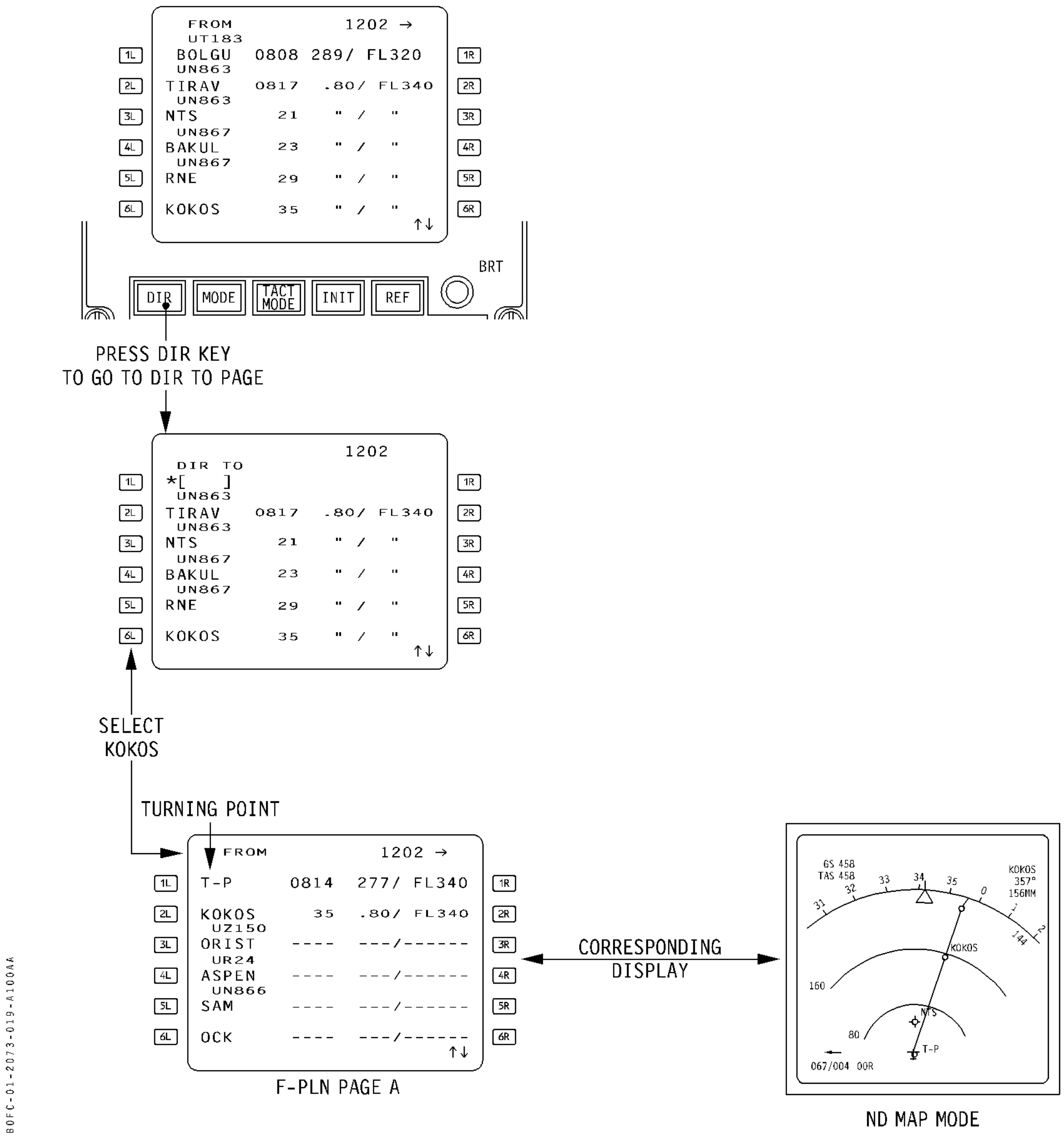
- A « F-PLN DISCONTINUITY » immediately follows the PROC T and this discontinuity cannot be cleared. A « DIRECT TO » must be performed once MIKE has been overflown as it is a manual terminated leg.



- A turn greater than 270° is not accepted.

Mod : 6789

DIR TO PAGE



Mod : 6789

1.7 – DIR TO PAGE

1.7.1 – Purpose

- The "DIRECT TO" provides a means of flying from PRESENT POSITION directly to any WPT in the active F-PLN or a WPT defined by its identifier or place/bearing/distance or lat/long.
- It is necessary to use it to exit MANUAL terminated legs (such as PROC T) with NAV mode engaged.

1.7.2 – Access

- By pressing DIR key on CDU.

1.7.3 – Actions to do

- Write a WPT in the scratchpad, then press LS key 1L (used when the WPT is not in the F-PLN).
- Press the left LS key next to desired « DIR TO » WPT if it belongs to the F-PLN.

Note : *1. When DIR TO page is accessed, « TO » WPT is displayed in line 2, then the rest of the original F-PLN (as on F-PLN page).*

2. All the PRIMARY F-PLN WPTs can be viewed on DIR TO page by using slew keys (↑ or ↓) as for F-PLN page.

3. In both solutions, display returns to F-PLN page with T-P (for Turning Point) as « FROM » WPT and the selected WPT as « TO » WPT. An immediate DIR TO maneuver is initiated if AP/FD is coupled.

4. A WPT can be entered in line 1L (first solution) by its IDENTIFIER, lat/long, place/brg/dist or place/distance.

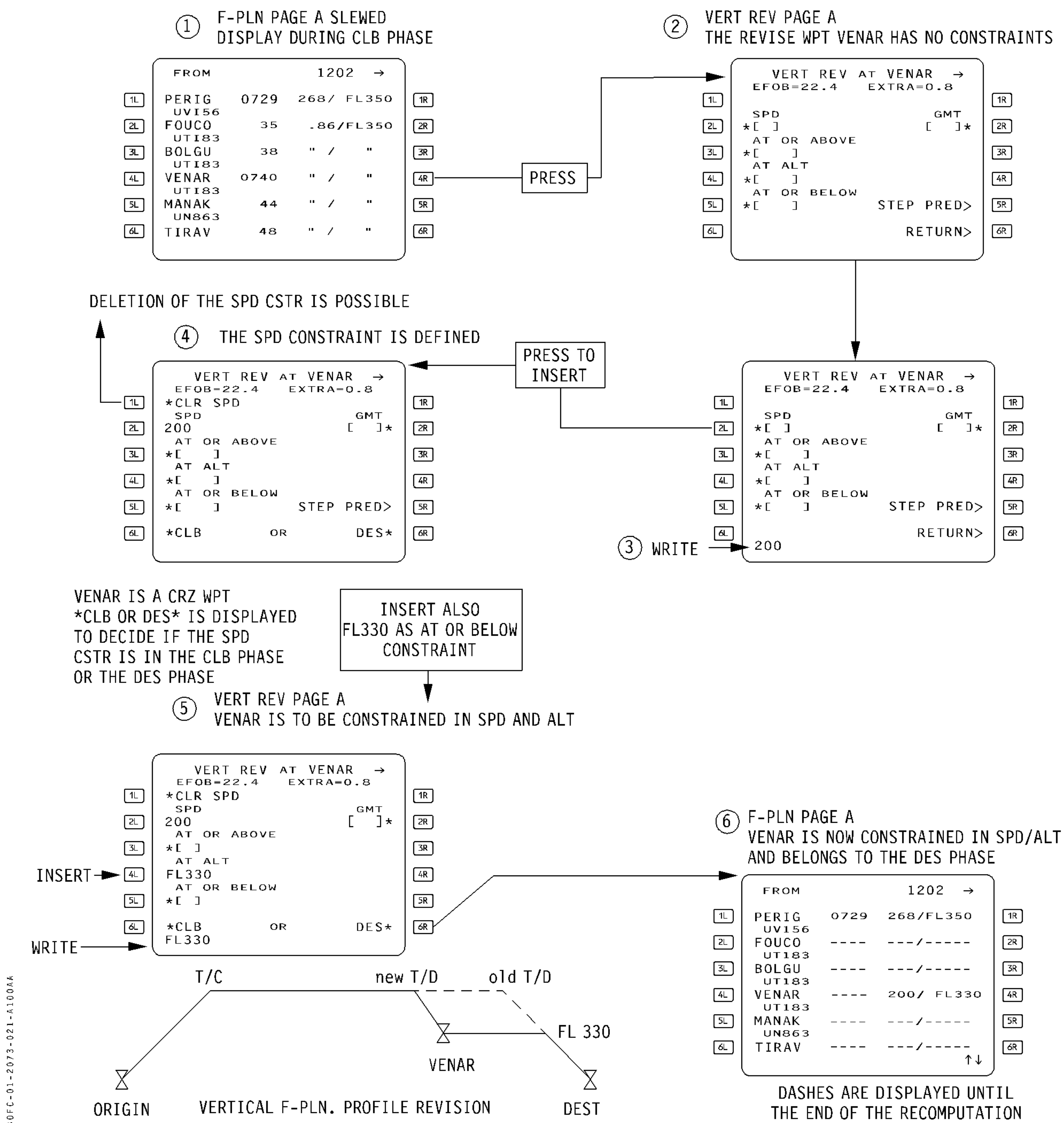
1.7.4 – « DIR TO » insertion rules into F-PLN

- Only a fixed waypoint can be inserted. Otherwise the « NOT ALLOWED » message will be displayed.
- If the « DIR TO » waypoint is a downpath WPT, all the WPTs prior to the « DIR TO » WPT are deleted.

  If it is not a downpath WPT, a discontinuity will be displayed between the « DIR TO » WPT and the first WPT after the present aircraft position.
- If the « DIR TO » waypoint is the DEST, a LAT REV at DEST is possible after « DIR TO » insertion to permit selection of RWY and STAR.

Mod : 6789

SPD/ALT CSTR INSERTION



Mod : 6789

2. VERTICAL REVISION PAGES

2.1 – VERT REV PAGE A

2.1.1 – Purpose

- Allows to insert TIME, SPD, and ALT constraints and a SPD LIMIT altitude at a particular WPT or pseudo-WPT.
- Allows access to STEP PRED page.
- SPD and ALT CSTR may also be inserted on F-PLN A but not TIME CSTR.

2.1.2 – Access

- By pressing the right LS key beside the WPT to be revised on F-PLN page A.
- Access is not allowed from the following pseudo-WPT which thus cannot be revised :

  I/P : intercept descent-path
  S/C : step climb point
  S/D : step descent point
  LEVEL : clearance altitude
  INTCPT : altitude intercept point
  T/C and T/D may be constrained. The CRZ FL may be changed by inserting an ALT CSTR.
- F-PLN Markers like F-PLN DISCONTINUITY cannot be vertically revised.

2.1.3 – Data displayed

- WPT identifier in the title line
- EFOB : estimated fuel on board at the revise WPT
- EXTRA : extra fuel at the revise WPT
- CONSTRAINTS which already exist at the revised WPT if any :
  - SPD CSTR if the revise WPT is not the T/C, T/D or SPD LIM
  - AT or ABOVE ALT CSTR
  - AT ALT CSTR
  - AT or BELOW ALT CSTR
  - TIME CSTR if the revise WPT is a fixed WPT
  - CLB SPD LIMIT altitude if the revise WPT is before T/C
  - DES SPD LIMIT altitude if the WPT is beyond T/D or during the CRZ, DES or APPR flight-phases

2.1.4 – Insertion of a constraint

- Write the constraint value (knots for a speed, either FL or feet for altitude, GMT hours and minutes for time), insert by pressing the LS key just besides the desired field
- The prompt * CLB or DES * may be displayed. Press LS key next CLB or DES to determine whether the CSTR is in the climb or the descent phase.
- If a time constraint is inserted at the origin waypoint, all predicted passing times at successive waypoints are computed and displayed on F-PLN page A.

2.1.5 – Deletion of a constraint

- Press the prompt * CLR SPD to delete a SPD CSTR
  * CLR ALT to delete ALT CSTR
  CLR GMT * to delete TIME CSTR
- The SPD LIM cannot be cleared on the VERT REV page. It is possible only on the F-PLN page A.

2.1.6 – Automatic deletion of CSTRs

- A TIME CSTR is automatically removed when :
  - ENG OUT is activated
  - a lateral revision is made prior the CSTR
  - loss of clocks
  - a second TIME CSTR is inserted
  - aircraft transitions from T/O to CLB meaning that a TIME CSTR must not be inserted on ground.

2.1.7 – CRZ FL

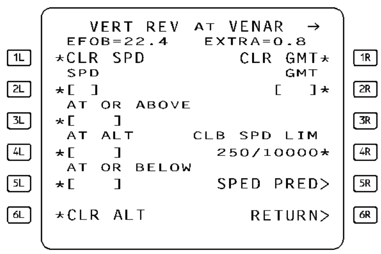
- If the revise WPT is T/C only CRZ FL is displayed instead of ALT CSTR fields. The CRZ FL may be changed here.

Mod : 6789

2.1.8 – SPD LIM

- Is defaulted to 250/10 000 and in this case displayed in small font.
  It can be changed by entering SPD/ALT in the scratchpad. If CLR key is pressed then the LS 4R key is pressed the SPD LIM is not cleared but it reverts to its default value.

VERT REV PAGE A WITH ALL POSSIBLE DISPLAYS AS AN EXAMPLE



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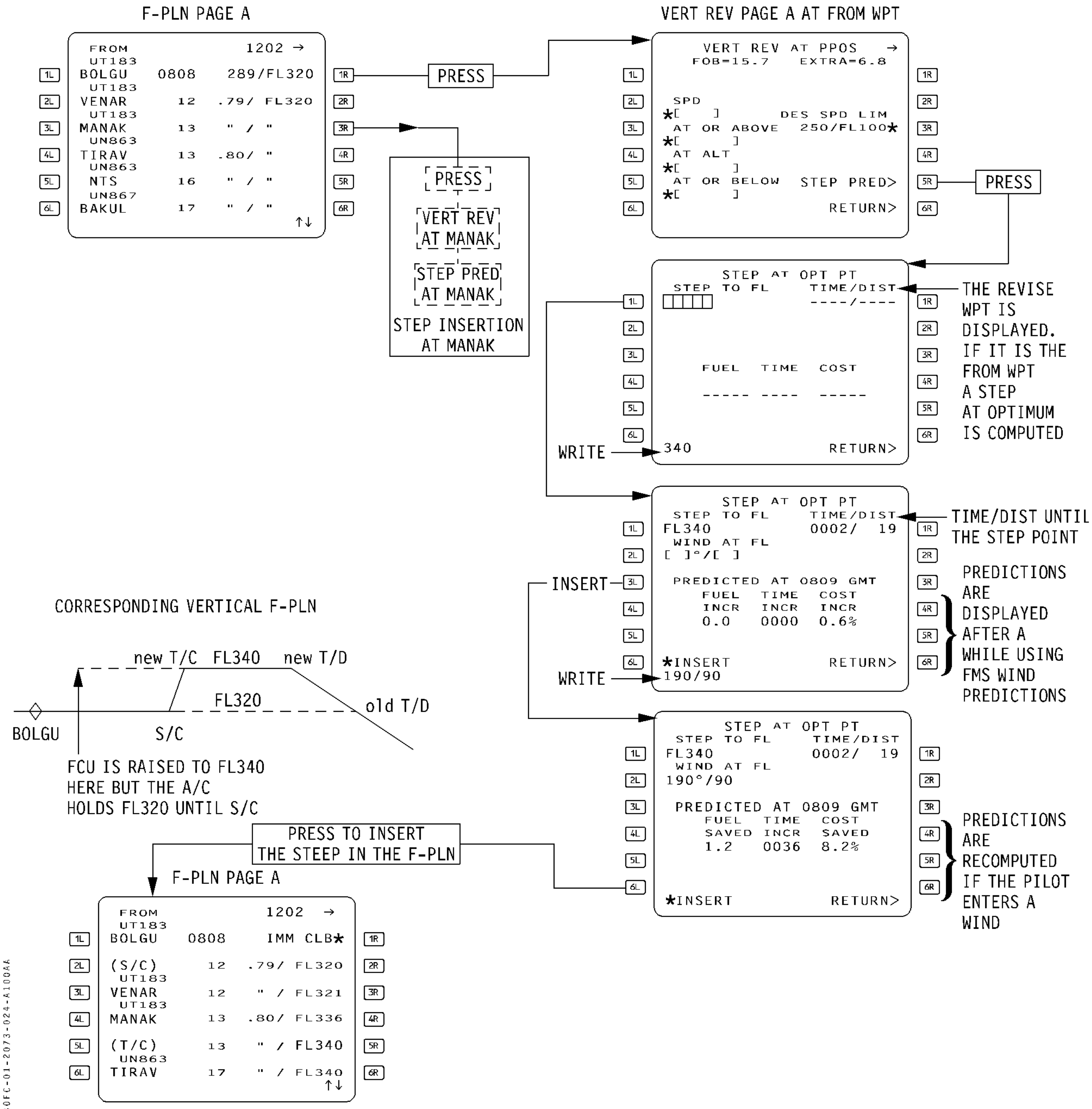
Mod : 6789

STEP CLIMB INSERTION AT OPTIMUM POINT (OR AT A GIVEN WPT)

(A STEP DESCENT IS INSERTED IN THE SAME WAY)



Mod : 6789

2.2 – STEP PRED PAGE

2.2.1 – Purpose

- Allows the crew to either :
  - predict fuel and time savings of an optimum step and to insert it in the F-PLN
  - satisfy an ATC constraint by inserting a step at a waypoint.

2.2.2 – Access

- By pressing the right LS key beside the STEP PRED prompt on VERT REV A.
- If the point from which VERT REV was accessed is the FROM WPT (1st line) then an optimum step will be computed. If it is a downpath WPT the STEP will be made at this WPT.

2.2.3 – Data displayed

- The point at which the step begins in the title line. This point is the revised WPT except if it is the FROM WPT. In this case the step begins at the OPTIMUM point.
- STEP TO altitude entered by the crew. For a STEP DES this altitude must be above the highest descent altitude constraint.
- WIND at STEP ALT
  Displayed in SMALL FONT if calculated by the FMC
  Displayed in LARGE FONT if entered by the crew.
- OPT FL, MAX FL reminders (displayed on PROGRESS page).
- FUEL, TIME, % SAVINGS in kilograms and minutes. SAVED is displayed under each data if it is saved. INCR is displayed if it is lost.

2.2.4 – Insertion

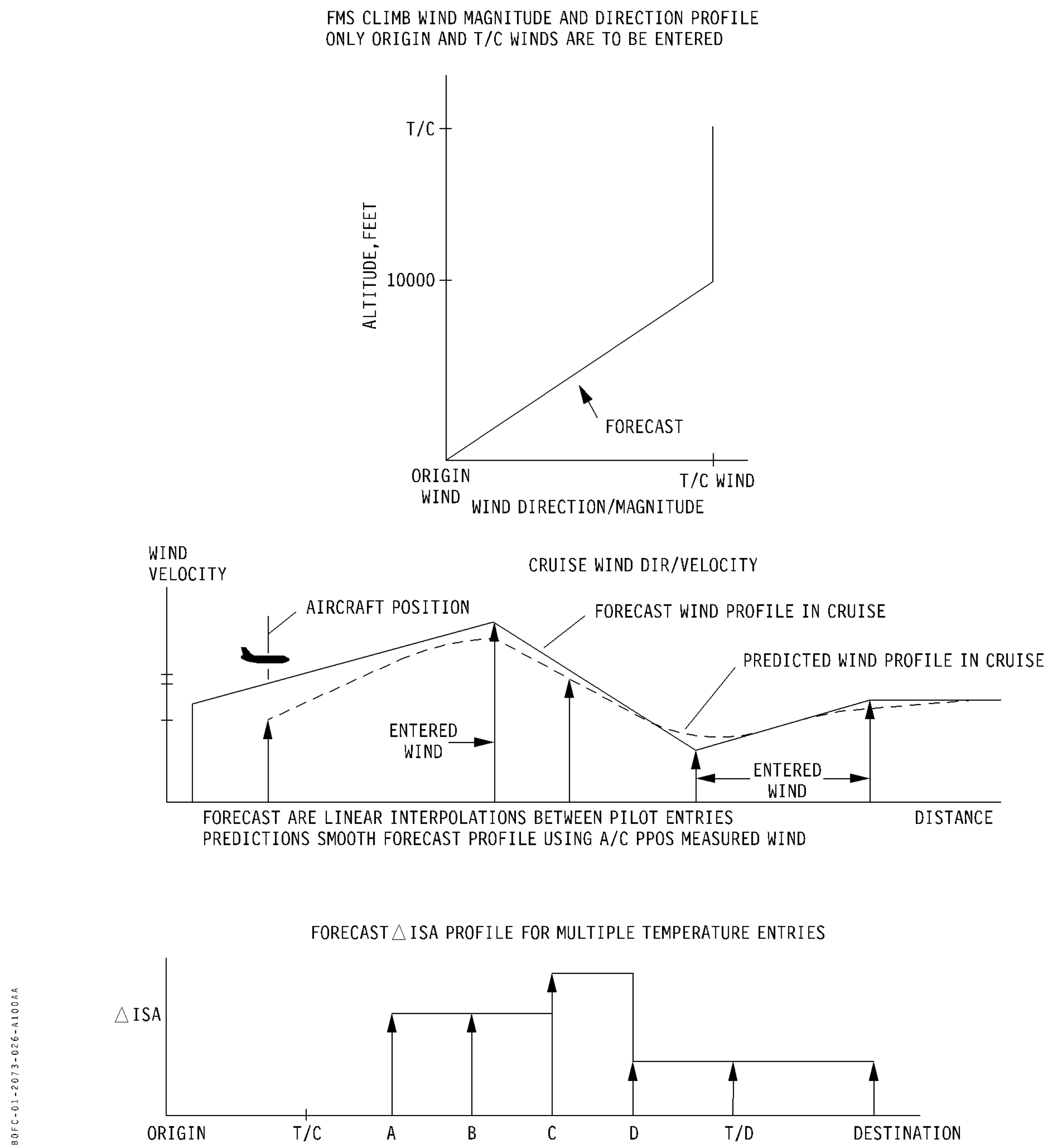
- Write the STEP ALT
- Insert in the STEP TO FL field
- Write the WIND DIRECTION/MAGNITUDE
- Insert in the WIND field
- Press the INSERT prompt
- If no WIND is inserted, the STEP is optimized with FMS wind predictions.

2.2.5 – Notes

- After insertion of a STEP climb or descent the FCU must be dialed up or down to the corresponding ALT but the aircraft will initiate its level change only at the STEP point. 30 sec before P-CLB armed on FMA will flash to advise the crew that a level change will be performed with no further actions.
- When a STEP is inserted in the F-PLN and when the aircraft has not yet reached the S/C point, if the FCU is dialed back from the STEP ALT to the present CRZ FL the STEP is removed and F-PLN recomputations are started.
- If the FCU is not dialed when reaching the S/C, the STEP is removed and a message is displayed.
- If the FCU is dialed at an altitude different from the step altitude, the step will be performed at the FCU ALT and a message will be displayed prior reaching the step point.
- A step leading to a level flight less than 5 min cannot be inserted. In this case a message is displayed.

Mod : 6789

WIND AND TEMPERATURES FORECASTS AND PREDICTIONS



Mod : 6789

2.3 – VERT REV PAGE B

2.3.1 – Purpose

- Allows to insert TEMPERATURE or WIND forecasts at WPT along the F-PLN.

2.3.2 – Access

- By pressing NEXT PAGE key from VERT REV page A or the right LS key beside the WPT to be revised on F-PLN page B.
- Access is not allowed from the same pseudo-WPT listed for VERT REV page A and also the FROM WPT except if it is the ORIGIN.

2.3.3 – Data displayed

- WPT identifier in the title line.
- EFOB : estimated fuel on board at the revised WPT.
- EXTRA : extra fuel at the revised WPT.
- Existing forecasts at the revised WPT if any. The predictions made by the FMS are not displayed.

2.3.4 – Temp Forecast insertion

- Write the TEMP in °C (with a – sign if necessary)
- Insert by pressing the left LS key below °C prompt.

2.3.5 – Wind forecast insertion

- Write WIND DIRECTION / WIND MAGNITUDE
Insert by pressing the left LS key below the WIND prompt.

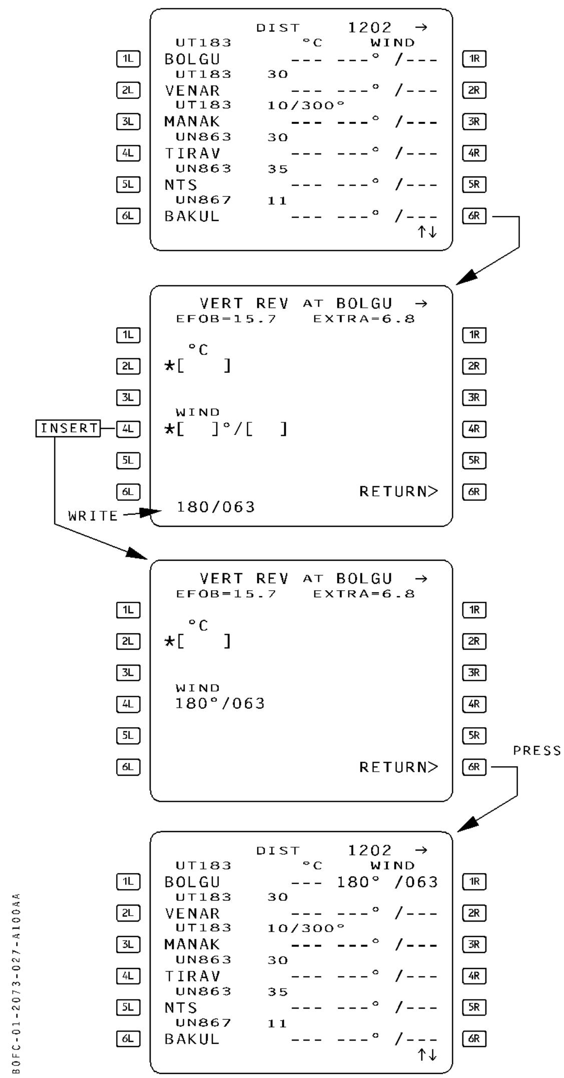
2.3.6 – Insertion rules

- Same as for F-PLN page B.
- WIND DIRECTION is referenced to the true North.
- Entries are allowed at ORIGIN, DEST, T/C, T/D and fixed WPT between T/C and T/D (CRZ WPT) but not for other pseudo-WPT.

Mod : 6789

- If a forecast is inserted at the T/C pseudo-WPT it will be considered as a CRZ forecast like the forecast entered on INIT A page or FUEL PRED page. The value displayed on these pages will be thus changed.
- Entries are displayed in LARGE FONT.
- When a CRZ wind direction is defined the defaulted wind direction for origin and destination is the same.

F-PLN PAGE B
DISPLAY ON GROUND



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Mod : 6789

1 – PROGRESS PAGE

1.1 – PURPOSE

- Allows to :
  - monitor ALTITUDE and NAVIGATION data
  - update the A/C POSITION
  - access the FUEL PRED page for fuel in-flight planning to enter the descent wind profile

1.2 – ACCESS

- By pressing PROG key on CDU.

1.3 – TITLE LINE

- Displays the performance mode and the vertical phase.

- Performance modes are (see strategic and tactical modes) :

  ECON
  MIN TIME
  MIN FUEL
  MAX CLB
  MAX DES
  MAX END
  SPD
  ENG OUT
  IMM CLB
  IMM DES
  DECEL

  (ENG OUT, IMM CLB, IMM DES, DECEL:) These are only situational commands (see F-PLN pages)

- Vertical phases are : CLB, CRZ, DES.

- In addition submodes are displayed :

  CSTR : the selected performance mode speed (TACT MODE or STRATEGIC) is not respected in order to meet a time constraint (if the aircraft is late, the FMS may order to fly at Vmax (the lowest of 340 kt or VMO – 10 kt).
  S/C : the aircraft is performing a STEP CLIMB
  S/D : the aircraft is performing a STEP DES
  ??? : the aircraft is between the target altitude and the FCU ALT because of an altitude conflict.

1.4 – ALTITUDE DATA

- Cruise (CRZ), optimum (OPT) and maximum (MAX) flight levels are displayed in line 1.

- Only the CRZ flight level can be changed.
  CRZ FL (if it has not been changed on PROGRESS page) is the one entered on INIT page A or B or the reassigned CRZ ALT.

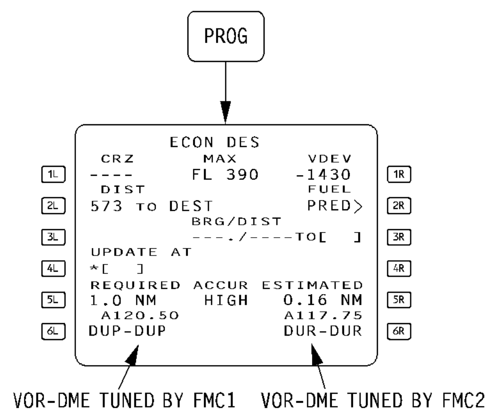
1.5 – FUEL PRED

- Pressing this prompt displays FUEL PRED page.

1.6 – VDEV

- The vertical deviation is displayed instead of OPT FL during the descent phase. It indicates the aircraft position above or below the precomputed descent path. This information is also displayed on the ND as a vertical scale similar to the G/S deviation scale.

- During holdings (manual) the vertical navigation is frozen.



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Mod : 11320 or 11364 or 12044 or 12045

1.7 – NAVIGATION DATA

1.7.1 – BRG/DIST TO

- Allows to know bearing/distance from present aircraft position to any WPT defined by its IDENTIFIER, its lat/long or its place/brg/dist.

  Note : Brg/dist is updated every 2 seconds.

1.7.2 – UPDATE AT

- Manual updating of navigation : In case no DME/DME or VOR/DME is available for AUTO UPDATING of the navigation, a manual updating of the FMCs (which are in this case in pure INERTIAL navigation) can be done :

- **Actions to do**
  - Write a WPT in the scratchpad by its identifier, lat/long or place/brg/dist.
  - Press LS key 4L – « UPDATE *» is displayed in 4R line while latitude/longitude of the entered WPT are displayed (and frozen) in 4L line.
  - Press LS key 4R when the aircraft overflies the UPDATE WPT.

    *Note : UPDATING can be cancelled while « UPDATE *» is displayed by pressing CLR key then LS key 4R.*

CAUTION

This updating applies only to the FMCs and not to the IRSs.

- An automatic updating of the FMS navigation on the RWY THRESHOLD coordinates (corrected with T.O SHIFT if inserted) is provided at takeoff when go-levers are pressed.
  This automatic updating can occur only if a RWY has previously been entered into F-PLN (through SID page).

Note : If AUTO UPDATING does not occur, a MANUAL UPDATING can be done as described above.

1.7.3 – Indication of VOR/DME tuned for display on NDs and RMIs

- VOR or VOR/DME tuned by FMC1 is shown on line 6L. The one tuned by FMC2 is shown on line 6R. The following informations are given :
  - Selected frequency
  - Tuning identifier
    A = fully automatically tuned by the FMC (autotune)
    R = navaid identifier is written/inserted by the crew in line 6L or 6R, but station is still automatically tuned by the FMC (remote tune).
    M = navaid selected by the crew on the VOR control panel (manual tune).
  - Navaid identifier
    XXX-XXX for a VOR/DME or VORTAC.
    XXX for a VOR.
    -XXX for a DME.

See chapter 1.20.32 for details on autotune, manual tune, and priorities of displayed stations.

1.7.4 – DIST to DEST

- Actual distance to destination along the F-PLN is displayed in line 2L, provided a destination airport has been entered into the F-PLN.

1.7.5 – Navigation accuracy

- Accuracy is permanently displayed. See chapter 1.20.31 for description of navigation accuracy.

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2 – FUEL PREDICTION PAGE

2.1 – PURPOSE

- Displays FUEL information pertaining to the active F-PLN for flight crew reference.

- Allows to change FUEL parameters.

2.2 – ACCESS

- By pressing « FUEL PRED » LS key on PROGRESS page.

2.3 – FUEL AND TIME PARAMETERS DISPLAY

- DESTINATION : here EGLL and EHAM.
  They cannot be changed on this page.

- TIME PREDICTIONS at destination. When A/C is airborne the field title is GMT. If A/C is on ground the title is TIME and predictions are durations.

- EXPECTED FUEL ON BOARD (EFOB) at destination during cruise phase only.
  GMT at destination is displayed during cruise phase or during deescent phase if destination is the TO or NEXT WPT.

- GW, in line 3L will change ZFW.

- FOB (Fuel on Board) in line 3R. FOB and sensors (Fuel Flow and Fuel Quantity) used for FOB calculation are displayed.

  One of the sensors can be deselected. For example here to deselect FQ sensor the crew will write/insert« /FF » in line 3R.

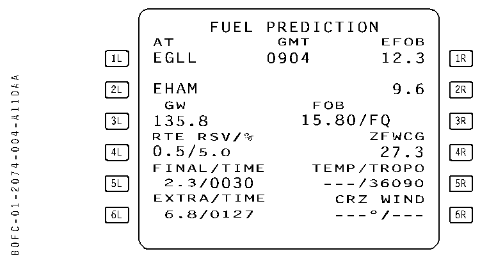
  FOB can be re-initialized by writing/inserting a new value in line 3R. This is possible only if FQ + FF or FF is displayed.
  Insertion of a new FOB deletes the FQ sensor for calculation.

- RTE RSV, FINAL/TIME, EXTRA/TIME are not available. Corresponding fields remain dashed.

- CG in 4R. Identical to CG on INIT page B. Can be changed by the crew but is displayed only during preflight phase

- TEMP/TROPO in line 5R. Identical to the TEMP/TROPO on INIT page A. TEMP is displayed in climb phase only.

- CRZ WIND on line 6R. Identical to CRZ WIND on INIT page A. It is displayed in climb phase only.



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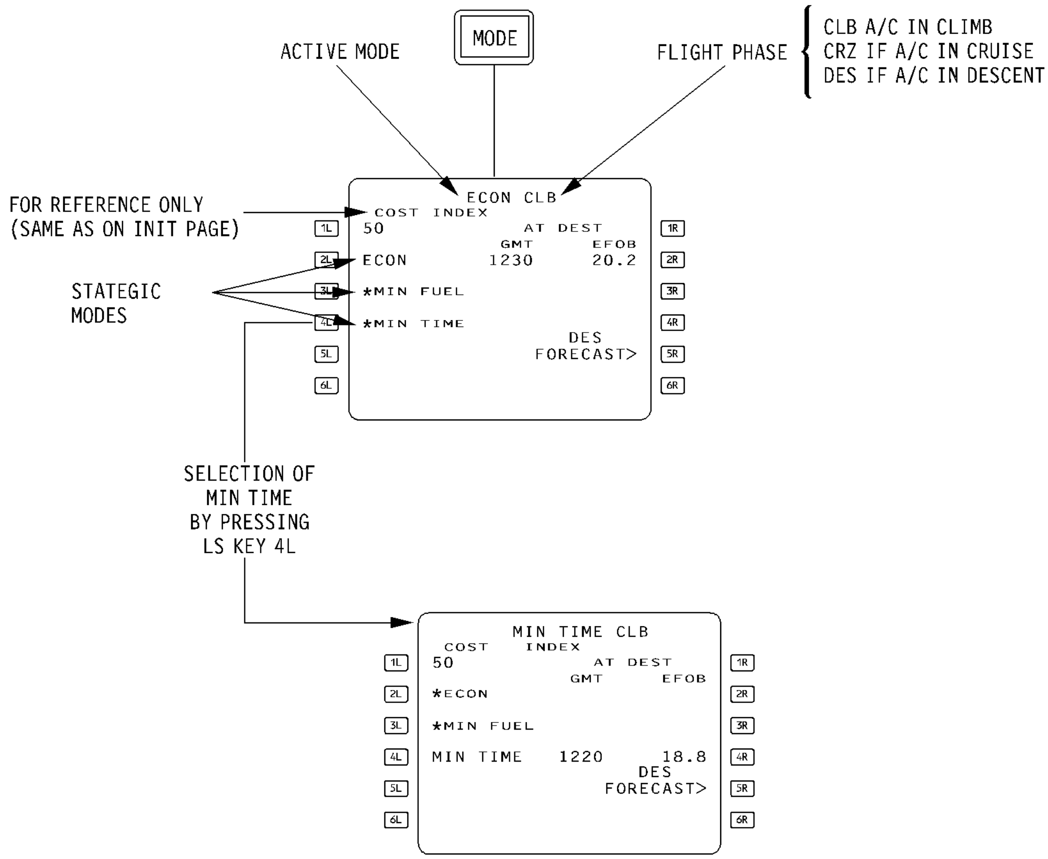
Mod : 6789

MODE PAGE



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Mod : 11320 or 11364 or 12044 or 12045

1 – MODE PAGE

1.1 – PURPOSE

- Allows to :
  - select a STRATEGIC MODE available for all the remaining parts of the flight.
  - modify the COST INDEX (if necessary).
  - access the DES FORECAST page.
- Displays TIME and FUEL predictions at destination for the active mode only.

1.2 – ACCESS

- By pressing MODE key on CDU.

1.3 – STRATEGIC MODES

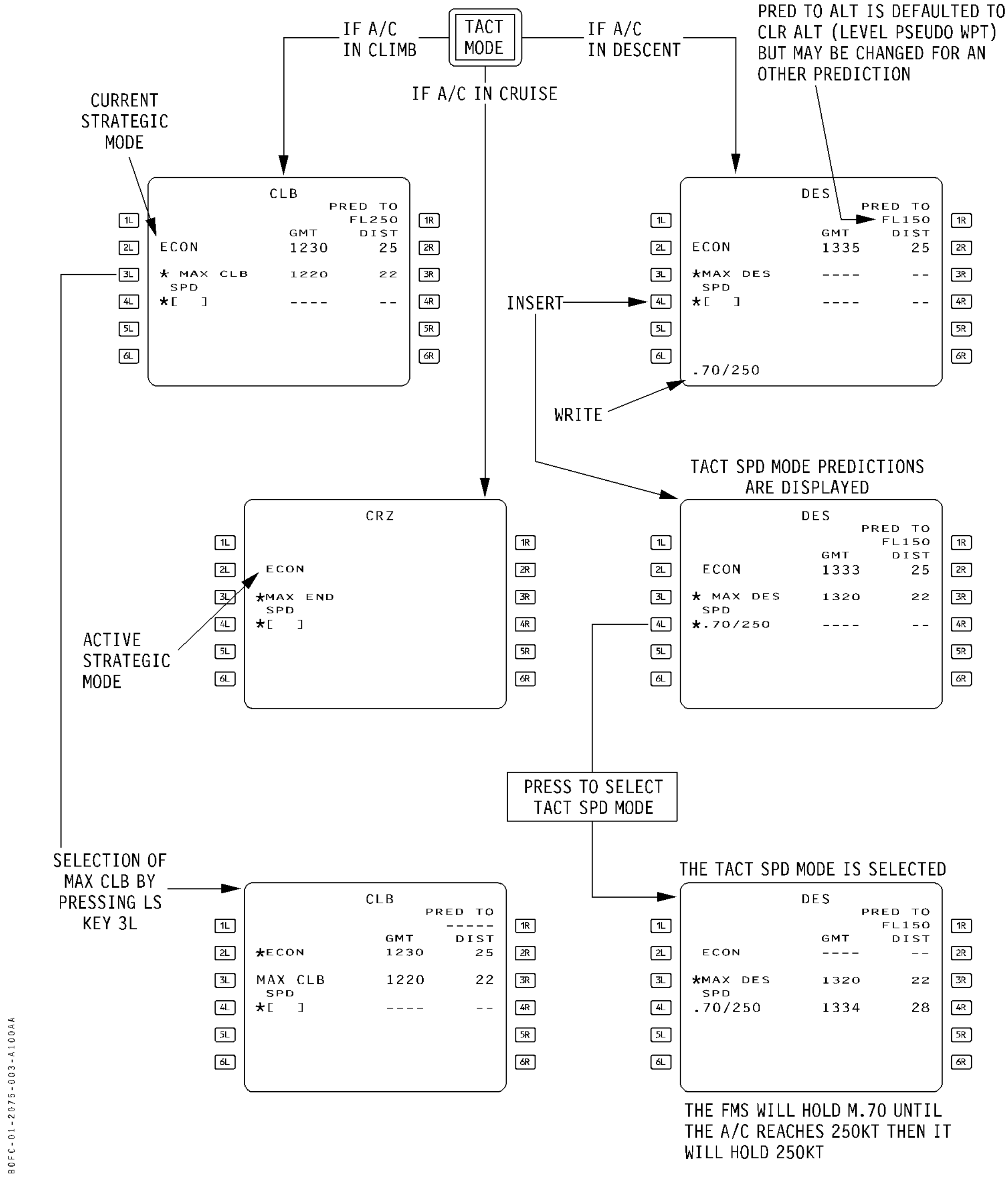
- The selected STRATEGIC MODE (or TACTICAL mode, if one has been selected on the TACTICAL MODE page) is displayed in title with the present flight phase (CLB, CRZ or DES).
- The title line is identical to the PROGRESS page title line.
- Three strategic modes can be selected on the MODE page by pressing next LS key :
  - ECON (Economic mode). This mode, which is the normal predetermined mode of the system, is based on the COST INDEX defined by the airline for the present CO RTE. (Optimization between MIN TIME and MIN FUEL).
  - MIN FUEL (Minimum fuel). This mode computes optimum speeds leading to a minimum fuel consumption. It corresponds to a CI equal to zero.
  - MIN TIME (Minimum time). This mode provides the maximum aircraft speeds within the speed envelope. It corresponds to a CI equal to 999. Selection is done by pressing the corresponding left LS key. When a mode is selected it is displayed in large font.
  - If a TACTICAL MODE is selected, the predictions are based on the present TACTICAL MODE until the end of the current phase. The STRATEGIC MODE is assumed to be resumed at this point.

  Note : – *The optimization for the ECON and MIN FUEL modes results in constant CAS/MACH climb targets. The computation is based on CDU pilot entries (cruise wind, temperature, flight level, ...)*
  – *For CRUISE phase, the optimum MACH is updated as a function of actual weight, winds, temperature and CG location.*
  – *For DESCENT phase, a fixed MACH/CAS speed target is provided. This target uses the cruise mach and a computed CAS which is a function of aircraft weight and wind component at the end of cruise phase and of pilot entries (CRZ ALT, CI).*

- In all strategic modes, the target speed is limited to GREEN DOT (or F or S) as lowest value and VM0 − 10 kt or MMO − 0.02 which ever is the lowest (or VFE or VLE) as maximum value.
- As for FUEL PRED page GMT PREDICTIONS are displayed when aircraft airborne.
  If aircraft is on ground TIME PREDICTIONS are displayed.

Mod : 11320 or 11364 or 12044 or 12045

TACT MODE PAGES



Mod : 6789

2 – TACTICAL MODE PAGE

2.1 – PURPOSE

- Allows to select a tactical mode for the present flight phase. Displays the TIME and DIST predictions to an altitude.

2.2 – ACCESS

- By pressing TACT MODE key on CDU.

2.3 – TACTICAL MODES

- Three different pages with different selectable TACTICAL MODES may be displayed depending on the present flight phase :
  - CLB page with ECON CLB, MAX CLB, SPD TACT MODES.
  - CRZ page with ECON CRZ, MAX END, SPD TACT MODES.
  - DES page with ECON DES, MAX DES, SPD TACT MODES.
- MAX CLB mode provides maximum angle of climb. The target speed becomes GREEN DOT (or F or S if not in clean configuration).
- MAX END mode maximizes the time-per-fuel ratio (minimum fuel flow). The corresponding target speed is that speed which provides maximum lift-over-drag ratio (approximately GREEN DOT).
- MAX DES mode provides maximum angle of descent.
  The target speed is MMO – 0.02 or 340 kt or VMO – 10 which ever is the lowest (or VFE or VLE).
- SPD mode allows the pilot to directly control the aircraft speed. In case the pilot wants to fly faster, the SPD LIM below the SPD LIM ALT, it is advisable to clear the SPD LIM first to avoid irrelevant messages, and to fly an optimal profile.
- Active strategic mode (here ECON) is displayed in line 2,
  - in LARGE font if no tactical mode is selected,
  - in small font (and with a * before it to allow re-activation) when a tactical mode is selected.
- Selection of a TACTICAL MODE in line 3 (MAX CLB, MAX END or MAX DES) is done simply by pressing the LS key 3L. This causes the selected TACTICAL MODE to be displayed in large font.
- To select SPD tactical mode in line 4L, first a speed must be entered (then a * appears before it) and LS key 4L must be pressed. (A SPD/MACH double entry is possible for CLB and DES phases).
- Once a tactical mode is selected, it is active until the end of the present flight phase, unless another mode is selected on TACTICAL MODE page. At the end of the present flight phase, the selected STRATEGIC MODE is automatically re-activated.
- Selection of a TACTICAL MODE does not change any other page (except the title line in MODE page) but the predictions on all CDU pages are recomputed in consequence.

2.4 – PREDICTIONS

- PRED TO on CLB and DES pages in line 2R displays the altitude to which the predictions are made.
  This altitude is defaulted to the clearance altitude but may be changed. (Altitude Intercept pseudo-WPT is calculated upon this altitude).
- GMT and DIST to the altitude are displayed for ECON mode and MAX mode. Computations begins as soon as the page is accessed.

Mod : 6789

3 – DES FORECAST PAGE

3.1 – PURPOSE

- Allows to enter descent and destination wind values for the active F-PLN.

3.2 – ACCESS

- LS key 5R on MODE page.

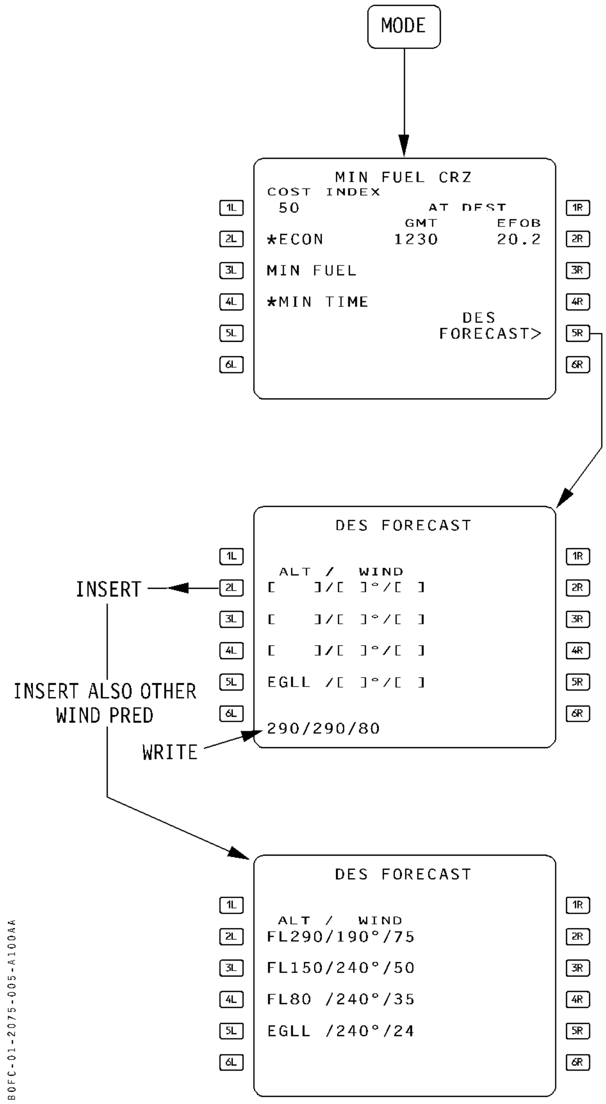
3.3 – ACTIONS TO DO

- WIND PROFILE FORECAST
  - Enter via the scratchpad altitude/wind direction/wind magnitude.
  - A maximum of three points can be defined. They are sorted by decreasing altitudes.
  - A single data can be changed in one field.
- WIND AT DESTINATION
  - Enter wind direction/wind magnitude. This data is identical to those displayed on VERT REV page B and F-PLN page B.
  - The destination cannot be changed here.

CAUTION

If the PRIMARY DESTINATION is changed or cleared (with LAT REV), DES FORECAST page is cleared and the display reverts to MODE page.

Note : 1. Predictions start immediatly after the first wind has been entered.
2. The DEST TEMP may be entered on the F-PLN page B. It has not a great influence on the descent computations. Therefore it is not necessary to enter it.



Mod : 11320 or 11364 or 12044 or 12045

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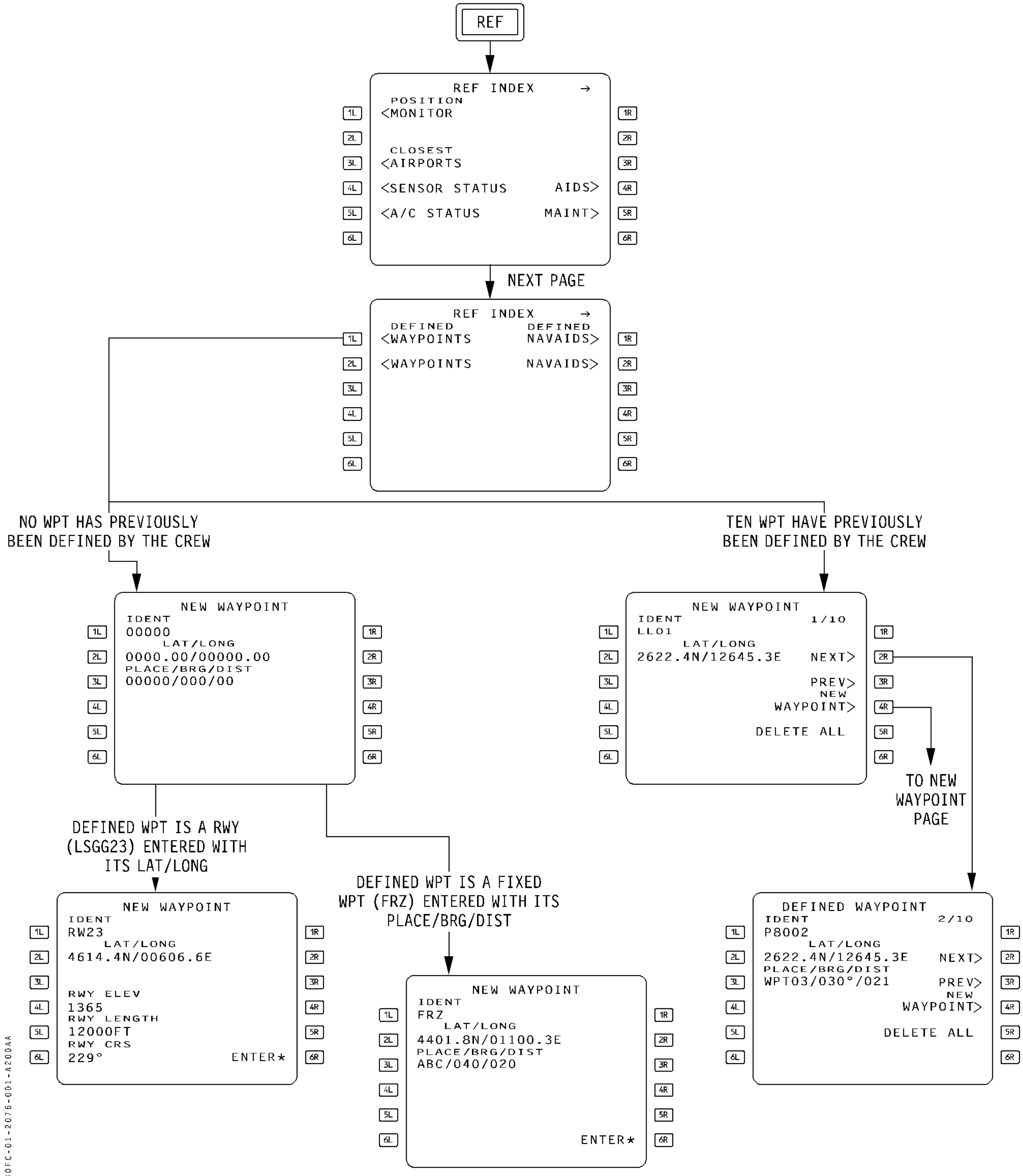
Mod : 11320 or 11364 or 12044 or 12045

REF INDEX, DEFINED WAYPOINT, NEW WAYPOINT PAGES



Mod : 11320 or 11364 or 12044 or 12045

1 – REF INDEX PAGE

1.1 – PURPOSE

- Allows, through the two REF INDEX pages, access to the functions of the different REFERENCE pages :
  - display information on existing or new waypoints
  - display information on existing or new navaids
  - display closest airports
  - display the status of the devices that provide sensor inputs to the FMCs
  - display database and aircraft identification data
  - access AIDS page
  - access maintenance page

1.2 – ACCESS

- By pressing REF key on CDU. This gives access to the first REF INDEX page which then gives access to different REFERENCE pages. The second REF INDEX page is displayed after pressing NEXT PAGE key.

2 – DEFINED WAYPOINT PAGE

2.1 – PURPOSE

- Allows to display and/or to delete waypoints defined by the crew on the NEW WAYPOINT page, or entered (by lat/long or place/brg/dist) directly on F-PLN page.

2.2 – ACCESS

- DEFINED WAYPOINTS LS key on the second REF INDEX page, when at least one WPT has been defined by the crew.

- Automatically when a new waypoint is inserted on NEW WAYPOINT page.

2.3 – INFORMATION DISPLAYED

- In the title, the number of defined WPTs and which one is displayed (here 10 WPTs have been entered and the first one is displayed).

- Identifier of the defined WPT in line 1L.
  If this WPT has been defined by its lat/long or place/bearing/distance or place/distance directly on F-PLN or DIR TO page it appears with LL (for lat/long) or PBD (for place/bearing/distance) or PD (for place/distance) and a number corresponding to its rank of entry (e.g. LL01 for the first entered WPT, PBD02 for the second entered WPT)

- Latitude/longitude of the WPT in line 2L.

- Place/Bearing/Distance of the WPT, if defined that way, in line 3L.

- Runway elevation, Length and Course, if the DEFINED WPT is a RUNWAY in line 4L, 5L, 6L.

2.4 – OPERATION RULES

- NEXT and PREV LS keys allow to change the display to view the next or previous DEFINED WAYPOINT (note that the first WPT follows the last WPT).

- A DEFINED WPT can also be viewed by entering its identifier in line 1L.

- NEW WAYPOINT LS key allows access to the NEW WAYPOINT page to define a new WPT.

- DELETE ALL LS key allows to delete all WPTs previously defined by the crew, except the ones belonging to the active F-PLN or SEC F-PLN.
  When all the WPTs are deleted, the NEW WAYPOINT PAGE is displayed.
  If certain WPTs belonged to the active F-PLN or SEC F-PLN, the display remains on the DEFINED WAYPOINT page and « F-PLN WPT/NAV RETAINED » message appears.
  The number of remaining waypoints is indicated in the title.

  Note : To delete only one WPT, clear it in line 1L. by using CLR key.

Mod : 11320 or 11364 or 12044 or 12045

3 – NEW WAYPOINT PAGE

3.1 – PURPOSE

- Allows to define new waypoints (which are not in the database). Up to 20 WPTs may be defined by the crew.

3.2 – ACCESS

- DEFINED WAYPOINTS LS key on the second REF INDEX page, if there is no defined WPT.
- NEW WAYPOINT LS key on DEFINED WAYPOINT page.

3.3 – OPERATION RULES

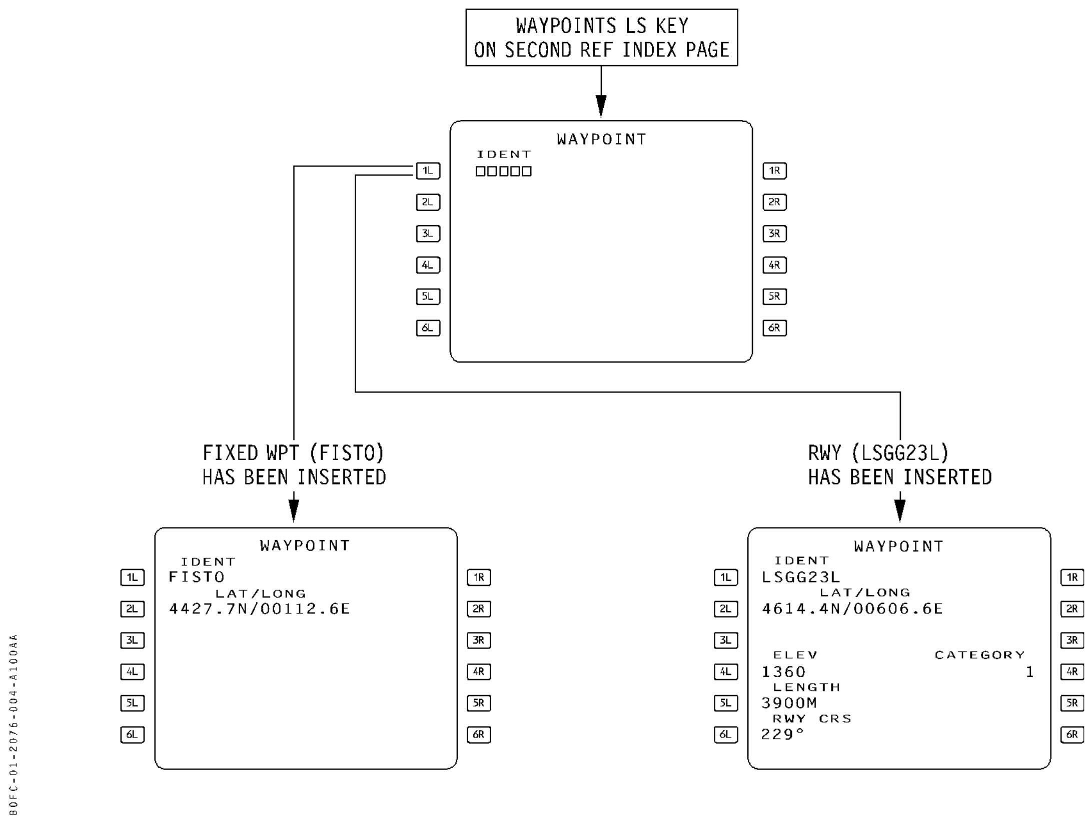
- Write/insert the waypoint identifier in line 1L.
  If it is a RUNWAY, write/insert RW NN A where NN is a number from 0 to 36 and A is either blank or an L, R or C.
  If it is an AIRPORT, write/insert the desired RWY identifier. For example insert RW32L for LFBO32L.
- Write/insert
  - either the latitude/longitude in line 2L (lat/long must be entered as 4341.1N/00144.3E or N4341.1/EO144.3. Leading zeros can be omitted).
  - or the place/bearing/distance in line 3L.

  Note : If line 2L is filled, line 3L is blanked ; but if line 3L is filled, line 2L is completed.
- If a RUNWAY has been entered in line 1L, prompts appears in line 4L, 5L and 6L.
  - Write/insert ELEVATION in line 4L.
  - Write/insert RWY LENGTH in line 5L (in feet or meters).
  - Write/insert RWY CRS in line 6L.
- ENTER * is displayed in line 6R when necessary fields are filled.
  Pressing LS key 6R inserts the WPT into the FMCs and displays the DEFINED WAYPOINT page with the newly inserted WPT.

  Note : If a 21st WPT is entered, the first one is deleted, unless it belongs to the F-PLN. In this case the second one is deleted.

Mod : 11320 or 11364 or 12044 or 12045

WAYPOINT PAGE



Mod : 11320 or 11364 or 12044 or 12045

4 – WAYPOINT PAGE

4.1 – PURPOSE

- Displays information about waypoints contained in the database.

4.2 – ACCESS

- WAYPOINT LS key on the second REF INDEX page.
- when DELETE ALL LS key is pressed on DEFINED WAYPOINT page.

4.3 – INFORMATION DISPLAYED

- Latitude/longitude of the waypoint (line 2L).
- Place/brg/dist (line 3L) if the WPT has been defined this way.
- In addition if the WPT is a runway, runway elevation (RWY ELEV), runway length (RWY LENGTH), runway course (RWY CRS), category of the approach (1, 2, 3) if there is an ILS.

4.4 – OPERATION RULES

- Write/insert WPT identifier in line 1L.
  WPT may be any database WPT, navaid airport or runway. For a runway the crew must write ARPT NN where NN is the runway number (followed by R, L or C if there is more than one RWY with the same NN) and ARPT is the ICAO airport identifier.

  Note : *1. WPT identifier may also be a DEFINED WPT.*
  2. If 2 WPTs have the same identifier, a page « DUPLICATE NAMES » appears and allows selection of the correct WPT.
  3. This page also appears, in the same conditions, when the identifier is inserted on :
  – F-PLN or SEC F-PLN pages
  – LAT REV page
  – DIR TO page
  – PROGRESS page
  – NAVAID page

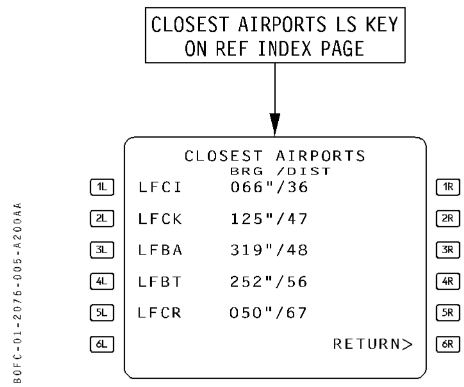
5 – CLOSEST AIRPORTS PAGE

5.1 – ACCESS

- CLOSEST AIRPORTS LS key on REF INDEX page.

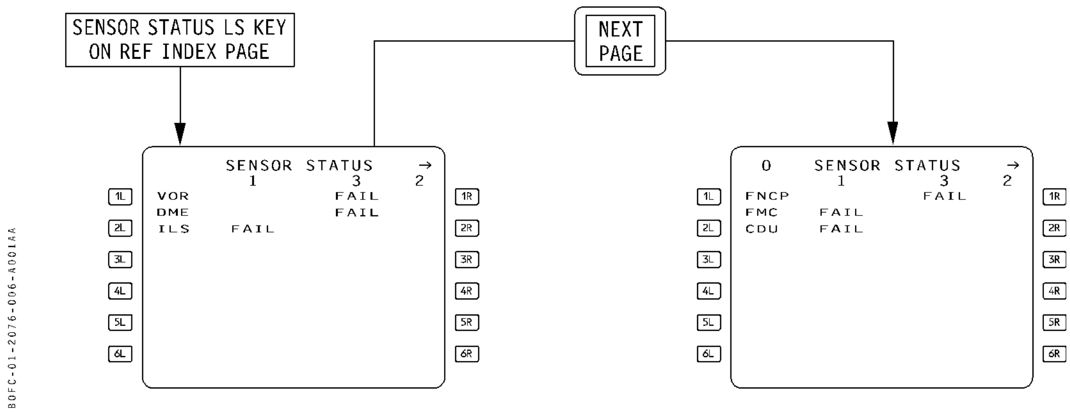
5.2 – INFORMATION DISPLAYED

- The five closest airports at the page selection time are displayed with their identifier and their magnetic bearing/distance from the aircraft position at that time. Only airports within 2000 NM from this position may be included in the display. When less than five airports are found, blanks are displayed.



Mod : 11320 or 11364 or 12044 or 12045

SENSOR STATUS PAGE



6 – SENSOR STATUS PAGE

6.1 – PURPOSE

- Displays informations on the status of the devices that provide sensor inputs to the FMCs.

6.2 – ACCESS

- SENSOR STATUS LS key on REF INDEX page.

6.3 – INFORMATION DISPLAYED

- When SENSOR STATUS page is accessed, the failed sensors for the current flight leg are displayed.
- Failed sensors for the 6 previous flights can also be displayed by pressing NEXT PAGE key.

  Each press of the NEXT PAGE key switches the display to an earlier flight in which a failure occured.

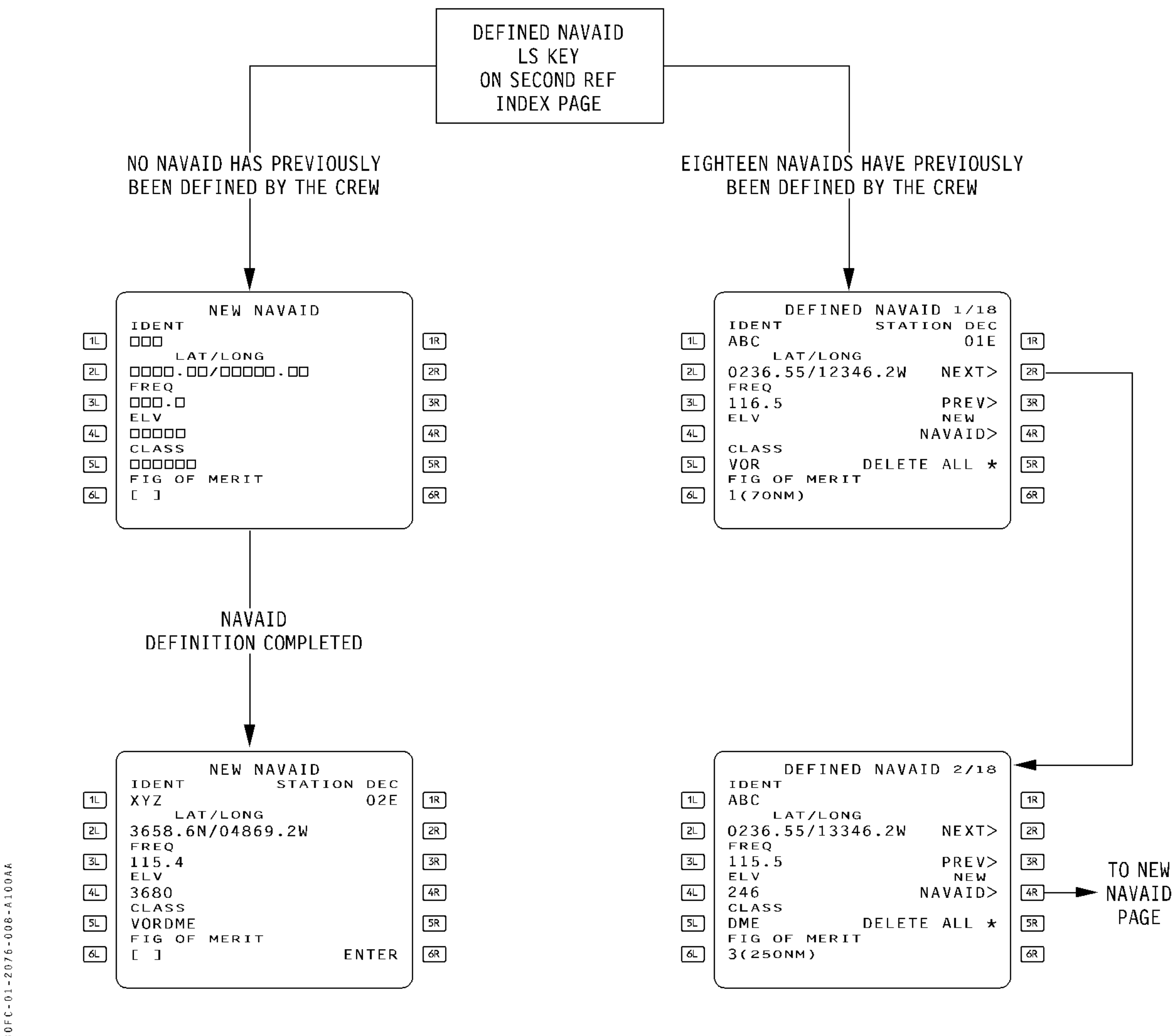
  The switching from current to previous occurs at touch down when ground speed is lower than 50 kt.
- Only the failed sensors will be displayed (up to 11 lines may be used for display, but vertical slewing is not available).
  Failed sensors are listed in 3 columns : 1 means left side of aircraft, 2 means right side and 3 means center.

  Note : when only one sensor of a type is fitted to the aircraft (FCU or FQ...), failure of this sensor is indicated in column 3.
- In title, for previous flight legs, the number of the flight is displayed (0, -1, -2, -3, -4, -5). 0 represents the first previous flight, -1 the second previous one, etc. For the current flight leg this field is not filled.

7 – A/C STATUS PAGE

- See paragraph 1.20.71 for description of the A/C STATUS page.

DEFINED NAVAID AND NEW NAVAID PAGES



Mod : 11320 or 11364 or 12044 or 12045

8 – DEFINED NAVAID PAGE

8.1 – PURPOSE

- Allows to
  - view the navaids already defined by the crew (through NEW NAVAID page).
  - have access to the NEW NAVAID page.
  - delete the navaids already defined by the crew.

8.2 – ACCESS

- DEFINED NAVAID LS key on the second REF INDEX page if at least one NAVAID has been defined by the crew.
- Automatically when a new navaid is inserted on NEW NAVAID page.

8.3 – INFORMATION DISPLAYED

- In the title the number of defined navaids and which one is displayed are indicated.
- NAVAID IDENTIFIER in line 1L.
- Latitude and Longitude (LAT/LONG) of the NAVAID in line 2L.
- Frequency in line 3L.
- Elevation in line 4L. Nothing is displayed in 4L if it is a VOR.
- CLASS (in line 5L) : the navaid may be a VOR, a DME, a LOC, an ILS, an ILS/DME, a VORTAC, a VOR/DME.
- FIG of MERIT (in line 6L) see definition in « NEW NAVAID PAGE » description.
- STATION DECLINATION is displayed in line 1R when the navaid is a VOR, VORTAC or VOR/DME.

8.4 – OPERATION RULES

- NEXT LS key : changes the display to the next defined navaid.

  Note : the first defined navaid follows the last one.

- PREV LS key : changes the display to the previous defined navaid.

  Note : the last defined navaid follows the first one.

- A DEFINED navaid can also be viewed by entering its identifier in line 1L.
- NEW navaid LS key : allows access to the NEW NAVAID page to define a new navaid.
- DELETE ALL LS key : allows to delete all navaids previously defined by the crew, except the ones used as WPTs in the active F-PLN.

  When all defined navaids are deleted the navaid page is displayed.

- If certain navaids were used as WPTs in the active F-PLN, the display remains on the DEFINED NAVAID page and « F-PLN WPT/NAV RETAINED » message appears. The number of remaining navaids is displayed in title.

  Note : To delete only one navaid, clear it in line 1L by using CLR key. Same remark as above applies if this navaid is an active F-PLN WPT.

Mod : 11320 or 11364 or 12044 or 12045

9 – NEW NAVAID PAGE

9.1 – PURPOSE

- Allows to define new navaids (which are not in the database). Up to 20 navaids can be defined by the crew.

9.2 – ACCESS

- DEFINED NAVAID LS key on the second REF INDEX page if no navaid has been defined by the crew.
- NEW NAVAID LS key on DEFINED NAVAID page.

9.3 – OPERATION RULES

- Write/insert the NAVAID identifier in line 1L.
- Write/insert the LATITUDE/LONGITUDE in line 2L.
- Write/insert the FREQUENCY in line 3L.
- Write/insert the ELEVATION to the nearest 10 ft in line 4L. Not necessary if the navaid is a VOR only.
- Write/insert the CLASS in line 5L.
  VOR = VOR only
  DME = DME or TACAN
  VORDME = collocated VOR/DME
  VORTAC = collocated VOR/TACAN
  LOC = LOCALIZER
  ILSDME = collocated ILS/DME

Note : *A LOC/DME navaid may be defined on the NEW NAVAID page by entering "ILSDME" in the CLASS field. The LOC/DME is considered by the FMS as an ILS/DME without GLIDE function.*

- Write/insert its FIGURE OF MERIT in line 6L.
  If nothing is inserted, 2 is assumed.
  For a LOC this field is not displayed.

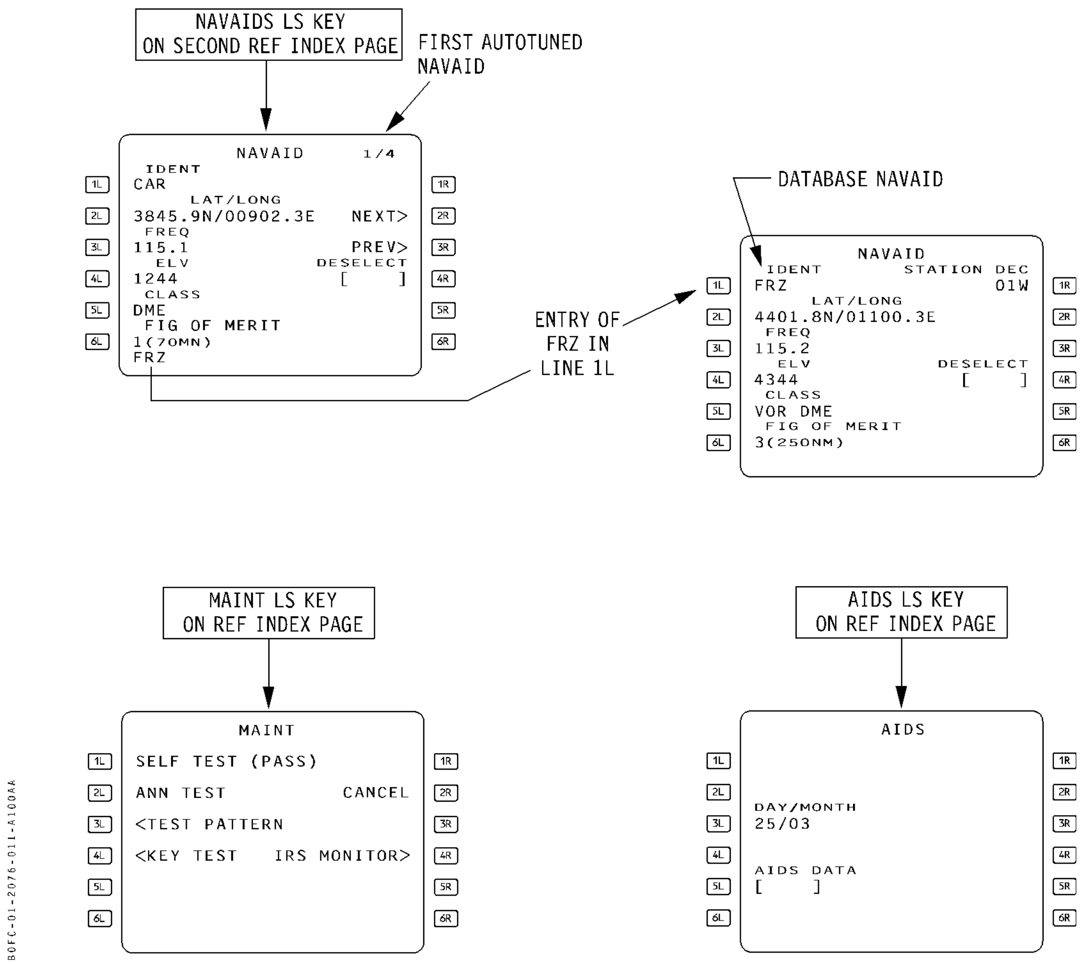
  The figure of merit is a number assigned to each navaid, indicating the maximum distance at which it can be tuned.
  0 means 40 NM at maximum
  1 means 70 NM at maximum
  2 means 130 NM at maximum
  3 means 250 NM at maximum

- If VOR, VORTAC or VORDME is entered in line 5L, station declination must also be written/inserted in line 1R.
- ENTER * is displayed in line 6R when necessary fields are filled.
  Pressing LS key 6R inserts the navaid into the FMCs and displays the DEFINED NAVAIDS page with the newly inserted navaid.

Note : *If a 21st NAVAID is entered, the first one is deleted, unless it is a F-PLN waypoint. In this case the second one is deleted.*

Mod : 11320 or 11364 or 12044 or 12045

NAVAID, MAINT, AIDS PAGES



Mod : 11320 or 11364 or 12044 or 12045

10 – NAVAIDS PAGE

10.1 – PURPOSE

- Displays characteristics of navaids being tuned by the FMC, or any navaid in the database.
- Allows to deselect navaids that are in the database.

10.2 – ACCESS

- NAVAID LS key on the second REF INDEX page
- When DELETE ALL LS key is pressed on DEFINED NAVAID page.

10.3 – INFORMATION DISPLAYED

- When the page is called it displays characteristics of the navaids automatically tuned by the FMCs.
- Characteristics of any database navaid can be obtained by inserting the navaid IDENTIFIER in line 1L.
  - In the title the number of autotuned navaids (by FMCs) and which one is displayed are indicated (here 4 navaids are autotuned and the first one is displayed).
    As soon as a NAVAID identifier is inserted in line 1L, these figures disappear.
  - For fields 1L, 2L, 3L, 4L, 5L, 6L, 1R display is identical to the one on DEFINED NAVAID page, except that non-collocated VOR/DME can be displayed.
    The consequences are that :
  - NON-COLLOCATED word is displayed in line 5.
  - LAT/LONG is the VOR lat/long.
  - ELEVATION is the DME elevation.

10.4 – OPERATION RULES

- When AUTOTUNE function is active (VOR/NAV/ILS switch on NAV or ILS) :
  - NEXT LS key : changes the display to the next autotuned navaid.

    Note : *the first autotuned navaid follows the last one.*
  - PREV LS key : changes the display to the previous autotuned navaid.

    Note : *the last autotuned navaid follows the first one.*
  - The navaid selected for DISPLAY is always displayed as number 1. Second and third ones are navaids for UPDATE and last one is the ILS/DME if being tuned.
- When AUTOTUNE function is not active :
  on the side where VOR/NAV/ILS switch is on VOR, only one navaid (the one tuned on VOR control panel) is displayed.
- For any database navaid :
  - Write/insert navaid identifier in line 1L.
  - NEXT and PREV prompts disappear.
- For any navaid DESELECTION : Write/insert navaid identifier in line 4R.

  Deselection results in that navaid not being tuned or used neither for navigation nor for display by the FMC. Only one station may be deselected at a time, deselection of a second station will allow the FMC to use again the first one.
  The deselected navaid can be cleared by using CLR key or is automatically cleared at landing (so the FMC can tune it again).
- If 2 navaids have the same identifier, a page DUPLICATE NAMES appears and allows selection of the correct navaid : see chapter 1.20.77.
  Note : *DUPLICATE NAMES page also appears, in the same conditions, when the identifier is inserted on :*
  - *F-PLN or SEC F-PLN pages*
  - *LAT REV page*
  - *DIR TO page*
  - *PROGRESS page*
  - *WAYPOINT page*

Mod : 11320 or 11364 or 12044 or 12045

11 – AIDS PAGE

11.1 – PURPOSE

- Allows to enter certain data into the AIDS.
  - Entering data into AIDS DATA field (line 5L) causes this data to be inserted into the AIDS.
  - Normally the date is automatically displayed in line 3L (from the clock), but it can be altered by the crew.
    The displayed date is automatically inserted into the AIDS.

11.2 – ACCESS

- AIDS LS key on REF INDEX page.

12 – MAINT (MAINTENANCE) PAGE

12.1 – PURPOSE

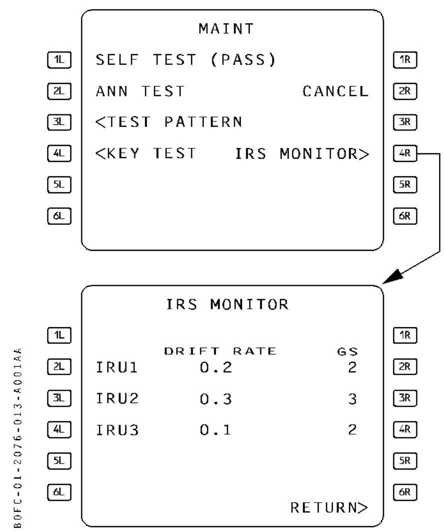
- Allows maintenance crew to perform certain test functions by pressing LS key 1L, 2L, 3L or 4L.

12.2 – ACCESS

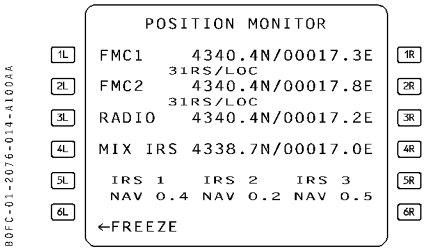
- MAINT LS key on REF INDEX page, only on ground, with engines shut down.

12.3 – IRS MONITOR PAGE

- The IRS MONITOR page provides IRU drift rates and terminal ground speed readings at the end of a flight.
  The page may be accessed on the ground only by pressing the REF key, selecting the maintenance page, and pressing the IRS MONITOR prompt.
  The page cannot be accessed during flight, and if displayed when the transition from preflight is made, the F-PLN page A is displayed.
- At takeoff, when the ground speed is greater that 120 kts, or the aircraft is airborne, the takeoff time and the bearing and distance from the FMC position to each IRU position are stored in FMC memory.
  After the aircraft has landed, and the ground speed is below 60 kts, the FMC once again measures the land time and bearing and distance from the FMC position to each IRU position and records it in memory.
  By resolving the two bearings and ranges for each IRU into total drift and then dividing by the trip time, the average drift rate for each IRU is calculated and displayed. The value is rounded up to the next whole tenth of a NM/hour.
- The ground speed (GS) displayed on the CDU is the residual ground speed for each IRU at engine stop rounded to the next whole NM/hour. If a valid ground speed is not being received at engine stop, dashes will be displayed.



13 – POSITION MONITOR PAGE



13.1 – PURPOSE

- Displays the following basic navigation data on a single page :
  - the FMC 1 and 2 aircraft position,
  - the FMC 1 and 2 navigation mode,
  - the aircraft radio position,
  - the mixed IRS position,
  - the IRS 1, 2 and 3 mode and deviation.

13.2 – ACCESS

- By pressing the POSITION MONITOR key on REF INDEX first page.

13.3 – INFORMATION DISPLAYED

- Title : when the page is called, the title is POSITION MONITOR. When pressing the FREEZE key, the title changes from POSITION MONITOR to POSITION FROZEN AT followed by the time (in green) at which the pilot has frozen the display.

- Lines 1 and 2 : display the aircraft position and the navigation mode from FMC 1 and 2. Navigation modes are described in chapter 1.20.32.

- Line 3 : displays the radio position or dashes.

- Line 4 : displays the mixed IRS position.
  See description in chapter 1.20.32.

- Line 5 : displays for each individual IRS :
  - the IRS mode (INVAL, ALIGN, NAV or ATT),
  - the deviation (in NM) between each IRS and the onside FMS. It is displayed only if the IRS are in NAV mode.

- Line 6 :
  - FREEZE/UNFREEZE prompt :

    At first access to the page, FREEZE prompt is displayed and data is continuously updated.

    - Pressing the adjacent key freezes the display (UNFREEZE prompt is displayed).
    - Pressing the adjacent key a second time unfreezes the display and revert to the current aircraft position display (FREEZE prompt is displayed again).

    If the page is left without unfreezing the display, the FREEZE prompt function is automatically deleted.

Mod : 11320 or 11364 or 12044 or 12045

1 – PURPOSE

- Allows the crew to select the right WPT or navaid when more than one exists in the with the same identifier database.

2 – ACCESS

- Automatically when a non-unique WPT, airport, runway or navaid identifier is inserted via the scratchpad in a data field of one of the following pages :
  - – F-PLN page A or B
  - – LAT REV
  - – SEC F-PLN page A or B
  - – PROGRESS
  - – NAVAID
  - – WAYPOINT
  - – DIR TO

3 – INFORMATION DISPLAYED

- The different WPTs or navaids that have a common identifier are displayed in line 1 to 6 with their LAT/LONG and, if the entered identifier is entered as a navaid, their frequency.
- If there are more than 6 common WPTs or navaids, vertical slewing is available.

4 – OPERATION RULES

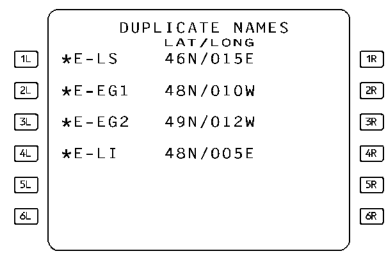
- Example 1 : E has been inserted as a WPT identifier in a data field of one of the above mentionned pages.
  The database search found 4 WPTs with an E followed by a minus, so those 4 WPTs are displayed as DUPLICATES.

  Note : The two letters after the minus (–) are the country code.
  E-EG1 for example means first waypoint ECHO in England.

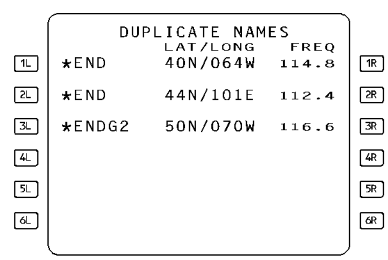
- Press LS key corresponding to correct WPT.
  This selects that WPT as the inserted WPT and the display reverts to the previously displayed page.
  In this example if E-LS had been entered on a data field instead of just E, the DUPLICATE NAMES PAGE would not have been reached because E-LS would have been a unique name.
- Example 2 : Three navaids ENO exist in the database : Press LS key corresponding to correct navaid.
  This selects this navaid as the inserted navaid and the display reverts to the previously displayed page.

DUPLICATE NAMES PAGE

EXAMPLE 1 : ECHO (E) WPT HAS BEEN ENTERED
ON A DATA FIELD



EXAMPLE 2 : END NAVAID HAS BEEN ENTERED
ON A DATA FIELD



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