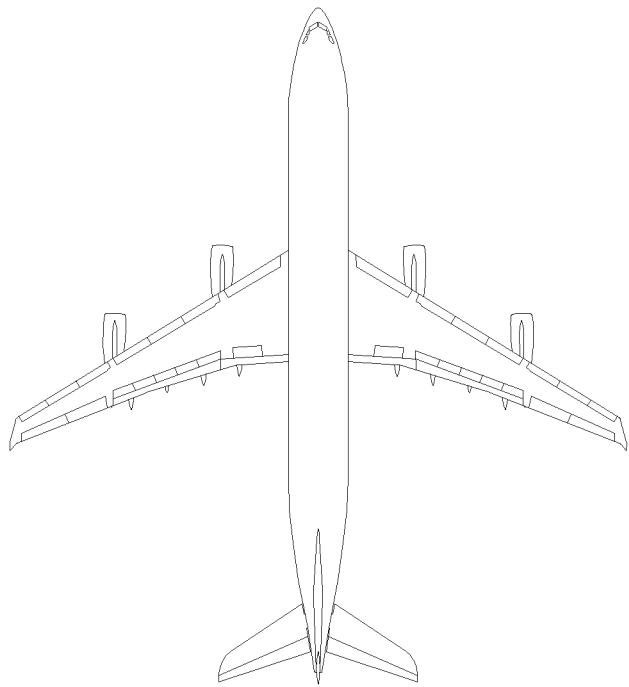


# **A340**

## **FLIGHT CREW OPERATING MANUAL**



### **SYSTEMS DESCRIPTION**

# **1**

 **AIRBUS**®

**A340**

FLIGHT CREW OPERATING MANUAL

**GENERAL INFORMATION**

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**CONTENTS**

SEQ. 001 REV. 08

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**FOREWORD**

- R This manual complements the approved Flight Manual. Airbus has attempted to ensure that the data contained in this manual agrees with the data in the Flight Manual. If there is any disagreement, the Flight Manual is the final authority.

**COMMENTS — QUESTIONS — SUGGESTIONS**

All manual holders and users are encouraged to submit any Flight Crew Operating Manual questions and suggestions to :

R

AIRBUS - BP N°33  
1 ROND POINT MAURICE BELLONTE  
31707 BLAGNAC CEDEX - FRANCE  
TELEX TLSBI7X or 530526F  
FAX 33.5.61.93.44.65 / 3.29.68  
ATTN. Flight Operations Support  
- STL

FOR TECHNICAL OR  
PROCEDURAL  
CONTENT

AIRBUS - BP N°33  
1 ROND POINT MAURICE BELLONTE  
31707 BLAGNAC CEDEX - FRANCE  
TELEX TLSBP7X or 530526F  
FAX 33.5.61.93.28.06  
ATTN. Technical Documentation Services  
- SDC

FOR PRINTING AND  
DISTRIBUTION

**CONTENT**

- R The Flight Crew Operating Manual is the support documentation for flight crew operations.
- R The Flight Crew Operating Manual provides operating crews with the technical, procedural
- R and performance characteristics of the A340 aircraft to ensure a safe and efficient
- R operation during normal and/or abnormal/emergency situations on ground and in flight.
- R However, the Flight Crew Operating Manual is not intended to provide basic jet aircraft
- R piloting techniques or information that are considered as basic airmanship for trained flight
- R crews familiar with that type of aircraft and with its general handling characteristics.
- R The Flight Crew Operating Manual is intended :
- R — To be used directly as flight crew operating manual or to be the basis for elaboration of
- R the relevant parts of the "crew manual" by the operations department of the operator
- R in accordance with applicable requirements.
- R — To be used as a flight crew training manual (initial and refresher).
- R However, the Flight Crew Operating Manual is not intended to be used for teaching basic
- R piloting skills.

The content is divided into four volumes :

- Vol 1 = Systems' description (description of the aircraft systems).
- Vol 2 = Flight preparation (performance information, plus loading data).
- Vol 3 = Flight operations (operating procedures, techniques, and performance information).
- Vol 4 = FMGS pilot's guide (procedures for FMGS use).

## USE

As a comprehensive set of references, the FCOM :

- can be used by an operator's Flight Operations department to supplement its own Crew Manual
- can be issued directly to crew members for training and subsequently for line operations.

### **WARNINGS, CAUTIONS AND NOTES**

**WARNING** : an operating procedure, technique, etc, which may result in personnel injury or loss of life if not carefully followed.

**CAUTION** : an operating procedure, technique, etc, which may result in damage to equipment if not carefully followed.

**NOTE** : an operating procedure, technique, etc, considered essential to emphasize.

### **COMPLEMENTARY INFORMATION**

The manual includes technical information required for training as well as complementary information.

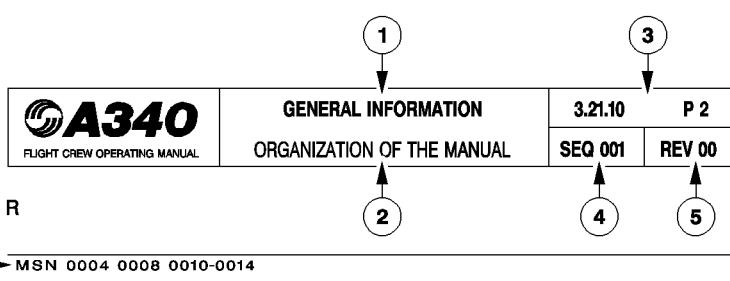
- Where a paragraph or schematic is preceded by the heading **FOR INFO** the details given are considered to be "nice to know". Knowledge of these items is not required for the type rating qualification.
- ECAM warnings and cautions are summarized in a table at the end of each chapter of volume 1. Numeric values are given for information only.

### **OPTIONAL EQUIPMENT**

The symbol "«" indicates that a paragraph or a schematic is applicable only if the related equipment is installed.

**PAGINATION**

FFC5-01-0010-003-A001AA



- ① Chapter title
- ② Subchapter title
- ③ FCOM volume number, chapter number, section number, page number
- ④ Sequence number is used for Airbus Industrie management of different aircraft configurations and allows to enter into list of effective pages.
- ⑤ Revision number of the manual at which the page has been revised.
- ⑥ Aircraft MSN
  - 0004 0008 means that the page is applicable to aircraft MSN 0004 and MSN 0008
  - 0010-0014 means that the page is applicable from aircraft MSN 0010 to MSN 0014
  - ALL means that the page is applicable to all aircraft covered by the manual.Correspondance between MSN and registration may be found in the cross reference table.
- ⑦ An R in front of a line indicates that the line has been revised.

## REVISIONS

### NORMAL REVISIONS

There are issued periodically to cover non-urgent corrections and changes and to add new data.

They are accompanied by filing instructions and an updated List of Effective Pages that includes customized pages.

A normal revision record sheet is at the front of each volume.

In addition each volume has a list of modifications affecting the manual that gives a simple explanation of the technical content of each incorporated modification and its validity per aircraft.

### INTERMEDIATE REVISIONS

- R They are issued between normal revisions to cover changes in the definition of the aircraft
- R or changes in the composition of the fleet of an airline.
- R They are numbered in ascending sequence e.g. 20A, 20B, 20C ... for intermediate revisions
- R issued between normal revisions 20 and 21.
- R They are accompanied by filing instructions and an updated list of effective pages.

### TEMPORARY REVISIONS

Printed on yellow paper the temporary Revisions (TR) are issued to cover urgent matters arising between normal revisions. They are accompanied by filing instructions and an updated, customized List of Effective TR.

A yellow temporary revision record sheet is at the front of each volume.

### INCORPORATION OF SERVICE BULLETINS IN THE MANUAL

When a service bulletin has been accomplished on one or more aircraft of the operator fleet, and notified to Airbus Industrie, all affected manuals will reflect the new aircraft configuration at next revision. If judged necessary by Airbus Industrie, or requested by the operator, a temporary revision or an intermediate revision is issued between normal revisions.

### OPERATIONS ENGINEERING BULLETINS

The Operations Engineering Bulletins (OEB) are issued as the need arises to give operators revised or new, but significant, technical or procedural information.

OEBs are provided with an OEB record sheet. This record sheet is re-issued with each normal revision to update the bulletin embodiment status.

They are accompanied by filing instructions and an updated customized list of effective OEBs.

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**GENERAL INFORMATION**

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**ORGANIZATION OF THE MANUAL**

SEQ. 001 REV. 08

**HOW TO INSERT A REVISION****FILING INSTRUCTIONS**

- Use the filing instructions as follows :
- R 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.
  - R The column NOTE indicates EFFECTIVITY CHANGE ONLY if the page is revised due to an effectivity change and not due to a 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**

As soon as any change has been completed on any airplane, the best way to get updated documentation is to advise :

AIRBUS INDUSTRIE

BP 33

31707 BLAGNAC CEDEX

FRANCE

Telex : TLSBP7X.. or 530526F

FAX 33.5.61.93.28.06

ATTN : Customer Service Directorate – Technical Documentation Services (AI/SE – D)

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FLIGHT CREW OPERATING MANUAL

**GENERAL INFORMATION**

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**LIST OF CODES**

SEQ. 001 REV. 22

To simplify automatic LEP processing some modifications have been grouped under a common code.

CODE	DESIGNATION
R 0001	Mod : $(49192+50718) = (49192+50982) = (50718+52306) = (52306+50982)$
R 0002	Mod : $49192 = (45900+46257+49192) = (45900+46257+49192+49633) = (45900+46257+49633+52306)$
R 0003	Mod : $(44063+49192) = (44063+52306)$
R 0004	Mod : $(46257+49192) = (46257+52306) = (47002+51973)$
R 0005	Mod : $40218 = 40494 = \text{MSN} : 026 = 061$
R 0006	Mod : $(46742+51561) = (46742+48732) = (46742+48732+51561)$
R 0007	Mod : $46742 = (46742+48732) = (46742+48732+51561)$
R 0008	Mod : $(47976+51561) = (47976+48732) = (46742+47976+48732) = (46742+47976+48732+51561)$
R 0009	STD = Mod : $40630 = 45341 = 52183 = (45341+52183)$
0010	Mod : $41240 = 42083 = 46893 = 44308 = 44339 = (44308+44724+44907)$
0011	Mod : $46893 = 44308 = 44339 = 46572 = (44308+44724+44907)$
0012	Mod : $(44604+45509) = (44604+45509+46095+46589)$
R 0013	Mod : $40518 = 41957 = 45342 = 47755 = (40518+45341) = (40518+45341+45342) = (47755+52183+52188) = (45341+47755+52183+52188)$
R 0014	Mod : $40257 = (40257+45341) = (40257+40518+40630+41957)$
0015	Mod : $(40815+44495+44968) = (40815+44495+44969)$
R 0016	Mod : $(47002+51973) = (45900+46257+47002+51973) = (47002+45900+46257+49633+51973)$
0017	Mod : $40336 = 43418 = 44183 = 44188 = 44672 = (40336+44183) = (40336+44188) = (40336+44672)$
R 0018	Mod : $(47002+40259) = (47002+40512) = (47002+40379)$
0020	Mod : $40256 = 41827 = 42114 = (40256+41827) = (41827+43145)$
R 0022	Mod : $(45522+49144) = (45522+49144+49633+52018)$
0023	Mod : $(47000+40395+40483) = (47001+40395+40483+47654)$
0024	Mod : $(42233+46257) = (42083+46257) = (44308+46257) = (44339+46257) = (44724+44907+46257) = (44308+44724+44907+46257)$
0025	Mod : $41450 = (40256+41195) = (40256+41450) = (41450+41827) = (41450+42114) = (41450+42913) = (41450+45179) = (40256+41195+41450) = (41039+41450+41827) = (41195+41450+42114) = (41450+41827+45966) = (41450+45179+45966) = (41039+41195+41450+42114)$
0026	Mod : $(43145+43597+43801) = (40021+42913+43597+43801) = (40021+42913+43145+43597+43801) = (40021+40256+43145+43597+43801+46145)$
0027	Mod : $(43145+43801+44408) = (40021+43145+43801+44408) = (40021+43145+43801+44408+46146)$
0028	Mod : $(40021+40256+40755) = (40021+40256+40755+43145+43801)$
0029	Mod : $40256 = 41827 = 42114 = (40256+41827) = (41827+43145)$
0030	Mod : $40256 = 41827 = 42114 = 42913 = 44451 = 44701 = 45179 = 45966 = 46728 = (40256+41827) = (41827+45966) = (45179+45966)$
0031	Mod : $41450 = 44451 = (40256+41450) = (41450+41827) = (41450+42114) = (41450+42913) = (41450+44451) = (41450+44701) = (41450+45179) = (40256+41195+41450) = (41039+41450+41827) = (41195+41450+42114) = (41450+41827+45966) = (41450+42913+46728) = (41450+45179+45966) = (41039+41195+41450+42114)$
0032	Mod : $(43442+47500) = (43442+50214) = (43442+46863+47500) = (43442+46863+50214)$

CODE	DESIGNATION
0034	Mod : $40065 = 41509 = 44222 = 44312 = 44547 = 45123 = 46514 = 48732 = 51561 = (44547+45123) = (41248+44547+45123) = (40065+41248+45123) = (40065+41248+45312) = (40065+41248+41509+44312) = (40065+41248+41509+44222+44312)$
R 0035	Mod : $(50175+51973+53511) = (50176+51973+53511) = (50175+50176+51973+53511)$
R 0036	Mod : $44968=44969=(44968+44969)=(44968+47524+50161)$
R 0037	Mod : $(44495+44968) = (44495+44969) = (44495+44968+44969) = (40815+44495+44968+44969+47865) = (40815+44495+44968+47865) = (40815+44495+44969+47865)$
0038	Mod : $(46307+47001) = (46307+46884+47001)$
0039	Mod : $47002 = (45191+46257+46532+47002)$
0040	Mod : $(40256+44968) = (40256+44968+44969) = (41827+44968+44969) = (42114+44968+44969) = (40256+41827+44968+44969)$
0041	Mod : $(41450+44968) = (40256+41450+44968) = (40256+41450+44969) = (41450+41827+44968) = (41450+42114+44968) = (41450+42114+44969) = (41450+42913+44968) = (41450+44968+45179) = (40256+41450+44968+44969) = (41195+41450+42114+44968) = (41450+41827+44968+44969) = (41450+41827+44968+44969) = (41450+42114+44968+44969) = (41450+42913+44968+44969) = (41450+44968+45179+45966) = (41450+41827+44969+45966)$
0042	Mod : $(40256+41450) = (41450+42114) = (41450+41827) = (40256+41195+41450)$
0043	Mod : $40256 = (40021+40256) = (40021+42114) = (40021+40256+41827) = (40021+41827+43145)$
R 0044	Mod : $(47001+51344+52831) = (42855+47001+50812+51344+51831)$
R 0045	Mod : $(47000+48487+50812+52831) = (42855+47000+48487+50812+52831)$
R 0046	Mod : $(47001+48487+51344+52831) = (42855+47001+48487+50812+51344+52831)$
R 0047	Mod : $41693 = (41693+48135+48137+48139)$
0048	Mod : $40256 = 41827 = 42114 = 42913 = 45179 = 45966 = 46728 = (40256+41827)$ Mod : $50714 = 47090 = 47091 = (47090+47091)$
R 0049	Mod : $47982 = 47090 = 47091 = (47090+47091)$
R 0050	Mod : $(41600+42611+46257) = (41600+42611+45292+46257)$
R 0051	Mod : $(D43391+D45356) = (D43391+D43999) = (D43391+D45124) = (D45130+D45356) = (D45260+D45356) = (D43999+D45130) = (D43999+D45260) = (D45124+D45130) = (D45124+D45260)$
0052	Mod : $(43211+46257) = (44100+46257) = (44754+46257)$
R 0054	Mod : $47244+47909+47932+49400+52423$
0055	Mod : $44164 = 44165 = 44968 = 44969 = (44164+44165) = (44164+44968) = (44165+44969) = (44968+44969) = (44164+44968+44969) = (44164+44165+44968+44969)$
R 0056	Mod : $40218 = 40494 = 42027 = 42912 = 45045 = D45190 = (D45190+51602) = (D45190+49641)$
R 0057	Mod : $45127 = (42953+45127) = (42953+44967+45127) = (CPA+42953+45127)$
0058	Mod : $40218 = 40494 = 42027 = 42912 = 45045 = D45190 = D43413 = (D45190+51602) = (D45190+49641)$
R 0059	Mod : $(50014+50723+53375) = (50014+51243+53375)$
R 0060	Mod : $46257 = (46257+47930) = (46257+47930+49633)$
R 0061	Mod : $(41600+46257) = (41600+46257+47930) = (41600+46257+47930+49633) = (41600+46257+47930+49844)$
R 0062	Mod : $(49633+49844) = (46257+47930+49633+49844)$
R 0063	Mod : $(49633+49844) = (46257+47930+49633+49844)$



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## **GENERAL INFORMATION**

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## **LIST OF CODES**

SEQ 001 | REV 22

CODE	DESIGNATION
0064	Mod : $(46257 + 47930 + 49800) = (46257 + 49800 + 49844) = (46257 + 47930 + 49800 + 49844)$
0065	Mod : $(49633 + 49800 + 49844) = (46257 + 47930 + 49633 + 49800 + 49844)$
0066	Mod : $(41600 + 46257 + 47002) = (41600 + 46257 + 47002 + 49800) = (S14942 + 41600 + 46257 + 47002 + 49800)$
0067	Mod : $44724 = (41240 + 44724) = (42083 + 44724)$
0068	Mod : $(41600 + 46257 + 47930 + S14942) = (41600 + 46257 + 47930 + 49800) = (41600 + 46257 + 47930 + 49800 + 49844) = (41600 + 46257 + 47930 + 49800 + 49844) = (S14942 + 41600 + 46257 + 47930 + 49633) = (S14942 + 41600 + 46257 + 47930 + 49633 + 49800)$
0069	Mod : $(41039 + 41827) = (40021 + 41039 + 41827) = (40021 + 41039 + 41827 + 43145 + 43801)$
0070	Mod : $(40256 + 41195) = (40021 + 40256 + 41195) = (40021 + 41195 + 42114 + 43145 + 43801) = (40021 + 41039 + 41195 + 42114 + 43145 + 43801) = (40021 + 41195 + 43145 + 43801 + 46145) = (40021 + 41195 + 42114 + 43145 + 43801 + 46145)$
0071	Mod : $(40256 + 40755) = (40256 + 40755 + 43145 + 43801) = (40755 + 42114 + 43145 + 43801)$
0072	Mod : $43801 = (40256 + 43801) = (43145 + 43801) = (40256 + 43145 + 43801) = (41827 + 43145 + 43801) = (42114 + 43145 + 43801) = (42913 + 43145 + 43801) = (42913 + 43145 + 43801) = (42913 + 43145 + 43597 + 43801) = (41039 + 41827 + 43145 + 43801) = (42913 + 43145 + 43597 + 43801)$
0073	Mod : $(41600 + 49633 + 49800 + 49844) = (41600 + 46257 + 47930 + 49633 + 49800 + 49844) = (S14942 + 41600 + 46257 + 47930 + 49633 + 49800 + 49844) = (S14942 + 41600 + 46257 + 47930 + 49633 + 49800 + 49844)$
0074	Mod : $40818 = (40818 + 44099) = (44800 + 45252) = (40818 + 44099 + 44100) = (44800 + 45252 + 45253) = (40818 + 44099 + 44100 + 44754) = (44100 + 44800 + 45252 + 45253)$
0075	Mod : $(40256 + 41195) = (41195 + 43145 + 43801) = (41195 + 42114 + 43145 + 43801) = (41039 + 41195 + 42114 + 43145 + 43801)$
0076	Mod : $(41600 + 42611 + 49633 + 49844) = (41600 + 42611 + 46257 + 47930 + 49633 + 49844)$
0077	Mod : $(41600 + 42611 + 46257 + 47930 + 49800) = (41600 + 42611 + 46257 + 47930 + 49800 + 49844)$
0078	Mod : $(40256 + 40755) = (40256 + 40755 + 43145 + 43801)$
0079	Mod : $(41039 + 41827) = (41039 + 41827 + 43145 + 43801)$
0080	Mod : $(41600 + 42611 + 49633 + 49800 + 49844) = (41600 + 42611 + 46257 + 47930 + 49633 + 49800 + 49844)$
0081	Mod : $(48728 + 48949) = (48635 + 48949) = (48635 + 48949 + 52183)$
0082	STD : Mod : $44724 = (44308 + 44724) = (44724 + 44907)$
0083	Mod : $(42913 + 43597 + 43801) = (42913 + 43145 + 43597 + 43801) = (40256 + 43145 + 43597 + 43801 + 46145)$
0084	Mod : $(40256 + 41195) = (41195 + 42114 + 43145 + 43801) = (41195 + 43145 + 43801 + 46145) = (41039 + 41195 + 42114 + 43145 + 43801) = (41195 + 42114 + 43145 + 43801 + 46145)$
0085	Mod : $40256 = 41827 = 42114 = 42913 = 45179 = 45966 = (40256 + 41827)$
0086	Mod : $40256 = 41827 = 42114 = 42913 = 44701 = 45179 = 45966 = 44451$
0087	Mod : $44482 = 46976 = (44482 + 45897 + 46976)$
0088	Mod : $44308 = 44339 = 46893 = (42083 + 44724 + 44907) = (44308 + 44724 + 44907)$
0089	Mod : $44308 = 44339 = 46893 = (44308 + 44724 + 44907)$
0090	Mod : $47990 = 50321 = 50982 = (44308 + 44724 + 50982)$
0091	Mod : $(44308 + 47990) = (44339 + 47990) = (46893 + 47990) = (46893 + 50982) = (46893 + 50321) = (44308 + 44724 + 44907 + 47990)$
0092	Mod : $42083 = 42233 = 44308 = 44339 = (44724 + 44907)$

	<b>CODE</b>	<b>DESIGNATION</b>
R	0093	Mod : $46893 = (46572+46893) = (44308+44724+44907)$
R	0094	Mod : $(46893+50859+50860) = (46893+47002+47482)$
R	0095	Mod : $45126 = (44724+45126) = (44308+44724+45126) = (44724+44907+45126)$
R	0096	Mod : $(45126+44308) = (44339+45126) = (45126+46893) = (44308+44724+44907+45126)$
R	0097	Mod : $(44339+45126+46587) = (45126+46587+46893)$
R	0098	Mod : $(44308+45126+46587+50718) = (45126+46587+46893+50718) = (45126+46587+46893+50982) = (45126+46587+46893+50321) = (44308+44724+44907+45126+46587+50718)$
R	0099	Mod : $44308+44724+45126+46587+50982$
R	0100	Mod : $46587 = (44308+44724+46587)$
R	0101	Mod : $44495 = (40815+47865) = (44968+44969) = (40815+44495+47865) = (40815+44968+44969+47865)$
R	0102	Mod : $(40373+45451+46257) = (40373+45452+46257)$
R	0103	Mod : $(44308+46587) = (44339+46587) = (46587+46893) = (44308+44724+44907+46587)$
R	0104	STD = Mod : $(44308+44724) = (44724+44907)$
R	0105	Mod : $(44100+44339) = (44339+44754) = (43211+44308) = (44100+44308) = (44100+46893) = (44308+44754) = (44754+46893) = (43211+44308+44724+44907)$
R	0106	Mod : $(44100+46893+50161) = (44754+46893+50161)$
R	0107	Mod : $(43145+43801+44408) = (43145+43801+44408+46145)$
R	0108	Mod : $(43145+43597+43801) = (40256+43145+43597+43801)$
R	0109	Mod : $(46893+46257) = (46572+46257+46893)$
R	0110	Mod : $(41832+45452) = (42685+45451+46609)$
R	0111	Mod : $(47976+48135) = (47976+48137) = (47976+48139)$
R	0112	Mod : $(47001+47968) = (47001+42855+47968)$
R	0113	Mod : $47500 = 50214 = (46863+47500) = (46863+50214)$
R	0114	Mod : $47000 = (47000+43442+46863+47500+48882)$
R	0115	STD = Mod : $44724 = (44308+44724)$
R	0116	MP : $(D41829+D43391) = (D41829+D45260) = (D41987+D43391) = (D41987+D43391)$
R	0117	Mod : $44308 = 44339 = (44308+44724+44907) = (42083+44724+44907)$
R	0118	Mod : $49192 = 52306 = (45900+46257+49192) = (45900+46257+52306) = (45900+46257+49192+49633) = (45900+46257+49633+52306)$
R	0119	Mod : $49192 = 52306 = (40064+43057+49192) = (40064+43057+52306)$
R	0120	Mod : $(46307+47000) = (46307+46884+47000)$
R	0121	Mod : $(47001+47968+52831) = (42855+47001+47968+48487+50812+52831)$
R	0122	Mod : $44495 = (47002+47482+47484) = (47002+47482+47484+50321)$
R	0123	Mod : $(47000+49688) = (47001+47654+49688)$
R	0124	Mod : $(45522+47002) = (45522+47002+46257)$
R	0125	Mod : STD = $(47002+47482) = (47002+47482+47484) = (50859+50860)$
R	0126	Mod : $(43442+46863) = (43442+51393) = (43442+46863+47500+51393)$
R	0127	Mod : $(47002+48972) = (47002+49101) = (47002+49829) = (48818+50021)$
R	0128	Mod : $46863 = 51393 = (47500+51393) = (46863+47500+51393)$



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## **GENERAL INFORMATION**

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## **LIST OF CODES**

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CODE	DESIGNATION
0129	Mod : $46145 = (40256 + 43801) = (40256 + 46145) = (43145 + 43801) = (41827 + 46145)$ $= (40256 + 40755 + 46467) = (40256 + 43145 + 43801) = (41827 + 43145 + 43801) =$ $(42114 + 43145 + 43801) = (43145 + 43801 + 46145) = (41827 + 46145 + 46467) =$ $(40256 + 43145 + 43801 + 46145) = (41827 + 43145 + 43801 + 46145) =$ $(42114 + 43145 + 43801 + 46145) = (42913 + 43145 + 43801 + 46145) =$ $(40755 + 42114 + 43145 + 43801 + 46145)$
0130	Mod : $52426 = (46742 + 52426) = (46742 + 51561 + 52426) =$ $(46742 + 48732 + 51561 + 52426)$
0131	Mod : $46893 = (46893 + 47002 + 47484 + 47482 + 52166) =$ $(46893 + 47002 + 47484 + 47482 + 52167)$
0132	Mod : $(40256 + 49366) = (41827 + 49366) = (42114 + 49366) = (42913 + 49366) =$ $(45179 + 49366) = (45966 + 49366) = (40256 + 41827 + 49366)$
0133	Mod : $(46728 + 49366) = (46824 + 49366) = (46896 + 49366) = (47392 + 49366) =$ $(47572 + 49366) = (47002 + 49366)$
0134	Mod : $(49366 + 40256) = (49366 + 41827) = (49366 + 42114) = (49366 + 42913) =$ $(49366 + 44451) = (49366 + 44701) = (49366 + 45179) = (49366 + 45966) =$ $(49366 + 46824)$
0135	Mod : $(42913 + 43597 + 43801 + 49366) = (42913 + 43145 + 43597 + 43801 + 49366) =$ $(40256 + 43145 + 43597 + 43801 + 46145 + 49366)$
0136	Mod : $47002 = (40073 + 44482 + 45897 + 46926 + 47002 + 47340)$
0137	Mod : $40073 = (44482 + 45897) = (40073 + 44482 + 45897) =$ $(40073 + 44482 + 45897 + 46926) = (40073 + 45897 + 46926 + 47340) =$ $(40073 + 44482 + 45897 + 46926 + 47340)$
0138	Mod : $45897 = 46976 = (40073 + 44482) = (40073 + 44482 + 45897 + 46926 + 46976) =$ $(40073 + 44482 + 45897 + 46926 + 46976 + 47340)$
0139	Mod : $(46893 + 47244) = (46893 + 47002 + 47244 + 47482 + 47484)$
0140	Mod : $(46893 + 47244 + 50859 + 50860) = (46893 + 47244 + 47482 + 47002)$
0141	Mod : $51315 = 51885 = (47002 + 51315) = (47002 + 51885) = (47002 + 51315 + 52936)$
0151	Mod : $47002 = (45900 + 46257 + 47002) = (45900 + 46257 + 47002 + 49633)$
0152	Mod : $STD = 44724 = (44724 + 44907) = (44308 + 44724)$
0153	Mod : $44339 = (44339 + 44341) = (44341 + 46893) = (44339 + 44341 + 46893) =$ $(44341 + 46572 + 46893)$
0156	Mod : $(47642 + 47002) = (46742 + 47419 + 47669) = (46742 + 47002 + 47669)$
0159	Mod : $(47002 + 47482 + 46893) = (46893 + 50859 + 50860)$
0160	Mod : $46893 = (46893 + 47002 + 47482 + 47484)$
0161	Mod : $42083 = 42233 = (44724 + 44507)$
0163	Mod : $(46893 + 47002 + 47482) = (46893 + 50859 + 50860)$
0164	Mod : $46893 = (46893 + 47002 + 47482 + 47484) = (46893 + 50859 + 50860 + 50861)$
0166	Mod : $44308 = 44339 = 46572 = 46893 = (44308 + 44724 + 44907) = (46572 + 46893)$
0167	Mod : $STD = 42083 = 42233 = 44724 = (41420 + 44724) = (41240 + 44308 + 44724)$
0168	Mod : $41240 = 42083 = 42233 = (42083 + 44724 + 44907)$
0169	Mod : $44308 = 44339 = 46893 = (41240 + 44308) = (42083 + 44339) = (42233 + 44339) =$ $(46572 + 46893) = (42083 + 44339 + 46893) = (42083 + 46572 + 46893) =$ $(44308 + 44724 + 44907) = (41240 + 44308 + 44724 + 44907)$
0171	Mod : $STD = 44724 = 46257 = (44724 + 44907) = (44308 + 44724) =$ $(44724 + 44907 + 46257)$
0173	Mod : $47001 = (47001 + 43442 + 46863 + 47500 + 48882)$
0174	Mod : $49633 = (49633 + 43442 + 45900 + 46257)$
0179	Mod : $(44754 + 46728) = (44754 + 47572) = (44754 + 47392) = (44754 + 46824) =$ $(44100 + 46986) = (44100 + 46824) = (44100 + 46728) = (44100 + 47392) =$ $(44100 + 47572) = (43211 + 46728)$
0183	Mod : $(47324 + 50616) = (45748 + 47324 + 50516)$

CODE	DESIGNATION
0184	Mod : $47990 = 50321 = 50982 = (46893+47990) = (46893+50321) = (46893+50982)$ $= (44308+47990) = (44339+47990) = (44308+44724+50982) =$ $(44339+46893+47990) = (46572+46893+47990) = (46572+46893+50982) =$ $(44308+44724+44907+47990)$
0185	Mod : $(46587+46257+49103) = (46587+46257+47990) = (46587+46257+50321) =$ $(46587+46257+50982)$
0193	Mod : $51315 = 51885 = (47002+51315) = (47002+51885)$
0199	Mod : $(40256+49769) = (41827+49769) = (42114+49769)$
0200	Mod : $(43127+49769) = (43162+49769) = (44451+49769) = (44655+49769) =$ $(44701+49769) = (45179+49769) = (45966+49769)$
0201	Mod : $(46728+49769) = (46824+49769) = (46986+49769) = (47392+49769) =$ $(47572+49769)$
0202	Mod : $(43211+46728+49769) = (44100+46728+49769) = (44100+46824+49769) =$ $(44100+46986+49769) = (44100+47392+49769) = (44100+47572+49769) =$ $(44754+46728+49769) = (44754+46824+49769) = (44754+47392+49769) =$ $(44754+47572+49769)$
0203	Mod : $(47000+50812) = (41600+47000+50812)$
0204	Mod : $(47001+48487) = (42855+47001+48487)$
0205	Mod : $(47000+50812) = (42855+47000+50812)$
0206	Mod : $(47000+48487+50812) = (42855+47000+48487+50812)$
0209	Mod : $(40412+51847) = (40412+49137+51847)$
0210	Mod : $(40412+47002+51847) = (40412+47002+49137+51847)$
0211	Mod : $(47000+47524) = (47000+50161) = (S15556+47000+47524) =$ $(S15556+47000+50161)$
0212	Mod : $(47001+47524) = (47001+50161) = (S15556+47001+47524) =$ $(S15556+47001+50161)$
0214	Mod : $(46257+46587+47990) = (46257+46587+49103) = (46257+46587+50321) =$ $(46257+46587+50982)$
0216	Mod : $44845 = (44845+47244+52166) = (44845+47244+52167)$
0218	STD = Mod : $(47244+52166) = (47244+52167)$
0219	STD = Mod : $46898 = (47244+52166) = (47244+52167)$
0220	STD = Mod : $(40081+47943) = (47244+52166) = (47244+52167)$
0222	Mod : $40065 = 41509 = 44222 = 44312 = 44547 = 45123 = 46514 = (44547+45123)$ $= (40065+41248+44312) = (40065+41248+45123) = (41248+44547+45123) =$ $(40065+41248+41509+44312) = (40065+41248+41509+44222+44312)$
0224	Mod : $52018 = (46292+52018) = (46627+52018)$
0225	Mod : $47002 = (47002+52018) = (46292+47002+52018) = (46627+47002+52018)$
0226	Mod : $47002 = 51839 = 52018 = (47002+48753) = (47002+48754) = (47002+51340)$ $= (47002+51356) = (48753+52018) = (48754+52018) = (51340+52018) =$ $(51356+52018)$
0228	Mod : $(49657+49738) = (40259+49657+49738)$
0252	Mod : $47001 = (42855+47001) = (42855+47001+50812)$
0253	Mod : $(47000+46447) = (47001+46447+47654) = (47000+47654+48050) =$ $(47001+47654+48050)$
0262	Mod : $40259 = 40512 = 40379 = (40259+40379) = (40512+40379) =$ $(40259+40512+40379)$
0263	Mod : $40099 = (40099+50108+50853) = (40099+50901+50853)$
0264	Mod : $47197 = 50108 = (47883+47002)$
0266	Mod : $(52426+47976) = (46742+48227+52426+47976)$



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CODE	DESIGNATION
0272	Mod : $44308 = 44339 = 46893 = (44339+46893) = (46572+46893) = (44724+44907)$ = $(44308+44724+44907)$
0273	Mod : $STD = 43093 = 46131 = 44754 = (43093+43705) = (43093+44754) = (44787+49012) = (43093+43705+44754) = (44754+44800+46131)$
0274	Mod : $50640 = (44100+44800+45252+45253+50640)$
0277	Mod : $45451 = 45452 = 48447 = (45451+46609)$
0280	Mod : $46145 = (40021+40256+43801) = (40021+40256+46145) = (40021+41345+43801) = (40021+40256+40755+46467) = (40021+40256+43145+43801) = (40021+41827+43145+43801) = (40021+43145+43801+46145) = (40021+41827+46145+46467) = (40021+40256+43145+43801+46145) = (40021+41827+43145+43801+46145) = (40021+42114+43145+43801+46145) = (40021+42913+43145+43801+46145) = (40021+40755+42114+43145+43801+46467)$
0283	Mod : $40379 = 47937 = 49952 = (40379+40259) = (47937+40259) = (49952+40259)$ = $(40379+49952) = (40379+49952+40259)$
0284	Mod : $47197 = 47883 = 50108 = (40259+47197) = (40259+47883) = (40259+50108)$
0285	Mod : $(40379+47549) = (40379+47967) = (40379+49157) = (40379+48558) = (47937+47549) = (47937+47967) = (47937+49157) = (47937+48558) = (49952+47549) = (49952+47967) = (49952+49157) = (49952+48558) = (40259+40379+47549) = (40259+40379+47967) = (40259+40379+49157) = (40259+40379+48558) = (40259+47937+47549) = (40259+47937+47967) = (40259+49952+47549) = (40259+49952+47967) = (40259+49952+49157) = (40259+49952+48558)$
0286	Mod : $40379 = 47937 = 49952 = (40379+49952)$
0287	Mod : $(40259+40379) = (40259+47937) = (40259+49952) = (40259+40379+49952)$
0289	Mod : $40379 = 47937 = 49952 = (40259+40379) = (40259+47937) = (40259+49952)$ = $(40379+49952) = (40259+40379+49952)$
0291	Mod : $(44308+46257) = (44339+46257) = (46893+46257) = (46572+46893+46257)$ = $(44339+46257+46893) = (44308+44724+44907+46257)$
0292	Mod : $44495 = (47002+47482+47484) = (50859+50860+50861)$
0293	Mod : $(50859+50860) = (47002+47482+50321)$
0294	Mod : $50718 = 50982 = (44495+50718) = (44495+50982)$
0295	Mod : $52426 = (46742+52426) = (46742+50076+51561+52426)$
0296	Mod : $49103 = 47990 = 50982 = (45237+49103) = (45237+47990)$
0297	Mod : $47990 = 49103 = 50321 = 50982 = (45237+49103) = (45237+47990)$
0298	Mod : $44724 = (44724+44907) = (44724+44308) = (44339+44724) = (44308+44724+46257) = (44339+44724+46257) = (44724+44907+46257)$
0299	Mod : $44308 = 44339 = 46893 = (46572+46893) = (44308+44724+44907) = (44339+44724+44907)$
0301	Mod : $(41600+46257+49633+49844) = (41600+46257+47930+49633+49844)$
0307	Mod : $47002 = (51885+52599) = (47002+51885+52599)$
0309	Mod : $(44308+46257) = (44339+46257) = (46893+46257) = (46572+46257) = (44308+44724+44907+46257) = (44339+44724+44907+46257)$
0311	Mod : $(41600+47524+47930) = (41600+50161+47930)$
0313	Mod : $47524 = 50161 = (40064+43057+47524) = (40064+43057+50161)$
0314	Mod : $47524 = 50161 = (40815+47524+47865) = (40815+50161+47865)$
0315	Mod : $(44100+47524) = (44754+47524) = (43211+47524) = (44100+50161) = (44754+50161) = (43211+50161)$
0316	Mod : $(40256+47254) = (44451+47524) = (45179+47524) = (45966+47524) = (46728+47254) = (46986+47524) = (40256+50161) = (44451+50161) = (45179+50161) = (45966+50161) = (46728+50161) = (46986+50161)$
0317	Mod : $(47524+49495) = (47524+50640) = (49495+50161) = (50161+50640)$

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**LIST OF NORMAL REVISIONS**

SEQ. 001 REV. 22

R

Nº	ISSUE DATE	
00	FEB 91	
01	AUG 91	
02	MAY 92	
03	DEC 92	
04	FEB 93	
05	NOV 93	
06	MAR 94	
07	OCT 95	
08	OCT 97	
09	MAR 98	
10	SEP 98	
11	JAN 99	
12	JUL 99	
13	FEB 00	
14	JUN 00	
15	NOV 00	
16	MAY 01	
17	NOV 01	
18	JUL 02	
19	DEC 02	
20	OCT 03	
21	MAR 04	
22	DEC 04	

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**GENERAL INFORMATION**

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**RECORD OF TEMPORARY REVISIONS**

SEQ. 001 REV. 08

R

Nº	TITLE	STATUS	LOCATION
To be filled by the operator, if needed			

A	Amber
AA	Airworthiness Authorities
AB	Abort
ABN	Abnormal
R A/BRK	Autobrake
ABV	Above
AC	Alternating Current
A/C	Aircraft
ACARS	ARINC Communication Addressing and Reporting System
ACCEL	Acceleration
R ACCU	Accumulator
ACP	Audio Control Panel
ACMS	Aircraft Condition Monitoring System
ACQ	Acquire
ADF	Automatic Direction Finder
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
ADM	Air Data Module
ADR	Air Data Reference
ADV	Advisory
R AEVC	Avionic Equipment Ventilation Controller
AFIS	Airbus in-Flight Information Services
AFS	Auto Flight System
AGL	Above Ground Level
AIDS	Aircraft Integrated Data System
AIL	Aileron
R AIME	Autonomous Integrity Monitoring Extrapolation
AINS	Aircraft Information Network System
AMJ	Advisory Material Joint
R AMU	Audio Management Unit
ANSU	Aircraft Network Server Unit
ANT	Antenna
ALT	Altitude
ALTN	Alternate
A/P	Autopilot
AOA	Angle Of Attack
AOC	Airline Operational Control
APPR	Approach
APPU	Assymetry Position Pick-off Unit
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio Incorporated
ARN	Aircraft Registration Number
ARPT	Airport
A/S	Airspeed

	ASAP	As Soon As Possible
	ASI	Air Speed Indicator
	A/SKID	Anti-skid
	ATC	Air Traffic Control
	A/THR	Auto Thrust
R	ATIS	Airbus Technical Information System
	ATSU	Air Traffic Service Unit
	ATT	Attitude
	AVNCS	Avionics
	AWY	Airway
	B	Blue
	BARO	Barometric
	BAT	Battery
	BCL	Battery Charge Limiter
R	BCM	Back-up Control Module
R	BCRC	Bulk Crew Rest Compartment
	BITE	Built-in Test Equipment
	BMC	Bleed Monitoring Computer
	BNR	Binary
	BRG	Bearing
	BRK	Brake
	BRT	Bright
	BSCU	Braking Steering Control Unit
	BTC	Bus Tie Contactor
	BTL	Bottle
	C	Centigrade
	CAB	Cabin
	CAPT	Captain, Capture
	CAS	Calibrated Airspeed
	CAT	Category
	C/B	Circuit Breaker
R	CBMU	Circuit Breaker Monitoring Unit
	CCRC	Cabin Crew Rest Compartment
	CDL	Configuration Deviation List
R	CDLS	Cockpit Door Locking System
R	CDSS	Cockpit Door Surveillance System
	CDU	Control Display Unit
	CED	Cooling Effect Detector
	CG	Center of Gravity
	CHG	Change
	CHK	Check
	CIDS	Cabin Intercommunication Data System

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**GENERAL INFORMATION**

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**ABBREVIATIONS**

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R	CINS	Cabin Information Network System
	C/L	Checklist
	CKPT	Cockpit
	CLB	Climb
	CLR	Clear
	CLSD	Closed
R	CMPTR	Computer
	CM 1(2)	Crewmember 1 (left seat) or 2 (right seat)
	CMC	Central Maintenance Computer
	CMD	Command
	CMM	Calibration Memory Module
	CMS	Central Maintenance System
	CPTR	Computer
	CNTOR	Contactor
	CO	Company
	COM	Communication
R	COND	Conditioning
	CONF	Configuration
	CONT	Continuous
	CO RTE	Company Route
	CPCU	Cabin Pressure Controller Unit
	CRC	Continuous Repetitive Chime
	CRG	Cargo
	CRS	Course
	CRT	Cathode Ray Tube
	CRZ	Cruise
	CSM/G	Constant Speed Motor/Generator
	CSTR	Constraint
	CTL	Control
	CTLR	Controller
	CTR	Center
	CTL PNL	Control Panel
	CUDU	Current Unbalance Detection Unit
	CVR	Cockpit Voice Recorder
	DA	Drift Angle
	DAR	Digital AIDS Recorder
	DC	Direct Current
	DDCU	Datalink Control and Display Unit
	DDRMI	Digital Distance and Radio Magnetic Indicator
	DECCEL	Deceleration
	DEG	Degree
	DES	Descent
	DEST	Destination

DET	Detection
DEU	Decoder/Encoder Unit
DFDR	Digital Flight Data Recorder
DH	Decision Height
DIR	Direction
DIR TO	Direct To
DISC	Disconnect
DISCH	Discharge
DIST	Distance
DMC	Display Management Computer
DME	Distance Measuring Equipment
DMU	Data Management Unit (Aids)
DN	Down
DSCS	Door Slide Control System
DSDL	Dedicated Serial Data Link
DTG	Distance To Go
DTMS	Damage Tolerance Monitoring System
DU	Display Unit
E	East
R EBCU	Emergency Braking Control Unit
R ECAM	Electronic Centralized Aircraft Monitoring
R ECAS	Emergency Cockpit Alerting System
R ECB	Electronic Control Box (APU)
R ECMU	Elec Contactor and Management Unit
R ECON	Economic
R ECP	ECAM Control Panel
R ECS	Environmental Control System
R ECU	Engine Control Unit
R EDP	Engine-Driven Pump
R EEC	Engine Electronic Control
R EFCS	Electronic Flight Control System
R EFIS	Electronic Flight Instruments System
R EFOB	Estimated Fuel On Board
R EGPWS	Enhanced Ground Proximity Warning System
R EIU	Engine Interface Unit or Engine Interface and Vibration Monitoring Unit
R EIS	Electronic Instruments System
R ELAN	Ethernet Local Area Network
R ELEV	Elevator, Elevation
R ELEC	Electricity
R ELMU	Electrical Load Management Unit
R ELT	Emergency Locator Transmitter
R EMER	Emergency
R EMER GEN	Emergency Generator
ENG	Engine

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**GENERAL INFORMATION**

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**ABBREVIATIONS**

SEQ. 001 REV. 20

	EO	Engine-Out
	EPGS	Electrical Power Generation System
	EPR	Engine Pressure Ratio
R	EROPS	Extended Range Operation
	ESS	Essential
	EST	Estimated
	ETA	Estimated Time of Arrival
	ETE	Estimated Time en Route
R	ETOPS	Extended Twin Operations
	ETP	Equal Time Point
	E/WD	Engine/Warning Display
	EXT PWR	External Power
	EXTN	Extension
	F	Flaps retraction speed
	FADEC	Full Authority Digital Engine Control System
	FAF	Final Approach Fix
	FAR	Federal Aviation Regulations
	FAV	Fan Air Valve
R	F/C	Flight Crew
	FCDC	Flight Control Data Concentrator
	FCMC	Fuel Control and Monitoring Computer
R	FCOM	Flight Crew Operating Manual
R	FCRC	Flight Crew Rest Compartment
	FCU	Flight Control Unit
	FD	Flight Director
	FDIU	Flight Data Interface Unit
	F/D TEMP CTL	Flight Deck Temperature Control
	FDU	Fire Detection Unit
	FE	Flight Envelope
	FF	Fuel Flow
	FG	Flight Guidance Computer
	FL	Flight Level
	FLP, F	Flap
	FLT	Flight
	FLT CTL	Flight Control
	FLX TO	Flexible Takeoff
	FM	Flight Management
	FMA	Flight Mode Annunciator
	FMGC	Flight Management Guidance Computer
	FMGS	Flight Management Guidance Envelope System
	FMS	Flight Management System
	F/O	First Officer
	FOB	Fuel on Board
	F-PLN	Flight Plan

FPA	Flight Path Angle
FPPU	Feedback Position Pick-Off Unit
FPV	Flight Path Vector
FQI	Fuel Quantity Indication
FREQ	Frequency
FRV	Fuel Return Valve
FT	Foot, Feet
FT/MN	Feet per Minute
FU	Fuel Used
FWD	Forward
FWC	Flight Warning Computer
FWS	Flight Warning System
G	Green
GA	Go-Around
R	GAPCU Ground and Auxiliary Power Control Unit
	GCU Generator Control Unit
	GEN Generator
	GLC Generator Line Contactor
	GMT Greenwich Mean Time
	GND Ground
	GPCU Ground Power Control Unit
	GPS Global Positioning System
	GPSSU Global Positioning System Sensor Unit
	GPWC Ground Proximity Warning Computer
	GPWS Ground Proximity Warning System
R	GRND Ground
	GRVTY Gravity
	GRU Ground Refiguration Unit
	GS Ground Speed
	G/S Glideslope
	GW Gross Weight
	H Hour, Hot
	HCU Hydraulic Control Unit
	HDG Heading
	HDG/S Heading Selected
	HF High Frequency
	HI High
	HLD Hold
	HMU Hydraul-Mechanical Unit
	HP High Pressure
R	HPA Hectopascal
	HPTCC High Pressure Turbine Clearance Control

HPV	High Pressure Valve
HSMU	Hydraulic System Monitoring Unit
HUD	Head Up Display
HYD	Hydraulic
HZ	Hertz
IAS	Indicated Airspeed
IDENT	Identification
R IDG	Integrated Drive Generator
R IFE	In Flight Entertainment
IFR	Instrument Flight Rules
IGN	Ignition
ILS	Instrument Landing System
IMM	Immediate
INB	Inbound
INBO	Inboard
INCREM	Increment
INIT	Initialization
INOP	Inoperative
INR	Inner
INST	Instrument
INTCP	Intercept
INV	Inverter
I/O	Inputs/Outputs
I/P	Input or Intercept Profile
IP	Intermediate Pressure
IPPU	Instrumentation Position Pick-Off Unit
R IR	Inertial Reference
R IRS	Inertial Reference System
ISA	International Standard Atmosphere
ISO	International Organization for Standardization
ISOL	Isolation
R ISPSS	In Seat Power Supply System
JAR	Joint Airworthiness Requirements
KG	Kilogram
KT	Knot
L	Left
R LAF	Load Alleviation Function
LAN	Local Area Network
LAT	Latitude
LAT REV	Lateral Revision

R	LAV	Lavatory
	LCN	Load Classification Number
	LDG	Landing
R	LF	Low Frequency
	L/G	Landing Gear
	LGCIU	Landing Gear Control Interface Unit
R	LH	Left-hand
	LIM	Limitation
R	LK	Lock
	LO	Low
	LOC	Localizer
	LONG	Longitude
	LP	Low Pressure
	LPTCC	Low Pressure Turbine Clearance Control
	LRU	Line Replaceable Unit
	LSK	Line Select Key
	LT	Light
	LVL	Level
	LVL CHG	Level Change
	LW	Landing Weight
	M	Magenta, Mach, Meter
	MABH	Minimum Approach Break off Height
	MAC	Mean Aerodynamic Chord
	MAG	Magnetic
	MAG DEC	Magnetic Declination
	MAG VAR	Magnetic Variation
	MAINT	Maintenance
	MAN	Manual
	MAX CLB	Maximum Climb
	MAX DES	Maximum Descent
	MAX END	Maximum Endurance
	MB	Milibar
	MC	Master Caution
	MCT	Maximum Continuous Thrust
	MCDU	Multipurpose Control and Display Unit
	MDA	Minimum Descent Altitude
	MDDU	Multifunction Disk Drive Unit
	MDH	Minimum Descent Height
	MECH	Mechanic
	MED	Medium
	MEL	Minimum Equipment List
R	MFA	Memorized Fault Annunciator
R	MIN	Minimum, Minute

MKR	Marker
MLA	Maneuver Load Alleviation
MLS	Microwave Landing System
MLW	Maximum Landing Weight
MMEL	Master Minimum Equipment List
MMO	Maximum Operating Mach
R MMR	Multi Mode Receiver
R MN	Minute, Mach number
MNPS	Minimum Navigation Performance Specification
MSA	Minimum Safe Altitude
MSG	Message
MSL	Mean Sea Level
MTBF	Mean Time Between Failure
MTOW	Maximum Takeoff Weight
MW	Master Warning
MZFW	Maximum Zero Fuel Weight
N	North
N/A	Not Applicable
NACA	National Advisory Committee for Aeronautics
NAV	Navigation
NAVAID	Navigation Aid
NCD	Non Computed Data
ND	Navigation Display
NDB	Non Directional Beacon — Nav Database
NM	Nautical Mile
NORM	Normal
NW	Nosewheel
NWS	Nosewheel Steering
OAT	Outside Air Temperature
OBRM	On Board Replaceable Module
OFF/R	Off Reset
OFST	Offset
O/P	Output
OPP	Opposite
OPS	Operations
OPT	Optimum
OUTB	Outbound
OUTR	Outer
OVBD	Overboard
OVHD	Overhead
OVHT	Overheat
OVRD	Override

OVSPD	Overspeed
OXY	Oxygen
PA	Passenger Address
PAX	Passenger
P-ALT	Profile Altitude
PB, pb	Pushbutton
P-CLB	Profile Climb
P-DES	Profile Descent
PERF	Performance
R PES	Passenger Entertainment System
PFD	Primary Flight Display
PHC	Probes Heat Computer
PIM	Programming and Indication Module
P-MACH	Profile Mach
PMV	Pressure Maintenance Valve
P/N	Part Number
PNL	Panel
POB	Pressure Off Brake
P-SPEED	Profile Speed
POS	Position
PPOS	Present Position
PR	Pressure
PRAM	Prerecorded Announcement and Music
PRED	Prediction
PRIM	FLT CTL Primary Computer (FCPC)
PROC	Procedure
PROC T	Procedure Turn
PROF	Profile
PROG	Progress
PROT	Protection
PRV	Pressure Regulating valve
PSCU	Proximity Switch Control Unit
PT	Point
R PTT	Push To Talk
PTLU	Pedal Travel Limiter Unit
PVI	Paravisual Indicator
PWR	Power
QAR	Quick Access Recorder
QCCU	Quantity Calculation and Control Unit
QFE	Field Elevation Atmosphere Pressure
QFU	Runway Heading
QNE	Sea Level Standard Atmosphere Pressure (1013 MB)
QNH	Sea Level Atmosphere Pressure

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FLIGHT CREW OPERATING MANUAL

**GENERAL INFORMATION**

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**ABBREVIATIONS**

SEQ. 001 REV. 20

QT	Quart (US)
QTY	Quantity
R	Right, Red
RA	Radio Altitude
RACSB	Rotor Active Clearance Control Start Bleed
RAIM	Receiver Autonomous Integrity Monitoring
RAT	Ram Air Turbine
R	RTAC
	Remote ATC Box
	RCDR
	Recorder
	RCL
	Recall
	RCVR
	Receiver
	REAC
	Reactive
	REC
	Recovery
	REG
	Regulation
	REL
	Release
	REV
	Reverse
	R/I
	Radio/Inertial
R	RH
	Right-hand
	RMI
	Radio Magnetic Indicator
	RMP
	Radio Management Panel
	RNG
	Range
	RNP
	Required Navigation Performance
	RPLNT
	Repellent
	RPM
	Revolution Per Minute
	RPTG
	Repeating
	RQRD
	Required
	RSV
	Reserves
	RSVR
	Reservoir
	RTE
	Route
	RTL
	Rudder Travel Limit
	RTOW
	Runway Takeoff Weight
	RUD
	Rudder
	RVSM
	Reduced Vertical Separation Minimum
	RWY
	Runway
S	South, Slats Retraction Speed
SAE	Society of Automotive Engineers
SAT	Static Air Temperature
SC	Single Chime
S/C	Step Climb
SD	System Display
STAT INV	Static Inverter
S/D	Step Descent

	SDAC	System Data Acquisition Concentrator
	SDCU	Smoke Detection Control Unit
	SEC	FLT CTL Secondary Computer (FCSC)
	SEL	Selector
	S/F	Slats/Flaps
	SFCC	Slat/Flap Control Computer
R	SFE	Seller-Furnished Equipment
	SID	Standard Instrument Departure
	SIM	Simulation
R	SIU	Server Interface Unit
	SLFT (-PM)	Sea Level Feet (-per minute)
	SLT, S	Slat
	S/N	Serial Number
	SPD	Speed
	SPD LIM	Speed Limit
	SPLR	Spoiler
	SRS	Speed Reference System
	SSM	Sign Status Matrix
	STAR	Standard Terminal Arrival Route
	STAT	Static
	STBY	Standby
	STD	Standard
	STEER	Steering
	STRG	Steering
	STS	Status
	SW	Switch
	SWTG	Switching
	SYNC	Synchronize
	SYS	System
R	T	True, Turn, Total, Tons
R	TACS	Taxi Aid Camera System
	TACT	Tactical
	TAS	True Air Speed
	TAT	Total Air Temperature
	TAU	Time to intercept
	TBC	To be Confirmed
	TBD	To be Determined
R	TBV	Transient Bleed Valve
	T/C	Top of Climb
	TCAS	Traffic Collision Alert System Avoidance System
	T/D	Top of Descent
	TEMP	Temperature
	TFTS	Terrestrial Flight Telephon System
	TGT	Target

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**GENERAL INFORMATION**

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**ABBREVIATIONS**

SEQ. 001 REV. 20

THR	Thrust
THS, STAB	Trimmable Horizontal Stabilizer
TK	Tank
T, TK	Trim Tank
TK	Track angle
TKE	Track Angle Error
TMR	Timer
TLA	Throttle Lever Angle
T.O., T/O	Takeoff
TOGA	Takeoff - Go-Around
TOGW	Takeoff Gross Weight
TOW	Takeoff Weight
T-P	Turn Point
TPIS	Tire Pressure Indicating System
R	T-R Transmitter-Receiver
	TR Transformer Rectifier Unit
	TRV Travel
	TRANS Transition
	TROPO Tropopause
	TRK Track
	TTG Time to Go
R	TVMC Minimum Control Speed Temperature
R	TWLU Terminal Wireless LAN Unit
R	ULB Underwater Locator Beacon
	UNLK Unlock
R	UP Up, Upper
	UTC Universal Coordinated Time
	V Volt
	V1 Critical Engine Failure Speed
	V2 Takeoff Safety Speed
	VBV Variable Bypass Valve
R	VCC Video Control Center
R	VEL Velocity
	VENT Ventilation
	VFE Maximum Velocity Flaps Extended
	VFEN VFE Next
	VFTO Velocity Final Takeoff
	VHF Very High Frequency
R	VHV Very High Voltage
	VIB Vibration
	VLE Maximum Landing Gear Extended Speed
	VLS Lowest Selectable Speed

VLV	Valve
VM	Maneuvering Speed
VMAX	Maximum Allowable Speed
VMCA	Minimum Control Speed in the Air
VMCG	Minimum Control Speed on Ground
VMCL	Minimum Control Speed at Landing
VMCL-2	Minimum control speed at landing with 2 engines inop on one wing
VMIN	Minimum Operating Speed
VMO	Maximum Operating Speed
VMU	Minimum Unstick Speed
VOR	VHF Omnidirectional Range
VOR-D	VOR-DME
VR	Rotation Speed
VREF	Landing Reference Speed
VS	Reference Stalling Speed
V/S	Vertical Speed
VSI	Vertical Speed Indicator
VSV	Variable Stator Vane
W	White, West
WARN	Warning
WBC	Weight and Balance Computer
WBS	Weight and Balance System
WHC	Window Heat Computer
WNDW	Window
WPT	Waypoint
WSHLD	Windshield
WT	Weight
WTB	Wing Tip Brake
WXR	Weather Radar
R	XCVR
	Transceiver
	XFR
	Transfer
R	XMTR
	Transmitter
	XPDR
	Transponder
	XTK
	Crosstrack Error
	Y
	Yellow
Z	Altitude
	ZFCG
	Zero Fuel Center of Gravity
	ZFW
	Zero Fuel Weight

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FLIGHT CREW OPERATING MANUAL

**GENERAL INFORMATION**

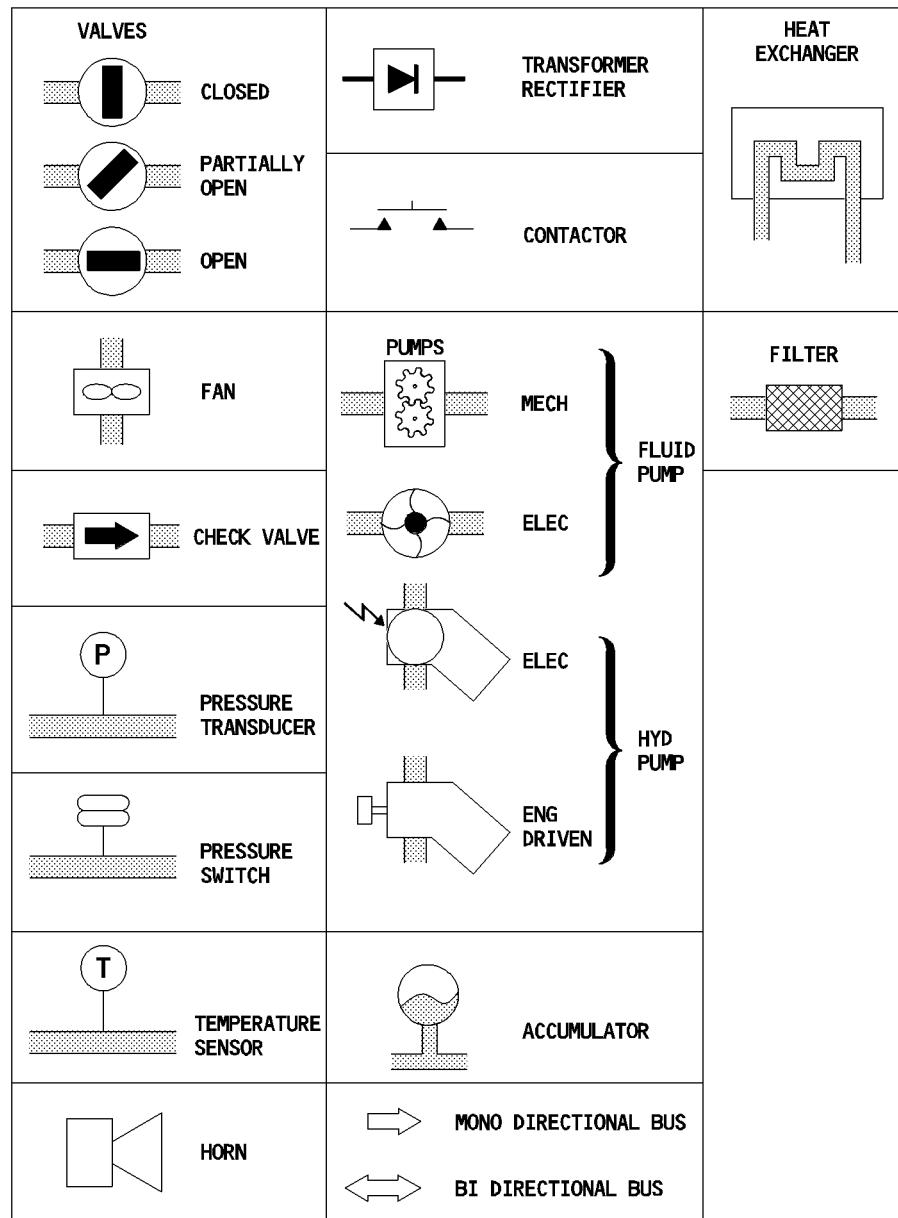
1.00.50 P 1

**UNITS CONVERSION TABLE**

SEQ. 001 REV. 07

R

	<b>METRIC → US</b>	<b>US → METRIC</b>
LENGTH	1 millimeter (mm) = 0.0394 inch (in)	1 inch (in) = 25.4 millimeter (mm)
	1 meter (m) = 3.281 feet (ft)	1 foot (ft) = .3048 meter (m)
	1 meter (m) = 1.094 yard (yd)	1 yard (yd) = .914 meter (m)
	1 kilometer (km) = .540 nautical mile (nm)	1 nautical mile (nm) = 1.852 kilometer (km)
SPEED	1 meter/second (m/s) = 3.281 feet/second (ft/s)	1 foot/second (ft/s) = .3048 meter/second (m/s)
	1 kilometer/hour (km/h) = .540 knot (kt)	1 knot (kt) = 1.852 kilometer/hour (km/h)
WEIGHT	1 gram (g) = 0.353 ounce (oz)	1 ounce (oz) = 28.35 grams (g)
	1 kilogram (kg) = 2.2046 pounds (lb)	1 pound (lb) = .4536 kilogram (kg)
	1 ton (t) = 2 204.6 pounds (lb)	1 pound (lb) = .0004536 ton (t)
FORCE	1 Newton (N) = .2248 pounds (lb)	1 pound (lb) = 4.448 Newtons (N)
	1 deca Newton (daN) = 2.248 pounds (lb)	1 pound (lb) = .4448 deca Newton (daN)
PRESSURE	1 BAR = 14.505 pounds per square inch (P.S.I.) 1 millibar (mbar) = 1 hpa = .0145 P.S.I.	1 pound per square inch (P.S.I.) = .0689 bar 1 P.S.I. = 68.92 millibars (mbar) = 68.92 hpa
VOLUME	1 liter (l) = .2642 U.S. Gallons	1 US Gallon = 3.785 liters (l)
	1 cubic meter (m³) = 264.2 U.S. Gallons	1 US Gallon = .003785 cubic meter (m³)
	1 liter (l) = 1.0568 Qt	1 Qt = 0.94625 liter (l)
	1 cubic meter (m³) = 1056.8 Qt	1 Qt = 0.000946 cubimeter (m³)
MOMENTUM	1 meter × deca Newton (m, daN) = 88.50 pound × inch (lb. in)	1 pound × inch (lb. in) = .0113 meter × deca Newton (mdaN)
TEMPERATURE	$t (^{\circ}\text{C}) = \frac{5}{9} \{t (^{\circ}\text{F}) - 32\}$	$t (^{\circ}\text{F}) = t (^{\circ}\text{C}) \times 1.8 + 32$



FFC5-01-0060-001-A001AA

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
0063	LV-ZPO
0074	LV-ZPJ
0080	LV-ZPX
0085	LV-ZRA

ARG

1.00.70

PAGE : CRT001

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VOL. 1 SYSTEMS DESCRIPTION

HIGHLIGHTS REV022C

V CH SEC ---PAGE-- SEQ-- REV-- VALIDATION CRITERIA-----  
-----REASONS OF CHANGE-----

-----

1 22 20 002 110 REV016 CODE:0166  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46572  
- INCORPORATION OF MOD 46893

1 22 20 003 110 REV010 CODE 0169  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 20 004 100 REV022 CODE 0088  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 20 005 105 REV016 CODE 0153  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 20 006 110 REV017 CODE 0153  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 20 007 100 REV022 CODE 0088  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 20 008 100 REV022 CODE 0089  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 20 009 200 REV022 CODE 0291  
- INCORPORATION OF MOD 46893

1 22 20 010 100 REV019 CODE:0166  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46572  
- INCORPORATION OF MOD 46893

1 22 20 013 100 REV022 CODE 0088  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 20 025 100 REV022 CODE 0089  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA-----  
-----REASONS OF CHANGE-----

1 22 30 054 200 REV022 CODE 0096  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 22 60 002 204 REV021 CODE 0309  
- INCORPORATION OF MOD 46257  
- INCORPORATION OF MOD 46893

1 24 20 007 101 REV016 M:45509  
- INCORPORATION OF MOD 45509

1 31 10 004 100 REV022 CODE 0089  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 31 40 030 103 REV021 CODE 0272  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 31 45 019 200 REV022 CODE 0105  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 31 45 021 100 REV022 CODE 0089  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 31 45 022 200 REV022 CODE 0105  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

1 31 45 023 100 REV016 MOD : 46324  
- INCORPORATION OF MOD 46324

1 31 45 024 100 REV019 46324  
- INCORPORATION OF MOD 46324

1 31 50 003 100 REV014 M:46324  
- INCORPORATION OF MOD 46324

1 34 00 001 100 REV022 CODE 0088  
- INCORPORATION OF MOD 44308  
- INCORPORATION OF MOD 44339  
- INCORPORATION OF MOD 46893

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VOL. 1 SYSTEMS DESCRIPTION

HIGHLIGHTS REV022C

V	CH	SEC	--PAGE--	SEQ-	--REV--	-----VALIDATION CRITERIA-----	-----REASONS OF CHANGE-----
1	34	10	001	103	REVO15	CODE:0010	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 41240</li><li>- INCORPORATION OF MOD 42083</li><li>- INCORPORATION OF MOD 44308</li><li>- INCORPORATION OF MOD 44339</li><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	10	003	100	REVO21	CODE:0011	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 42083</li><li>- INCORPORATION OF MOD 44308</li><li>- INCORPORATION OF MOD 44339</li><li>- INCORPORATION OF MOD 46572</li><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	15	001	110	REVO10	CODE 0093	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	15	002	110	REVO10	46893=46572+46893	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	15	003	215	REVO21	CODE:0109	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46257</li><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	30	002	103	REVO18	CODE:0160	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	30	003	100	REVO19	CODE:0164	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	30	004	100	REVO21	46893	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46893</li></ul>
1	34	70	001	110	REVO19	46324	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46324</li></ul>
1	34	70	002	110	REVO19	MOD : 46324	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46324</li></ul>
1	34	70	003	110	REVO10	MOD : 46324	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46324</li></ul>
1	34	70	004	110	REVO10	MOD : 46324	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46324</li></ul>
1	34	70	005	110	REVO10	MOD : 46324	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46324</li></ul>
1	34	70	008	110	REVO19	46324	<ul style="list-style-type: none"><li>- INCORPORATION OF MOD 46324</li></ul>

V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA-----  
-----REASONS OF CHANGE-----

1 34 70 009 110 REVO14 M:46324  
- INCORPORATION OF MOD 46324  
1 34 70 010 110 REVO19 46324  
- INCORPORATION OF MOD 46324  
1 34 70 011 110 REVO10 MOD : 46324  
- INCORPORATION OF MOD 46324  
1 34 70 012 110 REVO14 M:46324  
- INCORPORATION OF MOD 46324  
1 34 70 013 110 REVO15 M:46324  
- INCORPORATION OF MOD 46324  
1 34 70 014 202 REVO20 46324+49633  
- INCORPORATION OF MOD 46324  
- INCORPORATION OF MOD 49633  
1 34 95 001 101 REVO22 CODE 0131  
- INCORPORATION OF MOD 46893

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022CM V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
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1 00 00 001	001	REVO08		ALL
1 00 10 001	001	REVO18		ALL
1 00 10 002	001	REVO18		
1 00 10 003	001	REVO08		ALL
1 00 10 004	001	REVO08		
1 00 10 005	001	REVO08		ALL
1 00 20 001	001	REVO22	LIST OF CODES	ALL
1 00 20 002	001	REVO22	LIST OF CODES	
1 00 20 003	001	REVO22	LIST OF CODES	ALL
1 00 20 004	001	REVO22	LIST OF CODES	
1 00 20 005	001	REVO22	LIST OF CODES	ALL
1 00 20 006	001	REVO22	LIST OF CODES	
1 00 20 007	001	REVO22	LIST OF CODES	ALL
1 00 30 001	001	REVO22	LIST OF NORMAL REVISIONS	ALL
1 00 35 001	001	REVO08	RECORD OF TEMPORARY REVISION	ALL
1 00 36 001	001	REVO22	LIST OF TEMPORARY REVISIONS	ALL
1 00 40 001	001	REVO20		ALL
1 00 40 002	001	REVO20		
1 00 40 003	001	REVO20		ALL
1 00 40 004	001	REVO20		
1 00 40 005	001	REVO20		ALL
1 00 40 006	001	REVO20		
1 00 40 007	001	REVO20		ALL
1 00 40 008	001	REVO20		
1 00 40 009	001	REVO20		ALL
1 00 40 010	001	REVO20		
1 00 40 011	001	REVO20		ALL
1 00 40 012	001	REVO20		
1 00 40 013	001	REVO20		ALL
1 00 40 014	001	REVO20		
1 00 50 001	001	REVO07		ALL
1 00 60 001	001	REVO07		ALL
R 1 00 70 CRT	001	REVO22	CROSS REFERENCE TABLE	ALL
1 00 75 HL	001	REVO22	HIGHLIGHTS	ALL
R 1 00 80 LEP	001	REVO22	LIST OF EFFECTIVE PAGES	ALL
1 00 85 LOM	001	REVO22	LIST OF MOD/MP/SB	ALL

M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
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1 20 00 001	001	REV008	ALL
1 20 10 001	001	REV008	ALL
1 20 20 001	100	REV010 MOD 40023	ALL
1 20 20 002	001	REV019	
1 20 20 003	200	REV014 M:40023+47500	ALL
1 20 20 004	001	REV016	
1 20 20 005	001	REV016	ALL
1 21 00 001	001	REV015	ALL
1 21 10 001	105	REV017 40412	ALL
1 21 10 002	001	REV007	
1 21 10 003	001	REV020	ALL
1 21 10 004	001	REV014	
1 21 10 005	001	REV017	ALL
1 21 10 006	001	REV009	
1 21 10 007	103	REV015 MOD 43764	ALL
1 21 10 008	100	REV017 40412	
1 21 10 009	001	REV022	ALL
1 21 10 010	001	REV021	
1 21 10 011	100	REV009 MOD 40412	ALL
1 21 10 012	100	REV017 M:40412	
1 21 10 013	001	REV007	ALL
1 21 10 014	001	REV018	
1 21 10 015	001	REV022	ALL
1 21 10 016	001	REV007	
1 21 10 017	001	REV009	ALL
1 21 10 018	001	REV007	
1 21 10 019	202	REV017 40097+40099	ALL
1 21 10 020	204	REV022 52306+43188	
1 21 20 001	001	REV016	ALL
1 21 20 002	001	REV007	
1 21 20 003	001	REV017	ALL
1 21 20 004	001	REV009	
1 21 20 005	001	REV015	ALL
1 21 20 006	001	REV016	
1 21 20 007	001	REV007	ALL
1 21 20 008	001	REV016	
1 21 20 009	001	REV017	ALL
1 21 20 010	100	REV016 MOD 42399	

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022CM V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
-----

1	21	20	011	001	REVO15		ALL
1	21	20	012	001	REVO09		
1	21	20	013	001	REVO15		ALL
1	21	20	014	001	REVO15		
1	21	20	015	001	REVO09		ALL
1	21	20	016	001	REVO07		
1	21	20	017	200	REVO21	CODE 0004	ALL
1	21	30	001	001	REVO09		ALL
1	21	30	002	001	REVO15		
1	21	30	003	001	REVO07		ALL
1	21	30	004	001	REVO15		
1	21	30	005	001	REVO15		ALL
1	21	30	006	001	REVO09		
1	21	30	006A	001	REVO18		ALL
1	21	30	007	001	REVO09		ALL
1	21	30	008	001	REVO15		
1	21	30	008A	001	REVO18		ALL
1	21	30	009	001	REVO15		ALL
1	21	30	010	001	REVO07		
1	21	30	011	103	REVO07	MOD 42630	ALL
1	21	40	001	001	REVO07		ALL
1	21	40	002	100	REVO15	CODE 0263	
1	21	40	003	105	REVO17	CODE 0263	ALL
1	21	40	004	001	REVO07		
1	21	40	005	200	REVO19	M:40096+40097	ALL
1	21	40	006	100	REVO19	40097	
1	21	40	007	206	REVO07	MOD 40096+40097	ALL
1	21	40	008	001	REVO09		
1	21	40	009	002	REVO18		ALL
1	21	40	010	001	REVO09		
1	21	40	011	200	REVO15	M:40097+40099	ALL
1	21	40	012	200	REVO09	MOD 40097+40099	
1	21	40	013	100	REVO18	46257	ALL
1	21	50	001	001	REVO07		ALL
1	22	00	001	001	REVO10		ALL
1	22	00	002	001	REVO10		
1	22	10	001	001	REVO10		ALL
1	22	10	002	001	REVO10		

M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
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1 22 10 003	001	REV010		ALL
1 22 10 004	001	REV021	STD=47002+47482=50859+50860	
1 22 10 005	100	REV021	M:41958	ALL
1 22 10 006	001	REV021	STD=50859+50860=47002+47482	
1 22 10 007	001	REV012		ALL
1 22 10 008	001	REV010		
1 22 10 009	001	REV010		ALL
1 22 10 010	001	REV010		
1 22 10 011	001	REV010		ALL
1 22 10 012	001	REV012		
1 22 10 013	001	REV020		ALL
1 22 10 014	001	REV010		
1 22 10 015	001	REV007		ALL
1 22 10 016	001	REV010		
1 22 10 017	001	REV010		ALL
1 22 10 018	001	REV010		
1 22 10 019	100	REV018	M:41958	ALL
1 22 10 020	100	REV014	M:41958	
1 22 10 021	001	REV010		ALL
1 22 10 022	001	REV010		
1 22 10 023	001	REV010	STD=M:40815+47865	ALL
1 22 10 024	100	REV018	M:41958	
1 22 10 025	100	REV018	M:41958	ALL
1 22 10 026	001	REV010		
N 1 22 20 001	001	REV010		ALL
N 1 22 20 002	110	REV016	CODE:0166	
N 1 22 20 003	110	REV010	CODE 0169	ALL
N 1 22 20 004	100	REV022	CODE 0088	
N 1 22 20 005	105	REV016	CODE 0153	ALL
N 1 22 20 006	110	REV017	CODE 0153	
N 1 22 20 007	100	REV022	CODE 0088	ALL
N 1 22 20 008	100	REV022	CODE 0089	
N 1 22 20 009	200	REV022	CODE 0291	ALL
N 1 22 20 010	100	REV019	CODE:0166	
1 22 20 011	100	REV010	CODE 0122	ALL
1 22 20 012	001	REV010	STD=CODE 0294	
N 1 22 20 013	100	REV022	CODE 0088	ALL
N 1 22 20 014	100	REV010	M:44495	
1 22 20 015	001	REV010		ALL
1 22 20 016	001	REV017		

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA---- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA---- -----EFFECTIVITY-----

1	22	20	017	001	REVO10		ALL
1	22	20	018	001	REVO10		
1	22	20	019	001	REVO10		ALL
1	22	20	020	001	REVO10		
1	22	20	021	001	REVO10		ALL
1	22	20	022	001	REVO10		
1	22	20	023	001	REVO10		ALL
1	22	20	024	001	REVO13		
N	1	22	20	025	100	REVO22 CODE 0089	ALL
N	1	22	20	026	001	REVO13	
1	22	20	027	001	REVO18		ALL
1	22	20	028	100	REVO10	M:44495	
1	22	20	029	001	REVO10		ALL
1	22	20	030	001	REVO10		
1	22	20	031	001	REVO11		ALL
1	22	20	032	001	REVO18		
1	22	20	032A	001	REVO21		ALL
1	22	20	033	001	REVO10		ALL
1	22	20	034	001	REVO10	STD=M:40815+47865	
1	22	20	035	001	REVO10		ALL
1	22	20	036	001	REVO10		
1	22	30	001	001	REVO10		ALL
1	22	30	002	001	REVO10		
1	22	30	003	001	REVO10	STD=M:40815+47865	ALL
1	22	30	004	102	REVO21	45126	
1	22	30	005	001	REVO10	STD=M:40815+47865	ALL
1	22	30	006	001	REVO10	STD=M:40815+47865	
1	22	30	007	100	REVO10	MOD 44495	ALL
1	22	30	008	100	REVO19	44495	
1	22	30	009	001	REVO14	STD	ALL
1	22	30	010	001	REVO10		
1	22	30	011	001	REVO10		ALL
1	22	30	012	001	REVO10		
1	22	30	013	100	REVO10	M:41958	ALL
1	22	30	014	001	REVO11		
1	22	30	015	001	REVO10		ALL
1	22	30	016	001	REVO10		
1	22	30	017	001	REVO10		ALL
1	22	30	018	001	REVO10		

M	V	CH	SEC	--PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA----	-----EFFECTIVITY-----
M	V	CH	SEC	--PAGE--	SEQ-	--REV--	----VALIDATION CRITERIA----	-----EFFECTIVITY-----

1	22	30	019		001	REVO10		ALL
1	22	30	020		001	REVO10		
1	22	30	021		001	REVO16		ALL
1	22	30	022		001	REVO10		
1	22	30	023		001	REVO15		ALL
1	22	30	024		001	REVO14		
1	22	30	025		001	REVO14		ALL
1	22	30	026		001	REVO10	STD=M:40815+47865	
1	22	30	027		001	REVO10	STD=M:40815+47865	ALL
1	22	30	028		001	REVO10		
1	22	30	029		001	REVO10		ALL
1	22	30	030		001	REVO14		
1	22	30	031		001	REVO10		ALL
1	22	30	032		001	REVO10		
1	22	30	033		100	REVO18	44495	ALL
1	22	30	034		100	REVO10	M:44495	
1	22	30	035		110	REVO10	41958=40815+41958+47865	ALL
1	22	30	036		001	REVO10		
1	22	30	037		001	REVO10		ALL
1	22	30	038		100	REVO21	46257=40815+46257+47865	
1	22	30	038A		102	REVO21	46257=40815+46257+47865	ALL
1	22	30	039		102	REVO21	46257=40815+46257+47865	ALL
1	22	30	040		001	REVO21	STD=40815+47865	
1	22	30	041		001	REVO21	STD=40815+47865	ALL
1	22	30	042		001	REVO21		
1	22	30	043		001	REVO21		ALL
1	22	30	044		001	REVO21		
1	22	30	045		100	REVO10	MOD 44495	ALL
1	22	30	046		001	REVO18	STD=47002+47482=50859+50860	
1	22	30	047		100	REVO14	M:44495=(47002+47482+47484)	ALL
1	22	30	048		110	REVO17	44495=40815+44495+47865	
1	22	30	048A		100	REVO18	49103=47990=50321=50982	ALL
1	22	30	049		001	REVO21		ALL
1	22	30	050		001	REVO20		
1	22	30	051		001	REVO11		ALL
1	22	30	052		001	REVO21		
N	1	22	30	053	100	REVO15	49103=47990=50321=50982	ALL
N	1	22	30	054	200	REVO22	CODE 0096	
1	22	30	054A		100	REVO21	47990=49103=50321	ALL

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) -

-REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA---- -----EFFECTIVITY-----  
M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA---- -----EFFECTIVITY-----

1 22 30 055	001	REVO10		ALL
1 22 30 056	001	REVO10		
1 22 30 057	001	REVO20		ALL
1 22 30 058	001	REVO18		
1 22 30 059	001	REVO15		ALL
1 22 30 060	001	REVO15		
1 22 30 061	001	REVO16	STD OR M:45237	ALL
1 22 30 062	001	REVO10		
1 22 30 063	110	REVO21	CODE 0296	ALL
1 22 30 064	102	REVO18	CODE 0297	
1 22 30 065	100	REVO18	CODE 0213	ALL
1 22 30 065A	100	REVO18	CODE 0213	ALL
1 22 30 066	001	REVO19		ALL
1 22 30 067	100	REVO21	46257	ALL
1 22 30 068	001	REVO16		
1 22 30 069	001	REVO15		ALL
1 22 30 070	001	REVO21		
1 22 30 071	001	REVO16		ALL
1 22 30 072	001	REVO10		
1 22 30 073	001	REVO10		ALL
1 22 30 074	001	REVO12		
1 22 40 001	001	REVO07		ALL
1 22 40 002	001	REVO07		
1 22 40 003	001	REVO08		ALL
1 22 40 004	001	REVO08		
1 22 40 005	001	REVO08		ALL
1 22 40 006	001	REVO10		
1 22 45 001	100	REVO10	M:40542=46514=46742	ALL
1 22 45 002	100	REVO10	M:40542=46514=46742	
1 22 45 003	100	REVO10	M:40542=46514=46742	ALL
1 22 45 004	100	REVO10	M:40542=46514=46742	
1 22 45 005	100	REVO10	M:40542=46514=46742	ALL
1 22 45 006	100	REVO10	M:40542=46514=46742	
1 22 45 007	100	REVO10	M:40542=46514=46742	ALL
1 22 45 008	100	REVO10	M:40542=46514=46742	
1 22 46 001	100	REVO10	M:40542=46514=46742	ALL
1 22 46 002	100	REVO17	40542=46514=46742	
1 22 50 001	001	REVO07		ALL

M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

N 1 22 60 001	001	REV016	ALL
N 1 22 60 002	204	REV021 CODE 0309	
1 22 70 001	001	REV008	ALL
1 23 00 001	001	REV020	ALL
1 23 10 001	001	REV007	ALL
1 23 10 002	001	REV017	
1 23 10 003	001	REV012	ALL
1 23 10 004	001	REV010	
1 23 10 005	001	REV009	ALL
1 23 20 001	001	REV009	ALL
1 23 20 002	001	REV017 STD	
1 23 20 003	001	REV017 STD	ALL
1 23 20 004	001	REV008	
1 23 20 005	001	REV019	ALL
1 23 20 006	001	REV009	
1 23 20 007	001	REV009	ALL
1 23 20 008	001	REV009	
1 23 20 009	001	REV008	ALL
1 23 20 010	001	REV009	
1 23 20 011	001	REV009	ALL
1 23 20 012	001	REV009	
1 23 20 013	001	REV009	ALL
1 23 20 014	001	REV009	
1 23 20 015	001	REV020	ALL
1 23 20 016	001	REV017	
1 23 20 017	001	REV020	ALL
1 23 20 018	001	REV009	
1 23 20 019	001	REV016	ALL
1 23 20 020	001	REV014	
1 23 30 001	001	REV009 STD=42253=45268=45495	ALL
1 23 30 002	001	REV017 STD	
1 23 30 003	001	REV015	ALL
1 23 40 001	100	REV009 CODE 0034	ALL
1 23 40 002	100	REV009 CODE 0034	
1 23 40 003	100	REV012 CODE 0034	ALL
1 23 40 004	100	REV012 CODE 0034	
1 23 40 005	100	REV009 CODE 0034	ALL
1 23 40 006	100	REV009 CODE 0034	

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----

1 23 40 007	100	REVO09	CODE 0034	ALL
1 23 40 008	100	REVO21	CODE 0034	
1 23 40 009	100	REVO21	CODE 0034	ALL
1 23 45 001	100	REVO14	M:41832=41834=42685=47232	ALL
1 23 45 002	102	REVO16	M:41834=42685	
1 23 50 001	110	REVO14	M:47419	ALL
1 23 50 002	105	REVO18	49633	
1 23 60 001	100	REVO17	CODE:0222	ALL
1 24 00 001	001	REVO08		ALL
1 24 10 001	001	REVO08		ALL
1 24 10 002	001	REVO21		
1 24 10 003	001	REVO08		ALL
1 24 10 004	001	REVO08		
1 24 10 005	001	REVO07		ALL
1 24 10 006	001	REVO08		
1 24 10 007	001	REVO08		ALL
1 24 10 008	001	REVO08		
1 24 10 009	001	REVO18		ALL
1 24 10 010	001	REVO08		
1 24 10 011	001	REVO08		ALL
1 24 10 012	001	REVO08		
1 24 10 013	001	REVO08		ALL
1 24 10 014	001	REVO16		
1 24 10 015	001	REVO07		ALL
1 24 10 016	001	REVO08		
1 24 10 017	001	REVO17		ALL
1 24 10 018	100	REVO08	MOD:41537	
1 24 10 019	001	REVO10		ALL
1 24 10 020	001	REVO14		
1 24 10 021	001	REVO10		ALL
1 24 20 001	001	REVO08		ALL
1 24 20 002	001	REVO08		
1 24 20 003	100	REVO13	M:44710=45117	ALL
1 24 20 004	100	REVO17	40335	
1 24 20 005	001	REVO09		ALL
1 24 20 006	001	REVO07		
N 1 24 20 007	101	REVO16	M:45509	ALL
N 1 24 20 008	001	REVO18		

M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 24 20 009	001	REV009	ALL
1 24 20 010	001	REV015	
1 24 20 011	001	REV015	ALL
1 24 20 012	001	REV019	
1 24 20 013	001	REV015	ALL
1 24 20 014	001	REV015	
1 24 20 015	001	REV015	ALL
1 24 20 016	001	REV015	
1 24 20 017	001	REV015	ALL
1 24 20 018	001	REV022	
1 24 20 019	001	REV007	ALL
1 24 20 020	001	REV007	
1 24 20 021	001	REV007	ALL
1 24 20 022	001	REV007	
1 24 20 023	001	REV014	ALL
1 24 20 024	110	REV020 M:49633=(47419+49633)	
1 25 00 001	001	REV019	ALL
1 25 10 001	001	REV015	ALL
1 25 10 002	001	REV019	
1 25 10 003	001	REV008	ALL
1 25 10 004	001	REV012	
1 25 10 005	001	REV017	ALL
1 25 10 006	001	REV019	
1 25 10 006A	001	REV019	ALL
1 25 10 007	002	REV019	ALL
1 25 10 008	002	REV009	
1 25 10 009	002	REV008	ALL
1 25 10 010	002	REV008	
1 25 10 011	002	REV008	ALL
1 25 10 012	002	REV008	
1 25 10 013	002	REV008	ALL
1 25 10 014	100	REV016 45191	
1 25 10 015	100	REV008 MOD 40231	ALL
1 25 11 001	300	REV022 MOD : 50014+51233+52230	ALL
1 25 11 002	200	REV019 (50014+50723):(50014+51243)	
1 25 11 003	100	REV019 M:50014	ALL
1 25 11 004	100	REV019 M:50014	
1 25 11 005	200	REV019 (50014+50723):(50014+51243)	ALL
1 25 11 006	200	REV019 (50014+50723):(50014+51243)	

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022CM V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
-----

1 25 12 001	200	REVO16	40259+40260	ALL
1 25 12 002	200	REVO19	40259+40260	
1 25 15 001	100	REVO15	40259=40379=40512	ALL
1 25 15 002	100	REVO14	40259=40379=40512	
1 25 15 003	100	REVO14	40259=40379=40512	ALL
1 25 16 001	001	REVO14	STD	ALL
1 25 20 001	001	REVO19		ALL
1 26 00 001	001	REVO19		ALL
1 26 10 001	001	REVO17		ALL
1 26 20 001	001	REVO09		ALL
1 26 20 002	001	REVO09		
1 26 20 003	001	REVO17		ALL
1 26 20 004	001	REVO09		
1 26 20 005	001	REVO10		ALL
1 26 20 006	001	REVO09		
1 26 20 007	001	REVO09		ALL
1 26 20 008	001	REVO09		
1 26 20 009	001	REVO09		ALL
1 26 20 010	105	REVO22	49192=52306	
1 26 30 001	001	REVO18		ALL
1 26 30 002	001	REVO07		
1 26 30 003	001	REVO09		ALL
1 26 30 004	001	REVO10		
1 26 40 001	001	REVO07		ALL
1 26 40 002	001	REVO10		
1 26 50 001	001	REVO17		ALL
1 26 50 001A	001	REVO19	STD	ALL
1 26 50 002	001	REVO17		ALL
1 26 50 003	100	REVO18	40314=40487=40314+40487	ALL
1 26 50 004	001	REVO16		
1 26 50 005	001	REVO14		ALL
1 26 57 001	210	REVO21	CODE 0285	ALL
1 26 57 002	210	REVO21	CODE 0287	
1 26 57 003	200	REVO16	CODE 0285	ALL
1 26 57 004	215	REVO21	CODE 0287	
1 26 60 001	001	REVO19		ALL

M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 27 00 001	001	REV021	ALL
1 27 10 001	001	REV018	ALL
1 27 10 002	001	REV007	
1 27 10 003	100	REV014 M:41486	ALL
1 27 10 004	001	REV010	
1 27 10 005	001	REV018	ALL
1 27 10 006	001	REV010	
1 27 10 007	001	REV010	ALL
1 27 10 008	001	REV007	
1 27 10 009	001	REV010	ALL
1 27 10 010	001	REV014	
1 27 10 011	100	REV021 M:46292=46627	ALL
1 27 10 012	001	REV012	
1 27 10 013	001	REV007	ALL
1 27 10 014	001	REV018	
1 27 10 015	001	REV007	ALL
1 27 10 016	001	REV007	
1 27 10 017	100	REV018 41486	ALL
1 27 20 001	001	REV007	ALL
1 27 20 002	001	REV007	
1 27 20 003	001	REV020	ALL
1 27 20 004	100	REV020 48753=48754=51340=51356	
1 27 20 005	001	REV007	ALL
1 27 20 006	001	REV007	
1 27 20 007	001	REV014	ALL
1 27 20 008	001	REV014	
1 27 20 009	001	REV018	ALL
1 27 30 001	103	REV020 MOD 44438	ALL
1 27 30 002	001	REV016	
1 27 30 003	100	REV016 MOD 44438	ALL
1 27 30 004	001	REV008 STD=M:40815+47865	
1 27 30 005	001	REV007	ALL
1 27 40 001	001	REV019	ALL
1 27 40 002	100	REV019 M:46292=46627	
1 27 40 003	001	REV007	ALL
1 27 40 004	100	REV010 M:41855	
1 27 40 005	100	REV007 MOD 41855	ALL
1 27 40 006	001	REV007	

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----

1 27 40 007	001	REVO07		ALL
1 27 40 008	001	REVO07	STD=M:40815+47865	
1 27 40 009	001	REVO07		ALL
1 27 40 010	001	REVO07		
1 27 40 011	001	REVO20		ALL
1 27 40 012	105	REVO21	49192=52306	
1 27 40 013	100	REVO18	M:46257	ALL
1 27 40 014	001	REVO20		
1 27 50 001	001	REVO15		ALL
1 27 50 002	001	REVO08		
1 27 50 003	001	REVO07		ALL
1 27 50 004	001	REVO17		
1 27 50 005	001	REVO15		ALL
1 27 50 006	001	REVO07		
1 27 50 007	001	REVO07		ALL
1 27 50 008	001	REVO15		
1 27 50 009	100	REVO14	M:46257	ALL
1 27 60 001	001	REVO22		ALL
1 28 00 001	001	REVO15		ALL
1 28 10 001	001	REVO20	STD=M:42490+49428	ALL
1 28 10 002	001	REVO14		
1 28 10 003	001	REVO14		ALL
1 28 10 004	001	REVO14		
1 28 10 005	001	REVO14		ALL
1 28 10 006	001	REVO18		
1 28 10 007	001	REVO14		0063
1 28 10 008	001	REVO14		
1 28 10 007	100	REVO14	M:41600	0074-0085
1 28 10 008	100	REVO14	M:41600	
1 28 10 009	002	REVO14		ALL
1 28 10 010	002	REVO14		
1 28 10 011	110	REVO14	M:40023	0063
1 28 10 012	002	REVO18		
1 28 10 011	110	REVO14	M:40023	0074-0085
1 28 10 012	101	REVO18	41600	
1 28 10 013	002	REVO14		ALL
1 28 10 014	002	REVO14		
1 28 10 015	102	REVO22	M:47930	0063
1 28 10 016	002	REVO14		

M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 28 10 015	202	REV022	M:41600+47930	0074-0085
1 28 10 016	002	REV014		
1 28 10 017	002	REV014		0063
1 28 10 018	002	REV014		
1 28 10 017	101	REV014	M:41600	0074-0085
1 28 10 018	101	REV014	M:41600	
1 28 10 019	002	REV014		0063
1 28 10 020	002	REV014		
1 28 10 019	002	REV014		0074-0085
1 28 10 020	101	REV014	M:41600	
1 28 10 021	002	REV014		0063
1 28 10 022	102	REV016	M:47930	
1 28 10 021	002	REV014		0074-0085
1 28 10 022	201	REV016	M:41600+47930	
1 28 10 023	002	REV014		0063
1 28 10 024	001	REV014		
1 28 10 023	101	REV014	M:41600	0074-0085
1 28 10 024	001	REV014		
1 28 20 001	001	REV015		0063
1 28 20 002	001	REV015		
1 28 20 001	100	REV015	M:41600	0074-0085
1 28 20 002				
1 28 20 003	001	REV015		0063
1 28 20 004	001	REV015		
1 28 20 003	100	REV015	M:41600	0074-0085
1 28 20 004	001	REV015		
1 28 20 005	001	REV015		ALL
1 28 20 006	001	REV017		
1 28 20 007	001	REV015		ALL
1 28 20 008	001	REV015		
1 28 20 009	001	REV015		ALL
1 28 20 010	001	REV017		
1 28 20 011	001	REV015		ALL
1 28 20 012	001	REV015		
1 28 20 013	002	REV015		ALL
1 28 20 014	002	REV015		
1 28 20 015	002	REV015		ALL
1 28 20 016	100	REV015	M:44575	
1 28 20 017	306	REV022	CODE 0065	0063
1 28 20 018	105	REV015	M:46257	

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----

1 28 20 017	405	REVO18	CODE 0073	0074-0085
1 28 20 018	105	REVO15	M:46257	
1 28 30 001	001	REVO18		ALL
1 28 30 002	001	REVO14		
1 29 00 001	001	REVO08		ALL
1 29 10 001	001	REVO09		ALL
1 29 10 002	001	REVO08		
1 29 10 003	001	REVO21		ALL
1 29 10 004	001	REVO08		
1 29 10 005	001	REVO08		ALL
1 29 10 006	001	REVO08		
1 29 10 007	001	REVO08		ALL
1 29 10 008	001	REVO20		
1 29 20 001	100	REVO22	45191	ALL
1 29 20 002	001	REVO17		
1 29 20 003	100	REVO19	45191	ALL
1 29 20 004	001	REVO20		
1 29 20 005	001	REVO15		ALL
1 29 20 006	300	REVO16	MOD : 45191+46257+46532	
1 29 20 007	001	REVO09		ALL
1 29 20 008	100	REVO18	46257	
1 29 20 009	001	REVO08		ALL
1 29 30 001	001	REVO08		ALL
1 30 00 001	001	REVO20		ALL
1 30 10 001	001	REVO17	CODE:0138	ALL
1 30 20 001	001	REVO16		ALL
1 30 20 002	001	REVO09		
1 30 20 003	001	REVO17		ALL
1 30 30 001	001	REVO10		ALL
1 30 30 002	100	REVO22	M:47297=47002	
1 30 30 003	100	REVO12	MOD : 46257	ALL
1 30 40 001	001	REVO12		ALL
1 30 40 002	001	REVO07		
1 30 50 001	001	REVO09		ALL
1 30 50 002	001	REVO20		
1 30 50 003	100	REVO20	49192=50902=52306	ALL
1 30 55 001	001	REVO07		ALL

M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 30 60 001	100	REV012	CODE 0087	ALL
1 30 60 002	100	REV012	CODE 0087	
1 30 60 003	100	REV008	CODE 0087	ALL
1 30 70 001	001	REV018		ALL
1 30 80 001	001	REV017		ALL
1 31 00 001	001	REV017		ALL
1 31 00 002	001	REV021		
1 31 00 003	001	REV017		ALL
1 31 05 001	001	REV008		ALL
1 31 05 002	001	REV008		
1 31 05 003	001	REV008		ALL
1 31 05 004	001	REV008		
1 31 05 005	001	REV015		ALL
1 31 05 006	001	REV008		
1 31 10 001	001	REV008		ALL
1 31 10 002	001	REV018		
N 1 31 10 003	001	REV008		ALL
N 1 31 10 004	100	REV022	CODE 0089	
1 31 10 005	107	REV021	46257	ALL
1 31 15 001	001	REV008		ALL
1 31 15 002	001	REV016		
1 31 15 003	001	REV015		ALL
1 31 15 004	001	REV022		
1 31 15 005	001	REV008		ALL
1 31 20 001	001	REV008		ALL
1 31 20 002	001	REV018		
1 31 20 003	001	REV008		ALL
1 31 20 004	001	REV008		
1 31 20 005	001	REV008		ALL
1 31 20 006	001	REV014		
1 31 25 001	001	REV008		ALL
1 31 25 002	001	REV008		
1 31 25 003	001	REV008		ALL
1 31 25 004	001	REV008		
1 31 25 005	001	REV008		ALL
1 31 25 006	001	REV008		
1 31 25 007	001	REV008		ALL

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----

1	31	30	001	001	REVO14		ALL	
1	31	30	002	001	REVO17			
1	31	30	003	001	REVO16		ALL	
1	31	30	004	001	REVO15			
1	31	30	005	001	REVO08		ALL	
1	31	40	001	001	REVO22		ALL	
1	31	40	002	001	REVO16	STD=M:40815+47865		
1	31	40	003	001	REVO08	STD=40815+47865	ALL	
1	31	40	004	001	REVO08			
1	31	40	005	001	REVO08		ALL	
1	31	40	006	001	REVO08			
1	31	40	007	001	REVO08		ALL	
1	31	40	008	001	REVO08			
1	31	40	009	001	REVO08		ALL	
1	31	40	010	001	REVO08			
1	31	40	011	001	REVO17	STD=40064+43057	ALL	
1	31	40	012	001	REVO20	STD = MOD 40064+43057		
1	31	40	013	001	REVO08	STD=M:40815+47865	ALL	
1	31	40	014	001	REVO08			
1	31	40	015	001	REVO19		ALL	
1	31	40	016	001	REVO08	STD=M:40815+47865		
1	31	40	017	001	REVO08		ALL	
1	31	40	018	001	REVO08	STD=M:40815+47865		
1	31	40	019	001	REVO10	STD=M:40815+47865	ALL	
1	31	40	020	001	REVO08	STD=M:40815+47865		
1	31	40	021	001	REVO13	STD=M:40815+47865	ALL	
1	31	40	022	001	REVO08			
1	31	40	023	200	REVO09	CODE 0037	ALL	
1	31	40	024	100	REVO08	M:41925=(40815+41925+47865)		
1	31	40	025	001	REVO08		ALL	
1	31	40	026	001	REVO08			
1	31	40	027	100	REVO20	47002=49192=52306	ALL	
1	31	40	028	001	REVO17			
N	1	31	40	029	100	REVO22	CODE 0036	ALL
N	1	31	40	030	103	REVO21	CODE 0272	
1	31	40	031	100	REVO18	44100=44754=43211	ALL	
1	31	45	001	001	REVO22		ALL	
1	31	45	002	001	REVO12			

M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 31 45 003	001	REV014	ALL
1 31 45 004	001	REV014	
1 31 45 005	001	REV021	ALL
1 31 45 006	001	REV008	
1 31 45 007	001	REV012	ALL
1 31 45 008	001	REV008 STD = MOD 40437+43721	
1 31 45 009	001	REV012	ALL
1 31 45 010	002	REV008	
1 31 45 011	100	REV018 44495	ALL
1 31 45 012	100	REV008 MOD 44495	
1 31 45 013	002	REV021	ALL
1 31 45 014	002	REV008	
1 31 45 015	002	REV017	ALL
1 31 45 016	002	REV021	
1 31 45 016A	001	REV021	ALL
1 31 45 017	100	REV020 M:44100=44754=43211	ALL
1 31 45 018	002	REV018	
N 1 31 45 019	200	REV022 CODE 0105	ALL
N 1 31 45 020	100	REV009 MOD 44100 = 44754 = 43211	
N 1 31 45 021	100	REV022 CODE 0089	ALL
N 1 31 45 022	200	REV022 CODE 0105	
N 1 31 45 023	100	REV016 MOD : 46324	ALL
N 1 31 45 024	100	REV019 46324	
1 31 50 001	001	REV021	ALL
1 31 50 002	001	REV008	
N 1 31 50 003	100	REV014 M:46324	ALL
N 1 31 50 004	001	REV012	
1 31 55 001	001	REV009 STD OR MOD 44967	ALL
1 31 55 002	001	REV009 STD = MOD 44967	
1 31 55 003	001	REV009 STD=M:44967	ALL
1 31 55 004	001	REV009 STD = MOD 44967	
1 31 60 001	001	REV017	ALL
1 31 60 002	001	REV017	
1 31 60 003	100	REV017 40077	ALL
1 31 60 004	100	REV015 M:40077	
1 31 75 001	001	REV015	ALL
1 31 80 001	001	REV009	ALL
1 32 00 001	001	REV015	ALL

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022CM V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----

1 32 10 001	001	REVO09		ALL
1 32 10 002	001	REVO09		
1 32 10 003	001	REVO09		ALL
1 32 10 004	001	REVO20		
1 32 10 005	001	REVO09		ALL
1 32 10 006	001	REVO09		
1 32 10 007	001	REVO09		ALL
1 32 10 008	001	REVO09		
1 32 10 009	001	REVO09		ALL
1 32 10 010	001	REVO09		
1 32 10 011	001	REVO09		ALL
1 32 10 012	001	REVO09		
1 32 10 013	001	REVO09		ALL
1 32 10 014	001	REVO09		
1 32 10 015	001	REVO09		ALL
1 32 10 016	001	REVO09		
1 32 10 017	001	REVO09		ALL
1 32 20 001	115	REVO14	CODE:0113	ALL
1 32 20 002	001	REVO07		
1 32 20 003	105	REVO15	CODE 0113	ALL
1 32 20 004	001	REVO07		
1 32 20 005	001	REVO15	STD=(48882+43442)	ALL
1 32 20 006	100	REVO20	M:49633	
1 32 30 001	001	REVO07		ALL
1 32 30 002	001	REVO17		
1 32 30 003	001	REVO17		ALL
1 32 30 004	001	REVO21		
1 32 30 005	100	REVO14	M:45900	ALL
1 32 30 006	100	REVO12	M:45900	
1 32 30 007	001	REVO07		ALL
1 32 30 008	001	REVO07		
1 32 30 009	100	REVO07	MOD 42192	ALL
1 32 30 010	100	REVO19	M:45900	
1 32 30 011	001	REVO07		ALL
1 32 30 012	001	REVO16		
1 32 30 013	001	REVO15		ALL
1 32 30 014	001	REVO15		
1 32 30 015	103	REVO20	CODE 0118	ALL
1 32 50 001	001	REVO17		ALL

M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 33 00 001	001	REV017	ALL
1 33 10 001	001	REV007	ALL
1 33 10 002	001	REV007	ALL
1 33 10 003	001	REV007	ALL
1 33 10 004	001	REV010	ALL
1 33 10 005	001	REV008	ALL
1 33 10 006	001	REV007	ALL
1 33 10 007	001	REV007	ALL
1 33 20 001	001	REV007	ALL
1 33 20 002	001	REV007	ALL
1 33 20 003	100	REV007 MOD 40239	ALL
1 33 20 004	001	REV007	ALL
1 33 30 001	001	REV015	ALL
1 33 30 002	001	REV012	ALL
1 33 30 003	001	REV012	ALL
1 33 40 001	150	REV012 M:41619=41728=41923=43558	ALL
1 33 40 002	001	REV007	ALL
1 33 50 001	001	REV022	ALL
N 1 34 00 001	100	REV022 CODE 0088	ALL
N 1 34 00 002	100	REV022 M:43211=44100=44754	ALL
N 1 34 10 001	103	REV015 CODE:0010	ALL
N 1 34 10 002	001	REV007	ALL
N 1 34 10 003	100	REV021 CODE:0011	ALL
N 1 34 10 004	001	REV009	ALL
1 34 10 005	001	REV009	ALL
1 34 10 006	001	REV007	ALL
1 34 10 007	001	REV009	ALL
1 34 10 008	001	REV009	ALL
1 34 10 009	102	REV022 CODE 0119	ALL
N 1 34 15 001	110	REV010 CODE 0093	ALL
N 1 34 15 002	110	REV010 46893=46572+46893	ALL
N 1 34 15 003	215	REV021 CODE:0109	ALL
1 34 20 001	001	REV022 CODE 0218	ALL
1 34 20 002	001	REV009 CODE 0219	ALL
1 34 20 003	001	REV019 CODE 0220	ALL
N 1 34 30 001	001	REV013 STD=47002+47482+47484	ALL
N 1 34 30 002	103	REV018 CODE:0160	ALL

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) -

-REV 022C

M	V	CH	SEC	---PAGE---	SEQ-	--REV--	----VALIDATION CRITERIA----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE---	SEQ-	--REV--	----VALIDATION CRITERIA----	-----EFFECTIVITY-----

N	1	34	30	003	100	REVO19	CODE:0164	ALL
N	1	34	30	004	100	REVO21	46893	
1	34	30	005	001	REVO21		ALL	
1	34	30	006	001	REVO13	STD=47002+47482+47484		
1	34	30	007	001	REVO09	STD=47002+47482+47484	ALL	
1	34	30	008	001	REVO09	CODE:0125		
1	34	30	009	001	REVO16	STD=CODE:0125	ALL	
1	34	30	010	001	REVO09			
1	34	40	001	100	REVO15	M:46257	ALL	
1	34	40	002	001	REVO08			
1	34	50	001	001	REVO15	STD=M:40021+41827	ALL	
1	34	50	002	100	REVO10	CODE 0029		
1	34	60	001	110	REVO15	CODE 0074	ALL	
1	34	60	002	110	REVO09	CODE 0074		
1	34	60	003	100	REVO22	44100	ALL	
1	34	60	004	100	REVO22	44100		
1	34	60	005	200	REVO22	CODE 0054	ALL	
N	1	34	70	001	110	REVO19	46324	ALL
N	1	34	70	002	110	REVO19	MOD : 46324	
N	1	34	70	003	110	REVO10	MOD : 46324	ALL
N	1	34	70	004	110	REVO10	MOD : 46324	
N	1	34	70	005	110	REVO10	MOD : 46324	ALL
N	1	34	70	006	001	REVO19		
N	1	34	70	007	001	REVO19	STD	ALL
N	1	34	70	008	110	REVO19	46324	
N	1	34	70	009	110	REVO14	M:46324	ALL
N	1	34	70	010	110	REVO19	46324	
N	1	34	70	011	110	REVO10	MOD : 46324	ALL
N	1	34	70	012	110	REVO14	M:46324	
N	1	34	70	013	110	REVO15	M:46324	ALL
N	1	34	70	014	202	REVO20	46324+49633	
1	34	80	001	210	REVO21	CODE 0251	ALL	
1	34	80	002	100	REVO08	CODE 0030		
1	34	80	003	100	REVO08	CODE 0030	ALL	
1	34	80	004	100	REVO09	CODE 0030		
1	34	80	005	100	REVO09	CODE 0048	ALL	
1	34	80	006	200	REVO19	CODE 0179		
1	34	80	007	105	REVO14	CODE:0097	ALL	
1	34	80	008	110	REVO10	CODE 0020		

M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 34 80 009	210	REV010	CODE 0040	ALL
1 34 80 010	100	REV009	CODE 0085	
1 34 80 011	100	REV020	CODE:0098	ALL
1 34 80 012	100	REV014	CODE:0035	
1 34 80 013	105	REV022	CODE:0099	ALL
1 34 80 014	100	REV009	CODE:0088	
N 1 34 95 001	101	REV022	CODE 0131	ALL
1 35 00 001	001	REV008		ALL
1 35 10 001	001	REV008		ALL
1 35 20 001	001	REV020	STD=M:40087=40237	ALL
1 35 20 002	001	REV008		
1 35 20 003	001	REV008		ALL
1 35 20 004	001	REV018		
1 35 20 005	001	REV015		ALL
1 35 20 006	001	REV020		
1 35 20 007	001	REV015		ALL
1 35 20 008	001	REV008		
1 35 30 001	100	REV022	CODE 0013	ALL
1 35 30 002	001	REV022		
1 35 30 003	001	REV010		ALL
1 35 30 004	001	REV009		
1 35 40 001	001	REV008		ALL
1 35 40 002	001	REV008		
1 35 50 001	001	REV010		ALL
1 36 00 001	001	REV007		ALL
1 36 10 001	001	REV007		ALL
1 36 10 002	001	REV007		
1 36 10 003	001	REV018		ALL
1 36 10 004	001	REV007		
1 36 10 005	001	REV007		ALL
1 36 10 006	100	REV008	MOD 42143=42223=(42143+42223)	
1 36 10 007	001	REV007		ALL
1 36 10 008	001	REV007		
1 36 10 009	001	REV007		ALL
1 36 10 010	001	REV007		
1 36 20 001	001	REV007		ALL
1 36 20 002	100	REV007	42143=42223	

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) -

-REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
-----

1 36 20 003	001	REVO07		ALL
1 36 20 004	001	REVO20		
1 36 20 005	100	REVO09	CODE 0056	ALL
1 36 20 006	001	REVO08		
1 36 20 007	110	REVO22	49192=52306	ALL
1 36 20 008	001	REVO15		
1 36 30 001	001	REVO07		ALL
1 38 00 001	001	REVO07		ALL
1 38 10 001	001	REVO08		ALL
1 38 10 002	002	REVO09		
1 38 10 003	001	REVO08		ALL
1 38 10 004	001	REVO09		
1 38 10 005	001	REVO20	STD=M40106+47892=47582+51370	ALL
1 38 20 001	001	REVO07		ALL
1 45 00 001	001	REVO07		ALL
1 45 10 001	001	REVO07		ALL
1 45 10 002	001	REVO11		
1 45 10 003	001	REVO21		ALL
1 45 10 004	001	REVO07		
1 45 10 005	001	REVO07		ALL
1 45 20 001	001	REVO07		ALL
1 45 20 002	001	REVO07		
1 45 20 003	001	REVO10		ALL
1 45 20 004	001	REVO10		
1 45 20 005	001	REVO16		ALL
1 45 20 006	001	REVO07		
1 45 20 007	001	REVO07		ALL
1 45 20 008	001	REVO10		
1 45 20 009	001	REVO07		ALL
1 45 20 010	001	REVO07		
1 45 20 011	001	REVO16		ALL
1 45 20 012	001	REVO07		
1 45 30 001	100	REVO19	M: 40783	ALL
1 45 35 001	001	REVO10		ALL
1 45 35 002	001	REVO07		
1 45 35 003	001	REVO07		ALL
1 45 40 001	001	REVO07		ALL

M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE-- SEQ- --REV-- -----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 -----

1 49 00 001	001	REVO09		ALL
1 49 10 001	001	REVO09		ALL
1 49 10 002	100	REVO09	42143=42223	ALL
1 49 10 003	100	REVO09	42143=42223	ALL
1 49 10 004	001	REVO22		ALL
1 49 20 001	001	REVO21		ALL
1 49 20 002	001	REVO17		ALL
1 49 20 003	001	REVO07		ALL
1 49 20 004	100	REVO09	M:44164=44165=44968=44969	ALL
1 49 20 005	001	REVO09		ALL
1 49 20 006	001	REVO09		ALL
1 49 30 001	001	REVO09		ALL
1 52 00 001	001	REVO08		ALL
1 52 10 001	001	REVO08		ALL
1 52 10 002	001	REVO08		ALL
1 52 10 003	001	REVO08		ALL
1 52 10 004	001	REVO07		ALL
1 52 10 005	104	REVO19	50014	ALL
1 52 10 006	100	REVO19	M:41649	ALL
1 52 10 007	100	REVO18	50014=50334	ALL
1 52 10 008	001	REVO07		ALL
1 52 10 009	001	REVO08		ALL
1 52 10 010	001	REVO08		ALL
1 52 20 001	001	REVO08		ALL
1 52 20 002	001	REVO07		ALL
1 52 30 001	100	REVO07	MOD 40088	ALL
1 70 00 001	005	REVO07	CFM ALL	ALL
1 70 00 002	005	REVO07	CFM ALL	ALL
1 70 10 001	005	REVO12	CFM ALL	ALL
1 70 20 001	005	REVO09	CFM ALL	ALL
1 70 20 002	005	REVO07	CFM ALL	ALL
1 70 20 003	005	REVO09	CFM ALL	ALL
1 70 20 004	005	REVO09	CFM ALL	ALL
1 70 20 005	005	REVO13	CFM ALL	ALL
1 70 20 006	005	REVO17	CFM	ALL
1 70 30 001	005	REVO09	CFM ALL	ALL
1 70 30 002	005	REVO09	CFM ALL	ALL

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FCOM VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) - -REV 022C

M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
 M V CH SEC ---PAGE--- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----

1	70	30	003	005	REVO09	CFM ALL	ALL
1	70	30	004	005	REVO16	CFM ALL	
1	70	30	005	005	REVO07	CFM ALL	ALL
1	70	40	001	005	REVO09	CFM ALL	
1	70	40	002	005	REVO09	CFM ALL	ALL
1	70	40	003	005	REVO18	CFM ALL	
1	70	40	004	005	REVO09	CFM ALL	ALL
1	70	40	005	005	REVO13	CFM ALL	
1	70	40	006	005	REVO07	CFM ALL	ALL
1	70	40	007	110	REVO13	M:47297/CFM	ALL
1	70	50	001	005	REVO09	CFM ALL	ALL
1	70	60	001	005	REVO07	CFM ALL	
1	70	60	002	005	REVO07	CFM ALL	ALL
1	70	70	001	005	REVO09	CFM ALL	
1	70	70	002	005	REVO09	CFM ALL	ALL
1	70	70	003	150	REVO09	CFM ALL MOD 42800 = 43487	ALL
1	70	80	001	110	REVO13	M:47297 CFM ALL	
1	70	80	002	110	REVO13	M:47297 CFM ALL	ALL
1	70	80	003	005	REVO07	CFM ALL	
1	70	80	004	110	REVO13	M:47297/CFM	ALL
1	70	80	005	005	REVO07	CFM ALL	
1	70	80	006	005	REVO16	CFM ALL	ALL
1	70	80	007	005	REVO07	CFM ALL	
1	70	80	008	005	REVO16	CFM ALL	ALL
1	70	80	009	005	REVO07	CFM ALL	ALL
1	70	90	001	005	REVO07	CFM ALL	
1	70	90	002	110	REVO19	M:47297/CFM	ALL
1	70	90	003	005	REVO07	CFM ALL	
1	70	90	004	005	REVO17	CFM	ALL
1	70	90	005	005	REVO08	CFM ALL	
1	70	90	006	108	REVO17	46532/C2/C3	ALL
1	70	90	007	105	REVO18	M:46532/CFM ALL	0063
1	70	90	008	005	REVO11	CFM ALL	
1	70	90	007	210	REVO18	46532+41150	0074-0085
1	70	90	008	005	REVO11	CFM ALL	
1	70	90	009	005	REVO09	CFM ALL	
1	70	90	010	005	REVO07	CFM ALL	ALL

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FCOM

VOL.1 (SYSTEMS DESCRIPTION )  
LIST OF EFFECTIVE PAGES (LEP) -

-REV 022C

M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
M V CH SEC ---PAGE-- SEQ- --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----  
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1 70 90 011	110	REV017	47297/CFM	ALL
1 70 90 012	005	REV007	CFM ALL	
1 70 90 013	105	REV018	M:44063/CFM 56-5-C2/C3	ALL
1 70 90 014	108	REV020	49633-44063+46257+49633/CFM	
1 70 90 015	105	REV008	CFM ALL MOD 44063	ALL
1 70 91 001	150	REV009	CFM ALL MOD 42800 = 43487	ALL

M	V REV	MOD MP	TITLE	VALIDITY
T		SB		

- . 011A 40021 ..... ELECTRICS-GENERATION-DISTRIBUTION-VU'S  
..... AND AVIONICS-DEFINE BASIC A/C  
..... ALL
- . 011A 40023 ..... GENERAL- ADAPT BASIC DEFINITION FOR ST2  
..... (A340-200)  
..... ALL
- . 021A 40033 ..... POWER PLANT-DEFINE CFM56 POWER PLANT  
..... AND ASSOCIATED SYSTEMS  
..... ALL
- . 011A 40065 ..... COMMUNICATIONS-DEFINE ACARS MU  
..... INSTALLATION (SUNDSTRAND)  
..... ALL
- . 017 40073 ..... ICE AND RAIN PROTECTION-DEFINE RAIN  
..... REPELLENT SYSTEM  
..... ALL
- . 015 40077 ..... INDICATING/RECORDING SYSTEMS-DEFINE  
..... ACMS DATA MANAGEMENT UNIT (DMU)  
..... ALL
- . 011A 40088 ..... DOORS-COCKPIT DOOR-PROVIDE ELECTRICAL  
..... RELEASE LATCH  
..... ALL
- . 011A 40096 ..... AIR CONDITIONING-DEFINE VENTILATION OF  
21-4068 01 FORWARD CARGO COMPARTMENT  
..... ALL
- . 011A 40097 ..... AIR CONDITIONING-DEFINE TEMPERATURE  
21-4068 01 CONTROL OF FORWARD CARGO COMPARTMENT  
..... ALL
- . 011A 40099 ..... AIR CONDITIONING-DEFINE HEATING SYSTEM  
..... FOR LOWER DECK BULK CARGO COMPARTMENT  
..... ALL
- . 020 40106 ..... WATER/WASTE - INSTALL A 3RD WASTE TANK  
..... ALL
- . 011A 40231 ..... EQUIPMENT/FURNISHINGS-COCKPIT-  
25-4088 INSTALL FLOOR HEATING PANELS  
..... ALL

M V T	REV MOD SB	TITLE	VALIDITY
.	011A 40239 .....	LIGHTS-EXTERIOR LIGHTS-INTRODUCE 33-4016 01 MANUAL CONTROL OF LOGO LIGHTS ALL	
.	014 40259 .....	EQUIPMENT/FURNISHINGS-CREW REST COMPARTMENT-INSTALL STRUCTURAL PROVISIONS ALL	
.	016 40260 .....	EQUIPMENT/FURNISHINGS-CREW REST COMPARTMENT-INSTALL SYSTEM PROVISIONS ALL	
.	017 40335 .....	ICE AND RAIN PROTECTION-INSTALL GIRT BAR FITTING HEATING SYSTEM FOR ENTRY DOORS ALL	
.	021 40379 .....	EQUIPMENT/FURNISHINGS-INSTALL PROVISIONS FOR AN UNDERFLOOR CREW REST CONTAINER (BFE) ALL	
.	011A 40391 .....	GENERAL-INTRODUCE MINOR IMPROVEMENTS FROM A/C 29 ALL	
.	011A 40412 .....	AIR CONDITIONING - COCKPIT AIR 21-4066 VENTILATION - INSTALL ELECTRIC HEATERS FOR SIDE WINDOW AIR OUTLET ALL	
.	011A 40487 .....	FIRE PROTECTION-INSTALL H.T.L. EXTINGUISHER IN FWD AND AFT CARGO COMPARTMENT ALL	
.	011A 40512 .....	EQUIPMENT/FURNISHINGS-CREW REST ROOM - UNCLIP BFE U.C.R.C. CIRCUIT BREAKERS ALL	
.	011A 40542 .....	AUTOFLIGHT -FMGES- DEFINE INTERFACE WITH ACARS ALL	

M	V	REV	MOD	MP	TITLE	VALIDITY
T				SB		

- . 012 40783 ..... ONBOARD MAINTENANCE SYSTEMS-UP AND DOWN  
DATA LOADING-ADD A SECOND ROTATING KNOB  
ALL
- . 011A 40818 ..... NAVIGATION-WEATHER RADAR SYSTEM-REPLACE  
ALLIED SIGNAL BY COLLINS WEATHER  
RADAR SYSTEM (BFE)  
ALL
- . 018 41150 ..... ENGINE FUEL AND CONTROL - GENERAL -  
76-4003 01 PROVIDE DERATED TAKE OFF FACILITY  
FOR CFMI ENGINES  
LV-ZPJ LV-ZPX LV-ZRA
- . 011A 41486 ..... FLIGHT CONTROLS-RUDDER-INSTALL ON  
SECOND TRAVEL LIMITER UNIT  
ALL
- . 011A 41537 ..... ELECTRICAL POWER-A/C ESSENTIAL  
GENERATION SWITCHING-MODIFY LAND  
RECOVERY BUSBAR SUPPLY  
ALL
- . 011A 41600 ..... FUEL-TRIM TRANSFER SYSTEM-FIT FORWARD  
TRANSFER PUMP IN THE TRIM HORIZONTAL  
STABILIZER  
LV-ZPJ LV-ZPX LV-ZRA
- . 011A 41619 ..... COMMUNICATIONS-CIDS-DEFINE PAL1 VERSION  
ALL
- . 013 41649 ..... DOORS-CARGO COMPARTMENT DOOR HYDRAULIC  
SYSTEM-INTRODUCE MODIFIED ELECTRICAL  
(MANUAL) SELECTOR VALVE  
ALL
- . 011A 41827 ..... NAVIGATION -TCAS II-INSTALL AND  
CERTIFY A HONEYWELL - SYSTEM WITH  
ATC MODES COLLINS  
ALL
- . 011A 41855 ..... FLIGHT CONTROLS-INTRODUCE VISUAL  
27-4005 11 INDICATION OF SIMULTANEOUS SIDE  
STICK ACTIONS  
ALL

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M	V	REV	MOD	MP	TITLE	VALIDITY
				SB		

- . 011A 41925 ..... INDICATING/RECORDING SYSTEMS-DISPLAY  
31-4030 A RISING RUNWAY SYMBOL ON THE PFD  
ALL
- . 011A 41957 ..... OXYGEN -PASSENGER OXYGEN-INSTALL  
..... ALTERNATIVE OXYGEN BOXES EXTENDED  
DURATION 22 MINUTES (VENDOR PURITAN)  
ALL
- . 011A 41958 ..... AUTOFLIGHT-FCU-INTRODUCE FCU WITH 4  
22-4001 03 DIGITS ON V/S FPA (TARGET WINDOW)  
ALL
- . 011A 42143 ..... APU-CONTROL AND MONITORING-  
..... INTRODUCE STANDARD-7 ECB  
ALL
- . 011A 42192 ..... LANDING GEAR-NORMAL BRAKING-FIT S4B  
..... STANDARD BSCU-  
ALL
- . 011A 42223 ..... APU - CONTROL AND MONITORING -  
..... INTRODUCE IMPROVED ECB -8  
LV-ZRA
- . 011A 42399 ..... AIR CONDITIONING - PRESSURE CONTROL AND  
21-4018 01 MONITORING - IMPROVE LANDING FIELD  
ELEVATION SELECTOR  
ALL
- . 011A 42630 ..... AIR CONDITIONING-AVIONICS EQUIPMENT  
21-4026 VENTILATION-INCREASE HORN TIME DELAY  
WARNINGIN CASE OF VENT EXTRA FAULT  
ALL
- . 014 42685 ..... COMMUNICATIONS-SATELLITE COMMUNICATIONS  
23-4034 09 - INSTALL "HONEYWELL" 6 CHANNEL HIGH  
RATE SATCOM AVIONICS (P/N -18036)  
ALL
- . 011A 42800 ..... EXHAUST - THRUST REVERSER - INSTALL  
..... INDEPENDENT SHUT OFF VALVE AND  
ACTIVATE T/R LOCK CONTROL  
LV-ZPX LV-ZRA

M	V	REV	MOD	MP	TITLE	VALIDITY
T				SB		

- . 011A 43127 ..... NAVIGATION - INSTALL HONEYWELL TCAS II  
..... -(904) UPGRADED WITH CHANGE 6.04A  
..... LV-ZPX LV-ZRA
- . 011A 43188 ..... AIR CONDITIONING - CABIN TEMPERATURE  
CONTROL - MODIFY ZONE CONTROLLER INTO  
-06 STANDARD  
ALL
- . 011A 43487 ..... EXHAUST - THRUST REVERSER - INSTALL AND  
78-4007 02 ACTIVATE ADDITIONAL THRUST REVERSER  
LOCK CONTROL (RETROFIT SOLUTION)  
LV-ZPO LV-ZPJ
- . 011A 43764 ..... AIR CONDITIONING - CABIN TEMPERATURE  
21-4051 CONTROL - MODIFY ZONE CONTROLLER INTO  
- 07 STANDARD  
ALL
- . 011A 44063 ..... INDICATING/RECORDING SYSTEMS - CENTRAL  
31-4021 02 WARNING SYSTEM - INSTALL NEW FWC  
STANDARD LS.0  
ALL
- . 011A 44099 ..... NAVIGATION - WEATHER RADAR SYSTEM -  
34-4049 02 INSTALL COLLINS DUAL WEATHER RADAR  
ARINC 708 A  
ALL
- . 011A 44100 ..... NAVIGATION - WEATHER RADAR SYSTEM -  
34-4050 04 ACTIVATE DUAL PREDICTIVE WINDSHEAR  
RADAR SYSTEM, COLLINS  
ALL
- . 011A 44164 ..... INDICATING/RECORDING SYSTEM - ELECTRONIC  
31-4031 INSTRUMENT SYSTEM (E.I.S) - INSTALL DMC  
SOFTWARE V107X ON DMC B HARDWARE STD  
ALL
- . 011A 44165 ..... INDICATING/RECORDING SYSTEM - ELECTRONIC  
31-4031 INSTRUMENT SYSTEM (EIS) - INSTALL DMC  
SOFTWARE V107X ON DMC A HARDWARE STD  
ALL

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- . 011A 44438 ..... FLIGHT CONTROL - FCPC - INSTALL  
27-4047 FCPC STANDARD L13  
ALL
- . 011A 44482 ..... ICE AND RAIN PROTECTION -  
30-4020 03 WINDSHIELD RAIN PROTECTION -  
DEACTIVATE RAIN REPELLENT SYSTEM  
ALL
- . 011A 44495 ..... AUTO FLIGHT - FMGEC - INTRODUCE L6  
22-4011 STD FOR CFMI  
ALL
- . 011A 44575 ..... FUEL - FMCS - FIT FCMC (STAGE 7.1) WITH  
28-4046 01 CHANGES TO SOFTWARE FOR A330 AND A340  
AIRCRAFT  
ALL
- . 011A 44968 ..... INDICATING/RECORDING SYSTEM-ELECTRONIC  
31-4031 INSTRUMENT SYSTEM (E.I.S.) - INSTALL  
DMC SOFTWARE V109X WITH DMC B HARDWARE  
ALL
- . 011A 44969 ..... INDICATING/RECORDING SYSTEM-ELECTRONIC  
31-4031 INSTRUMENT SYSTEM (E.I.S.) - INSTALL  
DMC SOFTWARE V109X WITH DMC A HARDWARE  
ALL
- . 011A 45025 ..... INDITING/RECORDING SYSTEM - F.W.C. -  
31-4034 INSTALL NEW F.W.C. STANDARD LS-1  
ALL
- . 014 45117 ..... ELECT. POWER-AC MAIN DISTRIB.-ACTIVATE  
24-4024 05 NEW GALLEY SHEDDING BY CTL OF 115XP  
AND 208XP SUB BUS BARS BY ECMU1, ECMU2  
ALL
- . 021A 45126 ..... AUTO FLIGHT-FLIGHT CONTROL UNIT-  
22-4017 08 ACTIVATE AUTOMATIC ENGAGEMENT OF FLIGHT  
DIRECTOR WITH CROSS BARS IN GO AROUND  
ALL
- . 011A 45191 ..... HYDRAULIC POWER - MAIN HYDRAULIC POWER-  
29-4032 02 INTRODUCE PUSH BUTTON SWITCHES AND  
SWITCHGUARDS ON HYDRAULIC CONTROL PANEL  
ALL

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T				SB		

. 013 45237 ..... AUTO FLIGHT - FMGEC - INSTALL STD L7 -  
22-4016 02 A7 FOR A340 WITH CFMI ENGINES  
ALL

. 021 45312 ..... INDICATING/RECORDING SYSTEMS-ACMS-  
31-4033 01 INSTALL OPTICAL DAR PENNY AND GILES  
P/N D52000-62000  
ALL

N 022C 45509 ..... NAVIGATION - MMR - INSTALL COLLINS  
MULTI-MODE RECEIVERS PROVIDING ILS  
(FM IMMUNE) AND GPS PRIMARY FUNCTION  
ALL

. 017 45900 ..... LANDING GEAR - NORMAL BRAKING -  
32-4109 01 INSTALL BSCU SOFTWARE STANDARD S7A  
ALL

. 016 45966 ..... NAVIGATION-TCAS-INSTALL TCAS 2000  
34-4094 HONEYWELL P/N 751-7900-10002  
ALL

. 013 46257 ..... INDICATING/RECORDING SYSTEMS - FWC -  
31-4042 INSTALL NEW FWC STANDARD L7-0  
ALL

. 013 46292 ..... FLIGHT CONTROLS-FCPC-INTRODUCE NEW L15  
27-4067 SOFTWARE STD ON FCPC HARDWARE LA 2K1  
ALL

N 022C 46324 ..... NAVIGATION - GPWS - ACTIVATE ENHANCED  
GPWS  
ALL

. 013 46532 ..... INDICATING/RECORDING SYSTEMS - EIS -  
31-4041 02 DISPLAY MANAGEMENT COMPUTER - INSTALL  
NEW DMC SOFTWARE V110X  
ALL

. 013 46627 ..... FLIGHT CONTROLS-FCPC-INTRODUCE NEW L15  
27-4070 SOFTWARE STD ON FCPC HARDWARE LA 2K0  
ALL

. 013 46863 ..... LANDING GEAR - NORMAL BRAKING - INSTALL  
32-4131 02 BSCU SOFTWARE STANDARD S8C  
ALL

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				SB		

N	022C	46893	.....		NAVIGATION - MMR - INSTALL COLLINS MULTI-MODE RECEIVERS P/N 822-1152-121 ALL	
.	014A	47297	.....	73-4015	ENGINE FUEL AND CONTROL - CONTROLLING - INSTALL FADEC SOFTWARE STD C3G	
.	015A	47392	.....	34-4099 01	NAVIGATION-TCAS-INSTALL TCAS II HONEYWELL 2000 (CHANGE 7) P/N 7517900-10003	
.	017A	47419	.....	31-4054	INDICATING/RECORDING SYSTEMS - FLIGHT WARNING COMPUTER (FWC) - INSTALL NEW FWC STANDARD L8-0	
.	018A	47500	.....	32-4154 02	LANDING GEAR - NORMAL BRAKING - INSTALL BSCU SOFTWARE STANDARD S8D	
.	020	47892	.....	38-4046 05	WATER WASTE -- TOILET - DELETE WASTE TANK BALANCING SYSTEM FOR THREE TANK VERSIONS (RETROFIT SOLUTION)	
.	018A	47930	.....	28-4085 01	FUEL - FCMS - INSTALL FCMS STAGE 9.0 ALL	
.	015A	47967	.....	25-4153 03	EQUIPMENT/FURNISHINGS - CREW REST ROOM (UNDERFLOOR) - DELETE AUTOMATIC FIRE EXTINGUISHING SYSTEM	
.	022A	48753	.....	27-4116 01	FLIGHT CONTROLS - FCPC - INTRODUCE NEW L16 SOFTWARE STD ON FCPC HARDWARE 2K0	
.	018A	49103	.....	22-4029 01	AUTO FLIGHT - FMGEC - INSTALL STANDARD L10A10 FOR CFM ENGINES	
					ALL	

M	V	REV	MOD	MP	TITLE	VALIDITY
T				SB		

- . 017 49157 ..... EQUIPMENT/FURNISHINGS-CREW REST  
25-4153 03 ROOM (UNDERFLOOR)-DELETE AUTOMATIC  
FIRE EXTINGUISHING SYSTEM  
ALL
- . 021B 49633 ..... INDICATING/RECORDING SYSTEMS - FWC -  
31-4067 01 REPLACE THE EXISTING STANDARD FWC BY A  
NEW STD L9 FOR A340 - FAR 121-344  
ALL
- . 021A 49800 ..... FUEL - FCMS - ACTIVATE CREW ALERT  
28-4096 01 'FUEL FU/FOB DISCREPANCY'  
ALL
- . 019B 49844 ..... FUEL - FCMS - INSTALL FCMC STAGE 10.0  
28-4095 01 ALL
- . 019A 50014 ..... EQUIPMENT/FURNISHINGS - COCKPIT -  
25-4181 02 INSTALL AN ARMoured COCKPIT DOOR  
ALL
- . 022 50214 ..... LANDING GEAR - NORMAL BRAKING -  
32-4187 01 INTRODUCE STAGE 9 STANDARD BSCU  
ALL
- . 019A 50334 ..... FUSELAGE - GENERAL- ADAPT COCKPIT  
DOOR REINFORCEMENT TO BASIC LR  
ALL
- . 019A 50723 ..... DOORS - COCKPIT DOOR RELEASE SYSTEM  
52-4078 03 - OVERRIDE ELECTRICAL SYSTEM  
ALL
- . 020 51233 ..... EQUIPMENT/FURNISHINGS - PAX COMPARTMENT  
25-4194 - INSTALL A DECOMPRESSION PANEL IN  
COCKPIT DOOR FROM VENDOR RBE  
ALL
- . 022A 51356 ..... FLIGHT CONTROL - FCPC - INTRODUCE NEW  
27-4116 01 SOFTWARE FCPC STANDARD L16-A2KO ON A340  
SB ONLY  
ALL

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				SB		

- . 022 52230 ..... EQUIPMENT/FURNISHINGS - CURTAINS AND  
25-4218 01 PARTITIONS -MODIFY CDS STRIKE  
TOLERANCE  
ALL
- . 022B 52306 ..... INDICATING/RECORDING SYSTEM-FWS-INSTALL  
FWC L10 (A340) WITH 386 CPU BOARD  
ALL

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FLIGHT CREW OPERATING MANUAL

**AIRCRAFT GENERAL****CONTENTS**

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**20.00 CONTENTS****20.10 INTRODUCTION**

– GENERAL . . . . . 1

**20.20 GENERAL ARRANGEMENT**

– GENERAL ARRANGEMENT . . . . .	1
– PRINCIPAL DIMENSIONS . . . . .	1
– UNPRESSURIZED COMPARTMENTS . . . . .	2
– ANTENNAS LOCATION . . . . .	2
– GROUND MANEUVERING . . . . .	3
– GROUND SERVICE CONNECTIONS AND PANELS . . . . .	4

**A340**

FLIGHT CREW OPERATING MANUAL

**AIRCRAFT GENERAL**

INTRODUCTION

1.20.10 P 1

SEQ. 001 REV. 08

**GENERAL**

The A340 is a subsonic long range civil transport aircraft.

**ENGINES**

The aircraft has four high by-pass turbofan engines mounted under the wings.

**COCKPIT**

The cockpit is arranged for a two member-crew. It also has a place for two observers.

**CABIN**

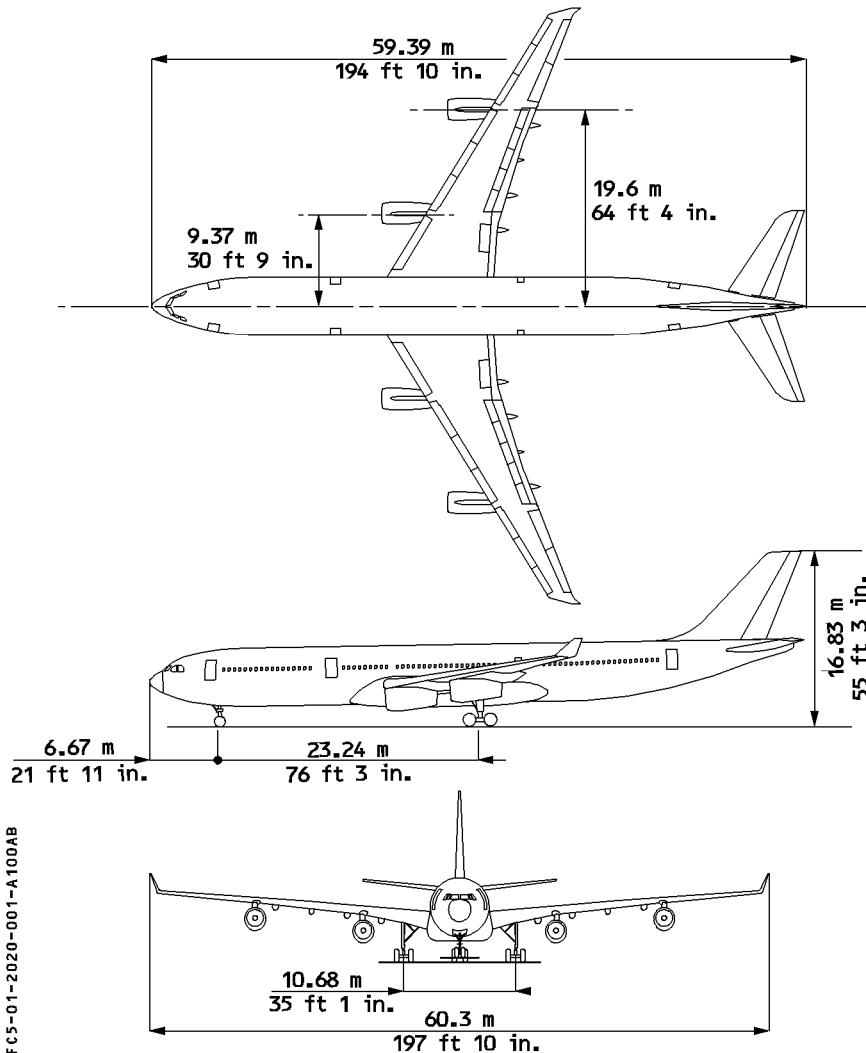
The layout for passenger seating may be varied to suit operating requirements. The certified maximum is 375 seats.

**CARGO**

Three cargo compartments are under the cabin floor.

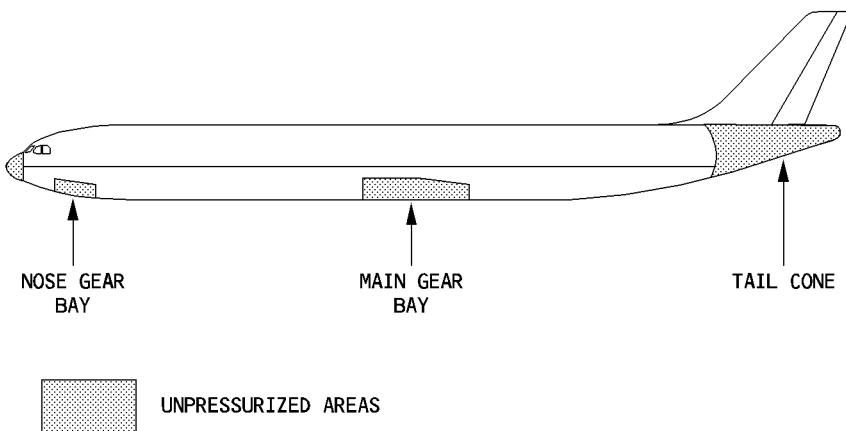
**GENERAL ARRANGEMENT**

This subchapter gives the principal dimensions of the aircraft, the location of unpressurized areas, antennas, ground service connections and the ground maneuvering characteristics.

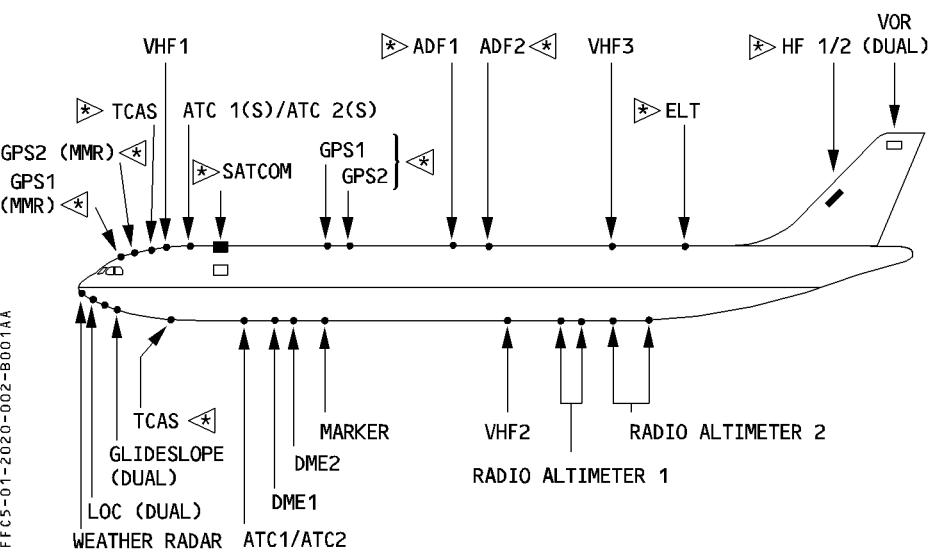
**PRINCIPAL DIMENSIONS**

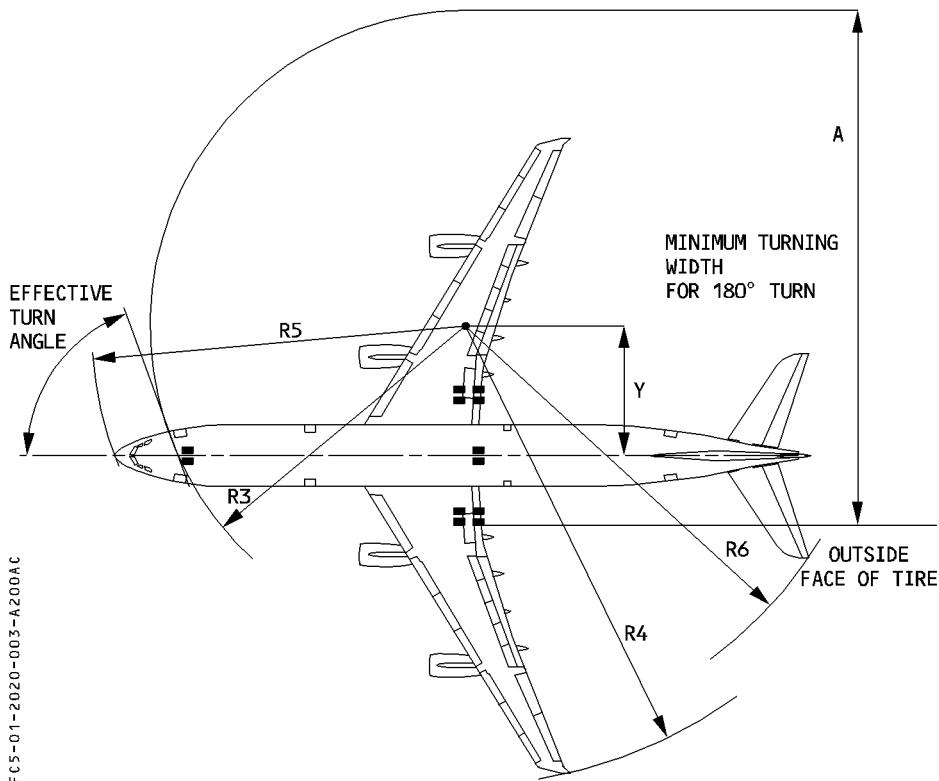
**UNPRESSURIZED COMPARTMENTS**

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**ANTENNAS LOCATION**

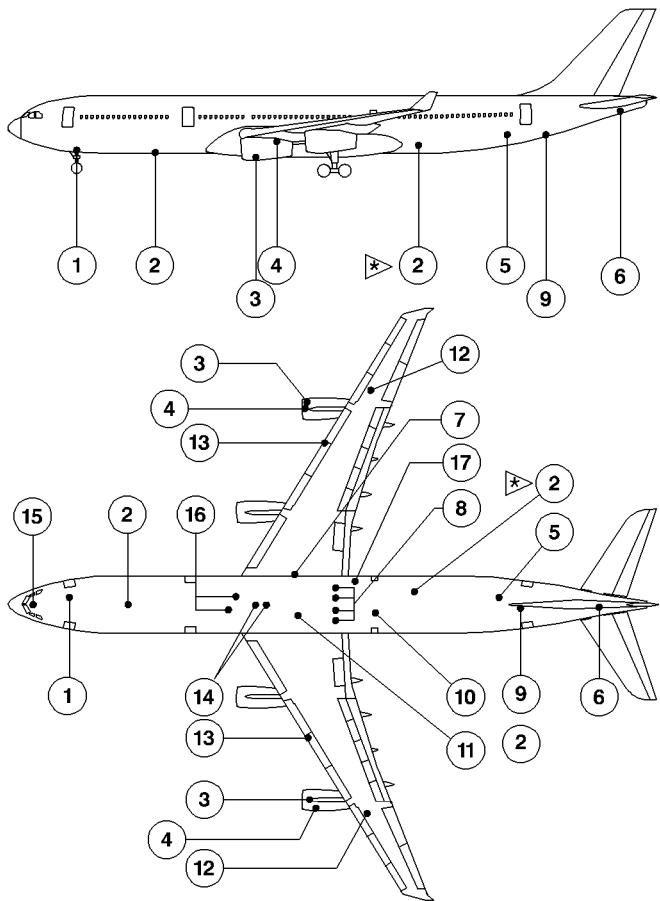
FFCS-01-2020-002-B001AA



**GROUND MANEUVERING****MINIMUM TURNING RADII**

NWS limit angle	Y	A	R3	R4	R5	R6
72°	13 m 42 ft	46 m 150 ft	27 m 88 ft	44 m 144 ft	33 m 108 ft	34 m 111 ft

The above figures assume symmetric thrust and no differential braking.

**GROUND SERVICE CONNECTIONS AND PANELS**

FFCS-01-2020-004-A001AA

- R ① External ground power panel receptacle
- ② Remote water drain
- ③ IDG oil filling

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**AIRCRAFT GENERAL  
GENERAL ARRANGEMENT**

1.20.20 P 5

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- (4) Engine oil filling
- (5) Potable water filling
- (6) APU oil filling
- (7) Hydraulic ground power (yellow)
- (8) Air charging for hydraulic accumulators
- (9) Toilet servicing
- (10) Hydraulic reservoir filling and ground power (green)
- (11) Hydraulic reservoir pressurization and ground power (blue)
- (12) Fuel gravity filling
- (13) Refuel/defuel couplings
- (14) HP ground air supply connectors
- (15) Oxygen system
- (16) LP ground air supply connectors
- R (17) Refuel/Defuel control panel

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FLIGHT CREW OPERATING MANUAL

**AIR COND / PRESS / VENT****CONTENTS**

1.21.00 P 1

SEQ. 001 REV. 15

**21.00 CONTENTS****21.10 AIR CONDITIONING**

– GENERAL . . . . .	1
– MAIN COMPONENTS . . . . .	3
– TEMPERATURE AND FLOW REGULATION . . . . .	6
– SYSTEM OPERATION UNDER FAILURE CONDITION . . . . .	9
– CONTROLS AND INDICATORS . . . . .	11
– WARNINGS AND CAUTIONS . . . . .	20

**21.20 PRESSURIZATION**

– GENERAL . . . . .	1
– MAIN COMPONENTS . . . . .	3
– SYSTEM OPERATION . . . . .	4
– CONTROLS AND INDICATORS . . . . .	10
– WARNINGS AND CAUTIONS . . . . .	16

**21.30 VENTILATION**

– GENERAL . . . . .	1
– AVIONICS VENTILATION . . . . .	2
– AVIONICS GROUND COOLING ◄ . . . . .	5
– BATTERY VENTILATION . . . . .	6
– LAVATORY AND GALLEY VENTILATION . . . . .	6
R – BULK CARGO RACK VENTILATION ◄ . . . . .	6A
– PACK BAY VENTILATION . . . . .	7
– CONTROLS AND INDICATORS . . . . .	8
– WARNINGS AND CAUTIONS . . . . .	11

**21.40 CARGO**

– GENERAL . . . . .	1
– SYSTEM OPERATION . . . . .	2
– CONTROLS AND INDICATORS . . . . .	8
– WARNINGS AND CAUTIONS . . . . .	13

**R 21.45 LOWER DECK FACILITIES ◄****21.50 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
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FLIGHT CREW OPERATING MANUAL

**AIR COND/PRESS/VENT**

1.21.10 P 1

AIR CONDITIONING

SEQ. 105 REV. 17

**GENERAL**

The air conditioning system is fully automatic.

It provides continuous air renewal and maintains a constant selected temperature in the following four zones: COCKPIT, FWD CABIN, MID CABIN, AFT CABIN, which are independently controlled.

Air is supplied by the pneumatic system, via :

- Two pack flow control valves,
- Two packs,
- The mixing unit, which mixes air coming from both the cabin and the packs.

It is then distributed to the cockpit and the cabin.

Temperature regulation is optimized via two hot air pressure regulating valves and the trim air valves that add hot air tapped upstream of the packs to the mixing unit air via the two hot air manifolds.

In an emergency, a ram air inlet can provide ambient air to the mixing unit.

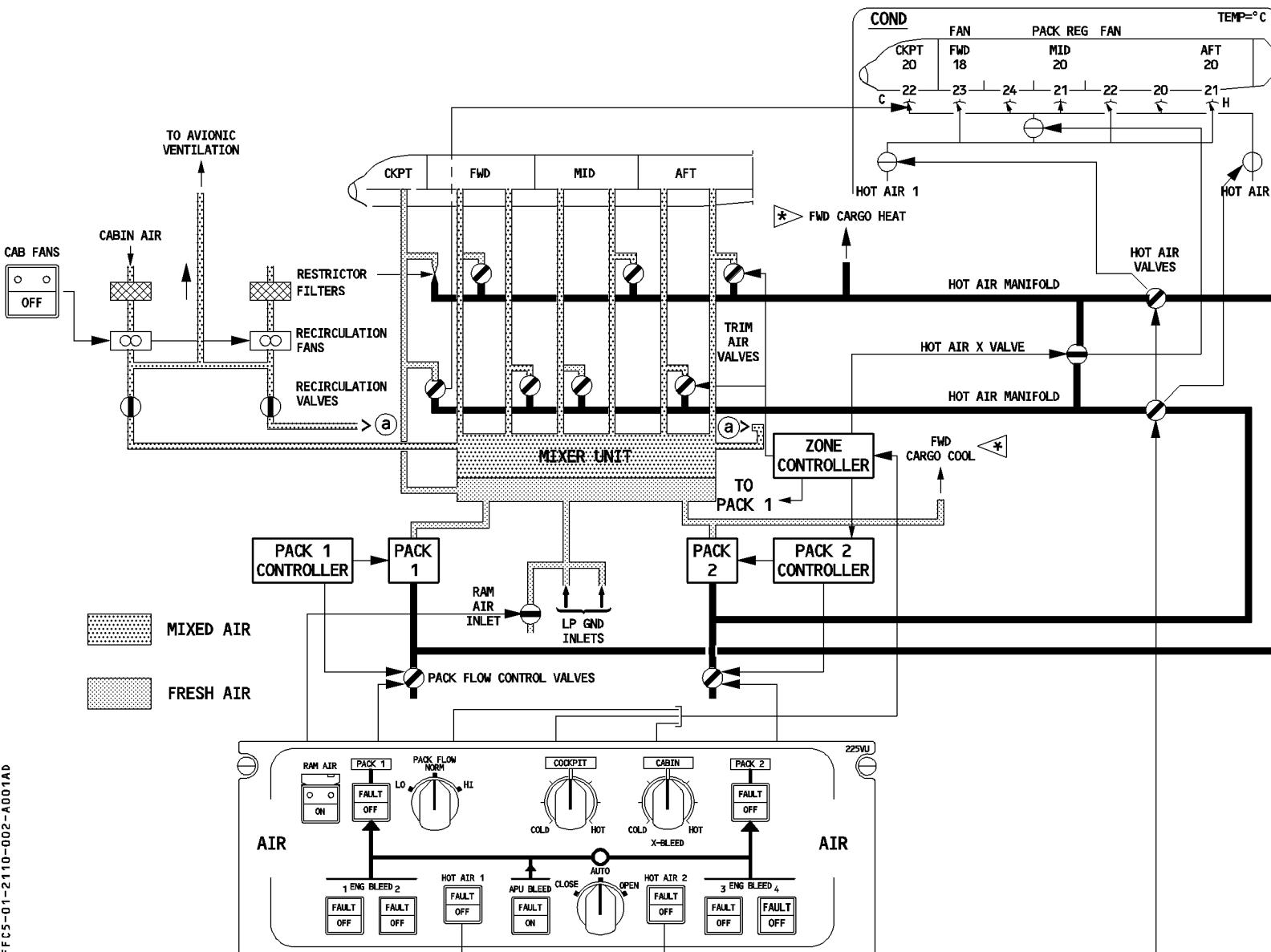
Temperature regulation is controlled by a zone controller and two pack controllers. Flight deck and cabin temperature can be selected from the AIR panel in the cockpit.

Individual heating of the cockpit's left or right-hand side is provided by additional electrical heating of side window blow air.

A control panel is provided on the forward attendant panel. During cruise, the cabin crew can modify each cabin zone temperature from the cockpit, with a limited authority of  $\pm 2.5^{\circ}\text{C}$  ( $4.5^{\circ}\text{F}$ ).

Low pressure air is supplied to the mixing unit via a ground connection.

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**A340**

FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

1.21.10 P 3

AIR CONDITIONING

SEQ. 001 REV. 20

## MAIN COMPONENTS

### AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by the pack controller.

Warm pre-conditioned bleed air enters the cooling path via the pack flow control valve and is ducted to the primary heat exchanger.

Then, the cooled bleed air enters the compressor section of the aircycle machine and is compressed to a higher pressure and temperature.

It is again cooled in the main heat exchanger, and enters the turbine section where it expands. In expanding, it generates power to drive the compressor and cooling air fan.

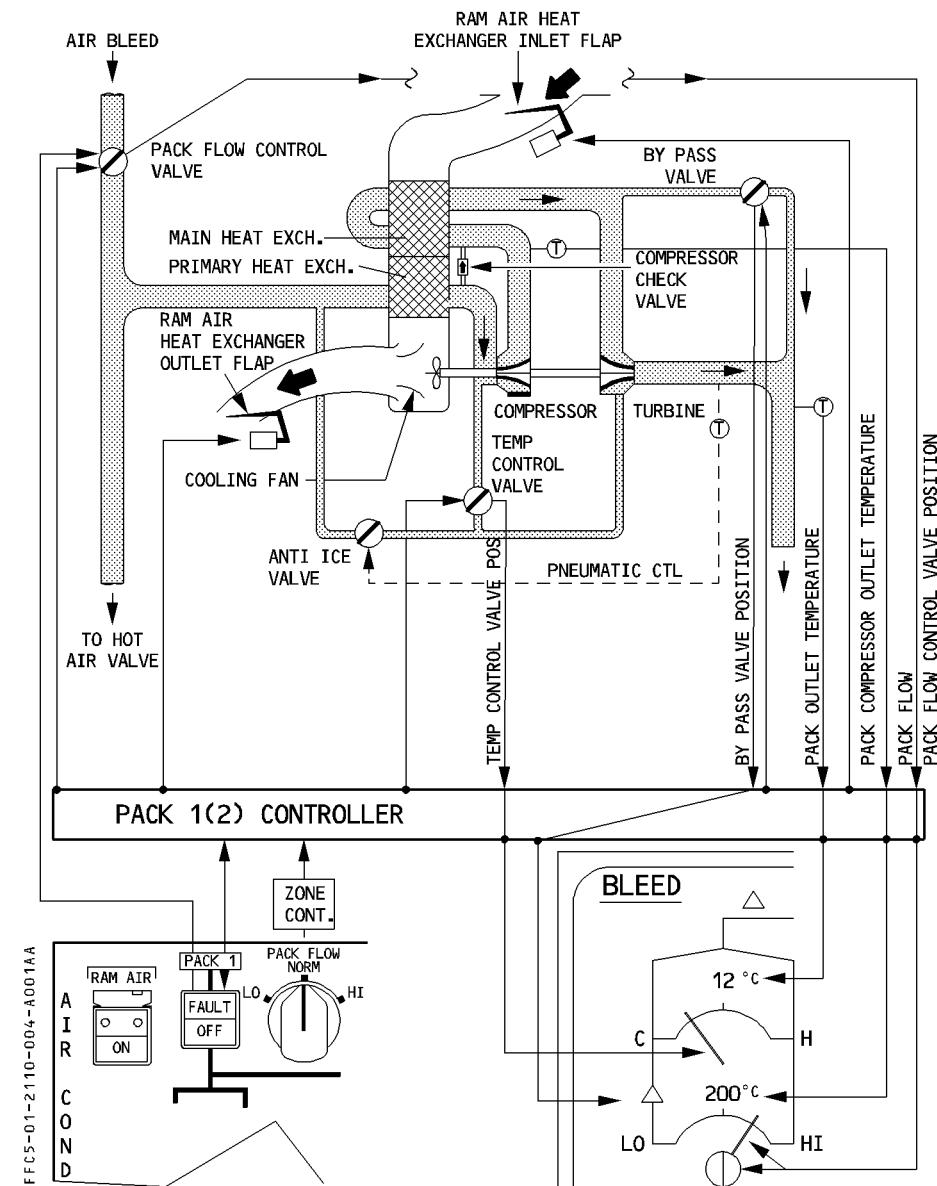
The removal of energy during this process reduces the air temperature, resulting in a very low air temperature at turbine discharge.

The temperature control valve can modify the pack outlet temperature by adding uncooled air to the turbine outlet flow.

- R In case of an air cycle machine failure, a by pass valve allows the bleed air to be cooled by the corresponding heat exchanger only.

**PACK SCHEMATIC****FOR INFO**

R



## **PACK FLOW CONTROL VALVE**

This valve is pneumatically-operated and electrically-controlled. It regulates the air flow in accordance with signals received from the pack controller.

In the absence of air pressure, a spring keeps the valve closed.

In the absence of electrical supply, the valve is open in a position equivalent to the NORM selection, provided air supply is available.

The valve closes automatically in case of pack overheating, engine starting, operation of the fire or ditching pushbuttons, any unclosed doors at engine start, or insufficient upstream pressure. The valve is controlled from the AIR panel.

## **RAM AIR**

An emergency ram air inlet ventilates the cockpit and cabin, if both packs fail.

The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR panel.

This pushbutton opens the ram air valve, provided that ditching is not selected.

- R The outflow valves open about 50 %, provided that they are under automatic control and
- R  $\Delta P$  is less than one psi. They do not automatically open if they are under manual control, even if the  $\Delta P$  is less than one PSI. If  $\Delta P$  is greater than one psi, the check valve, located downstream the ram air door, will not open. No airflow will then be supplied.

## **MIXER UNIT**

This unit mixes cold fresh air from the packs with the cabin air being recirculated through recirculation fans. The mixer unit is also connected to the emergency ram air inlet and the low pressure ground inlets.

*Note : In case both packs are inoperative, the recirculation valves are partially closed.*

## **HOT AIR VALVES**

These valves regulate the pressure of hot air, tapped upstream of the packs.

They are pneumatically-operated and electrically-controlled from the HOT AIR 1 and HOT AIR 2 pushbuttons on the AIR panel. In the absence of electrical supply, the hot air valves are closed. In the absence of air pressure, a spring keeps the valve closed.

The valve closes automatically, if the duct overheats.

## **TRIM AIR VALVES**

These valves are electrically-controlled by the zone controller. Two trim air valves, associated with each zone, adjust the temperature by adding hot air from the two hot air manifolds. For the cockpit supply, only one trim air valve is fitted to regulate air from the hot air manifold 2. Air from the hot air manifold 1 passes through a restrictor.

## HOT AIR X VALVE

- A HOT AIR X valve is fitted between the two hot air manifolds. The valve is normally closed.
- R It automatically opens if one hot air supply fails.

## TEMPERATURE AND FLOW REGULATION

Temperature regulation is automatic and controlled by one zone controller and two pack controllers.

## PACK CONTROLLER

- R Each pack controller regulates the temperature of its associated pack in accordance with a demand signal from the zone controller by modulating the bypass valve, the ram air inlet flaps and the ram air outlet flaps.
- The ram air inlet and outlet flaps close during takeoff and landing to avoid ingestion of foreign objects.

Note : During takeoff the ram air inlet and outlet flaps close when thrust lever is at or above CL and wheel speed (sent by the BSCU) is at or above 70 knots.

During landing they close as soon as landing gear is compressed and speed is at or above 70 knots.

They open when the speed is below 70 knots with a 15 seconds delay.

- R The pack controllers also provide flow regulation by modulating the associated pack flow control valve in accordance with the zone controller demand.

## ZONE CONTROLLER

### PACK FLOW CONTROL

- R The crew can use the pack flow selector to adjust the pack flow for the number of passengers and for external conditions.
- R Whatever the crew selects, the system delivers high flow for any of the following circumstances :
- in single pack operation or,
  - when the APU is supplying bleed air.

Note : Due to ambient conditions, high flow may not be achieved.

- R If the crew selects LO flow and the temperature demand cannot be satisfied, the zone controller generates an ECAM advisory message to inform the crew that normal flow should be manually selected.

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AIR CONDITIONING

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**Engine pressure demand**

When the cooling demand in one zone cannot be satisfied, if the bleed pressure is too low, the zone controller sends a pressure demand signal to both engines' Engine Interface Units (EIU), in order to increase the minimum idle and to raise the bleed pressure.

**APU flow demand**

When the APU bleed valve is open, the zone controller signals the APU Electronic Control Box ECB to increase the APU flow output when any zone temperature demand cannot be satisfied.

**Bleed temperature demand**

If the cooling demand cannot be satisfied, the zone controller signals the Bleed Monitoring Computer (BMC) to decrease the bleed temperature from normal (200°C) to reduced setting (150°C). This reduction is inhibited, if the wing-anti-ice is ON.

**TEMPERATURE REGULATION**

- R The zone controller regulates the cabin and cockpit temperature.

**BASIC TEMPERATURE REGULATION**

The flight crew uses the temperature selectors on the air conditioning panel in the cockpit to select the reference temperature. The flight attendant adjusts the cabin temperature from the Forward Attendant Panel (FAP).

The cabin altitude can be automatically corrected to adjust the cabin temperature for passenger comfort. The correction is done to the master temperature selected in the cockpit to compensate for the dryness of the air and the coldness of the lining. (The altitude correction can be programmed, but the basic manufacturer setting is without correction). The zone controller computes a temperature demand, depending on the selected temperature and the actual temperature.

The actual temperature is measured by sensors in the :

– Cockpit

– Lavatory extraction circuit and galley ventilation system for the cabin.

A signal corresponding to the lowest demanded zone temperature goes to the pack controller, which then makes both packs produce the required outlet temperature.

## OPTIMIZED TEMPERATURE REGULATION

The zone controller optimizes temperature by acting on the trim air valves.  
The temperature selection range is from 18°C (64°F) to 30°C (86°F).

### CREW INDIVIDUAL HEATING

To compensate for the sun's effect on cockpit temperature, two electrical heaters are installed : One on each side of the cockpit. These additional heaters are controlled via the CREW HEATER selector on the AIR panel. The heater includes a protection against overheating.

The cockpit's ambient temperature is selected on the AIR panel by the pilot who feels the hottest. (The one in the sun.) The pilot who feels the coldest can increase the temperature on his side by selecting LO or HI on the CREW HEATER selector.

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AIR COND/PRESS/VENT

AIR CONDITIONING

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## SYSTEM OPERATION UNDER FAILURE CONDITION

Each Controller has a Channel 1 (that is normally in control), and a Channel 2 (that acts as a backup, if Channel 1 fails).

### ZONE CONTROLLER

#### **CHANNEL 1 OR 2 FAILURE**

A Channel 1 or 2 failure has no effect on zone temperature regulation.

#### **CHANNELS 1 AND 2 FAILURE**

Optimized and backup temperature regulation are lost. The packs deliver a fixed pack outlet temperature of 20 degrees C (68 degrees F). A Channel 1 and 2 failure removes all information from the ECAM COND page, which then displays "PACK REG". Flow selection from the PACK FLOW selector is lost.

### PACK CONTROLLERS

#### **CHANNEL 1 OR 2 FAILURE**

A Channel 1 or 2 failure has no effect on pack regulation.

#### **CHANNEL 1 AND 2 FAILURE**

- R The corresponding anti-ice valve regulates the pack outlet temperature between approximately 1 degree C and 15 degrees C (respectively 34 and 59 degrees F). The ECAM signals, associated with the corresponding pack, are lost. The flow control valve pneumatically regulates the pack flow to approximately 120 % of the NORM flow.

## AIR CYCLE MACHINE FAILURE

If the Air Cycle Machine (ACM) fails (compressor/turbine seizure), the affected pack may be operated in the heat-exchanger cooling mode. Warm pre-conditioned bleed air enters the cooling path, via the pack flow control valve, and goes to the primary heat exchanger. Then, the compressor check valve and the bypass valve open, and air is cooled only by the heat exchanger. The ACM seizure reduces the pack flow.

As in normal pack operation :

- The pack controller regulates temperature, in accordance with zone controller demand, by modulating the temperature control valve and the ram air inlet and outlet flaps.
- The zone controller regulates the flow of hot air, through the trim air valves, to optimize cockpit/cabin temperature regulation. Hot air flow is less in normal pack operation, because the pack flow is reduced.

*Note : A pack with a seized ACM must be switched off on ground, due to the unavailability of RAM air cooling.*

## HOT AIR VALVES FAILURE

One or both valves failed open : No effect.

One valve failed closed : No effect (HOT AIR X valve opens)

Both valves failed closed : Optimized regulation is lost. Trim air valves are driven to full closed position. Packs only regulate the temperature.

## TRIM AIR VALVE FAILURE

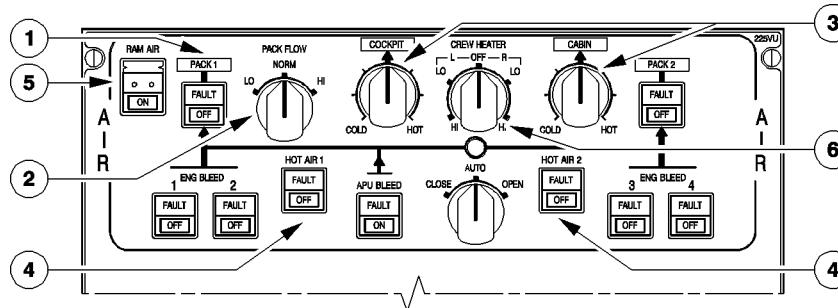
Failed closed : Optimized temperature regulation of half of the corresponding zone is lost.

Failed open : Corresponding hot air valve closes.

Optimized temperature regulation of half of each zone is lost.

**CONTROLS AND INDICATORS****OVERHEAD PANEL**

FFC5-01-2110-011-A100AA

**① PACK pb sw**

On : The pack flow control valve is automatically controlled.

It opens except in the following cases :

- upstream pressure below minimum
- compressor outlet overheat
- engine start sequence :

1. Both valves close when :

- the MODE selector is set to IGN when on ground (valves reopen if MASTER switch or MAN START pushbutton switch are not set to ON within 30 seconds)
- the MODE selector is set to IGN (or CRANK) and when on either engine :

- the MASTER switch is set to ON (or MAN START pushbutton switch is set to ON) and,
- the start valve is open, and
- N2 < 50 %.

2. On ground, the valves reopening is delayed 30 seconds to avoid a supplementary pack closure cycle during subsequent engine start.

- any door is not closed and locked, aircraft on ground and any engine running.
- outside engine fire pushbutton pressed.
- ditching selected.

*Note : If there is no electrical power, the flow valves remain open and permit NORM flow.*

OFF : The pack flow control valve closes provided it is electrically supplied.

FAULT It : AMBER light , associated with ECAM caution, comes on when pack flow control valve position disagrees with selected position or in case of compressor outlet overheat or pack outlet overheat.

R

**(2) PACK FLOW sel**

Enables the selection of pack flow, depending on the number of passengers and ambient conditions (smoke removal, hot or wet conditions). LO (80 %) – NORM (100 %) – HI (125 %). In case one bleed fails, the HI flow is limited to 112 %. Manual selection is irrelevant in single pack operation, or with APU bleed supply. In these cases, HI is automatically selected.

**(3) Zone temperature sel**

- 12 o'clock position : 24° C (76° F)
- COLD position : 18° C (64° F)
- HOT position : 30° C (86° F)

**(4) HOT AIR 1 (or 2) pushbutton**

On : The valve regulates hot air pressure.

OFF : The valve closes. The FAULT circuit is reset.

Forward cargo heating  $\triangleleft$  is lost, if HOT AIR 1 is affected.

FAULT It : The amber light and associated ECAM caution come on, when duct overheat is detected. Duct overheat is detected when the duct

R temperature reaches 88° C (190° F). The valve, and the associated trim air valves close automatically. The FAULT light goes off, when the temperature drops below 70° C (158° F), and the flight crew selects OFF.

**(5) RAM AIR pushbutton (guarded)**

ON : The ON light comes on white.

If the DITCHING pushbutton, on the CABIN PRESS panel, is in normal position :

– The RAM air inlet opens.

R R – If  $\Delta P < 1$  psi : Each outflow valve opens to about 50 %, when under automatic control. They do not automatically open when under manual control. The emergency ram air flow is directly supplied to the mixer unit.

– If  $\Delta P \geq 1$  psi : Each outflow valve remains normally-controlled. No emergency ram air flows in.

Off : The RAM air inlet closes.

**(6) CREW HEATER sel**

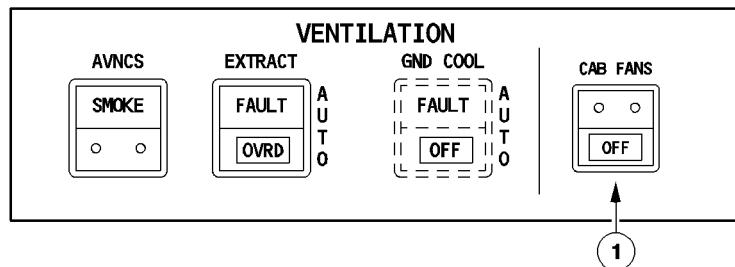
OFF : Both heaters are off. Blow air temperature is provided according to the COCKPIT sel.

LO : Blow air temperature increases by 12.5°C (22.5°F).

HI : Blow air temperature increases by 25.0°C (45°F).

*Note : Only one heater operates at a time. Either on the Captain (L) or F/O (R) side.*

FFC5-01-2110-013-A001AA



### ① CAB FANS pb sw

On : The two cabin fans run. The air from the cabin is blown to the avionics compartment and also to the mixer unit of the conditioning systems.

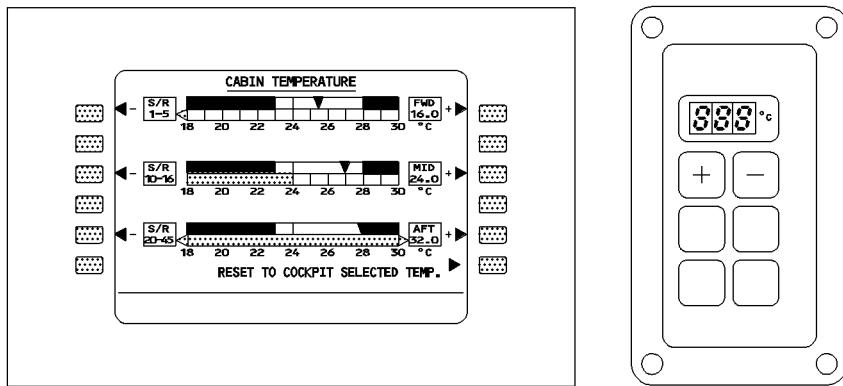
OFF : the two cabin fans stop.

*Note : Should a fan failure occurs, ECAM caution is activated.*

### **FWD ATTENDANT PANEL**

Allows fine trimming of individual zone temperature ( $\pm 2,5^{\circ}\text{C}/\pm 4,5^{\circ}\text{F}$ ).

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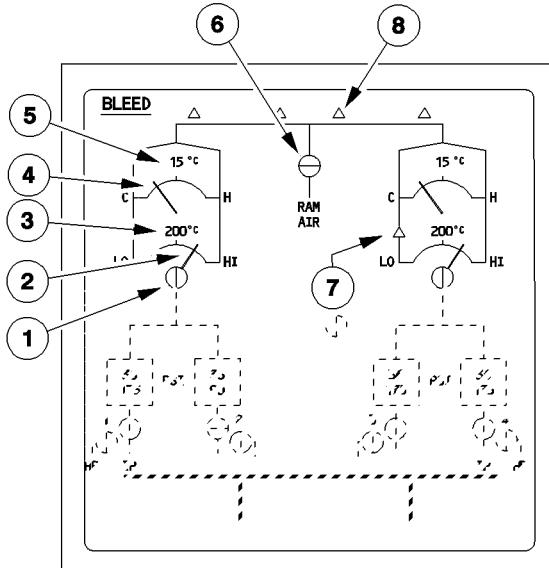


### **ADDITIONAL ATTENDANT PANEL**

The additional attendants panel can be installed in different locations. Temperature setting of related zone can be changed ( $\pm 2,5^{\circ}\text{C}/\pm 4,5^{\circ}\text{F}$ ).

**ECAM BLEED PAGE**

FFC5-01-2110-014-A001AA

**① Pack flow control valve**

In line - Green : The valve is open.  
 Crossline - Amber : The valve is closed.

**② Pack flow indication**

The needle position (green) represents the actual flow rate. The 12 o'clock position corresponds to a 100 % airflow

LO : 80 % airflow

HI : 125 % airflow

**③ Pack compressor outlet temperature indication**

It is normally green.

R It becomes amber, if the temperature is above 260°C.

**④ Temperature control valve position indication**

It is green.

C : The valve is closed.

H : The valve is open.

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**AIR COND/PRESS/VENT****AIR CONDITIONING**

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**⑤ Pack outlet temperature indication**

- R It normally appears in green.  
R But, it appears in amber, if the temperature is higher than 95°C. It remains amber as long as the temperature is not lower than 60°C.

**⑥ Emergency RAM AIR inlet indication**

- R Crossline - Green : The flap is normally closed.  
R In Transit - Amber : The flap is partially open.  
R Inline - Amber : If open on ground, or if the flap position disagrees with the position of the RAM AIR pushbutton (OFF).  
R Inline - Green : The flap is fully open.  
R Crossline - Amber : The flap is closed, and the RAM AIR pushbutton is in the ON position.

**⑦ Bypass valve indication**

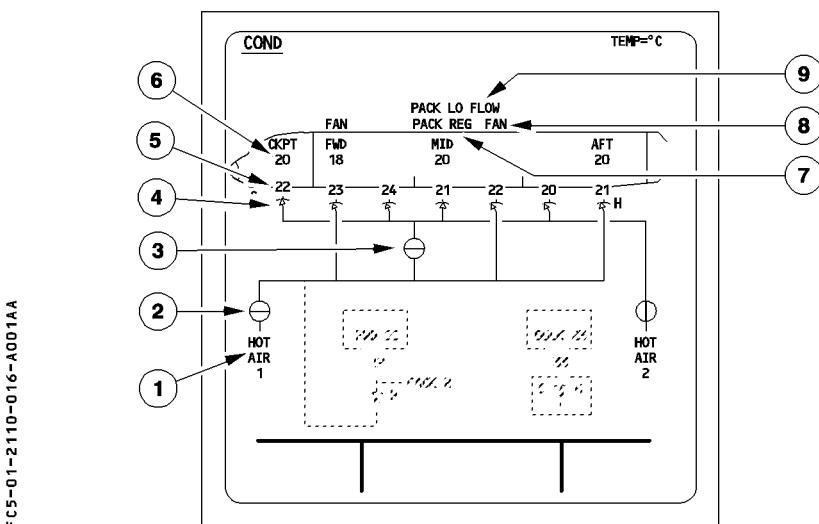
- R Triangle - Green : The bypass valve is normally open.  
R Triangle - Amber : The bypass valve is failed open.  
R No Display : The bypass valve is fully closed.

**⑧ Bleed users' indication**

- R It normally appears in green.  
R But, it appears in amber, when the RAM AIR flap is fully closed, and if no air comes from the two packs, or if the two flow control valves are fully closed.

**ECAM COND PAGE**

FFC5-01-2110-016-A001AA

① HOT AIR indication

Normally green.  
Becomes amber if the flow control valve is fully closed.

② Hot air valve indication

- ⊖ green : normally open (not fully closed).
- ⊖ green : normally closed (fully closed).
- ⊖ amber : fully closed but controlled open.
- ⊖ amber : not fully closed and controlled closed.

③ Hot air x valve indication

Identical to the HOT AIR valve indication

④ Trim air valve position indication

FFC5-01-21-10-017-A001AA



The arrow is normally green. It becomes amber if the valve is failed (as seen by the zone controller).

C : valve fully closed

H : valve fully open

R *Note : Depending on the cabin configuration, the number of trim air valves changes.*

⑤ Zone duct temperature indication

R Indication is green.

R Becomes amber if the temperature is above 88°C.

⑥ Zone temperature indication

Indication is green.

*Note : This information is also displayed on the ECAM CRUISE page.*

⑦ PACK REG indication

Appears in green when the zone controller is inoperative (both channels fault).

Temperature is regulated by packs only.

⑧ FAN indication

R Appears in amber if the FAN fails or is selected OFF through the FAN pushbutton.

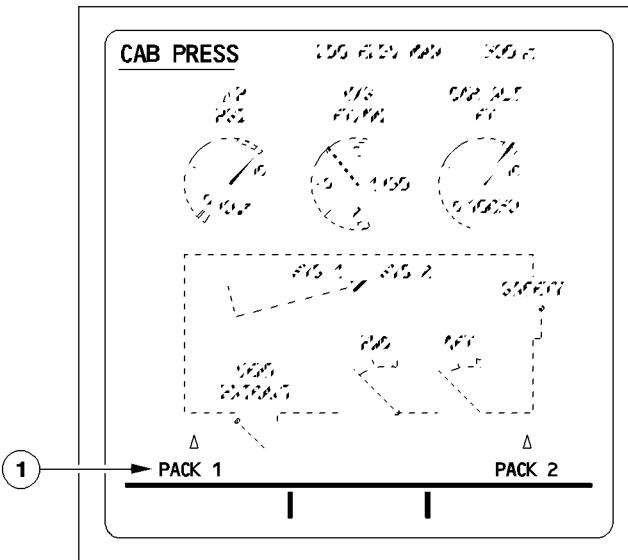
⑨ PACK LO FLOW indication

R Displayed in green, pulsing, when the flow is insufficient to reach the selected

R temperature, indicating that the zone controller requests a flow increase.

**ECAM CAB PRESS PAGE**

FFC5-01-2110-018-A001AA

① PACK indication

pack flow control valve open :

△ Green

PACK 1 White

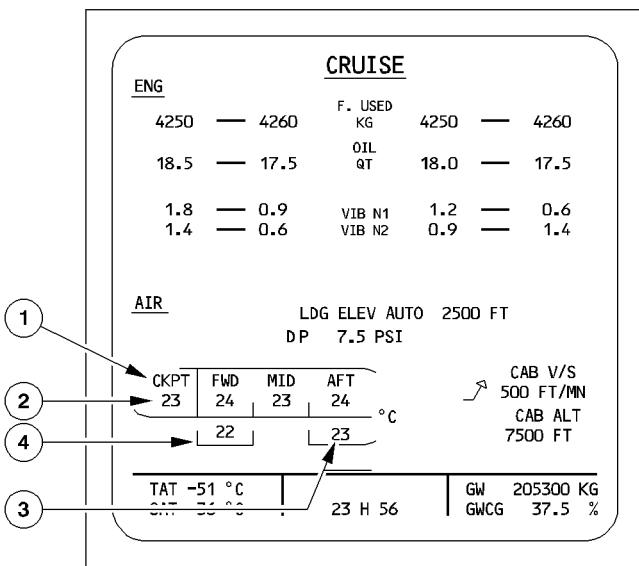
pack flow control valve closed :

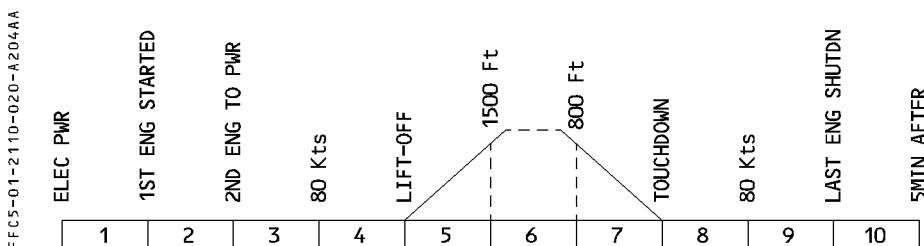
△ Amber

PACK 1 Amber

**ECAM CRUISE PAGE**

FFC5-01-2110-019-A202AA



**WARNINGS AND CAUTIONS**

E/AWD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PACK 1(2) OVHT Pack compressor outlet temperature above 260°C, or pack outlet temp above 95°C.	SINGLE CHIME	MASTER CAUT	BLEED	PACK FAULT It	3, 4, 5, 7, 8
PACK VALVE 1(2) FAULT Pack valve disagrees with selected position.				PACK OFF It	1 to 5 7 to 10
PACK 1(2) OFF, Pack pb is off, with no failure.				PACK FAULT It	3, 4, 5, 7, 8
PACK 1+2 FAULT One pack off, then the other is faulty.	NIL	NIL	COND	NIL	1, 2, 3, 4, 5, 7, 8
PACK 1(2) REGUL FAULT Pack controller failed or air is only cooled by heat exchanger (ACM fault, or RAM door failed closed, or Temperature Control Valve failed)					
ZONE CTLR 1(2) FAULT One zone controller channel is failed.					
ZONE REGUL FAULT Zone controller failed, or hot Air 1+2 failed.	SINGLE CHIME	MASTER CAUT	COND	HOT AIR FAULT It	3, 4, 5, 7, 8
DUCT OVHT (FWD CRG, COCKPIT, FWD/MID/AFT CABIN Duct temp > 88°C or above 80°C, 4 times in one flight					
HOT AIR SYS 1(2) FAULT Hot air valve 1(2) and Hot air x valve failed closed.					
L + R (L, R) CAB VENT FAULT Cab fan or recirculation valve failure.	SINGLE CHIME	MASTER CAUT	NIL	NIL	3 *, 4, 5, 7, 8
LAV + GAL VENT FAULT	NIL	NIL			3 to 8

\* Only in the case of a single failure.

**MEMO DISPLAY**

- The “RAM AIR” message appears in green, if the RAM AIR pushbutton is ON. It becomes amber in flight phases 1 and 2.
- The “PACK FLOW LO” or “HI” message appears in green, depending on the PACK FLOW selector position.

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FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

1.21.20 P 1

PRESSURIZATION

SEQ. 001 REV. 16

## GENERAL

In normal operation, pressurization control is fully automatic.

The system consists of :

- Two Cabin Pressure Controllers (CPC)
- Two outflow valves, with actuators that incorporate three motors (two for automatic operation, one for manual operation)
- One control panel
- Two safety valves
- One negative relief valve

Any one of the three independent electric motors can power the outflow valves.

Normally, one of the two cabin pressure controllers operates the outflow valves by means of its associated automatic motor. In case of ditching, an override switch on the control panel allows the flight crew to close the outflow valves, and all valves below the flotation line. The flight crew can set the system to operate automatically, semi-automatically, or manually.

In normal operation, cabin pressurization is fully automatic.

## AUTOMATIC OPERATION

The flight crew monitors system operation, but does nothing to control it. Air pressure in the cabin follows external schedules that the system receives as signals from the Flight Management and Guidance System (FMGS).

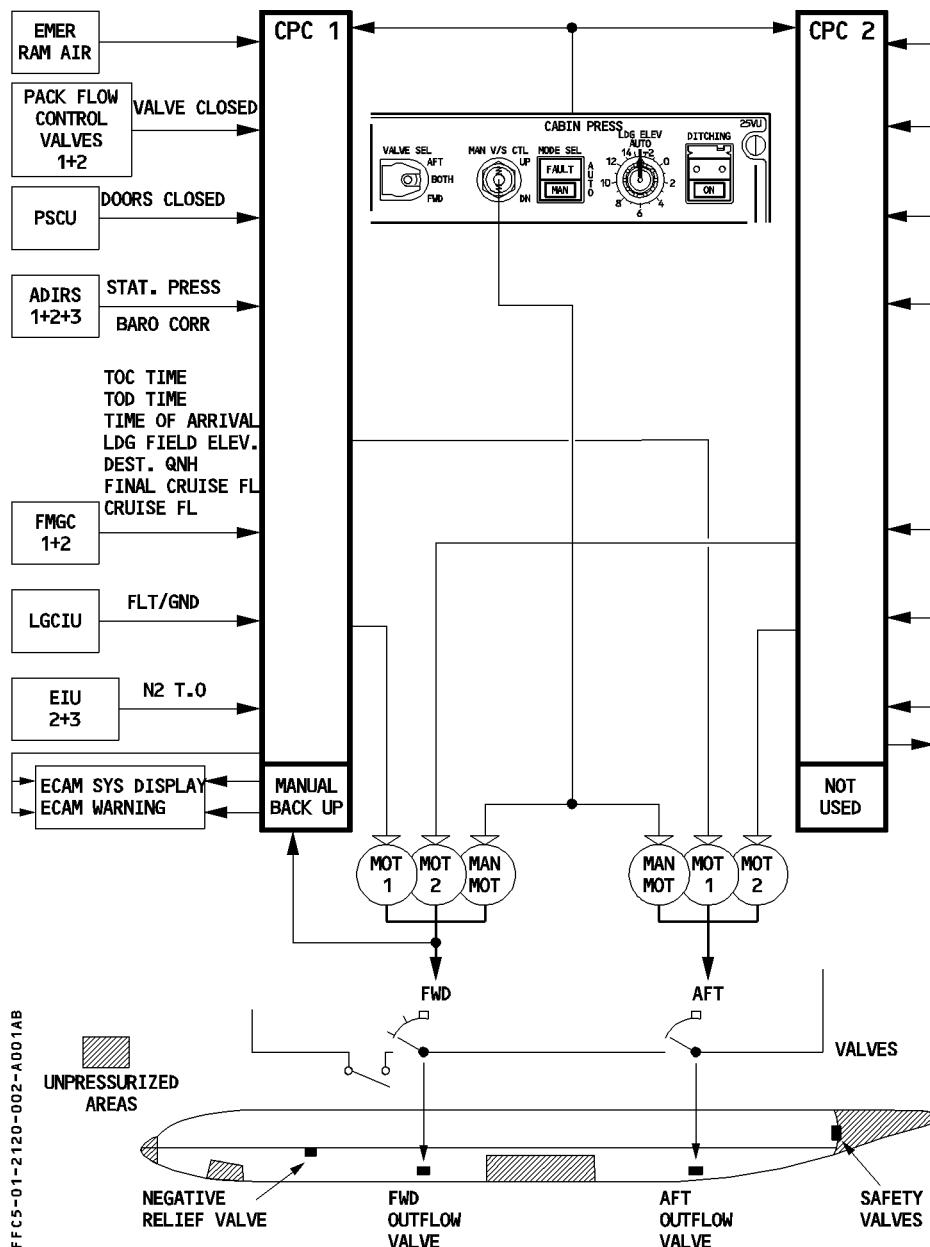
When FMGS data is not available for automatic pressurization, the crew only needs to select the landing field elevation.

- R The pressurization system then uses the manually-selected landing field elevation for internal schedules.

## MANUAL OPERATION

In manual mode, the flight crew controls the cabin altitude via the manual motor of the outflow valves, by operating controls on the pressurization control panel.

Manual operation has priority over all other modes.

**SCHEMATICS**

**A340**

FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

1.21.20 P 3

PRESSURIZATION

SEQ. 001 REV. 17

## MAIN COMPONENTS

### CABIN PRESSURE CONTROLLERS

Two identical, independent, automatic digital controllers control the system, and automatically maintain the proper cabin pressure. They receive signals from the Air Data Inertial Reference System (ADIRS), the Flight Management and Guidance Computer (FMGC), the Engine Interface Unit (EIU), the Landing Gear Control Interface Unit (LGCIU), the Proximity Switch Control Unit (PSCU) and the pack flow control valves.

When the system is in automatic or semi-automatic mode, one controller is active, the other is on standby.

The controllers also generate signals for the Electronic Centralized Aircraft Monitoring (ECAM).

For operation in manual mode, each controller has a backup section, which is powered by an independent power supply in the controller N° 1 position. This section also has a pressure sensor that generates the cabin altitude and pressure signal for the ECAM, when MAN mode is selected.

The controllers communicate with each other via a cross-channel link.

### OUTFLOW VALVES

The outflow valves are located below the flotation line. Each outflow valve assembly consists of a flush, skin-mounted, rectangular frame, carrying inward and outward opening flaps linked to the actuator. The actuator contains the drives of two automatic motors, and the drive of the manual motor. Either of two automatic motors operates the valve in automatic mode, and the manual motor operates it in manual mode.

In automatic mode, the operating controller signals the position of the valve to the ECAM.

In manual mode, the backup section of the N° 1 controller signals the position of the valve to the ECAM.

The outflow valves automatically close, if the cabin altitude reaches 15 000 feet, provided that the valves are in automatic mode.

When one pack is OFF and  $\Delta p$  is above 4 psi, the aft outflow valve closes and the forward outflow valve controls the cabin pressure.

*Note : When the RAM AIR pushbutton is ON, and  $\Delta p$  is below 1 psi, the system drives the outflow valves about 50 % open if it is under automatic control. If the system is under manual control, the outflow valves do not automatically open, even if  $\Delta P$  is below 1 psi.*

R

R

R

## **SAFETY VALVES**

- R Two independent pneumatic safety valves prevent the cabin pressure from going too high
- R (8.85 psi above external ambient pressure) or too low (1 psi below external ambient pressure). They are on the rear pressure bulkhead, above the flotation line.

## **NEGATIVE RELIEF VALVE**

- R It is below the floor level, aft of left door n° 1, above the floatation line.
- R It assists the safety valves to prevent the cabin pressure from going too low.

## **SYSTEM OPERATION**

### **AUTOMATIC PRESSURE CONTROL MODE**

- Two identical, independent, automatic systems (each consisting of a controller and its associated motors) control cabin pressure.
- R Either system controls the two outflow valves.  
Only one controller operates at a time.  
An automatic transfer occurs :
  - 80 seconds after each landing.
  - If the operating system fails.
- R — The controller normally uses the landing elevation and QNH from FMGC, and the pressure altitude from ADIRS.  
If FMGC data are not available, the controller uses captain Baro Reference from the ADIRS and the LDG ELEV selection.  
— Pressurization is assumed through the following modes :

#### **R Ground (GND)**

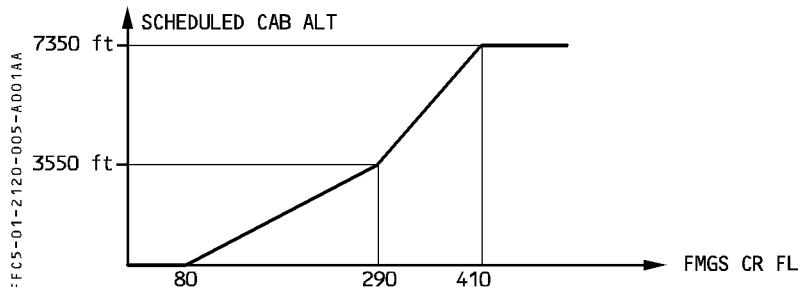
- R Before takeoff and 80 seconds after landing, the system keeps the outflow valves fully open
- R to ensure there is no residual pressure differential inside the aircraft.
- R At touchdown, to release any remaining pressure differential, a depressurization sequence
- R maintains the cabin rate of descent at 500 feet/minute.

#### **R Takeoff (TO)**

- R To avoid a pressure surge at rotation, the controller prepressurizes the aircraft at a rate of  
— 328 feet/minute until the pressure differential reaches 0.1 psi. At lift-off, the controller initiates the climb phase.

#### **R Climb in internal mode (CI)**

- CAB V/S varies, according to a preprogrammed law, in order to reach the scheduled CAB ALT at the top of climb defined by the FMGS cruise FL.
- R The CAB V/S is limited to 1000 feet/minute.



The LDG ELEV selector has no effect in climb.

If FMGS cruise FL is not valid, the default FL 410 is used.

### Climb in external mode (CE)

CAB ALT varies according to FMGS estimated times and planned cruise FL.

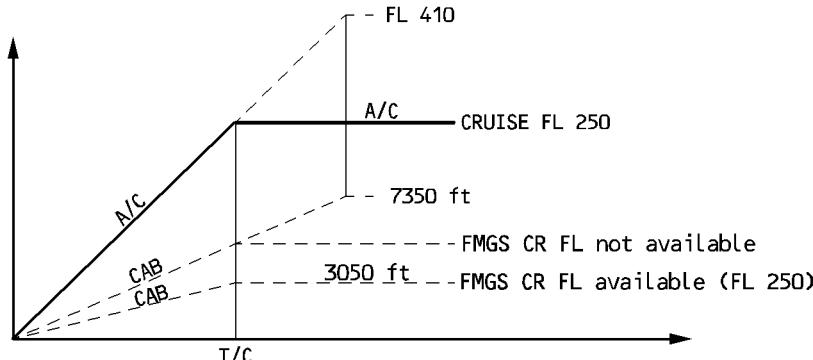
The cabin climb rate is limited to 1000 feet/minute.

### Cruise (CRZ)

When the CPC switches to CRZ mode, the cabin altitude is controlled to the lower of cabin altitude reached at the top of climb, or the scheduled CAB ALT for the actual cruise flight level. If the cabin altitude at the top of climb is higher (no FMGS CR FL available), it will descend with a rate of 300 feet/minute to the scheduled CAB ALT.

If a LDG ELEV above the actual CAB ALT is selected (manual or FMGS), the cabin altitude increases up to the higher of CAB ALT, at the top of climb, or to the LDG ELEV minus 6000 feet). The cabin altitude is limited to a maximum of 7350 feet.

R



**Descent in internal mode (DI)**

Pressure rate is optimized so that cabin pressure reaches landing field pressure + 0.1 psi just prior to landing. The cabin descent rate is limited to 750 feet/minute.

**Descent in external mode (DE)**

CAB altitude varies according to FMGS-estimated times, and cabin pressure reaches landing field pressure + 0.1 psi just prior to landing. The cabin descent rate is limited to 750 feet/minute.

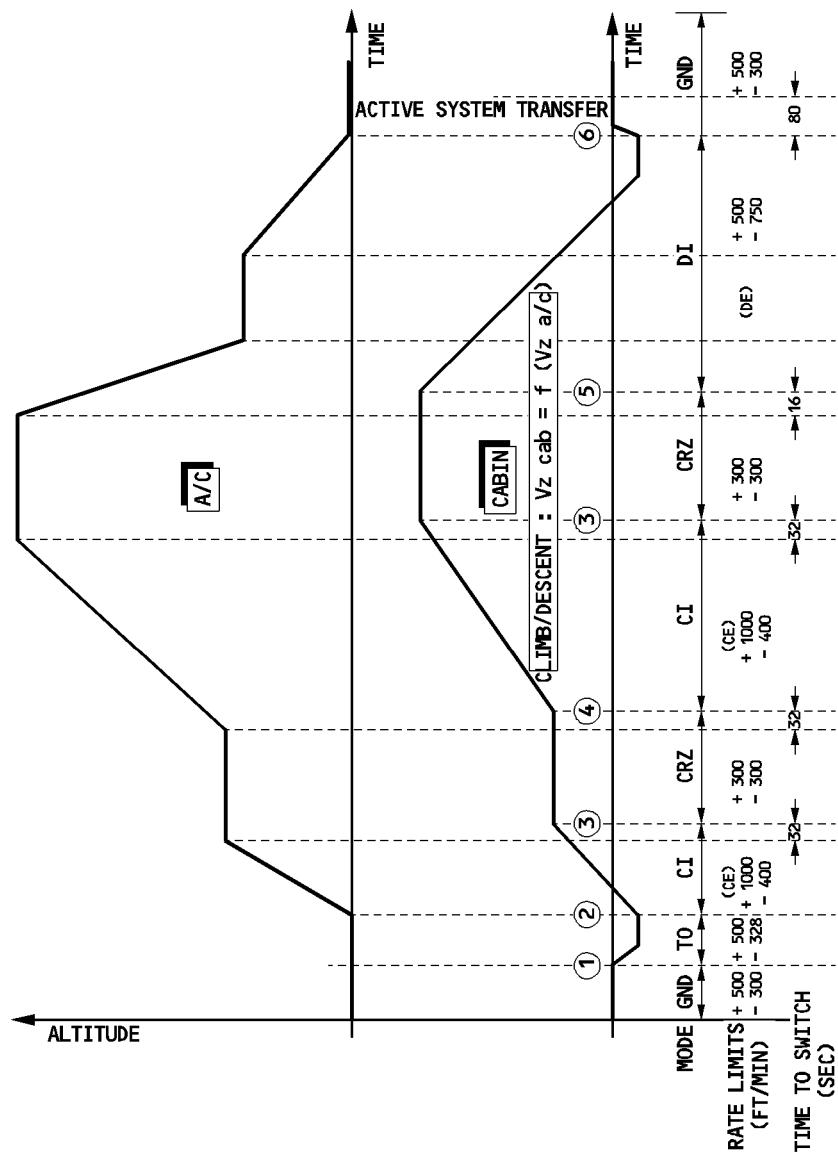
**Abort (AB)**

The abort mode prevents the cabin altitude from climbing, if the aircraft does not climb after takeoff.

- R Cabin pressure is set back to the takeoff altitude + 0.1 psi.

**FOR INFO**

R CPC INTERNAL MODE



FFFC5-01-2120-007-A001AA

**PRESSURIZATION MODES SWITCHING**

	FROM	GND	TO	GND	CL	AB	TO	CL	CRZ	CRZ	DES	DES	AB
	TO	TO	CL	CL	AB	GND	GND	CRZ	CL	DES	CL	GND	CL
	ENG 2 and ENG 3 TLA $\geq$ CL (Engine Running)	1					0						
	MAIN L/G SYS1 and SYS2 COMPRESSED	1	0	0									
	MAIN L/G SYS1 or SYS2 COMPRESSED					1	1						1
	ALL Doors Closed	1		1									
C	A/C ALT < 8000Ft and A/C ALT change since TO $>$ 5000Ft								1a				
O	A/C ALT < 8000Ft or A/C ALT change since TO $>$ 5000Ft					1							
N	A/C Rate of Climb > 50 SLFPM for 32 seconds												1
D	A/C Rate of Climb > 50 SLFPM for 48 seconds												1
I	A/C Rate of Climb > 250 SLFPM for 32 seconds								1				
O	A/C Rate of Climb < 50 SLFPM for 32 seconds								1				
N	A/C Rate of Descent > 150 SLFPM for 32 seconds												
S	A/C Rate of Descent > 250 SLFPM for 16 seconds						1						1
	A/C ALT > A/C ALT at switch into CRZ + 380 SLFT								1				
	A/C ALT > CRZ FL + 180 SLFT								1b				
	End of Cruise Flag set					0							
	Special Function f (ALT, LFE)										1		

FFC5-01-2-120-008-A001AA

O: CONDITION NOT VALID a: ONLY CLIMB INTERNAL

1: CONDITION VALID b: ONLY CLIMB EXTERNAL

(1) (2)

(3) (4) (5) (6)

**MAXIMUM DIFFERENTIAL PRESSURE LIMITER FUNCTION**

- R This function is only available in automatic mode. If the differential pressure is above 8.70 psi, the CPC maintains the  $\Delta p$  constant, to avoid over-pressurization. As a result, the outflow valves open and the CAB V/S increases. Once the differential pressure has decreased below the threshold, normal automatic control of the valves resumes ; this generally causes the valves to go towards the closed position.

**CAUTION**

Except for the outflow valve position indication and the  $\Delta p$  value on the ECAM PRESS page, there is no indication in the cockpit that the limiter function is activated.

Once the  $\Delta p$  limiter function has opened the valves, do not counteract the automatic operation by trying to close the valves in manual mode.

Due to the slow movement of the outflow valves in manual mode, the valves cannot be closed fast enough and the cabin altitude quickly increases above 20000 feet (even if an emergency descent is initiated simultaneously). The automatic mode provides the safest and the quickest way to reduce differential pressure, and recover normal pressure control.

**A340**

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AIR COND/PRESS/VENT

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PRESSURIZATION

SEQ. 001 REV 17

## **MANUAL PRESSURE CONTROL MODE**

If both automatic systems fail, the flight crew may use the CABIN PRESS control panel to manually control cabin pressurization.

- Press the MODE SEL pushbutton to select MAN, and
- Push the MAN V/S CTL toggle switch UP or DN to increase or decrease cabin altitude. According to the VALVE SEL position, the flight crew manually controls both, or only one, outflow valve(s). If only one outflow valve is selected, the other one remains under automatic control.

*Note : 1. Due to the slow operation of the outflow valves in manual mode, and the limited resolution of the outflow valves' position on the ECAM, the visual ECAM indication of a change in the outflow valves' position can take up to 5 seconds.*

- R      *2. As the pressurization system is manually-controlled, the outflow valves do not automatically open at touchdown.*

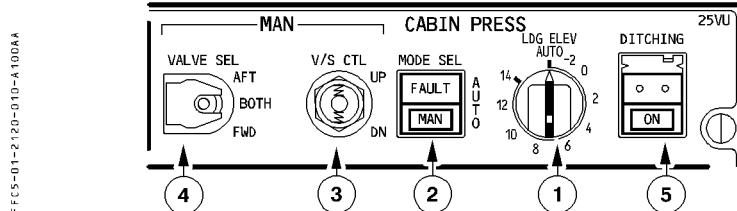
## **DITCHING**

To prepare for ditching, the flight crew must press the DITCHING pushbutton on the CABIN PRESS control panel to close the outflow valves, the emergency ram air inlet, the avionics ventilation inlet and extract valves, and the pack flow control valves. The cabin fans stop.

## **PREVENTION OF PRESSURIZATION WITH A DOOR NOT CLOSED AND LOCKED**

On ground, at takeoff power application, if at least one door is not closed and locked, the CPC will remain in ground mode (outflow valves open).

*Note : As a backup, the zone controller closes the pack valves (Refer to 1.21.10).*

**CONTROLS AND INDICATORS****OVERHEAD PANEL****① LDG ELEV sel**

**AUTO** : The pressurization system uses the FMGS data to construct an optimized pressure schedule. To exit the AUTO position, pull out and turn the selector.

**Other positions** : The pressurization schedule does not use the landing elevation from the FMGS, but instead uses the landing elevation selected with this knob (from – 2000 to 14000 feet) as its reference.

R *Note : The LDG ELEV selector scale is only given as an indication ; refer to the ECAM information for accurate adjustment.*

**② MODE SEL pb**

**AUTO** : Automatic mode is operating. One of the two systems controls the outflow valves.

*Note : If the pilot suspects that the operating pressurization system is not performing properly, he can attempt to select the other system by switching the MODE SEL pushbutton to MAN for at least 3 seconds, then returning it to AUTO.*

**MAN** : This legend appears in white, and FAULT does not come on. The flight crew then uses the MAN V/S CTL switch to control the system.

**FAULT It** : This legend appears in amber and the ECAM caution only comes on when both automatic systems are faulty.

R *Note : The pilot may notice variations (up to ± 1000 feet) in the CAB ALT indication on the ECAM PRESS page, when the system switches from the cabin pressure control AUTO mode to MAN mode, due to reduced resolution of the back up pressure sensor.*

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PRESSURIZATION

SEQ. 001 REV 15

### ③ V/S CTL toggle

The switch is spring loaded to neutral and controls the outflow valve position selected through the VALVE SEL. It controls the MAN motor, when the MODE SEL pushbutton is in the MAN position.

UP : The valve(s) move(s) towards the open position.

DN : The valve(s) move(s) towards the closed position.

### ④ VALVE SEL guarded sel

AFT : The aft outflow valve can be manually controlled. The forward outflow valve remains under automatic control.

BOTH (guarded position) : Both outflow valves can be manually controlled.

FWD : The forward outflow valve can be manually controlled. The aft outflow valve remains under automatic control.

### ⑤ DITCHING guarded pb

Normal : The system functions normally.

ON : The outflow valves, emergency ram air inlet, avionics ventilation overboard valve, cargo compartment isolation valves, and pack flow control valves close.

The ON light appears in white.

The cabin fans are stopped.

*Note : The outflow valve(s) will not close automatically, if it (they) is (are) under manual control.*

#### CAUTION

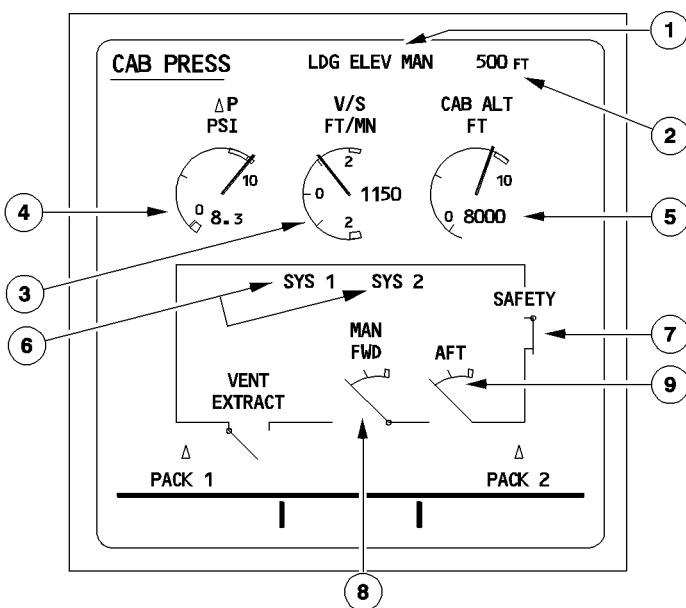
1. On ground, if the ditching pushbutton is set to ON, with the low pressure ground cart connected and all doors closed, a differential pressure will build up.

2. As the galley and toilet extract fan starts before the outflow valves are reopened, a small amount of negative differential pressure builds up when the ditching pushbutton is released.

R  
R  
R

**ECAM CAB PRESS PAGE**

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**① LDG ELEV AUTO / MAN**

- R - LDG ELEV AUTO : appears in green when the LDG ELEV selector is in AUTO.
- R Becomes amber if the landing elevation is not transmitted by the FMGS.
- R - LDG ELEV MAN : appears in green when the LDG ELEV selector is not in AUTO.
- R Neither appear when the MODE SEL pushbutton switch is in MAN and the VALVE SEL selector is in BOTH, or when the LDG ELEV selector is faulty.

**② Landing Elevation**

Landing elevation selected either automatically by the FMGS or manually by the pilot appears in green. (But not when the MODE SEL pushbutton is in MAN position and the VALVE SEL is in BOTH position).

**③ V/S FT/MIN (cabin vertical speed)**

The analog and digital presentation appear in green when V/S is in the normal range.

- R The digital presentation pulses when V/S is greater than or less than 1800 feet/minute.

④  $\Delta P$  PSI (cabin differential pressure)

- R The scale is displayed in white. The needle and the  $\Delta P$  digital value appear in green when  $\Delta P$  is in the normal range. They appear in amber when  $\Delta P < -0.2$  psi or  $\Delta P > 8.85$  psi.  
 R The digital presentation pulses if  $\Delta p > 1.5$  psi during final approach (flight phase 7).

⑤ CAB ALT FT (cabin altitude)

- R The scale is displayed in white. The needle and the altitude appear in green in normal range. They appear in red, if the cabin altitude goes above 9550 feet.  
 R The cabin altitude value and the needle pulse in green when  $8800 \text{ ft} < \text{CAB ALT} < 9550 \text{ ft}$ .  
 R

⑥ Active system indication (SYS 1 or SYS 2)

SYS 1 or SYS 2 appears in green when active, and in amber when faulty.

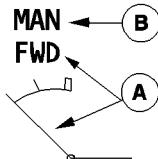
⑦ Safety valve position

- R SAFETY appears in white and the indication in green when all safety valves are fully closed. SAFETY and the indication appear in amber when either valve is not closed.

Note : *The safety valve opens when the cabin differential pressure is between 8.75 and 8.95 psi.*

⑧ Forward outflow valve position

FF C2-01-2120-013-A001AA



- Ⓐ When the valve is operating normally, the needle is green and the FWD indication appears in white. Both become amber when the valve :

- Opens more than 95 % during flight, or
- Fails under automatic control.

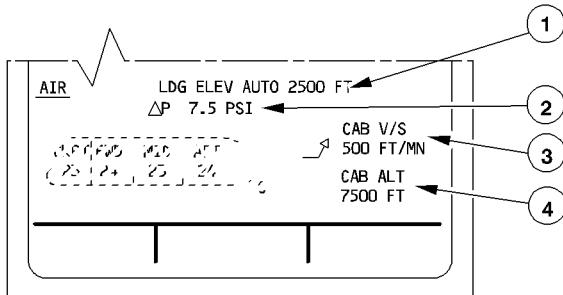
- Ⓑ When the valve is under manual control, the MAN indication appears in green.

⑨ Aft outflow valve position

Identical to the forward outflow valve.

**R ECAM CRUISE PAGE**

FFC5-01-2120-014-A001AA

**① LDG ELEV AUTO / MAN**

Identical to the CAB PRESS page.

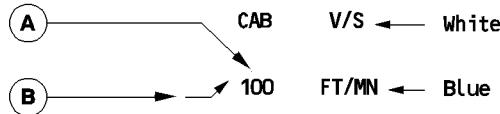
**②  $\Delta P$  indication**

- It is normally in green.
- It pulses green between 1.5 and 8.85 psi, when the aircraft is in final approach.
- It becomes amber below -0.2 psi, or above + 8.85 psi.

**(3) CAB V/S FT/MN (cabin vertical speed indication)**

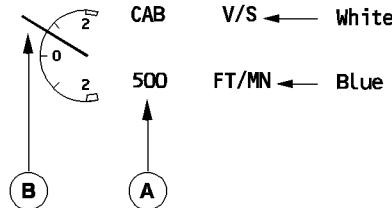
In AUTO PRESS mode

FFC5-01-2120-015-A001AA



- R **(A)** Absolute value of cabin vertical speed is normally green.  
It pulses green above 1800 feet/minute or below -1800 feet/minute
- R **(B)** ↗ : displayed green when the cabin vertical speed is between 25 and 1800 feet/minute.  
pulsing green when the cabin vertical speed is above 1800 feet/minute.  
↖ : displayed green when the cabin vertical speed is between -1800 and -25 feet/minute.
- R pulsing green when the cabin vertical speed is below -1800 feet/minute.  
nothing is displayed when the cabin vertical speed is between -25 and +25 feet/minute.
- R In MAN PRESS mode ( MODE SEL pushbutton at MAN and VALVE SEL at BOTH position):

FFC5-01-2120-015-B001AA

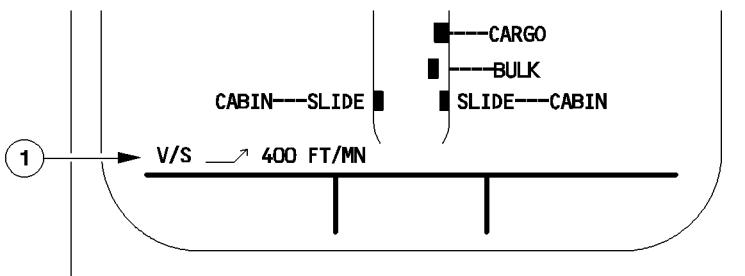


- (A)** Identical to AUTO PRESS mode, but minus sign is added for negative values.
- R **(B)** The needle for the cabin vertical speed indication is normally green.  
It pulses green below -1800 feet/minute or above +1800 feet/minute.
- (4) CAB ALT FT (cabin altitude indication)**

Refer to CAB ALT value on CAB PRESS page.

**ECAM DOOR/OXY PAGE**

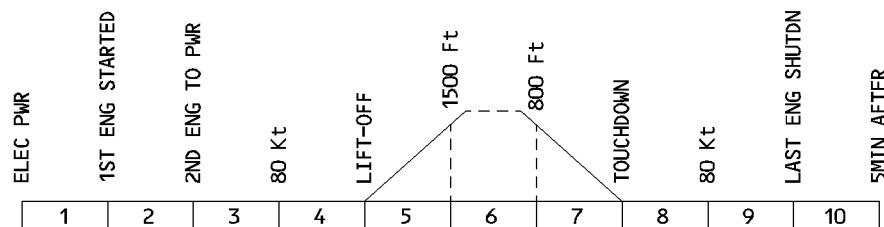
FFC5-01-2120-016-A001AA



- ① identical with cabin vertical speed indication on cruise page when in AUTO PRESS mode.

**WARNINGS AND CAUTIONS**

FFC5-01-2120-017-A200AA



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXCESS CAB ALT Cabin altitude exceeds : – In CLB (DES) the higher of both : 9550 feet or takeoff (landing) field pressure altitude + 1000 feet – In CRZ 9550 feet	CRC	MASTER WARN		NIL	1 to 5 7 to 10
SYS 1 + 2 FAULT Both pressure controllers fail.				MODE SEL FAULT It	4, 5, 7, 8
LO DIFF PR Time to reach $\Delta P = 0 < 1.5$ minutes Not active below (Landing field pressure altitude + 1500 SLFT)	SINGLE CHIME	MASTER CAUT	CAB PRESS		1 to 5 7 to 10
FWD (AFT) OFV NOT OPEN Outflow valve not fully open on ground (time delay 90 seconds).					3 to 8
SAFETY VALVE OPEN Safety valves not fully closed.					2 to 5 7, 8
LDG ELEV FAULT No data available with LDG ELEV sel at AUTO.					1, 3, 4, 5 7 to 10
SYS 1 (or 2) FAULT Pressure controller fault.	NIL	NIL			3, 4, 5 7, 8
EXCESS RESIDUAL PR When, on ground, the differential pressure is still above 2.5 hPa (0.036 PSI) five minutes after landing.	CRC	MASTER WARN			1 to 8

**MEMO DISPLAY**

- The "MAN LDG ELEV" message is displayed in green, if the LDG ELEV selector is not in the AUTO position.  
This message becomes amber in Phases 1 and 2.

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AIR COND/PRESS/VENT

VENTILATION

1.21.30 P 1

SEQ. 001 REV. 09

**GENERAL**

- R The ventilation system includes ventilation for :
  - R — the avionics,
  - R — the batteries,
  - R — the lavatories and galleys,
  - R — the pack bay.
- R Note : For a description of the cargo ventilation see 1.21.40.

Two computers are provided :

- the Avionic Equipments Ventilation Controller (AEVC),
- and the Ventilation Controller.

## AVIONICS VENTILATION

### GENERAL

The avionics ventilation system is fully automatic.

It cools the electrical and electronic components, in the electronic bay and flight deck (including the instruments).

It uses air recirculated from the cabin, and extracts air from the different panels and equipments racks.

### MAIN COMPONENTS

#### TWO CABIN FANS

Two electric fans operate continuously, as long as the aircraft's electrical system is supplied. These fans can be simultaneously cutoff via the CABIN FAN pushbutton.

They make the air circulate around the avionics equipment, and blow to the mixer unit of the air conditioning system through the recirculation valves.

#### RECIRCULATION VALVES

The recirculation valves are normally open and are partially closed automatically by the ventilation controller, when both packs are OFF (provided that both CABIN FANS are ON to ensure a sufficient air flow to avionics).

#### EXTRACT FAN

R The extract fan operates continuously, as long as the aircraft's electrical system is supplied, and blows air through the underfloor extract or overboard extract valve.

#### R UNDERFLOOR AND OVERBOARD EXTRACT VALVES

These valves are fitted with actuators, controlled by the Avionics Equipment Ventilation Computer (AEVC), or by the EXTRACT pushbutton from the flight deck.

R Air is blown overboard through the overboard extract valve.

R Through the underfloor extract valve, air is blown under the forward cargo compartment, then overboard through the outflow valve.

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FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

1.21.30 P 3

VENTILATION

SEQ. 001 REV. 07

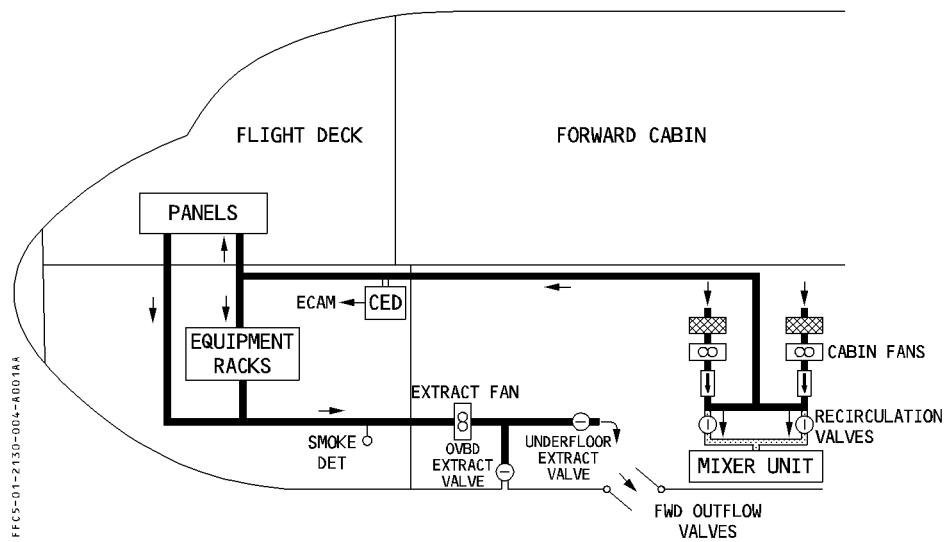
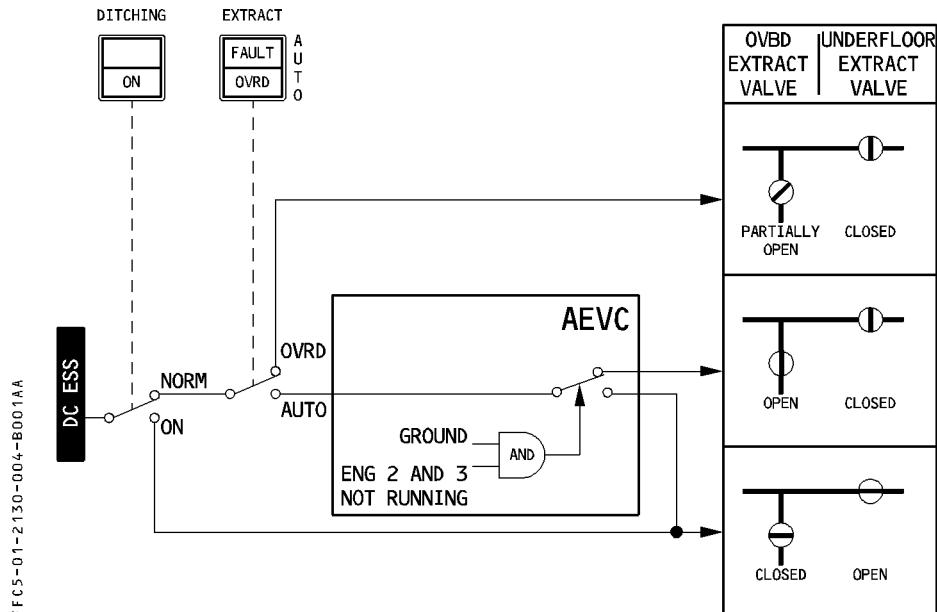
**COOLING EFFECT DETECTOR (CED)**

This detector triggers an ECAM caution when the cooling capacity (flow and temperature) of the blown air is abnormal. On ground, it also activates the external horn and the external warning light.

**AVIONICS EQUIPMENT VENTILATION COMPUTER (AEVC)**

The Computer controls the position of the INBD and OVBD valves.

R

**FOR INFO**

**A340**

FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

1.21.30 P 5

VENTILATION

SEQ. 001 REV. 15

## **SYSTEM OPERATION**

The cabin and the extract fans operate continuously. Air, recirculated from the cabin, is provided to the avionics compartment and flight deck instrument panels.

*Note : In case of failure of two cabin fans, fresh air is blown from the packs.*

In normal operation, fresh air is blown by the extract fan :

- R — On the ground, engines not running : Through the OVBD extract valve (the underfloor extract valve is closed).
- R — In flight, or on ground, with inner engines running : Through the underfloor extract valve (the OVBD extract valve is closed).
- R If OVRD is selected on the EXTRACT pushbutton, air is blown through the OVBD extract valve which is partially open (the underfloor extract valve is closed).
- R When the DITCHING pushbutton is ON, the OVBD extract valve is closed, the cabin fans stop and the underfloor extract valve is open, whatever the position of the EXTRACT pushbutton.

## **AVIONICS GROUND COOLING**

NOT APPLICABLE

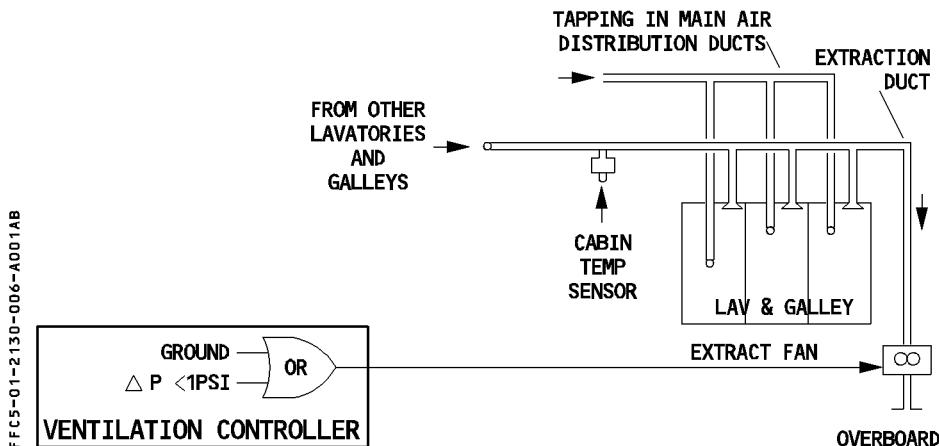
**BATTERY VENTILATION**

- R A venturi in the skin of the aircraft draws air from the space around the batteries and vents it overboard. The resulting airflow ventilates the batteries.

**LAVATORY AND GALLEY VENTILATION**

Lavatory and galley are ventilated with air from main cabin distribution system. Air is discharged outside through a venturi. On ground, or when  $\Delta P < 1$  psi, it is extracted by an electrical fan controlled by the ventilation controller.

The ventilation of the cabin temperature sensors is connected to the extraction duct.

**FOR INFO**



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FLIGHT CREW OPERATING MANUAL

**AIR COND/PRESS/VENT**

**VENTILATION**

**1.21.30 P 6a**

**SEQ. 001 REV 18**

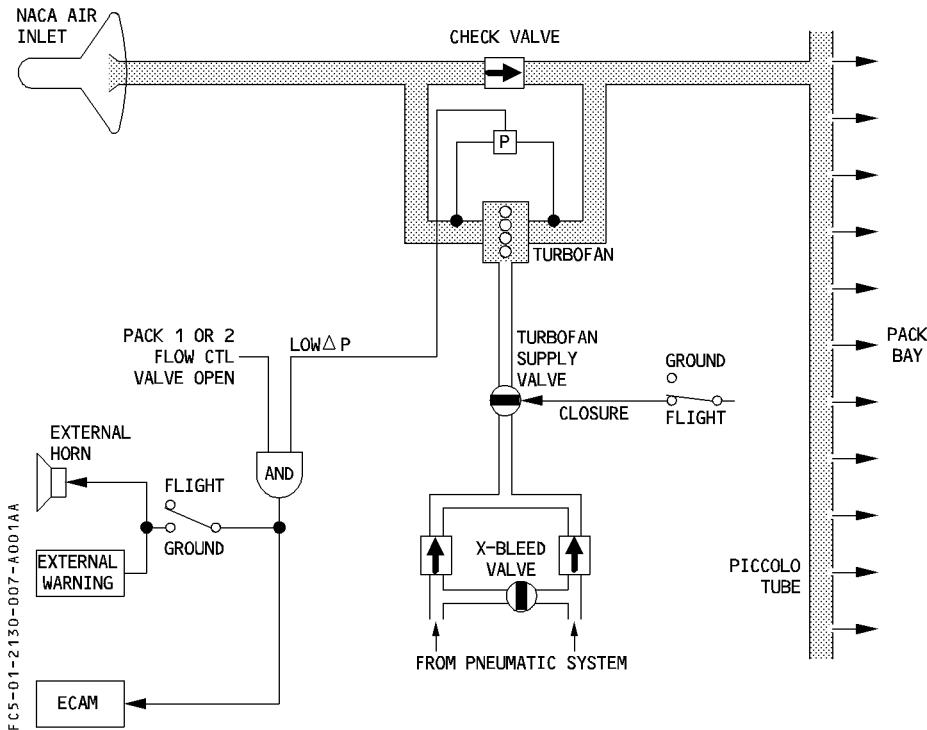
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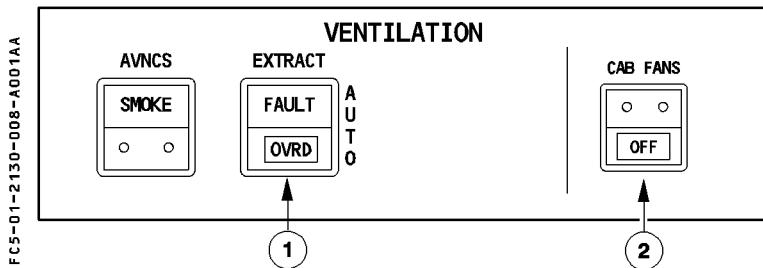
**PACK BAY VENTILATION**

- R The ventilation of the pack bay ensures air circulation in order to maintain, on ground and in flight a mean temperature compatible with the structure constraints in the relevant area.
- R In flight, air from the outside flows into the pack bay through a NACA air inlet.
- R On ground, a turbofan provides sufficient airflow.
- R The turbofan is driven by air from the bleed system which is supplied through the turbofan supply valve. Controlled by the AEVC, the fan operates when the aircraft is on ground. An ECAM warning associated with an external horn on ground is triggered in case of failure of the turbofan (supply valve failed closed or turbofan jammed).

**FOR INFO**

R



**CONTROLS AND INDICATORS****OVERHEAD PANEL**

- R      AUTO    : On ground, with Engines 2 and 3 not running, the underfloor extract valve is closed and the OVBD extract valve is open, provided DITCHING is not selected.
- R      In flight, or on ground, with Engine 2 or 3 running, the underfloor extract valve is open and the OVBD extract valve is closed.
- R      OVRD    : The underfloor extract valve closes and the OVBD extract valve partially opens, provided DITCHING is not selected.
- FAULT It : The amber light and associated ECAM caution come on, when an extract low flow is detected in the avionics compartment.  
The FAULT light goes out when OVRD is selected.

**② CAB FAN pb**

(Refer to 1.21.10)



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FLIGHT CREW OPERATING MANUAL

**AIR COND/PRESS/VENT**

**VENTILATION**

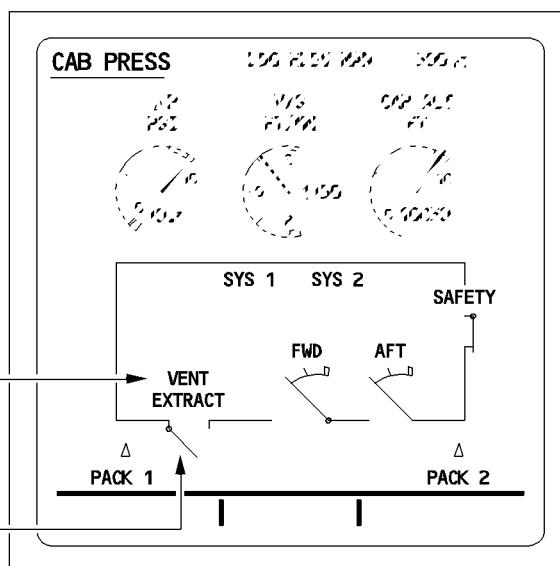
**1.21.30 P 8a**

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**ECAM CAB PRESS PAGE**

FFC5-01-2130-009-A001AA



**R** ① OVBD extract valve position indication

FFC5-01-2130-009-B001AA

EXTRACT This indicates that the OVBD extract valve is fully closed.

EXTRACT This indicates that the OVBD extract valve is partially open.

EXTRACT This indicates that the OVBD extract valve is fully open.

Normally, the EXTRACT indication appears in white and the valve symbol is in green. Both become amber in case of an abnormal position.

② VENT indication

This normally appears in white.  
It becomes amber in case of extract low flow.



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FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

VENTILATION

1.21.30

P 10

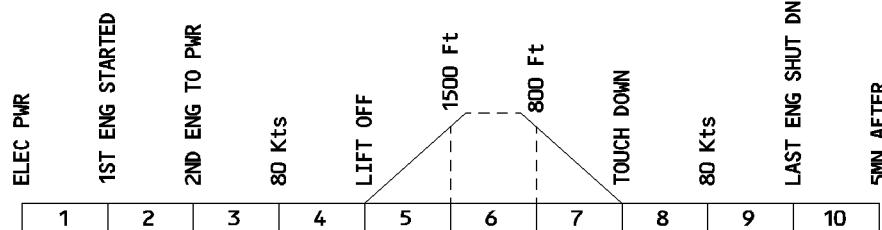
SEQ 001

REV 07

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**WARNINGS AND CAUTIONS**

FFC5-01-2130-011-A103AA



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
BLOWING FAULT *	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
Low cooling capacity detected by the CED			CAB PRESS	EXTRACT FAULT light	3, 4, 5, 7, 8
EXTRACT FAULT *			NIL	NIL	3 to 8
Low extract flow detected by the pressure switch					
OVBD VALVE FAULT					
Valve open at engine start or, not partially open after override					
PACK BAY VENT FAULT *					
Lo $\Delta P$ detected across the turbofan, with at least one pack in operation					

\* Associated with ground external horn triggered after a time delay of 5 minutes.

**A340**

FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

CARGO

1.21.40 P 1

SEQ. 001

REV. 07

**GENERAL**

The system provides ventilation and heating to the cargo compartments. It is controlled by the ventilation controller which has two channels. Channel 2 is a backup in case of channel 1 failure.

**SYSTEM OPERATION****BULK CARGO COMPARTMENT****VENTILATION**

Air from the cabin goes via the inlet isolation valve to the bulk cargo compartment, and is driven by an extraction fan. Air is controlled by the outlet isolation valve, goes to the bilge, then through the aft outflow valve.

**— Normal operation**

The cargo ventilation controller controls the inlet and outlet isolation valves and the extraction fan. The ventilation system operates when the isolation valves are open. To open the isolation valves, switch the BULK ISOL VALVE pushbutton to the on position. The controller closes the isolation valves and stops the extraction fan when :

- R     — The flight crew selects the BULK ISOL VALVE pushbutton OFF, or  
      — The bulk cargo smoke detection unit detects smoke.  
The outlet valve closes and the extraction fan stops, when the flight crew selects the DITCHING pushbutton ON.  
In case of overheat, the extraction fan stops and OVHT COND FANS RESET FAULT light comes on, on the maintenance panel.

**HEATING**

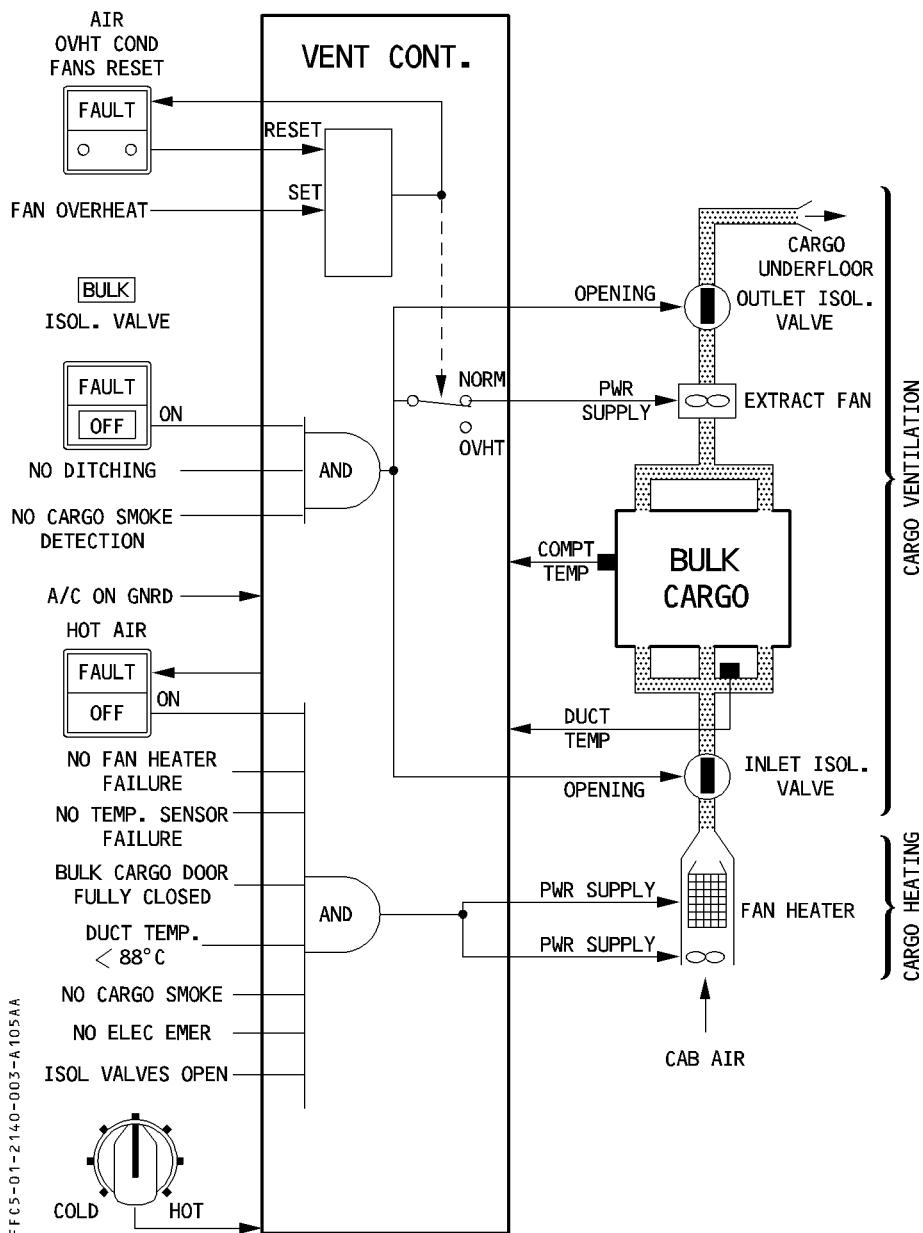
Bulk cargo compartment heating is performed by an electrical fan heater. Air from the cabin, driven by the electrical fan, goes into the compartment through a heating element. The temperature is selected from the cockpit.

**— Normal operation**

Provided the cargo door is closed, the heater operates when the temperature sensors indicate that the compartment air temperature is less than the selected one.

**— On ground operation**

When the bulk cargo door is open, electrical power no longer supplies the heating element of the fan heater. Compartment heating is not available, as long as the cargo door remains open.



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**A340**

**AIR COND/PRESS/VENT**

**CARGO**

**1.21.40**

**P 4**

**SEQ 001**

**REV 07**

## **AFT CARGO COMPARTMENT**

### **VENTILATION**

**NOT APPLICABLE**

**A340**

FLIGHT CREW OPERATING MANUAL

AIR COND/PRESS/VENT

1.21.40 P 5

CARGO

SEQ. 200 REV 19

## **FORWARD CARGO COMPARTMENT**

### **R VENTILATION AND COOLING**

Due to extract fan suction, the cabin air flows through the inlet isolation valves into the forward cargo compartment via the sidewall and ceiling inlets. Air is extracted through outlets, on the opposite sidewall, and goes via the extract fan and outlet isolation valve to the underfloor bilge area near the forward outflow valve.

To decrease compartment temperature, the inlet ventilation air is mixed with cold air from Pack 2. The cold air valve has three positions to adjust the quantity of cooled conditioned air that is mixed with the ventilation air. The valve position is selected from the cockpit.

- Note : 1. In general, if COOLING is selected at NORM or MAX, the parameters could be different between both packs.  
2. Below 20000 feet, pack 2 outlet temperature is limited to 5° C, in order to avoid ice accumulation on the cold air valve.*

#### **– Normal operation**

Operation starts automatically, when the isolation valves are fully open. To open the isolation valves, the FWD ISOL VALVE pushbutton is set to ON. The extract fan starts to operate continuously.

The controller closes the isolation valves, and stops the extract fan, when :

- a) The FWD ISOL VALVE pushbutton is switched OFF, or
- b) The forward cargo smoke detection system is triggered, or
- c) DITCHING pushbutton on CABIN PRESS panel is switched ON.

In case of an overheat, the extract fan stops, and OVHT COND FANS RESET FAULT light, on the maintenance panel, comes on.

The cold air valve will be fully closed, when :

- a) The COOLING selector is selected OFF, or
- b) The forward cargo door is not fully closed, or
- c) The forward cargo smoke detection system is triggered, or
- d) The forward cooling system fails, or
- e) At least one pack is off.

## HEATING

- R To provide variable temperature, inlet air is mixed with hot air from the hot air manifold. The forward cargo trim air valve controls the quantity of hot air added. The temperature is selected from the cockpit.

### Normal operation

When the HOT AIR 1 pushbutton (Refer to Air Conditioning Overhead Control Panel, described in 1.21.10) is ON, hot air is added to the cargo ventilation system. A trim air valve controls the quantity of hot air. The Ventilation Controller controls the position of this trim air valve, according to the sensed duct temperature and to the selected temperature. Manually switching the HOT AIR 1 pushbutton OFF stops the heating.

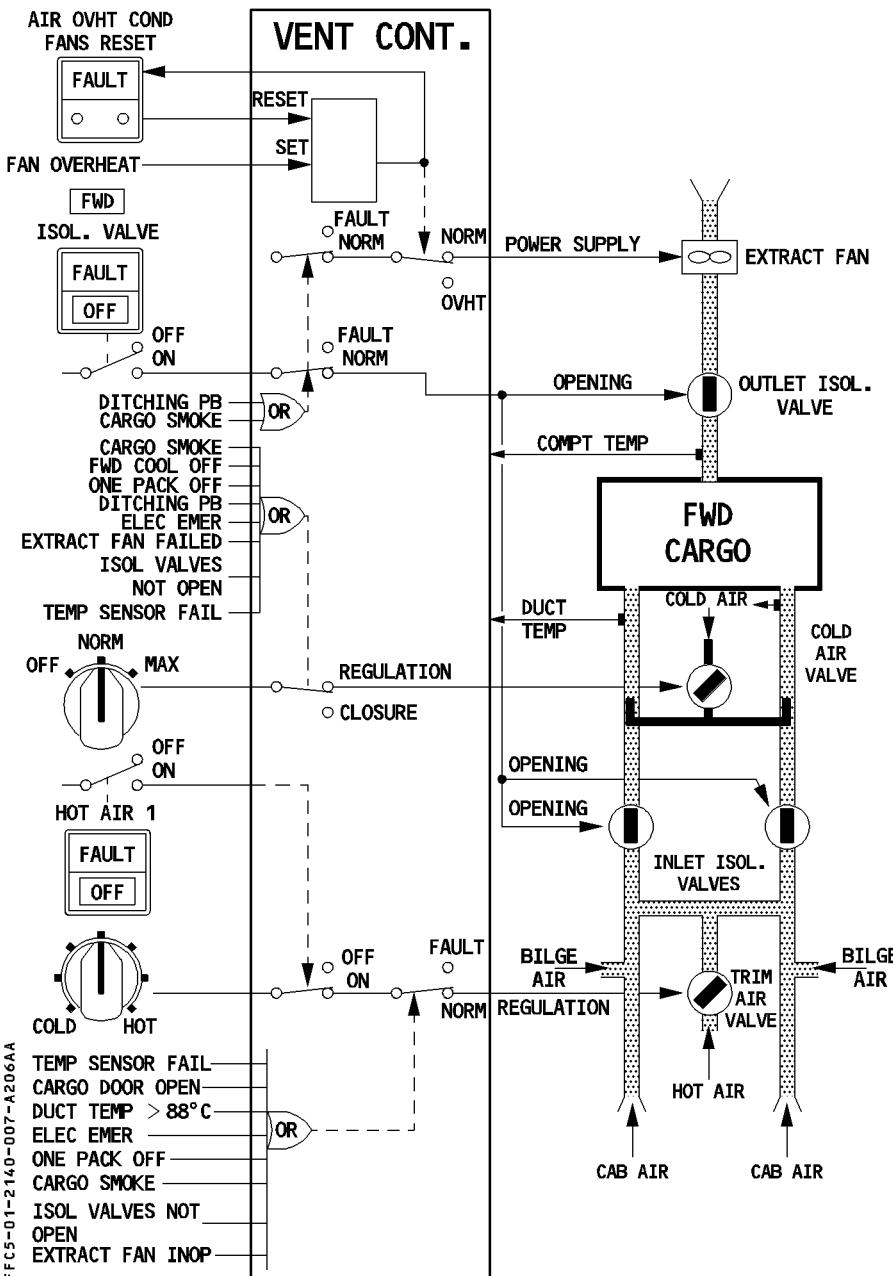
*Note : If there is a failure in one of the hot air supplies, the hot air crossvalve opens. The forward cargo compartment supply remains, either through Channel 1 (Channel 2 failure), or through Channel 2 (Channel 1 failure).*

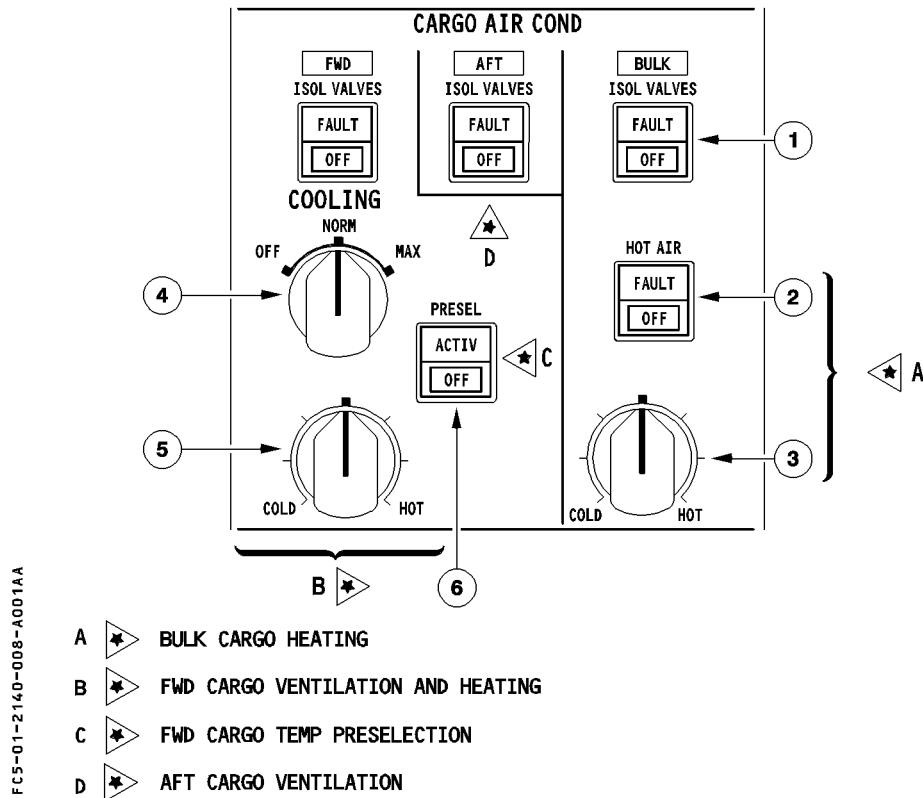
If the forward cargo compartment heating system is stopped via the HOT AIR 1 pushbutton, temperature control for the respective cabin zones (Refer to 1.21.10) is also lost.

### On ground operation

The trim air valve closes when the forward cargo door opens. Compartment heating is unavailable, as long as the cargo door remains open.

R



**CONTROLS AND INDICATORS****OVERHEAD CARGO AIR COND PANEL****① ISOL VALVE pushbutton**

- R On : The inlet and outlet isolation valves open, and the extraction fan run. If smoke is detected in the cargo compartment, or DITCHING is selected, the valves close, and the fan stops.
- R OFF : The inlet and outlet isolation valves close and the extraction fan stops.
- R FAULT It : The light comes on amber associated with ECAM caution when either inlet or outlet valve is not in the selected position.

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**AIR COND/PRESS/VENT**

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CARGO

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**(2) HOT AIR pushbutton ◄**

- ON : The fan heater operates, provided the BULK cargo compartment temperature is below the selected one, and the BULK cargo door is closed.
- OFF : The fan heater stops. Inlet air is not heated.
- FAULT It : The amber light, and associated ECAM message, come on when the duct overheats (above 88°C/190°F). The light goes off, when the temperature drops below 70°C (158°F), and OFF is selected. The fan heater stops.

**(3) Temperature selector ◄**

- COLD : 5°C (41°F)
- HOT : 25°C (79°F)
- Middle position : 15°C (60°F)

R Note : *Cargo compartment temperature may vary due to such factors as flight duration, outside temperature, and cabin temperature. As a result, the actual temperature may be higher than the one indicated by the selector position.*

**(4) COOLING selector ◄**

- OFF : The cold air valve is closed. No cold air is added to the ventilation air.
- NORM : The cold air valve is partially open for normal operation.
- MAX : The cold air valve is fully open. Maximum quantity of cold air is supplied to cool the forward cargo compartment.

**(5) Temperature selector ◄**

- COLD : 5°C (41°F)
- HOT : 25°C (79°F)
- Middle position : 15°C (60°F)

**(6) FWD PRESEL pushbutton ◄**

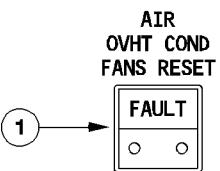
R ACTIV It : The light comes on green, when FWD PRESEL is set to ON, or the cargo compartment service panel's ON/OFF toggle is momentarily switched to ON. Once this toggle switch is ON, the temperature can be preselected on the forward cargo compartment service panel.

R OFF : ACTIV light goes out. Temperature selection from the cockpit overrides the temperature preselected from the service panel.

Note : *The preselection system is automatically set to OFF, when the forward cargo door is opened after a flight.*

**OVERHEAD MAINTENANCE PANEL**

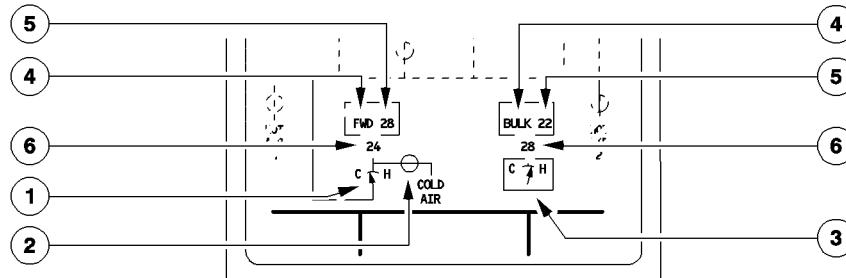
FFC5-01-2140-010-A001AA

**① OVHT COND FANS RESET pb sw**

- R FAULT It : The light comes on amber when extract fan overheat occurs. Fan is stopped. To resume fan operation, press the OVHT COND FANS RESET pushbutton (FAULT light goes out).

**ECAM COND PAGE**

FFC5-01-2140-011-A200AA

**① Trim air valve (Heating)**

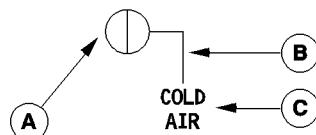
H - Hot (Green) : Valve is open.

C - Cold (Green) : Valve is closed.

R C - Cold (Amber) : Valve is failed.

**② COLD AIR VALVE**

FFC5-01-2140-011-B200AA



- R **(A)** In line – Green : Valve is fully open.  
 R In line – Amber : Valve is failed open.  
 R In transit – Green : Valve is partially open.  
 R In transit – Amber : Valve is failed partially open, or in transit.  
 R Cross line – Green : Valve is fully closed.  
 R Cross line – Amber : Valve is failed closed.

Note : The color of the symbol changes from green to amber, if one of the two pack flow control valves is fully closed, independent of the cold air valve position.

- (B)** This indication is in green either when the pack flow control valves are not fully closed, or when positions are not available. It becomes amber when one of the two valves is fully closed.  
**(C)** This indication is in white.

R **(3) Bulk fan heater**

R This normally green, it becomes amber if the valve is failed.

R C - cold : Heater working at its lowest level.

R H - hot : Heater working at its highest level.

R **(4) Compartment indication**

R This indication is displayed in white

R **(5) Compartment temperature**

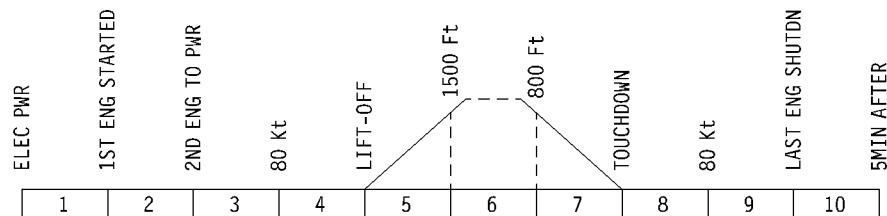
R This indication is displayed in green

R **(6) Duct temperature**

R This is normally green, it becomes amber when the temperature is above 88°C.

**WARNINGS AND CAUTIONS**

F FC5-01-2140-013-A100AA



R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
VENT SYS FAULT Ventilation controller failed.	SINGLE CHIME	MASTER CAUT	COND	NIL	
BULK (FWD) CRG HEAT FAULT ◀ Heating system failure.					
BULK (FWD) (AFT) CRG ISOL FAULT ◀ Cargo isolation valve disagreement.					
BULK (FWD) (AFT) CRG VENT FAULT ◀ Ventilation system failure.	NIL	NIL	NIL	ISOL VALVE FAULT It	3, 4, 5, 7, 8
FWD CRG COOL FAULT ◀ Cooling system failure.			COND	NIL	
BULK CRG DUCT OVHT ◀ Duct temp > 88°C or above 80°C 4 times in one flight.	SINGLE CHIME	MASTER CAUT	COND	HOT AIR FAULT It	
CAB REST ISOL FAULT ◀ Cargo rest isolation valve disagreement.	NIL	NIL	NIL	NIL	

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**AIR COND/PRESS/COND****ELECTRICAL SUPPLY**

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**BUS EQUIPMENT LIST**

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
AIR COND	PACK CONTROLLER	1 channel 1 channel 2	AC1-2 AC1-2	DC1 DC1				
		2 channel 1 channel 2	AC2-3 AC2-3	DC2 DC2				
	ZONE CONTROLLER	channel 1 channel 2		DC1 DC2				
	PACK VALVES CLOSURE					X		
	RAM AIR INLET					X		
PRESS	CAB PRESS CONT	1				X		
		2	DC2					
		MANUAL CONTROL		X				
VENT	CABIN FANS	1	AC1-2					
		2	AC2-3					
	AVIONIC	AEVC	AC1-2					
	EXTRACT FAN	AC1-2						
CARGO	VENT CONT		DC2			SHED		
	BULK	EXTRACT FAN	AC2-4					
		ISOL VALVES (3)	AC2-4					
		FAN HEATER	AC1-1					
	AFT	EXTRACT FAN	AC1-2					
		ISOL. VALVES	AC1-2					
	FWD	EXTRACT FAN	AC2-4					
		ISOL. VALVES	AC2-4					
		COLD AIR VALVE	AC2-4					
		HOT AIR VALVE	AC2-4	DC2		SHED		

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**PREAMBLE**

The Auto Flight System is described in the volume 1 and 4 :

- the volume 1 chapter 22 gives a general description of the system and the different functions (architecture, modes, FMA, functions...).
- the volume 4 "FMGS PILOT'S GUIDE" is devoted to the FMGS System operation (MCDU pages, MCDU message, Procedures).

**DESCRIPTION**

The Flight Management Guidance and envelope System (FMGS) contains the following units :

- Two Flight Management Guidance and envelope Computers (FMGC).
- Three Multipurpose Control and Display Units (MCDU)
- One Flight Control Unit (FCU)
- One Flight Management source selection device.

**GENERAL PHILOSOPHY**

The Flight Management and Guidance System (FMGS) provides predictions of flight time, mileage, speed, economy profiles and altitude. It reduces cockpit workload, improves efficiency and eliminates many routine operations normally performed by the pilots.

During cockpit preparation the pilot inserts a preplanned route from origin to destination via the Multifunction Control and Display Units (MCDUs). This route includes the departure, enroute waypoints, arrival, approach, missed approach and alternate route as selected from the navigation database. The system generates optimum vertical and lateral flight profiles and predicted progress along the entire flight path. Either FMGC performs all operations if one FMGC fails.

The pilot may modify any flight parameter on a short term basis (SPD, V/S, HDG...) and the FMGS will guide the aircraft to the manually selected target. This pilot controlled guidance is called "selected".

There are two types of GUIDANCE :

- Managed guidance : The aircraft is guided along the preplanned route, vertical, lateral, and speed/Mach profile. This type of preplanned guidance is called "Managed". Predicted targets are computed by the FMGS.
- Selected guidance : The aircraft is guided to the selected target modified by the pilot. Targets are selected on the flight control unit located on the pilots glareshield. The decision to engage a "selected" or a "managed" guidance is always under the control of the pilot.  
Selected guidance has priority over managed guidance.

## **FLIGHT MANAGEMENT GUIDANCE COMPUTER (FMGC)**

Each FMGC is divided into four main parts :

- The Flight Management (FM) part controls the following functions :
  - Navigation and management of navigation radios.
  - Management flight planning.
  - Prediction and optimization of performance.
  - Management of displays.
- The Flight Guidance (FG) part performs the following functions :
  - Autopilot (AP) command
  - Flight Director (FD) command
  - Autothrust (A/THR) command
- The Flight Envelope (FE) part controls the following functions :
  - Computation of data for the flight envelope and speed functions
  - Monitoring of parameters used by FG and FE parts
  - Windshear and aft Center of Gravity (CG) detection
  - Computation of GW and CG information
- The Fault Isolation and Detection System (FIDS) part providing :
  - Acquisition and concentration of maintenance data
  - Interface with the Central Maintenance Computer (CMC)

Each FMGC has its own database (one Mega words - 16 bits) and each comprises two fields.

- One field, which the pilot cannot modify, contains customer-tailored data and standard navigation data : navaids, waypoints, airways, en route information holding patterns, airports, runways, procedures (SIDs, STARs, etc.), company routes, fuel policy, alternates.

The customer (airline) is responsible for defining, acquiring, updating, loading and using this data.

The airline updates this part every 28 days. The data go into each FMGC separately, although it can be copied into one FMGC from the other if the system has the optional crossload function. The updating operation takes 20 minutes to complete or 5 minutes if crossload from the opposite FMGC.

- The second field contains pilot-stored elements that allow the pilot create 20 waypoints, 10 runways, 20 navaids and 5 routes.

Note : When the two FMGCs are not working with the same database, the FMGS operates in independent operation. (See FMGS MODES OF OPERATION).

- Each FMGC also contains an integrated performance database that the FM part uses for computing predictions. The airline does not have access to this database.

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## **MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU)**

Three MCDUs are installed on the pedestal for flight crew loading and display of data. The use of MCDU allows the flight crew to interface with the FMGC by selection of a flight plan for lateral and vertical trajectories and speed profiles. The crew may also modify selected navigation or performance data and specific functions of Flight Management (revised flight plan, engine-out, secondary flight plan, etc.). Additional data from peripherals (Centralized Maintenance System (CMS), ARINC Communications, Reporting System (ACARS) can also be displayed. Data that are entered into the MCDU that are illogical or beyond the aircraft capabilities will either be disregarded or will generate an advisory message.

The MCDUs allow back up navigation in case of dual FM failure.

## **FLIGHT CONTROL UNIT (FCU)**

The FCU located on the glareshield, is the short-term interface between the crew and the FMGC. It is used to select any flight parameters or modify those selected in the MCDU. The autopilots and autothrust functions may be engaged or disengaged. Different guidance modes can be selected to change various targets (speed, heading, track, altitude, flight path angle, vertical speed).

## **FM SOURCE SELECTOR**

This selector allow to switch the FMGC data to the offside MCDU and EFIS display in case of one FM failure.

## **OTHER CREW INTERFACES**

### **THRUST LEVERS**

The thrust levers are the main interface between the Flight Management Guidance Computer, the Full Authority Digital Engine Control System (FADEC), and the flight crew.

They :

- arm the autothrust at takeoff, when “FLX” or “TOGA” is selected,
- limit the maximum thrust by their position when autothrust is active,
- disconnect the autothrust system when the flight crew sets them to “IDLE”,
- command the thrust manually when autothrust is not active,
- engage the common modes (takeoff or goaround) when TOGA (or “FLX” for takeoff) is set,
- when positioned between IDLE and CL detent (MCT in engine out), set the autothrust to the active mode.

## ELECTRONIC FLIGHT INSTRUMENTS (EFIS)

Two Primary Flight Displays (PFD) and Navigation Displays (ND) provide the crew with full-time flight guidance, navigation and system advisory information for all flight phases. An EFIS control panel is located at each end of the glareshield and is used to control both Primary and Navigation Displays. This panel includes controls to select various modes within the PFD. A selector allows the barometric altimeter setting to be displayed on the PFD. Various distance ranges can be selected on the ND, and two toggle switches allow either the left or right VOR/ADF bearing pointers to be displayed on the ND.

### PRIMARY FLIGHT DISPLAYS

The PFDs combine several conventional flight instrument indications on one color display panel, for centralized reference of flight data.

This centralized color display includes :

- Flight Director attitude guidance targets
- Armed and engaged modes
- Navigation and instrument approach information
- Altimeter setting
- Barometric altitude
- System messages.

### NAVIGATION DISPLAYS

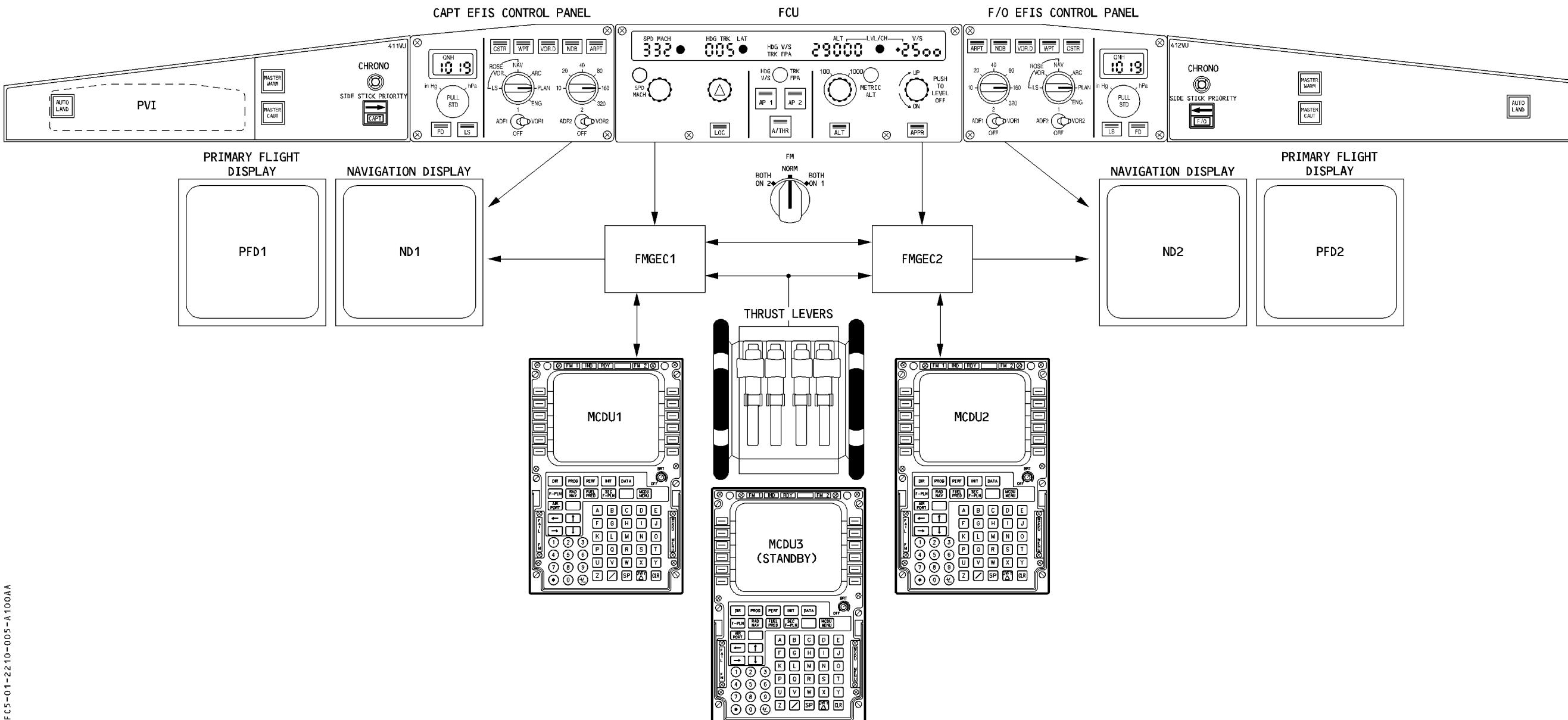
Five different color navigation compass displays can be selected :

- ARC (map mode)
- ROSE NAV (map mode)
- ROSE VOR
- ROSE LS
- PLAN

Information displayed on these modes uses the aircraft's position as a reference point for the flight plan navigation data (lateral and vertical information).

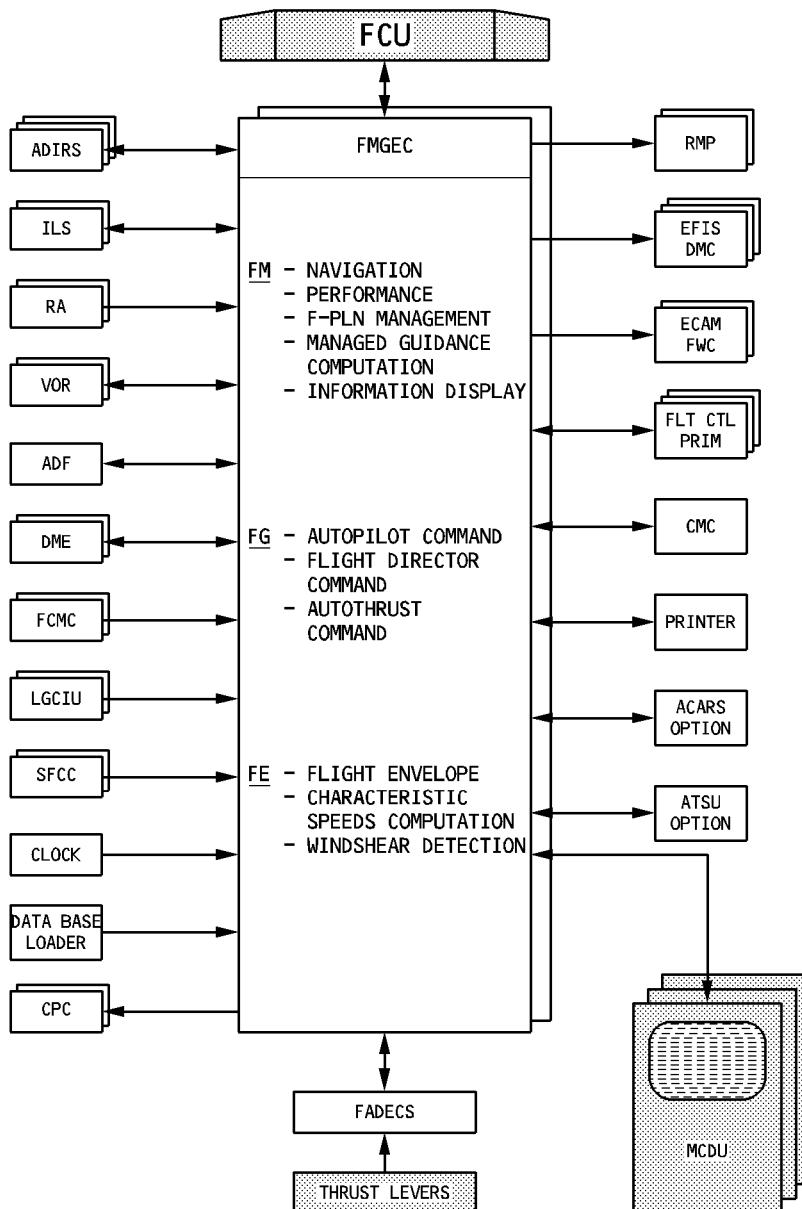
**CREW INTERFACE WITH FMGEC**

R



**SYSTEM INTERFACE DIAGRAM**

R



## FMGS MODES OF OPERATION

The FMGS has four modes of operation :

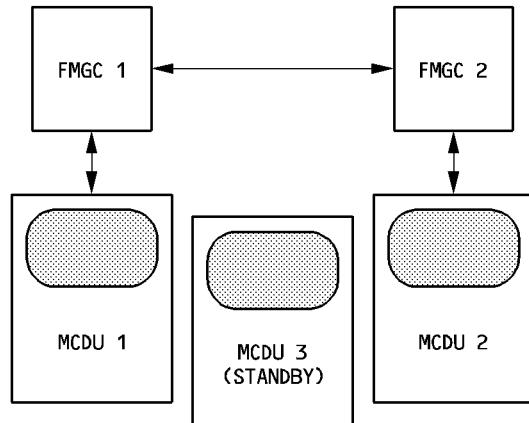
- dual mode (the normal mode)
- independent mode. Each FMGC being controlled by its associated MCDU.
- single mode (using one FMGC only)
- back up navigation mode

### **DUAL MODE**

This is the normal mode. The two FMGCs are synchronized : each performs its own computations and exchanges data with the other through a crosstalk bus.

One FMGC is the master, the other the slave, so that some data in the slave FMGC comes from the master. All data inserted into any MCDU is transferred to both FMGCs and to all peripherals.

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### **MASTER FMGC LOGIC :**

- If one autopilot (AP) is engaged, the related FMGC is master :
  - it uses the onside FD for guidance
  - it controls the A/THR
  - it controls the FMA 1 and 2
- If two APs are engaged, FMGC1 is master.
- If no AP is engaged and
  - the FD1 pushbutton is on, then FMGC1 is master.
  - the FD1 pushbutton is off, and FD2 pushbutton on then FMGC2 is master.
- R – if no AP/FD is engaged, A/THR is controlled by FMGC1.

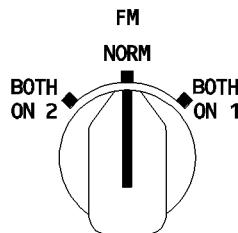
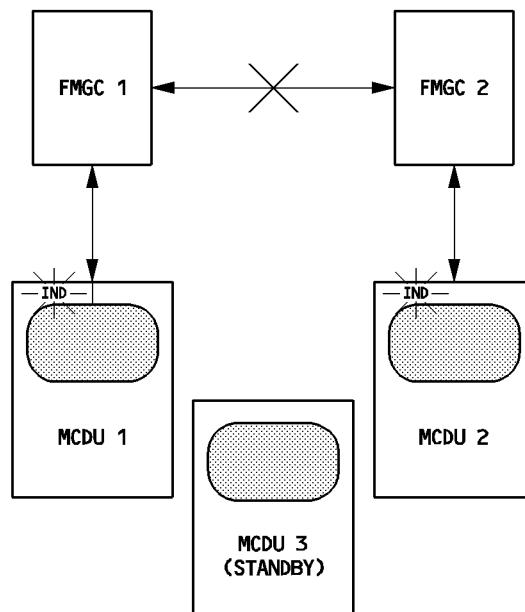
## INDEPENDENT MODE

The system selects this degraded mode automatically if it has a major mismatch (database incompatibility, operations program incompatibility . . . ). Both FMGCs work independently and are linked only to peripherals on their own sides of the flight deck ("onside" peripherals).

When this occurs, "INDEPENDENT OPERATION" appears on the MCDU scratchpad.

The "IND" annunciator light illuminates amber on the top of the MCDU when the onside FMGC detects an independent operation.

Each MCDU transmits data it receives only to its onside FMGC, and it affects only the onside EFIS (Electronic Flight Instrument System) and RMP (Radio Management Panel).



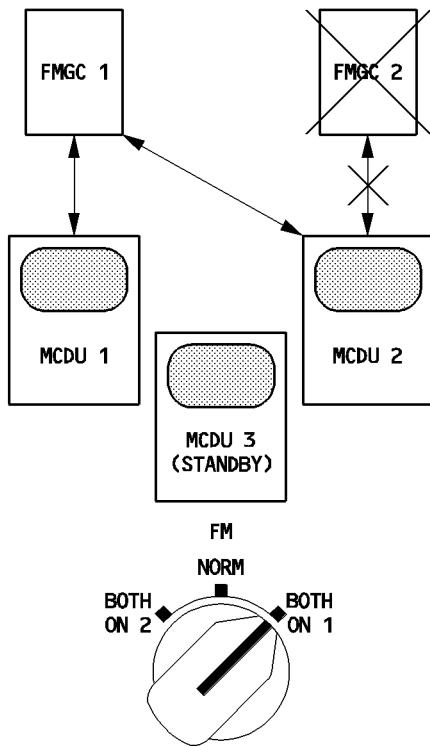
FFC5-01-2210-008-A001AA

R For independent mode procedure refer to 4.06.10.

**SINGLE MODE**

The system selects this degraded mode automatically if one FMGC fails. The pilot selects the FM source selector to transfer the remaining FMGC data to the offside MCDU and EFIS display. The remaining FMGC drives all the peripherals, so, for example, any entry on one MCDU goes to both MCDUs.

- R The ND on the side with the failed FMGC displays "OFF SIDE FM CONTROL" in amber.



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- R For single mode procedure refer to 4.06.10.

## BACK UP NAVIGATION MODE

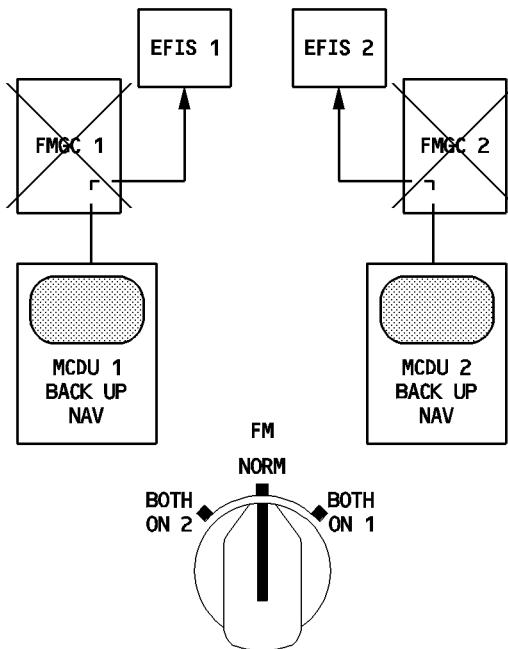
The pilot selects on the MCDU menu page this degraded mode when both FMGC fail. He recovers the navigation function through the MCDU and IRS.

The MCDU memorizes the flight plan which has been continuously downloaded in its memory by the FMGC until it failed.

The following features are provided:

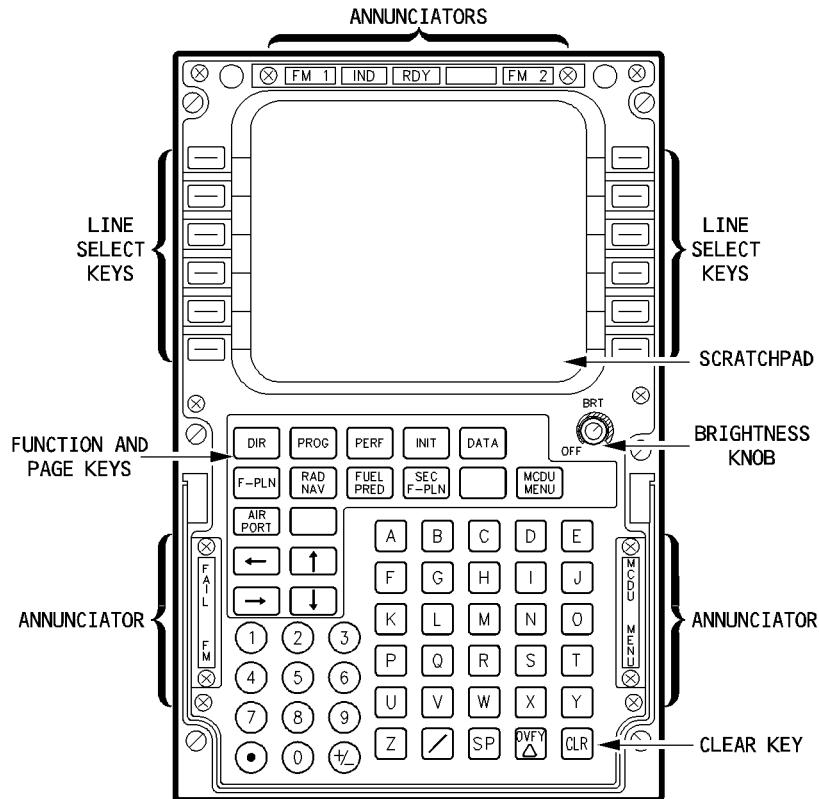
- Flight Planning
- Aircraft position using onside IRS or IRS 3
- F-PLN display on ND
- No AP/FD NAV mode
- Limited lateral revision
- F-PLN automatic sequencing

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Note : *MCDU 3 is not able to operate as back up navigation even when it replaces MCDU 1 or 2.*

*The back up navigation mode is only accessible on the MCDU MENU page if the FM source selector is set to NORM position.*

**PILOT INTERFACE****MULTI PURPOSE CONTROL DISPLAY UNIT (MCDU)**

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**GENERAL**

The MCDU is a cathode ray tube that generates 14 lines of 24 characters each :

- a title line that gives the name of the current page in large letters,
- six label lines, each of which names the data displayed just below it (on the data field line),
- six data field lines that display computed data or data inserted by the pilot
- The scratchpad line which displays :
  - specific messages
  - information the pilot has entered by means of the number and letter keys and which he can then move to one of the data fields.

## LINE SELECT KEYS

There is a column of keys on each side of the screen. The pilot uses these to:

- Move a parameter he has entered in the scratchpad to the appropriate line on the main screen.
- Call up a specific function page indicated by a prompt displayed on the adjacent line.
- Call up lateral or vertical revision pages from the flight plan page.

## KEYBOARD

The keyboard includes :

- Function and Page keys      Call up functions and pages the pilot uses for flight management functions and computations.
- ↑ ↓ (or SLEW) keys      Move a page up or down to display portions that are off the screen.
- ← → key      Moves to the next page of a multi-page element. An arrow in the top right corner indicates that another page is available.
- AIRPORT key      Calls up the flight plan page that contains the next airport along the current flight plan. Successive pushes on the key show the alternate airport, the origin airport (before takeoff), and the next airport again.
- Number and letter keys allow the pilot to insert data in the scratchpad so that he can use a key to enter it in the main display.
- Three keys have special functions :
  - CLR (clear) key      Erases material (messages or inserted data) from the scratchpad or from certain areas of displayed pages.
  - OVFY (overfly) key      Allows the aircraft to overfly a selected waypoint.
  - SP (space) key      Allows to insert a space in specific messages.

## ANNUNCIATORS (on the side of the keyboard)

- |  |   |
|--|---|
| <b>FAIL</b> (amber)<br><b>MCDU MENU</b> (white)<br><b>R FM</b> (white) | Indicates that the Multipurpose Control and Display Unit (MCDU) has failed.<br>Indicates that the pilot should call up a peripheral linked to the MCDU (such as ACARS or CMS).<br>Comes on while the crew is using the MCDU to display peripherals. |
|--|---|

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**ANNUNCIATORS (on the top of the keyboard)**

FM 1 and FM 2 (amber) : the onside FM is failed

- Note : – The FM failure annunciator on MCDU 3 comes on only if MCDU 3 operates as a back up of MCDU 1 or 2  
– A MCDU has never both FM failure annunciators ON.

IND (amber) : The onside FM detects an independent mode of operation while both FM are healthy.

R RDY (green) : MCDU has passed its power up test after its BRT knob was turned to OFF.

**BRT KNOB**

Controls the light intensity of the entire MCDU.

- Note : In case of MCDU 1 or 2 failure, its brightness knob has to be switched off to allow the MCDU3 connection to the corresponding FMGC.

## DATA ENTRY

The pilot enters data by typing it into the scratchpad on the MCDU. Next, pressing the line select key will load the data from the scratchpad into the desired field. An error message displays if the data are out of range or not formatted correctly. To correct data, the pilot may clear the message with the clear (CLR) key and then retype the message into the scratchpad. Pressing the CLR key when the scratchpad is empty displays "CLR". To clear data from a field, line select CLR from the scratchpad to the data field to be cleared.

## MCDU ENTRY FORMAT

The pilot enters information into the MCDU at the bottom line of the scratchpad. When data has lead zeros, they may be omitted if desired. For example a three-digit wind direction of 060 may be typed as 60. The display will still show 060. To enter an altitude below 1000 feet, the lead zero must be added as 0400 for 400 feet. This differentiates the altitude from a flight level.

To enter a double data entry such a speed/altitude, the separating slash must be used. If entering only the first part of a double entry, omit the slash. To enter only the second part of a double entry, a leading slash must be used i.e./0400 feet.

## MESSAGES

The scratchpad displays various messages for pilot information. These messages are prioritized by importance to the pilot as either amber or white.

Amber messages are :

- Navigation messages
- Data entry message
- EFIS repeat messages

Amber messages are categorized into two types :

- Type 1 message that is a direct result of a pilot action. Type 1 messages are displayed immediately in the scratchpad ahead of other messages.
- Type 2 messages inform the pilot of a given situation or request a specific action. Stored in "last in", "first out" message queue that holds maximum of 5 messages.

Type 2 messages are displayed in the scratchpad only if there are no Type 1 messages or other data and will remain until all the messages have been viewed and cleared with the CLR key.

White messages are advisory only.

## CHARACTERS

Small and large fonts are displayed according to the following rules :

- The title line and the scratchpad are displayed in large font.
- Datafields are usually displayed in large font.
- Label lines are displayed in small font.
- Pilot entries and modifiable data are displayed in large font.
- Defaulted/computed and non modifiable data are displayed in small font.

## COLORS

DATA	MCDU COLOR
TITLES, COMMENTS <, >, ↑ ↓ ← → DASHES, MINOR MESSAGES	WHITE
MODIFIABLE DATA SELECTABLE DATA BRACKETS	BLUE
NON MODIFIABLE DATA ACTIVE DATA	GREEN
– MANDATORY DATA (BOXES) – PILOT ACTION REQUIRED – IMPORTANT MESSAGES – MISSED CONSTRAINT	AMBER
CONSTRAINTS MAX ALTITUDE	MAGENTA
PRIMARY F-PLN	GREEN WAYPOINTS, WHITE LEGS
TEMPORARY F-PLN	YELLOW WAYPOINTS, WHITE LEGS
SECONDARY F-PLN	WHITE WAYPOINTS AND LEGS
MISSED APPROACH (not active)	BLUE WAYPOINTS, WHITE LEGS
ALTERNATE F-PLN (not active)	BLUE WAYPOINTS, WHITE LEGS
OFFSET	GREEN WAYPOINTS, WHITE LEGS OFST IN THE TITLE OF F-PLN PAGE
TUNED NAVAID	BLUE
TO WAYPOINT AND DESTINATION	WHITE

## SCREEN PROMPTS

→ : UPPER RIGHT CORNER OF THE SCREEN  
INDICATES THAT NEXT PAGE IS AVAILABLE  
BY DEPRESSING THE → KEY.

□ □ □ : DATA ENTRY IS MANDATORY TO  
ALLOW THE FMGC TO PERFORM ALL  
ITS FUNCTIONS.

↑↓ : WHEN THESE ARROWS ARE BESIDE  
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

--- : THIS DATA WILL BE COMPUTED BY THE  
FMGC IF IT HAS ENOUGH INFORMATION,  
PROVIDED OUT OF THE DATA BASE,  
OR INSERTED BY THE CREW.

←→ : A TURN (LEFT← OR REGT→)  
IS SPECIFIED ON THE LEG WHICH  
STARTS AT THE WAYPOINT  
ADJACENT TO THE ARROW.

\* : INDICATES THAT A CONSTRAINT  
HAS BEEN INSERTED. DISPLAYED  
ONLY IF PREDICTIONS AVAILABLE.

D : DISPLAYED BESIDE A FIXED  
WAYPOINT ON THE F-PLN PAGE  
TO INDICATE THAT THE A/C  
MUST OVERFLY THE FIXED WAYPOINT

\* : INDICATES THAT PRESSING THE  
ADJACENT LS KEY WILL CHANGE  
PARAMETERS AFFECTING THE  
ACTIVE SITUATION

←→ : INDICATES THAT PRESSING  
THE ADJACENT LS KEY WILL  
ACTIVATE THE PROMPT OR  
SELECT SOME DATA

↑↓ : SCROLLING IS AVAILABLE BY PRESSING  
□ OR KEYS ON THE KEYBOARD.  
THE PAGE IS NOT LARGE ENOUGH TO  
DISPLAY THE WHOLE INFORMATION.

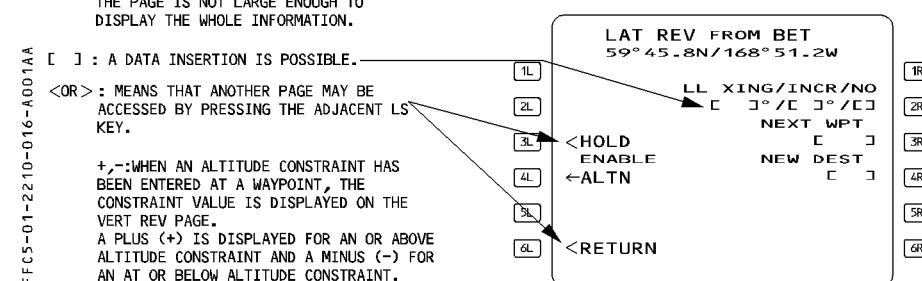
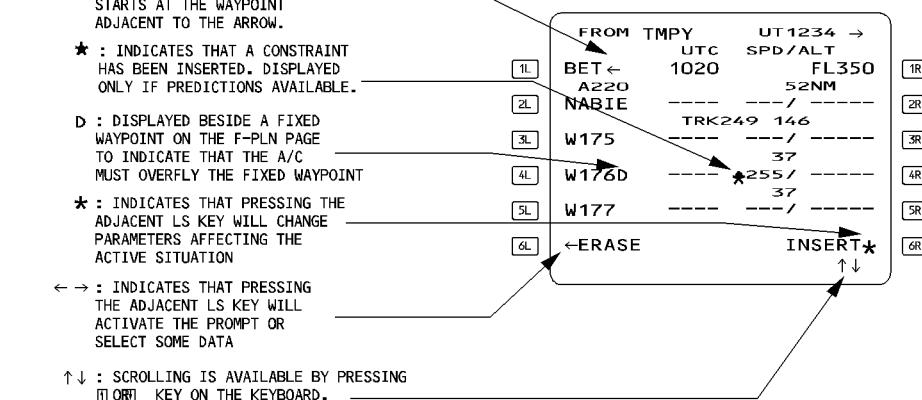
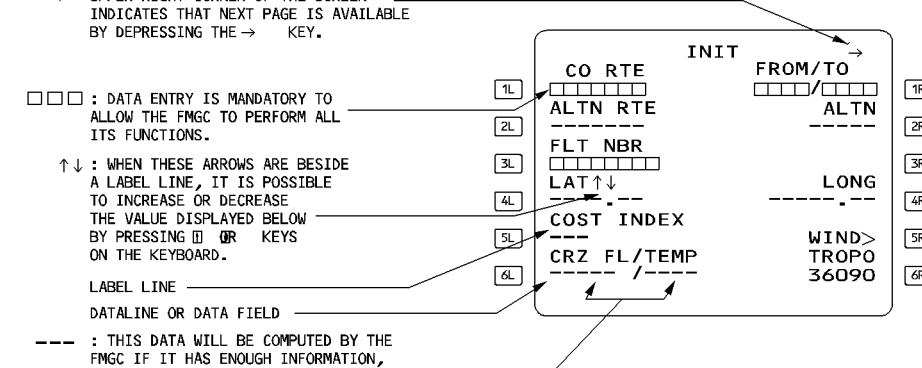
[ ] : A DATA INSERTION IS POSSIBLE.

<OR> : MEANS THAT ANOTHER PAGE MAY BE  
ACCESSED BY PRESSING THE ADJACENT LS  
KEY.

+,-:WHEN AN ALTITUDE CONSTRAINT HAS  
BEEN ENTERED AT A WAYPOINT, THE  
CONSTRAINT VALUE IS DISPLAYED ON THE  
VERT REV PAGE.  
A PLUS (+) IS DISPLAYED FOR AN OR ABOVE  
ALTITUDE CONSTRAINT AND A MINUS (-) FOR  
AN AT OR BELOW ALTITUDE CONSTRAINT.

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ARG ALL





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## MCDU FUNCTION KEYS

The function keys on the Multipurpose Control and Display Units allow the pilot to call up MCDU pages quickly.

The following is a summary of the purpose of each key. (Volume 4, FMGS Pilot's Guide provides a full description of the pages).

- |      |  |
|------|--|
| DIR  | Calls up the DIR TO page, and allows the pilot to proceed directly from present position to any waypoint entered manually or selected in the active flight plan.   |
| PROG | Calls up the progress page corresponding to the phase of the active flight plan that is in progress.<br>This page displays navigation information and active data such as the optimum and maximum recommended cruise flight levels. It allows the pilot to update the FMGS position and to get a bearing and distance to any location.   |
| PERF | Calls up the performance pages, which display the optimum speed or Mach number for each phase. The pilot can amend these pages. The first page to be displayed is the one corresponding to the current flight phase (except for preflight and done phases).<br>The pilot can then use the appropriate 6L or 6R key to call up pages corresponding to future flight phases.   |
| INIT | Calls up the flight plan initialization A page, which also gives the pilot access to the B page. The pilot uses the INIT pages to initialize Flight Management for the flight.<br>The pilot uses the INIT A page primarily to insert his flight plan and to align the inertial reference system.<br>The pilot uses the INIT B page to insert aircraft weight, fuel on board, CG and various fuel requirements. The FMGS uses this data to compute predictions and fuel planning parameters.<br>The pilot has access to the INIT A page only in the preflight phase.<br>INIT B page (not accessible after engine start) is called up by pressing the "NEXT PAGE" key. |

DATA	Calls up the data index page. This gives the pilot access to various reference pages that show aircraft position, aircraft status, runways, waypoints, navaids, routes and data stored by the pilot.
F-PLN	<p>Calls up the flight plan A and B pages, which contain a leg-by-leg description of the active primary flight plan.</p> <p>The pilot can use the slewing keys to review the entire active flight plan. He can make all lateral and vertical revisions to the flight plan through these pages, using the left keys for lateral revision and the right keys for vertical revision.</p>
RAD NAV	Calls up the RADIO NAV page. This page displays the radio navaids tuned automatically or manually through the FMGC.
FUEL PRED	Calls up the fuel prediction page. Once the engines are started, this page displays the fuel predicted to be remaining at the destination and the alternate, as well as fuel management data.
SEC F-PLN	Calls up the index page for the secondary flight plan. The pilot can use this page to call up the secondary flight plan and all the functions related to it (copying, deleting, reviewing, activating, and the INIT and PERF pages).
MCDU MENU	<p>Calls up the MCDU MENU page, which displays the subsystems currently addressed via the MCDU. The key next to the name of a subsystem enables the crew to select that subsystem.</p> <p>When the MCDU MENU annunciator lights up, the pilot should press the MCDU MENU key. The menu will have [REQ] displayed next to the name of the subsystem that requires attention.</p>
AIRPORT	Calls up the flight plan page which includes the next airport along the current flight plan. The first push on AIRPORT key displays the destination. Successive pushes show the alternate, the origine, and the destination again.

### **MCDU PAGES**

(Refer to FCOM 4.30.20).

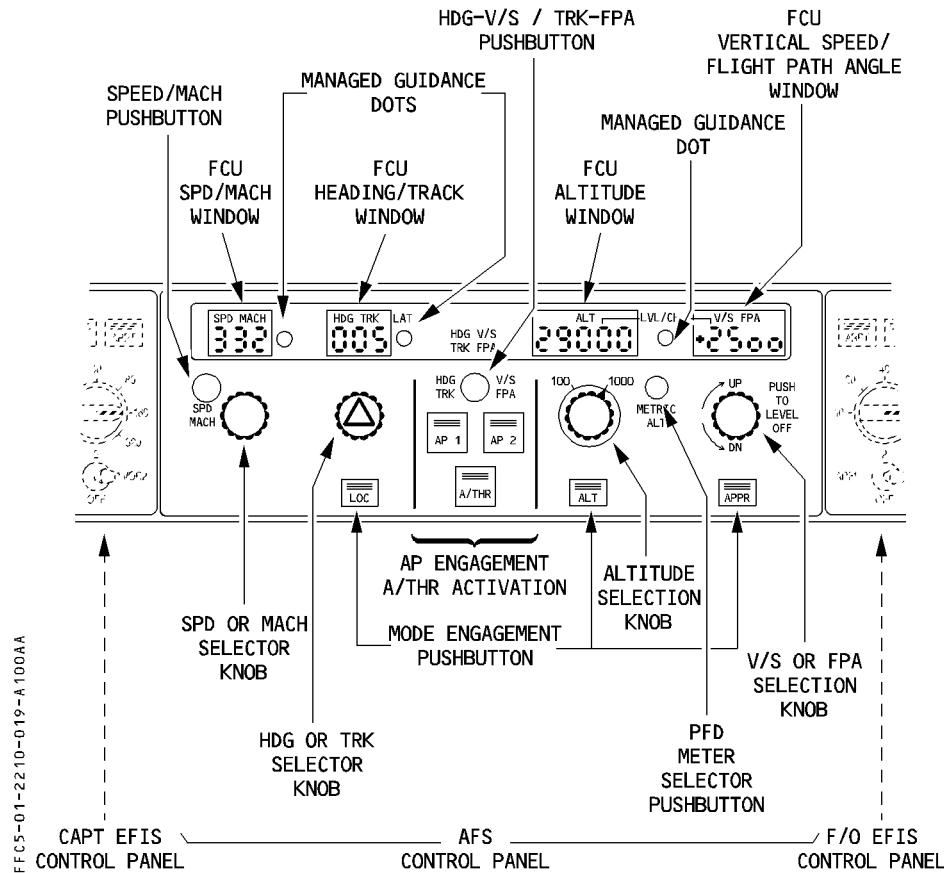
**FLIGHT CONTROL UNIT (FCU)**

The FCU, which is on the glareshield, actually consists of three control panels : One for the automatic flight controls, and two for the Electronic Flight Instrument System (EFIS).

For a description of the EFIS control panel, see Chapter 1.31.

The FCU has three channels, each of which can independently command the central panel. If one channel fails, the other channels can control all the functions.

R



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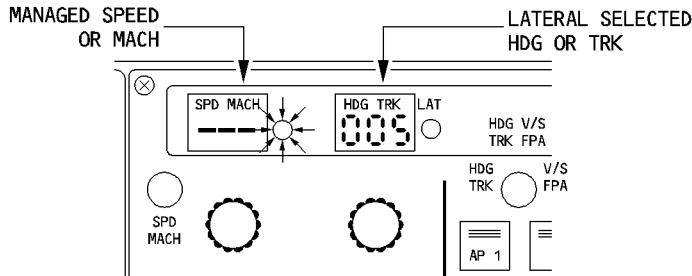
## FCU PHILOSOPHY

The pilot can use two types of guidance to control the aircraft in auto flight. One type is managed by the Flight Management Guidance System (FMGS). The other uses target quantities which are manually entered by the pilot.

When the aircraft uses target quantities from the FMGS (managed guidance), the FCU windows display dashes and the white dots next to those windows light up.

When the aircraft uses target quantities, entered by the pilot (selected guidance), the windows display the selected numbers and the white dots do not light up.

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Note : The altitude window always displays an altitude selected by the pilot (never dashes).

The FCU has four selector knobs :

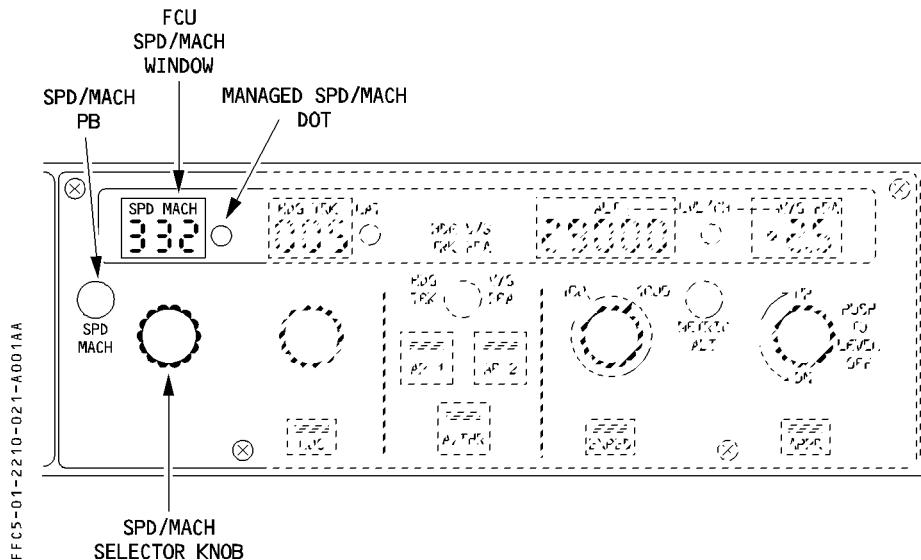
- SPD-MACH
- HDG-TRK
- ALT
- V/S-FPA

The selector knobs can be rotated, pushed in, and pulled out.

R · In order to arm or engage managed guidance for a given mode, the pilot presses the associated selector knob. If, for example, he presses the HDG selector knob, he engages or arms the NAV mode.

R · In order to engage a selected guidance mode, the pilot turns the selector knob to set the desired value, then pulls the knob out to engage the mode with a target value equal to the selected value.

R Note : In managed guidance (lateral, vertical guidance or managed speed), the corresponding window is dashed. Turning a selector knob without pulling it displays a value that is the sum of the current target and the turn action value. The display remains 45 seconds before dashes reappear. This rule does not apply to the ALT selector knob/window.

**SPEED/MACH CONTROL AREA**

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**· SPD/MACH selector knob**

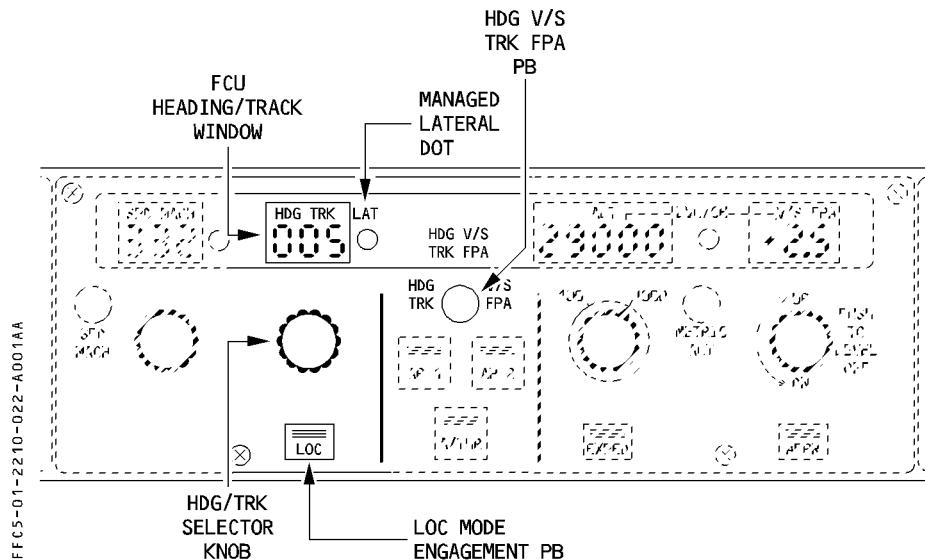
Display range : between 100 and 399 knots for speed, between 0.10 and 0.99 for Mach number.

One rotation of the knob corresponds to approximately 30 knots or 0.3 Mach.

**· SPD/MACH pushbutton**

Pushing this pushbutton changes the SPD target to the corresponding MACH target and vice versa.

## LATERAL CONTROL AREA

**· HDG/TRK selector knob**

Display range : between 0° and 359°.

One rotation of the knob corresponds to 30° (1° per click).

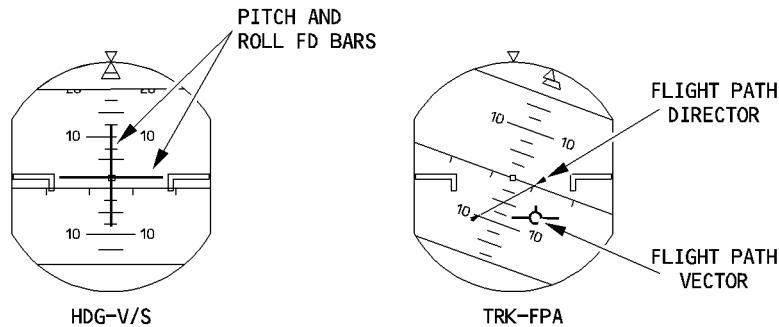
**· LOC pushbutton**

Pushing this pushbutton arms, engages, or disengages the LOC mode.

**· HDG V / S - TRK FPA pushbutton**

The pilot uses this pushbutton to select HDG (associated with V/S) or TRK (associated with FPA). Pushing it :

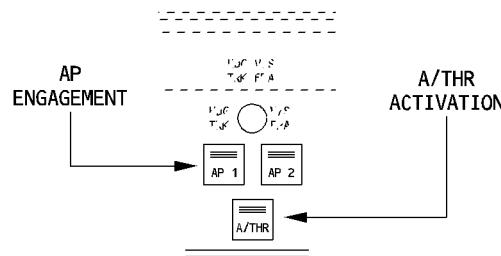
- Displays the Flight Path Vector (FPV) on the Primary Flight Display (PFD) or deletes it.
- On the PFD, changes the FD crossbar display (with the aircraft attitude as its reference) to the aircraft Flight Path Director (with the flight path vector as its reference) and vice versa.
- Changes heading reference into track reference in the HDG/TRK window and vice versa.
- Changes vertical speed reference target into flight path angle reference target in the V/S-FPA window and vice versa.



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## AP-A/THR CONTROL AREA

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**· AP1 AP2 pushbuttons**

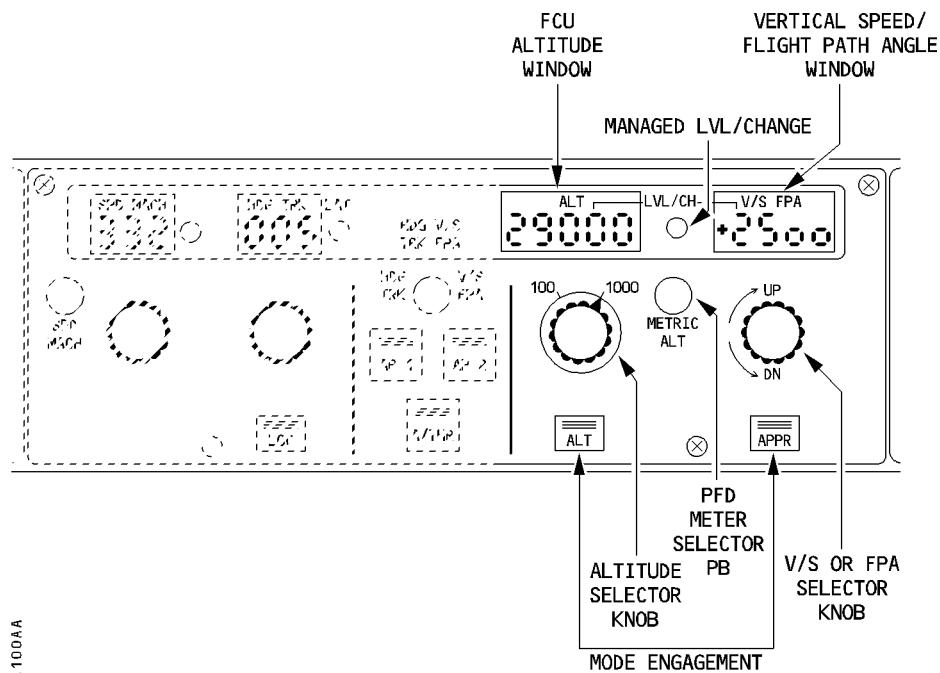
The pilot uses these pushbuttons to engage or disengage the autopilots. The buttons illuminate green when the autopilot is engaged.

**· A/THR pushbutton**

The pilot uses this pushbutton to arm, activate, or disconnect the autothrust (A/THR). This button illuminates green if the A/THR is armed or active.

**VERTICAL CONTROL AREA**

R



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**VERTICAL CONTROL AREA (CONT'D)**

The FCU altitude window always displays a target value selected by the pilot. It never displays dashes.

**· Altitude selector knob (inner and outer)**

Display range : 100 to 49000 feet

- The outer knob has two positions : 100 and 1000.
- The inner knob sets the altitude in the FCU windows, in increments of 100 or 1000 feet, depending upon the position of the outer knob.

**· ALT pushbutton**

The pilot uses this pushbutton to command an immediate level-off.

**· METRIC ALT pushbutton**

R The pilot uses this pushbutton to display the target altitude (either the FCU-selected altitude, or the FM altitude constraint) and the current altitude in meters on the PFD.

**· V/S or FPA selector knob**

Range (V/S) : – 6000 to + 6000 feet/minute

2 clicks = 100 feet/minute

If the pilot turns the knob slowly, each click equals 100 feet/minute

Range (FPA) : – 9.9° to + 9.9°

1 click = 0.1°

The pilot turns this knob to set the value of vertical speed (V/S) or flight path angle (FPA) to be displayed in the V/S or FPA window. (He chooses which, V/S or FPA, is to be displayed by pushing the HDG V/S or TRK FPA pushbutton.

One rotation of the knob corresponds to 32 clicks. One complete rotation sets :

FPA = 3.2°

V/S = 1600 feet/minute

When the pilot pushes in the V/S or FPA knob the system commands an immediate level-off by engaging the V/S or FPA mode with a target of zero. The flight mode annunciator (FMA) then displays "V/S = 0" in green when V/S or FPA is nulled. If the pilot now turns the knob to put in a new setting for V/S or FPA, the aircraft changes flight path accordingly.

**· APPR pushbutton**

This pushbutton arms, disarms, engages, or disengages the approach modes :

LOC and G/S modes if an ILS approach is selected in the active F-PLN.

APP NAV-FINAL modes, if a non precision approach is selected in the active F-PLN.



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**FLIGHT MANAGEMENT**

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**GENERAL**

The Flight Management part of the FMGC performs four main functions :

- Navigation
- Flight Planning (lateral and vertical)
- Prediction and optimization of performance
- Management of the displays (MCDU, ND, PFD)

**NAVIGATION**

Essential navigation functions are :

- Computation of position.
- Evaluation of position accuracy (also see FCOM Vol 4 for a detailed description of pilot's procedure).
- Radio navigation tuning.
- Alignment of Inertial Reference System.
- Polar navigation.

## **POSITION COMPUTATION**

Each FMGC computes its own aircraft position (called the "FM position") from a MIX IRS position (see below), and a computed radio position or GPS position.

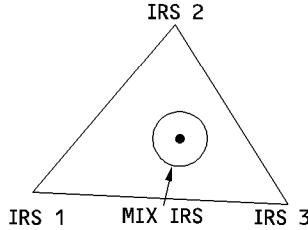
The FMGS selects the most accurate position, considering the estimated accuracy and integrity of each positioning equipment.

GPS/INERTIAL is the basic navigation mode, provided GPS data is valid and successfully tested. Otherwise, navaids plus inertial or inertial only are used. (Refer to Navigation modes).

### **MIX IRS POSITION**

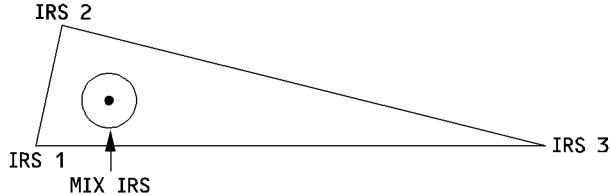
Each FMGC receives a position from each of the three IRSs, and computes a mean-weighted average called the "MIX IRS" position.

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- R — If one of the IRSs drifts abnormally, the MIX IRS position uses an algorithm that decreases the influence of the drifting IRS within the MIX IRS position.

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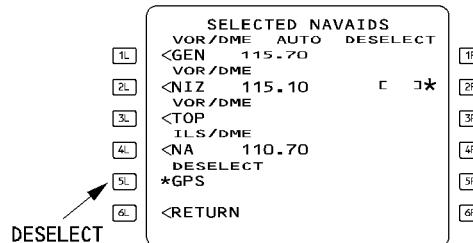


- If one of the IRSs fails, each FMGC uses only one IRS (onside IRS or IRS3). Each IRS position and inertial speed are continuously tested. If the test fails, the corresponding IRS is rejected.

**GPS POSITION**

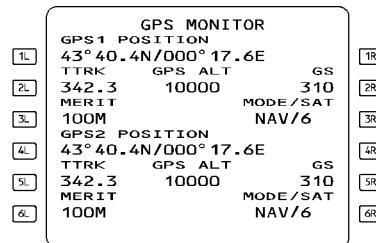
- R Each IRS computes an hybrid position that is a mix IRS/GPS position called GPIRS. Among these 3 GPIRS hybrid positions received by each FMGC, one is selected according to a figure of merit and a priority. The selection is performed using the following hierarchy :
- R – onside GPIRS position
  - R – GPIRS 3
  - R – opposite GPIRS position
- R If the GPIRS data do not comply with an integrity criteria, the GPS mode is rejected and radio position updating is used, "GPS PRIMARY LOST" message is displayed on ND and MCDU scratchpad.
- R During non ILS approach, the loss of the GPS primary function triggers a triple click aural warning.
- R When the GPS primary function is recovered, the "GPS PRIMARY" message comes up on ND and MCDU scratchpad. It means that GPIRS data comply again with the required integrity criteria.
- R As long as GPS primary is in use, all usual required navigation performance are met.
- R The crew can deselect/select the GPS on the SELECTED NAVAIDS page if necessary.

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- R Information concerning the GPS position is displayed on GPS MONITOR page.

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## RADIO POSITION

Each FMGC uses onside navaids to compute its own radio position. These navaids are displayed on the SELECTED NAVAIDS page. The navaids it can use are :

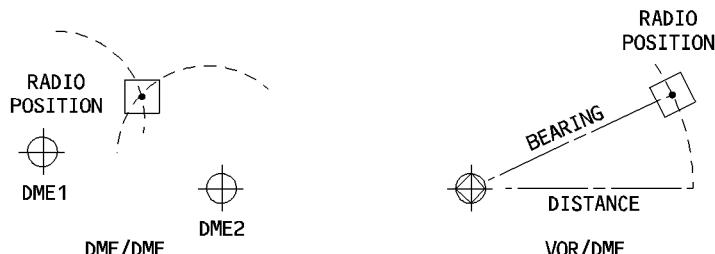
- DME/DME
- VOR/DME
- LOC
- DME/DME-LOC
- VOR/DME-LOC

It uses LOC to update the lateral position, using LOC beam during ILS approach.

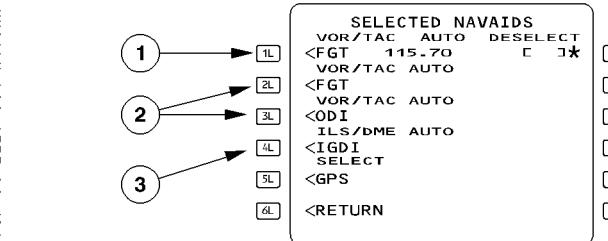
LOC is also used for quick update, when in GPS/IRS mode.

If one or more navaids fail, each FMGC can use offside navaids to compute the VOR/DME or DME/DME radio position.

The radio navaid selection is displayed on the DATA "SELECTED NAVAIDS" page.



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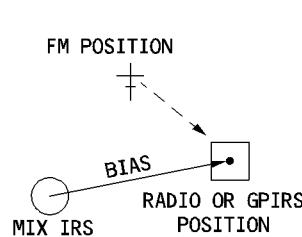


- ① VOR/DME selection (auto or manual) for display (onside VOR).
- ② DMEs automatic selection for DME/DME onside radio position.
- ③ ILS selection auto or manual for LOC update computation.

## FM POSITION

At flight initialization, each FMGC displays an FM position that is a mix IRS/GPS position (GPIRS).

- At takeoff, the FM position is updated to the runway threshold position, as stored in the database, possibly corrected by the takeoff shift entered on PERF TO page.
- In flight, the FM position approaches the radio position, or the GPS position, at a rate that depends upon the aircraft altitude.



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- R For each IRS, the FMGCs compare the FM position with the IRS position. When this difference exceeds a threshold (depending on the elapsed time since IRS alignment), the "CHECK IRS 1,2 or 3 FM position" message is displayed on the MCDUs. (Refer to FCOM 4.03.30).
- R When the FWC detects an abnormal IRS drift, the ECAM triggers the "NAV FM/IR POSITION DISAGREE" message (Refer to FCOM 3.02.34).

### Bias

Each FMGC computes a vector from its MIX IRS position to the radio or GPIRS position. This vector is called the "bias".

Each FMGC continuously updates its bias, if a radio position, or a GPIRS position is available.

If an FMGC loses its radio/GPIRS position, it memorizes the bias and uses it to compute the FM position, which equals the mix IRS position plus the bias.

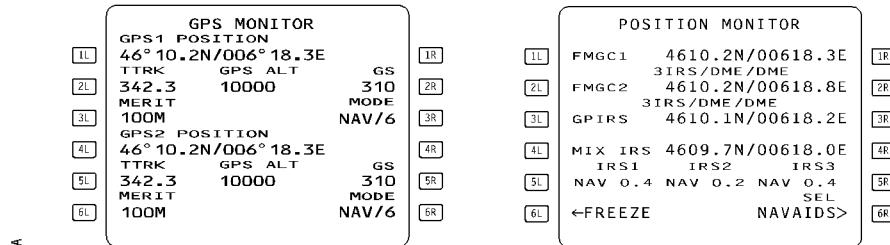
Until the radio or the GPIRS position is restored, the bias does not change.

The crew can manually update the FM position. This also updates the bias.

## POSITION MONITOR

The crew may check the position computation using the "GPS MONITOR" or "POSITION MONITOR" page.

R



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- 1L FM POSITION (ONSIDE FMGC)
- 2L FM POSITION (OFFSIDE FMGC)
- 3L GPIRS OR RADIO POSITION (ONSIDE FMGC)  
WHICHEVER IS USED FOR POSITION UPDATING
- 4L MIX IRS POSITION (ONSIDE FMGC)

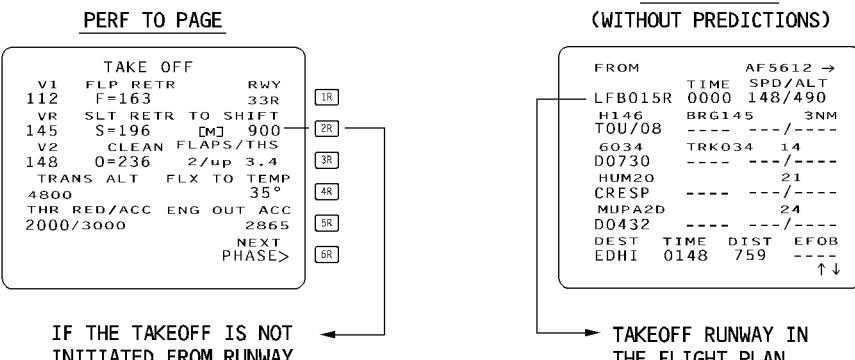
## TAKEOFF UPDATE

A takeoff update requires that the takeoff runway be part of the flight plan. This provides the most accurate position update.

If the takeoff run starts at an intersection, enter a takeoff shift on the PERF TO page to refine the takeoff update.

An accurate takeoff update ensures a precise aircraft position during departure.

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IF THE TAKEOFF IS NOT INITIATED FROM RUNWAY THRESHOLD, TO SHIFT SHOULD BE INSERTED TO UPDATE THE POSITION.

→ TAKEOFF RUNWAY IN THE FLIGHT PLAN.

## NAVIGATION MODES

The FMGS updates the FM position using radio navaids or GPS. It can use four main different FM navigation modes to make this update. The decreasing order of priority is :

- IRS-GPS
- IRS-DME/DME
- IRS-VOR/DME
- IRS only

During ILS approaches, the system performs a temporary lateral updating, using one of the following modes :

- IRS-GPS-LOC
- IRS-DME/DME-LOC
- IRS-VOR/DME-LOC
- IRS-LOC

## EVALUATION OF POSITION ACCURACY

The FMGS computes continually an Estimated Position Error (EPE).

It is an estimate of how much the FM position has drifted, and is a function of the navigation mode the system is using.

CURRENT NAV MODE	EPE (RATE or THRESHOLD)	REMARK
IRS/GPS (Radio position available)	Tends towards 0.28 NM	EPE decreases from initial value to 0.28 NM.
IRS/DME/DME	Tends towards 0.28 NM	EPE decreases from initial value to 0.28 NM.
IRS/VOR/DME	0.1 NM + 0.05 X DME DIST minimum : 0.28 NM	EPE increases or decreases as the distance between the a/c and the VOR/DME.
IRS ONLY	+ 2.45 NM/1st hour + 1.4 NM/h after (3.5 NM and 2 NM if only one IRS is used)	EPE increases continuously

On takeoff and following an IRS alignment, the EPE is set to 0.4 NM.

In IRS/GPS mode, the EPE is function of the radio position availability :

- If a radio position is available, the EPE is the radio position EPE.
- If no radio position is available, the EPE is the IRS ONLY EPE and increases continuously.

The system displays the EPE to the flight crew, and compares it with the Required Navigation Performance (RNP).

- If the EPE does not exceed the appropriate criteria, accuracy is HIGH.
  - If the EPE exceeds the appropriate criteria, accuracy is LOW.

The RNP is displayed on the PROG page. These figures are default value and can be modified by the flight crew.

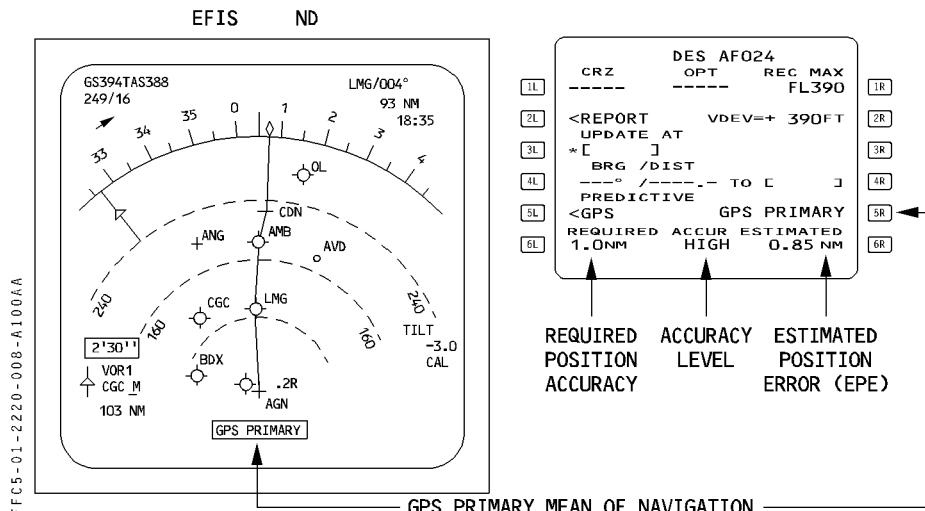
When the message "SYSTEM RNP IS XX.XX" is displayed, the flight crew should check the manually-entered RNP value in the REQUIRED field of the PROG page, and clear or modify it, if necessary.

The RNP value shall be in accordance with the specified RNP values of the navigation/approach charts (if a RNP is specified).

This message is also displayed upon a flight area change, if the new required criteria (default value) is smaller than the displayed manually-entered value.

POSITION ACCURACY CRITERIA defined by airworthiness authorities	
FLIGHT AREA	REQUIRED NAVIGATION PERFORMANCE (RNP)
EN ROUTE	3.41 NM
TERMINAL	2.07 NM
APPROACH	VOR/DME 0.61 NM OTHER CASES 0.36 NM

When the position computation uses IRS/GPS mode, the EPE is always smaller than any airworthiness required value. As a result, accuracy is HIGH and GPS is the primary mean of navigation. "GPS PRIMARY" is displayed on PROG page and temporarily on ND.



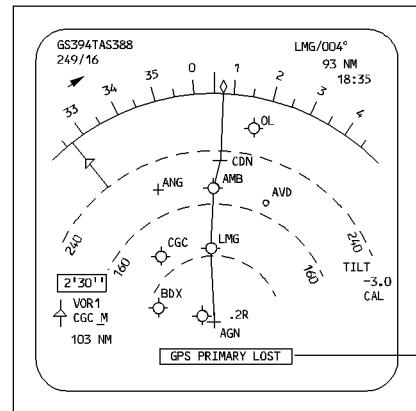
When the GPS function is lost, a "GPS PRIMARY LOST" message is displayed on the ND and the MCDU scratchpads. The MCDU message can be cleared, the ND message cannot. During a non ILS approach, a triple click aural warning is also triggered.

When the GPS is lost, NAV accuracy does not immediately downgrade, but only when the EPE exceeds the required criteria.

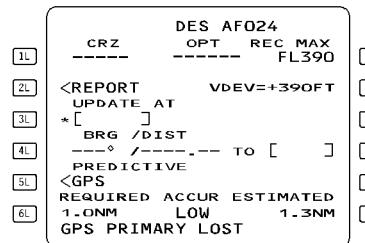
R

EFIS

ND



MCDU PROG PAGE



ACCURACY LEVEL INFORMATION

message appears on ND  
and any MCDU page

FFC5-01-2220-009-A200AA

**CAUTION**

"HIGH" or "LOW" indicates FM position accuracy, based upon estimated drift. Therefore, the flight crew must periodically check position accuracy, when the GPS function is lost.

When the GPS is manually deselected, the "GPS IS DESELECTED" message is displayed on the MCDU, 80 NM before T/D, or at approach phase transition.

**FM/GPS POSITION DISAGREEMENT**

The lower ECAM displays the "NAV FM/GPS POS DISAGREE" amber caution, when the GPS PRIMARY function is active, and either of the FMGC positions deviates from the GPS positions 1 or 2 by more than :

- 0.5 minutes of latitude ;
- For longitude :
  - 0.5 minutes of longitude, when the aircraft latitude is between 0° and 45°
  - 0.7 minutes of longitude, when the aircraft latitude is between 45° and 60°
  - 1 minute of longitude, when the aircraft latitude is between 60° and 70°.

Above 70° of latitude, a longitude difference does not trigger the alarm.

The master caution light comes on, and the single chime sounds. This amber caution is inhibited during the takeoff phase.

## PREDICTIVE GPS PAGE

- R The predictive GPS page is only operative with the Honeywell ADIRS equipment. All fields are dashed with Litton ADIRS equipment.

The predictive GPS function predicts the availability of the GPS within  $\pm$  15 minutes of ETA at destination, or at any waypoint entered by the crew.

FFC5-01-22220-010-A100AA

PREDICTIVE GPS												
DEST	PRIMARY				ETA							
EDDF	-15	-10	-5	ETA	+5	+10	+15					
	Y	Y	Y	Y	Y	Y	Y					
WPT	ETA											
AGN	1330											
	-15	-10	-5	ETA	+5	+10	+15					
	Y	Y	N	N	N	N	N					
	DESELECTED SATELLITES											
6	21											
	[ ]											
	[1L]	[2L]	[3L]	[4L]	[5L]	[6L]	[7L]	[8L]	[9L]	[10L]	[11L]	[12L]
	[1R]	[2R]	[3R]	[4R]	[5R]	[6R]	[7R]	[8R]	[9R]	[10R]	[11R]	[12R]

Predictions are displayed on the predictive GPS page at time intervals of 5 minutes (+15 and -15 minutes of ETA).

To access this page, press the 5L key of the PROG page.

This page also enables the deselection of up to 4 satellites at a time.

## RADIO NAVIGATION TUNING

Radio navaids are tuned for two different purposes : display and computation.

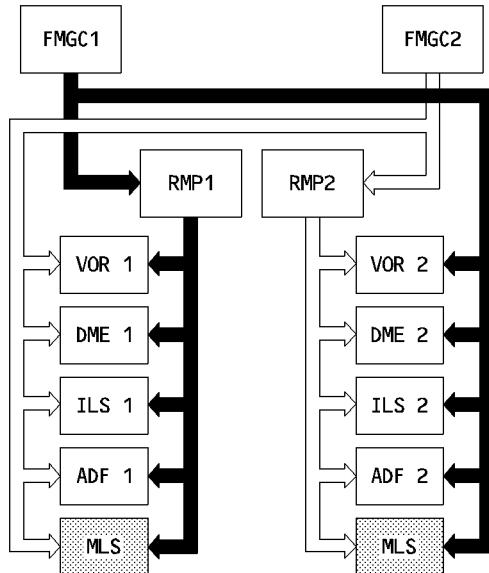
Tuning for display may be performed in three different ways :

- automatic tuning (FMGC software)
- manual tuning through the MCDU RAD NAV page
- manual tuning through the Radio Management Panel (RMP) if both FMGCs or both MCDUs fail.

The FMGS automatically tunes the radio navaids for the computation of radio position.

R *Note : The manual selection of a VOR or VOR/DME may prevent the FMGS from tuning a VOR/DME automatically to compute position. If so, the relevant MCDU will display "TUNE BBB FFF.FF" (BBB = ident, FFF.FF = frequency).*

## ARCHITECTURE



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- In dual mode and independent mode each FMGC tunes the navaids on its side of the console (one VOR, 5 DMEs, one ILS/MLS, and one ADF) simultaneously. In these modes, the pilot can also tune the VOR (and associated DME), ILS/MLS, and ADF manually.
- In single mode, the valid FMGC will tune both side navaids. The pilot can also use the RAD NAV page to tune both VORs, both ADFs and the ILS manually.

Manual tuning has priority over autotuning.

*Note : If one radio receiver fails, both FMGCs use the operative radio receiver to compute the aircraft position.*

## VOR

Each FMGC may tune one VOR only (manual or automatic).

Autotuning obeys the following priorities for tuning the VOR :

1. The navaid specified for the approach
2. The navaid to be used for computing present radio position
3. For displays purposes
  - A navaid specified for the active leg
  - The “to” waypoint (TO WPT) if it is a navaid
  - The “from” waypoint (FROM WPT) if it is a navaid
  - A waypoint farther along the flight path if it is a navaid
  - The navaid closest to the aircraft’s present position

The scratchpad displays “SPECIFIC VOR-D UNAVAIL” if the VOR or VOR/DME required for tuning has been deselected.

*Note : If the manual selection of a VOR does not match the VOR requested for autotuning the relevant MCDU will display : “TUNE BBB CRS XXX”  
 (BBB = ident of the requested VOR) ; (XXX = course of the requested VOR)*

## DME

Each FMGC automatically uses its five DMEs as follows :

- One DME for display. It may be manually tuned or autotuned.
- Two DMEs in DME/DME mode for calculating the aircraft’s radio position. The FMGC autotunes these as a function of their best accuracy. The flight crew receives no indication that this process is going on.
- One DME autotuned for radio position. This occurs in the VOR/DME mode whenever DME/DME is not available and the conditions for a VOR/DME update are met. In this case, the VOR/DME used for display is identical to the VOR/DME navaid used for the computation of radio position.
- One DME linked to ILS/DME.

## ADF

The FMGC autotunes one ADF in any area if the TO or FROM waypoint is an NDB, or in approach when the flight plan specifies an NDB approach and a fix in the approach is the “TO” waypoint. The scratchpad displays “SPECIFIC NDB UNAVAIL” if the NDB required for autotuning has been deselected.

## ILS/MLS (ILS)

Each FMGC autotunes one ILS frequency (and one MLS simultaneously  ) :

- In PREFLIGHT or TAKEOFF phase, when the takeoff runway has an associated ILS/MLS.
- In CLIMB-CRUISE-DESCENT, APPROACH, or GO AROUND phase, when the type of approach in the flight plan is ILS/MLS.
- when the direct distance to destination is less than 300 NM.

The scratchpad displays "RWY/LS MISMATCH", when the pilot has manually tuned the ILS, and the entered frequency disagrees with the LS or LOC IDENT/FREQ requested for autotuning.

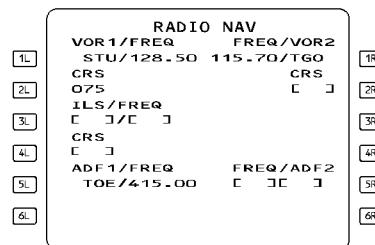
## SELECTION OF NAVAIDS ON MCDU PAGES

The MCDU displays the navaids tuned by the FMGC on two pages :

- The RADIO NAV page
- The SELECTED NAVAIDS page
- The RADIO NAV page

This page shows which navaids have been automatically or manually tuned for display.

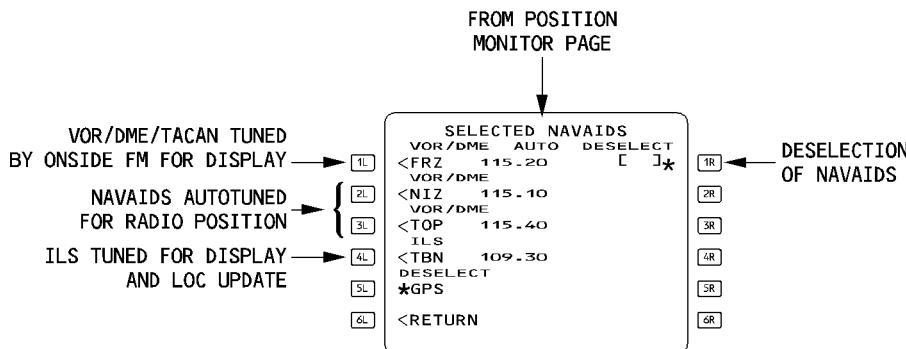
FFC5-01-2220-013-A100AA



- The SELECTED NAVAIDS page

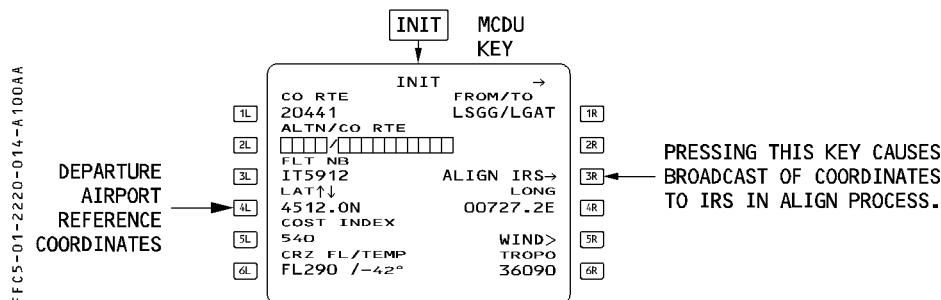
This page lists the navaids tuned by the onside FMGC. No navaids can be modified on this page (left keys). The pilot can deselect up to 6 unreliable navaids for the whole flight (using 1R key).

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## ALIGNMENT OF INERTIAL REFERENCE SYSTEM

The FMGS uses the reference point coordinates of the departure airport to align the IRS. It calls these up from the database automatically after the flight crew has entered a company route or an origin-destination city pair and pressed the ALIGN IRS key on the MCDU. The flight crew can adjust these coordinates manually to the gate position. A normal alignment takes ten minutes, a fast alignment 30 seconds. Fast alignment is used to refine a position when time is limited.



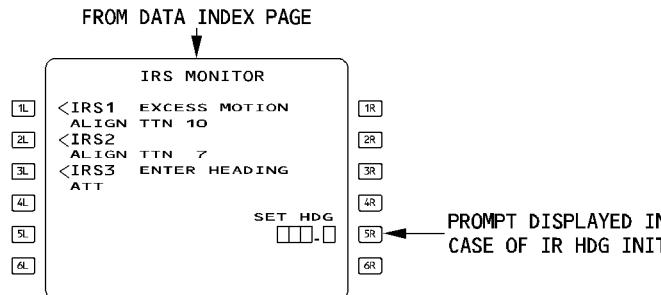
Note : If "IRS IN ALIGN" memo flashes, during the alignment process, it indicates one of the following :

- It has detected excessive motion. (It automatically restarts the alignment).
- It has detected a mismatch between the position the MCDU has sent to the IRS and the last memorized IRS position. The pilot must order the MCDU to send a new position to the IRS.
- It has detected a mismatch between the latitude the MCDU has sent to the IRS and the latitude the IRS has computed during the alignment.

**IR IN ATT MODE : HDG SET**

When one IRS at least is in ATT mode, the pilot must set and periodically update the heading to have an attitude information. The entry is performed on the MCDU IRS MONITOR page.

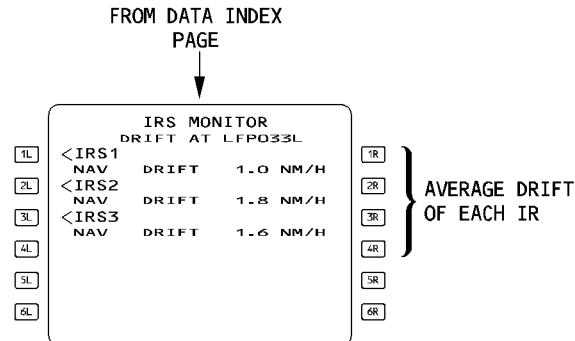
FFCS-01-22220-015-A001AA

**AVERAGE DRIFT COMPUTATION**

The FMGC computes an average drift on the ground at the end of the flight for each IR. This drift is then displayed on the IRS page.

The drift is the difference between the IR position at landing and the geographic landing position (destination runway threshold plus a shift of 400 m).

FFCS-01-22220-015-B001AA

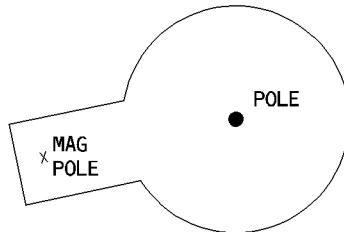


The FMGC then computes the time since last alignment.

## POLAR NAVIGATION

- R IRS are able to provide MAG HEADING between latitudes 82°30N and 60°30S, except in the vicinity of North magnetic pole.  
The FMGC computes the aircraft position within polar area even at North pole using the MIX IRS position.
- R *Note : The IRS may be aligned up to latitude 73N without any particular procedures.*
- R *Between 73N and 82N (North or South), the required alignment time is greater and a specific procedure has to be performed. Beyond 82° North or South, no ADIRS alignment is possible.*

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As a general rule the MCDU displays all parameters referenced to North according to the NORTH REF pushbutton switch position.

In order to provide most SAFE and FLEXIBLE operation, a MAG/TRUE NORTH REF pushbutton switch is available, with various messages provided on EFIS ND/MCDU and ECAM, indicating to the pilot what reference should be applicable in the flight area the aircraft is flying in.

**FLIGHT PLANNING**

For flight planning, the pilot inserts the following into the FMGS via the MCDU :

- 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.

**GENERAL**

The FMGS can contain two different flight plans :

- the ACTIVE flight plan, which is the basis for :
  - lateral and vertical guidance
  - MCDU and ND display
  - radio navigation autotuning
  - performance predictions
  - fuel planning
- the SECONDARY flight plan which the pilot may use :
  - to prepare and store a second departure procedure before takeoff
  - to plan a diversion
  - to prepare the next flight leg
  - 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

The pilot enters the flight plan in either of two ways :

- automatically by selecting a company route. Such a selection will call all the elements of the route out of the database.
- manually by selecting an ORIGIN/DEST pair, and then selecting all successive waypoints, procedures, and vertical constraints on the MCDU.

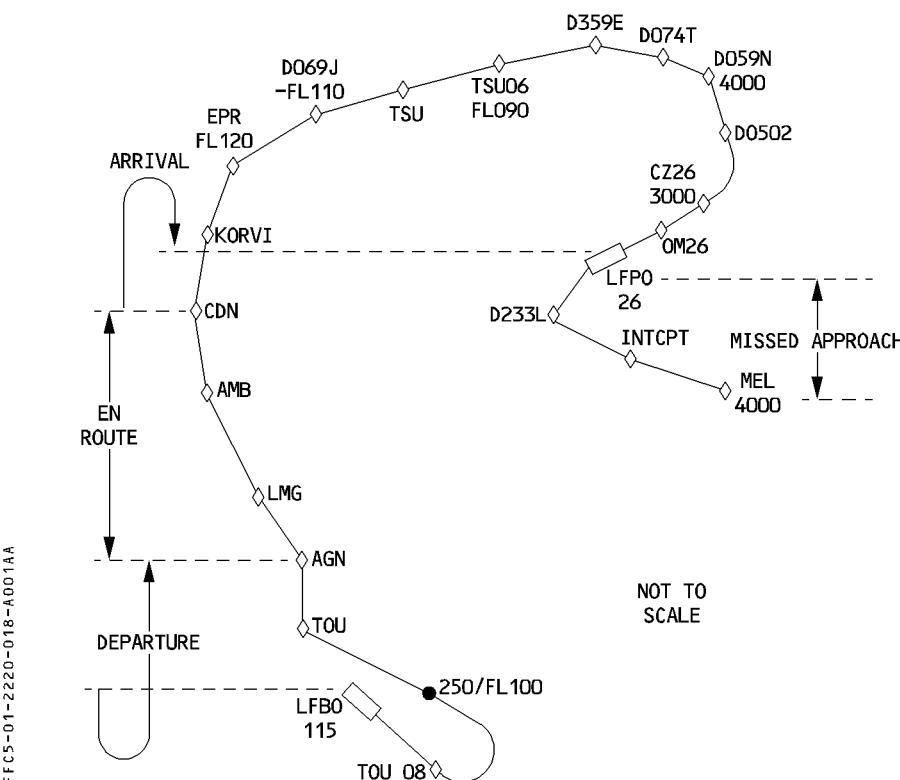
The pilot may then modify the flight plan on the ground or in flight, by making lateral and vertical revisions.

## LATERAL FLIGHT PLAN

The lateral flight plan includes the following elements :

- Departure
  - Takeoff runway
  - SID
  - En route transition
- En route
  - En route waypoints and airways
- Arrival
  - En route transition
  - STARs/VIAs
  - Landing runway with selected approach
  - Missed approach
- Alternate flight plan

These elements are defined by waypoints and legs between the waypoints.



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**FLIGHT MANAGEMENT**

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The FMGC strings the legs in sequence automatically.

The flight plan has a discontinuity if any two waypoints do not have a leg defined between them.

The computer assumes that the aircraft will fly a direct leg between the two waypoints that define the discontinuity.

Note : When the aircraft enters a flight plan discontinuity, the NAV mode automatically switches to the HDG (TRK) mode.

The FMGS automatically strings additional types of legs when departure or arrival procedures (SID-STAR-TRANS) are defined. Some of these legs are specific legs, such as:

- DME arc leg
- holding pattern to a fix or reverse turn
- course-to-fix leg
- heading leg
- MANUAL leg

The pilot cannot create these types of legs : they are part of the stored departure/arrival procedures he has selected.

The pilot can create only direct legs between manually defined geographic points (navaids, airports, waypoints).

Note : The departure and arrival procedures are defined in the database to minimize the amount of memory required. They are divided as follows :

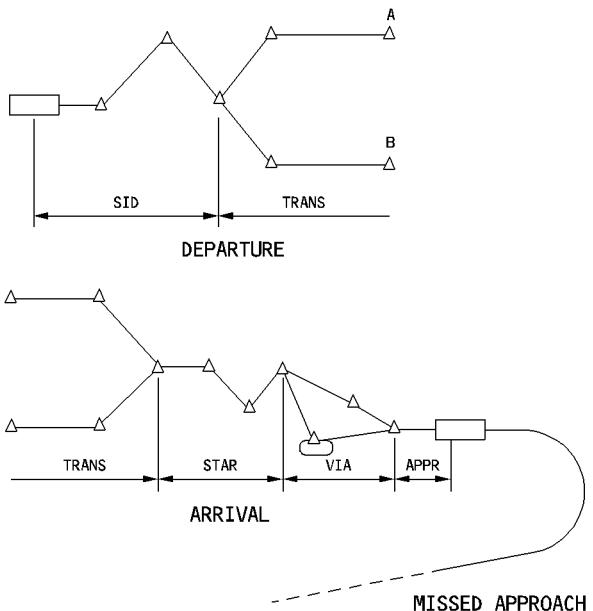
**DEPARTURE = SID + EN ROUTE TRANSITION**

**ARRIVAL = APPR VIA + STAR + EN ROUTE TRANSITION**

*The SID is the central common part of the departure procedure, as the STAR is of the arrival procedure. En route transitions (TRANS) are the various possible trajectories defined between the last point of the SID and the first en route waypoints and between the last en route waypoint and the first fix of the STAR.*

*"APPR VIAs" are the possible trajectories defined between the last point of the STAR and the first point of the approach.*

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## R MANUAL LEG

- R A MANUAL leg stays on a constant course, TRK or HDG and has no termination point. You R cannot insert it into a flight plan manually (except using the DIR TO RADIAL OUT function, R refer to 4.03.20) : it is part of a given procedure such as a SID or a STAR. When the aircraft R is flying a MANUAL leg, the NAV mode remains engaged and predictions assume that the R aircraft will fly a direct leg from its present position to the next waypoint (DIR TO). When R the aircraft is cleared to fly to the next waypoint of the flight plan, the pilot performs a DIR R TO.
- R Note : — In NAV mode a MANUAL leg is sequenced only by performing a DIR TO.  
R — The use of the descent mode (DES) on a MANUAL leg is not recommended.

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FROM		AF5612 →	
1L	ABC	UTC	SPD / ALT
		1014	235 / 2000
2L	SID1	BRG137	33NM
DEF122	1020	235 / 6000	
3L	SID1	TRK122	
MANUAL			
4L	---F-PLN DISCONTINUITY---		1R
5L	SID1	29	2R
JKL	-----	-----	3R
6L	DEST	UTC	SPD / ALT
	ARPT33R	1245	2000
			8.4
			↑↓

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## LATERAL REVISIONS

There are two types of lateral revisions :

- lateral revisions that have an immediate effect on the active flight plan
  - The pilot inserts, deletes, or changes an individual waypoint on the flight plan page.
  - The pilot creates a direct leg (DIR TO) from his present position to a selected waypoint.
- lateral revisions that lead to a temporary flight plan (TMPY) before they take effect. For these, you can select, delete, or modify waypoints that belong to an airway or to a procedure (SID, STAR, HOLD, TAKEOFF or LANDING RWY). This modification is made on specific "LAT REV" pages from the flight plan page.

Possible revisions are :

- Insert or modify departure procedure.
- Insert or modify arrival procedure.
- Insert a waypoint.
- Change the destination.
- Insert an airway.
- Insert an offset.
- Insert a holding pattern.
- Select or enable an alternate flight plan.
- Fix information

## TEMPORARY F-PLN

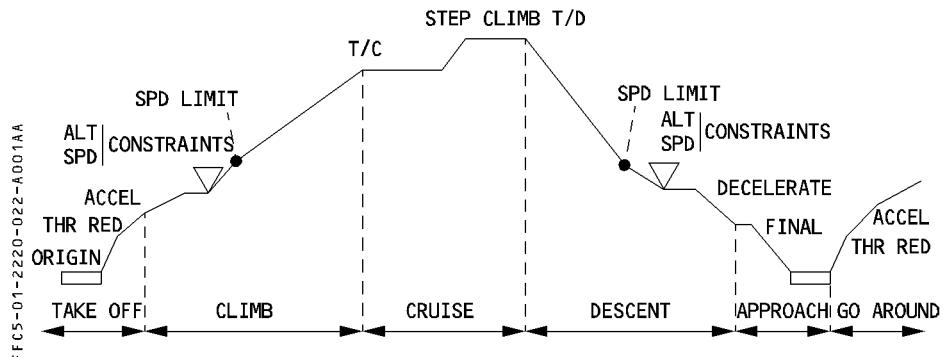
The purpose of the temporary flight plan is to allow the pilot to check a revision on the MCDU and EFIS ND before he inserts the changes into the active flight plan. It is a copy of the active flight plan that has been changed according to the pilot revision. While it is displayed the aircraft will continue 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.  
For details, Refer to 4.04.10 (TEMPORARY F-PLN).

## VERTICAL FLIGHT PLAN

The vertical flight plan is divided into the following flight phases.

Preflight - Takeoff - Climb - Cruise - Descent – Approach - Go Around - Done.

All but preflight and done are associated with speed and altitude profiles.



Each phase has an assigned profile of target speeds. For each phase the FMGS computes an optimum (ECON) speed as a function of the strategic parameters (CI, CRZ FL, ZFWCG, block FUEL, winds and temperature) and performance criteria.

ECON speed is the basis of the managed speed profile.

The ECON speed can be modified by presetting a speed or Mach number on the MCDU (PERF page) for the next phase, or by selecting on the FCU a speed or a Mach number for the active phase, or by inserting speed constraints or speed limits on the MCDU vertical revision (VERT REV) page.

The vertical flight plan includes vertical constraints (altitude, speed, time) that may be stored in the database or entered manually by the crew through vertical revision pages. The crew may also define step climbs or step descents for cruise purposes. If the crew plans to climb to a higher flight level or descend to a lower level, it can use a vertical revision at any waypoint to insert the new level.

When all the vertical data have been defined, the FMGC computes the vertical profile and the managed speed/Mach profile from takeoff to landing.

For details, refer to 4.03.20 (VERTICAL REVISIONS).

**PERFORMANCE**

The performance function includes optimization and predictions.

**OPTIMIZATION**

The FMGC minimizes cost by optimizing speed. The optimization function computes the following items :

- takeoff, approach, and go around speeds (F, S, Green Dot, VAPP)
- an optimum target speed for CLB and DES phases (ECON CLB/DES SPD)
- an optimum target Mach number for CRZ phase (CRZ MACH)
- an optimum FL, for information purposes
- an optimum descent profile from CRZ FL down to the destination airport.

These items depend on the data the pilot inserts during lateral and vertical flight planning and revision procedures.

Most are displayed on the PERF pages associated with the appropriate flight phases.

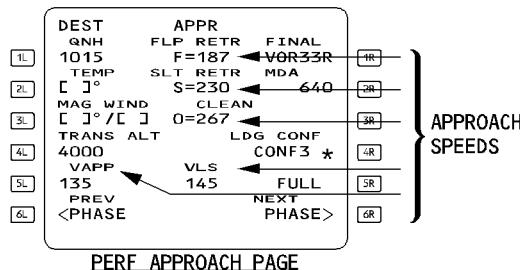
**Takeoff, approach and go around speeds**

The FMGC computes takeoff speeds (F, S, Green Dot) during the preflight and takeoff phases, using the performance model in the database and the takeoff weight.

The pilot has to insert V1, VR, and V2 in the PERF TO page manually.

The FMGC uses the performance model and either the predicted landing weight or the current gross weight at transition to the approach phase to compute approach speeds (VLS, VAPP, F, S, Green Dot). On the PERF APPR page, the selected LDG CONF determines the applicable VLS and VAPP, the latter being updated by the WIND correction that the pilot enters on the same page.

The FMGC uses the performance model and gross weight to compute go around speeds (F, S, Green Dot).



**Optimum target speed for CLB or DES phase**

The FMGC computes optimum speeds as functions of :

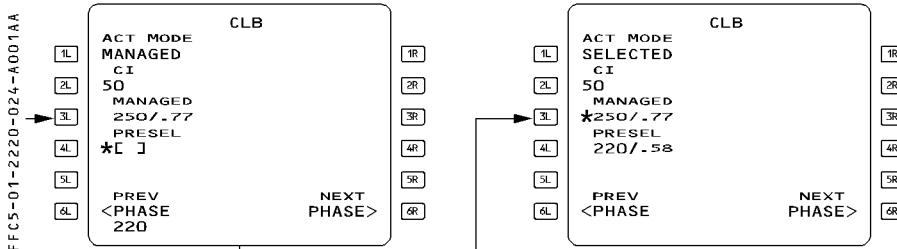
- the gross weight (GW)
- the cost index (CI)
- the cruise flight level (CRZ FL)
- the wind and temperature models
- the performance factor

When there is no time or speed constraint/limit, ECON SPEED is the optimum speed for the selected cost index. It refers to fuel and time cost and not directly to fuel saving.

- R FM calculates ECON CLB speed before the climb phase begins, and this speed cannot be changed during the climb phase itself.
- R ECON DES speed is used to compute the optimum descent profile and the associated top of descent (T/D).

**Preset target speed for CLB phase**

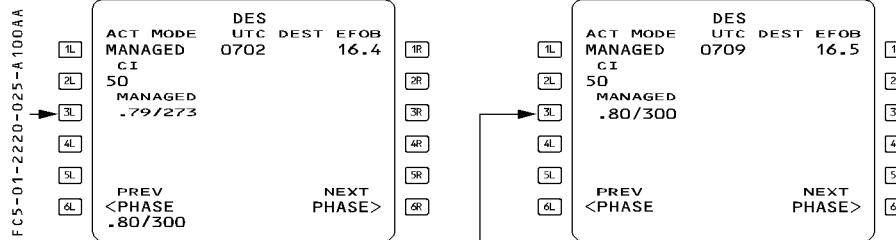
- R The pilot can preselect the climb speed as long as the CLB phase is not active, by inserting a speed in the PRESEL field :
- R



- R The active mode field changes from MANAGED to SELECTED, and the FM will use the entered speed for climb predictions computation. The pilot can revert to managed mode by pressing the 3L key.

**Preset target speed/Mach for DES phase**

- R The pilot can change the speed and/or Mach as long as the DES phase is not active by inserting a speed and/or Mach in the MANAGED field.
- R Although the entered speed is chosen by the pilot, the FMGS uses it to compute the descent profile and top of descent. It is therefore part of the managed descent profile.



The pilot can revert to the optimum speed/Mach by clearing the field 3L.

### Optimum target Mach number in cruise

The FM computes ECON CRZ MACH as the optimum speed and continuously updates it, taking into account :

- Current weather conditions
- Modifications to the flight plan.

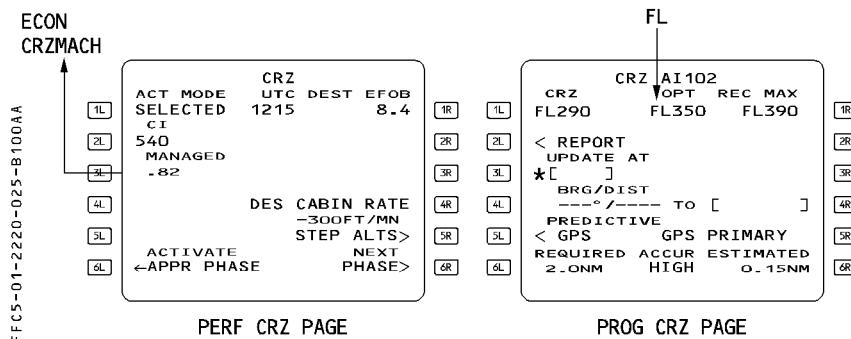
Note : Below FL 250 the FMGS calculates ECON CRZ SPD instead of ECON CRZ MACH.

### Optimum flight level in cruise

The optimum flight level is the flight level at which the aircraft incurs the lowest cost for a given flight plan, cost index, and gross weight (assuming a 15-minute minimum cruise flight level at that altitude). The FM updates it continuously during the cruise phase, and displays it on the PROG page. The PROG page displays dashes for this quantity :

- At least 15 NM before top of descent
- When the system detects an engine-out condition
- When DES phase is activated.

R



**COST INDEX (CI)**

CI is the ratio of flight time cost (CT) to fuel cost (CF).

CI = CT/CF      KG/MIN or 100 LB/H

The cost index is used to compute the best economic speed and Mach to be flown considering the ratio between the cost of the flight time and the cost of the fuel.

CI = 0      corresponds to minimum fuel consumption (max range)

CI = 999      corresponds to minimum time

For CI = LRC      refer to table volume 4 section 4.05.50.

It is recommended to modify the CI in flight :

- In case a fuel problem is encountered, CI = 0 may be selected ; the ECON SPD profile is then computed to ensure minimum fuel consumption.
- In case the aircraft is behind its schedule, CI = 999 may be selected. The ECON SPD profile is then computed to ensure minimum time.

**Optimum step point**

Only one optimum step point may be computed from the current cruise FL to a higher cruise FL. After insertion, the optimum step point is fixed and no longer updated.

The step altitude, time and fuel savings are provided before the insertion of an optimum step climb point on the STEP ALTS page.

**Optimum descent profile**

Refer to 4.02.30..

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FLIGHT MANAGEMENT

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## PREDICTIONS

The FMGC computes predictions for the primary flight plan and the secondary flight plan and displays them on the Multipurpose Control and Display Units (MCDUs) and on the Navigation Display (ND) of the Electronic Flight Instrument System (EFIS). The computations use the current state of the aircraft (GW, CG, position, altitude, speed, engaged mode of the autopilot or flight director, time, wind, temperature) for the active flight plan.

### PREDICTIONS FOR THE PRIMARY FLIGHT PLAN

The predictions displayed on the MCDU assume that the FMGS will guide the aircraft along the preplanned lateral and vertical flight plans. The predictions displayed on the ND assume that the aircraft will continue to operate in the modes (selected or managed) that are currently active.

As long as the aircraft is flying the flight plan under managed guidance, the predictions on the MCDU will match those on the ND.

- R If the pilot does not fly the flight plan, the MCDU predictions assume that :
  - R – The pilot will fly back toward the flight-planned route.
  - R – The pilot will immediately resume flying the FMGC-managed modes.
- R If the pilot does not fly the managed speed profile, the MCDU predictions assume that he will maintain the selected speed until he reaches :
  - R – In the climb or descent phase, the next speed limit or speed constraint if any, or next phase,
  - R – In cruise, the top of descent.
- R Then, the predictions assume that the pilot will revert to managed speed.

### UPDATE OF PREDICTIONS

The FMGCs recompute the predictions, whenever there is a modification to the :

- Lateral flight plan
- Vertical flight plan
- Forecast atmospheric conditions entered by the crew
- Cost index
- Speed control (managed/selected)

*Note : During recomputation, prediction fields on the MCDU pages display dashes.*

### WINDS USED FOR PREDICTIONS

See VERTICAL FUNCTIONS in the FMGS Pilot's Guide (04.04.20).

## EFIS ND PREDICTIONS

Refer to FLIGHT MANAGEMENT PRINCIPLES, 4.02.20.

## MCDU PREDICTIONS

Refer to FLIGHT MANAGEMENT PRINCIPLES, 4.02.20.

## OTHER COMPUTATIONS

### Engine-out case

The FMGS computes an engine-out target speed for each flight phase.

It computes an engine-out maximum altitude (EO MAX ALT) at long-range cruise speed, and displays it on the PROG page.

The new speed target becomes green dot in climb phase or EO CRZ SPD in level flight.

The system computes the flight plan predictions down to the primary destination assuming that the cruise phase is at the lower of CRZ FL or EO MAX ALT.

For the engine out obstacle strategy the system computes a drift down descent at green dot and down to a level off altitude.

### Fuel Planning

After the F-PLN, CRZ FL, CI, ZFW, ZFWCG insertion, the FMGC may compute on crew request the minimum fuel to meet the requirements of the flight taking into account a predetermined fuel policy (navigation database).

Fuel predictions are automatically performed after the F-PLN, CRZ FL, ZFW insertion. The FMGC has to know the FOB either inserted by the crew (BLOCK FUEL) or computed by the system.

### Equi-time point (ETP)

The ETP is a pseudo waypoint along the lateral flight plan at which the time to reach 2 reference waypoints is the same, taking distance and winds into account.

### Time Marker

This pseudo waypoint may be created for display on MCDU/ND.

### Recommended maximum altitude (REC MAX)

The recommended maximum altitude is the lowest of :

- maximum altitude the aircraft can reach with a 0.3 g buffet margin
- maximum altitude the aircraft can fly in level flight at MAX CRZ rating
- maximum altitude the aircraft can maintain a V/S of 300 feet/minute at MAX CLB thrust
- maximum altitude the aircraft can fly at a speed higher than Green Dot speed and lower than VMO/MMO
- maximum altitude the aircraft is certified (FL 410)

The REC MAX altitude is displayed on the PROG page.

A maximum altitude using a 0.2 g buffet margin is also computed. It is not displayed, but the system uses it to limit CRZ ALT entry.

**Predictions for alternates**

Predictions for alternates are displayed on the ALTERNATES page.

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ALTERNATES FOR LGAT					
		CO RTE			
1L	ALTN		1907		
2L	LGTS	TRK	EXTRA DIST		
3L	1987	325°	0.9	161	
4L	2AB3				
5L	←LGRP	113°	0.7	230	
6L	7113				
7L	←LGKR	298°	0.8	197	
8L	2828				
9L	←LGTR	305°	0.5	257	
10L	<RETURN				↑

They are based on :

- A default cruise FL equal to 220 if the airway distance is less than 200 NM, otherwise FL 310.
- Simplified wind/temperature models based on crew entries :
  - ALTN CRZ wind as entered in the primary DESCENT WIND page.
  - Wind/temperature at primary destination (APPR page).
  - A zero wind and/or zero ISA deviation is assumed by default if there is no crew entry.
- Initial aircraft weight equal to landing weight at primary destination.
- A track equal to mean track between active primary and alternative destination.
- A constant delta ISA and a constant cruise wind.
- Cost index = 0 (minimum fuel)

Note : – No step can be inserted in an alternate flight plan.

- No predictions are displayed for the selected alternate on flight plan pages, but the pilot can read ALTN trip fuel and time on the INIT B page before engine start, and estimated time and estimated fuel on board at alternate on the FUEL PRED page after engine start.

**Predictions for secondary flight plan**

Predictions are provided on the SEC F-PLN, SEC INIT and SEC PERF pages as for the active primary flight plan.

However the predictions are provided for the SEC F-PLN on the condition that the primary and secondary flight plan have their active leg common (same TO WPT).

**Predictions for fuel**

Up to eight fuel policy records may be specified in the navigation database.

If a specific data is not provided in the database fuel policy, the value is the default value given here after :

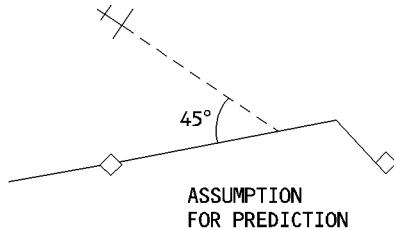
PARAMETERS	DEFAULT VALUES
RTE RSV (percentage of route reserve)	5 %
RSV MIN (minimum value of route reserve)	0 kg
RSV MAX (maximum value of route reserve)	25.600 kg
RSV FLT (reserve remains computed in flight)	yes
RSV ALTN (reserve is computed with alternate trip fuel)	no
FINAL TIME (time for final holding pattern)	30 min
FINAL FIX (Fuel burnt in the final holding pattern)	0 kg
FINAL ALT (altitude of the final holding pattern)	1 500 ft AGL
TAXI (fuel for taxi)	600 kg
FINAL DEST (final holding pattern is flown at ALTN)	ALTN

Furthermore RTE RSV, FINAL TIME and TAXI may be modified on the MCDU through the INIT B or FUEL PRED pages.

**RETURN-TO-TRAJECTORY ASSUMPTIONS**

If the aircraft is not on the lateral flight plan, the FMGC assumes (for prediction) that it will return immediately to the active lateral leg with a 45° convergence angle or that it will fly direct or the "TO" waypoint whenever the required convergence angle is greater than 45°.

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If the pilot flies outside the planned flight plan, predictions are still available, but they assume an immediate return to the flight plan.  
For other computations, (Refer to FCOM 4 .02.20).

## IDLE/PERF FACTORS

MCDU fuel predictions can be corrected to match the actual aircraft fuel consumption.  
This is done, on ground only, by modifying the IDLE/PERF factor.

### **IDLE FACTOR**

IDLE and PERF factors use the same principle.

The PERF factor is mainly used for prediction during cruise phase, the IDLE factor is dedicated to the FM descent segment.

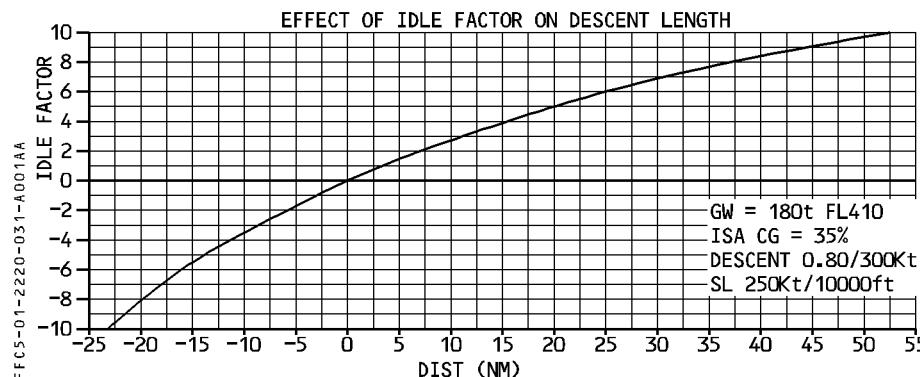
The aim of the IDLE factor is to adjust the FM descent predictions, in particular the position of the Top Of Descent (TOD), with the actual engine idle thrust used during descent.

A positive IDLE FACTOR gives an earlier top of descent (shallower path).

A negative IDLE FACTOR delays the top of descent (steeper path).

The following figure shows the IDLE FACTOR effect on the descent length.

R



## PERF FACTOR

The performance factor is a positive or negative percentage that is used to correct the predicted fuel flow, used for fuel prediction computation within the FMGS. It is necessary, when the actual aircraft performance differs from the performance model stored in the FMGS database, usually due to an increase in aircraft drag and engine performance deterioration.

This difference can be due to one, or both, of the following cases :

1. The FMS contains a performance database, used to compute the predictions and the performance data. Due to the numerous possible aircraft configurations, the same performance database is sometimes used for aircraft with slightly different behaviors. In these cases, a PERF factor is entered to correct the computations performed with a database not exactly tailored for the given configuration. As a result, the aircraft or engine type identification on the MCDU's A/C STATUS page may not correspond to that of the actual aircraft.
2. Since the actual aircraft drag and engine performance deviate from the nominal model, due to the aircraft's age, airline flight operations will periodically apply a correction factor to adapt fuel predictions to actual fuel consumption.

The PERF factor modifies the predicted fuel flow, according to the following formula :

$$FF_{pred} = FF_{model} \left( 1 + \frac{PERF\ FACT}{100} \right)$$

FF<sub>pred</sub> is the FF used for prediction.

FF<sub>model</sub> is the FF from the aero-engine model.

This correction is applied throughout the entire flight, and modifies performance predictions and the ECON speed or Mach. For example : Entering a PERF factor of + 1.5 means that Flight Operations have evaluated the aircraft fuel deviation as 1.5 %, compared to the basic performance model (0.0).

### Procedure for modifying the PERF factor :

On the aircraft status page :

- ENTER "ARM" in the CHG CODE line's [5L] brackets.
- WRITE the new IDLE/PERF factors.
- INSERT using the [6L] key.

A manually-entered IDLE/PERF factor is displayed in large blue fonts. Changing an IDLE/PERF factor is usually the responsibility of maintenance, or Flight Operations.

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**AUTO FLIGHT**

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**FLIGHT MANAGEMENT**

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**PERF Factor to be used on FMS 1 at delivery :**

A340-211 CFM56-5C2	: - 1.5 %
A340-212 CFM56-5C3	: - 3.0 %
A340-213 CFM56-5C4	: - 2.0 %
A340-311 CFM56-5C2	: - 1.5 %
A340-312 CFM56-5C3	: - 1.5 %
A340-313 CFM56-5C4	: - 0.5 %
A340-313E or A340-300B CFM56-5C4	: 0.0 %

All these numbers assume that : The aircraft is brand-new, anti-ice is off, the air conditioning is on NORMAL and the conservative Fuel Lower Heating Value (FLHV) is 18400 btu/lb.

When an aircraft ages, fuel consumption degradation will be measured to determine the so-called "monitored fuel factor". This factor corresponds to the deviation of the

- R aircraft's actual fuel consumption from the nominal model. Generally, the FLHV that is
- R used during fuel factor monitoring is higher than the FMS value. In order not to penalize
- R FMS predictions, it is necessary to correct the "monitored fuel factor". For example,
- R add - 1 % to the "monitored fuel factor", when an FLHV of 18590 btu/lb is used. Once
- R this factor is established by the airline, it should be arithmetically-added to the
- R above-noted performance factor.

## MANAGEMENT OF THE DISPLAYS

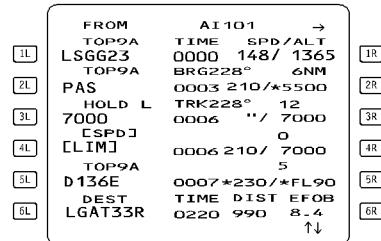
The flight management system displays navigation, performance and guidance information on :

- the Multipurpose Control and Display Unit (MCDUs)
- the Navigation Display (ND) of the Electronic Flight Instrument System (EFIS)
- the Primary Flight Display (PFD) of the EFIS.

### MCDU DISPLAY

The MCDUs display :

- Position and accuracy information
- Tuned navaids
- Lateral and vertical flight plans (waypoints, pseudo waypoints, constraints)
- Predictions (SPD, TIME, ALT, WIND)
- Fuel predictions and fuel management information (estimated fuel on board, extra fuel)
- Performance data.

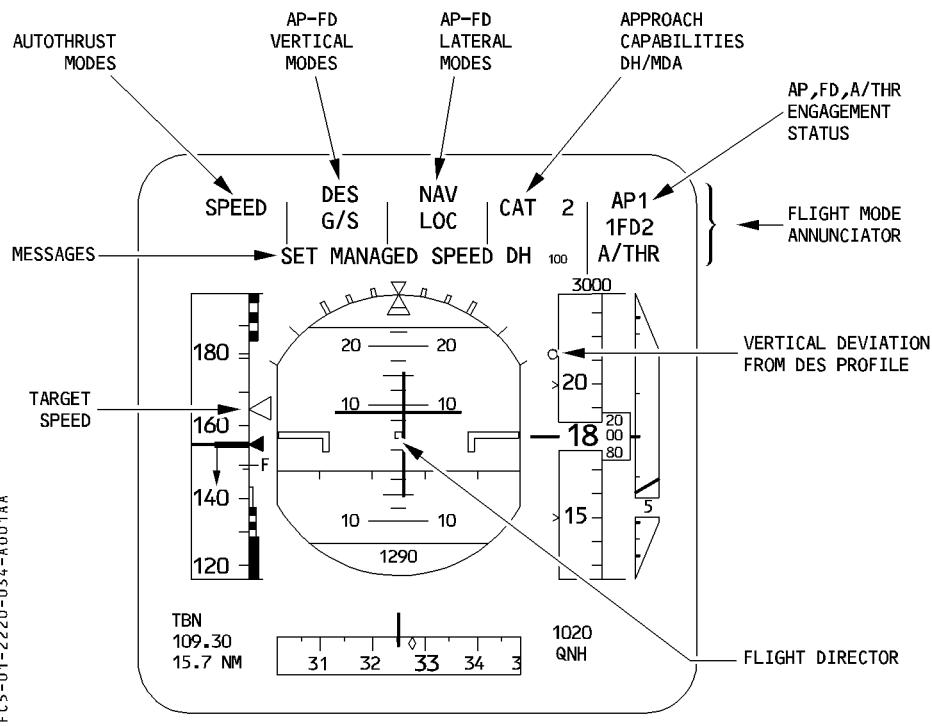


F-PLN page

**EFIS PRIMARY FLIGHT DISPLAY (PFD)**

The Flight Management generates the following information :

- Armed and engaged modes on the Flight Mode Annunciator (FMA)
- FMGS guidance targets (SPD, ALT, HDG)
- Vertical deviation from descent profile
- Messages
- Navigation information

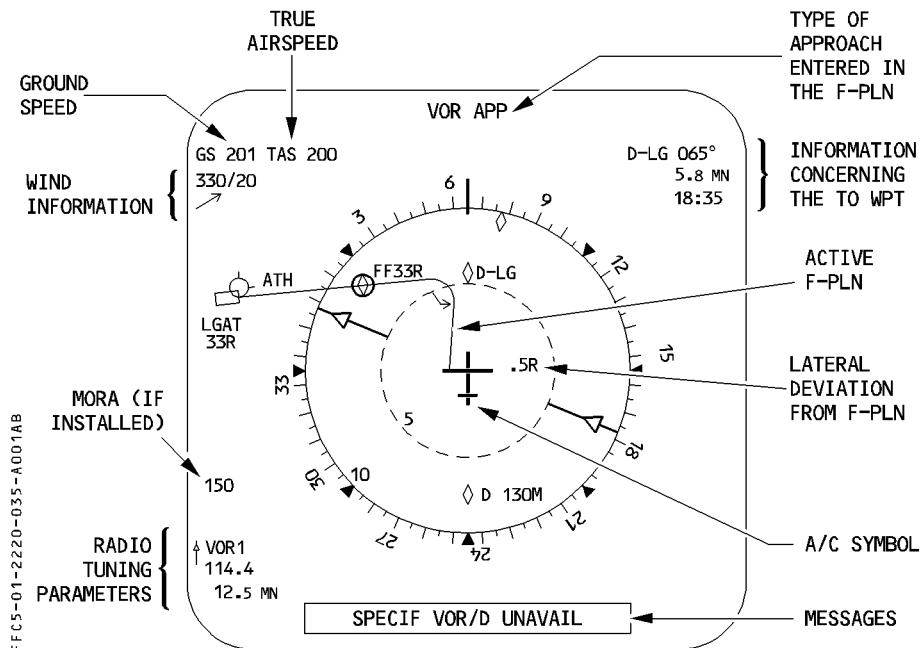


Note : For more details concerning EFIS PFD refer to 1-31 chapter.

**EFIS NAVIGATION DISPLAY (ND)**

Flight Management (FM) generates the following information :

- aircraft position
- flight plans (active, secondary, temporary, and dashed)
- lateral deviation from primary flight plan
- pseudo waypoints along the flight plan
- raw data from tuned navaids
- wind information
- various options, depending on what the pilot selects on the EFIS control panel : waypoints, navaids, NDBs, airports, constraints
- type of approach selected
- messages



Note : For more details concerning EFIS ND refer to 1-31-45.

**COLORS USED FOR DISPLAYING FLIGHT PLANS**

F-PLN	Color
Primary flight plan	steady green in managed, dashed green in selected
track line	steady green
alternate flight plan	dashed blue
missed approach	steady blue
offset flight plan	steady green (original flight plan dashed green)
temporary flight plan	dashed yellow
engine-out SID	steady yellow (not inserted)
secondary flight plan	dimmed white
abeam / radial	dashed blue

**GENERAL**

The guidance function is achieved by the Flight Guidance (FG) part of the FMGS which controls :

- the Flight Director (FD)
- the Auto Pilot (AP)
- the Auto Thrust (A/THR).

**GUIDANCE MODES**

Two types of autopilot and flight director modes are available to guide the aircraft :

- Managed modes, which steer the aircraft along the lateral, vertical, and speed profiles according to the data the pilot inserts into the MCDU. Flight Management (in the Flight Management and Guidance Computer) computes the corresponding guidance targets.
- Selected modes, which steer the aircraft according to target values that the pilot selects and the FCU windows display.

GUIDANCE	MANAGED modes	SELECTED modes
LATERAL	NAV, APP NAV B/C*, B/C, LOC*, LOC RWY RWY TRK GA TRK ROLL OUT	HDG – TRK
VERTICAL	SRS (T.O and G.A) CLB, DES ALT*, ALT ALT CSTR*, ALT CSTR G/S*, G/S FINAL, FLARE	OP CLB, OP DES V/S, FPA ALT*, ALT
SPEED	FMGC REFERENCE (ECON, Auto SPD, SPD LIM)	FCU REFERENCE

**MODE SELECTION****MANAGED MODES**

- At takeoff, the managed modes engage automatically when the pilot sets the thrust levers at the TO or FLX detent.
- During flight, the pilot can arm or engage the managed modes (if the aircraft meets engagement conditions) by pushing in the appropriate knobs on the Flight Control Unit (FCU).
- The pilot pushes the “DIR TO” key on the MCDU to insert a DIR TO leg. It engages or maintains the NAV mode.
- The pilot pushes the “APPR” pushbutton on the FCU to arm or engage the localizer and glide slope or “APP NAV-FINAL”, depending upon the approach type he had inserted in the flight plan.
- The “LOC” pushbutton arms or engages only the localizer mode.

## SELECTED MODES

The pilot can engage the selected modes by pulling out the appropriate FCU selection knobs.

### INTERACTION BETWEEN AP/FD AND A/THR MODES

The AP/FD pitch modes can control a target SPD/MACH or a vertical trajectory ; the A/THR modes can control a fixed thrust or a target SPD/MACH. AP/FD and A/THR cannot simultaneously control a target SPD/MACH. Consequently the AP/FD pitch modes and A/THR modes are integrated as follows :

- If an AP/FD pitch mode controls a vertical trajectory, the A/THR mode controls the target SPD/MACH.
  - If an AP/FD pitch mode controls a target speed or Mach, the A/THR mode controls the thrust.
  - If no AP/FD pitch mode is engaged, the A/THR mode reverts to SPD/MACH mode.
- In other words, the selection of a pitch mode determines the associated A/THR mode.

<b>AP/FD pitch modes</b>	<b>A/THR modes</b>
V/S – FPA DES (geometric path) ALT*, ALT G/S*, G/S FINAL	SPD/MACH MODE
AP/FD OFF	
OPEN CLB/OPEN DES CLB/DES (idle path) SRS	THR (CLB, IDLE) MODE
FLARE	RETARD (IDLE)

**FLIGHT DIRECTOR****GENERAL**

The Flight Director (FD) displays guidance commands from the Flight Management and Guidance Computer (FMGC) on the Primary Flight Display (PFD).

The pilot may fly the aircraft manually, following FMGC guidance commands, or crosscheck the FMGC orders when the autopilot is engaged.

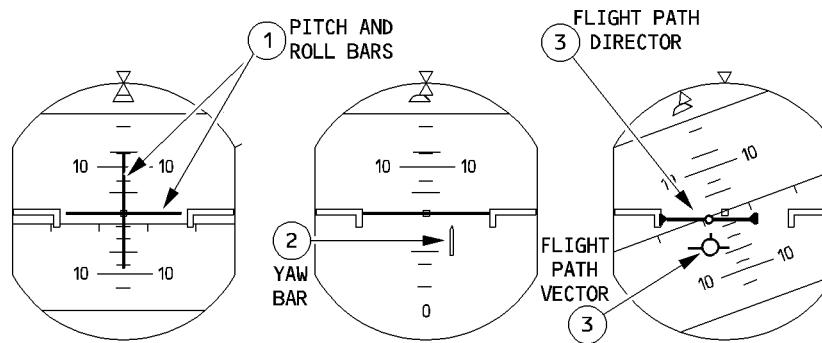
In normal operations, FD1 displays FMGC1 orders on PFD1 and FD2 displays FMGC2 orders on PFD2.

The FDs use their respective onside FMGCs.

On the PFD :

1. The FD pitch and roll crossbars show pitch and roll demands.
2. Below 30 feet during landing and takeoff, when a localizer is available, the vertical bar is replaced by a yaw bar that gives lateral orders.
3. The Flight Path Director (FPD) symbol relates to the Flight Path Vector (FPV).

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The HDG V/S – TRK FPA pushbutton on the FCU permits the pilot to select either type of reference and display.

The FD pushbutton on the Electronic Flight Instrument System (EFIS) control panel allows the FD bars to be displayed or removed.

**FD bars (HDG V/S selected on the FCU)**

- The pitch bar is displayed if a vertical mode is engaged. It gives pitch orders for the vertical guidance.
- The roll bar is displayed if a lateral mode is engaged. It gives roll orders for lateral guidance.

**Flight Path Director (TRK FPA selected on the FCU)**

The display is an alternate way of transmitting flight director commands.

- The Flight Path Vector (FPV) symbol illustrates the actual track and flight path angle being flown.
  - The Flight Path Director (FPD) symbol shows the pilot how to intercept and fly the vertical and lateral flight trajectory.
- When the pilot superimposes the FPV and the FPD symbols, the aircraft flies the commanded trajectory.

**FLIGHT DIRECTOR (FD) ENGAGEMENT**

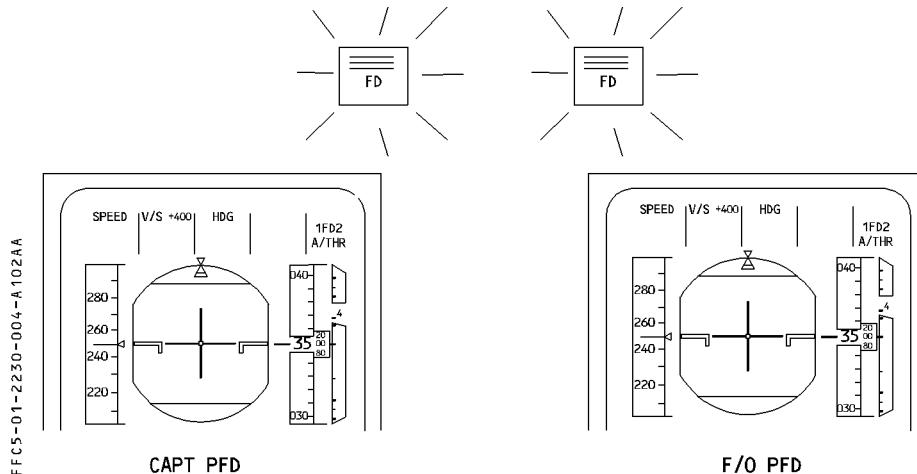
The FDs are automatically engaged whenever the FMGC powers up.

**GROUND ENGAGEMENT**

- The “1 FD2” symbol appears on both PFDs.
- No FD bars appear on the PFDs. The PFD displays FD orders when a mode is active on the corresponding axis.
- The FCU windows display dashes.

**MANUAL FLIGHT ENGAGEMENT**

- R Provided AP/FD is off (no lateral or vertical mode displayed on FMA), the two FDs engage in the HDG V/S or TRK FPA modes (basic modes) when FD pushbuttons are pressed.

**AUTOMATIC FLIGHT ENGAGEMENT**

FD bars are automatically restored in SRS/GA TRK modes at go-around engagement. If FPV/FPD was previously selected, it reverts to FD bars.

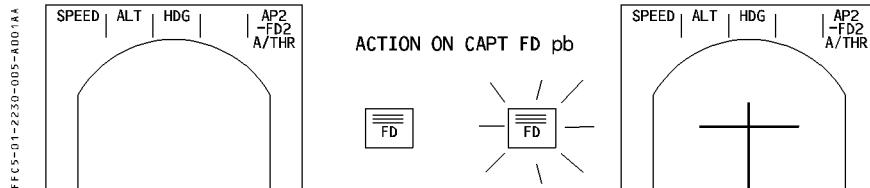
## FLIGHT DIRECTOR (FD) DISENGAGEMENT

The flight crew may disengage one or two FDs manually, or FDs may disengage automatically if there is a failure.

### **MANUAL FLIGHT DIRECTOR DISENGAGEMENT**

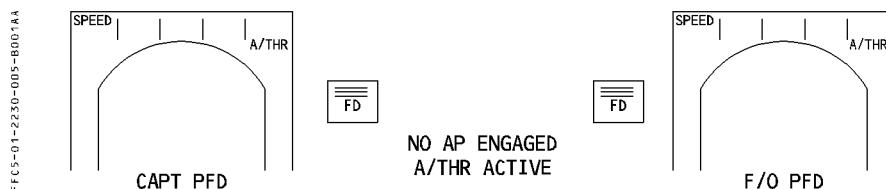
#### **One FD off :**

- The FD bars no longer appear on the associated PFD.
- The corresponding FD is disengaged.



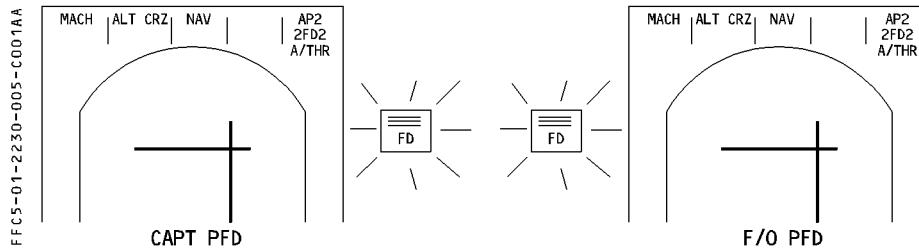
#### **Both FDs off:**

- The FD bars disappear from both PFDs.
- If no AP was engaged, lateral and vertical modes disengage. The A/THR, if active, automatically reverts to (or remains in) SPEED/MACH mode.
- If one AP was engaged when FDs are switched OFF, this AP remains engaged in the active modes but the FDs are no longer displayed.



### **AUTOMATIC FLIGHT DIRECTOR DISENGAGEMENT**

If one FD fails or one FMGC is not valid, both PFDs display the remaining FD.



## **AUTOMATIC DISENGAGEMENT DUE TO SPEED PROTECTION**

When APs are not engaged and if you do not fly the FD bars, an automatic disengagement of FDs and corresponding FMA modes will occur if the aircraft speed reaches VMAX in climb with CLB or OP CLB mode engaged or if the aircraft speed decreases to VLS in descent with DES, OP DES mode engaged.

Refer to Automatic speed protection in this chapter.

### **AUTOMATIC FD REMOVAL**

- The FD pitch bar is removed when no vertical mode is engaged or when ROLL OUT is engaged.
- The roll FD bar is removed when no lateral mode is engaged or when the RWY or ROLL OUT mode is engaged.
- Both FDs are removed when the aircraft pitch exceeds 25° up or 13° down, or bank angle exceeds 45°.

Note : If from AP/FDs off, FD2 then FD1, are engaged within 150 milliseconds (one computation cycle), a flip flop of master FMGC may occur.

As a result, no vertical mode engages and dashes are displayed on FMA 1st column, 1st line (A/THR mode).

Engaging V/S mode manually reselects the correct FMGC and restores the display.

### **FD WARNINGS**

<b>FD WARNINGS</b>	<b>CONDITIONS</b>
Pitch FD bar (or FPV) flashes 10 seconds	<ul style="list-style-type: none"> <li>— if the ALT* mode is lost further to FCU altitude reference change of more than 250 ft.</li> <li>— when in APPR mode (G/S*, G/S, LAND, FINAL) FD reverts to V/S mode (pilot action or loss of vertical approach mode)</li> <li>— one AP or one FD is engaged while both AP/FD were previously off.</li> </ul>
Pitch FD bar (or FPV) flashes permanently	Transmission of the GLIDE data is interrupted when in G/S, G/S* or LAND modes above 100 ft RA.
Roll FD bar (or FPV) flashes 10 seconds	<ul style="list-style-type: none"> <li>— When in APPR mode (LOC*, LOC, LAND, APP NAV) FD reverts to HDG mode (Pilot action or loss of lateral approach mode).</li> <li>— One AP or one FD is engaged while both AP/FD were previously off.</li> </ul>
Roll FD bar (or FPV) flashes permanently	Transmission of the LOC data is interrupted when in LOC, LOC* or LAND modes above 15 ft RA.

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FLIGHT CREW OPERATING MANUAL

**AUTO FLIGHT**

1.22.30 P 7

**FLIGHT GUIDANCE**

SEQ. 100 REV 10

**AUTOPILOT****GENERAL**

The AP :

- stabilizes the aircraft around its center of gravity
- acquires and tracks a flight path
- flies the aircraft to an automatic landing or go around.

The AP commands the :

- position of the flight control surfaces for pitch, roll, and yaw
- nose wheel position.

**AP ENGAGEMENT**

The flight crew can engage AP1 or AP2 by pressing the corresponding pushbutton on the FCU if the aircraft has been airborne for at least five seconds.

When one AP is engaged, the corresponding FCU pushbutton comes on and AP1 (or 2) is displayed on the FMAs.

AP can be engaged when :

- \* Aircraft speed is within VLS and VMAX.
  - \* Aircraft pitch angle does not exceed 10° nose down or 22° nose up.
  - \* Bank angle is less than 40°
  - \* On ground, if the engines are not running. It disengages when one engine is started.
  - \* Two APs may be engaged at a time (AP1 active, AP2 in standby), when the localizer/glide-slope or roll out or go around mode is armed or engaged.
- Only one AP can be engaged at a time in all other cases.
- \* If one AP pushbutton is set to on with both FDs off, the AP engages in HDG V/S or TRK FPA mode, depending upon which the pilot has selected on the FCU.
  - \* If one AP pushbutton is set to on with at least one FD already on, the AP engages in the current active FD modes.
  - \* AP engagement increases the break out force on the sidestick controllers and on the rudder pedals.

In dual BACK UP NAV, AP can be engaged in selected modes if the FG part is available.

AP engagement is indicated when the corresponding FCU pushbutton lights up, and when "AP1" (or 2) appears on the PFD's Flight Mode Annunciator.

### **AP DISENGAGEMENT**

AP1 or 2 disengages when :

- The pilot presses the takeover pushbutton on the sidestick.
- The pilot presses the corresponding AP pushbutton on the FCU.
- The pilot pushes on the sidestick harder than a certain threshold. (Disengagement through rudder pedals is only active on ground).
- The other AP is engaged, except when localizer/glideslope modes are armed or engaged, or rollout or go-around mode is engaged.
- The thrust levers are set above the MCT detent, and the aircraft is on ground.
- The aircraft reaches the MDA/MDH – 50 feet (MDH – 50 feet), or 400 feet AGL if no MDA/MDH, with APPR mode engaged and a non-ILS approach is selected.
- One of the engagement conditions is lost.  
Furthermore, in normal law with all protections available, the AP will disconnect if :
  - High speed protection is active.
  - Angle-of-attack protection is active ( $\alpha$  prot + 1° is reached).
  - Pitch attitude exceeds 25° up or 13° down, or bank angle exceeds 45°.

The standard way for the flight crew to disengage the AP is to press the takeover pushbutton on the sidestick.

When the AP is OFF, the associated FCU pushbutton goes off, and the "AP1" (or AP2) disappears from the PFD's FMA.

## **AP WARNINGS**

When the AP is disengaged, the system warns the pilot :

- If the pilot disengages it with the takeover pushbutton on the sidestick, the warnings are temporary.
- If the disengagement results either from a failure, from the pilot pushing the pushbutton on the FCU, or from a force on the sidestick, the visual and audio warnings are continual.

		AP DISENGAGEMENT	
		TAKE OVER PB on SIDESTICK	BY OTHER MEANS
CONSEQUENCE	MASTER WARNING	flashing red during 3 sec max	flashing red
	ECAM	red AP OFF message 9 sec maximum	red warning AUTO FLT AP OFF
	AUDIO	cavalry charge 0.5 sec min 1.5 sec maximum	continuous cavalry charge 1.5 sec minimum
	CLR PB on ECAM CONTROL PANEL	extinguished	illuminated
ACTION	MASTER WARNING	extinguishes M.W. erases ECAM warning stops audio if pressed within 1.5 sec	extinguishes M.W. stops audio after 1.5 sec
	CLR PB on ECAM CONTROL PANEL	No effect	extinguishes CLR pb erases ECAM message calls status
	TAKE OVER PB	extinguishes M.W. erases ECAM warning stops audio if pressed within 1.5 sec.	extinguishes M.W. stops audio after 1.5 sec
ECAM STATUS MESSAGE		NO	YES

## **AUTOLAND WARNING**

The autoland red warning flashes in LAND mode when :

- The radio altitude goes below 200 feet and :
  - \* The aircraft gets too far off the beam (LOC or GLIDE).
  - \* Or both glide slope transmitters or receivers fail.
  - \* Or both localizer transmitters or receivers fail.
- R \* Or both radio altimeters differ from more than 15 feet.
- R \* Or both autopilots fail.

## SPEED/MACH CONTROL

In flight either the AP/FD pitch control or the autothrust may acquire and hold a target speed or Mach number, according to the engaged modes.

The speed control is :

- managed when the target comes from the FMGS
- selected when the target comes from the SPD/MACH FCU window.

### **MANAGED SPEED/MACH TARGET**

When the speed target is managed, the SPD/MACH window of the FCU shows dashes, and the corresponding dot is lighted. The PFD speed scale shows the speed target in magenta.

### **ENGAGEMENT CONDITIONS**

The SPD target is managed whenever AP or FD is engaged and one of the following occurs:

- The pilot pushes in the SPD/MACH selector knob.
- V2 is inserted in the MCDU.
- The speed reference system (SRS) is engaged (takeoff or go around mode).

*Note : At takeoff, SRS will not engage if V2 is not available.*

### **DISENGAGEMENT CONDITIONS**

Managed speed disengages any time the pilot selects a speed target on the FCU, or if the speed was preselected.

### **SPEED PROFILE**

The form of the managed SPD profile depends on the lateral NAV mode.

- If NAV mode is engaged, the SPD profile takes into account all the constraints linked to the flight plan.

The SPD profile is :

V2 - SPD LIM - SPD CSTR (if applicable) - ECON CLB SPD/MACH - ECON CRZ MACH - ECON or selected DES MACH/SPD - SPD LIM - SPD CSTR (if applicable) - HOLD SPD (if applicable) - VAPP

R

- If NAV mode is not engaged, the SPD/MACH constraints are not considered.

The SPD profile is :

- R V2 - SPD LIM - ECON CLB SPD/MACH - ECON CRZ MACH - ECON or selected DES MACH/SPD - SPD LIM - VAPP.

Note : – When both AP/FDs are OFF, A/THR reverts to selected SPEED mode except, when the approach phase is activated on MCDU where both managed and selected SPD are available.

- The managed speed/Mach target may be set below maneuvering speed but as long as the speed target is managed, the FMGS limits the aircraft to the maneuvering speed of the current slats/flaps configuration (VAPP, F, S, Green Dot).
- If the managed speed/Mach target is set above VMAX (VFE, VMO, MMO) the FMGS automatically limits the speed to VMAX.

## MINI GROUND SPEED

In approach phase the managed speed target is the Mini Ground Speed target computed by the Flight Guidance (FG) part of the FMGS. Refer to 1.22.30 Autothrust for details.

## SELECTED SPEED/MACH TARGET

To use a selected speed/Mach target, the pilot uses the knob on the FCU to set the target speed, which is then displayed in the FCU window. It is also displayed in blue on the PFD speed scale.

Note : The selected speed/Mach target may be set beyond VLS or VMAX, but when autothrust is active, the guidance limits the speed to VLS or VMAX.

Selected speed has priority over managed speed. The only automatic change-over from selected to managed speed target may occur at go around mode engagement.

In flight, if the situation calls for managed speed, both the PFD and the MCDU display a message proposing a manual change to managed speed (for example, SET MANAGED SPEED, SET HOLD SPEED).

## ENGAGEMENT CONDITIONS

The aircraft has a selected speed target under any one of the following conditions :

- The pilot pulls out the SPD/MACH selector knob (5 seconds after lift-off)
- Both AP/FDs are OFF (except in APPR phase)
- The FM speed target is lost except below 700 feet RA in takeoff, LAND or go around mode.
- The MCDU has a preselected speed for the next phase, and the aircraft transitions into that phase.
- The FMGC is powered up in flight.
- 5 seconds after lift off when a takeoff is initiated without managed or selected speed.

## **DISENGAGEMENT CONDITIONS**

The selected speed target disengages when :

- the managed speed target engages
- on ground at AP or FD engagement
- on ground at engine start

*Note : It is not possible to activate selected speed mode on the ground with engines running and FD on until after takeoff.*

### **R SELECTED DESCENT SPEED**

A manual speed or Mach may be inserted by the crew on the PERF DES page to replace the ECON DES SPD.

In this case, although the value is selected by the crew, this speed or Mach is taken into account to compute the top of descent and the descent profile.

### **SPEED/MACH SWITCHING**

- At the crossover altitude, the FMGC automatically changes the selected speed target to the corresponding Mach target.  
The FCU displays the Mach number corresponding to the speed at the switching altitude.

*Note : when the speed is selected, the pilot can do the switching manually by pressing the SPEED/MACH pushbutton on the FCU. The FCU then displays the aircraft Mach number.*

- When the target speed is managed, the FMGC commands the switchover automatically as a function of the ECON MACH value.

### **MANAGED SPEED TARGET MEMORIZATION**

A dual FM failure has different consequences when it occurs in different phases of the flight. The system handles target speed and SPD mode as follows :

- During approach with LOC and G/S engaged and radio altitude < 700 feet, the target speed is set to VAPP as previously memorized, and managed SPD target is maintained.
- At go around, the target speed becomes the memorized go around speed, which is the higher of VAPP or the speed when go around was initiated. Managed SPD target is maintained.
- In all other cases managed target speed reverts to selected, the value being the speed at the moment of the failure.

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## **SPEED/MACH FCU WINDOW SYNCHRONIZATION**

When the target SPD is managed, the SPD/MACH display of the FCU shows dashes. However, the window displays the target SPD or MACH in the following situations.

- The pilot turns the SPD/MACH selector knob.
  - If the pilot does not pull the knob within 45 seconds after turning it, the selection reverts to dashes.
- The pilot manually engages a selected SPD target.
- If the flight crew has manually preselected a speed or Mach number for the next phase on the MCDU PERF page, that preselected SPD/MACH engages when the aircraft enters that phase and the FCU window then displays as the target the preselected speed or Mach.
- If the FMGS is powered up in flight, the synchronized speed/Mach value is the current aircraft speed or Mach number.
- If no V2 is entered at takeoff, the V/S mode engages 5 seconds after lift-off (no speed reference system). The FCU speed target is the speed at V/S mode engagement. (A/THR becomes active when the thrust levers are set in the active range).
- If both FMGCs fail, the speed displayed is the last aircraft speed acquired before the failure.

## AP/FD MODES GENERAL

The FMGS has guidance parameters for both AP/FD lateral and vertical modes.

**The AP/FD lateral modes are :**

RWY, RWY TRK	Runway, Runway track mode
NAV	Nav mode
HDG, TRK	Heading, track mode. Also called basic modes.
APP NAV	Approach Nav mode
LOC*, LOC	Loc capture, Loc track mode
LOC B/C	Loc back course
• LAND	Land mode. Managed submode that includes LOC and G/S modes below 400 feet RA.
• FINAL APP	Final approach mode. Managed submode that includes APP NAV and FINAL modes during non precision approach.
ROLL OUT	Roll out mode. (Autoland)
GA TRK	Go around track mode

**The AP/FD vertical modes are :**

SRS	SRS mode used for takeoff and go around
CLB	Climb mode
DES	Descent mode
OP CLB	Open Climb mode
OP DES	Open Descent mode
R V/S or FPA	Vertical speed mode or Flight Path Angle mode. Also called basic modes.
R ALT*	Altitude capture,
ALT	Altitude Hold mode
ALT CST*	Altitude constraint capture,
ALT CST	Altitude constraint hold mode
ALT CRZ*	Altitude capture of the cruise flight level
ALT CRZ	Altitude hold of the cruise flight level
G/S*	Glide slope capture,
G/S	Glide slope mode.
FINAL	Final mode (non precision approach)
FLARE	Flare mode (Autoland)

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## AP/FD LATERAL MODES

### **HEADING OR TRACK : HDG - TRK**

These modes guide the aircraft laterally along a heading or track selected by the flight crew. The HDG/TRK window of the FCU displays the target heading or track. The pilot uses the HDG V/S -TRK FPA pushbutton to select heading or track.

### **ENGAGEMENT CONDITIONS**

HDG or TRK is engaged when one of the following conditions is met :

- The pilot pulls out the HDG-TRK selector knob (not sooner than five seconds after lift-off).
- NAV is disengaged, either by the loss of the lateral flight plan or by the pilot entering a flight plan discontinuity.
- FINAL mode (armed or engaged) is lost when the aircraft is in APP NAV mode.
- LOC or LOC\* mode is lost.
- The pilot engages the AP/FD with no other mode already engaged (basic mode of AP/FD engagement).
- LOC mode is armed when FINAL APP were previously engaged.
- LOC or LOC\* being armed or engaged, the APPR pushbutton is deactivated (above 400 feet).

### **DISENGAGEMENT CONDITIONS**

The engagement of any other lateral mode disengages HDG or TRK.

### **SYNCHRONIZING THE HDG/TRK WINDOW OF THE FCU**

The lateral window of the FCU displays a heading or a track value when :

- The HDG/TRK mode is engaged. The displayed value is the current HDG/TRK or the manually selected value of the target.
- The pilot turns the HDG/TRK selection knob. The value in the window first synchronizes with the current HDG/TRK, then displays the manual selection. It remains displayed for 45 seconds depending upon FCU standard, then vanishes if the pilot does not pull the knob (except in HDG preset).
- A HDG/TRK is preset (see below).
- AP/FD is lost. The value becomes that of the aircraft current heading or track.

*Note : If HDG is switched to TRK (or vice versa), the value displayed in the window switches from heading to track (or vice versa).*

**HDG/TRK PRESET**

The system has a HDG/TRK preset function for takeoff and go around.

If the pilot chooses not to fly the flight plan after takeoff or go around, he may preset a HDG or a TRK on the FCU by turning the HDG/TRK selector knob. The value he sets remains displayed in the FCU HDG/TRK window until the knob is pulled.

**Operation at takeoff**

HDG/TRK preset is available before takeoff and up to 30 feet RA. Turning the HDG/TRK selector knob before 30 feet sets the desired HDG/TRK. As a consequence:

- NAV is disarmed
- At 30 feet, RWY TRK is annunciated until the HDG/TRK knob is pulled.

**Operation at go around**

Whenever the LOC\*, LOC, LAND, FINAL, or GA modes are engaged, the HDG preset is available. If the pilot rotates the HDG/TRK knob to set the value, it will remain displayed in the window. Pull out the HDG/TRK knob to activate the mode and turn the aircraft on to the preset value.

**Cancellation**

The pilot can cancel a preset HDG/TRK by :

- engaging the NAV mode (DIR TO)
- pushing in the HDG/TRK knob (arming NAV mode)
- disengaging AP/FD

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## NAVIGATION (NAV)

NAV mode is a managed mode that steers the aircraft laterally along the flight plan defined in the FMGS. It is designed to have a zero cross-track error. The pilot can arm or engage the NAV mode if the MCDU contains a lateral flight plan.

### **ARMING CONDITIONS**

Satisfying one of the following conditions arms NAV :

- The aircraft is on the ground with no HDG/TRK preset and no other lateral mode except runway mode
- The pilot pushes in the HDG/TRK selector knob, unless the LOC mode is engaged.
- The pilot presses the APPR pushbutton, if a non-ILS approach is selected.
- The pilot selects a DIR TO/INTERCEPT when in HDG or TRK mode.

### **DISARMING CONDITIONS**

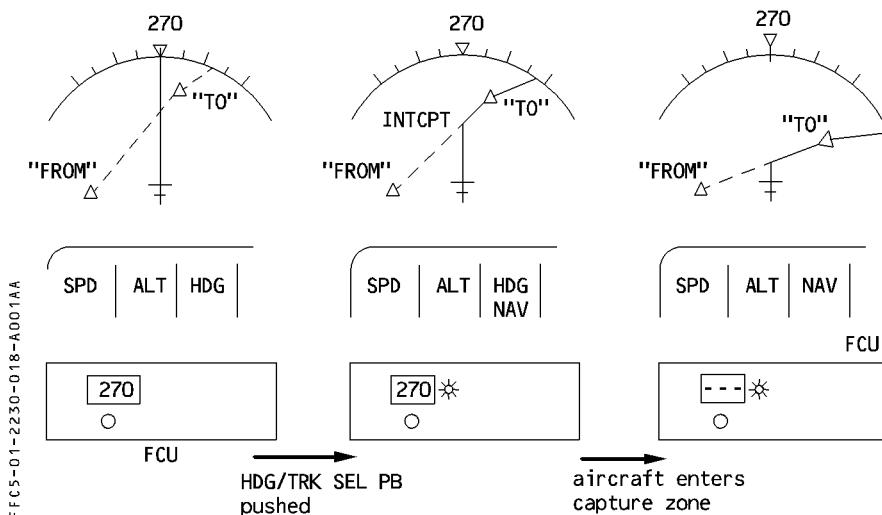
NAV mode disarms if one of the following occurs :

- The pilot pulls out the HDG/TRK selector knob.
- The pilot selects a preset HDG/TRK (TO or GA)
- The pilot arms the LOC mode by pressing the LOC pushbutton.
- The pilot selects GA mode.
- LAND mode has engaged.
- The pilot presses the APPR pushbutton to deselect the non-ILS approach.
- The pilot deselects both AP/FDs.

### **ENGAGEMENT CONDITIONS**

NAV mode engages :

- Automatically at 30 feet RA after takeoff (if armed on the ground).
- When the pilot orders "DIR TO" (except below 700 feet RA in LOC mode).
- When the pilot pushes in the HDG/TRK select knob when the aircraft is close to (within ~ 1 NM of) the active flight plan leg.
- Automatically in flight when NAV is armed and the aircraft reaches the capture zone for the active flight plan leg.

**CAUTION**

When NAV is armed, it will automatically engage if :

- \* the aircraft track line intercepts the flight plan before the TO waypoint and
- \* the intercept waypoint (INTCPT) is displayed on the ND and
- \* the aircraft reaches the active flight plan leg.

Note : The TO waypoint is displayed in white on NDs and MCDUs.

### DISENGAGEMENT CONDITIONS

The NAV mode disengages when :

- Any other lateral mode is engaged.
- The flight plan is lost or the aircraft enters a flight plan discontinuity.
- At MDA-50 feet when APP NAV is engaged.

### INTERACTIONS WITH VERTICAL MODES

When NAV mode is engaged, the vertical managed modes CLB or DES or FINAL take into account altitude and speed constraints linked to waypoints on the lateral flight plan. If NAV mode is disengaged the vertical managed modes are not available and all downpath altitude and speed constraints are ignored.

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## **LOCALIZER MODE THROUGH THE LOC PUSHBUTTON**

This mode captures and tracks a localizer beam independently of the glide path beam. Pilots use it to fly localizer-only approaches or to initiate an ILS approach when intercepting the glide slope from above.

### **ARMING CONDITIONS**

The pilot arms the LOC mode by pressing the LOC pushbutton, provided that :

- An ILS is tuned (frequency and runway course).
- The aircraft is above 400 feet RA.
- TO or GA mode is not engaged.

### **DISARMING CONDITIONS**

LOC mode is disarmed by :

- Pressing the LOC pushbutton when LOC is armed.
- Arming the NAV mode.
- Engaging the GA mode.

*Note : Engaging NAV mode by selecting DIR TO does not disarm the LOC mode.*

### **ENGAGEMENT CONDITIONS**

The LOC mode engages automatically when capture conditions are met.

### **DISENGAGEMENT CONDITIONS**

The LOC mode disengages :

- When another lateral mode is engaged.
- When the pilot presses the LOC pushbutton again (engaging the HDG/TRK mode on the current HDG/TRK).

### **LOC BACK COURSE MODE (LOC B/C)**

This mode captures and tracks the back beam of a LOC. This approach is considered as a non precision approach, and must be flown with AP/FD in TRK/FPA modes, A/THR being active.

See FMGS Pilot's Guide 4.05.70 for details. (FCOM Vol 4).

**AP/FD VERTICAL MODES**

Vertical modes guide the aircraft in the vertical plan.

**PRINCIPLES**

To leave an FCU selected altitude for another target altitude, two things must happen : the pilot must turn the altitude (ALT) selector knob in order to display the new target altitude and either :

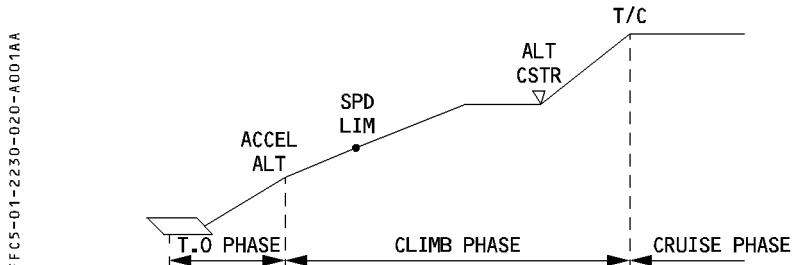
- pull out the ALT selector knob to engage the OPEN CLB/DES mode, or
- push in the ALT selector knob to engage the CLB/DES mode, or
- select a target vertical speed (V/S) and pull out the V/S FPA selector knob to engage V/S mode.

This arms ALT mode.

**CLIMB MODE (CLB)**

CLB mode guides the aircraft in a managed climb, at either a managed or a selected target speed, to an FCU selected altitude, taking into account altitude constraints at waypoints. The system also considers speed constraints if the target speed is managed.

The vertical flight path may include several segments :



The pilot can arm the CLB mode during the takeoff, go around, climb, and cruise phases and engage it during the climb and cruise phases.

**ARMING CONDITIONS**

The CLB mode is armed :

- on the ground or when SRS mode is engaged (TO or GA) if the following conditions are met :
  - No other vertical mode is engaged.
  - The ACCEL ALT (defined on the MCDU PERF TO or GA pages) is below the FCU selected altitude and the lowest altitude constraint.

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- In flight, when the climb or go-around phase is active, and the following conditions are met :
  - The lateral NAV mode is engaged, and
  - The FCU-selected altitude is above the aircraft's present altitude and the aircraft captures or flies an altitude constraint.

## DISARMING CONDITIONS

The CLB mode is disarmed, if one of the following conditions is met :

- Another vertical mode is engaged.
- The FCU-selected altitude is lower than the present aircraft level.
- The FCU-selected altitude is set at an altitude constraint, while ALT CSTR\* or ALT CSTR mode is engaged.
- The aircraft transitions to DES or APPR phase.
- Arming requirements are no longer met.
- Vertical flight path validity is lost, or NAV mode is lost with ALT CSTR\* or ALT CSTR or ALT or ALT\* is mode engaged.

R

## ENGAGEMENT CONDITIONS

The CLB mode can be engaged, if the following conditions are all met :

- The aircraft has been in flight for more than 5 seconds.
- The selected FCU level is above the present aircraft level.
- R – The descent, or approach, or go-around phase is not active.
- NAV mode is engaged.
- Glideslope (G/S) mode is not engaged.

CLB mode automatically engages, when the aircraft reaches ACC ALT, or sequences a waypoint with an altitude constraint while the CLB mode is armed.

CLB mode manually engages, when the pilot pushes in the ALT select knob, with the CLB mode not armed and an altitude constraint not effective.

Note : When CLB mode is engaged :

- The V/S (FPA) window of the FCU shows dashes.
- The managed LVL/CH dot on the FCU lights up.
- The Flight Mode Annunciator displays "CLB" in Column 2.

## DISENGAGEMENT CONDITIONS

The CLB mode disengages, if one of the following conditions is met :

- NAV mode is lost or disengaged (OP CLB engages).
- Another vertical mode engages.
- The pilot selects an altitude on the FCU that is lower than the present aircraft altitude.
- V/S (FPA) engages on current V/S (FPA).

## GUIDANCE

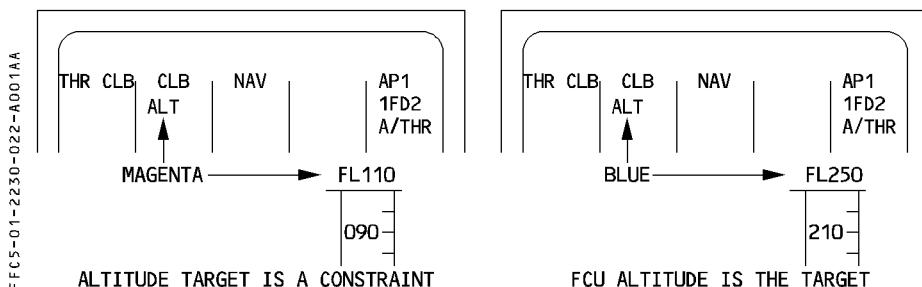
Climb mode guides the aircraft up to the FCU selected altitude. It tries to respect speed and altitude constraints.

The AP/FD pitch controls the speed or Mach number target while the A/THR controls the thrust set at maximum climb thrust.

When climb mode is engaged :

The system arms ALT mode and displays the next applicable altitude target on the PFD altitude scale.

- ALT is magenta on the FMA second line and the altitude value is displayed in magenta on the PFD scale if the next altitude target is a constraint.



- ALT is blue on the FMA second line and the altitude value is displayed in blue on the PFD altitude scale if the next altitude target is the FCU selected altitude.

In climb mode, the system does not modify the target speed to match the altitude constraints. The pilot has to select it manually using the information displayed on the PROG page.

When the aircraft levels off at an altitude constraint, CLB mode arms. It will engage automatically when the waypoint is sequenced. (If the FCU selected altitude is above the constraint).

## **OPEN CLIMB**

The OPEN CLB mode is a selected mode. It uses the AP/FD pitch mode to maintain a speed or a Mach (selected or managed) while the A/THR, if active, maintains the maximum climb thrust.

### **R ENGAGEMENT CONDITIONS**

- R The OPEN CLB mode can only be engaged, if all of the following conditions are met :
- The aircraft is in flight for more than 5 seconds ;
  - The LAND mode is not engaged ;
  - The FCU selected altitude is higher than the aircraft's present altitude.

The OPEN CLB mode is engaged by one of the following conditions :

- The pilot pulls out the ALT selector knob ;
  - The pilot pulls out the SPD/MACH selector knob when TO or GA mode is engaged ;
  - Acceleration altitude is reached, with CLB armed, and NAV mode not engaged ;
- R – NAV mode or vertical F-PLN is lost when CLB mode is engaged (see mode reversions).  
ALT mode is systematically armed.

### **DISENGAGEMENT CONDITIONS**

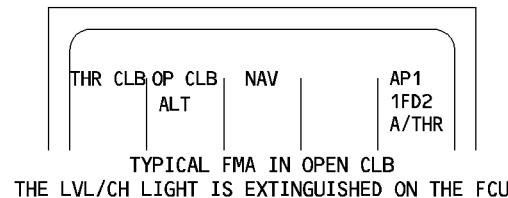
The OPEN CLB mode is disengaged by one of the following conditions :

- Engagement of any other vertical mode.
- Selection of a lower altitude (on FCU) than the current aircraft altitude. V/S (FPA) engages on current V/S (FPA) (See mode reversions).

### **GUIDANCE**

When OPEN CLB is engaged, the target Speed/Mach is held by adjusting the pitch with the elevator, whereas thrust is maintained either by the A/THR or manually by the pilot. Speed may be either selected or managed.

The OPEN CLB mode disregards all altitude constraints up to the FCU-selected altitude.



*Note : A level change of less than 1200 feet in OPEN CLB mode with A/THR active produces a 1000 ft/min climb.*

## DESCENT MODE (DES)

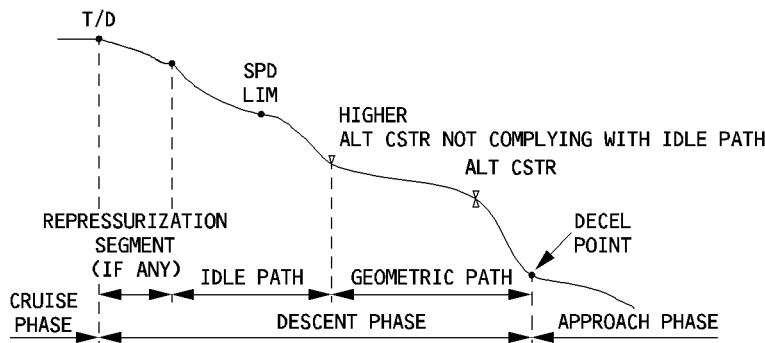
DES mode provides managed vertical guidance along a computed descent profile. The profile is computed from "Top of Descent" at the cruise flight level down to the "Decel" point, where guidance begins the deceleration to VAPP, to be reached at 1000 feet above touch down on the final descent path.

The descent profile takes into account wind data and data from the lateral and vertical flight plans and it is based upon the managed descent speed profile. It does not take holding patterns into consideration.

The descent profile has several segments :

- A repressurization segment. When necessary, this produces a repressurization rate for the cabin during descent. It is a function of the destination airport altitude and the selected cabin rate (defaulted to – 350 feet/min but this can be modified).
- Idle path segment. The AP/FD controls the speed and autothrust stays at idle thrust. Guidance computes this profile from top of descent or the end of the repressurization segment to the first vertical constraint that cannot be flown at idle thrust.
- Geometric path segments. The AP/FD controls the vertical path, and autothrust controls the speed. These segments take the aircraft from the first constraint to the deceleration point.

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The descent mode is a managed mode that may be engaged during cruise. It can be armed or engaged in descent and approach phases (unless the FCU selected altitude is higher than the present aircraft altitude).

## ARMING CONDITIONS

- R The DES mode is armed when an ALT CSTR is captured and all the following conditions are met :
  - R — FCU selected altitude is lower than present altitude
  - R — NAV, LOC\* or LOC is engaged.
  - R — Take off or go-around phase is not active.
  - R — Flight profile is available.

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## DISARMING CONDITIONS

The DES mode is disarmed, if one of the following conditions is met :

- Engagement of another vertical mode.
- FCU-selected altitude higher than present altitude.
- Loss of NAV, LOC\*, or LOC mode.
- Switching to takeoff or go-around or climb phase.

R – Loss of vertical flight path validity.

## ENGAGEMENT CONDITIONS

The DES mode engages when the following conditions are met :

- The FCU-selected altitude is lower than the present altitude.
- NAV, LOC\*, or LOC is engaged.
- Takeoff, climb, or go-around phase is not active.
- Vertical flight path is valid.

– TO, G/S, LAND, FINAL or GA mode is not engaged and :

- R · The aircraft sequences a waypoint with an ALT CSTR, and DES mode is armed. The DES mode engages automatically.
- R or
- R · The pilot presses the ALT selector knob and ALT CSTR\* or ALT CSTR mode is not engaged.
- R or
- R · The pilot presses the ALT selector knob, ALT\* or ALT is engaged and the current altitude is not an effective altitude constraint of the F-PLN.

Note : When DES mode is engaged :

- The V/S FPA window of FCU shows dashes.
- The managed LVL/CH dot on the FCU lights up.

## DISENGAGEMENT CONDITIONS

The DES mode is disengaged if one of the following conditions is met :

- The NAV mode is disengaged and the V/S FPA engages (see reversions).
- Another vertical mode engages.
- The pilot selects an altitude on the FCU that is higher than present altitude and V/S FPA engages on current V/S FPA.

R – NAV mode is lost due to a discontinuity in the descent profile ; AP/FD reverts to basic mode.

## GUIDANCE

### **Descent initiation**

In order to initiate the descent, the pilot :

- Turns the ALT selector knob to set the cleared altitude.
- Pushes in the ALT selector knob.
  - If the aircraft has not reached top of descent (T/D), it will descend immediately at a constant V/S, converging on the descent profile.
  - If the aircraft is at or beyond T/D, it descends immediately at idle thrust.

### **During the descent :**

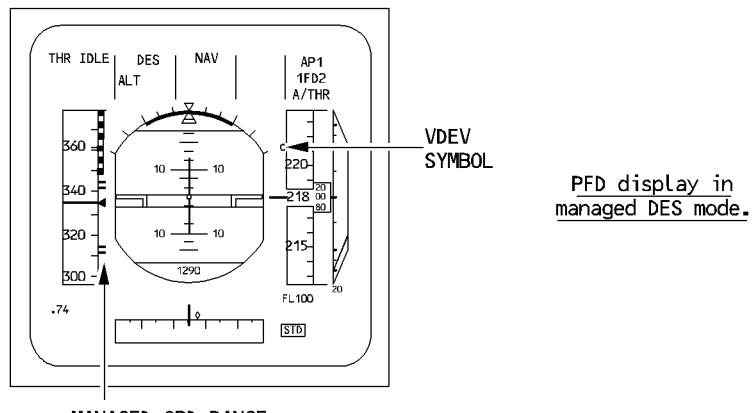
The pilot sees a vertical deviation symbol (VDEV) along the ALT scale on the PFD and on the PROG page, so as to monitor the aircraft vertical position on the calculated descent profile.

The aircraft may deviate from the DES path while DES mode is engaged if :

- unexpected wind conditions is encountered or,
- anti-icing is turned on or,
- lateral flight plan is modified.

R

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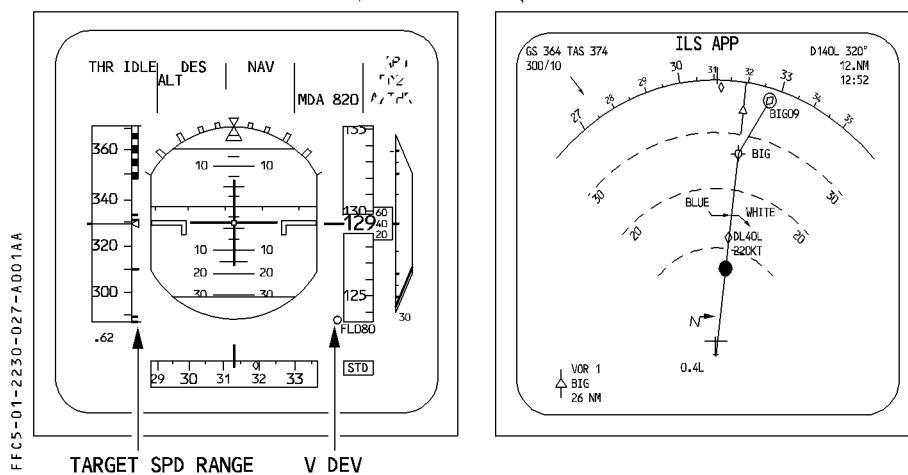
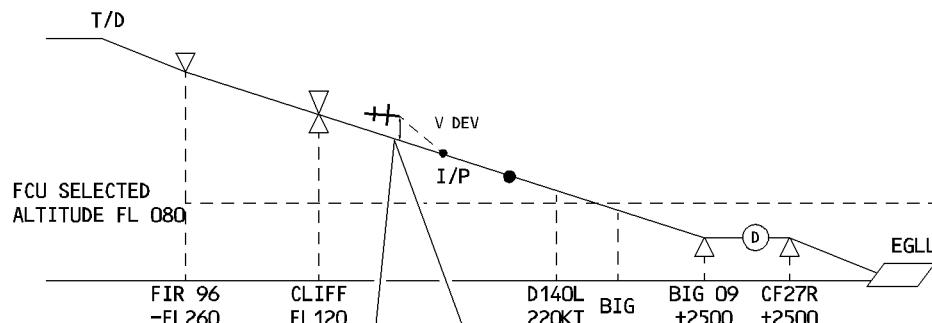


VDEV value on the  
PROG page

When the speed is managed, a managed SPD range shows, on the PFD, acceptable speed variations around the nominal descent speed target (limited to  $\pm$  20 knots).

Associated with the V DEV displayed on PFD, the ND shows an intercept point ↗ on the flight plan. It indicates the position where the system predicts that the aircraft will intercept the descent profile.

R



**— Aircraft above the descent profile :**

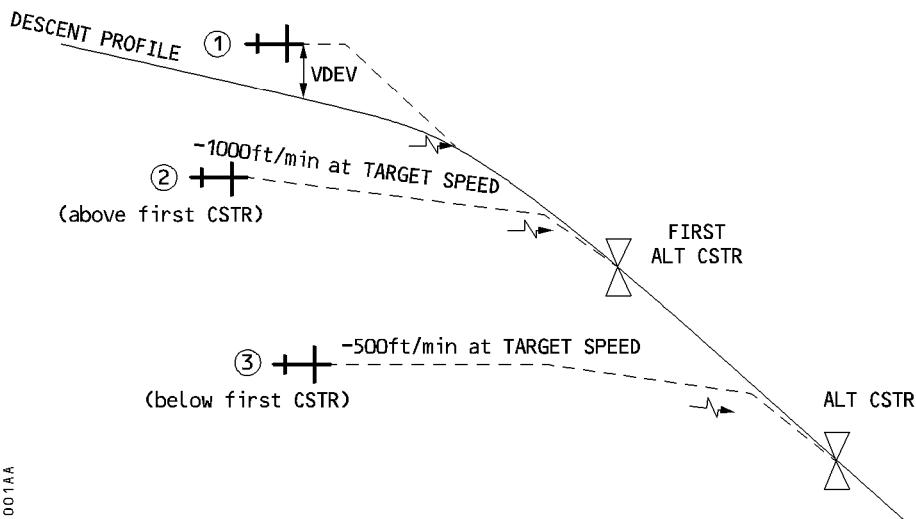
If the aircraft is above the descent profile, the speed will increase toward the upper limit of the managed speed range. If the speed reaches the upper limit, the aircraft will maintain the speed but will deviate from the profile (autothrust at idle).

The navigation display presents a pseudo waypoint ↗ (intercept point) along the flight plan, that assumes the aircraft will return to the profile using :

- idle thrust
- 1/2 speedbrake extension
- ECON speed plus a margin (until intercepting the profile).

Whenever the intercept point is predicted to be close to a constrained waypoint, the PFD and MCDU display an "EXTEND SPD BRK" message.

*Note : With DES mode engaged, the speedbrakes extension will not necessarily increase the descent rate. It increases only if the aircraft is above path.*



**① A/C ABOVE THE PROFILE**     - IDLE THRUST  
     - TARGET SPD + MARGIN  
     - 1/2 SPEEDBRAKES IF REQUESTED

**② and ③ A/C BELOW THE PROFILE**     - SPEED MODE  
     - TARGET SPEED

### **– Aircraft below the profile**

If the aircraft is below the descent profile, its speed will be maintained at target speed until it reaches the descent profile.

The intercept point on the navigation display is based on the following assumptions :

- if the aircraft is flying an idle segment :

The FMGS maintains  $V/S = -1000 \text{ ft/min}$  and target speed, until it reaches the constraint altitude or intercepts the profile.

- if the aircraft is flying a geometric segment :

The FMGS maintains a constant  $-500 \text{ ft/min}$  until it intercepts either the altitude constraint or the profile.

### **– Leveling off at a constraint**

- If the aircraft levels off at an ALT CSTR, the DES mode arms and remains armed until the aircraft passes the constraint, then reengages (if the FCU altitude is set below the altitude of the constraint).

- if the FCU selected altitude is that of a constraint, the pilot may continue the descent below that altitude by turning the ALT SEL knob and pushing it in. This arms the DES mode, which reengages when the aircraft passes the constraint waypoint.

### **· Guidance in a hold :**

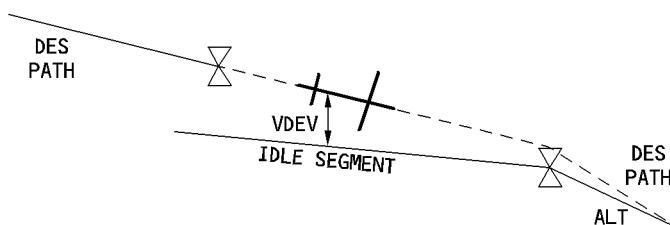
Just before the aircraft enters a holding pattern, the speed target becomes the holding speed. In the holding pattern, the DES mode commands  $V/S = -1000 \text{ ft/min}$  while autothrust maintains the holding speed. The aircraft will level off at the next altitude constraint if it is reached during the hold.

The vertical deviation (VDEV) is based on the altitude at which the aircraft is supposed to cross the exit fix in order to be properly positioned on the descent profile.

### **· Too steep path :**

A segment between two constraints is called "too steep path" when Flight Management predicts that it is impossible to fly it at the preplanned speed with 1/2 speedbrakes extended. The MCDU displays TOO STEEP PATH and FM does not furnish predictions for the waypoints included in the TOO STEEP PATH segment. When the aircraft reaches the beginning of the too steep path segment, the FM recomputes the VDEV using an idle segment from the end of the too steep path segment.

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**— FMA display**

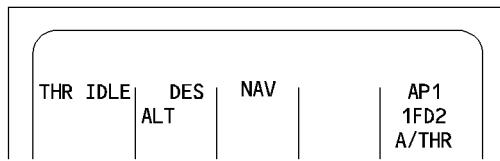
When DES mode is engaged, the system arms ALT and displays the applicable target altitude on the PFD altitude scale.

- If the next predicted level-off is an altitude constraint, ALT is magenta on the FMA second line and the PFD displays the altitude constraint magenta below the altitude scale.

When ALT CSTR (green) is engaged (aircraft flying at ALT CSTR), the system arms DES blue. When the aircraft meets the constraint, DES again engages automatically.

- If the next predicted level-off is the FCU altitude, ALT is blue on the FMA and the PFD displays the FCU-selected altitude in blue.

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Typical FMA in DES

## OPEN DESCENT MODE (OP DES)

The OPEN DESCENT mode is a selected mode. It maintains a SPD/MACH (selected or managed) with the AP/FD pitch mode while autothrust (if active) maintains IDLE thrust. It is not to be used for final approach.

### ENGAGEMENT CONDITIONS

The OPEN DES mode can be engaged only if the following conditions are met :

- the aircraft has been in flight for more than five seconds,
- LAND mode is not engaged.
- the FCU selected altitude is lower than present altitude.

The OPEN DES mode is engaged by :

- pulling out the ALT selection knob.

*Note : When OP DES is engaged :*

- the FMA displays "OP DES".
- the managed LVL/CH dot on the FCU goes out.
- the system arms the ALT mode.

### DISENGAGEMENT CONDITIONS

The OPEN DES mode is disengaged by one the following :

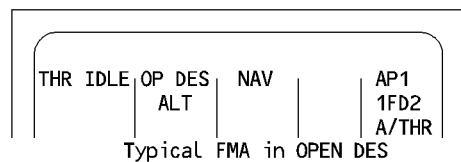
- Manual engagement of another vertical mode.
- Selection of an altitude higher than present altitude. V/S (FPA) engages on current V/S (FPA).

### GUIDANCE

When OPEN DES is engaged, pitch control maintains the target speed/ Mach number, and autothrust maintains idle thrust (or the pilot maintains it manually).

The speed target may be either selected or managed.

The OPEN DES disregards all altitude constraints.



### ALTITUDE ACQUIRE MODE (ALT\*, ALT CSTR\*, ALT CRZ\*)

ALT\* mode guides the aircraft to acquire the FCU selected altitude.

ALT CSTR\* guides the aircraft to acquire an altitude constraint provided by Flight Management.

ALT CRZ\* guides the aircraft to acquire the cruise altitude as selected on the FCU and the MCDU PROG page.

Once the aircraft has reached the altitude, the altitude mode ALT or ALT CSTR or ALT CRZ engages.

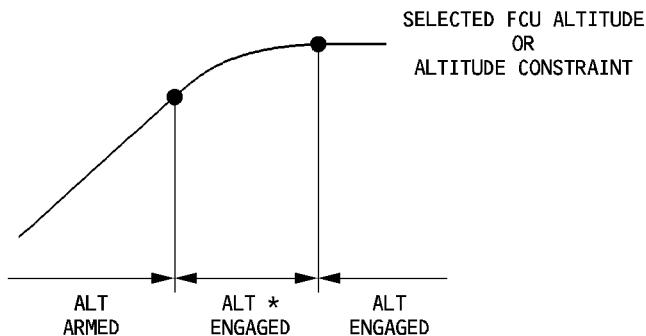
### ARMING CONDITIONS

ALT\* or ALT CSTR\* or ALT CRZ\* can be internally armed but the pilot does not see any display of it.

### ENGAGEMENT CONDITIONS

The mode engages when the aircraft reaches the altitude capture zone defined by the aircraft vertical speed (among other parameters).

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Note : ALT\* and ALT CSTR\* cannot be engaged below 400 feet if either the takeoff or the go around mode is engaged.

### DISENGAGEMENT CONDITIONS

- Engagement of V/S mode on current vertical speed by changing the FCU altitude selector knob by more than 250 feet.
- Engagement of another vertical mode provided the FCU altitude has been changed by more than 250 feet.

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## GUIDANCE

ALT\* mode has an internal V/S guidance that is a direct function of the difference between present altitude and the altitude target.

- R ALT\* and ALT CSTR\* modes have internal protections that decreases the vertical speed when VLS or VMAX is reached. (VLS or VMAX becomes the priority target).  
The system switches automatically to ALT (altitude hold) when the altitude deviation becomes less than 40 feet.

Note : – If the baro setting is changed during ALT\*, this may lead to an FCU target overshoot due to the change of the current value of the altitude. However ALT\* mode will allow the FCU altitude to be regained.

- For aircraft equipped with QFE option, a switching from STD to QFE (or vice versa) in ALT CSTR\*, will change the target value and a reversion to V/S may occur if the target value is modified of 250 feet or more.

## ALTITUDE HOLD MODE (ALT/ALT CST/ALT CRZ)

The ALT mode maintains a target altitude. This target altitude is either the FCU selected altitude (ALT, ALT CRZ) or an altitude constraint delivered by the Flight Management (ALT CSTR).

### **ARMING CONDITIONS**

The ALT mode arms automatically whenever the aircraft climbs or descends toward the target altitude.

When ALT is armed, the FMA displays the ALT message on its second line :

- blue when the target altitude is the FCU selected altitude
- magenta if the target altitude is an altitude constraint.

### **ENGAGEMENT CONDITIONS**

ALT mode engages when :

- the difference between present altitude and target altitude becomes less than 40 feet with ALT\* engaged.
- or when the ALT pushbutton of the FCU is pressed.

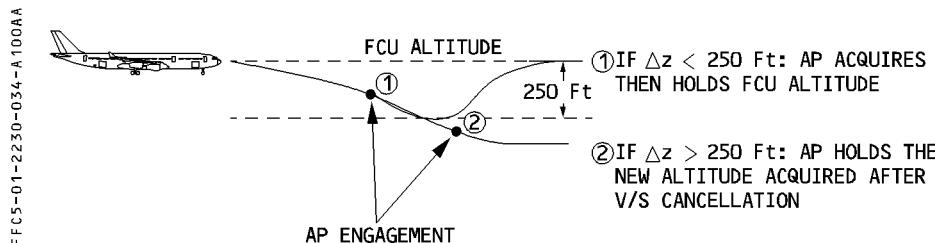
### **DISENGAGEMENT CONDITIONS**

The ALT mode disengages when any other vertical mode engages.

The ALT pushbutton cannot be used to disengage ALT mode.

### **GUIDANCE**

- The altitude that ALT mode holds is the altitude it memorized when engaged. It is not affected by a change of barometric reference or by a change in the barometric correction.
- When ALT is engaged, the FMA displays “ALT” in green if it is the FCU altitude or ALT CSTR in green if it is an altitude constraint.
- If the AP is engaged while FD is already engaged in ALT mode at the FCU-selected altitude, the autopilot :
  - acquires and holds the FCU altitude if present altitude is within 250 feet of it, or
  - commands a level-off if present altitude is more than 250 feet from the FCU altitude.

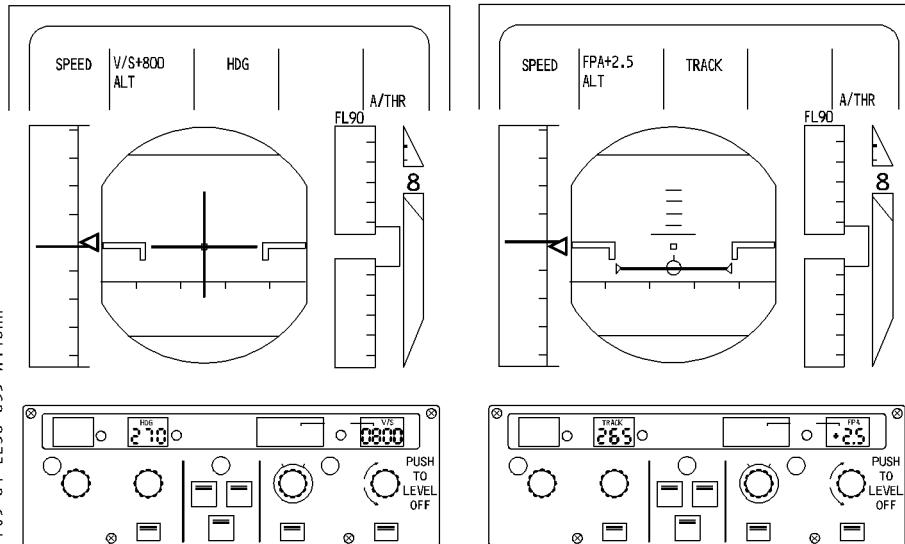


**VERTICAL SPEED MODE — FLIGHT PATH ANGLE MODE (V/S - FPA)**

The V/S - FPA is a selected mode. It acquires and holds the vertical speed or the flight path angle displayed in the V/S - FPA window of the FCU.

The HDG V/S TRK FPA pushbutton on the FCU allows the pilot to select either type of reference to be used for guidance and for display on the PFD.

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**ENGAGEMENT CONDITIONS**

The pilot can engage the mode manually as follows :

- Pull out the V/S FPA selection knob (at least five seconds after lift-off) or push it in for an immediate level-off (V/S = 0).
- Engage the AP and/or FD if AP and FD were not engaged (basic mode of AP/FD engagement).
- Select a different altitude (more than 250 feet from present altitude) when in ALT\*.
- Select a higher altitude than present altitude when in DES, OP DES mode.
- Select a lower altitude than present altitude when in CLB, OP CLB mode.

The mode engages automatically :

- five seconds after lift-off, if no other vertical mode is engaged
- upon loss of G/S\* or G/S mode
- upon loss of FINAL mode
- upon loss of LOC\* or LOC mode
- upon loss of NAV mode when DES mode is engaged
- upon loss of vertical flight path in DES mode

When V/S - FPA mode is engaged, V/S or FPA is displayed in green on the FMA with the current target.

### **DISENGAGEMENT CONDITIONS**

The pilot can disengage the V/S mode manually by :

- pulling or pushing the altitude selector knob
- initiating a go around.

It disengages automatically :

- when the aircraft reaches the FCU altitude or
- upon G/S\* engagement.

### **GUIDANCE**

The FMGC pitch mode guides the aircraft to the target V/S or FPA. The corresponding A/THR mode is SPEED or MACH. The FMA displays "V/S (FPA)".

The V/S (FPA) guidance has priority over the speed guidance. If the selected target V/S or FPA is too high (relative to the current thrust condition and speed), the FMGC will steer the aircraft to the target V/S or FPA, but the aircraft will also accelerate or decelerate. When the speed reaches the authorized limit, the V/S or FPA decreases automatically to maintain the minimum (or maximum) speed limit. (Also refer to reversion modes).

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## **MODE REVERSIONS AND AUTOMATIC SPEED MODE PROTECTIONS**

There are several types of mode reversions, each one observes a specific logic that can be described as follows :

### **R INTERACTION BETWEEN LATERAL MODES, VERTICAL MODES, AND MANAGED SPEED PROFILE**

#### **· When NAV mode is engaged :**

The FMGS guides the aircraft along the flight plan and considers the constraints attached to the F-PLN waypoints. As a result, managed CLB and DES modes are available.

#### **· When NAV mode is not engaged :**

The FMGS considers that the flight plan is not followed and ignores all speed and altitude constraints linked to the flight plan waypoints. As a consequence the managed vertical CLB and DES modes are not available, and the managed SPD profile disregards the speed constraints.

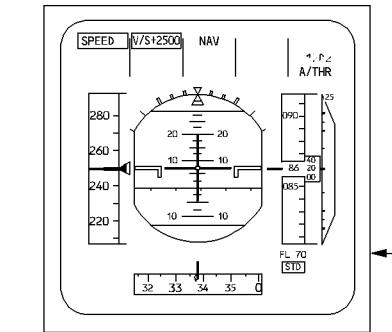
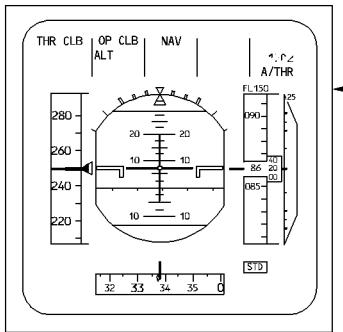
#### **As a consequence : When NAV mode disengages (manual or automatic)**

- R — CLB mode, when engaged, reverts to OPEN CLB.
- R — DES mode, when engaged, reverts to V/S mode on current value.
- R — Speed and altitude constraints are disregarded (but speed limit is retained)

## MODE REVERSION DUE TO FCU ALTITUDE CHANGE

- When an OPEN mode is engaged, the aircraft climbs or descends towards the altitude set on the FCU. If the pilot sets the FCU altitude to a target incompatible with the active open mode, a mode reversion occurs and V/S (FPA) engages on the current V/S (FPA). This reversion applies to CLB, OP CLB, DES, OP DES.  
e.g. : Reversion from OP CLB to V/S.

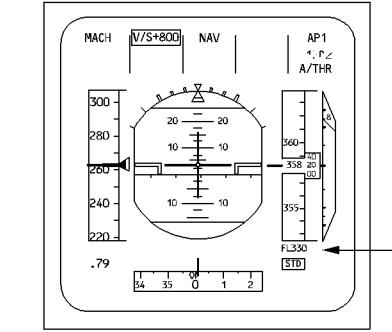
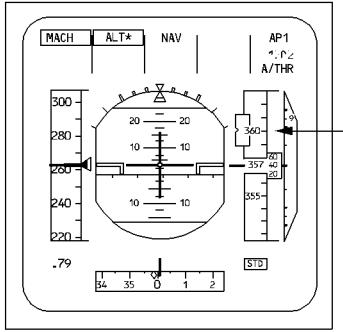
FFC5-01-2230-038-A100AA



FCU ALTITUDE CHANGE FROM FL150 to FL70

- With ALT\* engaged, if the target altitude is changed by any value greater than 250 feet, V/S (FPA) engages on the current V/S (or FPA). (Also Refer to the mode reversion table.)

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FCU ALTITUDE CHANGE FROM FL360 TO FL330

If within 5 seconds after reversion to V/S (FPA) the pilot does not confirm the altitude target change by :

- Pulling the ALT knob, or
- Setting a new V/S (FPA) target, or
- Pushing the ALT pushbutton on the FCU,

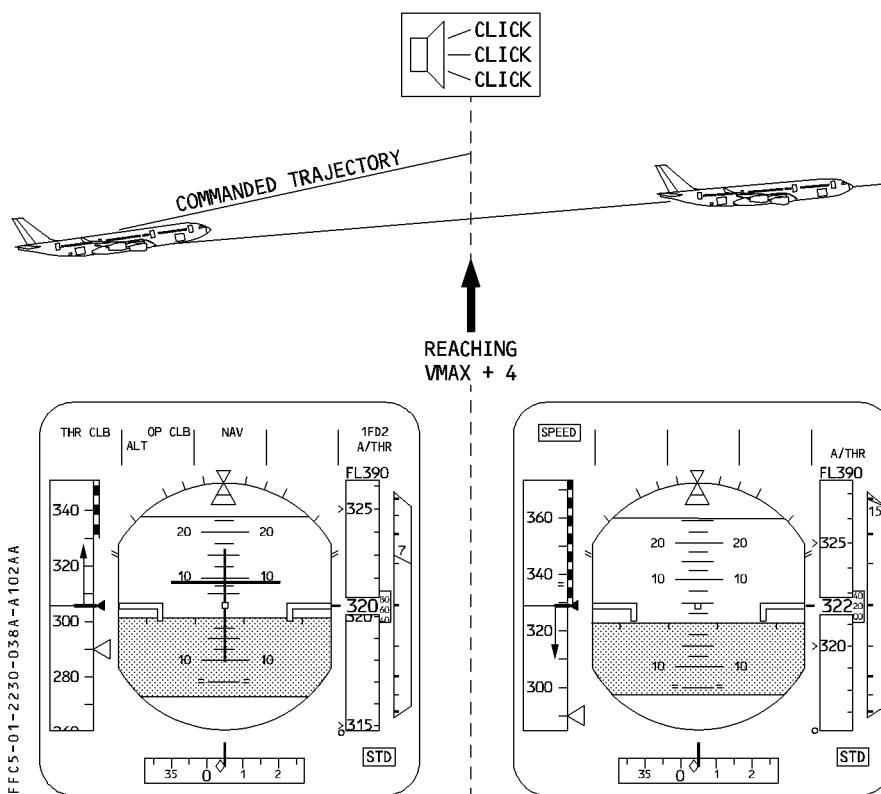
A triple click aural warning sounds, and the V/S (FPA) is boxed white for 10 additional seconds.

## AUTOMATIC SPEED MODE PROTECTION

### **FD bars are engaged in an OPEN mode in climb with AP not engaged**

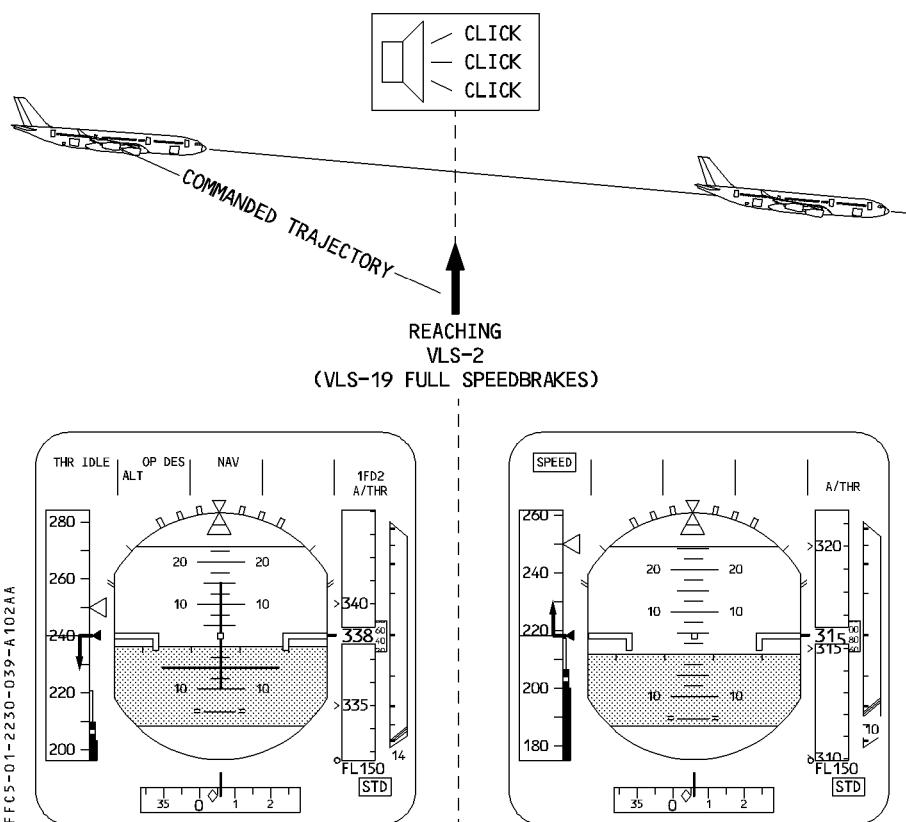
If FD bars are engaged in CLIMB, or OPEN CLIMB mode and the pilot does not follow the FD bars to maintain the commanded climb (pitch too low and autothrust in maximum climb thrust), the aircraft accelerates.

Both FD bars disengage when VMAX+4 is reached (VMAX being VMO, VLE or VFE). If the A/THR is active, it reverts to SPEED mode and reduces the thrust to recover the speed target. A triple click aural warning sounds.



**AUTOMATIC SPEED MODE PROTECTION****FDs are engaged in an OPEN mode, in descent with the AP not engaged**

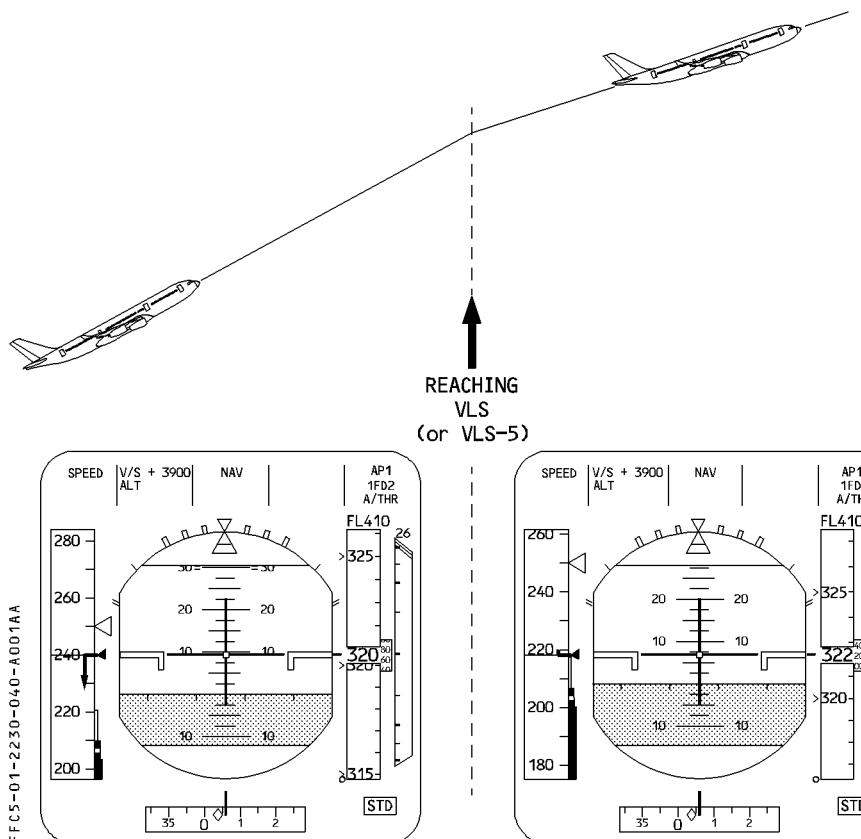
- If the FDs are engaged in DES or OP DES mode and, if the pilot does not follow the FD bars to maintain the commanded pitch, the aircraft decelerates (insufficient descent rate and idle thrust).
- If the airspeed reaches VLS-2, both FDs disengage. (If speedbrakes are extended, the FDs disengage between VLS-2 and VLS-19, depending on the position of the speedbrakes). The A/THR, if active, reverts to SPEED mode upon FD bars disengagement, and increases thrust to recover the speed target. A triple-click aural warning sounds.
- R



## AUTOMATIC SPEED PROTECTION IN V/S (OR FPA) MODE

**R In climb**

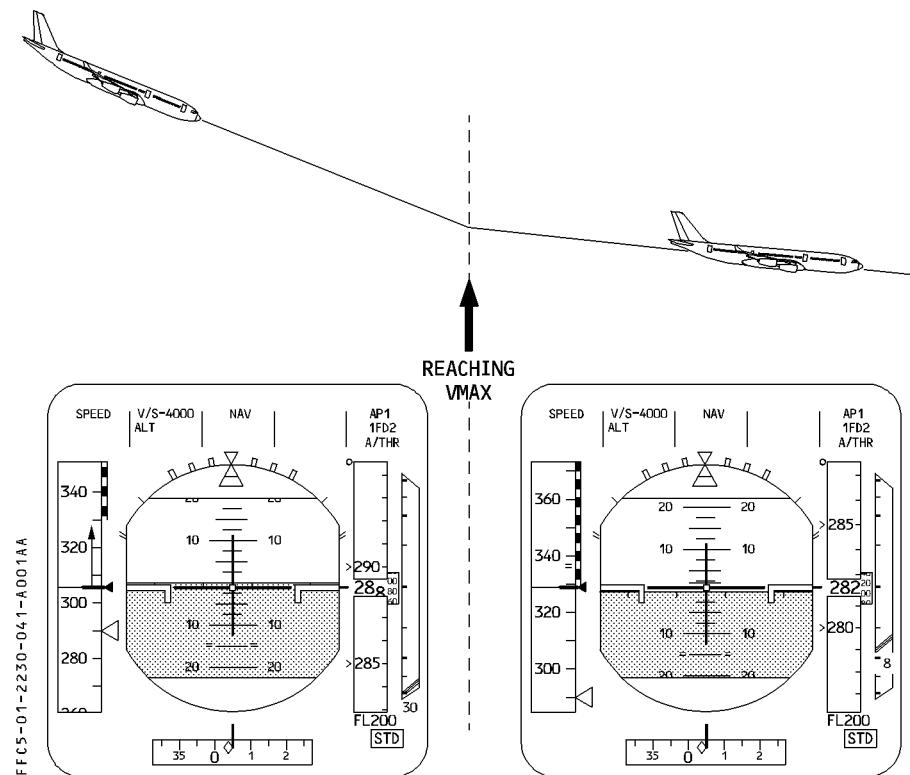
R When climbing with V/S mode engaged : If the selected V/S value is excessive (with R regards to thrust and speed), the FMGS maintains the V/S target, but the airspeed R decreases. When reaching VLS (or VLS - 5, if the speed target is VLS), the AP temporarily R abandons the V/S target, and automatically decreases the vertical speed to maintain VLS. R The same applies, if FPA mode is used with an excessive FPA target.



- R V/S mode remains engaged. The V/S target does not change, but is no longer followed.
- R Note : When flying with FD bars only (AP OFF), the FMGS adjusts the pitch bar so that VLS is maintained.

**AUTOMATIC SPEED PROTECTION IN V/S (OR FPA) MODE****R In descent**

- R When descending with V/S mode engaged : If the selected V/S value is excessive (with regards to thrust and speed), the FMGS maintains the V/S target, but the airspeed increases. When reaching VMAX (VMO or VLE in clean, or VFE + 4 knots), the AP temporarily abandons the V/S target, and automatically decreases the vertical speed to maintain VMAX.
- R The same applies, if FPA mode is used with an excessive FPA target.



- R V/S mode remains engaged. The V/S target does not change, but is no longer followed.
- R Note : When flying with FD bars only (AP OFF), the FMGS adjusts the pitch bar so that VMAX is maintained.

## **MODE REVERSIONS**

### **Reversion due to FCU ALTITUDE changes**

CONDITIONS	ACTION	CONSEQUENCE
OP CLB engaged CLB engaged	FCU-selected ALT set below a/c altitude	V/S-FPA engages on current V/S-FPA
OP DES engaged DES engaged	FCU-selected ALT set above a/c altitude	
ALT* active	FCU-selected ALT modification (greater than 250 ft)	

### **Reversion due to the loss of NAV mode**

CONDITIONS	EVENT	CONSEQUENCE
CLB engaged	Loss of lateral managed mode : NAV	OP CLB engages
DES engaged		V/S engages

## R **SPEED PROTECTION, when FD orders are not followed by the crew (AP not engaged)**

R

CONDITIONS	EVENT	CONSEQUENCE
<ul style="list-style-type: none"> <li>· FD engaged only (no AP) and</li> <li>· OP DES or DES engaged</li> <li>· A/THR active (IDLE thrust)</li> </ul>	IAS = VLS – 2 (if speedbrakes are extended between VLS – 2 and VLS – 19)	FD bars disappear. If A/THR active, automatic engagement of SPEED mode on the A/THR. Thrust increases, and the speed is regained.
<ul style="list-style-type: none"> <li>· FD engaged only (no AP) and</li> <li>· OP CLB or CLB engaged</li> <li>· A/THR active (CLIMB thrust)</li> </ul>	IAS = VMAX + 4 VMAX = VFE or VLE or VM0/MM0	FD bars disappear. If A/THR active, automatic engagement of SPEED mode on the A/THR. Thrust increases, and the speed is regained.

## R **SPEED PROTECTION due to excessive V/S**

R

CONDITIONS	EVENT	CONSEQUENCE
<ul style="list-style-type: none"> <li>· Excessive V/S or FPA selected in climb</li> </ul>	IAS = VLS (or VLS – 5, if target = VLS)	The selected V/S (or FPA) target is temporarily abandoned to maintain VLS in climb, or VMAX in descent.
<ul style="list-style-type: none"> <li>· Excessive V/S or FPA selected in descent, and</li> <li>· Clean configuration</li> </ul>	IAS = VMAX	
<ul style="list-style-type: none"> <li>· Excessive V/S or FPA &lt; 0 selected in descent, and</li> <li>· Configuration other than clean</li> </ul>	IAS = VMAX	

**AP/FD COMMON MODES****GENERAL**

These modes are called "common" because they are related to both the lateral and the vertical axes.

The AP/FD common modes are :

- On takeoff : Runway/Runway track associated to SRS vertical modes.
- In approach : ILS approach (LAND) or non-ILS approach (FINAL APP).
- In Go-around : Go-Around Track associated to SRS vertical modes.

These modes are engaged simultaneously on both axes.

COMMON MODES		VERTICAL	LATERAL
TAKEOFF		SRS	RWY RWY TRK
APPROACH MODES	ILS APPROACH	G/S* G/S	LOC* LOC
		LAND, FLARE, ROLL OUT	
	NON ILS APPROACH	FINAL	APP NAV
	GO AROUND (GA)	SRS	GA TRK

**TAKEOF**

Takeoff mode combines the SRS (Speed Reference System) vertical mode with the RWY lateral mode.

Both are simultaneously engaged, but may be disengaged separately.

Takeoff mode is available :

- During the takeoff run and initial climb for FD bars guidance.
- Five seconds after lift-off for AP use.

## SRS (SPEED REFERENCE SYSTEM)

SRS mode controls pitch to steer the aircraft along a path in the vertical plane at a speed defined by the SRS guidance law.

### — Engagement conditions

The SRS mode automatically engages when the thrust levers are set to the TOGA or FLX/MCT detent, providing :

- V2 has been inserted in the MCDU PERF TO page. If V2 has not been inserted, V/S mode engages 5 seconds after lift-off on the current V/S value.
- The slats are extended.
- The aircraft has been on the ground for at least 30 seconds.

### — Disengagement conditions

The SRS mode disengages :

- R · Automatically, at the acceleration altitude (ACC ALT), or if ALT\* or ALT CST\* mode engages (above 400 feet RA).
- R · If the crew engages another vertical mode.

R      Note : In Engine Out conditions, the SRS mode does not automatically disengage at EO ACC ALT. Refer to Engine Out procedures.

### — Guidance

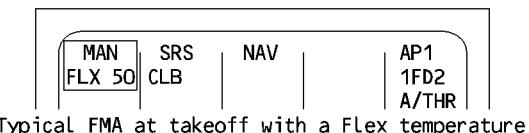
In SRS mode, the aircraft maintains a speed target equal to V2 + 10 knots in normal engine configuration. When the FMGS detects an engine failure, the speed target becomes the highest of V2 or current speed, limited by V2 + 15 knots.

The SRS guidance law also includes :

- Attitude protection to reduce aircraft nose-up effect during takeoff ( $15^\circ$  or  $22.5^\circ$  maximum in case of windshear).
- Flight path angle protection that ensures a minimum climb slope of  $0.5^\circ$ .

Note : If during takeoff the pilot inadvertently sets an altitude on the FCU below the current altitude, the aircraft will remain in SRS mode until the pilot takes some other action.

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## RUNWAY (RWY)

The RUNWAY mode has two submodes :

- RWY mode, which gives lateral guidance orders during takeoff roll and initial climb out (up to 30 feet RA) if a LOC signal is available.
- RWY TRK mode, which gives lateral guidance on the track the aircraft was flying at mode engagement (at 30 feet RA).

### Engagement conditions

The RWY engagement conditions are :

- The conditions required for SRS mode engagement :
  - V2 is inserted in the MCDU PERF TO page
  - slats are extended.
  - the aircraft has been on ground for at least 30 seconds.
- The aircraft is receiving a LOC signal and LOC deviation is less than 1/2 dot.
- The aircraft heading is within 20° of the ILS related course.
- The ILS course is identical to the runway heading of the origin airport as selected for the active flight plan, if any.

The RWY TRK mode engages automatically at 30 feet (RA) if NAV mode does not engage (NAV not armed prior to takeoff).

### Disengagement conditions

RWY mode disengages if :

- The LOC signal is lost below 30 feet RA or the aircraft heading and the runway heading differ by more than 20°.
- Another lateral mode is engaged.

Note : If the takeoff runway has no ILS or if an ILS back course has been selected RWY mode is not available and the PFD does not display the yaw bar nor RWY on FMA.

### Guidance

- The RWY mode uses the LOC signal to guide the aircraft on the runway centerline while the aircraft is on the ground.  
The PFD displays the FD yaw bar.  
The FMA displays RWY.
- The RWY TRK mode guides the aircraft on the track the aircraft was flying at mode engagement.  
The FD displays the conventional guidance bar. The FMA displays "RWY TRK".



Typical FMA with RWY mode engaged.

## APPROACH

The aircraft can fly two different types of approaches :

- ILS (or LOC) approaches
  - Non-ILS approaches (VOR/DME, VOR, NDB, RNAV)
- The pilot uses an ARRIVAL lateral revision to insert these approaches into the flight plan. The APPR pushbutton on the FCU is used to arm engage the guidance modes related to the approach inserted into the flight plan.
- For an ILS approach, the guidance modes are LOC and G/S.
  - For a non-ILS approach, the guidance modes are APP NAV and FINAL (FINAL APP).

### ILS APPROACH

The ILS approach mode includes the following modes :

VERTICAL MODE	LATERAL MODE
G/S* (capture) G/S (track)	LOC* (capture) LOC (track)
COMMON MODES LAND - FLARE - ROLL OUT	

The sequencing of these modes is automatic, once the pilot has pushed the APPR pushbutton and the conditions for engagement are met.

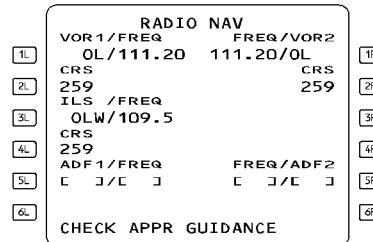
#### Selection

- R The ILS approach is selected by pressing the FCU's approach pushbutton, and :
- an ILS approach or a runway only or no approach is inserted in the Flight Management flight plan (arrival page), and an ILS frequency is set in on the MCDU, or
  - both radio management panels are set to NAV and each has the ILS frequency and course set in.

Note : The ILS frequency will be automatically tuned when the direct distance to destination is below 300 NM.

**Check approach guidance message**

If the pilot inserts a non-ILS approach into the flight plan and then uses the RAD NAV page to manually tune in an ILS. The MCDU displays "CHECK APPR GUIDANCE". This message is a reminder that the available APPR guidance modes are APP NAV and FINAL.



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Example : OLW was manually entered on the RAD NAV page, although a VOR approach is selected in the flight plan.

**Arming conditions of LOC and G/S modes**

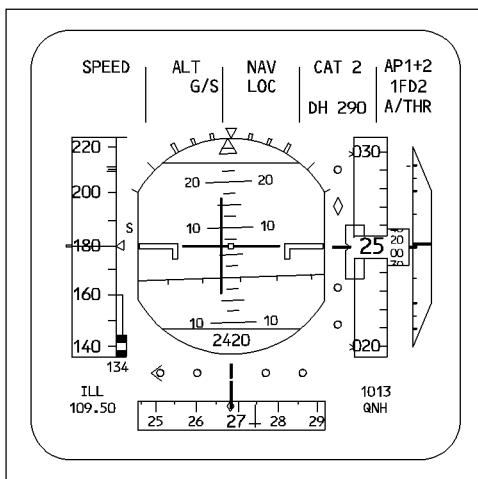
The pilot arms the (ILS) APPR mode (LOC and G/S in blue on the FMA) by pushing the APPR pushbutton on the FCU, provided that :

- An ILS approach is selected,
- The aircraft is above 400 feet RA,
- The ILS is available,
- Go-around or takeoff or final mode is not engaged,
- ILS frequency and course are identically set on both receivers.
- LOC and G/S blue are displayed on the FMAs. Both modes will automatically engage when conditions are met.
- Second autopilot may be engaged.
- Current landing capability is displayed on the FMAs.

**Disarming conditions of LOC and G/S modes**

- R ILS APPR mode is disarmed if the aircraft is above 400 feet and one of the following conditions is met :
- When the pilot presses the APPR pushbutton, both the LOC and the G/S modes disarm.
    - The HDG/TRK mode engages, if the LOC mode was engaged, and the V/S or FPA mode engages if the G/S mode was engaged.
  - When the pilot presses the LOC pushbutton, only the G/S mode disarms and :
    - The V/S or FPA mode engages, if the G/S mode was engaged.
- R — The pilot pulls the HDG/TRK selector knob.
- R — The pilot engages go-around mode.

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LOC AND G/S ARMED

### **Engagement conditions of LOC and G/S modes**

When ILS capture conditions are fulfilled :

- LOC\* mode engages, and
- G/S\* mode engages (No radio altimeter validity is required with this standard for G/S engagement).

The FMA displays "LOC\*" or "G/S\*" or both in green.

Nevertheless, G/S\* mode cannot engage if :

- LOC\* mode is not engaged, or
- the aircraft is above the glide path and its trajectory does not cross the ILS G/S beam.

The FMA displays "LOC" and "G/S" in green.

Once the aircraft is established on LOC axis :

- LOC mode engages,
- G/S mode engages when the aircraft is established on G/S axis.

The FMA displays "LOC" and "G/S" in green.

The AP/FD guides the aircraft along the G/S down to 30 feet and along the LOC during the flare and the roll out.

- R    Note : G/S\* or G/S may engage at altitudes that are above the radio altimeter validity (8000 feet for TRT, 5000 feet for Collins radio altimeter) but the landing capability displayed on the FMA will reflect the lack of radio altimeter validity (CAT1 only) until the RAs become active.

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**Disengagement conditions of LOC and G/S modes**

If the aircraft is above 400 feet the (ILS) APPR mode disengages :

- When the pilot pushes in the APPR pushbutton : the system reverts to basic modes (HDG V/S or TRK FPA).
- When the pilot pushes in the LOC pushbutton : LOC mode remains engaged. The system reverts to V/S (FPA), if G/S was engaged.
- When the pilot pulls out the HDG/TRK selector knob : the system reverts to basic modes HDG V/S or TRK FPA.
- When the pilot engages go-around mode.
- When LOC or G/S signal has been lost for 7 seconds or more above 200 feet RA. AP/FDs disengage and FDs reengage in basic modes (HDG V/S or TRK FPA).

**Disengagement conditions of G/S only**

- When the pilot pulls out the V/S FPA selector knob, LOC mode remains engaged but G/S mode disengages and V/S or FPA engages.
- When the pilot pushes or pulls the ALT selector knob, LOC mode remains engaged and the mode selected by the crew engages as a function of the FCU selected altitude.

**LOC capture assistance function**

In NAV mode, and when within 20 NM of the destination runway, the aircraft is guided with a track angle of 20° from the LOC axis. This helps the aircraft to intercept and capture the LOC beam. When the ILS frequency, or the ILS ident entered on the RAD NAV page, differs from the ILS of the destination runway entered in the Flight Plan :

- The aircraft loses the LOC capture assistance function.
- The message "RWY/ILS MISMATCH" is displayed on the scratchpad.
- The pilot should select the HDG mode to perform the LOC capture.

*Note : There is no G/S capture assistance. The pilot must ensure that the aircraft's flight path intercepts the glideslope beam.*

**LAND MODE****Engagement conditions**

LAND mode automatically engages when the LOC and G/S modes are engaged and the aircraft is below 400 feet RA. The FMA displays "LAND", indicating that LOC and G/S are locked. No action on the FCU will disengage LAND mode. FLARE and ROLL OUT modes will successively engage.

**Disengagement conditions**

LAND mode disengages :

- Upon engagement of the go-around mode ;
- If the pilot presses the APPR pushbutton, when the aircraft has been on ground for at least 10 seconds with the autopilot disconnected.

Note : When LAND is not displayed on the FMA at/or slightly below 400 feet, the landing capability degrades to CAT 1 and an aural triple click is generated. Autoland is not allowed with CAT 1 displayed on the FMA.

**FLARE MODE**

- R Once the aircraft reaches approximately 55 feet RA (the precise value is a function of V/S),
  - FLARE mode engages.
  - The FMA displays "FLARE" in green.
- R Around 45 feet RA, the AP/FD aligns the yaw axis with the runway centerline and the aircraft starts to flare on the pitch axis. If the autothrust is active, thrust is automatically reduced to IDLE during flare (refer to A/THR RETARD mode).
- R When both AP/FDs are disengaged, FLARE mode disengages.  
After main landing gear touchdown, the autopilot (if engaged) sends a nose down order.

**Align sub-mode**

- Align is a sub-mode of LAND that lines up the aircraft's axis with the ILS course at approximately 45 feet. Align sub-mode is not displayed to the crew.

Note : Align sub-mode is often known as "decrab" function.

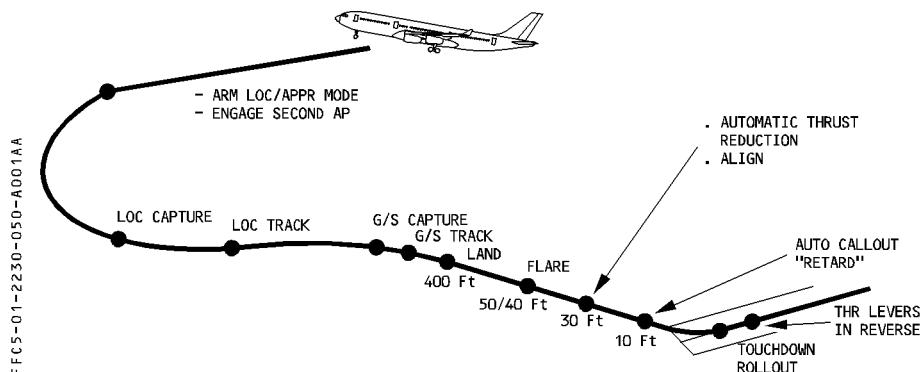
**ROLL OUT MODE**

At touchdown, ROLL OUT mode engages and guides the aircraft along the runway centerline. The FMA displays "ROLL OUT" in green, and the PFD displays the yaw bar and no FD bars.

## SPEED CONTROL

- R The autothrust, when active, controls speed. The approach speed target (VAPP) is either managed by the FMGS or selected by the crew :
- R – When managed, the speed target is computed by the FMGS and may be modified by the crew through the MCDU. At 700 feet RA, the current speed target value is memorized by the autothrust, to ensure stabilized speed guidance, even if Flight Management fails. Below 700 feet, any new VAPP or WIND entry in the MCDU has no effect on the speed target.
- R – When selected, the autothrust always targets the speed selected on the FCU.

## TYPICAL ILS APPROACH



## AUTOLAND WARNING LIGHT

The following situations, when occurring below 200 feet RA with the aircraft in LAND mode, trigger the flashing AUTOLAND red warning and a triple click aural warning :

- Both APs OFF below 200 feet RA
- Excessive deviation in LOC (1/4 dot above 15 feet RA) or GLIDE (1 dot above 100 feet RA). In addition, LOC and GLIDE scales flash on the PFD.
- Loss of LOC signal above 15 feet or loss of GLIDE signal above 100 feet. The FD bars flash on the PFD. The LAND mode remains engaged.
- The difference between both radio altimeter indications is greater than 15 feet.

## LANDING CAPABILITIES

Each FMGC computes its own automatic landing capability, according to the availability of computers or sensors or functions (Refer to 4.05.70)

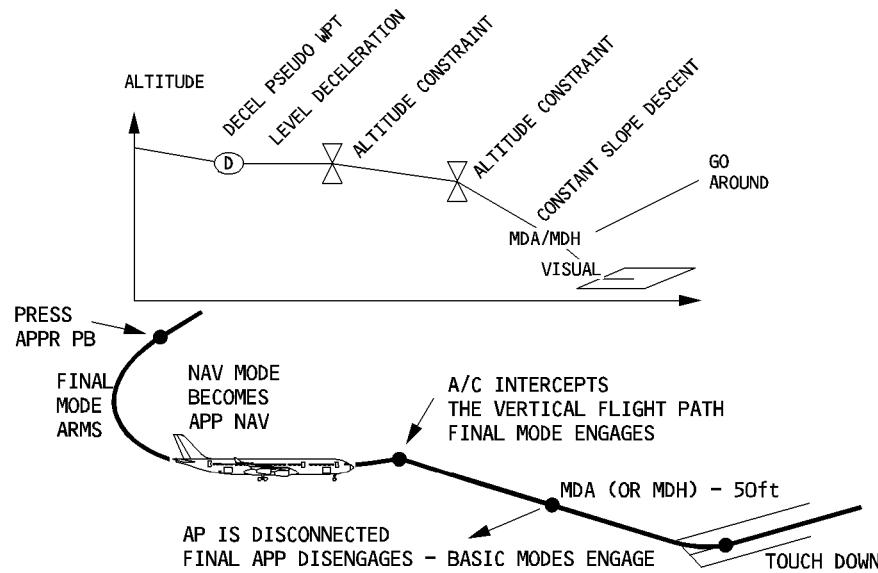
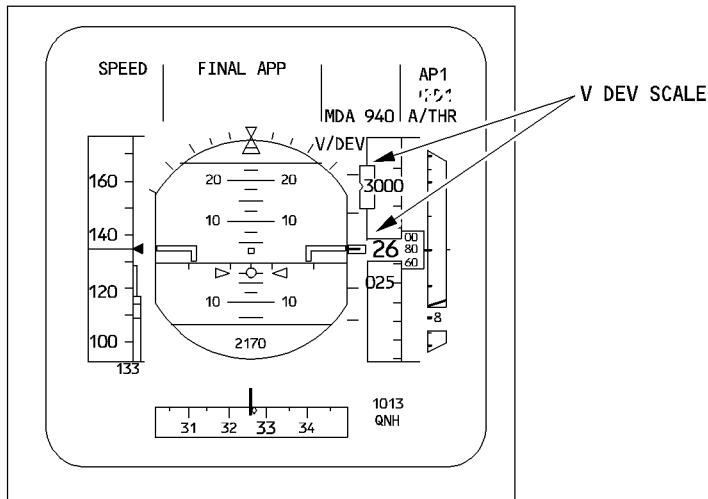
The FMA displays "CAT1", "CAT 2", "CAT 3 SINGLE" or "CAT 3 DUAL" messages as soon as the APPR pushbutton is pushed in to arm ILS approach modes.

## NON PRECISION APPROACH MODE

This mode guides the aircraft laterally and vertically down to the Minimum Descent Altitude (MDA) or Minimum Descent Height (MDH) along the final descent profile computed by the FMGS.

This mode is used to fly a NON ILS approach (VOR, VOR/DME, NDB, RNAV...) as inserted into the flight plan.

R



A non precision approach includes the following managed modes :

- APP NAV mode for lateral guidance,
- FINAL mode for vertical guidance.

## SELECTION

- R The non precision approach guidance modes are available, if a non-precision approach (VOR, VOR-DME, NDB, RNAV) has been inserted in the active flight plan.

## ARMING CONDITIONS

The crew arms APP NAV and FINAL modes by pressing the FCU's APPR pushbutton, provided all of the following conditions are met :

- The aircraft is above 400 feet AGL,
- The active flight plan is valid (lateral and vertical profile),

- R – A non precision approach has been selected in the active flight plan,  
– GA mode is not engaged.

The FMA displays "FINAL" and "APP NAV" in blue.

If NAV mode was already engaged, APP NAV engages immediately.

## DISARMING CONDITIONS

FINAL and NAV modes are disarmed, if the pilot :

- Presses the APPR pushbutton, or
- Presses the LOC pushbutton (thus arming LOC mode), or
- Engages GO AROUND mode.

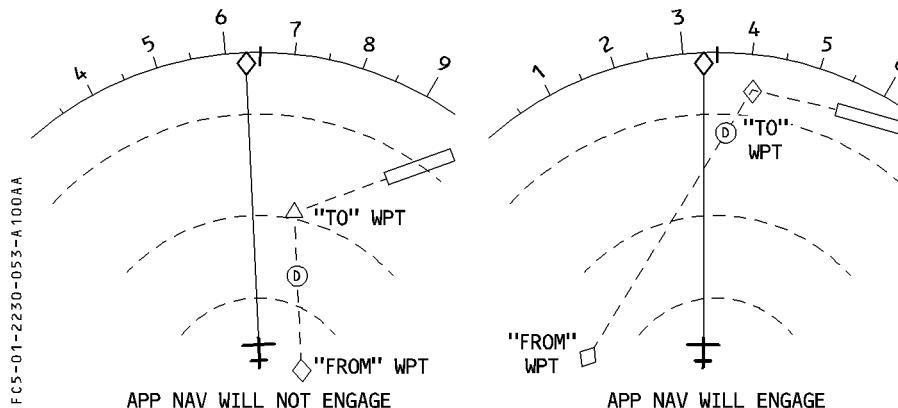
## ENGAGEMENT CONDITIONS

APP NAV and NAV modes engage under the same conditions :

If NAV mode was engaged, APP NAV engages immediately. If HDG/TRK is engaged, APP NAV engages when the intercept conditions are met (the aircrafts' heading or track intercepts the flight plan active leg).

FINAL mode engages, if :

- The APPR phase is active, and the deceleration point has been sequenced, and
- APP NAV mode is engaged, and
- The crosstrack error is less than 1.5 NM, and
- FINAL mode is armed, and :
  - The aircraft intercepts a descending leg of the vertical flight path, or
  - In V/S (FPA) or OP DES mode, the aircraft intercepts a level-off segment of the vertical flight profile, with a selected altitude different from this level-off segment.



## DISENGAGEMENT CONDITIONS

The FINAL and APP NAV modes disengage :

- If the pilot pushes the APPR pushbutton (HDG V/S or TRK FPA mode engages)
- If the pilot pushes the LOC pushbutton (LOC mode arms if an ILS is selected, otherwise HDG V/S or TRK FPA mode engages)
- R – If the pilot pulls out the HDG TRK selector knob, the FMGS reverts to basic modes HDG V/S or TRK FPA
- R – Automatically at MDA (or MDH) – 50 feet or 400 feet AGL if no MDA/MDH entered.
- When the GO AROUND mode engages.

Note : If the pilot engages V/S or FPA mode, only FINAL mode disengages with this FMGS standard. NAV mode remains engaged.

## GUIDANCE

The FINAL mode guides the aircraft on the vertical profile down to the Minimum Descent Altitude (or the Minimum Descent Height if the aircraft has the QFE pin program installed). The FINAL mode does the following :

- Displays a vertical deviation scale ( $\pm 200$  feet) on the Primary Flight Display and a VDEV symbol showing deviation from descent path.
- Anticipates leaving the altitude selected by the Flight Control Unit when the aircraft reaches the Continue Descent symbol (arrow blue on the navigation display)
- Gives precise vertical guidance on the descent and final path with an internal vertical speed limitation to avoid excessive V/S.

If the autopilot is engaged while you are using the APP NAV/FINAL modes, it automatically disengages at MDA (or MDH) – 50 feet.

FD modes revert to basic HDG-V/S or TRK-FPA.

## **WARNING**

When the GPS PRIMARY function is installed, a triple-click aural warning sounds, if the GPS PRIMARY function is lost during a non precision approach.

### **GO AROUND (GA)**

Go-around mode combines the Speed Reference System (SRS) vertical mode with the Go-Around Track (GA TRK) lateral mode.

### **ENGAGEMENT CONDITIONS**

Setting at least one thrust lever to the TOGA detent engages both SRS/GA TRK modes, if:

- The flaps lever is at least in position 1, and
- The aircraft is in flight, or
- The aircraft has been on ground for less than 30 seconds (AP disengages and can be re-engaged 5 seconds after liftoff).

The FMA displays "SRS" and "GA TRK" in green.

FD bars are automatically restored in SRS/GA TRK modes.

If FPD-FPV was selected for approach, it reverts to FD bars.

### **DISENGAGEMENT CONDITIONS**

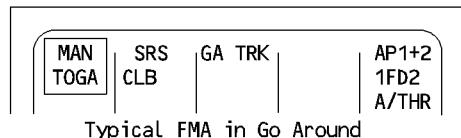
- The SRS mode disengages :
  - Automatically, at the go-around acceleration altitude (GA ACC ALT) or if ALT\* or ALT CST\* mode engages (above 400 feet RA).
  - If the flight crew engages another vertical mode.
  - If the flight crew selects a speed while in SRS mode : SRS reverts to OP CLB mode.

Note : In Engine Out conditions, the SRS mode does not automatically disengage at EO ACC ALT. Refer to Engine Out procedures.

- GA TRK disengages when the pilot engages another lateral mode above 100 feet RA. In dual AP configuration, disengagement of the go-around mode, on either axis, causes AP2 to disconnect.

**GUIDANCE**

- The SRS law maintains the current speed at Go-around engagement, or VAPP, whichever is higher. Nevertheless, the SRS speed is limited to VLS + 25 kt in normal engine configuration and VLS + 15 kt in engine out. When the SRS mode disengages, the target speed becomes Green Dot speed.
- GA TRK mode guides the aircraft along the current track at Go-around initiation.



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## **AUTOTHROTTLE**

### **GENERAL**

The autothrust (A/THR) is a function of the FMGS, it includes 2 independent A/THR commands, one per FMGC. Each one is able to control the thrust of the 4 engines simultaneously through 4 engine interface units and 4 engine control units. Only one FMGC controls the active A/THR, it is called the master FMGC.

Thrust is controlled :

- automatically when the A/THR is active
- manually by the pilot.

The autothrust is active when the A/THR pushbutton of the FCU is lighted green and A/THR is displayed white in the FMA 5th column.

The position of the thrust levers determines whether A/THR is armed, active, or disconnected.

The autothrust system, when active :

- maintains a specific thrust in THRUST mode
- controls the aircraft speed or MACH in SPEED/MACH mode
- uses ALPHA FLOOR mode to set maximum thrust when the aircraft angle of attack exceeds a specific threshold.

The autothrust system can operate independently or with the AP/FD.

- When performing alone, A/THR always controls the speed.
- If the autothrust system is working with the AP/FD, the A/THR mode and AP/FD pitch modes are linked together. (Refer to 1.22.30 Interaction between AP/FD and A/THR modes).

When autothrust is active, the FMGS commands the thrust according to the vertical mode logic, but uses a thrust not greater than the thrust commanded by the position of the thrust lever. For example, when the thrust levers are set at the CL (climb) detent, A/THR can command thrust between idle and max climb.

The autothrust system, when armed, automatically activates if the thrust levers are moved into the active range sector. Outside of this range, thrust levers control thrust directly.

### **Master A/THR**

The thrust being controlled being one A/THR only, when one AP is engaged, priority is given to the associated autothrust.

When both APs are engaged or no AP/FD engaged, A/THR 1 has the priority.

## THRUST LEVERS

The pilot uses the thrust levers to do the following :

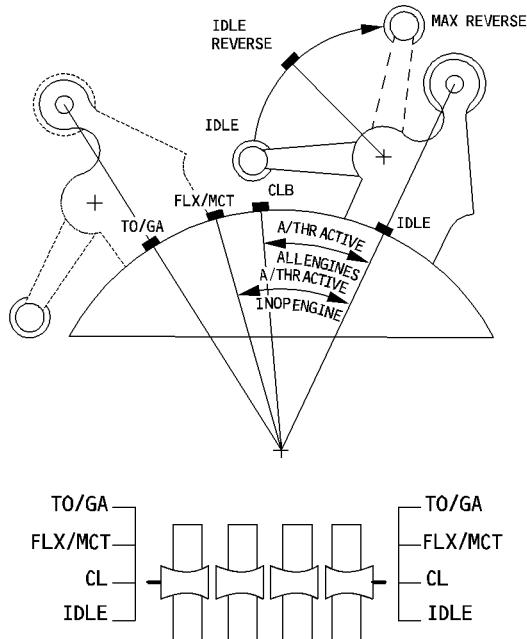
- Manually select engine thrust.
- Arm and activate autothrust (A/THR).
- Engage reverse thrust.
- Engage the takeoff and go around modes.

When autothrust is disconnected, the thrust levers control thrust directly : each lever position corresponds to a given thrust.

4 detents divide each of the thrust lever sectors into three segments. The detents are :

- |         |   |   |
|---------|---|---|
| TO GA   | : | Maximum takeoff thrust                        |
| FLX MCT | : | Maximum continuous thrust (or FLX at takeoff) |
| CL      | : | Maximum climb thrust                          |
| IDLE    | : | Idle thrust.                                  |

When the thrust levers are at the IDLE position, the pilot can pull the reverse levers.



## **A/THR ARMING CONDITIONS**

- R There are a considerable number of A/THR arming conditions. The following is a list of the most important ones :
- One FMGC operative
  - 2 ADIRS operative
  - 3 FADECs operative, and the A/THR function is available on each engine
  - One operative FCU channel
  - A/THR is not manually disabled (instinctive disconnect pushbutton has not been pressed for more than 15 seconds).

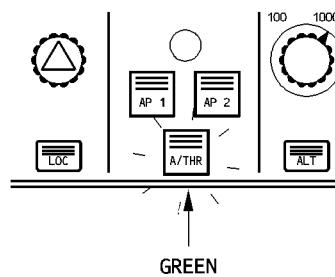
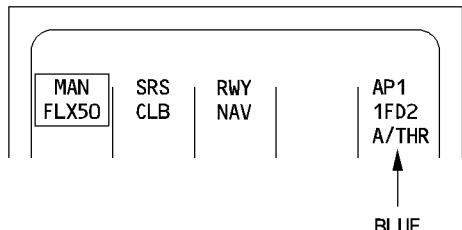
The pilot arms the A/THR :

- On ground :
  - By pushing the FCU's A/THR pushbutton, when the engines are not running, or
  - By setting the thrust levers at the FLX or TOGA detent, when the engines are running.
- In flight :
  - By pushing the FCU's A/THR pushbutton, while the thrust levers are out of the active range, or
  - While A/THR is active ("A/THR" white on the FMA), by setting all thrust levers beyond the CL detent, or at least one lever beyond the MCT detent, or
  - By engaging the go-around mode.

When the A/THR is armed :

- The FCU's A/THR pushbutton light comes on
- "A/THR" is displayed in blue on the FMA.

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Note : At takeoff, if the thrust levers are set back to idle, the A/THR disengages and cannot be rearmed until airborne.

## A/THR ACTIVATION

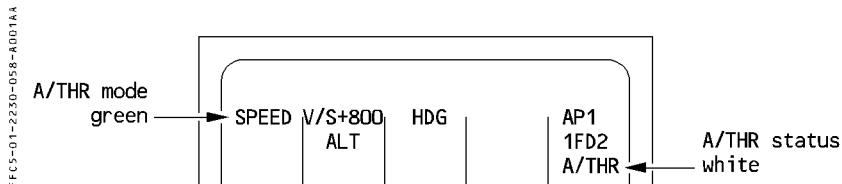
A/THR is active when it controls thrust or speed. The thrust lever position determines the maximum thrust that the A/THR system can command (except in  $\alpha$ -floor condition).

The A/THR, being armed, is activated when the pilot sets the thrust levers between :

- CL and IDLE detents (all engines operative).
- MCT and IDLE detents (one engine inoperative).

The A/THR, being disconnected, is activated when the pilot pushes the FCU pushbutton while the thrust levers are within the active range, including the IDLE position.

- R *Note : When the pilot sets all thrust levers to the IDLE position, A/THR disconnects. However, if the pilot pushes the FCU's A/THR pushbutton, the autothrust will be simultaneously armed and activated. Due to the thrust levers' position, IDLE thrust will be maintained.*
- R When ALPHA FLOOR is activated, regardless of the initial A/THR status, and position of the thrust levers, the A/THR activates.
- R When A/THR is active :
- The FCU's A/THR pushbutton lights up.
  - The FMA displays A/THR mode in green (in the first column) and A/THR in white (in the fifth column).



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## EFFECTS OF THRUST LEVER MOVEMENT WHILE A/THR IS ACTIVE

- When all thrust levers are set above the CL detent or at least one above the MCT detent, the A/THR reverts from active to armed. "A/THR" turns to blue on the FMA and the thrust levers control the thrust directly. The FMA displays "MAN THR" white in its first column.  
The thrust levers provide the crew with an immediate increase of thrust when thrust levers are pushed above the CL detent (4 engines) or the active thrust levers above the MCT detent (one engine inoperative).
- When all thrust levers are set below the CL (4 engines) or 3 thrust levers are set below the MCT (1 engine inoperative), "ATHR LIMITED" ECAM message is activated (with single chime and amber caution) every 5 seconds until the pilot moves the levers into the detent, "THR LVR" green is displayed on the FMA.  
"LVR CLB" (all engines operative) or "LVR MCT" (one engine inoperative) flashes white in the first column of the FMA.  
This device reminds the crew that the normal operating position of the thrust levers, when A/THR is active, is the CL detent (all engines) or the MCT detent (one engine inoperative).
- When at least one thrust lever is set out of the CL (or MCT) detent, with autothrust active, the "LVR ASYM" amber message comes up until all levers are set in the CL detent.

## A/THR DISCONNECT

When the A/THR is disconnected, it is neither armed nor active.

The A/THR can be disconnected in two ways :

- \* Standard disconnection
  - The pilot pushes the instinctive disconnect pushbutton on the thrust levers (which immediately sets the thrust corresponding to the lever positions) or
  - The pilot sets all thrust levers to IDLE detent.
- \* Non-standard disconnection
  - The pilot pushes the A/THR pushbutton on the FCU while A/THR is armed/active, or
  - The system loses one of the arming conditions.

### R \* **Below 100 feet radio altitude**

When the radio altitude is below 100 feet and the pilot sets all thrust levers above the CL detent or one above the MCT detent, the autothrust will disconnect. It will rearm automatically when at least one of the thrust levers is set to TOGA.

If the PF set the thrust levers above CL detent but below TOGA and come back to CL detent, the A/THR will disconnect and remain disconnected. As a result, the thrust will increase up to CLIMB thrust. The crew has to manually set the appropriate thrust for landing (or go around).

**CAUTION**

If the pilot pushes and holds one instinctive disconnect pushbutton for more than 15 seconds, the A/THR system is disconnected for the remainder of the flight. All A/THR functions including ALPHA FLOOR are lost, and they can be recovered only at the next FMGC power-up (on ground).

**THRUST LOCK FUNCTION**

- The THRUST LOCK function is activated when the thrust levers are in the CL detent (or the MCT detent with one engine out) and the pilot pushes the FCU A/THR pushbutton or the A/THR disconnects due to a failure.
- R The thrust is locked or frozen at its level prior to disconnection. Moving the thrust levers out of the CL or MCT detent suppresses the thrust lock, and reverts to manual control.
- When the thrust lock function is active :
- "THR LK" flashes amber on the FMA.
  - ECAM "ENG THRUST LOCKED" flashes every five seconds.
  - ECAM displays "THR LEVERS..... MOVE"
  - A single chime sounds and the Master Caution Light flashes every five seconds.
- All warnings cease when the pilot moves the thrust levers out of the detent.

**A/THR DISCONNECT CAUTION**

- R The standard disconnection triggers a temporary ECAM message and a single chime.
- R The non standard disconnection (A/THR pb pressed on the FCU or A/THR failure) triggers continuous visual cautions until the pilot reacts. The single chime sounds.

		<b>A/THR DISCONNECTION</b>	
		<b>BY INSTINCTIVE DISCONNECT OR SETTING TWO LEVERS TO IDLE (if above 50 feet RA)</b>	<b>BY OTHER MEANS</b>
<b>CONSEQUENCE</b>	MASTER CAUTION	illuminated-3 sec max	illuminated
	ECAM MESSAGE	amber A/THR OFF message 9 sec maximum	caution
	AUDIO	single chime	single chime
	CLR pushbutton on ECAM CONTROL PANEL	extinguished	illuminated
<b>ACTION</b>	MASTER CAUTION pushbutton	extinguishes MASTER CAUTION light, erases ECAM message.	extinguishes MASTER CAUTION light
	CLR pushbutton on ECAM CONTROL PANEL	No effect	extinguishes MC light and CLR pushbutton, erases ECAM message calls status
	INSTINCTIVE DISCONNECT pushbutton	extinguishes MASTER CAUTION light, erases ECAM message.	extinguishes MASTER CAUTION light
<b>ECAM STATUS MESSAGE</b>		NO	YES

**A/THR MODES**

Except in takeoff and go-around situations, normal operation of the A/THR system requires the thrust levers to be :

- In the CL detent for the 4 engine configuration. If they are not set in the CL detent, “LVR CLB” flashes white on the FMA.
- In MCT detent, when in one-engine-out configuration. If the other levers are not set in the MCT detent, “LVR MCT” flashes white on the FMA.

The A/THR modes are automatically selected in conjunction with the AP/FD modes (except for ALPHA FLOOR).

A/THR in THRUST mode	AP/FD pitch mode maintains the speed : OP CLB - OP DES - CLB - SRS - FLARE and DES (IDLE path)
A/THR in SPEED/MACH mode	If neither AP nor FD is engaged. If AP/FD controls a vertical path V/S-FPA-ALT*- ALT CST*-ALT-ALT CRZ-G/S*-G/S-FINAL and DES (geometric path)
A/THR in RETARD mode	Automatic landing (AP engaged in LAND mode).

**THRUST mode**

- In THRUST mode, autothrust commands a specific thrust level in conjunction with the AP/FD pitch mode. This thrust level is limited by the thrust lever position.

R

FMA display	Meaning
THR MCT	The most advanced thrust lever is in the MCT detent (engine-out)
THR CLB	The most advanced lever is in the CL detent.
THR LVR	Thrust levers are either below CL or MCT detent, or at least one thrust lever is in CL detent and the others above CL detent.
THR IDLE	A/THR commands IDLE thrust.
THR DES	A/THR commands a reduced thrust while DES mode is engaged.

*Note : When the A/THR is armed for takeoff, or go-around, the FMA displays “MAN TOGA” (or “MAN FLX” or MAN DTO  $\triangleleft$ ) in white to remind the crew that the thrust levers have been positioned properly.*

### **RETARD mode**

The RETARD mode is available only during automatic landing (AP engaged in LAND mode). RETARD mode engages at approximately 40 feet RA and remains engaged after touchdown.

The A/THR commands IDLE thrust during the flare and the FMA and engine warning display show "IDLE".

If the autopilot is disengaged during the flare before touchdown, the SPEED mode replaces RETARD mode, and the pilot has to reduce thrust manually.

*Note : In automatic landing, the system generates a "RETARD" callout at 10 feet RA, which prompts the pilot to move the thrust levers to IDLE in order to confirm thrust reduction. In manual landing conditions, the system generates this callout as a reminder at 20 feet RA.*

### **SPEED/MACH mode**

In SPEED/MACH mode, the A/THR adjusts the thrust in order to acquire and hold a speed or Mach target.

The speed or Mach target may be :

- selected on the FCU by the pilot
- managed by the FMGC.

When in SPEED or MACH mode, the A/THR does not allow speed excursions beyond the following limits regardless of the target speed or Mach number :

- For a selected speed target, the limits are VLS and VMAX (VMO-MMO, VFE-VLE, whichever applies).
- For a managed speed target, the limits are maneuvering speed (Green Dot, S, F, whichever applies) and maximum speed (320/.84-VFE-VLE whichever applies).

The changeover from SPEED to MACH mode is either automatically performed by the FMGC or manually by the pilots (in selected speed target only) by pushing the SPD/MACH change-over pushbutton.

The FMA displays "SPEED" or "MACH".

## MACH MODE IN CRUISE PHASE (A/THR SOFT MODE)

- R When the aircraft is in ALT CRZ mode with the autopilot engaged, autothrust engaged in MACH mode, and is within a  $+/- 3$  knot range of the target speed, the autothrust soft mode engages. This mode reduces the thrust variation in cruise, specifically in light turbulence. The autothrust soft mode disengages, when the speed deviation from the target becomes too large or the target is modified ; autothrust transition from soft to basic mode may lead to transient thrust variation. This mode is inhibited with the speedbrakes extended, or with an engine-out, or when Mach target is below 0.65.

## SPEED MODE IN APPROACH PHASE

When the aircraft flies an approach in managed speed, the speed target displayed on the PFD in magenta, is variable during the approach.

This managed speed target is computed in the FMGS, using the "ground speed mini" function.

## GROUND SPEED MINI FUNCTION PRINCIPLE

The purpose of the ground speed mini function is to take advantage of the aircraft's inertia, when the wind conditions vary during the approach. It does so by providing the crew with an adequate indicated speed target. When the aircraft flies this indicated speed target, the energy of the aircraft is maintained above a minimum level, ensuring standard aerodynamic margins versus stall.

If the A/THR is active in SPEED mode, it will automatically follow the speed target, ensuring efficient thrust management during the approach.

The minimum energy level is the energy level the aircraft will have at touchdown, if it lands at VAPP speed with the Tower-reported wind as inserted in the PERF APPR page.

The minimum energy level is represented by the Ground Speed the aircraft will have at touchdown. This Ground Speed is called "GROUND SPD MINI".

During the approach, the FMGS continuously computes the speed target using the wind experienced by the aircraft in order to keep the ground speed at, or above, the "Ground Speed Mini".

The lowest speed target is lower limited by VAPP, and is upper limited by VFE of next configuration in CONF1, 2, 3 and VFE-5 in CONF FULL.

The speed target is displayed on the PFD speed scale in magenta, when approach phase and managed speed are active. It is independent of the AP/FD, and/or ATHR engagements.

Wind is a key factor in the ground speed mini function.

## TWR WIND

TWR WIND is the MAG WIND entered in the PERF approach page. It is the average wind, provided by the ATIS or the Tower. Gusts must not be inserted ; they are included in the aircraft target speed computation.

## TWR HEADWIND COMPONENT

- R The TWR HEADWIND COMPONENT is the component of the TWR wind projected on the runway axis (landing runway entered in the flight plan). It is used to compute VAPP and GS mini. The TWR wind is the wind announced by the ATC and entered in the PERF APPR page (MAG WIND field).

## CURRENT WIND COMPONENT

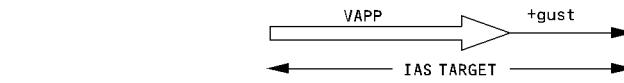
- R The actual wind measured by ADIRS is projected on the aircraft axis to define the CURRENT HEADWIND COMPONENT (instantaneous headwind).
- R The CURRENT HEADWIND COMPONENT is used to compute the variable speed target during final (IAS target).

## R VAPP COMPUTATION

- R VAPP, automatically displayed on the MCDU PERF APPR page, is computed as follows :
- R  $VAPP = VLS + \frac{1}{3}$  of the TWR HEADWIND COMPONENT or
- R  $VAPP = VLS + 5$  knots, which ever is highest.
- R "1/3 of the TWR HEADWIND COMPONENT" has 2 limits :
- R – 0 knots as the minimum value (no wind or tailwind)
- R – +15 knots as the maximum value.
- R The crew can manually modify the VAPP and TWR wind values on the PERF APPR page.

## R SPEED TARGET COMPUTATION

- R The FMGS continuously computes a speed target (IAS target) that is the MCDU VAPP value plus an additional variable gust.



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- R The IAS target is displayed on the PFD as a magenta triangle moving with the gust variation.

## R Speed target computation above 400 feet :

- R The gust is the instantaneous difference between the CURRENT HEADWIND COMPONENT and the TWR HEADWIND COMPONENT. It is always positive (or equal to zero for no wind or tailwind).
- R The IAS targets have 2 limits :
  - VAPP as minimum value
  - VFE – 5 knots in CONF FULL and VFE in CONF 1, 2, 3 as maximum value.

**R Speed target computation below 400 feet :**

R The gust taken into account is only 1/3 of the instantaneous difference between CURRENT HEADWIND and the TWR HEADWIND COMPONENT. This is done to prevent any important thrust variation in late final. Min and Max values remain unchanged.

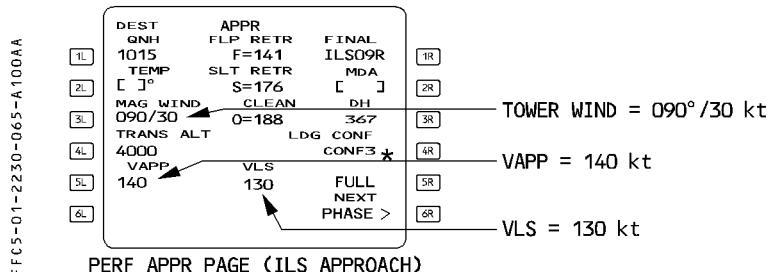
**R GROUND SPEED MINI (GS mini) COMPUTATION**

R Ground speed mini concept has been defined to prevent the aircraft energy from dropping below a minimum level during final approach. The GS mini value is not displayed to the crew.

**R EXAMPLE**

R Approach on runway 09

R The tower wind direction is on the runway axis.



**R IAS TARGET VALUES**

R If we turn the previously explained speed target definition into formulae, we obtain the following result :

**Above 400 feet**

R IAS TARGET = Max [VAPP, (VAPP + CURRENT HEADWIND - TWR HEADWIND)] (1)

Current wind in approach	IAS target
(a) 090/50	Max [VAPP, (140 + 50 - 30)] = 160 kt
(b) 090/10	Max [VAPP, (140 + 10 - 30)] = 140 kt
(c) 270/10	Max [VAPP, (140 + 0 - 30)] = 140 kt
(d) 090/30	Max [VAPP, (140 + 30 - 30)] = 140 kt

(1) For this computation, the TWR HEADWIND is voluntarily limited to 10 kt as a minimum.

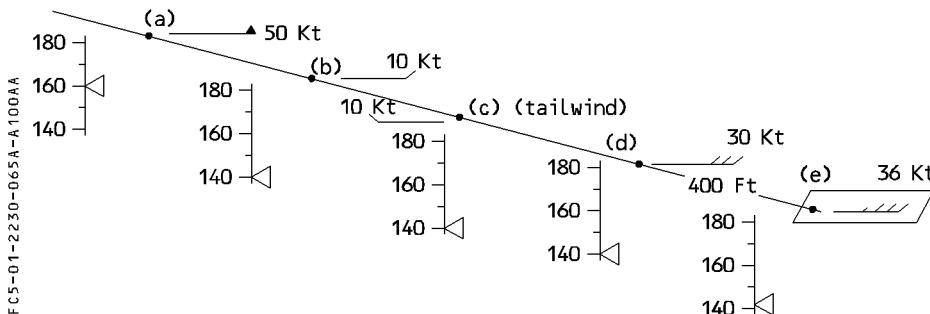
**Below 400 feet**

IAS TARGET = Max [VAPP, VAPP + 1/3 (CURRENT HEADWIND – TWR HEADWIND)]

That is equivalent to :

IAS TARGET = Max (VAPP, VLS + 1/3 of CURRENT HEADWIND COMPONENT)

Current wind in approach	IAS target
(e) 090/36	Max [VAPP, (130 + 12) = 142 kt



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## **A/THR MODE REVERSION**

CONDITIONS	EVENT	CONSEQUENCES
<ul style="list-style-type: none"> <li>• A/THR active in THR mode</li> <li>• AP OFF</li> <li>• FD engaged</li> <li>• DES or OP DES engaged (CLB, or OP CLB)</li> </ul>	Aircraft speed = VLS (Vmax)	<ul style="list-style-type: none"> <li>• A/THR reverts to SPD mode</li> <li>• FD bars are removed</li> </ul>

For more details, refer to "Speed mode protection".

### **Alpha Floor**

ALPHA FLOOR protection is triggered when the FMGCs receive a signal elaborated by the PRIMs. This signal is sent, when the aircraft's angle of attack is above a pre-determined threshold function of the aircraft's configuration. A/THR is automatically activated and commands TOGA thrust, regardless of the thrust lever positions. This protection is available from lift-off to 100 feet RA in approach.

The following indications are then provided :

- A-FLOOR on the FMA and on the EWD, as long as  $\alpha$  floor conditions are met.
- TOGA LK on the FMA, when the aircraft leaves the  $\alpha$  floor conditions.

TOGA thrust is then frozen.

A FLOOR and TOGA LK are displayed in green, and outlined with a flashing amber box.

In order to cancel ALPHA FLOOR or TOGA LK thrust, disconnect the A/THR.

Note : Alpha Floor is inhibited :

- In case of a single outer engine failure, with the flaps extended.
- In case of a single outer engine failure, with derated TO selected.
- In case of a dual engine failure on the same wing.
- Below 100 feet at landing.
- Above M.53.

Alpha Floor protection is lost, in case of an A/THR failure.

#### **CAUTION**

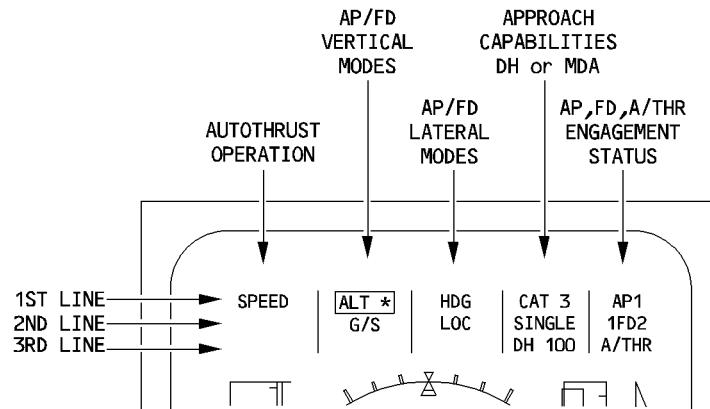
- R      The system may consider an outer engine to be failed, when this engine's Thrust Lever Angle (TLA) is below 5°, and the TLA of at least one other engine is above 5°. Therefore, Alpha Floor may be inhibited.
- R      In manual thrust control, when simultaneously moving all thrust levers back to about the IDLE position, and in order to avoid undue Alpha Floor inhibition, check that all levers are well-aligned and that no TLA is below 5°.

**FLIGHT MODE ANNUNCIATOR (FMA)**

The Flight Mode Annunciator (FMA), located on the top of the PFDs, reflects the status of the A/THR, the AP/FD vertical and lateral modes, the approach capabilities, and the AP/FD-A/THR engagement status.

A white box is displayed for 10 seconds around each new annunciation. The white box display time may be increased to 15 seconds in some mode reversion cases associated with a triple click aural warning.

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**In the three left columns :**

The engaged modes are displayed in green on the first line.

The armed modes are displayed in blue, or in magenta, on the second line.

Modes, armed due to a constraint, are displayed in magenta.

Special messages, are displayed on the third line :

- First priority is given to messages related to flight controls :
  - MAN PITCH TRIM ONLY flashes red for 9 seconds, then remains steady.
  - USE MAN PITCH TRIM pulses amber for 9 seconds, then remains steady.
- Lower priority messages related to FMGS.

**In the fourth column, approach capabilities are displayed in white.**

DH or MDA/MDH is displayed in blue.

**In the right column, AP, FD, A/THR engagement status are displayed in white.**

FD is boxed for 10 seconds, in case of automatic FMGC switching.

When armed, A/THR is displayed blue.

*Note : The FMGS synchronizes A/THR mode, AP/FD modes, and landing capability to provide identical information on both PFDs.*

**AUTO THRUST ANNUNCIATIONS (FMA COLUMN 1)****First line**

R

DISPLAY	COLOR	MEANING
MAN TOGA	White White box	A/THR is armed, at least one thrust lever is in TOGA detent.
MAN FLX 50	White White box	A/THR is armed, at least one thrust lever is in MCT/FLX detent, with FLX TO temp set at, 50°. Other thrust levers are at, or below, the MCT/FLX detent. 50 is displayed in blue.
MAN MCT	White White box	A/THR is armed, at least one thrust lever is in MCT detent ; the others are at, or below, this detent and no FLX or DTO is entered.
MAN DTO $\triangleleft$	White White box	A/THR is armed, at least one thrust lever is in MCT/FLX detent, with an entered derated level. Other thrust levers are at, or below, the MCT/FLX/DTO detent.
MAN THR	White Amber box	A/THR is armed. This indication is not displayed during T.O or GA phases. The most advanced thrust lever is above the MCT detent ; or, all thrust levers are above CL detent.
THR MCT	Green	A/THR is active in thrust mode and the most advanced thrust lever is in the MCT detent (engine-out).
THR CLB	Green	A/THR is active in thrust mode, and the most advanced thrust lever is in the CL detent.
THR DCLB 1 (Z) $\triangleleft$	Green	A/THR is active in thrust mode. The most advanced thrust lever is in the CL detent, and the crew has selected a derated climb.
THR IDLE	Green	A/THR is active in thrust mode, and commands idle thrust.
THR LVR	Green	A/THR is active in thrust mode, all thrust levers are below CL detent, or the most advanced thrust lever(s) is between CL and MCT detent with at least one lever in CL detent.
THR DES	Green	A/THR is active in thrust mode and commands a reduced thrust, while DES mode is engaged.
SPEED or MACH	Green	A/THR is active in SPEED or MACH mode.
A. FLOOR	Green Amber box	A/THR is active and commands a reduced TOGA thrust, while $\alpha$ FLOOR conditions are met.
TOGA LK	Green Amber box	A/THR is active and TOGA thrust is frozen ( $\alpha$ FLOOR conditions are no longer met).

**Second/third lines**

The second and third lines display various caution messages.

**Second line**

DISPLAY	COLOR	MEANING
LVR CLB (flashing)	White	Request to set the thrust levers in CLB detent
LVR MCT (flashing)	White	Request to set the thrust levers in MCT detent.

**Third line**

R

DISPLAY	COLOR	MEANING
LVR ASYM	Amber	One thrust lever is in a detent (CLB or MCT) while all others are not in this detent. (4 engines only).
THR LK (flashing)	Amber	The thrust is frozen due to non-standard A/THR disconnection (FCU disconnection or failure).

Note : The amber caution flashes and a single chime sounds every 5 seconds, as long as the pilot does not take action in the following cases :

- THR LK
- THR CLB (if the thrust levers are below the CLB detent)
- LVR MCT (if the thrust levers are below the FLX/MCT detent).

**AP/FD VERTICAL MODES (FMA COLUMN 2)****First line**

R

DISPLAY	COLOR	MEANING
SRS	Green	Takeoff or go-around mode is engaged.
CLB	Green	Climb mode is engaged. The FMGS target altitude is higher than the actual altitude. ALT CSTR are taken into account.
OP CLB	Green	Open Climb mode is engaged. The FCU-selected altitude is higher than the actual altitude.
ALT*	Green	ALT CAPTURE at the FCU-selected altitude is engaged.
ALT CST*	Green	ALT CAPTURE at the ALT CSTR altitude (vertical profile) is engaged.
ALT CRZ*	Green	ALT CAPTURE at the CRZ FL is engaged.
ALT	Green	ALT mode is engaged. The FCU-selected altitude is held.
ALT CST	Green	An ALT CSTR is held (vertical profile).
ALT CRZ	Green	The CRZ FL altitude hold mode is engaged. The A/THR soft mode is engaged.
DES	Green	Descent mode is engaged. The FMGS target altitude is lower than the actual altitude. ALT CSTR are taken into account.
OP DES	Green	Open Descent mode is engaged. The FCU-selected altitude is lower than the actual altitude.
G/S*	Green	Glide Slope capture mode is engaged.
G/S	Green	Glide Slope mode is engaged.
V/S ± XXXX	Green	Vertical speed mode is engaged to acquire and hold the V/S selected on the FCU. Target is displayed in blue.
FPA ± X.X°	Green	Flight Path Angle mode is engaged to acquire and hold the FPA selected on the FCU. Target is displayed in blue.

**Second line**

DISPLAY	COLOR	MEANING
CLB	Blue	Climb mode is armed before the climb phase.
OP CLB	Blue	Open Climb mode is armed.
ALT	Blue or Magenta	Altitude mode is armed : – Blue, when the target altitude is the FCU-selected altitude. – Magenta, when the target altitude is an ALT CSTR.
ALT CRZ	Blue	Altitude mode is armed. Target altitude is the CRZ FL.
DES	Blue	Descent mode is armed before the descent phase.
G/S	Blue	Glide Slope mode is armed.
FINAL	Blue	Final descent mode is armed.

Note : Two modes may be armed at the same time : ALT G/S, ALT FINAL, DES G/S, DES FINAL.

**Third line**

DISPLAY	COLOR	MEANING
SPEED SEL XXX	Blue	Indicates a preset speed associated with the cruise, climb or descent phase.
MACH SEL. XX	Blue	Indicates a preset Mach associated with the cruise, climb or descent phase.

Note : These two messages are displayed in the first and second columns (third line).

**AP/FD LATERAL MODES (FMA COLUMN 3)****First line**

R

DISPLAY	COLOR	MEANING
RWY	Green	RWY mode is engaged.
RWY TRK	Green	RWY mode is engaged once airborne at, or above, 30 feet.
TRACK	Green	TRACK mode is engaged.
HDG	Green	HEADING mode is engaged.
NAV	Green	NAV mode is engaged to guide the aircraft along the FM lateral F-PLN.
LOC*	Green	LOC capture mode is engaged.
LOC	Green	LOC track mode is engaged.
LOC B/C*	Green	Back beam capture mode is engaged.
LOC B/C	Green	Back beam mode is engaged.
APP NAV	Green	NAV mode is engaged during a NON ILS approach.
GA TRK	Green	GO AROUND track mode is engaged.

**Second line**

DISPLAY	COLOR	MEANING
LOC B/C	Blue	Back beam mode is armed.
LOC	Blue	LOC mode is armed.
APP NAV	Blue	NAV mode is armed for a NON ILS approach.
NAV	Blue	NAV mode is armed.

### **AP/FD COMMON MODES (FMA COLUMN 2 AND 3)**

DISPLAY	COLOR	MEANING
ROLL OUT	Green	Roll out mode is engaged.
FLARE	Green	Flare mode is engaged.
LAND	Green	Land mode is engaged below 400 feet RA.
FINAL APP	Green	APP NAV and FINAL modes are engaged during a NON ILS approach

### **APPROACH CAPABILITIES (FMA COLUMN 4)**

#### **First line**

DISPLAY	COLOR	MEANING
CAT 1	White	CAT 1 capability available
CAT 2	White	CAT 2 capability available
CAT 3	White	CAT 3 capability available

#### **Second line**

DISPLAY	COLOR	MEANING
SINGLE	White	CAT 3 capability available, with FAIL PASSIVE condition.
DUAL	White	CAT 3 capability available, with FAIL OPERATIONAL condition.

#### **Third line**

DISPLAY	COLOR	MEANING
MDA/MDH XXX	White Blue	Minimum descent altitude or minimum descent height as inserted by the pilot on PERF APPR page.
DH XXX/NO DH	White Blue	Decision height as inserted by the pilot on PERF APPR page. NO DH: when NO inserted on PERF APPR page.

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**AP/FD – A/THR ENGAGEMENT STATUS (FMA COLUMN 5)****First line**

DISPLAY	COLOR	MEANING
AP 1 + 2	White	Autopilot 1 and 2 are engaged.
AP 1	White	Autopilot 1 is engaged.
AP 2	White	Autopilot 2 is engaged.

**Second line**

DISPLAY	COLOR	MEANING
X FD Y	White	X and Y give the FD engagement status on PFD 1 and PFD 2. X and Y can be 1, 2, –. – : no FD is engaged on the corresponding PFD 1 : FD 1 is engaged. 2 : FD 2 is engaged. e.g. : the normal status (FD 1 and 2 are engaged) is 1FD2.

**Third line**

DISPLAY	COLOR	MEANING
A/THR	White	A/THR is active.
A/THR	Blue	A/THR is armed and not active.

**SPECIAL MESSAGES (FMA COLUMNS 2 AND 3)**

Three types of messages are displayed on the third line :

- first priority is given to F/CTL messages
- then vertical FM messages
- then EFIS reconfiguration messages

R

DISPLAY	COLOR	CONDITIONS
MAN PITCH TRIM ONLY	Red	Displayed in case of loss of L + R elevators.
USE MAN PITCH TRIM	Amber	F/CTL are in direct law or in flare law with dual RA failure.
CHECK APP SELECTION	White	The aircraft is in cruise at less than 100 NM from the top of descent or in descent or in approach and: – a non ILS approach has been selected. – an ILS frequency is tuned on the RAD NAV page
SET MANAGED SPEED	White	The SPEED target is selected and a preselected SPEED does not exist for the next flight phase
SET GREEN DOT SPEED	White	The aircraft is in Engine Out mode and the SPEED target is selected. This message is displayed if: the FCU selected speed is : ≤ Green Dot – 10 kt or ≥ Green Dot + 10 kt except in ALT* and ALT mode
SET HOLD SPEED	White	The aircraft is in selected SPEED control, an HM leg is inserted in the F-PLN and the aircraft is 30 seconds before the deceleration zone to the precomputed HOLD SPEED.
DECELERATE	White	This message is displayed if the thrust is not reduced when passing the top of descent, and the aircraft is above the flight profile.
EXTEND SPD BRK	White	DES mode is engaged, idle is selected, and: – either the aircraft is above the vertical profile and the predicted intercept point of the theoretical profile is at less than 2 NM from the next ALT CSTR and the predicted aircraft altitude at next ALT CSTR is greater than ALT CSTR – 500 feet. – or in auto speed control if the aircraft enters in an speedbrake decelerating segment (next speed limit or speed constraint)
RETRACT SPD BRK	White	Speedbrakes are extended, DES mode is engaged and : – ALT* or ALT mode engages or – aircraft is below the path. – CONF 3 or FULL is reached.
EFIS SINGLE SOURCE 1 or EFIS SINGLE SOURCE 2	White	CAPT and F/O Display Units are fed by the same source : either captain side source (1) or first officer side source (2). Range and mode selections can be done only by the appropriate side.
EFIS SWTG NOT ALLOWED	Amber	EFIS configuration selected by the pilot is not allowed: DMC 1 for F/O Display Units or DMC 2 for CAPT Display Units, and conditions for "EFIS SINGLE SOURCE" not fulfilled.

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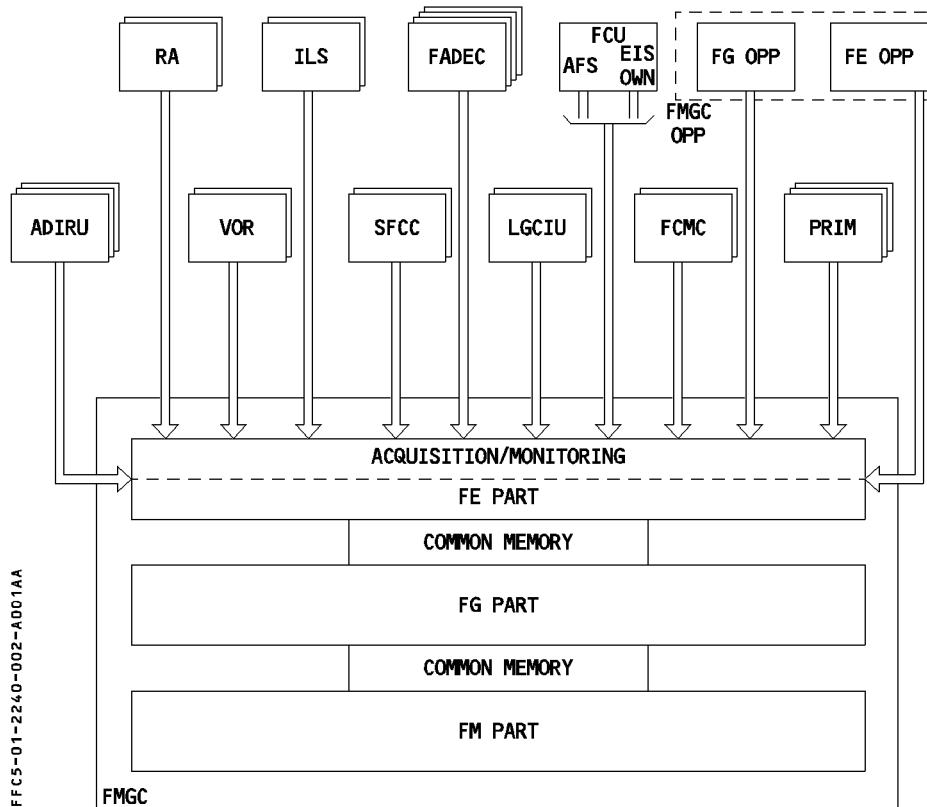
**GENERAL**

The Flight Envelope (FE) part of the FMGS performs the following functions :

- acquisition and monitoring of parameters used by FE and FG parts
- characteristic speeds computation
- back-up weight and CG computation
- aft CG monitoring
- windshear detection

**ACQUISITION/MONITORING**

Acquisition and monitoring of buses common to FM, FG or FE are performed by the FE. Only ARINC buses specific to the FM part are acquired by the FM itself. Dialogue between FM, FG and FE is achieved through common memories.



The FE function generates the following information :

- flight/ground conditions (LGCIU/SFCC)
- flap/slat configuration (SFCC)
- engine configuration (FADEC)
- ADR/IR parameters after filtering and consolidation (used by the control laws).



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**FLIGHT ENVELOPE**

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## **CHARACTERISTIC SPEEDS COMPUTATION**

FE part computes the characteristic speeds and sends them to :

- the FG which uses them as limits for guidance modes
- the EFIS for display on the PFD speed scale

The following speeds are computed :

### **Minimum speeds**

- **VLS**

(Refer to 3.04.10)

- **Manoeuvring speeds F, S, O (Green Dot)**

(Refer to 3.04.10)

**WEIGHT AND CENTER OF GRAVITY COMPUTATION**

The FMGC uses the weight and center of gravity from the FCMC (Fuel Computer) when available.

The GW and CG computed by the FE part are used :

- as back-up in case of dual FCMC failure.
- to trigger the aft CG caution and warning signals (independently of the FCMC).

**FE Weight computation (back up)**

- When the aircraft is below 14625 feet and 255 knots :

$$GW = f(\alpha, CAS, N1/EPR \text{ actual}, CG \text{ from FE part}, \text{altitude})$$

- When the aircraft is above 14625 feet or 255 knots :

$$GW = TOGW - WFU$$

TOGW : takeoff gross weight

WFU : weight fuel used acquired from FADECs.

**FE Center of gravity computation (back up/aft cg warning)**

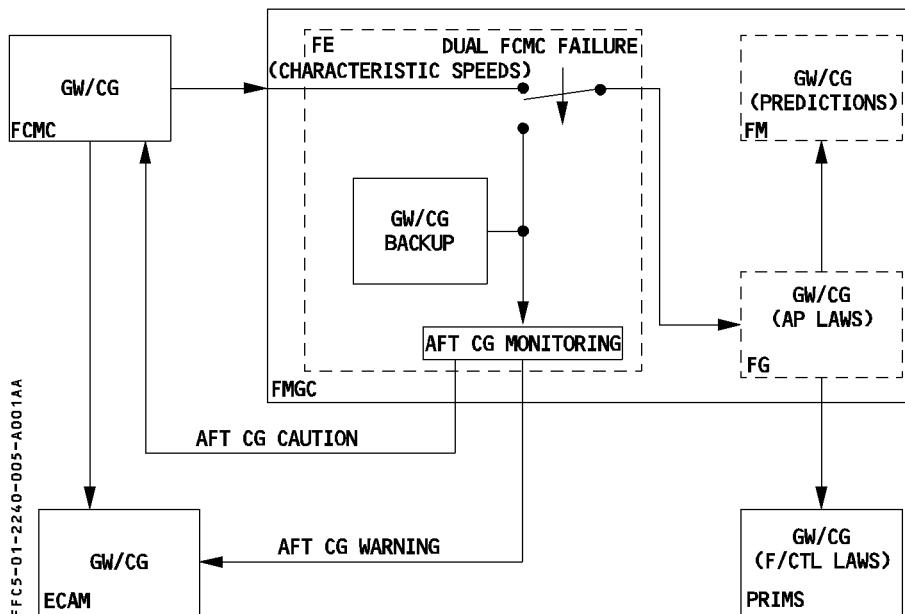
The CG is computed from the position of the horizontal stabilizer and is function of the N1/EPR, Vc, ALT, MACH and GW from FE part.

**AFT CG MONITORING**

The flight envelope uses only its own computed gross weight (GW) and center of gravity (CG) to trigger the aft CG signals.

The current CG is compared to the aft CG limit computed from the GW.

If the CG > CG limit -1 %, an aft CG caution signal is sent to the FCMCs. The target CG is then shifted forward by 1.5 % (only one time). If the CG becomes higher than the CG limit the aft CG warning signal is sent to the FWCs which trigger a red warning.



- R Note : AFT CG monitoring is available above 20 000 ft if the aircraft is in clean configuration with speed brakes retracted.

## WINDSHEAR DETECTION

A windshear detection signal is generated whenever the aircraft encounters a windshear and the predicted energy level falls below a predetermined safe minimum energy threshold (reactive windshear detection).

Note : The energy threshold is expressed as an angle of attack threshold  $\alpha_0$ .

The aircraft predicted energy level is  $\alpha + \Delta\alpha$  where :

- $\alpha$  is the current angle of attack
- $\Delta\alpha$  is the equivalent AOA computed from measured vertical drafts and longitudinal shears.

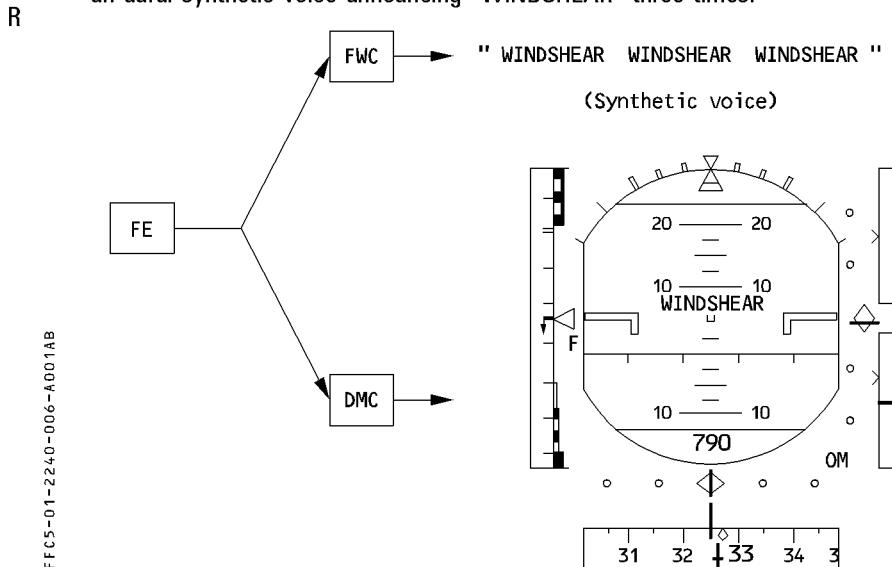
If  $\alpha + \Delta\alpha > \alpha_0$  the windshear conditions are detected.

The windshear detection function is provided in takeoff and approach phase under the following conditions :

- At takeoff, from lift off up to 1300 feet
- At landing from 1300 feet to 50 feet.
- With at least CONF 1 selected.

The warning consists of :

- a visual "WINDSHEAR" red message displayed on both PFDs for a minimum of 15 seconds.
- an aural synthetic voice announcing "WINDSHEAR" three times.



**GENERAL**

The FMS ACARS function gives an interface between a ground station and one onboard FMGC, allowing data transmission between these two computers via the ACARS Management Unit.

Two different sets of message can be exchanged :

UPLINK messages from the ground station. They consist in reception of data requested or directly sent to the crew.

DOWNLINK messages from the FMGC (master). They consist in reports or requests sent to the ground station.

The FMGS/ACARS interface enables the following ACARS capabilities.

- F-PLN initialization (flight plan and performance data)
- Takeoff data
- Wind data
- Flight reports
- Broadcast data

Crews can send message using ACARS function pages or relevant MCDU pages.

Only one FMGC talks to the ground station. This FMGC is called FMGC "master".

**GENERAL SCRATCHPAD MESSAGES**

NOT XMITTED TO ACARS : A crew request or report was sent to the ground but the communication was not established or not acknowledged.

NO ANSWER TO REQUEST : A crew request was previously sent to the ground and no answer (uplink message) was received within 4 minutes.

## FLIGHT PLAN INITIALIZATION FUNCTION

This function enables lateral and vertical flight plan data as well as performance data to be exchanged between the aircraft and a ground station. The aircraft may send flight plan requests for active and secondary flight plan. (downlink messages). The ground station may send flight plan and performance data (uplink messages) either under aircraft request or automatically without any request.

Each uplink message concerns either the active or secondary flight plan but never both flight plans at the same time. The data sent to the aircraft are checked for flight plan consistency.

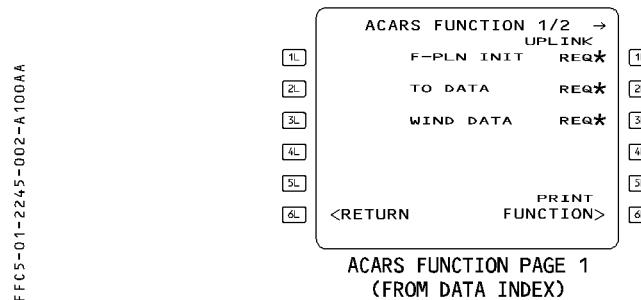
A MCDU message comes up when an uplink message is received. "ACT (or SEC) RTE UPLINK".

If an error prevents the decoding process of the message, "INVALID RTE UPLINK" is displayed on MCDUs.

An uplink message can be routed to the active flight plan if no engine is started and no active flight plan exists. Otherwise, it is routed to the secondary. The crew will insert it into the secondary flight plan or will reject it using the CLR key.

Note : *The flight plan may also be initialized using the ACARS function page selected from DATA INDEX page.*

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## **PERFORMANCE DATA**

On ground and before engine start, the ground station may also send performance data to the aircraft.

Performance data are always associated with the uplink flight plan. It is either automatically inserted with the active flight plan data, or stored in the secondary with the corresponding flight plan.

This message contains part or all of the following data :

ZFW, ZFWCG, taxi fuel, block fuel, cruise flight level, tropopause altitude, cruise temperature, transition altitude, cost index, performance factor.

*Note : After engine start an uplink performance data message is rejected automatically without any scratchpad message.*

## **SCRATCHPAD MESSAGES RELATED TO FLIGHT PLAN AND PERFORMANCE**

INVALID RTE UPLINK	An error is detected, the uplink message is rejected.
ACT or SEC RTE UPLINK	A F-PLN is stored in the active or secondary flight plan.
FLT NUMBER UPLINK	FLT NBR has been initialized within a F-PLN message without previous request.
CHECK FLT NUMBER	The uplinked FLT NBR differs from the one specified in the request.
CHECK CO RTE	The uplinked CO RTE ident differs from the one specified in the request.
INVALID FLT NBR UPLINK	The uplink contains a valid F-PLN but the FLT NBR is invalid.
PERF DATA UPLINK	Performance data is received
INVALID PERF UPLINK	Performance uplink message has been rejected
RTE DATALINK IN PROG	A flight plan modification is performed after a F-PLN INIT request has been sent ; this message is displayed until the uplink is received.
UPLINK INSERT IN PROG	This message is displayed during insertion of a Flight Plan.

## TAKEOFF DATA FUNCTION

The takeoff data function is available for the active flight plan only. It is used to request to the ground station, information data for up to 2 runways and to receive this data for up to 4 runways.

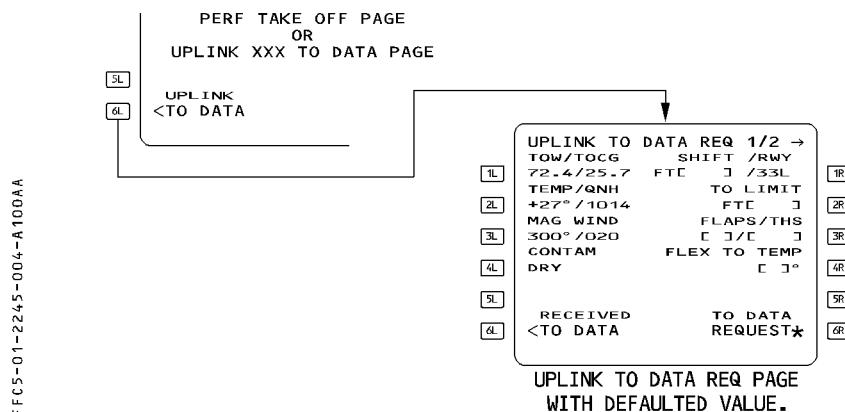
The crew sends a request indicating the departure airport, runway idents, CG, GW and weather conditions (such as baro setting wind, temperature...). In response he receives the takeoff speeds for up to 4 runways but only one set of data may be inserted in the active flight plan for the selected active runway.

Takeoff speeds are computed for max and flex takeoff.

The takeoff data function has required the modification of the standard PERF TAKEOFF page and the addition of 2 news pages :

- UPLINK TO DAT REQ page that enables the crew to specify a request to the ground.
- UPLINK XXX TO DATA page (XXX for MAX or FLEX)

These 2 pages are accessed from the PERF TAKEOFF page in PREFLIGHT and DONE phase only.



## SCRATCHPAD MESSAGES RELATED TO TAKEOFF DATA

**TAKEOFF DATA UPLINK** : Takeoff data uplink message is received  
**INVALID TAKEOFF UPLINK** : The UPLINK message is rejected

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**ACARS INTERFACE**

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**WIND DATA FUNCTION**

This function enables the crew to request and to receive forecasted winds associated to the active or secondary flight plan.

The uplink message (ground station to aircraft) may be received upon crew request or automatically without crew request.

The request is initiated from WIND pages or from ACARS FUNCTION page (Refer to 4.03.20).

The uplink wind data when received are directly displayed on the wind pages but not inserted in the flight plan, one set for each flight phase : CLIMB, CRUISE, DESCENT. The alternate wind at alternate cruise flight level is displayed on DESCENT page.

\* Winds are associated to altitude for climb and descent phases

\* Winds are associated to four altitudes for each waypoint for cruise phase and step level.

- On ground and without entered winds (except the trip wind), an uplink message is directly inserted in the flight plan.

- In flight, winds are temporarily stored until the crew inserts them phase per phase. Phase of flight is indicated in the WIND title page.

- Clearing the INSERT UPLINK\* prompt using the CLR key deletes the uplink wind data for the selected phase.

When uplink winds are deleted, the wind page reverts to the previous status.

The flight plan B page is modified of the uplink wind only after it is inserted by the crew. ACARS uplink winds are then considered as crew manual entries (large font).

**SCRATCHPAD MESSAGES RELATED TO WIND DATA****INVALID WIND UPLINK**

An error is detected, the uplink is rejected.

**WIND DATA UPLINK**

Uplinked winds are received.

**WIND UPLINK PENDING**

A temporary flight plan exists or a DIR TO page is displayed when a wind uplink is received. The message is stored.

**WIND UPLINK EXISTS**

A F-PLN modification (active or secondary) is attempted when uplink winds are not inserted. This message disappears automatically when the wind uplink is inserted or deleted.

**CHECK DEST DATA**

The aircraft is at 180 NM from destination, and the destination QNH, TEMP or WIND displayed on the PERF APPR page was received by ACARS uplink or, if following insertion of a descent wind uplink, a conflict concerning the above parameters exists.

**CHECK ALTN WIND**

The uplinked alternate cruise flight level differs from the default alternate cruise flight level.

**FLIGHT REPORTS**

Flight reports provide real time information to the ground concerning the aircraft current situation and position.

Several types of flight reports are available :

- The Position report : provides current aircraft position
- the Progress report : provides data relative to the destination
- The Flight-Plan report : provides the active route
- the Performance Data report : provides performance data currently used by FMS.

These reports may be manually initiated via a dedicated prompt or automatically sent in response to a ground request or upon specific conditions.

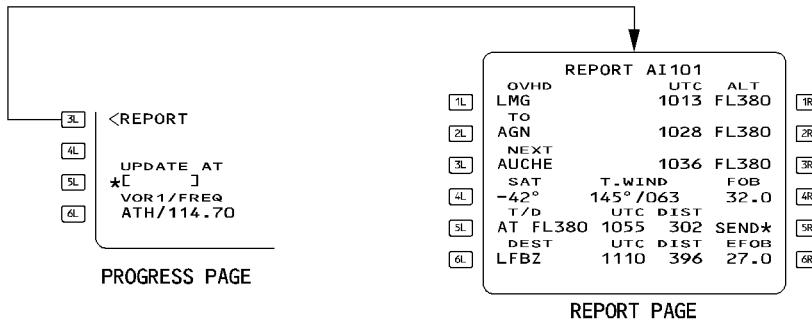
**POSITION REPORT**

This report is sent :

- manually via a MCDU prompt or
- following a ground request or
- automatically upon sequencing a designated reporting fix (designated by the ground in a uplink message).

The manual POSITION REPORT downlink prompt is displayed on the REPORT page POS prompt.

FFCS-01-2245-006-A100AA



Note : Position report are initiated from active flight plan only.

**A340**

FLIGHT CREW OPERATING MANUAL

**AUTO FLIGHT****ACARS INTERFACE**

1.22.45 P 7

SEQ 100 REV 10

## **POSITION report content**

The downlinked message contains exactly the REPORT page data.

## **PROGRESS REPORT**

A progress report contains data relative to the aircraft arrival time and EFOB at destination for the active F-PLN.

This downlink message is automatically sent following :

- a ground request or
- a change of destination or
- a change of runway or
- a specific event. The possible events that can be selected in the navigation database policy file are :
  - . X minutes to Top of Descent
  - . Z minutes to Destination
  - . ETA changes more than W minutes from the previous report.

X, Z and W are minutes of time set in the navigation database policy file.

The progress report cannot be manually sent by the crew via a dedicated MCDU prompt.

## **PROGRESS report content**

- Flight Number
- Arrival Airport Ident
- Destination Runway Ident
- Predicted remaining fuel
- ETA at destination
- Reason for report (specific event, ground request...).

## **FLIGHT PLAN REPORT**

The F-PLN report broadcasts flight plan data to the ground. Only data from the active flight plan can be sent.

This downlink message is sent to the ground :

- automatically following a ground request
- manually by the crew using a prompt displayed on the ACARS FUNCTION page. (Refer to ACARS page description). This prompt may be invalidated through the navigation database policy file.

The Flight Plan report can be downlinked either while on ground or in flight during any flight phase.

### **FLIGHT PLAN report content**

The report contains the active and alternate flight plan.

## **PERFORMANCE DATA REPORT**

The Performance Data report is a downlink message that allows the transmission of performance data (GW, FUEL, CG...) relative to the active F-PLN.

This message is automatically sent following a ground request. Manual sending is not possible.

### **PERFORMANCE DATA report content**

Sends to the ground :

- Current GW
- Cruise Altitude
- Current CG
- Fuel on Board
- Block Fuel
- Reserve Fuel
- Cost Index
- Top of Climb Temperature
- Climb Transition Altitude
- Tropopause Altitude
- Taxi Fuel
- ZFW
- ZFWCG

**A340**

FLIGHT CREW OPERATING MANUAL

**AUTO FLIGHT****PRINT INTERFACE**

1.22.46 P 1

SEQ 100 REV 10

**PRINT FUNCTION**

The print function enables several types of data and report to be printed :

- \* Flight plan initialization data
- \* Takeoff data
- \* Wind data
- \* Preflight report
- \* In flight report
- \* Post flight report

The 3 first reports may differ when automatically or manually printed for the following reason :

The automatic process prints the uplink message although the manuall process prints the current active data as displayed on the relevant MCDU pages.

The last 3 reports being processed from the same sources are identical in automatic or manual printing.

*Note : ACARS is not necessary linked to printing process. The printing function may be activated within the FMGS and selected independently from the ACARS.*

- One or several print functions may be deactivated (refer to PRINT FUNCTION PAGE).
- If an ACARS function is not active, (not selected in the nav database policy file) the printing process is invalidated for this specific ACARS function.

## R **ACARS/PRINTER PROGRAMMING OPTIONS**

Option programming for the ACARS/PRINTER functions is obtained through the Navigation Data Base policy file.

The list summarizes the possible options :

ACARS Inhibit	Disables ACARS function
F-PLN Data Request Inhibit	Disables uplink and downlink requests of F-PLN initialization data
Performance Data Request Inhibit	Disables uplink and downlink requests of Performance Initialization data
Takeoff Data Request Inhibit	Disables uplink and downlink request of Takeoff Initialization data
Wind Data Request Inhibit	Disables uplink and downlink request of predicted wind data
Flight Number Enable	Flight Number is included within the F-PLN Request or Progress Report downlinks
Position Report Inhibit	Disables a manual Position Report downlink
Progress Report Triggers	Defines the triggers for the automatic downlink of the Progress Report
F-PLN Report Inhibit	Disables the manual downlink of the F-PLN Report
Auto Print of ACARS uplink	Selects/Deselects the automatic printing of the F-PLN, INIT, TO and wind data uplinks. If Autoprint is selected, the crew can deselect it manually. If auto printing is deselected, the crew cannot manually reselect it.
Auto Print of Flight Reports	Selects/Deselects the automatic printing of the Preflight, Inflight, Postflight reports. If selected, the crew can deselect it manually. If autoprint is deselected, the crew cannot manually preselected it.

**A340**

FLIGHT CREW OPERATING MANUAL

**AUTO FLIGHT**

1.22.50 P 1

**FAULT ISOLATION AND DETECTION**

SEQ. 001 REV. 07

**DESCRIPTION**

The Fault Isolation and Detection System (FIDS) is installed in FMGC 1. The system achieves the following functions :

- detection and memorization of all internal and external failures
- tests initiation

The FIDS serves as the system BITE (maintenance data concentration).

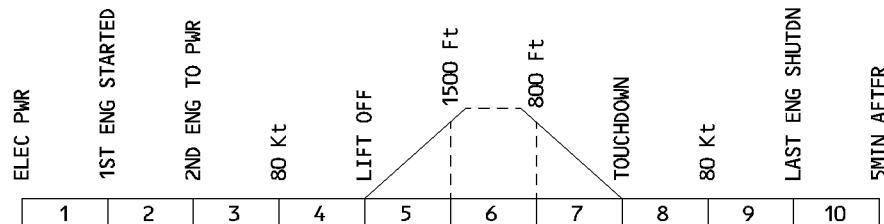
It is connected to the BITE's of the various AFS computers (FM, FG, FE, FCU, MCDU) and linked to the CMS.

Display and interrogation of FIDS function are done by selecting appropriate key on the MCDU page.

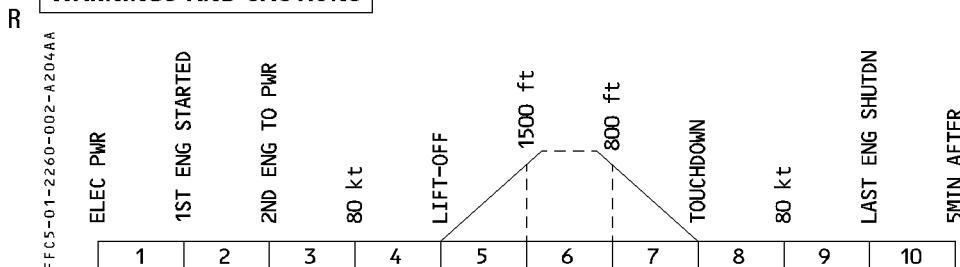
**WARNINGS AND CAUTIONS**

R

FFC5-01-2260-001-A001A



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
AP OFF Involuntary disconnection (refer to 1.22.30).	CAVALRY CHARGE	MASTER WARN		NIL	NIL
A / THR OFF Involuntary disconnection (refer to 1.22.30).	SINGLE CHIME	MASTER CAUT			1,4,8,10
WINDSHEAR (NO ECAM message)	SYNTHETIC VOICE "WINDSHEAR" repeated 3 times	NIL		WINDSHEAR on PFDs	2,3,4 8,9
FM1 or 2 FAULT	NIL			MAP NOT AVAIL on related ND	3,4,5,8
FM1 + 2 FAULT				MAP NOT AVAIL on NDs	
A / THR ENG 1 (2) (3) (4) OFF Authorthrust is inoperative on one engine.					3,4,5,8
A/THR LIMITED A/THR is active, the thrust levers are not in the CLB or MCT detent.	SINGLE CHIME	MASTER CAUT			all except 6
FCU FAULT Loss of two channels, or complete loss of the FCU.					4,5
REAC W/S DET FAULT Windshear detection function is inoperative.					1,3,4,5 8,10
LOW ENERGY (No ECAM message). Available between 100 and 2000 feet. Thrust must be increased.	SYNTHETIC VOICE "SPEED" repeated 3 times	NIL			1 to 4 8 to 10
ILS Capability downgrade. Conditions required for CAT 3/CAT 2 are no longer fulfilled. (Refer to FCOM 04.05.70).	TRIPLE CLICK				2, 3, 4 5, 8, 9 10
AUTOLAND (No ECAM message) only available below 200 feet.	NIL	AUTO LAND (red) on glareshield			
FM/IR POS DISAGREE msg. A discrepancy is detected between any FM position and any IRS position.	SINGLE CHIME	MASTER CAUT			1, 2, 3, 4, 5, 7, 8, 9, 10

**WARNINGS AND CAUTIONS**

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
When GPS primary is lost, the "GPS PRIMARY LOST" message is displayed on ND and PFD.	TRIPLE* CLICK	NIL	NIL	ND/MCDU message	2, 3, 4, 5, 8, 9, 10
"NAV FM/GPS POS DISAGREE": When the FMS 1 or 2 position differs from the GPS 1 or 2 position by more than 0.5 minutes of latitude or: – 0.5 minutes of longitude, if the aircraft latitude is included between 0° and 45°. – 0.7 minutes of longitude, if the aircraft latitude is included between 45° and 60°. – 1 minute of longitude, if the aircraft latitude is included between 60° and 70°. Above 70° of latitude, a longitude difference does not trigger the alarm.	SINGLE CHIME	MASTER CAUT		NIL	1, 3, 4, 10

\* Only during a non precision approach.

**MEMO DISPLAY**

FM SWTG is displayed in green, when the FM switching selector is on the BOTH ON 1(2) position.

**A340**

FLIGHT CREW OPERATING MANUAL

**AUTO FLIGHT**

1.22.70 P 1

**POWER SUPPLY**

SEQ. 001 REV. 08

**BUS EQUIPMENT LIST**

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
FMGC	1		DC1				
	2		DC2				
FCU	A and B				X		
	C		DC2				
MCDU	1				SHED		
	2	AC 2-4					
	3				GND		
Sidestick locking			DC1				
Rudder artificial feel			DC1				

**23.00 CONTENTS****23.10 RADIO COMMUNICATION**

– GENERAL . . . . .	1
– VHF/HF/SELCAL . . . . .	2
– RADIO TUNING . . . . .	3

**23.20 INTERCOMMUNICATION SYSTEMS**

– GENERAL . . . . .	1
– CONTROLS . . . . .	5
– INTERPHONE SYSTEMS . . . . .	8
– CALL SYSTEMS . . . . .	12
– PASSENGER ADDRESS . . . . .	16
– EMER EVAC ◀ . . . . .	19
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**R 23.22 EMERGENCY COCKPIT ALERTING SYSTEM ◀**

R – CABIN TO COCKPIT ALERT . . . . .	1
R – COCKPIT TO CABIN ALERT . . . . .	2

**23.30 COCKPIT VOICE RECORDER**

– DESCRIPTION . . . . .	1
– CONTROLS AND INDICATORS ON OVERHEAD PANEL . . . . .	2

**23.40 ACARS ◀**

– GENERAL . . . . .	1
– COCKPIT ARRANGEMENT . . . . .	2
– OPERATION MODES . . . . .	3
– ACARS FUNCTIONS . . . . .	4

**23.45 SATCOM ◀**

– GENERAL . . . . .	1
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**23.50 WARNINGS AND CAUTIONS**

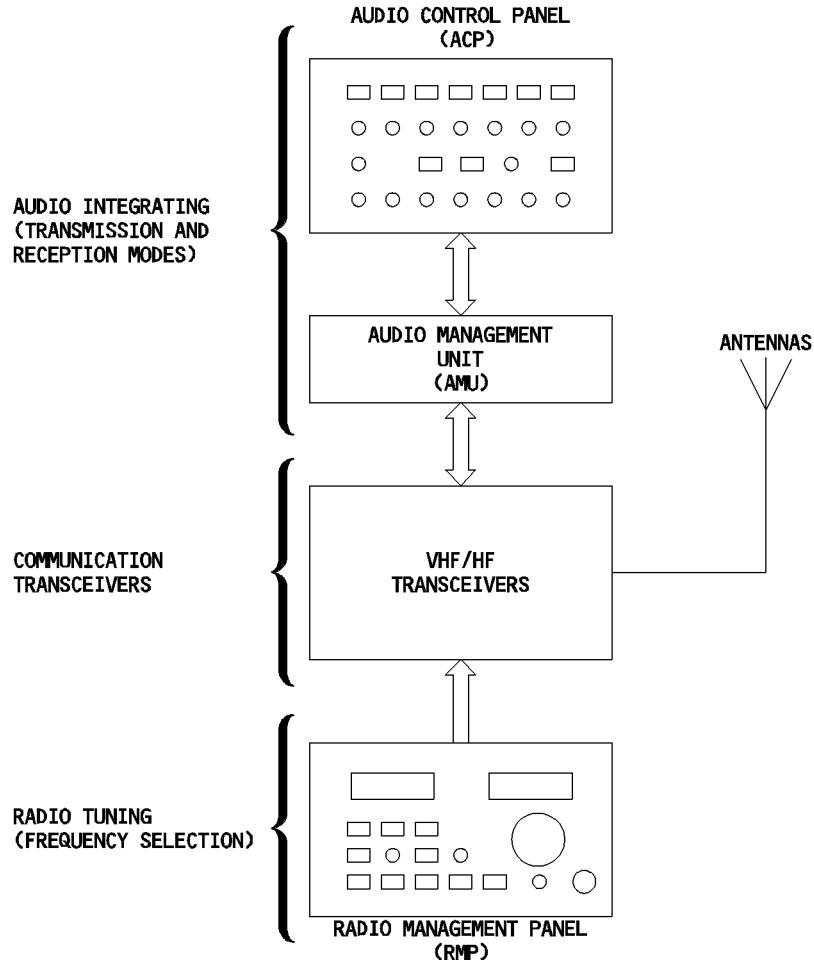
– DESCRIPTION . . . . .	1
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**23.60 ELECTRICAL SUPPLY**

**GENERAL**

The communications system comprises the following subsystems:

- VHF / HF transceivers
- Radio tuning systems (Radio Management Panels)
- Audio integrating system (Audio Management Unit, Audio Control Panels)



**VHF / HF / SELCAL**

The flight crew can use either of the three Radio Management Panels (RMPs) to tune each transceiver.

To transmit, the flight crew uses the Audio Control Panel (ACP) to select a VHF or HF system. The ACP works through the Audio Management Unit (AMU). Each system is connected to the RMPs for frequency selection, and to the AMU for connection to the audio integrating and SELCAL (selective calling) systems.

**— VHF**

Three identical VHF communication systems are installed. Each system has a transceiver in the avionics compartment, and an antenna on the fuselage. Only VHF1 functions in EMER ELEC CONFIG. Its range is from 118.0 to 136.975 MHZ. The VHF has an alarm to indicate if the microphone is stuck (✉). If a microphone is in the emission position for more than 30 seconds, an interrupted tone sounds for 5 seconds, and the emission is turned off. To reactivate the emission, the crew releases the push-to-talk button and presses it again.

**— HF**

Two identical HF communication systems are installed. Each has a transceiver installed in the avionics compartment, and a common tuner and antenna in the vertical stabilizer. Its range is from 2.8 to 24.0 MHZ.

**— SELCAL (Selective Calling)**

Upon receiving a call code corresponding to that of the aircraft, the SELCAL system aurally and visually advises the flight crew that a ground station is calling the aircraft.

R The aural signal is inhibited during takeoff and landing.

**RADIO TUNING****DESCRIPTION**

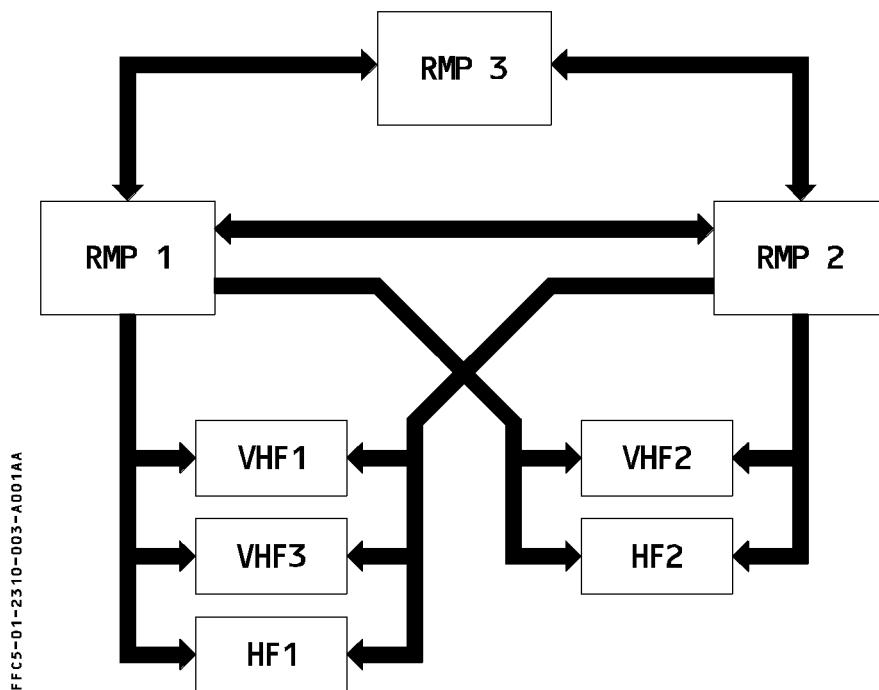
Identical RMPs :

- Give the flight crew control of all radio communication systems (VHF and HF frequency control).
- Back up to FMGC's for controlling radio navigation systems (Refer to 1.34).

Two RMPs are on the center pedestal and the third on the overhead panel.

Each RMP can control any VHF or HF transceiver. RMP1 and 2 are connected directly to all VHF and HF transceivers, whereas RMP3 is connected to them via RMP1 and 2. RMPs are connected together so that each RMP is updated to the selections made on other RMPs.

Only RMP1 functions in EMER ELEC CONFIG.

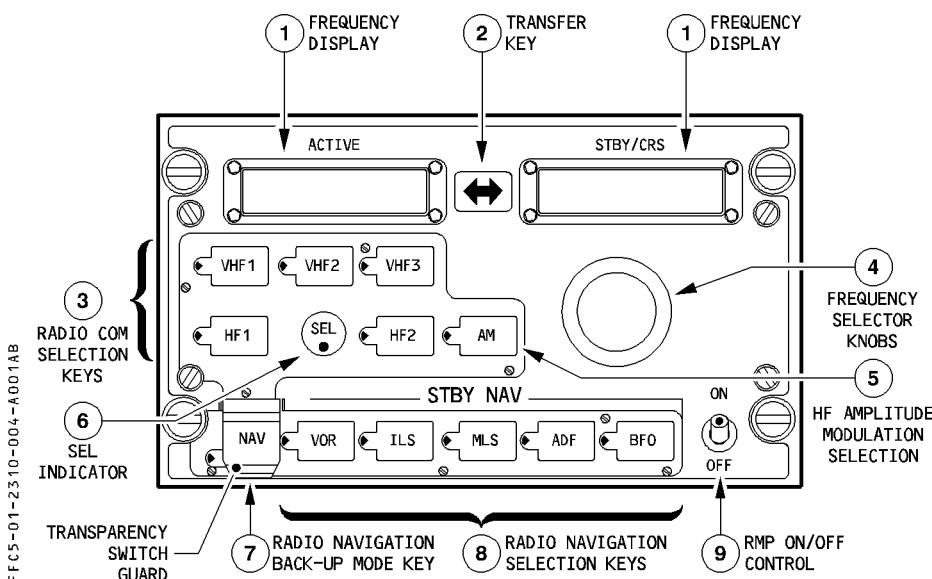


If two RMPs fail, the remaining one controls all the VHF and HF transceivers.

R If ACARS or ATSU is installed, do not use VHF3 for voice communication.

**RADIO MANAGEMENT PANEL**

R

**① Frequency displays**

- R · The ACTIVE display window shows the active frequency of the selected radio, which is identified by a green light on the selection key.
- R · The STBY/CRS (standby / course display) display window shows a standby frequency that the pilot can activate by pressing the transfer key or change by rotating the tuning knobs.
- R · For a description of the CRS function see 1.34.

**② Transfer key**

- R · Pressing this key moves the active frequency to the standby window and the standby frequency to the active window.
- R · This tunes the selected receiver to the new active frequency.

**③ Radio comm. selection keys**

- R · When the pilot presses one of these keys :
  - The ACTIVE window displays the frequency set on that radio.
  - The STBY/CRS window displays the selected frequency or course.
  - The selected key displays a green monitor light.

R **(4) Frequency selector knobs**

R

R The pilot uses these concentric knobs to select the STBY frequency or CRS.

R The outer knob controls whole numbers ; the inner knob controls decimal fractions.

R

R **(5) AM pb sw**

R

R If the aircraft has HF radios and the flight crew has selected an HF transceiver, this switch selects the AM mode. (The default mode is the SSB, or single side-band, mode).

R This key displays a green monitor light when the AM mode is active.

R

R **(6) SEL indicator**

R

R The SEL indicator comes on white on both RMPs when a transceiver normally associated with one RMP is tuned by another :

- VHF1 tuned by RMP2 or 3,

- VHF2 tuned by RMP1 or 3,

- VHF3, HF1, HF2 tuned by RMP1 or 2.

R

R **(7) NAV pb sw (with transparent switchguard)**

R

R The pilot presses this key to be able to select navigation receivers and courses through the RMP. It does not affect the selection of communication radios and their frequencies

R Refer to 1.34 for additional information.

R

R **(8) Radio navigation selection keys**

R

R The pilot presses one of these keys to select a navigation radio to control through this RMP. This turns on the green monitor light in the key.

R (Refer to 1.34) for additional information.

R

R **(9) ON/OFF sw**

R

R This switch controls the power supply of the RMP.

R

R *Note : RMP3 is able to control VHF and HF transceivers through RMP1 and RMP2 even when they are OFF.*

**A340**

FLIGHT CREW OPERATING MANUAL

**COMMUNICATIONS**

1.23.20 P 1

**INTERCOMMUNICATION SYSTEM**

SEQ. 001 REV. 09

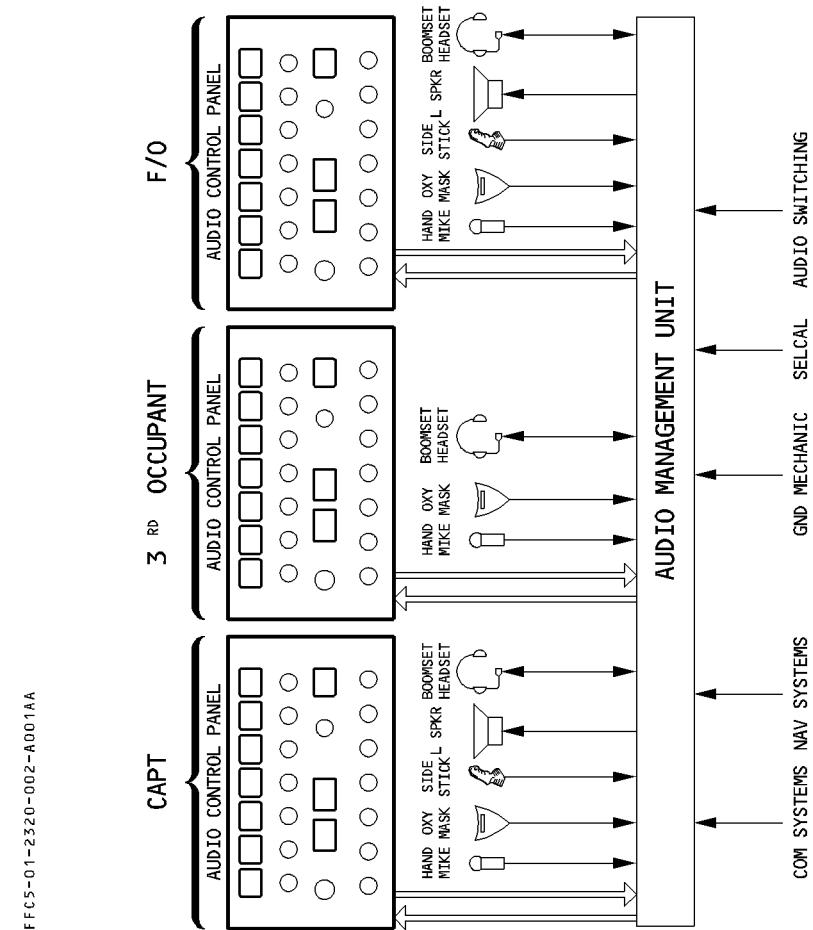
**GENERAL**

- R Intercommunication is divided into two main systems:
  - R – the audio management system.
  - R – the cabin intercommunication data system.
- R

**R AUDIO MANAGEMENT SYSTEM**

- R The audio management system allows the flight crew to use :
  - R – all the radio communication and radio navigation facilities installed on the aircraft in transmission and reception mode.
  - R – the interphone systems
  - R – the call systems
  - R – the passenger address system
- R The audio management system includes :
  - R – an audio management unit (AMU)
  - R – three audio control panels (ACPs)
  - R – sockets at each pilot's station
    - headset jack, boomset connector and hand microphone connector for pilot, copilot, and third occupant
    - headset jack for the fourth occupant
  - R – one interphone jack socket at the ground power receptacle
  - R – boomsets for the pilot, copilot, and third occupant and three hand microphones.
  - R – three cockpit oxygen mask microphones
  - R – one radio press-to-talk switch on each sidestick
  - R – one SELCAL code selection panel
  - R – two cockpit loudspeakers with separate volume controls
  - R – an audio switching facility
- R If audio channel 1 or 2 fails due to a failure either in an ACP or the corresponding AMU, the crew can use the AUDIO SWITCHING selector to select the third audio channel.

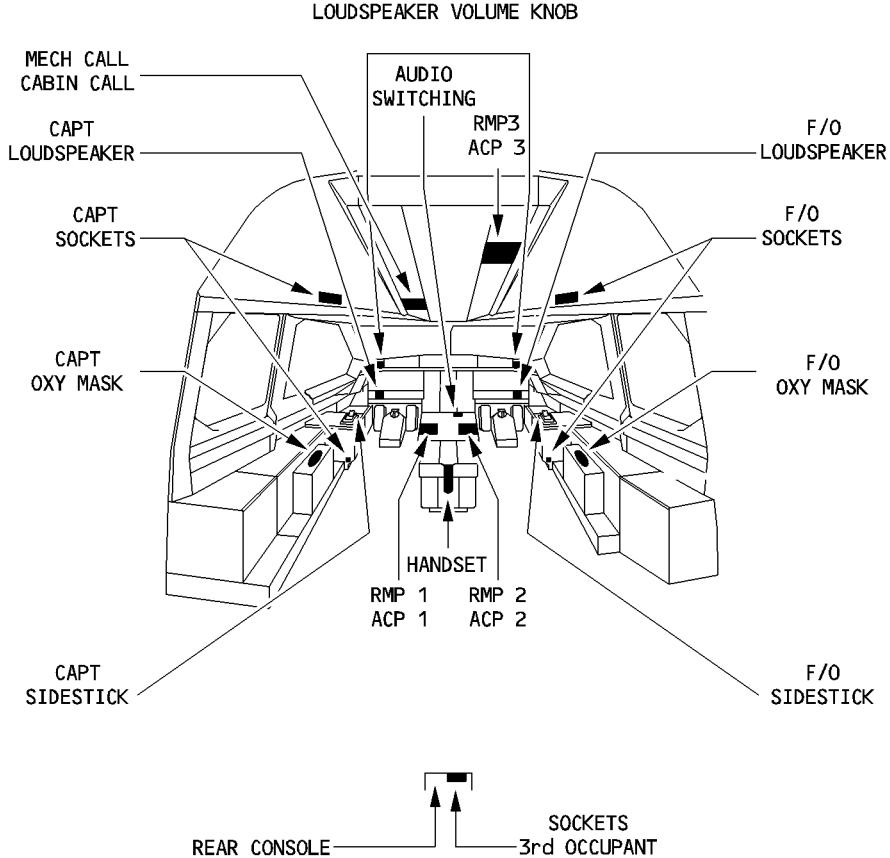
R



FFCS-01-2320-002-A001AA

**COMPONENTS' LOCATION**

R



FFC5-01-2320-003-A001AA

## CABIN INTERCOMMUNICATION DATA SYSTEM

The Cabin Intercommunication Data System (CIDS) provides signal transmission, control and processing for the following cabin systems:

- Cabin and service interphone
- Passenger address
- Passenger signs
- Reading lights
- General cabin illumination
- Emergency evacuation signalling
- Lavatory smoke indication
- Passenger entertainment music and video

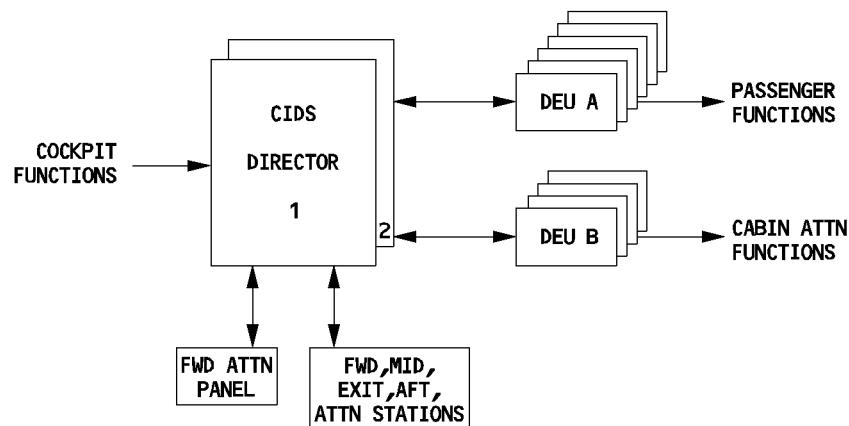
The CIDS includes the following main components:

- Two CIDS directors connected in parallel, one is active the other in stand-by.
- Forward attendant panel for controls of the cabin systems.

It also includes a programming and test module which allows reprogramming in case of cabin configuration changes.

- Attendant stations (FWD, MID, EXIT, AFT).

FFC5-01-2320-004-A001AA

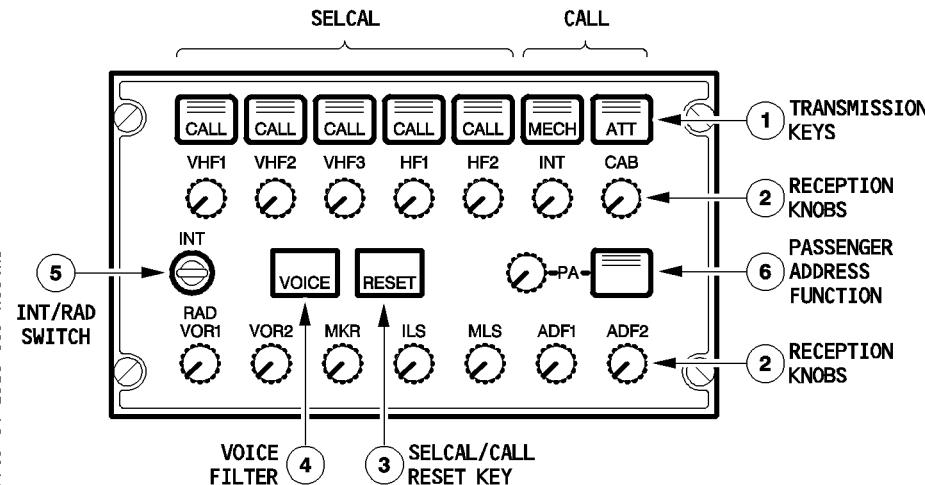


Decoder / Encoder Units (DEUs) are linked to the two directors.

- Type A (for passengers): installed in three rows (left, center, right). The loudspeakers, signs, CALL buttons, CALL lights and general illumination ballast units are divided into small groups each connected to a DEU A.
- Type B (for attendants): installed on each cabin side. The Area Call panels, attendant handsets, slide / door pressure sensors, attendant indicator panels are connected to DEU B.

**CONTROLS****AUDIO CONTROL PANEL**

FFC5-01-2320-005-A001AB

**① Transmission keys**

- Pressed : The associated channel is selected for transmission.  
 The three green lines come on.  
 The pilot deselects the channel by pressing the pushbutton again, or by selecting another channel.
- CALL It : The legend flashes amber (and buzzer sounds) when the SELCAL system detects a call.
- MECH It : The legend flashes amber (and buzzer sounds) for a call from the nose gear bay. The MECH light goes off after 60 seconds, if it is not reset.
- ATT It : The legend flashes amber for a call from a cabin attendant. The ATT light goes off after 60 seconds, if it is not reset.

**② Reception knobs**

- Pressing and releasing the knob (knob out) selects the associated audio reception channel.  
 The integral white light comes on. Rotating the knob adjusts the volume. The INTEG LT knob controls the brightness.
- Pressing the knob (knob stays in) disconnects the associated audio reception channel.

R Note : For reception of DME audio navigation signals associated to an ILS or MLS station, the LS pushbutton on the FCU must also be selected.

③ RESET key

Pressing this key extinguishes CALL, MECH and ATT lights and cancels the buzzers.

④ VOICE key

This key allows the flight crew to inhibit the audio navigation signals (VOR, ADF). Pressing this key filters out ident signals and turns on the green ON light.

⑤ INT / RAD sw

This switch operates as a push-to-talk switch for boom mike or oxygen mask mike.

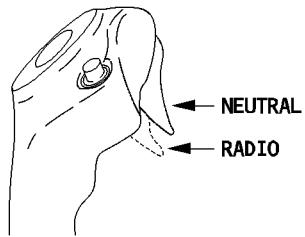
- INT : Boom and mask mikes transmit on interphone regardless of which transmission key is selected. For reception on interphone, the crew member must have the INT selected (INT reception knob out).
- Neutral : Reception is normal. Boom and mask mikes do not transmit.
- RAD (press and hold) : Boom and mask mikes transmit on the radio selected on the audio control panel.

⑥ Passenger address (PA) function

PA transmission key and reception knob.  
(Refer to 1.23.20)

**SIDE STICK RADIO SELECTOR**

FFCS-D1-2320-006-A001AA



This selector has the same function as the INT/RAD switch on the ACP.

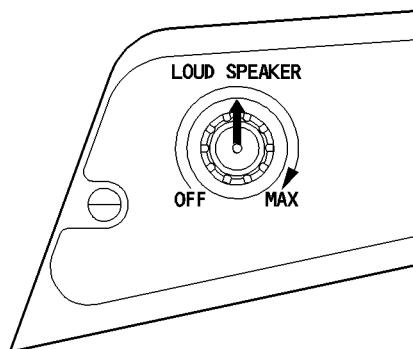
NEUTRAL (spring-loaded) : Boom and mask mikes are dead. Reception is normal.

RADIO (aft position) : Boom and mask mikes transmit the equipment selected by the transmission key on the ACP.

Note : If RADIO is selected on the side stick when the INT/RAD switch is on INT, the radio function has priority over the interphone function.

## LOUDSPEAKER VOLUME KNOB

FFC5-01-2320-007-A001AA



This knob adjusts the volume of the loudspeaker for radio communication.

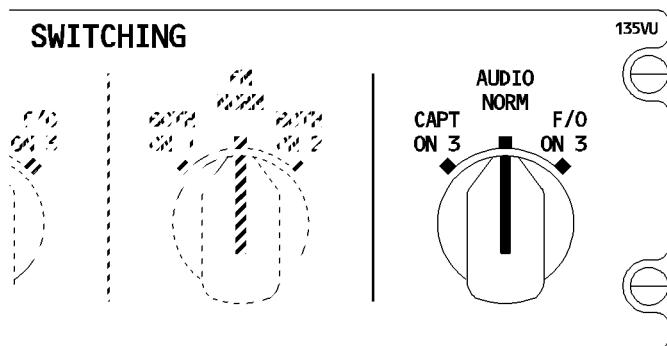
OFF : Loudspeaker does not respond to signals from the aircraft's radio equipment.

Clockwise rotation : Loudspeaker broadcasts signals from the aircraft's radio equipment at increasing volume.

Note : This knob does not control the loudness of aural alert and voice message.

## AUDIO SWITCHING

FFC5-01-2320-007-B001AA



The crew can switch to the third audio channel if ACP1 or ACP2 fails.

When the crew does this, it takes away the third occupant's access to the acoustic equipment.

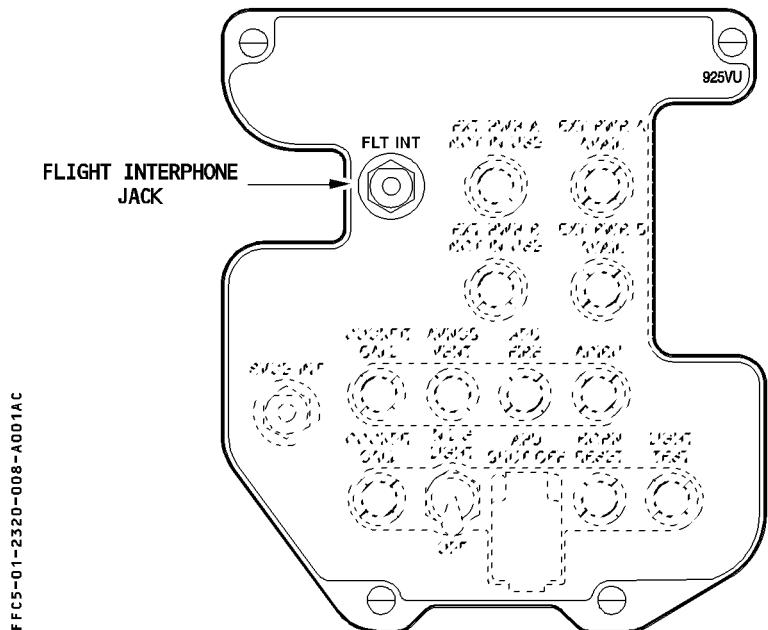
NORM : Each crew member uses his dedicated communication equipment.

CAPT ON 3 : The pilot uses his acoustic equipment and the third occupant's ACP.

F/O ON 3 : The copilot uses his acoustic equipment and the third occupant's ACP.

**INTERPHONE SYSTEMS****FLIGHT INTERPHONE SYSTEM**

This system allows the flight crew to communicate among themselves and, through a jack on the external power panel, with the ground mechanic.

**EXTERNAL POWER PANEL (GROUND POWER RECEPTACLE)****COCKPIT OPERATION FOR GROUND MECHANIC COMMUNICATION**

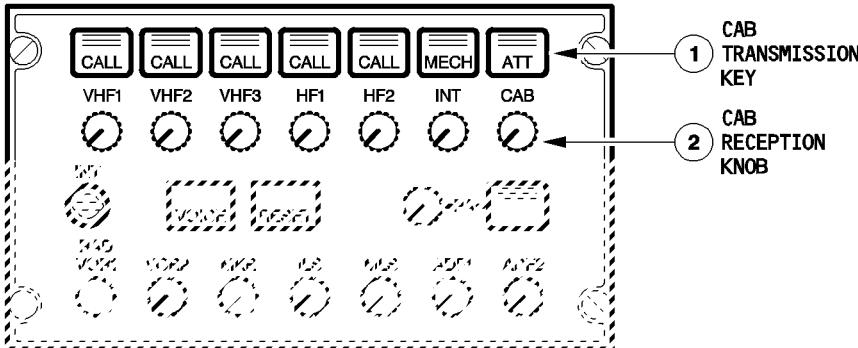
	MECH TRANSMISSION KEY ON ACP	INT RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE
BOOMSET OR OXYGEN MASK	PRESSED	OUT	INT OR RAD (maintained)	
HANDMIKE	PRESSED	OUT		PRESSED

## CABIN INTERPHONE SYSTEM

The system provides communication and call facilities between:

- flight crew and attendant stations
- two attendant stations

FFC5-01-2320-009-A001AC



### ① CAB transmission key

Depressed : Three green lines come on.

Boomset, mask mikes and hand mike may be used for cabin interphone.

### ② CAB reception knob

Depressed and released : The integrated white light comes on.  
(knob out)  
Audio signal from cabin is received.

Rotate knob to adjust volume.

Depressed : The white light goes off.  
(knob in)  
Cabin interphone is disconnected.

## COCKPIT OPERATION

	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HAND MIKE
BOOMSET OR OXYGEN MASK	DEPRESSED	OUT	RAD	–
HANDMIKE	DEPRESSED	OUT	–	PRESSED

## SERVICE INTERPHONE SYSTEM

The system allows for communication between:

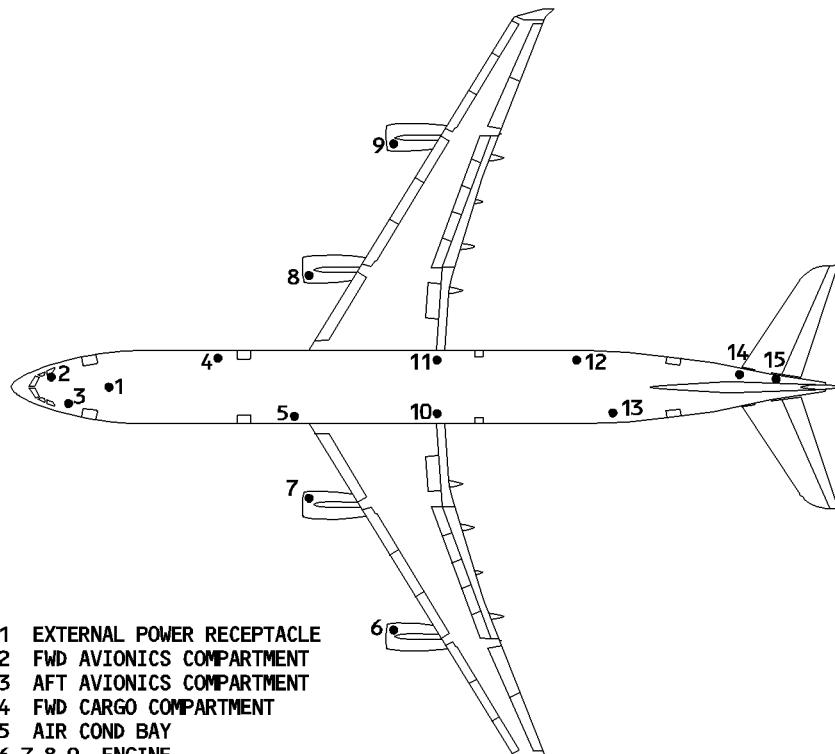
- the flight crew and the service interphone jacks
- the flight attendant stations and the service interphone jacks
- the different service interphone jacks.

The Service Interphone system has :

- fifteen interphone jacks
- an OVRD switch located on the overhead panel.

The audio lines from the interphone jacks are connected to both CIDS directors.

## **LOCATION OF INTERPHONE JACKS**

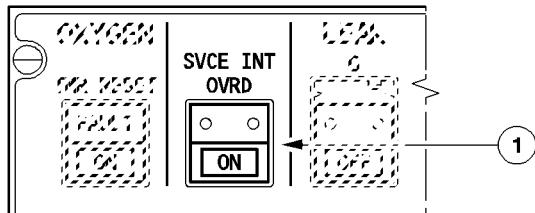


- 1 EXTERNAL POWER RECEPTACLE
- 2 FWD AVIONICS COMPARTMENT
- 3 AFT AVIONICS COMPARTMENT
- 4 FWD CARGO COMPARTMENT
- 5 AIR COND BAY
- 6,7,8,9 ENGINE
- 10,11 HYDRAULIC COMPARTMENT
- 12 AFT CARGO COMPARTMENT
- 13 DIGITAL FLIGHT DATA RECORDER
- 14 TRIM ACTUATOR
- 15 APU COMPARTMENT

## CONTROLS AND INDICATORS AT OVERHEAD PANEL

For maintenance purpose only.

FFC5-01-2320-011-A001AA



### ① SVCE INT OVRD pb sw

Auto : Ground personnel can communicate with the flight crew by means of the service interphone jacks after the aircraft has landed. The landing gear must be compressed.

ON : Communication is possible when the landing gear is not compressed.  
The ON light is white.

## COCKPIT OPERATION

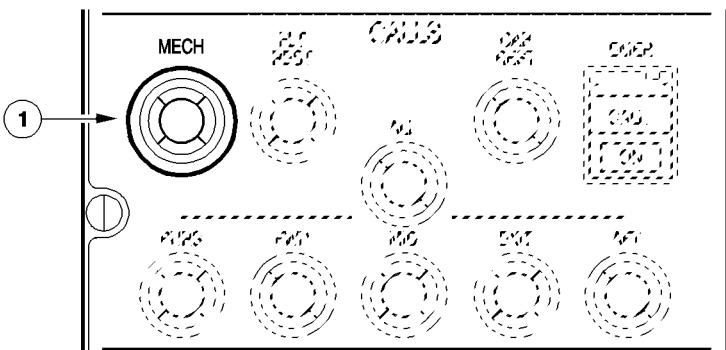
	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE	SVCE INT OVRD PB SW
BOOMSET	PRESSED	OUT	RAD (maintained)		ON IF L/G NOT COMPRESSED
HANDMIKE	PRESSED	OUT		PRESSED	

**CALL SYSTEMS****GROUND MECHANIC CALL**

The system allows the flight crew and ground mechanics to communicate each other.

**CONTROLS AND INDICATORS ON OVERHEAD PANEL**

FFC5-01-2320-012-A001AE

**① MECH pb**

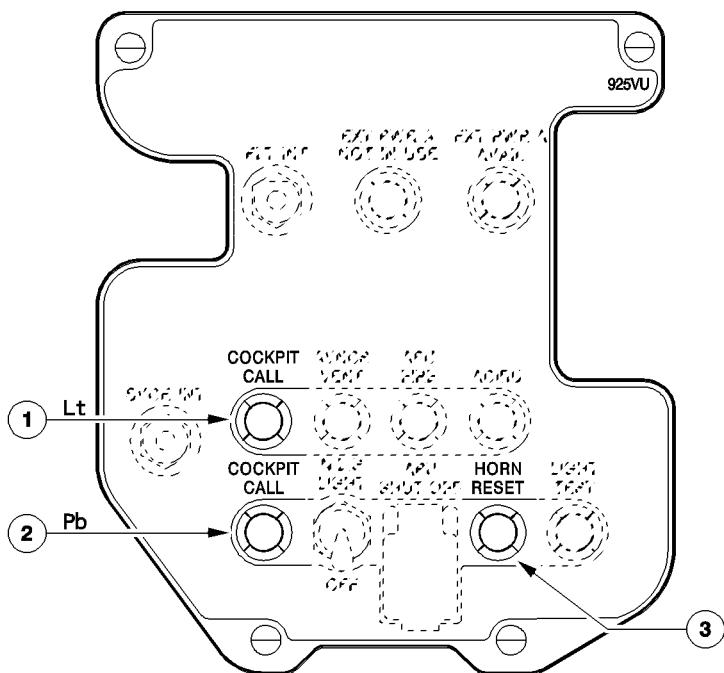
Pressed (and held) : COCKPIT CALL lights up blue on the external power panel.  
An external horn sounds.

Released : COCKPIT CALL remains lighted.  
The ground mechanic can extinguish it by pressing the HORN RESET pushbutton on the external power panel. The external horn stops sounding.

Note : To communicate with the ground mechanic, the flight crew must select the MECH key and the INT reception knob on the ACP must be selected.

## CONTROLS AND INDICATORS ON EXTERNAL POWER PANEL

FFC5-01-2320-013-A001AB

**① COCKPIT CALL lt**

The blue light appears when cockpit calls the ground mechanic. An external horn also sounds.

**② COCKPIT CALL pb**

- Pressed : This calls the cockpit.  
The MECH lights flash amber on the ACPs and a buzzer sounds.  
Released : The MECH lights go out after 60 seconds if they are not reset on the ACPs. The buzzer stops.

**③ HORN RESET pb**

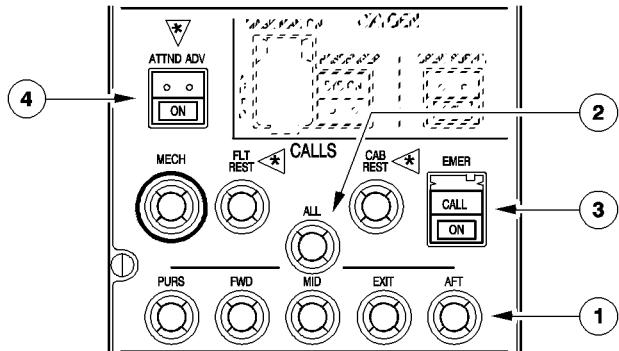
- Pressed : The COCKPIT CALL light goes out.  
The external horn stops sounding.

## CABIN CALL SYSTEM

This system is for communication between the cockpit and the cabin.

### CALL FROM THE COCKPIT

FFCS-01-2320-014-A001AA



#### R ① FLT REST / CAB REST / PURS / FWD / MID / EXIT / AFT pb

Pressed : A steady pink light comes on at the corresponding area call panel. CAPTAIN CALL appears at the corresponding attendant indication panel and a green light comes on. A high-low chime sounds through corresponding loudspeaker.

#### ② ALL pb

Pressed : All stations respond as above simultaneously CALL ALL CAPT appears on the attendant indication panels.

#### ③ EMER pb sw (guarded)

ON : Pink light illuminates at all area call panels. CALL PRIO CAPT appears at all attendant indication panel and a red light comes on. High-low chime (repeated 3 times) sounds through all loudspeakers. ATT amber lights flash on Audio Control Panels.

ON It : This light flashes white for an emergency call from the cockpit to the cabin.

CALL It : This light flashes amber for an emergency call from the cockpit or cabin. For an emergency call from the cabin to the cockpit:

- The white ON light and amber CALL light flash.
- The amber ATT lights flash on the audio control panels.
- Three long buzzers sound in the cockpit.

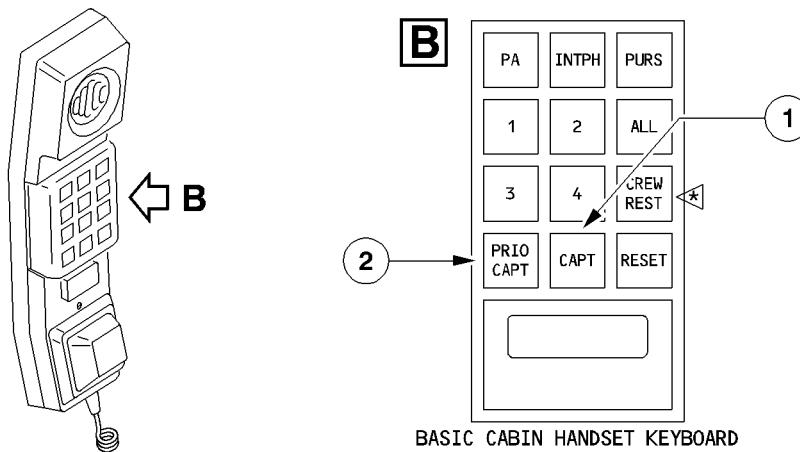
The system reset when the attendant hangs up the relevant handset.

**④ ATTND ADV pushbutton ◄**

**ON** : When pressed, a green light on the attendant area call panel comes on. It is used to inform cabin crew of imminent takeoff or landing. The ON light comes on in blue.

**CALL FROM THE CABIN**

FFC5-01-2320-015-A001AA

**① CAPT key**

Pressed : In the cockpit, the "ATT" lights up on the ACP, and a buzzer sounds.  
In the cabin, "CAPTAIN" appears on the AIP, where the CAPT button was pressed. The buzzer is inhibited during takeoff and landing.

R

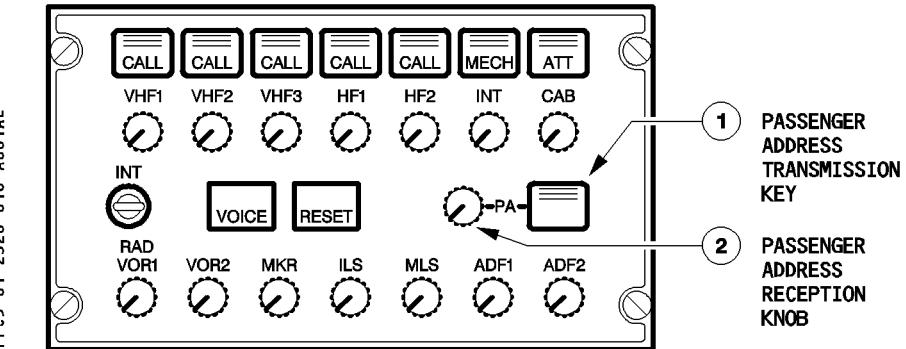
**② PRIO CAPT key**

Pressed : This key is used for emergency calls. In the cockpit, the "ATT" lights up on the ACP, and three buzzers sound.  
In the cabin, "PRIO CAPTAIN" appears at the AIP, where the PRIO CAPT button was pressed. The buzzer is inhibited during takeoff and landing.

R

## PASSENGER ADDRESS

The passenger address system allows flight personnel to make passenger announcements in the cabin via the loudspeakers. It can be operated from the cockpit (with ACP, or handset), or from the cabin (attendant stations).



## ① PA transmission key

- Pressed and held : The flight crew may use a boom, mask, or hand mike to make an announcement.  
Three green lines come on.

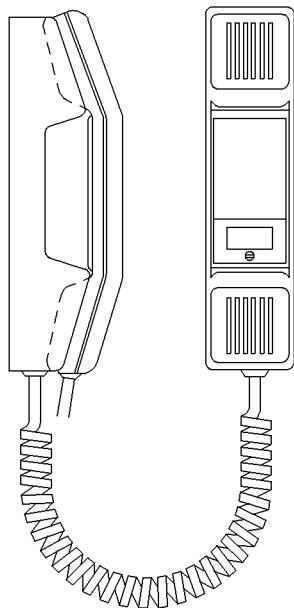
Note : The flight crew may use a cockpit handset to make PA announcements without action on the ACPs.

② PA reception knob

- |                                    |  |
|------------------------------------|--|
| Pressed and released<br>(knob out) | : The message goes to the loudspeakers and the integral white light comes on.<br>The flight crew can rotate the knob to adjust the volume. |
| Pressed<br>(knob in)               | : The PA system is disconnected<br>The white light goes out.   |

**Cockpit handset**

- R The cockpit handset at the bottom of the pedestal is used for PA announcements.

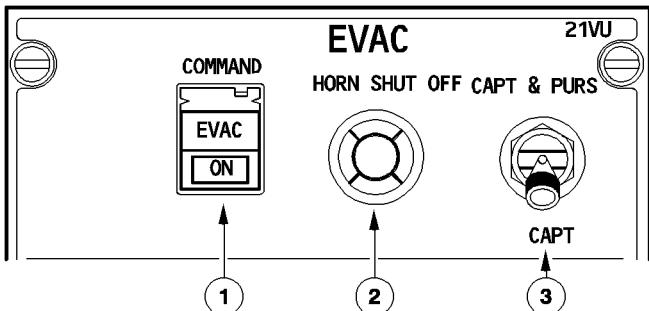


**PA from cockpit**

	PA TRANSMISSION KEY ON ACP	PA RECEPTION KNOB ON ACP	PUSH TO TALK ON HANDMIKE	PUSH TO TALK ON HANDSET
BOOMSET OR OXYGEN MASK	PRESSED (held)	OUT		
HANDMIKE	PRESSED (held)	OUT	PRESSED	
HANDSET				PRESSED

**EMER EVAC**

FFC5-01-2320-019-AD01AA

**① COMMAND pb**

ON

- : In the cockpit : – EVAC light flashes red.
- In the cabin : – EVAC RESET lights flash at all attendant panels.
- "EVACUATION ALERT" appears on all attendant indication panels and a red light flashes.
- Specific evacuation tone sounds.

Off

- : The alert is stopped.

The EVAC light flashes red when the alert is activated.

**② HORN SHUT OFF pb**

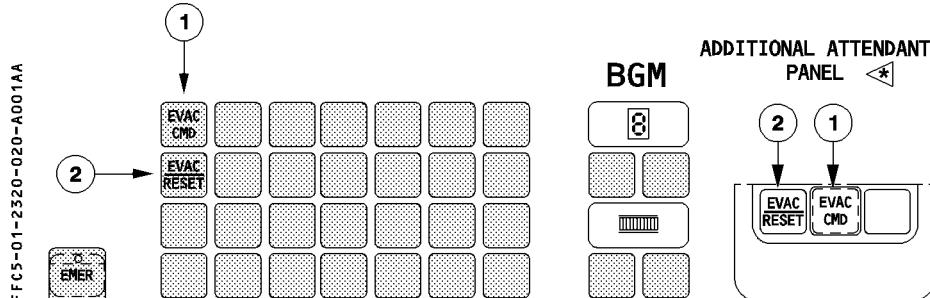
This button silences the cockpit horn (generated when evacuation is activated from the cabin).

**③ CAPT and PURS / CAPT sw**

CAPT and PURS : The alert may either be activated from the cockpit or the cabin.

CAPT : The alert may only be activated from the cockpit.

R R If one of the cabin EVAC CMD keys is pressed, only the cockpit horn sounds for 3 seconds.

**PURSER STATION****(1) EVAC CMD key**

- R When this key is pressed :
- R In the cockpit : – The cockpit horn sounds.  
– EVAC It flashes red.
- R In the cabin : – EVAC RESET lights flash red at all attendant stations.
- R – EVAC CMD light comes on green on the forward attendant panel.
- R – “EVACUATION ALERT” is displayed on all attendant indication panels.
- R – The EVAC tone sounds.

**(2) EVAC RESET key**

- R Pressing this key silences the EVAC tone.

**A340**

FLIGHT CREW OPERATING MANUAL

**COMMUNICATIONS****COCKPIT VOICE RECORDER**

1.23.30 P 1

SEQ. 001 REV. 09

**DESCRIPTION**

The cockpit voice recorder (CVR) records :

- direct conversations between crew members in the cockpit
- all aural warnings sounded in the cockpit
- communications received and transmitted by radio
- intercom conversations between crew members
- announcements transmitted over the passenger address system, if PA reception is selected on third audio control panel.

Only the last 30 minutes of recording are retained.

The CVR system consists of :

- a remote microphone behind overhead panel,
- a crashproof four-track recorder, equipped with an underwater locating beacon, in the aft section of the aircraft
- a control panel on the overhead panel.

It is energized automatically :

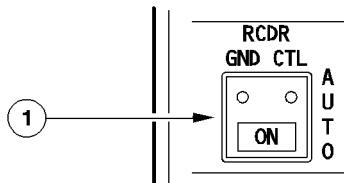
- on ground during the first 5 minutes after the aircraft electrical network is energized
- on ground with one engine running,
- in flight

It is stopped automatically 5 minutes after last engine shutdown.

On the ground, personnel can energize the CVR manually by pressing GND CTL pushbutton.

**CONTROLS AND INDICATOR ON OVERHEAD PANEL****RECODER**

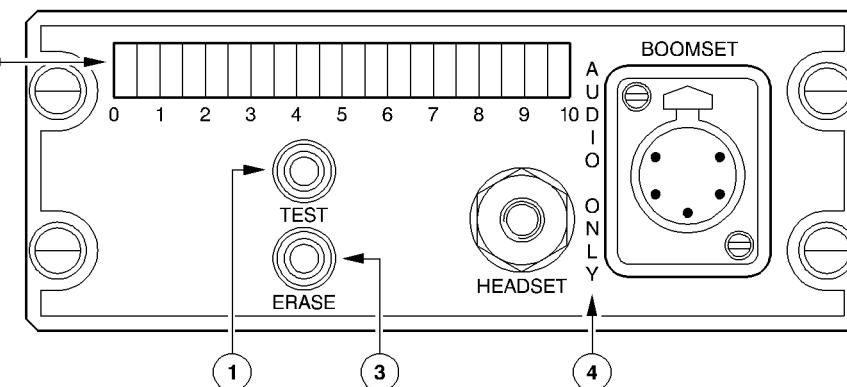
FFCS-01-2330-002-A001AA

**(1) GND CTL sw (spring-loaded)**

- R      ON : The CVR and the digital flight data recorder (DFDR) are energized.  
          The ON light comes on in blue.
- R      AUTO : The CVR and DFDR are automatically energized according to the logic (see page 1).  
          The ON light goes off.

**CVR PANEL**

FFC5-01-2330-003-A001AA

**① TEST pb**

Pressed : This activates the test, if the CVR is energized.  
The result of the test is visible on the test result indicator.  
If an acoustic equipment is plugged into the jack, the test will be heard as low-frequency signal.

**② Test result indicator**

R Green and red LEDs compose the indicator.  
Illumination of one or more green LEDs indicates that the test result is good.

**③ ERASE pb**

Pressed for 2 seconds : This erases the tape completely, if the aircraft is on the ground, and the parking brake is on.

**④ Headset and Boomset jacks**

When a headset or boomset is plugged into the jack:  
– Cockpit sounds, picked up by the microphone, are audible.  
– The test tone is audible, when the TEST pushbutton is pressed.  
– The erase tone is audible when the ERASE pushbutton is pressed.

**GENERAL****INTRODUCTION**

The Aircraft Communication Addressing and Reporting System (ACARS) allows direct exchange of data between aircraft and airline ground computer through the VHF 3.

Aircraft to ground messages (downlink) comprise operational, maintenance, monitoring, performance and cabin data.

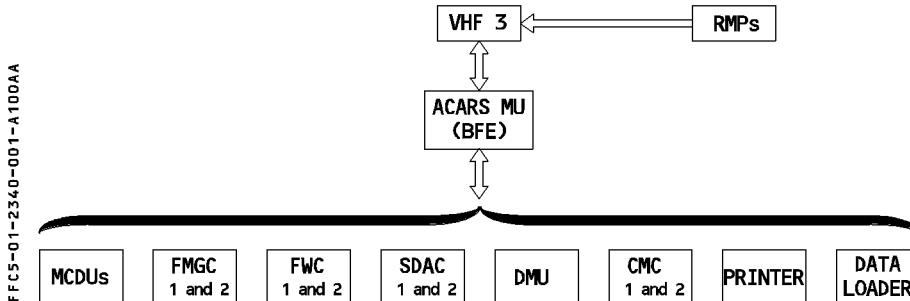
Ground to aircraft messages (uplink) contain crew information (wind for example) or might request for transmission of data which are sent automatically or by crew action.

Automatic downlink of reports is carried out by ACARS Management Unit (MU), which is programmed according to airline needs (Buyer Furnishing Equipment).

Due to the highly customized programming, the ACARS functions may vary for different airlines and therefore are not described in detail.

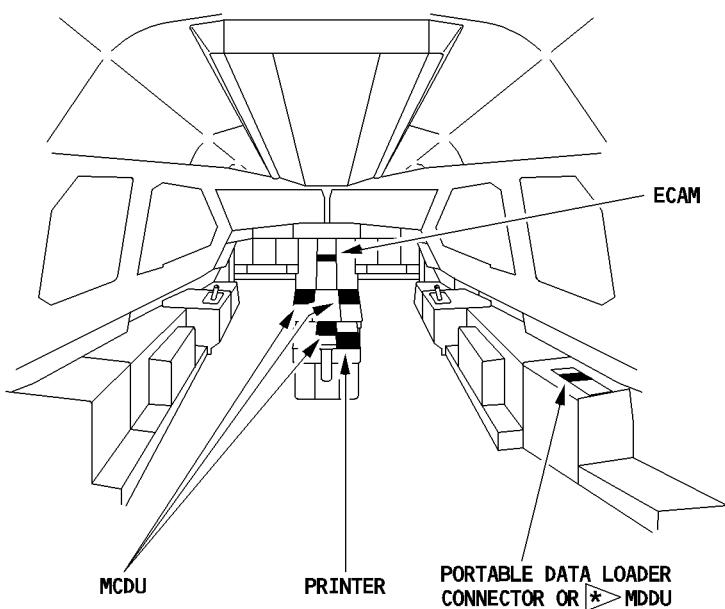
**SYSTEM ARCHITECTURE**

The ACARS system consists of a Management Unit (MU) connected to the following elements:



**COCKPIT ARRANGEMENT**

FFC5-01-2340-002-A100AB



ACARS operation is performed through the already available cockpit equipment:

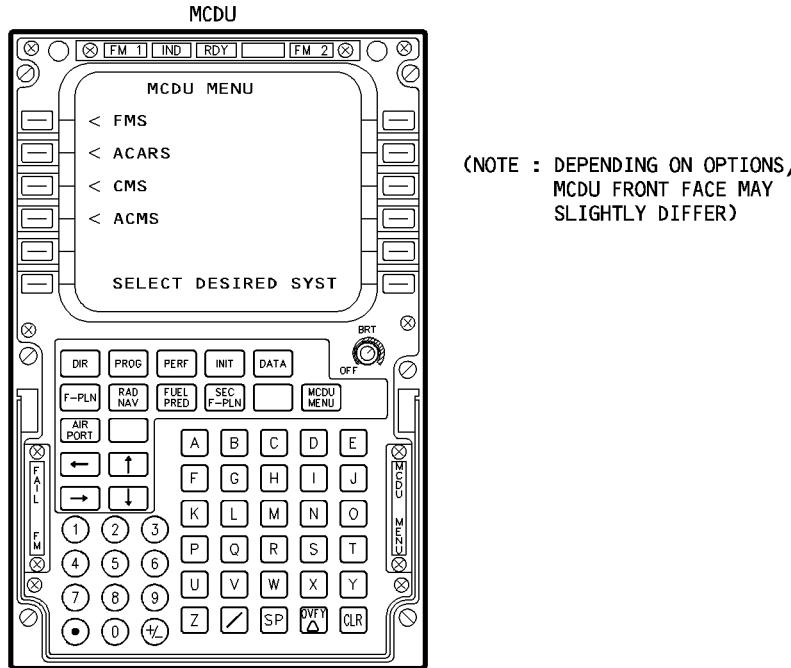
- ECAM for operational indications.
- MCDU for control of ACARS related functions.
- PRINTER for hard-copies.
- R — Either connector for portable data loader or Multifunction Disk Drive Unit (MDDU). ◁

## **OPERATION MODES**

# **MANUAL ACCESS TO ACARS FUNCTIONS**

ACARS functions are manually selected through MCDU. They are obtained for FMGC, CMS or ACMS by selecting the corresponding key. Cabin management functions (if available) are accessible through the cabin installed system.

R



Pressing of a system key will display the system pages as defined in the airline customized MU programming.

## **AUTOMATIC ACCESS TO ACARS FUNCTIONS**

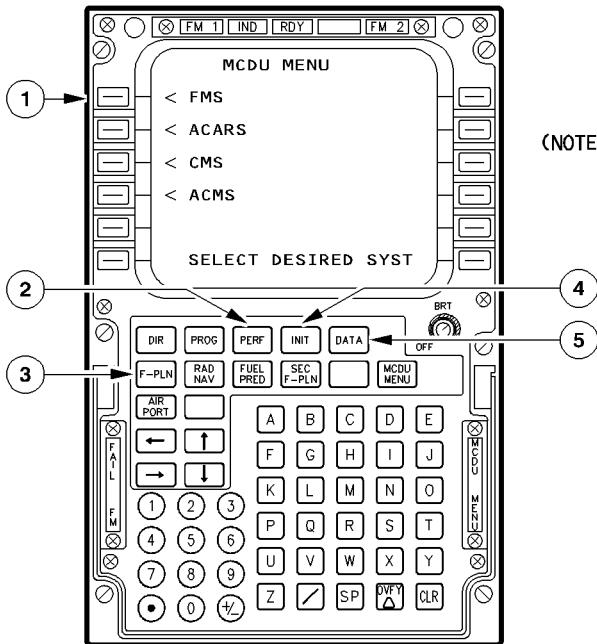
Automatic data transmission can be initiated by MU or aircraft systems programming on an uplink message. There is no cockpit indication nor crew action is required. It is a dialogue between ground and aircraft computers.

**ACARS FUNCTIONS**

Data and reports of a particular system are available through Airbus defined interfaces (Seller Furnishing Equipment).

**FMS**

R



- FFC5-01-2340-004-A100AA
- ① Pressing key selects related system,then
  - ② Pressing key gives access to takeoff data (Uplink only)
  - ③ Pressing key gives access to wind data (F-PLN page)
  - ④ Pressing key gives access to F-PLN initialisation and wind data (Uplink only)
  - ⑤ Pressing key gives access to Pre-flight, Post-flight report and ACARS print/program (downlink only).  
For operation see FMGS PILOT GUIDE (Refer to 4.04.50).

**A340**

FLIGHT CREW OPERATING MANUAL

**COMMUNICATIONS**

ACARS

1.23.40 P 5

SEQ. 100 REV. 09

## **ACARS**

Pressing ACARS key displays airline defined functions (message transmission , event times for example).

### **CMS (Refer to 1.45.20)**

Through the CMS interface it is possible to downlink the following data :

- Post flight report (on the ground) or current flight report (in flight) which concerns :
  - all failure messages detected by the BITEs
  - the warnings displayed to the crew during the last or current flight leg.
- Reports can be downlinked upon crew or ACARS MU request.
- Avionics data which concerns the individual system BITE data (manual downlink only).
- Failure messages and warnings (broadcast data transmitted in real-time to the MU).
- Class 3 report (on the ground) containing all class 3 failures detected during the last flight leg. The report can be downlinked upon crew or ACARS MU request.

## **ACMS**

The ACMS ACARS interface provides the capability to transmit to the ACARS MU the data for the following applications:

- Aircraft Performance Monitoring (APM),
- Engine Condition Monitoring (ECM),
- APU Health Monitoring (AHM).

Any of the ACMS DMU reports can be downlinked (transmitted to the MU):

- manual on the ground or in flight upon crew request,
- automatically in real-time,
- upon ACARS MU (ground or automatic) request.

## **AUTOMATIC DOWLINK OF REPORTS**

Automatic downlink of reports are provided by ACARS (AIDS "CRUISE PERFORMANCE" report, CFDS "POST FLIGHT REPORT, ...). Each report generated by a peripheral system may be downlinked depending on each airline MU programming.

## **UPLINK MESSAGES**

Two types of uplink messages are provided :

- Messages not indicated to the crew :

There is no indication given to the crew, neither for uplink message nor for downlink answer. It is a dialogue between ground and aircraft computers.

- Messages indicated to the crew by :

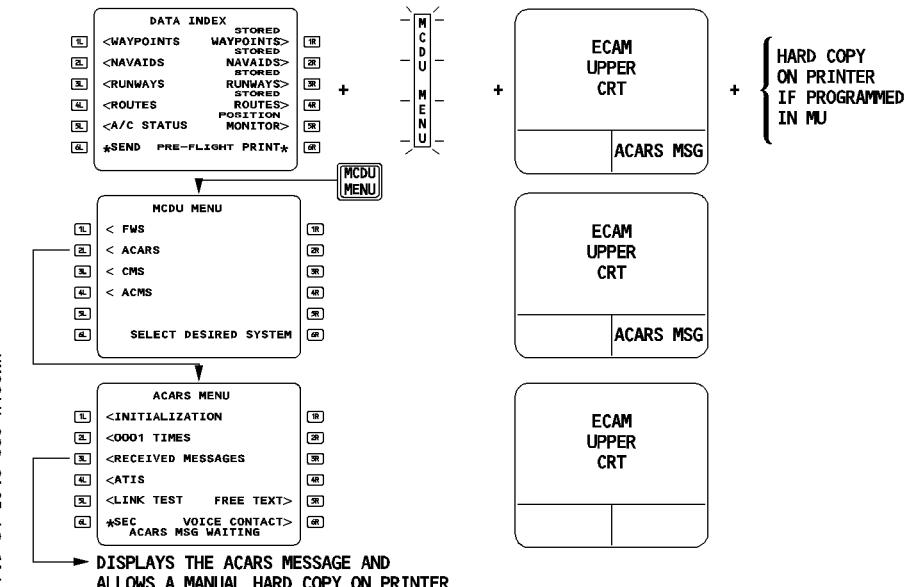
- "ACARS MSG" advisory (in green) on ECAM Memo

*Note : A steady green "ACARS STBY" advisory is displayed in case of ACARS communications loss between aircraft and ground.*

- Message on MCDU (ACARS MSG WAITING for example) or MCDU MENU light illumination if the MCDU is not in the mode where uplink message can be displayed in order to select the correct mode (FMS, ACARS, ACMS, CMS)

- Hard copy on cockpit printer depending on MU programming.

Example of uplink message indication with MCDU in FMS mode :



## VOICE/ACARS transfer on VHF 3

VHF 3 can be used in VOICE mode in case of :

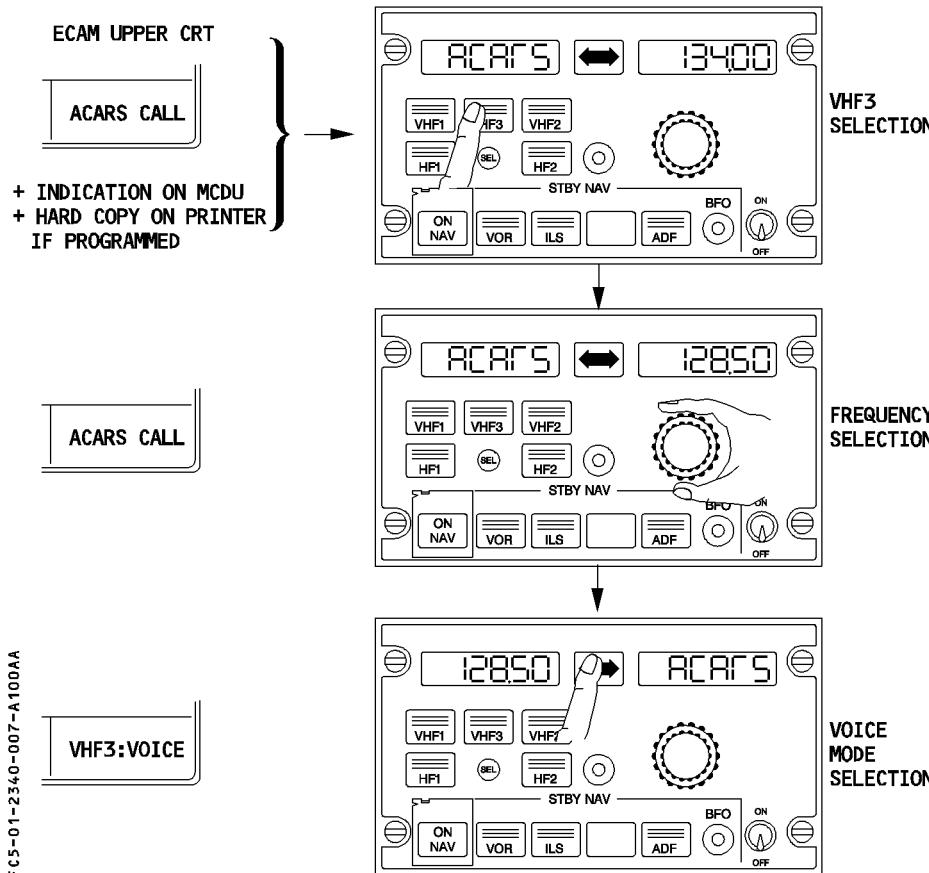
- VHF 1 or VHF 2 failure
- ACARS CALL

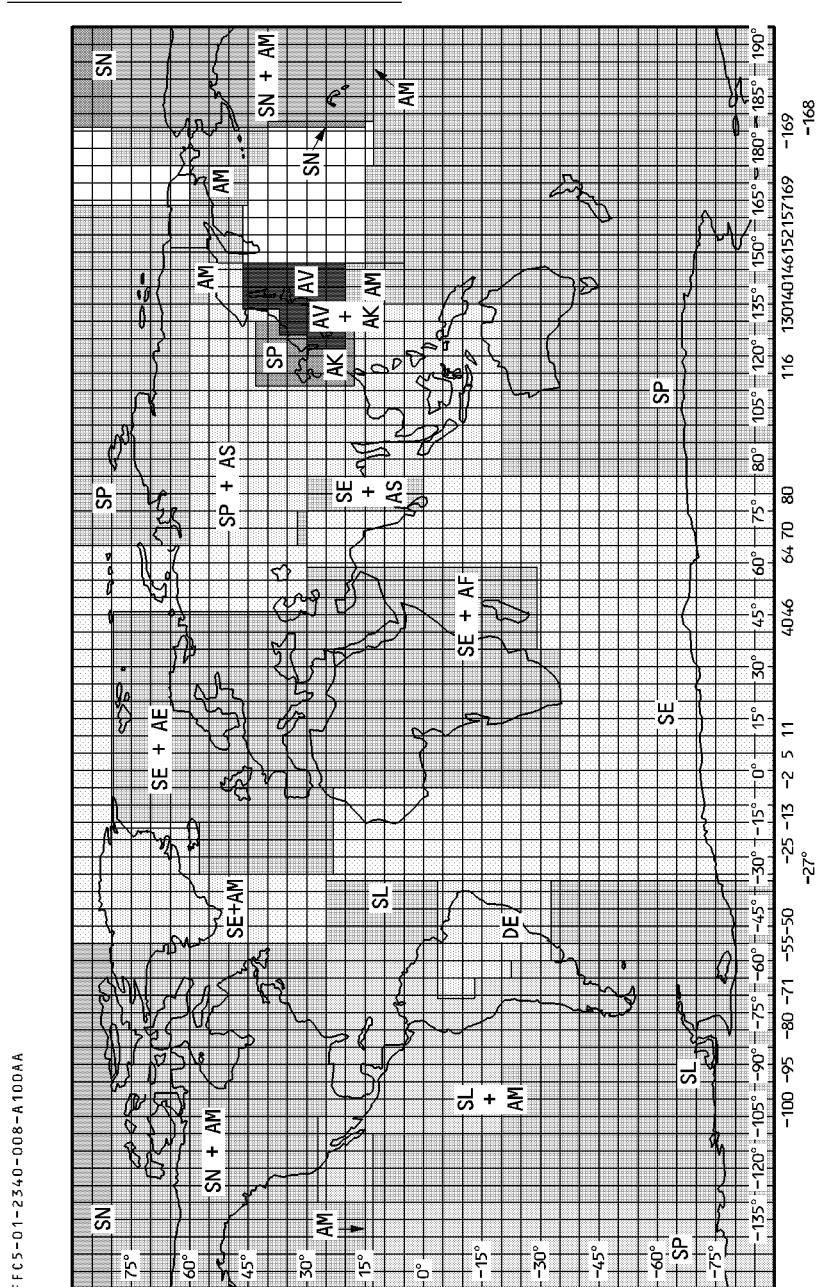
The green pulsing "ACARS CALL" advisory indicates that a message requesting a voice conversation has been received from the ground.

The green "VHF 3 : VOICE" advisory indicates that the VHF 3 transceiver operates in voice mode, therefore the ACARS communications are interrupted.

Depending on MU programming, the ACARS frequency may be either automatically tuned by the ACARS MU or manually tuned through the RMP.

In this case, the ACARS/VOICE transfer is made directly on any of RMP's (without using MCDU).



R **WORLD MAP ACARS FREQUENCIES**

FFC5-01-2340-008-A100AA

**SOUTH  
ACARS WORLD MAP**

**WORLD MAP ACARS FREQUENCIES (CONT'D)**

The table below defines the world zone abbreviations, indicates their associated Service Provider, MCDU label, and ACARS frequency.

ABBREVIATION	SERVICE PROVIDER	MCDU LABEL	FREQUENCY	Family
SP	SITA PACIFIC	SIT-PAC	131.550 MHz	SITA
SN	SITA NORTH AMERICA	SIT-NAM	136.850 MHz	SITA
SL	SITA LATIN AMERICA	SIT-LAM	131.725 MHz	SITA
SE	SITA EUROPE	SIT-E/A	131.725 MHz	SITA
DE	DEPV BRAZIL	DEPV	131.550 MHz	SITA
AV	AVICOM	AVICOM	131.450 MHz	SITA
AM	ARINC AMERICA	ARI-AM	131.550 MHz	ARINC
AE	ARINC EUROPE	ARI-EUR	136.925 MHz	ARINC
AF	ARINC AFRICA	ARI-AFR	126.900 MHz	ARINC
AK	ARINC KOREA	ARI-KOR	131.725 MHz	ARINC
AS	ARINC ASIA	ARI-ASI	131.450 MHz	ARINC

**A340**

FLIGHT CREW OPERATING MANUAL

**COMMUNICATIONS****SATCOM**

1.23.45

P 1

SEQ. 100

REV. 14

**GENERAL**

The Satellite Communication (SATCOM) system allows the exchange of information between the aircraft and a Ground Earth Station (GES), via geosynchronous satellites.

- R It provides up to six independent channels :
- R One channel is used for data transmissions (ATSU or ACARS). Two or five channels are used for voice transmissions (cockpit or cabin voice). The cockpit voice function must be activated, in order for it to be available. The cabin telephone system must be installed, to be able to use cabin voice function.

ACARS or ATSU communications normally transmit via VHF3. They automatically switch to SATCOM when VHF3 is not available.

The cockpit voice interface is controlled by the Audio Control Panels (ACPs) for call set-up and call termination, and by the MCDU for the call number selection. It allows the crew :

- To initiate air to ground calls and to receive ground to air calls.
- To select the call priority, in case of air to ground calls.
- To use manual dial or pre-recorded phone numbers.

SATCOM functions are programmed through the Owner Requirement Table (ORT), according to airline needs.

Due to the highly customized programming, the SATCOM functions may vary for different airlines and are, therefore, not described in detail.

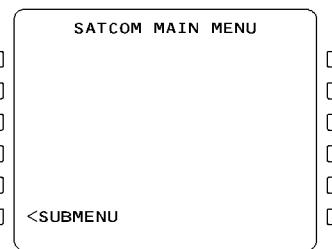
**CONTROLS AND INDICATORS****ACP INTERFACE**

Refer to the 1.23.20 description.

**MCDU INTERFACE****SATCOM MAIN MENU PAGE**

The crew accesses this page by selecting SAT on the MCDU MAIN page.

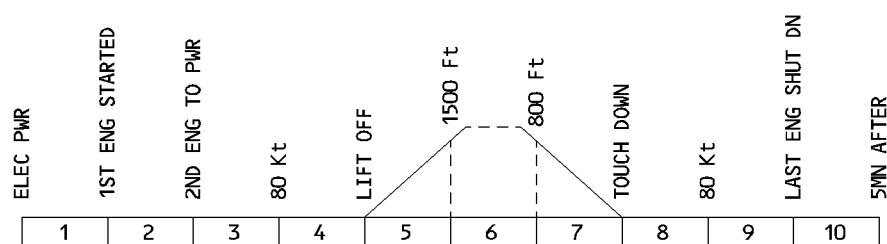
FFCS-01-2345-0002-A102AA



- 6L      This key provides access to the SATCOM SUBMENU page, which contains LOG ON and channel status information.

**DESCRIPTION**

F FC5-01-2350-001-A110A



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
VHF 1 (2) (3) EMITTING HF 1 (2) EMITTING Transceiver emitting more than 60 s	SINGLE CHIME	MASTER CAUT			3,4,5
CIDS 1 + 2 FAULT Total loss of CIDS	NIL	NIL	NIL	NIL	1*, 3, 4, 5 7, 8, 10*
CIDS PA FAULT Loss of passenger address part					3,4,5, 7,8
ACARS 1 (2)(1+2) FAULT ◁ SATCOM FAULT ◁ Telephone and ACARS transmissions are lost.					3,4,5 7,8
SATCOM DATA FAULT ◁ ACARS transmissions via SATCOM are lost. Telephone transmissions are still available.	NIL	NIL			
SATCOM VOICE FAULT ◁ Telephone transmissions are lost, ACARS is still transmitted via SATCOM.					
VHF3 DATA FAULT ◁	SINGLE CHIME	MASTER CAUT			

\* The SATCOM FAULT message is inhibited in flight phases 1 and 10, when the IRS are not aligned.

**MEMO DISPLAY**

- Displays “SEAT BELTS” and “NO SMOKING” messages in green, when the corresponding sign on the overhead panel is on.
- Displays “AUDIO SWTG” in green, if the AUDIO SWITCHING selector is not on NORM.
- Displays “PA IN USE” (optional) in green, during passenger address operation.
- Displays “VIDEO IN USE” (optional) in green, during video operation in the cabin.
- Displays “CABIN READY” in green (pulses for 10 seconds, then remains steady ; except at the beginning of flight phase 6, when it is steady), when a signal is sent from the cabin crew, and in the takeoff and landing memo. ☐

In addition, if ACARS is installed, the display shows :

- ACARS VHF 3, VOICE in green, flashes continuously, if VHF 3 is operating in voice mode and ACARS communication is interrupted.
- ACARS MSG in green, flashes for 10 seconds if ACARS has received a message from the ground, and a continuous buzzer sounds.
- ACARS STBY in green, if ACARS communications between the aircraft and the ground are lost.
- ACARS CALL in green, flashes for 10 seconds when an uplink message requests voice communication.
- ACARS ALERT in green, when an uplink alert message has been received.

If ATSU is installed, the displays shows :

- VHF3 VOICE in green if VHF3 is operating in voice mode.
- HF : VOICE in green, flashes for 10 seconds if both HFs (☐) are operating in voice mode.
- HF DATA OVRD in green, when HF (☐) is operating in data mode on the ground.

If SATCOM is installed, the display shows “SATCOM ALERT” in green, when a message with a priority level below 4 is received from the ground.

**BUS EQUIPMENT LIST**

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
RADIO COMMUNICATIONS	VHF1					X	
	VHF2		DC 2				
	VHF3		DC 1				
	HF1	AC1-2					
	HF2	AC2-3					
	RMP1				X		
	RMP2		DC 2				
	RMP3		DC 1				
	CAPT ACP				X		
	F/O ACP				X		
	THIRD ACP		DC 1				
	SELCAL		DC 1				
	FLT INTERPHONE				X		
	CAPT LOUDSPEAKER				X (1)		
CABIN INTERCOMM DATA SYS	F/O LOUDSPEAKER				X (1)		
	EXT HORN					HOT 2	
	CIDS1		GND/FLT		X		
COCKPIT VOICE RECORDER	CIDS2		GND/FLT		X		
	DEU (A/B)		GND/FLT		X		
ACARS	CVR CTL		DC 1				
	CVR				SHED		
ACARS	MU	AC1-1					

- (1) Normal supply is from DC ESS BUS. DC BUS 1 supplies CAPT (or F/O) loudspeaker when AUDIO SWITCHING selector is set to CAPT (or F/O) on 3.

**A340**

FLIGHT CREW OPERATING MANUAL

**ELECTRICAL**

1.24.00 P 1

CONTENTS

SEQ. 001 REV. 08

**24.00 CONTENTS****24.10 DESCRIPTION**

– GENERAL . . . . .	1
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– OPERATIONS . . . . .	6

**24.20 CONTROLS AND INDICATORS**

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– FORWARD CABIN . . . . .	8
– EXTERNAL POWER PANEL . . . . .	9
– ECAM ELEC AC PAGE . . . . .	10
– ECAM ELEC DC PAGE . . . . .	17
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– WARNINGS AND CAUTIONS . . . . .	23
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**A340**

FLIGHT CREW OPERATING MANUAL

**ELECTRICAL**

1.24.10 P 1

DESCRIPTION

SEQ. 001 REV. 08

**GENERAL**

The electrical power system consists of a three phase 115/200-volt 400-hertz constant-frequency AC system and a 28-volt DC system.

Electrical transients are acceptable for equipment.

Commercial supply has secondary priority.

Normally, the system produces alternating current, some of which it then transforms into direct current for certain applications.

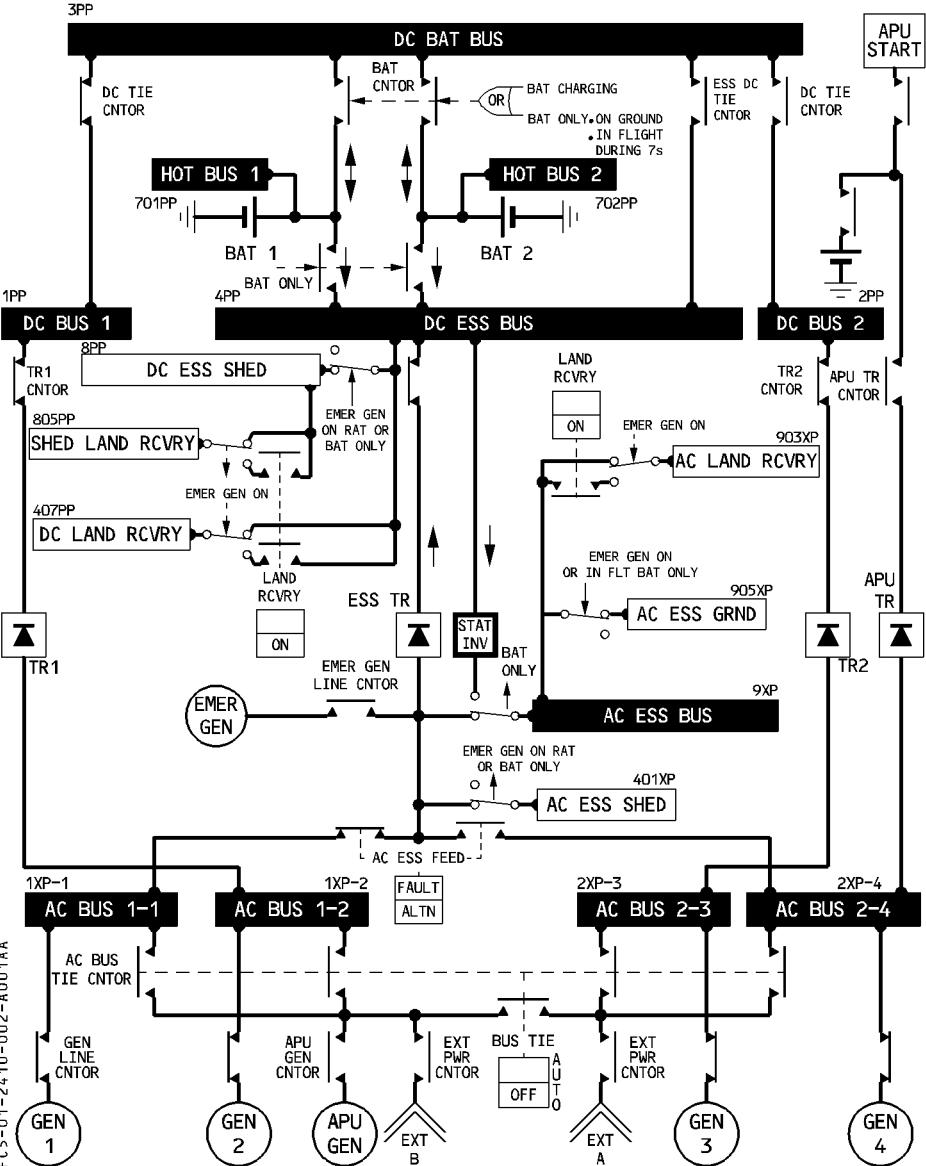
At least two generators are required to supply all electrical bus bars.

If all normal AC generation is lost, an emergency generator can supply AC power.

If all AC generation is lost, the system can transform DC power from the batteries into AC power.

**FOR INFO**

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**GENERATION OF ELECTRICAL POWER****AC GENERATION****MAIN GENERATORS**

Four three-phase AC generators (GEN1, GEN2, GEN3 and GEN4), driven by the engine through an integrated drive, supply aircraft electrical power. Each generator can supply up to 75 KVA of three phase 115/200-volt 400 hertz power.

A fifth generator (APU GEN), driven directly by the APU and producing up to 115 KVA of three phase 115/200-volt 400 hertz power can replace one or more main engine generators at any time.

A generator control unit (GCU) controls the output of each generator. The main functions of each GCU are :

- Control the frequency and voltage of the generator output.
- Protect the network by controlling the associated generator line contactor (GLC).

**EXTERNAL POWER**

Two ground power connectors near the nose wheel allow ground power to be supplied to all bus bars (with some galleys shed in case of overload). Two ground power units (90 kVA max each) can supply the aircraft.

A Ground Power Control Unit (GPCU) :

- Protects the network by controlling the external power contactor.
- Generates a reference frequency used by GCU for synchronisation before No Break Power Transfer (NBPT).

**EMERGENCY GENERATOR**

The green hydraulic circuit drives an emergency generator that automatically supplies emergency AC power to the aircraft electrical system if all main generators fail. This generator supplies 5.5 KVA of three-phase 115/200-volts 400-hertz power, except when the Ram Air Turbine powers the green hydraulic circuit, and the aircraft speed is below 260 knot in this case, the emergency generator supplies 3.5 KVA, leading to some shedding.

A generator control unit (GCU) :

- keeps the emergency generator at a constant speed
- controls the generator's output voltage
- protects the network by the controlling the emergency generator line contactor
- controls the emergency generator start-up

## STATIC INVERTER

A static inverter transforms DC power from the DC ESS bus into 2.5 KVA of single-phase 115-volt 400-hertz AC power, which is then supplied to part of the AC essential bus. In flight, the inverter is activated automatically if nothing but the batteries is supplying electrical power to the aircraft, regardless of the positions of the BAT 1 and BAT 2 pushbutton switches.

On the ground, the inverter is activated if nothing but the batteries is supplying electrical power to the aircraft and the BAT 1 and BAT 2 pushbutton switches are both on.

## DC GENERATION

### TRANSFORMER RECTIFIERS (TR)

Two main Transformer Rectifiers TR1 and TR2 (200 A) and one essential TR (100 A), supply the aircraft electrical system with DC current.

A fourth TR (100A) is dedicated to APU start or APU battery charging.  
Each TR controls its contactor by internal logic.

## BATTERIES

Two main batteries, each with a normal capacity of 37 Ampere-hours, are permanently connected to the two hot busses.

A third battery (37 Ah) is dedicated to APU start.

Each battery has an associated Battery Charge Limiter (BCL).

The BCL monitors battery charging and controls its battery contactor.

## CONTACTORS

Two identical Electrical Contactor Management Units (ECMUs) provide:

- AC and DC contactors control (excepted TR contactors which are controlled by the TR itself).
- Galley shedding control.
- No Break Power Transfer control (NBPT).
- Monitoring and indicating.

For this purpose, each ECMU receives following information:

- Voltage of all normal busbars
- position of all AC and DC contactors
- availability of all generators or power source (from GCU or GPCU)
- position of all galleys contactors
- TR status
- pushbutton position (BUS TIE, GALLEY SHED and COMMERCIAL)
- flight/ground signal from associated LGCIU.

## AC AND DC CONTACTOR CONTROL

- ECMU 1 controls :
- The Generator Line Contactor (GLC) 1 and 2.
  - The AC Bus Tie Contactor (BTC) 1 and 2.
  - The APU Generator Contactor.
  - The external power B contactor
  - Both DC Tie Contactors.
  - The BUS TIE contactor
- ECMU 2 controls :
- The Generator Line Contactor (GLC) 3 and 4.
  - The AC Bus Tie Contactor (BTC) 3 and 4.
  - The external power A contactor.
  - Both DC tie Contactors.

## NO BREAK POWER TRANSFER

This function avoids busbar power interruption during supply source transfer on ground in normal configuration. It is inhibited in flight.

ECMU controls simultaneous connection of the two sources for a short time. To achieve this, both sources are synchronized on a frequency reference signal sent by the GPCU. Synchronization may take up to 15 seconds for APU GEN with GPU, and some milliseconds in all other cases.

If synchronization is not achieved within allowed time transfer is performed anyway (without simultaneous connection of the two sources). This function has a back-up in the GCU.

## MONITORING AND INDICATING

Each ECMU sends the following information to the ECAM:

- Bus bars supplied or not
- contactor status
- galley supply status, and galley switch position.

## **CIRCUIT BREAKERS**

All circuit breakers are in the electronic equipment bay.

A Circuit Breaker Monitoring Unit (CBMU) monitors the circuit breaker status. It sends this information to the ECAM system.

## **OPERATIONS**

### **GENERAL**

Each AC BUS is supplied in priority order by :

- the corresponding engine generator.
- the APU generator or the external power A (if both are connected, the APU generator has priority for the left side bars, and the external power has priority for the right side bars).
- the external power B (if both external powers are connected, B has priority for the left side bars and A has priority for the right side bars).
- the engine generator located on the same side.
- the other side outer engine generator.

The APU generator or an external power may supply all the network.

Two generators can supply all the network (with galley shedding in case of overload detection).

When only one engine generator is available it supplies only its side.

The generators cannot be connected in parallel (except on ground during No Break Power Transfers).

**NORMAL CONFIGURATION****IN FLIGHT**

Each engine driven generator supplies its associated AC BUS (1.1, 1.2, 2.3, 2.4) via its Generator Line Contactor (GLC 1 and GLC 2, GLC 3 and GLC4).

AC BUS 1.1 normally supplies the AC ESS BUS via a contactor.

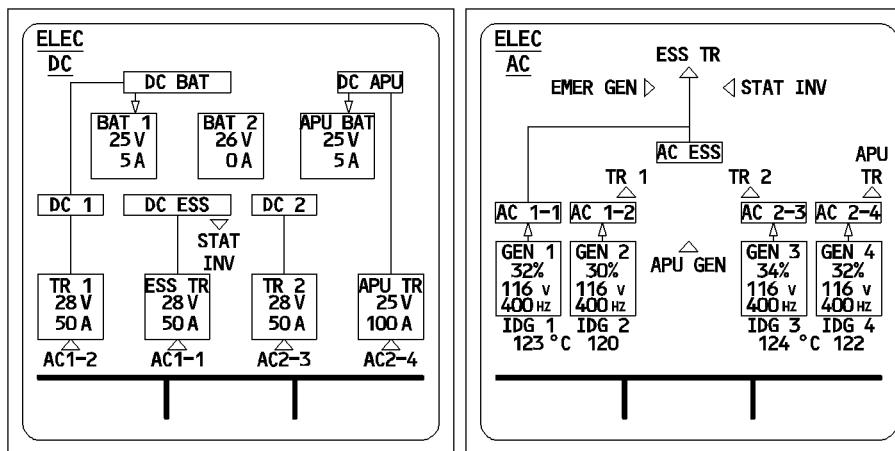
AC BUS 1.2 supplies TR 1 which normally supplies DC BUS 1, DC BAT BUS.

AC BUS 2.3 supplies TR 2 which normally supplies DC BUS 2.

AC BUS 1.1 supplies ESS TR which normally supplies DC ESS BUS.

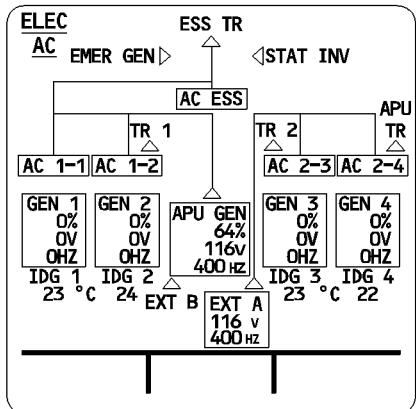
The two batteries are connected to the DC BAT BUS if they need charging. When they are fully charged the Battery Charge Limiter disconnects them.

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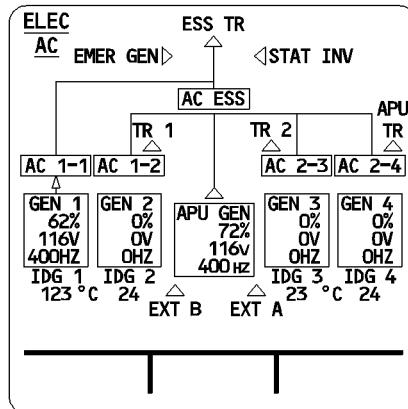


## ON GROUND

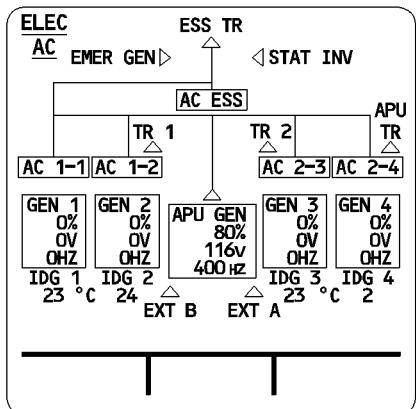
Either the APU generator or external power may supply the complete system (with some galley shedding in case of overload).



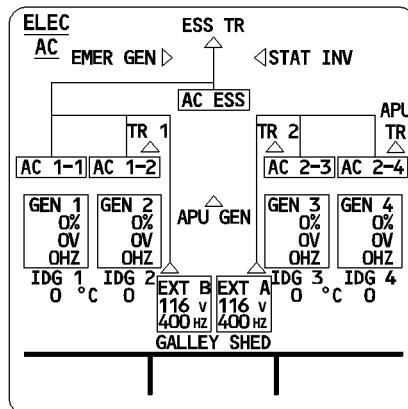
**APU GEN + EXTERNAL POWER**



**APU GEN + GEN 1**



**APU GEN ONLY**



**EXTERNAL POWER ONLY**

If external power A and external power B plus APU supply the complete system, the APU has priority over external power B.

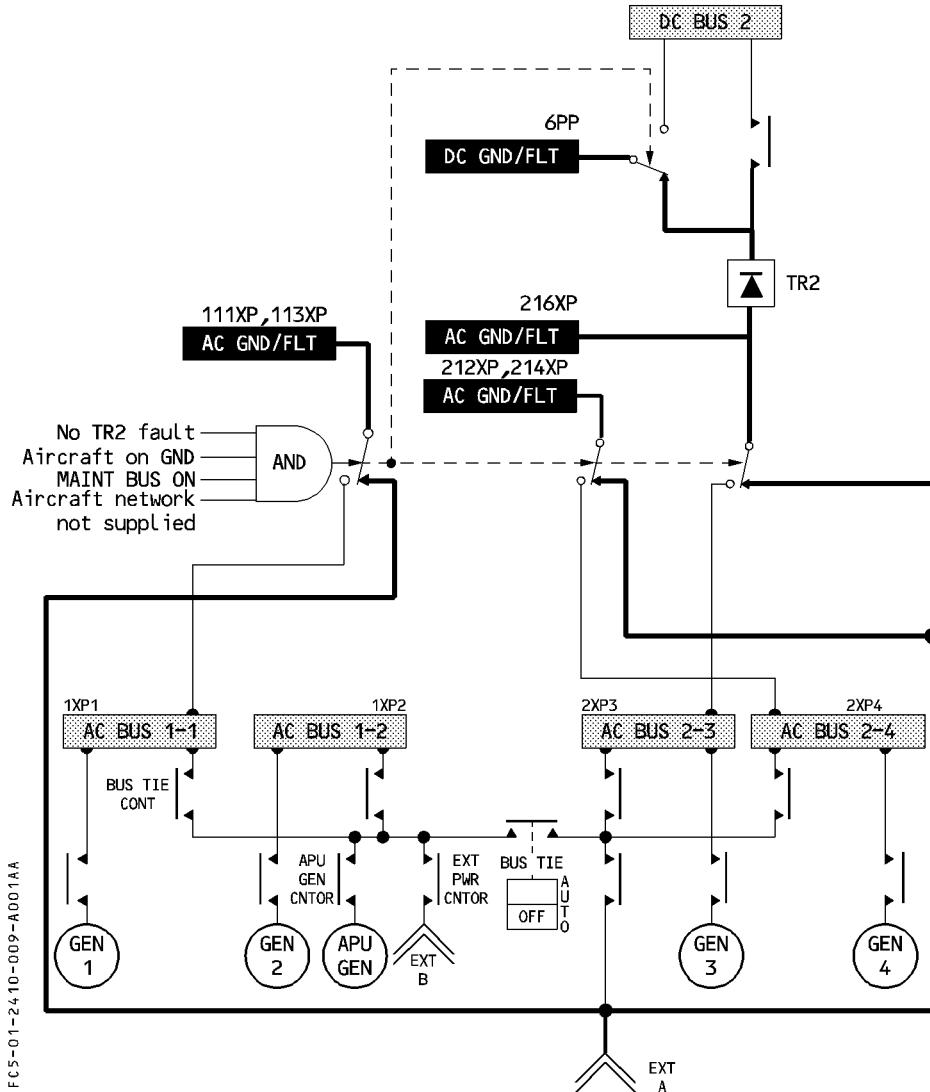
Situation then will be as displayed for case APU plus external power.

On ground, when only ground services are required, external power can supply the AC and DC GND/FLT buses directly, without supplying the aircraft's entire network.

This configuration is selected via the MAINT BUS switch, located in the forward entrance area.

FOR INFO

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## ABNORMAL CONFIGURATIONS

### ENGINE GENERATOR FAILURES

ECMU provides automatic reconfiguration.

Complete network remains supplied provided at least two generators (including APU generator) are available.

Some galleys are automatically shed.

Note : If a generator is lost due to overcurrent detection, reconfiguration does not occur and the related AC BUS is lost.

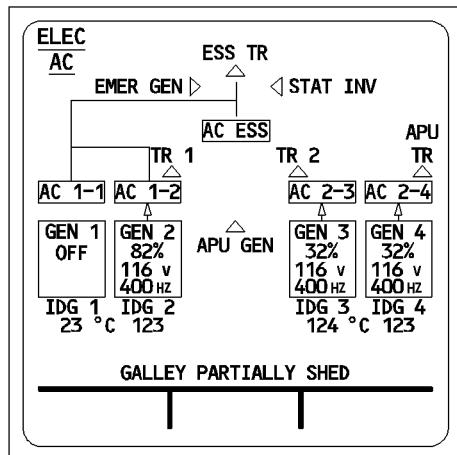
#### Failure of one engine generator

The system automatically replaces the failed generator by the other engine generator of the same side, through the associated AC BUS or the APU generator if available.

#### Failure of two engine generators located on opposite sides

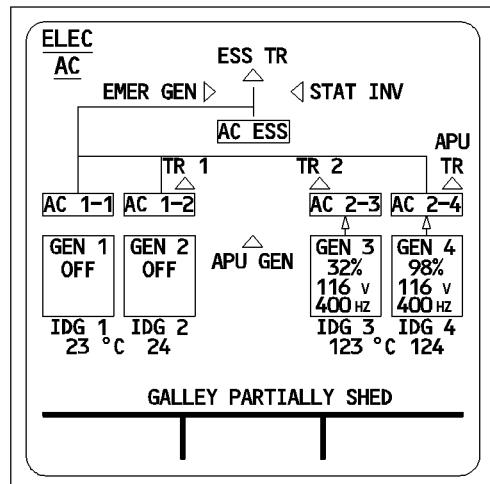
The system automatically replaces each failed generator by the other engine generator of its side, or by the APU generator if available.

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**Failure of two engine generators located on the same side**

The system automatically replaces the failed generators by the outer engine generator of the other side, or by the APU generator if available.

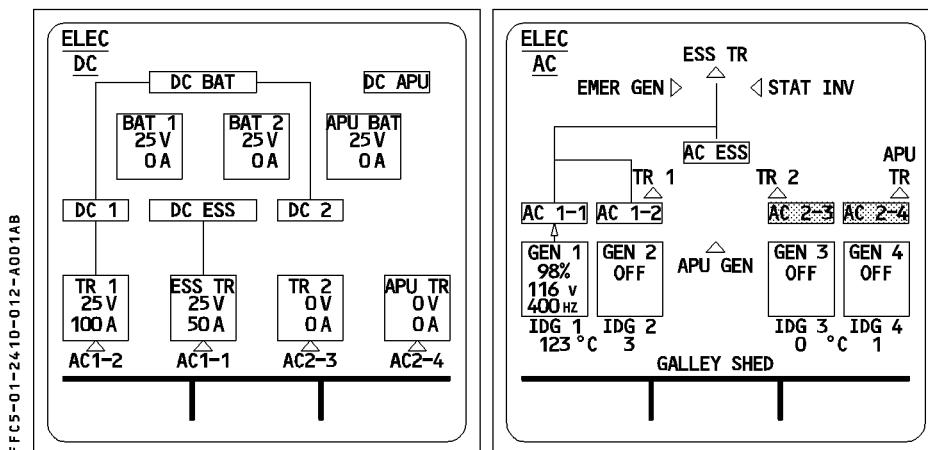


**Failure of three engine generators**

If APU generator is available it replaces all failed engine generators.

If APU generator is not available, the AC NORM BUS on one side are lost.

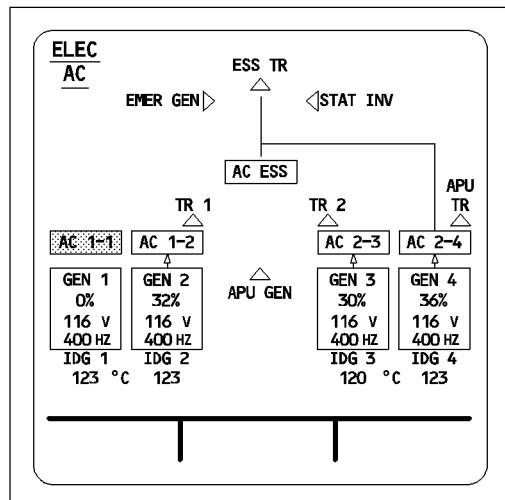
Example : GEN 1 remaining



Note : If the remaining generator is on the right side, the AC ESS BUS is automatically supplied by the AC BUS 2.4.

**FAILURE OF THE AC BUS 1.1**

The AC BUS 2.4 automatically supplies the AC ESS BUS and the ESS TR



## TR FAILURES

The contactor of each TR automatically opens, in case of :

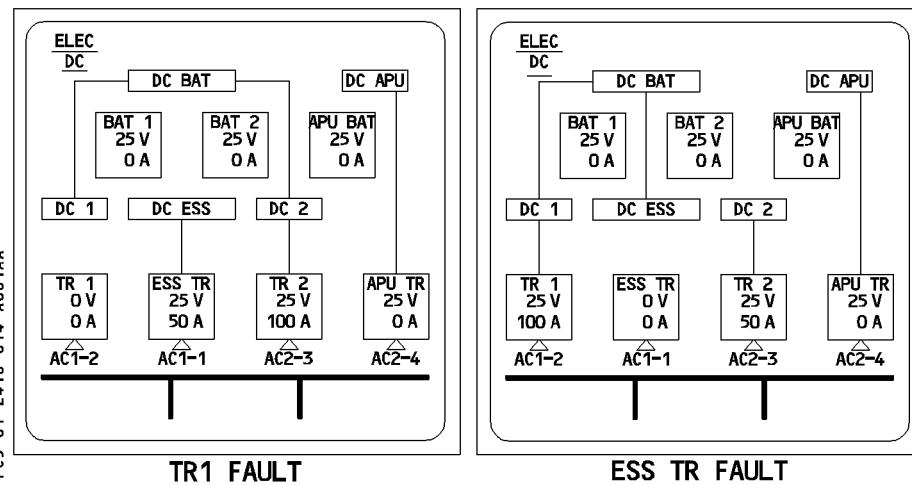
- Overheat
- Minimum current
- Overcurrent
- Open or short circuit.

The ECMU provides automatic reconfiguration (except for APU TR).

R *Note : If a TR is lost due to overcurrent detection, reconfiguration does not occur and the related DC BUS and DC BAT BUS are lost.*

### Failure of one TR

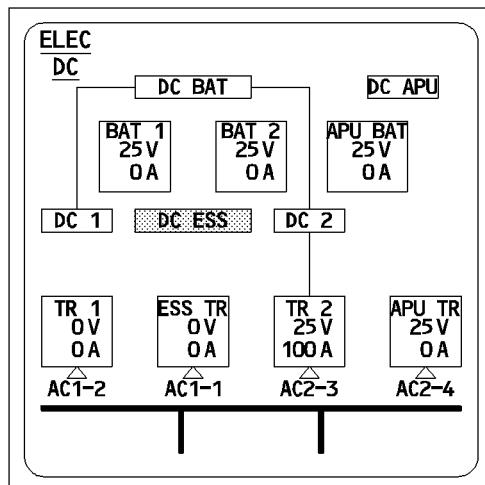
- TR 1 or 2 lost : The available TR replaces the faulty one.
- ESS TR lost : TR 1 replaces the ESS TR.



**Failure of ESS TR and TR 1 (or TR 2)**

The remaining TR supplies the two DC norm busses and the DC BAT bus.

The DC ESS bus is lost.



## EMERGENCY GENERATION AFTER LOSS OF ALL MAIN GENERATORS

If both buses, AC1.1 and 2.4, are lost and if the engines 1 and 4 are lost, the ram-air turbine (RAT) extends automatically.

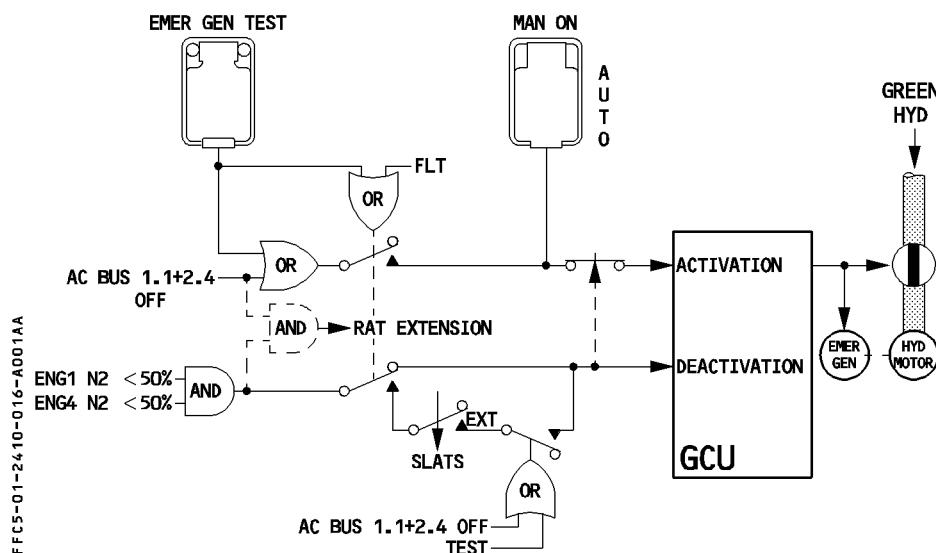
If powered by the RAT only, the emergency generator is inhibited when slats are extended. The emergency generator can be manually activated through the MAN ON pushbutton.

Emergency generator deactivation occurs only automatically :

- In flight : at slats extension if powered by the RAT only (engines 1 and 4 lost). It can be reactivated after slats retraction through the MAN ON pushbutton.
- On the ground : after engine 1 and 4 shutdown.

EMER GEN TEST pushbutton allows to activate the emergency generator and to connect it to the essential network. This test is inhibited when the slats are extended.

**FOR INFO**



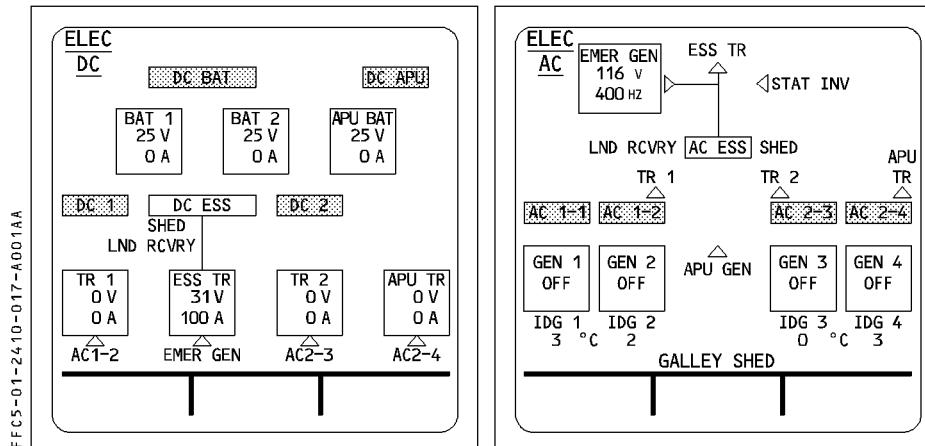
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- If the green hydraulic system, which actuates the emergency generator, is powered by an engine-driven pump, the emergency generator supplies the :
  - AC ESS BUS,
  - AC ESS SHED.
 And, through the ESS TR, the :
  - DC ESS BUS,
  - DC ESS SHED.
- If the green hydraulic system is powered by the Ram Air Turbine, the emergency generator supplies the :
  - AC ESS BUS, and
  - DC ESS BUS, through the ESS TR.

All LAND RECOVERY AC and DC BUS bars are shed. They are recovered when the LAND RECOVERY pushbutton is ON.

The AC ESS GND is lost.

R



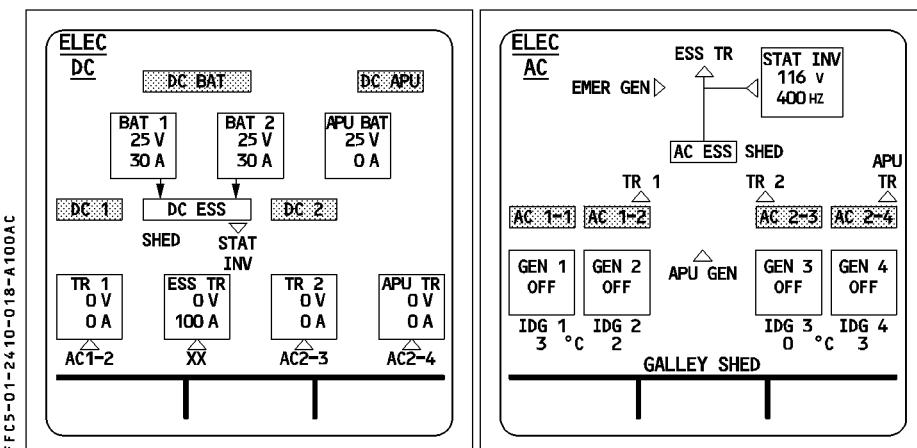
**FLIGHT WITH BATTERIES ONLY**

When emergency generator is not available, the batteries supply the DC ESS BUS, the DC LAND RECOVERY (whatever the LAND RECOVERY pushbutton position is) and through the STAT INV:

The AC ESS bus the AC LAND RECOVERY (whatever the LAND RECOVERY pushbutton position is)

The AC ESS SHED and the DC ESS SHED and the SHED LAND RECOVERY are not supplied.  
The AC ESS GND is lost.

Example : flight with batteries only .

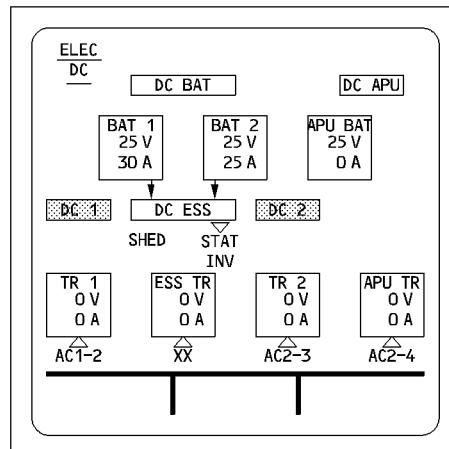


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**ON GROUND, BATTERIES ONLY**

Provided they are both selected AUTO, the batteries supply :

- the DC ESS BUS
  - the DC BAT BUS
  - the DC LAND RECOVERY (whatever the LAND RECOVERY pushbutton position is) and through the static inverter :
  - the AC ESS BUS
  - the AC ESS GND
  - the AC LAND RECOVERY (whatever the LAND RECOVERY pushbutton position is)
- The AC ESS SHED, the DC ESS SHED and the SHED LAND RECOVERY are not supplied.



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Note : ELEC AC ECAM page is identical to flight with batteries only case.

**DISTRIBUTION TABLE**

R

	AC BUS 1-1	AC BUS 1-2	AC BUS 2-3	AC BUS 2-4	AC ESS BUS	AC ESS GND	AC ESS SHED	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED
NORM CONFIG	GEN 1	GEN 2	GEN 3	GEN 4	GEN 1	GEN 1	GEN 1	TR 1 GEN 2	TR 2 GEN 3	TR 1 GEN 2	ESS TR GEN 1	ESS TR GEN 1
GEN 1 INOP (GEN 2 INOP:GEN 1 replaces GEN 2)	GEN 2 (3)	GEN 2	GEN 3	GEN 4	GEN 2 (3)	GEN 2 (3)	GEN 2 (3)	TR 1 GEN 2 (3)	TR 2 GEN 3	TR 1 GEN 2 (3)	ESS TR GEN 2 (3)	ESS TR GEN 2 (3)
GEN 3 INOP (GEN 4 INOP:GEN 3 replaces GEN 4)	GEN 1	GEN 2	GEN 4 (3)	GEN 4	GEN 1	GEN 1	GEN 1	TR 1 GEN 2	TR 2 GEN 4 (3)	TR 1 GEN 2	ESS TR GEN 1	ESS TR GEN 1
GEN 1 AND 2 INOP	GEN 4 (3)	GEN 4 (3)	GEN 3	GEN 4	GEN 4 (3)	GEN 4 (3)	GEN 4 (3)	TR 1 GEN 4 (3)	TR 2 GEN 3	TR 1 GEN 4 (3)	ESS TR GEN 4 (3)	ESS TR GEN 4 (3)
GEN 3 AND 4 INOP	GEN 1	GEN 2	GEN 1 (3)	GEN 1 (3)	GEN 1	GEN 1	GEN 1	TR 1 GEN 2	TR 2 GEN 1 (3)	TR 1 GEN 2	ESS TR GEN 1	ESS TR GEN 1
AC BUS 1-1 Lost	-	GEN 2	GEN 3	GEN 4	GEN 4	GEN 4	GEN 4	TR 1 GEN 2	TR 2 GEN 3	TR 1 GEN 2	ESS TR GEN 4	ESS TR GEN 4
TR 1 FAULT								TR 2 GEN 3 (2)	TR 2 GEN 3	TR 2 GEN 3 (2)	ESS TR GEN 1	ESS TR GEN 1
TR 2 FAULT								TR 1 GEN 2 (2)	TR 1 GEN 2 (2)	TR 1 GEN 2 (2)	ESS TR GEN 1	ESS TR GEN 1
TR 1 + 2 FAULT								-	-	-	ESS TR GEN 1	ESS TR GEN 1
ESS TR								TR 1 GEN 2	TR 2 GEN 3	TR 1 GEN 2	TR 1 GEN 2 (2)	TR 1 GEN 2 (2)
TR 1 FAULT and ESS TR FAULT								TR 2 GEN 3 (2)	TR 2 GEN 3	TR 2 GEN 3 (2)	-	-
TR 2 FAULT and ESS TR FAULT								TR 1 GEN 2	TR 1 GEN 2 (2)	TR 1 GEN 2 (2)	-	-

NOT AFFECTED

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White compartments : Same supply as in normal configuration.  
 Shaded compartments : Back up supply.

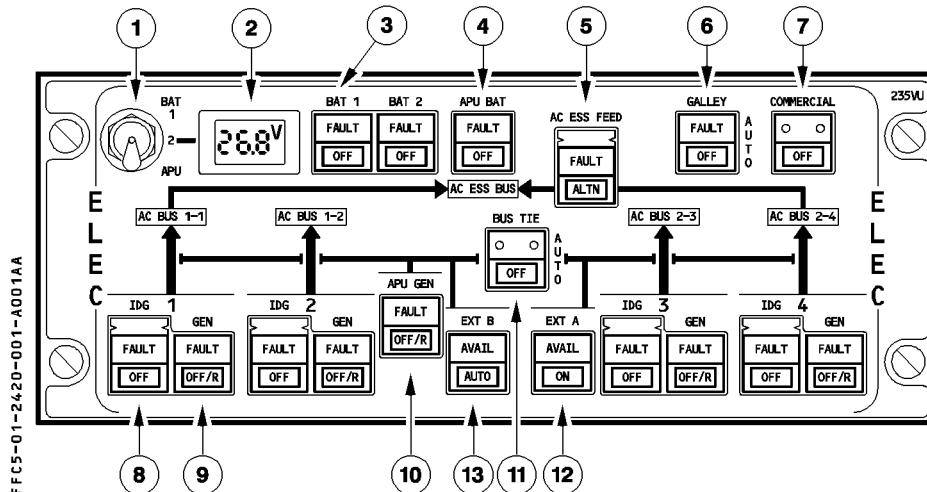
**DISTRIBUTION TABLE (cont'd)**

R

EMER CONFIG	AC BUS 1-1	AC BUS 1-2	AC BUS 2-3	AC BUS 2-4	AC ESS BUS	AC ESS GND	AC ESS SHED	AC LAND REC	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED	DC LAND REC	SHED LAND REC
• BATTERIES ONLY (in flight)	-	-	-	-	STAT INV BAT 1-2	-	-	STAT INV BAT 1-2	-	-	(4)	BAT 1-2	-	BAT 1-2	-
• EMER GEN SUPPLIED BY ENGINE DRIVEN PUMP	-	-	-	-	EMER GEN	-	EMER GEN	EMER GEN (1)	-	-	-	ESS TR EMER GEN	ESS TR EMER GEN (1)	ESS TR EMER GEN (1)	ESS TR EMER GEN (1)
• EMER GEN SUPPLIED BY RAT	-	-	-	-	EMER GEN	-	-	EMER GEN (1)	-	-	-	ESS TR EMER GEN	-	ESS TR EMER GEN (1)	-

ON GROUND	AC BUS 1-1	AC BUS 1-2	AC ESS BUS 2-3	AC BUS 2-4	AC ESS BUS	AC ESS GND	AC ESS SHED	AC LAND REC	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC ESS SHED	DC LAND REC	SHED LAND REC
BAT only, V>50 Kt	-	-	-	-	STAT INV BAT 1-2	-	-	STAT INV BAT 1-2	-	-	-	BAT 1-2	-	BAT 1-2	-
BAT only, V<50 Kt	-	-	-	-	STAT INV BAT 1-2	STAT INV BAT 1-2	-	STAT INV BAT 1-2	-	-	BAT 1-2	BAT 1-2	-	BAT 1-2	-

- (1) Supplied when LAND RECOVERY pushbutton is at ON.
- (2) Lost in case of overcurrent on the faulty TR.
- (3) In case of differential protection failure
  - . the affected generator is not replaced
  - . the associated TR is switched off.
- (4) Lost after 7 seconds.

**OVERHEAD PANEL**

① BAT 1 (2 or APU) sel

Selects the battery for voltage indication.

② BAT 1 (2 or APU) voltage indication

Selected battery voltage.

③ BAT 1 (2) pb sw

Controls the operation of the corresponding Battery Charge Limiter.

- Auto : The Battery Charge Limiter controls automatically the connection and the disconnection of the corresponding battery to the DC BAT BUS by closing and opening of the battery line contactor.
- The batteries are connected to the DC BAT BUS in the following cases :
    - Battery voltage below 26.5 volt (battery charge). The charging cycle ends when battery charge current goes below 4 Amperes (for 10 seconds on ground, 30 minutes in flight).
    - On the ground (with speed below 50 knots), when batteries only are supplying the aircraft.
    - In flight DC generation lost (limited to 7 seconds).
  - The batteries are connected to the DC ESS BUS when batteries only are supplying :
    - in flight
    - on the ground (speed below 50 knots) provided they are both selected auto.

Note : 1. In normal configuration the batteries are disconnected most of the time.

2. A battery automatic cut off logic prevents batteries from discharging completely discharge when the aircraft on the ground (parking).

Automatic battery contactors open when :

- The aircraft is on the ground.
- The main power supply (external power plus all generators) is cut off.
- The battery voltage is lower than 23 volt for more than 16 seconds.

The flight crew can reset the contactors by switching the BAT pushbutton switch to OFF then AUTO.

OFF : The Battery Charge Limiter is not operating, the DC ESS BUS is not connected to the battery (except in flight in emergency configuration).  
OFF comes on white if the DC BAT BUS is powered.

Hot buses remain supplied.

FAULT It : Comes on amber accompanied by an ECAM caution, when the charging current for corresponding battery is outside limits.  
In this case the battery contactor opens.

**④ APU BAT pb sw**

Controls the operation of the APU Battery Charge Limiter.

**AUTO** : The APU Battery Charge Limiter automatically controls the closure/opening of the line APU BAT contactor.

The battery is connected in the following cases :

- To ensure battery charge (as for BAT 1 or 2)
- When the APU start sequence is initiated.

*Note : Automatic cut off, as for BAT 1 or 2, is provided.*

**OFF** : The Battery Charge Limiter is not operating, the battery line contactor is open.

OFF light illuminates.

**FAULT It** : Illuminates amber associated to ECAM caution activation as for BAT 1 or 2.  
In this case the battery contactor opens.

**⑤ AC ESS FEED pb sw**

**Normal** : The AC ESS BUS is supplied from AC BUS 1.1.

It is automatically supplied by the AC BUS 2.4 when the AC BUS 1.1 is lost.

**ALTN** : The AC ESS BUS is supplied from AC BUS 2.4.

**FAULT It** : Comes on amber accompanied by ECAM activation when the AC ESS BUS is not electrically supplied.

*Note : In case of total loss of main generators the AC ESS BUS is automatically supplied by the emergency generator or by the static inverter if the emergency generator is not available.*

**⑥ GALLEY pb sw**

**AUTO** : The galleys are normally supplied. The ECMU automatically controls the shedding of one or more galleys in case of generator(s) failure or in case of overload detection. On ground when APU generator or the external power supplies, all galleys are supplied provided no overload is detected.

**OFF** : All galleys are shed and water/waste (drain mast) ice protection is lost.

**FAULT It** : Illuminates amber associated with ECAM in case of overload detection if the automatic shedding is not performed.

*Note : Switching OFF then AUTO resets the galleys which have been automatically shed by the ECMU.*

⑦ COMMERCIAL pb

OFF : The following equipment is shed :

- Galleys
- Passenger entertainment system (music and video)
- Cargo loading system
- Electrical service
- Escape slide lock mechanism ice protection
- Water/waste (drain mast) ice protection
- Lavatory and cabin lights
- Water heater

⑧ IDG 1 (2, 3 or 4) (Integrated Drive Generator) pb

Normally springloaded out.

When pressed, the IDG is disconnected from its drive shaft and can only be reconnected by maintenance action on ground.

CAUTION

1. If the pushbutton is pressed for more than about 3 seconds, damage may occur to the disconnection mechanism.
2. IDG disconnection is inhibited when engine N2 is below the low speed threshold.

FAULT It : Comes on amber, along with an ECAM caution, in case of :

- IDG oil outlet overheat (above 185° C), or
- IDG oil pressure low. Inhibited at low engine speed (N2 below 14 %). It goes off when the IDG is disconnected.

⑨ GEN 1 (2, 3 or 4) pb

On : The generator field is energized and the line contactor closes, provided electrical parameters are normal.

OFF/R : The generator field is de-energized and the line contactor opens. The fault circuit is reset.

FAULT It : Comes on amber, along with an ECAM caution, in the event of protection trip initiated by the associated Generator Control Unit (GCU). The line contactor opens.

Note : If the protection trip is initiated by a differential fault, the reset action has no effect after two attempts.

**(10) APU GEN pb sw**

- On : The APU generator field is energized and the line contactor closes provided parameters are normal.  
Each bus tie contactor 1, 2, 3 and (or) 4 automatically close if its associated generator is not operative.
- OFF/R : The generator field is de-energized and the line contactor opens. The fault circuit is reset.
- FAULT It : Same as GEN FAULT.  
APU GEN FAULT light is inhibited when APU speed is too low.

**(11) BUS TIE pb sw**

- AUTO : The five BUS TIE contactors open or close automatically according to the priority logic in order to maintain power supply to all AC buses.
- When a generator is lost, the associated AC BUS bar remains supplied through its associated BUS TIE contactor and the adjacent one which will automatically close.
  - When the aircraft is supplied only by APU generator or single ground power unit, the five contactors close.
  - When the aircraft is supplied by only two generators located on the same side the following contactors will close :
    - the two contactors associated to both lost generators
    - the contactor associated to the external running generator
    - the fifth contactor (located between left and right side).
- OFF : The five BUS TIE contactors open.

R Note : Selecting the BUS TIE pushbutton to OFF then AUTO on the ground inhibits the NBPT function.

R The function may be recovered by switching OFF all aircraft electrical sources and resetting GPCU with ground power unit disconnected.

**(12) EXT A pb : (momentary action)**

- AVAIL It : Illuminates green provided external power parameters are normal.
- Momentarily pressed : – If the AVAIL light was on :
  - The external power line contactor closes
  - The AVAIL light goes off
  - The ON light comes on blue– If the ON light was illuminated :
  - The external power line contactor opens
  - The ON light goes off
  - The AVAIL light comes on.

**(13) EXT B pb : (momentary action)**

AVAIL lt : Illuminates green provided external power parameters are normal.

- Momentarily pressed :
- If the AVAIL light was on :
    - Provided the APU generator is off the external power line contactor closes
    - The AVAIL light goes off
    - The AUTO light comes on.
  - If the AUTO light was on :
    - The external power line contactor opens
    - The AUTO light goes off
    - The AVAIL light comes on.

Note : The APU generator has priority over external power (A and B) for AC BUS 1.1 and AC BUS 1.2.

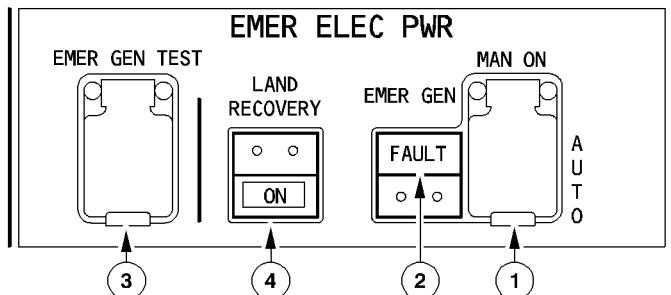
The external power A has priority over the APU GEN for AC BUS 2.3 and 2.4.  
APU generator has priority over external power B for AC BUS 2.3 and 2.4.

The engine generators have priority over the external powers or APU.

The external power B has priority over external power A for AC Bus 1.1 and AC BUS 1.2.

When external power B is selected AUTO, AUTO light remains illuminated even when the APU generator has taken over.

FFC5-01-2420-007-A101AA



### ① MAN ON pb (guarded)

- AUTO : In case of normal AC supply loss in flight, the emergency generator is automatically started.  
 Pressed : The emergency generator runs and is connected to the aircraft network.

### ② EMER GEN FAULT lt

The light comes on red, if the emergency generator is not supplying and normal AC supply is lost in flight.

### ③ TEST pb (guarded)

- Pressed : The emergency generator runs (provided the green hydraulic system is pressurized) and supplies the DC ESS BUS and the AC ESS BUS.

### ④ LAND RECOVERY pb

ON : When pressed in electrical emergency configuration, the AC LAND RECOVERY and the DC LAND RECOVERY buses are recovered and the following equipment is restored :

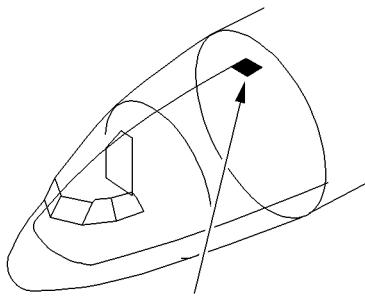
- LGCIU 1
- SFCC 1 (flap channel is not recovered, if the emergency generator is powered by the RAT).

The remaining fuel pump (if any) is lost, and replaced by the forward APU pump.

*Note : The remaining fuel pump will be shed at 260 knots, if the emergency generator is powered by the RAT, or upon LAND RECOVERY selection, whichever occurs first.*

**FORWARD CABIN****R MAINT BUS switch**

FFC5-01-2420-008-A-001AA



- R** This switch allows maintenance and ground service personnel to energize electrical circuits for ground servicing, without energizing the aircraft's entire electrical system.

**ON** : The selector latches magnetically, provided the external power A parameters are normal (AVAIL light is on). The AC and DC GRND/FLT busbars are supplied and the following services can be energized :

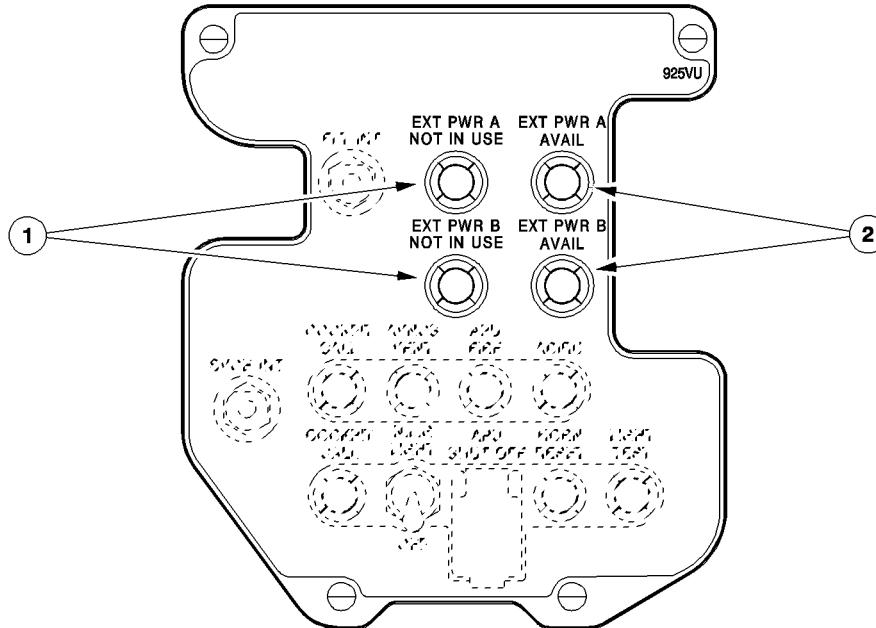
- Passenger compartment lighting
- Galley lighting
- Entrance area lights
- Lavatory lighting and service
- Vacuum cleaner outlets
- Flight compartment service outlets
- Flight compartment flood lighting
- Fuel quantity indications
- Refueling
- Lower deck cargo compartment lighting and power outlets.
- Main and nose landing gear compartment lighting
- Hydraulic compartment lighting
- Landing gear compartment service outlets
- Ground call
- Equipment compartment lights and service outlets
- Navigation lights
- Escape slide locking mechanism ice protection ◁
- Parking brake
- Cargo door hydraulic pump

The switch trips, when the external source is removed, or in case of a TR 2 fault.

**OFF** : The AC and DC GRND/FLT busbars are connected to normal AC buses and DC BUS 2.

**EXTERNAL POWER PANEL**

(This panel is located closed to the external power connector)



FFC5-01-2420-009-A001AA

**① EXT PWR A (B) NOT IN USE**

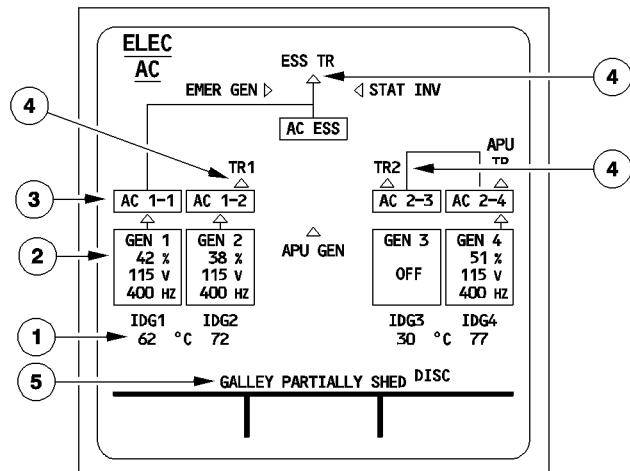
R This white light comes on to inform the ground personnel that the ground power unit is not supplying the aircraft network and can be disconnected. It goes off if EXT A(B) is in use.

**② EXT PWR A (B) AVAIL**

R This amber light comes on to indicate that external power is available and the voltage is correct.

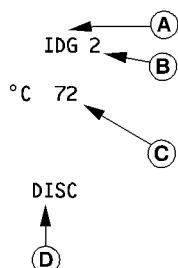
**ELEC AC ECAM PAGE****FLIGHT CONFIGURATION**

FFCS-01-2420-010-A001AB



**① IDG indications**

FFC5-01-2420-011-A001AA

**(A) IDG indication :**

- normally white
- amber in case of :
  - IDG outlet temperature overheat (above 185 °C) or,
  - IDG oil low pressure or,
  - IDG disconnection.

**(B) IDG number :**

- white if associated engine is running
- amber if stopped.

**(C) Outlet oil temperature :**

- Normally green.
- Green, pulsing in case of advisory (above 142 °C).
- Amber in case of overheat (above 185 °C).

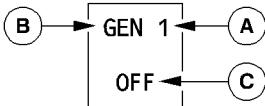
**(D) DISC / LO PR indication :**

- DISC appears in amber, if the IDG is disconnected.
- LO PR appears in amber, if an oil low pressure occurs when the IDG is connected.  
It is inhibited at low engine speed (N2 below 14 %).

**(2) GEN 1 (2, 3 and 4) indications**

When the GEN pushbutton is OFF :

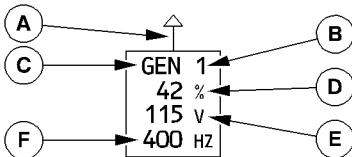
FFC5-011-2420-012-A001AA



- Ⓐ The GEN number is white, if the associated engine is running. It becomes amber, when the associated engine stops.
- Ⓑ The GEN indication is amber.
- Ⓒ The OFF indication is white.

When the GEN pushbutton is ON :

FFC5-011-2420-012-B001AA



- Ⓐ The arrow indication is green, when the generator line contactor is in line.
- R Ⓑ The GEN number is white, if the associated engine is running. It becomes amber, when the associated engine stops.
- R Ⓒ The GEN indication is normally white. It becomes amber, when the generator fails, or when the associated engine stops.
- D Ⓓ The GEN load is normally green. It becomes amber, if the load is greater than 108%, for more than 10 seconds.
- E Ⓔ The GEN voltage is normally green. It becomes amber below 110 V, or above 120 V.
- F Ⓕ The GEN frequency is normally green. It becomes amber below 390 Hz, or above 410 Hz.

(3) AC 1.1 (or 1.2, 2.3, 2.4)

- normally green
- amber when the bar is not powered

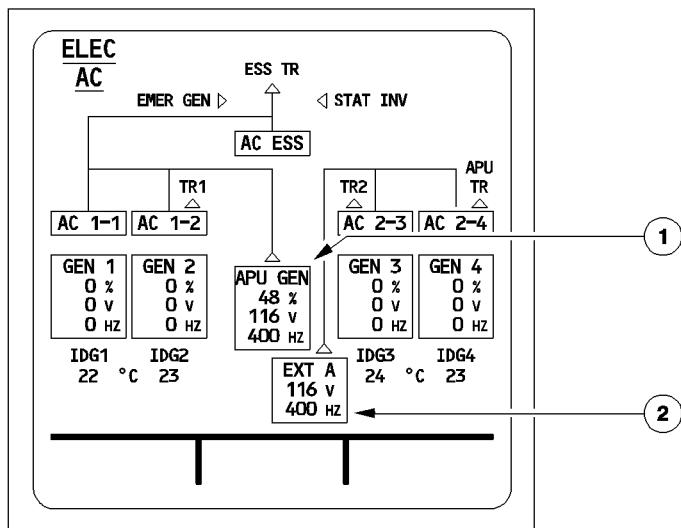
(4) TR

- normally white
- amber when the TR is failed or in case of abnormal current.

(5) Galley indication

If applicable one of the following messages appears in white, according to the priority order of (1 : highest priority).

1. COMMERCIAL OFF
2. GALLEY SHED
3. GALLEY PARTIALLY SHED

**GROUND CONFIGURATION**

① APU Generator

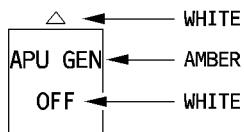
– When APU MASTER SW is off :

FFCS-01-2420-014-A001AA



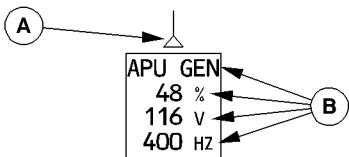
– When APU MASTER SW is ON and APU GEN pb sw is OFF :

FFCS-01-2420-014-B001AA



– When APU MASTER SW is ON and APU GEN pb sw is on :

FFCS-01-2420-014-C001AA



Ⓐ – green when APU generator supplies one or more AC bus bar  
– white otherwise

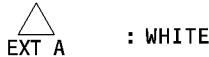
Ⓑ same logic as engine generator

## (2) External power A (External power B symbol appears beside with the same principle) :

(only displayed when aircraft is on ground)

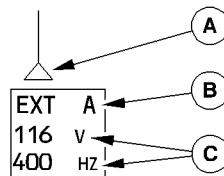
- When external power is not available

FFC5-01-2420-015-A001AA



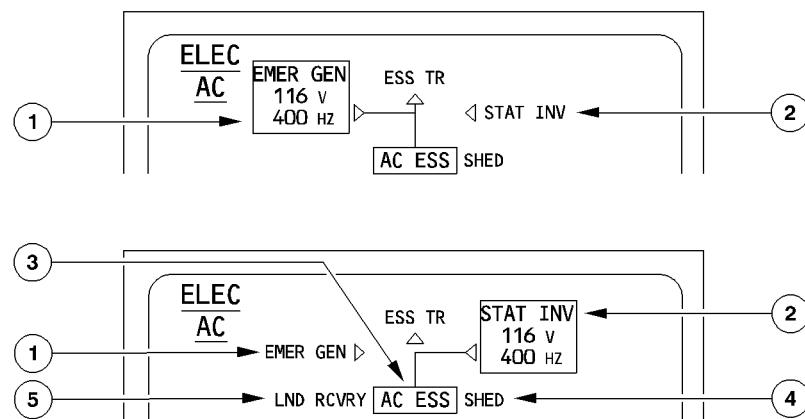
- When external power is available

FFC5-01-2420-015-B001AA



## EMER CONFIGURATION

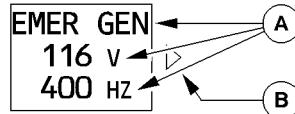
FFC5-01-2420-016-A001AA



### ① Emergency generator

- When the emergency generator contactor is closed :

FFC5-01-2420-016-B001AA



- Ⓐ same logic as engine generator

- Ⓑ green

- When the Emer Gen Contactor is open :
  - EMER GEN ⌄ : white
  - EMER GEN : becomes amber when faulty

### ② Static inverter

Same logic as emergency generator

### ③ AC ESS BUS

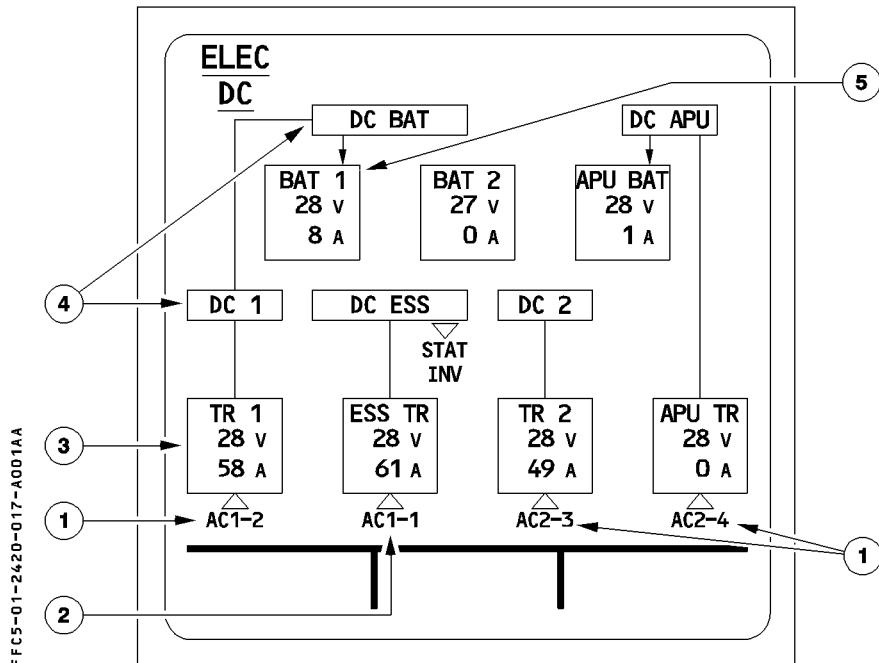
- normally green
- amber when the bus is not supplied.

④ SHED indication

Appears in amber when AC ESS SHED BUS is not supplied.

⑤ LND RCVRY indication

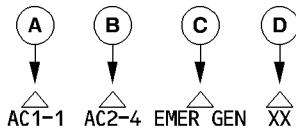
Appears in green when LAND RECOVERY pushbutton is pressed.

**ELEC DC ECAM PAGE****NORMAL CONFIGURATION**① TR 1 (or TR 2 or APU TR) power supply

- normally white
- amber when the bus bar is not powered.

② ESS TR power supply

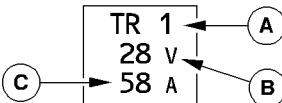
FFC5-01-2420-018-0001AA



- Ⓐ Appears in white, when the AC 1-1 busbar supplies the ESS TR.
- Ⓑ Appears in white, when the AC 2-4 busbar supplies the ESS TR.
- Ⓒ Appears in white, when the emergency generator is not failed, and supplies the ESS TR.  
Appears in amber, when the emergency generator is failed, and is connected to the ESS TR.
- Ⓓ Appears in amber in all other cases (ESS TR not supplied, or information not available).

③ Transformer Rectifier (1, 2, APU, and ESS)

FFC5-01-2420-018-0001AA



- Ⓐ TR indication :
  - Appears in white
  - Appears in amber, when the voltage or the current (value) is abnormal, or when the TR is failed (overheat, minimum current, overcurrent, open or short circuit).
- Ⓑ Voltage :
  - Appears in green
  - Appears in amber, when the voltage is less than 25V, or greater than 31V.

*Note : For APU TR, voltage indication remains green, even if abnormal during APU start.*
- Ⓒ Current :
  - Appears in green
  - Appears in amber, when the TR is failed or the current is less than 2A.

R

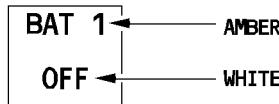
R

## (4) DC BUS bars

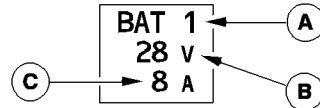
- normally green
- amber if no voltage on the bar

## (5) Batteries

- if BAT pb is selected OFF



- if BAT pb is selected AUTO



## (A) BAT indication

- normally white
- amber if the battery is faulty

## (B) Voltage

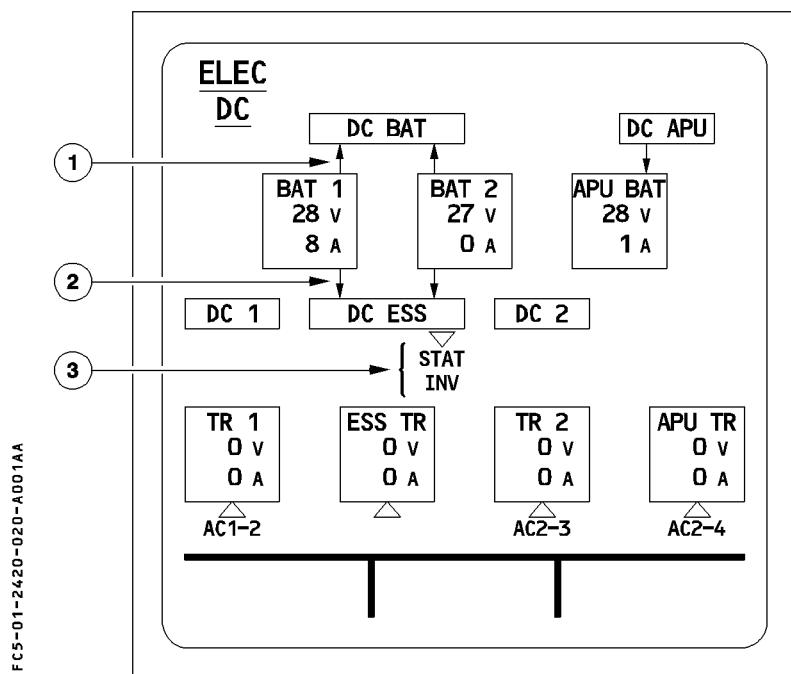
- normally green
- amber below 25V or above 31V

R (c) Current (charge or discharge) :

- normally green
- amber if discharge current is above 5A.

Note : For APU battery, even if voltage or current is abnormal, the values remain green during APU start.

## EMERGENCY CONFIGURATION



### ① DC BAT – BAT connection

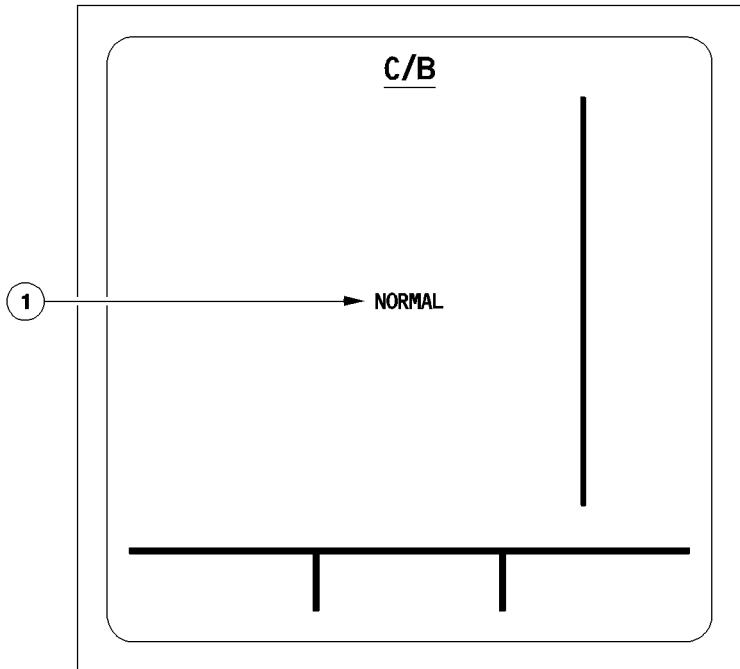
- Battery Line Contactor open : nothing displayed
- Battery Line Contactor closed :
  - ↓ green : battery charge
  - ↑ amber : battery discharge

### ② DC ESS – BAT connection

↓ amber : appears when the contactor is closed. (Batteries supplying DC ESS bus)

### ③ Static inverter

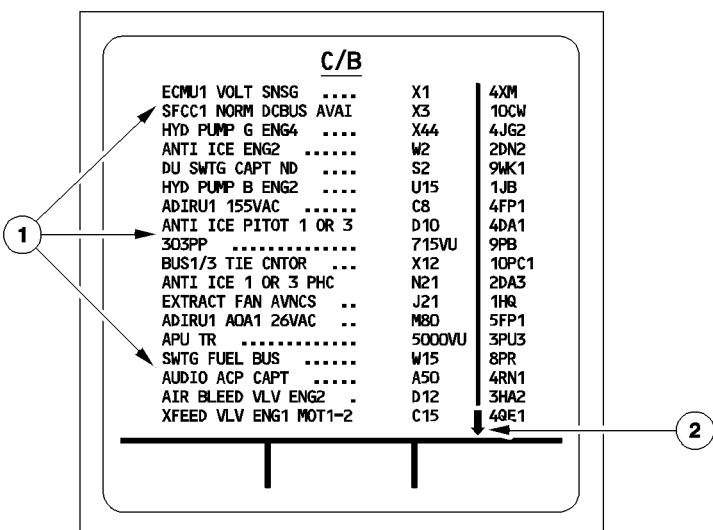
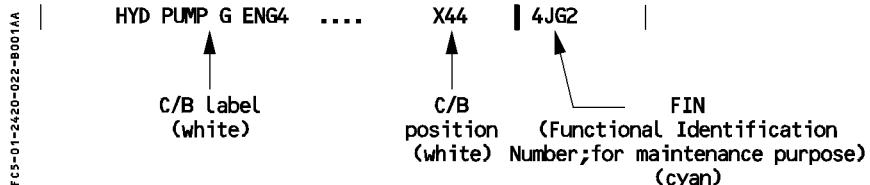
- normally white
- amber when the static inverter is faulty.

**C / B ECAM PAGE****NO C / B PULLED****① NORMAL**

Displayed in green when no circuit breaker is pulled.

**C / B PULLED**

FFC5-01-2420-022-B001AA

**① Open circuit breaker identification**

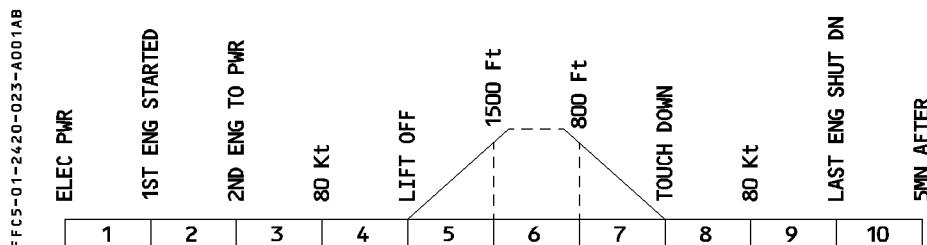
The last tripped Circuit Breakers is displayed on the top of the screen.  
 All Circuit Breakers are monitored except commercial Circuit Breakers.

**② Circuit Breakers page overflow symbol**

Displayed in green when pulled Circuit Breakers list is not closed.

- Note :
1. To display the next page, press again Circuit Breaker pushbutton or CLEAR pushbutton on the ECAM control panel.
  2. A maximum of three pages is available.

## WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
EMER CONFIG Loss of main generators. The four normal AC BUS are lost	CRC	MASTER WARN	Nil *	EMER GEN FAULT It	
AC BUS 1-1 FAULT AC BUS 1-2 FAULT AC BUS 2-3 FAULT AC BUS 2-4 FAULT Busbar(s) is (are) no longer supplied				NIL	4, 8
AC ESS BUS FAULT Busbar is no longer supplied				AC ESS FEED FAULT It	
AC ESS BUS SHED Busbar is no longer supplied				NIL	
GEN 1(2)(3)(4) FAULT . Protection trip initiated by associated GCU . Or opening of line contactor with GEN pb at ON				GEN 1(2)(3)(4) FAULT It	1, 3, 4, 5, 7, 8, 10
GEN 1(2)(3)(4) OFF GEN 1(2)(3)(4) pb at OFF with no FAULT				NIL	
APU GEN FAULT . Protection trip initiated by associated GCU . Or opening of line contractor with APU GEN pb at ON				APU GEN FAULT It	3, 4, 5 7, 8
GEN 1(2)(3)(4) or APU GEN OVERLOAD Load of one generator is above 100 % of rated output				GALLEY FAULT It	3 to 8
EXT PWR A (B) OVERLOAD Load of external power is above 100 % of rated output				IDG 1(2)(3)(4) FAULT It	1, 4, 5, 7, 8, 10
IDG 1(2)(3)(4) OIL LO PR IDG oil pressure low. Inhibited if N2 < 14%				IDG OFF It	3 to 10
IDG 1(2)(3)(4) OIL OVHT IDG outlet oil temp. above 185°C				NIL	3, 4, 5, 7, 8
IDG 1(2)(3)(4) DISCONNECTED on ground					
ECMU 1(2) FAULT					

- \* ELEC pages can be called up on the upper ECAM by pressing and holding the ELEC pushbutton on the ECAM control panel.

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB	
C / B TRIPPED One C / B tripped.	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8	
BAT 1(2) FAULT Charging current increases at an abnormal rate.			ELEC DC	BAT 1(2) FAULT It		
APU BAT FAULT Charging current increases at an abnormal rate.				APU BAT FAULT It		
DC BUS 1 FAULT			ELEC AC	NIL	4, 8	4, 8
DC BUS 2 FAULT					3, 4, 8, 9	
DC BUS 1 + 2 FAULT					3,4,5 7,8	
DC ESS BUS FAULT Busbar(s) is (are) no longer supplied.					4 to 8	
DC ESS BUS SHED Busbar is no longer supplied.					3,4,5 7,8,9	
DC BAT BUS FAULT Busbar is no longer supplied.			ELEC DC	NIL	3, 4, 5 7, 8, 9, 10	
BUS TIE OFF The BUS TIE pb is abnormally OFF.					3, 4, 5, 7, 8	
AC ESS BUS ALTN AC ESS BUS is abnormally supplied by AC 2-4 bus.	2,3,4, 5,6, 7,8					
PART GALLEY SHED						
BAT 1(2) or APU BAT OFF BAT pb at OFF without fault.	NIL	NIL				
TR 1 (2), APU TR or ESS TR FAULT						
BAT 1 (2) or APU BAT SYS FAULT						
STATIC INV FAULT C/B MONITOR FAULT Loss of CBMU.						
IDG 1 (2) (3) (4) OIL SYS FAULT						

**MEMO DISPLAY**

- EMER GEN is displayed in green, when the emergency generator is running.
- ELEC EXT PWR is displayed in green, if external power is available. This message becomes amber, if more than one engine is running.
- PART GALLEY SHED FOR TO is displayed in green.

**A340**

FLIGHT CREW OPERATING MANUAL

**EQUIPMENT**

1.25.00 P 1

**CONTENTS**

SEQ. 001 REV. 19

**25.00 CONTENTS****25.10 FLIGHT DECK**

– GENERAL . . . . .	1
– COCKPIT PLAN . . . . .	3
– SEATS . . . . .	6
– COCKPIT WINDOW . . . . .	10
– PILOT'S INSTRUMENT PANELS . . . . .	11
– PEDESTAL . . . . .	13
– OVERHEAD PANEL . . . . .	14
– FOOT WARMER ◁ . . . . .	15

**25.11 COCKPIT DOOR SECURITY SYSTEM ◁**

R – DOOR DESCRIPTION . . . . .	1
R – COCKPIT DOOR LOCKING SYSTEM . . . . .	2
R – CONTROLS . . . . .	3

**25.12 FLIGHT CREW REST COMPARTMENT ◁****25.14 BULK CREW REST COMPARTMENT ◁****25.15 LOWER DECK**

– LOWER DECK MOBILE CREW REST COMPARTMENT ◁ . . . . .	1
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**25.16 IN SEAT POWER SUPPLY SYSTEM (ISPSS) ◁**

– GENERAL . . . . .	1
– CONTROLS . . . . .	1

**25.20 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
--------------------------------	---

**GENERAL**

The aircraft and system controls, required for piloting the aircraft, are arranged in such a way that the crew faces forward and all crewmembers can monitor instruments and systems. The designers concentrated system controls on the overhead panel by making extensive use of pushbuttons, directly installed in the system synoptic.

Note : *The electrical circuit breaker panel is in the avionics bay to increase available space in the cockpit without any penalty in the passenger cabin.*

**PRINCIPLES FOR PUSHBUTTONS WITH INTEGRATED INDICATIONS**

Whenever possible, pushbuttons used for corrective actions, have integrated status and failure indications.

The pushbutton positions, and their illuminated indications, follow the "lights out" principle.

– While corresponding to particular aircraft configurations, indications also have the following color codes :

- Warnings

- RED : A failure requiring immediate action.

- Cautions

- AMBER : A failure, of which the flight crew should be aware, but does not call for immediate action.

- Indications

- GREEN : For normal system operation.

- BLUE : For normal operation of a system used temporarily.

- WHITE : – For an abnormal pushbutton position.

- For a test result or maintenance information.

When the aircraft is in normal configuration, only green lights can be permanently lit, whereas blue lights can be lit intermittently.

– Pushbutton positions :

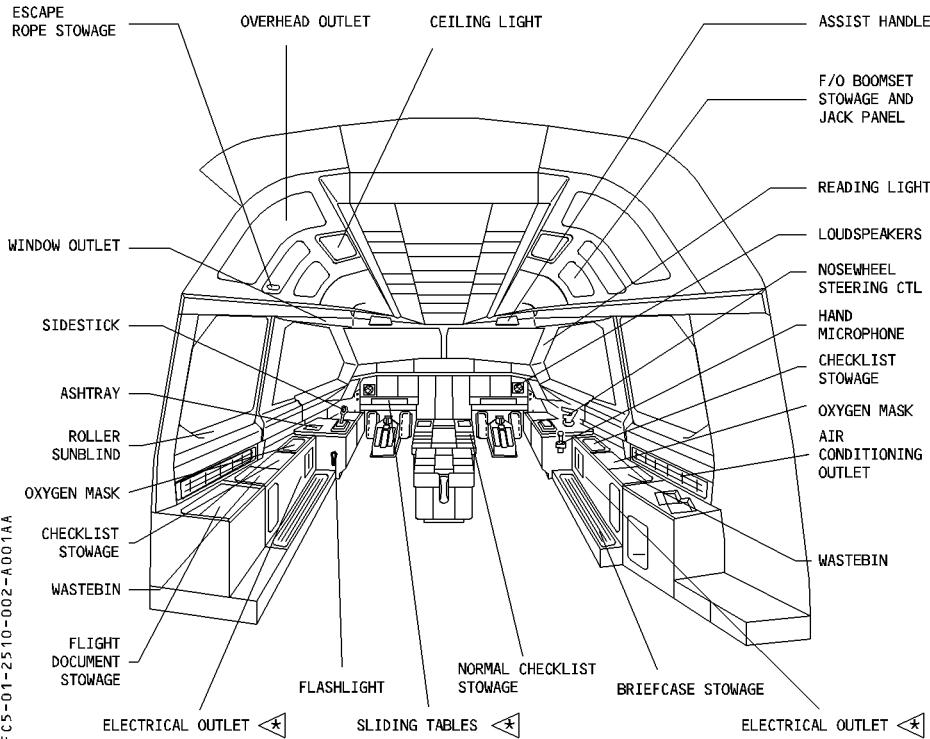
POSITION	BASIC FUNCTION
Pressed In	ON, AUTO, OVRD
Released Out	OFF, MAN

Note : 1. Certain pushbutton lights have two dots, indicating that the corresponding part of the pushbutton is not used.

R        2. Certain pushbuttons do not remain pressed in. These are referred to as "Momentary Action" pushbuttons.

**GENERAL ARRANGEMENT**

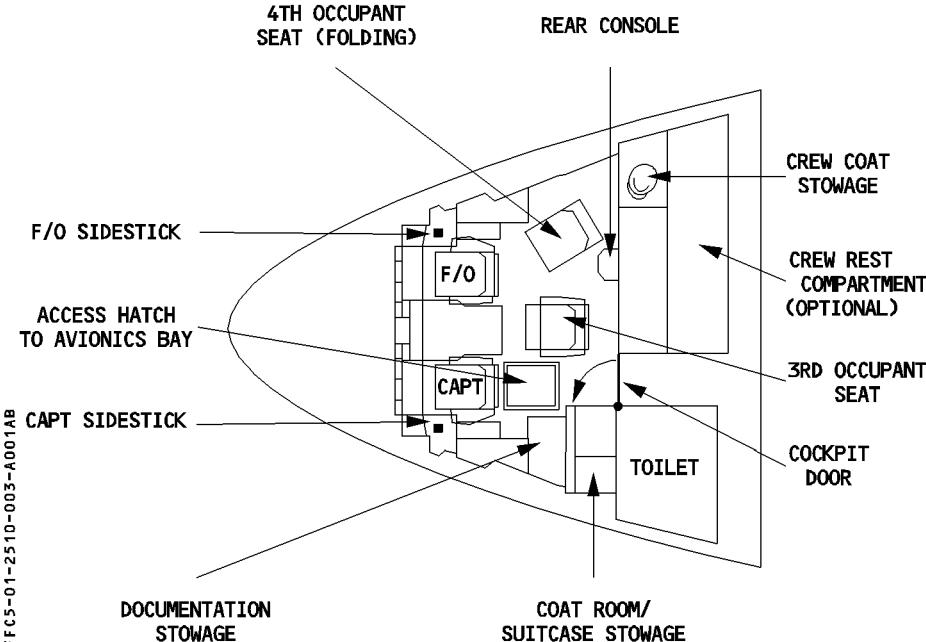
R

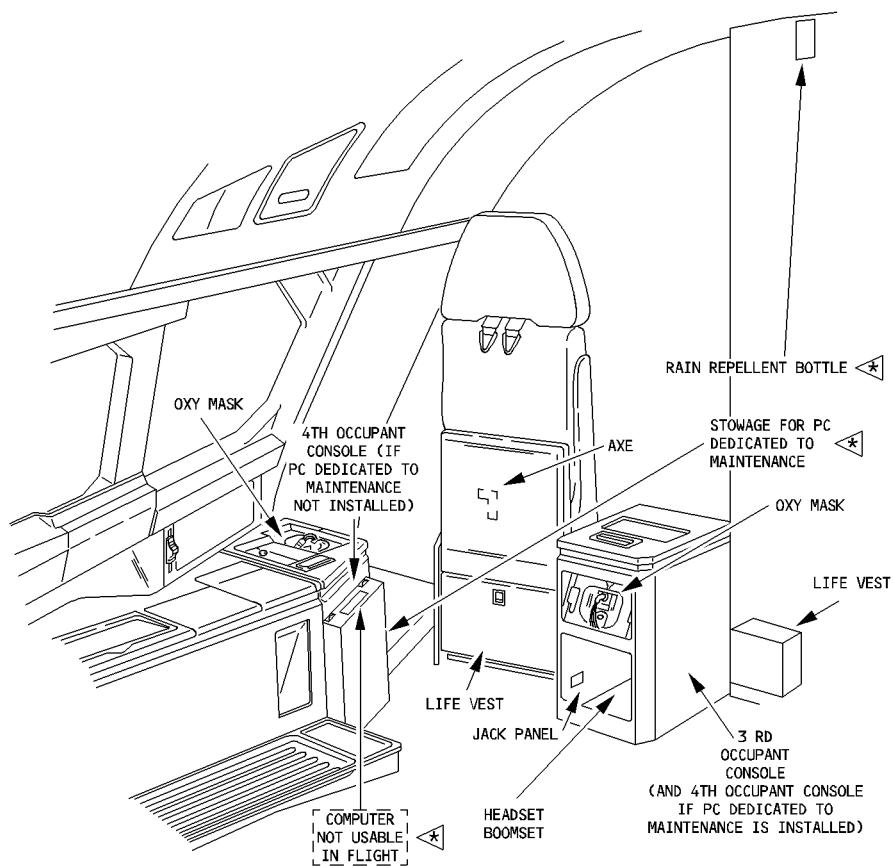


**COCKPIT PLAN**

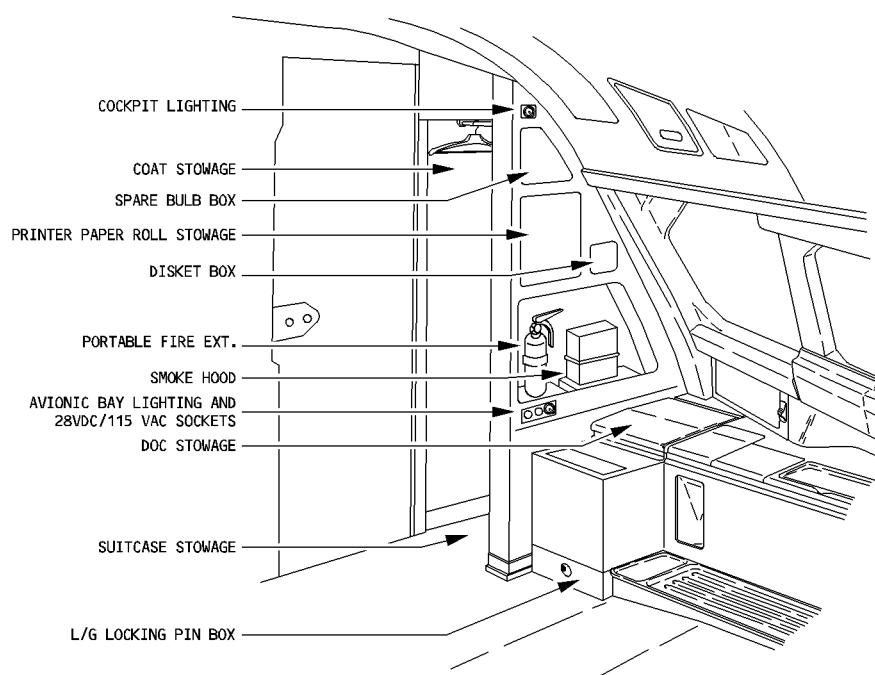
The cockpit can accommodate two crew members plus two other occupants.

- R The two pilot seats are mounted on columns.
- R The third occupant seat is also mounted on column and can rotate.
- R The fourth occupant seat is a folding seat.



R **RIGHT REAR CORNER**

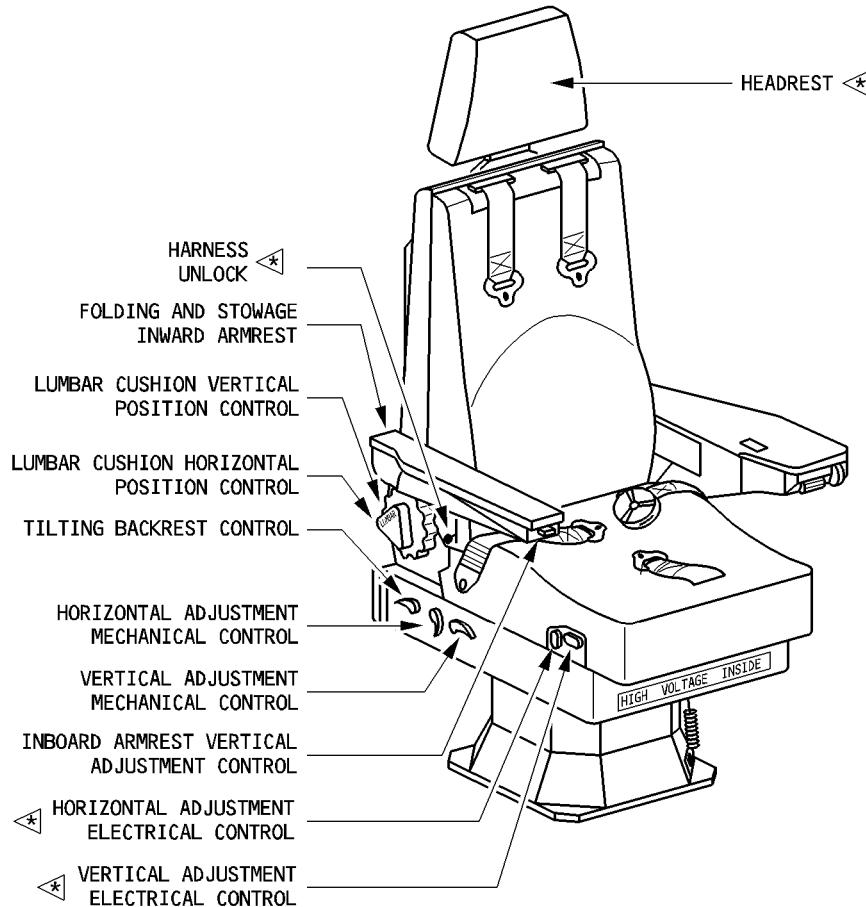
FFCS-01-2510-004-A001AC

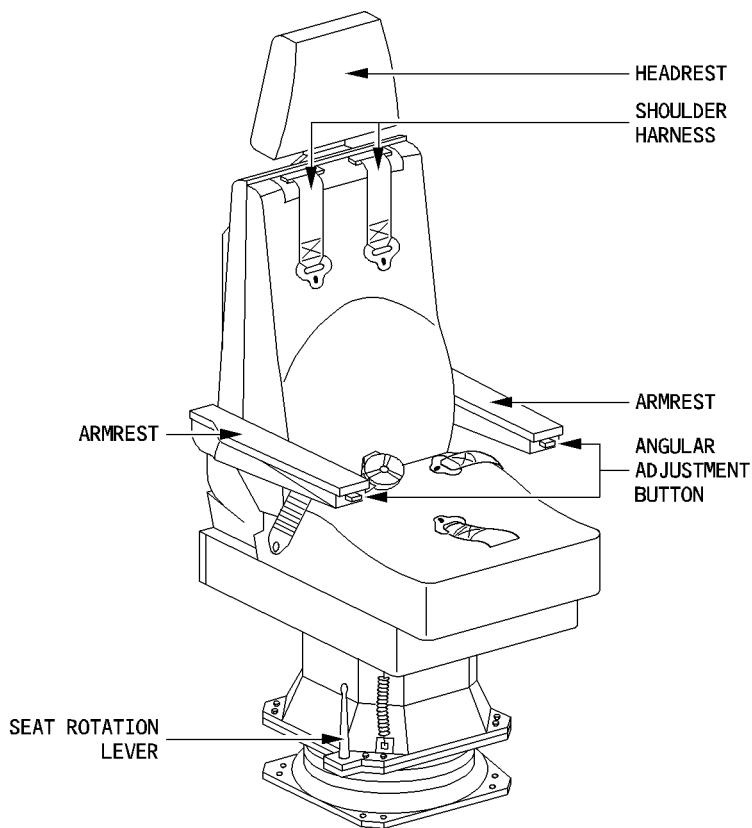
**LEFT REAR CORNER**  
R

FFC5-01-2510-005-A001AA

**SEATS****R PILOT SEATS**

They are column-mounted and electrically adjustable.



**THIRD OCCUPANT SEAT**

FFC5-01-2510-006A-A001AA

**A340**

FLIGHT CREW OPERATING MANUAL

**EQUIPMENT**

1.25.10 P 7

**FLIGHT DECK**

SEQ. 002 REV 19

## **PILOT AND THIRD OCCUPANT SEAT MECHANICAL ADJUSTMENT**

- To adjust a seat mechanically, the occupant must lift the appropriate control handle. This unlocks the seat so that it may be moved. Releasing the control handle returns it to the springloaded locked position. Pilot seat mechanical adjustment is a backup : The seat should be adjusted electrically.
- R When aligned with the aircraft's centerline, and in the maximum forward position, the third occupant's seat can be rotated by using the rotation lever, located on the seat base.

### **R PILOT SEAT ELECTRICAL ADJUSTMENT**

To adjust a seat electrically, the occupant must press the appropriate control switch in the desired direction, and release it when the seat reaches the desired position. The switch then returns to the springloaded neutral position.

To adjust the vertical position of the lumbar cushion, the occupant must :

- Pull the control out to the unlocked position,
- Turn the control to adjust the position of the cushion, and
- Push the control into the locked position.

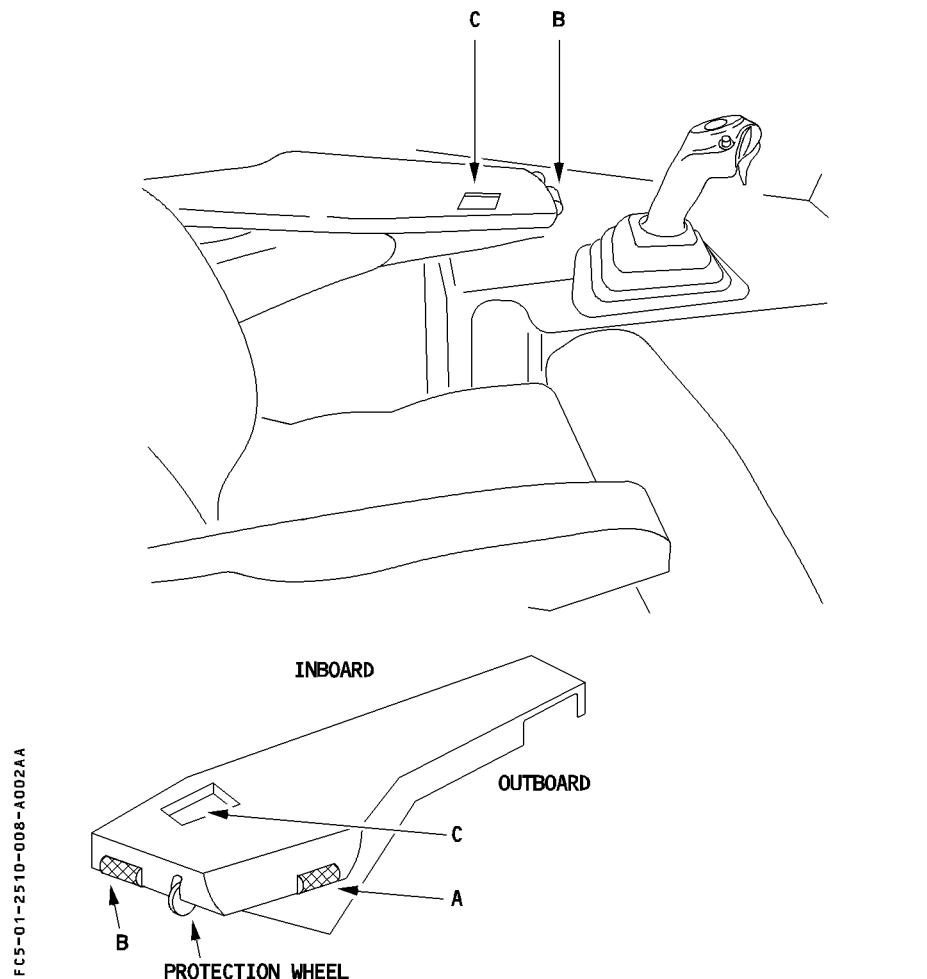
## **HEADREST ADJUSTMENT**

To adjust the headrest in inclination, the occupant must press the inclination control button, and release it to lock the position.

To control the height of the headrest, the occupant must push it horizontally, then adjust the height. Once released, it locks the position.

## **PILOT SEAT INBOARD ARMREST ADJUSTMENT**

To adjust the inboard armrest, the occupant must turn the knurled knob, located on the bottom surface of the armrest.

**PILOT SEAT OUTBOARD ARMREST ADJUSTMENT**

The position of the armrest is adjustable as follows :

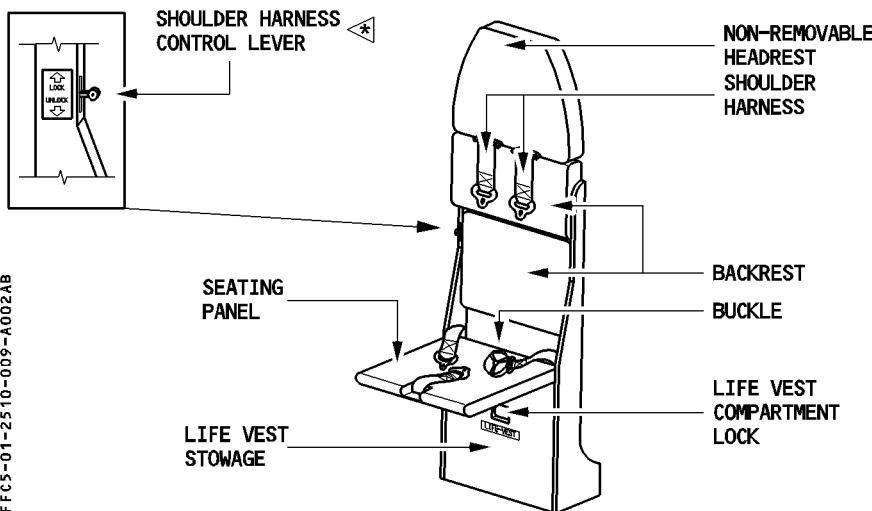
A – Height adjustment

B – Pitch adjustment

The armrest also has a memory display (C) that shows pitch and height.

**FORTH OCCUPANT SEAT**

It is a folding seat.



FFC5-01-2510-009-A002AB

**COCKPIT WINDOW**

The cockpit has fixed and sliding windows.

**FIXED WINDOWS**

There are four fixed windows :

- two windshields
- two fixed side windows

**SLIDING WINDOWS**

The flight crew can use the sliding window as emergency exits. Therefore they are not permitted to stow any object so that it protrudes into the window area from the side console.

Each sliding window includes a panel which has an anti-icing and defogging system, and the opening and closing mechanism.

**Opening mechanism**

Fully press the operating lever to disengage the locking pins from their latches.

Rotate aft the operating lever to free the window panel from its fixed structure.

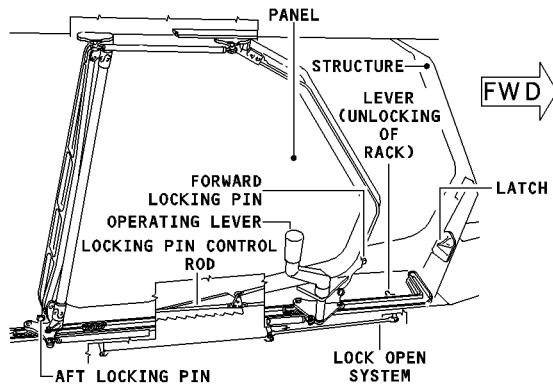
At the end of the operating lever travel, pull backwards to slide the window panel aft.  
Move control lever forward lock the window.

**Closing mechanism**

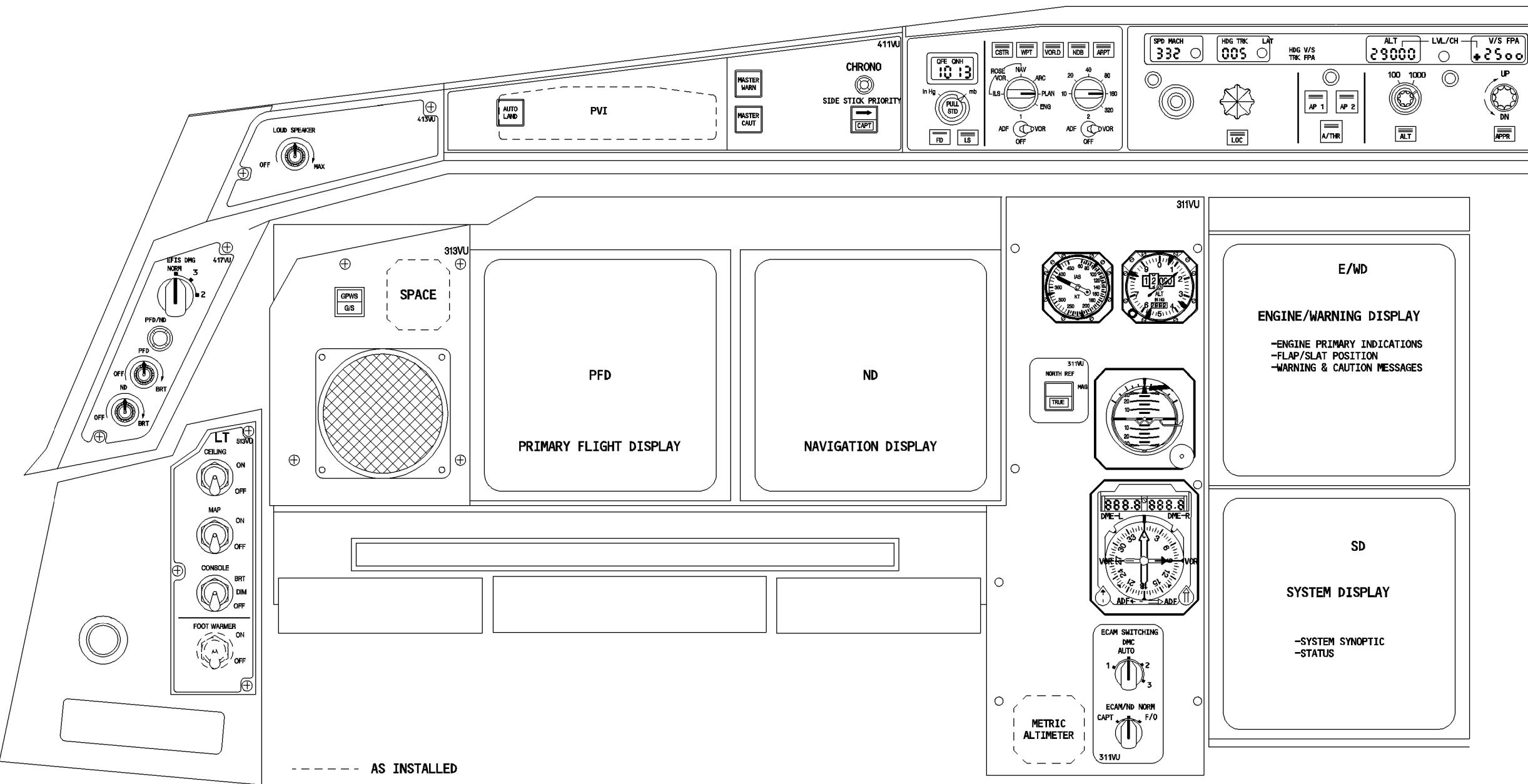
Move control lever aft unlock the window.

Push operating lever forward until the panel is in position opposite its fixed frame.

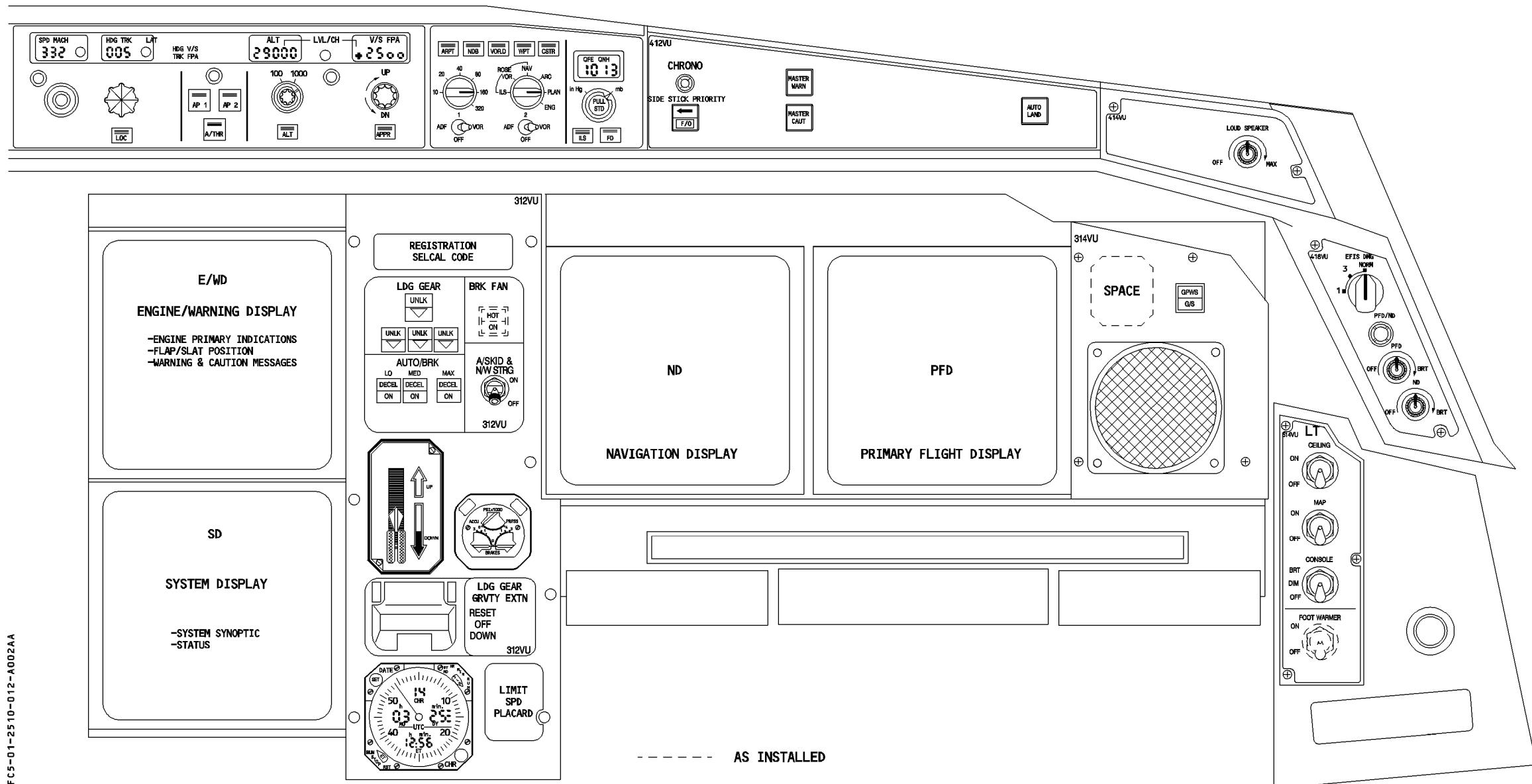
Rotate the operating lever forward to move the panel into its frame and engage the locking pins in their latches.



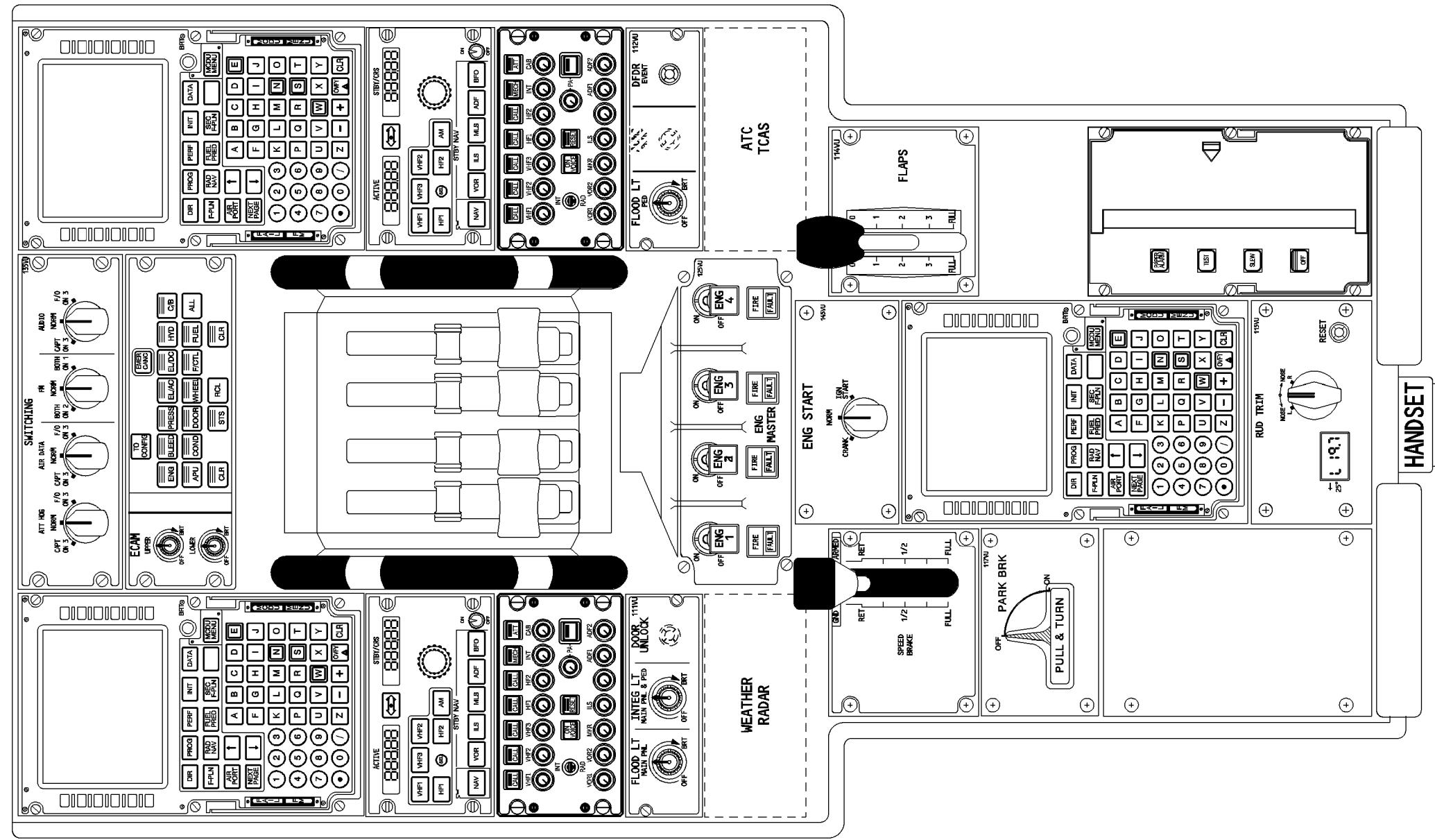
**PILOT'S INSTRUMENT PANELS**



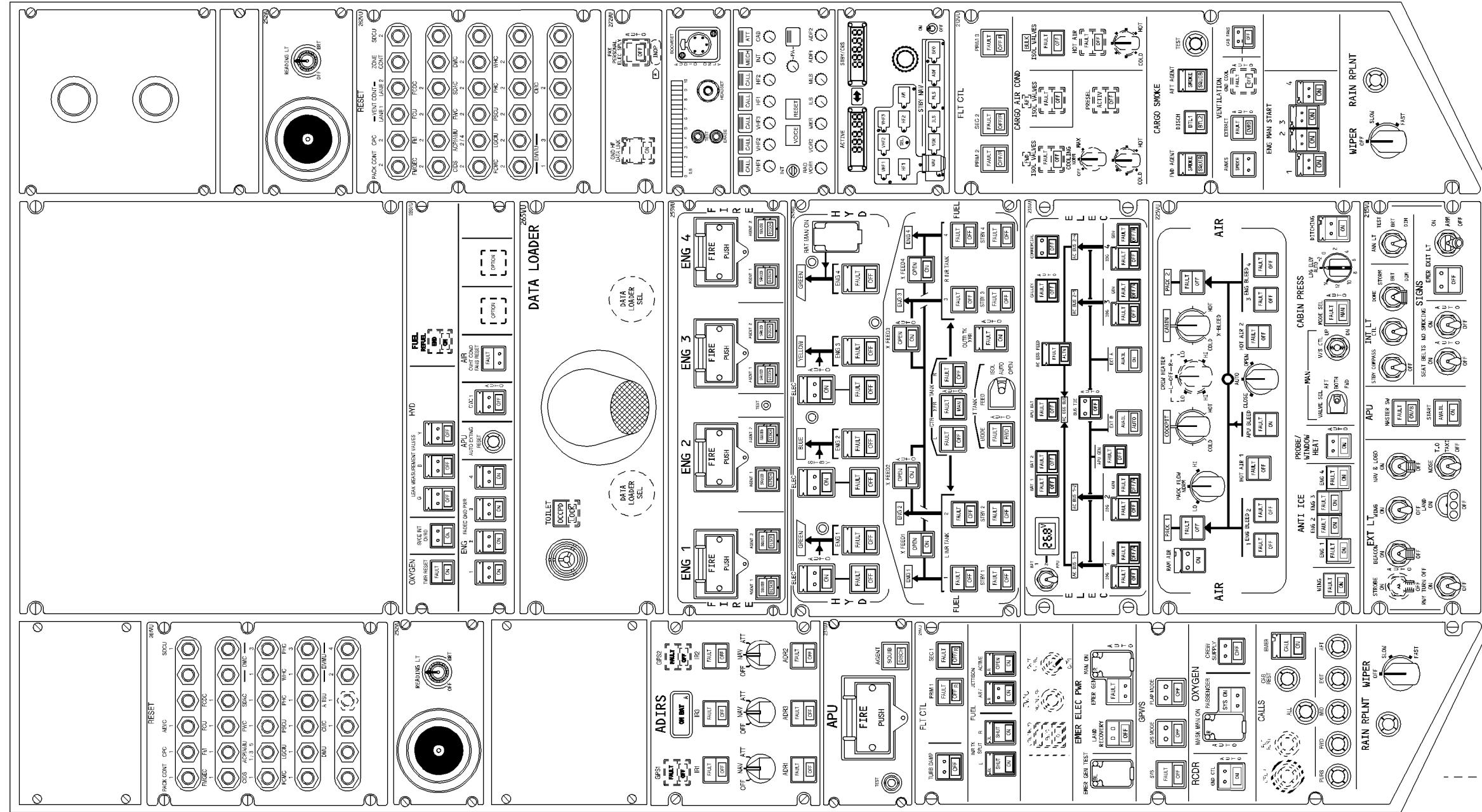
**PILOT'S INSTRUMENT PANEL (cont'd)**



## PEDESTAL



## OVERHEAD PANEL

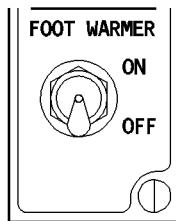


**FOOT WARMER**

A heating panel is attached to each pedal. The temperature of the panels is about 20°C (68°F).

**CONTROLS**

At main instrument panel on captain and first officer side.

**FOOT WARMER sw**

Operation of foot warmer panels on related pedals.

**COCKPIT DOOR DESCRIPTION**

A forward-opening hinge door separates the cockpit from the passenger compartment. It has an electric-locking latch, controlled by the flight crew. In normal conditions, when the door is closed, it remains locked. When there is a request to enter the cockpit, the flight crew can authorize entry by unlocking the door, that remains closed until it is pushed open. When the flight crew does not respond to requests for entry, the door can also be unlocked by the cabin crew, by entering a two to seven-digit code (programmed by the airline) on the keypad, installed on the door post. The door is bulletproof and fully compliant with rapid decompression requirements.

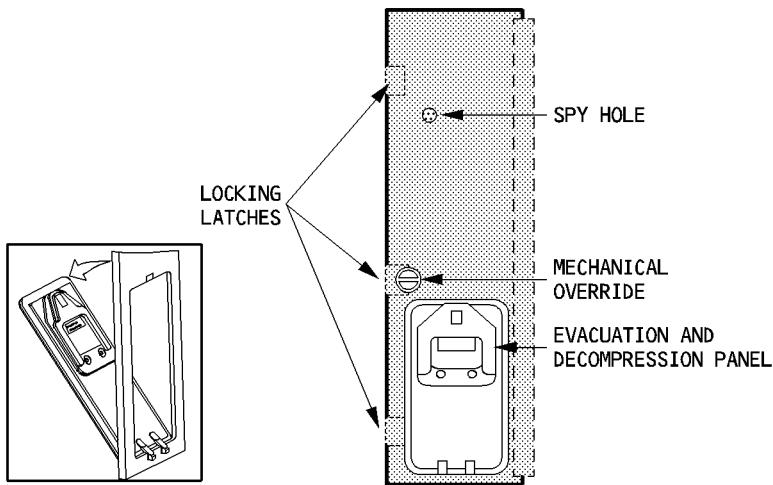
A mechanical override enables the flight crew to open the door from the cockpit side. The evacuation and decompression panel enables the flight crew to evacuate the cockpit, in case of an emergency, when the door is jammed or stuck.

This panel can only be removed from the cockpit side by kicking it open.

The panel also automatically falls open, in case of rapid cabin decompression (in case of rapid decompression in the cockpit, the CDLS automatically unlocks the door).

In case of an electrical supply failure, the door is automatically unlocked, but remains closed.

FFCS-01-2511-001-A300AA



A Circuit Breaker (C/B) box, is installed on the left-hand side of the door frame. This C/B box has three C/Bs. Each C/B is connected to one cockpit door electrical latch.

## COCKPIT DOOR LOCKING SYSTEM (CDLS)

The Cockpit Door Locking System (CDLS) provides a means of electrically locking and unlocking the cockpit door. This system is mainly composed of :

- A keypad, located in the forward cabin, near the cockpit door,
- A toggle switch, located on the center pedestal's Cockpit Door panel,
- A control unit and its CKPT DOOR CONT normal panel, located on the left-hand side of the overhead panel,
- A backup control unit, identical to the first one, and its CKPT DOOR CONT backup panel, located on the right-hand side of the overhead panel,
- An additional CKPT DOOR BKUP panel, which is composed of a LKG SYS switch and a OPEN/FAULT control pushbutton,
- A buzzer.

The keypad enables the cabin crew to request access to the cockpit. There are two different access request types : "Routine" and "Emergency" access request (Refer to 3.04.25).

The toggle switch enables the flight crew to lock or unlock the cockpit door, following an access request, thereby allowing or denying entry into the cockpit.

The cockpit door control unit is the system controller, in charge of :

- Locking or unlocking the door latches, upon flight crew action.
- Unlocking the door, in case of cockpit decompression (the door then opens towards the cockpit under differential pressure).
- Indicating system failures of electrical latches and pressure sensors.
- Activating the access request buzzer and turning on the keypad LEDs.

The CDLS backup control unit is a backup for locking/unlocking the door by flight crew action, and for unlocking the door in case of decompression. The backup control has to be used only when the normal control unit has failed, or when the two pressure sensors have failed.

When operating the CDLS with the backup control unit, both the toggle switch and the keypad are inoperative. In this condition :

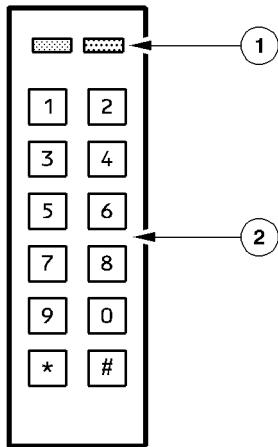
- The cabin crew has to use the interphone to perform any cockpit access request, and
- The flight crew has to use the OPEN/FAULT CTL P/B located on the CKPT DOOR BKUP overhead panel, to unlock the door when access to the cockpit is authorized.
- No emergency access from the cabin to the cockpit is available.

By using the CKPT DOOR BKUP LKG SYS switch, it is possible to operate the CDLS in normal condition, in backup condition, or to deactivate the system to facilitate maintenance tasks and ground operations.

The buzzer sounds in the cockpit for 1 to 9 seconds to indicate that a routine access request has been made, or sounds continuously if an emergency access procedure has been initiated.

**CONTROLS****KEYPAD**

- R The keypad is used by the cabin crew to request pilots to open the door (Refer to 3.04.25).

**① LOCKED/UNLOCKED DOOR INDICATOR**

- R GREEN light ON : The door has been unlocked either by a flight crew action, 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.
- R GREEN light 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.
- R RED light ON : The flight crew has denied access, and the door remains locked.

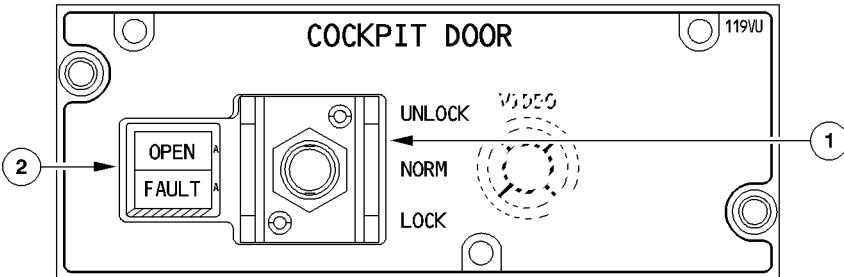
**② DIGITAL KEYPAD**

- R The keypad is used to sound the buzzer in the cockpit for one to nine seconds (three seconds by default), by entering a zero to seven-digit code, as programmed by the airline, followed by the '#' key.
- R It is also used to enter the two to seven-digit emergency code, followed by the '#' key, when the flight crew does not respond.

## CENTRAL PEDESTAL COCKPIT DOOR PANEL

The secured cockpit door opening is controlled by a toggle switch, located on the central pedestal.

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### ① COCKPIT DOOR toggle switch

**UNLOCK position** : This position is used to enable the cabin crewmember to open the door. The switch must be pulled and maintained in the unlock position until the door is pushed open.

**NORM position** : All latches are locked, and EMERGENCY access is possible for the cabin crew.

**LOCK position** : Once the switch has been moved to this position, the door is locked ; emergency access, the buzzer, and the keypad are inhibited for a preselected time (5 to 20 minutes).

- R      **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 emergency access to open the cockpit door.  
       2. The *UNLOCK* position overrides and resets any previous selection.  
       3. In case of an electrical supply failure, the cockpit door is automatically unlocked, but remains closed.

### ② COCKPIT DOOR Fault Open indicator

R      **OPEN** light ON : The door is not closed, or not locked.

**OPEN** light flashes : The cabin crew has started an emergency access procedure. If there is no reaction from the flight crew, the door will unlock at the end of the adjustable time delay (15 to 120 seconds).

**FAULT** : This light comes on when a system failure has been identified (Example : Latch, pressure sensors, control unit).

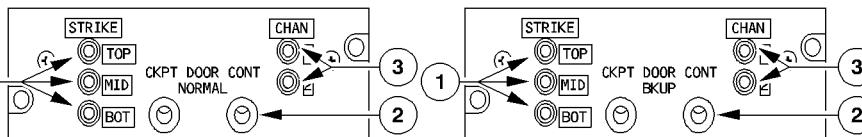
R      The inoperative item can be identified by checking the strike and pressure sensor status lights on the CKPT DOOR CONT panel.

R      R      The inoperative item can be identified by checking the strike and pressure sensor status lights on the CKPT DOOR CONT panel.

## OVERHEAD CONTROL PANEL

The CDLS consists of two separate but identical control units and, therefore, there are two CKPT DOOR CONT panels (normal and backup). The normal control panel is located on the overhead left-hand side, whereas the backup is located on the right-hand side.

FFC5-01-2511-005-A2000AA



### ① Strikes' status lights

- Off : The corresponding (upper, mid, or lower) locking latch is operative.  
On : The corresponding (upper, mid, or lower) locking latch is faulty.

### ② Pressure sensor

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

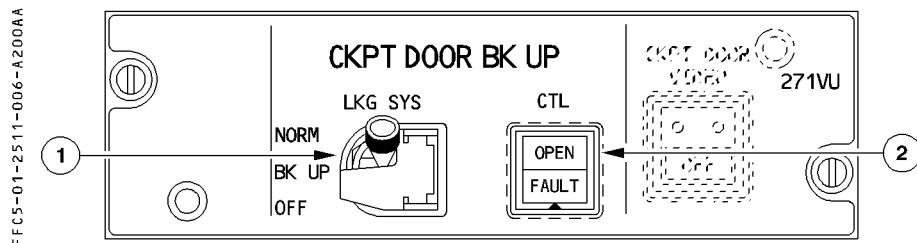
### ③ Pressure sensor status lights

- Off : The corresponding (1 or 2) pressure sensor is operative.  
On : The corresponding (1 or 2) pressure sensor is faulty.

Note : These indicators enable the crew to identify the faulty item, when the CDLS Fault indicator light is ON, (either for the normal or backup system).

## COCKPIT DOOR BACKUP

The cockpit door backup control panel consists of a guarded three-position switch, and of a control pushbutton with a dual visual indicator.



### ① LKG SYS Switch

**NORM** : The basic system has no failure ; the normal control is operative.

**BK UP** : The normal control is deactivated, and backup control is activated.

**OFF** : The Cockpit Door Locking System is deactivated. Both normal and backup controls are inoperative. Therefore, the door is unlocked. It can be pushed open from the cabin side.

### ② CTL pushbutton, OPEN/FAULT Indicator

**OPEN P/B** : Pressing this pushbutton unlocks the door. Keep the pushbutton pressed until the door is pushed open.

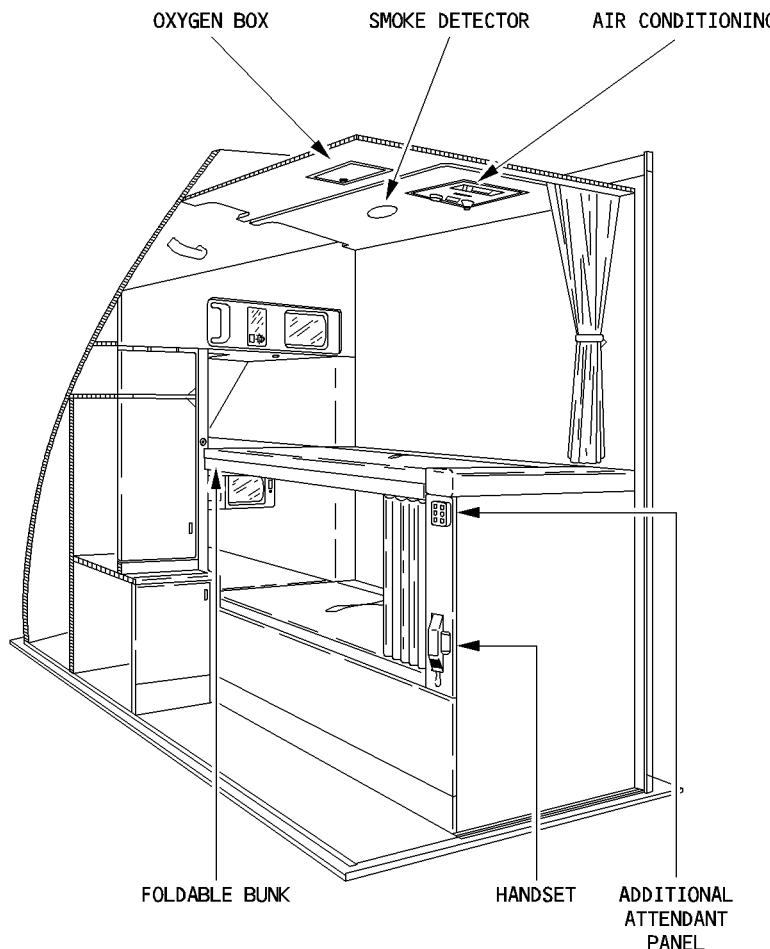
**OPEN light ON** : The door is not closed, or not locked.

**FAULT light ON** : This light comes on when a backup system failure has been identified. The inoperative item can be identified by checking the strike and pressure sensor status lights on the CKPT DOOR CONT backup panel.

**GENERAL**

Since the Flight Crew Rest Compartment (FCRC) is buyer-furnished equipment, only the standard features (as stated in the Airbus Industrie Standard Interface Specifications) are described in this section. For a more detailed description of the systems inside the compartment, refer to the supplier's documentation.

The FCRC is designed to provide the crew (maximum of two people) with the possibility to relax during long-haul flights. For this purpose, there are two bunks. The upper one is foldable, to allow the crew to sit down in the lower bunk. The FCRC is installed between the cockpit wall and the RH Door 1.



FFCS-01-2512-001-A200AA

## DOOR

The entrance door has a locking device, designed to be unlocked from the outside in case of an emergency. The door must be open and secured during takeoff and landing.

## AIR CONDITIONING

Air conditioning is taken from the cabin's air supply. In addition, an independent electrical heating system in the Flight Crew Rest Compartment (FCRC) enables the crew to select the desired FCRC temperature.

## COMMUNICATIONS

The FCRC is equipped with a cabin interphone handset, controlled via CIDS, and a loudspeaker. It allows occupants to communicate with the cockpit, and with the cabin attendants. Entertainment systems are also available. ◁

## LIGHTS

The CIDS controls the dimmable lights, via an Additional Attendant Panel. Reading lights and No Smoking/Fasten Seatbelt signs are provided. Emergency lights are connected to the aircraft's emergency lighting system.

## SMOKE DETECTION

If smoke is detected, the smoke detection system triggers :

- The Master Warning light and a continuous repetitive chime (CRC) in the cockpit,

- A call light in the cabin, and

R     – A CRC in the compartment for 30 seconds, followed by a triple chime in the cabin every 30 seconds.  
 R        (Refer to the FCOM 1.26.57).

## OXYGEN

In case of cabin depressurization, masks are automatically released and can be used if the crew is either sitting or lying down.

## EMERGENCY EQUIPMENT

Two life vests can be found under the FCRC's lower bunk.

## NORMAL OPERATIONS

During taxi, takeoff, and landing, the FCRC must be unoccupied, unless it has been additionally designed for this use. ◁

## LOWER DECK MOBILE CREW REST COMPARTMENT

### GENERAL

Since the crew rest compartment is buyer-furnished equipment, only the common features (as stated in the Airbus interface specifications), are described in this section. For a description of the systems inside the compartment, refer to the supplier documentation. The Lower Deck Mobile Crew Rest (LDMCR) compartment is installed in the most forward section of the lower aft cargo compartment. It is accessible from the cabin via a staircase. Berths are provided to allow the crew to relax on long-range flights.

The LDMCR interfaces with the following aircraft systems :

### DOORS

For normal operation, the LDMCR is accessible through the staircase door and a hatch in the cabin floor. The LDMCR is equipped with an additional emergency hatch to evacuate directly into the cabin.

### AIR CONDITIONING

The air supplied to the LDMCR is a mixture of fresh and recirculated air, taken from the cabin air supply. An air supply isolation valve is installed in the supply duct, which is controlled by the ventilation controller. The valve is closed, when the access hatch is not fully open, or smoke is detected in the LDMCR or aft/bulk cargo compartment.

*Note : Pressing the TEST pushbutton on the CARGO SMOKE panel, or performing the LDMCR internal smoke detection system test, closes the air supply isolation valve.*

An independent electrical heating system is installed in the LDMCR. Temperature control inside the LDMCR allows the selection of a temperature within the range of +20°C to +25°C. The heating only operates in flight.

R *Note : The LDMCR heating system is lost in case of LGCIU2 or GEN 4 failure.*

### COMMUNICATION

The LDMCR is equipped with an interphone station, an attendant indication panel and additional attendant panels. Passenger address and audio entertainment systems are available.

### ELECTRICAL SYSTEM

AC and DC power is provided to the LDMCR.

## FIRE PROTECTION

- R Refer to FCOM 1.26.57.

## LIGHTS

General illumination is installed. The CIDS controls the general illumination via the two Additional Attendant Panels (AAP). An independent continuous staircase illumination is also installed. Reading lights and No Smoking/Fasten Seat Belt signs are provided. The aircraft emergency lighting system controls and supplies the emergency lights and

- R emergency exit sign, installed in the LDMCR.

## OXYGEN

- R Chemical oxygen generators are provided in the LDMCR. The aircraft system releases the masks.

## NORMAL OPERATIONS

- R During taxi, takeoff, and landing the LDMCR must be unoccupied. In flight, if the LDMCR is occupied, the access hatch must stay fully open to ensure that the air supply isolation valve is open.

**A340**

FLIGHT CREW OPERATING MANUAL

<b>EQUIPMENT</b>	1.25.15	P 3
	LOWER DECK	SEQ. 100   REV. 14

## **ABNORMAL OPERATION**

### **PRESSURE LOSS**

In case of pressure loss a high-low chime alerts the occupants for 30 seconds and the oxygen masks drop down.

### **LOW AIR FLOW**

- R If insufficient air flow can be provided to the LDMCR, an internal buzzer (minimum 30 seconds) alerts the occupants to evacuate. The heating system is automatically turned off.
- R Note : Pressing the TEST pushbutton on the CARGO SMOKE panel closes the air supply isolation valve that triggers the LOW AIR FLOW warning in the LDMCR.

### **SMOKE DETECTION**

- R Refer to FCOM 1.26.57.

### **LDMCR ISOLATION VALVE FAILURE**

- R If the LDMCR isolation valve is not closed, but both hatches are closed, the "DO NOT OPEN HATCH" sign comes on in the staircase.
- R If the air supply isolation valve fails in the open position, or if it does not close when commanded, the ECAM caution "COND CRG REST ISOL FAULT" is triggered.



**A340**

FLIGHT CREW OPERATING MANUAL

**EQUIPMENT**

IN SEAT POWER SUPPLY SYSTEM

1.25.16

P 1

SEQ. 001

REV. 14

**GENERAL**

NOT APPLICABLE

**CONTROLS**

NOT APPLICABLE

**A340**

FLIGHT CREW OPERATING MANUAL

**EQUIPMENT**  
**ELECTRICAL SUPPLY**

1.25.20 P 1

SEQ. 001 REV. 19

**BUS EQUIPMENT LIST**

R

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
CAPTAIN SEAT	AC1-1					
F/O SEAT	AC2-4					
FOOT WARMER ◄	AC1-1					
IN SEAT POWER SUPPLY ◄	AC1-2					
COCKPIT DOOR LOCKING SYSTEM ◄		DC2				
COCKPIT DOOR LOCKING SYSTEM BACKUP ◄		DC1				
COCKPIT DOOR SURVEILLANCE SYSTEM ◄		DC1				

**26.00 CONTENTS****26.10 GENERAL**

– DESCRIPTION ..... 1

**26.20 ENG AND APU**

– DESCRIPTION ..... 1

– CONTROLS AND INDICATORS ..... 3

– WARNINGS AND CAUTIONS ..... 10

**26.30 AVIONICS BAY**

– DESCRIPTION ..... 1

– CONTROLS AND INDICATORS ..... 3

– WARNINGS AND CAUTIONS ..... 4

**26.40 LAVATORY**

– DESCRIPTION ..... 1

– WARNINGS AND CAUTIONS ..... 2

**26.50 CARGO COMPARTMENTS**

– SMOKE DETECTION ..... 1

– FIRE EXTINGUISHING ..... 3

– CONTROLS AND INDICATORS ..... 4

– WARNINGS AND CAUTIONS ..... 5

**26.55 BULK CARGO RACK ◄**

– SMOKE DETECTION ..... 1

– WARNINGS AND CAUTIONS ..... 1

**R 26.56 VCC/IFEC SMOKE DETECTION ◄**

– SMOKE DETECTION ..... 1

R – CONTROLS AND INDICATION ..... 1

R – WARNINGS AND CAUTIONS ..... 2

**26.57 CREW REST COMPARTMENTS ◄**

– SMOKE DETECTION ..... 1

– FIRE EXTINGUISHING ..... 3

– WARNINGS AND CAUTIONS ..... 4

**26.60 ELECTRICAL SUPPLY**

**A340**

FLIGHT CREW OPERATING MANUAL

**FIRE PROTECTION****GENERAL**

1.26.10 P 1

SEQ. 001 REV. 17

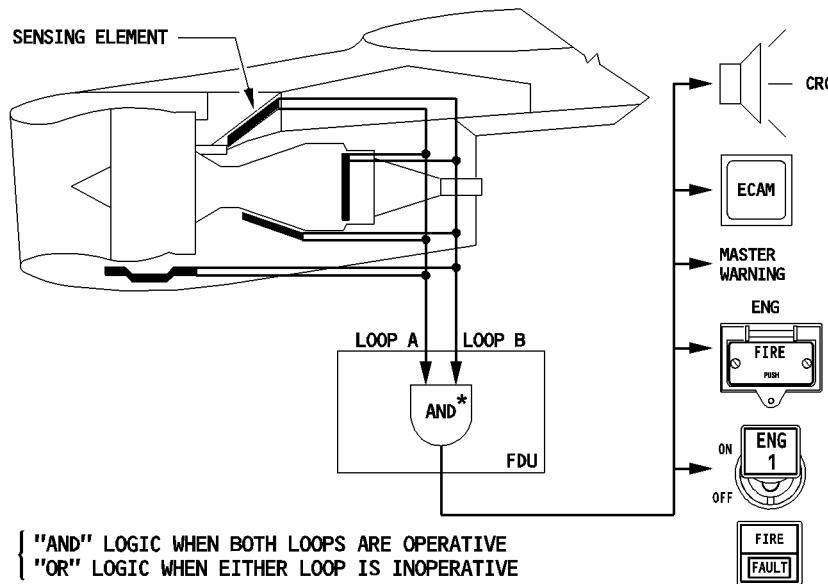
**DESCRIPTION****Aircraft fire protection systems include :**

- Fire and overheat detection and extinguishing systems for the :
  - Engines
  - APU
- Smoke detection and extinguishing for the :
  - Cargo compartments
  - Lavatories
- Smoke detection for the :
  - Avionic bay
- Portable fire extinguishers for the :
  - Flight compartment
  - Passenger cabin

**DESCRIPTION****DETECTION**

- R The engines and the APU each have a fire and overheat detection system consisting of :
  - Two identical gas detection loops (A and B) mounted in parallel.
  - A Fire Detection Unit (FDU).
- R The gas detection loops consist of :
  - Four sensing elements for each engine, located in the pylon nacelle, in the engine core and in the engine fan sections.
  - One sensing element in the APU compartment.
- R When a sensing element is subjected to heat, it sends a signal to the fire detection unit.
- R As soon as loops A and B detect temperature at a preset level, it triggers the fire warning system.
- R A fault in one loop (break or loss of electrical supply) does not affect the warning system.
- R The unaffected loop still protects the aircraft.
- R If the system detects an APU fire while the aircraft is on the ground, it shuts down the APU automatically and discharges extinguishing agent.

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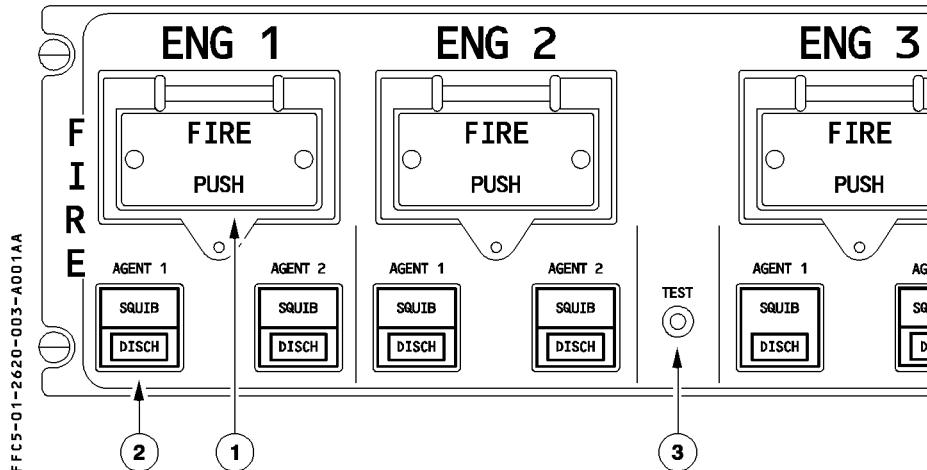


## EXTINGUISHING

- R Each engine has two extinguisher bottles equipped with electrically operated squibs to discharge their contents. Each squib has a dual electric supply. The flight crew controls the discharge from the ENG FIRE panel in the cockpit.
- R The APU has one fire extinguisher bottle that has an electrically operated squib to discharge its agent. The flight crew controls the discharge from the APU FIRE panel in the cockpit. This bottle also discharges automatically if there is an APU fire when the aircraft is on the ground.

## FIRE WARNINGS AND LOOP CAUTIONS

- R Fire detection units process all the warnings and cautions originating in the sensing elements :
- R — The fire warning appears in case of :
  - a fire signal from both loop A and B or,
  - a fire signal from one loop when the other is faulty, or
  - breaks in both loops occurring within 5 seconds of each other (flame effect), or
  - a test performed on the control panel.
- R — The loop-fault cautions appear if :
  - one loop is faulty or,
  - both loops are faulty or,
  - the fire detection unit fails.

**CONTROLS AND INDICATORS****OVERHEAD PANEL****ENG FIRE PANEL**

The aircraft has four identical ENG FIRE panels, which contain the following switches and indicators and include a single TEST pushbutton :

**① ENG 1 (2, 3, 4) FIRE pb**

This pushbutton's normal position is in, and guarded.

The pilot pushes it to release it. It pops out, sending an electrical signal that performs the following for the corresponding engine :

- Silences the aural fire warning
- Arms the fire extinguisher squibs
- Closes the low-pressure fuel valve
- Closes the engine fuel return valve
- Closes the hydraulic fire shut off valve
- Closes the engine bleed valve (on the related and adjacent engine)
- Closes the pack flow control valve
- Cuts off the FADEC power supply
- Deactivates the IDG.

**ENG 1 (2, 3, 4) FIRE lt**

This red light comes on, regardless of the pushbutton's position, whenever the fire warning for the corresponding engine is activated.

R

**(2) AGENT 1 and AGENT 2 pb**

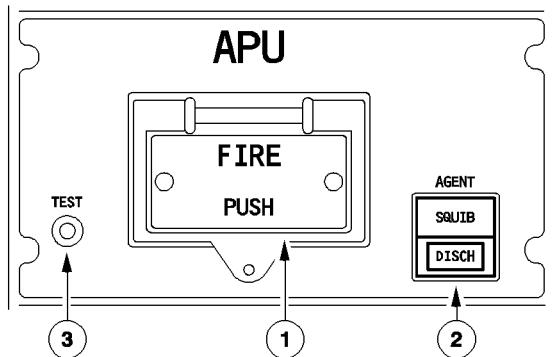
- R Both of these pushbuttons become active when the flight crew pops the ENG FIRE button for the associated engine.
- R A brief push on the pushbutton discharges the corresponding fire bottle.
- R – “SQUIB” comes on white when the flight crew pops the ENG FIRE button for its engine to help the flight crew identify the AGENT pushbutton to be activated.
- R – “DISCH” comes on amber when its fire extinguisher bottle has lost pressure.

**(3) TEST pb**

- R This pushbutton permits the flight crew to test simultaneously the operation of the fire detection and extinguishing system for the four engines.
- R – When the flight crew presses it :
  - R – A continuous repetitive chime sounds.
  - R – The MASTER WARN lights flash.
  - R – ENG FIRE warning appears on ECAM.
- R On the FIRE panel :
  - R – The ENG FIRE pushbutton comes on red.
  - R – The SQUIB lights come on white if discharge supplies are available.
  - R – The DISCH lights come on amber.
- R On the ENG panel (pedestal) :
  - R – The FIRE lights come on red.

**APU FIRE PANEL**

FFC5-01-2620-005-A001AA

**① APU FIRE pb**

This pushbutton's normal position is in and guarded.

The pilot pushes it to release it. It pops out, sending an electrical signal that performs the following for the APU :

- shuts down the APU
  - silences the aural warning
  - arms the squib on the APU fire extinguisher
  - closes the low-pressure fuel valve
  - shuts off the APU fuel pumps (aft and forward).
  - closes the APU bleed valve and X bleed valve and deactivates the APU generator.
- The red APU FIRE light comes on when the APU fire warning is activated, regardless of the position of the pushbutton.

**② AGENT pb**

This pushbutton becomes active when the pilot pops the APU FIRE button.

The flight crew presses it briefly to discharge the fire bottle.

- SQUIB comes on white when the pilot pops the APU FIRE button.
- DISCH comes on amber when the fire extinguisher bottle has lost pressure.

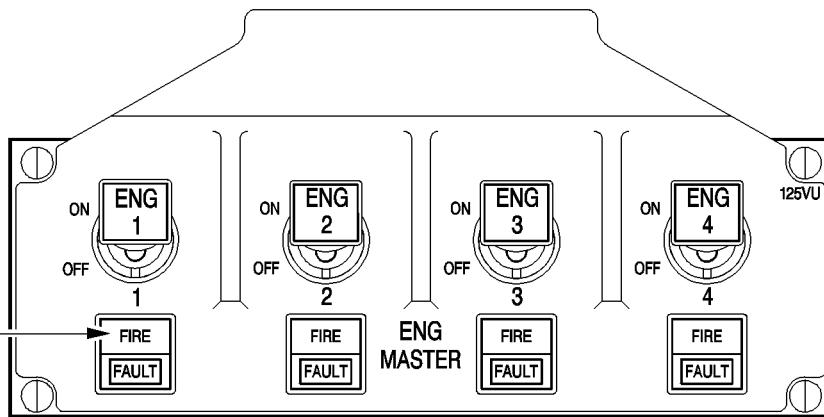
R      Note : A red disk, which is outside at the rear of the fuselage, signals that the agent is not discharged overboard due to bottle overpressure.

**(3) TEST pb**

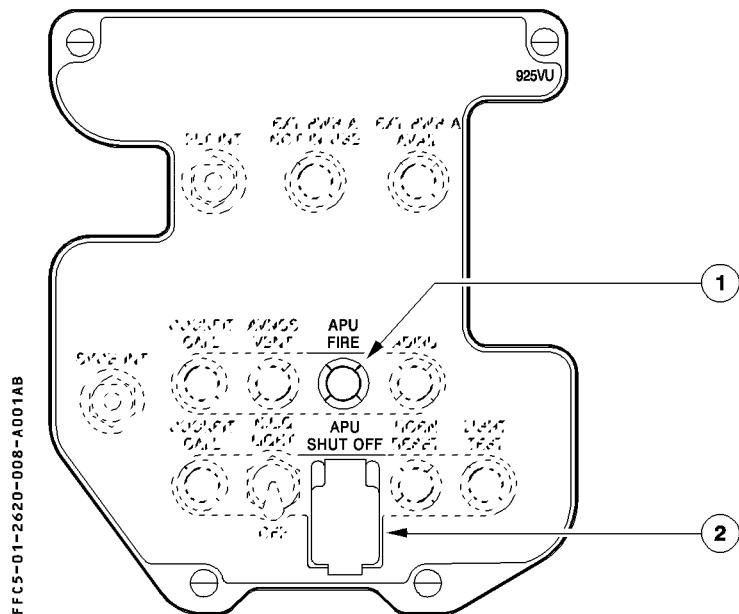
- R This pushbutton permits the flight crew to test the operation of the fire detection and extinguishing system for the APU.
- R – When the flight crew presses it :
- R – A continuous repetitive chime sounds.
- R – The MASTER WARN lights flash.
- R – APU FIRE warning appears on ECAM.
- R On the APU FIRE panel :
- R – The APU FIRE pushbutton comes on red.
- R – The SQUIB light comes on white.
- R – The DISCH light comes on amber.
- R *Note : The automatic shutdown of the APU on the ground will not occur while the flight crew is performing this test.*

**PEDESTAL**

FFC5-01-2620-007-A001AB

**① FIRE lt**

- R This light identifies the engine to be shutdown because of fire.  
R The light comes on red when an engine fire warning is triggered.

**EXTERNAL POWER PANEL**

- R When the aircraft is on the ground, an APU fire causes an additional external warning.

**① APU FIRE lt**

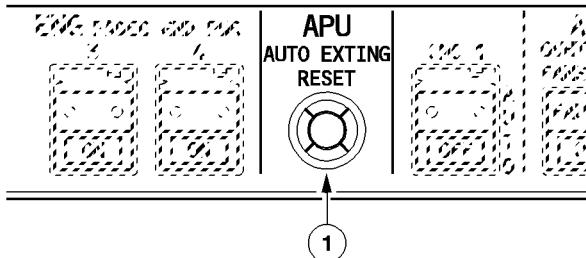
- R The APU FIRE light comes on red and an external warning horn sounds when the system detects an APU fire.  
R The APU fire extinguisher discharges automatically three seconds after the appearance of the fire warning.  
R The light goes out when the fire has been extinguished.

**② APU SHUT OFF pb**

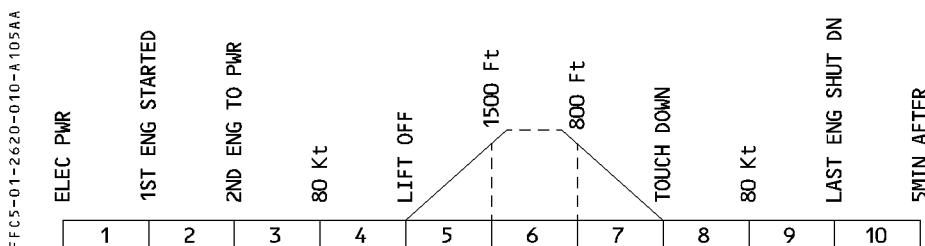
- R A flap guards this pushbutton. When there is an APU fire and someone outside the aircraft presses this button, it confirms that the APU has shut down automatically and silences the external warning horn.

**MAINTENANCE PANEL**

FFC5-01-2620-009-A001AA

**① APU AUTO EXTING RESET pb**

- R Pressing this button resets the automatic shutdown function.  
R During the test or if the fire signal is active, the reset is inoperative.

**WARNINGS AND CAUTIONS**

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1 (2, 3, 4) FIRE Fire detected by both loops or by one loop, the other one being faulty, or break in both loops occurring within 5 seconds	CRC	MASTER WARN	ENGINE	FIRE Its on ENG FIRE pb and on ENG panel	(*)
APU FIRE Fire detected by both loops or by one loop, the other one being faulty			APU	FIRE It on APU FIRE pb	NIL
ENG 1 (2, 3, 4) (APU) FIRE DET FAULT Both loops inoperative, or Fire Detector Unit inoperative	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8
ENG 1 (2, 3, 4) (APU) LOOP A (B) FAULT	NIL	NIL			

(\*) Alert inhibited between V1 and lift off + 15 seconds.

**DESCRIPTION**

Avionics smoke detection is provided by :

- Two smoke detectors (ionization type), in the air extraction duct of the avionics ventilation system. Each detector is linked to one of the two detection loops (dual loop principle).
- The Smoke Detection Control Unit (SDCU) receives signals from the two detectors, and transmits them to the ECAM, which displays a warning in the cockpit.

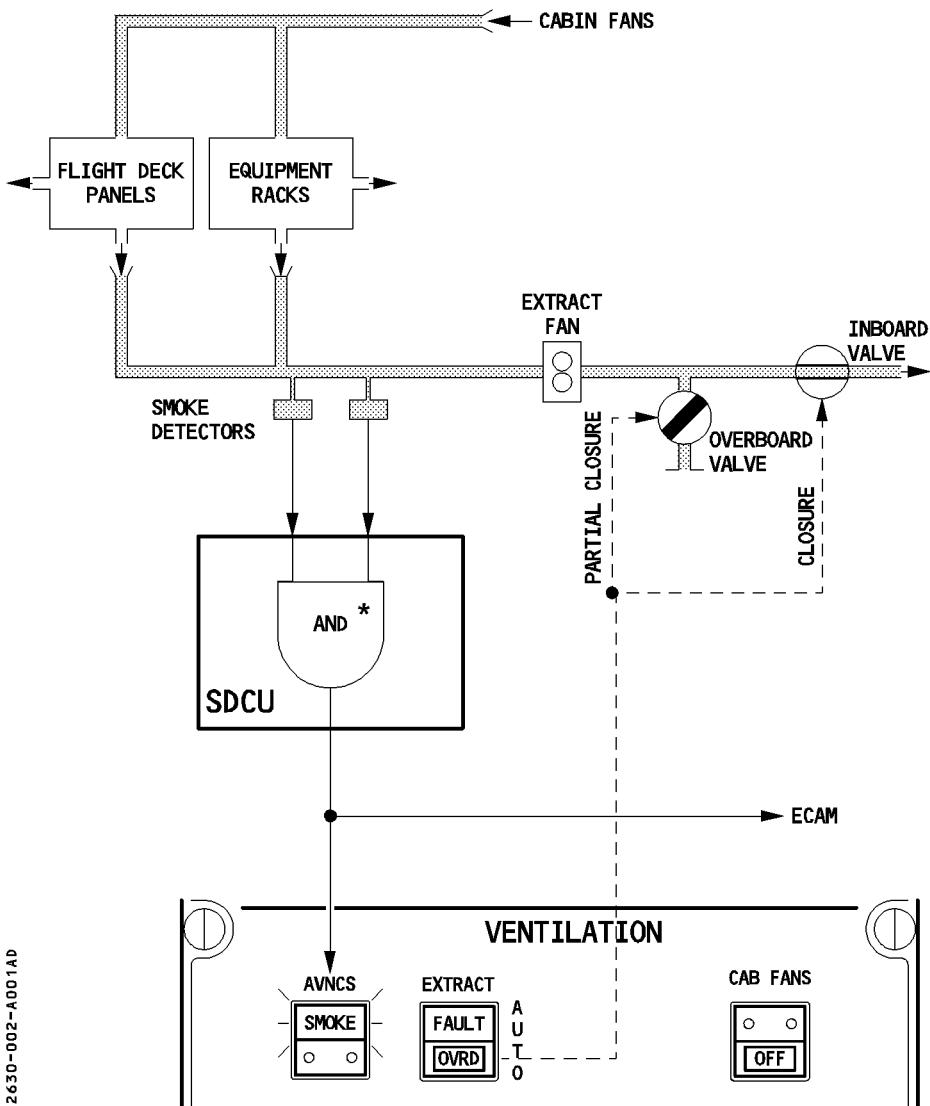
Smoke activates the avionics smoke warning, if :

- R – Both detectors detect it for more than 5 seconds, or
- R – One smoke detector detects it for more than 5 seconds, and the other is inoperative.

When smoke is detected :

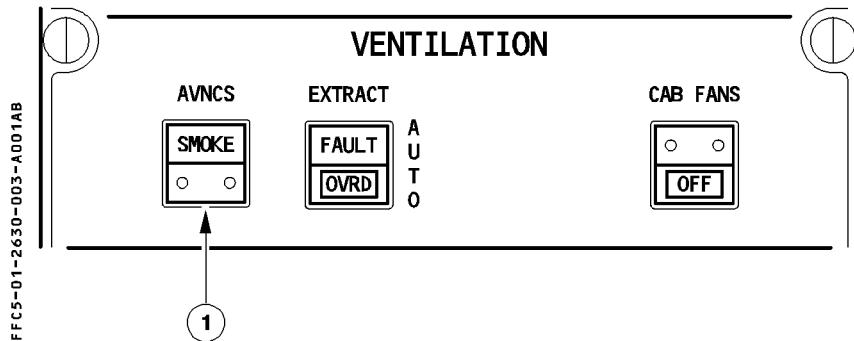
- The Repetitive Chime sounds.
- The MASTER WARNING light, on the glareshield, comes on.
- The ECAM displays a caution on the E/WD.
- The SMOKE light, on the VENTILATION panel, comes on.

R



FFC5-01-2630-002-A001AD

\* { "AND" LOGIC WHEN BOTH DETECTORS ARE OPERATIVE  
"OR" LOGIC WHEN EITHER DETECTOR IS INOPERATIVE

**CONTROLS AND INDICATORS****OVERHEAD PANEL****① AVNCS SMOKE**

- R     SMOKE lt : Comes on red along with a warning on ECAM, when smoke is detected in the avionics ventilation duct.
- R     Note : For test, see CARGO COMPARTMENTS, CONTROLS AND INDICATORS (Refer to 1.26.50)

**WARNINGS AND CAUTIONS**

R

FFC5-01-2630-004-A001AB

ELEC PWR

1ST ENG STARTED  
2ND ENG TO PWR  
80 Kt

LIFT OFF  
1500 Ft  
800 Ft

TOUCH DOWN

80 Kt  
LAST ENG SHUT DN

5MIN AFTER

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AVNCS VENT SMOKE Smoke detected in the ventilation extraction duct	REPETITIVE CHIME	MASTER WARN	NIL	SMOKE lt on VENTILATION panel	4, 5, 7, 8
AVIONICS DET FAULT Loss of the avionic smoke detectors	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8

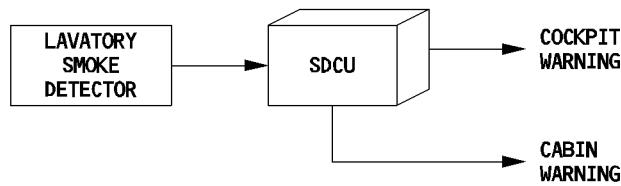
**DESCRIPTION****SMOKE DETECTION**

The system consists of :

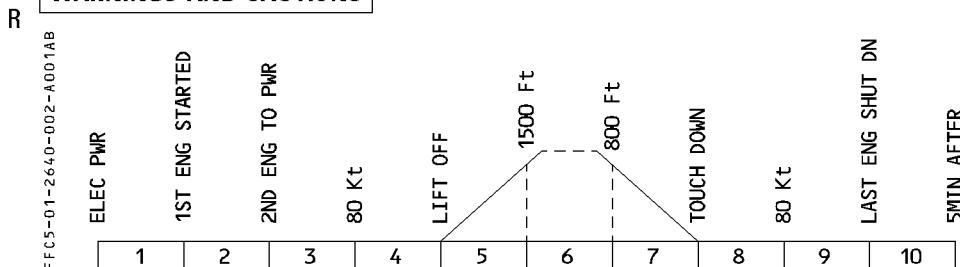
- ionization type smoke detectors (one in each lavatory air extraction duct)
- a double channel Smoke Detection Control Unit (SDCU).

When smoke is detected in a lavatory, the detector sends a signal to SDCU which transmits it to FWC (for warning display in the cockpit) and to CIDS (for warning in the cabin)

FFC5-01-2640-001-A001AA

**WASTE BIN FIRE EXTINGUISHING**

Each lavatory waste bin is equipped with an automatic fire extinguishing system.

**WARNINGS AND CAUTIONS**

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
LAVATORY SMOKE Smoke detected in a lavatory	CRC	MASTER WARN	NIL	NIL	4, 5, 7, 8
LAVATORY DET FAULT Loss of the lavatory smoke detection	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8

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FLIGHT CREW OPERATING MANUAL

**FIRE PROTECTION**  
**CARGO COMPARTMENTS**

1.26.50 P 1

SEQ. 001 REV. 17

**SMOKE DETECTION**

The cargo compartments have a smoke detection system.

- Cavities in the cargo compartment ceiling panels hold smoke detectors (ionization type). Each cavity has two smoke detectors, and each detector is linked to one of the two detection loops (dual loop principle).
- The forward cargo compartment has two cavities.
- The bulk cargo compartment has one cavity.
- The aft cargo compartment has two cavities.
- The Smoke Detection Control Unit (SDCU) receives signals from the detectors and transmits them to ECAM, which displays a warning in the cockpit. The SDCU has two identical channels.

Smoke in one cavity activates the cargo smoke warning, if :

- Both smoke detectors detect it, or
- One smoke detector detects it, and the other is inoperative.

- R When the cargo smoke warning is activated, the isolation valves of this compartment close automatically and the extraction fan stops, if the affected compartment is ventilated.



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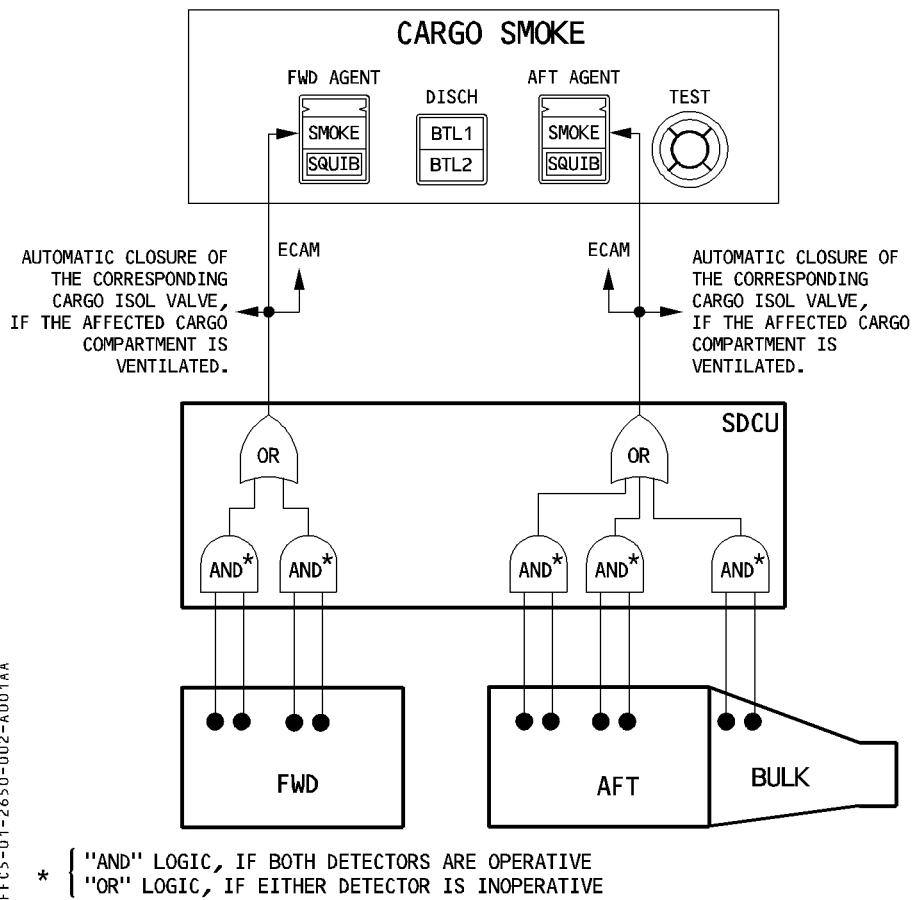
**FIRE PROTECTION**  
**CARGO COMPARTMENTS**

1.26.50 P 1a

SEQ. 001 REV. 19

LEFT INTENTIONALLY BLANK

R



FFC5-01-2650-002-A001AA

**FIRE EXTINGUISHING**

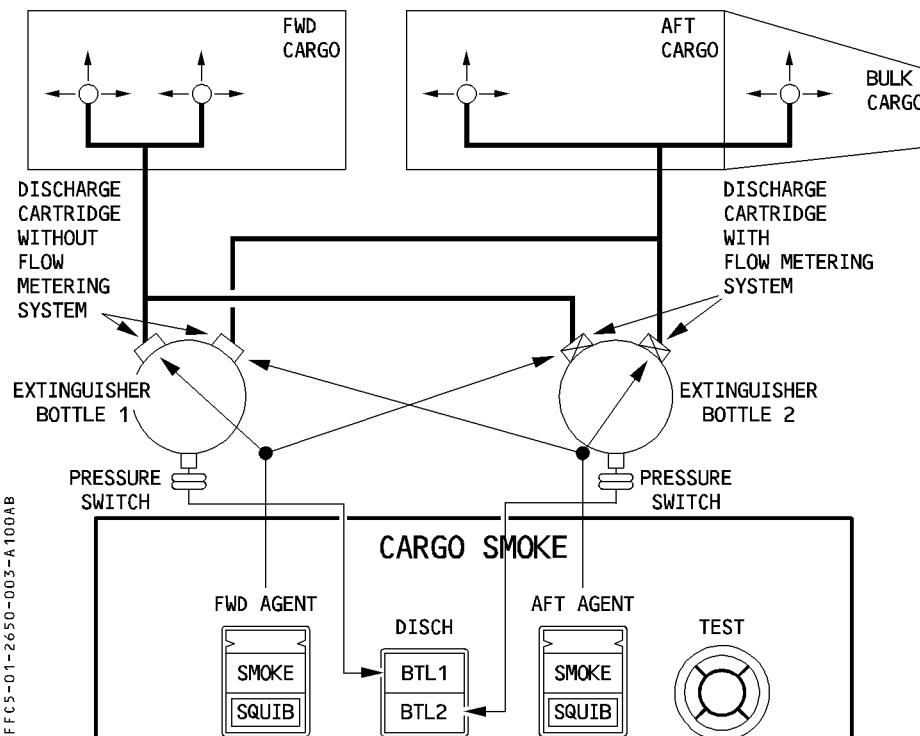
A fire extinguishing system protects the cargo compartments. Two fire extinguishing bottles are installed, and their contents can either be discharged into the FWD or AFT (including BULK) cargo compartment. Each bottle has two discharge heads, one for each compartment.

Pressing the AGENT pushbutton, associated with the FWD (AFT / BULK) compartment, ignites the squib of the two bottles, and Bottle 1 discharges the extinguishing agent into that compartment, which takes about 60 seconds.

The R discharge cartridge of Bottle 2 is comprised of a flow metering system, the fire extinguishing agent slowly discharges into the compartment, to ensure sufficient agent concentration for 240 minutes.

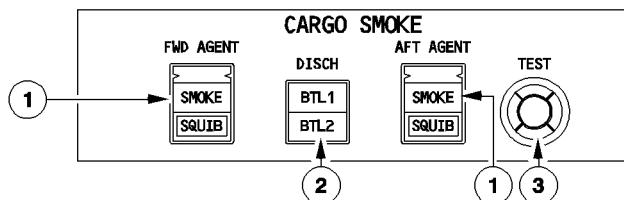
The SDCU monitors the squib integrity and bottle pressure.

When Bottle 1 (2) is discharged, the BTL 1 (BTL 2) light comes on white.



**CONTROLS AND INDICATORS****OVERHEAD PANEL**

FFCS-01-2650-004-A001AB

**① FWD (AFT) AGENT pb**

Pressing this pushbutton ignites the associated squib to discharge the extinguishing agent in the respective compartment (FWD or AFT).

The SMOKE light comes on red, and the ECAM displays a warning when the system detects smoke in the indicated compartment.

In case of a positive test, the SQUIB light comes on white.

**② DISCH It**

The BTL1 or BTL2 light comes on white, when the associated bottle has discharged.

**③ TEST pb**

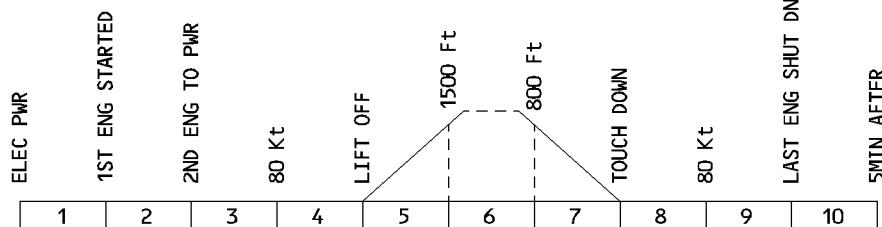
R Pressing this pushbutton for at least 3 seconds, and until it is released :

- Tests the smoke detectors in sequence,
- Turns on the white BTL lights,
- Closes the ventilation system's isolation valves.
- Turns on the white SQUIB lights, if one of the two SQUIB filaments is serviceable,
- Turns on the red SMOKE lights (AFT, FWD, CARGO and AVNCS), displays the ECAM warnings, and a continuous respective chime sounds.

Note : Each SDCU channel sounds its own warning, which lasts about 25 seconds, with a delay of about 30 seconds in between.

**WARNINGS AND CAUTIONS**

FFC5-01-2650-005-A001AB



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
FWD (AFT/BULK) CARGO SMOKE Smoke detected in the corresponding cargo	CRC	MASTER WARN		SMOKE lt on CARGO SMOKE	4, 5, 7, 8
DET FAULT Both SDCU channels fault or Loss of all smoke detectors	SINGLE CHIME	MASTER CAUT	NIL		
FWD (AFT) CRG BTL 1 (2) FAULT Loss of FWD or AFT bottle 1(2)				NIL	3, 4, 5, 7, 8
FWD (AFT/BULK) CRG DET FAULT Loss of the smoke detection in the corresponding cargo	NIL	NIL			

**SMOKE DETECTION****LOWER DECK MOBILE CREW REST COMPARTMENT**

The Lower Deck Mobile Crew Rest (LDMCR) smoke detection system consists of :

- Five (six, if installed) smoke detectors ;
- A Crew Rest Smoke Detection (CRSD) control unit located in the LDMCR ;
- A double channel Smoke Detector Control Unit (SDCU).

When a detector detects smoke in the LDMCR, it sends a signal to the CRSD and :

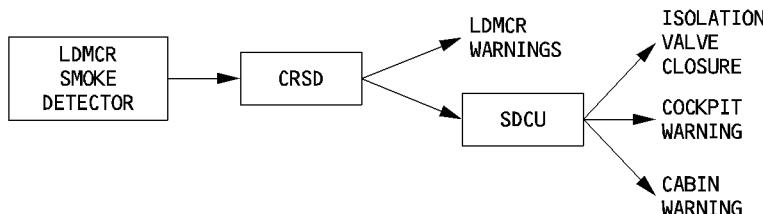
- The horn in the CRSD control unit is activated.
- The related smoke detector indicator flashes on the CRSD control unit.
- The CRSD control unit sends a smoke signal to the SDCU.

When the exit and emergency exit hatches are closed, the "DO NOT OPEN HATCH" sign comes on in the staircase housing.

The SDCU transmits the smoke signal to :

- The Flight Warning Computer (FWC), for a warning display in the cockpit.
- The CIDS, for a warning display in the cabin.
- The ventilation controller, which closes the ventilation isolation valve. In the LDMCR, the "LEAVE MCR" sign comes on, the low-flow buzzer activates, a CRC sounds during 30 seconds and the lights' intensity increases to 100%.

*Note : The internal smoke detection system is only available when electrical power is supplied to the LDMCR.*



## STAIRCASE HOUSING

The staircase housing's smoke detection system consists of :

- One smoke detector
- A double-channel Smoke Detector Control Unit (SDCU).

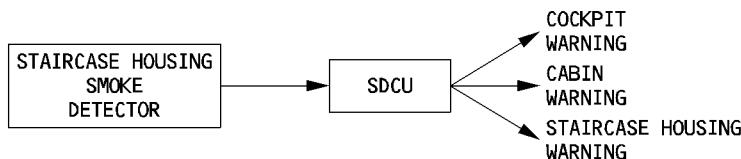
When the detector detects smoke in the staircase housing, it sends a signal to the SDCU.

The SDCU transmits it to the Flight Warning Computer (for a warning display in the cockpit) and to the CIDS (for a warning display in the cabin, and for a visual and aural warning in the staircase housing).

Note : The internal smoke detection system is only available when electrical power is supplied to the LDMCR.

R

FFC5-01-2657-002-A210AA



## FLIGHT CREW REST COMPARTMENT

The Flight Crew Rest Compartment's (FCRC) smoke detection system consists of :

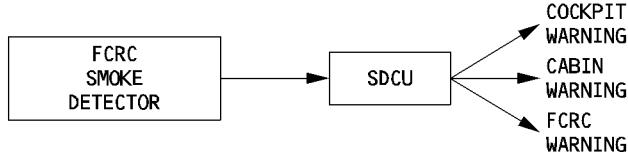
- One smoke detector
- A double-channel Smoke Detector Control Unit (SDCU).

When the detector detects smoke in the FCRC, it sends a signal to the SDCU. The SDCU transmits it to the Flight Warning Computer (for a warning display in the cockpit), and to the CIDS (for a warning display in the cabin, and for a visual and aural warning in the FCRC compartment).

Note : The internal smoke detection system is only available when electrical power is supplied to the FCRC.

R

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**FIRE PROTECTION**

1.26.57 P 3

**CREW REST COMPARTMENTS**

SEQ. 200 REV 16

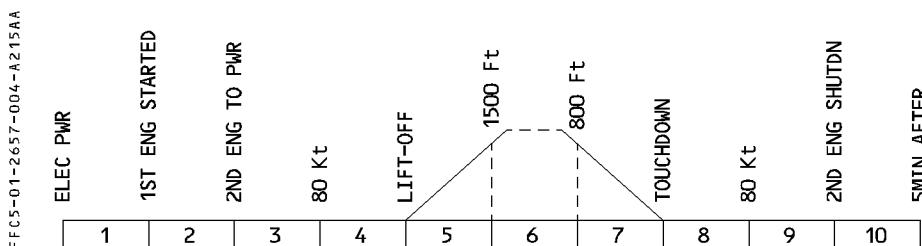
**FIRE EXTINGUISHING**

- R The fire extinguishing system operates manually in the LDMCR when the Fire Extinguishing System (FES) switch, in the staircase housing, is set to the FES DISCHARGE position. The manual circuit (FES switch) ignites the squib on the fire bottle, which discharges a fire extinguishing agent through the spray nozzles in the LDMCR.

*Note : The internal fire extinguishing system is only available when electrical power is supplied to the LDMCR.*

**CAUTION**

Selecting the FES switch activates the fire extinguishing system, regardless of whether smoke has been detected or not.

**WARNINGS AND CAUTIONS**

R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CAB REST SMOKE Smoke has been detected in the LDMCR, or in the staircase housing.	CRC	MASTER WARN	NIL	NIL	4, 5, 7, 8
FLT REST SMOKE Smoke has been detected in the FCRC.					
CAB (FLT) REST DET FAULT	NIL	NIL			4, 5, 7, 8

**BUS EQUIPMENT LIST**

R

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
ENG/APU	FIRE DETECTION	ENG LOOP A					X	
		ENG LOOP B		DC2				
		APU LOOP A					X	
		APU LOOP B			X			
	FIRE EXTINGUISHING	ENG 1 + 4						
		BTL 1 SQUIB A					HOT 2	
		BTL 1 SQUIB B		DC 2				
		BTL 2 SQUIB A					HOT 1	
		BTL 2 SQUIB B		DC 2				
		ENG 2 + 3						
		BTL 1 SQUIB A					HOT 2	
		BTL 1 SQUIB B		DC 2				
		BTL 2 SQUIB A					HOT 1	
		BTL 2 SQUIB B		DC 2				
CARGO LAV AVIONICS	APU							
	BTL SQUIB A						HOT 1	
	BTL SQUIB B			X				
	APU AUTO EXT							HOT 2
BCRC ▲	SDCU 1						SHED	
	SDCU 2			DC 2				
	CARGO SQUIB A						HOT 1	
	CARGO SQUIB B			DC 2				
LDMCRC ▲	SMOKE DETECTION	SDCU 1					SHED	
		SDCU 2		DC 2				
	FIRE EXTINGUISHING				X			
FCRC ▲	SMOKE DETECTION	SDCU 1					SHED	
		SDCU 2		DC 2			SHED	
	FIRE EXTINGUISHING				DC 2			

**A340**

FLIGHT CREW OPERATING MANUAL

**FLIGHT CONTROLS**

1.27.00 P 1

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SEQ. 001 REV. 21

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--------------------------------	---

**GENERAL**

The fly-by-wire system was designed and certified to render the new generation of aircraft even more safe, cost effective, and pleasant to fly.

**BASIC PRINCIPLE**

Flight control surfaces are all :

- Electrically-controlled and
- Hydraulically-activated.

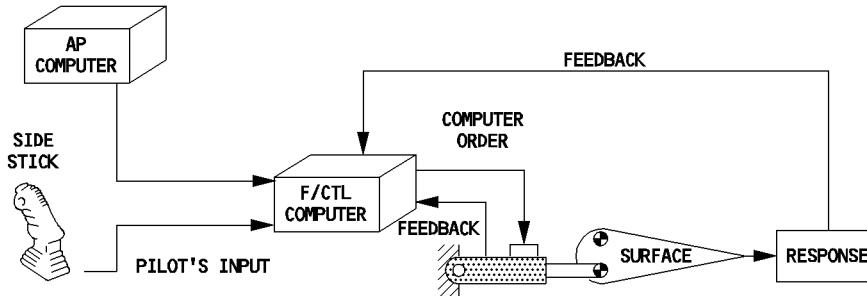
The stabilizer and rudder can also be mechanically-controlled.

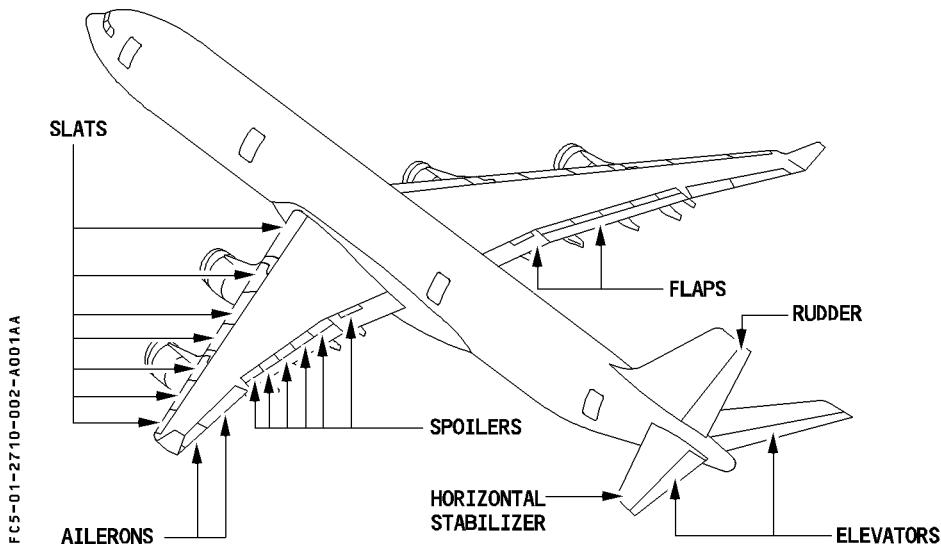
Pilots use the sidesticks to fly the aircraft in pitch and roll (and in yaw, indirectly, through turn coordination).

Computers interpret pilot input and move the flight control surfaces, as necessary, to follow their orders.

- R However, when in normal law, regardless of the pilot's input, the computers will prevent excessive maneuvers and exceedance of the safe envelope in pitch and roll axis.  
R However, as on conventional aircraft, the rudder has no such protection.

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**CONTROL SURFACES**

The flight controls are electrically or mechanically controlled as follows :

**Pitch axis**

Elevator control = Electrical

Stabilizer control = Electrical for normal or alternate control. Mechanical for manual trim control

**Roll axis**

Aileron control = Electrical

Spoiler control = Electrical

**Yaw axis**

Rudder control = Mechanical, however control for yaw damping, turn coordination and trim is electrical.

**Other controls**

Speed brakes = Electrical

Note : All surfaces are hydraulically actuated.

## COCKPIT CONTROLS

- R — Two side stick controllers are used for pitch and roll manual control. One is on the CAPT's lateral console, the other is on the FO's lateral console.
- R The two controllers are springloaded to neutral, and are not mechanically coupled.
- R Each controller independently sends electrical signals to the flight control computers.
- R — Two pairs of rigidly interconnected pedals ensure mechanical control of the rudder.
- R — A speed brake control lever is provided in the center pedestal.
- R — Two handwheels, on the center pedestal, are used to mechanically control the THS.
- R — A switch, installed on the center pedestal, ensures the rudder trim control.
- R — No manual aileron trim switch is provided.

## COMPUTERS

Five flight control computers process pilot and autopilot inputs according to normal, alternate or direct flight control laws.

The computers are :

### **3 PRIM computers**

(Flight Control Primary Computer – FCPC) for :

- Normal, alternate, and direct control laws.
- Speedbrake and ground spoiler control.
- R — Protection speed computation.

### **2 SEC computers**

(Flight Control Secondary Computer – FCSC) for :

- Direct control laws, including yaw damper function.
- Rudder trim, rudder travel limit, and pedal travel limit.

One computer of any type is capable of controlling the aircraft and of assuming safe flight and landing.

In normal operation, one PRIM computer is declared to be the master (P1). It processes the orders and sends them to the other computers (P1 / P2 / P3 / S1 / S2), which will then execute them on their related servo-control.

If one computer is unable to execute the orders sent by the master, another computer executes the task of the affected computer (except for spoiler control).

- R If the master computer (P1) is not able to be the master, P2 (or P3 if P2 not available) becomes the master.

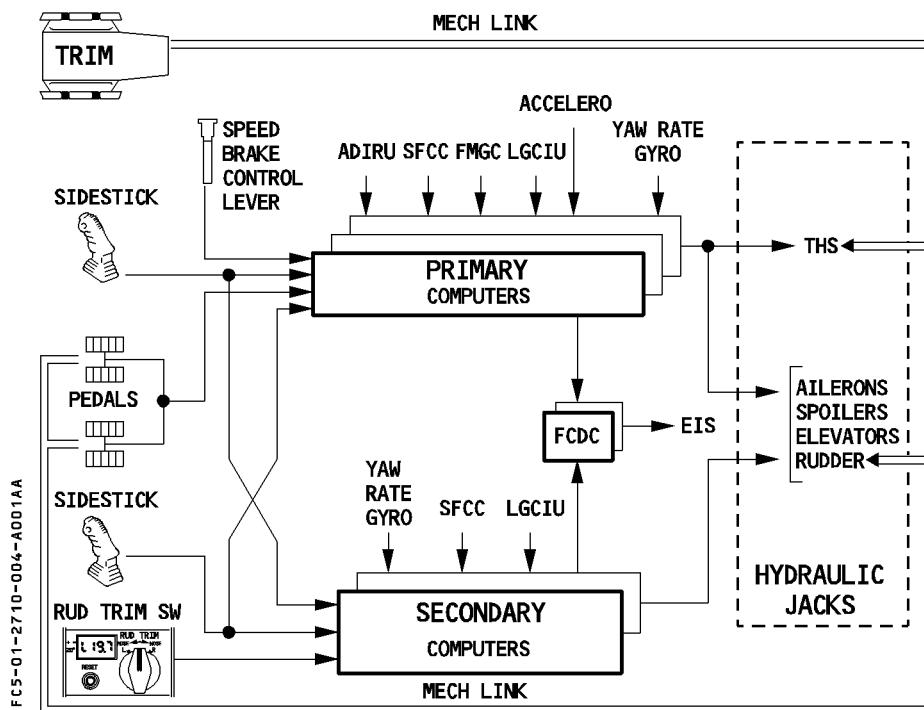
Note : When green hydraulic system is lost, P2 replaces P1 as master computer.

In case of loss of all PRIM computers each SEC is its own master and controls its associated servoloop in direct law.

A single SEC can provide complete aircraft control in direct law.

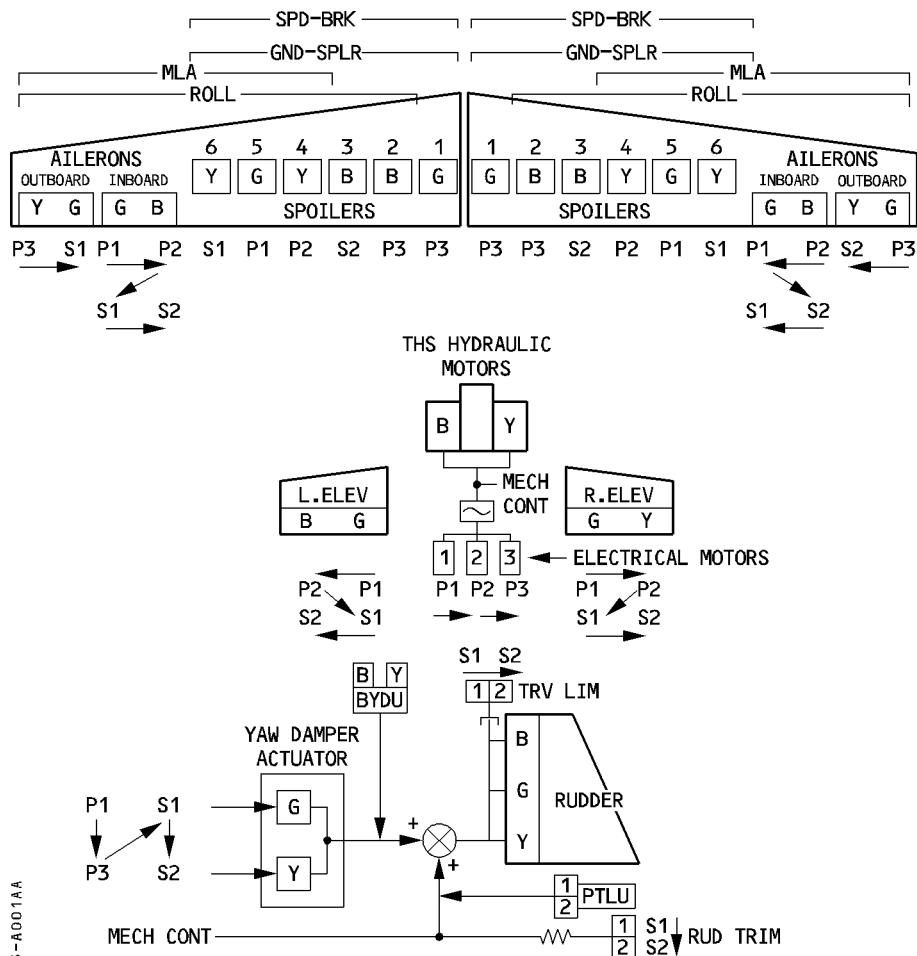
## 2 FCDC computers

(Flight Control Data Concentrators) acquire data from the PRIMs and SECs and send this data to EIS and CMC.



**ARCHITECTURE****GENERAL ARCHITECTURE****FOR INFO**

R



P= PRIM COMPUTERS

S= SEC COMPUTERS

ARROWS INDICATE THE CONTROL RECONFIGURATION PRIORITIES

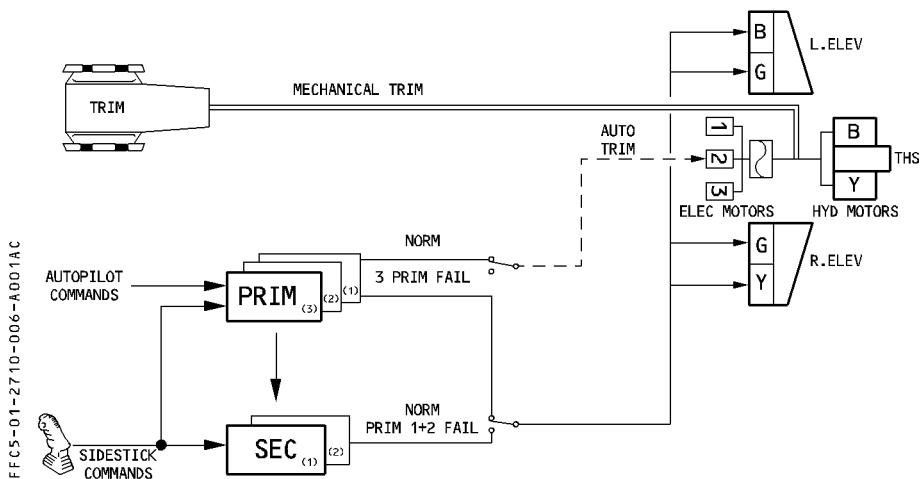
INDICATES THE HYDRAULIC POWER SOURCE FOR EACH SERVO CONTROL

MLA = MANEUVER LOAD ALLEVIATION

BYDU = BACKUP YAW DAMPER UNIT

PTLU = PEDAL TRAVEL LIMIT UNIT

## PITCH CONTROL



- R Two elevators and the trimmable horizontal stabilizer (THS) control the aircraft in pitch. The maximum elevator deflection is 30° nose up and 15° nose down. The maximum THS deflection is 14° nose up and 2° nose down.

## ELECTRICAL CONTROL

- R – In normal operations, the PRIM 1 controls the elevators and the horizontal stabilizer, and the green hydraulic jacks drive the left and right elevator surfaces.
  - R The THS is driven by N° 1 of three electric motors.
  - R – If a failure occurs in PRIM 1 or the associated hydraulic systems or hydraulic jacks, the system shifts pitch control to PRIM 2. PRIM 2 then controls the elevators via the blue and yellow hydraulic jacks and controls the THS via the N° 2 electric motor.
  - R – If neither PRIM 1 nor PRIM 2 is available, the system shifts pitch control either to SEC 1 for elevator control, and to PRIM 3 for THS control via the N° 3 electric motor.
  - R In case of 3 PRIM failure the SEC 1 controls the elevator.
- Electrical control of THS is lost. THS actuation is still available through manual pitch trim wheel control.

## MECHANICAL CONTROL

Mechanical control of the THS is available from the pitch trim wheel at any time if either the blue or the yellow hydraulic system is functioning.  
Mechanical control from the pitch trim wheel has priority over electrical control.

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**FLIGHT CONTROLS**

1.27.10 P 7

DESCRIPTION

SEQ. 001 REV. 10

**ACTUATION****Elevators**

- Two electrically controlled hydraulic servojacks drive each elevator.

Each servojack has three control modes :

- . Active : Jack position is electrically controlled.
- . Damping : Jack follows surface movement.
- . Centering : Jack is hydraulically maintained in neutral position.

- In normal operation:

- One jack is in active mode.
- The other jack is in damping mode.
- Some maneuvers cause the second jack to become active.

R — If the active servojack fails, the damped one becomes active and the failed jack is automatically switched to the damping mode.

R If neither jack is being controlled electrically nor hydraulically, both are automatically switched to the damping mode.

R If neither of the four jacks is being controlled electrically, the four jacks are automatically

R switched to the centering mode.

**Stabilizer**

R — A screwjack driven by two hydraulic motors drives the stabilizer.

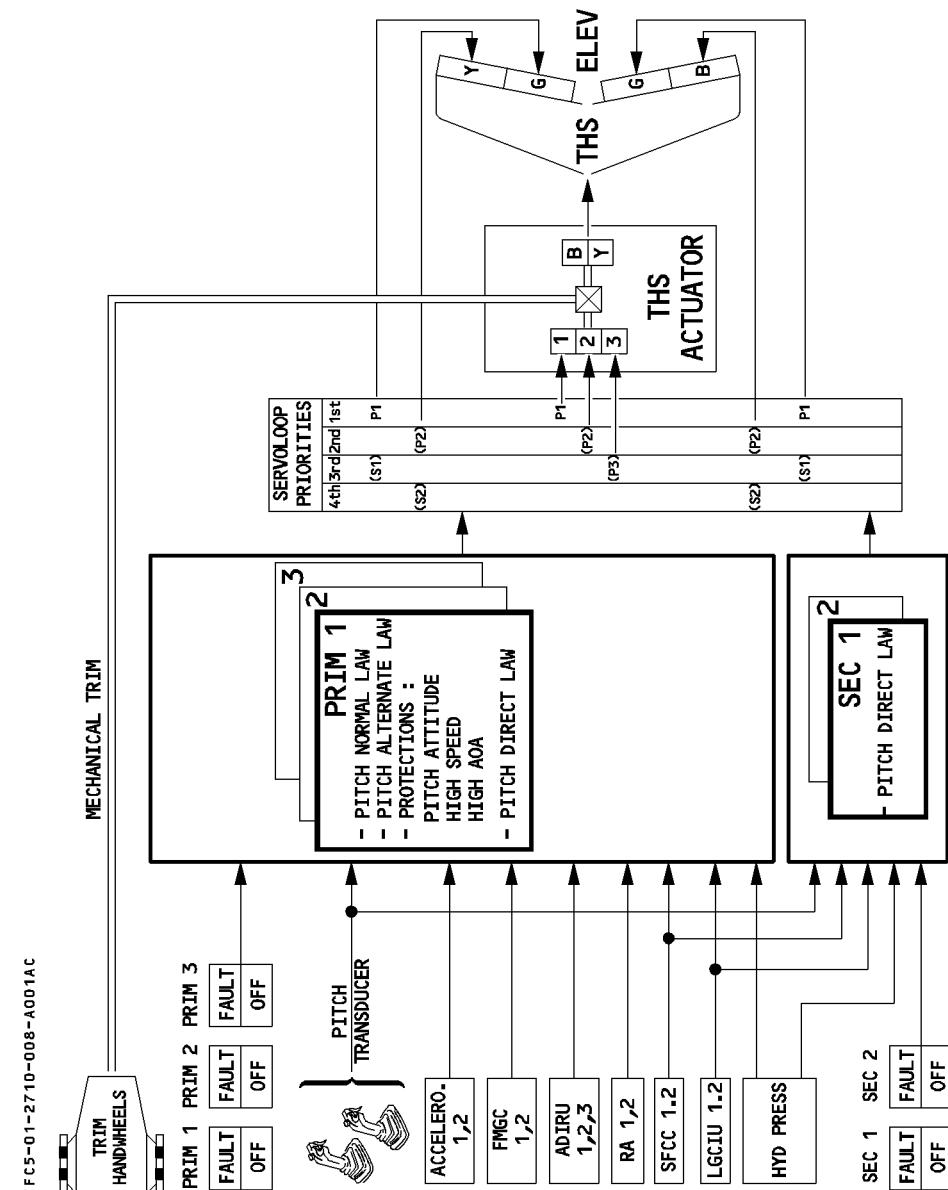
R — The two hydraulic motors are controlled by :

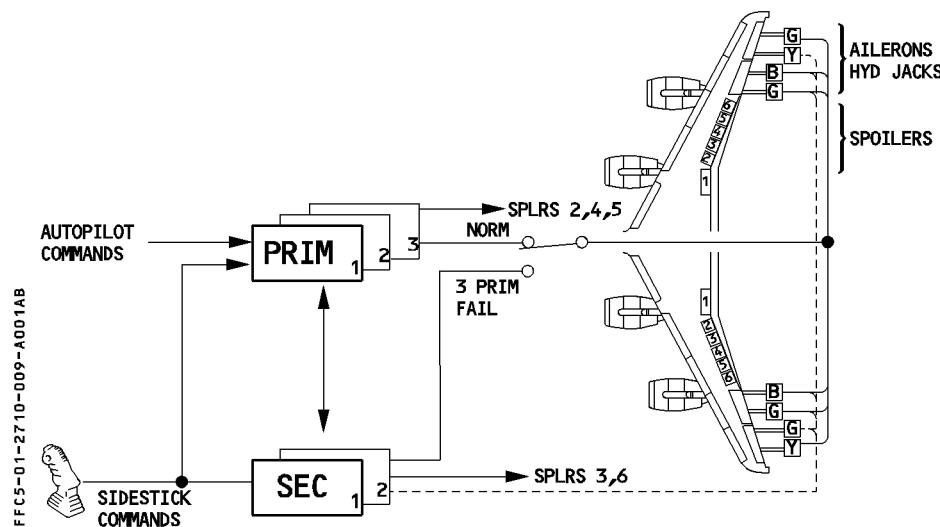
- one of three electric motors, or
- the mechanical trim wheel.

## PITCH CONTROL – SCHEMATIC

FOR INFO

R



**ROLL CONTROL**

- R Two ailerons and five spoilers on each wing control the aircraft about the roll axis.  
 R The maximum deflection of the ailerons is 25°.  
 R Ailerons extend when the flaps are extended (aileron droop).  
 R The maximum deflection of the spoilers is 35°.

**ELECTRICAL CONTROL**

- The inboard ailerons are normally controlled from PRIM 1 (LH) and PRIM 2 (RH) with each of these computers being capable of controlling both sides. SEC 1 and 2 provide the back up control in case of PRIM 1 and 2 failure.
  - The outboard ailerons are normally controlled from PRIM 3. The SEC 1 and 2 provide the back up control in case of PRIM 3 failure.
- R – The SEC control the N° 3 and 6 spoilers, the PRIM control the N° 2, 4 and 5 spoilers.

## **ACTUATION**

### **– Ailerons**

Each aileron has two electrically controlled hydraulic servojacks.

Each servojack has two control modes :

- Active : Jack position is electrically controlled.
  - Damping : Jack follows surface movement.

The system automatically selects damping mode, in the event of green and yellow or blue and green low pressure, or if the respective computer fails.

At high speed (above 190 knots, in CONF 0), the outboard ailerons are controlled to zero deflection.

In autopilot mode, or in some failure cases, the outboard ailerons are used up to 300 knots.

When the emergency generator is supplied by the RAT only, the outboard ailerons are controlled in damping mode to reduce hydraulic power consumption.

### **– Spoilers**

A servojack positions each spoiler. Each servojack receives hydraulic power from either the green, yellow, or blue hydraulic system, controlled by the PRIM or SEC (as shown in the diagram on Page 13).

The system automatically retracts the spoilers to their zero position, if it detects a fault or loses electrical control.

If the system loses hydraulic pressure, the spoiler retains the deflection it had at the time of the loss, or a lesser deflection if aerodynamic forces push it down.

R When a spoiler surface on one wing fails, the symmetric one on the other wing is inhibited (except for spoilers 4 and 6).

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FLIGHT CREW OPERATING MANUAL

**FLIGHT CONTROLS**

1.27.10 P 11

DESCRIPTION

SEQ. 100 REV. 21

**SPEEDBRAKE AND GROUND SPOILER CONTROL****SPEEDBRAKE CONTROL**

The pilot controls the speedbrakes with the speedbrake lever. The speedbrakes involve spoilers 1 to 6. Speedbrake extension is inhibited, if :

- Maneuver Load Alleviation (MLA) is activated.
- Angle-of-attack protection is active.
- Low speed stability is active.
- Flaps are in Conf 3 or FULL.
- At least one thrust lever above MCT.
- Alpha floor activation.

If an inhibition occurs when the speedbrakes are extended, they automatically retract and stay retracted until the inhibition condition disappears, and the pilots reset the lever. (The speedbrakes can be extended again, 5 seconds after the lever is reset). When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

**FOR INFO**

*Maximum deflection : 25° for spoiler 1*

*30° for spoilers 2 to 6*

*Reduced in Conf 2*

*For surfaces 2 to 6 (which perform roll and speedbrake functions), the roll function has priority : When the sum of a roll order and a simultaneous speedbrake order on one surface is greater than the maximum deflection achievable in flight, the symmetrical one is retracted until the difference between the two surfaces is equal to the roll order.*

**GROUND SPOILER CONTROL**

Spoilers 1 to 6 act as ground spoilers.

When a ground spoiler surface on one wing fails, the symmetric one on the other wing is inhibited.

**Arming :**

The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

**Extension :****– Full extension**

The ground spoilers automatically extend during rejected takeoff (at a speed greater than 72 knots) or at landing, when both main landing gear have touched down, and :

- All thrust levers are set to idle, provided ground spoilers are armed, or
- Reverse is selected on at least two symmetrical engines (remaining engines at idle).

R      The spoiler roll function is inhibited when spoilers are used for the ground spoiler function.

— **Partial extension**

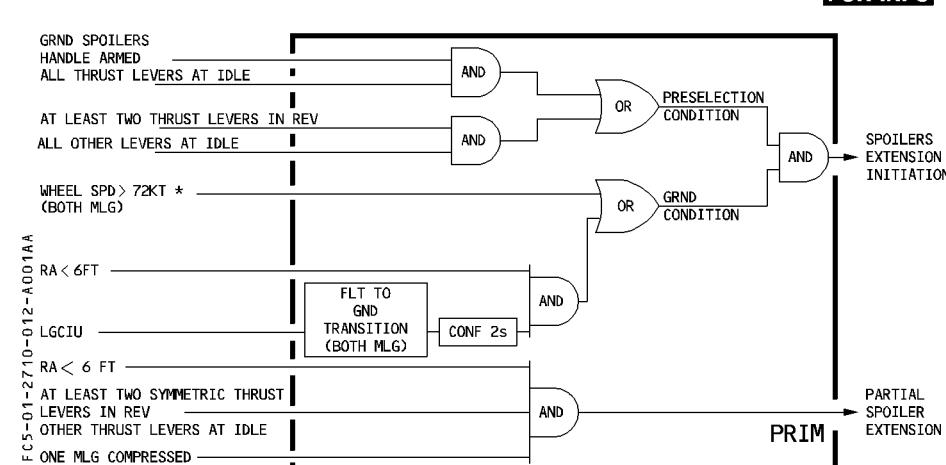
The ground spoilers partially extend when reverse is selected on at least two symmetric engines (remaining engines at idle) and one main landing gear is compressed.

This partial extension, by decreasing the lift, will ease the compression of the second main landing gear, and consequently will lead to the normal ground spoiler extension.

**Retraction :**

The ground spoilers retract when :

- one thrust lever is above idle
- or, all thrust levers are at forward idle and the speedbrakes control lever is pushed down.

**FOR INFO**

\* Condition on wheel speed is inhibited after GND/FLT transition.

The condition is rearmed if wheel rotation stops.

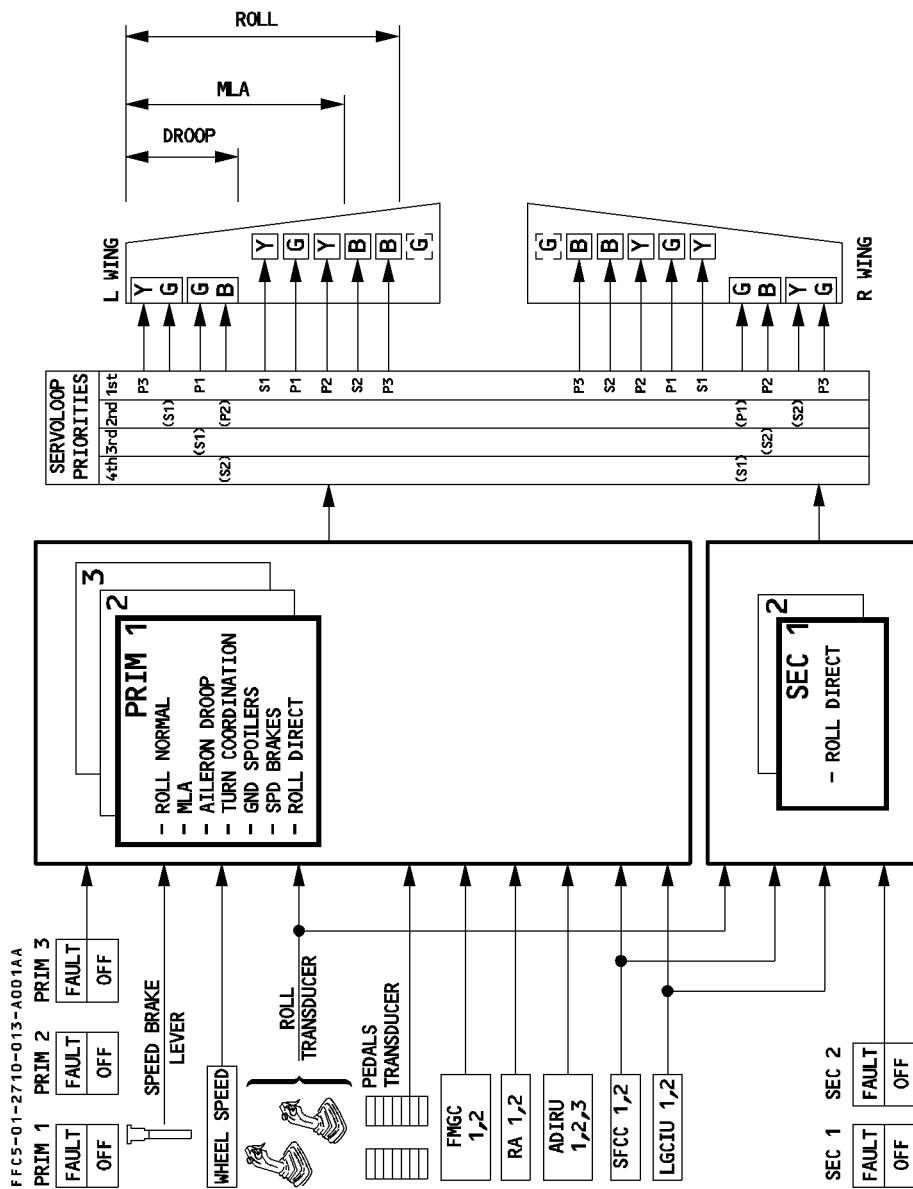
Consequently after an aircraft bounce (aircraft airborne) if the spoilers are extended :

- They remain extended with thrust lever at idle
- They retract if thrust is increased above idle (go around), and extend again after the next touch down

The thrust levers are considered at idle when they are below 4.7° when the RA is above 6 feet and below 32° when the RA is below 6 feet.

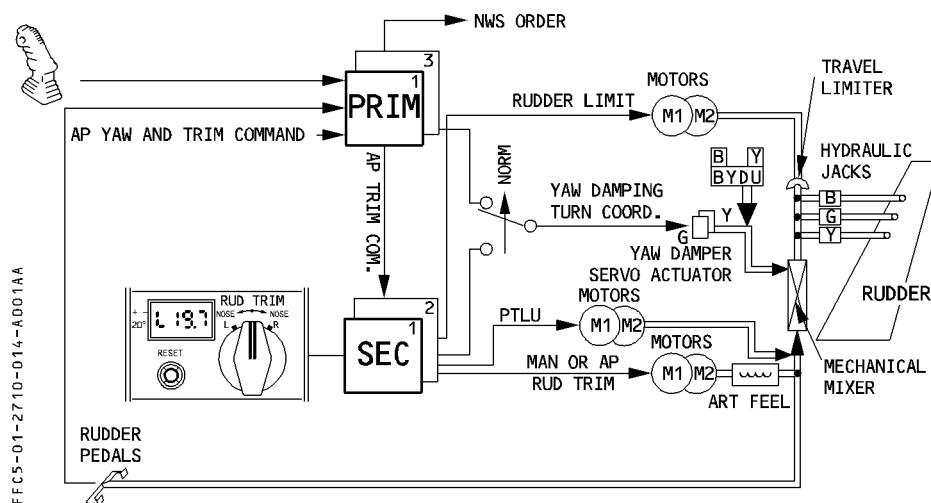
Surfaces extend partially/fully to : 14°/35° for spoiler 1, 28°/50° for spoilers 2 to 6

R ROLL CONTROL - SCHEMATIC



**YAW CONTROL**

R



Yaw control is achieved by one rudder surface (rudder deflection  $\pm 31.6^\circ$ ).

**ELECTRICAL RUDDER CONTROL**

In flight, yaw damping and turn coordination functions are automatic, and are controlled by the PRIMs and SECs. (Refer to the yaw control schematic).

**MECHANICAL RUDDER CONTROL**

Conventional mechanical rudder control is available from the pilot's rudder pedals.

**RUDDER ACTUATION**

The rudder is actuated by 3 independent hydraulic jacks, which operate in parallel.

## YAW DAMPING, TURN COORDINATION

The three hydraulic servo jacks are actuated by a green hydraulic servo actuator. A yellow servo actuator remains synchronized and will take over in case of failure.

There is no feedback to the rudder pedals from yaw damping and turn coordination functions.

In case of total loss of electrical power or total loss of flight controls computers the back up yaw damper unit (BYDU) becomes active for yaw damping function.

The BYDU is constituted of an electro mechanical actuator in parallel, with the two normal yaw dampers and incorporates one gyrometer and associated electronics. Independent electric supply is provided by two dedicated electrical generators, one driven by the blue hydraulic system, the other one by the yellow hydraulic system.

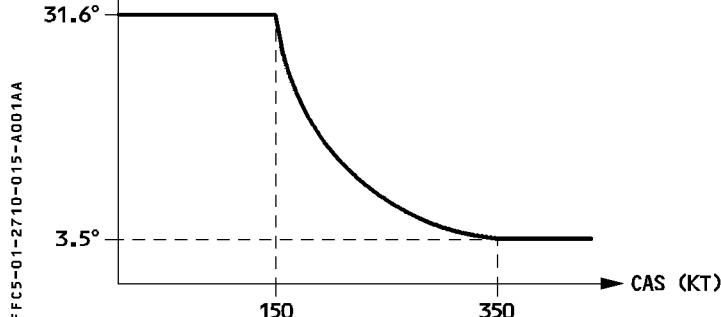
## RUDDER AND PEDAL TRAVEL LIMIT

Rudder and pedal deflection is limited as a function of the speed.

Each channel of the limiter is controlled and monitored by its associated SEC.

In case of double SEC failure the maximum rudder deflection remains at the value reached before failure then maximum deflection is available when the slats are extended.

MAX RUDDER DEFLECTION



## RUDDER TRIM

Rudder trim is achieved by two electric motors which position the artificial feel unit. In normal operation SEC 1 / MOTOR 1 are driving with SEC 2 / MOTOR 2 remaining synchronized as back up.

The pilot can apply in manual flight, rudder trim from the RUD TRIM rotary switch located on the pedestal.

- Authority : 85 % of max rudder deflection limited to 25°
- Rudder trim speed : 1°/sec in clean configuration, in case slats/flaps extended 1°/sec for input up to 1.5 sec and 3°/sec above.

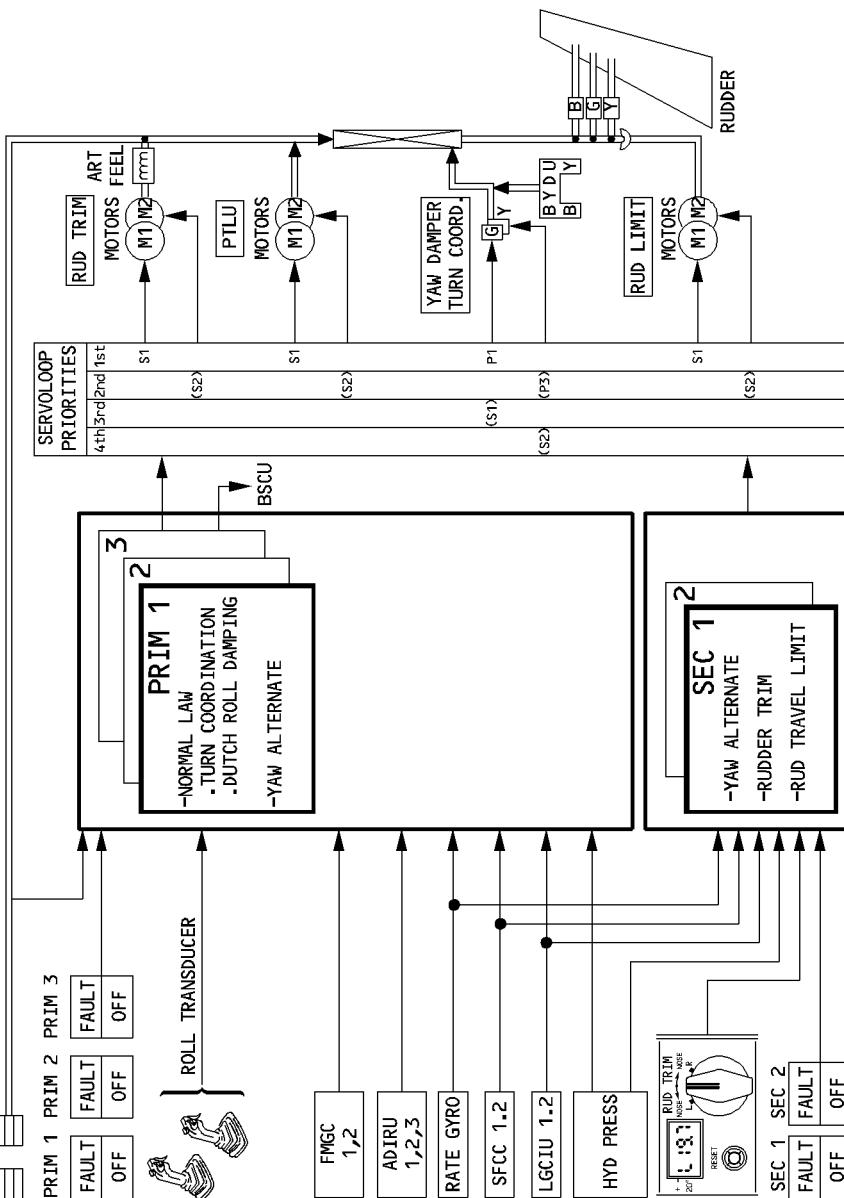
A button is provided on the RUD TRIM panel to reset the rudder trim to zero.

- R Note : With autopilot engaged, rudder trim orders are computed by FMGC.  
 R Rudder trim rotary switch is not active.

## YAW CONTROL – SCHEMATIC

FOR INFO

R



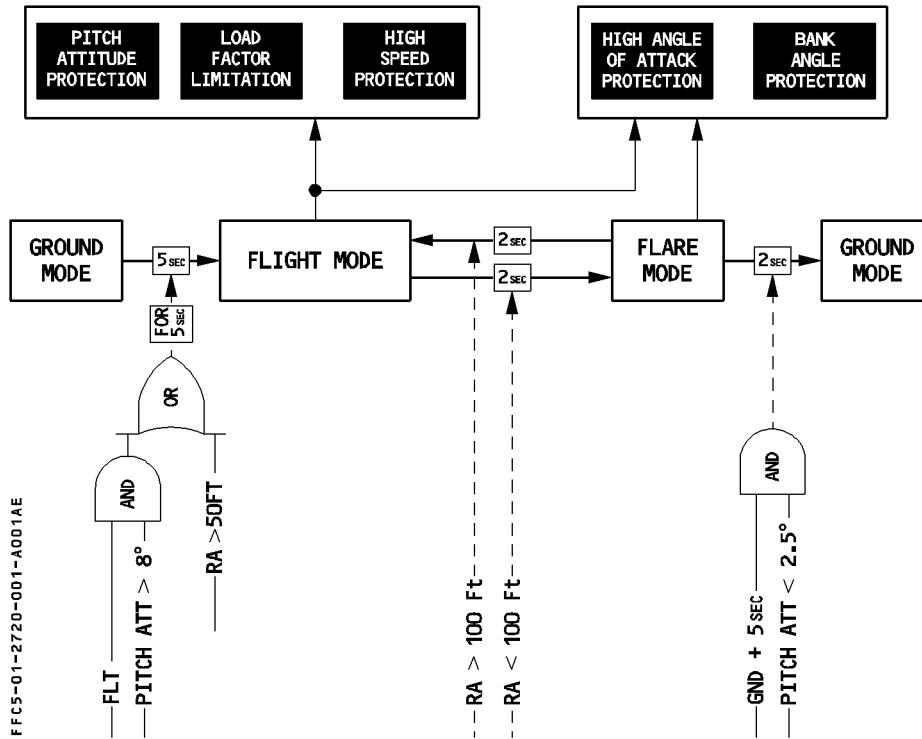
## **GENERAL**

Flight control normal law provides:

- 3 Axis control
  - Flight envelope protection
  - Maneuver load alleviation

**FOR INFO**

R



## PITCH CONTROL

### GROUND MODE

Ground mode is active on ground. It is a direct relationship between sidestick deflection and elevator deflection without auto trim. The THS is automatically set at 5° up (inside the green band). Manual setting according to CG has priority for take off.

The rotation maneuver is flown in direct law with full authority.

Immediately after the aircraft becomes airborne the flight mode is progressively blended in. The reverse process occurs after touch down.

### FLIGHT MODE

The normal law flight mode is a load factor demand law with auto trim and full flight envelope protection.

It provides control of elevator and THS from the side stick controllers to achieve a load factor proportional to stick deflection, independent of speed.

With the side stick at neutral, wings level, the system maintains 1 G in pitch corrected for pitch attitude, and there is no need for the pilot to trim with speed or configuration changes.

- R Pitch trim is automatic in both manual mode and when the autopilot is engaged.
- R In normal turns (up to 33° of bank) no pitch correction is required once the turn is established.
- R The flight mode is active from TO to landing according to the logic (page 1). Automatic pitch trim is frozen in the following cases:
  - Manual trim order
  - Radio altitude below 100 ft for flare
  - Load factor lower than 0.5 g
  - In high speed protection
- R When angle of attack protection is active, THS is limited between setting at entry in protection and 2° nose down (i.e. further nose up trim cannot be applied).
- R Similarly when the load factor is higher than 1.3 g, or when the bank angle gets outside ± 33°, the THS is limited between the actual setting and 2° nose down.

#### **Control with autopilot engaged**

- R – The autopilot orders are limited by the PRIM
- R – A force must be overcome to move the sidestick with the autopilot engaged. If the pilot moves the side stick to overcome this force the autopilot will disconnect.
- R – All protections remain effective.

## **FLARE MODE**

The flight mode changes to flare at landing, when passing 100 feet.

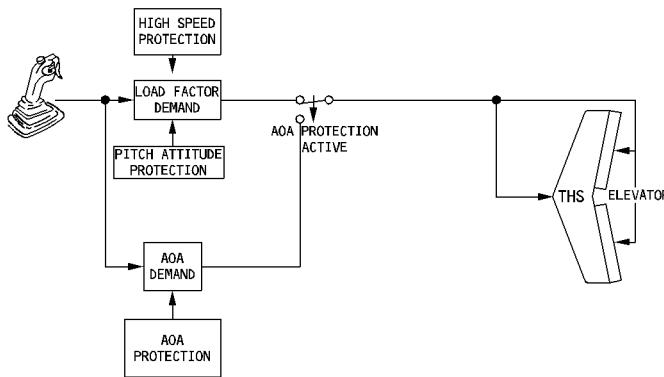
- R Flare mode is a direct stick-to-elevator relationship (with some damping provided by load factor and pitch rate feedbacks). In addition, at 50 feet, a slight pitch down elevator order is applied, so that the pilot has to move the stick rearwards to maintain a constant path, so as to reproduce conventional aircraft aerodynamic characteristics.

## **PROTECTIONS**

The normal law provides complete flight envelope protection as follow :

- Load factor limitation
- Pitch attitude protection
- High angle of attack (AOA) protection
- High speed protection

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## **LOAD FACTOR LIMITATION**

The load factor is automatically limited to :

- + 2.5 g to -1 g, slats retracted
- + 2 g to 0, slats extended

## **PITCH ATTITUDE PROTECTION**

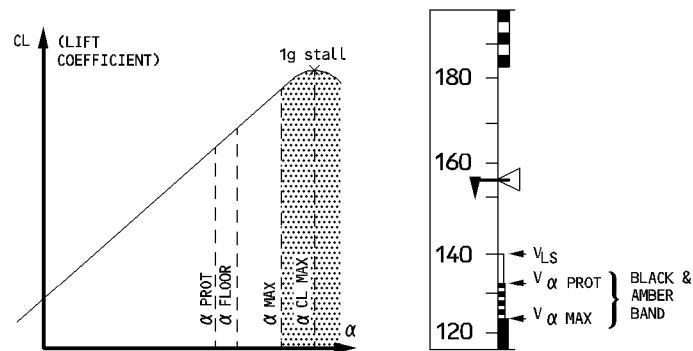
Pitch attitude is limited to 30° nose up (progressively reduced to 25° at low speed), and to 15° nose down (indicated by green symbols “=” on the PFD pitch scale (Refer to 1.31.40)).

## HIGH ANGLE OF ATTACK PROTECTION

In normal law, when the angle-of-attack becomes greater than  $\alpha_{prot}$ , the system switches the elevator control from normal mode to a protection mode, in which the angle-of-attack is proportional to sidestick deflection. That is, in the  $\alpha_{prot}$  range, from  $\alpha_{prot}$  to  $\alpha_{max}$ , the sidestick commands  $\alpha$  directly. However the angle-of-attack will not exceed  $\alpha_{max}$ , even if the pilot gently pulls the sidestick all the way back. If the pilot releases the sidestick, the angle-of-attack returns to  $\alpha_{prot}$  and stays there.

This protection against stall and windshear has priority over all other protections.  
The autopilot will disconnect, if the protection is active.

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- $V\alpha_{prot}$ ,  $V\alpha_{max}$ , and  $\alpha_{floor}$  condition vary according to weight and configuration
- $V\alpha_{prot}$  and  $V\alpha_{max}$ , displayed on the PFD, are computed by the PRIM.
- $\alpha_{floor}$  activation logic is provided by the PRIM.

Note : 1. At takeoff,  $\alpha_{prot}$  is equal to  $\alpha_{max}$  for 8 seconds.

2.  $\alpha_{FLOOR}$  is activated through the autothrust system, when :
  - $\alpha$  is greater than a threshold depending on the aircraft configuration, the ground speed variation, and the difference between ground speed and air speed, or the
  - Sidestick deflection is above  $14^\circ$ , and the :
    - Pitch attitude is greater than  $25^\circ$ , or
    - AOA protection active
3.  $\alpha_{FLOOR}$  inhibition (Refer to 1.22.30)

The aircraft leaves angle-of-attack protection when the :

- Sidestick is pushed more than  $8^\circ$  forward, or
- Sidestick is pushed more than  $0^\circ$  forward for at least 1 second, when  $\alpha < \alpha_{max}$ , or
- $\alpha < \alpha_{prot}$ , if the sidestick has not been deflected since the latest autopilot disconnection.

## HIGH SPEED PROTECTION

The aircraft automatically recovers following a high speed upset. Depending on the flight conditions (high acceleration, low pitch attitude), the High Speed Protection is activated at/or above VMO/MMO.

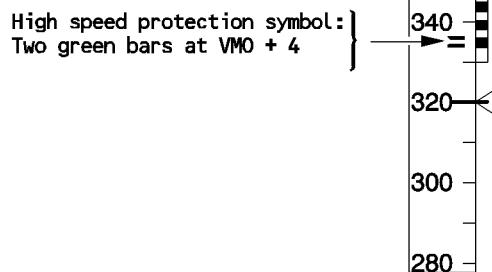
- R When it is activated, the pitch trim is frozen. Positive spiral static stability is introduced to 0° bank angle (instead of 33° in normal law), so that with the sidestick released, the aircraft always returns to a bank angle of 0°. The bank angle limit is reduced from 67° to 45°.

As the speed increases above VMO/MMO, the sidestick nose-down authority is progressively reduced, and a permanent nose-up order is applied to aid recovery to normal flight conditions.

The High Speed Protection is deactivated when the aircraft speed decreases below VMO/MMO, where the usual normal control laws are recovered.

The autopilot disconnects when high speed protection goes active.

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Note : OVERSPEED ECAM warning is provided at :

- VMO + 4 kt
- MMO + 0.006

## LOW ENERGY WARNING

- R A low energy aural warning "SPEED SPEED SPEED" repeated every 5 seconds indicates to the pilot that the aircraft energy becomes lower than a threshold under which to recover a positive flight path angle through pitch control, the thrust must be increased.  
 R It is available in configuration 2, 3 and full between 100 and 2000 ft.  
 The low energy warning is computed by the PRIM's from the following inputs:  
   – Aircraft configuration  
   – Air speed deceleration rate  
   – Flight path angle  
 It is inhibited when:  
   – TOGA is selected  
   – Below 100 ft RA  
   – Above 2000 ft RA  
   – Alpha floor or GPWS alert is triggered  
 R – In alternate or direct law  
   – If both RA are failed  
 The low energy warning is triggered during deceleration before alpha floor (unless alpha floor is triggered by stick deflection), the delay between the two warnings depends on deceleration rate.

**LATERAL CONTROL****LATERAL NORMAL LAW**

When the aircraft is on the ground (in "on ground" mode), the sidestick commands the aileron and roll spoiler surface deflection. The amount of control surface deflection that results from a given amount of sidestick deflection depends upon aircraft speed. The pedals control rudder deflection through a direct mechanical linkage.

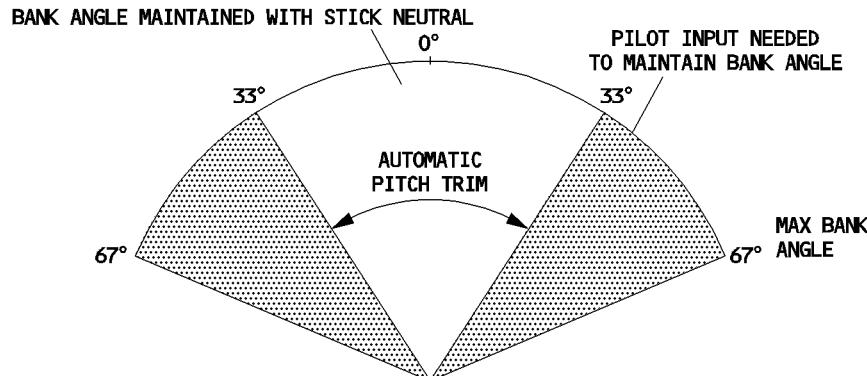
When the aircraft is in the "in flight" mode, normal law combines control of the ailerons, spoilers (except N° 1 spoilers), and rudder (for turn coordination) in the sidestick. While the system thereby gives the pilot control of the roll and heading, it also limits the roll rate and bank angle, coordinates the turns, and damps the dutch roll.

The roll rate requested by the pilot during flight is proportional to the sidestick deflection, with a maximum rate of 15° per second when the sidestick is at the stop.

When the aircraft is in "flare" mode, the lateral control is the same as in "in flight" mode.

**BANK ANGLE PROTECTION**

- R Inside the normal flight envelope, the system maintains positive spiral static stability for bank angles above 33°. If the pilot releases the sidestick at a bank angle greater than 33°, the bank angle automatically reduces to 33°. Up to 33°, the system holds the roll attitude constant when the sidestick is at neutral. If the pilot holds full lateral sidestick deflection, the bank angle goes to 67° (indicated by a pair of green bar lines "=" on the PFD) and no further.

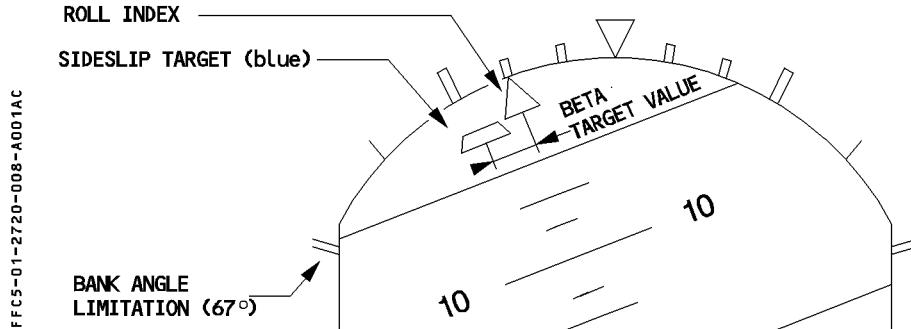


- If the angle-of-attack protection or high speed protection is operative, the bank angle goes to  $45^\circ$  and no further, if the pilot holds full lateral sidestick deflection. If high speed protection is operative, the system maintains positive spiral static stability from a bank angle of  $0^\circ$ , so that with the sidestick released, the aircraft always returns to a bank angle of  $0^\circ$ .
- R When bank angle protection is active, auto trim is inoperative.
- If the bank angle exceeds  $45^\circ$ , the autopilot disconnects and the FD bars disappear. The FD bars return when the bank angle decreases to less than  $40^\circ$ .

### **SIDESLIP TARGET**

Should an engine failure occur, the sideslip indication is slightly modified to ensure that optimum pilot rudder application is made to achieve optimum climb performance (ailerons to neutral and spoilers retracted).

In takeoff configuration, when asymmetrical thrust is detected (30 % N1) and at least one engine is above 80 % N1, the sideslip indication will change from yellow to blue.



Crew response is normal and instinctive:

- Zero, the beta target value for optimum performance with appropriate rudder application.
- Accelerate if beta target cannot be zeroed with full rudder.

The computation is made by the PRIM.

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**FLIGHT CONTROLS**

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NORMAL LAW

SEQ. 001 REV 18

**MANEUVER LOAD ALLEViation (MLA)**

The purpose of MLA is to redistribute the lift over the wing to relieve structural loads on the outer wing surfaces (bending moment).

The demanded load factor is maintained.

MLA utilises spoilers 4, 5, and 6 and the ailerons.

- R The MLA becomes active when the sidestick is pulled more than 8°, and the load factor is more than 2g, in which case :

- The ailerons are deflected symmetrically upwards :
  - . Maximum 11° added to roll demand, if any.
- Spoilers 4, 5, 6 are symmetrically deflected :
  - . Maximum 9° added to roll demand if any.
  - . Deflection is proportional to load factor in excess of 2 g.
- An elevator demand is simultaneously applied to compensate for the pitching moment induced by spoilers and ailerons.

The load alleviation is only available when :

- The aircraft speed is above 250 knots.
- The FLAPS lever is in the 0 position.
- In normal or alternate law flight mode.

The MLA has priority over the speedbrakes.

**TURBULENCE DAMPING FUNCTION**

The purpose of the turbulence damping function is to damp the structural modes induced by atmosphere turbulence.

The function uses the Nz accelerometer and two dedicated Ny accelerometers. The PRIMs compute a turbulence damping command, which is added to the normal law command for the elevator and the yaw damper.

This function is automatically monitored and becomes inoperative for the remainder of the flight, when a failure is detected. In addition, it may be manually inhibited by switching off the TURB DAMP pushbutton on the overhead panel, when it is considered that comfort is degraded instead of being improved, and no failure is detected.

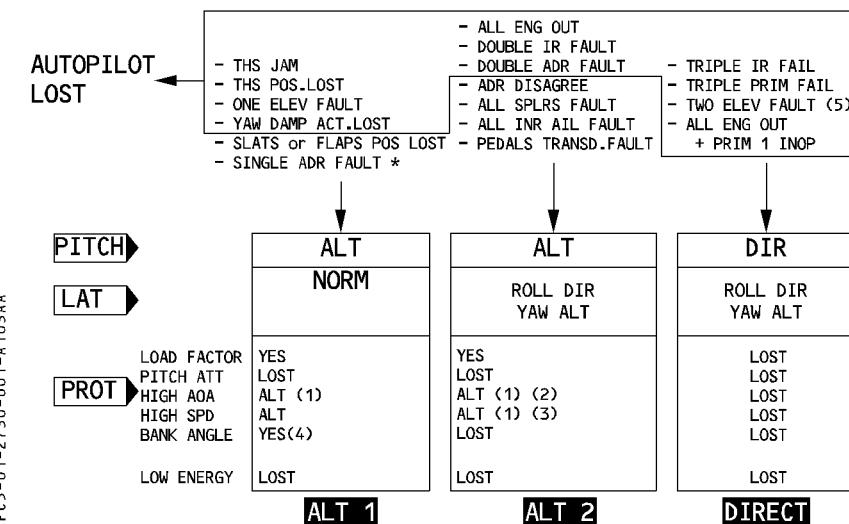
It is only available if the following conditions are met :

- Aircraft in flight
- Aircraft speed greater than 200 knots.
- Autopilot engaged or normal law active.
- Aircraft within the normal flight envelope.

**GENERAL**

Depending on the type of failures affecting the flight control system, or its peripherals, there are 3 possible reconfiguration levels :

- Alternate law (ALT 1 or ALT 2)
- Direct law, or
- Mechanical.



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- \* Only in case the AOA, of the remaining ADRs, disagrees with the AOA (as computed by the PRIM's).
- (1) Protection is totally lost, in case of VS1g computation failure (loss of weight or slat/flap position).
- (2) Protection is lost, in case of a dual ADR failure (or ADR DISAGREE).
- (3) Protection is lost, in case of a triple ADR failure (or ADR DISAGREE).
- (4) Bank angle limitation remains effective in ALT 1, which uses roll normal. However, since ALT 1 is generally an unprotected law, all protection marks on the PFD are in amber for simplicity.
- (5) When both elevators have failed, only pitch mechanical backup is available, by using the manual pitch trim (THS). "MAN PITCH TRIM ONLY" is displayed in red on the PFDs.

- Note :**
1. In case of dual RA failure, flare law is introduced when the landing gear is extended and both autopilots are disengaged. The specific normal law pitch down effect at 50 feet no longer applies.
  2. A jerk may be felt, in the case of flight control computers reconfiguration (due to hydraulic failure, computer failure, electrical transient...).

**ALTERNATE LAW****ALT 1****PITCH CONTROL****Ground mode**

Identical to normal law ground mode.

**Flight mode**

Flight law is a load factor demand law, similar to normal law, with limited pitch rate feedback and gains, depending on the speed and configuration.

Note : When the yaw damper actuators are not available (hydraulic G+Y failure, for example), the yaw damping function is made through the ailerons and the BYDU.

**Flare mode**

Flare law is identical to normal flare law.

**LATERAL CONTROL**

The lateral control is similar to normal law, except that alterations of positive spiral static stability will not occur due to the loss of high AOA and high speed protection.

**PROTECTIONS****R Low speed stability**

At low speed, a nose down demand is introduced in reference to IAS, instead of angle of attack, and alternate law changes to direct law. It is available, whatever the slats/flaps configuration, and it is active from about 5 knots up to about 10 knots above the stall warning speed, depending on the aircraft's weight and slats/flaps configuration. A gentle progressive nose down signal is introduced, which tends to keep the speed from falling below these values. The pilot can override this demand. Bank angle compensation is provided. In addition, audio stall warning (crickets + "STALL" synthetic voice message) is activated at an appropriate margin from the stall condition. The PFD speed scale is modified to show a black/red barber pole below the stall warning.  $V_{\alpha}$  prot and  $V_{\alpha}$  max are replaced by  $V_{sw}$  (stall warning). The  $\alpha$  floor protection is inoperative.

**R High speed stability**

Above  $V_{mo}/M_{mo}$ , a nose up demand is introduced to avoid an excessive increase in speed. The pilot can override this demand.

The high speed protection symbol ( $VMO + 4$ ) disappears.

In addition, the overspeed warning ( $VMO + 4$  or  $MMO + 0.006$ ) remains available.

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FLIGHT CREW OPERATING MANUAL

**FLIGHT CONTROLS**

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## RECONFIGURATION CONTROL LAWS

SEQ 100 REV 16

**Pitch attitude protection**

Lost.

**ALT 2****PITCH CONTROL**

Identical to ALT 1 law.

**LATERAL CONTROL****Roll direct law**

Provides a direct stick-to-surface position relationship. The gains are automatically set according to the slats/flaps configuration.

The maximum roll rate is approximately 20 to 25°/second, depending on the speed and configuration.

Spoilers 2, 3 and 6 are inhibited, except in case of some additional failures affecting the lateral control.

**Yaw alternate law**

The dutch roll damping function is available, and damper authority is limited to  $\pm 4^\circ$  rudder (CONF 0) and  $\pm 15^\circ$  (other configuration).

Turn coordination is also provided, except in CONF 0.

**PROTECTIONS**

Identical to protections in ALT 1, except that :

- 1. There is no bank angle protection in ALT 2 law.
- R 2. In case of failure of 2 ADRs, there is no low speed stability.
- R 3. In case of failure of 3 ADRs, there is no high speed stability.

**R DIRECT LAW**

The pitch direct law is a direct stick to elevator relationship (elevator deflection is proportional to stick deflection).

In all configurations the maximum elevator deflection is varied as a function of CG.

It provides a compromise between adequate controlability at forward CG and not too sensitive control at aft CG.

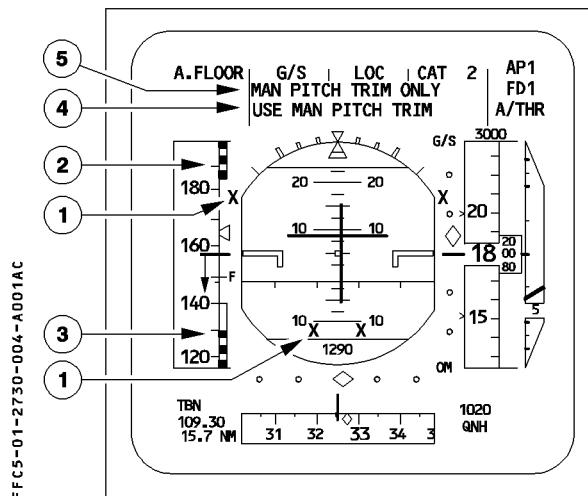
There is no automatic trim and the pilot has to use manual trim.

«USE MAN PITCH TRIM» amber message is displayed on the PFD.

All protections are inoperative

The  $\alpha$  floor function is inoperative.

Overspeed and stall warnings are available as for alternate law.

**RECONFIGURATION CONTROL LAWS – PFD DISPLAY**

- ① Bank angle and pitch limitation replaced by amber X
- ② Overspeed protection symbol (=) disappears
- ③  $V\alpha$  prot and  $V\alpha$  max are replaced by  $V_{sw}$
- ④ USE MAIN PITCH TRIM (amber) displayed in direct law, or, in flare law without RA
- ⑤ MAN PITCH TRIM ONLY (red) displayed if L + R elevator fault detected

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**FLIGHT CONTROLS**

1.27.30 P 5

## RECONFIGURATION CONTROL LAWS

SEQ. 001 REV. 07

**ABNORMAL ATTITUDE LAWS**

- R An abnormal attitude law in pitch and roll is provided if the aircraft is in flight and in any of these conditions :
  - R – Pitch attitude > 50° nose up or 30° nose down.
  - R – Bank angle > 125 °
  - R – Angle of attack > 30° or < - 10°
  - R – Speed > 440 kt or < 60 kt
  - R – Mach > 0.96 or < 0.1

The law in pitch is the alternate law without protection (except load factor protection) and without auto trim. In roll it is a full authority direct law with yaw alternate.

After recovery, the flight controls laws are :

in pitch : alternate law

in roll : direct law with yaw alternate law

**MECHANICAL BACK UP**

To control the aircraft during a temporary complete loss of electrical power.

**PITCH**

Pitch mechanical control is achieved through the THS using manual trim control.

- R «MAN PITCH TRIM ONLY» is displayed in red on the PFDs.

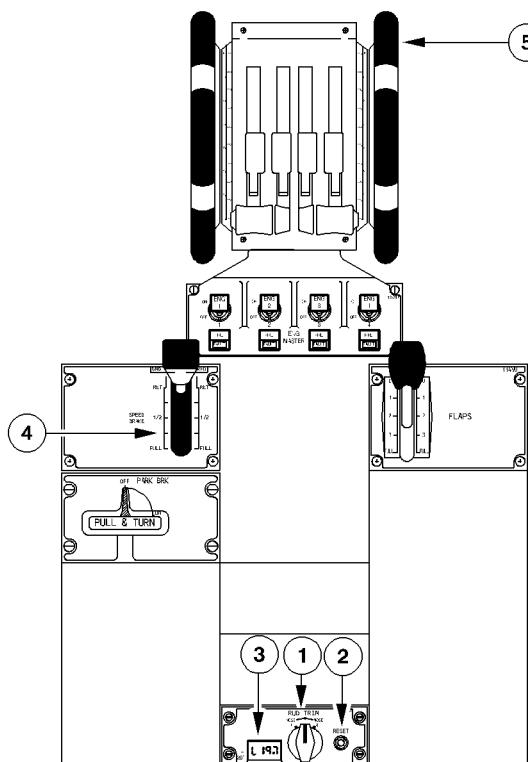
**LATERAL**

Lateral mechanical control is achieved through the rudder using pedals.

Dutch roll damping is provided by the back up yaw damper unit (BYDU).

**PEDESTAL**

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**① RUD TRIM selector**

Controls the rudder trim actuator, which moves the neutral point of the artificial feel by an equivalent of :

In clean configuration :  $1^\circ$  / second of rudder travel

Slats/flaps extended :  $1^\circ$  / second of rudder travel for quick inputs

$3^\circ$  / second for inputs longer than 1.5 seconds

**② RESET pushbutton**

By pushing the RESET pushbutton, the zero trim position is ordered at  $3^\circ$  / seconds.

Note : The rudder trim rotary switch, and the RESET pushbutton, are not active with autopilot engaged.

③ Position Indicator

Displays rudder trim direction (L or R) and value (0 to 25°).

④ SPEEDBRAKE lever

The lever controls:

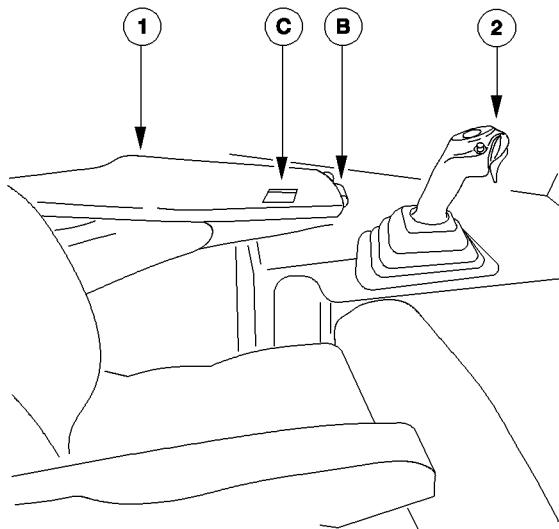
- The position of the speedbrake surfaces.  
To set speedbrake surfaces to a required position, the lever has to be pushed down and set to the required position. A "hardpoint" is provided at "½" SPEEDBRAKE position.
- The manual preselection of the ground spoilers.  
To arm the ground spoilers, the lever must be pulled up when in the RET position. When the lever is armed (or reverse thrust is selected), all spoilers' surfaces will automatically extend at landing, or in case of rejected takeoff.

⑤ PITCH TRIM wheel

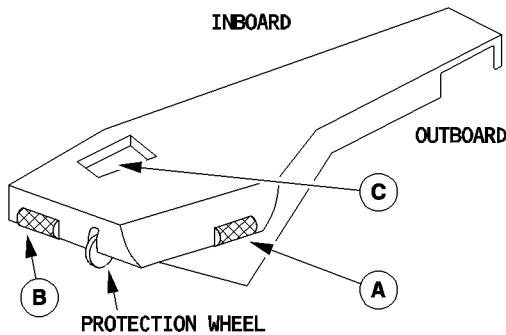
Both pitch trim wheels provide mechanical control of the THS and have priority over electrical control.

Note : Crew action on the pitch trim wheel does not disconnect the PRIMs (micro-switches, actuated by the override mechanism, ensure that the computers remain synchronized with the manually-selected position).

- R      The THS is manually-controlled on ground for the THS setting, before takeoff and in flight, when in direct law.
- R      – Before takeoff, the pilot sets the THS to the angular value, determined as a function of the aircraft CG, using the CG scale on the wheel. The relationship between the aircraft CG and the THS setting shown on the trim wheel is only applicable for takeoff.
- R      The limits of the THS normal setting range for takeoff are indicated by a green band on the pitch trim wheel.
- R      – In flight, when in direct law, the pilot uses the THS conventionally to fly in trim. In flight, the aircraft pitch trim setting depends on aircraft CG, weight, altitude and speed. Consequently, the relation between the aircraft CG, and the THS setting displayed on the pitch trim wheel, does not apply in flight.
- Following nosewheel touchdown, the pitch trim is automatically reset to 5° up, as the pitch attitude becomes less than 2.5° for more than 5 seconds, and if the ground spoilers are retracted.

**LATERAL CONSOLES**

FFC5-01-2740-003-A001AA

**① ARM REST**

FFC5-01-2740-003-B001AA

Arm rest is linked to the seat by means of a supporting arm.

The arm rest position is adjustable.

Following setting and indications are provided:

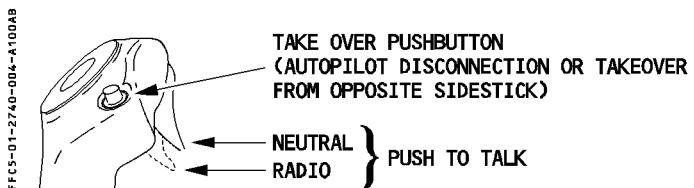
- (A) Height adjustment
- (B) Pitch adjustment
- (C) Armrest memory position display in pitch and in height.

## ② SIDESTICKS

Sidesticks, one on each lateral console, are used for manual pitch and roll control. They are springloaded to neutral.

When the autopilot is engaged a solenoid operated detent locks both sidesticks in the neutral position. If the pilot applies a force above a given threshold (5daN in pitch, 3.5 daN in roll) the autopilot disengages and the stick becomes unlocked and the deflection is sent as command to the computers.

The hand grip includes 2 pushbuttons :



### **Sidestick priority logic**

- When only one pilot operates the sidestick his demand is sent to the computers.
- When the other pilot operates his sidestick in the same or opposite direction both pilots inputs are algebraically added. The addition is limited to single stick maximum deflection.

*Note : In the event of simultaneous input on both sidesticks (2° deflection off the neutral position in any direction) the two green SIDE STICK PRIORITY lights on the glareshield illuminate.*

A pilot can deactivate the other stick and take full control by pressing and keeping pressed his takeover pushbutton.

R For latching the priority condition, it is recommended to press the takeover push button for more than 30 seconds. The takeover push button can then be released without losing priority.

However at any time, a deactivated stick can be reactivated by momentarily pressing either takeover pushbutton.

If both pilots press their takeover pushbuttons, the last pilot to press will get the priority.

*Note : If an autopilot is engaged, the first action on a takeover pushbutton will disengage it.*

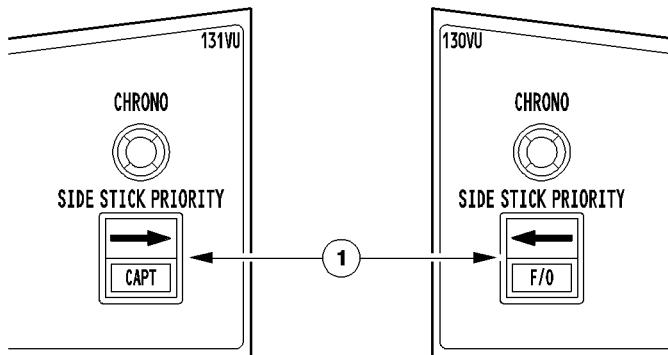
### **In a priority situation**

- A red light will come on in front of the pilot whose stick is deactivated
- A green light will come on in front of the pilot who has taken control, if the other stick is not in the neutral position (to indicate a potential and unwanted control demand).

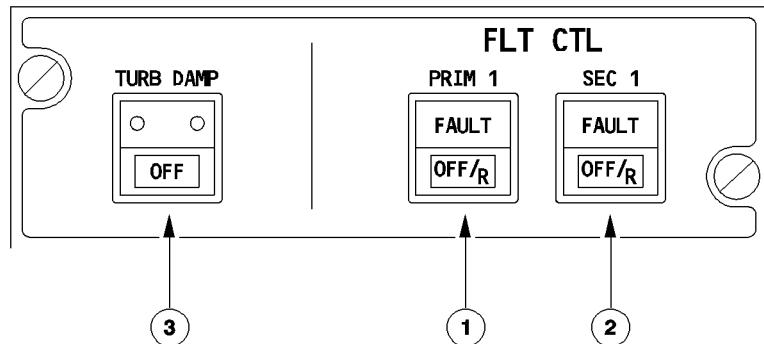
*Note : If, on ground at takeoff thrust application, one stick is deactivated, the takeoff «CONFIG» warning is triggered.*

**GLARESHIELD**

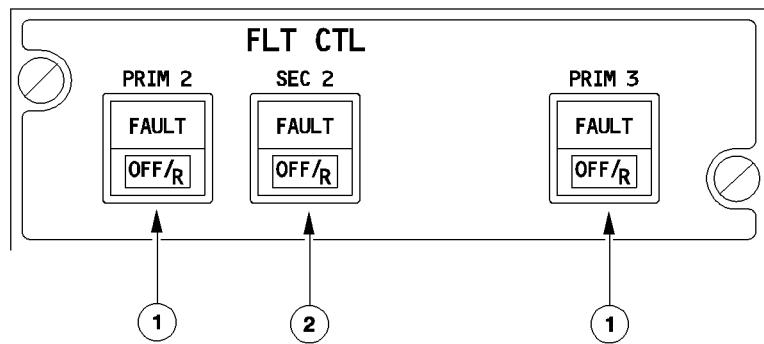
FFC5-01-2740-005-A100AA

**① SIDE STICK PRIORITY It**

- Arrow red It : – Illuminates in front of the pilot losing authority.  
– Extinguishes if he has recovered his authority, ie:  
· If the other take-over pushbutton is released prior priority condition is latched, or  
· If he has used his take-over pushbutton to cancel a latched priority situation.  
Sidestick priority audio: a «PRIORITY LEFT» or «PRIORITY RIGHT» audio voice message is given each time priority is taken.
- CAPT-F/O green It : – Illuminates in front of the pilot who has taken priority by pressing the takeover push button if the opposite stick is not at neutral.  
or  
– CAPT and F/O light illuminate in case of simultaneous input on both sidesticks.  
– Extinguishes when the opposite stick is returned to the neutral position.

**OVERHEAD PANEL**

FFC5-01-2740-006-A001AC



**① PRIM pb sw**

Control the Flight Control Primary Computers (FCPC)

ON : The following functions are provided by each computer :

- Normal pitch
- Normal lateral
- MLA
- Speed brakes, ground spoilers control logic
- Pitch alternate
- Pitch direct
- Roll direct
- Yaw alternate
- Ailerons droop
- Abnormal attitude law
- Autopilot orders acquisition
- Characteristic speeds computation

R

OFF : The corresponding computer is not active. Switching OFF then on resets it.

FAULT It : Illuminates amber accompanied by ECAM caution activation when a failure is detected

The FAULT It extinguishes when OFF selected, or at the end of PRIM power up test provided it is satisfactory.

**② SEC pb sw**

Control the Flight Control Secondary Computers (FCSC)

ON : The following functions are provided by each computer :

- Pitch direct
- Roll direct
- Yaw alternate
- Rudder trim
- Rudder travel

OFF : The corresponding computer is not active. Switching OFF then on resets it.

FAULT It : Illuminates amber accompanied by ECAM caution activation when a failure is detected.

The FAULT It extinguishes when OFF selected.

Flashes at the end of SEC power up test (at electrical power application).

**③ TURB DAMP pb sw**

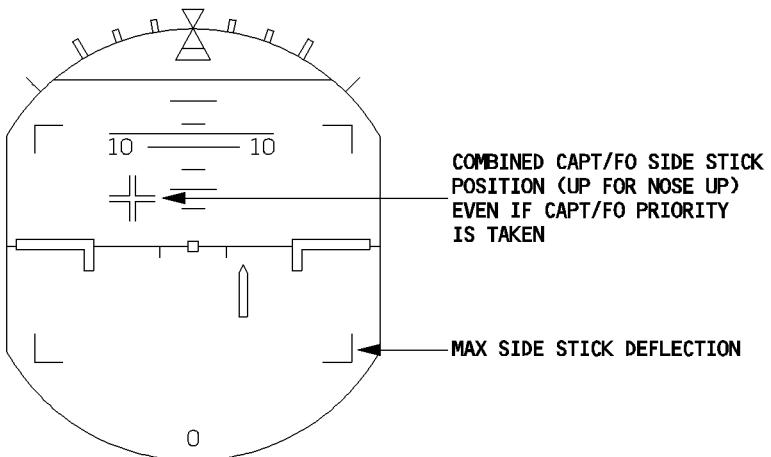
R on : Command of Turbulence damping function is added to normal law elevator and yaw damper command.

OFF : Turbulence damping function commands are inhibited.

**SIDE STICK INDICATIONS ON PFD**

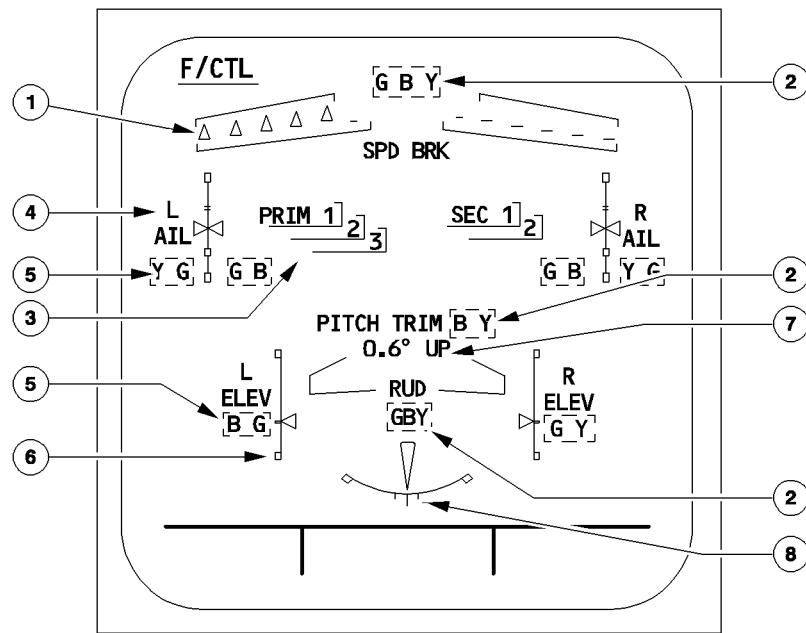
- R On ground, after first engine start, side stick position indications appear white on both PFDs.
- R The indication disappears when the aircraft passes from ground to flight.

FC5-01-2740-008-A001AA



**ECAM F / CTL PAGE**

FFC5-01-2740-009-A001AB

**① Spoilers / speed brakes indication**

- R       $\triangle$  : Spoiler not retracted (green)  
       — : Spoiler retracted (green)  
        $\triangle$  : Spoiler fault deflected (amber)  
       1 : Spoiler fault retracted (amber)

Note : Same indications are displayed on WHEEL page.

**② Hydraulic system pressure indication**

Normally green. Becomes amber in case of hydraulic system low pressure (downstream the leak valves).

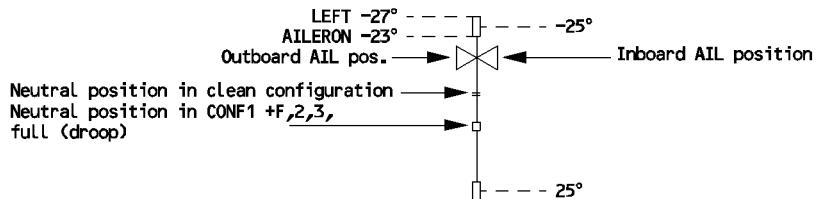
**③ PRIM / SEC indication**

- PRIM, SEC labels are always displayed in white.
- Computer number is normally green and boxed grey. Number and box become amber in case of computer failure.

**④ Ailerons position indication**

White scale and green indexes. Index becomes amber when both (associated) servojacks are not available.

FFCS-01-2740-010-A001AA



**⑤ Aileron / Elevator actuators indication**

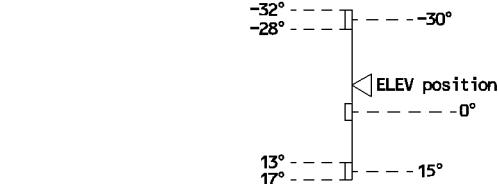
G, B and Y are normally displayed in green.

Becomes amber in case of hydraulic system low pressure . It is partially boxed amber in case of electrical failure detected by the PRIM.

**⑥ Elevator position indication**

White scale and green index. The index becomes amber when both associated actuators are not available.

FFCS-01-2740-010-B001AB



**⑦ Pitch trim position indication**

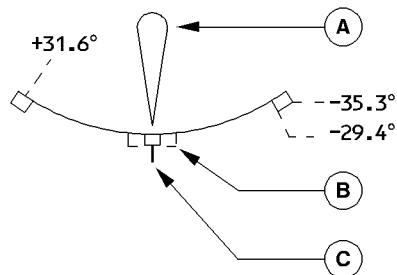
PITCH TRIM label : Normally white. Becomes amber in case of THS electrical control loss.

R Position indication : Varies from 2° down to 14° up.

R Normally green. Becomes amber in case of B + Y system low pressure.

## R ⑧ Yaw control indications

FFC5-01-2740-011-A001AA



## Ⓐ Rudder position indication

It is normally in green.

The rudder symbol becomes amber, in case of blue + green + yellow hydraulic low pressure.

## Ⓑ Rudder travel limiter or PTLU indication

It is normally in green.

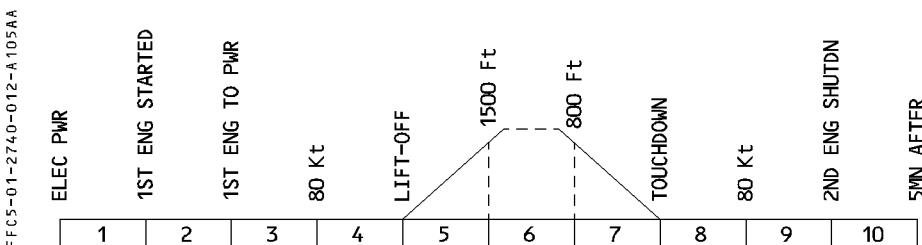
It becomes amber, when Travel Limiters 1 and 2 are faulty.

## Ⓒ Rudder trim position

It is normally in blue.

The position varies from -25 to +25 degrees.

It becomes amber if rudder trim systems 1 and 2 are inoperative.

**WARNINGS AND CAUTIONS**

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG . SPD BRK NOT RETRACTED, or . PITCH TRIM NOT IN TO RANGE (-7°, -1°) . RUD TRIM NOT IN TO RANGE ( $\pm 3^\circ$ ) Aircraft not in TO configuration when thrust levers are set at TO or Flex TO, or when pressing the TO CONFIG. pb.	CRC	MASTER WARN	F/CTL	NIL	5, 6, 7, 8
PITCH TRIM/MCDU/CG DISAGREE Disagreement between the real pitch trim value and the pitch trim value calculated by the FCMC, based on the CG.	SINGLE CHIME	MASTER CAUT			
CONFIG R (L) SIDESTICK FAULT (BY TAKE OVER) L or R sidestick is inoperative (deactivated by takeover pb) when thrust levers are set at TO or Flex TO, or when pressing TO CONFIG. pb.	CRC	MASTER WARN	NIL	Red * SIDESTICK PRIORITY lt	4, 5, 6, 7, 8
L + R ELEV FAULT Loss of both elevators.					
L (R) SIDESTICK FAULT Transducers on pitch or roll axis are failed on one sidestick.	SINGLE CHIME	MASTER CAUT	F/CTL	PFD message	NIL
PRIM 1 (2)(3) FAULT Failure of 1 primary computer.					
SEC 1 (2) FAULT Failure of one secondary computer.				FAULT lt on PRIM pb	3, 4, 5, 7, 8
FCDC 1 + 2 FAULT Failure of both FCDCs.				FAULT lt on SEC pb	3, 4, 5
DIRECT LAW Direct laws are active.				NIL	4, 5, 7
ALTN LAW Alternate laws are active.				PFD message	4, 5, 7, 8
				NIL	NIL

\* The red SIDESTICK PRIORITY light comes on, as soon as the sidestick is inoperative.

**A340**

FLIGHT CREW OPERATING MANUAL

**FLIGHT CONTROLS****CONTROLS AND INDICATORS**

1.27.40 P 13

SEQ 100 REV 18

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GND SPLR FAULT Loss of ground spoiler function in all PRIM computers	SINGLE CHIME	MASTER CAUT	F/CTL	NIL	3, 4, 5
SPD BRK DISAGREE Position disagree between the surfaces and handle position.					1 to 5 8 to 10
SPD BRK FAULT Spd brake lever transducers to all PRIMs failed.			NIL		4, 5
SPD BRK STILL OUT The SPEED BRK memo has been amber for more than 30 seconds.			F/CTL		3, 4, 5, 7
STAB CTL FAULT Loss of electrical control of the stabilizer.			F/CTL		4, 5, 7, 8
L (R) ELEV FAULT Loss of both servojacks on one elevator.			F/CTL		4, 5,
L (R) OUTR (INR) AIL FAULT Loss of both servojacks on one aileron.			F/CTL		4, 5, 7, 8
SPLR FAULT Loss of one or more spoilers.			F/CTL		1, 4, 5, 7, 8, 10
RUD TRIM FAULT Rudder trim 1 + 2 fault			NIL		4, 5, 6, 7, 8
RUD TRV LIM FAULT Travel limiter 1 + 2 failure.			NIL		NIL
YAW DAMPER FAULT Yaw damper 1 + 2 fault.	3, 4, 5, 7, 8, 10				
ELEV REDUND LOST Loss of elevator redundancy, for which a subsequent failure would lead to a degraded pitch control or pitch mechanical backup.	3, 4, 5, 7, 8				
SENSOR FAULT Loss of any F/CTL system sensor.	3, 4, 5, 7, 8				
ELEV SERVO FAULT Loss of one servojack on one elevator.	3, 4, 5, 7, 8				
AIL SERVO FAULT Loss of one servojack on one aileron.	3, 4, 5, 7, 8				
FCDC 1 (2) FAULT	3, 4, 5, 7, 8				
YAW DAMPER 1 (2)	3, 4, 5, 7, 8				
RUD TRIM 1 (2) FAULT	3, 4, 5, 7, 8				
RUD TRV LIM 1 (2)	3 to 8				
RUD B (G) (Y) SERVO JAM	3 to 8				
SEC 1(2) PITCH FAULT	3, 4, 5, 7, 8				
PRIM 1(2)(3) PITCH FAULT	3, 4, 5 7, 8				
TURB DAMP FAULT Longitudinal or lateral turbulence damping lost due to accelerometer failure.	3, 4, 5 7, 8				

**MEMO**

- R — SPEED BRK memo display logic :
- R     · When the speedbrakes are extended, in Flight Phase 2, 3, 4, and 5, the SPEED BRK memo flashes amber.
- R     · When the speedbrakes are extended, in Flight Phase 6 and 7, the SPEED BRK memo is displayed in green. It flashes amber, after 50 seconds, if at least one engine is above idle.
- R     — GND SPLRS ARMED message is displayed in green when the ground spoilers are armed.
- R     — TURB DAMP OFF message is displayed in green when the TURB DAMP pushbutton switch is selected OFF.

**DESCRIPTION****GENERAL**

Lift augmentation is achieved on each wing by :

- 2 flaps surfaces
- 7 slats surfaces
- 2 ailerons (aileron droop function)

These surfaces are electrically-signalled and hydraulically-operated.

Slats and flaps are selected by the «FLAPS» lever, located on the center pedestal, which has 5 positions.

**MAIN COMPONENTS**

Slats and Flaps systems are similar, and consist of :

- Two Slats/Flaps Control Computers (SFCC), each containing one flap and one slat channel.
  - A Power Control Unit (PCU), consisting of 2 independent hydraulic motors coupled to a differential gearbox. The motors driven by the related channel, are supplied by blue and green hydraulic power for the slats, and green and yellow for the flaps.  
Pressure-Off Brakes (POB) are installed to lock the transmission when the flaps or slats surfaces have reached the selected position, or in case of hydraulic power failure.
  - 7 Slats and 2 Flaps surfaces per wing.
  - Two Asymmetry Position Pick-Off Units (APPU) measure the asymmetry between the left and right wings.
  - A flap disconnect detection system, which detects attachment failure and inhibits flap operation in order to limit further damage. The failure is detected by a sensor measuring excessive differential movement between the inner and outer flaps.
  - Wing tip brakes (WTB), activated in case of asymmetry, overspeed, or symmetrical runaway. They cannot be released in flight. They are supplied by blue and green hydraulic power for the slats, and by green and yellow for the flaps.
- R – The Feedback Position Pick-Off Units (FPPU) provide position feedback to the SFCCs.
- R – The Instrumentation Position Pick-Off Unit (IPPU) provide position data to the ECAM.

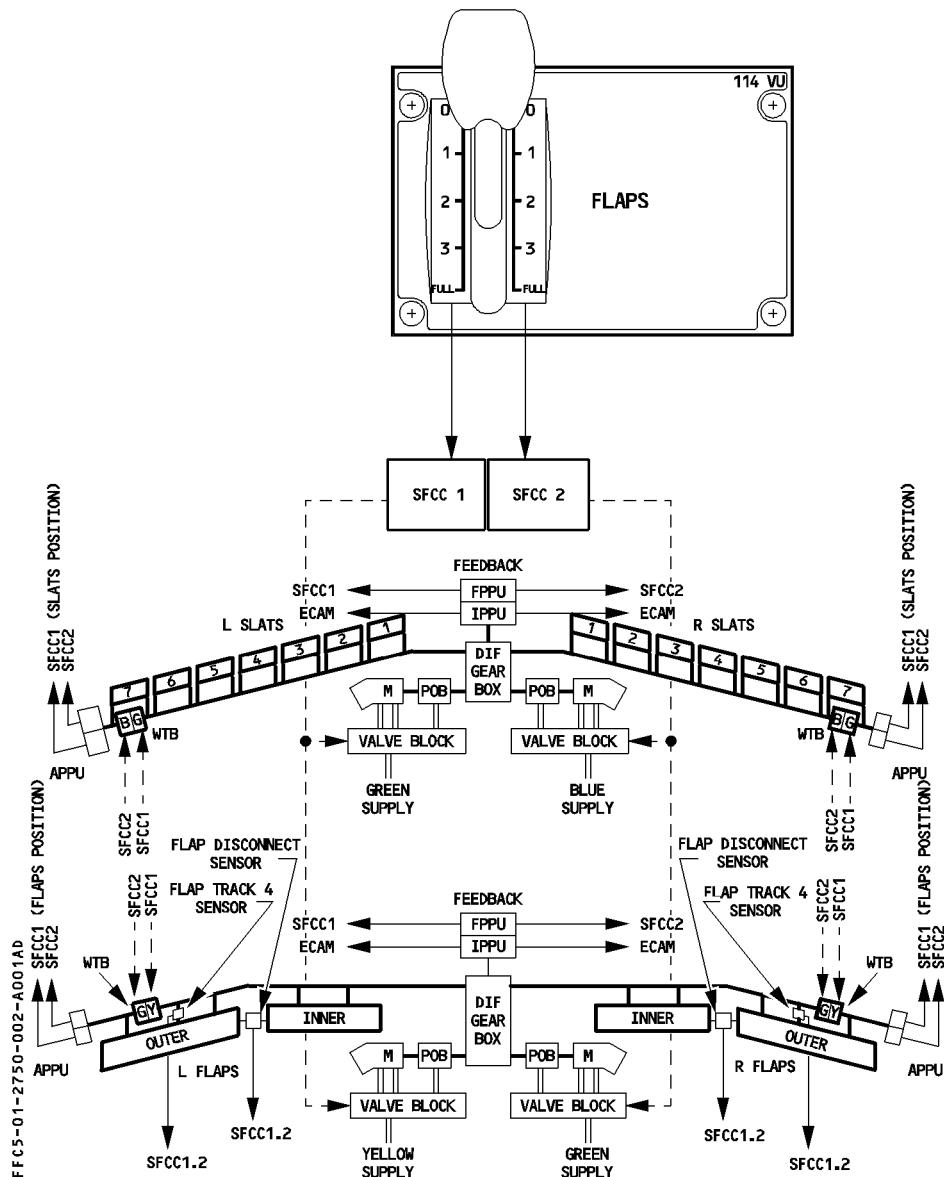
Note : If the flap wing tip brakes are activated, slat operation is still possible and vice versa.

If one SFCC is inoperative, both slats and flaps will operate at half speed.

If one hydraulic system is inoperative, the corresponding surfaces (slats or flaps) operate at half speed.

**ARCHITECTURE****FOR INFO**

R



**A340**

FLIGHT CREW OPERATING MANUAL

**FLIGHT CONTROLS****FLAPS AND SLATS**

1.27.50 P 3

SEQ. 001 REV. 07

**CONFIGURATIONS**

FLAPS lever has 5 positions: 0, 1, 2, 3 and FULL.

Two configurations correspond to FLAPS lever position 1 : CONF 1 or CONF 1+F. Selection is done as below.

**AUTOMATIC RETRACTION SYSTEM (ARS)**

- R When CONF 1 + F is selected, auto retraction of flaps to 0 occurs at 200 kt (before VFE which is 215 kt).

**FLAP LOAD RELIEF SYSTEM (FLRS)**

Available only in CONF 2, 3 or FULL. When activated, the system retracts the flaps to the deflection corresponding to the next further retracted lever position.

Auto retraction of flaps occurs only in case of VFE exceedance (VFE + 2.5 kt).

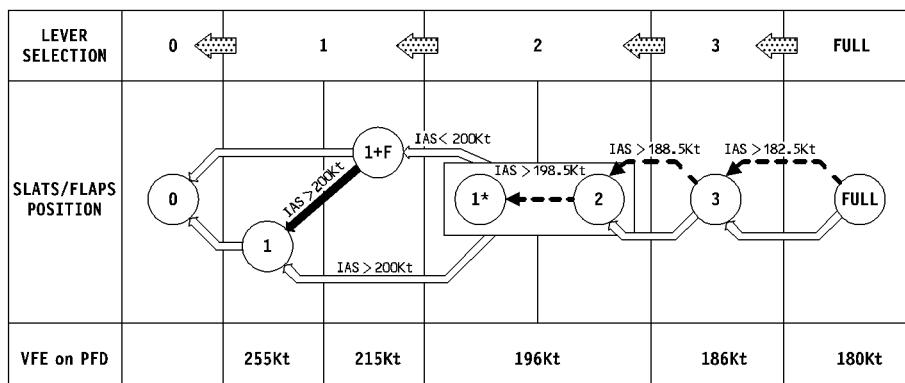
If speed is reduced below VFE (VFE - 2.5 kt) flaps return to normal (selected) position.

In CONF 2, auto retraction results in conf 1\* (24° slats/17° flaps) which can be obtained only by FLRS activation.

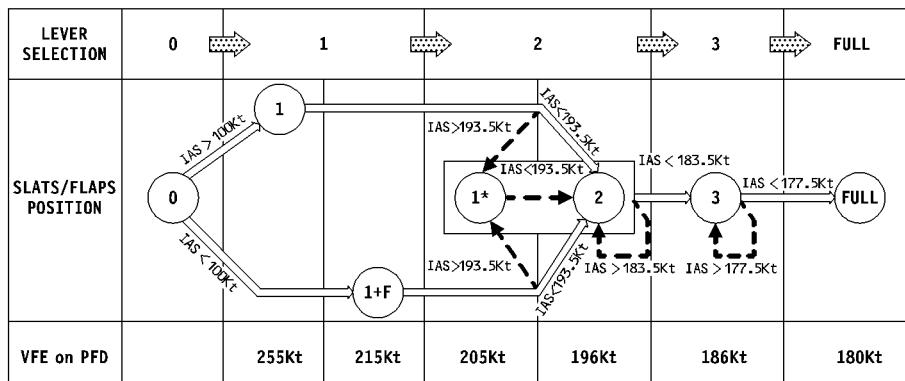
- R Note : 1. When FLAPS 1 is selected, VFE of CONF 1 or CONF 1 + F is displayed depending on actual configuration. In approach VFE next is 205 kt (VFE of CONF 1\*)
- R 2. When FLAP 2 is selected in approach, VFE of CONF 2 or CONF 1\* is displayed depending in FLRS activation.

In case of FLRS activation the ECAM upper display shows a flashing "RELIEF" message. If the speed is increased by 4 kt above the VFE corresponding to the actual flap/slat configuration an overspeed warning is provided on ECAM.

R

**RETRACTION**

→ FLAP LOAD RELIEF SYSTEM  
 → AUTOMATIC RETRACTION SYSTEM  
 → MANUAL SELECTION

**EXTENSION**

→ FLAP LOAD RELIEF SYSTEM  
 → AUTOMATIC RETRACTION SYSTEM  
 → MANUAL SELECTION

**A340**

FLIGHT CREW OPERATING MANUAL

**FLIGHT CONTROLS**

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**FLAPS AND SLATS**

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**SLATS ALPHA / SPEED LOCK FUNCTION**

This function inhibits slats retraction at a high angle-of-attack and/or at low speed.

The SFCCs use a corrected angle-of-attack (alpha), or air speed information from the ADIRUs to inhibit slat retraction.

If alpha exceeds 8.5 degrees, or the speed falls below 148 knots, the retraction from position 1 to 0 is inhibited.

The inhibition is removed when alpha falls below 7.5 degrees, or when the speed exceeds 154 knots. In this case, the slats automatically retract to 0.

The function is not active if:

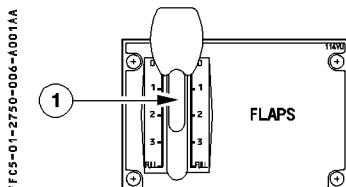
- Alpha exceeds 8.5 degrees, or the speed falls below 148 knots after the lever has been set to 0.
- Aircraft is on the ground, with the speed below 60 knots.

**SIGNALS TO OTHER SYSTEMS**

The SFCCs transmit flaps/slats positions to the following systems :

- PRIM and SEC
- FMGC
- ADIRU
- EIU
- CIDS
- GPWS

R *Note : The ECAM system receives the position information directly from the IPPU (Instrumentation Position Pick-Off Unit). This information is used for warnings and position indications on the E/WD.*

**CONTROLS AND INDICATORS****PEDESTAL****① FLAPS lever**

The FLAPS lever selects simultaneous operation of the slats and flaps.  
The five lever positions correspond to the following surface positions :

R

Lever Position	SLATS	FLAPS	AILERONS	Indication on ECAM	Flight phase
0	0	0	0		
1	20	0	0	1	
		17	10	1 + F	TO
2	24	17	10	2(a)	
	24	22	10	2	
3	24	26	10	3	TO
FULL	24	32	10	FULL	LDG

(a) this slats/flaps position corresponds to CONF 1\*

Before selection of any position, the lever must be pulled out of detent.

Moreover, balks are provided at position 1 and 3 to avoid excessive flap / slat travel demand by a single pilot action.

*Note : It is not possible to select an intermediate lever position.*

**Take off in CONF 1 :**

R CONF 1 + F (21 / 17) is selected. The flaps automatically retract at 200 kt.

**Take off or go-around in CONF 2 or 3 :**

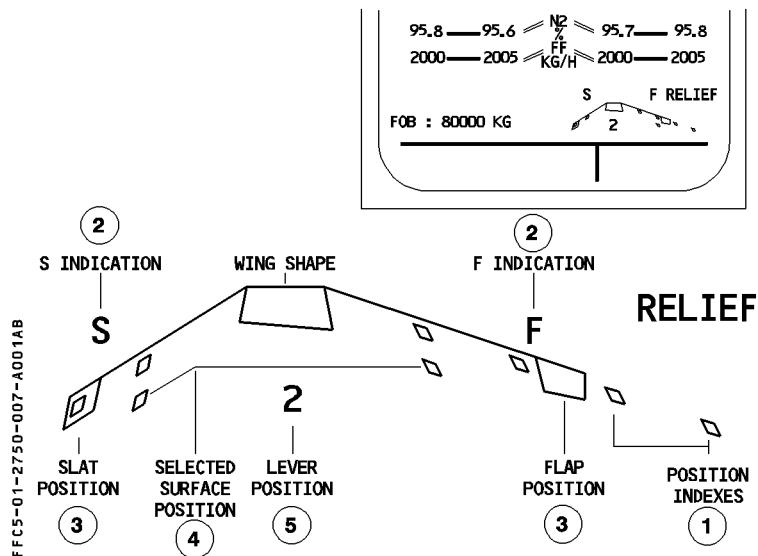
R At FLAPS 1 selection : CONF 1 + F (21 / 17) is selected if speed < 200 kt.  
Then, the flaps automatically retract at 200 Kt.

**0 to 1 above 100 Kt :**

R CONF 1 (21 / 0) is selected.

Note : After flaps retraction, CONF 1+F is no longer available until the speed is 100 kt or less, except if CONF 2 or more has been previously selected.

## R ECAM UPPER DISPLAY



### ① Position indexes:

A fixed grey center part, and two plus four white dots, show all the flaps and slats positions. The white dots are not displayed in clean configuration.

### ② F and S

Normally white. Not displayed in clean configuration.

The F symbol is :

- replaced by the amber “F LOCKED” message, when wing tip brake is applied to flaps.
- replaced by the green pulsing “F RELIEF” message when the flap load relief system is activated.
- displayed in amber at flap system failure or at yellow and green hydraulic system low pressure.

The S symbol is :

- replaced by the amber “S LOCKED” message when wing tip brake is applied to slats.
- replaced by the green pulsing “A LOCK” message when the alpha/speed lock function is activated.
- displayed in amber at slat system failure or at blue and green hydraulic system low pressure.

**③ Flaps/Slats actual position**

The green boxes move independently, when flaps/slats are retracted or extended. When fully retracted, boxes are side by side with wing fixed part. The signal is acquired by separate sensors, not used by the SFCC.

Symbols become amber when S (F) LOCKED. The slat box pulses in green, when the alpha/speed lock function is active. The flap box pulses in green, when the flap load relief system is active.

**④ Selected position**

It is in blue when the surfaces are in transit.

It disappears, when the selected position has been reached.

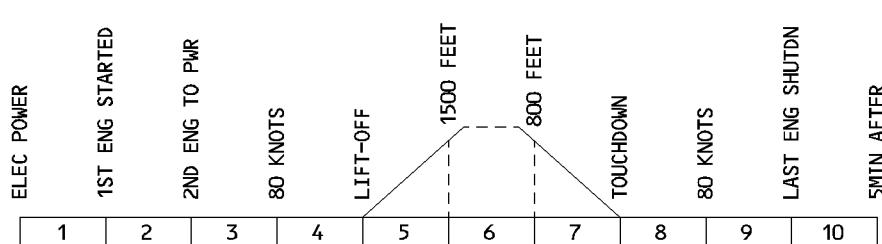
It is provided by the SFCC.

**⑤ Lever position**

R Numbers and letters indicate the flap/slat position. It is in green when the actual position agrees with the selected position. It is in blue, when the surfaces are in transit. It is not displayed in clean configuration. It is provided by the SFCC.

**WARNINGS AND CAUTIONS**

FFC5-01-2750-009-A100AA



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
CONFIG SLATS (FLAPS) NOT IN TO CONFIG slats or flaps are not in takeoff configuration when thrust levers are set at TO or FLEX TO or when depressing TO CONFIG pb.	CRC	MASTER WARN			5, 6, 7, 8
FLAP LVR NOT ZERO Slat/flap lever is not in zero position and altitude is above 22 000 ft.	CRC	SINGLE CHIME	MASTER CAUT	NIL	1 to 5 7 to 10
SLATS (FLAPS) FAULT failure of both slat or flap channels					4, 5, 8
SLATS (FLAPS) LOCKED slats or flaps wing tip brakes applied					1, 2, 4, 5, 6, 7, 8, 9, 10
FLAP/MCDU DISAGREE discrepancy between real TO flaps position and value entered into MCDU PERF TO page					NIL
LVR OUT OF DETENT The flap/slat lever is between two detents.					NIL
SLATS SYS 1 (2) FAULT failure of slat channel in one SFCC					
FLAP SYS 1 (2) FAULT failure of flap channel in one SFCC					
SLAT (FLAP) TIP BRK FAULT failure of one wing tip brake on slats or flaps					3, 4, 5, 7, 8

**BUS EQUIPMENT LIST****FOR INFO**

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
MAIN FLT CTL COMPUTERS	PRIM 1					X	X (1)
	PRIM 2		DC2 (2)				
	PRIM 3		DC2				
	SEC 1				X	X (1)	
	SEC 2		DC2				
	FCDC1				X		
	FCDC2		DC2				
FLAP SLAT COMPUTERS	SFCC 1 slats				LAND REC		
	SFCC 1 flaps				SHED (LAND REC)		
	SFCC2 slats		DC2				
	SFCC2 flaps		DC2				
SENSORS	RATE GYRO 1				X	X (1)	
	RATE GYRO 2				X	X (1)	
	ACCELRM 1				X	X (1)	
	ACCELRM 2		DC2				
PITCH TRIM	ACTUATOR 1				SHED		
	ACTUATOR 2		DC2 (2)				
	ACTUATOR 3		DC 2				
RUDDER TRIM	ACTUATOR 1				SHED		
	ACTUATOR 2		DC 2				
RUDDER TRAVEL	ACTUATOR 1				X		
	ACTUATOR 2		DC 2				

- (1) Hot bus supplies, when DC ESS BUS fails.  
 (2) Normal supply is from DC BUS 2. DC BUS 1 supplies, in case of a DC BUS 2 failure.

FUEL	1.28.00	P 1
CONTENTS	SEQ. 001	REV. 15

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**A340**

FLIGHT CREW OPERATING MANUAL

FUEL	1.28.10	P 1
DESCRIPTION	SEQ. 001	REV. 20

**GENERAL****DESCRIPTION**

The fuel system :

- Stores fuel.
- Controls and monitors the correct quantity of fuel.
- Supplies fuel to the engines and the Auxiliary Power Unit (APU).
- Controls the transfer of fuel to maintain the Center of Gravity (CG) within limits.
- Circulates fuel to cool the Integrated Drive Generator (IDG).
- Maintains fuel in the outer tanks for wing bending relief.
- Allows fuel jettison for rapid weight reduction.
- Controls refueling and defueling.

**TANKS**

Fuel is stored in the :

- Wings
- Center section
- Trimmable Horizontal Stabilizer (THS).

**DESCRIPTION**

The wings have inner and outer tanks. Each inner tank contains two collector cells that :

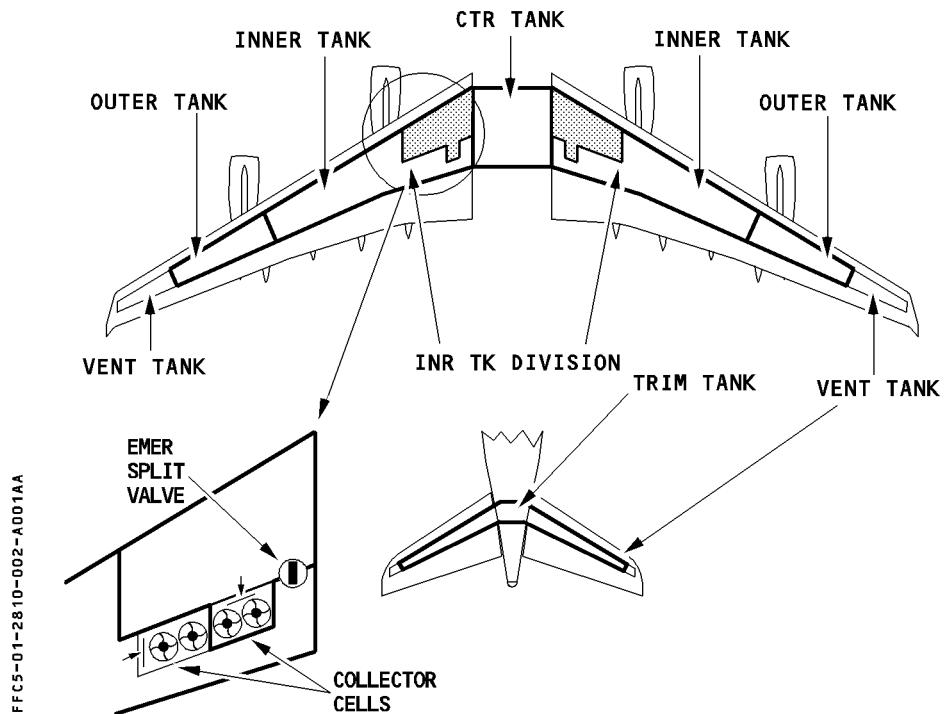
- Maintain a fuel reservoir for the fuel booster pumps and provide negative 'g' protection to feed the engines.
- R – Are maintained full and contain about 1000 kg (2200 lbs) of fuel.

Each inner tank is divided into two parts via a SPLIT valve that normally remains open. The inner tank is used as a single tank and, if tank damage is suspected (i.e. FQI data is lost or there is a rapid FQI decrease following an engine failure), the SPLIT valve can be manually closed by using the dedicated pushbutton on the overhead panel.

In each wing, and on the right of the THS trim tank, there is a vent surge tank outboard of the outer tank.

After refueling to maximum tank capacity, fuel can expand by 2 % (20°C temperature increase) without spillage.

There is an overpressure protector in each wing surge tank, in the trim surge tank, and between the center and the right inner tanks.

**TANK ARRANGEMENT**

USABLE FUEL						
		OUTER TANKS	INNER TANKS	CENTER TANK	TRIM TANK	TOTAL
VOLUME	(liters)	3688 x 2	42194 x 2	41720	6121	139605
	(US gallons)	975 x 2	11147 x 2	11022	1617	36883
WEIGHT *	(KG)	2895 x 2	33122 x 2	32750	4805	109589
	(LB)	6387 x 2	73024 x 2	72205	10593	241620

\* Fuel specific gravity: 0.785 kg/l or 6.551 lbs/US Gal.

**A340**

FLIGHT CREW OPERATING MANUAL

FUEL	1.28.10	P 3
DESCRIPTION	SEQ. 001	REV. 14

## FUEL CONTROL AND MONITORING SYSTEM (FCMS)

### GENERAL

The fuel system is controlled by two Fuel Control and Monitoring Computers (FCMC).

The FCMCs :

- Measure the fuel quantity and indicate it on the ECAM.
- Calculate the aircraft's Gross Weight and Center of gravity, based on the Zero Fuel Weight and the CG entered by the crew.
- Control transfer of fuel to the inner tanks for engine feed.
- Control transfer of fuel to and from the trim tank for CG control.
- Send signals to the FADEC to control the fuel recirculation system.

Magnetic level indicators are fitted in the lower surfaces of the center and wing tanks to allow the manual measurement of each tank's fuel quantity.

## FUEL QUANTITY INDICATION AND LEVEL SENSING

### FUEL QUANTITY INDICATION

One FCMC is active and the other is on standby. If the first FCMC fails, then the other FCMC takes over.

Each FCMC calculates the fuel quantity by using the :

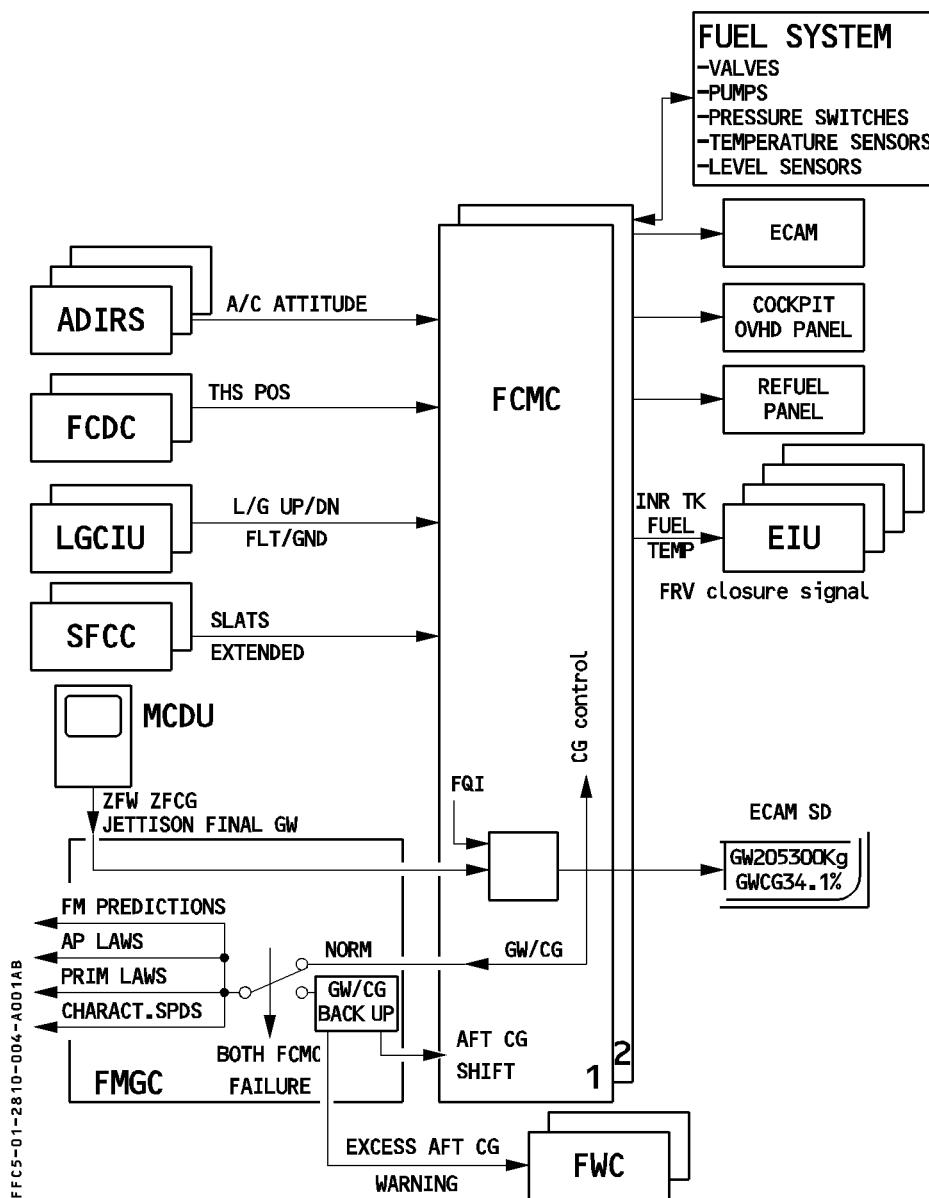
- Fuel volume from the fuel probes.
- Fuel density from the densitometers.
- Horizontal Stabilizer angle.
- Aircraft attitude.
- Fuel electrical characteristic from the compensators

The calculated fuel quantity is indicated on both the ECAM and the refuel control panel.

### FUEL LEVEL SENSING

The FCMC also uses information from the following fuel level sensors to control transfers and to provide warnings, independently of the fuel quantity indication :

- Low level sensors :
  - To trigger low level warnings and stop jettison.
  - To control center and trim tank transfers.
- High level sensors : To stop refueling when a tank is full.
- Vent surge tank level sensor : To stop refueling, or fuel transfer, in case of tank overflow.

ARCHITECTURE

FFCS-01-2810-004-A001AB

**A340**

FLIGHT CREW OPERATING MANUAL

FUEL	1.28.10	P 5
DESCRIPTION	SEQ. 001	REV. 14

## **ENGINE FEED**

### **GENERAL**

The main fuel pump system supplies fuel from the inner tanks to the engines. In each wing there are two collector cells, one for each engine. Each collector cell contains two fuel pumps, one main and one standby. When closed, the crossfeed valves separate the system into four parts, and their associated fuel pumps supply the engines. When open, the crossfeed valves allow any pump to supply any engine.

### **MAIN COMPONENTS**

#### **INNER TANK PUMPS**

During normal operation all main pumps run.

If a main pump fails, or is switched off, then the inner tank pump (standby pump) of that collector cell runs. With the crossfeed valves open, one pump is capable of supplying all four engines in cruise.

#### **CROSSFEED VALVES**

A X-FEED valve is associated with each engine. It connects the engine and its associated pumps to the X-FEED line. This enables any pump to supply any engine. All X-FEED valves automatically open :

- In electrical emergency configuration, and
- During jettison operation.

X-FEED valves 2 and 3 also open in the event of aft transfer from the inner tanks.

#### **ENGINE LP VALVE**

The flow of fuel to an engine can be stopped by closing its respective low pressure (LP) valve via the :

- Engine master switch, or the
- ENG FIRE pushbutton.

## **FUEL FEED WITH ALL ENGINES FLAME OUT (ELEC EMER CONFIG)**

### **EMER GEN POWERED BY THE RAT**

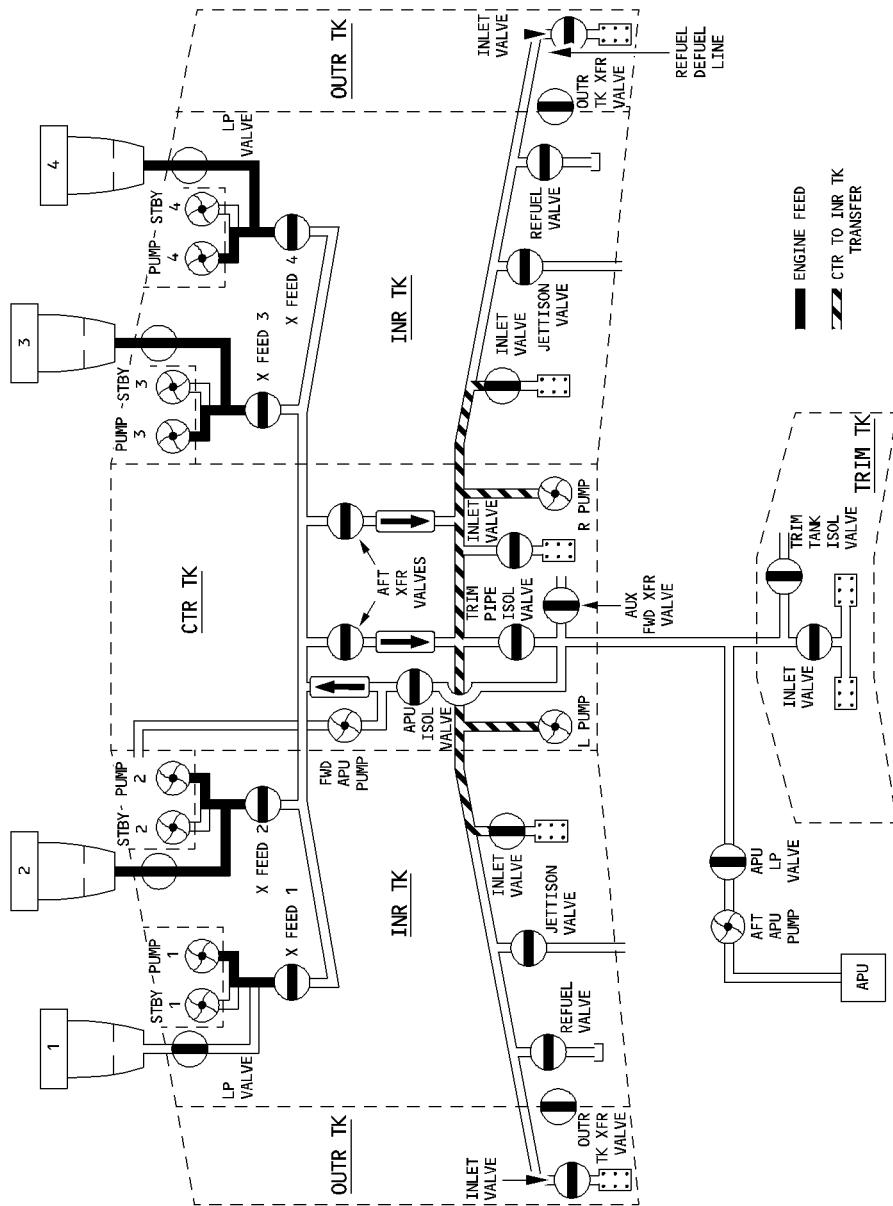
- All crossfeed valves automatically open.
- R — Only the main pump 1 remains powered.
- If pump 1 fails, or is selected OFF, STBY pump 4 will automatically replace it.
- When the speed decreases below 260 knots, or when LAND RECOVERY is selected ON,
- R all main and STBY pumps are lost.

### **FLIGHT ON BATTERIES**

- R — All main and STBY pumps are lost.
- The FWD APU pump automatically starts to assist engine start, irrespective of the APU master switch position.

## **ENGINE FEED AND CENTER TO INNER TRANSFER**

**FOR INFO**



## FUEL FEED SEQUENCE

### **NORMAL OPERATION**

Fuel is always fed to the engines from the inner tanks.

The fuel transfer sequence is as follows :

1. Center tank fuel transfers to the inner tanks.
- R 2. Each inner tank empties down to 5000 kg (11030 lbs).
3. Trim tank fuel transfers to the inner tanks.
- R 4. Each inner tank empties down to 4000 kg (8830 lbs).
5. Outer tank fuel transfers to the inner tanks.

## AUTOMATIC FUEL TRANSFERS

### **CENTER TO INNER TANK TRANSFER**

The center tank pumps run continuously whenever there is fuel in the center tank. Each inner tank inlet valve controls the transfer by cycling its inner tank contents between full

- R and approximately 2000 kg (4415 lbs) below full. When the center tank is empty, both center tank pumps stop, and both inner tank inlet valves close.

### **OUTER TO INNER TANK TRANSFER**

The outer tank transfers fuel to the inner tanks by gravity. Each outer tank transfer valve

- R controls the transfer by cycling its inner tanks contents between 4000 kg (8830 lbs) and

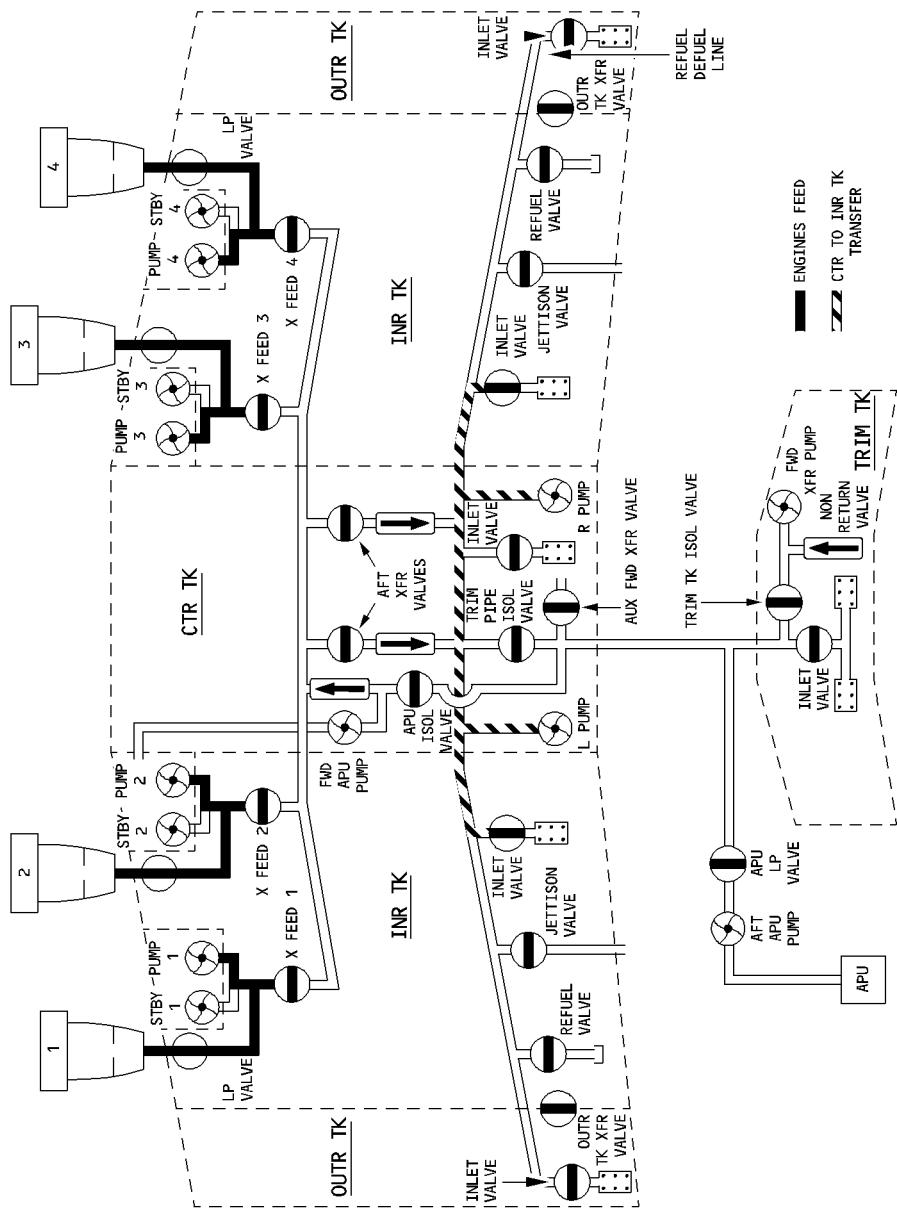
- R 4500 kg (9930 lbs). When each outer tank has been empty for five minutes, its outer tank transfer valves close.

### **TRIM TANK TRANSFER**

Refer to CG control.

## ENGINE FEED AND CENTER TO INNER TRANSFER

FOR INFO



## FUEL FEED SEQUENCE

### **NORMAL OPERATION**

Fuel is always fed to the engines from the inner tanks.

The fuel transfer sequence is as follows :

1. Center tank fuel transfers to the inner tanks.
- R 2. Each inner tank empties down to 4000 kg (8830 lbs).
3. Trim tank fuel transfers to the inner tanks.
- R 4. Each inner tank empties down to 3500 kg (7720 lbs).
5. Outer tank fuel transfers to the inner tanks.

## AUTOMATIC FUEL TRANSFERS

### **CENTER TO INNER TANK TRANSFER**

The center tank pumps run continuously whenever there is fuel in the center tank. Each inner tank inlet valve controls the transfer by cycling its inner tank contents between full

- R and approximately 2000 kg (4415 lbs) below full. When the center tank is empty, both center tank pumps stop, and both inner tank inlet valves close.

### **OUTER TO INNER TANK TRANSFER**

The outer tank transfers fuel to the inner tanks by gravity. Each outer tank transfer valve

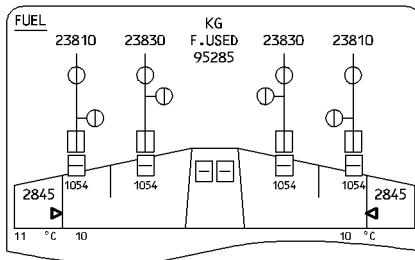
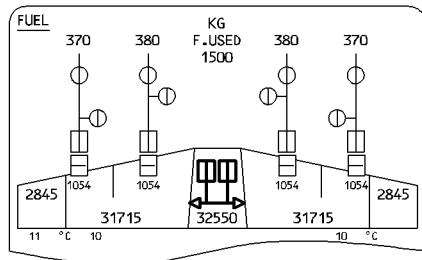
- R controls the transfer by cycling its inner tanks contents between 3500 kg (7720 lbs) and
- R 4000 kg (8830 lbs). When each outer tank has been empty for five minutes, its outer tank transfer valves close.

### **TRIM TANK TRANSFER**

Refer to CG control.

**R ECAM INDICATION**

FFC5-01-2810-009-A002AB



## MANUAL FUEL TRANSFERS

### **CENTER TO INNER TANK TRANSFER**

Transfer from the center to inner tanks can be manually selected with the CTR TANK XFR pushbutton. When selected MAN, the inner tank inlet valves are opened and the CTR TK pumps run.

The CTR TK pumps must be selected OFF when the :

- Inner tanks are full, to manually prevent inner tank overflow.
- Center tank is empty.

- R    Note : 1. When the fuel quantity of each inner tank is below 17000 kg (37520 lbs), all center tank fuel can be transferred without any risk of overflow.  
                   2. When the CTR TANK XFR pushbutton is pressed, aft transfer is inhibited.

### **OUTER TO INNER TANK TRANSFER**

Transfer from the outer to inner tanks can be manually selected with the OUTR TK XFR pushbutton. When selected ON, the outer tank fuel transfer valves, and the inner and outer inlet valves are opened.

- Note : 1. During an outer to inner tank transfer, the CTR TK pumps must be selected OFF to avoid inadvertent fuel transfer from the center tank to outer tanks.  
                   2. When the OUTR TK XFR pushbutton is pressed, aft transfer is inhibited.

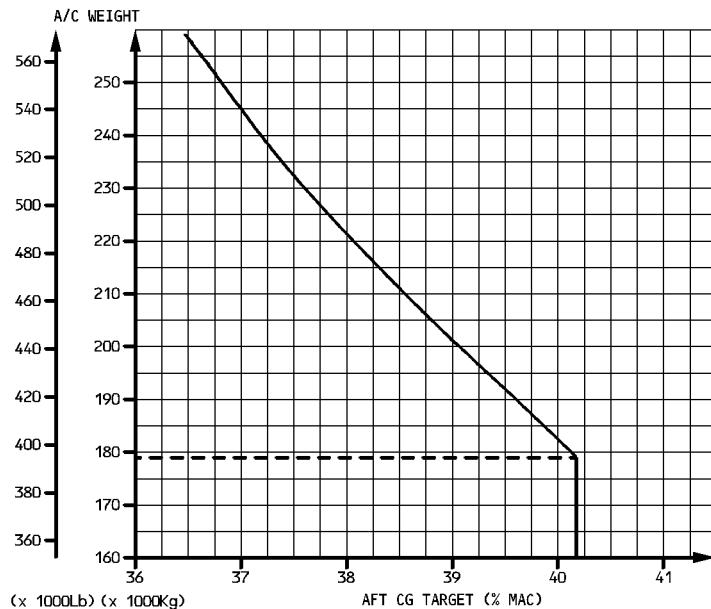
**CG CONTROL – TRIM TANK TRANSFER****GENERAL**

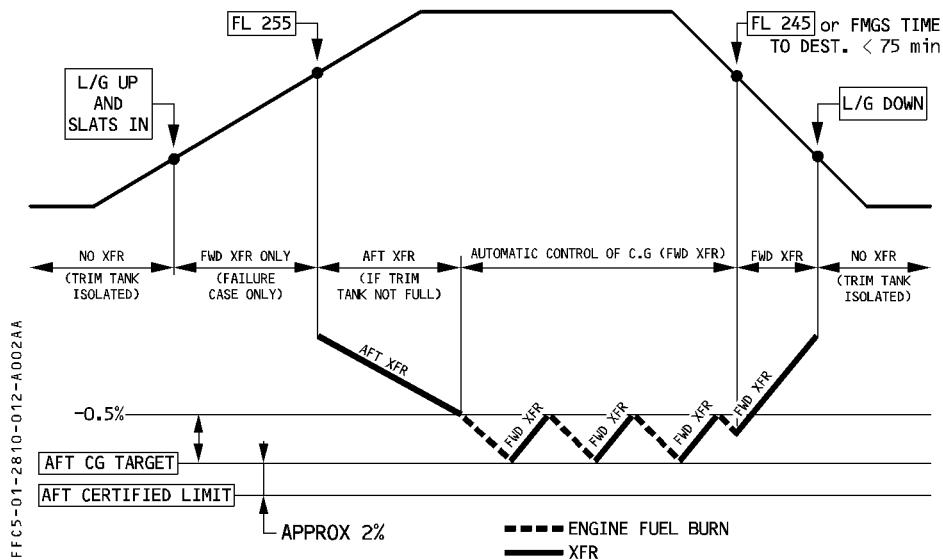
The trim tank transfer system controls the aircraft's Center of Gravity (CG).

- The system either transfers fuel to the trim tank (aft transfer) or from the trim tank (forward transfer).
- This movement of fuel changes the aircraft's CG.
- When the aircraft is in cruise, the system optimizes the CG position to increase fuel economy by reducing drag.
- Normal operation is automatic, but the crew can manually select a forward fuel transfer.
- The Fuel Control and Management Computer (FCMC) calculates the aircraft's CG and compares it to a target value. (This target depends on the aircraft's actual weight. See AFT CG Target Graph below).
- Based on this calculation, the FCMC determines the quantity of fuel to be moved aft or forward in flight.

**AFT CG TARGET****FOR INFO**

FFC5-01-2810-011-A110A



**NORMAL OPERATION****Automatic CG control :**

- Begins during climb to FL 255.
- Ends at descent to FL 245, or when the FMGS time to destination is less than 75 minutes.

Note : 1. The trim pipe isolation valve and the trim tank isolation valve are closed during takeoff and landing. It is possible to reopen them, when the landing gear is up and the slats are retracted (or when the MODE SEL switch is set at REFUEL on the REFUEL panel).

- R R
2. If the FMGC detects a CG that is too far aft, then the target will automatically be moved forward by 1.5 %. The target also moves forward 1.5 % in the case of FDI data degradation, or if ZFCG/ZFW have not been entered or need to be reinitialized in flight (modifying CG/GW via the MCDU).
  3. The above-mentioned CG target alterations should be added together.

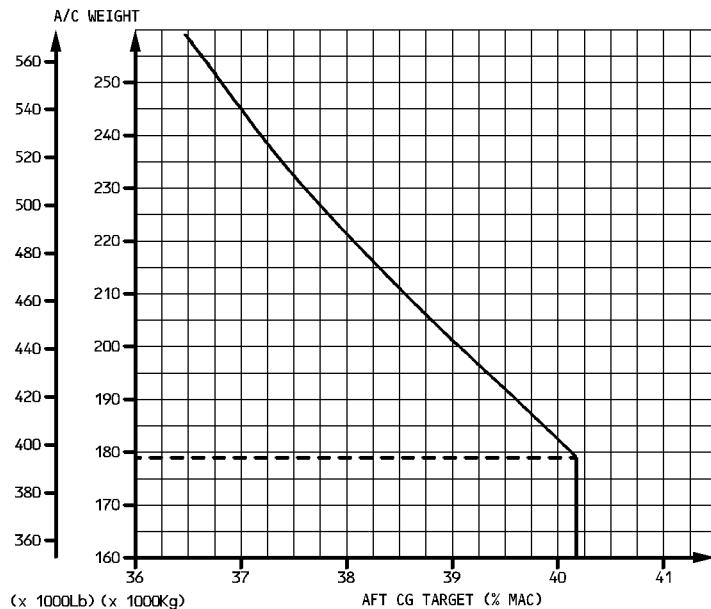
**CG CONTROL – TRIM TANK TRANSFER****GENERAL**

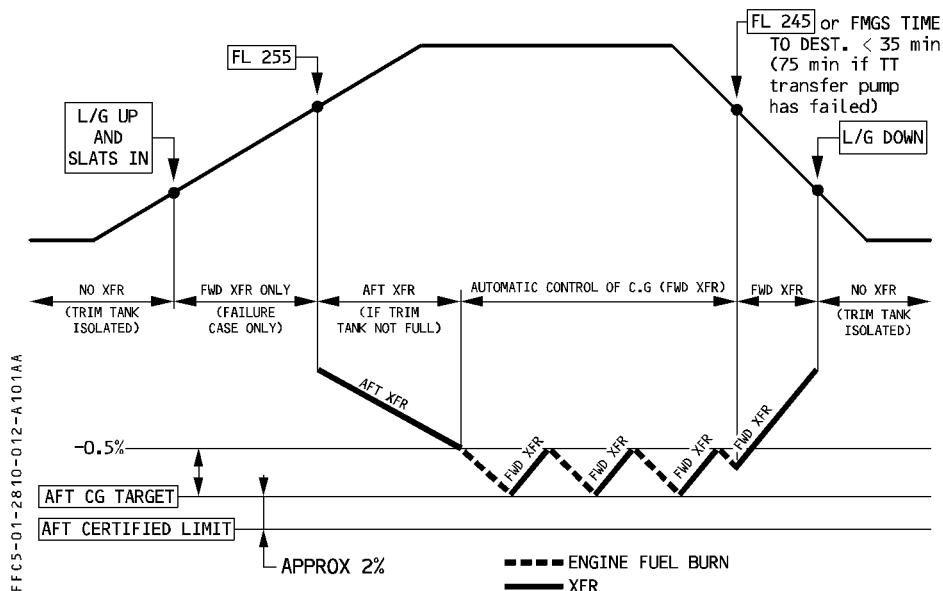
The trim tank transfer system controls the aircraft's Center of Gravity (CG).

- The system either transfers fuel to the trim tank (aft transfer) or from the trim tank (forward transfer).
- This movement of fuel changes the aircraft's CG.
- When the aircraft is in cruise, the system optimizes the CG position to increase fuel economy by reducing drag.
- Normal operation is automatic, but the crew can manually select a forward fuel transfer.
- The Fuel Control and Management Computer (FCMC) calculates the aircraft's CG and compares it to a target value. (This target depends on the aircraft's actual weight. See AFT CG Target Graph below).
- Based on this calculation, the FCMC determines the quantity of fuel to be moved aft or forward in flight.

**AFT CG TARGET****FOR INFO**

FFC5-01-2810-011-A110A



**NORMAL OPERATION**

## Automatic CG control :

- Begins during climb to FL 255.
- Ends at descent to FL 245, or when the FMGS time to destination is less than 35 minutes (or less than 75 minutes in the event of trim tank forward transfer pump failure).

Note : 1. The trim pipe isolation valve and the trim tank isolation valve are closed during takeoff and landing. It is possible to reopen them, when the landing gear is up and the slats are retracted (or when the MODE SEL switch is set at REFUEL on the REFUEL panel).

2. If the FMGC detects a CG that is too far aft, then the target will automatically be moved forward by 1.5 %. The target also moves forward 1.5 % in the case of FDI data degradation, or if ZFCG/ZFW have not been entered or need to be reinitialized in flight (modifying CG/GW via the MCDU).

3. The above-mentioned CG target alterations should be added together.

R

R

## **AFT FUEL TRANSFER**

In flight, the FCMC only starts an AFT fuel transfer, when all of the following conditions are met :

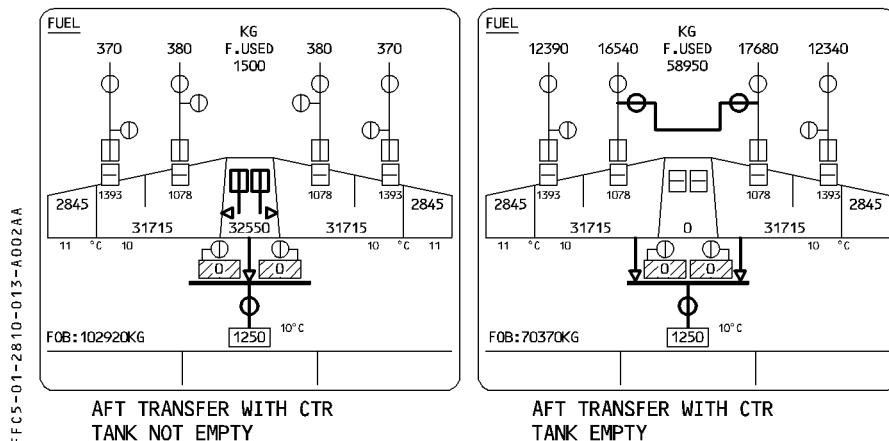
- Landing gear is retracted.
- Slats are retracted.
- Trim tank is not full.

- R – Inner tank's fuel quantity is above 6250 kg (13790 lbs).  
 R – Aircraft is above FL 255.  
 R – Aircraft CG is not on target.

Normally, only one aft fuel transfer occurs per flight. However, if the CG in cruise is ahead of the target by more than 2 %, and the trim tank quantity is below 3000 kg (6620 lbs), an additional aft transfer will occur. An aft transfer terminates when the :

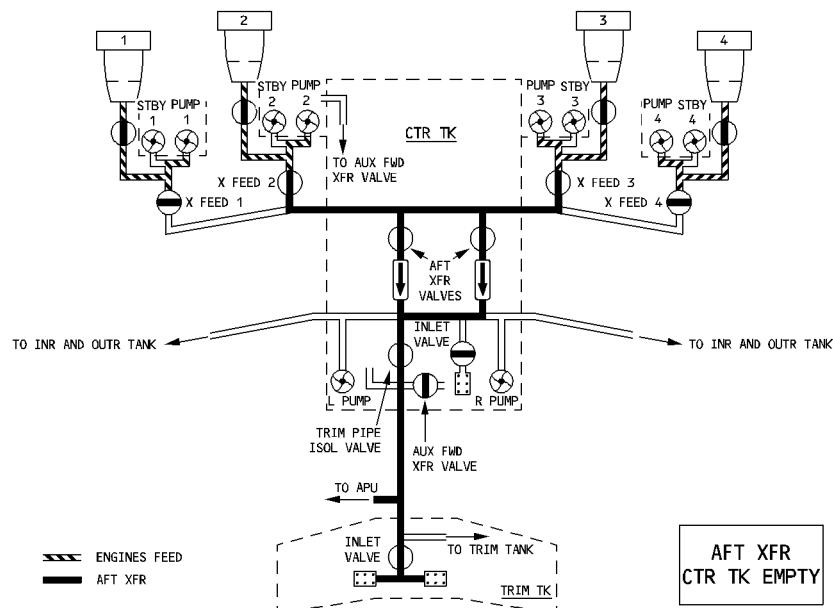
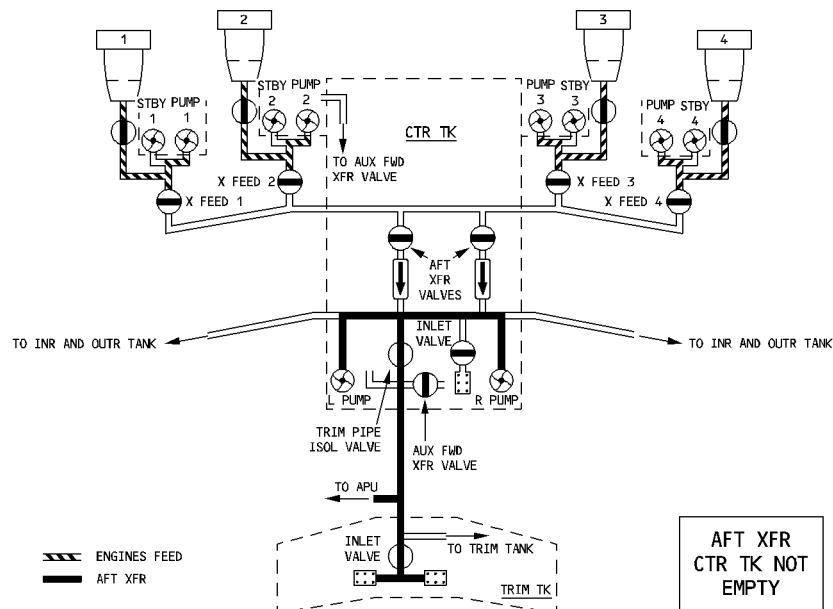
- Computed CG = Target CG - 0.5 %, or
  - Trim tank high level sensor becomes wet, or
- R – Inner tank's fuel quantity reaches 6250 kg (13790 lbs), or
- T tank pushbutton is selected FWD, or
  - Fuel transfer from the center or outer tanks to the inner tanks is manually selected.
- Fuel for trim tank aft transfer is provided by the center TK, when it contains fuel, or by the inner tanks when the center tank is empty. In the latter case, XFEED 2 and 3 valves are open. If, during the transfer, the inner tanks are unbalanced by more than 500 kg (1100 lbs), the transfer will stop on the lightest side, and the related aft transfer valve and XFEED valve will automatically close until fuel balance is restored.

## **ECAM INDICATION**



**AFT FUEL TRANSFER****FOR INFO**

R



**A340**

FLIGHT CREW OPERATING MANUAL

FUEL	1.28.10	P 15
DESCRIPTION	SEQ. 102	REV 22

## **AUTOMATIC FORWARD FUEL TRANSFER**

The FCMC triggers a forward fuel transfer, if one of the following conditions are met :

- The calculated CG = Target. Forward fuel transfer stops, when the computed CG = The target CG - 0.5 %.
- The fuel content of one of the two inner tanks decreases to 5000 kg (11030 lbs). Forward fuel transfer stops when the fuel content reaches 6000 kg (13240 lbs).
- The FMGS sends a time-to-destination signal, or the aircraft descends below FL 245. In this case, transfer is continuous, but is controlled by the inner tank high levels to prevent overflow.
- Jettison is initiated.
- In electrical emergency configuration.

R Note : If the center tank contains fuel and the CG is forward of 32 % MAC, the transfer will be completed in two steps :

- When the center tank quantity reaches 17000 kg (37520 lbs), the trim tank is decreased to 2400 kg (5290 lbs).
- When the center tank is empty, the trim tank will be emptied.

A forward transfer :

- Always occurs by gravity.
- Is normally directed to the inner tanks, and may be directed to the center tank, if it is not empty. In electrical emergency configuration, the forward transfer is always directed to the inner tanks.
- Is directed to the lighter inner tank, if there is an imbalance of 500 kg (1100 lbs) between the two inner tanks.

R – Is inhibited, when the aircraft pitch exceeds 3.4 degrees for more than one minute.

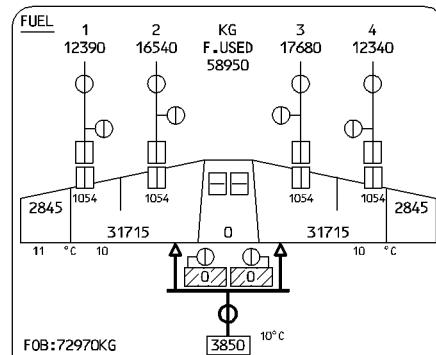
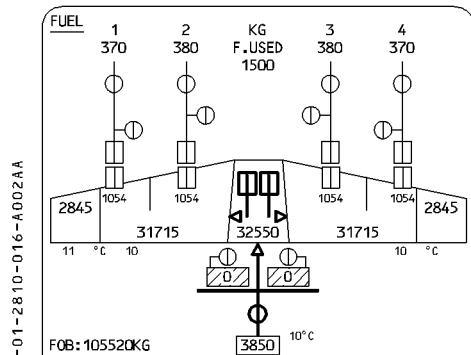
R – Restarts, when the aircraft attitude is lower than 3.4 degrees for more than one minute.

**CENTER TANK EMPTY**

- Fuel is transferred from the trim tank to the inner tanks.
- If an inner tank reaches the high level, the related inlet valve closes to prevent tank overflow.
- R — It reopens when the inner tank quantity reaches 2000 kg (4415 lbs) below high level.

**CENTER TANK NOT EMPTY**

- Fuel is transferred from the trim tank to the center tank.

**ECAM INDICATION**

**A340**

FLIGHT CREW OPERATING MANUAL

FUEL	1.28.10	P 15
DESCRIPTION	SEQ. 202	REV 22

## **AUTOMATIC FORWARD FUEL TRANSFER**

The FCMC triggers a forward fuel transfer, if one of the following conditions are met :

- The calculated CG = Target. Forward fuel transfer stops, when the computed CG = The target CG - 0.5 %.
- The fuel content of one of the two inner tanks decreases to 4000 kg (8830 lbs). Forward fuel transfer stops, when the fuel content reaches 5000 kg (11030 lbs).
- The FMGS sends a time-to-destination signal below the threshold, or the aircraft descends below FL 245. In this case, transfer is continuous, but is controlled by the inner tank high levels to prevent overflow.
- Jettison is initiated.
- In electrical emergency configuration.

- R Note : If the center tank contains fuel and the CG is forward of 32 % MAC, the transfer will be completed in two steps :
- When the center tank quantity reaches 17000 kg (37520 lbs), the trim tank is decreased to 2400 kg (5290 lbs).
  - When the center tank is empty, the trim tank will be emptied.

A forward transfer is normally directed to the inner tanks, and may be directed to the center tank, when it is not empty. The transfer is directed to the lighter inner tank, if there is an imbalance of 500 kg (1100 lbs) between the two inner tanks. In electrical emergency configuration, the forward transfer is always directed to the inner tanks.

In normal operations, a forward transfer is performed by the trim tank forward transfer pump. The pump starts to operate, when both the landing gear and the slats are retracted, as long as there is fuel in the trim tank. It operates continuously during the flight, until the trim tank is empty, or the T. TANK FEED selector is set to ISOL.

Note : The running trim tank forward transfer pump has no effect on the aft transfer, because the TRIM TK ISOL VALVE is normally closed during this transfer.

In the event of pump failure, forward transfer occurs by gravity, through the trim tank non-return valve. The FCMC :

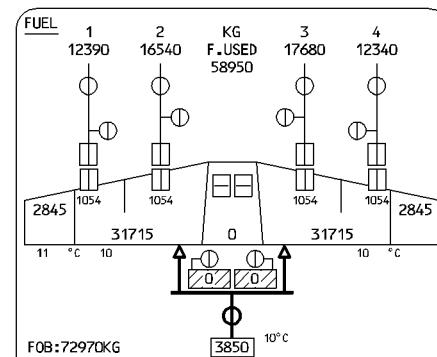
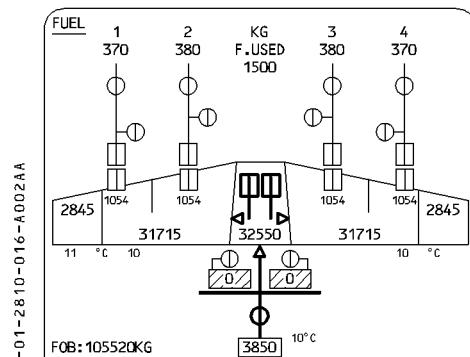
- Inhibits the forward transfer by closing the TRIM PIPE ISOL VALVE, when the aircraft pitch exceeds 3.4 degrees for more than one minute.
- Restarts the forward transfer, when the aircraft's attitude is lower than 3.4 degrees for more than one minute.

**CENTER TANK EMPTY**

- Fuel is transferred from the trim tank to the inner tanks.
- If an inner tank reaches the high level, the related inlet valve closes to prevent tank overflow.
- R — It reopens when the inner tank quantity reaches 2000 kg (4415 lbs) below high level.

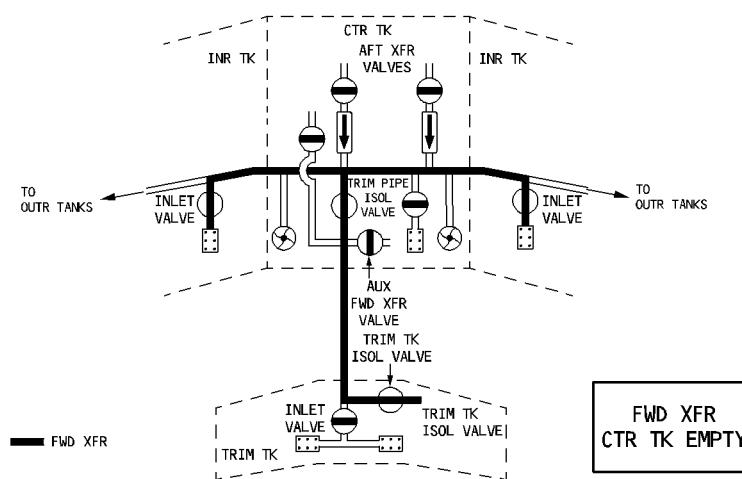
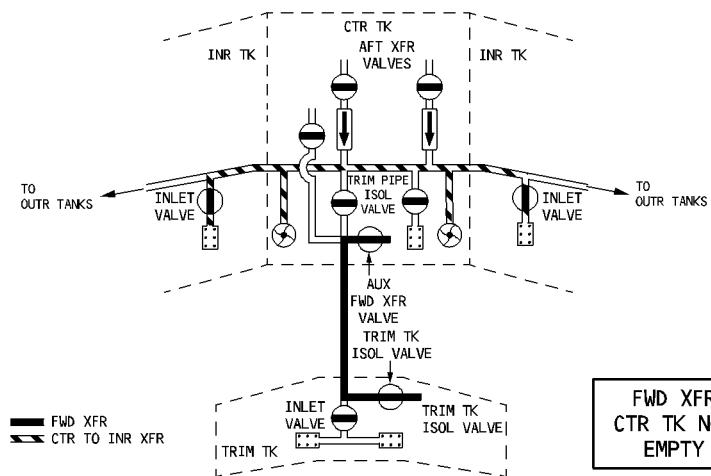
**CENTER TANK NOT EMPTY**

- Fuel is transferred from the trim tank to the center tank.

**ECAM INDICATION**

## AUTOMATIC FORWARD FUEL TRANSFER

FOR INFO



**MANUAL FORWARD FUEL TRANSFER**

When the T. TANK pushbutton is pressed, the FWD light comes on white, and :

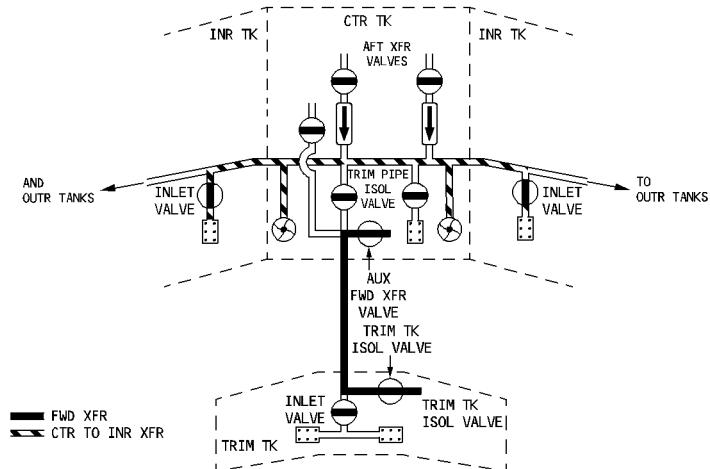
- The TRIM TK ISOL valve opens.
- The AUX FWD XFR valve opens.
- The two AFT XFR valves close.
- The TRIM PIPE ISOL valve closes.

Fuel transfers by gravity from the trim tank to the center tank.

Center tank overflow must be manually prevented, by releasing the pushbutton when the tank is full.

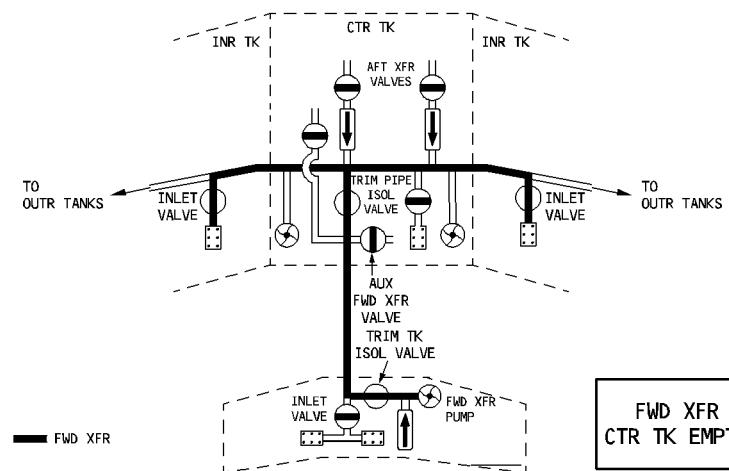
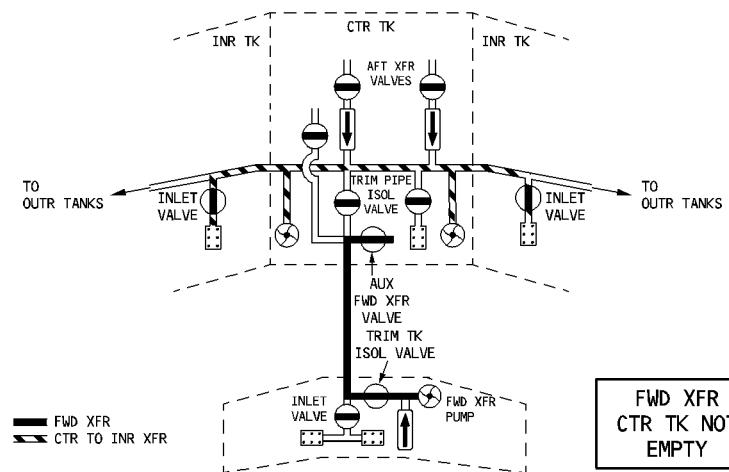
When the T. TANK pushbutton is released, the forward transfer stops.

FFCS-01-2810-018-A002AA



## AUTOMATIC FORWARD FUEL TRANSFER

FOR INFO



FFC5-01-2810-017-A101AA

**MANUAL FORWARD FUEL TRANSFER**

When the T. TANK pushbutton is pressed, the FWD light comes on white, and :

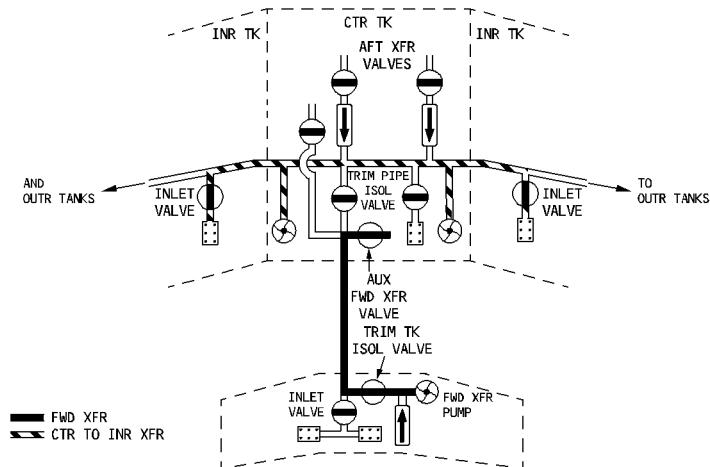
- The FWD XFR pumps runs.
- The TRIM TK ISOL valve opens.
- The AUX FWD XFR valve opens.
- The two AFT XFR valves close.
- The TRIM PIPE ISOL valve closes.

The forward transfer pump transfers the fuel from the trim tank to the center tank.

Center tank overflow must be manually prevented, by releasing the pushbutton when the tank is full.

When the T. TANK pushbutton is released, the forward transfer stops.

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**A340**

FLIGHT CREW OPERATING MANUAL

FUEL	1.28.10	P 19
DESCRIPTION	SEQ. 002	REV. 14

**APU FEED****FWD APU PUMP FEED**

The APU is fed from the Engine 2 collector cells (in the left inner tank) through the APU FWD pump and the APU ISOL valve when :

- On the ground (except during trim tank refueling), or
- In flight below FL 255, or
- In flight above FL 255, when the trim tank is empty.

In this case, the AFT APU pump is not running.

**AFT APU PUMP FEED**

The APU is fed from the trim pipe :

- During trim tank refueling or,
- During an aft transfer.

The APU is fed from the trim tank :

- In flight above FL 255, as long as the trim tank is not empty, or
- During a forward transfer.

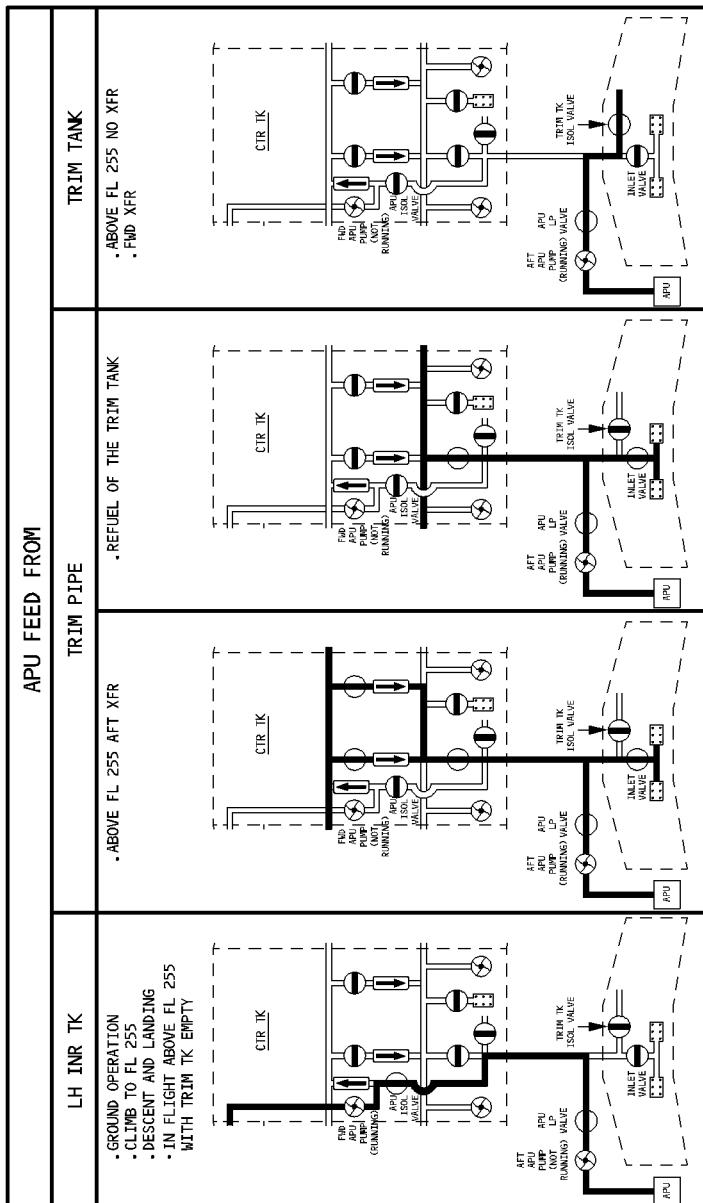
In the above cases, the :

- AFT APU pump is running.
- FWD APU pump is not running.
- APU ISOL valve is closed.

*Note : The AFT APU pump will automatically start, in the event of FWD APU pump failure.*

**APU FEED****FOR INFO**

R



FFC5-01-2810-020-A002AA

**A340**

FLIGHT CREW OPERATING MANUAL

FUEL	1.28.10	P 19
DESCRIPTION	SEQ. 002	REV. 14

**APU FEED****FWD APU PUMP FEED**

The APU is fed from the Engine 2 collector cells (in the left inner tank) through the APU FWD pump and the APU ISOL valve when :

- On the ground (except during trim tank refueling), or
- In flight below FL 255, or
- In flight above FL 255, when the trim tank is empty.

In this case, the AFT APU pump is not running.

**AFT APU PUMP FEED**

The APU is fed from the trim pipe :

- During trim tank refueling or,
- During an aft transfer.

The APU is fed from the trim tank :

- In flight above FL 255, as long as the trim tank is not empty, or
- During a forward transfer.

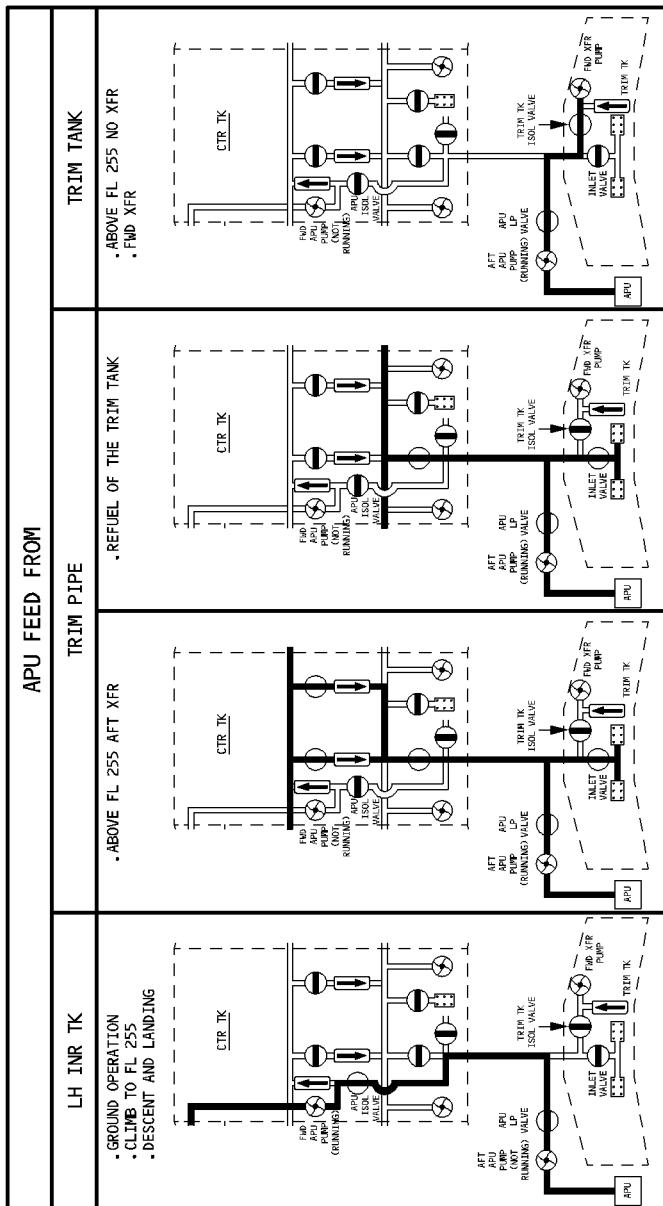
In the above cases, the :

- AFT APU pump is running.
- FWD APU pump is not running.
- APU ISOL valve is closed.

*Note : The AFT APU pump will automatically start, in the event of FWD APU pump failure.*

**APU FEED**

**FOR INFO**



FFC5-01-2810-020-A101AA

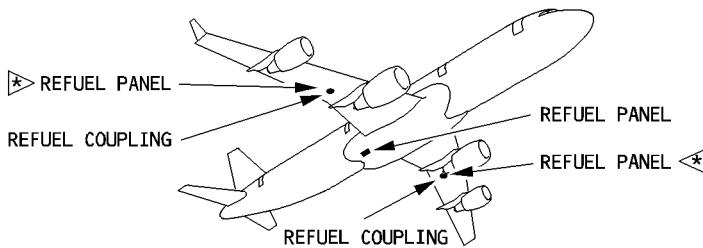
**REFUELING - DEFUELING**

Two refuel couplings are installed under the wings. These couplings allow refueling from both the right and left sides of the aircraft.

A refuel panel is located on the fuselage side, beneath the right wing.

A second and/or third panel  is installed close to the refuel couplings.

A gallery connects the refueling coupling to the fuel inlet valve of each tank.



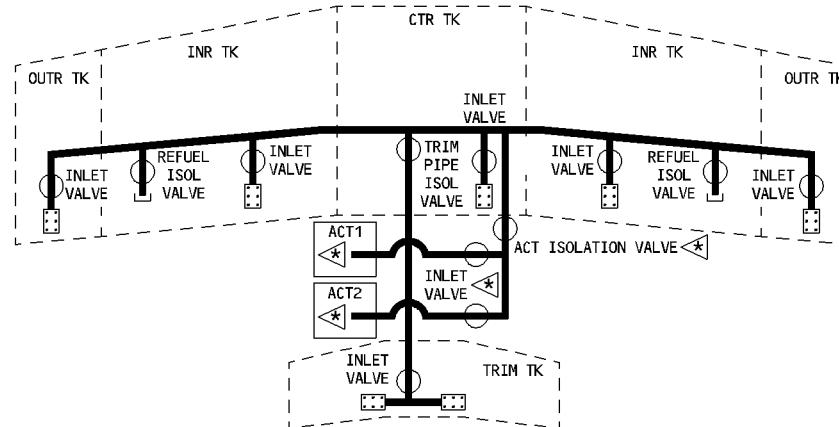
FFC5-01-2810-021-A002AA

From the cockpit, refueling can be controlled with the refuel pushbutton . Although manual control is possible, it is normally automatic when the required fuel load is set on the preselector. In addition, it is possible to refuel by battery power only.

Any tanks that require refueling start to be refueled simultaneously. Refuel valves automatically close either when the required quantity is reached, or when high level is detected.

Wing tank gravity refueling is achieved via overwing refueling points. If the FCMC is powered, transfer is possible from any tank (with inner or center pumps) to outer, inner or center tanks. When both side couplings are used, refueling time at nominal pressure (50 psi) is approximately 33 minutes for all tanks.

FFC5-01-2810-021-B002AA



**JETTISON**

The Jettison system :

- Makes it possible to jettison fuel in flight.
  - Output rate is approximate 1000 kg (2200 lbs) per minute, excluding fuel burn.
  - Is manually activated by two JETTISON pushbuttons, located on the overhead panel.
- Both pushbuttons must be pressed to select the jettison.

Fuel is simultaneously jettisoned from the inner and the center tanks.

When the crew starts the jettison operation :

- All X-FEED valves automatically open.
- All main and standby pumps run.

An automatic forward transfer into the center tank is initiated, as long as the pitch attitude is below 3°, even if the slats are out, the landing gear is down, and whatever the altitude.

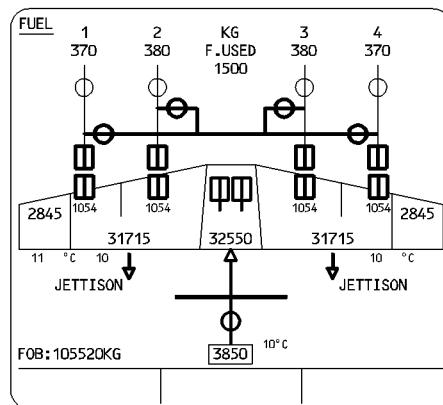
The jettison operation continues, until one of the following occurs :

- The crew stops the operation.
- Both inner fuel tank low level sensors on one side become dry.
- The Fuel Control and Monitoring System (FCMS) stops the operation at a fuel content level preset on the FMGS MCDU. ◀
- The combined inner tank fuel quantity is less than 10000 kg (22000 Lbs).

*Note : The crossfeed valves remain open, and the standby pumps continue to run, as long as both JETTISON pushbuttons are selected ON.*

**ECAM INDICATION**

FFCS-011-2810-022-A102AA



**REFUELING - DEFUELING**

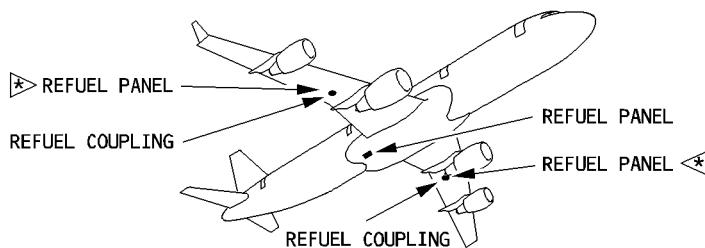
Two refuel couplings are installed under the wings. These couplings allow refueling from both the right and left sides of the aircraft.

A refuel panel is located on the fuselage side, beneath the right wing.

A second and/or third panel  is installed close to the refuel couplings.

A gallery connects the refueling coupling to the fuel inlet valve of each tank.

FFC5-01-2810-021-A002AA

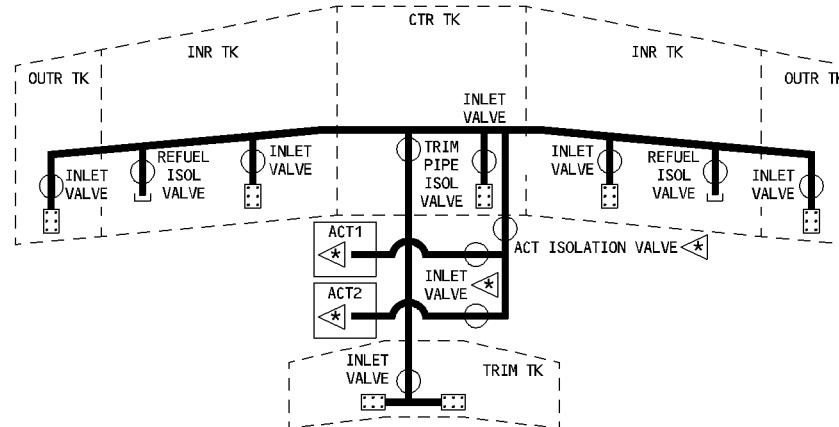


From the cockpit, refueling can be controlled with the refuel pushbutton . Although manual control is possible, it is normally automatic when the required fuel load is set on the preselector. In addition, it is possible to refuel by battery power only.

Any tanks that require refueling start to be refueled simultaneously. Refuel valves automatically close either when the required quantity is reached, or when high level is detected.

Wing tank gravity refueling is achieved via overwing refueling points. If the FCMC is powered, transfer is possible from any tank (with inner or center pumps) to outer, inner or center tanks. When both side couplings are used, refueling time at nominal pressure (50 psi) is approximately 33 minutes for all tanks.

FFC5-01-2810-021-B002AA



**JETTISON**

The Jettison system :

- Makes it possible to jettison fuel in flight.
- Output rate is approximate 1000 kg (2200 lbs) per minute, excluding fuel burn.
- Is manually activated by two JETTISON pushbuttons, located on the overhead panel. Both pushbuttons must be pressed to select the jettison.

Fuel is simultaneously jettisoned from the inner and the center tanks. To start :

- The crew starts the jettison operation.
- All X-FEED valves automatically open.
- All main and standby pumps run.

Both automatic forward transfer into the center tank is initiated, even if the slats are out, the landing gear is down, and whatever the altitude.

Note : In case of the trim tank pump failure, forward transfer is by gravity, as long as the pitch attitude is below 3°.

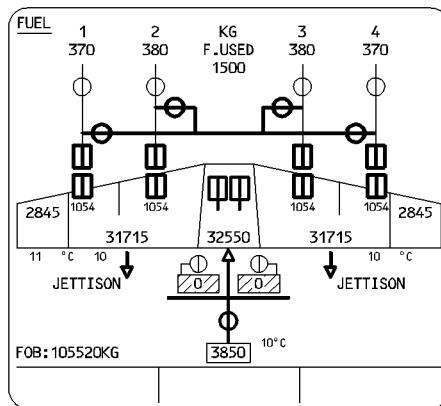
The jettison operation continues, until one of the following occurs :

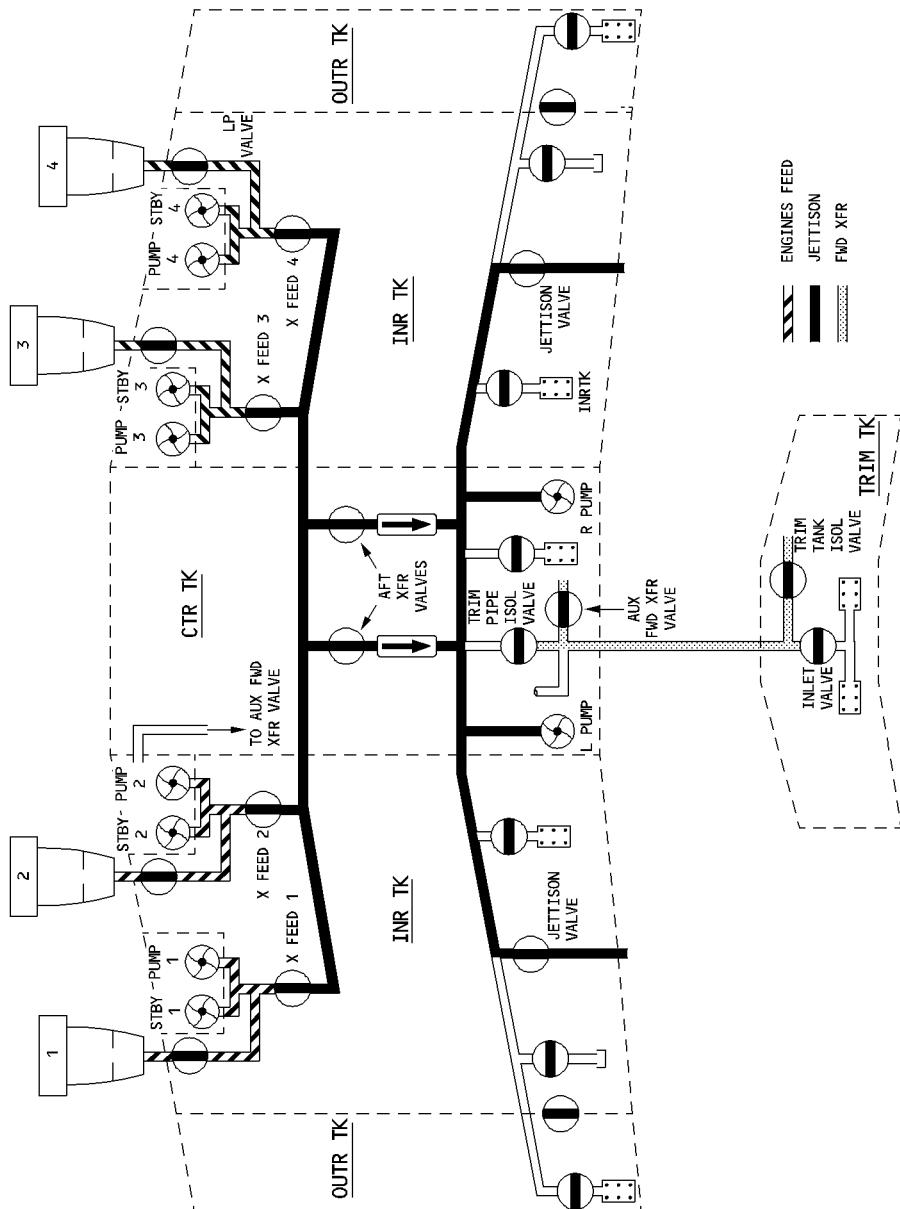
- The crew stops the operation.
- Both inner fuel tank low level sensors on one side become dry.
- The Fuel Control and Monitoring System (FCMS) stops the operation at a fuel content level preset on the FMGS MCDU. ◁
- The combined inner tank fuel quantity is less than 10000 kg (22000 Lbs).

Note : The crossfeed valves remain open, and the standby pumps continue to run, as long as both JETTISON pushbuttons are selected ON.

**ECAM INDICATION**

FFCS-01-2810-022-A201AA

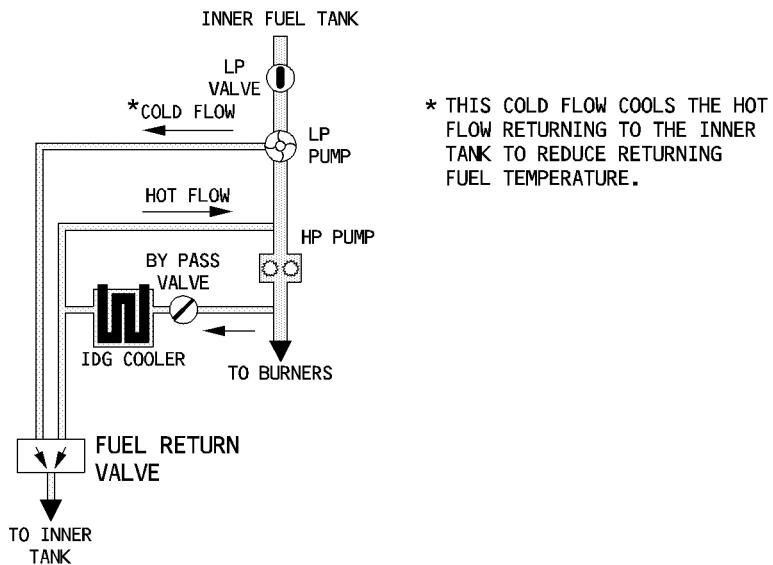


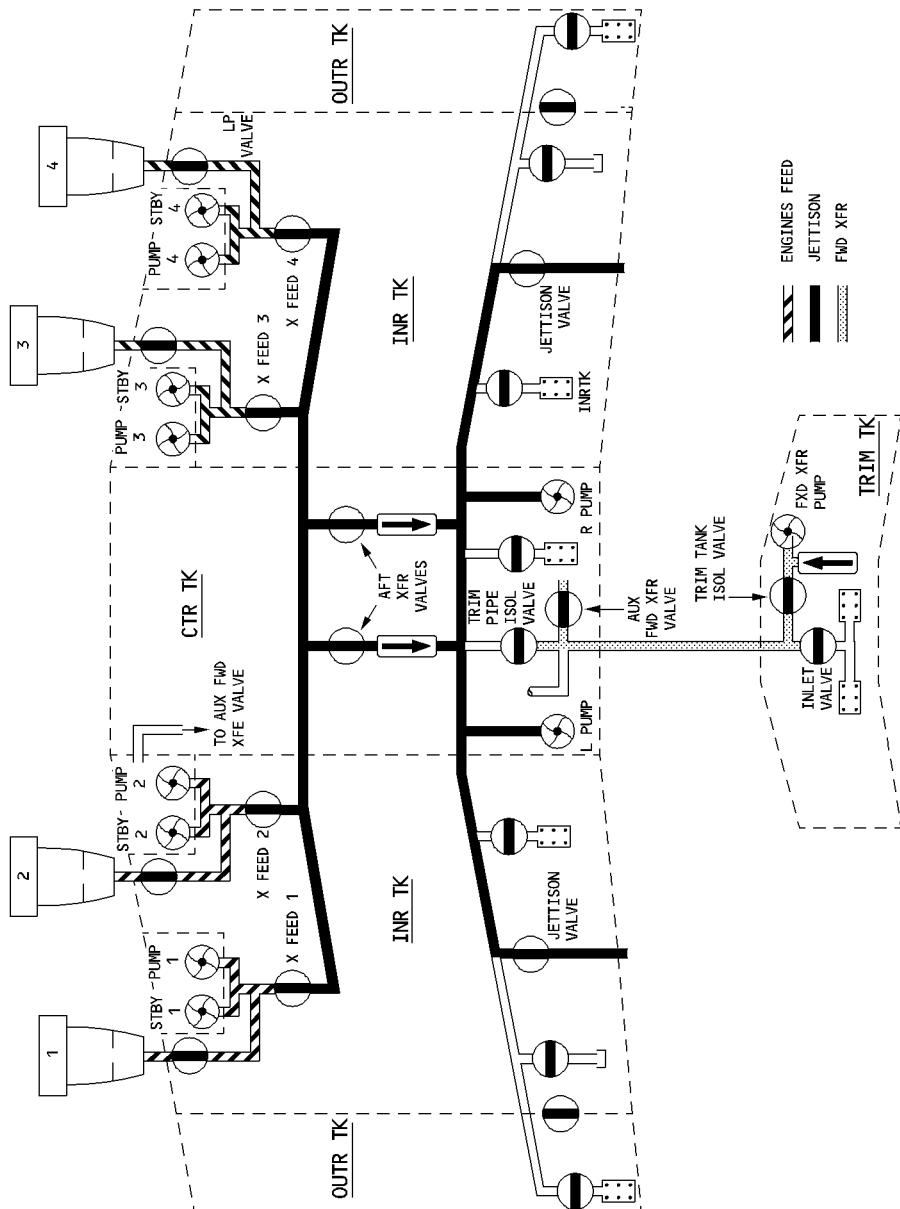
**JETTISON****FOR INFO**

## FUEL RECIRCULATION SYSTEM

- The inner fuel tanks supply fuel to the four engines.
- Some of this fuel is tapped from the high pressure fuel line of each engine. It goes through the Integrated Drive Generator (IDG) heat exchanger, where it absorbs heat, and continues to the inner fuel tank, via the fuel return valve.
- Fuel recirculation for IDG cooling moves this heated fuel, from the fuel return valve, back to the inner fuel tank. This operation ensures IDG cooling during high temperatures (or at low rates of engine fuel burn).
- The FADEC controls the fuel return valves, based on signals sent by the FCMC (refer to 1.70.40).

FFCS-01-2810-024-A001AA

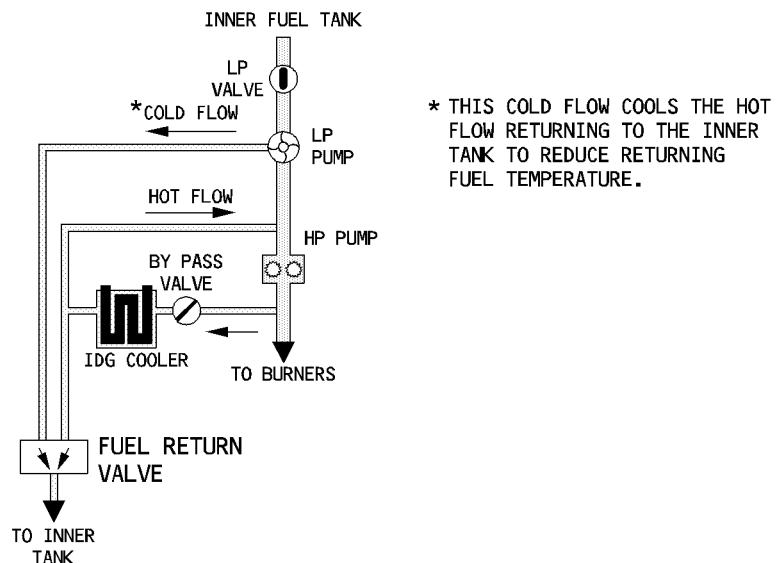


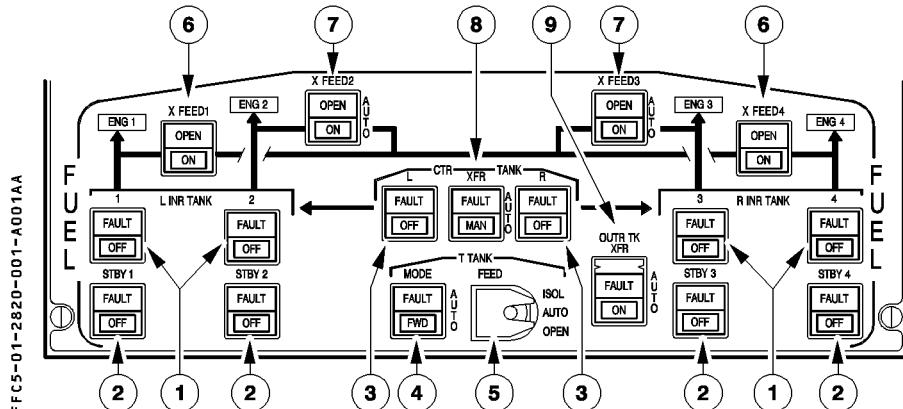
**JETTISON****FOR INFO**

## FUEL RECIRCULATION SYSTEM

- The inner fuel tanks supply fuel to the four engines.
- Some of this fuel is tapped from the high pressure fuel line of each engine. It goes through the Integrated Drive Generator (IDG) heat exchanger, where it absorbs heat, and continues to the inner fuel tank, via the fuel return valve.
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- The FADEC controls the fuel return valves, based on signals sent by the FCMC (refer to 1.70.40).

FFCS-01-2810-024-A001AA



**OVERHEAD PANEL****① L (or R) INR TANK 1 (2) (3) (4) pb**

On : Pump is on.

OFF : Pump is off.

FAULT It : The amber light and the ECAM caution come on, when the delivery pressure drops. It is inhibited when off is selected.

**② L (or R) INR TANK STBY 1 (2) (3) (4) pb**

On : Standby pump runs when associated main pump is failed or off.

OFF : Pump is off.

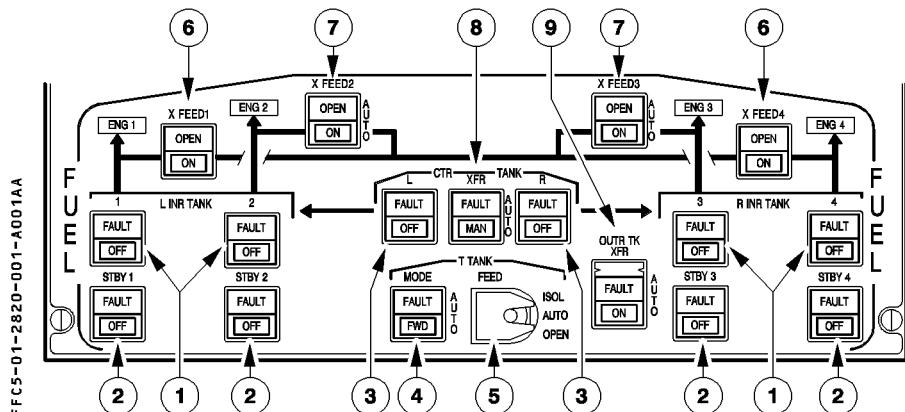
FAULT It : The amber light and the ECAM caution come on, when the delivery pressure drops. It is inhibited when off is selected, or the main pump is running.

③ L (or R) CTR TANK pb

- On : The center tank pump permanently runs. Appropriate valves control the transfer. The pump automatically stops when the tank is empty.
- OFF : Pump is off.
- FAULT It : The amber light and the ECAM caution come on when :
- The delivery pressure drops.
  - Or, the trim pipe isolation valve is failed open.
  - Or, a manual transfer from the center tank is required (failure of automatic transfer) and both inner tank quantities are above 17000 kg (37520 lbs).
  - Or, one outer or inner inlet valve is failed open and both inner tank quantities are above 17000 kg (37520 lbs).
- Is inhibited when off is selected.

④ T. TANK MODE pb

- AUTO : The FCMC controls the CG.
- FWD : Initiates a manual forward transfer to the center tank, by opening :
  - The trim tank isolation valve,
  - The auxiliary forward transfer valve,
 And by closing :
  - The trim pipe isolation valve,
  - The aft transfer valves.
 Center tank overflow must be manually prevented.
- FAULT It : The amber light and the ECAM caution come on when :
- The FMGS detects an excess aft CG, based on the THS position (independent of fuel quantity), or
  - The FCMC is unable to carry out the forward transfer.
  - The FUEL LO TEMP warning is triggered.

**OVERHEAD PANEL****① L (or R) INR TANK 1 (2) (3) (4) pb**

On : Pump is on.

OFF : Pump is off.

**FAULT It** : The amber light and the ECAM caution come on, when the delivery pressure drops. It is inhibited when off is selected.

**② L (or R) INR TANK STBY 1 (2) (3) (4) pb**

On : Standby pump runs when associated main pump is failed or off.

OFF : Pump is off.

**FAULT It** : The amber light and the ECAM caution come on, when the delivery pressure drops. It is inhibited when off is selected, or the main pump is running.

③ L (or R) CTR TANK pb

- On : The center tank pump permanently runs. Appropriate valves control the transfer. The pump automatically stops when the tank is empty.
- OFF : Pump is off.
- FAULT It : The amber light and the ECAM caution come on when :
- The delivery pressure drops.
  - Or, the trim pipe isolation valve is failed open.
  - Or, a manual transfer from the center tank is required (failure of automatic transfer) and both inner tank quantities are above 17000 kg (37520 lbs).
  - Or, one outer or inner inlet valve is failed open and both inner tank quantities are above 17000 kg (37520 lbs).
- Is inhibited when off is selected.

④ T. TANK MODE pb

- AUTO : The FCMC controls the CG.
- FWD : Initiates a manual forward transfer to the center tank, by opening :
  - The trim tank isolation valve,
  - The auxiliary forward transfer valve,
 And by closing :
  - The trim pipe isolation valve,
  - The aft transfer valves.
 And, by operating the trim tank forward transfer pump.  
 Center tank overflow must be manually prevented.
- FAULT It : The amber light and the ECAM caution come on when :
- The FMGS detects an excess aft CG, based on the THS position (independent of fuel quantity), or
  - The FCMC is unable to carry out the forward transfer.
  - The FUEL LO TEMP warning is triggered.

**⑤ T. TANK FEED sel**

- AUTO : Stops the forward transfer when the trim tank is at low level, to maintain the transfer line full.
- ISOL : The transfer line is isolated as the following valves close :
- trim tank isolation valve
  - trim tank inlet valve
  - auxiliary forward transfer valve
  - trim pipe isolation valve.
- OPEN : The valves used during a manual forward transfer, and the trim tank inlet valve open. The valves remain open, until 3 minutes after the trim tank is low, to allow drainage of the transfer pipe.

*Note : APU supply is not possible, when the pipe is drained.*

**⑥ X FEED 1 (4) pb**

- AUTO : Both valves automatically open :
- In electrical emergency configuration
  - Or, during jettison operation.
- ON : The valve opens.
- OPEN It : The green light comes on when the valve is fully open.

**⑦ X FEED 2 (3) pb**

- AUTO : Both valves automatically open :
- In electrical emergency configuration,
  - During jettison operation,
  - During aft transfer from the inner tanks.
- ON : The valve opens.
- OPEN It : The green light comes on when the valve is fully open.

**⑧ CTR TANK XFR pb**

- AUTO : The FCMC controls the center to inner tank transfer.
- MAN : Initiates the center to inner tank transfer :
- By opening the inner tank inlet valves,
- To avoid inner tank overflow, the center tank pumps may be selected off.
- FAULT It : The amber light and the ECAM caution come on when :
- The inner tank low level is reached and the center tank is not empty or,
  - The FCMC is unable to carry out the transfer to the inner tanks.

⑨ OUTR TANK XFR pb (guarded)

**AUTO** : The FCMC controls the outer to inner tank transfer.

**ON** : Initiates the outer to inner tank transfer by opening the :

- Outer transfer valves,
- Outer inlet valves,
- Inner inlet valves.

**FAULT It** : The amber light and the ECAM caution come on when :

- The inner tank low level is reached and the center tank is not empty, or
- The FCMC is unable to carry out the transfer to the inner tanks.
- The FUEL LO TEMP warning is triggered.

**⑤ T. TANK FEED sel**

- AUTO : Stops the forward transfer when the trim tank is at low level, to maintain the transfer line full.
- ISOL : The transfer line is isolated as the following valves close :  
– trim tank isolation valve  
– trim tank inlet valve  
– auxiliary forward transfer valve  
– trim pipe isolation valve  
The trim tank forward transfer pump stops.
- OPEN : The valves used during a manual forward transfer, and the trim tank inlet valve open. The valves remain open, until 3 minutes after the trim tank is low, to allow drainage of the transfer pipe.

*Note : APU supply is not possible, when the pipe is drained.*

**⑥ X FEED 1 (4) pb**

- AUTO : Both valves automatically open :  
– In electrical emergency configuration  
– Or, during jettison operation.
- ON : The valve opens.
- OPEN It : The green light comes on when the valve is fully open.

**⑦ X FEED 2 (3) pb**

- AUTO : Both valves automatically open :  
– In electrical emergency configuration,  
– During jettison operation,  
– During aft transfer from the inner tanks.
- ON : The valve opens.
- OPEN It : The green light comes on when the valve is fully open.

**⑧ CTR TANK XFR pb**

- AUTO : The FCMC controls the center to inner tank transfer.
- MAN : Initiates the center to inner tank transfer :  
– By opening the inner tank inlet valves,  
To avoid inner tank overflow, the center tank pumps may be selected off.
- FAULT It : The amber light and the ECAM caution come on when :  
– The inner tank low level is reached and the center tank is not empty or,  
– The FCMC is unable to carry out the transfer to the inner tanks.

⑨ OUTR TANK XFR pb (guarded)

**AUTO** : The FCMC controls the outer to inner tank transfer.

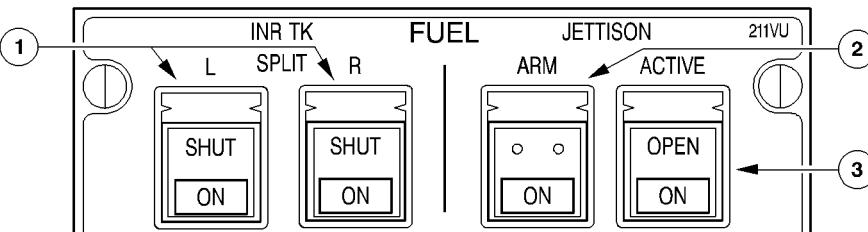
**ON** : Initiates the outer to inner tank transfer by opening the :

- Outer transfer valves,
- Outer inlet valves,
- Inner inlet valves.

**FAULT It** : The amber light and the ECAM caution come on when :

- The inner tank low level is reached and the center tank is not empty, or
- The FCMC is unable to carry out the transfer to the inner tanks.
- The FUEL LO TEMP warning is triggered.

FFC5-01-2820-005-A001AA



**① INR TK SPLIT L (or R) pb (guarded)**

- Off : The split valve (inner tank division) is open.  
The inner tank is used as a single tank.
  - ON : The valve closes and the inner tank is split into two parts.
    - The forward part feeds the inboard engine.
    - The aft part feeds the outboard engine and receives any fuel transferred to the inner tank from the center, outer or trim tank.
- The light comes on white.  
SHUT : The light comes on blue, when the valve is shut.

**② JETTISON ARM pb (guarded in Off)**

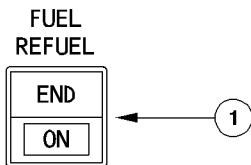
- Off : Jettison is disarmed.
- ON : Jettison is armed and can be activated via the ACTIVE pushbutton.

**③ JETTISON ACTIVE pb (guarded in Off)**

- Off : Jettison is inactive.
- ON : Jettison is activated, provided the ARM pushbutton is set to ON.
- OPEN It : Comes on when the jettison valves are open.

MAINTENANCE PANEL ▲

FC5-01-2820-006-A001AA



R ① REFUEL pushbutton

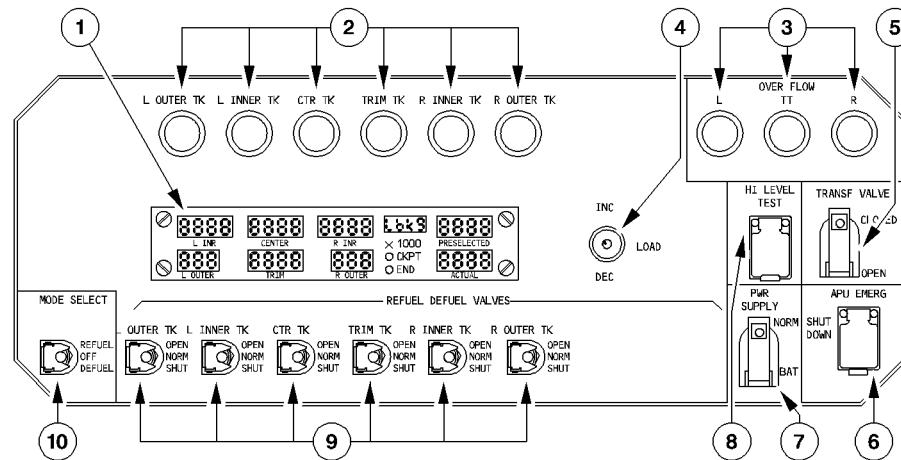
ON : Refueling is initiated according to the BLOCK FUEL quantity displayed on the FMGS MCDU INIT B page.

END It : Indicates that refueling is completed.

R Flashes when refueling is aborted, or when the high level test is negative.

**REFUELING CONTROL PANEL**

FFC5-01-2820-007-A001AA

**① FUEL QUANTITY indicator**

Displays, in kg (or lbs)  $\times 1000$  :

- The fuel quantity of each tank.
  - The pre-selected total quantity. At electrical power up (or FCMC reset), the display shows the ACTUAL value minus 500 kg (1100 lbs). Otherwise, the last pre-selected value is displayed.
  - The actual total fuel on board.
  - The applicable units (kg or lbs).
  - The CKPT light : Comes on when a BLOCK FUEL value has been entered and confirmed on the cockpit MCDU.
  - The END light, which flashes when :
    - There is an imbalance greater than 3000 kg (6620 lbs), after refueling.
    - A failure is detected during a high level test.
    - Refueling is aborted.
- Once refueling is finished, the END light stays on.

**② HI LVL lt**

- Comes on blue, when high level is detected (i.e. both high level sensors are wet).
- The corresponding refuel valve automatically closes.

③ OVERFLOW lt

- Comes on amber, when the associated vent tank overflow sensor is covered with fuel.

④ INC / DEC preselector rocker sw

- Pressing either side of the switch increases or decreases the preselected quantity.

⑤ TRANSF VALVE sw (guarded in CLOSED)

CLOSED : Transfer valves are closed.

OPEN : If the inner tank pumps are on for ground transfer, the aft transfer valves open. The trim tank inlet valve closes.

⑥ APU EMER pb (guarded)

When pressed, it initiates the APU shutdown sequence.

⑦ POWER SUPPLY sw (guarded in NORM)

NORM : Refueling / Defueling can be supplied either by external power or with the APU generator on line.

BAT : Refueling / Defueling is battery-powered.

⑧ HI LEVEL TEST sw (guarded)

During the test :

- Refueling stops.
- HI LEVEL and OVERFLOW lights come on, if their circuits are serviceable.
- CKPT and END lights come on.
- The PRESELECTED and ACTUAL fuel quantity display all 8s.

If a failure occurs during the high level test :

- The END light flashes and remains flashing after completion.
- The affected HI LVL light remains on.

⑨ REFUEL / DEFUEL VALVES sel (guarded in NORM)

NORM : Refuel / Defuel valves are automatically controlled.

OPEN : Valves open when the MODE SELECT switch is set to the REFUEL or DEFUEL position. In the REFUEL position, each refuel/defuel valve closes when high level is detected in the associated tank.

SHUT : Valves close.

**(10) MODE SELECT sw (guarded at OFF)**

**OFF** : Refueling system is off.

Refuel valves close.

APU emergency shutdown and high level test remain available.

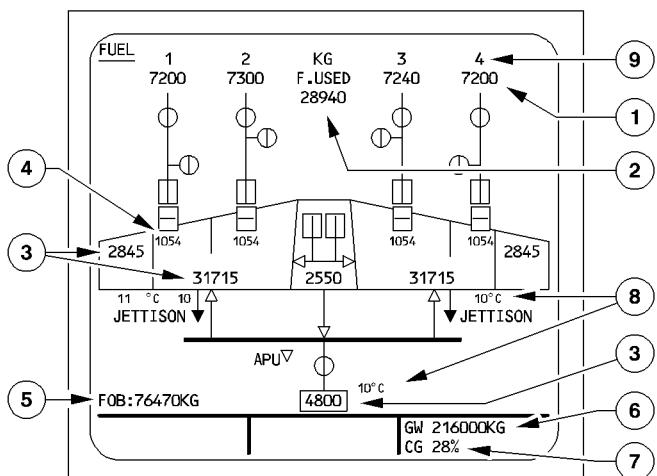
**REFUEL** : Refuel valves operate in automatic or manual mode, depending on the REFUEL / DEFUEL VALVES switch position.

**DEFUEL** : Refuel valves are open.

**ECAM FUEL PAGE**

**FUEL QTY, TEMP, GW AND CG INDICATIONS**

FFC5-01-2820-009-A001AB



**(1) Fuel used indication (per engine)**

- It is normally green.
- If the fuel flow detection system fails, the FADEC computes a synthetic FU value.
- When this computed value is considered erroneous by more than 136 kg (300 lbs), the displayed value is crossed out with two amber bars.
- Units may either be in KG or LB, depending on the DMC pin program.

**② Total fuel used indication**

- It is normally green.
- When either “engine fuel used” is crossed, two amber bars appear across the value.
- Units may either be in KG or LB, depending on the DMC pin program.

**③ Fuel quantity indication**

- It is normally green.
- When the fuel quantity indication is inaccurate, two amber bars appear across the last two digits.
- If the fuel is unusable (trim or outer tanks only), the quantity indication is displayed in an amber box.
- A partial amber box appears, if 15 tonnes of the center tank fuel is unusable.
- The fuel quantity indication becomes amber, in case of low level (inner tank only) or overflow.
- In the event of imbalance of more than 3 000 kg (6622 lbs) between the left and right wing tanks, fuel quantity pulses in the inner and outer tanks.
- Units may either be in KG or LB, depending on the DMC pin program.

**④ Collector cell fuel quantity indication**

- It is normally green.
- When the fuel quantity indication is inaccurate, two amber bars appear across the last two digits.
- Units may either be in KG or LB, depending on the DMC pin program.

**⑤ Fuel on board quantity indication**

- It is normally green.
- In case of degraded accuracy, the last two digits are dashed.

*Note : In case any tank's fuel is partially unusable, the quantity indication is displayed in a partial amber box.*

**⑥ Gross weight indication**

- It is normally green.
- When the fuel quantity indication is inaccurate, two amber bars appear across the last two digits.
- When the gross weight is not computed on ground, blue dashes appear.
- Units may either be in KG or LB, depending on the DMC pin program.

**⑦ Center of gravity indication**

- It is normally green.
- When the FMGC (FE part) detects an excess aft CG, it comes on red.
- When the CG is not computed on ground, blue dashes appear.

**⑧ Fuel temperature indication**

- It is normally green.
- It is amber in the following cases :
  - Inner tanks : Above 49°C in flight, or 45°C on ground.
  - Outer or trim tanks : Below – 40°C.
  - Inner tanks : Below – 35°C.
- It disappears when the tank quantity is below :
  - 1000 kg (2200 lbs) for the trim tank.
  - 1100 kg (2420 lbs) for the outer tank.

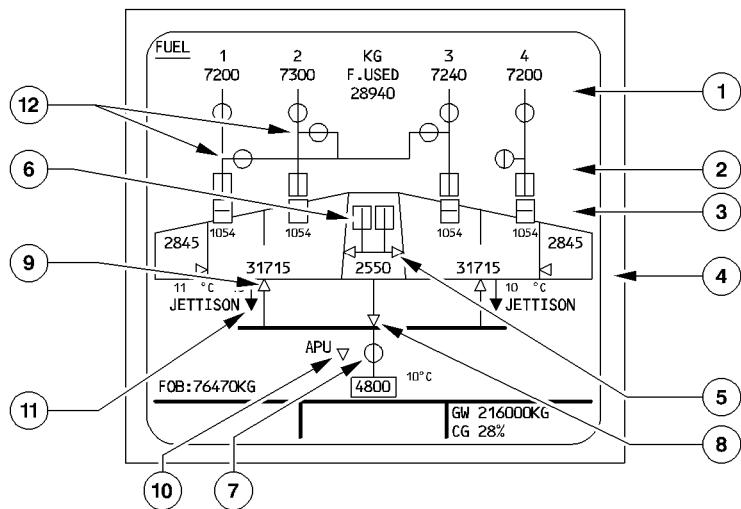
*Note : Fuel temperature is not indicated for the right outer tank.*

**⑨ Engine number**

- It is white when the engine is running.
- It is amber when the engine is not running.

**FUEL FEED, TRANSFER AND JETTISON INDICATIONS**

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**① Engine LP valves indication**

- In line – Green : Valve is open.
- In line – Amber : Valve is jammed open.
- Cross line – Amber : Valve is closed.
- Transit – Amber : Valve is in transit.

**② Engine feed pumps indication**

- In line – Green : Pump is running.
- In line – Amber : Pump abnormally running.
- Cross line – Amber : Pump not running.
- "LO" – Amber : Pump pressure is low. Pump is on.

**③ Stand-by engine feed pumps indication**

Are identical to the normal pump, except for pump not running.  
 Cross line – Green : Pump not running.  
 Cross line – Amber : Pump abnormally not running.

**④ Outer to inner transfer indication**

- ▷ Green : Normal transfer (auto).
- ▶ Green : Manual transfer.
- ▶ Amber : Abnormal transfer.
- No display : No transfer.

**⑤ Center to inner transfer indication**

Identical to the transfer from outer tanks.

**⑥ Center tank pumps indication**

Identical to the standby wing tank pumps.

**⑦ Trim tank isolation indication**

This valve represents the trim tank isolation valve and the trim tank inlet valve.

- In line – Green : One valve is open.
- Cross line – Green : Both valves are closed.
- In line – Amber : One valve is abnormally open.
- Cross line – Amber : Both valves are jammed closed.

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**FUEL**

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**(8) Trim to center transfer indication**

- No display : No transfer.  
Green : Manual forward ( $\uparrow$ ) transfer.  
Green : Normal aft ( $\downarrow$ ) or forward ( $\uparrow$ ) transfer (auto).  
Amber : Abnormal aft ( $\downarrow$ ) or forward ( $\uparrow$ ) transfer.

**(9) Trim to inner transfer indication**

- No display : No transfer.  
Green : Normal aft ( $\downarrow$ ) or forward ( $\uparrow$ ) transfer.  
Amber : Abnormal aft ( $\downarrow$ ) or forward ( $\uparrow$ ) transfer.  
If fuel transfers to/from only one inner tank due to a fuel imbalance, only one arrow is displayed.

**(10) APU LP valve indication**

- APU (White)  $\nabla$  (White) : Valve is closed.  
APU (White)  $\nabla$  (Green) : Fuel provided to the APU.  
APU (Amber)  $\blacktriangledown$  (Amber) : Failed open.  
APU (Amber) : Failed closed.

**(11) Jettison indication**

- No display : No jettison.  
 $\downarrow$  JETTISON (Green) : Jettison normally active.  
 $\downarrow$  JETTISON (Amber) : Abnormal jettison (valve jammed open).  
JETTISON (Amber) : Valve failed closed.

**(12) X-Feed valve**

- Cross line – Green : Valve is closed.  
In line – Green : Valve is open.  
Cross line – Amber : Valve is jammed closed.  
In line – Amber : Valve is jammed open.  
Transit – Amber : Valve is in transit.



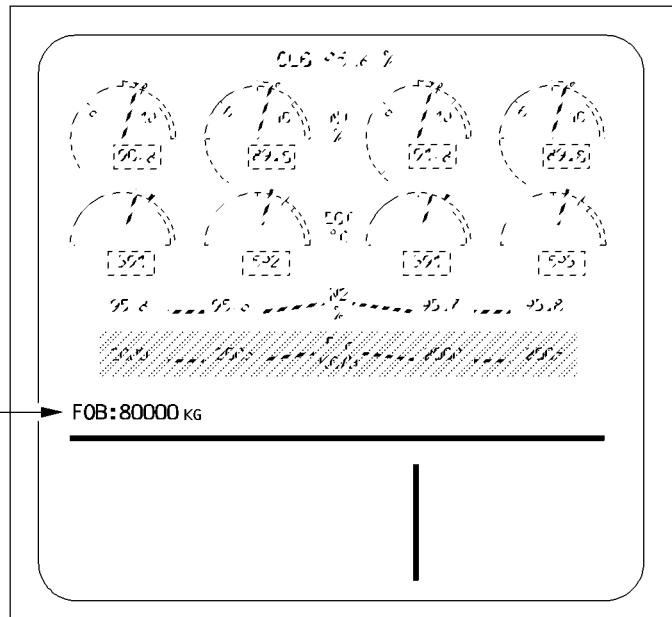
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CONTROLS AND INDICATORS

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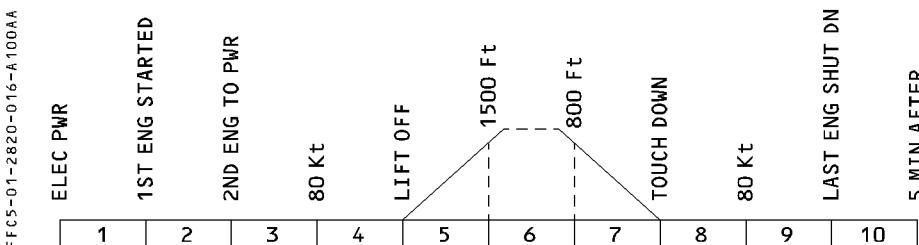
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**ECAM UPPER DISPLAY**

FFC5-01-2820-015-A002AC

**① FOB - Fuel on Board indication**

- It is normally green.
- An amber half box appears around FOB, when the indicated quantity is not fully usable.
- When the fuel quantity indication is inaccurate, two amber lines appear across the last two digits.
- Units may be indicated in kg or lbs.

**WARNINGS AND CAUTIONS**

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXCESS AFT CG	CRC	MASTER WARN		T TK XFR FAULT It	2 to 4, 8 to 10
PUMPS 1(2)(3)(4) + STBY LO PR Dual pump failure in one collector cell				PUMP and STBY PUMP FAULT Its	1, 3, 4 5, 7, 8, 10
L(R) WING PUMPS LO PR All pumps of the same wing low pressure				associated PUMP FAULT Its	4, 5, 7, 8
L + R CTR PUMPS LO PR					4, 5, 7, 8
ENG 1(2)(3)(4) LP VALVE FAULT valve disagree					3 to 8
ZFW ZFCG DISAGREE Disagree between the pilot entered values and the FCMC values					4, 5, 7, 8
JETTISON NOT CLOSED valve disagree in open position					3 to 5 7 to 9
JETTISON FAULT One wing tank low level sensor is failed.	NIL	NIL			3, 4, 5, 7, 8, 9
L(R) WING TK LO LVL Both level sensors of one inner tank have been dry for more than 60 seconds (Fuel quantity below 2700 kg/5952 lbs).					3, 4, 5, 7, 8, 9
L + R WING TK LO LVL All of the four level sensors in the inner tanks have been dry for more than 60 seconds (Fuel quantity in each tank below 2700 kg /5952 lbs).					3, 4, 5, 8
WING TK OVERFLOW One of the wing surge-tank overflow sensors has been wet for more than 25 seconds.					3, 4, 5, 7, 8
CTR TO INNER FAULT In case an anomaly is detected during CTR to INR XFR or an inlet valve of INR, OUTR tank is failed open				CTR XFR + PUMP FAULT It	4, 5, 7, 8
OUTR TO INR FAULT				OUTR TK XFR It	
T TANK XFR FAULT				TRIM TK FAULT It	3, 4, 5 7, 8
APU LP VALVE FAULT Valve disagree				NIL	

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
FCMC 1 + 2 FAULT Loss of automatic XFR control.	SINGLE CHIME	MASTER CAUT	FUEL	NIL	4, 5, 8
TRIM LINE FAULT Damage on the trim line, or in case of a trim tank isolation failure.				OUTR and TRIM TK FAULT It	
FUEL LO TEMP Inner fuel temp < -35°C Outer fuel temp < -40°C Trim fuel temp < -40°C	NIL	NIL	associated PUMP FAULT It	NIL	
L(R) INR TK HI TEMP Inner fuel temp > 49°C in flight Inner fuel temp > 45°C on ground				3, 4, 5, 7, 8	
PUMP 1(2)(3)(4) LO PR	SINGLE CHIME	MASTER CAUT	FUEL	NIL	1, 2, 3, 9, 10
L(R) CTR PUMP LO PR					
APU AFT PUMP FAULT	NIL	NIL	FUEL	NIL	1, 3, 4, 5, 7, 8, 10
X FEED 1 (2)(3)(4) FAULT Valve disagree.					
FCMC 1(2) FAULT	SINGLE CHIME	MASTER CAUT	FUEL	NIL	1, 3, 4, 5, 7, 8, 10
ABNORM MAN FWD XFR Pitch attitude is greater than 3.4° for more than 30 seconds, and T TANK MODE pb selected FWD, or TRIM TANK FEED sel selected OPEN.					
MAN XFR COMPLETED Manual XFR selected ON, and center or outer tank emptied.	SINGLE CHIME	MASTER CAUT	FUEL	NIL	1 to 5 7 to 10
NO WEIGHT/CG DATA No data inserted on INIT B page at engine start.					
FUEL FU/FOB DISCREPANCY Difference between initial FOB and current FOB plus fuel used data is more than 3500 kg.					
CELL NOT FULL On one wing side, the forward collector cell's fuel quantity is less than 500 kg and the split valve is closed ; or, on both wing sides, both forward collector cells' fuel quantities are less than 600 kg, and the split valves are closed.					

**MEMO DISPLAY**

- REFUEL IN PROCESS message is displayed in green in phases 1 and 10, if the refuel panel switches are not set in the appropriate position for flight.
- REFUEL PNL message is displayed in amber in phase 2 (after engine start) if the refuel panel or the cockpit refuel pushbutton () are not set in the appropriate position for flight.
- T TK XFRD message is displayed in flight phases 6, 7, 8, 9 when the trim tank has been emptied following a forward transfer.
- TRIM TK XFR message is displayed in green during trim tank transfer.
- OUTR TK XFRD message is displayed in green when the outer tank has been transferred into the inner tank.
- OUTR TK XFR message is displayed in green during outer tank transfer into the inner tank.
- FUEL X FEED message is displayed in green when at least two adjacent X Feed valves are open (automatically or manually). It becomes amber during takeoff (phases 3, 4, 5).

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**FUEL**

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**CONTROLS AND INDICATORS**

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E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
FCMC 1 + 2 FAULT Loss of automatic XFR control.	SINGLE CHIME	MASTER CAUT	FUEL	NIL	4, 5, 8
TRIM LINE FAULT Damage on the trim line, or in case of a trim tank isolation failure.				OUTR and TRIM TK FAULT It	
FUEL LO TEMP Inner fuel temp < -35°C Outer fuel temp < -40°C Trim fuel temp < -40°C	NIL	NIL	associated PUMP FAULT It	NIL	
L(R) INR TK HI TEMP Inner fuel temp > 49°C in flight Inner fuel temp > 45°C on ground				3, 4, 5, 7, 8	
PUMP 1(2)(3)(4) LO PR	SINGLE CHIME	MASTER CAUT	FUEL	NIL	1, 2, 3, 9, 10
L(R) CTR PUMP LO PR					1, 3, 4, 5, 7, 8, 10
APU AFT PUMP FAULT	NIL	NIL	FUEL	NIL	3, 4, 5, 7, 8
X FEED 1 (2)(3)(4) FAULT Valve disagree.					1, 3, 4, 5, 7, 8, 10
FCMC 1(2) FAULT	SINGLE CHIME	MASTER CAUT	FUEL	NIL	1 to 5 7 to 10
ABNORM MAN FWD XFR Trim TK pump failed, and pitch attitude is above 3.4° for more than 30 seconds, and T TANK MODE pb selected FWD, or TRIM TANK FEED sel selected OPEN.					1, 2, 3, 9, 10
MAN XFR COMPLETED Manual XFR selected ON, and center or outer tank emptied.					
TRIM TK PUMP LO PR	SINGLE CHIME	MASTER CAUT	FUEL	NIL	1, 3, 4, 5, 7, 8, 10
NO WEIGHT/CG DATA No data inserted on INIT B page at engine start.					3, 4, 5, 7, 8
FUEL FU/FOB DISCREPANCY Difference between initial FOB and current FOB plus fuel used data is more than 3500 kg.					1, 3, 4, 5, 7, 8, 10
CELL NOT FULL On one wing side, the forward collector cell's fuel quantity is less than 500 kg and the split valve is closed ; or, on both wing sides, both forward collector cells' fuel quantities are less than 600 kg, and the split valves are closed.					

**MEMO DISPLAY**

- REFUEL IN PROCESS message is displayed in green in phases 1 and 10, if the refuel panel switches are not set in the appropriate position for flight.
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- T TK XFRD message is displayed in flight phases 6, 7, 8, 9 when the trim tank has been emptied following a forward transfer.
- TRIM TK XFR message is displayed in green during trim tank transfer.
- OUTR TK XFRD message is displayed in green when the outer tank has been transferred into the inner tank.
- OUTR TK XFR message is displayed in green during outer tank transfer into the inner tank.
- FUEL X FEED message is displayed in green when at least two adjacent X Feed valves are open (automatically or manually). It becomes amber during takeoff (phases 3, 4, 5).

## BUS EQUIPMENT LIST

FOR INFO

			NORM		EMER ELEC			
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
FCMC	1	Main					SHED	
		Level Sensing					SHED	
	2	Main		DC2			X (1)	
		Level Sensing					SHED	
INNER TANK PUMPS	1					X (3)	X	
	2	AC1-2	DC1					
	3	AC2-3	DC2					
	4	AC2-4	DC2					
	STBY 1	AC2-3	DC2					
	STBY 2	AC2-4	DC2					
	STBY 3	AC1-2	DC1					
	STBY 4		DC1 (2)			X (3)	X (2)	
TRIM TK FWD XFR PUMP ↳			AC2-3	DC2				
CTR TK TRANSFER PUMPS	1	AC1-2	DC1					
	2	AC2-3	DC2					
CROSS FEED VALVES	MOTOR 1					X		
	MOTOR 2		DC2					
ENGINE LP VALVES	MOTOR 1						X	
	MOTOR 2		DC2					
AFT XFR VALVES	LH		DC1					
	RH		DC2					
TRIM TK ISOL VALVE						X		
TRIM PIPE ISOL VALVE						X	X (1)	
AUX FWD XFR VALVE						X		
OUTR TK XFR VALVES						X		

(1) HOT BUS supply during refueling on batteries

(2) Normal control is from DC1.

In emergency configuration, if the normal PUMP 1 is failed or switched OFF, then control of STBY PUMP 4 is automatically switched to DC ESS BUS.

(3) This supply is lost in emergency configuration :

- On batteries ;
- If the EMER GEN is powered by the RAT, when LAND RECOVERY is selected, or when the speed is below 260 knots (whichever occurs first) ;
- If the EMER GEN is powered by an engine-driven pump, when LAND RECOVERY is selected.

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
TANK INLET VALVES	TRIM TK					X	X (1)
	LH OUTR		DC1				
	RH OUTR		DC1				
	LH INR		DC1				
	RH INR				X	X (1)	
	CTR		DC2				X (1)
APU	AFT AND FWD PUMPS				X		
	ISOL VALVE						X
	LP VALVE			X			X
JETTISON VALVES L AND R	MOT 1		DC1				
	MOT 2		DC1				
REFUEL VALVES				X			X (1)

(1) HOT BUS supply during refueling on batteries

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FLIGHT CREW OPERATING MANUAL

**HYDRAULIC****CONTENTS**

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**29.00 CONTENTS****29.10 DESCRIPTION**

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**29.20 CONTROLS AND INDICATORS**

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– ECAM HYD PAGE . . . . .	4
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**29.30 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
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**GENERAL**

The aircraft has three continuously operating hydraulic systems : blue, green, and yellow. Each system has its own hydraulic reservoir. Normal system operating pressure is 3000 PSI (2500 PSI when powered by the RAT). Hydraulic fluid cannot be transferred from one system to another.

The system is monitored by a Hydraulic System Monitoring Unit (HSMU).

**GENERATION****GREEN SYSTEM PUMPS**

Two pumps driven by engines 1 and 4 pressurize the green system.

An electric pump which can be manually or automatically controlled can also pressurize the green system.

- R The electric pump automatically runs :
  - in flight for 25 seconds in the event of failure of engine 1 or 4, when landing gear lever is selected up (to ensure gear retraction in a proper time).
  - on the ground when engines 1 and 4 are stopped and engines 2 and 3 are running (to provide braking and nose wheel steering for taxi).
- R A pump driven by a ram air turbine (RAT) pressurizes the green system in an emergency. When the RAT pressurizes the green system, the aileron, elevator and spoiler servo control operating speeds are reduced.

**BLUE SYSTEM PUMPS**

A pump driven by engine 2 pressurizes the blue system.

A manually controlled electric pump can also pressurize the system.

**YELLOW SYSTEM PUMPS**

A pump driven by engine 3 pressurizes the yellow system.

In addition, an electric pump which can be manually or automatically controlled can also pressurize the yellow system. This enables ground operations when the engines are stopped.

- R The electric pump runs :
  - in flight, in the event of engine 3 failure, if the FLAPS lever is not at 0 and aircraft speed is above 100 knots (to ensure flap retraction in a proper time at takeoff). In this case, the pump runs continuously until last engine shut down.
  - on the ground during cargo door operation.

Crew members can also use a hand pump to pressurize the yellow system in order to operate the cargo doors when no electrical power is available.

Note : On each system, the electric pump flow is about 18 % of the engine driven pump flow capacity. It can be used to retract the surfaces but should not be used to replace the engine driven pumps.

### **RAM AIR TURBINE (RAT)**

A drop-out RAT coupled to a hydraulic pump allows the green system to function. The RAT may be extended at any time by pressing the RAT MAN ON pushbutton. The RAT deploys automatically in the event of four engine failure or electrical power loss when engines 1 and 4 are stopped (RAT required for EMER GEN operation) or a low level in the green and blue reservoirs. It can be deployed manually from the overhead panel. It can be stowed only when the aircraft is on the ground.

**FOR INFO**

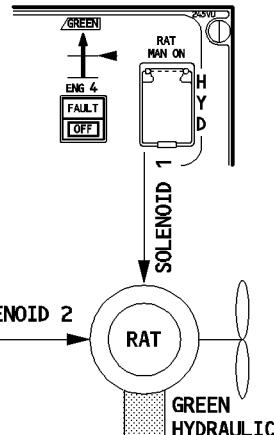
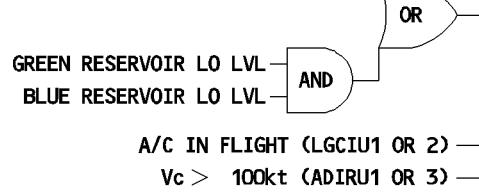
FFC5-01-2910-002-A001AB

FOUR ENGINES FAILED ( $N_2 < 50\%$ )

RAT REQUIRED FOR EMER GEN  
OPERATION (REFER TO 1.24.10)

GREEN RESERVOIR LO LVL  
BLUE RESERVOIR LO LVL

A/C IN FLIGHT (LGCIU1 OR 2)  
 $V_c > 100\text{kt}$  (ADIRU1 OR 3)



Note : The RAT flow varies between 15 % and 45 % of an engine driven pump flow capability according to the aircraft speed.

### **SYSTEM ACCUMULATORS**

An accumulator in each system helps to maintain a constant pressure by covering transient demands during normal operation.

## **PRIORITY VALVES**

A priority valve cuts off hydraulic power to heavy load users if green system hydraulic pressure gets low.

## **FIRE SHUTOFF VALVES**

Each of the green, blue and yellow systems has a fire shutoff valve in its line upstream of its engine-driven pump. The flight crew can close it by pushing the FIRE pushbutton.

The ENG 1 and ENG 4 fire shutoff valves are automatically closed by the HSMU in the event of green reservoir low level. This enables isolation of a possible leak in the engine pylon allowing restoration of the green system using the RAT, in the event of a further blue reservoir low level. The flight crew cannot re-open the fire shutoff valves in flight once they

- R have been automatically closed.

## **FILTERS**

**FOR INFO**

*Filters clean the hydraulic fluid as follows :*

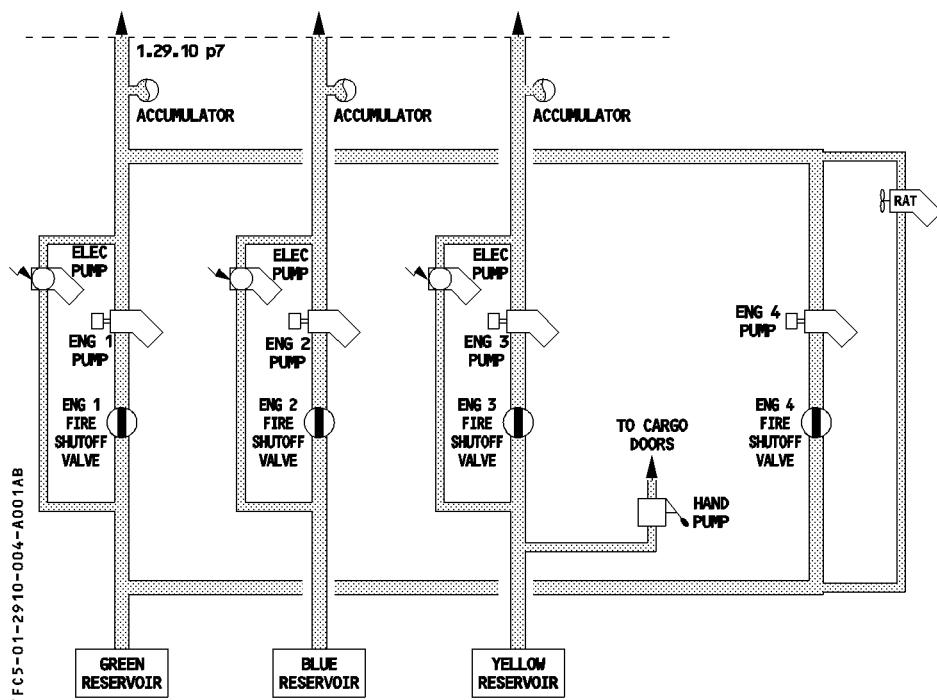
- HP filters on each system and on the reservoir filling system and the normal braking system
- return line filters on each line
- case drain filters on engine pumps (which permit maintenance to monitor engine wear by inspecting the filters for the presence of metallic particles).

## **HYDRAULIC SYSTEM MONITORING UNIT (HSMU)**

The HSMU monitors the hydraulic system.

It processes :

- R
- Control and monitoring of electric pumps
  - RAT extension
  - ENG 1 and ENG 4 fire shutoff valve closure in case of green reservoir low level
  - Hydraulic quantity indication correction for fluid temperature
  - Reservoir overheat warning
  - FAULT light illumination logic
  - LEAK MEASUREMENT VALVE control (closure inhibited in flight, closure of yellow valve during cargo door operation).

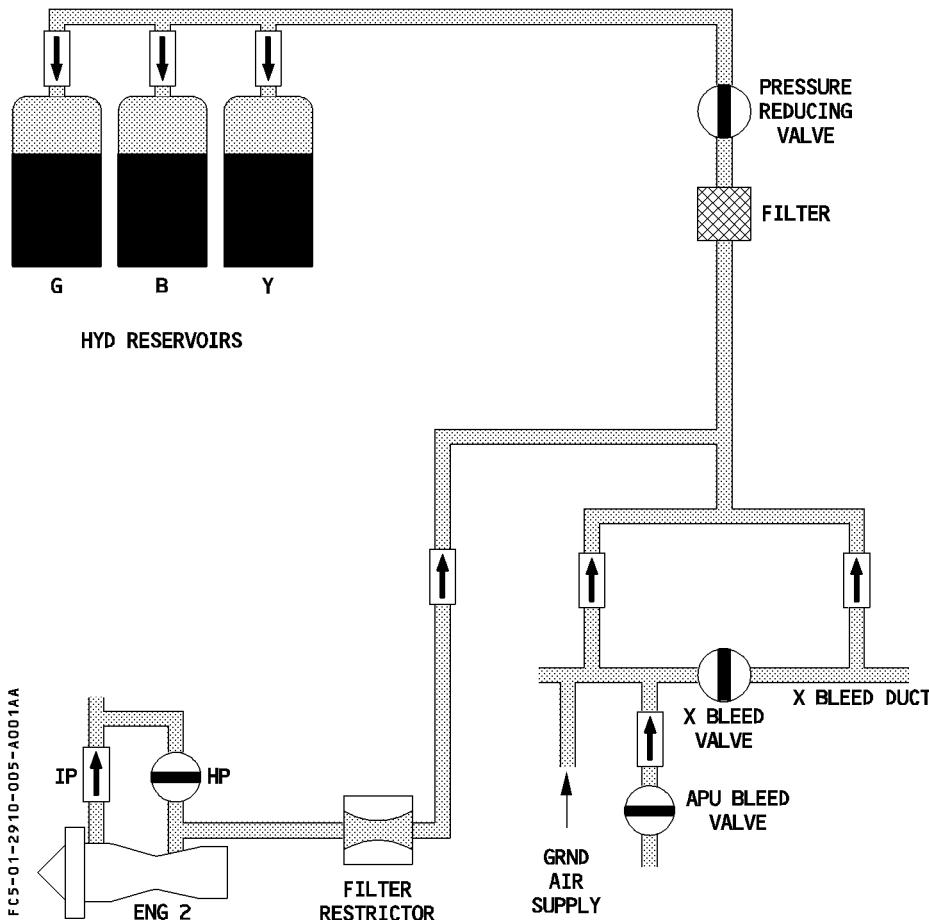
**HYDRAULIC GENERATION**

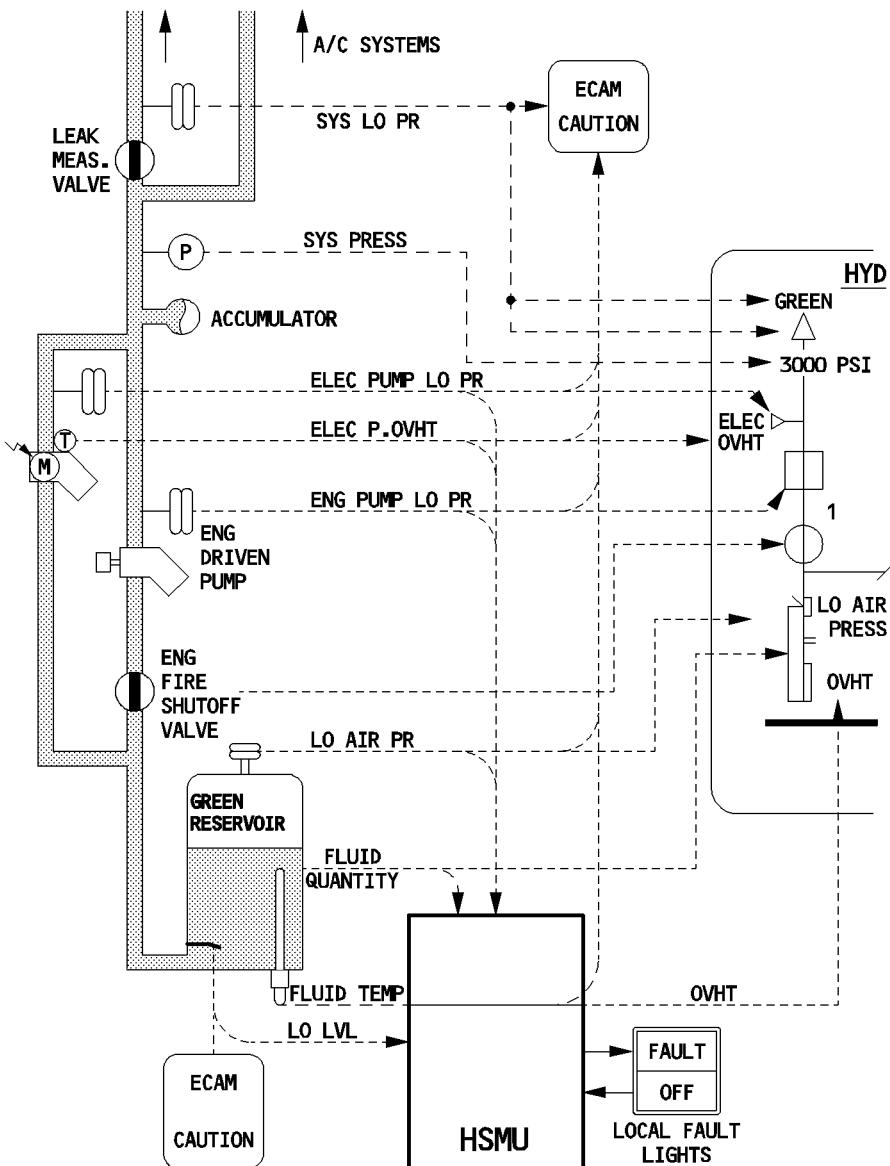
## RESERVOIR PRESSURIZATION

Normally, HP bleed air from engine 2 pressurizes the hydraulic reservoirs automatically. If the bleed air pressure is too low, the system takes bleed air pressure from the crossbleed duct.

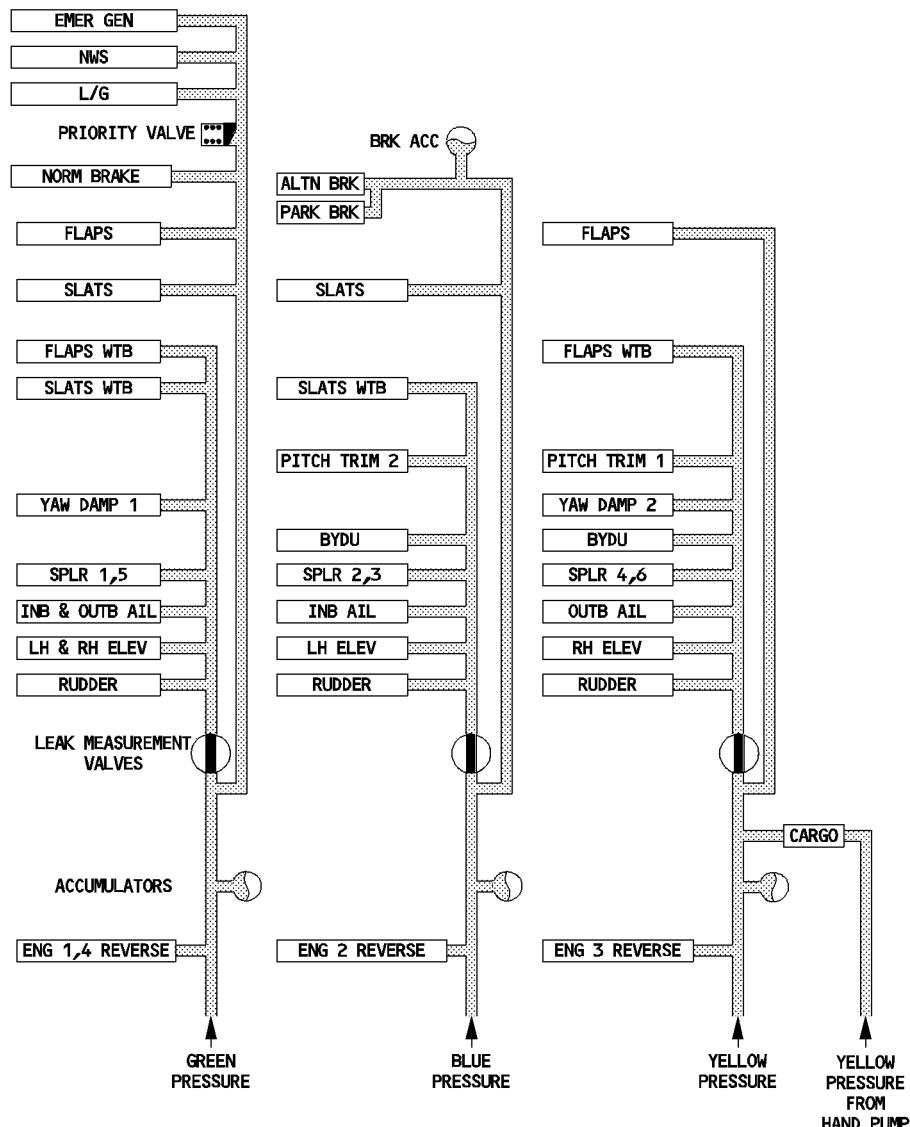
The systems maintain a high enough pressure to prevent their pumps from cavitating.

**FOR INFO**



**INDICATIONS**

FFC5-01-2910-006-A001AC

**DISTRIBUTION**

FFC5-01-2910-007-A001AB

## **LEAK MEASUREMENT VALVES**

Used only on ground.

Leak measurement valves are positioned upstream of the primary flight controls. They are used for the leak measurement of each system and may only be closed on ground, by using the LEAK MEASUREMENT VALVES pushbutton on the maintenance panel. The yellow valve is automatically closed during cargo door operation.

- R The HSMU inhibits the closure of the green, blue and yellow hydraulic leak measurement valves in flight.

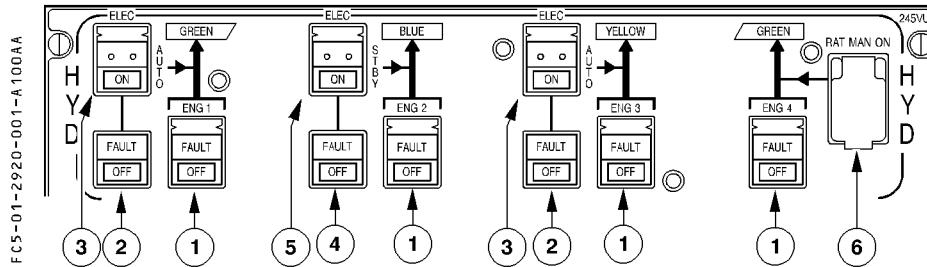
## **PRIORITY FUNCTION**

In the event of low hydraulic pressure, a priority valve cuts off hydraulic power to heavy load users (emergency generator, nosewheel steering, landing gear) in order to keep the pressure for normal braking and flight controls.

- R A Pressure-Off Brake system (installed on the flaps, slats, and THS actuator) ensures the same function.

**OVERHEAD PANEL**

R

**① ENG 1 (2, 3, or 4) PUMP pushbutton (guarded)**

- On : The pump pressurizes the system, when the engine is running.
- OFF : The pump is depressurized. Hydraulic power generation stops.
- FAULT It : This amber light and an associated ECAM caution come on, if :
- The reservoir level is low
  - The reservoir overheats
  - Reservoir air pressure is low
  - The pump pressure is low (inhibited on ground, when the engine is stopped).
- This light goes off, when the crew selects OFF, except during an overheat. (The light stays on, for as long as the overheat lasts).

**(2) GREEN (or YELLOW) ELEC PUMP pushbutton**

- AUTO** : The HSMU automatically controls the pump :
- The green electric pump runs :
    - For 25 seconds, in the event of an Engine 1 or 4 failure, when the landing selector lever is selected up and the aircraft speed is above 100 knots.
    - On ground, when Engines 1 and 4 are stopped, and Engines 2 and 3 are running.
  - The yellow electric pump runs :
    - In the event of an Engine 3 failure, if the FLAPS lever is not at zero and the aircraft speed is above 100 knots. It remains running until the last engine shutdown.
    - On ground, when the lever of the cargo door manual selector valve is set to the OPEN or CLOSE position. In this case, the yellow leak measurement valve closes, and yellow flap motor operation is inhibited.
- OFF** : The pump is off.
- FAULT lt** : This amber light, and an associated ECAM caution come on, if :
- The reservoir level is low, or
  - The reservoir overheats, or
  - Air pressure in the reservoir is low, or
  - The pump delivers low pressure (inhibited on the ground, when the engines are stopped), or
  - The pump overheats.
- R** : The light goes off when the crew selects OFF, except during an overheat.
- R** : In case of a reservoir overheat, the fault light stays on, until the overheat stops. In case of an electrical pump overheat, the light stays on, even if the overheat has stopped, and until the system is reset on ground.

*Note : If the yellow/green electric pump overheats, the pump automatically shuts down.*

**(3) GREEN (or YELLOW) ELEC PUMP ON pushbutton (springloaded-guarded)**

- AUTO** : The electric pump is controlled by the applicable ELEC PUMP pushbutton.
- ON** : The electric pump is on, provided the ELEC PUMP pushbutton is not selected OFF.
- After an electrical power interruption, the pump does not restart (ON light stays off).
- The ON light comes on blue when the pump is manually or automatically supplied.

**④ BLUE ELEC PUMP pushbutton**

- R Standby : The pump is controlled by the BLUE ELEC PUMP ON pushbutton.
- R OFF : The pump is off.
- R FAULT It : The amber fault light comes on (provided the blue electrical pump is running), along with an associated ECAM caution, if :
- The reservoir level is low, or
  - Air pressure in the reservoir is low, or
  - The reservoir overheats, or
  - Pump pressure is low, or
  - The pump overheats.
- The light goes off when the crew selects OFF, except during an overheat.  
In case of a reservoir overheat, the fault light stays on until the overheat stops. In case of an electrical pump overheat, the light stays on, even if the overheat has stopped, and until the system is reset on ground.

*Note : If the blue electric pump overheats, the pump automatically shuts down.*

**⑤ BLUE ELEC PUMP ON pushbutton (springloaded-guarded)**

- ON : The electric pump is on, provided the ELEC PUMP pushbutton is not selected OFF.  
If the electrical power supply is removed, the pump remains off when electrical power is applied again.
- STBY : The pump is off.

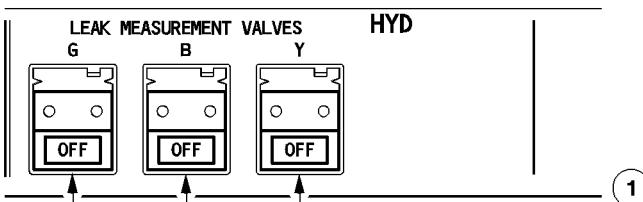
**⑥ RAT MAN ON pushbutton**

The flight crew may extend the RAT at any time by pressing the RAT MAN ON pushbutton.

*Note : The RAT automatically extends, if :*

- AC NORM buses, and Engines 1 and 4 fail, or
- Four engines fail, or
- GREEN + BLUE LO LVL

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R ① LEAK MEASUREMENT VALVES pushbutton (to be used on ground only)

OFF : The corresponding electrohydraulic valve closes, and shuts off hydraulic supply to the primary flight controls.

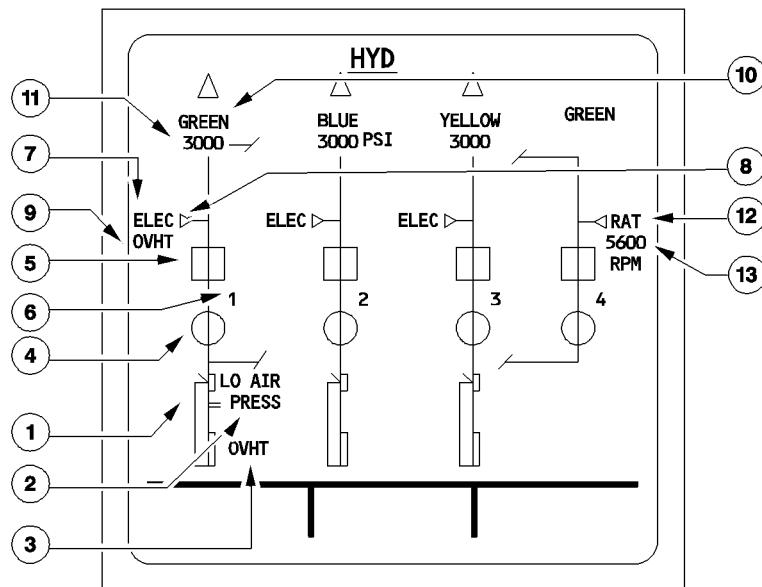
R This function and the OFF light are inhibited, when the aircraft speed is above

R 100 knots.

Note : On ground, the yellow valve is automatically closed when the cargo door is activated (to avoid inadvertent movement of flight control surfaces).  
The OFF light comes on.

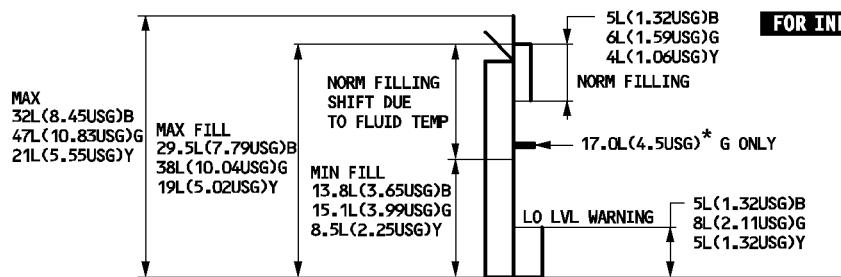
**ECAM HYD PAGE**

FFC5-01-2920-005-A001AA

**① Reservoir quantity**

This indication is in green, unless the fluid level goes below the warning level, in which case it becomes amber.

FFC5-01-2920-005-B001AA



\* A SINGLE WHITE BAR IS DISPLAYED WHEN ACTUAL FLUID LEVEL IS ABOVE 17L (4.5USG) AND IS REPLACED BY TWO AMBER BARS WHEN BELOW 17L.

- R Note : The normal filling range indication is corrected for fluid temperature effect. It is normally green. When the temperature information is not available, it is no longer corrected and the indication becomes white.

② Reservoir LO AIR PRESS

It is amber, and an associated caution appears on the ECAM, if the air pressure for the indicated reservoir drops below normal.

③ Reservoir OVHT

It is amber, and an associated caution appears on the ECAM, if the temperature of the returning hydraulic fluid, at the inlet to its reservoir, is above normal.

④ FIRE SHUTOFF VALVE

Crossline – Amber : The valve is fully closed.  
 In line – Green : The valve is partially closed.

⑤ ENG PUMPS control and low pressure indication

In line – Green : The designated PUMP's pushbutton is on, and hydraulic pressure is normal.  
 Crossline – Amber : The designated PUMP's pushbutton is off.  
 "LO" – Amber : The designated PUMP's pushbutton is on, and hydraulic pressure is low.

⑥ PUMP

It is white, and becomes amber when the corresponding engine's N2 is below idle.

⑦ ELEC

It is normally white. It becomes amber if the associated power supply fails, or if the pump is commanded on and does not provide normal pressure.

⑧ ELEC PUMP control

- ▷ White : – The electric pump is not commanded.
- ▷ Amber : – The electric pump is off.
- Green : – The electric pump is on.
- Amber : – The electric pump is on and the system has low pressure.

⑨ OVHT

- R It is amber, if the electric pump for that system overheats. This indication remains displayed on the ECAM, even if the overheat has stopped, and until the system is reset on ground.

**(10) System label (SYS LO PR sw)**

	PRESS > 1750 psi (press increasing)	PRESS < 1450 psi (press decreasing)
△	green	amber
GREEN	white	amber

**(11) System pressure**

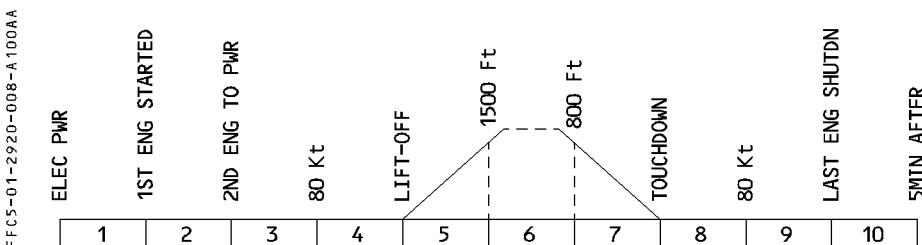
This legend, normally green, becomes amber when system pressure is below 1450 psi.

**(12) RAT control**

◁	RAT	MEANING
White	white	RAT stowed
Full green	white	RAT not stowed and RPM > 3000
White	amber	RAT fully stowed and stowing pressure applied
Full amber	amber	RAT not stowed and RPM < 3000

**(13) RPM**

R This appears in green when the rotation speed of the RAT is above 100 RPM.

**WARNINGS AND CAUTIONS**

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
B + Y SYS LO PR or G + B SYS LO PR or G + Y SYS LO PR System pressure ≤ 1450 psi Reset, if pressure ≥ 1750 psi	CRC	MASTER WARN			4, 5
G (Y)(B) RSVR LO AIR PR Reservoir air pressure ≤ 22 psi Reset, if air pressure ≥ 25 psi					3, 4, 5, 7, 8
G (Y)(B) RSVR OVHT Fluid temperature ≥ 95°C					4, 5 7, 8
G (Y)(B) RSVR LO LVL Fluid quantity : < 8L (2.11 USG)(Green) < 5L (1.32 USG)(Blue-Yellow)	SINGLE CHIME	MASTER CAUT	HYD	FAULT It on associated pump(s) pb	3*, 4, 5, 7, 8 * only for G ENG 1 (4)
G ENG 1(4) PUMP LO PR, or G ENG 1 + 4 PUMP LO PR, or B ENG 2 PUMP LO PR, or Y ENG 3 PUMP LO PR, or Engine pump pressure ≤ 1450 psi.					3, 4, 5, 7, 8
G (Y)(B) ELEC PUMP FAULT Elec pump LO PR or ovht					3, 4, 5, 7, 8
G (B)(Y) SYS LO PR System pressure ≤ 1450 psi Reset, if pressure ≥ 1750 psi					3, 4, 5, 7, 8
RAT FAULT RAT not fully stowed and not running, or stowing pressure applied.	NIL	NIL			3, 4, 5, 6 7, 8
MONITORING FAULT HSMU not racked.			NIL		3, 4, 5, 7, 8
G RSVR UNDERFILLED On ground reservoir quantity < 17 l, if temperature > 0°C or RSVR QTY < quantity function of temperature	SC	MC	HYD		3, 4, 5 6, 7, 8
G SYS LEAK In flight only.					1 to 5 7 to 10

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FLIGHT CREW OPERATING MANUAL

**HYDRAULIC****CONTROLS AND INDICATORS**

1.29.20

P 9

SEQ 001

REV 08

**MEMO DISPLAY**

HYD ELEC PUMP message appears in green when one of the three electric pumps is running (manually or automatic).

RAT OUT message appears in green if ram air turbine is not fully stowed. It becomes amber during flight phases 1 and 2.

**BUS EQUIPMENT LIST****FOR INFO**

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
HSMU	B, G CONTROL		DC1				
	Y, G CONTROL		DC2				
ENGINE DRIVEN PUMP CONTROL	ENG 4 and ENG 3		DC2				
	ENG 2 and ENG 1		DC1				
FIRE SHUT OFF VALVES	ENG 1		DC2		X (1)		
	ENG 2				X		
	ENG 3		DC2		X (1)		
	ENG 4				X		
ELECTRIC PUMPS	Green	AC1-1	DC1				
	Blue	AC2-3	DC1				
	Yellow	AC1-2 (2)	DC2 (3)				
LEAK MEASUREMENT VALVES			DC GND/FLT				
RAT	MANUAL CONTROL						X
	AUTO CONTROL				X		

(1) DC ESS supplies the valve motor when NORM DC2 is lost.

(2) or directly from external power

(3) or from DC GND/FLT bus

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**ICE AND RAIN PROTECTION****CONTENTS**

1.30.00 P 1

SEQ. 001 REV. 20

**30.00 CONTENTS****30.10 GENERAL**

– DESCRIPTION ..... 1

**30.20 WING ANTI-ICE**

– DESCRIPTION ..... 1

– CONTROLS AND INDICATORS ..... 2

– WARNINGS AND CAUTIONS ..... 3

**30.30 ENGINE ANTI-ICE**

– DESCRIPTION ..... 1

– CONTROLS AND INDICATORS ..... 2

– WARNINGS AND CAUTIONS ..... 3

**30.40 WINDOW HEAT**

– DESCRIPTION ..... 1

– CONTROLS AND INDICATORS ..... 2

– WARNINGS AND CAUTIONS ..... 2

**30.50 PROBES HEAT**

– DESCRIPTION ..... 1

– CONTROLS AND INDICATORS ..... 2

R – WARNINGS AND CAUTIONS ..... 3

**30.55 WATER/WASTE ANTI-ICE**

– DESCRIPTION ..... 1

– SYSTEM OPERATION ..... 1

**30.60 RAIN REMOVAL**

– DESCRIPTION ..... 1

– CONTROLS AND INDICATORS ..... 2

**30.80 ELECTRICAL SUPPLY**

**DESCRIPTION**

The ice and rain protection system allows unrestricted operation of the aircraft in icing conditions and heavy rain.

**ANTI ICE**

Either hot air or electrical heating protects critical areas of the aircraft as follows :

**HOT AIR**

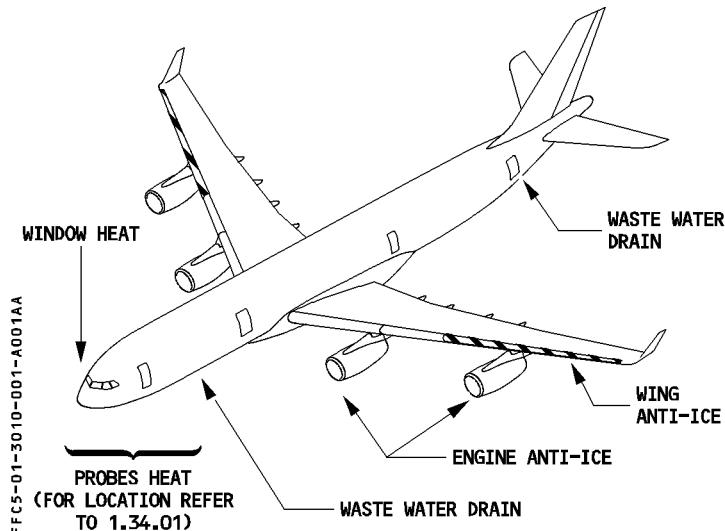
- Four outboard leading-edge slats of each wing.
- Engine air intakes.

**ELECTRICAL HEATING**

- Flight compartment windows.
- Sensors, pitot probes, static ports, TAT probes and angle-of-attack probes.
- Waste water drain mast.

**RAIN REMOVAL**

- R Wipers remove rain from the front windshield panels.



**DESCRIPTION**

Hot air from the pneumatic system heats the four outboard slats (4-5-6-7) of each wing in flight.

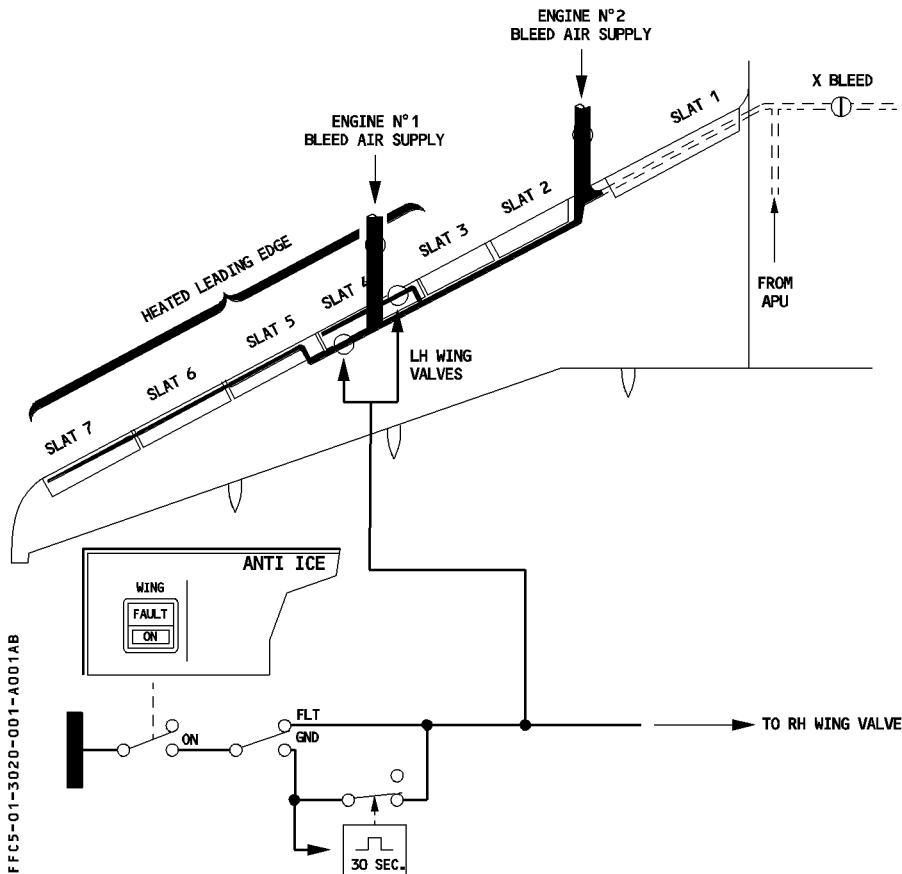
The WING pushbutton on the ANTI ICE panel controls the four valves.

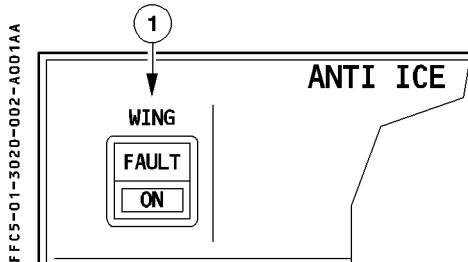
When the aircraft on ground, the flight crew can initiate a 30-second test sequence by turning the system ON.

R If the system detects a leak during normal operation, the affected side's wing anti-ice valve automatically closes (see 1.36.10).

When wing anti-ice is selected, the N1 limit is automatically reduced, and the idle N1 is automatically increased.

In the event of electrical power supply failure, the valves close.



**CONTROLS AND INDICATORS****OVERHEAD PANEL****① WING ANTI ICE pb sw**

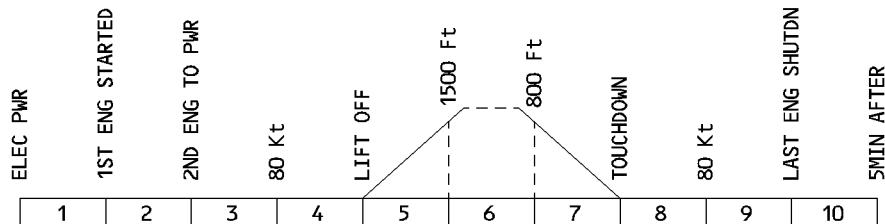
- R This switch controls the wing anti ice system on the left and right sides simultaneously.
- R ON : It lights up blue
- R WING A. ICE appears on the ECAM MEMO page
- R Wing anti ice control valves open if a pneumatic supply is available.
- R On the ground the wing anti ice valves open for 30 seconds only (test sequence).
- R Off : ON light goes out.
- R Wing anti ice control valves close.
- R FAULT It : Amber light comes on, and caution appears on ECAM, if :
  - the position of the anti ice control valve is not the required position, or
  - low pressure is detected.
- R *Note : The amber FAULT light comes on briefly during pressure built up, or when valves open.*

**ECAM BLEED PAGE**

- R (Refer to 1.36.20).

**WARNINGS AND CAUTIONS**

FFC5-01-3020-003-A001AA



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L(R) INR (OUTR) WING HI PR High pressure is detected	NIL	NIL		NIL	4, 5, 7, 8
L(R) INR (OUTR) WING LO PR Low pressure is detected			BLEED		3, 4, 5, 7, 8
L(R) INR (OUTR) WING OPEN One wing valve remains open when wing anti-ice is selected off.	SINGLE CHIME	MASTER CAUT	NIL	WING ANTI ICE FAULT lt	4, 8
WAI SYS FAULT Wing anti-ice relay failure			BLEED		
WING VLVE NOT OPEN One wing valve remains closed when wing anti-ice is selected on.					3, 4, 5, 7, 8
WING OPEN ON GND Time delay relay failure					

**MEMO DISPLAY**

- R WING A.ICE message appears in green, if the WING ANTI ICE pushbutton is ON.

**DESCRIPTION**

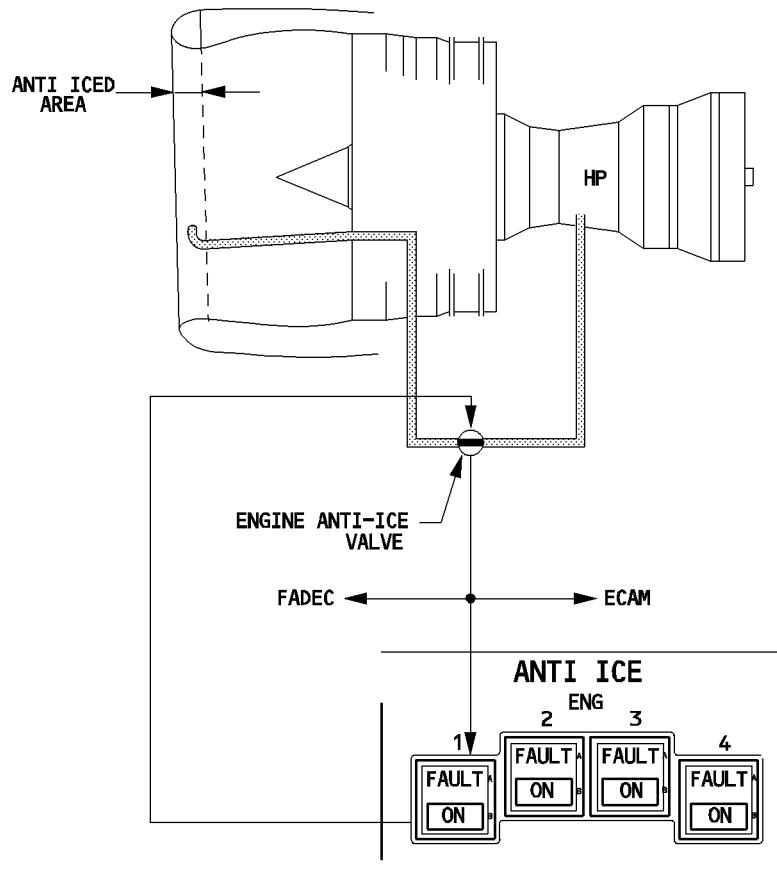
Each engine nacelle is anti iced by an independent air bleed from the high pressure compressor. The air is supplied through an open/closed valve.

The valve is controlled from the cockpit by an ENG pushbutton (one for each engine).

- R When an engine anti ice valve is open, the N1 limit is automatically reduced, and the idle N1 is automatically increased.

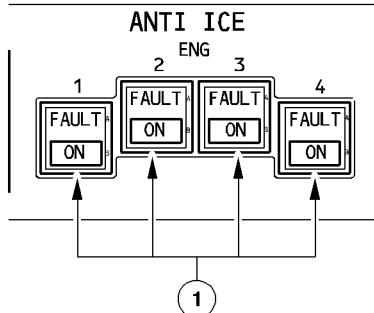
In the event of an electrical power supply failure the valve open.

FFC5-01-3030-001-A001AA



**CONTROLS AND INDICATORS****OVERHEAD PANEL**

FFC5-01-3030-002-A100AA

**① ENG 1 (2, 3 or 4) pushbutton**

**ON** : The ON light comes on blue.

The ECAM MEMO displays "ENG A. ICE".

The engine anti-ice valve opens.

**Off** : The ON light goes out.

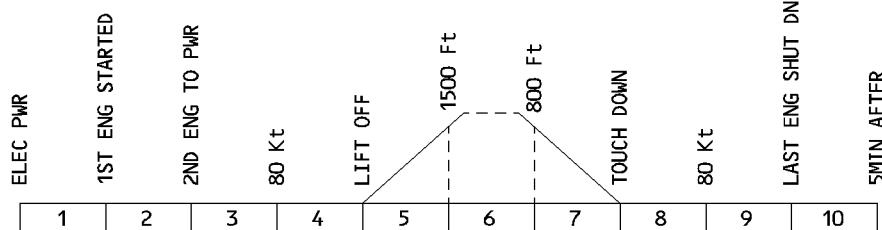
The engine anti-ice valve closes.

**R FAULT It** : Comes on amber, with an ECAM caution, if the position of the anti-ice valve disagrees with the ENG pushbutton selection.

*Note : The amber FAULT light comes on briefly, while the valve transits.*

**WARNINGS AND CAUTIONS**

FFC5-01-3030-003-A100AA



E/WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1(2)(3)(4)VALVE CLOSED valve disagree	SINGLE CHIME	MASTER CAUT	NIL	ENG affected ANTI ICE FAULT lt	3, 4, 5, 7, 8
ENG 1(2)(3)(4) VALVE OPEN valve disagree					

**MEMO DISPLAY**

- R This display shows ENG A.ICE message in green either if one ENG ANTI ICE pushbutton is at ON or if the nacelle anti ice valves are open.
- R If the ice detection system is installed, ICE NOT DET message appears in green, when ice is no longer detected after 130 seconds.

**DESCRIPTION**

The aircraft uses electrical heating for anti icing each windshield and demisting the cockpit side windows.

Two independent Window Heat Computers (WHC), one on each side, automatically regulate the system and protect it against overheating and indicate faults.

Window heating comes on :

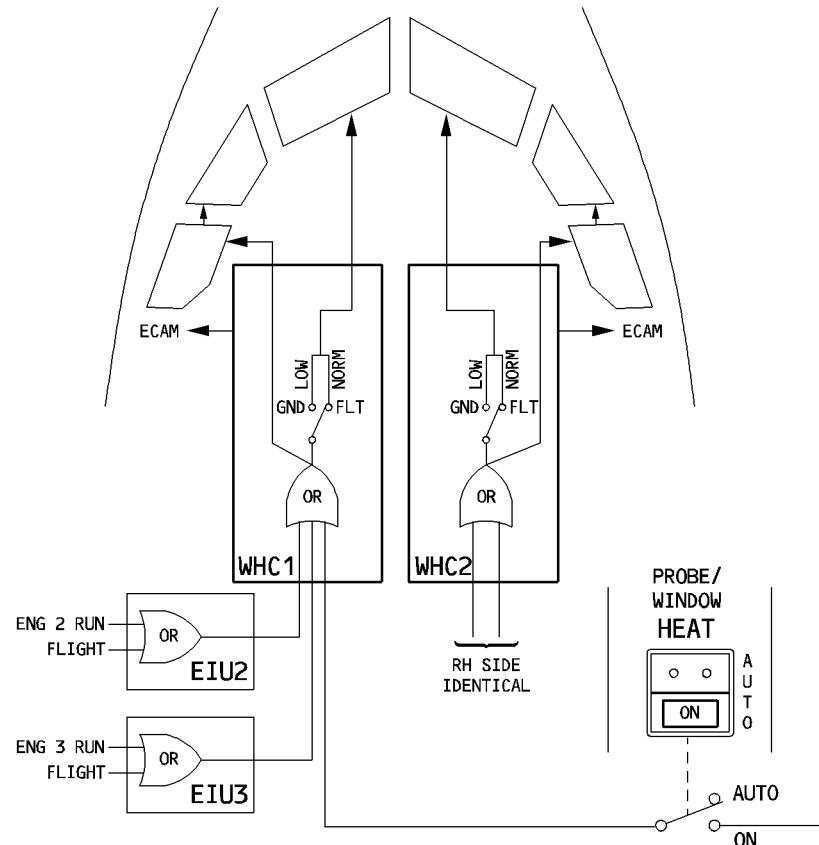
- automatically when engine 2 or 3 is running, or in flight
- manually when the flight crew switches ON the PROBE/WINDOW HEAT pushbutton switch.

R The windshield heating operates at low power on the ground and at normal power in flight.

R Only one heating level exists for the windows.

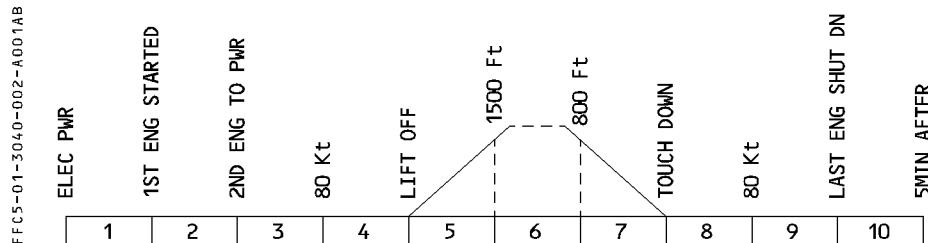
R

FFC5-01-3040-001-A001AA



**CONTROLS AND INDICATORS****OVERHEAD PANEL**

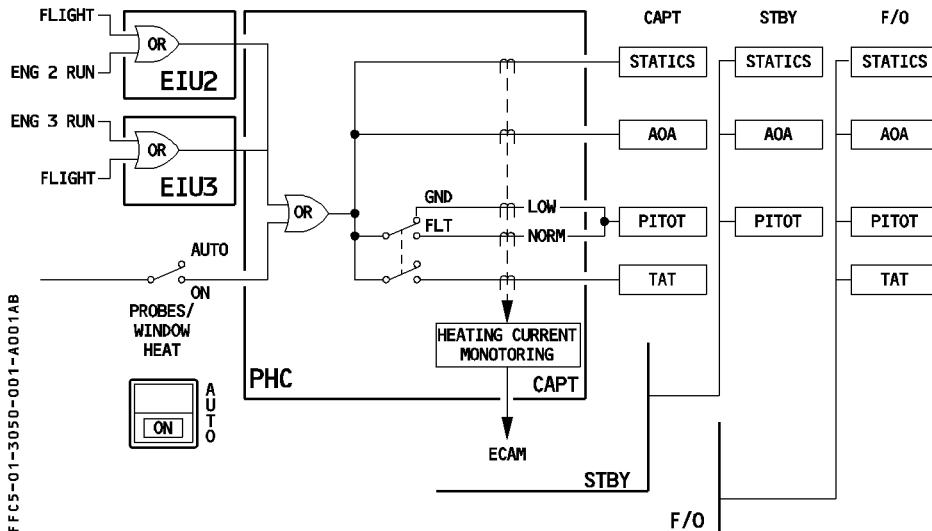
(Refer to 1.30.50)

**WARNINGS AND CAUTIONS**

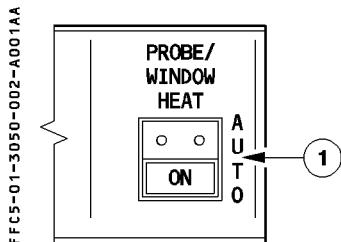
E/AWD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
L(R) WSHLD HEAT failure of L or R windshield heating	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8
L+R WSHLD HEAT failure of both windshield heatings					
L(R)(L+R) WINDOW HEAT failure of L, R or L+R window heatings	NIL	NIL			

**DESCRIPTION**

- R Electrical heating protects :
  - R — pitot heads.
  - R — static ports.
  - R — Angle-Of-Attack (AOA) probes.
  - R — Total Air Temperature (TAT) probes.
- R Three independent Probe Heat Computers (PHC) automatically control and monitor :
  - R — Captain probes
  - R — F/O probes
  - R — STBY probes
- R They protect against overheating and indicate fault.
- R The probes are heated :
  - R — automatically when engine 2 or 3 is running, or in flight
  - R — manually, when the flight crew switches ON the PROBES/WINDOW HEAT pushbutton switch.
- R On the ground, the TAT probes are not heated and pitot heating operates at low level (the changeover to normal power in flight is automatic).

**FOR INFO**

FFC5-01-3050-001-A001AB

**CONTROLS AND INDICATORS****OVERHEAD PANEL****(1) PROBES/WINDOW HEAT pushbutton**

**AUTO** : Probes/windows are automatically heated :

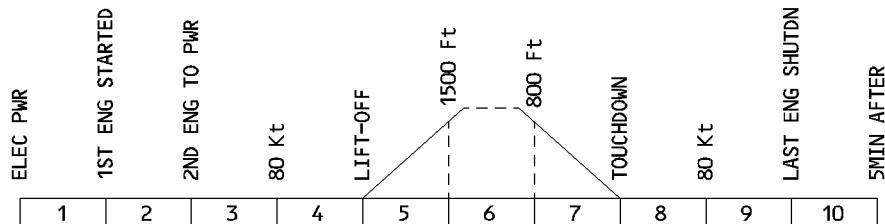
– In flight, or

– On ground (except TAT probes), provided Engine 2 or 3 is running.

**ON It** : The blue light indicates that the probes and windows are heated (except TAT probes on ground).

**WARNINGS AND CAUTIONS**

FFC5-01-3050-003-A100AA



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CAPT (F / O)(STBY) PROBES HEAT Failure of one Probe Heating Computer.	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
CAPT (F / O)(STBY) PITOT HEAT					3, 4, 5, 7, 8
CAPT (F / O)(STBY) AOA HEAT					
CAPT (F / O)(STBY) L(R) STAT HEAT CAPT (F / O) TAT HEAT Failure of corresponding probe heating.					
CAPT + F / O PITOT HEAT CAPT + STBY PITOT HEAT F / O + STBY PITOT HEAT Failure of the corresponding probes heating.					4, 5, 8
All PITOT Failure of CAPT, F / O, and STBY probes heating.					

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**ICE AND RAIN PROTECTION**

1.30.55 P 1

**WATER/WASTE ANTI ICE**

SEQ. 001 REV. 07

**DESCRIPTION**

An ice protection system is installed to prevent ice formation in the waste disposal system and the potable water system. Electrical heating elements in form of flexible tapes are attached to the waste/potable water lines which are installed in areas of possible icing conditions (in the vicinity of fuselage skin). Temperature sensors are installed to detect icing conditions. The fill/drain nipples on the water service/waste panel and the two drain masts are heated. The two Water Ice-Protection Control Units (WIPCU) installed operate independently : one controls the forward section of the ice protection system, the second one the aft section.

**SYSTEM OPERATION**

The temperature sensors measure permanently the water line temperature. In the WIPCU, the measured value is compared with a reference temperature for the related location. This threshold can be set individually for each area by maintenance action. If the temperature drops below the reference value the heating elements for the related area are turned on. A different (higher) threshold is used to turn the heating elements off.

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**ICE AND RAIN PROTECTION****RAIN REMOVAL**

1.30.60 P 1

SEQ. 100 REV. 12

**DESCRIPTION****WIPERS**

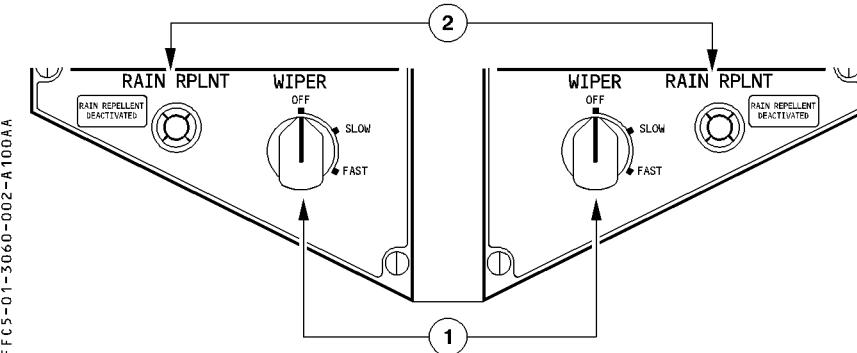
Each front windshield has a two speed electric wiper.  
A rotary selector controls each.

**RAIN REPELLENT**

R Deactivated.

**CONTROLS AND INDICATORS****OVERHEAD PANEL**

R

**① WIPER sel**

Each rotary selector controls its wiper at either low or high speed. When turned off the wiper stops out of view.

**② RAIN RPLNT pb**

R Deactivated.



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**ICE AND RAIN PROTECTION**

**RAIN REMOVAL**

**1.30.60 P 3**

**SEQ. 100 REV. 08**

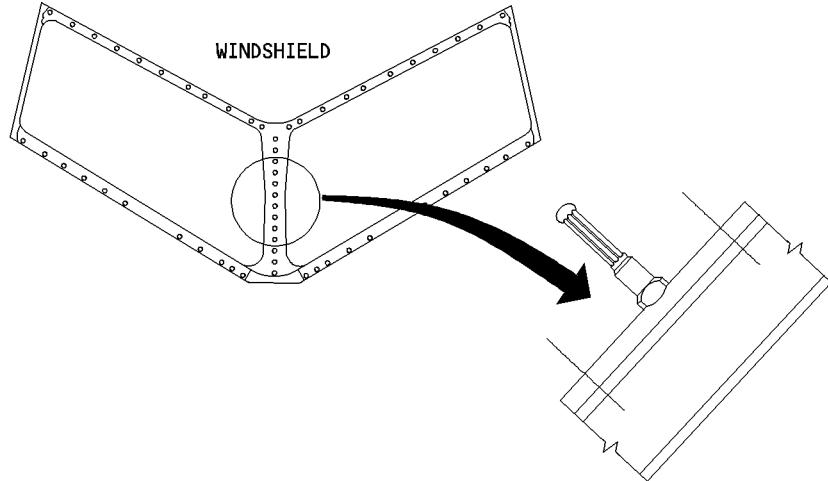
**RIGHT AFT CORNER OF THE COCKPIT**

Not applicable

**DESCRIPTION****VISUAL ICE INDICATOR**

An external visual ice indicator, which is visible to the crew, is installed between the two windshields. The indicator also has a light (◀).

R



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**BUS EQUIPMENT LIST**

R

			NORM			EMER ELEC			
			AC	DC	DC BAT	AC ESS	DC ESS	HOT	
WING ANTI ICE	INNER VALVES			DC1					
	OUTER VALVES			DC1					
ENG ANTI ICE CLOSURE	ENG 1 and ENG 3			DC2					
	ENG 2 and ENG 4			DC1					
WINDOW HEAT	WHC	1		DC1					
		2		DC2					
PROBE HEAT	HEATING POWER	L	AC1-1						
		R	AC2-4						
RAIN REMOVAL	PHC	CAPT OR STBY			X				
		F/O		DC2					
	STATICS	CAPT OR STBY		DC1					
		F/O		DC2					
	PITOT	CAPT			X (1)				
		F/O	AC2-3						
		STBY	AC1-2 (1)						
	AOA	CAPT	AC1-1						
		F/O	AC2-3						
		STBY	AC1-2						
	TAT	CAPT	AC1-1						
		F/O	AC2-3						
ICE DETECT SYSTEM ◀	ICE DETECTION	PROBE 1	AC1						
		PROBE 2	AC2-3						
WATER/WASTE ANT-ICE		WIPCU 1 and 2		DC2					
		HEATING ELEMENTS AND DRAIN MAST	AC1-1						

- (1) When AC1-2 is lost and AIR DATA is switched to "CAPT ON 3", the standby PITOT is switched to AC ESS BUS, and the Captain's pitot heading is lost.

**31.00 CONTENTS****31.05 EIS GENERAL**

– INTRODUCTION . . . . .	1
– COCKPIT ARRANGEMENT . . . . .	1
– ARCHITECTURE . . . . .	2
– CONTROLS AND SWITCHING . . . . .	4
– RECONFIGURING THE DMC . . . . .	5
– RECONFIGURING DUs . . . . .	5

**31.10 ECAM DESCRIPTION**

– ECAM DU ARRANGEMENT . . . . .	1
– COLOR CODE . . . . .	2
– WARNING / CAUTION CLASSIFICATION . . . . .	2
– PRIORITY RULES . . . . .	3
– TYPES OF FAILURES . . . . .	3
– AURAL INDICATORS . . . . .	4

**31.15 INDICATIONS ON E / WD**

– GENERAL . . . . .	1
– INDEPENDENT FAILURE . . . . .	2
– PRIMARY AND SECONDARY FAILURES . . . . .	2
– FLIGHT PHASES . . . . .	3
– MEMO . . . . .	4
– CONFIGURATION WARNINGS . . . . .	5

**31.20 INDICATIONS ON SD**

– GENERAL . . . . .	1
– SYSTEM PAGES . . . . .	1
– STATUS PAGE . . . . .	4
– PERMANENT DATA . . . . .	5

**31.25 ECAM SEQUENCE**

– GENERAL . . . . .	1
– EXAMPLE . . . . .	2

R

**31.30 ECAM CONTROLS**

– ECAM CONTROL PANEL . . . . .	1
– ECAM SWITCHING PANEL . . . . .	4
– ATTENTION GETTERS . . . . .	5

**31.40 INDICATIONS ON PFD**

– GENERAL . . . . .	1
– SPECIFIC GROUND INDICATIONS . . . . .	2
– ATTITUDE DATA . . . . .	3
– AIRSPEED . . . . .	5
– ALTITUDE . . . . .	11
– VERTICAL SPEED . . . . .	15
– HEADING . . . . .	16
– FLIGHT PATH VECTOR . . . . .	18
– GUIDANCE . . . . .	19
– TRAJECTORY DEVIATION . . . . .	21
– FLIGHT MODE ANNUNCIATOR . . . . .	25
– ALTITUDE ALERT . . . . .	27
– FLAGS AND MESSAGES DISPLAYED ON PFD . . . . .	28
– TCAS (refer to 1.34)	

**31.45 INDICATIONS ON ND**

– GENERAL . . . . .	1
– ROSE MODES . . . . .	2
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– ROSE VOR MODE . . . . .	7
– ROSE NAV MODE/ARC MODE . . . . .	8
– PLAN MODE . . . . .	15
– WEATHER RADAR . . . . .	16
– PREDICTIVE WINDSHEAR SYSTEM . . . . .	17
– ENGINE STANDBY PAGE . . . . .	18
– FLAGS AND MESSAGES DISPLAYED ON ND . . . . .	19
– EGPWS . . . . .	23

**31.50 EFIS CONTROLS**

– EFIS CONTROL PANEL . . . . .	1
– EFIS DMC PANEL . . . . .	3
– CHRONOMETER . . . . .	4

**31.55 CLOCK**

– GENERAL . . . . .	1
– CONTROLS AND INDICATORS . . . . .	2

**31.60 FLT RECORDERS**

– FLIGHT DATA RECORDING SYSTEM . . . . .	1
– CONTROLS AND INDICATORS . . . . .	2
– AIRCRAFT CONDITION MONITORING SYSTEM . . . . .	3

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**INDICATING / RECORDING SYSTEMS**

1.31.00 P 3

**CONTENTS**

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R

**31.75 WARNINGS AND CAUTIONS**

– MEMO DISPLAY . . . . . 1

**31.80 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . . 1

Note : For data loader, refer to 1.45.30.

**INTRODUCTION**

The electronic instrument system (EIS) presents data on six identical display units (DUs):

- The electronic flight instrument system (EFIS) displays mostly flight parameters and navigation data on the primary flight displays (PFDs) and navigation displays (NDs)
- The electronic centralized aircraft monitor (ECAM) presents data on the engine/warning display (E/WD) and system display (SD) :
  - Primary engine indications, fuel quantity, flap and slat position
  - Warning and caution alerts or memos
  - Synoptic diagrams of aircraft systems, and status messages
  - Permanent flight data

**COCKPIT ARRANGEMENT**

CAPTAIN :

EFIS CONTROL PANEL

NAVIGATION DISPLAY

MASTER WARNING  
AND CAUTION LIGHTS

PRIMARY FLIGHT  
DISPLAY

FFC5-01-3105-001-A001AB

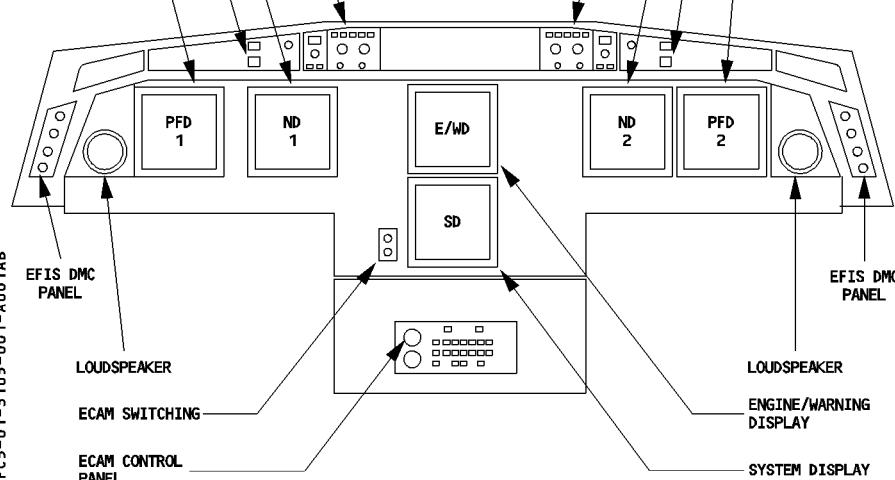
FIRST OFFICER :

EFIS CONTROL PANEL

NAVIGATION DISPLAY

MASTER WARNING  
AND CAUTION LIGHTS

PRIMARY FLIGHT  
DISPLAY



## ARCHITECTURE

### DISPLAY UNIT (DU)

The instrument panels have six identical units.  
These DUs are full-color .

### DISPLAY MANAGEMENT COMPUTER (DMC)

Three identical display management computers acquire and process all the signals received from sensors and other computers to generate the images to be displayed on the primary flight displays, navigation displays, engine/warning display, and system display.  
Each DMC has two independent channels, an EFIS channel and an ECAM channel, and is able to drive simultaneously one PFD, one ND, and either of the ECAMs in its engine warning or system status task.

### SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)

The two identical SDACs acquire data, then generate signals. Some of these signals go to the three DMCs, which use them to generate displays of system pages and engines parameters. Others go to the flight warning computers, which use them to generate ECAM messages and aural alerts.

### FLIGHT WARNING COMPUTER (FWC)

The two identical FWCs generate alert messages, memos, aural alerts, and synthetic voice messages. For this purpose they acquire data :

- directly from aircraft sensors or systems to generate red warnings.
- through the SDACs to generate amber cautions.

The ECAM display units display the alert messages generated by the FWCs.

The FWCs also generate :

- radio altitude callouts.
- decision height callouts.
- R — landing speed increments.

### ATTENTION-GETTERS

The FWCs also drive the attention-getters. Each pilot has a set of these on the panel under the glareshield. They are :

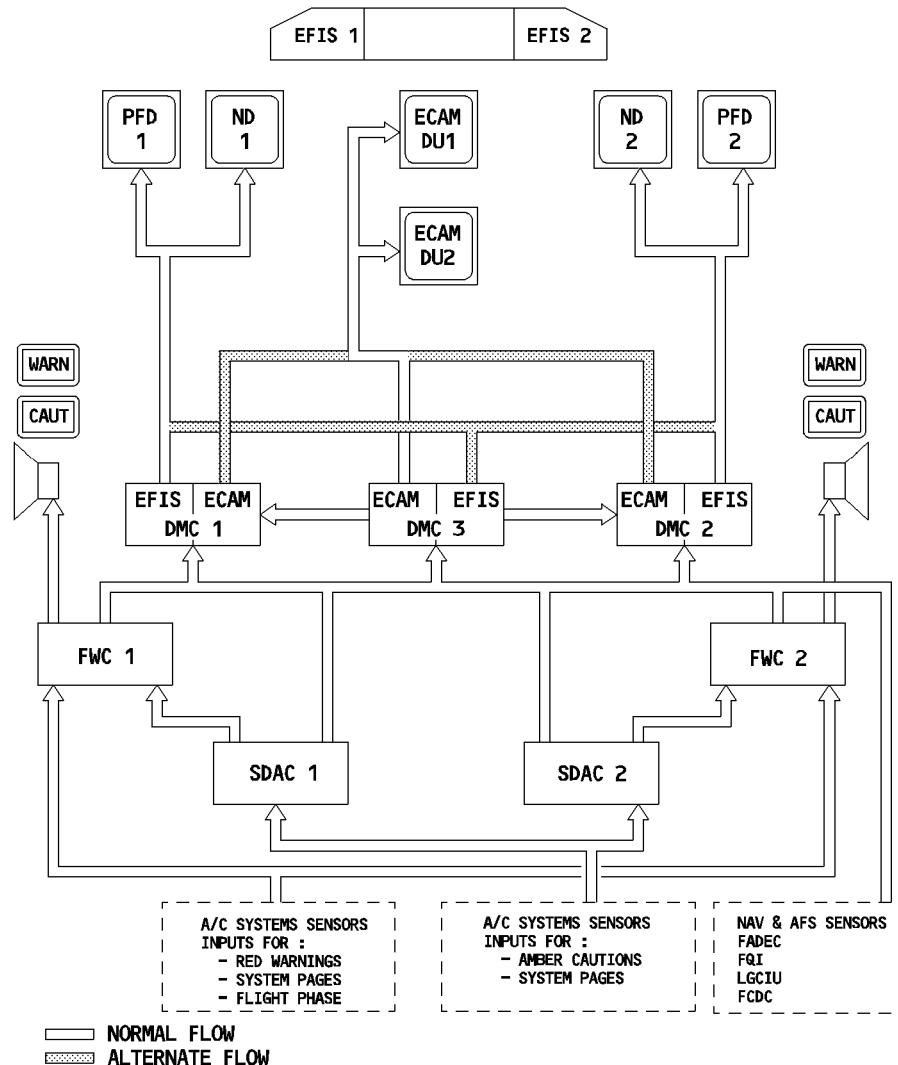
- a master warning light that flashes "MASTER WARN" in red for red warnings

- R      — a master caution light that illuminates "MASTER CAUT" in amber for amber cautions

## LOUDSPEAKER

The communications loudspeakers announce aural alerts and voice messages, and do so even when they are turned off.

## EIS BLOCK DIAGRAM



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## CONTROLS AND SWITCHING

### ECAM CONTROL PANEL (ECP)

This panel allows the pilot to have the ECAM display units display either warning and caution messages or system and system status images.

### ECAM DMC SWITCHING

A switch on the ECAM SWITCHING panel which is on the main instrument panel allows the flight crew to replace the DMC 3 with DMC 1 or DMC 2.

### ECAM/ND SWITCHING

A switch on the ECAM SWITCHING panel allows the flight crew to transfer the ECAM system display to either the captain's or the first officer's navigation display.

### PFD/ND SWITCHING

A PFD/ND XFR pushbutton on each side console allows the pilot to swap displays on respective onside DUs.

### EFIS DMC SWITCHING

A switch on each side console allows the pilot to manually select the DMC 3 or the opposite DMC for supply of data to the onside PFD/ND.

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EIS GENERAL

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**RECONFIGURING THE DISPLAY MANAGEMENT COMPUTER (DMC)**

In normal operation :

- DMC 1 supplies data to the captain's PFD and ND.
- DMC 2 supplies data to the first officer's PFD and ND.
- DMC 3 supplies data to the upper and lower ECAM DU.

In case of DMC 3 failure, the DMC 1 automatically takes over and supplies the ECAM DUs provided the ECAM SWITCHING selector is in AUTO position.

If a DMC fails (corresponding DU shows a diagonal line), the flight crew can replace DMC 1 or 2 with DMC 3 by turning the EFIS DMC selector on the EFIS DMC panel to 3.

**RECONFIGURING DISPLAY UNITS (DUS)****FAILURE OF UPPER ECAM DU (OR CTL/BRIGHTNESS KNOB TURNED TO OFF)**

If the upper ECAM display fails or is switched off :

- The engine/warning page automatically replaces the system/status page on the lower ECAM DU.

The flight crew can have the system/status page displayed by :

- using the "ECAM/ND XFR" switch on the ECAM SWITCHING panel to move it to a navigation display unit (NDU), or
- pushing and holding (for a maximum of 3 minutes) the related system page pushbutton on the ECAM control panel to display it temporarily on the lower ECAM DU (in place of the engine/warning page).

**FAILURE OF LOWER ECAM DU (OR CTL/BRIGHTNESS KNOB TURNED TO OFF)**

If the lower ECAM display fails or is switched off, the flight crew can have the system/status page displayed by :

- using the "ECAM/ND XFR" switch on the ECAM SWITCHING panel to display it on NDU, or
- pushing and holding (for a maximum of 3 minutes) the related system page pushbutton on the ECAM control panel to display it temporarily on the upper ECAM DU (in place of the engine/warning page).

**FAILURE OF BOTH ECAM DUs**

If both ECAM displays fail, the flight crew may :

- R – use the "ECAM/ND XFR" on the ECAM SWITCHING panel to display the engine/warning page on a navigation display and if needed,
- R – push and hold (for a maximum of 3 minutes) the related system page pushbutton on the ECAM control panel to display the system/status page temporarily on a ND.

## PFDU/NDU RECONFIGURATION

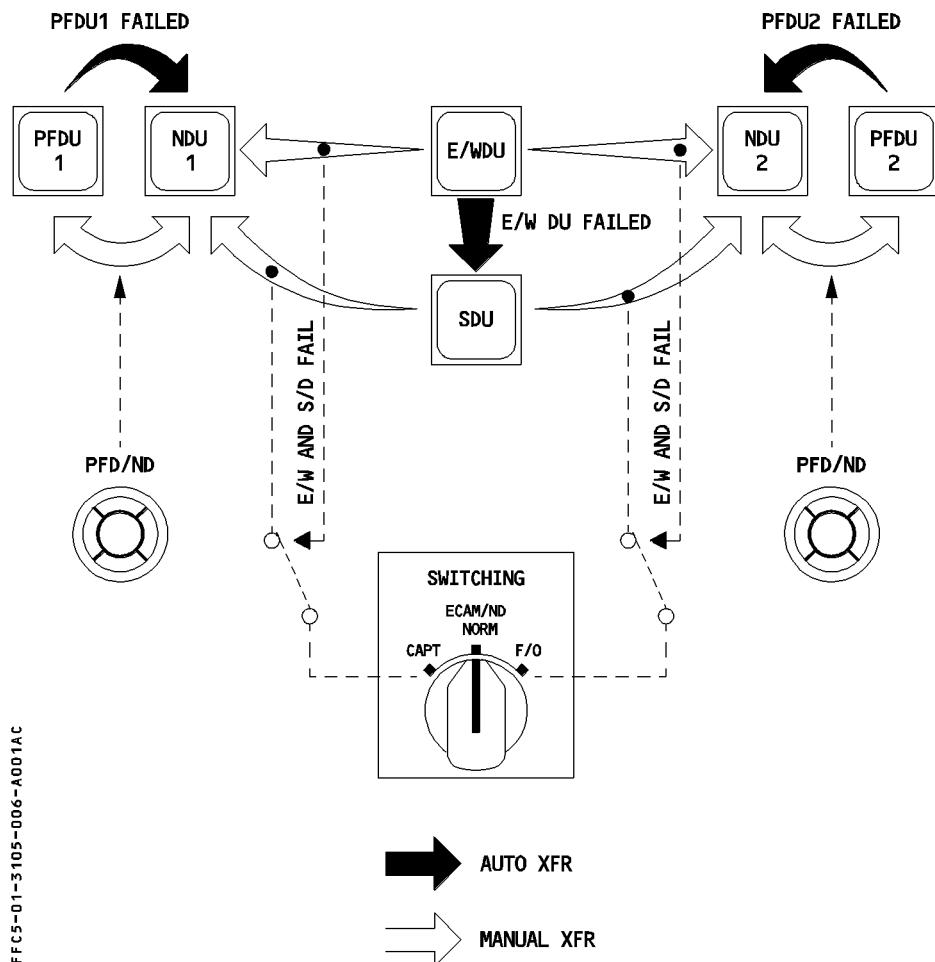
If a PFDU fails, the system automatically transfers the PFD to the NDU.

The pilot can also make this transfer manually by :

- turning the PFD ON-OFF/brightness control OFF, or
- pressing the PFD/ND/XFR pushbutton, which cross-changes the images between the PFDU and the NDU.

If an NDU fails, the pilot can use the PFD/ND/XFR pushbutton to transfer the ND image to the PFDU.

## DU RECONFIGURATION



**ECAM DU ARRANGEMENT**

The ECAM has two display units :

- one for the engine/warning display (E/WD).
- one for the system/status display (SD).

**Engine / warning display**

## MEMO—

- REMINDER OF FUNCTIONS TEMPORARILY USED UNDER NORMAL OPERATION
- T.O OR LDG MEMO (KEY ITEMS FOR T.O OR LDG)

**ENGINE control indication**  
Total FUEL  
FLAPS / SLATS position

MEMO

or

WARNING / CAUTION messages

## WARNING/CAUTION MESSAGES

- TITLE OF THE FAILURE
- CORRESPONDING PROCEDURES (ACTIONS TO BE PERFORMED)

SYSTEM SYNOPTICS  
CORRESPONDING TO:  
- WARNING/CAUTION SITUATION  
- ADVISORY SITUATION  
- CREW MANUAL SELECTION  
- CURRENT FLIGHT PHASE

**System display**

SYSTEM synoptics

or

STATUS

STATUS  
OPERATIONAL STATUS  
OF THE AIRCRAFT  
AFTER FAILURE INCLUDING  
RECOVERY PROCEDURES

## PERMANENT DATA

- TAT
- SAT
- UTC
- G.W
- C.G

TAT +51 °C	SAT +36 °C	23 H 56	GW 205300 KG	CG 57.5 %
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**COLOR CODE**

The ECAM display uses a color code that indicates the importance of the failure or the indication.

- RED** : The configuration or failure requires immediate action.
- AMBER** : The flight crew should be aware of the configuration or failure, but needs not take immediate action.
- GREEN** : The item is operating normally.
- WHITE** : These titles and remarks guide the flight crew as it executes various procedures.
- BLUE** : These are actions to be carried out, or limitations.
- MAGENTA** : These are particular messages that apply to particular pieces of equipment or situations (inhibition messages, for example).

**WARNING/CAUTION CLASSIFICATION**

R

	LEVEL	SIGNIFICATION	AURAL	VISUAL
FAILURE MODE	Level 3	Red warning: The configuration or failure requires immediate action : <ul style="list-style-type: none"> <li>– Aircraft in dangerous configuration or limit flight conditions (eg: stall, o/speed)</li> <li>– System failure altering flight safety (eg : Eng fire, excess cab alt)</li> </ul>	Continuous Repetitive Chime (CRC) or specific sound or synthetic voice	<ul style="list-style-type: none"> <li>– MASTER WARN light red flashing or specific red light</li> <li>– Warning message (red) on E/WD</li> <li>– Automatic call of the relevant system page on the S/D *</li> </ul>
	Level 2	Amber caution: The flight crew should be aware of the configuration or failure, but does not need to take any immediate action. However, time and situation permitting, these cautions should be considered without delay to prevent any further degradation of the affected system : <ul style="list-style-type: none"> <li>– System failure without any direct consequence on the flight safety (eg: HYD B SYS LO PR).</li> </ul>	Single Chime (SC)	<ul style="list-style-type: none"> <li>– MASTER CAUT light, amber steady :</li> <li>– Caution message (amber) on E/WD</li> <li>– Automatic call of the relevant system page on the S/D * .</li> </ul>
	Level 1	Amber caution : Requires crew monitoring : <ul style="list-style-type: none"> <li>– Failures leading to a loss of redundancy or system degradation (eg : FCDC fault)</li> </ul>	NONE	<ul style="list-style-type: none"> <li>– Caution message (amber) on E/WD, generally without procedure.</li> </ul>
INFORMATION	ADVISORY	System parameters' monitoring	NONE	<ul style="list-style-type: none"> <li>– Automatic call of the relevant system page on the S/D. The affected parameter pulses green.</li> </ul>
	MEMO	Information : Recalls normal or automatic selection of functions which are temporarily used.	NONE	<ul style="list-style-type: none"> <li>– Green, Amber, or Magenta message on E/WD</li> </ul>

\* except in some cases

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**ECAM DESCRIPTION**

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**PRIORITY RULES**

There are three priority levels for warnings and cautions :

- A level 3 warning has priority over a level 2 caution which has priority over a level 1 caution.

The FWC observes these priorities.

**TYPES OF FAILURES**

Independent : a failure that affects an isolated system or item of equipment without degrading the performance of others in the aircraft.

Primary : a failure of a system or an item of equipment that costs the aircraft the use of other systems or items of equipment.

Secondary : the loss of a system or an item of equipment resulting from a primary failure.

**AURAL INDICATORS**

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
CONTINUOUS REPETITIVE CHIME	RED WARNINGS	PERMANENT	Press * MASTER WARN lt
SINGLE CHIME	AMBER CAUTION	1/2 second	
CAVALRY CHARGE	AP DISCONNECTION BY TAKE OVER pb	1.5 second	Second push on TAKE OVER pb
	AP DISCONNECTION DUE TO FAILURE	PERMANENT	Press * MASTER WARN lt or TAKE OVER pb
CLICK	LANDING CAPABILITY CHANGE or in case of "GPS PRIMARY LOST" (APPR)	1/2 second (3 pulses)	
CRICKET + "STALL" message (synthetic voice)	STALL	PERMANENT	NIL
INTERMITTENT BUZZER	SELCAL CALL	PERMANENT	Press RESET key on ACP
BUZZER	CABIN CALL	3 seconds	NIL
	EMER CABIN CALL	3 seconds REPEATED 3 TIMES	NIL
	MECH CALL	As long as outside pb pressed	NIL
	ACARS ⌂ CALL or ALERT	PERMANENT	Message reading on MCDU or press MASTER CAUT
C CHORD	ALTITUDE ALERT (refer to 1.31.40)	1.5 second or PERMANENT	new ALTITUDE selection or press MASTER WARN pb
AUTO CALL OUT (synthetic voice)	HEIGHT ANNOUNCEMENT BELOW 2500 FT (refer to 1.34.40)	PERMANENT	NIL
GROUND PROXIMITY WARNING (synthetic voice)	(refer to 1.34.70)	PERMANENT	NIL
"WINDSHEAR" (synthetic voice)	WINDSHEAR	REPEATED 3 TIMES	NIL
"PRIORITY LEFT" "PRIORITY RIGHT" (synthetic voice)	AP TAKE OVER pb	1 second	NIL

\* All aural warnings may be cancelled by pressing either :

- The EMER CANC pushbutton on the ECAM control panel, or
- The MASTER WARN light, except for some warnings like OVERSPEED or L/G NOT DOWN or CAVALRY CHARGE, if AP disconnection is due to a VMO/MMO warning.

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**ECAM DESCRIPTION**

SEQ. 107 REV. 21

**AURAL INDICATORS**

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
"RETARD"(Synthetic voice)	THRUST LEVER NOT IN IDLE POSITION FOR LANDING	PERMANENT	THRUST LEVER
TCAS $\triangleleft$ (Synthetic voice)	refer to 1.34.80	PERMANENT	NIL
"SPEED, SPEED, SPEED" (Synthetic voice)	Current thrust is not sufficient to recover a positive flight through pitch control	Every 5 seconds until thrust is increased	THRUST LEVER(s)

\* All aural warnings may be cancelled by pressing :

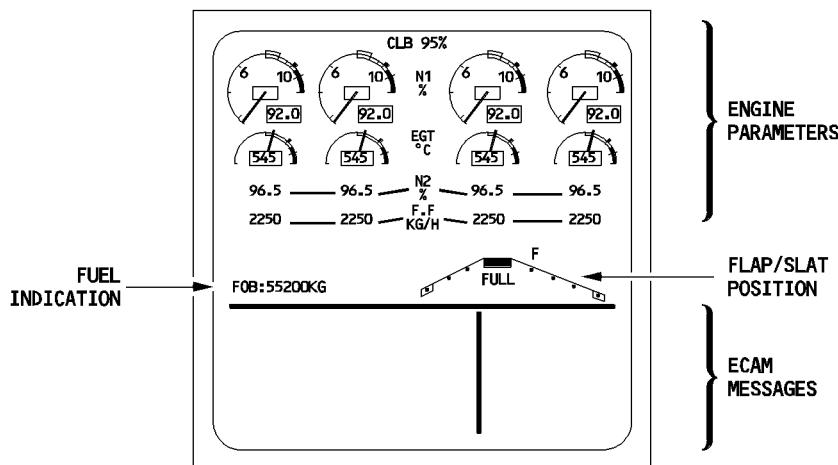
- either the EMER CANC pushbutton on ECAM control panel,
- or the MASTER WARN light except for some warnings like OVERSPEED or L/G NOT DOWN or CAVALRY CHARGE if AP disconnection is due to a VMO/MMO warning.

**GENERAL**

The E/WD appears on the upper ECAM display unit (DU).

- The upper part of this DU displays :
  - Engine parameters (refer to 1.70.90)
  - Fuel on board (FOB) (refer to 1.28.20)
  - Position of slats and flaps (refer to 1.27.40)
- The lower part of this DU displays messages generated by the FWC :
  - Warning and caution messages when a failure occurs
  - Memos when there is no failure

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The lower part, which is dedicated to ECAM messages, is divided into two parts of several lines each.

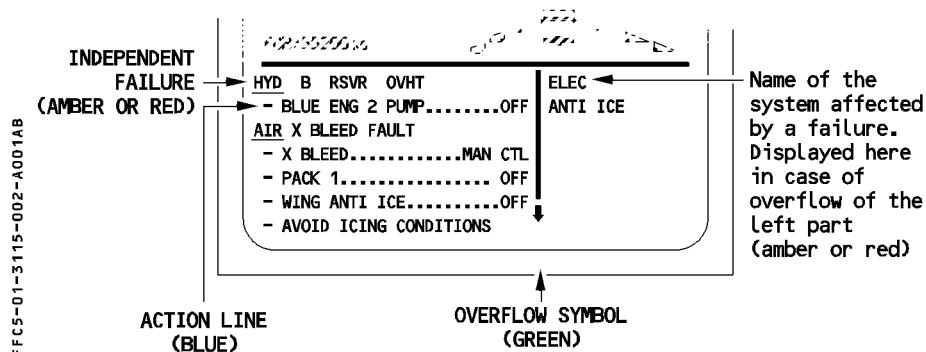
- Left part : – Primary or independent warnings and cautions, or  
– Memo information

- Right part : – Title of system affected by a primary or independent warning or caution in case of overflow on the left part, or  
– Secondary failure, or  
– Memo, or  
– Special lines (such as "AP OFF", "LAND ASAP")

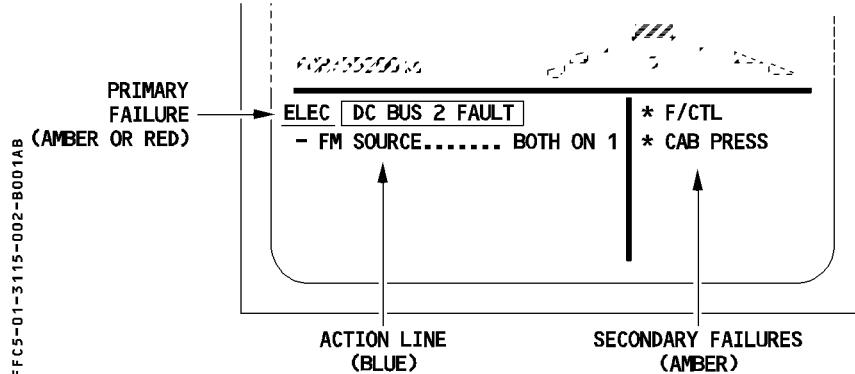
As soon as the FWC detects a failure, and if there is no flight phase inhibition active, the E/WD displays the title of the failure and actions to be taken.

The action line clears automatically when the flight crew has executed the required action.

Note : Certain actions will not disappear after execution.

**INDEPENDENT FAILURE**

If there are too many ECAM messages for the amount of space available in the lower part of the E/WD, a green arrow appears at the bottom of the display, pointing down to show that the information has overflowed off the screen. The pilot can scroll down to view additional messages by pushing the CLR pushbutton on the ECAM control panel (on the pedestal, just below the lower ECAM DU).

**PRIMARY and SECONDARY FAILURES**

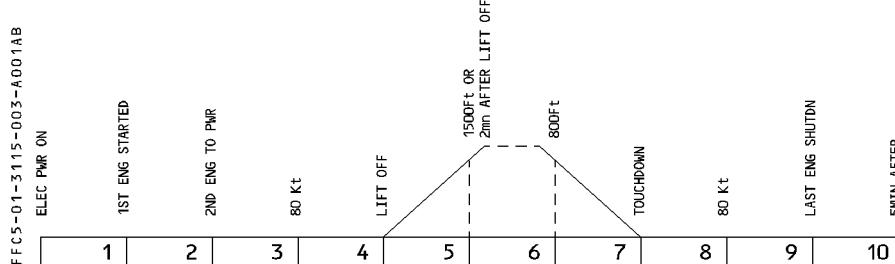
The ECAM DU displays a primary failure as a boxed title. It identifies a secondary failure by putting a star in front of the title of the affected system.

- R Note : The DU displays the overflow symbol, if primary or secondary failures overflow. In case of ECAM SINGLE DISPLAY, the secondary failures are inhibited.

**FLIGHT PHASES****GENERAL**

The FWC divides its functions according to these ten flight phases :

R



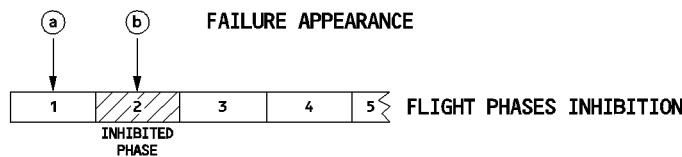
To improve its operational efficiency, the computer inhibits some warnings and cautions for certain flight phases. It does so to avoid unnecessarily alerting the pilots at times when they have high workloads (such as takeoff or landing). In these two phases, the DU displays magenta memos : "T.O. INHIBIT" (flight phases 3, 4, and 5), and "LDG INHIBIT" (flight phases 7 and 8).

Note : These flight phases are different from, and independent of, the ones used by FMGC.

**FLIGHT PHASE INHIBITION**

Two cases are possible (for instance) :

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Effect on E/WD :

- (a) The failure occurs during Phase 1. The E/WD immediately displays the warning and continues to display it as long as the failure is present, even in Phase 2.
- (b) The failure occurs during Phase 2. The E/WD only displays the warning once the aircraft has entered Phase 3, where it is not inhibited. Then, the warning remains displayed as long as the failure is present.

**MEMO****MEMO DISPLAY**

Memos appear in the lower part of the E/WD.

They are normally in green. But, in abnormal situations, they may be amber.

Memos list functions or systems that are temporarily used in normal operations.

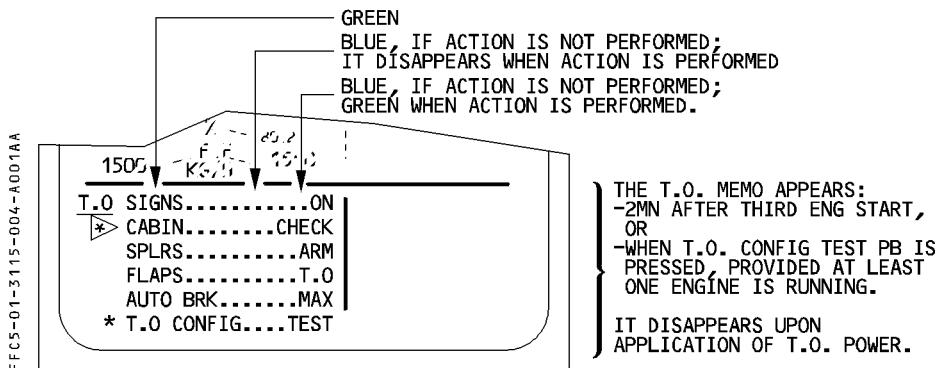
Each chapter of the "Warning and Cautions" section of this manual lists memo messages.

**T.O. AND LDG MEMOS**

During the takeoff and landing phases, the right-hand side of the memo area displays specific T.O. INHIBIT or LDG INHIBIT (magenta) memos.

Takeoff and landing memos are displayed, as follows, during the related flight phases :

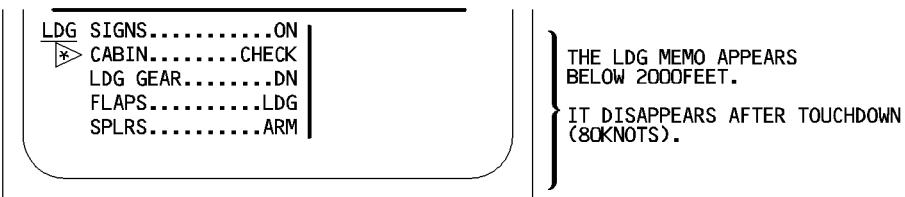
R



Note : \* This line disappears, when the test is completed. It is replaced by "T.O. CONFIG NORMAL", if the aircraft configuration is correct.

The test is requested again, if the configuration becomes abnormal.

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**CONFIGURATION WARNINGS**

The following warnings and cautions appear in the lower part of the E/WD if the aircraft is not in takeoff configuration when the pilot presses the T.O. CONFIG pushbutton on the ECAM control panel or applies takeoff power.

R

WARNINGS / CAUTIONS	T.O. CONFIG TEST	T.O. POWER
SLATS / FLAPS NOT IN TO CONFIG (R)		
PITCH TRIM NOT IN TO RANGE (R)		
RUD TRIM NOT IN TO RANGE (R)		
SPD BRK NOT RETRACTED (R)	TRIGGERED	TRIGGERED
SIDESTICK FAULT (R) (BY TAKE OVER)		
BRAKES HOT (A)		
DOOR (A)		
PARK BRK ON (R)	NOT TRIGGERED	
REDUCED THR NOT SET (A)		

Note : (R) Red warning  
(A) Amber caution

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**INDICATING/RECORDING SYSTEMS**

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**INDICATIONS ON SD**

SEQ 001 REV 08

**GENERAL**

- R The system/status Display (SD) uses the lower ECAM DU to display :
- either an aircraft system synoptic diagram page
  - or the STATUS page.

**SYSTEM PAGES**

- R The lower ECAM DU can display 14 system pages :

(For description see relevant FCOM chapter)

- ENGINE (Secondary engine parameters)
- BLEED (Air bleed)
- CAB PRESS (Cabin pressurization)
- ELEC AC (AC Electrical power)
- ELEC DC (DC Electrical power)
- HYD (Hydraulic)
- C/B (Circuit Breakers)
- APU (Auxiliary Power Unit)
- COND (Air conditioning)
- DOOR/OXY (Doors/oxygen)
- WHEEL (Landing Gear, Braking, ground spoilers, ...)
- F/CTL (Flight Controls)
- FUEL (Fuel)
- CRUISE (Cruise)

The pilot may manually call up a system page for display on the lower ECAM DU, or the system may automatically display a page.

— Manual :

- The pilot can use the pushbutton on the ECAM control panel to call up any system page, except the CRUISE page, for display at any time.

- The corresponding pushbutton on the ECAM control panel lights up.

R

— Automatic, related to a failure :

- A failure-related display automatically replaces a page the pilot has manually called up.

— Automatic, advisory :

- The relevant system page automatically appears, as soon as any fault or malfunction triggers a caution or warning message.

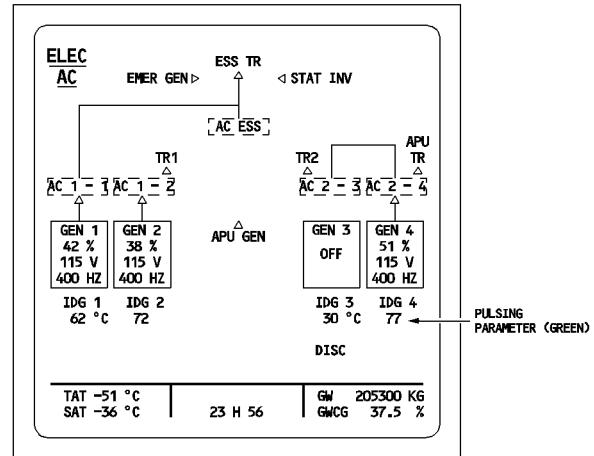
— Automatic, advisory :

- The relevant system page automatically appears, when a parameter drifts out of its normal range.

- The value (shown in green) pulses, as long as it is outside its limits.

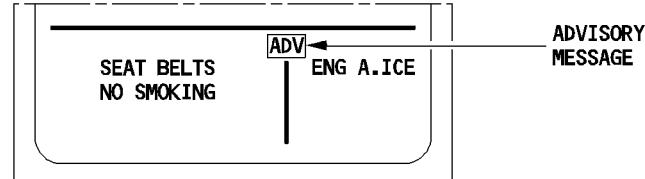
- The advisory mode is inhibited in some flight phases.

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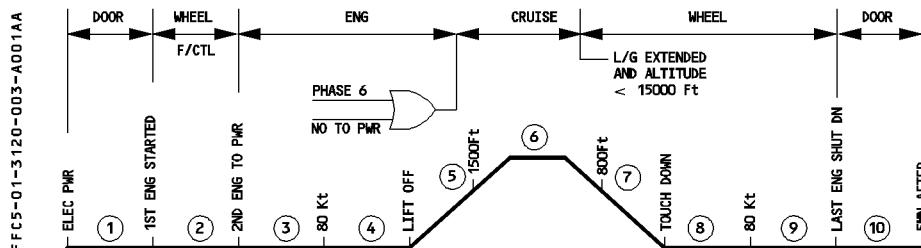


Note : If an advisory is triggered when the ECAM is in the single-display configuration, an advisory message appears on the upper part of the E/WD, and the associated key on ECAM control panel flashes to identify the appropriate system page.

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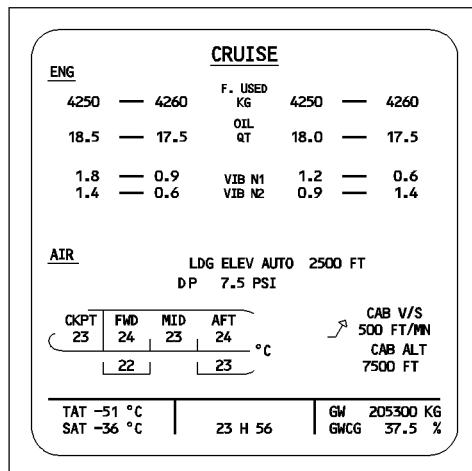


- Automatic, flight phase mode
  - If no other mode is engaged, the SD displays the system page related to the present flight phase, as shown in the following diagram.



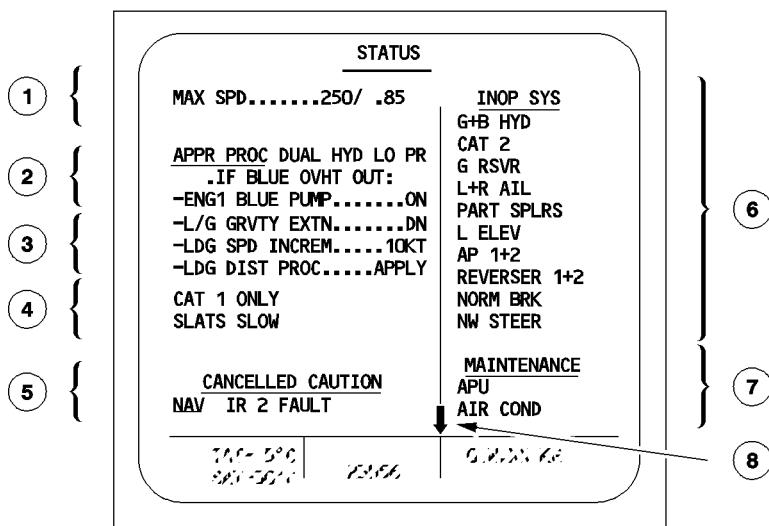
- Phase 2 : The F/CTL page replaces the WHEEL page for 20 seconds when either pilot moves his sidestick (more than 3° in pitch or roll) or when the rudder pedal deflection is more than 22°.
- The APU page appears when the APU MASTER switch is ON. It disappears when APU RPM has been above 95 % for 10 seconds, or when the APU MASTER switch is switched OFF.
- The ENGINE page appears at the beginning of start sequence or when a pilot selects "CRANK". It disappears at the end of the start sequence.

For a description of the ENGINE and AIR indications that appear when the SD is displaying the CRUISE page, see the relevant FCOM chapter.



**STATUS PAGE**

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The status page displays an operational summary of the aircraft status after the SD has displayed a failure. As shown in the illustration above, the summary includes :

- ① Limitations (speed, flight level) : Blue
- ② Approach procedures : White/Red or Amber
- ③ Procedures (corrections to apply for landing) : Blue
- ④ Information : Green
- ⑤ Cancelled caution : White
- ⑥ Inoperative system : Amber
- ⑦ Maintenance status : White
- ⑧ Symbol displayed if data overflows the left or right area.

The pilot scrolls the display to view overflow by pressing the CLR pushbutton.

Note : The titles of the different parts of the display are white and underlined.

The STATUS page appears automatically once the crew has cleared all the pages corresponding to the current failure.

The STATUS page also appears automatically during descent when the baro reference is selected or the slats are extended.

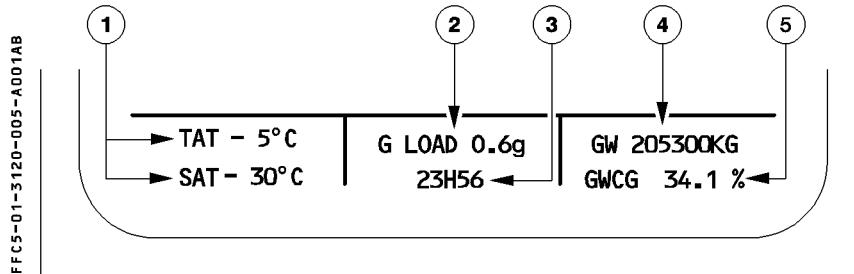
The pilot may call up the status page manually by pressing the STS key on the ECAM control panel.

If the STATUS page holds messages other than "CANCELLED CAUTION" or the MAINTENANCE part, the E/WD screen shows "STS" (status reminder).

If the STATUS page holds messages in the MAINTENANCE part at engine shut-down, the "STS" (status reminder) flashes on the E/WD screen.

The screen displays the MAINTENANCE only when the aircraft is on the ground, before engine start-up or after engine shut-down (phases 1 and 10).

### PERMANENT DATA



#### ① Temperature

The screen displays total air temperature (TAT) and static air temperature (SAT) in green.

#### ② Messages - G LOAD

The screen displays either of two items, one at a time :

- Load factor (G LOAD), in amber, when the value is above 1.4 g or below 0.7 g.  
This display is inhibited during flight phases 1 and 2.
- CHECK SD, in amber, when the DMC detects a discrepancy between acquisition and display on the DU.

(3) UTC

The screen displays Universal Time Coordinated (UTC), synchronized with the cockpit clock, in green.

(4) GW

The screen displays the gross weight (GW) as given by the FCMC, in green. The two last digits are dashed if accuracy is degraded. On ground, the indication is replaced by blue dashes, if no computed data are available.

(5) GWCG

R The screen displays the center of gravity, as given by the FCMC, in green. In case of an EXCESS AFT CG warning, the indication appears in red.

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ECAM SEQUENCE

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**GENERAL**

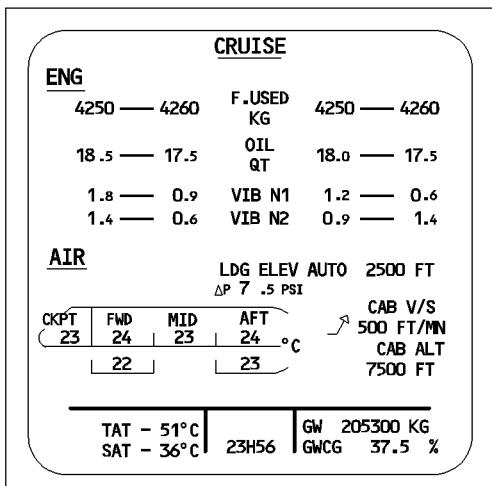
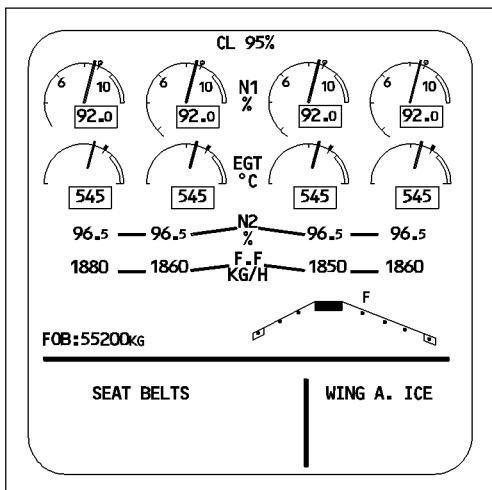
If ECAM detects a failure :

- The E/WD displays warning or caution messages.
- The master warning or master caution lights light up (except in the case of a level 1 caution).
- The system sounds an aural signal (except in the case of a level 1 caution).
- The system display (SD) shows the system page for the affected system.
- The CLR pushbutton on the ECAM control panel lights up.

In addition, a local warning light controlled directly by the affected system can light up.

After completing remedial procedures, the flight crew must push the CLR pushbutton repeatedly until the displays return to their normal configurations :

- MEMO messages on the E/WD
- The system page related to the present flight phase on the SD.
- The CLR light on the ECAM control panel turned off.

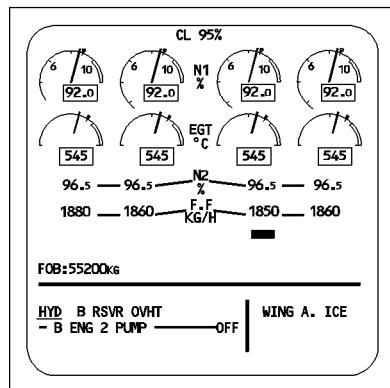
**EXAMPLE****1 — THE ECAM DETECTS NO FAILURE**

## **2 — THE ECAM DETECTS A FAILURE**

For example, a hydraulic reservoir is overheating.

### **COCKPIT INDICATIONS**

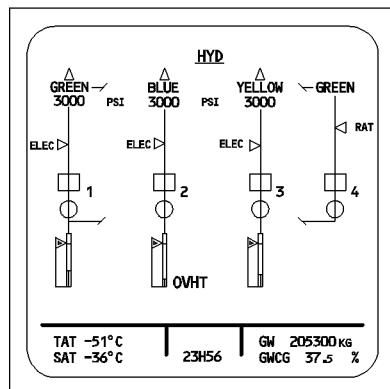
- A single chime sounds.
- Both MASTER CAUTION lights come on and stay on.
- A FAULT light on the overhead HYD panel comes on.
- The memo space on the E/WD displays the message "HYD B RSVR OVHT" and the instruction "BLUE ELEC PUMP . . . . OFF".
- The lower ECAM display (SD) automatically calls up the diagram of the hydraulic systems and displays "OVHT" in amber by the blue system.
- The CLR pushbutton on the ECP lights up.



**ECAM UPPER DISPLAY (E/WD)**

- LEFT PART
  - INDEPENDENT FAILURE
    - TITLE OF THE FAILURE
    - ACTIONS TO BE PERFORMED

- RIGHT PART
  - MEMO INFORMATION



**ECAM LOWER DISPLAY (SD)**

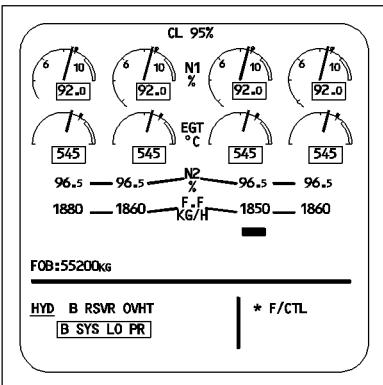
- SYNOPTIC OF THE AFFECTED SYSTEM AUTOMATICALLY CALLED OVHT IS DISPLAYED IN AMBER

### 3 — THE FLIGHT CREW FOLLOWS THE INSTRUCTION DISPLAYED ON THE E/WD

The crew switches off the blue ENG 2 pump, depressurizing the blue hydraulic circuit.

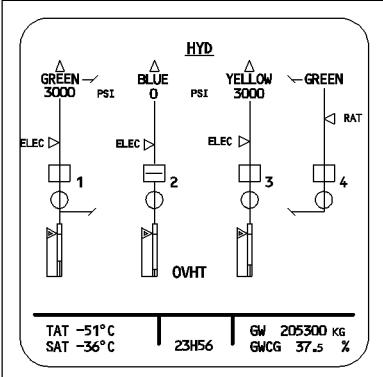
#### COCKPIT INDICATIONS

- A single chime sounds.
- Both MASTER CAUTION lights stay on.
- A FAULT/OFF light on the overhead panel comes on.
- The second part of the message on the E/WD changes to "B SYS LO PR".
- The system diagram on the SD shows an amber zero for the pressure in the blue system, along with the amber "OVHT".
- The right side of the memo area indicates a secondary failure in the flight control system.
- The CLR pushbutton on the ECAM control panel stays lighted.



ECAM UPPER DISPLAY (E/WD)

- LEFT PART
  - INDEPENDENT FAILURE AND PRIMARY FAILURE
- RIGHT PART
  - SECONDARY FAILURE



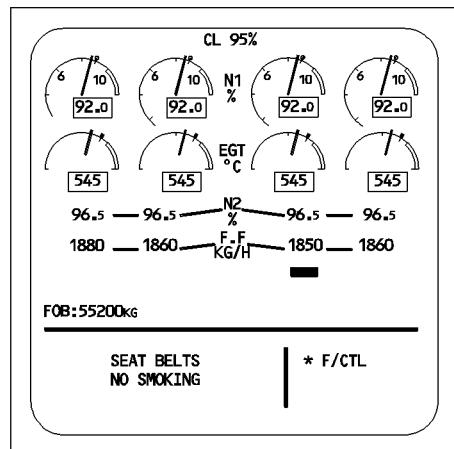
ECAM LOWER DISPLAY (SD)

- THE SYNOPTIC OF THE SYSTEM PAGE IS CHANGED ACCORDING TO THE NEW SYSTEM CONFIGURATION.  
OVHT AND THE PRESSURE ARE DISPLAYED IN AMBER

## 4 — ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON ON THE ECP

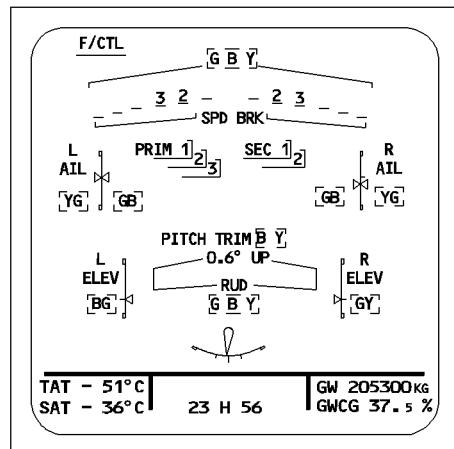
### COCKPIT INDICATIONS

- The CLR pushbutton stays lighted.
- The FAULT/OFF light stays on.
- The hydraulic system messages disappear from the E/WD, and the right side of the memo area indicates a secondary failure in the flight control system.
- The SD automatically calls up the flight control system page, with surface actuator indications associated with the blue hydraulic system shown in amber.



ECAM UPPER DISPLAY (E/WD)

- LEFT PART
  - MEMO INFORMATION
- RIGHT PART
  - SECONDARY FAILURE



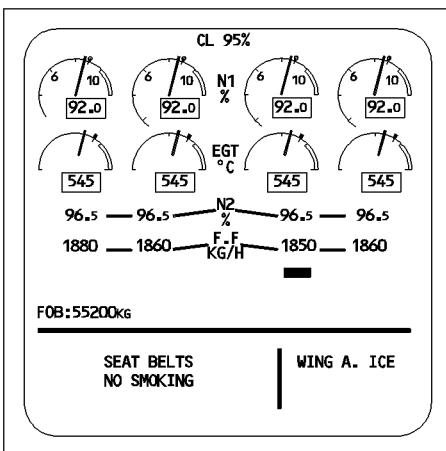
ECAM LOWER DISPLAY (SD)

- F/CTL SYSTEM PAGE AUTOMATICALLY DISPLAYED
  - FAULTY SPOILERS (n° 2+3)
  - AND SURFACE ACTUATOR PRESSURE INDICATION B ARE DISPLAYED IN AMBER

## 5 — THE PILOT PUSHES THE CLR PUSHBUTTON A SECOND TIME

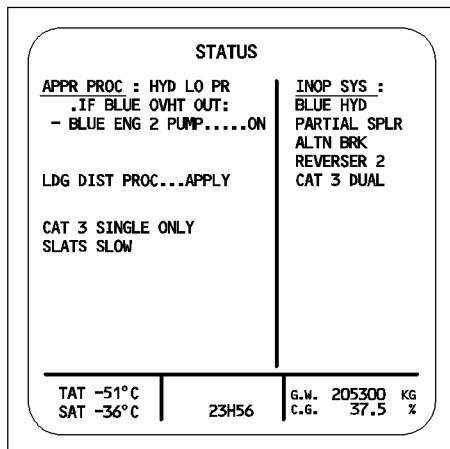
### COCKPIT INDICATIONS

- The CLR and STS pushbuttons on the ECP light up.
- The FAULT/OFF lights stay on.
- The memo area on the E/WD returns to normal.
- The STATUS page appears automatically on the SD, displaying the procedures for completing the flight with faulty blue system.



ECAM UPPER DISPLAY (E/WD)

- FULL MEMO DISPLAYED

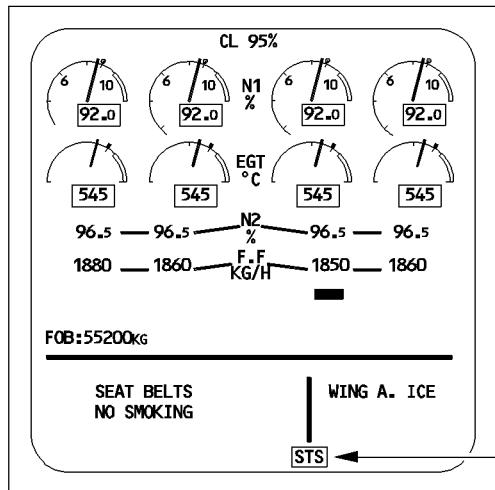


ECAM LOWER DISPLAY (SD)

- THE STATUS PAGE IS AUTOMATICALLY DISPLAYED TO
  - PROVIDE THE PROCEDURE TO APPLY FOR APPROACH
  - LIST THE INOPERATIVE SYSTEMS

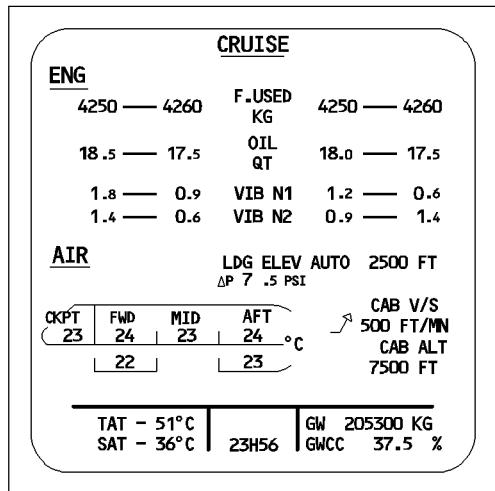
**6 — THE PILOT PUSHES THE CLR PUSHBUTTON A THIRD TIME****COCKPIT INDICATIONS**

- The CLR pushbutton light goes out.
- The FAULT/OFF lights stay on.
- A status reminder appears at the bottom of the E/WD.
- The SD automatically calls up the system page for the flight phase.

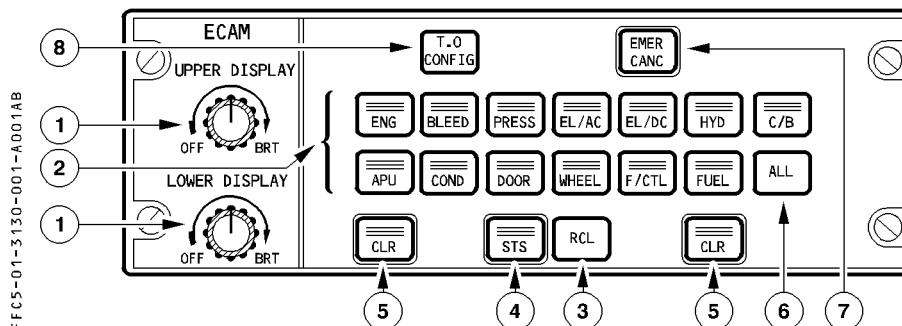
**ECAM UPPER DISPLAY (E/WD)**

— FULL MEMO DISPLAYED

STATUS REMINDER

**ECAM LOWER DISPLAY (SD)**

— RETURN TO THE FLIGHT PHASE  
RELATED SYSTEM PAGE :  
CRUISE PAGE

**ECAM CONTROL PANEL****① OFF / BRT knobs**

Used to turn the ECAM DUs on and off, and to control their brightness (automatic adjustment of brightness for ambient light conditions is superimposed on this manual control).

*Note : When the pilot turns the UPPER DISPLAY knob to OFF, the engine/warning (E/W) display appears on the lower display unit (automatic transfer).*

**② System page pushbuttons**

- Call up the corresponding system pages on the SD.
- Light up, when pushed for manual selection, or when an advisory is detected.
- Call up the aircraft system page corresponding to the present flight phase or the current warning when pushed a second time.

When only one ECAM display is on, the pilot can display a system page for up to 3 minutes by holding the system page pushbutton.

- If an advisory condition arises, the relevant system page is not automatically displayed, but the pushbutton light pulses.
- If an ECAM warning is triggered, the relevant system page is not automatically displayed, and the system page pushbutton does not light up.

**③ RCL pushbutton**

R The pilot pushes the RCL pushbutton to call up the warning messages, the caution messages, and the status page, that may have been suppressed by the activation of the CLR pushbutton or by flight-phase-related inhibition.

If there are no suppressed warnings or cautions, the E/WD shows "NORMAL" for five seconds.

If the pilot holds this pushbutton down for more than three seconds, the E/WD displays any caution messages that were suppressed by the EMER CANC pushbutton.

**④ STS (status) pushbutton**

The pilot pushes this pushbutton to display the STATUS page on the lower SD. The pushbutton remains lit, as long as the SD displays the STS page. If the system has no status messages, the status page displays "NORMAL" for five seconds.

The pilot can clear the STATUS page by pushing the CLR pushbutton, or by pushing the STS pushbutton a second time.

When only one ECAM display is on :

- It displays the STATUS page only when the pilot pushes the STATUS pushbutton and holds it. He can display the next STATUS page, if any, by releasing the pushbutton and pushing it again (before two seconds have elapsed). The new page then appears after a short delay.
- The pilot can keep the STS pushbutton pressed to display the STATUS page for a maximum of 3 minutes, after which the ECAM automatically displays the engine/warning page.

R

**⑤ CLR pushbutton**

This pushbutton remains lit as long as the E/WD is displaying a warning, or caution message or a status message on the SD.

If it is lit, pressing it changes the ECAM display.

**⑥ ALL pushbutton**

When this pushbutton is pressed and held down, the SD successively displays all the system pages at two-second intervals.

If the ECAM control panel fails, the pilot can use this pushbutton to page through the system pages until he comes to the one he wants to look at. He releases the pushbutton then to select that page.

**(7) EMER CANC pb**

This pushbutton affects the following :

– Warnings :

- Cancel (stop) an aural warning for as long as the failure condition continues.
- Extinguishes the MASTER WARNINGS lights.
- Does not affect the ECAM message display.

– Cautions :

- Cancel any present caution (single chime, MASTER CAUTION lights, ECAM message) for the rest of the flight.
- Automatically calls up the STATUS page, which displays "CANCELLED CAUTION" and the title of the failure that is inhibited.

The inhibition is automatically suppressed when Flight Phase 1 is initiated. The pilot may restore it manually by pressing the RECALL pushbutton for more than three seconds.

R      *Note : This pushbutton should only be used to suppress spurious MASTER CAUTIONS.*

**(8) TO CONFIG pb**

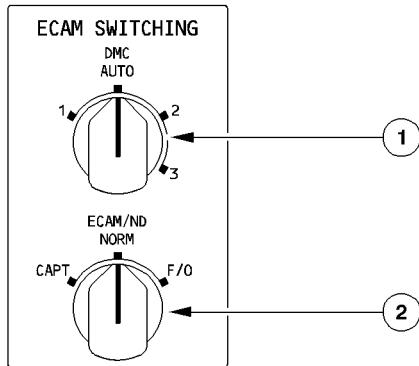
This pushbutton simulates the application of takeoff power. This is a test that triggers a warning, if the aircraft is not in takeoff configuration. (See 1.31.15).

If the configuration is correct, the E/WD displays the "TO CONFIG NORMAL" message in the TO MEMO section.

*Note : If the ECAM control panel fails, the CLR, RCL, STS, EMER CANC, and ALL pushbuttons remain operative, because their contacts are directly wired to the flight warning and display management computers.*

**ECAM SWITCHING PANEL**ON MAIN INSTRUMENT PANEL

FFCS-01-3130-004-A001AA

① DMC selector switch

**AUTO** : DMC 3 supplies data to both ECAM DUs

In case of DMC 3 failure, the DMC 1 automatically takes over.

1 : DMC 1 replaces DMC 3

2 : DMC 2 replaces DMC 3

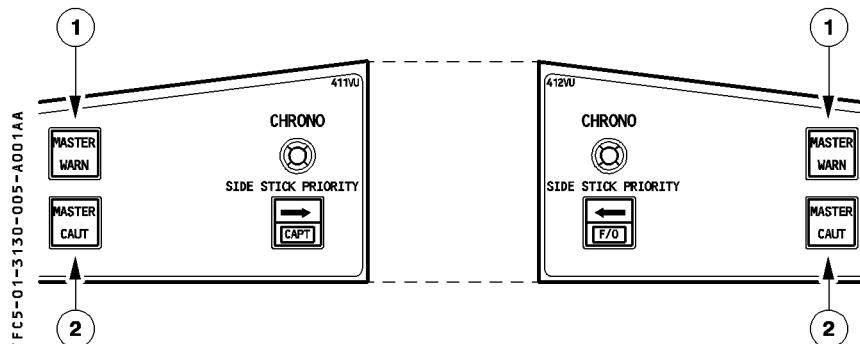
3 : DMC 3 supplies data to both ECAM DUs (for maintenance purpose)

*Note : If a DMC fails, each of its associated DUs displays a diagonal line.*

R ② ECAM/ND transfer selector switch

R Transfers the system/status display to either the captain's or the first officer's NDU.

*Note : If both ECAM DUs (E/WD and SD) fail, the flight crew can use this switch to transfer the E/W display to either navigation display.*

**ATTENTION GETTERS****① MASTER WARN lights**

- Flash red for level 3 warning.
- Accompanied by an aural warning (continuous repetitive chime, specific sounds or synthetic voice).

**② MASTER CAUT lights**

- Light up steady amber for a level 2 caution.
- Accompanied by a single chime.

These lights go out when :

- One pilot presses the light (except for some red warnings, such as the overspeed and stall warnings).
- The warning/caution situation is over.
- The pilot presses the CLR pushbutton on the ECAM control panel (except for some red warnings, such as the overspeed and stall warnings).
- The pilot presses the EMER CANC pushbutton on the ECAM control panel.

The aural warnings cease when :

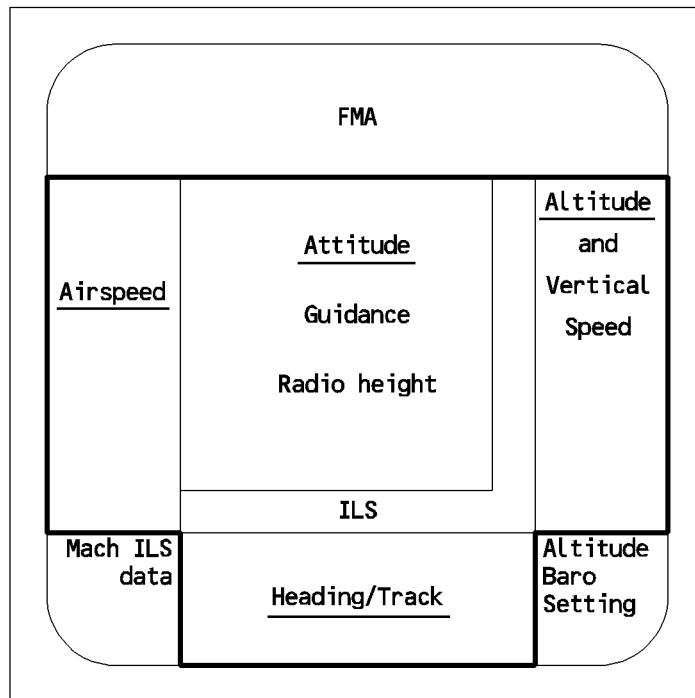
- One pilot presses the MASTER WARN light (except for some red warnings, such as the overspeed and stall warnings).
- The warning situation is over.

- R     – The pilot presses the EMER CANC pushbutton on the ECAM control panel.

**GENERAL**

The Primary Flight Display (PFD) provides the following information to the flight crew :

- Attitude and Guidance
- Airspeed
- Altitude (baro and radio) and vertical speed
- Heading and Track
- FMGS modes (Flight Mode Annunciator)
- Vertical and Lateral Deviations
- Radio navigation information (ILS, DME).



FFC5-01-3140-001-A001AA

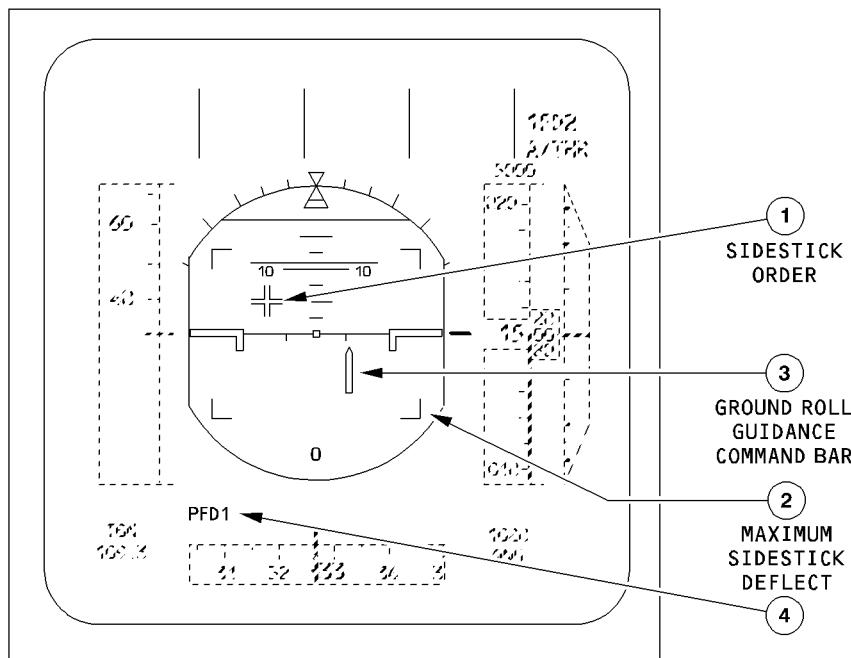
The FWC monitors such main parameters as : Attitude, heading, and altitude. Also refer to the "FLAGS AND MESSAGES DISPLAYED ON PFD" Chapter.

*Note : A grey background appears on the speed, the heading vertical speed, and the altitude speed scales of the PFD. If the Primary Flight Display (PFD) Unit temperature exceeds a defined threshold, the grey background disappears, in order to limit power consumption and prevent a DU overheat. Any additional increase in temperature will lead to a complete cut off of the power supply to this display unit.*

R  
R

**SPECIFIC GROUND INDICATIONS**

FFCS-01-3140-002-A001AB

**① Sidestick order indication (white)**

This is displayed, as soon as one engine is started.  
It indicates the total of the pilot's and copilot's sidestick orders (shown here as left wing down, pitch up).

**② Max Sidestick Deflection (white)**

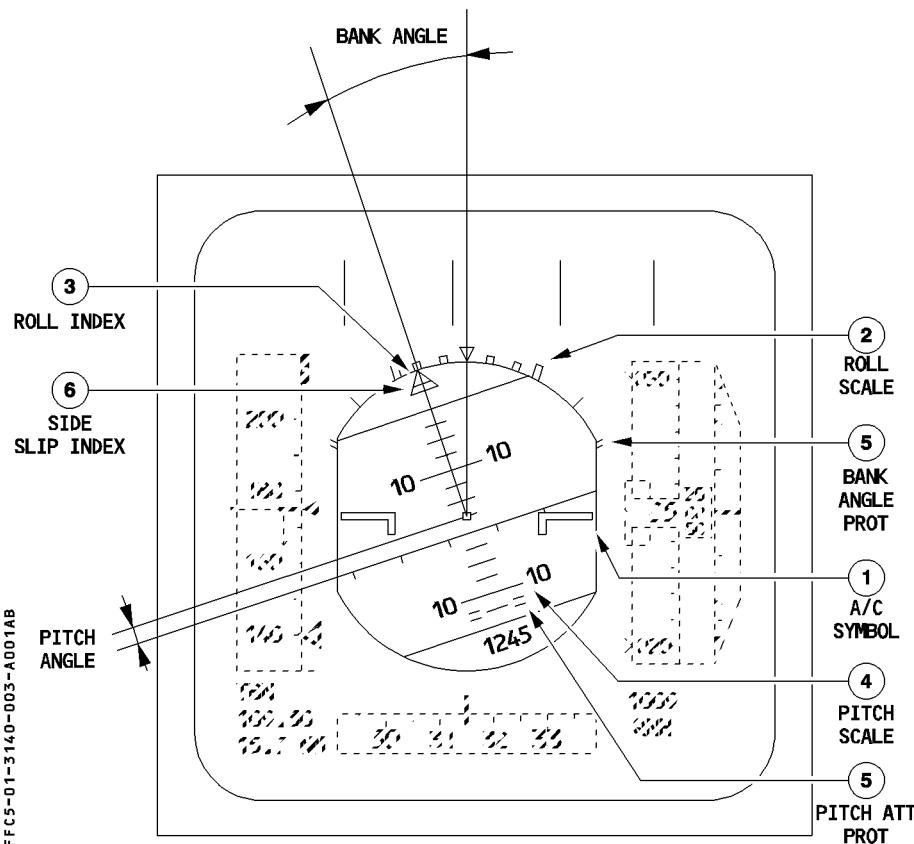
This is displayed, as soon as one engine is started.

**③ Ground Roll Guidance Command Bar (green)**

R This symbol is displayed when the aircraft is on the ground, or below 30 feet radio altitude, provided a localizer signal is available. It shows the flight director yaw orders, R to keep the runway centerline.

**④ PFD 1 (2 or 3) message (magenta)**

The display indicates which DMC drives the PFD. It appears only during tests on ground.

**ATTITUDE DATA****① Fixed Aircraft Symbol**

This symbol is black, outlined in yellow.

**② Roll Scale**

This scale is white, and has markers at 0, 10, 20, 30, and 45 degrees of bank.

**③ Roll Index (yellow)**

This pointer indicates the bank angle. When the bank angle exceeds 45°, all the PFD symbols except those for attitude, speed, heading, altitude, and vertical speed disappear. The display returns to normal when the bank angle decreases below 40°.

**④ Pitch Scale (white)**

This scale has markers every ten degrees between 80° nose up and 80° nose down (every 2.5° between 10° nose down and 30° nose up). When pitch angle exceeds 25° nose up or 13° nose down, all the PFD displays except attitude, speed, speed trend, heading, altitude, and vertical speed disappear. Beyond 30°, large red arrowheads indicate that the attitude has become excessive and show the direction to move the nose in order to reduce it. The display returns to normal when pitch angle becomes less than 22° nose up or 10° nose down.

**⑤ Flight Control Protection Symbols**

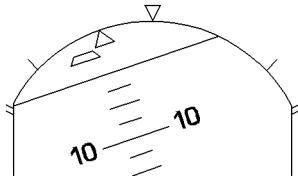
The display shows these symbols in green :

- on the roll scale at  $\pm 67^\circ$  to mark the bank angle limits
  - on the pitch scale at 15° nose down or 30° nose up to mark the pitch limits.
- An amber  $\times$  replaces these symbols if the corresponding protection is lost. (Refer to 1.27.30)

**⑥ Sideslip Index (yellow)**

This trapezoidal index moves beneath the roll index. On the ground it represents the lateral acceleration of the aircraft : in flight it shows sideslip (as furnished by ADIRS). One centimeter of displacement indicates 0.2g. The sideslip index is against its stop at 0.3g.

FFC5-01-2140-004-A001AA



In case of engine failure at take-off or go-around, the sideslip index changes from yellow to blue.

Note : *The sideslip target is blue if :*

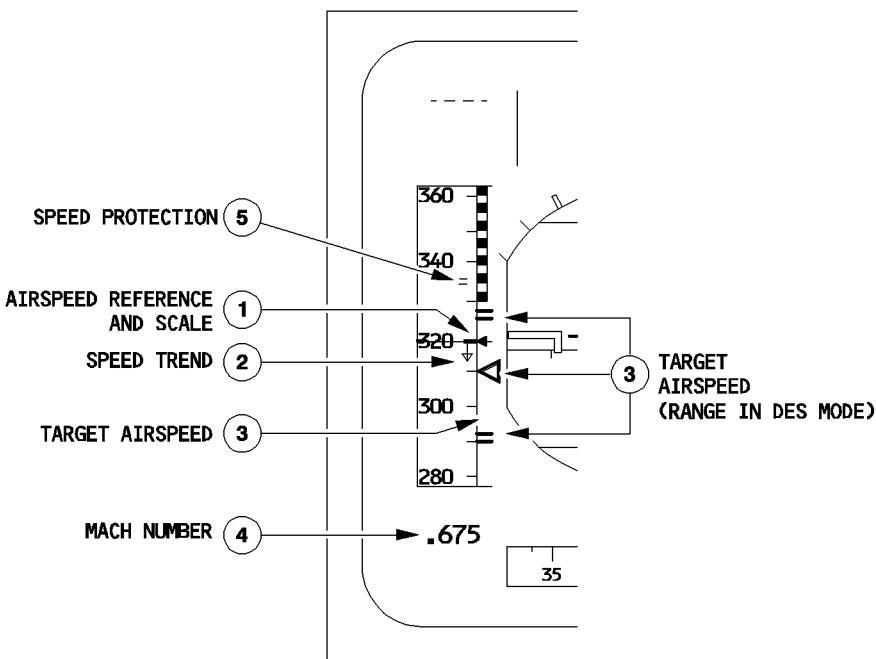
- CONF 1, 2, or 3 is selected, and
  - any ENG N1 > 80%, and
  - the difference between the ENG N1's exceeds 30%.
- In this case the sideslip index is called  $\beta$  target.*

When this index is centered with the roll index, the sideslip equals the sideslip target for optimum aircraft performance.

**AIRSPED**

R

FFC5-01-3140-005-A001AD

**① Actual Airspeed Reference Line and Scale**

A white scale on a gray background moves in front of a fixed yellow reference line next to a yellow triangle to show airspeed. The minimum airspeed indication is 30 knots.

**② Speed Trend (yellow)**

This pointer starts at the speed symbol. The tip shows the speed the aircraft will reach in 10 seconds if its acceleration remains constant. The pointer appears only when it is greater than 2 knots and disappears when it is less than 1 knot. It also disappears if the FMGCs fail.

**③ Target Airspeed (magenta or blue)**

This symbol gives the target airspeed or the airspeed corresponding to the target Mach number.

The target airspeed is the airspeed computed by FMGC in managed speed mode (magenta) or entered manually on the FCU for selected speed mode (blue).

When the target speed is off the speed scale, its value is displayed as numbers below or above the speed scale.

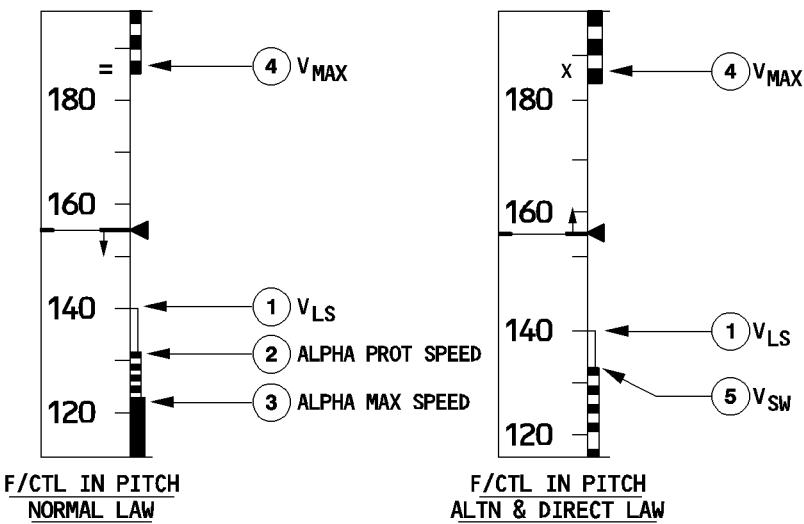
**④ Mach Number (green)**

This is displayed when it is greater than 0.5 and the LS pushbutton is not selected on the EFIS control panel.

**⑤ Speed Protection (green)**

This symbol indicates the speed ( $VMO + 4 \text{ kt}$  or  $MMO + 0.006$ ) at which overspeed warning will occur. This symbol is not displayed in pitch alternate or direct law because the protection is not available. (Refer to 1.27.30)

FFCS-01-3140-007-A001AC



### ① Minimum Selectable Speed (VLS)

The top of the amber strip along the speed scale indicates this speed. It represents the lowest selectable speed providing an appropriate margin to the stall speed. (Refer to 3.04.10)

VLS information is inhibited from touchdown until 1 second after liftoff.

### ② Alpha Protection Speed

The top of a black and amber strip along the speed scale indicates this speed. It represents the speed corresponding to the angle of attack at which alpha protection becomes active (Refer to 1.27.20).

It is displayed when in pitch normal law.

### ③ Alpha Max Speed

The top of a red strip along the speed scale indicates this speed. It represents the speed corresponding to the maximum angle of attack that the aircraft can attain in pitch normal law (Refer to 1.27.20).

It is displayed when in pitch normal law.

**④ VMAX**

The lower end of a red and black strip along the speed scale defines this speed.

It is the lowest of the following :

- VMO or the speed corresponding to MMO
- VLE
- VFE

(Refer to 3.04.10)

**⑤ Stall Warning Speed (VSW)**

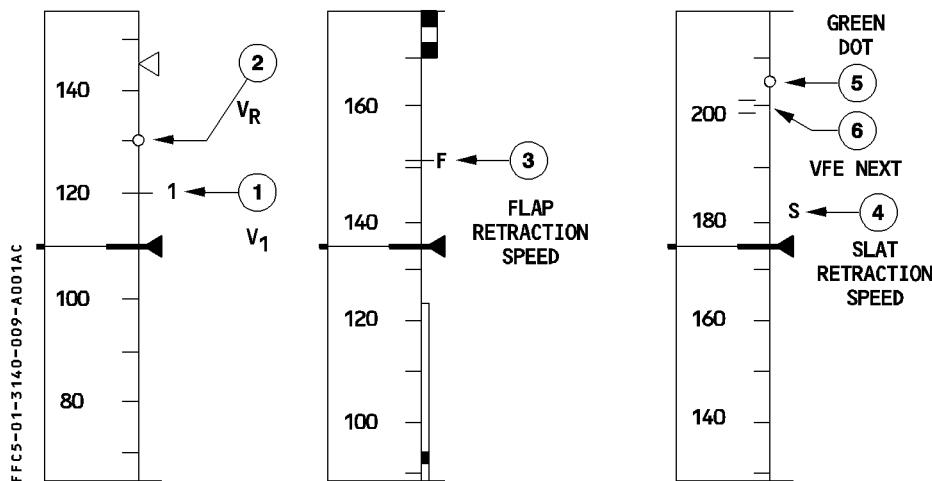
The top of a red and black strip along the speed scale defines this speed.

It is the speed corresponding to the stall warning. (Refer to 1.27.20)

VSW information is inhibited from touchdown until 5 seconds after liftoff.

It is displayed when operating in pitch alternate or pitch direct law.

R



### ① Decision Speed : (V1)

This is a blue symbol (numeral one) that the crew inserts manually through the MCDU. When it is off the scale, the upper part of the scale shows it in numbers. It disappears after liftoff. (Refer to 3.04.10)

### ② Rotation speed : (VR)

This is a blue circle and corresponds to the value that the crew inserts manually through the MCDU. It appears during takeoff while on ground.

Note : *V2 is represented by the target speed index during takeoff.  
V2 is manually inserted by the crew through the MCDU.*

### ③ Minimum Flap Retraction Speed

This is a green symbol (letter F). It appears when the flap selector is in position 3 or 2. (Refer to 3.04.10)

### ④ Minimum Slat Retraction Speed

Represented by a green symbol (letter S). It appears when flap selector is in position 1. (Refer to 3.04.10)

**⑤ Green Dot (Engine-out operating speed in clean configuration)**

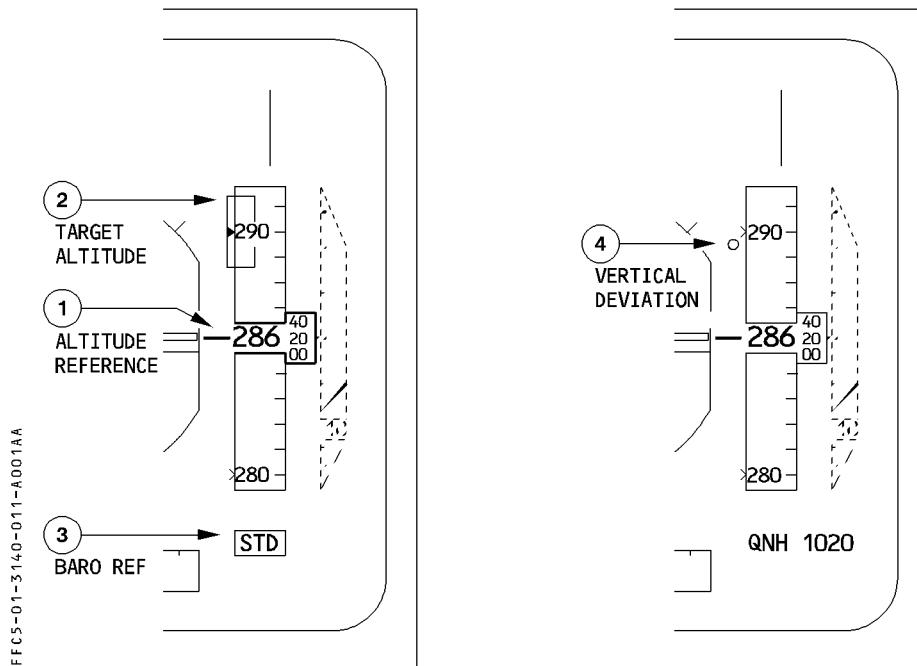
This green dot appears when the aircraft is flying in the clean configuration.  
It shows the speed corresponding to the best lift-to-drag ratio.

**⑥ VFE NEXT**

This symbol, an amber =, shows the VFE corresponding to the next flap lever position.  
It appears when the aircraft altitude is below 20000 feet. (Refer to 3.04.10)

**ALTITUDE**

R

**① Altitude Indication**

This appears both as a white moving scale and as a green digital readout on a grey background. "NEG" appears in the window in white for negative altitudes. The altitude window changes from yellow to amber, if the aircraft deviates from the FCU-selected altitude or flight level.

On any approach for which an MDA (MDH) is entered in the FMGS, the altitude numbers change from green to amber, when the aircraft goes below the MDA (MDH).

**② Target Altitude or Selected Flight Level Symbol (blue)**

This symbol shows the FCU-selected altitude (if QNH baro reference is selected), or the selected flight level (if STD baro reference is selected.)

When the FMGC operates in the vertical managed mode, this symbol is in magenta, if it represents a flight plan altitude constraint that the FMGC will follow. If the target altitude or flight level is on the scale, the symbol is displayed and the numerical value appears inside the symbol.

If it is off the scale, the symbol is not displayed, and the numerical value appears above or under the scale.

**③ Barometric Reference**

The display shows "STD" or it shows "QNH" and the numerical setting in hectoPascals or inches of mercury.

It pulses when the selection made by the pilot is not correct (STD not selected above transition altitude in climb or STD still selected in approach below transition level or 2500 feet radio height if transition level is not available).

**④ Vertical Deviation (magenta)**

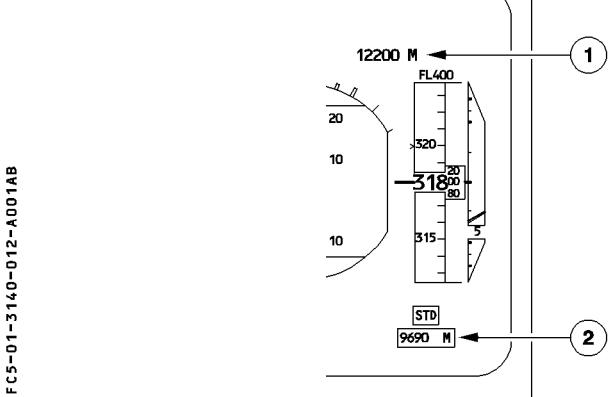
R This symbol appears next to the altitude corresponding to the theoretical vertical profile computed by the FMGC. It is displayed from the top of descent down to the MAP altitude.

R The pilot can read the VDEV directly from the altitude scale. The range is  $\pm 500$  feet. When the VDEV value exceeds  $\pm 500$  feet, the symbol stays at the range limit and the PROG page displays the exact value.

**METRIC ALTITUDE INDICATIONS**

If metric reference is selected on the FCU two additional symbols are displayed on PFD.

FFC5-01-3140-012-A001AB



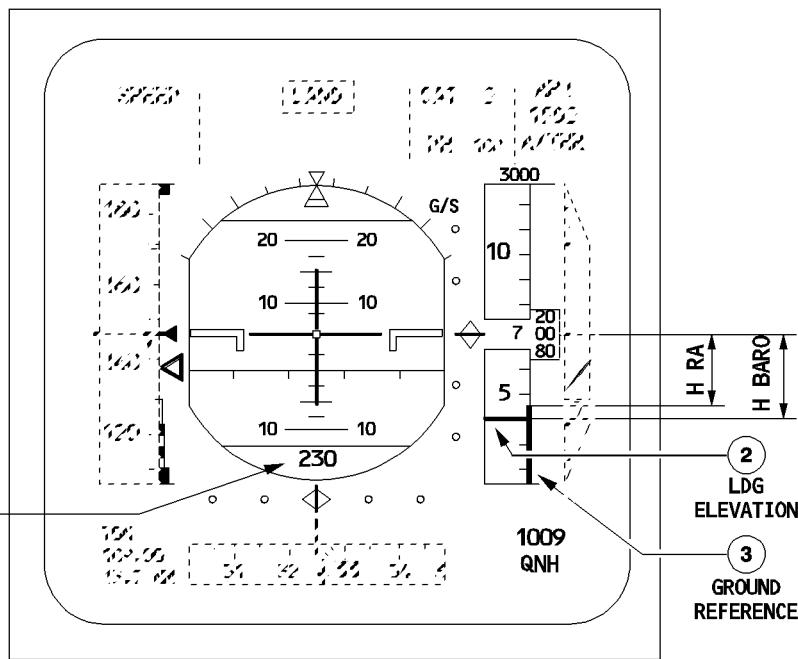
**① Target altitude or selected flight level (magenta or blue)**

The display shows the selected altitude value in meters.

**② Altitude indication (green)**

The display shows the actual aircraft altitude value in meters.

FFC5-01-3140-013-A001AB



### ① Radio Height

This quantity appears when it is less than 2500 feet.

- If a DH has been entered, the radio height appears :
  - in green when  $DH + 100 \text{ feet} < RA < 2500 \text{ feet}$
  - in amber when  $RA < DH + 100 \text{ feet}$

If "NO" is entered as the DH on the MCDU APPROACH page, 0 feet becomes a default value.

When the aircraft reaches the decision height selected on the MCDU, DH letters flash amber for three seconds, then stay in amber above the radio height indication.

- If no DH has been entered or if both FMGCs fail, the radio height appears :
  - in green when  $400 \text{ feet} < RA < 2500 \text{ feet}$
  - in amber when  $RA \leq 400 \text{ feet}$

The radio altitude indication changes every 10 feet down to 50 feet, then every 5 feet down to 10 feet, then every foot.

R

**(2) Landing Elevation (blue)**

The horizontal bar on the altitude scale shows the landing elevation at the flight-planned destination.

It is displayed :

- during flight phases 7 and 8 and
- if the QNH reference mode is selected.

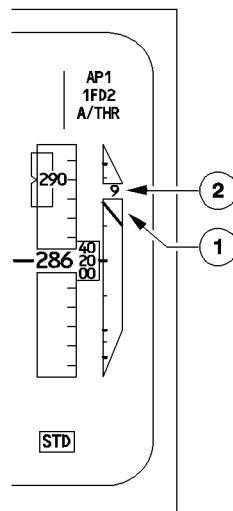
**(3) Ground reference**

A red ribbon on the right of the altitude scale represents the field elevation. This ribbon, which is driven by the radio altimeter signal, is displayed below 570 feet.

It moves up, as does the lower line of the attitude sphere, with the altitude scale as the aircraft descends. When the aircraft has touched down, the top of this ribbon is at the middle of the altitude window.

**VERTICAL SPEED**

- R The displayed vertical speed information is normally based on both inertial and barometric data. If inertial data is not available, it is automatically replaced by barometric information. In this case, the window around the numerical value becomes amber.



**① Analog pointer**

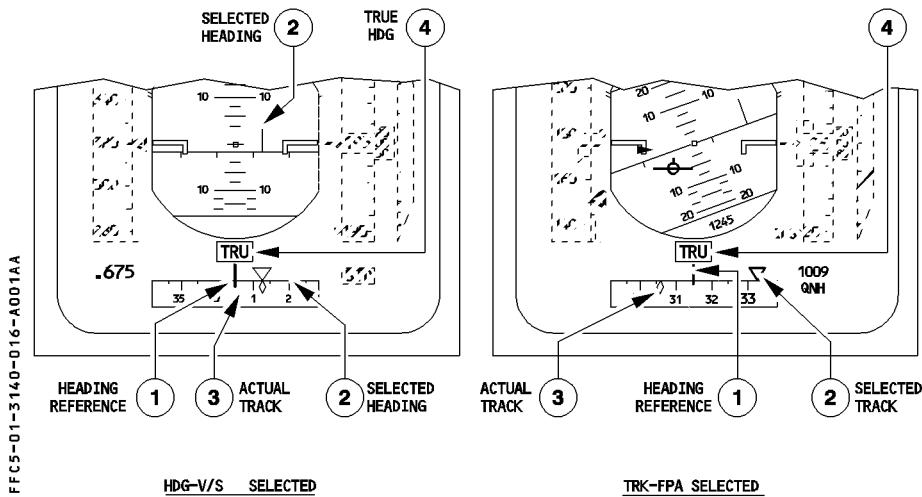
This pointer, which is normally green, points to a white vertical speed scale displayed on a grey background and graduated at intervals of 500 feet/minute.  
If the V / S is greater than 6000 feet/minute, the pointer stays at the end of the scale.

**② Digital indication**

This number, normally green, is the vertical speed in hundreds of feet per minute.  
It disappears if the vertical speed is less than 200 feet/minute.  
The analog pointer and the digital indication become amber, if :

- V / S is greater than 6000 feet/minute, (climb or descent)
- V / S is greater than 2000 feet/minute, during descent when  $1000 \text{ feet} < RA < 2500 \text{ feet}$ , or
- V / S is greater than 1200 feet/minute, during descent and  $RA < 1000 \text{ feet}$ .

*Note : For TCAS, refer to 1.34.80.*

**HEADING****① Heading Reference Line and Scale**

A white scale on a gray background moves in front of a fixed yellow reference line to show the actual magnetic heading.

**② Selected Heading or Track Index (blue)**

The pointer indicates the heading or track selected on the FCU HDG-TRK counter. The index is replaced by digits on the right or on the left side of the scale when the selected value is off the scale.

If the FD pushbutton switch is OFF a second heading or track symbol appears on the horizon line and markers are displayed every 10°.

**③ Actual Track Symbol**

This symbol is a small green diamond.

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**INDICATIONS ON PFD**

SEQ. 001 REV 08

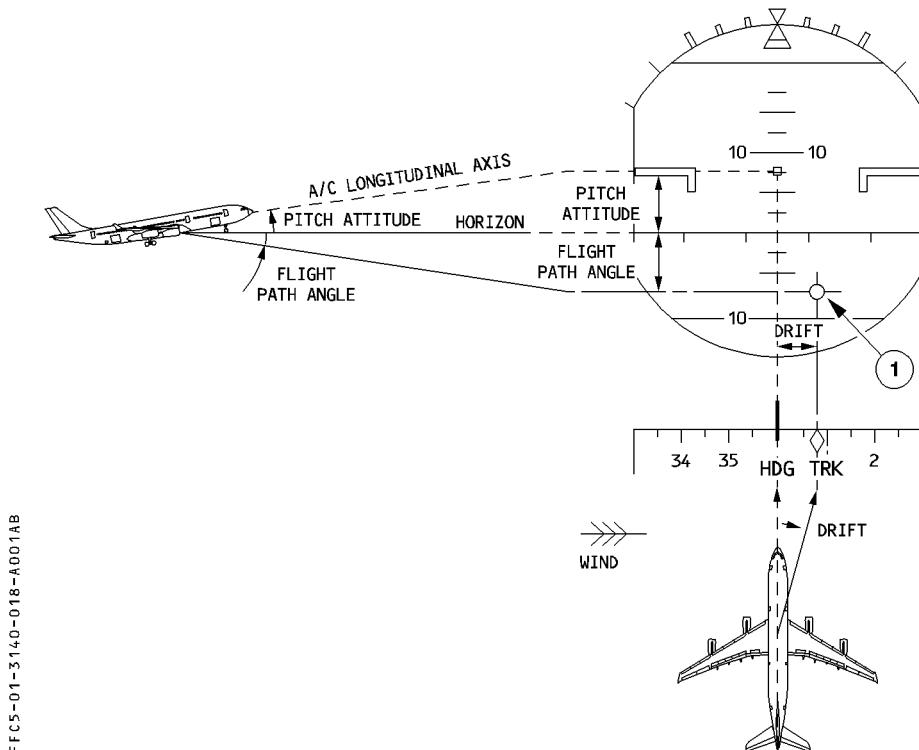
**④ True heading (blue)**

At high latitude above 82.5° North or 60.5° South (or entering the north, magnetic polar region latitude 73.5° N and longitude between 117.5° W and 92.5° W) the ADIRUs replace magnetic heading by true heading on EFIS and DDRMI.

When the aircraft is in close proximity to these regions (latitude above 82° North or 60° South or approaching the north polar region : 73° N and longitude between 90° W and 120° W) the ADIRU will trigger a message on ND « SELECT TRUE REF » requesting to change north reference.

In true heading configuration at slats extension « TRU » with flash for 9 seconds then remains steady.

Location of TRU indication is shifted to right hand side of the scale when the ILS localizer deviation scale is displayed.

**FLIGHT PATH VECTOR****① Flight Path Vector (FPV)**

This symbol appears when the pilot selects TRK/FPA on the FCU.

The flight path vector represents the lateral and vertical trajectory of the aircraft with respect to the ground.

- On the lateral scale it indicates the aircraft's track.
- On the vertical scale it indicates the aircraft's flight path angle.

Example : The aircraft flies a track of 009 (heading 360°, wind from west) and descends with a flight path angle of  $-7.5^\circ$ .

**GUIDANCE**

Two completely different flight director modes are available, each with its own characteristic symbols. The symbol displayed corresponds to the basic operating reference the pilot has selected. – either HDG V/S or TRK FPA.

In normal operation PFD1 displays FD1 orders.

If FD1 fails, PFD1 automatically displays FD2 orders, and on the PFD1 the FD2 indication in the right column of the FMA flashes for a few seconds.

The same applies for FD2 orders normally displayed on PFD2.

**IF THE CREW HAS SELECTED HDG V/S TO BE THE BASIC REFERENCE :**

The PFD displays pitch and roll bars in green. They automatically move out of view at touchdown in ROLL OUT mode.

They flash for 10 seconds and then remain steady in the following conditions :

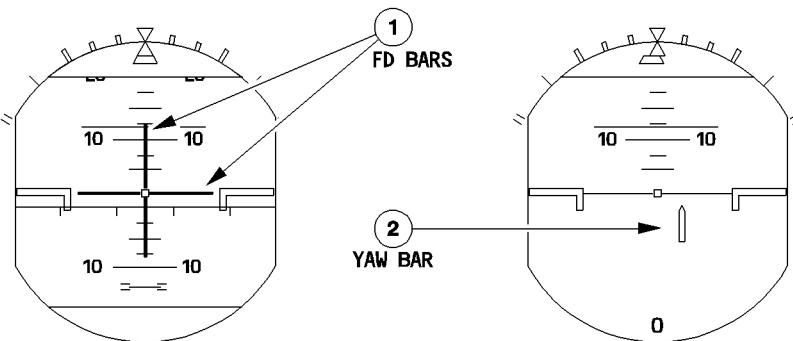
- reversion to the HDG V/S basic mode (manually or automatic)
- change of selected flight level when the autopilot is already engaged in ALT CAPTURE mode
- loss of LOC or G/S in LAND mode or loss of LAND mode
- at the first AP or FD engagement

The PFD displays a yaw bar in green below 30 feet radio altitude if a localizer signal is available:

- during takeoff (in RWY mode)
- upon landing (in FLARE and ROLL OUT mode).

R

FFC5-01-3140-019-A001AA



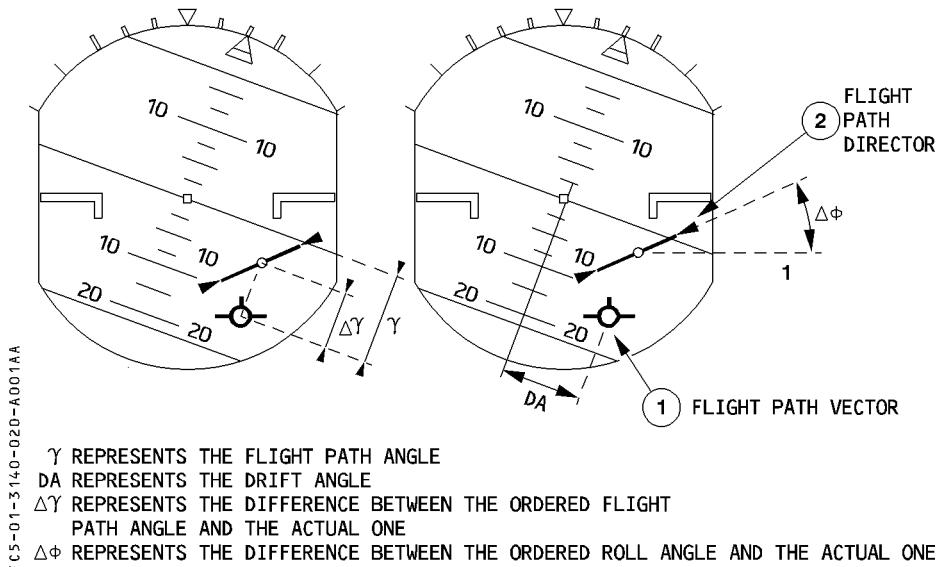
① FD Crossed Bars (green)

② Yaw Bar (green)

### **THE CREW HAS SELECTED TRK FPA AS THE BASIC REFERENCE :**

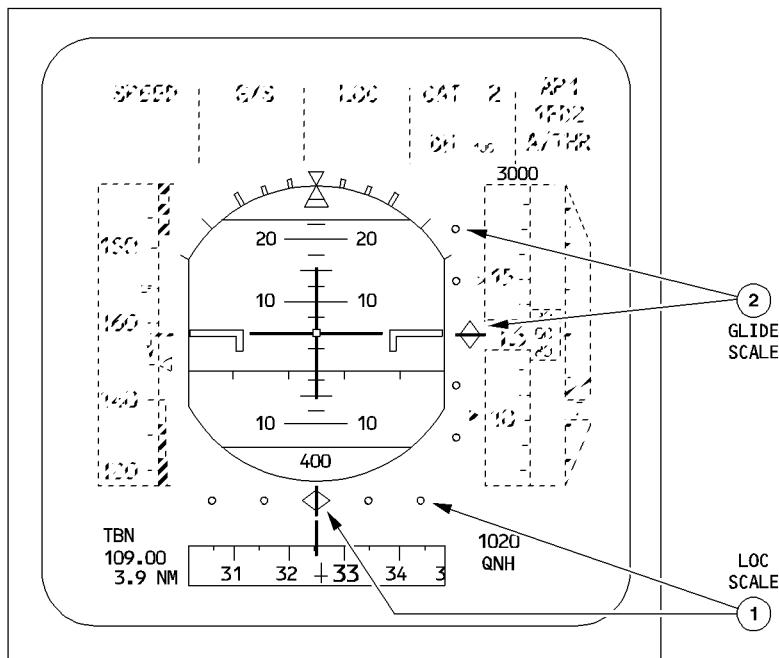
An inertial flight path vector defines the aircraft's horizontal and vertical track, taking wind effect into account.

An associated flight path director symbol guides the flight crew onto the vertical and horizontal flight path targets.



① Flight Path Vector (green)

② Flight Path Director (green)

**TRAJECTORY DEVIATION****ILS APPROACH**

FFC5-01-3140-021-A001AA

**① Localizer Deviation Scale and Index****② Glide Slope Deviation Scale and Index**

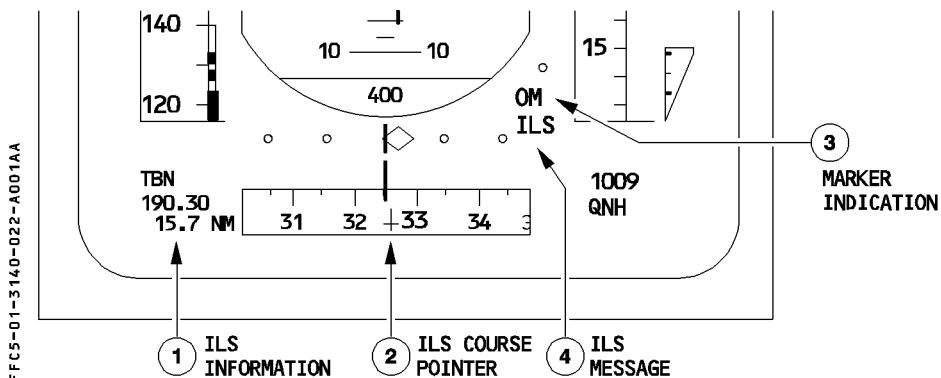
Deviation scales appear as soon as the flight crew pushes an LS pushbutton switch on the EFIS control panel. Deviation indexes appear when the glide slope and localizer signals are valid if deviation scales are displayed.

When a deviation index is out of the displayed range, only half a symbol appears at the end of the scale.

The LOC scale flashes and continues to flash if the deviation exceeds 1/4 dot for two seconds (above 15 feet RA). The glide scale flashes and continues to flash if the deviation exceeds one dot for two seconds (above 100 feet RA).

"LOC" and the glide scale half index symbols flash and continue to flash when the deviation exceeds two dots for two seconds.

- R One dot represents a deviation of  $\pm 0.8^\circ$  on the localizer scale and  $\pm 0.4^\circ$  on the glide slope scale.



① ILS information (magenta)

The following information appears on the PFD when the crew has selected an ILS frequency and course and pushed the LS pushbutton :

- ILS identification as decoded by the ILS receiver
- ILS frequency
- DME distance if the ILS has a DME

② ILS course Pointer (magenta)

This pointer appears on the PFD when the crew has selected an ILS frequency and course and pushed the LS pushbutton.

It is a dagger-shaped symbol on the heading scale.

The ILS course (numerical) appears in magenta on the right or the left side of the scale when it is outside the displayed range of headings.

③ Marker Indications

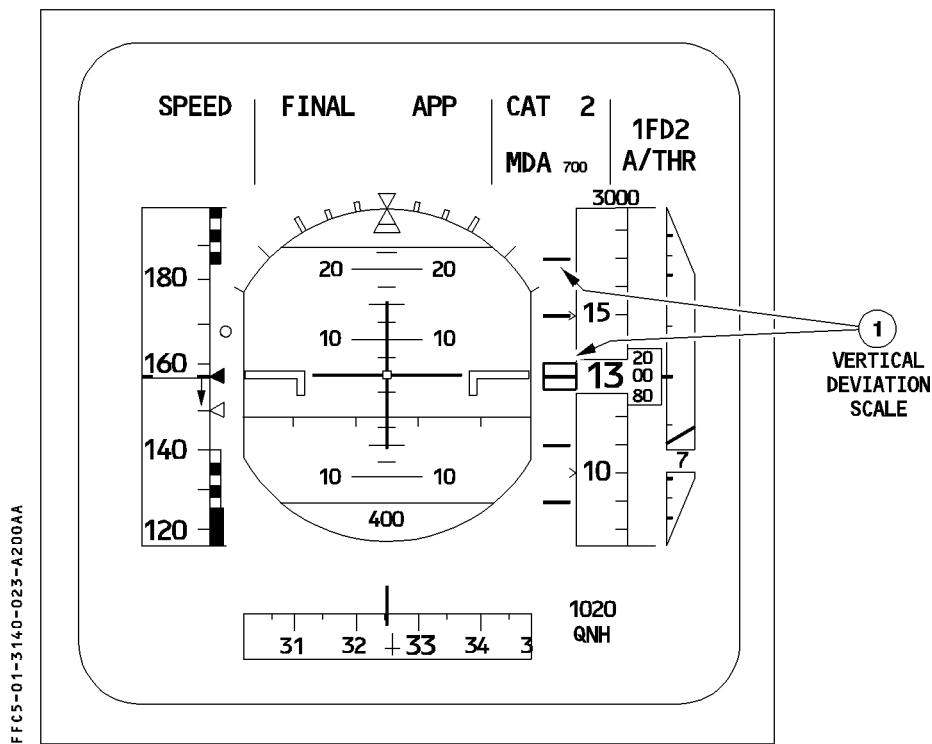
OM appears in cyan when aircraft flies over the outer marker

MM appears in amber when it flies over the middle marker

AWY appears in white when it flies over an airways marker beacon or the ILS inner marker.

④ ILS Message

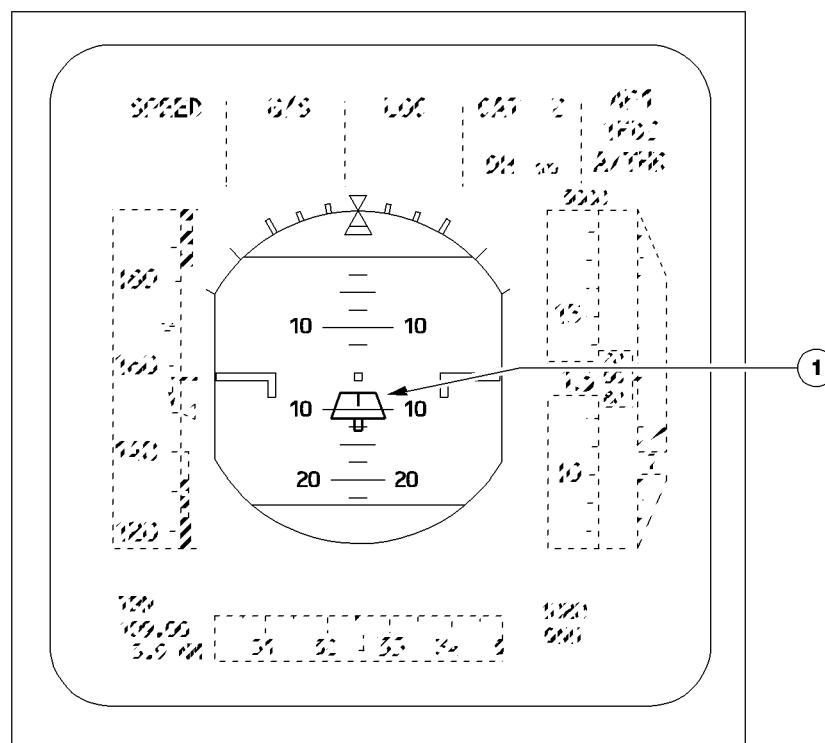
This flashes amber when the APPR mode is armed and the ILS display is not selected.

**NON PRECISION APPROACH****① Vertical Deviation Scale and Index**

The vertical deviation scale and index appear when in approach phase and the FINAL mode is armed/engaged or a non precision approach has been entered. They are displayed until MDA has been reached. They give the vertical deviation with respect to the trajectory defined by the FMGC.

Each index scale graduation represents 100 feet. Range limit is  $\pm$  200 feet.

Note : If LS pushbutton is pressed, glide deviation has priority over vertical deviation information.

**RISING RUNWAY SYMBOL****① Rising Runway Symbol (magenta)**

If :

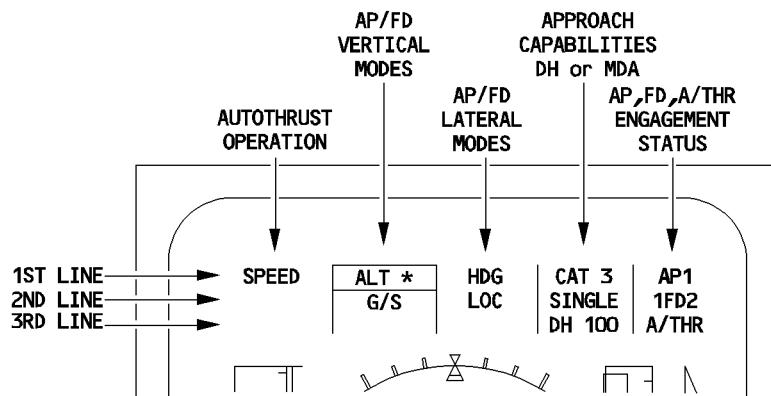
- The localizer signal is valid,
- The radio altitude is available, and
- The yaw bar is not displayed,

at 200 feet RA the runway symbol starts from the bottom of the pitch scale. Its vertical deviation is driven by the radio altitude and its lateral deviation by the localizer.

Note : When the rising runway option is installed, the lower line of the attitude sphere does not move for ground reference.

**FLIGHT MODE ANNUNCIATOR**

FFC5-01-3140-025-A001AA



For a detailed discussion of legends and messages that may appear during FMGS operations, see AFS chapter (Refer to 1.22.30).



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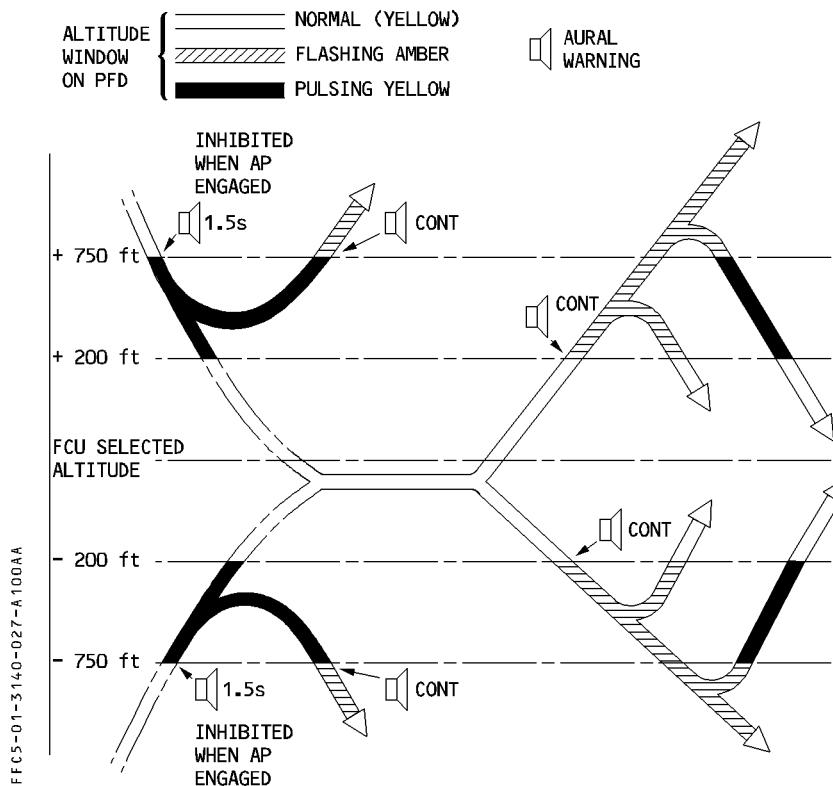
SEQ 001 REV 08

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**ALTITUDE ALERT**

The FWC generates an altitude warning (C chord sound, and PFD's altitude window pulses in yellow or flashes in amber), when the aircraft approaches a preselected altitude or flight level or when it deviates from its selected altitude or flight level.

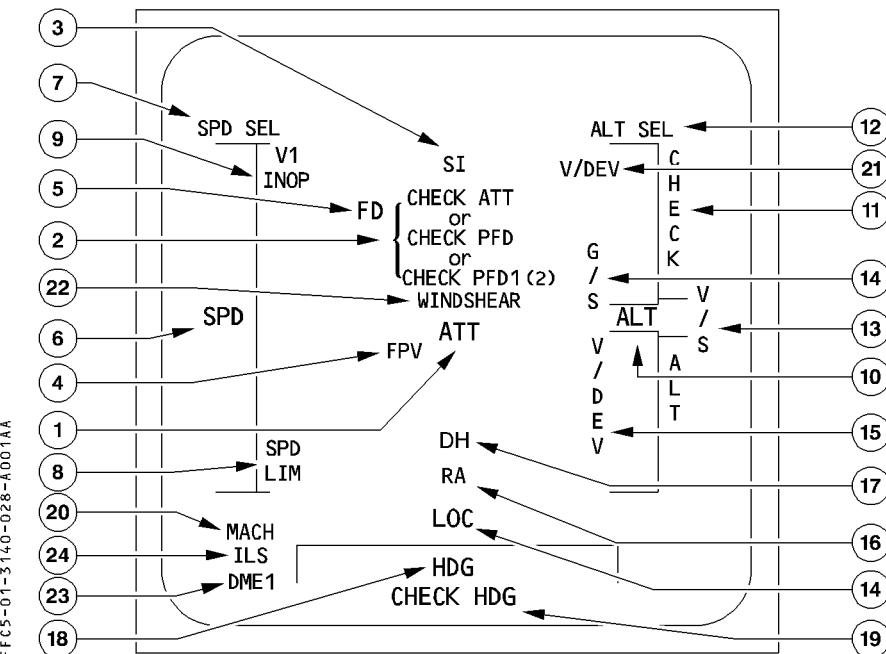
This warning results from a comparison between the altitude (ADIRS) and the preselected altitude displayed on the FCU.



- The continuous C chord is cancelled by selecting a new altitude, by pushing the ECAM control panels' EMER CANC pushbutton, or by pressing either MASTER WARN pushbutton.
- The altitude window stops flashing, if a new altitude is selected.
- The altitude alert is inhibited :
  - When the slats are out with the landing gear selected down, or
  - In approach after the aircraft captures the glideslope, or
  - When the landing gear is locked down.

**FLAGS AND MESSAGES DISPLAYED ON PFD**

R

**① ATT Flag (red)**

If the PFD loses all attitude data, its entire sphere is cleared to display the ATT flag.

**② CHECK ATT or CHECK PFD or CHECK PFD1 (or 2) flag (amber)**

"CHECK ATT" appears when there is a disagreement (of at least 5°) in the attitude information displayed by the two PFDs. The CHECK ATT flag appears on both PFDs, and a caution appears on the ECAM.

"CHECK PFD" appears when the DMC detects a disagreement between the two PFDs. The CHECK PFD flag appears on both PFDs.

"CHECK PFD 1(2)" appears when the DMC detects a disagreement between its own computation and its displayed information. The CHECK PFD 1(2) flag appears on the relevant PFD.

R

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## INDICATIONS ON PFD

SEQ. 100 REV. 22

**(3) SI flag (red)**

If the Sideslip Information (SI) is lost, the index disappears and a red SI flag appears.

**(4) FPV flag (red)**

In TRK FPA mode, when the drift angle or flight path angle is not valid, an FPV flag appears.

**(5) FD flag (red)**

If both FMGCs fail, or if both FDs are disengaged and the FD pushbutton is on and the attitude is valid, a red FD flag appears.

**(6) SPD flag (red)**

If the speed information fails, a SPD flag replaces the speed scale.

**(7) SPD SEL flag (red)**

If the selected speed information fails, a SPD SEL flag appears.

**(8) SPD LIM flag (red)**

The SPD LIM flag appears when both FMGCs (flight envelope part) are inoperative, or in case of an SFCC dual flap/slat channel failure.

In this case, the following PFD information is lost : VLS, S, F, Green Dot, Vtrend, Vmax, VFE next, VSW.

If only Vmax or VLS is lost, the flag appears the PFD, but the remaining valid information is still displayed.

**(9) V1 INOP flag (red)**

When the V1 signal is not valid, a V1 INOP flag replaces the digital value.

**(10) ALT flag (red)**

If the altitude information fails, the ALT flag replaces the altitude scale.

**(11) CHECK ALT flag (amber)**

The CHECK ALT flag appears, with an associated ECAM caution, if the difference between the altitude indications on the two PFDs is greater than 250 feet when QNH is selected, or greater than 500 feet when STD is selected.

R The caution and the flag disappear, when the Captain's and First Officer's barometer references are different.

**(12) ALT SEL flag (red)**

If the selected altitude information fails, an ALT SEL flag appears.

**(13) V/S flag (red)**

If the vertical-speed information fails, the V/S flag replaces the vertical speed scale.

**(14) LOC and G/S flags (red)**

If the localizer or glideslope receiver fails, a LOC or G/S flag appears on the deviation scale.

**(15) V/DEV flag (red)**

If vertical deviation information fails and the LS pushbutton is not pressed, a V/DEV flag replaces the V/DEV scale.

**(16) RA flag (red)**

If both radio altimeter fail, this flag appears in place of the radio height indication when aircraft altitude is below the transition altitude. The ground reference indication (red ribbon) will disappear.

**(17) DH flag (amber)**

A DH flag appears, when the aircraft reaches the selected DH.

**(18) HDG flag (red)**

If the heading information fails, the HDG flag replaces the heading scale.

**(19) CHECK HDG flag (amber)**

The CHECK HDG flag appears, as does an ECAM caution, if there is a discrepancy ( $5^\circ$ ) between pilot's and copilot's heading indications.

**(20) MACH flag (red)**

This flag appears if the Mach data fails.

**(21) V/DEV (amber)**

At the top of the glideslope scale this message flashes when in approach, either FINAL mode is armed/engaged or a non-ILS approach has been entered, and the LS pushbutton is selected.

**(22) WINDSHEAR (red) or W/S AHEAD (red or amber) warnings**

**WINDSHEAR** : Reactive windshear warning. Displayed, when the FMGC detects windshear.

The detection function is available at :

- Takeoff, from 3 seconds after lift-off, up to 1300 feet RA,
  - Landing, from 1300 feet RA, down to 50 feet RA,
- provided the aircraft is not in clean configuration.

It remains displayed at least 15 seconds after windshear detection.

Associated with an aural "WINDSHEAR" warning, which is repeated 3 times.

**W/S AHEAD** : Predictive windshear warning. Displayed, when a windshear alert is generated by the predictive windshear system below 1500 feet RA. The color depends on the alert level.

Three different alert levels exist, depending on windshear strength and proximity :

Alert Level	Aural Warning	PFD	ND (refer to 1.31.45)
Warning (Landing)	«GO AROUND WINDSHEAR AHEAD»	W/S AHEAD (red)	Windshear icon
Warning (Takeoff)	«WINDSHEAR AHEAD» (twice)	W/S AHEAD (red)	Windshear icon
Caution	«MONITOR RADAR DISPLAY»	W/S AHEAD (amber)	Windshear icon
Advisory	Nil	Nil	Windshear icon

Note : 1. All flags, except SI, V1 INOP, DME 1 (which are steady), flash for 9 seconds then are steady.

DH flag flashes for 3 seconds, then is steady.

2. For TCAS, Refer to 1.34.80.

**(23) DME 1 flag (red)**

When DME distance is not available, a DME 1 (on PFD 1) or DME 2 (on PFD 2) replaces the DME distance indication.

**R (24) ILS flag (red)**

R If an ILS frequency is not available, or if either the LOC or G/S signals fail, an ILS flag replaces the ILS frequency indication.

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**INDICATIONS ON ND**

SEQ. 001 REV 22

**GENERAL**

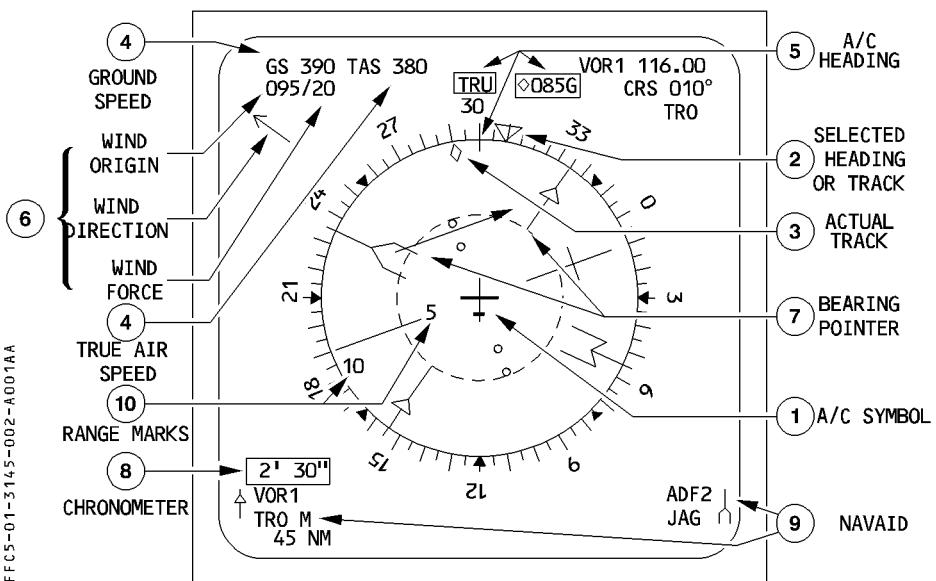
There are six different displays (five display navigation information, and one displays primary engine parameters) :

- ROSE LS
- ROSE VOR
- ROSE NAV
- ARC
- PLAN
- ENG (standby page)

The Navigation Display (ND) can provide a weather radar image in all modes, except PLAN.

*Note : In case avionics ventilation is not sufficient (e.g. due to a blower and extract fan failure), and the Navigation Display (ND) Unit temperature exceeds a defined threshold, the ND will not display the weather radar image, in order to limit power consumption and prevent a DU overheat. Any additional increase in temperature will lead to a complete cut off of the power supply to this display unit.*

R  
R

**ROSE MODES****① Aircraft symbol (yellow)**

Fixed and centered in the display, this symbol points to the yellow lubber line.

**② Selected heading or track (blue)**

This pointer shows the heading or track indicated on the HDG TRK counter of the FCU.

**③ Actual aircraft track (green)**

This symbol is a small green diamond.

**④ Ground speed and true air speed (green)**

ADIRS furnishes these speeds.

**⑤ Aircraft heading**

The fixed yellow rubber line points to the aircraft magnetic heading on the moving white compass rose. Small white triangles are fixed at 45° intervals on the circumference of the compass rose.

At latitudes above 82° North or 60° South (or when entering the north magnetic polar region, latitude 73° N and longitude between 120° W and 90° W), the ADIRUs replace magnetic heading with true heading on the EFIS and DDRMI.

When the aircraft is close to these regions (-0.5° away), the ADIRU causes "SELECT TRUE REF" to appear on the ND. When the crew selects TRU, "TRU" appears in blue above the heading scale.

TRU (blue) :

This appears on the ND when the compass is in the true heading configuration. The message flashes for 9 seconds, or until the slats are extended, then it is steady.

Grid track (green) :

The ND displays the grid track in numerical form, when switch is in true reference and the latitude is above 65° N or S.

**⑥ Wind direction and speed**

ADIRS furnishes the wind direction and speed. The digital direction is with respect to true north, and the analog direction (green arrow) is with respect to magnetic north. The arrow appears only if the wind speed is greater than two knots and the true airspeed is above 100 knots.

If the display does not receive either wind speed or direction, dashes replace the numbers on the display.

**⑦ Bearing pointer**

The ND displays the bearing pointer when bearing data is available. The pointer is :

- Green for ADF
- White for VOR.

If ROSE NAV or ARC mode is selected, and the computer detects a mismatch between aircraft and VOR reference, the bearing pointer appears in magenta. The VOR bearings are true bearings, having been corrected with the magnetic variation of the actual aircraft position (See also FMGS PILOTS GUIDE – POLAR NAVIGATION, 4.04.40).

R

If reception of a beacon ceases, or if the receiver fails, the associated bearing pointer disappears.

**⑧ Chronometer indication (white)**

These numbers appear when the onside chronometer is started.

They display the elapsed time.

The indication is in minutes and seconds from 0 to 59' 59", and in hours and minutes from 1 H to 99 H 59'. (Seconds are not displayed beyond 59' 59").

**⑨ Navaids**

When the ADF-OFF-VOR selector switch on either the pilot's or co-pilot's EFIS control panel is set to ADF or VOR, the onside ND displays the following characteristics of the corresponding navaid in white for VOR or in green for ADF (left side for receiver 1 and right side for receiver 2) :

- Type of navaid (ADF or VOR) ;
- Shape and color of the associated bearing pointer (if the bearing pointer is in view);
- Navaid identification (or frequency by default) ;
- DME distance, if a DME is collocated with the selected VOR ADF, and the DME distance are never displayed at the same time.
- Mode of tuning :
  - M for a navaid manually tuned by the pilot through the MCDU (underlined and dimmed),
  - R for a navaid tuned from an RMP (Radio Management Panel) (underlined and dimmed),
  - Nothing for a navaid automatically tuned by the FMGC.

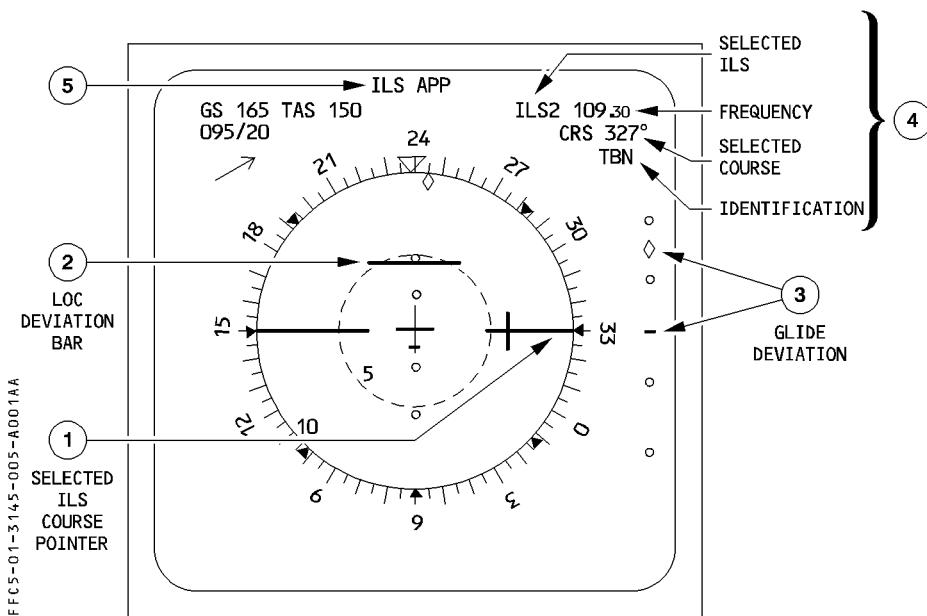
If reception fails, the ND stops displaying the associated data (except for the identification or frequency).

- If there is a mismatch between the aircraft and VOR reference, the following messages are displayed next to the navaid parameters :
  - In case ROSE NAV or ARC mode is selected : CORR (magenta).
  - In case ROSE VOR or ROSE LS mode is selected : MAG or TRU (amber) according to VOR reference.

R      Also see FMGS PILOTS GUIDE – POLAR NAVIGATION (Refer to 4.04.40).

**⑩ Range marks**

The range scale value, selected on the EFIS control panel (10 to 320 NM), governs the scale of the ND.

R **ROSE LS MODE****① ILS Course Pointer (magenta)**

This dagger-shaped symbol points to the selected ILS course.

The ILS is selected either by the FMGC (autotuned or manually) or through the RMP in backup mode.

**② Localizer Deviation Bar (magenta)**

This bar moves laterally with respect to the course pointer. Its scale consists of two dots on each side of zero deviation. Each dot represents a deviation of about  $\pm 0.8^\circ$ .

If the deviation becomes excessive (1/4 dot,  $0.2^\circ$ ) above 15 feet RA, the bar and the scale pulse.

**(3) Glide Deviation (magenta)**

This diamond moves on a vertical scale consisting of two white dots on each side of the yellow reference line. Each dot represents a deviation of about  $\pm 0.4^\circ$ .

If the deviation becomes greater than one dot above 100 feet RA, the scale and the diamond flash.

**(4) Selected ILS Information**

This display shows the ILS frequency (magenta), selected course (blue), and identification (magenta).

**(5) ILS APP Message (green)**

These letters appear when an ILS approach has been selected on the MCDU.

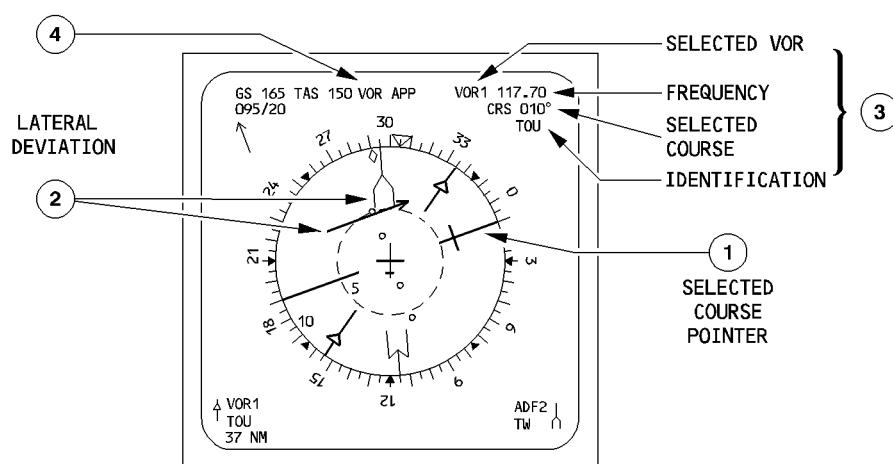
*Note : ILS1 information appears on PFD1 and ND2.*

*ILS2 information appears on PFD2 and ND1.*

R

**ROSE VOR MODE**

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**① VOR Course Pointer (blue)**

This dagger-shaped symbol points to the selected VOR course.

The VOR course is automatically selected by the FMGC or manually by the crew using the MCDU pages or the RMP backup mode.

**② Lateral Deviation Bar (Blue)**

This bar shows the VOR deviation on a lateral scale.

Each dot represents 5°. When the lateral deviation exceeds 10°, the bar remains displayed on the outer dot.

The arrow on the bar gives the TO/FROM indication.

**③ VOR Information (White)**

This area displays the frequency of the selected VOR and its identification (decoded by the receiver), the selected course, and the tuning mode.

**④ VOR APP Message (green)**

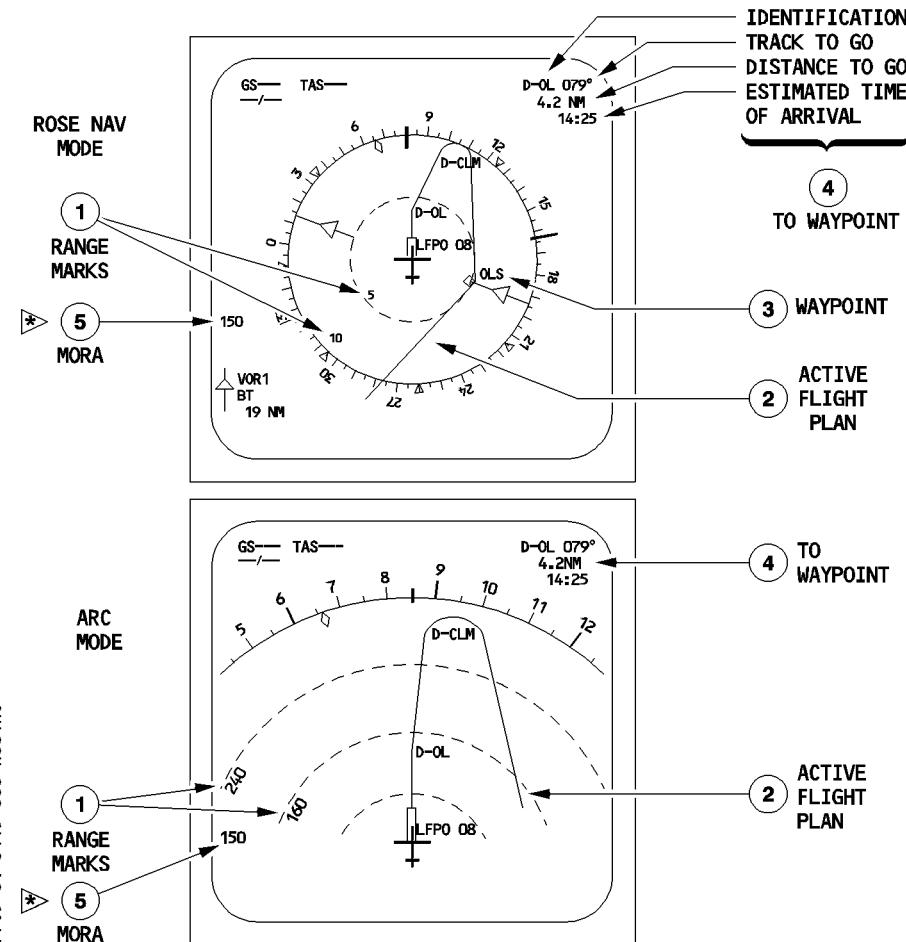
These letters appear when a VOR approach has been selected on the MCDU.

**ROSE NAV MODE/ARC MODE**

ROSE NAV and ARC modes give the pilot the same information, but ARC mode limits it to the forward 90° sector.

The ROSE NAV and ARC mode displays are oriented with respect to aircraft heading.

Note : The compass rose is oriented to magnetic or true north depending on NORTH REF pushbutton selection.



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**INDICATIONS ON ND**

SEQ. 001 REV 12

**① Range Marks and Values**

R The values displayed on the ND are :

- In ROSE NAV mode 1/4 of the selected range for the inner circle.
- 1/2 of the selected range for the heading scale circle.
- In ARC mode         1/4 of the selected range for the first inner arc.
- 1/2 of the selected range for the second inner arc.
- 3/4 of the selected range for the third inner arc.

## ② Flight Plan

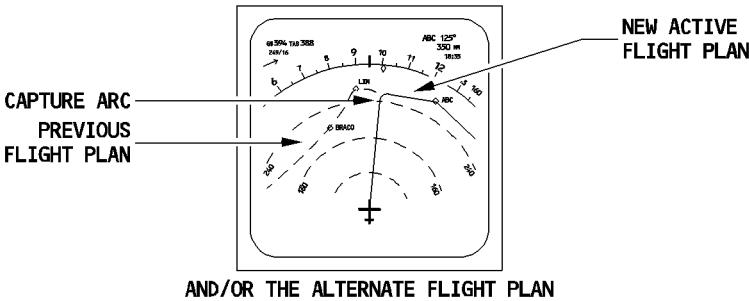
The crew can use the MCDU to select various types of flight plan :

- The active flight plan (the flight plan the aircraft is actually following when the AFS NAV mode is engaged) is represented by a continuous green line. The ND shows only the part of the flight plan that is ahead of the aircraft, as well as the waypoints that are still to be overflown and the waypoint from which the aircraft is coming.
- The ND does not show a SID or a STAR, except for the last waypoint of the SID and the first waypoint of the STAR, when the selected range is 160 or 320 NM.
- If the primary flight plan is not active, it is represented by a dotted green line.
- A continuous blue line portrays the missed approach procedure, and a dashed blue line portrays the flight plan to the alternate.
- The missed approach and the alternate flight plan are displayed when :
  - In ARC or ROSE NAV mode, a missed approach waypoint or an alternate flight plan waypoint is displayed on the onside MCDU.
  - In PLAN mode a missed approach or alternate waypoint is displayed in the 2L field of the onside MCDU.
- The secondary flight plan is represented by a continuous white line. The ND continues to display the active flight plan.
- Temporary flight plan
- The revised portion of the flight plan is represented by a dotted yellow line.
- Flight plan capture

When the aircraft is off the primary flight plan and is flying toward it in HDG mode with the NAV mode armed, the ND shows the new active flight plan as a continuous green line if the FMGC has computed the intercept path.

The part of the flight plan before the interception point shows as a dotted green line.

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- Abeam/Radial vectors

The pilot can select on the MCDU to have the display of :

- either the radial of a selected waypoint perpendicularly to the aircraft present track (abean)
- or the selected radial of a waypoint (Radial)

These vectors are displayed using a dashed blue line.

**(3) Waypoint**

The ND can display various kinds of waypoints :

Flight plan waypoints

The ND displays these as green diamonds (white, for TO waypoints). When the pilot selects the WPT option on his EFIS control panel, all waypoints other than flight plan waypoints are displayed in magenta.

Pseudo waypoint

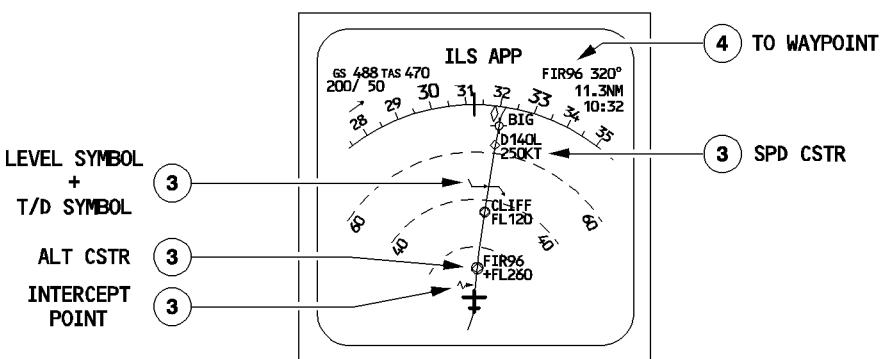
Point of the flight path where the aircraft is predicted to reach a selected or constrained altitude or speed.

R

Pseudo waypoint	Definition
↗ ↘	Level symbol (top of climb or level-off position), at the position where the aircraft reaches : <ul style="list-style-type: none"> <li>· The FCU-selected altitude (blue arrow) or</li> <li>· It is displayed in magenta, if it corresponds to a constraint.</li> <li>· It does not appear when the aircraft is within 100 feet above, or below, the selected altitude.</li> </ul>
↖	Top of descent, or continue descent symbol : <ul style="list-style-type: none"> <li>· White, if DES is not armed.</li> <li>· Blue, if DES is armed.</li> </ul>
↗	Start of climb symbol : <ul style="list-style-type: none"> <li>· White, if CLB is not armed.</li> <li>· Blue, if CLB is armed.</li> </ul>
↖	Intercept point symbol : <ul style="list-style-type: none"> <li>· Indicates the point at which the aircraft will intercept the FMGC-computed descent profile.</li> <li>· White, if DES is not armed.</li> <li>· Blue, if DES is armed.</li> </ul>
●	Speed change symbol (magenta) : <ul style="list-style-type: none"> <li>· Indicates the point at which the speed has to change.</li> </ul>
◎	Decelerate point symbol (magenta) : <ul style="list-style-type: none"> <li>· Indicates the point at which the aircraft is predicted to decelerate for approach (and thus switch to the approach phase).</li> <li>· Magenta, if in managed speed and NAV or approach mode is engaged.</li> <li>· White, if in selected speed or HDG/TRK mode.</li> <li>· Automatic decelerations only occur when displayed in magenta.</li> </ul>
○	1. ALT CSTR symbol set around the constrained waypoint : <ul style="list-style-type: none"> <li>· Magenta, when the ALT CSTR is predicted to be satisfied.</li> <li>· Amber, when the ALT CSTR is predicted to be missed.</li> <li>· White, when the ALT CSTR is not taken into account by the guidance, and NAV mode is engaged.</li> </ul> 2. Time marker or equitime point symbol appears in green, to indicate when the aircraft reaches the time marker or equitime point.
⌇	ENERGY CIRCLE symbol (green arc) : <ul style="list-style-type: none"> <li>· The radius represents the required distance to land from the present position.</li> <li>· It is computed by the FMGC and is only available in ROSE NAV and ARC modes.</li> </ul>

## (3) Waypoint (cont'd)

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## (4) TO waypoint

This is the next waypoint to be overflown.

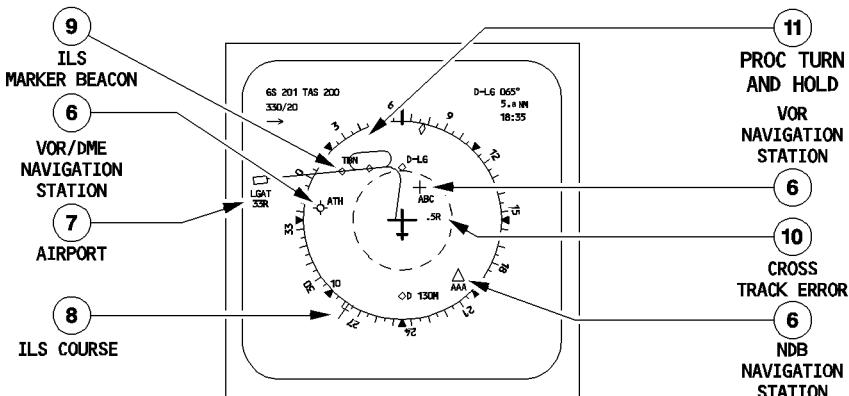
This area of the screen also shows :

- Waypoint identification (white).
- Track to go (green).
- Distance to go (green).
- Estimated time of arrival (green), assuming the aircraft will fly directly from its present position to the TO waypoint at the current ground speed.

## (5) Minimum Off Route Altitude (MORA) ◀

R Provided CSTR is selected and range is selected equal to or above 40 NM a digital readout (Flight Level) is displayed which represents the Minimum Off Route Altitude allowed in a circle of 40 NM around the aircraft. Nothing is displayed, if MORA for the chosen flight route is not available in the FMGS database.

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**(6) Navaids**

The display uses specific symbols for navaids :

DME or TACAN

+ VOR

◊ VOR/DME

△ NDB

The symbol appears :

- In green if the navaid is a current waypoint of the flight plan.
- In white if it is the TO waypoint.
- In blue when the navaid is tuned for display either automatically by the FMGC or manually through the MCDU.
- In magenta when the navaid is not part of the flight plan and is called for display as an option (corresponding option pushbutton pressed on the FCU EFIS control panel).

**(7) Airport**

Airport included in the flight plan :

- If the runway is not specified, the airport is represented by a star and the identification is displayed in white.

Example : \* LSGG

- If the runway is specified, it is represented by an oriented runway symbol in white.

FFC1-01-3145-013-002/A



LSGG  
33R

The runway is drawn to scale (paved length) if the selected range is 10, 20 or 40 NM.

Optional airport information

The airports that are not displayed as part of the flight plan may be called for display (ARPT pushbutton on the EFIS control panel).

They are represented by a star and the identification in magenta.

**(8) ILS Course (Magenta)**

- R When the pilot pushes the LS pushbutton switch on the EFIS control panel, and if an ILS station has been selected, the display shows an ILS course symbol.

**(9) ILS Marker Beacons**

The screen shows these as waypoints (diamonds).

When the aircraft overflies a marker beacon, the corresponding symbol flashes :

Blue for the outer marker.

Amber for the middle marker.

White for the inner marker.

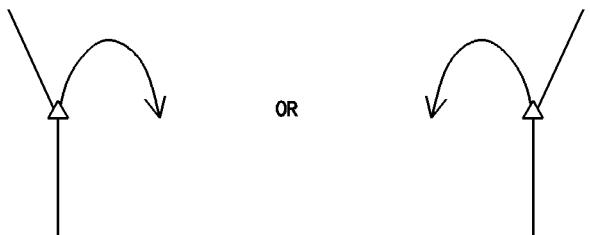
R **(10) Cross Track Error**

R This is the aircraft's lateral deviation from the active leg of the flight plan (related to the great circle route). It is indicated in nautical miles (NM), with the letter R (right) or L (left), according to the position of the aircraft with respect to the flight plan.

R **(11) Procedure turns and holding patterns**

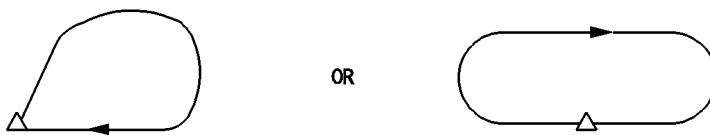
R These appear only when they are part of the flight plan. For the 160 and 320 NM range scales, each one is represented by a white arrow that originates at the associated fix and indicates the direction of the turn.

FFC5-01-3145-014-A002AA



R For shorter range scales and if the procedure turn or the holding pattern is in the next or the active leg, the display shows the full circuit or pattern.

FFC5-01-3145-014-B002AA



**PLAN MODE**

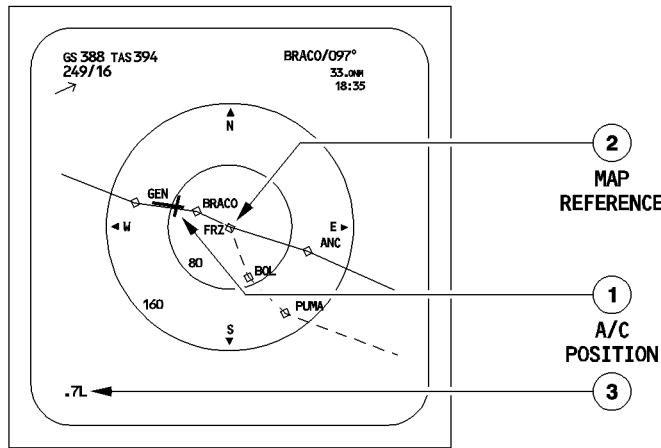
This mode statically displays the flight plan legs on a map oriented to true north. The map is centered on a map reference point that the pilot selects by slewing to it on his MCDU. The map reference point is the waypoint displayed on the second line of the MCDU F-PLN page. It can either be the active waypoint (next waypoint to be overflown), or any other waypoint of the flight plan.

The pilot can slew the overall flight plan and display it in PLAN mode.

The pilot chooses the scale of the map with the range selector. (The diameter of the outer circle corresponds to the selected range).

Data on navaids, and their characteristics and associated bearing pointers, are not available in this mode.

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**① Aircraft Position and True Track**

The orientation of the yellow aircraft symbol always indicates the aircraft's true track. Its position represents the aircraft position given by the FMGS.

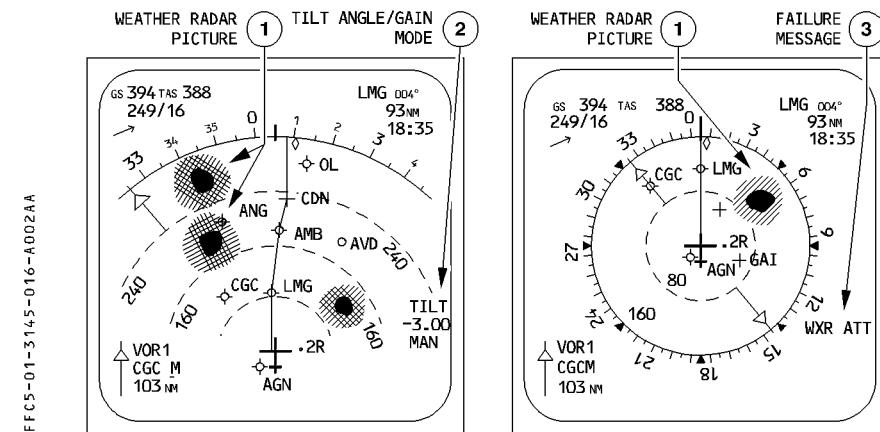
**② Map Reference Point**

**③ Crosstrack Error**

R See ROSE NAV MODE/ARC MODE.

**WEATHER RADAR**

R

**① Weather Radar Picture**

- R — When the radar is operating, and when the ND is not in PLAN mode, the ND displays the weather radar picture.
- R — The echoes appear in different colors, depending on the precipitation rates (black, green, yellow, red or magenta).
- R — The selected ND range will determine how often the image is refreshed.

**② Tilt Angle and Gain Mode**

- R — The value of the tilt angle is in degrees, and quarters of a degree. It appears in blue in the lower right-hand corner of the screen. This angle is the angle between the horizon and the radar beam axis.
- R — "MAN" appears in white, when the manual gain mode is selected.

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FLIGHT CREW OPERATING MANUAL

**INDICATING/RECORDING SYSTEMS**

1.31.45 P 16a

**INDICATIONS ON ND**

SEQ. 001 REV. 21

**(3) Failure Messages**

The ND lists the detected failures.

If the message is in "red", the ND does not display a radar image.

If the message is in "amber", the image is not affected.

WXR RT (red) : Radar transceiver failure.

WXR ANT (red) : Radar antenna failure.

WXR DU (red) : Overheating of the display unit

WXR CTL (red) : Radar control unit failure.

WXR RNG (red) : Range error.

WXR WEAK (amber) : Calibration failure.

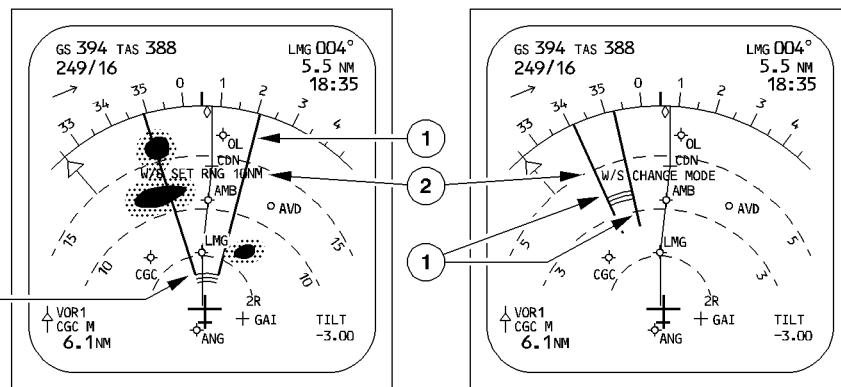
WXR ATT (amber) : Attitude control failure.

WXR STAB (amber) : Antenna stabilization failure.

**PREDICTIVE WINDSHEAR SYSTEM**

R

FFC5-01-3145-017-A100AA

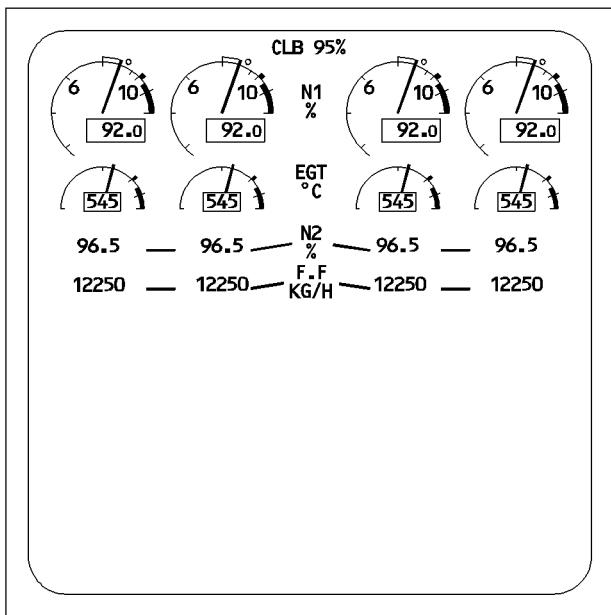
**① Predictive windshear area indication**

The predicted windshear areas are indicated by a red and black icon, and two yellow radial lines. Windshear information is available in ARC and ROSE ND modes, and is displayed, even if the weather radar is switched off, provided the weather radar panels' WINDSHEAR switch is set to AUTO.

Depending on the windshear alert level, the ND indication may be complemented by a PFD message (Refer to 1.31.40).

**R ② Windshear messages (W/S : CHANGE MODE, W/S : SET RNG 10 NM)**

R These messages are displayed (in amber for caution alert, red for warning alert) on the ND, when a windshear event is detected, and the ND mode (W/S:CHANGE MODE) or range (W/S:SET RNG 10 NM) is inadequate to display windshear echoes.

R **ENGINE STANDBY PAGE**

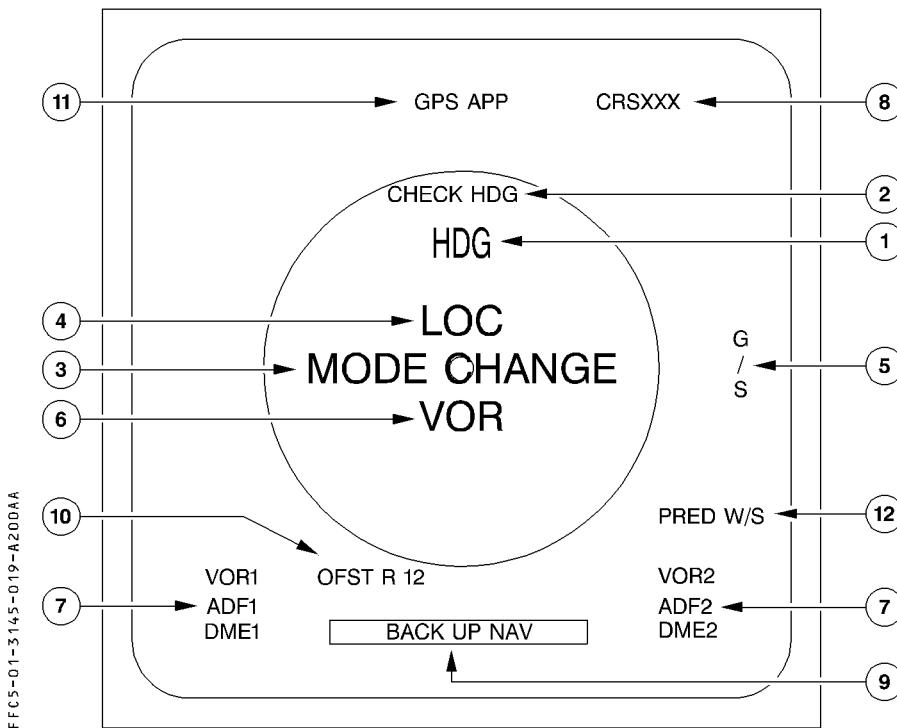
FFC5-01-3145-018-A002AA

In case all ECAM DMC channels fail, each pilot may display the engine standby page on their respective ND.

The displayed information is N1, N2, EGT, FF and limit modes (same presentation as the upper part of the primary engine page).

This information is generated by the DMCs' EFIS channel.

For more information on this page, see the POWERPLANT Chapter (Refer to 1.70.90).

**FLAGS AND MESSAGES DISPLAYED ON ND****① HDG flag (red)**

In case the heading data fails, the rose, arc and associated symbols disappear. A HDG flag flashes for 9 seconds, then remains steady in the upper part of the ND.

**② CHECK HDG flag (amber)**

When a disagree ( $5^\circ$ ) is detected by the FWC between sides 1 and 2, a CHECK HDG flag appears on both NDs, associated with an ECAM caution. This message is not available, when plan mode is selected.

**(3) Center Part Messages**

- The screen displays a MODE CHANGE message in green if there is a discrepancy between the selected mode on the EFIS control panel and the mode sent from the onside FMGC, or while the DMC is preparing a new page for display.
- The screen displays a RANGE CHANGE message in green if there is a discrepancy between the range selected on the EFIS control panel and the range sent from the onside FMGC. A MODE CHANGE message has priority over a RANGE CHANGE message.
- The screen displays a MAP NOT AVAIL message in red for several reasons :
  - The MODE CHANGE or RANGE CHANGE message has been displayed more than six seconds.
  - A disagreement between DMC and FMGC has been detected while EFIS control panel is failed (default mode ROSE NAV 80 NM).
  - The FMGC is not able to indicate the flight plan reference point (back up mode) while PLAN mode is selected.
  - The FMGC has failed.
  - The FMGC has delivered an invalid aircraft position.
- The screen displays CHECK ND (1,2) message (amber) when the DMC detects a discrepancy between acquisition and display of parameters.
- The screen displays CHECK EWD message (amber) when the DMC detects a discrepancy between acquisition and display of E/WD parameters.
- The screen displays a W/S SET RNG 10 NM message if a predictive windshear alert is triggered and the range is above 10 NM.
- The screen displays a W/S CHANGE MODE message if a predictive windshear alert is triggered and the ND is not in ARC or ROSE mode. The message appears in red or amber corresponding to the windshear alert.

**(4) LOC Flag (red)**

If LOC data fails, this flag flashes for nine seconds, then remains steady.

**(5) G/S Flag (red)**

If G/S data fails, this flag flashes for nine seconds, then remains steady.

**(6) VOR Flag (red)**

In ROSE VOR mode, when the VOR bearing is not valid, this flag flashes for nine seconds, then remains steady.

**(7) VOR1(2) or ADF1(2) or DME1 Flag (red)**

If a navigation receiver fails, the appropriate one of these flags flashes for nine seconds, then remains steady.

**⑧ VOR Course flag**

If the VOR course fails, a red CRSXXX flag appears.

If there is Non-Computed Data (NCD), a blue CRS - - - flag appears.

**⑨ Other messages**

**MAP PARTLY DISPLAYED** (amber) : In case of incomplete data transmission between the FMGC (priority criteria) and the DMC, or if the DMC cannot draw the complete MAP.

**NAV ACCUR UPGRAD**, or (white) : Signals a change in navigation accuracy.

**NAV ACCUR DOWNGRAD** (amber)

**SPECIF VOR/D UNAVAIL** (amber) : If the navaid, that is tuned for the selected approach or departure, is not available.

**BACK UP NAV** (amber) : If the MCDU backup navigation mode is activated (refer to 1.22).

**OFF SIDE FM CONTROL** (amber) : If the offside FM supplies the ND.

**CHK FLT PLN POSITION** (amber) : On ARC or ROSE NAV mode, if the DMC detects a disagree between the acquisition and the display of the flight plan.

**SELECT TRUE REF** (amber) : When entering the polar area, if the TRUE North reference is not selected by the flight crew (MAG/TRUE pushbutton).

**CHECK NORTH REF** (amber) : The NORTH REF pushbutton selection does not match the airport MAG/TRUE bearing reference (as stored in the FMGS navigation database), either at the departure airport (during preflight), or at the destination airport (when entering the ARRIVAL area).

↓  
(Green)  
: Overflow arrow, displayed when more than one of the following messages are present at the same time :  
– NAV ACCUR DOWNGRAD  
– NAV ACCUR UPGRAD  
– SPECIF VOR/D UNAVAIL  
– SELECT TRUE REF  
– CHECK NORTH REF  
– GPS PRIMARY  
– GPS PRIMARY LOST

**GPS PRIMARY** (white, boxed white) : This message appears when GPS PRIMARY mode is available, or has been recovered. The pilot can clear this message by pressing the CLR key on the MCDU.

**GPS PRIMARY LOST** (amber, boxed white) : This message appears when GPS PRIMARY is not available, and is not clearable by pilot action.

**(10) OFST R(L) XX message (yellow)**

This message is displayed, when a temporary or an offset flight plan is entered. The offset value is given in NM.

*Note : For TCAS messages (Refer to 1.34.80).*

**(11) GPS APP (green)**

This message is displayed, when a GPS approach has been selected.

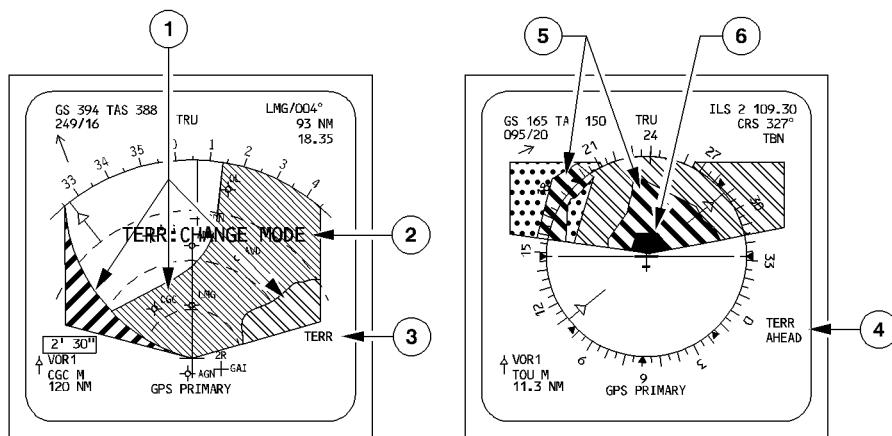
**(12) PRED W/S flag (amber)**

The WINDSHEAR switch on the weather radar panel is set to AUTO, and a Predictive Windshear System fault is detected. This message appears on ground, or when flaps and slats are extended.

It is associated with a single chime. The radar image remains available, provided that the fault does not affect the radar mode.

## EGPWS

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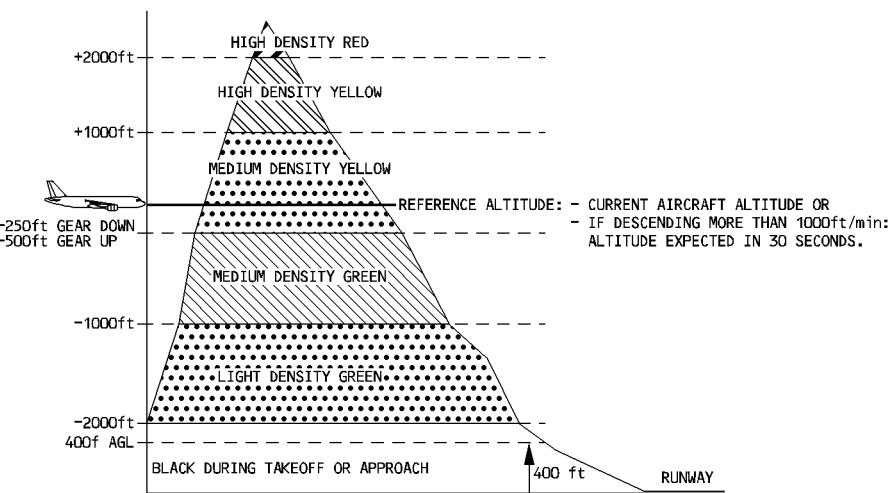


## ① EGPWS terrain picture

The ND presents the EGPWS terrain picture, when the TERR ON ND switch is selected ON, and the ND is not in PLAN or ENG mode. The terrain picture replaces the weather radar image.

The terrain appears in different colors and densities, according to its relative height :

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R

Note : Areas without available terrain data in the EGPWS database appear in magenta.

② TERR : CHANGE MODE indication

Displayed in red (or amber), in case of a Terrain Awareness Display (TAD) warning (or caution) alert, if the current selected display mode is PLAN.

③ TERR indication

To differentiate between the terrain and the weather display, the weather radar TILT is replaced by a blue TERR, and the terrain display sweeps from the center outward to both NDs' sides.

④ Warning and caution messages

TERR AHEAD (amber) : For a caution

TERR AHEAD (red) : For a warning.

When triggered, these messages flash for 9 seconds, then remain steady until the caution or warning alert condition disappears.

TERR RNG (red) : For a RANGE error warning.

TERR TST (amber) : Appears during the EGPWS test, when the terrain pattern is displayed, and there is no failure.

⑤ Terrain caution alert

Generated when a conflict exists between the terrain caution envelope, ahead of the aircraft, and the terrain data stored in the database. The conflict area is shown in solid yellow.

⑥ Terrain warning alert

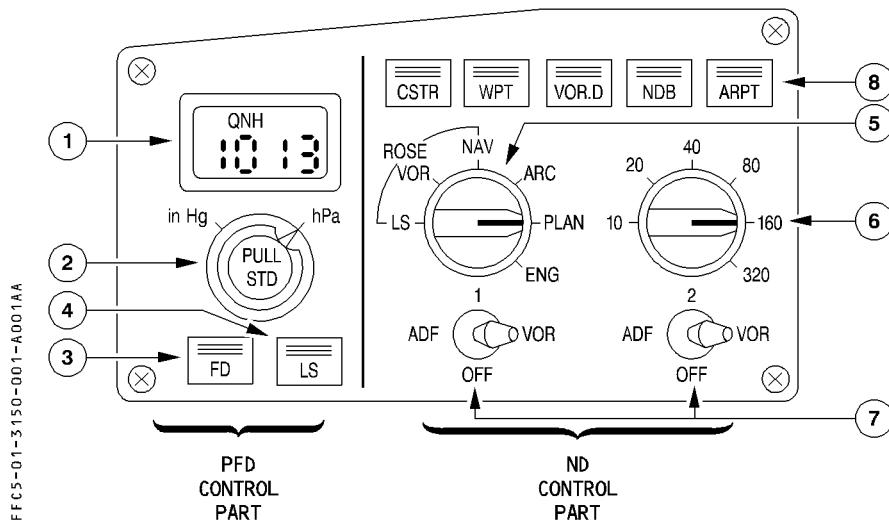
Generated when a conflict exists between the terrain warning envelope, ahead of the aircraft, and the terrain data stored in the database. The conflict area is shown in solid red.

Note : When an alert is generated (either caution or warning), and TERR ON ND is not selected, the terrain is automatically displayed and the TERR ON ND pushbutton ON light comes on.

R

**EFIS CONTROL PANEL**

R

**① Barometer Reference Display Window**

Range : 745 hPa to 1100 hPa.

**② Barometer Reference Selector**

- a) Outer ring : For selection of the units for the barometer reference, either hectoPascals or inches of mercury.

*Note : The selected unit does not appear on the PFD.*

- b) Inner knob : For selection of the reference value, displayed in the barometer reference display window and on the PFD below the altitude scale.

At FCU initialization, the window displays 1013 or 29.92, depending on the selected unit.

- Pulling the knob selects the standard baro reference setting. The PFD then displays "STD." (Rotating the knob has no effect.)
- Pushing the knob from the STD position makes the last selected QNH baro setting available.

**(3) FD Pushbutton**

Pushing this button removes the FD bars from the associated PFD (or removes the flight path director symbol if the TRK FPA reference is selected).

The pushbutton light goes out.

Pushing it again restores the FD bars (or the FPD symbol) and lights the green pushbutton light.

**(4) LS Pushbutton**

Pushing this button displays the localizer and glide slope scales on the PFD.

Deviation symbols appear if there is a valid ILS signal.

The green pushbutton light comes on.

**(5) Mode Select Switch**

This switch selects a navigation display for the onside ND.

**(6) Range Select Switch**

This switch selects a range scale for the onside ND.

Note : If the mode or the range data fails, the default selection is the ROSE NAV mode and 80 NM range.

**(7) ADF-VOR Select Switches**

These switches select ADF or VOR bearing pointers and DME distance on the onside ND, as well as the corresponding navaid data characteristics in any mode except PLAN mode.

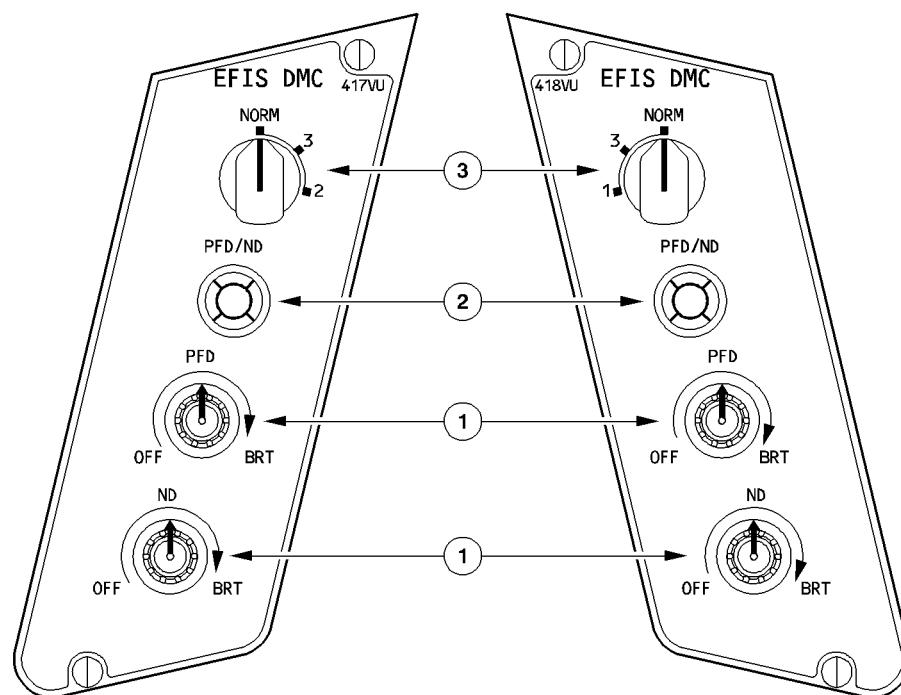
**(8) Optional Data Display Pushbutton**

Pushing this button displays optional data in addition to the data permanently displayed in PLAN, ARC, or ROSE NAV modes. The green pushbutton light comes on.

R Only one option can be activated at a time.

**EFIS DMC PANEL**

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**① OFF/BRT knobs**

- These knobs turn the PFD and ND display units on and off, and control their brightness.
- The display brightness automatically adjusts for changing light conditions. It may also be adjusted manually.

**PFD Brightness Control Knob**

Rotating this knob all the way counterclockwise switches off the PFD. In this case, the PFD image is automatically displayed on the NDU, but the pilot may recover the ND by means of the PFD-ND XFR pushbutton.

**ND Brightness Control Knob**

The outer knob controls the brightness of both the weather radar image and the EGPWS terrain display.

The inner knob controls the general brightness of the ND symbols.

Rotating this knob all the way counterclockwise switches off the NDU.

**② PFD/ND Pushbutton**

Pushing this button interchanges the PFD and the ND.  
If the PFDU fails, the PFD automatically transfers to the NDU.

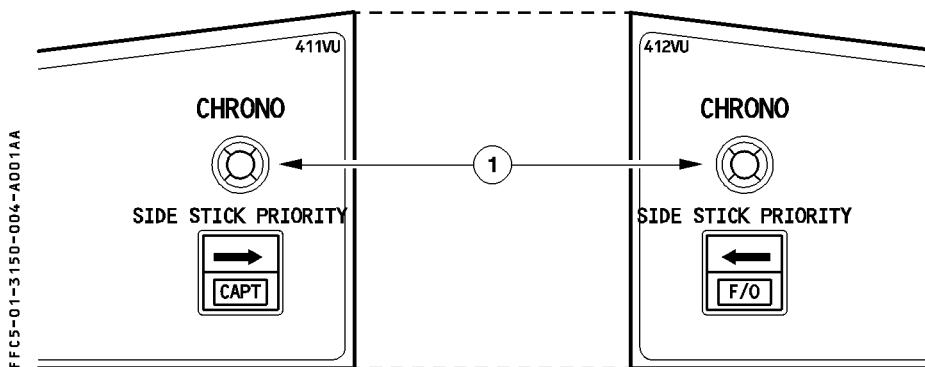
**③ EFIS DMC sel**

NORM : The DMC 1 supplies CAPT EFIS DUs and DMC 2 supplies F/O EFIS DUs.

3 : The onside DMC is replaced by DMC3.

2 or 1 : The onside DMC is replaced by DMC 2 or 1.

R Some switching configurations generate FMA message. Refer to 1.22.30 for details.

**CHRONOMETER (glareshield)****① CHRONO Pushbutton**

Pushing this button displays chronometer time on the onside ND.

Pushing it again freezes the displayed value.

Pushing it a third time resets the chronometer, and the chronometer time disappears from the display.

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**INDICATING/RECORDING SYSTEMS**

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CLOCK

SEQ. 001 REV 09

**GENERAL**

A fully independent clock is on the right side of the control panel.

It sends time to the centralized fault data interface unit, the flight data interface unit, and the flight management and guidance computer.

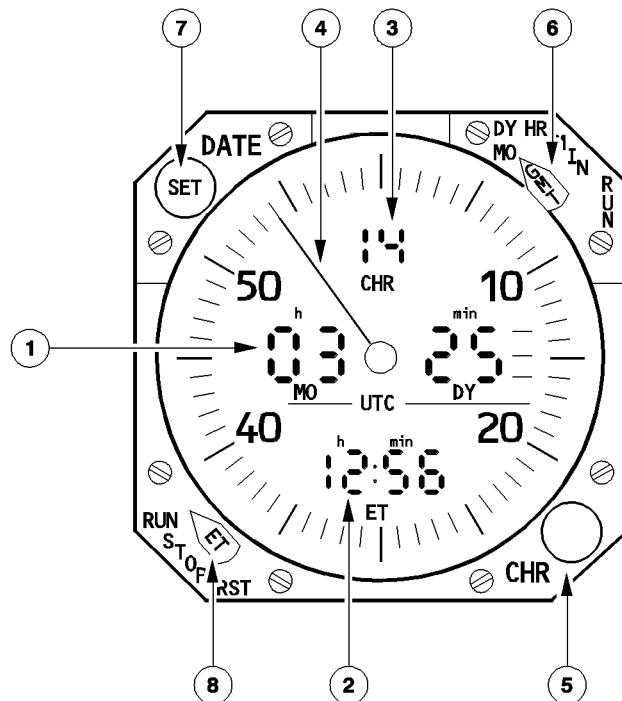
The clock has two electrical supplies, one of which is a direct connection to the aircraft battery hot bus.

The clock also has an internal battery that allows it to memorize time (for up to 50 hours) if the aircraft battery is removed.

The clock performs four functions :

- It displays "UTC" (GMT) time in hours and minutes on the center counter.
- It displays elapsed time (ET) (from engine startup) in hours and minutes on the lower counter.
- It drives the chronometer (CHR), which measures a time interval (from the pushing of the CHRONO button) in minutes and seconds.
- It can replace the UTC with the date.

## CONTROLS AND INDICATORS

① UTC (GMT) counter

This counter displays the present time in 24-hour format. A trend indicator, which divides a minute into four 15-second periods, uses three horizontal marks :  
 From 0 to 14 seconds No mark is lighted.  
 From 15 to 29 seconds The highest mark is lighted.  
 From 30 to 44 seconds The two highest marks are lighted.  
 From 45 to 59 seconds All the three marks are lighted.

② Elapsed Time (ET) counter

This counter registers elapsed time up to 99 hours and 59 minutes.

③ Chrono (CHR) counter

This counter registers elapsed time up to 59 minutes. It is controlled by the CHR pushbutton.

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FLIGHT CREW OPERATING MANUAL

**INDICATING/RECORDING SYSTEMS**

1.31.55 P 3

CLOCK

SEQ. 001 REV. 09

R **(4) CHR needle**

R This needle ticks off chronograph seconds.

R It is controlled by the CHR pushbutton.

R **(5) CHR pushbutton**

R First push : starts the second needle and the minute display.

R Second push : stops the second needle and sums up the minutes in the minute display.

R Third push : resets the second needle to zero and erases the minute display.

⑥ **UTC (GMT) selector**

"MO" : sets month and year

"DY" : sets days

"HR" : sets hours

"MIN" : sets minutes

"RUN" : starts the UTC counter

Note : Push and turn the selector to switch from MIN to RUN.

⑦ **SET pushbutton**

Sets the MO, DY, HR, MIN as selected by the UTC selector.

To increase the quantity, turn the button either way.

To decrease the quantity, push the button lightly.

⑧ **ET (elapsed time) selector**

"RUN" position : starts the ET counter.

"STOP" position : stops the counter, keeps the display at its last indication.

"RST" position : resets counter to zero (transient position).

### UPDATING MONTH, YEAR

Set the UTC selector on MO. The month and the year appear.

- To advance the month, turn the SET pushbutton until the proper month appears.
- To decrement the month, press the SET pushbutton.
- The year changes automatically when the month changes between 12 and 1.

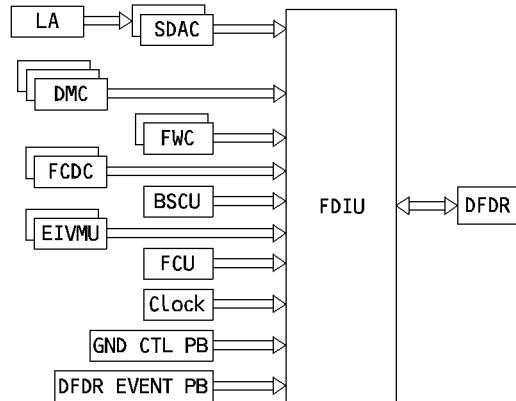
### UPDATING DAY, HOUR MINUTE

Use the procedure for changing day, hour and minute after selecting the appropriate position for the UTC selector.

*Note : To return to normal function, switch the UTC selector to "RUN."*

**FLIGHT DATA RECORDING SYSTEM****DESCRIPTION**

- R The Flight Data Recording System, which records the mandatory parameters, consists of the following components :
  - R – A Flight Data Interface Unit (FDIU)
  - R – A Digital Flight Data Recorder (DFDR)
  - R – A three-axis Linear Accelerometer (LA)
- R The FDIU collects and processes parameters from the SDACs, DMCs, FWCs, FCDCs, BSCU, EIVMUs, FCU, the DFDR event pushbutton, the GND CTL pushbutton and the Clock.
- R It stores the mandatory flight parameters in the DFDR.
- R The DFDR can store the last 25 hours data, at least. It stores this data on a fireproof and shockproof device. An underwater locator beacon is attached to the DFDR.
- R The linear accelerometer measures the acceleration of the aircraft along each of the three axes.
- R

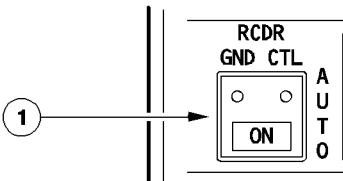


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- R The recording system is automatically active :
  - R – On the ground, during the first five minutes after the aircraft electric network is energized.
  - R – On the ground, after the first engine start.
  - R – In flight (whether the engines are running or not).
- R On the ground, the recording system stops automatically five minutes after the second engine shuts down.
- R On the ground, the crew can start the recording system manually by pressing the GND CTL pushbutton.

**CONTROLS AND INDICATORS****OVERHEAD PANEL**

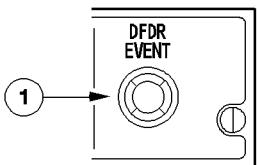
FFCS-01-3160-002-A001AA

**① RCDR GND CTL pushbutton (springloaded)**

- R – ON : The Cockpit Voice Recorder (CVR) and the Flight Data Recorders are active. The ON light is on.  
R – AUTO : The Cockpit Voice Recorder (CVR) and the Flight Data Recorders are active, according to the logic.  
The system automatically switches from ON to AUTO at the first engine start, and also in case of an electrical transient.

**PEDESTAL**

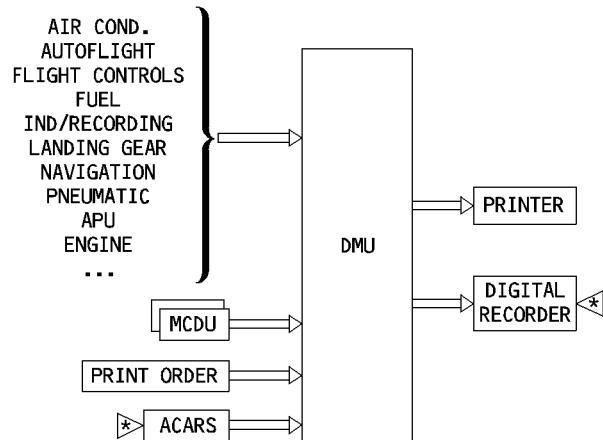
FFCS-01-3160-002-B001AA

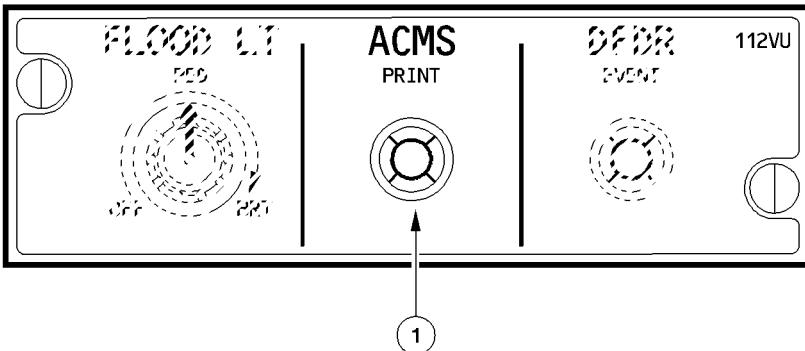
**① DFDR EVENT pushbutton**

- R – Pressing this button (briefly) sets an event mark on the Flight Data records.

**AIRCRAFT CONDITION MONITORING SYSTEM (ACMS)****DESCRIPTION**

- R The ACMS is used to monitor various aircraft system parameters in order to make maintenance easier and to allow formulating operational recommendations.
- R The ACMS can generate system reports. The Airbus Standard Reports are preprogrammed reports available at aircraft delivery. The operator can create its own reports.
- R The ACMS consists of a Data Management Unit (DMU) connected as shown below.
- R The system may be programmed using the MCDUs. The crew can select any report to be displayed on the MCDUs.
- R The Printer prints the flight phase programmed reports or any report selected on the MCDU.
- R This printing may be automatic or in response to the ACMS PRINT pushbutton.
- R The ACMS may send automatic reports via ACARS (✉).
- R An optional Digital Recorder may be installed to extend the recording capacity.

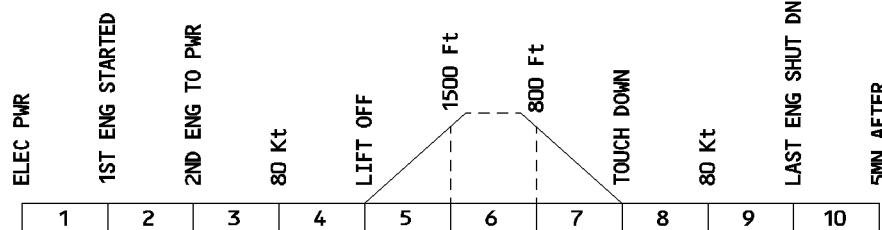


**CONTROLS ON PEDESTAL****① ACMS PRINT pushbutton**

This pushbutton is used to immediately print a specific report, depending on the flight phase. The crew may then use the MCDU to select and instantly print another report.

**WARNINGS AND CAUTIONS**

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R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
EFIS DMC 1(2)(3) FAULT failure of the EFIS part of one DMC	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
ECAM DMC 1(2)(3) FAULT failure of the ECAM part of one DMC				Message on related DU	3, 4, 5, 7, 8
DISPLAY DISCREPANCY (EWD, SD, PFD or ND)	NIL	NIL	NIL	NIL	NIL
FWC 1(2) FAULT SDAC 1(2) FAULT FWC 1+2 FAULT					
SDAC 1+2 FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
DFDR FAULT FDIU FAULT ECP FAULT	NIL	NIL			3, 4, 5, 7, 8

**MEMO DISPLAY**

- ECAM SWTG message is displayed in green when the ECAM SWTG DMC selector is not in AUTO position.
- EFIS SWTG message is displayed in green when either the CAPT or the F/O EFIS DMC selector are not in NORM position.

**BUS EQUIPMENT LIST**

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
DU	CAPT PFD				X		
	CAPT ND	AC1-2					
	F/O PFD	AC2-3					
	F/O ND	AC2-4					
	E/WD				X		
	SD	AC1-2					
DMC	DMC 1 EFIS PART				X		
	DMC 1 ECAM PART	AC1-2			X		
	DMC 2 EFIS PART	AC2-3					
	DMC 2 ECAM PART	AC2-4					
	DMC 3 EFIS PART	AC1-2			X (1)		
	DMC 3 ECAM PART				X (1)		
FWC	FWC 1				X		
	FWC 2	AC2-4					
SDAC	SDAC 1				X		
	SDAC 2	AC2-3					
ECP	ECP					X	
CLOCK						X	X
WBS □	WBC 1	AC2-3					
	WBC 1	AC2-3					
FLT RECORDERS	DFDR	AC2-3					
	FDIU	AC2-3					
	QAR □	AC1-2					
	LIN.ACCELEROMETERS		DC1				

(1) in case of switching only.

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FLIGHT CREW OPERATING MANUAL

**LANDING GEAR**

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**32.00 CONTENTS****32.10 GEARS AND DOORS**

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– CONTROLS AND INDICATORS . . . . .	11
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**32.20 NOSEWHEEL STEERING**

– DESCRIPTION . . . . .	1
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**32.30 BRAKES AND ANTISKID**

– DESCRIPTION . . . . .	1
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**32.40 TIRE PRESSURE INDICATING SYSTEM ◁**

– DESCRIPTION . . . . .	1
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**32.50 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
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**DESCRIPTION****GENERAL**

The landing gear consists of :

- two inboard retracting main gears
- a forward retracting nose gear
- a forward retracting center gear

Gear doors enclose the landing gear bays. Gears and doors are electrically controlled and hydraulically operated.

The doors which are fitted to the landing struts are mechanically operated by the gear and close at the end of gear retraction.

All gear doors open during landing gear transit. The hydraulically operated doors close at the end of each retraction and extension sequence.

Gears and doors actuation are electrically signalled by two Landing Gear Control and Interface Units (LGCIUs).

The LGCIUs process gears and doors positions, sequencing control and gear lever selection. They also provide landing gear information on ECAM, and ground/flight signals for other aircraft systems.

**MAIN GEAR**

Each main gear is a four wheel, twin tandem bogie assembly having an oleopneumatic shock absorber.

Each main wheel is fitted with antiskid brake.

A shortening mechanism attached to the wing reduces main gear length by retracting the shock absorber into the main leg during retraction.

An hydraulically operated pitch trimmer on each bogie beam damps the movement and ensures return to normal position after lift off.

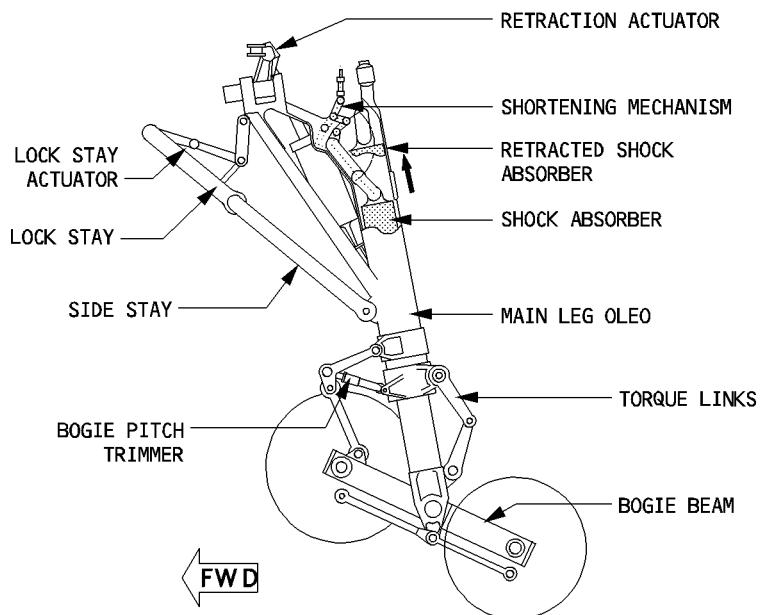
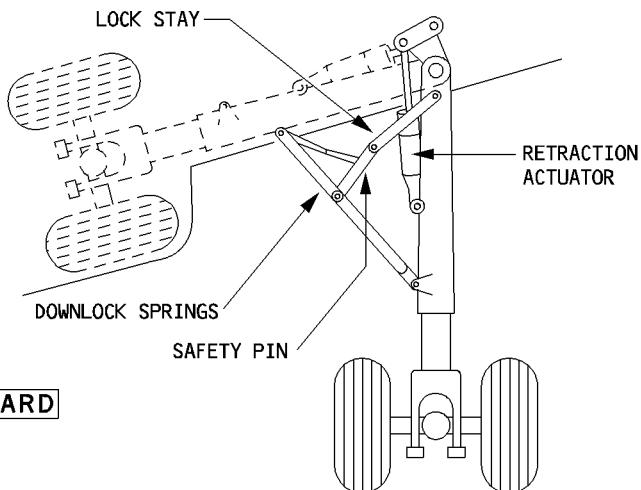
**NOSE GEAR**

The two wheel nose gear comprises an oleopneumatic shock strut and a nose wheel steering system. It retracts forwards into the fuselage.

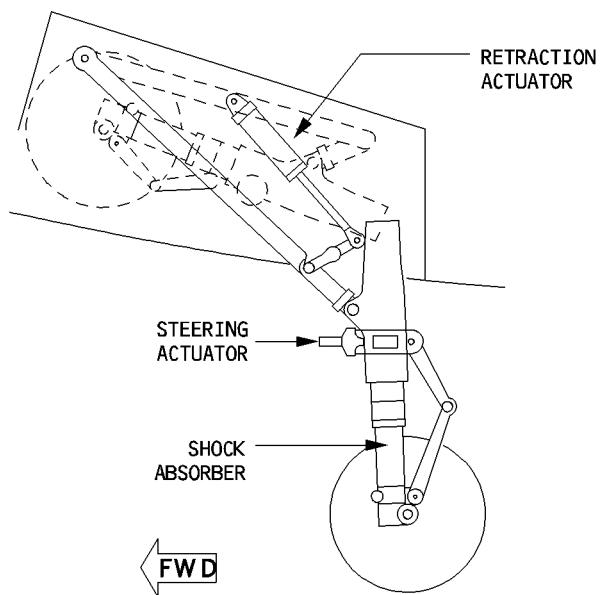
**CENTER GEAR**

The center gear is a two wheel assembly (identical wheels to those of the main gears) installed on the rear bulkhead in the main gearbay.

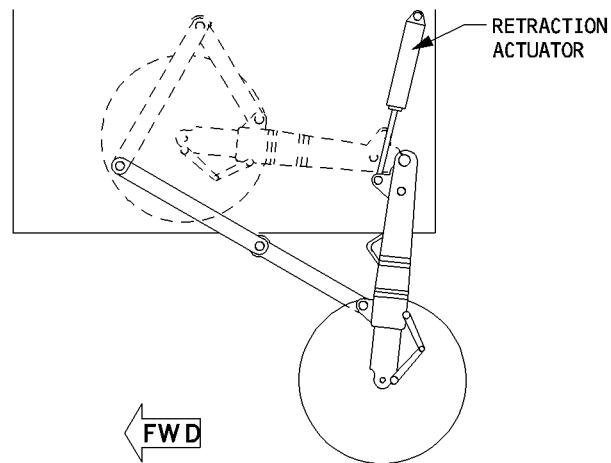
It comprises a two stage oleopneumatic shock absorber installed in the main fitting.

**SCHEMATICS****MAIN L/G**

FFC5-01-3210-002-A001AA

**NOSE L/G**

FFC5-01-3210-003-A001AA

**CENTER GEAR**

FFC5-01-3210-003-B001AA

## GEAR AND DOOR OPERATION

### NORMAL OPERATION

Landing gear normal operation is controlled by the lever located on the center instrument panel.

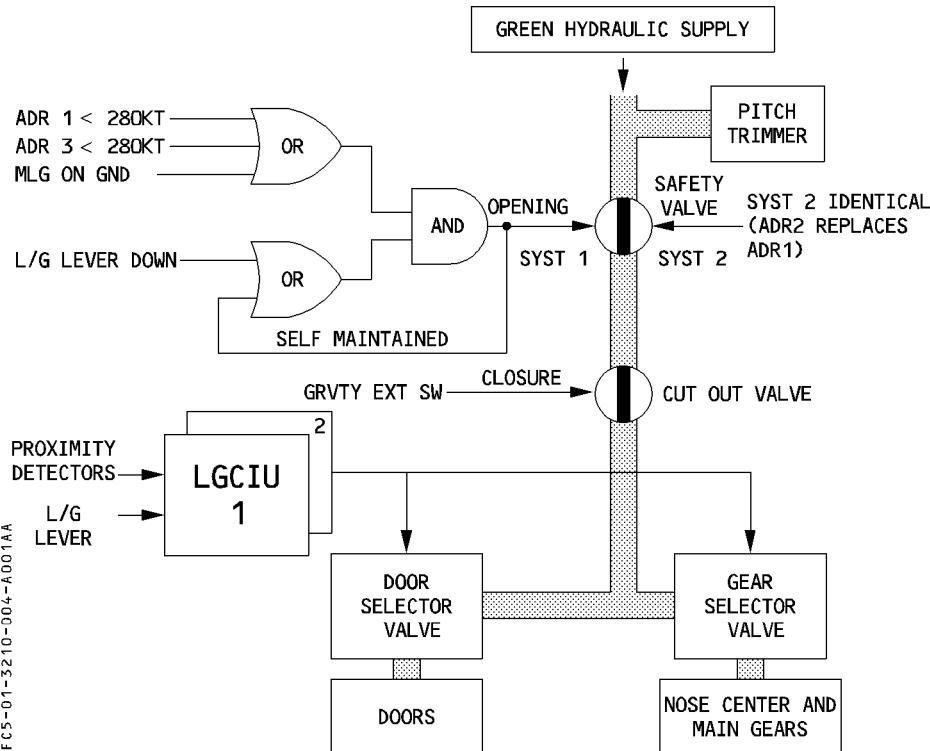
Gear and door sequencing is electrically-controlled by the LGCIUs. Each LGCIU controls one complete gear cycle and switches over automatically at each landing gear retraction cycle or in case of failure.

All gears and doors are hydraulically-actuated by the green hydraulic system. Hydraulic supply is automatically isolated by closing a safety valve above 280 knots. It is maintained closed until the landing gear lever is moved to the DOWN position and the aircraft speed decreases below 280 knots.

The center gear may be inhibited by ground maintenance action. Therefore, it will be mechanically-fixed in the uplock position while doors will continue to operate during the landing gear retract/extend sequence.

**FOR INFO**

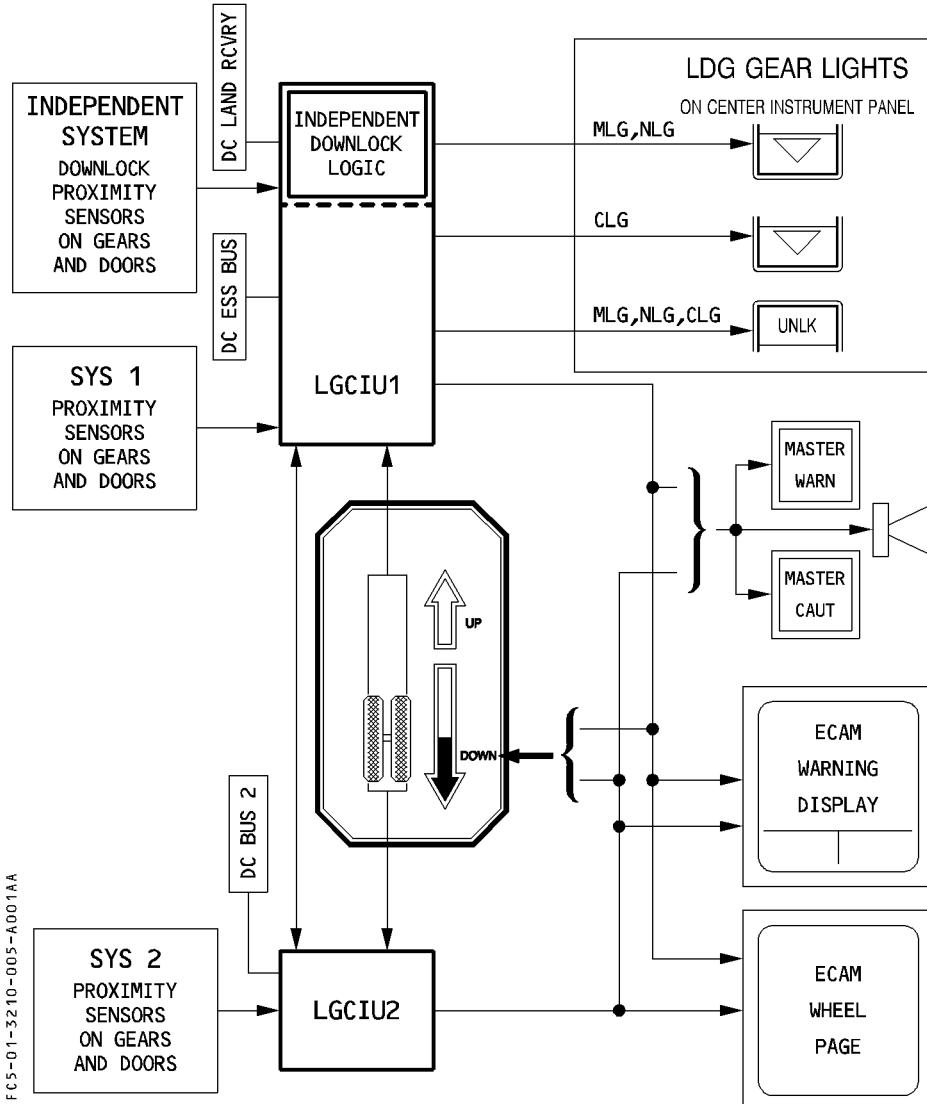
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**LANDING GEAR INDICATION AND WARNING ARCHITECTURE**

R



FFC5-01-3210-005-A001AA

Note : The landing gear position indications on center instrument panel are still provided by LGCIU 1 even when LGCIU 2 is controlling gear cycle.

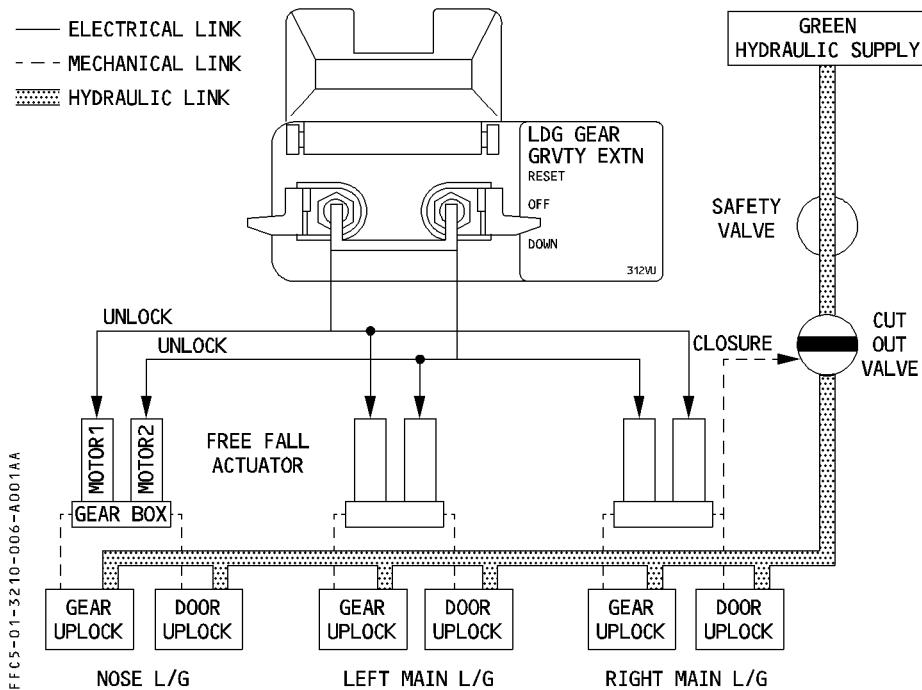
## GRAVITY EXTENSION

The gravity extension system is an electromechanical system controlled through two selectors located on the center instrument panel. It permits the main and nose landing gear extension in case of normal extension system failure.

When the related electrical selectors are set to down :

- the landing gear hydraulic system is isolated from green hydraulic system
- the main landing gear and nose landing gear doors and gears electrically unlock
- main landing gear and nose landing gear extend by gravity
- locking springs assist the downlocking
- The main and nose landing gear doors remain open.
- The center gear stays retracted and doors are closed.

After a free fall extension, it is possible to restore normal operation provided the green hydraulic pressure is available.



The indications given in the cockpit are the same as those for normal extension and retraction (retraction indication for center landing gear).

R Note : In case of landing gear gravity extension, the nose wheel steering is lost.

**L/G SYSTEM INTERFACE****LGCIU**

Two LGCIUs receive landing gear position information from the proximity detectors : landing gear downlocked or uplocked, shock absorber compressed or extended, door open or closed.

This information is sent by the LGCIUs to other aircraft systems.

Proximity detector failures :

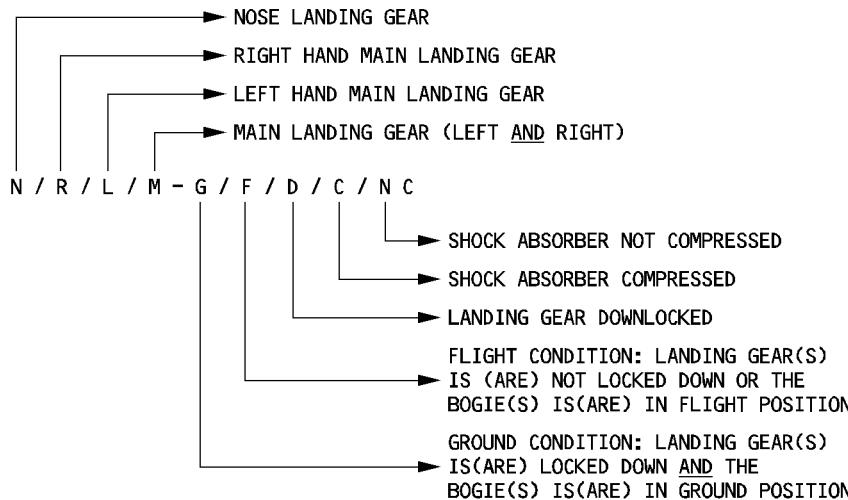
- electrical failure is detected by the LGCIU which signals the associated output to the flight position (shock absorber not compressed or landing gear uplocked).  
Landing gear operation is then automatically controlled by the non affected LGCIU.
- mechanical failure is not detected by the LGCIU. The effect on the interfaced system depends on which condition is incorrectly signalled.

In case of LGCIU electrical failure :

- The landing gear is controlled by the remaining healthy LGCIU
- The outputs of the failed LGCIU are not forced to the safe (flight) position :
  - some users will see "flight" condition,
  - some other will see "ground" condition.

**LANDING GEAR-AIRCRAFT SYSTEM INTERFACE**

The two LGCIUs provide following discrete logic signals to various aircraft systems.



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A semicolon (;) separates different signals send to the same system.

Two additional discretes are provided by the LGCIUs.

OP : Applicable LGCIU is signalled operative as long as system is supplied by power.

E : External power connected.

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT
AIR COND	Packs bay ventilation	L-F	R-G
	Avionics equipment ventilation	R-G	L-G ; OP
	Fwd and aft cargo compartment vent.		R-F
	Pressure control and monitoring	R-G	R-G
	Pack control and indicating		L/R-G
	Cockpit and cabin temperature control		R-G
FM	FMGS	N-C	N-C
COMMUNICATIONS	HF System	L-F	R-F
	VHF System	L-F	L/R-F
	Satellite communication		R-F
	Cockpit to ground crew call system	N-NC	
	Audio management	L-F	
	CVR	N-C/NC	
	CIDS	N-C/D ; E	N-C/D ; E
ELEC	Radio management	L-F	L/R-F
	AC main generation	N-C	
	AC emergency generation	N-NC	
	ECMS	N-C	
	DC essential normal generation switching	N-NC	
	Battery DC generation	N-C	
	GPCU	N-C	
APU	Circuit breaker monitoring	N-C	
	Control and monitoring	L-G	
	APU generator (GCU)	N-C	
FIRE	Engine fire and overheat protection	L/R-G	L/R-G
	APU fire and cargo compartment overheat detector	M-G	M-G
	Cargo compartment smoke detector	N-C ; E	N-C ; E
	APU fire extinguishing	M-G	

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**LANDING GEAR****GEARS AND DOORS**

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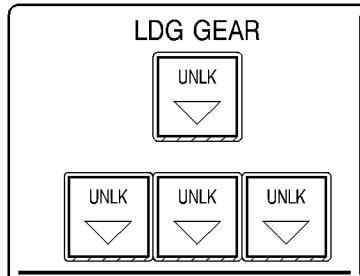
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(Cont'd)

	SYSTEM	LGCIU 1	LGCIU 2
FLT CTL	Flaps control and monitoring	M-G	M-G
	Slats control and monitoring	M-G	M-G
	EFCS	L/R-D ; N-C	L/R-D ; N-C
FUEL	APU fuel pump system	M-G	
	FCMS	L-D ; N-C	L-D ; N-C
HYD	Green main hydraulic power	M-G	M-G
ICE	Wing ice-protection	M-F	M-F
	Probe ice-protection	L/R-G ; E N-C ; OP	L/R-G ; E N-C ; OP
	Windscreen anti-icing and defogging	L/R-G	L/R-G
EIS	FWC - acquisition interface	R-G	L-G
	SDAC- acquisition interface	R-G	L-G
	DMC - acquisition interface	R-G	L-G
GEAR	Normal extension and retraction	R-G ; E	R-G ; E
	Normal braking	L/R-G ; N-C/D	R-G ; N-D
	Brake cooling		L-D
LIGHTS	Runway turn off lights	N-D	N-D
	Taxi and take off lights	N-D	N-D
	Logo lights		M-G
	Toilet system		N-C
NAVIGATION	Sensors	N-C	
	Altitude and airspeed standby data	L-G	
	ILS	L-F	R-F
	Weather radar system	L-F	R-F
	Radio altimeter	L-F	L-F
	TCAS	L-G/D	
	GPWS	L-D	
	DME	L-F	R-F
	ATC/MODE S	L-G	R-G
	ADF	L-F	R-F
	VOR/MARKER	L-F	R-F
MAIN	CMS acquisition interface	N-C ; E	
	Up and down data loading system	R-G	
DOOR	Doors and escape slide control system	N-C ; E	N-C ; E
ENG	FADEC	L/R-G ; DP N-C	L/R-G ; DP N-C

The following systems get landing gear position selection data from the landing gear lever

SYSTEM	L/G lever position
Refuel on battery	DOWN
FCMS	DOWN
Normal braking	UP
Cabin emergency lighting	UP

**CONTROLS AND INDICATORS****LDG GEAR INDICATOR PANEL**

Connected to LGCIU 1 which receives signals from proximity detectors.

UNLK light : illuminates red if the landing gear is not locked in selected position.

▽ lights : illuminate green if the landing gear is locked down.

Light off : indicates landing gear is retracted and locked up with landing gear lever selected up.

- R Note : ▽ lights on the LDG GEAR indicator panel light up as long as the LGCIU 1 is electrically supplied, except for the center landing gear, which may not light up, depending on the LGCIU failure.

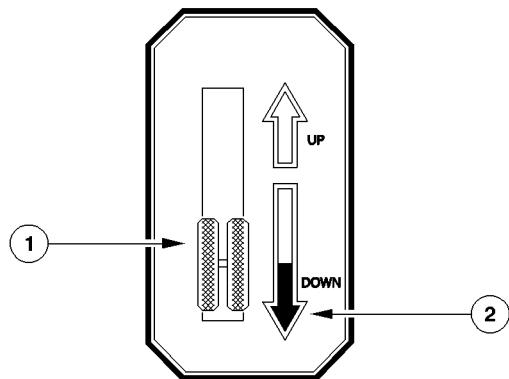
## LANDING GEAR SELECTOR LEVER

A two position selector lever provides electrical signals to the two LGCIUs which control green hydraulic supply by means of selector valves.

On selection of UP or DOWN and provided the airspeed is below 280 knots :

- all landing gear doors open then,
- landing gears move to the new selected position then,
- all doors close.

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### ① L/G LEVER

**UP** : The landing gear retraction is selected.

During gear door opening, main gear wheels are automatically braked by the normal brake system. The nose gear wheels are braked by a brake band in the gear well.

**DOWN** : The landing gear extension is selected.

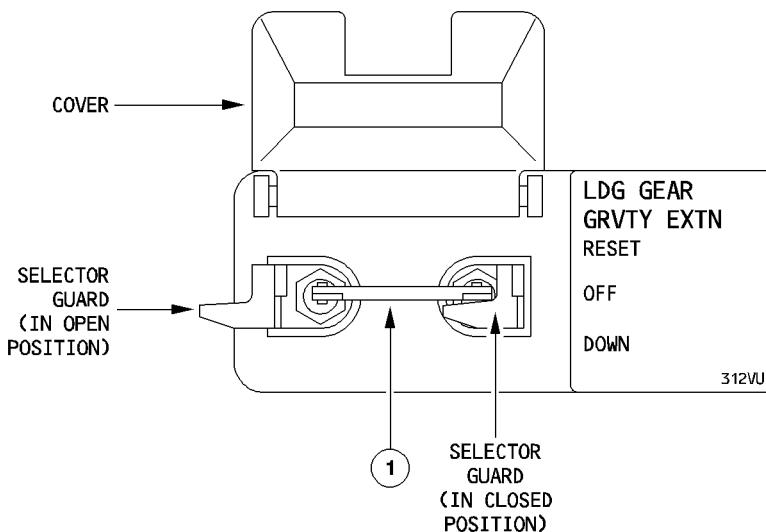
An interlock mechanism prevents unsafe retraction by locking the lever in DOWN position when either

- both main landing gear bogies are not trailedd (aircraft on ground)
- the center landing gear shock absorber is not fully extended
- the nose landing gear shock absorber is not fully extended and the nose wheels are not in the center position.

When the landing gear is extended the system remains pressurized (if green hydraulic pressure is available).

### ② RED ARROW

Illuminates red if the landing gear is not downlocked in landing configuration associated with a red ECAM warning. (Refer to WARNINGS and CAUTIONS section).

**GRAVITY EXTENSION**

FFC5-01-32210-013-A001AA

The landing gear gravity extension selectors are locked-toggle type selectors. The selectors are connected together with a link so that both are operated at the same time.  
When the link is disconnected each selector can be operated independently.

**① LDG GEAR GRVTY EXTN sel**

Each selector has three positions :

**DOWN** : The two motorised actuators are electrically powered to close the hydraulic (guarded) cut off valve and to disengage door and gear uplocks which permit the nose and main gear to deploy by gravity and to automatically lock down.

**OFF** : Normal position. Landing gear operation is controlled by the LGCIU and the landing gear lever.

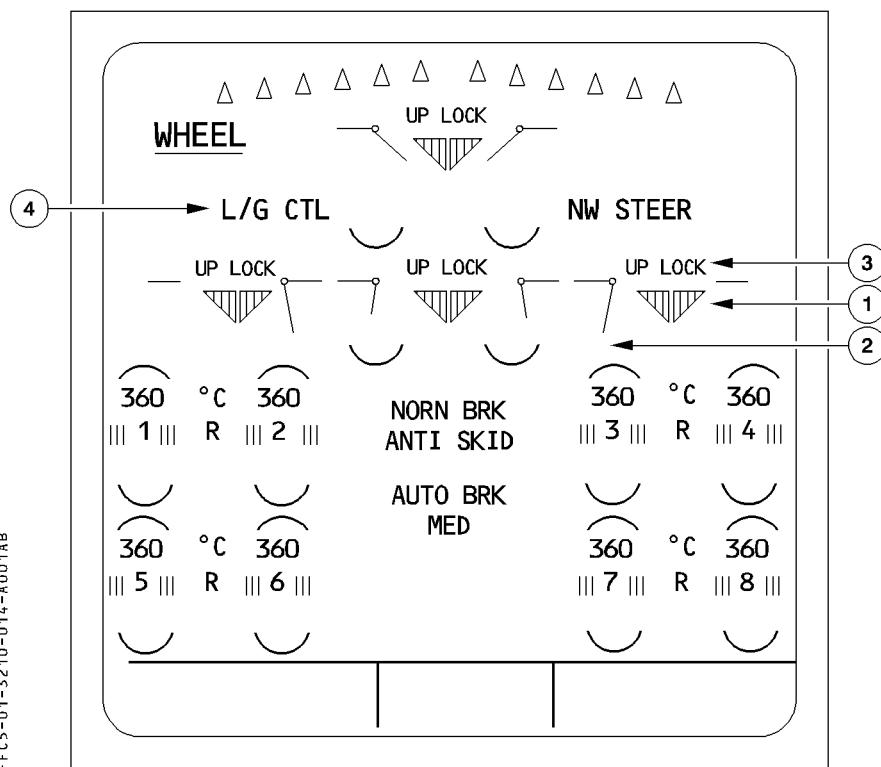
**RESET** : The actuators turn back to the initial position and automatically set the system back to the normal extension and retraction mode.  
The selectors are then set to off for normal operation.

*Note : To select landing gear both selector guards have to be open.*

**ECAM WHEEL PAGE**

The wheel page is automatically displayed :

- on ground before take-off with engine running (flight phase 2), it disappears at engine TO power application.
- in approach at landing gear down selection or below 800 ft radio altitude (flight phases 7, 8, 9), it disappears at engine shutdown.

**① Landing gear position indication**

The landing gear positions are indicated by 2 triangles for each gear.

The left triangle is controlled by LGCIU 1, the right one by LGCIU 2.

- green triangle when LGCIU detects landing gear downlocked.
- red triangle when LGCIU detects landing gear in transit
- no signal when LGCIU detects landing gear uplocked
- amber crosses in case of LGCIU failure.

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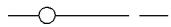
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**LANDING GEAR****GEARS AND DOORS**

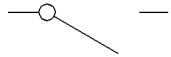
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**(2) Landing gear door position indication**

: DOOR LOCKED UP (GREEN)



: DOOR IN TRANSIT (AMBER)



: DOOR FULLY OPEN (AMBER)

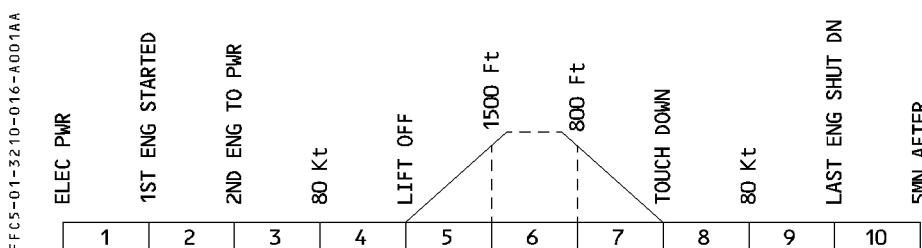
**(3) UPLOCK indication**

Appears amber associated with an ECAM caution if landing gear uplock is engaged when landing gear is downlocked.

**(4) L/G CTL indication**

Appears amber with a 30 seconds time delay when position of any landing gear disagrees with lever position. Associated ECAM caution is triggered.

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**WARNINGS AND CAUTIONS**

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
GEAR NOT DOWNLOCKED One or more gear(s) not downlocked and landing gear selected down		WHEEL	UNLK on LDG GEAR panel	3, 4, 5	
GEAR NOT DOWNLOCKED 1) Landing gear not downlocked and radio height lower than 750 ft and all engine not at TO power. or 2) Landing gear not downlocked and radio height lower than 750 ft and flaps 2, 3 or FULL or 3) Landing gear not downlocked and flaps at 2, 3 or FULL and both radio altimeters failed and all engines not at TO power NOTE : In the cases 2 above, the aural warning can only be cancelled by the emer canc pb.	CRC	MASTER WARN	RED ARROW lt on LDG GEAR panel	1 to 5 8 to 10	
DOORS NOT CLOSED One or more gear door(s) is not uplocked		NIL	NIL	1, 3, 4, 5, 8, 9, 10	
GEAR NOT UPLOCKED One or more gear(s) not uplocked and landing gear not selected down		WHEEL	UNLK lt on LDG GEAR panel	3, 4, 7 to 10	
GEAR UPLOCK FAULT One gear uplock engaged with corresponding gear downlocked	SINGLE CHIME	MASTER CAUT	NIL	4, 7, 8	
RETRACTION FAULT L/G selected up and - the bogie beam not in correct position or, - the pitch trimmer not in correct position or, - nose or center landing gear shock absorber not in correct position		NIL	NIL	1, 3, 4, 7, 8	
LENGTHENING (L)(R) FAULT Landing gear downlocked but shortening mechanism has not locked long position		WHEEL		3, 4, 5, 8	
LGCIU 1 + 2 FAULT				4, 5, 7, 8	

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**LANDING GEAR****GEARS AND DOORS**

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E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
LGCIU 1 (2) FAULT	NIL	NIL	WHEEL	NIL	3, 4, 5, 7, 8
SYS DISAGREE Disagree between landing gear or door positions detected by the two LGCIUs					

**DESCRIPTION**

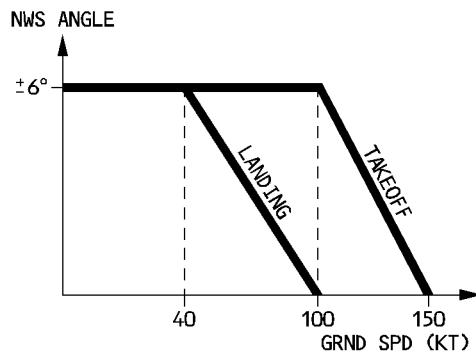
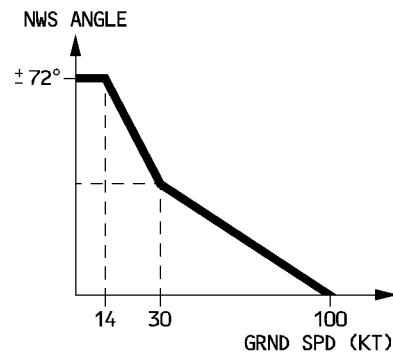
Nosewheel steering is provided by two actuators, powered by the green hydraulic system and electrically-signaled by the Brake and Steering Control Unit (BSCU).

The BSCU has two independent channels. Only one is active at a time, while the other is on standby.

To control the steering, the BSCU receives inputs from the steering hand wheels, the rudder pedals, and the Auto Pilot.

The BSCU transforms the pilot's order into a nosewheel steering angle, by controlling the servo-valve to provide the requested flow for the hydraulic actuators. The following limitations apply :

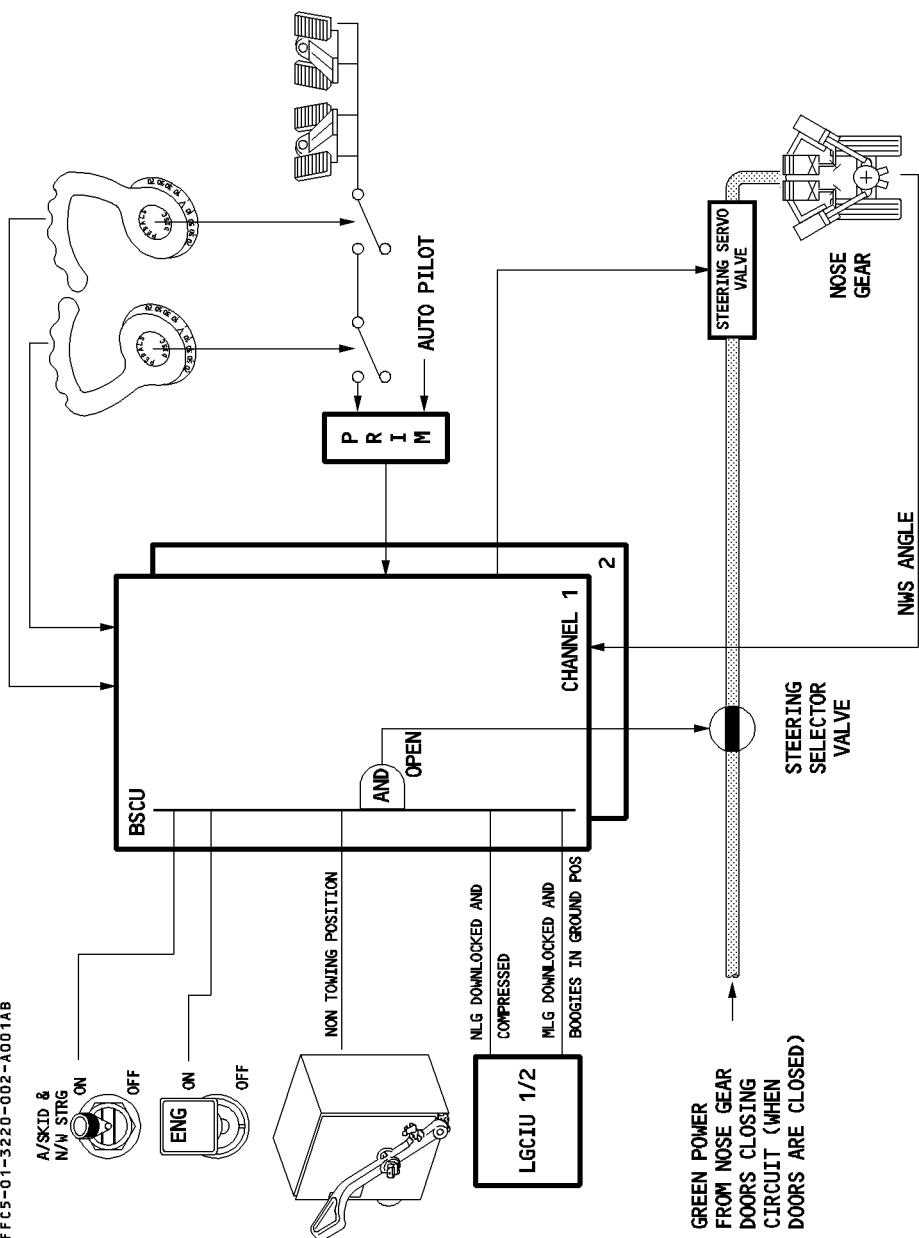
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ORDERS FROM RUDDER PEDALSORDERS FROM HAND WHEELS

Hand wheel control provides up to a ± 72° nosewheel steering angle. A lever on the towing electrical box (on the nose L/G) enables the steering system to be deactivated for towing purposes.

Pilots can disconnect the rudder pedal order to the BSCU through a pushbutton located on each steering hand wheel.

An internal cam mechanism returns the nosewheel to the centered position after takeoff.

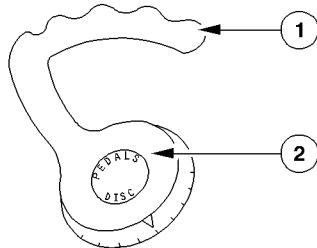


**CONTROLS AND INDICATORS****RUDDER PEDALS**

Rudder pedals provide nosewheel steering control below 100 knots. Control authority depends on aircraft speed. The nosewheel steering angle is a function of aircraft speed.

**SIDE CONSOLES**

FFC5-01-3220-003-A105AA

**① STEERING HAND WHEELS**

The steering handwheels control the nosewheel steering angle up to 72° in either direction.

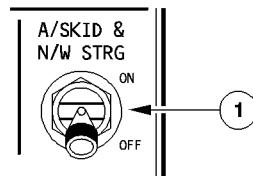
- R      *Note : Nosewheel steering centers itself (above 100 kt) for landing, and (above 150 kt) for takeoff.*

**② RUDDER PEDAL DISC pb**

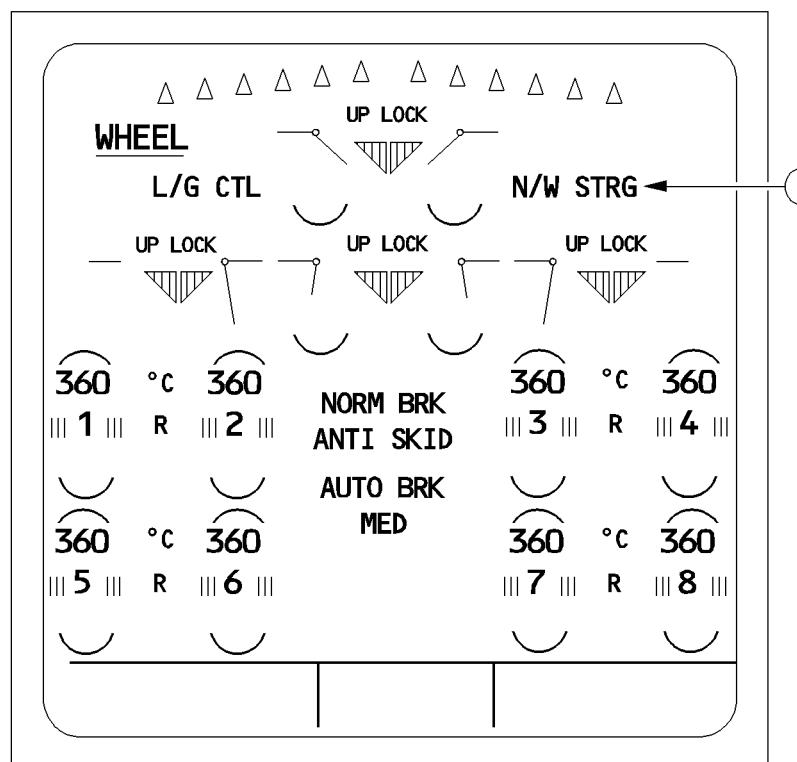
When maintained depressed, the nosewheel steering control by the pedals is disconnected.

**CENTER INSTRUMENT PANEL**

FFC5-01-3220-003-B105AA

**① A/SKID and N/W STRG sw**

An ON/OFF switch activates or deactivates the Nosewheel Steering and Anti-Skid (Refer to BRAKES-ANTISKID section).

**ECAM WHEEL PAGE**① N/W STRG indication

Appears amber in case of :

- nose wheel steering failure detected by the BSCU (associated with an ECAM caution)
- A/SKID & N/W STRG switch is at OFF
- failure of both BSCU channels (associated with ECAM caution).



**A340**

FLIGHT CREW OPERATING MANUAL

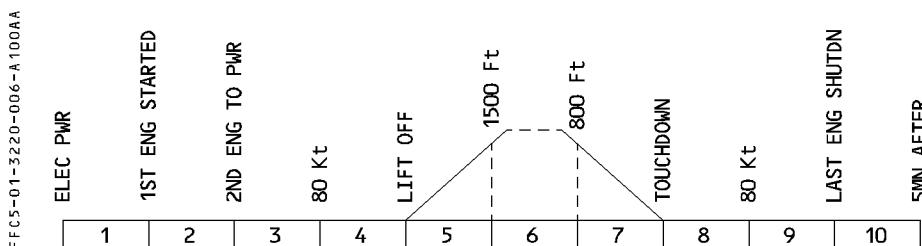
**LANDING GEAR**

**NOSE WHEEL STEERING**

**1.32.20 P 5**

**SEQ. 001 REV. 15**

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**WARNINGS AND CAUTIONS**

E/WD : FAILURE TITLE conditions					AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
N/W STRG FAULT detected by BSCU					SINGLE CHIME	MASTER CAUT	WHEEL	NIL	3, 4, 5, 8

**MEMO DISPLAY**

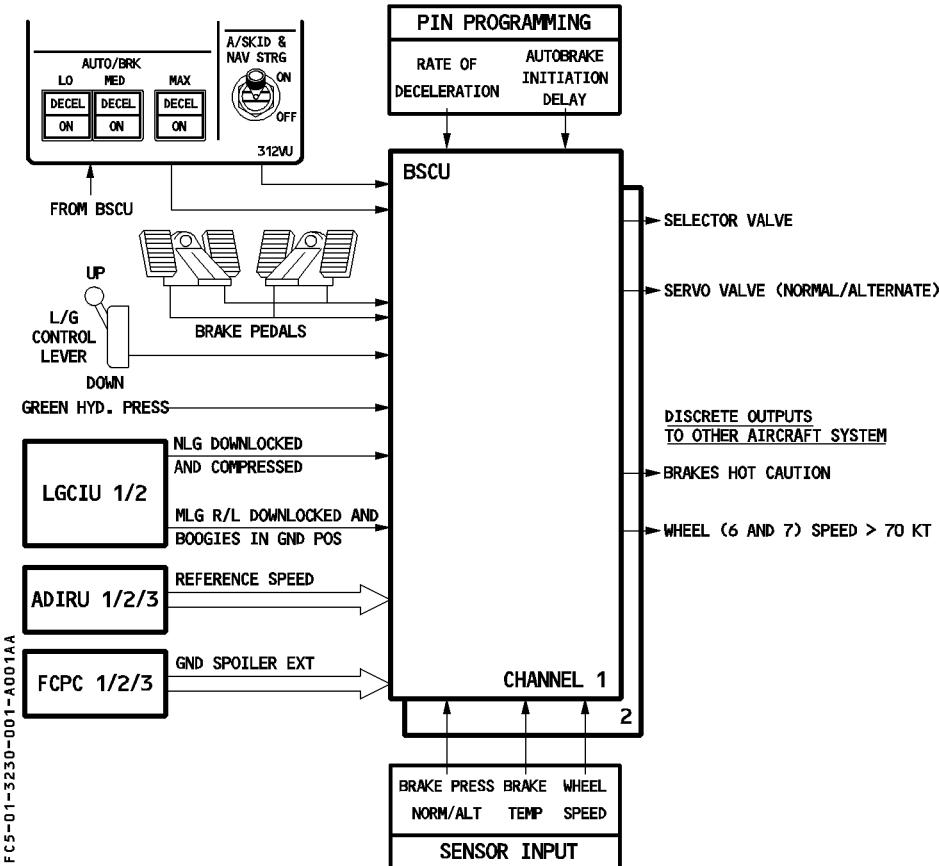
If the nose wheel steering switch is in the towing position, the N/WS DISC message is displayed in green. It becomes amber if two engines are running.

**DESCRIPTION****GENERAL**

The main wheels are equipped with carbon multidisc brakes which can be actuated by either of two independent brake systems.

The normal system uses green hydraulic pressure whilst the alternate system uses the blue hydraulic system backed up by hydraulic accumulator.

An antiskid and autobrake system is also provided.



Braking commands come either from the brake pedals (pilot action) or the autobrake system (deceleration rate selected by the crew).

All braking functions (normal and alternate braking control, autobraking, antiskid control) are controlled by a dual channel Brake and Steering Control Unit (BSCU).

The BSCU performs following secondary functions :

- it checks the residual pressure in the brakes
- it monitors the brake temperature
- it provides discrete wheel speed information to other aircraft systems

A change over between the two systems takes place at each DOWN landing lever selection or in case one channel fails.

The main gear wheels are fitted with fusible plugs which protect against tire burst in the event of overheat.

Main gear wheels are also equipped with brakes cooling fans which permit a high speed cooling of brakes.◀

### **ANTISKID SYSTEM**

The antiskid system provides maximum braking efficiency by maintaining the wheels at the limit of an impending skid.

At skid onset brake release orders are sent to the normal and to the alternate servovalves as well as to the ECAM system which displays the released brakes.

Full braking performance is achieved only with brakes pedals at full deflection.

The antiskid system is deactivated below 10 kt (ground speed).

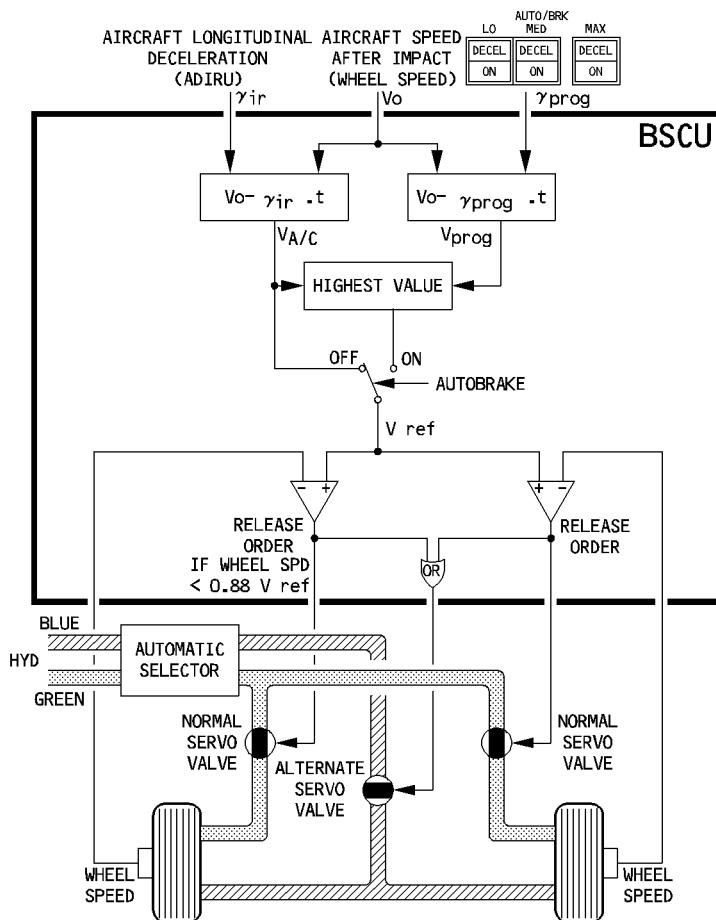
An ON/OFF switch activates or deactivates the antiskid system and nose wheel steering.

**PRINCIPLE**

The speed of each main gear wheel (given by a tachometer) is compared with the aircraft speed (reference speed). When the speed of a wheel decreases below 0.88 time reference speed, brake release orders are given to maintain the wheel slip at that value (best braking efficiency).

In normal operation, the reference speed is determined by BSCU from the horizontal acceleration from ADIRU 1 or ADIRU 2 or ADIRU 3.

In case all ADIRUs are failed, reference speed equals the maximum of either main landing gear wheel speeds. Deceleration is limited to a default value of  $2.5 \text{ m/s}^2$  ( $8.2 \text{ ft/s}^2$ ).

**FOR INFO**

## **AUTOBRAKE**

The aim of this system is :

- To reduce the braking delay in the event of an accelerate-stop to improve performance.
- To establish and maintain a selected deceleration rate during landing, to improve comfort and reduce crew workload.

## **SYSTEM ARMING**

The crew may arm the system by depressing the LO, MED, or MAX pushbutton provided all the following arming conditions are met :

- Green pressure available
- Antiskid electrically powered
- No failure in the braking system.
- At least two PRIMs are available
- At least one ADIRU is available

*Note : Autobrake may be armed with parking brake on.*

## **SYSTEM ACTIVATION**

- R Automatic braking activated by the ground spoiler extension command (Refer to 1.27). In addition for MAX mode the nose landing gear compressed signal is required. Consequently in the event of an acceleration stop, if the deceleration is initiated with the speed below 72 kt, the automatic braking will not activate because the ground spoilers will not be extended.

## **R SYSTEM DEACTIVATION**

- R The system deactivates :
- R — When it is disarmed (see below)
- R — When ground spoilers retract. However, it remains armed.

## **SYSTEM DISARMING**

The system is disarmed by :

- Pressing the pushbutton, or
- Loss of one or more arming conditions, or
- R — Applying sufficient deflection to one brake pedal when autobrake is active in MAX, MED or LO mode.
- R — After take-off/touch and go.

**A340**

FLIGHT CREW OPERATING MANUAL

**LANDING GEAR****BRAKES AND ANTI SKID**

1.32.30 P 5

SEQ. 100 REV. 14

**OPERATION**

There are four modes of operation :

- Normal braking.
- Alternate braking with antiskid.
- Alternate braking without antiskid.
- Parking brake.

**NORMAL BRAKING**

Antiskid is operative and autobrake is available.

Braking is normal when :

- green hydraulic pressure is available
- main landing gear in ground condition
- A/SKID and N/W STRG switch is ON

The control is electrically achieved through the BSCU :

- either via the pedals
- or automatically
  - on ground by autobrake system
  - in flight by setting the landing gear lever to the up position

Anti-skid system is controlled by the BSCU via the normal servo valves.

No brake pressure indication is provided.

**ALTERNATE BRAKING WITH ANTI SKID**

Autobrake is inoperative.

Active when green hydraulic pressure is insufficient and provided :

- blue hydraulic pressure is available
- A/SKID and N/W STRG switch is ON
- PARKING BRAKE is not ON

Note : Alternate braking is also active in flight when the landing gear is up.

The automatic switching between the green and blue system is achieved by an automatic hydraulic selector.

Control is achieved by the pedals through the auxiliary low hydraulic pressure distribution line acting on the dual valves. The BSCU controls antiskid system via the alternate servo valves.

The pressure delivered to the left and right brakes as well as the accumulator pressure are indicated on a triple indicator located on the center instrument panel.

## **ALTERNATE BRAKING WITHOUT ANTISKID**

Auto brake and antiskid are inoperative.

The antiskid system is deactivated :

- electrically (A/SKID and N/W STRG switch OFF or power supply failure or BSCU failure)
- or hydraulically (B + G system low pressure, the brakes are supplied by the brake accumulator only).

Control is achieved by the pedals (acting on the dual valves).

Alternate servo valves are fully open.

Brake pressure has to be limited by the pilot by referring to the triple indicator to avoid wheel locking.

The accumulators are dimensioned to supply at least seven full brakes applications.

## **PARKING BRAKE**

Brakes are supplied by blue hydraulic system or accumulator pressure via the dual shuttle valves. Alternate servo valves are open allowing full pressure application..

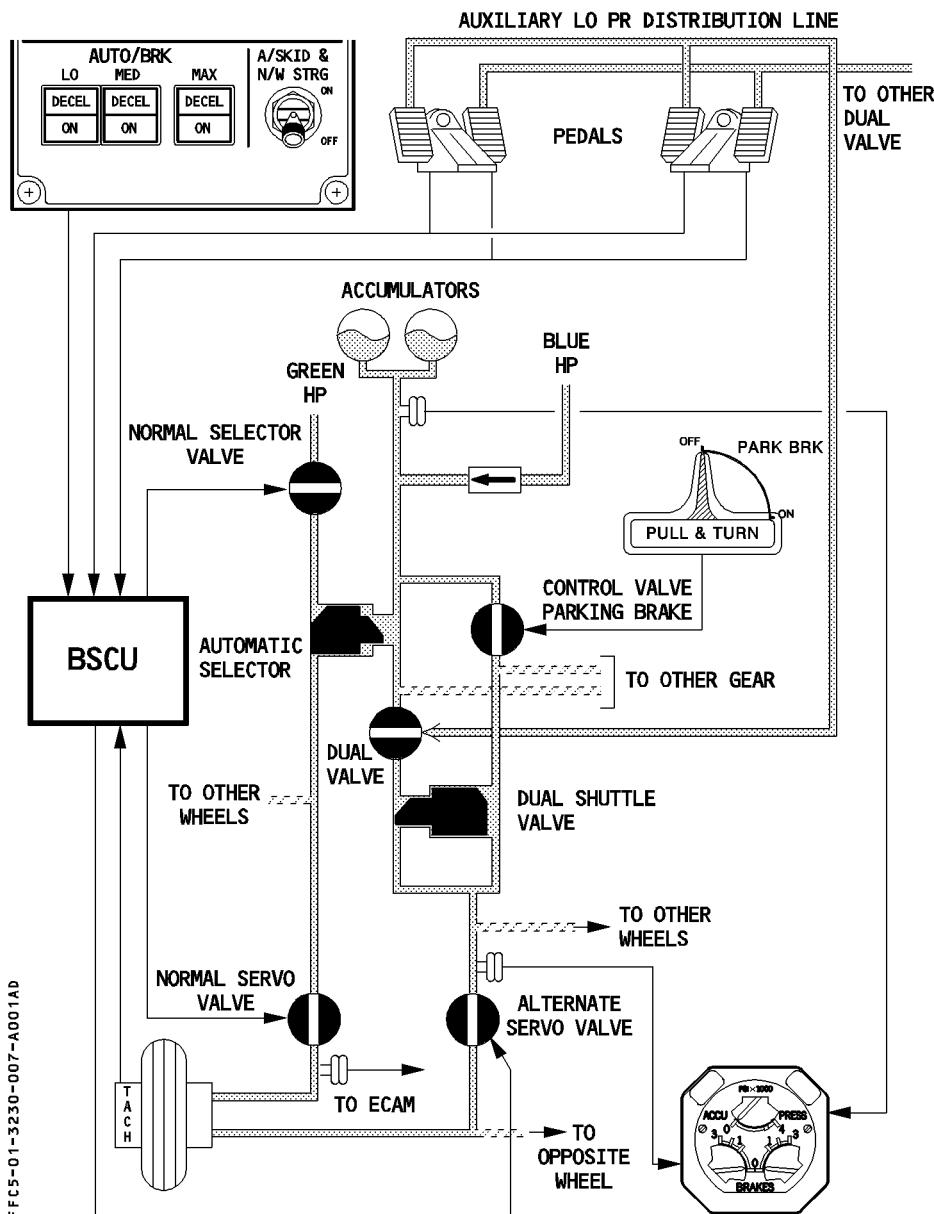
The accumulator maintains the parking pressure for at least 12 hours.

If the parking brake is activated and no blue hydraulic or accumulator brake pressure is available, then the normal braking system can be applied via the brake pedals.

Blue accumulators can be pressurized by pressing the blue electrical pump switch.

Brake pressure indications are available on the triple indicator.

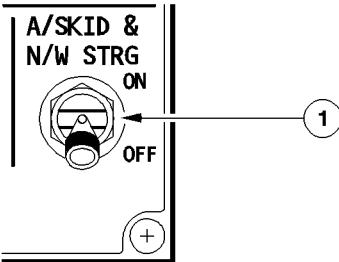
## BRAKING SCHEMATIC



FFC5-01-3230-007-A001AD

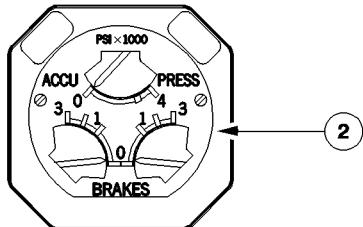
**CONTROLS AND INDICATORS****CENTER INSTRUMENT PANEL**

FFC5-01-3230-008-A001AB

**① A/SKID and N/W STRG switch**

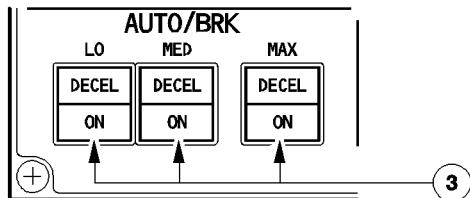
- ON :**
- If green hydraulic pressure available
    - Antiskid is available
    - Nose wheel steering is available
  - If green hydraulic pressure lost
    - Blue hydraulic pressure takes over automatically to supply the brakes
    - Antiskid remains available
    - Nose wheel steering is lost
    - Brake blue pressure is displayed on the triple indicator
- OFF :**
- Blue hydraulic pressure supplies the brakes.
  - Antiskid is deactivated. Brake pressure has to be limited by the pilot by referring to the triple indicator to avoid wheel locking
  - Nose wheel steering is lost
  - Differential braking remains available by pedals
  - Brake blue pressure is displayed on the triple indicator.

FFC5-01-3230-008-B001AA

**② BRAKE and ACCU PRESS indicator**

**ACCU PRESS indication :** Indicates the pressure in the brake blue accumulators.

**BRAKE pressure indication :** Indicates blue pressure delivered to left and right brakes measured upstream of the alternate servovalves.



### ③ MAX, MED, LO pb sw (springloaded)

The pb controls the arming of the required deceleration rate.

- MAX mode is normally selected for take off.

In the event of an aborted take off, maximum pressure is sent to the brakes as soon as ground spoiler deployment order is present.

- MED or LO mode is normally selected for landing.

- When LO is selected, progressive pressure is sent to the brakes starting 1 second after ground spoiler deployment order to provide a  $1.8 \text{ m/s}^2$  ( $5.9 \text{ ft/s}^2$ ) deceleration.
- When MED is selected, progressive pressure is sent to the brakes starting at ground spoiler deployment order to provide a  $3 \text{ m/s}^2$  ( $9.8 \text{ ft/s}^2$ ) deceleration.

ON : The ON light illuminates blue to indicate positive arming.

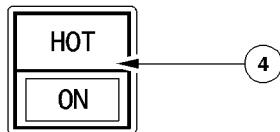
The DECEL light illuminates green only if the autobrake function is active and when actual aircraft deceleration corresponds to predetermined rate. This occurs approximately 8 (5) seconds after activation for LO, (MED) using brakes alone. Predetermined rates could be achieved also by reversers alone or a combination of both reversers and brakes.

(In LO or MED : 80% of the selected rate ; in MAX :  $2.65 \text{ m/s}^2$  ( $8.7 \text{ ft/s}^2$ ))

Note : On slippery runway, the predetermined deceleration may not be reached due to antiskid operation. In this case DECEL It will not illuminate. This does not mean that autobrake is not working.

Off : The corresponding autobrake mode is deactivated.

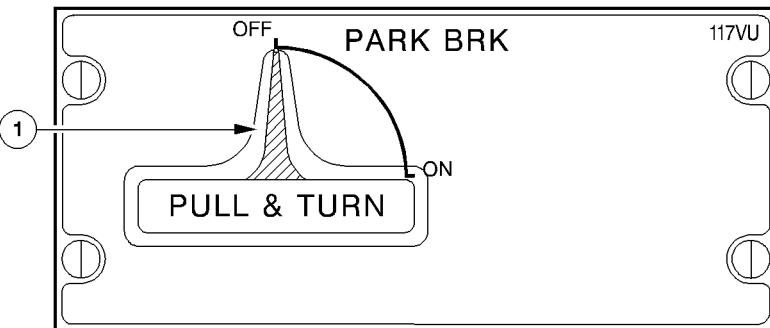
FFCS-01-3230-010-A100AA

**BRK FAN****④ BRK FAN pushbutton ▲**

- ON : The brake fans run, provided the main landing gear is downlocked.  
The ON legend comes on blue.
- Off : The brake fans stop.
- HOT It : Comes on amber, along with the associated ECAM caution, when one brake temperature exceeds 300°C.

**PEDESTAL**

FFCS-01-3230-010-B100AA

**① PARK BRK handle**

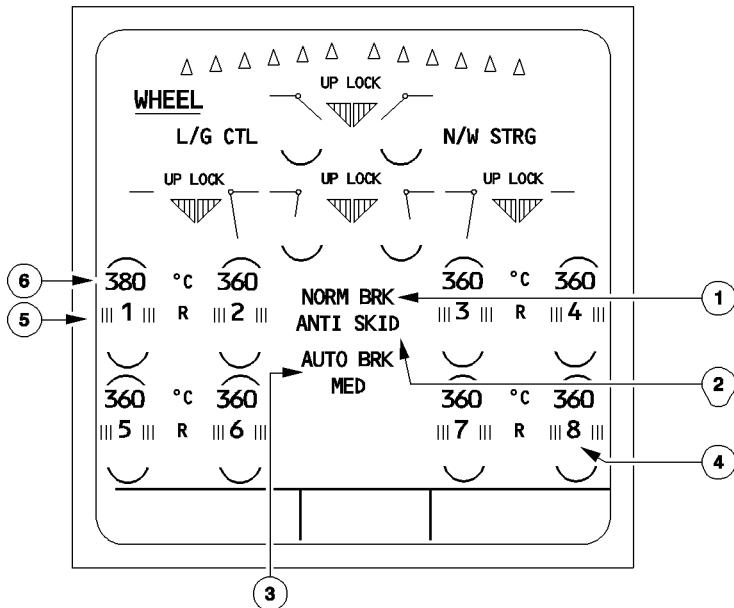
- R Pull the handle, then turn it clockwise to apply the parking brake.  
The «PARK BRK» message is displayed on the ECAM memo page.

**CAUTION**

As long as the handle is not in the «ON» position, the parking brake is not applied.

**ECAM WHEEL PAGE**

FFC5-01-3230-011-A001AC

**① NORM BRK indication**

- R      Appears in amber in case of :
- R      – normal braking is failed
  - R      – A/SKID & N/W STRG switch is at OFF (associated with ECAM caution)
  - R      – both BSCU channels are failed (associated with ECAM caution).

**② ANTISKID indication**

Appears amber associated with an ECAM caution in case of total BSCU failure or when the A/SKID & N/W STRG switch is OFF or in case of antiskid failure detected by the BSCU or when green and blue systems are failed.

**③ AUTO BRK indication**

Displayed : – green when autobrake is armed  
           – amber associated with an ECAM caution in case of autobrake system failure or failure of both BSCU channels.

MAX, MED or LO indicates the selected rate (green). Not displayed when autobrake is faulty.

④ Wheel number identification

It is in white.

⑤ III indications

- R It appears in green when :
  - In flight, the landing gear is extended, and the antiskid is valid, or
  - On ground, when antiskid is activated and the brakes are released.
- R It is amber in case of :
  - Residual pressure, or
  - Brake release fault
- R The R (Release) indication is always in white.

⑥ Brake temperature indications

- It is normally green (minimum indication 0°C).
- A green arc appears on the hottest wheel, when one brake temperature exceeds 100°C.
- The amber light, and associated ECAM caution, come on when the corresponding brake temperature exceeds 300°C.  
In addition, on the hottest wheel, the arc becomes amber.

Note : Below 100°C, the indicated brake temperature may be below the actual brake temperature. This difference can reach 25°C with an actual brake temperature of 30°C, and it decreases when the temperature increases.



**A340**

FLIGHT CREW OPERATING MANUAL

**LANDING GEAR**

BRAKES AND ANTI SKID

1.32.30 P 13

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**A340**

FLIGHT CREW OPERATING MANUAL

LANDING GEAR

BRAKES AND ANTI SKID

1.32.30

P 14

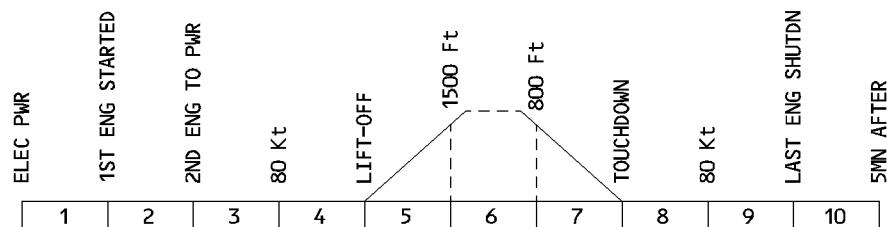
SEQ 001

REV 15

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**WARNINGS AND CAUTIONS**

FFC5-01-3230-015-A103AA



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG PARK BRK ON Parking brake is ON, when thrust levers are set to the T.O or FLX T.O power position.	CRC	MASTER WARN	NIL	NIL	1, 2, 5 to 10
PARK BRK LO PR					3 to 8
BRAKES HOT One brake temperature is higher than 300°C.			BRK FAN HOT $\triangleleft$		4, 8, 9, 10
AUTO BRK FAULT A tachometer is failed, or a servovalve is jammed closed on one or two wheels.					3, 4, 5
A/SKID FAULT					4, 5
A/SKID NWS OFF Switch in the OFF position.					1, 4, 5 10
RELEASED Brake of one wheel is released. It is detected when the landing gear is downlocked and at least one engine is running.	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	4, 5, 8
RESIDUAL BRAKING Residual brake pressure is detected with the pedals released :					3, 4, 5, 8
– On at least one wheel, if on normal braking system, or – On left or right main landing gear side (affecting the four wheels), if on alternate braking system.					3, 4, 5, 7, 8
HYD SEL VALVE Failure or brake normal selector valve in the open position.			NIL		
BSCU CH 1(2) FAULT One BSCU channel is failed.	NIL	NIL	NIL		

**MEMO DISPLAY**

- If the parking brake is on, the PARK BRK message is displayed :
  - In green, in flight phases 1, 2, 9 and 10.
  - In amber, in other flight phases.
- The BRK FAN memo is displayed in green, if the BRK FAN pushbutton is ON.  $\triangleleft$

**BUS EQUIPMENT LIST**

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
LANDING GEAR	LGCIU 1					LAND RECOV	
	LGCIU 2		DC2				
	SAFETY VALVE		DC1/DC2				
	GRVTY EXT SYS 1					HOT 1	
	GRVTY EXT SYS 2					HOT 2	
	LDG GEAR INDICATOR PANEL				X		
NWS	OVERSTEER WARNING ◄		DC1			HOT 1 (*)	
BRAKES	BSCU CHANNEL 1		DC1				
	BSCU CHANNEL 2		DC2				
	PARK BRK CTL		GND/FLT				HOT 1
	BRK FAN CTL ◄		DC2				
	COOLING FANS WHEEL 1, 2, 3, 4 ◄	AC2-3					
	COOLING FANS WHEEL 5, 6, 7, 8 ◄	AC1-2					
TIRE PRESS	TIRE PRESS INDICATING UNIT ◄		DC1				

(\*) : Or the tow tractor power supply.

LIGHTS	1.33.00	P 1
CONTENTS	SEQ. 001	REV. 17

**33.00 CONTENTS****33.10 COCKPIT LIGHTING**

– GENERAL . . . . .	1
– DESCRIPTION . . . . .	2
– CONTROLS AND INDICATORS . . . . .	4

**33.20 EXTERIOR LIGHTING**

R – GENERAL . . . . .	1
– CONTROLS AND INDICATORS . . . . .	2

**33.30 EMERGENCY LIGHTING**

– GENERAL . . . . .	1
– OPERATION . . . . .	1
– CONTROLS AND INDICATORS . . . . .	3

**33.40 SIGNS**

– CONTROLS AND INDICATORS . . . . .	1
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**33.50 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
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**A340**

FLIGHT CREW OPERATING MANUAL

**LIGHTS****COCKPIT LIGHTING**

1.33.10 P 1

SEQ. 001 REV. 07

**GENERAL**

The flight deck is provided with integral instrument lighting and flood lighting of the instrument panel.

The brightness of all panel lighting can be adjusted.

Work surfaces and side consoles are illuminated by incandescent spot lights and flood lights.

For general cockpit illumination, two dimmable DOME lights are installed.

**DESCRIPTION****Instrument and panel integrated lighting :**

All instruments and panels installed in the cockpit (other than DU) are integrally lit.  
The brightness of all instruments and panels can be adjusted.

**Annunciator light test and dimming :**

The brightness of all the annunciator lights in the flight deck can be changed, depending on the ANN LT TEST / BRT / DIM sw position on the overhead panel.

The lights are dimmed to a fixed level.

An annunciator light test is provided to verify cockpit annunciator lamp operation.

The test is done by selecting TEST position on ANN LT «TEST / BRT / DIM» sw and by visually checking that all lights illuminate.

**Dome lights and lighting strips :**

See 2 , 3 , 4

Two dome lights and lighting strips supply general cockpit illumination providing shadow free lighting.

**Map holder lighting :**

See 5 , 6

Map chart holder is provided at the CAPT and F/O stations.

**Console and floor lighting :**

See 7, 8

Briefcase stowage, side console and floor lighting are provided at the CAPT and F/O stations.

**Centre instrument and standby compass :**

See 10, 1

The centre instrument is lighted by a set of lights located below the glareshield. The standby compass is provided with integral illumination.

**Reading lights :**

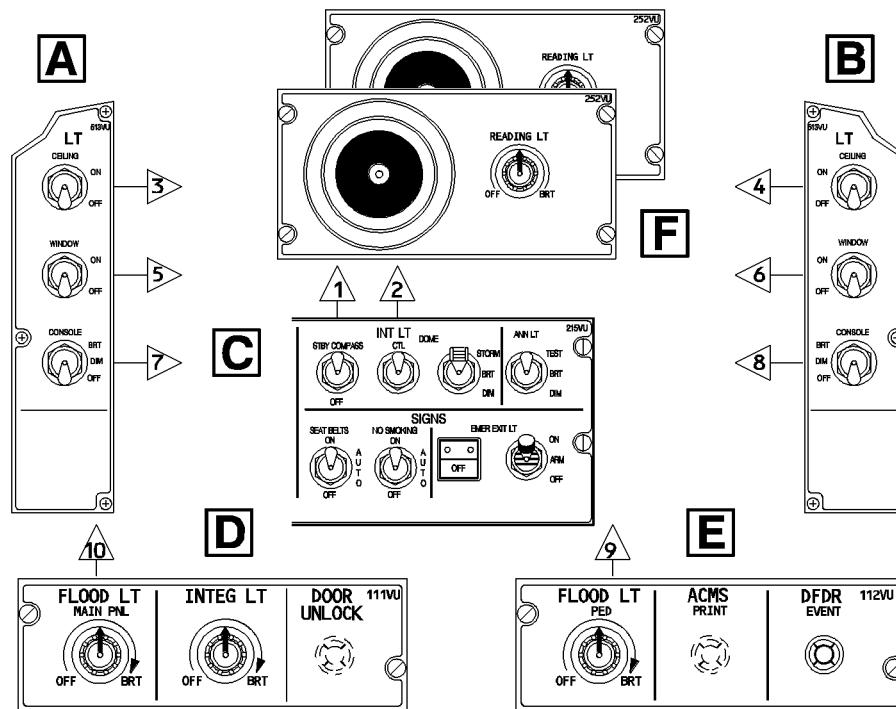
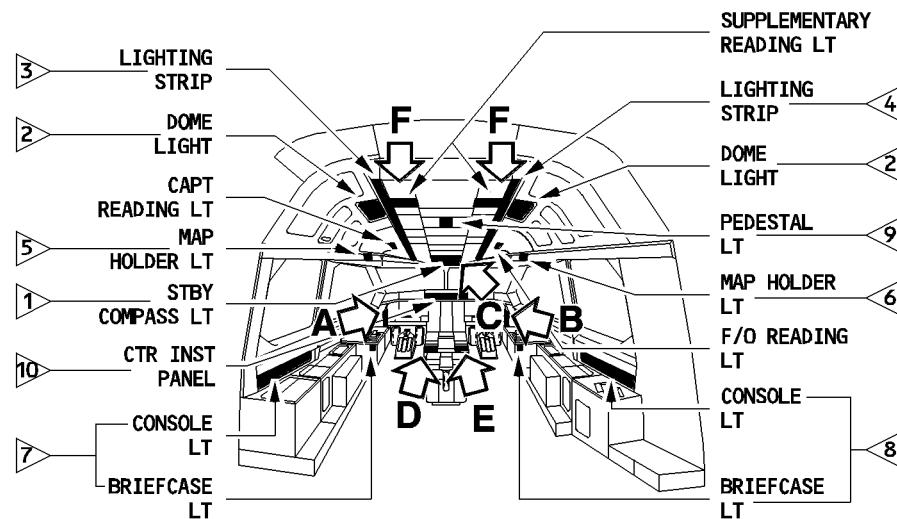
See detail F

Individual reading lights and supplementary reading lights are provided at the CAPT and F/O stations.

**Pedestal lighting :**

See 9

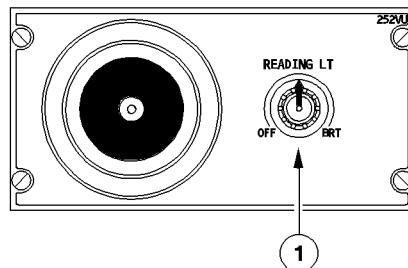
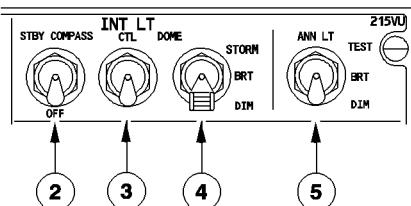
Located in the middle of the overhead panel, a flood light provides illumination of the centre pedestal.



FFC5-01-3310-003-A001AA

**CONTROLS AND INDICATORS****OVERHEAD PANEL**

FFC5-01-3310-004-A001AB

**① READING lt**

Two reading lights are fitted on each side of the overhead panel.

**R ② STBY COMPASS sw**

Operation of standby compass integral and seat alignment indicator lighting.

**③ CTL sw**

There are two two-way switches to control the dome light. The first one is located on the left rear panel close to the cockpit door and the second one labelled CTL is located on the INT LT panel.

Note : *On ground with the four engines stopped, for example after an accelerate stop, the right dome light automatically illuminates independently of the selected position of the switches.*

**④ DOME sel**

STORM : Operation of both dome lights and main instruments panel (flood lights) at high intensity

BRT : Both dome lights at high intensity (provided they are selected on through the CTL switch or the dome lighting switch on the rear left panel).

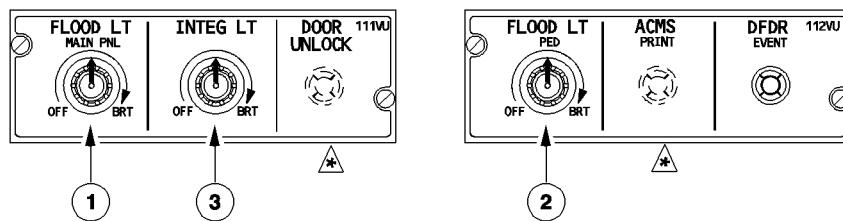
DIM : Both dome lights at low intensity (provided they are selected on through the CTL switch or the dome lighting switch on the rear left panel).

## ⑤ ANN LT sel

- TEST : · All flight deck annunciator lights illuminate.  
  · All Liquid Crystal Displays (LCD) indicate "eight".  
 DIM : Annunciator lights power supply voltage is reduced.  
 BRT : Normal operation.

**PEDESTAL**

FFC5-01-33310-005-A001AB

① FLOOD LT MAIN PANEL knob

Brightness adjustment of center instrument panel flood lighting.

② FLOOD LT PED knob

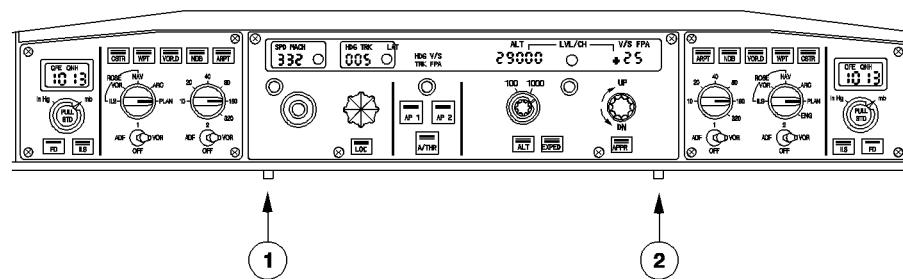
Brightness adjustment of pedestal flood lighting.

③ INTEG LT

Brightness adjustment of all flight deck integral lighting.

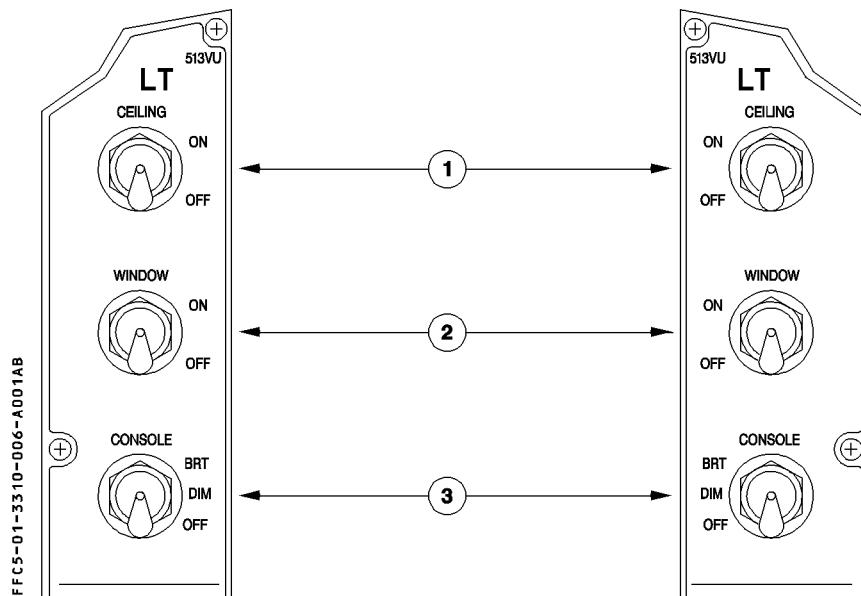
**GLARESHIELD**

FFC5-01-33310-005-B001AC



R ① Rotary potentiometer for glareshield integral lighting and LED on FCU lighting adjustment.

R ② Rotary potentiometer for FCU displays lighting adjustment.

**MAIN INST PANEL****① CEILING sw**

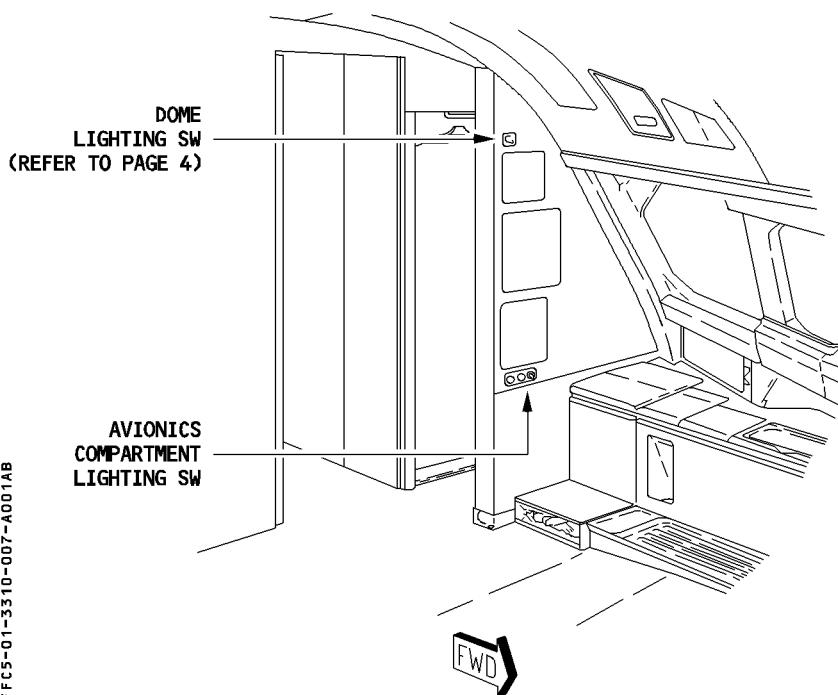
Operation of the two lighting strips located on either side of the overhead panel.

**② WINDOW sw**

Operation of the two lights located under the side windows for map holder lighting.

**③ CONSOLE sw**

Permits illumination of the side consoles, briefcases, and floor around the pilots seats (two lighting levels).

**LEFT REAR PANEL**

FFC5-01-3310-007-A001AB

**A340**

FLIGHT CREW OPERATING MANUAL

**LIGHTS**  
EXTERIOR LIGHTING

1.33.20 P 1

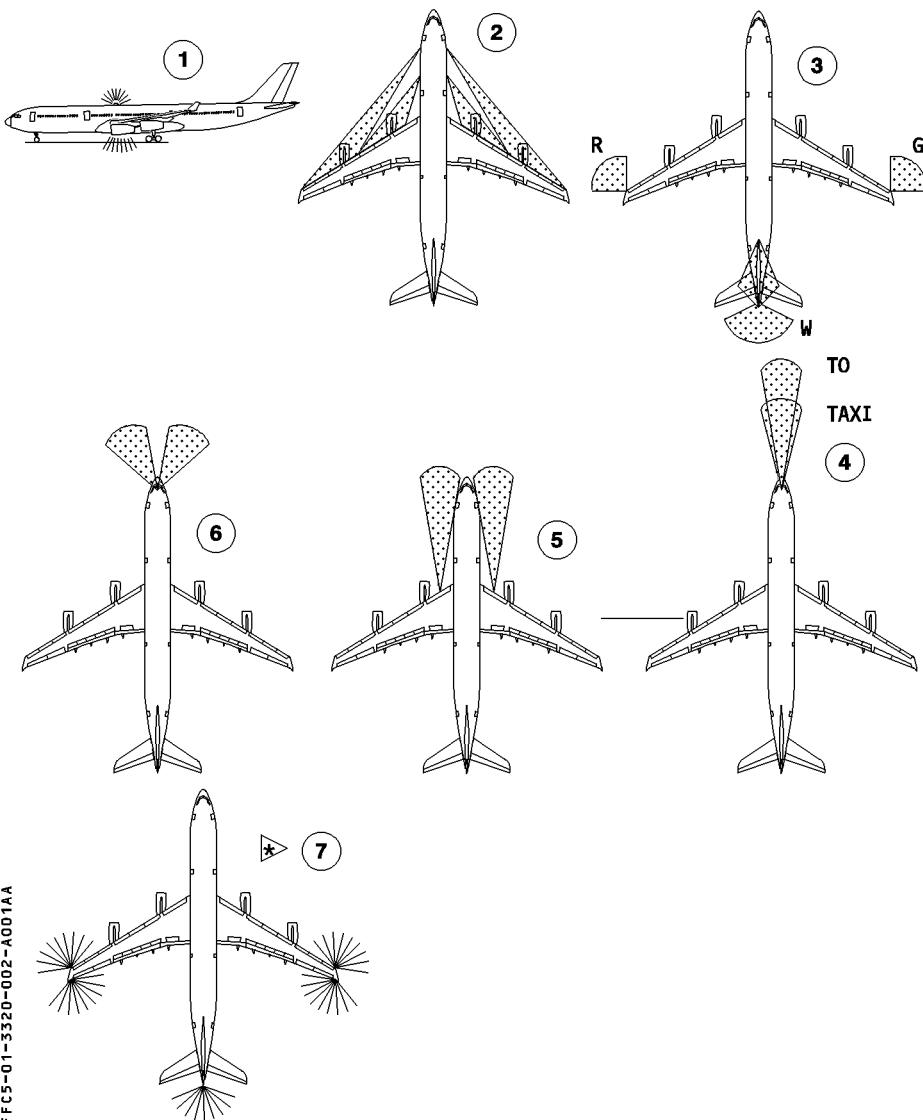
SEQ. 001 REV. 07

**GENERAL**

Exterior lights include :

- The navigation lights
- The landing lights
- The runway turn off lights
- The TO and TAXI lights
- The logo lights
- The anticollision lights
- The wing and engine scan lights.

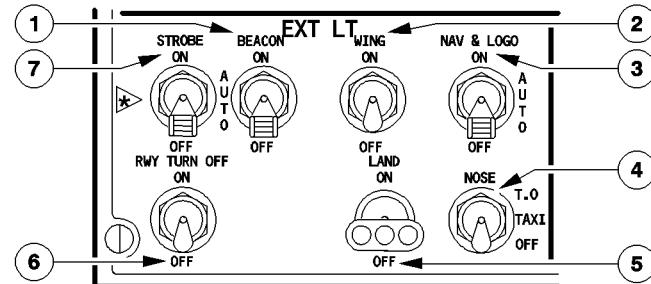
Exterior lighting is controlled by means of switches located on the overhead panel.

**CONTROLS AND INDICATORS**

FFC5-01-3320-002-A001AA

**OVERHEAD PANEL**

FFC5-01-3320-003-A100AA

**① BEACON sw**

Operation of the two flashing red lights, one on top and one on bottom of the fuselage.

**② WING sw**

Operation of two single beam lights on each side of the fuselage, to illuminate wing leading edge and engine air intake to detect ice accretion.

**③ NAV & LOGO sw**

Operation of Navigation and logo lights.

Navigation lights are located at each wing tip and in the APU tail cone.

Logo lights are installed in the upper surface of each horizontal stabilizer to illuminate the company logo on the vertical stabilizer

ON : Navigation and Logo lights illuminate.

AUTO : Navigation lights are on.

Logo lights are on when the main gear struts are compressed or the flaps are extended at 15° or more.

OFF : Navigation and logo lights extinguish.

**④ NOSE sw**

Operation of taxi and take-off lights.

T.O : Both taxi and take-off lights are illuminated.

TAXI : Only taxi light is illuminated.

OFF : Taxi and take-off lights off.

Note : These two lights, attached to the nose gear strut, go off automatically when landing gear is retracted.

**⑤ LAND sw**

Operation of landing lights.

**⑥ RWY TURN OFF sw**

Operation of runway turn-off light installed on the nose gear strut.

*Note : These lights go off automatically when landing gear is retracted.*

**⑦ STROBE sw ◄**

Operation of the two synchronized strobe lights on each wing tip plus one in the tail core.

ON : Strobe ligths flash white.

AUTO : Strobe lights are automatically switched on when the shock absorber is not compressed.

OFF : All lights are off.

**MEMO DISPLAY**

STROBE LT OFF message is displayed in green if the STROBE switch is at OFF in flight.

**A340**

FLIGHT CREW OPERATING MANUAL

**LIGHTS**  
EMER LIGHTING1.33.30      P 1  
SEQ. 001      REV 15**GENERAL**

Emergency lighting includes :

- Cabin emergency lighting :
  - Proximity emergency escape path marking,
  - Overhead emergency lights,
  - EXIT signs.
- Escape slide lighting.

**OPERATION**

- The proximity emergency escape path marking, overhead emergency lighting, and EXIT signs come on, if the EMER EXIT LT sel is at ON, or if the EMER pb on the purser panel is pressed.
- With the EMER EXIT LT sel at ARM :
  - Cabin emergency lighting comes on automatically, if :
    - \* DC ESS BUS fails, or
    - \* Normal aircraft electrical power fails.
  - Overhead emergency lights come on automatically, if AC BUS 1 fails, to provide minimum cabin lighting.
- In addition, EXIT signs automatically come on when the NO SMOKING SIGNS are on, or in case of excessive cabin altitude.

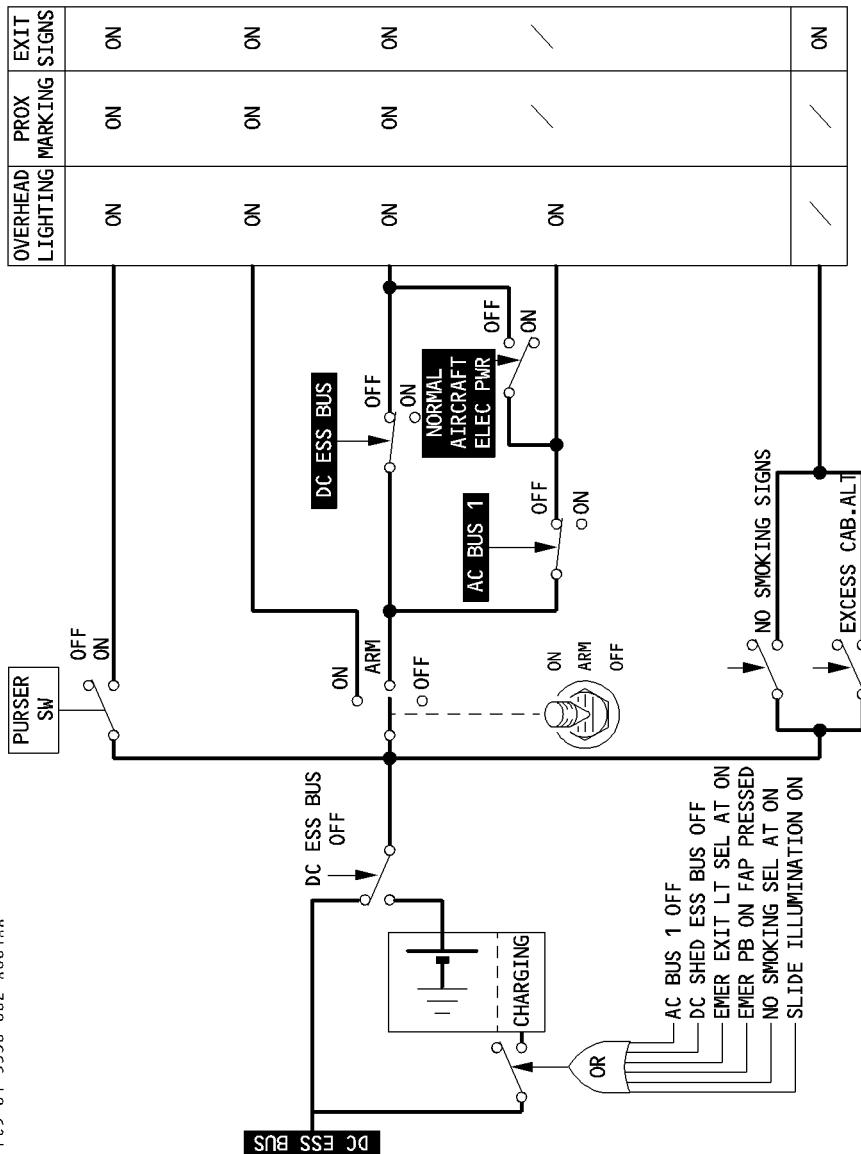
R

*Note : The emergency lighting system is supplied by DC ESS BUS and AC BUS 1.  
If DC ESS BUS fails, it is supplied by internal batteries (previously charged by the DC ESS BUS).*

- The escape slides are equipped with an integral lighting system. The escape slide lights come on automatically when the slide is armed and the door is open. They have the same supply as the cabin emergency lighting.

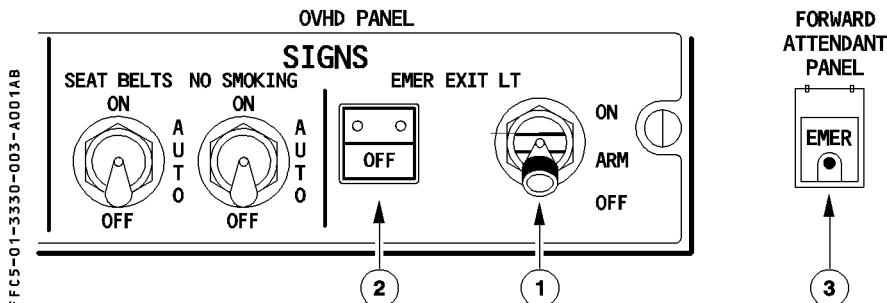
**EMERGENCY LIGHTING CONTROL LOGIC****FOR INFO**

R



FFC5-01-3330-002-A001AA

## CONTROLS AND INDICATORS

① EMER EXIT LT sel

ON : The cabin emergency lighting comes on.

OFF : The cabin emergency lighting is off.

ARM : – The cabin emergency lighting automatically comes on if :

- DC ESS BUS fails, or

- Normal aircraft electrical power fails

- The overhead emergency lights automatically come on if AC BUS 1 fails, to provide minimum cabin lighting

② EMER EXIT LT-OFF light

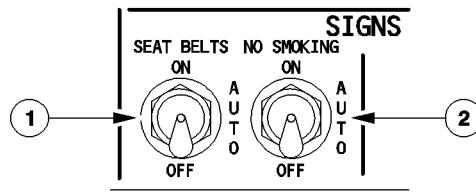
Comes on amber when the EMER EXIT LT sel is selected OFF.

③ EMER pb sw

R on : Emergency lights, EXIT signs and proximity emergency escape path marking illuminate.

**CONTROLS AND INDICATORS****OVERHEAD PANEL**

FFC5-01-3340-001-A150AA

**① SEAT BELTS sw**

- R ON : FASTEN SEAT BELT signs (in cabin) and RETURN TO YOUR SEAT signs (in lavatories) come on associated with low tone chime.
- R AUTO : FASTEN SEAT BELT and RETURN TO YOUR SEAT signs come on associated with low tone chime (depending on CIDS/CAM programming) when all engines are running and either the slats are extended (position 1, 2, 3 or FULL) or the main landing gear is extended.
- R OFF : Signs are off. Low tone chime sounds (depending on CIDS/CAM programming).

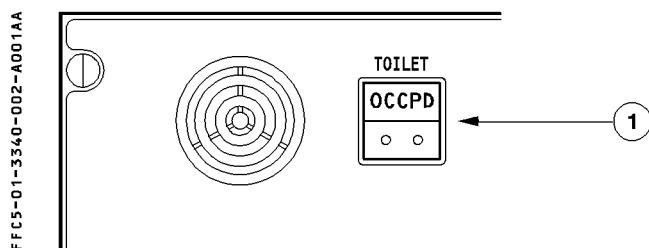
**② NO SMOKING sel**

- R ON : NO SMOKING and EXIT signs in cabin come on associated with low tone chime.
- R AUTO : NO SMOKING and EXIT signs in cabin come on when landing gear is extended and go off when landing gear is retracted. Low tone chime sounds (depending on CIDS/CAM programming) each time the signs go on or off.
- R OFF : Signs are off. Low tone chime sounds (depending on CIDS/CAM programming).

- Note : In the event of excessive cabin altitude (if cabin altitude equals EXCESS CAB ALT limit + 1750 feet ; max 14350 feet), the cabin lights come on (depending on CIDS/CAM programming) and the NO SMOKING, FASTEN SEAT BELT, EXIT signs come on regardless of SEAT BELTS and NO SMOKING selector switches.*

**MEMO DISPLAY**

SEAT BELTS and NO SMOKING messages are displayed in green when the corresponding sign is on.

**OVERHEAD PANEL****① TOILET OCCPD light**

Illuminates when lavatory located near the forward exit is occupied.

**CABIN CONTROLS**

NOT APPLICABLE

**BUS EQUIPMENT LIST****FOR INFO**

R

			NORM		EMER ELEC			
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
COCKPIT LIGHTS	LIGHTING STRIPS, MAP HOLDER, CONSOLE	L		DC1				
		R		DC2				
	DOME LT	L		DC GND				
		R				X		
	CTR. INST PANEL			DC 1			X	
	STBY COMPASS						X	
	SUPPLEMENTARY READING LT			DC1				
	PEDESTAL LT			DC1				
	CAPT, F/O READING LT			DC2				
	INST. PANELS-INTEGRAL LT	LAMPS	AC 1-1					
		LEDS		DC1				
	ANNUN LIGHTS SUPPLY:	SYS 1	AC1-1					
		SYS 2	AC2-4					
		ESS SYS				X		
	ANNUN LIGHTS TEST / DIM			DC2				
EXTERIOR LIGHTS	STROBE		AC2-4	DC2(2)				
	BEACON	UPPER	AC1-1					
		LOWER	AC2-4					
	WING	L	AC1-1					
		R(1)	AC1-1 + AC2-4					
	LAND	L	AC1-2	DC1				
		R	AC2-4	DC1				
	RWY TURN OFF	L	AC1-2	DC2				
		R	AC2-4	DC2				
	NOSE	L	AC1-2	DC2				
		R	AC2-4	DC2				
	NAV	SET 1	AC2-3					
		SET 2	AC2-3					
	LOGO	(1)	AC2-3 + AC2-4	DC2				
CABIN EMERGENCY LIGHTING			AC1-1				X	

- (1) Both ACs are required for operation.  
 (2) DC supply is only required for AUTO mode.

**A340**

FLIGHT CREW OPERATING MANUAL

**NAVIGATION**

1.34.00 P 1

**CONTENTS**

SEQ. 100 REV. 22

**34.00 CONTENTS****34.10 ADIRS**

– DESCRIPTION . . . . .	1
– CONTROLS AND INDICATORS . . . . .	4
– WARNINGS AND CAUTIONS . . . . .	8

**34.15 GPS**

– DESCRIPTION . . . . .	1
– NORMAL OPERATION . . . . .	2
– OPERATION IN CASE OF FAILURE . . . . .	3
– WARNINGS AND CAUTIONS . . . . .	3

**34.20 STANDBY INSTRUMENTS**

– COMPASS . . . . .	1
– HORIZON . . . . .	1
– AIRSPEED INDICATOR . . . . .	2
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**34.30 RADIO NAV**

– TUNING . . . . .	1
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– CONTROLS AND INDICATORS . . . . .	6
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**34.40 RADIO ALTIMETER**

– DESCRIPTION . . . . .	1
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**34.50 ATC**

– DESCRIPTION . . . . .	1
– CONTROL PANEL . . . . .	1

**34.60 WEATHER RADAR**

– DESCRIPTION . . . . .	1
– CONTROL PANEL . . . . .	1
– WINDSHEAR PREDICTION FUNCTION . . . . .	3
R – WARNINGS AND CAUTIONS . . . . .	5

**34.70 GPWS**

– DESCRIPTION . . . . .	1
– EGPWS FUNCTIONS ◀ . . . . .	8
– CONTROLS AND INDICATORS . . . . .	11
– WARNINGS AND CAUTIONS . . . . .	14

**34.80 TCAS ◀**

– DESCRIPTION . . . . .	1
– CONTROLS AND INDICATORS . . . . .	8
– WARNINGS AND CAUTIONS . . . . .	14
– MEMO DISPLAY . . . . .	14

**34.90 PARA VISUAL INDICATOR (PVI) ◀**

– GENERAL . . . . .	1
– CONTROLS AND INDICATORS . . . . .	2

**34.95 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
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**DESCRIPTION**

The Air Data and Inertial Reference System (ADIRS) supplies temperature and anemometric, barometric and inertial parameters to the EFIS system (PFD and ND) and to other user systems (FMGC, FADEC, PRIM, SEC, FWC, SFCC, ATC, GPWS, CMC, CPC).

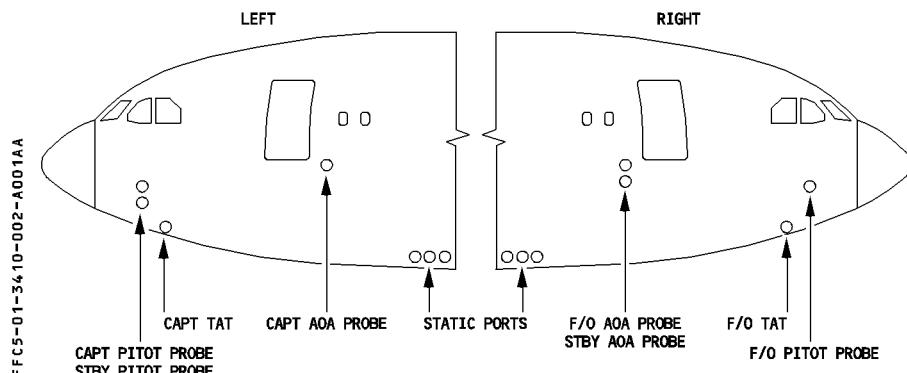
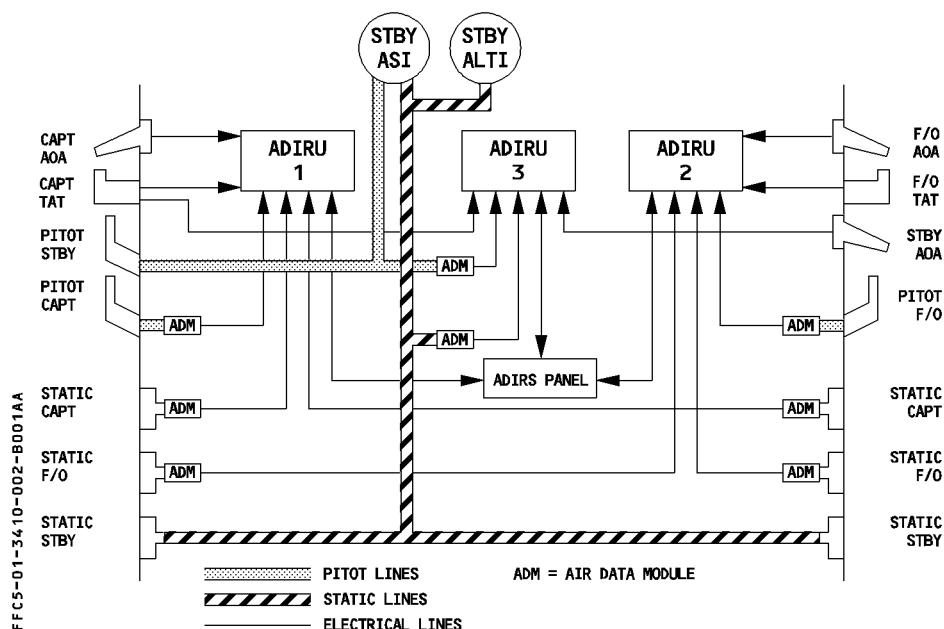
The system includes :

- three identical ADIRU's (Air Data and Inertial Reference Units).  
Each ADIRU is divided in two parts, either of which can work separately in case of failure in the other :
  - the ADR (Air Data Reference) part which supplies barometric altitude, airspeed, mach, angle of attack, temperature and overspeed warnings.
  - the IR (Inertial Reference) part which supplies attitude, flight path vector, track, heading, accelerations, angular rates, ground speed and aircraft position.

Note : *The ADIRU gives the true heading instead of magnetic heading :*

- R      – above 82.5° North
- R      – above 73.5° North between 92.5° and 117.5° West (magnetic polar region)
- R      – above 60.5° South

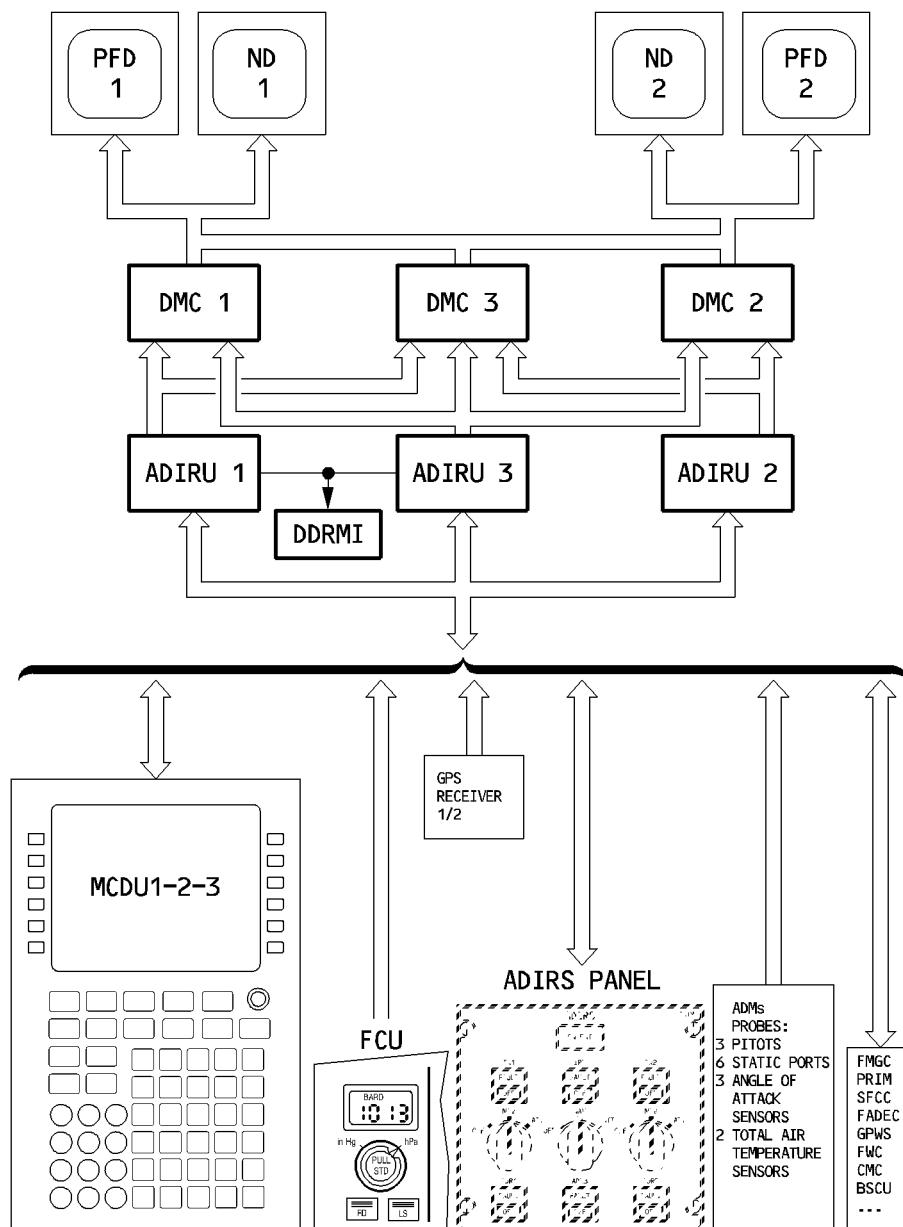
- one ADIRS control panel (ADIRS MSU) on the overhead panel for selection of modes (NAV, ATT, OFF) and indications of failures.  
The IR is initialized through the FMGES.
- Two GPS receivers, which are connected to the IR part of the ADIRU's for GP/IR hybrid position calculation.
- four types of sensors :
  - pitot probes (3)
  - static pressure probes (STAT) (6)
  - angle of attack sensors (AOA) (3)
  - total air temperature probes (TAT) (2)These sensors are electrically heated to prevent from icing up.
- eight ADMs (Air Data Modules) which convert pneumatic data from pitot and static probes into numerical data for the ADIRUs.
- a switching facility for selecting ADR3 or IR3 for instrument displays in case of ADIRU 1 or 2 failure.
- a MAG/TRUE pushbutton switch for polar navigation.
- AC BUS provides normal electrical supply. DC BUS provides a back up possibility through internal inverter.

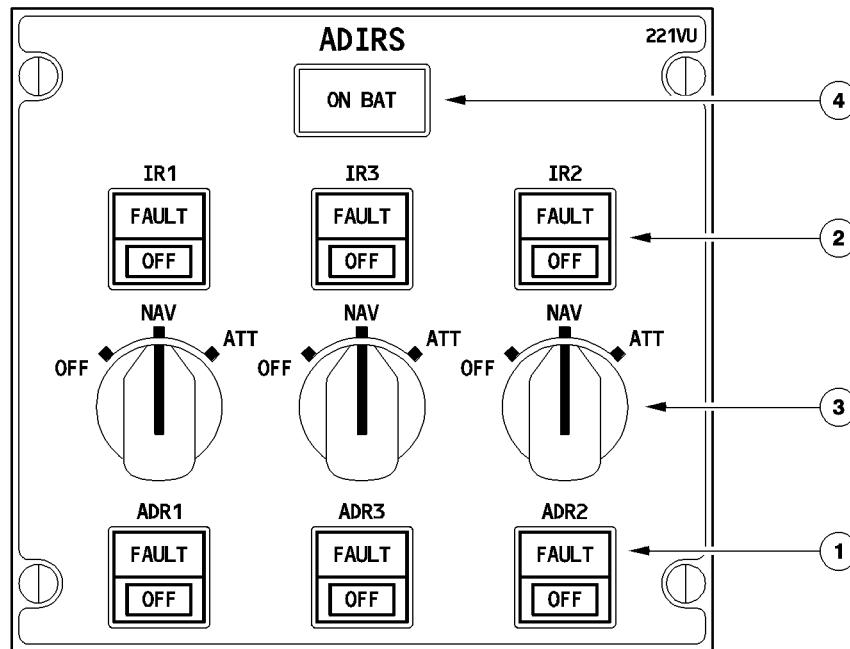
**PROBES LOCATION****PROBES SCHEMATIC**

Note : ADIRU 1 is supplied by CAPT probes,  
 ADIRU 2 is supplied by F/O probes,  
 ADIRU 3 is supplied by STBY probes and CAPT TAT

**ADIRS SCHEMATIC**

R



**CONTROLS AND INDICATORS****OVERHEAD PANEL**

R ① ADR 1 (2) (3) pb sw

OFF : Air data output disconnected.

R FAULT lt : This amber light comes on with an ECAM caution if a fault is detected in the air data reference part.

R ② IR 1 (2) (3) pb sw

OFF : Inertial data output disconnected.

R FAULT lt : This amber light comes on with an ECAM caution when a fault affects the respective IR.

R Steady : the respective IR is lost.

R Flashing : the attitude and heading information may be recovered in ATT mode.

R (3) IR 1 (2) (3) mode rotary sel

OFF : The ADIRU is not energized.

ADR and IR data are not available.

NAV : Normal mode of operation.

R Supplies full inertial data to aircraft systems.

R ATT : IR mode supplying only attitude and heading information if the system loses

R its ability to navigate.

The heading must be entered through the MCDU and has to be reset frequently (about every 10 minutes).

④ ON BAT lt

R Comes on amber when one or more IRS is supplied only by the aircraft battery. It

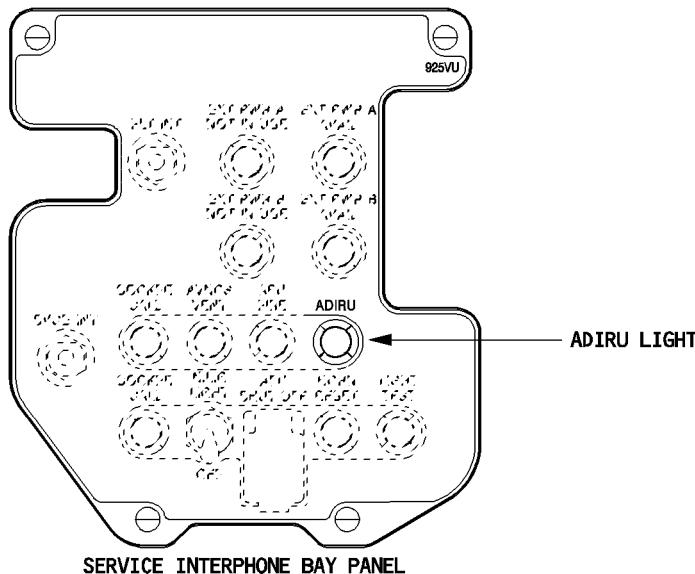
R also comes on for a few seconds at the beginning of the alignment but not for a fast

R realignment .

R Note : If, when the aircraft is on the ground, at least one ADIRU is supplied by aircraft batteries :

R – an external horn sounds

R – The ADIRU light comes on amber on the SERVICE INTERPHONE BAY panel.





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FLIGHT CREW OPERATING MANUAL

NAVIGATION

ADIRS

1.34.10

P 6

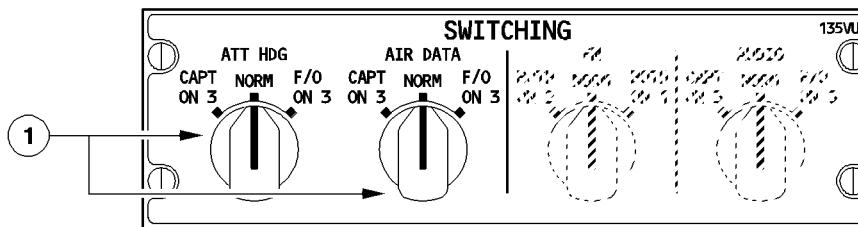
SEQ 001

REV 07

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**PEDESTAL**

FFC5-01-3410-007-A001AA

① ATT HDG and AIR DATA sel

NORM : ADIRU 1 supplies data to PFD1, ND1, DDRMI and ATC 1.  
 ADIRU 2 supplies data to PFD2, ND2 and ATC2.

CAPT ON 3 : ADR 3 or IR 3 replaces ADR 1 or IR 1.

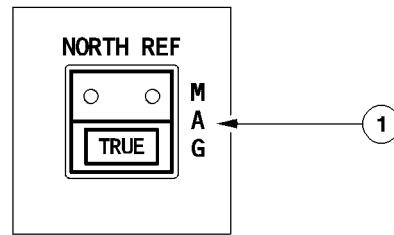
F/O ON 3 : ADR 3 or IR 3 replaces ADR 2 or IR 2.

**MAIN INSTRUMENTS PANEL**

At high latitude above 82.5° North or 60.5° South (or entering the north magnetic polar region : latitude 73.5° N and longitude between 117.5° W and 92.5° W) the ADIRUs replace magnetic heading by true heading on EFIS and DDRMI.

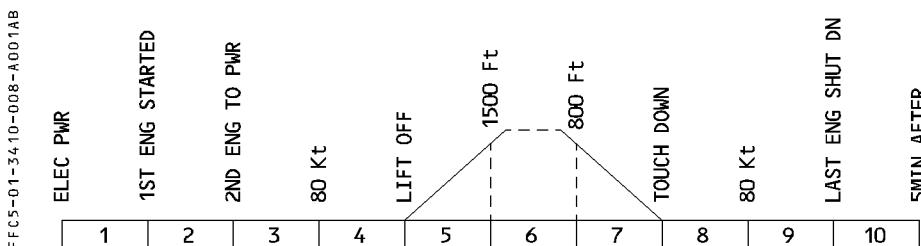
- R In addition the GRID track appears on ND. When the aircraft is in close proximity to these regions (latitude above 82° North or 60° South or approaching the north polar region : 73° N and longitude between 90° W and 120° W) the ADIRU will trigger a message on ND "SELECT TRUE REF" requesting to change north reference.

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① NORTH REF pb sw

TRUE (in) : Pressing this pushbutton selects the true heading for instrument display.  
 TRUE light comes on blue. The ND displays GRID track values if position is above 65° N or S.

MAG (out) : Magnetic heading is selected.

**WARNINGS AND CAUTIONS**

R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
STALL WARNING (No ECAM message) An aural stall warning is triggered when the AOA is greater than a predetermined angle This angle depends on – the Slats/Flap position – the Speed/Mach – the F/CTL law (normal, alternate/direct)	Cricket + STALL (synthetic voice)	MASTER WARN	NIL	NIL	
OVERSPEED – VMO/MMO aircraft speed/mach greater than VMO + 4 kt/MMO + 0.006 – VLE aircraft speed greater than VLE + 4 kt with L/G not uplocked or L/G doors not closed – VFE aircraft speed greater than VFE + 4 kt with slats or/and flaps extended.	CRC				
ADR 1(2)(3) FAULT			ADR FAULT lt	1, 4, 8, 10	
ADR 1+2 (1+3)(2+3) FAULT			IR FAULT lt	1, 4, 5, 7, 8, 10	
IR 1(2)(3) FAULT				1, 4, 8, 10	
IR 1+2 (1+3)(2+3) FAULT			CHECK HDG (on ND and PFD)		
HDG DISCREPANCY difference between heading on CAPT and F/O displays greater than 5° in TRUE or than 7° in MAG	SINGLE CHIME	MASTER CAUT	CHECK ATT (on PFD)		
ATT DISCREPANCY difference between roll or pitch angle displayed on CAPT and F/O PFD greater than 5°			CHECK ALT (on PFD)	4, 8	
ALTI DISCREPANCY difference between altitude displayed on CAPT and F/O PFD greater than : – 500 ft if baro ref STD is selected – 250 ft if QNH is selected					

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
EXTREME LATITUDE Aircraft enters a polar area, and the crew must select a true reference.	SINGLE CHIME	MASTER CAUT	NIL	NIL	4, 5, 7, 8
IR NOT ALIGNED Problem detected during IR alignment.					NIL
FM/IR POS DISAGREE Discrepancy between the a/c position, computed by the FMs and given by IRSs.				NIL	1, 2, 3, 4, 5, 7, 8, 9, 10
IAS DISCREPANCY One ADR is rejected by the flight control computers and there is a discrepancy between the speeds displayed in both PFDs.					4, 5, 7, 8
IR DISAGREE Disagree between two IRSs ; the third one failed.				PFD message	3, 4, 5, 7
ADR DISAGREE Disagree between two ADRs, the third one being failed or rejected by the PRIMs.				NIL	

**MEMO DISPLAY**

- “IRS IN ALIGN XXX” and “IR XXX IN ATT ALIGN” appear in green, during an IR alignment.
- “IRS IN ALIGN” :
  - Becomes amber, if engines are running
  - Flashes in green, if IRS alignment is faulty.
- “TRUE NORTH REF” appears in green, when the NORTH REF pushbutton is at TRUE. The message pulses for 10 seconds in Phase 1 or 2, or at slats’ extension.
- “ADIRS SWTG” appears in green, when either the AIR DATA or the ATT HDG selector is not in the NORM position.

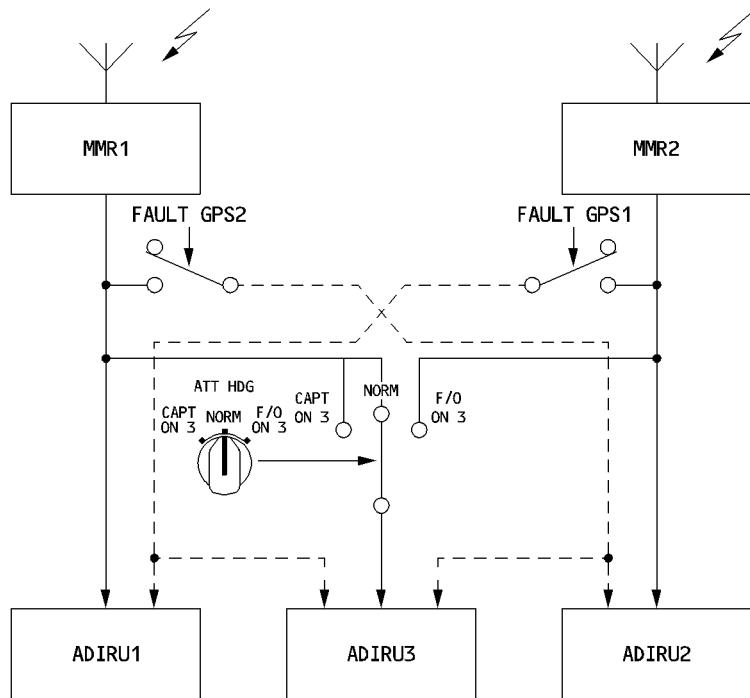
**DESCRIPTION**

The Global Positioning System (GPS) is a satellite based radio navigation aid. Worldwide 24 satellites broadcast accurate navigation data that the aircraft can use for the precise determination of its position.

The aircraft has two independent GPS receivers. Each GPS receiver is integrated in a modular avionics unit called MMR (Multi Mode Receiver) (GPS1 receiver in MMR1, GPS2 receiver in MMR2).

- R The MMR processes the data received and transfers them to the ADIRUs, which then perform a GP-IRS hybrid position calculation. The FMGCs use the hybrid position. The GPS MONITOR page on MCDU1 or MCDU2 can display pure GPS position, true track, ground speed, estimated position, accuracy level, and mode of operation for the information and use of the flight crew.

Note : Flight crew can use the MCDU NAVAID page to deselect the use of GPS data for calculating position. (See FCOM 4.03.20).

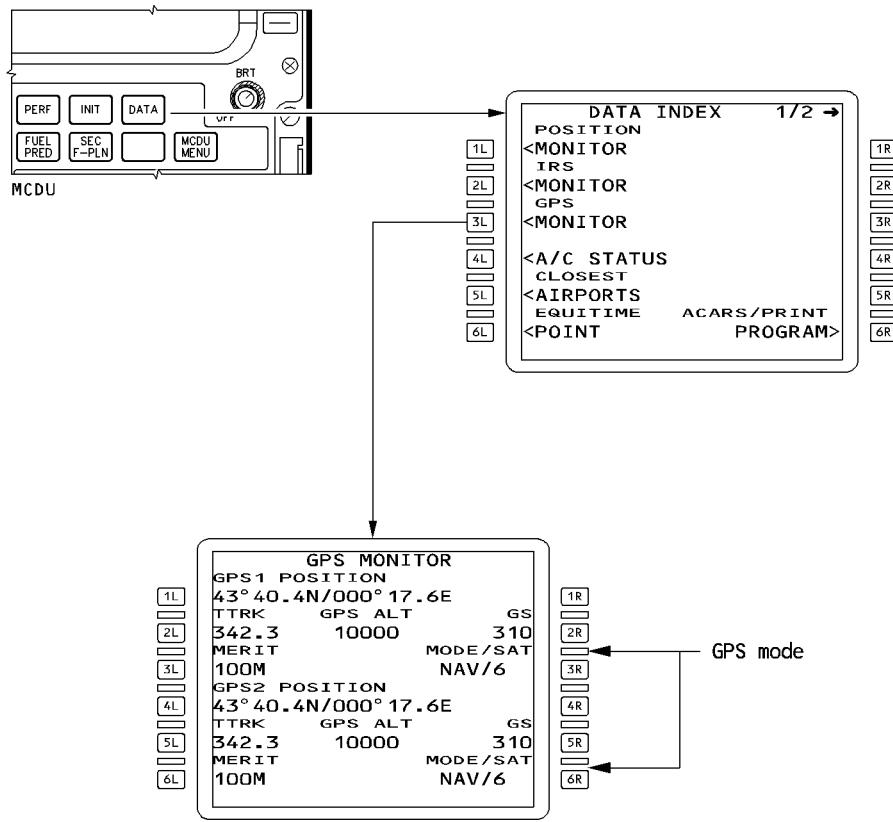


**NORMAL OPERATION**

In normal operation, the GPS receiver 1 supplies ADIRU 1 and ADIRU 3, the GPS receiver 2 supplies ADIRU 2.

The MMR operates in different modes which are indicated on the GPS MONITOR page :

R



R

**– Initialization mode (INIT)**

R When this mode is entered, the MMR hardware and software are initialized.

**– Acquisition mode (ACQ)**

The MMR enters in this mode after power up or during long periods of lost satellite signal. It remains in this mode until it is able to track at least four satellites, then transfers to NAV mode. To enter navigation mode more quickly, the MMR uses initial position, time and altitude from IRS.

– **Navigation Mode (NAV)**

When the MMR can track 4 or more satellites, it enters NAV mode and continuously supplies data to the ADIRUs.

– **Altitude Aiding (ALTAID)**

If the MMR can track at least 4 satellites, it uses the GPS altitude and the IR altitude to calculate an altitude bias.

R If the number of satellites drops to three, the altitude bias is frozen, and the MMR enters ALTAID mode, using the IR altitude (corrected with the altitude bias).

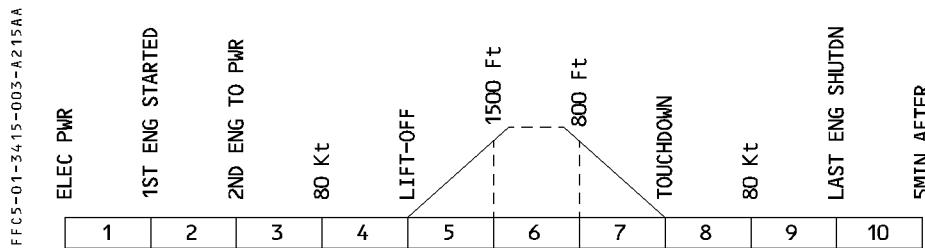
– **Fault Mode (FAULT)**

The fault mode is entered when a failure, which may prevent the MMR from transmitting valid data has been detected.

### OPERATION IN CASE OF FAILURE

If one GPS receiver fails, the three ADIRUs automatically select the only operative GPS receiver. If ADIRU 1 fails, ADIRU 3 is supplied by MMR 1, and ADIRU 2 is supplied by MMR 2. To maintain Side 1 and Side 2 segregation, in case ADIRU 2 fails, the ATT HDG selector must be set to F/O ON 3, so that ADIRU 3 will be supplied with MMR 2 data. If two ADIRUs fail, the remaining ADIRU is supplied by its own side GPS receiver.

### WARNINGS AND CAUTIONS

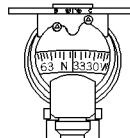


E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPS 1 (2) FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	4, 5, 7, 8
FM/GPS POS DISAGREE					1, 3, 4, 10
GPS PRIMARY LOST (No ECAM warning)	TRIPLE CLICK During non ILS approach only	NIL	ND/MCDU message		2, 3, 4, 5, 8, 9, 10

**COMPASS**

There is a compass located on top of the windshield center post.  
The deviation card is located above the compass.

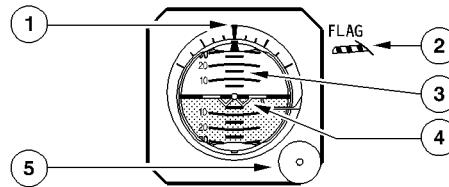
FFC5-01-3420-001-A001AA

**HORIZON**

The electric standby horizon normally obtains current from the DC ESS BUS. In the case of a total electrical failure, the horizon remains usable for 5 minutes.

- R Note : When leveling the wings, after performing a small turn of a small bank angle, the displayed roll attitude may temporarily be incorrect by a few degrees.

FFC5-01-3420-001-B001AA

**① Roll scale**

The role scale indicates the bank angle. It has bank angle graduations up to 60°. There is no rotation limit.

**② Flag**

The flag appears if the instrument fails or if power supply fails.

**③ Pitch scale**

The pitch scale indicates the pitch attitude. It can show pitch angle up to ± 85°

**④ Aircraft reference**

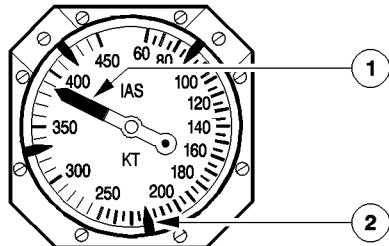
It is a fixed symbol which represent the aircraft.

⑤ Caging knob

- R Flight crew pulls it out to erect the gyro, and level and center the horizon, (the airplane should be level during this procedure).

R **AIRSPEED INDICATOR**

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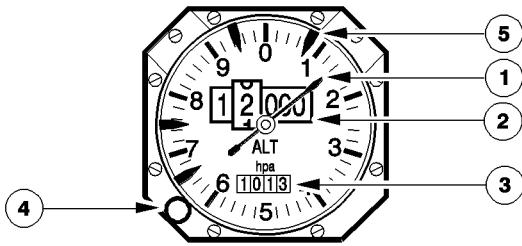
① Airspeed pointer

② Airspeed bugs (4)

- R For marking of airspeed references.

R **ALTIMETER**

FFC5-01-3420-002-B001AA



① Altitude pointer

R ② Altitude counter (feet)

The very left drum is replaced :

- for altitude below 10 000 feet by white/black stripes
- for altitude below 0 feet (reference altitude) amber/black stripes.

**A340**

FLIGHT CREW OPERATING MANUAL

**NAVIGATION****STANDBY INSTRUMENTS**

1.34.20 P 3

SEQ 001 REV 19

③ Altimeter setting

R Display pressure setting in hPa .

④ Altimeter setting knob

⑤ Altitude bugs (4)

For marking of altitude references.

**A340**

FLIGHT CREW OPERATING MANUAL

**NAVIGATION**

1.34.30 P 1

RADIO NAV

SEQ. 001 REV. 13

**TUNING**

The FMGC is the basic means for navaids tuning.  
Three modes of tuning are available.

**AUTOMATIC TUNING**

In normal operation, the FMGC tunes navaids automatically, with each FMGC controlling its own receiver.

If one FMGC fails, the remaining one controls both sides receivers, after activation of the FM selector switch.

**MANUAL TUNING**

The crew can use the MCDU to override the FMGCs' automatic selection and tuning of navaids, and select a specific navaid for visual display.

This does not affect the automatic function of the FMGC.

- R An entry on one MCDU is sent to both FMGC in dual mode, or to the remaining FMGC in single mode.

**BACK UP TUNING**

If both FMGCs fail, the flight crew can use the RMPs (Radio Management Panels 1 and 2) on the pedestal for back up tuning.

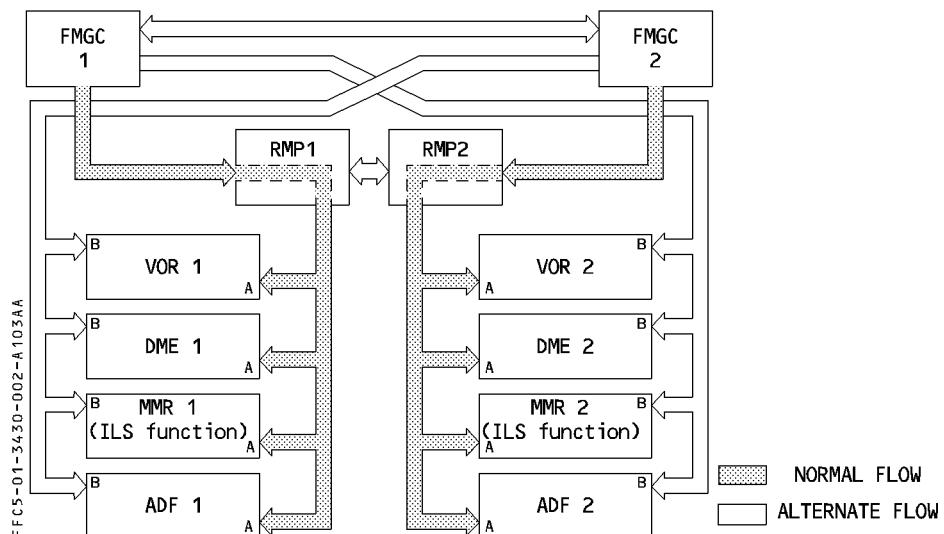
The CAPT RMP controls VOR 1 and ADF 1

The F/O RMP controls VOR 2 and ADF 2

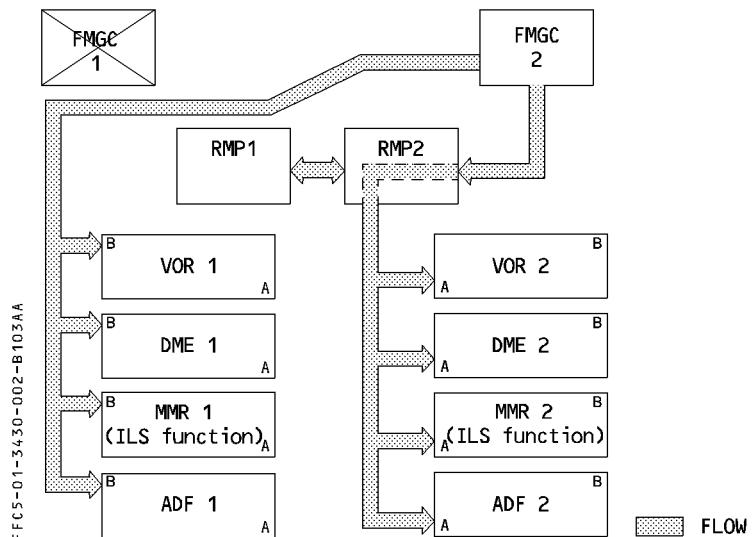
Each RMP controls both ILSs (provided NAV back up is selected on RMP 1 and RMP 2)  
RMP 3 is not used for navaids tuning.

## ARCHITECTURE

Normal operation :

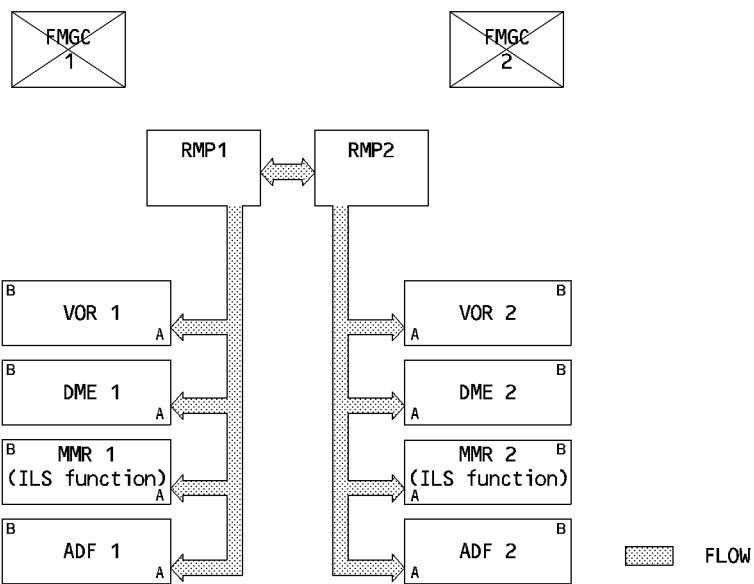


FMGC 1 failure :



Backup tuning :

FFC5-01-3430-003-A100AA



## NAVAIDS

### VOR

The aircraft has two VOR receivers.

(For tuning instructions, refer to the "TUNING" paragraph).

- The navigation displays (NDs) show VOR1 and VOR2 information in accordance with the position of the ADF/VOR selectors on the EFIS control panel (Refer to 1.31).
- The DDRMI on the center panel also displays VOR1 and VOR2 bearings if the heading signal is valid, in accordance with the ADF/VOR selector on the DDRMI.

### ILS

The aircraft has two ILS receivers. Each ILS receiver is integrated in a modular avionics unit called MMR (Multi Mode Receiver) (ILS1 receiver in MMR1, ILS2 receiver in MMR2).

(For tuning instructions, refer to the "TUNING" paragraph).

- PFD1 and ND2 display ILS1 information.
- PFD2 and ND1 display ILS2 information.

- R – The flight crew can display the ILS information on each PFD by pressing the LS pushbutton on the onside EFIS control panel (deviation scales and deviation indexes come on).
- R – The NDs display ILS information if the flight crew selects the ROSE LS mode on the EFIS control panel (Refer to 1.31).

### ADF

The aircraft has two ADF systems.

(For tuning instructions, refer to "TUNING" paragraph).

- The NDs display ADF1 and ADF2 information, depending on the position of the ADF/VOR selectors on the EFIS control panel. (See 1.31).
- The DDRMI also displays ADF1 and ADF2 bearings, depending on the position of the ADF/VOR selector (on the DDRMI).

**DME**

The aircraft has two DMEs.

The frequency set automatically on the DME corresponds to that set on the VOR or ILS.

Up to 5 ground stations are tuned by the FMGEC :

- Channel 1 is used for FMS radio position in VOR/DME mode
- Channel 2 and 3 for FMS radio position in DME/DME mode
- Channel 4 for VOR/DME display
- Channel 5 for ILS/DME display

The NDs and the DDRMI can display the VOR-DME information .

The ILS-DME information is displayed on NDs, and PFDs when the flight crew has pressed

R the LS pushbutton on the EFIS control panel.

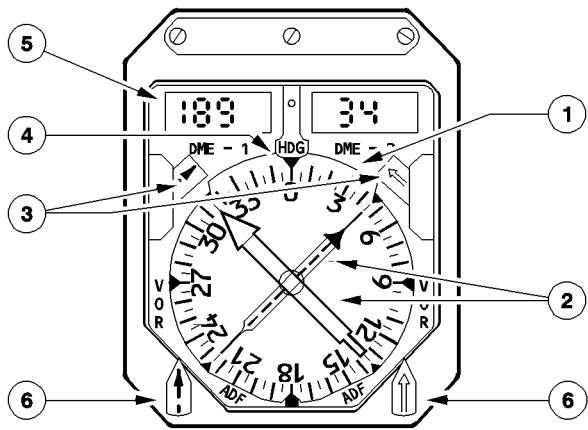
**MARKER BEACON**

One marker beacon system is included in VOR receiver 1.

The PFD displays the outer, middle and inner marker signals. (Refer to 1.31).

**CONTROLS AND INDICATORS****DIGITAL DISTANCE AND RADIO MAGNETIC INDICATOR (DDRMI)**

FFC5-01-3430-006-A001AC

**① Compass card**

ADIRU 1 normally supplies the signal that positions the compass card (ADIRU 3 supplies it when selected by the ATT HDG SWITCHING selector).

Display the MAG or TRUE heading as selected by the NORTH REF pushbutton.

- R Above 82.5° north or 60.5° south or in the north magnetic polar region, TRUE heading is automatically selected.

**② Bearing pointers**

Indicate the magnetic bearing to the station received by VOR 1 or ADF 1 (dashed pointer) and VOR 2 or ADF 2 (double pointer).

**③ VOR/ADF 1 (2) flags**

The indicators display these flags if :

- the VOR or ADF receiver fails (VOR/ADF selector position indicates the failed receiver), or
- the RMI has an internal failure, or
- the heading signal from ADIRS is not valid, or
- the power supply fails.

Associated with the flag, the relevant pointer moves to the 3 o'clock position.

Note : In ELEC EMER configuration only ADF 1 or VOR 1 is available at a time, according to the position of the VOR 1/ADF 1 selector.

**④ HDG flag**

Appears, associated with VOR/ADF flags display, when :

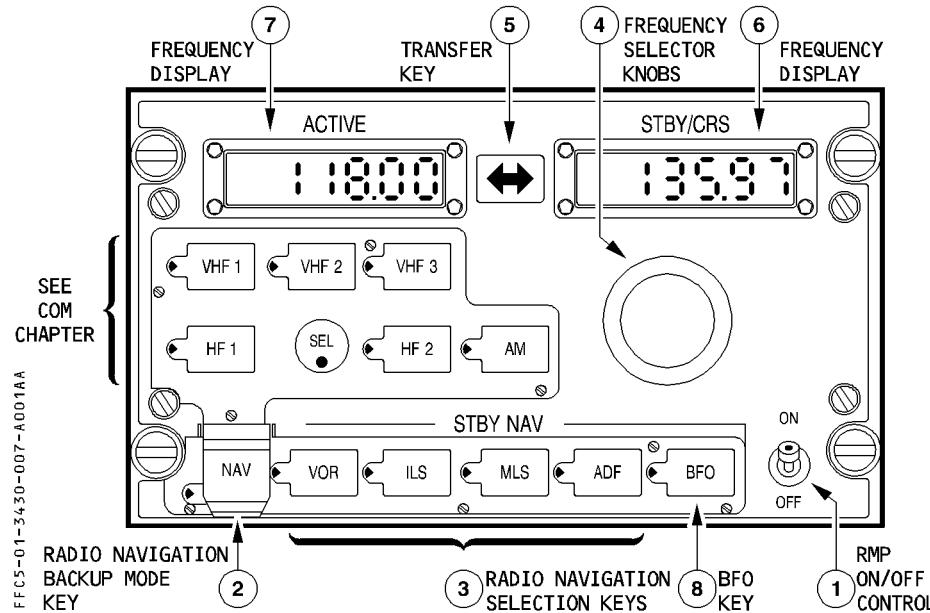
- R
- the heading signal from the supplying ADIRS is not valid, or
  - the RMI has an internal failure, or
  - the power supply fails.

**⑤ DME 1 (2) counters**

- R
- The counters indicate distances in NM and 1/10 th at less than 20 NM. At less than 1 NM, 0 is shown.

**⑥ VOR/ADF selector**

- VOR 1 or ADF 1 on single pointer.
- VOR 2 or ADF 2 on double pointer.

**RADIO MANAGEMENT PANEL (RMP)****① ON/OFF sw**

This switch controls the power supply to the panel.

② NAV key (transparent switchguard)

- Pressing this key engages the radio navigation backup mode. It takes control of the VOR, ILS, MLS and ADF receivers away from the FMGC and gives it to the RMP.
- The green monitor light comes on.
- Pressing the NAV key a second time returns control of the navigation radios to the FMGC.

*Note : — The flight crew must select this backup tuning mode on both RMP1 and RMP2 if both FMGCs or both MCDUs fail. In the emergency electrical configuration, only RMP1 receives power.  
 — Pressing the NAV key on RMP3 (if installed) has no effect.  
 — In the NAV backup mode, the flight crew can select radio communication systems as it would in the normal mode.  
 Setting one RMP to NAV backup mode removes navaids tuning from both FMGCs.*

③ STBY NAV keys

- R When the NAV key is on and the flight crew presses one of these STBY NAV keys, the ACTIVE window displays the frequency to which that receiver is tuned. The green monitor light on the selected key comes on, and the one on the previously selected STBY NAV or COM key goes out.

④ Rotating knob

Two concentric knobs allow the flight crew to preselect frequencies for communication radios and stand-by navigation systems and select courses for VOR and ILS. The desired frequency or course is set in the STBY/CRS window.

- R — setting frequency :  
 The outer knob controls the most significant digits, the inner knob controls the least significant digits. A rate multiplier speeds up the tuning when the knob is rotated rapidly.
- R — setting course :  
 Selected by inner knob only.

**⑤ Transfer key**

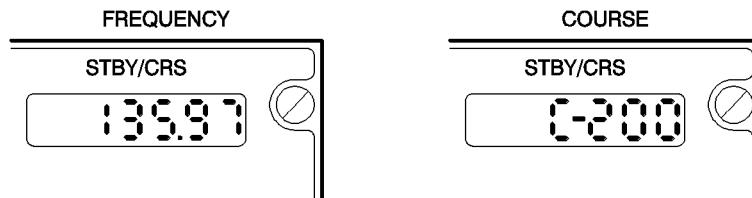
The flight crew presses this key to interchange ACTIVE and STBY frequencies. This action tunes the selected receiver to the new ACTIVE frequency.

**⑥ STBY/CRS window**

The flight crew can make the frequency displayed in this window become the active frequency by pressing the transfer key, or change it by rotating the tuning knob. If this window displays a course, then the ACTIVE window displays the associated frequency.

*Note : If the STBY/CRS window is displaying a course, then pressing the transfer key displays the active frequency in both windows.*

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**R ⑦ ACTIVE window**

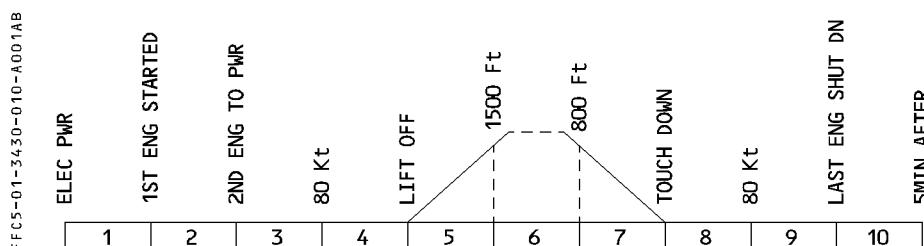
This window displays the frequency of the selected navaid which is identified by a green monitor light on the selection key.

**⑧ BFO key**

Pressing this key activates the BFO (Beat Frequency Oscillator) if the ADF receiver is selected.

The green monitor light comes on.

- R For most ADFs, with BFO activated, the audio identification is heard. However, there are some ADFs where the BFO must be deactivated, in order to hear the audio identification.

**WARNINGS AND CAUTIONS**

R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGSS	FLT PHASE INHIB
ILS 1 (2)(1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	Flag on PFD and ND	3, 4, 5

**DESCRIPTION**

The aircraft has two radio altimeters which provide the height of main landing gear above ground.

Normally the CAPT PFD displays the RA1 height and the F/O PFD displays the RA2 height.  
If either radio altimeter fails, both PFDs display the height from the remaining one.

**INDICATIONS ON PFD**

(Refer to 1.31.40).

**AUTOMATIC CALLOUT**

FWC generates a synthetic voice for radio height announcement below 2500 feet. These announcements come through the cockpit loudspeakers even if the speakers are turned off.

**PREDETERMINED CALLOUTS**

The altitude callout uses the following predetermined threshold :

R

height (ft)	call out
2500	TWO THOUSAND FIVE HUNDRED or TWENTY FIVE HUNDRED
2000	TWO THOUSAND
1000	ONE THOUSAND
500	FIVE HUNDRED
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 (or MDA/MDH) + 100	HUNDRED ABOVE
DH (or MDA/MDH)	MINIMUM

Note : The reference altitude for callouts is the radio altitude for precision approaches (DH) and baro altitude (MDA/MDH) for non precision approaches.

Pin programings allow the operator to select the callouts needed.

If aircraft remains at a height that is in the detection zone for a height callout, the corresponding message is repeated at regular intervals.

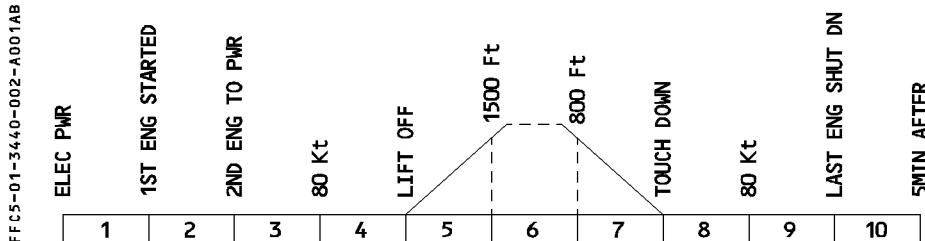
## R INTERMEDIATE CALL OUT

- R If time between two consecutive predetermined call outs exceeds a certain threshold, the present height is repeated at regular intervals.
- R The threshold is : 11 seconds above 50 feet
- R 4 seconds below 50 feet
- R The repeating interval is 4 seconds.

## R "RETARD" ANNOUNCEMENT

- R The loudspeaker announces "RETARD" at 20 feet or at 10 feet if autothrust is active and one autopilot is in LAND mode.

### WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
RA 1 (2)(1+2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	Flag on PFD	3, 4, 5, 8

**DESCRIPTION**

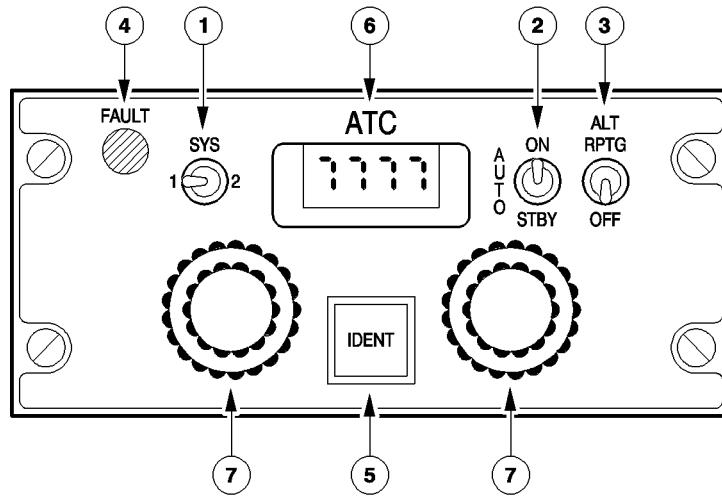
The aircraft has two ATC transponders which are controlled by a dual control box on the center pedestal.

Only the selected transponder operates.

The associated ADR (1 for transponder 1, etc...) supplies the altitude for altitude reporting.  
In case of a failure, ADR 3 can do this when selected by the AIR DATA SWITCHING selector.

**CONTROL PANEL**

FFC5-01-3450-001-A001AA

**① SYS sel**

This switch selects transponder 1 or 2.

**② Mode sel**

STBY : Both ATC transponders are electrically supplied but not operating.

ON : Selected ATC operates.

- R AUTO : In flight : Selected transponder operates ;  
 R On ground : Selected transponder operates only in mode S (Selective A/C  
 R interrogation mode).

④ ATC FAIL lt

This light comes on if the selected transponder fails.

⑤ IDENT sw

The flight crew presses this button to send the aircraft identification signal.

⑥ Code display

The window displays the selected code.

⑦ Rotating Knobs

Flight crew uses these knobs to select the assigned code. Each knob has outer and inner ring.

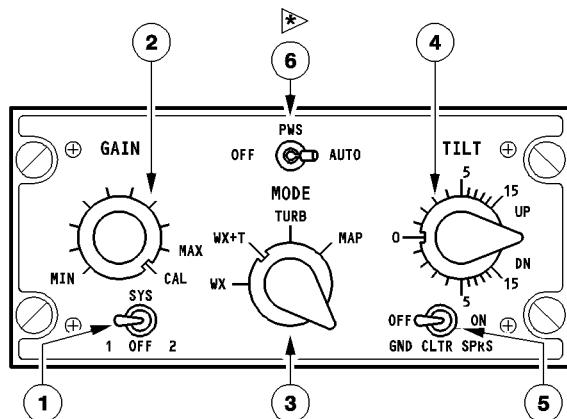
Each ring drives one digit.

**DESCRIPTION**

- R The aircraft has two weather radar systems. Only one transceiver works at a time. It can display the weather image on the ND, in any ND mode except PLAN. Each pilot may remove the weather image from their ND by setting the associated brightness control to minimum (refer to 1.31).

**CONTROL PANEL**

FFC5-01-3460-001-A110AA



- R ① SYS sel

R This switch is used to select the radar, or to turn both radars to OFF.

- ② GAIN knob

This knob adjusts the sensitivity of the receiver in weather mode (WX) or ground mapping mode (MAP). "CAL" is the normal position ; it adjusts the gain to a calibrated setting.

- ③ Mode sel

WX : Weather mode : Colors indicate the intensity of precipitation (black indicates the lowest intensity, green, amber and red indicate progressively higher intensities).

WX+T : The screen shows turbulence areas (in precipitation areas) in magenta (within 40 NM).

TURB : The screen only shows turbulence areas.

MAP : Radar operates in ground mapping mode : Black indicates water, green indicates the ground, and amber indicates cities and mountains.

④ TILT knob

This knobs controls antenna tilt.

Zero represents the horizon the ADIRS 1 sees it as follows :

- WX SYS 1 by ADIRS 1 (or 3 if selected)
- WX SYS 2 by ADIRS 2 (or 3 if selected)

⑤ GND CLTR SPRS

ON : The Ground Clutter Suppresses the ground echo on the screen.

OFF : Normal use of the radar.

*Note : Setting different scales on the ND reduces the sweep rate of each ND image.  
(8 seconds instead of 4 seconds)*

⑥ PWS sel ◁ (operative only if the windshear function is embodied)

- |     |   |
|-----|---|
| R   | AUTO : Windshear function is activated : windshear areas will be detected by the antenna scanning below 1500 feet RA even if transceiver selector (1) is set to off, and displayed on the ND. |
| R   | antenna scanning below 1500 feet RA even if transceiver selector (1) is set to off, and displayed on the ND.  |
| OFF | No windshear function.  |

## **WINDSHEAR PREDICTION FUNCTION**

The weather radars have a predictive windshear capability.

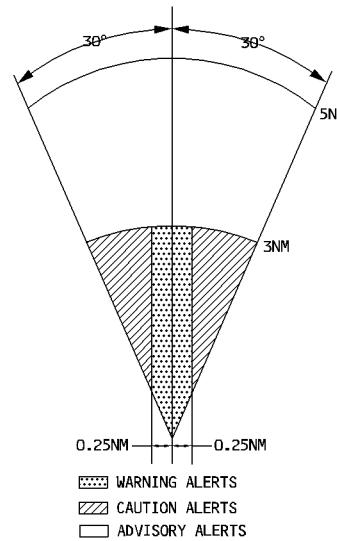
The Predictive Windshear System (PWS) operates, when :

- R – The PWS switch is in the AUTO position (Even if the weather radar is turned OFF), and
- The aircraft is below 2300 feet AGL, and
- The ATC is switched to the ON, or AUTO position, and
- Either engine is running.

- R *Note : When two weather radars are installed, if the selected weather radar fails, the PWS function is recovered by selecting the non-failed weather radar on the control panel.*

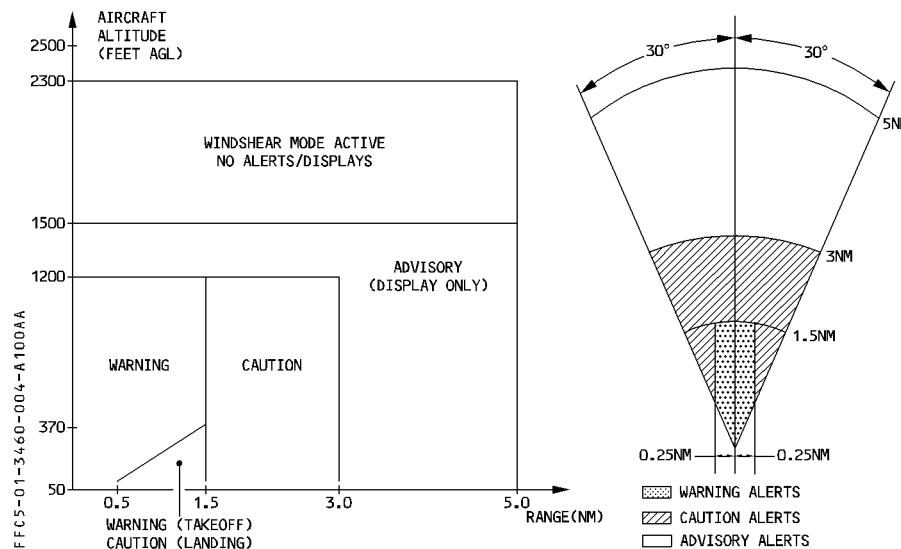
Below 1500 feet, when the system detects windshear, and depending on the range selected on the ND, a warning, caution, or advisory message appears on the ND. Predictive windshear warnings and cautions are associated with an aural warning.

### **R WINDSHEAR ALERTS during takeoff roll, up to 100 knots**



- R During the takeoff roll, up to 100 knots, both warnings and cautions are available within a range of 3 NM.

### WINDSHEAR ALERTS above 50 feet



During final approach, the visual and aural warning alerts are downgraded to caution alerts between 370 feet AGL and 50 feet AGL, and range between 1.5 NM and 0.5 NM.

### WINDSHEAR ALERTS inhibition

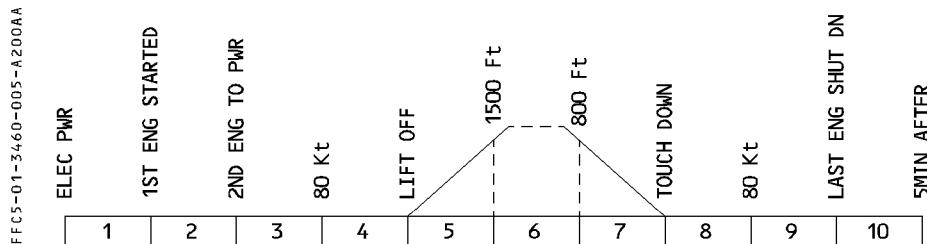
At takeoff, alerts are inhibited above 100 knots and up to 50 feet. During landing, alerts are inhibited below 50 feet.

Alert Level	Aural Warning	PFD	ND (refer to 1.31.45)
Warning (Approach)	«GO AROUND WINDSHEAR AHEAD»	W/S AHEAD (red)	Windshear icon
Warning (Takeoff)	«WINDSHEAR AHEAD» (twice)	W/S AHEAD (red)	Windshear icon
Caution	«MONITOR RADAR DISPLAY»	W/S AHEAD (amber)	Windshear icon
Advisory	Nil	Nil	Windshear icon

The aural alerts of the Predictive Windshear System (PWS) :

- Have priority over TCAS, GPWS and other FWC aural warnings.
- Are inhibited by windshear detection, by the FMGC, and stall warning aural messages.

### **WARNING AND CAUTIONS**



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PRED. W/S DET FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3, 4, 5, 8

### **MEMO DISPLAY**

The "PRED W/S OFF" message appears, when the windshear is set to OFF on the weather radar panel. It appears in green, during flight phases 2 and 6.

It appears in amber :

- In flight phases 3, 4, 5, 7, 8, 9.
- When the T.O. CONFIG pushbutton is pressed, during flight phase 2.

**DESCRIPTION**

The Enhanced Ground Proximity Warning System (EGPWS) generates aural and visual warnings when one of the following conditions occurs at radio altitudes between 30 and 2450 feet for Modes 2, 4, 5, and between 10 and 2450 feet for Modes 1 and 3.

- Mode 1 : Excessive rate of descent.
- Mode 2 : Excessive terrain closure rate.
- Mode 3 : Altitude loss after takeoff, or go-around.
- Mode 4 : Unsafe terrain clearance, when not in landing configuration.
- Mode 5 : Excessive deviation below the glideslope.

In addition to the basic GPWS functions, the GPWS has an enhanced function (EGPWS) which provides, based on a worldwide terrain database :

- A Terrain Awareness Display (TAD), which predicts the terrain conflict, and displays the terrain on the ND.
- A Terrain Clearance Floor (TCF), which improves the low terrain warning during landing. The cockpit loudspeakers broadcast, even if turned off, the aural warning or caution messages associated with each mode. The audio volume of these messages is not controlled by the loudspeaker volume knobs. (These knobs only allow volume adjustment for radio communication).

R GPWS lights come on to give a visual warning for Modes 1 to 4, TAD, and TCF. For mode 5, the glideslope lights, on the Captain and First Officer instrument panels, come on.

Note : *A number of airports throughout the world have approaches or departures that are not entirely compatible with standard GPWS operation. These airports are identified*

R *in the envelope modulation database in such a way that when the GPWS recognizes such an airport, it modifies the profile to avoid nuisance warnings.*

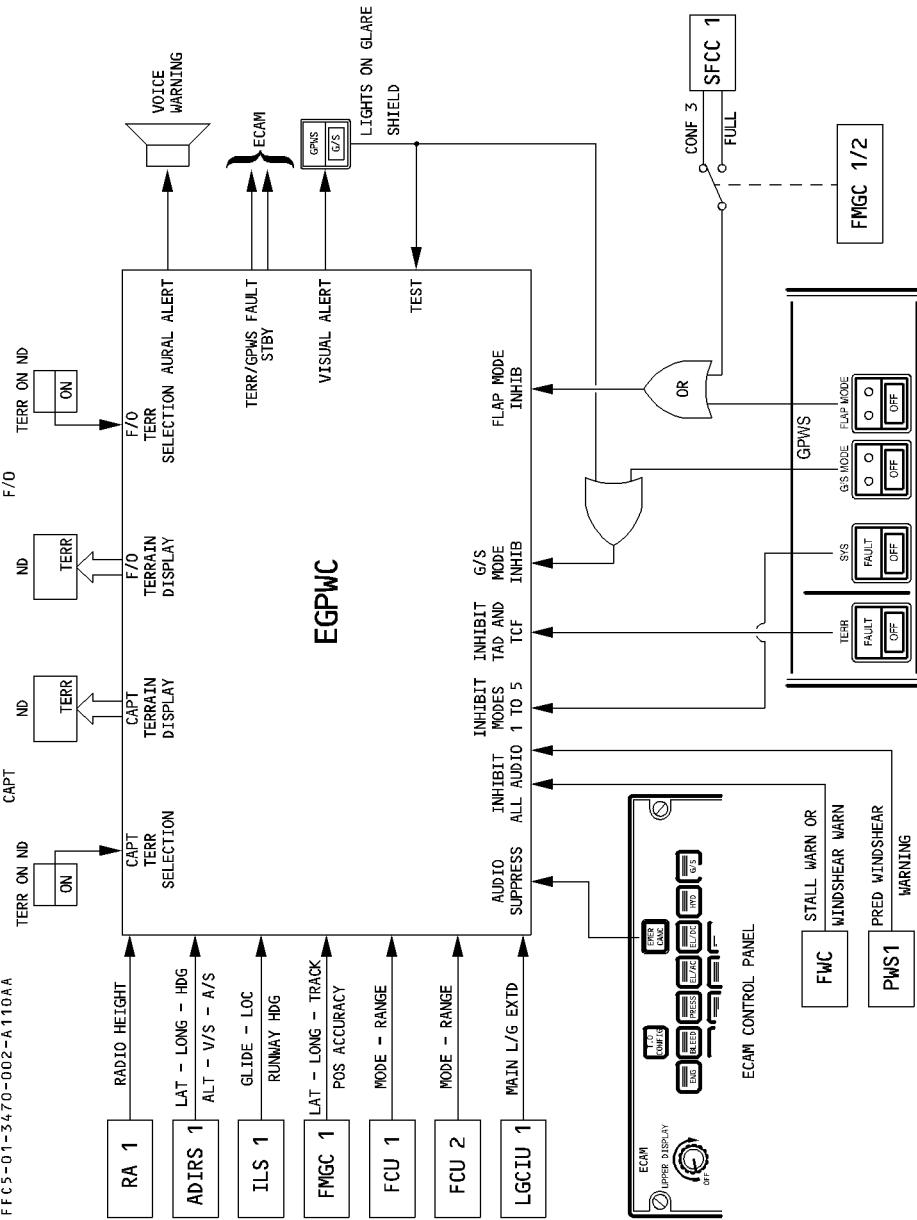
R *This envelope uses the baro altitude in QNH or QFE reference, depending on a pin program (QFE is an option).*

R *If the QFE option is installed, the Enhanced GPWS uses (for GPWS basic modes)*

R *the QFE barometric reference altitude, independently of the selected barometric reference setting on the EFIS control panel.*

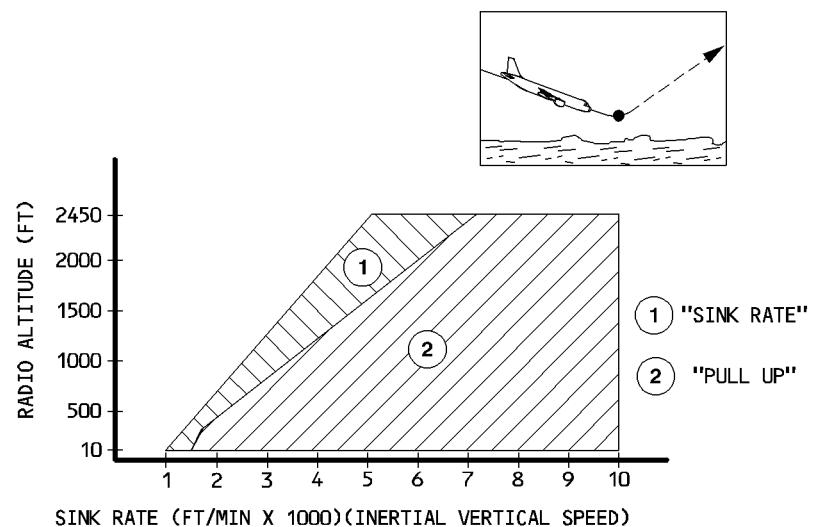
**FOR INFO**

R



**MODE 1 : EXCESSIVE RATE OF DESCENT**

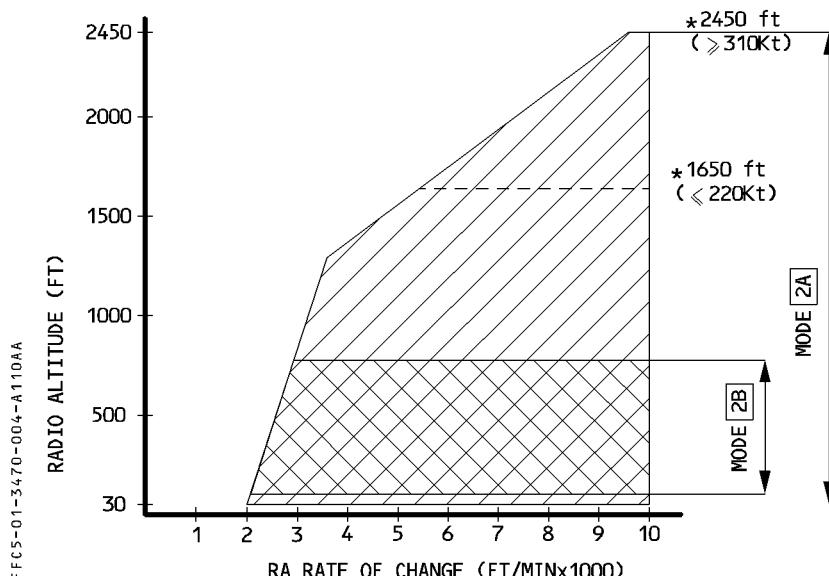
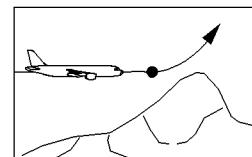
FFC5-01-34470-003-A110AA



Mode 1 has two boundaries. Penetration of the first boundary generates the illumination of the GPWS lights and a repeated aural alert "SINK RATE". Penetration of the second boundary generates the repetitive "PULL UP".

The lower cut-off limit is 10 feet radio altitude.

The upper cut-off limit is 2450 feet radio altitude.

**MODE 2 : EXCESSIVE TERRAIN CLOSURE RATE**

**2A** — Flaps not in landing configuration and aircraft not on the glide slope beam.  
Penetration of the boundary lights up the GPWS lights and sounds the repeated aural alert:  
“TERRAIN”.

After “TERRAIN” has sounded twice, the warning switches to “PULL UP”, repeated continually until the aircraft leaves the warning envelope. After the aircraft leaves the boundary the GPWS lights stay on and the voice message “TERRAIN” persists. These alerts cease when the aircraft increases either the barometric or inertial altitude by 300 feet. If it enters another alert region during this altitude gain time, then the whole process begins again with a new reference altitude for the 300 feet altitude gain.

\* Upper cut-off limit varies from 1650 feet to 2450 feet radio altitude depending on speed (between 220 kt to 310 kt).

At certain airports, the upper boundary is limited to reduce the warning sensitivity and minimize the nuisance warnings.

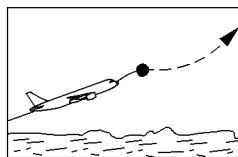
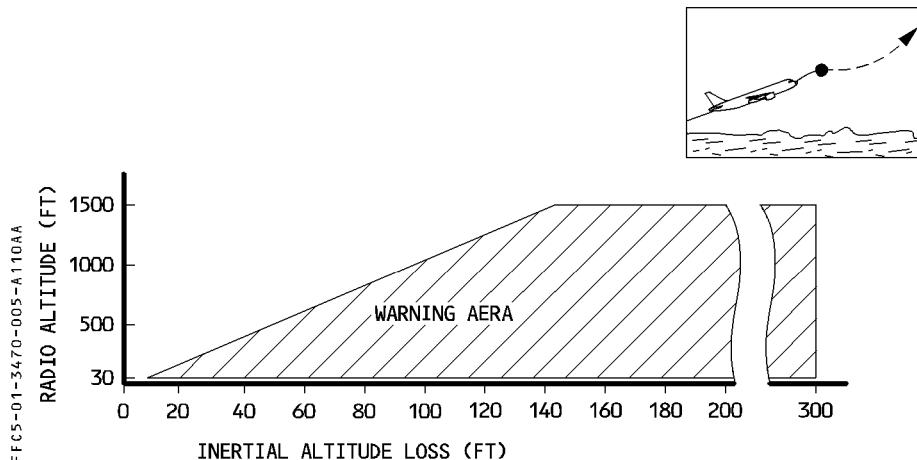
2B — Flaps in landing configuration.

Lowering the flaps to the landing position automatically switches GPWS to Mode 2B. In this case lower boundary varies between 200 feet to 600 feet depending on radio altitude rate of change. During ILS approach (glide slope deviation  $< \pm 2$  dots) the lower boundary is fixed at 30 feet.

When the aircraft enters the envelope, the alert is the same as for mode 2A. When gear and flaps are in the landing configuration, the voice message is "TERRAIN" and is not followed by "PULL UP" if the aircraft remains within the envelope.

### **MODE 3 : ALTITUDE LOSS AFTER TAKEOFF**

FFC5-01-3470-005-A110AAA



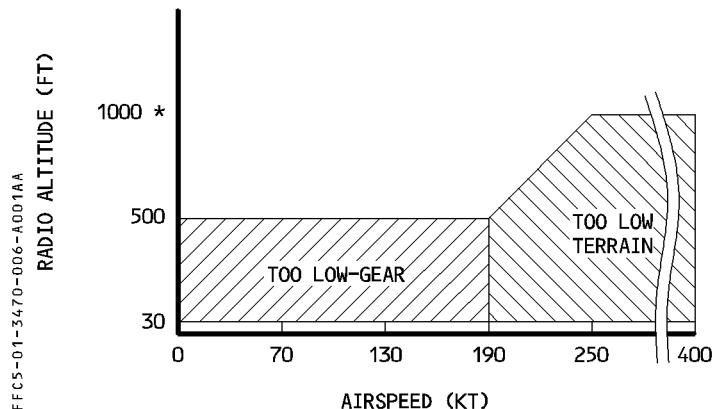
If the aircraft descends during the initial takeoff climb or during a go around, GPWS lights come on and the aural alert "DON'T SINK" sounds repeatedly.

The lower cut-off limit is 30 feet radio altitude.

Mode 3 is desensitized according to the time accumulated after departure and the radio altitude.

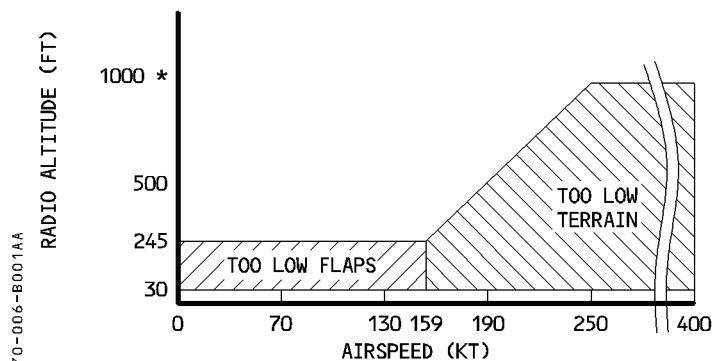
**MODE 4 : UNSAFE TERRAIN CLEARANCE WHEN NOT IN LANDING CONFIGURATION :**

R 4A - Landing gear up :



R Two aural warnings may be triggered, depending on the area : "TOO LOW-GEAR" or "TOO LOW-TERRAIN". In addition, the GPWS lights come on.

R 4B - Landing gear down, and flaps not in landing configuration.



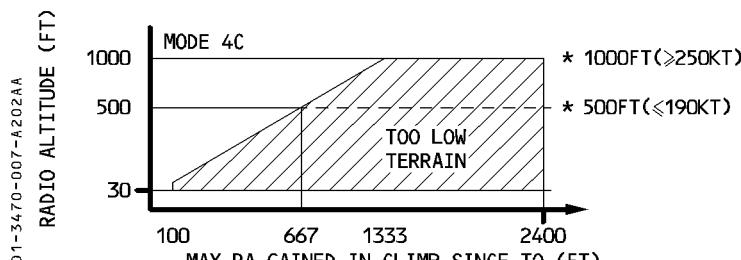
\* - OTHER MAXIMUMS ARE USED AT CERTAIN AIRPORTS TO MINIMIZE NUISANCE WARNINGS.

- THIS MAXIMUM IS ALSO REDUCED TO 800feet WHEN AN OVERFLIGHT IS DETECTED.

R Three aural warnings may be generated, depending on the area and the configuration : "TOO LOW-GEAR", "TOO LOW-FLAPS" or "TOO LOW-TERRAIN". In addition, the GPWS lights come on.

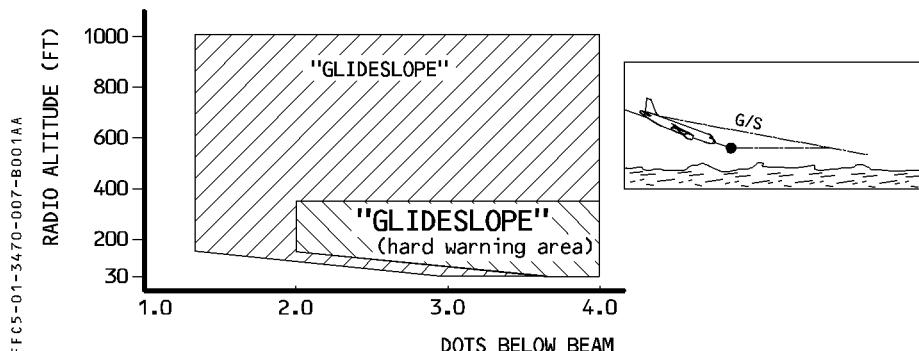
4 C – Landing gear up, or flaps not in landing configuration.

R



If the aircraft starts an inadvertent controlled flight into the ground during takeoff and climb, and penetrates the boundary, then the GPWS lights come on and the "TOO LOW TERRAIN" aural alert sounds repeatedly.

#### **MODE 5 : DESCENT BELOW GLIDESLOPE**



R Note : Normally, the GLIDESLOPE alert is only triggered with the gear down. For a few airports, the gear down logic requirement is deleted, and other upper limits are used to increase the warning envelope.

In both areas, the alert is a repeated "GLIDESLOPE" aural messages, and both G/S lights come on. The loudness and the repetition rate of the aural message increase, when the aircraft enters the hard warning areas.

The mode is armed, when ILS1 receives a valid signal.

Pressing the GPWS-G/S pushbutton cancels the warning. This is temporary and the mode is automatically reactivated for a new envelope penetration.

The upper cut-off limit is 1000 feet radio altitude.

The lower cut-off limit is 30 feet radio altitude.

## **EGPWS FUNCTIONS**

### **TERRAIN AWARENESS AND DISPLAY**

The Terrain Awareness and Display (TAD) function computes a caution and a warning envelope ahead of the aircraft, according to the aircraft altitude, the nearest runway altitude, the range to the nearest runway threshold, the ground speed, and the turn rate. When the boundary of these envelopes conflicts with the terrain memorized in the database, the system generates the relevant alert :

Alert Level	Aural Warning	ND (refer to 1.31.45)	Local Warning
Warning	TERRAIN AHEAD, PULL UP	<ul style="list-style-type: none"> <li>- Automatic terrain display *</li> <li>- Solid red areas</li> <li>- TERR AHEAD (red)</li> </ul>	The pb light comes on on each pilot's instrument panel
Caution	TERRAIN AHEAD	<ul style="list-style-type: none"> <li>- Automatic terrain display *</li> <li>- Solid yellow areas</li> <li>- TERR AHEAD (amber)</li> </ul>	

- \* When the TERR ON ND switch is selected ON, the ND displays the terrain memorized in the database according to the aircraft position, when ARC or ROSE mode is selected. The terrain is displayed in various densities of green, yellow, red, or magenta, depending on the threat (see 1.31.45, INDICATIONS ON ND). When an alert is generated (either caution or warning) and TERR ON ND is not selected, the terrain is automatically displayed, and the ON light of the TERR ON ND pushbutton will come on.

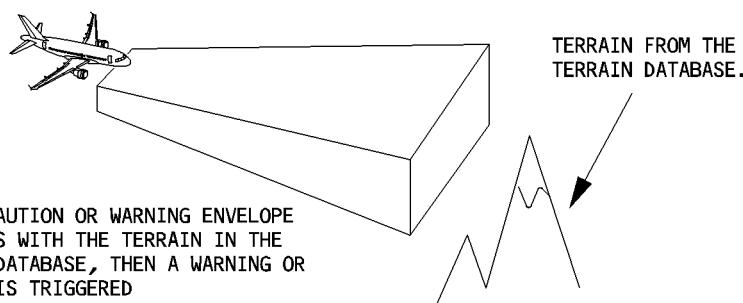
Note : 1. When TERR ON ND is selected, the weather radar display image is not displayed, even if the weather radar is ON.

- R 2. The relative height of the aircraft is computed by using the Captain's baro setting. Thus, the Terrain Awareness Display (TAD) does not protect against baro setting errors.
- R 3. The TAD and Terrain Clearance Floor (TCF) functions operate using the FMS 1 position. Thus, the system does not protect against an FMS 1 position error.

**TERRAIN CAUTION AND WARNING ENVELOPE BOUNDARIES**

FFCS-01-3470-009-A110AA

IF THE CAUTION OR WARNING ENVELOPE  
CONFLICTS WITH THE TERRAIN IN THE  
TERRAIN DATABASE, THEN A WARNING OR  
CAUTION IS TRIGGERED



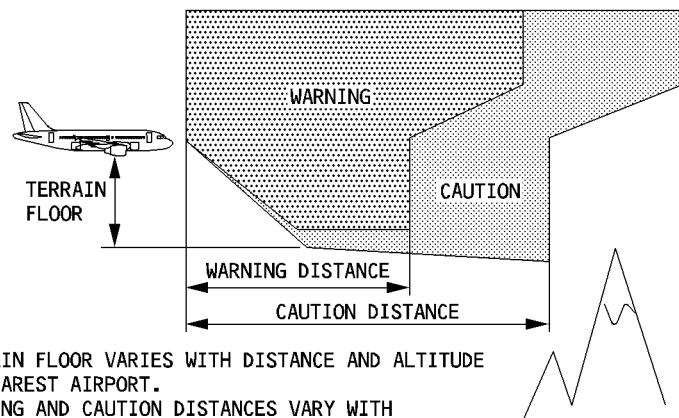
TERRAIN FROM THE  
TERRAIN DATABASE.

**VERTICAL ENVELOPE**

R

FFCS-01-3470-009-B110AA

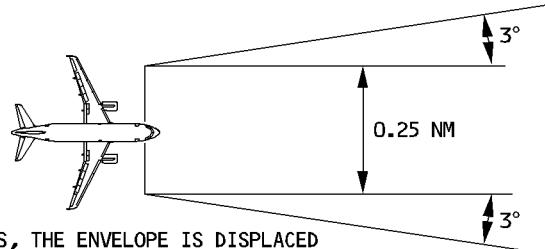
TERRAIN FLOOR VARIES WITH DISTANCE AND ALTITUDE  
TO NEAREST AIRPORT.  
WARNING AND CAUTION DISTANCES VARY WITH  
GROUNDSPEED AND TURN RATE. WARNING DISTANCE IS  
APPROX. 30 SECONDS. CAUTION DISTANCE IS APPROX.  
60 SECONDS.

**HORIZONTAL ENVELOPE**

R

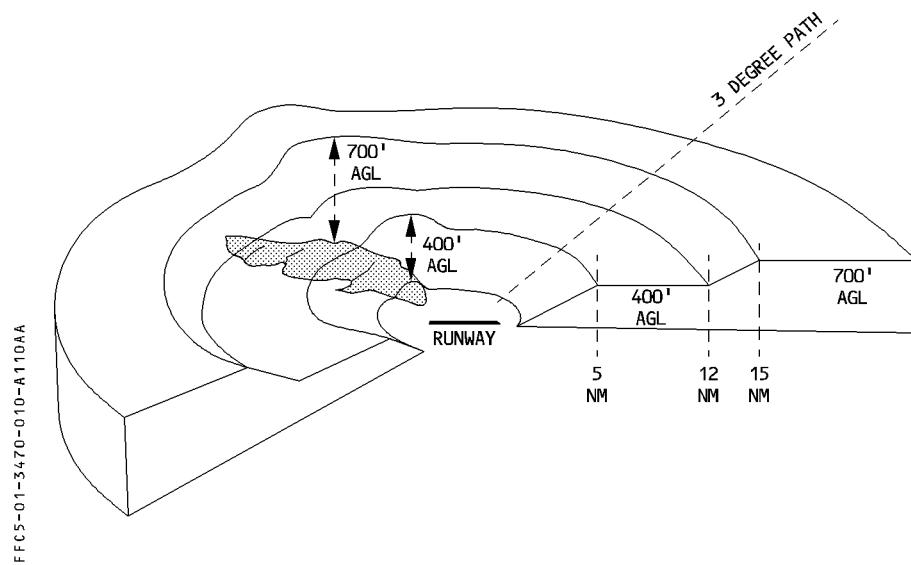
FFCS-01-3470-009-C110AB

DURING TURNS, THE ENVELOPE IS DISPLACED  
TO LOOK ALONG THE AIRCRAFT FLIGHT PATH.



## TERRAIN CLEARANCE FLOOR

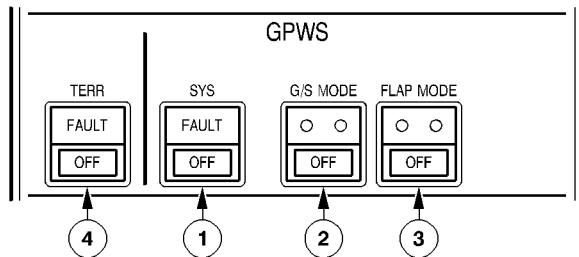
A terrain clearance floor envelope is stored in the database for each runway for which terrain data exist. The Terrain Clearance Floor (TCF) function warns of a premature descent below this floor, regardless of the aircraft's configuration.



- R If the airplane descends below this floor, a TOO LOW TERRAIN aural warning sounds, and the GPWS lights come on, on the glareshield.

**CONTROLS AND INDICATORS****OVERHEAD PANEL**

FFC5-01-3470-011-A110AA

**① SYS pb sw**

OFF : All basic GPWS alerts (Mode 1 to 5) are inhibited.

FAULT It : This amber light comes on, along with an ECAM caution, if the basic GPWS mode 1 to 5 malfunction.

*Note : If ILS 1 fails, only mode 5 is inhibited. Consequently, the FAULT light does not come on and the GPWS FAULT warning is not triggered.*

**② G / S MODE pb sw**

OFF : Glide slope mode (mode 5) is inhibited.

**③ FLAP MODE pb sw**

OFF : Flap mode ("TOO LOW FLAPS" mode 4) is inhibited.

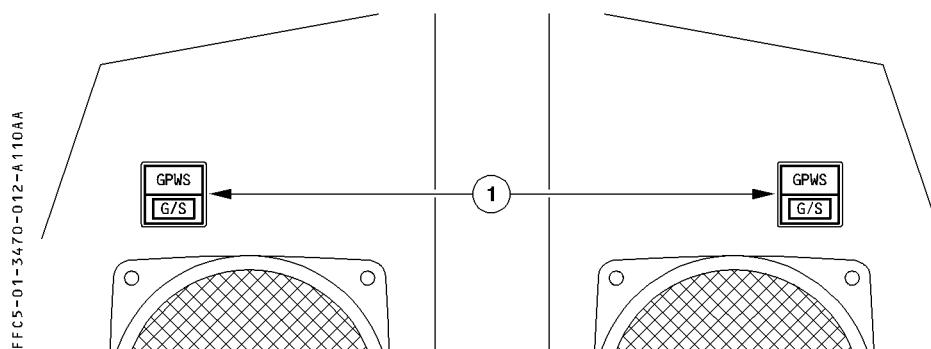
(To avoid nuisance warning in case of landing with reduced flaps setting).

Moreover if LDG CONF 3 is selected on MCDU the flap mode will be automatically inhibited when FLAPS 3 position is reached.

**④ TERR pb sw**

OFF : Inhibits the Terrain Awareness Display (TAD) and Terrain Clearance Floor (TCF) modes, and does not affect the basic GPWS mode 1 to 5.

FAULT It : This amber light comes on, along with an ECAM caution, if the TAD or TCF mode fails.. The basic GPWS mode 1 to mode 5 are still operative if the SYS pushbutton switch lights OFF or FAULT are not illuminated.

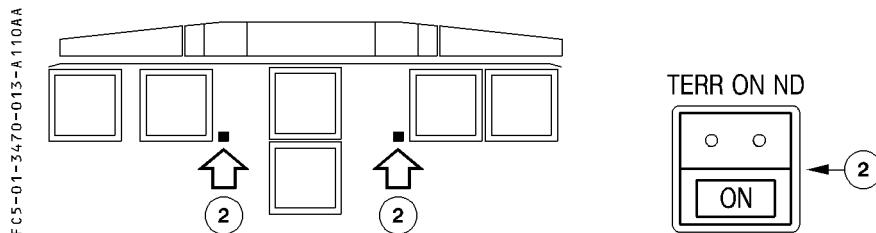
**MAIN INSTRUMENTS PANEL****① GPWS – G/S pb**

- R      GPWS : This red light comes on when any mode from 1 to 4 or TAD or TCF alert is activated. The corresponding aural warning sounds.  
 R      G/S : This amber light comes on when mode 5 is activated. The "GLIDE SLOPE" aural warning sounds.

Note : 1. If the flight crew presses this button briefly when a glide slope warning is on, the G/S light goes out and the "GLIDE SLOPE" aural warning (soft or loud) stops.

- R      2. The GPWS can be tested by pressing this pushbutton. If the pushbutton is pressed briefly, some of the aural warnings sound and pushbutton captions, related to the GPWS, come on. If the pushbutton is pressed continuously, then all the aural warnings sound.

R



② TERR ON ND pb

These pushbuttons are located on either side of the ECAM. Each pushbutton controls the onside terrain display.

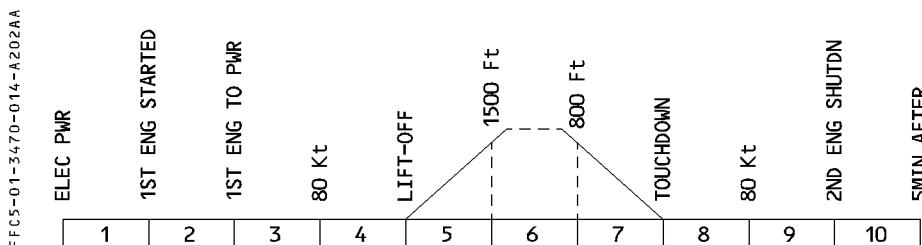
ON : The terrain is displayed on the ND if :

- TERR pushbutton is selected ON, and
- TERR FAULT light is not on.

The ON light comes on.

OFF : The terrain data is not displayed on the ND.

Note : · If the Terrain Awareness Display (TAD) mode generates a caution or a warning while the TERR ON ND is not switched ON, the terrain is automatically displayed on the NDs (see EGPWS specific caution and warning due to TAD mode) and the ON light of the TERR ON ND pushbutton will come on.  
· To differentiate between the terrain and the weather display, the terrain display sweeps from the center outward to both sides of the ND.

**WARNINGS AND CAUTIONS**

R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPWS FAULT	SINGLE CHIME	MASTER CAUT	NIL	GPWS SYS FAULT It	1, 3, 4, 5, 8
GPWS TERR DET FAULT The enhanced terrain detection function is inoperative. The basic GPWS modes 1 to 5 are still operative.				GPWS TERR FAULT It	1, 3, 4, 5 8,10

**MEMO DISPLAY**

- R GPWS FLP OFF is displayed in green, when the GPWS FLAP MODE pushbutton is OFF. TERR STBY appears in green, when the aircraft position accuracy (provided by the FMS) is insufficient to allow the enhanced TCF and TAD modes to operate. These modes are not available until the TERR STBY memo disappears. If selected, the terrain data display on the ND is automatically deselected when the TERR STBY memo is triggered. TERR OFF is displayed, when the EGPWS is voluntarily deselected.

**DESCRIPTION****GENERAL**

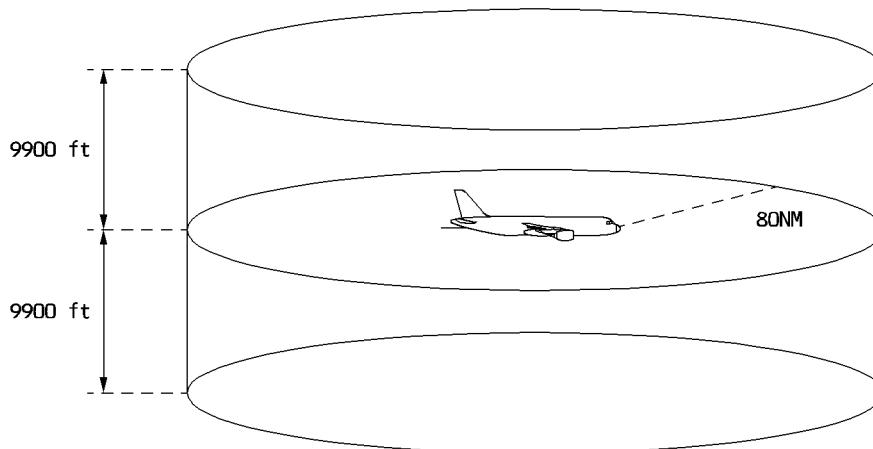
The TCAS (Traffic alert and Collision Avoidance System) :

- Detects any aircraft that is equipped with a transponder and is, flying in the vicinity
- Displays potential and predicted collision targets
- Issues vertical orders to avoid conflict.

TCAS is usually independent of ground-based air traffic control systems.

TCAS detection-capability is limited to intruders that fly within a maximum range of approximately 80 NM (depending on aircraft configuration and on external conditions), and within a maximum altitude of 9900 feet (above and below the threatened aircraft).

FFC5-01-3480-001-A210AA



## MAIN COMPONENTS

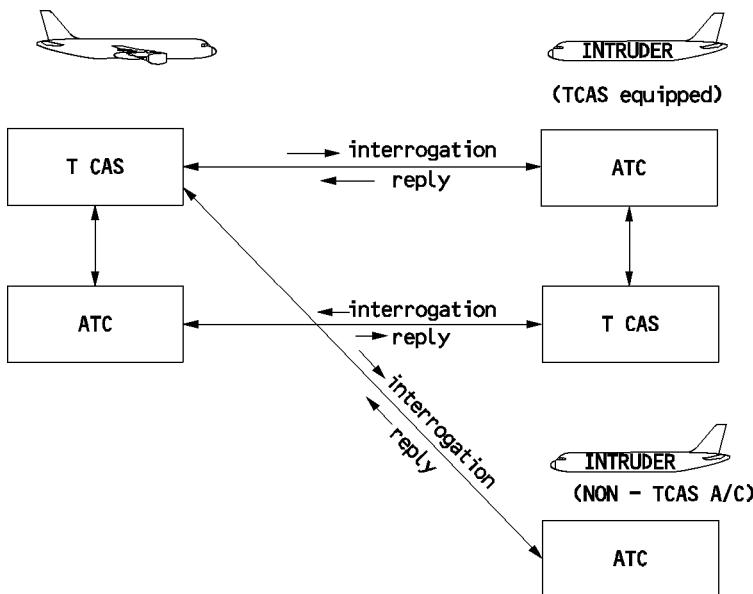
The system includes :

- a single channel TCAS computer
- two TCAS antennas
- two mode S ATC transponders, one active the other in standby.

These transponders allow :

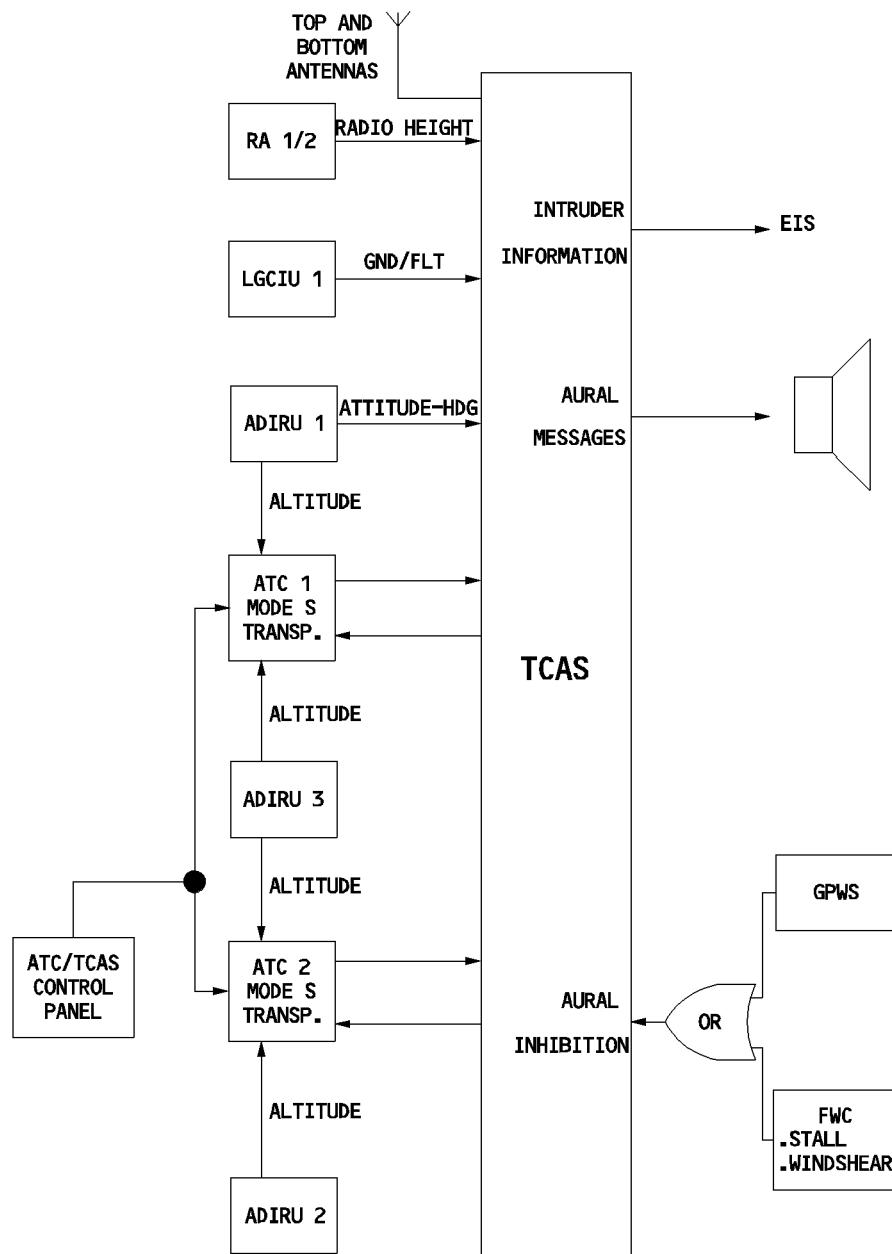
- interface between the ATC/TCAS control panel and the TCAS computer
- communication between the aircraft and intruders equipped with a TCAS system
- an ATC/TCAS control panel

R



FFCS-01-3480-002-A100AA

R



## PRINCIPLE

The TCAS interrogates transponder of intruders. From the transponder replies, the TCAS determines for each intruder:

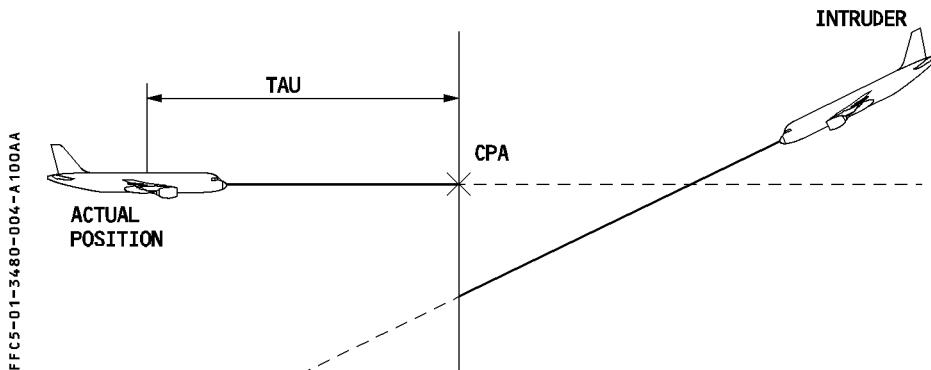
- its relative bearing
- its range and closure rate
- its relative altitude if available (ATC mode C or S).

Then the TCAS computes the intruder trajectory, the Closest Point of Approach (CPA) and the estimated time (TAU) before reaching the CPA.

Each time the relative position of the intruder presents a collision threat, aural and visual advisories are triggered.

TCAS optimizes vertical orders to ensure a sufficient trajectory separation and a minimal vertical speed variation considering all intruders.

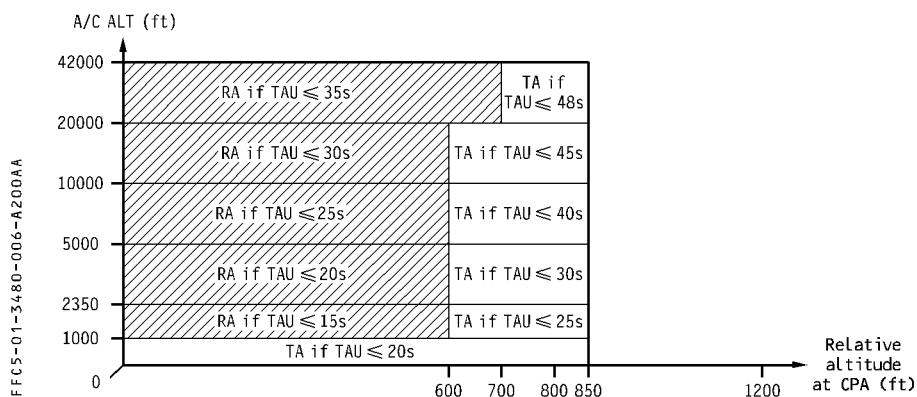
R



**INTRUDER CLASSIFICATION**

The intruders are classified in three levels :

LEVEL	INTRUDER POSITION	DISPLAYED INFORMATION
Proximate intruder	<ul style="list-style-type: none"><li>– no collision threat</li><li>– intruder in vicinity to a/c (closer than 6 NM in lateral and ± 1200 ft in vertical direction)</li></ul>	<ul style="list-style-type: none"><li>– ND : intruder position</li></ul>
Traffic Advisory (TA)	<ul style="list-style-type: none"><li>– potential collision threat</li><li>– TAU is about 40 seconds</li></ul>	<ul style="list-style-type: none"><li>– ND : intruder position</li><li>– Aural message</li></ul>
Resolution Advisory (RA)	<ul style="list-style-type: none"><li>– real collision threat</li><li>– TAU is about 25 seconds</li></ul>	<ul style="list-style-type: none"><li>– ND : intruder position</li><li>– Aural messages</li><li>– PFD : vertical orders<ul style="list-style-type: none"><li>. Maintain actual V/S (Preventive Advisory)</li><li>or</li><li>. Modify V/S (Corrective Advisory)</li></ul></li></ul>

**TA / RA THRESHOLDS****FOR INFO****TCAS MODES**

TCAS has 2 modes of operation :

**TA/RA** : Selected on the ATC/TCAS panel ; this mode allows the display of all intruders.

**TA** : Can be selected by :

- The crew, on the ATC/TCAS panel, in case of aircraft degraded performance (engine failure, landing gear extended), or when operating near closely-spaced parallel runways, or
- The special equipped ground stations, via ATC transponder uplink command, or
- Automatically, when the following priority messages are triggered :
  - Windshear
  - Stall
  - GPWS messages.

Consequently :

- All RAs are inhibited and converted into TAs.
- The TA threshold is set to  $TAU \leq 20$  seconds, irrespective of the aircraft's altitude.
- No vertical speed advisories are indicated on the PFD.
- "TA ONLY" is displayed on the NDs.

In case priority messages are triggered, all TCAS aural messages are suppressed.

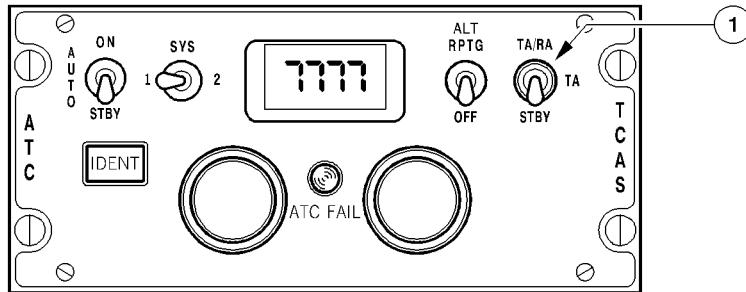
**ADVISORY INHIBITION**

Some advisories are inhibited, depending on the aircraft altitude :

- All intruders flying below 380 feet AGL, when the own aircraft altitude is below 1700 feet AGL.
- R — All RA aural messages below 1100 feet AGL in climb, and 900 feet AGL in descent. In this case, the RAs are converted into TAs.
- R — “Descend” type advisory below 1200 feet AGL in climb, or 1000 feet AGL in descent.
- R — “Increase Descent” RA below 1650 feet AGL in climb, or 1450 feet AGL in descent.
- All TA aural messages below 500 feet AGL.

**CONTROLS AND INDICATORS****ATC/TCAS PANEL**

FFC5-01-3480-008-A110AA

**① TCAS mode sel**

**TA/RA** : Normal position.

Proximate, traffic advisories and resolution advisories are displayed if :

- the ALT RPTG switch is at ON, and
- the ATC mode selector is at ON or AUTO.

**TA** : All RA are inhibited and converted into TA.

Proximate and other TA intruders are also displayed.

TA ONLY appears on the ND's.

This mode is activated if :

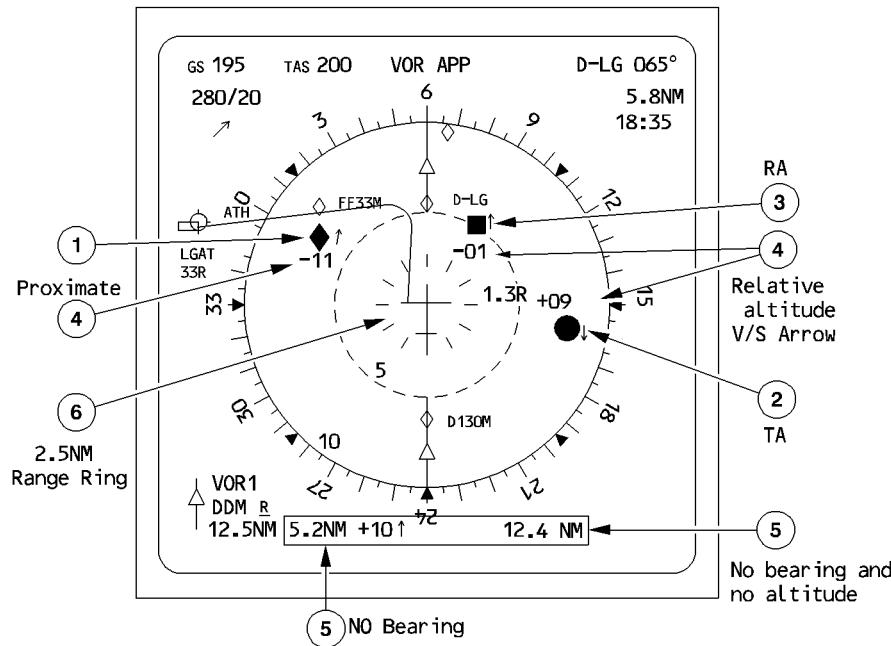
- ALT RPTG switch is at ON, and
- on the ground, the ATC mode selector is at ON
- in flight, the ATC mode selector is at ON or AUTO.

**STBY** : The TCAS is electrically supplied but not operating. No TCAS information is displayed on ND or PFD.

## ND INDICATIONS

The traffic is displayed in all ROSE modes and ARC mode whatever NM range is selected. Only the eight most threatening intruders are displayed.

FFC5-01-3480-009-A210AA



### ① Proximate intruder

Indicated by a white diamond only displayed if the system detects also one TA or RA intruder.

### ② TA intruder

Indicated by an amber circle.  
Associated with the TRAFFIC-TRAFFIC aural message.

③ RA intruder

Indicated by a red square.

Associated with vertical orders displayed on the PFD and aural messages.

Note : If the range of an intruder is not available, the intruder is not displayed.  
An intruder may be partially displayed when its range is out of scale.

④ Relative altitude/Vertical Speed arrow

Relative altitude : indicated in hundred of feet above or below the symbol depending on the intruder position.

R Vertical speed arrow : displayed only if the intruder vertical speed is greater than ±500 ft/min

Relative altitude and vertical speed arrow are displayed in the same color as the associated intruder symbol.

Note : If the altitude of an intruder is not available, neither altitude nor vertical speed indications are displayed.

⑤ No Bearing Intruder

If the bearing of TA or RA intruder is not available the following data is presented in digital form at the bottom of the ND :

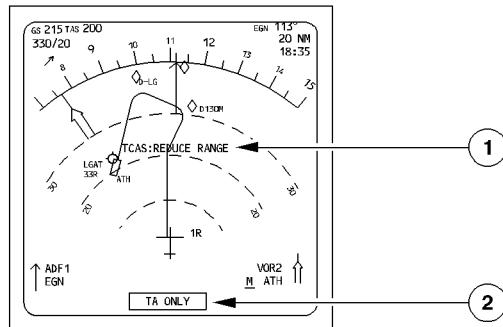
- range
  - relative altitude and vertical speed arrow if available.
- Displayed amber or red according to threat level.

⑥ Range Ring

A 2.5 NM white range ring is displayed when a 10 or 20 NM range is selected.

**TCAS MESSAGES**

FFC5-01-3480-011-A100AA

**① Mode and range messages**

The following messages may be displayed to get the pilot's attention :

TCAS : REDUCE RANGE : Displayed, when a TA or RA is detected, and the ND range is above 40 NM.

TCAS : CHANGE MODE : Displayed, when a TA or RA is detected, and the ND mode is PLAN.

It is displayed in amber or red, depending on the advisory level (TA or RA).

**② TCAS operation messages**

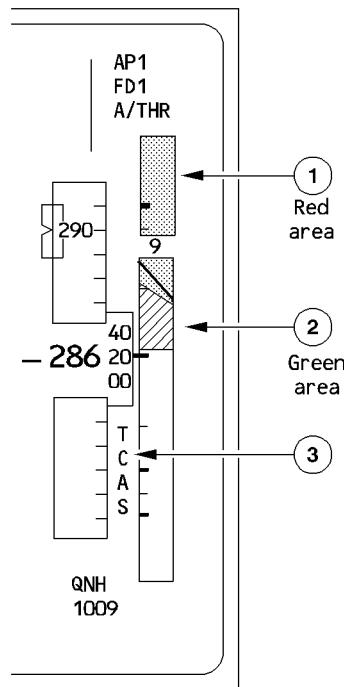
- R      TCAS            : It is displayed in red, in case of an internal TCAS failure. It flashes for 9 seconds, then remains steady.
- R      TA ONLY        : It is displayed in white, when selected by the crew.

## PFD INDICATIONS

- R In case of RA detection, the PFD presents vertical orders on the vertical speed scale. The vertical speed scale background which is normally grey may be partially replaced by green and/or red areas.

Note : When TCAS information has to be displayed on the vertical speed scale, the grey background of the air speed and heading scales are removed.

FFCS-01-3480-012-A100AB



### ① Red area

Indicates the vertical speed where risk of conflict is high.

### ② Green area

Indicates the recommended vertical speed range ("FLY TO" sector).

- R Note : — The aircraft can also fly in the grey vertical speed range without risk of conflict (preventive RA).

**(3) TCAS message**

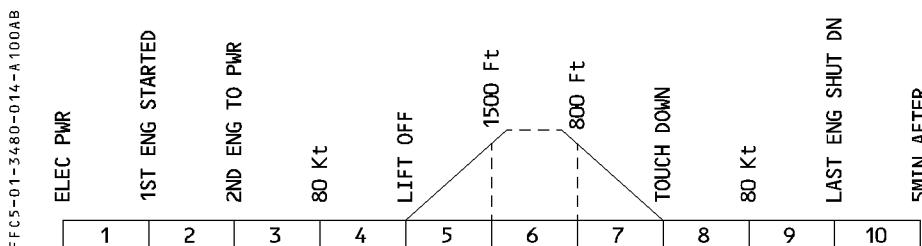
It appears in red, when the TCAS cannot provide RA data, or in case of a TCAS internal failure.

*Note : When within the red area, the vertical speed needle and digits change to red, but in a different pattern, so that it is possible to clearly distinguish them from the background.*

**AURAL MESSAGES**

TA/RA detection is associated with the following messages :

- |  |  |
|--|--|
| "TRAFFIC TRAFFIC"                                  | : Only in case of TA detection.  |
| "CLIMB CLIMB"                                      | : Climb at the vertical speed indicated by the green area on the PFD.  |
| "CLIMB, CROSSING CLIMB" (twice)                    | : Same as above. Indicates that you will cross through the intruder altitude.  |
| "INCREASE CLIMB" (twice)                           | : Triggered after the CLIMB message, if the vertical speed is insufficient to achieve safe vertical separation.                                      |
| "DESCEND DESCEND"                                  | : Descend at the vertical speed indicated by the green area on the PFD.  |
| "DESCEND, CROSSING DESCEND" (twice)                | : Same as above. Indicates that you will cross through the intruder altitude.  |
| "INCREASE DESCEND" (twice)                         | : Triggered after the DESCEND message, if the vertical speed is insufficient to achieve safe vertical separation.                                    |
| "ADJUST VERTICAL SPEED, ADJUST"                    | : Adjust the vertical speed to that indicated by the green area of the PFD, reducing climb vertical speed or descent vertical speed, as appropriate. |
| R  |  |
| "CLIMB, CLIMB NOW" (twice)                         | : Triggered after the DESCEND message, if the intruder trajectory has changed.   |
| "DESCEND, DESCEND NOW" (twice)                     | : Triggered after the CLIMB message, if the intruder trajectory has changed.   |
| "MONITOR VERTICAL SPEED"                           | : Ensure that vertical speed remains outside the red area. Triggered only once, in case of preventive RA.  |
| "MAINTAIN VERTICAL SPEED, MAINTAIN"                | : Maintain the vertical speed indicated on the green area of the PFD.  |
| "MAINTAIN VERTICAL SPEED ...<br>CROSSING MAINTAIN" | : Maintain the vertical speed indicated on the green area of the PFD. Indicates that you will cross through the intruder altitude.                   |
| "CLEAR OF CONFLICT"                                | : The range increases, and separation is adequate. Return to assigned clearance.   |

**WARNINGS AND CAUTIONS**

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
TCAS FAULT	NIL	NIL	NIL	Flag on PFD and ND	3, 4, 5, 7, 8

**MEMO DISPLAY**

TCAS STBY appears in green when :

- R — the crew selects TCAS STBY on ATC/TCAS panel, or
- R — both ATC or RA fail, or
- R — the crew turns OFF the ALT RPTG switch.

**BUS EQUIPMENT LIST****FOR INFO**

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
ADIRU	ADIRU 1				X		HOT 1 (1)
	AOA RESOLVER 1				X (2)		
	ADIRU 2	AC2-3					HOT 2 (1) during 5 mn
	AOA RESOLVER 2	AC2-3					
	ADIRU 3	AC1-2			X (3)		HOT 2 (1)
	AOA RESOLVER 3	AC1-2			X (2)		
STBY INST	HORIZON					X	
	ALTIMETER					SHED	
	COMPASS					X	
NAVAIDS	VOR 1				X		
	VOR 2	AC2-3					
	MMR 1				X		
	MMR 2	AC2-3					
	ADF 1				X		
	ADF 2	AC2-3					
	DDRFMI				X		
	DME 1	AC1-1					
	DME 2	AC2-3					
RADIO ALTIMETER	RA 1	AC1-2					
	RA 2	AC2-3					
ATC	ATC 1				X		
	ATC 2	AC2-3					
GPWS		AC1-2					
WEATHER RADAR	WX 1	AC1-2					
	WX 2	AC2-3					
TCAS □		AC1-1					
PVI □		AC1-1					

(1) Backup supply.

(2) AOA1 resolver power supply is lost, and AOA3 resolver power supply is recovered,  
when AC1-2 is lost and AIR DATA CAPT ON 3 is selected.

(3) When AC1-2 is lost.

**A340**

FLIGHT CREW OPERATING MANUAL

OXYGEN	1.35.00	P 1
CONTENTS	SEQ. 001	REV. 08

**35.00 CONTENTS****35.10 GENERAL****R 35.20 FIXED OXYGEN SYSTEM FOR COCKPIT**

– DESCRIPTION . . . . .	1
– CONTROLS AND INDICATORS . . . . .	4

**R 35.30 FIXED OXYGEN SYSTEM FOR CABIN**

– DESCRIPTION . . . . .	1
– CONTROLS AND INDICATORS . . . . .	3

**35.40 PORTABLE OXYGEN SYSTEM****35.50 ELECTRICAL SUPPLY**

**A340**

FLIGHT CREW OPERATING MANUAL

**OXYGEN**

GENERAL

1.35.10 P 1

SEQ. 001 REV. 08

**DESCRIPTION**

The oxygen system consists of :

- a fixed oxygen system for the cockpit.
- a fixed oxygen system for the cabin.
- a portable oxygen system.

The oxygen system supplies adequate breathing oxygen to the crew and passengers in case of depressurization or the presence of smoke or toxic gas.

**A340**

FLIGHT CREW OPERATING MANUAL

**OXYGEN**

1.35.20

P 1

**FIXED OXYGEN SYSTEM FOR COCKPIT**

SEQ. 001

REV. 20

**DESCRIPTION**

The cockpit's fixed oxygen system consists of :

- One (or two, as installed) high-pressure cylinder in the left-hand lower fuselage.
- One (or two, as installed) pressure regulator, connected directly to the cylinder that delivers oxygen, at a pressure suitable for user.
- Two overpressure safety systems to vent oxygen overboard, through a safety port, if the pressure gets too high.
- A supply solenoid valve that allows the crew to shut off the distribution system.
- Four full-face quick-donning masks, stowed in readily-accessible boxes adjacent to the crewmembers' seats (one at each seat).
- One (or two, as installed) filling port for external oxygen replenishment.

**OPERATION**

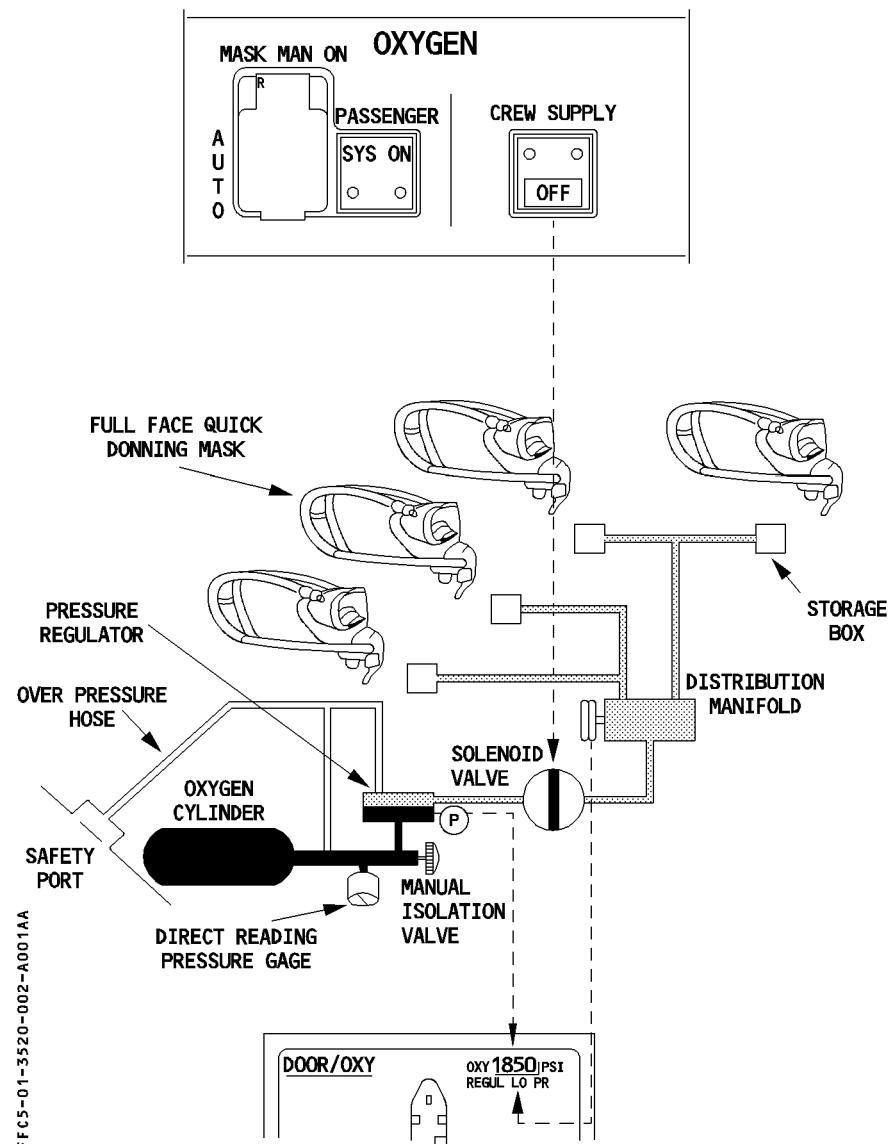
The crewmember squeezes the red grips to pull the mask out of its box, and this action causes the mask harness to inflate.

A mask-mounted regulator supplies a mixture of air and oxygen or pure oxygen, or performs emergency pressure control. With the regulator set to NORMAL, the user breathes a mixture of cabin air and oxygen up to the cabin altitude at which the regulator supplies 100 % oxygen. The user can select 100 %, in which case the regulator supplies pure oxygen at all cabin altitudes.

If the situation calls for it, the user can use the emergency overpressure rotating knob and receive pure oxygen at positive pressure.

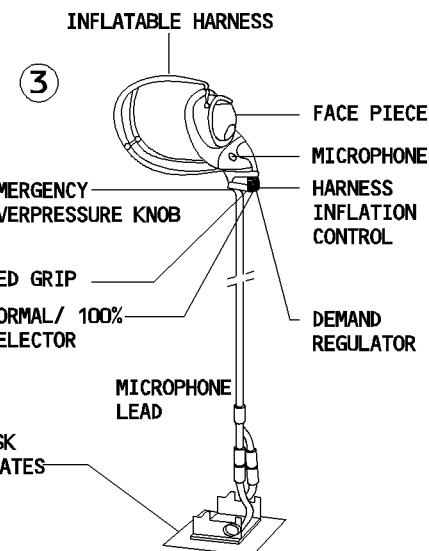
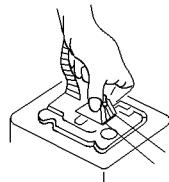
The storage box contains a microphone lead, with a quick-disconnect, for connection to the appropriate mask microphone cable.

R    *Note : Each mask may have a removable film that protects the visor against scratches.  
This strip is optional and may be removed from the mask at any time.*

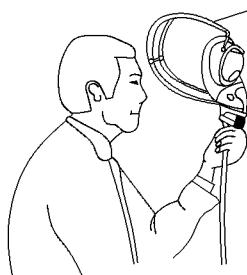


**MASK DONNING**

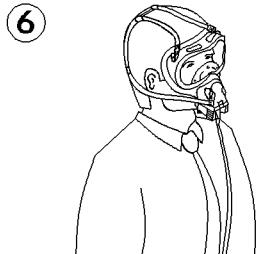
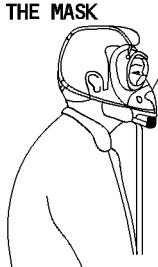
- ① TAKE THE MASK BY SQUEEZING THE RED RIGHT HAND SIDE GRIP



- ④ DONNING OF THE MASK (HARNESS INFLATED)



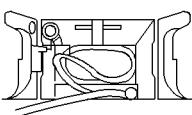
- ⑤ RELEASE THE RED HAND SIDE GRIP HARNESS DEFOLATES AND MAINTAINS THE MASK



R **MASK STOWAGE**

R

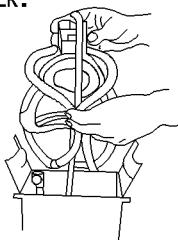
- ① - COIL THE HOSE, AND PLACE IT IN THE BOTTOM OF THE STOWAGE BOX.



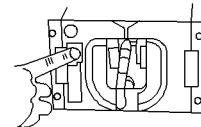
- ③ - PLACE THE MASK IN THE STOWAGE BOX.  
- MAKE SURE THE MASK REGULATOR IS FULLY SEATED AGAINST THE STOP IN THE STOWAGE BOX.



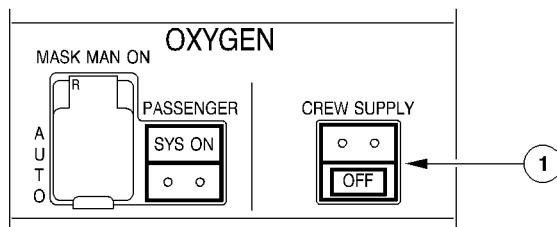
- ② - POSITION THE REMAINING HOSE IN THE MIDDLE OF THE MASK.  
- FOLD THE TWO HARNESS PORTIONS TOGETHER.



- 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.

**CONTROLS AND INDICATORS****OVERHEAD PANEL**

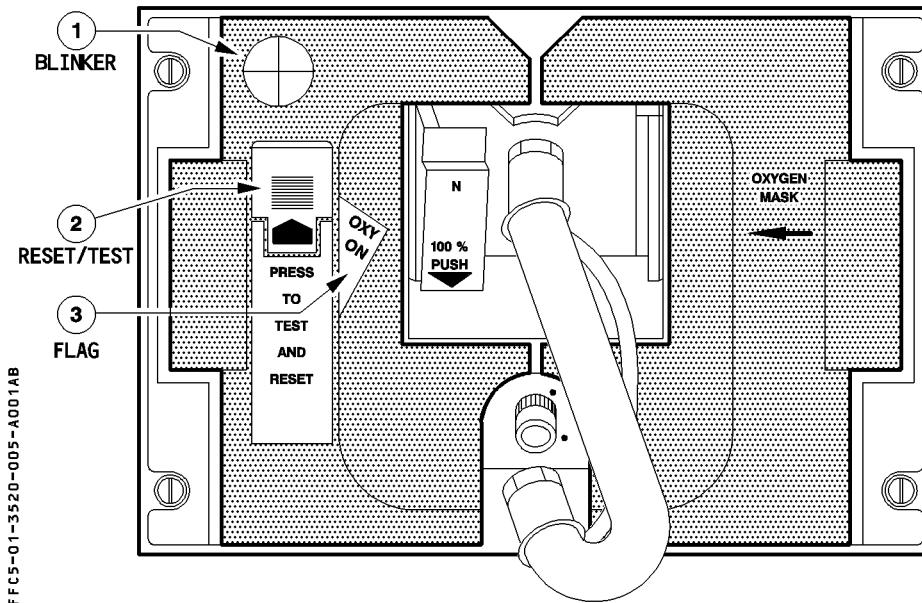
FFC5-01-3520-004-B001AA

**① CREW SUPPLY pushbutton**

This pushbutton controls the solenoid valve.

ON : The valve is open, and supplies low pressure oxygen to the masks (normal position in flight).

OFF : The valve is closed, and the white light comes on.

**LATERAL CONSOLES****STOWAGE BOX****(1) Blinker flowmeter (yellow)**

This indicator flashes when oxygen is flowing.

**(2) RESET / TEST control slide**

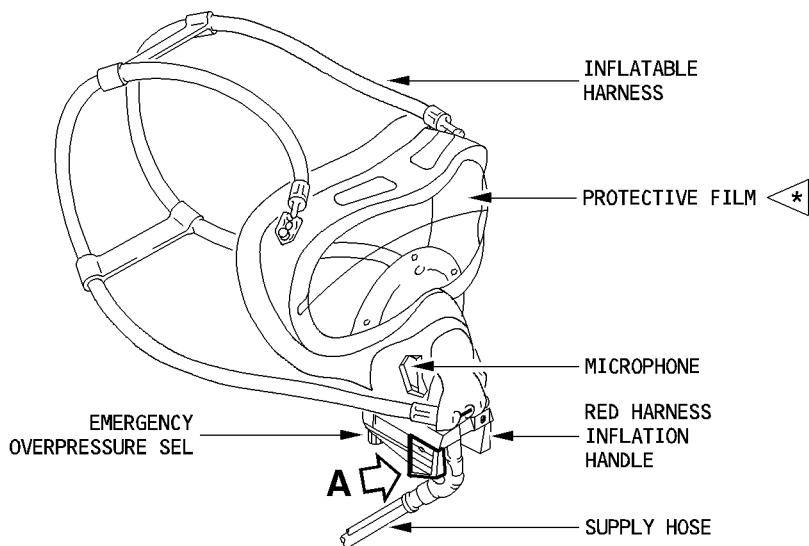
The crewmember presses the slide, and pushes it in the direction of the arrow to test: the operation of the blinker ; the regulator supply ; system sealing downstream of the valve ; and the regulator sealing and system operation. Pressing the RESET control slide, after the oxygen mask has been used, cuts off the oxygen, and the mask microphone.

**(3) OXY ON flag**

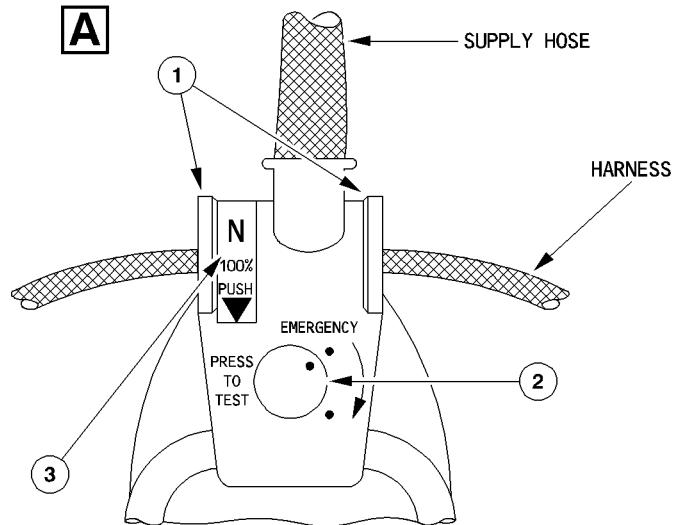
- R As soon as the left flap door opens, the mask is supplied with the oxygen and, once it closes (mask still supplied with oxygen), the "OXY ON" flag appears.

**CREW OXYGEN MASK**

R

**PRESSURE REGULATOR**

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FLIGHT CREW OPERATING MANUAL

**OXYGEN**  
FIXED OXYGEN SYSTEM FOR COCKPIT1.35.20 P 7  
SEQ. 001 REV. 15**① Red grips**

Squeezing the righthand side grip unlocks the two-flap door and permits the harness to inflate.

**② EMERGENCY pressure selector**

Use of this selector creates an overpressure which eliminates condensation and prevents smoke, smell or ashes from entering the mask.

- Pressing this knob generates an overpressure for a few seconds.
- Turning the knob, in the direction of the arrow, generates a permanent overpressure.

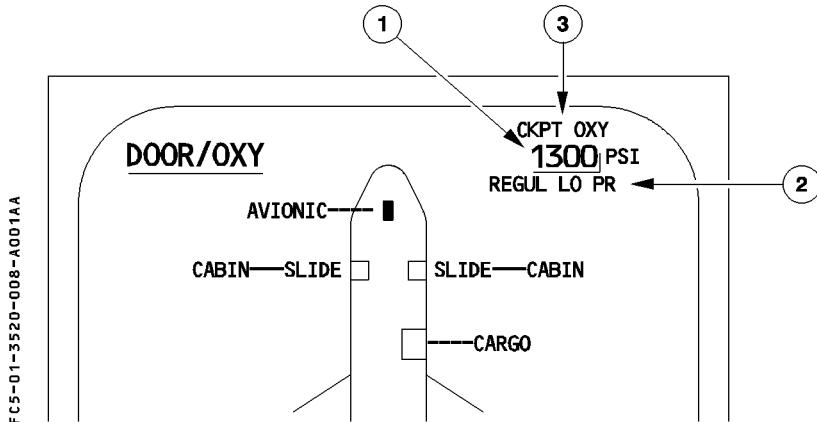
*Note : Overpressure supply is automatically started, when cabin altitude exceeds 30000 feet.*

**③ N/100 % sel**

R This two-position button is locked down (100 % position) when the crewmember pulls the mask out of the stowage. Pushing up the button from underneath releases it, and it pops up to the N (normal) position. Pressing it again returns it to 100 %.

100 % The mask delivers 100 % oxygen.

N The mask delivers a mixture of air and oxygen, the content of which varies with cabin altitude. When cabin altitude goes above 35000 feet, the air inlet closes and the wearer breathes 100 % oxygen.

**ECAM DOOR/OXY PAGE****① OXY high pressure indication**

Green : When pressure is  $\geq 400$  psi

Amber : When pressure is  $< 400$  psi

An amber half frame appears when oxygen pressure is  $< 1500$  psi.

In this case, the flight crew must check that the remaining quantity is not below the minimum (Refer to OPERATING LIMITATIONS, 3.01.35).

**② REGUL LO PR indication**

Appears amber if oxygen pressure on the low-pressure circuit is low (50 psi).

**③ CKPT OXY indication**

Normally white.

Becomes amber when

- Pressure goes below 400 psi.
- Low oxygen pressure is detected.
- The OXYGEN CREW SUPPLY pushbutton switch on overhead panel is OFF.

**A340**

FLIGHT CREW OPERATING MANUAL

**OXYGEN**

1.35.30 P 1

## FIXED OXYGEN SYSTEM FOR CABIN

SEQ. 100 REV. 22

**DESCRIPTION**

The fixed oxygen system in the cabin supplies oxygen to the occupants, in case of cabin depressurization.

- R Chemical generators produce the oxygen. Each generator feeds a group of 2, 3, 4, 5 or 6 masks. Generators and masks are in containers above the passenger seats, in the lavatories, in each galley, and at each cabin crew station.

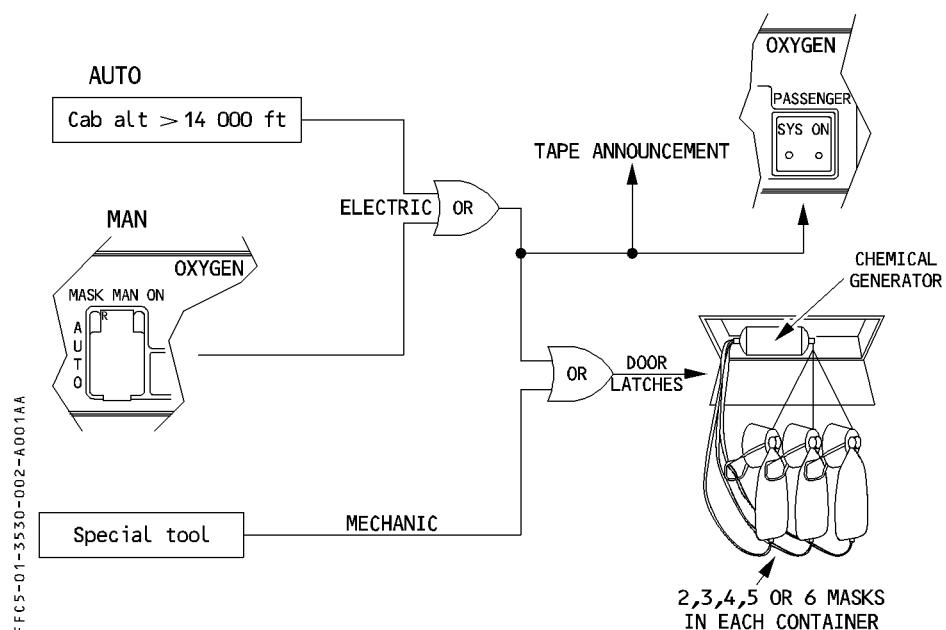
**OPERATION**

Each container has an electrical latching mechanism that opens automatically to allow the masks to drop, if the cabin pressure altitude exceeds 14000 feet (+ 0, - 500 feet). The flight crew can override the automatic control.

When the masks are released, the passenger address system automatically broadcasts prerecorded instructions for their use.

The generation of oxygen begins, when the passenger pulls the mask toward the passenger seat. The chemical reaction used for oxygen generation creates heat. Therefore, a smell of burning, smoke and an increase in cabin temperature may be associated with the normal operation of the oxygen generators. The mask receives pure oxygen under positive pressure for about 22 minutes, until the generator is exhausted.

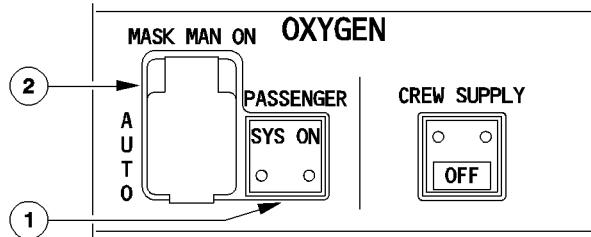
A reset is available to rearm the system after the masks are restowed. A manual release tool allows crewmembers to open the doors manually, in case of electrical failure.



## CONTROLS AND INDICATORS

### OVERHEAD PANEL

FFC5-01-3530-003-A001AA



#### ① PASSENGERS SYS ON lt

This white light comes on when the control for the oxygen mask doors is activated, and remains on until someone pushes the TMR RESET pushbutton. (See maintenance panel, below).

#### ② MASK MAN ON pb

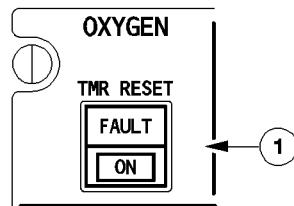
The guard keeps this button in the AUTO position.

AUTO : The mask doors open automatically when the cabin altitude exceeds 14 000 feet.

Pressed : The mask doors open.

### MAINTENANCE PANEL

FFC5-01-3530-003-B001AA



#### ① TMR RESET pb sw

The maintenance crew uses this pushbutton to reset the control circuit after the system has operated.

- R      ON : This white light comes on, and the PASSENGER SYS ON light goes off.  
 FAULT : This amber light comes on when the door latch solenoids are energized for more than 30 seconds.



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OXYGEN

FIXED OXYGEN SYSTEM FOR CABIN

1.35.30

P 4

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REV 09

**ECAM DOOR/OXY PAGE**

NOT APPLICABLE

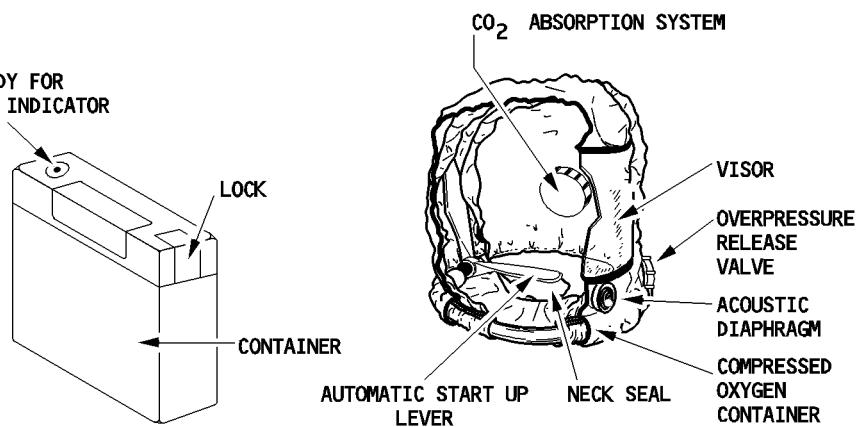
**DESCRIPTION****FLIGHT CREW'S PORTABLE OXYGEN SYSTEM**

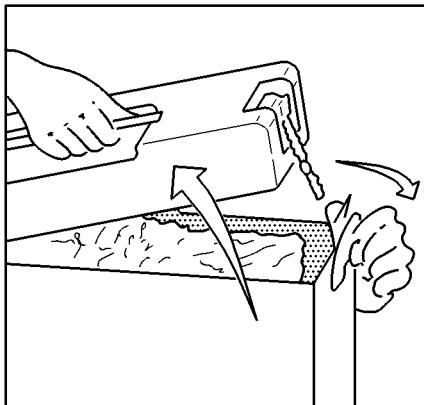
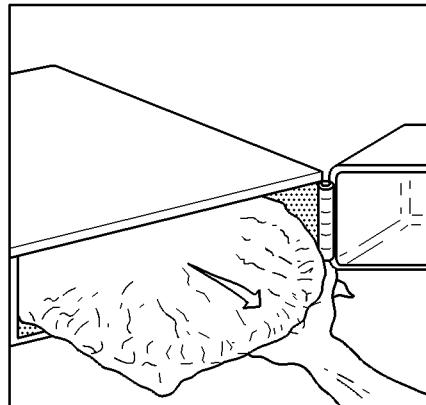
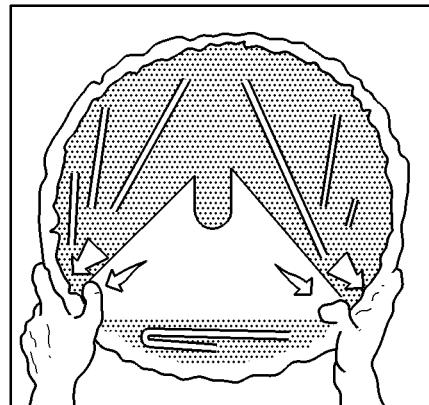
The flight crew smoke hood on the left back side of the cockpit, ensures the eyes and respiratory system protection of one flight crew member when fighting a fire and in case of smoke or noxious gas emissions or cabin depressurization.

The smoke hood is equipped with one oxygen cylinder and one CO<sub>2</sub> absorption system which furnish an effective time of use of 15 minutes.

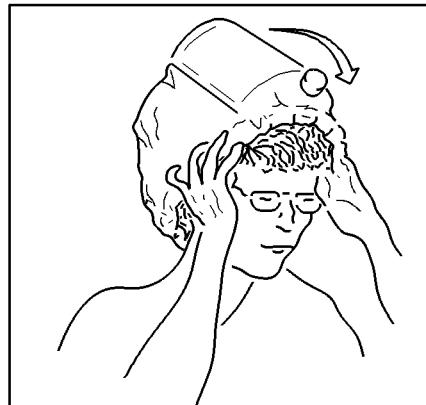
A « ready for use » status of the hood is ensured by checking that the indicator mounted on the hood container is not red.

FFC5-01-3540-001-A001AA



**R USING THE HOOD****1 OPEN THE HOOD CONTAINER****2 REMOVE THE HOOD AND OPEN THE PROTECTIVE BAG****3 ENLARGE THE NECKSEAL AS INDICATED**

FFC5-01-3540-002-A001AA

**4 THE OXYGEN SUPPLY IS AUTOMATICALLY ACTIVATED WHEN THE HOOD IS PUT ON**

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FLIGHT CREW OPERATING MANUAL

**OXYGEN**  
**ELECTRICAL SUPPLY**

1.35.50 P 1

SEQ. 001 REV. 10

**BUS EQUIPMENT LIST****FOR INFO**

		NORM			EMER ELEC		
		AC	DC	DCB AT	AC ESS	DC ESS	HOT
CREW OXY CTL						SHED	
PAX OXYGEN	ACTUATION				X		
	AUTO CONTROL					X	

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FLIGHT CREW OPERATING MANUAL

**PNEUMATIC**

1.36.00 P 1

CONTENTS

SEQ. 001 REV. 07

**36.00 CONTENTS****36.10 DESCRIPTION**

– GENERAL . . . . .	1
– ENGINE BLEED SYSTEM . . . . .	2
– APU BLEED AIR SUPPLY . . . . .	6
– HP GROUND AIR SUPPLY . . . . .	6
– CROSS BLEED . . . . .	7
– LEAK DETECTION . . . . .	8
R – OPERATION FOLLOWING FAILURE . . . . .	10

**36.20 CONTROLS AND INDICATORS**

– OVERHEAD PANEL . . . . .	1
– ECAM BLEED PAGE . . . . .	3
– WARNINGS AND CAUTIONS . . . . .	6
– MEMO DISPLAY . . . . .	6

**36.30 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
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**A340**

FLIGHT CREW OPERATING MANUAL

**PNEUMATIC**

1.36.10 P 1

DESCRIPTION

SEQ. 001 REV. 07

**GENERAL**

The pneumatic system supplies high pressure air for :

- Air conditioning
- Engine starting
- Wing anti icing
- Water pressurization
- Hydraulic reservoir pressurization
- Pack bay ventilation turbofan actuation

High pressure air is supplied from three sources :

- R – Engine bleed systems
- R – APU load compressor
- R – Two HP ground connections
- R Engine bleed systems are interconnected by a crossbleed duct to which the APU and ground sources are connected.  
A valve, mounted on the crossbleed duct, allows the left side (ENG 1 and ENG 2) and right side (ENG 3 and ENG 4) to be interconnected.
- R Pneumatic system operation is controlled and monitored by four Bleed Monitoring Computers (BMC 1, 2, 3 and 4), the overhead control panel and the ECAM. The APU bleed supply is controlled by the APU Electronic Control Box (ECB).  
A leak detection system is provided to detect any overheat in the vicinity of hot air ducts.

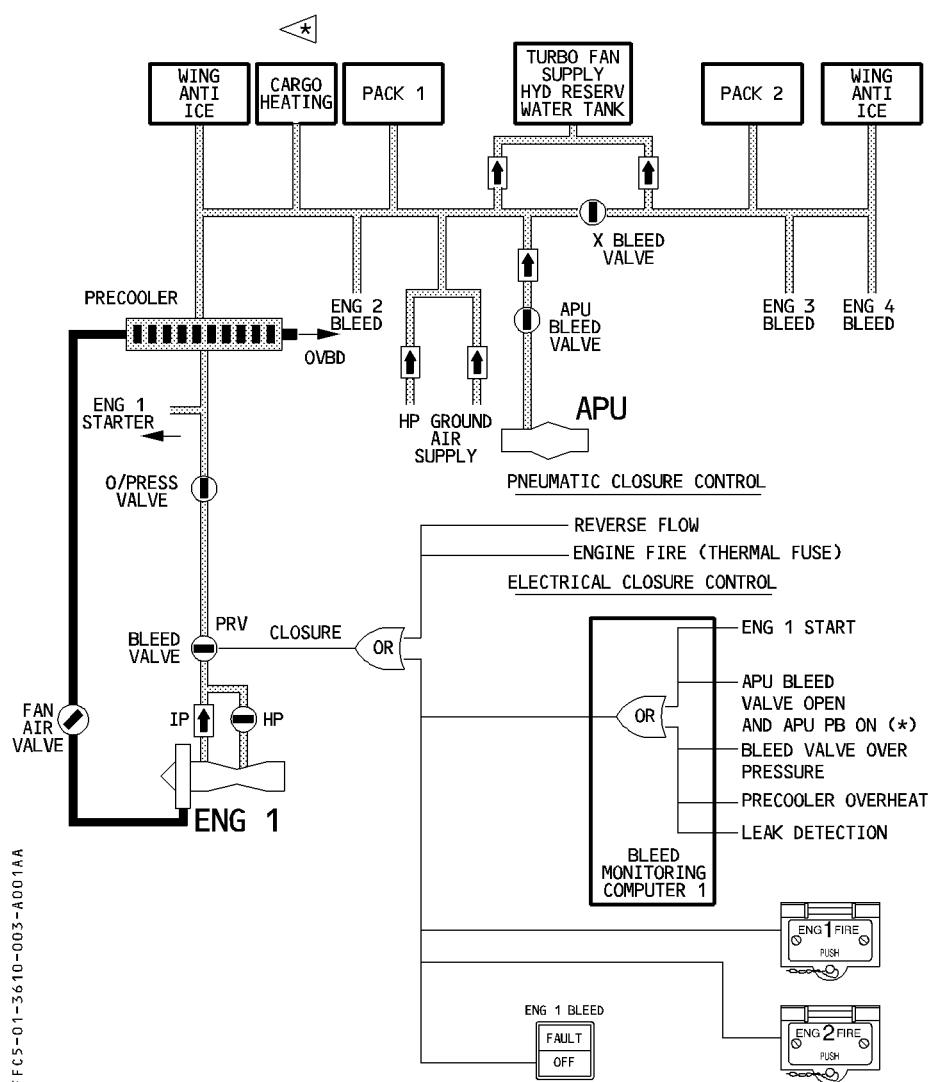
## ENGINE BLEED SYSTEM

### GENERAL

- R Engine bleed systems are similar
  - Each system is designed to :
    - select the air source compressor stage
    - regulate bleed air pressure
    - regulate bleed air temperature
  - Each system is controlled and monitored by one Bleed Monitoring Computer.
- R Each BMC is provided with bleed pressure, temperature and valve position information, and is interconnected to :
  - other systems involved with bleed system
  - the other BMCs
- R and provides indications and warnings to the ECAM and CMC.
- R In case of failure of one BMC, the BMC of the adjacent engine takes over most of the monitoring functions.
  - Each bleed valve is electrically controlled by its associated BMC and pneumatically operated.

FOR INFO

R



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R (\*) The engine 3 and 4 bleed valves close when the APU bleed valve opens, only if the crossbleed valve is open.

**ENGINE AIR SUPPLY**

Air is normally bled from the intermediate pressure stage (IP) of engine HP compressor, to minimize fuel penalty.

- R When pressure from IP is not sufficient (low engine speed), air is bled from the high pressure (HP) stage thru the HP valve which limits downstream pressure to  $36 \pm 4$  psi. An intermediate pressure check valve, mounted downstream of the IP port, closes to prevent air from HP stage being circulated to the IP stage.

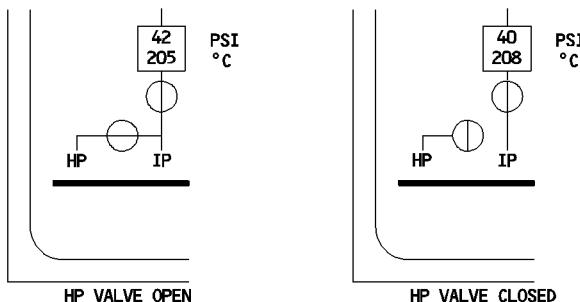
**FOR INFO**

*The HP valve is automatically closed*

- pneumatically :
  - in case of low upstream pressure
  - in case of excessive upstream pressure
- electrically when :
  - the BLEED valve is electrically controlled closed or,
  - wing anti-ice is OFF and upstream HP valve pressure is  $> 73$  psi

**ECAM INDICATION**

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**PNEUMATIC**

1.36.10 P 5

**DESCRIPTION**

SEQ. 001 REV. 07

## **PRESSURE REGULATION AND LIMITATION**

- R Downstream of the junction of HP and IP ducting, air is admitted into the bleed valve which acts as a shut off and Pressure Regulating Valve (PRV).  
Delivery pressure is regulated between 38 and 48 psi, depending on the flow and is modulated to balance the flow bled from the two engines located on the same wing.  
The pressure can be reduced in case of overtemperature at the precooler inlet.  
In case of pressure regulation failure, the overpressure valve (OPV) closes when pressure > 85 psi.
- The bleed valve is fully closed :
- pneumatically in case of :
    - upstream pressure < 8 psi or
    - return flow
- R · engine fire (thermal fuse)
- electrically through :
- R · the BLEED pushbutton when switched OFF
- R · the ENG FIRE pushbutton (of related or adjacent engine) when pushed
- the BMC in the following cases :
    - overtemperature
    - overpressure
    - leak detection
- R · APU bleed ON (for RH engines, provided X-bleed valve is not closed).
- starting sequence

## **TEMPERATURE REGULATION AND LIMITATION**

The temperature regulation of bleed air is achieved by a precooler, mounted downstream of the bleed valve.

The precooler is an air to air heat exchanger which uses cooling air bled from the engine fan, to regulate the temperature to 200°C.

Fan air flow is controlled by the Fan Air Valve.

- R When wing anti-ice is selected off, the temperature may be regulated to 150°C, upon zone controller demand.

The fan air valve is spring loaded closed in the absence of pressure.

## **APU BLEED AIR SUPPLY**

Air supplied by the APU load compressor is available on ground and in flight.

APU bleed air is controlled by the APU bleed valve which operates as shut off valve. It is electrically controlled and pneumatically operated.

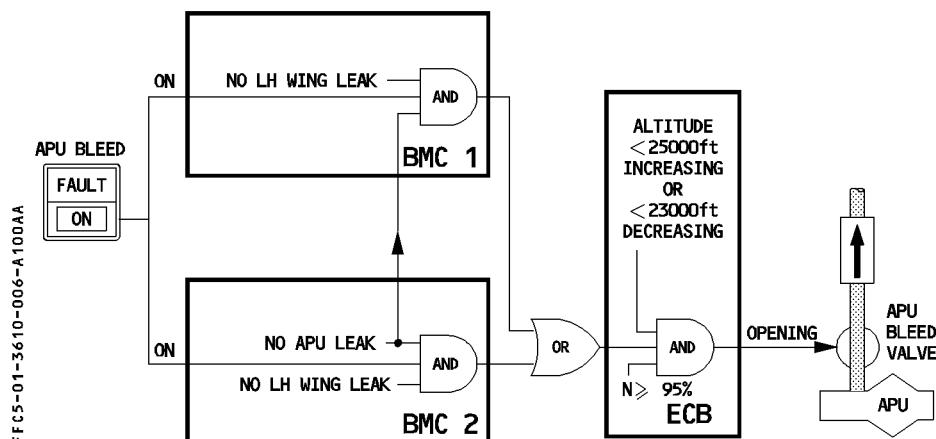
The APU bleed valve is controlled by the APU BLEED pushbutton on the AIR panel.

When pushbutton is selected to ON, APU bleed air supplies the pneumatic system provided APU N > 95%. This causes the X-BLEED valve to open and the engine bleed valves to close.

A non-return valve, located near the crossbleed duct, protects the APU when air is bled from another supply source.

#### **APU BLEED VALVE OPENING LOGIC**

**FOR INFO**



## **HP GROUND AIR SUPPLY**

- R Air is supplied via two HP ground connectors to the a/c pneumatic system. The crossbleed valve has to be opened manually to provide air for both sides.

**CROSSBLEED**

A crossbleed valve, installed on the crossbleed duct, permits the isolation or interconnection of LH (ENG 1 and 2) and RH (ENG 3 and 4) air supply system.

The crossbleed valve is electrically controlled from a rotary selector located on the AIR panel.

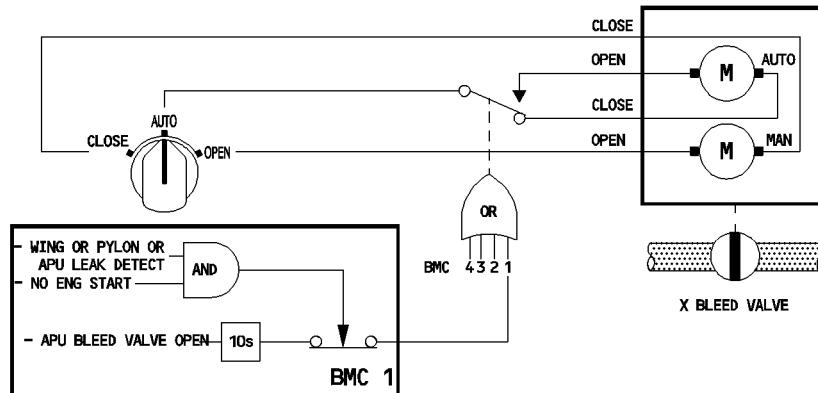
The valve is controlled by two electric motors : one for the automatic mode, the other one for the manual mode.

In automatic mode the crossbleed valve is normally closed and opens when APU bleed air is used. In this case, it closes when any air leak is detected (except during engine Start).

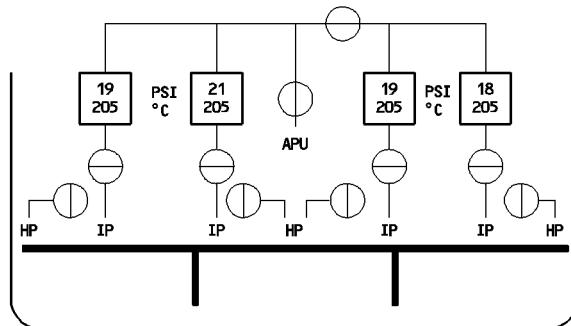
**X-BLEED VALVE CONTROL LOGIC****FOR INFO**

R

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**ECAM INDICATION**

FFC5-01-3610-007-B001AB



**LEAK DETECTION**

The air leakage detection loops detect any ambient overheat in the vicinity of the hot air ducts in the fuselage, pylons and wings.

The sensing elements are tied to form a single loop, for pylon and APU, or, a double loop for the wing.

A wing leak signal is activated when the two loops detect a leak, or when one loop detects the leak and the other is inoperative.

The system has identical control logic included in each BMC.

– In case of wing leak signal

- both bleed valve and HP valve on the related side are automatically closed.

- both associated FAULT light on the AIR panel are illuminated

R     · the X-bleed valve automatically closes (except during an engine start or manually selected open).

- if the APU bleed valve is open, and if the leak concerns the left wing, it automatically closes (except during engine start).

– In case of pylon leak signal

- both bleed valve and HP valve on the related side are automatically closed

- only the FAULT light associated with the related engine is illuminated on the AIR panel

R     · the X-bleed valve automatically closes (except during an engine start or manually selected open).

– In case of APU leak signal

- the APU bleed valve automatically closes

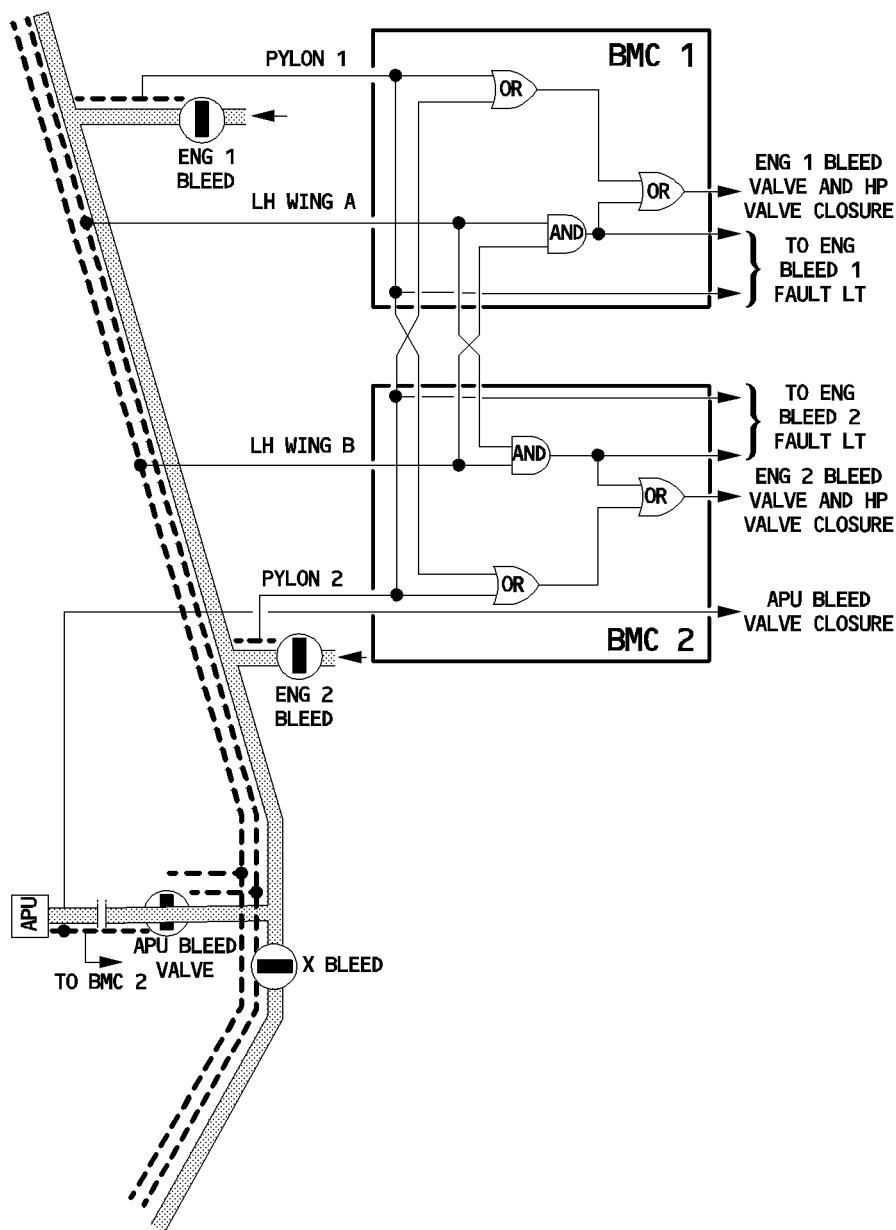
- the FAULT light illuminates on the APU bleed pushbutton on the AIR panel.

R     · the X-bleed valve automatically closes (except during an engine start or manually selected open).

APU bleed leak detection is performed only by BMC 2.

**FOR INFO**

R

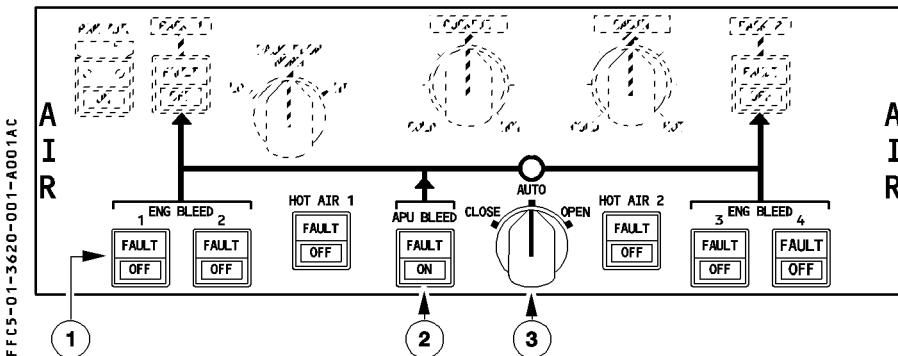


R **OPERATION FOLLOWING FAILURES**

**BMC FAILURE**

If one BMC is failed the BMC of the adjacent engine takes over monitoring of the bleed system and ensures the following ECAM warnings :

- R — ENG BLEED FAULT (overpress and overtemperature only)
- R — WING LEAK
- R — BLEED LO TEMP (if wing anti ice is on)
- R Nevertheless the associated FAULT light on the AIR panel is lost, and the bleed valve does not close automatically.  
ENG BLEED LEAK warning is lost for the associated engine as well as APU BLEED LEAK warning if BMC2 is concerned.

**OVERHEAD PANEL****① ENG 1 (2, 3 or 4) BLEED pb sw**

**On** : Bleed valve opens provided :

- Upstream pressure is above 8 psi.
- APU BLEED pushbutton is at OFF, or, APU bleed valve is closed.

**R** – There is no onside wing or pylon leak, overpressure or overtemperature detected.

**R** – ENG FIRE pushbutton not released out

**R** – Eng start valve closed

**FAULT lt** : illuminates amber, associated with ECAM caution, in case of :

- Bleed valve not closed during engine start
- Bleed valve not closed with APU bleed ON (and for RH engine X-bleed open)

and additionally associated with autoclosure of the bleed and HP valves :

- Overpressure downstream of the bleed valve.
- Bleed overheat
- Wing or engine leak on the related side

It extinguishes when the ENG BLEED pushbutton sw is at OFF provided the failure has disappeared

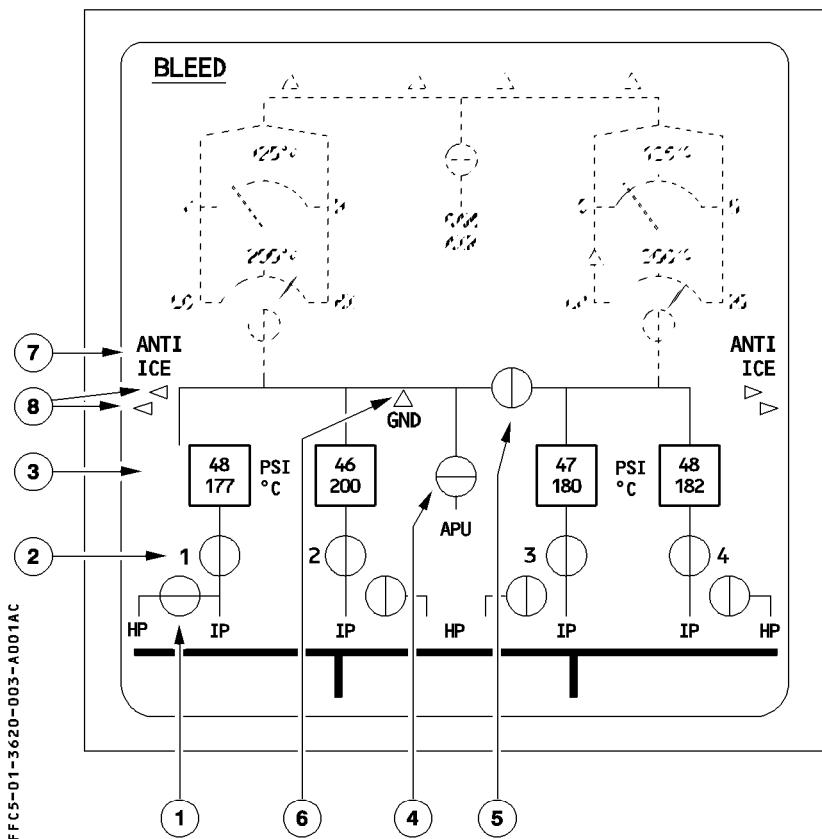
**OFF** : Bleed valve and HP valve close. OFF light illuminates white. FAULT light and autoclosure signal are reset.

② APU BLEED pb sw

- ON : APU valve opens provided :
- N > 95 %
  - Altitude < 25000 ft climbing  
or < 23000 ft descending
  - No leak detected on APU or LH bleed (Should a leak occur on the RH side, the X-bleed would close).
- ON light illuminates blue.
- Off : APU valves closes.
- FAULT It : illuminates amber, associated with ECAM caution, when APU leak is detected.

③ X-BLEED sel

- AUTO : X-bleed valve is open if APU bleed valve is open  
X-bleed valve is closed if APU bleed valve is closed.
- OPEN : X-bleed valve is open.
- CLOSE : X-bleed valve is closed.

**ECAM BLEED PAGE**

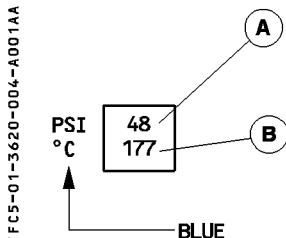
- green : HP valve normally fully closed
- green : HP valve not fully closed
- amber : HP valve disagree in closed position  
or when HP valve is fully closed and the respective engine is not running.

## ② ENGINE BLEED VALVES

- R In line – Green : The bleed valve is normally open.
- R Crossline – Green : The bleed valve is fully closed (by manual or automatic control).
- R In line – Amber : The bleed valve disagrees in the open position.
- R Crossline – Amber : The bleed valve disagrees in the closed position, or the bleed valve is fully closed and the respective engine is not running.

Note : In certain circumstances (such as different engine setting, or one minor bleed valve regulation drift), it is possible that one bleed valve on one side closes and will be indicated closed and green on the ECAM BLEED page. There is no operational impact on the bleed system, provided there is no associated "AIR ENG X BLEED FAULT" ECAM warning.

## ③ ENGINE BLEED INDICATIONS



**(A) Precooler inlet pressure**

It is normally in green.

It becomes amber, if lower than 4 psi, or in case the BMC detects an overpressure (above 60 psi).

**(B) Precooler outlet temperature**

It is normally in green.

It becomes amber, if the BMC detects an overheat or low temperature.

Overheat : Temperature exceeds :

- 290°C for more than 5 seconds, or
- 270°C for more than 15 seconds, or
- 257°C for more than 55 seconds.

Low temperature is detected, if the bleed temperature drops below 150°C, and if wing anti-ice is on. Low temperature may, however, only be due to low outside air temperature.

R R

**④ APU BLEED VALVE**

Displayed only if APU MASTER SW is ON.

- green : APU valve not fully open and the APU BLEED pushbutton is OFF
- amber : APU valve is not fully open and APU BLEED pushbutton is ON.
- green : APU valve fully open.

**⑤ CROSS BLEED VALVE**

- green : crossbleed valve is normally closed.
- green : crossbleed valve is normally open.
- amber : crossbleed valve disagrees in closed position.
- amber : crossbleed valve disagrees in open position.
- amber : crossbleed valve in transit

**⑥ GND HP ground connection indication**

△ : displayed in white on the ground  
GND

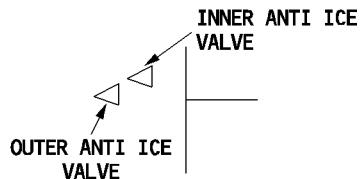
**⑦ ANTI ICE indication**

Displayed in white if the WING pushbutton on the ANTI ICE panel is ON and both valves on the related side are open. The associated anti ice indication becomes amber if :

- the position of at least one valve of the related side disagrees with the anti ice selection
- at least one arrow symbol is amber on the related side.

⑧ Arrows

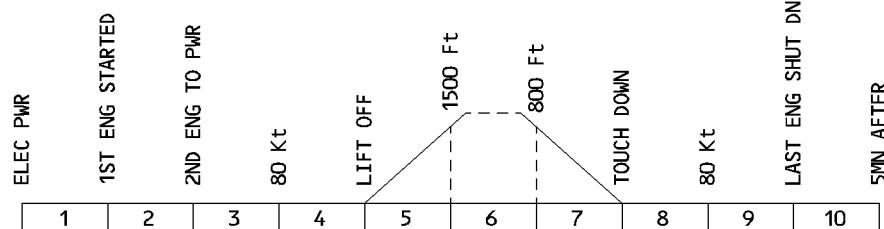
FFC5-01-3620-006-A001AA



ARROW DISPLAY	
not displayed	Valve closed
Green	Valve normally open
Amber	Valve open and at least one of the following condition is met : – bleed air pressure high or low – wing anti-ice pushbutton is at OFF position – open for more than 35 seconds while aircraft is on ground.

**WARNINGS AND CAUTIONS**

FFC5-01-3620-007-A110A



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB		
ABNORM BLEED CONFIG Bleed system configuration has to be changed.	SINGLE CHIME	MASTER CAUT	BLEED	NIL	3, 4, 5, 8		
ENG 1 (2) (3) (4) BLEED FAULT Bleed air pressure overheat or low pressure* or hi pressure or loss of the back flow protection function.				ENG BLEED FAULT lt	1, 3, 4, 5, 7, 8, 10		
L (R) WING LEAK Temperature > 124° C detected by the loops.				NIL	APU BLEED FAULT lt	3, 4, 5, 7, 8	
ENG 1 (2) (3) (4) BLEED LEAK Temperature > 204° C detected by the loops.							
ENG 1 (2) (3) (4) BLEED NOT CLSD Bleed valve not automatically closed during engine start or with APU bleed selected.							
APU BLEED FAULT APU available and valve disagree.							
APU BLEED LEAK temperature > 124° C detected by the loops.							
X BLEED FAULT Valve disagree.				NIL	NIL	NIL	1 to 5 8 to 10
BLEED LO TEMP Bleed air below 150°C with wing anti ice selected ON.							
ENG 1 (2) (3) (4) HPV NOT OPEN HP valve is abnormally closed.							
BMC 1 + 2 (3+4) FAULT Computer failure.							
BMC 1 (2) (3) (4) FAULT Single computer failure.	NIL	NIL	NIL	3, 4, 5, 7, 8			
L (R) WNG LEAK DET FAULT Both detection loops inoperative in one wing.							
APU LEAK DET FAULT APU Bleed leak detection loop inoperative.							

\* Local warning is not triggered, in case of low pressure.



FLIGHT CREW OPERATING MANUAL

**A340****PNEUMATIC  
CONTROLS AND INDICATORS**1.36.20 P 8  
SEQ 001 REV 15**MEMO DISPLAY**

- APU BLEED message appears in green if the APU is available and the APU BLEED pushbutton is ON.

**A340**

FLIGHT CREW OPERATING MANUAL

**PNEUMATIC  
ELECTRICAL SUPPLY**

1.36.30 P 1

SEQ. 001 REV. 07

**BUS EQUIPMENT LIST****FOR INFO**

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
BMC	1		DC2				
	2					X	
	3					X	
	4		DC2				
BLEED VALVES	ALL ENGINES					X	
HP VALVES AND FAN AIR VALVES	ENG 1 AND ENG 3		DC2				
	ENG 2 AND ENG 4		DC1				
X-BLEED VALVE	AUTO CONTROL		DC2				
	MANUAL CONTROL					X	

**A340**

FLIGHT CREW OPERATING MANUAL

**WATER / WASTE**

1.38.00 P 1

CONTENTS

SEQ. 001 REV. 07

**38.00 CONTENTS****38.10 DESCRIPTION**

– GENERAL . . . . .	1
– POTABLE WATER . . . . .	2
– WASTE WATER SYSTEM . . . . .	3
– TOILET SYSTEM . . . . .	4

**38.20 POWER SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
--------------------------------	---

**A340**

FLIGHT CREW OPERATING MANUAL

**WATER WASTE**

1.38.10 P 1

**DESCRIPTION**

SEQ. 001 REV. 08

**GENERAL**

The water and waste system :

- distributes potable water to the toilets and the galleys.
- disposes waste water.
- stores toilet wastes.

The system is insulated to prevent water leaks and ice build up.

The water and waste control panel is located at the forward cabin attendant's panel.

**POTABLE WATER**

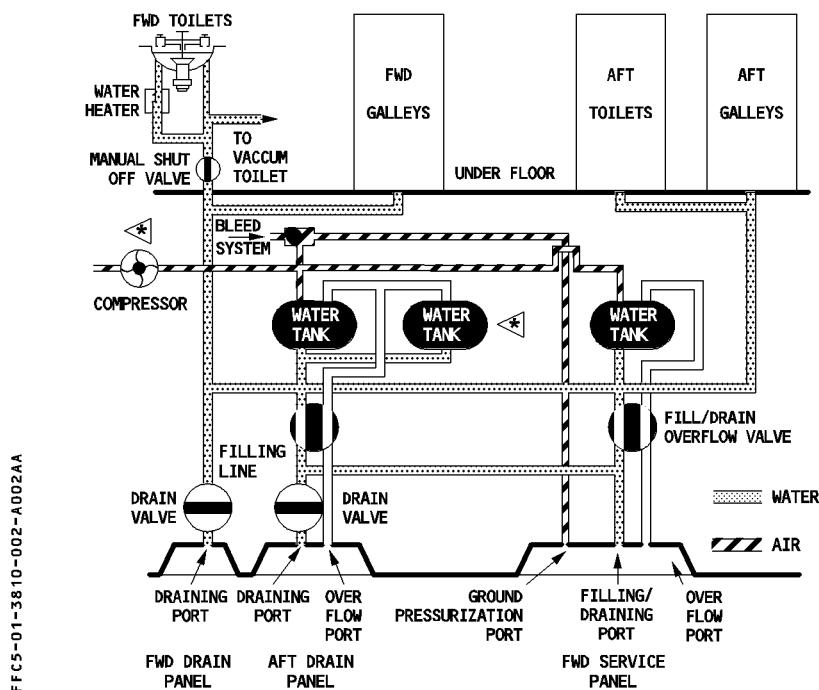
Potable water is stored in two (or three  $\triangleleft$ ) 350-liters tanks in the side walls of the aft cargo compartment.

While airborne, the aircraft uses bleed air to pressurize the water system ; on the ground it uses air from the service panel pressure port.

If no bleed air is available, an electrical compressor ( $\triangleleft$ ) starts automatically when air pressure is not sufficient for normal operation of potable water system.

- R Potable water is piped to the galleys and lavatories. Manual shutoff-valves isolate the washbasin and toilet from the water system. These valves, easily identifiable by OPEN and SHUT legends, are behind an access door under the toilet bowl (on washbasin side). A placard inside the access door gives instructions on this valve operation.
- R The system can be filled or drained from the service panel at the bottom of the fuselage. For filling, the quantity is preselected on the forward attendant's panel.

Indicators on the forward attendants panel show how much water the water tanks contain.

**FOR INFO**

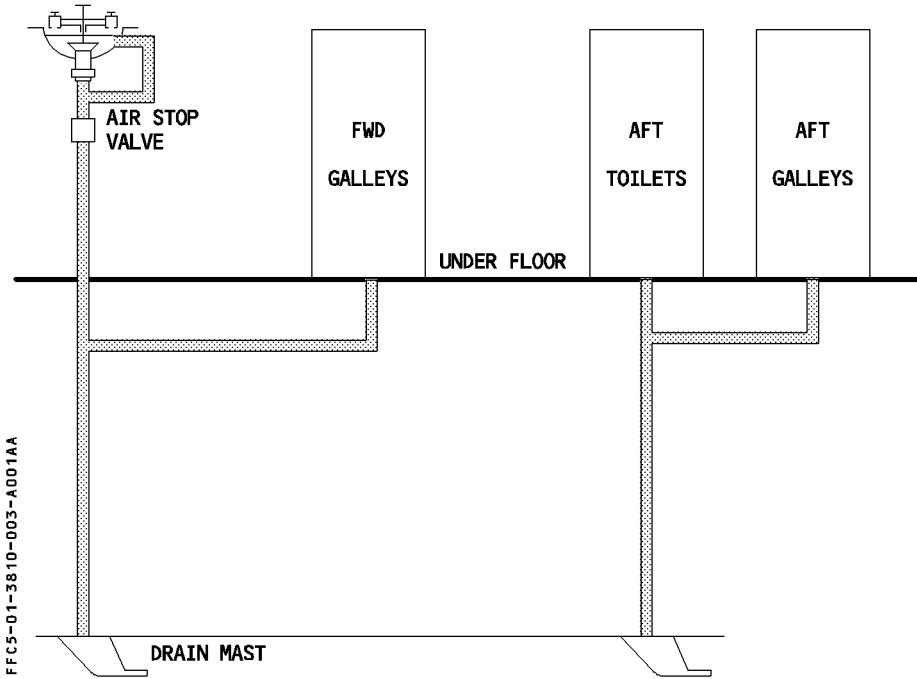
FFC5-01-3810-002-A002AA

**WASTEWATER SYSTEM**

Wastewater from the galleys and from the sinks in the lavatories drains overboard through two anti-iced drain masts.

The forward mast drains wastewater from the forward cabin ; the aft mast drains it from the aft cabin.

Differential pressure discharges the wastewater in flight, and gravity does so on the ground.

**FOR INFO****FWD TOILETS**

**TOILET SYSTEM**

Differential pressure forces waste from toilet bowls into 2 or 3 waste storage tanks. On the ground and at altitudes below 16000 feet, a vacuum generator produces the necessary pressure differential.

Clear water from the potable water system flushes the toilets.

A flush control unit in each toilet controls the flush sequence.

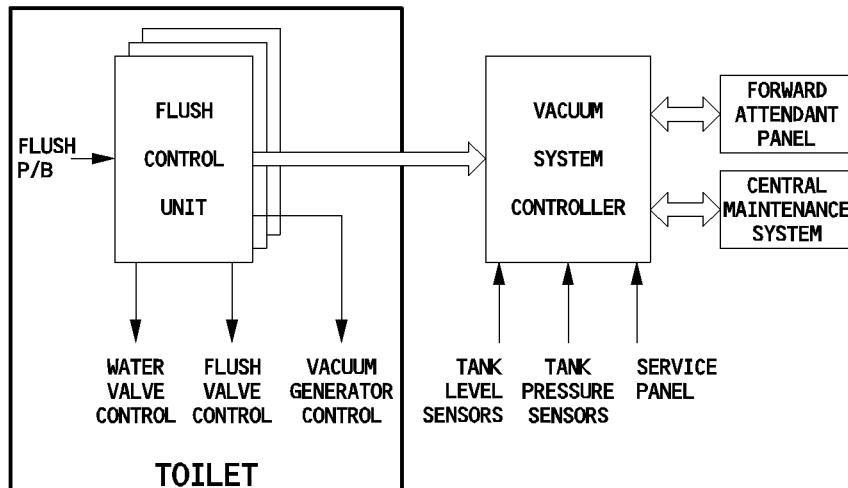
- R The Vacuum System Controller (VSC) furnishes operational information, including the waste level in the storage tank, to the flight attendant's panel, and maintenance information and a test program to the centralized maintenance system.

The waste tank has a total capacity of 700 liters (or 1050 liters if 3 tanks).

Ground personnel service the waste tank through a single service panel under the fuselage. A manual shutoff valve at the lower righthand side of the toilet bowl isolates an inoperative toilet.

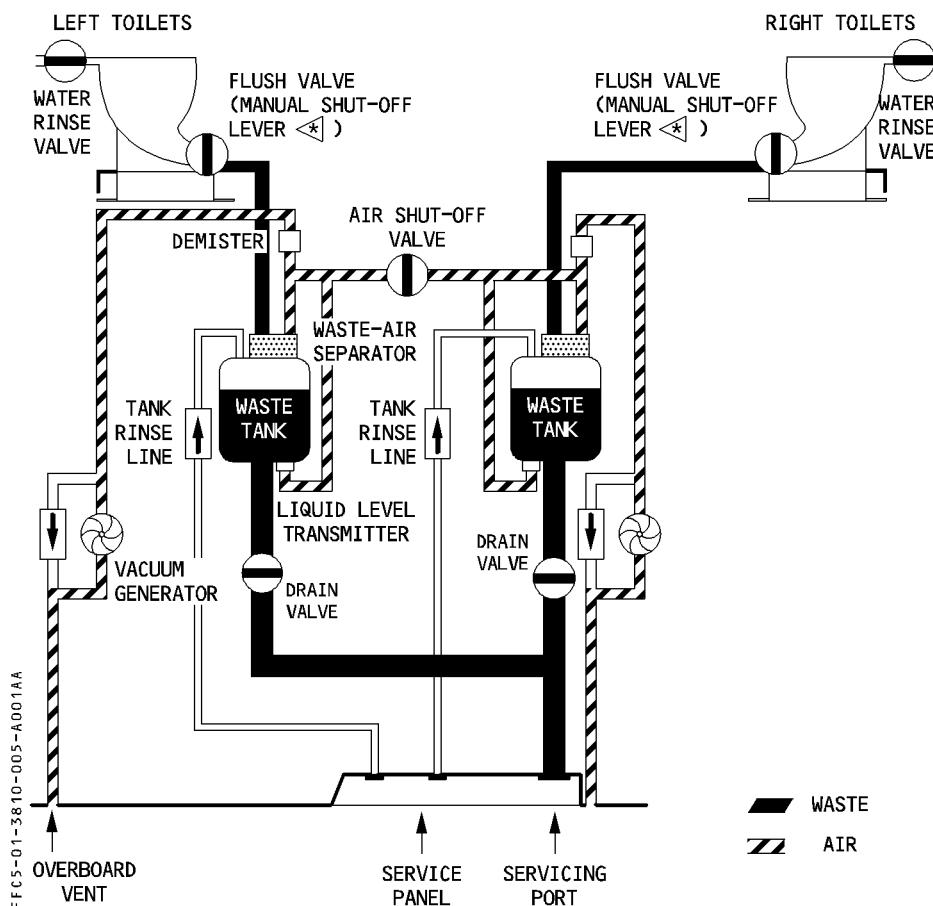
**ARCHITECTURE****FOR INFO**

FFCS-01-3810-004-A001AA



**FOR INFO**

R



**A340**

FLIGHT CREW OPERATING MANUAL

**WATER WASTE**

1.38.20 P 1

**POWER SUPPLY**

SEQ. 001 REV. 07

**BUS EQUIPMENT LIST****FOR INFO**

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
POTABLE WATER SYS		GND/FLT				
WATER HEATER	AC2-4 or AC1-1					
VACUUM GENERATOR L	AC1-1					
VACUUM GENERATOR R	AC2-4					
PRESSURIZED WATER SYS	AC2-4					
FLUSH CONTROL UNITS		GND/FLT				
VACUUM SYS CONTROLLER		GND/FLT				
COMPRESSOR ◁	GND/FLT	GND/FLT				

**A340**

FLIGHT CREW OPERATING MANUAL

**MAINTENANCE SYSTEM**

1.45.00 P 1

**CONTENTS**

SEQ. 001 REV. 07

**FOR INFO****45.00 CONTENTS****45.10 DESCRIPTION**

– GENERAL . . . . .	1
– COMPONENTS . . . . .	1
– MODES OF OPERATION . . . . .	1
– ARCHITECTURE . . . . .	2
– FAILURE CLASSIFICATION . . . . .	3
– CMS FUNCTIONS . . . . .	4
– COCKPIT/CMS INTERFACE . . . . .	5

**45.20 SYSTEM OPERATION**

– MAINTENANCE MENU . . . . .	1
– POST OR CURRENT FLIGHT REPORT . . . . .	2
– PREVIOUS FLIGHT REPORT . . . . .	4
– AVIONICS STATUS . . . . .	5
– CLASS 3 REPORT . . . . .	7
– SYSTEM REPORT/TEST . . . . .	9
– UTC/DATE INIT . . . . .	11
– CMC RECONFIGURATION . . . . .	12

**45.30 DATA LOADER**

– DESCRIPTION . . . . .	1
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**45.35 PRINTER**

– DESCRIPTION . . . . .	1
– CONTROLS AND INDICATORS . . . . .	2

**45.40 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST . . . . .	1
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**A340**

FLIGHT CREW OPERATING MANUAL

**MAINTENANCE SYSTEM**

1.45.10 P 1

**DESCRIPTION**

SEQ. 001 REV. 07

**GENERAL**

The purpose of the Central Maintenance System (CMS) is to ease the maintenance task by directly indicating in the cockpit the fault messages and allowing some specific tests.

Two levels of maintenance are possible :

at the line stop : equipment removal

at the main base : trouble shooting

**COMPONENTS**

The CMS includes :

- the BITEs (Built In Test Equipment) of all electronic systems
- two fully redundant Central Maintenance Computers (CMCs)
- three MCDUs (Multipurpose Control Display Units) used also for FMGS, ACMS (Aircraft Condition Monitoring System) and ACARS (if installed) which dialogue with the CMC for display of information or initiation of tests.
- one printer (A4 format)

Normally only CMC 1 is used while CMC 2 is in stand-by. CMC 2 will automatically takes over if CMC 1 fails.

A push-button on the overhead panel allows to force the transfer to CMC 2 by setting the CMC 1 in off position.

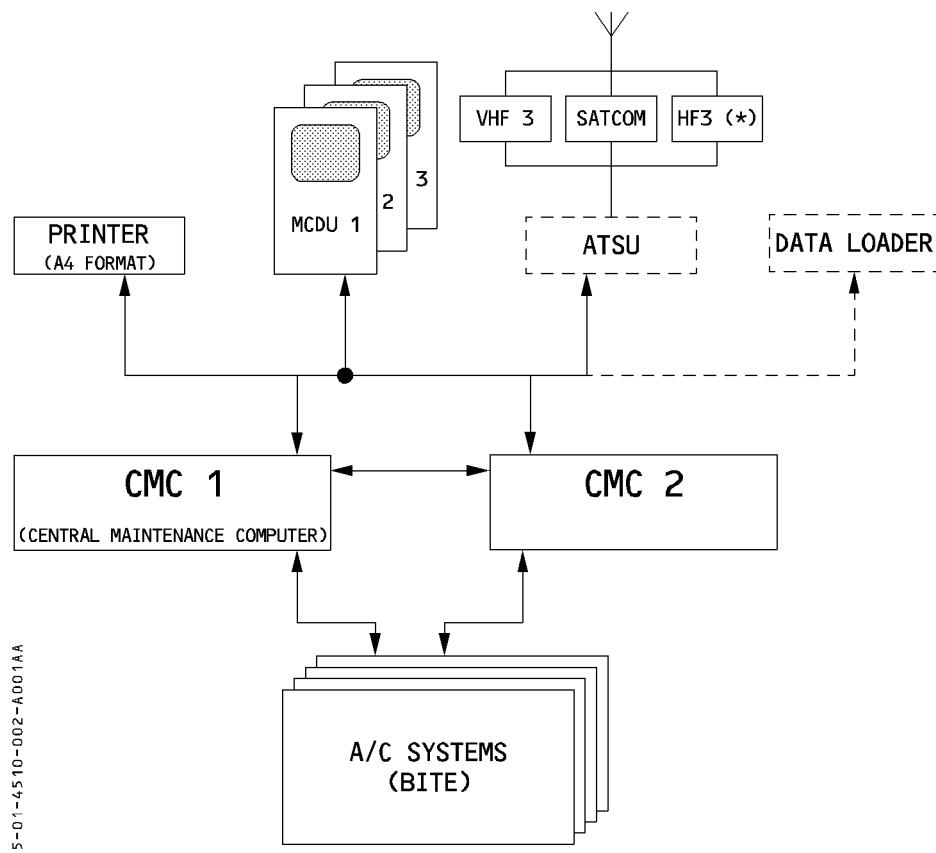
**MODES OF OPERATION**

The CMS operates in two main modes :

- the NORMAL mode or REPORTING mode in flight
- the INTERACTIVE mode or MENU mode on ground

In NORMAL mode, the CMS records and displays the failure messages permanently transmitted by each system BITE.

In INTERACTIVE mode, the CMS allows the connection of any BITE system with the MCDU in order to display the maintenance data stored and formated by the system BITE itself or to initiate a TEST.

**ARCHITECTURE**

FFCS-01-4510-002-A001AA

**A340**

FLIGHT CREW OPERATING MANUAL

**MAINTENANCE SYSTEM**

1.45.10 P 3

**DESCRIPTION**

SEQ. 001 REV. 21

**FAILURE CLASSIFICATION**

There are three classes of failure :

Class 1: Failures indicated to the flight crew by means of a flight deck effect (e.g. ECAM or instrument flags).

R Class 2: Failures which can be left uncorrected until the next scheduled maintenance check (with a maximum delay of 600 FH).

Class 3: Failures not indicated to the flight crew, with no fixed time quoted for correction.

R

Failure Classes	Class 1	Class 2	Class 3
Operational consequences	YES	NO	NO
Indication to the flight crew	YES Automatically displayed in real time : - Warning or caution messages on Engine Warning Display - Flags on Primary Flight Display or Navigation Display, or System Display, - Local warning	YES STATUS flashing at the end of the flight : - Maintenance Status messages on SD	NO
Dispatch consequences	Refer to MEL may be: "GO" "GO IF" "NO GO"	MEL not applicable. "GO" without conditions. Corrections can be deferred for 600 flight hours.	MEL not applicable. No fixed time quoted for corrections. However, correction is recommended to improve dispatch reliability.
Indication to the maintenance team	YES Automatically print out at the end of each flight : Failure messages on the CMC Post Flight Report	YES On request, when needed, Failure messages on CMC Class 3 Report.	

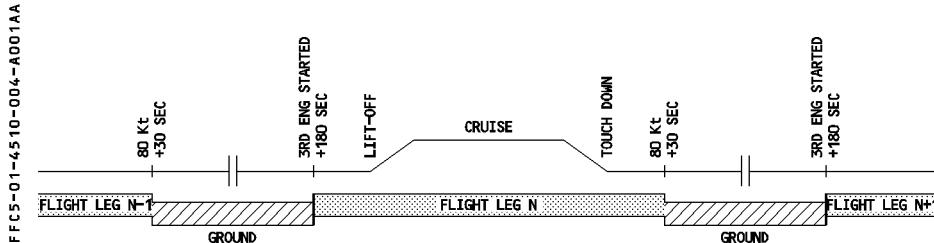
Note : Most Class 1 failures have an operational consequence on the current flight.

Some Class 1 failures, such as MINOR FAULT, have no operational consequence on the current flight, but must be corrected in accordance with the MEL preamble, or the time specified in the associated dispatch condition of the MEL.

**CMS FUNCTIONS**

The main functions of the CMS are :

- acquisition and storing of messages transmitted by the connected system BITEs or by the Flight Warning Computer (Warning / Caution titles).
- elaboration of the maintenance phases.



- elaboration of the maintenance reports.

- POST OR CURRENT FLIGHT REPORT

Presents all ECAM warning/caution and failure messages (class 1 and 2 failures) recorded during the last flight leg or current flight leg.

Available in flight and on ground.

- PREVIOUS FLIGHT REPORT

Presents all ECAM and failure messages recorded during the 63 previous flight legs (post flight reports).

Available on ground only.

- AVIONICS STATUS

Presents in real time the systems affected by a failure.

Available in flight and on ground.

- CLASS 3 REPORT

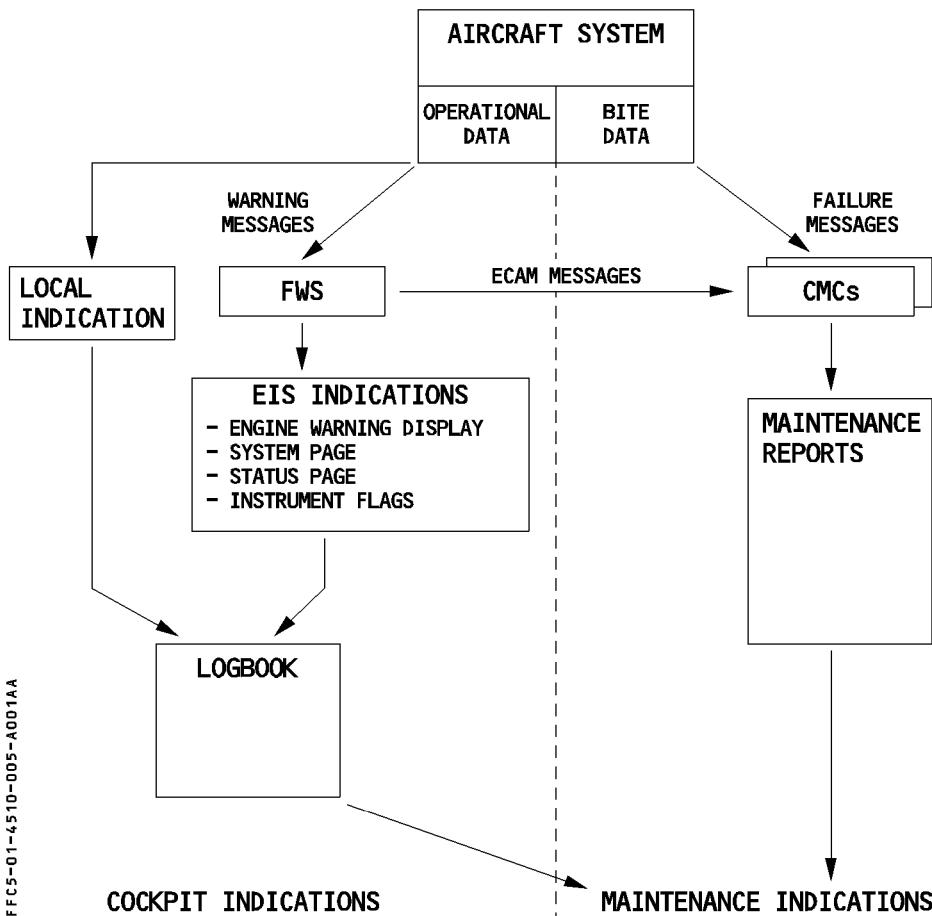
Presents the class 3 failure messages detected during the last flight leg.

Available on ground only.

- SYSTEM REPORT/TEST

Allows interactive dialogue between any system and the MCDU.

Available on ground only.

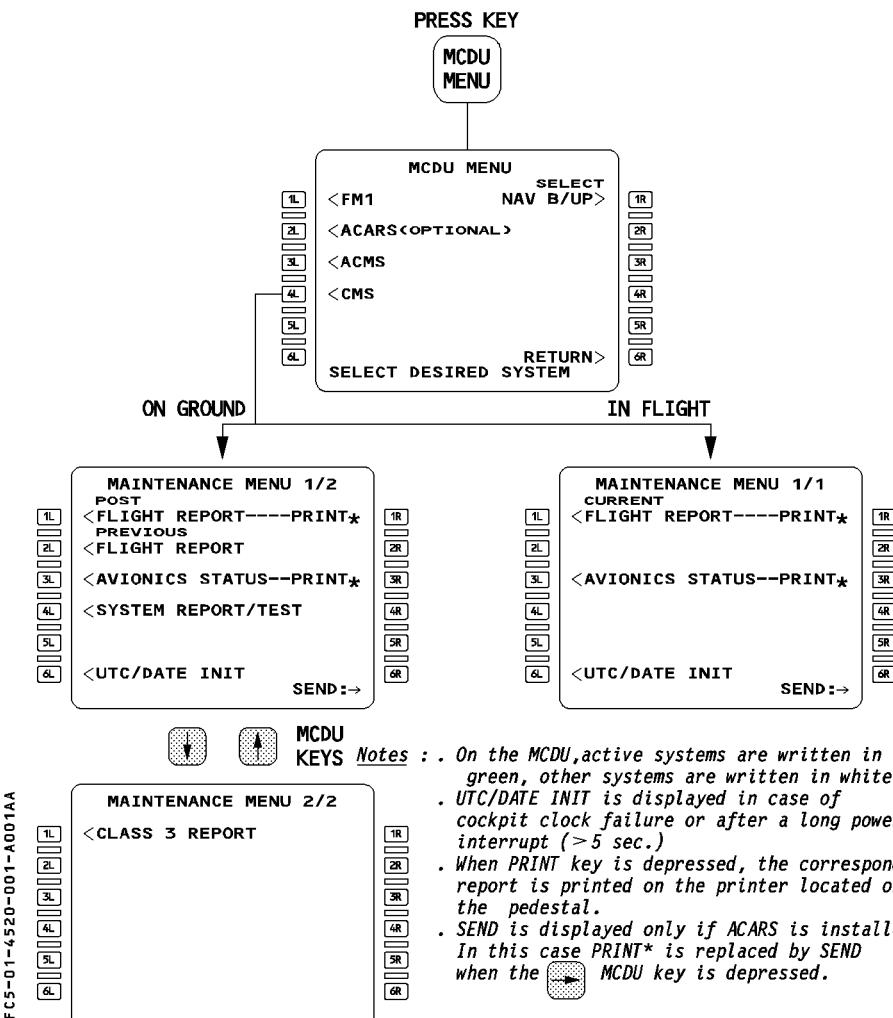
**COCKPIT / CMS INTERFACE**

FFC5-01-4510-005-A001A4

**MAINTENANCE MENU**

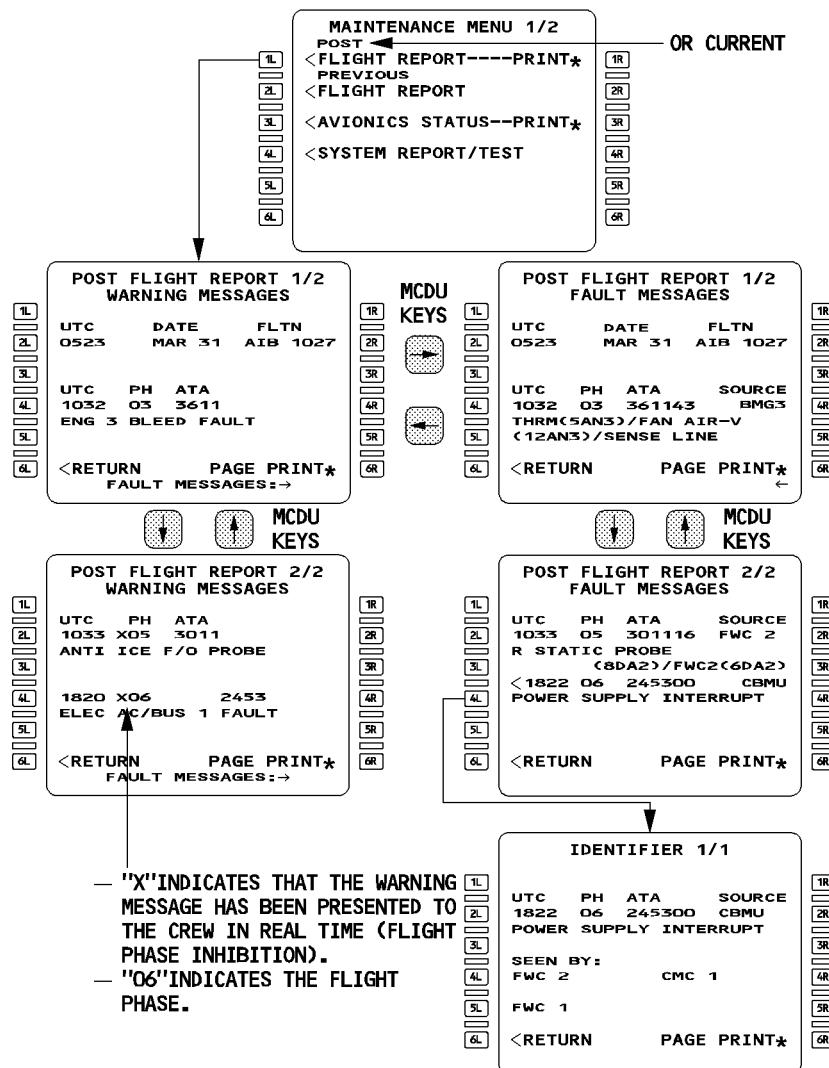
The CMS uses menus displayed on the MCDU. The operator chooses the functions or reports inside these menus.

Pressing the "MCDU MENU" key and then selecting CMS gives access to the MAINTENANCE MENU page. These pages are different in flight and on ground.



**POST OR CURRENT FLIGHT REPORT**

POST FLIGHT REPORT on ground or CURRENT FLIGHT REPORT in flight, presents all class 1 and 2 failures and all system failure messages received by the CMS during the last flight leg or current leg.



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FLIGHT CREW OPERATING MANUAL

**MAINTENANCE SYSTEM**

1.45.20 P 3

**SYSTEM OPERATION**

SEQ. 001 REV. 10

The POST or CURRENT FLIGHT REPORT is automatically printed after engines shut down or manually by selecting the PRINT key.

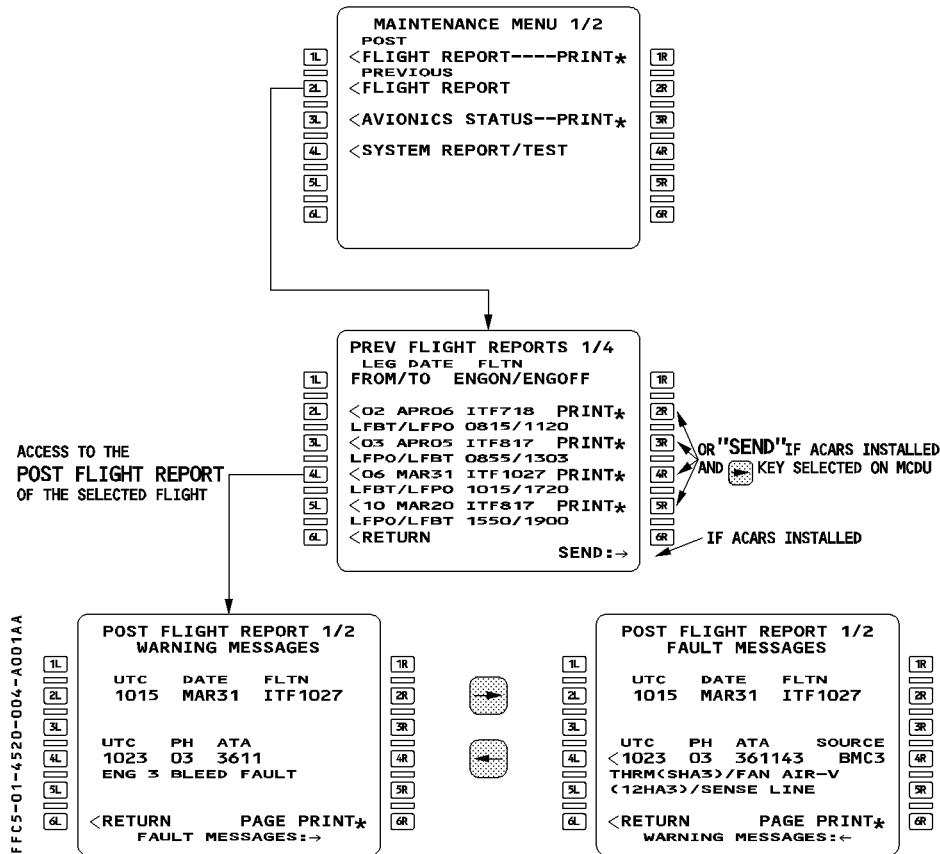
- R It is also automatically send to ACARS or ATSU (if installed) after engines shut down or manually by selecting SEND.

**POST FLIGHT REPORT print out**

MAINTENANCE (CURRENT or) POST FLIGHT REPORT				LEG-00
AIRCRAFT IDENTIFICATION : F-GGEA DATE : MAR31 FLIGHT NUMBER : AIB 1027	ENGINE ON/ENGINE OFF : 1015/1720 FROM/TO : LFBO/LFBT	PRINTING DATE : APR02 UTC : 1406		
COCKPIT EFFECTS		FAULTS		
ATA 36-11 MESSAGE DISPLAYED : ENG 3 BLEED FAULT	UTC: 1032 FLIGHT PHASE : TAKEOFF ROLL	ATA 36-11-42 SOURCE : BMC3 MESSAGE : THRM (5HA3)/FAN AIR-V (12HA3)/SENSE LINE	INTERMITTENT	CLASS 1 IDENTIFIERS : CP1C CPC2
ATA 30-11 MESSAGE DISPLAYED : ANTI-ICE F/O PROBE	UTC: 1033 FLIGHT PHASE : CLIMB	ATA 36-11-16 SOURCE : PHC2 MESSAGE : R STATIC PROBE (8DA2)/ PHC2 (6DA2)	HARD	CLASS 1 IDENTIFIERS : ADIRU1 ADIRU2 ADIRU3
ATA 24-53 MESSAGE DISPLAYED : ELEC AC 1.1 BUS FAULT	UTC : 1822 FLIGHT PHASE : CRUISE	ATA 24-53-00 SOURCE : SDAC MESSAGES : POWER SUPPLY INTERRUPT	HARD	CLASS 1 IDENTIFIERS : CBMU
END OF REPORT (or CONTINUED, if more than 1 page)				

## PREVIOUS FLIGHT REPORT

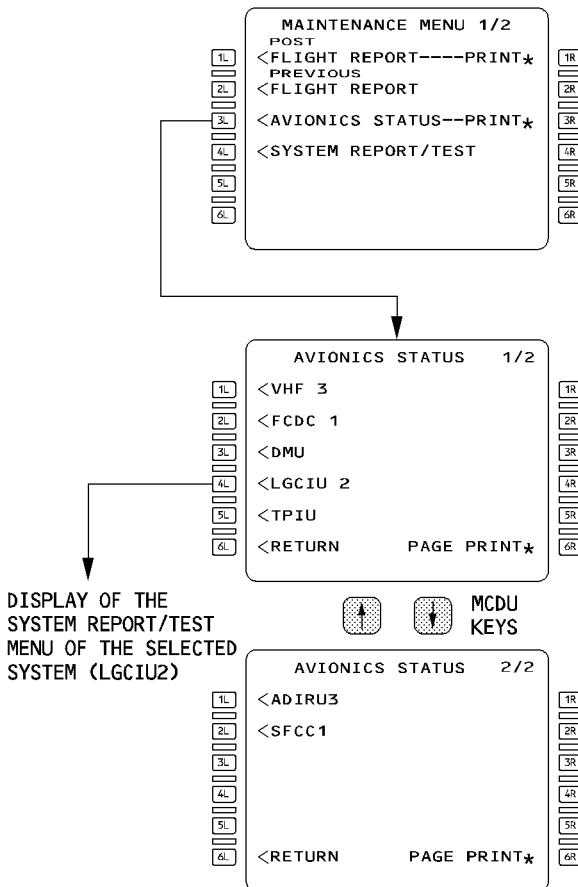
This report allows to have access to the POST FLIGHT REPORTS of the 63 previous flight legs.



- R On ground, the operator can print either a flight report or a screen copy. The format is identical to the POST FLIGHT REPORT's one. If ACARS or ATSU is installed, the operator can send a flight report by selecting the corresponding SEND key.

**AVIONICS STATUS**

- R This screen displays the list of systems affected by a Class 1 or 2 failure.
- R The Operator can press the button next to a system to directly call up that system page without going through the SYSTEM REPORT/TEST menu.
- R



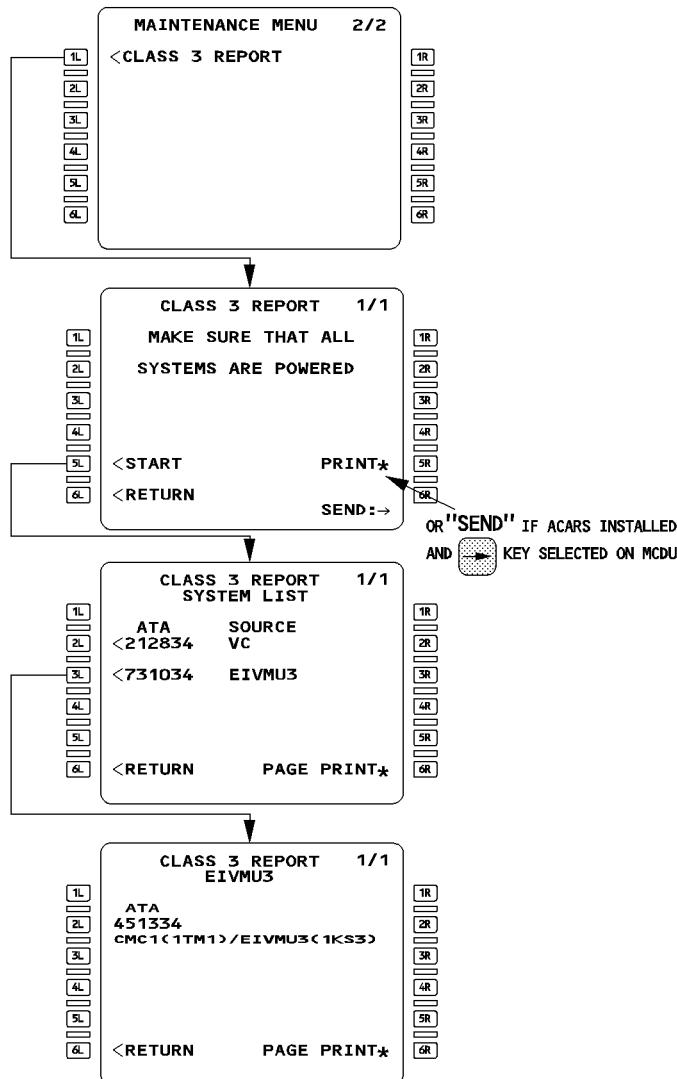
In flight, or on ground, the operator can either print the complete AVIONICS STATUS report, or only a copy of the screen.

**AVIONICS STATUS print out**

MAINTENANCE AVIONICS STATUS			
AIRCRAFT IDENTIFICATION : F-GGEA	PRINTING	DATE : APR10	UTC : 1830
VHF3 TPIU	FCDC1 ADIRU3	DMU SFCC1	LGCIU2
END OF REPORT (or CONTINUED, if more than 1 page)			

CLASS 3 REPORT

This report is created upon operator request only on ground. It presents all class 3 failures detected during the last flight leg, classified by ATA reference number.



On ground, the operator can print either the complete report or only a screen copy. If R ACARS or ATSU is installed, he can send the complete CLASS 3 REPORT.

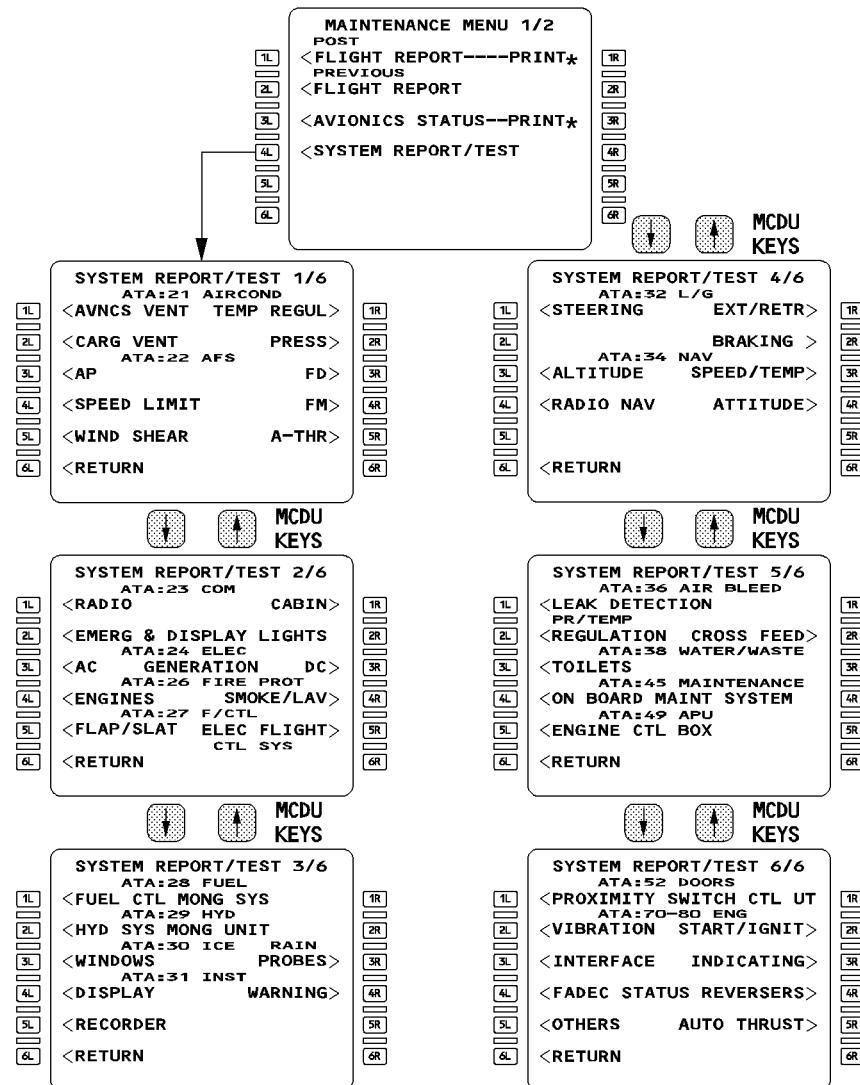
**CLASS 3 REPORT print out**

<b>MAINTENANCE CLASS 3 REPORT</b>				
AIRCRAFT IDENTIFICATION : F-GGEA			PRINTING	DATE : APR10 UTC : 1830
SOURCE				
ATA	NAME	ATA MESSAGE :		ATA MESSAGE :
212834	VC	212830 OUTFLOW VALVE 10HL1 451334 CMC1(1TM1)/EIVMU3(1KS3)		213020 TEMP SENSOR 23HK
731034	EIVMU2	451334 CMC1(1TM1)/EIVMU3(1KS3)		
END OF REPORT (or CONTINUED, if more than 1 page)				

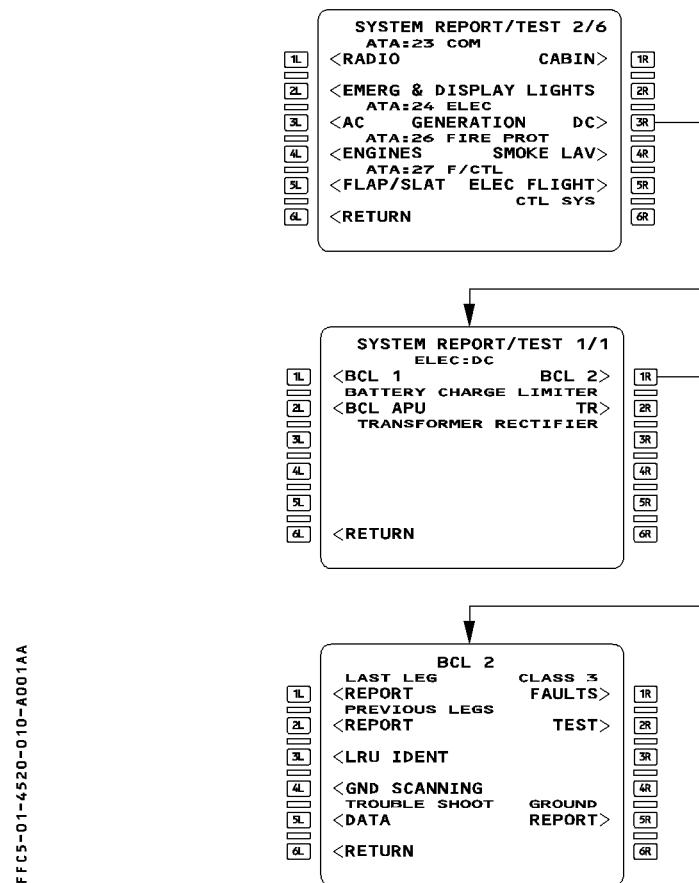
**SYSTEM REPORT / TEST**

It allows access to all electronic systems. After the system selection, the CMC enters into the interactive dialogue with this system.

All systems are classified by ATA chapter on six MCDU pages.



Example : access to BCL 2



In this example, the operator has accessed to the menu of the selected systems :

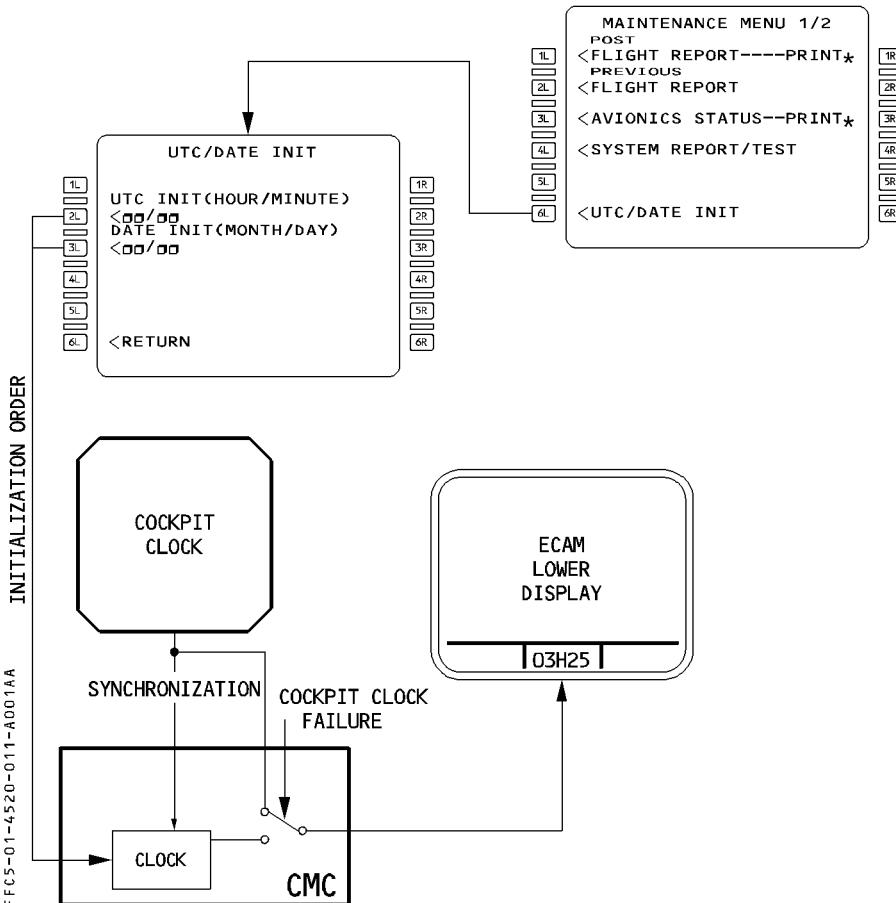
- LAST or PREVIOUS LEG REPORT : presents the list of LRU affected by a failure
- LRU IDENT : contains the P / N of all LRUs of the system.
- GND SCANNING : runs the flight monitoring on ground and presents the faulty LRU
- TROUBLE SHOOT DATA : provides system internal data concerning each failure.
- CLASS 3 FAULT : presents class 3 failures detected by the system during the last flight leg.
- TEST : runs the power up test and system test (if any) and display the result.
- GROUND REPORT : presents the list of LRU affected by a failure with the aircraft on ground.

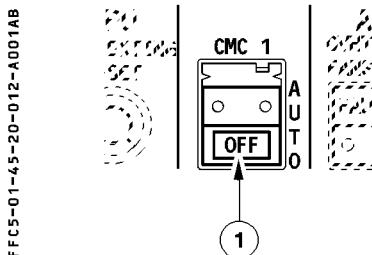
**UTC / DATE INIT**

The CMC transmits to the aircraft systems, and the lower ECAM displays the GMT coming from the main clock (except in Phases 1 and 2, if the WBS system is installed).

In case of cockpit clock failure, the internal clock of the CMC (synchronized on the cockpit clock) takes over. If, in addition, there is a long power interrupt (greater than 5 seconds), crew action is required to initialize the GMT and DATE via the MCDU.

R



**CMC RECONFIGURATION****① CMC 1 pb sw**

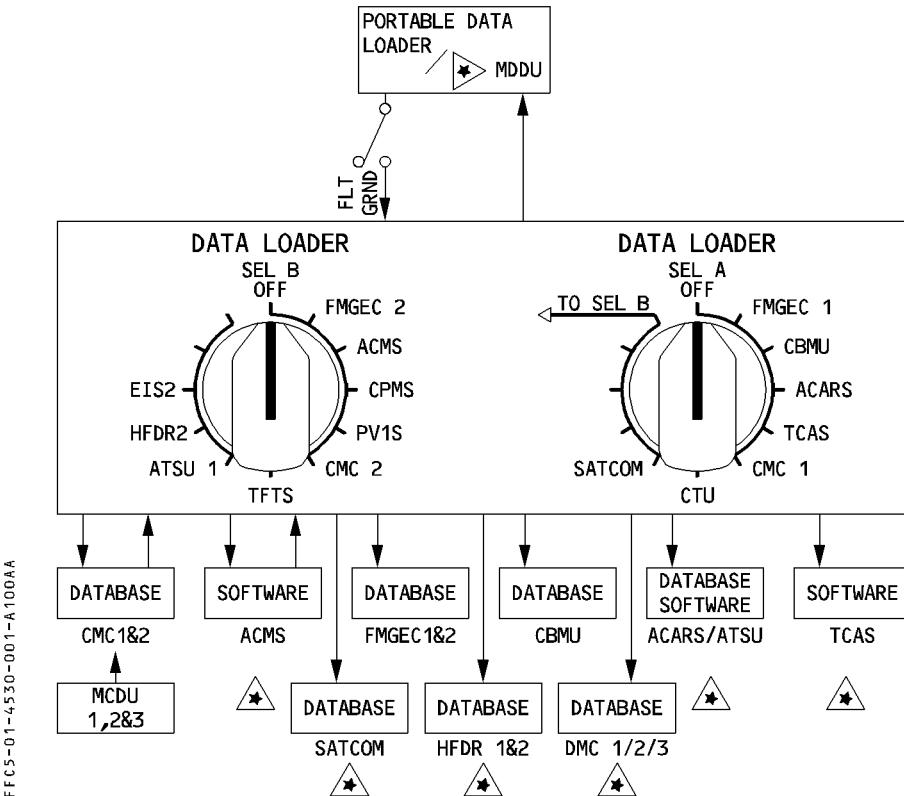
- AUTO : CMC 1 is active while CMC 2 is in stand-by.  
CMC 2 automatically takes over if CMC 1 fails.
- OFF : CMC 1 selected off.  
CMC 2 is active.

## **DESCRIPTION**

With the data loading system, it is possible to either upload databases and operational software, or to download system reports from various onboard computers.

Data transfer is performed on 3.5 inch diskettes, via a portable data loader or (◀) the aircraft's fixed Multipurpose Disk Drive Unit (MDDU). The Data Loader selector, on the overhead panel, enables the applicable aircraft system to be selected.

R

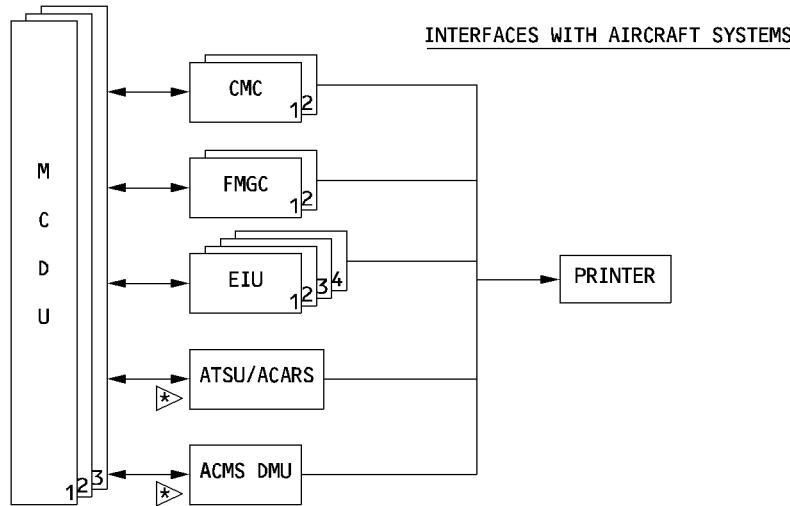


**DESCRIPTION**

The printer is the output unit for data printing which can be generated either manually from the MCDUs or automatically depending on the system.

The data printings are described in the CMC FUNCTIONS description 1.45.20 or in the according system descriptions.

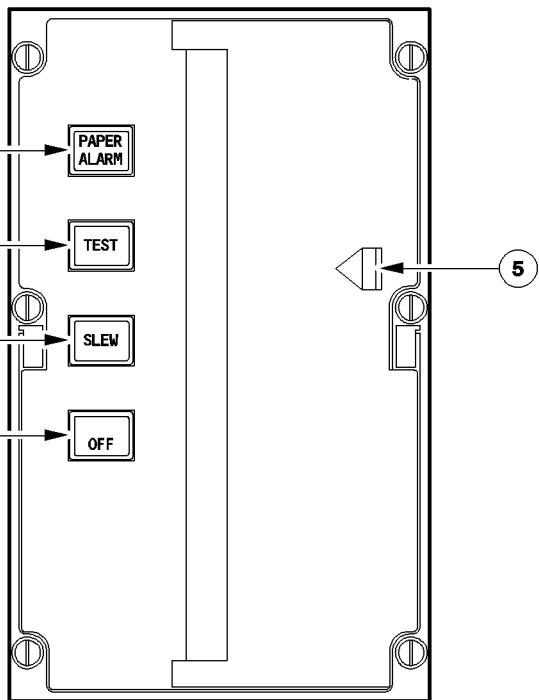
FFC5-01-4535-001-A001AB



The printer is installed at the rear of the pedestal on the F/O side.

**CONTROLS AND INDICATORS**

FFC5-01-4535-002-A001AA

**① OFF pb sw**

OFF : OFF light (amber) comes on steady, printer is off.

On : OFF light extinguishes, then after approximately 30 seconds it illuminates for 10 seconds while power up test is performed. Then the printer is in normal operation provided :

- no indication light on front panel is illuminated
- the access door is closed
- there is paper in front of the print head.

Note : When a printer internal fault is detected the pushbutton illumination will come on steady.

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FLIGHT CREW OPERATING MANUAL

**MAINTENANCE SYSTEM**

1.45.35 P 3

PRINTER

SEQ. 001 REV. 07

**(2) TEST pb**

When depressed a printing of a test pattern is performed, provided the printer is not in communication with a connected system. During test the OFF light is flashing.

**(3) SLEW pb sw**

The SLEW pb sw is used to exit paper from the printer.

**(4) PAPER ALARM pb sw**

The pb sw is illuminated when there is approximately less than 25 ft of paper available in the printer.

For testing the PAPER ALARM light the pushbutton is depressed. The illumination goes off approximately 2 seconds after releasing the pushbutton.

Note : If SLEW and PAPER ALARM pb sw are depressed at the same time.

- during the printout of a message, the printout is aborted. PAPER ALARM pb illuminates.
- while there is no printout, access door is open and paper roll outside the printer, the paper is moved rearward. This function can be used in case of a paper jam inside the printer.

**(5) PRINTER DOOR latch**

The printer door latch locks the printer door. The access door is spring loaded and stays open when released. On the inner side of the door, a label gives paper loading instructions.

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FLIGHT CREW OPERATING MANUAL

**MAINTENANCE SYSTEM****ELECTRICAL SUPPLY**

1.45.40 P 1

SEQ. 001 REV. 07

**BUS EQUIPMENT LIST**

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
CMC 1				GND		
CMC 1 SWITCHING		DC 1				
CMC 2	AC 2-4					
CMC 2 SWITCHING		DC2				
DATA LOADER	AC 1-2					
PRINTER	AC 1-1					

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FLIGHT CREW OPERATING MANUAL

<b>APU</b>	1.49.00	P 1
	CONTENTS	SEQ. 001   REV. 09

**49.00 CONTENTS****49.10 DESCRIPTION**

– GENERAL . . . . .	1
– MAIN COMPONENTS . . . . .	2

**49.20 CONTROLS AND INDICATORS**

– OVERHEAD PANEL . . . . .	1
– EXTERNAL CONTROLS . . . . .	3
– ECAM APU PAGE . . . . .	4
– WARNINGS AND CAUTIONS . . . . .	6
– MEMO DISPLAY . . . . .	6

**49.30 ELECTRICAL SUPPLY**

**GENERAL**

The Auxiliary Power Unit (APU) is a self contained unit which makes the aircraft independent of external pneumatic and electrical power supply.

**On ground**

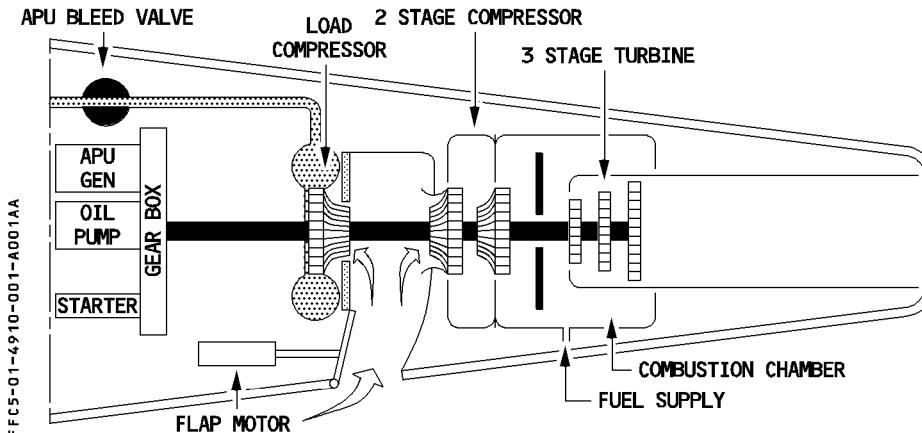
- R – It supplies bleed air for starting the engine and for the air conditioning system.
- R – It supplies electrical power to the electrical system.

**During Take-Off**

- R – It supplies bleed air for air conditioning, thus avoiding a reduction in engine thrust caused by the use of engine bleed air for this purpose, when optimum aircraft performance is required.

**In Flight**

- R · It backs up the Electrical system
- R · It backs up the Air conditioning
- R · It can be used to start the engines
- R The APU may obtain power for starting from the aircraft batteries, or in combination with the external power, or from ground service, or from normal aircraft supply.  
APU start is permitted throughout the normal flight envelope, except when APU battery only is supplying. (Refer to FCOM 3 01.49).  
The ECAM displays APU parameters..

**FOR INFO**

## MAIN COMPONENTS

### APU ENGINE

- R The basic element of the APU is a single shaft gas turbine which delivers mechanical shaft
- R power for driving the accessory gearbox (electrical generator) and produces bleed air
- R (engine starting and pneumatic supply).

### ELECTRONIC CONTROL BOX

The Electronic Control Box (ECB) is primarily a full authority digital electronic controller that performs the APU system logic for all modes of APU operation such as :

- Sequence the start and monitors it
- Monitors speed and temperature
- Monitors bleed air (IGV)
- Sequence the shut down (manual or automatic)

### AIR INTAKE SYSTEM

- R The air intake and an electrically operated flap allow the external air to reach the
- R compressor inlet.

### STARTER

- R The ECB controls the electrical starter. The starter engages if the air intake is fully open and
- R provided the MASTER SW and the START pushbutton are ON.

### FUEL SYSTEM

The APU is supplied from the trim tank transfer line (Refer to 1.28.10)

- R The ECB controls the fuel flow.

### OIL SYSTEM

The APU has an integral independent lubrication system (for lubrication and cooling).

### INLET GUIDE VANES (IGV)

- R The IGVs control bleed air flow, and a fuel-pressure-powered actuator positions the IGVs.
- R The ECB controls the actuator in response to aircraft demand.

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FLIGHT CREW OPERATING MANUAL

APU	1.49.10	P 3
DESCRIPTION	SEQ. 100	REV 09

## AIR BLEED SYSTEM

The ECB controls the APU BLEED valves. It is automatically closed above 25000 ft (climbing) or 23000 ft (descending).

### R CONTROLS

- R The flight crew uses the controls on the APU panel for routine shutdown. For emergency shutdown :
  - R – The flight crew can push the APU FIRE handle, or
  - R – The ground crew can push the APU SHUT OFF pushbutton on the interphone panel under the nose fuselage or the APU EMER SHUT DOWN pushbutton on the refueling/defueling panel.

## GROUND OPERATIONS SAFETY DEVICES

### — APU FIRE WITH AUTOMATIC SHUTDOWN

The APU may run, without cockpit crew supervision, when the aircraft is on ground. In case of fire in the APU compartment :

- APU fire warnings operate in the cockpit
- A horn in the nose gear bay sounds
- The "AVAIL" light goes off
- The "FAULT" light in the MASTER SW comes on
- The APU shuts down
- The APU fire extinguisher discharges.

Note : On ground, the No Break Power Transfer (NBPT) function is inhibited, in the following cases of APU shutdown :

- The APU is shut down, by using the APU SHUT OFF switch on the external power panel (925 VU).
- An APU emergency shutdown is triggered, by using the APU EMER SHUT DOWN switch on the REFUEL/DEFUEL panel (990VU).
- An automatic APU shutdown is triggered by the ECB.
- The APU is shut down, by using the APU FIRE pushbutton.

## OPERATION UNDER FAILURE CONDITIONS

### — APU FAULT WITH AUTOMATIC SHUTDOWN

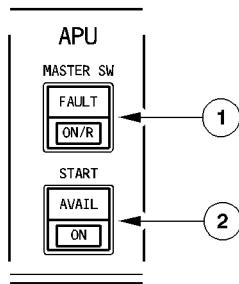
The following failures cause an automatic shutdown :

1. Overspeed
2. Certain critical ECB internal failures
3. Underspeed
4. Start abort
- R 5. Low oil pressure
6. High oil temperature
7. Load compressor overtemperature
8. Generator high oil temperature
9. DC power interrupt (BAT OFF, when aircraft on batteries only)
10. Overtemperature
11. Certain ECB internal failures

Failure causes 1 and 2 lead to an automatic shutdown (protective shutdown) in all flight phases. For failures 3 through 11, the automatic shutdown is inhibited to ensure APU availability (inhibited shutdown in flight phase 2 to 9).

**OVERHEAD PANEL**

FFC5-01-4920-001-A001AA

**① MASTER SW pushbutton**

This pushbutton controls the electric supply for APU operation, and its protective features. It also controls the start and shutdown sequences.

ON/R : – The blue ON light comes on.

- Electric power goes to the APU system, and the ECB performs a power-up test.
- The APU air-intake flap opens.
- The APU fuel isolation valve and APU LP valve open.
- Depending on the transfer activities of the trim tank, and on the pressure in the trim tank line, the FWD APU and AFT APU fuel pumps operate.
- If the aircraft has ground power or main generator power, the APU page appears on the ECAM display.

Off : Manual shutdown sequence.

- The ON light of the MASTER pushbutton SW goes off.
- The APU keeps running for a cooling period of 105 sec. at 100% speed.
- Then, after an additional running period of 15 seconds (for No Break Power Transfer), the APU shuts down and the AVAIL light goes off.
- At N 7 % the air-inlet flap closes.

*Note : Switching OFF then ON the MASTER SW resets the ECB.*

R FAULT It : This amber light comes on, and a caution appears on the ECAM, when an automatic APU shutdown occurs (Refer to 1.49.10).

**(2) START pushbutton**

**ON** : The blue light comes on.

When the flap is completely open, the APU starter is energized.

When N = 7 %, ignition is turned on.

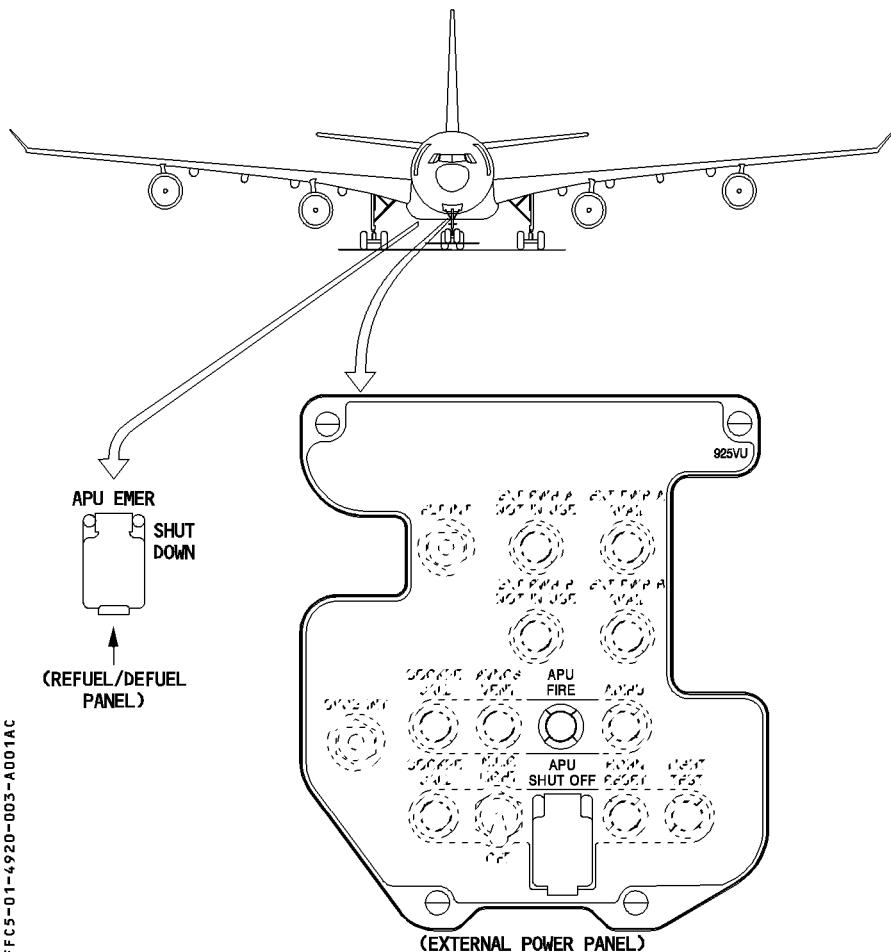
**R** When N = 50 %, the APU starter is de-energized, and ignition is turned off.

**R** When N = 95 %, the ON light on the START pushbutton goes off and AVAIL comes on in green.

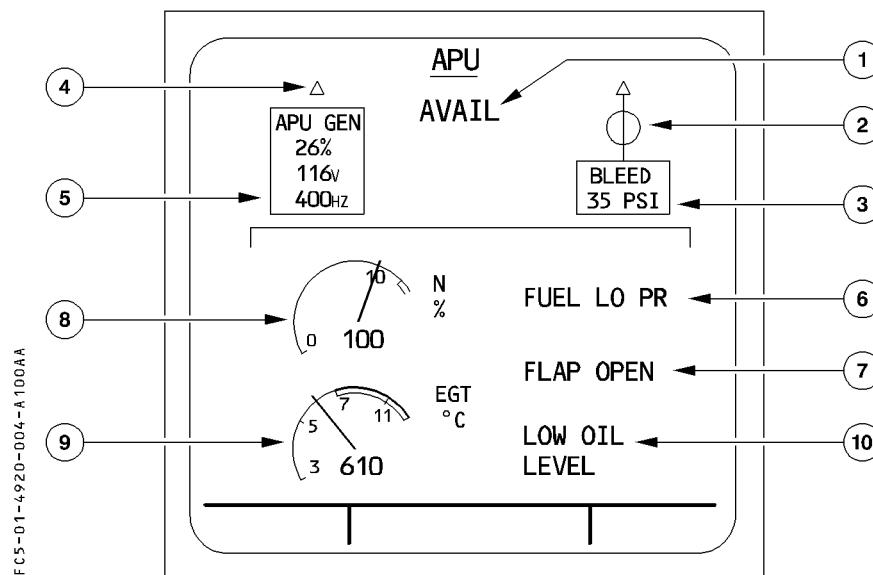
· The APU may now supply bleed air and electrical power to the aircraft systems.

10 seconds later, the APU page disappears from the ECAM display.

**AVAIL It** : This light comes on green, when N reaches 95 %.

**EXTERNAL CONTROLS**

FFC5-01-4920-003-A001AC

**ECAM APU PAGE****① AVAIL indication**

Displayed green when APU N above 95 %

**② APU bleed valve position**

- R Displayed only if the APU MASTER SW is ON/R.
- R  $\ominus$  green : APU valve fully open.
- R  $\ominus$  green : APU valve not fully open and APU BLEED pushbutton is OFF.
- R  $\ominus$  amber : APU valve not fully open if APU BLEED pushbutton is ON

**③ APU bleed air pressure**

- R This box displays the relative bleed air pressure in green.
- R It shows an amber XX when the ADIRS 1 is not available, or selected OFF.

**④ APU GEN line contactor indication**

- R Displayed in green when the APU GEN line contactor is closed. In white when if line contactor is open.

R (5) APU GEN

Identical to APU GEN parameters on ELEC page.

R (6) FUEL LO PR

R      Displayed amber if of APU fuel low pressure detection

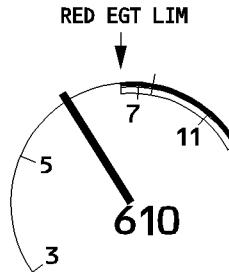
R (7) FLAP OPEN

R      Displayed green when APU air intake flap is fully open (MASTER SW pushbutton at ON)

R (8) APU N

R      – Displays APU speed in green

R      – Becomes red when  $N \geq 107\%$ .

R (9) APU EGT

FFC5-01-4920-005-A001AB

R      – Displays APU EGT (needle and digital indication) in green

R      – It pulses when the ECB detects an advisory

R      – Becomes red when  $EGT \geq RED\ EGT\ LIM^*$  associated with automatic shut down

R      \* ECB calculates the RED EGT LIM and transmits it to the ECAM, it is equal to

R      the lower border of the red sector. It is a function of N during start and a

R      function of ambient temperature and pressure when APU is running.

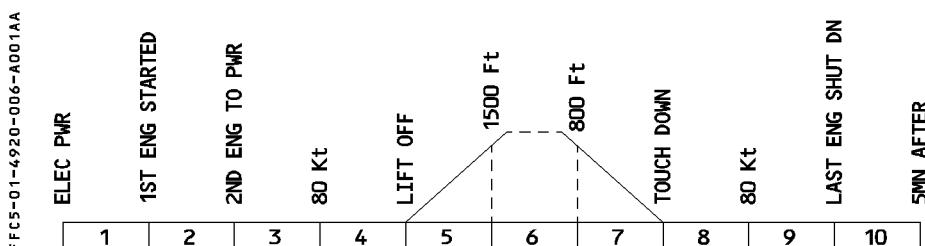
R      Maximum EGT during start :  $1250^\circ C$  (refers to 0 % APU speed)

R      Maximum EGT with APU running :  $650^\circ C$  (Sea level, standard day).

(10) LOW OIL LEVEL

R      Advisory : displayed if the ECB detects a low APU oil level when the aircraft is on

R      the ground and the APU is not running.

**WARNINGS AND CAUTIONS**

R

E/WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AUTO SHUT DOWN Automatic shut down of APU for a reason other than a fire	SINGLE CHIME	MASTER CAUT	APU	APU MASTER SW FAULT lt	3, 4, 5 7, 8
EMER SHUT DOWN Use of APU shut off pushbutton on interphone panel or on refueling/defueling panel or APU FIRE pushbutton pushed. If non automatic shut down a failure has been detected by the ECB, but the APU remains available.					

**MEMO DISPLAY**

APU AVAIL message is displayed in green when APU N is above 95 %.

**BUS EQUIPMENT LIST****FOR INFO**

R

	NORM			EMER ELEC			APU BAT BUS
	AC	DC	DC BAT	AC ESS	DC ESS	HOT	
ECB SUPPLY					X (2)		X (1)
STARTER MOTOR	APU TR						X

- R (1) ECB is supplied by APU HOT BUS on ground if APU BAT BUS is not supplied  
(2) This supply is necessary only during the APU start (due to a loss of voltage on the APU BAT BUS during this phase).

**A340**

FLIGHT CREW OPERATING MANUAL

DOORS	1.52.00	P 1
CONTENTS	SEQ. 001	REV. 08

**52.00 CONTENTS****52.10 DESCRIPTION**

– GENERAL . . . . .	1
– PASSENGER DOORS . . . . .	2
– EMERGENCY EXITS . . . . .	5
– CARGO DOORS . . . . .	5
– AVIONICS COMPARTMENT ACCESS DOOR . . . . .	7
– COCKPIT DOOR . . . . .	7
– ESCAPE SLIDES/RAFTS . . . . .	8
– DOORS AND SLIDES CONTROL SYSTEM . . . . .	10

**52.20 CONTROLS AND INDICATORS**

– ECAM DOOR / OXY PAGE . . . . .	1
– WARNINGS AND CAUTIONS . . . . .	2

**52.30 ELECTRICAL SUPPLY**

R

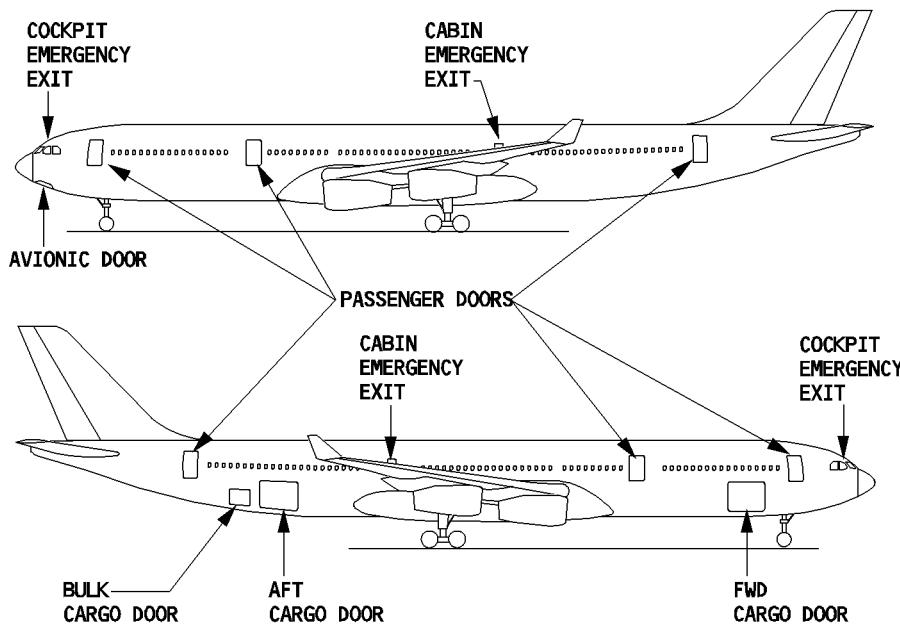
**GENERAL**

R The fuselage of A340 has :

- six passenger doors
- two emergency exits in the cabin
- cockpit emergency exits (two sliding windows).
- three cargo compartment doors
- one avionic compartment access door.

All doors are monitored by the Door and Slide Control System (DSCS) which generate warnings on ECAM and on the doors themselves.

FFC5-01-5210-001-A001AA



## PASSENGER DOORS

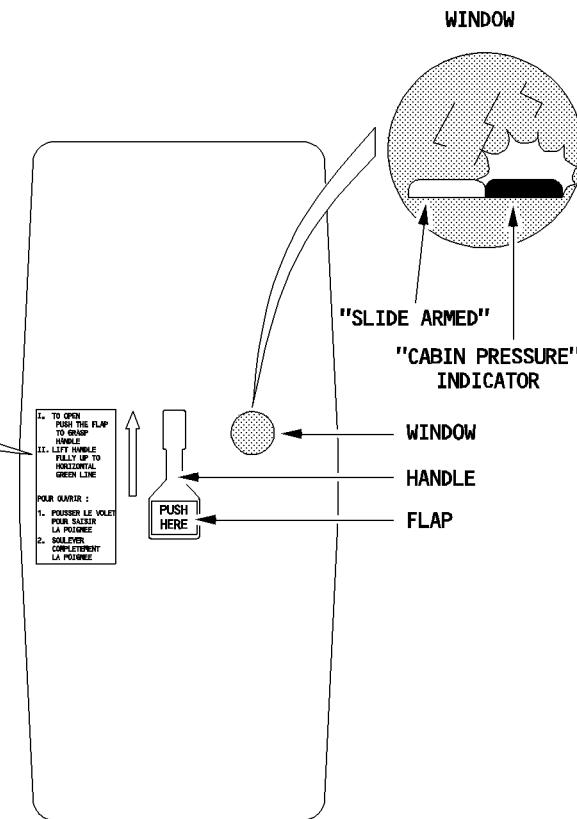
- R The aircraft has six plug-type doors that open outward and forward. There are three of these on each side of the fuselage (two forward, two mid, two aft).
- R They can be operated from inside or outside the aircraft. Normal operation is manual, with hydraulic damping.
- R Each door has features that tailor it to emergency situations :
  - an escape slide stowed in a container attached to the inboard lower side of the door.
  - a damper actuator that limits the door travel in normal mode, but in an emergency acts as an actuator for automatic door opening.
  - a slide arming lever.
- R When the slide arming lever is in the ARMED position, the slide is connected to the floor brackets on both sides of the door. When the door is opened, the slide inflates and deploys automatically. If the inflation bottle fails to discharge automatically, a crew member can open its valve to make it perform its function.
- R Opening the door from the outside disarms the door and the escape slide.
- R Each passenger door has :
  - two mechanical locking indicators that shows whether the door is locked or unlocked
  - one warning light to show whether the escape slide is ARMED or DISARMED
  - one CABIN PRESSURE warning light that warns of residual pressure in the cabin

**OUTSIDE**

I. TO OPEN  
PUSH THE FLAP  
TO GRASP  
HANDLE  
II. LIFT HANDLE  
FULLY UP TO  
HORIZONTAL  
GREEN LINE

POUR OUVRIR :

1. POUSSER LE VOLET
- POUR SAISIR LA POIGNEE
2. SOULEVER COMPLÈTEMENT LA POIGNEE

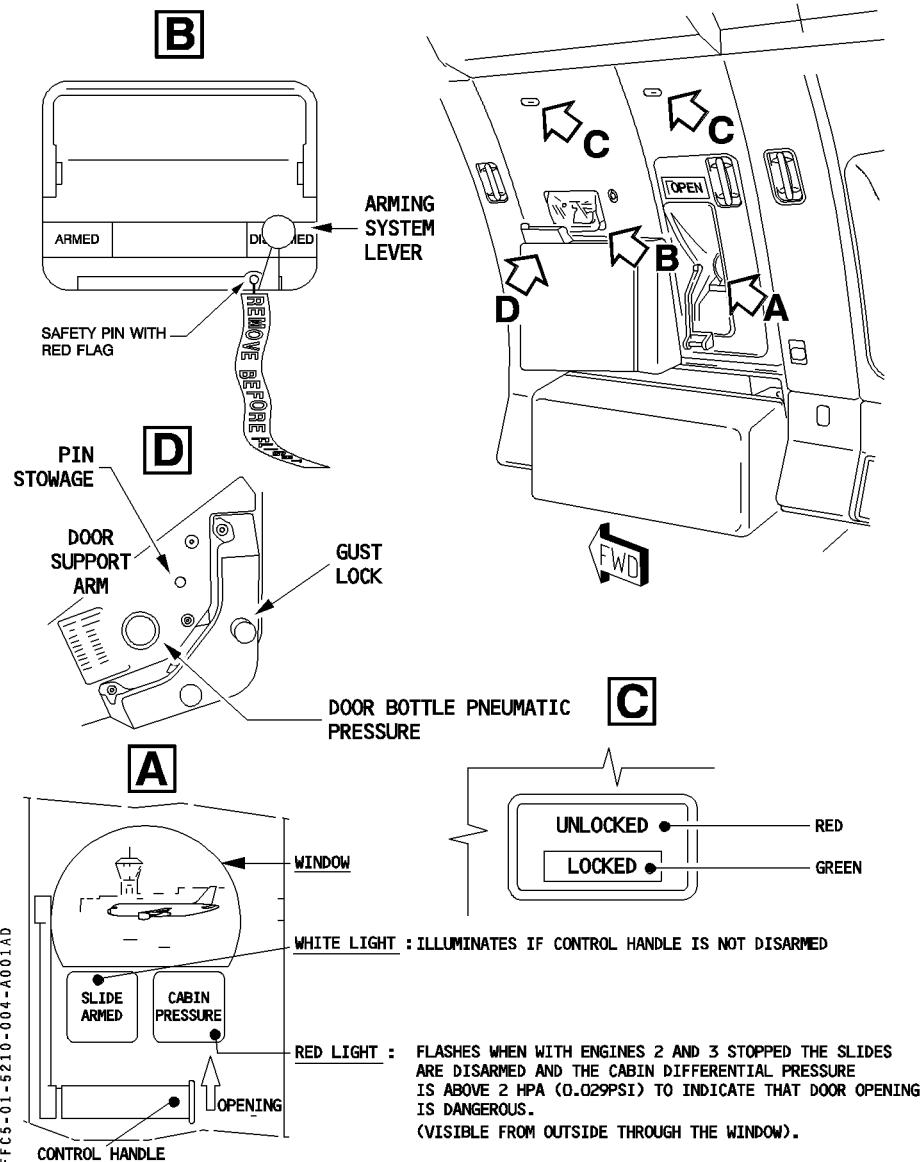


FC5-01-5210-003-A001AA

- R Each cabin door can be opened from the outside.
- R Opening instructions are posted next to the opening handle.
- R Note : Opening a cabin door from the outside disarms the automatic opening system.

**INSIDE**

R



**A340**

FLIGHT CREW OPERATING MANUAL

DOORS	1.52.10 P 5	
DESCRIPTION	SEQ. 104	REV. 19

## EMERGENCY EXITS

### COCKPIT

The two sliding windows in the cockpit are flight crew emergency exits.

A small compartment, located above each window, contains an escape rope that reaches the ground, when lowered through the window on the other side of the cockpit.

The cockpit windows can only be opened from the inside.

Emergency cockpit evacuation is also possible through the cockpit door escape panel. It is designed to be pushed open in the direction of the cabin, after removal of the quick-release pins.

### CABIN

One plug-type emergency exit is located on each side of the cabin.

They open outward and forward, and are each equipped with an escape slide, stowed in a compartment, below the cabin floor.

## CARGO DOORS

The aircraft has three cargo doors on the right side of the fuselage, below the cabin floor.

### FWD AND AFT CARGO DOORS

These outward and upward opening doors are mechanically-locked and hydraulically-operated by the yellow hydraulic system.

If the yellow system's electric pump fails, the system can be pressurized by using a hand pump, located on the hydraulic maintenance panel.

The FWD and AFT cargo doors can only be opened from the outside.

A red light, fitted in the locking handle's housing area, indicates a residual cabin pressure. The door open indicator light shows that the door is locked in the open position, allowing safe cargo loading operation.

Ten flag indicators show whether the door is fully locked. A popped-out indicator flag signifies that a hook is not locked.

*Note : When the electric pump operates the FWD or AFT cargo doors, the only other yellow system device that can operate is Engine 3 reverse. The yellow hydraulic leak measurement valves close, and an SFCC inhibition prevents any flap movement.*

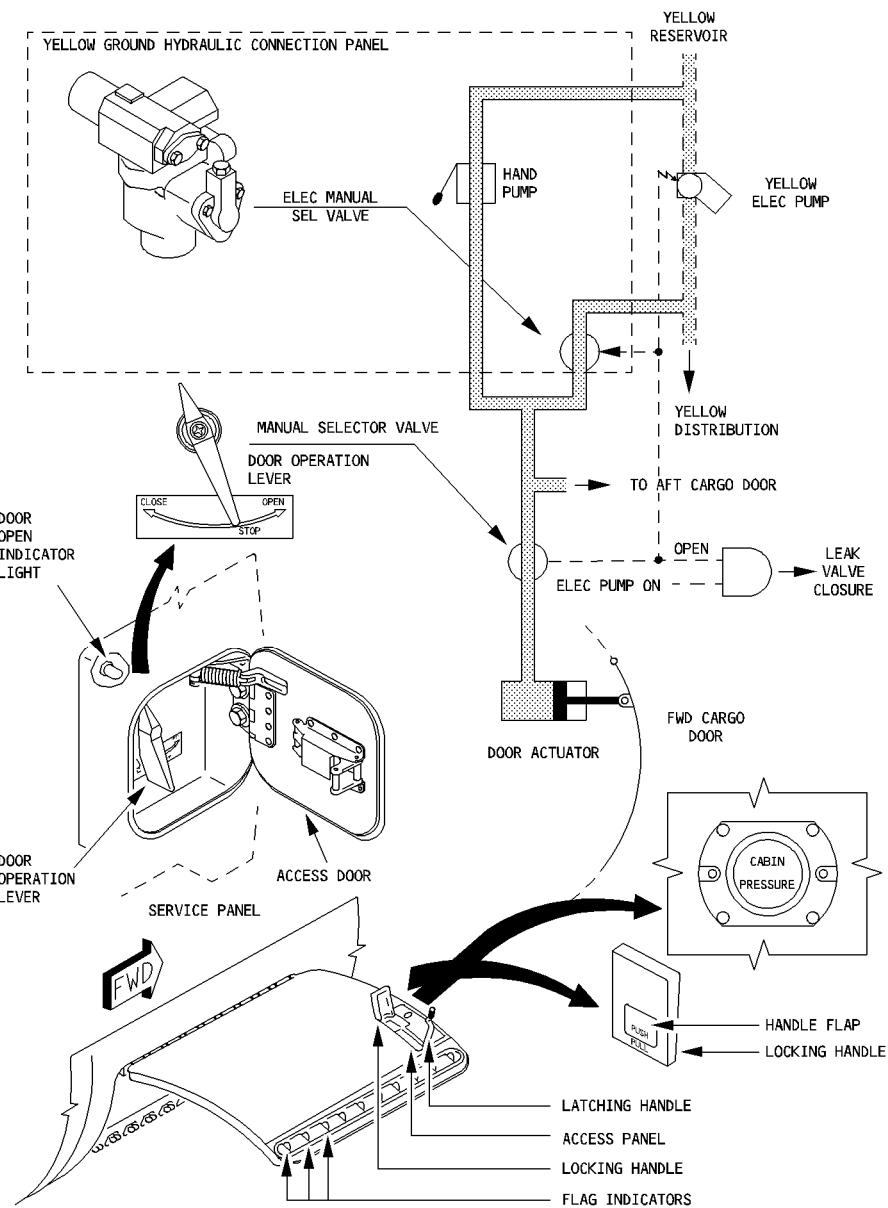
### BULK CARGO DOOR

The BULK plug-type cargo door is mechanically-locked and manually-operated.

It opens inwards then upwards, and can be either opened from the inside or outside.

**CARGO DOORS****FOR INFO**

R



**A340**

FLIGHT CREW OPERATING MANUAL

DOORS	1.52.10	P 7
DESCRIPTION	SEQ. 100	REV 18

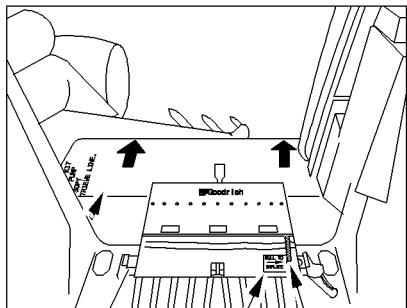
### **AVIONICS COMPARTMENT ACCESS DOOR**

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

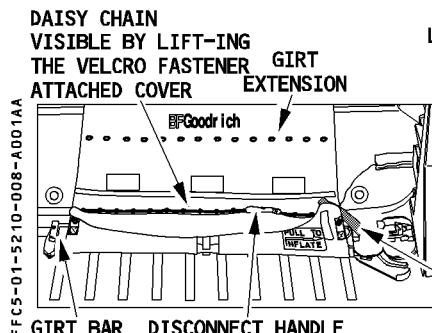
This compartment is also accessible from the cockpit, via a floor hatch located behind the captain's seat. A fixed ladder is in the avionics compartment for access from the cockpit.

### **COCKPIT DOOR**

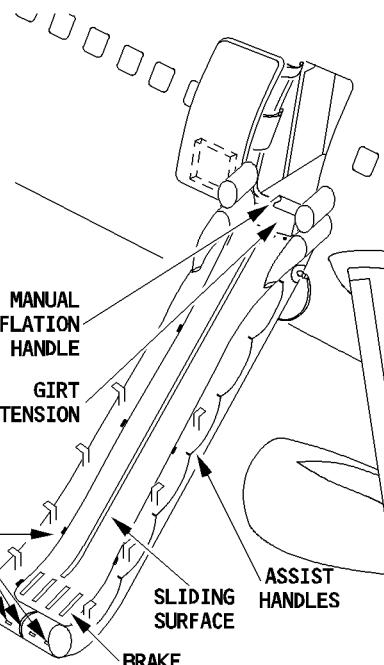
Refer to 1.25.11, for information about the secured cockpit door.

**ESCAPE SLIDES/RAFTS****PASSENGER DOOR SLIDES/RAFTS**

GIRT BAR      INSTRUCTION PLACARD  
MANUAL INFLATION HANDLE (RED)  
ATTACHED WITH VELCRO FASTENER



DAISY CHAIN  
VISIBLE BY LIFT-ING  
THE VELCRO FASTENER  
GIRT ATTACHED COVER      GIRT EXTENSION  
LIGHTS  
GIRT BAR      DISCONNECT HANDLE  
MANUAL INFLATION HANDLE  
DETACHED FROM VELCRO FASTENER

**— SLIDE MODE**

Automatic operation : Normally automatic inflation when slide is armed and door opens

Manual operation : If the slide falls down from the door but does not inflate, inflation can be started manually by pulling the handle which is attached at the girt extension of the slide/raft.

**— RAFT MODE**

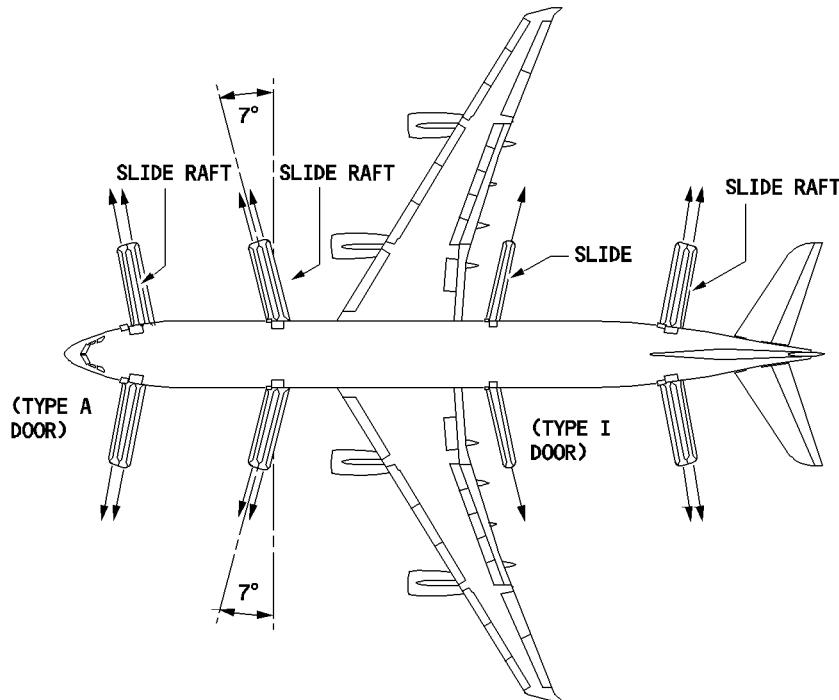
To disconnect the slide from the aircraft, pull the disconnect handle. The slide raft is moored to the aircraft by means of the ditching line which has to be cut to completely free the slide/raft from the aircraft.

**EMERGENCY EXIT SLIDES**

Operation is identical to passenger door slides/rafts operation. Only slide mode is available.

**ESCAPE SLIDE ARRANGEMENT**

- R Each passenger door has a dual lane escape slide raft and each emergency exit has a single lane escape slide.



## DOORS AND SLIDES CONTROL SYSTEM

The Doors and Slides Control System (DSCS) consists in :

- proximity switches installed on each door
- the Proximity Switch Control Unit (PSCU)
- a pressure switch ( $\Delta P$  of the cabin)
- an autonomous standby power supply

The Doors and Slide Control system performs the following functions:

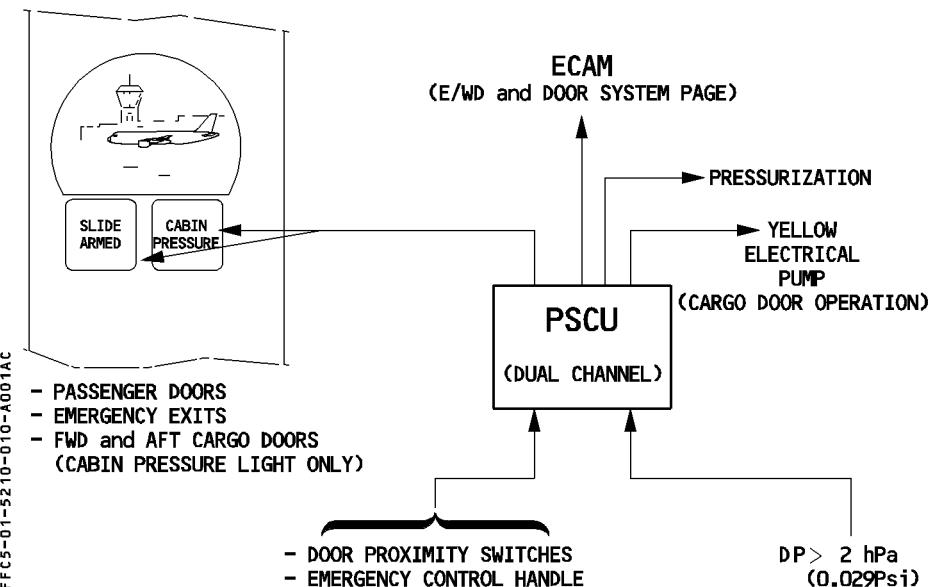
- Door warning system: to indicate on the ECAM the state (LOCKED/UNLOCKED) of each door
- Escape slide warning system: to indicate on the ECAM and on the slide warning light the state (ARMED / DISARMED) of the slide.
- Overpressure warning system: to indicate an excessive residual differential cabin pressure to the passenger doors, the emergency exits and the FWD and AFT cargo doors.
- Electrical control of the FWD and AFT cargo doors.

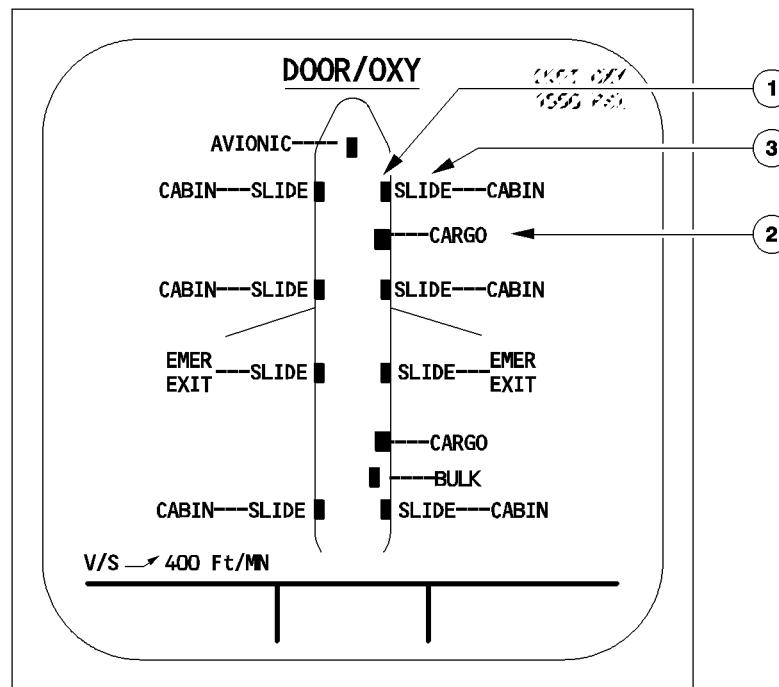
The DSCS also prevents the aircraft pressurization with one engine running when a door (CAB, CARGO, BULK) is not fully closed and locked or if a sensor is defective. In this case the DSCS sends a signal to the cabin pressure system to keep the outflow valves open and to the Zone Controller to close the pack flow control valves.

## ARCHITECTURE

R

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**ECAM DOOR / OXY PAGE****① DOOR symbol**

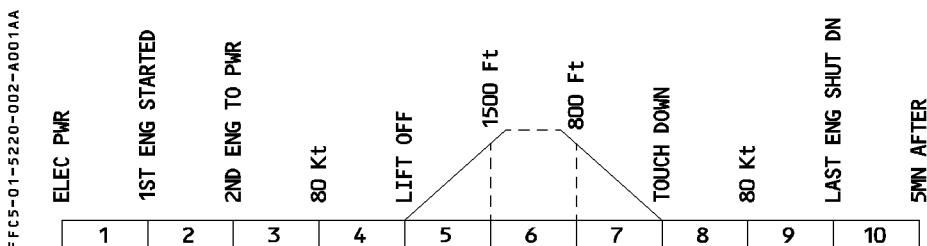
Green (symbol outline) : the door is closed and locked.  
Amber (filled symbol) : the door is not locked

**② DOOR indication**

- R This appears amber when door is not locked.  
R This appears white when the information is not valid.  
R This is suppressed when door is closed

**③ SLIDE indication**

- R SLIDE appears white when slide is armed.  
- - - appears amber when the slide is disarmed and the door is open.  
Both suppressed when the slide is disarmed and the door is closed.

**WARNINGS AND CAUTIONS**

R

E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L (R) FWD CABIN L (R) MID CABIN L (R) AFT CABIN L (R) EMER EXIT FWD (AFT) (BULK) CARGO AVIONIC	SINGLE CHIME	MASTER CAUT	DOOR	NIL	1, 4, 5, 7, 8, 10
POS DET 1 (2) (1 + 2) PSCU failure					3, 4, 5, 7, 8

**BUS EQUIPMENT LIST****FOR INFO**

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
DOORS and SLIDES CTL	NORMAL		GND/FLT				
	STBY			X (1)			
COCKPIT DOOR			X				

- (1) If both busbars are inoperative the system is supplied by an autonomous standby power supply (Battery).

**70.00 CONTENTS****70.10 ENGINE**

– GENERAL . . . . .	1
– DESCRIPTION . . . . .	1

**70.20 FADEC**

– GENERAL . . . . .	1
– FUNCTIONS . . . . .	3
– POWER SUPPLY . . . . .	5

**70.30 THRUST CONTROL SYSTEM**

– GENERAL . . . . .	1
– THRUST LEVERS . . . . .	1
– THRUST RATING LIMIT . . . . .	2
– THRUST CONTROL . . . . .	3

**70.40 FUEL SYSTEM**

– GENERAL . . . . .	1
– FUEL PUMP UNIT . . . . .	2
– SHUT-OFF VALVES . . . . .	2
– HYDROMECHANICAL UNIT . . . . .	2
– IDG COOLING SYSTEM . . . . .	6

**70.50 OIL SYSTEM**

– GENERAL . . . . .	1
---------------------	---

**70.60 AIRBLEED SYSTEM**

– GENERAL . . . . .	1
– COOLING . . . . .	2

**70.70 THRUST REVERSER SYSTEM**

– GENERAL . . . . .	1
– ACTUATION LOGIC . . . . .	2
– ENG1 AND 4 THRUST REVERSER LEVER INTERLOCK . . . . .	2
– IDLE PROTECTION . . . . .	2
– SCHEMATIC . . . . .	3

**70.80 IGNITION AND STARTING**

– GENERAL . . . . .	1
– IGNITION SYSTEM . . . . .	3
– ENGINE STARTING SYSTEM . . . . .	5
– ALTERNATE START/IGNITION INFORMATION . . . . .	9

**70.90 CONTROLS AND INDICATORS**

– PEDESTAL .....	1
– OVERHEAD PANEL .....	4
– ECAM .....	5
– WARNINGS AND CAUTIONS .....	13
– MEMO DISPLAY .....	15

**70.91 ELECTRICAL SUPPLY**

– BUS EQUIPMENT LIST .....	1
----------------------------	---

**GENERAL**

- R The CFM 56-5C engine is a high bypass ratio turbofan.

**DESCRIPTION****– Low-pressure (LP) compressor / turbine**

The low-speed rotor (N1) consists of a front fan (single stage) and a four-stage LP compressor connected to a five-stage LP turbine.

**– High-pressure (HP) compressor / turbine**

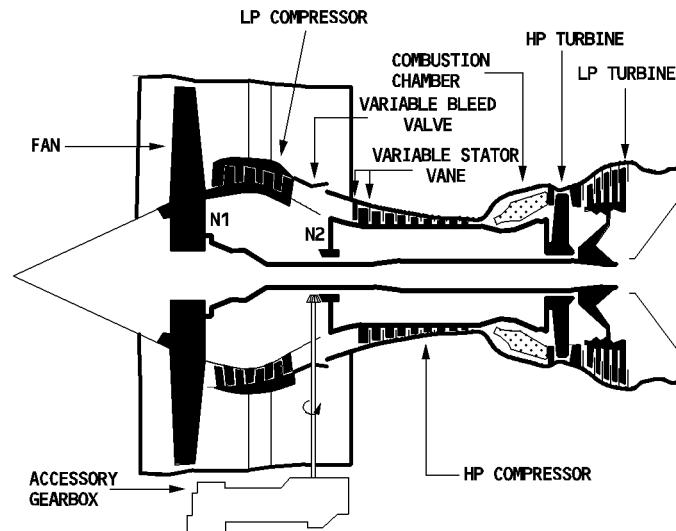
The high-speed rotor (N2) consists of a nine-stage HP compressor connected to a single-stage HP turbine.

**– Combustion chamber**

The annular combustion chamber is fitted with 20 fuel nozzles and 2 igniters.

**– Accessory gearbox**

The accessory gearbox, located at the bottom of the fan case, receives torque from horizontal HP rotor drive shaft and drives gearbox mounted accessories such as : IDG, hydraulic pump, oil pump, engine driven pump, HMU and electrical generator for the FADEC.



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**A340**

FLIGHT CREW OPERATING MANUAL

**POWER PLANT**

1.70.20 P 1

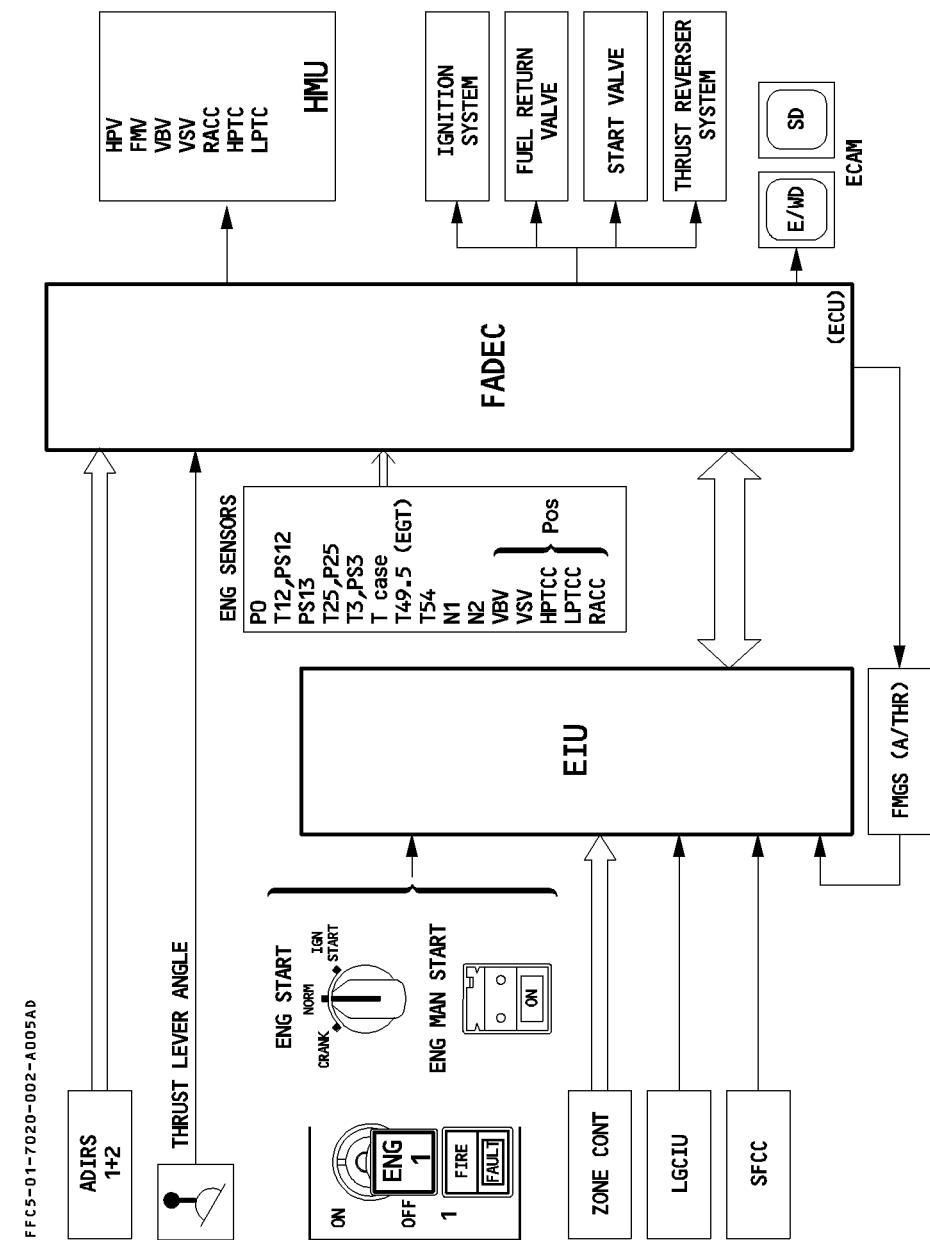
FADEC

SEQ 005

REV 09

**GENERAL**

- R Each power plant has a FADEC (Full Authority Digital Engine Control) system.
- R FADEC, also called the electronic control unit (ECU), is a digital control system that performs complete engine management.
- R FADEC has two-channel redundancy, with one channel active and one in standby. If one channel fails, the other automatically takes control.
- R The system has a magnetic alternator for an internal power source.
- R FADEC is mounted on the fan case.
- R The engine interface unit (EIU) transmits to FADEC the data it uses for engine management.



**FUNCTIONS**

The FADEC system performs the following functions:

**R    Control of gas generation**

- control of fuel flow
- acceleration and deceleration schedules
- variable bleed valve and variable stator vane schedules
- control of turbine clearance
- idle setting

**R    Protection against engine exceeding limits**

- protection against N1 and N2 overspeed
- monitoring of EGT during engine start

**Power management**

- automatic control of engine thrust rating
- computation of thrust parameter limits
- manual management of power as a function of thrust lever position
- automatic management of power (ATS demand).

**Automatic engine starting sequence**

- control of :
  - the start valve
  - the HP fuel valve
  - the fuel flow
  - the ignition
- monitoring of N1, N2, FF and EGT
- R    – initiation of abort and recycle (on the ground only).

**Manual engine starting sequence**

- R    – passive monitoring of engine
- active protection (on ground only) against high EGT and for starter reengagement speed
- control of:
  - the start valve
  - the HP fuel valve
  - the ignition

**Thrust reverser control**

- actuation of the blocker doors.
- engine setting during reverser operation

**Fuel recirculation control**

- recirculation of fuel to the fuel tanks according to the engine oil temperature, the fuel system configuration and the flight phase.

**Transmission of engine parameters and engine monitoring information to cockpit indicators**

- the primary engine parameters
- the starting system status
- the thrust reverser system status
- the FADEC system status
- secondary engine parameters (oil temperature, nacelle temperature, oil filter clog and fuel filter clogging)

**Computation of fuel used**

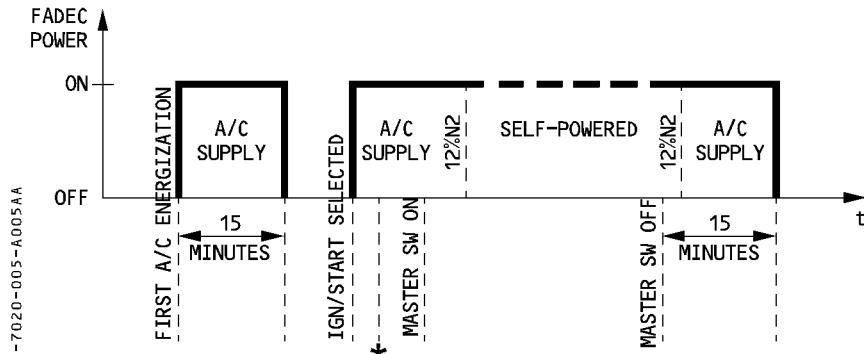
- integration of fuel flow.

**Detection, isolation, and recording of failures**

**POWER SUPPLY**

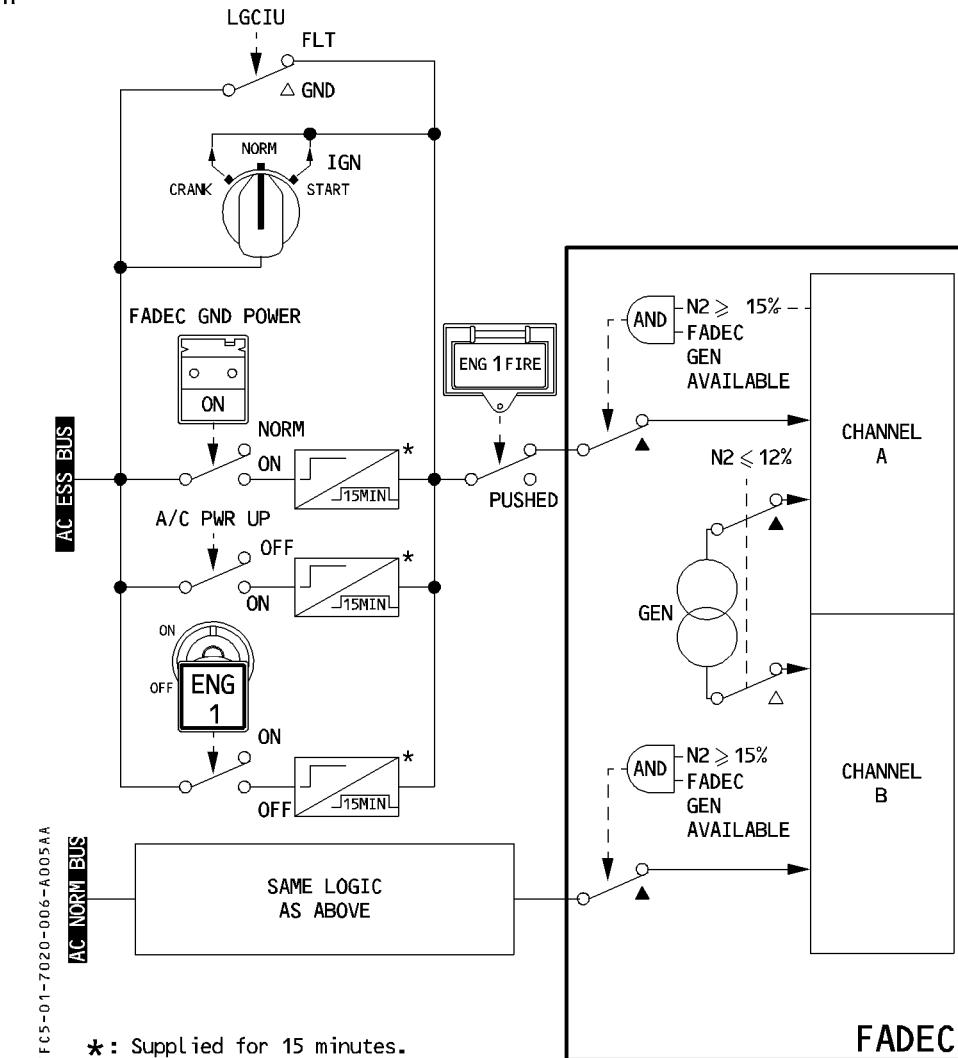
The FADEC system is

- powered by the aircraft electrical circuit below 15 % N2
- self-powered above 12 % N2.
- both supplies are connected between 12 and 15 %.

**R FADEC ELECTRICAL SUPPLY LOGIC**

**FADEC POWER SUPPLY****FOR INFO**

R



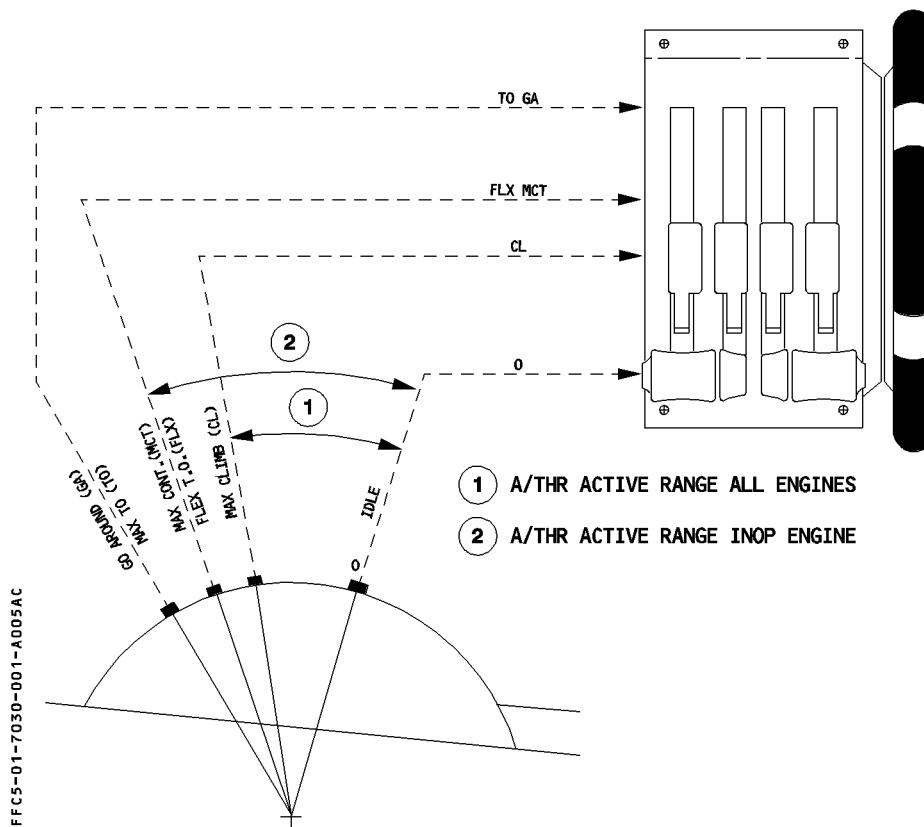
FFC5-01-7020-006-A005AA

**GENERAL**

A FADEC dedicated to each engine controls thrust.

The pilot uses the thrust levers to set the thrust in manual mode, and the FMGS sets the thrust in automatic mode.

The FADEC prevents the thrust from exceeding the limit for the thrust lever position in both manual and automatic modes.

**THRUST LEVERS**

The thrust levers can only be moved manually.

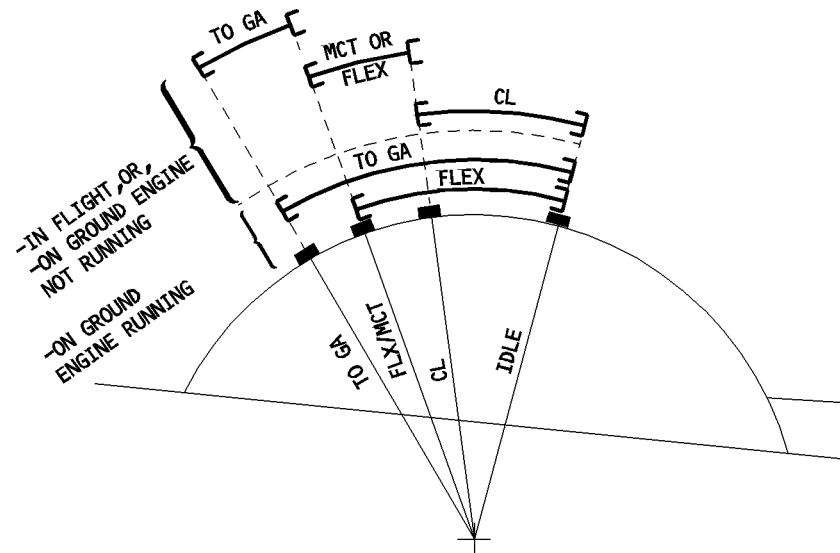
The range of movement is divided into 3 operating segments.

Thrust lever position is transmitted to the FADEC which computes and displays the thrust rating limit and the N1 TLA.

**THRUST RATING LIMIT**

The FADEC computes the thrust rating limit for each thrust lever position, as shown below. If the thrust lever is set in a detent, the FADEC selects the rating limit corresponding to this detent.

If the thrust lever is set between two detents, the FADEC selects the rating limit corresponding to the higher detent.

**N1 RATING LIMITS :**

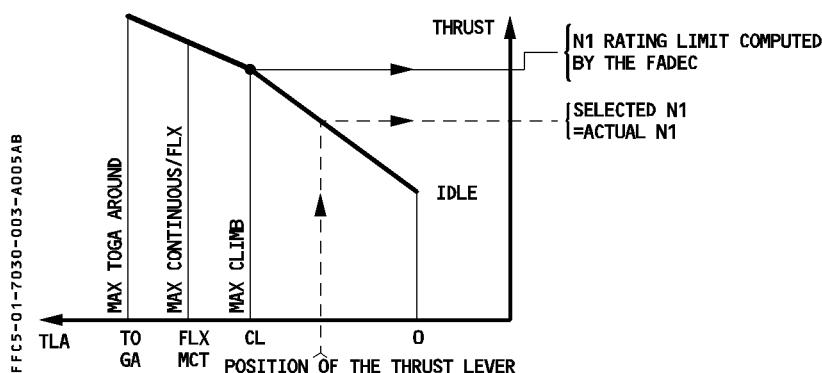
**THRUST CONTROL****MANUAL MODE**

The engines are in the manual mode provided the A/THR function is:

- not armed or
  - armed and not active (thrust lever not in the A/THR operating range and no alpha floor).
- In these conditions, each engine is controlled by the position of its thrust lever.

The pilot controls the thrust by moving the thrust lever from IDLE to TO GA positions. Each position of the thrust lever within these limits corresponds to an N1.

When the thrust lever is in a detent, the corresponding N1 is equal to the N1 rating limit computed by the FADEC for this engine.



When the thrust lever is in the FLX-MCT detent :

**– On the ground :**

The engine runs at the flex takeoff thrust rating if the MCDU has selected a flex takeoff temperature that is higher than the current total air temperature (TAT). Otherwise the engine produces maximum continuous thrust (MCT).

Note : A change of FLEX TEMP during the takeoff has no effect on the thrust.

**– After take-off :**

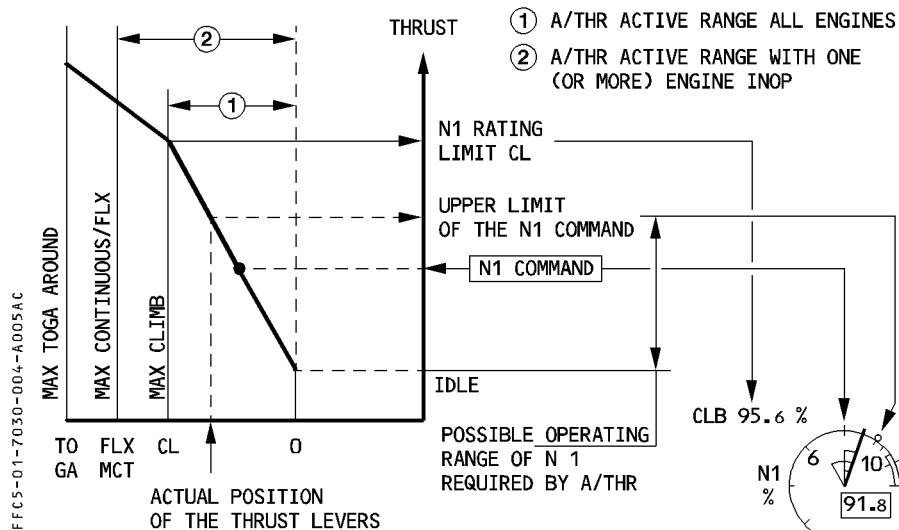
The pilot can change from FLX to MCT by moving the thrust lever to TO GA or CL, then back to MCT. After that, he cannot use the FLX rating.

The pilot can always get MAX TO thrust by pushing the thrust lever all the way forward.

Note : Setting the thrust lever out of FLX MCT detent without reaching TO GA or CL detent has no effect.

## AUTOMATIC MODE

In the autothrust mode (A / THR function active), the FMGC computes the thrust, which is limited to the value corresponding to the thrust lever position (unless the alpha-floor mode is activated).



## R INDICATIONS ON FMA

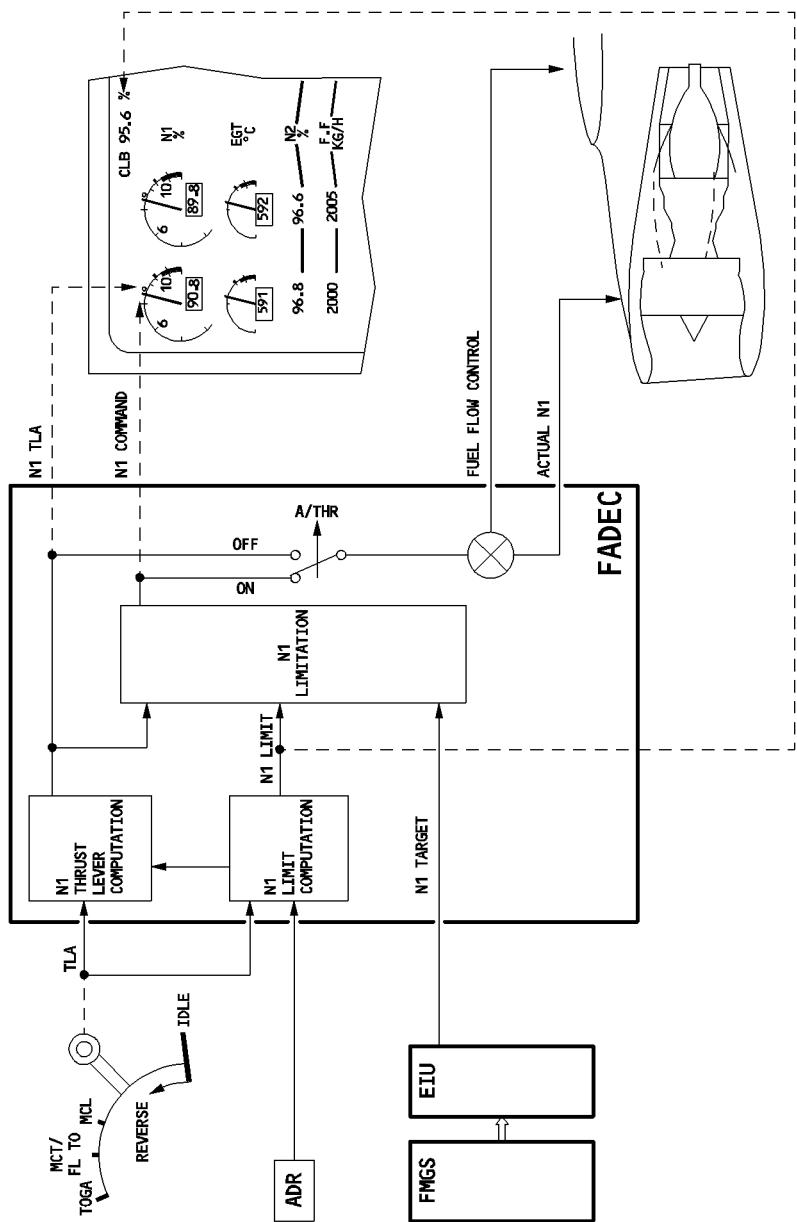
The FADECs monitor the positions of the thrust levers, and trigger appropriate indications on the FMA :

LVR ASYM : Appears in amber (third line on the FMA) if, with the A/THR active and all engines running, one, two or three thrust levers are set out of the CLB notch.

LVR CLB : Flashes white (3rd line on the FMA), if the thrust levers are not in the CL position, while the aircraft is above the altitude of thrust reduction with all engines running.

LVR MCT : Flashes white (3rd line on the FMA), if the thrust levers are not in the MCT position after an engine failure (with speed above green dot).

THR LK : Flashes amber (third line on the FMA) after A/THR disconnection (pilot action or failure) resulting in the thrust being frozen.

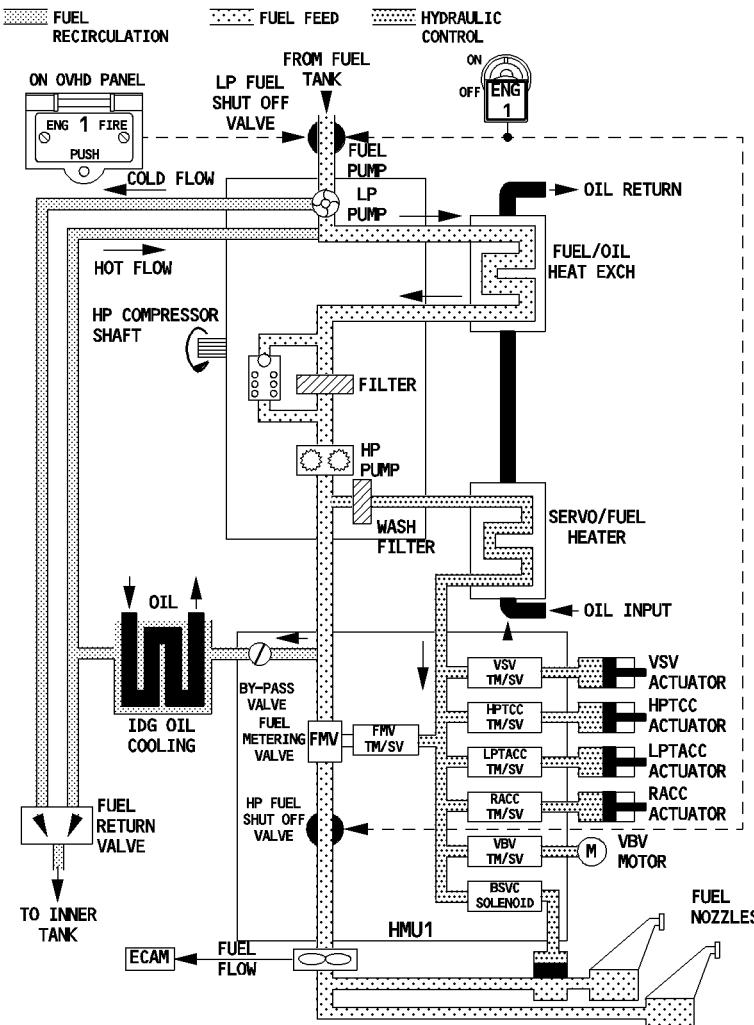
**THRUST CONTROL**

FFC5-01-7030-005-A005AB

**GENERAL**

The fuel system supplies fuel to the combustion chamber at the required flow rate, pressure and temperature.

The fuel flows from the tank, via the fuel pump unit and the fuel/oil heat exchanger, to the Hydromechanical Unit (HMU) and to the fuel nozzles.

**FOR INFO**

**FUEL PUMP UNIT**

The HP compressor shaft drives the HP fuel pump assembly. Fuel flows through the LP pump, then through the fuel/oil heat exchanger and the HP pump (gear pump).

The fuel then divides into a filtered flow for the servo fuel heater and the servo valves of the hydromechanical unit (HMU), and an unfiltered flow for the metering valve of the HMU.

**SHUT-OFF VALVES**

Moving the ENG MASTER switch to OFF directly commands the closing of the LP and HP fuel shut off valves for that engine's fuel system.

It also closes the fuel return valve and opens the bypass valve.

**HYDROMECHANICAL UNIT**

The FADEC controls the HMU, which :

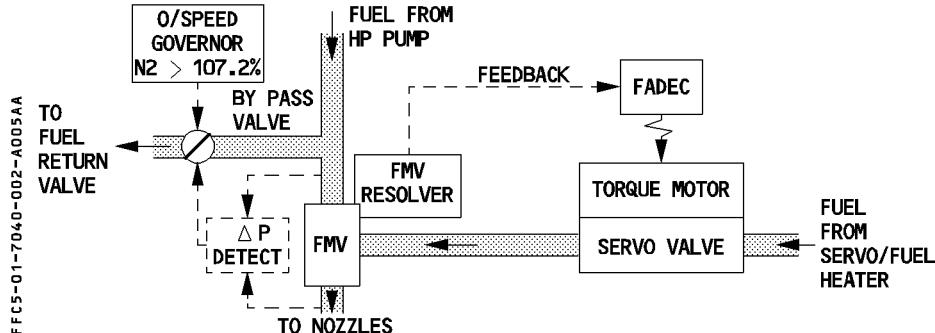
- controls fuel flow to the engine combustion chamber
- controls fuel hydraulic signals to actuators
- protects against overspeeding

**FUEL FLOW****FOR INFO**

*The Fuel Metering Valve (FMV) transforms FADEC orders through a torque motor and servovalve into fuel flow to the engine fuel nozzles.*

*The FMV resolver generates a feedback signal proportional to the FMV position.*

*The bypass valve maintains a constant pressure drop across the FMV to ensure that metered fuel flow is proportional to the FMV position.*



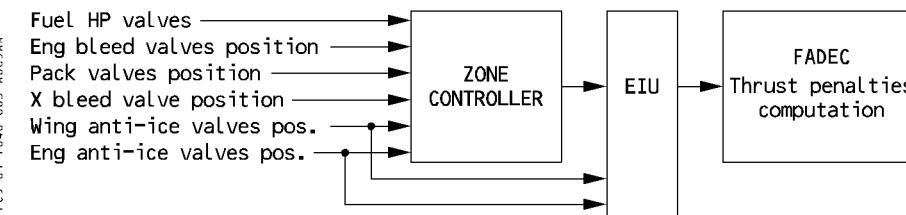
The FADEC computes the fuel flow that will maintain the target N1.

As the FADEC maintains this N1, it allows N2 to vary while remaining between N2 minimum and N2 maximum. The FADEC also controls the engine parameters to :

- Limit acceleration and deceleration ;
- Avoid engine stall or flameout ;
- Limit max N1 and N2 ;
- Maintain the air bleed pressure requirement.

The FADEC computes the N2 correction according to the bleed configuration.

FFC2-011-7040-003-A005AA



## Overspeed Governor System

Independent of the FADEC, the overspeed governor limits the N2 by opening the fuel bypass valve, in the event of a malfunction that could lead to an overspeed condition.

## IDLE CONTROL

The FADEC has the following three idle modes :

### Modulated idle

- R – Is regulated according to :
- Bleed system demand
  - Oil temperature
  - Mach number.
- Is selected :
- In flight, when the flaps are retracted and the gear is up.
  - On ground, provided reverse is not selected.

### Approach idle

- R – Is regulated according to aircraft altitude, regardless of bleed system demand.
- Selected in flight, when the FLAPS are extended to FLAP 2, FLAP 3, or FULL, or when the landing gear is down.
- Allows the engine to rapidly accelerate from idle to go-around thrust.

### Reverse idle

- Selected on ground, when reverse idle thrust is selected.
- Slightly higher than forward idle thrust.

## FUEL HYDRAULIC SIGNALS

FOR INFO

Fuel hydraulic signals go to :

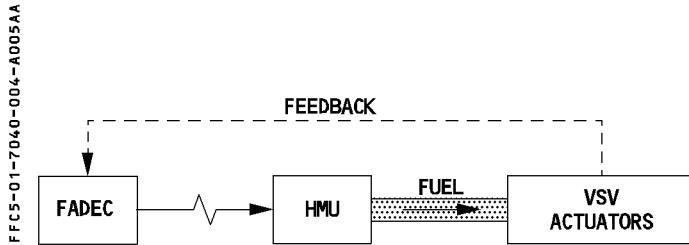
- **Low Pressure Turbine Clearance Control (LPTCC) valves.**  
(Refer to 1.70.60)
- **High Pressure Turbine Clearance Control (HPTCC) valves.**  
(Refer to 1.70.60)
- **Rotor Active Clearance Control (RACC) system.**  
(Refer to 1.70.60)

– **Variable Stator Vanes (VSVs)**

The VSV system positions the compressor variable vanes

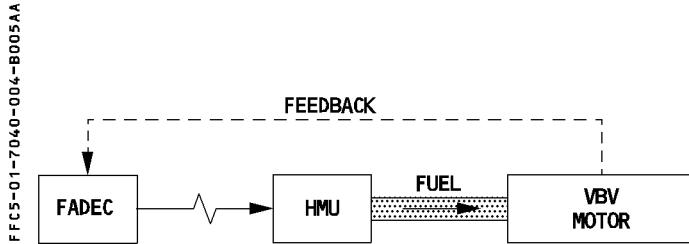
The FADEC maintains optimum compressor efficiency at a steady state and an adequate stall margin for transient engine operation.

VSV are fully closed during engine start and are fully open at high thrust.



– **Variable Bleed Valves (VBVs)**

The FADEC controls the VBV, upstream of the HP compressor. Their setting depends on compressor inlet temperature and on N2. It varies between full open (start, low thrust, and during fast deceleration) and full closed (high thrust) positions.



**FOR INFO****Burner Staging Valve (BSV) :**

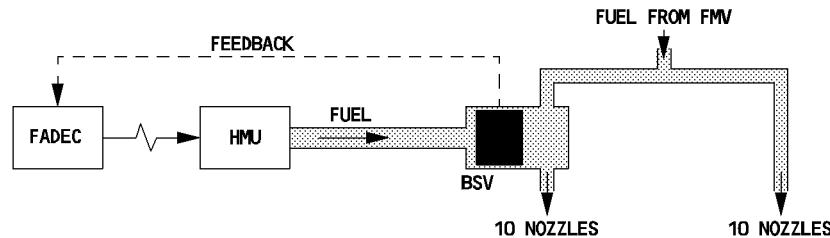
The FADEC controls the BSV, which allows fuel to go to either 10 or 20 fuel nozzles :

- It supplies 10 nozzles permanently.
- It supplies the other 10 nozzles when the engine requires a high fuel-air ratio (BSV open).

The BSV is closed during engine deceleration and low idle.

If the fuel control system fails, an internal safety system ensures that all nozzles are supplied.

FFC5-01-7040-005-A005AA

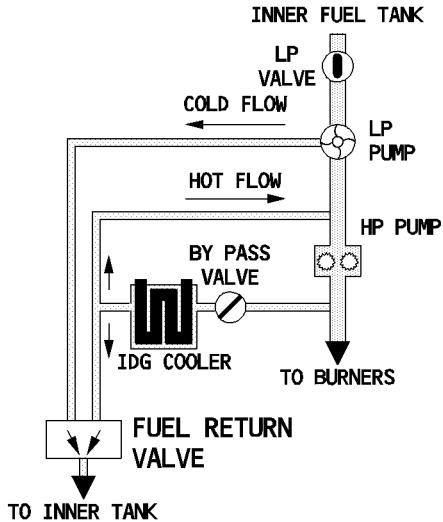


**IDG OIL COOLING SYSTEM**

Fuel flow from the HMU is partly used as a cooling agent for the IDG oil system ; it then returns to the fuel pump unit or to the tank.

**FOR INFO**

FFC5-01-7040-006-A005AA



*Fuel for IDG cooling is tapped downstream of the HP pump.  
It goes through the integrated drive generator (IDG) heat exchanger (where it absorbs heat).*

*A part of the fuel is returned upstream of the HP pump.  
The other part is returned to the inner tank when the fuel return valve is controlled open by the FADEC.  
A cold flow (from the LP pump) is mixed to the hot flow returning to the tank to reduce returning fuel temperature.*

**RECIRCULATION FUEL FLOW CONTROL LOGIC**

The FADEC controls the fuel flow to the tank through the fuel return valve, according to the engine oil temperature (which is dependent on the IDG oil temperature). There are two levels of recirculation.

The flow also depends on the inner tank fuel temperature and the flight/ground condition. At low engine power if oil temperature still increases the FADEC increases the modulated idle.

**A340**

FLIGHT CREW OPERATING MANUAL

**POWER PLANT**

1.70.40 P 7

**FUEL SYSTEM**

SEQ 110 REV 13

A fuel flow of 950 kg/hr is recirculated when the engine oil temperature reaches 70°C (50°C when the fuel temperature is above 15°C). It is stopped when the temperature decreases to 60°C (40°C when the fuel temperature is above 15°C). When the temperature is above 70°C, the idle speed is increased.

For some cases of failure, the fuel flow is reduced to a lower value.

**FUEL RECIRCULATION INHIBITION**

The recirculation to tank is inhibited (Fuel Return Valve (FRV) closed) in the following cases:

- Engine starting
- Engine shutdown (N2 below 50 %)
- When fuel flow is above 2700 kg per hour (take-off power)
- Upon fuel system request which occurs in the following conditions :
  - . Inner tank temperature above 59,5°C or,
  - . Engines feed by gravity or,
  - . Inner tank quantity below 500 kg or,
  - . Inner tank high level and vent tank sensors are wet and at least one X-feed valve on each wing is open.

This closure signal is inhibited if all the following coonditions are met :

- \* Fuel flow below 1000 kg per hour
- \* Engine oil temperature above 115°C
- \* Altitude above 15,000 ft.

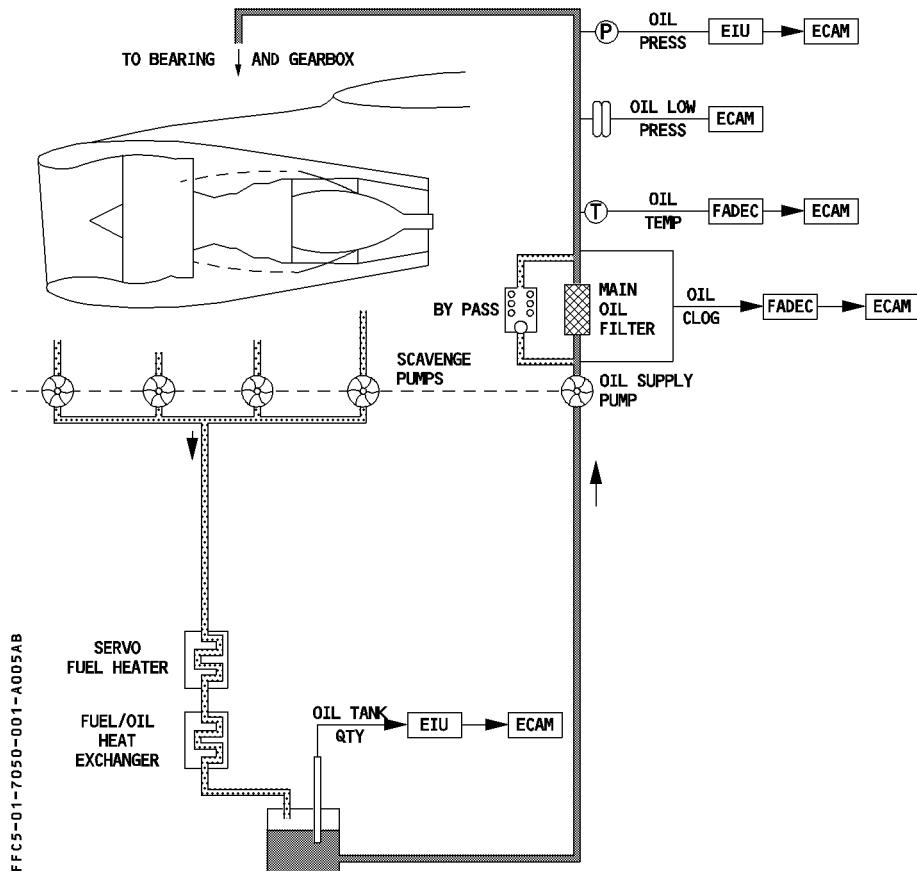
- When fuel flow is above 1300 kg per hour in emergency electrical configuration.

**GENERAL**

The oil system lubricates the engine components.

It contains :

- the oil tank
- the lube and scavenge pump modules
- the fuel/oil heat exchangers
- the filter, pressure relief and bypass valves.

**FOR INFO**

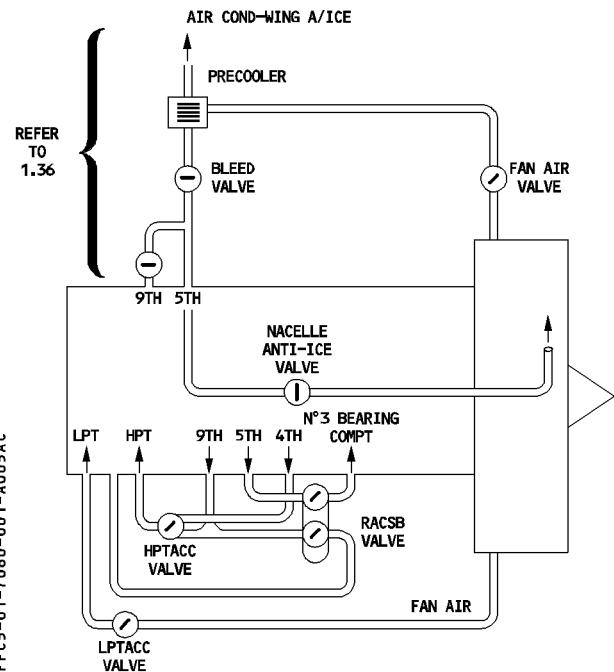
**GENERAL**

The air bleed system is provided for various aircraft uses.

It is used for :

- pneumatic system (Refer to 1.36)
- cooling the engine compartment and the turbine

FFC5-01-7060-001-A005AC



**COOLING**

**ROTOR ACTIVE CLEARANCE CONTROL START BLEED SYSTEM**

The rotor active clearance (RAC) and the start bleed (SB) control systems use air from 5th stage to control the clearance of the high pressure compressor rotor blades relative to the high pressure compressor stator case, and 9th stage to unload the compressor during starts and accelerations.

The function of the RAC system is to improve compressor efficiency during cruise, and the function to the SB system is to improve stall margin during engine start and acceleration.

**HP TURBINE CLEARANCE CONTROL (HPTCC) SYSTEM**

The HPTCC system is controlled by the FADEC through the HMU and controls the high pressure turbine clearance. The FADEC modulates the high pressure compressor bleed air flow for the high pressure turbine case cooling.

It provides optimization of high pressure turbine performance and EGT reduction.

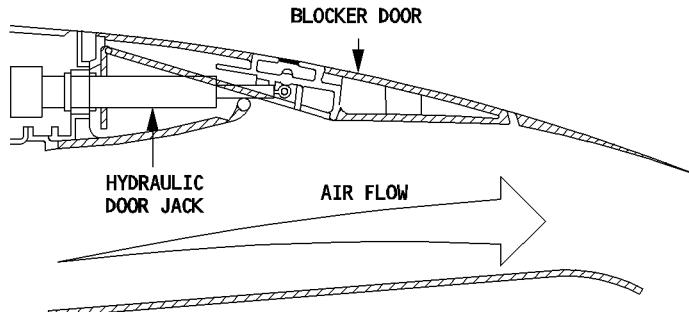
**LP TURBINE CLEARANCE CONTROL (LPTCC) SYSTEM**

The LPTCC system is controlled by the FADEC through the HMU and controls low pressure turbine clearance.

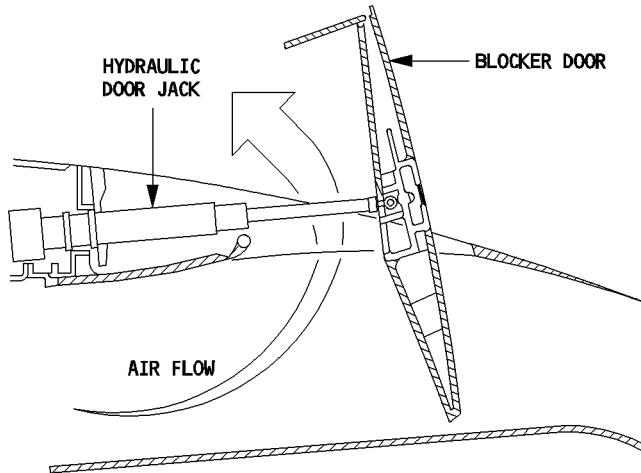
The FADEC modulates the fan bleed air flow for the low pressure turbine case cooling.

**GENERAL**

The aircraft reverses engine thrust by using four pivoting blocker doors on each engine to deflect the fan airstream.

**FAN REVERSER (STOWED)****FAN REVERSER (DEPLOYED)**

FFC5-01-7070-001-A005AA



A hydraulic door jack positions each door .

- The green circuit powers the doors on ENG 1 and ENG 4.
- The blue circuit powers the doors on ENG 2.
- The yellow circuit powers the doors on ENG 3.

The thrust reverser system is independently controlled for each engine by the associated FADEC. It is controlled and monitored by each FADEC channel.

The thrust reverser system on each engine includes :

- 4 actuators
- 4 latches
- door position switches
- A shut off valve which allows the hydraulic pressure to the HCU.
- a Hydraulic Control Unit (HCU) which :
  - pressurizes the thrust reverser hydraulic system
  - regulates the blocker doors speed
  - supplies actuators with hydraulic power

Each pivoting door moves independently (no synchronization). The total actuation time is less than 2 seconds.

### **ACTUATION LOGIC**

Deployment requires :

- one FADEC channel operating with its associated throttle reverse signal
- aircraft on ground from at least one LGCIU
- TLA reverse signal from PRIM 1 (FLT CTL PRIMARY COMPUTER 1) or associated PRIM
- switch reverse signal from associated EIU

Before the transit completion of the blocker doors, the FADEC sets reverse idle thrust.

### **ENG 1 AND 4 THRUST REVERSER LEVER INTERLOCK**

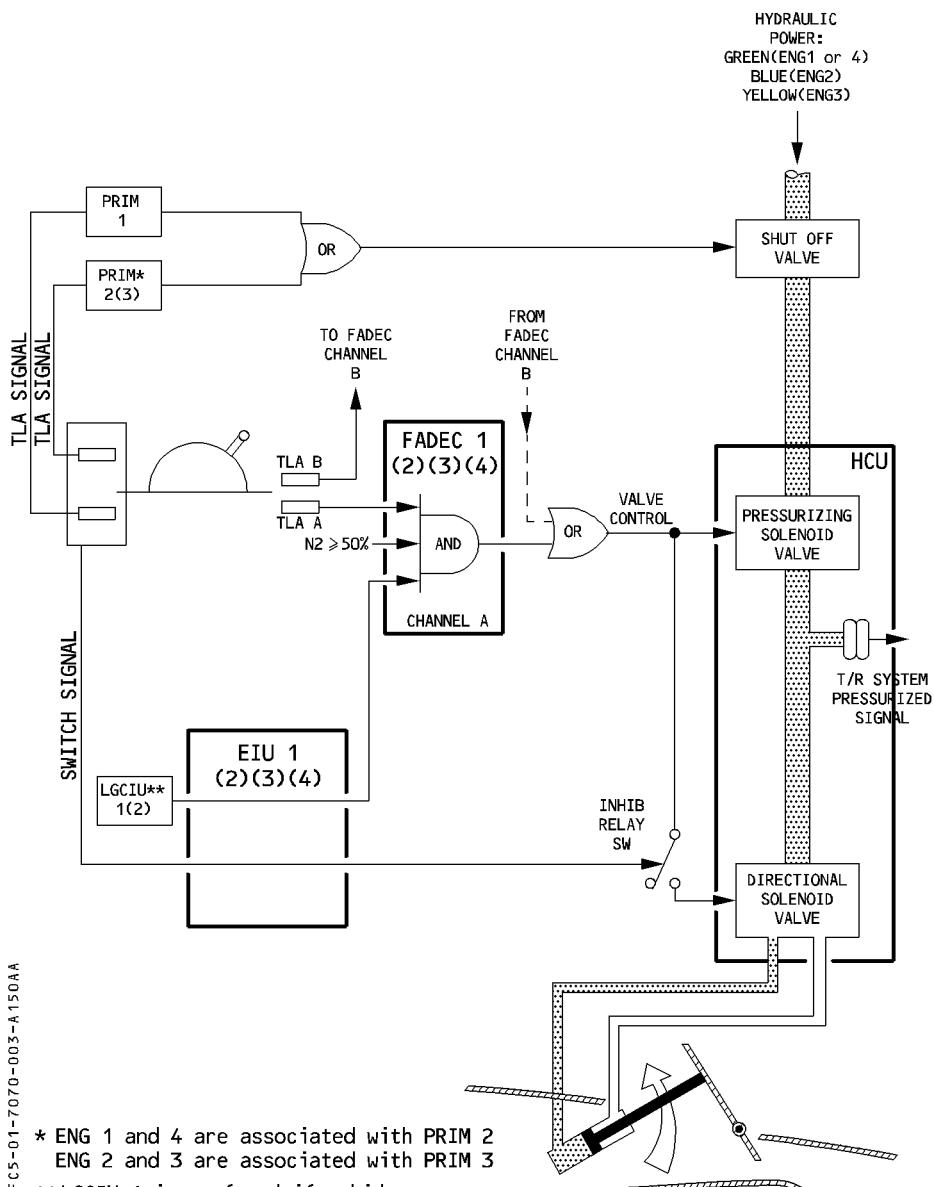
Thrust reverser lever interlock prevents the application of asymmetrical reverse thrust on the outboard engines.

For this purpose the thrust lever is limited at reverse idle until both EIU 1 and 4 have released the interlock, confirming that both thrust reversers are fully deployed.

### **IDLE PROTECTION**

The FADEC will automatically select idle thrust if the reverse thrust is not selected and one of three following conditions occurs :

- 4 doors are unstowed or,
- at least one door is unstowed and the thrust reverser system is pressurized, or
- the thrust reverser position is not determined and the reverser system is pressurized.

**SCHEMATIC****FOR INFO**

**A340**

FLIGHT CREW OPERATING MANUAL

**POWER PLANT****IGNITION AND STARTING**

1.70.80

P 1

SEQ 110

REV 13

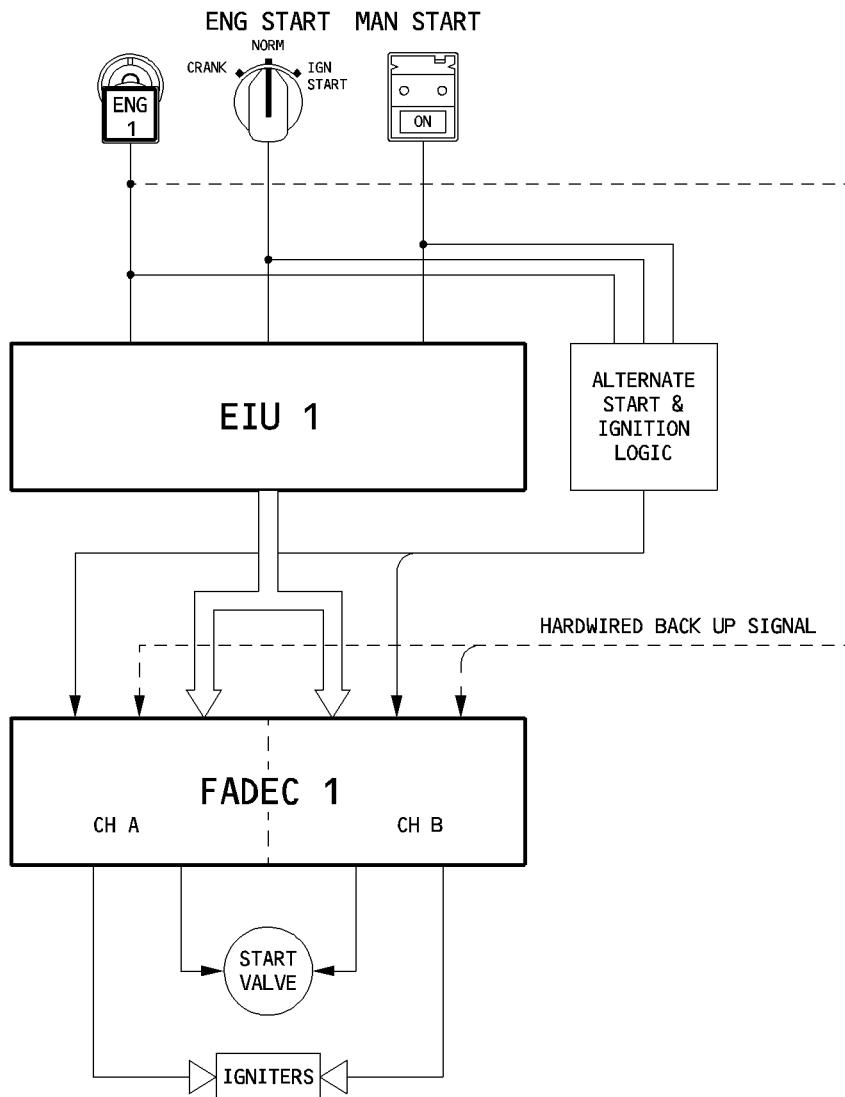
**GENERAL**

The ignition and starting system is controlled by the FADEC according to :

- engine start selector position
- engine master switch position
- ENG MAN START pushbutton position
- flight/ground aircraft condition.

In normal operation, the FADEC receives its inputs from the EIU.

In the event of EIU signal loss, all the functions, except man start and wet crank, will remain available by using both a back up signal from the engine master switch, and the alternate start/ignition signal.

**ARCHITECTURE**

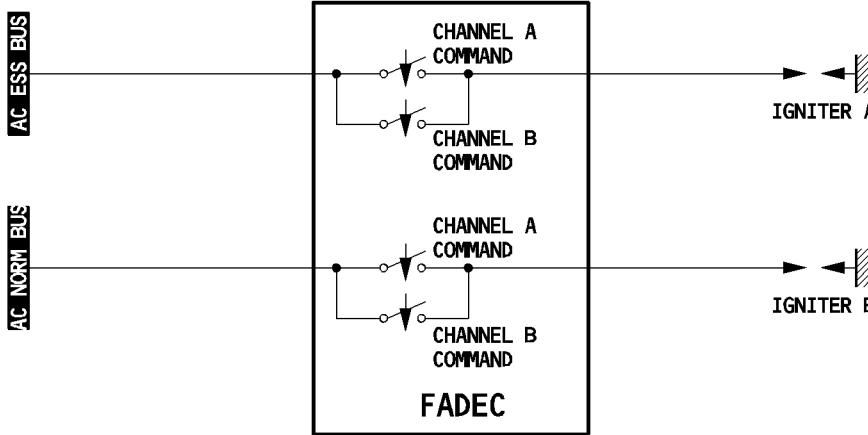
FFCS-01-7080-002-A110AA

**IGNITION SYSTEM**

The ignition system is provided for engine starting on the ground and restart in flight. The system consists of two identical independent circuits for each engine, normally controlled by the FADEC channel A with the channel B in standby. Each FADEC channel can control both igniters.

**FOR INFO**

FFC5-01-7080-003-A005AA

**IGNITION FOR STARTING****ON THE GROUND**

During an automatic start only one igniter is supplied. The FADEC automatically alternates the use of igniters at each start.

The ignition is automatically selected when N2 reaches 16 %.

It is automatically cut off when N2 reaches 50 % N2.

During a manual start both igniters are supplied, when the engine master switch is at ON, it is automatically cut off when N2 reaches 50 % N2.

**IN FLIGHT**

Both igniters are supplied, when the engine master switch is at ON.

## **CONTINUOUS IGNITION**

Continuous ignition is either selected manually or automatically to protect engine combustion.

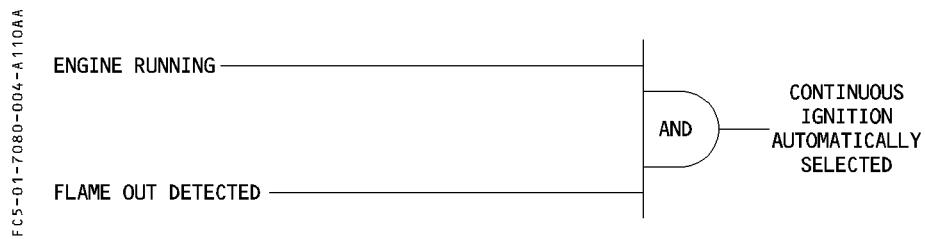
Note : When the compressor delivery pressure (PS3) is high, the igniters are not excited, even if the continuous ignition is selected and IGN is displayed in green on the ECAM.

### **MANUAL SELECTION**

In flight, continuous ignition is selected when the ENG START selector is on IGN/START provided the related engine is running.

On ground, after starting, since ignition is automatically cut off, it is necessary to cycle the ENG START selector to NORM, then back to IGN/START, to select the continuous ignition.

### **AUTOMATIC SELECTION**



FFC5-01-7080-004-A110AA

**A340**

FLIGHT CREW OPERATING MANUAL

**POWER PLANT**  
IGNITION AND STARTING1.70.80 P 5  
SEQ. 005 REV. 07**ENGINE STARTING SYSTEM****GENERAL**

The engine starting system consists of an air turbine starter and a start valve.  
The start valve admits air supplied by the pneumatic system to operate the starter.  
The FADEC controls the start valve electrically. On the ground, in the event of electrical control failure the start valve can be manually operated by a handle.

**AUTOMATIC STARTING**

This sequence is under the full authority of the FADEC which controls :

- the start valve
- the igniter(s)
- the fuel HP valves.

It provides:

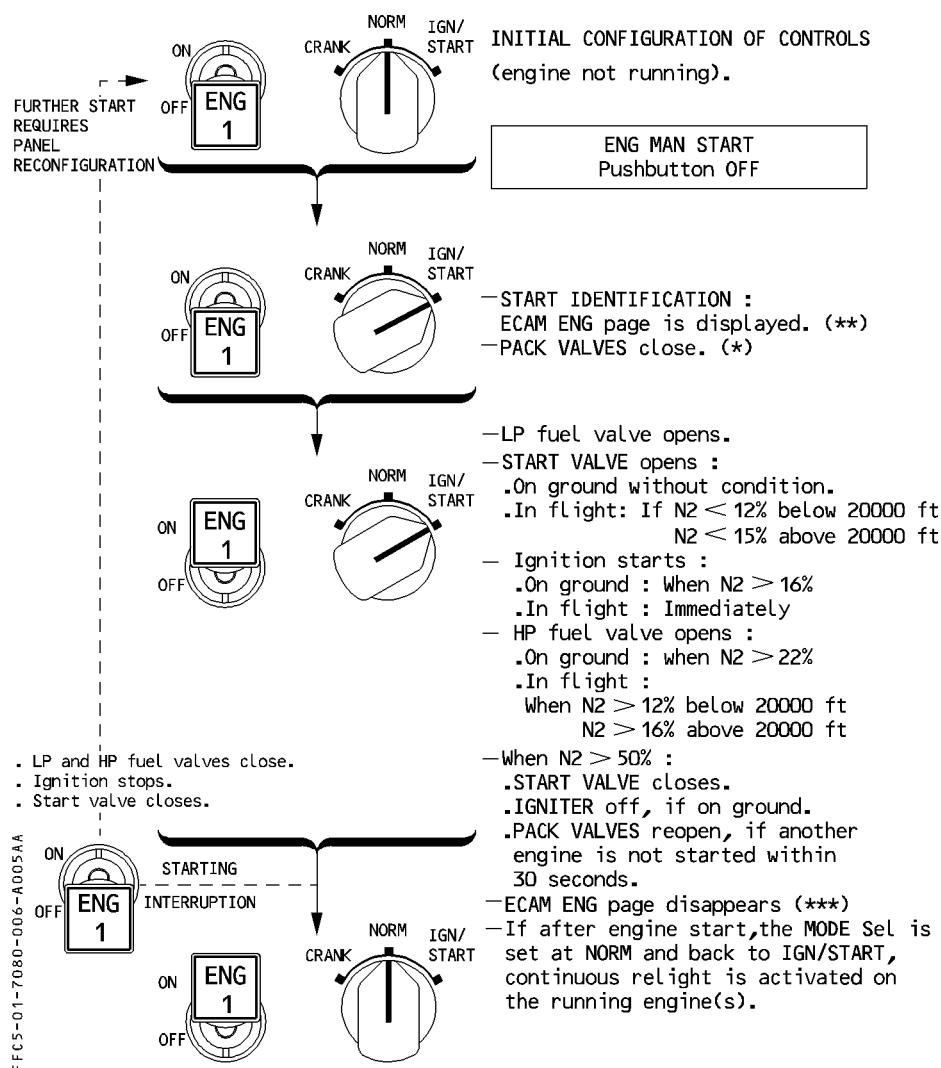
- detection of hot start, hung start, stall or no light up, and protection for starter reengagement speed and time.
- FAULT announcement with specific ECAM message.
- Start abort on ground (high pressure valve closure, start valve closure, ignition stopped) and automatic engine crank after start abort and control of any additional start attempts.

In flight, the FADEC will select a starter assisted airstart if N2 is below 16 %.

This sequence may be interrupted by selecting the engine master switch to OFF.

## AUTOMATIC STARTING SEQUENCE

R



R Note : (\*) If after 30 seconds the engine master switch is not ON, the pack valves will reopen.

R (\*\*\*) At first engine start, if after IGN/START selection no further action is applied, the ECAM ENG page will automatically disappear after 30 seconds.

R (\*\*\* ) If ENG START selector is not switched to NORM, the ENG page is automatically replaced by the WHEEL page 15 seconds after 4th engine start.

**A340**

FLIGHT CREW OPERATING MANUAL

**POWER PLANT**  
IGNITION AND STARTING1.70.80 P 7  
SEQ. 005 REV. 07**MANUAL STARTING**

Manual starting is under limited authority by the FADEC which controls :

- start valve opening when the ENG START selector is set to IGN/START and the MAN START pushbutton sw is depressed
- high pressure fuel valve and operation of both igniters when the engine master switch is set to ON.
- start valve closure at 50 % N2, and, on ground, ignition cut off.

The FADEC provides a passive survey of the engine during the starting sequence.

On the ground, it will automatically abort the starting sequence in case of starting EGT limit exceedance or starter reengagement speed exceedance.

The sequence may be interrupted :

- before engine master switch set to ON by selecting MAN START pushbutton to off.
- after engine master switch set to ON by selecting it back to OFF. In this case a dry crank shall be selected by the crew.

*Note : When the engine master switch is set to on, selecting the MAN START pushbutton to off has no effect.*

In flight, the FADEC always commands a starter assisted astart.

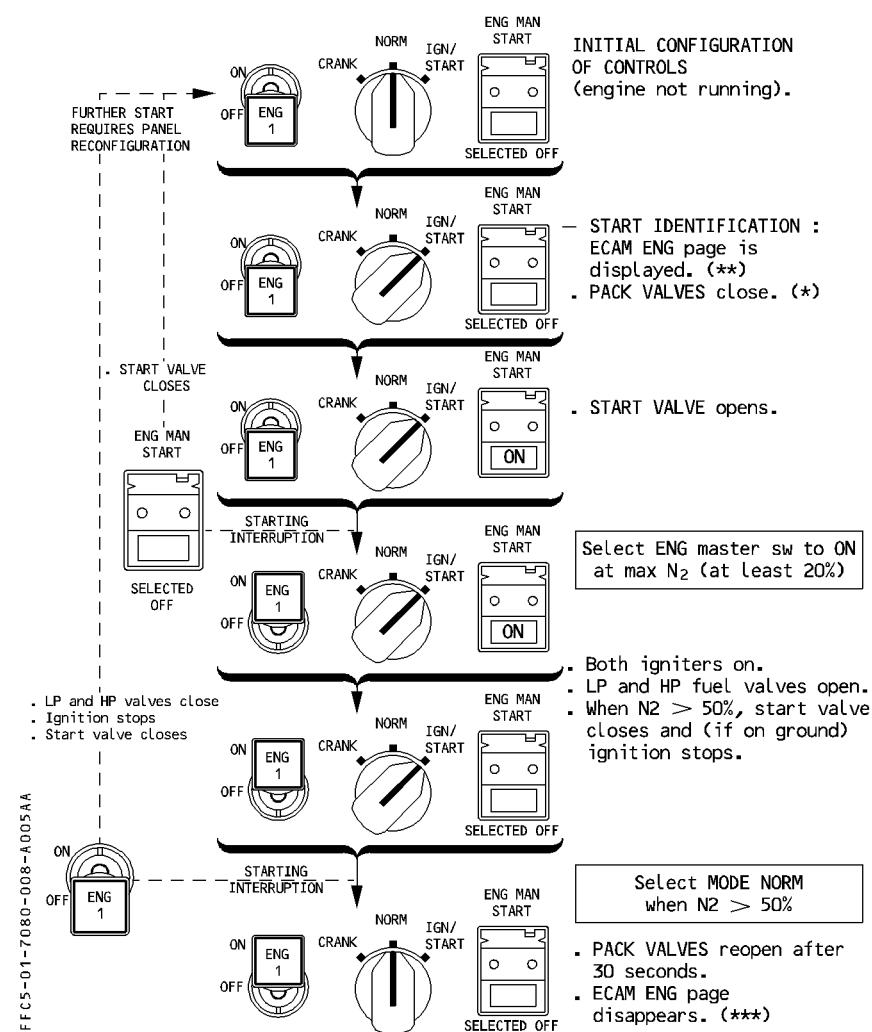
**ENGINE VENTILATION (Dry cranking)**

A dry cranking cycle enables the engine to be ventilated to remove fuel vapors after an unsuccessful start attempt on the ground.

Cranking can be manually selected by setting the ENG START selector to CRANK and the MAN START pushbutton to ON (engine master switch OFF). It is stopped by setting the MAN START pushbutton to off. APU speed (if used) increases during the dry cranking cycle.

**CAUTION**

Selecting the ENG START selector to NORM would not stop the cranking.

R MANUAL STARTING SEQUENCE

R Note : (\*) If, after 30 seconds the ENG MAN START pushbutton is not switched ON, the pack valves will reopen.

R (\*\*\*) At first engine start, if after IGN/START selection no further action is applied, the ECAM ENG page will automatically disappear after 30 seconds.

(\*\*\*) If ENG START selector is not switched to NORM, the ENG page is automatically replaced by the WHEEL page 15 seconds after 4th engine start.

**ALTERNATE START / IGNITION INFORMATION**

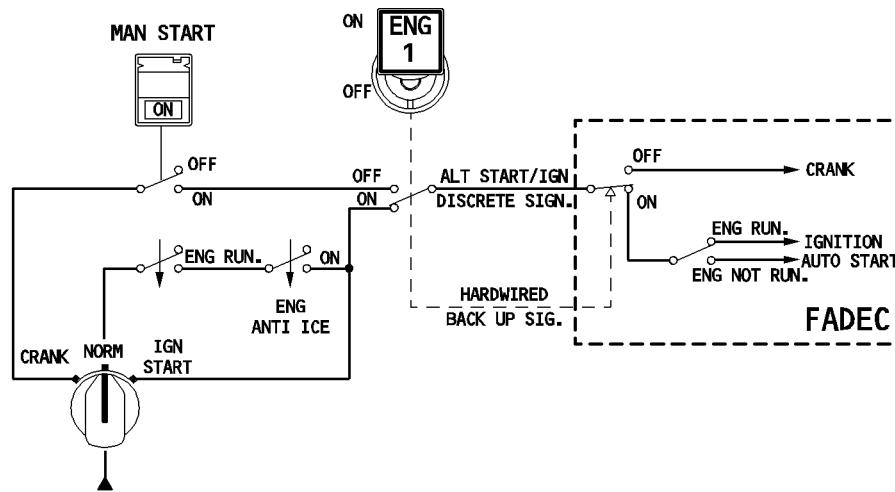
In case of EIU failure, the FADEC uses a backup signal from the engine master switch and the alternate start/ignition signal to control :

- an automatic starting,
- a dry crank or
- the continuous ignition

Manual starting is no longer available.

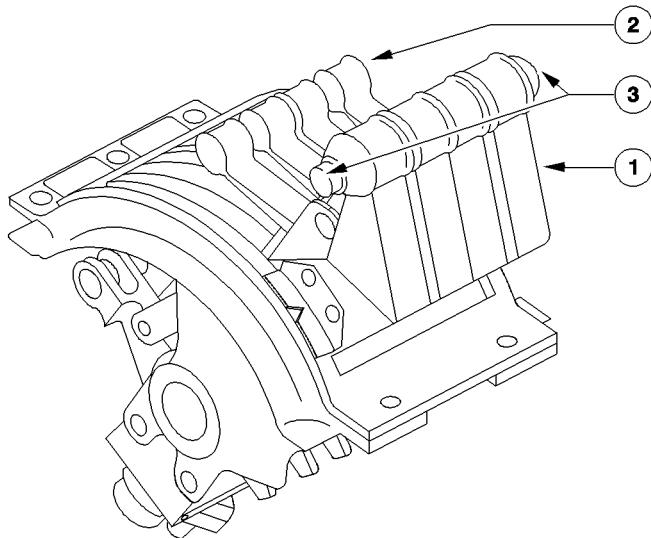
**FOR INFO**

FFC5-01-7080-009-A005AB



**PEDESTAL**

FFC5-01-7090-001-A005AA

**① Thrust levers**

(Refer to 1.70.30)

**② Reverse control levers**

When the thrust levers are not at idle, the reverse control levers are mechanically locked in the stowed position.

When the thrust levers are at idle, thrust reverser operation can be controlled by pulling backward the reverse control levers.

A detent indicates to the crew the reverse idle position. For engines 1 and 4, this position cannot be exceeded until complete deployment of the reversers of the two engines.

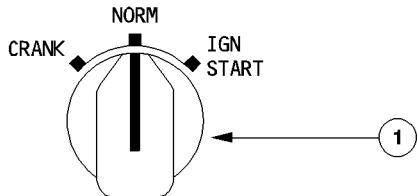
For reverse thrust application the reverse control levers are pulled rearward as required.

For stowage of reversers the levers are moved forward then pushed down.

**③ Autothrust instinctive disconnect pb**

(Refer to 1.22)

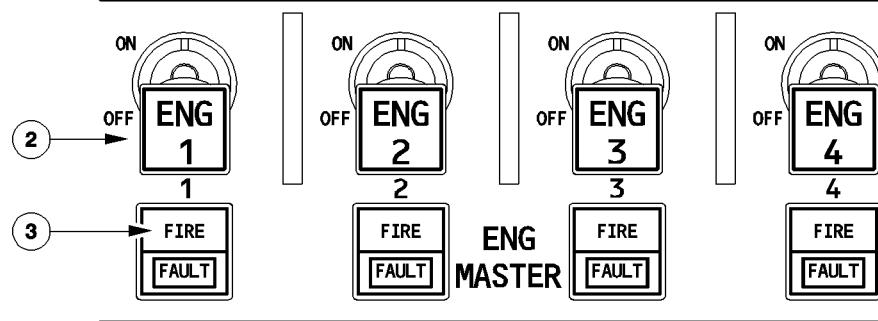
FFC5-01-7090-002-A110AA

**ENG START****① ENG START selector**

- R CRANK : The start valve opens, provided the MAN START pushbutton is ON. Ignition is not supplied. Both pack flow control valves close when CRANK is selected, provided the MAN START pushbutton is ON.
- R NORM : Continuous ignition A + B is selected when the engine is running, and a flame-out is detected.
- IGN START : – If the engine master switch is ON and  $N2 \geq$  idle, continuous ignition is selected.  
                   When the compressor delivery pressure (PS3) is high, the igniters are not excited, even if the continuous ignition is selected and IGN is displayed in green on the ECAM.  
                   – During an automatic start, the ignition will be selected :  
                     · On ground, when  $N2 \geq 16\%$   
                     · In flight, at start sequence initiation.  
                   – During a manual start, the ignition is selected when the engine master switch is selected ON.
- R Both pack flow control valves automatically close during the start sequence (Refer to 1.21.20). APU speed (if used) increases.

Note : *On ground, the ignition is automatically cut off at the end of the start sequence ( $N2 > 50\%$ ).*

FFC5-01-7090-003-A005AA



### ② ENG MASTER sw 1 (2) (3) (4)

ON : Low pressure fuel valve will open (provided the ENG FIRE pushbutton is in).

- During an automatic start, the high pressure fuel valve opens provided :
  - the ENG START selector is at IGN / START
  - the N2 is above the following threshold :
    - \* on ground : 22 %
    - \* in flight : 12 % below 20000 ft, 16 % above 20000 ft.
- During a manual start, the high pressure fuel valve will open provided :
  - ENG START selector is at IGN / START
  - MAN START pushbutton is ON

OFF : A Closure signal is sent directly to the high pressure fuel valve and the low pressure fuel valve.

Controls the reset of both channels of the FADEC.

*Note : Releasing ENG FIRE pushbutton permits engine shutdown by closing the LP fuel valve. There is a time delay of about 40 seconds at ground idle (the time delay is due to fuel left between low pressure valve and nozzles)*

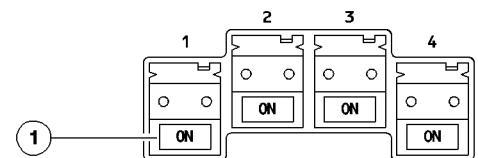
### ③ FIRE FAULT lt 1 (2) (3) (4)

FAULT lt : Illuminates amber associated with ECAM caution in case of:

- an automatic start abort
- a disagreement between the high pressure fuel valve position and its commanded position.

**OVERHEAD PANEL**

F C5-01-7090-004-A005AA

**ENG MAN START****① ENG MAN START pushbutton**

**ON** : The start valve opens, provided the ENG START selector is set to CRANK or IGN/START.

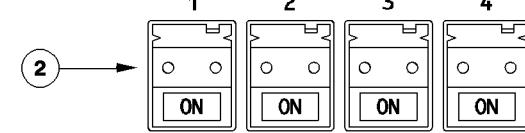
Both pack valves close during the start sequence.

*Note : The start valve automatically closes when  $N2 \geq 50\%$ .*

The ON light comes on blue.

**Off** : When the ENG MAN START pushbutton is set off during a manual engine start, the start valve closes, provided the engine master switch is in the OFF position.

F C5-01-7090-004-B005AA

**ENG FADEC GND PWR****② ENG FADEC GND PWR pushbutton**

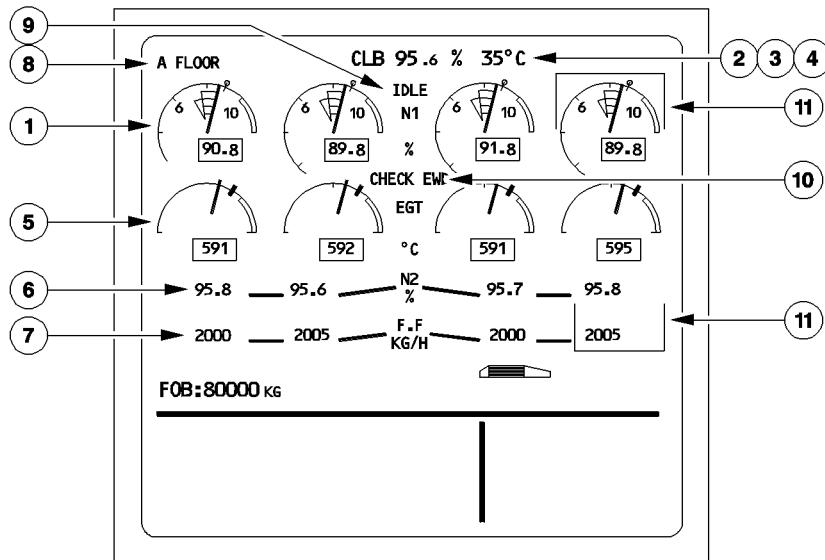
**R ON** : The FADEC is supplied by the aircraft network for 15 minutes (unless the ENG FIRE pushbutton is released out, or the FADEC Generator is available). The "ON" light comes on with a delay of 2 seconds.

**ECAM****GENERAL**

The engine primary parameters are permanently displayed on the upper ECAM.

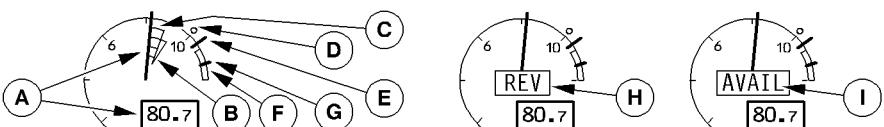
The secondary parameters are displayed on the lower ECAM SD when selected automatically or manually.

In case of all DMC ECAM channel failure the engine primary parameters can be displayed on each ND using the ND selector on the EFIS control panel.

**PRIMARY PARAMETER**

**① LP rotor speed (N1)**

FFCS-01-7090-006-A108AA



**(A) Actual N1**

The N1 needle and N1 digital indication are :

- Normally green
- Amber, when the actual N1 is above the N1 MAX (see E )
- Red, when the actual N1 is above the N1 RED line (100.3 %).

When N1 is degraded (in case both N1 sensors fail), the last digit of the digital display is amber-dashed.

**(B) N1 Command (N1 tendency)**

The green needle corresponds to N1 demanded by the FADEC. In addition, next to the N1 trend needle a green triangle indicates the direction of N1 tendency. These symbols are only displayed when A/THR is active.

**(C) Transient N1**

Symbolizes the difference between the N1 command and the actual N1. It is only displayed when A/THR is active.

**(D) N1TLA (blue circle)**

N1 corresponding to the thrust lever position (predicted N1).

**(E) N1 MAX**

Amber index at the value corresponding to the N1 limit value of the TOGA or REV mode.

**(F) Max permissible N1**

N1 redline is represented by a red arc at the end of the scale, beginning at 100.3%.

**(G) N1 exceedance**

If 100.3 % is exceeded, a red mark appears and remains at the maximum value achieved. It will disappear after a new start on ground, or after maintenance action via the MCDU.

**(H) REV indication**

The REV indication appears in amber when one reverser is unstowed or unlocked. It changes to green when the doors are fully deployed and reverse mode is selected. (If unlocked in flight, the indication first flashes for 9 seconds and then remains steady).

① AVAIL indication

Displayed in green to indicate a successful engine start on ground.  
It pulses in green to indicate a successful engine relight in flight.  
It is triggered when the engine is at, or above, idle.

② Thrust limit mode

R TOGA, FLX, CLB, MCT, limit mode selected by the thrust lever is displayed in blue.

③ N1 rating limit

Computed by the FADEC, according to the thrust lever angle, and is displayed in green.

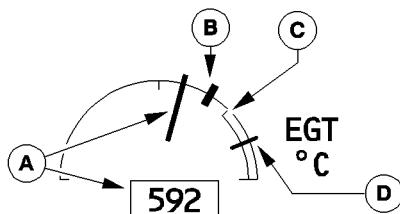
R Note : – *The highest thrust limit mode of the four engines, and its associated N1 limit value, is displayed.*  
– *On ground, with the engines running, the displayed N1 rating limit corresponds to the TOGA thrust limit, whatever the thrust lever position may be.*  
*On ground, with the engines running and if FLEX mode is selected, FLEX N1 is displayed, whatever the thrust lever position may be, between IDLE and FLX / MCT.*

④ FLEX temperature

If a FLEX temperature has been entered via the MCDU and validated by the FADEC, this temperature is displayed in blue.

(5) EGT indicator

FFCS-01-7090-008-A005A

(A) Actual EGT

— Normally green

R — Becomes amber above 915°C (or above 725°C during start sequence) except for high power operation (FLEX takeoff or thrust lever above MCT or at maximum REV, or activation of alpha-floor).

R — Becomes red above 950°C.

(B) EGT Max (amber)

725°C at engine start then 915°C.

(C) Max permissible EGT

EGT red line is at 950°C. A red arc is displayed above 950°C to the end of the scale.

(D) EGT exceedance

If 950°C is exceeded, a red mark appears at the max value achieved. It will disappear after a new start on the ground or after a maintenance action through the MCDU.

(6) HP rotor speed N2

Digital indication normally green is over brightning during engine start and located in a grey background box.

When the N2 is above 105 % the indication becomes red and a red cross appears next to the digital indication. The red cross will disappear only after a new start on ground or after a maintenance action through the MCDU.

When the N2 value is degraded (in case of a dual N2 sensor failure), the last digit is amber dashed.

(7) Fuel flow

Green indication

(8) A FLOOR message

Is displayed amber when the ECUs receive the corresponding signal from FMGS.

**A340**

FLIGHT CREW OPERATING MANUAL

**POWER PLANT**

1.70.90 P 7

CONTROLS AND INDICATIONS

SEQ. 210 REV 18

① AVAIL indication

Displayed in green to indicate a successful engine start on ground.  
It pulses in green to indicate a successful engine relight in flight.  
It is triggered when the engine is at, or above, idle.

② Thrust limit mode

TOGA, FLX, CLB, MCT, limit mode, selected by the thrust lever, is displayed in blue.  
If a derated takeoff has been selected by the crew, D04, D08, D12, D16, D20, or D24 will  
be displayed.

③ N1 rating limit

Computed by the FADEC, according to the thrust lever angle, and is displayed in green.

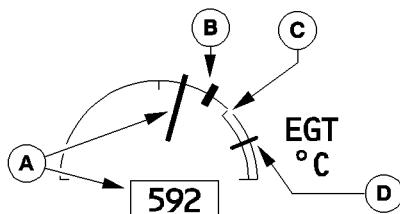
- Note :
- *The highest thrust limit mode of the four engines, and its associated N1 limit value, is displayed.*
  - *On ground, with the engines running, the displayed N1 rating limit corresponds to the TOGA thrust limit, whatever the thrust lever position may be.*
  - On ground, with the engines running and if FLEX mode is selected, FLEX N1 is displayed, whatever the thrust lever position may be, between IDLE and FLX / MCT.*
  - On ground, with the engines running and if DERATED mode is selected, DERATED N1 is displayed, whatever the thrust lever position may be, between IDLE and FLX/MCT.*

④ FLEX temperature

If a FLEX temperature has been entered via the MCDU and validated by the FADEC, this temperature is displayed in blue.

(5) EGT indicator

FFCS-01-7090-008-A005A

(A) Actual EGT

— Normally green

R — Becomes amber above 915°C (or above 725°C during start sequence) except for high power operation (FLEX takeoff or thrust lever above MCT or at maximum REV, or activation of alpha-floor).

R — Becomes red above 950°C.

(B) EGT Max (amber)

725°C at engine start then 915°C.

(C) Max permissible EGT

EGT red line is at 950°C. A red arc is displayed above 950°C to the end of the scale.

(D) EGT exceedance

If 950°C is exceeded, a red mark appears at the max value achieved. It will disappear after a new start on the ground or after a maintenance action through the MCDU.

(6) HP rotor speed N2

Digital indication normally green is over brightning during engine start and located in a grey background box.

When the N2 is above 105 % the indication becomes red and a red cross appears next to the digital indication. The red cross will disappear only after a new start on ground or after a maintenance action through the MCDU.

When the N2 value is degraded (in case of a dual N2 sensor failure), the last digit is amber dashed.

(7) Fuel flow

Green indication

(8) A FLOOR message

Is displayed amber when the ECUs receive the corresponding signal from FMGS.

**(9) IDLE message**

IDLE is displayed in green when running engines operate at minimum power. First pulses for 10 seconds then remains steady.

**(10) CHECK EWD message**

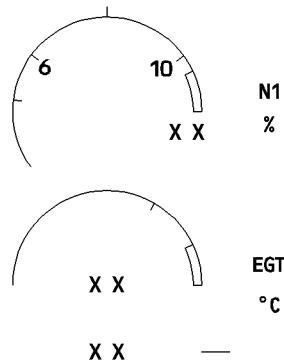
Is displayed amber on the EWD and on both ND in case of discrepancy between N1, N2, EGT, FF values on FADEC DMC bus and corresponding displayed information.

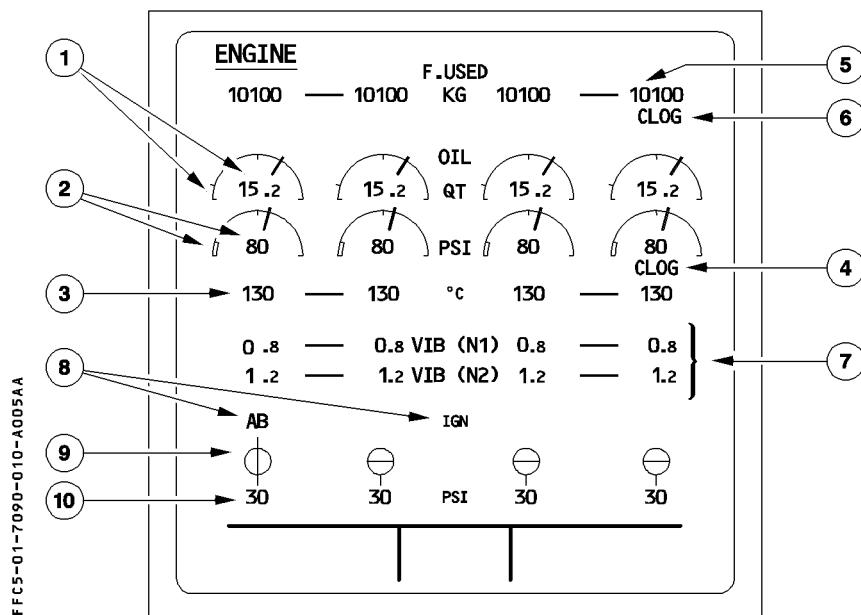
**(11) White box**

Displayed around a parameter when an engine needs specific monitoring i.e. :

- Red or amber line exceedance of any parameter
- Engine starting sequence
- Engine stopped (in flight).
- Reverser unstowed in flight or on ground out of REV mode.

*Note : In case of invalidity of any parameter, the associated digital indication is replaced by two amber crosses. For N1 and EGT parameters, the needle and the box around the digital display are removed.*



**SECONDARY PARAMETERS****START CONFIGURATION****① Oil quantity indication**

The needle and the digital indication are normally green.

The digital indication pulses if the oil quantity drops below 1.8 quarts.  
(Also displayed on ECAM CRUISE page).

Advisory is inhibited :

- at TO (FLEX or derated) or go around
- when reversers are selected
- in alpha floor mode

**② Oil pressure indication**

The needle and the digital indication are normally green.

The digital indication pulses if oil pressure exceeds 90 psi.

The needle and the digital indication are red if the oil pressure drops below 13 psi.

**(3) Oil temperature indication**

It is normally green.

The indication pulses above 140° C.

The indication becomes amber, if the temperature exceeds :

- 140° C for more than 15 minutes, or
- 155° C without delay.

**(4) Oil filter clog indication**

R The CLOG message appears in amber, in case of an excessive pressure loss across the main oil filter.

*Note : This is not an indication that the bypass valve is open.*

**(5) Fuel used indication**

The fuel used value, computed by the FADEC, is normally displayed in green.

After a transmission interruption by the FADEC, if the displayed value is 100 kg less than the actual value, it is crossed by 2 amber dashes.

It is reset at engine start, on ground.

It is also displayed on the ECAM CRUISE page.

**(6) Fuel filter clog indication**

The CLOG message appears in amber, in case of an excessive pressure loss across the fuel filter.

**(7) VIB indications**

It is indicated in green.

It pulses above 5.7 units for N1, and 5.6 units for N2.

It is also displayed on the ECAM CRUISE page.

**(8) Ignition indication**

IGN is displayed in white during the start sequence.

The selected ignitors "A", or "B", or "AB" are displayed in green when supplied.

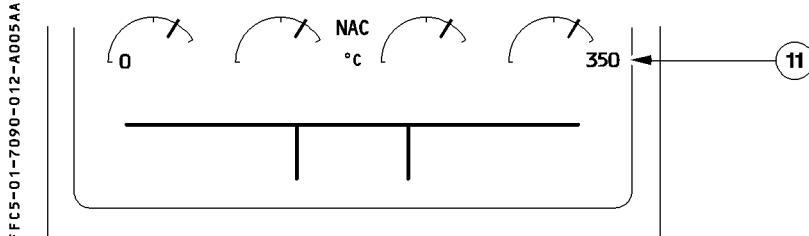
*Note : When the compressor delivery pressure is high, the igniters are not supplied, even if IGN is displayed.*

**⑨ Start valve position indication**

- Ⓐ green : valve fully open
- Ⓑ green : valve fully closed.
- Ⓐ amber : valve abnormally fully open
- Ⓑ amber : valve abnormally fully closed

**⑩ Engine bleed pressure**

Bleed pressure upstream of the precooler is normally displayed in green.  
It becomes amber below 21 psi with  $N2 \geq 10\%$  or in case of overpressure.

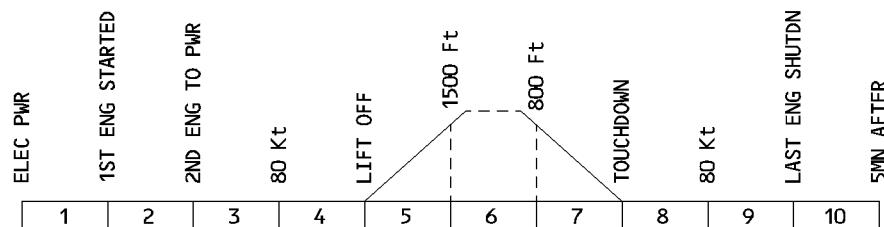
**AFTER START CONFIGURATION****⑪ Nacelle temperature indication**

Nacelle temperature needles are displayed. Becomes pulsing if the temperature exceeds 240°C.  
The advisory threshold is indicated by a small mark on the arc.  
NAC is displayed in white.  
All nacelle temperature indications are removed during engine start.

Note : In case of invalidity of any parameter, the associated digital indication is replaced by two amber crosses.  
For OIL QTY, OIL PR and NAC TEMP the needle is removed.

**WARNINGS AND CAUTIONS**

FFC5-01-7090-013-A105AB



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E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB		
ALL ENG FLAME OUT Total engine flame out	CRC	MASTER WARN	NIL		NIL		
N1 OVERLIMIT N1 above 100.3 %					4, 8		
N2 OVERLIMIT N2 above 105 %							
EGT OVERLIMIT EGT above 915°C (950° at TO power)	SINGLE CHIME	MASTER CAUT					
OIL LO PR Oil pressure low	CRC	MASTER WARN	ENG		1, 10		
MINOR FAULT Engine short time limited dispatch	NIL	NIL					
CTL SYS FAULT VBV or VSV failure or loss of parameters (PS 3, T25, T3, N1, N2) or loss of FMV, VSV position or burn staging valve failure or RAC system failure.	SINGLE CHIME	MASTER CAUT	NIL		4, 5, 7, 8		
BLEED STATUS FAULT Bleed status not received by active FADEC channel					3, 4, 5, 7, 8		
ENG FAIL Eng core speed below idle with master sw ON and fire pb is not pushed							NIL
ENG SHUT DOWN Eng master at OFF in phases 3 to 8 or eng fire pb pushed in phases 1, 2, 9 and 10							
THR LEVERS NOT SET Throttle set between MCLB and MCT at TO Flex or derated takeoff mode not selected by at least one FADEC					1 4 to 8 10		
ENG T.O. THRUST DISAGREE One FADEC at least selects a different thrust takeoff mode on ground					1 4 to 10		
ENG STALL Stall detected (not during start sequence)		ENG			3, 4, 5, 7, 8		

R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB		
EIU FAULT Data bus between EIU and FADEC failed. Engine vib indication is lost.	SINGLE CHIME	MASTER CAUT	NIL	ENG	3, 4, 5, 8		
FADEC SYS FAULT One NOGO failure affects one or both channels. Channel failure, or alternate fault, or overspeed governor fault, or sensor failure.		NIL			4, 5, 6, 7, 8		
FADEC FAULT Data bus between FADEC and ECAM failed.		MASTER CAUT			4, 5, 7, 8		
FADEC OVHT	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8		
FUEL FILTER CLOG	NIL	NIL			3 to 10		
IGN A+ B FAULT Both ignition circuits are failed.	SINGLE CHIME	MASTER CAUT			3, 4, 5		
IGN A(B) FAULT Ignition circuit A or B is failed.	NIL	NIL			3 to 8		
TYPE DISAGREE Disagree between pin programming on the FADEC and on the FWC (engine rate).	SINGLE CHIME	MASTER CAUT			1, 8,		
REV FAULT Loss of thrust reverser on one engine.					NIL	8	
REV ISOL FAULT					NIL	NIL	1 to 4, 8 to 10
REV PRESSURIZED Reverser system is pressurized, while rev doors are stowed and locked, with no deploy order (on ground).					NIL	NIL	3 to 8
REV UNLOCKED One reverser door not the locked in the stowed position, with no deploy order.					NIL	NIL	8
REV SET Reverse thrust has been selected by the crew in flight.					NIL	NIL	4, 5, 8
REV INHIBITED Reverser is inhibited by maintenance action.			NIL	NIL	3 to 9		
THR LEVER FAULT Both resolvers on one thrust lever are failed.			SINGLE CHIME	MASTER CAUT	4, 5, 7, 8		
THR LEVER DISAGREE Disagree between both resolvers of a thrust lever.					NIL	2, 3, 4, 8, 9	
OIL LO TEMP Engine oil temp < -10°C (on ground before takeoff).					ENG		
OIL HI TEMP Engine oil temp between 140°C and 155°C for more than 15 minute, or above 155°C.	NIL						
OIL FILTER CLOG It can only be triggered when N1 is less than 75% and altitude is below 20 000 feet.							
THRUST LOCKED Thrust is frozen on one or more engines, after an involuntary A/THR disconnection. This caution is recalled every 5 seconds, until thrust levers are moved.							

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E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
<b>START VALVE FAULT</b> The start valve is either stuck closed or stuck open or no starter air pressure is available (valve disagree)					
<b>START FAULT</b> Start fault due to : . starter time exceeded or . stall or . EGT overlimit or . no light up or . low N1 or . starter failure or . hung start or . high tailwind start or . THR levers not at idle.	SINGLE CHIME	MASTER CAUT	ENG	Associated FAULT It on ENG panel on pedestal (except in case of starter time exceeded)	3, 4, 5, 7, 8
<b>HP FUEL VALVE</b> Fuel valve failed closed or open					
<b>FUEL RETURN VALVE</b> valve failed closed or open	NIL	NIL	NIL	NIL	1, 4 to 10
<b>ENG THRUST LOSS</b> In case of bleed problem during takeoff	SINGLE CHIME	MASTER CAUT	ENG		

**MEMO DISPLAY**

- IGNITION message is displayed in green when selected either automatically by the FADEC or manually by the crew.

**BUS EQUIPMENT LIST****FOR INFO**

			NORM			EMER ELEC		
			AC	DC	DC BAT	AC ESS	DC ESS	HOT
FADEC	CHANNEL A	ALL ENGINES				X		
	CHANNEL B	ENG 1 and ENG 3 ENG 2 and ENG 4	AC2-3 AC2-4					
EIU (ALL ENGINES)					X			
HP VALVES						X		
OIL PRESS	ENG 1 and ENG 3		DC2					
	ENG 2 and ENG 4		DC1					
IGNITION	A	All ENG				X		
	B	ENG 1 and ENG 3 ENG 2 and ENG 4	AC2-3 AC1-2					
REVERSERS DIRECTIONAL SOLENOID VALVE	A	All ENG		DC1				
	B	All ENG		DC2				
REVERSER SHUT OFF VALVE	ENG 1		AC2-4	DC2(1)				
	ENG 2		AC1-2			X	X(2)	
	ENG 3		AC2-3	DC2				
	ENG 4		AC1-1			X	X(2)	

(1) DC1 supplies if DC2 fails.

(2) HOT BUS supplies if DC ESS BUS fails.