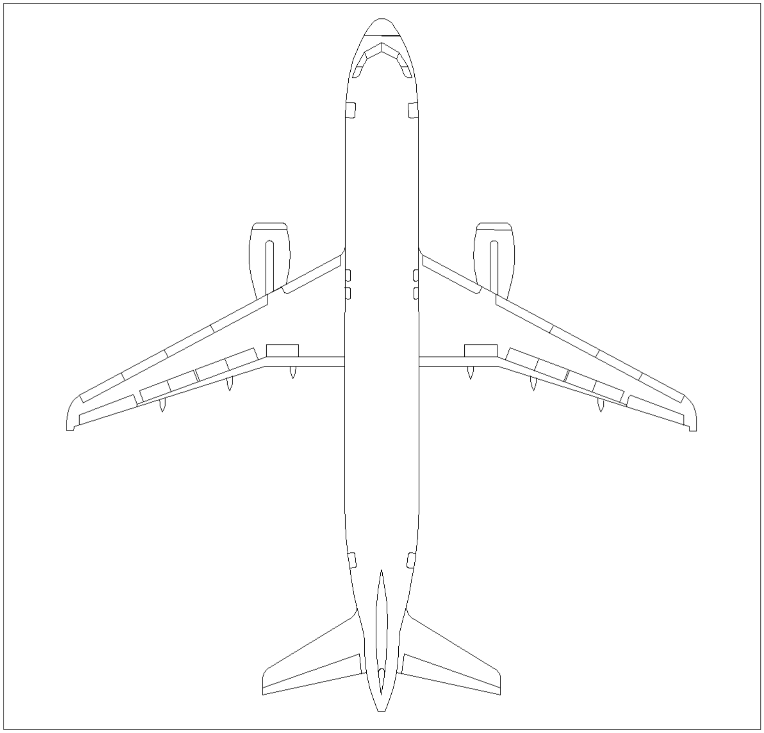
A318/A319/A320/A321

FLIGHT CREW OPERATING MANUAL



SYSTEMS DESCRIPTION

1

AIRBUS®

00.00 CONTENTS

FOREWORD

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 :

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

FOR TECHNICAL OR PROCEDURAL CONTENT

AIRBUS - BP N°33
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FOR PRINTING AND DISTRIBUTION

NFC5-01-0010-001-A001AA

CONTENT

The Flight Crew Operating Manual is the support documentation for flight crew operations. The Flight Crew Operating Manual provides operating crews with the technical, procedural and performance characteristics of the A320 family aircraft to ensure a safe and efficient operation during normal and/or abnormal/emergency situations on ground and in flight. However, the Flight Crew Operating Manual is not intended to provide basic jet aircraft piloting techniques or information that are considered as basic airmanship for trained flight crews familiar with that type of aircraft and with its general handling characteristics.
The Flight Crew Operating Manual is intended :

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

The 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.

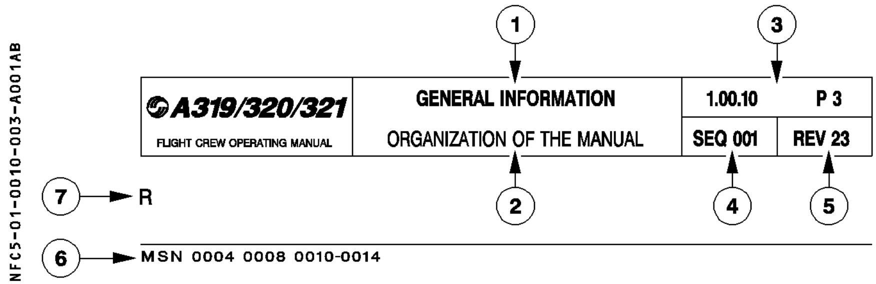
COMPLEMENTARY INFORMATION

The manual includes technical information required for training as well as complementary information.
- Where a paragraph or schematic is preceeded 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 volume1. Numeric values are given for information only.

OPTIONAL EQUIPMENT

The legend ⊲* indicates that a paragraph or a schematic is applicable only if the related equipment is installed.

PAGINATION



(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
R — 0004 0008 means that the page is applicable to aircraft MSN 0004 and MSN 0008
R — 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.

R **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. They are numbered in ascending
R sequence e.g. 20A, 20B, 20C... for intermediate revisions issued between normal revisions
R 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 provide information 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
R configuration at next revision. If judged necessary by Airbus Industrie, or requested by the
R 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.

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
R 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)

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

CODE	DESIGNATION
0001	Mod : (24035 + 25863) or (24035 + 25345 + 25863) or (24035 + 25346 + 25863) or (24160 + 25345 + 25863) or (24189 + 25345 + 25863) or (24035 + 25345 + 25346 + 25863)
0002	Mod : (24035 + 26497) or (24160 + 26497) or (24211 + 26497)
0003	Mod : 25053 or 25416 or 25538 or 25871 or 25893 or 26338 or (25053 + 26338) or (25416 + 25871) or (25538 + 25893) or (25416 + 25871 + 25893)
0004	Mod : 20682 or 20683 or 20686 or 20723 or 20724 or 20859 or 21373 or 21531 or 21710 or 21876 or 21930 or 22221 or 22442 or 22508 or 22579 or 22742 or 22748 or 23099 or 23284 or 23298 or 23399 or 23897
0005	STD or Mod : (22941 + 23453) or (22941 + 23531)
0006	Mod : 22226 or 22567 or 25115 or 27886 or (22226 + 22567) or (22567 + 25115) or (22567 + 27886) or (22226 + 22431 + 22567)
0007	Mod : 21744 or 22431 or (21459 + 21744) or (22431 + 22567) or (22567 + 26520) or (22567 + 26589) or (22567 + 27643)
0008	Mod : 22230 or 22432 or (22230 + 22567) or (22432 + 22567) or (22485 + 22976) or (22567 + 26195) or (22567 + 26520) or ANA
0009	Mod : 24035 or 24160 or 24211 or (24035 + 24211) or (24035 + 26497 + 28290) or (24160 + 26497 + 28290) or (24211 + 26497 + 28290)
0010	Mod : (23672 + 23885) or (23672 + 26111) or (23672 + 26999) or (23672 + 25205) or (23672 + 27646) or (23672 + 28382) or (23672 + 30241) or (23510 + 24075) or (23510 + 26999) or (23510 + 27646) or (23510 + 30635) or (23510 + 28382) or (24075 + 24785 + 25205) or (23672 + 25205 + 26999 + 28495) or (23672 + 26999 + 28382 + 28495) or (23510 + 25205 + 26999 + 28495) or (23510 + 26999 + 28382 + 28495)
0011	Mod : (22013 + 28479) or (22013+ 28916) or (24105 + 28479) or (24105 + 28702) or (24105 + 28916) or (26334 + 28479) or (26334 + 28702) or (26334 + 28916) or (26335 + 28479) or (26335 + 28702) or (26335 + 28916)
0012	Mod : 25529 or 26117 or 26270 or 26345 or (25529 + 26345 + 26378)
0013	Mod : 25529 or 25819 or 26117 or 26270 or 26345 or (25529 + 25819) or (26117 + 26270) or (25529 + 26345 + 26378)
0014	Mod : (23742 + 24211) or (23585 + 23742 + 24035) or (23585 + 23742 + 24160) or (23585 + 23742 + 24211) or (23585 + 23742 + 24035 + 24211)
0015	Mod : 23672 or 23510 or (26999 + 27917) or (23672 + 26999 + 28495) or (23510 + 26999 + 28495)
0016	Mod : 25205 or 26111 or 26999 or 28382 or 30241 or 30635 or 26485 or 30631 or (25205 + 26968) or (26999 + 28382 + 28495)
0017	Mod : 25295 or 27522 or (25295 + 27522 + 28360)
0018	Mod : 25404 or (25053 + 25404) or (25404 + 25416) or (25404 + 25538) or (25404 + 25871) or (25404 + 25893) or (25404 + 26338) or (25053 + 25404 + 26338) or (25404 + 25416 + 25871) or (25404 + 25893 + 26338) or (25404 + 25416 + 25871) or (25404 + 25538 + 25893)
0019	Mod : (24871 + 25409) or (24871 + 25072 + 25409) or (22562 + 24871 + 25072 + 25409)
0020	Mod : 28479 or 28702 or 28916 or(24044 + 28479) or (24044 + 28702) or (24044 +28916) or (25410 + 28479) or (25410 + 28702) or (25410 + 28916) or (24044 + 25410 +28479) or (24044 + 25410 + 28702) or (24044 + 25410 + 28916)
0021	Mod : (22562 + 25000) or (22562 + 26608)
0022	Mod : 25000 or 26608 or (25000 + 25072) or (25072 + 26608)

CODE	DESIGNATION
0023	Mod : (20477 + 20559) or (20175 + 20477 + 20559)
0024	Mod : 27522 or (25295 +25381) or (25381 + 27522) or (25295 + 25381 + 27522 + 28360)
0025	Mod : (21391 + 26526) or (20361 + 21391 + 26526 + 27638)
0026	Mod : 24035 or 24160 or 24189 or (24189 + 24211)
0027	Mod : 22562 or (21237 + 22562) or (21237 + 22562 + 25888 + 27609)
0028	Mod : (22562 + 24871 + 25000) or (22562 + 24871 + 26608)
0029	Mod : 22634 or (22634 + 25404) or (22634 + 26017)
0030	Mod : 24035 or 24160 or 24211 or (24035 + 24211) or (24035 + 26497 + 28290) or (24160 + 26497 + 28290) or (24211 + 26497 + 28290)
0031	Mod : (24871 + 25000) or (24871 + 26608) or (24871 + 25000 + 25072) or (24871 + 25072 + 26608) or (22562 + 24871 + 25000 + 25072) or (22562 + 24871 + 25072 + 26608)
0032	Mod : (23742 + 24035 + 26497) or (23742 + 24160 + 26497)or (23742 + 24211 + 26497)
0033	Mod : (20522 + 26526) or (21391 + 26526) or (20522 + 21391 + 26526)
0034	Mod : (24035 + 25863) or (24160 + 25863) or (24189 + 24211 + 25863)
0035	Mod : (20067 + 20069 + 20071) or (20067 + 20069 + 20816 + 27063)
0036	Mod : 26999 or 28382 or 30241 or 30631 or 30635 or (26999 + 28382 + 28495)
0037	Mod : (20361 + 22769 + 26526) or (20522 + 22769 + 26526)
0038	Mod : 21237 or (21237 + 25072) or (21237 + 22562 + 25072) or (21237 + 25888 + 27609) or (21237 + 22562 + 25072 + 25888 + 27609)
0039	Mod : 23885 or 24075 or (23885 + 24075 + 26999 + 28495)
0040	Mod : (22013 + 25404) or (25053 + 25404) or (25404 + 26338) or (25053 + 25404 + 26338)
0041	Mod : (20522 + 26526) or (20361 + 20522 + 26526 + 27638)
0042	Mod : (25404 + 26017) or (22634 + 25404 + 26017)
0043	Mod : 21459 or 22431 or (22431 + 22567) or (22567 + 26589) or (22567 + 27643) or CDN
0044	Mod : (22249 + 25529) or (22249 + 25819) or (22249 + 26117) or (22249 + 26270) or (22249 + 26345) or (22249 + 25529 + 26345)
0045	Mod : 25205 or 26111 or 26999 or 28382 or 30241 or 30635 or (26999 + 28382 + 28495) or (25205 + 26999 + 28495)
0046	Mod : 24310 or 24624 or 25625 or 26169 or 26191 or 26203 or (20283 + 26203 + 28684) or (20283 + 26169 + 26203 + 28684)
0048	Mod : 23672 or 25108 or 25336 or 27917 or (23219 + 23672) or (23672 + 25294) or (23672 + 25336) or (25108 + 25336) or (23219 + 23672 + 25336) or (23672 + 25294 + 25336)
0049	Mod : 20173 or 20461 or (20173 + 20461) or (20173 + 20210 + 20461)
0050	Mod : (24511 + 27276) or (24511 + 24745 + 27276)
0051	Mod : (20117 + 26999) or (21678 + 26999) or (21678 + 27646) or (21678 + 26999 + 27646)
0052	Mod : (24136 + 24064) or (24136 + 24065) or (24136 + 24066) or (24136 + 24067) or (24136 + 27831) or (24136 + 24064 + 26497 + 28290) or (24136 + 24066 + 26497 + 28290)
0053	Mod : (20081 + 20818) or (20042 + 20081 + 20818 + 25735)
0054	STD or Mod : (24917 + 25335) or (24917 + 25894) or (24917 + 25335 + 25894)

CODE	DESIGNATION
0055	Mod : 22013 or (22013 + 24511) or (24105 + 24511)
0056	Mod : (20069 + 20071) or (20069 + 20816) or (20067 + 20069 + 20071) or (20069 + 20071 + 20816) or (20067 + 20069 + 20816 + 27063)
0057	Mod : (20069 + 20071) or (20069 + 20816) or (20069 + 20071 + 20816)
0058	Mod : 22013 or 24105 or (22013 + 24613) or (24105 + 24613)
0059	Mod : 24871 or (22562 + 24871 + 25072)
0060	Mod : (24035 + 26017) or (24160 + 26017) or (24189 + 26017)
0061	Mod : 24035 or 24084 or (24035 + 24084)
0062	Mod : 24035 or 24084 or (24035 + 24084) or (20586 + 22802 + 24035) or (20586 + 22802 + 24084) or (20586 + 22802 + 24035 + 24084)
0063	Mod : 20850 or 22461 or (20850 + 22461)
0064	Mod : 20024 or (20024 + 22802) or (20024 + 20586 + 22802)
0065	Mod : (20024 + 25415) or (20024 + 22802 + 25415) or (20024 + 22802 + 25415 / L)
0066	Mod : (22461 + 23408) or (20850 + 22461 + 23408)
0067	Mod : (20081 + 20230 + 20818) or (20042 + 20081 + 20230 + 20818 + 25735)
0068	Mod : (26621 + 26678) or (21437 + 23480 + 26621 + 26678)
0069	Mod : (20057 + 20082) or (20057 + 20059 + 20082 + 20084)
0070	Mod : (MP K2211 + 22013 + 22681) or (MP K2211 + 22013 + 25839) or (22013 + 26539 + 26858)
0071	Mod : 24871 or (24871 + 25072) or (22562 + 24871 + 25072)
0072	Mod : 25205 or 26111 or 26999 or 28382 or 30241 or 30635 or 30631 or 26485 or (26999 + 28382 + 28495)
0073	Mod : (22013 + 22089 + 27993) or (22013 + 24871 + 27993)
0074	Mod : (28479 + 30206) or (28702 + 30206) or (28916 + 30206)
0075	Mod : 20682 or 20683 or 20686 or 20723 or 20724 or 20859 or 21373 or 21531 or 21710 or 21876 or 21930 or 22221 or 22442 or 22508 or 22579 or 22742 or 22748 or 23099 or 23284 or 23298 or 23399 or 25958 or 26691 or (20682 + 20723) or (20683 + 23099) or (20686 + 26691) or (21710 + 23099) or (21710 + 23298) or (22221 + 23099) or (23099 + 23399) or (23099 + 25958) or (20683 + 23099 + 25958)
0076	Mod : 24035 or 24160 or (24035 + 24211) or (24189 + 24211) or (24035 + 25863 + 28551) or (24160 + 25863 + 28551) or (24035 + 24211 + 25863 + 28551) or (24189 + 24211 + 25863 + 28551)
0077	Mod : (20173 + 26999) or (26274 + 26999) or (26274 + 27646) or (20173 + 27646) or (20173 + 30631) or (26274 + 28382) or (26274 + 26999 + 27646) or (20173 + 26274 + 26999) or (20173 + 27646 + 28382) or (26274 + 26999 + 28382 + 28495)
0078	Mod : (22249 + 25529) or (22249 + 25819) or (22249 + 26117) or (22249 + 26270) or (22249 + 26345) or (22249 + 25529 + 25819) or (22249 + 25521 + 26345) or (22249 + 26117 + 26270) or (22249 + 28308 + 28811) or (22249 + 25529 + 28308 + 28811)
0079	STD or Mod : 24871 or 25072 or 25409 or (22562 + 25072) or (24871 + 25072) or (22562 + 24871 + 25072) or (22562 + 25072 + 25409) or (24871 + 25072 + 25409)
0080	Mod : 22562 or (22562 + 24871) or (22562 + 24871 + 25409)
0081	Mod : (20057 + 20082) or (20059 + 20084) or (20057 + 20059 + 20084) or (20057 + 20059 + 20082 + 20084)
0082	Mod : 20057 or 20059 or 30067 or (20057 + 20059) or (20057 + 20082) or (20059 + 21161)

	CODE	DESIGNATION
	0083	Mod : 20057 or 20059 or 20586 or 22706 or 22707 or (20057 + 20059) or (20057 + 22707) or (20059 + 20586) or (20059 + 22707) or (20586 + 22707) or (22706 + 22707) or (20057 + 20059 + 22707) or (20059 + 20586 + 22707) or (20586 + 22706 + 22707)
	0084	Mod : (20059 + 20084) or (30066 + 30067) or (20059 + 20084 + 22707) or (20057 + 20059 + 20084 + 22707) or (20059 + 20084 + 22706 + 22707) or (20057+20059+20084+22706+22707) or (P2878 + 20059+20084+22706+22707)
	0085	Mod : 20057 or 20059 or 30067 or (20057 + 20059) or (20059 + 22706) or (20057 + 22706 + 22707) or (20059 + 22706 + 22707) or (20057 + 20059 + 22706 + 22707) or (20059 + 20586 + 22706 + 22707)
	0086	Mod : (20059 + 20084 + 20586) or (20057 + 20059 + 20084 + 20586) or (20059 + 20084 + 20586 + 22707) or (20059 + 20084 + 20586 + 22706 + 22707) or (20057 + 20059 + 20084 + 20586 + 22707)
	0087	Mod : (20057 + 20059 + 20082 + 20084) or (20057 + 20059 + 20082 + 20084 + 22707) or (20057 + 20059 + 20082 + 20084 + 22706 + 22707)
	0088	Mod : (22013 + 22681) or (22013 + 25839) or (22013 + 25903) or (22013 + 26539)
	0089	Mod : (20457 + 26703) or (20457 + 27170) or (20458 + 27170) or (21144 + 27170) or (25125 + 27170) or (25386 + 25577) or (25386 + 27170) or (25576 + 25577) or (26155 + 27170) or (25386 + 25576 + 25577) or (20457 + 26703 + 27170)
	0090	Mod : 27211 or (22013 + 22681 + 25903) or (22013 + 22681 + 27211) or (22013 + 25839 + 27170) or (22013 + 26539 + 27170)
	0091	Mod : 20457 or 20458 or 21144 or 22681 or 25125 or 25386 or 25839 or 26155 or 26539
	0092	Mod : 27211 or (20457 + 26703) or (20457 + 27170) or (20458 + 27170) or (21144 + 27170) or (22681 + 27170) or (22681 + 27211) or (25125 + 27170) or (25386 + 25577) or (25386 + 27170) or (25576 + 25577) or (25839 + 27170) or (25903 + 25904) or (26155 + 27170) or (26539 + 27170) or (25386 + 25576 + 25577)
	0093	Mod : 20075 or 20219 or 21776 or 24266 or 24267 or 31006 or (20075 + 20219) or (20075 + 24267) or (24266 + 24267)
	0094	Mod : (20457 + 26703) or (20457 + 27170) or (20458 + 27170) or (21144 + 27170) or (25125 + 27170) or (25386 + 25577) or (25576 + 25577) or (25839 + 27170) or (25903 + 25904) or (26155 + 27170) or (26539 + 27170) or (25386 + 25576 + 25577) or (20457+26703+27170)
	0095	Mod : 22536 or 23227 or 23529 or 25564 or 31699 or MSN : 163, 164, 168, 169, 179, 193, 221 ,222, 230, 294 ,299, 301 ,338, 348, 349, 362, 363, 424, 429, 437, 444, 449, 476,
	0096	Mod : (22249 + 28308) or (22249 + 25529 + 28308) or (22249 + 25819 + 28308) or (22249 + 26117 + 28308) or (22249 + 26270 + 28308) or (22249 + 25529 + 25819 + 28308)
	0097	Mod : (MP K2211 + 21144) or (MP K2211 + 26155)
R R	0098	Mod :(20071 + 21708) or (20067 + 20069 + 20071 + 21708) or (20067 + 20069 + 20816 + 21708 + 27063)
	0099	Mod : (MP K2211 + 21144) or (MP K2211 + 22681) or (MP K2211 + 25839) or (MP K2211 + 26155)
	0100	MSN : 163, 164 ,168 ,169 ,179 ,193 ,221 ,222 ,230 ,294 ,299 ,301 ,338 ,348 ,349 ,362 ,362 ,363 ,424 ,429 ,437, 444, 449, 476.
R R R R R	0101	Mod : 26999 or 28382 or 30241 or 30631 or 30635 or 27646 or (27646 + 28382) or (27646 + 30241) or (24075 + 28382) or (26111 + 26999) or (26111 + 28382) or (26999 + 27646 + 30241) or (27646 + 28382 + 30635) or (26999 + 27646 + 30241) or (23885 + 26111 + 26999) or (26999 + 28382 + 28495) or (26999 + 27646 + 28382 + 28495)

	CODE	DESIGNATION
	0102	Mod : (20510 + 20818 + 21144) or (20510 + 20818 + 26155) or (20510 + 20818 + 26539)
	0103	Mod : (24211 + 25863) or (24035 + 25345 + 25863) or (24035 + 25346 + 25863) or (24160 + 25345 + 25863) or (24035 + 25345 + 25346 + 25863)
	0104	Mod : 26526 or (22769 + 26526) or (20361 + 22769 + 26526) or (20361 + 26526 + 27638) or (20361 + 22769 + 26526 + 27638)
	0105	Mod : 20057 or 20059 or 30067 or (20057 + 20059)
	0106	Mod : 20024 or 20167 or (20024 + 20167)
	0107	Mod : (23742 + 24035 + 26497) or (23742 + 24160 + 26497) or (24189 + 24211 + 26497)
R R	0108	Mod : 24035 or 24160 or 24211 or (24035 + 28290) or (24035 + 26497 + 28290) or (24160 + 26497 + 28290)
	0109	Mod : (23742 + 24035) or (23742 + 24160) or (23742 + 24211) or (23742 + 24035 + 24197)
	0110	Mod : (23742 + 24035) or (23742 + 24160) or (23742 + 24211) or (23742 + 24035 + 26497 + 28290) or (23742 + 24160 + 26497 + 28290)
	0111	Mod : (22311 + 23853) or (22311 + 23853 + 25184) or (22311 + 23853 + 25184 + 27285)
	0112	Mod : (25184 + 26207) or (25184 + 27281) or (22311 + 25184 + 26207) or (22311 + 25184 + 26875+ 27281) or (22311 + 25184 + 27281 + 27285) or (22311 + 25184 + 26207 + 27281 + 27285)
	0113	Mod : 22791 or (22311 + 22791) or (22311 + 22791 + 25184) or (22311 + 22791 + 25184 + 27285) or (22311 + 22876 + 25184 + 28952)
	0114	Mod : (20283 + 21252 + 26169) or (20283 + 21252 + 26203) or (20283 + 21252 + 26169 + 26203)
	0115	Mod : 25888 or (21237 + 25888) or (22562 + 25888) or (25072 + 25888) or (22562 + 25072 + 25888) or (21237 + 22562 + 25072 + 25888)
	0116	STD or Mod : 25072 or (22562 + 25072) or (25888 + 27609) or (22562 + 25072 + 25888 + 27609)
	0117	Mod : 20042 + 20081 + 20230 + 21746 + 22260
R	0118	Mod : 20457 or 20458 or 21144 or 25125 or 25386 or 26155 or 32682
R	0120	Mod : 22013 or (22013 + 24511) or (22013 + 24745) or (22013 + 24511 + 24745)
	0121	STD or Mod : 25072 or (22562 + 25072) or (25888 + 27609)
R R R	0122	Mod : (24871 + 25000 + 27777) or (24871 + 26608 + 27777) or (22562 + 24871 + 25072 + 27777) or (22562 + 24871 + 25072 + 26608 + 27777) or (24871 + 25072 + 26608 + 27777)
	0123	Mod : (20457 + 20510) or (20458 + 20510) or (20510 + 21144) or (20510 + 22681) or (20510 + 25125) or (20510 + 25386) or (20510 + 25839) or (20510 + 26155) or (20510 + 26539)
	0124	Mod : (20042 + 20081 + 20230) or (20042 + 20081 + 27395)
	0125	Mod : 26017 or (24612 + 26017) or (20139 + 22129 + 24612 + 26017)
	0126	Mod : (22562 + 24871 + 27777) or (22562 + 24871 + 25000 + 27777) or (22562 + 24871 + 26608 + 27777)
	0127	STD or Mod : 25072 or 27609 or (22562 + 25072) or (25072 + 27609) or (22562 + 25072 + 27609)
	0128	Mod : (22536 + 28308) or (23227 + 28308) or (23529 + 28308)
	0129	Mod : 27777 or (26608 + 27777)
	0130	Mod : 26017 / IAE V2500/V2522/V2524/V2527/V2527E/V2527M
	0131	IAE V2522/V2524/V2527/V2527E/V2527M

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0132	STD or Mod : 26963 or (25419 + 26963) or (25419 + 26963 + 27992)
0133	Mod : (25440 + 26231) or (25440 + 26231 + 26275 + 28293)
0134	STD or Mod : 28684 or (20283 + 28684)
0136	Mod : (22249 + 24035) or (22249 + 24160) or (22249 + 24211)
0137	Mod : (25205 + 28916) or (26111 + 28916) or (26999 + 28916) or (28382 + 28916) or (28916 + 30241) or (28916 + 30635) or (26485 + 28916) or (28916 + 30631)
0138	Mod : 22013 or 25053 or 26338 or (25053 + 26338)
0139	Mod : (25529 + 28916) or (25529 + 28479) or (26117 + 28479) or (26117 + 28702) or (26270 + 28479) or (26117 + 28916) or (26270 + 28916) or (26345 + 28916) or (25529 + 26345 + 26378 + 28916)
0140	Mod : (23885 + 28916) or (24075 + 28916) or (24075 + 25205 + 26999 + 28495 + 28916)
0141	Mod : 26093 or 26243 or 26716 or 26717 or 26799 or 26968 or 27780 or 27831 or 27832 or 28416
0142	Mod : 26093 or 26243 or 26716 or 26717 or 26799 or 26968 or 27780 or 27831 or 27832 or 28416 or (26968 + 26999 + 28495)
0143	Mod : (22311 + 22536 + 23346) or (22311 + 22536 + 23346 + 25184) or (22311 + 22346 + 22536 + 25184 + 27285)
0144	Mod : (22536 + 25184 + 26380) or (22311 + 22536 + 22876 + 25184 + 26380) or (22311 + 22876 + 23529 + 25184 + 26380 + 27285)
0145	Mod : (28308 + 28369) or (23450 + 28308 + 28369) or (20406 + 23450 + 28308 + 28369)
0146	Mod : (20586 + 24035) or (20586 + 24084) or (20586 + 24035 + 24084)
0148	Mod : (22249 + 24035) or (22249 + 24160) or (22249 + 24189)
0149	Mod : (22536 + 22791) or (22311 + 22791 + 23227) or (22311 + 22536 + 22791 + 25184) or (22311 + 22791 + 23227 + 25184) or (22311 + 22791 + 23529 + 25184) or (22311 + 22791 + 23227 + 25184 + 27285) or (22311 + 22876 + 23529 + 25184 + 28952)
0150	Mod : 24035 or 24084 or 24160 or 24189 or (24035 + 24084) or (24035 + 24160) or (24035 + 24189) or (24035 + 24084 + 24160) or (24035 + 24084 + 24189) or (24035 + 24160 + 24189) or (24035 + 24084 + 24160 + 24189)
0151	Mod : (20586 + 24035) or (20586 + 24084) or (20586 + 24160) or (20586 + 24189) or (20586 + 24035 + 24084) or (20586 + 24035 + 24160) or (20586 + 24035 + 24189) or (20586 + 24084 + 24160) or (20586 + 24084 + 24189) or (20586 + 24160 + 24189)
0152	Mod : (22013 + 24044 + 28479) or (22013 + 24044 + 25410 + 28479)
0153	Mod : 20850 or 22461 or 23408 or (20850 + 22461) or (22461 + 23408) or (20850 + 22461 + 23408)
0154	Mod : (20024 + 22013) or (20024 + 22013 + 22802) or (20024 + 20586 + 22013 + 22802)
0155	Mod : (20024 + 22013 + 25415) or (20024 + 22013 + 22802 + 25415) or (20024 + 20586 + 22013 + 22802 + 25415)
0156	Mod : 25053 or 26338 or (25053 + 26338)
0157	Mod : 22013 or 24035 or 24160 or 24189 or (22013 + 24035)
0158	Mod : 22226 or 22567 or (22226 + 22567) or (22567 + 25115) or (22567 + 27886) or (22226 + 22431 + 22567)
0159	Mod : (22311 + 22536 + 23853) or (22311 + 23529 + 23853) or (22311 + 23227 + 23853 + 25184) or (22311 + 23529 + 23853 + 25184) or (22311 + 23529 + 23853 + 25184 + 27285)

CODE	DESIGNATION
0160	Mod : (22536 + 25184 + 27281) or (23529 + 25184 + 26875 + 27281) or (22311 + 23227 + 25184 + 27281 + 27285) or (22311 + 23529 + 25184 + 26875 + 27281) or (22311 + 23529 + 25184 + 27281 + 27285) or (22311 + 23227 + 25184 + 26875 + 27281 + 27285) or (22311 + 23529 + 25184 + 26875 + 27281 + 27285)
0161	Mod : (22536 + 25184 + 26670) or (22311 + 22536 + 25184 + 26670) or (22311 + 23227 + 25184 + 26670) or (22311 + 23529 + 25184 + 26670) or (22311 + 22536 + 25184 + 26670 + 27285) or (22311 + 23227 + 25184 + 26670 + 27285) or (22311 + 23529 + 25184 + 26670 + 27285)
0162	Mod : 24035 or 24084 or 24160 or (24035 + 24084) or (24035 + 24160) or (24084 + 24160) or (24035 + 24084 + 24160)
0163	Mod : 20024 or (20024 + 22802) or (20024 + 22802/L)
0164	Mod : (22013 + 25415) or (20024 + 22013 + 25415)
0165	STD or L or Mod : 22802 or 22802/L or 25415 or 25415/L or (22802 + 25415)
0166	Mod : (22013 + 23839) or (20024 + 22013 + 23839)
0167	Mod : (25529 + 30368) or (25819 + 30368) or (26117 + 30368) or (26270 + 30368) or (26345 + 30368) or (25529 + 26345 + 30368)
0168	Mod : (20283 + 24042) or (20283 + 24310) or (20283 + 24624) or (20283 + 25625) or (20283 + 26169) or (20283 + 26191) or (20283 + 26203) or (24624 + 20283) or (26169 +20283) or (20283 + 24042 + 24624) or (20283 + 24624 + 26203) or (20283 + 25625 + 26203) or (20283 + 26169 + 26203) or (20283 + 26191 + 26203) or (20283 + 26169 + 26191 + 26203)
0170	Mod : (22536 + 25184 + 26235) or (22311 + 22536 + 25184 + 26235) or (22311 + 23529 + 25184 + 26235)
0171	Mod : 28238 or (28238 + 28308)
0172	Mod : (20057 + 20059) or (20057 + 20059 + 20084)
0174	Mod : (20059 + 20084) or (30066 + 30067) or (20057 + 20059 + 20084) or (20059 + 20084 + 22707) or (20059 + 20084 + 20586) or (20057 + 20059 + 20082 + 20084) or (20057 + 20059 + 20084 + 20586) or (20057 +20059 + 20084 + 22707) or (20059 + 20084 + 20586 + 22707) or (20059 + 20084 + 22706 + 22707) or (20057 + 20059 + 20082 + 20084 + 22707) or (20057 + 20059 + 20084 + 20586 + 22707) or (20057 + 20059 + 20084 + 22706 + 22707) or (20059 + 20084 + 20586 + 22706 + 22707) or (20057 + 20059 + 20082 + 20084 + 22706 + 22707)
0175	Mod : 25529 or 25819 or 26117 or 26270 or 26345 or (25529 + 26345)
0176	Mod : 24035 or 24160 or (24189 + 24211) or (24035 + 26497 + 28290) or (24160 + 26497 + 28290) or (24189 + 24211 + 26497 + 28290)
0177	STD or Mod : 25345 or 25346 or (23742 + 25345) or (23742 + 25346) or (23742 + 25345 + 25346)
0178	Mod : 24035 or 24160 or (24189 + 24211) or (24035 + 25863 + 28551) or (24160 + 25863 + 28551) or (24189 + 24211 + 25863 + 28551)
0179	Mod : (22311 + 25184 + 26193) or (22311 + 22876 + 25184 + 26380) or (22311 + 22876 + 25184 + 26380 + 27285)
0180	Mod : 24035 or 24160 or 24211 or (24035 + 25863 + 28551) or (24160 + 25863 + 28551) or (24211 + 25863 + 28551)
0181	Mod : (20059 + 22706) or (20059 + 22706 + 22707)
0182	Mod : (22536 + 26540) or (23227 + 26540) or (23529 + 26540)
0183	Mod : (22536 + 25409) or (23227 + 25409) or (23529 + 25409)
0184	Mod : (26526 + 27046) or (26526 + 27046 + 28244 + 30170)
0185	Mod : (25110 + 26923) or (25110 + 27255) or (25110 + 27572) or (25110 + 26723 + 27572)

CODE	DESIGNATION
0186	Mod : (27046 + 28244) or (26526 + 27046 + 28244)
0187	Mod : 25184 or (22311 + 25184) or (22311 + 27285) or (25184 + 26875) or (22311 + 25184 + 26875) or (22311 + 25184 + 27285) or (22311 + 25184 + 26875 + 27281) or (22311 + 22791 + 25184 + 30389) or (22311 + 25184 +26207 + 27285) or (22311 + 25184 + 26380 + 26875) or (25184 + 26207 + 26875 + 27281) or (25184 + 26380 + 26875 + 27285) or (22311 + 22876 + 25184 + 26380 + 26875) or (25184 + 27281 + 27285) or (22311 + 25184 + 26380 + 26875 + 27285) or (22311 + 25184 + 26380 + 26875 + 27281 + 27285) or (22311 + 22876 + 25184 + 26380 + 26875 + 27281 + 27285) or (22091 + 25184 + 26875 + 27285 + 27608)
0188	Mod : (25184 + 26235) or (22311 + 25184 + 26235) or (22311 + 25184 + 26207 + 26235)
0189	Mod : (25184 + 27281) or (22311 + 25184 + 26207) or (25184 + 26875 + 27281) or (22311 + 25184 + 26875 + 27285) or (22311 + 25184 + 27281 + 27285) or (22311 + 25184 + 26207 + 27281 + 27285) or (22311 + 25184 + 26875 + 27281 + 27285)
0190	Mod : 27558 or (22311 + 22876) or (22311 + 22876 + 25184) or (22311 + 22876 + 25184 + 27285) or (22311 + 25184 + 26875 + 27285) or (22311 + 25184 + 26670 + 27285 + 27558)
0191	Mod : (22311 + 23346) or (22311 + 23346 + 25184) or (22311 + 23346 + 25184 + 27285)
0192	STD or Mod : 28809 or (27624 + 28809)
0193	MP : (K0385 + K5043) or (K1170 + K5043) or (K0385 + K1170 + K5043)
0194	STD or Mod : 28308 or (28308 + 28811) or (28378 + 31897) or (28308 + 28369 + 28811) or (28238 + 28308 + 31897)
0195	Mod : (24064 + 25205) or (24064 + 26111) or (24064 + 26999) or (24064 + 28382) or (24065 + 25205) or (24065 + 26111) or (24065 + 26999) or (24065 + 28382) or (24066 + 25205) or (24066 + 26111) or (24066 + 26999) or (24066 + 28382) or (24067 + 25205) or (24067 + 26111) or (24067 + 26999) or (24067 + 28382) or (24064 + 30241) or (24066 + 30241) or (24064 + 30635) or (24066 + 30635) or (24064 + 30631) or (24065 + 30631) or (24066 + 30631) or (24067 + 30631) or (24064 + 26485) or (24065 + 26485) or (24066 + 26485) or (24067 + 26485) or (26999 + 28382 + 28495)
0196	Mod : (21039 + 24215) or (21039 + 24588) or (21039 + 25534)
0197	Mod : (21038 + 24215) or (21038 + 24588) or (21038 + 25534)
0198	Mod : (21038 + 24215 + 25469) or (21038 + 24215 + 26093) or (21038 + 24215 + 26799) or (21038 + 24215 + 26968) or (21038 + 24215 + 27780) or (21038 + 24215 + 28416) or (21038 + 24588 + 26799) or (21038 + 24588 + 26968) or (21038 + 24588 + 27780) or (21038 + 25534 + 27780)
0199	Mod : (21039 + 24215 + 26243) or (21039 + 24215 + 26716) or (21039 + 24215 + 26717) or (21039 + 24215 + 27831) or (21039 + 24215 + 27832) or (21039 + 24588 + 26243) or (21039 + 24588 + 27832) or (21039 + 25534 + 27832)
0200	MSN 119, 123, 124, 205, 370, 390, 402, 511.
0201	Mod : 20057 + 20059 + 20084 + 22706 + 22707
0202	Mod : 25888 or (22562 + 25888) or (25072 + 25888) or (22562 + 25072 + 25888)
0203	Mod : 25888 or (24871 + 25888) or (25072 + 25888) or (25409 + 25888) or (22562 + 25072 + 25888) or (22562 + 25409 + 25888) or (24871 + 25409 + 25888) or (24871 + 25072 + 25409 + 25888) or (25072 + 25409 + 25888) or (22562 + 24871 + 25072 + 25409 + 25888) or (22562 + 25072 + 25409 + 25888)
0204	Mod : 24404 or 24405 or 25530 or 27640
0205	Mod : (20057 + 20082 + 22707) or (20057 + 20082 + 22706 + 22707)

	CODE	DESIGNATION
R	0206	Mod : 26999 or 27646 or 30631or 28382 or 30241 or (26999 + 27531) or (26999 + 27646) or (27531 + 27646) or (27646 + 28382) or (26999 + 27531 + 27646) or (26274 + 27646 + 30955) or (26999 + 28382 + 28495) or (26274 + 27646 + 28382 + 30955)
R	0207	Mod : 23672 or 24582 or 24785 or 25108 or 25204 or 25336 or 26000 or 26001 or 26002 or 28218 or (31896 + 32332) or (31897 + 32333)
	0208	Mod : (20024 + 23839 + 25415) or (20024 + 22013 + 23839 + 25415) or (20024 + 22013 + 23839 + 25415 + 30206)
	0209	Mod : (25184 + 26670) or (22311 + 25184 + 26670) or (22311 + 25184 + 26670 + 27285)
	0210	Mod : (25184 + 26193) or (22311 + 22876 + 25184 + 26380) or (22311 + 22876 + 25184 + 26380 + 27285)
	0211	Mod : 25184 or (22311 + 25184) or (22311 + 27285) or (25184 + 26875) or (25184 + 27285) or (22311 + 25184 + 26875) or (22311 + 25184 + 27285) or (22311 + 22791 + 25184 + 30389) or (22311 + 25184 + 26207 + 27285) or (22311 + 25184 + 26380 + 26875) or (25184 + 26207 + 26875 + 27281) or (25184 + 26380 + 26875 + 27285) or (22311 + 22791 + 25184 + 30389) or
		(22311 + 22876 + 25184 + 26380 + 26875) or (22311 + 25184 + 26875 + 27281 + 27285) or (25184 + 26207 + 26875 + 27281 + 27285) or (22311 + 25184 + 26380 + 26875 + 27285) or (22311 + 25184 + 26380 + 26875 + 27281 + 27285) or (22311 + 22876 + 25184 + 26380 + 26875 + 27281 + 27285) or (22091 + 25184 + 26875 + 27285 + 27608)
	0212	Mod : (22311 + 25184 + 26670) or (22311 + 25184 + 26670 + 27285)
	0217	Mod : 22536 or 23227 or 23529 or (22311 + 22536) or (22311 + 23227) or (22311 + 23529)
R	0219	Mod : (25184 + 26875) or (22791 + 30389) or (22311 + 22536 + 25184) or (22311 + 23227 + 25184) or (22311 + 23529 + 25184) or (22311 + 23529 + 27285) or (22311 + 25184 + 27285) or (23227 + 25184 + 26875) or (23529 + 25184 + 26875) or (23529 + 25184 + 27285) or (22311 + 22536 + 25184 +26875) or (22311 + 22536 + 25184 + 27285) or (22311 + 23227 + 25184 + 26875) or (22311
R	0219	+ 23227 + 25184 + 27285) or (22311 + 23529 + 25184 + 26875) or (22311 + 23529 + 25184 + 27285) or (23227 + 25184 + 26875 + 27285) or (25184 + 26380 + 26875 + 27285) or (22311 + 22791 + 23529 + 25184 + 30389) or (22311 + 22876 + 25184 + 26380 + 26875) or (22311 + 23227 + 25184 + 26875 + 27285) or (22311 + 23529 + 25184 + 26380 + 26875) or (22311 + 22876
R		+ 23529 + 25184 + 26380 + 26875) or (22311 + 23529 + 25184 + 26875 + 27285) or (23227 + 25184 + 26875 + 27281 + 27285) or (22311 + 23529 + 25184 + 26380 + 26875 + 27281 +27285) or (22311 + 22876 + 23529 + 25184 + 26380 + 26875 + 27281 + 27285) or (23227 + 25184 + 26875 + 27281) or (22311 + 22536 + 22791 + 25184 + 26670 + 30389) or (22311 + 27285) or (22536 + 22791 + 26670 + 30389) or (23227 + 25184 + 26875 + 27281)
	0220	Mod : (22536 + 22876) or (22536 + 27558) or (22311 + 22876 + 23227) or (22311 + 22536 + 22876 + 25184) or (22311 + 22876 + 23227 + 25184) or (22311 + 22876 + 23529 + 25184) or (22311 + 22536 + 22876 + 25184 + 27285) or (22311 + 22876 + 23227 + 25184 + 27285) or (22311 + 23529 + 25184 + 26670 + 27285 + 27558)
	0221	Mod : 22433 or (22433 + 22567) or (TAP + 22226) or (TAP + 22226 + 22431 + 22567)
	0222	Mod : 22230 or 22432 or (22230 + 22567) or (22432 + 22567) or (22485 + 22976) or (22567 + 26195) or ANA
	0223	Mod : 22876 or (22311 + 22876) or (22311 + 22876 + 25184) or (22311 + 22876 + 25184 + 27285)

	CODE	DESIGNATION
R	0224	Mod : (27256 + 23742) or (27541 + 23742) or (32262 + 23742) or (27256 + 26358) or (27541 + 26358) or (32262 + 26358)
	0225	Mod : 22707/IAE V2500/V2522/V2524/V2527/V2527E/V2527M
	0226	IAE V2500/V2522/V2524/V2527/V2527E/V2527M
	0227	Mod : 24404 or 24405 or 25530 or 27640
	0230	Mod : 26526 or (20361 + 26526) or (20361 + 26526 + 27638)
	0231	Mod : 26723 or 27410 or 27639 or 27763 or 30277 or (27255 + 27572 + 27639)
	0232	Mod : (25110 + 26723) or (25110 + 27410) or (25110 + 27639) or (25110 + 27763) or (25110 + 30277) or (25110 + 26723 + 27572 + 27763)
	0233	Mod : (24136 + 24064 + 26497) or (24136 + 24066 + 26497) or (24136 + 26497 + 26968) or (24136 + 26497 + 27831)
	0234	Mod : (24035 + 26497) or (24160 + 26497) or (24211 + 26497)
	0235	Mod : 24211 or (23742 + 24035) or (23742 + 24160) or (23742 + 24211) or (23742 + 24035 + 26497 + 28290)
	0236	Mod : (24211 + 26497) or (23742 + 24035 + 26497) or (23742 + 24160 + 26497)
	0237	Mod : 24414 or (24035 + 24414) or (24211 + 24414)
	0238	Mod : (24035 + 24064) or (24035 + 24065) or (24035 + 24066) or (24035 + 24067) or (24064 + 24211) or (24065 + 24211) or (24067 + 24211)
R	0239	Mod : 20173 or 25650 or 26274 or (20173 + 25650) or (20173 + 26274) or (26274 + 26999 + 28495)
	0240	Mod : 23346 or (22311 + 23346) or (22311 + 23346 + 25184) or (22311 + 23346 + 25184 + 27285)
	0241	Mod : 23853 or (22311 + 23853) or (22311 + 23853 + 25184) or (22311 + 23853 + 25184 + 27285)
	0243	Mod : 26497 or (24035 + 26497) or (24160 + 26497) or (24211 + 26497)
	0245	Mod : 26877 or 27698 or 27740 or 27753 or 28738 or 28739 or 30163 or 31699 or (22536 + 27698) or (23227 + 28739) or (23529 + 27740)
	0246	Mod : 22536 or 23227 or 23529 or (22536 + 28308 + 28811) or (23227 + 28308 + 28811) or (23529 + 28308 + 28811) or MSN : 163, 164, 168, 169, 179, 193, 221, 222, 230, 294, 299, 301, 338, 348, 349, 362, 363, 424, 429, 437, 444, 449, 476.
	0247	STD or Mod : 23450 or 28308 or (20406 + 23450) or (28308 + 28811) or (28308 + 28369 + 28811) or (23450 + 28308 + 28369 + 28811) or (20406 + 23450 + 28308 + 28369 + 28811)
	0248	Mod : 20406 or (20406 + 28308) or (20406 + 28308 + 28369 + 28811)
	0249	Mod : 28378 or (28308 + 28369 + 28378 + 28811)
	0250	Mod : 20024 + 20167 + 22013 + 25415 + 28652
	0251	Mod : (20024 + 22013 + 25415) or (20024 + 22013 + 25415 + 28652)
	0252	Mod : (20024 + 25415) or (20024 + 25415 + 26110) or (20024 + 25415 + 28652)
	0255	Mod : (21038 + 25469) or (21038 + 26799) or (21038 + 26968) or (21038 + 27780) or (21038 + 28416)
	0256	Mod : 25381 or 27522 or (25295 + 25381) or (25295 + 27522)
	0257	Mod : 26093 or 26243 or 26716 or 26717 or 26799 or 26968 or 27780 or 27831 or 27832 or 28416 or (26999 + 28495)
	0258	Mod : 23885 or 24075 or 25205 or 26111 or (24075 + 25205 + 26999 + 28495)
	0259	Mod : 25205 or 26111 or (24075 + 25205 + 26999 + 28495)

	CODE	DESIGNATION
	0260	STD or Mod : 25069 or (25440 + 26185) or (25440 + 26208) or (25440 + 26382 + 30387) or (25440 + 26185 + 26275 + 28293) or (25440 + 26208 + 26275 + 28293) or (25440 + 26231 + 26275 + 28293 + 30951)
	0261	Mod : 20175 or 25738 or (20175 + 25808) or (25440 + 26194) or (25440 + 26194 + 26275) or (25440 + 26231 + 26829) or (25440 + 26194 + 26829) or (25440 + 26194 + 26275 + 28293) or (25440 + 26231 + 26275 + 26829 + 28293)
	0263	Mod : 21441 or 25440 or (25440 + 26275 + 28293) or (25440 + 26194 + 28293)
R	0264	Mod : 25667 or (20175 + 25667) or (25440 + 26185 + 26275) or (25440 + 26275 + 26430) or (25440 + 26275 + 26560) or (25440 + 26194 + 26275 + 28293 + 31838) or (25440 + 26194 + 26275 + 28293 + 31838)
	0265	Mod : 27650 or (25440 + 26185 + 27650) or (25440 + 26275 + 27650 + 28293) or (25440 + 26185 + 26275 + 26650 + 28293) or (25440 + 26194 + 26275 + 27650 + 28293)
	0266	Mod : 22914 or (20175 + 20704) or (20175 + 21441) or (21441 + 22183) or (21441 + 22192) or (25440 + 26275) or (20175 + 21441 + 22192) or (20175 + 21441 + 22914)
	0270	Mod : 21441 or 21595 or 25440 or (25440 + 26275 + 28293) or (25440 + 26194 + 28293)
R	0276	Mod : (26999 + 28916) or (28382 + 28916) or (26999 + 28479) or (26999 + 28702) or (28916 + 30241) or (28916 + 30241) or (27646 + 28382 + 28916) or (26999 + 27646 + 28479 + 28495) or (28382 + 28916) or (26999 + 28382 + 28495 + 28916) or (26999 + 27646 + 28382 + 28495 + 28916) or (26999 + 27646 + 28382 + 28495 + 28702)
	0277	Mod : 25199 or 25200 or 25314 or 25315 or 26716 or 26799 or 26968 or 27780 or 27831 or 27832 or 28416
	0278	Mod : (20024 + 23839) or (20024 + 23839 + 30206)
	0281	Mod : 21310 or (25440 + 26231) or (25440 + 26231 + 26275 + 28293)
	0282	Mod : 26269 or (21441 + 26269) or (25440 + 26269) or (25440 + 26382) or (26194 + 30571) or (25440 + 26269 + 26275 + 28293) or (25440 + 26275 + 26382 + 28293) or (25440 + 26194 + 26275 + 28293 + 30571)
	0283	Mod : 22769 or (20361 + 22769 + 27638) or (22769 + 26526 + 28956)
	0284	Mod : 28258 or 30470 or (27624 + 28258) or (27624 + 30470)
	0285	Mod : (24871 + 27777) or(22562 + 24871 + 25072 + 27777)
	0286	Mod : (24871 + 27777 + 27993) or (22562 + 24871 + 25072 + 27777 + 27993)
	0287	Mod : 22562 + 24871 + 26608 + 27777 + 27993
	0288	Mod : (24871 + 26608 + 27777 + 27993) or (22562 + 24871 + 25072 + 26608 + 27777 + 27993)
	0289	Mod : 20024 + 20586 + 22013 + 25415 + 28652
	0290	Mod : 24351 or (27330 + 28486) or (24351 + 25901 + 27330 + 28486)
	0292	STD or Mod : (26526 + 28956) or (26526 +28244 +28956)
	0293	Mod : 22769 or (26526 + 28956) or (22769 + 26526 + 28956)
	0294	Mod : (22562 + 24404) or (22562 + 24405) or (22562 + 25530) or (22562 + 27640)
	0295	Mod : (22562 + 24404 + 27993) or (22562 + 24405 + 27993) or (22562 + 25530 + 27993) or (22562 + 27640 + 27993)
	0296	Mod : 27256 or (23742 + 27256) or (27256 + 26358 + 30980) or (33742 + 27256 + 26358 + 30980)
	0297	Mod : (26017 + 26540) or (25410 + 26017 + 26540)
	0298	Mod : (20024 + 20164 + 22013 + 25415 + 28652)

	CODE	DESIGNATION
	0299	Mod : 27993 or (22089 + 27993) or (24871 + 27993)
	0300	Mod : (20067 + 20069 + 20071 + 31425) or (20067 + 20069 + 20071 + 32010) or (20067 + 20069 + 20071 + 31424 + 31425)
	0301	Mod :(20075 + 30020) or (20219 + 30020) or (21776 + 30020) or (24266 + 30020) or (30020 + 31006)
	0302	Mod :27229 or 28180 or 28777 or 31090 or 31558 or 31668
	0303	Mod : 27230 or 28677or 28778 or 31134 or 31177 or 27540 or 30467 or 30338 or 30335 or (30339 K7358) + k7358)
	0304	Mod : 25199 or 25200 or 25314 or 25315 or 26716 or 26799 or 26968 or 27780 or 27831 or 27832 or 28416 or (20701 + 23892)
	0305	Mod : Std or 28413 or (27189 + 28413) or (27014 + 28413)
	0306	Mod : 22013 or 24105 or 27014 or 27189 or 30020
	0307	Mod : 24064 or 24065 or 24066 or 24067 or (24064 + 26999 + 28495) or (24066 + 26999 + 28495)
	0308	Mod : (20067 + 20069 + 20071 + 21708) or (20067 + 20069 + 20071 + 31425) or (20067 + 20069 + 20816 + 21708 + 21708 + 27063) or (20067 + 20069 + 20071 + 31424 + 31425) or (20057 + 20067 + 20069 + 20071 + 21708) or (20059 + 20067 + 20069 + 20071 + 21708) or (20059 + 20067 +20069 + 20071 + 21708) or (20057 + 20059 + 20067 + 20069 + 20071 + 21708)
	0309	Mod : (28308 + 28369) or (28238 + 28308 + 28369 + 31897) or (28378 + 28308 + 28369 + 31897)
	0310	Mod : (26858 + K5043) or (K5043 + 26858 + K0385 + K7738)
	0311	Mod : (20818 + K2211) or (K2211 + 20818 + K0385 + K7738)
	0312	Mod : (20818 + 30206) or (20818 + 30206 + K0385 + K7738)
	0313	Mod : (20818 + K5043) or (K5043 + 20818 + K0385 + K7738)
	0314	STD or Mod : (22875+ 25398) or (22875 + 30249)
	0315	MSN : 313, 325, 345, 375, 419, 421, 438, 445, 459, 466, 497, 537.
	0316	Mod : (22013 + 28479) or (22013 + 28916) or (25951 + 28479) or (25951 + 28916) or (22013 + 25410 + 28479) or (22013 + 25410 + 28916) or (25951 + 25410 + 28479) or (25410 + 25951 + 28916)
R	0317	Mod : (28240 + 30292) or (28221 + 28240 + 30292)
R	0318	Mod : (27993 + 30020) or (22089 + 27993 + 30020)
R R	0319	Mod : 23888 or 25829 or 26438 or 27624 or 28558 or 30470 or 32015 or MSN (0912, 0916, 1007)
	0320	mod : (20067 + 20069 + 20071) or (20067 + 20069 + 20816 + 27063) or (20067 + 20069 + 20071 + 32146)
	0321	mod : (20067 + 22006) or (20069 + 22006)
	0322	mod : 20067 or 20069 or (20067 + 20069)
	0323	Mod : (20173 + 22561) or (20461+ 22561) or (20173 + 20461+ 22561) or (20173 + 20210 + 20461+ 22561)
	0324	Mod : (20057 + 20067 + 20069 + 20071) or (20059 + 20067 + 20069 + 20071) or (20057 + 20067 + 20069 + 20816 + 27063) or (20059 + 20067 + 20069 + 20816 + 27063)
	0325	Mod : 22013 / CFM 56-5-A4 / A5 / B1 / B2 / B3 / B4 / B5 / B6 / B7
	0326	STD or 26111 or (26999 + 28218) or (28218 + 28382) or (28218 + 30241) or (28218 + 30631) or (28218 + 30635) or (28218 + 28495)
	0327	Mod : 25205 or (26001 + 26999) or (26001 + 28382) or (26001 + 30241) or (26001 + 30631) or (26001 + 30635) or (26001 + 28495)

	CODE	DESIGNATION
R	0328	Mod : (25205 + 28916) or (26111 + 28916) or (26999 + 28916) or (28382 + 28916) or (28916 + 30241) or (28916 + 30635) or (28916 + 30631) or (25205 + 28479) or (26111 + 28479) or (26999 + 28479) or (28382 + 28479) or (30241 + 28479) or (30635 + 28479) or (30631 + 28479) or (26999 + 28702) or (28382 + 28702) or (25205 + 26999 + 28495 + 28916)
	0329	Mod : (22013 + 25469) or (22013 + 26799) or (22013 + 26968) or (22013 + 26093) or (22013 + 26243)
	0330	Mod : 26093 or 26799 or 26968 or 27780 or 28416 or (24105 + 25469) or (24105 + 26968) or (24105 + 26799) or (24105 + 26243) or (24105 + 26093)
	0331	Mod : 25205 or 26111 or 26485 or 26999 or 28382 or 30241 or 30631 or 30635 or (26999 + 28382 + 28495) or (25205 + 26999 + 28495)
	0332	STD or Mod : (22013 + 24044) or (25951 + 32239)
R	0333	Mod : 25951 or 28479 or 28916 or 32239 or (24044 + 28479) or (24044 + 28916) or (25410 + 28479) or (25410 + 28916) or (25410 + 28702) or (24044 + 25410 + 28479) or (24044 + 25410 + 28916) or (25951 + 28916 + 32239) or (25410 + 25951 + 28479 + 32239) or (25410 + 25951 + 28916 + 32239) or (22013 + 24044 + 25410 + 28479) or (22013 + 24044 + 25410 + 28916)
	0334	Mod : 25410 or (22013 + 24044 + 25410) or (25410 + 25951 + 32239)
	0335	Mod : (25205 + 31896) or (25205 + 31897) or (26111 + 31896) or (26111 + 31897)
	0336	Mod : 20057 or 20059 or (20059 + 22707) or (20057 + 22707) or (20057 + 20059) or (20059 + 22706 + 22707) or (20057 + 20059 + 22707) or (20057 + 20059 + 22706 + 22707)
	0337	Mod : 30067 or (P2878 + 20059 + 22706 + 22707) or (P2878 + 20059 + 20586 + 22706 + 22707)
	0338	Mod : (20057 + 20082 + 22706 + 22707) or (P2879 + 20057 + 20082 + 22706 + 22707)
R	0339	Mod : (20057 + 20059 + 20082 + 20084) or (P2878 + P2879 + 20057 + 20059 + 20082 + 20084 + 22706 + 22707) or (20057 + 20059 + 20082 + 20084 + 22706 + 22707)
	0340	Mod : (P2878 + P2879 + 20057 + 20059 + 22706 + 22707)
	0341	Mod : 20057 or 20059 or 30067 or (20059 + 22707) or (20057 + 22707) or (20057 + 20059) or (20059 + 22706 + 22707) or (20057 + 20059 + 22706 + 22707) or (20057 + 20059 + 22707) or (P2878 + 20059 + 22706 + 22707) or (P2878 + 20059 + 20586 + 22706 + 22707) or (P2878 + P2879 + 20057 + 20059 + 22706 + 22707)
	0342	Mod : (20059 + 20084) or (30066 + 30067) or (20059 + 20084 + 22707) or (20057 + 20059 + 20084 + 22707) or (20059 + 20084 + 22706 + 22707) or (20057 + 20059 + 20084 + 22706 + 22707) or (P2878 + 20059 + 20084 + 22706 + 22707) or (20059 + 20084 + 20586) or (20059 + 20084 + 20586 + 22707) or (20059 + 20084 + 20586 + 22706 + 22707) or (P2878 + 20059 + 20084 + 20586 + 22706 + 22707) or (P2878 + P2879 + 20057 + 20059 + 20082 + 20084 + 22706 + 22707) or (20057 + 20059 + 20082 + 20084)
R	0343	Mod : (25110 + 26923) or (25110 + 27255) or (25110 + 27572)
R	0344	Mod : (25110 + 26723) or (25110 + 27410) or (25110 + 27639) or (25110 + 27763) or (25110 + 30277) or (25110 + 30385) or (25110 + 30386) or (25110 + 26723 + 27572) or (25110 + 26723 + 27572 + 27639)
R	0345	Mod : (20164 + 25453) or (20164 + 28378) or (20164 + 30422)
R	0346	Mod : (20024 + 22013 + 25453) or (20024 + 22013 + 30422)
R	0347	Mod : (20024 + 20164 + 22013 + 30422) or (20024 + 20164 + 22013 + 25453 + 30422)
R	0348	Mod : (20024 + 22013 + 30422) or (20024 + 22013 + 25453 + 30422)
R	0349	Mod : (20024 + 30422) or (20024 + 25453 + 30422)

CODE	DESIGNATION
0350	Mod : (P6146 + 28479) or (P6146 + 28702) or (P6146 + 28916)
0351	Mod : (P0164 + 30660 + 31371) or (27522 + 31371 + 31728) or (P0164 + 27522 + 30660 + 31371)
0352	Mod : (27522 + 31371) or (P0164 + 30660 + 31371) or (P0164 + 27522 + 30660 + 31371)
0353	Mod : (22013 + 20047) or (22013 + 20047 + US)
0354	Mod : (24105 + 20047) or (24105 + 20047 + US)
0355	Mod : (20067 + 20069 + 20071 + 21708) or (20067 + 20069 + 20816 + 21708 + 27063) or (20067+ 20069 + 20071 + 31424 + 32515)
0356	Mod : 26018 or (31896 + 32332) or (31897 + 32333)
0357	Mod : 31896 or 31897 or 32745 or 32401 or 32402 or (31896 + 28238) or (31897 + 28238) or (32475 + 28238) or (32401 + 28238) or (32402 + 28238) or (31896 + 32332 + 32475)
0358	STD or Mod : (31896 + 32332) or (31897 + 32333)
0359	Mod : 32475 or 32401 or 32402 or (31896 + 32402) or (31897 + 32401) or (31896 + 32332 + 32475)
0360	Mod : 32262 or (27541 + 28829 + 23593 + 32262) or (27256 + 28829 + 23593 + 32262)
0361	Mod : 32475 or 32401 or 32402 or (31896 + 32402) or (31897 + 32401) or (31896 + 32332 + 32475)
0362	STD or Mod : (26999 + 28495) or (26999 + 27917)
0363	Mod : 25205 or 26111 or 26999 or 28382 or 30241 or 30631 or 30635 or 26485 or (26999 + 28382 + 28495) or (25205 + 31896 + 32332) or (26111 + 31896 + 32332) or (26999 + 31896 + 32332) or (28382 + 31896 + 32332) or (30241 + 31896 + 32332) or (30631 + 31896 + 32332) or (30635 + 31896 + 32332) or (26485 + 31896 + 32332) or (25205 + 31897 + 32333) or (26111 + 31897 + 32333) or (26999 + 31897 + 32333) or (28382 + 31897 + 32333) or (30241 + 31897 + 32333) or (30631 + 31897 + 32333) or (30635 + 31897 + 32333) or (26485 + 31897 + 32333) or (26999 + 28382 + 28495 + 26999 + 28495 + 28382) or (25205 + 31896 + 32332 + 26999 + 28495 + 28382)
	or (26111 + 31896 + 32332+ 26999 + 28495 + 28382) or (26999 + 31896 + 32332 + 26999 + 28495 + 28382) or (28382 + 31896 + 32332 + 26999 + 28495 + 28382) or (30241 + 31896 + 32332 + 26999 + 28495 + 28382) or (30631 + 31896 + 32332 + 26999 + 28495 + 28382) or (30635 + 31896 + 32332 + 26999 + 28495 + 28382) or (26485 + 31896 + 32332 + 26999 + 28495 + 28382) or (25205 + 31897 + 32333 + 26999 + 28495 + 28382) or (26111 + 31897 + 32333 + 26999 + 28495 + 28382) or (26999 + 31897 + 32333 + 26999 + 28495 + 28382) or (28382 + 31897 + 32333 + 26999 + 28495 + 28382) or (30241 + 31897 + 32333 + 26999 + 28495 + 28382) or
	(30631 + 31897 + 32333 + 26999 + 28495 + 28382) or (30635 + 31897 + 32333 + 26999 + 28495 + 28382) or (26485 + 31897 + 32333 + 26999 + 28495 + 28382)
0364	Mod : (20117 + 26999 + 27620) or (21678 + 26999 + 27620) or (21678 + 27646 + 27620) or (21678 + 26999 + 27620 + 27646)
0365	Mod : (20117 + 27620) or (21678 + 27620) or (20117 + 21678 + 27620)
0366	Mod : (25205 + 31896) or (26111 + 31896) or (26999+ 31896) or (28382 + 31896) or (30241 + 31896) or (30631 + 31896) or (30635 + 31896) or (26485 + 31896) or (25205 + 31897) or (26111 + 31897) or (26999 + 31897) or (28382 + 31897) or (30241 + 31897) or (30631 + 31897) or (30635 + 31897) or (26485 + 31897) or (25205 + 32475) or (26111 + 32475) or (26999 + 32475) or (28382 + 32475) or (30241 + 32475) or (30631 + 32475) or (30635 + 32475) or (26485 + 32475) or (25205 + 32401) or (26111 + 32401) or (26999 + 32401) or (28382 + 32401) or (30241 + 32401) or (30631 + 32401) or (30635 + 32401) or (26485 + 32401) or (25205 + 32402) or (26111 +

CODE	DESIGNATION
	32402) or (26999 + 32402) or (28382 + 32402) or (30241 + 32402) or (30631 + 32402) or (30635 + 32402) or (26485 + 32402) or (31896 + 32332 + 32475 + 25205) or (31896 + 32332 + 32475 + 26111) or (31896 + 32332 + 32475 + 26999) or (31896 + 32332 + 32475 + 28382) or (31896 + 32332 + 32475 + 30241) or (31896 + 32332 + 32475 + 30631) or (31896 + 32332 + 32475 + 30635) or (31896 + 32332 + 32475 + 26485) or (31896 + 26999 + 28495 + 28382) or (31897 + 26999 + 28495 + 28382) or (32475 + 26999 + 28495 + 28382) or (31896 + 32332 + 32475 + 26999 + 28495 + 28382)
0367	Mod : (25205 + 31896) or (26111 + 31896) or (26999+ 31896) or (28382 + 31896) or (30241 + 31896) or(30631 + 31896) or (30635 + 31896) or (26485 + 31896) or (25205 + 31897) or (26111 + 31897) or (26999 + 31897) or (28382 + 31897) or (30241 + 31897) or (30631 + 31897) or (30635 + 31897) or (26485 + 31897) or (26999 + 28495 + 28382 + 31896) or (26999 + 28495 + 28382 + 31897)
0368	Mod : (32475 + 25205) or (32475 + 26111) or (32475 + 26999) or (32475 + 28382) or (32475 + 30241) or (32475 + 30631) or (32475 + 30635) or (32475 + 26485) or (31896 + 32402 + 25205) or (31896 + 32402 + 26111) or (31896 + 32402 + 26999) or (31896 + 32402 + 28382) or (31896 + 32402 + 30241) or (31896 + 32402 + 30631) or (31896 + 32402 + 30635) or (31896 + 32402 + 26485) or (31897 + 32401 + 25205) or (31897 + 32401 + 26111) or (31897 + 32401 + 26999) or (31897 + 32401 + 28382) or (31897 + 32401 + 30241) or (31897 + 32401 + 30631) or (31897 + 32401 + 30635) or (31897 + 32401 + 26485) or (31896 + 32332 + 32475 + 25205) or (31896 + 32332 + 32475 + 26111) or (31896 + 32332 + 32475 + 26999) or (31896 + 32332 + 32475 + 28382) or (31896 + 32332 + 32475 + 30241) or (31896 + 32332 + 32475 + 30631) or (31896 + 32332 + 32475 + 30635) or (31896 + 32332 + 32475 + 26485) or (32475 + 26999 + 28495 + 28382) or (31896 + 32402 + 26999 + 28495 + 28382) or (31897 + 32401 + 26999 + 28495 + 28382) or (31896 + 32332 + 32475 + 26999 + 28495 + 28382)
0369	STD or Mod : 24075 or 23895 or (31896 + 32332) or (31897 + 32332) or (23885 + 24075 + 26999 + 28495)
0370	Mod : (26526 + 31426) or (22769 + 26526 + 31426)
0371	Mod : (26526 + 31426) or (26526 + 28244 + 30170 + 31426)
0372	Mod : (27046 + 28244 + 31426) or (26526 + 27046 + 28244 + 31426)
0373	Mod : 31896 or 31897 or 32402 or 32401 or 32475 or (31896 + 32332 + 32475)
0374	Mod : 24414 or 25346 or (24414 + 32600) or (25346 + 32600)
0375	Mod : (24035 + 32600 + 26497) or (24160 + 32600 + 26497) or (24211 + 32600 + 26497)
0376	Mod : 24035 or 24160 or 24211 or (24035 + 26497 + 28290) or (24160 + 26497 + 28290) or (24211 + 26497 + 28290)
0377	Mod : (24035 + 26497) or (24160 + 26497) or (24211 + 26497)
0378	Mod : 26111 or 25205 or 26999 or 28382 or 30241 or 26485 or 30631 or (23885 +26111) or (25205 + 26999 + 28495) or (26999 + 28495 + 28382) or (26999 + 31896 +32332) or (26999 + 31897 + 32333) or (26999 + 28495 + 28382 + 31897 + 32333)
0379	Mod : 24035 or 24160 or 24211 or (31896 + 32332) or (31897 + 32333)
0380	Mod : (24035 + 22249) or (24160 + 22249) or (24211 + 22249) or (31896 + 32332) or (31897 + 32333)
0381	Mod : (31896 + 22249) or (31897 + 22249) or (32475 + 22249) or (32401 + 22249) or (32402 + 22249) or (31896 + 32332 + 32475 + 22249)
0382	Mod : (31896 + 22249 + 32600) or (31897 + 22249 + 32600) or (32475 + 22249 + 32600) or (32401 + 22249 + 32600) or (32402 + 22249 + 32600) or (31896 + 32332 + 32475 + 22249 + 32600)

	CODE	DESIGNATION
R	0383	Mod : 32475 or (31896 + 32402) or (31897 + 32401) or (31896 + 32332 + 32475) or (26999 + 28495 + 32475)
R	0384	Mod :20701 or (31896 + 32332 + 20701) or (31897 + 32333 + 20701)
R	0385	Mod : 31896 or 31897 or 32402 or 32401 or 32475 or (31896 + 32332 + 32475)
R	0386	Mod : (31896 + 20701) or (31897 + 20701) or (32402 + 20701) or (32401 + 20701) or (32475 + 20701) or (31896 + 32332 + 32475 + 20701)
R	0387	STD or Mod : (31896 + 32332) or (31897 + 32333)
R	0388	Mod : 22013 or 24105 or 25225 or (31896 + 32332) or (31897 + 32333)
R	0389	Mod : (24035 + 24414) or (24160 or 24414) or (24211 + 24414) or (24035 + 25346) or (24160 or 25346) or (24211 + 25346)
R	0390	Mod : 31896 or 31897 or (26999 + 28495 + 31896)
R	0391	Mod : (30660 + 31371) or (27522 + 30660 + 31371)
R	0392	Mod : (20071 + 21708) or (20067 + 20069 + 20071 + 21708) or (20067 + 20069 + 20071 + 31425) or (20067 + 20069 + 20071 + 31424 + 31425) or (20067 + 20069 + 20071 + 32514 + 32515) or (20067 + 20069 + 20816 + 21708 + 27063)
R	0393	Mod : 20067 + 20069 + 20071 + 21708 + 25426
R	0394	Mod : (20067 + 20069 + 20071 + 31424) or (20067 + 20069 + 20071 + 32514)
R	0395	Mod : (20067 + 20069 + 20071 + 31424) or (20057 + 20067 + 20069 + 20071+ 31424) or (20059 + 20067 + 20069 + 20071 + 31424)
R	0396	Mod : 27522 or (27522 + 31371 + 31728) or (P0164 + 27522 + 30660 + 31371 + 31728)
R	0397	Mod : 20117 or 21678 or (20117 + 21678) or (21678 + 26999 + 28495)
R	0398	Mod : 26999 or 27646 or 30631 or (26999 + 28382 + 28495)
R	0399	Mod : (20117 + 26999) or (21678 + 26999) or (21678 + 27646) or (21678 + 28382) or (21678 + 30631) or (21678 + 26999 + 27646) or (21678 + 26999 + 28382 + 28495)
R	0400	STD or Mod : 23885 or (26999 + 28495) or (26999 + 27817)
R	0401	Mod : 32475 or (31896 + 32402) or (31897 + 32401) or (31896 + 32332 + 32475) or (26999 + 28495 + 32475)
R	0402	Mod : (26999 + 31896) or (26999 + 31897) or (28382 + 31897) or (26999 + 28382 + 28495 + 31896)
R	0403	Mod : (26999 + 32475) or(26999 + 31896 + 32332 + 32475) or (26999 + 28382 + 28495 + 32475) or (26999 + 28382 + 28495 + 31896 + 32402)
R	0404	STD or 23895 or (26999 + 28495) or (26999 + 27917)
R	0405	Mod : (26526 + 27046) or (26526 + 27046 + 28308)
R	0406	Mod : 32262 or 32766 or (27256 + 32262) or (27256 + 32766)
R	0406	Mod : 23885 or 24075 or 25205 or 26999 or 27646 or 28382 or 26111 or 30241 or 30635 or 30631 or 26485 or (26999 + 28495 + 28382) or (25205 + 26999 + 28495)
R	0407	Mod : 32600 or (25529 + 28479 + 32600) or (26270 + 28479 + 32600)
R	0408	STD or (26526 + 28956) or (26526 + 28244 + 28956) or (26526 + 27046 + 28244 + 28956)
R	0409	STD or 25072 or 25888 or (22562+25072) or (22562+25888) or (22562+25072+25888)
R	0410	Mod : 27993 or (27993 + 25072) or (27993 + 25562 + 25072)
R	0411	Mod :(24871 + 26608 + 27993) or (24871 + 25072 + 26608 + 27993) or (22562 + 24871 + 25072 + 26608 + 27993)
R	0412	Mod : 27993 or (25072 + 27993) or (22562 + 25072 + 27993)

	CODE	DESIGNATION
R	0413	Mod : (24871 + 27993) or (22562 + 24871 + 25072 + 27993)
R	0414	STD or Mod : (26999 + 28495) or (26999 + 27917)
R	0415	Mod : 31896 or 31897 or 32475 or (31896 + 32402) or (31897 + 32401) or (26999 + 28495 + 31896) or (31896 + 32332 + 32475) or (26999 + 28495 + 32475)
R	0416	Mod : 25205 or 26111 or 26999 or 28382 or 30241 or 30631 or 26485 or (23885 + 26111) or (25205 + 26999 + 28495) or (26999 + 28495 + 28382) or (26999 + 31897 + 32333) or (26999 + 28495 + 28382 + 31897 + 32333)
R	0417	Mod : (26999 + 31896) or (26999 + 31897) or (28382 + 31897) or (26999 + 32475) or (26999 + 28382 + 28495 + 31896) or (26999 + 31896 + 32332 + 32475) or (26999 + 28382 + 28495 + 32475) or (26999 + 28382 + 28495 + 31896 + 32402)

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N°	ISSUE DATE	
00	JUL 86	
01	NOV 86	
02	FEB 87	
03	OCT 87	
04	JAN 88	
05	MAR 88	
06	MAY 88	
07	JUL 88	
08	OCT 88	
09	JAN 89	
10	APR 89	
11	SEP 89	
12	MAR 90	
13	SEP 90	
14	NOT DISPATCHED	
15	AUG 91	
16	MAR 92	
17	DEC 92	
18	MAR 93	
19	SEP 93	
20	DEC 93	
21	JUL 94	
22	OCT 95	
23	JAN 97	
24	NOV 97	
25	APR 98	
26	SEP 98	
27	FEB 99	

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N°	ISSUE DATE	
28	JUL 99	
29	FEB 00	
30	JUN 00	
31	NOV 00	
32	MAY 01	
33	NOV 01	
34	JUL 02	
35	DEC 02	

N° TITLE	STATUS	LOCATION
To be filled by the operator, if needed.		

	ABN	Abnormal
	AC	Alternating Current
	A/C	Aircraft
	ACARS	ARINC Communication Addressing and Reporting System
	ACP	Audio Control Panel
R	ACT	Additional Center Tank
	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
	AEVC	Avionic Equipment Ventilation Controller
	AFS	Auto Flight System
	AIDS	Aircraft Integrated Data System
	AIL	Aileron
R	AIME	Autonomous Integrity Monitoring Extrapolation
	AIU	Audio Interface Unit
	AMU	Audio Management Unit
	ANT	Antenna
	ALT	Altitude
	ALTN	Alternate
R	AOC	Airline Operational Control
	A/P	Auto Pilot
	APPR	Approach
	APPU	Assymetry Position Pick off Unit
	APU	Auxiliary Power Unit
R	ARN	Aircraft Registration Number
	ARPT	Airport
	A/S	Airspeed
	ASAP	As Soon As Possible
	ASI	Air Speed Indicator
	ASP	Audio Selector Panel
	A/SKID	Anti-Skid
	ATC	Air Traffic Control
	ATE	Automatic Test Equipment
	A/THR	Auto Thrust Function
	ATS	Auto Thrust System
R	ATSU	Air Traffic Service Unit
	ATT	Attitude
	AWY	Airway
	BARO	Barometric
	BAT	Battery
	BCL	Battery Charge Limiter

BCDS	Bite Centralized Data System
BITE	Built-in Test Equipment
BIU	Bite Interface Unit
BFE	Buyer Furnished Equipment
BMC	Bleed Air Monitoring Computer
BNR	Binary
BRG	Bearing
BRK	Brake
BRT	Bright
BSCU	Braking Steering Control Unit
BTC	Bus Tie Contactor
BTL	Bottle
C	Centigrade
CAPT	Captain, Capture
CAS	Calibrated Airspeed
C/B	Circuit Breaker
CBMS	Ciruit Braker Monitoring System
CDL	Configuration Deviation List
CDU	Control Display Unit
CFDIU	Centralized Fault Data Interface Unit
CFDS	Centralized Fault Display System
CG	Center of Gravity
CHG	Change
CIDS	Cabin Intercommunication Data System
C/L	Check List
CLB	Climb
CLR	Clear
CMPTR	Computer
R CM 1(2)	Crew member 1 (left seat) or 2 (right seat)
CO	Company
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
CSCU	Cargo Smoke Control Unit
CSD	Constant Speed Drive
CSM/G	Constant Speed Motor/Generator
CSTR	Constraint
CTR	Center
CTL PNL	Control Panel

CVR	Cockpit Voice Recorder
DA	Drift Angle
DAR	Digital AIDS Recorder
DC	Direct Current
DCDU	Datalink Control and Display Unit
DDRMI	Digital Distance and Radio Magnetic Indicator
DES	Descent
DEST	Destination
DFA	Deplayed Flap Approach
DFDR	Digital Flight Data Recorder
DH	Decision Height
DIR	Direction
DIR TO	Direct To
DISC	Disconnect
DIST	Distance
DITS	Digital Information Transfer System
R DIV	Diverter
DMC	Display Management Computer
DME	Distance Measuring Equipment
DMU	Data Management Unit
DSDL	Dedicated Serial Data Link
DSPL	Display
DTG	Distance To Go
DU	Display Unit
E	East
ECAM	Electronic Centralized Aircraft Monitoring
ECB	Electronic Control Box (APU)
ECM	Engine Condition Monitoring
ECON	Economic
ECP	ECAM Control Panel
ECS	Environmental Control System
ECU	Engine Control Unit
EDP	Engine Driven Pump
EEC	Electronic Engine Computer
EFCS	Electronic Flight Control System
EFIS	Electronic Flight Instrument System
EFOB	Estimated Fuel On Board
EIU	Engine Interface Unit
EIS	Electronic Instruments System
ELAC	Elevator Aileron Computer
ELV	Elevation
ELEC	Electrics
EMER	Emergency
EMER GEN	Emergency Generator

R

ENG	Engine
EO	Engine-Out
EPR	Engine Pressure Ratio
ESS	Essential
EST	Estimated
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
ETP	Equal Time Point
EVMU	Engine Vibration Monitoring Unit
E/WD	Engine/Warning Display
EXT PWR	External Power
EXTN	Extension
F	Fahrenheit
FAC	Flight Augmentation Computer
FADEC	Full Authority Digital Engine Control System
FAF	Final Approach Fix
FAR	Federal Aviation Regulations
FAV	Fan Air Valve
F/C	Flight Crew
FCDC	Flight Control Data Concentrator
FCU	Flight Control Unit
FD	Flight Director
FDIU	Flight Data Interface Unit
FDU	Fire Detection Unit
FF	Fuel Flow
FGC	Flight Guidance Computer
FIDS	Fault Isolation and Detection System
FL	Flight Level
FLT	Flight
FLT CTL	Flight Control
FMA	Flight Mode Annunciator
FMGC	Flight Management Guidance Envelope 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/FQU	Fuel Quantity Indication/Unit
FREQ	Frequency
FRT	Front
FRV	Fuel Return Valve

R	FT	Foot, Feet
	FT/MN	Feet per Minute
	FU	Fuel Used
	FWD	Forward
	FWC	Flight Warning Computer
	FWS	Flight Warning System
	GA	Go Around
	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
	GPWS	Ground Proximity Warning System
	GRND	Ground
	GRP	Geographic Reference Point
	GRVTY	Gravity
	GS	Ground Speed
	G/S	Glide Slope
	GW	Gross Weight
	H	Hour, Hot
R	HC	Harness Connector
	HCU	Hydraulic Control Unit
	HDG	Heading
	HDG/S	Heading Selected
	HDL	Handle
	HI	High
	HLD	Hold
	HMU	Hydrau-Mechanical Unit
R	HMS	Heat Management System
	HP	High Pressure
	HPA	Hecto Pascal
	HPV	High pressure Valve
	HUD	Head Up Display
	HYD	Hydraulic
	HZ	Hertz
	IAF	Initial Approach Fix
	IAS	Indicated Airspeed
	IDENT	Identification
	IDG	Integrated Drive Generator
	IFR	Instrument Flight Rules

R	IGN	Ignition
R	ILS	Instrument Landing System
R	IMM	Immediate
	INB	Inbound
	INBO	Inboard
	INCREM	Increment
	INIT	Initialization
	INOP	Inoperative
	INR	Inner
	INST	Instrument
	INTCP	Intercept
	I/O	Inputs/Outputs
	I/P	Input or Intercept Profile
	IP	Intermediate Pressure
	IPC	Intermediate Pressure Check valve
	IPPU	Instrumentation Position Pick-Off Unit
	IRS	Inertial Reference System
	ISA	International Standard Atmosphere
	ISDU	Initial System Display Unit
	ISOL	Isolation
	KG	Kilogram
	KT	Knot
	L	Left
	LAF	Load Alleviation Function
	LAT	Latitude
	LAT REV	Lateral Revision
	LAV	Lavatory
	LCN	Load Classification Number
	LDG	Landing
	L/G	Landing Gear
	LGCIU	Landing Gear Control Interface Unit
	LGPIU	Landing Gear Position Indicator Unit
	LH	Left Hand
	LIM	Limitation
	LIS	Localizer Inertial Smoothing
	LK	Lock
	LL	Latitude/Longitude
	LLS	Left Line Select key
	LOC	Localizer
	LONG	Longitude
	LP	Low Pressure
	LRRA	Low Range Radio Altimeter
	LRU	Line Replaceable Unit

R	LSK	Line Select Key
R	LT	Light
R	LVL	Level
	LVL/CH	Level Change
	LW	Landing Weight
	M	Magenta, Mach, Meter
	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	Millibar
	MCT	Maximum Continuous Thrust
	MCDU	Multipurpose Control and Display Unit
	MCU	Modular Concept Unit
	MDA	Minimum Descent Altitude
	MDDU	Multifunction Disk Drive Unit
	MECH	Mechanic
	MEL	Minimum Equipment List
	MFA	Memorized Fault Annunciator
	MIN	Minimum, Minute
	MKR	Marker
	MLS	Microwave Landing System
	MLW	Maximum Landing Weight
	MMEL	Master Minimum Equipment List
	MMO	Maximum Operating Mach
	MN	Mach Number
	MRIU	Maintenance and Recording Interface Unit
	MSA	Minimum Safe Altitude
	MSG	Message
	MSL	Mean Sea Level
	MSU	Mode Selector Unit
	MTBF	Mean Time Between Failure
	MTOW	Maximum Takeoff Weight
	MZFW	Maximum Zero Fuel Weight
	N	Normal, North
	NACA	National Advisory Comittee for Aeronautics
	NAV	Navigation

R	NAVAID	Navigation Aid (VOR/DME)
R	NCD	Non Computed Data
R	ND	Navigation Display
	NDB	Non Directional Beacon
	NM	Nautical Mile
	NW	Nosewheel
	OAT	Outside Air Temperature
	OBRM	Unboard Replaceable Module
	OFF/R	Off Reset
	OFST	Offset
	O/P	Output
	OPP	Opposite
	OPT	Optimum
	OUTB	Outbound
	OUTR	Outer
	OVBD	Overboard
	OVHD	Overhead
	OVHT	Overheat
	OVRD	Override
	OVSPD	Overspeed
	P-ALT	Profile Altitude
	PB, pb	Pushbutton
	P-CLB	Profile Climb
	PCU	Power Control Unit
	P-DES	Profile Descent
	PDU	Pilot Display Unit
	PERF	Performance
	PFD	Primary Flight Display
	PHC	Probes Heat Computer
	P-MACH	Profile Mach
	POB	Pressure Off Brake
	P-SPEED	Profile Speed
	POS	Position
	PPOS	Present Position
	PPU	Position Pick-off Unit
	PR	Pressure
	PRED	Prediction
	PROC	Procedure
	PROC T	Procedure Turn
	PROF	Profile
	PROG	Progress
	PROTEC	Protection

R	PSU	Passenger Service Unit
R	PT	Point
R	PTR	Printer
	PTU	Power Transfer Unit (Hydraulic)
	PVI	Paravisual Indicator
	PWR	Power
	QAR	Quick Access Recorder
	QFE	Field Elevation Atmosphere Pressure
	QFU	Runway Heading
	QNE	Sea Level Standard Atmosphere Pressure (1013 hPa)
	QNH	Sea Level Atmosphere Pressure
	QT	Quart (US)
	QTY	Quantity
	R	Right, Red
	RA	Radio Altitude
	RACC	Rotor Active Clearance Control
	RAIM	Receiver Autonomous Integrity Monitoring
	RAT	Ram Air Turbine
	RCDR	Recorder
	RCL	Recall
	RCVR	Receiver
	REAC	Reactive
	REL	Release
	REV	Reverse
	RH	Right Hand
	R/I	Radio/Inertial
	RLSK	Right Line Select Key
	RMI	Radio Magnetic Indicator
	RMP	Radio Management Panel
	RNG	Range
	RNP	Required Navigation Performance
	RPM	Revolution Per Minute
	RPTG	Repeating
	RQRD	Required
	RSV	Reserves
	RTE	Route
	RTOW	Regulatory Takeoff Weight
	RVSM	Reduced Vertical Separation Minimum
	RWY	Runway
	S	Slats Retraction Speed
	S	South

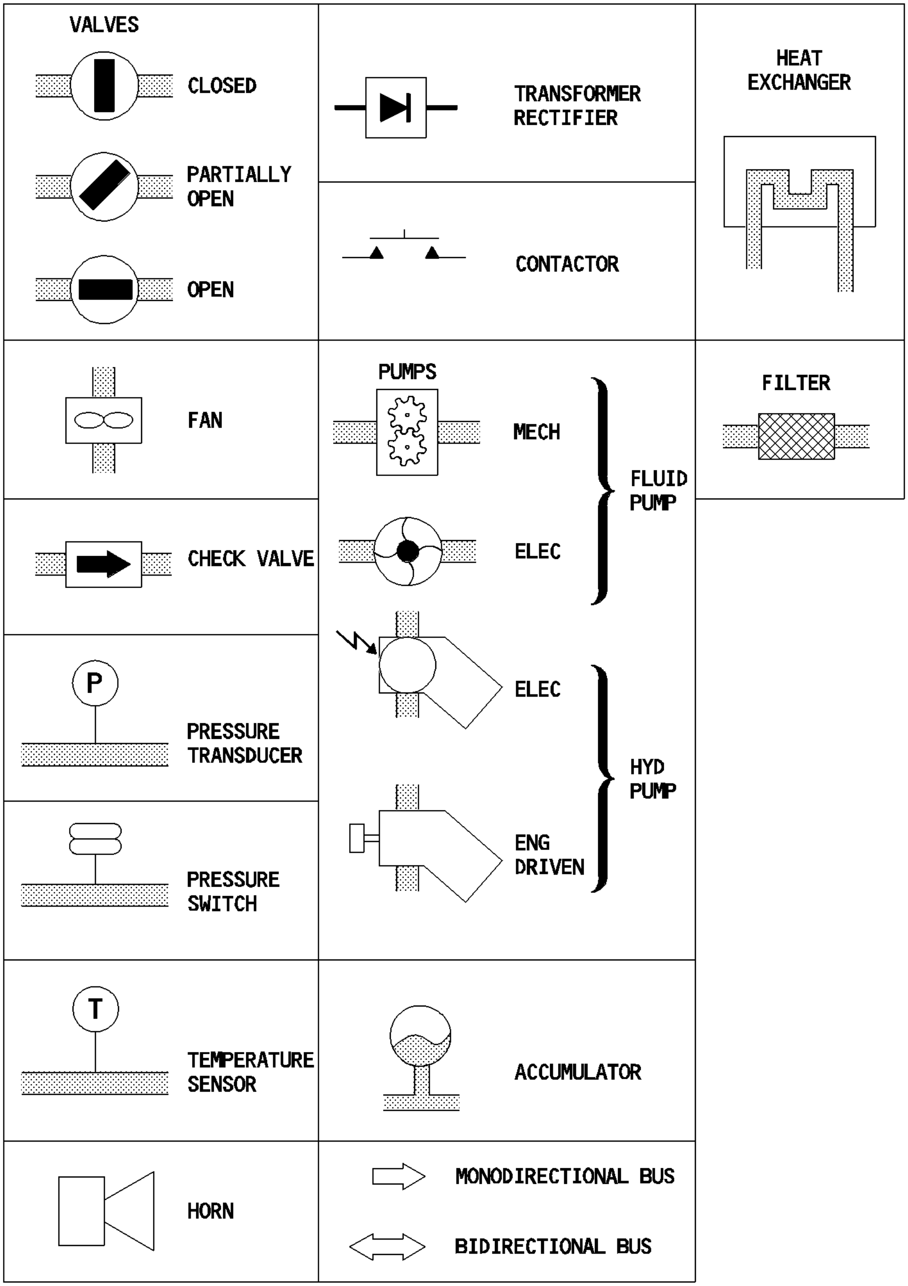
R	SC	Single Chime
R	S/C	Step Climb
R	SD	System Display
	STAT INV	Static Inverter
	S/D	Step Descent
	SDAC	System Data Acquisition Concentrator
	SDCU	Smoke Detection Control Unit
	SEC	Spoiler Elevator Computer
	SEL	Selector
	SFCC	Slat/Flap Control Computer
	SFE	Seller Furnished Equipment
	SID	Standard Instrument Departure
	SIM	Simulation
	SLT	Slat
	SPD	Speed
	SPD LIM	Speed Limit
	SPLR	Spoiler
	SRS	Speed Reference System
	STAR	Standard Terminal Arrival Route
	STEER	Steering
	STRG	Steering
	STS	Status
	SW	Switch
	SWTG	Switching
	SYNC	Synchronize
	SYS	System
	T	Tons, Temperature
	TACT	Tactical
	TAS	True Air Speed
	TAT	Total Air Temperature
	TAU	Time to intercept
	TBD	To Be Determined
	T/C	Top of Climb
	TCAS	Traffic Collision Alert System or Threat-Analysis/Collision Avoidance System
	T/D	Top of Descent
	TEMP	Temperature
	TFTS	Terrestrial Flight Telephone System
	TGT	Target
	THR	Thrust
	THS	Trimmable Horizontal Stabilizer
	TK	Tank
	TK	Track angle
	TKE	Track angle Error

R	TMR	Timer
R	TLA	Throttle Lever Angle
R	TO	Takeoff
	TOGA	Takeoff - Go-Around
	TOGW	Takeoff Gross Weight
	TOW	Takeoff Weight
	T-P	Turn Point
	TPIS	Tire Pressure Indicating System
	T-R	Transmitter-Receiver
	TRANS	Transition
	TROPO	Tropopause
	TRK	Track
	TRU	Transformer Rectifier Unit
	TTG	Time To Go
	TVMC	Minimum Control Speed Temperature
	UFD	Unit Fault Data
	ULB	Underwater Locator Beacon
	UNLK	Unlock
	UTC	Universal Coordinated Time
	V	Volt
	V1	Critical Engine Failure Speed
	V2	Takeoff Safety Speed
	VBV	Variable Bypass Valve
	VC	Calibrated airspeed
	VEL	Velocity
	VFE	Maxi Velocity Flaps Extended
	VFEN	VFE Next
	VFTO	Velocity Final Takeoff
	VHF	Very High Frequency
	VHV	Very High Voltage
	VIB	Vibration
	VM	Maneuvering Speed
	VMCA	Minimum Control Speed in the Air
	VMCG	Minimum Control Speed on the Ground
	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
	V/S	Vertical Speed

R	VSI	Vertical Speed Indicator
R	VSV	Variable Stator Vane
R	VU	Visual Unit
R	W	White, West, Weight
	WBC	Weight and Balance Computer
	WGD	Windshield Guidance Display
	WHC	Window Heat Computer
	WPT	Waypoint
	WTB	Wing Tip Brake
	WXR	Weather Radar
	XCVR	Transceiver
	XFR	Transfer
	XMTR	Transmitter
	XPDR	Transponder
	XTK	Crosstrack Error
	Y	Yellow
	ZFCG	Zero Fuel Center of Gravity
	ZFW	Zero Fuel Weight
	A>B	A greater than B
	A≥B	A greater than or equal to B
	A<B	A less than B
	A≤B	A less than or equal to B

	METRIC → US	US → METRIC
LENGTH	1 millimeter (mm) = 0.0394 inch (in) 1 meter (m) = 3.281 feet (ft) 1 meter (m) = 1.094 yard (yd) 1 kilometer (km) = 0.540 nautical mile (nm)	1 inch (in) = 25.4 millimeter (mm) 1 foot (ft) = 0.3048 meter (m) 1 yard (yd) = 0.914 meter (m) 1 nautical mile (nm) = 1.852 kilometer (km)
SPEED	1 meter/second (m/s) = 3.281 feet/second (ft/s) 1 kilometer/hour (km/h) = 0.540 knot (kt)	1 foot/second (ft/s) = 0.3048 meter/second (m/s) 1 knot (kt) = 1.852 kilometer/hour (km/h)
WEIGHT	1 gram (g) = 0.353 ounce (oz) 1 kilogram (kg) = 2.2046 pounds (lb) 1 ton (t) = 2 204.6 pounds (lb)	1 ouce (oz) = 28.35 grams (g) 1 pound (lb) = 0.4536 kilogram (kg) 1 pound (lb) = 0.0004536 ton (t)
FORCE	1 Newton (N) = 0.2248 pounds (lb) 1 deca Newton (daN) = 2.248 pounds (lb)	1 pound (lb) = 4.448 Newtons (N) 1 pound (lb) = 0.4448 deca Newton (daN)
PRESSURE	1 BAR = 14.505 pounds per square inch (psi) 1hpa = 0.0145 psi	1 pound per square inch (psi) = 0.689 bar 1 psi = 68.92 millibars (hPa)
VOLUME	1 liter (l) = 0.2642 U.S. Gallons 1 cubic meter (m^3) = 264.2 U.S. Gallons	1 US Gallon = 3.785 liters (l) 1 US Gallon = 0.03785 cubic meter (m^3)
MOMENTUM	1 meter × deca Newton (m. daN) = 88.50 pound × inch (lb. in)	1 pound × inch (lb. in) = 0.0113 meter × deca Newton (mdaN)
TEMPERATURE	t (°C) = 5/9 (t (°F) - 32)	t (°F) = t (°C) × 1.8 + 32

R



NFC5-01-0060-001-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
1068	OO-SSB
1145	OO-SSF

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

1 20 10  001       103 REV035  24105=(24105+US)

                      - TECHNICAL AMENDMENT
                         1)Description updated, to indicate that
                           the aircraft is equipped with one
                           observer seat.

1 20 20  002       001 REV035

                      - TECHNICAL AMENDMENT
                         Modification of the "Antennas Location"
                         drawing to :
                         1)Correctly position the TCAS antennas.
                         2)Add the SATCOM antenna.

1 21 10  015       001 REV035

                      - TECHNICAL AMENDMENT
                         1)Deletion of the forward cargo heating
                           note, as the forward cargo heating
                           option is not installed.
                         2)Minor text modifications for improved
                           technical understanding and FCOM
                           standardization.

1 21 20  007       001 REV035

                      - TECHNICAL AMENDMENT
                         1)Deletion of reference to the forward
                           cargo outlet isolation valve, since
                           forward cargo ventilation is not
                           installed.

1 21 20  009       001 REV035

                      - TECHNICAL AMENDMENT
                         1)Deletion of reference to the forward
                           cargo outlet isolation valve, since
                           forward cargo ventilation is not
                           installed.

1 21 20  013       001 REV035

                      - TECHNICAL AMENDMENT
                         1)Deletion of the forward passenger door
                           airstairs indication, as it is not
                           installed.

1 22 10  012       100 REV028  27256

                      - INCORPORATION OF MOD 27256
                      - DELETION OF MOD 27541

1 22 10  016       100 REV026  M:27256=27541=(27256+27541)

                      - DELETION OF MOD 27541

1 22 20  002       110 REV032  CODE 0072

                      - DELETION OF MOD 30635

1 22 20  005       110 REV026  CODE 0072

                      - DELETION OF MOD 30635
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                         -----------------------REASONS OF CHANGE--------------------
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1 22 20  006       110 REV026  CODE 0072

                      - DELETION OF MOD 30635

1 22 20  008       100 REV026  CODE 0072

                      - DELETION OF MOD 30635

1 22 20  014       110 REV028  CODE 0207

                      - INCORPORATION OF MOD 24852
                      - DELETION OF MOD 24582

1 22 20  023       001 REV035  CODE 0358

                      - TECHNICAL AMENDMENT
                         1)No technical change. Page covering the
                           Honeywell or Thales-Smiths FMS2
                           introduction.

1 22 20  025       001 REV035  CODE 0358

                      - TECHNICAL AMENDMENT
                         1)No technical change. Page covering the
                           Honeywell or Thales-Smiths FMS2
                           introduction.

1 22 20  026B      001 REV035  CODE 0358

                      - TECHNICAL AMENDMENT
                         1)No technical change. New page
                           introduced for repagination purposes.

1 22 20  027       001 REV035  CODE 0358

                      - TECHNICAL AMENDMENT
                         1)Page moved for repagination purposes.
                         2)Information regarding the PERF factor
                           for CFM 56-5B engines has been moved
                           from the previous and next page.
                         3)Some figures have been corrected for
                           CFM 56-5B engines.

1 22 30  042       205 REV035  CODE 0377

                      - TECHNICAL AMENDMENT
                         1)No technical change. The sequence
                           number has changed to ensure correct
                           validity to all customers.

1 22 30  051       001 REV035  STD=(20701+23892)

                      - TECHNICAL AMENDMENT
                         1)No technical change. Page covering the
                           Honeywell or Thales-Smiths FMS2
                           introduction.

1 22 30  052       001 REV035  CODE 0387

                      - TECHNICAL AMENDMENT
                         1)No technical change. Page covering the
                           Honeywell or Thales-Smiths FMS2
                           introduction.
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                       ----------------------REASONS OF CHANGE--------------------
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1 22 30  056       115 REV035  CODE 0416

                      - INCORPORATION OF MOD 25205
                      - INCORPORATION OF MOD 26111
                      - INCORPORATION OF MOD 26485
                      - INCORPORATION OF MOD 30241
                      - INCORPORATION OF MOD 30631

1 22 30  056A      100 REV035  25863

                      - INCORPORATION OF MOD 25863
                      - TECHNICAL AMENDMENT
                         1)No technical change. New page created
                           for repagination purposes.

1 22 30  057       100 REV035  CODE 0379

                      - INCORPORATION OF MOD 24160
                      - INCORPORATION OF MOD 24211
                      - TECHNICAL AMENDMENT
                         1)No technical change. New page created
                           for repagination purposes.

1 22 30  071       200 REV025  CODE 0389

                      - INCORPORATION OF MOD 25346
                      - DELETION OF MOD 24414

1 22 40  005       120 REV035  24215=24588=25534 CFM:ALL

                      - INCORPORATION OF MOD 24215
                      - INCORPORATION OF MOD 25534
                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE
                      - TECHNICAL AMENDMENT
                         1)No technical change. The sequence
                           number was changed to ensure the
                           correct page validation for all
                           customers.

1 23 20  005       100 REV035  27699=(27699+31907)

                      - TECHNICAL AMENDMENT
                         1)Note added to explain the procedure to
                           couple the DME reception to the ILS or
                           MLS reception.

1 25 00  001       001 REV035

                      - TECHNICAL AMENDMENT
                         1)Page updated to reflect the new
                           cockpit door security chapter
                           configuration.

1 25 20  001       001 REV035

                      - TECHNICAL AMENDMENT
                         1)Page modified to address the Cockpit
                           Door Surveillance System.

1 26 20  001       005 REV024  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                        -----------------------REASONS OF CHANGE--------------------
-------------------------------------------------------------------------------------

1 26 40  002       102 REV035  22561=(20067+20069+22561)

                     - INCORPORATION OF MOD 22561
                     - TECHNICAL AMENDMENT
                        1)No technical change. The sequence
                          number was changed to ensure the
                          correct page validation for all
                          customers.

1 26 50  003       410 REV035  CODE 0324

                     - TECHNICAL AMENDMENT
                        1)Revision of the DISCH light
                          description to emphasize that the
                          amber "DISCH" light does not come on
                          as soon as the DISCH pushbutton is
                          pressed, but takes about 60 seconds,
                          which is the approximate agent bottle
                          discharge time.

1 27 20  008       005 REV023  CFM ALL

                     - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 27 40  001       001 REV035

                     - TECHNICAL AMENDMENT
                        1)Information has been moved from
                          1-27-40, page 2.

1 27 40  002       001 REV035

                     - TECHNICAL AMENDMENT
                        1)Text modified for improved technical
                          understanding and standardization.
                        2)The description of the pitch trim
                          wheel has been enhanced to highlight
                          the fact that, in flight, the relation
                          between the aircraft CG and trim
                          position displayed on the wheel does
                          not apply.
                        3)Information has been moved to 1-27-40
                          p1.

1 27 50  003       001 REV035

                     - TECHNICAL AMENDMENT
                        1)Reference to a specific VFE value has
                          been deleted, in order to have a
                          common page for aircraft having higher
                          VFE.

1 28 10  006       105 REV023  CODE 0106/CFM ALL

                     - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 28 20  012       105 REV023  M:20024/CFM ALL

                     - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 31 10  002       001 REV035

                     - TECHNICAL AMENDMENT
                        1)A recommendation is added to point out
                          that the level 2 amber cautions must
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                       ----------------------REASONS OF CHANGE-------------------
------------------------------------------------------------------------------------
                          be considered as soon as possible
                          (time and situation permitting), to
                          avoid any further degradation of the
                          affected system.

1 31 25  002       005 REV030  CFM ALL

                        - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 31 25  003       005 REV026  CFM ALL

                        - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 31 25  005       005 REV030  CFM ALL

                        - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 31 25  006       005 REV030  CFM

                        - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 31 25  007       005 REV030  CFM ALL

                        - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 31 40  004       005 REV026  CFM ALL

                        - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 31 40  015       001 REV035

                        - TECHNICAL AMENDMENT
                          1)PFD drawing improved.
                          2)Page modified to highlight the fact
                            that vertical speed is not only
                            inertial, but based on both inertial
                            and barometric data.

1 31 40  022       100 REV034  CODE 0331

                        - INCORPORATION OF MOD 26485

1 31 40  028       100 REV034  CODE 0331

                        - INCORPORATION OF MOD 26485

1 31 45  018       101 REV035  M:26526=(26526+28308+28811)

                        - TECHNICAL AMENDMENT
                          1)Text moved to 1-34-70, page 8, and
                            slightly modified for improved
                            technical understanding.

1 31 45  018       200 REV035  M:26526+28308

                        - TECHNICAL AMENDMENT
                          1)Text moved to 1-34-70, page 8, and
                            slightly modified for improved
                            technical understanding.

1 31 45  021       200 REV035  CODE 0183

                        - TECHNICAL AMENDMENT
                          1)Page modified to include the overflow
                            arrow in the item 9 description.
                          2)Information has been moved to the next
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                         ----------------------REASONS OF CHANGE-------------------
-------------------------------------------------------------------------------------
                              page to accommodate additional text on
                              this page.

1 31 45  022       100 REV035  M:22536=23227=23529

                         - INCORPORATION OF MOD 22536
                         - INCORPORATION OF MOD 23227
                         - INCORPORATION OF MOD 23529
                         - TECHNICAL AMENDMENT
                            1)Text moved from the previous page to
                              accommodate additional information on
                              page 21.

1 34 10  001       203 REV023  CODE 0010

                         - INCORPORATION OF MOD 23510
                         - INCORPORATION OF MOD 26999
                         - INCORPORATION OF MOD 28382
                         - INCORPORATION OF MOD 28495

1 34 10  003       100 REV023  CODE 0407

                         - INCORPORATION OF MOD 23885
                         - INCORPORATION OF MOD 24075
                         - INCORPORATION OF MOD 25205
                         - INCORPORATION OF MOD 26111
                         - INCORPORATION OF MOD 26485
                         - INCORPORATION OF MOD 26999
                         - INCORPORATION OF MOD 27646
                         - INCORPORATION OF MOD 28382
                         - INCORPORATION OF MOD 28495
                         - INCORPORATION OF MOD 30241
                         - INCORPORATION OF MOD 30631
                         - INCORPORATION OF MOD 30635

1 34 10  009       001 REV025  STD=M:23450=(23450+20406)

                         - TECHNICAL AMENDMENT
                            MEMO DISPLAY UPDATED

1 34 15  003       110 REV032  CODE:0101

                         - INCORPORATION OF MOD 27646
                         - DELETION OF MOD 30241
                         - DELETION OF MOD 30631
                         - DELETION OF MOD 30635

1 34 30  003       200 REV025  CODE 0077

                         - INCORPORATION OF MOD 28382
                         - INCORPORATION OF MOD 28495
                         - DELETION OF MOD 27646

1 34 60  003       100 REV035  CODE 0013

                         - TECHNICAL AMENDMENT
                            1)A note has been added to indicate
                              that, if the selected weather radar
                              fails when two weather radars are
                              installed, the PWS function is
                              recovered by selecting the non-failed
                              weather radar on the control panel.

1 34 70  001       109 REV035  CODE 0230

                         - TECHNICAL AMENDMENT
```

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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                       ----------------------REASONS OF CHANGE-------------------
----------------------------------------------------------------------------------
                          1)Suppression of the Geometric Altitude
                            description that was inadvertently
                            introduced on this page.
                          2)TAD and TCF have been added to the
                            list of events that can cause the GPWS
                            light to come on.
                          3)Text modified for improved technical
                            understanding.

1 34 70  002       103 REV035  26526

                        - TECHNICAL AMENDMENT
                          1)Page updated to further specify the
                            aircraft definition : GPWS / G/S
                            pushbuttons on the glareshield.

1 34 70  006       001 REV035

                        - TECHNICAL AMENDMENT
                          1)The conditions for activating GPWS
                            Modes 4A and 4B have been revised to
                            reflect the actual design.
                          2)Addition of a note to highlight the
                            fact that the upper operational limit
                            is reduced to 800 feet, when an
                            overflight is detected.

1 34 70  007       103 REV035  M:26526

                        - TECHNICAL AMENDMENT
                          1)Page modified to explain that the
                            glideslope alert is normally only
                            triggered with the gear down, except
                            for a few airports.
                          2)Addition of a note to explain the fact
                            that the upper operational limit of
                            the Mode 4C warning envelope linearly
                            depends on the aircraft speed.

1 34 70  008       100 REV035  MOD 28244 OR (26526 + 28244)

                        - TECHNICAL AMENDMENT
                          1)Text moved from 1-31-45 page 18, for
                            improved technical understanding.

1 34 97  001       206 REV035  CODE 0399

                        - INCORPORATION OF MOD 28382
                        - INCORPORATION OF MOD 28495

1 34 97  001       206 REV025  CODE 0051

                        - DELETION OF MOD 27646

1 34 97  001       206 REV035  CODE 0399

                        - TECHNICAL AMENDMENT
                          1)The DDRMI has been moved to the
                            NAVAIDS section for improved technical
                            understanding and standardization.

1 36 10  006       100 REV035  22562=(22562+25888+27609)

                        - INCORPORATION OF MOD 22562
                        - TECHNICAL AMENDMENT
                          1)New page corresponding to the APIC
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                         -----------------------REASONS OF CHANGE--------------------
-------------------------------------------------------------------------------------
                            APS 3200 APU : The APU bleed valve is
                            operated by fuel pressure.

1 70 00  001        005 REV023  CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 00  002        005 REV023  CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 10  001        120 REV028  CODE:0227/CFM 56-5-B

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 20  001        005 REV023  CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 20  002        105 REV024  MOD.22238/CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 20  005        005 REV028  CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 20  006        005 REV032  CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 30  001        105 REV023  MOD.22112/CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 30  002        005 REV023  CFM=PW

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 30  003        005 REV023  CFM=PW

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 30  004        105 REV023  24035 CFM/PW

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 30  005        005 REV023  CFM=PW

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 30  006        005 REV023  STD=M:27441 CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 40  001        105 REV024  CODE:0204/CFM

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 40  002        005 REV023  CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 40  004        005 REV023  CFM ALL

                         - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                        -----------------------REASONS OF CHANGE--------------------
-------------------------------------------------------------------------------------

1 70 40  004       005 REV023  CFM ALL

1 70 40  006       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 40  007       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 50  001       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 60  001       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 60  002       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 70  001       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 70  003       106 REV028  M:25404/CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 80  002       005 REV031  CFM

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 80  003       005 REV031  CFM

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 80  004       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 80  006       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  001       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  002       005 REV031  CFM

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  003       005 REV024  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  004       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE
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V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA-----
                         -----------------------REASONS OF CHANGE--------------------
-------------------------------------------------------------------------------------

1 70 90  005       105 REV033  CODE 0062/CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  006       025 REV023  CFM56-5-B

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  007       005 REV033  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  008       148 REV033  22707/CFM 56-5-B

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  009       118 REV033  CODE 0061/CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  010       107 REV028  M:22707/CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  011       005 REV023  CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  012       105 REV023  MOD.22707/CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE

1 70 90  014       146 REV035  26017=22634+26017/CFM 56-5-B

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE
                      - TECHNICAL AMENDMENT
                         1)Correction of the flight phase
                           inhibitions for the ENG 1(2) THR
                           LEVER FAULT procedure.
                         2)With the FWC E2 Standard, the "ENG REV
                           UNLOCKED" message is only inhibited in
                           flight phase 8.

1 70 90  015       220 REV026  CODE 0042 CFM ALL

                      - VERSION AND/OR ENGINE INCORPORATION, DELETION OR CHANGE
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M V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----
M V CH SEC ---PAGE-- SEQ --REV-- ----VALIDATION CRITERIA----- -----EFFECTIVITY-----

M	V	CH	SEC	PAGE	SEQ	REV	VALIDATION CRITERIA	EFFECTIVITY
	1	00	00	001	001	REV024	CONTENTS	ALL
	1	00	10	001	001	REV034	ORGANIZATION OF THE MANUAL	ALL
	1	00	10	002	001	REV034		
	1	00	10	003	001	REV024		ALL
	1	00	10	004	001	REV024		
	1	00	10	005	001	REV024		ALL
R	1	00	20	001	001	REV035	LIST OF CODES	ALL
R	1	00	20	002	001	REV035	LIST OF CODES	
R	1	00	20	003	001	REV035	LIST OF CODES	ALL
R	1	00	20	004	001	REV035	LIST OF CODES	
R	1	00	20	005	001	REV035	LIST OF CODES	ALL
R	1	00	20	006	001	REV035	LIST OF CODES	
R	1	00	20	007	001	REV035	LIST OF CODES	ALL
R	1	00	20	008	001	REV035	LIST OF CODES	
R	1	00	20	009	001	REV035	LIST OF CODES	ALL
R	1	00	20	010	001	REV035	LIST OF CODES	
R	1	00	20	011	001	REV035	LIST OF CODES	ALL
R	1	00	20	012	001	REV035	LIST OF CODES	
N	1	00	20	013	001	REV035	LIST OF CODES	ALL
N	1	00	20	014	001	REV035	LIST OF CODES	
N	1	00	20	015	001	REV035	LIST OF CODES	ALL
N	1	00	20	016	001	REV035	LIST OF CODES	
N	1	00	20	017	001	REV035	LIST OF CODES	ALL
R	1	00	30	001	001	REV027	LIST OF NORMAL REVISIONS	ALL
R	1	00	30	002	001	REV035	LIST OF NORMAL REVISIONS	
	1	00	35	001	001	REV024	RECORD OF TEMPORARY REV.	ALL
R	1	00	36	001	001	REV035	LIST OF EFFECTIVE TR	ALL
	1	00	40	001	001	REV028	ABBREVIATIONS	ALL
	1	00	40	002	001	REV031	ABBREVIATIONS	
	1	00	40	003	001	REV031	ABBREVIATIONS	ALL
	1	00	40	004	001	REV031	ABBREVIATIONS	
	1	00	40	005	001	REV031	ABBREVIATIONS	ALL
	1	00	40	006	001	REV031	ABBREVIATIONS	
	1	00	40	007	001	REV031	ABBREVIATIONS	ALL
	1	00	40	008	001	REV031	ABBREVIATIONS	
	1	00	40	009	001	REV031	ABBREVIATIONS	ALL
	1	00	40	010	001	REV031	ABBREVIATIONS	

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	00	40	011	001	REV031	ABBREVIATIONS	ALL
	1	00	40	012	001	REV031	ABBREVIATIONS	
	1	00	50	001	001	REV023	UNITS CONVERSION TABLE	ALL
	1	00	60	001	001	REV023	SYMBOLS	ALL
R	1	00	70	CRT	001	REV035	CROSS REFERENCE TABLE	ALL
R	1	00	75	HL	001	REV035	HIGHLIGHTS	ALL
R	1	00	80	LEP	001	REV035	LIST OF EFFECTIVE PAGES	ALL
R	1	00	85	LOM	001	REV035	LIST OF MODIFICATIONS	ALL
	1	20	00	001	001	REV023		ALL
R	1	20	10	001	103	REV035	24105=(24105+US)	ALL
R	1	20	20	001	100	REV031	M:24105	ALL
R	1	20	20	002	001	REV035		
	1	20	20	003	206	REV030	M:20268+24105	ALL
	1	20	20	004	103	REV032	M:24105	
	1	21	00	001	001	REV030		ALL
	1	21	10	001	001	REV023		ALL
	1	21	10	002	001	REV023		
	1	21	10	003	001	REV023		ALL
	1	21	10	004	105	REV028	M:26363	
	1	21	10	005	100	REV033	M:24139=24340=(24139+24340)	ALL
	1	21	10	006	105	REV028	M:26363	
	1	21	10	007	001	REV023		ALL
	1	21	10	008	001	REV024		
	1	21	10	009	100	REV034	26363	ALL
	1	21	10	010	001	REV033		
	1	21	10	011	105	REV032	CODE 0299	ALL
	1	21	10	012	001	REV033		
	1	21	10	013	001	REV023		ALL
	1	21	10	014	001	REV023		
R	1	21	10	015	001	REV035		ALL
R	1	21	10	016	001	REV023		
	1	21	10	017	001	REV030		ALL
	1	21	10	018	001	REV033		
	1	21	10	019	001	REV023		ALL
	1	21	20	001	001	REV032		ALL
	1	21	20	002	100	REV023	M:23344	

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	21	20	003	001	REV033		ALL
	1	21	20	004	001	REV023		
	1	21	20	005	001	REV032	STD=(26251+32221)	ALL
	1	21	20	006	001	REV023		
R	1	21	20	007	001	REV035		ALL
R	1	21	20	008	100	REV032	M:23344	
R	1	21	20	009	001	REV035		ALL
R	1	21	20	010	001	REV025		
	1	21	20	011	001	REV028		ALL
	1	21	20	012	001	REV024		
R	1	21	20	013	001	REV035		ALL
R	1	21	20	014	100	REV026	M:23124	
	1	21	30	001	001	REV023		ALL
	1	21	30	002	001	REV023	STD=M:28221=28240	
	1	21	30	003	001	REV026		ALL
	1	21	30	004	001	REV026		
	1	21	30	005	001	REV026		ALL
	1	21	30	006	001	REV023		
	1	21	30	007	001	REV023		ALL
	1	21	30	008	001	REV023	STD=M:22190	
	1	21	30	009	001	REV023		ALL
	1	21	30	010	001	REV023	STD=M:22190	
	1	21	30	011	001	REV023	STD=M:22190	ALL
	1	21	30	012	001	REV023	STD=M:22190	
	1	21	30	013	001	REV030	STD=M:22190	ALL
	1	21	40	001	100	REV023	CODE 0105	ALL
	1	21	40	002	103	REV023	20059=30067	
	1	21	40	003	103	REV023	20059=30067	ALL
	1	21	40	004	103	REV023	20059=30067	
	1	21	40	005	100	REV023	CODE 0082	ALL
	1	21	40	006	110	REV033	CODE 0337	
	1	21	40	007	100	REV026	CODE 0341	ALL
	1	21	40	008	100	REV023	M:20057=20059=(20057+20059)	
	1	21	50	001	100	REV025	M:21678	ALL
	1	22	00	001	001	REV031		ALL
	1	22	00	002	001	REV025		
	1	22	10	001	001	REV032		ALL
	1	22	10	002	001	REV032	CODE 0358	

M V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
1	22	10	003	001	REV025		ALL
1	22	10	004	001	REV025		
1	22	10	005	110	REV034	CODE 0296	ALL
1	22	10	006	001	REV023		
1	22	10	007	001	REV028		ALL
1	22	10	008	001	REV024		
1	22	10	009	001	REV024		ALL
1	22	10	010	105	REV028	M:27541=(27256+27541)	
1	22	10	011	100	REV028	M:27541=(27256+27541)	ALL
1	22	10	012	100	REV028	27256	
1	22	10	013	001	REV023		ALL
1	22	10	014	001	REV025		
1	22	10	015	001	REV025		ALL
1	22	10	016	100	REV026	27256	
1	22	10	017	100	REV034	23742=(26358+30980)	1068
1	22	10	018	100	REV030	M:23742	
1	22	10	017	105	REV034	26358	1145
1	22	10	018	100	REV030	M:23742	
1	22	10	019	100	REV023	M:23742	ALL
1	22	10	020	100	REV023	M:23742	
1	22	10	021	001	REV025	CODE 0177	ALL
1	22	10	022	200	REV034	23742+24414	
1	22	10	023	305	REV034	23585+23742+24414	ALL
1	22	20	001	001	REV023		ALL
1	22	20	002	110	REV032	CODE 0378	
1	22	20	003	110	REV034	CODE 0072	ALL
1	22	20	004	001	REV032		
1	22	20	005	110	REV026	CODE 0378	ALL
1	22	20	006	110	REV026	CODE 0378	
1	22	20	007	110	REV028	CODE 0016	ALL
1	22	20	008	100	REV026	CODE 0378	
1	22	20	009	106	REV032	CODE 0072	ALL
1	22	20	010	100	REV032	CODE 0327	
1	22	20	011	100	REV027	CODE 0141	ALL
1	22	20	012	001	REV030		
1	22	20	013	100	REV025	CODE 0141	ALL
1	22	20	014	110	REV028	CODE 0207	
1	22	20	015	100	REV026	M:24064=24065=24066=24067	ALL
1	22	20	016	001	REV023		

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

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	REV025		ALL
	1	22	20	018	001	REV025		
	1	22	20	019	001	REV025	CODE 0358	ALL
	1	22	20	020	001	REV025		
	1	22	20	021	001	REV027		ALL
	1	22	20	022	001	REV029	CODE 0358	
N	1	22	20	023	001	REV035	CODE 0358	ALL
N	1	22	20	024	100	REV034	24064=24065=24066=24067	
N	1	22	20	025	001	REV035	CODE 0358	ALL
N	1	22	20	026	001	REV032		
N	1	22	20	026B	001	REV035	CODE 0358	ALL
N	1	22	20	027	001	REV035	CODE 0358	ALL
N	1	22	20	028	001	REV034		
	1	22	20	029	100	REV030	M:24035=24160=(24189+24211)	ALL
	1	22	20	030	001	REV030	CODE 0358	
	1	22	30	001	100	REV033	24035=24160=24211	ALL
	1	22	30	002	100	REV026	M:24035=24160=24211	
	1	22	30	003	001	REV031		ALL
	1	22	30	004	215	REV026	CODE 0001	
	1	22	30	005	100	REV025	M:24035=24160=24189	ALL
	1	22	30	006	100	REV029	M:26497	
	1	22	30	007	001	REV025		ALL
	1	22	30	008	303	REV034	CODE 0233	
	1	22	30	009	001	REV023		ALL
	1	22	30	010	001	REV032		
	1	22	30	011	001	REV026	CODE 0358	ALL
	1	22	30	012	001	REV025		
	1	22	30	013	001	REV025		ALL
	1	22	30	014	001	REV025	CODE 0358	
	1	22	30	015	100	REV033	24035=24160=24211	ALL
	1	22	30	016	001	REV025		
	1	22	30	017	001	REV025		ALL
	1	22	30	018	100	REV027	M:24035=24160=24211	
	1	22	30	019	001	REV025	CODE 0358	ALL
	1	22	30	020	001	REV025		
	1	22	30	021	001	REV032		ALL
	1	22	30	022	100	REV026	M:24035=24160=24211	
	1	22	30	023	001	REV025		ALL
	1	22	30	024	001	REV023		

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	22	30	025	001	REV030		ALL
	1	22	30	026	001	REV030		
	1	22	30	027	100	REV025	M:24035=24160=24211	ALL
	1	22	30	028	100	REV026	M:24035=24160=24211	
	1	22	30	029	001	REV025		ALL
	1	22	30	030	001	REV025		
	1	22	30	031	100	REV025	M:24064=24065=24066=24067	ALL
	1	22	30	032	100	REV025	M:26497	
	1	22	30	033	100	REV034	24035=24160=24211	ALL
	1	22	30	034	105	REV034	CODE 0243	
	1	22	30	035	200	REV025	CODE 0109	ALL
	1	22	30	036	100	REV025	M:24035=24160=24211	
	1	22	30	037	300	REV026	CODE 0032	ALL
	1	22	30	038	210	REV028	CODE 0236	
	1	22	30	039	100	REV023	CODE 0374	ALL
	1	22	30	040	105	REV028	CODE 0237	
	1	22	30	040A	001	REV032		ALL
	1	22	30	040B	100	REV026	M:24035=24160=24211	ALL
N	1	22	30	041	203	REV028	CODE:0002	ALL
N	1	22	30	042	205	REV035	CODE 0377	
	1	22	30	043	200	REV028	CODE 0234	ALL
	1	22	30	044	200	REV028	CODE 0234	
	1	22	30	045	100	REV025	M:26497	ALL
	1	22	30	046	001	REV025		
	1	22	30	047	200	REV025	CODE 0380	ALL
	1	22	30	048	100	REV025	M:24035=24160=24211	
	1	22	30	049	001	REV025		ALL
	1	22	30	050	001	REV030		
N	1	22	30	051	001	REV035	STD=(20701+23892)	ALL
N	1	22	30	052	001	REV035	CODE 0387	
	1	22	30	052A	001	REV033		ALL
	1	22	30	053	100	REV030	26017	ALL
	1	22	30	054	200	REV027	CODE 0238	
N	1	22	30	055	001	REV033		ALL
N	1	22	30	056	115	REV035	CODE 0416	
N	1	22	30	056A	100	REV035	25863	ALL
N	1	22	30	057	100	REV035	CODE 0379	ALL
N	1	22	30	058	001	REV025		

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

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	1	22	30	060	001	REV028		
	1	22	30	061	001	REV028		ALL
	1	22	30	062	200	REV031	CODE 0034	
	1	22	30	063	100	REV031	M:24035=24160=24189	ALL
	1	22	30	064	100	REV023	M:24035=24160=24211	
	1	22	30	065	100	REV034	24035=24160=24211	ALL
	1	22	30	066	001	REV025	CODE 0358	
	1	22	30	067	100	REV034	CODE 0388	ALL
	1	22	30	068	100	REV034	22013=24105=25225	
	1	22	30	069	100	REV028	M:24035=24160=24189	ALL
	1	22	30	070	106	REV032	M:24035=24160=(24189+24211)	
	1	22	30	071	200	REV025	CODE 0389	ALL
	1	22	30	072	100	REV023	M:24035=24160=24211	
	1	22	30	073	100	REV032	CODE 0379	ALL
	1	22	30	074	100	REV023	M:24035=24160=24211	
	1	22	30	075	100	REV023	CODE 0026	ALL
	1	22	30	076	100	REV025	CODE 0379	
	1	22	40	001	001	REV025		ALL
	1	22	40	002	001	REV025		
	1	22	40	003	110	REV026	M:24105	ALL
	1	22	40	004	001	REV024		
N	1	22	40	005	120	REV035	24215=24588=25534 CFM:ALL	ALL
N	1	22	40	006	100	REV025	M:22249	
	1	22	45	001	100	REV024	CODE 0017	ALL
	1	22	45	002	100	REV024	CODE 0017	
	1	22	45	003	100	REV024	CODE 0017	ALL
	1	22	45	004	100	REV024	CODE 0017	
	1	22	45	005	100	REV024	CODE 0017	ALL
	1	22	45	006	100	REV024	CODE 0017	
	1	22	45	007	100	REV024	CODE 0017	ALL
	1	22	45	008	100	REV024	CODE 0017	
	1	22	46	001	100	REV024	CODE 0256	ALL
	1	22	46	002	100	REV024	CODE 0024	
	1	22	60	001	200	REV032	CODE 0148	ALL
	1	22	60	002	001	REV032		
	1	22	75	001	100	REV023		ALL
	1	23	00	001	001	REV031	CODE 0192	ALL
	1	23	00	002	001	REV030		

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	1	23	10	003	001	REV026		ALL
	1	23	10	004	001	REV026		
	1	23	10	005	100	REV023	M:20137	ALL
	1	23	20	001	001	REV023		ALL
	1	23	20	002	001	REV023		
	1	23	20	003	001	REV023		ALL
	1	23	20	004	001	REV028		
R	1	23	20	005	100	REV035	27699=(27699+31907)	ALL
R	1	23	20	006	001	REV026		
	1	23	20	007	001	REV023		ALL
	1	23	20	008	001	REV023		
	1	23	20	009	001	REV026		ALL
	1	23	20	010	001	REV028		
	1	23	20	011	001	REV023		ALL
	1	23	20	012	001	REV026		
	1	23	20	013	001	REV023		ALL
	1	23	20	014	001	REV026		
	1	23	20	015	100	REV023	M:20308=26023=26433=MPK4453	ALL
	1	23	20	016	100	REV032	22013=24105=K5070	
	1	23	20	017	001	REV029		ALL
	1	23	20	018	001	REV024		
	1	23	20	019	001	REV032		ALL
	1	23	20	020	002	REV024		
	1	23	30	001	205	REV028	CODE:0168	ALL
	1	23	30	002	001	REV034	STD	
	1	23	40	001	100	REV025	CODE 0075	ALL
	1	23	40	002	100	REV025	CODE:0075	
	1	23	40	003	100	REV028	CODE 0075	ALL
	1	23	40	004	100	REV028	CODE 0075	
	1	23	40	005	100	REV025	CODE 0075	ALL
	1	23	40	006	100	REV025	CODE 0075	
	1	23	40	007	100	REV025	CODE 0075	ALL
	1	23	40	008	100	REV025	CODE 0075	
	1	23	50	001	001	REV023		ALL
	1	23	60	001	001	REV023		ALL
	1	24	00	001	001	REV023		ALL

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	1	24	10	003	001	REV023		ALL
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	1	24	10	005	001	REV023		ALL
	1	24	10	006	001	REV023		
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	1	24	10	008	001	REV023		
	1	24	10	009	001	REV023		ALL
	1	24	10	010	001	REV023		
	1	24	10	011	001	REV023		ALL
	1	24	10	012	001	REV023		
	1	24	10	013	100	REV025	M:22013=24105=28160	ALL
	1	24	10	014	100	REV023	M:22013=24105=28160	
	1	24	10	015	001	REV023		ALL
	1	24	10	016	001	REV023		
	1	24	10	017	001	REV027		ALL
	1	24	10	018	001	REV023		
	1	24	10	019	100	REV025	M:22013=24105=28160	ALL
	1	24	20	001	200	REV028	M:21230+27498	ALL
	1	24	20	002	200	REV023	M:21230+21213	
	1	24	20	003	001	REV023		ALL
	1	24	20	004	100	REV028	M:27498	
	1	24	20	005	001	REV023		ALL
	1	24	20	006	100	REV025	M:22013=24105=28160	
	1	24	20	007	001	REV023		ALL
	1	24	20	008	001	REV023		
	1	24	20	009	001	REV023		ALL
	1	24	20	010	001	REV023		
	1	24	20	011	001	REV023		ALL
	1	24	20	012	001	REV023		
	1	24	20	013	001	REV023		ALL
	1	24	20	014	001	REV023		
	1	24	20	015	001	REV032		ALL
	1	24	20	016	001	REV023	STD=(IAE ALL+25409)=25409	
	1	24	20	017	001	REV023		ALL
	1	24	20	018	100	REV033	25999	
R	1	25	00	001	001	REV035		ALL

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	1	25	10	003	100	REV034	20047=20255=23577	ALL
	1	25	10	004	001	REV033		
	1	25	10	005	001	REV033		ALL
	1	25	10	006	100	REV023	M:22941	
	1	25	10	007	001	REV028		ALL
	1	25	10	008	001	REV023		
	1	25	10	009	001	REV023		ALL
	1	25	10	010	001	REV023		
	1	25	10	011	110	REV029	M:27320	ALL
	1	25	10	012	110	REV029	M:27320	
	1	25	10	013	200	REV029	M:22112+27256	ALL
	1	25	10	014	206	REV031	CODE 0278	
	1	25	10	015	001	REV023		ALL
	1	25	10	016	001	REV023		
	1	25	15	001	001	REV032	STD=27229+27230=27229+27540	ALL
R	1	25	20	001	001	REV035		ALL
	1	26	00	001	100	REV034	CODE 0322	ALL
	1	26	10	001	100	REV034	MOD 20067=20069=22006	ALL
	1	26	20	001	005	REV024	CFM ALL	ALL
	1	26	20	002	001	REV026		
	1	26	20	003	100	REV033	23839	ALL
	1	26	20	004	001	REV023		
	1	26	20	005	100	REV026	M:23839	ALL
	1	26	20	006	001	REV023		
	1	26	20	007	001	REV024		ALL
	1	26	20	008	001	REV023		
	1	26	20	009	001	REV023		ALL
	1	26	20	010	001	REV023		
	1	26	30	001	001	REV030		ALL
	1	26	30	002	001	REV023		
	1	26	30	003	001	REV023		ALL
N	1	26	40	001	001	REV030		ALL
N	1	26	40	002	102	REV035	22561=(20067+20069+22561)	
	1	26	50	001	201	REV030	M:20067+20069	ALL
	1	26	50	002	300	REV023	CODE 0320	

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	1	26	60	001	100	REV030	M:21678	ALL
	1	27	00	001	001	REV023		ALL
	1	27	10	001	001	REV034		ALL
	1	27	10	002	001	REV023		
	1	27	10	003	001	REV023		ALL
	1	27	10	004	001	REV023		
	1	27	10	005	100	REV024	M:22013=24105=26334=26335	ALL
	1	27	10	006	001	REV023		
	1	27	10	007	100	REV023	M:21964	ALL
	1	27	10	008	001	REV023		
	1	27	10	009	105	REV028	M:24105 OR 26334 OR 26335	ALL
	1	27	10	010	001	REV030		
	1	27	10	011	405	REV027	M:24105+24511+24745+27276	ALL
	1	27	10	012	100	REV030	CODE 0055	
	1	27	10	013	001	REV030		ALL
	1	27	10	014	100	REV024	M:22013=24105=26334=26335	
	1	27	10	015	001	REV023		ALL
	1	27	10	016	100	REV024	M:24105	
	1	27	10	017	001	REV023		ALL
	1	27	20	001	001	REV023	CODE 0054	ALL
	1	27	20	002	100	REV023	M:24136	
N	1	27	20	003	100	REV028	M:27276	ALL
N	1	27	20	004	001	REV023	STD=24105	
	1	27	20	005	001	REV030		ALL
	1	27	20	006	001	REV030		
	1	27	20	007	100	REV024	M:22013=24105=26334=26335	ALL
	1	27	20	008	005	REV023	CFM ALL	
	1	27	30	001	001	REV023		ALL
	1	27	30	002	100	REV023	CODE 0058	
	1	27	30	003	001	REV023		ALL
	1	27	30	004	001	REV023		
	1	27	30	005	001	REV032		ALL
	1	27	30	006	001	REV023		
	1	27	30	007	001	REV023		ALL
N	1	27	40	001	001	REV035		ALL
N	1	27	40	002	001	REV035		

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	1	27	40	004	100	REV023	M:26540=25477	
	1	27	40	005	001	REV023		ALL
	1	27	40	006	100	REV024	M:22013=24105=26334=26335	
	1	27	40	007	001	REV023		ALL
	1	27	40	008	001	REV023		
	1	27	40	009	100	REV033	22013=24105=26334=26335	ALL
	1	27	40	010	001	REV032		
	1	27	40	011	100	REV024	M:22013=24105=26334=26335	ALL
	1	27	40	012	201	REV033	CODE 0297	
	1	27	40	013	103	REV026	M:22013=24105=26334=26335	ALL
	1	27	50	001	001	REV023	STD=M:24105	ALL
	1	27	50	002	001	REV023	STD=M:24105	
R	1	27	50	003	001	REV035		ALL
R	1	27	50	004	001	REV023	STD=M.24105	
	1	27	50	005	050	REV023	IAE ALL	ALL
	1	27	50	006	001	REV023		
	1	27	50	007	001	REV023		ALL
	1	27	50	008	001	REV023		
	1	27	60	001	001	REV023		ALL
	1	28	00	001	001	REV023		ALL
	1	28	10	001	203	REV025	M.20024+20167	ALL
	1	28	10	002	100	REV025	M.20024	
	1	28	10	003	100	REV023	M.20024	ALL
	1	28	10	004	100	REV024	M:20024	
	1	28	10	005	100	REV026	M:20024	ALL
	1	28	10	006	105	REV023	CODE 0106/CFM ALL	
	1	28	10	007	203	REV024	M:20024+20164	ALL
	1	28	10	008	001	REV023		
	1	28	10	009	001	REV024		ALL
	1	28	20	001	100	REV024	M:20024	ALL
	1	28	20	002	100	REV024	M:20024	
	1	28	20	003	100	REV023	CODE 0163	ALL
	1	28	20	004	100	REV023	M:20164	
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	1	28	20	006	100	REV023	M:20164=(20164+22802)	
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	1	28	20	008	100	REV023	CODE 0064	

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	1	28	20	011	100	REV023	CODE 0064	ALL
	1	28	20	012	105	REV023	M:20024/CFM ALL	
	1	28	20	013	203	REV026	M:20024+20164	ALL
	1	28	30	001	001	REV025	STD=M:20024	ALL
	1	29	00	001	001	REV023		ALL
	1	29	10	001	001	REV023		ALL
	1	29	10	002	100	REV023	M:22013=24105=26334=26335	
	1	29	10	003	001	REV023		ALL
	1	29	10	004	001	REV023		
	1	29	10	005	100	REV033	CODE 0306	ALL
	1	29	10	006	100	REV023	M:22013=24105=26334=26335	
	1	29	20	001	001	REV030		ALL
	1	29	20	002	001	REV025		
	1	29	20	003	001	REV027	STD=M:21679=(21591+21679)	ALL
	1	29	20	004	001	REV030		
	1	29	20	005	001	REV023		ALL
	1	29	20	006	001	REV023		
	1	29	20	007	001	REV030	STD=M:23795=(23119+23795)	ALL
	1	29	20	008	001	REV031		
	1	29	30	001	001	REV024		ALL
	1	30	00	001	001	REV034		ALL
	1	30	10	001	001	REV028	CODE 0132	ALL
	1	30	20	001	010	REV034	CFM ALL	ALL
	1	30	20	002	001	REV026		
	1	30	20	003	100	REV034	22875=28558	ALL
	1	30	30	001	110	REV034	20327/CFM ALL	ALL
	1	30	30	002	100	REV026	M:20327	
	1	30	30	003	100	REV034	22875=28558	ALL
	1	30	40	001	001	REV028		ALL
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	1	30	60	001	100	REV032	M:20319	ALL
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	1	31	05	003	001	REV028		ALL
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	1	31	05	006	001	REV026		
R	1	31	10	001	001	REV023		ALL
R	1	31	10	002	001	REV035		
	1	31	10	003	001	REV023		ALL
	1	31	10	004	100	REV031	CODE 0012	
	1	31	10	005	200	REV031	CODE 0182	ALL
	1	31	15	001	001	REV026		ALL
	1	31	15	002	001	REV032		
	1	31	15	003	001	REV023		ALL
	1	31	15	004	100	REV033	26017	
	1	31	15	005	100	REV023	25410	ALL
	1	31	20	001	100	REV026	M:25409=26018=(25409+26018)	ALL
	1	31	20	002	001	REV033		
	1	31	20	003	100	REV028	M:25409=26018=(25409+26018)	ALL
	1	31	20	004	001	REV024		
	1	31	20	005	002	REV034	CODE 0194	1068
	1	31	20	006	001	REV023		
	1	31	20	005	200	REV034	CODE 0309	1145
	1	31	20	006	001	REV023		
	1	31	25	001	001	REV026		ALL
	1	31	25	002	005	REV030	CFM ALL	
	1	31	25	003	005	REV026	CFM ALL	ALL
	1	31	25	004	001	REV024		
	1	31	25	005	005	REV030	CFM ALL	ALL
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	1	31	25	007	005	REV030	CFM ALL	ALL
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	1	31	40	005	001	REV024		ALL
	1	31	40	006	001	REV024		
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	1	31	40	008	001	REV026		
	1	31	40	009	001	REV023		ALL
	1	31	40	010	001	REV023		
	1	31	40	011	001	REV033		1068
	1	31	40	012	001	REV028	CODE:0247	
	1	31	40	011	001	REV033		1145
	1	31	40	012	201	REV028	CODE 0145	
	1	31	40	013	001	REV023		ALL
	1	31	40	014	100	REV023	M:22707	
R	1	31	40	015	001	REV035		ALL
R	1	31	40	016	001	REV024		
	1	31	40	017	001	REV023		ALL
	1	31	40	018	001	REV026		
	1	31	40	019	001	REV024		ALL
	1	31	40	020	001	REV029		
	1	31	40	021	001	REV031		ALL
	1	31	40	022	100	REV034	CODE 0331	
	1	31	40	023	100	REV026	M : 24035=24160=24189	ALL
	1	31	40	024	001	REV024		
	1	31	40	025	001	REV023		ALL
	1	31	40	026	200	REV034	CODE 0078	
	1	31	40	027	100	REV032	M:26018	ALL
	1	31	40	028	100	REV034	CODE 0331	
	1	31	40	029	200	REV034	CODE 0044	ALL
	1	31	45	001	001	REV028		ALL
	1	31	45	002	001	REV028		
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	1	31	45	004	001	REV028		

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	1	31	45	007	001	REV028		ALL
	1	31	45	008	001	REV024		
	1	31	45	009	100	REV034	CODE 0356	ALL
	1	31	45	010	001	REV023		
	1	31	45	011	001	REV023		ALL
	1	31	45	012	100	REV023	M:22707	
	1	31	45	013	001	REV023		ALL
	1	31	45	014	001	REV024		
	1	31	45	015	001	REV029		ALL
	1	31	45	016	100	REV031	CODE 0175	
R	1	31	45	017	101	REV032	M:26526	1068
R	1	31	45	018	101	REV035	M:26526=(26526+28308+28811)	
R	1	31	45	017	101	REV032	M:26526	1145
R	1	31	45	018	200	REV035	M:26526+28308	
	1	31	45	019	002	REV024		ALL
	1	31	45	020	100	REV024	CODE 0175	
N	1	31	45	021	200	REV035	CODE 0183	ALL
N	1	31	45	022	100	REV035	M:22536=23227=23529	
	1	31	50	001	001	REV029	STD=M:23450=(20406+23450)	1068
	1	31	50	002	001	REV029		
	1	31	50	001	105	REV029	M:26358=(20406+23450+26358)	1145
	1	31	50	002	001	REV029		
	1	31	50	003	100	REV030	M:26526	ALL
	1	31	50	004	001	REV026		
	1	31	55	001	100	REV030	M:27330	ALL
	1	31	55	002	110	REV026	MOD.27330=(24351+25901+27330	
	1	31	55	003	110	REV026	M:27330=(24351+25901+27330)	ALL
	1	31	55	004	110	REV032	M. 27330=(24351+25901+27330)	
	1	31	60	001	001	REV033	STD OR 31647	ALL
	1	31	60	002	002	REV033		
	1	31	60	003	100	REV033	20073	ALL
	1	31	60	004	110	REV026	M : 20073	
	1	31	65	001	001	REV023		ALL
	1	31	65	002	001	REV023		
	1	31	65	003	001	REV023		ALL
	1	31	65	004	001	REV023		
	1	31	67	001	001	REV023		ALL

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

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	31	68	001	001	REV023		ALL
	1	31	70	001	001	REV032		ALL
	1	31	75	001	100	REV028	M:21678	ALL
	1	32	00	001	001	REV023		ALL
	1	32	10	001	001	REV026	STD=M:20139+22129	ALL
	1	32	10	002	001	REV023		
	1	32	10	003	001	REV023	STD=M:20139+22129	ALL
	1	32	10	004	001	REV023		
	1	32	10	005	001	REV023	STD=M:20139+22129	ALL
	1	32	10	006	001	REV023		
	1	32	10	007	001	REV023	STD=M:20139+22129	ALL
	1	32	10	008	001	REV027		
	1	32	10	009	001	REV023		ALL
	1	32	10	010	100	REV030	M:22562	
	1	32	10	011	001	REV023		ALL
	1	32	10	012	001	REV029		
	1	32	10	013	001	REV023		ALL
	1	32	10	014	001	REV023		
	1	32	10	015	100	REV030	M:22013=24105=28160	ALL
	1	32	10	016	001	REV030	STD=M:20139+22129	
	1	32	10	017	001	REV023		ALL
	1	32	10	018	001	REV025		
	1	32	10	019	100	REV029	M:28482	ALL
	1	32	10	020	001	REV023		
	1	32	10	021	001	REV024	STD=M:20139+22129	ALL
	1	32	10	022	001	REV023		
	1	32	10	023	110	REV029	CODE 0125	ALL
	1	32	20	001	002	REV027		ALL
	1	32	20	002	002	REV027		
	1	32	20	003	001	REV023		ALL
	1	32	20	004	001	REV023		
	1	32	20	005	100	REV023	M:24612	ALL
	1	32	30	001	100	REV024	M:23208=24077=(23208+24077)	ALL
	1	32	30	002	001	REV025	STD=M:(20139+22129)	
	1	32	30	003	100	REV023	M:24449	ALL
	1	32	30	004	001	REV023		
	1	32	30	005	001	REV023		ALL
	1	32	30	006	001	REV023	STD=M:(20139+22129)	

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	32	30	007	001	REV023		ALL
	1	32	30	008	100	REV027	M:20994	
	1	32	30	009	001	REV027		ALL
	1	32	30	010	001	REV023		
	1	32	30	011	001	REV023	CODE 0332	ALL
	1	32	30	012	104	REV024	CODE 0334	
	1	32	50	001	001	REV025		ALL
	1	33	00	001	001	REV032		ALL
	1	33	10	001	001	REV023		ALL
	1	33	10	002	100	REV034	23642	
	1	33	10	003	100	REV023	M:24851	ALL
	1	33	10	004	103	REV024	M:24851	
	1	33	10	005	100	REV023	M:23642	ALL
	1	33	10	006	001	REV034		
	1	33	10	007	100	REV034	23642	ALL
	1	33	20	001	001	REV023		ALL
	1	33	20	002	200	REV025	M.20042+20081	
	1	33	20	003	303	REV024	CODE 0124	ALL
	1	33	20	004	100	REV023	M:20081	
	1	33	30	001	001	REV031		ALL
	1	33	30	002	103	REV033	24105	
	1	33	30	003	001	REV031		ALL
	1	33	30	004	001	REV025		
	1	33	40	001	205	REV033	CODE 0193	ALL
	1	33	40	002	100	REV034	20081	
	1	33	50	001	100	REV034	24851	ALL
	1	33	50	002	001	REV023		
	1	34	00	001	001	REV032		ALL
	1	34	00	002	001	REV029		
N	1	34	10	001	203	REV023	CODE 0010	ALL
N	1	34	10	002	001	REV024		
N	1	34	10	003	100	REV023	CODE 0407	ALL
N	1	34	10	004	100	REV023	CODE 0048	
	1	34	10	005	001	REV025		ALL
	1	34	10	006	001	REV031		
	1	34	10	007	001	REV023		ALL
	1	34	10	008	001	REV033		
	1	34	10	009	001	REV025	STD=M:23450=(23450+20406)	ALL

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	34	15	001	110	REV026	CODE:0036	ALL
	1	34	15	002	120	REV026	CODE:0036	
	1	34	15	003	110	REV032	CODE:0101	ALL
	1	34	20	001	001	REV023		ALL
	1	34	20	002	001	REV033		
	1	34	20	003	001	REV024	STD=M:21126	ALL
	1	34	30	001	001	REV027		ALL
	1	34	30	002	001	REV023		
	1	34	30	003	200	REV025	CODE 0077	ALL
	1	34	30	004	001	REV023	STD OR (20210+31003)	
	1	34	30	005	001	REV023	STD OR(20210+31003)	ALL
	1	34	30	006	001	REV023		
	1	34	30	007	001	REV031	STD OR M:27531	ALL
	1	34	30	008	001	REV031		
	1	34	30	009	001	REV032		ALL
	1	34	40	001	002	REV024		ALL
	1	34	40	002	001	REV023		
	1	34	50	001	121	REV031	CODE:0187	ALL
	1	34	50	002	121	REV024	CODE:0211	
	1	34	60	001	100	REV028	CODE 0261	ALL
	1	34	60	002	100	REV031	CODE 0261	
R	1	34	60	003	100	REV035	CODE 0013	ALL
R	1	34	60	004	100	REV026	CODE 0013	
R	1	34	70	001	109	REV035	CODE 0230	ALL
R	1	34	70	002	103	REV035	26526	
	1	34	70	003	100	REV026	M:26526	ALL
	1	34	70	004	109	REV025	M:26526=(22769+26256)	
R	1	34	70	005	110	REV029	M:26526 OR (22769+26526)	ALL
R	1	34	70	006	001	REV035		
R	1	34	70	007	103	REV035	M:26526	ALL
R	1	34	70	008	100	REV035	MOD 28244 OR (26526 + 28244)	
	1	34	70	009	100	REV030	M:26526	ALL
	1	34	70	010	103	REV024	M:26526	
	1	34	70	011	100	REV030	M:26526=(22769+26526)	ALL
	1	34	70	012	100	REV026	M:26526	
	1	34	70	013	105	REV032	MOD 28244 OR (26526 + 28244)	ALL
	1	34	70	014	101	REV027	CODE 0104	
	1	34	80	001	100	REV033	CODE 0095	ALL
	1	34	80	002	100	REV023	CODE 0095	

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	34	80	003	100	REV023	CODE 0095	ALL
	1	34	80	004	100	REV031	CODE 0095	
	1	34	80	005	150	REV031	CODE:0245	ALL
	1	34	80	006	150	REV028	CODE 0245	
	1	34	80	007	210	REV031	CODE 0219	1068
	1	34	80	008	100	REV031	CODE:0246	
	1	34	80	007	210	REV031	CODE 0219	1145
	1	34	80	008	200	REV031	CODE 0128	
	1	34	80	009	100	REV023	CODE 0095	ALL
	1	34	80	010	100	REV031	CODE 0095	
	1	34	80	011	100	REV030	CODE 0095	ALL
	1	34	80	012	150	REV028	CODE 0245	
	1	34	80	013	100	REV024	CODE 0095	ALL
R	1	34	97	001	206	REV035	CODE 0399	ALL
	1	35	00	001	001	REV023		ALL
	1	35	10	001	001	REV024		ALL
	1	35	20	001	001	REV028		ALL
	1	35	20	002	001	REV034		
	1	35	20	003	001	REV023		ALL
	1	35	20	004	001	REV034		
	1	35	20	005	001	REV031		ALL
	1	35	20	006	001	REV029		
	1	35	20	007	001	REV032		ALL
	1	35	20	008	001	REV025		
	1	35	30	001	110	REV032	M:26923=27255=27572	ALL
	1	35	30	002	001	REV023		
	1	35	30	003	001	REV024		ALL
	1	35	40	001	112	REV023	CODE 0158	ALL
	1	35	40	002	112	REV023	CODE:0006	
	1	35	50	001	001	REV031	STD=M:25110	ALL
	1	36	00	001	001	REV023		ALL
	1	36	10	001	001	REV023		ALL
	1	36	10	002	001	REV023		
	1	36	10	003	001	REV023		ALL
	1	36	10	004	050	REV024	M.24105=IAE ALL=(IAE+24105)	
N	1	36	10	005	001	REV028		ALL
N	1	36	10	006	100	REV035	22562=(22562+25888+27609)	

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	36	10	007	001	REV023		ALL
	1	36	10	008	001	REV023		
	1	36	10	009	001	REV023		ALL
	1	36	10	010	001	REV023		
	1	36	20	001	001	REV023		ALL
	1	36	20	002	001	REV023		
	1	36	20	003	001	REV023		ALL
	1	36	20	004	100	REV023	M:24805	
	1	36	20	005	001	REV023		ALL
	1	36	20	006	100	REV023	M:24805	
	1	36	20	007	001	REV023		ALL
	1	36	30	001	100	REV023	M:21678	ALL
	1	38	00	001	001	REV023		ALL
	1	38	10	001	001	REV023		ALL
	1	38	10	002	100	REV025	M:21003	
	1	38	10	003	001	REV023		ALL
	1	38	10	004	100	REV034	20109	
	1	38	10	005	100	REV023	M:20109	ALL
	1	38	20	001	100	REV034	MOD 20109	ALL
	1	45	00	001	001	REV030		ALL
	1	45	10	001	001	REV023		ALL
	1	45	10	002	001	REV023	STD OR (27522+28360)	
	1	45	10	003	100	REV032	23119=22013	ALL
	1	45	10	004	001	REV023		
	1	45	10	005	001	REV023		ALL
	1	45	20	001	001	REV023	STD=M:27522+28360	ALL
	1	45	20	002	001	REV023		
	1	45	20	003	200	REV032	20201+24287	ALL
	1	45	20	004	001	REV032		
	1	45	20	005	001	REV023		ALL
	1	45	20	006	001	REV023		
	1	45	20	007	001	REV032		ALL
	1	45	20	008	001	REV023		
	1	45	20	009	100	REV023	CODE 0004	ALL
	1	45	25	001	100	REV030	M:25293	ALL
	1	45	30	001	001	REV023		ALL

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	45	40	001	001	REV023		ALL
	1	49	00	001	001	REV023		ALL
	1	49	10	001	100	REV023	M:22562	ALL
	1	49	10	002	001	REV023		
	1	49	10	003	100	REV023	M:22562OR(22562+25888+27609)	ALL
	1	49	20	001	100	REV023	CODE 0027	ALL
	1	49	20	002	100	REV028	M:22562OR(22562+25888+27609)	
	1	49	20	003	001	REV023		ALL
	1	49	20	004	203	REV024	M:22562+25409	
	1	49	20	005	103	REV032	M:22562OR(22562+25888+27609)	ALL
	1	49	20	006	100	REV023	M:22562	
	1	49	30	001	100	REV032	M:22013 OR 24105 OR 28160	ALL
	1	52	00	001	001	REV023		ALL
	1	52	10	001	106	REV023	M:24105	ALL
	1	52	10	002	001	REV023		
	1	52	10	003	001	REV023		ALL
	1	52	10	004	001	REV028		
	1	52	10	005	001	REV023		ALL
	1	52	10	006	103	REV032	M:24105	
	1	52	10	007	103	REV023	M:24105=(AFR+24105)	ALL
	1	52	10	008	001	REV034		
	1	52	10	009	001	REV023		ALL
	1	52	10	010	103	REV025	M:24105	
	1	52	10	011	103	REV034	24105=30020	ALL
	1	52	20	001	203	REV024	M:24105+22707	ALL
	1	52	20	002	100	REV034	MOD 24105	
	1	52	30	001	001	REV023	STD=M:(20062+22188)	ALL
	1	52	30	002	001	REV026	STD=M:(20062+22188)	
	1	52	40	001	001	REV023		ALL
	1	70	00	001	005	REV023	CFM ALL	ALL
	1	70	00	002	005	REV023	CFM ALL	
	1	70	10	001	120	REV028	CODE:0227/CFM 56-5-B	ALL
	1	70	20	001	005	REV023	CFM ALL	ALL
	1	70	20	002	105	REV024	MOD.22238/CFM ALL	
	1	70	20	003	001	REV023		ALL
	1	70	20	004	001	REV023		

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	70	20	005	005	REV028	CFM ALL	ALL
	1	70	20	006	005	REV032	CFM ALL	
	1	70	30	001	105	REV023	MOD.22112/CFM ALL	ALL
	1	70	30	002	005	REV023	CFM=PW	
	1	70	30	003	005	REV023	CFM=PW	ALL
	1	70	30	004	105	REV023	24035 CFM/PW	
	1	70	30	005	005	REV023	CFM=PW	ALL
	1	70	30	006	005	REV023	STD=M:27441 CFM ALL	
	1	70	40	001	105	REV024	CODE:0204/CFM	ALL
	1	70	40	002	005	REV023	CFM ALL	
	1	70	40	003	105	REV034	22238/CFM	ALL
	1	70	40	004	005	REV023	CFM ALL	
	1	70	40	005	105	REV033	CODE:0204/CFM	ALL
	1	70	40	006	005	REV023	CFM ALL	
	1	70	40	007	005	REV023	CFM ALL	ALL
	1	70	50	001	005	REV023	CFM ALL	ALL
	1	70	60	001	005	REV023	CFM ALL	ALL
	1	70	60	002	005	REV023	CFM ALL	
	1	70	70	001	005	REV023	CFM ALL	ALL
	1	70	70	002	110	REV031	CODE:0018/CFM	
	1	70	70	003	106	REV028	M:25404/CFM ALL	ALL
	1	70	80	001	001	REV023		ALL
	1	70	80	002	005	REV031	CFM	
	1	70	80	003	005	REV031	CFM	ALL
	1	70	80	004	005	REV023	CFM ALL	
	1	70	80	005	240	REV031	M:22562+27993/CFM	ALL
	1	70	80	006	005	REV023	CFM ALL	
	1	70	80	007	320	REV032	CODE 0295/CFM	ALL
	1	70	90	001	005	REV023	CFM ALL	ALL
	1	70	90	002	005	REV031	CFM	
	1	70	90	003	005	REV024	CFM ALL	ALL
	1	70	90	004	005	REV023	CFM ALL	
	1	70	90	005	105	REV033	CODE 0062/CFM ALL	ALL
	1	70	90	006	025	REV023	CFM56-5-B	
	1	70	90	007	005	REV033	CFM ALL	ALL
	1	70	90	008	148	REV033	22707/CFM 56-5-B	
	1	70	90	009	118	REV033	CODE 0061/CFM ALL	ALL
	1	70	90	010	107	REV028	M:22707/CFM ALL	

M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
M	V	CH	SEC	---PAGE--	SEQ	--REV--	----VALIDATION CRITERIA-----	-----EFFECTIVITY-----
	1	70	90	011	005	REV023	CFM ALL	ALL
	1	70	90	012	105	REV023	MOD.22707/CFM ALL	
R	1	70	90	013	209	REV024	CODE 0060/CFM ALL	ALL
R	1	70	90	014	146	REV035	26017=22634+26017/CFM 56-5-B	
	1	70	90	015	220	REV026	CODE 0042 CFM ALL	ALL
	1	70	98	001	001	REV028	STD=M:20165	ALL

M V T	REV	MOD	MP SB	TITLE / VALIDITY
.	034A	......	K0385	LIGHTS - CABIN - MODIFY SIGN CONTROL OF FSB - ALL
.	034A	......	K4453	COMMUNICATION - INSTALL AN ALL CABIN ATTENDA CALL PUSH BUTTON IN THE FLIGHT COMPARTMENT ALL
.	034A	......	K5043	COMMUNICATIONS - CIDS - CABIN CONFIGURATION FOR NON-SMOKING FLIGHTS ALL
N	035	......	P0164	COMMUNICATIONS - DATA LINK SYSTEM - DEFINE PIN PROGRAMMING ALL
.	034A	......	P2878	INDICATING RECORDING SYSTEM - SDAC - DEFINE A PIN PROGRAM FOR REAR C.C. VENTILATION ALL
.	034A	20024	......	FUEL- INSTALL A CENTRE TANK SYSTEM- ALL
.	034A	20042	......	LIGHTS - EXTERNAL LIGHTS - INSTALL LOGO LIGHTS ALL
.	034A	20059	......	AIR CONDITIONING - CARGO COMPARTMENT - VENTILATION - INSTALL SYSTEM IN AFT COMPARTMENT - ALL
.	034A	20067	......	FIRE PROTECTION - FWD CARGO COMPARTMENT - INSTALL SMOKE DETECTION SYSTEM - ALL
.	034A	20069	......	FIRE PROTECTION - AFT CARGO COMPARTMENT - INSTALL SMOKE DETECTION SYSTEM - ALL
.	034A	20071	......	FIRE PROTECTION - CARGO COMPARTMENT FIRE EXTINGUISHING - INSTALL A SINGLE SHOT SYSTEM - ALL

M V T	REV	MOD	MP SB	TITLE / VALIDITY
.	034A	20073	....	INDICATING/RECORDING SYSTEMS - INSTALL AN AIRCRAFT INTEGRATED DATA SYSTEM - ALL
.	034A	20081	....	LIGHTS - EXTERIOR LIGHTS - INSTALL SYNCHRONIZED STROBE LIGHTS ALL
.	034A	20109	....	WATER/WASTE- INSTALL VACUUM TOILET SYSTEM - ALL
.	034A	20137	....	COMMUNICATIONS - RADIO MANAGEMENT - INSTALL A 3RD RMP - ALL
.	034A	20164	....	FUEL - REFUEL/DEFUEL SYSTEM - INSTALL A FUEL QUANTITY PRE-SELECTOR IN FLIGHT COMPARTMENT - ALL
.	034A	20167	....	STRUCTURE - REINFORCE STRUCTURE TO ALLOW MTOW 72T-MLW 63T-MZFW 59T DESIGN WEIGHTS ALL
.	034A	20201	....	COMMUNICATIONS-INSTALL DATA LINK SYSTEM ALL
.	034A	20230	....	LIGHTS - NAVIGATION LIGHTS - INSTALL A SECOND NAVIGATION LIGHT SYSTEM - ALL
.	034A	20268	....	WINGS-WING TIP FENCES-INTRODUCE WING TIPS INCLUDING FENCES- ALL
.	034A	20283	....	COMMUNICATIONS - PROVIDE "HOT MIKE" RECORDING ALL
.	034A	20319	....	ICE AND RAIN PROTECTION-WINDSHIELD RAIN PROTECTION - ADD AN INTERMITTENT FUNCTION ALL

M V T	REV	MOD MP SB	TITLE VALIDITY
.	034A	20324 ...... 28-1030 04	FUEL - COUPLING REFUEL/DEFUEL - ADD COUPLING ON LH WING (72T MTOW A/C) ALL
.	034A	20327	MINOR IMPROVEMENTS INTRODUCED FROM A/C 60 - AS ZONE - ALL
.	034A	20994	LANDING GEAR-WHEELS AND BRAKES-INSTALL BSCU STD5- ALL
.	034A	21003	WATER/WASTE - RELOCATE POTABLE WATER TANK - ALL
.	034A	21213	ELECTRICAL POWER - DC GENERATION - REVISE "BAT OFF" INDICATION - ALL
.	034A	21230	ELECTRCIAL POWER - DC - IMPROVE BCL - ALL
.	034A	21237	APU - INTRODUCE APU MODE 6 AND ASSOCIATED ECB (GARRETT) ALL
.	034A	21678	ELECTRICAL POWER-AC/DC ESSENTIAL POWER DISTRIBUTION-PROVIDE PROVISIONS FOR ETOPS- ALL
.	034A	21679	HYDRAULIC POWER-MODIFY ELECTRICAL ROUTING OF GREEN LEAKAGE MEASUREMENT ELECTROVALVE CONTROL ALL
.	034A	21964	FLIGHT CONTROLS - ELAC/EFCS SYSTEM - INTRODUCE SOFTWARE L62 ALL
.	034A	22089	ENGINE FUEL AND CONTROL - EIU/CFM - INTRODUCE SOFTWARE 11 ALL

M V T	REV	MOD MP SB	TITLE	VALIDITY
.	034A	22112	MINOR IMPROVEMENTS INTRODUCED FROM A/C 268 - AS ZONE	ALL
.	034A	22238	ENGINE FUEL AND CONTROL - CFM 56 - INTRODUCE EIU VERSION 12 AND ADDITIONAL WIRING	ALL
.	034A	22249	AUTO FLIGHT - ACTIVATE WINDSHEAR FUNCTION	ALL
.	034A	22311	NAVIGATION - TCAS II - INTRODUCE COMPLETE PROVISIONS	ALL
.	034A	22536	NAVIGATION - INSTALL A BENDIX TCAS II COLLISION AVOIDANCE SYSTEM	ALL
.	034A	22561	FIRE PROTECTION - LAVATORY SMOKE DETECTION - INTRODUCE AMBIENT SYSTEM	ALL
.	034A	22562	AIRBORNE AUXILIARY POWER UNIT - INTRODUCE APIC APS-3200	ALL
.	034A	22567	EQUIPMENT/FURNISHINGS - EMERGENCY EQUIPMENT - INTRODUCE PBE DRAEGER IN THE COCKPIT	ALL
N	035	22572	LANDING GEAR - MLG - IMPROVE LOOM SEGREGATION	ALL
.	034A	22634	INDICATING/RECORDING SYSTEMS - CENTRAL WARNING SYSTEM - DEFINE STD FWC FOR A321	ALL

M V T	REV	MOD MP SB	TITLE / VALIDITY
.	034A	22706	INDICATING/RECORDING SYSTEMS - CENTRAL WARNING SYSTEM - INSTALL SDAC A320/321 STANDARD ALL
.	034A	22707	INDICATING RECORDING SYSTEMS - EIS - DEFINE COF A STANDARD FOR A320/A321 DMC ALL
.	034A	22769	NAVIGATION - GPWS - INSTALL GPWC MARK V WITH INTERFACE WITH CFDS ALL
.	034A	22875	ICE AND RAIN PROTECTION - ICE DETECTION - INSTALL DUAL ADVISORY ICE DETECTION SYSTEM ALL
.	034A	22941	EQUIPMENT/FURNISHINGS - COCKPIT SEATS - INTRODUCE TYPE A340 SEATS ALL
.	034A	23099	COMMUNICATIONS - ACARS - INSTALL SUNDSTRAND ACARS MANAGEMENT UNIT BFE ALL
.	034A	23119	HYDRAULIC POWER-BLUE MAIN HYDRAULIC POWER-IMPROVE MAINTENANCE STATUS OF BLUE HYDRAULIC RESERVOIR ALL
.	034A	23124	AIR CONDITIONING - PRESSURIZATION CONTROL - IMPROVE CONTROLLER TO ENABLE USE OF EXTERNAL MODE ALL
.	034A	23208	LANDING GEAR - WHEELS AND BRAKES - INTRODUCE BSCU STD 6 ALL
.	034A	23344	AIR CONDITIONING - IMPROVE CABIN PRESSURIZA-TION CONTROL ON 25VU PANEL. ALL
N	035	23510	NAVIGATION - ADIRS - ADAPT SHELVES FOR 4 MCU ADIRS INSTALLATION ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	034A	23577	......	EQUIPMENT/FURNISHINGS-COCKPIT SEATS- INTRODUCE ADDITIONAL BONDING STRIP ON FOURTH CREW MEMBER'S SEAT ALL
.	034A	23585	......	AUTO FLIGHT - FCU - INTRODUCE FCU M-9 STD ALL
.	034A	23642	......	LIGHTS - COCKPIT ILLUMINATION - INTRODUCE IMPROVED COCKPIT LIGHTING ALL
.	034A	23672	......	NAVIGATION - ADIRS - INSTALL LITTON 4MCU ON A321 A/C ALL
.	034A	23742	......	AUTO FLIGHT - FCU - INTRODUCE FCU STANDARD M10 ALL
.	034A	23795	......	HYDRAULIC POWER - INDICATING - REMOVE SENSOR AND ASSOCIATED WIRING FOR BLUE RESERVOIR INDICATION ALL
.	034A	23839	......	FIRE PROTECTION - DETECTION - INTRODUCE MODIFIED ENGINE AND APU FIRE PANEL ALL
.	034A	24035	......	INDICATING/RECORDING SYSTEMS - GENERAL- DEFINE CPIP3 ALL
.	034A	24064	......	AUTO FLIGHT-FMS-INTRODUCE FMGC A320/321 B1 STD WITH OPTIONS AND 400 KILOWORDS FOR CFM 56 VERSIONS ALL
.	034A	24077	......	LANDING GEAR - BSCU - TWIN WHEEL - INTRODUCE A320/A321 STD 6 VERSION 60C ALL

M V T	REV	MOD MP SB	TITLE VALIDITY
.	034A	24084	AUTO FLIGHT - A320/A321 FOR IAE AND CFM ENGINES - INSTALL WIRING PROVISION FOR ENERGY MANAGEMENT ACTIVATION ALL
.	034A	24105	FUSELAGE - REAR FUSELAGE - ADAPT SECTION 17/19 STRUCTURE TO A319 DEFINITION ALL
.	034A	24106	FUSELAGE - DEFINE INTERFACES AND ASSEMBLING OF SECTION 14 TO 15/21 TO A319 DEFINITION ALL
.	034A	24136	FLIGHT CONTROLS - ELAC SYSTEM - INTRODUCE A320/A321 ELAC STD ALL
.	034A	24139	AIR CONDITIONING - COCKPIT AND CABIN TEMPERATURE CONTROL - INTRODUCE ZONE TEMPERATURE CONTROLLER -03 ALL
.	034A	24215	AUTO FLIGHT - FAC - INSTALL TWO FACS P/N BAM 0509 ALL
.	034A	24287	INDICATING/RECORDING SYSTEMS - CFDR - INTRODUCE CFDIU STD -7 ALL
.	034A	24351	INDICATING/RECORDING SYSTEMS - ELECTRICAL CLOCK - INSTALL A CLOCK SMITHS TYPE 2610 ALL
.	034A	24414	AUTO FLIGHT - FLIGHT CONTROL UNIT (FCU) DELETE "EXPEDITE" FUNCTION FROM FCU ALL
.	034A	24449	LANDING GEAR - A320/A321 TWIN WHEELS - INTRODUCE BSCU STANDARD 7 (70B VERSION) ALL

M V T	REV	MOD MP SB	TITLE / VALIDITY
.	034A	24511	FLIGHT CONTROLS -S.E.C. SYSTEM INTRODUCE A320/A321 S.E.C STANDARD P/N BAM0508 — ALL
.	034A	24588	AUTO FLIGHT-FAC-INTRODUCE FAC P/N BAM 510 — ALL
.	034A	24612	INDICATING/RECORDING SYSTEMS - FWC - INTRODUCE FWC D2 STD — ALL
.	034A	24613	FLIGHT CONTROLS - ELAC - INTRODUCE ELAC STD P/N L69 — ALL
.	034A	24745	FLIGHT CONTROLS-SEC SYSTEM-"PARTIAL LIFT DUMPING" FUNCTION ACTIVATION — ALL
.	034A	24805	PNEUMATIC-ENGINE BLEED AIR SUPPLY- INTRODUCE A BLEED AIR MONITORNG COMPUTER STD6 — ALL
.	034A	24851	ICE AND RAIN PROTECTION-ICE DETECTION- PROVIDE ICE DETECTOR ILLUMINATION — ALL
N	035	24852	NAVIGATION-ADIRU-INTRODUCE ADIRU P/N -307 — ALL
.	034A	24917	FLIGHT CONTROLS-INTRODUCE ELAC STD L69J — ALL
.	034A	25184	NAVIGATION-TCAS-INSTALL ATC/TCAS CONTROL PANEL SEXTANT P/N 04-AA01. — ALL
.	034A	25287	POWERPLANT - GENERAL - INSTALL ON A319 ENGINE RATED VERSION OF CFM 56-5B6 23500 LBS — ALL

M V T	REV	MOD MP SB	TITLE / VALIDITY
.	034A	25293	INDICATING/RECORDING SYSTEM - INSTALL A PORTABLE DATA LOADER CONNECTOR AND DISK STOWAGE ALL
.	034A	25294	NAVIGATION - ADIRS - INSTALL HONEYWELL ADIRS CAPABLE OF A319 A/C ALL
.	034A	25295	AUTOFLIGHT - FMGC - ACTIVATE ACARS INTERFACE IN FMS (CFM AND IAE ENGINES) ALL
.	034A	25296	FLIGHT CONTROLS - FCDC SYSTEM - PROVIDE A VISUAL INDICATION FOR SIMULTANEOUS SIDE STICK ACTION ALL
.	034A	25335	FLIGHT CONTROLS-ELAC-INTRODUCE A319 EIS L77 SOFTWARE STD- ALL
.	034A	25336	NAVIGATION-ADIRS-INTRODUCE AIRU LITTON P/N -308 ALL
.	034A	25345	AUTOFLIGHT-FCU-INTRODUCE F.C.U. STANDARD M11 ALL
.	034A	25346	AUTOFLIGHT-FCU-INTRODUCE FCU STANDARD M11 WITHOUT EXPEDITE FUNCTION ALL
.	034A	25381	AUTOFLIGHT - FMGC - ACTIVATE PRINTER INTERFACE IN FMS (CFM AND IAE ENGINES) ALL
.	034A	25404	EXHAUST-THRUST REVERSER CONTROL AND INDICATING-ACTIVATE ADDITIONAL THRUST REVERSER LOCK CONTROL ALL

M V T	REV	MOD SB	MP	TITLE / VALIDITY
.	034A	25409	......	INDICATING RECORDING SYSTEMS-DMC- INTRODUCE D.M.C. V31 STANDARD ALL
.	034A	25410	......	INDICATING RECORDING SYSTEM-FWC- INTRODUCE F.W.C. E1 STANDARD ALL
.	034A	25419	......	ICE AND RAIN PROTECTION-WINDSHIELD RAIN PROTECTION-DESACTIVATION OF RAIN REPELLENT SYSTEM ALL
.	034A	25440	......	NAVIGATION - GENERAL - CHANGE EQUIPMENTS TO COMPLY WITH MARCH 95 SPECS. ALL
.	034A	25529	......	NAVIGATION - WEATHER RADAR SYSTEM - ACTIVATE PREDICTIVE WINDSHEAR FUNCTION ALL
.	034A	25530	......	ENGINE - COMBUSTION SECTION - INTRODUCE DOUBLE ANNULAR COMBUSTOR ON CFM56-5B6 (CFM56-5B6/2) ALL
.	034A	25863	......	AUTO FLIGHT - FCU - DEFINE FLIGHT DIRECTOR ENGAGEMENT IN CROSSED BARS AT GO AROUND ALL
.	034A	25871	......	ENGINE FUEL AND CONTROL-CONTROLLING- INTRODUCE ECU SOFTWARE 5DH FOR CFM56-5B (DAC -DAC/P) ENGINES ALL
.	034A	25894	......	FLIGHT CONTROLS-ELAC SYSTEM-INTRODUCE ELAC SOFTWARE STD L78 ALL
.	034A	25901	......	INDICATING/RECORDING SYSTEMS-ELECTRICAL CLOCK- INSTALL SEXTANT CLOCK IN PLACE OF SMITHS BASIC CLOCK OO-SSB

M V T	REV	MOD MP SB	TITLE / VALIDITY
.	034A	25999	ELECTRICAL POWER-DC GENERATION- MODIFY TRANSFORMER RECTIFIER OVERHEAT PROTECTION ALL
.	034A	26000	NAVIGATION-ADIRS-INTRODUCE HONEYWELL ADIRU 4 MCU STD WITH HARDWARE P/N AD09 ALL
.	034A	26001	NAVIGATION-ADIRS-INTRODUCE HONEYWELL 4 MCU P/N AC09 ALL
.	034A	26002	NAVIGATION-ADIRS-INTRODUCE LITTON ADIRU 4 MCU STD WITH P/N-309 (AIME FUNCTION) ALL
.	034A	26017	INDICATING/RECORDING SYSTEMS-FLIGHT WARNING COMPUTER (FWC)-INTRODUCE FWC ST2 E2 ALL
.	034A	26018	INDICATING/RECORDING SYSTEMS-DISPLAY MANAGEMENT COMPUTER (DMC)-INTRODCUE DMC V32 STD ALL
.	034A	26194	NAVIGATION - WEATHER RADAR SYSTEM - ALLIED SIGNAL CONFIGURATION AND FULL PROVISION FOR A SECOND TRANSCEIVER ALL
.	034A	26203	COMMUNICATIONS - SSCVR - INSTALL SSCVR ALLIED SIGNAL P/N 980-6022-001 ALL
.	034A	26250	WATER/WASTE-TOILET SYSTEM-INTRODUCE MODIFIED TOILET ASSY ALL
.	034A	26274	NAVIGATION - ADF - INSTALL A SECOND ADF RECEIVERS ALL

M V T	REV	MOD MP SB	TITLE	VALIDITY
.	034B	26275	NAVIGATION-WEATHER RADAR SYSTEM- INSTALL FULL PROVISION FOR 2ND TRANSCEIVER	00-SSF
.	034B	26358	AUTOFLIGHT-FLIGHT CONTROL UNIT- (FCU) INTRODUCE SEXTANT MODULAR FCU	00-SSF
.	034A	26363	AIR CONDITIONING-AIR COOLING SYSTEM- INTRODUCE MODIFIED RAM AIR OUTLET	ALL
.	034A	26497	AUTO FLIGHT-GENERAL-ACTIVATE GLOBAL SPEED PROTECTION AND F/D DISENGAGEMENT UPON SPEED CONSTRAINTS	ALL
.	034A	26526	NAVIGATION - GPWS - ACTIVATE ENHANCED FUNCTIONS OF THE EGPWS	ALL
.	034A	26540	INDICATING/RECORDING SYSTEMS - FWC - PROVIDE NEW SYNTHETIC VOICE "DUAL INPUT"	ALL
.	034A	26923	OXYGEN-PASSENGER OXYGEN-INTRODUCE MODIFIED CHEMICAL OXYGEN CONTAINER (DRAEGER) P/N -0004	ALL
.	034A	26963	ICE AND RAIN PROTECTION-WINSHIELD RAIN PROTECTION-ACTIVATION OF RAIN REPELLENT SYS.(FLUID COMPATIBLE WITH OZONE RULES)	ALL
.	034A	26968	AUTO FLIGHT-FMGC-INTRODUCE FMGC CAM0102 FOR A319 AUTOLAND AND GPS/ACARS FOR CFM ENGINES	ALL
.	034B	26999	NAVIGATION - MMR - INSTALL COLLINS MMR PROVIDING ILS AND GPS FUNCTION	00-SSF

M V T	REV	MOD	MP / SB	TITLE	VALIDITY
.	034A	27014	....	HYDRAULIC POWER-AUXILIARY HYDRAULIC POWER-INTRODUCE MODIFIED SUNDSTRAND RAM AIR TURBINE	ALL
.	034A	27255	....	OXYGEN - PASSENGER OXYGEN SYSTEM - INTRODUCE OXYGEN CONTAINER DRAGER P/N -0003	ALL
.	034A	27256	....	AUTO FLIGHT - MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU) - INTRODUCE MCDU HONEYWELL 2ND GENERATION (P/N -980)	ALL
.	034A	27276	....	FLIGHT CONTROLS-ELAC SYSTEM-INTRODUCE ELAC SOFTWARE "L80"	ALL
.	034A	27285	....	NAVIGATION-ATC MODE"S"-INTRODUCE ATC/TCAS CONTROL UNIT P/N C12404AB02	ALL
.	034A	27320	....	INFORMATION SYSTEM-AIR TRAFFIC AND INFO MANAGEMENT SYS(ATIMS)-COCKPIT-INTRODUCE SYS PROVISIONS FOR FANS "A"(ATSU-2DCDU)	ALL
.	034A	27330	...... 31-1133 05	INDICATING/RECORDING SYSTEMS - ELECTRICAL CLOCK- INSTALL AIR PRECISION P/N APE5100-1 CAPABLE OF GPS TIME	ALL
.	034A	27498	....	ELECTRICAL POWER - GENERAL - AC-DC MAIN DISTRIBUTION - INSTALL AC-DC SHEDDABLE BUSBARS	ALL
.	034B	27522	....	INFORMATION SYSTEM - AIR TRAFFIC AND INFORMATION SYSTEM (ATIMS) - INSTALL ATSU COMPUTER FOR ACARS	00-SSF

M V T	REV	MOD MP SB	TITLE	VALIDITY
.	034A	27541	AUTO FLIGHT - MCDU - INSTALL AN MCDU 2ND GENERATION HONEYWELL FMS (MCDU WITH A340 KEYBOARD)	ALL
.	034A	27572	OXYGEN-PASSENGER OXYGEN-INTRODUCE MODIFIED CHEMICAL OXYGEN CONTAINER -15 MIN- PURITAN	ALL
.	034A	27646	NAVIGATION - MMR - INSTALL SEXTANT MMR PROVIDING ILS (FM IMMUNE)	ALL
.	034A	27698 ...... 34-1177 10	NAVIGATION - TCAS - INSTALL ALLIED SIGNAL TCAS COMPUTER P/N 066-50000-2220 (WITH CHANGE 7.0)	ALL
.	034A	27699	COMMUNICATIONS - AUDIO MANAGEMENT SYSTEM - INSTALL SATCOM AMU AND ACP	ALL
.	034A	27993	AIR CONDITIONING - PACK COOLING AIR CONTROL - INTRODUCE LOGIC RELAY FOR CONTROL PACK CLOSURE AT ENGINE START	ALL
.	034A	28218	NAVIGATION-ADIRS-INTRODUCE LITTON ADIRU 4 MCU STD-312	ALL
.	034A	28244 ...... 34-1193 17	NAVIGATION-GPWS-INTRODUCE EGPWS P/N 206-206 AND INHIBIT AUTOMATIC DEACTIVATION ENHANCED FUNCTIONS	ALL
.	034B	28293	NAVIGATION - WEATHER RADAR SYSTEM - REINSTALL A SINGLE WEATHER RADAR CONFIGURATION	00-SSF
.	034B	28308	INDICATING RECORDING SYSTEM-DMC- INTRODUCE DMC V40 STANDARD	00-SSF

M V T	REV	MOD	MP SB	TITLE	VALIDITY
.	034B	28360	....	INFORMATION SYSTEMS-ATIMS-REMOVE ATSU INSTALLATION BACK TO ACARS PROVISIONS	00-SSF
.	034B	28369	....	INDICATING/RECORDING SYSTEMS - DMC - DISPLAY ALTITUDE IN METRIC UNITS ON THE PRIMARY FLIGHT DISPLAY (PFD)	00-SSF
.	034A	28382	....	NAVIGATION - MMR - ACTIVATE GPS PRIMARY FUNCTION (HYBRID) IN SEXTANT MMR (WITH HONEYWELL OR LITTON ADIRU)	ALL
.	034A	28482	....	LANDING GEAR-NOSE LANDING GEAR WHEELS-REMOVE RUBBING STRIPS	ALL
.	034B	28495	....	NAVIGATION - MMR - REMOVE COLLINS MMR PROVIDING ILS (FM IMMUNE) AND GPS PRIMARY FUNCTION (PREVIOUS SPEC.)	00-SSF

20.00 CONTENTS

20.10 INTRODUCTION

20.20 GENERAL ARRANGEMENT

GENERAL

The A319 is a subsonic, medium-range, civil transport aircraft.

ENGINES

The aircraft has 2 high bypass turbofan engines mounted under the wings.

COCKPIT

R The cockpit is designed for a two-member crew. It also has a place for 1 observer.

CABIN

The passenger seating layout may vary, depending on operating requirements. The certified maximum is 145 seats.

CARGO

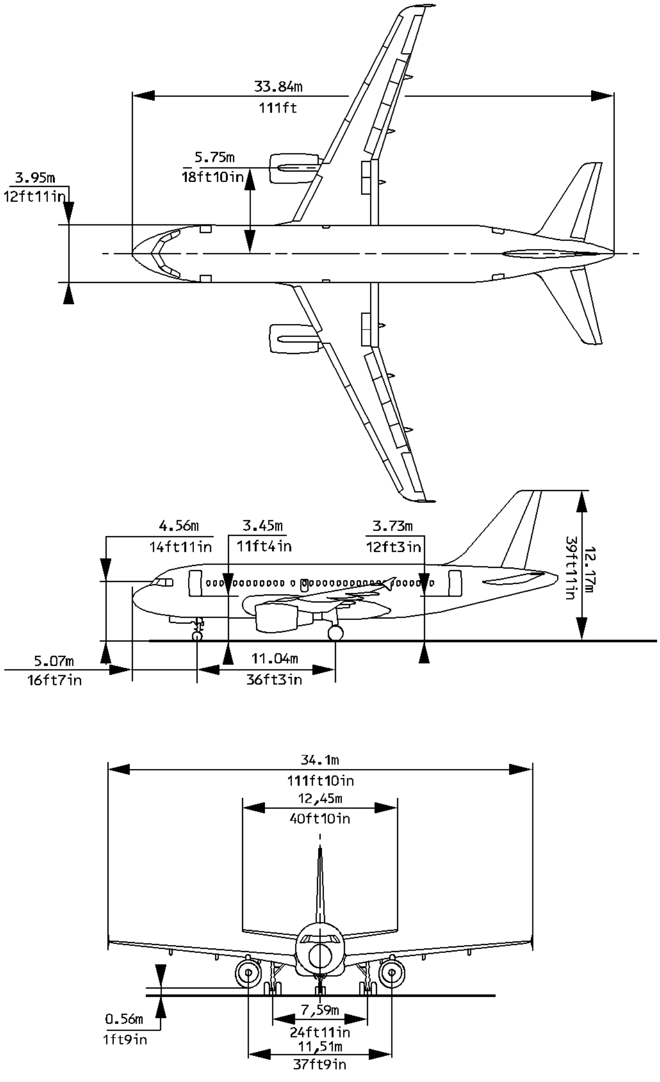
Two cargo compartments are under the cabin floor.

GENERAL ARRANGEMENT

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

PRINCIPAL DIMENSIONS

R



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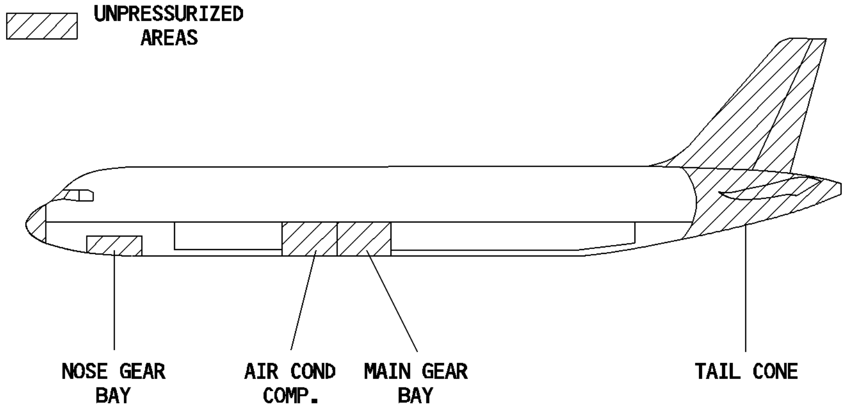
UNPRESSURIZED COMPARTMENTS



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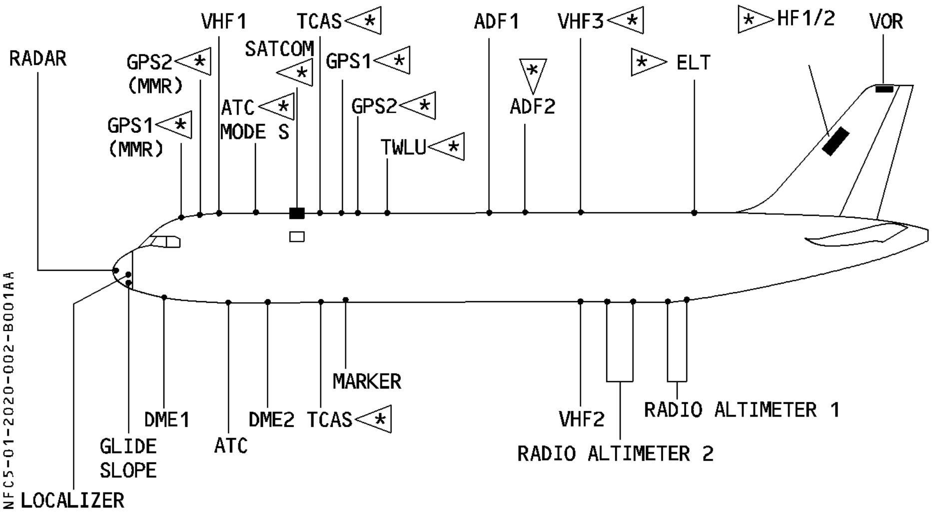
ANTENNA LOCATIONS

R



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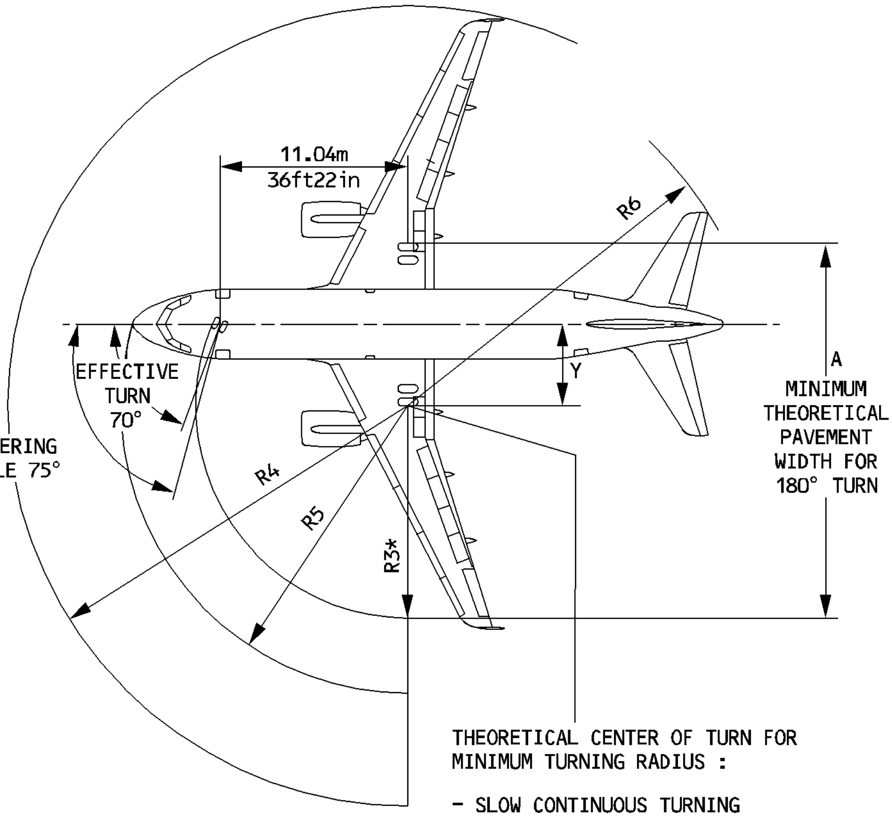
GROUND MANEUVERING

R MINIMUM TURNING RADIUS



THEORETICAL CENTER OF TURN FOR MINIMUM TURNING RADIUS :

- SLOW CONTINUOUS TURNING
- APPROXIMATELY IDLE THRUST ON ALL ENGINES
- NO DIFFERENTIAL BRAKING
- DRY SURFACE

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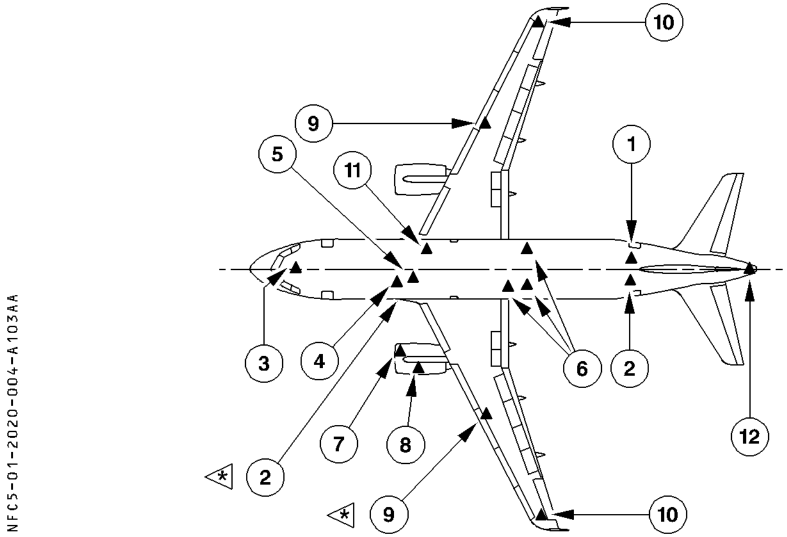
	Y	A	R3	R4	R5	R6
FT	13ft2in	67ft9in	39ft9in	70ft10in	54ft6in	64ft10in
M	4.01	20.64	12.11	21.58	16.6	19.77

* NOSE GEAR RADIUS (R3) MEASURED FROM OUTSIDE FACE OF TIRE

R **GROUND SERVICE CONNECTIONS AND PANELS**



(1) Toilet servicing

R (2) Water filling and/or draining

R (3) Electrical ground power receptacle

(4) LP ground air supply connectors

(5) HP ground air supply connectors

(6) Hydraulic

(7) IDG oil filling

(8) Engine oil filling

(9) Refueling/defueling

(10) Gravity filling panels

(11) Refueling/defueling panel

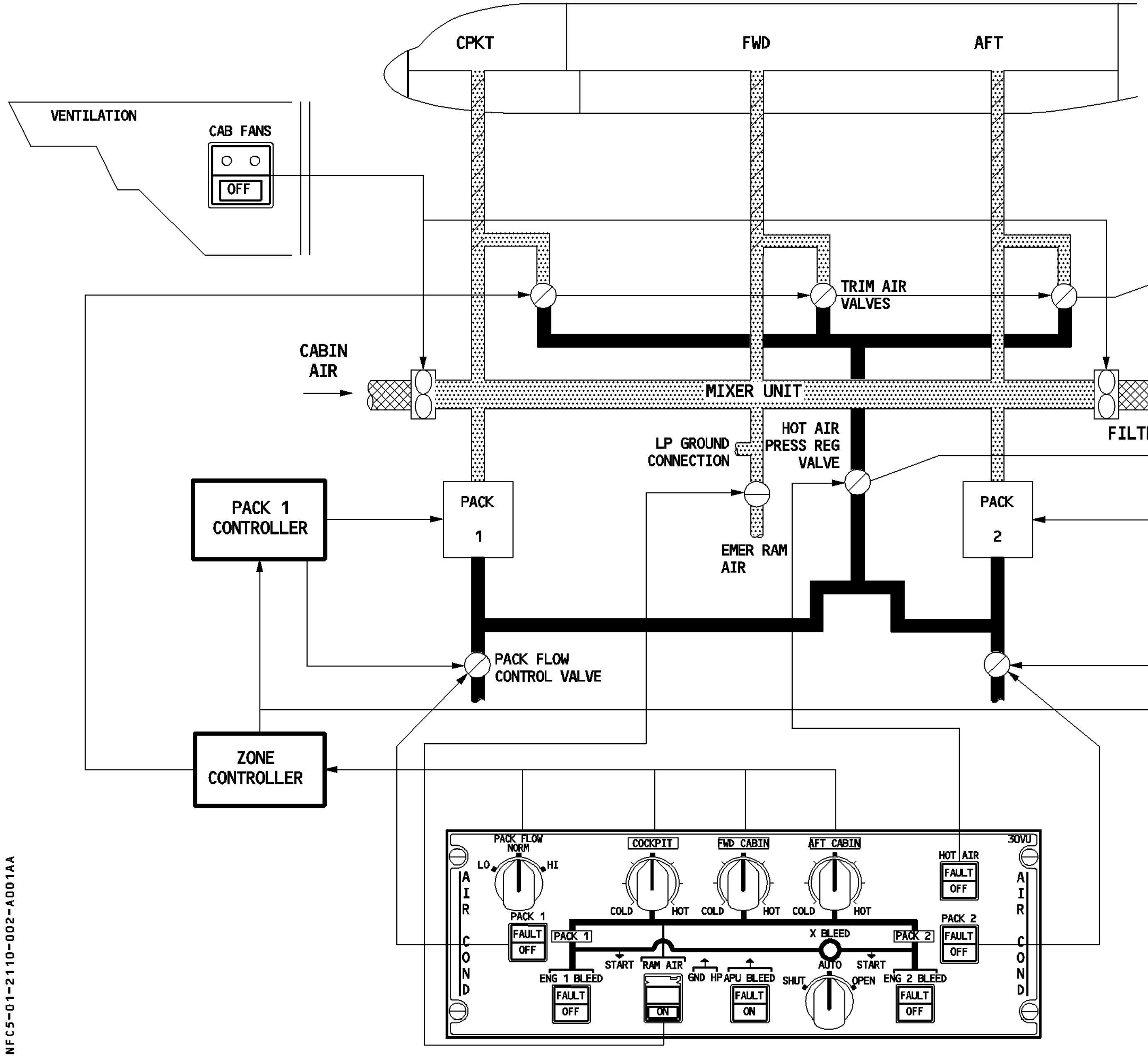
(12) APU oil filling

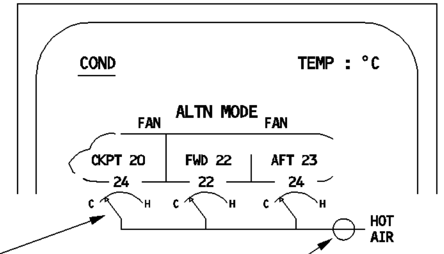
21.00 CONTENTS

GENERAL

The air conditioning system operation is fully automatic.
It provides a continual renewal of air and maintains a constant selected temperature in the three following zones : COCKPIT, FWD CABIN, AFT CABIN which are independently controlled.
The air is supplied by the pneumatic system, via :
- two pack flow control valves
- two packs
- the mixing unit, which mixes the air coming from the cabin and from the packs.

It is then distributed to the cockpit and the cabin.
The temperature regulation is optimized through the hot air pressure regulating valve and the trim air valves which add hot air tapped upstream of the packs to the mixing unit air.
In an emergency, a ram air inlet can provide ambient air to the mixing unit.
The temperature regulation is controlled by a zone controller and two pack controllers.
Flight deck and cabin temperature can be selected from the AIR COND panel in the cockpit.
Low pressure air is supplied to the mixing unit by a ground connection.





NOTE : AN OPTION ALSO PERMITS TO DISPLAY THE ABOVE TEMPERATURE IN °F

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MAIN COMPONENTS

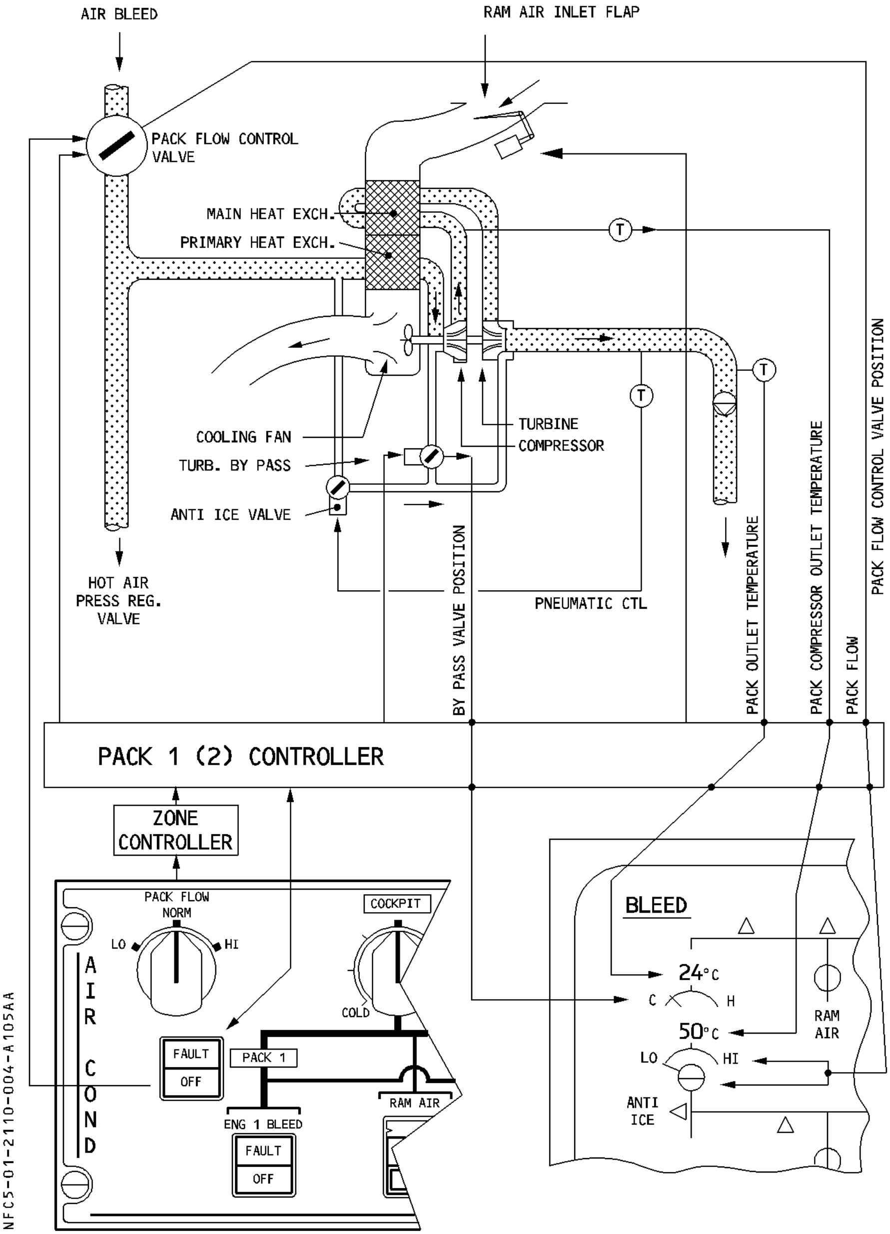
AIR CONDITIONING PACK

The two packs operate automatically and independently of each other. Pack operation is controlled by pack controller signals.
Warm pre-conditioned bleed air enters the cooling path via the pack valve and is ducted to the primary heat exchanger.
Then the cooled bleed air enters the compressor section of the air-cycle machine and is compressed to a higher pressure and temperature.
It is cooled again in the main heat exchanger and enters the turbine section, where it expands and in expanding generates power to drive the compressor and cooling air fan. The removal of energy during this process reduces the temperature of the air, resulting in very low air temperature at turbine discharge.

FOR INFO

A water separator system dries the air before it enters the turbine section.

PACK SCHEMATIC (SIMPLIFIED)



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.
The valve closes automatically in case of pack overheating, engine starting, or operation of the fire or ditching pushbutton.
The valve is controlled from the AIR COND panel.

RAM AIR

An emergency ram air inlet ventilates the cockpit and cabin to remove smoke, or if both packs fail.
The emergency ram air inlet valve is controlled by the RAM AIR pushbutton on the AIR COND panel.
This pushbutton opens the ram air valve, provided that ditching is not selected.
R When the RAM AIR pushbutton is ON : The outflow valve opens about 50 %, provided that
R it is under automatic control and ΔP is less than one psi. The outflow valve does not
R automatically open if it is under manual control, even if ΔP is less than one psi. If ΔP is
greater than one psi, the check valve located downstream the ram air door will not open, even if the ram air door has been selected 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.

HOT-AIR PRESSURE-REGULATING VALVES

This valve regulates the pressure of hot air, tapped upstream of the packs.
It is pneumatically-operated and electrically-controlled from the HOT AIR pushbutton on the AIR COND panel. In the absence of air, a spring keeps the valve closed.
The valve closes automatically, if :
- The duct overheats, or
- The cockpit trim air valve fails, or
- Both cabin trim air valves fail.

The hot-air pressure-regulating valve remains operative, even if either the forward or aft cabin trim air valve fails.

TRIM AIR VALVES

These valves are electrically-controlled by the zone controller. A trim air valve, associated with each zone, adjusts the temperature by adding hot air.

TEMPERATURE AND FLOW REGULATION

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

PACK CONTROLLER

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 and the ram air inlet flaps.
The ram air inlet flaps close during takeoff and landing to avoid ingestion of foreign matter.

Note : *During takeoff, the ram air inlet flaps close when TO. power is set and the main landing gear struts are compressed.*
During landing they close as soon as the main landing gear struts are compressed, as long as speed is at or above 70 knots.
They open 20 seconds after the speed drops below 70 knots.

The pack controllers also regulate flow by modulating the associated pack flow control valve.

ZONE CONTROLLER

PACK FLOW CONTROL

The crew can use the PACK FLOW selector to adjust the pack flow for the number of passengers and for external conditions.
Whatever the crew selects, the system delivers high flow for any of the following circumstances :
– in single-pack operation,
– when the APU is supplying bleed air.
The system delivers normal flow if the crew selects LO flow and the temperature demand cannot be satisfied.

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 Engine Interface Units (EIU) 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's Electronic Control Box (ECB) to increase the APU flow output when any zone temperature demand cannot be satisfied.

TEMPERATURE REGULATION

The zone controller regulates the temperature of the two cabin zones and the cockpit.

BASIC TEMPERATURE REGULATION

The flight crew uses the temperature selectors on the air conditioning panel in the cockpit to select the reference temperatures. The zone controller computes a temperature demand from the selected temperature and the actual temperature.
The actual temperature is measured by sensors :
– in the cockpit, for the cockpit zone
– in the 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 the temperature by action on the trim air valves.
The temperature selection range is from 18°C (64°F) to 30°C (86°F).

SYSTEM OPERATION UNDER FAILURE CONDITION

Each controller consists of a primary channel that is normally in control and a secondary channel that acts as a backup if the primary channel fails.

ZONE CONTROLLER

PRIMARY CHANNEL FAILURE

The secondary channel operates as backup.
The flow setting function and optimized temperature regulation are not available. HOT AIR and TRIM AIR valves close.
The zones are controlled to 24°C (76°F) (backup regulation). Pack 1 controls the cockpit temperature. Pack 2 controls the FWD and AFT cabin temperatures.
ALTN MODE appears on the ECAM (Electronic Centralized Aircraft Monitoring) COND page.

SECONDARY CHANNEL FAILURE

This has no effect on zone temperature regulation.
Backup mode is lost.

PRIMARY AND SECONDARY CHANNEL FAILURE

Optimized and backup temperature regulation is lost.
The packs deliver a fixed temperature : 20°C (68°F) for pack 1, 10°C (50°F) for pack 2. The
R failure removes all information from the ECAM COND page, which then displays PACK REG.

PACK CONTROLLERS

PRIMARY CHANNEL FAILURE

The secondary computer operates as a backup.
Regulation is not optimized.
Pack flow is fixed at the previous setting.

SECONDARY CHANNEL FAILURE

This failure has no effect on pack regulation. Backup mode is lost.
ECAM signals related to the corresponding pack are lost.

PRIMARY AND SECONDARY CHANNEL FAILURE

As a backup, corresponding pack outlet temperature is controlled by the anti-ice valve and is stabilized to a temperature between 5°C (41°F) and 30°C (86°F) in a maximum of 6 minutes.
ECAM signals, related to the corresponding pack, are lost.

AIR CYCLE MACHINE FAILURE

If the Air Cycle Machine (ACM) fails (compressor/turbine seizure), the affected pack may be operated in heat exchanger cooling mode.
Warm pre-conditioned bleed air enters the cooling path via the pack valve, and goes to the primary heat exchanger. Then, the main part of the cooled air goes directly downstream of the ACM turbine through the bypass valve, and the rest goes through the failed ACM.
The ACM seizure reduces the pack flow.
As for normal pack operation :
- The pack controller regulates temperature, in accordance with zone controller demand, by modulating the bypass valve and the ram air inlet flap.
- The zone controller regulates the hot air flow through the trim air valves to optimize cockpit/cabin temperature regulation. Hot air flow is lower than in normal pack operation, because pack flow is reduced.

HOT AIR PRESSURE REGULATING VALVE FAILURE

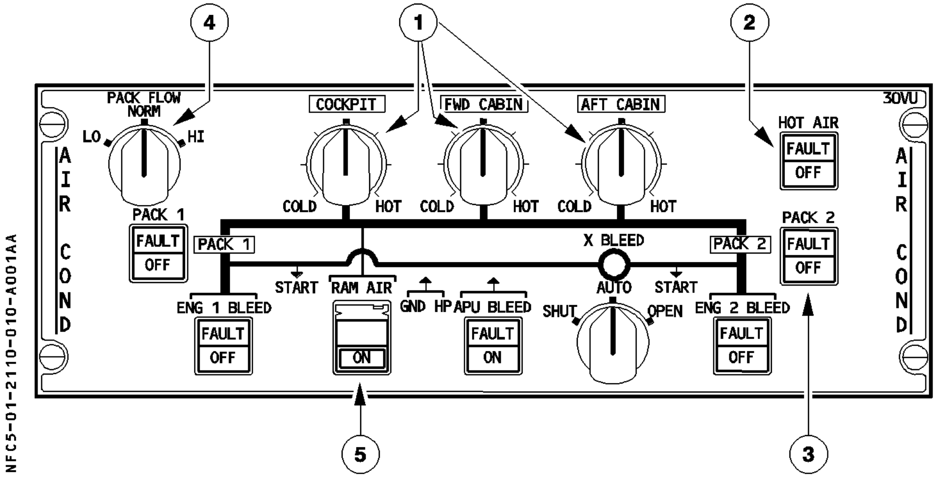
Failed open : No effect.
Failed closed : Optimized regulation is lost. Trim air valves are driven to the full closed position. Pack 1 controls the cockpit temperature to the selected value, and pack 2 controls the cabin temperature (FWD and AFT) to the mean value, of the selected temperatures.

TRIM AIR VALVE FAILURE

Optimized temperature regulation of the corresponding zone is lost.

CONTROLS AND INDICATORS

CONTROLS ON OVERHEAD PANEL



(1) Zone temperature sel

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

(2) HOT AIR pushbutton

On : The valve regulates hot air pressure.
OFF : The valve closes, and the trim air valves close.
The FAULT circuit is reset.
FAULT : The amber light, and associated ECAM caution come on when duct overheat is detected. The fault circuit detects an overheat when the duct
R temperature reaches 88°C (190°F).
The valve and the 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.

③ PACK pb

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. If the crossbleed valve is closed, the valve located on the starting engine side immediately closes, when the MODE selector is set to IGN (or CRK).
  2. It remains closed on the starting engine side (provided the crossbleed valve is closed) when :
     · The MASTER switch is set to ON (or the MAN START pushbutton is set to ON), and
     · The start valve is open, and
     · N2 < 50 %.

     Note : If the crossbleed valve is open at engine start, both pack flow control valves close.

  3. On ground, reopening of the valves is delayed for 30 seconds to avoid a supplementary pack closure cycle during second engine start.
- The fire pushbutton, of the engine on the related side, is pressed,
- Ditching is selected.

OFF : The pack flow control valve closes.

FAULT lt : Comes on amber, and a caution appears on the ECAM, if the pack flow control valve position disagrees with the selected position, or in the case of compressor outlet overheat or pack outlet overheat.

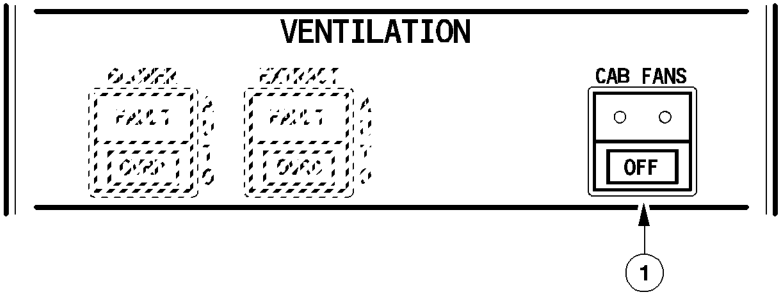
④ PACK FLOW sel

· Permits the selection of pack valve flow, according to the number of passengers and ambient conditions (smoke removal, hot or wet conditions).
LO (80 %) – NORM (100 %) – HI (120 %).
· Manual selection is irrelevant in single pack operation, or with APU bleed supply. In these cases, HI is automatically selected.
· If LO is selected, the pack flow can be automatically selected up to 100 % when the cooling demand cannot be satisfied.

(5) RAM AIR pb (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.
- If $\Delta p \geq 1$ psi : The outflow valve control remains normal. No emergency RAM air flows in.
R - If $\Delta p < 1$ psi : The outflow valve opens to about 50 % when under automatic
R control. It does not automatically open when it is under manual control.
R Emergency RAM airflow is directly supplied to the mixer unit.

Off : The RAM air inlet closes.

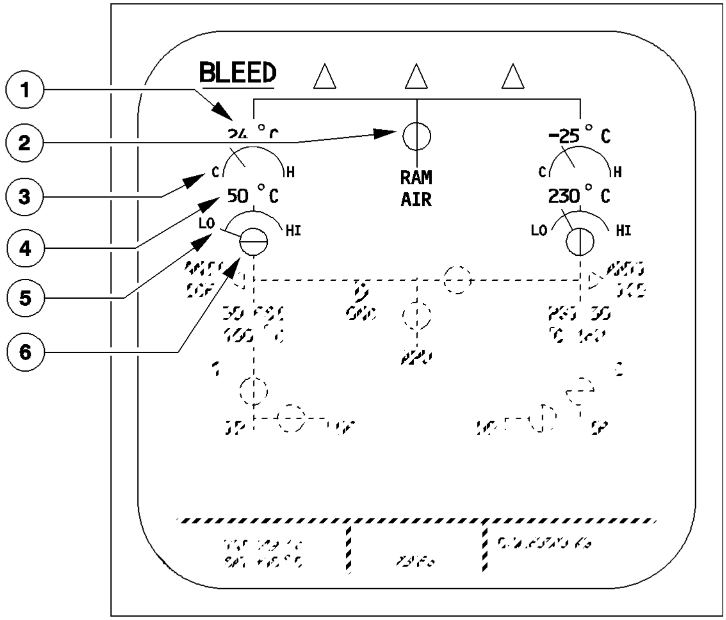


NFC5-01-2110-012-A001AA

(1) CAB FAN pushbutton

On : The two cabin fans are on.
OFF : The two cabin fans are off.

ECAM BLEED PAGE



NFC5-01-2110-013-A001AA

① Pack outlet temperature

Indication is green - Becomes amber if temperature above 90°C.

② RAM AIR inlet

⦶ Green : fully open in flight
⦶ Amber : fully open on ground
⊖ Green : fully closed
Amber : transit

③ Pack by pass valve position

Indication is green.
C = Cold – Valve closed
H = Hot – Valve open.

④ Pack compressor outlet temperature

Indication is green – Becomes amber if temperature above 230°C.

(5) Pack flow

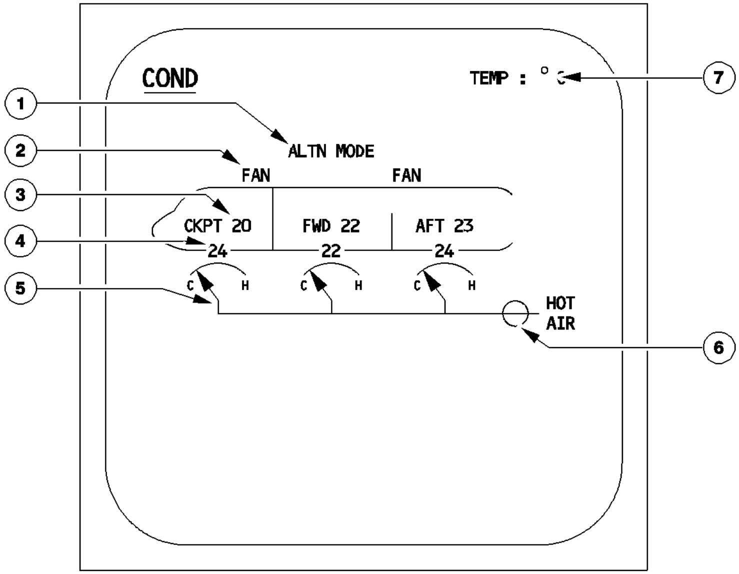
Indication is normally green. Becomes amber if pack flow control valve is closed.

Note : The pack flow indication can be up to 30 % below the actual flow rate.

(6) Pack flow control valve

⦶ Green : not closed.
⦶ Amber : not closed, disagree with control position.
⊖ Green : fully closed.
⊖ Amber : fully closed, disagree with control position.

ECAM COND PAGE



NFC5-01-2110-014-A001AA

(1) Zone controller fault indication

ALTN MODE : Primary zone controller fault (green).
PACK REG : Zone controller fault (basic regulation by packs only) (green).
No indication : Zone controller normal operation.

(2) Cabin FAN fault indication

Appears amber if fault detected.

③ Zone temperature indication

It is green.

④ Zone duct temperature

It is normally green, and becomes amber at 80°C (176°F).

⑤ Zone trim air valve position indication

It is normally green, and becomes amber, if the valve fails.
C = Cold valve is fully closed.
H = Hot valve is fully open.

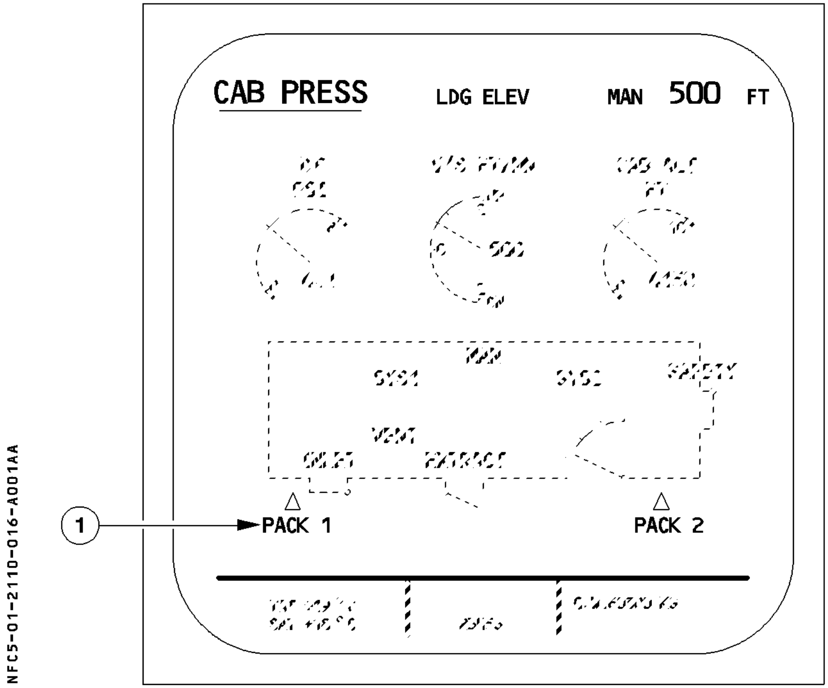
⑥ Hot air pressure regulating valve

R	In line	– Green	: The valve is open.
R	In line	– Amber	: The valve is not closed ; disagrees with the control position.
R	Crossline	– Green	: The valve is fully closed, and the pushbutton is at auto.
R	Crossline	– Amber	: The valve is closed, and pushbutton is OFF, or the valve
R			disagree is closed.

⑦ TEMP

R Unit of measure (°C or °F) is indicated in cyan.

ECAM CAB PRESS PAGE

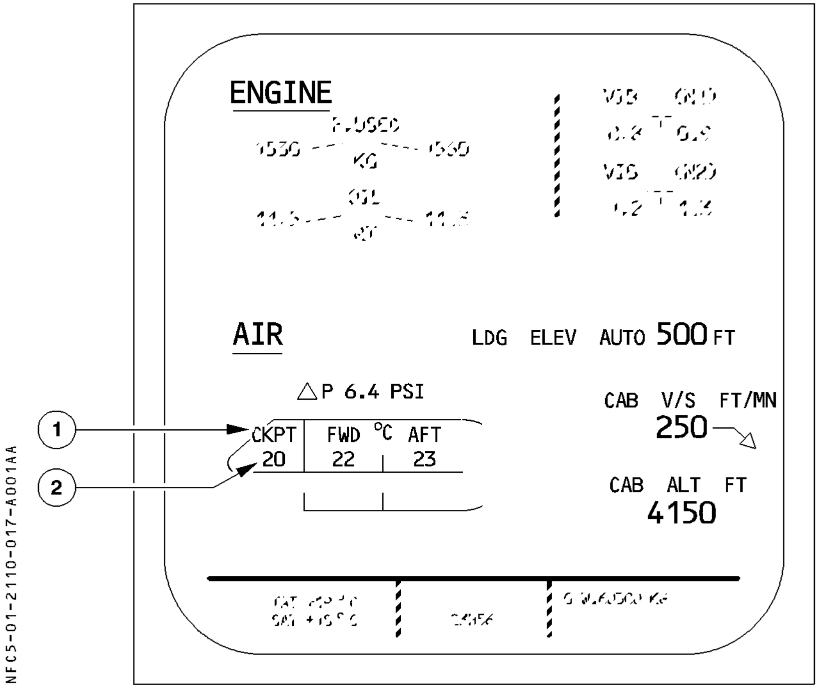


① PACK indication

Triangle normally green, PACK 1(2) indication normally white. Both become amber when pack flow control valve is closed with associated engine running.

ECAM CRUISE PAGE

R

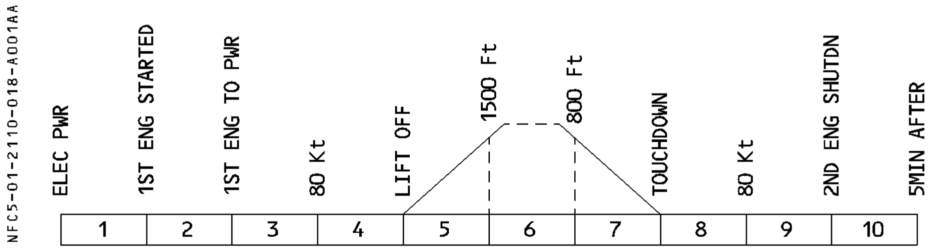


① Zone indication

This field also displays the temperature scale in use (°C or °F).

② Zone temperature

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E/WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>PACK 1 (or 2) OVHT
Pack compressor outlet temperature above 260°C, or pack outlet temp above 95°C.</td><td rowspan="7">SINGLE CHIME</td><td rowspan="7">MASTER CAUT</td><td rowspan="4">BLEED</td><td rowspan="3">PACK FAULT lt</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>PACK 1 (or 2) FAULT
Pack valve disagree with selected position, or Pack compressor outlet temperature above 230°C four times during one flight.</td></tr>
<tr><td>PACK 1 + 2 FAULT
One pack off, then the other fault</td></tr>
<tr><td>PACK 1 (2) OFF
Pack pb at off with no failure</td><td>NIL</td><td>1, 2, 3, 4, 5, 7 8, 9, 10</td></tr>
<tr><td>CKPT (FWD CAB OR AFT CAB) DUCT OVHT
Duct temperature above 88°C.</td><td rowspan="3">COND</td><td rowspan="2">HOT AIR FAULT lt</td><td rowspan="5">3, 4, 5, 7, 8</td></tr>
<tr><td>HOT AIR FAULT
Hot air pressure regulating valve disagrees with selected position</td></tr>
<tr><td>L + R CAB FAN FAULT
Both fan failure</td><td rowspan="5">NIL</td></tr>
<tr><td>PACK 1(2) REGUL FAULT
Pack main channel, or pack main and secondary channels failed.</td><td rowspan="4">NIL</td><td rowspan="4">NIL</td><td>BLEED</td></tr>
<tr><td>ZONE REGUL FAULT
Zone controller main channel, or main and secondary channels failed.</td><td>COND</td></tr>
<tr><td>LAV + GALLEY FAN FAULT</td><td rowspan="2">NIL</td><td>3, 4, 5, 7, 8, 9</td></tr>
<tr><td>TRIM AIR SYS FAULT
One trim air valve fault, or overpressure downstream hot air valve.</td><td>3, 4, 5, 7, 8</td></tr>
</table>

MEMO DISPLAY

RAM AIR ON appears in green if the ram air pushbutton switch is ON.

GENERAL

The cabin pressurization system has four general functions :
- Ground function : Fully opens the outflow valve on ground.
- Prepressurization : During takeoff, increases cabin pressure to avoid a surge in cabin pressure during rotation.
- Pressurization in flight : Adjusts cabin altitude, and rate of change to provide passengers with a comfortable flight.
- Depressurization : After touchdown, gradually releases residual cabin overpressure before the ground function fully opens the outflow valve.

The system consists of :
- Two Cabin Pressure Controllers (CPC)
- One outflow valve, with an actuator that incorporates three motors (two for automatic operation, one for manual operation)
- One control panel
- Two safety valves

Any one of the three independent electric motors may power the outflow valve.
Normally, one of the two cabin pressure controllers operates the outflow valve 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 valve 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.

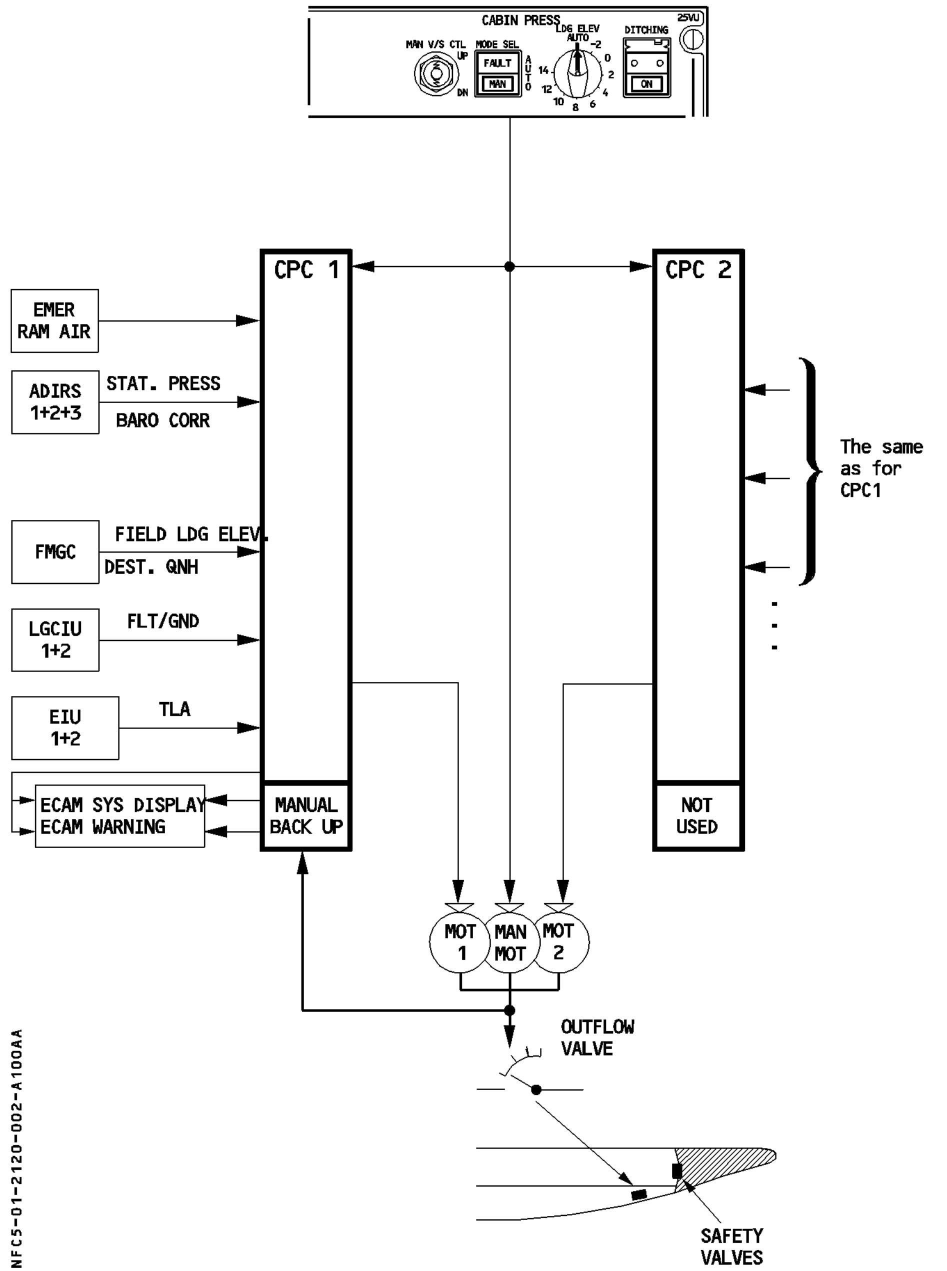
AUTOMATIC OPERATION

The flight crew monitors the operation of the system, 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
R 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.

SCHEMATICS



CABIN PRESS
25VU
MAN V/S CTL
UP
DN
MODE SEL
FAULT
MAN
AUTO
LDG ELEV
AUTO
-2
0
2
4
6
8
10
12
14
DITCHING
ON
CPC 1
CPC 2
EMER
RAM AIR
ADIRS
1+2+3
STAT. PRESS
BARO CORR
FMGC
FIELD LDG ELEV.
DEST. QNH
LGCIU
1+2
FLT/GND
EIU
1+2
TLA
ECAM SYS DISPLAY
ECAM WARNING
MANUAL
BACK UP
NOT
USED
The same
as for
CPC1
MOT
1
MAN
MOT
MOT
2
OUTFLOW
VALVE
SAFETY
VALVES
NFC5-01-2120-002-A100AA

MAIN COMPONENTS

CABIN PRESSURE CONTROLLERS

Two identical, independent, digital controllers automatically control the system, by maintaining 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), and the Landing Gear Control Interface Unit (LGCIU).
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 VALVE

The outflow valve is on the right-hand side of fuselage, behind the aft cargo compartment and below the flotation line.
The 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 the two automatic motors and 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.

<u>Note</u> : *When the RAM AIR pushbutton is ON, and Δp is below 1 psi, the system drives the*
R *outflow valve about 50 % open if it is under automatic control. If the system is under*
R *manual control, the outflow valve does not automatically open, even if Δp is below*
R *1 psi.*

SAFETY VALVES

Two independent pneumatic safety valves prevent cabin pressure from going too high (8.6 psi above ambient) or too low (0.25 psi below ambient).
They are located on the rear pressure bulkhead, above the flotation line.

SYSTEM OPERATION

AUTOMATIC PRESSURE CONTROL MODE

– Two identical, independent, automatic systems (each consisting of a controller and its associated motors) control cabin pressure.
  Either system controls the single outflow valve.
  Only one controller operates at a time.
  An automatic transfer occurs :
  · 70 seconds after each landing.
  · If the operating system fails.
– The controller automatically controls the cabin pressure. It limits the cabin pressure to 8000 feet maximum and optimizes it during climb and descent phases.
– The controller normally uses the landing elevation and the QNH from the FMGC, and the pressure altitude from ADIRS.
  If FMGC data are not available, the controller uses the captain Baro Reference from the ADIRS and the LDG ELEV selection.
– Pressurization is assumed through the following modes :

Ground (GN)

Before takeoff, and 55 seconds after landing, the outflow valve fully opens to ensure there is no residual cabin pressure.
At touchdown, any remaining cabin pressure is released at a cabin vertical speed of 500 feet/minute.

Takeoff (TO)

To avoid a pressure surge at rotation, the controller prepressurizes the aircraft at a rate of 500 feet/minute, until the ΔP reaches 0.1 psi.
At liftoff, the controller initiates the climb phase.

Climb (CL)

During climb, the cabin altitude varies according to a fixed preprogrammed law that takes into account the aircraft's actual rate of climb.

Cruise (CR)

During cruise, the controller maintains cabin altitude at level-off value, or the landing field elevation, whichever is higher.

Descent (DE)

During descent, the controller maintains a cabin rate of descent such that cabin pressure reaches landing field pressure just before the landing.
The maximum descent rate is 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.

PRESSURIZATION MODES SWITCHING

FOR INFO

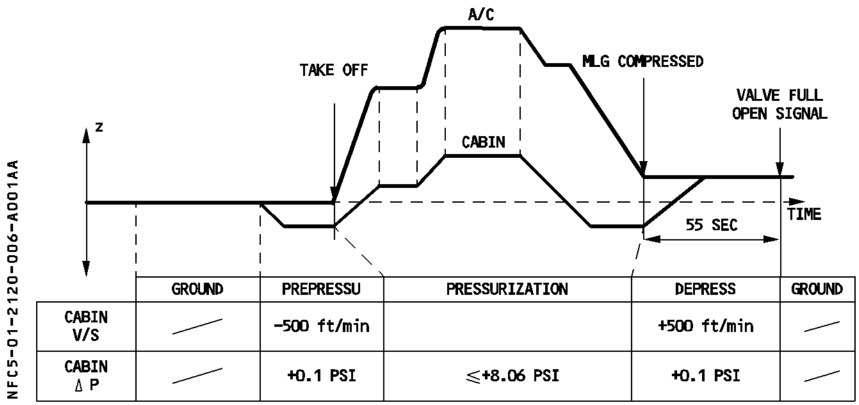
	FROM	GN	TO	GN	CL	AB	TO	CL	CR	CR	DE	DE	AB
	TO	TO	CL	CL	AB	GN	GN	CR	CL	DE	CL	GN	CL
CONDITIONS	ENG 1 and ENG 2 TLA ≥ MCT (*)	1					0						
	L/G sys 1 or sys 2 COMPRESSED	1					1						
	One L/G sys UNLOADED and A/C speed above 100 kt		1	1									
	One L/G sys COMPRESSED and A/C speed below 100 kt					1						1	
	A/C ALT. < 8000 FT				1A								
	A/C ALT. ≥ 8000 FT							1					
	A/C ALT. CHANGE SINCE T/O ≤ 5075 SLFT				1A								
	A/C ALT. CHANGE SINCE T/O ≥ 5075 SLFT							1					
	A/C RATE OF CLIMB ≥ 21 SL FPM FOR 60 SEC.										1		1
	A/C RATE OF CLIMB ≥ 100 SL FPM FOR 30 SEC.							0	1				
	A/C RATE OF DESCENT ≥ 200 SL FPM FOR 30 SEC.				1								
	A/C RATE OF DESCENT ≥ 250 SL FPM FOR 30 SEC									1			

0 : Condition not valid
1 : Condition valid
1A : Only one A condition necessary
(*) : Engine running

Example

The cabin pressure controller switches from CL (climb) mode to AB (abort) mode when:
- the aircraft is below 8000 feet, or the aircraft has changed altitude less than 5075 feet since takeoff and,
- the aircraft rate of descent is greater than 200 feet/minute for 30 seconds.

PRESSURIZATION FLIGHT PROFILE



MANUAL PRESSURE CONTROL MODE

If both automatic systems fail, the flight crew may use the CABIN PRESS control panel to take over manual control of cabin pressurization.
· Press the MODE SEL pushbutton to select MAN, and
· Push the MAN V/S CTL switch UP or DN to increase or decrease cabin altitude.
The first of these actions cuts off power to the AUTO motors, and enables the MAN motor to control the outflow valve.

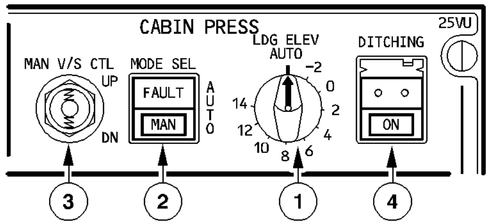
Note : 1. *Due to the slow operation of the outflow valves in manual mode, and the limited resolution of the outflow valves' position on the ECAM, the visual ECAM indication of a change in the outflow valves' position can take up to 5 seconds.*
2. *As the pressurization system is manually-controlled, the outflow valve does not open automatically 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 valve, the emergency ram air inlet, the avionics
R ventilation inlet and extract valves, and the pack flow control valves.

CONTROLS AND INDICATORS

OVERHEAD PANEL



NFC5-01-2120-008-A100AA

(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 ;*
R *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 valve.

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 10 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 outflow valve.

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

Note : The pilot may notice a variation in the CAB ALT indication on the ECAM PRESS page, when the system switches from the cabin
R *pressure control AUTO mode to MAN mode, due to the reduced*
R *resolution of the backup pressure sensor.*

③ MAN V/S CTL toggle switch

The switch, springloaded to neutral, controls the outflow valve position through operation of the MAN motor, when the MODE SEL pushbutton is in the MAN position.
UP : The valve moves towards the open position.
DN : The valve moves towards the closed position.

Note : The outflow valve operates slowly, so the pilot must hold the toggle switch in the UP or DN position until reaching the target V/S.

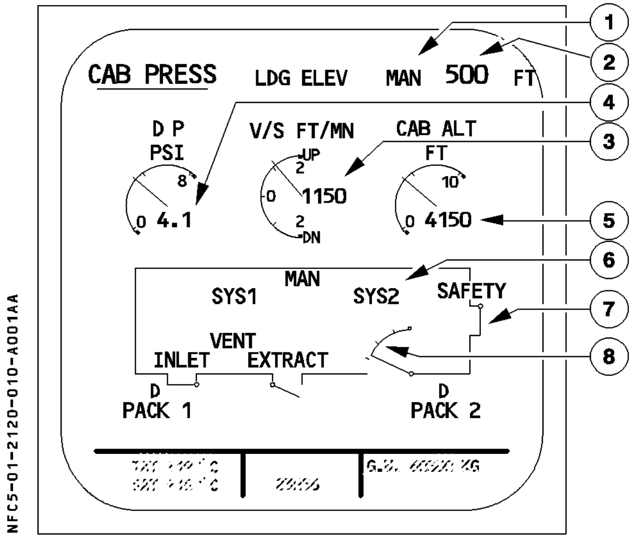
④ DITCHING guarded pushbutton

Normal : The system functions normally.
ON : The operating system sends a "close" signal to the outflow valve, emergency ram air inlet, avionics ventilation inlet and extract valves, and
R pack flow control valves.

Note : The outflow valve will not close automatically, if it is under manual control.

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

ECAM CAB PRESS PAGE



① LDG ELEV AUTO/MAN

– LDG ELEV AUTO appears in green when the LDG ELEV selector is in AUTO.
– LDG ELEV MAN appears in green when the LDG ELEV selector is not in AUTO.
R – Neither appears when the MODE SEL pushbutton switch is in MAN.

② Landing elevation

The landing elevation selected either automatically by the FMGS or manually by the pilot
R appears in green (but not when the MODE SEL pushbutton switch is in MAN).

③ V/S FT/MIN (cabin vertical speed)

The analog and digital presentations appear in green when V/S is in the normal range. They appear in amber when V/S ≥ 2000 feet/minute.
The digital presentation pulses when V/S > 1800 feet/minute (resets at 1600 feet/minute).

4 △P PSI (cabin differential pressure)

The analog and digital presentations appear in green when △P is in the normal range.
R They appear in amber when $\Delta P \leq -0.4$ psi or ≥ 8.5 psi.
The digital presentation pulses if $\Delta p > 1.5$ psi (resets at 1 psi) during flight phase 7. (See page 14 to identify flight phases).

5 CAB ALT FT (cabin altitude)

The analog and digital presentations appear in green, in normal range.
They appear in red if the cabin altitude goes above 9550 feet.
The digital presentation pulses if the cabin altitude is at or above 8800 feet (resets at 8600 feet).

6 Active system indication (SYS 1 or SYS 2 or MAN)

SYS 1 or SYS 2 appears in green when active and in amber when faulty. When either system is inactive, its title does not appear.
MAN appears in green when the MODE SEL switch is in MAN.

7 Safety valve position

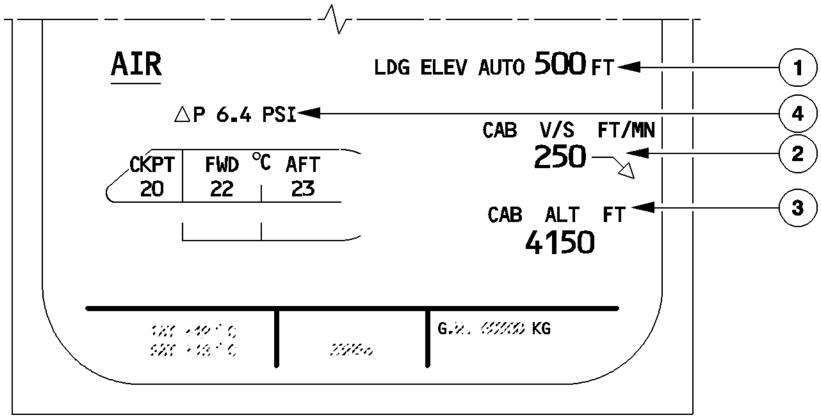
SAFETY appears in white and the diagram in green when both safety valves are fully closed. SAFETY and the diagram appear in amber when either valve is not closed.

Note : *The safety valve opens when the cabin differential pressure is between 8.2 and 8.9 psi. The range is due to the reduced accuracy of △P measurements (in MAN mode), combined with the decrease in cabin differential pressure that occurs immediately after the safety valves open.*

8 Outflow valve position

The diagram is green when the valve is operating normally.
The diagram becomes amber when the valve opens more than 95 % during flight.

ECAM CRUISE PAGE



NFC5-01-2120-012-A001AA

① LDG ELEV AUTO/MAN

Identifical to CAB PRESS page

R ② CAB V/S FT/MIN (cabin vertical speed)

Green, in normal range.
Amber, when out of normal range : V/S ≥ 2000 feet/minute
R Pulses when V/S > 1800 feet/minute (resets at 1600 feet/minute)

NFC5-01-2120-012-B001AA

R ③ CAB ALT FT (cabin altitude)

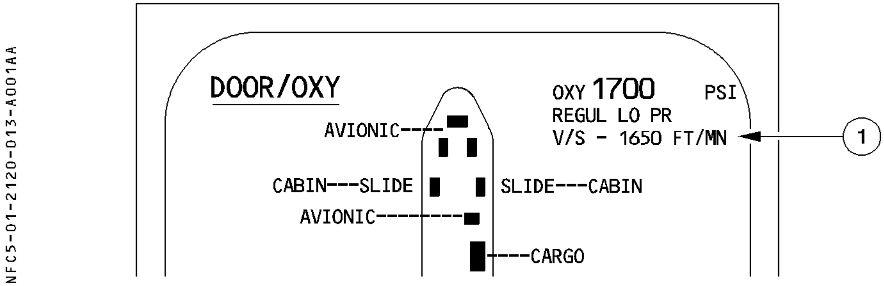
Green, in normal range.
Red, for excessive cabin altitude : ≥ 9550 feet.
R Pulses for cabin altitude at or above 8800 feet (resets at 8 600 feet)

④ △P indication

Normally green.
Amber when out of normal range △p ≤ – 0.4 psi or ≥ 8.5 psi.

ECAM DOOR PAGE

R

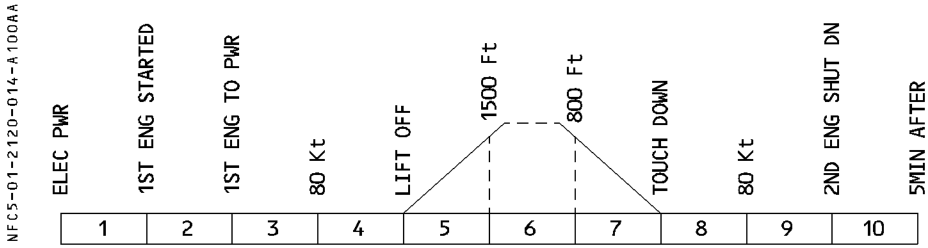


(1) V/S (cabin vertical speed)

This number only appears during flight phases 5, 6 and 7. (See page 14 for flight phase definitions).

- It is normally green.
- It becomes amber when the V/S is greater than 2000 feet/minute, or less than – 2000 feet/minute.

WARNINGS AND CAUTIONS



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 and DES the higher of : 9550 ft or landing field elevation plus 1000 ft – in CRZ 9550 ft	CRC	MASTER WARN	CAB PRESS	NIL	2, 3, 4 5, 7, 8 9, 10
SYS 1 + 2 FAULT Both pressure controllers fault	SINGLE CHIME	MASTER CAUT	CAB PRESS	MODE SEL FAULT lt	4, 5, 7, 8
LO DIFF PR Time to reach ΔP = 0 < 1.5 minutes and time to reach ΔP = 0 ≤ (time for cab alt to reach landing elevation) + 30 seconds and aircraft is at least 3000 ft above landing field. Note : The warning is maintained when aircraft descends below 3000 ft above landing field.	SINGLE CHIME	MASTER CAUT	CAB PRESS	NIL	2, 3, 4 5, 7, 8 9, 10
OUTFLOW VALVE NOT OPEN Valve not fully open on ground (time delay 3 minutes)	SINGLE CHIME	MASTER CAUT	CAB PRESS	NIL	3, 4, 5 6, 7, 8
SAFETY VALVE OPEN Either safety valve not fully closed on ground or not fully closed for more than 1 minute in flight.	SINGLE CHIME	MASTER CAUT	CAB PRESS	NIL	4, 5, 7 8, 9, 10
LDG ELEV FAULT No FMGS LDG ELEV data available	SINGLE CHIME	MASTER CAUT	CAB PRESS	NIL	1, 3, 4 5, 7, 8 9, 10
SYS 1 (or 2) FAULT Pressure controller fault	NIL	NIL	CAB PRESS	NIL	3, 4, 5 7, 8

MEMO DISPLAY

MAN LDG ELEV message is displayed in green if LDG ELEV selector is not in the AUTO position.

GENERAL

The ventilation system includes ventilation for :
- the avionics, controlled by the avionics equipment ventilation controller (AEVC),
- the battery,
- the lavatories and galleys.

Note : For a discussion of cargo ventilation, see 1.21.40.

AVIONICS VENTILATION

GENERAL

The avionics ventilation system is fully automatic.
It cools the electrical and electronic components in the avionics compartment and on the flight deck, including the instrument and circuit breaker panels. It uses two electric fans to force the circulation of cooling air.
Whatever the configuration of the avionics ventilation system is, a part of the avionics ventilation air is sucked from the cockpit through the different cockpit panels.

MAIN COMPONENTS

FANS

Two electric fans operate continuously as long as the aircraft electrical system is supplied. They make the air circulate around the avionics equipment.

SKIN AIR INLET AND EXTRACT VALVES

These valves admit air from outside the aircraft and evacuate hot air from inside the aircraft.

SKIN EXCHANGE INLET AND OUTLET BYPASS VALVES

These valves permit air to circulate between the avionics bay and the space under the cargo compartment floor.

AIR CONDITIONING INLET VALVE

This valve opens to permit the air conditioning circuit to supply fresh air to the avionics bay.

SKIN EXCHANGE ISOLATION VALVE

This valve connects or isolates the skin heat exchanger.

AVIONICS EQUIPMENT VENTILATION COMPUTER (AEVC)

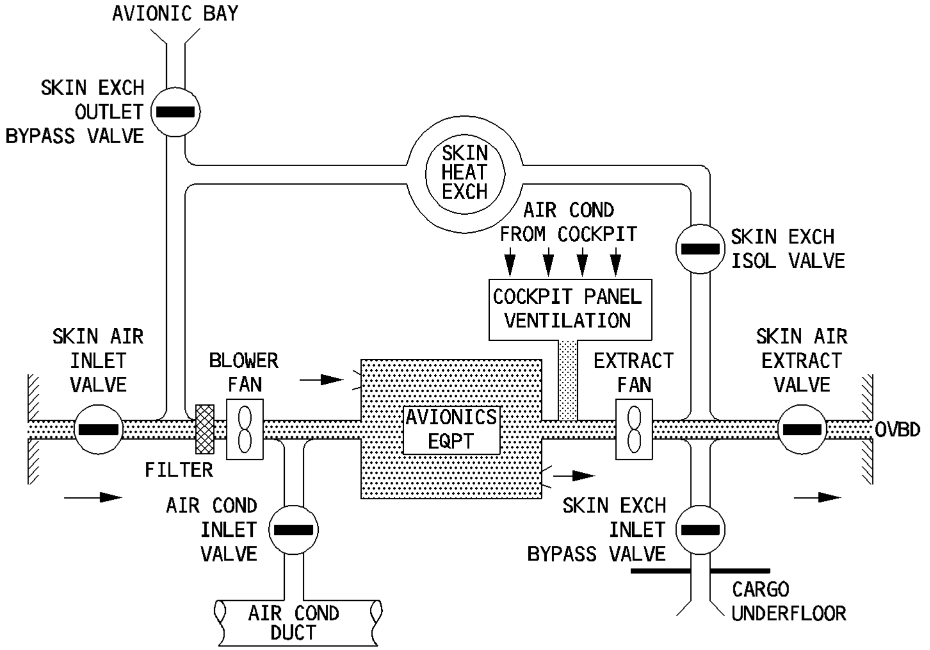
The AEVC controls the operation of all fans and valves in the avionics ventilation system.

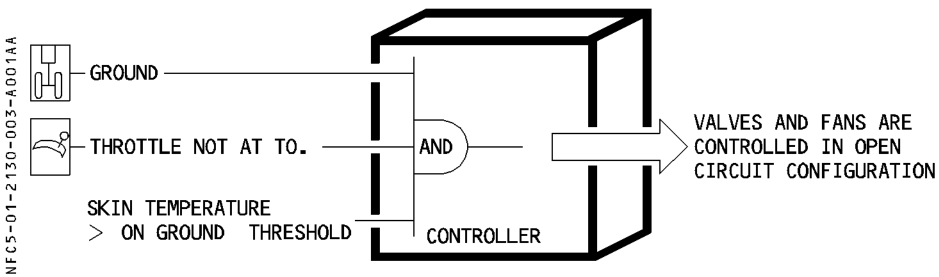
NORMAL OPERATION, OPEN-CIRCUIT CONFIGURATION

GROUND OPERATIONS

The open-circuit configuration operates when skin temperature is above the on-ground threshold.

On-ground threshold = + 12°C (53°F), temperature increasing, or
= + 9°C (48°F), temperature decreasing.





NORMAL OPERATION, CLOSE-CIRCUIT CONFIGURATION

Flight operations

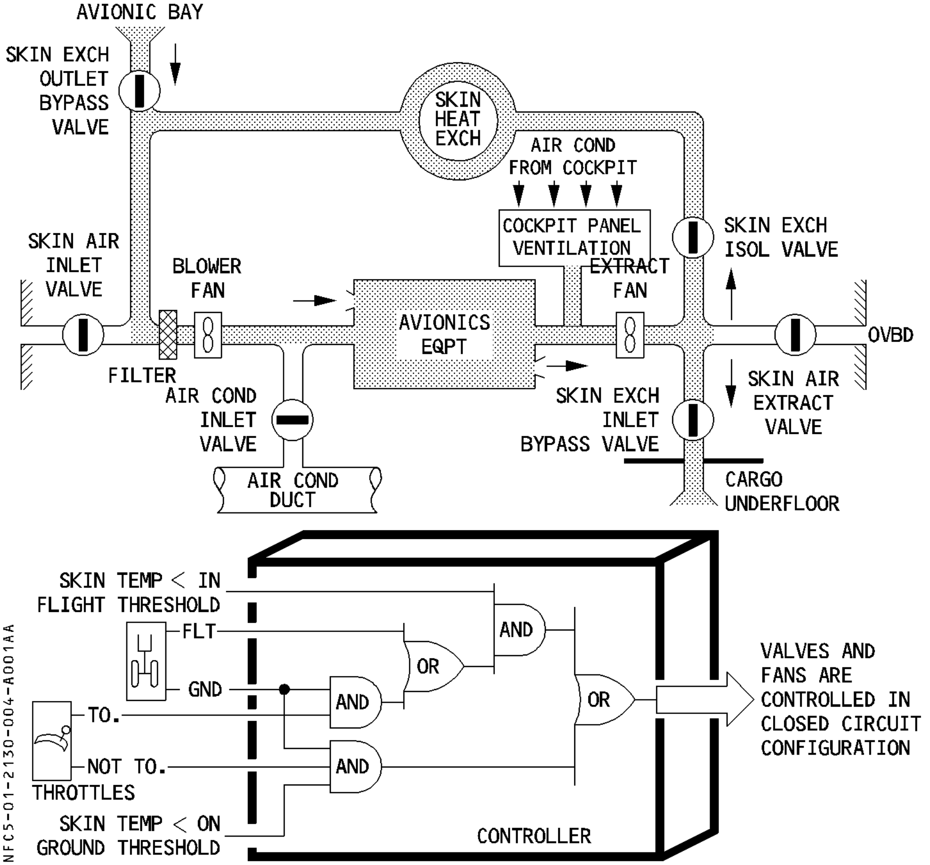
The close-circuit configuration operates when skin temperature is beneath the in-flight threshold.

In flight threshold = + 35°C (95°F), temperature increasing, or
= + 32°C (90°F), temperature decreasing.

Ground operations

The close-circuit configuration operates when skin temperature is beneath the on-ground threshold.

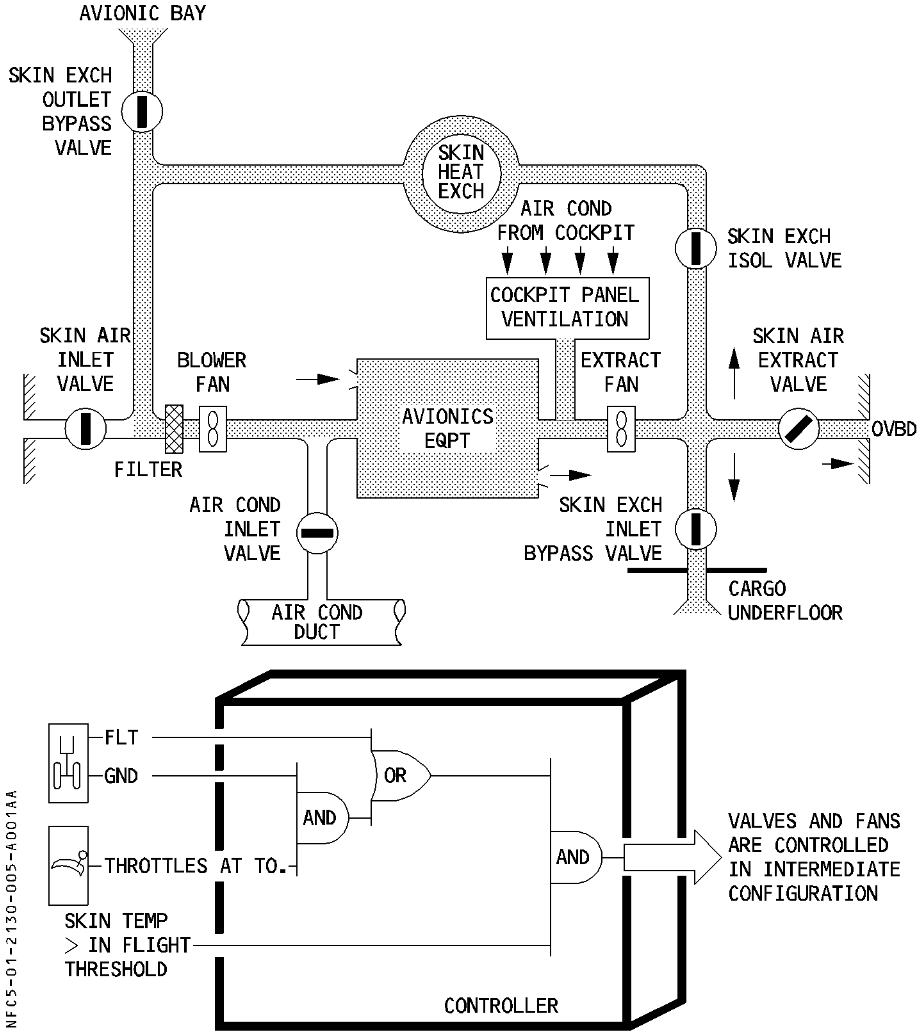
On ground threshold = + 12°C (53°F), temperature increasing, or
= + 9°C (48°F), temperature decreasing.



NORMAL OPERATION, INTERMEDIATE CONFIGURATION

Flight operations

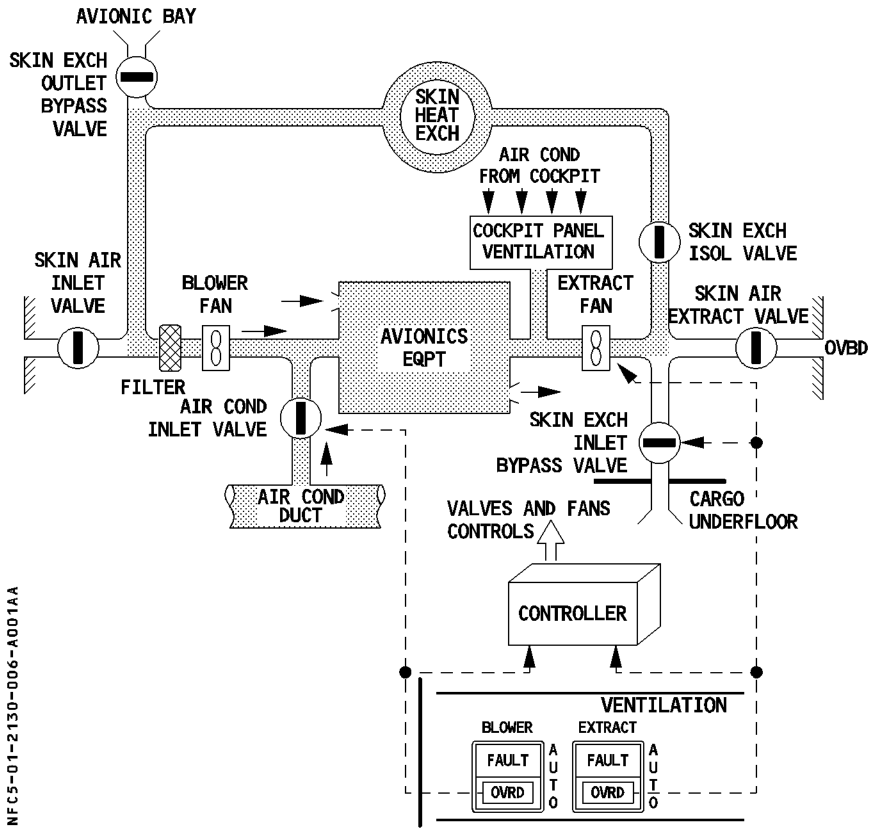
The intermediate configuration operates when skin temperature is above the in-flight threshold.
In flight threshold = + 35°C (95°F), temperature increasing, or
= + 32°C (90°F), temperature decreasing.



ABNORMAL OPERATION

BLOWER FAULT or EXTRACT FAULT warning

When the BLOWER or the EXTRACT pushbutton switch is set at the OVRD (override) position, the system is in closed-circuit configuration and adds air from the air conditioning system to the ventilation air.



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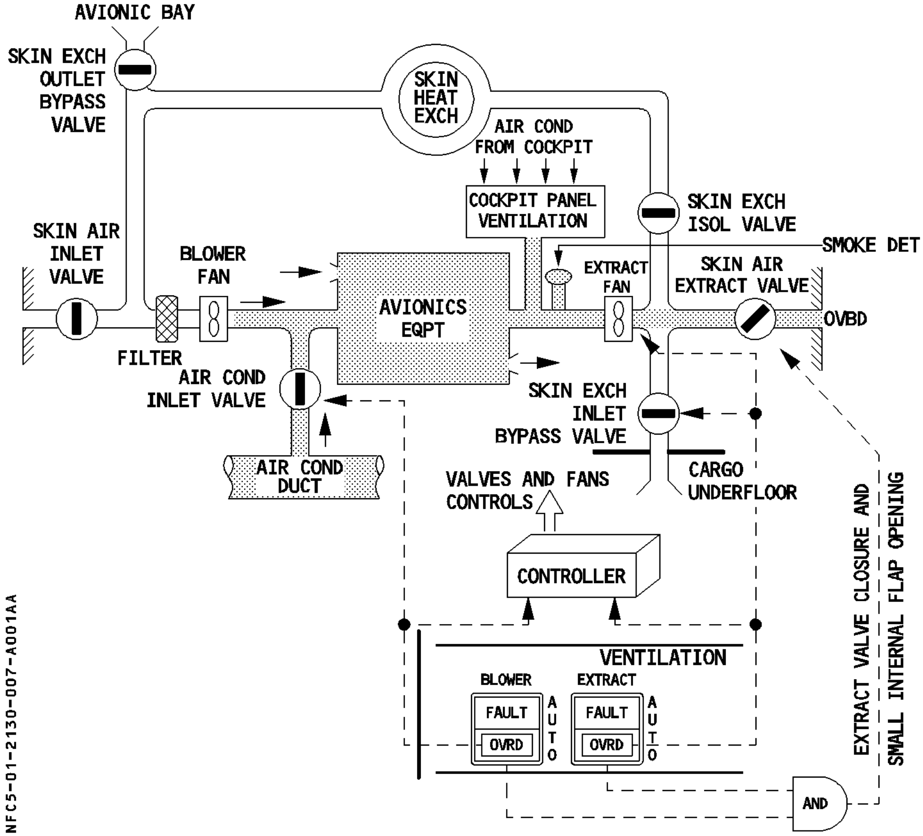
When the BLOWER pushbutton switch is set at OVRD, the blower fan is stopped and the extract fan continues to run.
When the EXTRACT pushbutton switch is set at OVRD, the extract fan is controlled directly from the pushbutton. Both fans continue to run.

Smoke configuration

When the smoke detector detects smoke in the avionics ventilation air the BLOWER and the EXTRACT FAULT lights come on.
When both the BLOWER and the EXTRACT pushbuttons are set to the OVRD position, the air conditioning system supplies cooling air, which is then exhausted overboard. The blower fan stops.



Controller failure

The system goes to the same configuration as above, except that the skin exchange isolation valve stays open.
The inlet valve and the skin exchange inlet bypass valve remain in the position they were in before the failure occurred.
The extract fan keeps running.

AVIONICS GROUND COOLING

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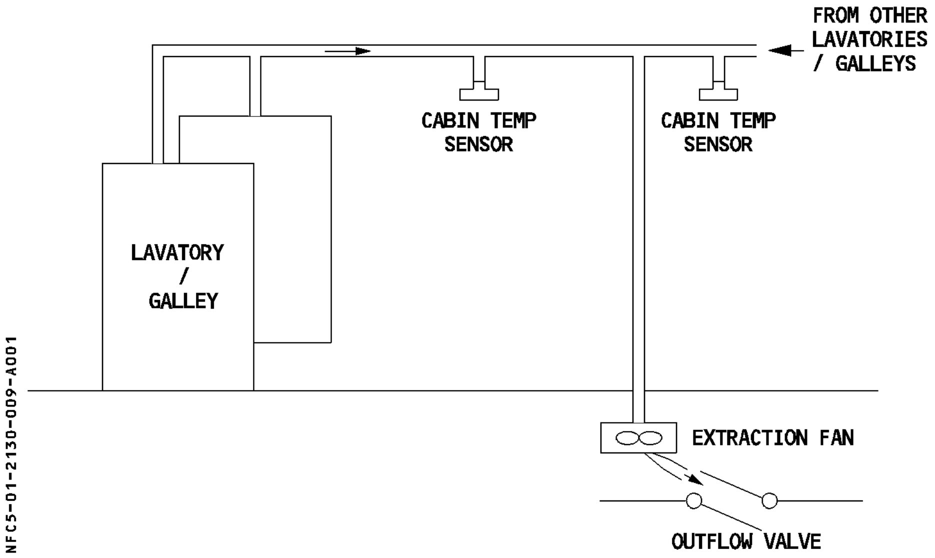
BATTERY VENTILATION

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.

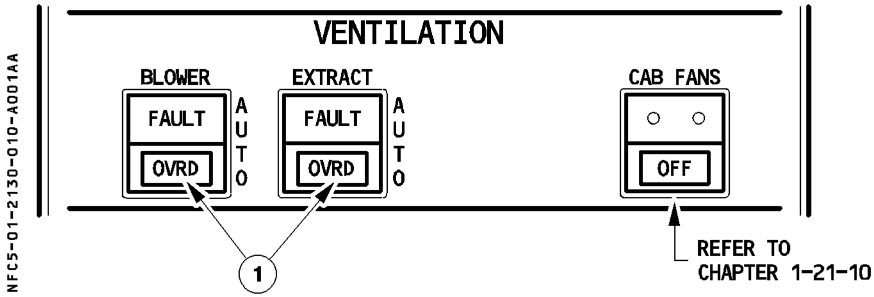
LAVATORY AND GALLEY

An extraction fan draws ambient cabin air through the lavatories and galleys and exhausts it near the outflow valve.
The extraction fan runs continually when electric power is available.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) BLOWER and EXTRACT pb sw

AUTO : When both pushbutton switches are on AUTO :
- On the ground before the application of TO power, the ventilation system is in open circuit configuration (closed configuration when the skin temperature is below the ground threshold).
- On the ground after the application of TO power, and in flight, the ventilation system is in closed circuit configuration.

OVRD : When either pushbutton switch is on OVRD :
- The system goes to closed circuit configuration.
- Air from the air conditioning system is added to ventilation air. (The blower fan stops if the BLOWER pushbutton switch is in the OVRD position).

When both pushbutton switches are on OVRD :
- Air flows from the air conditioning system and then overboard.
- The extract fan continues to run.

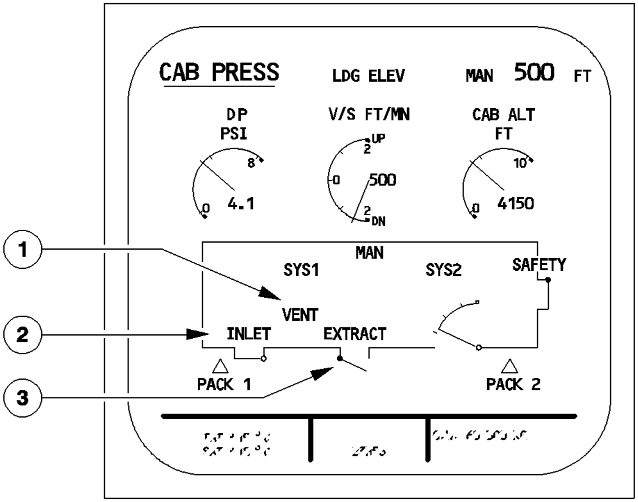
FAULT lt : Lights up amber (and ECAM activates)

in the blower switch, if :
- blowing pressure is low*
- duct overheats*
- computer power supply fails
- smoke warning is activated

in the extract switch, if :
- extract pressure is low*
- computer power supply fails
- smoke warning is activated.

* If the warning occurs on the ground when the engines are stopped, the external horn sounds.

ECAM CAB PRESS PAGE



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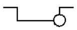
① VENT

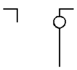
This normally appears in white. It becomes amber if there is a BLOWER FAULT, EXTRACT FAULT, or AVNCS SYS FAULT.

② INLET and EXTRACT indications

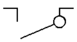
Normally white. Corresponding indication becomes amber in case of BLOWER FAULT or EXTRACT FAULT.

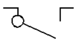
③ INLET and EXTRACT valve diagrams

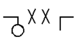

This indicates that the valve is fully closed.
It is normally green, but is amber if there is a disagreement.


This indicates that the valve is fully open.
It is normally green, but is amber if there is a disagreement.

NOTE: Because of the accuracy of the temperature sensors, on the ground the closed or open indication may become amber when the temperature is close to the valve opening or closing threshold.


This indicates that the inlet valve is in transit (inlet valve only).
It is amber.


This indicates that the extract valve is partially open (the extract valve is closed but a small internal flap is open).



It is normally green, but is amber when the valve failed in transit.

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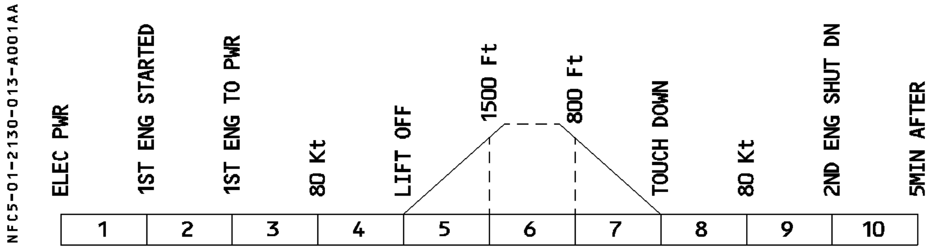
WARNINGS AND CAUTIONS



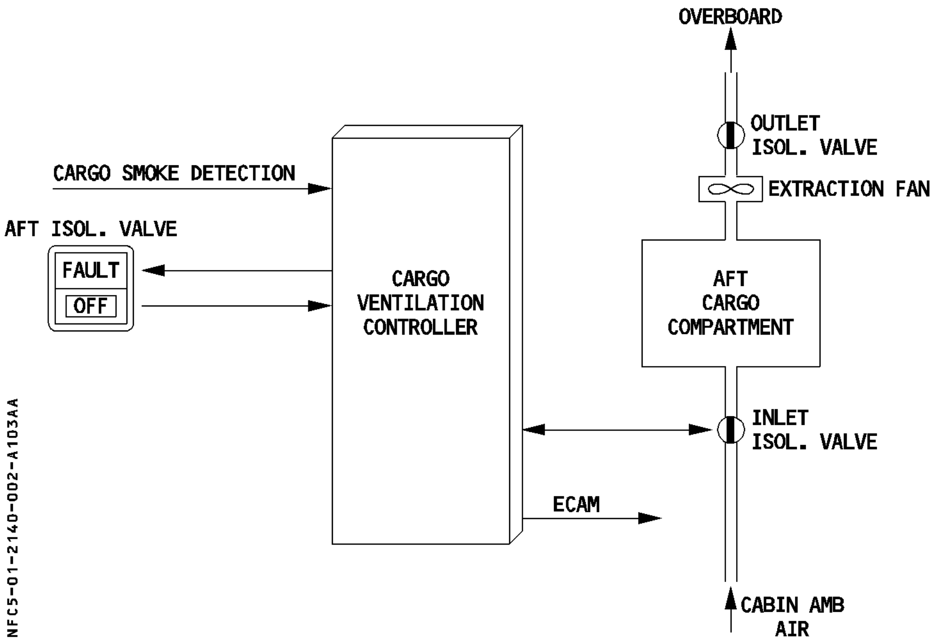
R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>BLOWER FAULT
Blowing pressure low or duct overheat</td><td rowspan="4">SINGLE CHIME</td><td rowspan="4">MASTER CAUT</td><td rowspan="4">CAB PRESS</td><td>BLOWER* FAULT lt</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>EXTRACT FAULT
Extract pressure low</td><td>EXTRACT* FAULT lt</td></tr>
<tr><td>SKIN VALVE FAULT
1. Extract valve fully open in phase 3 or
2. Extract valve fully open in flight or
3. Inlet valve not fully closed in flight</td><td>NIL</td><td>4, 5, 7, 8</td></tr>
<tr><td>AVNCS SYS FAULT
Power up test not satisfactory or AEVC not supplied or valves position disagree</td><td>BLOWER and EXTRACT FAULT lts**</td><td>3, 4, 5, 6, 7, 8 9</td></tr>
</table>

* Associated with ground external call.
** Only in case of AEVC power supply failure on ground.

GENERAL

An extraction fan draws air from the cargo compartments (◁) and exhausts it overboard. Air from the cabin replaces the exhausted air, thus ventilating the cargo compartments.


OVERBOARD
OUTLET ISOL. VALVE
EXTRACTION FAN
CARGO SMOKE DETECTION
AFT ISOL. VALVE
FAULT
OFF
CARGO VENTILATION CONTROLLER
AFT CARGO COMPARTMENT
INLET ISOL. VALVE
ECAM
CABIN AMB AIR
NFC5-01-2140-002-A103AA

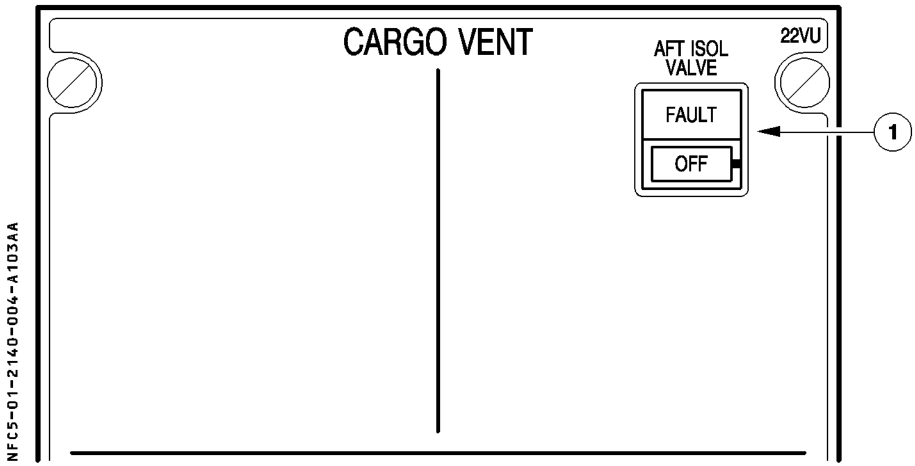
SYSTEM OPERATION

AFT CARGO COMPARTMENT VENTILATION

Air from the cabin goes via the inlet isolation valve to the aft cargo compartment, driven by an extraction fan. Air is controlled by the outlet isolation valve and then goes outboard through the outflow valve.
The cargo ventilation controller controls the operation of the inlet and outlet isolation valves and the extraction fan.
When the isolation valves are fully open, the extraction fan operates continuously when the aircraft is on the ground and during flight.
The controller closes the isolation valves and stops the extraction fan when :
– the flight crew turns the AFT ISOL VALVE pushbutton switch OFF.
– The aft cargo smoke detection unit detects smoke.

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) AFT ISOL VALVE pb sw

The switch controls the isolation valves and the extraction fan.

Auto : The inlet and outlet isolation valves open. The extraction fan runs if there is no smoke detected in the AFT CARGO.

OFF : The inlet and outlet isolation valves close, the extraction fan stops.

FAULT lt : 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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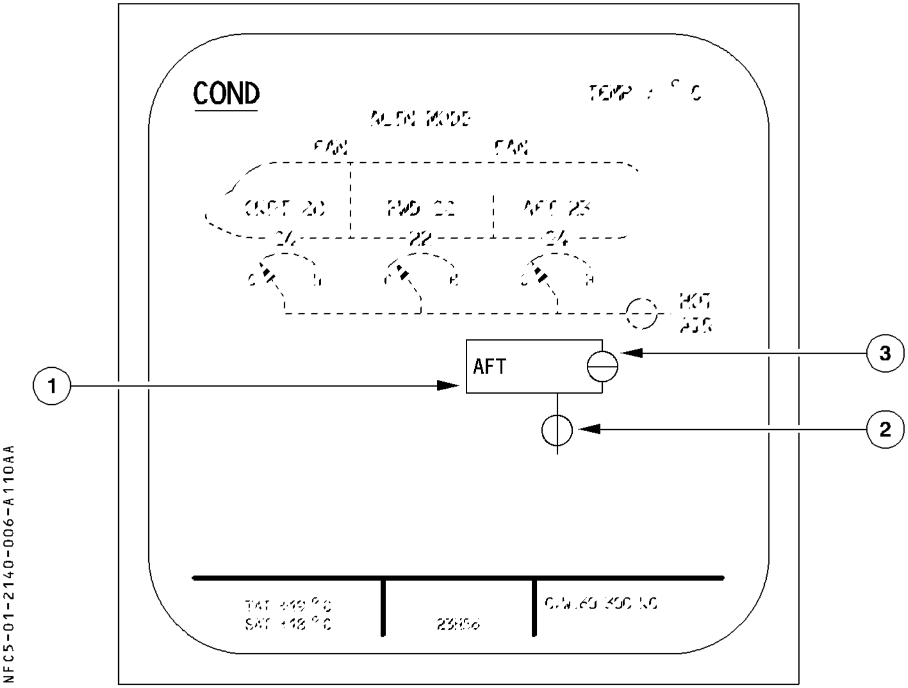
ECAM COND PAGE



(1) Zone indication

It is white.

(2) Inlet isolation valve

In line – Green : Valve is open.
Crossline – Amber : Valve is closed.

(3) Outlet isolation valve

Crossline – Green : Valve is open.
In line – Amber : Valve is closed.

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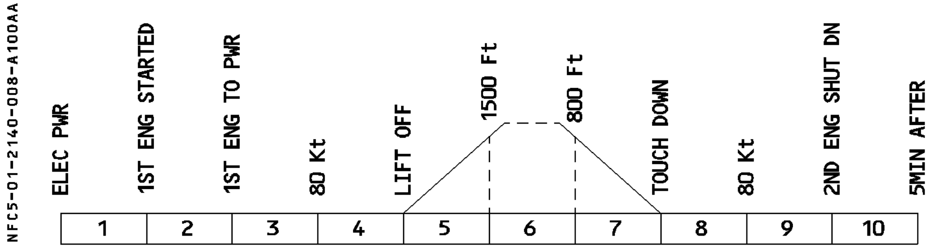
WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AFT (FWD) CRG ISOL VALVE Cargo isolation valve disagreement	NIL	NIL	NIL	ISOL VALVE FAULT lt	3, 4, 5 7, 8
AFT (FWD) CRG VENT FAULT Cargo fan fault				NIL	

BUS EQUIPMENT LIST

R

			NORM AC	NORM DC	EMER ELEC AC ESS	EMER ELEC DC ESS	EMER ELEC HOT
AIR COND	PACK CONT	1 PRIM. SEC.	AC1 AC1	DC1 DC1			
		2 PRIM. SEC.	AC2 AC2	DC2 DC2			
	ZONE CONT	PRIM. SEC.	AC1 AC2	DC1 DC2			
	PACK 1 VALVE CLOSURE					SHED	
	PACK 2 VALVE CLOSURE			DC2			
	RAM AIR INLET					X	
PRESS	CAB PRESS CONT	1				X	
		2		DC2			
		MANUAL CTL		DC BAT			
VENT	CABIN FANS	1	AC1	DC1			
		2	AC2	DC2			
	AEVC			DC1		SHED	
	AVIONIC FANS	FAN BLOWER	AC1	DC1			
		EXTRACT	AC2			SHED	
	GND COOL UNIT ◁	UNIT FAN CONTROL	AC2 AC1 DC1				
FWD/ AFT CARGO	VENT CONT ◁					SHED	
	HEAT CONT ◁					SHED	
	VENT/HEAT FANS(S) ◁		AC1				

22.00 CONTENTS

22.10 GENERAL

22.20 FLIGHT MANAGEMENT

PREAMBLE

The Auto Flight System is described in Volumes 1 and 4 :
- Volume 1, Chapter 22 gives a general description of the system and the different functions (architecture, modes, FMA, functions...).
- Volume 4 "FMGS PILOT'S GUIDE" is devoted to the FMGS System operation (MCDU pages, MCDU message, Procedures).

DESCRIPTION

The Flight Management Guidance System (FMGS) contains the following units :
- Two Flight Management Guidance Computers (FMGC)
- Two Multipurpose Control and Display Units (MCDU) (third MCDU optional)
- One Flight Control Unit (FCU)
- Two Flight Augmentation Computers

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 generally 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 NAV 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 referred to as "selected".
There are two types of Guidance :
R - 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.
R - 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 pilot's glareshield. The decision to engage a "selected" or "managed" guidance is always under the control of the pilot.
R Selected guidance has priority over managed guidance.

FLIGHT MANAGEMENT GUIDANCE COMPUTER (FMGC)

Each FMGC is divided into two main parts.

- The Flight Management (FM) part controls the following functions :
  - Navigation and management of navigation radios.
  - Management of 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

Each FMGC has its own database (190 Kwords or 400 Kwords, depending upon the FMGS standard), and each is comprised of two fields.

- One field, which the pilot cannot modify, contains customized and standard navigation data : Navaids, waypoints, airways, enroute information, holding patterns, airports, runways, procedures (SIDs, STARs, etc.), company routes, fuel policy, alternates.
  The airline updates this part every 28 days, and is responsible for defining, acquiring, updating, loading, and using this data.
  The data goes into each FMGC separately, although it can be copied from one FMGC to the other, if the system has the optional crossload function. This updating operation takes about 20 minutes.
- The second field contains pilot-stored elements that enable the pilot to create 20 waypoints, 10 runways, 20 navaids, and 3 routes.

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

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

MULTIPURPOSE CONTROL AND DISPLAY UNIT (MCDU)

Two MCDUs are installed on the pedestal for flight crew loading and display of data. The use 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 Fault Display System (CFDS), ARINC Communications, Reporting System (ACARS) can also be displayed. Data that is entered into the MCDU that is illogical or beyond the aircraft capabilities will either be disregarded or will generate an advisory message.

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).

FLIGHT AUGMENTATION COMPUTER (FAC)

The FAC controls rudder, rudder trim and yaw damper inputs. It computes data for the flight envelope and speed functions. The FAC also provides warning for low-energy and windshear detection if these functions are installed.

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 :

R — 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,
R — engage the common modes (takeoff or go-around) when TOGA (or “FLX” for takeoff) is
R set,
R — when positionned between IDLE and CL detent (MCT in engine out), set the autothrust
R to the active mode.

ELECTRONIC FLIGHT INSTRUMENTS (EFIS)

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

PRIMARY FLIGHT DISPLAYS

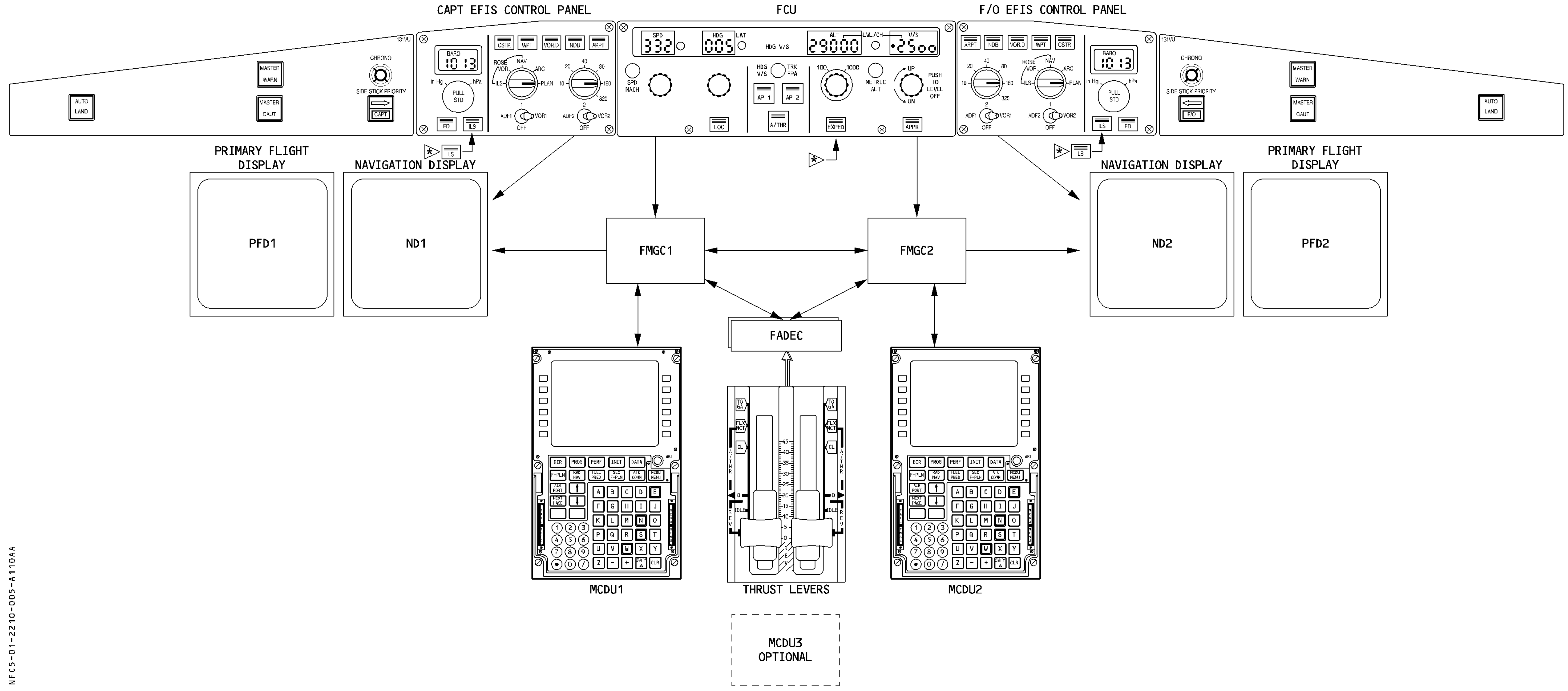
The PFDs combine several conventional flight instrument indications onto one color display panel for pilot centralized reference of flight data.
This centralized color display includes :
- Flight Director attitude guidance targets
- armed and engaged modes
- navigation and instrument approach information
- altimeter setting
- barometric altitude
- system messages.

NAVIGATION DISPLAYS

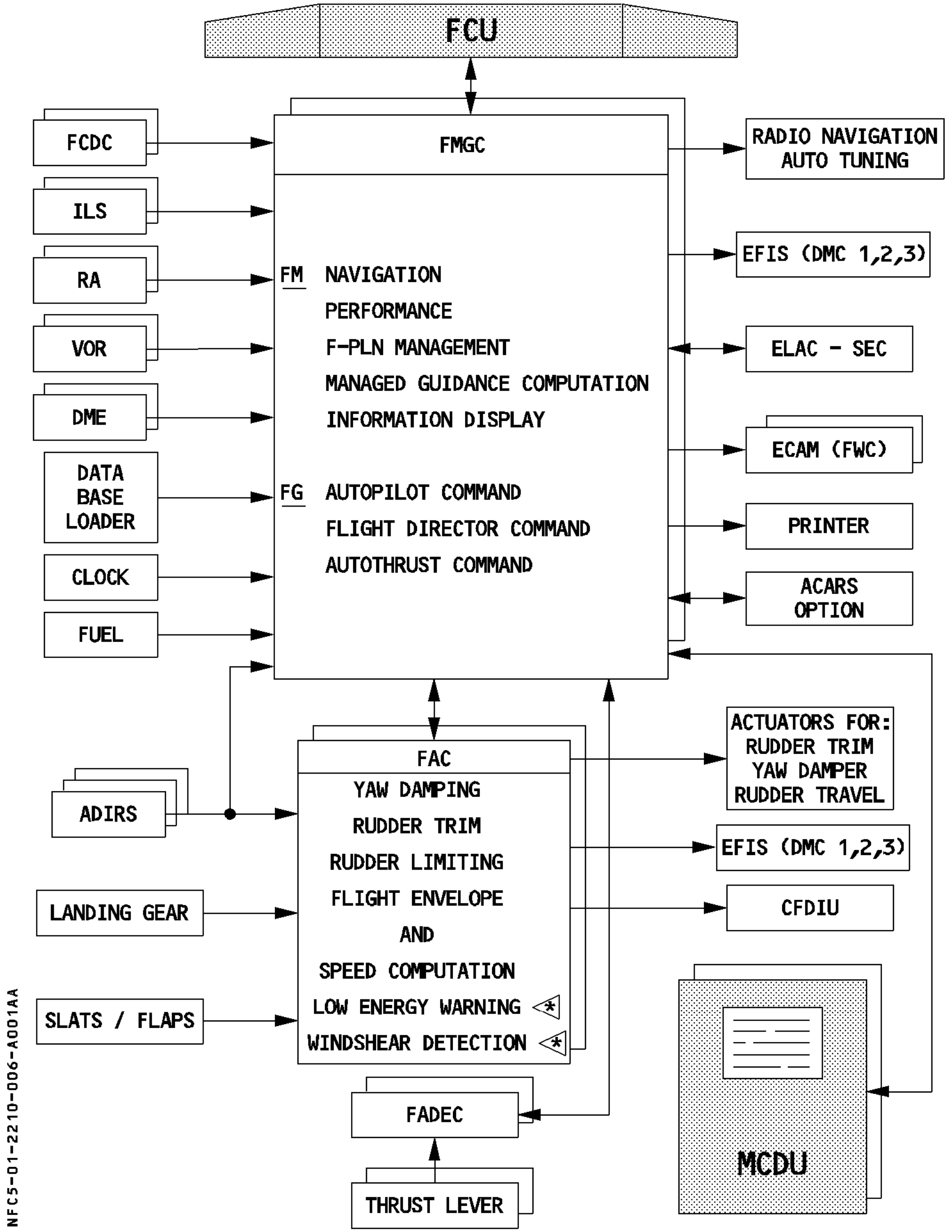
Five different color navigation compass displays can be selected.
- arc (map mode)
- compass rose NAV (map mode)
- compass rose VOR
- compass rose ILS
- plan

Information displayed onto these modes uses aircraft position as a reference point to the flight plan navigation data (lateral and vertical information).

R **CREW INTERFACE WITH FMGC**



SYSTEM INTERFACE DIAGRAM

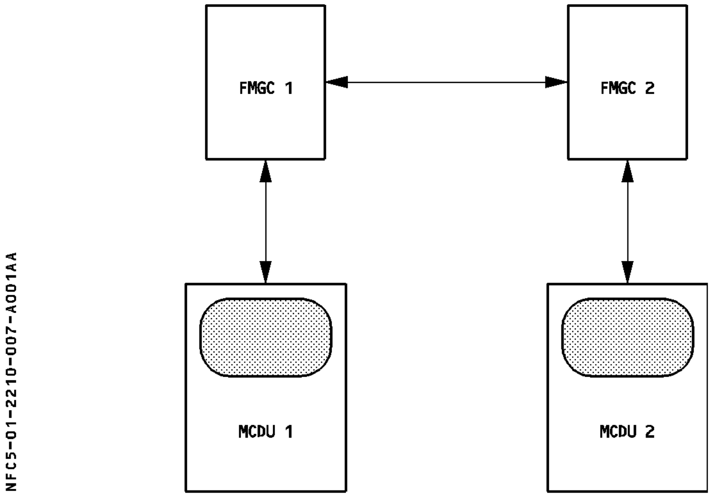


FMGS MODES OF OPERATION

The FMGS has three modes of operation :
- dual mode (the normal mode)
- independent mode. Each FMGC being controlled by its associated MCDU.
- single mode (using one FMGC only)

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.



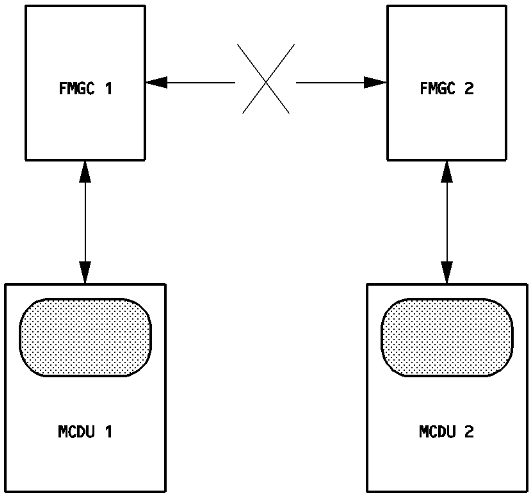
MASTER FMGC LOGIC :

- 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.
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).

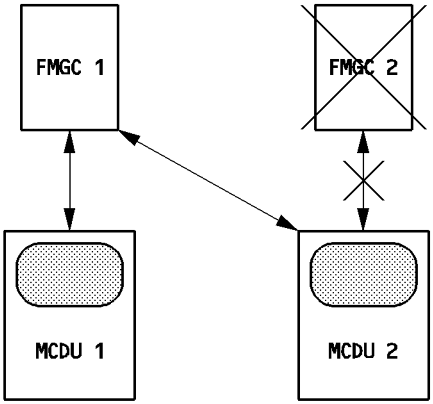


NFC5-01-2210-008-A001AA

R For independent mode procedure refer to 4.06.10.

SINGLE MODE

The system selects this degraded mode automatically if one FMGC fails. The remaining FMGC drives all the peripherals, so, for example, any entry on one MCDU goes to both MCDUs.
When one FMGC fails, the corresponding MCDU displays "OPP FMGC IN PROCESS" in white. The ND on the side with the failed FMGC has to be set to the same range and mode as the other ND. Otherwise the ND displays "SELECT OFFSIDE RNG/MODE" in amber.



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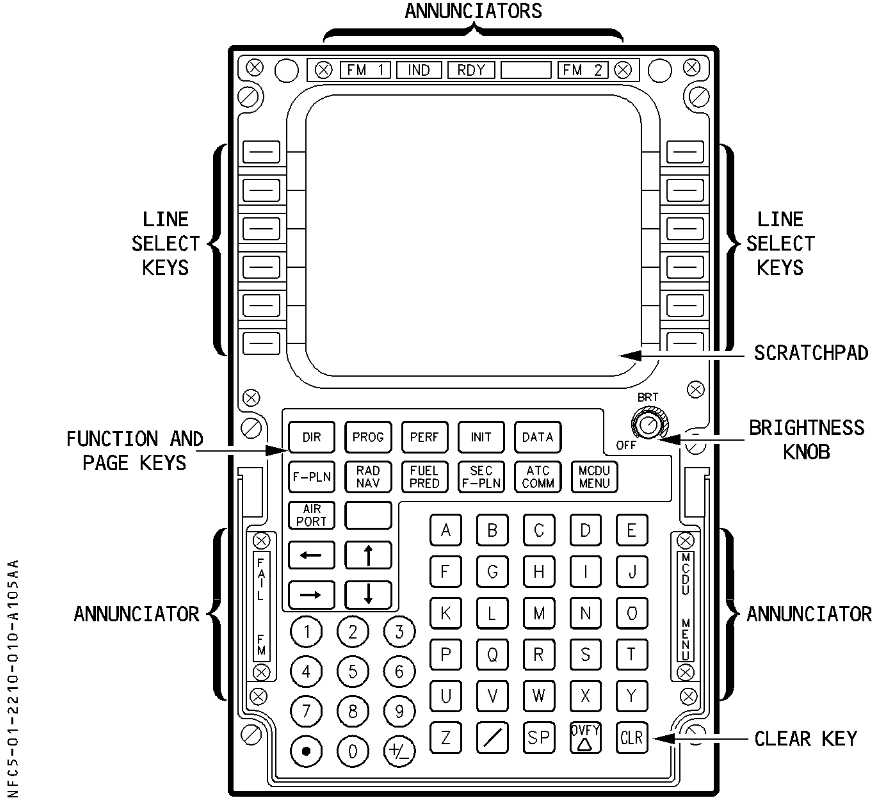
For single mode procedure refer to 4.06.10.

PILOT INTERFACE

MULTI CONTROL DISPLAY UNIT (MCDU)

R



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 line select 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 line select 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 message.

ANNUNCIATORS (on the side of the keyboard)

FAIL (amber)	Indicates that the Multipurpose Control and Display Unit (MCDU) has failed.
MCDU MENU (white)	Indicates that the pilot should call up a peripheral linked to the MCDU (such as ACARS or CFDS).
FM (white)	Comes on while the crew is using the MCDU to display peripherals.

BRT KNOB

Controls the light intensity of the entire MCDU.

ANNUNCIATORS (on the top of the keyboard)

FM 1 and FM 2 (amber)	The onside FM is failed
IND (amber)	The onside FM detects an independent mode of operation while both FM are healthy.
RDY (geeen)	MCDU has passed its power up test after its BRT knob was turned to ON.

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 is 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. Theses 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 DISPLAYED IN THE TITLE OF F-PLN PAGE
TUNED NAVAID	BLUE
"TO" WAYPOINT AND DESTINATION	WHITE

SCREEN PROMPTS

R

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

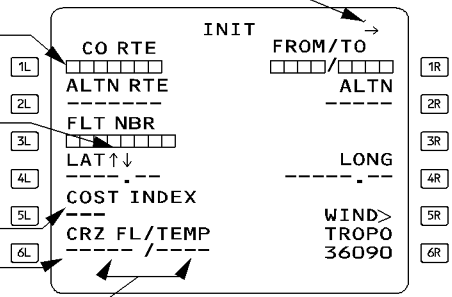
□□□ : DATA ENTRY IS MANDATORY TO ALLOW THE FMGC TO PERFORM ALL ITS FUNCTIONS.

↑↓ : 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, OR PROVIDED OUT OF THE DATA BASE, OR INSERTED BY THE CREW.



← → A TURN (LEFT ← OR RIGHT →) IS SPECIFIED ON THE LEG WHICH STARTED AT THE WAYPOINTS ADJACENT TO THE ARROW.

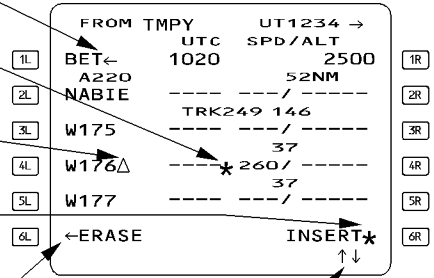
* : INDICATES THAT A CONSTRAINT HAS BEEN INSERTED. DISPLAYED ONLY IF PREDICTIONS AVAILABLE.

△ : DISPLAYED BESIDE A FIXED WAYPOINT ON THE F-PLN PAGE TO INDICATE THAT THE A/C WILL 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.

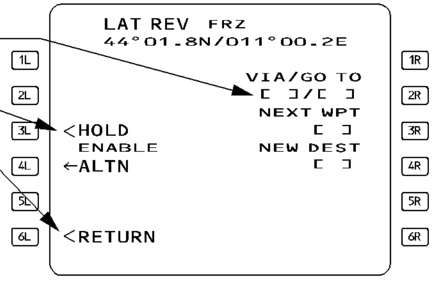
↑↓ : SCROLLING IS AVAILABLE BY PRESSING ↓OR↑ KEY ON THE KEYBOARD. THE PAGE IS NOT LARGE ENOUGH TO DISPLAY THE WHOLE INFORMATION.



[ ] : 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 AT OR ABOVE ALTITUDE CONSTRAINT AND A MINUS (-) FOR AT OR BELOW ALTITUDE CONSTRAINT.



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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.

R 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. 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). The pilot can then use the appropriate 6L or 6R LSK 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. The pilot uses the INIT A page primarily to insert his flight plan and to align the inertial reference system. 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. The pilot has access to the INIT A page only in the preflight phase. INIT B page (not accessible after engine start) is called up by pressing the "NEXT PAGE" key.

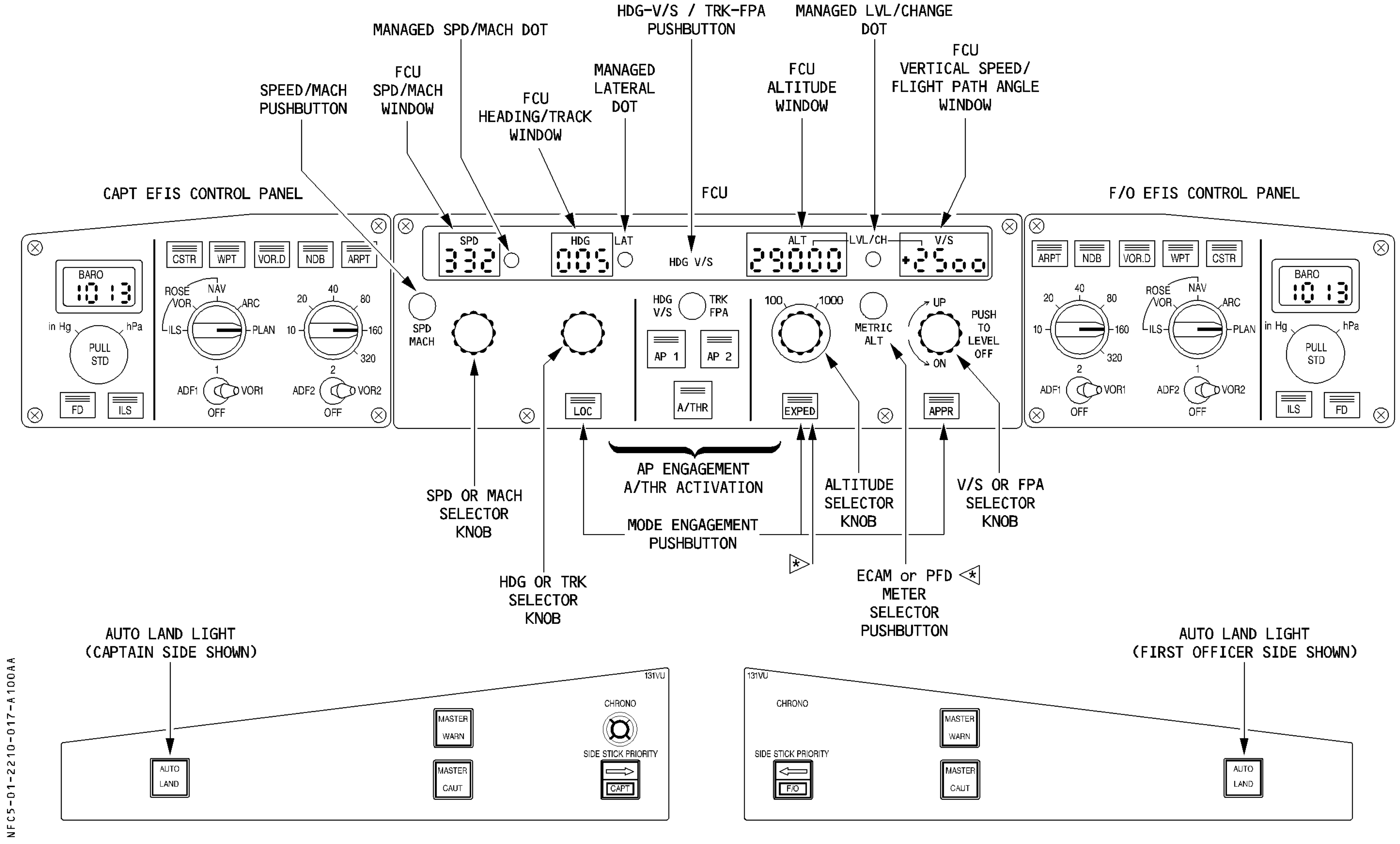
DATA	Calls up the data index page. This gives the pilot access to various reference pages that show aircraft position, aircraft status, runways, waypoints, navaids, routes and data stored by the pilot.
F-PLN	Calls up the flight plan A and B pages, which contain a leg-by-leg description of the active primary flight plan. 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 LSKs for lateral revision and the right keys for vertical revision.
RAD NAV	Calls up the Radio Navigation 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).
ATC COMM	Calls up the ATC applications. (not activated).
MCDU MENU	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. 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.

MCDU PAGES

(Refer to FCOM 4.03.20).

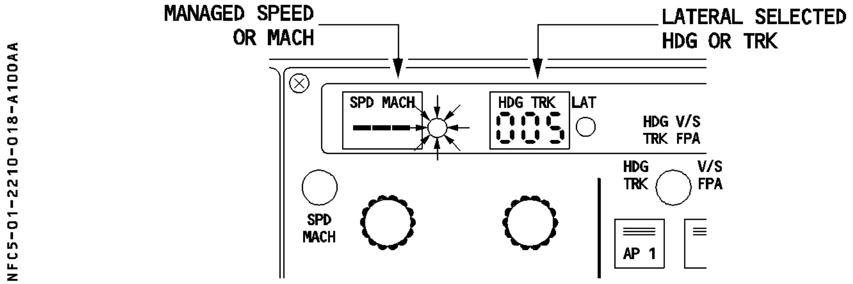
FLIGHT CONTROL UNIT (FCU)

The FCU, which is on the glareshield, is actually 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.
R The FCU has two channels, each of which can independently command the central panel. If one channel fails, the other channel can control all the functions.



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.



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.
· In order to arm or engage managed guidance for a given mode, the pilot pushes in the associated selector knob. If, for example, he pushes in the HDG selector knob, he engages
R or arms the NAV mode.
· 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*
R *corresponding window is dashed. Turning a selector knob without pulling it,*
R *displays a value that is the sum of the current target and the turn action value. The*
R *display remains 45 seconds on the HDG/TRK and V/S windows and 10 seconds on*
R *the Speed/Mach window before the dashes reappear. This rule does not apply to*
R *the ALT selector knob/window.*

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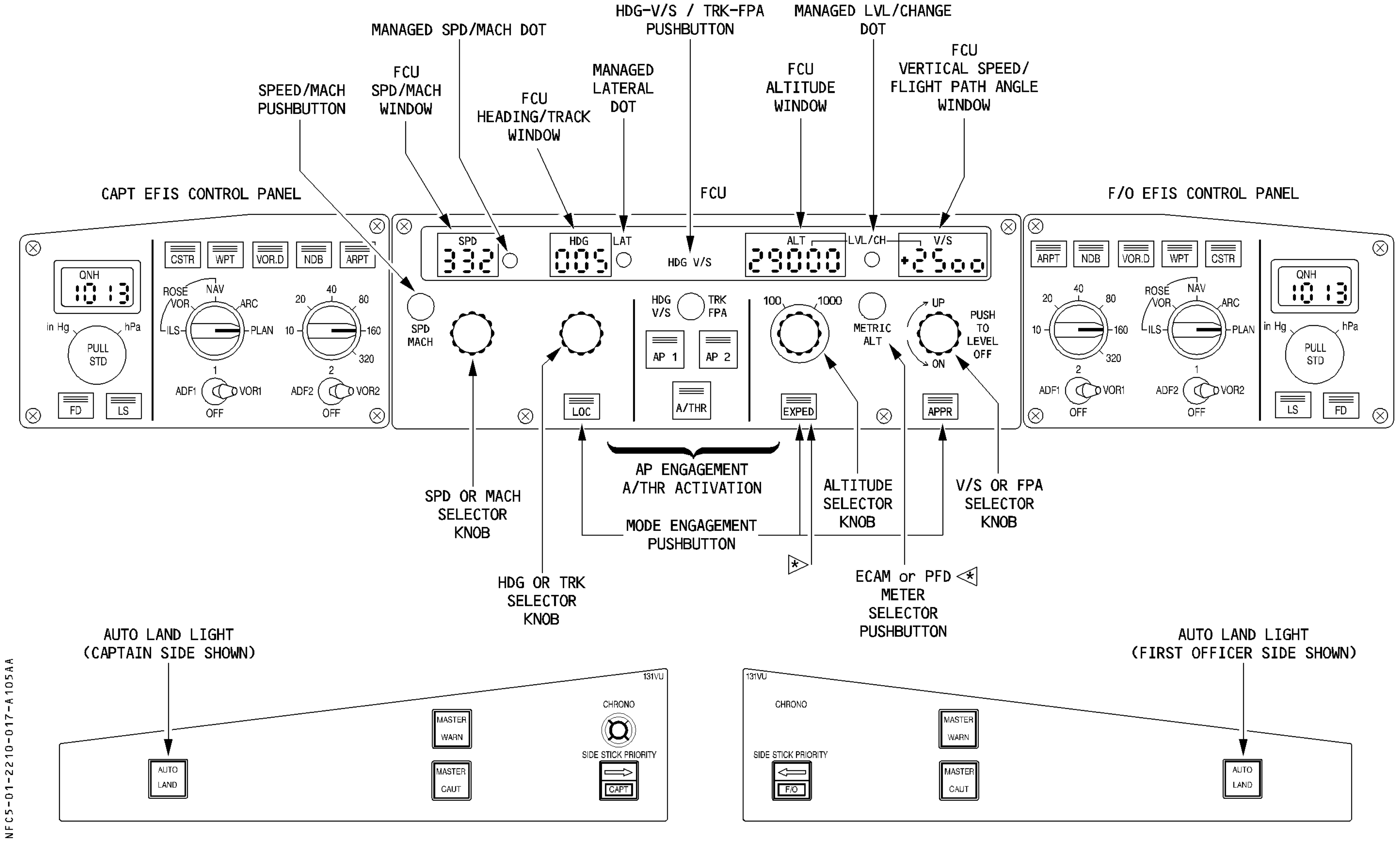

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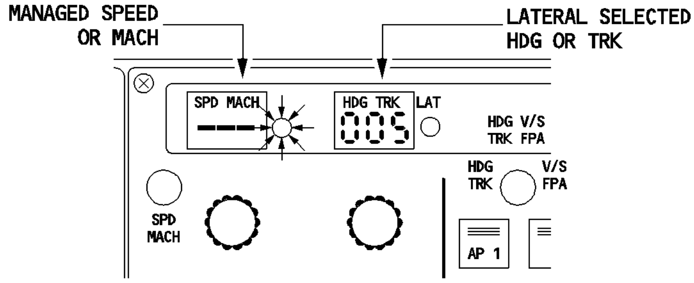

NFC5-01-2210-018-A100AA

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

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- HDG-TRK
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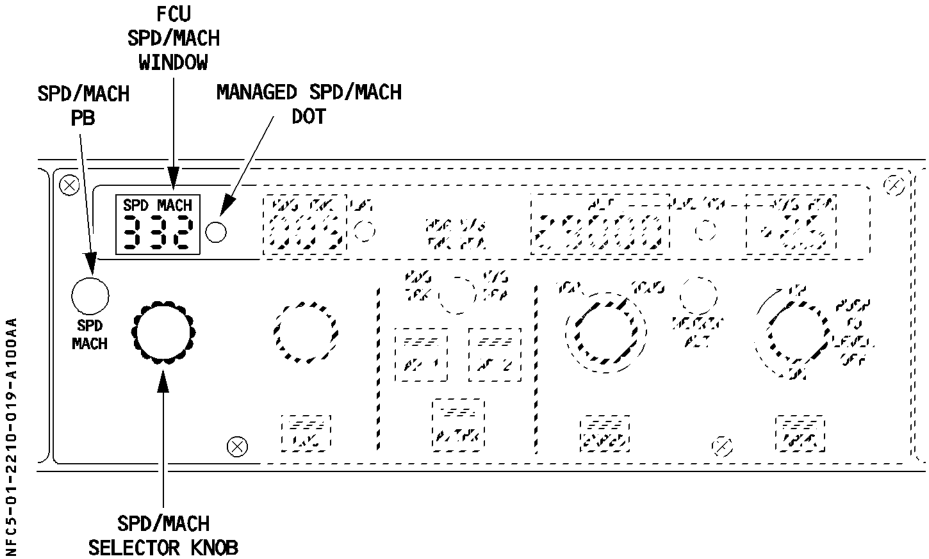
R *the Speed/Mach window before the dashes reappear. This rule does not apply to*
R *the ALT selector knob/window.*

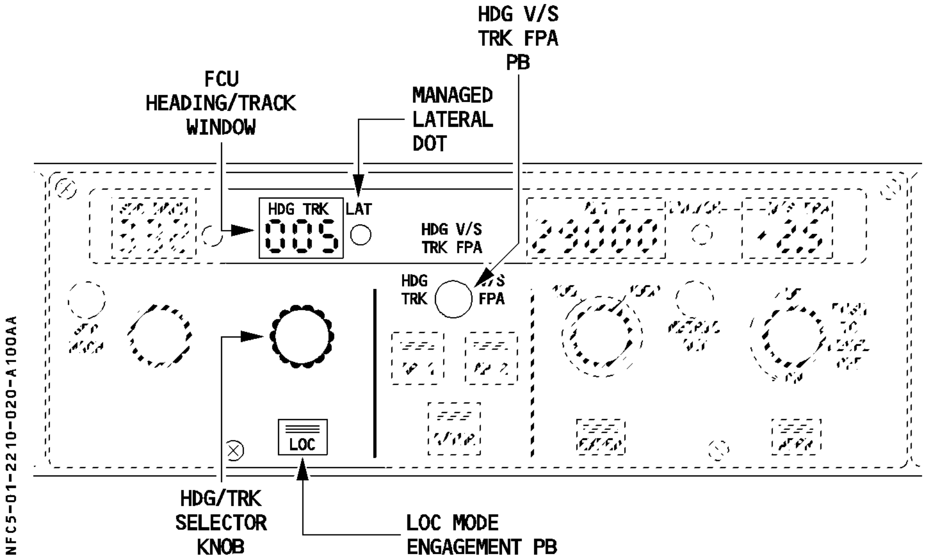
SPEED/MACH CONTROL AREA



- **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 32 knots or 0.32 Mach.

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

LATERAL CONTROL AREA



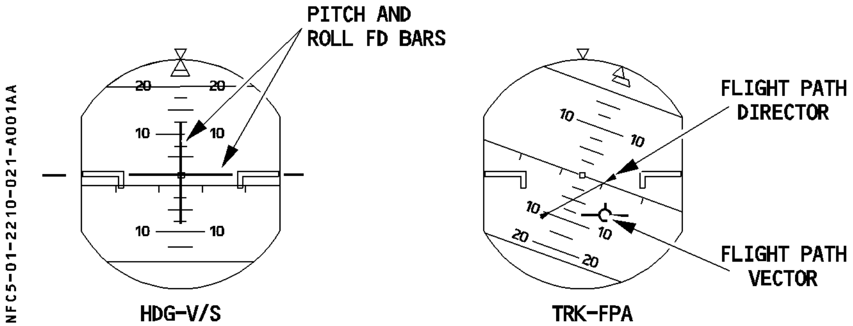
· **HDG/TRK selector knob**
Display range : between 0° and 359°.
One rotation of the knob corresponds to 32° (1° per click).

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

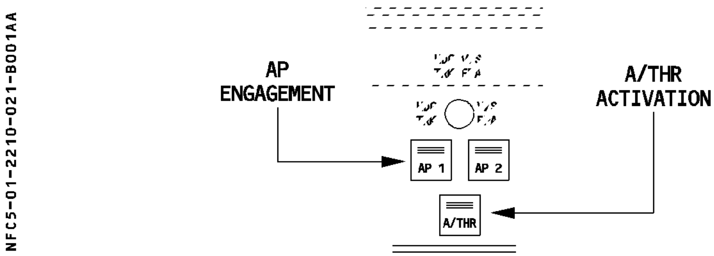
· **HDG V / S - TRK FPA pushbutton**

R The pilot uses this pushbutton to select HDG (associated with V/S) or TRK (associated
R 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.



AP-A/THR CONTROL AREA



· **AP1 AP2 pushbuttons**

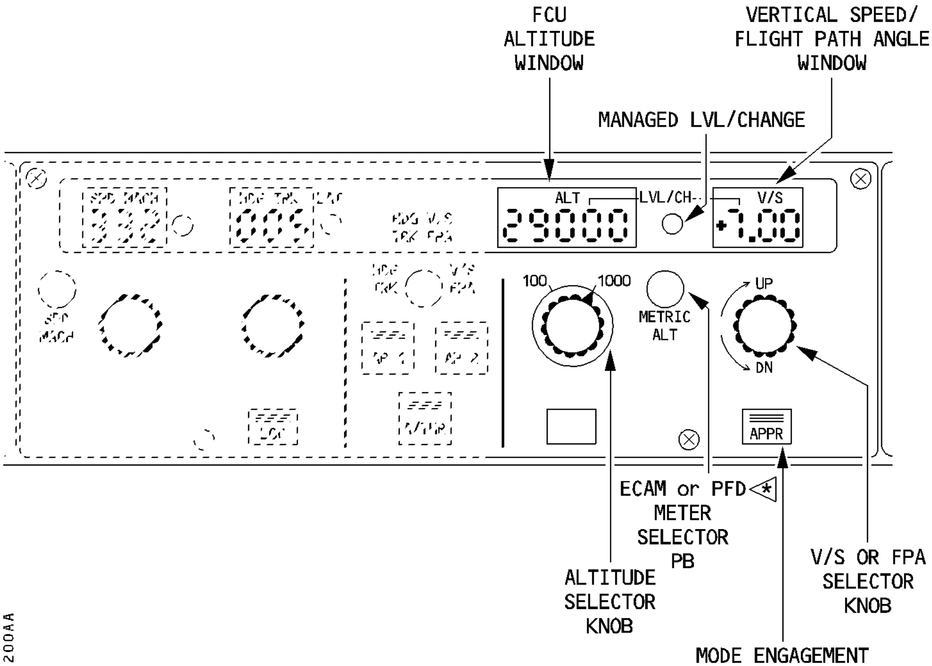
R The pilot uses these pushbuttons to engage or disengage the autopilots. The buttons
R illuminate green when the autopilot is engaged.

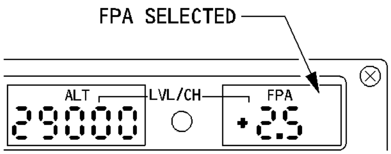
· **A/THR pushbutton**

The pilot uses this pushbutton to arm, activate, or disconnect the autothrust (A/THR).
R 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.

· **<u>Altitude selector knob (inner and outer)</u>**
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.

· **<u>METRIC ALT pushbutton</u>**
R This pushbutton is used to display the FCU altitude target in meters on the ECAM, or the
R current altitude and FCU/FM altitude target in meters on the PFD ◁.

· **<u>V/S or FPA selector knob</u>**
Range (V/S) : – 6000 to + 6000 feet/min
2 clicks = 100 feet/min
If the pilot turns the knob slowly, each click equals 100 feet/min.
Range (FPA) : – 9.9° to + 9.9°
1 click = 0.1°
The pilot turns this knob to set the value of the 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.
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 ALT 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.

· **<u>APPR pushbutton</u>**
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.

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.

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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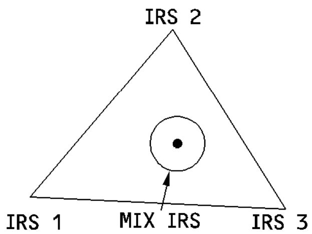

– If one of the IRSs drifts abnormally, the MIX IRS position uses an algorithm that decreases the influence of the drifting IRS within the MIX IRS position.

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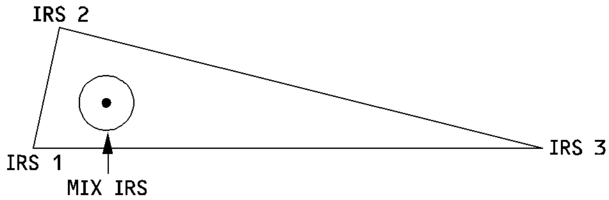

– If one of the IRSs fails, each FMGC uses only one IRS (onside IRS or IRS3). Each IRS position and inertial speed are continuously tested. If the test fails, the corresponding IRS is rejected.
– When the MIX IRS position differs from the radio position by more than 12 NM, the "CHECK A/C POSITION" message is displayed on the MCDUs.

GPS POSITION

R Each IRS computes a hybrid position that is a mixed IRS/GPS position called GPIRS. For this, each IRS can independently select their GPS source in order to maximize GPS data availability. Among these 3 GPIRS positions received by each FMGC, one is selected according to a figure of merit and priority. The selection is performed using the following hierarchy :

- Onside GPIRS position
- GPIRS 3
- Opposite GPIRS position

If the GPIRS data does not comply with an integrity criteria, the GPS mode is rejected, and radio position updating is used, the "GPS PRIMARY LOST" message is displayed on the ND and on the MCDU scratchpad.

During non ILS approach, the loss of the GPS primary function triggers a triple click aural warning.

When the GPS primary function is recovered, the "GPS PRIMARY" message comes up on the ND and on the MCDU scratchpad. It means that GPIRS data again complies with the required integrity criteria.

As long as GPS primary is in use, all usual navigation performance requirements are met. The crew can deselect/select the GPS on the SELECTED NAVAIDS page, if necessary.

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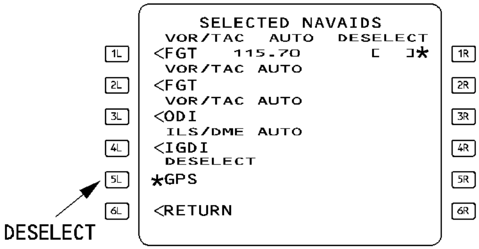
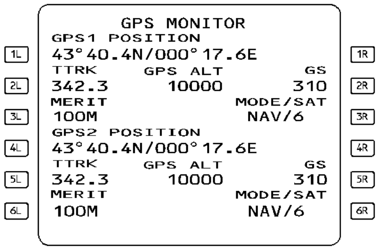


Information concerning the GPS position is displayed on the GPS MONITOR page.

NFC5-01-2220-003-B110AA

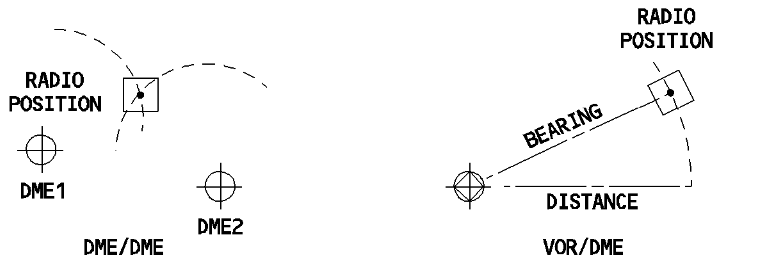


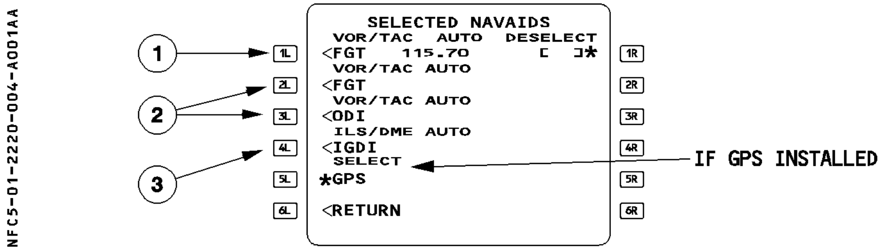
R *Note : In normal operations, all ADIRUs may elect the same GPS source. As a result, data*
R *of the non-elected GPS may be dashed on the GPS MONITOR page, without any*
R *detected GPS failure or triggered "GPS PRIMARY LOST" message.*

RADIO POSITION

Each FMGC uses onside navaids to compute its own radio position. These navaids are displayed on the SELECTED NAVAIDS page. The available navaids 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 GPS installed).
If one or more navaids fail, each FMGC can use offside navaids to compute the VOR/DME, or the DME/DME radio position.
The radio navaid selection is displayed on the DATA "SELECTED NAVAIDS" page.





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.

R CHECK A/C POSITION MESSAGE

R This message comes up on the MCDU, when the radio position and the IRS position differ
R by more than 12 NM.

FM POSITION

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

It is subsequently updated :

- At takeoff, when the FM position is updated to the runway threshold position as stored in the data base, 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 depending upon the aircraft altitude.

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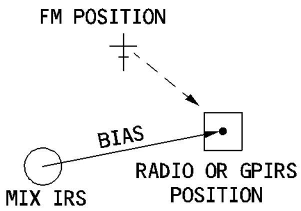


Bias

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

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

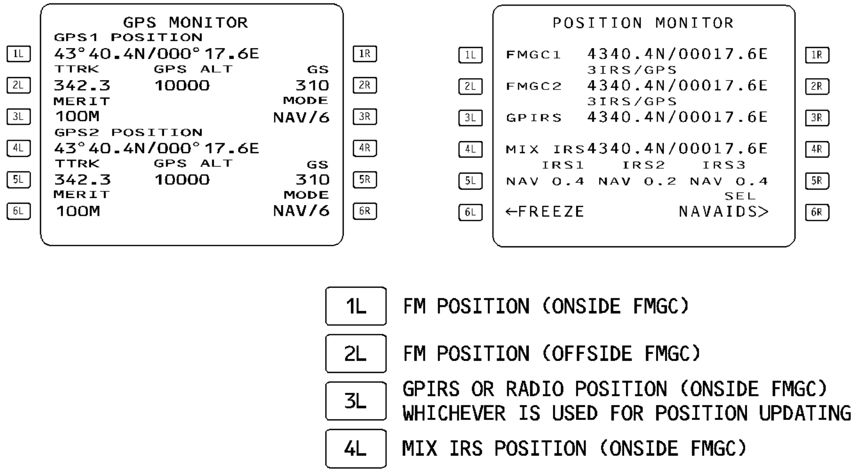
If an FMGC looses its radio/GPIRS position, it memorizes the bias and uses it to compute the FM position, which equals the mix IRS position plus the bias.

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

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

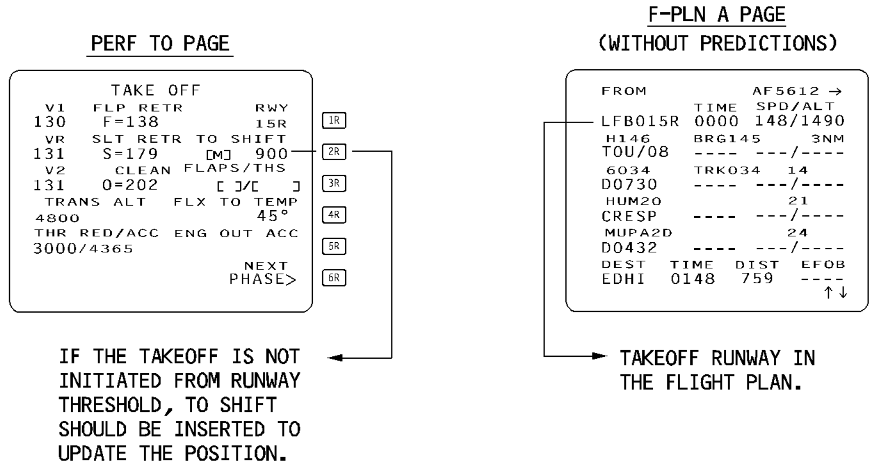
POSITION MONITOR

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



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.



NAVIGATION MODES

The FMGS updates the FM position using GPS or radio navaids if the GPS function in inoperative.
It can use 4 main different FM navigation modes to make this update. The decreasing priority order is:
- IRS-GPS
- IRS-DME/DME
- IRS-VOR/DME
- IRS only

During ILS approaches the system performs, a lateral temporary 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 an Estimated Position Error (EPE) continually.
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	$\sqrt{(FOM^2 + 100^2)}$ in meters	FOM = Figure of Merit of GPS If above 0.28 NM the GPS position is rejected.
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	+ 8 NM/h for the first 21 min. + 2 NM/h after	EPE increases continuously

Note : After an IRS alignment or at takeoff the EPE is set at 0.2 NM.

The system displays the EPE to the 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 required navigation performance is displayed on the PROG page. These figures are defaulted value and can be modified by the crew.

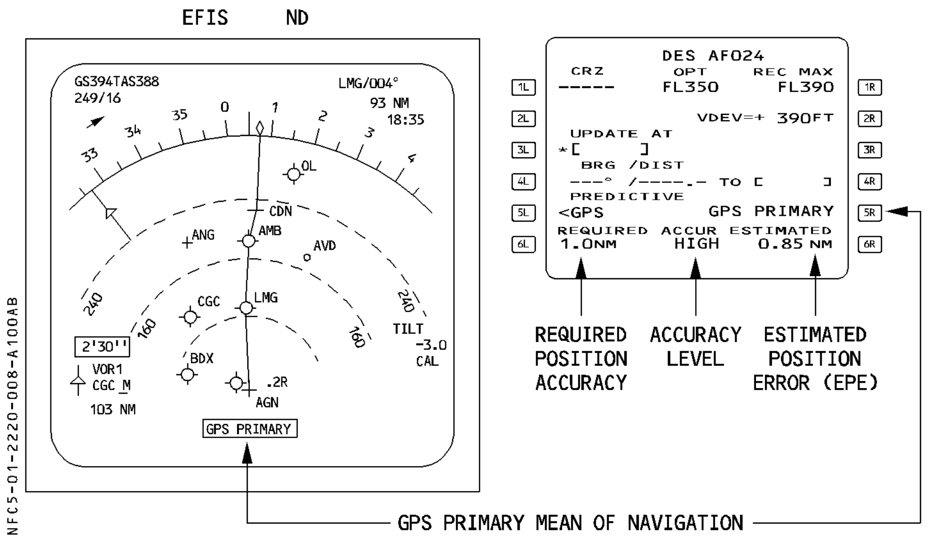
When the message "SYSTEM RNP IS XX.X" is displayed, the crew should verify the manually entered RNP value in the REQUIRED field of the PROG page and clear or modify it if necessary.

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

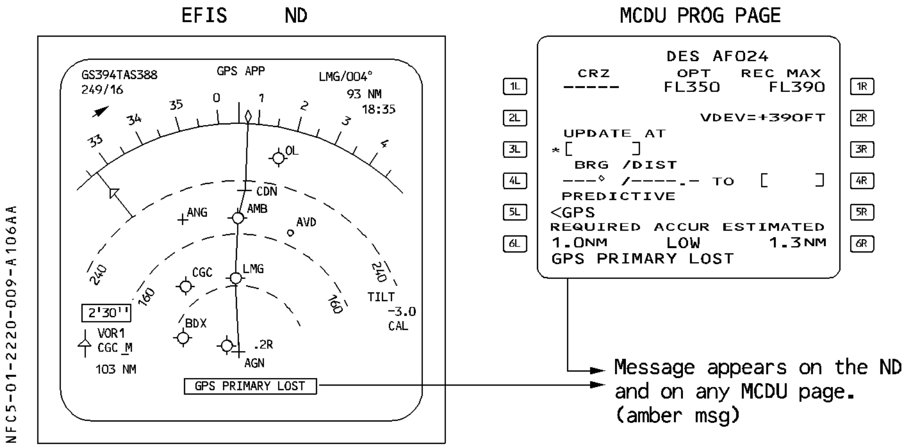
This message is also displayed at change of flight area if the new required criteria (defaulted value) is smaller than the displayed manually entered value.

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 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.



CAUTION

“HIGH” or “LOW” indicates FM position accuracy, based upon estimated drift.
This is why 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.

GPS/FMS POSITION DISAGREEMENT

When GPS primary is active, and either of the FMGC positions deviate from the GPS
R positions 1 or 2 by more than 0.5 minutes of latitude or longitude, then the lower ECAM display unit displays the NAV FMS/GPS POS DISAGREE amber message and A/C POS... CHECK in blue.
The master caution light comes on, and the single chime sounds.

PREDICTIVE GPS

R The predictive GPS page is only operative with the Honeywell ADIRS equipment.
The predictive GPS function predicts the availability of the GPS within ± 15 minutes of ETA at destination, or at any waypoint entered by the crew.

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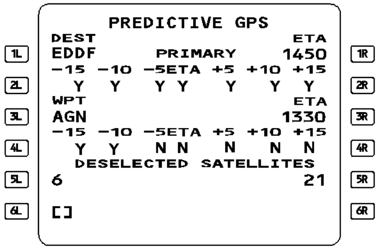


Predictions are displayed on the predictive GPS page at time intervals of 5 minutes (+15 and –15 minutes of ETA).
To access this page, press the 5L key of the PROG page.
This page also enables the deselection of up to 4 satellites at a time.

RADIO NAVIGATION TUNING

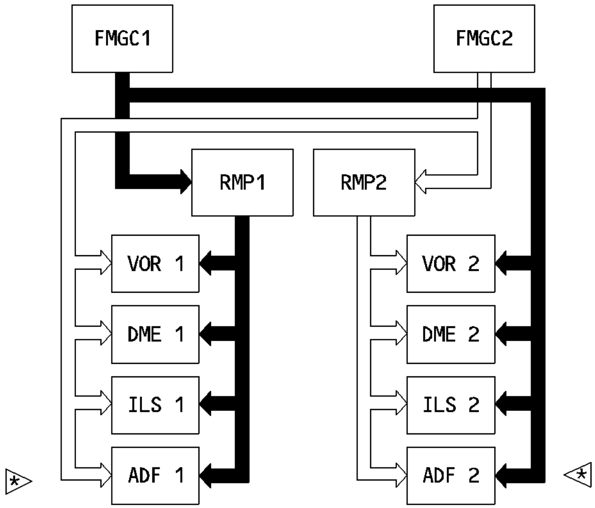
Radio navaids are tuned for two different purposes : display and computation.
Tuning for display may be performed in three different ways :
- automatic tuning (FMGC software)
- manual tuning through the MCDU RAD NAV page
- manual tuning through the Radio Management Panel (RMP) if both FMGCs or both MCDUs fail.

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

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

R



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- In dual mode and independent mode each FMGC tunes the navaids on its side of the
R console (one VOR, 5 DMEs, one ILS, and one ADF ◁*) simultaneously. In these modes,
R the pilot can also tune the VOR (and associated DME), ILS, and ADF (◁*) manually.
- In single mode, the valid FMGC will tune both side navaids. The pilot can also use the
R 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 only one VOR (manual or automatic).
Autotuning follows the following VOR tuning priorities :
1. The navaid specified for the approach.
2. The navaid to be used for computing the present radio position.
3. For display 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.

DME

Each FMGC automatically uses its five DMEs as follows :
- One DME for display. It may be manually or automatically tuned.
- 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 unavailable 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 a radio position.
- One DME is linked to the ILS/DME.

ADF

The FMGC autotunes one ADF, 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

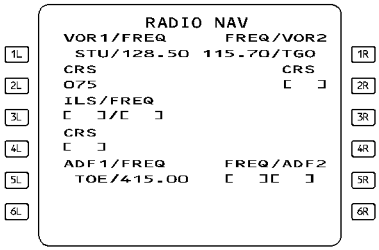
Each FMGC autotunes one ILS frequency :
- In the PREFLIGHT or TAKEOFF phase, when the takeoff runway has an associated ILS.
- In the CLIMB-CRUISE-DESCENT, APPROACH, or GO-AROUND phase, when the type of approach in the flight plan is ILS.

The scratchpad displays "RWY/ILS MISMATCH" when the pilot has manually tuned the ILS and the entered frequency does not match the ILS or LOC IDENT/FREQ requested for
R autotuning. The FMGS logic does not allow the crew to modify the course of an ILS when
R its frequency is identical to the ILS selected in the F-PLN.

SELECTION OF NAVAIDS ON MCDU PAGES

The MCDU displays navaids tuned by the FMGC on two pages :
- RADIO NAV page
- SELECTED NAVAIDS page

· RADIO NAV page
This page shows which navaids have been tuned automatically or manually for display purposes.



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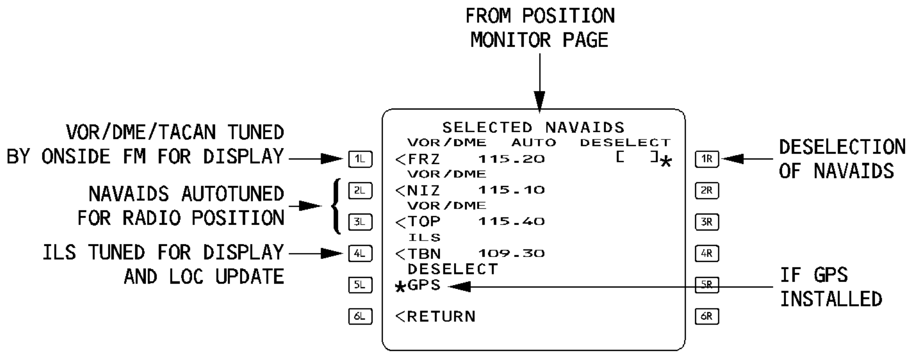
· SELECTED NAVAIDS page
This page lists the navaids being tuned by the onside FMGC. No navaids can be modified
R on this page. The pilot may deselect as many as six unreliable navaids for the whole flight
(using 1R key).
R



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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. 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.

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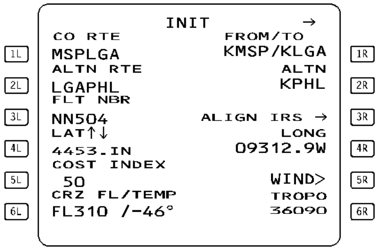


Note : If the ADIRS overhead CDU flashes "ALIGN", during the alignment process, it indicates one of the following :

- *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.*
- *The IRS has not received a position from the MCDU or the ADIRS overhead CDU.*

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

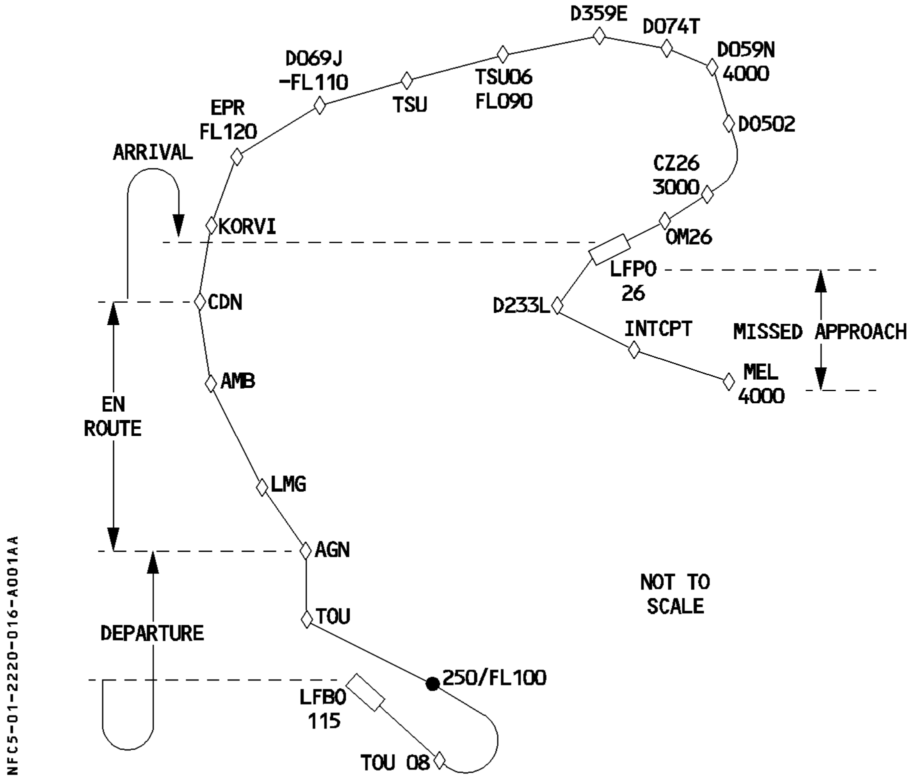
The FMGS can contain two different flight plans :
— the ACTIVE flight plan, which is the basis for :
 · lateral and vertical guidance
 · MCDU and ND display
 · radio navigation autotuning
 · performance predictions
 · fuel planning
— the SECONDARY flight plan which the pilot may use :
R · when an alternate takeoff runway is probable
 · to plan a diversion
 · to prepare the next flight
R · 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.



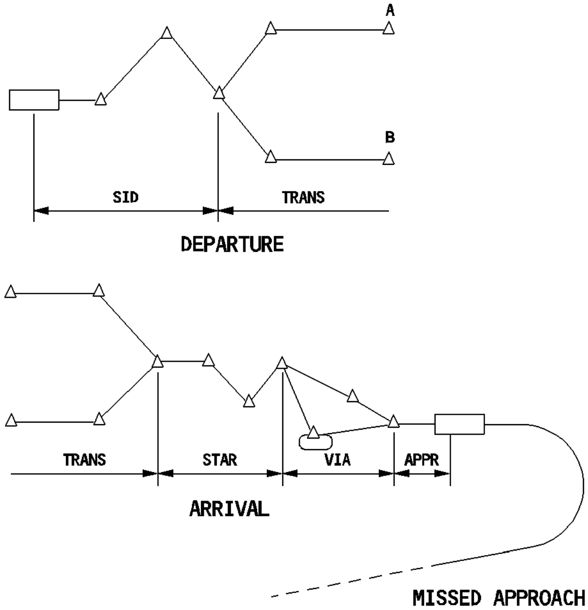
The FMGC automatically strings the legs in sequence.
The flight plan has a discontinuity if any two waypoints do not have a leg defined between them.
The computer assumes that the aircraft will fly a direct leg between the two waypoints that define the discontinuity.

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 only create 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. Enroute transitions (TRANS) are the various possible trajectories defined between the last SID point and the first enroute waypoints, and between the last enroute waypoint and the first fix of the STAR.
"APPR VIAs" are the possible trajectories, defined between the last STAR point and the first point of the approach.



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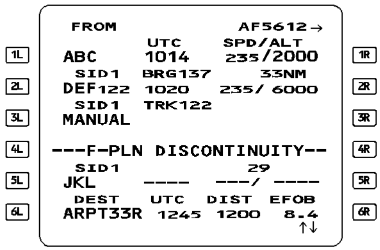
MANUAL LEGS

A MANUAL leg stays on a constant TRK or HDG and has no termination point. You cannot insert it into a flight plan manually : it is part of a given procedure such as a SID or a STAR. When the aircraft is flying a MANUAL leg, the NAV mode remains engaged and predictions assume that the aircraft will fly a direct leg from its present position to the next waypoint
R (DIR TO). When the aircraft is cleared to fly to the next waypoint of the flight plan, the pilot
R performs a DIR TO.

Note : – *In NAV mode a MANUAL leg is sequenced only by performing a DIR TO.*
– *The use of the descent mode (DES) on a MANUAL leg is not recommended.*



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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
R procedure (SID, STAR, HOLD, TAKEOFF or LANDING RWY). This modification is made on
R specific "LAT REV" pages from the flight plan page.

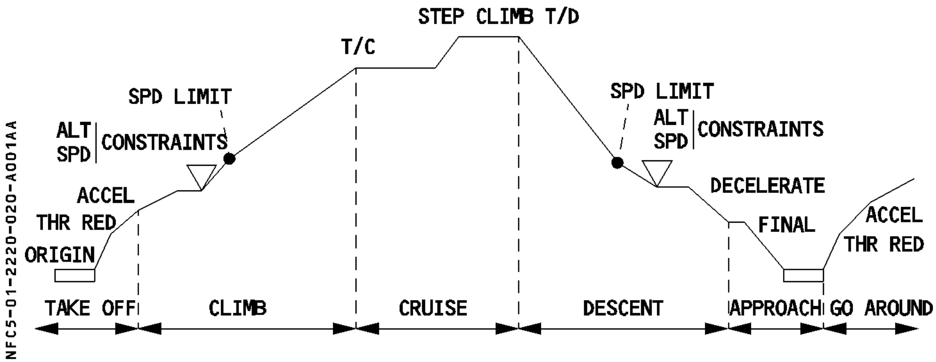
Possible revisions are :
· Insert or modify departure procedure.
· Insert or modify arrival procedure.
· Insert a waypoint.
· Change the destination.
· Insert an airway.
· Insert an offset.
· Insert a holding pattern.
· Select or enable an alternate flight plan.

TEMPORARY FLIGHT PLAN

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 the TEMPORARY F-PLN chapter (FCOM 4.04).

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, ZFW, ZFCG, block FUEL) 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 data base 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 has been defined, the FMGC computes the vertical profile and the managed speed/Mach profile from takeoff to landing.
R For details, refer to vertical revision pages 4.03.20.

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).

R

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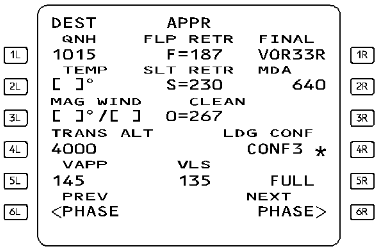


PERF APPROACH PAGE

Optimum target speed for CLB or DES phase

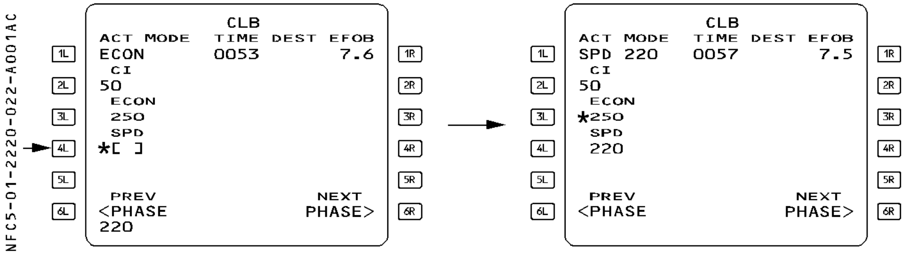
The FMGC computes optimum speeds as functions of :

- 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 The FM calculates ECON CLB, ECON DES and the associated top of climb and top of
R descent as a function of cost index, cruise FL, and meteo data.

R **Preset target speed for CLB phase**
R The pilot can preselect the climb speed before the CLB phase begins, by inserting a speed
R in the SPD field :
R



R The active mode field changes from ECON to SPD XXX (XXX being the speed entered in the
R SPD field), and the FM will use the entered speed for climb predictions computation. The
R pilot can revert to managed mode by pressing the 3L key.

R **Preset target speed/Mach for DES phase**
R The pilot can change the speed and/or Mach displayed in the ECON field before the DES
R phase begins by inserting a speed and/or Mach in the ECON field.
R The 3L field name changes from ECON to AUTO SPD.
R Although the entered speed is choosen by the pilot, the FMGS uses it to compute the
R descent flight path and top of descent. It is therefore part of the managed descent profile.

R

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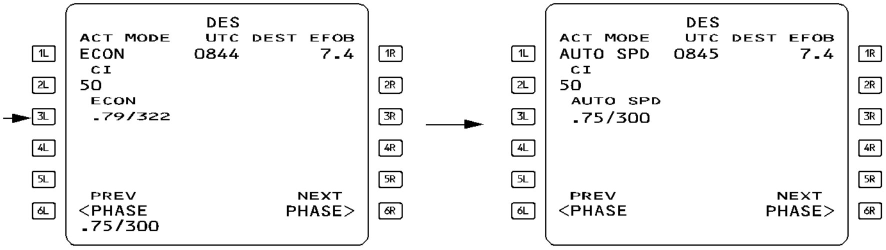

R The pilot can revert to the optimum speed/Mach by clearing the field 3L.

Optimum target Mach number in cruise

FM computes ECON CRZ MACH as the optimum speed and updates it continually, 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. 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

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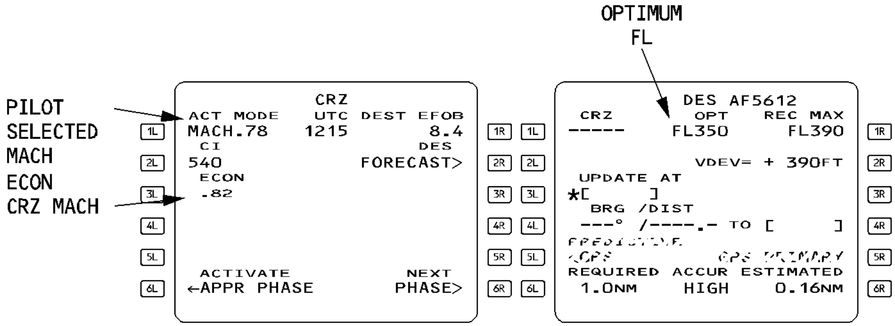

PERF CRZ PAGE PROG DES PAGE

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 flight time cost and the fuel cost.
CI = 0 Corresponds to minimum fuel consumption (max range).
CI = 999 Corresponds to minimum time.

PREDICTIONS

The FMGC computes predictions for the primary and secondary flight plans 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.
The computations use pilot-entered data for the secondary flight plan when it is not a copy of the active flight plan.
When the secondary flight plan is a copy of the active flight plan, it uses the same data.

PREDICTIONS FOR THE PRIMARY FLIGHT PLAN

The predictions displayed on the MCDU assume that the system 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 towards 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
R 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
R 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
- the vertical flight plan
- forecast atmospheric conditions entered by the crew
- the cost index
- speed control (managed/selected)

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

WINDS USED FOR PREDICTIONS

See VERTICAL FUNCTIONS, 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.

Predictions for secondary flight plan
Refer to FCOM 4.04.30 Secondary flight plan.

OTHER COMPUTATIONS

Engine-out case
The FMGS computes an engine-out target speed for each flight phase.
It computes an engine-out maximum altitude at long-range cruise speed, and displays it on the PROG page.
When the aircraft loses an engine, it also loses predictions for the active flight plan, in the takeoff, climb, and cruise phases. However, the system restores predictions for twin-engine operation in the descent and approach phases.

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 390).

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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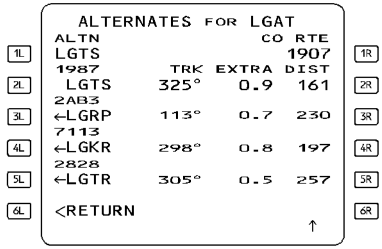

They are based on :
- A default cruise FL equal to 220, if the airway distance is less than 200 NM. Otherwise, it is FL 310.
- Simplified wind/temperature models, based on crew entries :
  - ALT CRZ wind, as entered on the FUEL PRED page.
  - CRZ temperature interpolated from the temperature model for the primary flight plan.
- Airway distance, or direct distance, as provided by the database (manual entry, if not in the database).
- Cost index = 0 (minimum fuel).
- Initial aircraft weight equal to landing weight at primary destination.

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.*

RETURN-TO-TRAJECTORY ASSUMPTIONS

If the aircraft is not on the lateral flight plan, predictions assume an immediate return to the active lateral leg with a 45° convergence angle, or that it will fly direct to the "TO" waypoint
R whenever the required convergence angle is greater than 45°. (Refer to 4.02.20).

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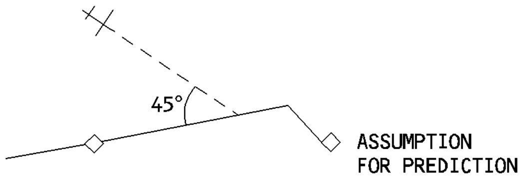

ENERGY CIRCLE

The energy circle is a green arc, centered on the aircraft's position and oriented towards the current track line. It is displayed on the NDs during descent, when HDG or TRK mode is selected. It represents the required distance to land from the aircraft's position down to airport elevation at VAPP speed, considering all speed constraints on the vertical profile.

PERF FACTOR

The PERF 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 aircraft's performance differs from the performance model stored in the FMGS database. 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
R database not exactly tailored for the given configuration. As a result, the aircraft or
R engine type identification on the MCDU's A/C STATUS page may not correspond to that
R 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 :
FFpred = FFmodel (1 + PERF FACT/100).
FFpred is the FF used for prediction.
FFmodel is the FF from the aero-engine model.
This correction is applied throughout the flight, and modifies the 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).

R **Procedure for modifying the PERF factor (on ground only) :**
R On the aircraft status page :
R – WRITE the new PERF factor.
R – INSERT using [6R] key.
R A manually-entered PERF factor is displayed in large blue fonts. Changing a PERF factor is
R usually the responsibility of maintenance, or Flight Operations.

PERF factor to be used on FMS 1 at delivery, depending on engine type :

– For CFM 56-5B engines only :
Depending on the engine type : CFM 56–5B SAC (Single Annular Chamber) or DAC (Double Annular Chambers), or /P and /2P (new LP and HP blade compressor), a negative performance factor has to be entered on the MCDU STATUS page to decrease the FMGS' predicted fuel consumption and match the actual fuel burnt.

		Non/P		/P	
		SAC	DAC	SAC	DAC
A321-111	CFM56-5B1	0.0	0.0	–2.0	–1.5
A321-112	CFM56-5B2	0.0	0.0	–2.0	–1.5
A321-211	CFM56-5B3	0.0	0.0	–2.0	–1.5
A321-212	CFM56-5B1	0.0	0.0	–2.0	–1.5
A321-213	CFM56-5B2	0.0	0.0	–2.0	–1.5
A320-214	CFM56-5B4	0.0	0.0	–3.0	–2.0
A319-111	CFM56-5B5	0.0	0.0	–4.5	–3.5
A319-112	CFM56-5B6	0.0	0.0	–4.5	–3.5
A319-115	CFM56-5B7	0.0	0.0	–4.5	–3.5

– For other engines :
A321-232 V2530-A5 : – 0.5 %
A321-231 V2533-A5 : – 0.5 %
A321-131 V2530-A5 : – 0.5 %
A320-233 V2527E-A5 : + 0.5 %
A320-232 V2527-A5 : + 0.5 %
A320-231 V2500-A1 : 0.0 %
A320-212 CFM 56–5A3 : + 0.5 %
A320-211 CFM 56–5A1 : + 0.5 %
A320-111 CFM 56-5A1 : 0.0 %
A319-133 V2527M-A5 : – 0.5 %
A319-132 V2524-A5 : – 0.5 %
A319-131 V2522-A5 : – 0.5 %
A319-114 CFM 56-5A5 : 0.0 %
A319-113 CFM 56-5A4 : 0.0 %
All these numbers assume a brand new aircraft, anti-ice OFF, air conditioning normal and Fuel Lower heating value (FLHV) of 18400 btu/lb. When FLHV goes up from 18400 to 18590, it's necessary to amend the performance factors by – 1.0 %.
When the aircraft ages, the degradation of the fuel consumption will be measured and arithmetically added to this number.

MANAGEMENT OF THE DISPLAYS

The flight management system displays navigation, performance, and guidance information on the :
- Multipurpose Control and Display Unit (MCDUs) ;
- Navigation Display (ND) of the Electronic Flight Instrument System (EFIS) ; and
- 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

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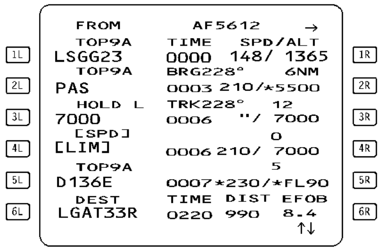
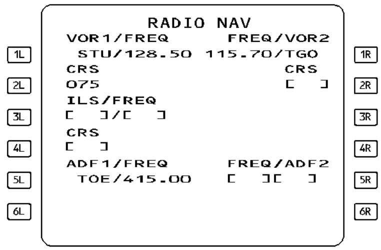


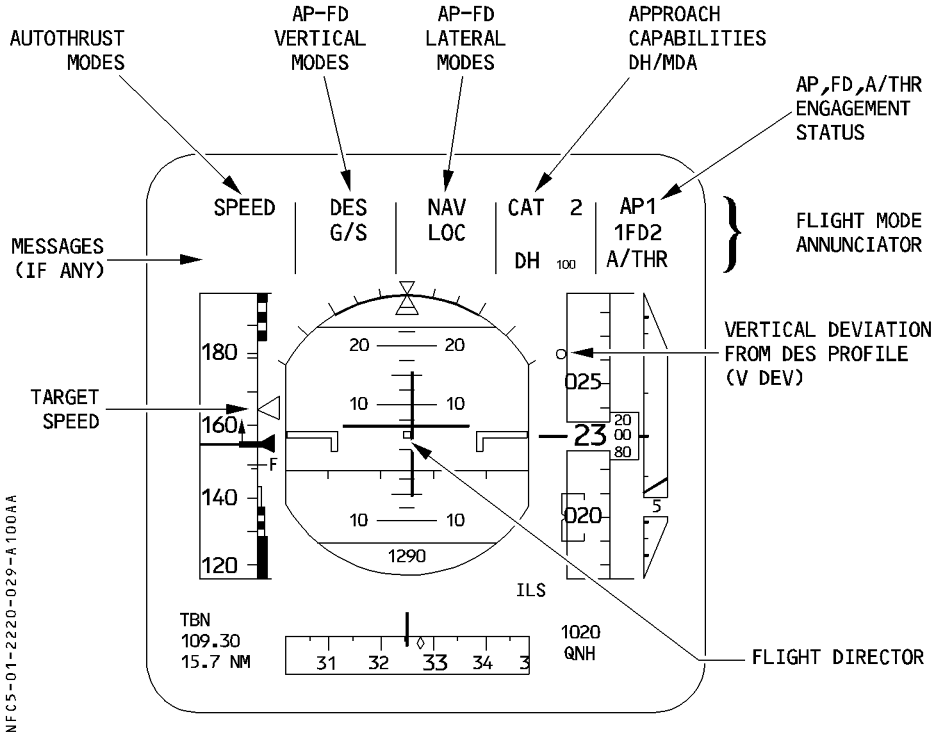
F-PLN A page



RADIO NAV PAGE

EFIS PRIMARY FLIGHT DISPLAY (PFD)

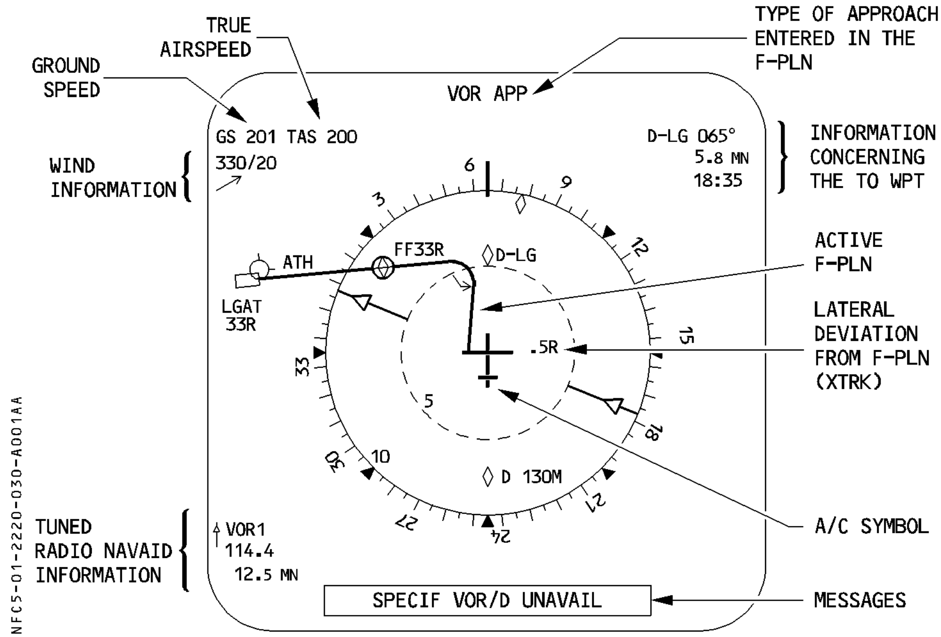
Flight Management (FM) generates the following information :
- Armed and engaged modes displayed on the Flight Mode Annunciator (FMA) ;
- FMGS guidance targets (SPD, ALT, HDG) ;
- Vertical deviation from descent profile ;
- Messages ;
- Navigation information.



Note : For more details on the EFIS PFD, refer to Chapter 1.31.

EFIS NAVIGATION DISPLAY (ND)

The FMGS generates the following information, displayed on the NDs :
- Flight plan (active secondary, temporary, dashed) ;
- Aircraft position and lateral deviation from the flight plan ;
- Pseudo-waypoints along the flight plan ;
- Raw data from tuned Navaids and type of selected approach ;
- Various display options (waypoints, Navaids, NDBs, airports, constraints) ;
- Wind information and various messages.



FLIGHT PLAN DISPLAY COLORS

	Primary flight plan	Managed mode : Steady green.
R		Selected mode : Dashed green.
	Track line	Steady green
	Alternate flight plan	Dashed blue
	Missed approach	Steady blue
R	Offset flight plan	Steady green (Original flight plan : Dashed green)
	Temporary flight plan	Dashed yellow
	Engine-out SID (not inserted)	Steady yellow
	Secondary, flight plan	Steady, dimmed white

GENERAL

The Flight Guidance (FG) part of the FMGS controls the :
– Flight Director (FD)
– Autopilot (AP)
– Autothrust (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.

R

GUIDANCE	**MANAGED modes**	**SELECTED modes**
LATERAL	NAV, APP NAV LOC*, LOC RWY RWY TRK GA TRK ROLL OUT	HDG-TRK
VERTICAL	SRS (T.O and G.A) CLB, DES ALT CST, ALT CST* ALT CRZ G/S*, G/S FINAL, FINAL APP FLARE	OP CLB, OP DES V/S, FPA ALT*, ALT EXPEDITE ⊲
SPEED	FMGC REFERENCE (ECON, Auto SPD, SPD LIM) EXPEDITE	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 " FINAL APP", 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 and FD pitch modes can control a target SPD/MACH or a vertical trajectory, and the A/THR mode can control a fixed thrust or a target SPD/MACH. However, the AP/FD and the A/THR cannot both control a target SPD/MACH simultaneously. Therefore the AP/FD pitch modes and A/THR mode are coordinated 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 SPD or MACH, the A/THR mode controls the thrust.
- If no AP/FD pitch mode is engaged, the A/THR mode reverts to controlling the SPD/MACH mode.

  In other words, the selection of an AP/FD pitch mode determines which mode the A/THR controls.

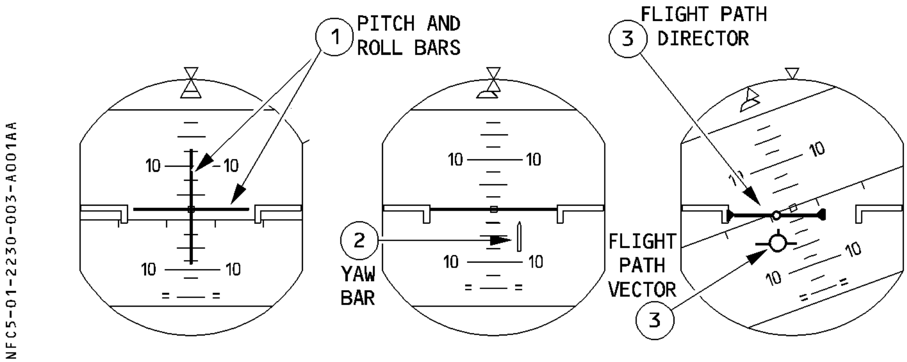
<table>
<tr><th>AP/FD pitch modes</th><th>A/THR modes</th></tr>
<tr><td>V/S – FPA
DES (geometric path)
ALT*, ALT
ALT CRZ*, ALT CRZ
ALT CST*, ALT CST
G/S*, G/S
FINAL, FINAL APP</td><td rowspan="2">SPEED/MACH MODE</td></tr>
<tr><td>AP/FD OFF</td></tr>
<tr><td>CLB/DES (idle path)
OPEN CLB/OPEN DES
EXP CLB/EXP DES
SRS</td><td>THR (CLB, IDLE) MODE</td></tr>
<tr><td>FLARE</td><td>RETARD (IDLE)</td></tr>
</table>

FLIGHT DIRECTOR

GENERAL

The Flight Director (FD) displays guidance commands from the Flight Management and Guidance Computer (FMGC) on the Primary Flight Display (PFD).
You may manually fly the aircraft , following FMGC guidance commands, or crosscheck the FMGC orders when the autopilot is engaged.
In normal operations, FD1 displays FMGC1 orders on the PFD1, and the FD2 displays FMGC2 orders on the 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).

R



The HDG V/S – TRK FPA pushbutton on the FCU enables 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.

R **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 track and flight path angle actually being flown.
- The Flight Path Director (FPD) symbol shows the pilot how to intercept and fly the vertical and lateral flight path defined by the FMGC.
  When the pilot superimposes the FPV and the FPD symbols, the aircraft is flying the commanded trajectory.

Yaw bar

The yaw bar is displayed in RWY mode on takeoff and in FLARE and ROLL OUT modes at landing.

FLIGHT DIRECTOR (FD) ENGAGEMENT

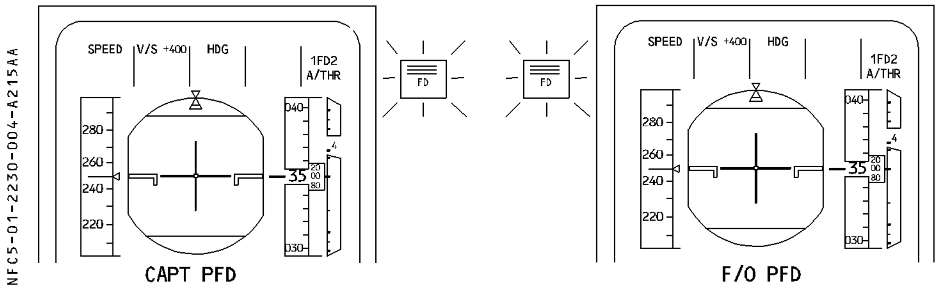
The FDs are engaged automatically whenever the FMGC powers up.

GROUND ENGAGEMENT

- The symbol “1 FD2” 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

The two FDs engage in the HDG V/S or TRK FPA mode (basic modes).



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

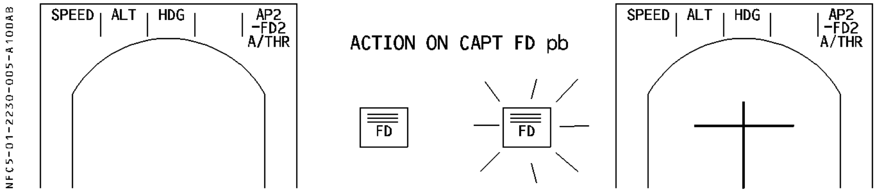
The flight crew may disengage one or two FDs manually, or FDs may disengage automatically if there is a failure.

MANUAL FLIGHT DIRECTOR DISENGAGEMENT

One FD off :

- The FD bars no longer appear on the associated PFD.
- The corresponding FD is disengaged.

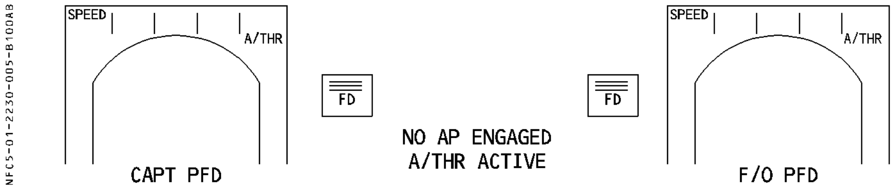
R



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.

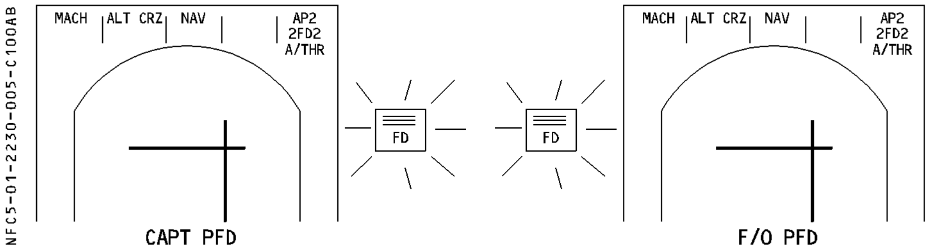
R



AUTOMATIC FLIGHT DIRECTOR DISENGAGEMENT

If one FD fails or one FMGC is not valid, both PFDs display the remaining FD.

R



AUTOMATIC DISENGAGEMENT DUE TO SPEED PROTECTION

When APs are not engaged and the pilot does not follow the FD bars to maintain the commanded trajectory, in climb with CLB or OP CLB, (or EXP CLB ◁*) engaged or in descent with DES or OP DES (or EXP DES ◁*) engaged the FDs will disengage at the activation of the automatic speed mode protection.
Refer to FCOM 1.22.30 AUTOMATIC SPEED MODE PROTECTION for the conditions of activation.

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 180 milliseconds (one computation cycle), a flip flop of master FMGC may occur.*
R *As a result, no vertical mode engages, the FMA 1st column, 1st line (A/THR mode)*
R *is blank, or displays dashes.*
Engaging V/S mode manually reselects the correct FMGC and restores the display.

FD WARNINGS

FD WARNINGS	CONDITIONS
Pitch FD bar (or FPV) flashes 10 seconds	– if the ALT* mode is lost further to FCU altitude reference change of more than 250 ft. – when in APPR mode (G/S*, G/S, LAND, FINAL) FD reverts to V/S mode (pilot action or loss of vertical approach mode) – one AP or one FD is engaged while both AP/FD were previously off.
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	– When in APPR mode (LOC*, LOC, LAND, APP NAV) FD reverts to HDG mode (Pilot action or loss of lateral approach mode). – One AP or one FD is engaged while both AP/FD were previously off.
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.

AUTOPILOT (AP)

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.

R The AP commands the :
R - position of the flight control surfaces for pitch, roll, and yaw
R - nose wheel position.

AP ENGAGEMENT

R The flight crew can engage AP1 or AP2 by pressing the corresponding pushbutton on the
R FCU if the aircraft has been airborne for at least five seconds.
R When one AP is engaged, the corresponding FCU pushbutton comes on and AP1 (or 2) is
R displayed on the FMAs.

Note :
- *One AP can be engaged on the 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.*

AP engagement is indicated by the lighting of the corresponding FCU pushbutton and by the appearance of "AP1" (or 2) 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 or moves on the rudder pedals above a threshold.

R – The pilot moves the pitch trim wheel beyond a certain threshold.
- The other AP is engaged, except when localizer/glideslope modes are armed or engaged, or when the rollout or go-around mode is engaged.
- Both thrust levers are set above the MCT detent and the aircraft is on the ground.
- The aircraft reaches the MDA- 50 feet (MDH-50 feet), or 400 feet AGL if no MDA/MDH, with APPR mode engaged and a non-ILS approach 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 (α prot + 1° is reached) ;
  · Pitch attitude exceeds 25° up, or 13° down, or bank angle exceeds 45° ;
  · A rudder pedal deflection is more than 10° out of trim.

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 "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 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 autopilots fail
  or both localizer transmitters or receivers fail
  or both glide slope transmitters or receivers fail.

SPEED/MACH CONTROL

In flight, either the AP/FD pitch control, or autothrust may acquire and hold a target speed or Mach number, depending on the engaged modes.
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 lit. 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).
- EXPEDITE mode is engaged ◁*.

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 -
R ECON or preset DES MACH/SPD - SPD LIM - SPD CSTR (if applicable) - HOLD SPD (if applicable) - VAPP

– If NAV mode is not engaged, the SPD/MACH constraints are not considered.
The SPD profile is :
V2 - SPD LIM - ECON CLB SPD/MACH - ECON CRZ MACH - ECON or preset DES MACH/SPD - SPD LIM - VAPP.

R *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.*
– *When expedite mode is engaged, the system disregards SPD LIM and SPD CSTR no matter what lateral mode is engaged.*
R – *The managed speed/Mach target may be set below maneuvring 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
R 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 SPD AUTO, SET
R HOLD SPD, or SET VFTO or SET GREEN DOT ◁*).

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 in SRS, G/S, LAND, and GO AROUND modes).
– The MCDU has a preselected speed for the next phase, and the aircraft transitions into that phase.
– The FMGC is powered up in flight.

DISENGAGEMENT CONDITIONS

The selected speed target disengages :
– when the managed SPD engages
– when the aircraft is on the ground at engine start.

R *Note : With engine running, the pilot can select a speed on the FCU only after takeoff.*

AUTO SPD

The pilot may insert the AUTO SPD (speed or Mach) on the PERF DES page to replace the ECON DES SPD.
In this case, the managed speed profile takes into account the selected value. The top of descent and the descent path are computed on AUTO SPD assumption.

SPEED/MACH SWITCHING

R – 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.

SPEED/MACH CROSS OVER TABLE.

ALTITUDE							
30500	280						
29500		290					
28500	295		300				
27500		305		310			
26500	300		315		325		
25500		310		325		330	
24500			320		335		350
MACH	0.76	0.77	0.78	0.79	0.80	0.81	0.82

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R *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.
- R In all other cases managed target speed reverts to selected, the value being the speed
R at the moment of the failure.

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 10 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).

AP/FD MODES GENERAL

R 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
ROLL OUT	Roll out mode. (Autoland)
GA TRK	Go around track mode
• 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.

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
	EXP CLB	Expedite mode in climb
	EXP DES	Expedite mode in descent
	V/S or FPA	Vertical speed mode or Flight Path Angle mode. Also called basic modes.
	ALT*	Altitude capture,
	ALT	Altitude Hold mode
	ALT CST*	Altitude constraint capture,
	ALT CST	Altitude constraint hold mode
R	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)

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.
R 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 APP NAV FINAL were previously engaged.

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 10 seconds or 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
R 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
R available. If the pilot rotates the HDG/TRK knob to set the value, it will remain displayed in
R 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

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.

DISARMING CONDITIONS

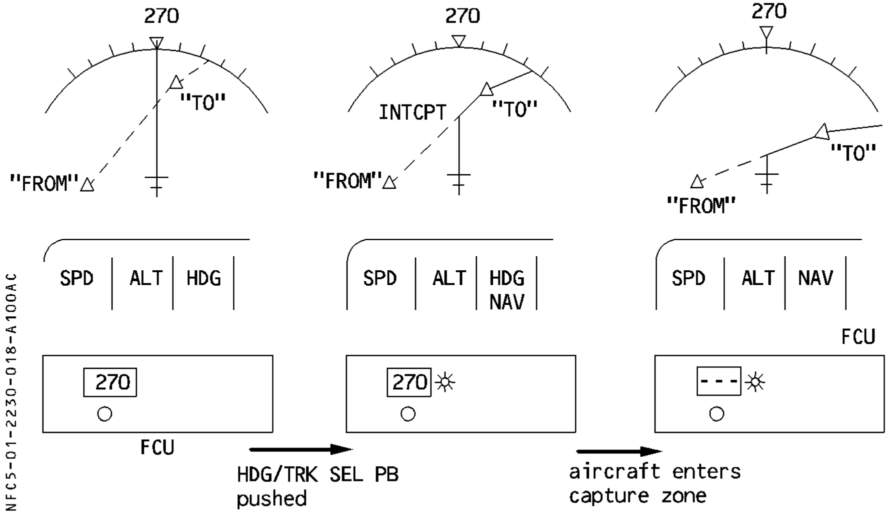
NAV mode disarms if one of the following occurs :

— 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.

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.

R



> **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.

INTERACTIONS WITH VERTICAL MODES

R 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.

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

R 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).

AP/FD VERTICAL MODES

Vertical modes guide the aircraft in the vertical plan.

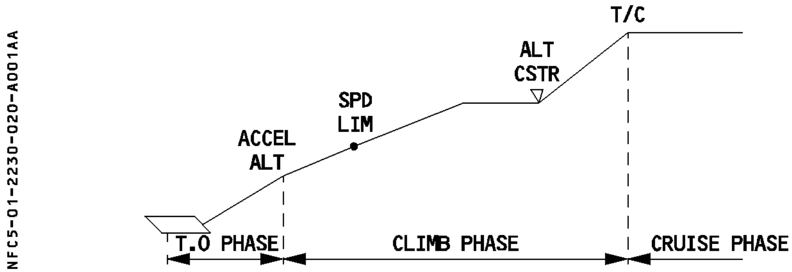
PRINCIPLES

R 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, or
- select EXPEDITE ◁*.

This arms ALT mode.

R 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.

- 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 the altitude constraint while ALT CSTR* or ALT CSTR (ALT* or ALT magenta ◁) 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 while ALT CSTR* or ALT CSTR (ALT* or ALT magenta ◁) mode is engaged.

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, 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 the current altitude is not an effective altitude constraint of the flight plan.

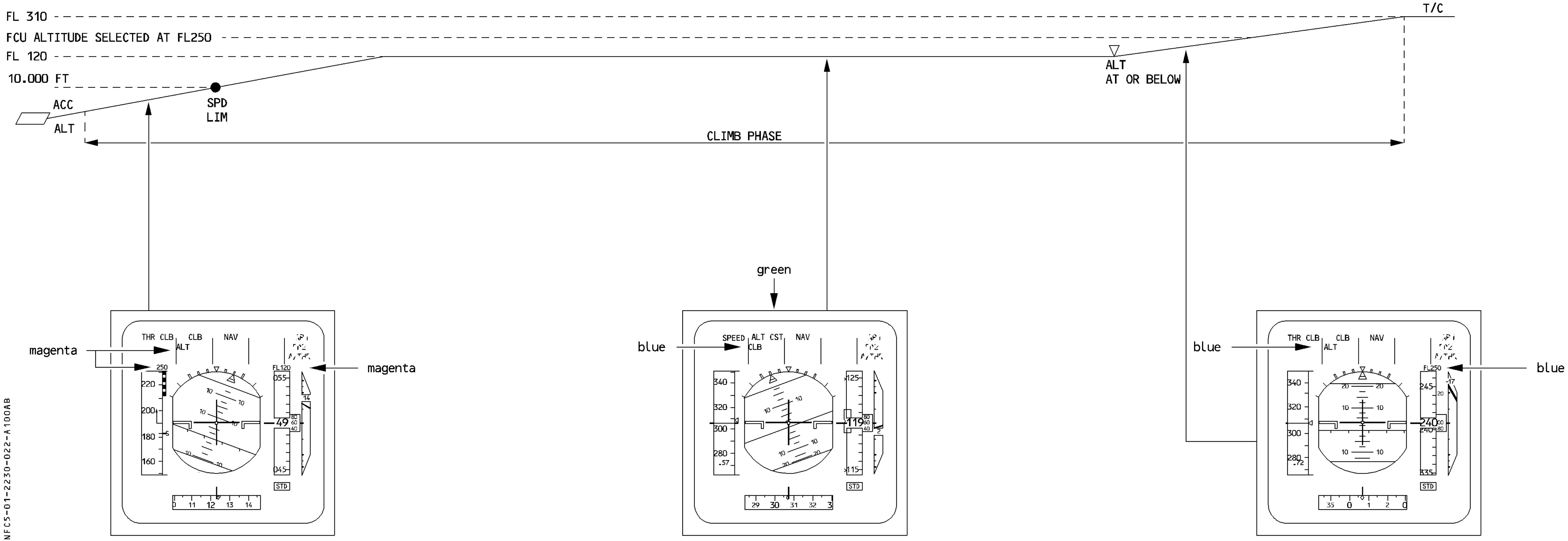
Note : When CLB mode is engaged :
- *The V/S (FPA) window of the FCU shows dashes.*
- *The managed LVL/CH dot on the FCU lights up.*
- *The Flight Mode Annunciator displays "CLB" in Column 2.*

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 the current V/S (FPA).

GUIDANCE

Climb mode gives the aircraft managed vertical guidance to the FCU selected altitude. It meets altitude constraints at waypoints either with managed speed incorporating speed constraints or with selected speed as target speed. The AP/FD pitch controls the speed or Mach number target and the A/THR is in thrust mode (CLB) corresponding to maximum climb thrust. The flight path may include several segments. R



· When CLB mode is engaged :
The system arms ALT and displays the applicable target altitude on the ALT scale.
– If the next predicted level-off is an ALT CSTR, ALT is magenta on the FMA and the ALT CSTR is displayed in magenta on the altitude scale.
– If the next predicted level-off is the FCU altitude, ALT is blue on the FMA and the FCU-selected altitude is displayed in blue on the altitude scale.
· The guidance does not modify the target speed in order to satisfy an altitude constraint. Therefore the constraint may not be met and may be predicted as missed.
· When the aircraft levels off at the ALT CSTR, CLB mode arms automatically, then engages when the aircraft passes the constrained waypoint (if the FCU altitude is above the constraint altitude).

OPEN CLIMB MODE (OP CLB)

The OPEN CLIMB mode is a selected mode. It uses the AP/FD pitch mode to maintain a SPD/MACH (selected or managed), while the autothrust, if active, maintains maximum climb thrust.

ENGAGEMENT CONDITIONS

The OPEN CLB mode can be engaged only if the following conditions are met :
- The aircraft has been in flight for more than five seconds.
- The LAND mode is not engaged.
- The FCU-selected altitude is higher than the aircraft present altitude.

The OPEN CLB mode is engaged by one of the following :
- The pilot pulls out the ALT selector knob.
- The aircraft reaches acceleration altitude with CLB mode armed and NAV mode not engaged.
- The pilot pulls out the SPD/MACH selection knob if TOGA mode or EXPED CLB ⊲*] is engaged.

R – Guidance reverts to ensure speed protection. (Refer to 1.22.30 reversions).
- The NAV mode is lost (or disengaged) when previously in CLB mode.

When OPEN CLB is engaged : "OP CLB" is displayed on the FMA and the managed LVL/CH dot on the FCU goes out.

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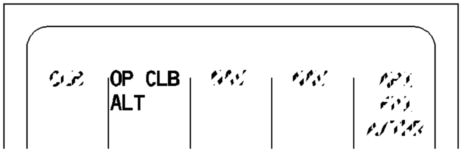


Typical FMA in OPEN CLIMB

DISENGAGEMENT CONDITIONS

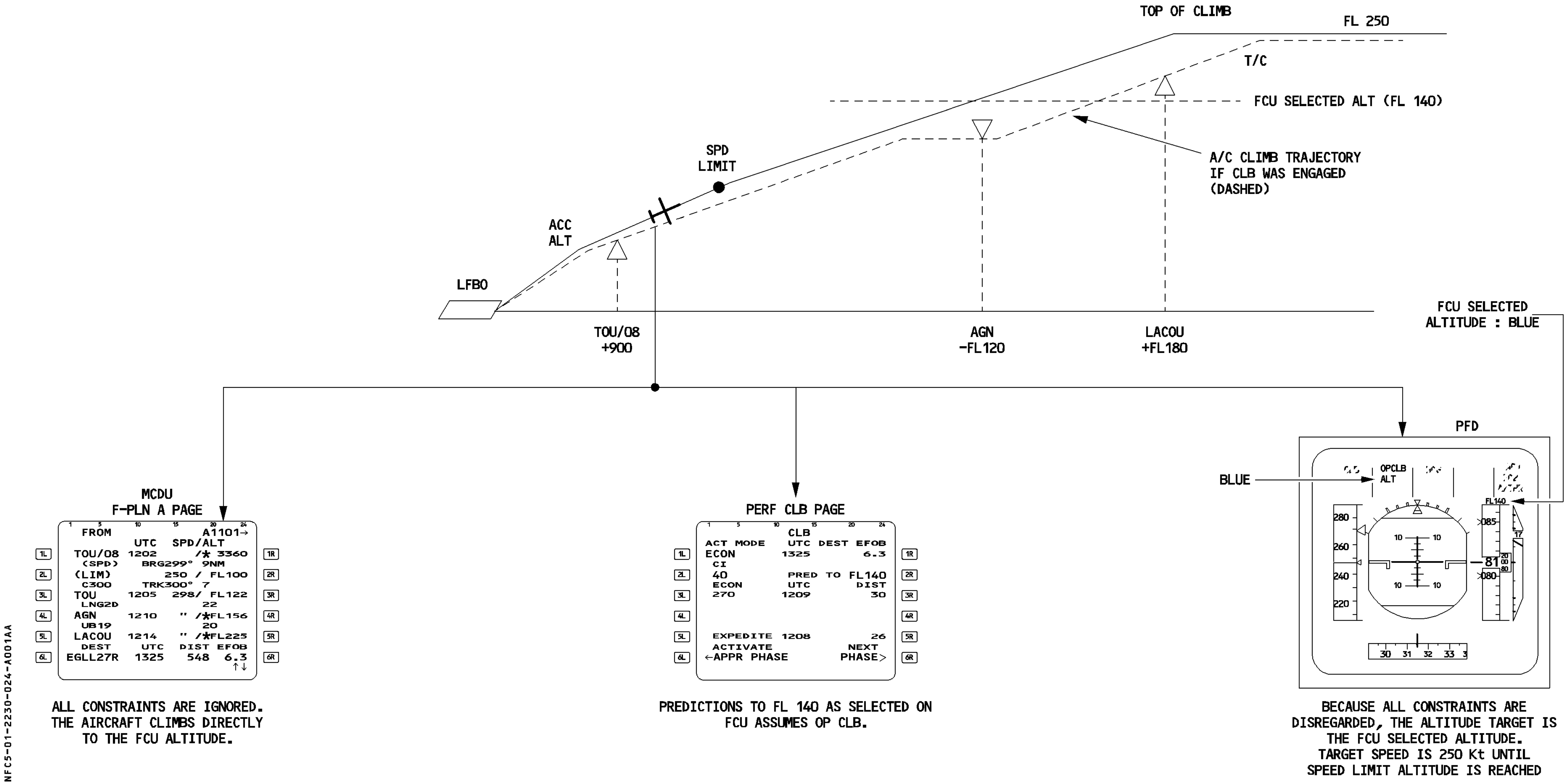
The OPEN CLB is disengaged by any one of the following :
- Engagement of any other vertical mode

R – Reversion to V/S mode (Refer to 1.22.30 reversions)
R – Selection of an altitude lower than the aircraft present altitude (V/S FPA engages on current V/S or FPA).

GUIDANCE

When OPEN CLB is engaged, the system maintains the target speed/Mach by adjusting the pitch with the elevator. The system may maintain thrust by use of autothrust, or the pilot may control it manually. The speed target may be either selected or managed.
R The OPEN CLB mode disregards all altitude constraints up to the FCU selected altitude.

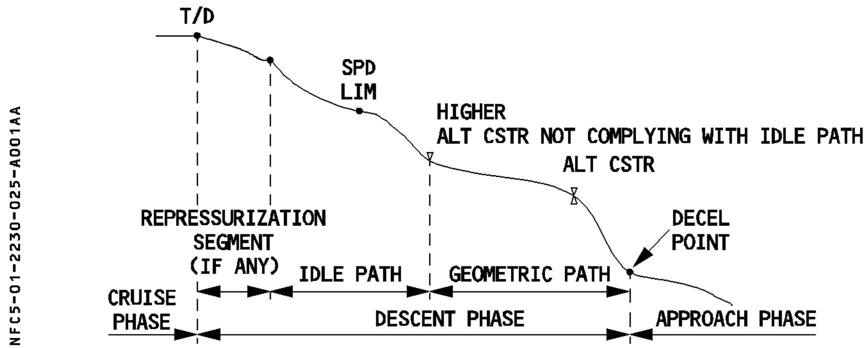
OPEN CLB modes, MANAGED SPEED



Note : If the change is less than 1200 feet in OPEN CLB mode, the aircraft responds with a rate of climb of 1000 ft/min.

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 touchdown 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.



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).

R **ARMING CONDITIONS**

R The DES mode is armed when an altitude constraint is captured and all the following
R conditions are met :
R – FCU-selected altitude is lower than present altitude.
R – NAV, LOC* or LOC mode is engaged.
R – Takeoff or go-around phase is not active.
R – Flight profile is available.

DISARMING CONDITIONS

The DES mode is disarmed if one of the following conditions is met :
- Engagement of another vertical mode.
- FCU-selected altitude is set above the aircraft current altitude.
- Loss of NAV, LOC*, or LOC mode.
- Switching to the go-around phase.
- Loss of vertical flight path validity.

R - Setting the FCU-selected altitude at an altitude constraint while ALT CSTR* (ALT*
R magenta ◁*) was engaged. (ALT* green engages and DES mode disarms).

ENGAGEMENT CONDITIONS

The DES mode can be engaged, when the following conditions are met :
- The FCU-selected altitude is lower than 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.

R · The aircraft sequences a waypoint with an altitude constraint, and DES mode is armed.
R The DES mode engages automatically.
R or
R · The pilot presses the ALT selector knob, while ALT CSTR* or ALT CSTR (ALT* or ALT
R magenta ◁*) is not engaged.
R or
R · The pilot presses the ALT selector knob, while ALT* or ALT is engaged, but the current
R altitude is not an effective altitude constraint of the flight plan.

Note : When DES mode is engaged :
- *The V/S FPA window of the 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 lost or disengaged and the V/S or FPA mode engages.
- Another vertical mode engages.
- The pilot selects an altitude on the FCU that is higher than the aircraft altitude, V/S /FPA) engages on current V/S (FPA)
- 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 :

R – Turns the ALT selector knob to set the cleared altitude.

– Pushes in the ALT selector knob.

R · 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.

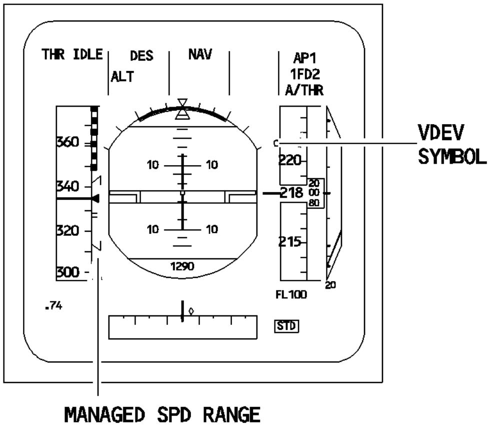
· If the aircraft is at or beyond T/D, it descends immediately at idle thrust.

During the descent :

The pilot sees a vertical deviation symbol (VDEV) along the ALT scale on the PFD and on
R 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 :

R – unexpected wind conditions is encountered or,
R – anti-icing is turned on or,
R – lateral flight plan is modified.



PFD display in managed DES mode.

VDEV value on the PROG page

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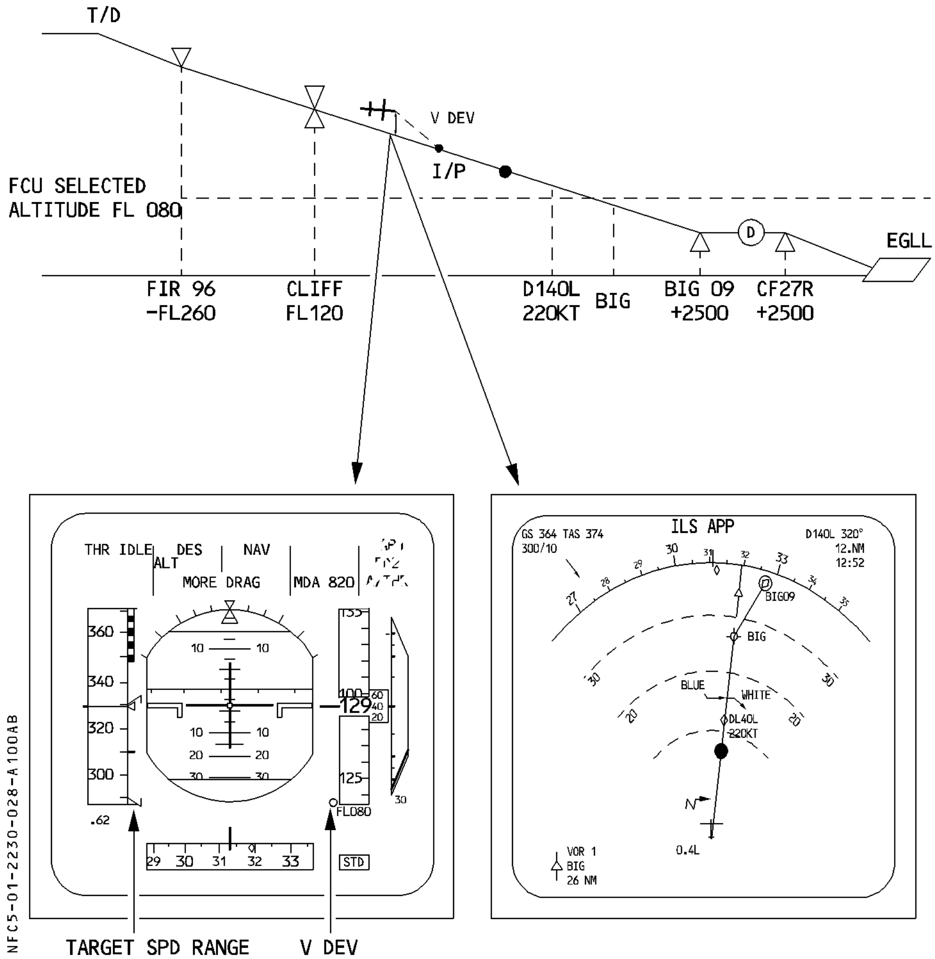
R When the speed is managed, a managed SPD range shows, on the PFD, acceptable speed
R variations around the nominal descent speed target (limited to ± 20 knots).

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 :**

R If the aircraft is above the descent profile, the speed will increase toward the upper limit
R of the managed speed range. If the speed reaches the upper limit, the aircraft will
R maintain the speed but will deviate from the profile (autothrust at idle).
The navigation display presents a pseudo waypoint ↯ (intercept point) along the flight
R 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 "AIRBRAKES" or "MORE DRAG" message depending upon the FMGS standard.

Note : With DES mode engaged, the speedbrakes extension will not necessarily increase the descent rate. It increases only if the aircraft is above path.

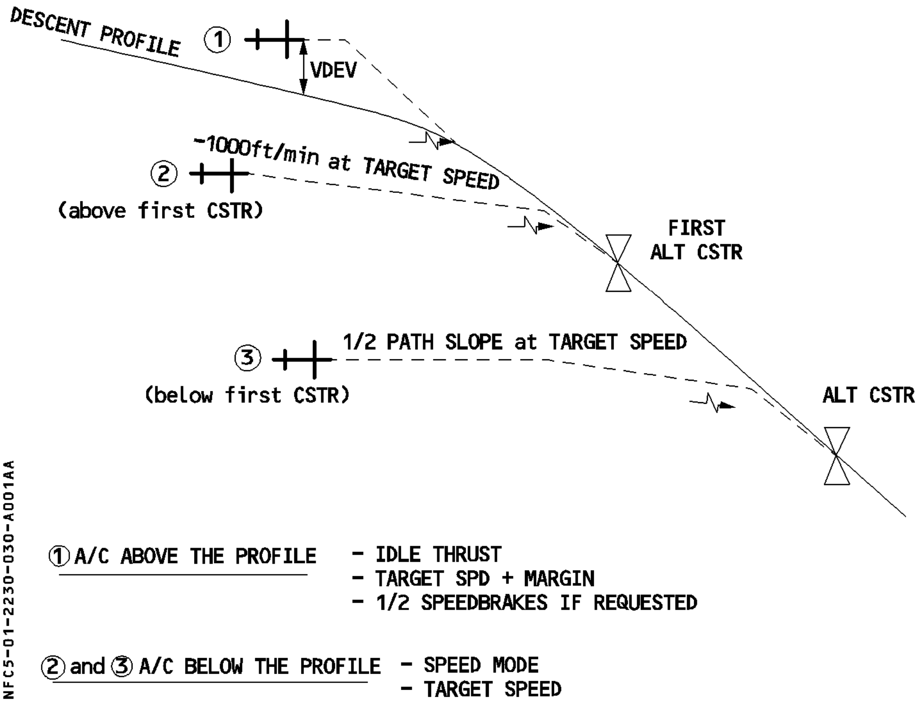
– **Aircraft below DES profile**

If the aircraft is below the DES profile, its speed will be maintained at target speed until
R 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 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 flight path angle (half of the theoretical FPA of the profile) 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.

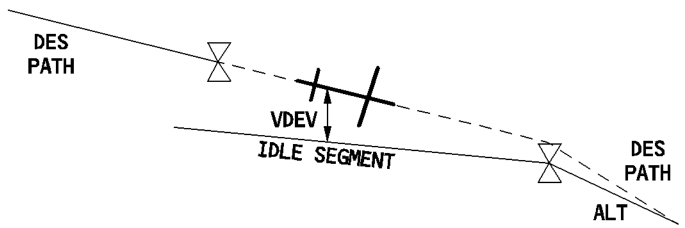
– **Guidance in a hold :**

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 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.
R The vertical deviation (VDEV) is based on the altitude at which the aircraft is supposed
R 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.

NFC5-01-2230-031-A100AA

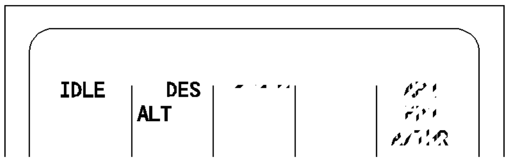


– **FMA display**

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 above the altitude scale.
When ALT CSTR (green) is engaged (aircraft flying at ALT CSTR), the system arms DES
R blue. When the aircraft meets the constraint, DES engages again 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.

NFC5-01-2230-031-B100AA



Typical FMA in DES

R **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 one of the following :

R – Pulling out the ALT selection knob.
R – Selecting a manual speed when EXP mode is engaged. ◁

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.*

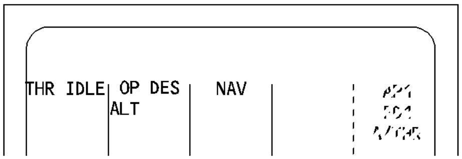
DISENGAGEMENT CONDITIONS

R – Manual engagement of another vertical mode.
R – 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 either be selected or managed.
The OPEN DES disregards all altitude constraints.

NFC5-01-2230-033-A100AA



Typical FMA in OPEN DES

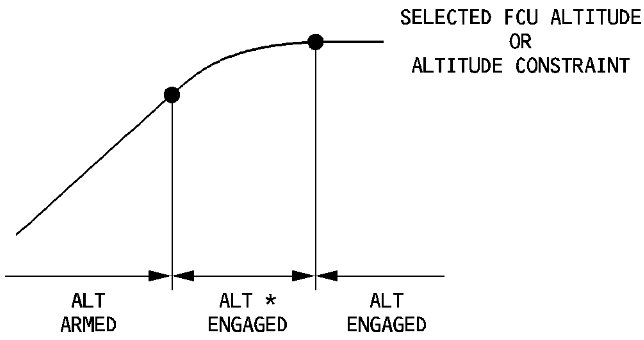
ALTITUDE ACQUIRE MODE (ALT*, ALT CSTR*)

ALT* mode guides the aircraft to acquire the FCU-selected altitude.
R ALT CSTR* guides the aircraft to acquire an altitude constraint, provided by Flight
R Management.
R Once the aircraft has reached the altitude, the altitude mode (ALT or ALT CSTR green) engages.

ENGAGEMENT CONDITIONS

The mode engages when the aircraft reaches the altitude capture zone, defined by the aircraft vertical speed (among other parameters).

NFC5-01-2230-033-B100AA

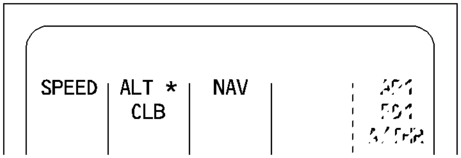


Note : ALT and ALT CSTR* cannot be engaged below 400 feet, if either the takeoff or the go-around mode is engaged.*

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.

NFC5-01-2230-034-A105AA



Typical FMA in ALT *

GUIDANCE

The ALT* and ALT CSTR* modes have internal V/S guidance that is a direct function of the difference between present altitude and the altitude target.
The system switches automatically to ALT (altitude hold) when the altitude deviation becomes less than 20 feet.
R ALT* and ALT CSTR* modes have internal protections that decreases the vertical speed
R when VLS or VMAX is reached (VLS or VMAX becomes the priority target).

R *Note* : – *If the baro setting is changed during ALT*, this may lead to an FCU target*
R *overshoot due to the change of the current value of the altitude. However ALT**
R *mode will allow the FCU altitude to be regained.*
R – *For aircraft equipped with QFE option, a switching from STD to QFE (or vice*
R *versa) in ALT CSTR*, will change the target value and a reversion to V/S may*
R *occur if the target value is modified of 250 feet or more.*

R **ALTITUDE HOLD MODE (ALT/ALT CST/ALT CRZ)**

R The ALT mode maintains a target altitude. This target altitude is either the FCU selected altitude or an altitude constraint delivered by Flight Management.

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

- The ALT mode is engaged automatically when the difference between present altitude and the target altitude becomes less than 20 feet with ALT* engaged.

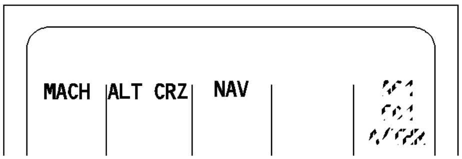
DISENGAGEMENT CONDITIONS

The ALT mode disengages when any other vertical mode engages.

GUIDANCE

- The altitude that ALT mode holds is the altitude it memorized when engaged. It is not affected by a change of reference in the ALT window or by a change in the barometric correction.
- When ALT is engaged, the FMA displays “ALT” in green (FCU altitude hold) or ALT CSTR in green if it is an altitude constraint.

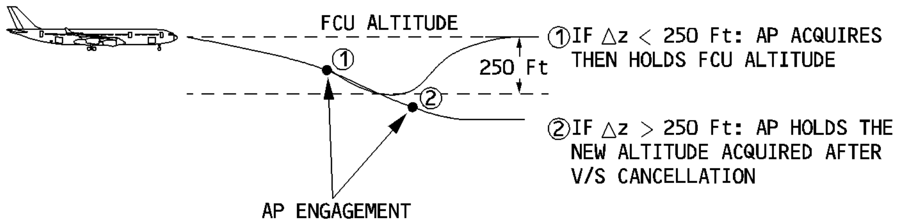
NFC5-01-2230-035-A200AA



typical FMA in ALT MODE

- 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.

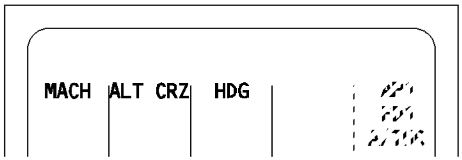
NFC5-01-2230-036-A100AB



SOFT ALTITUDE

R On reaching the planned cruise altitude, ALT CRZ engages and A/THR maintains the
R speed/mach target.
R Two minutes after ALT CRZ engages, if the mach mode is operative, SOFT ALT mode
R engages. This allows the aircraft to deviate ± 50 feet from the target altitude, thereby
R minimizing thrust variations and reducing fuel consumption.

NFC5-01-2230-036-B100AA

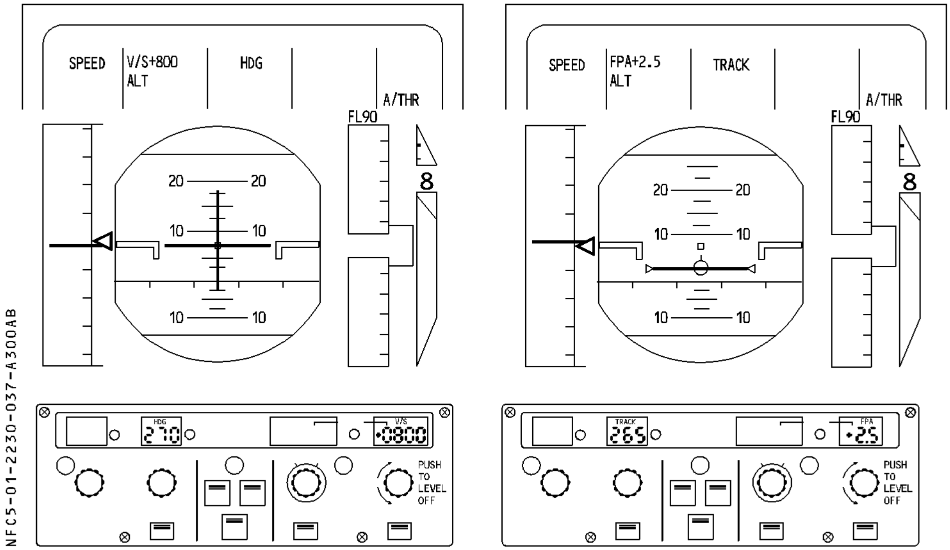


FMA in SOFT ALT HOLD MODE

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.

R



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, or EXP DES⊲ mode.
- Select a lower altitude than present altitude when in CLB, OP CLB, or EXP CLB⊲ modes.

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

DISENGAGEMENT CONDITIONS

The pilot can disengage the V/S mode manually by :
– pulling or pushing the altitude selector knob
– pushing the EXPED pushbutton ◁* or
– 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.

Note : If the pilot sets V/S = 0 or pushes the V/S-FPA pushbutton to level off (if the push to level off function is installed), it automatically sets the V/S or FPA target to zero and the aircraft levels off and maintains its altitude.

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LEFT INTENTIONALLY BLANK

MODE REVERSIONS

There are several types of mode reversions. Each one observes a specific logic that can be described as follows :

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.
- The managed speed profile includes :
  V2 - SPD CSTR (if applicable) - SPD LIM - ECON CLB SPD/MACH - ECON CRZ MACH - ECON DES (AUTO SPD) - SPD/MACH - SPD CSTR - SPD LIM - HOLD SPD - VAPP/GS MIN

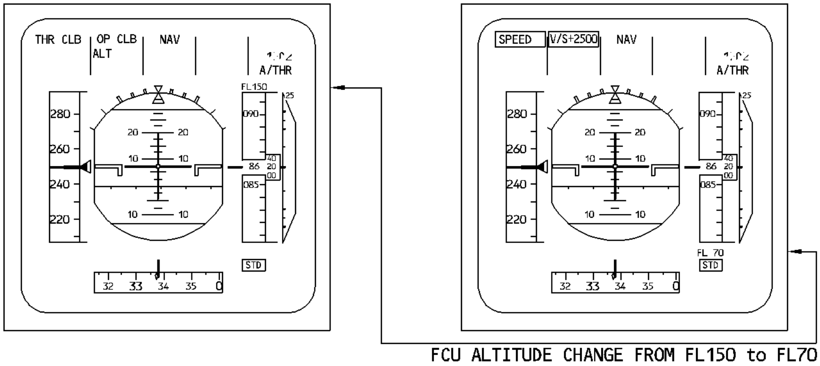
R It is valid for all vertical modes, except EXPEDITE (⊲*).

· **When NAV mode is not engaged :**
The FMGS considers that the flight plan is not followed, and ignores all speed and altitude contraints linked to the flight plan waypoints. As a result :
- The managed vertical CLB and DES modes are not available.
- The managed SPD profile disregards the speed constraints and includes :
  V2 - SPD LIM - ECON CLB - ECON CRZ - ECON DES (AUTO SPD) - SPD LIM - VAPP/GS MIN target.

As a consequence : When NAV mode disengages (manual or automatic)
- CLB mode, when engaged, reverts to OPEN CLB.
- DES mode, when engaged, reverts to V/S mode on current value.
- Speed and altitude constraints are disregarded (but speed limit is retained).

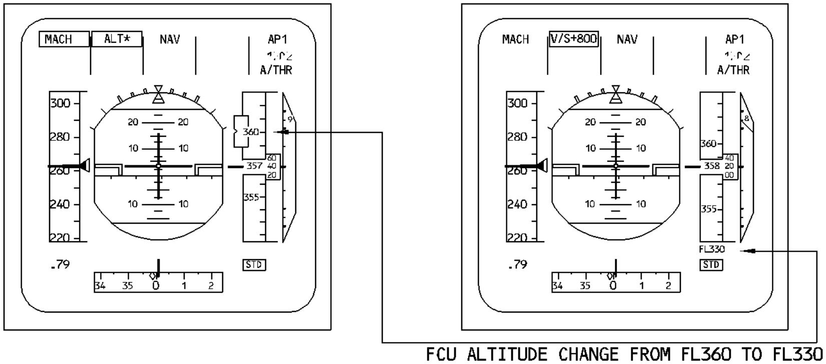
MODE REVERSION DUE TO FCU ALTITUDE CHANGE

1. 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 not compatible with the active open mode, a mode reversion occurs and V/S (or FPA) engages on current V/S (or FPA).
   This reversion applies to CLB, OP CLB, DES, OP DES, EXP DES ◁*, EXP CLB ◁*.
   e.g. : Reversion from OP CLB to V/S



NFC5-01-2230-040B-A100AA

2. If ALT* being engaged, the target altitude is changed of <u>any</u> value greater than 250 feet, V/S (or FPA) engages on currents V/S.
   Also Refer to mode reversion table p 45.



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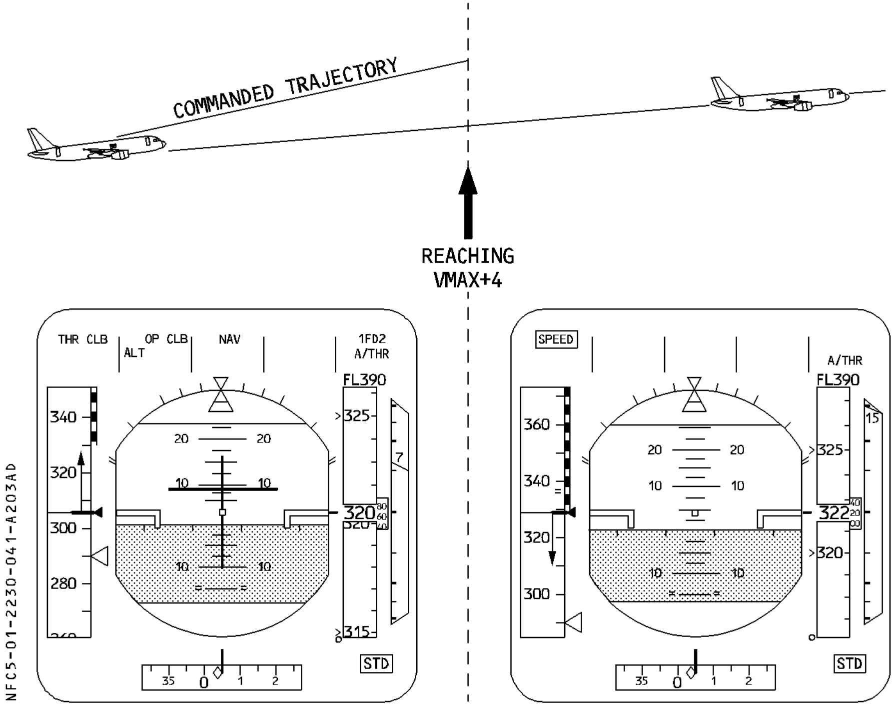
AUTOMATIC SPEED MODE PROTECTION

FDs are engaged in an OPEN mode in climb with AP not engaged

R If FDs are engaged in CLIMB or OPEN CLIMB mode or EXP CLB (if installed) 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.

R Both FDs disengage when VMAX+4 is reached (VMAX being VMO, VLE or VFE). The A/THR, if active, reverts to SPEED mode, and reduces the thrust to recover the speed target.

R



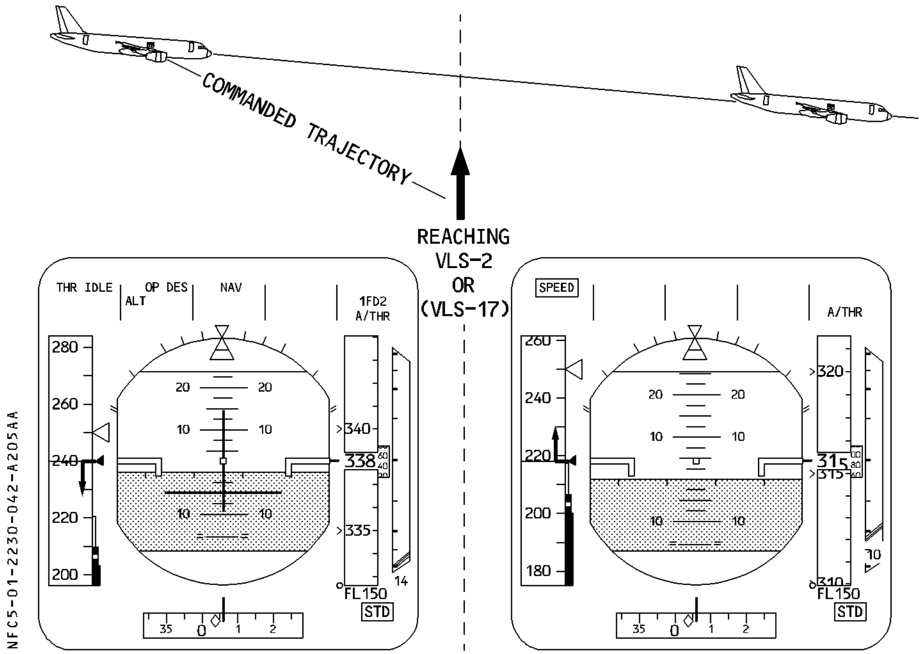
AUTOMATIC SPEED MODE PROTECTION

FDs are engaged in an OPEN mode in descent with AP not engaged

R If FDs are engaged in DES or OPEN DES mode or EXP DES (if installed) and if the pilot does not follow the FD bars to maintain the commanded descent, the aircraft decelerates (pitch too high and autothrust in IDLE).

R Both FDs disengage when VLS-2 (or VLS-17 if speedbrakes extended) is reached.
The A/THR if active, reverts to SPEED mode, and increases the thrust to recover the speed target.

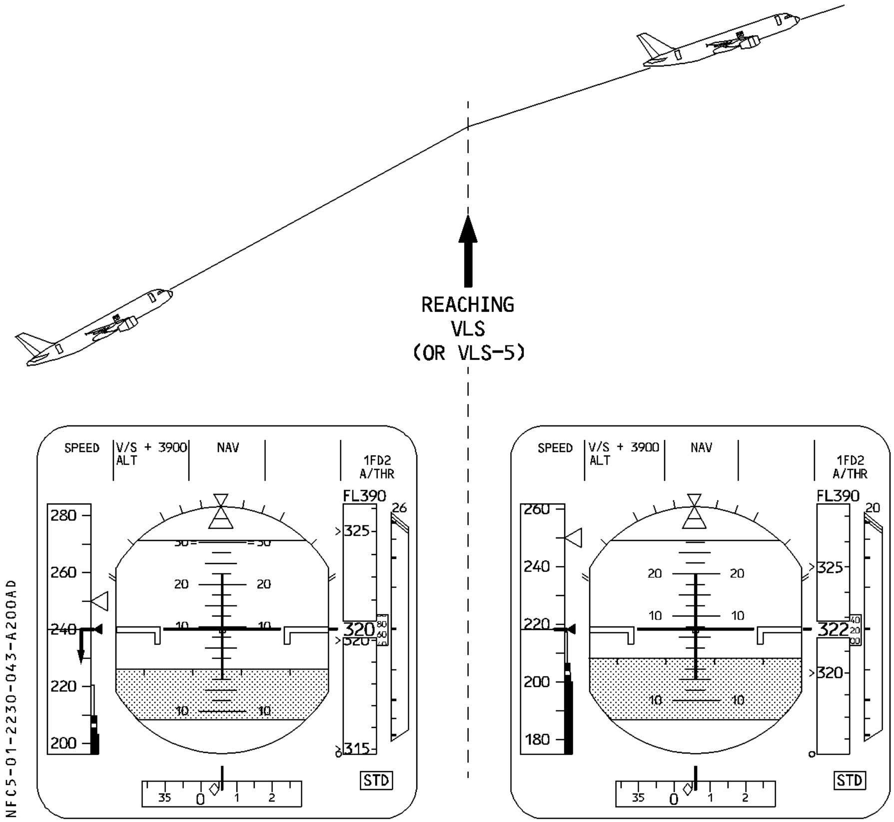
R



AUTOMATIC SPEED PROTECTION IN VERTICAL SPEED MODE

During climb

If the selected target V/S or FPA is too high (relative to the thrust condition and speed), the FMGS maintains the target V/S or FPA but the aircraft decelerates and the indicated
R airspeed decreases. When reaching VLS (or VLS-5 if the speed target is VLS), the selected V/S or FPA target is temporarily abandonned to maintain VLS but V/S mode remains engaged.
R



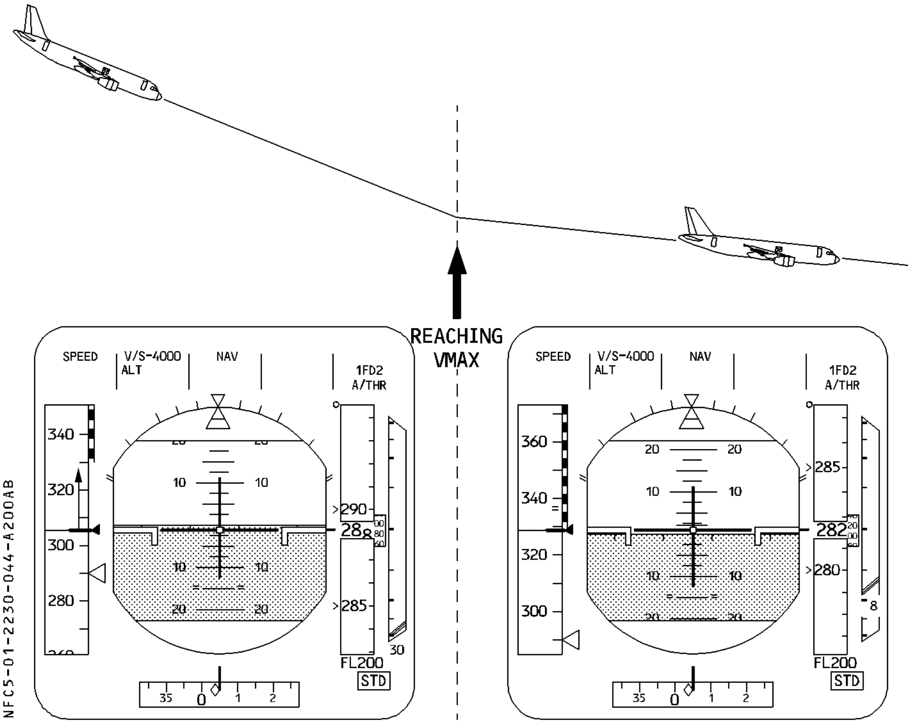
R The FMGS automatically decreases the vertical speed to maintain VLS.
R The target V/S does not change but is no longer followed.

AUTOMATIC SPEED PROTECTION IN VERTICAL SPEED MODE

During descent

If the selected target V/S or FPA is excessive, the FMGS maintains the target V/S or FPA
R but the aircraft accelerates towards VMAX (VMO or VLE in clean, or VFE + 2 knots). When reaching VMAX, the selected V/S or FPA target is temporarily abandoned to maintain VMAX but V/S mode remains engaged.

R



R The FMGS automatically decreases the vertical speed to maintain VMAX.
R The target V/S does not change but is no longer followed.

MODE REVERSIONS (SUMMARY)

R On aircraft equipped with the global speed protection, there are only 2 types of reversion:

Reversion due to a change of the FCU selected altitude

Vertical mode engaged	FCU altitude selection change	Vertical mode switches to
CLB - OPEN CLIMB EXPED CLIMB	BELOW AIRCRAFT ALTITUDE	V/S on current V/S
DES - OPEN DESCENT EXPED DESCENT	ABOVE AIRCRAFT ALTITUDE	
ALT* ACTIVE	ANY CHANGE	

Reversion due to loss of NAV mode (manual or automatic)

CONDITIONS	EVENT	CONSEQUENCE
CLB engaged	Loss of NAV mode	OP CLB engages
DES engaged		V/S engages

R **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 (APP NAV FINAL)
— In go around : Go around track associated to SRS vertical modes.
These modes are engaged simultaneously on both axes.

<table>
<tr><th colspan="2">COMMON MODES</th><th>VERTICAL</th><th>LATERAL</th></tr>
<tr><td colspan="2">TAKEOFF</td><td>SRS</td><td>RWY
RWY TRK</td></tr>
<tr><td rowspan="3">APPROACH
MODES</td><td rowspan="2">ILS
APPROACH</td><td>G/S*
G/S</td><td>LOC*
LOC</td></tr>
<tr><td colspan="2">LAND, FLARE,
ROLL OUT</td></tr>
<tr><td>NON
ILS
APPROACH</td><td>FINAL</td><td>APP NAV</td></tr>
<tr><td colspan="2">GO AROUND
(GA)</td><td>SRS</td><td>GA TRK</td></tr>
</table>

TAKEOFF

Takeoff mode combines the vertical mode of the Speed Reference System (SRS) with the RWY lateral mode.
Both are engaged simultaneously, but they may be disengaged separately.
Takeoff mode is available :
– during the takeoff run and initial climb on the FD
– five seconds after lift-off on AP.

R SRS (SPEED REFERENCE SYSTEM)

This vertical mode controls pitch to steer the aircraft along a path in the vertical plane at a speed defined by the SRS guidance law.

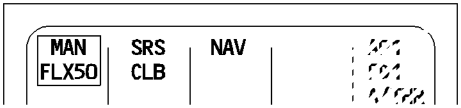
– **Engagement conditions**
The SRS mode engages automatically when the thrust levers are set to the TOGA detent or the MCT/FLX detent if :
· V2 is inserted in the MCDU PERF TO page.
· Slats are extended.
· The aircraft has been on the ground for at least 30 seconds.

– **Disengagement conditions**
The mode disengages :
· manually when another vertical mode engages
· automatically when the aircraft reaches acceleration altitude or an FCU selected altitude (if it is lower than the ACCEL ALT but above 400 feet RA).

– **Guidance**
R The pitch reference is :
· V2 + 10 knots in normal engine configuration
· the current speed or V2, whichever is greater, if the FMGS detects an engine failure.
R The guidance law also includes :
· attitude protection to reduce aircraft nose-up during takeoff (18° or 22.5° maximum in case of windshear)
· flight path angle protection that ensures a minimum vertical speed of 120 ft/min.

Note : If during takeoff the pilot inadvertently sets on the FCU an altitude below present altitude, the aircraft will remain in SRS mode until the pilot takes some other action.

NFC3-01-2230-047-A200AA



Typical FMA at takeoff with a Flex temperature

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
R 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, 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".

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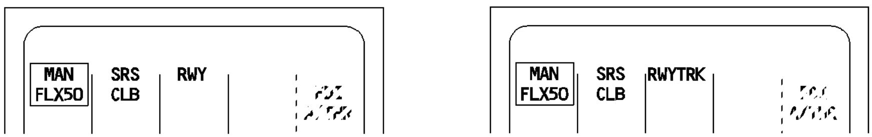

Typical FMA with RWY mode engaged.

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 revison 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 FINAL and APP NAV.

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 when the approach pushbutton of the FCU is pressed 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.

Check approach guidance message

If the pilot inserts a non-ILS approach into the flight plan, and then uses the RAD NAV page to tune an ILS manually, 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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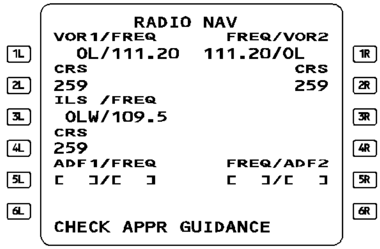


Example : OLW was manually entered on the RAD NAV page although a VOR approach is selected in the flight path.

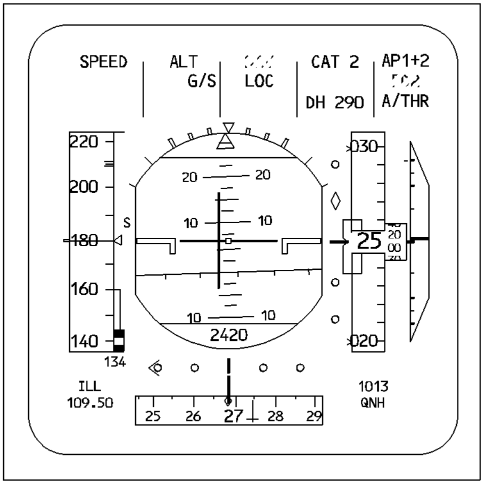
R **(ILS) APPR MODE**

Arming conditions

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 and RA are 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 FMA. Both modes will automatically engage when conditions are met.
– Second autopilot may be engaged.
– Current landing capability is displayed on the FMA.

Disarming conditions

ILS APPR mode is disarmed, if the aircraft is above 400 feet and :
– 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 FPA mode engages if the G/S mode was engaged.
– When the pilot presses the LOC pushbutton, only the G/S mode disarms.
  · The V/S (FPA) mode engages, if the G/S mode was engaged.
R – When the pilot pulls the HDG/TRK selector knob.
R – When the pilot engages the go-around mode.



LOC AND G/S ARMED

NFC5-01-2230-051-A001AA

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 FMGC standard for G/S engagement. The FMA displays "LOC*", or "G/S*", or both, in green.

Nevertheless, the 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.

When the aircraft is established on the LOC axis, the LOC mode engages.
When the aircraft is established on the G/S axis, the G/S mode engages.
The FMA displays "LOC" and "G/S" in green. The AP/FD guides the aircraft along the G/S
R down to 30 feet, and along the LOC during the flare and rollout.

Disengagement conditions of LOC and G/S modes

If the aircraft is above 400 feet, the (ILS) APPR mode disengages when the pilot :
- Presses the APPR pushbutton, HDG V/S or TRK FPA engages.
- Presses the LOC pushbutton, the LOC mode remains engaged. The system reverts to V/S (FPA), if G/S was engaged.
- Pulls out the V/S FPA selector knob, the system reverts to basic modes (HDG V/S or TRK FPA engages).
- Pulls out the HDG/TRK selector knob, HDG V/S or TRK FPA engages.
- Engages the go-around mode.

Note : G/S or G/S modes may be engaged above the operating range of the radio altimeters (8000 feet for TRT, and 5000 feet for Collins and Honeywell RA). The landing capability displayed on the FMA will reflect the lack of RA validity (CAT 1) until the radio altimeters become active.*
But, if the radio altimeters fail, or if the FMGS receives no radio altimeter data, LOC, G/S, and AP/FDs will disengage and FDs will re-engage on basic modes.

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 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 “RWY/ILS MISMATCH” message is displayed on the scratchpad ;
– The pilot should select HDG mode to perform the LOC capture.

Note : There is no glideslope capture assistance. The pilot shall ensure that the aircraft flight path intercepts the G/S 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 the 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 CAT1 and the triple click is generated. No autoland is
R *authorized with CAT1 displayed on the FMA.*

FLARE MODE

Once the aircraft reaches approximately 40 feet RA (the precise value is a function of V/S):
- The FLARE mode engages.
- The FMA displays “FLARE” in green.

At 30 feet RA, the aircraft flares on the pitch axis. If autothrust is active, thrust reduction is activated.
When both AP/FDs are disengaged, FLARE mode disengages.
After main landing gear touchdown, the autopilot (if engaged) sends a nose down order.

R **Align sub-mode**

R Align is a sub-mode of LAND also known as "decrab" that lines up the aircraft's axis with
R the ILS course at approximatively 30 feet. It is not displayed to the crew.

ROLL OUT MODE

At touchdown, the 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

During an ILS approach, autothrust controls the speed, and the speed target may be selected or managed.
Autothrust memorizes the approach speed at 700 feet RA, so that it can continue to fly a stable approach even if the FMGS fails.

TYPICAL ILS APPROACH

R

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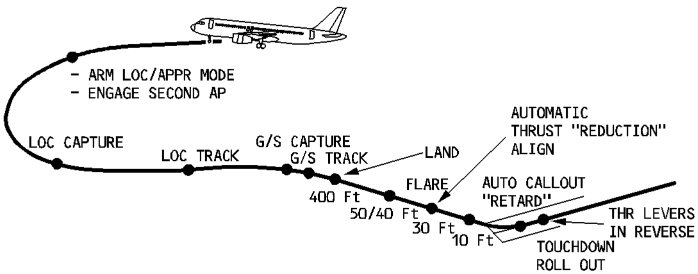


AUTOLAND WARNING LIGHT

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.
R 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

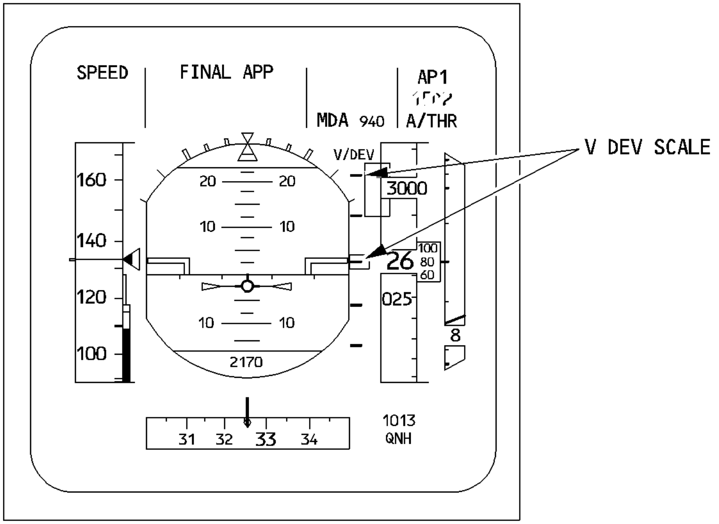
R Each FMGC computes its own automatic landing capability.
The FMA displays "CAT1", "CAT 2", "CAT 3 SINGLE" or "CAT 3 DUAL" messages as soon as the APPR pushbutton is pushed in to arm ILS approach modes (Refer to 4.05.70).

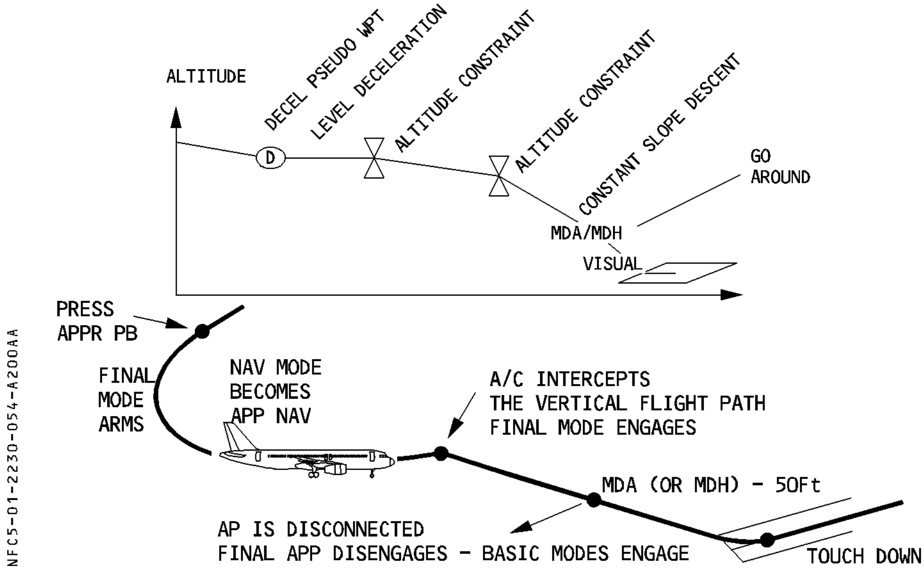
NON PRECISION APPROACH MODE

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





The NON ILS approach includes the following managed modes :
APP NAV mode for lateral guidance
FINAL mode for vertical guidance

SELECTION

A NON ILS approach (VOR, VOR/DME, NDB, RNAV) is selected, if the active flight plan calls for it (and it has been inserted in that flight plan).

ARMING CONDITIONS

The pilot arms the APP NAV and FINAL modes by pressing the APPR pushbutton on the FCU, if all of the following conditions are met :
– The aircraft is above 400 feet AGL.
– The flight plan is valid (lateral and vertical profile).
– The active flight plan has selected a NON ILS approach.
– GA mode is not engaged.
The FMA displays "FINAL" and "APP NAV" in blue.
If NAV mode was already engaged, APP NAV engages immediately.

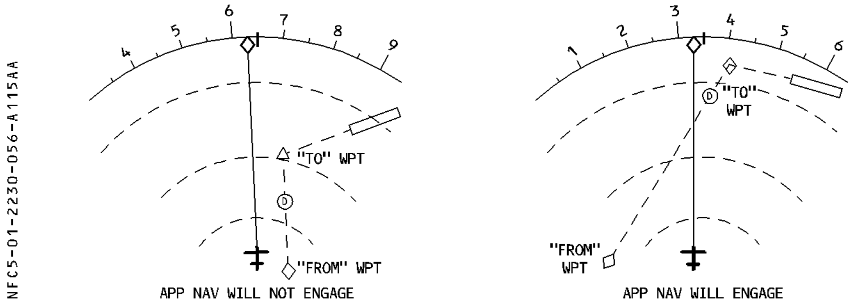
DISARMING CONDITIONS

FINAL and NAV modes are disarmed if the pilot :
– Presses the APPR pushbutton, or
– Presses the LOC pushbutton arming the LOC mode, or
– Engages the 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 (aircraft track line must intercept the flight plan active leg).
FINAL mode engages, if :
– APPR phase is active, and the deceleration point has sequenced, and
– APP NAV is engaged, and
– Crosstrack error is less than 1.5 NM, and
– FINAL is armed, and
R – The aircraft intercepts a descending leg of the vertical flight path, or
R – In V/S (FPA) or OPEN DES, the aircraft intercepts a level-off segment of the vertical
R flight profile, with an FCU-selected altitude different from this level-off segment.

The “TO” waypoint is displayed in a white color on the ND and MCDU.



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 and HDG V/S or TRK FPA mode engages)

R R — If the pilot pulls out the HDG TRK selector knob, the FMGS reverts to basic modes HDG V/S or TRK FPA

R R — If the pilot engages V/S or FPA mode, FINAL APP NAV disengages and basic modes HDG V/S or TRK FPA engage.

- Automatically at MDA (or MDH) – 50 feet or 400 feet AGL if no MDA/MDH entered.
- When the GO AROUND mode engages.

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 (± 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 disengages automatically at MDA (or MDH) – 50 feet.
FD modes revert to basic HDG-V/S or TRK-FPA.

WARNING

If, during a non ILS approach, the GPS PRIMARY function is lost, a triple click aural warning is triggered.

GO AROUND (GA)

Go-around mode combines the speed reference system (SRS) vertical mode with the 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 the ground for less than 30 seconds (AP disengages and can be re-engaged five seconds after lift-off).
- FD bars are automatically restored in SRS/GA TRK modes.
  If FPV/FPD was previously selected, it reverts to FD bars.
  The FMA displays "SRS" and "GA TRK" in green.

R **DISENGAGEMENT CONDITIONS**

- SRS mode disengages :
  - When the pilot engages another vertical mode.
  - When the pilot selects a speed while in SRS mode, SRS reverts to OP CLB.
  - Automatically, at go-around acceleration altitude (GA ACC ALT) or when ALT* engages, whichever occurs first (above 400 feet).
- GA TRK disengages when the pilot engages another lateral mode above 100 feet RA.

Note : In dual AP configuration, disengagement of the GO AROUND mode on either axis causes AP2 to disconnect.

GUIDANCE

- The SRS guidance law maintains the speed the aircraft had at GA engagement or VAPP, whichever is higher. At ACC ALT, the target speed becomes Green Dot Speed.
- GA TRK mode guides the aircraft along the track the aircraft was following at mode engagement.

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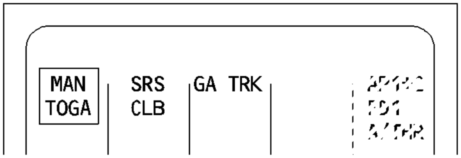


Typical FMA in Go Around

AUTOTHRUST

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 both engines simultaneously through 2 engine interface units and 2 electronic engine controls (IAE engines) or 2 engine control units (CFM engines). 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).

R When autothrust is active, the FMGS commands the thrust according to the vertical
R 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, FG 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.

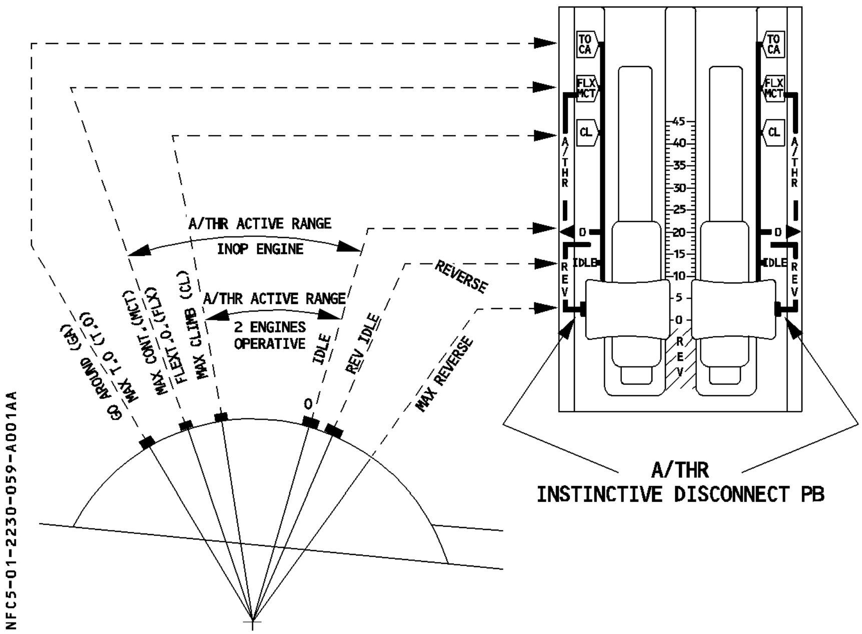
THRUST LEVERS

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.
Five detents divide each of the thrust lever sectors into four segments. The detents are :

TO GA	:	Max takeoff thrust
FLX MCT	:	Max continuous thrust (or FLX at takeoff)
CL	:	Maximum climb thrust
IDLE	:	Idle thrust for both forward and reverse thrust
MAX REV	:	Maximum reverse thrust

When the thrust levers are at the IDLE position, the pilot can pull them up to clear the IDLE stop and select reverse thrust. (There is no reverse detent as such).

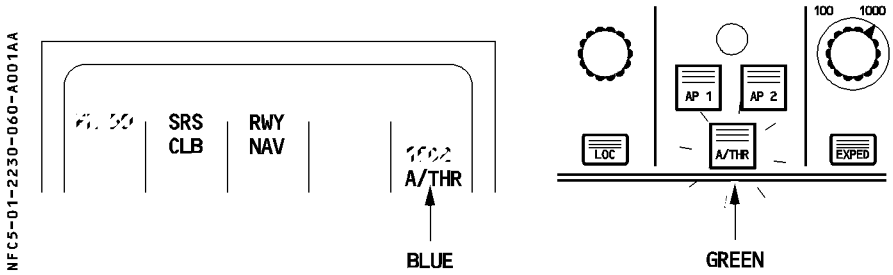


A/THR ARMING

Arming conditions of the A/THR are numerous, let's quote the most important :
- one FMGC operative
- one FAC operative
- 2 ADIRS operative
- 2 FADECs operative
- one channel of the FCU operative
- one LGCIU operative
- A/THR is not manually disabled (instinctive disconnect pushbutton has not been pressed for more than 15 seconds).

The pilot arms A/THR :
- on the ground
  - by pushing the A/THR pushbutton on the FCU 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 A/THR pushbutton on the FCU while the thrust levers are out of the active range or
R - while A/THR being active (A/THR white on FMA), the pilot sets both thrust levers
R beyond the CL detend or one above the MCT detent.
  - by engaging the go around mode.

A/THR armed is indicated by :
- illumination of A/THR pushbutton on FCU
- A/THR displayed in blue on the FMA



A/THR ACTIVATION

The A/THR is active when it controls thrust or speed. The position of the thrust lever determines the maximum thrust that the A/THR system can command (except in α-floor condition).

The A/THR being armed, is activated :

- when the pilot sets both thrust levers between the CL and IDLE detents (two engines operative)
- when the pilot sets one thrust lever between the 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 IDLE position.

Note : When the pilot sets both thrust levers to IDLE position, the A/THR disconnects but, if the pilot pushes the A/THR pushbutton of the FCU, he will simultaneously arm and activate the autothrust. Due to the thrust levers position, IDLE thrust will be maintained.

- when ALPHA FLOOR is activated, regardless of the initial status of A/THR and the position of the thrust levers.

When A/THR is active :

- The A/THR pushbutton on the FCU 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 both thrust levers are set above the CL detent (both engines operative) or one thrust lever is set above MCT (one engine operative) 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 both thrust levers are pushed above the CL detent (2 engines) or the active thrust lever above the MCT detent (one engine operative).
- When both thrust levers are set below the CL detent (both engines operative) or one thrust lever is set below MCT (one engine operative), a repeating warning (amber caution, single chime, ECAM message "A/THR LIMITED") is activated every 5 seconds until the pilot moves the lever back into the detent. "THR LVR" green is displayed on the FMA
  "LVR CLB" (both engines operative) or "LVR MCT" (one engine operative) 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 (2 engines) or the MCT detent (one engine operative).
- When one thrust lever is in the CL detent and the other one out of the detent, the "LVR ASYM" amber message comes up until both levers are set in the CL detent (only with both engines operative).

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 both 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**
R When the radio altitude is below 100 feet and the pilot sets both thrust levers above the
R CL detent or one above the MCT detent, the autothrust will disconnect. It will rearm
R automatically when at least one of the thrust levers is set to TOGA.
R If the PF sets the thrust levers slightly above CL detent but below TOGA and come back
R to CL detent, the A/THR will disconnect and remain disconnected. As a result, the thrust
R will increase up to CLIMB thrust. The crew has to manually set the appropriate thrust for
R 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 A/THR pushbutton on the FCU or the A/THR disconnects due to a failure.
- "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.

The thrust is locked at its level prior to disconnection. Moving the thrust levers out of CL or MCT suppresses the thrust lock and gives the pilot manual control with the thrust levers. All warnings cease when the pilot moves the thrust levers out of the detent.

A/THR DISCONNECT CAUTION

		A/THR DISCONNECTION	
		BY INSTINCTIVE DISCONNECT OR SETTING TWO LEVERS TO IDLE (if above 50 ft RA)	**BY OTHER MEANS**
CONSEQUENCE	MASTER CAUTION	illuminated-3 sec max	illuminated
	ECAM MESSAGE	amber A/THR OFF message 9 sec maximum	Flashing "ENG THRUST LOCKED" (amber AUTO FLT A/THR OFF THR LEVERS..... MOVE (blue)
	AUDIO	single chime	single chime
	CLR pushbutton on ECAM CONTROL PANEL	extinguished	illuminated
ACTION	MASTER CAUTION pushbutton	extinguishes MASTER CAUTION light erases ECAM message	extinguishes MASTER CAUTION light
	CLR puhbutton 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
ECAM STATUS MESSAGE		NO	YES

R – Standard disconnection triggers temporary ECAM message and caution light. Single
R chime sounds.
R – Non standard disconnection triggers caution light and ECAM message removed only by
R a pilot action. Single chime sounds.

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 two-engine configuration. If they are not set in the CL detent, "LVR CLB" flashes white on the FMA.
— In MCT detent when in the one-engine-out configuration. If the appropriate lever is not set in the MCT detent, "LVR MCT" flashes white on the FMA.

The A/THR modes are selected automatically 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 - EXP CLB◁* - EXP DES◁* - 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 thrust lever position.

FMA display	Meaning
THR MCT	Single engine thrust in climb. The live engine is at maximum continuous thrust (thrust lever in MCT detent)
THR CLB	Climb thrust two engine configuration (at least one thrust lever in the CL detent, the other one below CL)
THR LVR	Undetermined thrust (neither CLB or MCT thrust)
THR IDLE	Minimum thrust (both engines at IDLE thrust)

Note : When the A/THR is armed for takeoff or go around, the FMA displays "MAN TOGA" (or "MAN FLX") in white to remind the crew that the thrust levers have been positioned properly.

RETARD MODE

The RETARD mode is only available during automatic landing (AP engaged in LAND mode). At approximately 40 feet RA, the RETARD mode engages and remains engaged after touchdown. The A/THR commands IDLE thrust during the flare, and the FMA and engine warning display "IDLE". If the autopilot is disengaged during the flare before touchdown, the SPEED mode replaces the RETARD mode, and the pilot has to manually reduce thrust.

Note : *In an automatic landing, the system generates a "RETARD" callout at 10 feet radioaltitude (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 at 20 feet RA, as a reminder.*

ALPHA FLOOR

ALPHA FLOOR is a protection that commands TOGA thrust, regardless of the thrust levers' positions. This protection is available from lift-off to 100 feet RA on approach.
ALPHA FLOOR calls up the following indications :
- "A FLOOR" in green, surrounded by a flashing amber box on the FMA, and in amber on the engine warning display, (as long as α-floor conditions are met).
- "TOGA LK" in green, surrounded by a flashing amber box on the FMA, when the aircraft leaves the α-floor conditions. TOGA thrust is frozen.

To cancel ALPHA FLOOR or TOGA LK thrust, the pilot must disconnect the autothrust.

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 SPD/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 (340/.80-VFE-VLE, whichever applies).

The changeover from SPEED to MACH mode is either automatic, performed by the FMGC, or manual, with the pilot pushing the SPD/MACH changeover pushbutton.
The FMA displays "SPEED" or "MACH".

Approach autothrust :

R Below 3200 feet radioaltitude, with at least CONF 1, the A/THR logic is modified to be more responsive to speed variation. This is referred to as approach autothrust.

SPEED MODE IN APPROACH PHASE

When the aircraft flies an approach in managed speed, the speed target displayed on the
R PFD in magenta, is variable during the approach.
R 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 inertia, when the wind conditions vary during the approach. It does so by providing the crew with
R 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 IAS target, ensuring an efficient thrust management during the approach.
The minimum energy level is the energy level the aircraft will have at touch down 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 limited to VAPP.
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

It is the MAG WIND entered in the PERF approach page. It is the average wind as provided by the ATIS or the tower. Gusts must not be inserted, they are included in the ground speed mini computation.

TWR HEADWIND COMPONENT

The TWR HEADWIND COMPONENT is the component of the MAG WIND projected on the runway axis (landing runway entered in the flight plan). It is used to compute VAPP and GS mini.

CURRENT HEADWIND COMPONENT

The actual wind measured by ADIRS is projected on the aircraft axis to define the CURRENT HEADWIND COMPONENT (instantaneous headwind).
The CURRENT HEADWIND COMPONENT is used to compute the variable speed target during final (IAS target).

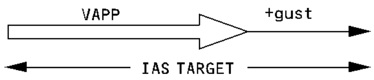
VAPP COMPUTATION

VAPP, automatically displayed on the MCDU PERF APPR page, is computed as follows :
VAPP = VLS + 1/3 of the TWR HEADWIND COMPONENT or
VAPP = VLS + 5 knots, which ever is highest.
"1/3 of the TWR HEADWIND COMPONENT" has 2 limits :
- 0 knots as the minimum value (no wind or tailwind)
- + 15 knots as the maximum value.

The crew can manually modify the VAPP and TWR wind values on the PERF APPR page.

SPEED TARGET COMPUTATION

The FMGS continuously computes a speed target (IAS target) that is the MCDU VAPP value plus an additional variable gust.



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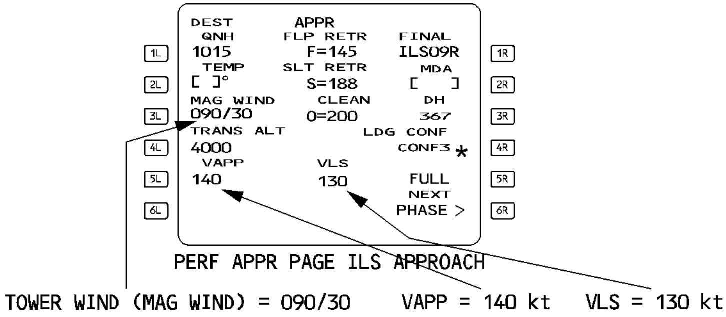
The gust is the instantaneous difference between the CURRENT HEADWIND COMPONENT and the TWR HEADWIND COMPONENT. It is always positive (or equal to zero for no wind or tailwind).
The IAS target is displayed on the PFD as a magenta triangle moving with the gust variation. VAPP is the IAS target minimum value.

GROUND SPEED MINI (GS mini) COMPUTATION

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.

EXAMPLE

R Approach on runway 09
R The tower wind direction is on the runway axis.
R



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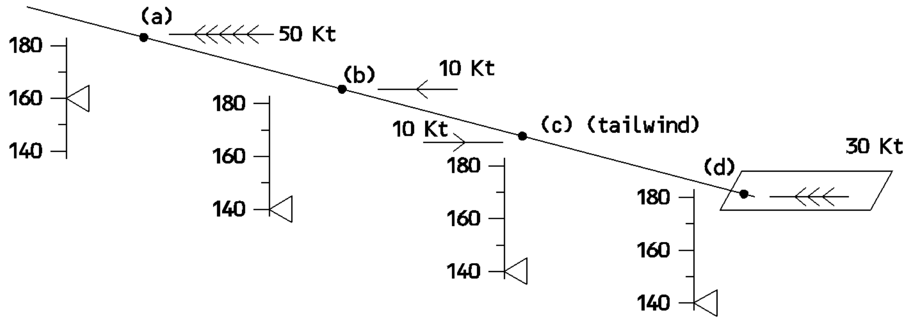
R **IAS TARGET VALUES**

R If we turn the previously explained speed target definition into formulae, we obtain the
R following result :
IAS TARGET = Max [VAPP, (VAPP + CURRENT HEADWIND - TWR HEADWIND)]

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



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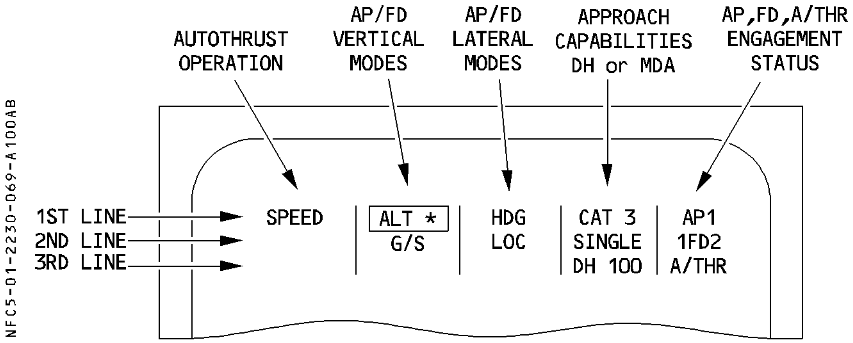
FLIGHT MODE ANNUNCIATOR (FMA)

The flight mode annunciator (FMA), which is just above the primary flight displays, shows the status of the autothrust, the vertical and lateral modes of the autopilot and flight director, and the approach capabilities, and the engagement status of the AP/FD and the autothrust.
After each mode change, the FMA displays a white box around the new annunciation for ten seconds.



In the three left columns :
The first line shows the engaged modes in green.
The second line shows the armed modes in blue or magenta.
Magenta indicates that the modes are armed or engaged because of a constraint.
The third line displays special messages :
- Messages related to flight controls have first priority :
  - "MAN PITCH TRIM ONLY" in red, flashing for 9 seconds, then steady
  - "USE MAN PITCH TRIM" in amber, pulsing for 9 seconds, then steady
- Messages related to the FMGS have second priority.

The fourth column :
Displays approach capabilities in white.
Displays DH or MDA/MDH in blue.

The fifth column :
Displays the engagement status of AP, FD, and A/THR in white.
Displays a box around FD for 10 seconds in case of automatic FMGC switching.
Displays "A/THR" in blue when autothrust is armed but not active.

R *Note : The FMGS synchronises A/THR mode, AP/FD modes and approach capability to*
R *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 XX	White White box blue numbers	A/THR is armed, at least one thrust lever is in MCT/FLX detent, with FLX TO temp set at XX°. The other thrust lever is at, or below, the MCT/FLX detent.
MAN MCT	White White box	A/THR is armed, at least one thrust lever is in the MCT/FLX detent, the other is at, or below, this detent.
MAN THR	White Amber box	A/THR is armed, and the most advanced thrust lever is above CL detent (2 engines operative, or one above MCT/FLX (engine-out) and not in a detent.
THR MCT	Green	A/THR is active in thrust mode and the most advanced thrust lever is in the MCT/FLX 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 IDLE	Green	A/THR is active in thrust mode and commands idle thrust.
THR LVR	Green	A/THR is active in thrust mode with both thrust levers below CL detent, or the live thrust lever (1 engine) below MCT.
SPEED or MACH	Green	A/THR is active in SPEED or MACH mode.
A. FLOOR	Green Amber box	A/THR is active and commands TOGA thrust, while α FLOOR conditions are met.
TOGA LK	Green Amber box	A/THR is active and TOGA thrust is locked (α FLOOR conditions are no longer met).

Third line

DISPLAY	COLOR	MEANING
LVR CLB (flashing)	White	Request to set the thrust levers in CL detent.
LVR MCT (flashing)	White	Request to set the live thrust lever in MCT/FLX detent.
LVR ASYM	Amber	(2 engines only). One thrust lever is in CL or MCT/FLX detent, and the other one is not in this detent.
THR LK (flashing)	Amber	After A/THR disconnection (pilot's action on FCU or failure) resulting in thrust being frozen. Both thrust levers being in CL detent, or one in MCT/FLX (engine-out) detent.

Note : The amber caution light flashes and a single chime sounds every five seconds, as long as the pilot takes no appropriate action in the following cases :
· THR LK
· LVR 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 CSTR are disregarded.
ALT* or ALT CST*	Green	ALT CAPTURE is engaged – ALT* green in case of FCU selected altitude capture. – ALT CST* green in case of ALT CSTR capture (vertical profile)
ALT or ALT CST	Green	ALTITUDE HOLD mode is engaged. – ALT is green when the FCU selected altitude is held. – ALT CST is green when an ALT CSTR is held (vertical profile)
ALT CRZ	Green	ALT mode is engaged and CRZ FL is held.
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 thant he actual altitude. ALT CSTR are disregarded.
G/S*	Green	Glide Slope capture mode is engaged.
G/S	Green	Glide Slope mode is engaged.
V/S ± XXXX	Green + blue numbers	Vertical speed mode is engaged to acquire and hold the V/S selected on the FCU. ALT CSTR are disregarded.
FPA ± XX	Green + blue numbers	Flight Path Angle mode is engaged to acquire and hold the FPA selected on the FCU. ALT CSTR are disregarded.

AP/FD VERTICAL MODE (FMA COLUMN 2)

Second line

DISPLAY	COLOR	MEANING
CLB	Blue	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.
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.
ALT G/S	Blue/Blue	ALT and G/S modes are armed.
ALT G/S	Magenta/ Blue	ALT CSTR and G/S modes are armed.
ALT FINAL	Blue/Blue	ALT and FINAL modes are armed.
ALT FINAL	Magenta/ Blue	ALT CSTR and FINAL modes are armed.
DES G/S	Blue/Blue	DES and G/S modes are armed.
DES FINAL	Blue/Blue	DES and FINAL modes are armed.

Third line

DISPLAY	COLOR	MEANING
SPEED SEL : XXX	Blue	Indicates a preset speed associated with the cruise or climb phase
MACH SEL : .XX	Blue	Indicates a preset Mach associated with the cruise or climb phase

Note : These two messages use both the first and second columns (third line).

AP/FD LATERAL MODES (FMA COLUMN 3)

First line

DISPLAY	COLOR	MEANING
RWY	Green	RWY mode is engaged.
RWY TRK	Green	RWY mode is engaged once airborne at or above 30 feet RA.
HDG	Green	HEADING mode is engaged.
TRACK	Green	TRACK 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.
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
NAV	Blue	NAV mode is armed.
LOC	Blue	LOC mode is armed.
APP NAV	Blue	NAV mode is armed for a NON ILS approach.

AP/FD COMMON MODES (FMA COLUMN 2 AND 3)

DISPLAY	COLOR	MEANING
LAND	Green	Land mode is engaged below 400 feet RA.
FLARE	Green	Flare mode is engaged.
ROLL OUT	Green	Roll out mode is engaged.
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 XXXX	White Blue	Minimum descent altitude or minimum descent height as inserted by the pilot on PERF APPR page.
DH XXX NO DH	White/Blue White	Decision height as inserted by the pilot on PERF APPR page. NO DH : when NO inserted on PERF APPR page.

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 PFD1 and PFD2. X and Y can be 1, 2, –. – : no FD is engaged on the corresponding PFD 1 : FD1 is engaged on the corresponding PFD 2 : FD2 is engaged on the corresponding PFD e.g. : the normal status (FD 1 and 2 engaged) is 1FD2.

Third line

DISPLAY	COLOR	MEANING
A/THR	White	A/THR is active.
A/THR	Blue	A/THR is armed.

SPECIAL MESSAGES (FMA COLUMNS 2 AND 3)

The third line displays three types of messages :
- It gives first priority to flight control messages
- It gives second priority to vertical Flight Management messages
- It gives last priority to EFIS reconfiguration messages.

R

DISPLAY	COLOR	MEANING
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.
CHECK APP SEL	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 SPD	White	The SPEED target is selected but a preselected SPEED does not exist for the next flight phase.
SET GREEN DOT SPD	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*, ALT mode
SET HOLD SPD	White	The aircraft is in selected SPEED control, an Holding pattern is inserted in the F-PLN and the aircraft is 30 seconds before the deceleration point 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 descent profile.
MORE DRAG	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. – or in auto speed control and the aircraft enters a speedbrake decelerating segment.
VERT DISCON AHEAD	Amber	DES mode is engaged and : – a TOO STEEP path exists on the next leg. – the aircraft is less than 30 seconds from the TOO STEEP path.

GENERAL

The aircraft has two flight augmentation computers (FACs) that perform four main functions:

· Yaw function
 — Yaw damping and turn coordination
 — Rudder trim
 — Rudder travel limitation

· Flight envelope function
 — PFD speed scale management
  * Minimum/maximum speed computation
  * Maneuvering speed computation
 — Alpha-floor protection

· Low-Energy Warning function ◁*

· Windshear detection function ◁*

In performing these functions the FAC uses independent channels :

Yaw damper
Rudder trim
Rudder travel limit
Flight envelope

Each FAC interfaces with the elevator aileron computers (ELACs) when the APs are disengaged, or with the FMGS when at least one AP is engaged.

Both FACs engage automatically at power-up.

The pilot can disengage or reset each FAC (in case of failure) by means of a pushbutton on the flight control overhead panel.

When a FAC is disengaged (FAC pushbutton set off) but still valid, the flight envelope function of the FAC remains active.

R If both FACs are valid, FAC1 controls the yaw damper, turn coordination, rudder trim, and rudder travel limit, and FAC2 is in standby.

FAC1 keeps the aircraft within the flight envelope through FD1 ; FAC2 performs this function through FD2.

If a failure is detected on any channel of FAC1, FAC2 takes over the corresponding channel.

YAW FUNCTIONS

YAW DAMPING

Yaw damping stabilizes the aircraft in yaw and coordinates its turns.
R In automatic flight (AP engaged) during takeoff and go around, it assists rudder application after an engine failure (short-term yaw compensation).

Note : When the AP is engaged, the FMGS sends orders to the FAC to give :
- *yaw damping during approach*
- *yaw control for runway alignment in ROLL OUT mode*

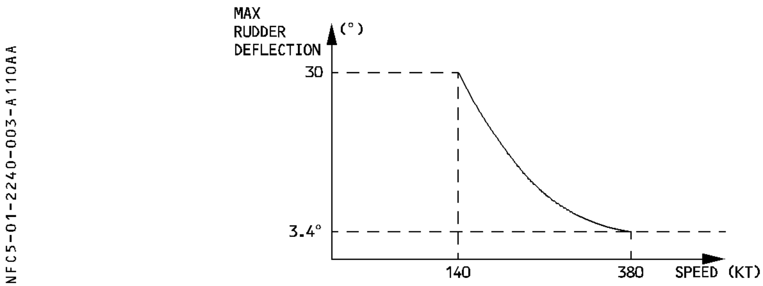
RUDDER TRIM

The rudder trim function :
– Executes trim orders the pilot enters with the manual trim knob
– When AP is engaged
  * executes trim orders from the FMGS.
  * Assists the system in recovering from engine failure (long-term yaw compensation) in all flight guidance modes.
  * If the pilot pushes the rudder more than 10° out of trim, it disengages the AP.

Note : When the AP is engaged, the rudder trim knob is inoperative : the master FMGC sends rudder trim orders to the FAC.

RUDDER TRAVEL LIMITATION

This function limits rudder deflection as a function of speed in order to avoid high structural loads. It is governed by the following law :



If both FACs lose the rudder travel limitation function, the value of the rudder deflection limit is locked at the time of the second failure.
When the slats are extended, the FACs automatically set the rudder deflection limit at the low-speed setting (maximum authorized deflection).

FLIGHT ENVELOPE FUNCTION

As long as one Flight Augmentation Computer (FAC) is valid, it governs the flight envelope function, the rudder position display, and the rudder trim indication regardless of what the pilot does with the FAC pushbutton.

PFD SPEED SCALE MANAGEMENT

The FAC controls the speed scale on the PFD. (Refer to 1.31)
When both FACs are operative, FAC1 supplies data to PFD1 and FAC2 supplies it to PFD2.
The FAC computes :
- The minimum and maximum speeds :
  * VSW (stall warning)
  * VLS
  * VFE and VFE for the next configuration
  * VLE
  * VMO/MMO
- The maneuvering speeds :
  * Green Dot Speed
  * S speed
  * F speed

  (Refer to 3.04.10 for speed definition).

The FAC also computes the speed trend and displays it as an arrow on the PFD speed scale.
The PFD displays these various speeds as appropriate, and they also go to the FMGC to be used as limits for various guidance modes

Note : The principle of the speed computation is as follows :

R *- First, the FAC computes VS1G (stall speed). From VS1G it computes the gross*
R *weight which is also sent to the Elevator Aileron computers :*
  * *When the aircraft is below 14500 feet and 250 knots, it computes this from current angle of attack, speed/Mach, altitude, thrust, and CG.*
  * *When the aircraft is above 14500 feet or 250 knots, it computes this out of the GW, which it has memorized and updated with a fuel consumption model set in the FAC.*

- Finally the FAC computes the various minimum and maneuvering speeds, Vα prot and Vsn.

- The accuracies of the various minimum and maximum speeds are functions of the accuracy with which the FAC computes aircraft gross weight. Normal accuracy for VLS in CONFIG FULL is about ± 3 kt.

ALPHA-FLOOR PROTECTION

Alpha-floor protection automatically sets the thrust at TOGA thrust, when the aircraft reaches a very high angle of attack.
The Flight Augmentation Computer (FAC) generates the signal that triggers the alpha-floor mode. This, in turn, sets TOGA thrust on the engines, regardless of the thrust lever positions (Refer to 1.22.30 A/THR modes).
The FAC sends this signal when the angle of attack is above a predetermined threshold, that is a function of the configuration.
In CONF3 and CONF FULL, this threshold decreases as a function of the aircraft deceleration rate (down to – 3°).
Alpha-floor is available from lift-off until the aircraft reaches 100 feet RA in approach.

<u>Note</u> : – *Alpha-floor is lost, when one of the following combinations of failures occurs :*
SFCC1 and FAC2, or
SFCC2 and FAC1, or
Both FCU channels, or
1 EIU, or
Both FMGCs.
– *Alpha-floor is lost under alternate or direct flight control law.*
R – *Alpha-floor is lost in engine-out, when slats/flaps are extended.*

LOW-ENERGY WARNING

An aural low-energy “SPEED SPEED SPEED” warning, repeated every five seconds, warns the pilot that the aircraft’s energy level is going below a threshold under which he will have to increase thrust, in order to regain a positive flight path angle through pitch control.
It is available in Configuration 2, 3, and FULL. The FAC computes the energy level with the following inputs :
– Aircraft configuration
– Horizontal deceleration rate
– Flight path angle
The warning is inhibited when :
– TOGA is selected, or
– Below 100 feet RA, or
– Above 2000 feet RA, or
– Alpha floor, or the ground proximity warning system alert is triggered, or
– In alternate or direct law, or
– If both radio altimeters fail.
During deceleration, the low-energy warning is triggered before alpha floor (unless alpha floor is triggered by stick deflection). The amount of time between the two warnings depends on the deceleration rate.

WINDSHEAR DETECTION FUNCTION

Whenever a flight augmentation computer (FAC) detects windshear conditions, it triggers a warning :
– "WINDSHEAR" in red on both PFDs (for at least 15 seconds)
– an aural warning, "windshear", repeated three times
The windshear detection function is operative during takeoff and during approach, as follows:
– at takeoff, from lift-off up to 1300 feet
– during approach, from 1300 feet to 50 feet
R In both situations, the aircraft must be in configuration 1, 2, 3 or FULL.

WINDSHEAR DETECTION PRINCIPLES

The FACs generate the windshear warning whenever the predicted energy level for the aircraft falls below a predetermined threshold.
In computing this energy level prediction, the FACs use data from different sources. From ADIRS comes data such as vertical speed, air and ground speeds and slope ; from other sources come such derived parameters as total slope, longitudinal wind gradient, and vertical wind.
The FACs express this energy level as an angle of attack and compare it with an angle-of-attack threshold above which windshear conditions are most likely and pilot action is required.

GUIDANCE

In windshear conditions, flight guidance acts on specially adapted FD pitch orders received from the speed reference system (SRS). The pilot must set go around thrust immediately (which also triggers the FD SRS mode), and follow the pitch order to execute the optimum escape maneuver.

CONTROLS AND INDICATORS

FAC ENGAGEMENT

See 1.27 FLIGHT CONTROL CHAPTER

RUDDER TRIM OPERATION

See 1.27 FLIGHT CONTROL CHAPTER

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”.

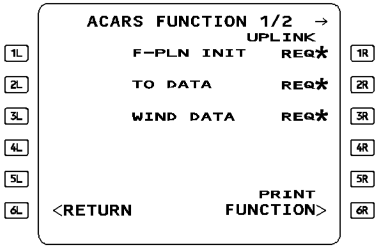
GENERAL SCRATCHPAD MESSAGES

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 decodind process of the message, "INVALID RTE UPLINK" is displayed on MCDUs.
Au 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.

<u>Note</u> : *The flight plan may also be initialized using the ACARS function page selected from DATA INDEX page.*



ACARS FUNCTION PAGE 1
(FROM DATA INDEX)

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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.

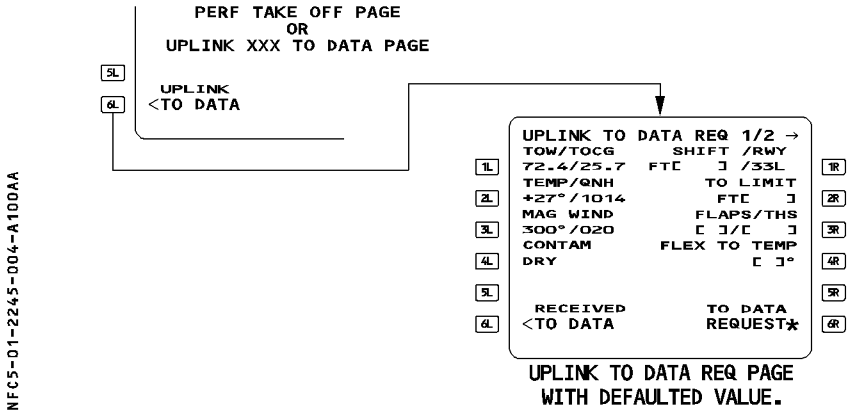
Note : After engine start an uplink performance data message is rejected automatically without any scratchpad message.

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.



UPLINK TO DATA REQ PAGE
WITH DEFAULTED VALUE.

SCRATCHPAD MESSAGES RELATED TO TAKEOFF DATA

TAKEOFF DATA UPLINK : Takeoff data uplink message is received
INVALID TAKEOFF UPLINK : The UPLINK message is rejected

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 an descent phases
* Winds are associated to waypoint for cruise phase and step level. One wind per waypoint.
  - On ground and without entered winds, an uplink message is directly inserted in the flight plan.
  - In flight, winds are temporary stored until the crew inserts it 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

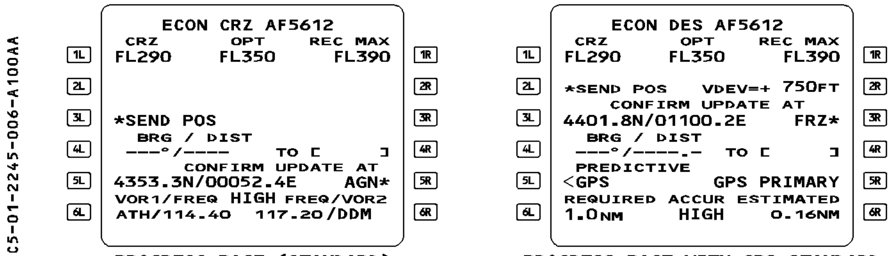
Flight reports provide real time information to the ground concerning the aircraft current situation and position.
Several types of flight reports are available :
- The Position report : provides current aircraft position
- the Progress report : provides data relative to the destination
- The Flight-Plan 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 PROG page. (SEND POS prompt).



PROGRESS PAGE (STANDARD) PROGRESS PAGE WITH GPS STANDARD

Note : Position report are initiated from active flight plan only.

POSITION report content

- Aircraft position
- Overfly reporting waypoint
- Time of report (UTC)
- Aircraft altitude
- Next reporting waypoint
- ETA at next reporting waypoint
- Reporting waypoint following next report
- SAT
- Current wind
- Remaining fuel

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 (CG, 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

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.*

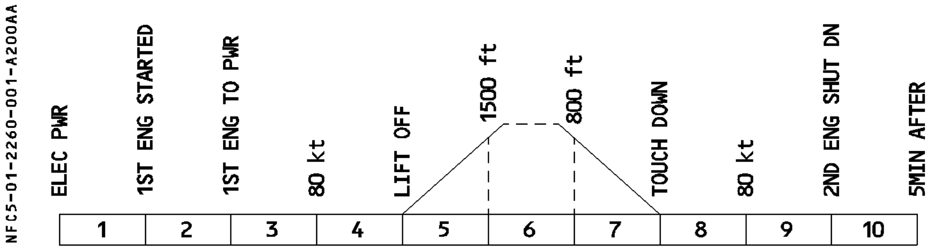
- One or several print functions may be deactivated (refer to PRINT FUNCTION PAGE).
- If an ACARS function is not active, (not selected in the nav database policy file) the printing process is invalidated for this specific ACARS function.

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.

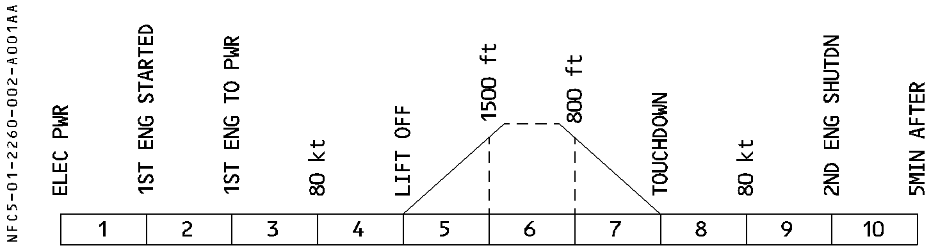
WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
FAC 1 (2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	FAC FAULT lt	3, 4, 5 7,8
YAW DAMPER 1 (2)	NIL	NIL		NIL	3, 4, 5 7, 8, 10
RUDDER TRIM 1 (2) FAULT					3, 4, 5 7, 8
RUD TRV LIM 1 (2)					
FCU 1 (2) FAULT					
FAC 1 + 2 FAULT	SINGLE CHIME	MASTER CAUT		FAC FAULT lts	4, 5, 7, 8
YAW DAMPER SYS				NIL	4, 5, 7, 8, 10
RUD TRIM SYS			F/CTL		4, 5, 7, 8
RUD TRV LIM SYS					
A/THR OFF A/THR disconnection (Refer to 1.22.30).			NIL		1, 4, 8, 10
A/THR LIMITED A/THR is active but thrust levers are set below CL detent (2 engines), or MCT detent (1 engine).	SINGLE CHIME every 5 seconds	MASTER CAUT every 5 seconds			1, 2, 3, 4 8, 9, 10
FCU 1 + 2 FAULT	SINGLE CHIME	MASTER CAUT			3, 4, 5, 7, 8
AP OFF AP disengagement (Refer to 1.22.30).	CAVALRY CHARGE	MASTER WARN			-
(ILS) CAPABILITY DOWNGRADE Condition(s) required for CAT3/CAT2 are no longer fulfilled (Refer to 4.05.70).	CLICK	NIL			2, 3, 4, 5, 8, 9, 10
WINDSHEAR No ECAM message	SYNTHETIC VOICE "WINDSHEAR" repeated 3 times			WINDSHEAR on PFDs	1, 2, 3, 4 8, 9, 10
WINDSHEAR DET FAULT or REAC W/S DET FAULT ◁*	NIL			NIL	3, 4, 5 8, 9
LOW ENERGY WARNING ◁* Available between 100 and 2000 feet in CONF $\geq$ 2. No ECAM message.	SYNTHETIC VOICE "SPEED" 3 times every 5 seconds				1, 2, 3, 4 8, 9, 10

WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AUTOLAND (No ECAM message) Only available below 200 feet.	NIL	AUTO LAND (red) on glareshield		NIL	2, 3, 4, 5, 8, 9 10
When GPS primary is lost, the "GPS PRIMARY LOST" message is displayed on the ND and PFD.	TRIPLE* CLICK	NIL	NIL	ND/MCDU message	
"NAV FMS/GPS POS DISAGREE" : When the FMS 1 or 2 position differs by more than 0.5 minutes of latitude or longitude from the GPS 1 or 2 position, this message comes up on the ECAM.	SINGLE CHIME	MASTER CAUT		NIL	1, 10

* Only during a non precision approach.

BUS EQUIPMENT LIST

		NORM		EMER ELEC		
		AC	**DC**	**AC ESS**	**DC ESS**	**HOT**
FMGC	1				SHED	
	2		DC2			
MCDU	1			SHED		
	2	AC2				
	3 ◁*	AC1				
FCU	1				X	
	2		DC2			

23.00 CONTENTS

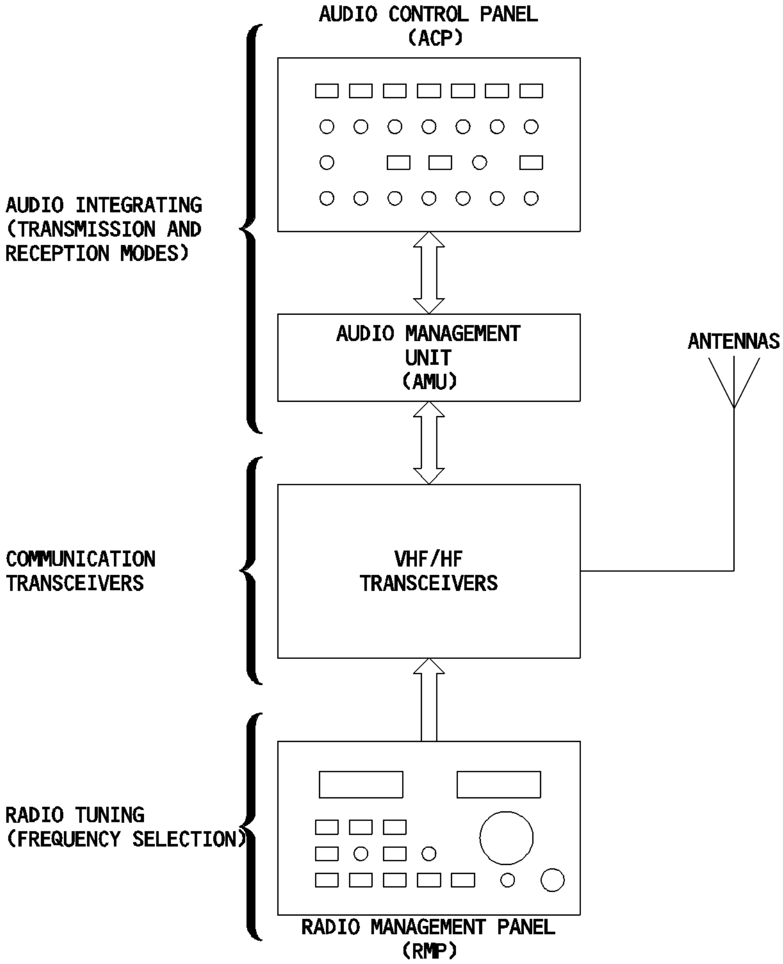
23.10 RADIO COMMUNICATION

23.20 INTERCOMMUNICATION SYSTEMS

23.30 COCKPIT VOICE RECORDER

GENERAL

The communications system comprises the following subsystems :
- VHF/HF tranceivers
- Radio tuning systems (Radio Management Panels).
- Audio integrating system (Audio Management Unit, Audio Control Panels).



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VHF/HF/SELCAL

Either of the two Radio Management Panels (RMPs) (third RMP ◁) can be used 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**
  Two identical VHF communication systems (third VHF system ◁) are installed.
  Each system has a transceiver in the avionics compartment, and an antenna on the fuselage. Only VHF1 functions in EMER ELEC CONFIG.
  VHF has an alarm which indicates 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.

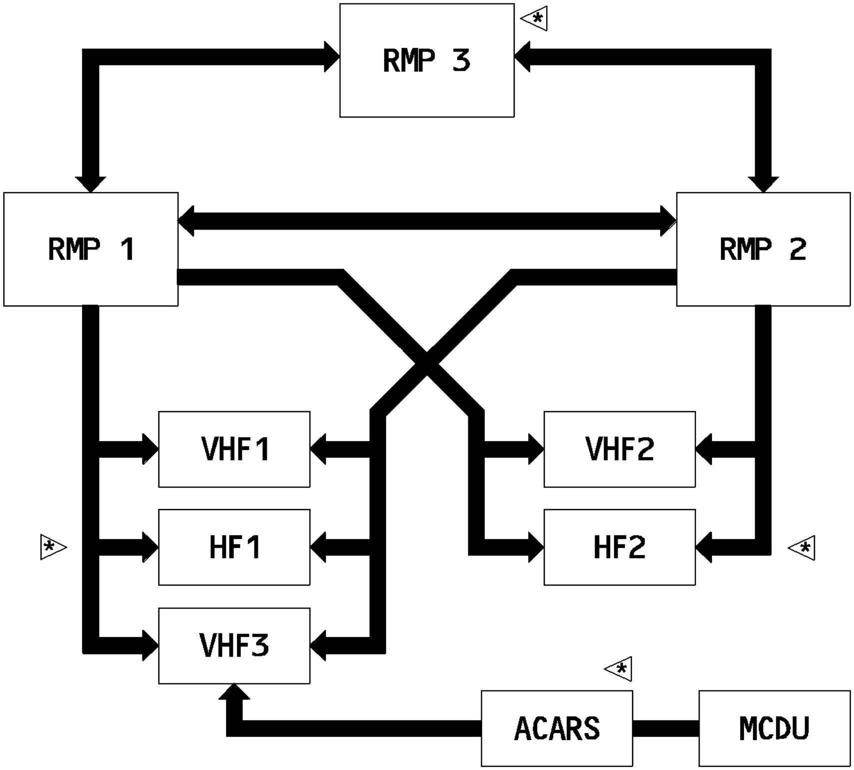
– **HF (◁)**
  Two identical HF communication systems are optional. Each has a transceiver in the avionics compartment, and a common tuner and antenna in the vertical stabilizer.

– **SELCAL (Selective Calling)**
  Upon receiving a call code corresponding to that of the aircraft, the SELCAL system aurally and verbally advises the flight crew that a ground station is calling the aircraft.
R The aural warning is inhibited during takeoff and landing.

RADIO TUNING

DESCRIPTION

Identical RMPs (Radio Management Panels) :
· Give the flight crew control of all VHF radio communication systems (HF systems ◁*).
· Back up to FMGCs for controlling radio navigation systems (Refer to 1.34).
Two RMPs are on the center pedestal (and the third is on the overhead panel ◁*).
Each RMP can control any VHF (HF ◁*) transceiver. RMP1 and RMP2 are connected directly to all VHF (HF ◁*) transceivers, (whereas RMP3 is connected to them via RMP1 and RMP2 ◁*). RMPs are connected together so that each RMP is updated to the selections made on other RMPs.
Only RMP1 functions in EMER ELEC CONFIG.



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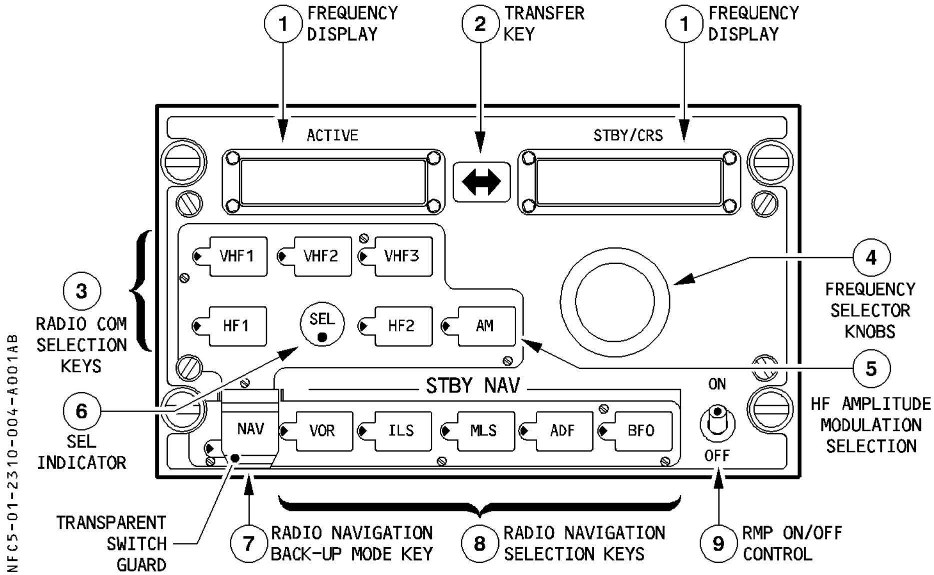
R If one RMP fails, the remaining one controls all the VHF (HF ◁*) tranceivers.

RADIO MANAGEMENT PANEL

R



(1) Frequency displays

The ACTIVE display window shows the active frequency of the selected radio, which is identified by a green light on the selection key.
The STBY/CRS (standby/course) display window shows a standby frequency that the pilot can activate by pressing the transfer key or change by rotating the tuning knobs. (For a description of the CRS function (see 1.34)).

(2) Transfer key

Pressing this key moves the active frequency to the standby window and the standby frequency to the active window.
This tunes the selected receiver to the new active frequency.

(3) Radio com selection keys

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 standby frequency or course.
· The selected key displays a green monitor light.

4 Frequency selector knobs

The pilot uses these concentric knobs to select the STBY frequency or CRS.
The outer knob controls whole numbers ; the inner knob controls decimal fractions.

5 AM pb sw

If the aircraft has HF radios and the flight crew has selected an HF tranceiver, this switch selects the AM mode. (The default mode is the SSB, or single side-band, mode).
This key displays a green monitor light when the AM mode is active.

6 SEL indicator

The SEL indicator glows white on both RMPs when a transceiver normally associated with one RMP is tuned by another :
· VHF1 tuned by RMP2 or RMP3,
· VHF2 tuned by RMP1 or RMP3.
· VHF3, HF1, HF2 (◁*) tuned by RMP1 or RMP2.

7 NAV pb sw (with transparent switchguard)

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.
(Refer to 1.34 for additional information).

8 Radio navigation selection keys

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.
(Refer to 1.34 for addition information).

9 ON/OFF sw

This switch controls the power supply to the RMP.

Note : *RMP3 is able to control VHF and HF transceivers through RMP1 and RMP2 even when they are OFF.*

GENERAL

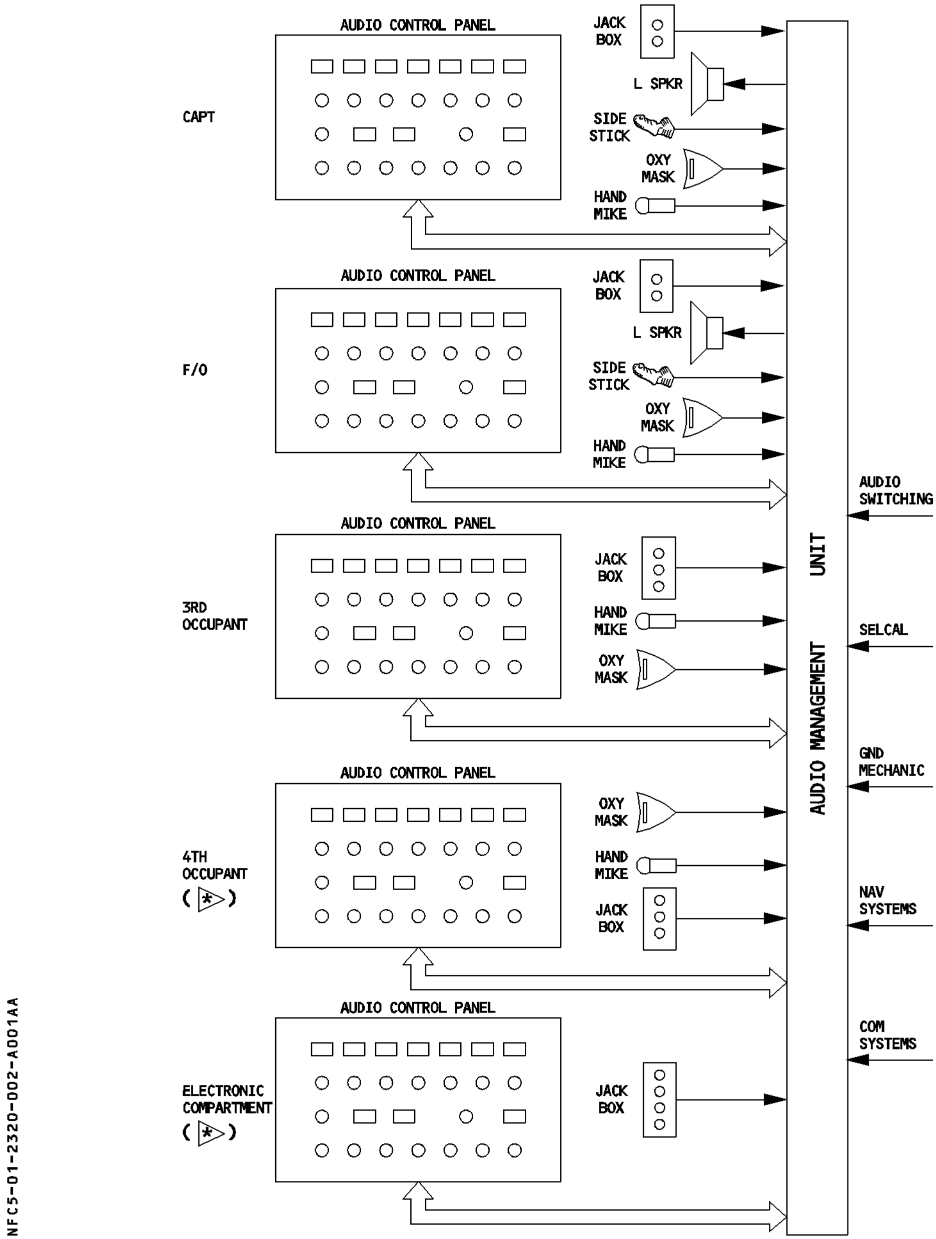
Intercommunications is divided into two main systems:
– the audio management system.
– the cabin intercommunication data system.

AUDIO MANAGEMENT SYSTEM

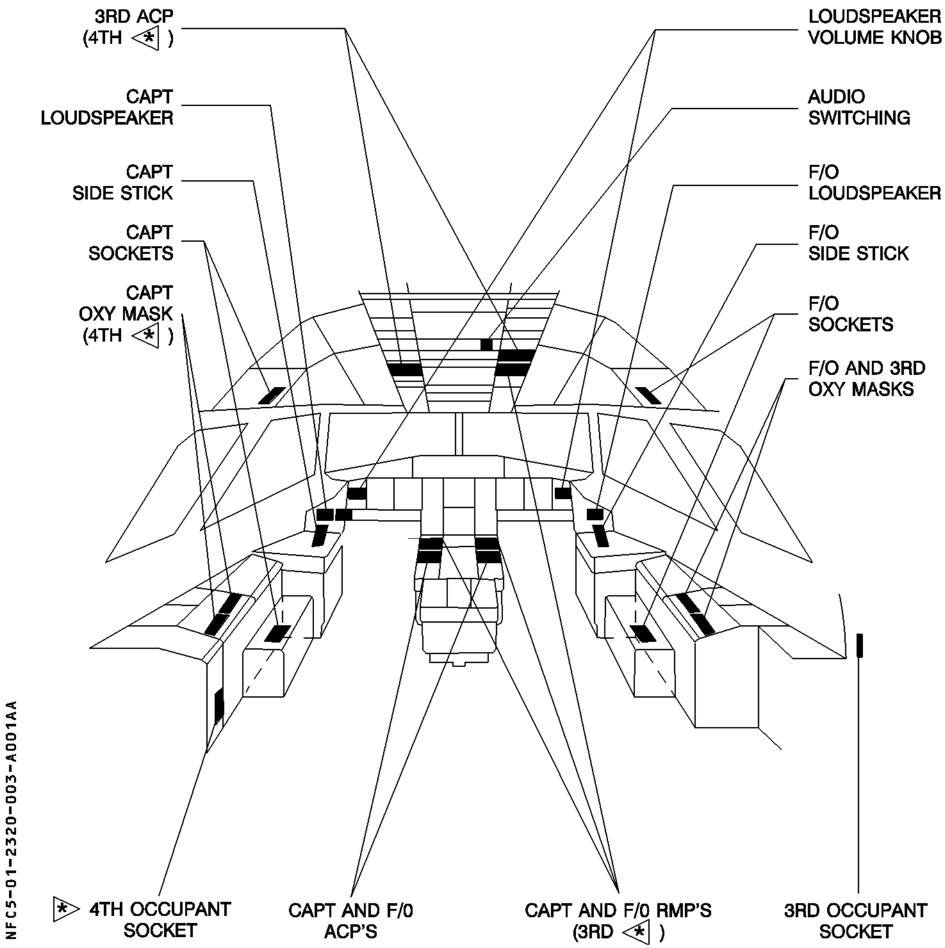
The audio management system allows the flight crew to use :
– all the radio communication and radio navigation facilities installed on the aircraft in transmission and reception mode.
– the interphone systems
– the call systems
– the passenger address system

The audio management system includes :
– an audio management unit (AMU)
– three audio control panels (ACPs) (fourth and fifth optional)
– sockets at each station
  · headset jack and boomset connector (hand microphone connector (⊲*)) for pilot, copilot, and third occupant
  · headset jack for fourth occupant
– one interphone jack at the ground power receptacle
– boomsets for the pilot, copilot, and third occupant, and three hand microphones (fourth (⊲*))
– three cockpit oxygen mask microphones
– one radio press-to-talk switch on each sidestick
– one SELCAL code selection panel (avionics compartment)
– two cockpit loudspeakers with separate volume controls
– if installed, a jack panel in the electronic compartment that groups the headset jack, service interphone jack, hand mike connector, and boomset
– an audio switching facility

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.


AUDIO CONTROL PANEL
CAPT
JACK BOX
L SPKR
SIDE STICK
OXY MASK
HAND MIKE
AUDIO CONTROL PANEL
F/O
JACK BOX
L SPKR
SIDE STICK
OXY MASK
HAND MIKE
AUDIO CONTROL PANEL
3RD OCCUPANT
JACK BOX
HAND MIKE
OXY MASK
AUDIO CONTROL PANEL
4TH OCCUPANT
OXY MASK
HAND MIKE
JACK BOX
AUDIO CONTROL PANEL
ELECTRONIC COMPARTMENT
JACK BOX
AUDIO MANAGEMENT UNIT
AUDIO SWITCHING
SELCAL
GND MECHANIC
NAV SYSTEMS
COM SYSTEMS
NFC5-01-2320-002-A001AA

LOCATION OF COMPONENTS (PILOT'S STATION)



CABIN INTERCOMMUNICATION DATA SYSTEM

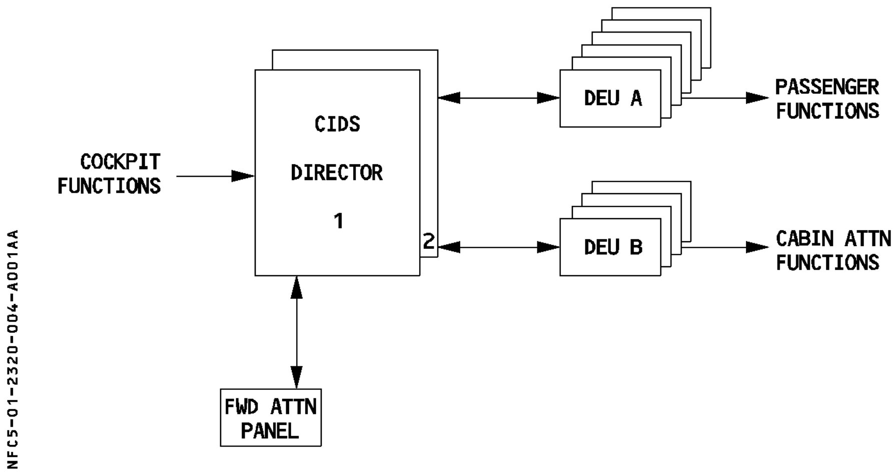
The Cabin Intercommunication Data System (CIDS) transmits, controls, and processes signals for the following cabin systems :

- cabin and service interphone
- passenger address
- passenger lighted sign
- reading light
- general cabin illumination
- emergency evacuation signalling
- lavatory smoke indication
- passenger entertainment music and video ◁*
- R escape slide bottle pressure monitoring ◁*

The CIDS has the following main components :

- two CIDS directors connected in parallel, one active and the other in standby.
- forward attendant panel for control of the cabin systems.
- programming and test module that allows the system to be reprogrammed after changes are made in the cabin configuration.

FOR INFO



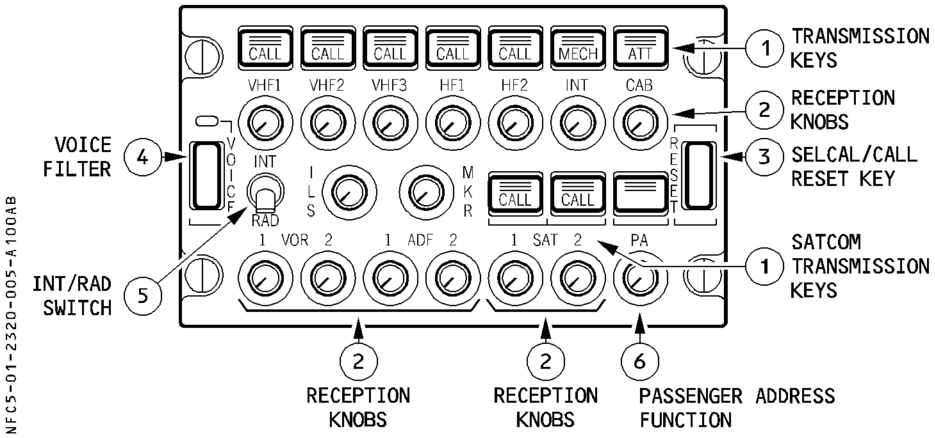
Decoder/Encoder Units (DEUs) are linked to the two directors.

· Type A units (for passengers) are along each side of the passenger cabin. The loudspeakers, lighted signs, call buttons, call lights and general illumination ballast units are divided into small groups each connected to a type A DEU.

· Type B units (for attendants) are near the exit doors. The area call panels, attendant handsets, slide and door pressure sensors, and attendant indicator panels are connected to type B DEUs.

CONTROLS

AUDIO CONTROL PANEL



(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 lt : The legend flashes amber (and buzzer sounds) when the SELCAL system detects a call.

MECH lt : The legend flashes amber (and buzzer sounds) for a call from the nose gear bay. MECH light goes off after 60 seconds, if it is not reset.

ATT lt : The legend flashes amber (and buzzer sounds) for a call from a cabin attendant. The ATT light goes off after 60 seconds, if it is not reset.

SAT CALL lt : This function is inoperative.

(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 ANN LT knob controls the brightness.
- Pressing the knob (knob stays in) disconnects the associated audio reception channel.

Note : – *SATCOM reception knobs are inoperative.*
R – *For reception of DME audio navigation signals associated to an ILS or MLS*
R *station, the ILS (or LS) pushbutton on the FCU must also be selected.*

R (3) SELCAL/CALL RESET key

Pressing this key extinguishes CALL, MECH, and ATT lights.

(4) ON 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

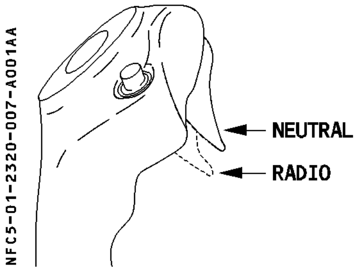
This switch operates as a press-to-talk switch for boom mike or oxygen mask mike.

INT	:	Boom and mask mikes transmit on interphone regardless of which transmission key is selected. For reception on interphone, the crew member must have 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

(Refer to PASSENGER ADDRESS 1.23.20, below).

SIDE STICK RADIO SELECTOR



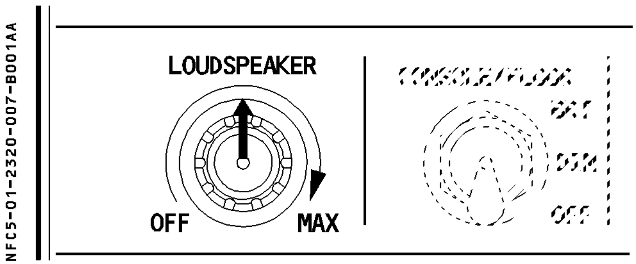
This selector has the same function as the INT/RAD switch on the ACP.

NEUTRAL (spring-loaded) : Boom and mask mikes are dead.
Reception is normal.

RADIO (squeezed) : Boom and mask mikes transmit through 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



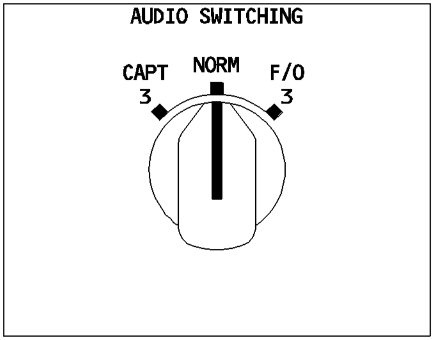
This knob adjusts the volume of the loudspeaker for radio communication.

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 messages.

AUDIO SWITCHING



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The crew can switch to the third ACP if ACP1 or ACP2 fails.

When the crew does this, it takes away the third occupant's access to the acoustic equipment. AUDIO 3 XFRD appears in green on the ECAM MEMO display.

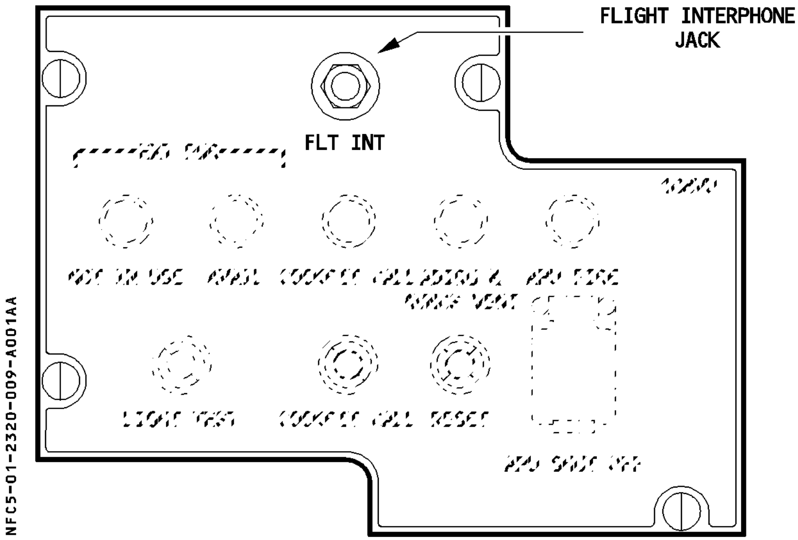
NORM : Each crew member uses his dedicated communication equipment.
CAPT 3 : The pilot uses his acoustic equipment and the third occupant's ACP.
F/O 3 : The copilot uses his acoustic equipment and the third occupant's ACP.

INTERPHONE SYSTEMS

FLIGHT INTERPHONE SYSTEM

This system allows the flight crew members to communicate among themselves and, through a jack on the external power panel, with the ground mechanic.

EXTERNAL POWER PANEL (FORWARD OF THE NOSE L/G BAY)



COCKPIT OPERATION FOR GROUND MECHANIC COMMUNICATION

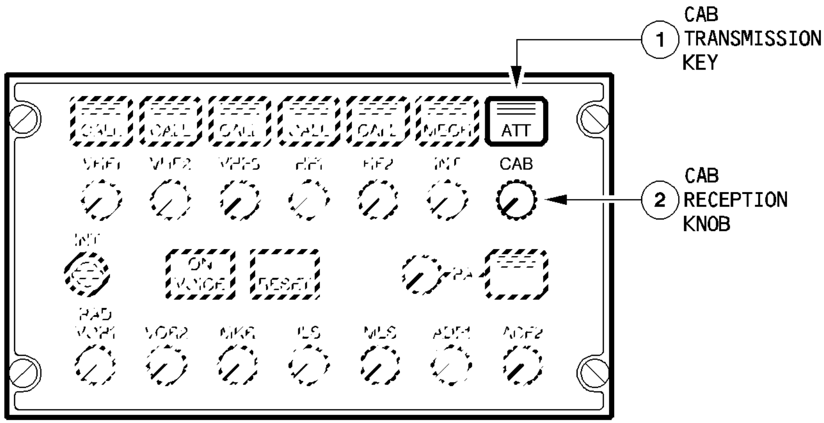
R

	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	–
HANDMIKE	PRESSED	OUT	–	PRESSED

CABIN INTERPHONE SYSTEM

The system allows the flight crew to communicate with the flight attendants, and the flight attendants to communicate among themselves.

R



NFC5-01-2320-010-A001AA

1 CAB transmission key

Pressed : Three green lines come on.
Boom, mask, and hand mikes may be used for cabin interphone.

2 CAB reception knob

Pressed and released (knob out) : The integral white light comes on.
The station receives audio signals from the cabin.
Rotating the knob adjusts the volume.

Pressed (knob in) : The white light goes out.
The cabin interphone is disconnected.

COCKPIT OPERATION FOR CABIN COMMUNICATION

	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE
BOOMSET OR OXYGEN MASK	PRESSED	OUT	RAD	–
HANDMIKE	PRESSED	OUT	–	PRESSED

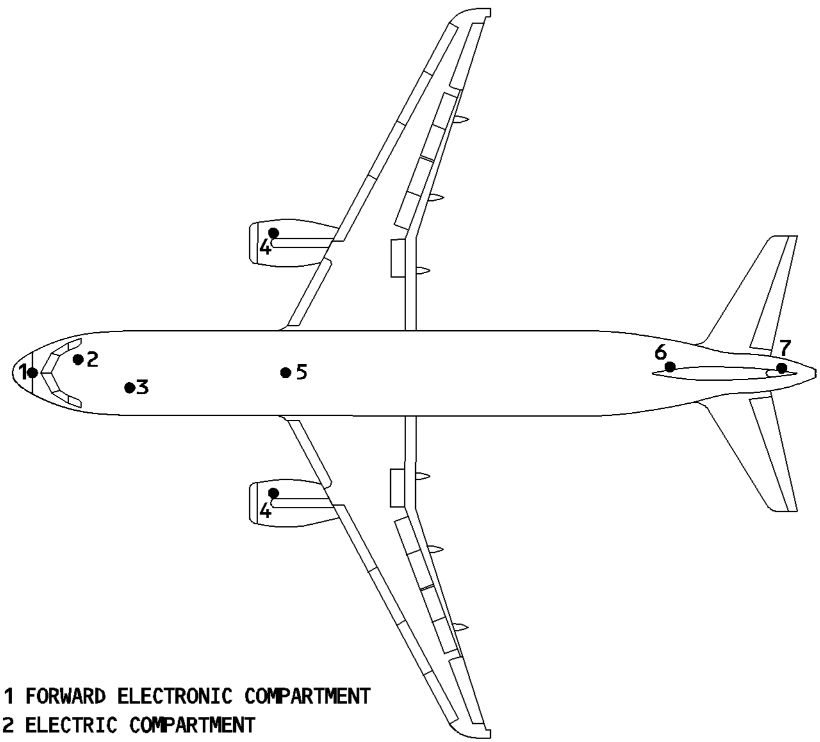
SERVICE INTERPHONE SYSTEM

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 :
- seven 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 FORWARD ELECTRONIC COMPARTMENT
2 ELECTRIC COMPARTMENT
3 AVIONICS COMPARTMENT
4 ENGINE (L & R)
5 BELLY FAIRING PANEL
6 AFT FUSELAGE
7 NEAR APU BAY

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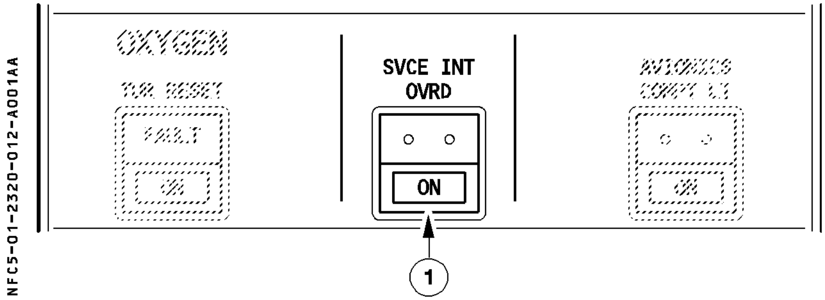
CONTROLS AND INDICATORS AT OVERHEAD PANEL



(1) SVCE INT OVRD pb sw

Auto : Ground personnel can communicate with the flight crew by means of the service interphone jacks 10 seconds 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

R

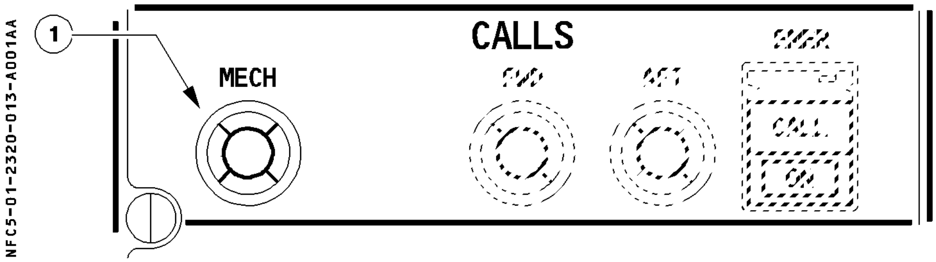
	CAB TRANSMISSION KEY ON ACP	CAB RECEPTION KNOB ON ACP	INT/RAD SW ON ACP	PUSH TO TALK ON HANDMIKE	SVCE INT OVRD PB SW
BOOMSET	PRESSED	OUT	RAD	–	SEE ABOVE CONDITIONS.
HANDMIKE	PRESSED	OUT	–	PRESSED	

CALL SYSTEMS

GROUND MECHANIC CALL

The system allows the flight crew and ground mechanics to communicate with each other.

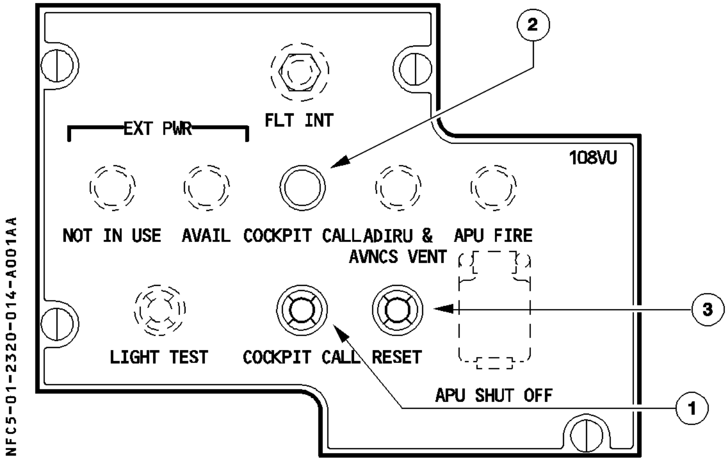
CONTROLS AND INDICATORS ON OVERHEAD PANEL



(1) MECH pb

Pressed (and held)	:	COCKPIT CALL lights up blue on the external power panel in the nose L/G bay. An external horn sounds.
Released	:	COCKPIT CALL remains lighted. The ground mechanic can extinguish it by pressing the RESET button on the external power panel. The external horn stops sounding.

R **CONTROLS AND INDICATORS ON THE EXTERNAL POWER PANEL**



(1) <u>COCKPIT CALL pb</u>

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.

(2) <u>COCKPIT CALL lt</u>

The blue light appears when cockpit calls the ground mechanic. An external horn also sounds.

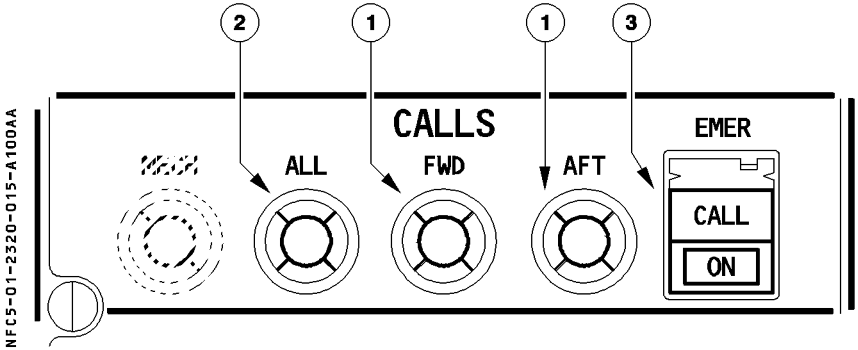
(3) <u>RESET pb</u>

R Pressed : The COCKPIT CALL light goes out.

CABIN CALL SYSTEM

This system is for communication between the cockpit and the cabin.

CALL FROM THE COCKPIT



1 FWD, MID, EXIT, and AFT pb

Pressed : A red 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.

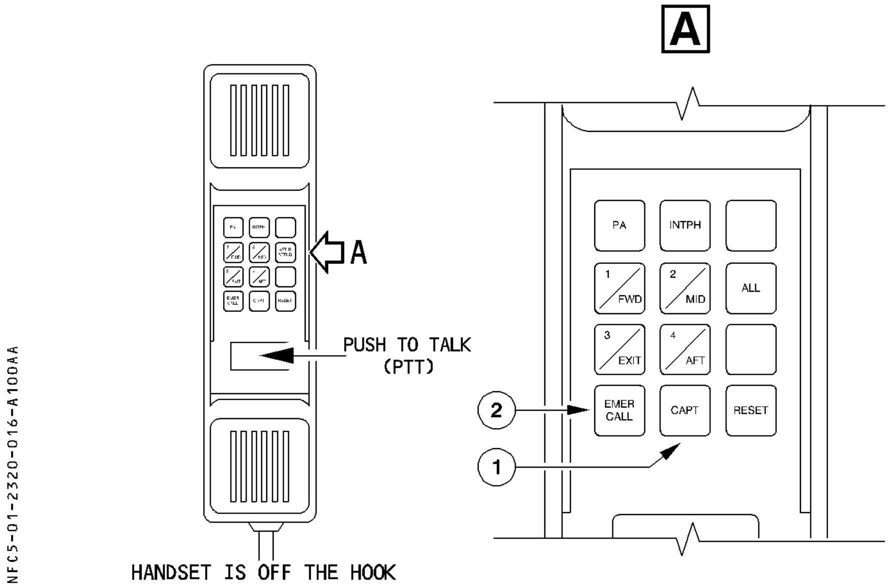
3 EMER pb sw (guarded)

ON : Pink light flashes at all area call panels. EMERGENCY CALL appears on all attendant indication panels. High-low chime (repeated 3 times) sounds through all loudspeakers.
ON lt : This light flashes white for an emergency call from the cockpit to the cabin.
CALL lt : This light flashes amber for an emergency call from the cockpit to the 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 resets when the attendant hangs up the relevant handset.

CALL FROM THE CABIN



(1) CAPT

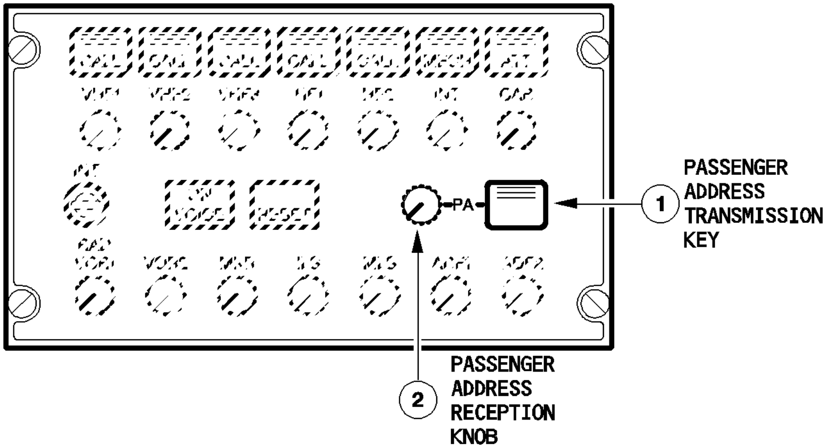
Pressed : In the cockpit the "ATT" lights flash on the ACP, and a buzzer sounds.
This buzzer is inhibited during takeoff and landing.
In the cabin "CAPTAIN" appears at the AIP where the CAPT button was pressed.

R (2) EMER CALL

R Pressed : In the cockpit :
R – The ATT lights flash on the ACP.
R – The EMER CALL and EMER ON pushbutton lights flash on the overhead
R panel.
R – A buzzer sounds.
R It is inhibited during takeoff and landing.
R In the cabin, "EMERGENCY CALL" is displayed on the AIP.

PASSENGER ADDRESS

The passenger address allows flight personnel to make announcements to passengers in the cabin through loudspeakers. It can be operated from the cockpit (with ACP or handset) or from the cabin (attendant stations).



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(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.

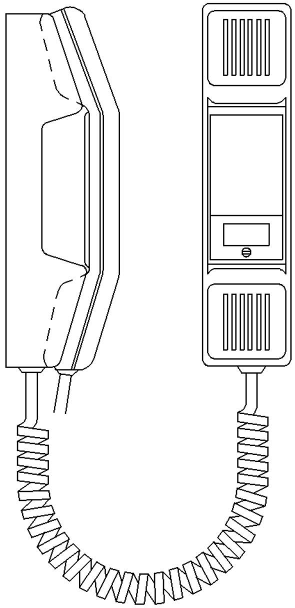
(2) PA reception knob

Pressed and released (knob out) : The message goes to the loudspeakers and the integral white light comes on.
R The flight crew can rotate the knob to adjust the volume.

Pressed (knob in) : The PA system is disconnected.
The white light goes out.

Cockpit handset

The cockpit handset at the bottom of the pedestal is for PA announcements.

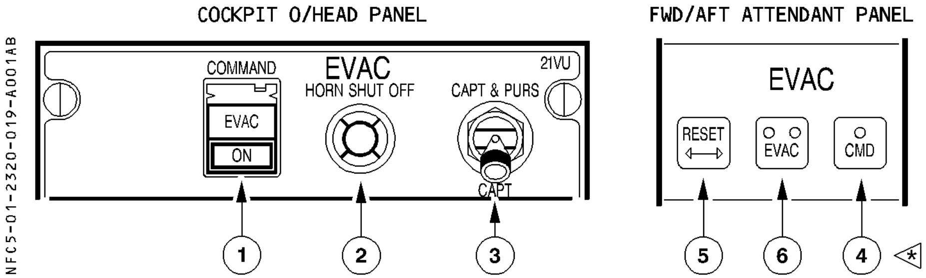


PA from cockpit

R

	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	OUT		
HANDMIKE	PRESSED	OUT	PRESSED	
HANDSET				PRESSED

EMER EVAC



(1) COMMAND pb

ON : In the cockpit : – EVAC light flashes red.
– Horn sounds.
In the cabin : – EVAC lights flash at FWD and AFT attendant panels.
– Evacuation tone sounds.

Off : The alert is stopped.

The EVAC light flashes red when the alert is activated.

(2) HORN SHUT OFF pb

Pressing this button silences the cockpit horn.

(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 If one of the cabin CMD pushbuttons is pressed, only the cockpit
R horn sounds for 3 seconds.

(4) CMD pb

Pressing this button activates the alert, if the cockpit switch is at the CAPT & PURS position.
Pressing it again stops the alert.

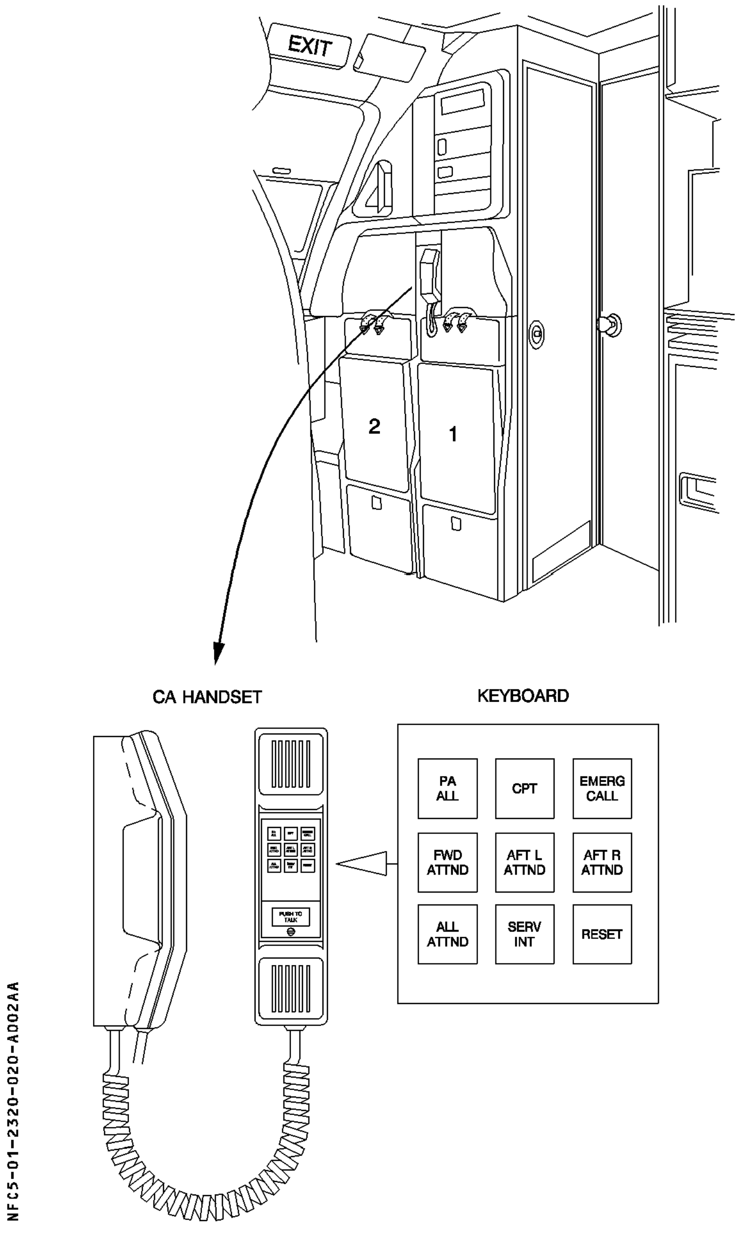
(5) RESET pb

Pressing this button silences the EVAC tone.

(6) EVAC lt

This light flashes when the alert is activated.

PURSER STATION



DESCRIPTION

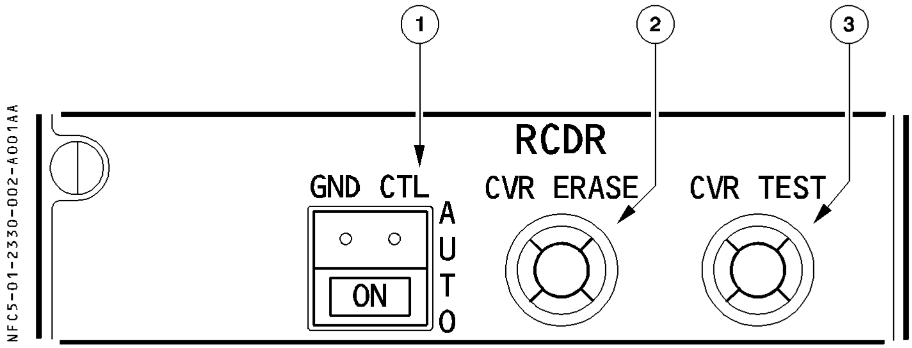
The cockpit voice recorder (CVR) records :
- direct conversations between crew members in the cockpit
- all aural warnings sounded in the cockpit
- communications received and transmitted by radio
- intercommunication conversations between crew members
- announcements transmitted over the passenger address system, if PA reception is selected on the third audio control panel.

Only the last 2 hours of recording are retained.
The CVR system consists of :
- a remote microphone behind the overhead panel.
- a “hot mike” function, which records the crew members voice directly from their microphone, even if the push to talk switch is not activated.
- 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 the ground during the first 5 minutes after the aircraft electrical network is energized
- on the ground with one engine running
- in flight

On the ground, it is stopped automatically 5 minutes after the last engine shutdown.
On the ground, the crew can energize the CVR manually by pressing the GND CTL pushbutton.

CONTROLS AND INDICATORS ON OVERHEAD PANEL



(1) <u>GND CTL switch (spring-loaded)</u>

ON : The CVR, DFDR, and QAR ◁ are on.
The ON light comes on blue.

AUTO : The CVR, DFDR, and QAR ◁ are on, according to the logic. (See page 1).

(2) <u>CVR ERASE pushbutton</u>

Pressed for 2 seconds : This completely erases the tape, if :
– The aircraft is on the ground, and
– The parking brake is on.

(3) <u>CVR TEST pushbutton</u>

Pressed and held : This activates the test, if the CVR is on (the GND CTL pushbutton pressed, or during the first 5 minutes after energization of the aircraft electrical network), and the parking brake is on.
R Refer to the FCOM 3.03.06, p. 2 for additional
R information.

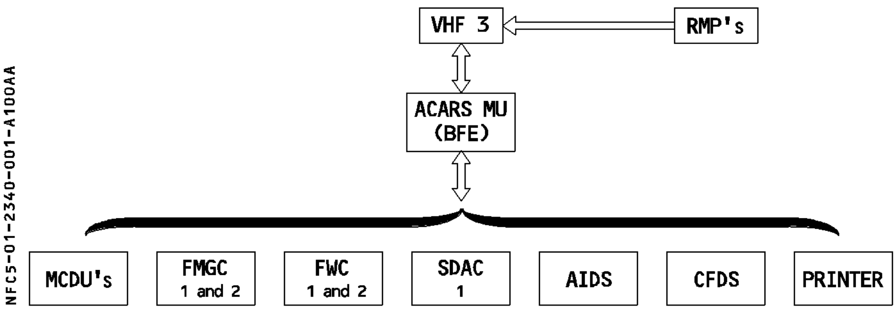
GENERAL

INTRODUCTION

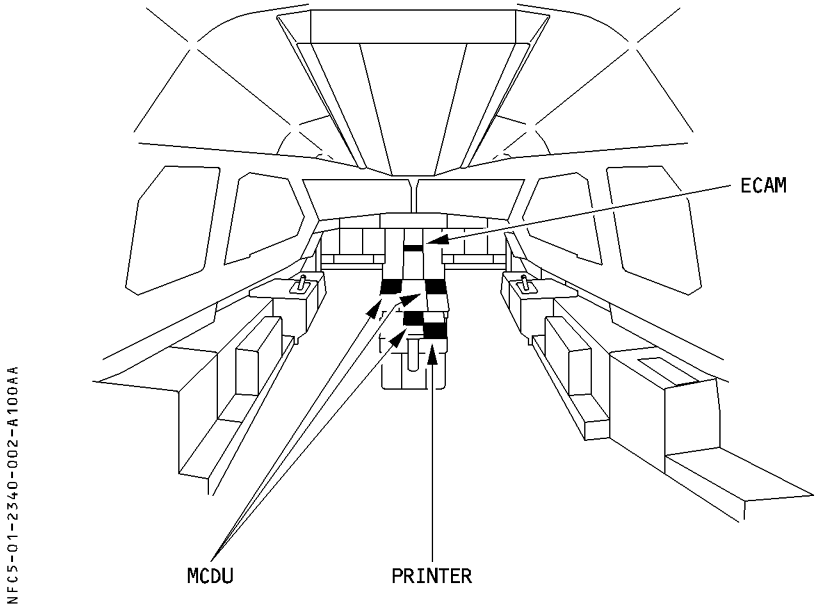
The Aircraft Communication Adressing and Reporting System (ACARS) allows direct exchange of data between aircraft and airline ground computer through the VHF 3.
Aircraft to ground messages (downlink) comprise operational, maintenance, monitoring, performance and cabin data.
Ground to aircraft messages (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



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 The connector for portable data loader is in the avionics bay.

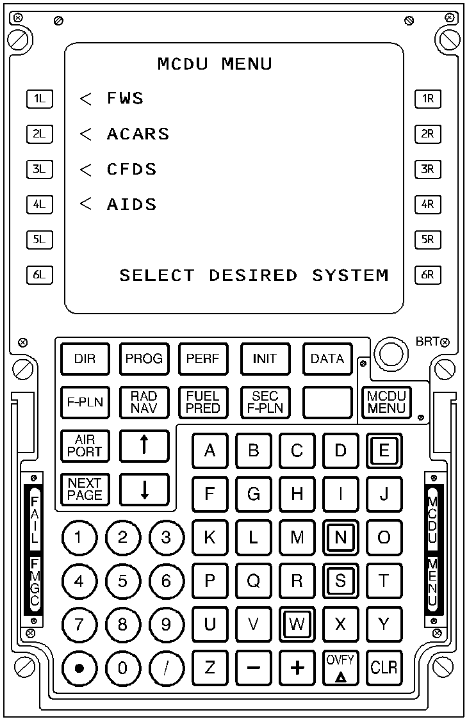
OPERATION MODES

MANUAL ACCESS TO ACARS FUNCTIONS

ACARS functions are manually selected through MCDU. They are obtained for FMGC, CFDS or AIDS by selecting the corresponding key. Cabin management functions (if available) are accessible through the cabin installed system.

R

MCDU



(NOTE : DEPENDING ON OPTIONS, MCDU FRONT FACE MAY SLIGHTLY DIFFER)

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Pressing of a system key will display the system pages as defined in the airline customized MU programming.

AUTOMATIC ACCESS TO ACARS FUNCTIONS

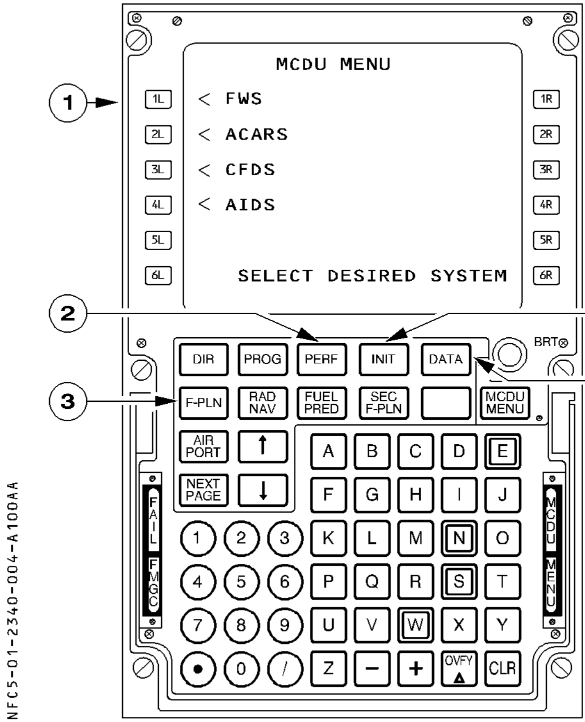
Automatic data transmission can be initiated by MU or aircraft systems programming or an uplink message. There is no cockpit indication nor crew action is required. It is a dialogue between ground and aircraft computers.

ACARS FUNCTIONS

Data and reports of a particular system are available through Airbus defined interfaces (seller furnishing equipment).

R **FMS**

MCDU



(NOTE : DEPENDING ON OPTIONS, MCDU FRONT FACE MAY SLIGHTLY DIFFER)

1. Pressing key selects related system then
2. Pressing key gives access to TO 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 4.04.40).

ACARS

Pressing ACARS key displays airline defined functions (message transmission , event times for example).

CFDS (Refer to 1.45.20)

The CMS ACARS interface permits to downlink the following data :
- Post flight report (on 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 ground) containing all class 3 failures detected during the last flight leg. The report can be downlinked upon crew or ACARS MU request.

AIDS

The AIDS ACARS interface transmits 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 AIDS 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 DOWNLINK OF REPORTS

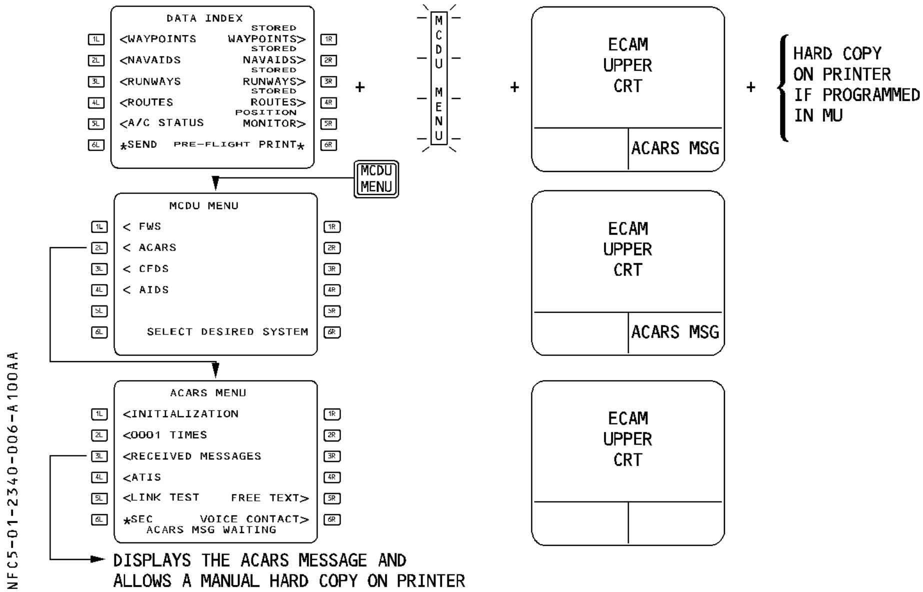
Automatic downlink of reports are provided by ACARS. Each report generated by a peripheral system may be downlinked depending on each airline MU programming.

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 (pulsing green) on ECAM Memo

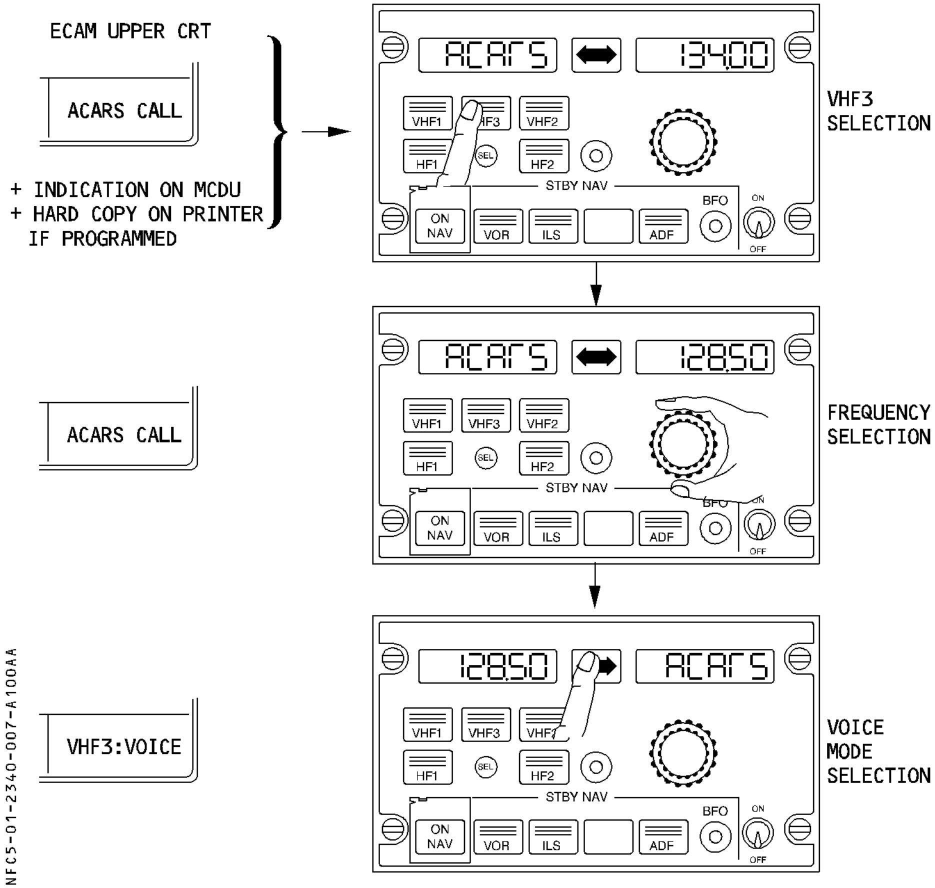
Note : A steady green "ACARS STBY" advisory is displayed in case of ACARS communications loss between aircraft and ground.

— 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 (FMGC, ACARS, AIDS, CFDS)
— Hard copy on cockpit printer depending on MU programming.
Example of uplink message indication with MCDU in FMS mode :



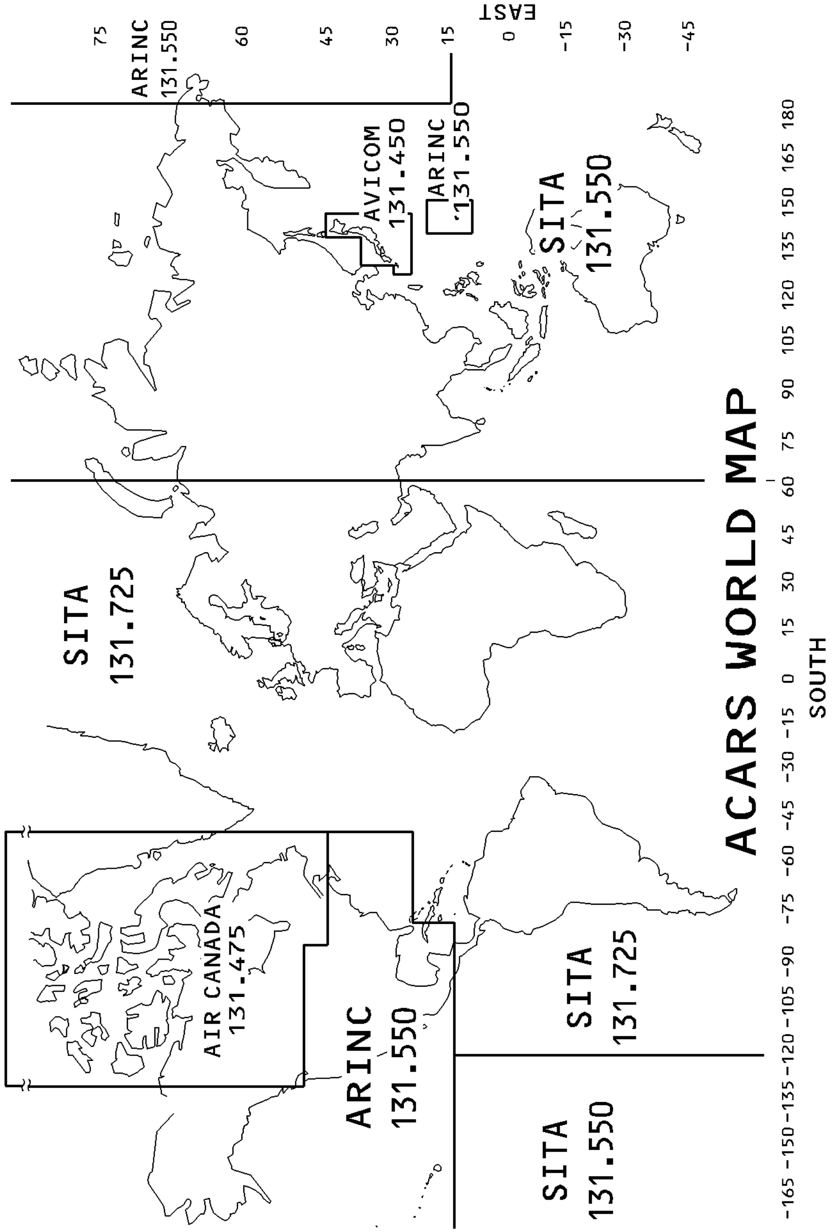
VOICE/ACARS transfer on VHF 3

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 RMPs (without using MCDU).



Return to ACARS mode is provided by pressing again the transfer key on RMP.

WORLD MAP ACARS FREQUENCIES



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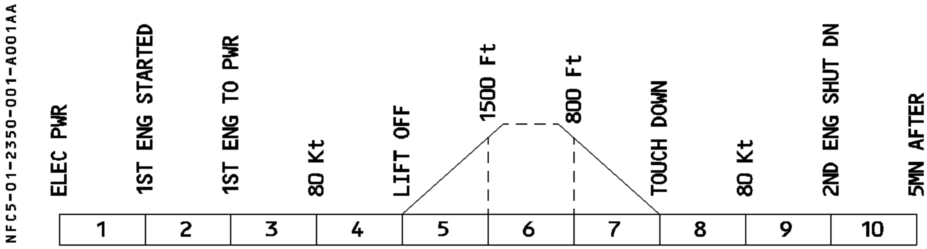
WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CIDS 1 + 2 FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	3,4,5 7,8
VHF 1(2) (3) EMITTING HF 1 (2) EMITTING Transmitter emitting more than 60 s					
ACARS FAULT (◁*)	NIL	NIL			

MEMO DISPLAY

This display shows AUDIO 3 XFRD in green if the AUDIO SWITCHING selector is not on NORM.

In addition, if ACARS is installed the display shows :

- ACARS CALL in green, pulsing, if ACARS has received a message from the ground requesting a voice conversation
- VHF 3 : VOICE in green if VHF3 is operating in voice mode and ACARS communication is interrupted
- ACARS MSG in green, pulsing, if ACARS has received a message from the ground
- ACARS STBY in green if ACARS communications between the aircraft and the ground are lost

BUS EQUIPMENT LIST

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
RADIO COMMUNICATIONS	VHF1				X	
	VHF2		DC2			
	VHF3		DC1			
	HF1	AC1				
	HF2	AC2				
	RMP1				X	
	RMP2		DC2			
	RMP3		DC1			
	CAPT ACP				X	
	F/O ACP				X	
	THIRD ACP		DC1			
	FOURTH ACP		DC1			
	SELCAL		DC1			
	FLT INTERPHONE				X	
	CAPT LOUDSPEAKER				X	
	F/O LOUDSPEAKER		DC2			
	EXT HORN					HOT 2
CABIN INTERCOM DATA SYS	CIDS1		GND/FLT		X	
	CIDS2		GND/FLT		X	
	DEU (A/B)		GND/FLT		X	
COCKPIT VOICE RECORDER	CVR CTL				SHED	
	CVR			SHED		
ACARS		AC1				

24.00 CONTENTS

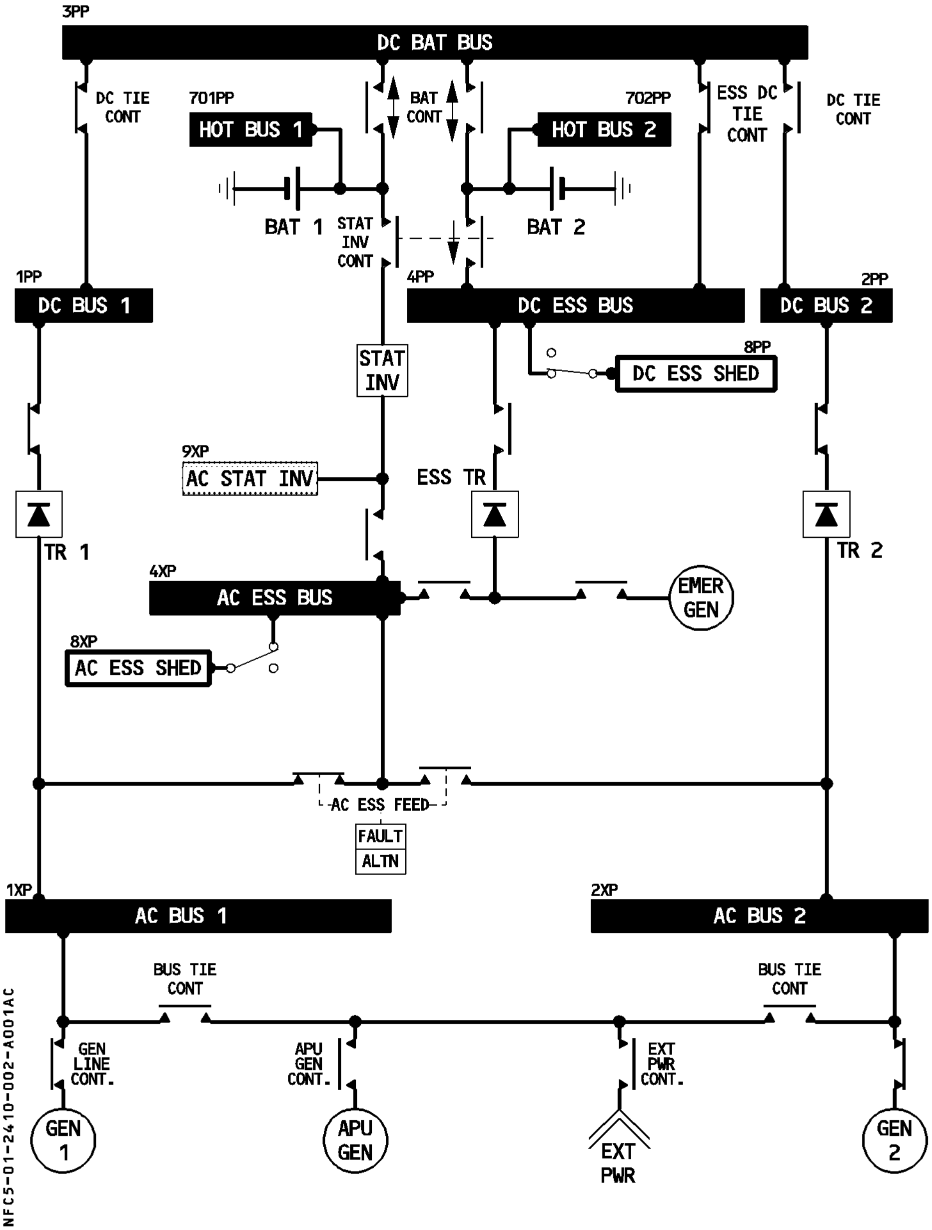
24.10 DESCRIPTION

24.20 CONTROLS AND INDICATORS

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.
Each of the aircraft's three generators can supply the whole network.
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


3PP
DC BAT BUS
DC TIE CONT
701PP
HOT BUS 1
BAT CONT
702PP
HOT BUS 2
ESS DC TIE CONT
DC TIE CONT
BAT 1
STAT INV CONT
BAT 2
1PP
DC BUS 1
4PP
DC ESS BUS
2PP
DC BUS 2
STAT INV
8PP
DC ESS SHED
9XP
AC STAT INV
ESS TR
TR 1
TR 2
4XP
AC ESS BUS
EMER GEN
8XP
AC ESS SHED
AC ESS FEED
FAULT
ALTN
1XP
AC BUS 1
2XP
AC BUS 2
BUS TIE CONT
BUS TIE CONT
GEN LINE CONT.
APU GEN CONT.
EXT PWR CONT.
GEN 1
APU GEN
EXT PWR
GEN 2
NFC5-01-2410-002-A001AC

GENERATION OF ELECTRICAL POWER

AC GENERATORS

MAIN GENERATORS

Two three-phase AC generators (GEN 1, GEN 2), one driven by each main engine through an integrated drive, supply aircraft electrical power. Each generator can supply up to 90 KVA of power at 115 and 200 volts and 400 hertz.
A third generator (APU GEN), driven directly by the APU and producing the same output as each main engine generator, can replace either or both 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

A ground power connector near the nose wheel allows ground power to be supplied to all bus bars.
A Ground Power Control unit (GPCU) protects the network by controlling the external power contactor.

EMERGENCY GENERATOR

The blue hydraulic circuit drives an emergency generator that automatically supplies emergency AC power to the aircraft electrical system if all three main generators fail. This generator supplies 5 KVA of three-phase 115/200-volt 400-hertz power.
A Generator Control Unit (GCU) :
- keeps the emergency generator at a constant speed
- controls the generator's output voltage
- protects the network by controlling the emergency generator line contactor
- controls the emergency generator start-up

STATIC INVERTER

A static inverter transforms DC power from Battery 1 into one KVA of single-phase 115-volt 400-hertz AC power, which is then supplied to part of the AC essential bus. When the aircraft speed is above 50 knots, the inverter is automatically activated, if nothing but the batteries are supplying electrical power to the aircraft, regardless of the BAT 1 and BAT 2 pushbutton positions.
When the aircraft speed is below 50 knots, the inverter is activated, if nothing but the batteries are supplying electrical power to the aircraft, and the BAT 1 and BAT 2 pushbuttons are both on at auto.

DC GENERATION

TRANSFORMER RECTIFIERS (TRs)

Two main transformer rectifiers, TR 1 and TR 2, supply the aircraft's electrical system, with up to 200 amperes of DC current.
A third (identical) transformer rectifier, the ESS TR, can power the essential DC circuit from the emergency generator, if the engine and APU generators all fail, or if TR 1 or TR 2 fails.
Each TR controls its contactor by internal logic.

BATTERIES

Two main batteries, each with a normal capacity of 23 ampere-hours, are permanently connected to the two hot buses.
Each battery has an associated Battery Charge Limiter (BCL).
The BCL monitors battery charging and controls its battery contactor.

CIRCUIT BREAKERS (C/Bs)

The aircraft has two types of C/Bs :
- Monitored (green) : When out for more than one minute, the C/B TRIPPED warning is triggered on the ECAM.
- Non-monitored (black).

The Wing Tip Brakes (WTB) C/Bs have red caps on them to prevent them from being reset.
R The C/B TRIPPED warning on the ECAM indicates the location of the affected C/B. The
R following panels are monitored : OVHD PNL, L(R) ELEC BAY, REAR PNL J-M or N-R or S-V
R or W-Z.

R *Note : The C/B TRIPPED, warning may be cleared from the ECAM. In this case, if a second*
R *C/B is tripped on the same panel, the corresponding C/B TRIPPED warning will not*
R *be triggered.*

OPERATIONS

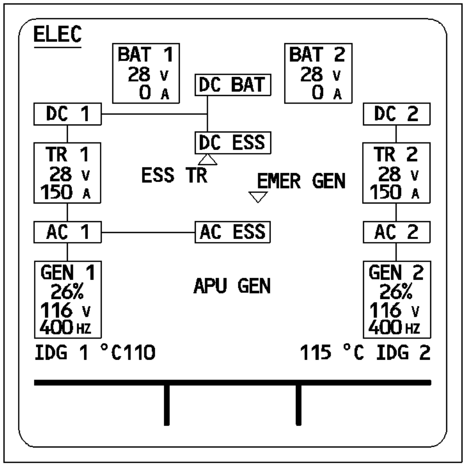
GENERAL

GEN 1 and 2 when operating have priority over the APU generator and over external power.
External power has priority over the APU generator when the EXT PWR pushbutton switch is ON.
The APU generator or external power can supply the entire network.
One engine generator can supply the entire network.
The generators cannot be connected in parallel.

NORMAL CONFIGURATION

IN FLIGHT

Each engine-driven generator supplies its associated AC BUS (1 and 2) via its generator line contactor (GLC 1 and GLC 2).
AC BUS 1 normally supplies the AC ESS BUS via a contactor.
TR 1 normally supplies DC BUS 1, DC BAT BUS, and DC ESS BUS.
TR 2 normally supplies DC BUS 2.
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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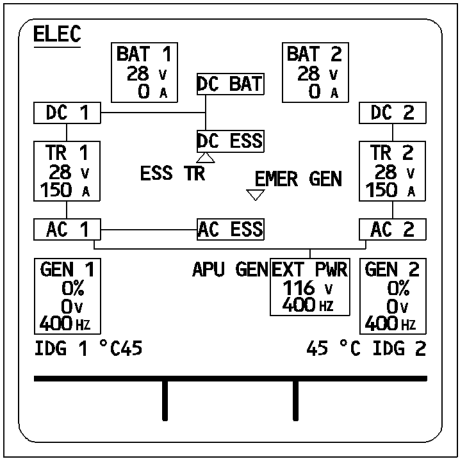
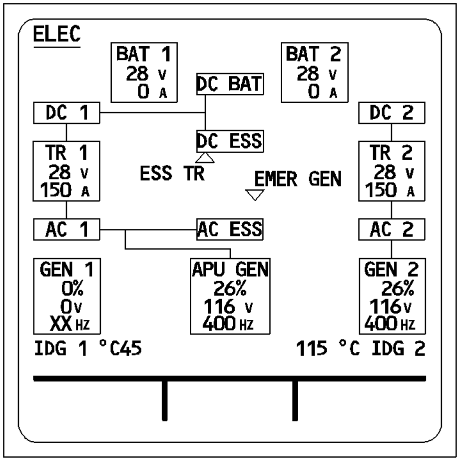
ON GROUND

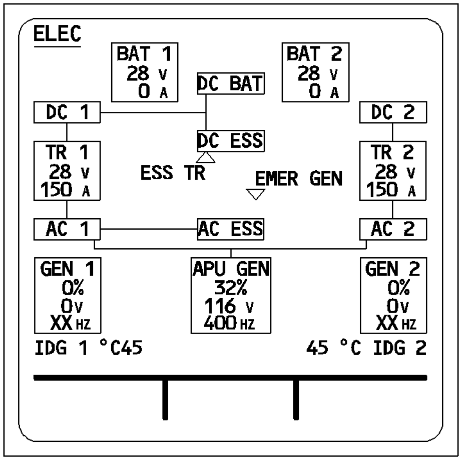
Either the APU generator or external power may supply the complete system.



EXTERNAL POWER ONLY



APU GEN + GEN 2



APU GEN ONLY

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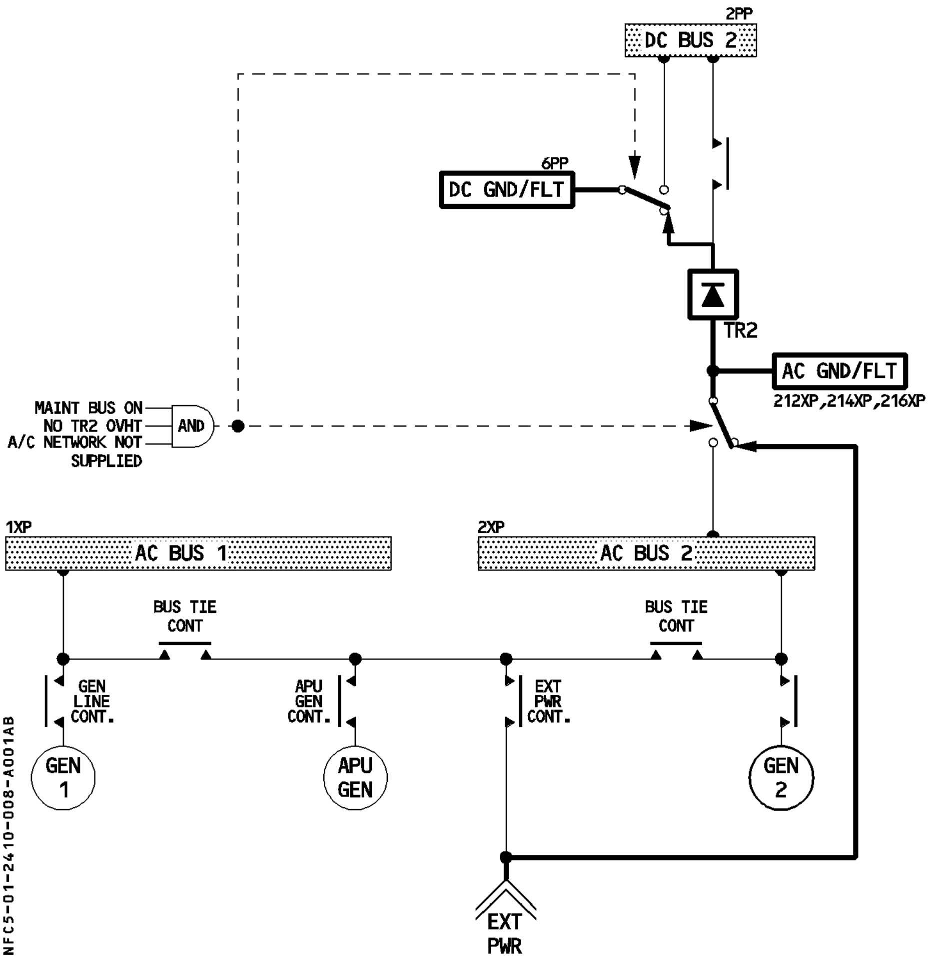
On ground, when only ground services are required, external power can supply the AC and DC GND/FLT BUSES directly without supplying the entire aircraft network.
Personnel select this configuration with the MAINT BUS switch in the forward entrance area.

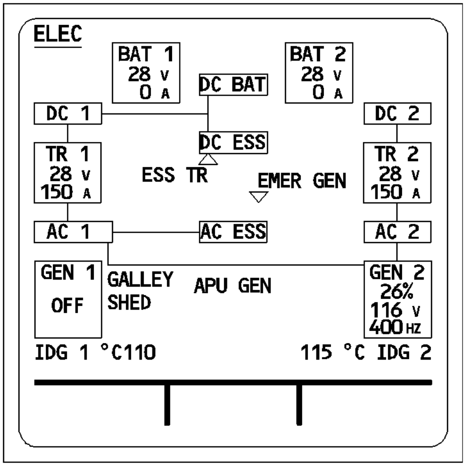
FOR INFO



ABNORMAL CONFIGURATIONS

FAILURE OF ONE ENGINE GENERATOR

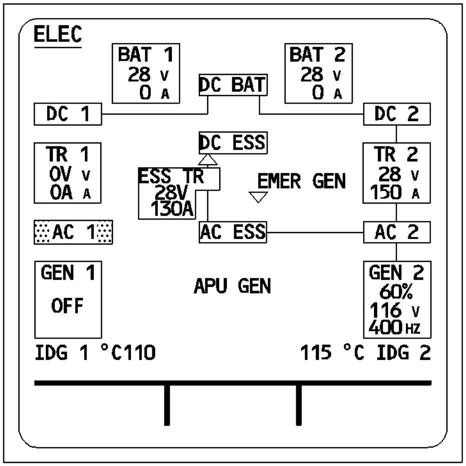
The system automatically replaces the failed generator with
- the APU GEN if available, or
- the other engine generator (automatically shedding part of the galley load).



NFC5-01-2410-009-A001AA

FAILURE OF AC BUS 1

- The AC BUS 2 can supply the AC ESS BUS and the ESS TR can supply the DC ESS BUS, both through the AC ESS FEED pushbutton switch.
- The DC BUS 2 supplies the DC BUS 1 and DC BAT BUS automatically after 5 seconds.



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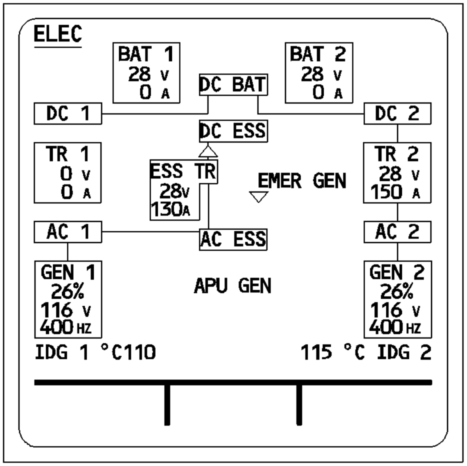
FAILURE OF ONE TR

The contactor of each TR opens automatically in case of :
- overheat
- minimum current

The other TR automatically replaces the fautly one.
The ESS TR supplies the DC ESS BUS.



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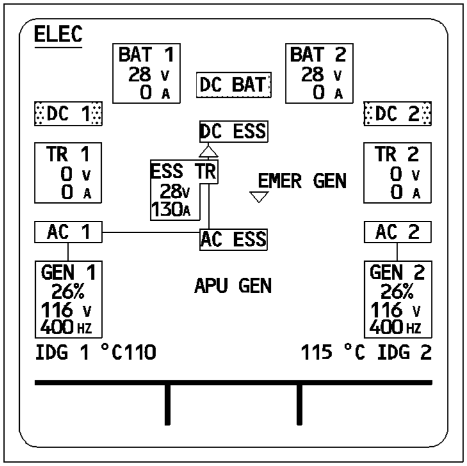
FAILURE OF TR 1 AND TR 2

If TR 1 and TR 2 are lost, DC BUS 1, DC BUS 2, and DC BAT BUS are lost. The DC ESS BUS is supplied by the ESS TR.



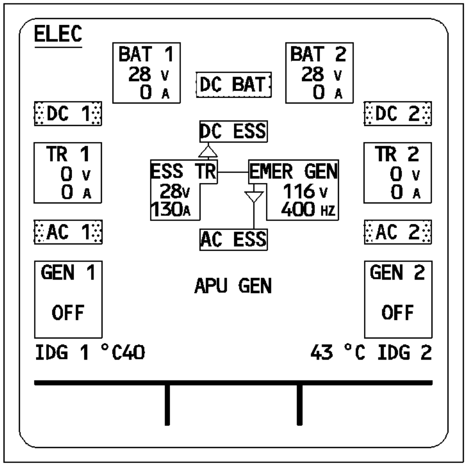
NFC5-01-2410-012-A001AA

EMERGENCY GENERATION AFTER LOSS OF ALL MAIN GENERATORS

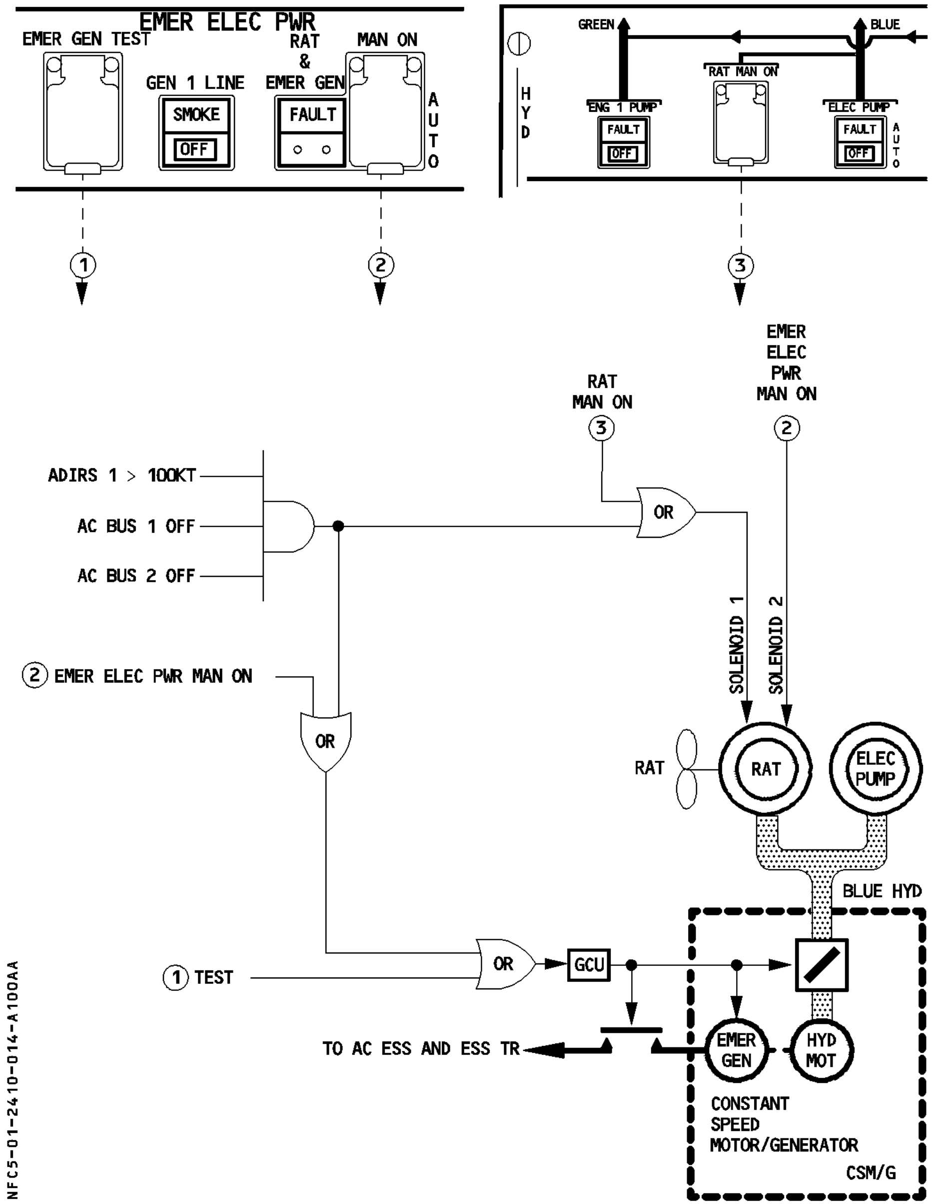
If both the AC BUS 1 and AC BUS 2 buses are lost and the aircraft speed is above 100 knots, the Ram-Air Turbine (RAT) extends automatically. This powers the blue hydraulic system, which drives the emergency generator by means of a hydraulic motor. This generator supplies the AC ESS BUS, and the DC ESS BUS via the ESS TR.
If the RAT stalls or if the aircraft is on the ground with speed below 100 knots, the emergency generator has nothing to drive it. The emergency generation network transfers automatically to the batteries and static inverter, and the system automatically sheds the AC SHED ESS and DC SHED ESS buses.
When the aircraft is on the ground :
– Below 100 knots the DC BAT BUS is automatically connected to the batteries.
– Below 50 knots the AC ESS BUS is automatically shed, leading to the loss of all CRTs.

R *Note : During RAT extension and emergency generator coupling (about 8 seconds), the batteries power the emergency generation network.*

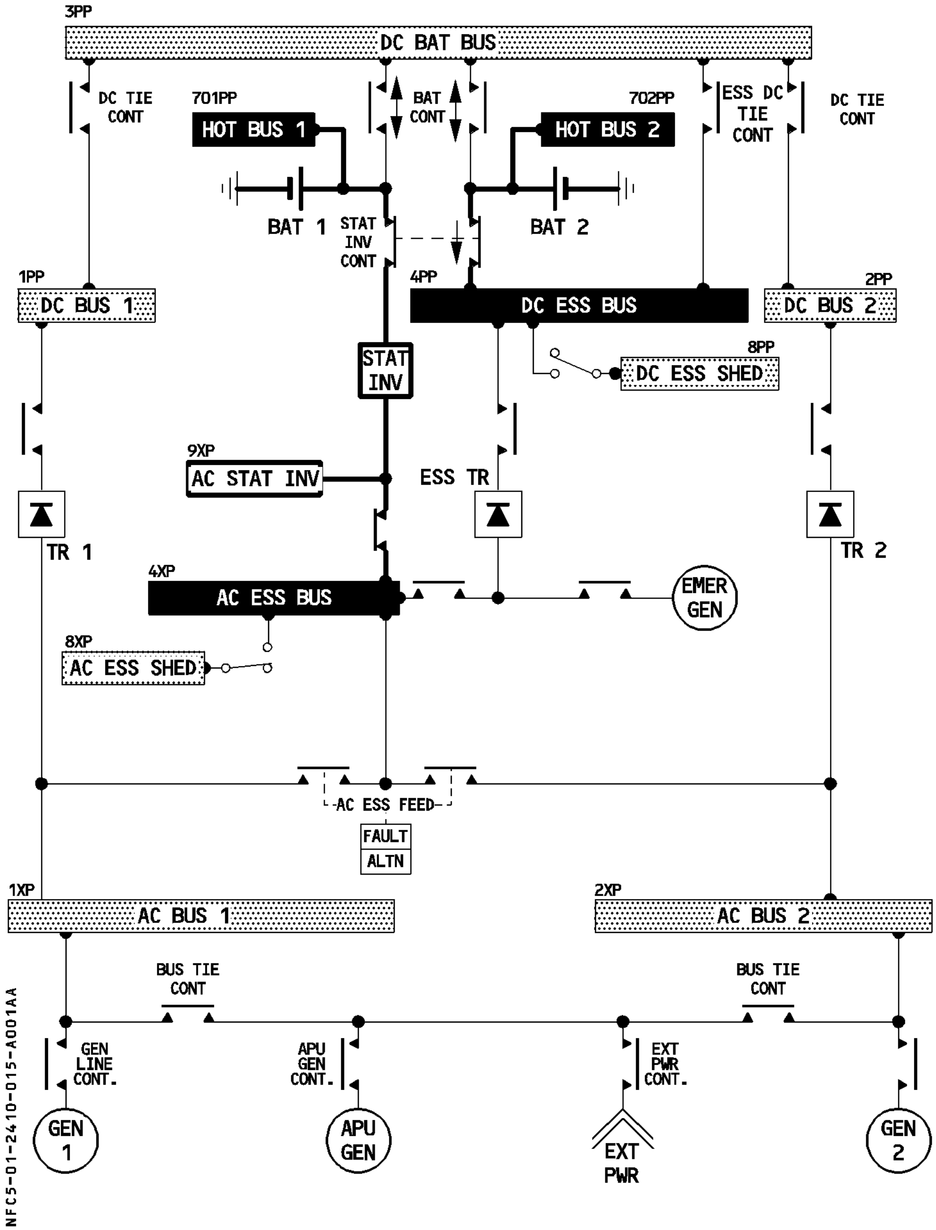
EMER GEN RUNNING



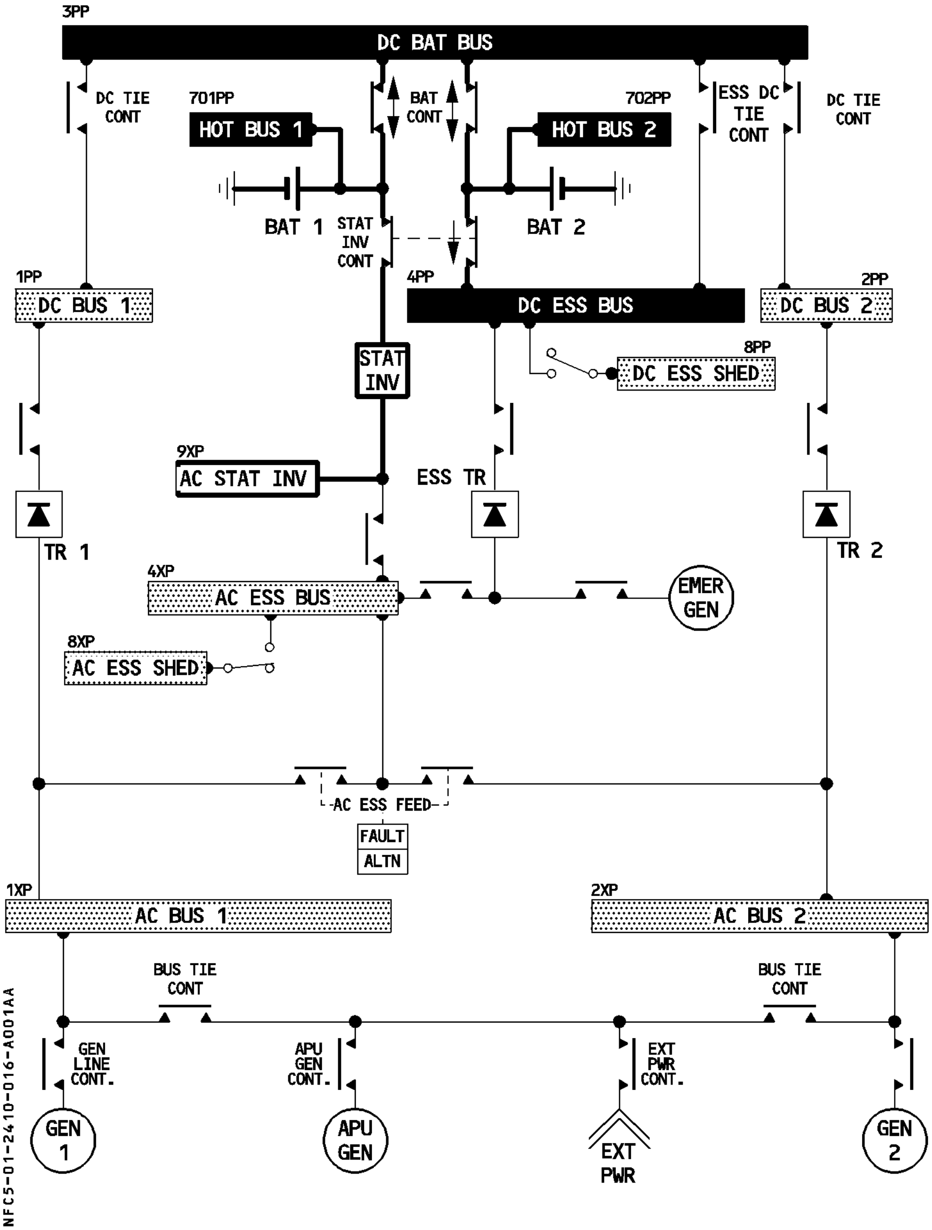
NFC5-01-2410-013-A100AA


EMER ELEC PWR
EMER GEN TEST
GEN 1 LINE
SMOKE
OFF
RAT & EMER GEN
FAULT
MAN ON
AUTO
GREEN
BLUE
HYD
RAT MAN ON
ENG 1 PUMP
FAULT
OFF
ELEC PUMP
FAULT
OFF
AUTO
EMER ELEC PWR MAN ON
RAT MAN ON
ADIRS 1 > 100KT
AC BUS 1 OFF
AC BUS 2 OFF
OR
EMER ELEC PWR MAN ON
OR
SOLENOID 1
SOLENOID 2
RAT
RAT
ELEC PUMP
BLUE HYD
TEST
OR
GCU
TO AC ESS AND ESS TR
EMER GEN
HYD MOT
CONSTANT SPEED MOTOR/GENERATOR
CSM/G
NFC5-01-2410-014-A100AA

FLIGHT WITH BATTERIES ONLY



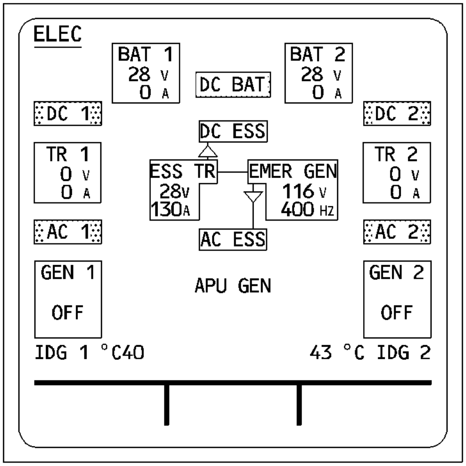
ON GROUND, BATTERIES ONLY (speed < 50 kt)



SMOKE CONFIGURATION

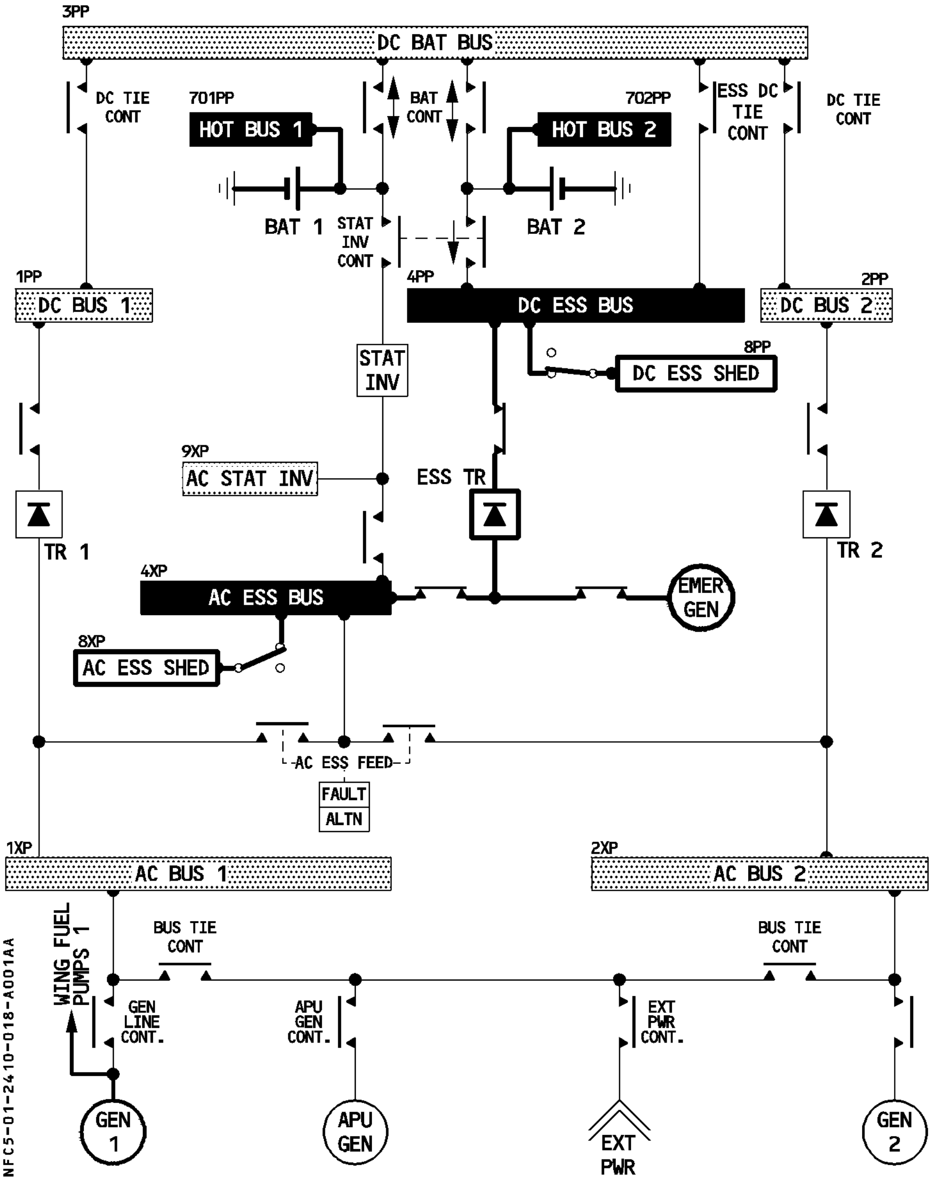
R In this configuration the main bus bars are shedded. The electrical distribution is the same as it is in the emergency configuration (loss of main generators), except that the fuel pumps are connected upstream of the GEN 1 line connector.
The procedure sheds about 75 % of electrical equipment. All equipment that remains powered is supplied through C/Bs on the overhead panel (except for that which is supplied by hot buses).

R



NFC5-01-2410-017-A001AB

SMOKE configuration



Note : ECAM ELEC page is identical to that for emergency generator running.

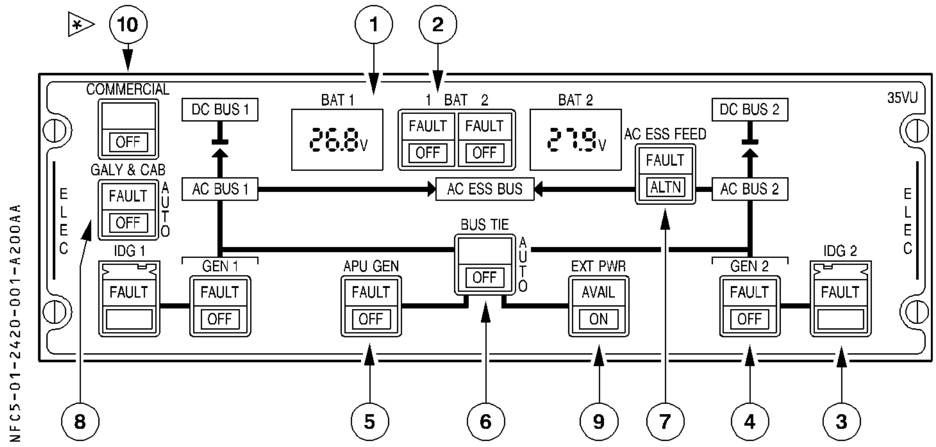
DISTRIBUTION TABLE

R

	AC BUS 1	AC BUS 2	AC ESS BUS	AC SHED ESS	AC STAT INV	TR1	TR2	ESS TR	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC SHED ESS	HOT BUS 1	HOT BUS 2
NORM CONF	GEN1	GEN2	GEN1	GEN1	–	GEN1	GEN2	–	TR1 GEN1	TR2 GEN2	TR1 GEN1	TR1 GEN1	TR1 GEN1	BAT1	BAT2
ONE GEN INOP AVAIL-X- (1,2 or APU)	GENX	GENX	GENX	GENX	–	GENX	GENX	–	TR1 GENX	TR2 GENX	TR1 GENX	TR1 GENX	TR1 GENX	BAT1	BAT2
EMER CONF · BEFORE EMER GEN AVAILABILITY (about 8 sec)	–	–	ST INV BAT1	–	ST INV BAT1	–	–	–	–	–	–	BAT2	–	BAT1	BAT2
· EMER GEN RUNNING	–	–	EMER GEN	EMER GEN	–	–	–	EMER GEN	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	BAT1	BAT2
TR1 FAULT	GEN1	GEN2	GEN1	GEN1	–	–	GEN2	GEN1	TR2 GEN2	TR2 GEN2	TR2 GEN2	ESS TR GEN1	ESS TR GEN1	BAT1	BAT2
TR2 FAULT	GEN1	GEN2	GEN1	GEN1	–	GEN1	–	GEN1	TR1 GEN1	TR1 GEN1	TR1 GEN1	ESS TR GEN1	ESS TR GEN1	BAT1	BAT2
TR1 + 2 FAULT	GEN1	GEN2	GEN1	GEN1	–	–	–	GEN1	–	–	–	ESS – TR GEN1	ESS – TR GEN1	BAT1	BAT2

ON GROUND BAT. ONLY	AC BUS 1	AC BUS 2	AC ESS BUS	AC SHED ESS	AC STAT INV	TR1	TR2	ESS TR	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC SHED ESS	HOT BUS 1	HOT BUS 2
Speed > 100kt	–	–	EMER GEN	EMER GEN	–	–	–	EMER GEN	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	BAT1	BAT2
rat stall or 50 kt ≤ speed ≤100 kt	–	–	ST INV BAT1	–	ST INV BAT1	–	–	–	–	–	BAT 1-2	BAT2	–	BAT1	BAT2
speed < 50 kt	–	–	–	–	ST INV BAT1	–	–	–	–	–	BAT 1-2	BAT2	–	BAT1	BAT2

OVERHEAD PANEL



① BAT 1(2) ind.

Shows battery voltage in white.

(2) 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 (3 PP) by closing and opening of the battery line contactor.

- The batteries are connected to the DC BAT BUS in the following cases :
  - · APU starting (MASTER SW at ON and N < 95%).

    Note : The connection is limited to 3 minutes when the emergency generator is running.

  - · Battery voltage below 26.5 V (battery charge). The charging cycle ends when battery charge current goes below 4 amperes.
    - on ground, immediately
    - in flight, after a time delay of 30 minutes.
  - · Loss of AC BUS 1 and 2 when below 100 knots (EMER GEN not supplying).
- If AC BUS 1 and 2 are not energized and emergency generator is not supplying :
  - · battery 1 supplies the AC STAT INV BUS, and, if speed is greater than 50 kt, the AC ESS BUS.
  - · battery 2 supplies the DC ESS BUS.

    Note : In normal configuration the batteries are disconnected most of the time.

    Note : A battery automatic cut-off logic prevents the batteries from discharging completely when the aircraft is on the ground (parking).
    Automatic battery contactors open when :
    — The aircraft is on the ground.
    — The BAT pushbutton switches are at AUTO.
    — The main power supply (EXT PWR + GEN) is cut off.
    — Battery voltage is low.
    The flight crew can reset the contactors by switching the BAT pushbutton switch to OFF then to AUTO.

OFF : The battery charge limiter is not operating : the battery line contactor is open.
OFF comes on white if the DC BAT BUS is supplied. Hot buses remain supplied.

FAULT lt : Comes on amber, accompanied by an ECAM caution, when the charging current for the corresponding battery is outside limits.
In this case the battery contactor opens.

③ IDG 1 (2) (Integrated Drive Generator) pb sw (guarded)

CAUTION

1. Holding this pusbutton switch in for more than about 3 seconds may damage the disconnection mechanism.
2. Do not disconnect the IDG when the engine is not running (or not windmilling), because starting the engine after having done so will damage the IDG.

The IDG switches are normally springloaded out.
Pressing this switch disconnects the IDG from its driveshaft : only maintenance personnel can reconnect it.
FAULT lt : Lights up amber, and ECAM caution comes on, if :
- IDG oil outlet overheats (above 185°C), or
- IDG oil pressure is low (inhibited at low engine speed : N2 below 14 %)

It extinguishes when the IDG is disconnected.

④ GEN 1 (2) pb sw

ON : The generator field is energized and the line contactor closes if electrical parameters are normal.
OFF : The generator field is de-energized and the line contactors opens.
The fault circuit is reset.
FAULT lt : Lights up amber, and an ECAM caution comes on, if :
- The associated generator control unit (GCU) trips it.

Note : If a differential fault trips the protection, reset action has no effect after two attempts.

- Opening of the line contactor (except if the GEN pushbutton switch is selected OFF)

⑤ APU GEN pb sw

ON : The APU generator field is energized and the line contactor closes if parameters are normal and the EXT PWR line contactor is open.
The bus tie contactor 1 (2) closes automatically if GEN 1 (2) is not operating.
OFF : The generator field is de-energized and the line contactor opens. The fault circuit is reset.
FAULT lt : Same as GEN 1 or 2 FAULT
The APU GEN FAULT light is inhibited when APU speed is too low or if the APU GEN line contactor opens after EXT PWR or ENG GEN takes over.

⑥ BUS TIE pb sw

AUTO : The bus tie contators (BTCs) open or close automatically in order to maintain power supply to both AC BUS 1 and AC BUS 2.
- One contactor is closed when :
  · One engine generator supplies the associated AC BUS, and
  · The APU generator or external power supplies the other side.
- Both contactors are closed during single-engine operation, or operation on the APU generator or external power supply.

OFF : Both bus tie contactors open.

⑦ AC ESS FEED pb sw

The AC ESS BUS is normally supplied from AC BUS 1.
It may be supplied by AC BUS 2 through the AC ESS FEED pushbutton switch.
NORMAL : The AC ESS BUS is supplied from AC BUS 1.
ALTN : The AC ESS BUS is supplied from AC BUS 2.
FAULT lt : Comes on amber, and ECAM caution comes on, 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.

⑧ GALY & CAB pb sw

AUTO : Main galley, secondary galley and in-seat power supply ◁✱ are supplied. The main galley and in-seat power supply ◁✱ are shed automatically when :
- In flight : only one generator is operating.
- On the ground : only one engine generator is operating. (All galleys are available when the APU GEN or EXT PWR is supplying power.)

OFF : The main galley, secondary galley and in-seat power supply ◁✱ are not supplied.

FAULT lt : Comes on amber, and ECAM caution comes on, when the load on any generator is more than 100 % of rated output.

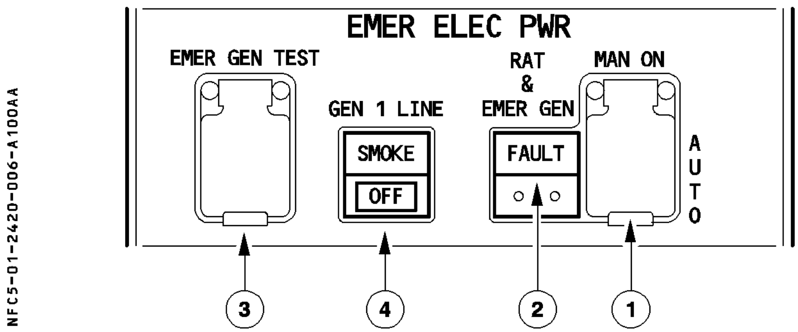
9 EXT PWR pb (momentary action)

AVAIL light comes on green if :
– external power is plugged in, and
– external power parameters are normal.
Pressed momentarily :
– 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 on :
  · The external power line contactor opens.
  · The ON light goes off.
  · The AVAIL light comes on.

Note : 1. External power has priority over the APU generator. The engine generators have priority over external power.
2. The ON light stays on even when the engine generators supply the aircraft.

10 COMMERCIAL pb sw ⊲*

ON : All aircraft commercial electrical loads are supplied :
– cabin and cargo lights
– water and toilet system
– drain mast ice protection
– galley
– passengers' entertainment
– semi-automatic cargo loading (if installed)
OFF : Switches off all aircraft commercial electrical loads.



(1) MAN ON pb (guarded)

AUTO : When the following conditions are met :
· AC BUS 1 is not electrically supplied.
· AC BUS 2 is not electrically supplied.
· Aircraft speed is greater than 100 knots.
– The RAT extends.
– The blue hydraulic system drives the emergency generator.
– As soon as the emergency generator electrical parameters are within tolerance the emergency generator is connected to the aircraft network.

Pressed : This selects manual RAT extension.
R Emergency generator coupling occurs 3 seconds after the RAT is supplying
R the emergency generator.

(2) FAULT lt

This light comes on red if the emergency generator is not supplying power when AC BUS 1 and AC BUS 2 are not powered.

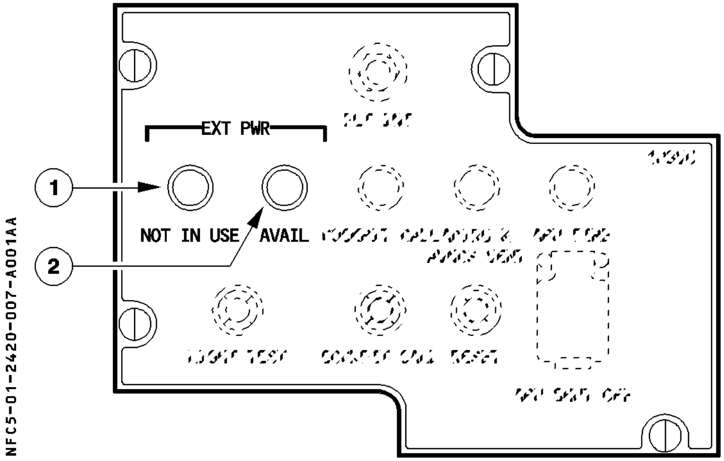
(3) EMER GEN TEST pb (guarded)

Pressed and held :
· If AC NORMAL BUSES are supplied :
– The EMER GEN is driven hydraulically if the blue electric pump is running.
The AC ESS BUS and the DC ESS BUS are connected to the emergency generator. (The DC ESS SHED and AC ESS SHED buses are not powered.)
– ECAM displays the ELEC page automatically (only on the ground).
· If only the batteries supply the aircraft :
– The static inverter powers the AC ESS BUS.

④ GEN 1 LINE pb sw

OFF : GEN 1 line contactor opens.
The AC BUS 1 channel is supplied from GEN 2 through bus tie contactors. This is used for smoked drill.
SMOKE lt : (Refer to 1.26)

EXTERNAL POWER PANEL



① EXT PWR NOT IN USE

This white light comes on to inform ground personnel that the ground power unit is not supplying the aircraft network and can be removed.

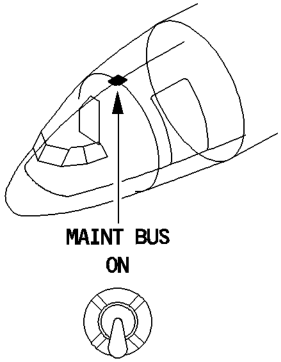
② EXT PWR AVAIL

This amber light comes on to indicate that external power is available and the voltage is correct.

FORWARD CABIN

MAINT BUS sw :

NFC5-01-2420-008-A001AA



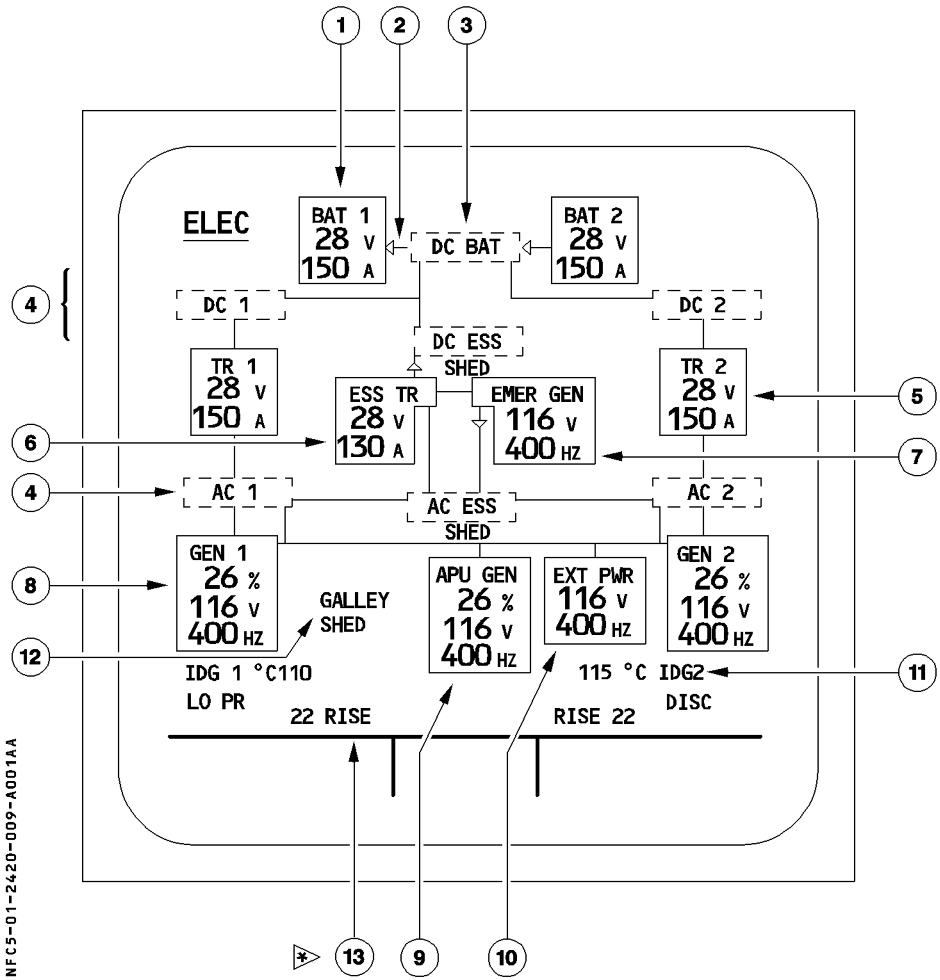
This switch allows personnel to energize electrical circuits for ground servicing without energizing the entire aircraft electrical system.

ON : The switch latches magnetically if external power is connected and normal (AVAIL light on).
The AC and DC GND/FLT buses have power and the following loads can be energized :
- passenger compartment lighting
- galley lighting
- entrance area lights
- lavatory lighting and service
- vacuum cleaner sockets
- flight compartment service outlets
- hydraulic pump (yellow system)
- flight compartment flood lighting
- fuel quantity indications
- refueling
- cargo hold lighting
- main and nose landing gear compartment lighting
- belly fairing panel service outlets
- ground call
- equipment compartment lights and service outlets
- navigation lights.

The switch trips when the external source is removed.

OFF : The AC and DC GND/FLT buses are connected to AC BUS 2 and DC BUS 2.

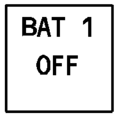
ECAM ELEC PAGE



1 Battery indications

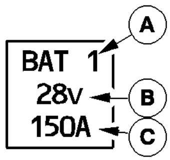
— BAT pushbutton switch at OFF :
Legend is in white.

NFC5-01-2420-010-A001AA



— BAT pushbutton switch at Auto :

NFC5-01-2420-010-B001AA



A Legend is normally white, but becomes amber
· when voltage and current indications change to amber, or
· in case of a BAT FAULT warning.

B Battery voltage is normally green, but becomes amber if V > 31 V or V < 25 V.

C Battery current is normally green, but becomes amber if discharge current > 5 A.

2 Battery charge/discharge indication

NFC5-01-2420-010-C001AA

BATTERY CONTACTOR CLOSED. BATTERY CHARGING CURRENT > 1A (GREEN)

BATTERY CONTACTOR CLOSED. BATTERY DISCHARGE CURRENT > 1A (AMBER)

BATTERY CONTACTOR CLOSED. CURRENT < 1A (GREEN)

BATTERY CONTACTOR OPEN.

③ DC BAT indication

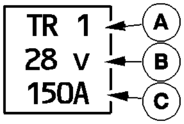
This legend normally green, becomes amber if DC BAT voltage ≤ 25 V.

④ Bus indication

This label, normally green, becomes amber when the corresponding bus is off.
SHED appears in amber when AC or DC SHED ESS BUS is off.

⑤ TR 1 (2) indication

NFC5-01-2420-011-A001AA



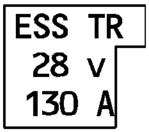
Ⓐ Normally white, this legend becomes amber when legends B and C do.

Ⓑ The TR voltage, normally green, becomes amber if V > 31 V or V < 25 V.

Ⓒ The TR current, normally green, becomes amber when the TR current ≤ 5 A.

⑥ ESS TR indication

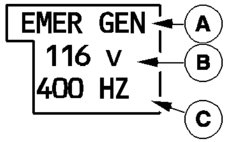
NFC5-01-2420-011-B001AA



This legend follows the logic described above for the TR 1 (2) legend.
The voltage and current are not displayed when the essential TR contactor is open.

(7) EMER GEN indication

NFC5-01-2420-012-A001AA



(A) This legend, normally white, becomes amber when either the voltage or frequency legend becomes amber.

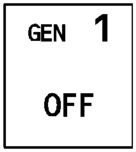
(B) This legend, normally green, becomes amber
if V > 120 V or
if V < 110 V.

(C) This legend, normally green, becomes amber
if F > 410 Hz or
if F < 390 Hz.
Voltage and frequency indications are not displayed when the EMER GEN line contactor is open.

8 GEN 1/2 indications

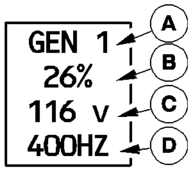
- GEN pushbutton switch is OFF :
  GEN is amber.
  OFF indication is white
  1 or 2 indication is white if the associated engine is running, amber if it is not.

NFC5-01-2420-013-A001AA



- GEN pushbutton switch is ON.

NFC5-01-2420-013-B001AA



(A) GEN1 or GEN2, normally white, becomes amber if any of the following legends become amber.

(B) The load legend, normally green, becomes amber if load > 100 %.

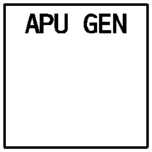
(C) The voltage legend, normally green, becomes amber if V > 120 V or V < 110 V.

(D) The frequency legend, normally green, becomes amber if F > 410 Hz or F < 390 Hz.

9 APU GEN indications

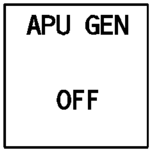
- When the APU MASTER switch is OFF this legend is white regardless of the position of the APU GEN pushbutton switch.

NFC5-01-2420-014-A001AA



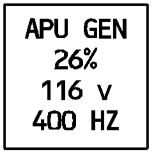
- When the APU MASTER switch is ON, and the APU GEN pushbutton switch is OFF:
  The APU GEN legend is amber.
  The OFF legend is white.

NFC5-01-2420-014-B001AA



- When the APU MASTER switch is ON and the APU GEN pushbutton switch is ON :
  The indications are the same as for GEN 1 (2).

NFC5-01-2420-014-C001AA



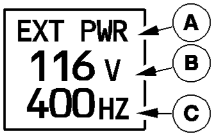
(10) EXT PWR indications

— External power is not available.

NFC5-01-2420-015-A001AA

— When external power is available :

NFC5-01-2420-015-B001AA

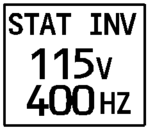


(A) This legend is normally white, but becomes amber, if either of the following legends turns amber.

(B) This legend is normally green, but becomes amber, if V > 120 V or if V < 110 V.

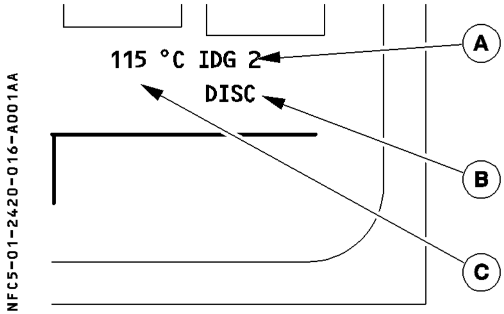
(C) This legend is normally green, but becomes amber, if F > 410 Hz or if F < 390 Hz.

NFC5-01-2420-015-C001AA



R — This legend appears during the static inverter test, and when pressing the ELEC
R pushbutton on the ECAM control panel while ESS BUSES are supplied by the
R batteries. It is normally green, but becomes amber, if :
V < 110 V or V> 120V.
F < 390 Hz or F > 410 hz.

(11) IDG indications



(A) IDG1 (2) legend
The IDG legend, normally white, becomes amber if
· Oil outlet temperature > 185° C.
· Oil pressure gets too low.
· IDG becomes disconnected.
The 1 or 2 is white if the corresponding engine is running, amber if it is not and the FADEC is powered.

(B) DISC/LO PR indication
The DISC legend appears in amber when the IDG is disconnected.
LO PR appears in amber when IDG low pressure is detected and the associated engine is running.

(C) Oil outlet temperature
This legend, normally green, appears amber if T > 185° C. It flashes if 147° C < T < 185° C (advisory).

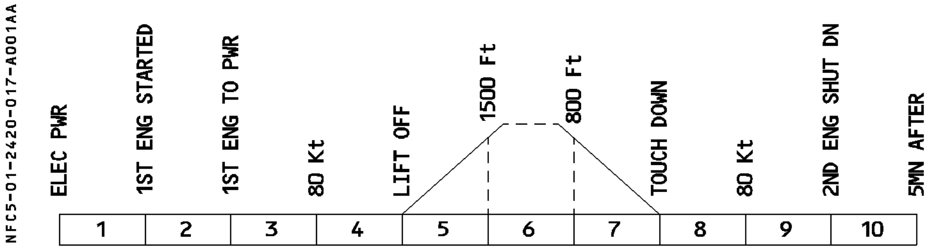
(12) GALLEY SHED indication

This legend appears in white when :
– GALLEY pushbutton switch is OFF, or
– the main galleys are shed, meaning :
  · In flight, only one generator is operating.
  · On the ground, the aircraft is being supplied by one engine generator only.
The legend is not displayed when the aircraft is in its normal configuration.

(13) RISE indication ⊲*

This number, displayed in green, is the difference between the temperature at the IDG inlet and that at the IDG outlet.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
EMER CONFIG Loss of main generators.	CRC	MASTER WARN	NIL *	RAT AND EMERGEN FAULT lt	4, 8
AC BUS 1 FAULT AC BUS 2 FAULT AC ESS BUS SHED DC BUS 1 FAULT DC BUS 2 FAULT DC BUS 1 + 2 FAULT DC ESS BUS FAULT DC ESS BUS SHED Bus(es) is (are) no longer supplied	SINGLE CHIME	MASTER CAUTION	ELEC	NIL	
AC ESS BUS FAULT Bus is no longer supplied				AC ESS FEED FAULT lt	
DC BAT BUS FAULT Bus is no longer supplied				NIL	4, 5, 7, 8
ESS BUSES ON BAT DC and AC ESS BUSES are supplied by batteries					1, 2, 3, 4, 8, 9, 10
DC EMER CONFIG DC BUS 1 and 2 and DC ESS BUS are not supplied					4, 8
GEN 1(2) FAULT · protection trip initiated by associated GCU · or opening of line contactor with GEN pb sw at ON				GEN 1(2) FAULT	1, 4, 5, 7, 8,10
GEN 1(2) OFF GEN 1(2) pb sw at OFF with no FAULT				NIL	1, 3, 4 5, 7, 8 10

* The flight crew must call up the ELEC page on the upper ECAM by pressing and holding the ELEC pushbutton on the ECAM control panel.

<table>
<tr><th>E / WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>APU GEN FAULT
· Protection trip initiated by associated GCU,
· or opening of line contactor with APU GEN pb at ON</td><td rowspan="6">SINGLE CHIME</td><td rowspan="6">MASTER SINGLE</td><td rowspan="5">ELEC</td><td>APU GEN FAULT lt</td><td>4, 5, 7, 8</td></tr>
<tr><td>GEN 1(2) or APU GEN OVERLOAD
Load of one generator is above 100 % of rated output</td><td>GALLEY FAULT lt</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>IDG 1(2) OIL LO PR
IDG oil pressure low</td><td rowspan="2">IDG 1(2) FAULT lt</td><td rowspan="2">1, 4, 5 7, 8, 10</td></tr>
<tr><td>IDG 1(2) OIL OVHT
IDG outlet oil temp above 185°C</td></tr>
<tr><td>BAT 1(2) FAULT
Charging current increases at an abnormal rate</td><td>BAT 1(2) FAULT lt</td><td>3, 4, 5 7, 8</td></tr>
<tr><td>C/B TRIPPED ON OVHD PNL
C/B TRIPPED ON L (R) ELEC BAY
C/B TRIPPED REAR PNL J-M or N-R or S-V or W-Z
One C/B tripped in the designated zone</td><td>NIL</td><td rowspan="6">NIL</td><td>3, 4, 5, 7, 8, 9, 10</td></tr>
<tr><td>BAT 1(2) OFF
BAT pb at OFF without fault</td><td rowspan="5">NIL</td><td rowspan="5">NIL</td><td rowspan="3">ELEC</td><td>1, 3, 4, 5 7, 8, 9, 10</td></tr>
<tr><td>TRI 1(2) FAULT</td><td rowspan="3">3, 4, 5 7, 8</td></tr>
<tr><td>BCL 1(2) FAULT</td></tr>
<tr><td>STATIC INV FAULT</td><td rowspan="2">NIL</td></tr>
<tr><td>EMER GEN 1 LINE OFF
GEN 1 LINE pb at OFF position</td><td>1, 3, 4, 5 7, 8, 9, 10</td></tr>
</table>

MEMO DISPLAY

EMER GEN is displayed in green when the emergency generator is running.

25.00 CONTENTS

25.10 FLIGHT DECK

25.11 COCKPIT DOOR SECURITY SYSTEM ⊲

25.15 IN SEAT POWER SUPPLY SYSTEM ⊲

25.20 ELECTRICAL SUPPLY

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.

PRINCIPLES FOR PUSHBUTTONS WITH INTEGRATED INDICATIONS

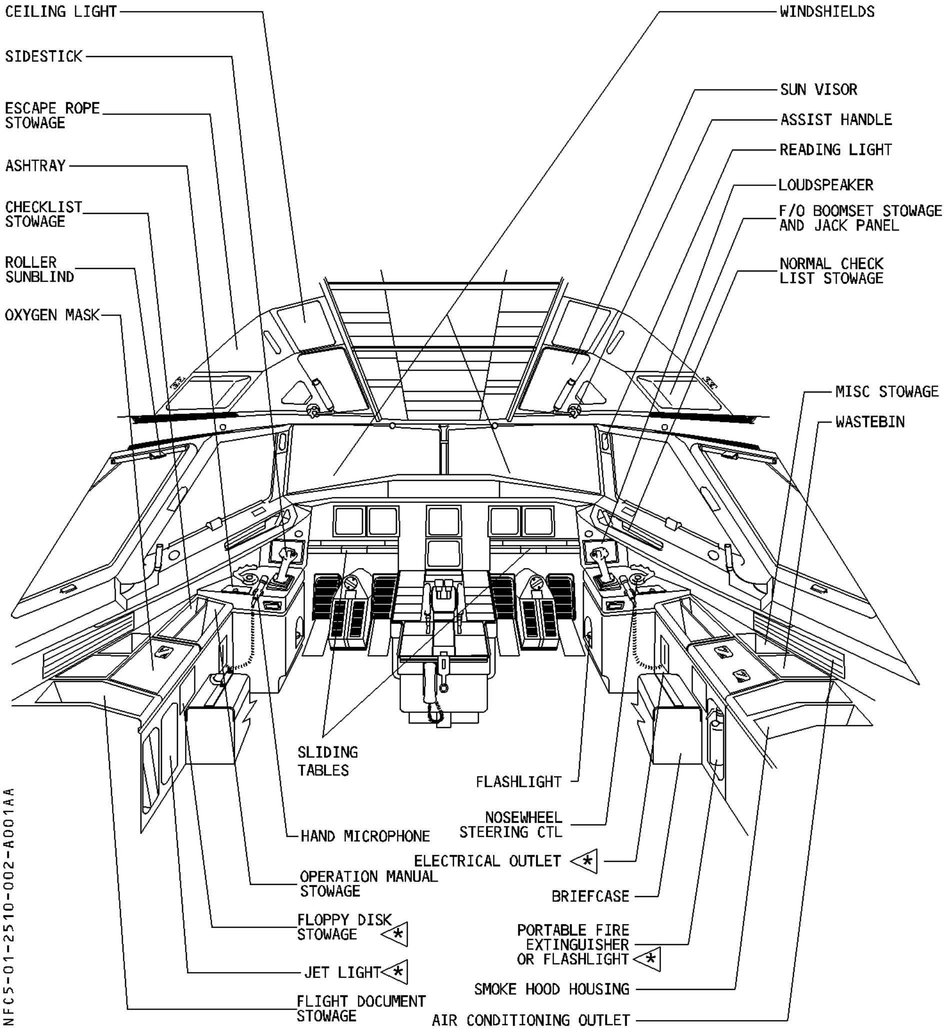
Whenever possible, pushbuttons used for corrective actions, have integrated status and failure indications.
The pushbutton positions, and their illuminated indications, follow the 'lights out" principle.
— While corresponding to particular aircraft configurations, indications also have the following 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 a normal configuration, only green lights can be permanently lit, whereas blue lights can be intermittently.
— Pushbutton positions :

POSITION	BASIC FUNCTION
Pressed In	ON, AUTO, OVRD, OPEN
Released Out	OFF, MAN, ALTN, SHUT

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*
R *"Momentary Action" pushbuttons.*

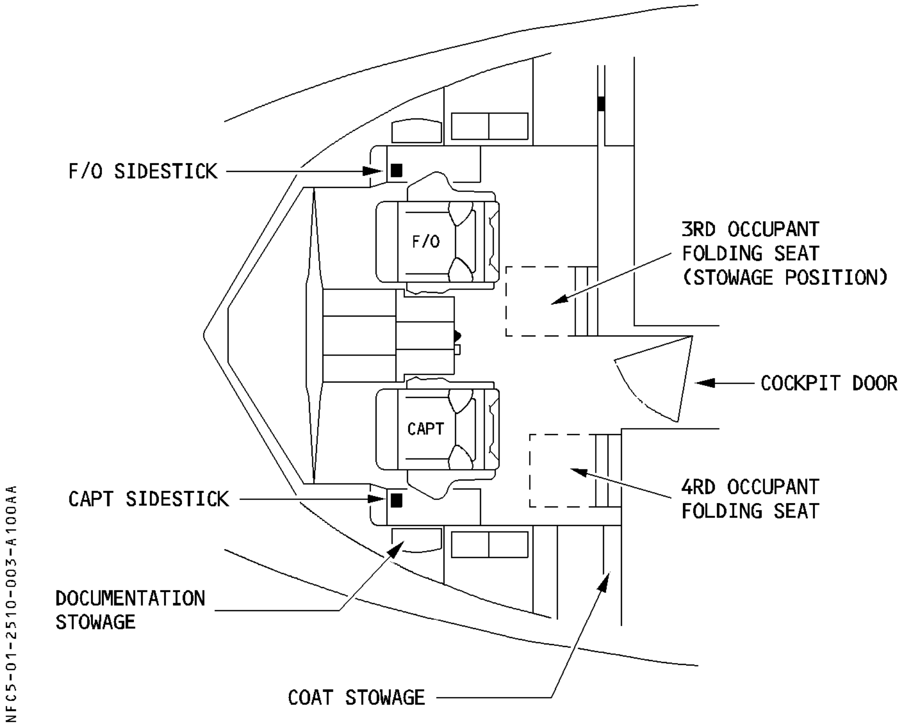
GENERAL ARRANGEMENT

R

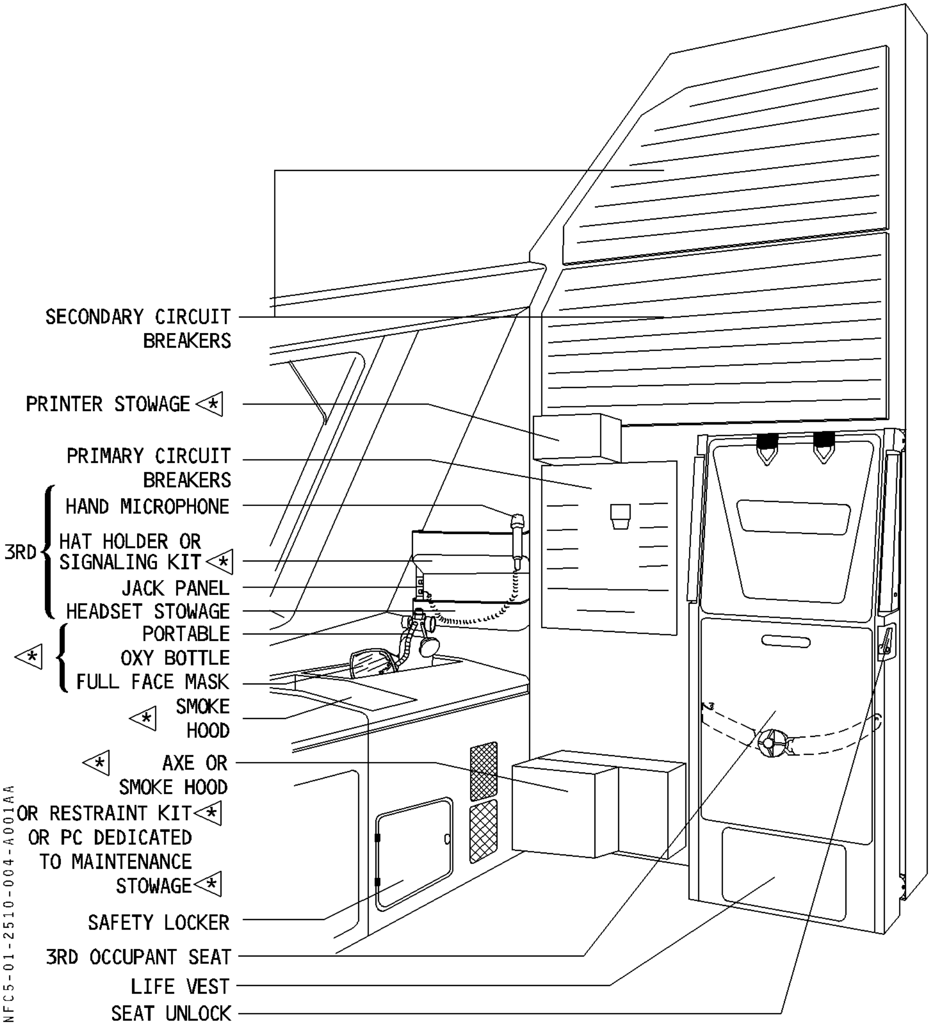


COCKPIT PLAN

The cockpit can accommodate two crewmembers, plus a third and fourth occupant.
The two pilot seats are mounted on columns.
The third and fourth occupant seats are folding seats.

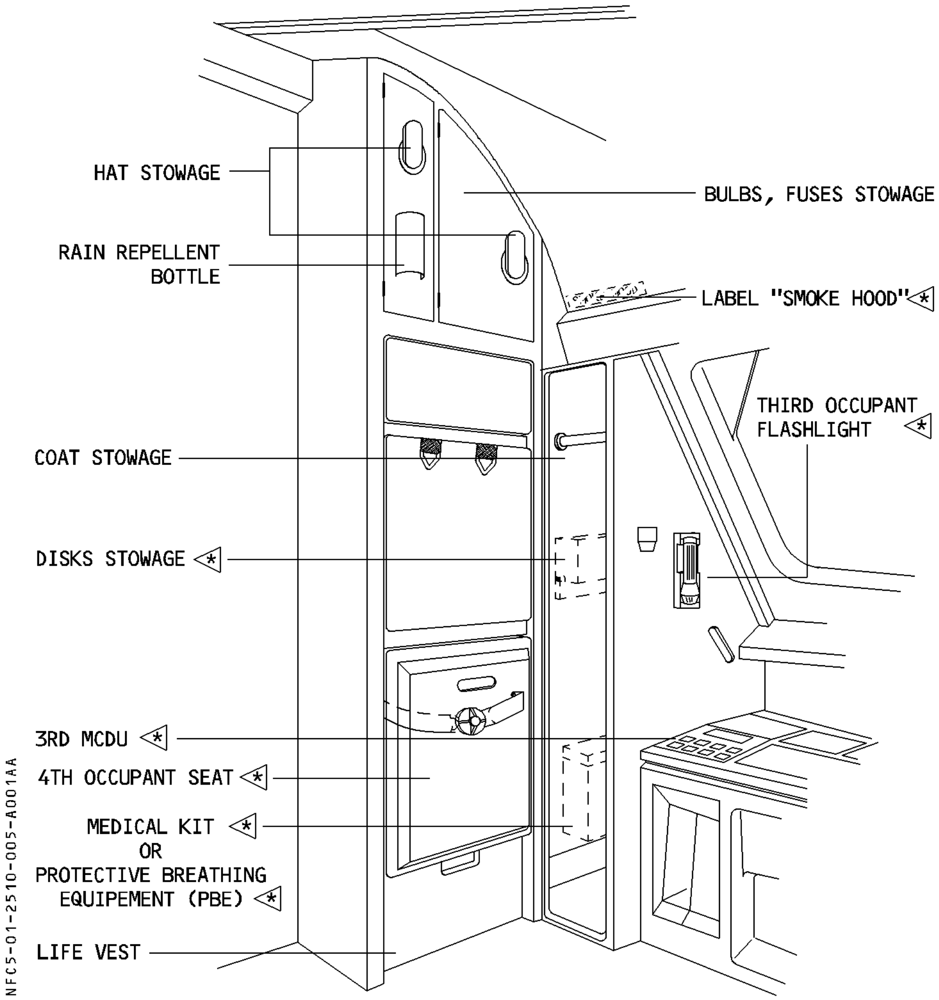


R **RIGHT REAR CORNER**



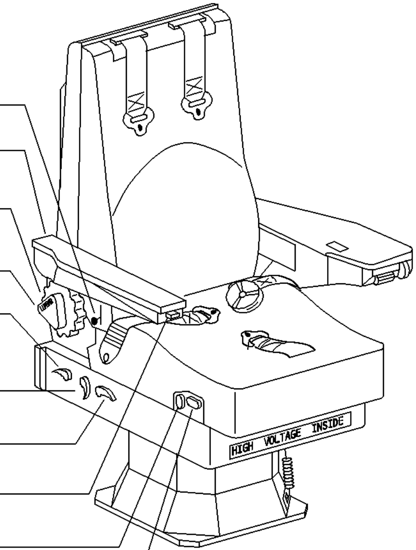
LEFT REAR CORNER

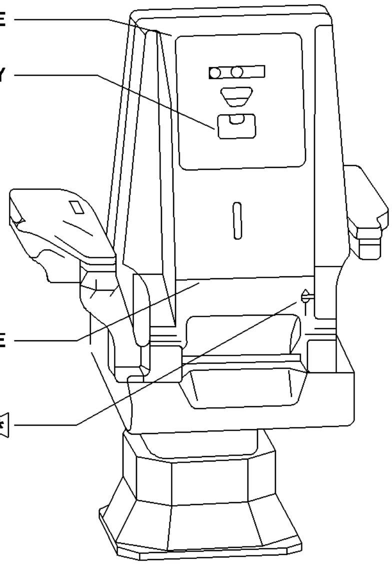
R



SEATS

PILOT SEATS





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PILOT 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
R springloaded locked position. On electrically powered seats, the mechanical adjustment
R is a backup : the seat should be adjusted electrically.

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 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.

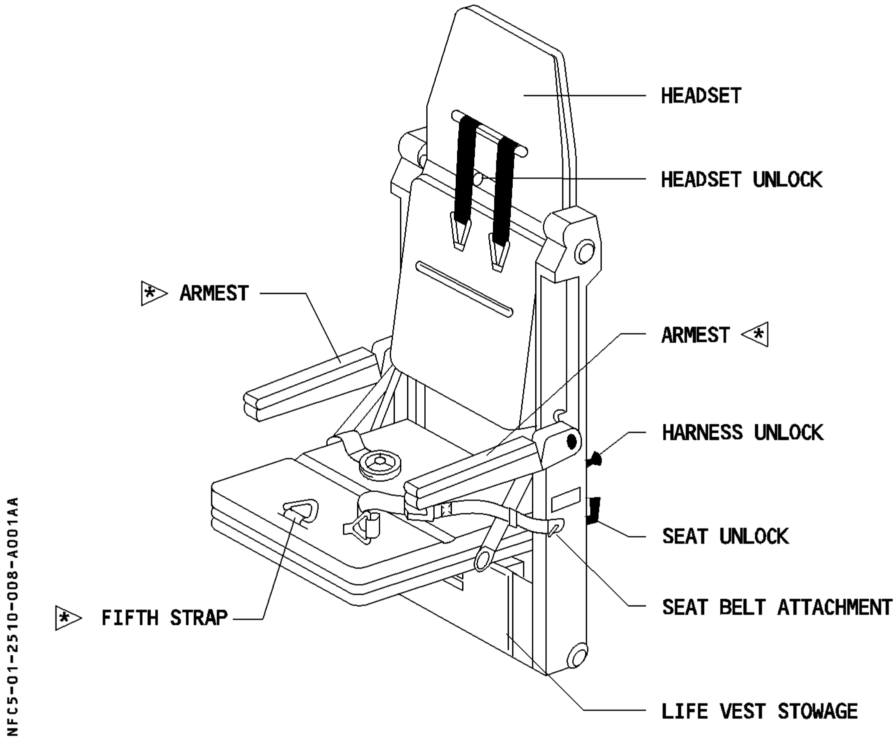
HEADREST ADJUSTMENT

To adjust the headrest in inclination, the occupant presses the inclination control button. He releases it to lock the position.
To control the height of the headrest, the occupant must push it horizontaly, then adjust the height. Released it locks the position.

ARMREST ADJUSTMENT

To adjust inboard armrest the occupant turns the knurled knob located on the bottom surface of the armrest.

OBSERVER SEAT

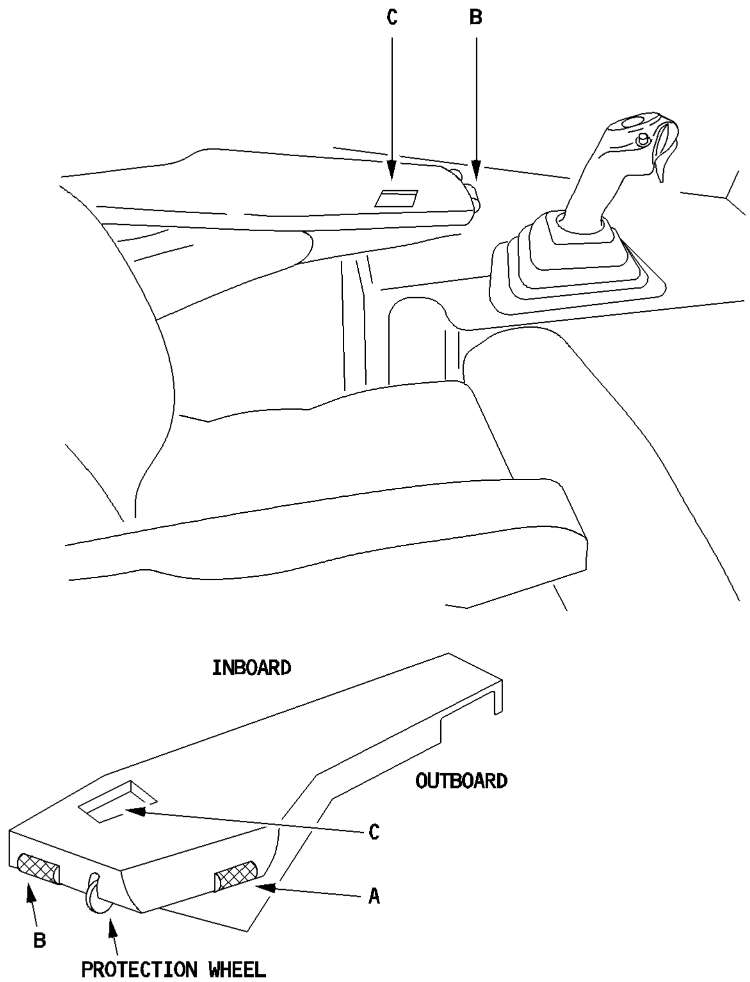


OBSERVER SEAT ADJUSTMENT

This seat has three positions :

- normal : centred on aircraft axis.
- intermediate : clear of the cockpit entrance.
- stowed : seat vertical and headrest folded back. The seat is usable in this position, which is out of the way of access to the documents and equipment on the right side of the cockpit.

ARM REST



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The position of the arm rest is adjustable as follows :
A – Height adjustment
B – Pitch adjustment
The armrest also has a memory display (C) that shows pitch and height.

COCKPIT WINDOW

The cockpit has fixed and sliding windows.

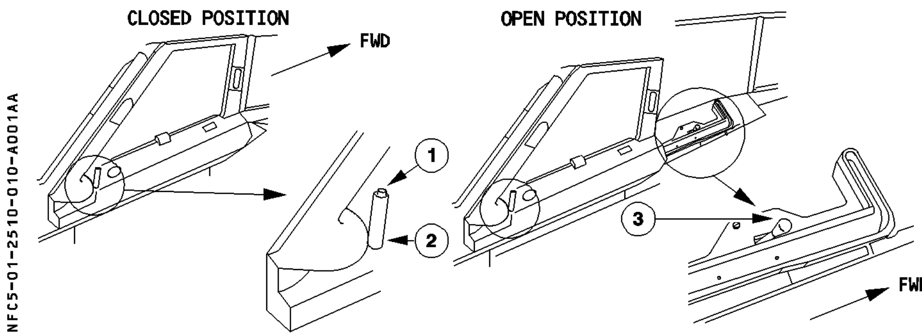
FIXED WINDOWS

There are four fixed windows :
- two windshields
- two fixed side windows

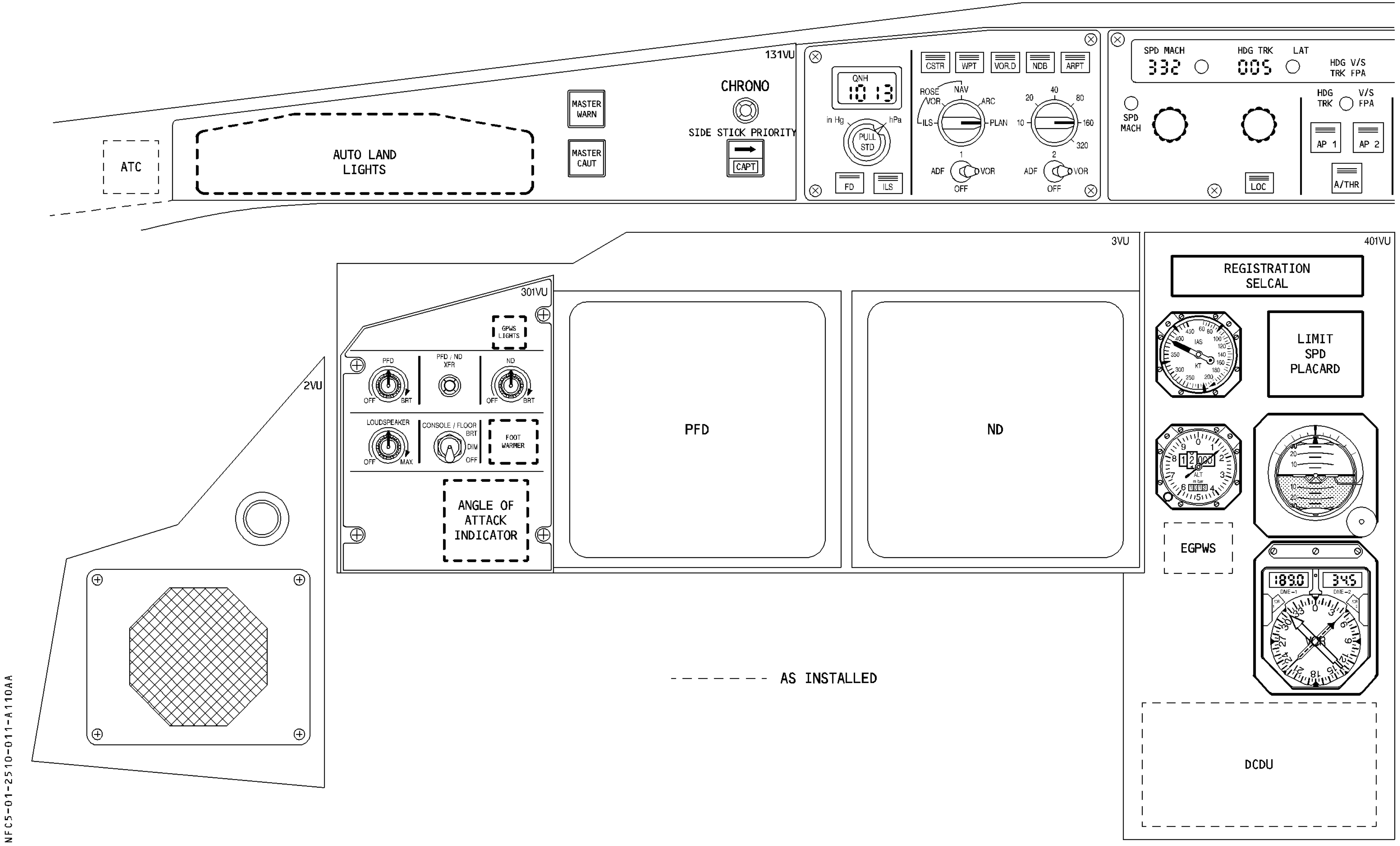
SLIDING WINDOWS

The flight crew can use the sliding windows as emergency exits. Therefore they are not permitted to stow any object so that it protrudes into the window area from the side console. Members of the flight crew can use the control handle to slide each of the windows rearward, and can use a locking pin to lock each window open.

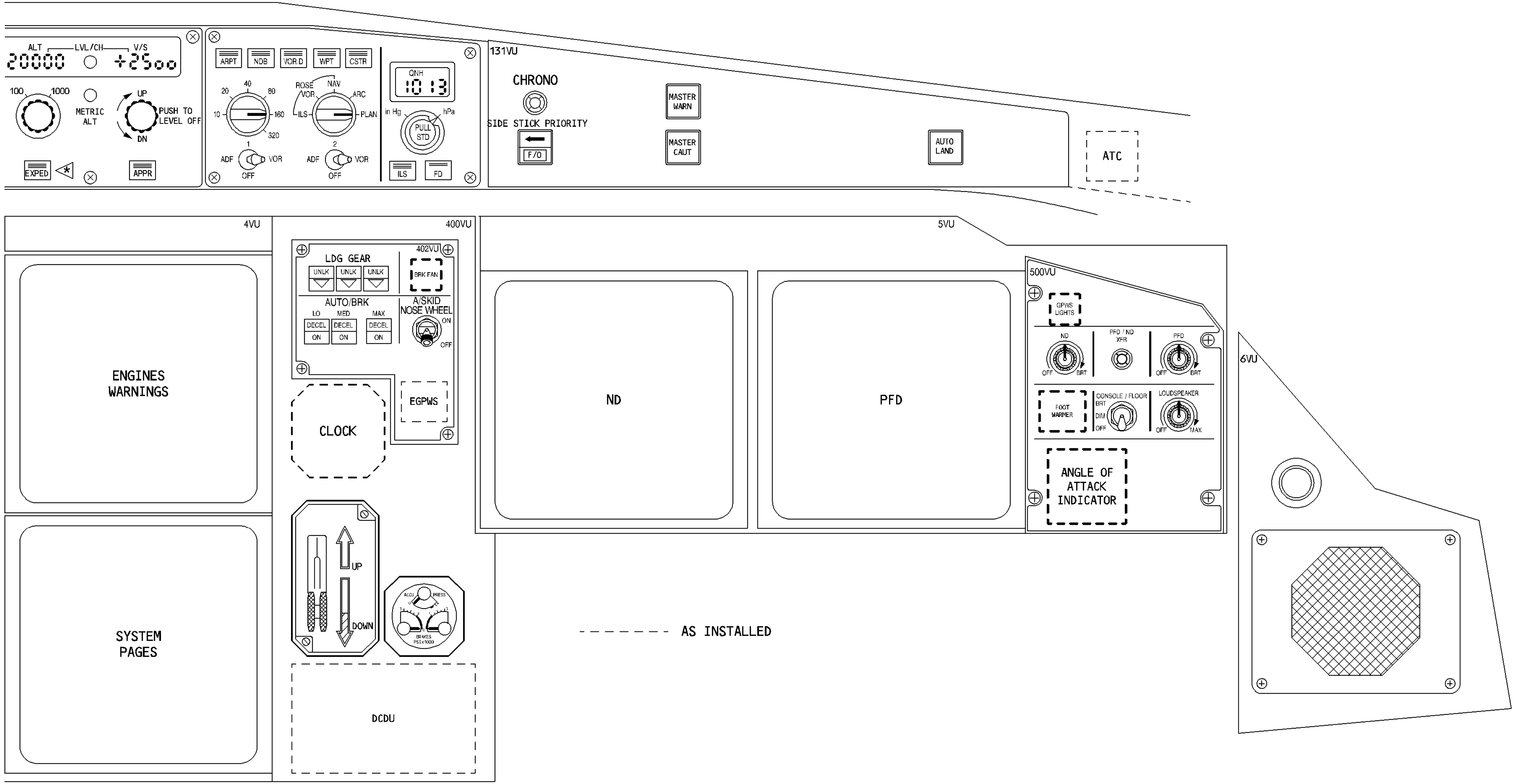
1. Unlocking button
   Flight crew presses this button to unlock the control handle.
2. Control handle
   - To open the window, the crew member pulls inward and rearward.
   - To close the window, the crew member pushes forward.
3. Locking pin
   This pin locks the window open.
   It is near the window's lower guide track and is visible when the window is open.
   - Forward
     Between the closed position and the one-third open position, the window is free to move forward and aft.
     When the window is more than one-third open, this pin prevents it from moving forward.
   - Aft
     Flight crew must move the locking pin aft in order to close the window. Left sliding window.



PILOT's INSTRUMENT PANELS



PILOT's INSTRUMENT PANEL (cont'd)



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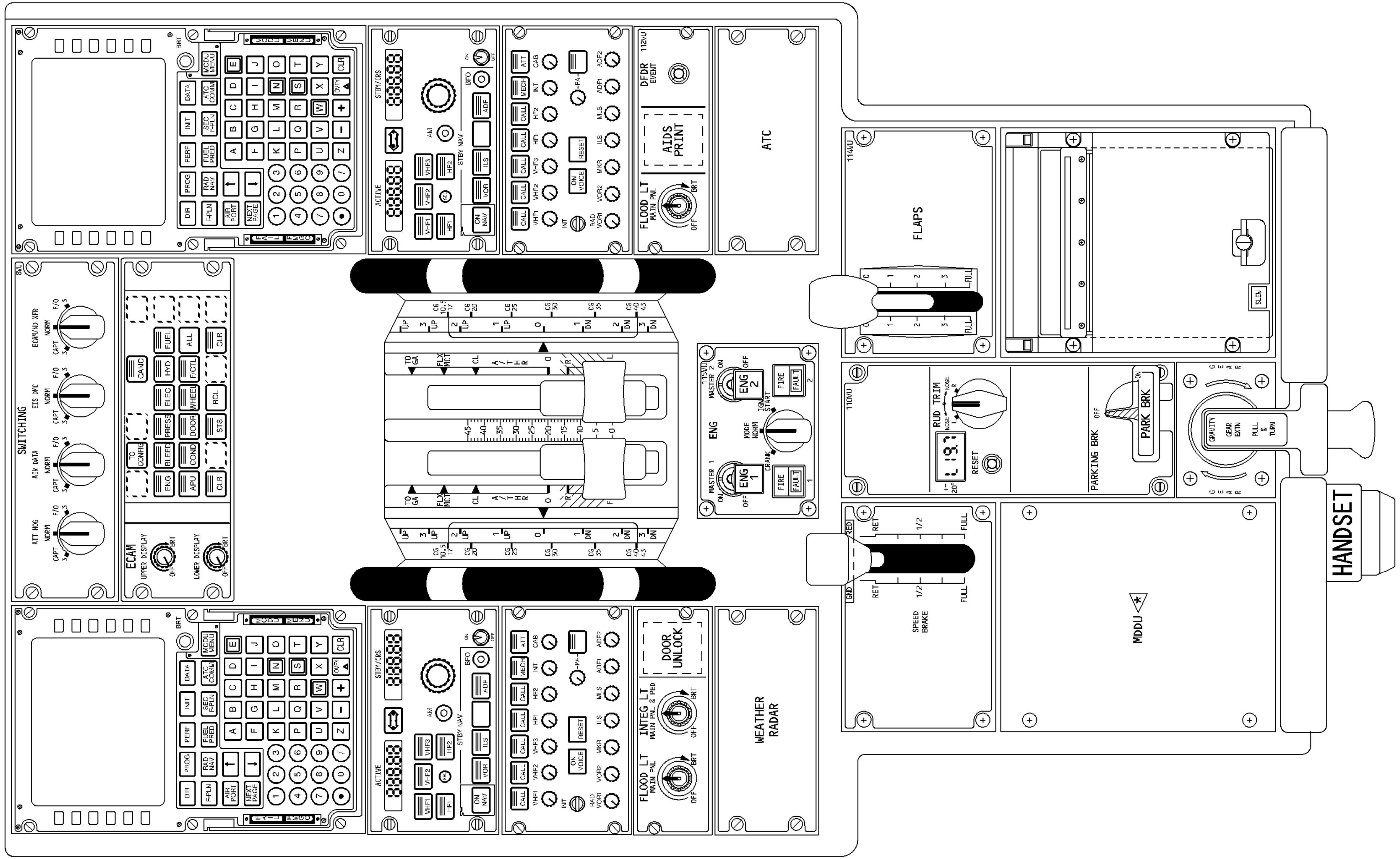
PEDESTAL

R



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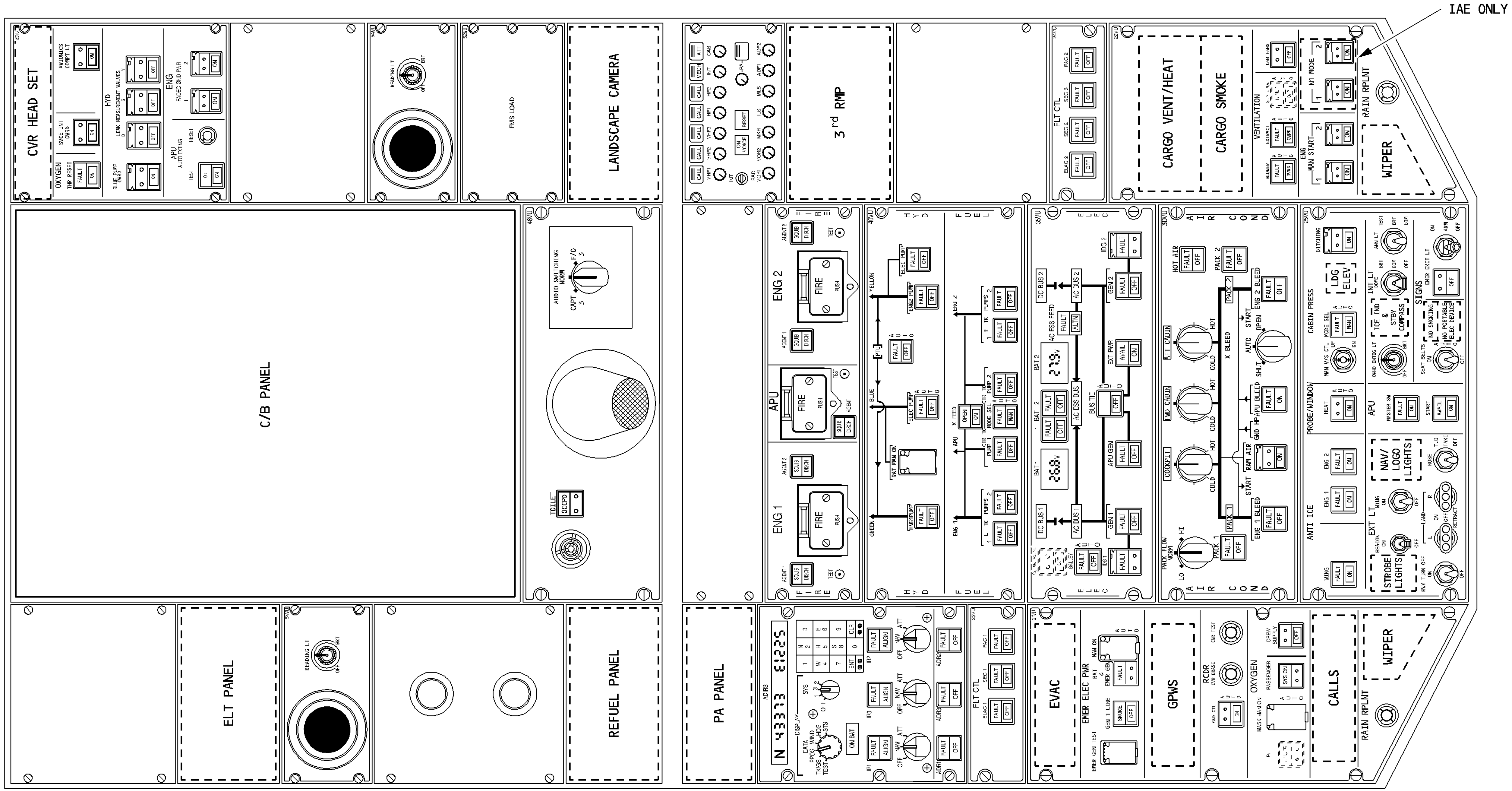
OVERHEAD PANEL

R



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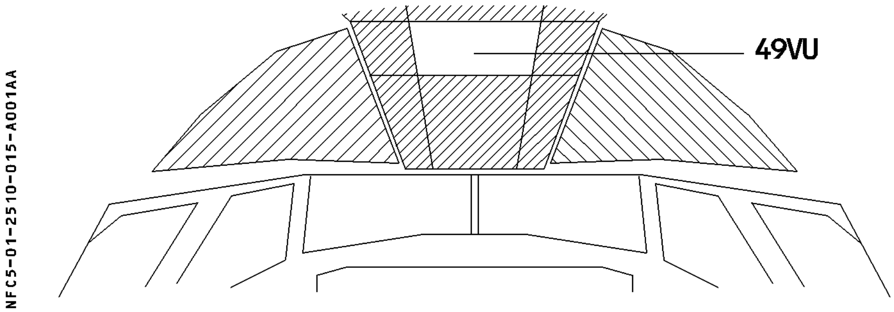
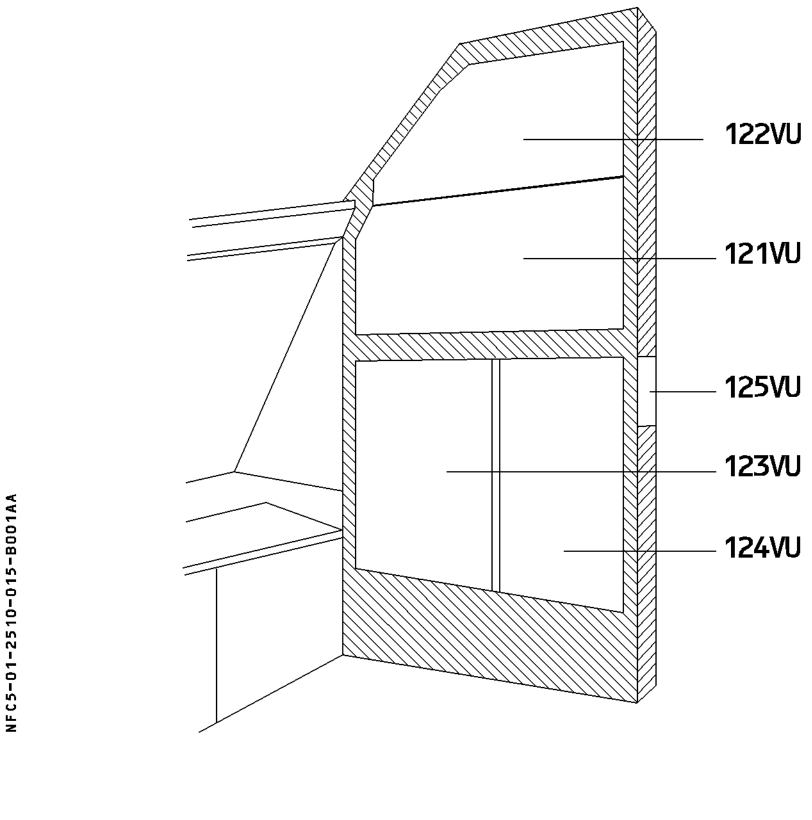
C / B PANELS

OVERHEAD PANEL



RIGHT REAR PANEL



LEFT INTENTIONALLY BLANK

GENERAL

NOT APPLICABLE

CONTROLS

NOT APPLICABLE

BUS EQUIPMENT LIST

R

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
CAPTAIN SEAT motors ◁	AC1					
F/O SEAT motors ◁	AC2					
FOOT WARMERS ◁	AC2					
IN SEAT POWER SUPPLY ◁	AC2					
COCKPIT DOOR LOCKING SYSTEM ◁		DC2				
COCKPIT DOOR LOCKING SYSTEM BACKUP ◁		DC1				
COCKPIT DOOR SURVEILLANCE SYSTEM ◁		DC1				

26.00 CONTENTS

DESCRIPTION

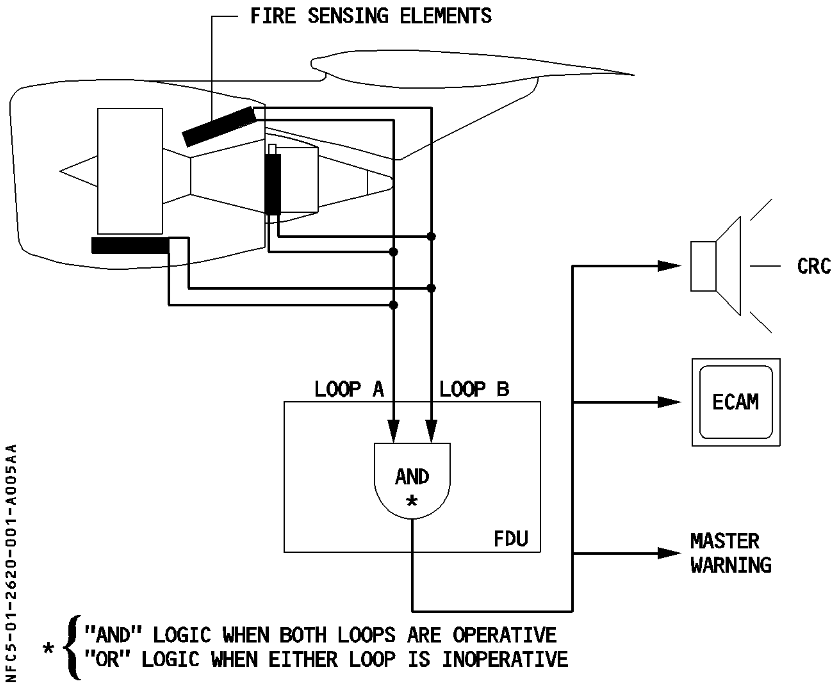
Aircraft Fire Protection Systems are comprised of :

- Fire and overheat detection and extinguishing systems for the :
  - Engines
  - APU
- Smoke detection and extinguishing systems for the :
  - Cargo compartments
  - Lavatories
- Smoke detection for the :
  - Avionic bay
- Portable fire extinguishers for the :
  - Flight compartment
  - Passenger cabin

DESCRIPTION

DETECTION

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).
The gas detection loops consist of :
— Three sensing elements for each engine, one in the pylon nacelle, one in the engine core and one in the engine fan section.
— One sensing element in the APU compartment.
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, they trigger the fire warning system.
A fault in one loop (break or loss of electrical supply) does not affect the warning system. The unaffected loop still protects the aircraft.
If the system detects an APU fire while the aircraft is on the ground, it shuts down the APU automatically and discharges extinguishing agent.



EXTINGUISHING

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.
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
R cockpit. This bottle also discharges automatically if there is an APU fire when the aircraft is on the ground.

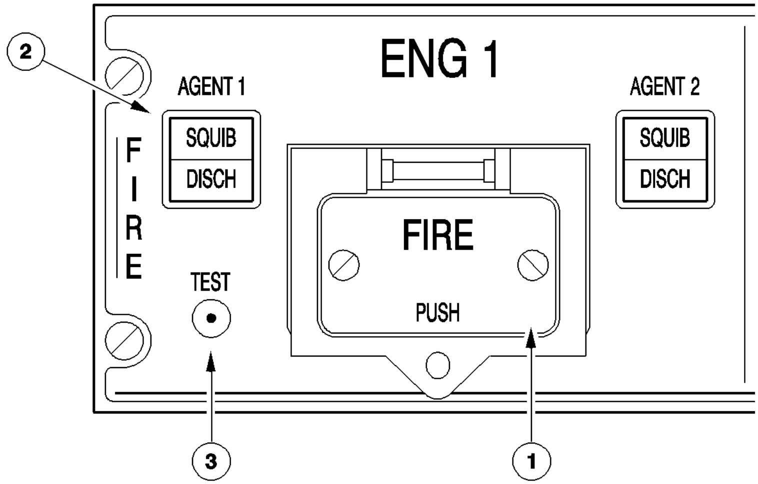
FIRE WARNINGS AND LOOP CAUTIONS

Fire detection units process all the warnings and cautions originating in the sensing elements :
- 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 occuring within 5 seconds of each other (flame effect), or
  - a test performed on the control panel.
- The loop-fault cautions appear if :
  - one loop is faulty or,
  - R both loops are faulty or,
  - the fire detection unit fails.

CONTROLS AND INDICATORS

OVERHEAD PANEL

ENG FIRE PANEL



NFC5-01-2620-003-A100AA

The aircraft has two identical ENG FIRE panels, which contain the following switches and indicators :

(1) ENG 1 (2) 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 hydraulic fire shut off valve
- Closes the engine bleed valve
- Closes the pack flow control valve
- R Cuts off the FADEC power supply
- R Deactivates the IDG

ENG 1 (2) FIRE lt
This red light comes on, regardless of the pushbutton's position, whenever the fire warning for the corresponding engine is activated.

② AGENT 1 and AGENT 2 pb

Both of these buttons become active when the flight crew pops the ENG FIRE button for their engine.
A brief push on the button discharges the corresponding fire bottle.
- "SQUIB" lights up 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.
- "DISCH" lights up amber when its fire extinguisher bottle has lost pressure.

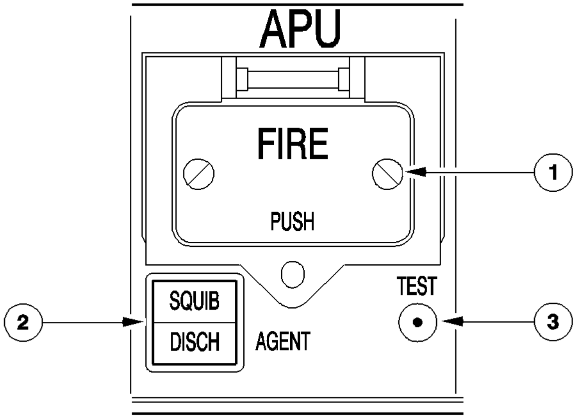
③ TEST pb

This button permits the flight crew to test the operation of the fire detection and extinguishing system.
- When the flight crew presses it :
  - A continuous repetitive chime sounds.
  - The MASTER WARN lights flash.
  - ENG FIRE warning appears on ECAM.

  On the FIRE panel :
  - The ENG FIRE pushbutton lights up red.
  - The SQUIB lights come on white if discharge supplies are available.
  - The DISCH lights come on amber.

  On the ENG panel (pedestal) :
  - The FIRE lights come on red.

APU FIRE PANEL



NFC5-01-2620-005-A100AA

① APU FIRE pb sw

This switch'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 pump
- closes the APU bleed valve and X bleed valve and deactivates the APU generator.

The red APU FIRE light comes when the APU fire warning is activated, regardless of the position of the pushbutton.

② AGENT pb

This button becomes active when the pilot pops the APU FIRE button.
The flight crew presses it briefly to discharge the fire bottle.
- SQUIB lights up white when the pilot pops the APU FIRE button.
- DISCH lights up amber on 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*
R *is not discharged overboard due to bottle overpressure.*

(3) TEST pb

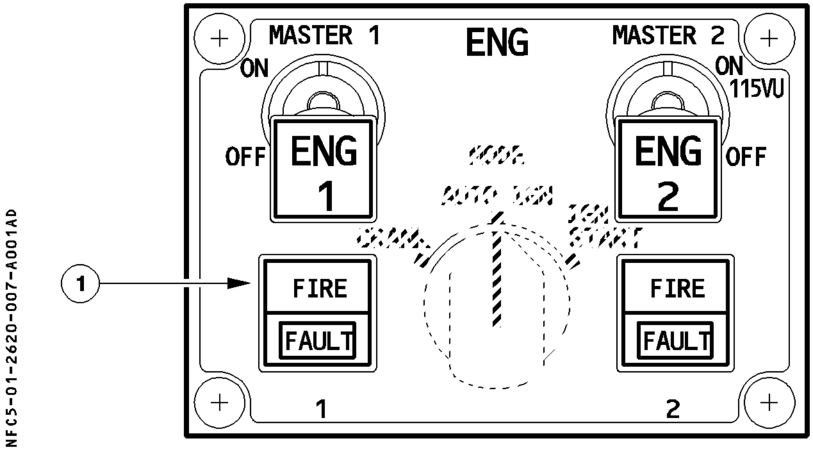
This button permits the flight crew to test the operation of the fire detection and extinguishing system for the APU.

- When the flight crew presses it :
  - A continuous repetitive chime sounds.
  - The MASTER WARN lights flash.
  - APU FIRE warning appears on ECAM.

  On the APU FIRE panel :
  - The APU FIRE pushbutton lights up red.
  - The SQUIB light comes on white.
  - The DISCH light comes on amber.

Note : *The automatic shutdown of the APU on the ground will not occur while the flight crew is performing this test.*

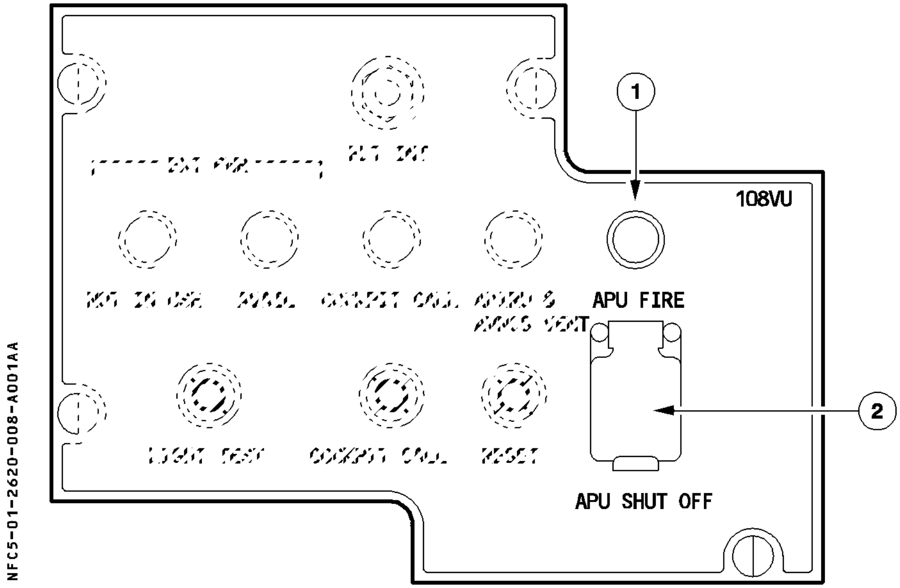
PEDESTAL



(1) FIRE lt

This light identifies the engine to be shutdown because of fire.
Light comes on red when an engine fire warning is triggered.

R **EXTERNAL POWER PANEL**



When the aircraft is on the ground, an APU fire causes an additional external warning.

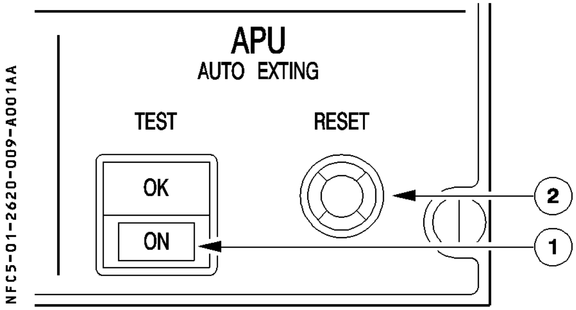
(1) APU FIRE lt

The red APU FIRE light comes on and an external warning horn sounds when the system detects an APU fire.
The APU fire extinguisher discharges automatically three seconds after the appearance of the fire warning.
The light goes out when the fire has been extinguished.

(2) APU SHUT OFF pb

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



① TEST pb sw

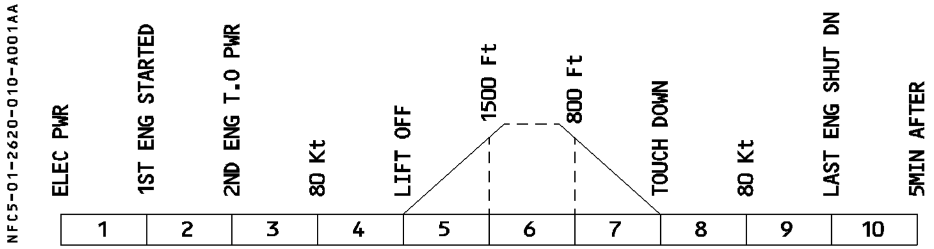
The person performing the test must keep this button pressed during the test. The APU MASTER switch must be ON.
This switch tests the APU FIRE warning, auto extinguishing, and shutdown circuits. The test sequence lasts for ten seconds.
The OK light comes on to indicate that all components are functioning properly.

Note : If the APU was running, it shuts down.

② RESET pb

Pressing this button resets the test circuit.

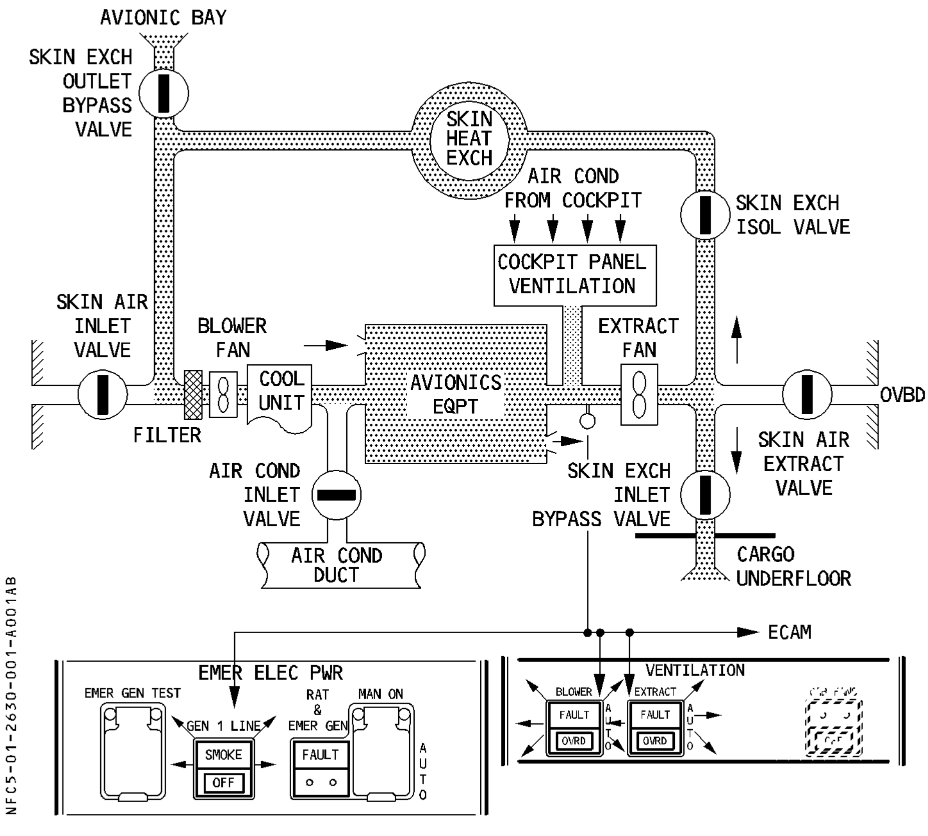
WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1 (2) FIRE Fire detected by both loops or by one loop, the other one being faulty, or break in both loops occuring within 5 seconds	CRC	MASTER WARN	ENGINE	FIRE lts on ENG FIRE pb and on ENG panel	NIL
APU FIRE Fire detected by both loops or by one loop, the other one being faulty, or break in both loops occuring within 5 seconds			APU	FIRE lt on APU FIRE pb	
ENG 1 (2) 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) APU LOOP A (B) FAULT	NIL	NIL			

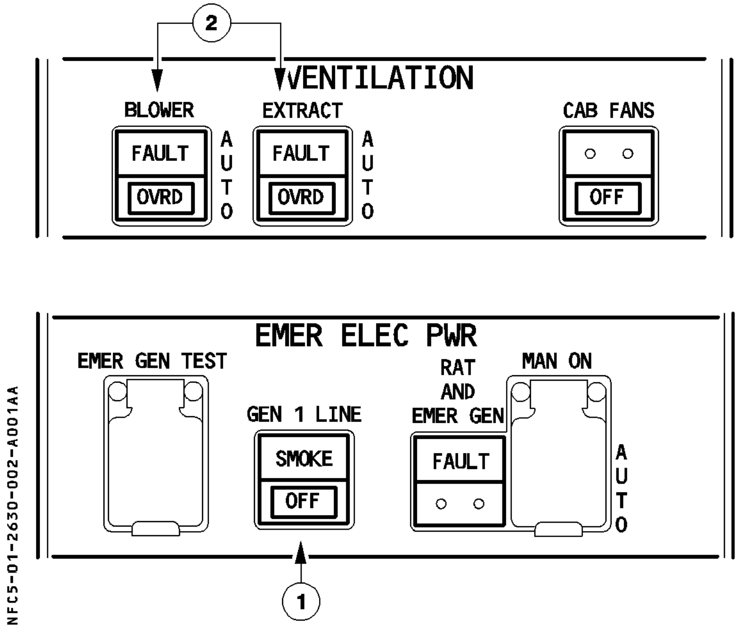
DESCRIPTION

R One smoke detector in the air extraction duct of the avionics ventilation system detects smoke in the avionics compartment.
It signals the ECAM to display a warning in the cockpit.
When it detects smoke for more than 5 seconds :
– A single chime sounds.
– The MASTER CAUTION lights, on the glareshield, light up.
– The ECAM displays a caution on the E/WD.
– The SMOKE light, on the EMER ELEC PWR panel, lights up.
– The BLOWER and EXTRACT FAULT, on the VENTILATION panel, light up.
If smoke is detected for more than 5 minutes, the caution can be cleared ; but, it remains latched, and can be recalled. On the ground, a dual FWC reset will unlatch the caution.



CONTROLS AND INDICATORS

OVERHEAD PANEL



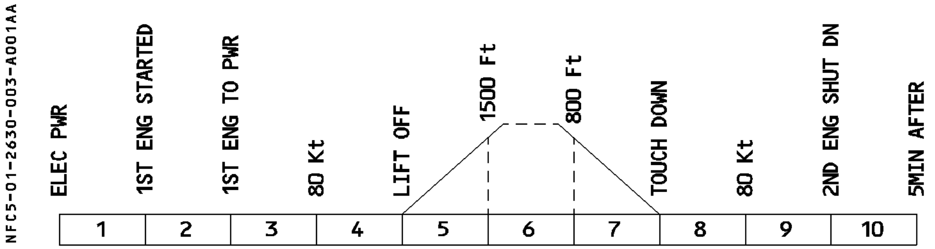
(1) GEN 1 LINE (See 1.24.10)

SMOKE lt : Comes on amber, along with a warning on ECAM, when smoke is detected in the avionics ventilation duct.

(2) BLOWER and EXTRACT pb sw (See 1.21.30)

FAULT lts : Both FAULT lights come on amber, along with a warning on ECAM, when smoke is detected in the avionics ventilation duct.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
AVNCS SMOKE Smoke detected in ventilation extraction duct	SINGLE CHIME	MASTER CAUT	ELEC	. SMOKE lt on EMER ELEC PWR panel . FAULT lts on BLOWER and EXTRACT pb sw	4, 5, 7, 8

DESCRIPTION

SMOKE DETECTION

The lavatory smoke detection system consists of :

R – One smoke detector in each lavatory.

– A double channel Smoke Detection Control Unit (SDCU).

When a detector finds smoke in a lavatory, it sends a signal to the SDCU. The SDCU transmits it to the flight warning computer (for warning display in the cockpit) and to the CIDS (for warning in the cabin).

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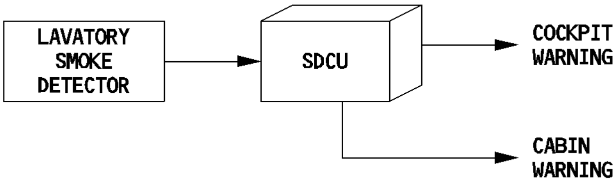
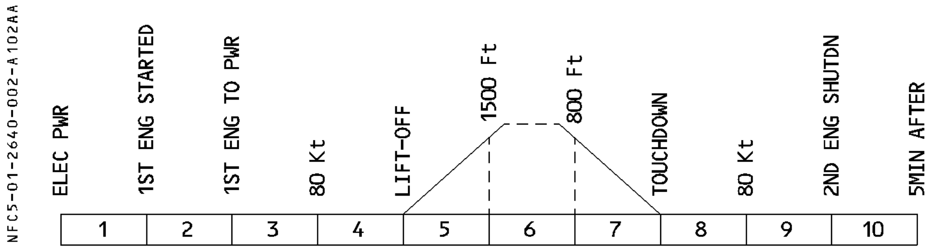


WASTEBIN FIRE EXTINGUISHING

Each lavatory wastebin has 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 one lavatory.	CRC	MASTER WARN			4, 5, 7, 8
LAVATORY DET FAULT Lavatory smoke detection fault, or Lavatory and galley fan faulty.	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
LAV + CRG DET FAULT Both SDCU channels failed.	SINGLE CHIME	MASTER CAUT			

SMOKE DETECTION

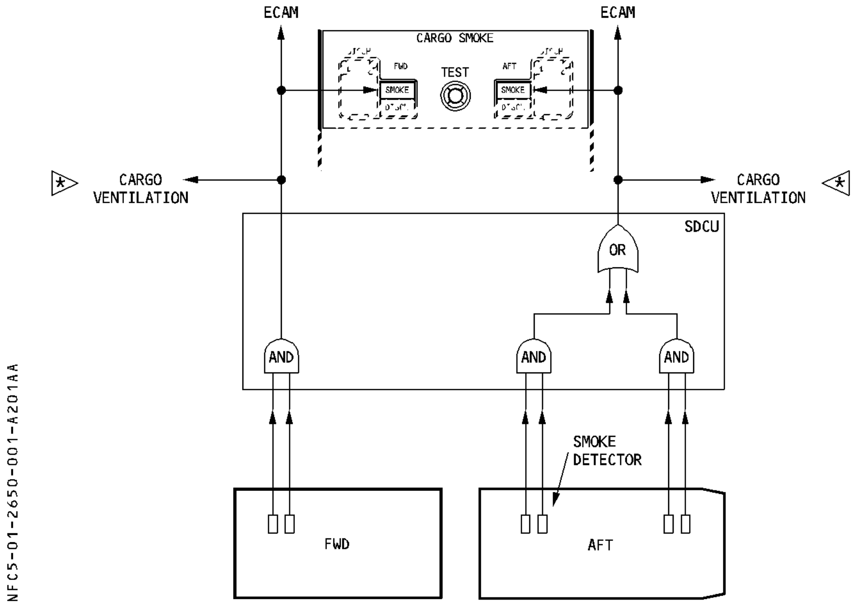
The cargo compartments have a smoke detection system.

R – Cavities in the cargo compartment ceiling panels each hold two smoke detectors. Each detector is linked to one of the two detection loops (dual loop principle).
– The forward 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 the 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.

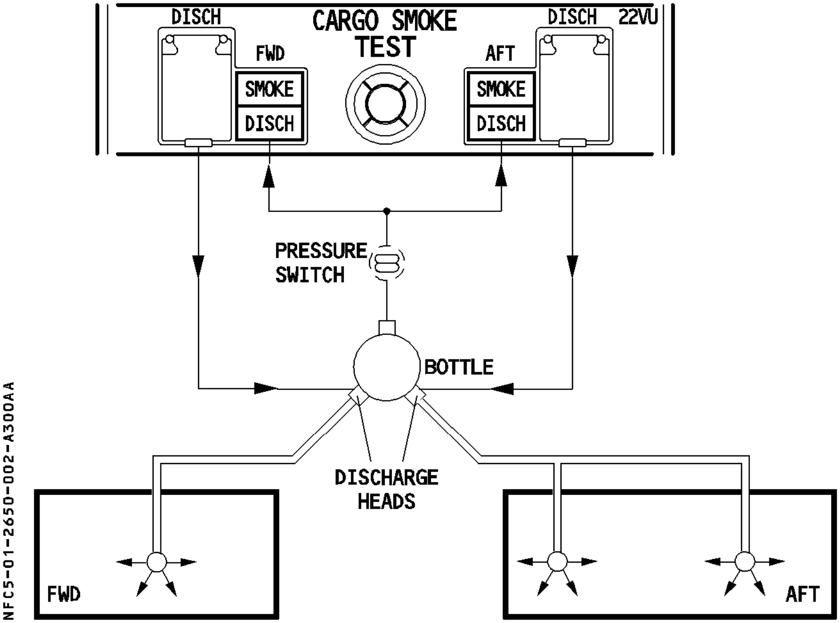
If cargo ventilation is installed, and the cargo smoke warning is activated in either compartment, the associated isolation valves (◁*) automatically close and the extraction fan stops. ◁*

R



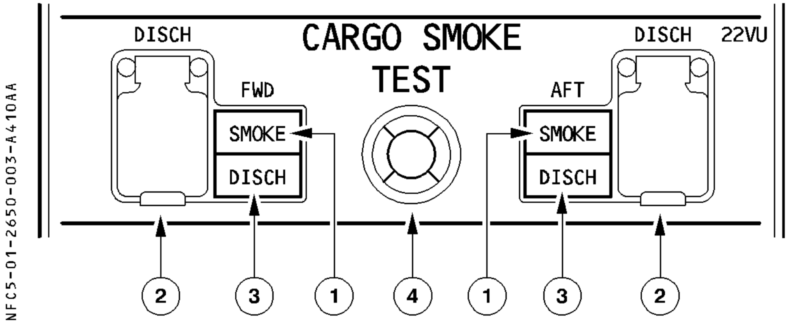
FIRE EXTINGUISHING

A fire extinguishing system protects the FWD and AFT cargo compartments.
One fire bottle supplies three nozzles (one in FWD compartment and two in AFT compartment). The bottle has two discharge heads, one for each compartment. When a member of the flight crew presses the DISCH pushbutton for either compartment, the action ignites the corresponding squib on the fire bottle, which then discharges extinguishing agent into that compartment.
When the bottle has discharged, the amber DISCH light comes on.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) SMOKE light

This red light, and the associated ECAM warning, come on when the system detects smoke in the indicated compartment. This light comes on, if :
– Both channels detect smoke, or
– One channel detects smoke and the SDCU finds that the other channel is faulty.

(2) DISCH pushbutton

This button ignites the squib to discharge the extinguishing agent in the corresponding compartment (FWD or AFT).

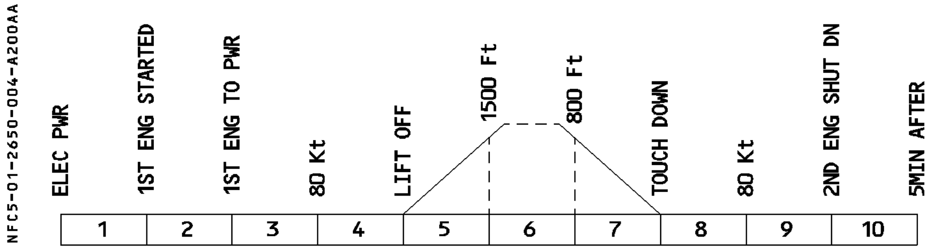
(3) DISCH light

R Within 60 seconds after pressing the discharge pushbutton, this amber light comes on,
R thereby indicating that the agent bottle has fully discharged.

(4) TEST pushbutton

Pressing this button for at least 3 seconds, and until it is released :
– Tests the smoke detectors in sequence,
– Turns on the red smoke lights twice, and displays the ECAM warning,
– Closes the ventilation system's isolation valves.
– Turns on the amber DISCH lights.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
FWD (AFT) CARGO SMOKE Smoke detected	CRC	MASTER WARN	NIL	SMOKE lt on CARGO SMOKE panel	4, 5, 7, 8
FWD (AFT) CRG DET FAULT Smoke detection fault	NIL	NIL		NIL	3, 4, 5, 7, 8
LAV + CRG DET FAULT Both SDCU channels failed	SINGLE CHIME	MASTER CAUTION			
FWD (AFT) BTL SQUIB FAULT Forward or aft bottle squib failed					4, 5, 7, 8

BUS EQUIPMENT LIST

R

			NORM		EMER ELEC		
			AC	**DC**	**AC ESS**	**DC ESS**	**HOT**
ENG/APU	FIRE DETECTION	ENG 1 LOOP A				X	
		ENG 1 LOOP B		DC2			
		ENG 2 LOOP A		DC2			
		ENG 2 LOOP B				X	
		APU LOOP A		DC BAT			
		APU LOOP B		DC BAT			
	FIRE EXTINGUISHING	ENG 1/2					
		BTL 1 SQUIB A					HOT 1
		BTL 1 SQUIB B					HOT 2
		BTL 2 SQUIB A		DC 2			
		BTL 2 SQUIB B		DC 2			
		APU					
		BTL SQUIB A					HOT 1
		BTL SQUIB B		DC BAT			
		AUTO EXT		DC BAT			
CARGO LAVATORIES		SDCU CH 1				SHED	
		SDCU CH 2		DC 2			
		FWD/AFT CARGO EXTING BOTTLES		DC BAT			

27.00 CONTENTS

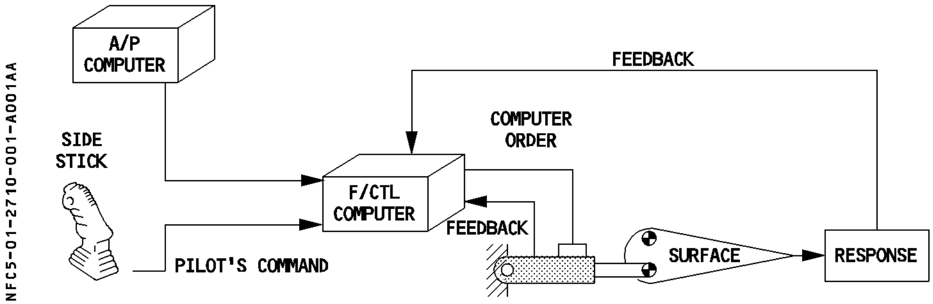
GENERAL

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.

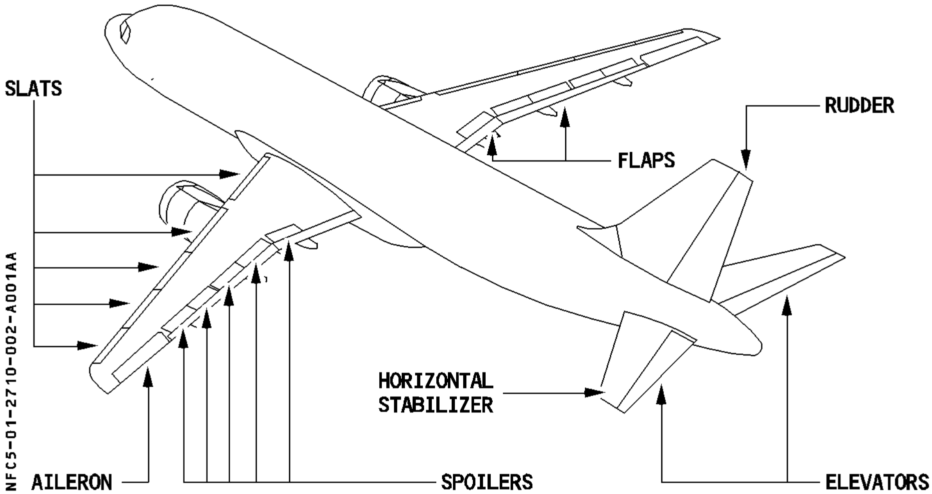
BASIC PRINCIPLE

Flight control surfaces are all :
- Electrically-controlled, and
- Hydraulically-activated.

The stabilizer and rudder can also be mechanically-controlled.
Pilots use 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
R 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.



CONTROL SURFACES



The flight controls are electrically or mechanically controlled as follows :

Pitch axis

Elevator = Electrical

Stabilizer = Electrical for normal or alternate control. Mechanical for manual trim control

Roll axis

Ailerons = Electrical

Spoilers = Electrical

Yaw axis

Rudder = Mechanical, however control for yaw damping, turn coordination and trim is electrical.

Speed brakes

Speed brakes = Electrical

Note : All surfaces are hydraulically actuated.

COCKPIT CONTROLS

- Each pilot has a sidestick controller with which to exercise manual control of pitch and roll. These are on their respective lateral consoles.
  The two sidestick controllers are not coupled mechanically, and they send separate sets of signals to the flight control computers.
- Two pairs of pedals, which are rigidly interconnected, give the pilot mechanical control of the rudder.
- The pilots control speed brakes with a lever on the center pedestal.
- The pilots use mechanically interconnected handwheels on each side of the center pedestal to control the trimmable horizontal stabilizer.
- The pilots use a single switch on the center pedestal to set the rudder trim.
- There is no manual switch for trimming the ailerons.

COMPUTERS

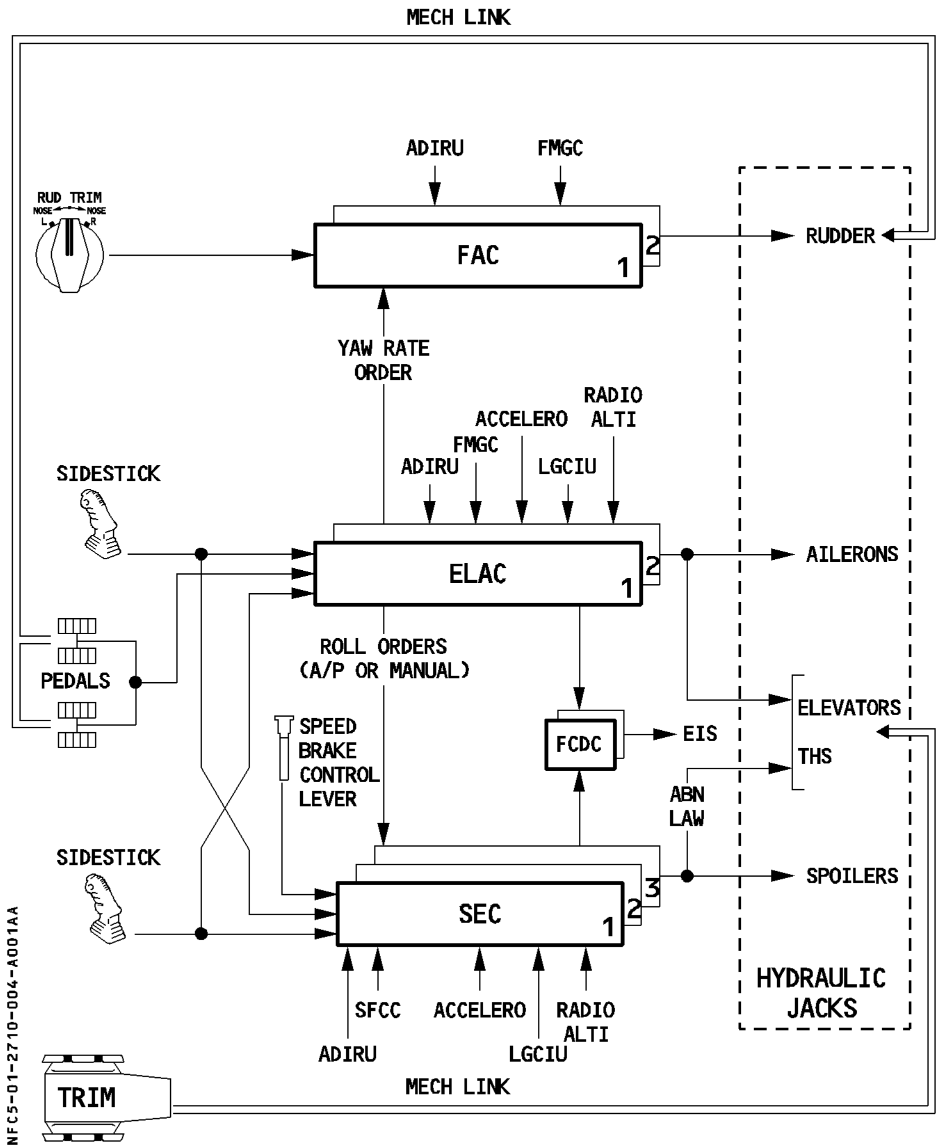
Seven flight control computers process pilot and autopilot inputs according to normal, alternate, or direct flight control laws.
The computers are :

2 ELACs
(Elevator Aileron Computer)
For : Normal elevator and stabilizer control.
Aileron control.

3 SECs
(Spoilers Elevator Computer)
For : Spoilers control.
Standby elevator and stabilizer control.

2 FACs
(Flight Augmentation Computer)
For : Electrical rudder control.

In addition 2 FCDC
Flight Control Data Concentrators (FCDC) acquire data from the ELACs and SECs and send it to the electronic instrument system (EIS) and the centralized fault display system (CFDS).


MECH LINK
ADIRU
FMGC
RUD TRIM
NOSE
L
R
FAC
1
2
RUDDER
YAW RATE
ORDER
RADIO
ALTI
ACCELERO
FMGC
ADIRU
LGCIU
SIDESTICK
ELAC
1
2
AILERONS
PEDALS
ROLL ORDERS
(A/P OR MANUAL)
SPEED
BRAKE
CONTROL
LEVER
FCDC
EIS
ELEVATORS
THS
ABN
LAW
SIDESTICK
SEC
1
2
3
SPOILERS
SFCC
ACCELERO
RADIO
ALTI
ADIRU
LGCIU
HYDRAULIC
JACKS
TRIM
MECH LINK
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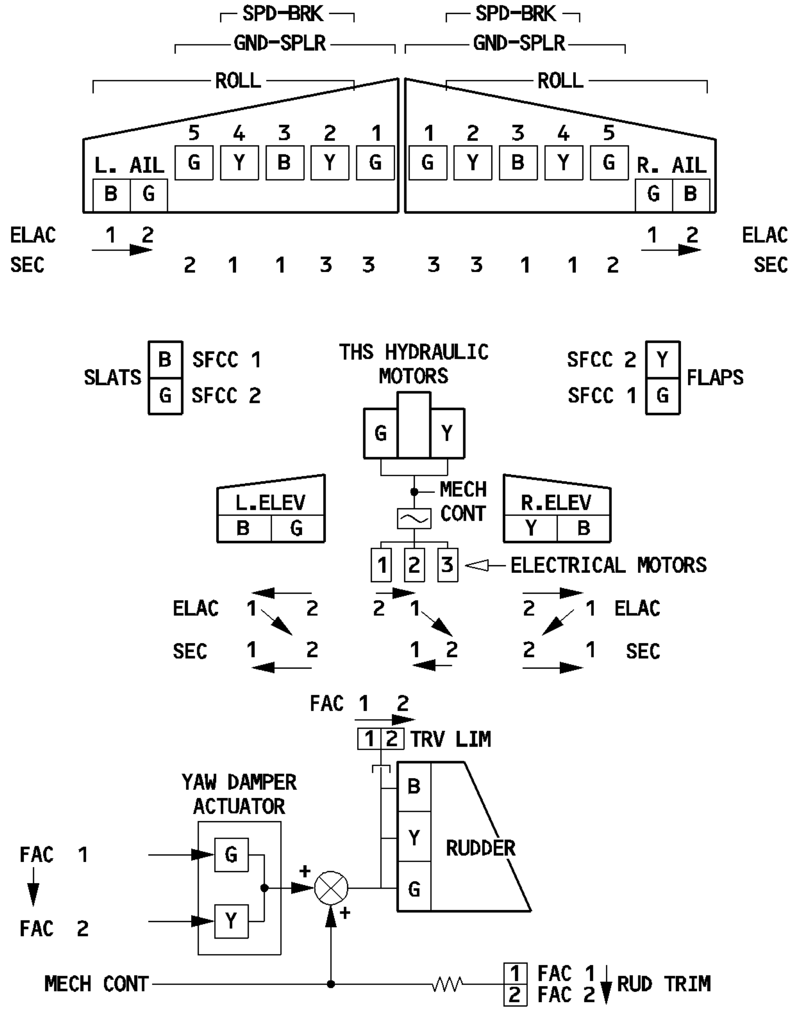
ARCHITECTURE

GENERAL ARCHITECTURE

FOR INFO



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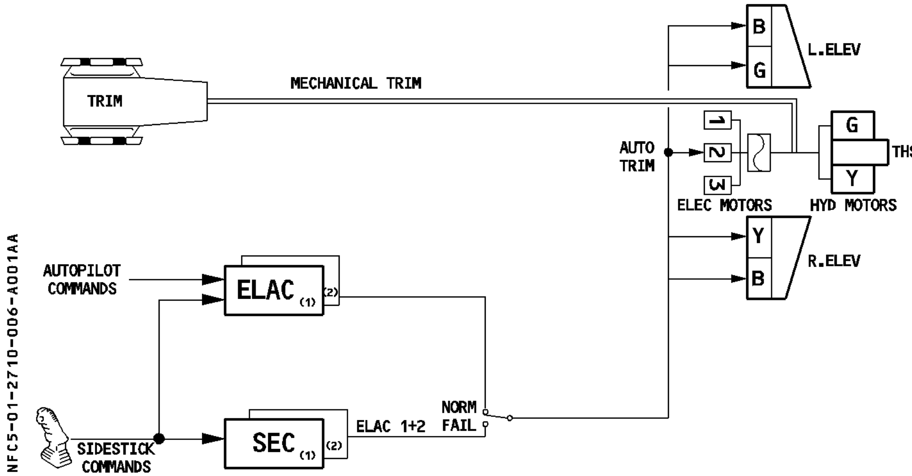
Arrows indicate the control reconfiguration priorities

G B Y indicates the hydraulic power source (green, blue, or yellow) for each servo control.

PITCH CONTROL



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 13.5° nose up and 4° nose down.

ELECTRICAL CONTROL

- In normal operations, the ELAC2 controls the elevators and the horizontal stabilizer, and the green and yellow hydraulic jacks drive the left and right elevator surfaces respectively.
  The THS is driven by N° 1 of three electric motors.
- If a failure occurs in ELAC2 or the associated hydraulic systems or hydraulic jacks, the system shifts pitch control to ELAC1. ELAC1 then controls the elevators via the blue hydraulic jacks and controls the THS via the N° 2 electric motor.
- If neither ELAC1 nor ELAC2 is available, the system shifts pitch control either to SEC1 or to SEC2, depending on the status of associated circuits, and to THS motor N° 2 or N° 3.

Page 8, below, describes how the actuators are reconfigured in case of failure.

MECHANICAL CONTROL

Mechanical control of the THS is available from the pitch trim wheel at any time if either the green or the yellow hydraulic system is functioning.
Mechanical control from the pitch trim wheel has priority over electrical control.

ACTUATION

Elevators

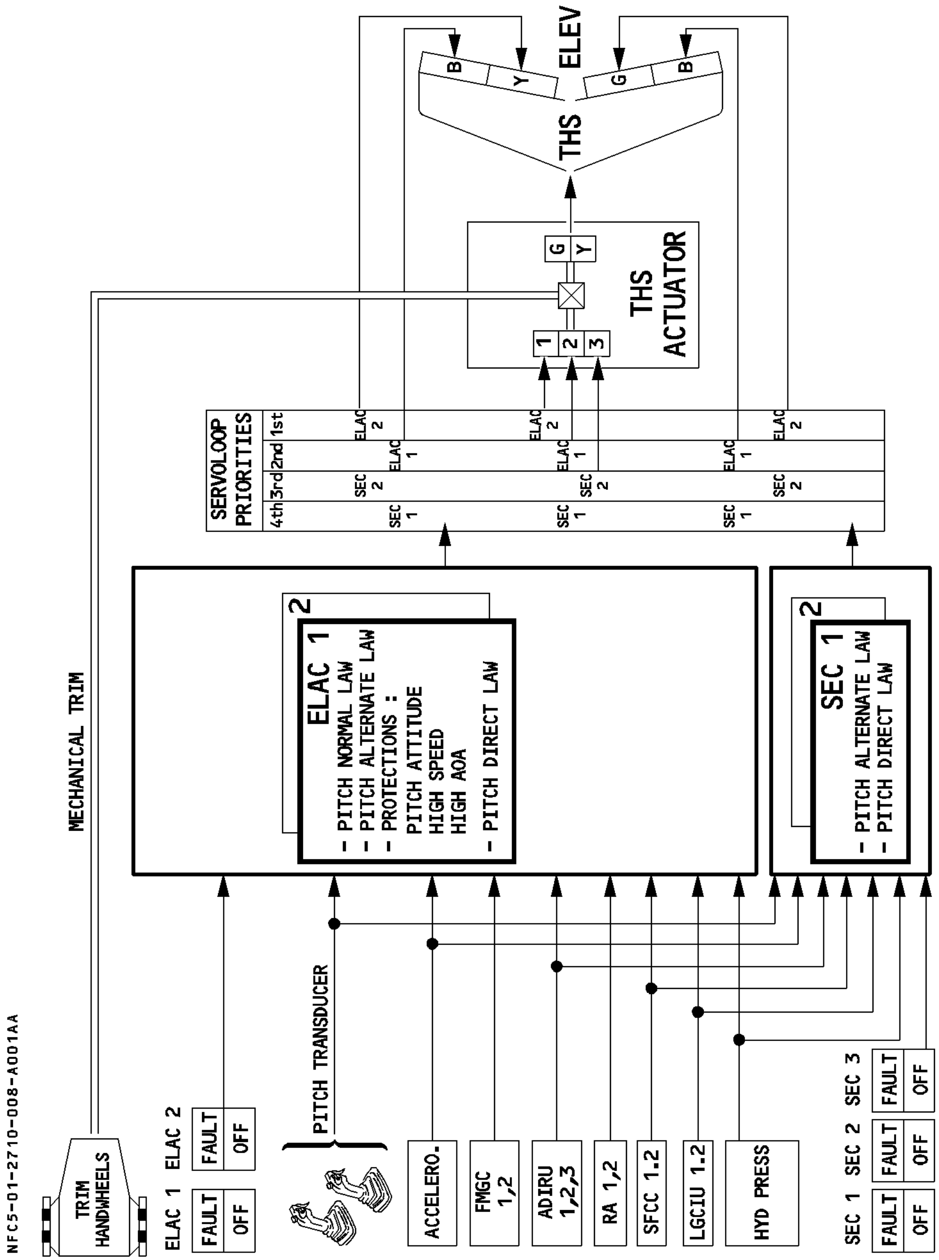
- Two electrically controlled hydraulic servojacks drive each elevator.
  Each servojack has three control modes :
  . Active : Jack position is electrically controlled.
  . Damping : Jack follows surface movement.
  . Centering : Jack is hydraulically retained in neutral position.
- In normal operation :
  · One jack is in active mode.
  · The other jack is in damping mode.
  · Some maneuvers cause the second jack to become active.
- If the active servojack fails, the damped one becomes active and the failed jack is automatically switched to the damping mode.
- If neither jack is being controlled electrically nor hydraulically, both are automatically switched to the centering mode.
- If one elevator fails, the deflection of the remaining elevator is limited to avoid putting excessive asymmetric loads on the horizontal tailplane or rear fuselage.

Stabilizer

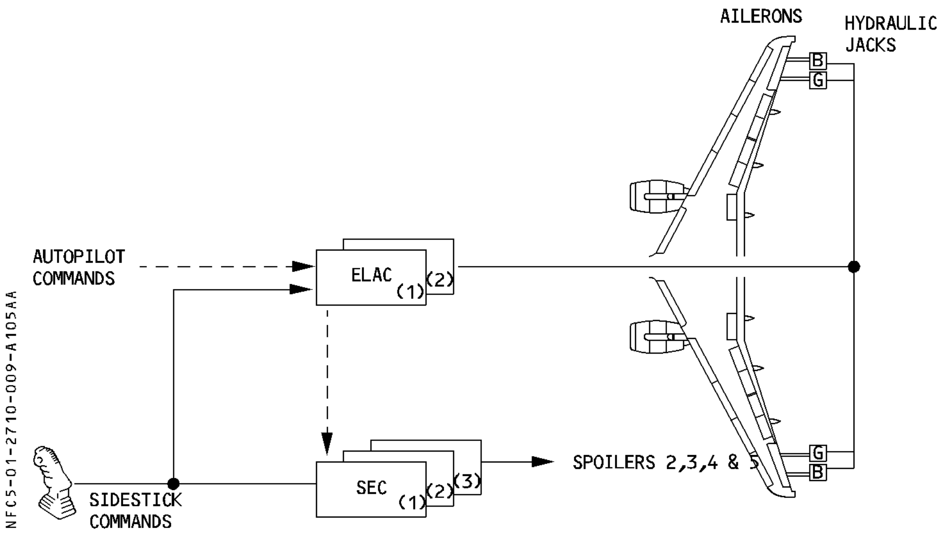
- A screwjack driven by two hydraulic motors drives the stabilizer.
- The two hydraulic motors are controlled by :
  · one of three electric motors, or
  · the mechanical trim wheel.

PITCH CONTROL – SCHEMATIC

FOR INFO



ROLL CONTROL



One aileron and four spoilers on each wing control the aircraft about the roll axis.
The maximum deflection of the ailerons is 25°.
The ailerons extend 5° down when the flaps are extended (aileron droop).
The maximum deflection of the spoilers is 35°.

ELECTRIC CONTROL

- The ELAC 1 normally controls the ailerons.
  If ELAC1 fails, the system automatically transfers aileron control to ELAC2.
  If both ELACs fail, the ailerons revert to the damping mode.
- SEC3 controls the N° 2 spoilers, SEC1 the N° 3 and 4 spoilers, and SEC2 the N° 5 spoilers.
  If a SEC fails, the spoilers it controls are automatically retracted.

ACTUATION

Ailerons

Each aileron has two electrically controlled hydraulic servojacks.
One of these servojacks per aileron operates at a time.
Each servojack has two control modes :
Active : Jack position is controlled electrically
Damping : Jack follows surface movement.

The system automatically selects damping mode, if both ELACs fail or in the event of blue and green hydraulic low pressure.

Spoilers

A servojack positions each spoiler. Each servojack receives hydraulic power from either the green, yellow, or blue hydraulic system, controlled by the SEC1, 2 or 3 (as shown on page 5).
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.

SPEEDBRAKES AND GROUND SPOILERS

SPEEDBRAKE CONTROL

The pilot controls the speedbrakes with the speedbrake lever.
The speedbrakes are actually spoilers 2, 3 and 4.
Speedbrake extension is inhibited if :
– SEC1 and SEC3 both have faults.
– An elevator (L or R) has a fault (in this case only spoilers 3 and 4 are inhibited).
– Angle-of-attack protection is active.
– Flaps are in configuration FULL.
– Thrust levers above MCT position
– Alpha floor activation
If an inhibition occurs when the speedbrakes are extended, they retract automatically and stay retracted until the inhibition condition disappears and the pilots reset the lever. (The speedbrakes can be extended again 10 seconds or more after the lever is reset).
When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

Note : *1. For maintenance purposes, the speedbrake lever will extend the N° 1 surfaces when the aircraft is stopped on the ground, whatever the slat/flap configuration.*
2. When the aircraft is flying faster than 315 knots or Mach 0.75 with the autopilot engaged, the speedbrake retraction rate is reduced (Retraction from FULL to in takes about 25 seconds).

FOR INFO

The maximum deflection for spoilers is :
· 25° for spoilers 3 and 4
· 12.5° for spoilers 2 in configuration 3, and 17.5° in other configurations

For these surfaces (which perform both roll and speed-brake 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 available in flight, the same surface on the other wing is retracted until the difference between the two surfaces is equal to the roll order.

GROUND SPOILER CONTROL

Spoilers 1 to 5 act as ground spoilers.
R When a ground spoiler surface on one wing fails, the symmetric one on the other wing is
R inhibited.

Arming
The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

Full extension
The ground spoilers automatically extend during rejected takeoff, at a speed greater than 72 knots, or at landing when both main landing gears have touched down, when :
- Ground spoilers are armed and all thrust levers are at idle, or
- Reverse is selected (on at least one engine, other thrust lever at idle), if ground spoilers were not armed.

Partial extension
The ground spoilers partially extend (10°) when reverse is selected (on at least one engine's other thrust lever, at or near idle) and one main landing gear strut is compressed. This partial extension, by decreasing the lift, eases the compression of the second main landing gear strut, and consequently leads to full ground spoiler extension.

Retraction
The ground spoilers retract :
- After landing, or after a rejected takeoff, when the ground spoilers are disarmed.

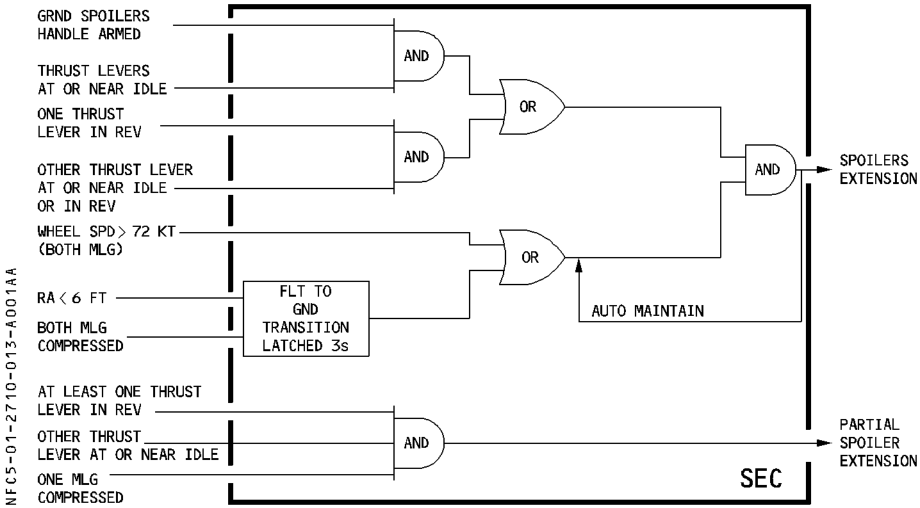
Note : If ground spoilers are not armed, they extend at the reverse selection and retract when idle is selected.

- During a touch and go when at least one thrust lever is advanced above 20°.

Note : After an aircraft bounce, the ground spoilers remain extended with the thrust levers at idle.

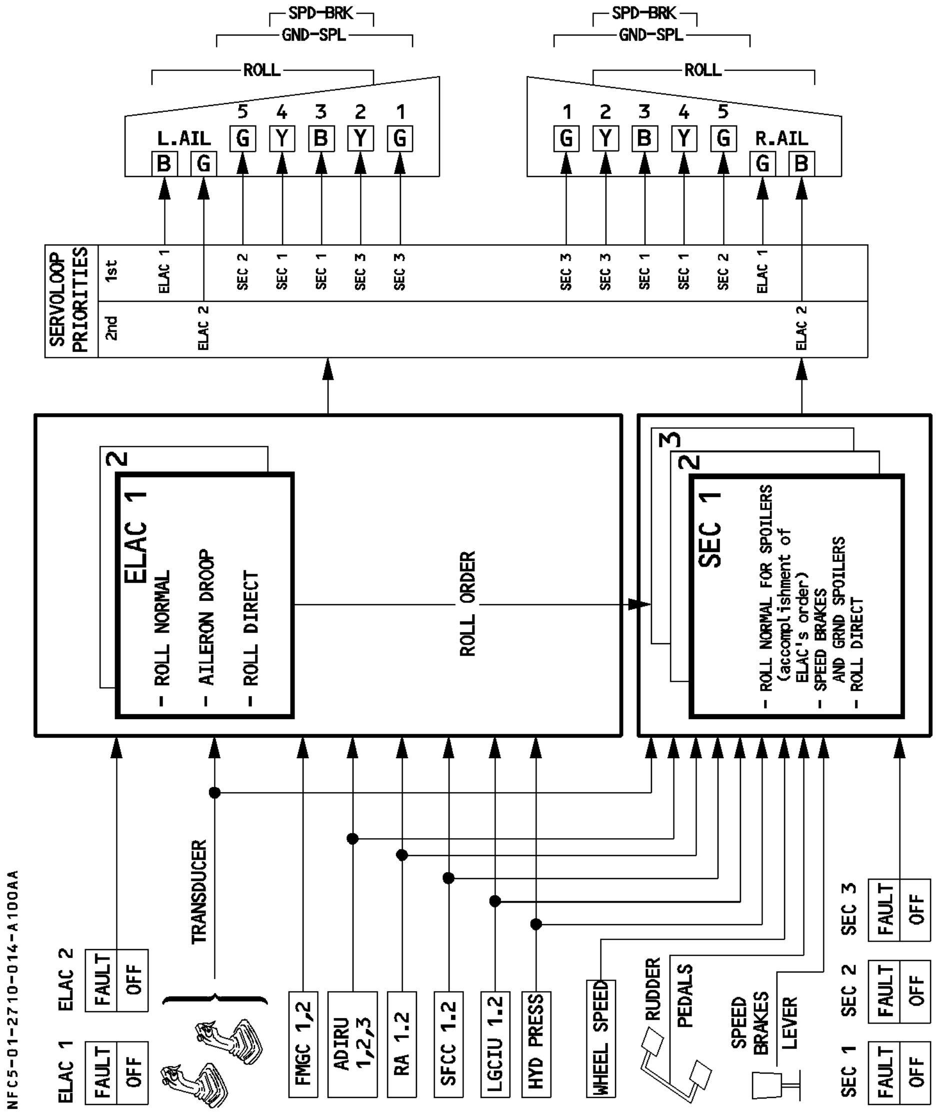
FOR INFO

R *The landing gear touchdown condition is triggered for both main landing gear, either when*
R *their wheel speed is greater than 72 knots, or when their landing gear struts are*
R *compressed and the radio altitude is very low (RA < 6 feet).*
R *For the ground spoiler logic, idle signifies :*
R *Thrust lever position < 4° or < 15° when below 10 ft*
R

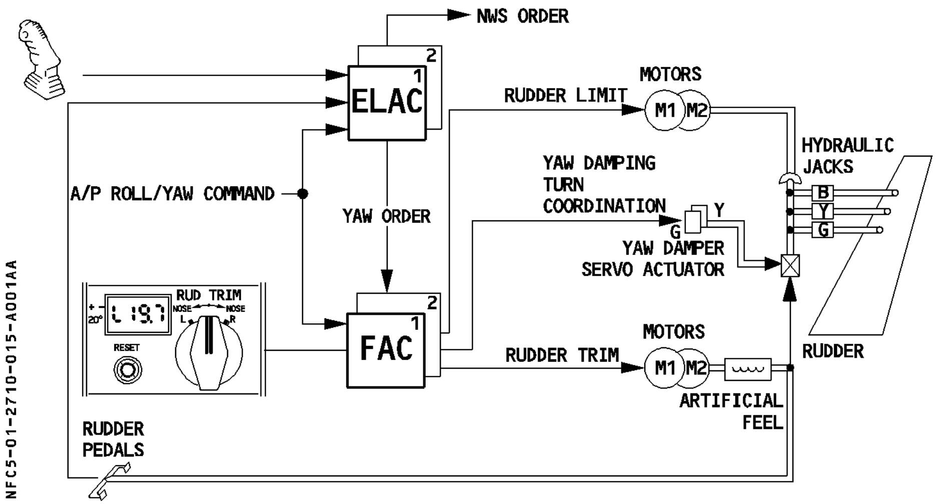


ROLL CONTROL – SCHEMATIC

FOR INFO



YAW CONTROL



One rudder surface controls yaw.

ELECTRICAL RUDDER CONTROL

The yaw damping and turn coordination functions are automatic.
The ELACs compute yaw orders for coordinating turns and damping yaw oscillations, and transmit them to the FACs.

MECHANICAL RUDDER CONTROL

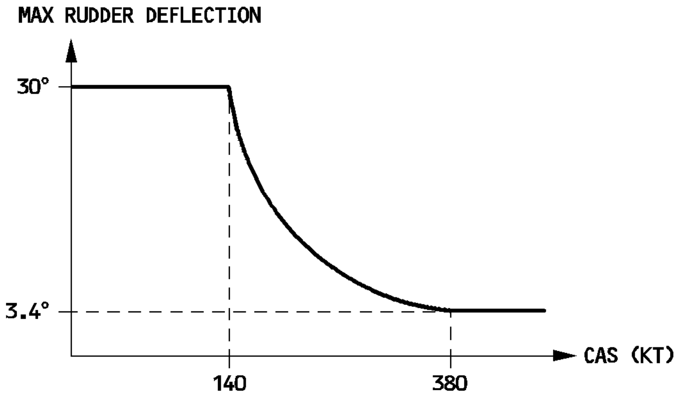
The pilots can use conventional rudder pedals to control the rudder.

RUDDER ACTUATION

Three independent hydraulic servojacks, operating in parallel, actuate the rudder. In automatic operation (yaw damping, turn coordination) a green servo actuator drives all three servojacks. A yellow servo actuator remains synchronized and takes over if there is a failure.
There is no feedback to the rudder pedals from the yaw damping and turn coordination functions.

RUDDER TRAVEL LIMIT

The deflection of the rudder and the pedals is limited as a function of speed.
Each channel of the limiter is controlled and monitored by its associated FAC. If both FACs fail, maximum deflection is available when the slats are extended.



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RUDDER TRIM

The two electric motors that position the artificial feel unit also trim the rudder. In normal operation, motor N° 1, controlled by FAC1, drives the trim, and FAC2 with motor N° 2 remains synchronized as back-up.
In manual flight, the pilot can apply rudder trim with the rotary RUD TRIM switch on the pedestal.

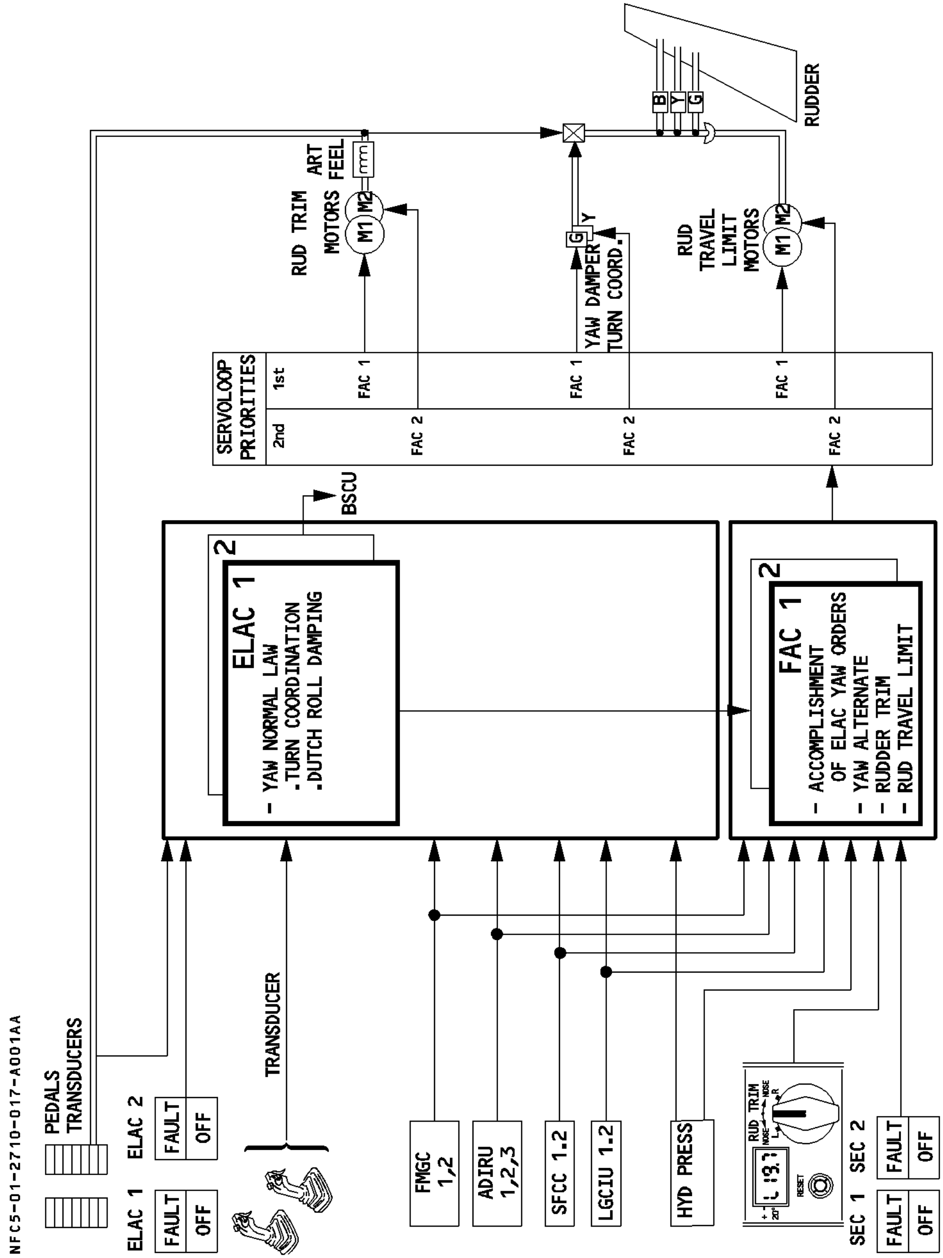
- Maximum deflection is ± 25°.
- Rudder trim speed is one degree per second.
- In addition to limitation by TLU, if rudder trim is applied, maximum rudder deflection may be reduced in the opposite direction.

The pilot can use a button on the RUD TRIM panel to reset the rudder trim to zero.

Note : *With the autopilot engaged, the FMGC computes the rudder trim orders. The rudder*
R *trim rotary switch and the rudder trim reset pushbutton are not active.*

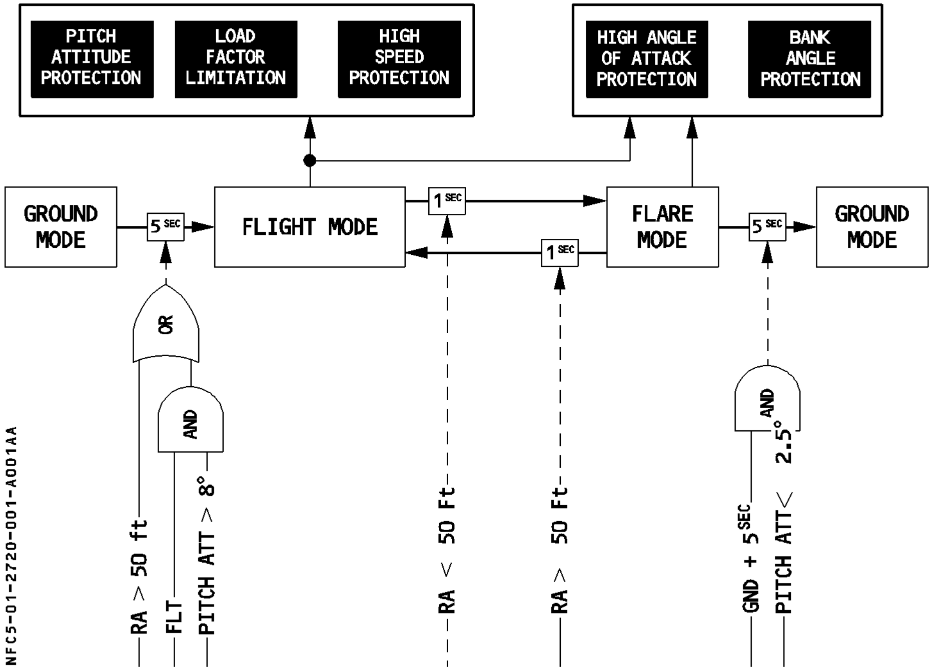
YAW CONTROL – SCHEMATIC

FOR INFO



GENERAL

Flight control normal law covers :
- three-axis control
- flight envelope protection
- alleviation of maneuver loads



PITCH CONTROL

GROUND MODE

Ground mode is active when the aircraft is on the ground. It is a direct relationship between sidestick deflection and elevator deflection, without auto trim.
It automatically sets the trimmable horizontal stabilizer (THS) at 0° (inside the green band).
A setting that the pilot enters manually to adjust for CG has priority for takeoff.
When the aircraft reaches 70 knots during the takeoff roll, the system reduces the maximum up elevator deflection from 30° to 20°, and the aircraft performs the rotation maneuver in direct law.
As soon as the aircraft becomes airborne, the system blends in the flight mode.
The reverse process occurs after touchdown.

FLIGHT MODE

The normal-law flight mode is a load-factor-demand mode with automatic trim and protection throughout the flight envelope.
Following normal law, the sidestick controllers set the elevator and THS to maintain load factor proportional to stick deflection and independent of speed.
With the sidestick 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 by changing speed or configuration.
Pitch trim is automatic both in manual mode and when the autopilot is engaged. In normal turns (up to 33° of bank) the pilot does not have to make any pitch corrections once the turn is established.
The flight mode is active from takeoff to landing, and follows the logic shown schematically on page 1, above.
Automatic pitch trim freezes in the following situations :
- The pilot enters a manual trim order.
- The radio altitude is below 50 feet (100 feet with autopilot engaged).
- The load factor goes below 0.5 g.
- The aircraft is under high-speed or high-Mach protection (except when there is fault in one of the elevators).

When angle-of-attack protection is active, the THS setting is limited between the setting at the aircraft's entry into this protection and 3.5° nose down. (Neither the pilot nor the system can apply additional nose-up trim).
Similarly, when the load factor is higher than 1.25 g or when the aircraft exceeds 33° of bank, the THS setting is limited to values between the actual setting and 3.5° nose down.

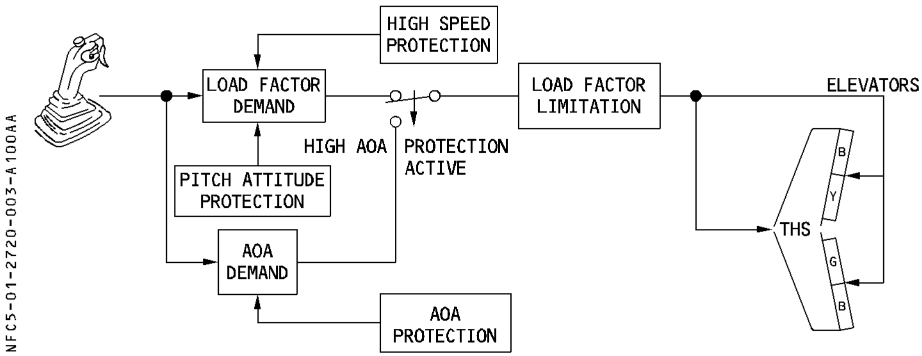
Control with autopilot engaged
- The ELACs and SECs limit what the autopilot can order.
- The pilot has to overcome a restraining force in order to move the sidestick when the autopilot is engaged. If he overcomes this force and does move the sidestick, he disconnects the autopilot.
- The pilot can also disconnect the autopilot by pushing on the rudder pedals (10° out of trim) or by moving the pitch trim wheel.
- All protections of normal laws remain effective except pitch attitude protection.

FLARE MODE

The flight mode changes to flare mode when the aircraft passes 50 feet RA as it descends to land.
The system memorizes the attitude at 50 feet, and that attitude becomes the initial reference for pitch attitude control.
As the aircraft descends through 30 feet, the system begins to reduce the pitch attitude, reducing it to 2° nose down over a period of 8 seconds. This means that it takes gentle nose-up action by the pilot to flare the aircraft.

PROTECTIONS

The normal law protects the aircraft throughout the flight envelope, as follows :
– load factor limitation
– pitch attitude protection
– high-angle-of-attack (AOA) protection
– high-speed protection.



LOAD FACTOR LIMITATION

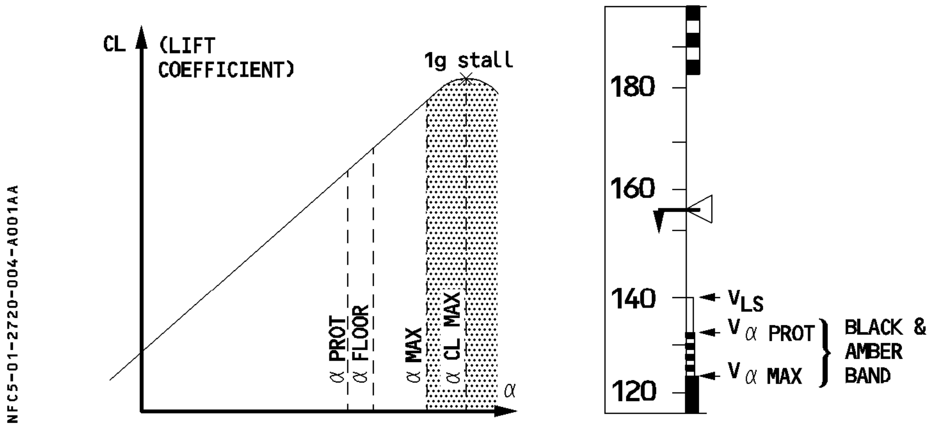
The load factor is automatically limited to :
+ 2.5 g to – 1 g for clean configuration.
+ 2 g to 0 for other configurations.

PITCH ATTITUDE PROTECTION

Pitch attitude is limited to :
– 30° nose up in conf 0 to 3 (progressively reduced to 25° at low speed).
– 25° nose up in conf FULL (progressively reduced to 20° at low speed).
– 15° nose down (indicated by green symbols "=" on the PFD's pitch scale).
The flight director bars disappear from the PFD when the pitch attitude exceeds 25° up or 13° down. They return to the display when the pitch angle returns to the region between 22° up and 10° down.

HIGH ANGLE OF ATTACK PROTECTION

Under normal law, when the angle of attack becomes greater than αprot, the system switches elevator control from normal mode to a protection mode in which angle of attack is proportional to sidestick deflection. That is, in the αprot range, from α prot to αmax, the sidestick commands α directly. However, the angle of attack will not exceed αmax, even if the pilot gently pulls the sidestick all the way back. If the pilot releases the sidestick, the angle of attack returns to αprot and stays there.
This protection against stall and windshear has priority over all other protections. The autopilot disconnects at α prot + 1°.



Vα prot, Vα floor, Vα max vary according to the weight and the configuration.
To deactivate the angle of attack protection, the pilot must push the sidestick :
– More than 8° forward, or,
– More than 0.5° forward for at least 0.5 second when α < α max.

Note : *1. At take off αprot is equal to αmax for 5 seconds.*
2. αfloor is activated through A/THR system when :
– α > α floor (9.5° in configuration 0; 15° in configuration 1, 2; 14° in configuration 3 ; 13° in configuration FULL), or,
– sidestick deflection > 14° nose up with either pitch attitude or angle of attack protection active.
αfloor function is available from lift-off to 100 feet RA before landing.

HIGH-SPEED PROTECTION

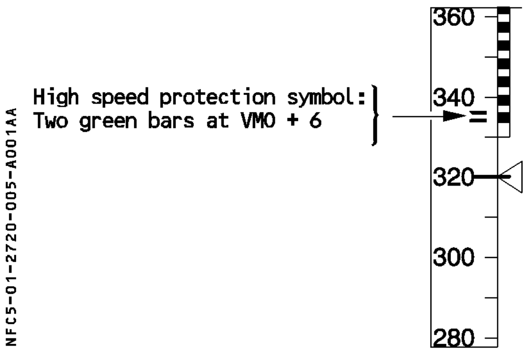
The aircraft automatically recovers following a high speed upset. Depending on the flight conditions (high acceleration, low pitch attitude), the High Speed Protection is activated at/or above VMO/MMO.

R When it is activated, the pitch trim is frozen. Positive spiral static stability is introduced to
R 0° bank angle (instead of 33° in normal law), so that with the sidestick released, the aircraft
R 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.



Note : The ECAM displays an "O/SPEED" warning at VMO + 4 knots and MMO + 0.006.

LOW ENERGY WARNING

The low energy warning is computed by the FAC, see 1.22.40.

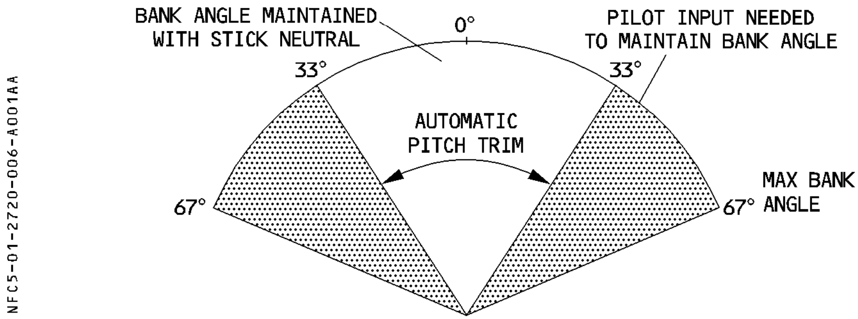
LATERAL CONTROL

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

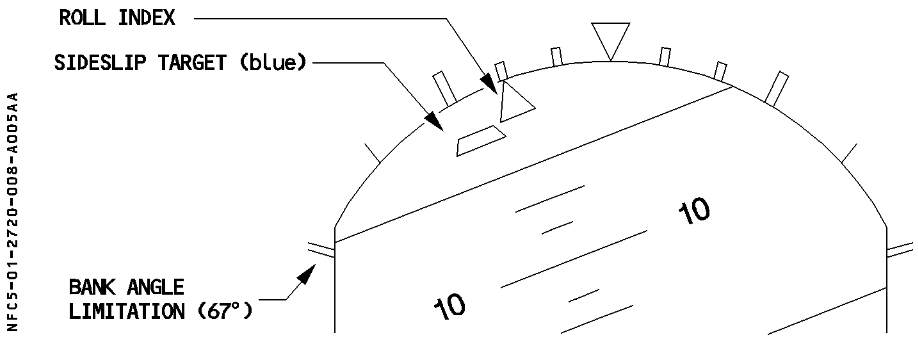
R Inside the normal flight envelope, the system maintains positive spiral static stability for bank angles above 33°. If the pilot releases the sidestick at a bank angle greater than 33°, the bank angle automatically reduces to 33°. Up to 33°, the system holds the roll attitude constant when the sidestick 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° and no further, if the pilot holds full lateral sidestick deflection. If high speed
R protection is operative, the system maintains positive spiral static stability from a bank angle of 0°, so that with the sidestick released, the aircraft always returns to a bank angle of 0°.
When bank angle protection is active, auto trim is inoperative.
If the bank angle exceeds 45°, the autopilot disconnects and the FD bars disappear. The FD bars return when the bank angle decreases to less than 40°.



LEFT INTENTIONALLY BLANK

SIDESLIP TARGET

If one engine fails, the FAC modifies the sideslip indication slightly to show the pilot how much rudder to use to get the best climb performance (ailerons to neutral and spoilers retracted).
In takeoff configuration (1,2,3) when the FAC detects asymmetric thrust (35 % N1) and at least one engine is above 80% N1, the slideslip indication on the PFD changes from yellow lo blue.



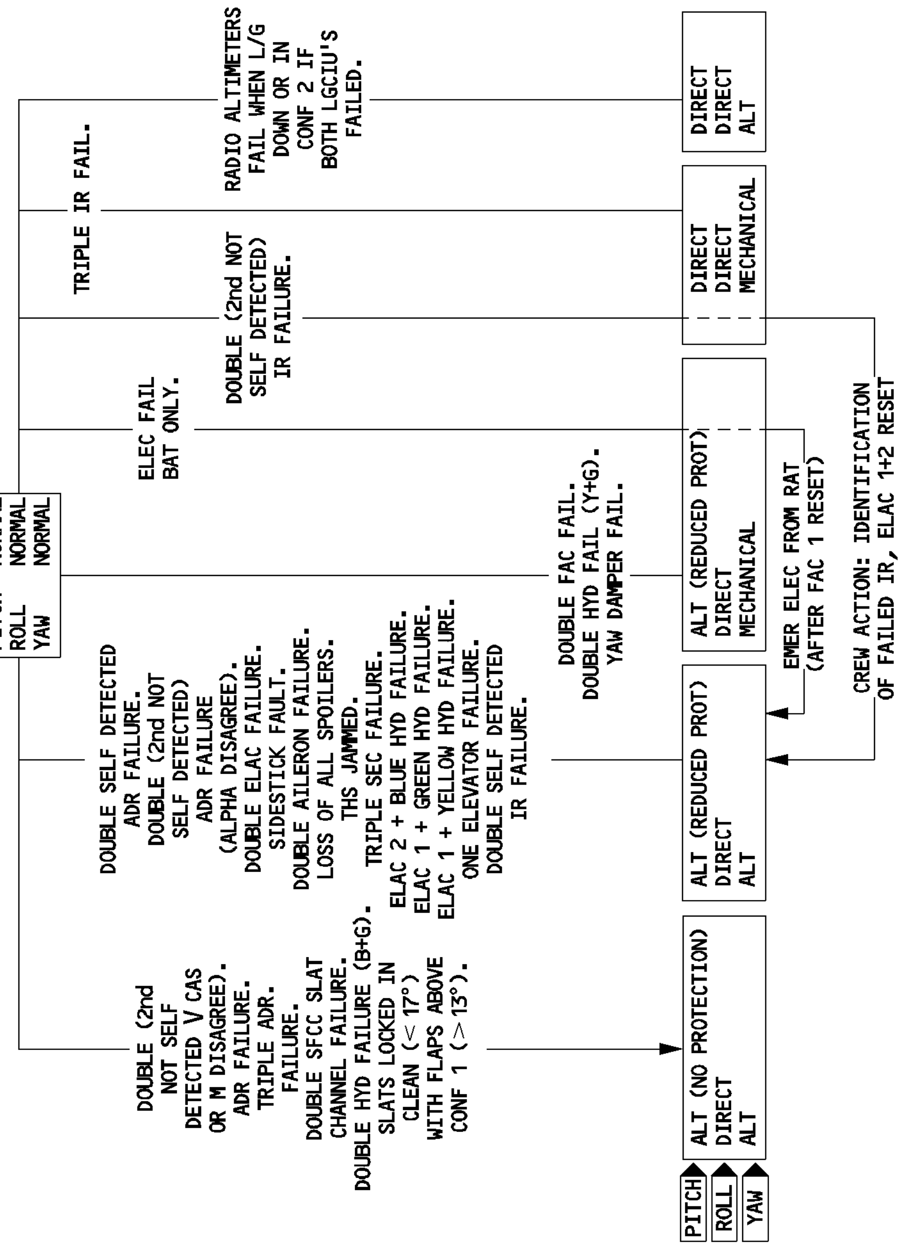
The pilot's response is normal and instinctive : zero the slip indication by applying the right amount of rudder to get the best climb performance.

GENERAL

Depending on the failures occuring to the flight control system, or on its peripherals, there are 3 levels of reconfiguration :

- Alternate law
  They are two levels of alternate law : with and without reduced protections.
- Direct law
- Mechanical

FLIGHT CONTROLS LAW RECONFIGURATION



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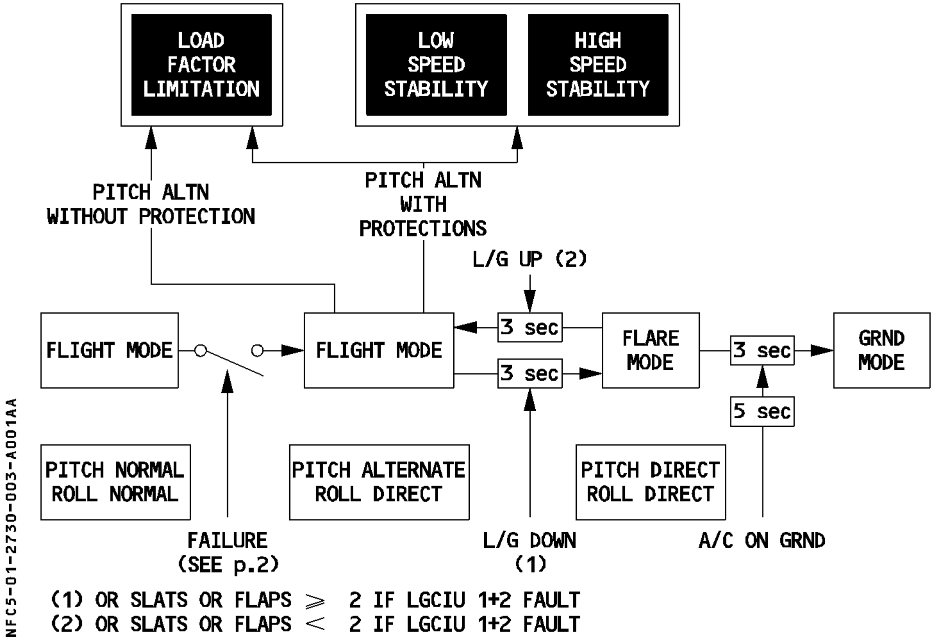
ALTERNATE LAW



PITCH CONTROL

GROUND MODE

Under alternate law the ground mode becomes active on the ground five seconds after touchdown.
It is identical to the ground mode of the normal law.

FLIGHT MODE

In flight, the alternate law pitch mode follows a load-factor demand law much as the normal law pitch mode does, but it has less built-in protection (reduced protections).

FLARE MORE

In pitch alternate law the flight mode changes to the flare mode when the pilot selects landing gear down. The flare mode is a direct stick-to-elevator relationship.
(See DIRECT LAW).

LATERAL CONTROL

When the aircraft flying in pitch alternate law, lateral control follows the roll direct law associated with yaw alternate or mechanical.

ROLL DIRECT LAW

See page 6.

YAW ALTERNATE LAW

Only the yaw damping function is available. Damper authority is limited to ± 5° of rudder deflection.

REDUCED PROTECTIONS

LOAD FACTOR LIMITATION

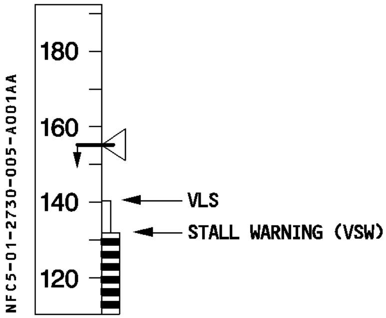
The load factor limitation is similar to that under normal law.

PITCH ATTITUDE PROTECTION

There is no pitch attitude protection. Amber Xs replace the green double bars "=" on the PFD.

R **LOW SPEED STABILITY**

An artificial low speed stability replaces the normal angle-of-attack protection. It is available for all slat/flap configurations, and the low speed stability is active from about 5 knots up to about 10 knots above stall warning speed, depending on the aircraft's gross 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 system also injects bank-angle compensation, so that operation effectively maintains a constant angle of attack.
In addition, audio stall warnings (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.
The α floor protection is inoperative.



R **HIGH SPEED STABILITY**

Above VMO or MMO, a nose up demand is introduced to avoid an excessive increase in speed. The pilot can override this demand.
In addition, the aural overspeed warning (VMO + 4 or MMO + 0.006) remains available.

BANK ANGLE PROTECTION

Not provided.

Note : *The AP will disconnect, if speed exceeds VMO/MMO, or if the bank angle exceeds 45°.*

ALTERNATE LAW WITHOUT REDUCED PROTECTION

This is identical to alternate law except that it does not include the low-speed stability or the high-speed stability. It includes only the load factor limitation.

DIRECT LAW

PITCH CONTROL

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 varies as a function of CG.
It is a compromise between adequate controllability with the CG forward, and not-too-sensitive control with the CG aft.
There is no automatic trim : the pilot must trim manually.
The PFD displays in amber the message "USE MAN PITCH TRIM".
No protections are operative.
The α floor function is inoperative.
Overspeed and stall warnings are available as for alternate law.

LATERAL CONTROL

When flying in "direct law", the roll direct law associated with mechanical yaw control governs lateral control.

ROLL DIRECT LAW

The roll direct law is a direct stick-to-surface-position relationship. System gains are set automatically to correspond to slat/flap configuration.
With the aircraft in the clean configuration, the maximum roll rate is about 30° per second.
With slats extended, it is about 25° per second.
To limit roll rate, the roll direct law uses only ailerons and spoilers N° 4 and 5.
If spoiler N° 4 has failed, spoiler N°3 replaces it.
If the ailerons have failed, all roll spoilers become active.

YAW MECHANICAL CONTROL

The pilot controls yaw with the rudder pedals.
The yaw damping and turn coordination functions are lost.

ABNORMAL ATTITUDE LAWS

The system applies an abnormal-attitude law in pitch and roll if the aircraft exceeds any of these limits in flight.
– Pitch attitude > 50° nose up or 30° nose down
– Bank angle > 125°
– Angle of attack > 30° or < – 10° (– 15° for A319 and A321)
– Speed > 440 knots or < 60 knots
– Mach > 0.91 or < 0.1
The law in pitch is the alternate law with no protection except load-factor protection and without auto trim. In roll it is a full-authority direct law with a yaw mechanical.
When the aircraft has recovered from its abnormal attitude, the flight control laws in effect are :
– in pitch : alternate law without protection with autotrim.
– in roll : full authority direct law with yaw alternate law.
There is no reversion to the direct law when the pilot extends the landing gear.

MECHANICAL BACK-UP

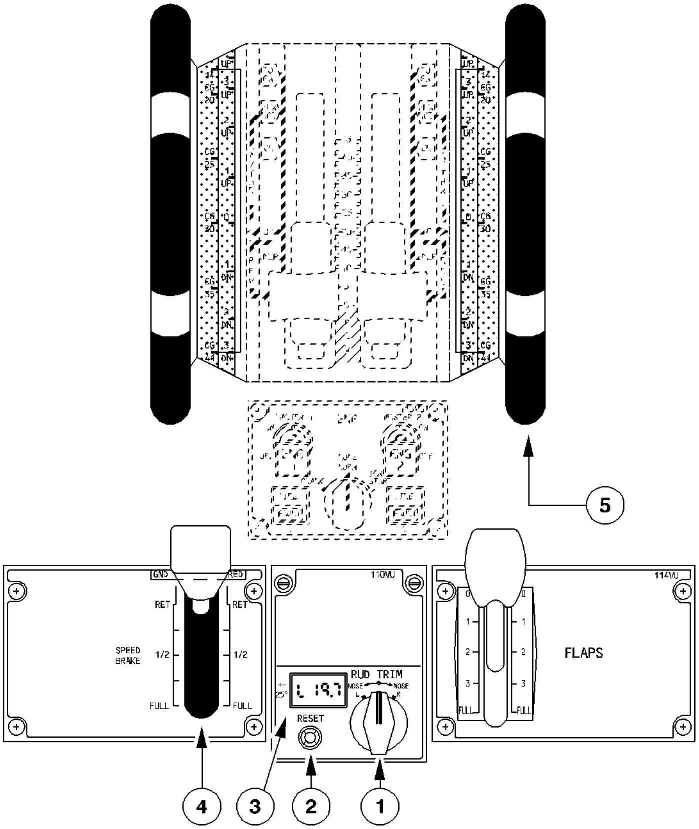
PITCH

Mechanical back-up permits the pilot to control the aircraft during a temporary complete loss of electrical power.
He does this in pitch by applying trim manually to the THS.
The PFDs display "MAN PITCH TRIM ONLY" in red.

LATERAL

The pilot uses the rudder pedals as the mechanical back-up to control the aircraft laterally.

PEDESTAL



NFC5-01-2740-001-A001AA

① RUD TRIM rotary switch

Controls the rudder trim actuator, which moves the neutral point of the artificial feel by the equivalent of one degree of rudder travel per second.

Note : The rudder trim rotary switch has no effect when the autopilot is engaged.

② RESET pushbutton

By pushing the RESET pushbutton, the zero trim position is ordered at 3° / seconds.

Note : The RESET pushbutton is not active with the autopilot engaged.

(3) Position Indicator

Displays the rudder trim direction (L or R) and value (0 to 20°).

(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 spoiler's surfaces will automatically extend at landing, or in case of a rejected takeoff.

(5) PITCH TRIM wheel

Both pitch trim wheels provide mechanical control of the THS and have priority over electrical control. A pilot action on the pitch trim wheel disconnects the autopilot.

Note : *Crew action on the pitch trim wheel does not disconnect the ELACs (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,
R when in direct law.
R – Before takeoff, the pilot sets the THS to the angular value, determined as a function
R of the aircraft CG, using the CG scale on the wheel. The relationship between the
R 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
R on the pitch trim wheel.
R – In flight, when in direct law, the pilot uses the THS conventionally to fly in trim. In
R flight, the aircraft pitch trim setting depends on aircraft CG, weight, altitude and
R speed. Consequently, the relation between the aircraft CG, and the THS setting
R displayed on the pitch trim wheel, does not apply in flight.
R Following nosewheel touchdown, as the pitch attitude becomes less than 2.5° for more
R than 5 seconds, pitch trim is automatically reset to zero.

Note : *This function is inoperative, when the green or yellow hydraulic system is not pressurized.*

LATERAL CONSOLES

SIDESTICKS

Each pilot has on his lateral console a sidestick he can use to control pitch and roll manually. Each sidestick is 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 (5 daN in pitch, 3.5 daN in roll) the stick becomes free and the autopilot disengages.
The hand grip has two switches :
— Autopilot disconnect and sidestick takeover pushbutton.
— Push-to-talk button.

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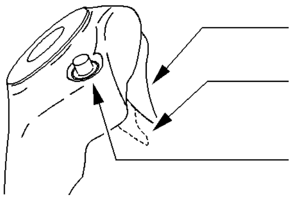


Sidestick priority logic

— When only one pilot operates the sidestick, it sends his control signals to the computers.
— When the pilots move both side stick simultaneously in the same or opposite direction and neither takes priority, the system adds the signals of both pilots algebraically. The total is limited to the signal that would result from the maximum deflection of a single sidestick.
Both green CAPT and F/O SIDE STICK PRIORITY lights flash and a “DUAL INPUT” audio voice message is given every 5 seconds as long as both pilots operate their side stick simultaneously.

A pilot can deactivate the other stick and take full control by pressing and keeping pressed his priority takeover pushbutton.
For latching the priority condition, it is recommended to press the takeover push button for more than 40 seconds.
This allows the pilot to release his takeover push button without losing priority.
However, a pilot can at any time reactivate a deactivated stick by momentarily pressing the takeover push button on either stick.
If both pilots press their takeover pushbuttons, the pilot that presses last gets priority.

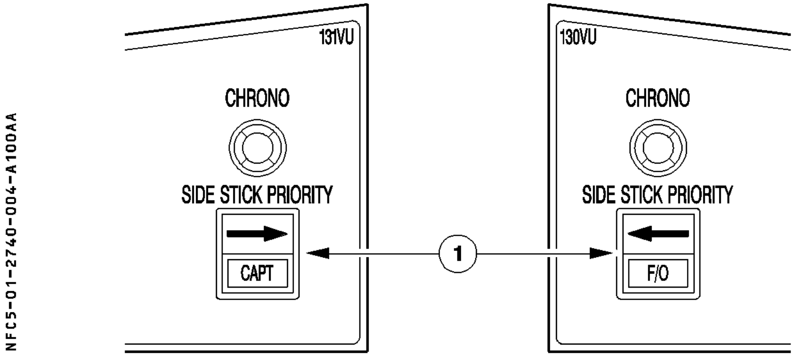
Note : If an autopilot is engaged, the first action on a takeover pushbutton disengages it.

In a priority situation

- A red light comes on in front of the pilot whose stick is deactivated.
- A green light comes 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 the aircraft is on the ground and commencing its takeoff run and one stick is deactivated, this triggers the takeoff "CONFIG" warning.

GLARESHIELD



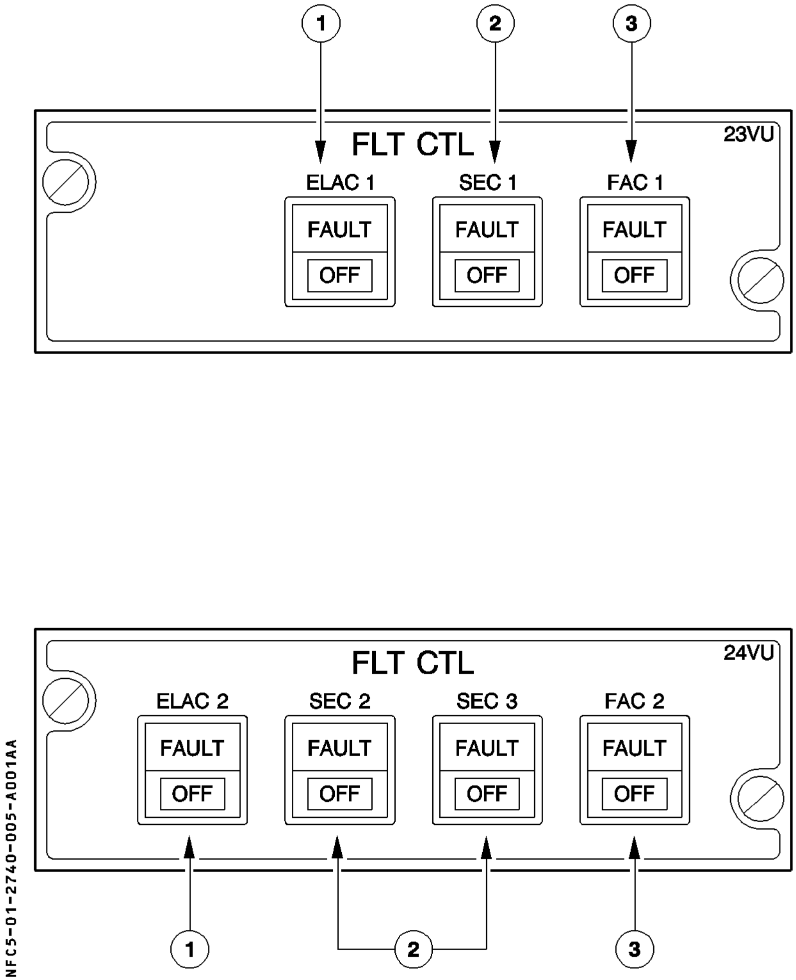
(1) SIDE STICK PRIORITY lt

Red arrow light :
- comes on in front of the pilot losing authority.
- goes out if he has recovered his authority
  - · if the other pilot releases his TAKEOVER pushbutton prior the priority condition is latched.
    or
  - · If he has used his takeover push button 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.

Green CAPT and F/O lights :
- Both lights flash when the pilots move both sidesticks simultaneously and neither takes priority.
- When a pilot has taken priority by pressing the takeover pushbutton and the other pilot's sidestick is not at neutral, the light in front of the pilot with priority lights up. It goes out when the other pilot returns his stick to the neutral position.

OVERHEAD PANEL



1 ELAC 1(2) pb sw

Controls the elevator and aileron control (ELAC) computer 1(2).

ON : ELAC 1(2) performs the following functions :
- normal pitch and roll
- alternate pitch
- direct pitch and roll
- abnormal attitude
- aileron droop
- acquisition of autopilot orders.

OFF : The corresponding computer is not active. Switching it OFF and then ON resets the computer.

FAULT : Lights up in amber, along with a "CAUTION" advisory on ECAM :
- when a failure is detected
- during ELAC power-up test (eight seconds).

Note : ELAC power-up test occurs when electrical power is turned on or after the occurrence of an electrical transient lasting longer than 25 milliseconds.

The FAULT light goes out when the pilot selects OFF, or at the end of the ELAC power-up test if its results are satisfactory.

2 SEC 1(2)(3) pb sw

Controls the spoiler and elevator (SEC) computers 1(2)(3).

ON : SEC 1(2)(3) performs the following functions :
- normal roll (by controlling the spoilers)
- speed brakes and ground spoilers (SEC 1 and SEC 3 only)
- alternate pitch (SEC 1 and SEC 2 only)
- direct pitch (SEC 1 and SEC 2 only)
- direct roll
- R abnormal attitude.

OFF : The corresponding computer is not active. Switching it OFF and then on resets the computer.

FAULT : Lights up in amber, along with a "CAUTION" advisory on the ECAM, when a failure is detected.
The FAULT light goes out when the pilot selects OFF.

(3) FAC 1(2) pb sw

Controls the flight augmentation computer (FAC) 1(2).

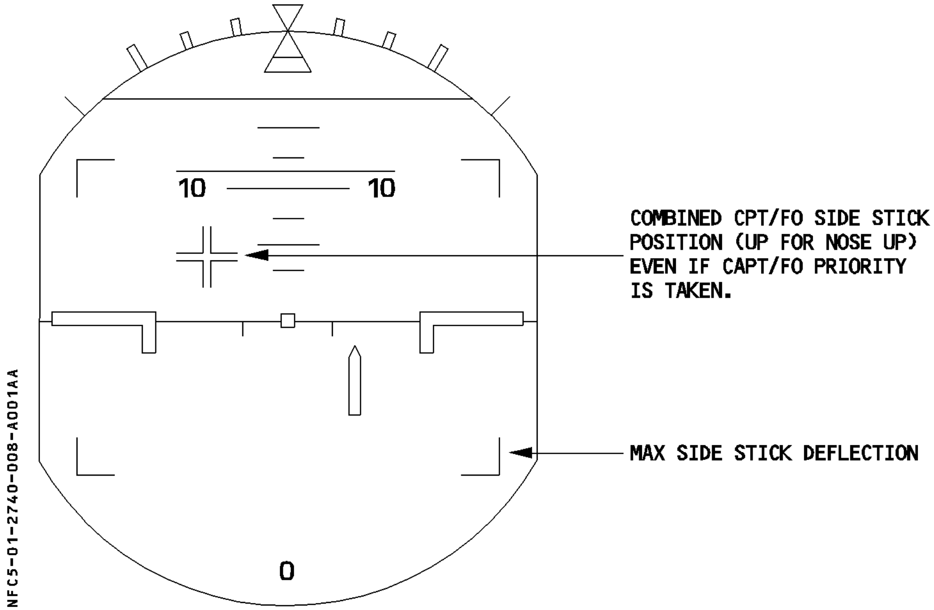
ON : Both FACs perform the following functions :
- Normal roll (coordinating turns and damping dutch roll)
- Rudder trim
- Rudder travel limit
- Alternate yaw

OFF : The corresponding computer is not active. Switching it OFF and then ON resets the computer.

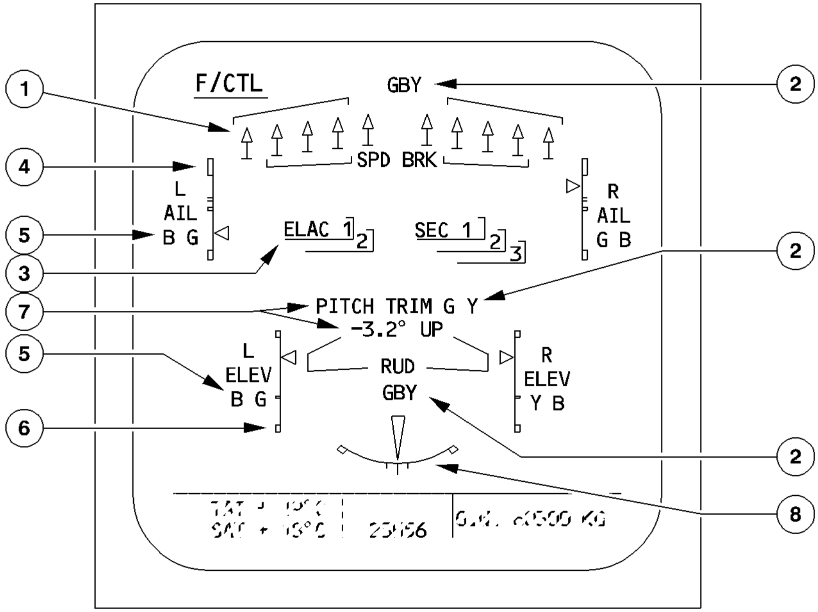
FAULT : Lights up in amber, along with a caution on ECAM, when a failure is detected. The FAULT light goes out when the pilot selects OFF.

SIDE STICK INDICATIONS ON PFD

On the ground, after the first engine start, sidestick position indications appear white on both PFDs.
The indications disappear when the aircraft goes from the ground into flight.



R **ECAM F/CTL PAGE**



NFC5-01-2740-009-A100AA

① Spoilers/speed brakes indication

NFC5-01-2740-009-B100AA

: SPOILER DEFLECTED BY MORE THAN 2.5°(GREEN)

— : SPOILER RETRACTED (GREEN)

: SPOILER FAULT DEFLECTED (AMBER)

1 : SPOILER FAULT RETRACTED (AMBER)

② Hydraulic system pressure indication

Normally green. Changes to amber if pressure in the hydraulic system gets low.

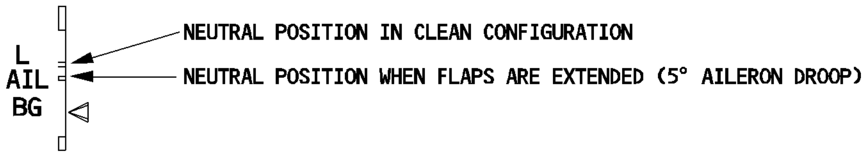
③ ELAC/SEC indication

Normally green. Changes to amber if there is a failure in the ELAC or the SEC, or if ELAC or SEC pushbutton is off, or if both flight control data concentrators (FCDCs) fail.
The surrounding box is normally grey. It changes to amber if the ELAC or SEC indication does.

(4) Aileron position indication

White scale and green index. Changes to amber when neither (green nor blue) servojack is available.

NFC5-01-2740-010-A001AA



(5) Aileron and elevator actuator indication

"G" and "B" are normally displayed in green.
R The color changes to amber in case of a green or blue hydraulic system low pressure.
R The partial box also changes to amber if the associated computer or actuator fails.

(6) Elevator position indication

White scale and green index. The index changes to amber when both associated actuators are not available.

(7) Pitch trim position indication

The pitch trim numbers are green. They change to amber if the hydraulic pressure gets low in the green and yellow systems.
The legend, "PITCH TRIM", is white. It changes to amber if there is a pitch trim jam.

(8) Yaw control indications

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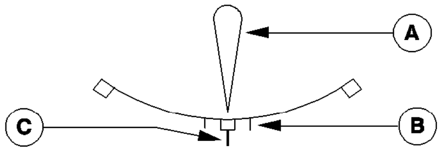
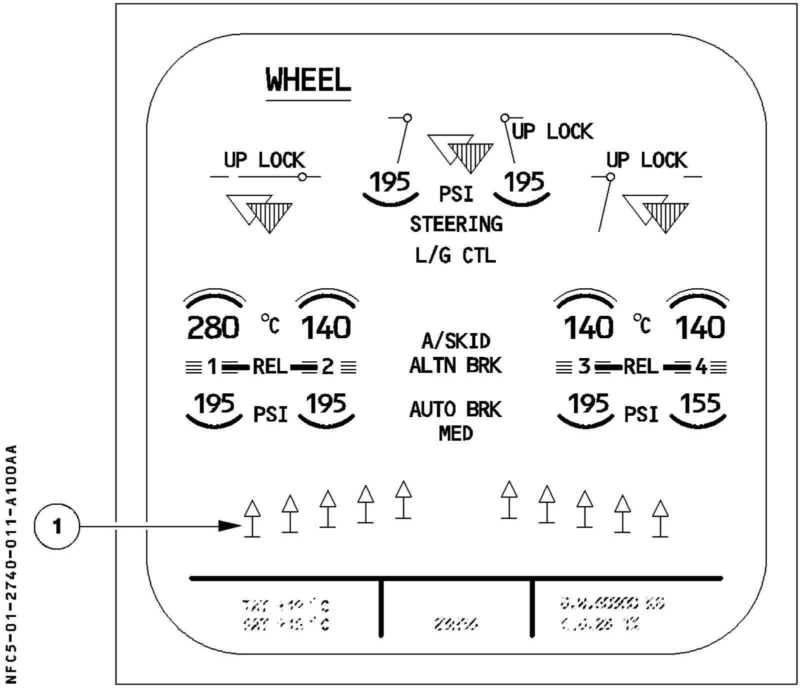


(A) Rudder position indication
Normally green. The rudder symbol and scale become amber if blue + green + yellow hydraulic pressure is low.

(B) Rudder travel limiter
Indication of high-speed position.

(C) Rudder trim position
Normally blue. Changes to amber if rudder trim reset fails.

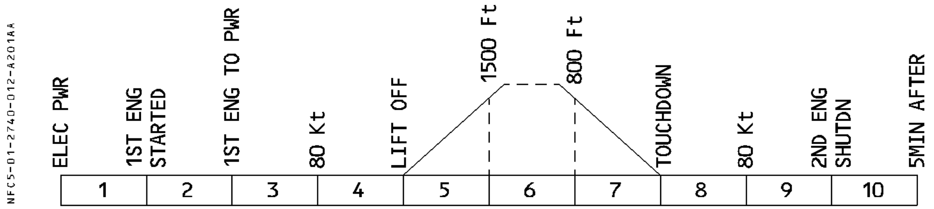
ECAM WHEEL PAGE



(1) SPOILERS/SPEED BRAKES INDICATION

These indications are the same as those displayed on the FLT CTL page.

WARNINGS AND CAUTIONS



R

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG . SLATS/FLAPS NOT IN T.O CONFIG, or . SPD BRK NOT RETRACTED, or . PITCH TRIM NOT IN TO RANGE, or . RUD TRIM NOT IN T.O RANGE A/C not in TO configuration when thrust levers are set at TO, or Flex TO, or when pressing TO CONFIG. pb.	CRC	MASTER WARN	F/CTL	NIL	5, 6, 7, 8
CONFIG R (L) SIDESTICK FAULT (BY TAKE OVER) L or R sidestick is inoperative (take over pb pressed more than 30 sec) when thrust levers are set at TO, or Flex TO, or when pressing TO CONFIG pb.				Red * SIDESTICK PRIORITY lt	
L +R ELEV FAULT Loss of both elevators				PFD message	NIL
L (R) SIDESTICK FAULT Transducers on pitch or roll axis are failed on one sidestick	SINGLE CHIME	MASTER CAUT		NIL	
ELAC 1 (2) FAULT Failure of ELAC (pitch and roll channel)				FAULT lt on ELAC pb	3, 4, 5, 7, 8
ELAC 1 (2) FAULT One sidestick transducer fault				NIL	
SEC 1 (2) (3) FAULT Failure of one SEC				FAULT lt on SEC pb	
FCDC 1 + 2 FAULT Failure of both FCDCs				NIL	4, 5, 7
DIRECT LAW Direct laws are active				PFD message	4, 5, 7, 8
ALTN LAW Alternate laws are active			NIL	NIL	
IR DISAGREE Disagree between two IR, with the third one failed				FAULT lts on ELAC pbs and PFD message	3, 4, 5, 7
DUAL INPUT Both sidesticks are moved simultaneously	Synthetic voice repeated every 5 seconds	NIL	NIL	SIDESTICK Priority light	NIL

* The red SIDESTICK PRIORITY light comes on as soon as the sidestick becomes inoperative.

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>ADR DISAGREE
One ADR is faulty or has been rejected by the ELAC and there is a speed or angle of attack disagree between the two remaining ADR</td><td rowspan="8">SINGLE CHIME</td><td rowspan="8">MASTER CAUTION</td><td>NIL</td><td>FAULT lts on ELAC pbs</td><td>3, 4, 5, 7</td></tr>
<tr><td>GND SPLR FAULT
loss of ground spoiler function in
SEC 1 + 3 or 1 + 2 or 2 + 3 or 1 + 2 + 3</td><td rowspan="13">F/CTL</td><td rowspan="15">NIL</td><td rowspan="3">3, 4, 5</td></tr>
<tr><td>SPD BRK DISAGREE
position disagree between surfaces and lever position</td></tr>
<tr><td>SPD BRK FAULT
spd brake lever transducers to SEC 1 and 3 failed</td></tr>
<tr><td>STABILIZER JAM
Jamming of stabilizer</td><td rowspan="3">4, 5</td></tr>
<tr><td>L (R) ELEV FAULT
loss of both servojacks on one elevator or activation of elevator flutter protection in ELAC</td></tr>
<tr><td>L (R) AIL FAULT
loss of both servojacks on one aileron</td></tr>
<tr><td>SPLR FAULT
loss of one or more spoilers</td><td>3, 4, 5, 7</td></tr>
<tr><td>ELAC 1 PITCH FAULT
failure of pitch channel in ELAC 1</td><td rowspan="8">NIL</td><td rowspan="8">NIL</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>ELAC 2 PITCH FAULT
failure of pitch channel in ELAC 2, or loss of one or both ELAC 2 rudder pedal transducers</td></tr>
<tr><td>GND SPLR 1 + 2 (3 + 4)
gnd splr channel failed in SEC 3 (1)</td><td rowspan="2">3, 4, 5</td></tr>
<tr><td>ELEV SERVO FAULT
loss of one servojack on one elevator</td></tr>
<tr><td>SPD BRK 2 (3 + 4) FAULT
spd brake lever transducers to SEC 3 (1) failed</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>AIL SERVO FAULT
loss of one servojack on one aileron or loss of one or both ELAC 1 rudder pedal transducers</td></tr>
<tr><td>FCDC 1 (2) FAULT</td><td rowspan="2">NIL</td></tr>
<tr><td>SIDESTICK PRIORITY
Failure in a sidestick priority logic circuit</td><td>3, 4, 5, 6, 7, 8, 9</td></tr>
</table>

MEMO DISPLAY

- "SPEED BRK" appears in green if the speed brakes are extended. It flashes amber if, during flight, one engine's N1 is above 50 %.
- "GND SPLRS ARMED" appears in green if ground spoilers are armed.

DESCRIPTION

GENERAL

Each wing has the following lift augmentation devices :
- two flap surfaces
- five slat surfaces.

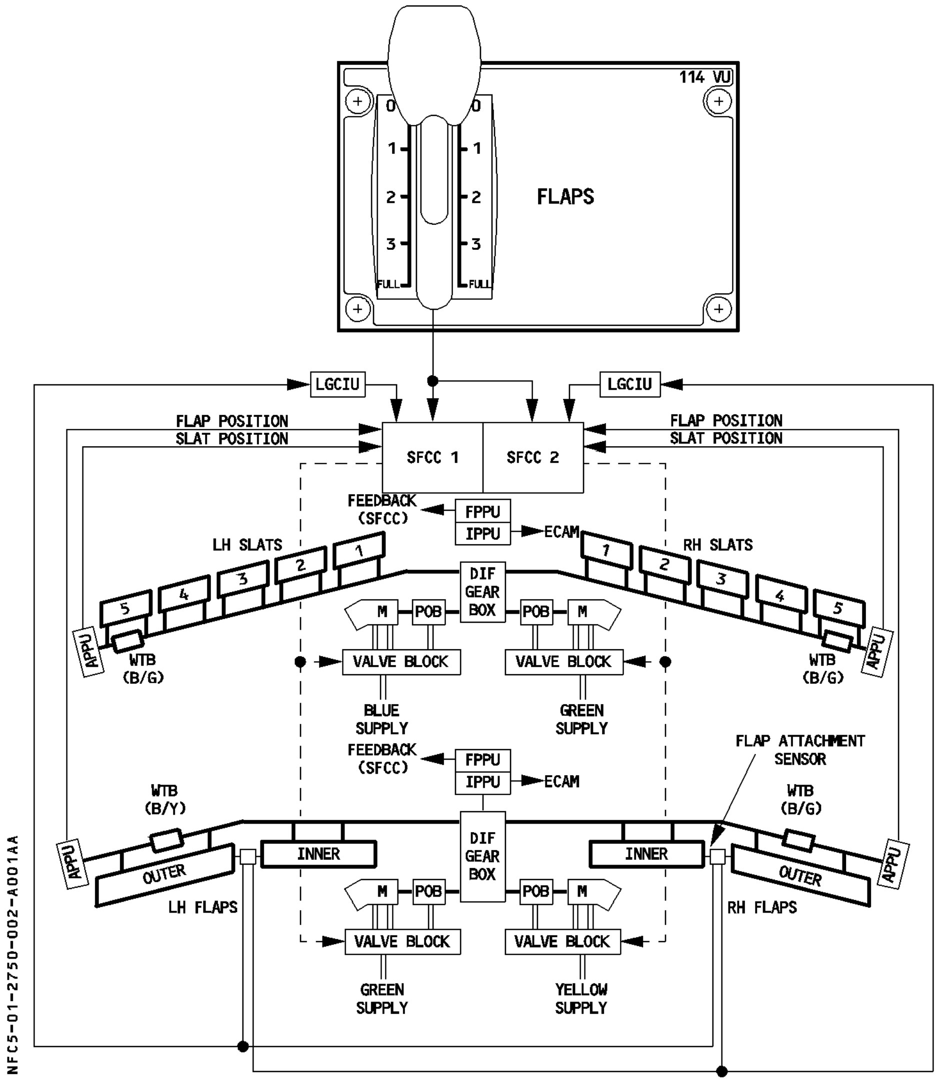
These surfaces are electrically controlled and hydraulically operated.
The pilot extends slats and flaps by moving the FLAPS lever on the center pedestal.
It has five positions.

MAIN COMPONENTS

The slat and flap systems are similar, comprising :
- Two slat flap control computers (SFCCs), each containing one slat channel and one flap channel.
- A power control unit (PCU) consisting of two independent hydraulic motors coupled by a differential gearbox.
  The motors use green and blue hydraulic power for the slats and yellow and green power for the flaps.
  Pressure-off brakes (POBs) lock the transmission when the slat or flap surfaces have reached the selected position or if hydraulic power fails.
- Five slat surfaces and two flap surfaces per wing.
- An assymetry position pick-off unit (APPU) that measures the assymetry between the left and right wings.
- A flap disconnect detection system, which detects attachment failure and inhibits flap operation in order to prevent further damage. A sensor detects the failure by measuring excessive differential movement between the inner and the outer flaps.
- Wingtip brakes (WTBs), activated in case of assymetry, mechanism overspeed, symmetrical runaway, or uncommanded movement of the surfaces. They cannot be released in flight.
  They use blue and green hydraulic power for the slats and for the right wing flaps, and blue and yellow hydraulic power for the left wing flaps.
- Feedback position pick-off units (FPPUs) that feed back position information to the SFCCs.
- An indication position pick-off unit (IPPU) that sends position data to the ECAM.

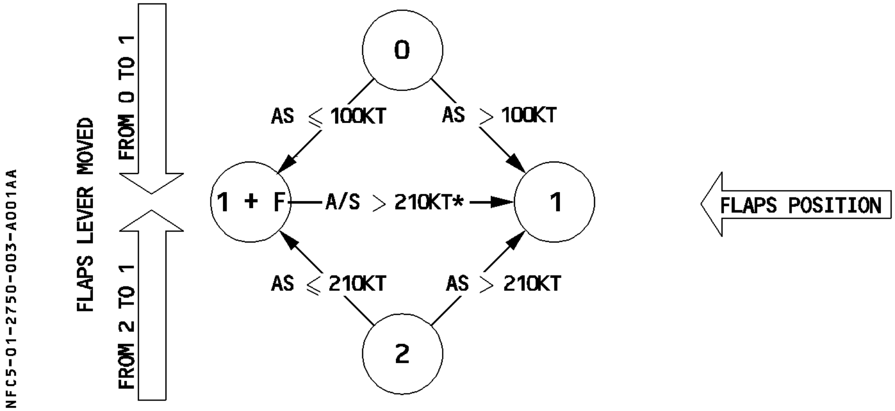
Note : *If the flap wingtip brakes are on, the pilot can still operate the slats, and if the slat wingtip brakes are on, he can still operate the flaps.*
If one SFCC is inoperative, slats and flaps both operate at half speed.
If one hydraulic system is inoperative, the corresponding surfaces (slats or flaps) operate at half speed.

ARCHITECTURE



CONFIGURATIONS

The FLAPS lever has five positions : 0, 1, 2, 3 and FULL.
Two configurations correspond to position 1 : Configuration 1 and Configuration 1 + F.
The pilot selects these as follows :



* When Configuration 1 + F is selected, the flaps retract to 0° automatically at 210
R knots (before the airspeed reaches VFE).

ALPHA/SPEED LOCK FUNCTION (SLATS)

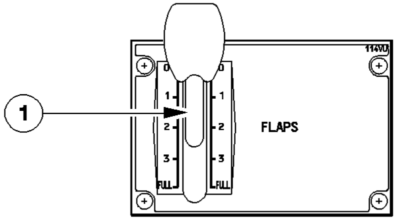
This function inhibits slat retraction at high angles of attack and low speeds.
The SFCCs use corrected angle-of-attack (alpha) or airspeed information from the air data inertial reference units (ADIRUs) to key the inhibition of slat retraction.
If alpha exceeds 8.6° or the airspeed falls below 148 knots, retraction from position 1 to position 0 is inhibited.
The inhibition is removed when alpha falls below 7.6° or when the speed exceeds 154 knots.
This function is not active if :

- Alpha exceeds 8.6° or the airspeed falls below 148 knots after the pilot has moved the lever to 0.
- The aircraft is on the ground with its speed less than 60 knots.

CONTROLS AND INDICATORS

PEDESTAL

NFC5-01-2750-005-A050AA



(1) FLAPS lever

The FLAPS lever selects simultaneous operation of the slats and flaps.
The five lever positions correspond to the following surface positions :

<table>
<tr><th>Position</th><th>SLATS</th><th>FLAPS</th><th>Indications on ECAM</th><th colspan="3"></th></tr>
<tr><td>0</td><td>0</td><td>0</td><td></td><td rowspan="2"></td><td>CRUISE</td><td rowspan="2">HOLD</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">18</td><td>0</td><td>1</td><td rowspan="3"></td></tr>
<tr><td>10</td><td>1 + F</td><td rowspan="3">TAKEOFF</td><td></td></tr>
<tr><td>2</td><td>22</td><td>15</td><td>2</td><td rowspan="2">APPR</td></tr>
<tr><td>3</td><td>22</td><td>20</td><td>3</td><td rowspan="2">LDG</td></tr>
<tr><td>FULL</td><td>27</td><td>40</td><td>FULL</td><td></td><td></td></tr>
</table>

Before selecting any position, the pilot must pull the lever out of the detent. Balks at positions 1 and 3 prevent the pilot from calling for excessive flap/slat travel with a single action.

Note : The pilot cannot select an intermediate lever position.

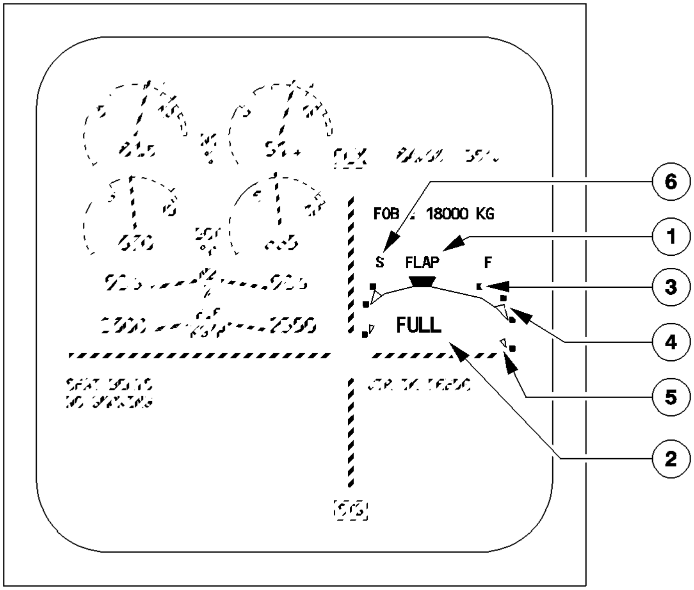
Takeoff in configuration 1 :
1 + F (18°/10°) is selected. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

Takeoff or go-around in configuration 2 or 3 :
If the pilot selects configuration 1, he gets 1 + F (18°/10°) if airspeed is under 210 knots. If the pilot does not select configuration 0 after takeoff, the flaps retract automatically at 210 knots.

configuration 0 to configuration 1 in flight :
configuration 1 (18°/0°) is selected.

Note : After flap retraction, configuration 1 + F is no longer available until the airspeed is 100 knots or less, unless configuration 2, 3, or FULL has been selected previously.

ECAM UPPER DISPLAY



NFC5-01-2750-006-A001AA

① FLAP indication

The “FLAP” legend appears when the slats or the flaps are not fully retracted.
- The legend is white when the slats and flaps are in the selected position.
- The legend is cyan when the slats and flaps are in transit.
- The legend is amber if :
  - Both relevant hydraulic systems go down (except on the ground with engines stopped).
  - The wingtip brakes are on.
  - There is a fault in the slats or flaps.

② Flap lever position

The legend “0,” “1 + F,” “1,” “2,” “3,” or “FULL” appears.
- The legend is green when the slats and flaps are in the selected position. “0” is not displayed when the aircraft attains the clean configuration.
- The legend is cyan when the slats and flaps are in transit.
  The legend “S (F) LOCKED” appears in amber, associated with an ECAM caution, when the wingtip brakes are applied or when the system detects a non-alignment between two flaps.
  The legend “A-LOCK” pulses in cyan when the slat alpha/speed-lock function is active.

③ Position indexes

These white points indicate that the slats and flaps are in a selectable position. They do not appear when the aircraft is in the clean configuration.

④ Slat and flap position

These green triangles indicate the actual position of the slats and flaps.
They change to amber if :
– Both relevant hydraulic systems go down, unless the aircraft is on the ground with both engines stopped.
– The wingtip brakes are on.
– There is a fault in the slats or flaps.

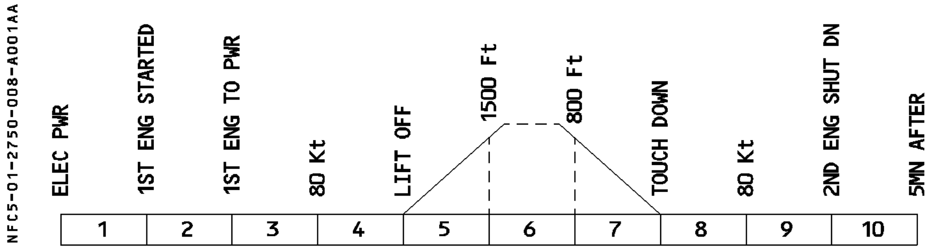
⑤ Selected surface position

These blue triangles indicate the position the pilot has selected.
(With the current standard display management computer, the blue triangles may disappear before the slats and flaps are all completely in the selected position).

⑥ S and F indications

The “S” and “F” normally appear in green. They become amber if :
– Both relevant hydraulic systems go down, unless the aircraft is on the ground with both engines stopped.
– The wingtip brakes are on.
– There is a fault in the slats or flaps.

WARNINGS AND CAUTIONS



<table>
<tr><th>E/WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>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.</td><td>CRC</td><td>MASTER WARN</td><td rowspan="7">NIL</td><td rowspan="7">NIL</td><td>5, 6 *
7, 8</td></tr>
<tr><td>SLATS (FLAPS) FAULT
failure of both slat or flap channels</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="2">4, 5, 8</td></tr>
<tr><td>SLATS (FLAPS) LOCKED
slats or flaps wing tip brakes applied or non alignment detected between 2 flaps</td></tr>
<tr><td>SLATS SYS 1 (2) FAULT
failure of slat channel in one SFCC</td><td rowspan="4">NIL</td><td rowspan="4">NIL</td><td rowspan="4">3, 4, 5,
7, 8</td></tr>
<tr><td>FLAP SYS 1 (2) FAULT
failure of flap channel in one SFCC</td></tr>
<tr><td>SLAT (FLAP) TIP BRK FAULT
failure of one wing tip brake on slats or flaps or failure of one wing tip brake solenoid on slats or flaps</td></tr>
<tr><td>FLAPS ATTACH SENSOR
failure of flap attachment failure detection sensor</td></tr>
</table>

* The warning is automatically recalled by depressing the TO CONFIG pushbutton.

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
COMPUTERS	MAIN FLT CTL	ELAC 1				X	HOT 1 (1)
		ELAC 2		DC2			HOT 2 (1)
		SEC 1				X	HOT 1 (1)
		SEC 2		DC2			
		SEC 3		DC2			
		FAC 1			X	SHED	
		FAC 2	AC2	DC2			
		FCDC 1				SHED	
		FCDC 2		DC2			
	FLAPS SLATS	SFCC 1 slats				X	
		SFCC 1 flaps				X	
		SFCC 2 slats		DC2			
		SFCC 2 flaps		DC2			
PITCH TRIM		MOTOR 1		DC2			HOT 2 (1)
		MOTOR 2				X	
		MOTOR 3		DC2			
RUDDER TRIM		MOTOR 1				X	
		MOTOR 2		DC2			
		INDIC		DC2			
RUDDER TRAVEL LIMIT		MOTOR 1				X	
		MOTOR 2		DC2			

(1) standby supply

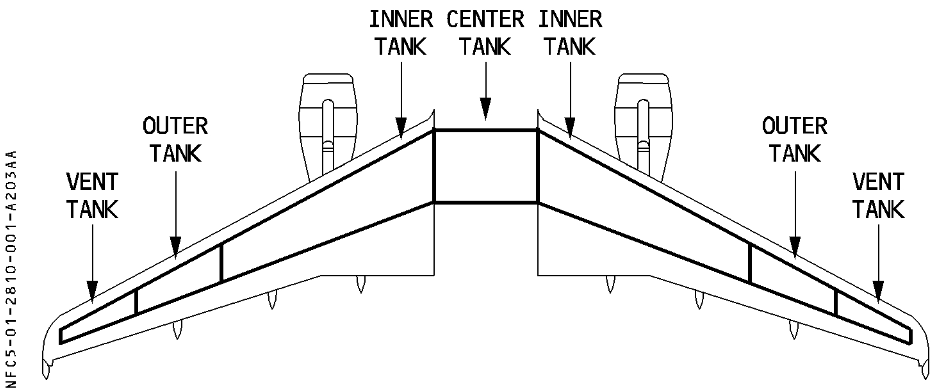
28.00 CONTENTS

GENERAL

The fuel system :
- stores fuel in the tanks
- supplies fuel in the correct quantities to the fuel tanks during refueling
- supplies fuel to the engines and the auxiliary power unit (APU)
- circulates fuel to cool the integrated drive generator (IDG)
- keeps fuel in the outer wing for wing bending and flutter relief.

TANKS

The fuel is stored in the wings and the center section. The wings have inner and outer tanks.
There is a vent surge tank outboard of the outer tank in each wing.
When the aircraft has been refueled to maximum capacity, the fuel can expand by 2 % (20° temperature rise) without spilling.
There is an overpressure protector in each vent outer and inner tank and between the center tank and the left inner tank.



USABLE FUEL					
		OUTER TANKS	INNER TANKS	CENTER TANK	TOTAL
VOLUME	(liters)	880 x 2	6924 x 2	8250	23858
	(US gallons)	232 x 2	1829 x 2	2180	6302
WEIGHT *	(KG)	691 x 2	5435 x 2	6476	18728
	(LB)	1520 x 2	11982 x 2	14281	41285

* Fuel density : 0.785 kg/l or 6.551 lb/US Gal.

ENGINE FEED

GENERAL

The main fuel pump system supplies fuel from the center tank or the inner wing tanks to the engines. The system has six main fuel pumps.

MAIN COMPONENTS

TANK PUMPS

R In normal operation each engine is supplied by one pump in the center tank or two pumps in its own side wing tank.
All wing tank pumps remain on throughout the flight. They are fitted with pressure relief
R sequence valves which ensure that, when all pumps are running, the center tank pumps will deliver fuel preferentially.

TRANSFER VALVES

Two electrical transfer valves are mounted in each wing to permit fuel transfer from outer to inner tank.

CROSS FEED VALVE

A cross feed valve controlled by a double motor allows both engines to be fed from one side or one engine to be fed from both sides.

ENGINE LP VALVES

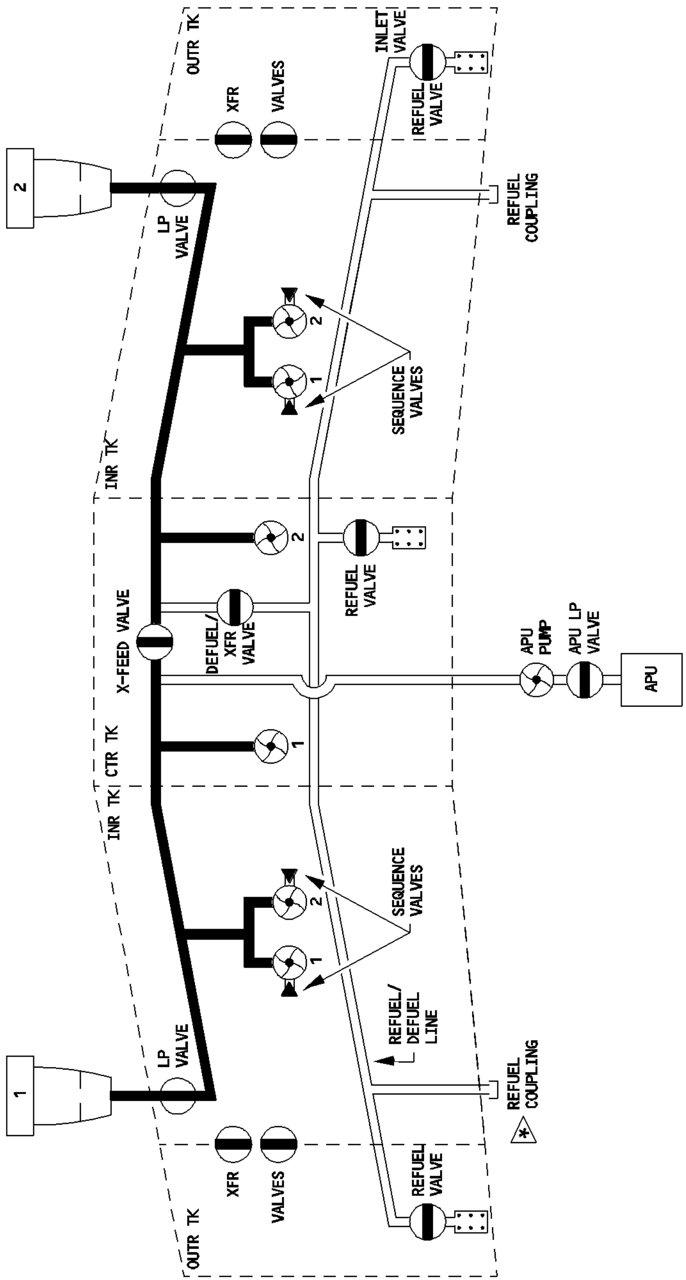
The fuel flow to an engine can be stopped by its low pressure (LP) fuel valve, the closure of the LP fuel valve is by :
– the engine master switch, or
– the ENG FIRE PUSH pushbutton.

SUCTION VALVES

Closed by pumps pressure in normal operation, they allow engines to be fed by gravity if the inner tank pumps fail.

R *Note : Center tank pumps are not fitted with suction valves. Therefore, gravity feeding is not possible from the center tank.*

ENGINE FEED

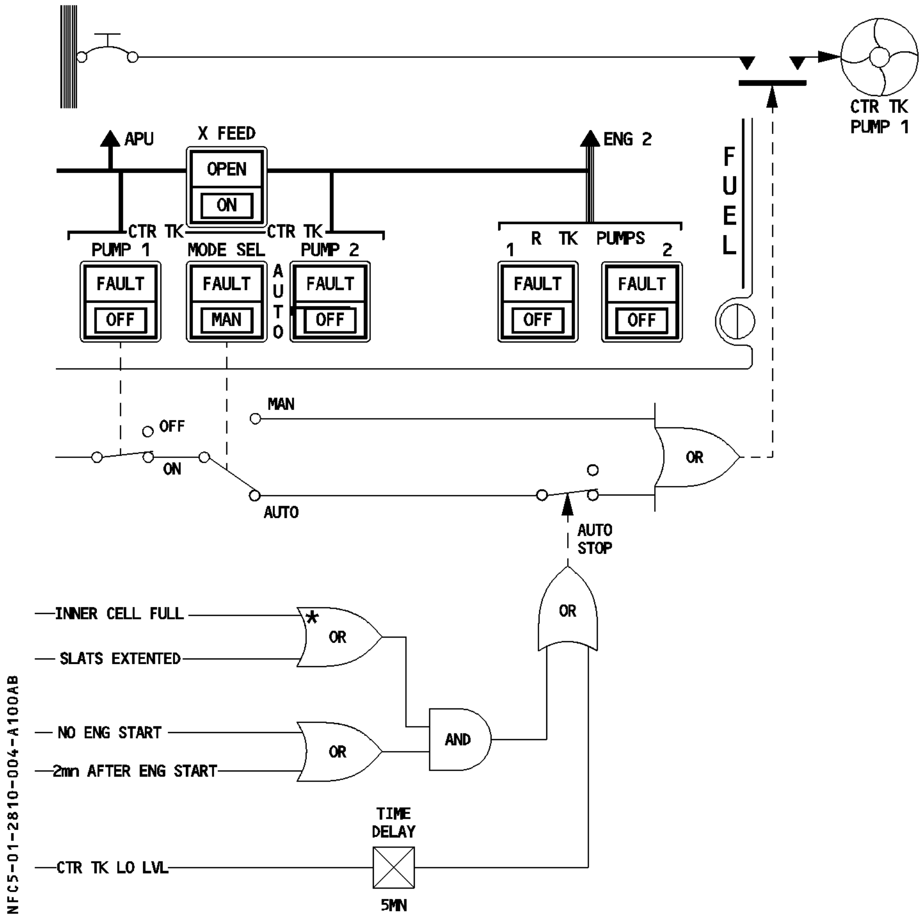


NFC5-01-2810-003-A100AA

FUEL FEED SEQUENCE

The tanks empty in the following sequence :
1. center tank
2. inner tanks (down to 750 kg in each inner tank)
3. outer tanks (fuel transfered into the inner tanks)

CENTER TANK PUMPS CONTROL LOGIC



* Each center tank pump stops until approximately 500 kg (1100 lb) of its associated inner tank fuel has been used (when the fuel level reaches the underfull sensors).

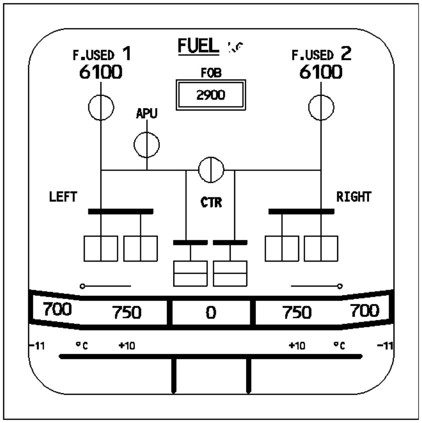
R With the MODE SEL in MAN position, the center tank pumps will run. In manual mode the
R CTR TK PUMP pushbuttons must be selected off when the center tank is empty.

FUEL TRANSFER FROM OUTER TO INNER TANKS

The transfer valves automatically open when the inner tank fuel reaches the low level (about 750 kg/1650 lb), thus permitting fuel to drain from the outer to inner tanks.
When open, the valves are latched open. They will automatically close at the next refuel operation (MODE SELECT at REFUEL position).

Note : 1. *Two level sensors are installed in each inner tank. Each sensor controls two transfer valves, one in each wing, ensuring that transfer is simultaneous in both wings.*
2. *The 750 kg/1650 lb value is based on a level aircraft attitude with no acceleration. During steep descents or accelerations/decelerations, the transfer valves may open with more than 750 kg/1650 lb of fuel in each inner tank and the low level warning may be triggered.*

ECAM INDICATION



NFC5-01-2810-005-A100AB

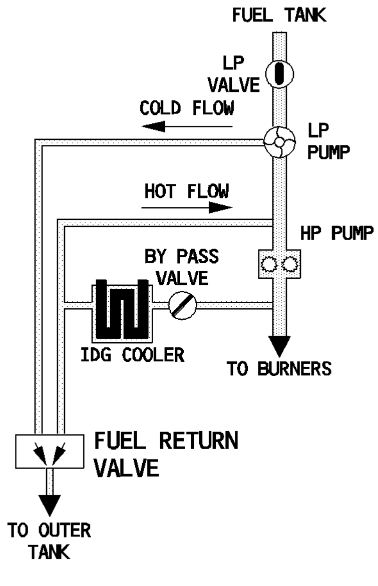
TRANSFER FROM OUTER
TO INNER TANKS
+
INNER TANK FEEDING

APU FEED

A special fuel pump supplies fuel for APU startup when fuel feed pressure is low (due to loss of tank pumps or loss of normal AC electrical supply). This pump normally runs off the AC ESS SHED, but runs off the AC STAT INV BUS if the AC ESS SHED fails.

FUEL RECIRCULATION SYSTEM

See also 1.70.40 “IDG COOLING SYSTEM”.
Some of the fuel supplied to each engine goes from the high-pressure fuel line in that engine, through the integrated drive generator (IDG) heat exchanger (where it absorbs heat), to the fuel return valve, and to the outer fuel tank.
This operation ensures the IDG cooling when the oil temperature is high or when at low engine power.
The FADEC controls the fuel return valve.
If the outer tank is already full, the fuel overflows to the inner tank through a spill pipe.
If center tankis feeding, the wing tank will tend to overfill and the system automatically selects the CTR TK PUMP off when the inner tank is full. The wing tank pumps will feed until the engine have used approximately 500 kg (1100 lb) of fuel when the fuel level reaches the underfull sensors. The logic circuits then restart the center tank pumps.

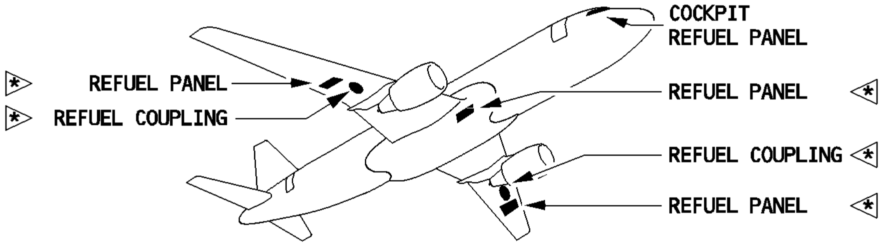


NFC5-01-2810-006-A105AA

REFUELING – DEFUELING

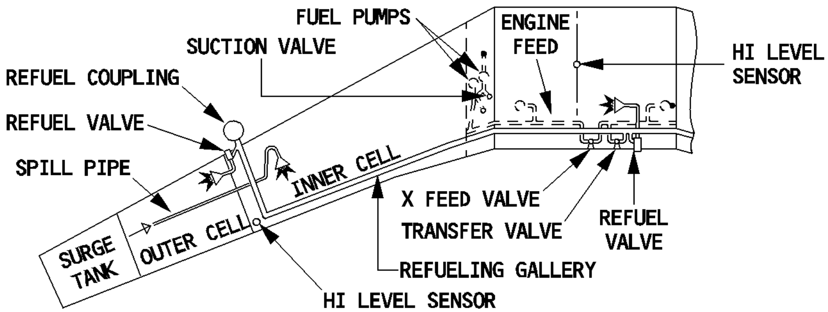
R One (two) refueling point(s) is (are) installed under the wings allowing the refueling from
R either the right or left (<*) side of the aircraft.
R – A refuel panel is located either on the fuselage side beneath the right wing or under the
R right or left wing adjacent to the refuel coupling.
– Another refuel panel is located on the cockpit overhead maintenance panel.
– A "READY FOR FUELING" green light is installed adjacent to the refuel coupling.

NFC5-01-2810-007-A203AB



A gallery connects the refuel coupling to the refuel valve of each tank.
Refueling is normally automatic, the required fuel load being set on the preselector.
Manual control is also available.
Automatic refueling starts by the outer cells. If the selected fuel load exceeds the wing tank capacity, the center tank is refuelled simultaneously.
When an outer cell is full the fuel overflows into the inner cell through a spill pipe.
Refuel valves close automatically when the tanks contain the preselected load or when sensors detect a high fuel level.
The aircraft can be refueled when only battery power is available.
The wing tanks can be refueled by gravity through refueling points on top of the wings.
A transfer valve between the engine feed system and the refueling gallery permits :
– tank pumps to transfer fuel from one tank to another.
– defueling through the refuel coupling.
Approximate refueling time at nominal pressure is :
– 17 minutes for wing tanks.
– 20 minutes for all tanks.

NFC5-01-2810-007-B203AA



FUEL QUANTITY INDICATION AND LEVEL SENSING

FUEL QUANTITY INDICATION (FQI) SYSTEM

The FQI is a computerized system that :
- transmits the actual total fuel mass, as well as the quantity and temperature of fuel in the tanks, to the ECAM.
- controls automatic refueling.

Two channels perform fuel computations : channel 2 activates automatically if channel 1 fails.
The FQI system comprises :
- an FQI computer.
- a set of capacitance probes in each tank to measure fuel level and temperature.
- one densitometer (cadensicon) sensor in each wing inner tank permitting the calculation of the fuel quantity.
- one Capacitance Index Compensator (CIC) in each inner tank giving the dielectric constant of the fuel in case of cadensicon failure.
- a quantity indicator for each tank installed on the refuel/defuel panel.
- a preselector on the refuel/defuel panel that shows the preselected and actual total fuel quantity.

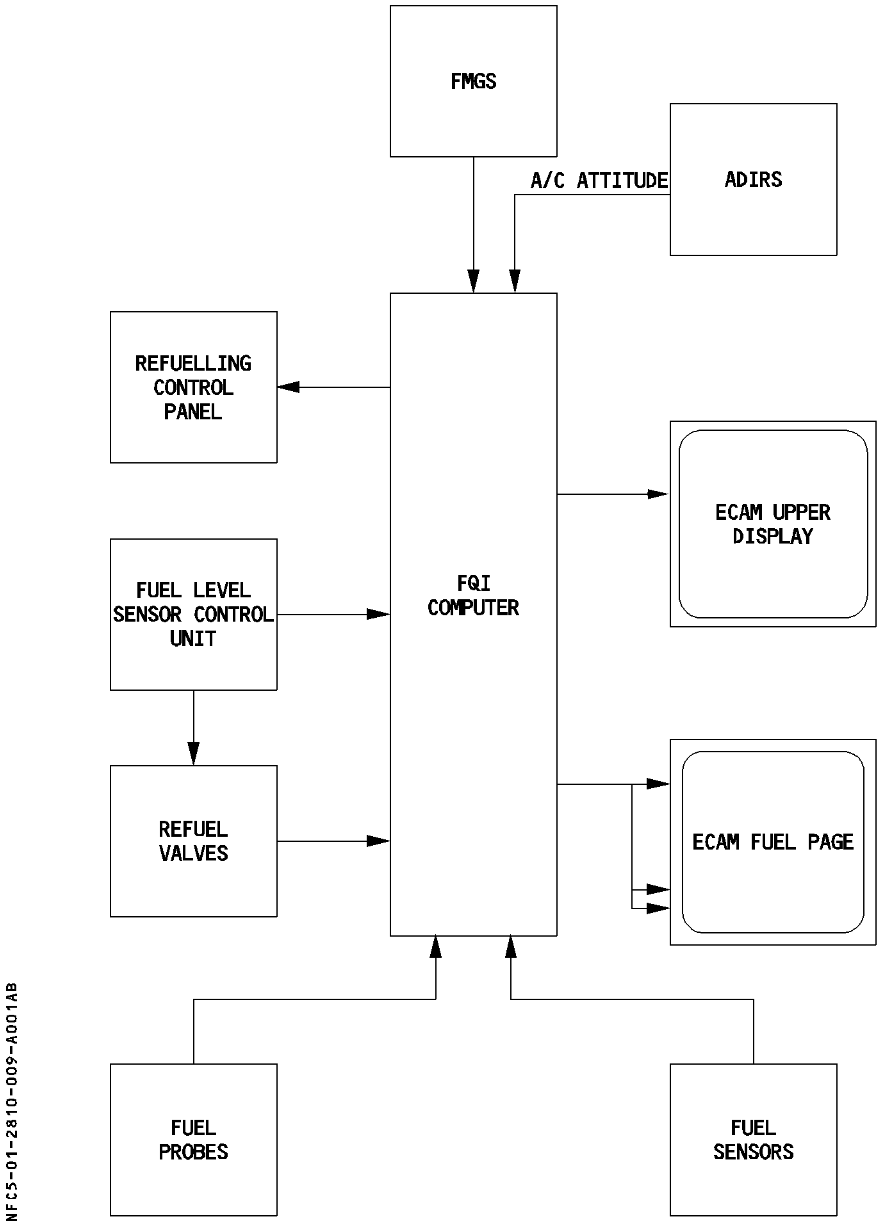
FUEL LEVEL SENSING CONTROL UNIT (FLSCU)

The fuel level system generates fuel-level and fuel-temperature signals in order to operate the appropriate switching functions for refueling and defueling and control the IDG cooling recirculation system and the center-tank-to-wing-tank fuel transfer system.
The FLSCU comprises :
- fuel level sensors in the tanks to sense high, low, and overflow levels.
- a fuel temperature sensor to control the IDG cooling recirculation.

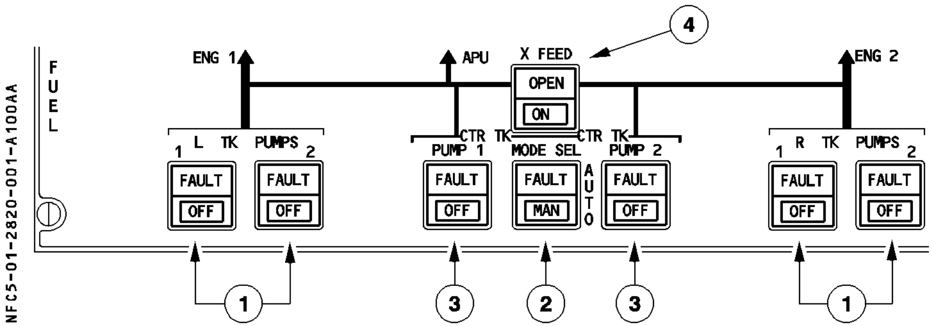
When fuel quantity in one wing tank goes below 750 kg (1650 lb), the low-level sensor triggers the LO LVL warning on ECAM.

FUEL SYSTEM ARCHITECTURE

R



OVERHEAD PANEL



① L (R) TK PUMPS 1(2) pb sw

On : Pump is on but fuel feeds only when center tank pumps delivery pressure drops below threshold.
OFF : Pump is OFF and OFF button lights up white.
FAULT light : Amber light comes on, and ECAM caution comes on, when the delivery pressure drops. It does not come on when OFF is selected.

② MODE SEL pb sw

AUTO : Control of center tank pumps is automatic.
· They run at engine start for 2 minutes.
· Before or after engine start sequence, the pumps run if the slats are retracted.
· They stop automatically 5 minutes after center tank low level is reached.
MAN : Flight crew controls the center tank pumps manually with center tank pumps pushbutton switches.
FAULT light : Amber light comes on, and ECAM caution comes on when center tank has more than 250 kg (550 lb) of fuel and the left or right wing tank has less than 5000 kg (11000 lb).

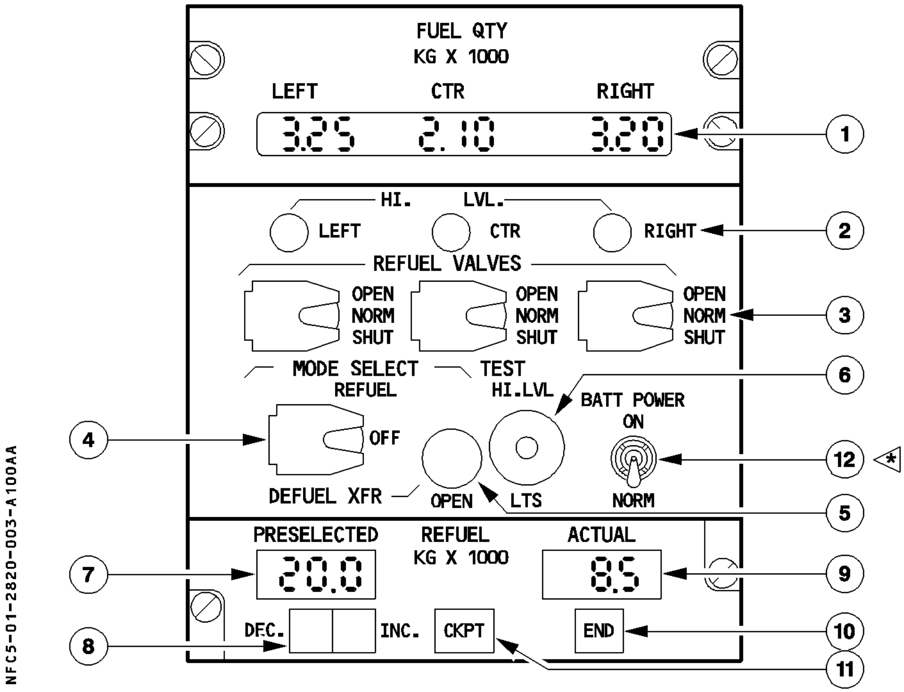
③ CTR TK PUMP 1(2) pb sw

On : · Pump runs if MAN mode is selected on MODE SEL pushbutton switch.
· Pump is automatically controlled when AUTO mode is selected.
OFF : Pump is OFF and OFF button lights up white.
FAULT light : Amber light comes on, associated with ECAM caution, when the pump is in operation and the delivery pressure drops.

4 X FEED pb sw

Off	:	Valve closes and button does not light up.
ON	:	Valve opens and ON button lights up white.
OPEN light	:	This green light comes on when the valve is fully open.

REFUELING CONTROL PANEL



① FUEL QUANTITY indicator

The number shows the quantity of fuel in each tank.

② HI LVL lt

This blue light comes on when the system detects a high fuel level.
The corresponding refuel valve closes automatically.

③ REFUEL VALVES sel (guarded in NORM)

NORM : Automatic refueling logic controls the refuel valves.
OPEN : Valves open when the MODE SELECT switch is set to REFUEL or DEFUEL position. When the MODE SELECT switch is in the REFUEL position, each refuel/defuel valve closes when the system detects a high level in the associated tank.
SHUT : Valves close.

(4) MODE SELECT sw (guarded at OFF)

OFF : Refuel system is de-energized. Refuel valves are closed.
REFUEL : Refuel valves operate in automatic or in manual mode depending on the position of REFUEL/DEFUEL VALVES switches.
DEFUEL : Refuel/Defuel transfer valve opens.
Refuel valve opens if the associated REFUEL VALVE selector is at OPEN.

(5) OPEN lt

This amber light comes on when the transfer valve is open.

(6) TEST sw

When this switch is pressed, the HI LVL lights come on if high level sensors and associated circuits are serviceable.

Note : If tanks are full (HI LVL lights on) during this test, the HI LVL lights go out if high level sensors and associated circuits are serviceable.

LTS : Lights on panel and all 8's on FQI and preselector come on.

(7) PRESELECTED display

This display shows the preselected total fuel quantity in kg (lb) × 1000 (multiply by 1000 to get actual amount).

(8) Preselector rocker switch

Pressing the left or right side of the switch decreases or increases the preselected quantity.

(9) ACTUAL display

This display shows the total fuel on board.

(10) END lt

- This green light comes on steady when automatic refueling is completed.
- It flashes green if refueling is aborted.

(11) CKPT lt

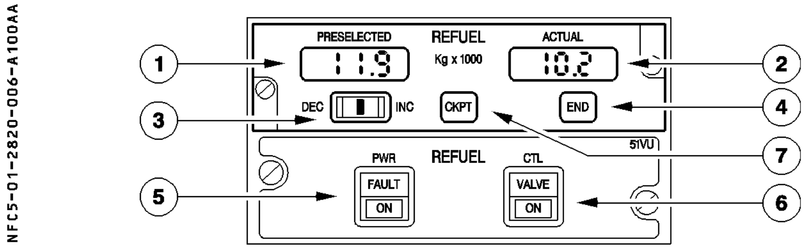
Indicates that cockpit refuel panel has priority.
Illuminates when electrical PWR pushbutton switch on cockpit refuel is pressed.

(12) BATT POWER toggle sw ⊲*

ON : When flight crew switches this switch ON momentarily and releases it, HOT BUS 1 supplies the FQI. After completion of the FQI tests (about 40 secondes), the fuel quantity indications appear and the refuel operation can be selected.
The electrical supply is cut off automatically :
– after 10 minutes, if no refuel operation is selected
– or, at the end of refueling

NORM : The FQI is not supplied by batteries

MAINTENANCE PANEL



(1) PRESELECTED display

This display shows the preselected total fuel quantity in kg × 1000 (multiply by 1000 to get actual amount).

(2) ACTUAL display

This display shows the total fuel on board.

(3) Preselector rocker switch

Pressing the left or the right side of the switch decreases or increases the preselected quantity.

(4) END lt

- This green light comes on steady when automatic refueling is achieved (associated with the green refuel light on wing extinguishing ⊲∗|).
- It flashes green if refueling is aborted.

(5) PWR pb sw

ON : – Refuel system is energized.
– Cockpit refuel control/preselector panels takes priority (cockpit lights illuminate on cockpit and external refuel control panels).
– Automatic high level test.
– REFUEL caption is displayed on ECAM.

Off : – Refuel system is deenergized.
– ECAM "REFUEL" caption is cleared.
– priority is cleared.

FAULT : This amber light comes on when auto high level test not satisfied.

(6) CTL pb sw

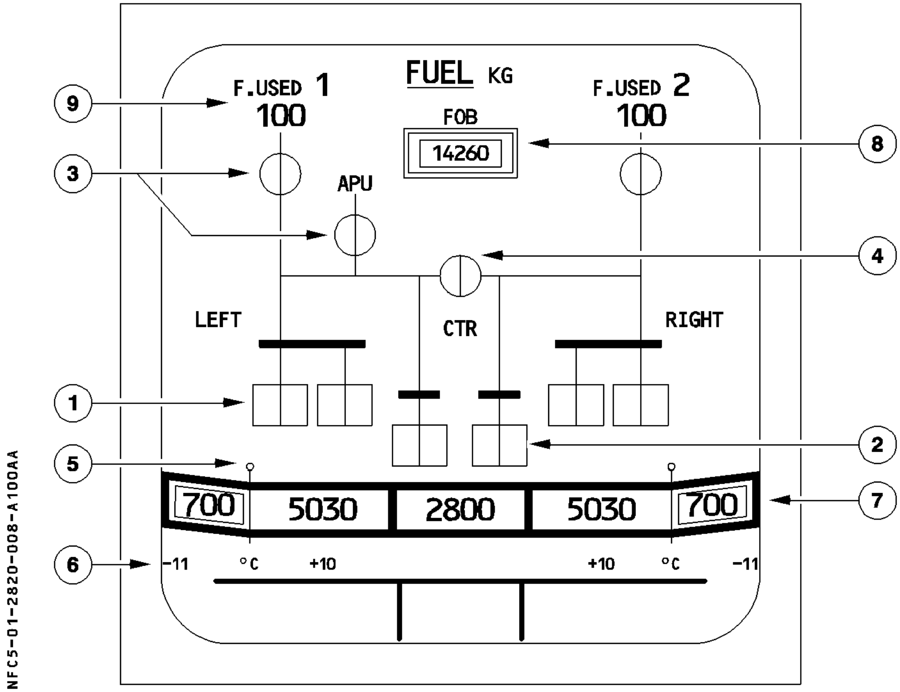
ON : – Start of refuel, (associated with refuel green light illumination on wing ◁*).
– Auto shut off occurs when the selected load is reached or in case of HI level detection.
– VALVE light comes amber if REFUEL VALVE CTL switch are not at NORM position (on refueling control panel).

Off : Refuel stops. The selected load can be reset.

(7) CKPT lt

Comes on when PWR pushbutton switch is ON associated with the CKPT light on the external refuel control panel.

ECAM FUEL PAGE



① Wing pumps indications

In line — Green : pump pressure is normal (pump contactor on).
"LO" — Amber : pump pressure is low (pump contactor on).
Cross line — Amber : pump contactor is off.

② CTR tank pumps indications

In line — Green : pump pressure is normal (pump contactor on).
"LO" — Amber : pump pressure is low (pump contactor on).
Cross line — Green : pump contactor is off and auto shut off is required.
Cross line — Amber : pump contactor is off and auto shut off is not required.

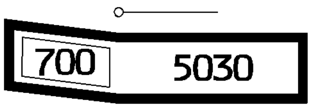
3 LP valve (eng-apu) indications

In line — Green : valve is open.
In line — Amber : valve is open with ENG (APU) MASTER switch OFF or FIRE pushbutton out.
Cross line — Green : APU valve is closed.
Cross line — Amber : ENG valve is closed or APU valve is closed with master switch ON.
Transit — Amber : Valve is in transit.

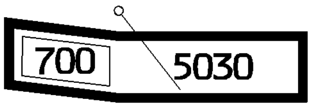
4 X feed indications

In line — Green : valve is open.
In line — Amber : valve is open with pushbutton switch off.
Cross line — Green : valve is closed.
Cross line — Amber : valve is closed with pushbutton switch ON.
Transit — Amber : valve is in transit.

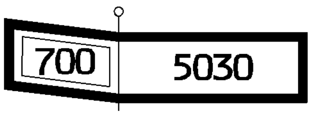
5 Transfer valves indications



One transfer valve is open :
Green : LH or RH inner cell is at low level.
Amber : LH and RH inner cells are not at low level
(associated with ECAM caution).



One transfer valve is in transit.



Both transfer valves are closed
Green : LH or RH inner cells are not at low level.
Amber : LH and RH inner cell is at low level
(associated with ECAM caution).

NFC5-01-2820-009-A100AA

(6) Fuel temperature indication

This appears when its associated temperature sensor is wet.
It is normally green.
Advisory in phases 2 and 6 only, when fuel temperature is :
· above 45° C for inner cell or 55° C for outer cell.
· below – 40° C.
It becomes amber, and ECAM displays a caution, if the temperature goes above the high limit or below the low limit.

(7) Fuel quantity indication

NFC5-01-2820-010-A100AA

- Normally green
- An amber line appears across the last two digits when FQI is inaccurate (Refer to 3.04.28). The outer indication is boxed amber if both transfer valves fail to open when inner at low level.
R - The center tank indication is boxed amber if both center tank pumps are failed or
R switched OFF.
- Advisory in flight phases 2 and 6, when difference between fuel quantities in the two wings is greater than 1500 kg (3300 lb). The indications of the wing inner and outer tanks with the highest fuel level pulses.

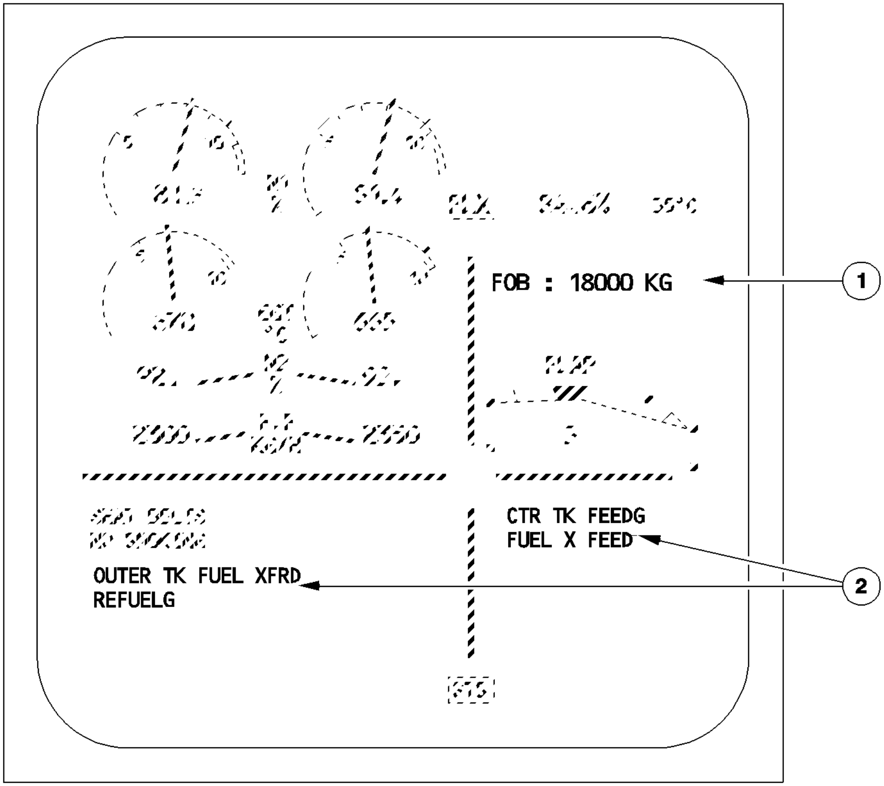
R (8) Fuel on board (FOB) indication

It is normally green.
An amber line appears across the last two digits when the FQI is inaccurate (Refer to 3.04.28).
The indication is boxed amber if :
- Center tank pumps failed or switched OFF
- Both transfer valves fail to open when inner cell at low level.

(9) Fuel used indication

F.USED 1
3100
- The engine identification number is amber when the engine is below idle, and it is white when it is at or above idle.
- The fuel used indication is green from flight phase 2 until electrical power is cut off at the end of the flight. It is automatically reset when the engine is started on ground.

ECAM UPPER DISPLAY



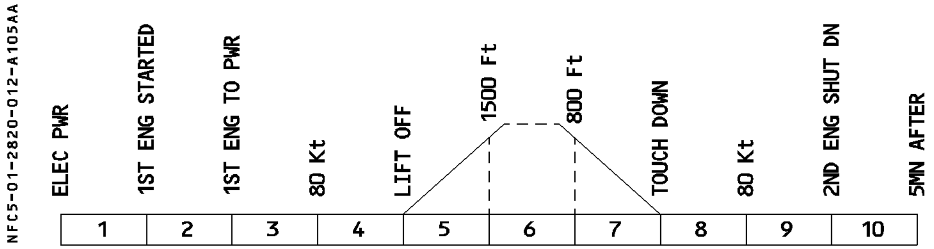
NFC5-01-2820-011-A100AA

(1) Total fuel indication

An amber half box appears around FOB when the quantity shown is not all usable
R (intercell transfer valve failure or loss of center tank pumps).
In case of degraded data, the last two significant digits have dashes across them (refer to 3.04.28).

(2) Memo indications : (green)

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>L(R) TK PUMP 1 + 2 LO PR</td><td rowspan="11">SINGLE CHIME</td><td rowspan="11">MASTER CAUT</td><td rowspan="11">FUEL</td><td>L(R) TK PUMP 1 + 2 FAULT lt</td><td rowspan="3">3, 4, 5, 7, 8 *</td></tr>
<tr><td>CTR TK PUMP 1(2) LO PR</td><td>CTR TK PUMP 1(2) FAULT lt</td></tr>
<tr><td>CTR TK PUMPS LO PR</td><td>CTR TK PUMP FAULT lts</td></tr>
<tr><td>CTR TK PUMPS OFF
CTR TK pb at OFF with no FAULT</td><td>OFF lt on CTR TK PUMP pb</td><td>1, 3, 4, 5, 7, 8, 9, 10</td></tr>
<tr><td>AUTO FEED FAULT
(CTR TK > 250 kg (550 lb) and
L or R WING TK < 5000 kg (11000 lb)
——————OR ——————
(CTR TK pumps do not stop after slat extension or CTR TK low level)</td><td>MODE SEL FAULT lts
———
NIL</td><td>3, 4, 5, 8</td></tr>
<tr><td>L(R) WING TK LO LVL (750 kg - 1650 lb)</td><td rowspan="5">NIL</td><td rowspan="2">3, 4, 5, 7, 8, 9</td></tr>
<tr><td>L + R WING TK LO LVL
Low level detected in both wing inner cells
(remaining flight time is about 30 min)</td></tr>
<tr><td>L(R) OUTER TK HI TEMP or
L(R) INNER TK HI TEMP
Fuel temp above :
in outer cell above 55° on ground
in outer cell above 60° in flight
in inner cell above 45° on ground
in inner cell above 54° in flight</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>L(R) XFR VALVE CLOSED
both transfer valves fail to open after inner cell low level</td></tr>
<tr><td>ENG 1(2) LP VALVE OPEN
valve disagree in open position</td><td>4, 5, 7, 8</td></tr>
</table>

* inhibited if pump selected OFF

R

<table>
<tr><th>E / WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>APU LP VALVE FAULT
valve position disagree</td><td rowspan="6">NIL</td><td rowspan="6">NIL</td><td rowspan="6">FUEL</td><td rowspan="2">NIL</td><td rowspan="6">3, 4, 5, 7, 8 *</td></tr>
<tr><td>L(R) OUTER TK LO TEMP or
L(R) INNER TK LO TEMP
fuel temperature < – 48°C</td></tr>
<tr><td>L(R) TK PUMP 1(2) LO PR</td><td>L(R) TK PUMP 1(2) FAULT lt</td></tr>
<tr><td>L(R) XFR VALVE OPEN
either transfer valve opens before inner cell reaches low level</td><td rowspan="3">NIL</td></tr>
<tr><td>X FEED VALVE FAULT
valve position disagree</td></tr>
<tr><td>FQI CH 1 (2) FAULT</td></tr>
</table>

* PUMP LO PR is inhibited if the pump is selected OFF in phases 1 and 10.

MEMO DISPLAY

- OUTR TK FUEL XFRD appears in green if at least one transfer valve is open in one wing tank.
- CTR TK FEEDG appears in green if at least one center tank pump is energized.
- FUEL X FEED appears in green if fuel X FEED valve pushbutton switch is ON and X FEED valve is not fully closed. It appears in amber in flight phases 3, 4 or 5.
- REFUELG appears in green when :
  - the fuselage refueling control panel door is opened, or
  - the PWR pushbutton of the cockpit refuel panel is at ON.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
FQI	CH 1				SHED	(1)
	CH 2		DC2			(1)
INNER TANK PUMPS	L 1	AC1 (3)	DC1		X (2) (3)	
	L 2	AC2	DC2			
	R 1	AC1 (3)	DC1		X (2) (3)	
	R 2	AC2	DC2			
CTR TK PUMPS (◁)	1	AC1	DC1			
	2	AC 2	DC2			
CROSS FEED VALVE	MOT 1				SHED	
	MOT 2		DC2			
ENGINE LP VALVES	ENG 1 MOT 1				X	
	ENG 1 MOT 2		DC2			
	ENG 2 MOT 1				X	
	ENG 2 MOT 2		DC2			
XFR VALVES	L 1				SHED	
	L 2		DC2			
	R 1				SHED	
	R 2		DC2			
APU	PUMP			AC STAT INV or AC ESS SHED		HOT 1
	LP VALVE		DC BAT			HOT1
REFUEL VALVES			DC2			(1)

(1) HOT BUS supplies power during refueling on battery.
(2) This occurs if DC BUS 1 is lost.
(3) In smoke configuration (GEN 1 LINE pushbutton OFF), inner tank pumps 1 are supplied directly by IDG (instead of AC 1) and pump relays by DC ESS (instead of DC 1).

29.00 CONTENTS

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.

GENERATION

GREEN SYSTEM PUMP

A pump driven by engine 1 pressurizes the green system.

BLUE SYSTEM PUMPS

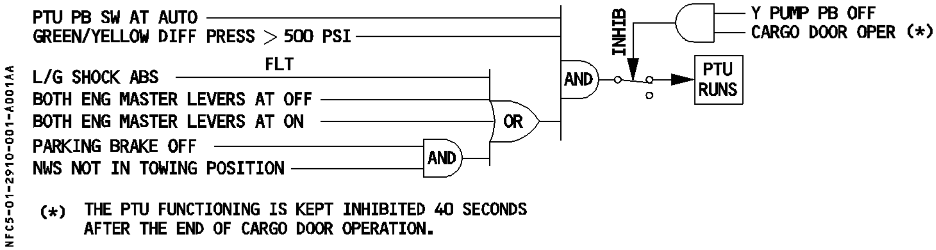
An electric pump pressurizes the blue system. A pump driven by a ram air turbine (RAT) pressurizes this system in an emergency.

YELLOW SYSTEM PUMPS

A pump driven by engine 2 pressurizes the yellow system.
An electric pump can also pressurize the yellow system, which allows yellow hydraulics to be used on the ground when the engines are stopped.
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.

POWER TRANSFER UNIT (PTU)

A bidirectional power transfer unit enables the yellow system to pressurize the green system and vice versa.
The power transfer unit comes into action automatically when the differential pressure between the green and the yellow systems is greater than 500 PSI.
The PTU therefore allows the green system to be pressurized on the ground when the engines are stopped.



RAM AIR TURBINE (RAT)

A drop-out RAT coupled to a hydraulic pump allows the blue system to function if electrical power is lost or both engines fail. The RAT deploys automatically if AC BUS 1 and AC BUS 2 are both lost. It can be deployed manually from the overhead panel. It can be stowed only when the aircraft is on the ground.

SYSTEM ACCUMULATORS

An accumulator in each system helps to maintain a constant pressure by covering transient demands during normal operation.

PRIORITY VALVES

Priority valves cut off hydraulic power to heavy load users if hydraulic pressure in a system gets low.

FIRE SHUTOFF VALVES

Each of the green 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 ENG 1(2) FIRE pushbutton.

LEAK MEASUREMENT VALVES

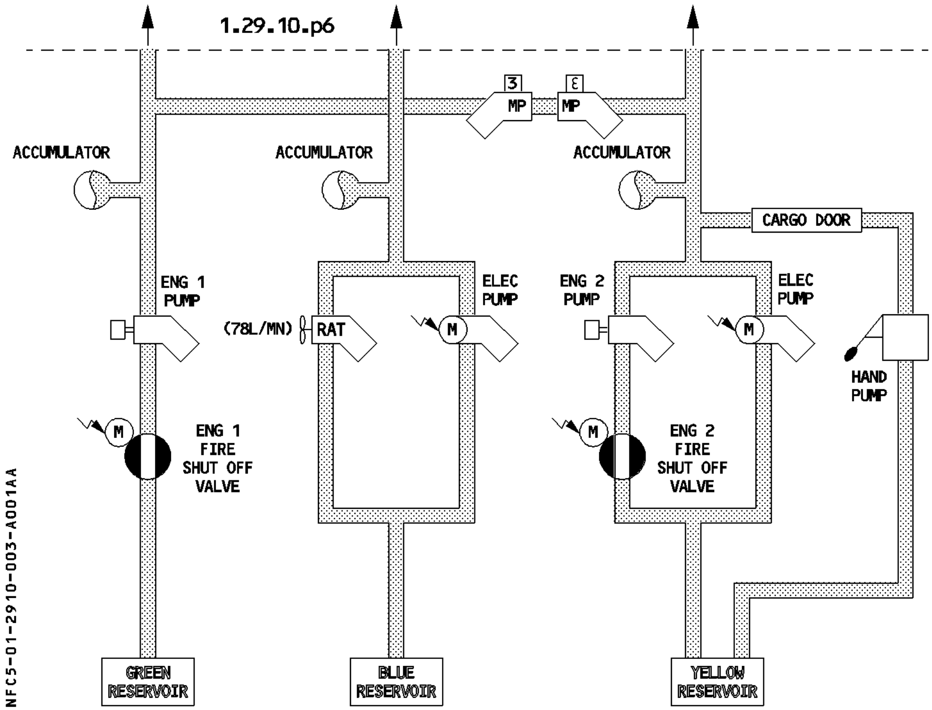
Each system has a leak measurement valve upstream of the primary flight controls.
These valves, which measure the leakage in each circuit, are closed by operation of the LEAK MEASUREMENT VALVES pushbutton switch on the maintenance panel.

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 and the blue electric pump (which permit maintenance to monitor engine wear by inspecting the filters for the presence of metallic particles).*

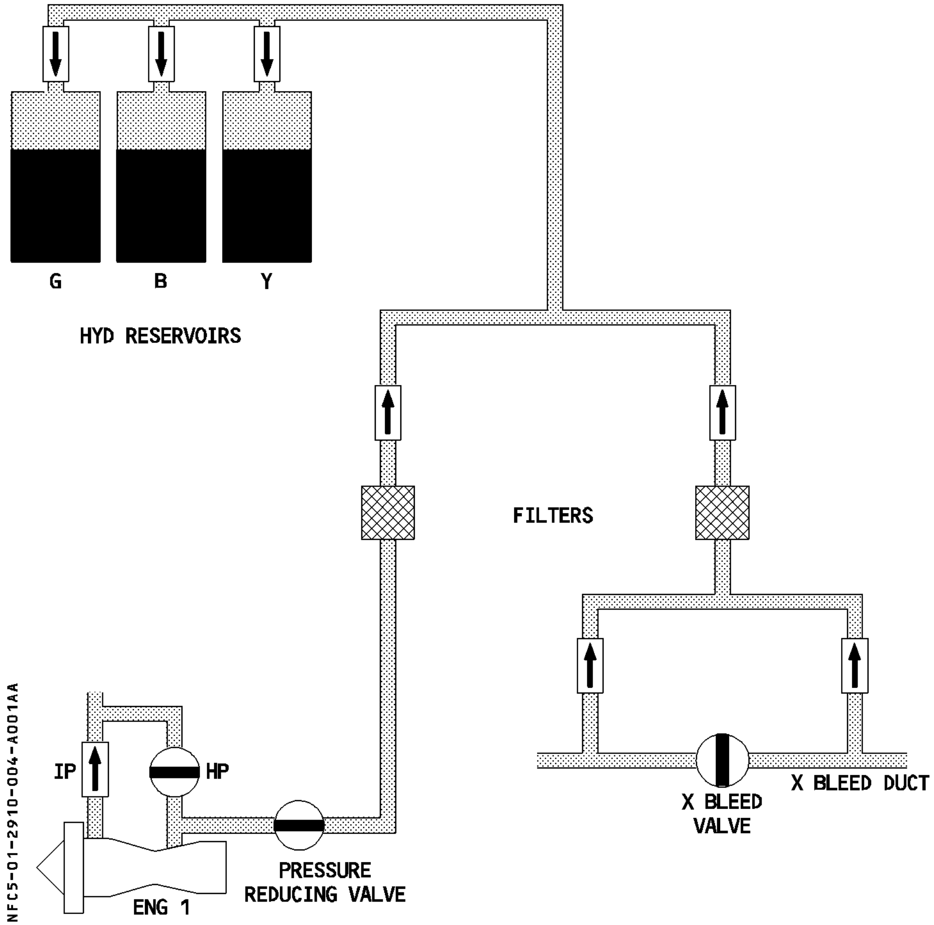
GENERATION


1.29.10.p6
3
MP
MP
3
ACCUMULATOR
ACCUMULATOR
ACCUMULATOR
CARGO DOOR
ENG 1 PUMP
(78L/MN)
RAT
ELEC PUMP
ENG 2 PUMP
ELEC PUMP
M
M
HAND PUMP
M
ENG 1 FIRE SHUT OFF VALVE
M
ENG 2 FIRE SHUT OFF VALVE
GREEN RESERVOIR
BLUE RESERVOIR
YELLOW RESERVOIR
NFC5-01-2910-003-A001AA

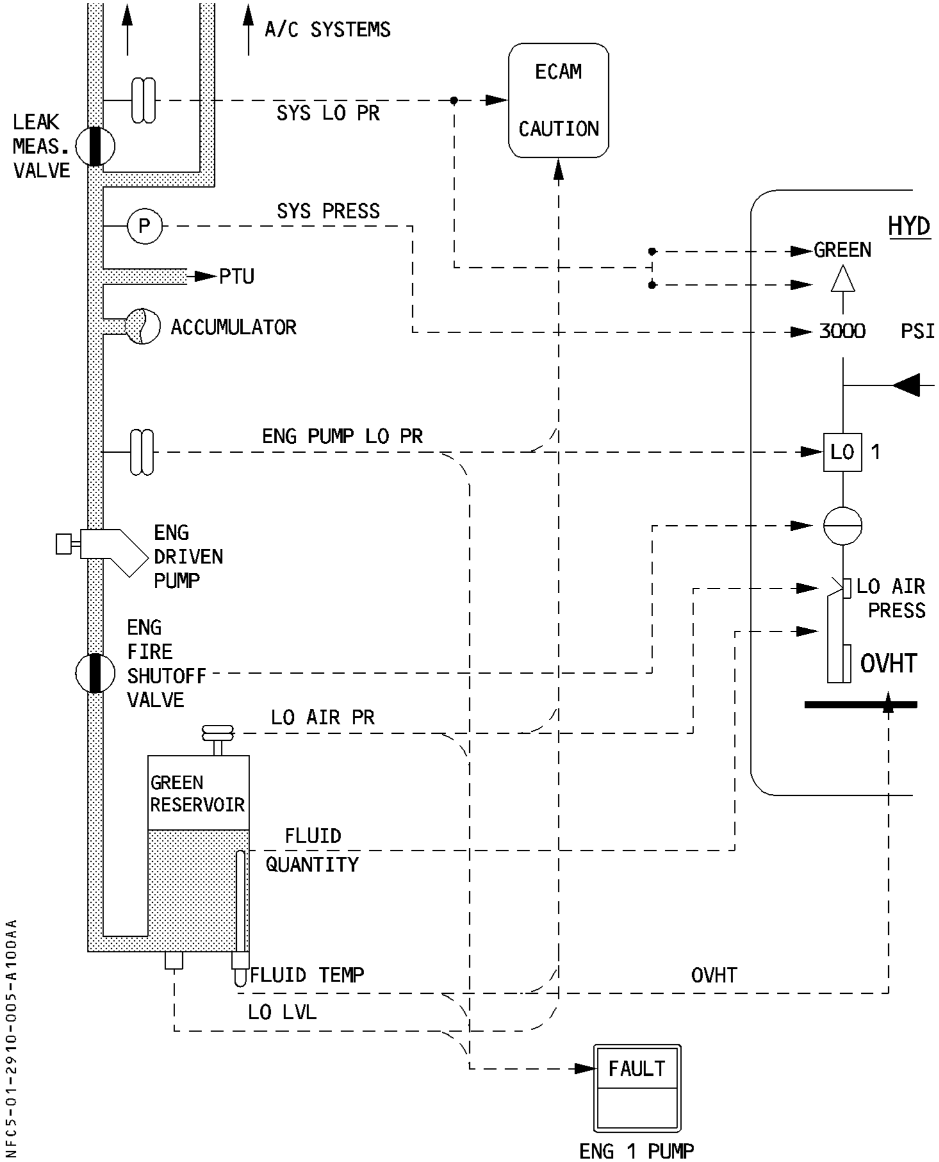
RESERVOIR PRESSURIZATION

Normally, HP bleed air from engine 1 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.

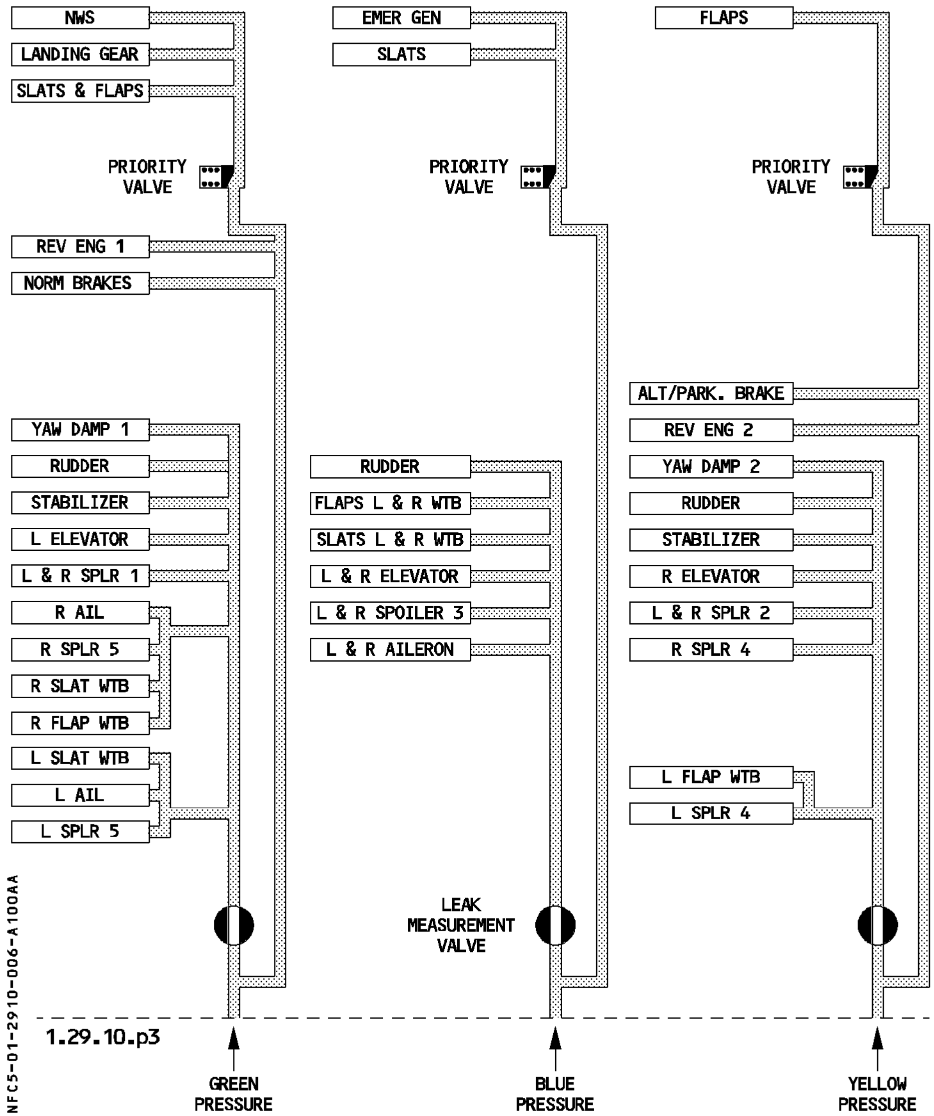
FOR INFO



INDICATIONS

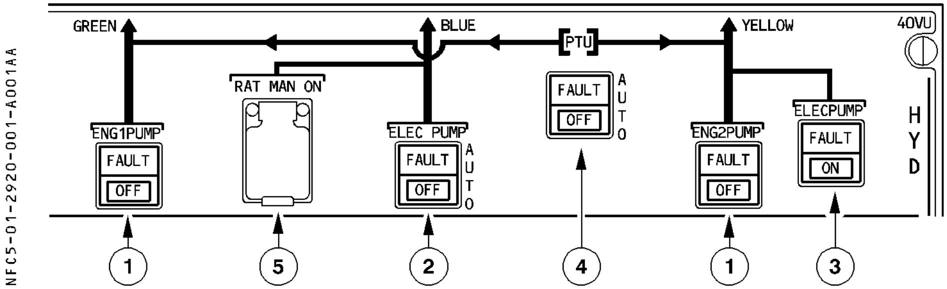


DISTRIBUTION



OVERHEAD PANEL

R



(1) ENG 1 (2) PUMP pb

On : The pump pressurizes the system when the engine is running.
OFF : The pump is depressurized. The generation of hydraulic power stops.
FAULT lt : This amber light comes on, and the ECAM caution appears, if :
- The reservoir level is low
- The reservoir overheats
- The reservoir air pressure is low
- The pump pressure is low (inhibited on the ground, when the engine is stopped).

This light goes out, when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

(2) BLUE ELEC PUMP pb

AUTO : If AC power is available, the electric pump operates :
- In flight
- On the ground, if one engine is running or if the crew has pressed the BLUE PUMP OVRD pushbutton on the maintenance panel.

OFF : The pump is de-energized.
FAULT lt : This amber light comes on, and a caution appears on the ECAM, if :
- The reservoir level is low
- The reservoir overheats
- The air pressure in the reservoir is low
- The pump is delivering low pressure (inhibited on the ground, when the engines are stopped)
- The pump overheats.

The light goes out, when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

③ YELLOW ELEC PUMP pb sw (springloaded)

ON : The electric pump is ON.
If the electrical power supply is removed, the pump will remain off when electrical power is applied again.

Off : The pump is off.
It comes on automatically when a crewman sets the lever of the cargo door manual selector valve to OPEN or CLOSE.
This inhibits the operation of other yellow system functions (except alternate braking and engine 2 reverse).

FAULT lt : This amber light, accompanied by an ECAM caution, comes on if :
- the reservoir level is low
- air pressure in the reservoir is low
- the reservoir overheats
- pump pressure is low
- the pump overheats.

The light goes out when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

④ PTU pb sw

AUTO : The bidirectional power transfer unit is armed and both the yellow and the green electrohydraulic valves are open.
The power transfer unit runs automatically when the differential pressure between the green and yellow systems is more than 500 PSI.

Note : The PTU is inhibited during the first engine start and automatically tested during the second engine start.

OFF : Both the green and the yellow PTU electrohydraulic valves close. Power transfer stops.

FAULT lt : This amber light comes on, and a caution appears on the ECAM, if :
- the green or the yellow reservoir overheats
- the green or the yellow reservoir has low air pressure
- the green or the yellow reservoir has a low flluid level.

The light goes out when the crew selects OFF, except during an overheat. (The light stays on as long as the overheat lasts).

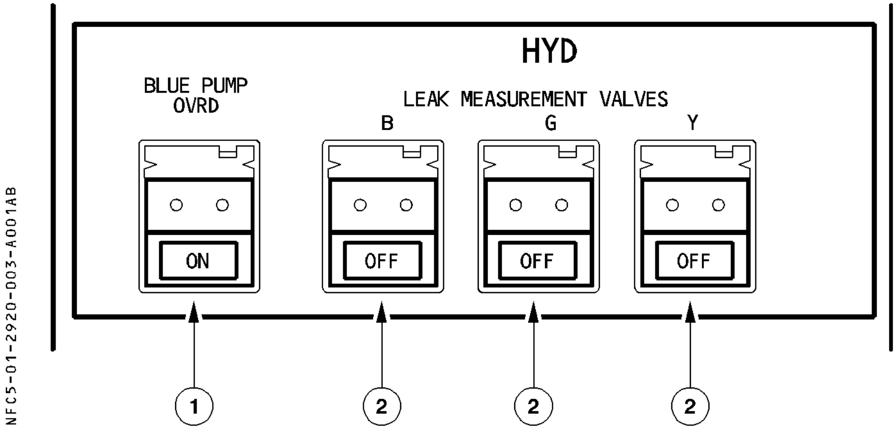
⑤ RAT MAN ON pb

The flight crew may extend the RAT at any time by pressing the RAT MAN ON pushbutton.

Note : The RAT extends automatically if AC BUS 1 and AC BUS 2 are lost.
R *(refer to 1.24.20).*

MAINTENANCE PANEL

R



① BLUE PUMP OVRD pb sw (springloaded)

ON : The blue electric pump is on if the ELEC PUMP pushbutton switch on the HYD panel is at AUTO.

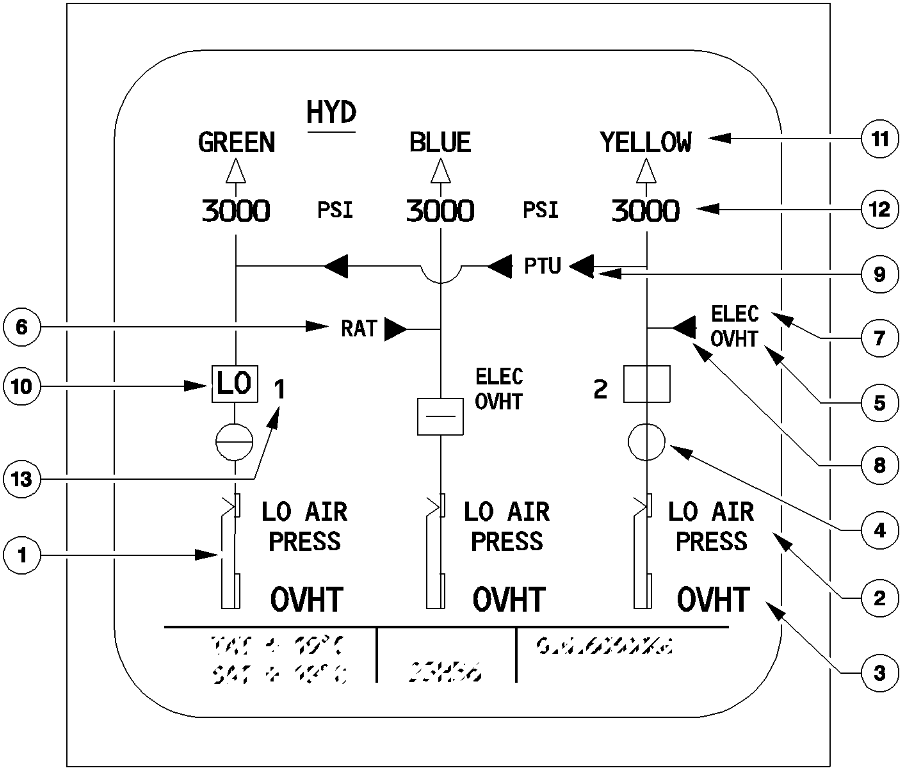
Off : The blue electric pump is off.

② LEAK MEASUREMENT VALVES pb sw

OFF : The corresponding electrohydraulic valve closes and shuts off hydraulic supply to the primary flight controls.

On : The corresponding electrohydraulic valve opens to go back to normal hydraulic supply.

ECAM HYD PAGE



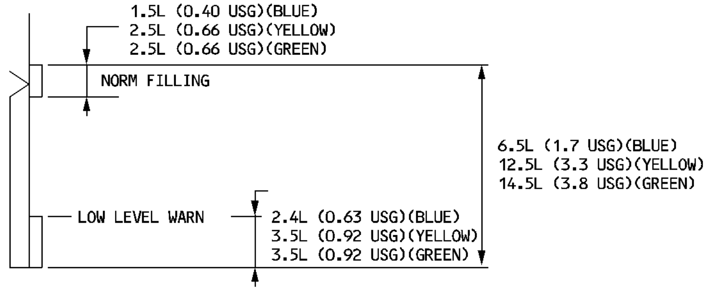
NFC5-01-2920-004-A001AA

① Reservoir quantity

This indication is green unless the fluid level gets below the warning level, in which case it becomes amber.

FOR INFO

R



NFC5-01-2920-004-B001AA

(2) Reservoir LO AIR PRESS

This appears in amber, and a caution appears on ECAM, if the air pressure for the indicated reservoir drops below normal.

(3) Reservoir OVHT

This appears in amber, and a caution appears on ECAM, if the temperature of returning hydraulic fluid temperature at the inlet to its reservoir is above normal.

(4) FIRE VALVE

Cross line Amber : The valve is fully closed.
In line Green : The valve is not fully closed.

(5) OVHT

This appears in amber if the electric pump for that system (blue or yellow) overheats.

(6) RAT

RAT ▷ : white — The RAT is stowed.
RAT ▶– : Green — The RAT is not stowed.
RAT ▶ : Amber — Pressure for stowing the RAT has been applied, or the RAT pump is not available.

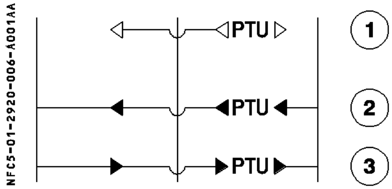
(7) ELEC

This legend, normally white, becomes amber if the associated power supply fails.

(8) YELLOW ELEC PUMP control

◁ : White — The electric pump is off.
–◀ : Green — The electric pump is ON.
◀ : Amber — The electric pump is ON and the yellow system has low pressure.

(9) PTU control



(1) Green : The power transfer unit (PTU) pushbutton switch is in AUTO and the PTU is not transferring pressure.
Amber : The PTU pushbutton switch is OFF.

(2) Green : The PTU is supplying the green hydraulic system.

(3) Green : The PTU is supplying the yellow hydraulic system.

(10) ENG PUMP control and low pressure indication

In line (Green) : The pushbutton switch for the designated PUMP is on and hydraulic pressure is normal.
Cross line (Amber) : The pushbutton switch for the designated PUMP is OFF.
"LO" (Amber) The pushbutton switch for the designated PUMP is on and hydraulic pressure is low.

(11) System label

	pressure > 1450 psi	pressure < 1450 psi
YELLOW	white	amber
△	green	amber

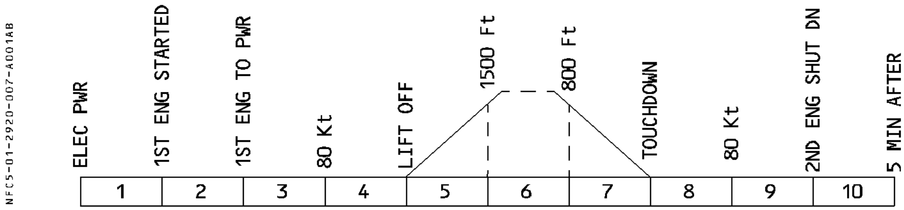
(12) System pressure

This legend, normally green, becomes amber when system pressure is below 1450 psi.

(13) PUMP

This legend, normally white, becomes amber when N2 is below idle.

WARNINGS AND CAUTIONS



R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
B + Y B + G SYS LO PR Y + G system pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)	CRC	MASTER WARN	HYD	FAULT lt	4, 5 *
G (Y)(B) RSVR LO AIR PR reservoir air pressure ≤ 22 psi (reset if air pressure ≥ 25 psi)	SINGLE CHIME	MASTER CAUT		FAULT lt on associated pump(s) pb and on PTU pb if Y or G sys affected	3, 4, 5, 7, 8
G (Y)(B) RSVR OVHT fluid temperature ≥ 93°C (reset if temp ≤ 88°C)					
G (Y)(B) RSVR LO LVL fluid quantity : < 3.5 L (0.92 USG) (green-yellow) < 2.4 L (0.63 USG) (blue)					4, 5, 7, 8
G (Y) ENG 1(2) PUMP LO PR pump outlet pressure ≤ 1750 psi (reset if pressure ≥ 2200 psi)				FAULT lt on affected pump pb	
Y ELEC PUMP LO PR yellow system pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi) with - Y ELEC PUMP pb at ON - Y ENG PUMP and PTU not available					
B ELEC PUMP LO PR pump outlet pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)					
B ELEC PUMP OVHT Y ELEC PUMP OVHT					3, 4, 5, 7, 8
G (Y) SYS LO PR pump outlet pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)					4, 5, 7, 8*
B SYS LO PR system pressure ≤ 1450 psi (reset if pressure ≥ 1750 psi)				NIL	1, 4, 5, 7, 8, 10

R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
PTU FAULT PTU not running on ground in case differential pressure higher than 650 psi between G and Y system, or in flight PTU still at AUTO position in case of G or Y reservoir low level and G or Y system low pressure.	SINGLE CHIME	MASTER CAUT	HYD	FAULT lt only in case of G or Y RSVR LO LVL or RSVR LO AIR PR or RSVR OVHT	3, 4, 5, 8, 9, 10
RAT FAULT RAT not fully stowed or pressure present in RAT stowing actuator or RAT pump not available				NIL	3, 4, 5, 6, 7, 8, 9

* Inhibited on the ground (flight phases 1, 2, 9, 10) when corresponding engine is shut down.

MEMO DISPLAY

– "RAT OUT" appears green, if the ram air turbine is not fully stowed.
The color changes to amber during flight phases 1 and 2.
– "HYD PTU" appears green, when the power transfer unit is running.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
ENG 1 driven PUMP control			DC1			
ENG 2 driven PUMP control			DC2			
ENG 1 FIRE shut off valve					X	
ENG 2 FIRE shut off valve					X	
BLUE ELEC PUMP	power	AC1				
	control				X	
Yellow ELEC PUMP	power	AC2 *				
	control		DC2			
Power Transfer Unit			DC2			
LEAK MEASUREMENT VALVES			DC GRND/FLT			
RAT	Manual control					HOT 2
	Auto control					HOT 1

* or from external power.

30.00 CONTENTS

DESCRIPTION

The ice and rain protection system allows unrestricted operation of the aircraft in icing conditions and heavy rain.

ANTI-ICING

Either hot air or electrical heating protects critical areas of the aircraft as follows.

HOT AIR

- three outboard leading-edge slats of each wing.
- engine air intakes.

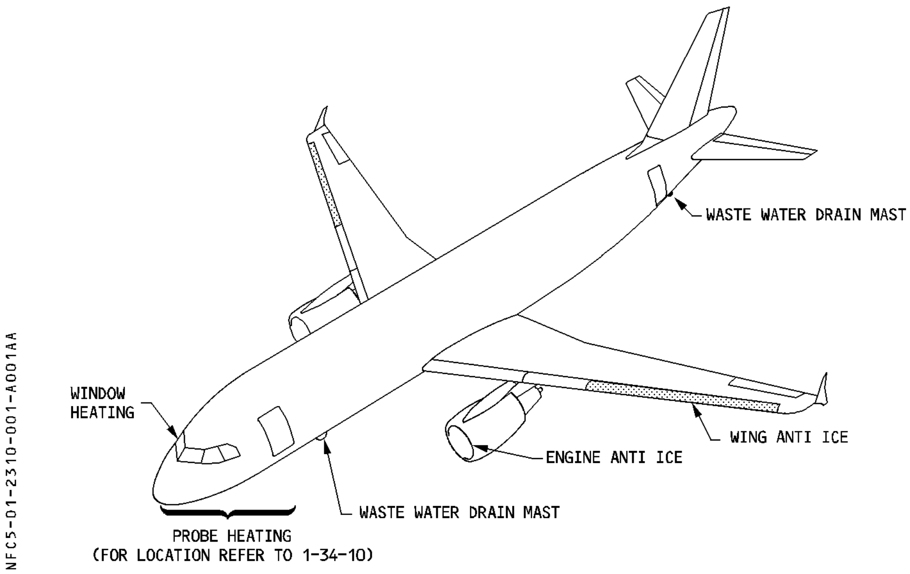
ELECTRICAL HEATING

- flight compartment windows.
- sensors, pitot probes and static ports.
- waste-water drain mast.

RAIN REMOVAL

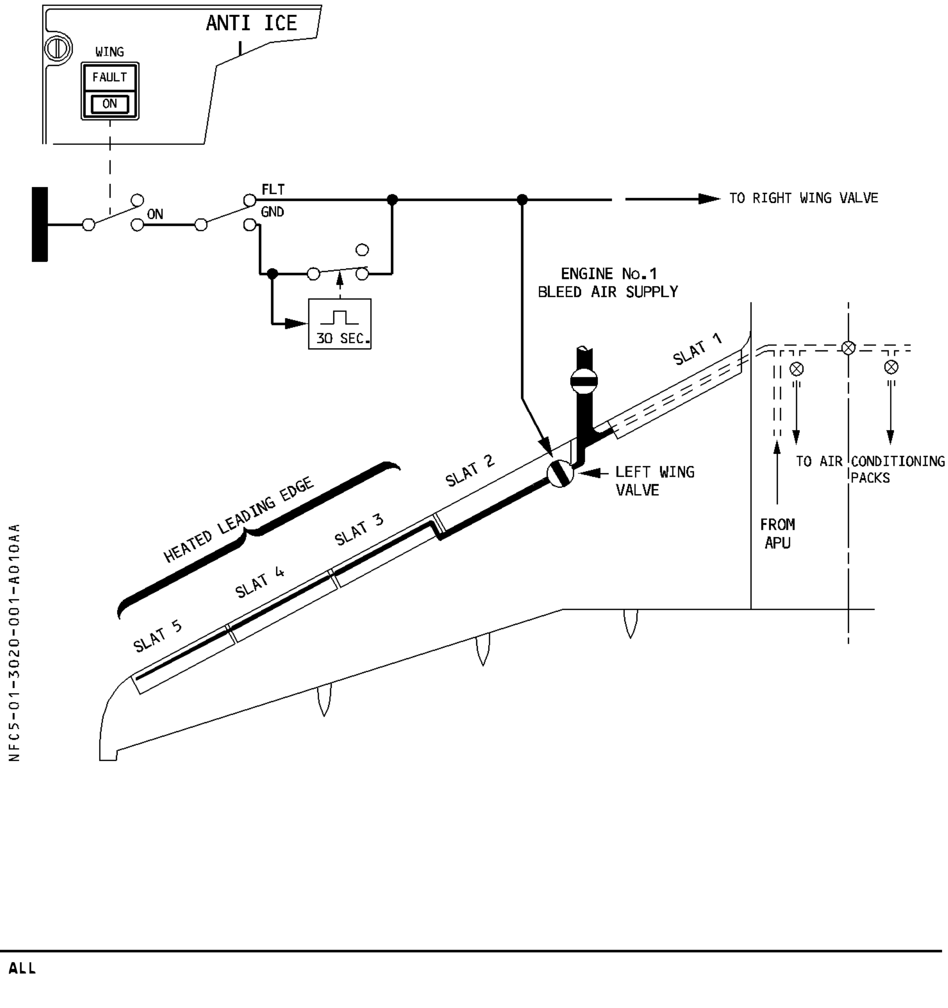
Wipers and when necessary, fluid rain repellent, remove rain from the front windshield panels.

R



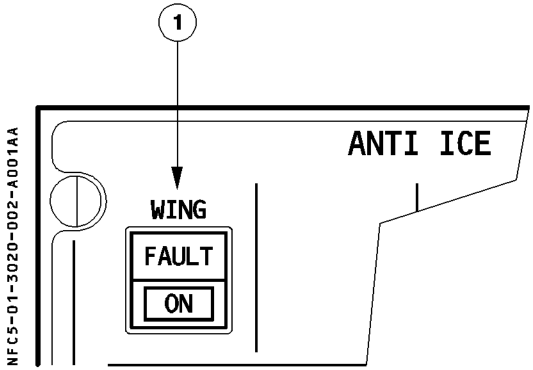
DESCRIPTION

In flight, hot air from the pneumatic system heats the three outboard slats (3-4-5) of each wing.
Air is supplied through one valve in each wing.
The WING pushbutton on the ANTI-ICE panel controls the valves.
When the aircraft is on ground, the flight crew can initiate a 30-second test sequence by turning the system ON.
If the system detects a leak during normal operation, the affected side's wing anti-ice valve automatically closes (see 1.36.10).
R When wing anti-ice is selected, the N1 limit is automatically reduced, and the idle N1 is
R automatically increased.
If the electrical power supply fails, 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.

ON : It lights up blue.
WING A. ICE appears on the ECAM MEMO page.
R Wing anti ice control valves open if a pneumatic supply is available.
On the ground the wing anti-icing control valves open for 30 seconds only (test sequence).

Off : ON light goes off.
Wing anti-icing control valves close.

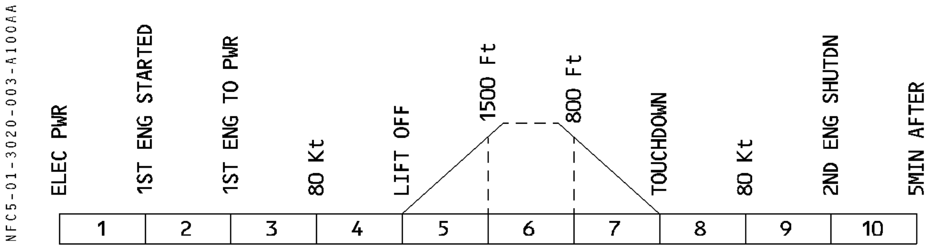
FAULT : Amber light comes on, and caution appears on ECAM, if :
– the position of the anti-icing control valve is not the required position, or
– low pressure is detected.

Note : The amber FAULT light comes on briefly as the valves transit.

ECAM BLEED PAGE

See 1.36.20.

WARNINGS AND CAUTIONS



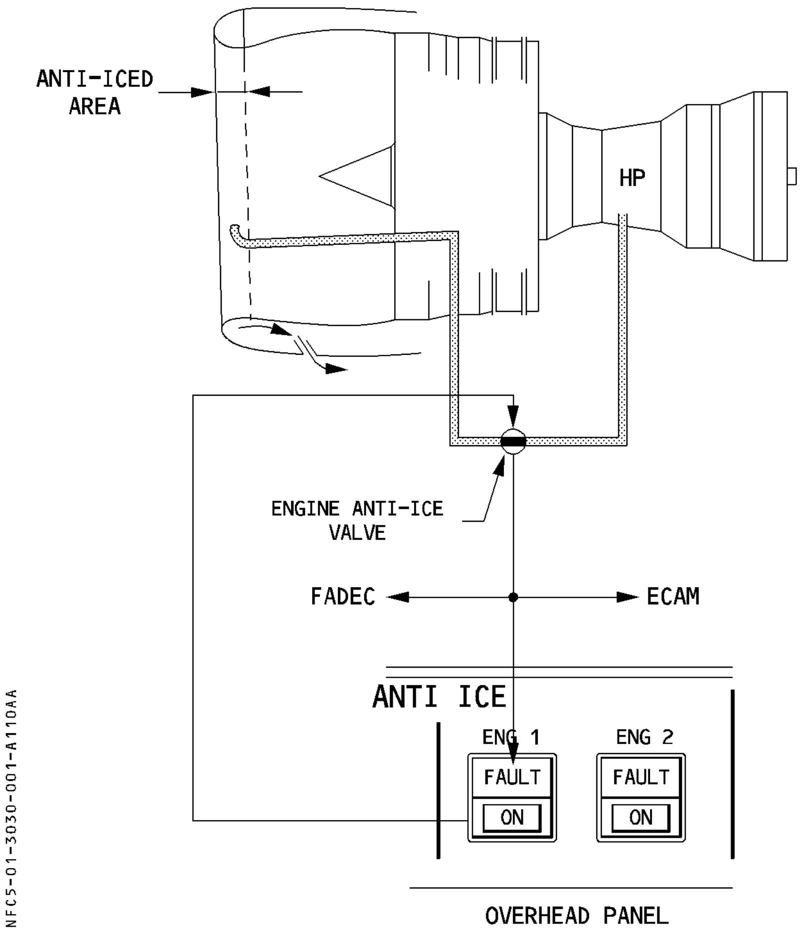
E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
WING A. ICE OPEN ON GND On ground, valves remain open more than 35 seconds after wing anti-ice is selected ON.	SINGLE CHIME	MASTER CAUT	BLEED	NIL	3, 4, 5, 6, 7, 8
SYS FAULT Valve not open when wing anti-ice selected ON.				ANTI ICE WING FAULT lt	3, 4, 5, 7, 8
L (R) VALVE OPEN Valve not closed when wing anti-ice selected off					4, 5, 7, 8
HI PR High pressure detected when the wing anti-ice is selected ON.	NIL	NIL		NIL	3, 4, 5, 7, 8

MEMO DISPLAY

The “WING A. ICE” message is displayed in green, if the WING ANTI ICE pushbutton is ON.
The “ICE NOT DET” message is displayed in green, if ice is no longer detected after 190 seconds.

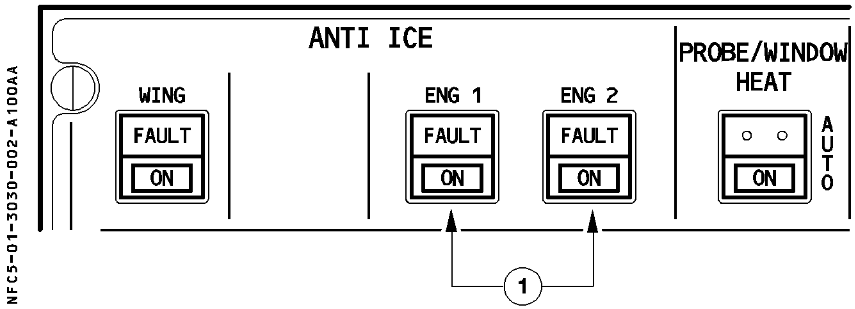
DESCRIPTION

An independent air bleed from the high pressure compressor protects each engine nacelle from ice. Air is supplied through a two-position (open and closed) valve that the flight crew controls with two pushbuttons, one for each engine.
The valve automatically closes, if air is unavailable (engine not running).
R When an engine anti-ice valve is open, the N1 limit is automatically reduced and, if necessary, the idle N1 is automatically increased for both engines in order to provide the required pressure.
If electrical power fails, the valves open.



CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) ENG 1 (2) pb sw

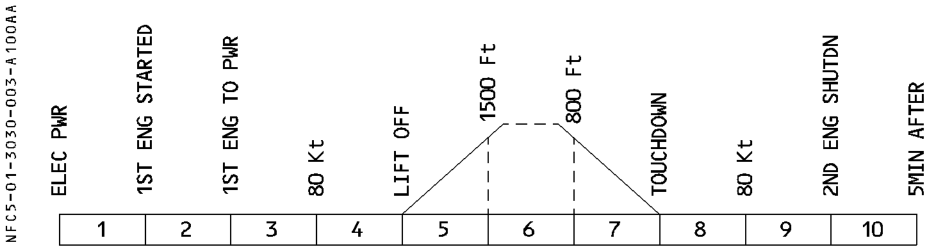
R ON : light comes on blue.
ECAM MEMO displays "ENG A. ICE".
Engine anti-ice valve opens if bleed air is available from the engine.
Continuous ignition is selected when the valve is opened and the ANTI ICE ENG pushbutton switch is selected ON.

Off : ON light goes out.
Engine anti-ice valve closes.

FAULT : Amber light comes on, and caution message appears on ECAM, if the position of the anti-icing valve disagrees with the ENG 1 (2) pushbutton selection.

Note : The amber FAULT light comes on briefly as valve transits.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1(2) VALVE OPEN Valve disagree in the open position.	SINGLE CHIME	MASTER CAUT	NIL	ENG 1 (2) ANTI ICE FAULT lt	3, 4, 5, 7, 8
ENG 1(2) VALVE CLSD Valve disagree in the closed position.					

MEMO DISPLAY

This display shows “ENG A. ICE” in green, if one or both ENG A. ICE pushbuttons are ON. The “ICE NOT DET” message appears in green, if no ice has been detected 190 seconds after the flight crew has selected the ENG A.ICE pushbutton ON.

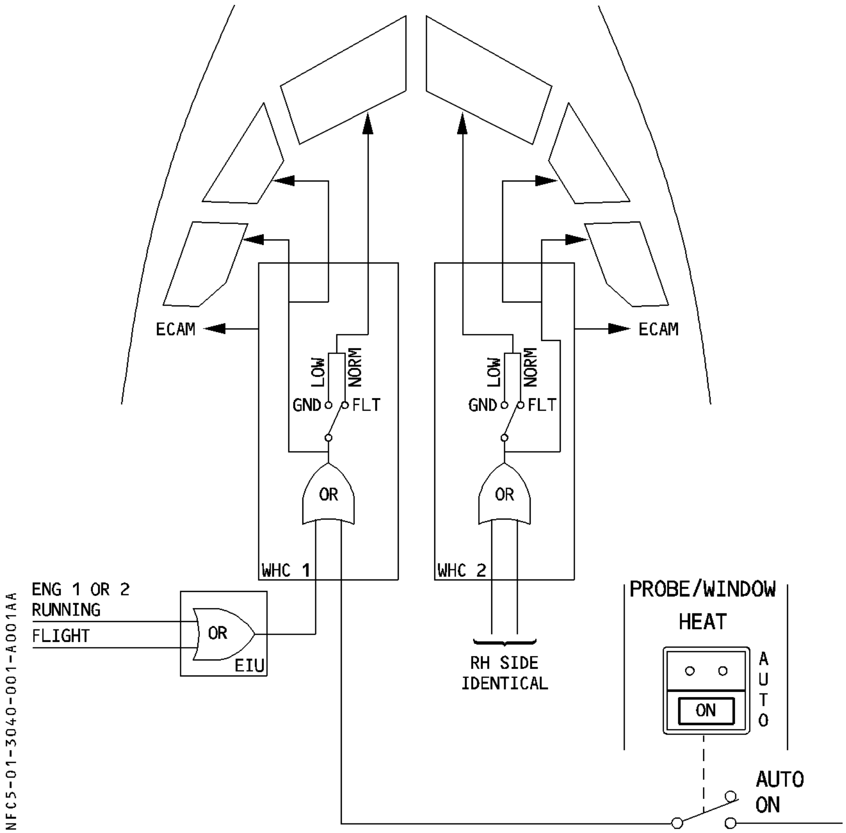
DESCRIPTION

The aircraft uses electrical heating for anti-icing each windshield and demisting the cockpit side windows.
Two independent Window Heat Computers (WHCs), one on each side, automatically regulate the system, protect it against overheating, and indicate faults.
Window heating comes on :
- automatically when at least one engine is running, or when the aircraft is in flight.
- manually, before engine start, when the flight crew switches ON the PROBE/WINDOW HEAT pushbutton switch.

R Windshield heating operates at low power on the ground and at normal power in flight. The changeover is automatic.
R Only one heating level exists for the windows.

FOR INFO

R

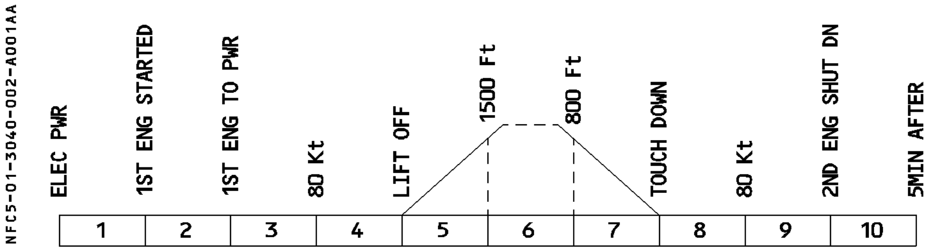


CONTROLS AND INDICATORS

OVERHEAD PANEL

Refer to 1.30.50.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
L(R) WINDSHIELD Failure of L or R windshield heating	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8
L+R WINDSHIELD Failure of both windshield heating					
L(R) WINDOW Failure of L or R window heating	NIL	NIL			

DESCRIPTION

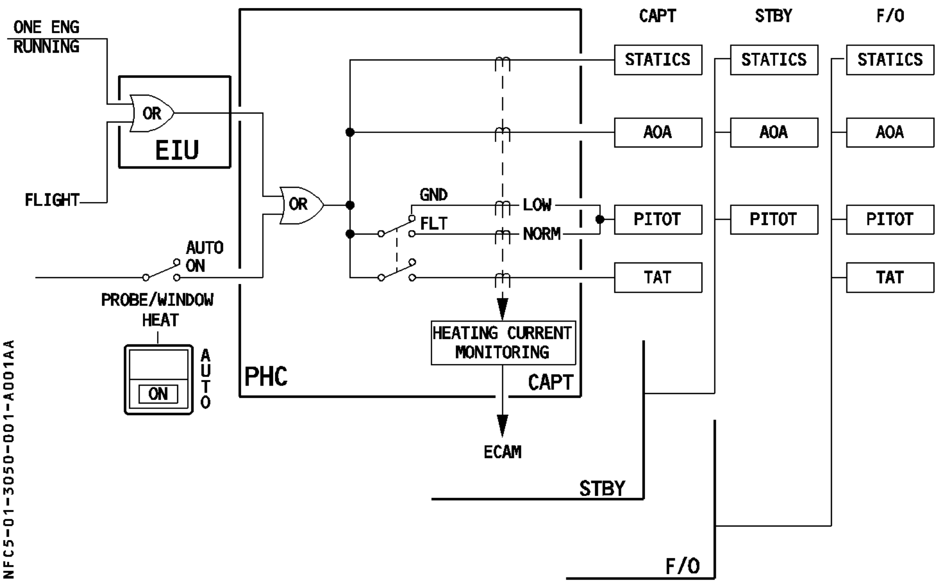
Electrical heating protects :
- pitot heads
- static ports
- Angle-Of-Attack probes (AOAs)
- Total Air Temperature (TAT) probes

Three independent Probe Heat Computers (PHCs) automatically control and monitor :
- Captain probes
- F/O probes
- STBY probes

They protect against overheating and indicate faults.
The probes are heated :
R – automatically when at least one engine is running, or when the aircraft is in flight.
- manually, when the flight crew switches ON the PROBE/WINDOW HEAT pushbutton switch

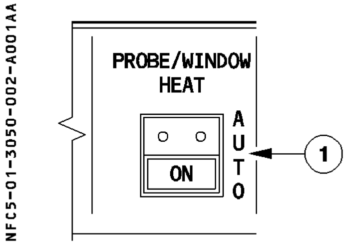
On the ground, the TAT probes are not heated and pitot heating operates at a low level (the changeover to normal power in flight is automatic).

FOR INFO



CONTROLS AND INDICATORS

OVERHEAD PANEL

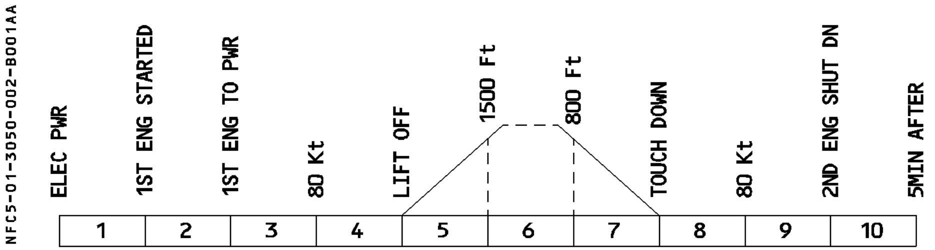


(1) PROBE/WINDOW HEAT pb

AUTO : Probes/Windows are heated automatically :
- in flight or
- on the ground (except TAT probes) provided one engine is running.

ON : Probes and windows are heated permanently. Blue light comes on.

WARNINGS AND CAUTIONS



R

E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CAPT (F/O) PITOT CAPT (F/O) L(R) STAT CAPT (F/O) AOA CAPT (F/O) TAT Failure of corresponding probe heating	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7,8
STBY PITOT STBY L(R) STAT STBY AOA Failure of corresponding probe heating					
CAPT (F/O) (STBY) PROBES Failure of one probe heat channel					

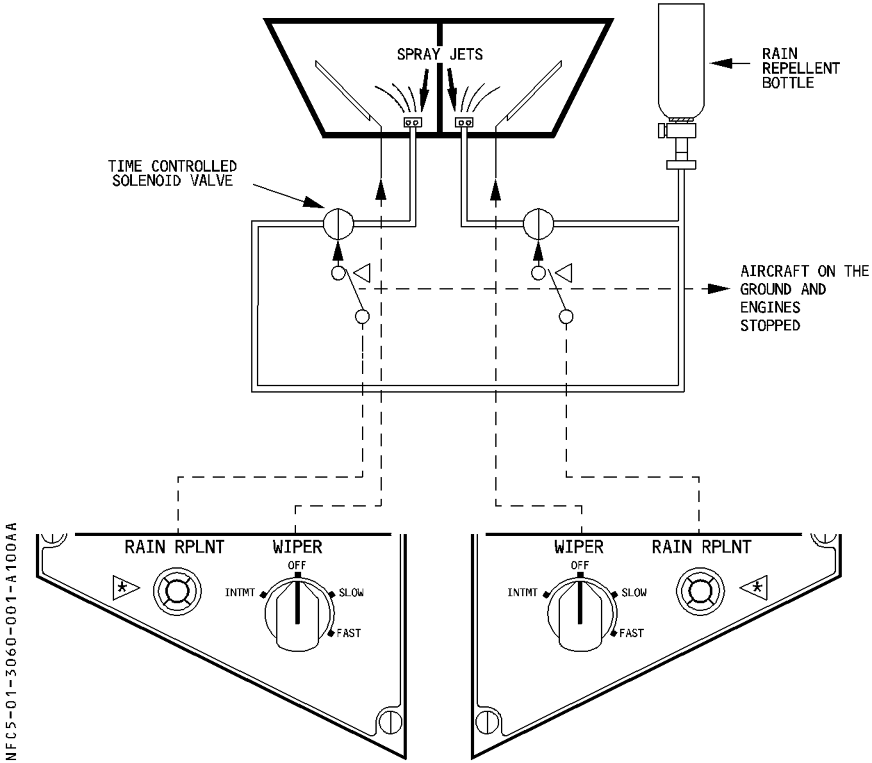
DESCRIPTION

WIPERS

Each front windshield has a two speed electric wiper, with an intermittent sweep function.
A rotary selector controls each.

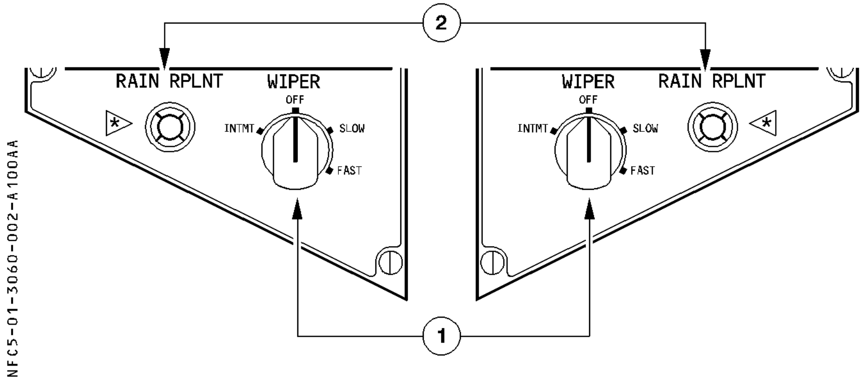
R **RAIN REPELLENT**

In moderate to heavy rain, the flight crew can spray a rain repellent liquid on the windshield to improve visibility.
After about 30 seconds, the window is covered by spray.
Separate pushbuttons control the rain repellent application each side of the windshield.



CONTROLS AND INDICATORS

OVERHEAD PANEL



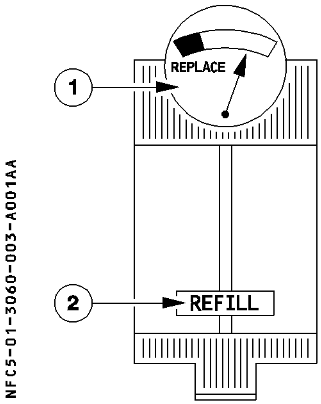
(1) WIPER rotary selector

Each rotary selector controls its wiper at low speed, high speed, or intermittent sweeping. When turned off the wiper stops out of view.

(2) RAIN RPLNT pbs

Each of these buttons controls the application of rain repellent fluid to one side of the front windshield.
When the flight crew pushes the button, the timer applies a measured quantity of rain repellent to the windshield. To repeat the cycle the flight crew must push the button again.
This function is inhibited when the aircraft is on the ground, engines stopped.

REAR COCKPIT



1 RAIN RPLNT pressure indicator

This gauge shows the nitrogen pressure in the rain repellent bottle. When the needle is in the yellow sector the bottle should be replaced.

2 RAIN RPLNT quantity indicator

When the REFILL float is in view the bottle should be replaced.

DESCRIPTION

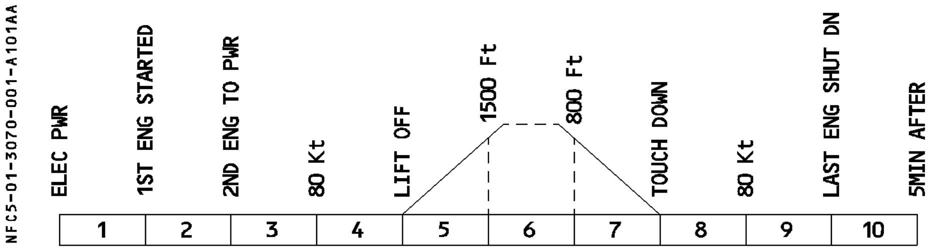
VISUAL ICE INDICATOR

An external visual ice indicator is installed between the two windshields.
R The indicator has also a light (◁).

ICE DETECTION SYSTEM

The ice detection system has two separate ice detector probes on the forward lower section of the fuselage.
The probes detect ice build-up. They also indicate, through the MEMO display, that icing conditions have disappeared. The system logic generates ECAM messages according to ice detector signals and the flight crew's selection of engine or wing anti-icing systems.
The ice detection system does not control the ENG or WING anti-icing systems.

WARNINGS AND CAUTIONS



E / WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
ICE DETECTED In FLT ≥ 1500 ft and TAT < 10°C and ice detected by at least one detector and ENG A. ICE pb at OFF	SINGLE CHIME	MASTER CAUT	NIL	NIL	3,4,5 7,8
SEVERE ICE DETECTED In FLT ≥ 1500 ft and TAT < 10°C and heavy icing detected by at least one detector and WING A. ICE pb at OFF					
ICE DETECT FAULT Ice detector 1 and 2 fault					

MEMO DISPLAY

Refer to 1.30.20 p 3 and 1.30.30 p 3.

BUS EQUIPMENT LIST

			NORM		EMER ELEC		
			AC	DC	AC ESS	DC ESS	HOT
WING ANTI ICE	L and R SHUT OFF VALVES					SHED	
ENG ANTI ICE CLOSURE	VALVE	1		DC1			
ENG ANTI ICE CLOSURE	VALVE	2		DC2			
WINDOW HEAT	WHC	1		DC1			
WINDOW HEAT	WHC	2		DC2			
WINDOW HEAT	HEATING POWER	L	AC1				
WINDOW HEAT	HEATING POWER	R	AC2				
PROBE HEAT	PHC	CAPT				X	
PROBE HEAT	PHC	F/O		DC2			
PROBE HEAT	PHC	STBY		DC1			
PROBE HEAT	STATICS	CAPT and STBY		DC1			
PROBE HEAT	STATICS	F/O		DC2			
PROBE HEAT	PITOT	CAPT			X (1)		
PROBE HEAT	PITOT	F/O	AC2				
PROBE HEAT	PITOT	STBY	AC1				
PROBE HEAT	AOA	CAPT			SHED		
PROBE HEAT	AOA	F/O	AC2				
PROBE HEAT	AOA	STBY	AC1				
PROBE HEAT	TAT	CAPT	AC1				
PROBE HEAT	TAT	F/O	AC2				
RAIN REMOVAL	WIPER	CAPT		DC1			
RAIN REMOVAL	WIPER	F/O		DC2			
RAIN REMOVAL	RAIN REPELLENT	CAPT				X	
RAIN REMOVAL	RAIN REPELLENT	F/O		DC2			
ICE DETECT SYSTEM	DETECTOR 1		AC1				
ICE DETECT SYSTEM	DETECTOR 2		AC2				

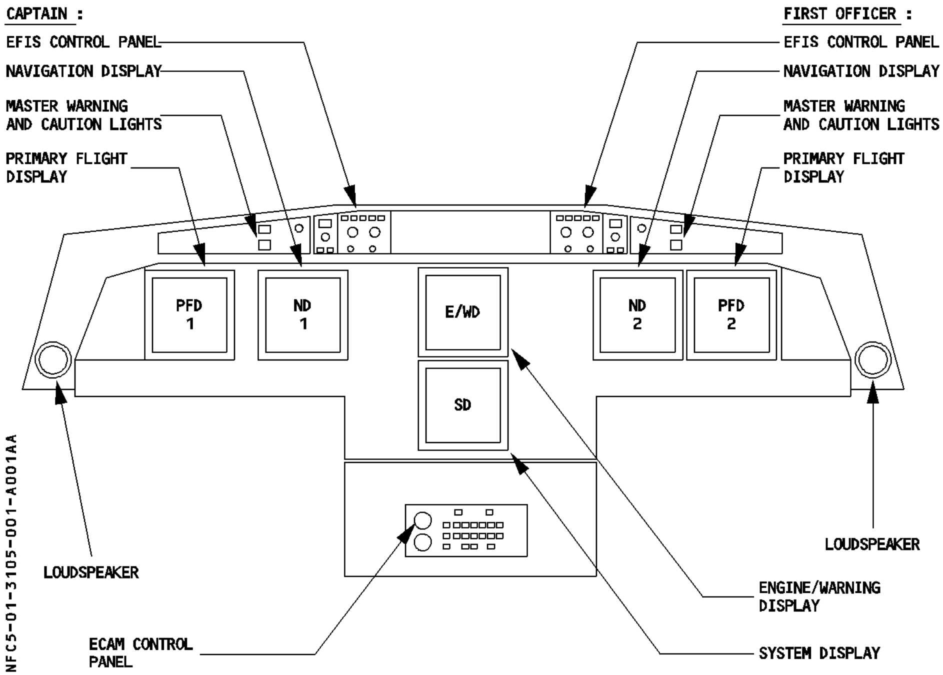
(1) When AC1 and AC2 are lost and AIR DATA is switched to “CAPT 3”, the STBY pitot is switched to AC ESS bus and CAPT pitot heating is lost.

31.00 CONTENTS

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



ARCHITECTURE

DISPLAY UNIT (DU)

The instrument panels have six identical units.
These DUs are full-color cathode ray tubes.

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.
– landing distance and landing speed increments.

ATTENTION-GETTERS

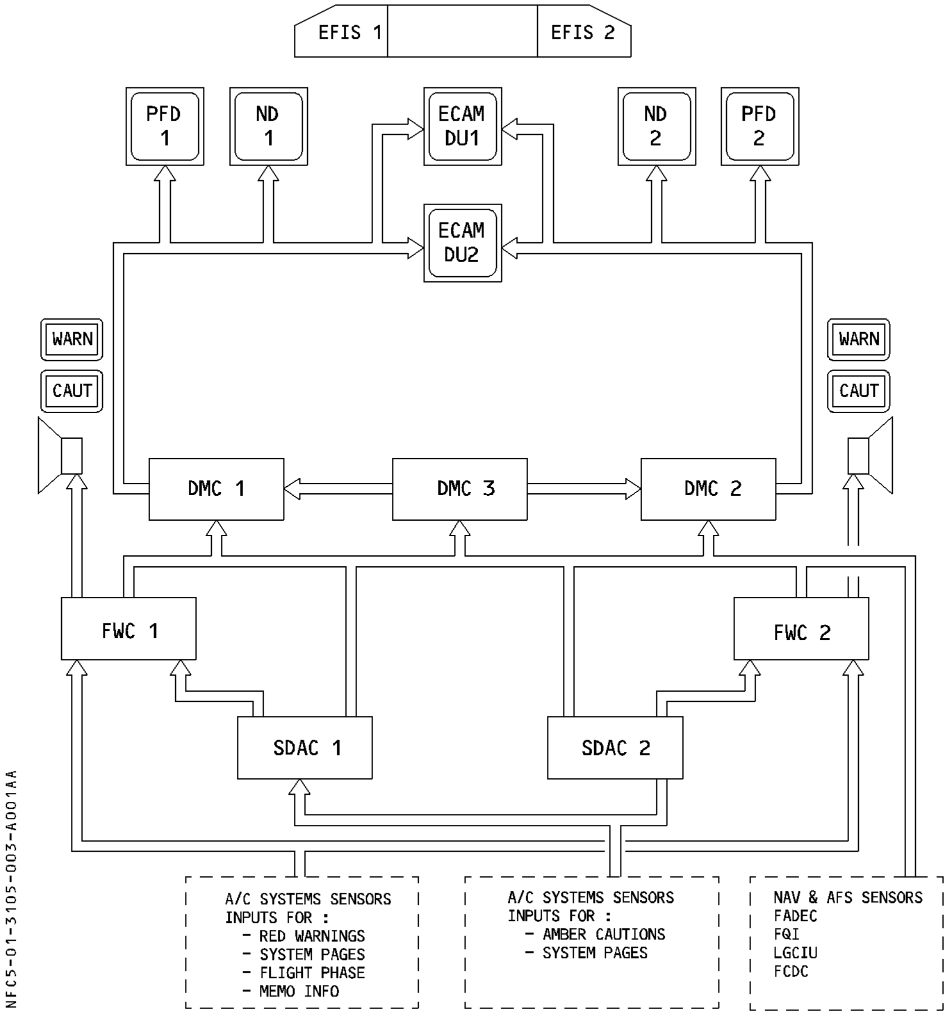
The FWCs also drive the attention-getters. Each pilot has a set of these on the panel under the glareshield. They are :
– a master warning light that flashes “MASTER WARN” in red for red warnings
– a master caution light that flashes “MASTER CAUT” in amber for amber cautions

LOUDSPEAKER

The communications loudspeakers announce aural alerts and voice messages, and do so even when they are turned off.

EIS BLOCK DIAGRAM

R



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.

EIS DMC SWITCHING SELECTOR

A switch near the center of the SWITCHING panel (which is just beyond the thrust lever quadrants) allows the flight crew to replace the captain's or the first officer's display management computer (DMC 1 or DMC 2) with DMC 3.

ECAM/ND SWITCHING

A switch at the right end of the SWITCHING panel allows the flight crew to transfer the ECAM system display to either the captain's or the first officer's navigation display.

EFIS SWITCHING

A PFD/ND XFR pushbutton on each side console allows the pilot to swap displays on respective onside DUs.

RECONFIGURING THE DISPLAY MANAGEMENT COMPUTER (DMC)

In normal operation :
– DMC 1 supplies data to the Captain's PFD and ND, and the upper ECAM DU.
– DMC 2 supplies data to the First Officer's PFD and ND, and the lower ECAM DU.
– DMC 3 is on standby.
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 EIS DMC switch on the SWITCHING panel to "CAPT 3" or "F/O 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 SWITCHING panel, to move it to a navigation display unit (NDU), or
R – Pushing and holding (for a maximum of 3 minutes) the related system page pushbutton on the ECAM control panel to temporarily display it 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 display the system/status page by :
– Using the "ECAM/ND XFR" switch, on the SWITCHING panel, to display it on NDU, or
R – Pushing and holding (for a maximum of 3 minutes) the related system page pushbutton, on the ECAM control panel to temporarily display it on the upper ECAM DU (in place of the engine/warning page).

FAILURE OF BOTH ECAM DUs

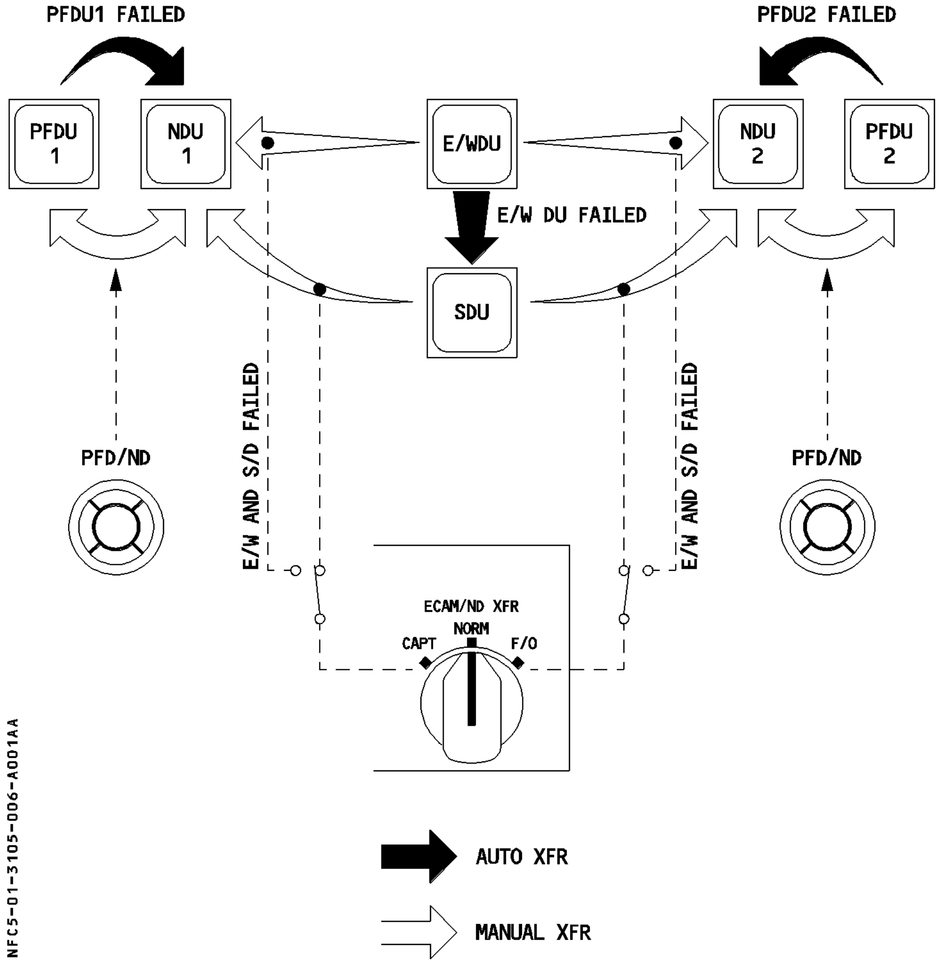
If both ECAM displays fail, the flight crew may :
– Use the "ECAM/ND XFR" on the SWITCHING panel to display the engine/warning page
R on a navigation display and, if needed,
R – Push and hold (for a maximum of 3 minutes) the related system page pushbutton on the ECAM control panel, to temporarily display the system/status page on an ND.

PFDU/NDU RECONFIGURATION

R If a PFDU fails, the system automatically transfers the PFD image 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.

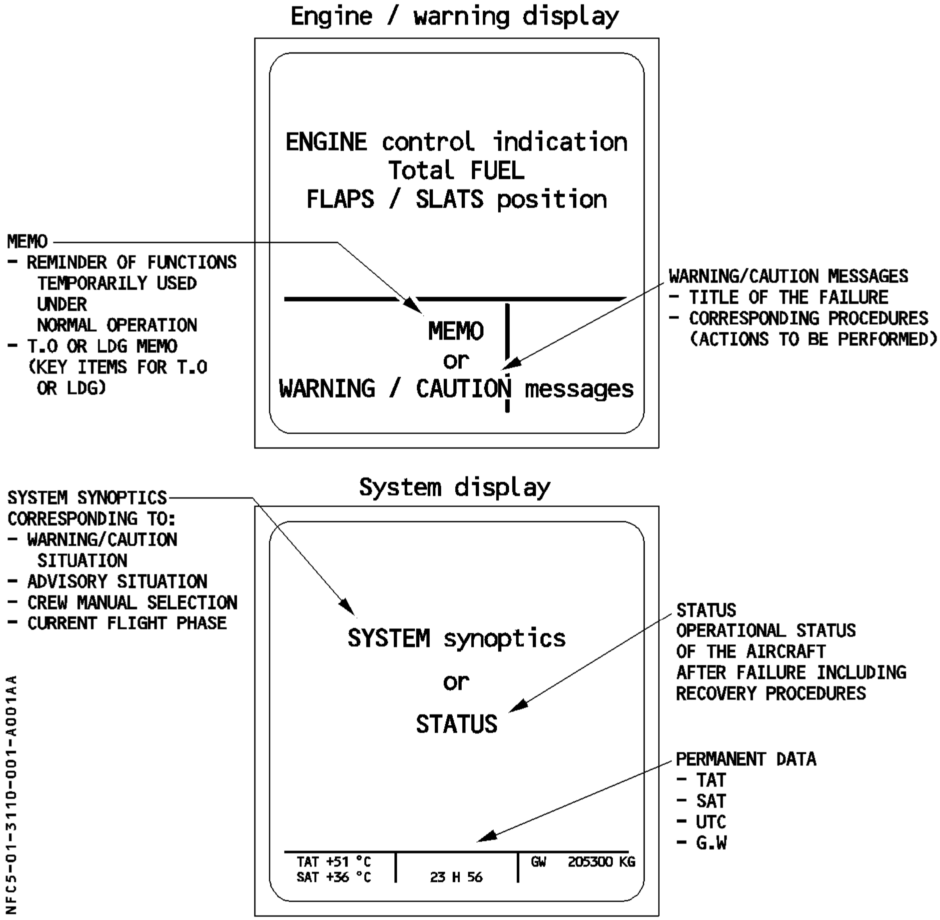
If an NDU fails, the pilot can use the PFD/ND/XFR pushbutton to transfer the ND image to the PFDU.

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).



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 need not take immediate action.
GREEN : The item is operating normally.
WHITE : These titles and remarks guide the flight crew, as they execute 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 : – Aircraft in dangerous configuration, or limit flight conditions (eg: stall, o/speed) – System failure altering flight safety (eg : Eng fire, excess cab alt)	Continuous Repetitive Chime (CRC) or specific sound or synthetic voice	– MASTER WARN light red flashing or specific red light – Warning message (red) on E/WD – Automatic call of the relevant system page on the S/D *
	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 : – System failure without any direct consequence on the flight safety (eg: HYD G SYS LO PR)	Single Chime (SC)	– MASTER CAUT light amber steady –Caution message (amber) on E/WD – Automatic call of the relevant system page on the S/D * .
	Level 1	Amber caution : Requires crew monitoring : – Failures leading to a loss of redundancy or system degradation (eg : FCDC fault)	NONE	– Caution message (amber) on E/WD generally without procedure.
INFORMATION	ADVISORY	System parameters monitoring	NONE	– Automatic call of the relevant system page on the S/D. The affected parameter pulses green.
	MEMO	Information : Recalls normal or automatic selection of functions which are temporarily used	NONE	– Green, Amber, or Magenta message on E/WD

* except in some cases

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

R

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
CONTINUOUS REPETITIVE CHIME	RED WARNINGS	PERMANENT	Press * MASTER WARN lt
SINGLE CHIME	AMBER CAUTION	1/2 seconds	
CAVALRY CHARGE	A/P DISCONNECTION BY TAKE OVER pb	1.5 seconds	Second push on TAKE OVER pb
	A/P DISCONNECTION DUE TO FAILURE	PERMANENT	Press MASTER WARN lt or TAKE OVER pb
CLICK	LANDING CAPABILITY CHANGE	1/2 sec. (3 pulses)	
CRICKET + "STALL" message (synthetic voice)	STALL	PERMANENT	NIL
BUZZER	CABIN CALL	3 seconds	NIL
	EMER CABIN CALL	3 seconds REPEATED 3 TIMES	NIL
	MECH CALL **	As long as outside pb pressed	NIL
CONTINUOUS BUZZER **	SELCAL CALL	PERMANENT	Press RESET key on ACP
"WINDSHEAR" (synthetic voice)	WINDSHEAR	REPEATED 3 TIMES	NIL
" GO AROUND WINDSHEAR AHEAD" (synthetic voice)	Windshear ahead detected during the landing phase	PERMANENT	NIL
"WINDSHEAR AHEAD" (twice) (synthetic voice)	Windshear ahead detected during the takeoff phase	PERMANENT	NIL
"MONITOR RADAR DISPLAY" (synthetic voice)	Windshear ahead detected caution message	PERMANENT	NIL

* The pilot can cancel any aural warning by pressing :
- The EMER CANC pushbutton on the ECAM control panel,
- The MASTER WARN pushbutton, except for OVERSPEED or L/G NOT DOWN warnings.

** The pilot can cancel the continuous buzzer by pressing the MASTER CAUT pushbutton.

R

WARNING SIGNAL	CONDITION	DURATION	SILENCING *
C CHORD	ALTITUDE ALERT (Refer to 1.31.40)	1.5 seconds or PERMANENT	new ALTITUDE selection or press MASTER WARN pb
AUTO CALL OUT (synthetic voice)	HEIGHT ANNOUNCEMENT BELOW 2500 FT (Refer to 1.34.10)	PERMANENT	NIL
GROUND PROXIMITY WARNING (synthetic voice)	(Refer to 1.34.70)	PERMANENT	NIL
"PRIORITY LEFT" "PRIORITY RIGHT" (synthetic voice)	A/P TAKE OVER pb	1 second	NIL
"RETARD" (synthetic voice)	THRUST LEVER NOT IN IDLE POSITION FOR LANDING	PERMANENT	THRUST LEVER
TCAS (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)
"DUAL INPUT" (synthetic voice)	Both sidesticks are moved simultaneously	Every 5 seconds	One sidestick deactivated

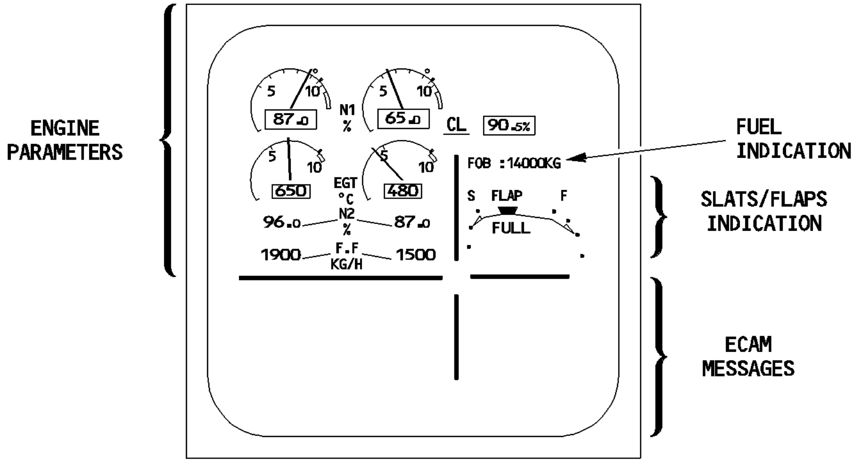
* The pilot can cancel any aural warning by pressing :
- The EMER CANC pushbutton on the ECAM control panel,
- The MASTER WARN pushbutton, except for OVERSPEED or L/G NOT DOWN warnings.

GENERAL

The E/WD appears on the upper ECAM display unit (DU).

– The upper part of this DU displays :
R · Engine parameters (refer to 1.70.90)
R · Fuel on board (FOB) (refer to 1.28.20)
R · 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.

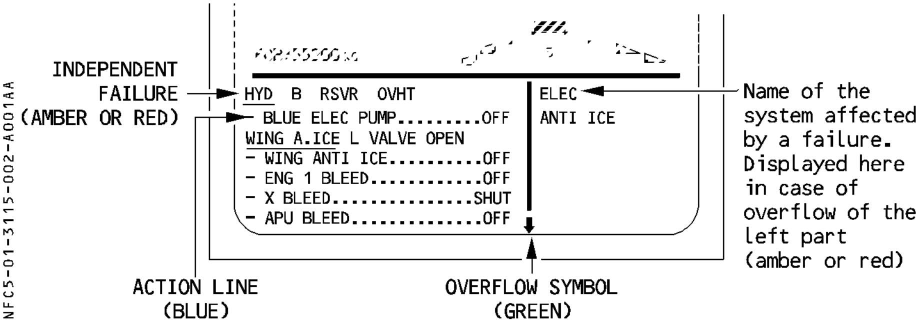
Left part : – Primary or independent warnings and cautions, or
– Memo information

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.

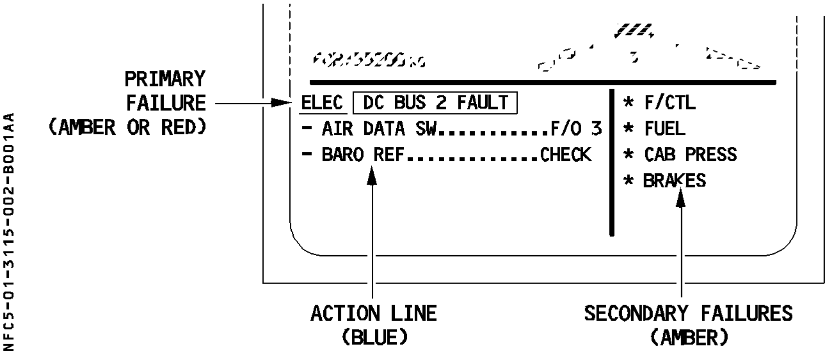
Note : Certain actions will not disappear after execution.

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 FAILURE



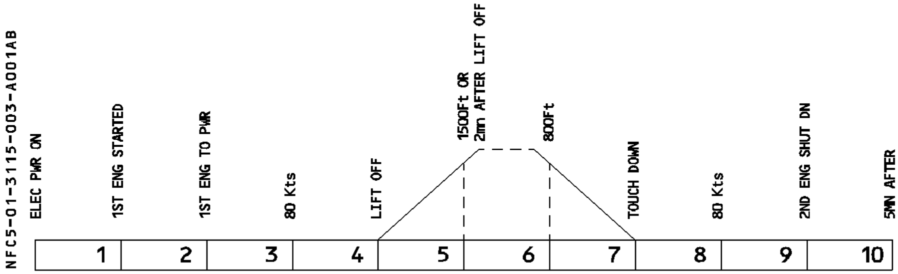
The ECAM DU displays a primary failure as a boxed title.
It identifies a secondary failure by putting a star in front of the title of the affected system.

R *Note : The DU displays the overflow symbol, if primary or secondary failures overflow. In*
R *case of ELEC EMER CONFIG, the secondary failures are inhibited.*

FLIGHT PHASES

GENERAL

The FWC divides its functions according to these ten flight phases :

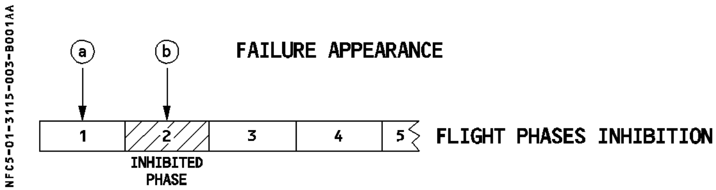


To improve its operational efficacy, the computer inhibits some warnings and cautions for certain flight phases. It does so to avoid alerting the pilots unnecessarily at times when they have high workloads, such as during takeoff or landing. In these two phases, the DU displays magenta memos : “T.O. 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 that the FMGC uses.

FLIGHT PHASE INHIBITION

Two cases are possible (for instance) :



Effect on E/WD :

(a) The failure occurs during phase 1. The E/WD displays the warning immediately 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 displays the warning only when the aircraft has entered phase 3, where it is not inhibited. Then the warning remains displayed as long as the failure is present.

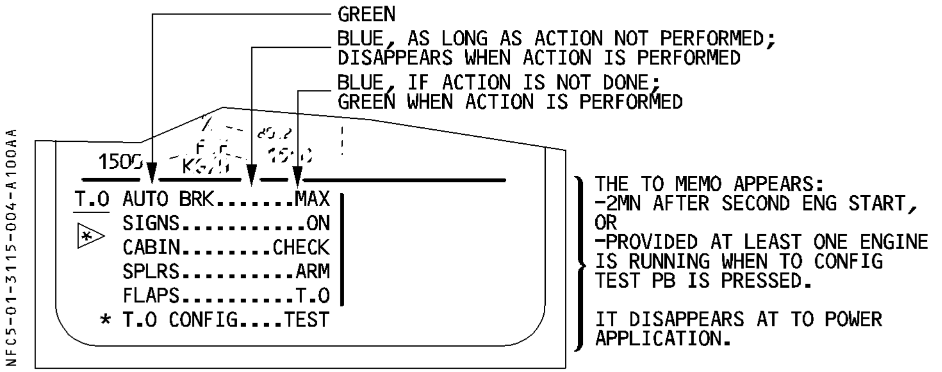
MEMOS

DISPLAY

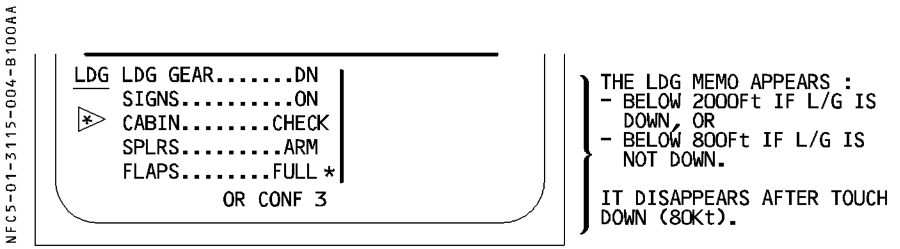
R Memos appear in the lower part of the E/WD. They are normally in green, but may be amber in abnormal situations.
Memos list functions or systems that are temporarily used in normal operations.
Each chapter of the "Warning and Cautions" section of this manual lists memo messages.

TO AND LDG MEMOS

During the takeoff and landing phases, the right 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 :



* This line disappears when the test is completed. It is replaced by "TO CONFIG NORMAL", if aircraft configuration is correct.
The test is requested again, if the configuration becomes abnormal.



* "CONF 3" is displayed in alternate or direct law, or if the GPWS LDG FLAP 3 pushbutton is ON.

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.

WARNINGS/CAUTIONS	TO CONFIG TEST	TO POWER
SLATS/FLAPS NOT IN TO CONFIG (R)	TRIGGERED	TRIGGERED
PITCH TRIM NOT IN TO RANGE (R)		
RUD TRIM NOT IN TO RANGE (R)		
SPD BRK NOT RETRACTED (R)		
SIDESTICK FAULT (R) (BY TAKE OVER)		
BRAKES HOT (A)		
DOORS (A)		
PARK BRAKE ON (R)	NOT TRIGGERED	
FLEX TEMP NOT SET (A)		

(R) Red warning
(A) Amber caution

GENERAL

The system/status display (SD) uses the lower ECAM DU to display :
– pages showing synoptic diagrams of the aircraft systems, or
– the status page.

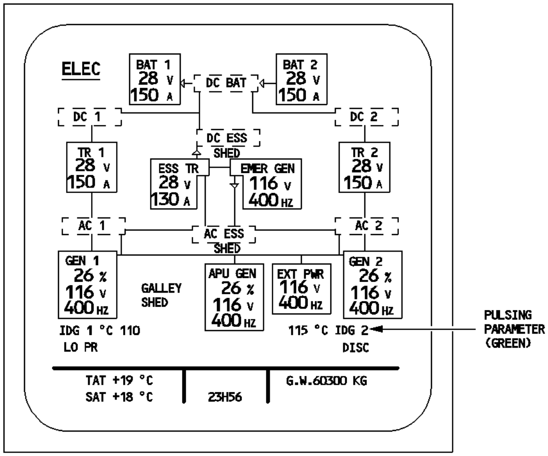
SYSTEM PAGES

The lower ECAM DU can display 12 system pages :
(For description see relevant FCOM chapter).
– ENGINE (secondary engine parameters)
– BLEED (air bleed)
– CAB PRESS (cabin pressurization)
– ELEC (electric power)
– HYD (hydraulic)
– FUEL (fuel)
– APU (auxiliary power unit)
– COND (air conditioning)
– DOOR/OXY (doors/oxygen)
– WHEEL (landing gear, braking, ground spoilers, etc.)
– F/CTL (flight controls)
– 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.

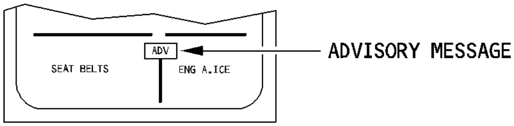
– Manual :
  · The pilot can use the pushbutton on the ECAM control panel to call up any system page, except the CRUISE page, for display at any time.
  · The corresponding pushbutton on the ECAM control panel lights up.
  · A failure-related or advisory display automatically replaces a page the pilot has manually called up.
– Automatic, related to a failure :
  · 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.

NFC5-01-3120-002-A001AA

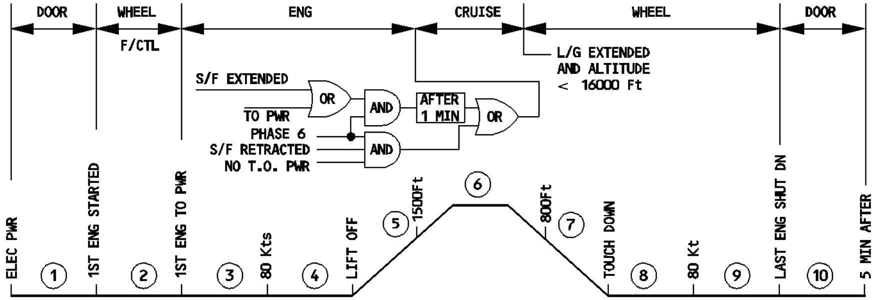


Note : If an advisory is triggered when the ECAM is in the single-display configuration, an
R *advisory message appears on the upper part of the E/WD, and the associated key on the ECAM control panel flashes to identify the appropriate system page.*

NFC5-01-3120-002-B001AA



— 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.

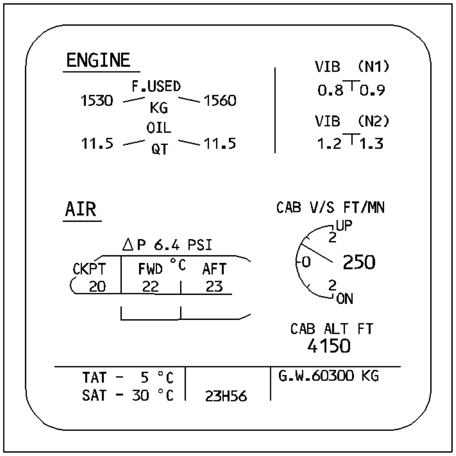


FCA5-01-3120-003-A100AA

 · 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 10 seconds after the end of the start sequence, when the ENG MODE sel is set to NORM.

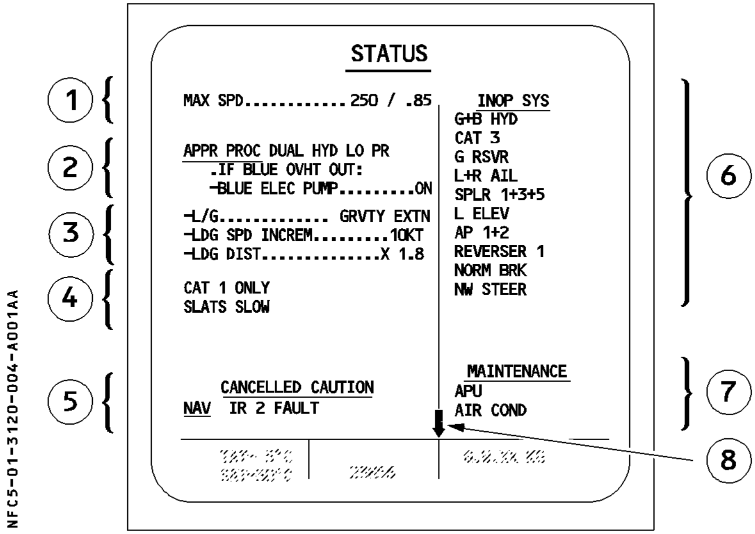
For a description of the ENGINE and AIR indications that appear when the SD is displaying the CRUISE page, see the relevant FCOM chapter.

R



NFC5-01-3120-003-B100AA

STATUS PAGE



The status page displays an operational summary of the aircraft status after the SD has
R 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

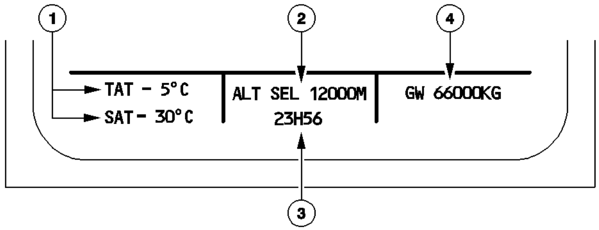
(8) Symbol displayed if data overflows the left or right area.

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 automatically appears, once the crew has cleared all the pages corresponding to the current failure. The STATUS page also appears automatically during descent, when the slats are extended, unless if the page is empty. The pilot may manually call up the status page 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 on engine shutdown, the "STS" (status reminder) flashes on the E/WD screen. The screen displays the MAINTENANCE, only when the aircraft is on ground, before engine start-up or after engine shutdown (Phases 1 and 10).

PERMANENT DATA



NFC5-01-3120-005-A002AA

(1) Temperature

"TAT" (Total Air Temperature) and "SAT" (Static Air Temperature) are displayed in green.

(2) G LOAD – ALT SEL

The screen displays either one of the two items :
- 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.
- Altitude selected through the flight control unit, in green, if the flight crew has selected metric units, when the load factor is not displayed.

(3) UTC

The screen displays the Universal Time Coordinated (UTC), synchronized with the cockpit clock, in green.

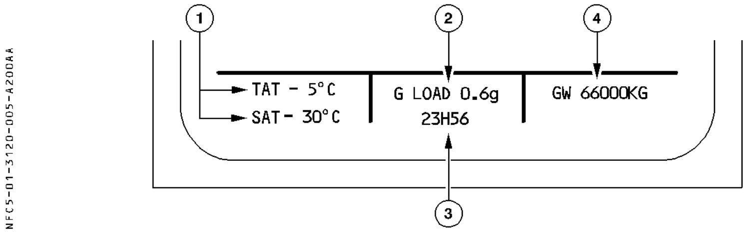
(4) GW

R The screen displays the gross weight (GW) in green, as soon as the first engine is started. The last two digits are dashed, if accuracy is degraded. On ground, the indication is replaced by blue dashes, if no computed data is available.

LEFT INTENTIONALLY BLANK

The STATUS page automatically appears, once the crew has cleared all the pages corresponding to the current failure. The STATUS page also appears automatically during descent, when the slats are extended, unless if the page is empty. The pilot may manually call up the status page 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 on engine shutdown, the “STS” (status reminder) flashes on the E/WD screen. The screen displays the MAINTENANCE, only when the aircraft is on ground, before engine start-up or after engine shutdown (Phases 1 and 10).

PERMANENT DATA



(1) Temperature

“TAT” (Total Air Temperature), and “SAT” (Static Air Temperature) are displayed in green.

(2) G LOAD – ALT SEL

“G LOAD” (the load factor) is displayed 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.

(3) UTC

The screen displays the Universal Time Coordinated (UTC), synchronized with the cockpit clock, in green.

(4) GW

R The screen displays the gross weight (GW) in green, as soon as the first engine is started. The last two digits are dashed, if accuracy is degraded. On ground, the indication is replaced by blue dashes, if no computed data is available.

LEFT INTENTIONALLY BLANK

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.

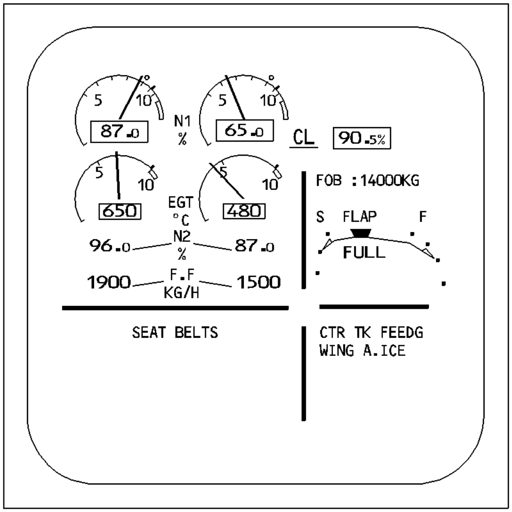
R - The CLR pushbutton on the ECAM control panel lights up.

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

R
1 – THE ECAM DETECTS NO FAILURE

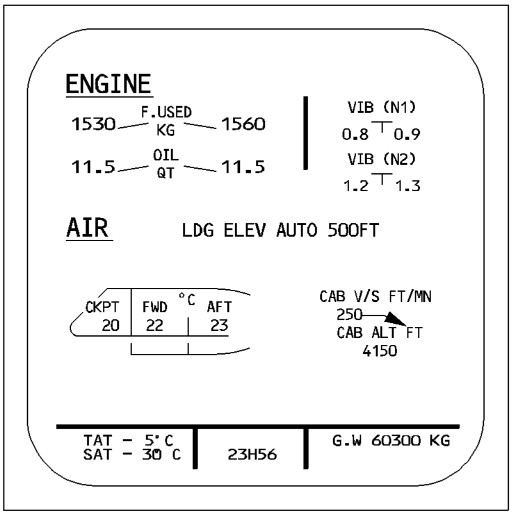
ECAM UPPER DISPLAY (E/WD)



- ENGINE CONTROL PARAMETERS
- FUEL QUANTITY INDICATION
- FLAPS/SLATS POSITION

- MEMO INFORMATION

ECAM LOWER DISPLAY (SD)



NFC5-01-3125-002-A005AB

- FLIGHT PHASE RELATED SYSTEM PAGE (CRUISE PAGE IN THIS EXAMPLE)

- PERMANENT DATA

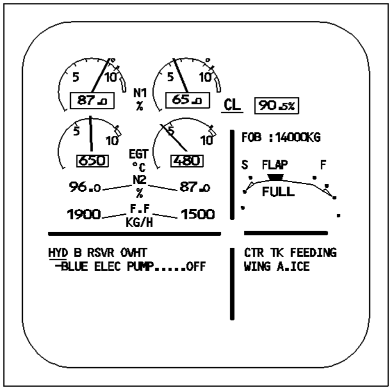
R 2 – THE ECAM DETECTS A FAILURE

For example, a hydraulic reservoir is overheating.

COCKPIT INDICATIONS

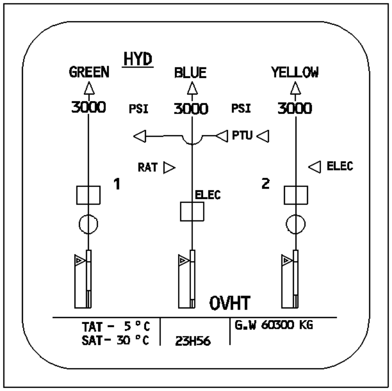
- A single chime sounds.
- Both MASTER CAUTION lights come on and stay on.
- A FAULT light on the overhead HYD panel comes on.
- The memo space on the E/WD displays the message “HYD B RSVR OVHT” and the instruction “BLUE ELEC PUMP . . . . . OFF”.
- The lower ECAM display (SD) automatically calls up the diagram of the hydraulic systems and displays “OVHT” in amber by the blue system.

R – The CLR pushbutton on the ECAM control panel 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

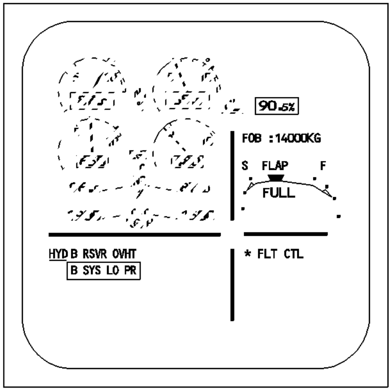
NFC5-01-3125-003-A005AA

3 – THE FLIGHT CREW FOLLOWS THE INSTRUCTION DISPLAYED ON THE E/WD

R The crew switches off the blue ELEC pump, depressurizing the blue hydraulic circuit.

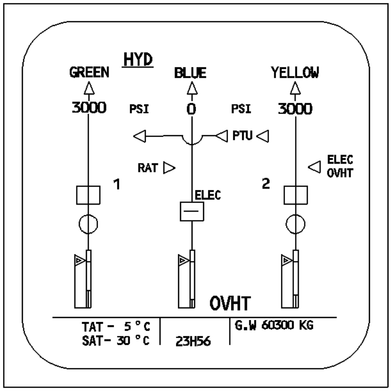
COCKPIT INDICATIONS

- 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



NFC5-01-3125-004-A001AA

ECAM LOWER DISPLAY (SD)

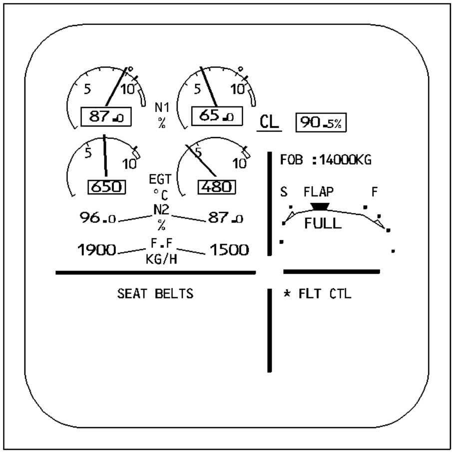
- THE SYNOPTIC OF THE SYSTEM PAGE IS CHANGED ACCORDING TO THE NEW SYSTEM CONFIGURATION OVHT AND THE PRESSURE ARE DISPLAYED IN AMBER

4 – ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON ON THE ECP

COCKPIT INDICATIONS

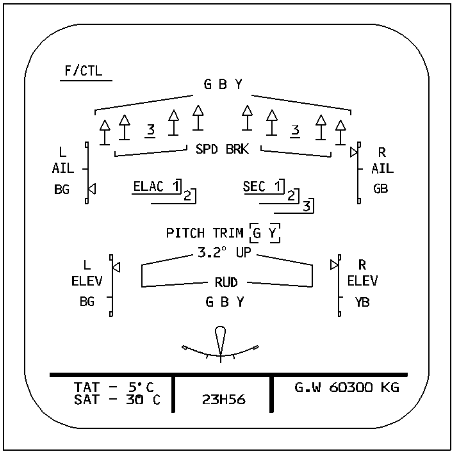
- The CLR pushbutton remains lit.
- The FAULT/OFF light stays on.
- The hydraulic system messages disappear from the E/WD, and the right side of the memo area indicates a secondary failure in the flight control system.
- The SD automatically calls up the flight control system page, with surface actuator indications associated with the blue hydraulic system shown in amber.

R



ECAM UPPER DISPLAY (E/WD)

- LEFT PART
  .MEMO INFORMATION
- RIGHT PART
  .SECONDARY FAILURE



NFC5-01-3125-005-A005AA

ECAM LOWER DISPLAY (SD)

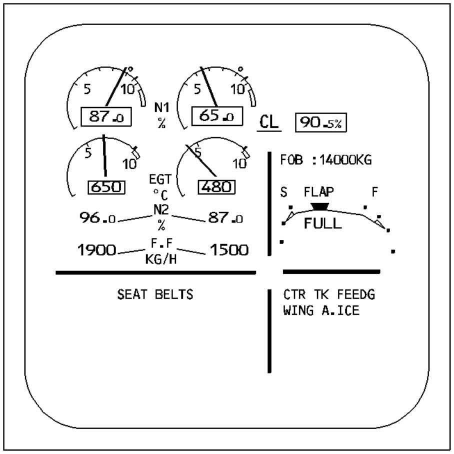
- F/CTL SYSTEM PAGE AUTOMATICALLY DISPLAYED FAULTY SPOILERS (n°3) AND SURFACE ACTUATORS PRESSURE INDICATIONS B ARE DISPLAYED IN AMBER

5 – ONE OF THE PILOTS 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 automatically appears on the SD, displaying the procedures for completing the flight with a faulty blue system.

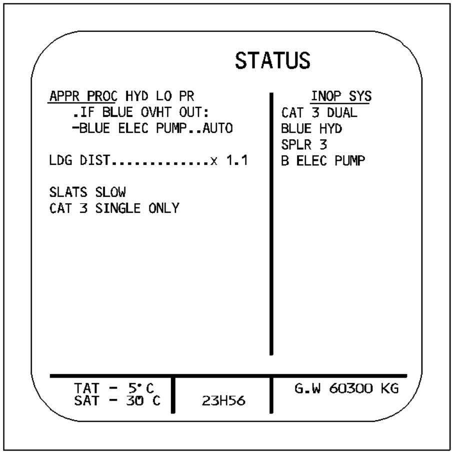
R



ECAM UPPER DISPLAY (E/WD)

- FULL MEMO DISPLAYED

ECAM LOWER DISPLAY (SD)



NFC5-01-3125-006-A005AA

-THE STATUS PAGE IS AUTOMATICALLY DISPLAYED TO:
.PROVIDE THE PROCEDURE TO BE APPLIED FOR APPROACH.
.PROVIDE LANDING DISTANCE FACTORS AND INFORMATION.
.LIST THE INOPERATIVE SYSTEMS.

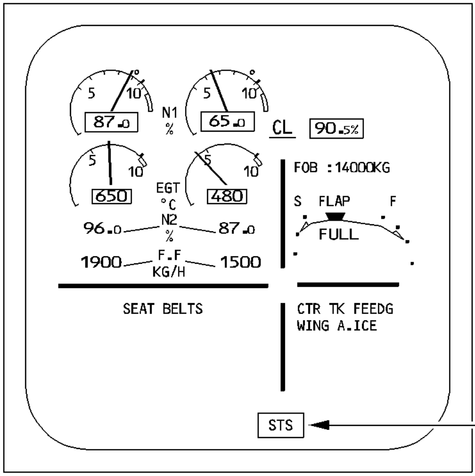
6 – ONE OF THE PILOTS PUSHES THE CLR PUSHBUTTON A THIRD TIME

COCKPIT INDICATIONS

- The CLR pushbutton light goes off.
- 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.

R

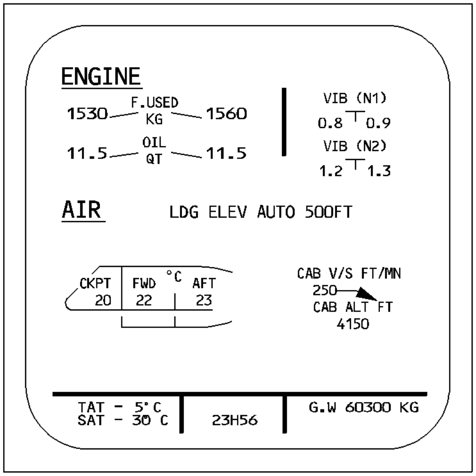
ECAM UPPER DISPLAY (E/WD)



- FULL MEMO DISPLAYED

STATUS REMINDER

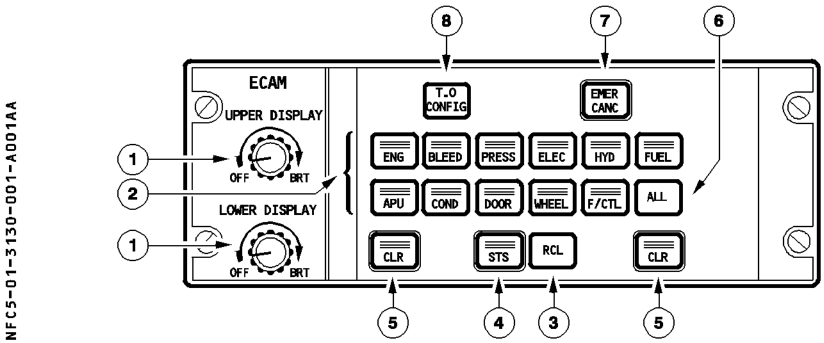
ECAM LOWER DISPLAY (SD)



- RETURN TO THE FLIGHT PHASE RELATED SYSTEM PAGE : CRUISE PAGE

NFC5-01-3125-007-A005AA

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.

R When only one ECAM display is on, the pilot can display a system page for up to 3
R minutes by pushing and 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

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
R maximum of three minutes, after which the ECAM automatically displays the engine/warning page.

5 CLR pushbutton

This pushbutton remains lit as long as the E/WD is displaying a warning or caution
R 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 one-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 then releases the pushbutton 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.*

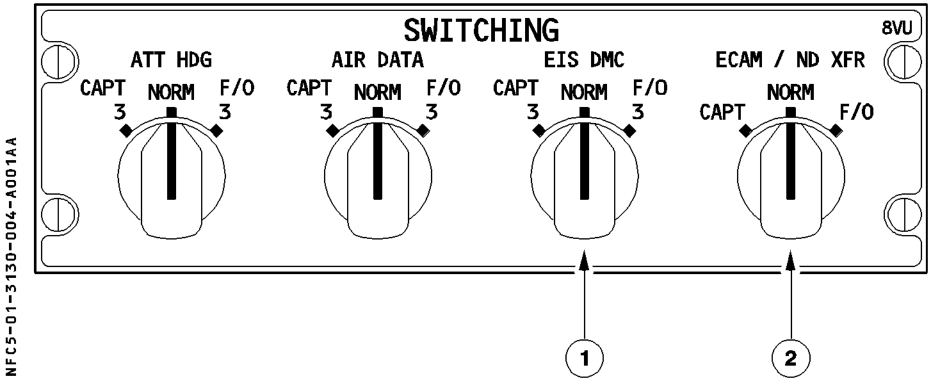
8 T.O. CONFIG pb

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.

SWITCHING PANEL

ON PEDESTAL



(1) EIS DMC selector switch

NORM : DMC 1 supplies data to PFD 1, ND 1, and the upper ECAM DU.
DMC 2 supplies data to PFD 2, ND 2, and the lower ECAM DU.
CAPT 3 : DMC 3 replaces DMC 1.
F/O 3 : DMC 3 replaces DMC 2.

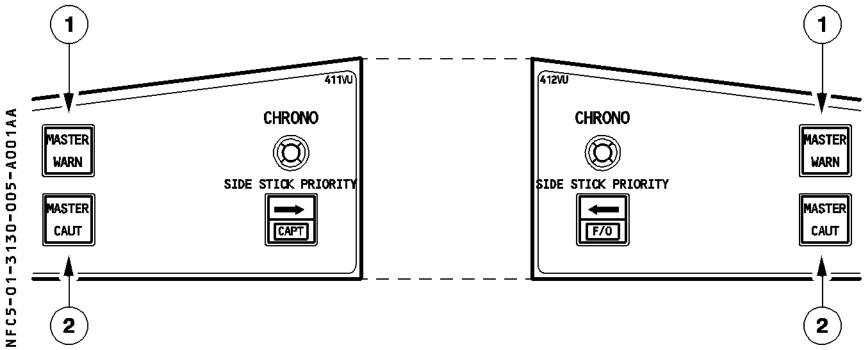
Note : If a DMC fails, each of its associated DUs displays a diagonal line.

R (2) ECAM/ND transfer selector switch

R Transfers the system/status display to either the Captain's or the First Officer's ND.

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

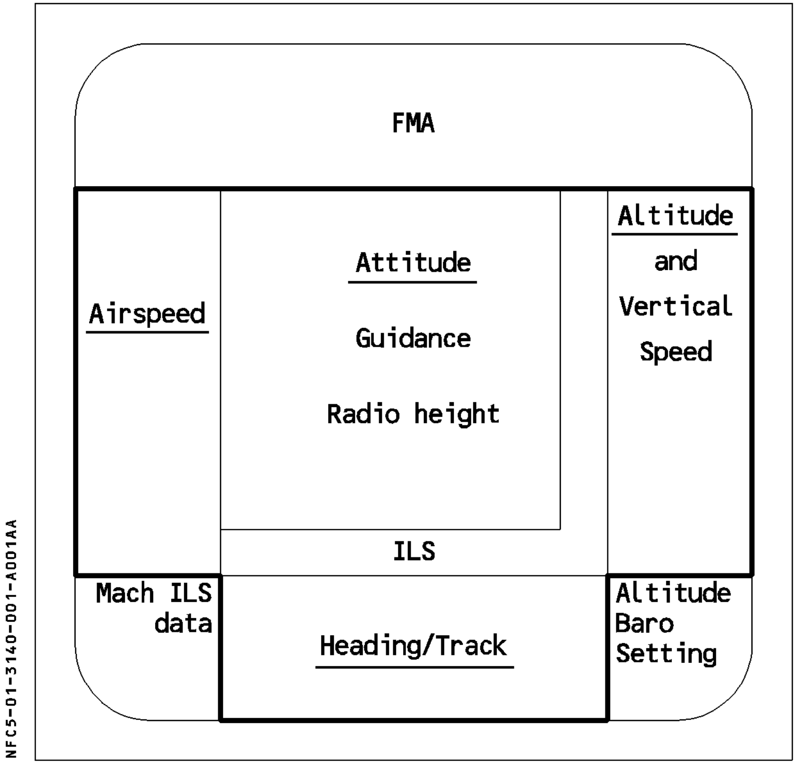
- Light up steady amber for a level 2 caution.
- Accompanied by a single chime.

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.
- The pilot presses the EMER CANC pushbutton on the ECAM control panel.

GENERAL

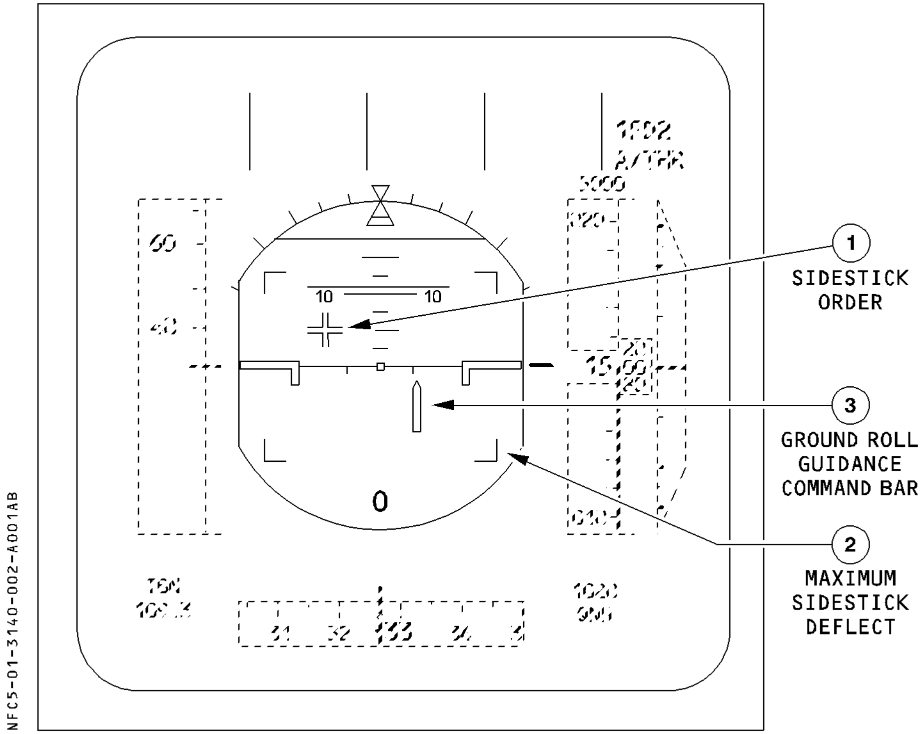
The Primary Flight Display gives the flight crew :
· Attitude and guidance information
· Airspeed
· Altitude (baro and radio) and vertical speed
· Heading and track
· FMGS modes (flight mode annunciator)
· Vertical and lateral deviations
· Radio navigation information (ILS, DME).



The FWC monitors main parameters such as attitude, heading, and altitude. See also "FLAGS AND MESSAGES DISPLAYED ON PFD" chapter.

R *Note : The speed, heading and altitude scales on the PFD have a gray background. If the ventilation for the avionics fails, this grey background is suppressed in order to prevent the PFD from overheating.*

SPECIFIC GROUND INDICATIONS



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).

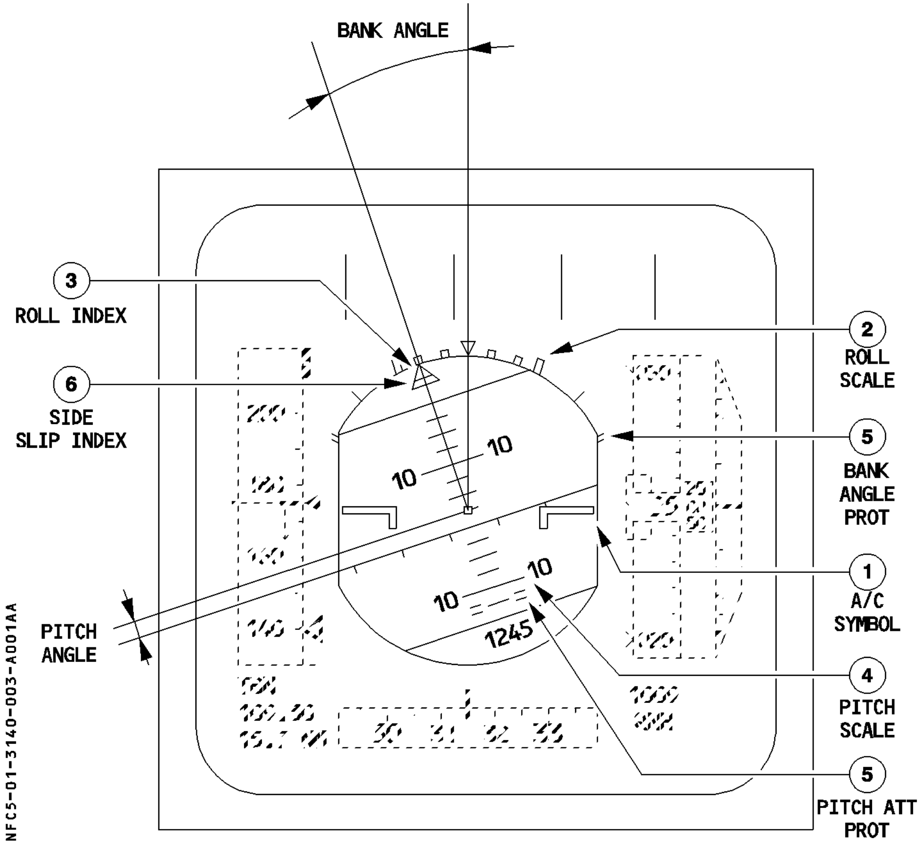
② Max Sidestick Deflection (white)

This is displayed, as soon as one engine is started.

③ Ground Roll Guidance Command Bar (green)

This symbol is displayed when the aircraft is on the ground, or below 30 feet radio
R altitude, provided a localizer signal is available. It shows the flight director yaw orders,
R to keep the runway centerline.

ATTITUDE DATA



(1) Fixed Aircraft Symbol

R This symbol is in black, and outlined in yellow. The yellow outline is dimmed if the crew
R selects TRK-FPA, unless the FMA is in the TOGA or FLX mode.

(2) Roll Scale

This scale is in 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 <u>Pitch Scale (white)</u>

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 <u>Flight Control Protection Symbols</u>

The display shows these symbols in green :
· on the roll scale at ± 67° 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 × replaces these symbols if the corresponding protection is lost.
R (Refer to 1.27.30)

⑥ <u>Sideslip Index (yellow)</u>

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.

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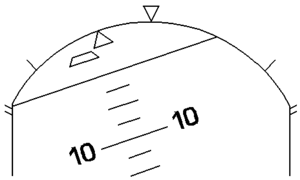
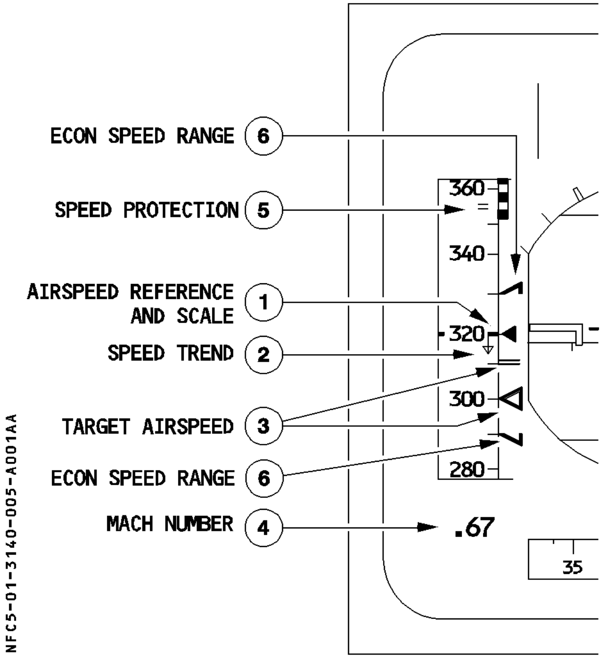


R In case of engine failure at takeoff or go around, the sideslip index changes from yellow to blue.

<u>Note</u> : 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 35%.
In this case the sideslip index is called β target.

When this index is centered with the roll index, the sideslip equals the sideslip target for optimum aircraft performance.

AIRSPEED



(1) Actual Airspeed Reference Line and Scale

R A white scale on a grey 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 FACs 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). The target speed is a magenta double bar (=) when associated with the ECON speed range. Otherwise it is a triangle (magenta or 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)

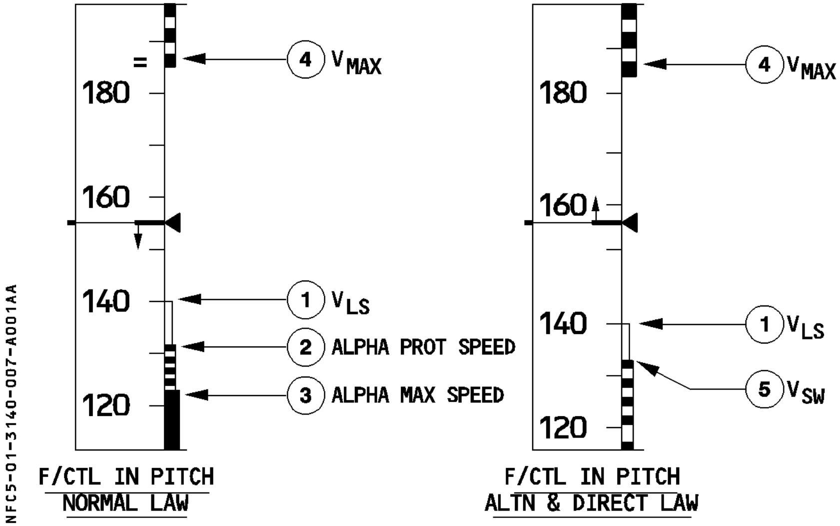
This is displayed when it is greater than 0.5.

⑤ Speed Protection (green)

This symbol indicates the speed (VMO + 6 kt or MMO + 0.01) at which overspeed
R protection becomes active. (Refer to 1.27.30)

R ⑥ ECON Speed Range (magenta)

R In descent mode with ECON/AUTO SPD mode active, these two half triangles replace the selected speed symbol. It shows the upper and lower limits calculated by the FMGC.
- The upper speed is target speed + 20 knots, limited to VMAX or VMO – 3 knots or MMO – 0.006, whichever is lowest.
  If a speed limit or a speed constraint applies, the upper margin is limited to ECON SPD + 5 knots.
R - The lower speed margin is the target speed – 20 knots, limited to green dot, F, S, or VLS, whichever is higher.



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 10 seconds 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
R becomes active (Refer to 1.27.20).
It is displayed when in pitch normal law.

③ Alpha Max Speed

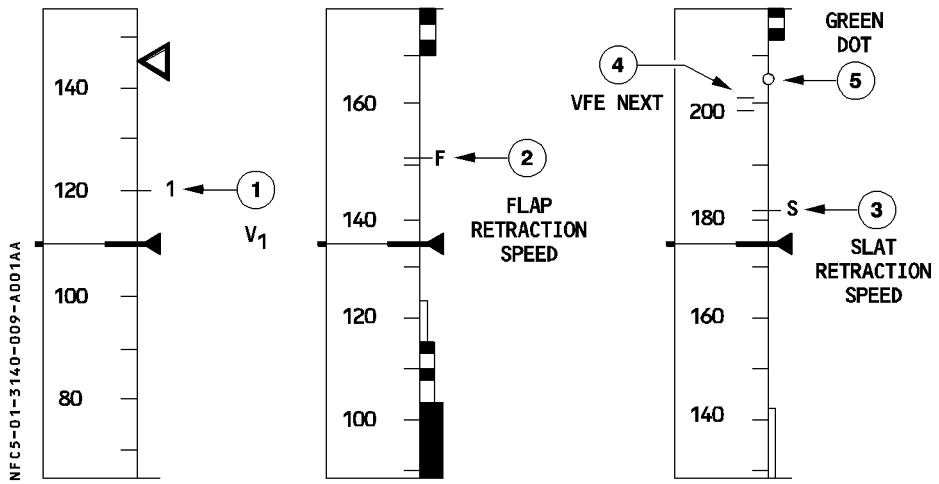
The top of a red strip along the speed scale indicates this speed. It represents the speed corresponding to the maximum angle of attack that the aircraft can attain in pitch normal
R law (Refer to 1.27.20).
It is displayed when in pitch normal law.

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.
R 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.



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 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)

③ Minimum Slat Retraction Speed

This is a green symbol (letter S).
It appears when the flap selector is in position 1. (Refer to 3.04.10)

④ VFE NEXT

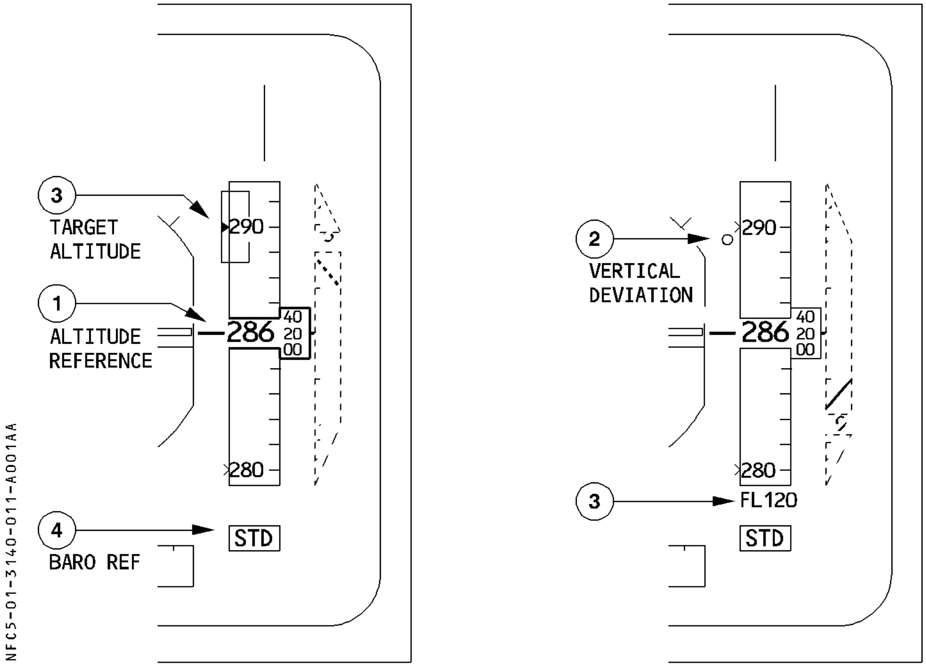
This symbol, an amber =, shows the VFE corresponding to the next flap lever position. It appears when the aircraft altitude is below 15,000 feet or 20 000 feet depending upon the FAC standard. (Refer to 3.04.10)

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.

ALTITUDE

R



(1) Altitude Indication

This appears both as a white moving scale, and as a green digital readout on a grey blackground. "NEG" appears in the window in white for negative values. 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) Vertical Deviation (magenta)

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 final intercept altitude.
The pilot can read the VDEV directly from the altitude scale. The range is ± 500 feet. When the VDEV value exceeds ± 500 feet, the symbol stays at the range limit and the PROG page displays the exact value.

R ③ Target Altitude or Selected Flight Level Symbol (blue)

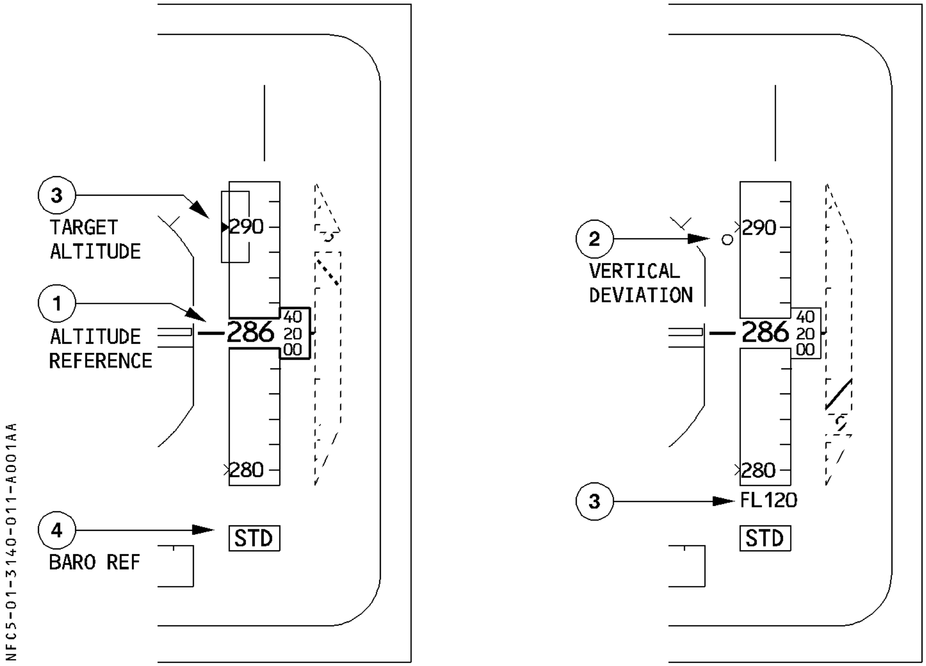
This symbol shows the FCU selected altitude (if QNH baro reference is selected) or the selected flight level (if STD baro reference is selected.)
When the FMGC operates in the vertical managed mode, this symbol is magenta if it represents a flight plan altitude constraint that the FMGC will follow. If 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 underneath the scale.

R ④ 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
R feet radio height if transition level is not available).

R

ALTITUDE



(1) Altitude Indication

This appears both as a white moving scale, and as a green digital readout on a grey blackground. "NEG" appears in the window in white for negative values. 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) Vertical Deviation (magenta)

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 final intercept altitude.
The pilot can read the VDEV directly from the altitude scale. The range is ± 500 feet. When the VDEV value exceeds ± 500 feet, the symbol stays at the range limit and the PROG page displays the exact value.

(3) Target Altitude or Selected Flight Level Symbol (blue)

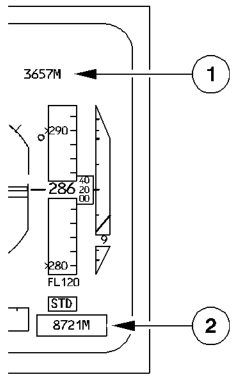
This symbol shows the FCU selected altitude (if QNH baro reference is selected) or the selected flight level (if STD baro reference is selected.)
When the FMGC operates in the vertical managed mode, this symbol is magenta if it represents a flight plan altitude constraint that the FMGC will follow. If 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 underneath the scale.

(4) 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).

METRIC ALTITUDE INDICATION

If metric reference is selected on the FCU two additional symbols are displayed on PFD.



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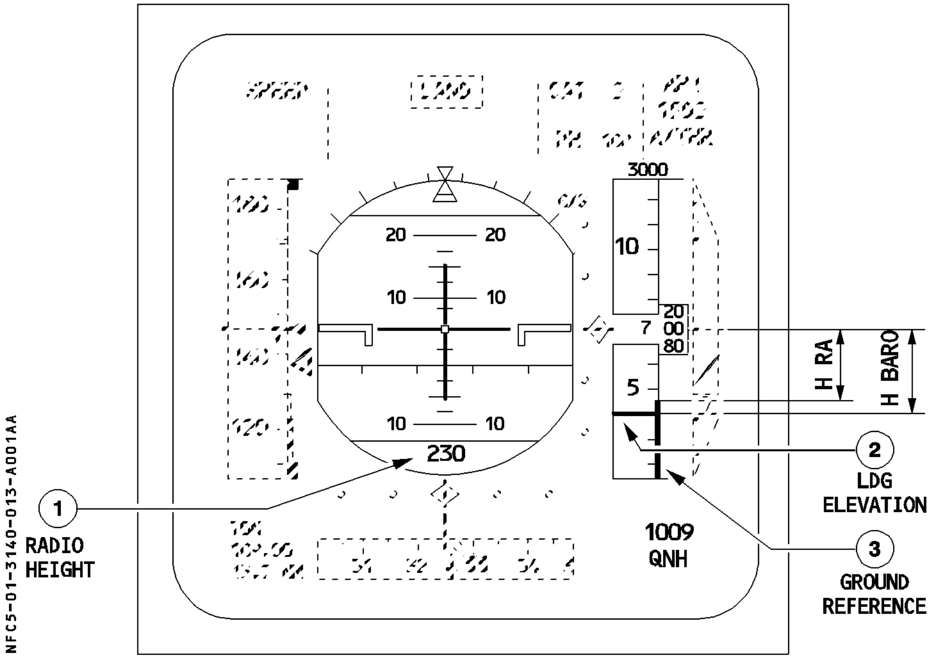
(1) Target altitude or selected flight level (magenta or blue)

The display shows the selected altitude value in meters.

(2) Altitude indication (green)

The display shows the actual aircraft altitude value in meters.



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 feet < RA < 2500 feet
  · in amber when RA < DH + 100 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 feet < RA < 2500 feet
  · in amber when RA ≤ 400 feet

The radio altitude indication changes every 10 feet down to 50 feet, then every 5 feet down to 10 feet, then every foot.

(2) Landing Elevation (blue)

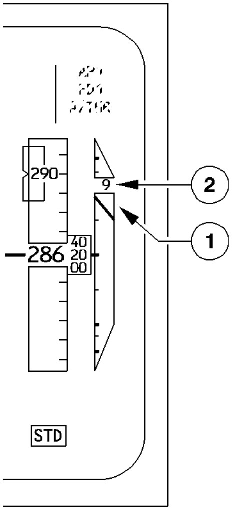
The horizontal bar on the altitude scale shows the landing elevation at the flight-planned destination.
It is displayed :
– during flight phases 7 and 8 and
– if the QNH reference mode is selected.

(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
R 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.
R



NFC5-01-3140-015-A001AA

① Analog pointer

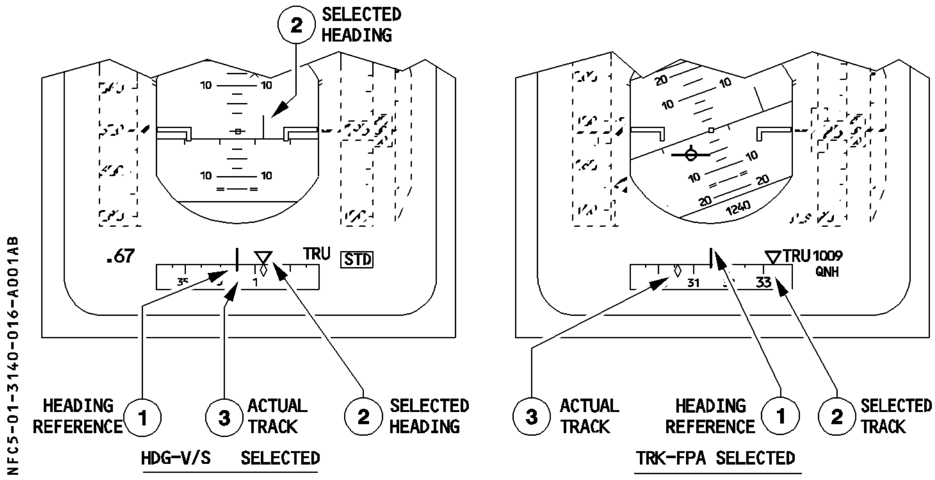
This pointer, which is normally green, points to a white vertical speed scale displayed on a grey background and graduated at intervals of 500 feet/minute.
If the V / S is greater than 6000 feet/minute, the pointer stays at the end of the scale.

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 feet < RA < 2500 feet, or
· V / S is greater than 1200 feet/minute, during descent and RA < 1000 feet.

Note : For TCAS, refer to 1.34.80.

HEADING



(1) Heading Reference Line and Scale

A white scale on a grey background moves in front of a fixed yellow reference line to show the actual magnetic heading.
“TRU” appears when the display shows true heading, instead of magnetic heading (latitude above 73° North or below 60° South).

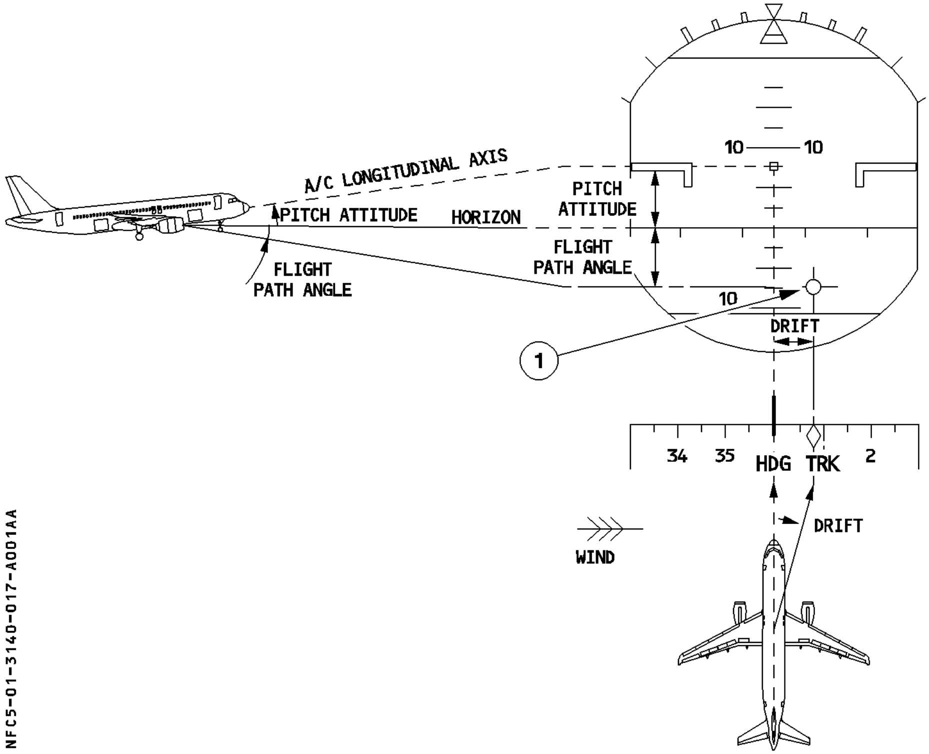
(2) Selected Heading or Track Index (blue)

R The pointer indicates the heading or track displayed on the FCU HDG-TRK window.
The index is replaced by digits on the right or left side of the scale when the selected value is off the scale.
R If the FD pushbutton switch is OFF a second heading/track symbol appears on the horizon line and markers are displayed every 10°.

(3) Actual Track Symbol

This symbol is a small green diamond.

FLIGHT PATH VECTOR



① Flight Path Vector (FPV)

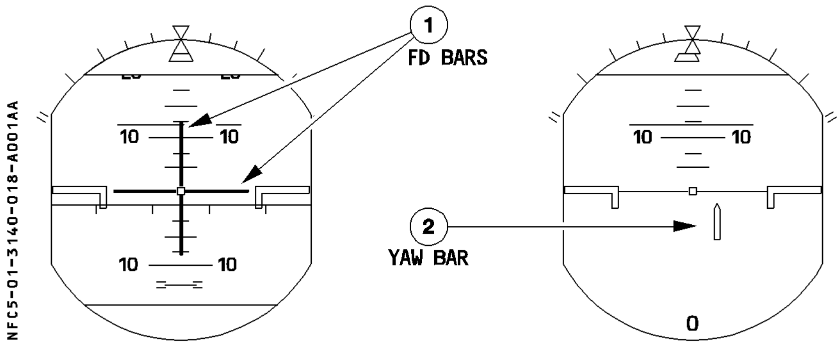
This symbol appears when the pilot selects TRK/FPA on the FCU.
The flight path vector represents the lateral and vertical trajectory of the aircraft with respect to the ground.
– On the lateral scale it indicates the aircraft's track.
– On the vertical scale it indicates the aircraft's flight path angle.
Example : The aircraft flies a track of 009 (heading 360°, wind from west) and descends with a flight path angle of – 7.5°.

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 (manual or automatic), or
– change of selected flight level when ALT CAPTURE mode is engaged, or
– loss of LOC or G/S in LAND mode or loss of LAND mode, or
– 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)
R – upon landing (in FLARE and ROLL OUT mode).



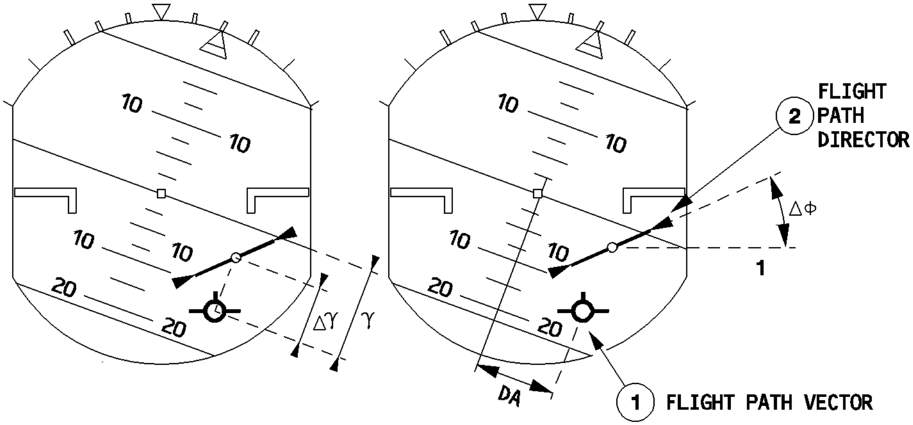
(1) FD Crossed Bars (green)

(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.

R



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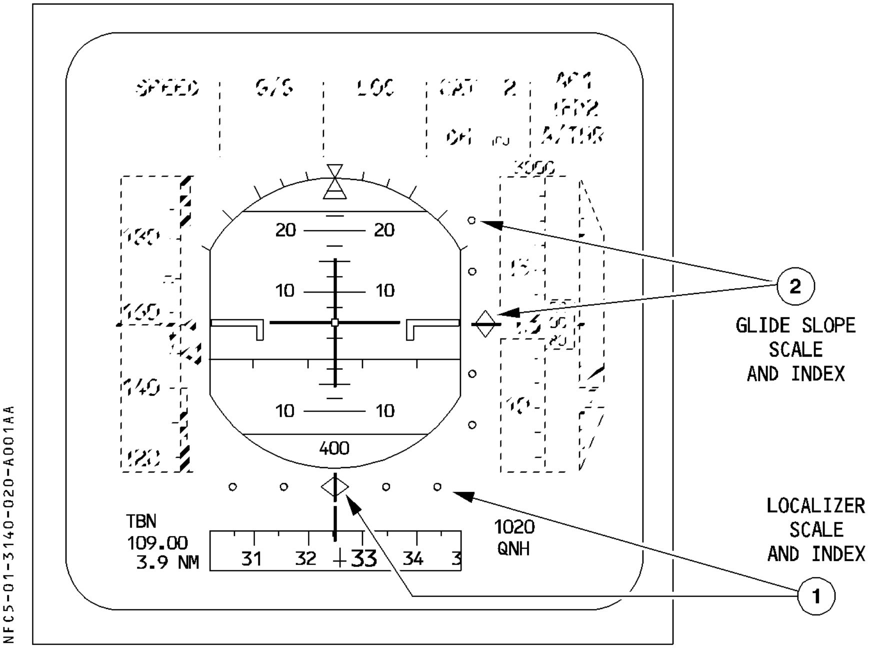
Υ REPRESENTS THE FLIGHT PATH ANGLE
DA REPRESENTS THE DRIFT ANGLE
ΔΥ REPRESENTS THE DIFFERENCE BETWEEN THE ORDERED FLIGHT PATH ANGLE AND THE ACTUAL ONE
ΔΦ REPRESENTS THE DIFFERENCE BETWEEN THE ORDERED ROLL ANGLE AND THE ACTUAL ONE

(1) Flight Path Vector (green)

(2) Flight Path Director (green)

TRAJECTORY DEVIATION

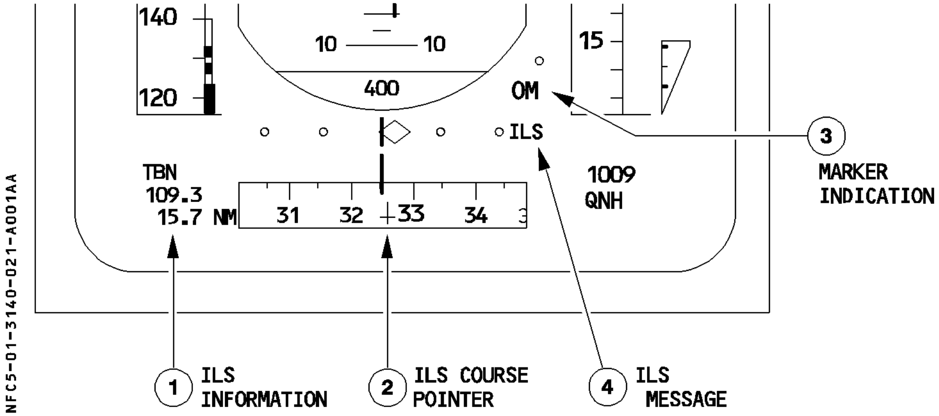
ILS APPROACH



1. Localizer Deviation Scale and Index

2. Glide Slope Deviation Scale and Index

Deviation scales appear as soon as the flight crew pushes an ILS 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 ± 0.8° on the localizer scale and ± 0.4° on the glide
R 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 ILS 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 ILS 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,
R when it is outside the displayed range of headings.

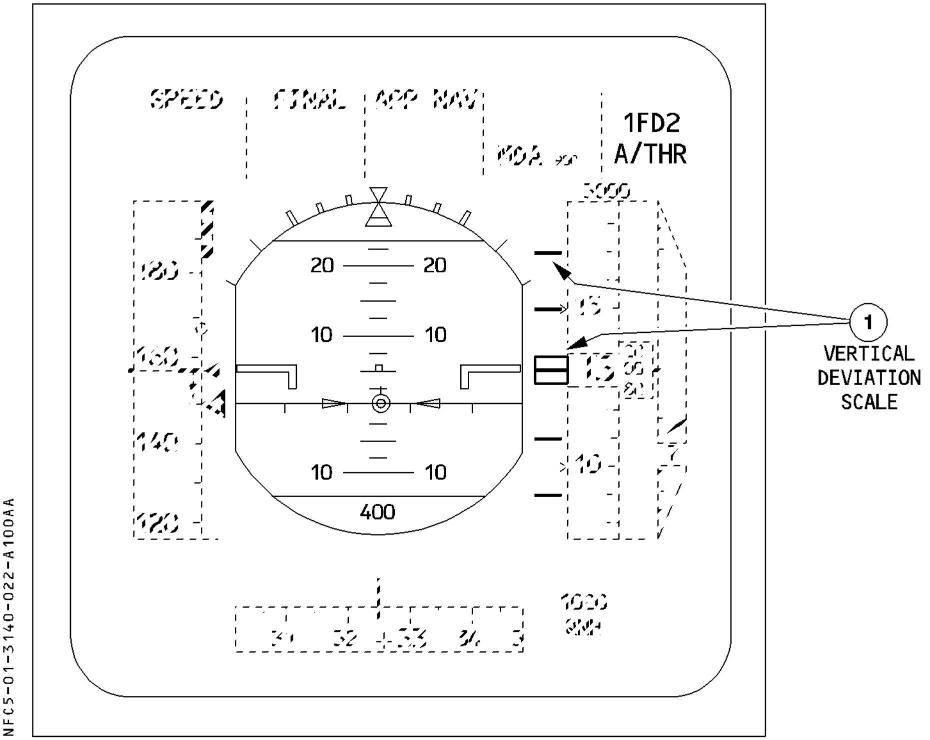
③ Marker Indications

OM appears in blue, when the 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

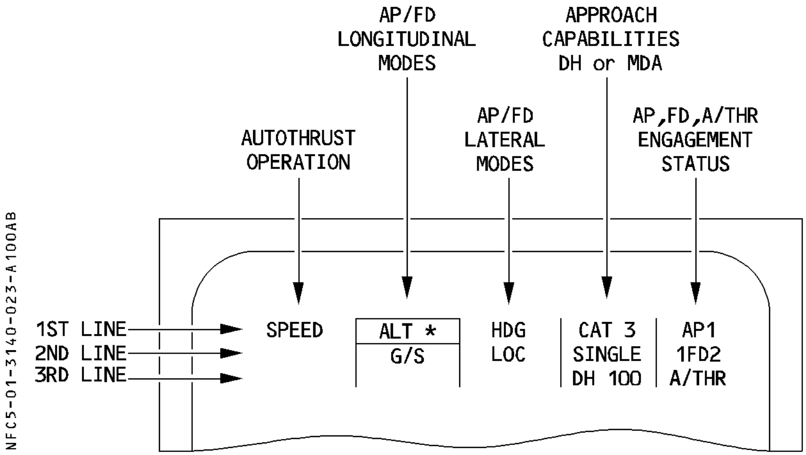


(1) Vertical Deviation Scale and Index

These symbols appear when in the approach phase and, when either FINAL is armed/engaged or a non-LS approach has been entered. They are displayed in the approach or go-around phase, until the MDA has been reached, or the MAP or the runway has been sequenced. They give the vertical deviation from the trajectory defined by the FMGC.
Each index scale graduation represents 100 feet. The range is ± 200 feet.

<u>Note</u> : · *If the ILS pushbutton is pressed, glide deviation has priority over vertical deviation information. As long as V/DEV display conditions are met, and the LS pushbutton is selected, an amber V/DEV message flashes above the glide scale.*

FLIGHT MODE ANNUNCIATOR

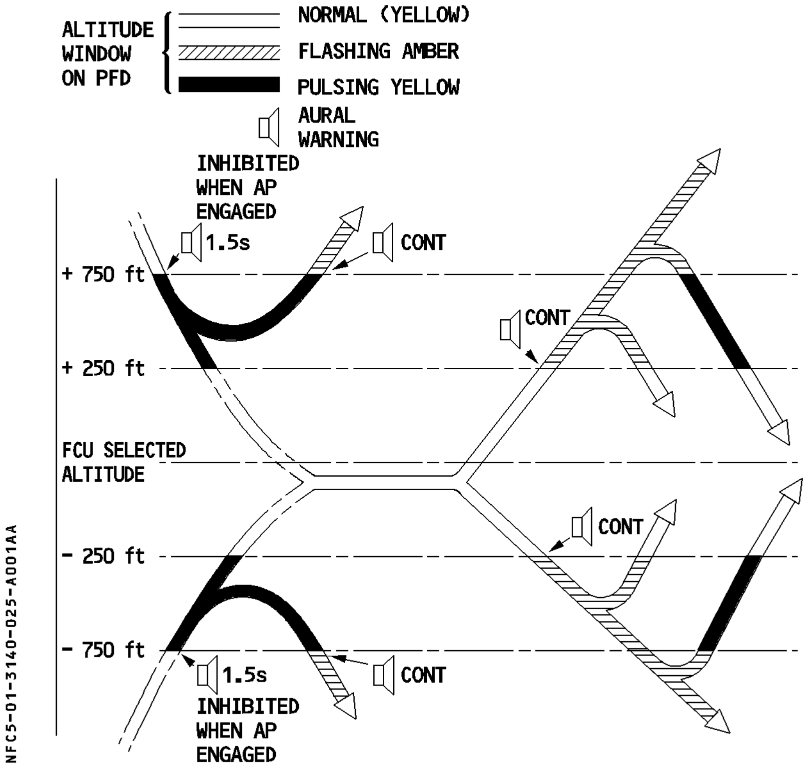


For a detailed discussion of legends and messages that may appear during FMGS operations, see FLIGHT GUIDANCE chapter (Refer to 1.22.30).

LEFT INTENTIONALLY BLANK

ALTITUDE ALERT

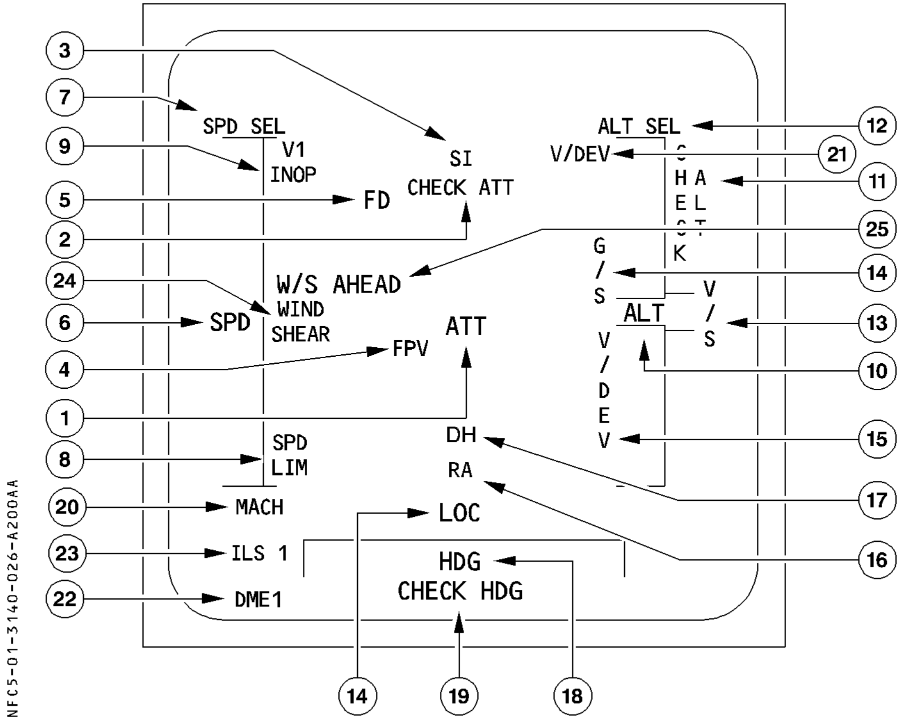
The FWC generates an altitude warning (C chord sound and altitude window of PFD pulsing yellow or flashing amber) when the aircraft approaches a preselected altitude or flight level or when it deviates from its selected altitude or flight level.
This warning results from a comparison between the altitude (ADIRS) and the preselected altitude displayed on FCU.



— The selection of a new altitude cancels the continuous C chord, as does the crew's pushing the EMER CANC pushbutton of the ECAM control panel or the pressing either MASTER WARN pushbutton.
— The selection of a new altitude stops the flashing of the altitude window.
— The altitude alert is inhibited :
 · when the slats are out with landing gear is selected down, or
 · in approach after the aircraft captures the glide slope, 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 (amber)

"CHECK ATT" appears when there is a disagreement (of a 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.

(3) SI flag (red)

If the sideslip information is lost or any reverse is deployed in flight, the index disappears and a red SI flag appears.

(4) FPV flag (red)

In the 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)

R This flag appears when both FACs are inoperative, or in case of SFCC dual flap/slat
R channel failure.
In this case, the following PFD information is lost : VLS, S, F, Green Dot, Vtrend, Vmax, VFE next, VSW.

(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, as does an ECAM caution, if the difference between the two PFD altitude indications is greater than 250 feet when QNH is selected, or 500 feet when STD is selected.
The caution and the flag disappears when the Pilot's and the Co-pilot's barometer or 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 the vertical deviation information fails, and the ILS pushbutton is not pressed, a V/DEV flag replaces the V/DEV scale.

(16) RA flag (red)

If both radio altimeters fail, this flag appears in place of the radio height indication.

(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°) between pilots'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 glide scale, this message flashes when in approach phase and, when either the FINAL mode is armed/engaged or a non-LS approach has been selected, and the LS pushbutton is selected.

R (22) DME 1 flag (red)

When DME distance is not available, a DME1 (on PFD1) or DME2 (on PFD2) flag replaces the DME distance indication.

R (23) ILS1 flag (red)

If an ILS frequency is not available, or if either the LOC or G/S signals fail, an ILS1 (on PFD1) or ILS2 (on PFD2) flag replaces the ILS frequency indication.

R (24) WINDSHEAR (red)

This message is displayed when the encounter of windshear is detected (reactive windshear warning).
The detection function is implemented in the FAC and is available when slats/flaps are extended as follows :
— At takeoff, from 5 seconds after lift off up to 1300 feet RA.
— At landing, from 1300 feet RA down to 50 feet RA.
It remains displayed at least 15 seconds after windshear detection, and is associated with an aural "WINDSHEAR" warning, which is repeated 3 times.

R (25) W/S AHEAD

This message is displayed, when the predictive windshear system has detected a windshear ahead of the aircraft.
The color of the message is amber or red, depending on the alert level. See PREDICTIVE WINDSHEAR SYSTEM (1.34.60).

Note : *1. All flags, except SI, V1 INOP and DME 1 (which are steady), flash for 9 seconds, then are steady.*
The DH flag flashes for 3 seconds, then is steady.
2. For information on the TCAS flag, refer to 1.34.80.

GENERAL

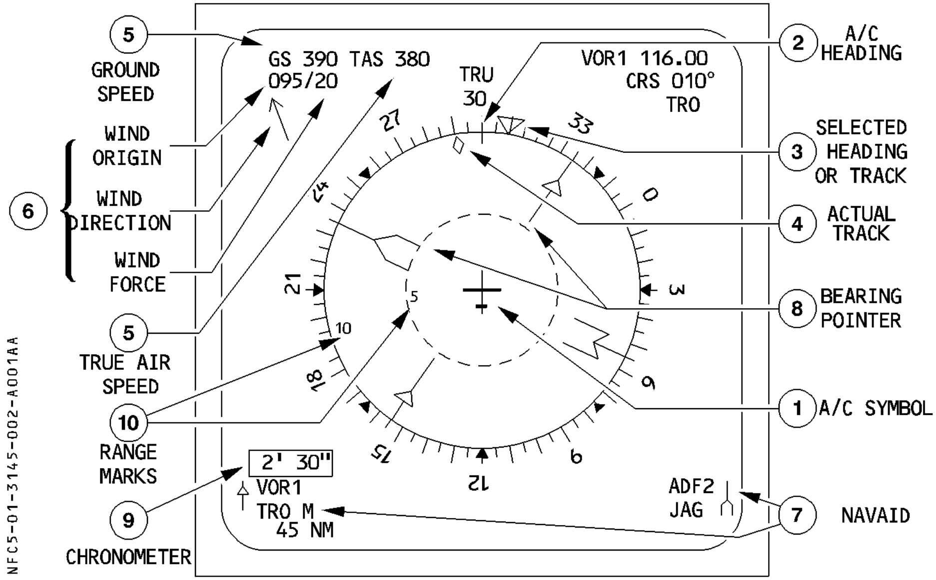
Five different displays are available (five modes to display navigation information) :
- ROSE ILS
- ROSE VOR
- ROSE NAV
- ARC
- PLAN

The navigation display (ND) can show a weather radar image in all modes except PLAN.

R *Note : The NDs do not show the weather radar image in order to limit their power*
R *consumption and to prevent them from overheating in case of insufficient avionic*
R *ventilation (blower and extract fans failure for example).*

ROSE MODES

R



1 Aircraft symbol (yellow)

Fixed and centered in the display, this symbol points to the yellow lubber line.

2 Aircraft heading

The fixed yellow lubber 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.
"TRU" appears at the top of the compass rose when it is displaying true heading instead of magnetic heading (latitude above 73° North or 60° South).

3 Selected heading or track (blue)

This pointer shows the heading or track indicated on the HDG TRK counter of the FCU.

4 Actual aircraft track (green)

This symbol is a small green diamond.

5 Ground speed and true air speed (green)

ADIRS furnishes these speeds.

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.
If the display does not receive either wind speed or direction, dashes replace the numbers on the display.

7 Navaids

When the ADF-OFF-VOR selector switch on either the pilot's or copilot'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 DME distance are never displayed at the same time.
- Mode of tuning
  - M for a navaid tuned manually 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 tuned automatically by the FMGC.

If reception fails, the ND stops displaying the associated data (except for the identification or frequency).

8 Bearing pointer (green for ADF, white for VOR)

This pointer appears when bearing data is available.
If the aircraft is not receiving the beacon or if a receiver fails, the associated bearing
R pointer disappears.

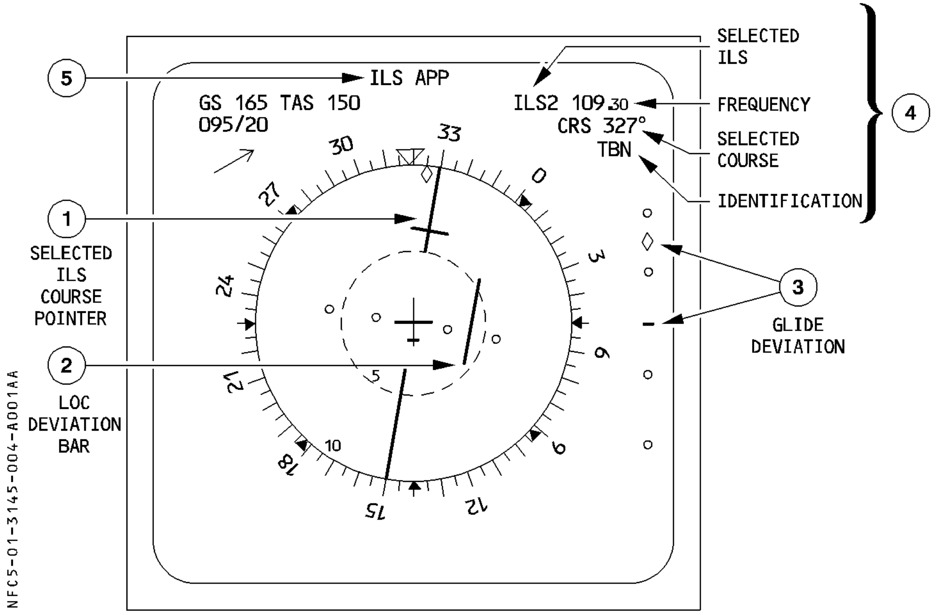
9 Chronometer Indication (white)

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").

R 10 Range marks

R The range scale value selected on the EFIS control panel (10 to 320 NM) governs the
R scale of the ND.

R **ROSE ILS 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. If no course has been entered, the value defaults to 360°.

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 ± 0.8°.
If the deviation becomes excessive (1/4 dot, 0.2°) 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 ± 0.4°.
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).

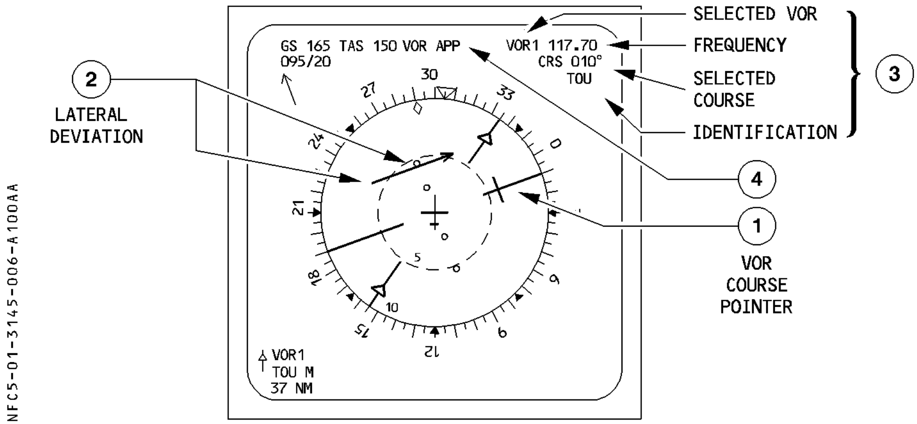
⑤ ILS APP message (green)

R This message appears when the flight crew has selected an ILS approach on the MCDU.

Note : ILS1 information appears on PFD1 and ND2.
ILS2 information appears on PFD2 and ND1.

ROSE VOR MODE

R



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
R 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.
R 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 (if decoded by the receiver), the selected course.

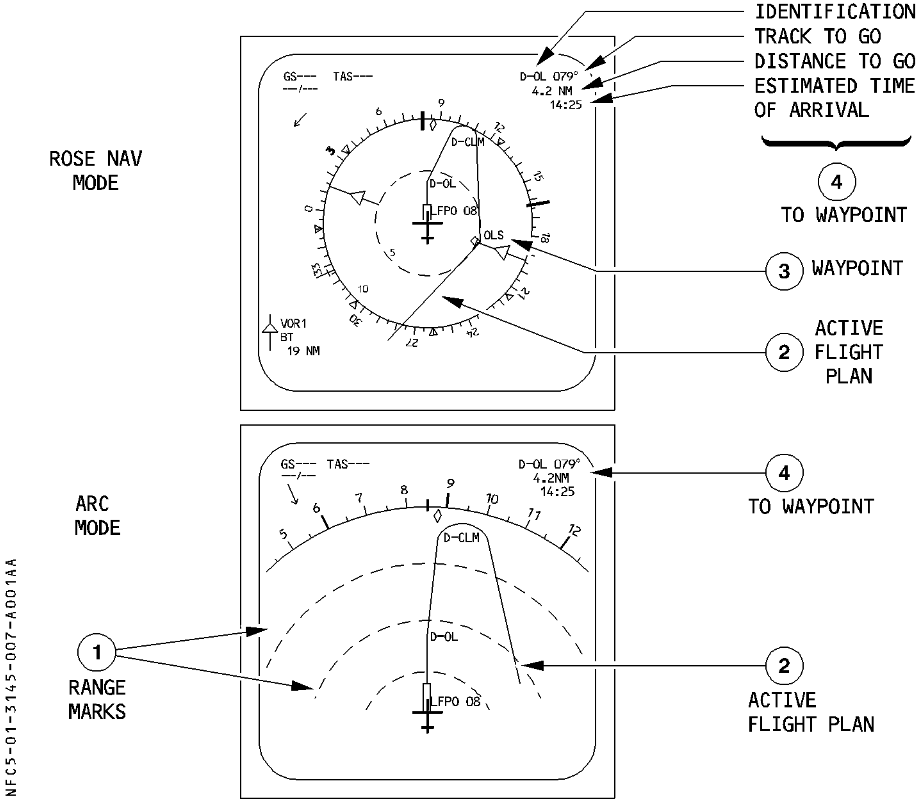
④ VOR APP or GPS APP Messages (green)

VOR APPR appears when the flight crew has selected a VOR approach on the MCDU.
GPS APP appears when the crew has selected a GPS approach.

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.

R



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 :

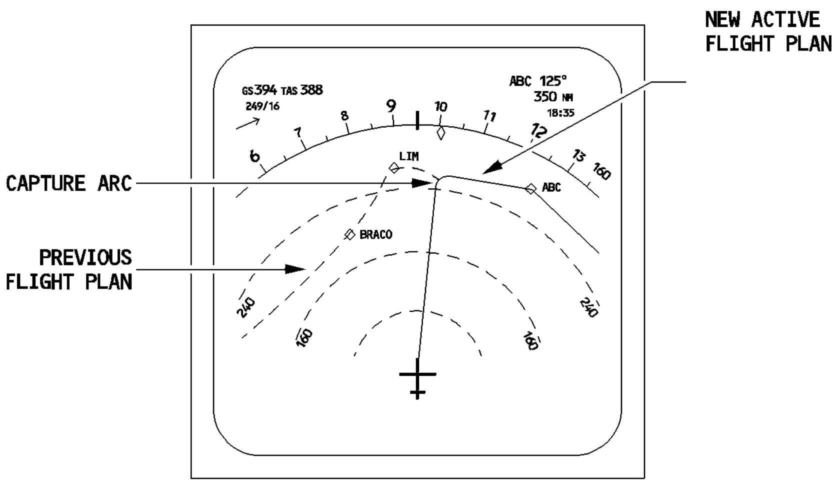
R · The active flight plan (the flight plan the aircraft is actually following when the NAV mode is engaged) is represented by a continuous green line. The ND shows only the part of the flight plan that is ahead of the aircraft, as well as the waypoints that are still to be overflown and the waypoint 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
R 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.



NFC5-01-3145-008-A001AB

(3) Waypoint

The ND can display various kinds of waypoints :

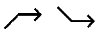
Flight plan waypoints

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.

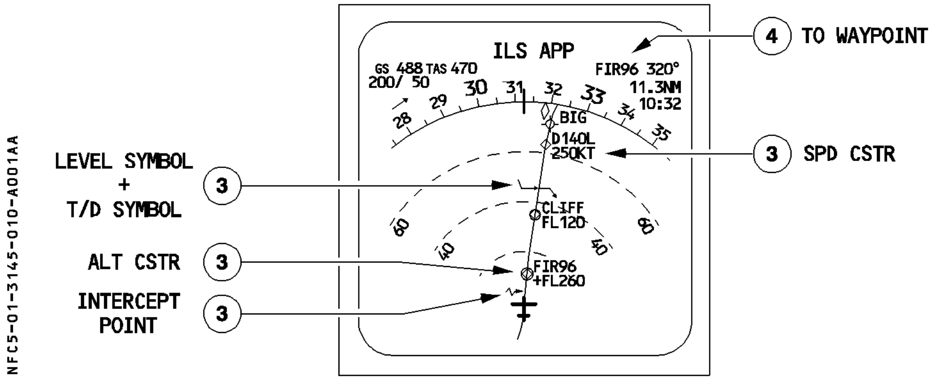
Pseudo waypoint

This is a point of the flight path where the aircraft is predicted to reach a selected altitude or speed.

R

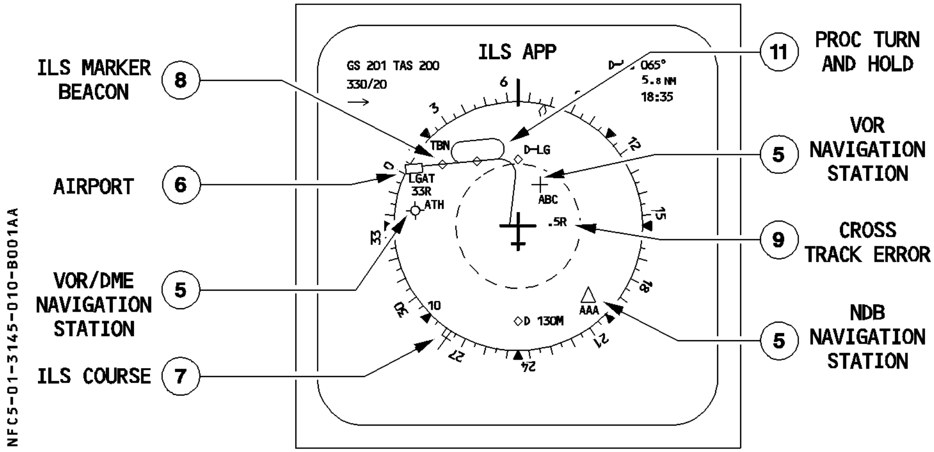
Pseudo waypoint	**Definition**
	Level symbol (top of climb or level-off position), when the aircraft reaches : · The FCU-selected altitude (blue). · The constrained altitude, if it is more restrictive than the FCU altitude, and if appropriate modes are engaged (magenta). · It does not appear when the aircraft is within 100 feet above, or below, the selected altitude.
	Top of descent symbol, or continue descent symbol : · White, if DES is not armed. · Blue, if DES is armed.
	Start of CLIMB symbol : · White, if CLB is not armed. · Blue, if CLB is armed.
	Intercept point symbol : · White, if only the NAV mode is engaged. · Blue, if DES mode is engaged. · Indicates the point at which the aircraft is predicted to intercept the descent path, if there is any vertical deviation while the aircraft is in DES mode.
●	Speed change symbol (magenta) : · Indicates the point at which the aircraft will start an automatic acceleration or deceleration from the current speed to a new computed speed for SPD LIM, SPD CSTR, or HOLDING SPD.
Ⓓ	Decelerate point symbol (magenta) : · Indicates where the aircraft will start an automatic deceleration toward VAPP (and thus switch to the approach phase). Although the symbol is always displayed, automatic deceleration only occurs if in managed speed, and NAV or approach mode is engaged.
○	ALT CSTR symbol set around the constrained waypoint : · Magenta, when the ALT CSTR is predicted to be satisfied. · Amber, when the ALT CSTR is predicted to be missed. · White, when the ALT CSTR is not taken into account by the guidance, and NAV mode is engaged.
	ENERGY CIRCLE symbol (green arc) : · Is centered on the aircraft position and oriented to the current track line. · Represents the Required Distance to Land. · Only displayed in the descent and approach phases, when a selected lateral mode is engaged (HDG or TRK).

③ Waypoint (cont'd)



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.



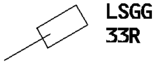
5 Navaids

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).

6 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.

NFC5-01-3145-011-A001AA



The runway is drawn to scale (paved lenght) 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.

7 ILS Course (Magenta)

When the pilot pushes the ILS pushbutton switch on the EFIS control panel, and if an ILS station has been selected, the display shows an ILS course symbol.

8 ILS Marker Beacons

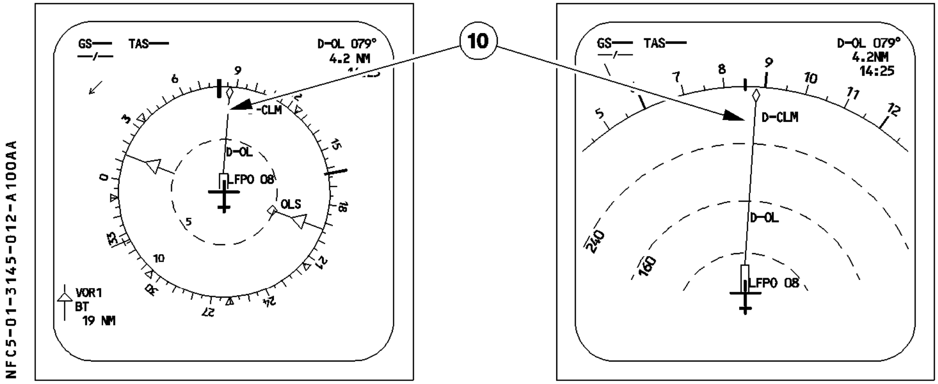
The screen shows these as waypoints (diamonds).
When the aircraft overflies a marker beacon, the corresponding symbol flashes :
Blue for the outer marker.
Amber for the middle marker.
White for the inner marker.

⑨ Cross Track Error

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.

⑩ Track line

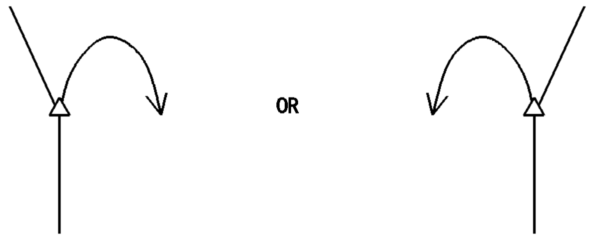
This line appears in green only in the ROSE NAV or ARC mode when HDG or TRK has been selected on the FCU.



(11) Procedure turns and holding patterns

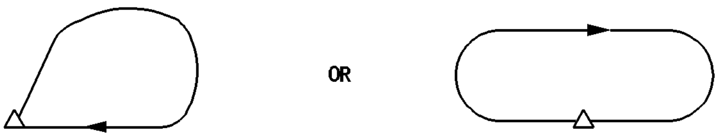
These appear only when they are part of the flight plan. For the 160 and 320 NM range scales, each one is represented by a white arrow that originates at the associated fix and indicates the direction of the turn.

NFC5-01-3145-013-A001AA



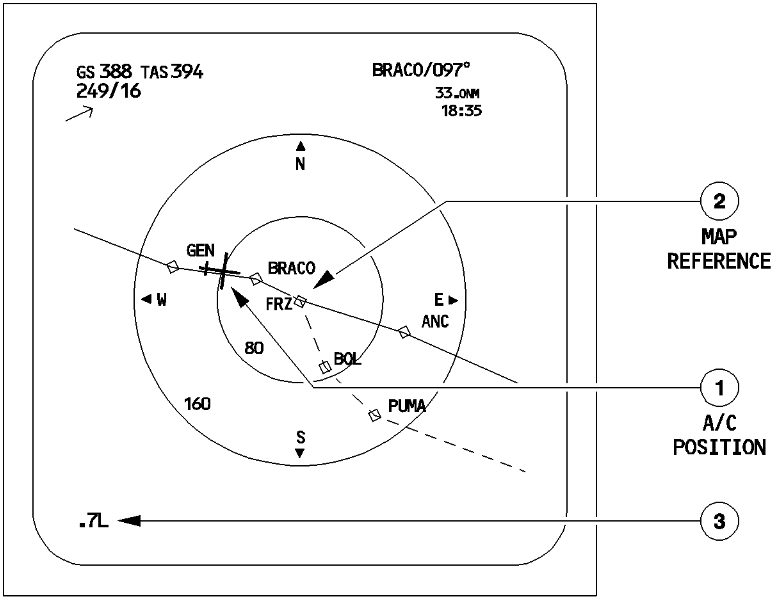
For shorter range scales and if the procedure turn or the holding pattern is in the next or the active leg, the display shows the full circuit or pattern.

NFC5-01-3145-013-B001AA



PLAN MODE

This mode displays statically the flight plan legs on a map oriented to true north. The map is centered on a map reference point that the pilot chooses 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 be either 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).
R Data on navaids and their characteristics and associated bearing pointers are not available
R in this mode.



NFC5-01-3145-014-A001AA

(1) Aircraft Position and True Track

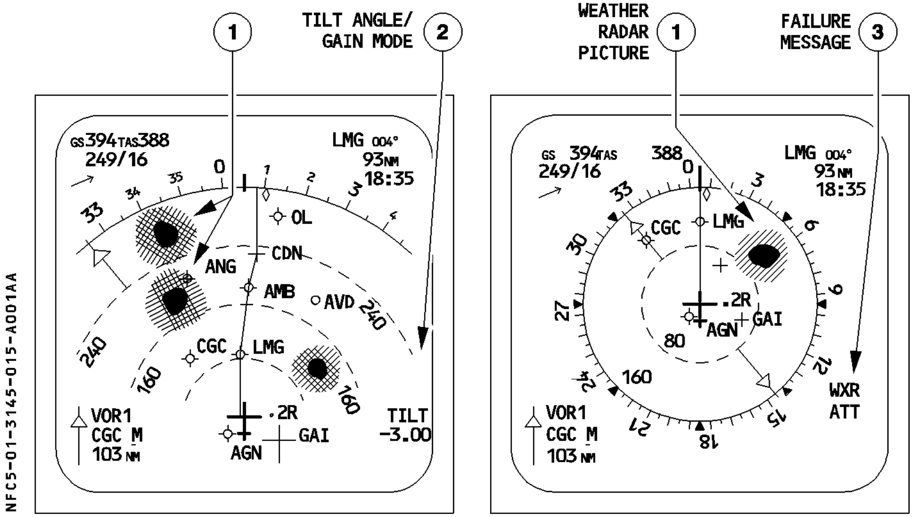
The orientation of the yellow aircraft symbol always indicates the true track of the aircraft. Its position represents the aircraft position given by the FMGS.

(2) Map Reference Point

(3) Cross Track Error

See ROSE NAV MODE/ARC MODE chapter.

WEATHER RADAR



R ① Weather radar picture

The ND presents the weather radar image when the radar is operating and the ND is not in PLAN mode.
The echoes appear in different colors : black, green, yellow, red, or magenta, according to the precipitation rates.
The refresh rate for the presentation depends on the range selected for the ND.

R ② Tilt angle and gain mode

The antenna tilt angle appears in degrees and quarters of a degree in the lower right corner of the screen (blue). It is the angle between the horizon and the radar beam axis.
When selected, the MAN calibration mode appears in green.

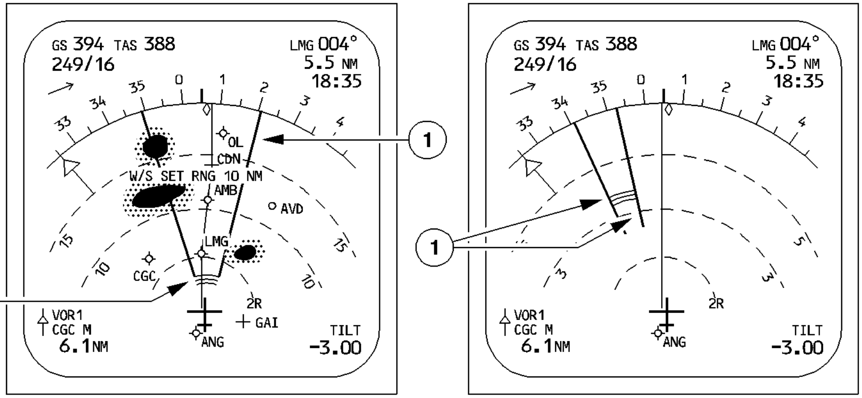
③ Failure messages

The ND lists failures detected in the system. If there is a "red" failure, the screen does
R not display a radar image. If the message is in "amber", the image is not affected.

WXR RT (red)	for a radar transceiver failure.
WXR ANT (red)	for a radar antenna failure.
WXR CTL (red)	for a radar control unit failure.
WXR RNG (red)	for a range error.
WXR WEAK (amber)	for a calibration failure.
WXR ATT (amber)	for an attitude control failure.
WXR STAB (amber)	for an antenna stabilization failure.

PREDICTIVE WINDSHEAR SYSTEM

R

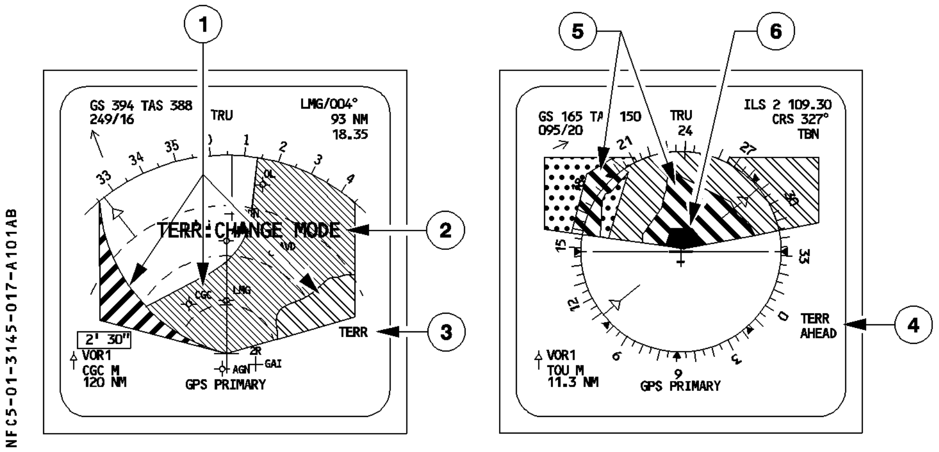


NFC5-01-3145-016-A100AA

(1) Predictive windshear area indication

The predicted windshear area is indicated by a red and black icon and two yellow radial lines. Windshear information is available in ARC and ROSE ND modes.
When the ND range is set above 10 NM, a W/S SET RNG 10 NM (Windshear, set range 10 NM) message appears, requesting the crew to adjust the ND range. It is displayed even if the weather radar is switched off, provided the WINDSHEAR switch on the weather radar panel is set to AUTO.
Depending on the windshear alert level, ND indication may be completed with a PFD message (Refer to 1.31.40).

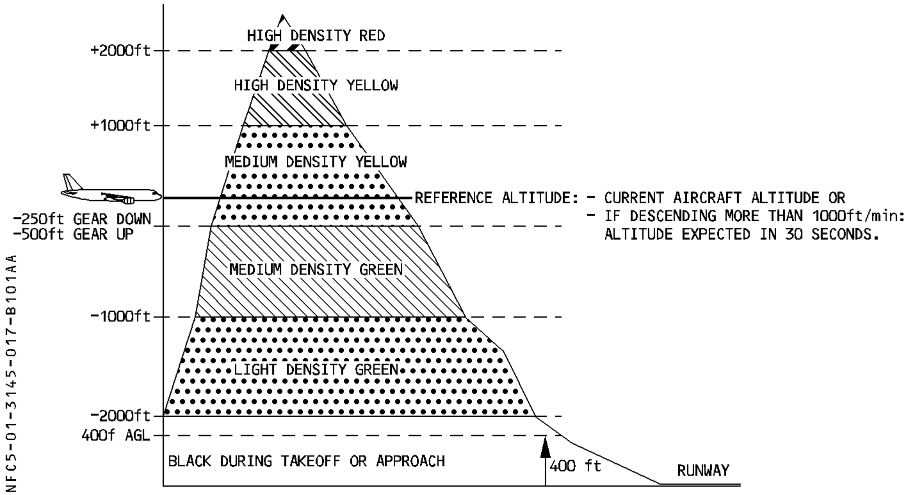
EGPWS



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 mode. The terrain picture replaces the weather radar image.

The terrain appears in different colors and densities, according to its relative height :



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 ND 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

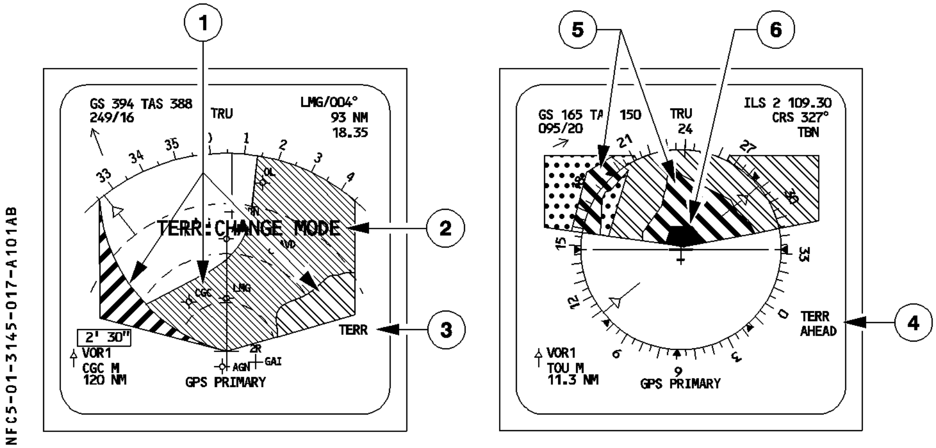
Generated when a conflict exists between the terrain caution envelope, ahead of the aircraft, and the terrain data stored in the database. The conflict area is shown in solid yellow.

(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's
R *pushbutton ON light comes on.*

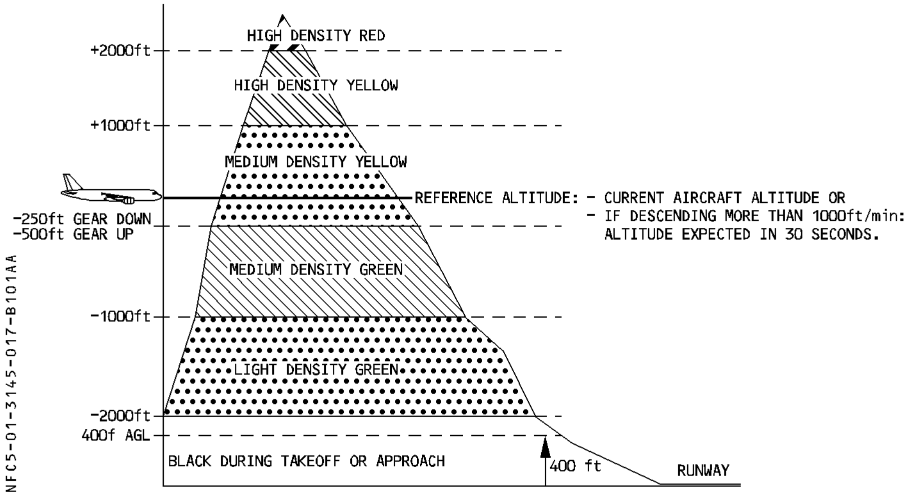
EGPWS



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 mode. The terrain picture replaces the weather radar image.

The terrain appears in different colors and densities, according to its relative height :



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 ND sides.

(4) Warning and caution messages

TERR AHEAD or OBST AHEAD (amber) : For a caution.
TERR AHEAD or OBST 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 or obstacle caution alert

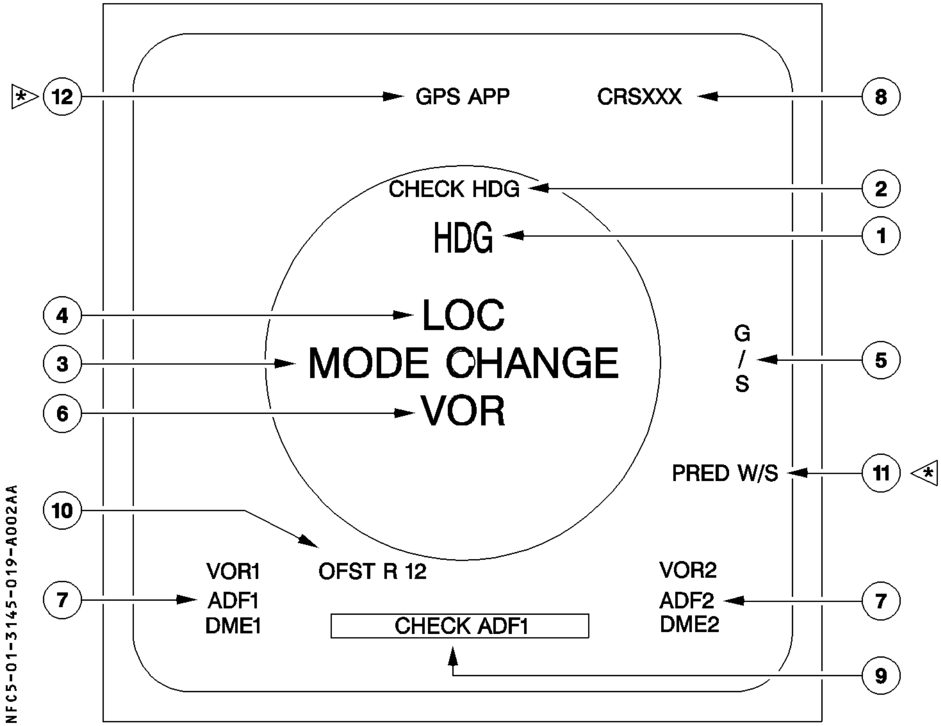
Generated when a conflict exists between the terrain caution envelope, ahead of the aircraft, and the terrain/obstacles data stored in the database. The conflict area is shown in solid yellow.

(6) Terrain or obstacle warning alert

Generated when a conflict exists between the terrain warning envelope, ahead of the aircraft, and the terrain/obstacles 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's*
R *pushbutton ON light comes on.*

FLAGS AND MESSAGES DISPLAYED ON ND



(1) HDG Flag (red)

If the heading data fails, the rose, arc and associated symbols disappear.
A HDG flag flashes for nine seconds, then remains steady in the upper part of the ND.

(2) CHECK HDG Flag (amber)

When the flight warning computer detects a discrepancy (5°) between sides 1 and 2, a CHECK HDG flag appears on both NDs, and a caution appears on the ECAM.

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 or
  - · The FMGC has failed or
  - · The FMGC has delivered an invalid aircraft position.
- 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 message is displayed in the color corresponding to the windshear alert : red for a warning, amber for a caution.
- 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 for a warning, or amber for a caution.

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.
This message is also displayed when a very long leg exists in the flight plan. A leg is considered as "very long" when the starting point (or endpoint) is located at more than 45° from the aircraft location (45° of longitude or latitude).
This DMC limitation results from a compromise between accurate drawing precision and maximum leg length that can be displayed.

NAV ACCUR UPGRAD, or (white) NAV ACCUR DOWNGRAD (amber) : Signals a change in navigation accuracy.

SPECIFIC VOR/D UNAVAIL (amber) : If the navaid, which is tuned for the selected approach or departure, is not available.

SET OFFSIDE RNG/MODE (amber) : Displayed on ND1(2), in case of an FMGC1(2) failure when the two ND ranges or modes selected on the EFIS control panels are different.

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 not clearable by pilot action.

R ↓ (green) : Overflow arrow, displayed when more than one of the
R following messages are present at the same time :
R – NAV ACCUR DOWNGRAD
R – NAV ACCUR UPGRAD
R – SPECIF VOR/D UNAVAIL
R – MAP PARTLY DISPLAYED
R – SET OFFSIDE RNG/MODE
R – GPS PRIMARY ◁*
R – GPS PRIMARY LOST ◁*

Note : For information about the TCAS messages, refer to 1.34.80.

(10) OFST R(L) XX message (yellow)

The screen displays this message when a temporary or an offset flight plan is entered. The offset value is given in NM.

Note : For information about the TCAS messages, refer to 1.34.80.

(11) PRED W/S flag (amber) ⊲*

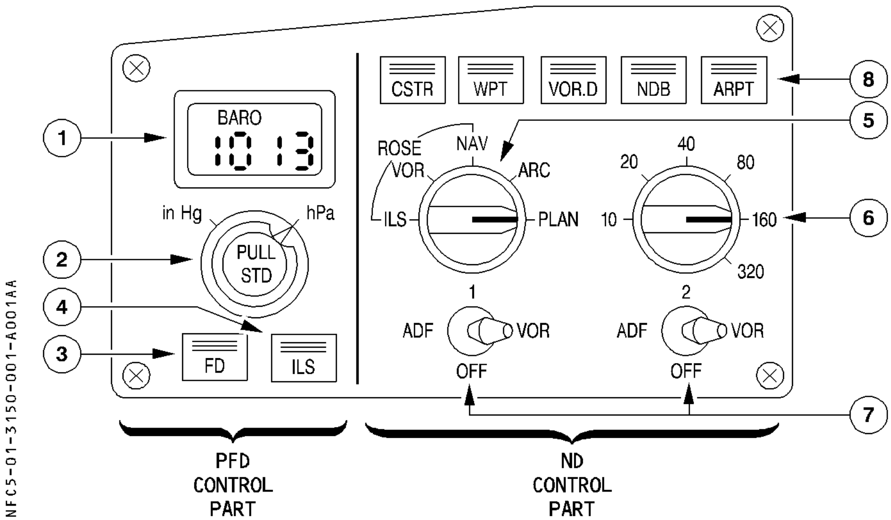
The WINDSHEAR switch on the weather radar panel is set to AUTO, and a Predictive Windshear System fault is detected. This message appears on ground, or when flaps and slats are extended.
It is associated with a single chime. The radar image remains available, provided the fault does not affect the radar mode.

(12) GPS APP (green) ⊲*

This message is displayed when a GPS approach has been selected.

EFIS CONTROL PANEL

R



(1) Barometer Reference Display Window

Range : 745 hPa to 1050 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 unit selected 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 unit selected.
· 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 displayed.

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 the green pushbutton light comes on.

R 4 ILS (or 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

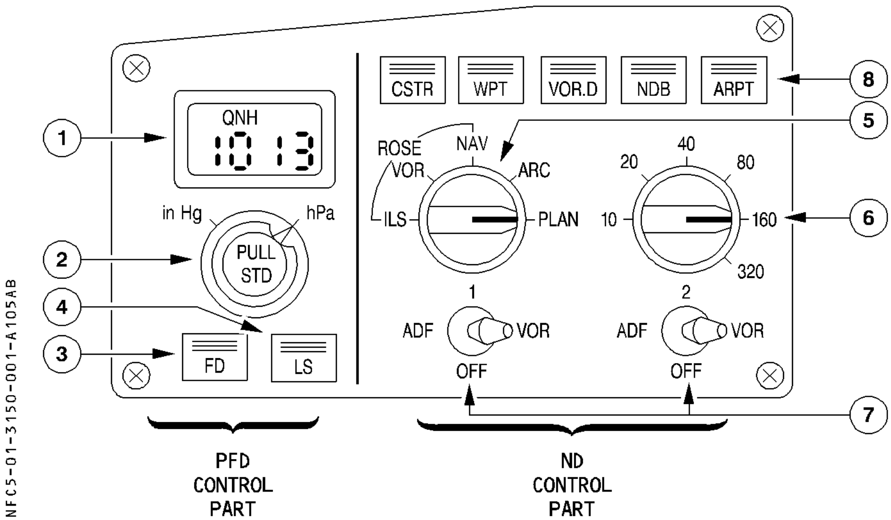
These switches select ADF or VOR bearing pointers and DME distance on the onside ND, as well as the corresponding navaid data characteristics in any mode except PLAN mode.

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.
Only one option can be activated at a time.

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 unit selected 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 unit selected.
· 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 the green pushbutton light comes on.

R ④ ILS (or 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.

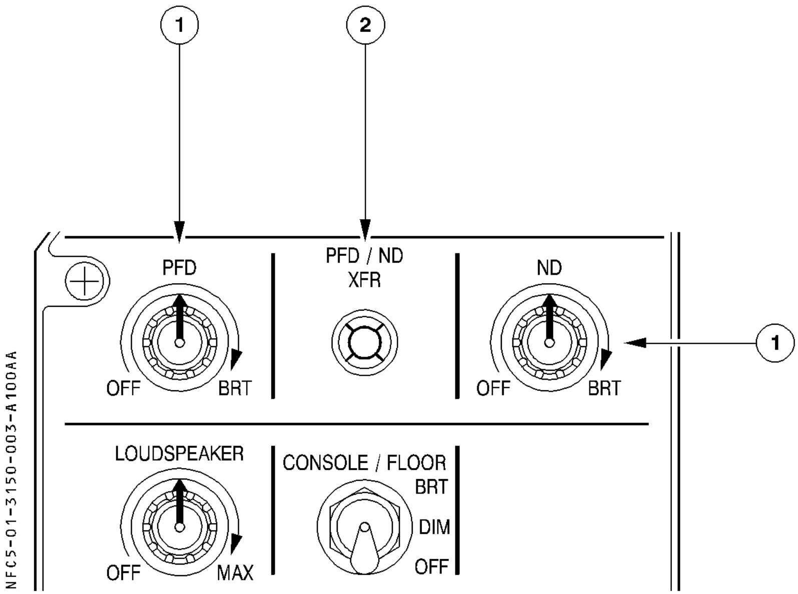
⑦ ADF-VOR Select Switches

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.
Only one option can be activated at a time.

OTHER EFIS CONTROLS



(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

R The outer knob controls the brightness of both the weather radar image and the EGPWS
R terrain display.

The inner knob controls the general brightness of the ND symbols.

Rotating this knob all the way counterclockwise switches off the NDU.

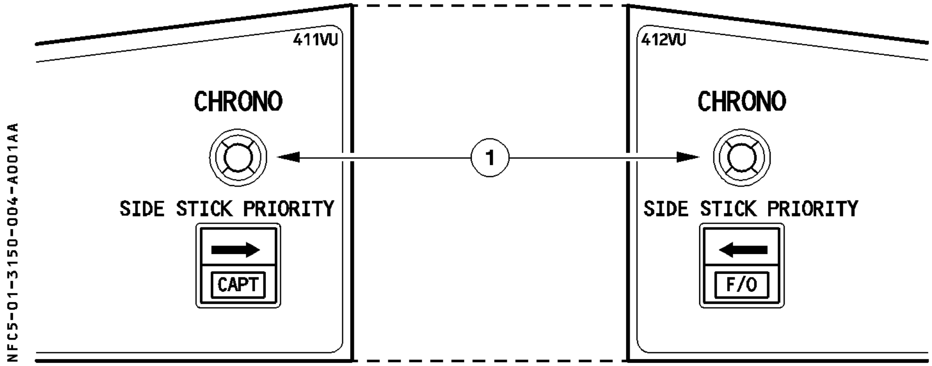
(2) PFD/ND XFR Pushbutton

Pushing this button interchanges the PFD and the ND.

If the PFDU fails, the PFD automatically transfers to the NDU.

CHRONOMETER

R



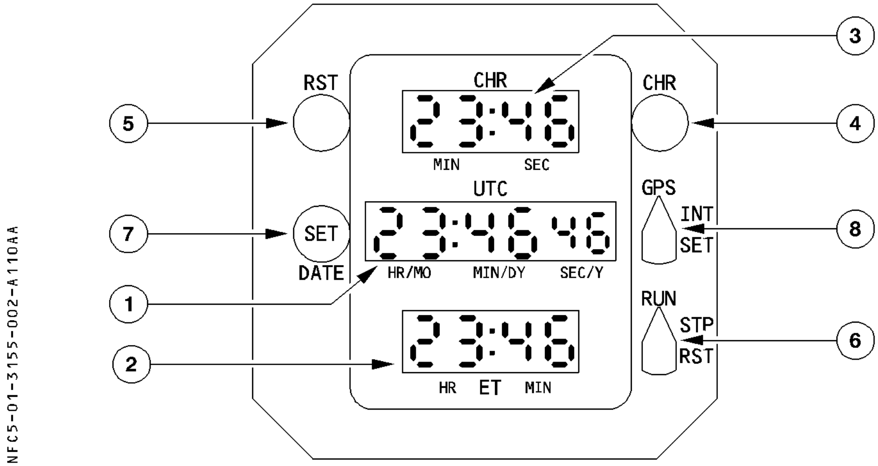
① CHRONO Pushbutton

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.

GENERAL

R 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 performs four functions :
- It displays "UTC" (GMT) time in hours, minutes and seconds 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 from 0 to 23 hours 59 minutes 59 seconds.

(2) Elapsed Time (ET) counter

This counter registers the aircraft's flight time from 0 to 99 hours 59 minutes.

(3) Chrono (CHR) counter

This counter registers elapsed time from 0 to 99 minutes 59 seconds. It is controlled by the CHR pushbutton.

4 CHR pushbutton

First push : starts the CHR counter
Second push : stops the CHR counter, keeps the display at its last indication.

5 Reset (RST) pushbutton

When pressed, the CHR counter restarts from 0 if the chrono is running.

6 ET selector

"RUN" : the ET counter starts
"STP" : the ET counter stops counting
spring loaded "RST": the ET counter is blanked. The selector returns to its STP position when the selector is released.

Note : A cumulative elapsed time can be realized by alternatively setting this switch in "RUN" and "STP" position.

7 DATE/SET button

First push : sets the clock to date mode. The UTC time display is replaced by the date (day month year).
Second push : sets the clock to time mode. The date display disappears.

Note : in order to select the date mode, the UTC selector must be set on "GPS" or "INT" position.

(8) UTC selector

"GPS": Time (or date, if selected) is displayed, and this data is synchronized on GPS information.

Note : – If the signal between the GPS and the clock is not detected, dashes are displayed. Only the "INT" and "SET" positions are then available.
– If the signal is detected, but GPS data is invalid, the clock automatically runs on its internal time.
R *– The clock will automatically resynchronize on the GPS information, as soon as*
R *the GPS data becomes available.*

"INT": Internal time (or date, if selected) is displayed.

R *Note : – The clock's internal time is always synchronized with the latest valid GPS*
R *information.*
R *– If there is no valid GPS information at power up, the internal time will be*
R *00:00:00, until the clock is initialized, or until valid GPS information is present.*

R "SET": Allows the internal time and date to be initialized.

R **INTERNAL TIME AND DATE INITIALIZATION**

Set the UTC selector on "SET". The minute digits flash, and the seconds' digits are blank.
To increase data, turn the DATE/SET button clockwise.
To decrease data, turn the DATE/SET button counterclockwise.
– First, push on DATE/SET : To set the hour.
– Second, push on DATE/SET : To set the year.
– Third, push on DATE/SET : To set the month.
– Fourth, push on DATE/SET : To set the day.
Switch the UTC selector to the "INT" position, and the clock starts with the seconds' digits at 00.

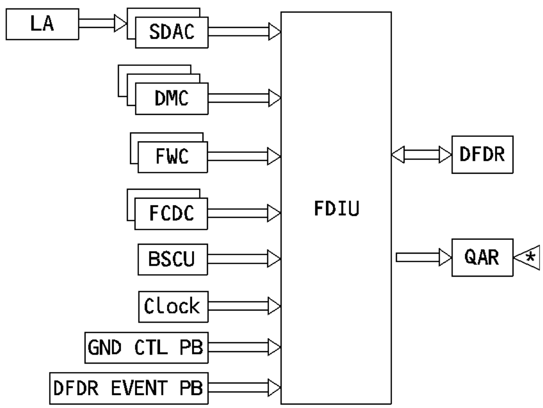
Note : This process must be completed in less than one minute. Otherwise, it will be necessary to reset the CFDS in order to synchronize the lower ECAM time display with the cockpit clock display. Resetting the CFDS is a maintenance operation.

FLIGHT DATA RECORDING SYSTEM

DESCRIPTION

The Flight Data recording System, which records the mandatory parameters, consists of the following components :
- A Flight Data Interface Unit (FDIU)
- A Digital Flight Data Recorder (DFDR)
- A three-axis Linear Accelerometer (LA)

The FDIU collects and processes parameters from the SDACs, DMCs, FWCs, FCDCs, BSCU, the DFDR event pushbutton, the GND CTL pushbutton and the Clock.
It stores the mandatory flight parameters in the DFDR.
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.
The linear accelerometer measures the acceleration of the aircraft along each of the three axes.
The QAR is an operational recorder that stores the same data as the DFDR. However the QAR is more accessible for the maintenance crew.



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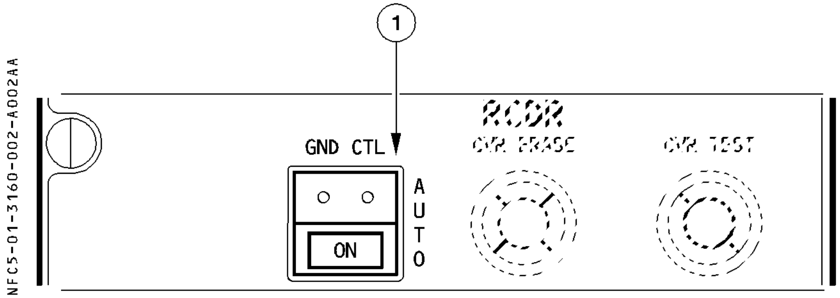
The recording system is automatically active :
- On the ground, during the first five minutes after the aircraft electric network is energized.
- On the ground, after the first engine start.
- In flight (whether the engines are running or not).

On the ground, the recording system stops automatically five minutes after the second engine shuts down.
On the ground, the crew can start the recording system manually by pressing the GND CTL pushbutton.

R **CONTROLS AND INDICATORS**

OVERHEAD PANEL



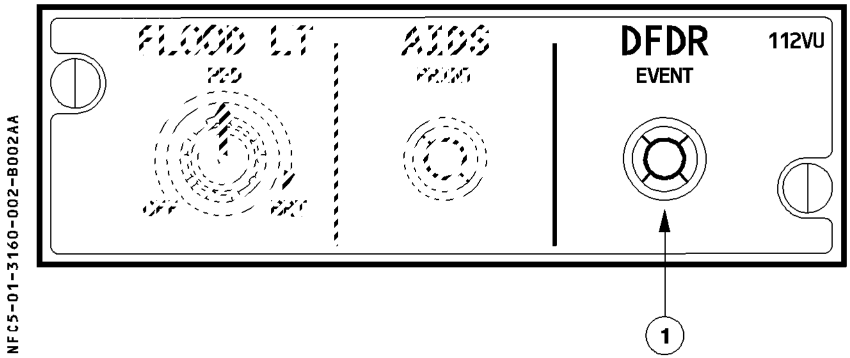
(1) GND CTL pushbutton (springloaded)

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



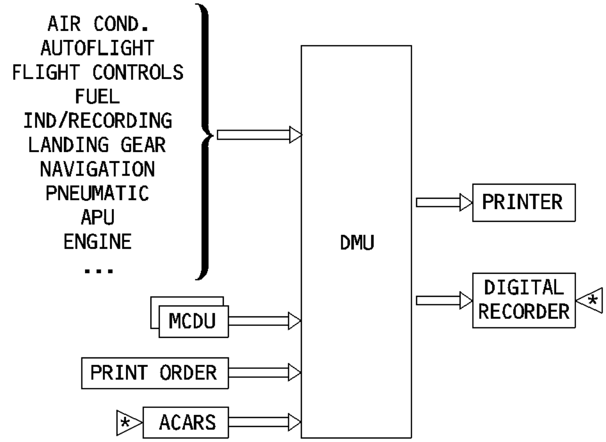
(1) DFDR EVENT pushbutton

R – Pressing this button (briefly) sets an event mark on the Flight Data records.

AIRCRAFT INTEGRATED DATA SYSTEM (AIDS)

DESCRIPTION

R The AIDS is used to monitor various aircraft system parameters in order to make
R maintenance easier and to allow formulating operational recommendations.
R The AIDS can generate system reports. The Airbus Standard Reports are preprogrammed
R reports available at aircraft delivery. The operator can create its own reports.
R The AIDS consists of a Data Managements Unit (DMU) connected as shown below.
R The system may be programmed using the MCDUs. The crew can select any report to be
R displayed on the MCDUs
R The Printer prints the flihgt phase programmed reports or any report selected on the MCDU.
R This printing may be automatic or in response to the AIDS PRINT pushbutton.
R The AIDS may send automatic reports via ACARS (*).
R An optional Digital Recorder may be installed to extend the recording capacity.
R



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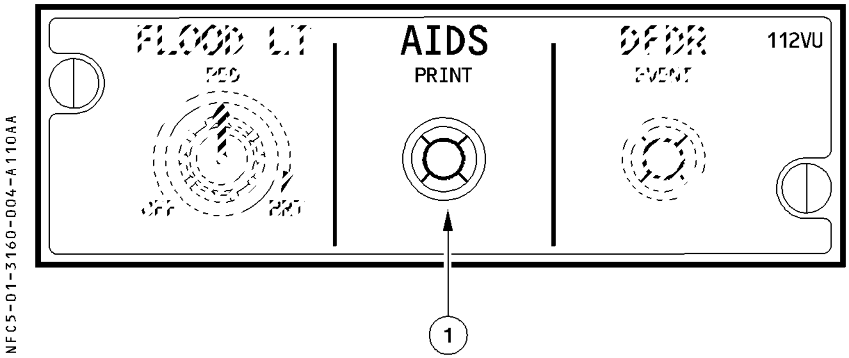
CONTROLS ON PEDESTAL



(1) AIDS PRINT pushbutton

Pushing this pushbutton causes the immediate printing of a specific report, depending on the flight phase. The crew may then use the MCDU to select another report for immediate printing.

DESCRIPTION

LEFT INTENTIONALLY BLANK

LEFT INTENTIONALLY BLANK

LEFT INTENTIONALLY BLANK

LEFT INTENTIONALLY BLANK

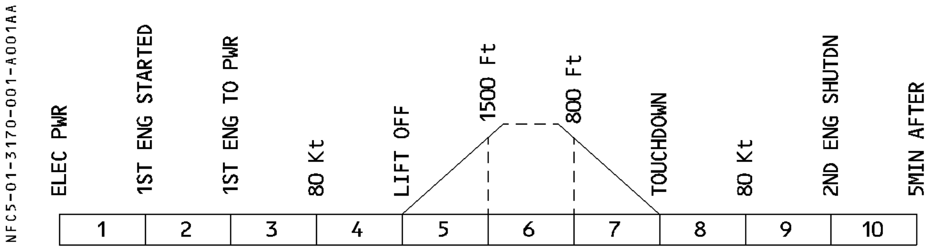
GENERAL

LEFT INTENTIONALLY BLANK

GENERAL

LEFT INTENTIONALLY BLANK

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLT PHASE INHIB</th></tr>
<tr><td>SDAC 1 + 2 FAULT</td><td rowspan="3">SINGLE CHIME</td><td rowspan="3">MASTER CAUT</td><td rowspan="8">NIL</td><td rowspan="8">NIL</td><td rowspan="3">4, 5, 7, 8</td></tr>
<tr><td>DMC 1 (2) FAULT</td></tr>
<tr><td>DMC 3 FAULT</td></tr>
<tr><td>SDAC 1 (2) FAULT</td><td rowspan="5">NIL</td><td rowspan="5">NIL</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>FWC 1 (2) FAULT</td></tr>
<tr><td>FWC 1 + 2 FAULT</td><td>NIL</td></tr>
<tr><td>DFDR FAULT</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>FDIU FAULT</td></tr>
</table>

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
DU	CAPT PFD			X		
	CAPT ND			SHED		
	F/O PFD	AC2				
	F/O ND	AC2				
	UPPER ECAM DU			X		
	LOWER ECAM DU	AC2				
DMC	DMC 1			X		
	DMC 2	AC2				
	DMC 3	AC1		X *		
FWC	FWC 1			X		
	FWC 2	AC2				
SDAC	SDAC 1			X		
	SDAC 2	AC2				
ECP	ECP				X	
FDIU/QAR ◁*		AC2				

* in case of EIS DMC switching to CAPT/3, with AC BUS 1 failed.

32.00 CONTENTS

32.10 LANDING GEAR AND DOORS

32.20 NOSE WHEEL STEERING

32.30 BRAKES AND ANTISKID

32.40 TIRE PRESSURE INDICATING SYSTEM

32.50 ELECTRICAL SUPPLY

DESCRIPTION

GENERAL

The landing gear consists of :
- two main gear that retract inboard,
- a nose gear that retracts forward.

Doors enclose the landing gear bays. Gear and doors are electrically controlled and hydraulically operated.
R The doors, which are fitted to the landing gear struts, are operated mechanically by the gear and close at the end of gear retraction.
All gear doors open while the gear is retracting or extending.
Two Landing Gear Control and Interface Units (LGCIUs) control the extension and retraction of the gear and the operation of the doors. They also supply information about the landing gear to ECAM for display, and send signals indicating whether the aircraft is in flight or on the ground to other aircraft systems.
A hand crank on the center pedestal allows the flight crew to extend the landing gear if the aircraft loses hydraulic systems or electrical power.

MAIN GEAR

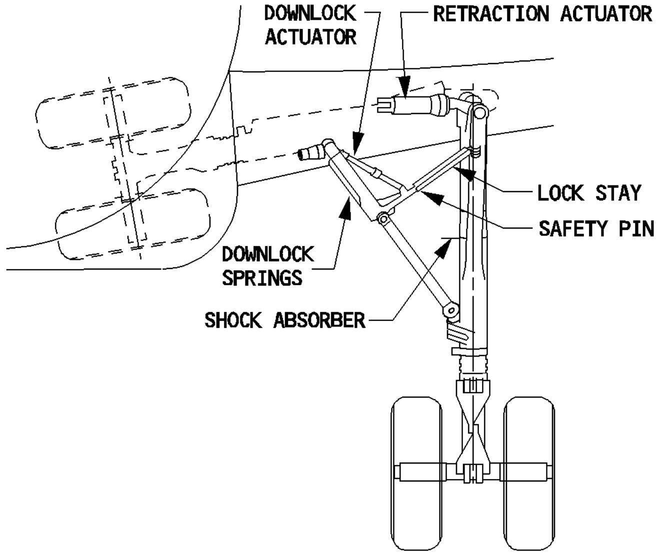
Each main gear has twin wheels and an oleopneumatic shock absorber.
Each main wheel has an antiskid brake.

NOSE GEAR

The two-wheeled nose gear has an oleopneumatic shock strut and a nose wheel steering system.

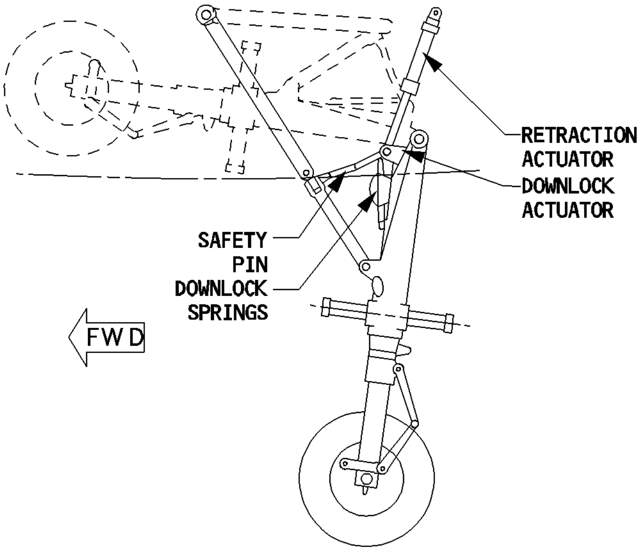
DRAWINGS

MAIN LANDING GEAR



NFC5-01-3210-002-A001AA

NOSE GEAR



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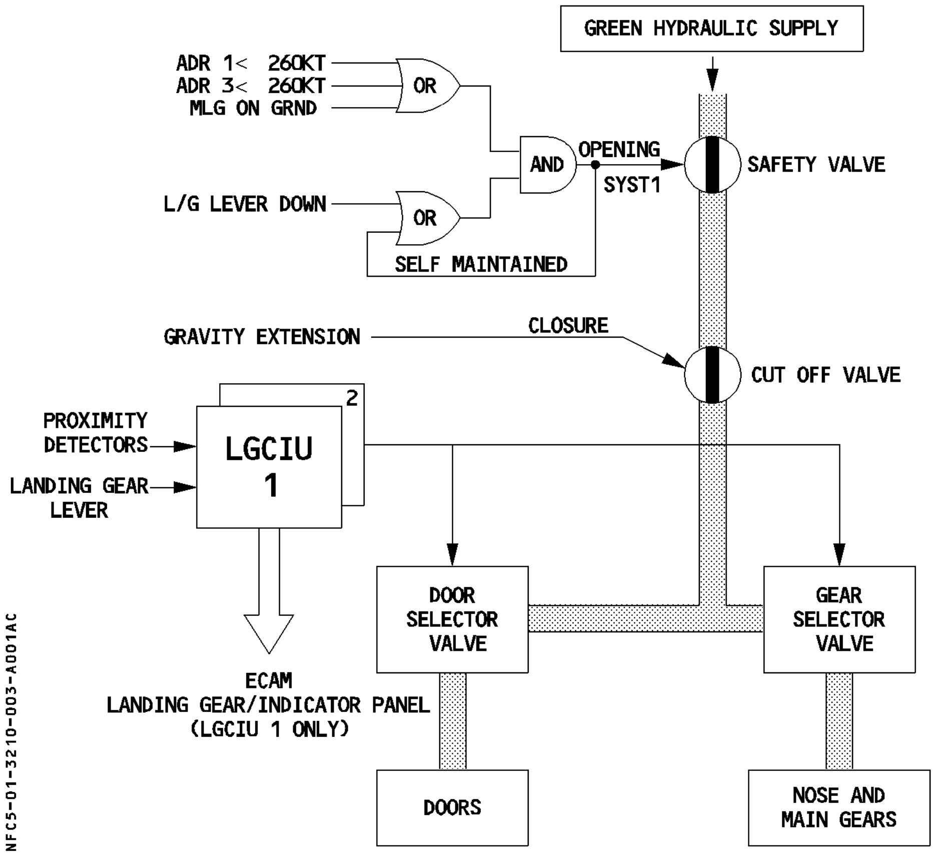
OPERATION OF GEAR AND DOORS

NORMAL OPERATION

The flight crew normally operates the landing gear by means of the lever on the center instrument panel.
The LGCIUs control the sequencing of gear and doors electrically. One LGCIU controls one complete gear cycle, then switches over automatically to the other LGCIU at the completion of the retraction cycle. It also switches over in case of failure.
The green hydraulic system actuates all gear and doors. When the aircraft is flying faster than 260 kt, a safety valve automatically cuts off hydraulic supply to the landing gear system. Below 260 kt, the hydraulic supply remains cut off as long as the landing gear lever is up.

FOR INFO



EMERGENCY EXTENSION

If the normal system fails to extend the gear hydraulically, the flight crew can use a crank to extend it mechanically.
When a crew member turns the crank, it :
- isolates the landing gear hydraulics from the green hydraulic system,
- unlocks the landing gear doors and the main and nose main gear,
- allows gravity to drop the gear into the extended position.

Locking springs help the crew to crank the main gear into the locked condition, and aerodynamic forces assist in the locking of the nose gear.
The gear doors remain open.
The flight crew can reset the emergency extension system in flight after using it for training (if green hydraulic pressure is available).

LANDING GEAR SYSTEM INTERFACE

LGCIUs

The LGCIUs receive position information from the landing gear, cargo door, and landing flap systems.

LANDING GEAR

The LGCIUs receive the following information about the landing gear from proximity detectors :
- gear locked down or up,
- shock absorbers compressed or extended,
- landing gear door open or closed.

Failure of a proximity detector :
- The LGCIU detects any electrical failure in a proximity detector, and signals the associated output to the flight position (shock absorber not compressed or landing gear uplocked).
  The other LGCIU then automatically takes over control of the landing gear operation.
- In case of mechanical failure, the LGCIU does not modify the associated output. The effect that such a failure has on the system depends upon which condition is signalled incorrectly.

Electrical failure of an LGCIU :
- The other (healthy) LGCIU takes control of the landing gear.
- The system does not force the outputs of the failed LGCIU to the safe (flight) condition.
  · Some users will see “flight” condition.
  · Some users will see “ground” condition.

CARGO DOORS

Sensors send to the LGCIUs the position of the following components :
- manuel selector valves,
- locking shaft,
- locking handle,
- safety shaft,
- door sills .◁*

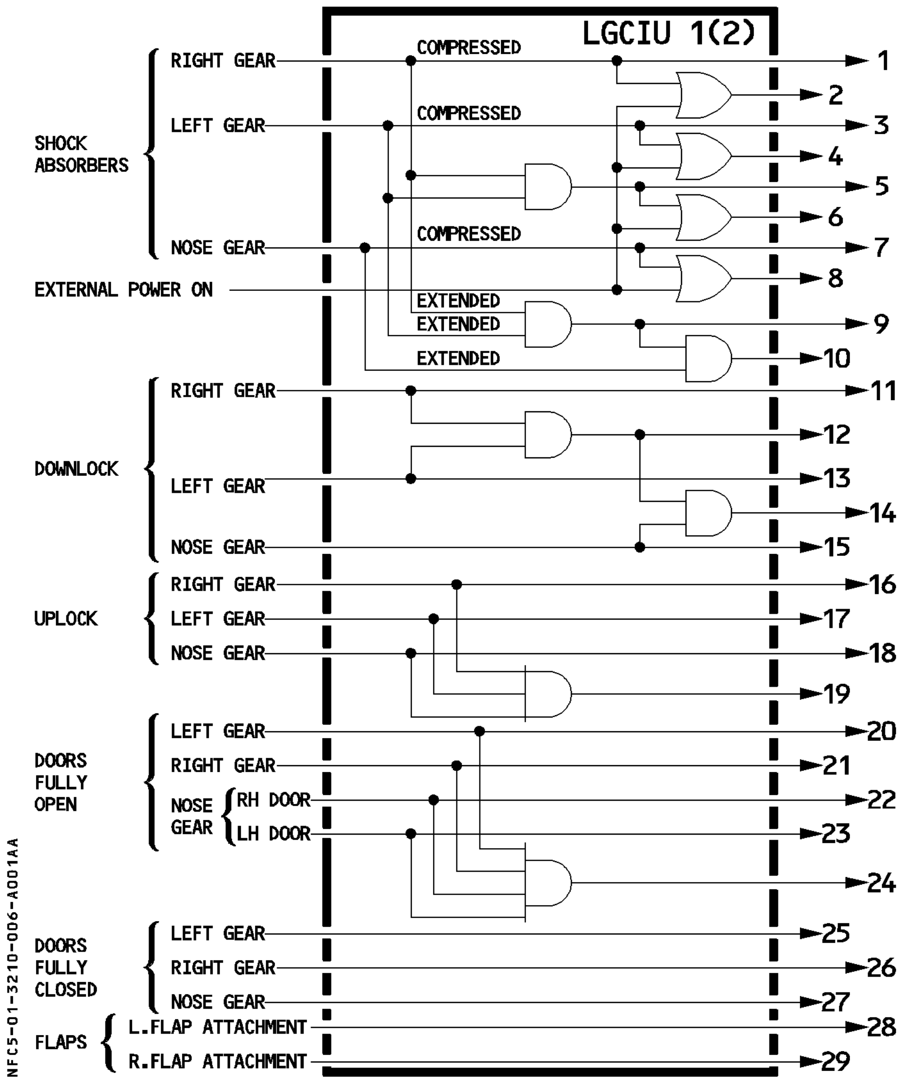
The LGCIUs detect electrical failures only in certain proximity switches in the cargo door system :
- locking shaft,
- locking handle,
- safety shaft.

When an LGCIU makes such a detection, it indicates the NON LOCKED condition for that component.

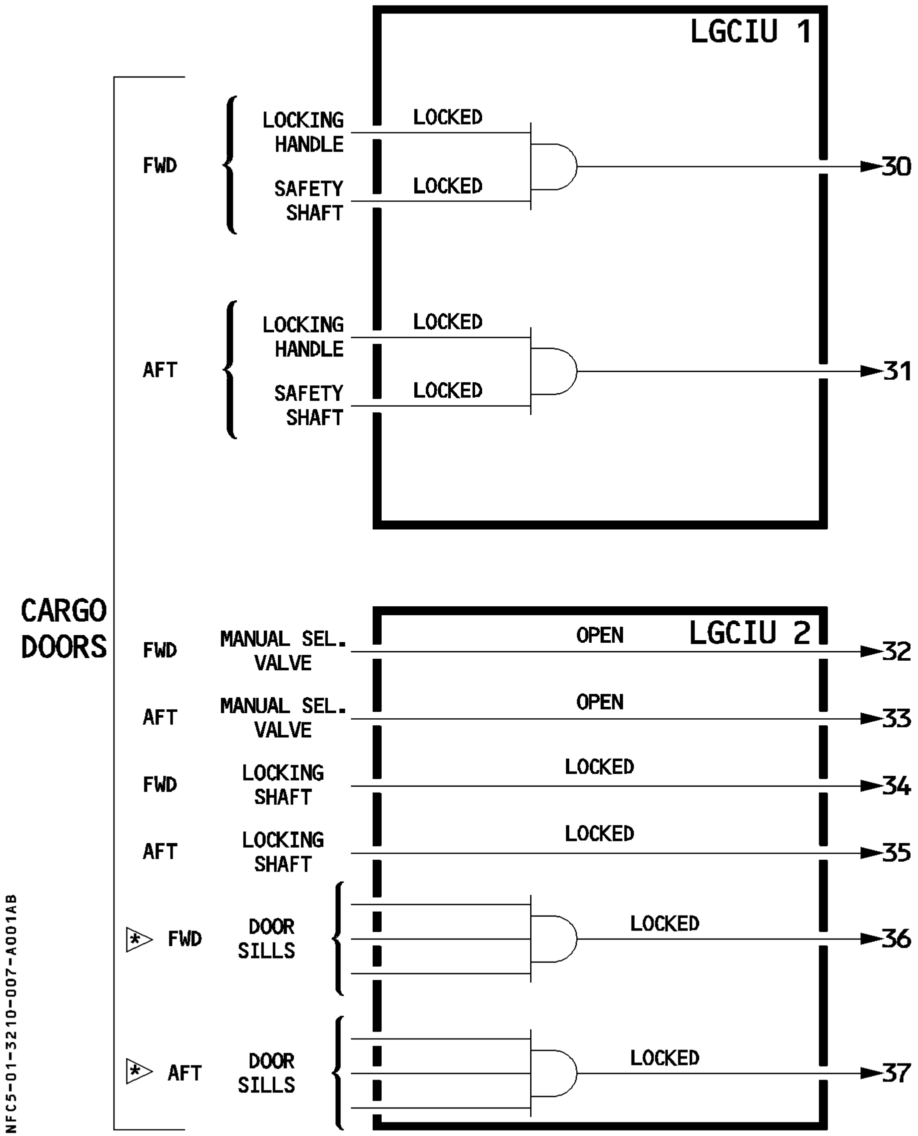
FLAPS

The LGCIUs process the signals from four flap disconnect proximity switches, then send them to the Slat/Flap Control Computers (SFCCs).
The LGCIUs do not monitor failures in the SFCC system.

PROXIMITY DETECTOR OUTPUT SIGNALS



PROXIMITY DETECTOR OUTPUT SIGNALS (CONT'D)



INTERACTIONS BETWEEN LANDING GEAR AND AIRCRAFT SYSTEMS

The following tables present the operational effects of the proximity detectors on aircraft systems.
How to read the tables :

R

SYSTEM	LGCIU 1	LGCIU 2	A/C IN FLT	A/C ON GROUND
SERVICE INTERPHONE	**6**	**6**	....	....
SFCC 1(2)	**5**	**(5)**	....	....

The above lines mean that the service interphone receives the output n° 6 from both LGCIUs, while SFCC 1 receive the output 5 from LGCIU 1 and SFCC 2 the output 5 from LGCIU 2.
The two additional colums give the system functioning when the aircraft is in flight and on the ground.

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
GENERAL	STROBE lts		**5**	On when AUTO selected	Off when AUTO selected
	LOGO lts		**5**	Off when flaps retracted	On
	AIRSTAIRS (if installed)	**3**	**1**	Control inhibited (1)	Control not inhibited (2)
	CARGO DOOR (5)		**5**	normal control not available	normal control available
	WATER FILLING		**5**	Preselect water servicing inhibited	Preselect water servicing available
AIR COND	AVNCS COOLING	**5**	**5**	. Skin temp. < 35° C : The system is in closed conf. (1) . Skin temp. > 35° C : The system is in intermediate conf. (1)	. Skin temp. < 5° C : The system is in closed conf. (2) . Skin temp. > 5° C : The system is in open conf. (2)
	GRND COOLING (if installed)	**1** **3**	**1** **3**	Inhibited (1)	Not inhibited (2)
	FWD CARGO VENT		**5**	Extract fan stopped when $\Delta P > 1$ psi	Extract fan on
	CAB PRESS	**5**	**5**	– Climb mode active (4)	– Prepressurization active before TO (3) –Depressurization active after LDG (3)
	PACK 1 (2) TEMP CONTROL		**3** **(1)**	Pack air inlet flaps opened.	Pack air inlet flap fully closed at T.O and LDG

(1) When either LGCIU indicates flight
(2) When both LGCIU indicate ground
(3) When either LGCIU indicates ground
(4) When both LGCIU indicate flight
(5) Valid from MSN 44.

PROXIMITY DETECTORS ON SHOCK ABSORBERS

R

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
APU	APU AUTO SHUTDOWN	5		– In case of oil low press, automatic shutdown is delayed by 15.5 seconds	– In case of oil low press, the automatic shutdown is delayed by : · 15.5 seconds if the oil temp < – 4°C · 0.05 seconds if oil temp > – 4°C
COMMUNICATIONS	SERVICE INTERPHONE	6	6	Inhibited (1)	Available (2)
	PUBLIC ADDRESS	1 3	1 3	P.A. increased level (1)	P.A. low level (2)
	ADIRU and AVIONICS ground warning	1 3	1 3	External horn and light inhibited (1)	External horn and light not inhibited (2)
	FLT INTERPHONE	9		Communication with ground mechanic inhibited	Communication with ground mechanic available
	COCKPIT CALL LIGHT	9		Inhibited	Not inhibited
	ACARS		7	Available	Available
	CVR	1 3 7	1 3	Runs (1)	Runs : (2) · during the first 5 minutes following energization · with one engine running Stops : (2) 5 minutes after second engine shutdown
	CVR		5	· ERASE function inhibited · No low frequency signal in the loudspeakers if test performed	· ERASE function not inhibited · Low frequency signal in the loudspeakers if test performed

(1) When either output indicates flight.
(2) When all outputs indicate ground.

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
ELEC	DC generation	5		APU start on batteries only, is delayed by 45 seconds	No APU start delay when on batteries only
ELEC	GALLEY supply		5	Main galley not supplied when APU GEN only is supplying	Main galley supplied when APU GEN only is supplying
EIS	EIS	5		Display test inhibited when ANN LT TEST is selected	Display test not inhibited
FIRE	APU	5		No APU fire automatic extinguishing	Automatic extinguishing not inhibited
FLT CTL	SFCC 1(2)	5	(5)	· For SFCC 1(2) : Slats alpha/speed lock function active · For SFCC (2) : No flaps movement inhibition if the cargo door is opened	· For SFCC 1(2) : Slats alpha/speed lock function active if speed > 60 kt · For SFCC (2) : Flaps movement inhibition if cargo door is opened
FLT INST	· DFDR · QAR (If installed)	1 3 7	1 3	Runs (1)	Runs : (2) · during the first 5 minutes following energization · with one engine running Stops : (2) 5 minutes after second engine shut down
FUEL	FQI	5		FQI uses flight attitude correction due to wing bending	FQI uses ground attitude correction

(1) When either output indicates flight
(2) When all outputs indicate ground

PROXIMITY DETECTORS ON SHOCK ABSORBERS

R

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
HYD	BLUE and GREEN pumps	1 3		Blue or green pump "FAULT" light not inhibited when related pump is stopped (1)	Blue or green pump "FAULT" light inhibited when related pump is stopped (4)
	BLUE pump	7		Runs when electrical power is available	Runs when at least one engine is running
	BLUE and YELLOW pumps		1 3	Blue or yellow pump "FAULT" light not inhibited when related pump is stopped (1)	Blue or yellow pump "FAULT" light inhibited when related pump is stopped (2)
	PTU		7	PTU runs if green/yellow diff. press > 500 psi	PTU runs if green/yellow diff. press > 500 psi and · both MASTER LEVERS are at OFF or · both MASTER LEVERS are at ON or · nose wheel steering is not in towing position with parking brake released. PTU is inhibited during the use of the cargo door hand pump and for 40 seconds after its use.
ICE RAIN PROT	CAPT, (F/O), (STBY) probes and CAPT, (F/O) windows heating	4, (2) ((8))	4, (2) ((8))	. CAPT, (F/O), ((STBY)) pitots and CAPT, (F/O) windows : high heating level applied . All other probes and windows are heated (1)	. With engines stopped :no heating (2) . With at least one engine running : . CAPT, (F/O), ((STBY)) pitots and CAPT, (F/O) windows are heated at low level (2)
	WING ANTI ICE	3	1	Wing anti ice valves open when the WING ANTI ICE pb is at ON (1)	Wing anti ice valves open for 30 seconds when the WING ANTI ICE pb is at ON (2)
	RAIN REPELLENT	1 3	1 3	Not inhibited (1)	Inhibited if engines are stopped (4)
	DRAIN MAST (5)		9	High heating level is applied	Low heating level is applied

(1) When either outputs indicates flight
(2) When both outputs indicate ground
(3) One valid output is sufficient
(4) When all outputs indicate ground
(5) Valid from MSN 22

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
LANDING GEAR	L/G SAFETY VALVE	**6**		Safety valve closes if aircraft speed > 260 kt	Safety valve opened
	L/G control	**10**	**10**	Retraction not inhibited (1)	Retraction inhibited (1)
	TIRE PRESS ◁*		**5**	"TYRE LO PRESS" warning threshold set to its flight level	"TYRE LO PRESS" warning threshold set to its ground level
NAVIGATION	STAND BY ALTI	**5**		VIBRATION function active	Vibration function inhibited
	ATC 1(2)	**3**	**(1)**	ATC 1(2) available in AUTO mode	ATC 1(2) inhibited in AUTO mode
	ADIRU 1 (2)	**7**		No external horn when ADIRU supplied from batteries only	External horn not inhibited

(1) One valid output is sufficient
(2) Valid from MSN 22

PROXIMITY DETECTORS ON SHOCK ABSORBERS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	A/C IN FLT	A/C ON GRND
POWER PLANT	FADEC 1(2)	1 3	(1) (3)	On Eng 1(2) : (1) · Reverse inhibited · No automatic start abort · FADEC always supplied · FLEX not available · If installed, BUMP not selectable	On Eng 1(2) : (2) · Reverse available · Automatic start abort available · 5 minutes after eng-shut down FADEC 1(2) no more supplied · FLEX available · If installed, BUMP selectable
		1 3 8	(1) (3) (8)	Modulated idle and approach idle are available (1)	Modulated idle only available (3)

(1) When either output indicates flight
(2) When both outputs indicate ground
(3) When all outputs indicate ground

PROXIMITY DETECTORS ON UPLOCKS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	L/G UPLOCKED	L/G NOT UPLOCKED
LANDING GEAR	L/G control	19	19	. If UP selected : (1) L/G doors will close	. If UP selected : (1) L/G doors will not close
	ECAM WHEEL page	16 17 18	16 17 18	. If UP selected : (2) L/G uplocked indications	. If UP selected : (2) L/G in transit indications
	L/G indicator panel	16 17 18		. If UP selected : (2) no indication	. If UP selected : (2) "UNLK" red indications

DOORS PROX DET

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	DOORS FULLY OPENED	DOORS CLOSED
LANDING GEAR	L/G control	24	24	L/G extension or retraction possible (1)	L/G extension or retraction inhibited (1)
	ECAM WHEEL PAGE	20 21 22 23	20 21 22 23	Doors fully opened indication	Doors closed indication

(1) One valid output is sufficient.
(2) When all outputs indicate the same position.

PROXIMITY DETECTORS ON DOWNLOCKS

R

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	L/G DOWNLOCKED	L/G NOT DOWNLOCKED
GEN	TAXI/T.O lights		**15**	lights not inhibited	lights inhibited
COMM.	SIGNS	**12**	**12**	"NO SMOKING" and "EXIT" signs on when AUTO selected (1)	"NO SMOKING" and "EXIT" signs inhibited when AUTO selected (2)
FLT. INST.	WBS	**15**	**15**	active (3)	inhibited (4)
FMGS	FAC 1(2)	**12**	**12**	VLE indication displayed on PFD 1(2)	no VLE indication
LANDING GEAR	L/G control	**14**	**14**	If DOWN selected : (5) L/G doors will close	If DOWN selected : (5) L/G doors will not close
	ECAM WHEEL page	**11** **13** **15**	**11** **13** **15**	If DOWN selected : (6) L/G down indications	If DOWN selected : (6) L/G in transit indications
	L/G INDIC panel	**11** **13** **15**		If DOWN selected : (6) L/G down indications	If DOWN selected : (6) L/G in transit indications
	BRAKING STEERING	**15**	**15**	BSCU test operative (1)	BSCU test inhibited (1)
	BRAKES COOLING		**13**	Cooling available when ON selected	Cooling inhibited when ON selected
NAV	GPWS	**13**		"TOO LOW-FLAPS" or "TOO LOW TERRAIN" warning operative	"TOO LOW-GEAR" or "TOO LOW TERRAIN" warning operative

(1) When either output indicates DOWNLOCK.
(2) When both outputs indicate NOT DOWNLOCK.
(3) When both outputs indicate DOWNLOCK.
(4) When either output indicates NOT DOWNLOCK.
(5) One valid output is sufficient.
(6) When all outputs indicate the same position.

PROXIMITY DETECTORS ON CARGO DOORS

LOCKING HANDLE OR SHAFT, DOOR SILLS

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	LOCKED	UNLOCKED
CRG DOORS	ECAM DOOR PAGE	**30 (31)**		Forward (aft) door symbol appears green	Forward (aft) door symbol appears amber, associated with "CARGO" amber.
	CARGO DOOR OPERATION		**34 (35)**	Forward (aft) door normal opening inhibition	Forward (aft) door normal opening possible
			36 ◁* (37) ◁*	Forward (aft) door normal operation possible	Forward (aft) door normal operation inhibited

MANUAL SELECTOR VALVE

	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	CLOSE	OPEN
CRG DOORS	CARGO DOOR OPERATION		**32 (33)**	Forward (aft) door normal opening inhibition	Forward (aft) door normal opening possible

PROXIMITY DETECTORS ON FLAP ATTACHMENTS

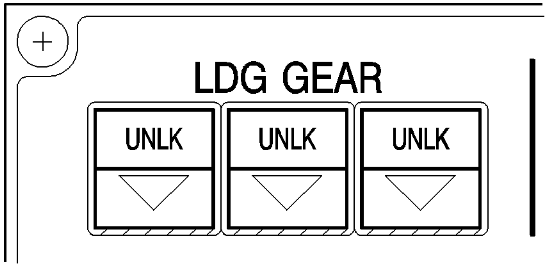
	SYSTEM	LGCIU 1 OUTPUT	LGCIU 2 OUTPUT	FLAP ATTACHMENT	FLAP ATTACHMENT FAILURE
FLT CTL	SFCC	**28 (29)**	**28 (29)**	L(R) FLAPS normal operation (1)	"FLAPS LOCKED" warning (2)

(1) When at least one SFCC detects normal operation
(2) When both SFCCs detect attachment failure

CONTROLS AND INDICATORS

LANDING GEAR INDICATOR PANEL

NFC5-01-3210-018-A001AA

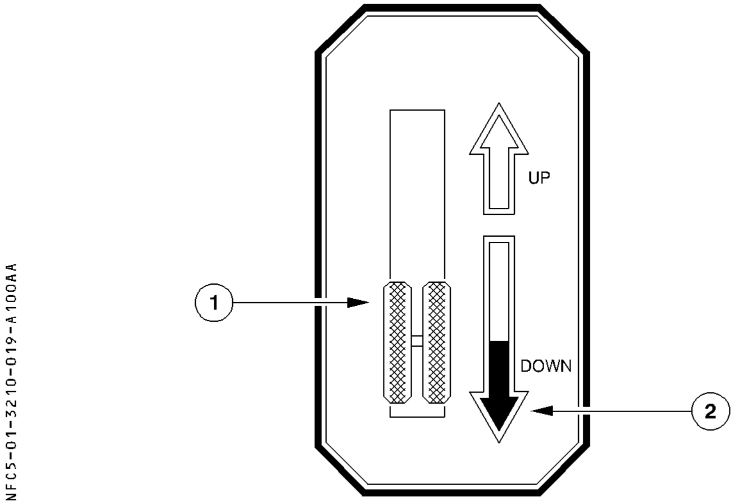


This panel is connected to LGCIU1, which receives signals from proximity detectors.
UNLK : come on red if the gear is not locked in the selected position.
▽ : come on green if the gear is locked down.

R *Note : The lights on the LDG GEAR indicator panel come on as long as the LGCIU1 is*
R *electrically supplied.*

LANDING GEAR SELECTOR LEVER

A two-position selector lever sends electrical signals to the two LGCIUs. These control the green hydraulic supply to the landing gear system by means of selector valves.
When the flight crew selects UP or DOWN (and if the airspeed is below 260 knots) :
– All landing gear doors open.
– Each landing gear moves to the selected position.
– All landing gear doors close.



(1) L/G LEVER

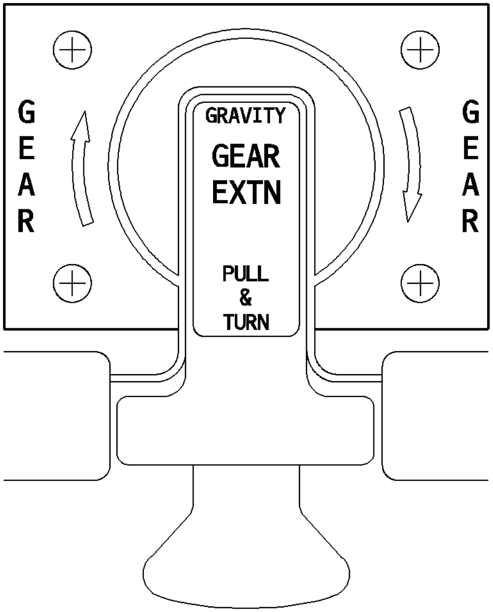
UP : This position selects landing gear retraction.
While the landing gear doors are opening, the normal brake system brakes the wheels of the main gear automatically.

DOWN : This position selects landing gear extension.
An interlock mechanism prevents anyone from accidentally retracting the gear while the aircraft is on the ground. It does so by locking the lever in DOWN position when the shock absorber on either main gear is compressed (aircraft on ground) or the nose wheel steering is not centered.
The landing gear hydraulic system remains pressurized as long as the landing gear is extended (if green hydraulic pressure is available).

(2) RED ARROW

This red arrow lights up if the landing gear is not locked down when the aircraft is in the landing configuration, and a red warning appears on ECAM.

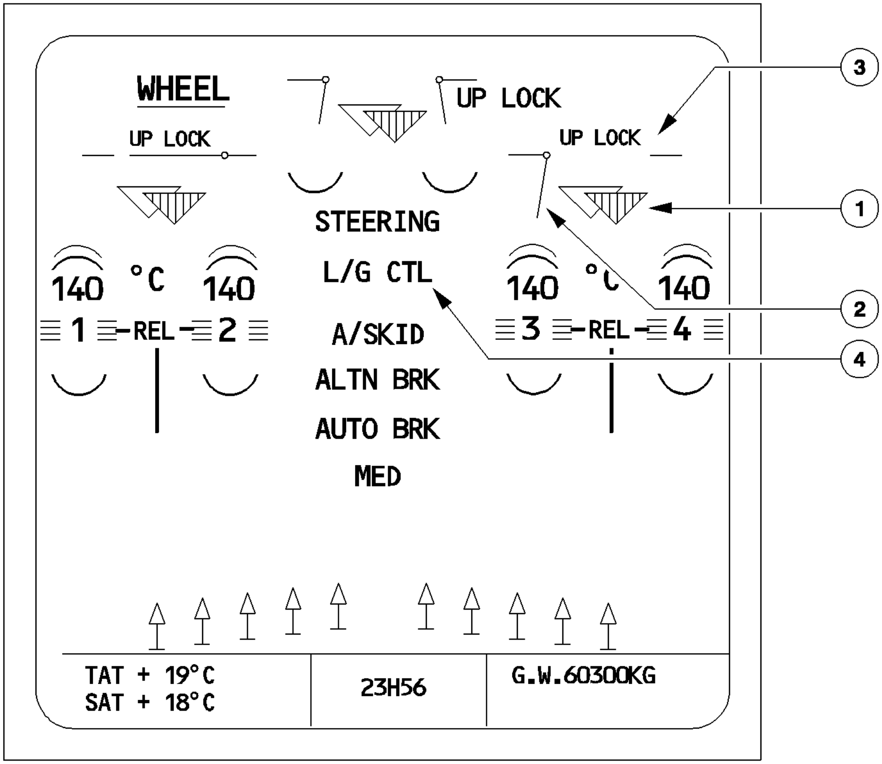
EMERGENCY EXTENSION



NFC5-01-3210-020-A001AA

To put the landing gear down by gravity, the flight crew must pull the gear crank out, then turn it clockwise for 3 turns.
When the flight crew operates the crank handle, the cutout valve shuts off hydraulic pressure to the landing gear system and depressurizes it.

R **ECAM WHEEL PAGE**

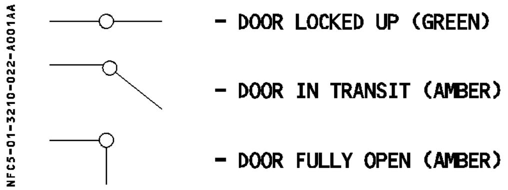


NFC5-01-3210-021-A001AB

① Landing gear position indication

The landing gear positions are indicated by 2 triangles for each gear.
Each triangle is controlled by one LGCIU :
— a green triangle indicates that one LGCIU detects a landing gear downlocked,
— a red triangle indicates that one LGCIU detects a landing gear in transit,
— no triangle indicates that one LGCIU detects a landing gear uplocked,
— amber crosses indicates that one LGCIU is failed.

② Landing gear door position indication



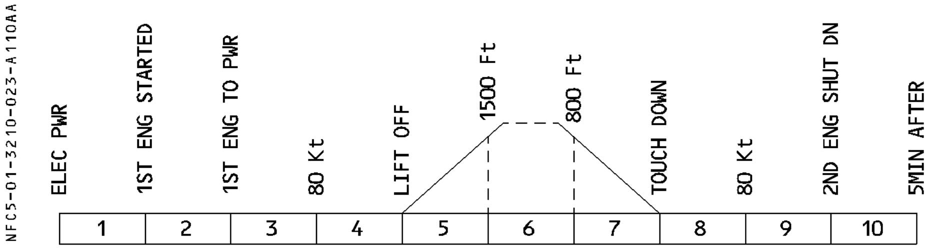
③ UP LOCK

This legend appears amber along with a caution on the ECAM if the landing gear uplock is engaged when the landing gear is down locked.

④ L/G CTL

This legend appears amber along with an ECAM caution if the landing gear lever and the landing gear position do not agree.

WARNINGS AND CAUTIONS

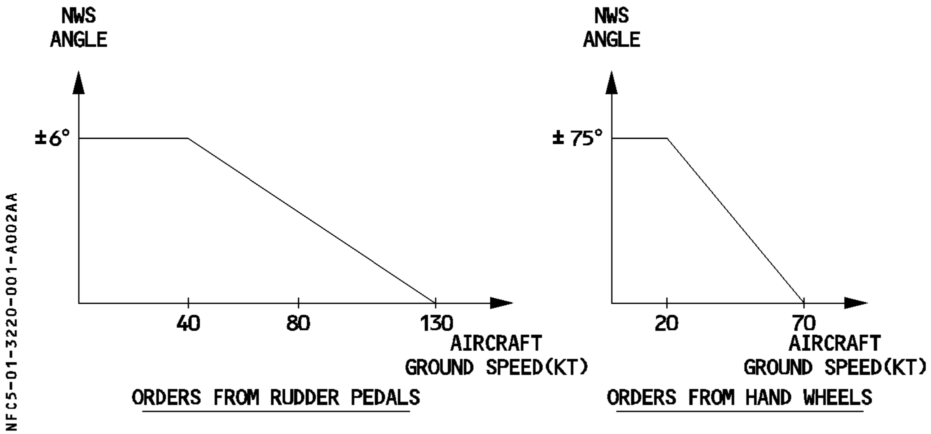


E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GEAR NOT DOWNLOCKED One gear not downlocked and L/G selected down	CRC	MASTER WARN	WHEEL	UNLK lt on	3, 4, 5
GEAR NOT DOWN 1. L/G not downlocked and radio height lower than 750 ft and both engines N1 lower than 75 % (or if engine shut down N 1 of remaining engine lower than 97 %) or 2. L/G not downlocked and radio height lower than 750 ft and flaps at 3 or FULL or 3. L/G not downlocked and flaps at 3 or FULL and both radio altimeters failed NOTE : In the cases 2 and 3 above, the aural warning can only be cancelled by the emergency cancel pushbutton.			NIL	DOWN ARROW lt on LDG GEAR panel	
SHOCK ABSORBER FAULT One shock absorber not extended when airborne or not compressed after landing	SINGLE CHIME	MASTER CAUT		NIL	1, 3, 4, 8
DOORS NOT CLOSED One gear door is not uplocked			WHEEL		1, 3, 4, 5, 8, 9, 10
GEAR NOT UPLOCKED One gear not uplocked and L/G not selected down				UNLK lt on LDG GEAR panel	3, 4, 7, 8, 9, 10
GEAR UPLOCK FAULT One gear uplock engaged with corresponding gear downlocked					4
LGCIU 1 (2) FAULT	NIL	NIL		NIL	4, 5, 7, 8
SYS DISAGREE Disagree between L/G positions detected by the two LGCIU's					3, 4, 5, 7, 8

DESCRIPTION

A hydraulic actuating cylinder steers the nose wheel. The green hydraulic system supplies pressure to the cylinder, and electric signals from the Brake and Steering Control Unit (BSCU) control it.
The BSCU receives orders from :
- the Captain's and the First Officer's steering hand wheels (orders added algebraically),
- the rudder pedals,
- the autopilot.

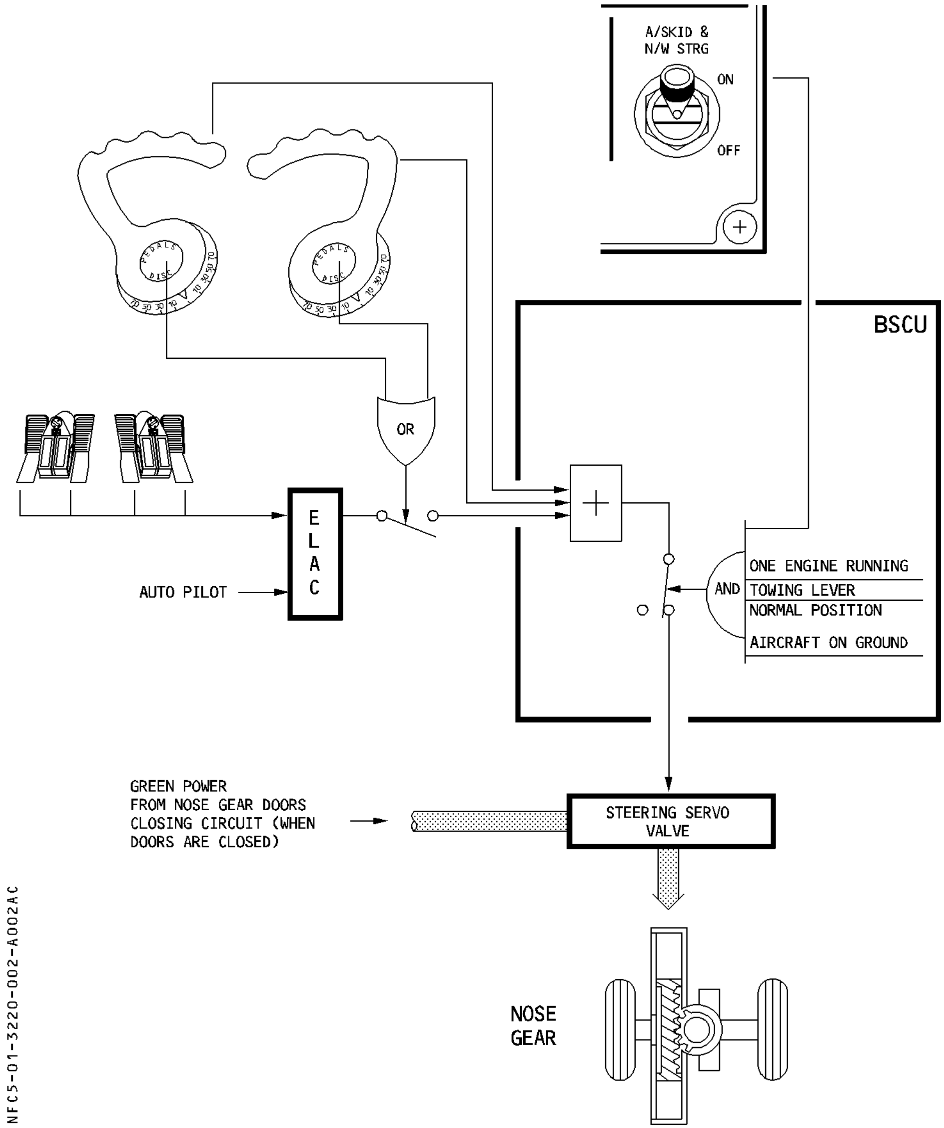
The BSCU transforms these orders into nose wheel steering angle. That angle has the following limits, which depend on ground speed and the origin of the orders.



The steering system receives actuating hydraulic pressure when :
- the A/SKID & N/W STRG switch is on and,
- the towing control lever is in normal position and,
- at least one engine is running and,
- the aircraft is on ground.

The nose landing gear doors must be closed in order for the green hydraulic system to apply pressure to the actuating cylinder.
The handwheel can turn the nose wheel up to 75° in either direction. A lever on the towing electrical box (on nose landing gear) allows ground crew to deactivate the steering system for towing. This then allows the wheel to be turned 95° in either direction.
The pilots can use a pushbutton on either steering handwheel to prevent rudder pedal
R orders or autopilot orders from going to the BSCU.
An internal cam mechanism returns the nose wheel to the centered position after takeoff.

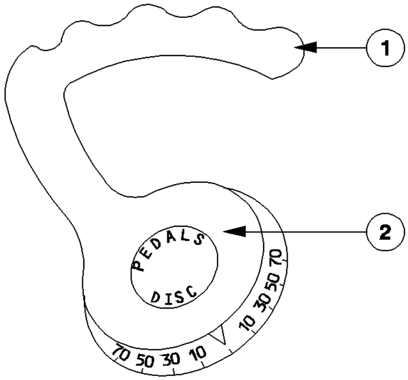
R


A/SKID &
N/W STRG
ON
OFF
PEDALS
DISC
70 50 30 10
10 30 50 70
BSCU
OR
E
L
A
C
AUTO PILOT
ONE ENGINE RUNNING
AND
TOWING LEVER
NORMAL POSITION
AIRCRAFT ON GROUND
GREEN POWER
FROM NOSE GEAR DOORS
CLOSING CIRCUIT (WHEN
DOORS ARE CLOSED)
STEERING SERVO
VALVE
NOSE
GEAR
NFC5-01-3220-002-A002AC

CONTROLS AND INDICATORS

SIDE CONSOLES

NFC5-01-3220-003-A001AA



① Steering handwheels

The steering handwheels, which are interconnected, can steer the nose wheel up to 75° in either direction.

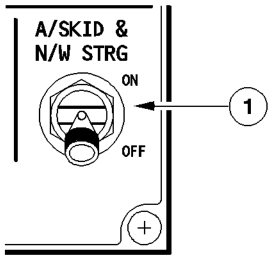
Note : The steering system centers the nose wheel automatically after liftoff.

② Rudder PEDAL DISC pb

Pressing this button on either handwheel removes control of nose wheel steering from the rudder pedals until the button is released.

CENTER INSTRUMENT PANEL

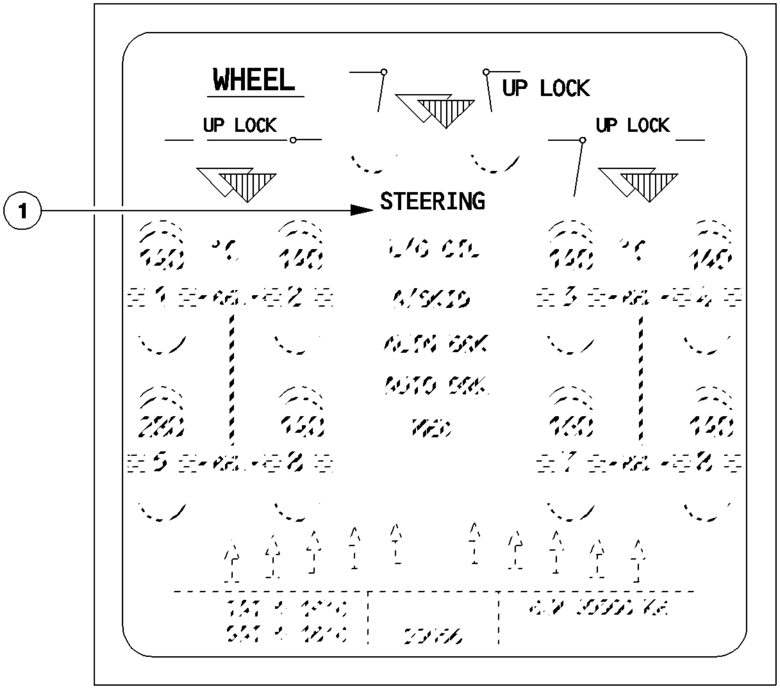
NFC5-01-3220-003-B001AA



① A/SKID & N/W STRG sw

This ON/OFF switch activates or deactivates the nose wheel steering and anti-skid. (Refer to 1.32.30, BRAKES AND ANTI-SKID).

ECAM WHEEL PAGE

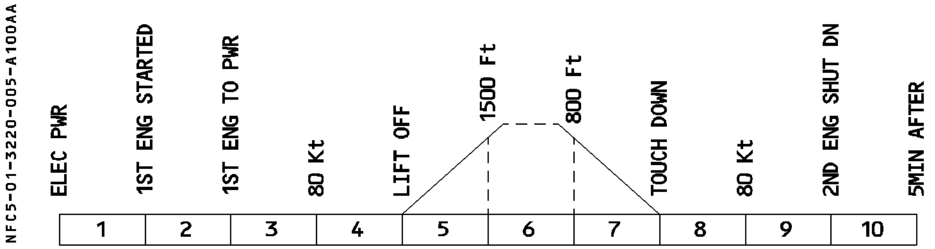


NFC5-01-3220-004-A001AA

(1) STEERING

This legend appears along with an ECAM caution if either the nose wheel steering or the anti-skid feature fails.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
NW STEER FAULT detected by BSCU	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	3, 4, 5, 8

MEMO DISPLAY

When the nose wheel steering selector is in the towing position, this display shows “NW STRG DISC” in green. The legend is amber if one engine is running.

DESCRIPTION

GENERAL

The main wheels have multidisc brakes that can be actuated by either of two independent brake systems.
The normal system uses green hydraulic pressure : the alternate system uses the yellow hydraulic system backed up by a hydraulic accumulator.
An anti-skid system and autobraking work through the brake system.
Braking commands come from either the brake pedals (pilot action) or the autobrake system (deceleration rate selected by the crew).
Two units on each main gear monitor the temperature of the brakes.
All braking functions (normal and alternate braking control, anti-skid control, autobraking, brake temperature indication) are controlled by a two-channel Brake and Steering Control Unit (BSCU).
The main wheels have fusible plugs that prevent the tires from bursting if they overheat.
The main wheels may also have brake cooling fans. ◁*

ANTI-SKID SYSTEM

The anti-skid system produces maximum braking efficiency by maintaining the wheels just short of an impending skid.
When a wheel is on the verge of locking, the system sends brake release orders to the normal and alternate servovalves — and to the ECAM, which displays the released brakes.
The anti-skid deactivates when ground speed is less than 20 knots.
An ON/OFF switch turns the anti-skid system and nose wheel steering on and off.

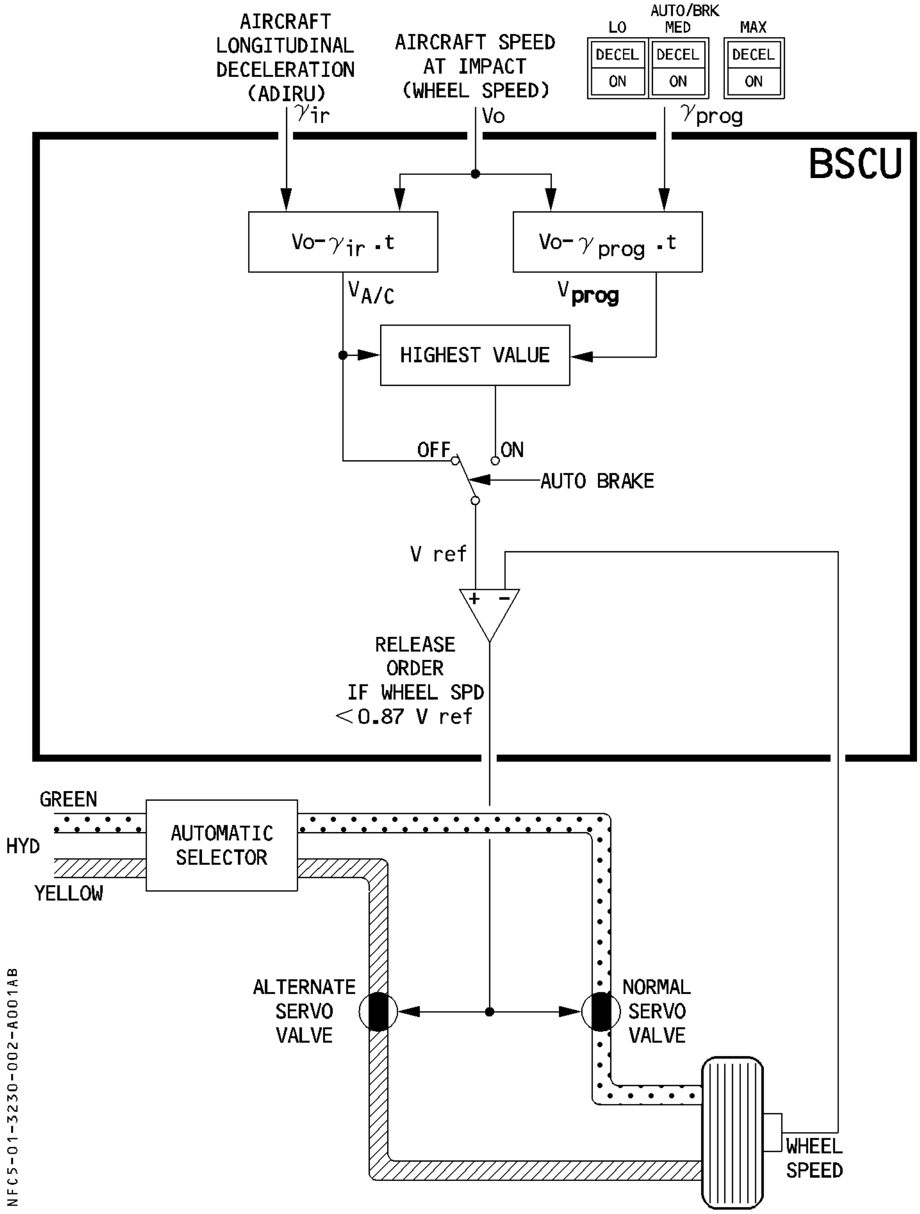
PRINCIPLE

The system compares the speed of each main gear wheel (given by a tachometer) with the speed of the aircraft (reference speed). When the speed of a wheel drops below 0.87 times the reference speed, the system orders brake releasing in order to maintain the brake slip at that value (best braking efficiency).
In normal operation, the BSCU determines the reference speed from the horizontal acceleration furnished by ADIRU1, ADIRU2, or ADIRU3.
If all three ADIRUs fail, reference speed equals the greater of either main landing gear wheel speed. Deceleration is limited to 1.7 meters/second^2 (5.6 feet/second^2)

ANTI-SKID PRINCIPLE

FOR INFO

R



AUTO BRAKE

The purposes of this system are :
- to reduce the braking distance in case of an aborted takeoff
- to establish and maintain a selected deceleration rate during landing, thereby improving passenger comfort and reducing crew workload.

ARMING

The system arms when the crew presses the LO, MED, or MAX pushbutton switch if :
- Green pressure is available.
- The anti-skid system has electric power.
- There is no failure in the braking system.
- At least one ADIRS is functioning.

Note : Auto brake may be armed with the parking brake on.

ACTIVATION

Automatic braking commences when the ground spoilers extend (Refer to 1.27.10 SPEED BRAKES AND GROUND SPOILERS). Therefore, if the aircraft makes an acceleration stop and begins to decelerate when its speed is under 72 knots, the automatic braking will not function because the ground spoilers will not extend.
For autobrake to activate, at least two SEC's must be operative.

DISARMING

The system disarms when :
- Flight crew presses the pushbutton switch or,
- One or more arming conditions is lost or,
- R Flight crew applies enough deflection to one brake pedal when autobrake is operating in MAX, MED or LO mode.
- The ground spoilers retract (Refer to 1.27.10).
- The aircraft has been in flight for 10 seconds.

OPERATION

There are four modes of operation :
- Normal braking,
- Alternate braking with anti-skid,
- Alternate braking without anti-skid,
- Parking brake.

NORMAL BRAKING

Braking is normal when :
- Green hydraulic pressure is available.
- The A/SKID & N/W STRG switch is ON.
- The parking brake is not ON.

During normal braking, anti-skid operates and autobrake is available.
Braking is controlled electrically through the BSCU :
- from the pilot's pedals or,
- automatically
  · on the ground by the autobrake system,
  · in flight when the landing gear lever is up.

The anti-skid system is controlled by the BSCU via the normal servo valves.
There is no indication of brake pressure in the cockpit.

ALTERNATE BRAKING WITH ANTI-SKID

Braking uses this mode when green hydraulic pressure is insufficient and :
- Yellow hydraulic pressure is available.
- The A/SKID & N/W STRG switch is ON.
- The parking brake is not ON.

An automatic hydraulic selector changes from the green to the yellow system.
The pedals brake through the auxiliary low-pressure hydraulic distribution line acting on the dual valves. The BSCU controls the anti-skid system via the alternate servo valves.
A triple indicator on the center instrument panel shows the pressure delivered to the left and right brakes, as well as the accumulator pressure.
Autobrake is inoperative.

ALTERNATE BRAKING WITHOUT ANTI-SKID

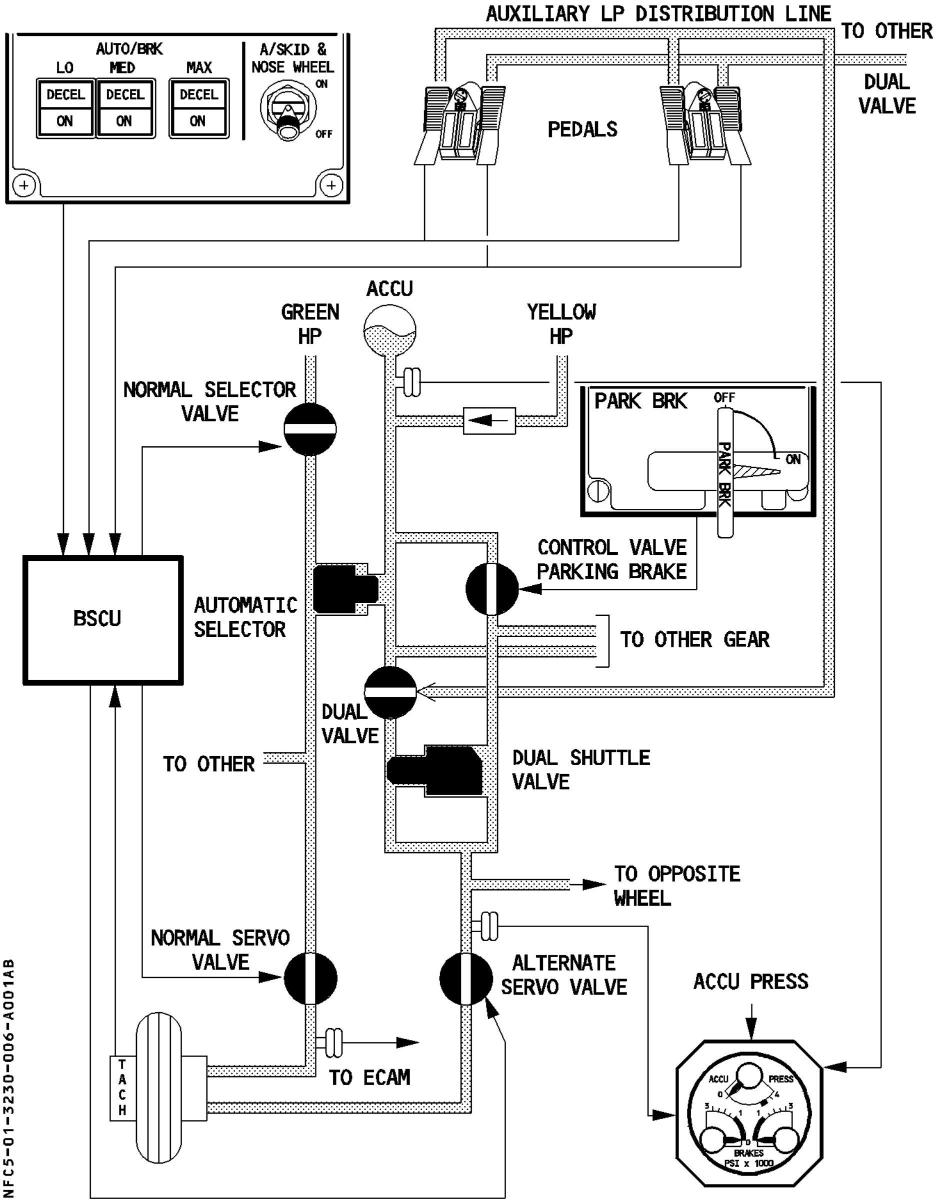
The anti-skid system can be deactivated :
- electrically (A/SKID & N/W STRG switch OFF, or power failure or BSCU failure),
- hydraulically (low pressure in both green and yellow systems, brakes being supplied by the brake accumulators only).

The pilot controls the braking with the pedals (acting on the dual valves).
Alternate servo valves are fully open.
The pilot must refer to the triple indicator to limit brake pressure in order to avoid locking a wheel.
The accumulator can supply at least 7 full brake applications.
Autobrake is inoperative.

PARKING BRAKE

Putting on the PARKING BRK deactivates the other braking modes and the anti-skid system.
The yellow hydraulic system or accumulators supply brake pressure via the dual shuttle valves. Alternate servo valves open to allow the application of full pressure.
Accumulators maintain the parking pressure for at least 12 hours.
Crew members can pressurize the yellow accumulators by pressing the yellow electric pump switch.
The triple indicator shows brake pressure.

BRAKING SCHEMATIC

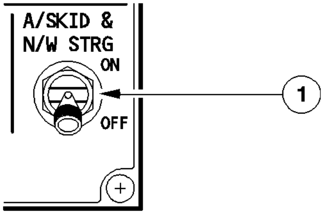


NFC5-01-3230-006-A001AB

CONTROLS AND INDICATORS

CENTER INSTRUMENT PANEL

NFC5-01-3230-007-A001AA



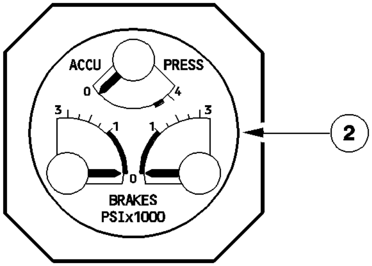
(1) A/SKID & N/W STRG sw

ON : If green hydraulic pressure is available :
- Anti-skid is available.
- Nose wheel steering is available.

If green hydraulic pressure is lost :
- Yellow hydraulic pressure takes over automatically to supply the brakes.
- Anti-skid remains available.
- Nose wheel steering is lost.
- The triple indicator shows yellow system brake pressure.

OFF : Yellow hydraulic system supplies pressure to the brakes.
- Anti-skid is deactivated. The pilot must refer to the triple indicator to limit brake pressure and avoid locking a wheel.
- Nose wheel steering is lost.
- Differential braking remains available through the pedals.
- The triple indicator displays yellow system brake pressure.

NFC5-01-3230-007-B001AA

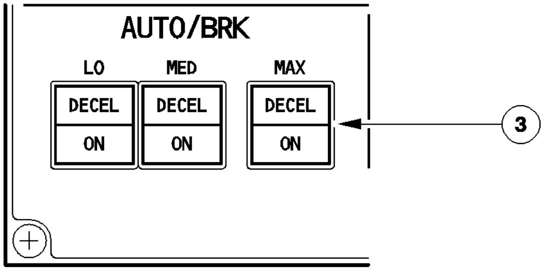


(2) BRAKES and ACCU PRESS indicator

ACCU PRESS : Indicates the pressure in the yellow brake accumulators.
BRAKES : Indicates the yellow pressure delivered to the left and right brakes, as measured upstream of the alternate servo valves.

AUTO BRK panel

NFC5-01-3230-008-A100AA



(3) AUTO/BRK panel

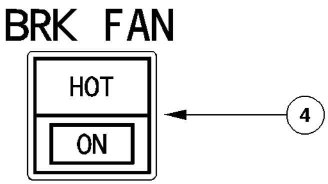
The springloaded MAX, MED, and LO pushbutton switches arm the appropriate deceleration rate.

- MAX mode is normally selected for takeoff.
  If the pilot aborts the takeoff, maximum pressure goes to the brakes as soon as the system generates the ground spoiler deployment order.
- MED or LO mode is normally selected for landing.
  - · LO mode sends progressive pressure to the brakes 4 seconds after the ground spoilers deploy in order to decelerate the aircraft at 1.7 meters/second^2 (5.6 feet/second^2).
  - · MED mode sends progressive pressure to the brakes 2 seconds after the ground spoilers deploy in order to decelerate the aircraft at 3 meters/second^2 (9.8 feet/second^2).
- Lights :
  - · The blue ON light comes on to indicate positive arming.
  - · The green DECEL light comes on when the actual deceleration is 80% of the selected rate.

R *Note : On slippery runway, the predetermined deceleration may not be reached due*
R *to antiskid operation. In this case DECEL light will not illuminate. This does*
R *not mean that autobrake is not working.*

· Off : The indicated brake mode is not active.

NFC5-01-3230-009-A001AA

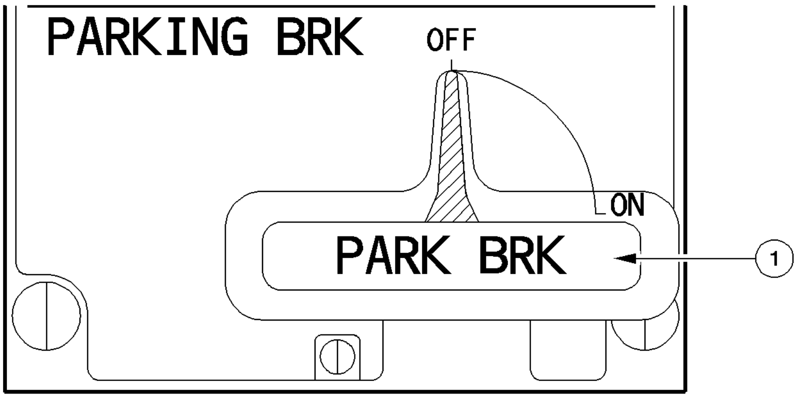


④ BRK FAN pb sw ◁*

ON : The brake fans run if the lefthand main landing gear is down and locked.
OFF : The brake fans stop.
HOT lt : This amber light comes on when the brakes get too hot. (A caution appears on ECAM, also).

PEDESTAL

NFC5-01-3230-009-B001AA

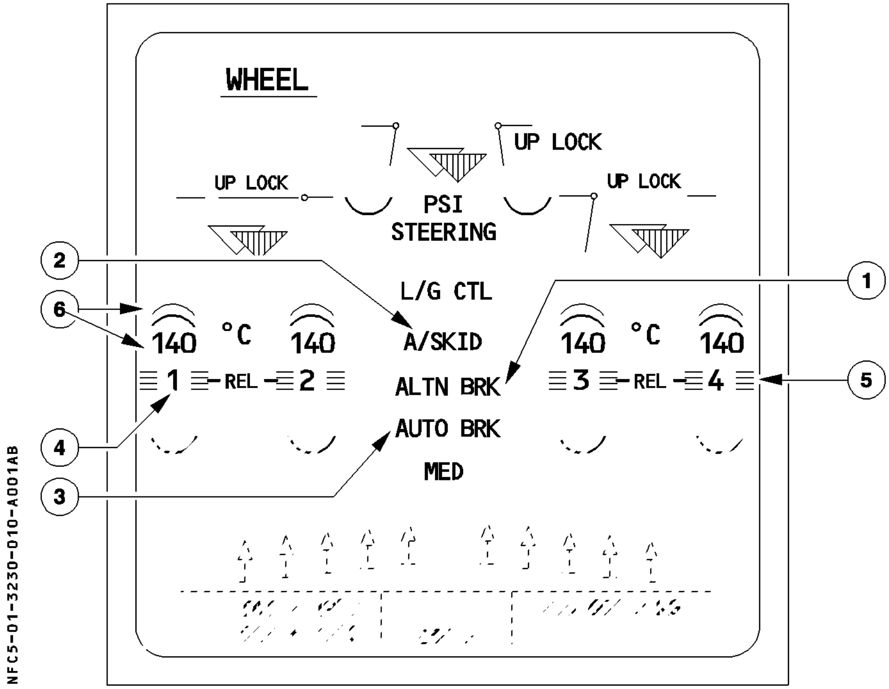


① PARKING BRK handle

Flight crew pulls this handle, then turns it clockwise, to apply the parking brake.
Applying the parking brake deactivates all the other braking modes.
The ECAM memo page displays “PARK BRK”.

CAUTION
If the pointer is not at ON, the parking brake is not on.

ECAM WHEEL PAGE



① ALTN BRK

This legend appears in green if the braking system is in alternate mode.

② A/SKID

This legend appears in amber, along with an ECAM caution, in case of total BSCU failure, or when the A/SKID & N/W STRG switch is OFF, or if the BSCU detects an ANTI-SKID failure.

③ AUTO BRK

This legend appears :
– in green when auto brake is armed,
– flashing green for 10 seconds after autobrake disengagement,
– in amber, along with an ECAM caution, to indicate a system failure.
MED, LO, or MAX appears underneath in green to show which rate has been selected.

④ Wheel number

This white number identifies individual wheels of the main landing gear.

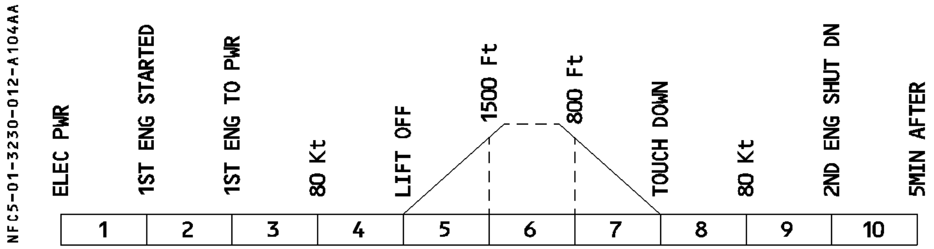
⑤ Release indicators

≡ These green lines appear temporarily after the landing gear has been lowered to indicate that the anti-skid function is ready.
They reappear after touchdown, along with REL (blue), when the anti-skid is active.

⑥ Brake temperature

- The temperature normally appears in green.
- The green arc appears on the hottest wheel when one brake temperature exceeds 100°C.
- The green arc becomes amber, and an ECAM caution appears, when the corresponding brake temperature exceeds 300°C.

WARNINGS AND CAUTIONS



<table>
<tr><th>E/WD : FAILURE TITLE
condition</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>CONFIG PARK BRK ON
parking brake is on when thrust levers are set at TO or FLX TO power position</td><td>CRC</td><td>MASTER WARN</td><td>NIL</td><td>NIL</td><td>1, 2
5 to 10</td></tr>
<tr><td>BRAKES HOT
one brake temperature higher than 300°C</td><td rowspan="5">SINGLE CHIME</td><td rowspan="5">MASTER CAUT</td><td rowspan="4">WHEEL</td><td>HOT lt on BRK FAN pb sw</td><td>4, 8</td></tr>
<tr><td>AUTO BRK FAULT
failure of autobrake when armed</td><td rowspan="5">NIL</td><td>3 to 5, 8, 9</td></tr>
<tr><td>A/SKID NWS FAULT
· loss of normal brake system associated with Y HYD sys lo press or
· failure of both BSCU channels</td><td>4, 5</td></tr>
<tr><td>ANTI SKID/NWS OFF
switch at OFF position</td><td>4, 5</td></tr>
<tr><td>HYD SEL FAULT
failure of brake normal selector valve or NWS selector valve in open position</td><td rowspan="2">NIL</td><td rowspan="2">3 to 5, 7, 8</td></tr>
<tr><td>BSCU CH 1 (2) FAULT
failure of one BSCU channel</td><td>NIL</td><td>NIL</td></tr>
</table>

MEMO DISPLAY

- If the parking brake is on, this display shows PARK BRK :
  - in green in flight phases 1, 2, 9, and 10.
  - in amber in flight phases 4 to 8.

  It does not display this message in flight phase 3.
- If the autobrake is on, AUTO BRK LO, AUTO BRK MED, or AUTO BRK MAX appears.
- If the autobrake is faulty, AUTO BRK OFF appears.
- BRK FAN appears in green if the BRK FAN pushbutton switch is ON. ◁

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
LANDING GEAR	LGCIU 1		GRND/ FLT		X	
	LGCIU 2		GRND/ FLT			
	SAFETY VALVE				X	
	L/G INDICATOR PANEL			SHED (1)	X	
BRAKES	BSCU CH 1	AC1	DC1			
	BSCU CH 2	AC2	DC2			
	PARK BRK CTL		GRND/ FLT			HOT1
	PRESS INDICATOR				X	
	BRK FAN CTL ◁*		DC2			
	COOLING FANS ◁* (Wheels 1, 2, 3, 4)	AC2	DC2			
	COOLING FANS ◁* (bogie : Wheels 5, 6, 7, 8)	AC1	DC1			
TYRE PRESS	TIRE PRESS IND UNIT ◁*		DC1			

(1) The AC STAT INV supplies the landing gear indicator panel when the main generators are lost and the emergency generator is not running.

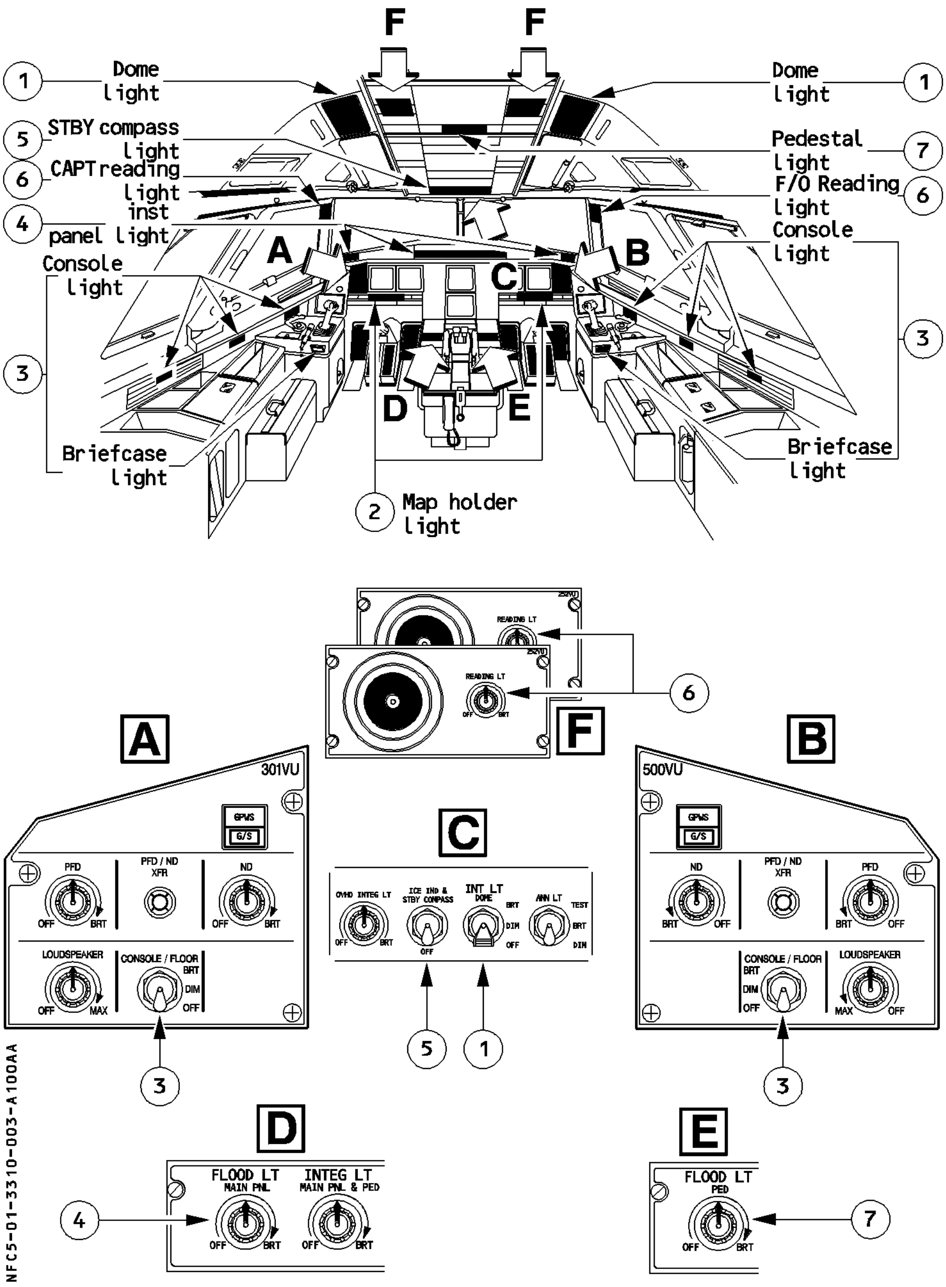
33.00 CONTENTS

GENERAL

The instrument panel has both integral instrument lighting and flood lighting.
The brightness of all panel lighting is adjustable.
Incandescent spot lights and flood lights illuminate all work surfaces and the side consoles.
Two dimmable dome lights illuminate the overall cockpit. When the batteries are supplying all electrical power, only the righthand dome light is on line.

DESCRIPTION

Integrated lighting for instruments and panels
All instruments and panels in the cockpit (other than display units) have integral lighting. The brightness of all integral lighting is adjustable.
Annunciator lights
The ANN LT switch, on the overhead panel, controls the brightness of all the annunciator lights on the flight deck.
It sets the brightness of all annunciator lights at the same level.
The flight crew can test the annunciator lights by selecting the TEST position on the ANN LT switch, and check to see that all the annunciator lights come on.
Dome lights
Two dome lights give the cockpit shadow-free illumination.
Mapholder lighting
Each pilot's station has a lighted map and chart holder.
Console and briefcase lighting
Each pilot's station has lighting for the briefcase stowage, the side console, and the floor.
Center instrument panel
Lights under the glareshield illuminate the center instrument panel.
Standby compass
The standby compass has integral lighting.
Reading lights
Each pilot's station has a reading light.
Pedestal lighting
A flood light in the middle of the overhead panel illuminates the center pedestal.

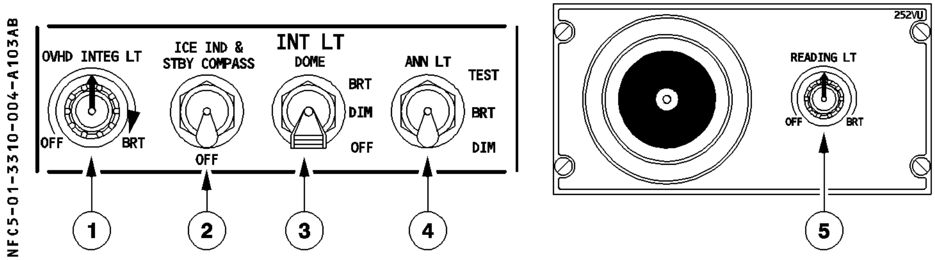


F
F
1 Dome light
1 Dome light
5 STBY compass light
7 Pedestal light
6 CAPT reading light
6 F/O Reading light
4 inst panel light
Console light
A
B
C
Console light
3
3
D
E
Briefcase light
Briefcase light
2 Map holder light
252VU
READING LT
OFF
BRT
6
F
A
301VU
GPWS
G/S
PFD
OFF
BRT
PFD / ND XFR
ND
OFF
BRT
LOUDSPEAKER
OFF
MAX
CONSOLE / FLOOR
BRT
DIM
OFF
3
C
OVHD INTEG LT
OFF
BRT
ICE IND & STBY COMPASS
OFF
INT LT DOME
BRT
DIM
OFF
ANN LT
TEST
BRT
DIM
5
1
B
500VU
GPWS
G/S
ND
BRT
OFF
PFD / ND XFR
PFD
BRT
OFF
CONSOLE / FLOOR
BRT
DIM
OFF
LOUDSPEAKER
MAX
OFF
3
D
FLOOD LT MAIN PNL
OFF
BRT
INTEG LT MAIN PNL & PED
OFF
BRT
4
E
FLOOD LT PED
OFF
BRT
7
NFC5-01-3310-003-A100AA

CONTROLS AND INDICATORS

OVERHEAD PANEL

R



(1) OVHD INTEG LT knob

This knob turns the integral lighting for the overhead panel on and off and adjusts its brightness.

(2) ICE IND & STBY COMPASS sw

This switch turns the integral lighting for the standby compass and the visual indicator on and off.

(3) DOME switch

This switch controls both dome lights.
BRT : Both dome lights on bright.
DIM : Both dome lights on dim.
OFF : Both dome lights off.

(4) ANN LT switch

This switch sets the brightness of all the cockpit annunciator lights at either "bright" or "dim", and also tests them.
TEST : Illuminates all flight deck annunciator lights.
Puts 8's up in all liquid crystal displays (LCDs).
DIM : Reduces voltage to all annunciator lights.
BRT : Allows annunciators to function normally.

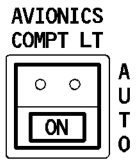
Note : Transfer of data between ECAM and the ND and switching between the electronic instrument system and the display management computer are not allowed during the ANN LT test.

(5) READING LT knob

The reading light on each side of the overhead panel has its own control knob that turns it on and off and adjusts its brightness.

MAINTENANCE PANEL

NFC5-01-3310-005-A100AA



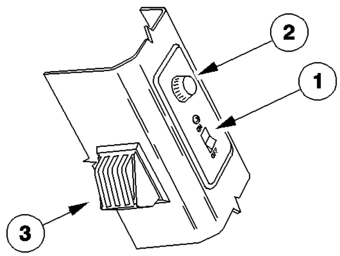
AVIONICS COMPT LT pushbutton switch

AUTO : avionic compartment lighting is automatically controlled by door opening.

ON : avionic compartment lighting is on.

LATERAL WINDOW

NFC5-01-3310-005-B100AA

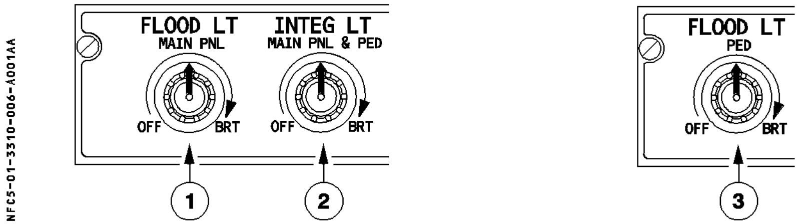


(1) Reading light switch (Captain and F/O).

(2) Brightness adjustment

(3) Light

PEDESTAL



(1) FLOOD LT MAIN PNL knob

This knob adjusts the brightness of the flood lighting for the center instrument panel, and turns it on and off.

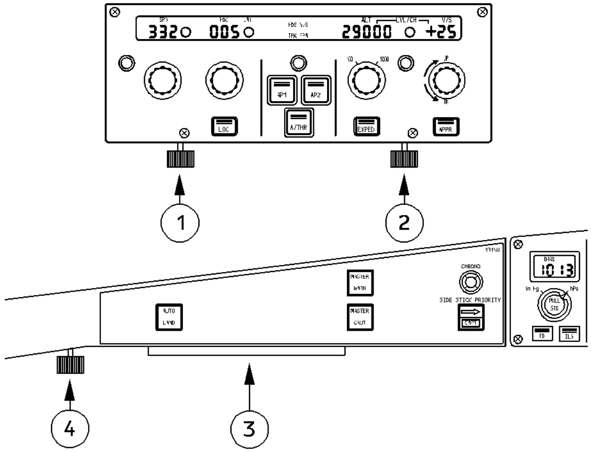
(2) INTEG LT MAIN PNL and PED knob

This knob adjusts the brightness of integral lighting for the main panel and pedestal, and turns it on and off.

(3) FLOOD LT PED knob

This knob adjusts the brightness of the flood lighting for the pedestal, and turns it on and off.

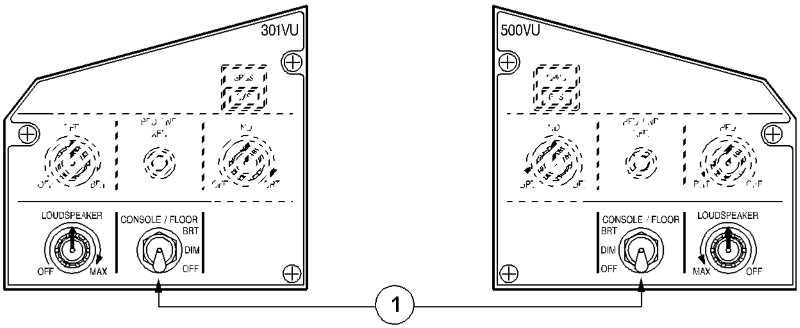
GLARESHIELD



NFC5-01-3310-007-A100AA

1. This knob adjusts the brightness of the integral lighting on the glareshield, and of the LEDs on the FCU.
2. This knob adjusts the brightness of the FCU displays.
3. This lighting illuminates the sliding table and map holder.
4. This knob adjusts the brightness of the sliding table and map holder lighting.

MAIN INST PANEL



NFC5-01-3310-007-B100AA

1. CONSOLE/FLOOR switch

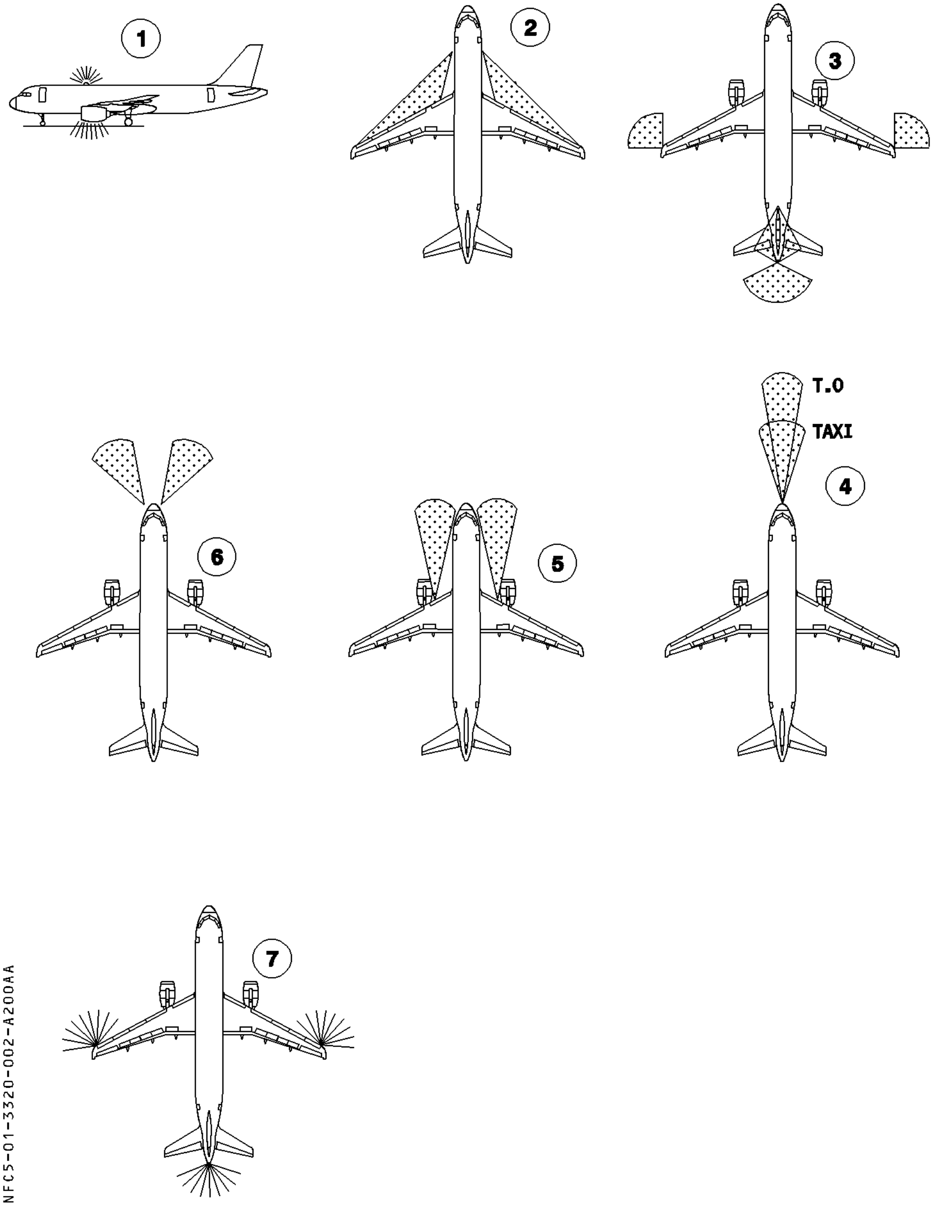
   Each of these switches controls the lights for the side console and briefcase on one side of the cockpit, and for the floor around one of the pilot's seats. The lights can either be bright, dim, or off.

GENERAL

Exterior lighting includes :
- navigation lights
- landing lights
- runway turn off lights
- TO and TAXI lights
- logo lights
- anticollision lights
- wing and engine scan lights

Switches on the overhead panel control the exterior lighting.

CONTROLS AND INDICATORS



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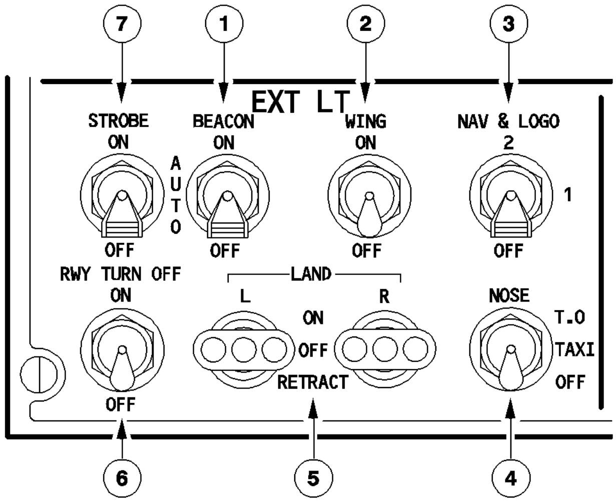
OVERHEAD PANEL



NFC5-01-3320-003-A303AA

(1) BEACON sw

This switch turns on and off the two flashing red lights, one on top and one on the bottom of the fuselage.

(2) WING sw

This switch turns on and off two beam lights on each side of the fuselage. These lights illuminate the leading edge of the wing and the engine air intake to show if ice is accumulating there.

R (3) NAV and LOGO sw

R This switch turns the navigation lights on and off.
R There are dual navigation lights on each wing tip and in the APU tail cone.
R Logo lights are installed in the upper surface of each horizontal stabilizer to illuminate the
R company logo on the vertical stabilizer provided the main gear struts are compressed or
R the slats are extended.
R 1 : Turns on the logo lights and the first set of navigation lights.
R 2 : Turns on the logo lights and the second set of navigation lights.
R OFF : All lights are off.

(4) NOSE sw

This switch turns the taxi and takeoff lights on and off.
T.O. : Turns on both taxi and takeoff lights.
TAXI : Turns on only taxi light.
OFF : Taxi and takeoff lights off.

Note : These two lights, attached to the nose gear strut, go off automatically when landing gear is retracted.

(5) L and R LAND sel

These selectors control the landing light.
ON : Extends the (left or right) landing light which comes on automatically when fully extended.
OFF : Shut off the landing light but leaves it extended.
RETRACT : Retracts the landing light and shuts it off.

(6) RWY TURN OFF sw

This switch turns the runway turn-off lights on and off.

Note : These lights go off automatically when landing gear is retracted.

(7) STROBE sw

This switch turns on and off the three synchronized strobe lights, one on each wing tip and one below the tail cone.
ON : The strobe lights flash white.
AUTO : The strobe lights come on automatically when the main gear strut is not compressed.
OFF : The strobe light are off.

DESCRIPTION

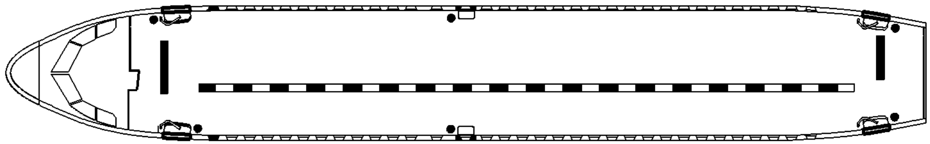
The emergency lighting system has :
· Proximity emergency escape path marking systems (escape path and exit markers),
· Overhead emergency lights,
· EXIT signs,
· Lavatory auxiliary lights,
· Overwing escape route lighting, and
· Escape slide lighting.

- EXIT signs come on, if the cabin altitude is too high, or (depending on the CIDS/CAM programming), if the NO SMOKING signs come on.
- The proximity emergency escape path marking system, overhead emergency lighting, and EXIT signs come on, if the EMER EXIT LT selector is ON, or if the EMER pushbutton on the Purser's panel is pressed.
- With the EMER EXIT LT selector at ARM :
  · The proximity emergency escape path marking system and the overhead emergency lighting automatically come on, if :
    - Normal aircraft electrical power system fails, or
    - DC SHED ESS BUS fails, or
    - AC BUS 1 fails.
  · Exit signs automatically come on, if :
    - Normal aircraft electrical power system fails, or
    - DC SHED ESS BUS fails.
- When on, the proximity emergency escape path marking system, the overhead emergency lights, and the EXIT signs are normally supplied by the DC SHED ESS BUS. If the DC SHED ESS BUS fails, batteries inside the light fixtures power all the lights. Normally the DC SHED ESS BUS charges the batteries when :
  · The EMER LT selector is not ON, and
  · The EMER pushbutton on the Purser's panel is not pressed, and
  · AC BUS 1 is supplied, and
R · The NO SMOKING selector is OFF, or at AUTO with the landing gear retracted.

Lavatory auxiliary lights are always on. They are supplied by 28V DC ESS BUS.
The escape slides have an integral lighting system. The escape slide lights and the overwing route lights come on automatically, when the slide is deployed. They are supplied by internal batteries.

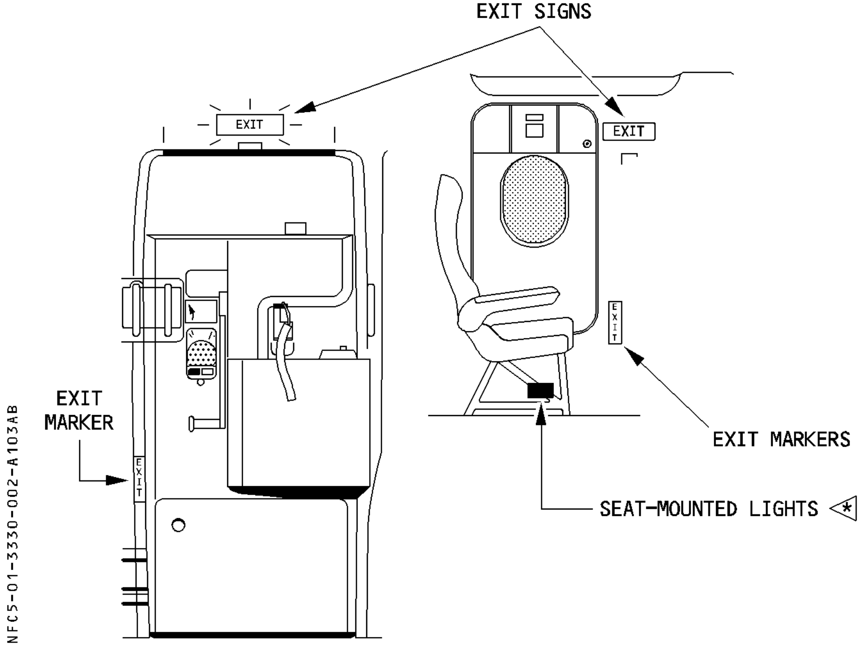
PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM/EXIT SIGNS

R



LEGEND

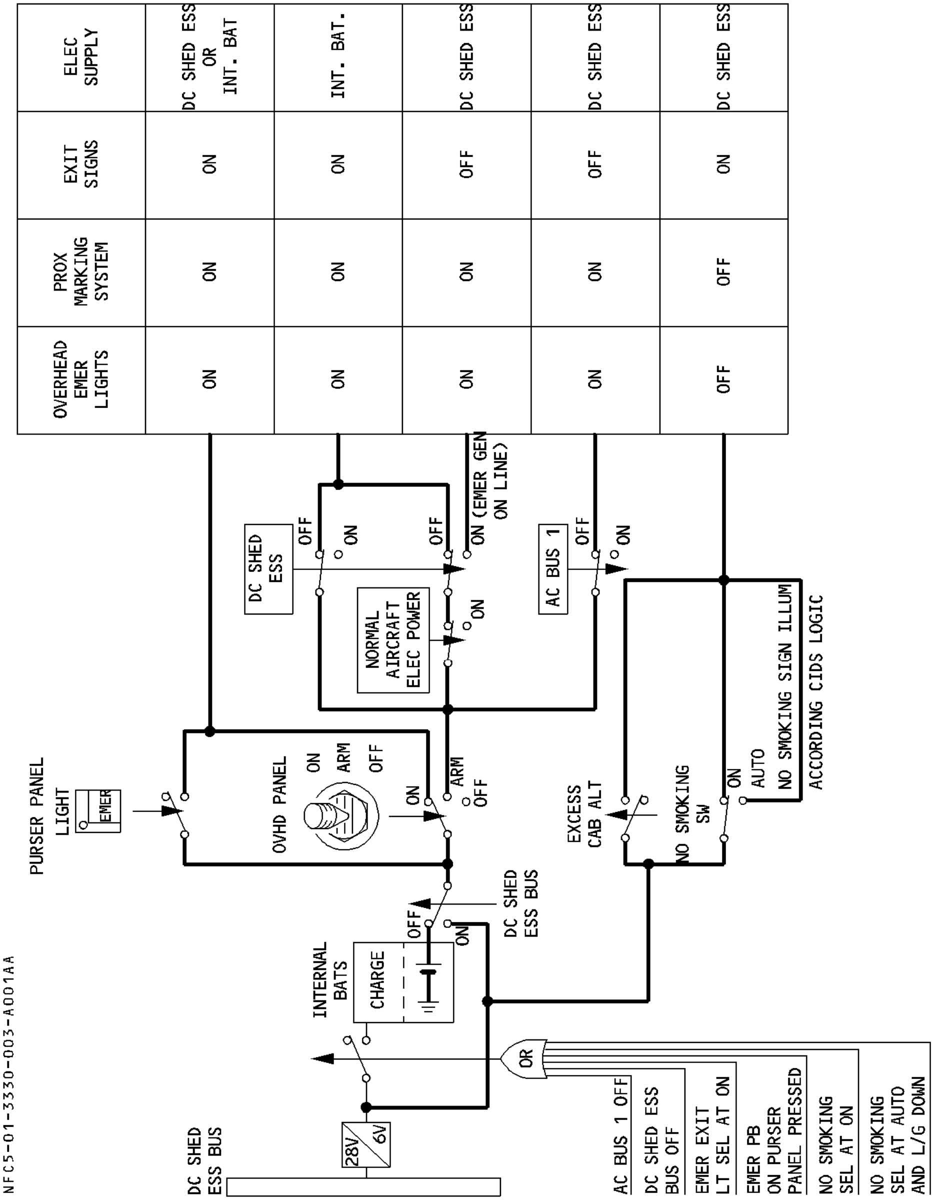
- PROXIMITY EMERGENCY ESCAPE PATH MARKING SYSTEM
- LIGHT STRIPS IN GALLEY AREA <*
- EXIT MARKERS



EMERGENCY LIGHTING CONTROL LOGIC

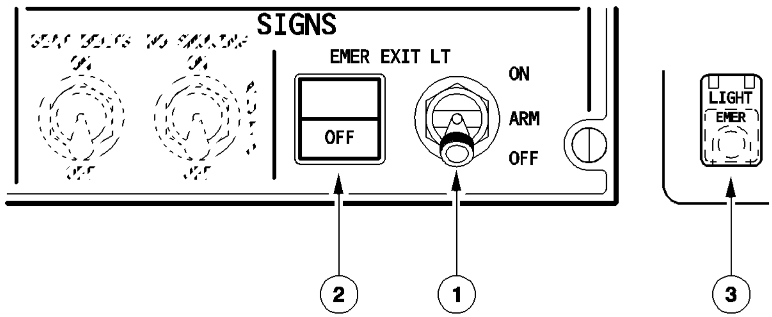
FOR INFO

R



CONTROLS AND INDICATORS

OVERHEAD PANEL PURSER PANEL



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① EMER EXIT LT sel

The selector has three detent positions.

R ON : Overhead emergency lights, EXIT signs and proximity marking system come on.

OFF : Above lights are off.

R ARM : · The proximity emergency escape path marking system and overhead
R emergency lighting come on if :
- Normal aircraft electrical power system fails or
R - DC SHED ESS BUS fails or
- AC BUS 1 fails.
R · Exit signs come on if :
- Normal aircraft electrical power system fails or
- DC SHED ESS BUS fails or

Note : The LIGHT EMER pushbutton on the purser's panel can turn on the emergency lighting independently of the positions of this selector switch.

② EMER EXIT LT-OFF lt

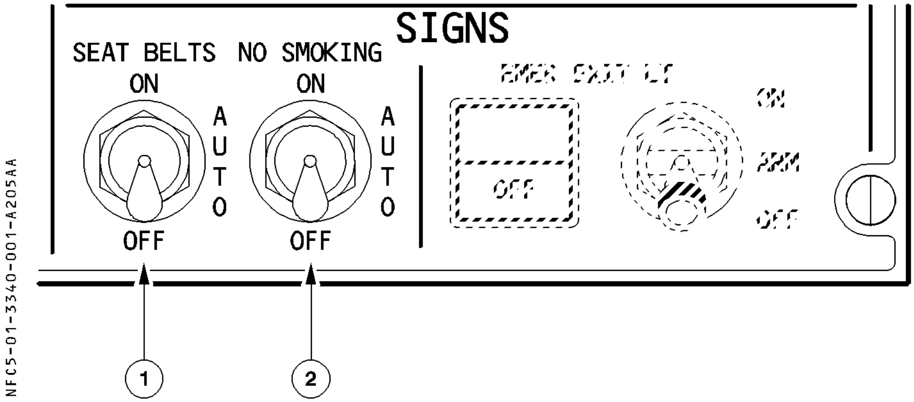
This light comes on amber when the EMER EXIT LT selector is selected OFF.

③ LIGHT EMER pb

When pressed, this button performs the same function as the EMER EXIT LT switch when it is ON.

CONTROLS AND INDICATORS

OVERHEAD PANEL



(1) SEAT BELTS sw

ON : The FASTEN SEAT BELT and RETURN TO SEAT signs come on, alongwith a low tone chime.
AUTO : The FASTEN SEAT BELT and RETURN TO SEAT signs come on automatically, alongwith a low tone chime (depending on the CIDS/CAM programming), when slats are extended more than 17° (position 1, 2, 3 or FULL) or when the main landing gear is extended. After landing, the signs remain on, even if the slats are retracted.
OFF : Signs are off. A low tone chime sounds when the lights go off (depending on the CIDS/CAM programming).

R (2) NO SMOKING sw

R ON : The EXIT and NO SMOKING signs come on, with a low tone chime.
AUTO : The EXIT signs come on, when the landing gear is extended, and they go off when the landing gear is retracted. A low tone chime sounds (depending on the CIDS/CAM programming) when the lights go on or off.
R The NO SMOKING signs are ON.
R OFF : The EXIT and NO SMOKING signs are off. A low tone chime sounds when the lights go off (depending on the CIDS/CAM programming).

Note : If the cabin altitude goes above 11300 feet (± 350 feet), the cabin illuminates (depending on the CIDS/CAM programming), and the FASTEN SEAT BELT, EXIT
R *and NO SMOKING signs come on, regardless of the SEAT BELTS and NO*
R *SMOKING switches.*

MEMO DISPLAY

– Displays “LDG LT” in green, if one landing light is extended.
– Displays “STROBE LT OFF” in green, if the STROBE switch is OFF in flight.
– Displays “SEAT BELTS” and “NO SMOKING” messages in green, when the corresponding sign is on.

BUS EQUIPMENT LIST

			NORM AC	NORM DC	EMER ELEC AC ESS	EMER ELEC DC ESS	EMER ELEC HOT
COCKPIT LIGHTS	Dome light	L		DC GND/ FLT			
COCKPIT LIGHTS	Dome light	R				X	
COCKPIT LIGHTS	Console light	L		DC1			
COCKPIT LIGHTS	Console light	R		DC2			
COCKPIT LIGHTS	Main inst panel	L				X	
COCKPIT LIGHTS	Main inst panel	R		DC1			
COCKPIT LIGHTS	Stby compass/ice ind					X	
COCKPIT LIGHTS	Supplementary reading light			DC1			
COCKPIT LIGHTS	Pedestal light			DC1			
COCKPIT LIGHTS	Reading light	L		DC1			
COCKPIT LIGHTS	Reading light	R		DC2			
COCKPIT LIGHTS	Briefcase light	L		DC1			
COCKPIT LIGHTS	Briefcase light	R		DC2			
COCKPIT LIGHTS	Map holder light	L		DC1			
COCKPIT LIGHTS	Map holder light	R		DC2			
COCKPIT LIGHTS	Floor light			DC1			
COCKPIT LIGHTS	Inst, panels-integral light		AC1				
COCKPIT LIGHTS	Annunciator light		AC1, 2 and AC STAT INV				
COCKPIT LIGHTS	Annunciator light test/dim			DC2			

		NORM		EMER ELEC		
		AC	DC	AC ESS	DC ESS	HOT
EXTERIOR LIGHTS	Navigation lts	GRD/ FLT				
	Landing lts L	AC1				
	Landing lts R	AC2				
	RWY turn off lts L	AC1	DC 2 *			
	RWY turn off lts R	AC2	DC 2 *			
	Taxi and TO lts	AC1	DC 2 *			
	Taxi and TO lts	AC2	DC 2 *			
	Logo lts L ◁	AC1	DC 2 *			
	Logo lts R ◁	AC2	DC 2 *			
	Beacon lts Upper	AC1				
	Beacon lts Lower	AC2				
	Strobe lts ◁	AC2				
	Wing lts R	AC1				
	Wing lts L	AC2				
CABIN LIGHTING		AC1 AC2 and GRND/ FLT			SHED **	

* Supply for the light control
** Standby supply (refer to EMERGENCY LIGHTING CONTROL LOGIC)

34.00 CONTENTS

DESCRIPTION

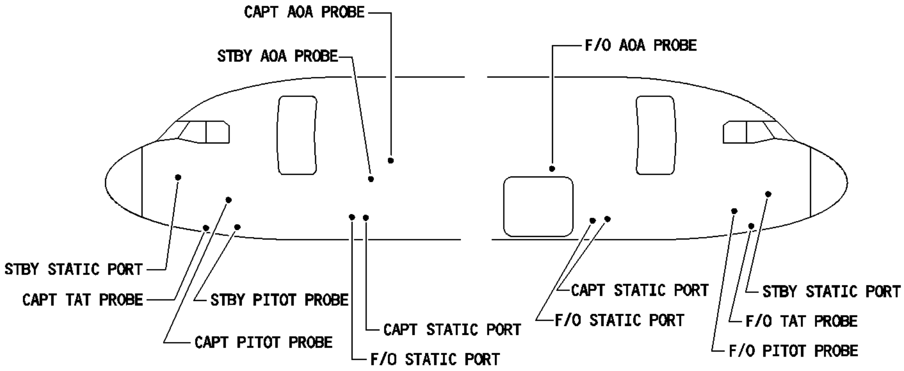
The Air Data and Inertial Reference System (ADIRS) supplies temperature, anemometric, barometric and inertial parameters to the EFIS system (PFD and ND) and to other user systems (FMGC , FADEC, ELAC, SEC, FAC, FWC, SFCC, ATC, GPWS, CFDIU, CPC).
The system includes :

- 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 part (Air Data Reference) part which supplies barometric altitude, airspeed, mach, angle of attack, temperature and overspeed warnings.
  · the IR part (Inertial Reference) which supplies attitude, flight path vector, track, heading, accelerations, angular rates, ground speed and aircraft position.

  Note : The ADIRU gives true heading instead of magnetic heading :
  – above 82° North
  – above 73° North between 90° and 120° West (magnetic polar region)
  – above 60° South

- one ADIRS control panel (ADIRS CDU) on the overhead panel for selection of modes (NAV, ATT, OFF) and indications of failures.
  The IR is normally initialized through the FMGS, but the ADIRS CDU may be used as a back up.
- 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 STAT 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.

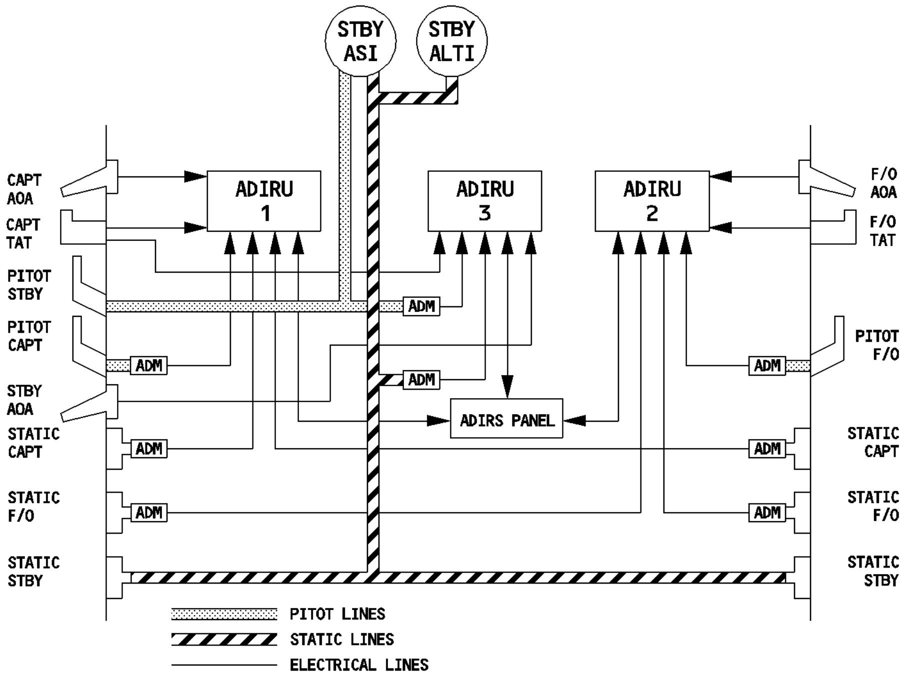
PROBES LOCATION



NFC5-01-3410-002-A001AA

PROBES SCHEMATIC

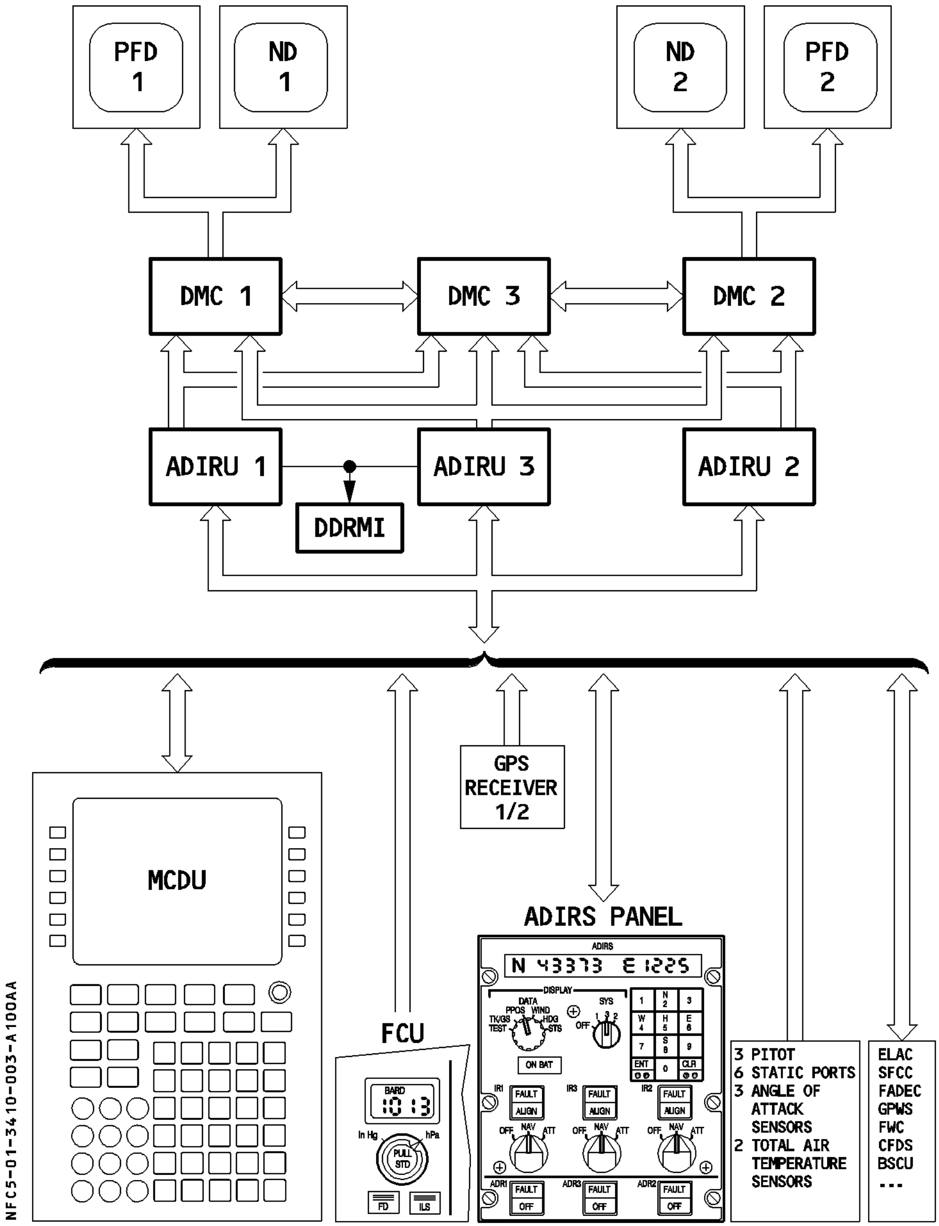
R



NFC5-01-3410-002-B001AB

Note : ADIRU (1) is supplied by CAPT probes,
(2) is supplied by F/O probes,
(3) is supplied by STBY probes and CAPT TAT.

ADIRS SCHEMATIC

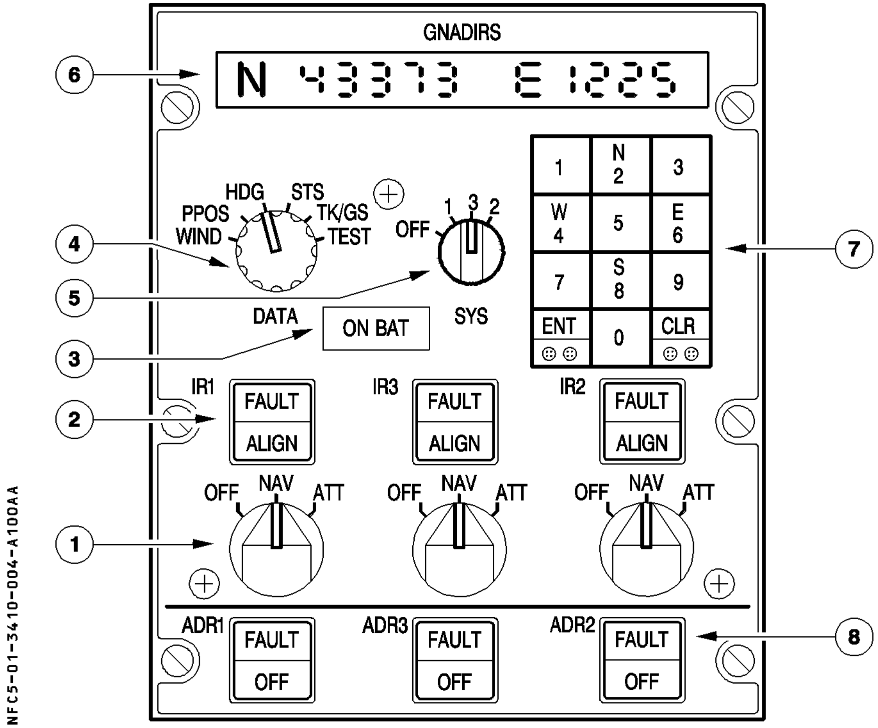


CONTROLS AND INDICATORS

OVERHEAD PANEL

The ADIRS CDU located on the overhead panel provides the controls and indicators to permit :

— selection of power supplies to the ADR and IR systems
— selection and display of navigation data
— manual initialization (normally performed through the FMGC)
— status and fault indication of IRs or ADRs.



(1) 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. Supplies full inertial data to aircraft systems.
ATT : IR mode supplying only attitude and heading information if the system loses its ability to navigate.
The heading must be entered through the CDU keyboard and has to be reset frequently (about every 10 minutes)

(2) IR 1 (2) (3) lt

R	FAULT	: Comes on amber associated 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	ALIGN	: Steady	:	the respective IR is operating normally in align mode.
R		Flashing if	:	IR alignment fault, or no present position entry after 10 min, or difference between position at shutdown and entered position exceeds 1° of latitude or longitude.
R		Extinguished	:	Alignment has been completed.

(3) ON BAT lt

Comes on amber when one or more IRs is supplied only by the a/c battery. It also comes on for a few sec at the beginning of the alignment, but not for a fast realignment.

Note : If, when the aircraft is on the ground, at least one ADIRU is supplied by aircraft batteries :
– an external horn sounds
– the ADIRU and AVNCS light comes on blue on the EXTERNAL POWER panel.

(4) DATA selector knob

This knob selects the information to be displayed in the ADIRS display window.

TEST	The ENT and CLR buttons on the keyboard come on, and the display shows all 8's.
TK/GS	The display shows true track and ground speed.
PPOS	The display shows present latitude and longitude
WIND	The display shows true wind direction and speed.
HDG	The display shows true heading and the minutes remaining until alignment is completed.
STS	The display shows an action code.

(5) SYS selector knob

OFF	: The CDU display is not energized. ADIRS are still energized if the associated IR mode rotary selectors are not at OFF.
1.2.3	: System selected for data display.

(6) Display

The display presents the data selected by the DATA selector.
A keyboard entry overrides the selected display.

(7) Keyboard

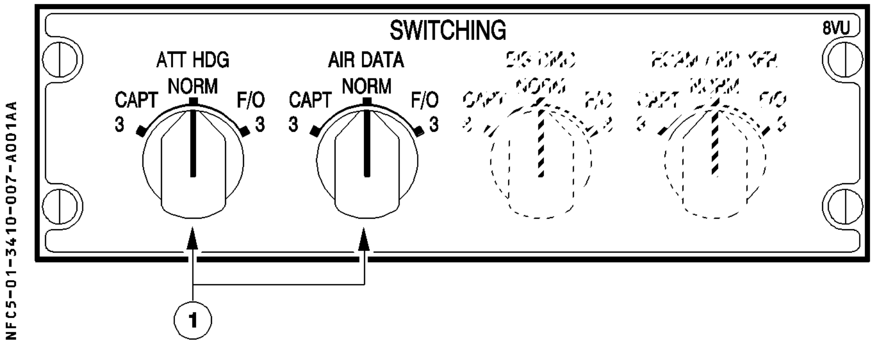
The flight crew can use the keyboard to enter the present position, or the heading in ATT mode, into the selected system.

Letter keys	:	Used to enter N, S, E, or W for position, or entering H (◁) for heading (ATT mode).
Number keys	:	Used to enter the present position (or the present magnetic heading in ATT mode).
CLR key	:	The integral cue light comes on after an entry operation, if the data has an unreasonable value. Pressing this key clears the data display, that has been keyed in but not yet entered.
ENT Key	:	The integral cue light comes on when a crewmember has keyed in a number for N, S, W, E or H (◁). Pressing the key enters data into the ADIRS.

R (8) ADR 1 (2) (3) pb (momentary action)

OFF	Air data output disconnected.
FAULT	This amber light comes on with an ECAM caution, if a fault is detected in the air data reference part.

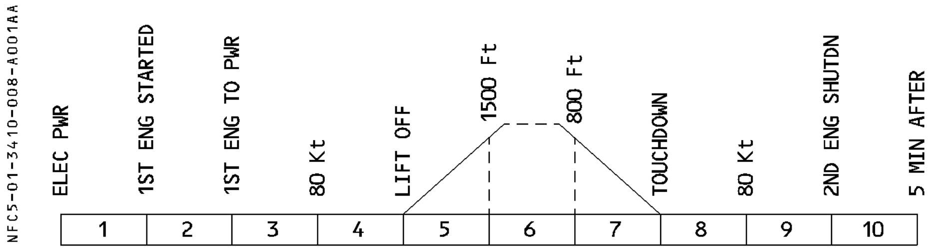
PEDESTAL



(1) ATT HDG and AIR DATA sel

NORM : ADIRU 1 supplies data to PFD 1, ND 1, RMI and VOR/DME.
ADIRU 2 supplies data to PFD 2, and ND2.
CAPT 3 : ADR 3 or IR 3 replaces ADR 1 or IR 1.
F/0 3 : ADR 3 or IR 3 replaces ADR 2 or IR 2.

WARNINGS AND CAUTIONS



R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>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
– Speed/Mach
– F/CTL law (normal, alternate/direct)</td><td>CRICKET+ STALL (SYNTHETIC VOICE)</td><td rowspan="2">MASTER WARN</td><td rowspan="9">NIL</td><td rowspan="2">NIL</td><td>GND</td></tr>
<tr><td>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</td><td>CRC</td><td>2, 3, 4
8, 9,10</td></tr>
<tr><td>ADR 1 (2) FAULT</td><td rowspan="7">SINGLE CHIME</td><td rowspan="7">MASTER CAUT</td><td rowspan="3">ADR FAULT lt</td><td>1, 4,8,10</td></tr>
<tr><td>ADR 3 FAULT</td><td>1,4,5
7,8,10</td></tr>
<tr><td>ADR (1+2) (1+3) (2+3) FAULT</td><td>1,4,8,10</td></tr>
<tr><td>IR 1 (2) FAULT</td><td rowspan="4">IR FAULT lt</td><td>4,5,7,8</td></tr>
<tr><td>IR 3 FAULT</td><td>4,5
7,8</td></tr>
<tr><td>IR (1 + 3) (2+3) FAULT</td><td rowspan="2">4, 8</td></tr>
<tr><td>IR 1 + 2 FAULT</td></tr>
</table>

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>HDG DISCREPANCY
difference between heading on CAPT and F/O displays greater than 5°</td><td rowspan="3">SINGLE CHIME</td><td rowspan="3">MASTER CAUT</td><td rowspan="3">NIL</td><td>CHECK HDG (on PFD and ND)</td><td>4,8</td></tr>
<tr><td>ATT DISCREPANCY
difference between roll or pitch angle displayed on CAPT and F/O PFD greater than 5°</td><td>CHECK ATT (on PFD)</td><td rowspan="2">3,4,8</td></tr>
<tr><td>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 (or QFE) is selected</td><td>CHECK ALT (on PFD)</td></tr>
</table>

MEMO DISPLAY

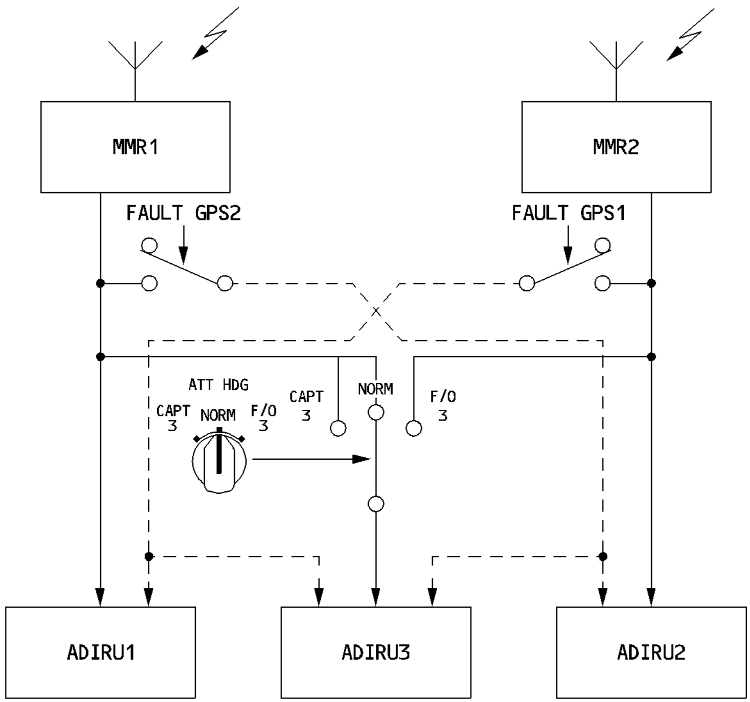
R · This displays shows IRS IN ALIGN X MN during phase 1 or 2 if :
R — at least one active IRS is in ALIGN submode
R — the time remaining until NAV mode is obtained, is X minutes ($1 < x < 10$).
R · IRS IN ALIGN appears if one of the 3 IRS is still in alignment
R These 2 messages are displayed :
R — in green if both engines are stopped
R — in amber if one engine is running.

DESCRIPTION

The Global Positioning System (GPS) is a satellite based radio navigation aid.
Worldwide 24 satellites broadcast accurate navigation data that 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) (GPS 1 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.

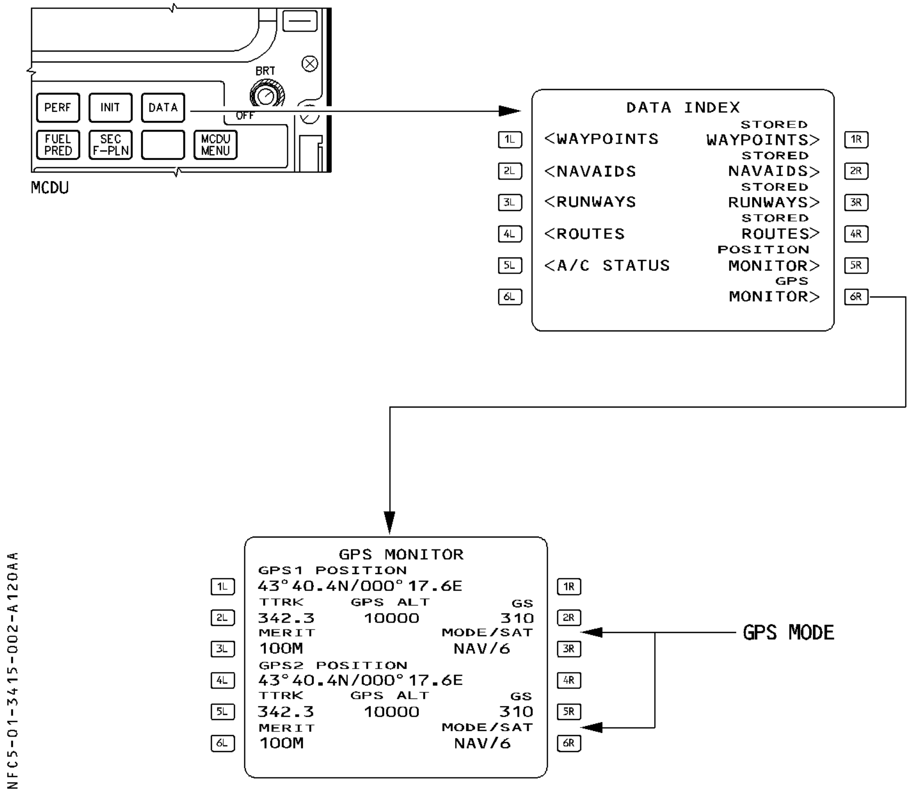
<u>Note</u> : *Flight crew can use the MCDU NAVAID page to deselect the use of GPS data for calculating position (refer to FCOM 4.03.20).*



NFC5-01-3415-001-A110AA

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 GPS 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 4 satellites, then transfers to NAV mode. To enter navigation mode more quickly, MMR uses initial position, time and altitude from IRS.

– **Navigation mode (NAV)**
R When the MMR can track 4 or more satellites, it enters NAV mode and continuously
R supplies data to the ADIRUs.

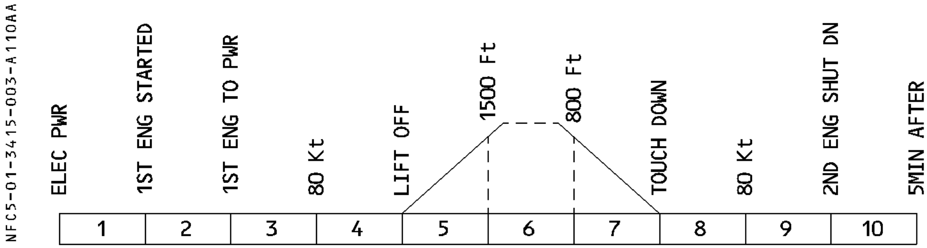
– **Altitude Aiding (ALTAID)**
If the MMR can track at least 4 satellites, it uses the GPS altitude and the IR altitude to calculate an altitude bias.
If the number of satellites drops to three, the altitude bias is frozen, and the MMR enters ALTAID mode, using the IR altitude corrected with the bias.
If after 2 minutes it has not acquired a fourth satellite, the MMR reverts to ACQ mode.

– **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 by MMR 2.
In order to maintain Side 1 and Side 2 segregation, in case ADIRU 2 fails, the ATT HDG selector has to be set to F/O 3, so that ADIRU 3 will be supplied with MMR 2 data.
If 2 ADIRUs fail, the remaining ADIRU is supplied by its own side GPS receiver.

WARNINGS AND CAUTIONS



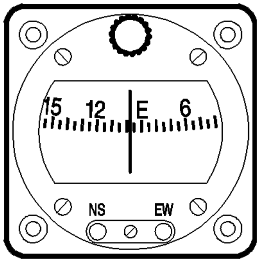
E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
GPS 1 (2) FAULT	SINGLE CHIME	MASTER CAUTION	NIL	NIL	4, 5, 7, 8
FM/GPS POS DISAGREE					1, 10
GPS PRIMARY LOST (No ECAM warning)	TRIPLE CLICK During non ILS approach only	NIL			2,3,4,5 8,9,10

COMPASS

This instrument is on top of windshield center post.
The deviation card is above it.

Note : Because of the location of the APU power on contactor in the cockpit, the APU start sequence may disturb the compass reading.

NFC5-01-3420-001-A001AA



HORIZON

The electric standby horizon normally draws current from the DC ESS BUS. In case of total electrical failure, the horizon remains usable for 5 minutes.

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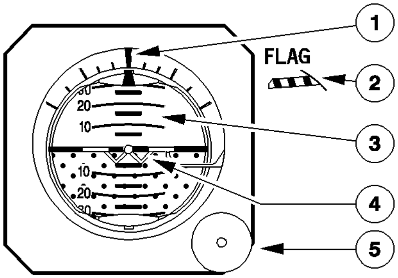


(1) Roll scale

Bank angle graduations up to 60°. No rotation limit.

(2) Flag

Appears if the instrument or power supply fails.

(3) Pitch scale

Measures pitch angle up to ± 85°.

4 Aircraft reference

Fixed symbol.

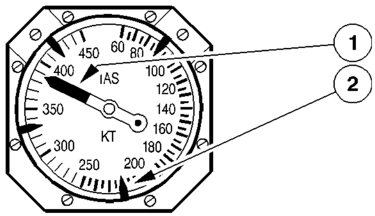
5 Caging knob

The flight crew pulls it out to reinitialize the gyro, and to level and center the horizon. (The airplane should be level during this procedure).

R *Note : After low-rate turns, the standby horizon may not give accurate indications. To*
R *correct this behavior, use the caging knob when the aircraft is level.*

AIRSPEED INDICATOR

NFC5-01-3420-002-A001AA



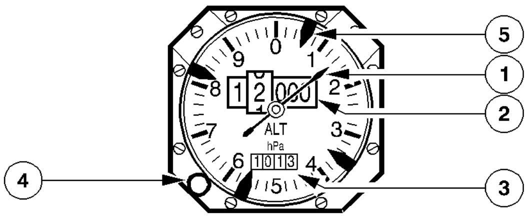
1 Airspeed pointer

2 Airspeed bugs (4)

For marking airspeed references.

ALTIMETER

NFC5-01-3420-002-B001AA



1 Altitude pointer

2 Altitude counter (feet)

3 Altimeter setting

Displays the pressure setting in hPa.

4 Altimeter setting knob

5 Altitude bugs (4)

For marking of altitude references.

ALTIMETER (in meter)

NOT APPLICABLE.

TUNING

The FMGC is the basic means for tuning navaids.
Three modes of tuning are available.

AUTOMATIC TUNING

In normal operation, the FMGC tunes navaids automatically, with each FMGC controlling its own receivers.
If one FMGC fails, the remaining one controls both sides receivers.

MANUAL TUNING

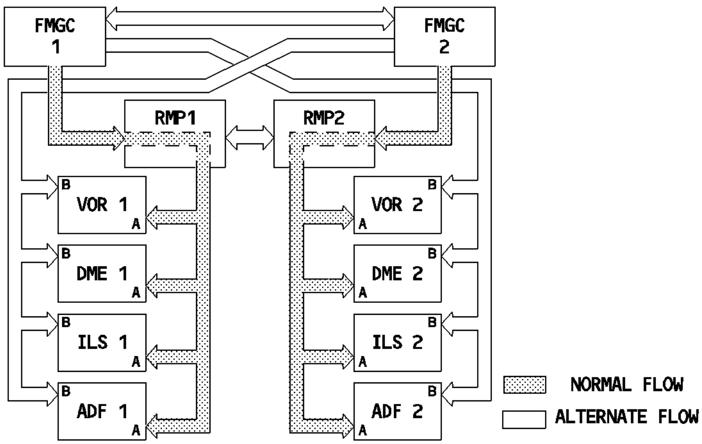
The crew can use the MCDU to override the FMGC's automatic selection and tuning of navaids and select a specific navaid for visual display.
This does not affect the automatic function of the FMGC. Any entry on one MCDU is sent to both FMGC in dual mode, or the remaining FMGC in single.

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.
R The CAPT RMP controls VOR 1 and ADF 1.
R The F/O RMP controls VOR 2 and ADF 2.
Either RMP controls both ILSs (provided NAV back up is selected on RMP 1 and RMP 2).
RMP 3 (if installed) is not used for navaids tuning.

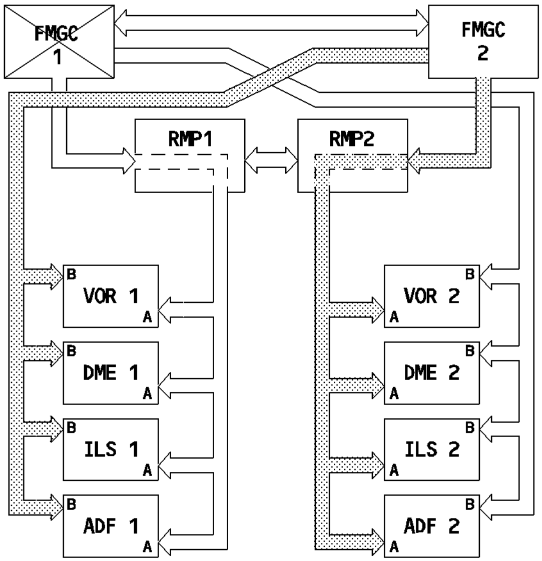
ARCHITECTURE

Normal operation



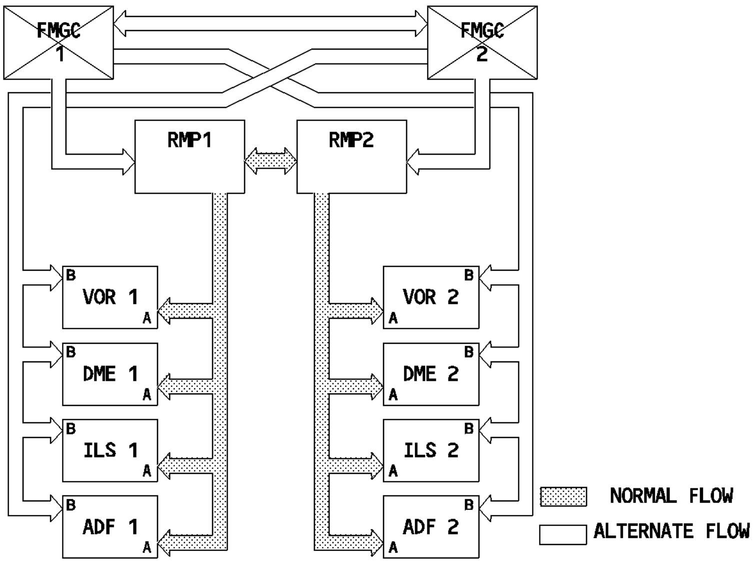
NFC5-01-3430-001-A001AA

FMGC 1 failure



NFC5-01-3430-002-A001AA

Back up tuning



NFC5-01-3430-002-B001AA

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.

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.
- The flight crew can put the same ILS information on each PFD by pressing the ILS button on the EFIS control panel (the green bars come on).
- The NDs display ILS information if the flight crew selects the ROSE ILS mode on the EFIS control panel (refer to 1.31).

ADF

The aircraft has two ADF systems.
(For tuning instructions refer to the TUNING paragraph).
- The NDs display ADF information, depending on the position of the ADF/VOR selectors on the EFIS control panel (refer to 1.31).
  - ◁* The DDRMI also displays ADF1 and ADF2 bearings, depending on the position of the ADF/VOR selector (on the DDRMI).

DME

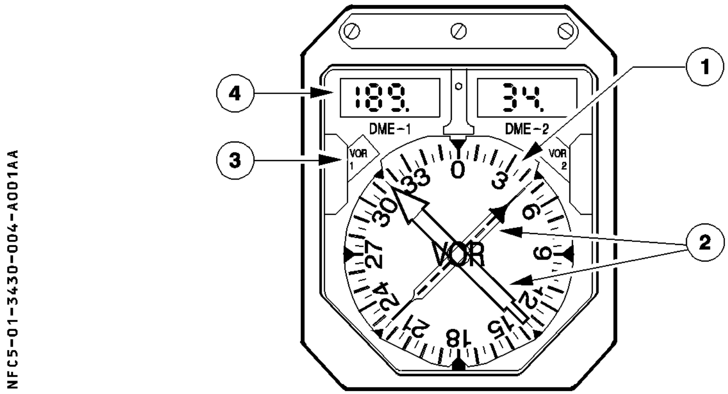
The aircraft has two DMEs.
The frequency set automatically on the DME corresponds to that set on the VOR or ILS.
The NDs and the DDRMI can display VOR DME information, and the PFDs can display ILS DME information (refer to 1.31).

MARKER BEACON

One marker beacon system is included in VOR receiver 1.
R The PFD displays the outer, middle, and inner marker signals (refer to 1.31).

CONTROLS AND INDICATORS

DIGITAL DISTANCE AND RADIO MAGNETIC INDICATOR (DDRMI)



(1) Compass card

ADIRU 1 normally supplies the signal that positions the compass card. ADIRU3 supplies it when selected by the ATT HDG SWITCHING selector.

(2) Bearings pointers

Indicate the magnetic bearing to the station received by VOR 1 (dashed pointer) and VOR 2 (double pointer).

Note : Depending on the quality of the VOR beacon's signal, and mainly at distances greater than 25 NM from the station, the processing of the signal, on aircraft equipped with COLLINS or BENDIX VOR may lead to bearing pointer oscillations.

(3) VOR 1(2) flags

The indicators display these flags if :
- the VOR receiver fails
- the RMI has an internal failure
- the heading signal from ADIRS is not valid
- the power supply fails.

As long as the flag shows, the relevant pointer remains at the last valid position.

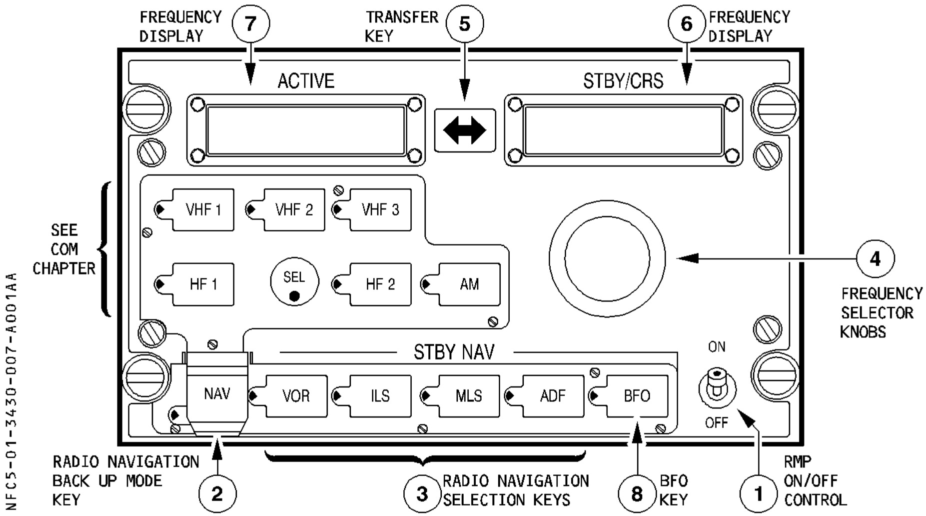
(4) DME 1(2) counters

The counters indicate distances in NM and 1/10th at less than 20 NM.
At less than 1 NM, 0 is shown.

LEFT INTENTIONALLY BLANK

LEFT INTENTIONALLY BLANK

R **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.
- *When the flight crew uses an RMP to turn an ILS/DME, the PFDs do not display the DME distance.*

③ STBY NAV keys

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 Frequency selector 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.

– 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.
– setting course :
  Selected by inner knob only.

⑤ Transfer key

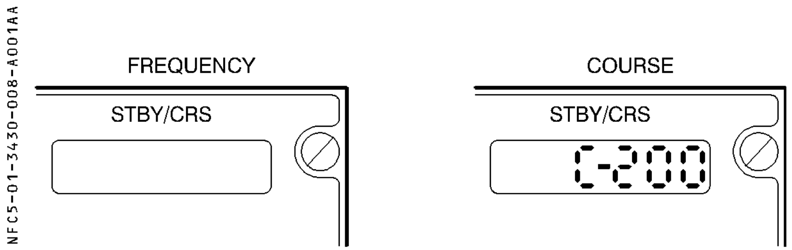
The flight crew presses this key to interchange ACTIVE and STBY frequencies. This action tunes the selected receiver to the new ACTIVE frequency.

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.

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 ADF, with BFO activated, the audio identification is heard. However there are
R some ADF where the BFO must be deactivated in order to hear the audio identification.

DESCRIPTION

The aircraft has two radio altimeters.
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).

AUTOMATIC CALL OUT

FWC generates synthetic voice for radio height announcement below 2500 feet. These announcements come through the cockpit loudspeakers even if the speakers are turned off.

Predetermined call out

The altitude call out uses the following predetermined threshold :

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 + 100	HUNDRED ABOVE
DH	MINIMUM

Pin programmings allow the operator to select the call outs 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.

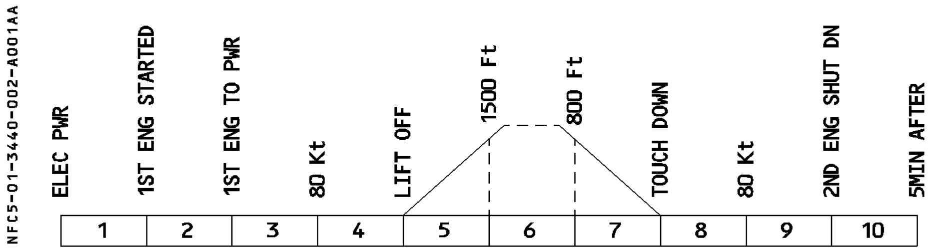
Intermediate call out

If time between two consecutive predetermined call outs exceeds a certain threshold, the present height is repeated at regular intervals.
The threshold is : 11 seconds above 50 feet
4 seconds below 50 feet
The repeating interval is 4 seconds.

RETARD announcement

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

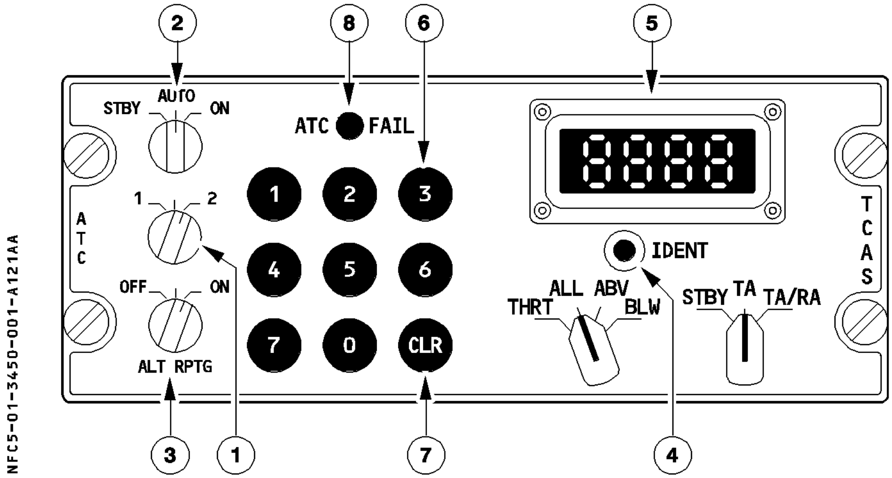


E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
RA 1 (2) FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4 5, 8

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 ADIRS (1 for transponder 1, etc ...) supplies the altitude for altitude reporting. In case of a failure, ADIRS 3 can do this when selected by the AIR DATA SWITCHING selector.

CONTROL PANEL



(1) ATC sel

This switch selects transponder 1 or 2.

(2) Mode sel

STBY : Both ATC transponders are electrically supplied but do not operate.
ON : Selected transponder operates.
R AUTO : In flight : Selected transponder operates.
R AUTO : On ground : Selected transponder operates only in mode S (Selective aircraft
R interrogation mode).

③ ALT RPTG sw

ON : The transponder sends barometric standard altitude data.
OFF : No altitude data transmission. If the TCAS is installed, the upper ECAM displays "TCAS STBY" in green.

④ IDENT sw

The flight crew presses this button to send the aircraft identification signal.

⑤ Code display

The window displays the selected code.

⑥ Keyboard

The flight crew uses these pushbuttons to set the code assigned by ATC.

⑦ CLR pb

The flight crew uses this pushbutton to clear the code display.

Note : As long as the four figures of the new code are not entirely written, the previous code remains.

⑧ ATC FAIL

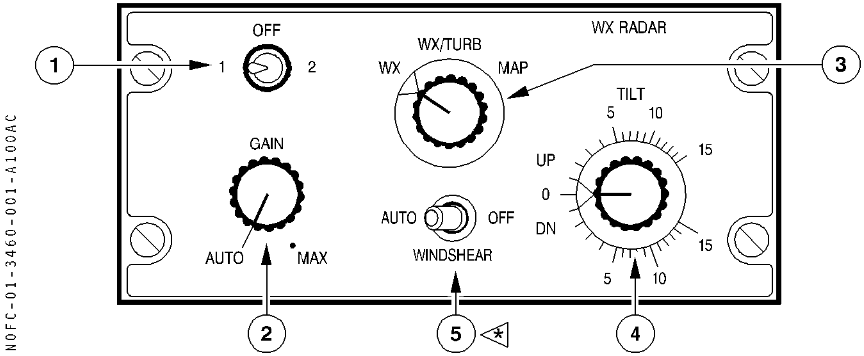
This light comes on if the selected transponder fails.

DESCRIPTION

The aircraft has two weather radar systems. Only one transceiver is working 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 his ND by setting the associated brightness control to the minimum (refer to 1.31).

R *Note : Some aircraft may be fitted with one weather radar system only.*

CONTROL PANEL



① Transceiver 1-2 sel

This switch allow to select one radar or to turn both radars to off.

R *Note : When one radar only is fitted on aircraft, no weather image will be displayed*
R *when switching on system 2.*

② GAIN knob

This knob adjusts the sensitivity of the receiver in all modes.
AUTO automatically adjusts the gain to the optimum setting.

③ Mode sel

WX	:	Weather mode : colors indicate the intensity of precipitation (black for the lowest intensity, green, amber and red indicating progressively higher intensities).
WX / TURB	:	The screen shows turbulence areas (in precipitation areas) in magenta (within 40 NM).
MAP	:	Radar operates in ground mapping mode : black indicates water, green ground and amber cities and mountains.

④ TILT knob

This knob controls antenna tilt.
R Radar 1 depends on ADIRS 1, radar 2 ⊲ on ADIRS 2. ADIRS 3 replaces either ADIRS if
R ATT HDG selector is used.
Zero represents the horizon as seen by ADIRS.

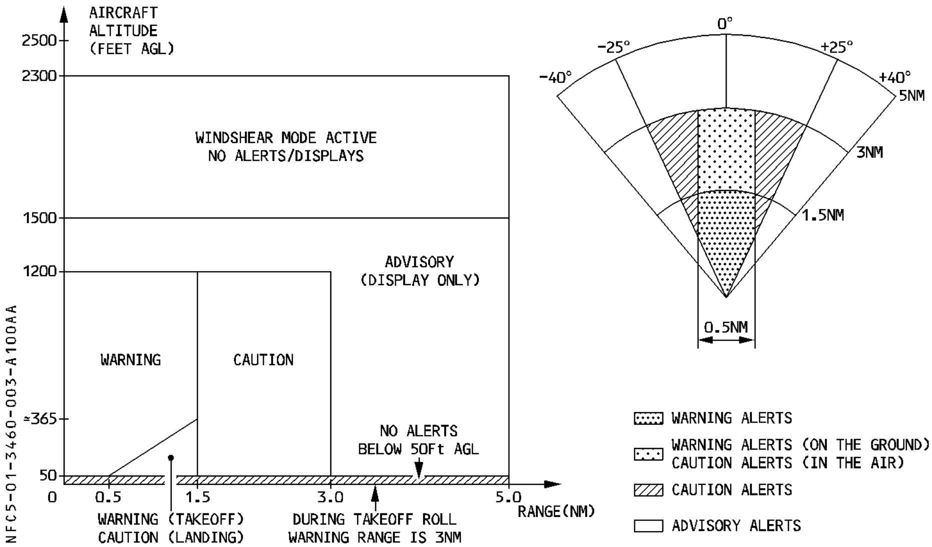
R ⑤ WINDSHEAR sw ⊲ (operative only if the predictive windshear function is embodied)

R AUTO : Predictive windshear function is activated : windshear areas are detected by
R the antenna scanning below 2300 feet RA, even if the transceiver 1-2
R selector is set to OFF, and displayed on the ND if below 1500 feet.
R OFF : No predictive windshear function.

WINDSHEAR PREDICTION FUNCTION

The weather radars have a predictive windshear capability.
The Predictive Windshear System (PWS) operates when :
- The PWS switch is in the AUTO position, and
- The aircraft is below 2300 feet AGL, and
- The ATC is switched to the ON, or AUTO, position, and
- Either engine is running.

The system scans the airspace, within a range of 5 NM ahead of the aircraft, for windshears. Below 1500 feet, when the system detects windshear, 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.
Windshear alert ranges, altitudes, and locations, for the three alert levels are indicated below :



During the takeoff roll, both warnings and cautions are available within a range of 3 NM.
At takeoff, alerts are inhibited above 100 knots and up to 50 feet.
At landing :
- Alerts are inhibited below 50 feet.
- The visual and aural warning alerts are downgraded to caution alerts between 370 feet AGL and 50 feet AGL, and range between 0.5 NM and 1.5 NM.

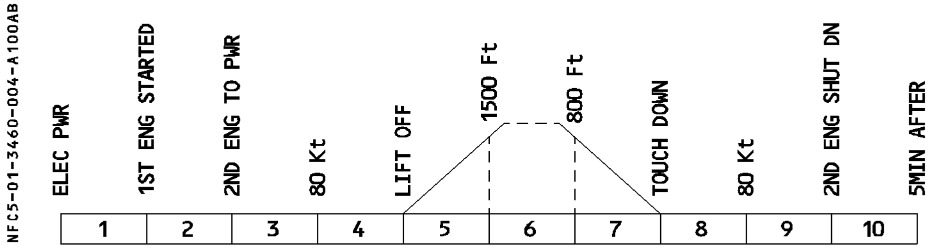
R *Note : If the selected weather radar fails when two weather radars are installed, the PWS*
R *function is recovered by selecting the non-failed weather radar on the control panel.*

R

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 predictive windshear system aural alerts :
– have priority over TCAS, GPWS and other FWC aural warnings
– are inhibited by windshear detection by FAC and stall warning aural messages.

WARNINGS 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

PRED W/S OFF appears when the windshear is selected OFF on the weather radar panel. It appears green when in flight phase 1, 2, 6, 10 and amber when in flight phase 3, 4, 5, 7, 8, 9.

DESCRIPTION

The Ground Proximity Warning System (GPWS) generates aural and visual warnings, when one of the following conditions occurs between radio altitudes 30 and 2450 feet.

- 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 : Too far below 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.

R – A Terrain Clearance Floor (TCF), which improves the low terrain warning during landing.

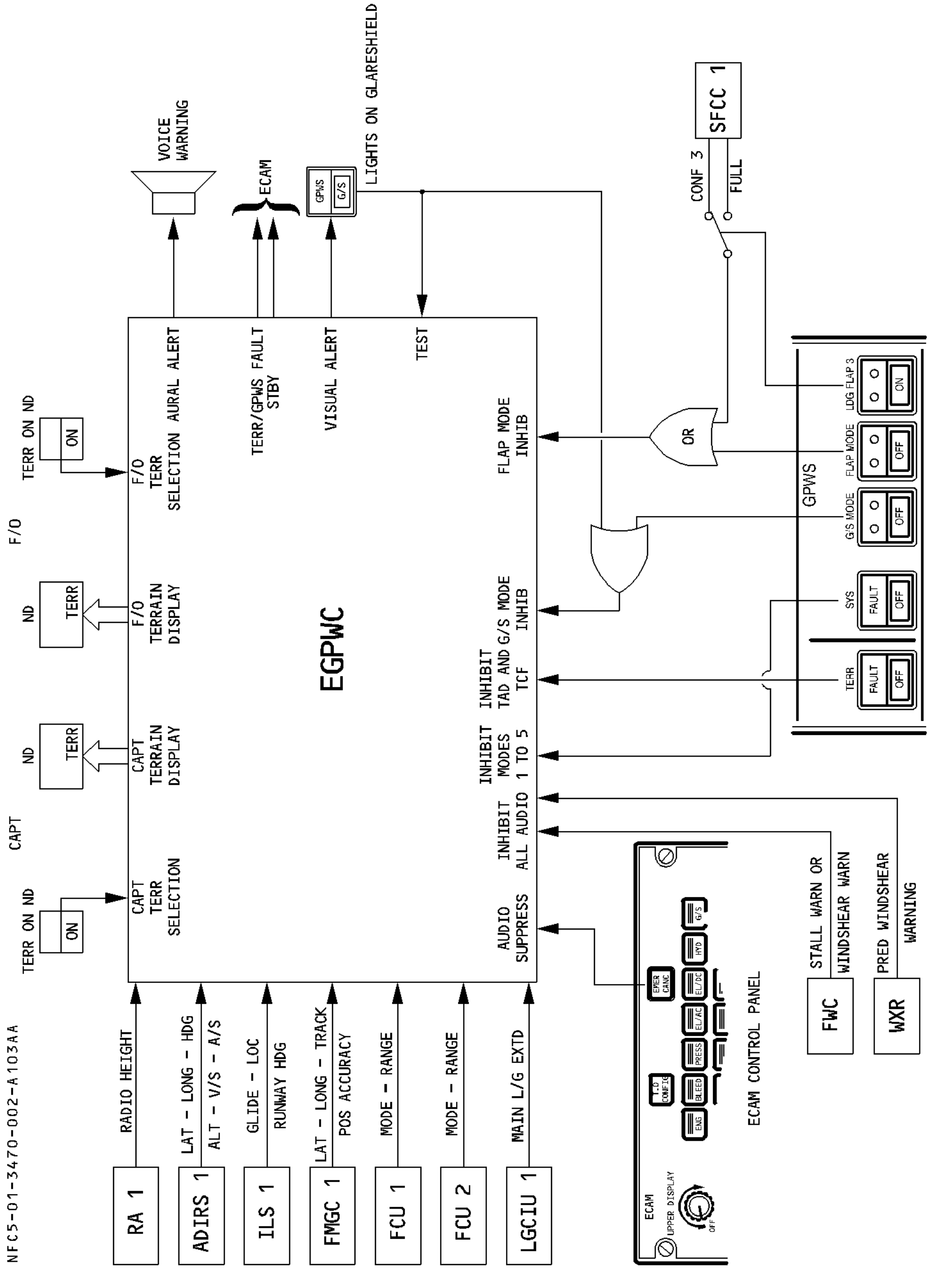
The cockpit loudspeakers broadcast, even if turned off, the aural warning or caution messages associated with each mode. The audio volume of these messages is not controlled by the loudspeaker volume knobs. (These knobs only allow volume adjustment for radio communication).

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.

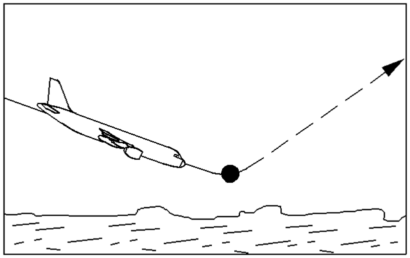
<u>Note</u> : *A number of airports throughout the world have approaches or departures that are not entirely compatible with standard GPWS operation. These airports are identified*
R *in the envelope modulation database, in such a way that, when the GPWS recognizes such an airport, it modifies the profile to avoid nuisance warnings.*

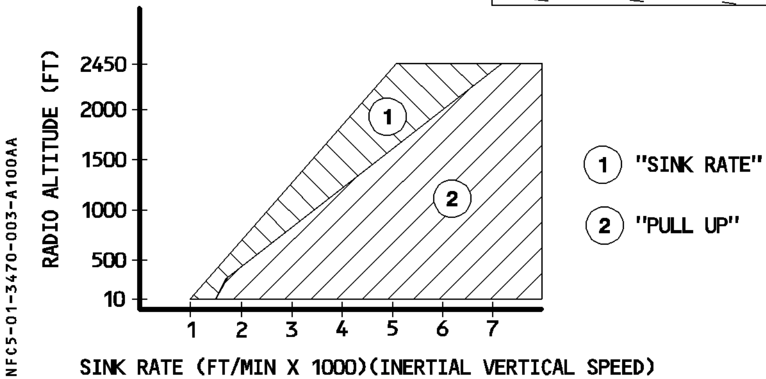
FOR INFO

R


VOICE WARNING
ECAM
GPWS
G/S
LIGHTS ON GLARESHIELD
SFCC 1
CONF 3
FULL
AURAL ALERT
TERR/GPWS FAULT STBY
VISUAL ALERT
TEST
TERR ON ND
ON
F/O TERR SELECTION
F/O
ND
TERR
F/O TERRAIN DISPLAY
CAPT TERRAIN DISPLAY
CAPT
CAPT TERR SELECTION
EGPWC
FLAP MODE INHIB
OR
G/S MODE INHIB
INHIBIT TAD AND TCF
INHIBIT MODES 1 TO 5
INHIBIT ALL AUDIO
AUDIO SUPPRESS
LDG FLAP 3
FLAP MODE
G/S MODE
SYS
TERR
FAULT
OFF
GPWS
STALL WARN OR WINDSHEAR WARN
PRED WINDSHEAR WARNING
FWC
WXR
ECAM CONTROL PANEL
EMER CANC
T.O CONFIG
ENG
BLEED
PRESS
EL/AC
EL/DC
HYD
ECAM UPPER DISPLAY
OFF
RADIO HEIGHT
LAT - LONG - HDG
ALT - V/S - A/S
GLIDE - LOC
RUNWAY HDG
LAT - LONG - TRACK
POS ACCURACY
MODE - RANGE
MAIN L/G EXTD
RA 1
ADIRS 1
ILS 1
FMGC 1
FCU 1
FCU 2
LGCIU 1
NFC5-01-3470-002-A103AA

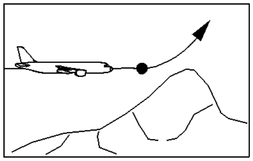
MODE 1: EXCESSIVE RATE OF DESCENT

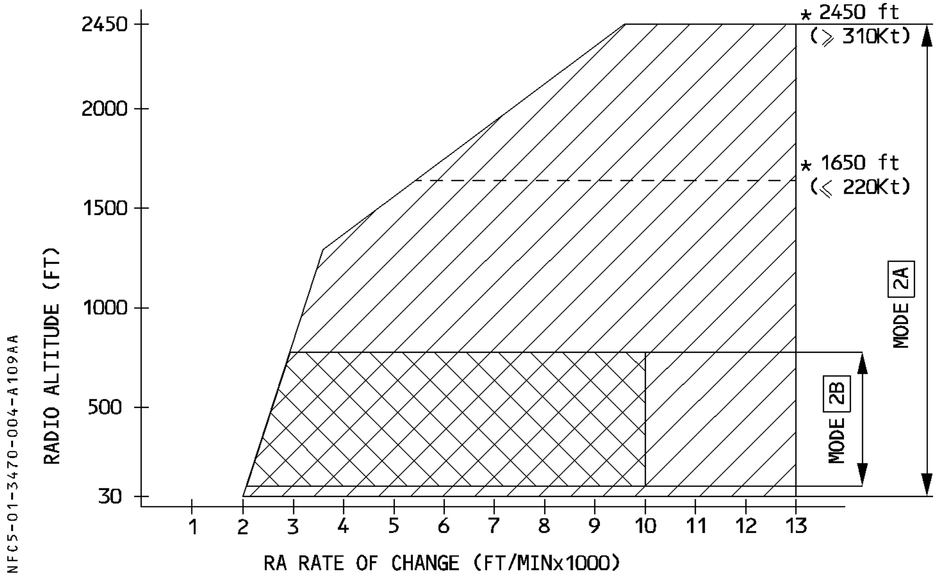




R Mode 1 has two boundaries. Penetration of the first boundary generates the illumination of
R the GPWS light and a repeated aural alert “SINK RATE”. Penetration of the second boundary generates a repetitive “PULL UP”.
R The upper cut-off limit is 2450 feet radio altitude.
R The lower cut-off limit is 10 feet radio altitude.

MODE 2 : EXCESSIVE TERRAIN CLOSURE RATE



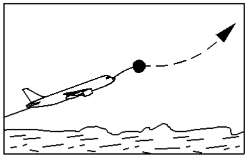


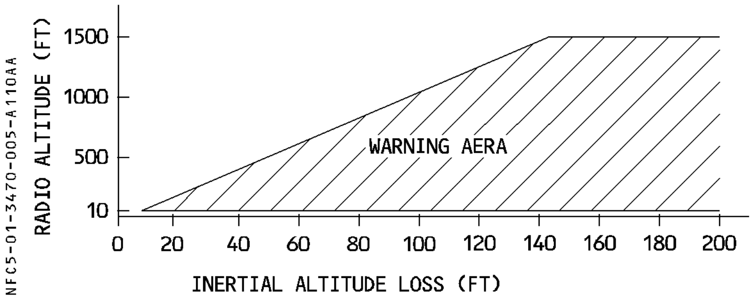
2A — Flaps not in landing configuration and aircraft not on the glide slope beam.
Penetration of the boundary lights up the GPWS lights and sounds the repeated aural alert: “TERRAIN”.
After “TERRAIN” has sounded twice, the warning switches to “PULL UP”, repeated continually until the aircraft leaves 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 knots to 310 knots). At certain airports, the upper boundary may be lowered down to 1250 feet 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 and 600 feet depending on altitude rate. In ILS approach (glide slope deviation < ± 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 aural message is “TERRAIN ” only, and is not followed by “PULL UP” if the aircraft remains in the envelope.

MODE 3 : ALTITUDE LOSS AFTER TAKEOFF

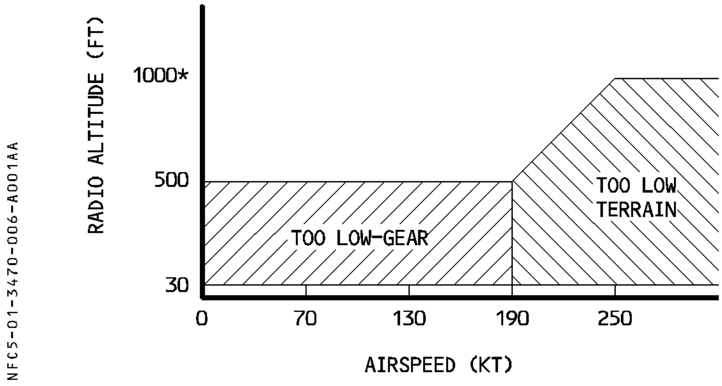




If the aircraft descends during the initial takeoff climb or during a go around, GPWS lights come on and the aural alert “DON'T SINK” sounds repeatedly.
The lower cut-off limit is 10 feet radio altitude.
Mode 3 is desensitized according to the time accumulated after departure and the radio altitude.

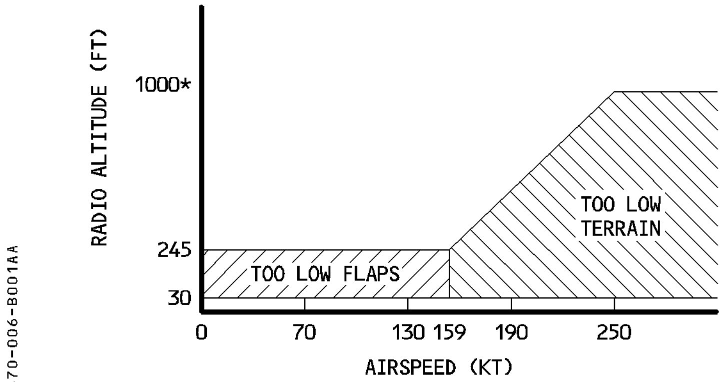
MODE 4 : UNSAFE TERRAIN CLEARANCE WHEN NOT IN LANDING CONFIGURATION

4A — Landing gear up.



Two aural warnings may be triggered, depending on the area : “TOO LOW-GEAR” or “TOO LOW-TERRAIN”.

4B — Landing gear down, and flaps not in landing configuration.

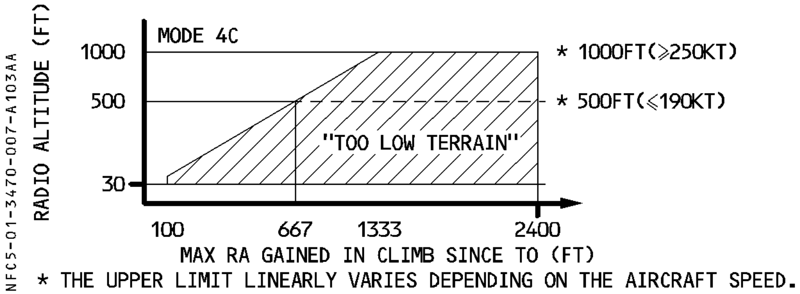


* : - OTHER MAXIMUMS ARE USED AT CERTAIN AIRPORTS TO MINIMIZE NUISANCE WARNINGS.
  - THIS MAXIMUM IS ALSO REDUCED TO 800 FEET, WHEN AN OVERFLIGHT IS DETECTED

Three aural warnings may be generated, depending on the area and configuration : “TOO LOW-GEAR”, “TOO LOW-FLAPS” or “TOO LOW-TERRAIN”.

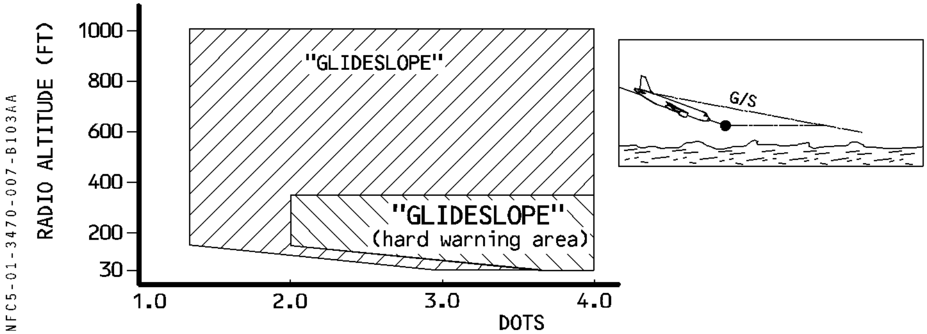
4C — Landing gear up, or flaps not in landing configuration.

R



If the aircraft starts an inadvertant 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*
R *airports, the gear down logic requirement is deleted and other upper limits are used*
R *to increase the warning envelope.*

In both areas, the alert is a repeated “GLIDESLOPE” aural message and lighting of both G/S lights.
The loudness of the aural message increases, when the aircraft enters the hard warning areas.
The mode is armed, when ILS 1 receives a valid signal.
Pressing the GPWS pushbutton cancels the warning. This is temporary ; the mode is automatically reactivated for a new envelope.
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 in front of the aircraft, which varies according to aircraft altitude, nearest runway altitude, distance to the nearest runway threshold, ground speed, and 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	– Automatic terrain display* – Solid red areas – TERR AHEAD (red)	The pb light comes on, on each pilot's instrument panel
Caution	TERRAIN AHEAD	– Automatic terrain display pop-up* – Solid yellow areas – TERR AHEAD (amber)	

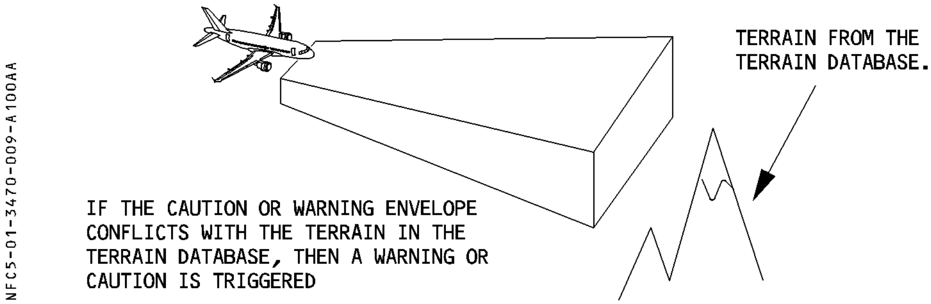
* When the TERR ON ND pushbutton is selected ON, and ARC or ROSE mode is selected, the terrain is displayed on the ND. The terrain is displayed in various densitites of green, yellow, red, or magenta, depending on the threat. (see 1.31.45, INDICATIONS ON ND). If an alert is generated (caution or warning) when TERR ON ND is not selected, the terrain will be 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 image is not displayed.*
R *2. The relative height of the aircraft is computed using the Captain's baro setting.*
R *Thus, the Terrain Awareness Display (TAD) does not protect against baro setting*
R *errors.*
R *3. The TAD and Terrain Clearance Floor (TCF) functions operate using the FMS 1*
R *position. Thus, the system does not protect against FMS 1 position error.*

If the crew identifies that navigation accuracy is low, then they must select the enhanced modes off via the TERR pushbutton. The 5 GPWS modes remain active.

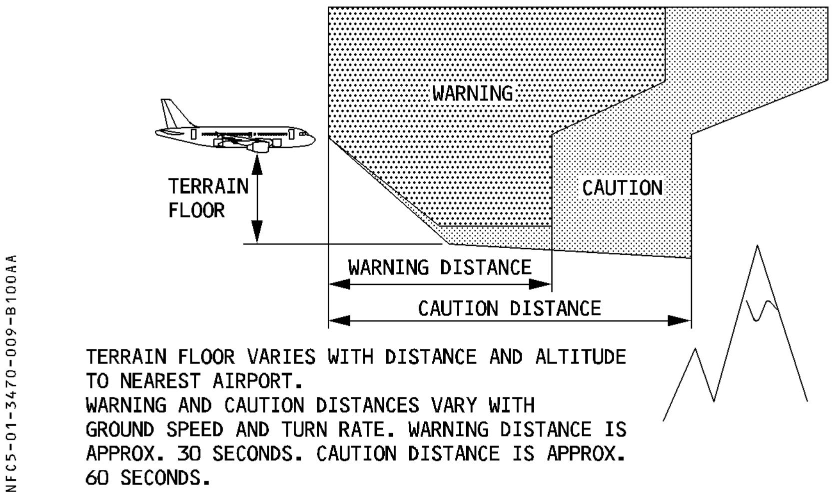
TERRAIN CAUTION AND WARNING ENVELOPE

R



VERTICAL ENVELOPE

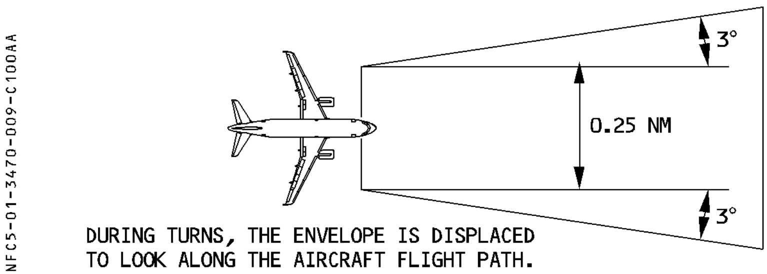
R



TERRAIN FLOOR VARIES WITH DISTANCE AND ALTITUDE TO NEAREST AIRPORT.
WARNING AND CAUTION DISTANCES VARY WITH GROUND SPEED AND TURN RATE. WARNING DISTANCE IS APPROX. 30 SECONDS. CAUTION DISTANCE IS APPROX. 60 SECONDS.

HORIZONTAL ENVELOPE

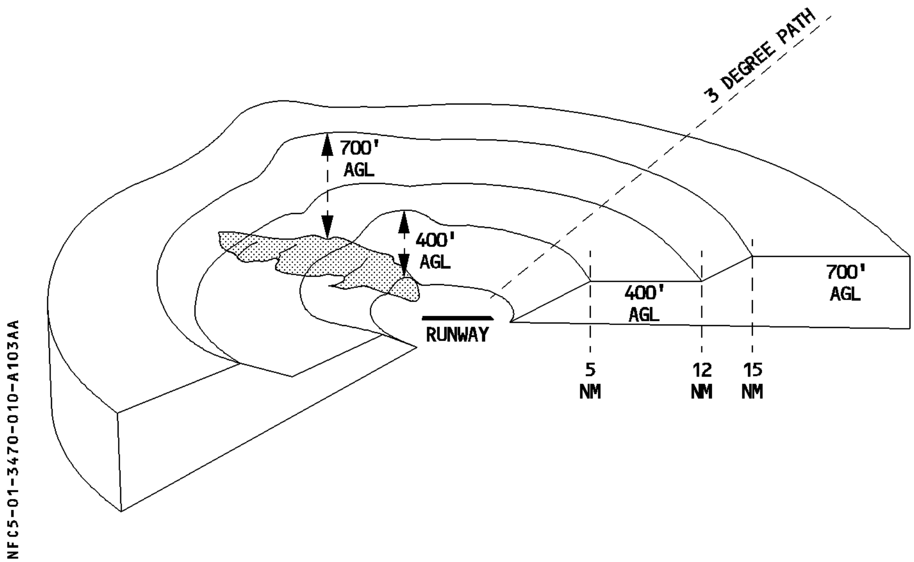
R



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 a premature descent below this floor, regardless of aircraft configuration.

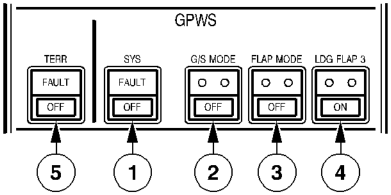


If the airplane descends below this floor, a TOO LOW TERRAIN aural warning is announciated, and the pushbutton light comes on on glareshield.

CONTROLS AND INDICATORS

OVERHEAD PANEL

NFC5-01-3470-011-A100AA



(1) SYS pb

OFF : All basic GPWS alerts (Mode 1 to 5) are inhibited.
FAULT lt : 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

OFF : Glideslope mode (mode 5) is inhibited.

(3) FLAP MODE pb

OFF : Flap mode ("TOO LOW FLAPS" mode 4) is inhibited.
(To avoid nuisance warning in case of landing with flaps setting reduced).

(4) LDG FLAP 3 pb

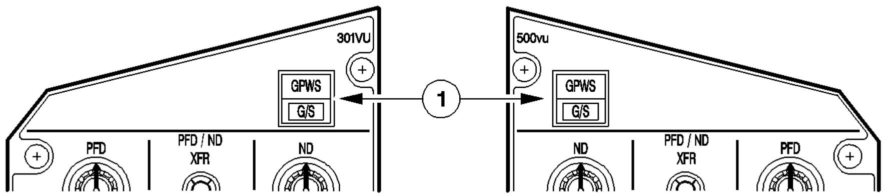
ON : Flap mode is inhibited when FLAPS CONF 3 is selected (to avoid nuisance warning in case of landing in CONF 3).
In this case, LDG MEMO displays FLAPS ... 3 instead of "CONF ... FULL".

(5) TERR pb

OFF : Inhibits the Terrain Awareness Display (TAD) and Terrain Clearance Floor
R (TCF) modes, and does not affect the basic GPWS mode 1 to 5. If OFF is
R selected the ECAM caution NAV GPWS TERR DET FAULT is displayed.
FAULT lt : This amber light comes on, along with an ECAM caution, if the TAD or
R TCF mode fails. The terrain is not shown on the ND. The basic GPWS mode 1 to mode 5 are still operative if the SYS pushbutton OFF or FAULT lights are not illuminated.

INSTRUMENT PANELS

NFC5-01-3470-012-A100AA



(1) GPWS – G / S pb

R GPWS : This red light comes on when any mode from 1 to 4, or any TAD or TCF alert is activated. A specific voice alert accompanies it.

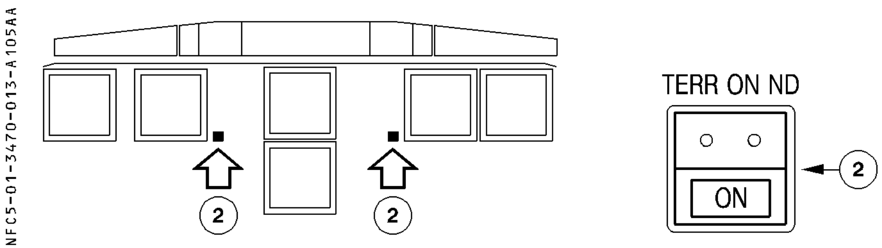
G / S : This amber light comes on when mode 5 is activated. The aural "GLIDE SLOPE" warning accompanies it.

Note : 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.

To test the GPWS, flight crew can push this button briefly :

· In flight, above 2000 feet RA and below 8000 feet RA :
  – GPWS FAULT light comes on on the overhead panel
  – The soft "GLIDE SLOPE" aural warning sounds
  – The "PULL UP" aural warning sounds (once)
  – TERR FAULT light comes on
R – the "TERRAIN AHEAD PULL UP" or "TERRAIN TERRAIN PULL UP" (⊲) aural warning sounds
  – the terrain self-test pattern is displayed on both NDs
  – The GPWS and G/S lights come on.

· On ground :
As above, plus pressing the switch either continually or during the "PULL UP" sequence, makes all aural warnings sound.



(2) TERR ON ND pb

These pushbuttons are located on either side of the ECAM. Each pushbutton controls the onside terrain display.

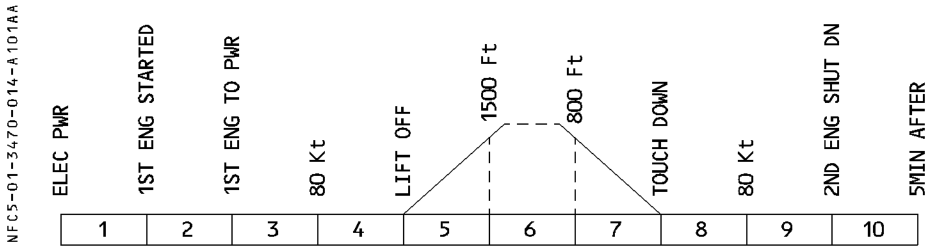
ON : The terrain is displayed on the ND, if the :
- TERR pushbutton is selected ON, and
- TERR FAULT light is not on.

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 comes on.*
· *To differentiate between the terrain and the weather displays, the terrain display sweeps from the center outward to both sides of the ND.*

WARNINGS AND CAUTIONS



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 lt	1, 3, 4, 5, 8, 9, 10
GPWS TERR DET FAULT The enhanced terrain detection function is inoperative. The basic GPWS mode 1 to 5 are still operative.				GPWS TERR FAULT lt	1, 3, 4, 5 8,10

MEMO DISPLAY

GPWS FLAP 3 is displayed in green when GPWS LDG FLAP 3 pushbutton switch is ON.
GPWS FLAP MODE OFF is displayed in green when GPWS FLAP MODE pushbutton switch is OFF.

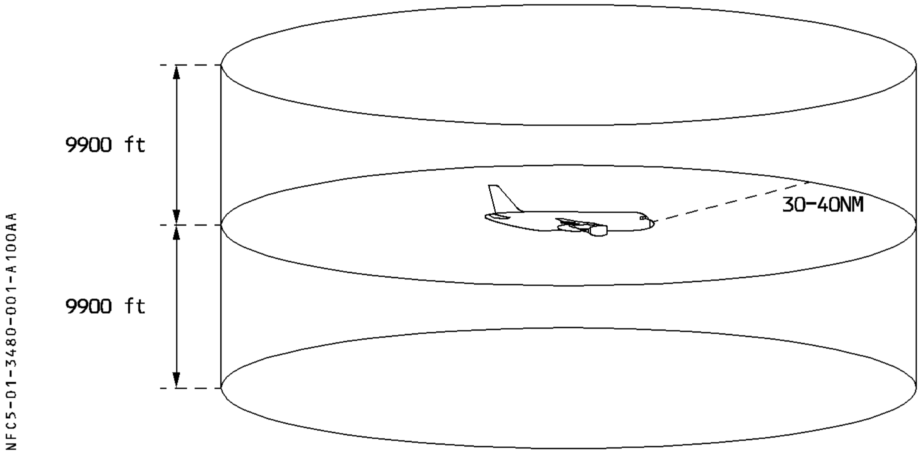
R Airborne TERR STBY appears in green when the aircraft position accuracy (provided by the
R FMS) is not sufficient to allow the enhanced TCF and TAD modes to operate. These modes
R are not available until the TERR STBY memo disappears. If selected, the terrain data display
R on ND is automatically deselected when the TERR STBY memo is triggered."

DESCRIPTION

GENERAL

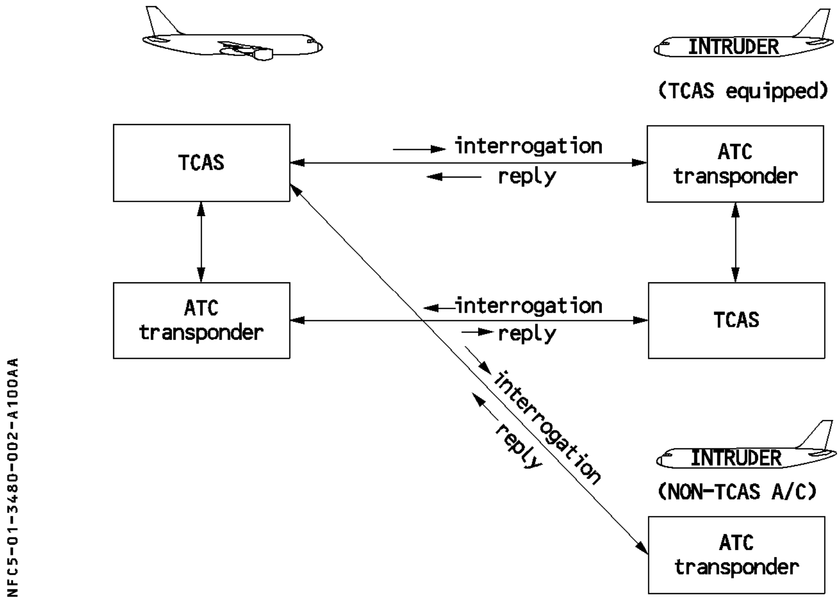
The TCAS (Traffic alert and Collision Avoidance System) :
- Detects any aircraft, equipped with transponders, flying in its vicinity ;
- Displays potential and predicted collision targets ;
- Issues vertical orders to avoid conflict.

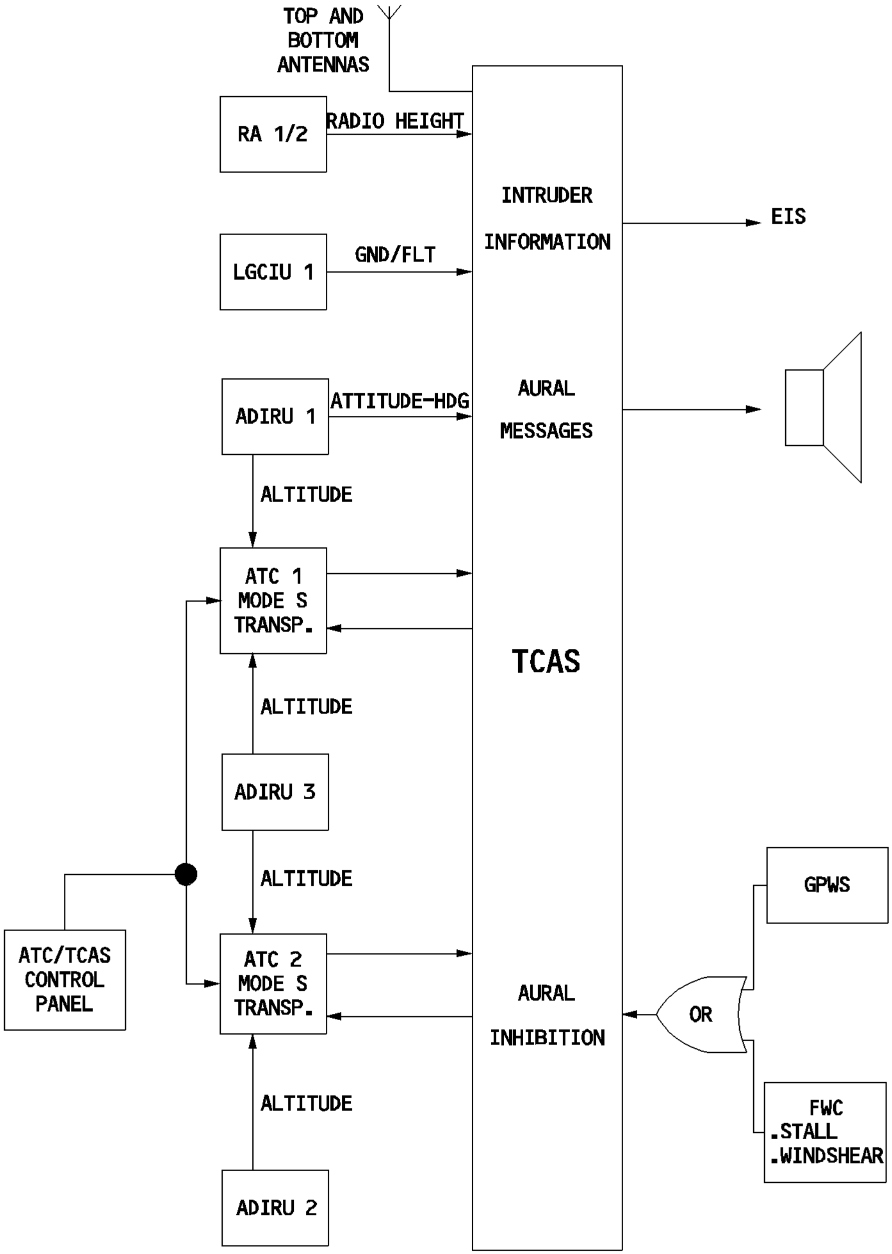
The TCAS is normally independent of the ground-based air traffic control system.
The TCAS detection capability is limited to intruders flying within a maximum range of 30-40 NM (depending on aircraft configuration and external conditions), and within a
R maximum altitude range of 9900 feet (above and below the threatened aircraft).



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.





NFC5-01-3480-003-A100AB

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.

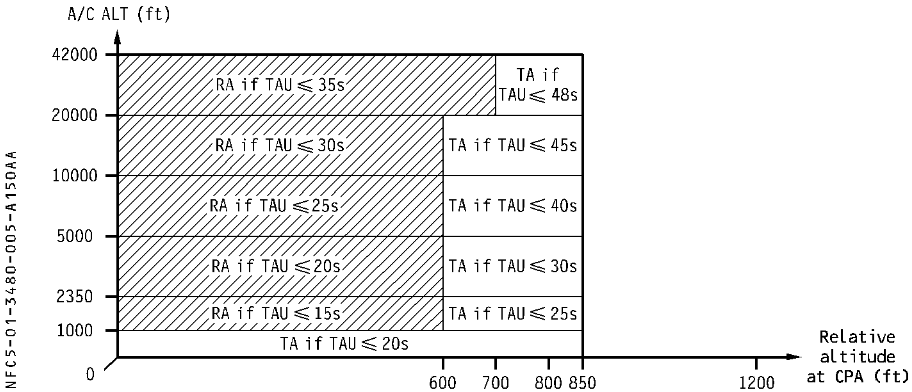
INTRUDER CLASSIFICATION

The intruders are classified in four levels :

LEVEL	INTRUDER POSITION	DISPLAYED INFORMATION
Proximate	— no collision threat — intruder in the vicinity of the a/c (closer than 6 NM laterally and ± 1200 ft vertically)	— ND : intruder position
Traffic Advisory (TA)	— potential collision threat — TAU is about 40 seconds	— ND : intruder position — Aural messages
Resolution Advisory (RA)	— real collision threat — TAU is about 25 seconds	— ND : intruder position — Aural messages — PFD : vertical orders · Maintain actual V/S (Preventive Advisory) or · Modify V/S (Corrective Advisory)
Other intruders (◁*)	— no collision threat — any non proximate, TA, RA within the surveillance envelope (lateral range : closer than 30 NM. vertical range : Refer to 1.34.80 p 7)	— ND : intruder position

TA / RA THRESHOLDS

FOR INFO



TCAS MODES

TCAS has 2 modes of operation :

TA/RA : This mode allows the display of all the 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
R spaced runways, or

· automatically, when the following messages are triggered :
  - windshear (⚠)
  - stall
  - GPWS messages

Consequently :

· All RAs are inhibited and converted into TAs
· the TA threshold is set to TAU ≤ 20 seconds, irrespective of the aircraft's altitude.
· No vertical speed advisories are indicated on the PFDs
· "TA ONLY" is displayed on the NDs

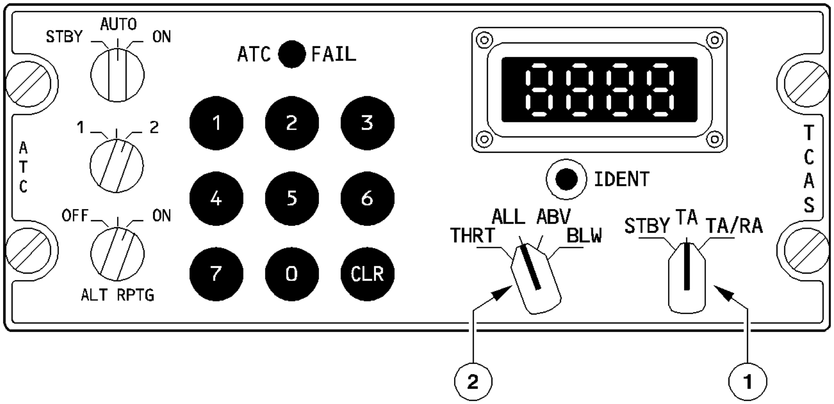
If windshear, stall or GPWS messages are triggered, all the TCAS aural messages are suppressed.

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.
- all RA below 1100 feet in climb and 900 feet in descent. In this case, the RAs are converted into TAs.
- “Descend” type advisory below 1200 feet AGL at takeoff or 1000 feet AGL in approach.
- “Increase Descent” RA below 1450 feet.
- all TA aural messages below 500 feet AGL

CONTROLS AND INDICATORS

ATC/TCAS PANEL



NFC5-01-3480-007-A210AA

① Mode sel

TA/RA : Normal position.
The RAs, TAs and proximate intruders are displayed, if the ALT RPTG switch is ON and the transponder is not on STBY.

TA : The TCAS does not generate any vertical orders. This mode should be used in case of aircraft degraded performance (engine failure, landing gear extended...), or on parallel runways.
All RAs are converted into TAs. TAs, proximate and other intruders are displayed, if the ALT RPTG switch is ON and the transponder is not on STBY.
The TA ONLY white memo is displayed on the NDs.

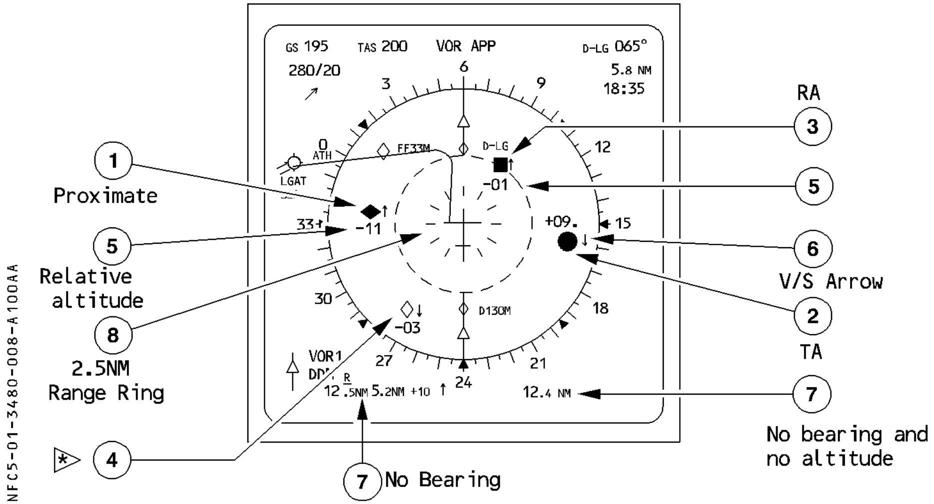
STBY : The TCAS is on standby.

② TRAFFIC sel

R THRT : Proximate and other intruders are displayed only if a TA or RA is present,
R and they are within 2700 feet above and 2700 feet below the aircraft.
R ALL : Proximate and other intruders are displayed even if no TA or RA is present
R (full time function). The altitude range is – 2700 feet to + 2700 feet.
R ABV : The same as ALL, except that the other intruders are displayed if within
R 9900 feet above the aircraft and 2700 feet below.
R BLW : The same as ALL, except that the other intruders are displayed if within
R 9900 feet below the aircraft and 2700 feet above.

ND INDICATIONS

The traffic is displayed in all ROSE modes and ARC mode when 10, 20 or 40 NM range is selected.
Only the 8 most threatening intruders are displayed.



1. Proximate intruder

Indicated by a white filled diamond.

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.

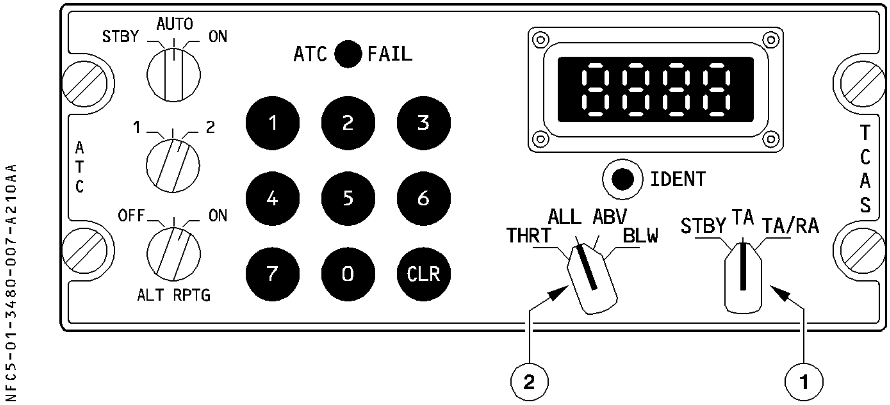
4. Other intruders

Indicated by a white empty diamond.

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.

CONTROLS AND INDICATORS

ATC/TCAS PANEL



(1) Mode sel

TA/RA : Normal position.
The RAs, TAs and proximate intruders are displayed, if the ALT RPTG switch is ON and the transponder is not on STBY.

TA : The TCAS does not generate any vertical orders. This mode should be used in case of aircraft degraded performance (engine failure, landing gear extended...), or on parallel runways.
All RAs are converted into TAs. TAs, proximate and other intruders are displayed, if the ALT RPTG switch is ON and the transponder is not on STBY.
The TA ONLY white memo is displayed on the NDs.

STBY : The TCAS is on standby.

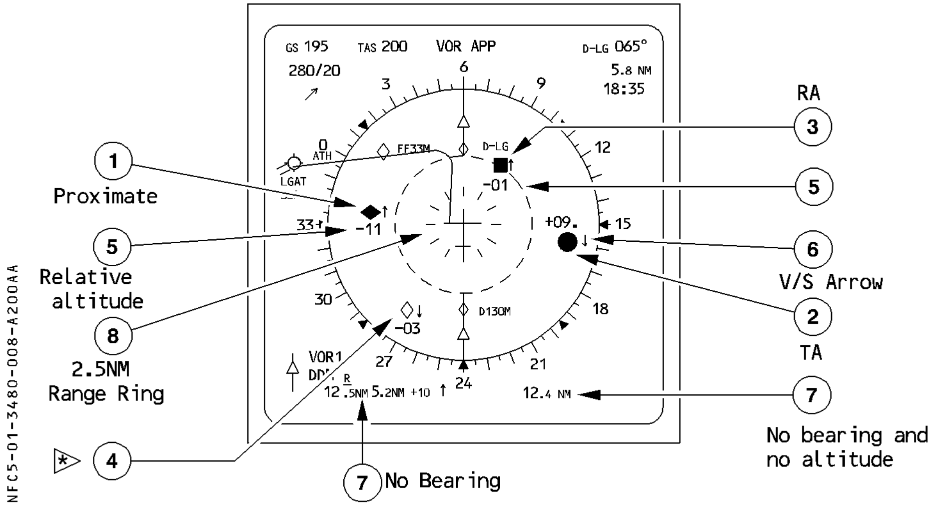
(2) TRAFFIC sel

R THRT : Proximate and other intruders are displayed only if a TA or RA is present,
R and they are within 2700 feet above and 2700 feet below the aircraft.
R ALL : Proximate and other intruders are displayed even if no TA or RA is present
R (full time function). The altitude range is – 2700 feet to + 2700 feet.
R ABV : The same as ALL, except that the other intruders are displayed if within
R 9900 feet above the aircraft and 2700 feet below.
R BLW : The same as ALL, except that the other intruders are displayed if within
R 9900 feet below the aircraft and 2700 feet above.

ND INDICATIONS

The traffic is displayed in all ROSE modes and ARC mode. Only the 8 most threatening intruders are displayed.

R



① Proximate intruder

Indicated by a white filled diamond.

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.

④ Other intruders

Indicated by a white empty diamond.

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.

⑤ Relative altitude

Indicated in hundred of feet above or below the symbol depending on the intruder position.

⑥ Vertical speed arrow

Displayed only if the intruder V/S > 500 feet/minute
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.

⑦ No bearing intruder

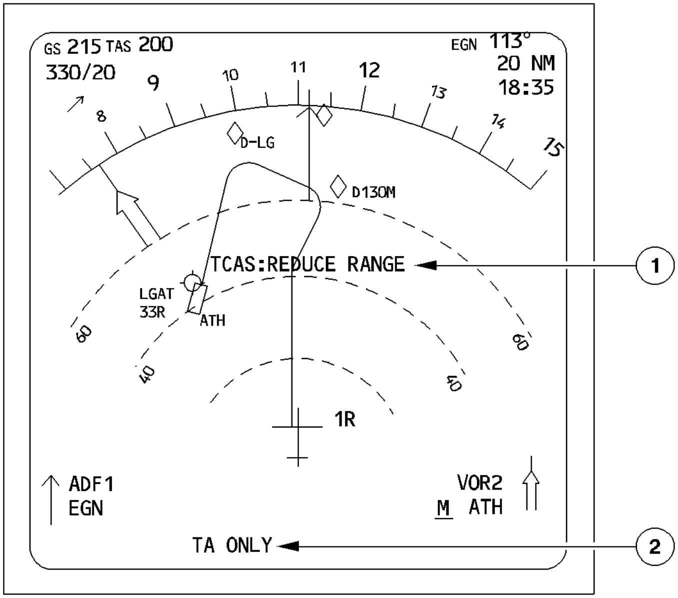
If the bearing of TA or RA intruder is not available the following data is presented in digital form at the bottom of the ND :
- range
- relative altitude and vertical speed arrow if available.

Displayed amber or red according to threat level.

⑧ Range ring

A 2.5 NM white range ring is displayed when a 10 or 20 NM range is selected.

TCAS MESSAGES



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(1) Mode and range messages

Following messages can be displayed to draw pilot's attention :

TCAS : REDUCE RANGE : displayed when a TA or RA is detected and ND range above 40 NM

TCAS : CHANGE MODE : displayed when a TA or RA is detected and ND mode is PLAN.

Displayed amber or red depending on the advisory level (TA or RA).

Flash 9 seconds then remain steady.

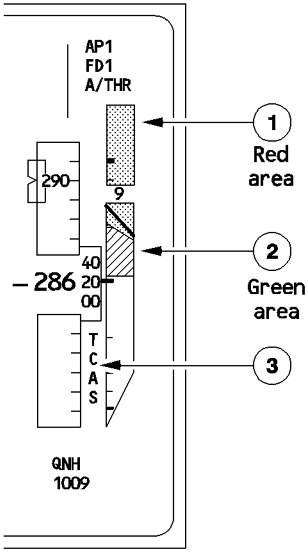
(2) TCAS operation messages

TCAS : displayed red in case of TCAS internal failure. Flashes 9 seconds then remains steady.

TA ONLY : displayed white when selected by the crew.

PFD INDICATIONS

In case of RA detection, the PFD presents vertical orders on the vertical speed scale. The vertical speed scale background is normally grey, but may be partially replaced by green and/or red areas.



NFC5-01-3480-011-A100AA

① Red area

Indicates the vertical speed range, where the risk of conflict is high.

② Green area

Indicates the recommended vertical speed range.

Note : — *The aircraft can also fly in the grey vertical speed range without the risk of conflict (preventive RA).*
— *The color of the vertical speed needle and the digits corresponds to the appropriate area.*

③ TCAS message

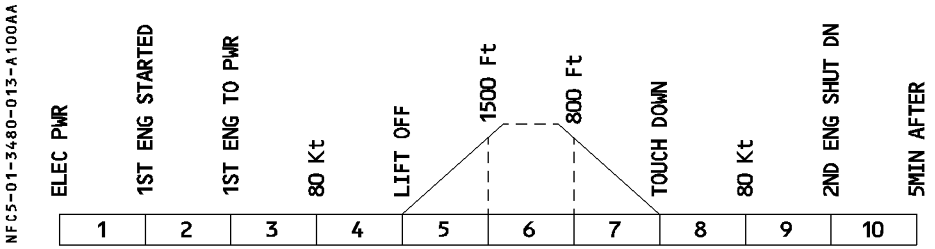
Appears in red when TCAS cannot deliver RA data, or in case of TCAS internal failure.

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 PFD.
CLIMB CROSSING CLIMB (twice)	:	same as above. Indicates that you will cross through the intruder altitude.
INCREASE CLIMB (twice)	:	triggered after CLIMB message if vertical speed not sufficient to achieve safe vertical separation.
DESCEND DESCEND	:	descend at the vertical speed indicated by the green area on PFD.
DESCEND CROSSING DESCEND (twice)	:	same as above. Indicates that you will cross through the intruder altitude.
INCREASE DESCEND (twice)	:	triggered after DESCEND message if vertical speed not sufficient to achieve safe vertical separation.
ADJUST VERTICAL SPEED ADJUST	:	adjust the vertical speed to that indicated on the PFD green area.
CLIMB CLIMB NOW (twice)	:	triggered after DESCEND message if the intruder trajectory has changed.
DESCEND DESCEND NOW (twice)	:	triggered after CLIMB message if the intruder trajectory has changed.
MONITOR VERTICAL SPEED	:	ensure that 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 PFD green area.
MAINTAIN VERTICAL SPEED CROSSING MAINTAIN	:	maintain the vertical speed indicated on the PFD green area. It further indicates that you will cross through the intruder altitude.
CLEAR OF CONFLICT	:	range is increasing and separation is adequate. Return to assigned clearance.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
TCAS FAULT in case of TCAS internal failure	SINGLE CHIME	MASTER CAUT	NIL	Flag on PFD and ND	3, 4, 5, 7

MEMO DISPLAY

TCAS STBY is displayed green when :
- ATC STBY or TCAS STBY is selected by the crew, or
- ALT RPTG is selected at off, or
- both ATC or both RA are failed.

BUS EQUIPMENT LIST

R

		NORM		EMER ELEC		
		AC	**DC**	**AC ESS**	**DC ESS**	**HOT**
ADIRU	ADIRU 1			X		HOT 2 *
ADIRU	AOA RESOLVER 1			X		
ADIRU	ADIRU 2	AC2				HOT 2 ** during 5 mn
ADIRU	AOA RESOLVER 2	AC2				
ADIRU	ADIRU 3	AC1				HOT 1 ***
ADIRU	AOA RESOLVER 3	AC1				
STD BY INST	HORIZON				X	
STD BY INST	ALTIMETER				SHED	
STD BY INST	COMPASS				X	
NAVAIDS	VOR 1			X		
NAVAIDS	VOR 2	AC2				
NAVAIDS	MMR 1			X		
NAVAIDS	MMR 2	AC2				
NAVAIDS	ADF 1			SHED		
NAVAIDS	ADF 2 ◁*	AC2				
NAVAIDS	DDRMI			X		
NAVAIDS	DME 1			SHED		
NAVAIDS	DME 2	AC2				
RADIO ALTIMETER	RA 1	AC1				
RADIO ALTIMETER	RA 2	AC2				
ATC	ATC 1			SHED		
ATC	ATC 2	AC2				
GPWS		AC1				
WEATHER RADAR	WX 1	AC1				
WEATHER RADAR	WX 2	AC2				
TCAS ◁*		AC1				

* Backup supply.
** Backup supply for 5 minutes.
*** Backup supply, when the ATT HDG is in the CAPT 3 position.
Backup supply for 5 minutes, when the ATT HDG is in the NORM or F/O3 position.

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
R case of depressurization or presence of smoke or toxic gas.

DESCRIPTION

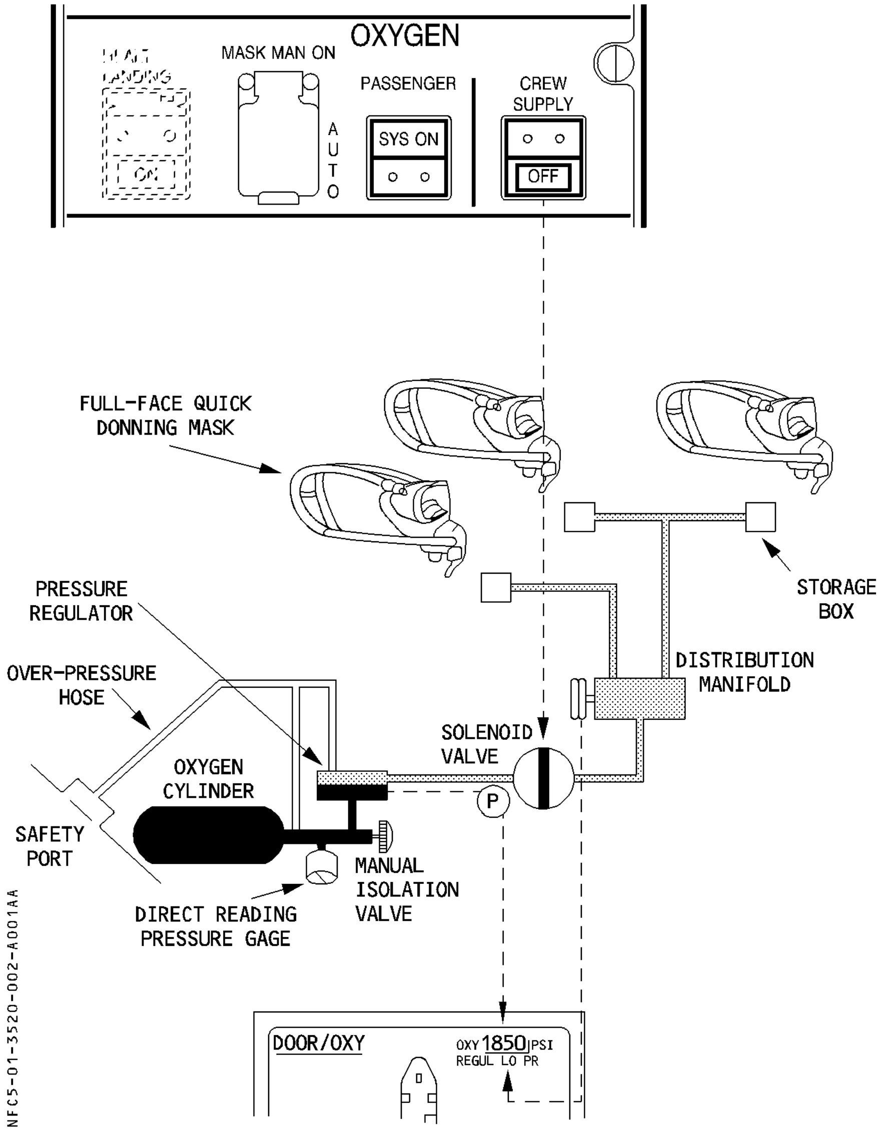
The cockpit's fixed oxygen system consists of :
- a high-pressure cylinder in the left hand lower fuselage
- a pressure regulator connected directly to the cylinder that delivers oxygen at a pressure suitable for users
- two overpressure safety systems to vent oxygen overboard through a safety port if the pressure gets too high
- a supply solenoid valve that allows the crew to shut off the distribution system
- three (or four as installed) full-face quick-donning masks stowed in readily accessible boxes adjacent to crew members' seats (one at each seat).

OPERATION

The crew member 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 on 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.

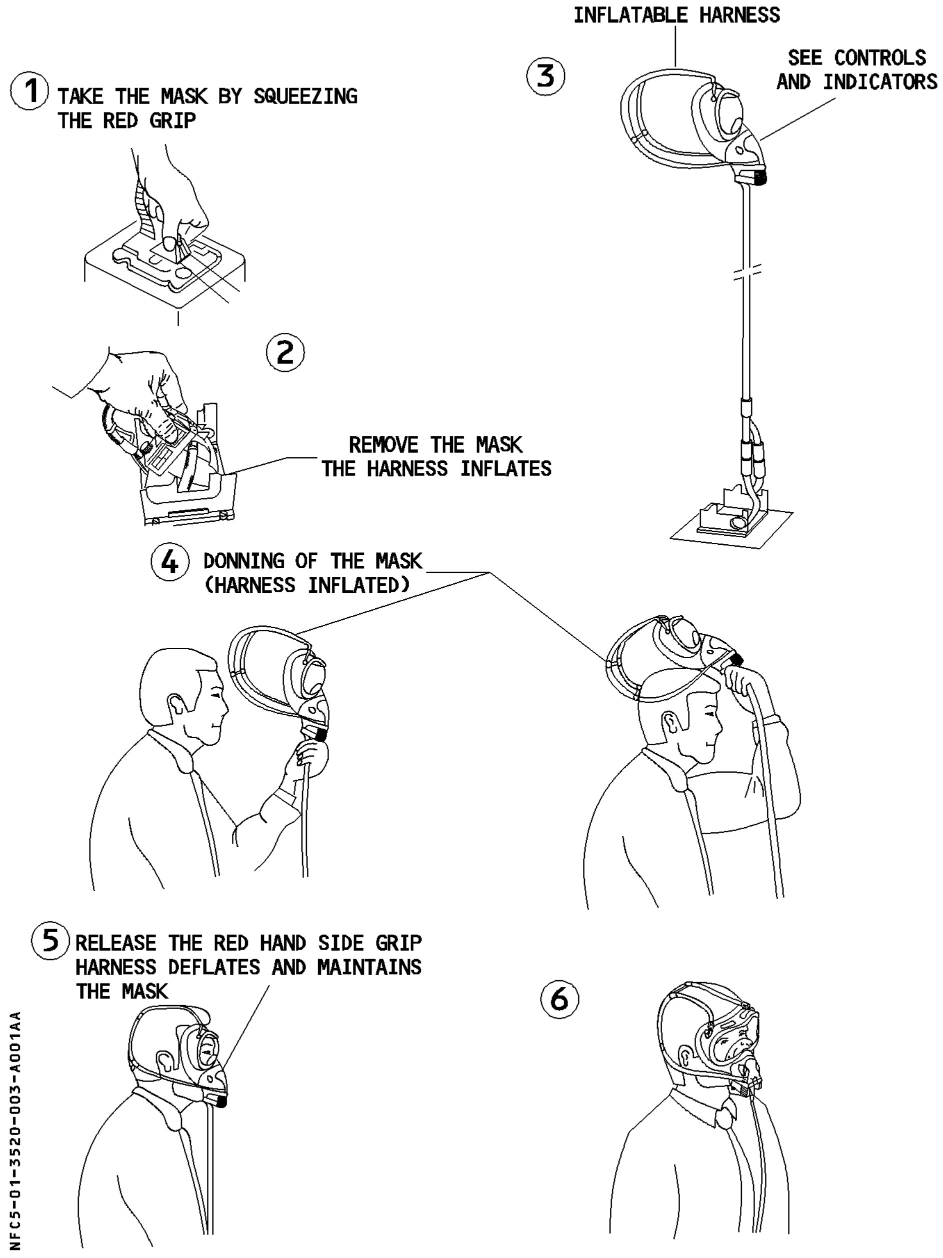
Note : Each mask has a removable strip that protects the visor against scratches and
R *which can be removed to recover partial sight in case of ice build-up on the mask*
R *subsequent to rapid depressurization.*

R



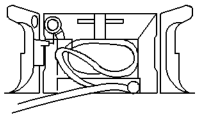
NFC5-01-3520-002-A001AA

MASK SETTING

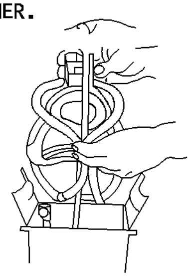


R
R
MASK STOWAGE

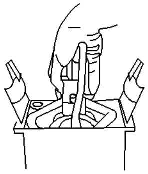
1 - COIL THE HOSE, AND PLACE IT IN THE BOTTOM OF THE STOWAGE BOX.



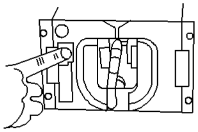
2 - POSITION THE REMAINING HOSE IN THE MIDDLE OF THE MASK.
- FOLD THE TWO HARNESS PORTIONS TOGETHER.



3 - PLACE THE MASK IN THE STOWAGE BOX.
- MAKE SURE THE MASK REGULATOR IS FULLY SEATED AGAINST THE STOP IN THE STOWAGE BOX.



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.

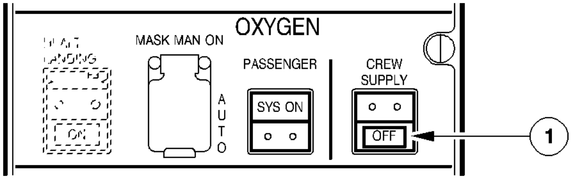


NFC5-01-3520-004-A001AA

CONTROLS AND INDICATORS

OVERHEAD PANEL

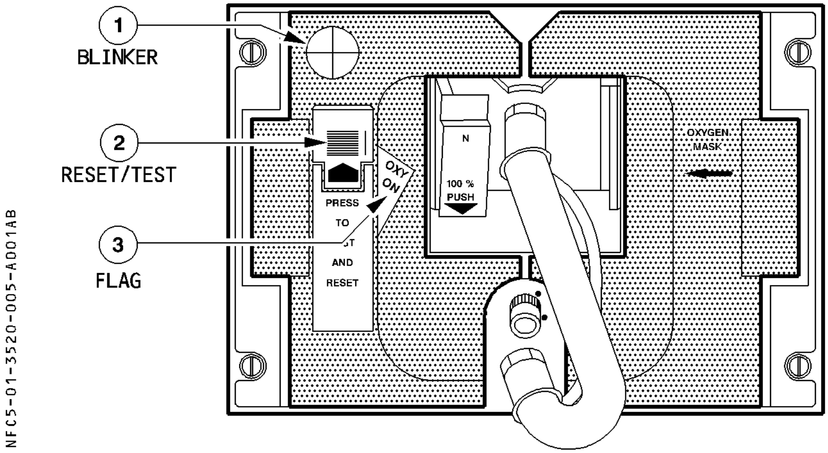
NFC5-01-3520-004-B001AA



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.

STOWAGE BOX



(1) Blinker flowmeter (yellow)

This indicator flashes when oxygen is flowing.

(2) RESET / TEST control slide

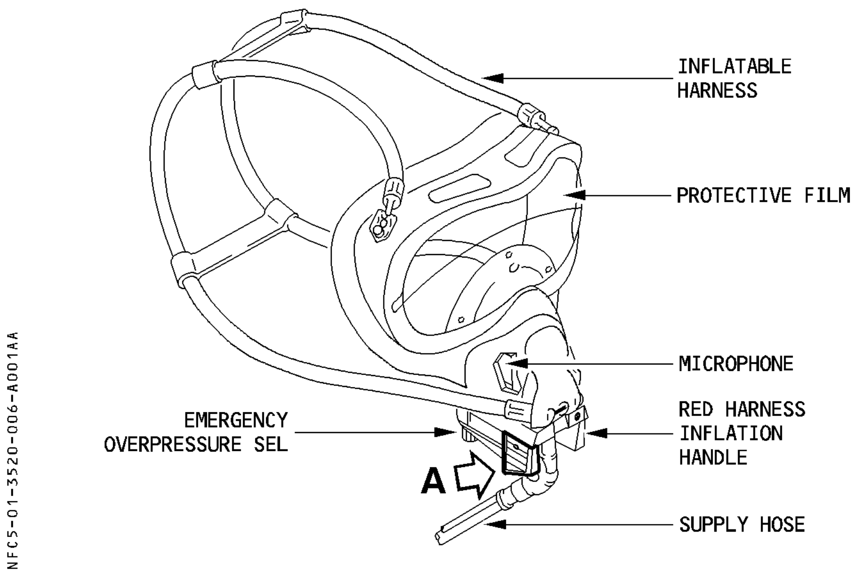
The crewmember presses the slide, and pushes it in the direction of the arrow to test : the operation of the blinker ; the regulator supply ; system sealing downstream of the valve ; and the regulator sealing and system operation. Pressing the RESET control
R slide, after the oxygen mask has been used, cuts off the oxygen, and the mask microphone.

(3) OXY ON flag

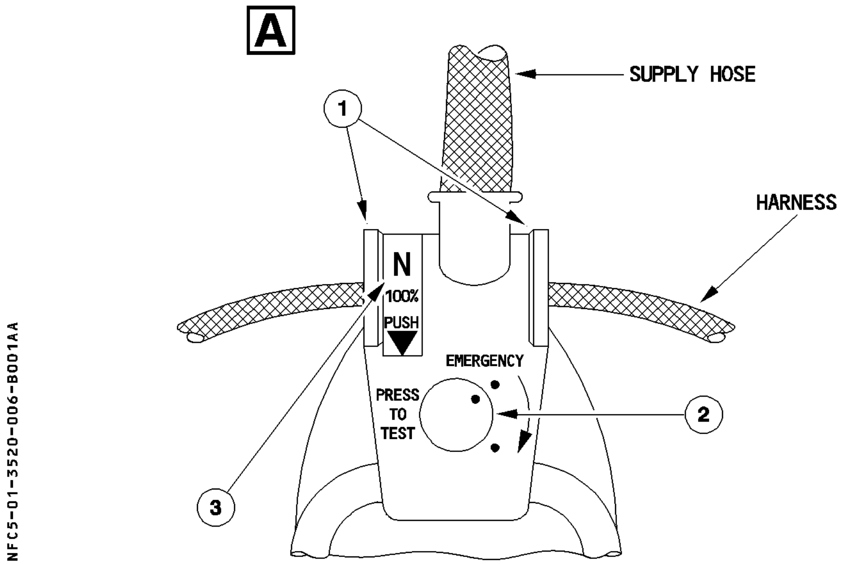
R As soon as the left flap door opens, the mask is supplied with oxygen and, once it closes
R (mask still supplied with oxygen), the “OXY ON” flag appears.

CREW OXYGEN MASK

R



PRESSURE REGULATOR



(1) Red grips

Squeezing the right-hand side grip unlocks the two-flap door, and permits the harness to inflate.

(2) EMERGENCY pressure selector

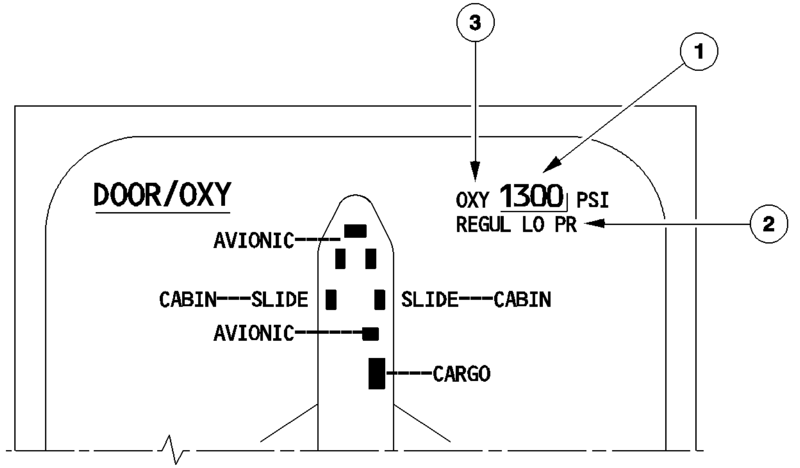
This selector creates an overpressure, which eliminates condensation and prevents smoke, smell, or ashes from entering the mask.
— Pressing this knob generates an overpressure for a few seconds.
— Turning the knob, in the direction of the arrow, generates a permanent overpressure.

Note : Overpressure supply is automatically started, when cabin altitude exceeds 30,000 feet.

(3) N/100 % selector

R Pushing the button up 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.

DOOR/OXY ECAM PAGE



NFC5-01-3520-008-A001AA

(1) OXY high pressure indication

R Green : When pressure is ≥ 400 psi.
R Amber : When pressure is < 400 psi.
R An amber half frame appears when oxygen pressure is < 1500 psi.
R In this case, the flight crew must check that the remaining quantity is not
R 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) OXY indication

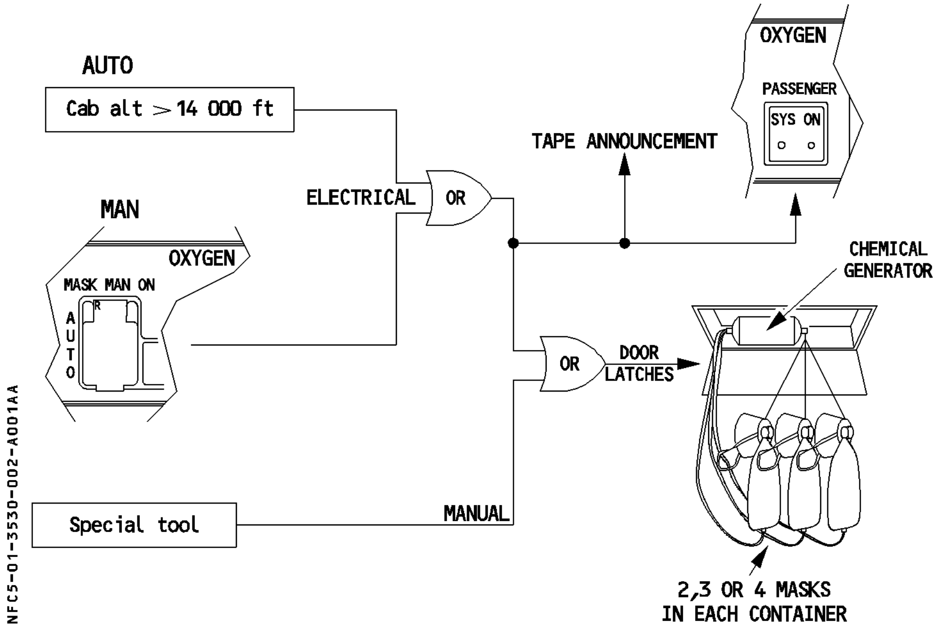
Normally green.
Becomes amber when :
– Pressure goes below 400 psi.
– Low oxygen pressure is detected.
– The OXYGEN CREW SUPPLY pushbutton switch on overhead panel is OFF.

DESCRIPTION

The cabin's fixed oxygen system supplies oxygen to the occupants, in case of cabin depressurization.
Chemical generators produce the oxygen. Each generator feeds a group of 2, 3, or 4 masks.
Generators and masks are in containers above the passenger seats, in the lavatories, in each galley (◁), and at each cabin crew station.

OPERATION

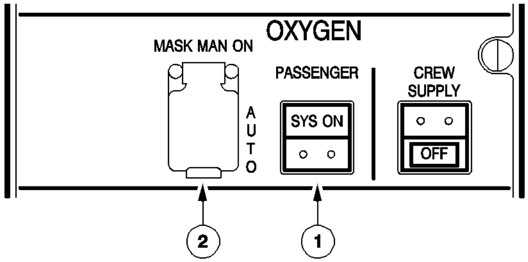
Each container has an electrical latching mechanism that opens automatically to allow the masks to drop, if the cabin pressure altitude exceeds 14000 feet (+ 0, – 500 feet). The flight crew can override the automatic control.
When the masks are released, the passenger address system automatically broadcasts prerecorded instructions for their use.
The generation of oxygen begins when the passenger pulls the mask towards the passenger seat. The chemical reaction used for oxygen generation creates heat. Therefore, the smell of burning or smoke, and cabin temperature increase, may be associated with the normal operation of the oxygen generators.The mask receives pure oxygen under positive pressure for about 15 minutes, until the generator is exhausted.
A reset is available for the rearming of the system after the masks are restowed. A manual release tool allows crewmembers to manually open the doors in case of electrical failure.


AUTO
Cab alt > 14 000 ft
MAN
OXYGEN
MASK MAN ON
AUTO
ELECTRICAL
OR
TAPE ANNOUNCEMENT
OXYGEN
PASSENGER
SYS ON
OR
DOOR LATCHES
CHEMICAL GENERATOR
Special tool
MANUAL
2,3 OR 4 MASKS IN EACH CONTAINER
NFC5-01-3530-002-A001AA

CONTROLS AND INDICATORS

OVERHEAD PANEL

NFC5-01-3530-003-A001AA



(1) PASSENGER 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

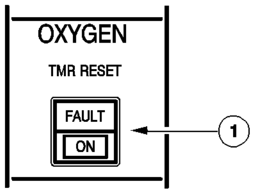
The guard keeps this button in the AUTO position.

AUTO The mask doors open automatically when the cabin altitude exceeds 14000 feet.

Pressed The mask doors open.

OVERHEAD MAINTENANCE PANEL

NFC5-01-3530-003-B001AA



(1) TMR RESET pb sw

The maintenance crew uses this pushbutton to reset the control circuit after the system has operated.

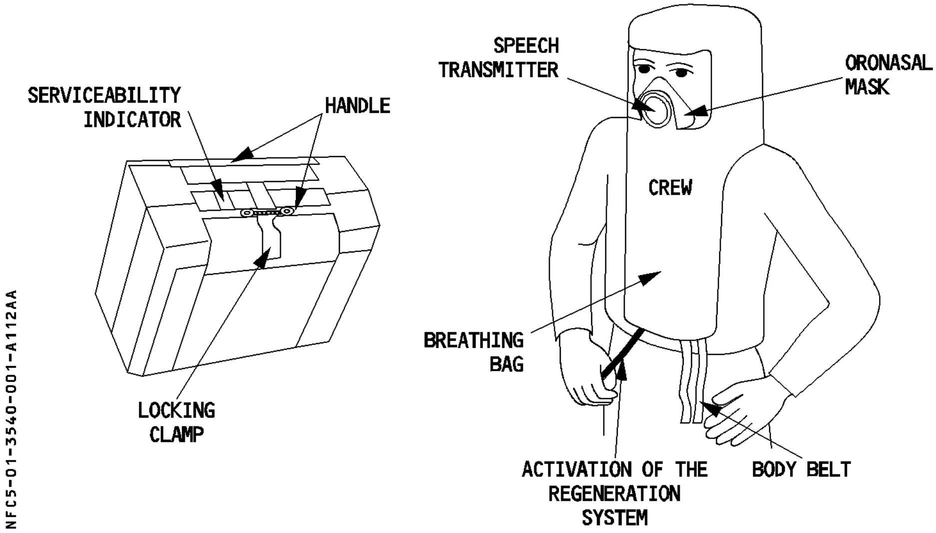
R ON The PASSENGER SYS ON light goes off.

FAULT This amber light comes on when the door latch solenoids are energized for more than 30 seconds.

DESCRIPTION

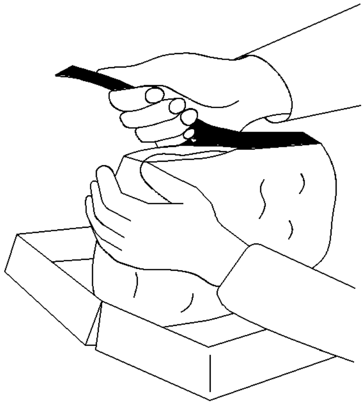
FLIGHT CREW'S PORTABLE OXYGEN SYSTEM

The smoke hood on the left back side of the cockpit protects the eyes and respiratory system of one member of the flight crew while he is fighting a fire, or if smoke or noxious gases enter the cabin, or if the cabin loses pressure.
The smoke hood uses a chemical air regeneration system, which is in the breathing key. An oronasal mask allows the hood's wearer to inhale regenerated air, and it returns the exhaled breath to the regeneration system.
The hood is serviceable as long as the yellow indicator on the case is not broken. The hood should work satisfactorily for at least 20 minutes.

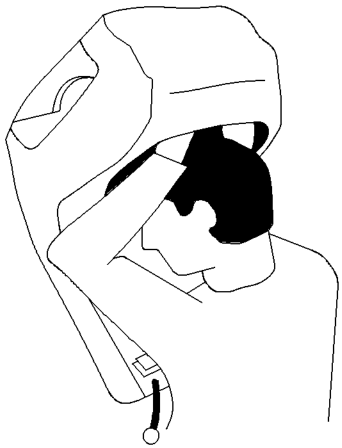


USING THE HOOD

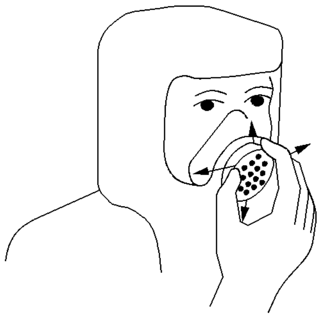
1 REMOVE UNIT FROM CASE AND REMOVE THE HOOD FROM THE PROTECTIVE BAG BY TEARING OFF THE STRIP.



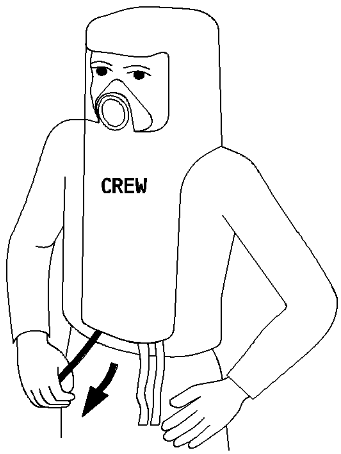
2 ENLARGE THE NECK SEAL AND PULL THE HOOD OVER YOUR HEAD.



3 CORRECTLY ADJUST THE INNER MASK.



4 PULL DOWN THE LANYARD TO ACTIVATE THE AIR REGENERATION SYSTEM.



NFC5-01-3540-002-A112AB

BUS EQUIPMENT LIST

FOR INFO

R

		NORM			EMER ELEC		
		AC	DC	DC BAT	AC ESS	DC ESS	HOT
CREW OXY CTL						SHED	
PAX OXYGEN	ACTUATION				SHED		
	AUTOCONTROL					SHED	

36.00 CONTENTS

36.10 DESCRIPTION

36.20 CONTROLS AND INDICATORS

36.30 ELECTRICAL SUPPLY

GENERAL

The pneumatic system supplies high-pressure air for :
- air conditioning
- engine starting
- wing anti-icing
- water pressurization
- hydraulic reservoir pressurization

High-pressure air has three sources :
- engine bleed systems
- APU load compressor
- HP ground connection

A crossbleed duct interconnects the engine bleed systems and receives air from the APU and ground sources when appropriate.
A valve mounted on the crossbleed duct allows the left side (engine 1) and right side (engine 2) to be interconnected.
Two Bleed Monitoring Computers (BMC1 and BMC2), the overhead control panel, and the ECAM control and monitor the operation of the pneumatic system.
A leak detection system detects any overheating in the vicinity of hot air ducts.

ENGINE BLEED SYSTEM

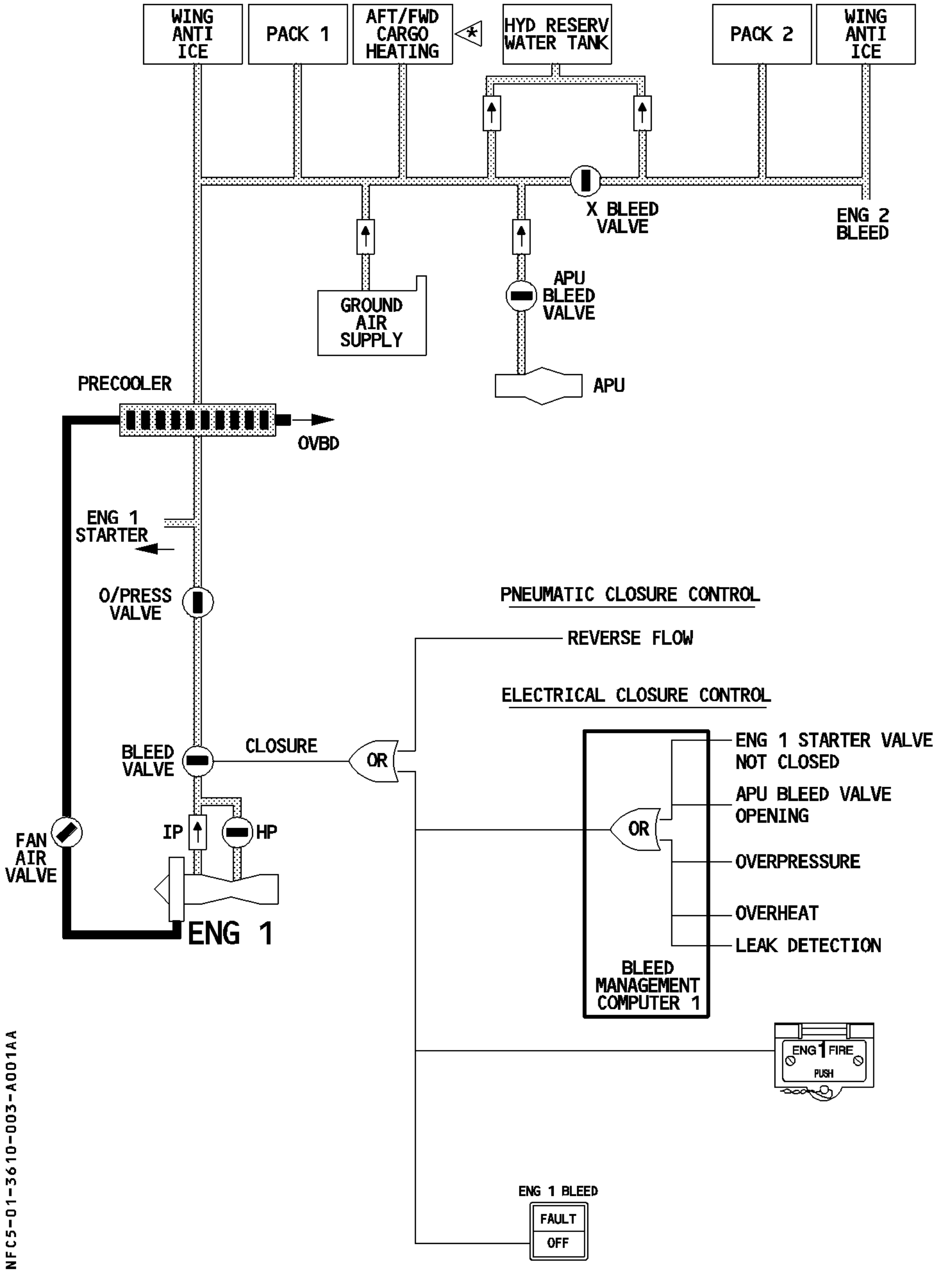
GENERAL

The aircraft has two similar engine bleed air systems.
Each system is designed to :
- select the compressor stage to use as a source of air
- regulate the bleed air temperature
- regulate the bleed air pressure.

A Bleed Monitoring Computer (BMC) controls and monitors each system.
Each BMC receives information about bleed pressure and temperature and valve position.
Each is connected with :
- other systems using air or information from the bleed system
- the other BMC.

Each supplies indications and warnings to the ECAM and CFDS.
If one BMC fails, the other one takes over most of the monitoring functions.
Each bleed valve is pneumatically operated and controlled electrically by its associated BMC.

FOR INFO



WING ANTI ICE
PACK 1
AFT/FWD CARGO HEATING
*
HYD RESERV WATER TANK
PACK 2
WING ANTI ICE
X BLEED VALVE
ENG 2 BLEED
GROUND AIR SUPPLY
APU BLEED VALVE
APU
PRECOOLER
OVBD
ENG 1 STARTER
O/PRESS VALVE
PNEUMATIC CLOSURE CONTROL
REVERSE FLOW
ELECTRICAL CLOSURE CONTROL
BLEED VALVE
CLOSURE
OR
ENG 1 STARTER VALVE NOT CLOSED
APU BLEED VALVE OPENING
OR
OVERPRESSURE
OVERHEAT
LEAK DETECTION
BLEED MANAGEMENT COMPUTER 1
FAN AIR VALVE
IP
HP
ENG 1
ENG 1 FIRE
PUSH
ENG 1 BLEED
FAULT
OFF
NFC5-01-3610-003-A001AA

AIR BLEED SELECTION

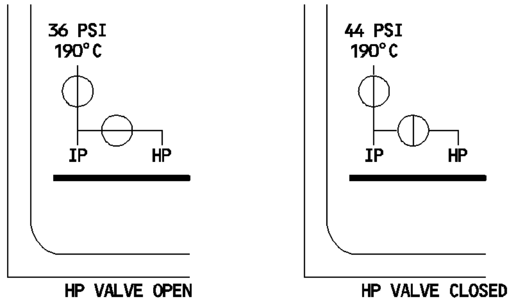
Air is normally bled from the intermediate pressure stage (IP) of engine's high-pressure (HP) compressor to minimize fuel penalty.
At low engine speed, when the pressure and temperature of the IP air are too low, the system bleeds air from the HP stage and maintains it at 36 ± 4 psi.
An intermediate pressure check valve downstream of the IP port closes to prevent air from the HP stage from being circulated to the IP stage.

FOR INFO

The HP valve closes automatically
- *pneumatically*
  - *in case of low upstream pressure*
  - *in case of excessive upstream pressure*
- *electrically :*
  - *when the bleed valve is closed electrically*
R - *in case of overpressure upstream of the HP valve with wing anti-ice off, two packs on*
R *and aircraft altitude above 15000 feet.*

ECAM INDICATION

NFC5-01-3610-004-A050AA



PRESSURE REGULATION AND LIMITATION

The bleed valve, which is downstream of the junction of HP and IP ducting, acts as a shut-off and pressure regulating valve.
It maintains delivery pressure at 44 ± 4 psi.

R *Note : Bleed pressure may fluctuate between 40 and 54 psi particularly at high engine*
R *power (takeoff or climb). This is acceptable as long as it does not cause variations in cabin vertical speed.*

The bleed valve is fully closed :
- pneumatically :
  - if upstream pressure goes below 8 psi
  - if there is return flow
- electrically by means of
  - the BLEED pushbutton switch (switched OFF)
  - the ENG FIRE pushbutton (pushed)
  - the Bleed air Monitoring Computer (BMC) in the following cases :
    - overtemperature
    - overpressure
    - leak
    - open starter valve
    - APU bleed being ON.

If pressure regulation fails, the overpressure valve closes when the pressure goes over 85 psi.

TEMPERATURE REGULATION AND LIMITATION

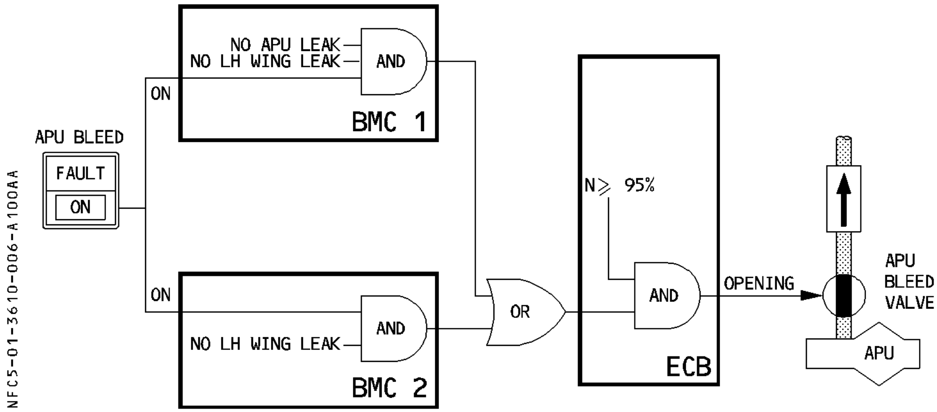
A precooler downstream of the bleed valve regulates the temperature of the bleed air.
The precooler is an air-to-air heat exchanger that uses cooling air bleed from the engine fan to limit the temperature to 200° C.
The fan air valve controls fan air flow.
A spring keeps the fan air valve closed in the absence of pressure.

APU BLEED AIR SUPPLY

Air from the APU load compressor is available on ground and in flight.
The APU bleed valve operates as a shut-off valve to control APU bleed air. It is electrically-controlled and operated by fuel pressure.
The APU BLEED pushbutton, on the AIR COND panel, controls the APU bleed valve.
When the flight crew selects ON with the pushbutton, APU bleed air supplies the pneumatic system, if the APU speed is above 95 %. This opens the crossbleed valve and closes the engine bleed automatically.
A check valve near the crossbleed duct protects the APU, when bleed air comes from another source.

APU BLEED VALVE OPENING LOGIC

FOR INFO



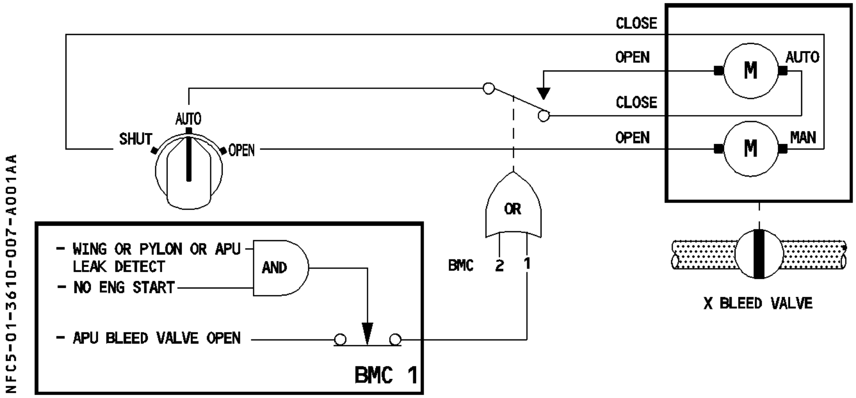
Note : 1. Leak detection is disregarded during an engine start.
2. APU leak detection is lost, if BMC1 is lost.

CROSSBLEED

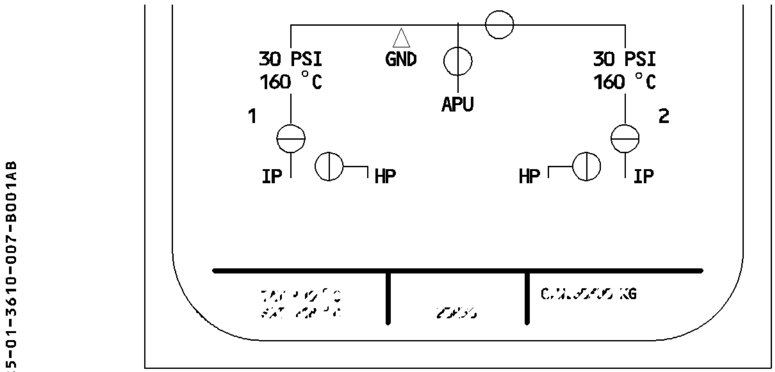
A crossbleed valve on the crossbleed duct allows the air supply systems of the two engines to be isolated or interconnected.
A rotary selector on the AIR COND panel controls the crossbleed valve electrically.
Two electric motors, one for automatic mode and one for manual mode, control the valve.
In automatic mode the crossbleed valve opens when the system is using APU bleed air. It closes if the system detects an air leak (except during engine start).

X-BLEED VALVE CONTROL LOGIC

FOR INFO



ECAM INDICATION

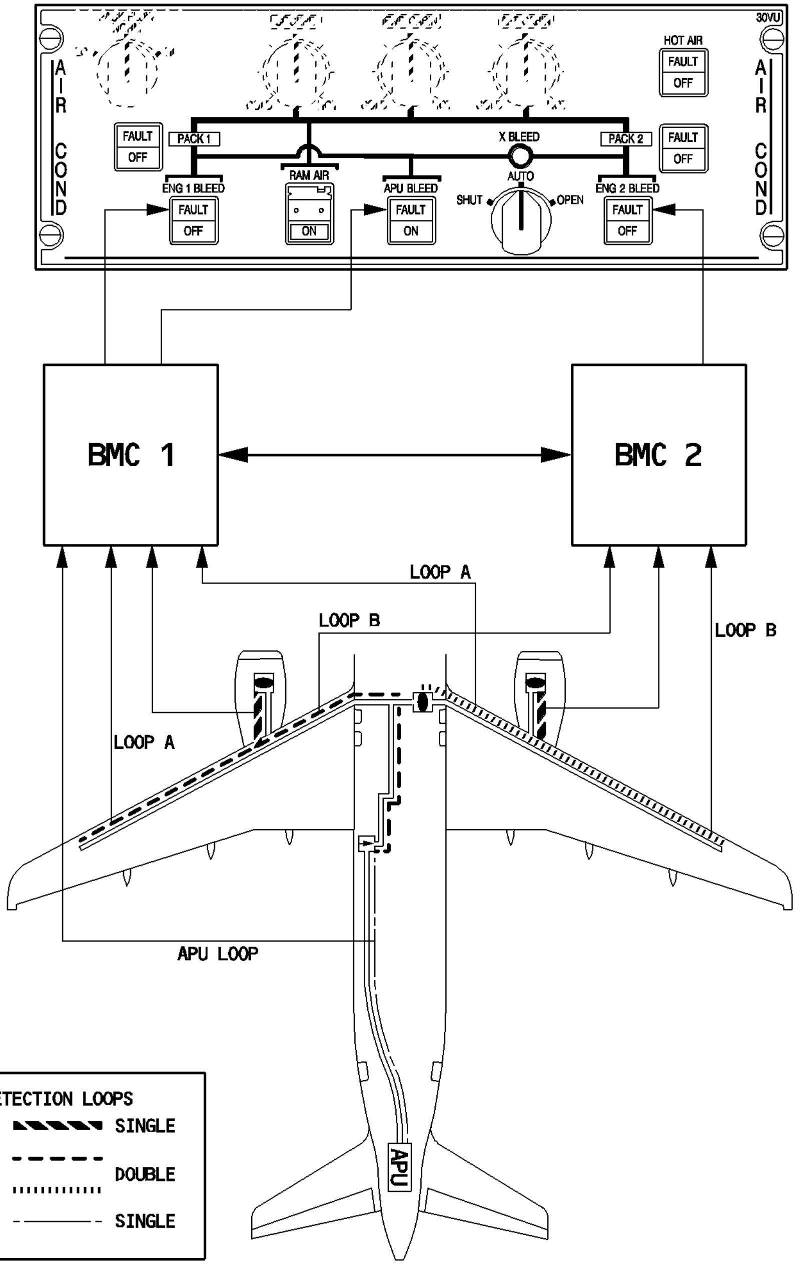


X-BLEED VALVE OPEN-AIR SUPPLIED FROM APU

LEAK DETECTION

Leak detection loops detect any overheating near the hot air ducts in the fuselage, pylons, and wings.
For the pylon and APU, the sensing elements are tied to form a single loop and for the wing, a double loop.
When the two wing loops detect a leak, or when one loop detects the leak and the other one is inoperative, they activate a wing leak signal.
BMC1 and BMC2 each contain identical control logic for the system.

- A wing leak signal causes :
  - the bleed valve on the related side to close automatically
  - the associated FAULT light on the AIR COND panel to come on
  - the x-bleed valve to close automatically (except during an engine start)
  - the APU bleed valve to close automatically (if it is open, and if the leak concerns the left wing) (except during engine start)
- A pylon leak signal causes :
  - the bleed valve on the related side to close automatically
  - the FAULT light for the related engine on the AIR COND panel to come on
  - the x-bleed valve to close automatically (except during an engine start).
- An APU leak signal causes :
  - the APU bleed valve to close automatically (except during engine start).
  - the FAULT light the APU BLEED pushbutton switch on the AIR COND panel to come on
  - the x-bleed valve to close automatically (except during an engine start).



NFC5-01-3610-009-A001AB

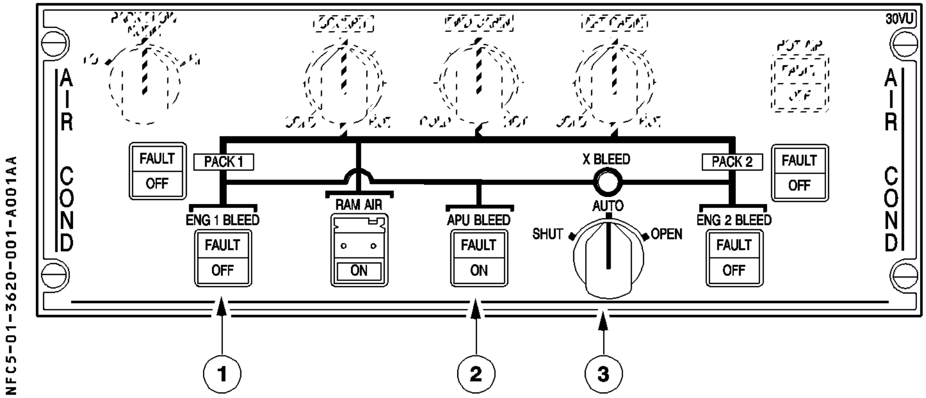
DETECTION LOOPS		
PYLON	▬▬▬	SINGLE
LH WING	– – – –	DOUBLE
RH WING	‖‖‖‖‖‖	DOUBLE
APU	-——-	SINGLE

OPERATION FOLLOWING FAILURES

BMC FAILURE

If one BMC fails, the adjacent BMC takes over the monitoring of the bleed system to issue the following ECAM warnings if necessary :
— overpressure
— overtemperature
— wing leak.
Nevertheless, the associated FAULT light on the AIR COND panel is lost, and the associated bleed valve does not close automatically.
ENG BLEED LEAK warning is lost for the associated engine, as is also the APU BLEED LEAK warning if BMC1 has failed.

OVERHEAD PANEL



(1) ENG 1 and ENG 2 BLEED pb sw

On : Bleed valve opens if :
- Upstream pressure is above 8 psi.
- APU BLEED pushbutton switch is off or APU bleed valve is closed.
- There is no onside wing or pylon leak, and no overpressure or overtemperature has been detected.
- The ENG FIRE pushbutton has not been popped out.
- The engine start valve is closed.

FAULT lt : This amber light comes on, and an ECAM caution appears, if :
- There is an overpressure downstream of the bleed valve.
- There is a bleed air overheat.
- There is a wing or engine leak on the related side.
- The bleed valve is not closed during engine start.
- The bleed valve is not closed with APU bleed ON.

It goes out when the ENG BLEED pushbutton switch is OFF if the fault has disappeared.

OFF : The bleed valve and HP valve close. The white OFF light comes on.

(2) APU BLEED pb sw

ON : The APU valve opens if N > 95 % and there is no leak in the APU or in the left side bleed. (If there is a leak on the right side, the x-bleed valve closes.)
The blue ON light comes on.

Off : The APU valve closes.

FAULT light : This amber light comes on, and an ECAM caution appears, when the system detects an APU leak.

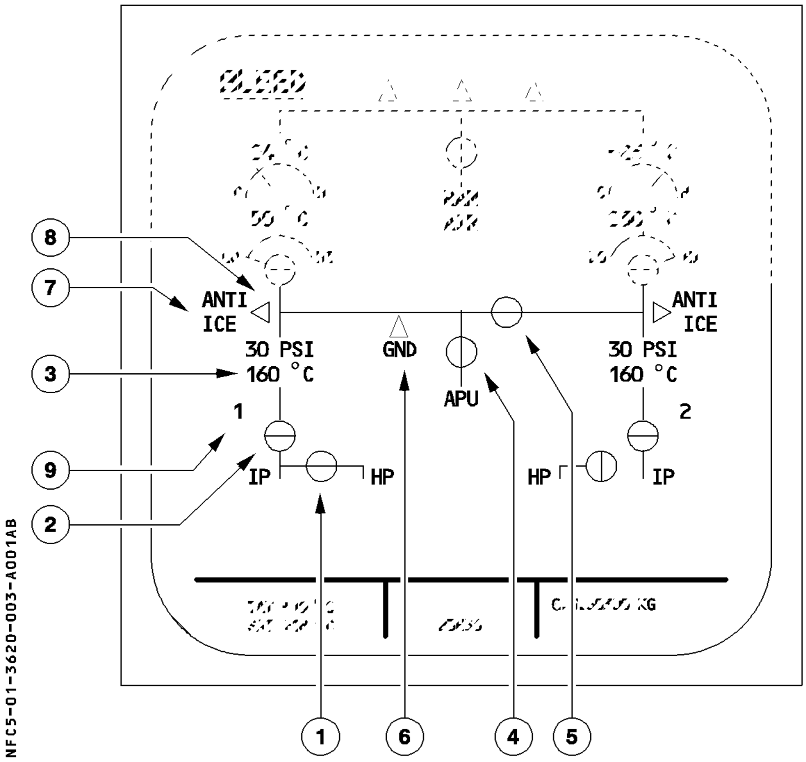
3 X-BLEED selector sw

AUTO : The crossbleed valve is open if the APU bleed valve is open.
The crossbleed valve is closed if the APU bleed valve is closed or, in case of a wing, pylon, or APU leak (except during engine start).

OPEN : The crossbleed valve is open.

CLOSE : The crossbleed valve is closed.

ECAM BLEED PAGE



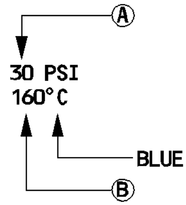
① HP VALVES

- ⦶ green : HP valve normally fully closed
- ⊖ green : HP valve not fully closed
- ⦶ amber : HP valve not in commanded (closed) position

② ENGINE BLEED VALVES

- ⦶ green : BLEED valve normally open
- ⊖ green : BLEED valve normally fully closed
- ⦶ amber : BLEED valve not in commanded (open) position
- ⊖ amber : BLEED valve not in commanded (closed) position

③ ENGINE BLEED INDICATIONS



NFC5-01-3620-004-A100AA

Ⓐ precooler inlet pressure
Normally green.
Becomes amber if under 4 psi or if overpressure detected by the BMC (threshold between 57 and 60 psi).

Ⓑ precooler outlet temperature
Normally green.
Becomes amber if BMC detects 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 temperature is lower than 150° C.

Note : On the ground with engines at idle, depending on ambient temperature, the precooler outlet temperature may be below 150° C.

④ APU BLEED VALVE

⊖ green : APU valve not fully open and APU master switch ON
⦶ green : APU valve fully open and APU master switch ON

⑤ CROSS BLEED valve

⦶ green : crossbleed valve normally closed
⊖ green : crossbleed valve normally open
⦶ amber : crossbleed valve not in commanded (closed) position
⊖ amber : crossbleed valve not commanded (open) position
⊘ amber : crossbleed valve in transit

⑥ GND HP ground connection indication

△ : displayed in green on ground
GND

(7) ANTI ICE indication

Displayed in white when the WING pushbutton switch on the ANTI-ICE panel is ON.

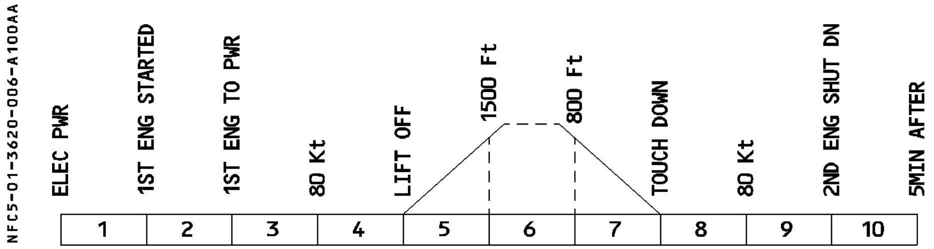
(8) Arrow

◁– : – normally not displayed when the corresponding valve is closed
– normally displayed green when the corresponding valve is open
– becomes amber when :
· the valve is open and air pressure is low or high, or
· the valve is open on the ground for more than 10 seconds.

(9) Engine identification (1-2)

Normally white.
Becomes amber when engine N2 below idle.

WARNINGS AND CAUTIONS



<table>
<tr><th>E / WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>ENG 1 (2) BLEED FAULT
engine 1 (2) running and bleed air pressure > 57 psig (+ 3/– 0) or temperature :
> 257°C for more than 55 sec
or > 270°C for more than 15 sec
or > 290°C for more than 5 sec</td><td rowspan="8">SINGLE CHIME</td><td rowspan="8">MASTER CAUT</td><td rowspan="8">BLEED</td><td rowspan="4">ENG BLEED FAULT lt</td><td>1, 3, 4, 5, 7, 8, 10</td></tr>
<tr><td>L (R) WING LEAK
temperature > 124°C detected by the loops</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td>ENG 1 (2) BLEED LEAK
temperature > 204°C detected by the loop and engine 1 (2) running</td></tr>
<tr><td>ENG 1 (2) BLEED NOT CLSD
bleed valve not automatically closed during engine start or with APU bleed selected</td></tr>
<tr><td>BLEED 1 (2) OFF
one engine bleed switched off with no fault</td><td>ENG BLEED OFF lt</td><td>1, 3, 4, 5, 7, 8, 9, 10</td></tr>
<tr><td>APU BLEED FAULT
APU available and APU bleed valve position disagrees with selected position.</td><td>NIL</td><td rowspan="2">3, 4, 5, 7, 8</td></tr>
<tr><td>APU BLEED LEAK
temperature > 124°C detected by the loop</td><td>APU BLEED FAULT lt</td></tr>
<tr><td>ENG 1 (2) BLEED ABNORM PR
regulated pressure is abnormal</td><td>NIL</td><td>1, 3, 4, 5, 7, 8, 10</td></tr>
</table>

<table>
<tr><th>E / WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>ENG 1 (2) (1+2) BLEED LO TEMP
one (both) engine bleed below 150°C in flight with wing anti ice ON</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="5">BLEED</td><td rowspan="5">NIL</td><td>3, 4, 5, 8</td></tr>
<tr><td>X BLEED FAULT
position disagree with selected position</td><td rowspan="4">3, 4, 5, 7, 8</td></tr>
<tr><td>ENG 1 (2) HP VALVE FAULT
HP valve is abnormally closed</td><td rowspan="3">NIL</td><td rowspan="3">NIL</td></tr>
<tr><td>BLEED MONITORING FAULT
Both BMC faulty</td></tr>
<tr><td>L(R) WING LEAK DET FAULT
Both detection loops inop in one wing</td></tr>
</table>

MEMO DISPLAY

APU BLEED appears in green if the APU is available and the APU BLEED pushbutton switch is ON.

BUS EQUIPMENT LIST

		NORM		EMER ELEC		
		AC	**DC**	**AC ESS**	**DC ESS**	**HOT**
BMC	1				SHED	
	2		DC2			
BLEED VALVES, HP VALVES AND FAN AIR VALVES	ENG 1				SHED	
	ENG 2		DC2			
X-BLEED VALVE	AUTO CONTROL		DC2			
	MANUAL CONTROL				SHED	

38.00 CONTENTS

38.10 DESCRIPTION

38.20 ELECTRICAL SUPPLY

GENERAL

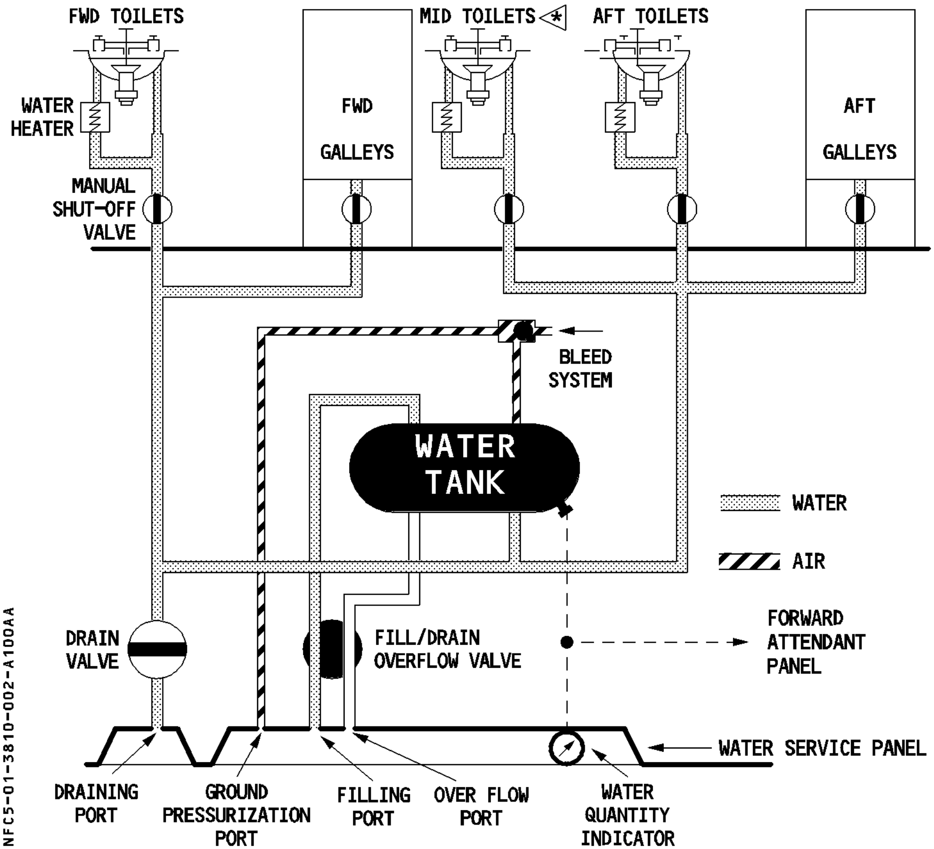
The water and waste system :
- distributes potable water to the toilets and the galleys.
- disposes waste water.
- stores toilet wastes.

The system is insulated to prevent water leaks and ice build up.
The water and waste control panel is on the forward cabin attendant's panel.

POTABLE WATER

Potable water is stored in a 200-liters tank in front of the wing box behind the forward 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.
R Potable water is piped to the galleys and lavatories. Manual shutoff valves isolate the forward, mid ⊲*| and aft washbasins from the water system. These valves, easily identifiable by OPEN and SHUT legends, are under washbasins or toilet bowls.
The system can be filled or drained from the service panel at the bottom of the fuselage. Indicators on the forward attendant's panel and the aft service panel show how much water the water tank contains.

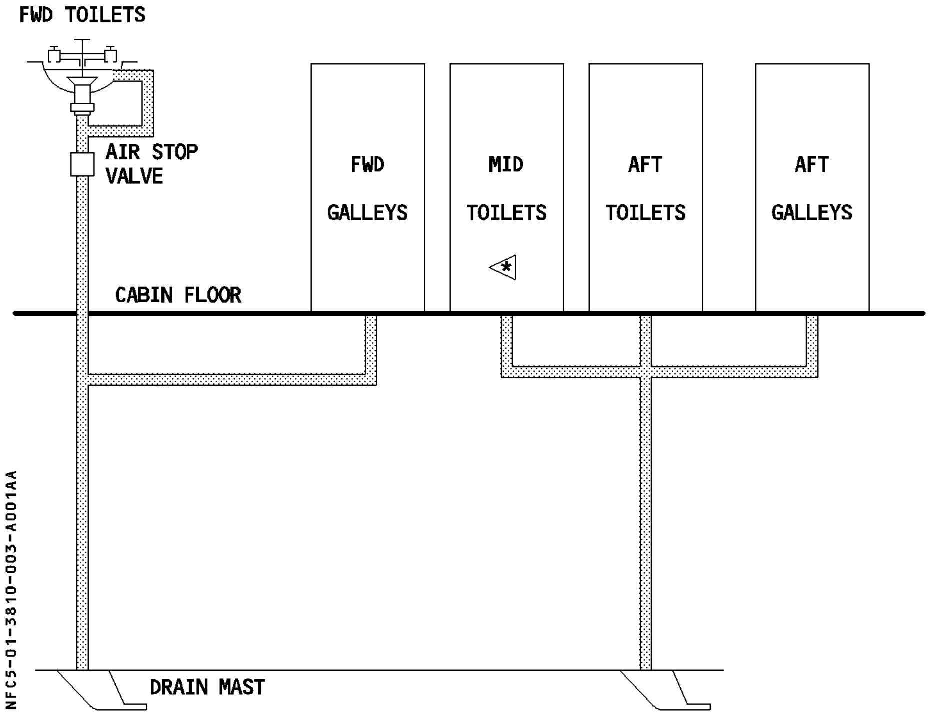
FOR INFO



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



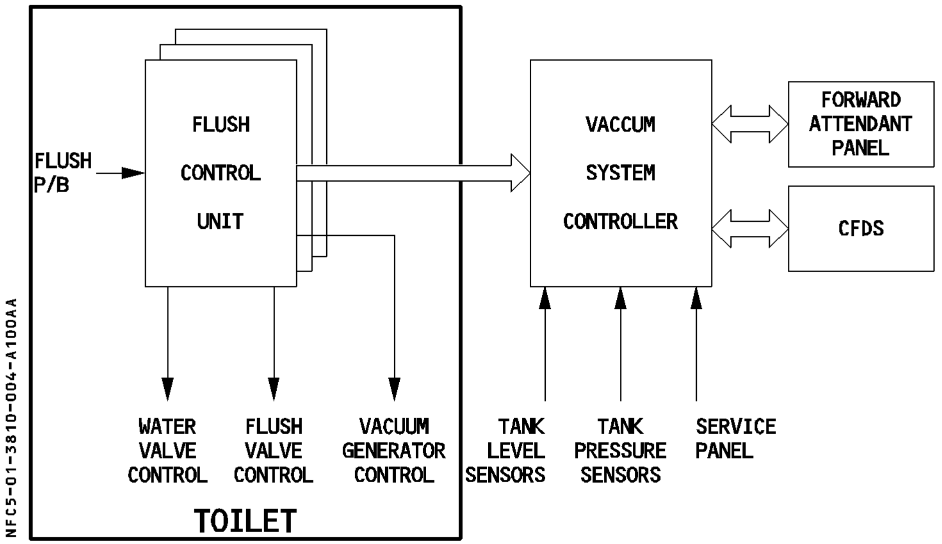
TOILET SYSTEM

Differential pressure forces waste from the toilet bowls into the waste storage tank. On 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, within each toilet, controls the flush sequence.
In case of an electrical failure in the flush valve, personnel can use a manual flush control
R under the toilet bowl.
The Vacuum System Controller (VSC) furnishes operational information, such as the waste level in the storage tank, to the Flight Attendants' panel, and maintenance information and a test program to the Centralized Fault Display System.

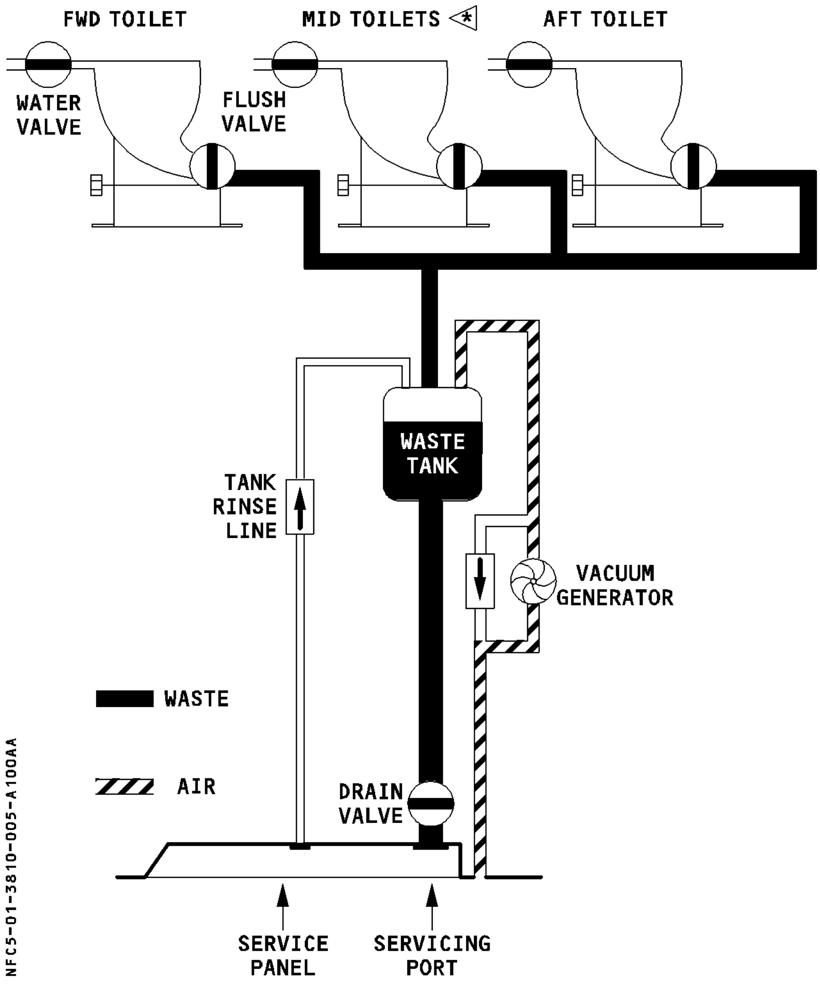
Note : To restart an inoperative toilet, a Flight Attendant may attempt to reset the VSC as follows :
VACUUM SYS C/B (on 2001 VU, aft cabin C/B panel) . . . . PULL for 30 seconds.
VACUUM SYS C/B (on 2001 VU, aft cabin C/B panel) . . . . . PUSH

The waste tank has a usable capacity of 170 liters.
Ground personnel services the waste tank via a single service panel under the fuselage.
A manual shut-off valve isolates an inoperative toilet.

ARCHITECTURE



SCHEMATIC


FWD TOILET
MID TOILETS
AFT TOILET
WATER VALVE
FLUSH VALVE
WASTE TANK
TANK RINSE LINE
VACUUM GENERATOR
WASTE
AIR
DRAIN VALVE
SERVICE PANEL
SERVICING PORT
NFC5-01-3810-005-A100AA

BUS EQUIPMENT LIST

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
POTABLE WATER SYS		GND/FLT				
WATER HEATER	AC2					
WATER DRAINING		GND/FLT				
VACUUM GENERATOR	AC2					
PRESSURIZED WATER SYS	AC2					
FLUSH CONTROL UNITS		GND/FLT				
VACUUM SYS CONTROLLER		GND/FLT				

45.00 CONTENTS

GENERAL

The purpose of the Centralized Fault Display System (CFDS) is to make the maintenance task easier by displaying fault messages in the cockpit and permitting the flight crew to make some specific tests.

There are two levels of maintenance :

at the line stop : removal and replacement of equipment

at the main base : troubleshooting

COMPONENTS

The CFDS includes :

- the BITE (Built-In Test Equipment) for each electronic system
- a central computer, the Centralized Fault Display Interface Unit (CFDIU)
- two MCDUs (Multipurpose Control and Display Units), used also for FMGS (Flight Management and Guidance System), AIDS (Aircraft Integrated Data System), and ACARS (Aircraft Communication And Reporting System, if installed), which work with the CFDIU to display information or initiate tests
- one printer.

If a main channel of the CFDIU fails, the backup channel takes over.

MODES OF OPERATION

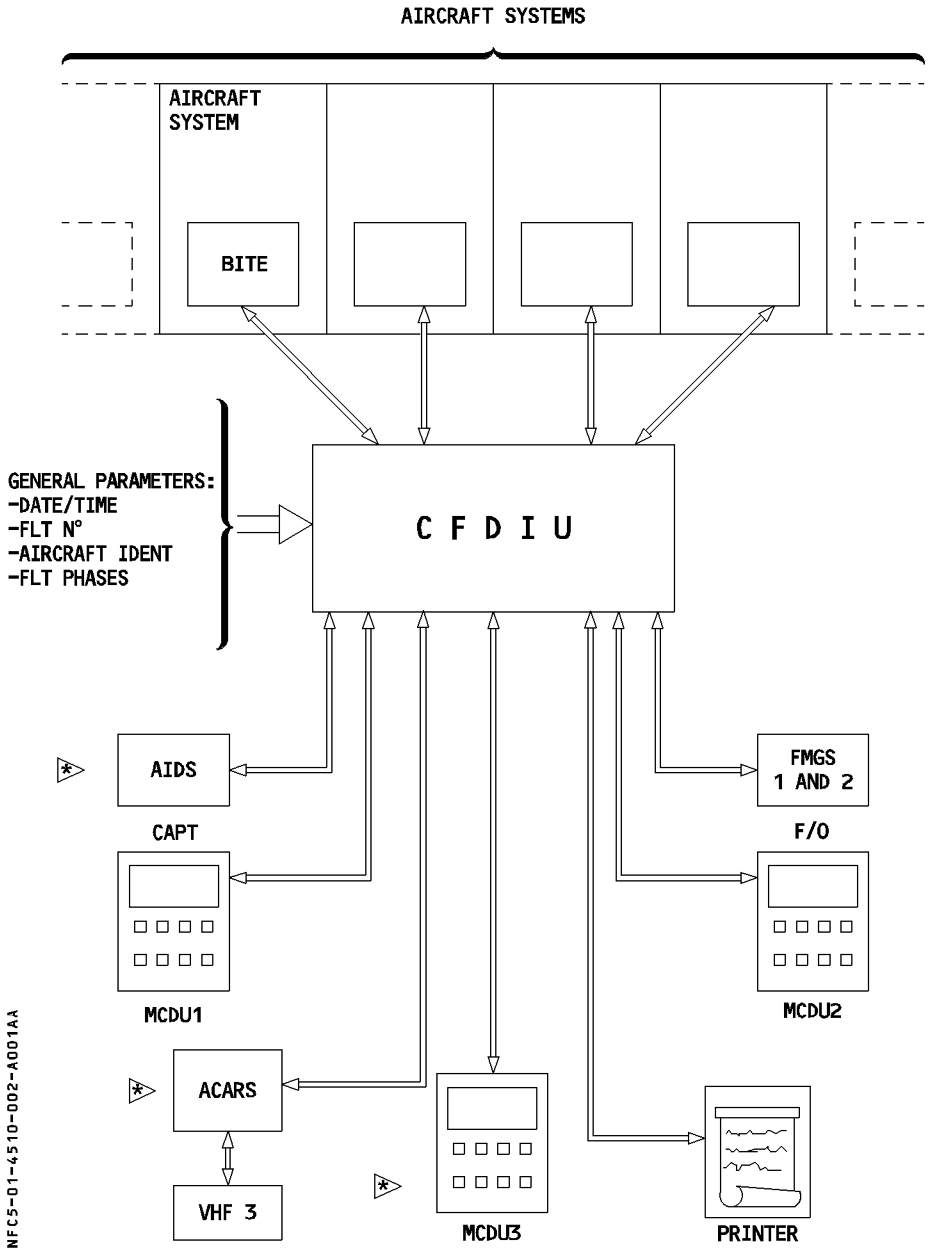
The CFDS operates in two main modes :

- the NORMAL mode or REPORTING mode (in flight)
- the INTERACTIVE mode or MENU mode (on ground).

In NORMAL mode, the CFDS records and displays the failure messages transmitted by each system BITE.

In INTERACTIVE mode, the CFDS allows any BITE to be connected with the MCDU in order to display the maintenance data stored and formatted by the BITE or to initiate a test.

ARCHITECTURE



FAILURE/FAULT CLASSIFICATION

The Centralized Fault Display System (CFDS) identifies the faulty system and puts any failures or faults into one of three classes :

Class 1: Failures indicated to the flight crew by means of the ECAM, or other flight
R deck effect. They must be repaired or entered in the MEL (Minimum Equipment List) before the aircraft can depart.

Class 2: Faults indicated to maintenance personnel by the CFDS, and which trigger a MAINT status entry on the maintenance part of the ECAM status page. The aircraft can operate with these faults, but they must be repaired within 10 days.

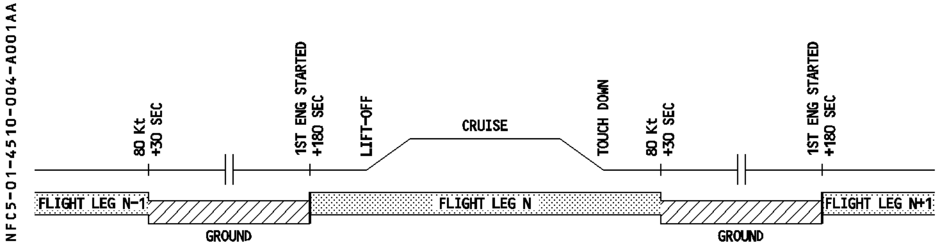
Class 3: Faults indicated to maintenance personnel by the CFDS, but which do not trigger a MAINT status. The operator may have these faults corrected at his convenience.

R

Failure/fault classes	Class 1	Class 2	Class 3
Operational consequences	YES	NO	NO
Indication to the flight crew	YES Automatically displayed : – Warning or caution messages on Engine Warning Display – Flag or indication in the flight deck.	YES Available on the ECAM status page.	NO
Dispatch consequences	Refer to MEL may be : "GO" "GO IF" "NO GO"	No need to refer to MEL except for the message – AIR BLEED For all the other class 2 messages, "GO" without conditions. Can be left uncorrected for 10 days.	MEL not applicable
Indication to the maintenance team	YES Automatically print out at the end of each flight : Fault messages on the CFDS Post Flight Report.		YES Available on request through system report/Test

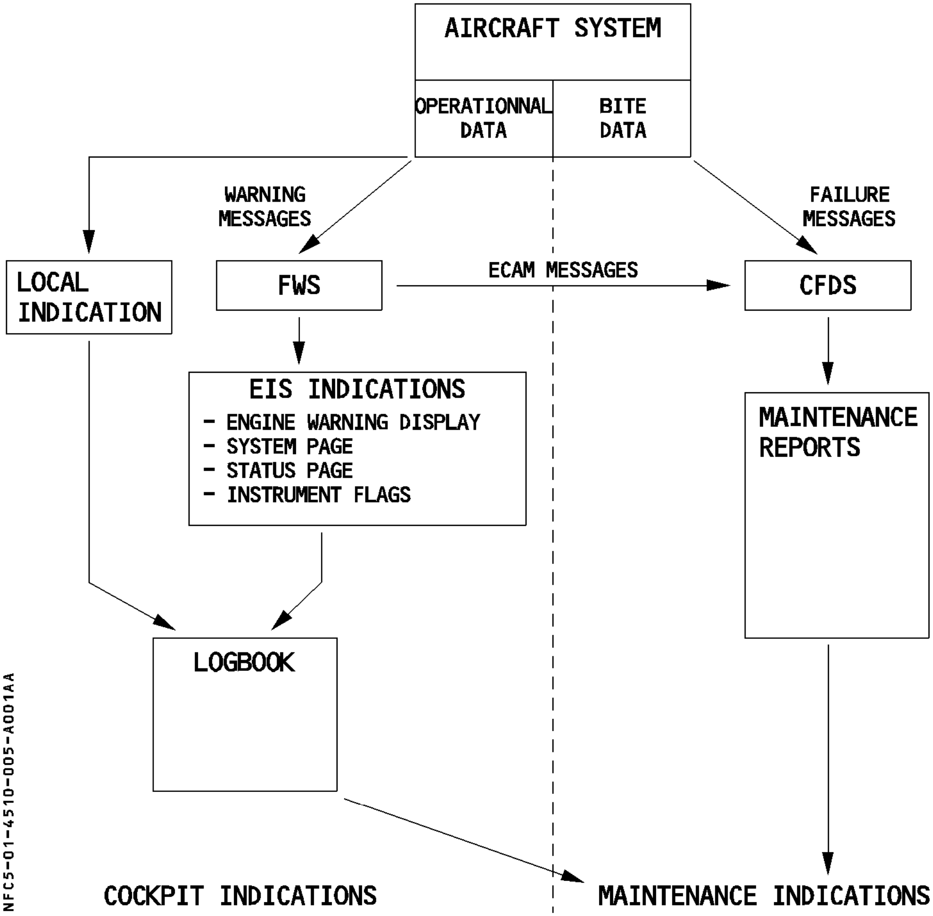
FUNCTIONS OF THE CENTRALIZED FAULT DISPLAY SYSTEM (CFDS)

The main functions of the CFDS are :
- acquiring and storing messages transmitted by the connected system BITEs or by the flight warning computer (warning and caution titles)
- detailing the maintenace phases.



- Presenting maintenance reports :
  · last leg report
  · last leg ECAM report
  · previous leg report
  · avionics status
  · system report test
  · post flight report.

COCKPIT/CFDS INTERFACE



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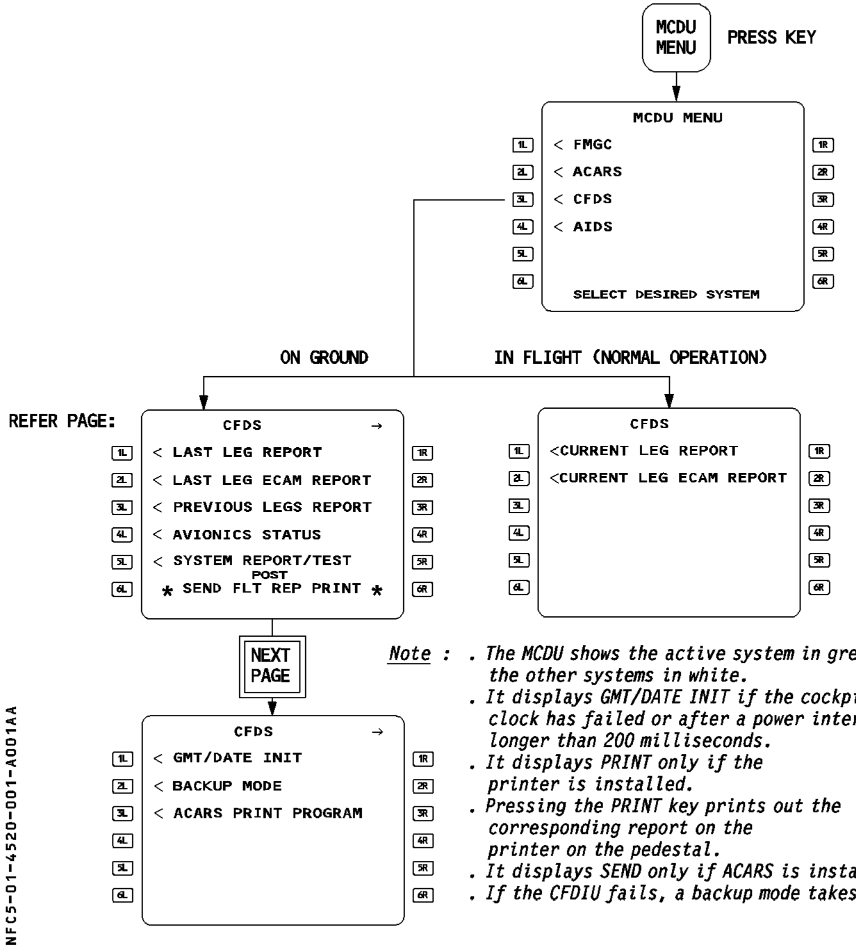
MAINTENANCE MENU

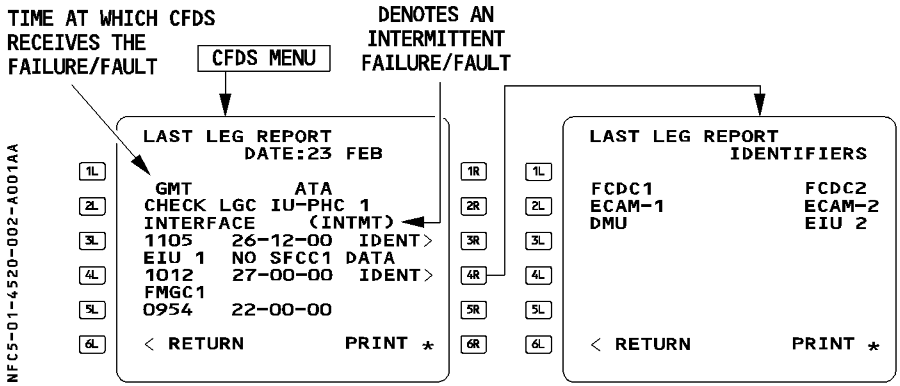
The CFDS uses menus displayed on the MCDU. The operator selects functions or reports from these menus.
Pressing the MCDU MENU key and then selecting CFDS brings up the MAINTENANCE MENU page (different pages for the aircraft in flight and the aircraft on the ground).



Note : . *The MCDU shows the active system in green, the other systems in white.*
. *It displays GMT/DATE INIT if the cockpit clock has failed or after a power interruption longer than 200 milliseconds.*
. *It displays PRINT only if the printer is installed.*
. *Pressing the PRINT key prints out the corresponding report on the printer on the pedestal.*
. *It displays SEND only if ACARS is installed.*
. *If the CFDIU fails, a backup mode takes over.*

LAST (or CURRENT) LEG REPORT

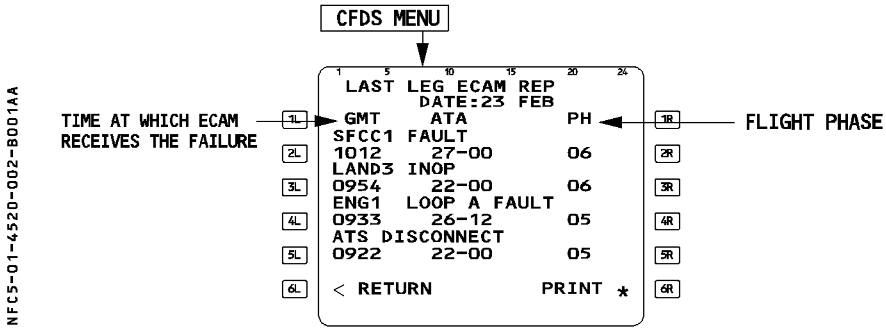
The LAST LEG REPORT (on the ground) or the CURRENT LEG REPORT (in flight), list all class 1 failures and class 2 faults and all system failure and system fault messages received by the CFDS during the last flight leg or the current flight leg. Pressing the IDENT key displays a list of the systems (called identifiers) affected by the failure or fault, which helps the pilot or maintenance person to identify the failure or fault.



LAST (or CURRENT) LEG ECAM REPORT

In flight : The CURRENT LEG ECAM REPORT displays the primary and independent warning (class I) messages and MAINTENANCE STATUS (class II) messages of the current flight leg.

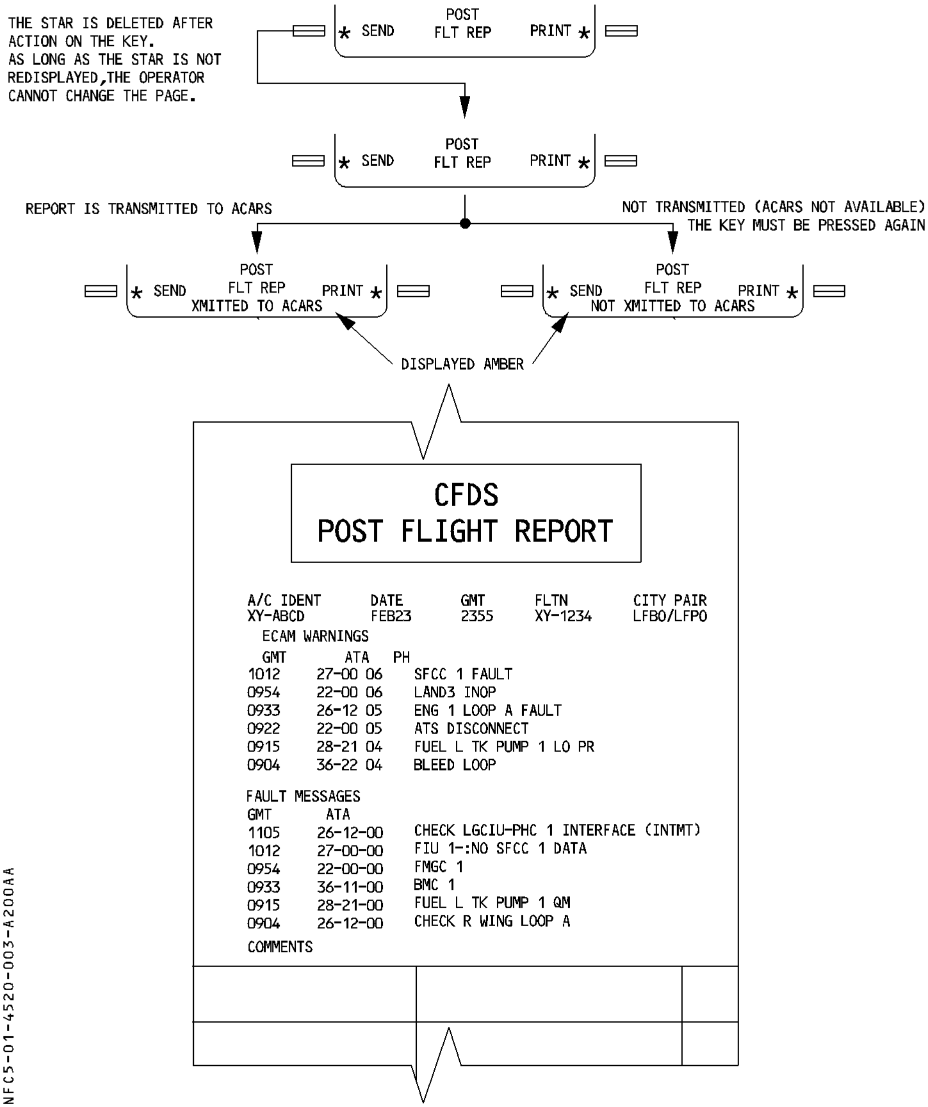
On the ground : The LAST LEG ECAM REPORT displays the primary and independent warning (class I) messages plus MAINTENANCE STATUS (class II) messages of the last flight leg.



Note : This screen displays PRINT only if the printer is installed.

POST FLIGHT REPORT

At the end of a flight, LAST LEG and LAST LEG ECAM REPORTS are printed out automatically after landing (30 seconds after reading 80 knots).
The flight or ground crew can also print them out by selecting POST FLIGHT REP PRINT.
It is also automatically sent to the ACARS after the last engine shutdown, or manually by selecting the SEND key.



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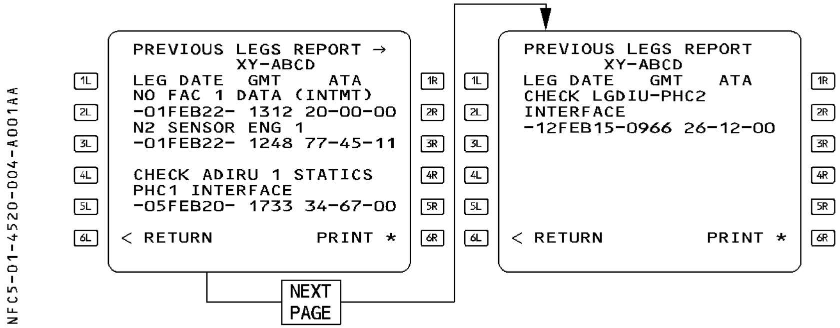
PREVIOUS LEGS REPORT

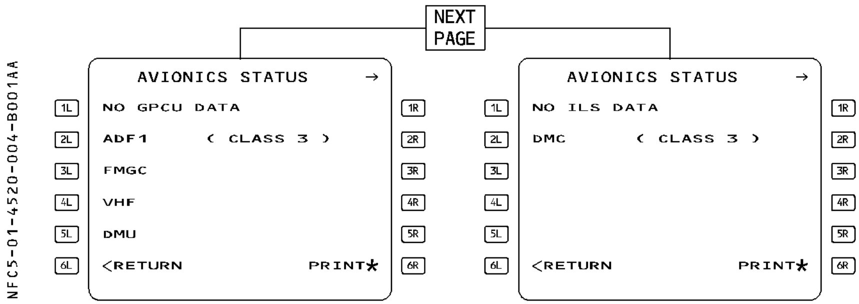
This report gives access to the POST FLIGHT REPORTS of the previous 63 flight legs.



On ground, the Operator can print copies of the screen. If ACARS is installed, the Operator can send the flight report (see the POST FLIGHT REPORT paragraph).

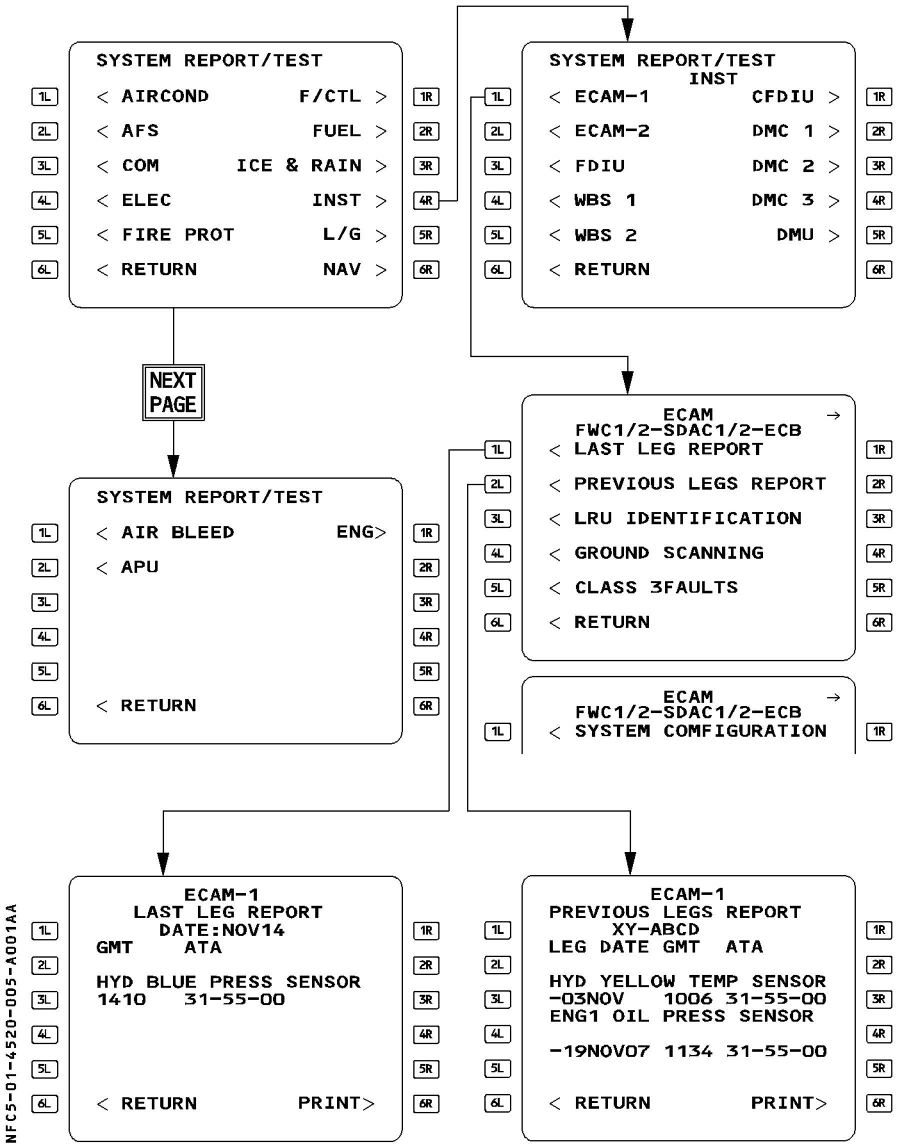
AVIONICS STATUS

This screen displays the list of systems affected by a failure or fault. If a system is affected
R by at least a Class 3 fault, CLASS 3 appears beside it. The display is continuously updated.
R



SYSTEM REPORT/TEST

This screen gives the operator access to all electronic systems. The CFDIU enters into interactive dialogue with the selected system.



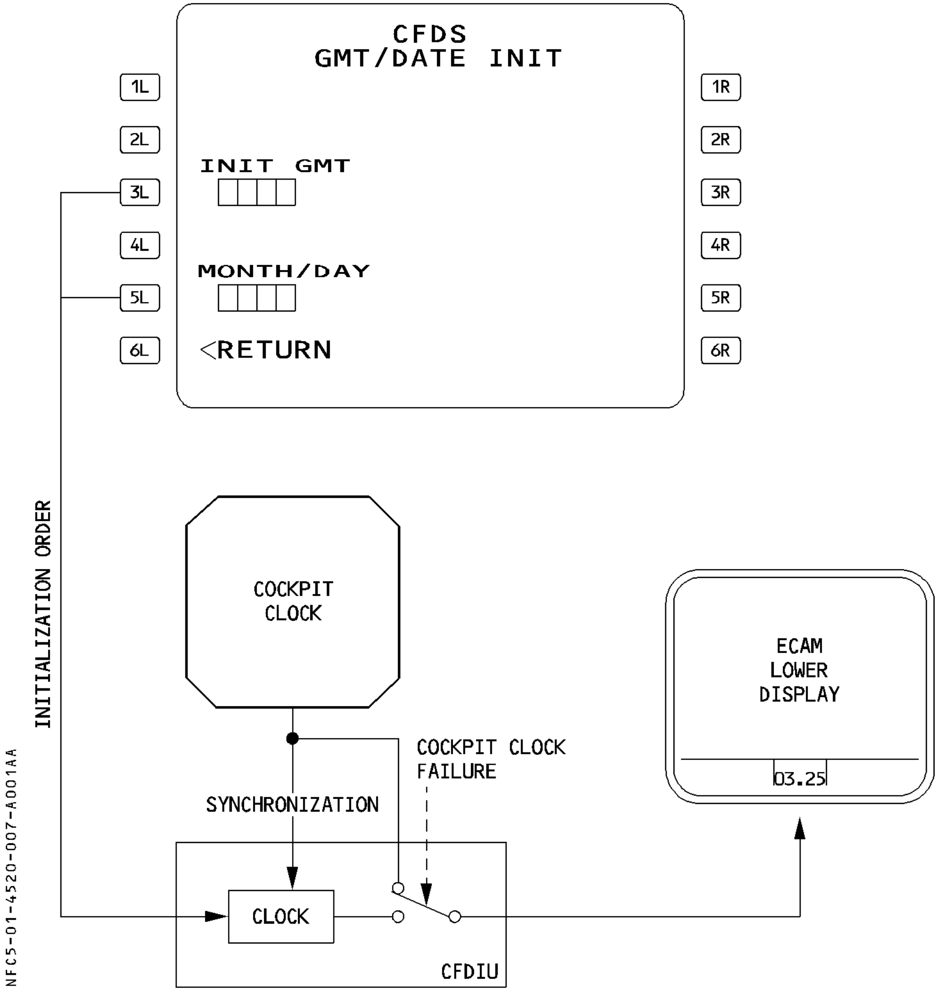
In the above example, the operator has called up menus of the selected systems :

- LAST or PREVIOUS LEG REPORT presents the list of Line-Replaceable Units (LRUs) affected by a failure.
- LRU IDENTIFICATION contains the part numbers of all LRUs in the system.
- GND SCANNING runs the flight monitoring on the ground and indicates the faulty LRU.
- CLASS 3 FAULTS lists class 3 faults detected by the system during the last flight leg.
- SYSTEM CONFIGURATION presents the system configuration in a digital form.

Note : These screens (except LAST or PREVIOUS LEG REPORT) are not shown above.

GMT/DATE INITIALIZATION

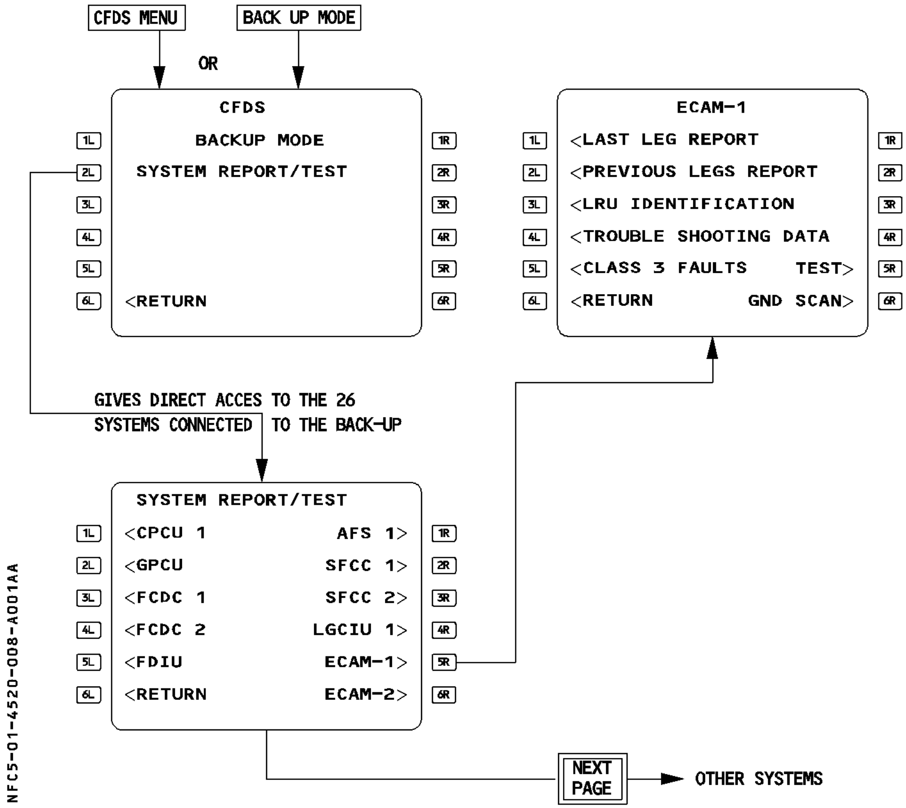
R A CFDIU clock is synchronized with the cockpit clock in order to keep GMT (UTC) displayed on the ECAM lower display (except in flight Phases 1 and 2, if the weight and balance system is installed). If the cockpit clock fails, the CFDIU clock continues to display GMT
R (UTC) on the ECAM lower display.
If electrical power is interrupted for more than 200 milliseconds, the crew initializes GMT
R (UTC) and the DATE via the MCDU :
R – Write GMT (UTC) in the scratchpad, then press the “INIT GMT” key.
– Do the same for the month and day.
R



BACK UP MODE

If the CFDIU's main channel fails, the backup channel allows the CFDS to operate in backup mode :
- on the ground only
- through MCDU1 (or MCDU3, if installed)
- in one mode of operation only : SYSTEM REPORT/TEST
- without the PRINTER or ACARS.

The system changes over from main channel to backup channel :
- Automatically in case of an important failure (power supply, for example). In this case, when the operator selects CFDS on the MCDU MENU, it displays the BACKUP MODE page.
- Manually if the operator selects BACKUP MODE on the CFDS menu after a minor failure.

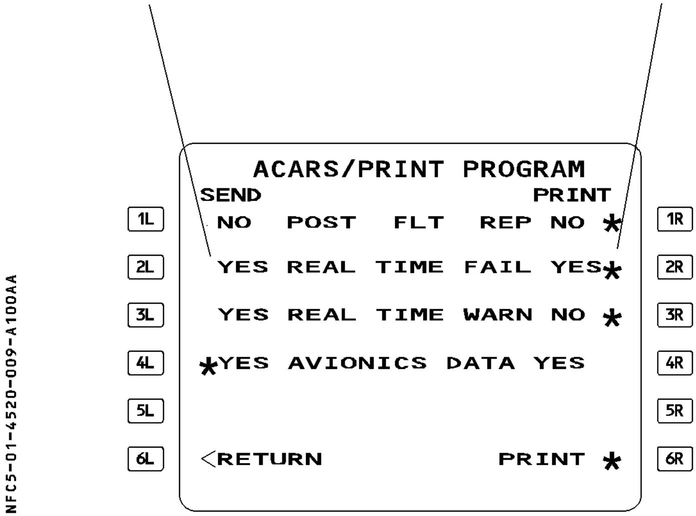


ACARS PRINT PROGRAM

This function gives access to reprogramming page.
The programming is provided by the ACARS or manually (on the ground or in flight) :

No star indicates an ACARS programming. The YES indicates that the REAL TIME FAIL will be automatically transmitted to the ACARS.

The star indicates a manually modified programming: pressing the corresponding key changes the YES into a NO. The YES indicates that the REAL TIME FAIL page will be printed simultaneously with the transmission to the ACARS.

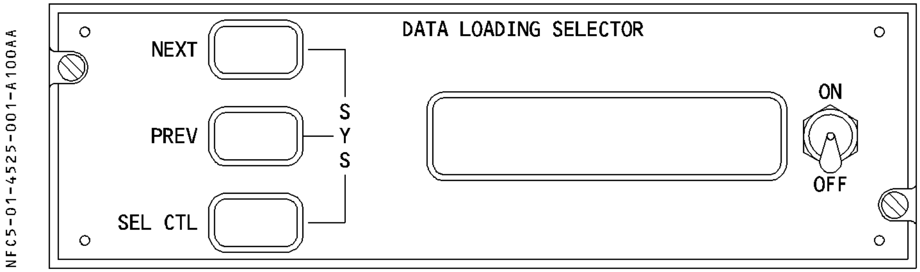


Note : The CFDIU memorizes all manual programming so that at initialisation the last configuration will be retained.

DESCRIPTION

With the data loading system, it is possible to upload databases and operational software, or to download system reports from various onboard computers.
The data transfer is performed via 3.5 inch disks and a portable data loader, or (⊲*) the aircraft fixed Multipurpose Disk Drive Unit (MDDU).

DATA LOADING SELECTOR on the OVERHEAD panel

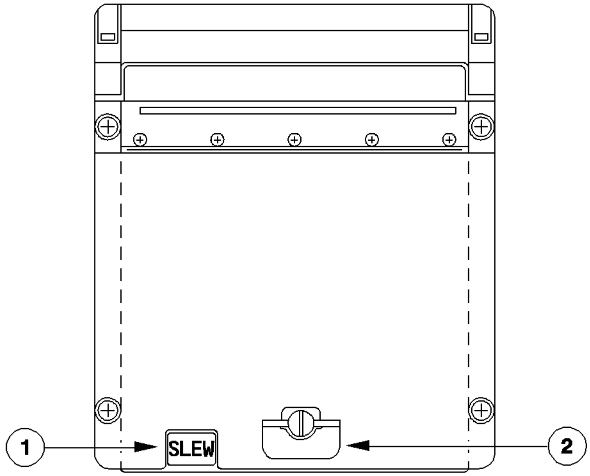


When the data loading selector is ON, the 3 keys (NEXT, PREV, SEL CTRL) enable the display and selection of various applicable aircraft systems (FMGC, TCAS ⊲* etc...).

GENERAL

The printer prints reports from the following systems (if installed) : ACARS, AIDS, FMGC, CFDIU and EVMU. It prints these on paper, and does so either on the ground or in flight. The printer is installed at the rear of the pedestal on the right side.

SYSTEM DESCRIPTION



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① SLEW sw :

The SLEW switch is used to feed paper after having loaded a new roll.

② PRINTER DOOR LATCH :

The printer door latch locks the door used for loading paper.

BUS EQUIPMENT LIST

	NORM		EMER ELEC		
	AC	DC	AC ESS	DC ESS	HOT
CFDS		DC1			

49.00 CONTENTS

49.10 DESCRIPTION

49.20 CONTROLS AND INDICATORS

49.30 ELECTRICAL SUPPLY

GENERAL

The Auxiliary Power Unit (APU) is a self-contained unit that makes the aircraft independent of external pneumatic and electrical power supplies.

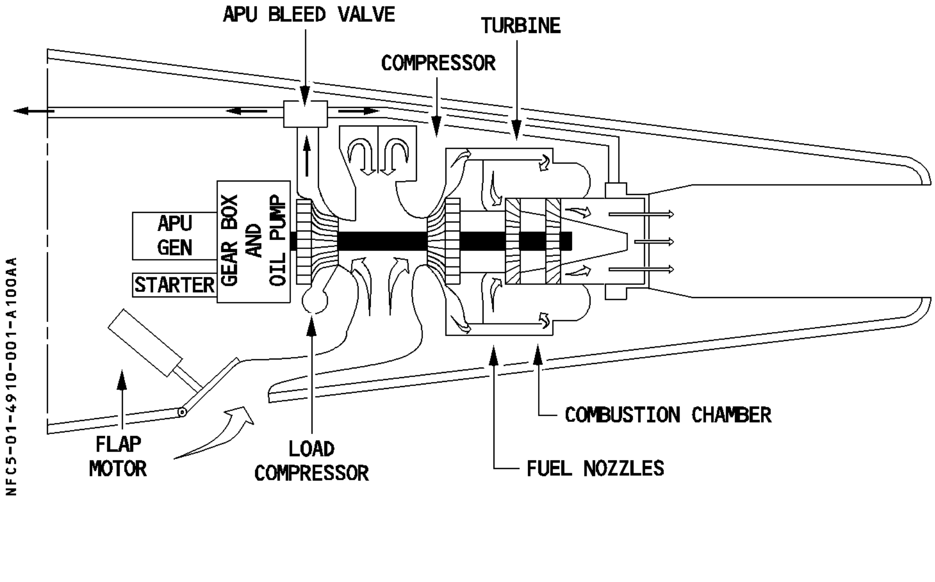
On the ground
- It supplies bleed air for starting the engines and for the air conditioning system.
- It supplies electrical power to the electrical system.

During takeoff
- 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
- It backs up the electrical system.
- It backs up the air conditioning.
- It can be used to start the engines.

The APU may obtain power for starting from the aircraft's batteries alone or in combination with the external power, or from ground service.
APU starting is permitted throughout the normal flight envelope.
The ECAM displays APU parameters.

FOR INFO



MAIN COMPONENTS

APU ENGINE

The basic element of the APU is a single-shaft gas turbine that delivers mechanical shaft power for driving the accessory gearbox (electrical generator, starter, etc.) and produces bleed air (engine starting and pneumatic supply).

ELECTRONIC CONTROL BOX

The Electronic Control Box (ECB) is a full-authority digital electronic controller that performs the bulk of the APU system logic for all modes of engine operation, such as :
- Sequences the start and monitors it.
- Monitors speed and temperature.
- Monitors bleed air.
- Sequences the shutdown.
- Controls the automatic shutdown.

AIR INTAKE SYSTEM

The air intake and an electrically operated flap allow external air to reach the compressor inlet.

STARTER

The ECB controls the electric starter. The starter engages if the air intake is fully open and the MASTER SW and the START pushbutton are ON.

FUEL SYSTEM

The left fuel feed line supplies the APU.
The required pressure is normally available from tank pumps.
If pressure is not available (batteries only or pumps off) the APU FUEL PUMP starts automatically.
The ECB controls the fuel flow.

OIL SYSTEM

The APU has an integral independent lubrication system (for lubrication and cooling).

INLET GUIDE VANES (IGV)

The IGVs control bleed air flow, and a fuel-pressure-powered actuator positions the IGVs. The ECB controls the actuator in response to aircraft demand.

AIR BLEED SYSTEM

The air bleed system is fully automatic.
The APU speed is always 100 % whatever the air bleed system demand and the ground/flight configuration are.

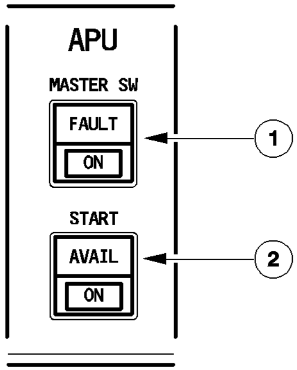
CONTROLS

The flight crew uses the controls on the APU panel for routine shutdown. For emergency shutdown :
- the flight crew can push the APU FIRE handle, or
- the ground crew can push the APU SHUT OFF pushbutton on the interphone panel under the nose fuselage.

GROUND OPERATION SAFETY DEVICES

The APU may run without cockpit crew supervision when the aircraft is on the 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 out.
- The FAULT light in the MASTER SW lights up.
- The APU shuts down.
- The APU fire extinguisher discharges.

OVERHEAD PANEL



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(1) MASTER SW pb sw

This switch controls the electric power supply for the operation of the APU and its protective features. It also controls the starting and shutdown sequences.

ON : The blue ON light comes on.
Electric power goes to the APU system ; the ECB performs a power-up test.
The APU air intake flap opens.
The APU fuel isolation valve opens.
If no fuel tank pump is running, the APU fuel pump operates.
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 on the MASTER SW pushbutton switch and the AVAIL light on the START pushbutton go out.
- The APU keeps running for a cooling period of 120 seconds at N 100 % speed.
- At 7 % the air inlet flap closes.

FAULT lt : This amber light comes on, and a caution appears on ECAM, when an automatic APU shutdown occurs, which happens in case of :

Fire (on ground only)	Reverse flow
Air inlet flap not open	Low oil pressure
Overspeed	High oil temperature
No acceleration	DC power loss. (BAT OFF when aircraft on batteries only)
Slow start	ECB failure
EGT overtemperature	loss of overspeed protection
No flame	
Underspeed	

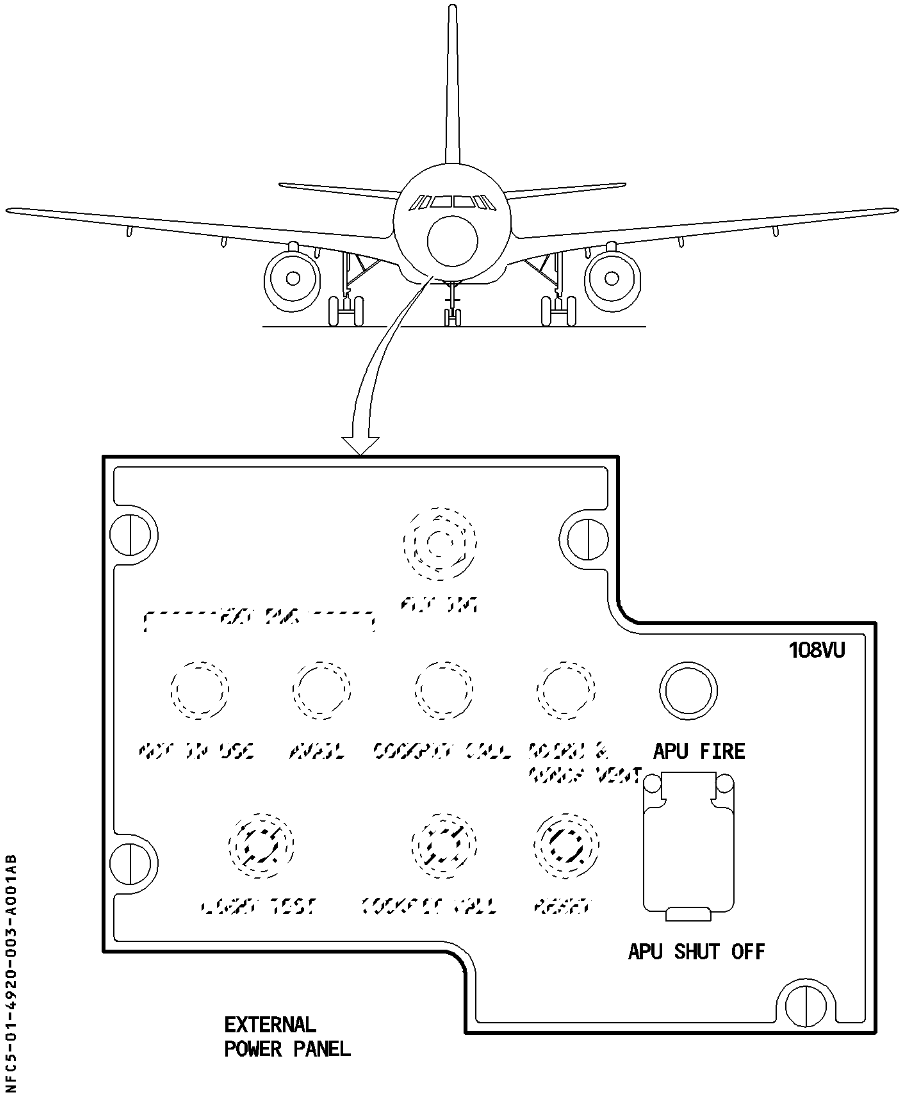
(2) START pb sw

ON : Blue ON light comes on.

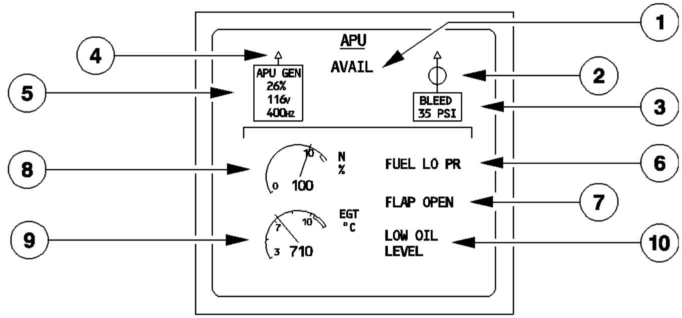
R
- When the flap is completely open, the APU starter is energized.
- 1.5 seconds after the starter is energized, the ignition is turned ON.
- When N = 55 %. The APU starter is de-energized. The ignition is turned off.
- 2 seconds after N reached 95 %, or when N is above 99.5 % :
  The ON light on the START pushbutton goes out.
  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 lt : This green light comes on when N is above 99.5 % or 2 seconds after N reaches 95 %.

EXTERNAL CONTROLS



ECAM APU PAGE



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(1) AVAIL

Displayed in green when APU N is above 99.5 % or 2 seconds after N is above 95 %.

(2) APU bleed valve position

⦶ : Valve not closed (green)
⊖ : Valve fully closed (green)
Valve fully closed (amber) if APU bleed ON

(3) APU bleed air pressure

This box displays the relative bleed air pressure in green.
It shows an amber XX when the ADIRS2 is not available or selected OFF.

(4) APU GEN line contactor indication

Displayed in green when the APU GEN line contactor is closed.

(5) APU GEN parameters

Identical to the APU GEN parameters on the ELEC page.

(6) FUEL LO PR

Displayed in amber if APU fuel pressure gets low.

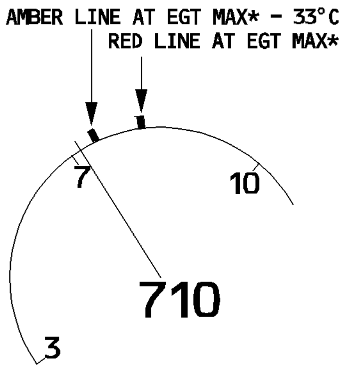
(7) FLAP OPEN

- Displayed in green when APU air intake flap is fully open (MASTER SW ON).
- Advisory if the flap is not fully closed 3 minutes after the MASTER SW has been turned OFF.

8 APU N

- Displays APU speed in green.
- Becomes amber when N ≥ 102 %.
- Becomes red when N ≥ 107 %.

9 APU EGT



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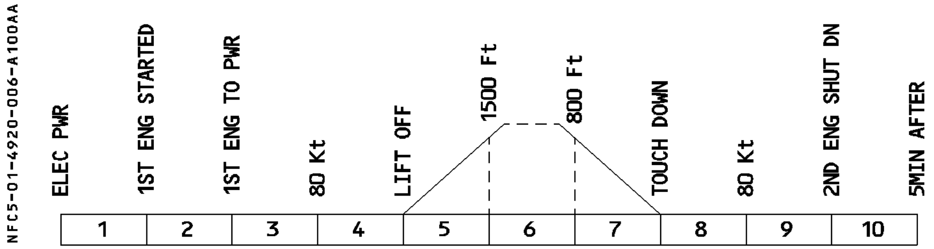
- Displays APU EGT in green.
- Becomes amber when EGT ≥ EGT max* – 33°C.
- Becomes red when EGT ≥ EGT max* (automatic shutdown begins).
  * ECB calculates EGT max and transmits it to the ECAM. It is a function of N during start, and a function of ambient temperature when the APU is running.
  Maximum EGT during start : 982°C.
  Maximum EGT with APU running :
R – 682°C during at least 5 seconds.
R – or, 700°C to 742°C depending on the ambient temperature.

10 LOW OIL LEVEL

Advisory : Displayed if the ECB detects a low APU oil level when the aircraft is on the ground, and the APU is not running.

WARNINGS AND CAUTIONS



<table>
<tr><th>E/WD : FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>AUTO SHUT DOWN
automatic shut down of APU for a reason other than a fire.</td><td rowspan="2">SINGLE CHIME</td><td rowspan="2">MASTER CAUT</td><td rowspan="2">APU</td><td rowspan="2">APU MASTER sw FAULT lt</td><td rowspan="2">3, 4, 5
7, 8</td></tr>
<tr><td>EMER SHUT DOWN
use of APU shut off pushbutton on external power panel or APU FIRE pushbutton pushed.
In case of APU fire on ground, the APU FIRE warning is triggered.</td></tr>
</table>

MEMO DISPLAY

– APU AVAIL appears in green when APU N is above N > 99.5 % or 2 seconds after N is above 95 %.

BUS EQUIPMENT LIST

	NORM			EMER ELEC		
	AC	DC	DC BAT	AC ESS	DC ESS	HOT
ECB SUPPLY			X			
STARTER MOTOR			X			

Note : *When the system is in electrical emergency configuration, battery contactors automatically close for a maximum of 3 minutes, when the APU MASTER SW is ON.*
When the aircraft is in flight, and when the system is in electrical emergency configuration, the APU start is inhibited for 45 seconds.

52.00 CONTENTS

52.10 DESCRIPTION

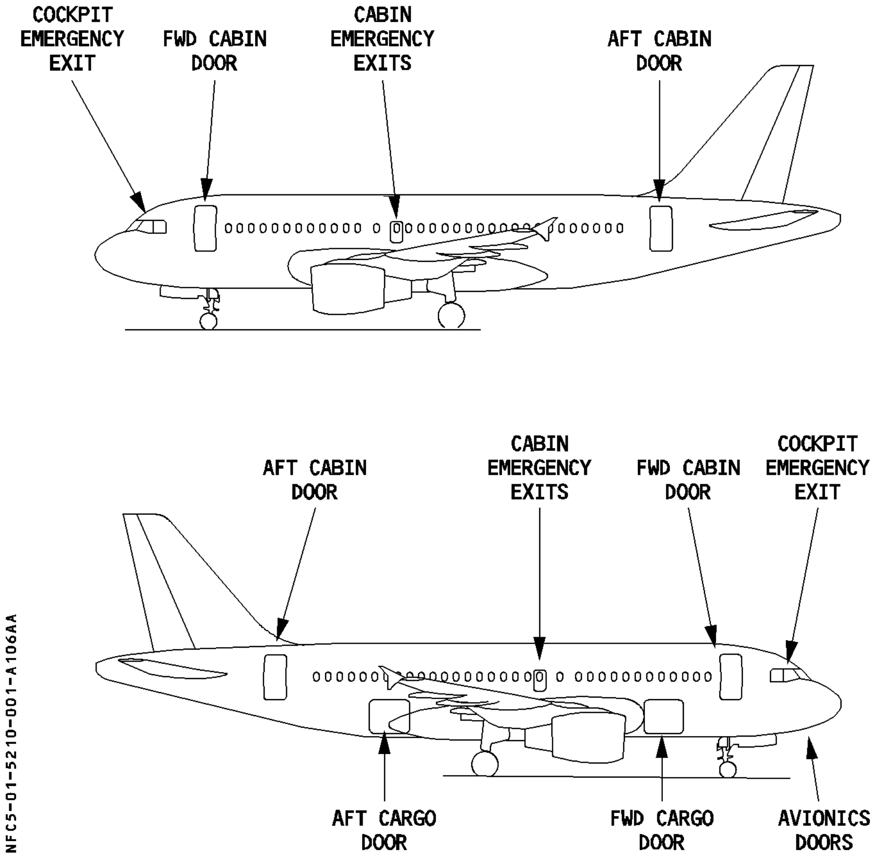
52.20 CONTROLS AND INDICATORS

52.30 AIRSTAIRS ◁*

52.40 ELECTRICAL SUPPLY

GENERAL

The fuselage of A319 has :
- four passenger doors
- two emergency exits in the cabin
- cockpit emergency exits (two sliding windows)
- two cargo compartment doors
- four avionic compartment access doors.

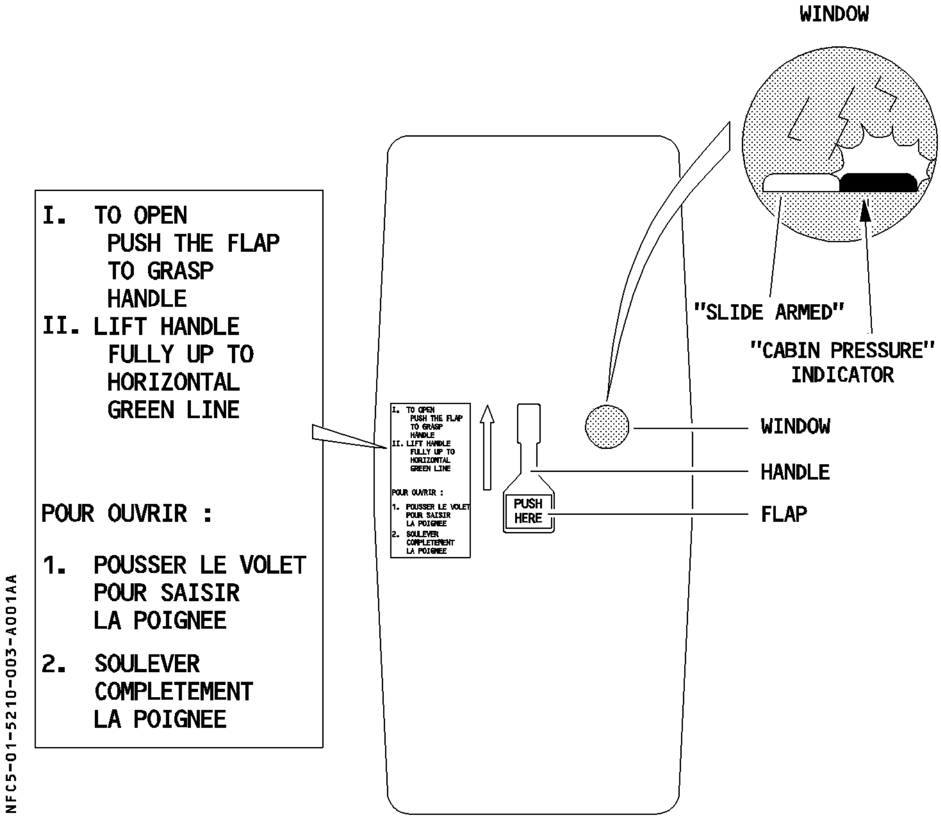


PASSENGER DOORS

The aircraft has four plug-type doors that open outward and forward. There are two of these on each side of the fuselage (two forward, two aft).
They can be operated from inside or outside the aircraft. Normal operation is manual, with hydraulic damping.
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 door travel in normal mode, but in an emergency acts as an actuator for automatic door opening.
— a slide arming lever.
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.
Opening the door from the outside disarms the door and the escape slide.
Each passenger door has :
— a mechanical locking indicator 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.

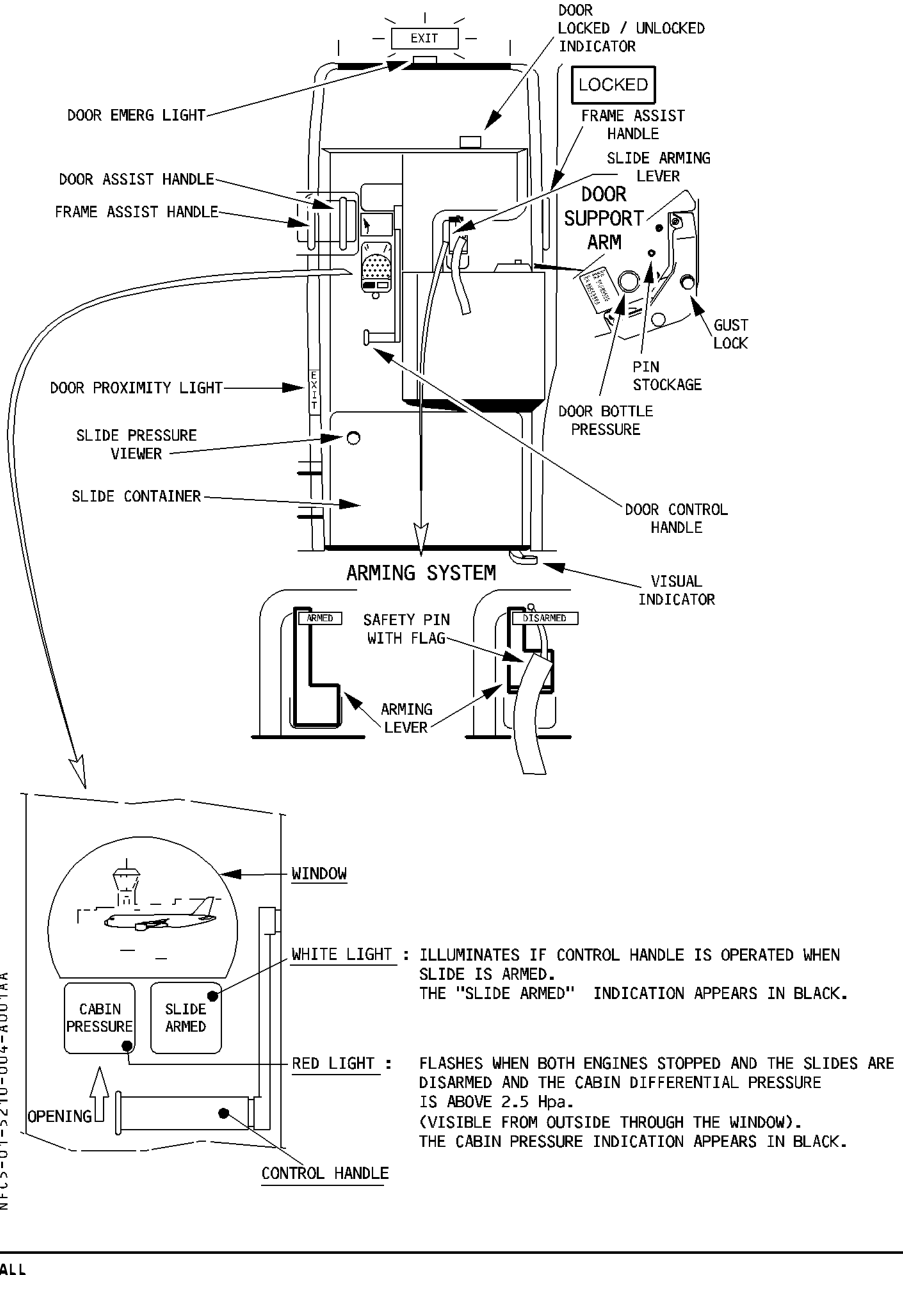
PASSENGERS DOORS

OUTSIDE



PASSENGERS DOORS

INSIDE



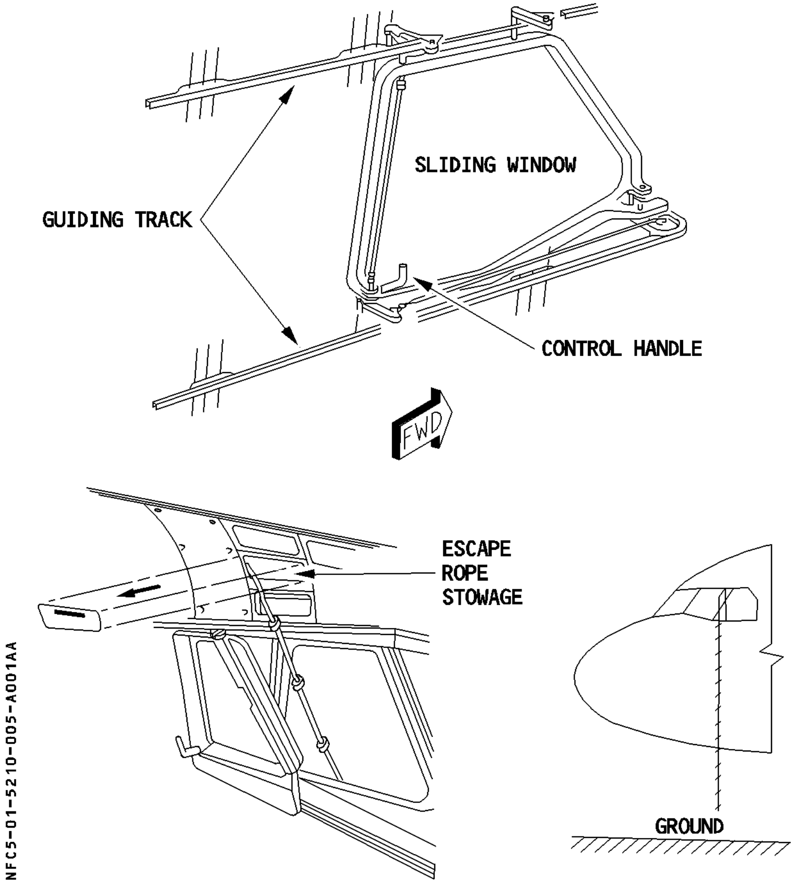
WHITE LIGHT : ILLUMINATES IF CONTROL HANDLE IS OPERATED WHEN SLIDE IS ARMED.
THE "SLIDE ARMED" INDICATION APPEARS IN BLACK.

RED LIGHT : FLASHES WHEN BOTH ENGINES STOPPED AND THE SLIDES ARE DISARMED AND THE CABIN DIFFERENTIAL PRESSURE IS ABOVE 2.5 Hpa.
(VISIBLE FROM OUTSIDE THROUGH THE WINDOW).
THE CABIN PRESSURE INDICATION APPEARS IN BLACK.

EMERGENCY EXITS

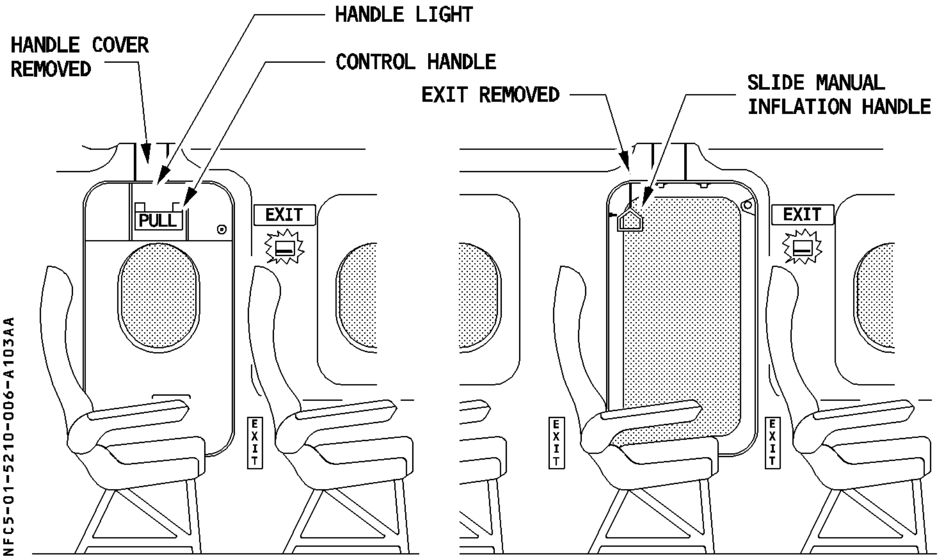
COCKPIT

The two sliding windows in the cockpit are emergency exits for the flight crew.
A small compartment above each window holds an escape rope that is long enough to reach the ground when lowered through either sliding window.
The cockpit windows can be opened from inside only.

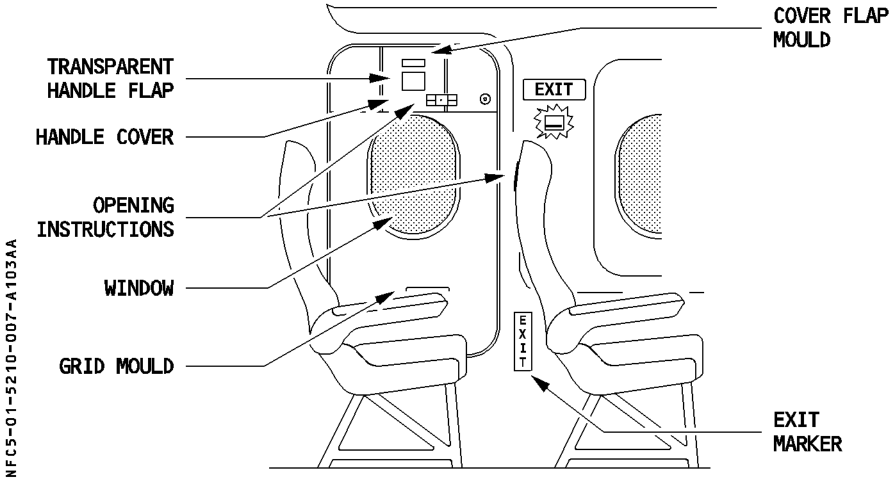


CABIN

R In case of an emergency, one inward opening emergency exit is provided on each side of the cabin, in addition to the regular cabin doors. It is also equipped with an escape slide.



The overwing emergency exit are always in armed configuration.
To open :
- Remove HANDLE COVER : The HANDLE LIGHT and SLIDE ARMED indicator illuminate.
- Pull CONTROL HANDLE : The EXIT moves inwards.
- Lift EXIT from frame by holding the GRIPMOULD.
- Throw EXIT out.



CARGO DOORS

The aircraft has two (three ◁) cargo doors on the right side of the fuselage below the cabin floor.

FWD AND AFT CARGO DOORS

The yellow hydraulic system opens these doors outward and upward. They lock open or closed mechanically.
If the yellow system's electric pump fails, crewmen can use a hand pump to pressurize the system. This hand pump is on the hydraulic maintenance panel.
The FWD and AFT cargo doors can be opened from the outside only.

Note : When the electric pump is operating the FWD or AFT cargo doors, the only other yellow system devices that can operate are braking and engine 2 reverse.

BULK CARGO DOOR ◁

The bulk cargo door opens inward and upward. It is a plug-type door that is mechanically locked and manually operated.
This door can be opened from the outside or from the inside.

AVIONICS COMPARTMENT ACCESS DOOR

Four inward opening, manually operated, hinged doors give external access to the avionics compartments. These doors are in the lower fuselage, around the nose landing gear bay.

COCKPIT DOOR

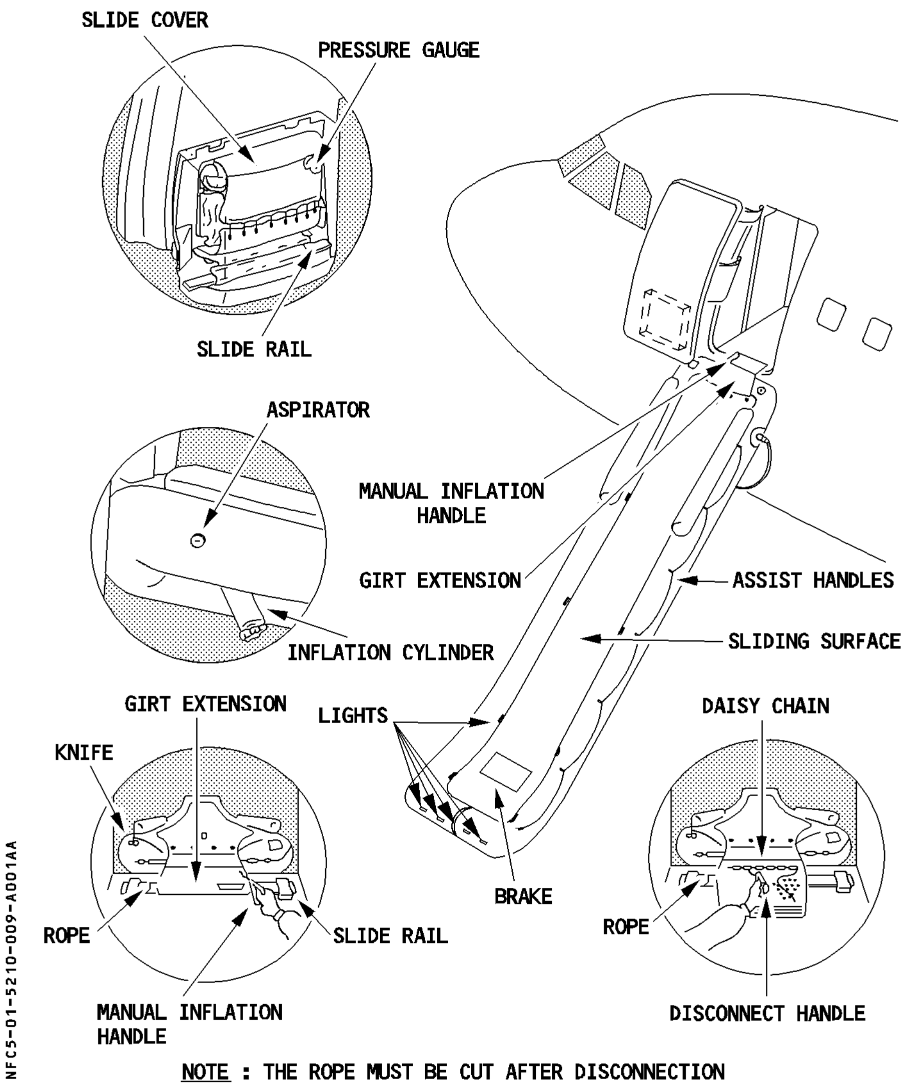
A forward-opening hinged door separates the cockpit from the passenger compartment. In an emergency it can be forced open in either direction.
The door has an electric locking latch (◁) controlled by the DOOR UNLOCK pushbutton on the pedestal. It also has an eye-level viewing lens.
R To unlock the door, the pilot must press the pushbutton, and maintain it pressed, while the
R cabin attendant pushes the cockpit door open.

STAIR DOOR ◁

The stair door is just below the forward passenger door on the left side of the aircraft. It opens to extend stairs to the ground to give passengers and crew access to the forward passenger door.
There are controls for this door near the forward passenger door in the cabin, and in the nose gear well.

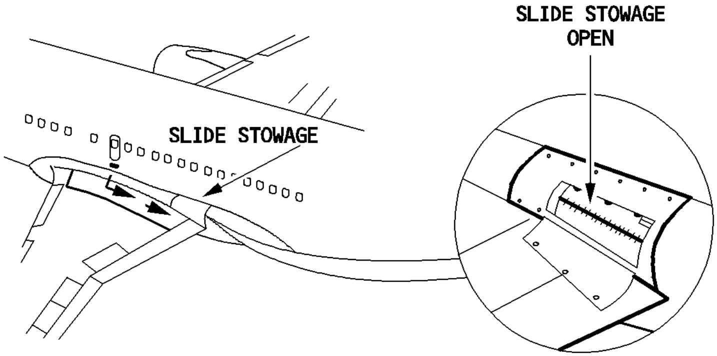
ESCAPE SLIDES/RAFT

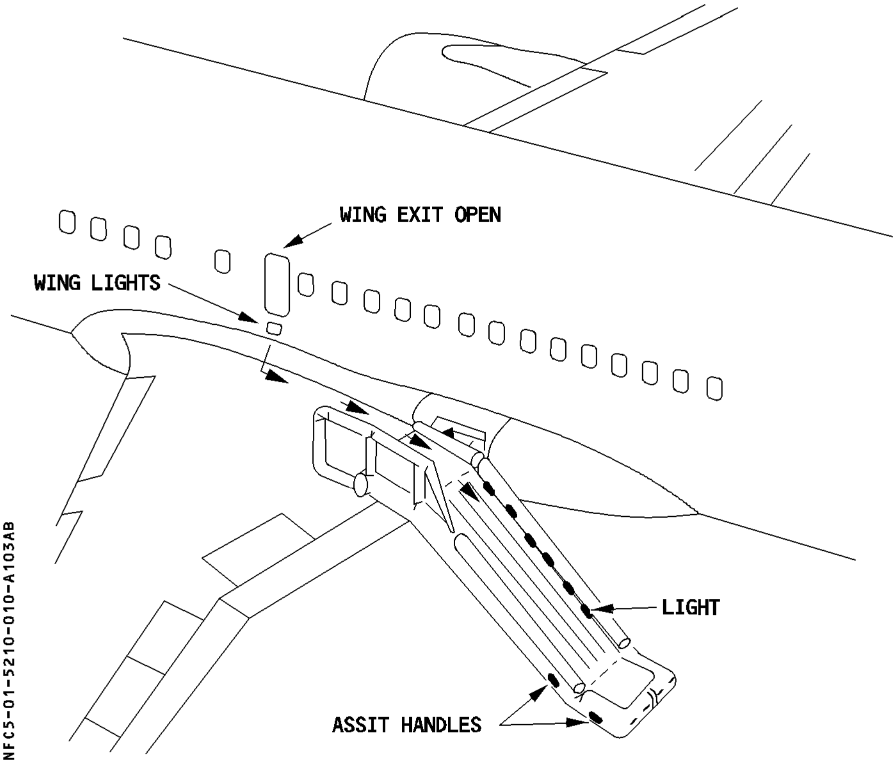
DOOR SLIDES



NOTE : THE ROPE MUST BE CUT AFTER DISCONNECTION

WING SLIDES

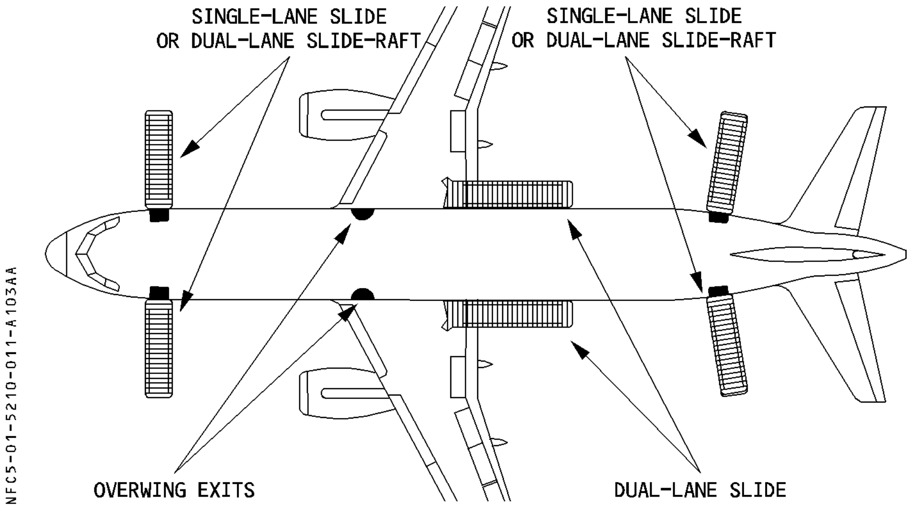

SLIDE STOWAGE OPEN
SLIDE STOWAGE


WING EXIT OPEN
WING LIGHTS
LIGHT
ASSIT HANDLES
NFC5-01-5210-010-A103AB

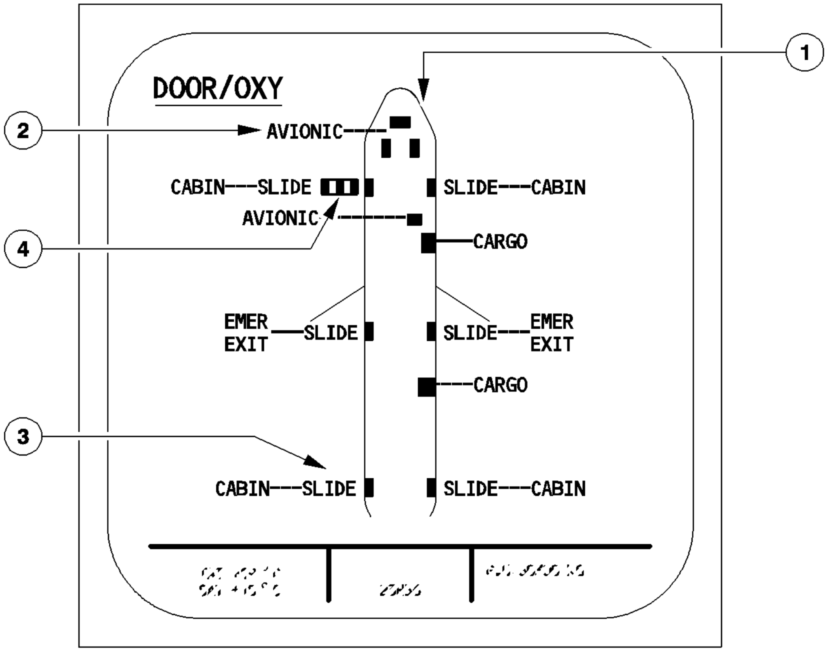
ESCAPE SLIDE ARRANGEMENT

R Each passenger door either has a single-lane escape slide, or a dual-lane slide-raft, and each emergency exit has a dual-lane escape slide.

R



ECAM DOOR PAGE



NFC5-01-5220-001-A203AA

① Door symbol

Green □ : The door is closed and locked.
Amber ■: The door is not locked.

② Door indication

This appears amber when the door is not locked.

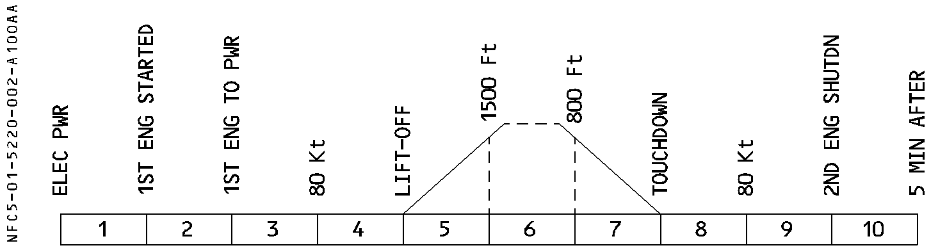
③ SLIDE indication

This appears white when the slide is armed.

④ Stair symbol (⧏)

This appears in amber when the stair door is not closed.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
L(R) FWD (AFT) AVIONICS L(R) FWD CABIN L(R) AFT CABIN L(R) EMER EXIT FWD CARGO AFT CARGO BULK CARGO STAIRS Affected door not closed (proximity detectors)	SINGLE CHIME	MASTER CAUT	DOOR	NIL	1, 4, 5 7, 8, 10

DESCRIPTION

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BUS EQUIPMENT LIST

	NORM		EMER ELEC		
	AC	DC	AC ESS	DC ESS	HOT
DOORS and SLIDES CTL		DC BAT (1)			HOT2 (1)
CARGO DOORS		DC GRND FLT			
AIR STAIRS ◁*		DC2			HOT2 (2)

(1) STBY supply (normally supplied by the EMER PWR SUPPLY UNIT)
(2) STBY supply

70.00 CONTENTS

GENERAL

R The CFM 56-5B engine is a high bypass ratio turbofan.

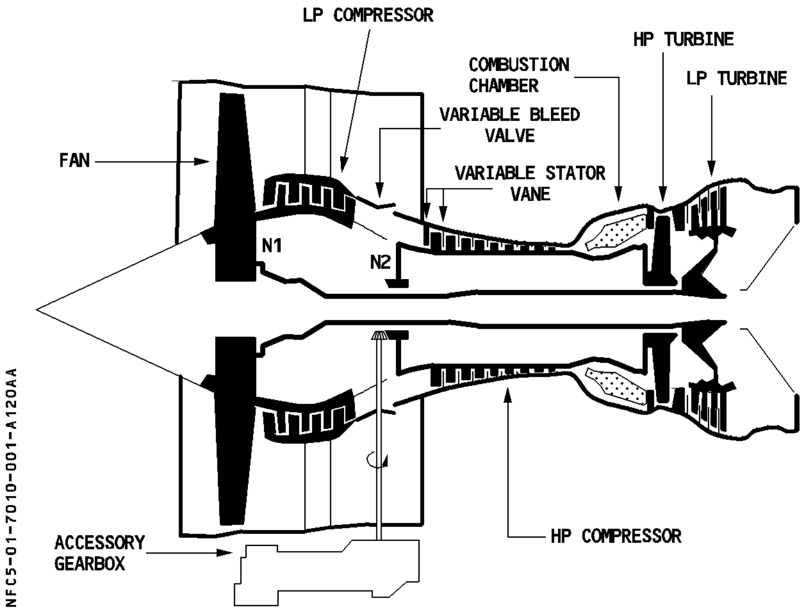
DESCRIPTION

- **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 four-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 40 fuel nozzles and 2 igniters.

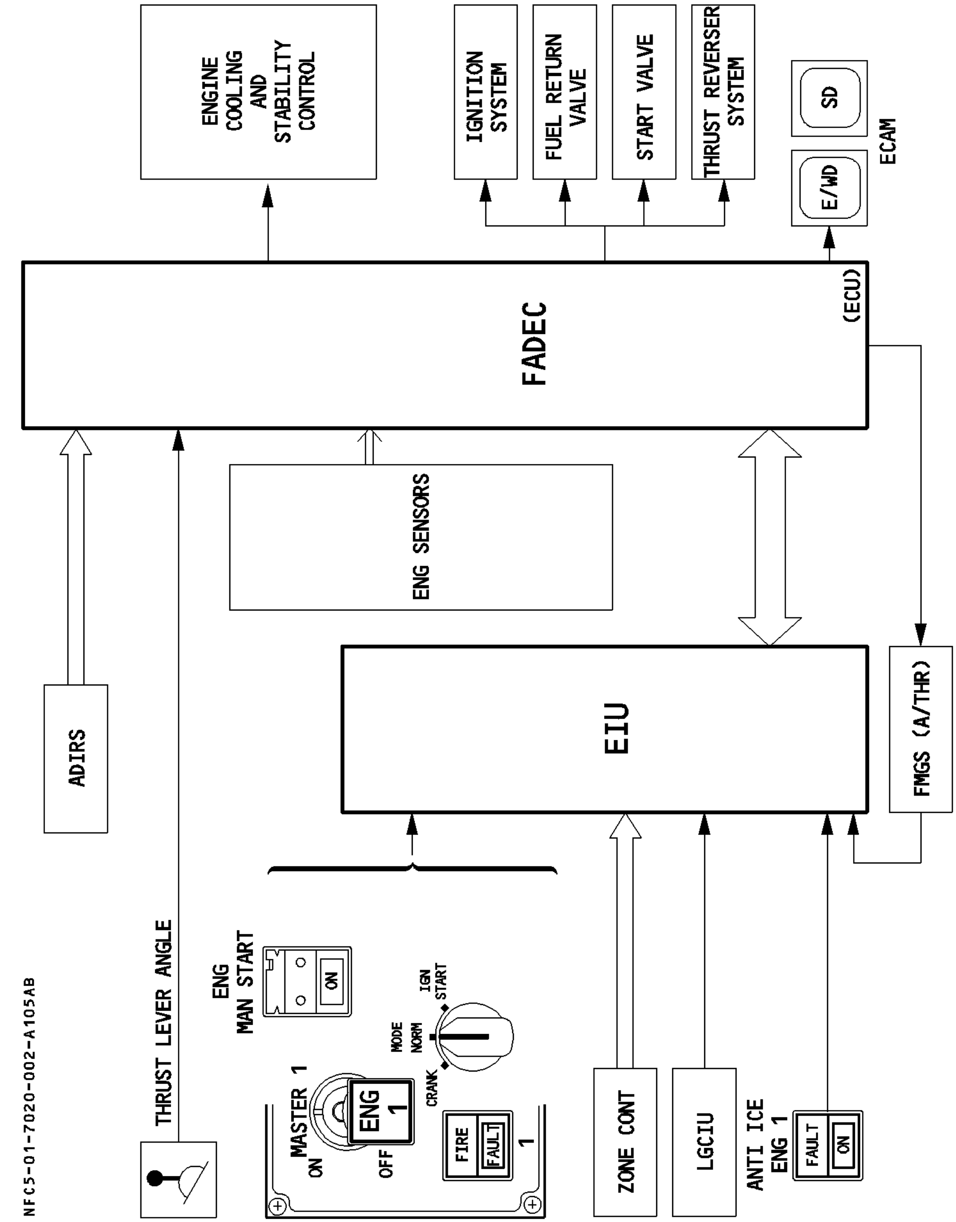
- **Accessory gearbox**
  The accessory gearbox, located at the bottom of the fan case, receives torque from horizontal HP rotor drive shaft and drives gearbox mounted accessories.



GENERAL

Each powerplant has a FADEC (Full Authority Digital Engine Control) system.
FADEC, also called the Electronic Control Unit (ECU), is a digital control system that performs complete engine management.
FADEC has two-channel redundancy, with one channel active and one in standby.
If one channel fails, the other automatically takes control.
The system has a magnetic alternator for an internal power source.
FADEC is mounted on the fan case.
The Engine Interface Unit (EIU) transmits to FADEC the data it uses for engine management.

R


ENGINE COOLING AND STABILITY CONTROL
IGNITION SYSTEM
FUEL RETURN VALVE
START VALVE
THRUST REVERSER SYSTEM
SD
E/WD
ECAM
FADEC
(ECU)
ENG SENSORS
EIU
FMGS (A/THR)
ADIRS
THRUST LEVER ANGLE
ENG MAN START
ON
MODE NORM
IGN START
CRANK
MASTER 1
ON
OFF
ENG 1
FIRE
FAULT
1
ZONE CONT
LGCIU
ANTI ICE ENG 1
FAULT
ON
NFC5-01-7020-002-A105AB

FUNCTIONS

The FADEC system performs the following functions :

Control of gas generator
· control of fuel flow
· acceleration and deceleration schedules
· variable bleed valve and variable stator vane schedules
· control of turbine clearance
· idle setting

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 (A/THR demand).

Automatic engine starting sequence
· control of :
  — the start valve (ON/OFF)
  — the HP fuel valve
  — the fuel flow
  — the ignition (ON/OFF)
· monitoring of N1, N2, FF and EGT
· initiation of abort and recycle (on the ground only)

Manual engine starting sequence
· passive monitoring of engine
· 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.

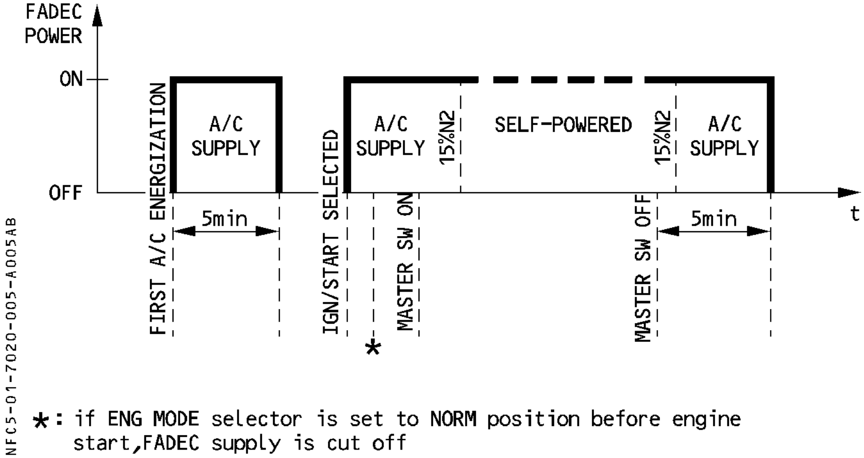
Transmission of engine parameters and engine monitoring information to cockpit indicators
· the primary engine parameters
· the starting system status
· the thrust reverser system status
· the FADEC system status

Detection, isolation, and recording of failures

FADEC cooling

POWER SUPPLY

R The FADEC system is self-powered above 15 % N2.
R

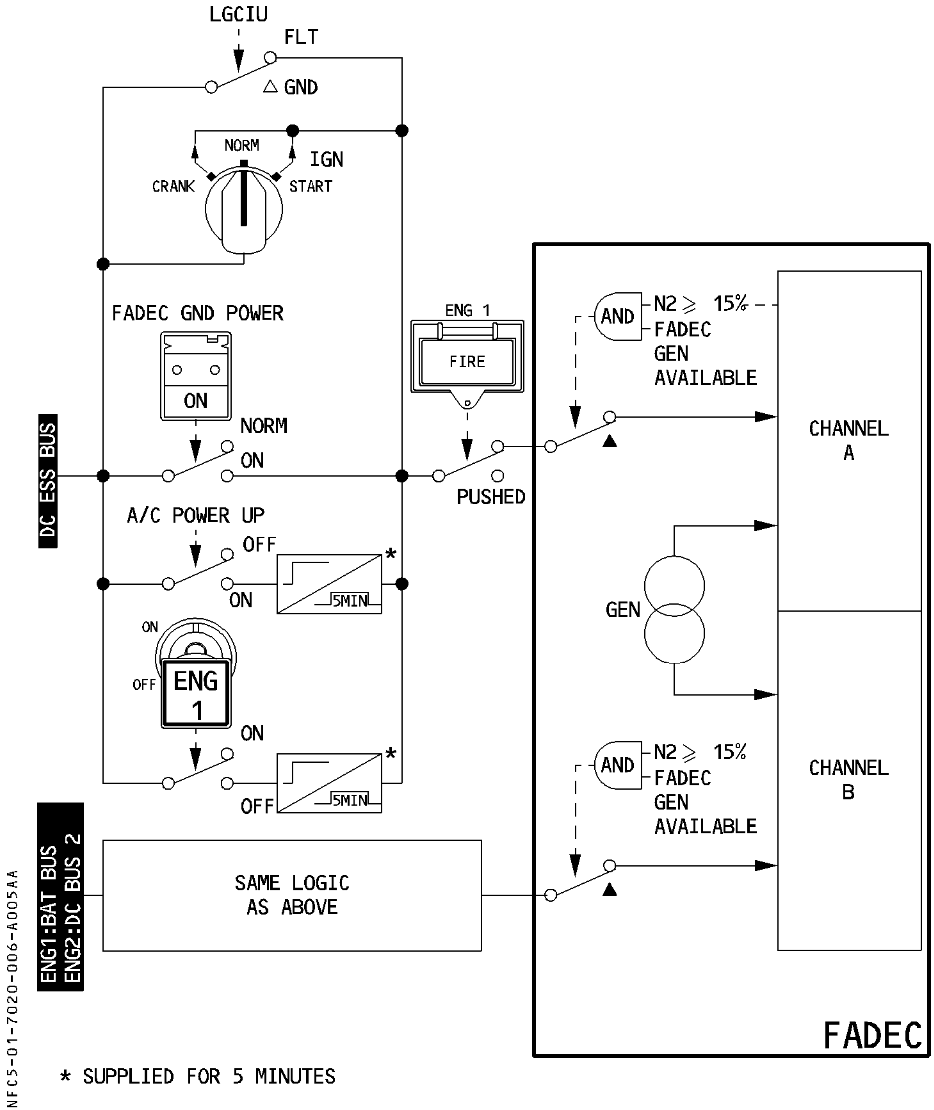


*: if ENG MODE selector is set to NORM position before engine start,FADEC supply is cut off

FADEC POWER SUPPLY

FOR INFO

R

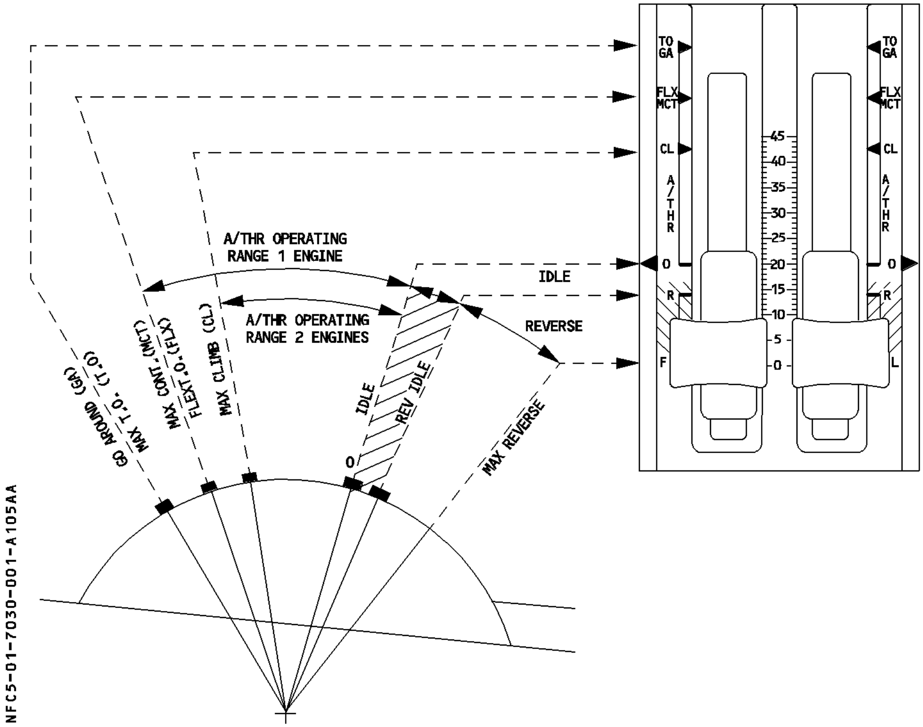


* SUPPLIED FOR 5 MINUTES

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



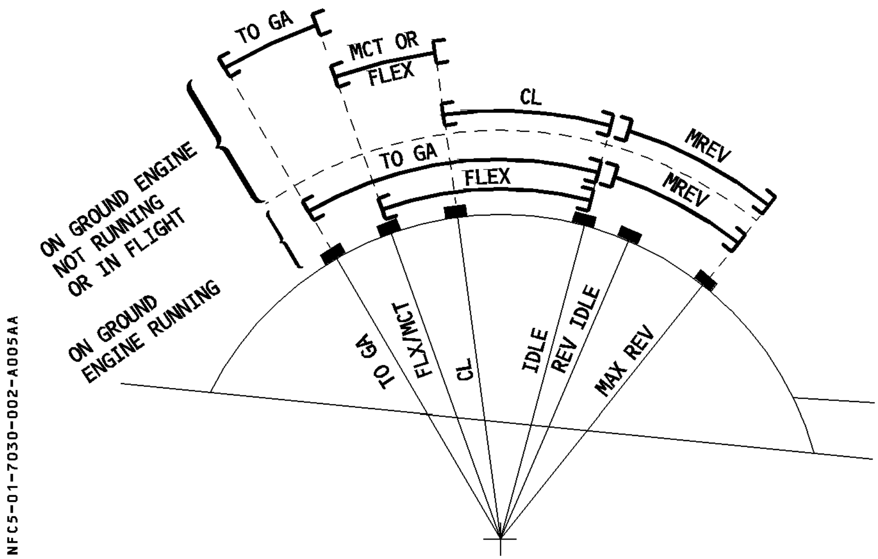
The thrust levers can only be moved manually.
They move over a sector that is divided into four operating segments.
The sector has five positions defined by detents or stops.
Thrust lever position is transmitted to the FADEC, which computes and displays the thrust rating limit and the N1 for that Thrust Lever Angle (TLA).

Note : There is no reverse idle detent. When the pilot moves the lever out of the idle stop by pulling up the reverse lever on the front of the thrust lever, he selects reverse idle.

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.

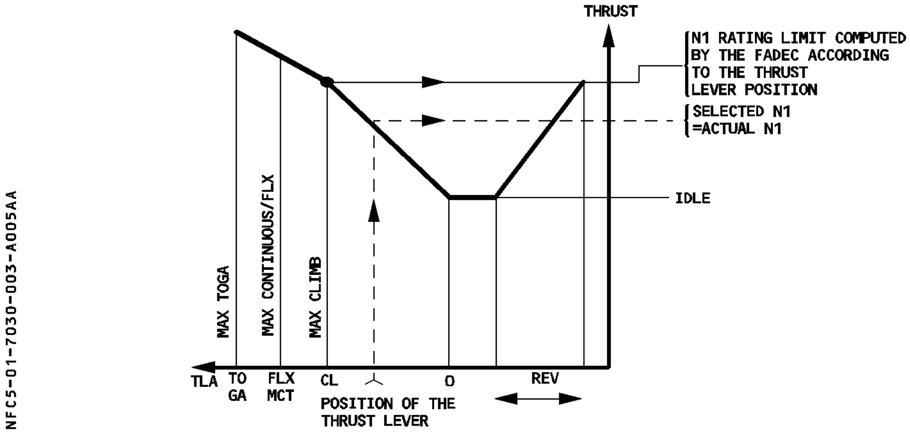
RATING LIMITS :



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 thrust by moving the thrust lever between the IDLE and TOGA 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 that 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 crew has selected a flex takeoff temperature on the MCDU that is higher than the current Total Air Temperature (TAT). Otherwise the engine produces Maximum Continuous Thrust (MCT).

Note : A change in FLEX TEMP during the takeoff has no effect on the thrust.

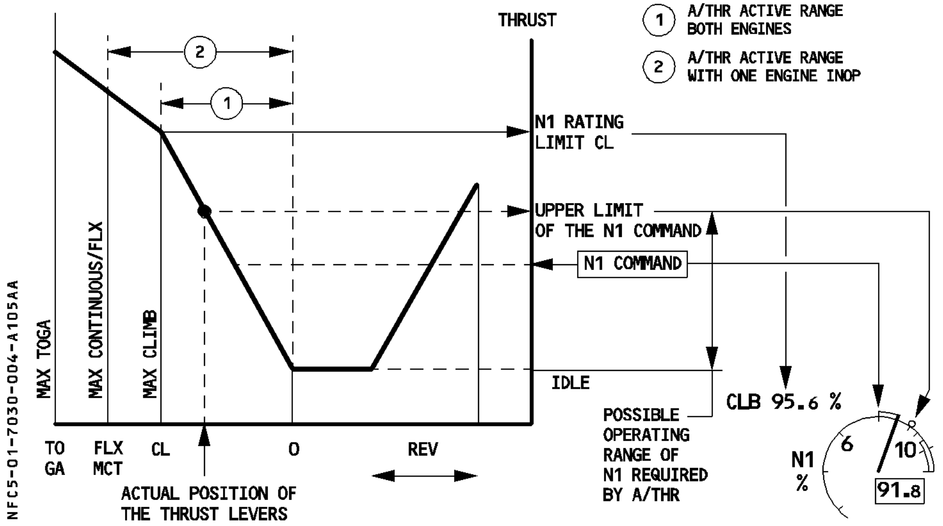
— **After takeoff**
The pilot can change from FLX to MCT by moving the thrust lever to TOGA or CL, then back to MCT. After that, he cannot use the FLX rating.

R *Note : Setting the thrust lever out of FLX/MCT detent without reaching TOGA or CL*
R *detent has no effect.*

The pilot can always get MAX TO thrust by pushing the thrust lever all the way forward.

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).



INDICATIONS ON FMA

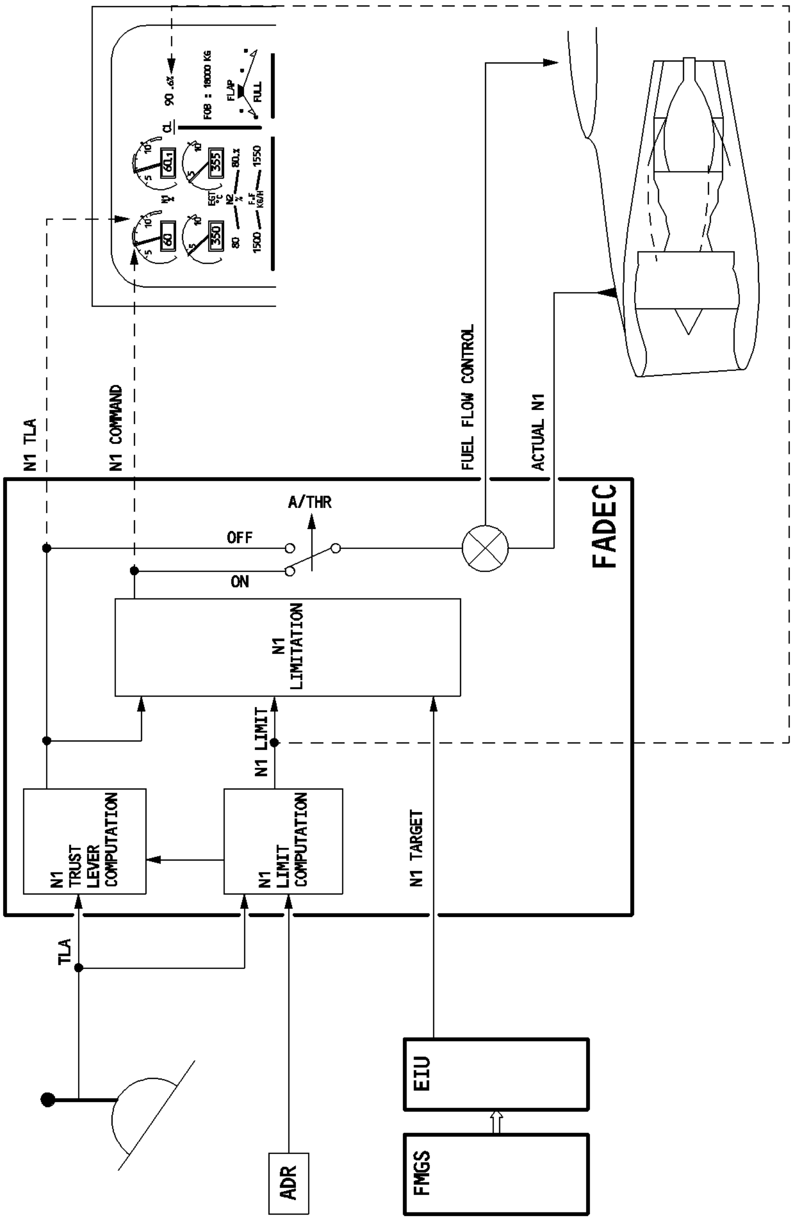
The FADECs monitor the positions of the thrust levers, and trigger appropriate indications on the FMA.

LVR ASYM : appears in amber (3rd line on the FMA) if, with A/THR active and both engines running, one thrust lever is set out of the CLB detent.

LVR CLB : flashes white (3rd line on the FMA) if the thrust levers are not in CL position while the aircraft is above the altitude of thrust reduction with both engines running.

LVR MCT : flashes white (3rd line on the FMA) if the thrust levers are not in MCT position after an engine failure (with speed above green dot).

THRUST CONTROL



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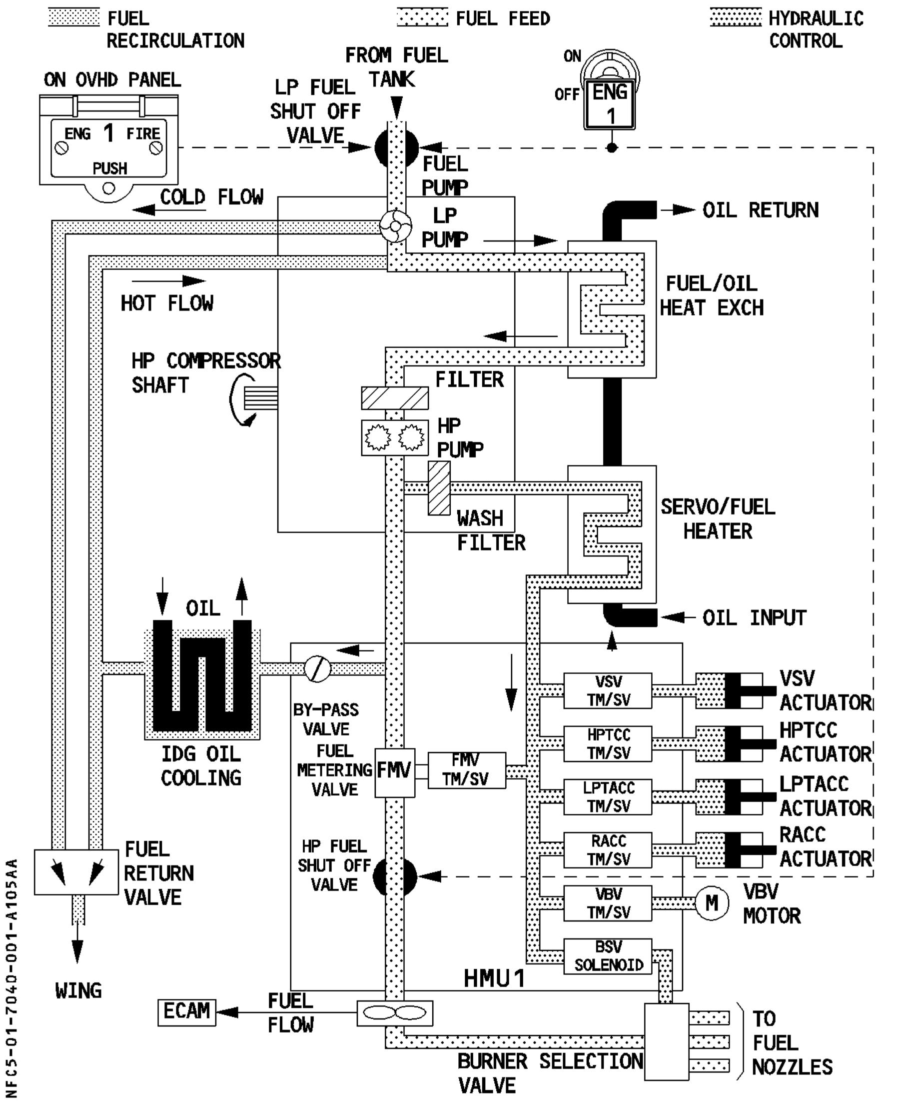
GENERAL

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 HMU, and an unfiltered flow for the metering valve of the HMU.

SHUT-OFF VALVES

Moving the ENG1 (ENG2) 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.

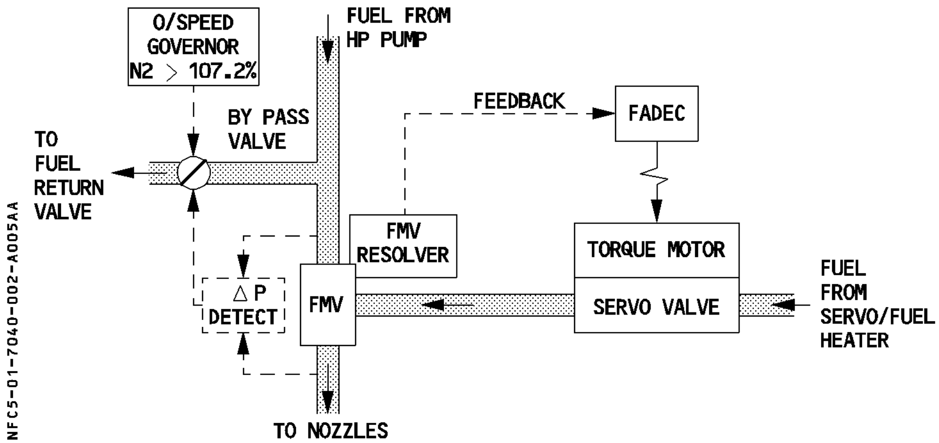
HYDROMECHANICAL UNIT

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

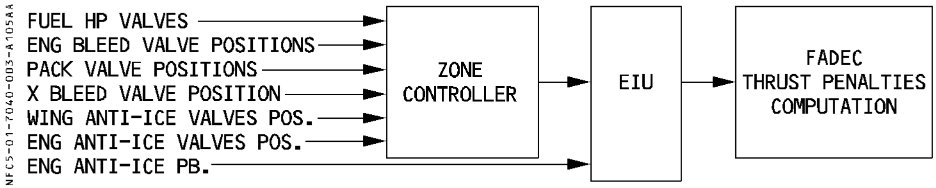
FOR INFO

The Fuel Metering Valve (FMV) transforms FADEC orders through a torque motor and servo valve 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 the 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 maximum N1 and N2 ;
- Maintain air bleed pressure requirement.

The FADEC computes an N2 correction according to the bleed configuration.



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
— Is selected :
  · In flight, when the flaps are retracted (FLAPS lever at zero position),
  · On ground, provided reverse is not selected.

Approach idle :

R — Is regulated according to aircraft altitude, regardless of bleed system demand.
— Is selected in flight, when the flaps are extended (FLAPS lever not at zero position)
— Allows the engine to accelerate rapidly from idle to go-around thrust

Reverse idle :

Is selected on ground, when the thrust lever is in REV IDLE position.
Is 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 (VSV)*
  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.
  VSVs are fully closed during engine start and are fully open at high thrust.

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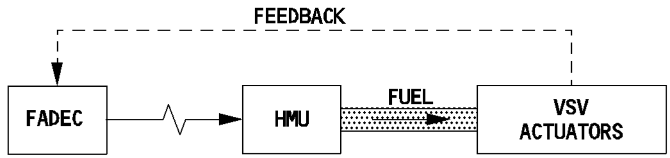
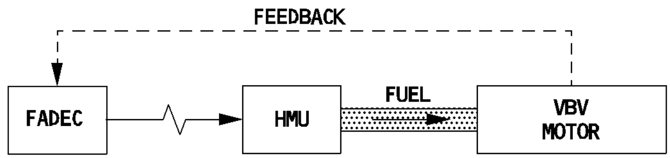


- *Variable Bleed Valves (VBV)*
  The FADEC controls the VBVs, upstream of the HP compressor. Their setting depends on compressor inlet temperature and on N2. It varies between full open (start, low thrust, and during fast deceleration) and full closed (high thrust) positions.

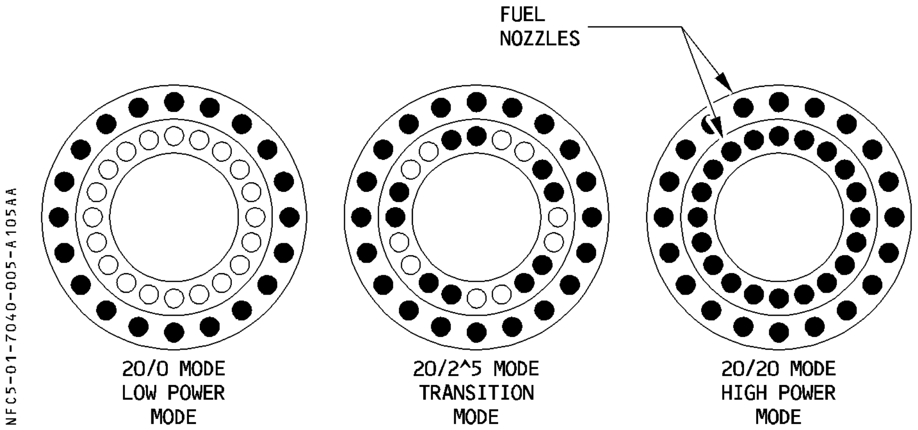
NFC5-01-7040-004-B005AA



FOR INFO

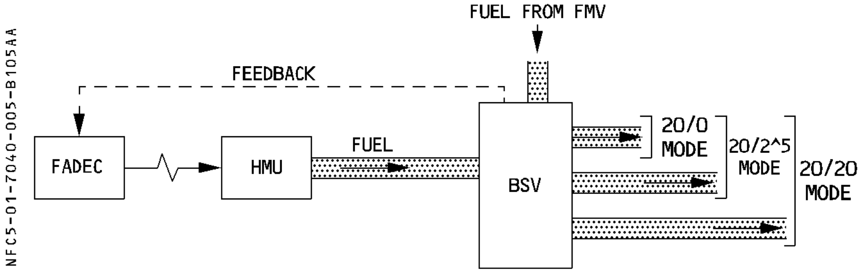
– <u>*Burner Selection Valve (BSV) :*</u>
The FADEC controls the BSV, which allows fuel to go either to 20, 30, or 40 fuel nozzles:

R



– *It supplies 20 nozzles permanently.*
R – *In the 20/2^5 mode, 5 groups of 2 fuel nozzles of the inner combustion chamber are*
R *supplied. The 20 nozzles of the outer chamber are supplied.*
R – *In the 20/20 mode, all the 40 fuel nozzles are supplied.*
– *In the event of a BSV failure, an internal safety system ensures that the 3 modes are operative.*

R



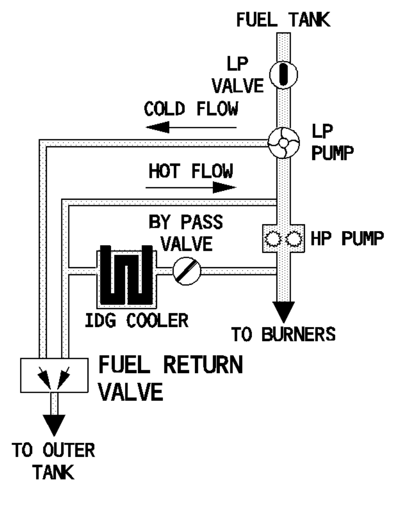
IDG COOLING SYSTEM

Some of the fuel flowing out of the HMU goes to cool the oil systems of the Integrated Drive Generators (IDGs). It then returns to the fuel pump unit or to the tank.
The Fuel Return Valve (FRV), controlled by the FADEC, ensures that this flow is adequate.

FOR INFO

At low engine thrust, if the oil going into the IDG is too hot, the cooling fuel is sent back to the tank (300 kg/h).
If oil temperature continues to rise, the ECU increases the minimum N2.
If oil temperature still keeps rising, the FADEC increases the fuel flow to the tank (from 300 to 600 kg/h, depending on fuel return temperature).
The fuel return valve is always mixing hot fuel with cold fuel so that the temperature of fuel returning to the tank stays below 100°C (from 200 to 400 kg/h, depending on fuel return temperature).
Fuel recirculation to the tank is inhibited (FVR closed) in the following cases :
- *at engine shutdown*
- *during takeoff and climb*
- *if :*
  - *wing tank level is below about 300 kg (660 lb).*
  - *there is fuel overflow in the surge tank*
  - *fuel feed is by gravity only.*
- *when fuel temperature in the wing tank in flight is above 52.5°C*

Note : On the ground high fuel temperature in the wing tanks does not cause the FRV to close.



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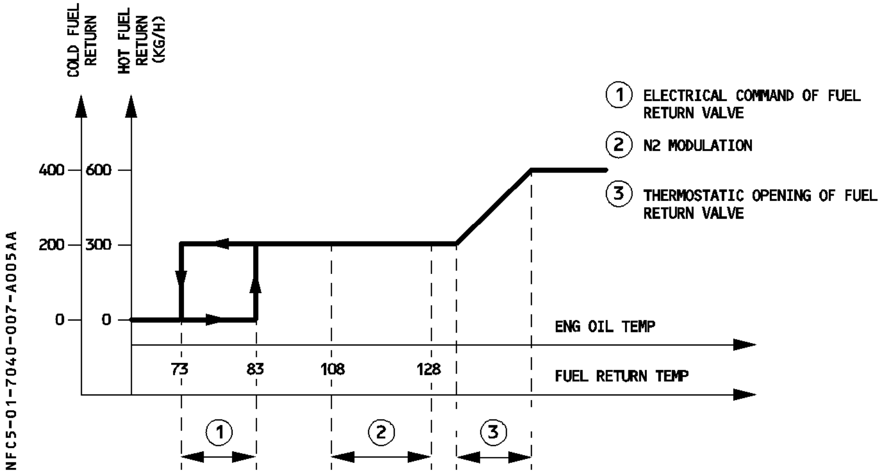
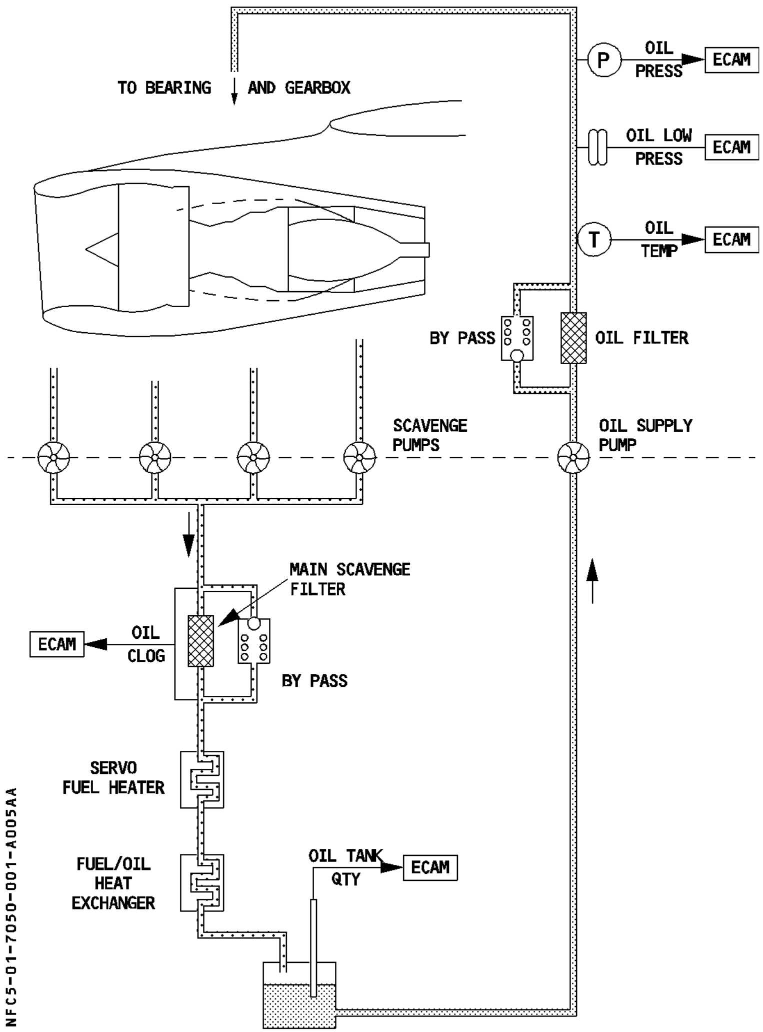

COLD FUEL RETURN
HOT FUEL RETURN (KG/H)
400
200
0
600
300
0
73
83
108
128
ENG OIL TEMP
FUEL RETURN TEMP
1
2
3
1 ELECTRICAL COMMAND OF FUEL RETURN VALVE
2 N2 MODULATION
3 THERMOSTATIC OPENING OF FUEL RETURN VALVE
NFC5-01-7040-007-A005AA

GENERAL

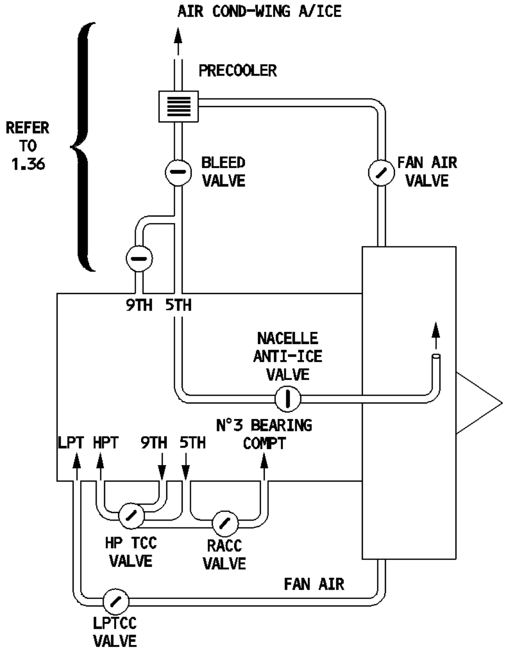
The oil system lubricates the engine components.
It contains :
- the oil tank
- the lube and scavenge pump modules
- the fuel/oil heat exchanger
- the filters, chip detectors, pressure relief and bypass valves.

FOR INFO



GENERAL

The air bleed system supplies the aircraft with compressed air.
It uses the air for :
– pneumatic system (refer to 1.36)
– cooling the engine compartment and the turbines.



NFC5-01-7060-001-A005AA

COOLING

ROTOR ACTIVE CLEARANCE CONTROL (RACC) SYSTEM

The FADEC controls the RACC system through the HMU. The RACC system controls the clearance between the rotor blades of the HP compressor and its stator case.
The RACC system uses fifth-stage compressor bleed air that has been modulated according to the N2 and the flight parameters. The bleed air goes to the N°3 bearing compartment, where it is mixed with fan boost discharge.
Clearances are at the maximum when the RACC valve is closed.

HP TURBINE CLEARANCE CONTROL (HPTCC) SYSTEM

The FADEC controls the HPTCC system through the HMU. The HPTCC system controls the HP turbine clearance by modulating the HP compressor bleed air flow for cooling the HP turbine case.
It optimizes HP turbine performance and reduces exhaust gas temperature.

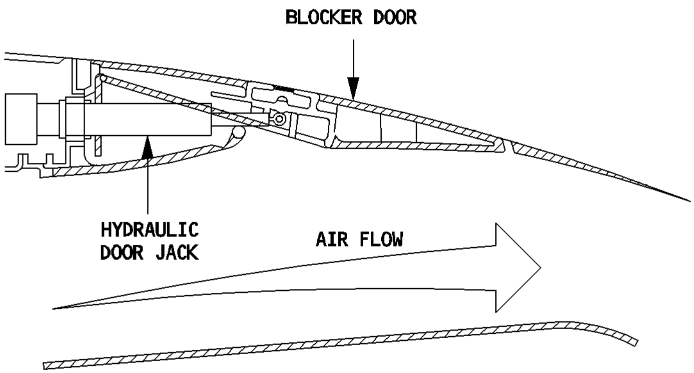
LP TURBINE CLEARANCE CONTROL (LPTCC) SYSTEM

The FADEC controls the LPTCC system through the HMU. The LPTCC system controls LP turbine clearance by modulating the fan bleed air flow for cooling the LP turbine case.

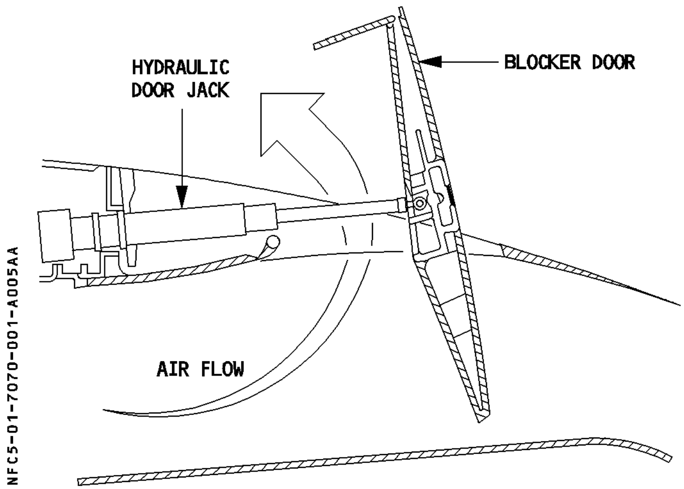
GENERAL

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)



A hydraulic door jack positions each door.
– The green circuit powers the doors on ENG 1.
– The yellow circuit powers the doors en ENG 2.

The associated FADEC controls the thrust reverser system. Each FADEC channel performs control and monitoring functions. The systems for the two engines are independent of each other.

The thrust reverser system on each engine has :

- 4 actuators,
- 4 latches,
- Door position switches,
- A Hydraulic Control Unit (HCU) that :
  - Pressurizes the thrust reverser hydraulic system,
  - Regulates the speed of the blocker doors, and
  - Supplies actuators with hydraulic power.
- A hydraulic shutoff valve which allows hydraulic pressure to the HCU.

Each pivoting door moves independently (the doors are not synchronized). The total actuation time is less than two seconds.

ACTUATION LOGIC

Deployment requires :

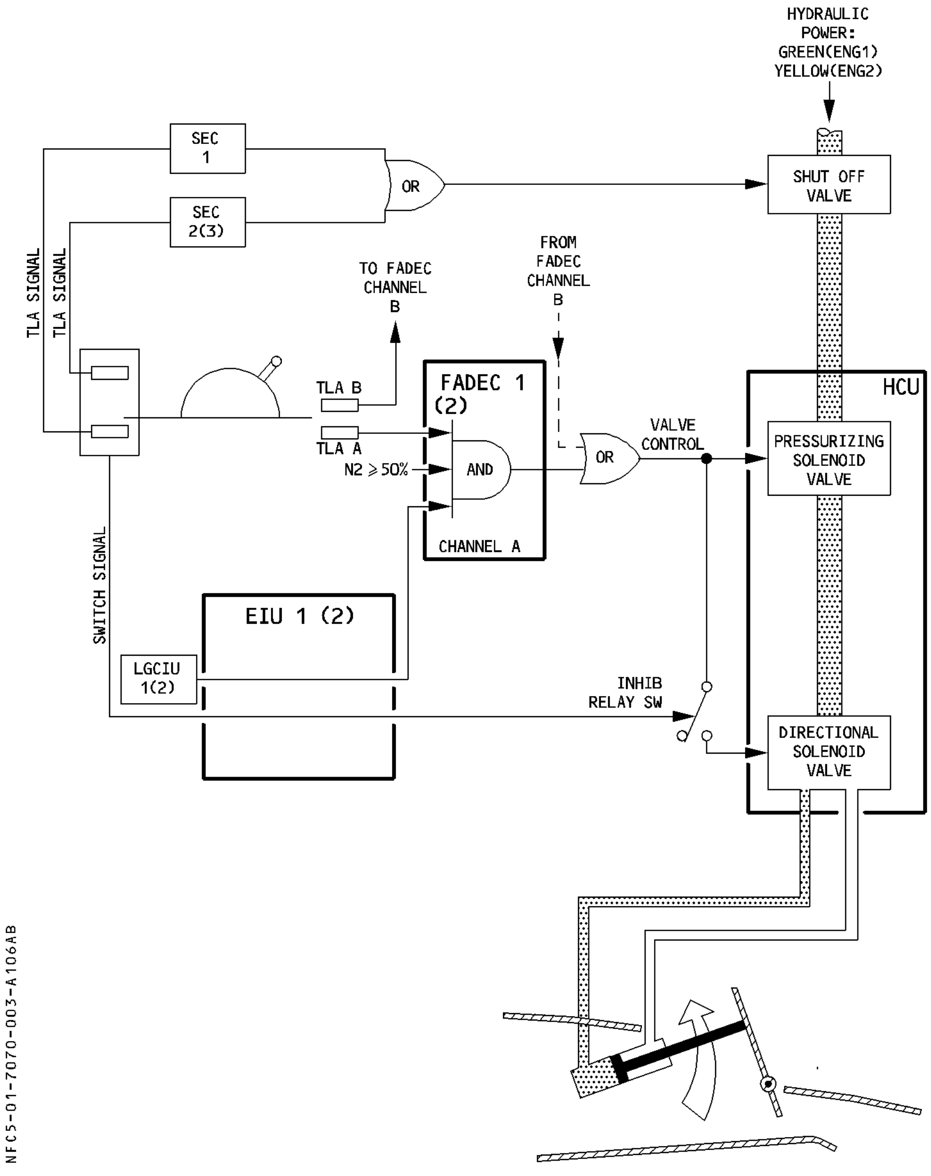
- One FADEC channel, operating with its associated throttle reverse signal ;
- Right and left main gear compressed signal from the corresponding LGCIUs ;
- A Thrust Lever Angle (TLA) reverse signals from at least one Spoiler Elevator Computer (SEC).

Before deployment is completed, the FADEC sets reverse idle thrust on the engine that is having its thrust reversed.

PROTECTION

- AUTO RESTOW FUNCTION
  The FADEC will automatically command the reverse to stow, if at least one door is unstowed and reverse thrust is not selected while the engine is running.
R Auto restow is totally inhibited in flight, and on ground, with N1 greater than 70 %.
- IDLE PROTECTION
  The FADEC will automatically select idle thrust if the reverse thrust is not selected and:
  - The four doors are detected unstowed, or
  - At least one door is detected unstowed, and hydraulic pressure is detected in the HCU (downstream of the pressurizing valve), or
  - The door position is indefinite, and hydraulic pressure is detected in the HCU (downstream of the pressurizing valve).

SCHEMATIC

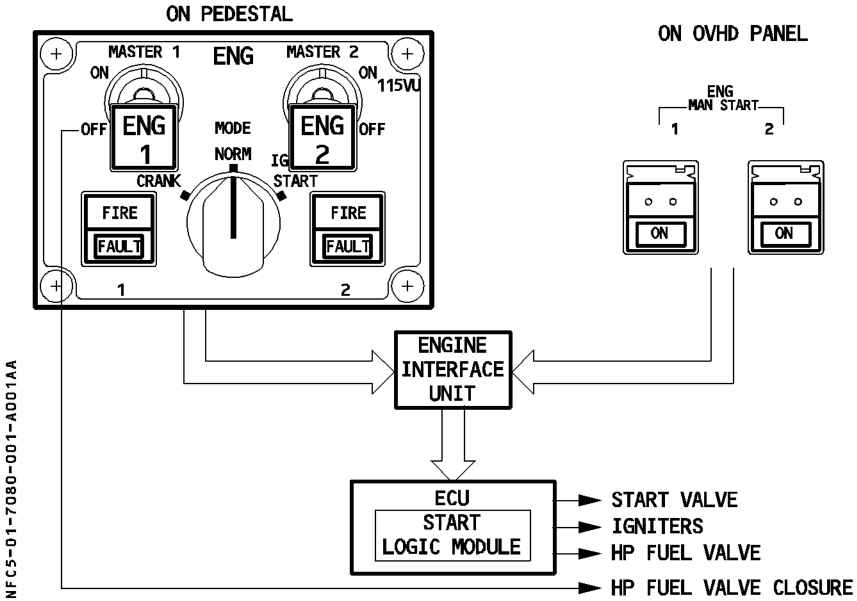

HYDRAULIC
POWER:
GREEN(ENG1)
YELLOW(ENG2)
SEC
1
SEC
2(3)
OR
SHUT OFF
VALVE
TLA SIGNAL
TLA SIGNAL
TO FADEC
CHANNEL
B
FROM
FADEC
CHANNEL
B
FADEC 1
(2)
TLA B
TLA A
N2 ⩾ 50%
AND
CHANNEL A
OR
VALVE
CONTROL
HCU
PRESSURIZING
SOLENOID
VALVE
SWITCH SIGNAL
EIU 1 (2)
LGCIU
1(2)
INHIB
RELAY SW
DIRECTIONAL
SOLENOID
VALVE
NFC5-01-7070-003-A106AB

GENERAL

The FADEC controls the ignition and starting system according to :
- the position of the engine start selector
- the position of the ENG MASTER switch
- the position of the ENG MAN START pushbutton switch
- the position of the ENG 1(2) ANTI ICE pushbutton switch
- the aircraft status (flight or ground).

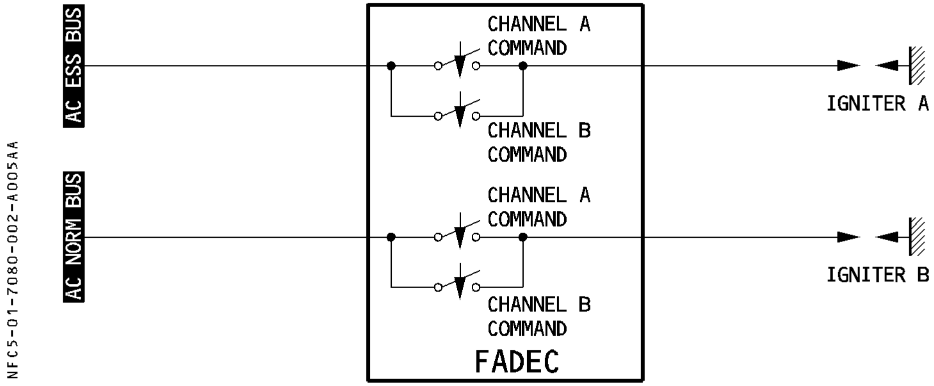
The FADEC receives its inputs from the Engine Interface Unit (EIU).

ARCHITECTURE



IGNITION SYSTEM

The ignition system is for engine starting on the ground and restarting in flight. It consists of two identical independent circuits for each engine, normally controlled by the FADEC channel A and channel B. Each FADEC channel can control both igniters.



Note : Supply for igniter A switches to the STAT INV BUS BAR as soon as the static inverter is operative.

IGNITION FOR STARTING

ON THE GROUND

- Automatic start
  · Only one igniter fires.
  · The FADEC automatically alternates the igniters used on successive starts following the sequence below :
  * channel A, igniter A
R * channel B, igniter A
R * channel A, igniter B
  * channel B, igniter B
  · The ignition comes on automatically when N2 reaches 16 % and cuts off automatically when N2 reaches 50 %.
- Manual start
  · Both igniters start firing when the MASTER switch is switched ON.
  · Both stop firing when N2 reaches 50 %.

IN FLIGHT

- Both igniters start firing when the MASTER switch is switched ON.

CONTINUOUS IGNITION

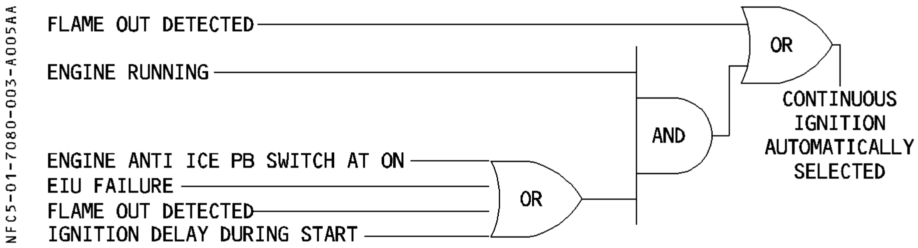
Continuous ignition is either selected manually or automatically to maintain engine combustion.

MANUAL SELECTION

In flight, continuous ignition is on when the ENG START selector is on IGN/START, if the corresponding engine is running.
Only one igniter is selected. If failed, both igniters are automatically selected.
On the ground after the engine is started, because ignition cuts off automatically, the flight crew must switch the ENG MODE selector to NORM then back to IGN/START to turn on continuous ignition.

AUTOMATIC SELECTION

R



ENGINE STARTING SYSTEM

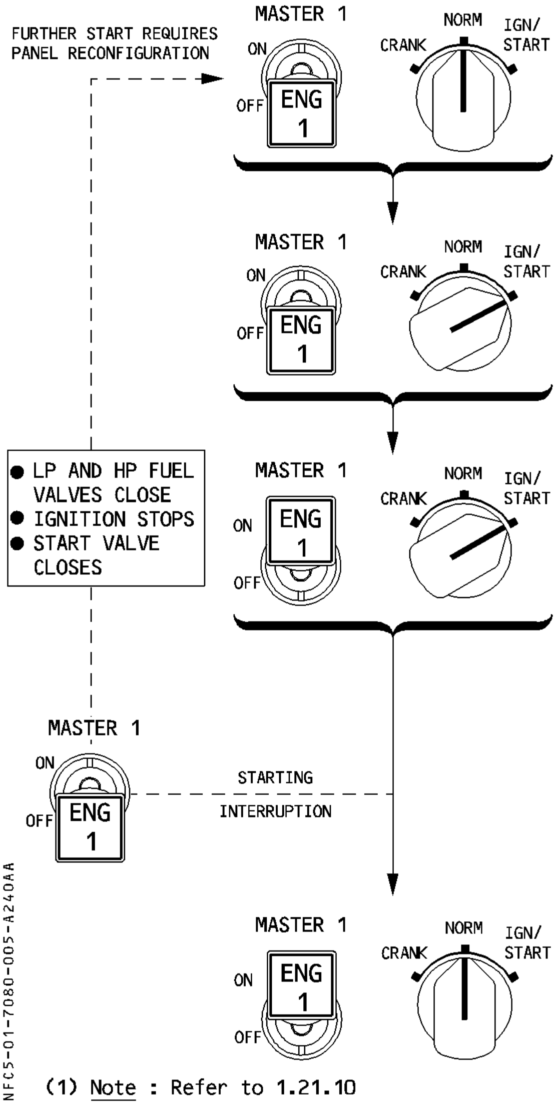
GENERAL

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. If electrical control fails when the aircraft is on the ground, a handle allows the start valve to be operated manually.

AUTOMATIC STARTING

This sequence is under the full authority of the FADEC, which controls :
— the start valve
— the igniters
— the fuel HP valves
The FADEC :
— detects a hot start, a hung start, a stall, or no light up
— announces FAULT and identifies the fault in an ECAM message
— runs an abort sequence if a start aborts on the ground
  · closes the HP valve
  · closes the start valve
  · turns off ignition
  · cranks the engine crank after the start abort in order to clear out fuel vapors
  · controls any additional start attemps.
For an inflight start, the FADEC decides whether the engine is windmilling fast enough or needs assistance from the starter in view of current engine parameters and flight environment parameters.
Flight crew may interrupt this start sequence by moving the MASTER switch to OFF.

AUTOMATIC STARTING SEQUENCE



INITIAL CONFIGURATION OF CONTROLS (engine not running).

ENG MAN START
pb sw OFF

- START IDENTIFICATION : ECAM displays ENG page
- PACK VALVE close (1)

- LP fuel valve opens
- START VALVE opens
- ignition starts:
  . on ground : when N2 > 16 %
  . in flight : immediately
- HP fuel valve opens :
  . on ground : when N2 > 22 %
  . in flight : when N2 > 15 %
- When N2 > 50 %
  . START VALVE closes
  . IGNITER off if on ground
  . PACK VALVE reopen with 30 seconds delay (remain closed if the other engine is started).

- ECAM ENG page disappears.
- After engine start, moving the MODE SEL switch to NORM and back to IGN/START activates continuous relight on the running engine (s).

(1) Note : Refer to 1.21.10

MANUAL STARTING

The FADEC has limited authority over manual starting controlling :
- the opening of the start valve when the ENG MODE selector is set to IGN/START and the MAN START pushbutton switch is pressed.
- the position of the HP fuel valve and the operation of both igniters, when the master switch is turned ON
- the closing of the start valve at 50 % N2, and, on the ground, the cutting off of ignition.

R The FADEC makes a passive survey of the engine during the starting sequence : the flight
R crew is made aware of an abnormal start by a proper ECAM warning and has to interrupt
R the start sequence. The FADEC has not the authority to abort the manual start :
R - in flight
R - on ground, except if the start EGT limit is exceeded before reaching 50 % N2. In this case
R only, the FADEC aborts the start.

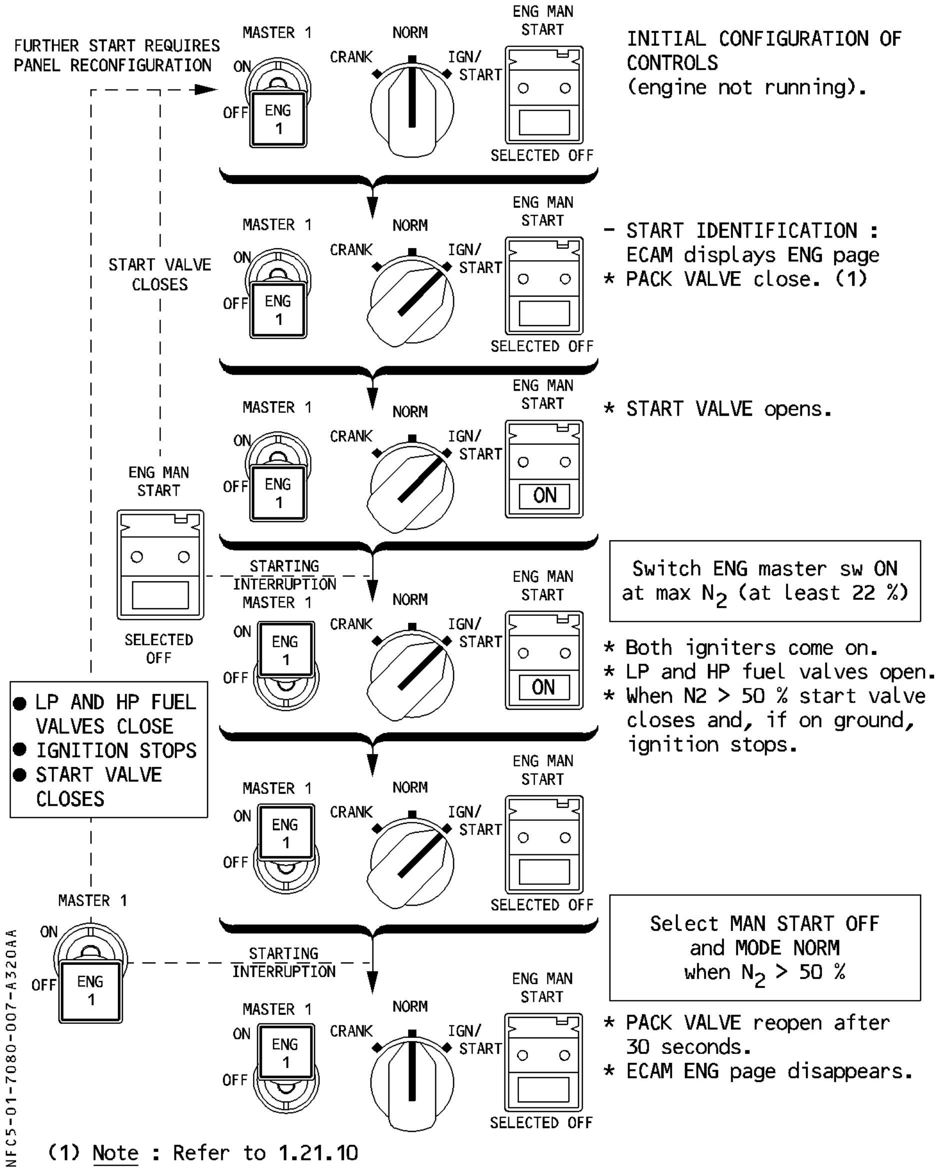
Flight crew may interrupt the starting sequence :
- before the MASTER switch is set to ON, by switching the MAN START pushbutton switch to OFF
- after the MASTER switch set to ON, by switching the MAN START pushbutton and the MASTER switch to OFF (flight crew must perform a dry cranking cycle).

In flight, the FADEC always commands a starter-assisted air start.

ENGINE VENTILATION (dry cranking)

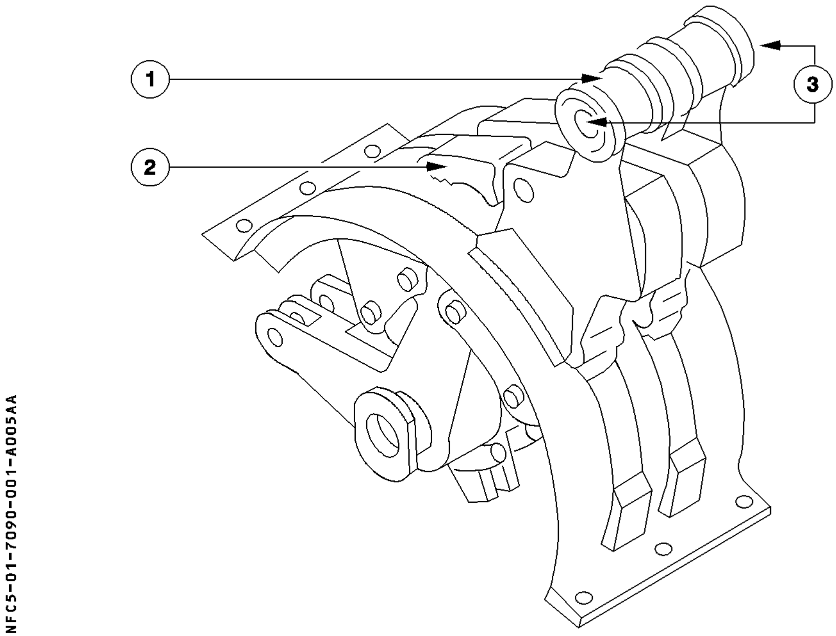
A dry cranking cycle ventilates the engine to remove fuel vapors after an unsuccessful start attempt on the ground.
The flight crew can manually select cranking by setting the ENG MODE selector to CRANK and the MAN START pushbutton switch to ON (MASTER switch OFF). Flight crew can stop the cranking by setting the MAN START pushbutton switch to OFF.

MANUAL STARTING SEQUENCE



(1) Note : Refer to 1.21.10

PEDESTAL



① Thrust levers

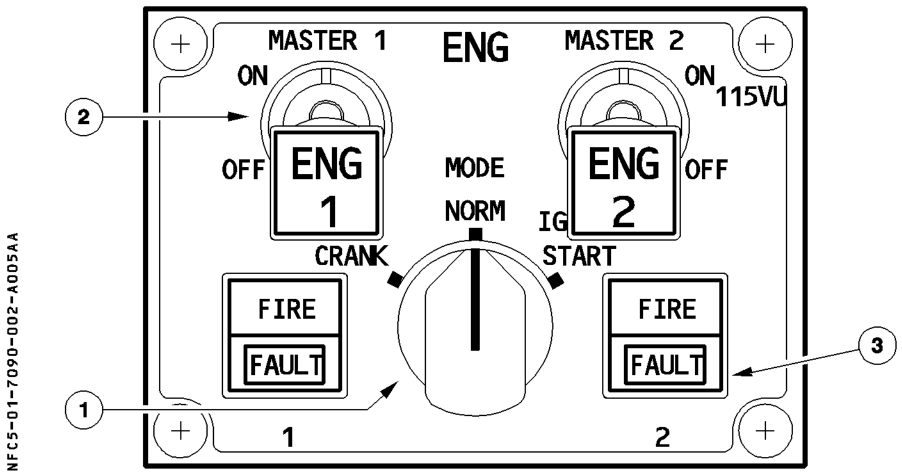
(Refer to 1.70.30).

② Reverser latching levers

These permit the pilot to override the stop at the forward idle position to select reverse thrust.
This stop resets when the pilot moves the lever back into the forward thrust area.

③ Autothrust instinctive disconnect pb

(Refer to 1.22).



(1) ENG MODE selector

CRANK : The start valve opens, if the MAN START pushbutton switch is ON. Ignition does not fire.

NORM : This turns on continuous ignition (A and B) when the engine is running and :
- The engine anti-ice pushbutton switch is ON, or
- A flame-out is detected, or
- An EIU fails.

IGN START : If the MASTER switch is ON and N2 ≥ idle, this position selects continuous ignition (A and B).
- During an automatic start :
  · On the ground, when N2 passes 16 %, ignition switches to A or B. However, if there is an ignition delay during the start sequence, ignition is continuous (A and B).
  · In flight, continuous ignition (A and B) begins when the start sequence begins.
- During a manual start, ignition commences when the MASTER switch is turned ON.

R Pack valve closes automatically during the start sequence. (See 1.21.10).

Note : On the ground, the ignition cuts off automatically at the end of the start sequence (N2 > 50 %).

② ENG MASTER sw 1 (2)

ON : LP fuel valve opens (if the ENG FIRE pushbutton is in).
- During an automatic start, the HP fuel valve opens if :
  - The ENG MODE selector is at IGN/START.
  - N2 is above the following threshold :
    - · 22 % on the ground
    - · 15 % in flight (R)
- During a manual start, the HP FUEL valve opens if :
  - The ENG MODE selector is at IGN/START.
  - The MAN START pushbutton switch is ON.

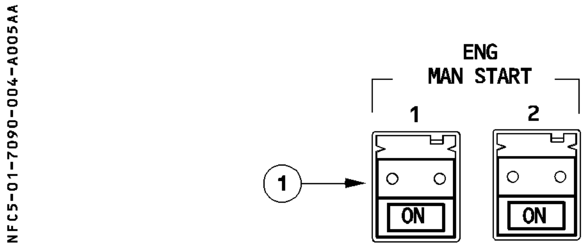
OFF : Close signals go directly to the HP fuel valve and the LP fuel valve. These signals cause both channels of the FADEC to be reset.

Note : Releasing the ENG FIRE pushbutton allows flight crew to shut down the engine by closing the LP fuel valve. There is a time delay of about 60 seconds at ground idle as the engine burns the fuel left between the LP valve and the nozzles.

③ FAULT lt 1 (2)

FAULT lt : This amber light comes on, and a caution appears on ECAM, if there is:
- an automatic start abort
- a disagreement between the HP fuel valve position and its commanded position.

OVERHEAD PANEL



(1) ENG MAN START pb sw

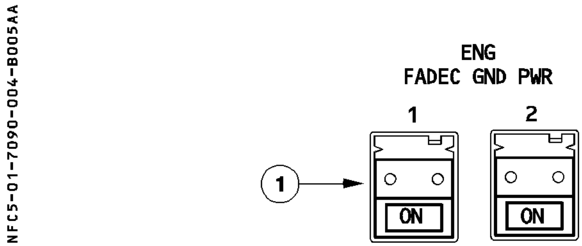
ON : The start valve opens if the ENG MODE selector is set to CRANK or IGN/START and N2 < 20 %.
Both pack valves close during the start sequence.

Note : The start valve closes automatically when N2 ≥ 50 %.

The blue ON light comes on.

Off : When the ENG MAN START pushbutton switch is set to OFF during a manual engine start, the start valve closes if the MASTER switch is OFF.

MAINTENANCE PANEL



(1) FADEC GND PWR pb sw

ON : FADEC has electrical power on the ground if the ENG FIRE pushbutton is not released.

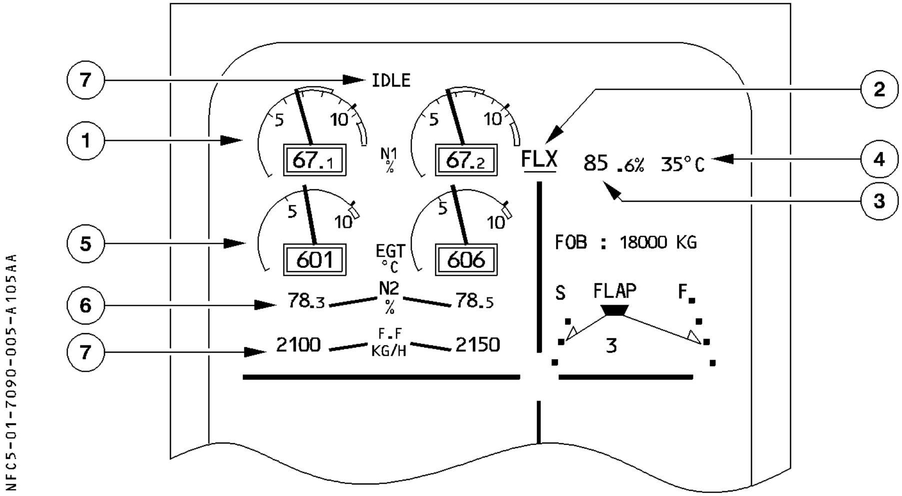
ECAM

GENERAL

The upper ECAM E/WD permanently displays the engines' primary parameters. The lower ECAM SD displays the secondary parameters, either when they are selected automatically by the system, or manually by the flight crew.

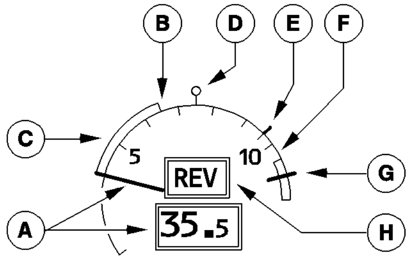
PRIMARY PARAMETER

R



① LP rotor speed (N1)

NFC5-01-7090-006-A025AA



(A) Actual N1 : the N1 needle and N1 digital indication are normally green.
The needle pulses amber when the actual N1 is above the N1 MAX (see (E)).
The needle pulses red when the actual N1 is above the red line N1 (104 %).
When N1 is degraded (in case both N1 sensors fail), the last digit of the digital display is amber dashed.

(B) N1 Command : this N1 corresponds to the demand of the autothrust system (A/THR), as limited by the position of the thrust lever. It is displayed only if A/THR is on.

(C) Transient N1 : this blue arc shows the difference between the actual N1 and the N1 commanded by the A/THR. It is displayed only if the A/THR is on.

(D) N1 TLA : this small white circle shows the N1 corresponding to the thrust lever position.

(E) Max N1 : this amber index shows the N1 the engine would produce with the thrust lever all the way forward.

(F) Max permissible N1 : this red arc, showing the prohibited or "redline" area of operation, begins at 104 %.

(G) N1 exceedance : if N1 exceeds 104 % during a flight, this red mark appears and remains at the highest N1 attained. It disappears after a new start on the ground or after maintenance action through the MCDU.

(H) REV : appears in amber when any one blocker door is unstowed or unlocked.
It changes to green when all four blocker doors are fully deployed.
(If a door unlocks in flight the indication first flashes for 9 seconds, then remains steady).

(2) Thrust limit mode

TOGA, FLX, CL, MCT, or MREV limit mode, selected by the position of whichever thrust lever is farther forward, is displayed in blue.

(3) N1 rating limit

It is computed by the FADEC for the present thrust lever angle, and is displayed in green.

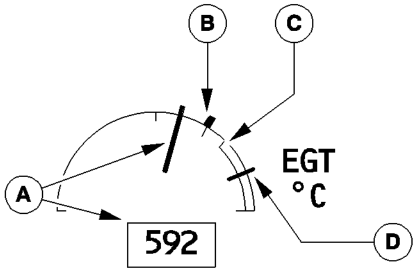
Note : *When the aircraft is on ground with the engines running, the N1 rating limit displayed here corresponds to the TOGA thrust limit, regardless of the thrust lever position.*
When the aircraft is on ground with the engines running and FLEX mode is selected, this number is the FLEX N1, regardless of the thrust lever position between idle and FLX/MCT.

R (4) FLEX temperature

R If FLX mode is selected, the flexible takeoff temperature selected through the MCDUs is
R displayed in blue.

R ⑤ EGT indicator

NFC5-01-7090-008-A148AA



Ⓐ Actual EGT
- It is normally green.
- It pulses amber above 915° C except for high power operation (FLEX TO or thrust lever above MCT or at MAX REV, or activation of alpha floor).
- It pulses amber above 725° C during start sequence.
- It pulses red above 950° C, and the numerical value becomes red.

Ⓑ Max EGT
The amber index appears at 725° C during engine start, then at 915°C.

Ⓒ Max permissible EGT
The EGT red line is at 950° C. Display shows red arc from 950° C to the end of the scale.

Ⓓ EGT exceedance
If the EGT goes over 950°C, a red mark appears at its maximum value. It disappears after a new takeoff, or after a maintenance action through the MCDU.

R ⑥ HP rotor speed N2

The numbers are normally green. (During the start sequence, they are green on a grey background).
When N2 is above 105 %, the indication turns red and a red cross appears next to it.
When the N2 value is degraded (if both N2 sensors fail), the last digit is amber and is dashed.

R (7) Fuel flow

These numbers are green.

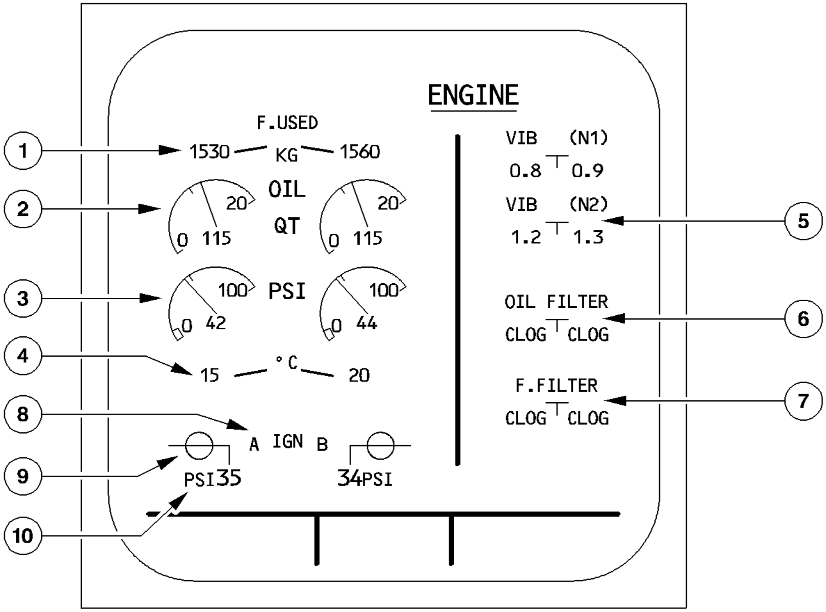
Note : If the system detects a discrepancy between the N1, N2, EGT and fuel flow values on the FADEC-DMC bus and the corresponding displayed values, an amber CHECK appears underneath the affected parameter.

R (8) IDLE indication

This legend appears in green when both engines are at idle. It flashes for 10 seconds, then remains steady.

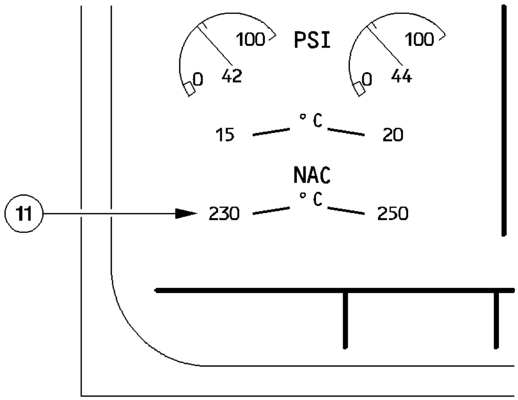
SECONDARY PARAMETERS

NORMAL CONFIGURATION



NFC5-01-7090-010-A107AA

R
R ### ONE NAC TEMPERATURE ABOVE 240° C



NFC5-01-7090-010-B107AB

(1) Fuel used

The green number is the fuel used as computed by the FADEC.
It resets when the engine starts (MASTER switch ON) on the ground.
It is frozen at its last value (until the next engine start) when the engine shuts down. (The ECAM CRUISE page also displays it).
The two last digits are dashed if the fuel-used indication is inaccurate due to the loss of fuel flow data for more than one minute.

(2) Oil quantity

The needle and the numbers are normally green.
The indication pulses when oil quantity goes below three quarts (decreasing) or above five quarts (increasing).

(3) Oil pressure

The needle and the numbers are normally green.
The digital indication pulses if :
– oil pressure exceeds 90 psi (increasing) or 85 psi (decreasing).
– oil pressure drops below 16 psi (decreasing) or 20 psi (increasing).
The indication turns red and a warning appears on ECAM if the oil pressure drops below 13 psi.

(4) Oil temperature

These numbers are normally green.
They pulse above 140°C (increasing) or 135° C (decreasing).
They turn amber and a warning appears on ECAM if the temperature exceeds :
– 140° C for more than 15 minutes, or
– 155° C without delay.

(5) VIB

The legend is green.
VIB N1 pulses above 6.
VIB N2 pulses above 4.3.
(These numbers also appear on the ECAM CRUISE page).

*Note : An MCDU procedure may reduce the advisory threshold to the level of vibration reached during the last flight.
If this function has been activated, the N1 and N2 VIB indications pulse below 6 and 4.3, respectively.*

(6) Oil filter clog

CLOG appears in amber if there is excessive pressure loss across the main oil scavenge filter.

(7) Fuel filter clog

CLOG appears in amber if there is excessive pressure loss across the fuel filter.

(8) Ignition

IGN appears in white during the start sequence.
The letters A, B or AB appear in green when the respective igniters are firing.

(9) Start valve position

⊖ Green : valve fully open.
⦶ Green : valve fully closed.

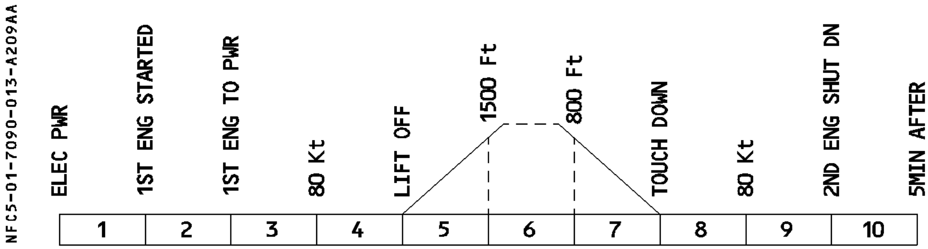
(10) Engine bleed pressure

The green numbers show the bleed pressure upstream of the precooler.
They become amber when the pressure drops below 21 psi with N2 ≥ 10 % or if there is an overpressure.

(11) Nacelle temperature

The screen displays both nacelle temperatures if at least one of them is above 240°C.
A nacelle temperature above 240° C pulses green.
During the start sequence, an ignition indication replaces these temperatures.

WARNINGS AND CAUTIONS



E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG DUAL FAILURE	CRC	MASTER WARN	ENG	Associated with GEN FAULT lts and PACK FAULT lt	NIL
ENG 1(2) OIL LO PR oil low pressure triggered at 13 psi by the oil press switch	CRC	MASTER WARN	ENG	NIL	1, 10
ENG STALL	SINGLE CHIME	MASTER CAUT	ENG	NIL	3, 4, 5, 7, 8
ENG 1(2) HP FUEL VALVE HP fuel valve failed closed	SINGLE CHIME	MASTER CAUT	ENG	Associated FAULT lt on ENG panel on pedestal (exception case of starter time exceeded)	3, 4, 5, 7, 8
ENG 1 (2) START FAULT start fault due to : . no light up or . eng stall or overtemp (above 725°C) or . starter time exceeded . thrust lever not at idle . low start air press	SINGLE CHIME	MASTER CAUT	ENG	Associated FAULT lt on ENG panel on pedestal (exception case of starter time exceeded)	3, 4, 5, 6, 7, 8
ENG 1(2) START VALVE FAULT position disagree	SINGLE CHIME	MASTER CAUT	ENG	Associated FAULT lt on ENG panel on pedestal (exception case of starter time exceeded)	3, 4, 5, 7, 8
ENG 1 (2) THR LEVER DISAGREE disagree between both resolvers of a thrust lever	SINGLE CHIME	MASTER CAUT	ENG	NIL	4, 5, 8
ENG 1(2) OIL HI TEMP oil temp between 140 and 155° C more than 15 min or oil temp above 155° C	SINGLE CHIME	MASTER CAUT	ENG	NIL	4, 5, 7, 8
ENG 1(2) FADEC FAULT both channels failed	SINGLE CHIME	MASTER CAUT	ENG	NIL	4, 5, 7, 8
ENG 1(2) LOW N1 No N1 rotation during start	SINGLE CHIME	MASTER CAUT	ENG	NIL	4, 5, 6, 7, 8, 9, 10
ENG THRUST LOCKED Thrust levers are not moved within 5 sec following an unvoluntary disconnection of the A/THR (or disconnection through the FCU pb)	SINGLE CHIME every 5 sec	MASTER CAUT every 5 sec	NIL	NIL	1, 2, 3, 4, 8, 9, 10
ENG FLEX TEMP NOT SET flex temp has not been entered on MCDU	SINGLE CHIME	MASTER CAUT	NIL	NIL	1, 4, 5, 6, 7, 8, 10
ENG 1(2) FADEC HI TEMP	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5 7, 8

R

<table>
<tr><th>E / WD: FAILURE TITLE
conditions</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNING</th><th>FLT PHASE INHIB</th></tr>
<tr><td>ENG 1(2) THR LEVER FAULT
Both resolvers on one thrust lever have failed.</td><td rowspan="14">SINGLE CHIME</td><td rowspan="14">MASTER CAUT</td><td rowspan="14">NIL</td><td rowspan="22">NIL</td><td>5</td></tr>
<tr><td>ENG 1(2) FAIL
Eng core speed below idle, with master sw ON and fire pb not pushed.</td><td rowspan="2">1, 10</td></tr>
<tr><td>ENG 1(2) SHUT DOWN
Eng master at off in phases 3 to 8, or eng fire pb pushed in phases 1, 2, 9 and 10.</td></tr>
<tr><td>ENG 1(2) REVERSE UNLOCKED
One or more reverser doors not locked in stowed position in flight, or on ground with no deploy order.</td><td>8</td></tr>
<tr><td>ENG 1(2) REV PRESSURIZED
Reverser system is pressurized, while rev doors are stowed and locked with no deploy order.</td><td>4, 5, 8</td></tr>
<tr><td>ENG 1(2) COMPRESSOR VANE
Variable bleed valve sys or variable stator vane sys fault.</td><td>4, 5, 7, 8</td></tr>
<tr><td>ENG 1(2) N1 or N2 or EGT OVER LIMIT
N1 above 104 %
N2 above 105.0 %
EGT above 950°C</td><td>4, 8</td></tr>
<tr><td>ENG 1(2) IGN A + B FAULT
Both ignition circuits are failed.</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>ENG 1(2) CTL VALVE FAULT
Burn stag valve failure or HPTC, or RAC system failure.</td><td rowspan="4">4, 5, 7, 8</td></tr>
<tr><td>ENG 1(2) FUEL CTL FAULT
Fuel metering valve position disagree.</td></tr>
<tr><td>ENG 1(2) SENSOR FAULT
PS 3 or T 25 or T3 or N1 or N2 data unavailable on both channels.</td></tr>
<tr><td>ENG 1(2) PROBES FAULT
T 12 or PO PT 2 data unavailable on both channels.</td></tr>
<tr><td>ENG 1(2) N1 (N2, EGT, FF) DISCREPANCY
Discrepancy between real and displayed values.</td><td>3, 4, 5, 8</td></tr>
<tr><td>ENG 1(2) BLEED STATUS FAULT
Bleed, X Bleed, pack, anti-ice valve position status not received by FADEC active channel.</td><td>3, 4, 5, 7, 8</td></tr>
<tr><td>ENG 1(2) FUEL FILTER CLOG</td><td rowspan="8">NIL</td><td rowspan="8">NIL</td><td rowspan="2">ENG</td><td rowspan="2">4, 5, 7, 8</td></tr>
<tr><td>ENG 1(2) OIL FILTER CLOG</td></tr>
<tr><td>ENG VIB SYS FAULT
Failure of vibration detection system.</td><td rowspan="6">NIL</td><td>3, 4, 5, 6, 7, 8, 9</td></tr>
<tr><td>ENG 1(2) OVSPD PROT FAULT
Loss of overspeed protection.</td><td>4, 5, 7, 8</td></tr>
<tr><td>ENG 1(2) IGN A(B) FAULT
Ignition circuit A or B failed.</td><td rowspan="4">3, 4, 5, 7, 8</td></tr>
<tr><td>ENG 1(2) FADEC ALTERNATOR
Loss of electrical auto supply of either FADEC channel.</td></tr>
<tr><td>ENG COMPRESSOR VANE
Engine 1 and 2 VBV or VSV fault.</td></tr>
<tr><td>ENG 1(2) FUEL RETURN VALVE
Fuel return valve is failed in the not open, or not closed position.</td></tr>
</table>

E / WD: FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
ENG 1(2) FADEC A(B) FAULT one FADEC channel failed					4, 5, 7, 8
ENG 1(2) EIU FAULT Data bus between EIU and ECU failed.	NIL	NIL	NIL	NIL	1, 3, 4, 5, 7, 8, 10
ENG 1(2) REVERSER FAULT loss of thrust reverser on one engine due to system components or input faults	NIL	NIL	NIL	NIL	3, 4, 5
ENG 1(2) REV ISOL FAULT	SC	CAUT	NIL	NIL	3 to 7
ENG 1(2) REV SWITCH FAULT failure of reverser permission switch	NIL	NIL	NIL	NIL	3, 4, 5, 6, 7, 8
ENG 1(2) FUEL RETURN VALVE Failure of the fuel return valve in open or closed position	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8
ENG 1(2) ONE TLA FAULT	NIL	NIL	NIL	NIL	3, 4, 5, 6, 7, 8

MEMO DISPLAY

IGNITION appears in green when the continuous ignition is activated on either engine.

BUS EQUIPMENT LIST

R

			NORM		EMER ELEC		
			AC	**DC**	**AC ESS**	**DC ESS**	**HOT**
FADEC	CHANNEL A	ENG 1 and 2				X	
FADEC	CHANNEL B	ENG 1		BAT			
FADEC	CHANNEL B	ENG 2		DC2			
EIU		ENG 1		BAT		X	
EIU		ENG 2				X	
HP VALVES						X	
LP VALVES				DC2		X	
OIL PRESS/QTY		ENG 1		DC1			
OIL PRESS/QTY		ENG 2		DC2			
IGNITION	A	ENG 1 and 2	AC ESS		AC ESS or AC STAT INV during RAT extension		
IGNITION	B	ENG 1	AC1				
IGNITION	B	ENG 2	AC2				
EVMU		ENG 1 and 2	AC1				