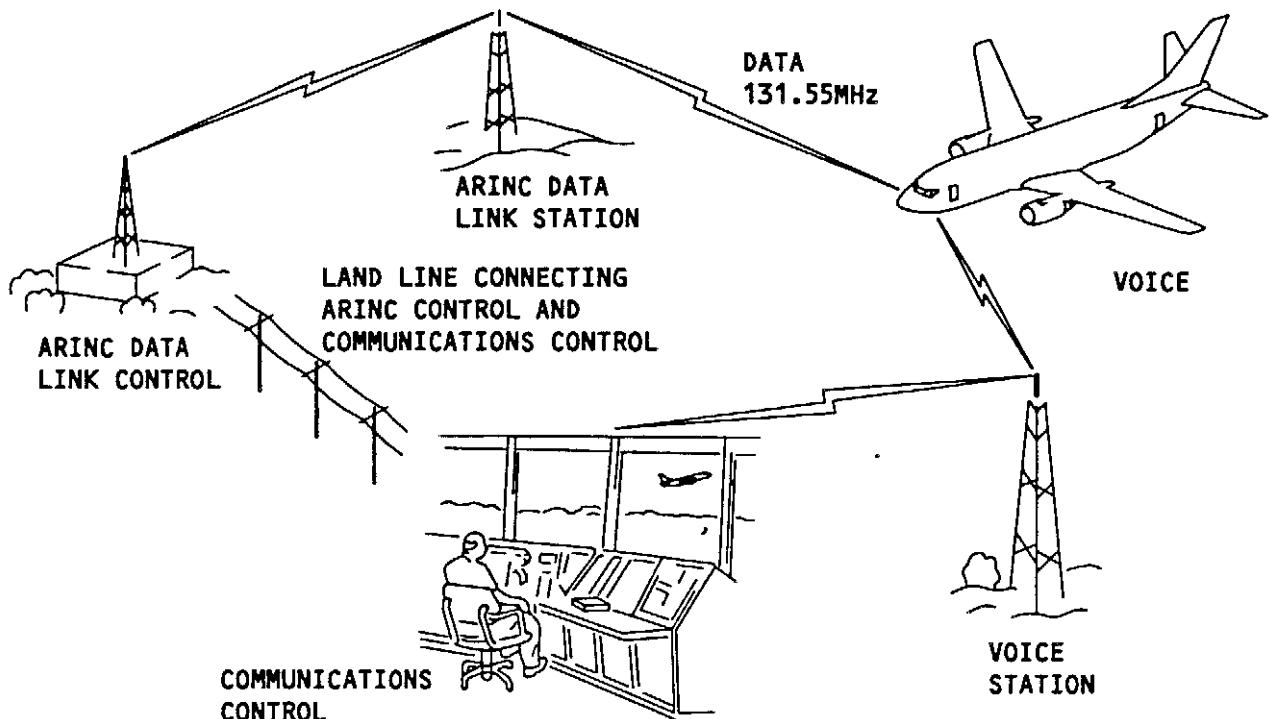


ACARS SYSTEM (As installed)

The ARINC Communication Addressing and Reporting System (ACARS) is an addressable digital data link system which permits exchange of data and messages between an aircraft and a ground-based operations center utilizing the on-board VHF-3 communication system.

The ACARS airborne subsystem provides for the manual entry of routine data such as departure/arrival information. Also possible is manual entry of addresses (telephone codes) of parties on the ground for voice communications.

The airborne system consists of a Management Unit (MU) in the E & E compartment and an Interactive Display Unit (IDU). Data is entered and automatically or manually transmitted to the ground operations center. The system also provides monitoring of the airplane Out/Off/On/In (OOOI) Sensors. These OOOI times are automatically transmitted to the ground station at times specified by the built-in program.

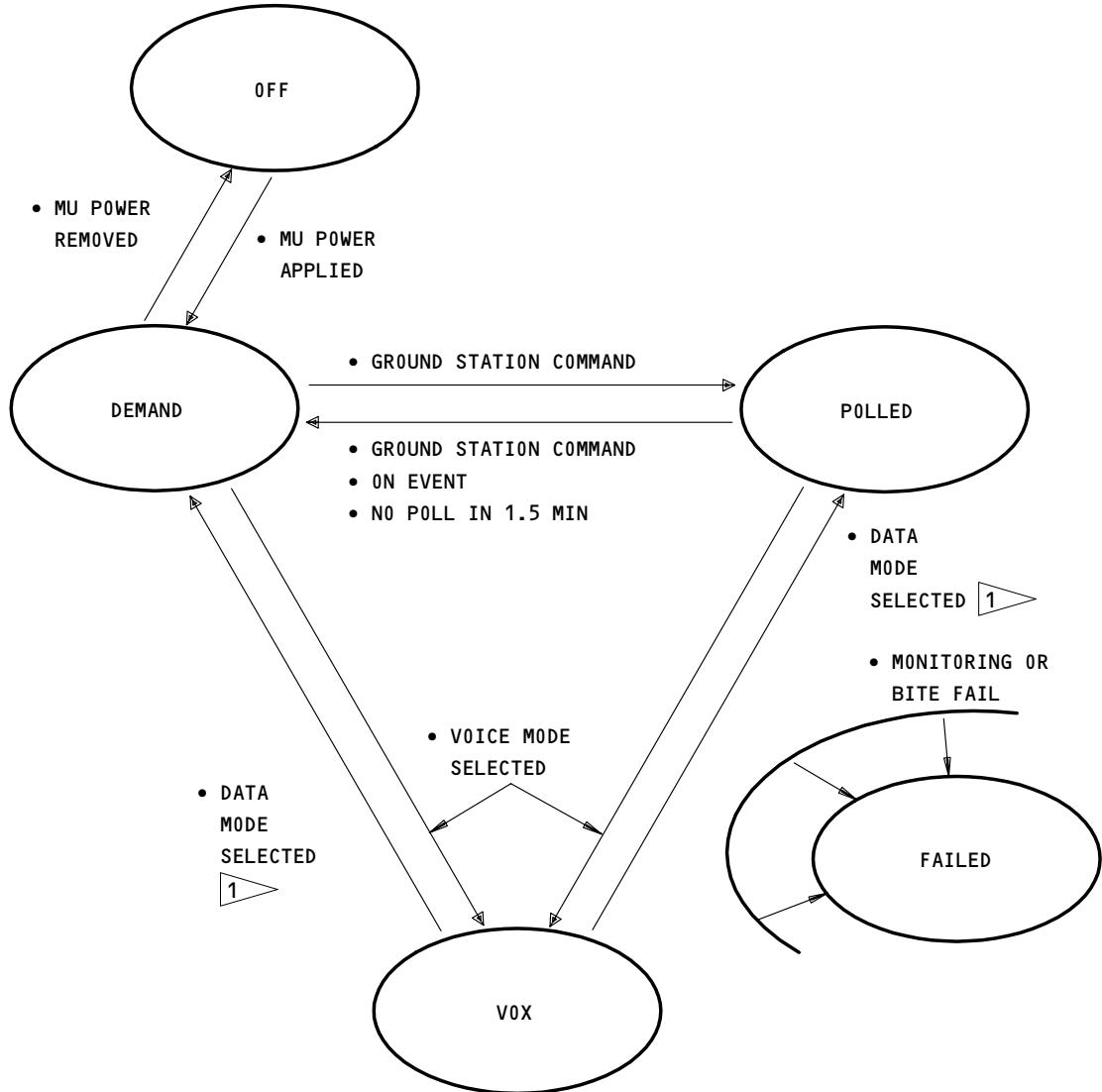


3. Operation

- A. The airborne ACARS system is used to transmit and receive data or messages. Messages for transmission can be generated automatically or can be input manually by crewmembers. The ACARS will then properly tune and key the VHF-3 transceiver for the data transmission.
- B. The VHF-3 can also be used for voice transmission in the ACARS voice mode of operation. Voice communications can be simplified by use of the ACARS. The crew can send a downlink message to request to talk to a party on the ground. The message can even contain the telephone number of the party. The ground can then make the arrangements, uplink the frequency the crew needs to tune in, and command the ACARS to automatically switch to voice mode.
- C. When the ACARS is not transmitting a message, or is not in the voice mode, it monitors the data frequency through the VHF-3 transceiver for messages from the ground. The system recognizes messages intended for the airplane in which it is installed by the address of the message. Each message has a 7 character address, which can be either the registration number or the flight number. The airplane's registration number is hardwired to the MU. The flight number is entered into the system by the crew before each flight. The ACARS will only process messages that have the correct registration or flight number.

D. Operational Modes (Fig. 2)

- (1) The airborne ACARS system operates in conjunction with the ground-based data processors. The two primary modes of operation are the demand mode and the polled mode. A third mode, the voice mode, allows for ACARS controlled voice communications. Two additional modes of operation are the off mode and the failed mode.
- (2) Off Mode
- (a) ACARS is in the off mode when 115v ac is removed from AC Bus 1 or when the ACARS MU AC circuit breaker is opened.
- (3) Demand Mode
- (a) The CMU adopts the demand mode of operation from the off mode upon application of 115v ac power.
- (b) In the demand mode, the CMU will initiate a downlink for each of the following conditions:
- 1) Automatically with the occurrence of pre-defined events. These include OOOI times and certain Aircraft Condition Monitoring System (ACMS) reports. The pre-defined events can be changed by software.
 - 2) Manually by crew request.
- 3) In response to uplink messages which require a response.
- (4) Polled Mode
- (a) The CMU enters the polled mode of operation when commanded to do so by a label "_j" uplink from the ground station.



RETURNS TO MODE THAT WAS VALID WHEN SWITCHED TO VOICE

ACARS Operational Modes Diagram
Figure 2

- (d) Once the ground station reaches the party that was requested, it uplinks a label "54" message to signify a voice go-ahead. The text field of the message can also contain the proper voice channel frequency for crew observation.
- (e) Upon receipt of the uplink by the MU, the MU gives the voice-go-ahead indication. If the uplinked message has a frequency in the text block, the MU will display that frequency on the MCDU. The crew can then manually tune the VHF-3 transceiver to the displayed frequency and begin voice communications.
- (f) Upon exit from the voice mode, the MU will downlink a label "Q6" message to advise the ground station it is back in a data mode. The MU will then resume operating in the mode it was in prior to voice mode.

NOTE: If the MU was in the polled mode, and more than 10 minutes passed during the voice mode, the MU will exit the voice mode into the demand mode.

(6) Failed Mode

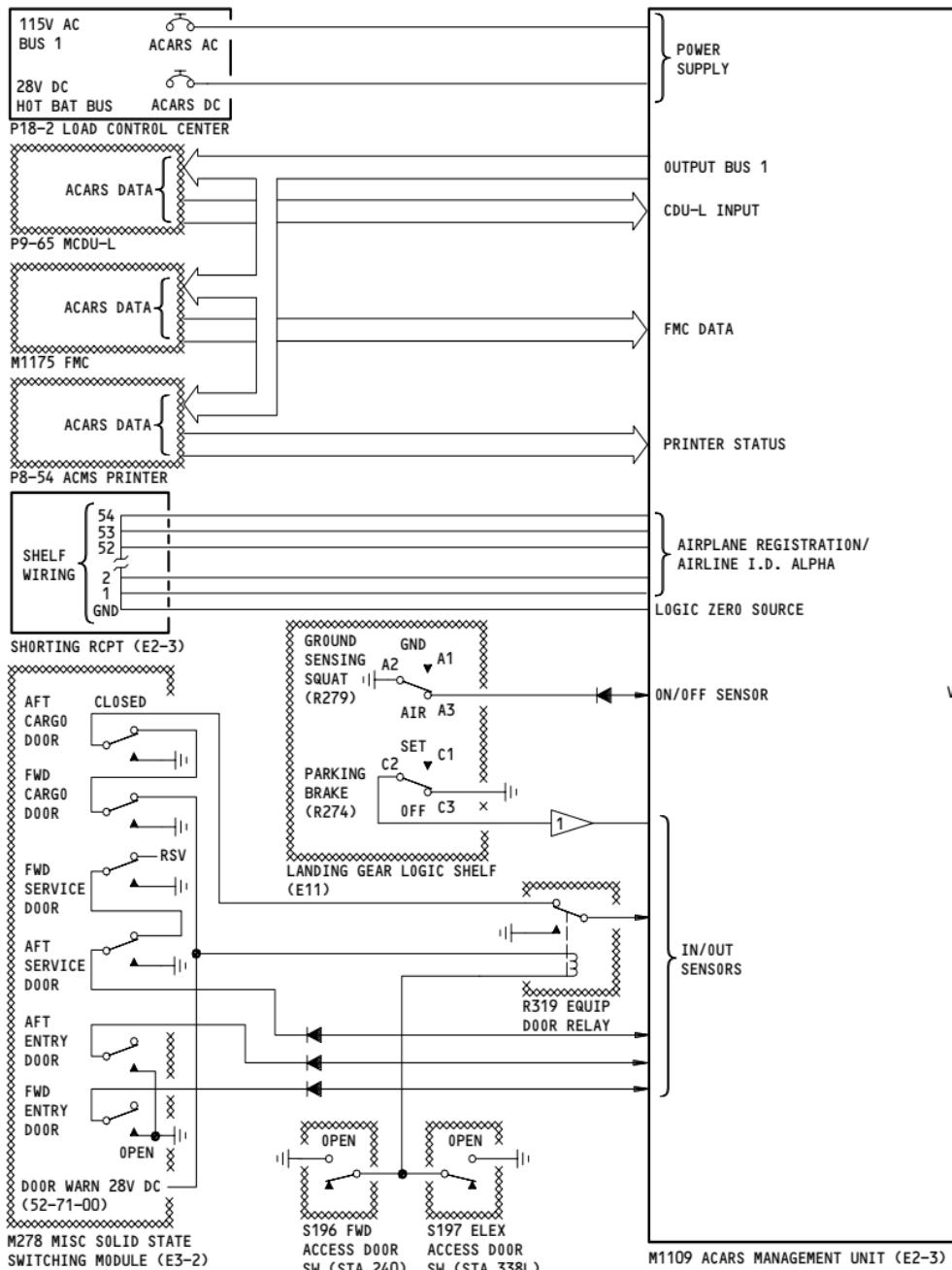
- (a) The MU continually runs tests to using Built-In Tests (BIT). The tests are designed to most failures. When a failure is detected an MCDU indication is activated.

E. Message Format

- (1) Messages transmitted and received by the ACARS MU are organized as a group of blocks. Each block ends with an ETB (End of Transmission Block) unless it is the end of a message in which case the block ends with an ETX (End of TeXt). Each block is structured as follows:
 - (a) Pre-Key (16 characters)
 - 1) Sixteen characters of all binary ones are transmitted before each block to allow the transmitter to stabilize its output power and the receiver to settle its automatic gain circuits.
 - (b) Bit Sync (2 characters)
 - 1) A "+" followed by a "*" is transmitted so that the receiving processing unit can resolve any bit ambiguity.
 - (c) Character Sync (2 characters)
 - 1) Two consecutive "SYN" characters are transmitted so that the receiving processor can determine where each character begins and ends.
 - (d) Start of Heading, SOH (1 character)
 - 1) The "SOH" character is transmitted to indicate the start of a message heading. This also alerts the MU to begin with the next character a block check sequence (BCS). The BCS is an error checking routine.
 - (e) Mode (1 character)
 - 1) The mode character will be a "2" in all areas that do not have Category B coverage. In areas that do have Category B coverage, the mode character will indicate the ground site address with which the MU is communicating.

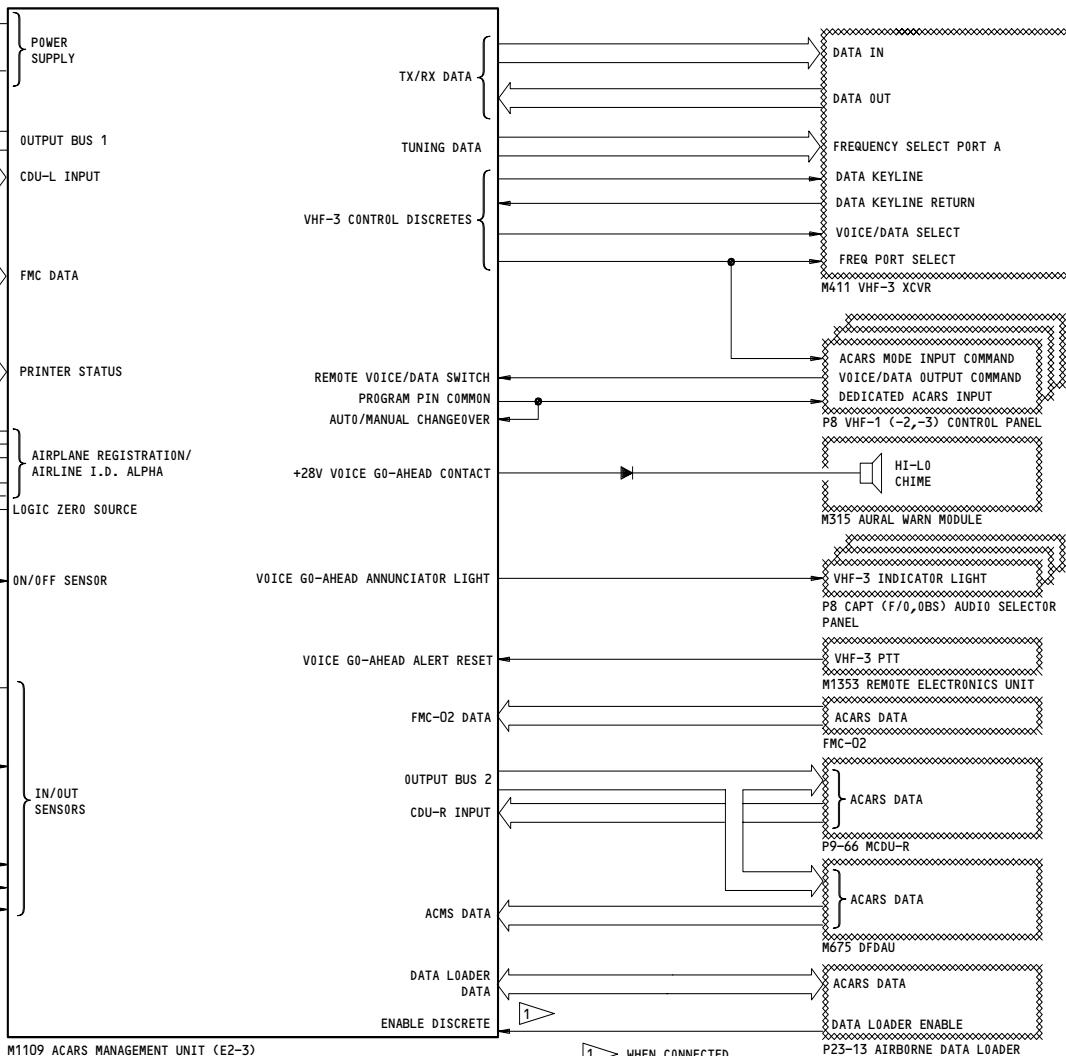
- (f) Address (7 characters)
 - 1) A seven character address identifies the airplane with which the ground station is communicating, or the airplane that sent the message.
- (g) Technical Acknowledgement (1 character)
 - 1) In Category A operating areas, every message will contain an "ACK" (acknowledge) character or a "NAK" (no acknowledge) character. which notifies the transmitting station of the success of the previous message reception.
 - 2) The "ACK" is generated when a valid address for the receiving terminal is received and a good block check sequence was performed.
 - 3) The "NAK" is generated when a valid address was received and a bad block check sequence was performed. The exception to this is when the receiving terminal is the ground-processor and the operating mode is the demand mode. In this case the ground-processor will have no response to a bad block check sequence.
 - 4) In Category B operating areas, the acknowledgement is letter from "A" - "Z" or a number from "0" - "9". A letter in a downlink message corresponds to the uplink block identifier letter that is in the message being acknowledged. A number in an uplink message corresponds to the downlink block identifier number that is in the message being acknowledged. All other rules for generation are the same as Category A.
- (h) Label (2 characters)
 - 1) The label identifies the message type. This determines the function the receiving terminal must perform.
- (i) Block Identifier (1 character)
 - 1) Block identifiers allow duplicate messages to be detected. If a NAK or no response results in retransmission of a message, the message will have the same block identifier. In this way, if a receiver gets a message and sends an ACK, but the transmitting station does not receive the ACK, the receiver will be able to ignore the duplicate transmission of the message.
- (j) Start of Text (1 character)
 - 1) If no text is present, the "ETX" character is contained here. If text follows, the "STX" character is present.
- (k) Text (220 characters maximum)
 - 1) Up to 220 characters of text can be transmitted per block.
- (l) Suffix (1 character)
 - 1) The text block is ended with the "ETX" character or "ETB" character. The "ETX" signifies that no more text will be transmitted in subsequent blocks. The "ETB" signifies that more blocks containing text will follow.
- (m) Block Check Sequence (16 bits)
 - 1) These 16 bits are for error detection.
- (n) BCS Suffix (1 character)
 - 1) The BCS suffix is always the "DEL" character.

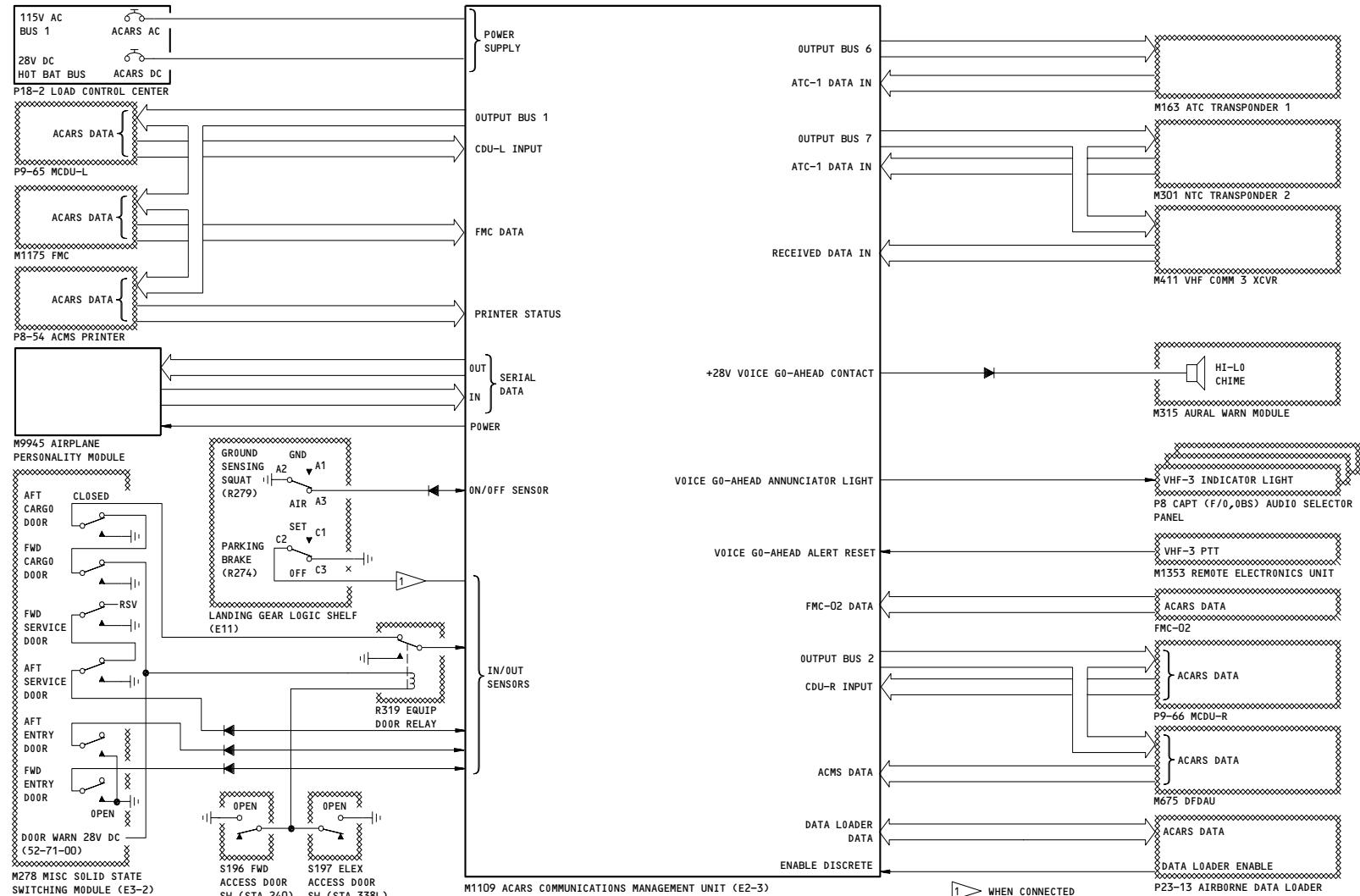
- (2) Off Mode
 - (a) ACARS is in the off mode when 115v ac is removed from AC Bus 1 or when the ACARS AC circuit breaker is opened.
 - (b) As long as 28v dc Hot Bat Bus power is available to the MU through the ACARS DC circuit breaker, essential RAM memory will be retained and the UTC (GMT) clock will continue to operate.
- (3) Demand Mode
 - (a) The MU adopts the demand mode of operation from the off mode upon application of 115v ac power.
 - (b) In the demand mode, the MU will initiate a downlink for each of the following conditions:
 - 1) Automatically with the occurrence of pre-defined events. These include 000I times and certain Aircraft Condition Monitoring System (ACMS) reports. The pre-defined events can be changed by software.
 - 2) Manually by crew request.
 - 3) In response to uplink messages which require a response.
- (4) Polled Mode
 - (a) The MU enters the polled mode of operation when commanded to do so by a label "_j" uplink from the ground station.
 - (b) In the polled mode, the MU will downlink data only when requested (polled) by an uplink from the ground station. The ground station polls an aircraft periodically (at most once every 2 seconds). If the MU has a message in memory for downlink, it will initiate a transmission. If no message is awaiting transmission, the MU will transmit a label "_j" general poll/response.
 - (c) The polled mode is used in areas of heavy ACARS traffic so that the ground station will be available equally to all aircraft that use the service.
 - (d) The MU will exit the polled mode and return to the demand mode under one of the following conditions:
 - 1) When commanded to do so by a label "_DEL" uplink.
 - 2) When the ON event occurs.
 - 3) When 1.5 minutes has passed without a poll from the ground station.
- (5) Voice (VOX) Mode
 - (a) The voice mode of operation can be entered from either the polled mode or the demand mode.
 - (b) In the voice mode, crew members can conduct voice communication with the ground on a frequency other than the data link frequency.
 - (c) The crew can request voice communications with a party on the ground via the ACARS menu functions on a CDU. A crew member can enter the address (telephone number) of the party on the ground. The MU will downlink a label "54" message with the desired address (telephone number) in the text field of the message.



ACARS Interface Block Diagram

Figure 3





ACARS Interface Block Diagram

Figure 3

VHF-3 Transceiver

- (a) The MU encodes the digital data for transmission as a series of 1200 Hz and 2400 Hz tones at 2400 baud (future ACARS systems may operate with 2400/4800 Hz at 4800 baud). A 1200 Hz tone indicates a bit change from the previous bit (0 to 1 or 1 to 0) while a 2400 Hz tone indicates no bit change (0 to 0 or 1 to 1).
- (b) The MU supplies the tuning word to the VHF transceiver on port A of the transceiver. The tuning word is in the 32 bit ARINC 429 format.
- (c) The MU grounds the voice/data select line of the VHF transceiver while it is in data mode so the transceiver can disable both received data from the audio output and transmit data from the sidetone output.
- (d) The MU grounds the data keyline of the transceiver when a message is to be transmitted.
-
- (e) The port select discrete between the MU and the transceiver is grounded by the MU when it is in data mode. This selects port A of the transceiver as the source for the tuning word, thereby allowing the MU to control the data frequency tuning. In voice mode, the MU will open the port select discrete to allow tuning by port B only if the VHF control panel is to tune the transceiver to the voice frequency. If the MU is to provide the voice frequency, the port select will remain grounded.
- (6) VHF Control Panels
- (a) The port select discrete to the VHF-3 transceiver is also connected to the VHF control panels. When grounded, the ACARS indication will show in the active display of the control panel that is selected to the VHF-3 transceiver, indicating that the MU has control of the tuning.
- (b) A discrete from the VHF control panel allows for remote voice/data switching. When ACARS is in voice mode and the display transfer button on the VHF control panel is pushed, ACARS changes to data mode and the ACARS indication moves to the active display.

ACARS SYSTEM (Cont)

Page Routines

When the IDU is initially powered up (AC busses powered) it establishes contact with the ACARS and the Digital Flight Data Acquisition Unit (DFDAU). The IDU screen then displays a Systems Menu for the user to select a system by touching the screen at the symbol (>) to the left of the desired system. Selecting ACARS brings up the STANDARD ACARS MENU. This is the root page for accessing all other ACARS pages. Return to this STANDARD ACARS MENU is possible by touching the MENU cue on any displayed page.

When a cue is touched on the IDU screen, the cue name is highlighted in reverse video. Moving the finger to another cue without breaking screen contact returns the cue first touched to normal video and highlights the new cue being touched. Releasing the highlighted cue activates the cue's function.

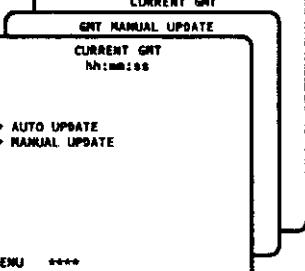
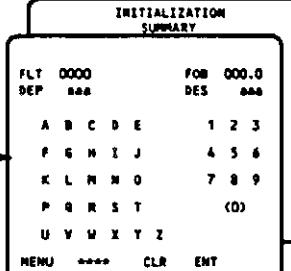
The following cues are special in that they always perform the same functions: MENU, TRN, ENT, CLR, SEND RE-DO, VOX and PRT. Other cues are advisory cues. Advisory cues appear in place of **** on the standard ACARS Menu. Some advisory cues flash from normal to reverse video: FAIL, DATA, SELC, *MSG*, and INIT. Other advisories are displayed in normal video: SEND, NOCOM, VOICE; and in reverse video: FAIL.

The following page presents a pictorial representation of the available menus and their selection interrelationships.

ON POWER-UP

SYSTEMS MENU

> ACARS
> DFBAU



STANDARD ACARS MENU

> INITIALIZATION
> GMT CLOCK
> D001 TIMES
> GROUND CALL
> ENGINE DATA
> MESSAGES
> MAINTENANCE
> CUSTOMER ACARS

MENU **** VOX

CALL COMPANY
FREQUENCY IS
000.00

> VOICE MODE

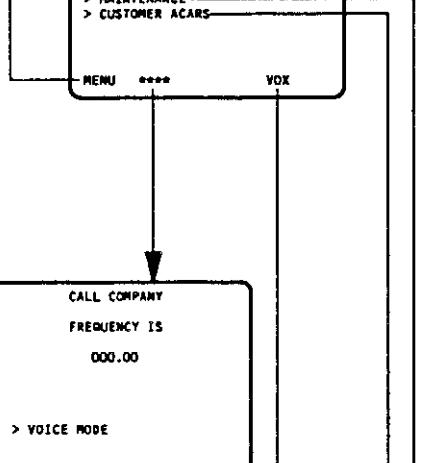
MENU **** RTN

VOICE MODE

TUNED FREQ
VOICE MODE
TUNING CONTROLLED VIA
COCKPIT CONTROL HEAD

> EXIT VOICE
(DATA MSG)
(WAITING)

MENU ****
501
NOV 01/89



MESSAGE TITLE P1/2
MESSAGE RECV'D

- > 8 GATE ADVISE (NEW)
- > 7 WEATHER INFO (NEW)
- > 6 SYSTEM TEST OLD
- > 5 etc OLD
- > 4 etc OLD
- > 3 - OLD
- > 2 - OLD
- > 1 LOAD SHEET OLD

MENU ****

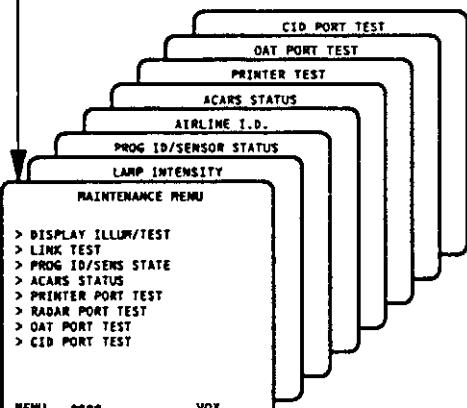
ENGINE PERFORMANCE REPORT

> REQUEST REPORT

XXXXXX

MENU ****

Maintenance Menu



Customer ACARS
performs basic
functions plus
other special
defined functions.

ACARS SYSTEM
PAGE SELECTION

09.20.09

23-27 ACARS Aircraft Communications Addressing and Reporting System

GENERAL

The Aircraft Communications Addressing and Reporting System (ACARS) is a digital data-link system that operates between an airplane and a ground-based network of receiver-transmitter stations and central processing stations. The transmission medium is generally a single frequency in the VHF frequency range. The VHF-3 is used by the ACARS to transmit and receive messages. By automatically transmitting routine messages, the ACARS reduces crew workload. Also, lengthy voice transmissions to communicate with the ground are reduced with the ACARS.

The airborne ACARS system is used to transmit and receive data or messages. Messages for transmission can be generated automatically or can be input manually by crewmembers. The ACARS will then properly tune and key the VHF-3 transceiver for the data transmission.

The VHF-3 can also be used for voice transmission in the ACARS voice mode of operation. Voice communications can be simplified by use of the ACARS. The crew can send a downlink message to request to talk to a party on the ground. The message can even contain the telephone number of the party. The ground can then make the arrangements, uplink the frequency the crew needs to tune in, and command the ACARS to switch automatically to voice mode.

The ACARS Management Unit (MU) controls all functions of the airborne ACARS system. The MU interfaces with many other systems on the airplane. Crew interface to the unit is via the FMC Multi-purpose Control Display Units (MCDU).

The MU is installed on the E2-3 electronics shelf. It is fastened to the equipment rack by two hooks at the front and a rack and panel connector on the rear.

A TEST switch and a PASS and FAULT light are located on the front of the MU. When the TEST switch is pushed, the unit stops all ACARS functions and starts a self-test. The result of the test is reported by lights on the front of the MU and are also sent to the MCDUs for display.

The left and right Multi-purpose Control Display Units (MCDUs) provide the user interface with the ACARS. When the MENU key on an MCDU is pushed, the <ACARS prompt will be available on that MCDU unless ACARS is being used on the other MCDU. ACARS can be used on only one MCDU at a time.

Selecting the line select key adjacent to the <ACARS prompt will call up the ACARS main menu page. From here, all ACARS functions can be accessed, such as pre-flight initialization, weather requests, system status checks, or link tests.

The airplane registration number and the airline ID are hardwired coded at the back of the MU by the shorting receptacle. The registration number is a seven character number and the airline ID a two character code.

Example of ACARS Applications

Taxi	Takeoff	Departure	En Route	Approach	Landing	Taxi
<u>From Aircraft</u> Link Test Clock Update Fuel Information Crew Information Delay Reports <u>Out</u> <small>1.15 nts - maxed!</small>	<u>From Aircraft</u> <u>Off</u>	<u>From Aircraft</u> <u>Engine Data</u> <u>ACMS</u>	<u>From Aircraft</u> Position Reports Weather Reports Delay Information ETA Reports Voice Request Engine Information Maint. Reports	<u>From Aircraft</u> Provisioning Gate Requests Special Requests Engine Information Maint. Reports	<u>From Aircraft</u> <u>On</u>	<u>From Aircraft</u> <u>In</u> Fuel Information Crew Information Fault Data from Maint. Computer
<u>To Aircraft</u> PDC ATIS Weight & Balance Airport Analysis V-Speeds Flight Plan- FMC load\ hard copy		<u>To Aircraft</u> Flight Plan Update Weather Reports	<u>To Aircraft</u> ATC Oceanic Clearances Weather Reports Ground Voice Requests (SELCAL) ATIS	<u>To Aircraft</u> Gate Assignments Connecting Gates		
0	0			0	I	000T

ACARS

Data Exchange between Aircraft and Ground Network

(1) Data coding

The data exchanged between the ACARS MU and the VHF3 transceiver are coded by 1200 and 2400 Hz tones (Ref. Fig. 005).

A zero-bit is coded:

-By a positive half period of 1200 Hz when it is the first of a string of zero-bits (even if the string only comprises this single bit).

-By a 2400 Hz period starting by the negative half period when this is not the case.

A one-bit is coded:

-by a negative half period of 1200 Hz when it is the first of a string of one-bits (even if the string only comprises this single bit).

-by a 2400 Hz period starting by the positive half period when this is not the case.

The signal transmitted by the ACARS MU to the VHF3 modulates the VHF radio signal sent to the ground. Conversely, the signal transmitted by the VHF3 to the ACARS MU is obtained after demodulation of the radio signal from the ground.

The result of this coding is that the transmission rate is 2400 bits per second from aircraft to ground and vice versa.

The transmitted data are characters from the ISO alphabet No. 5 except the block check sequence field at the end of transmission. (Ref. Fig. 006)

(2) Message format

The format of the messages exchanged between the ground and the aircraft is as follows (in the transmission order):

Pre-key (16 characters)

Bit synchro (2 characters)

Character synchro (2 characters)

Start of heading (1 character)

Mode (1 character)

Address (7 characters)

Technical acknowledgement (1 character)

Label (2 characters)

Uplink block identifier (1 character)

Start of text (1 character)

Text (220 characters max.)

Suffix (1 character)

Block check sequence (BCS)(16 bits)

BCS suffix (1 character)

-Pre-key: all the bits are at 1. This phase enables adjustment of VHF transmission and reception levels.

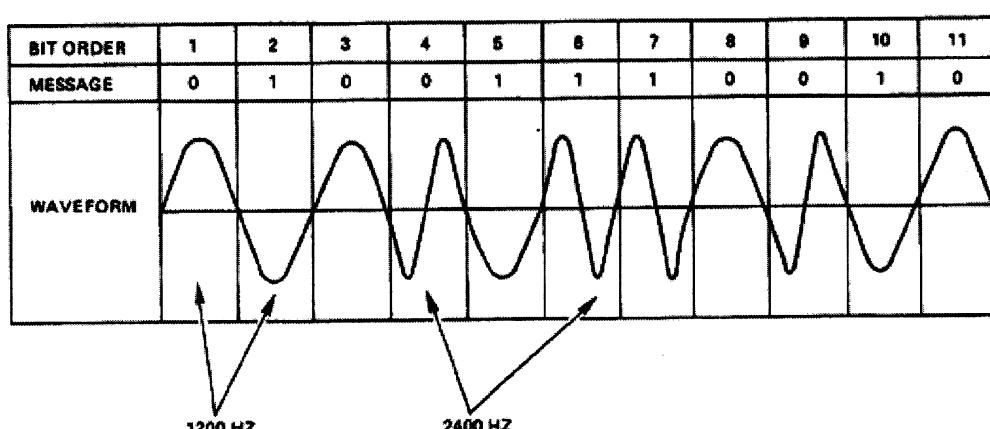


Figure 005 ACARS - Data Coding

b ₇ b ₆ b ₅				0 ₀	0 ₀ ₁	0 ₁ ₀	0 ₁ ₁	1 ₀ ₀	1 ₀ ₁	1 ₁ ₀	1 ₁ ₁	
				b ₄	b ₃	b ₂	b ₁	COLUMN →	ROW ↓			
0	0	0	0	0	0	0	0	NUL	DLE	SP	#	@
0	0	0	1	1	1	1	1	SOH	DC1	!	1	A
0	0	1	0	2	2	2	2	STX	DC2	"	2	B
0	0	1	1	3	3	3	3	ETX	DC3	#	3	C
0	1	0	0	4	4	4	4	EOT	DC4	\$	4	D
0	1	0	1	5	5	5	5	ENQ	NAK	%	5	E
0	1	1	0	6	6	6	6	ACK	SYN	&	6	F
0	1	1	1	7	7	7	7	BEL	ETB	'	7	G
1	0	0	0	8	BS	CAN	'	8	H	X	h	x
1	0	0	1	9	HT	EM)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	:	K	[k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	/
1	1	0	1	13	CR	GS	-	=	M]	m)
1	1	1	0	14	SO	RS	-	>	N	-	n	-
1	1	1	1	15	SI	US	/	?	O	-	o	DEL

ACK ACKNOWLEDGE
 BEL BELL
 BS BACKSPACE
 CAN CANCEL
 CR CARRIAGE RETURN
 DC DEVICE CONTROL
 DEL DELETE
 DCE DATA LINK ESCAPE
 EM END OF MEDIUM
 ENQ ENQUIRY
 EOT END OF TRANSMISSION
 ESC ESCAPE
 ETB END OF TRANSMISSION
 BLOC
 ETX END OF TEXT
 FF FORM FEED

FS FILE SEPARATOR
 GS GROUP SEPARATOR
 HT HORIZONTAL TABULATION
 LF LINE FEED
 RAK NEGATIVE ACKNOWLEDGE
 NUL NULL
 RS RECORD SEPARATOR
 SI SHIFT-IN
 SO SHIFT-OUT
 SOH START OF HEADING
 SP SPACE
 STX START OF TEXT
 SUB SUBSTITUTE
 SYN SYNCHRONOUS IDLE
 US UNIT SEPARATOR
 VT VERTICAL TABULATION

ACARS - ISO Alphabet No.5 Figure 006

- Bit synchro: enables to cross check the bits value.
- Character synchro: enables to establish synchronization on the characters.
- Start of heading: indicates the start of data transmission.
- Mode: enables selection of a ground station or a specific group of ground stations for communication with the aircraft.
- Address: contains the identification of the aircraft which transmits or receives the message.
- Technical acknowledgement: acknowledgement (either positive or negative) related to the last message received.
- Label: identifies a specific type of message.
- Uplink block identifier: only appears in the messages transmitted by the ground. Enables the aircraft to detect duplicated ground messages (aircraft – to - ground messages may have a downlink block identifier to enable detection of duplicated aircraft messages on the ground).
- Start of text: indicates the start of useful data transmission.
- Text: useful data. Only one part of the ISO 5 characters can be transmitted in this field (Ref. Fig. 007)

- Suffix: indicates the end of useful data transmission.
- Block check sequence: result of a computation made before transmission on the previous bits set. At reception, the same computation is made and the two results are compared. If they are identical, the transmission is correct.
- BCS suffix: indicates the end of transmission.

(3) Exchange protocol between the aircraft and the ground

This protocol is described in the ARINC 597 Specification (to which the ARINC 724B refers for the description of this protocol).

				0_{0_0}	0_{0_1}	0_{1_0}	0_{1_1}	1_{0_0}	1_{0_1}	1_{1_0}	1_{1_1}
				0	1	2	3	4	5	6	7
				SP	S		P				
0	0	0	0	0							
0	0	0	1	1				1	A	Q	
0	0	1	0	2				2	B	R	
0	0	1	1	3				3	C	S	
0	1	0	0	4				4	D	T	
0	1	0	1	5				5	E	U	
0	1	1	0	6				6	F	V	
0	1	1	1	7				7	G	W	
1	0	0	0	8		I	8	H	X		
1	0	0	1	9		I	9	I	Y		
1	0	1	0	10			:	J	Z		
1	0	1	1	11				K			
1	1	0	0	12				L			
1	1	0	1	13				M			
1	1	1	0	14				N			
1	1	1	1	15				O			

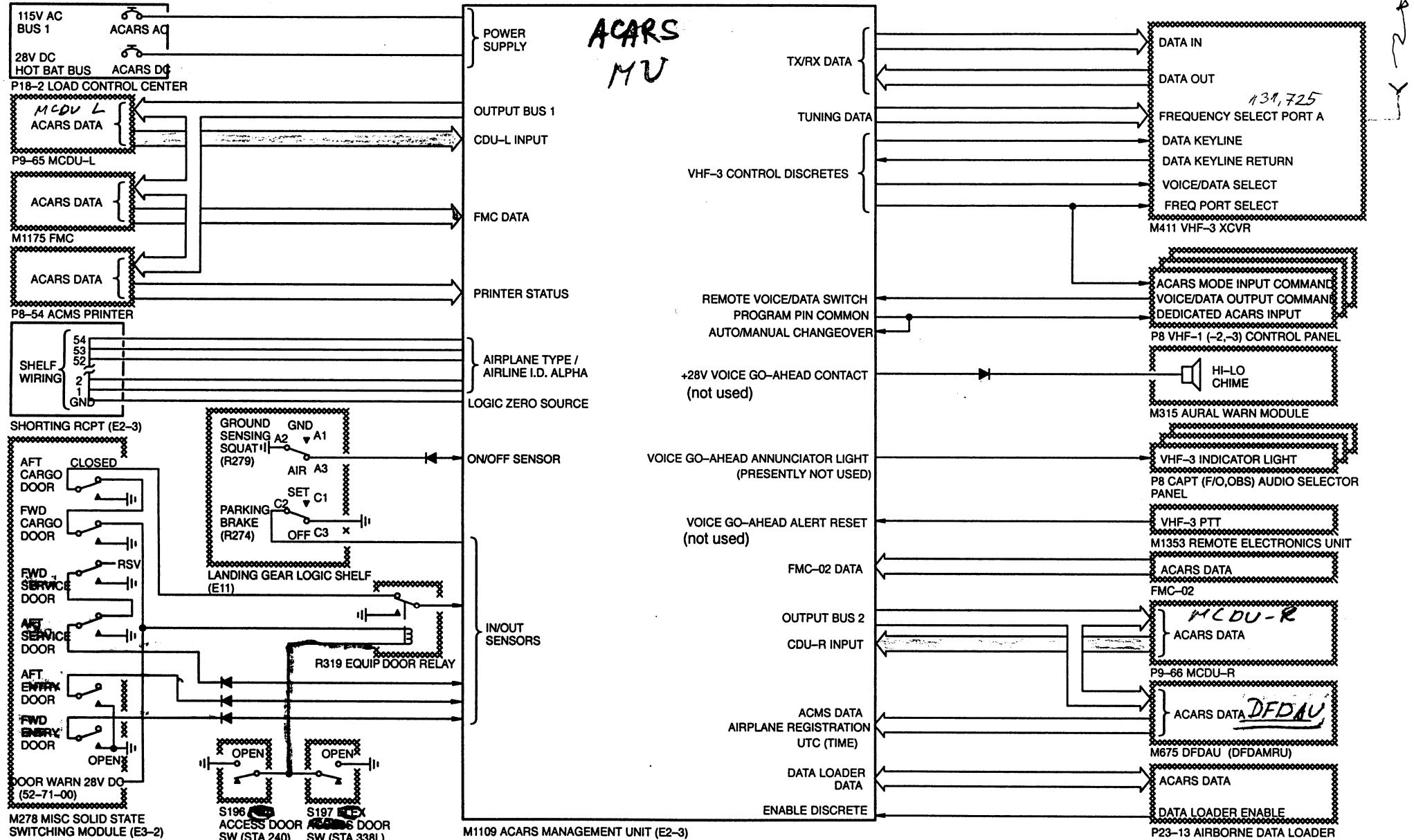


Figure 43 ACARS INTERFACE DIAGRAM

OPERATIONAL DESCRIPTION

When the ACARS is not transmitting a message, it monitors the data frequency through the VHF-3 transceiver for messages from the ground. The system recognizes messages intended for the airplane in which it is installed by the address of the message. Each message has a 7 character address, which can be either the registration number or the flight number. The airplane's registration number is provided by the ACMS system (DFDAMRU). The flight number is entered into the FMS system by the crew before each flight. The ACARS will only process messages that have the correct registration or flight number.

Confirmation of messages

Every message will contain an "ACK" (acknowledge) character or a "NAK" (no acknowledge) character, which notifies the transmitting station of the success of the previous message reception.

The "ACK" is generated when a valid address for the receiving terminal is received and a good block check sequence was performed.

The "NAK" is generated when a valid address was received and a bad block check sequence was performed. The exception to this is when the receiving terminal is the ground-processor and the operating mode is the demand mode. In this case the ground-processor will have no response to a bad block check sequence.

Operational Modes

The airborne ACARS system operates in conjunction with the ground-based data processors. The two primary modes of operation are the demand mode and the polled mode. Two additional modes of operation are the off mode and the failed mode.

(1) Off Mode

- ACARS is in the off mode when 115v ac is removed from AC Bus 1 or when the ACARS AC circuit breaker is opened.
- As long as 28v dc Hot Bat Bus power is available to the MU through the ACARS DC circuit breaker, essential RAM memory will be retained and the UTC (GMT) clock will continue to operate.

(2) Demand Mode

- demand - T6PC EHE or 020*
- The MU adopts the demand mode of operation from the off mode upon application of 115v ac power.
 - In the demand mode, the MU will initiate a downlink for each of the following conditions: → *6nH CTP. 79*

POLL - 210 CTP. 79

(3) Polled Mode

- The MU enters the polled mode of operation when commanded to do so by the ground station.
- In the polled mode, the MU will downlink data only when requested (polled) by an uplink from the ground station. The ground station polls an aircraft periodically (at most once every 2 seconds). If the MU has a message in memory for downlink, it will initiate a transmission.
- The polled mode is used in areas of heavy ACARS traffic so that the ground station will be available equally to all aircraft that use the service.
- The MU will exit the polled mode and return to the demand mode under one of the following conditions:
 - When commanded to do so by an uplink.
 - When the ON event occurs.
 - When 1.5 minutes has passed without a poll from the ground station.

(4) Failed Mode

The MU continually runs tests to using Built-In Tests (BIT). The tests are designed to most failures. When a failure is detected an MCDU indication is activated. Message Format

*Polled Mode :
no brk bat e or
BEMG T0*

CTP 78

VHF-3 Transceiver;

- The MU encodes the digital data for transmission as a series of 1200 Hz and 2400 Hz tones at 2400 baud (future ACARS systems may operate with 2400/4800 Hz at 4800 baud). A 1200 Hz tone indicates a bit change from the previous bit (0 to 1 or 1 to 0) while a 2400 Hz tone indicates no bit change (0 to 0 or 1 to 1).
- The MU supplies the tuning word to the VHF transceiver on port A of the transceiver. The tuning word is in the 32 bit ARINC 429 format.
- The MU grounds the voice/data select line of the VHF transceiver.
- The port select discrete between the MU and the transceiver is grounded by the MU when it is in data mode. This selects port A of the transceiver as the source for the tuning word, thereby allowing the MU to control the data frequency tuning. In VHF 3-voice mode, the MU will open the port select discrete to allow tuning by port B only as the VHF control panel has to tune the transceiver to the voice frequency.

Radio Communication Panels;

- The port select discrete to the VHF-3 transceiver is also connected to the Radio Communication Panels . When grounded, the ACARS indication will show in the active display of the control panel that is selected to the VHF-3 transceiver, indicating that the MU has control of the tuning.
- A discrete from the VHF control panel allows for remote voice/data switching. When VHF 3 is in voice mode and the display transfer button on the active ACARS control panel is pushed, ACARS will change to data mode and the ACARS indication will move to the active display.

Aural Warning Module;

- A voice-go-ahead discrete from the MU to the aural warning module provides the pilot with a chime to notify the pilot when a VOICE CONTACT message is received .
- Automatically with the occurrence of pre-defined events. These include OOOI times and certain Aircraft Condition Monitoring System (ACMS) reports. The pre-defined events can be changed by software.
- Manually by crew request.
- In response to uplink messages which require a response.

ACMC = Aircraft Condition Monitoring System.

demand mode
TOPСЕТЬ OT
самолета
ACARS

but CTP 78

CTP 79

LOCATION

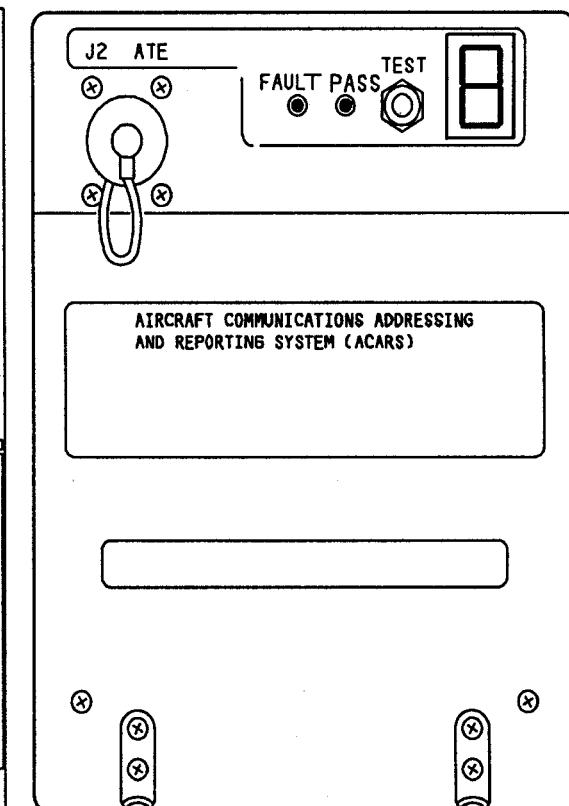
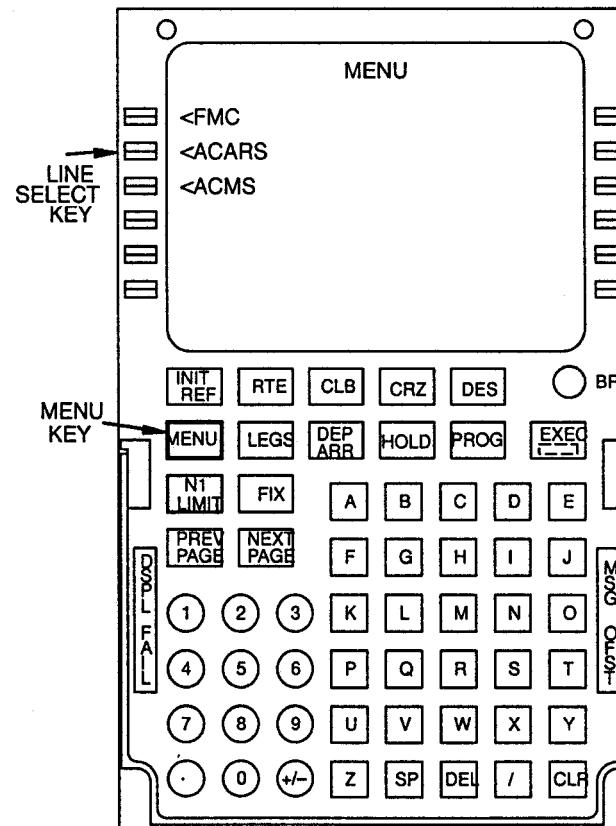
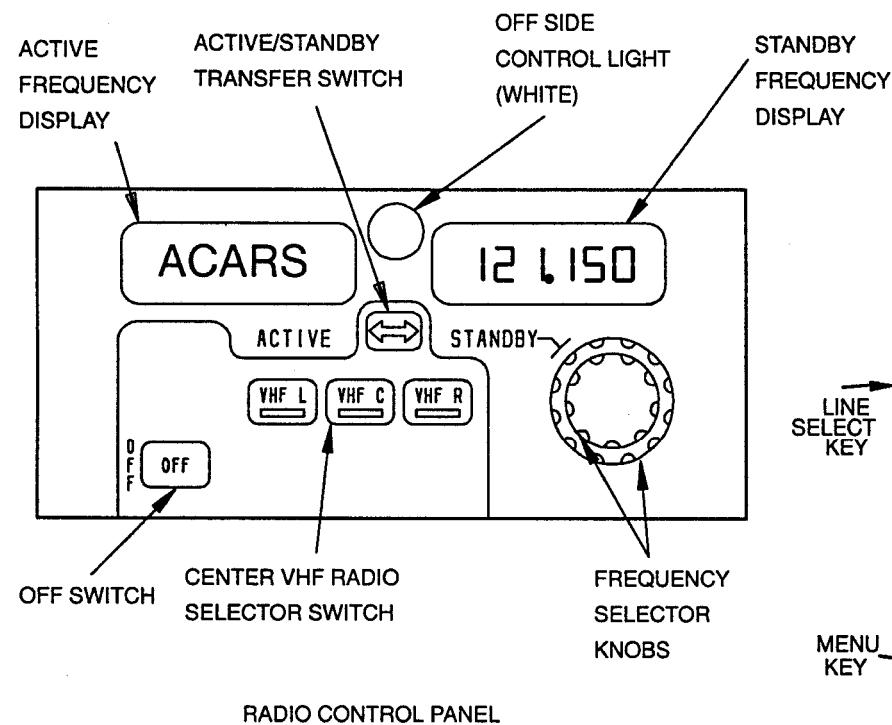


Figure 44 ACARS COMPONENTS

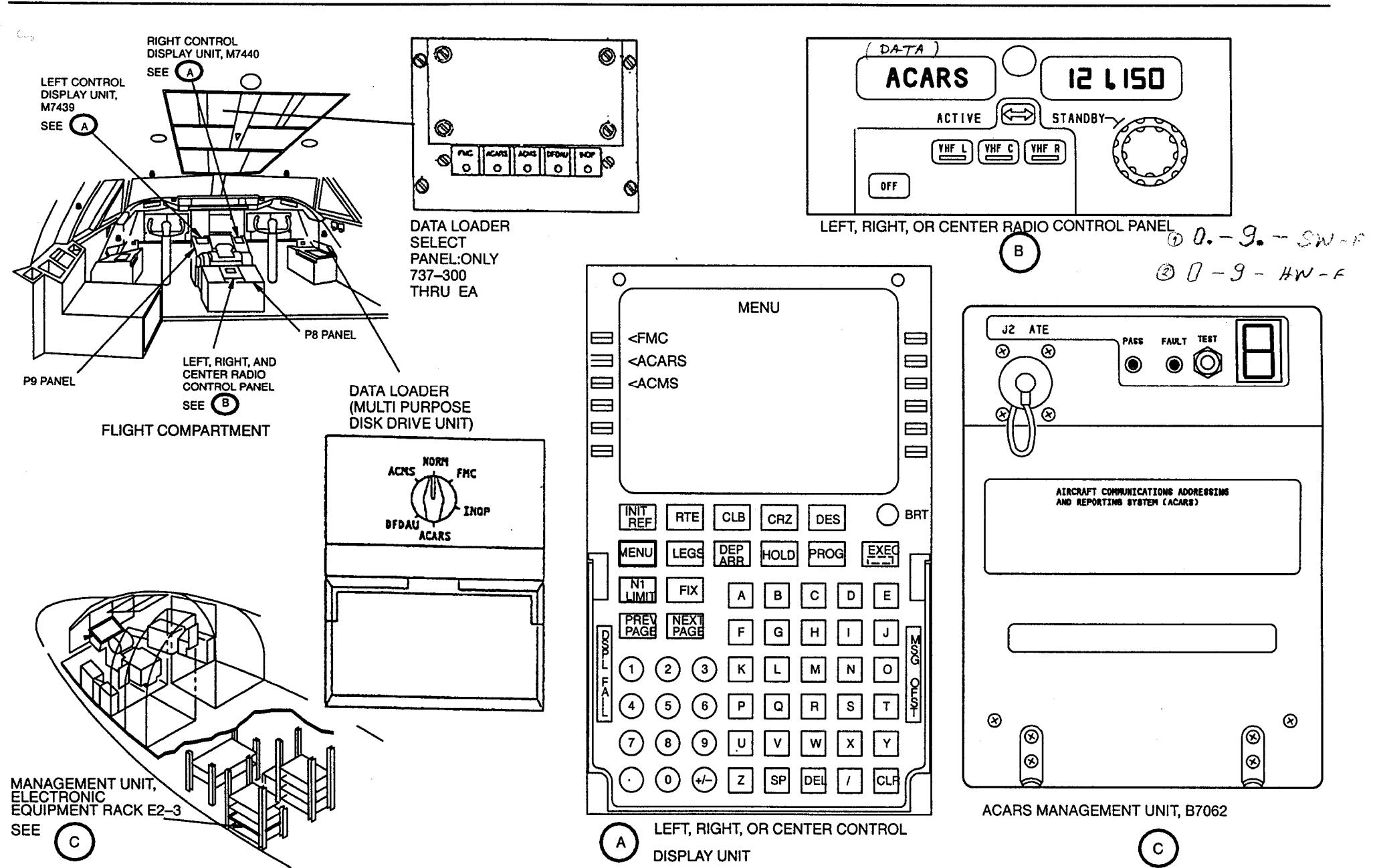


Figure 45 ACARS COMPONENT LOCATION

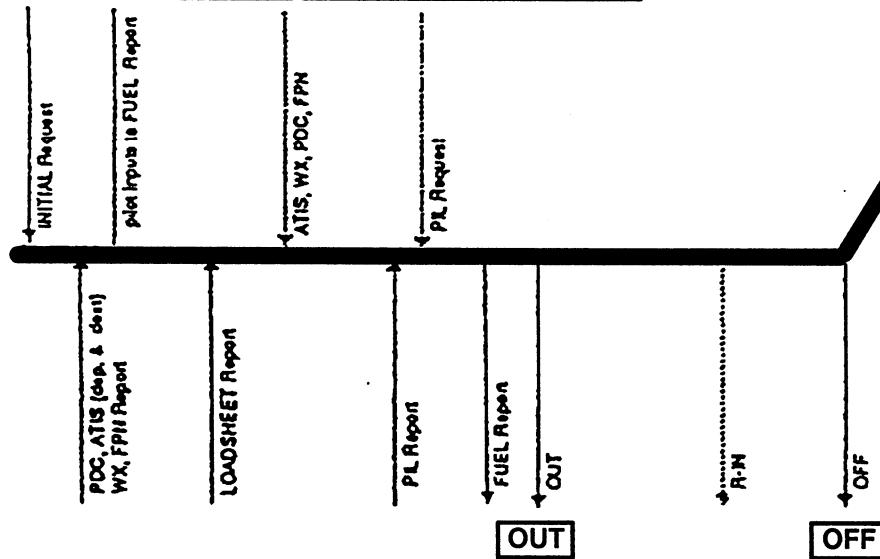
MANUAL action required

Profile Independent DL Reports:

Conn Gate Request
A/C Crew Rotation Request
Telex Report
Voice Request
ATIS Request
Weather Request
PDC Request

Profile Independent UL Reports:

Telex Report
ACARS CALL



AUTOMATIC

Profile Independent DL Reports:

ETA Change Report
Destination Airport Change Report
Destination Runway Change Report
Frequency Change Report

ALL - data link
DL (downlink)

UL (uplink)

— normal operation
— supplemental / abnormal operation

↑ update ↓ downlink

PARK BRAKE

	Trigger	Time
OUT	: First A/C movement and all doors closed	now
OFF	: Ldg gear decrompressed	now
ON	: Ldg gear compressed	now
IN	: Min one door open	Last time park brake set

Figure 46 ACARS Flight Profile

REPORTS / REQUESTS

Typ	Name	Dir	Function	Trigger	Back- Up
O P E R A T I O N	1.Movement Reports(0001)	DL	Out : DL of flight number, out time (off blocks) and departure airport	Automatic	Movement Message
			RET IN : DL of flight number, return in time and station	Automatic	
			OFF : DL of flight number, off time (takeoff time), destination and ETA	Automatic	
			ON : DL of flight number, on time (touch down time), destination, destination runway	Automatic	
			IN : DL of flight number, touch down time, in time (on block time) and destination	Automatic	
	2.Progress Report	DL	DL of estimated time of arrival, destination and runway	Automatic	Voice
	3a.Voice Cont. Req.	DL	Voice contact requests to various addresses	Manual	Voice
	3b.ACARS CALL	UL	Call request from ground ACARS LINE	Manual	Voice
	3c.Free Text	DL	Free text (telex) to various addresses	Manual	Voice
		UL	Free text (telex) to pilots from ground	Manual	Voice
	3d.Initial Req.	DL	Crew ready for ACARS messages (e.g. release for WX, ATIS, PDC, Loadsheets uplink)	Manual	Voice
	3e.Airport Weather	DL	Request for forecast and actual weather	Manual	Voice
		UL	UL of forecast and actual weather	after req.	Voice
	3f.ATIS	DL	Request for ATIS	Manual	Voice
		UL	UL of ATIS	after req.	Voice
	3g.PDC	DL	Request of Pre Departure Clearance	Manual	Voice
		UL	UL of Pre departure Clearance	after req.	Voice
	3h.Loadsheet	UL	UL of loadsheets	after req.	Manual Ramp
	4.Refueling Report	DL	DL of supplied fuel, remaining fuel and APU fuel	Automatic	Fuel Message
	5.A/C Crew Rotation	DL	Request for A/C crew rotation	Manual	Voice
		UL	Info about arrival position and next leg for PIC and A/C	Auto or req	Voice
S	6.Pax Info List	DL	Request for PIL	Manual	Voice
E		UL	UL of PIL	Auto or req	Manual Ramp
R	7.Connecting Gates	DL	Request for connecting gates	Manual	Voice
V		UL	Departure infos for connecting flights (Gate and time within the next 30 minutes)	Auto or req	Voice
	8.ACMS/AIDS	DL	Engine condition monitoring reports	Automatic	Print out

MESSAGES

The MCDU Scratch Pad (SP) display shows messages in the following priority:

4. user entries
5. **ERROR / ADVISORY** messages
6. **Label 270** messages

The **ACARS ERROR / ADVISORY** messages (priority 2) are shown, when the ACARS system is selected on the MCDU. Most of them can be cleared by pressing the CLR-key on the MCDU (see chart).

ACARS Error / Advisory Messages Chart

Message Text	Trigger Condition	Reset Condition
NO COMM, MSG NOT GEN	LSK that initiates a downlink is pressed while MU is in a NO COMM condition.	5 seconds or "CLR" key pressed or data entry
VOICE MODE, MSG NOT GEN	LSK that initiates a downlink is pressed while MU is in VOICE Mode.	5 seconds or "CLR" key pressed or data entry
PRINTER FAIL	LSK that initiates a print is pressed, and the printer cannot accept a message.	5 seconds or "CLR" key pressed or data entry
INVALID ENTRY	Invalid data entry	CLR key pressed or valid data entry
NO A / C REG, (^{DFDAMRU}) MU IN STBY	MU has not received the A / C Registration Number from the DFDAMRU (ACMS-system)	A / C Registration Number from DFDAMRU (Cold Start)
BUFFER FULL, MSG NOT GEN	LSK that initiates a downlink is pressed, and the downlink buffer is full.	5 seconds or "CLR" key pressed or data entry
AUTO / MAN FREQ MISMATCH	Manually selected VHF data frequency differs from frequency indicated by automatic frequency select logic.	Select correct frequency or "CLR" key or data entry
NO LAT / LON, USE MAN FREQ	MU is not receiving latitude and longitude data from aircraft IRS and FMC	VHF data frequency manually selected or aircraft starts broadcast data or "CLR" key pressed or data entry
BAD H / W PART NUM	Hardware part number is invalid	Hardware part number
AIRCRAFT TYPE MISMATCH	Aircraft type pins are not set for 737-330/430/530 aircraft	Reconfigure pins and reset MU
ACRFT REGNUM DBASE FAIL	Aircraft registration number initially received from broadcast does not match database	Install MU on proper aircraft or modify database

The **Label 270** messages are shown on the MCDU display.

Label 270 Chart

Message Text MCDU	Trigger Condition	Reset Condition
ACARS CALL	An ACARS CALL uplink has been received	Activate the ACARS MCDU Operation and select "ACARS REC MSG" Pg.
ACARS MESSAGE	An ACARS UPLINK has been received	Activate the ACARS MCDU Operation and select "ACARS REC MSG" Pg.
VHF3 VOICE	VHF 3 set in VOICE mode	Use TFR switch on RCP to select ACARS mode
ACARS NO COM	ACARS link not possible. Out of ground station range	Check VHF 3

Indications in the cockpit

Situation	Indication on MCDU	Indication on the MCDU display	Indication on RCP
No link to ground station	NO COMM, MSG NOT GEN	ACARS NO COM	ACARS in the "ACTIVE" WINDOW
ACARS not controlling VHF 3	VOICE MODE, MSG NOT GEN	VHF3 VOICE	ACARS in the "STANDBY" WINDOW
ACARS MU fault	ACARS not visible on MENU page	COM – ACARS FAULT	— in the "ACTIVE" WINDOW

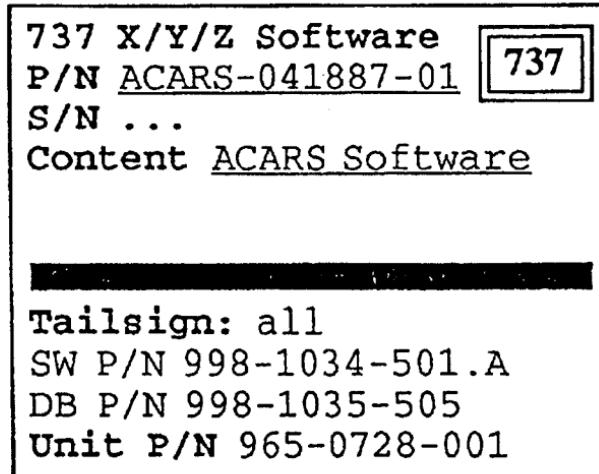
DATA LOADING

The task in this procedure is the installation of the ACARS software into the management unit.

- 1. Select ACARS position on the ADL selection panel.
- 2. Insert the diskette with the ACARS customer database into the ADL.
- 3. Make sure the RDY light comes on approximately five seconds.
- 4. Make sure the PROG light comes on approximately three seconds after the RDY light goes on.
- 5. Make sure the COMP light comes on. This is an indication that the software is installed.

Set the selector switch to NORMAL position on the ADL selection panel. Push the EJECT button on the data loader. Remove the diskette.

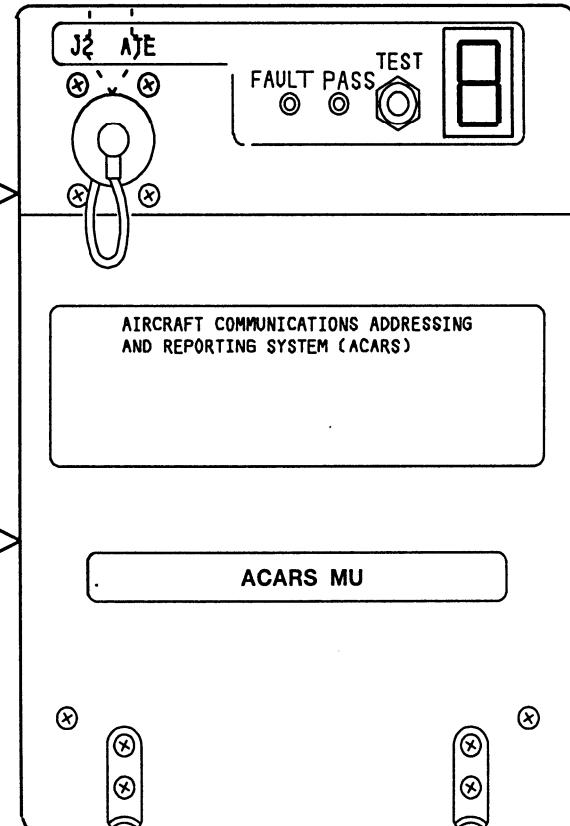
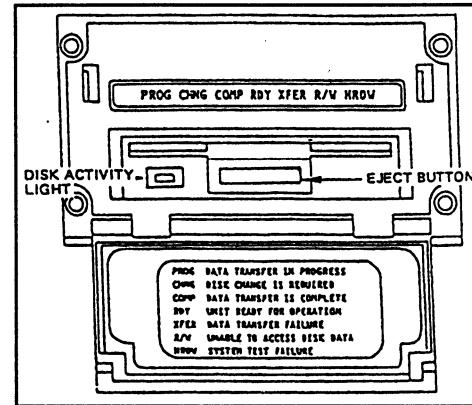
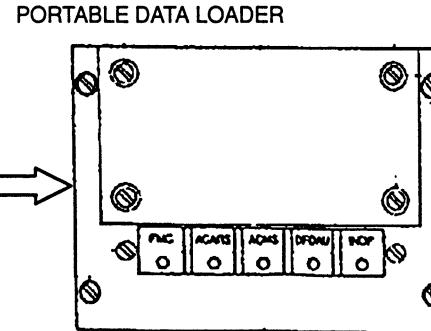
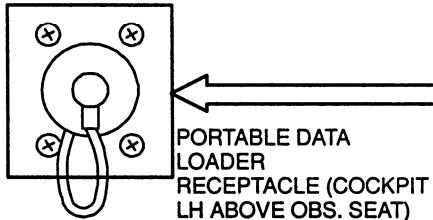
Make sure the software part-number on the ACARS maintenance page is correct, that means this P/N agree with the P/N at the diskette.



DISKETTEN - LABEL

ALTERNATE WAY OF DATALOADING
IF AIRBORNE DATA LOADER, DATA-
LOADER SELECTPANEL IS NOT IN-
STALLED OR INOP.

AIRPLANES WITHOUT
AIRBORNE
DATA LOADER



AIRPLANES WITH
INSTALLED
AIRBORNE DATA
LOADER

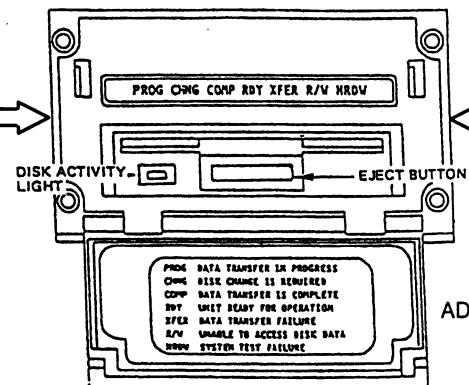
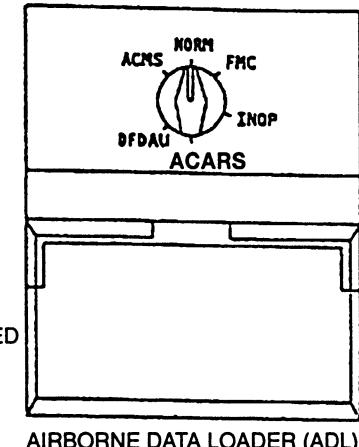


Figure 47 ACARS DATA LOADING

MCDU OPERATION MENU

You obtain the ACARS ERROR LOG page on this way:

ACARS PRFLIGHT MENU, → MISC, → MAINT, → STATUS, → ERROR LOG.

ACARS ERROR LOG

CLASS 1,2, und 3 FAULTS:

The failure with the highest priority occurs at first.

LSK2 L –Zeile: Failure description (LEG, DATE, UTC)

LSK3 L –Zeile: Fault Message Text

LSK5 L–Zeile: Troubleshooting Message Text

LSK5 R–Zeile: Failure-Count

GROUND FAULTS

Failure, occurs on ground. Failures exist after the landing.

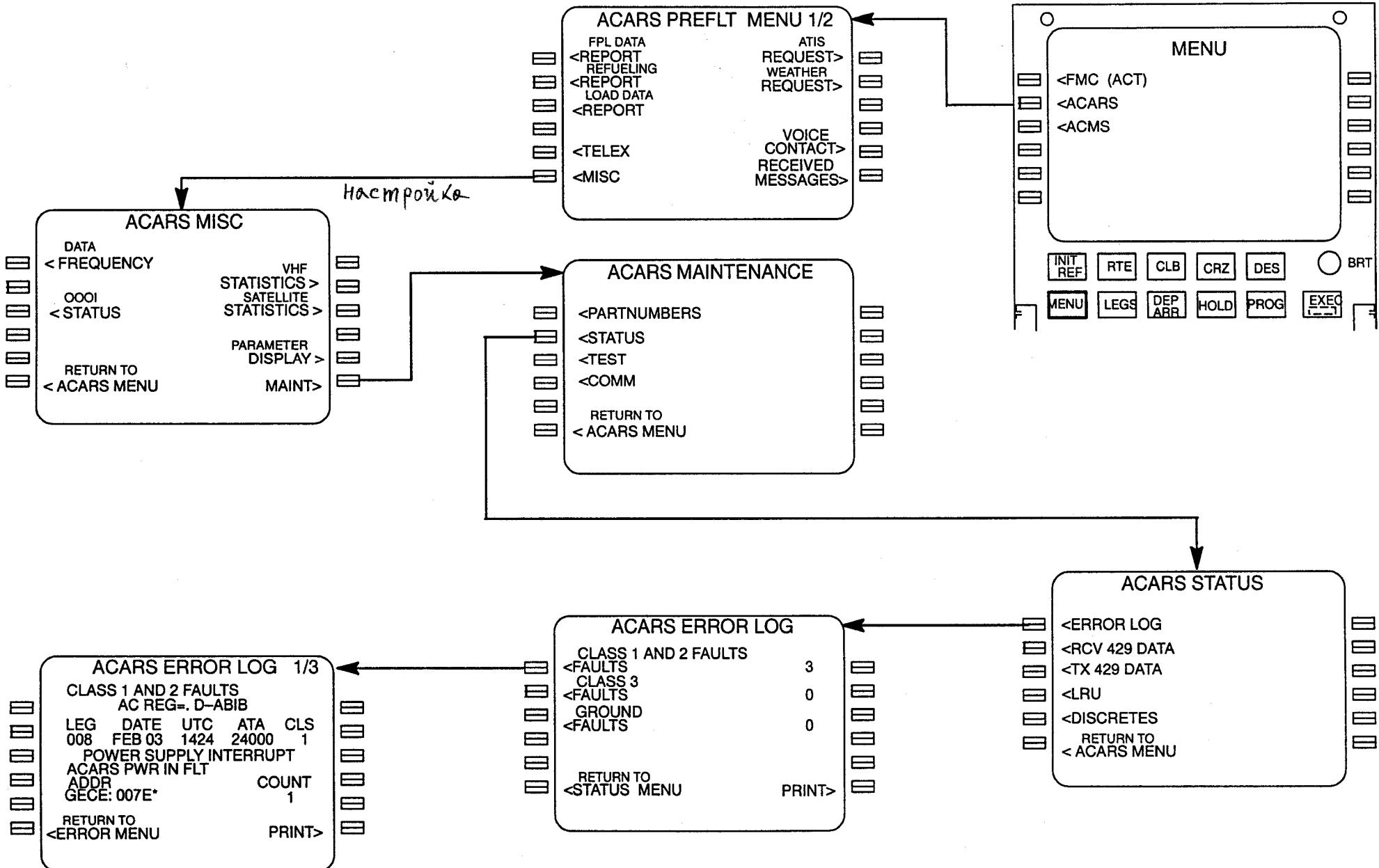


Figure 48 MCDU PAGES: ERROR LOG, FAULTS

ACARS FREQUENCY

This page shows the active ACARS frequency - default is Europe with the frequency of 131.725 MHz. Any other ACARS frequency is selectable by LSK.

The character before the frequency value means:

- A: -automatic selection
- M: -manually selected
- S: -selected by acars ground station
- D: -selected by acars ground station

The message AUTO/MAN FREQ MISMATCH appears in the Scratch Pad , when the manually selected area doesn't agree with the FMC PPOS.

Is a PPOS not available, the message NO LAT/LON, USE MAN FREQ appears.

TEST

On Maintenance Page you get access to the TEST page. On the associated RCP you can see the message ACARS in the active frequency window. That means the ACARS MU is connected to the VHF-3 transceiver.

- LINK TEST: This function activates a Downlink (DL) to test the link to a ground station. Push LSK 1L to activate the test. During the testprocedure, TEST is indicated. If the link is possible, PASS is shown. If there is no connection to a ground station, FAIL is shown. The message INITIATE appears about 5 s after the end of the test.
- PRINTER TEST: This function activates a test printout on the printer.
- COM AUDIT: this function can be switched ON and OFF. If the function is ON, a status report is printed, when a DL or a Uplink (UL) is activated.
- MCDU TEST: This function shows a test indication on the MCDU screen.
- RAM TEST: This function activates internal RAM testing. Indication is PASS or FAIL.

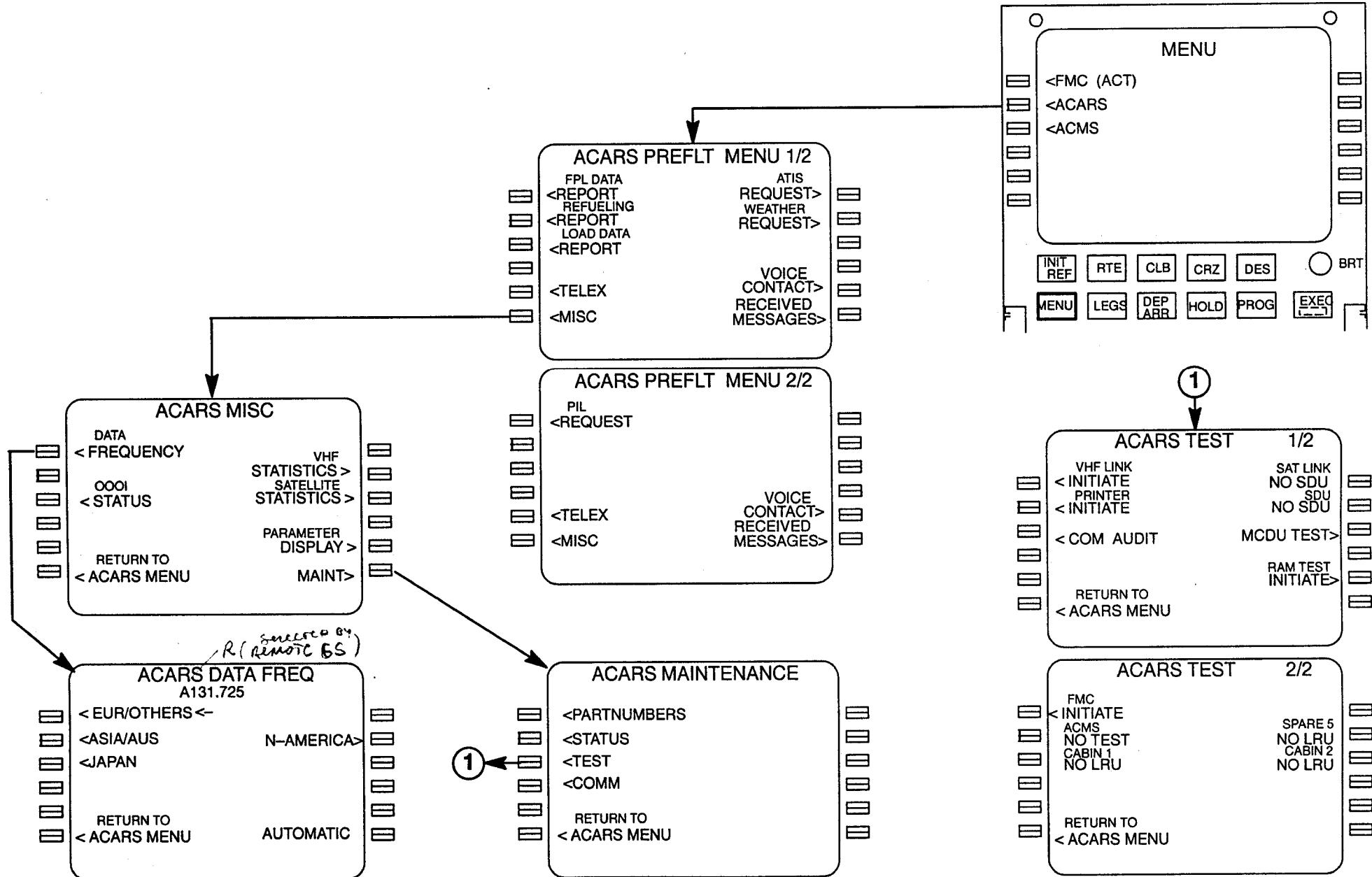


Figure 49 MCDU PAGES: FREQ., TEST

ACARS MAINTENANCE

On Maintenance Page you get access to the following functions: PARTNUMBERS-, STATUS-, COMM Status-and TEST-Pages.

ACARS PARTNUMBER

This page shows all part numbers of the system (hardware and software). The software partnumbers actually in the system and the information on the diskettes must be the same.

ACARS LRU STATUS

Shows all systems connected to the ACARS MU. Active systems are labeled ACTIVE, inactive systems are labeled INACTIVE.

ACARS COMM STATUS

Shows ACARS COMM status via VHF or SAT (LSK 1L/ LSK 1R)

- LSK 2L: COMM or NO COMM
- LSK 3L: DATA or VOICE mode
- LSK 4L: count of unsent DL's

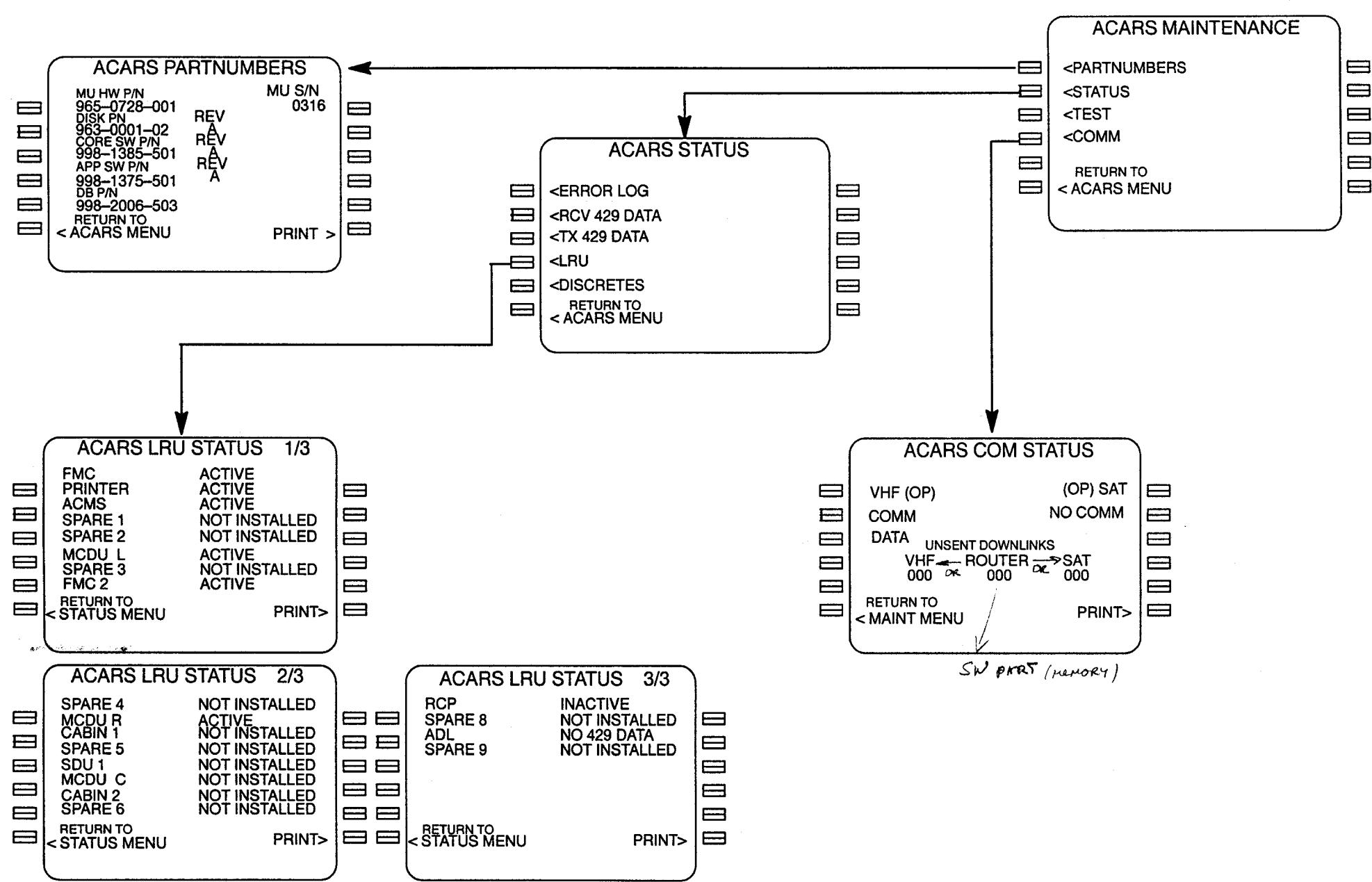


Figure 50 MCDU PAGES: ACARS MAINTENANCE

MU RESET

On the ACARS MAINTENANCE PAGE, you have to insert a special password and press LSK 6R. This will show the ACARS DEBUG page 1. On page 2, you will find the box-prompts MU RESET.

If the word **RESET MU** is entered in SP and LSK 6R is pressed, a COLD START is activated - system reinitialisation !

! WARNING !

Pressing the test knob at the MU initiates also a MU-coldstart. This resets all data the MU is presently working with, including datas entered via the MCDU.

Before you carry out the MU RESET, note the QTY BEFORE fuel data on the ACARS REFUELING REPORT PAGE. After MU RESET, enter this value into the SP (without point) and press the LSK 1R on the MCDU.

Nach Aufruf der REFUELING REPORT Seite wird mittels der MCDU Tasten der alte QTY BEFORE Wert, (abgelesen vor dem Reset der MU), ohne Kommastelle in das Scratch Pad eingegeben und mittels LSK 6R auf das entsprechende Feld gesetzt.

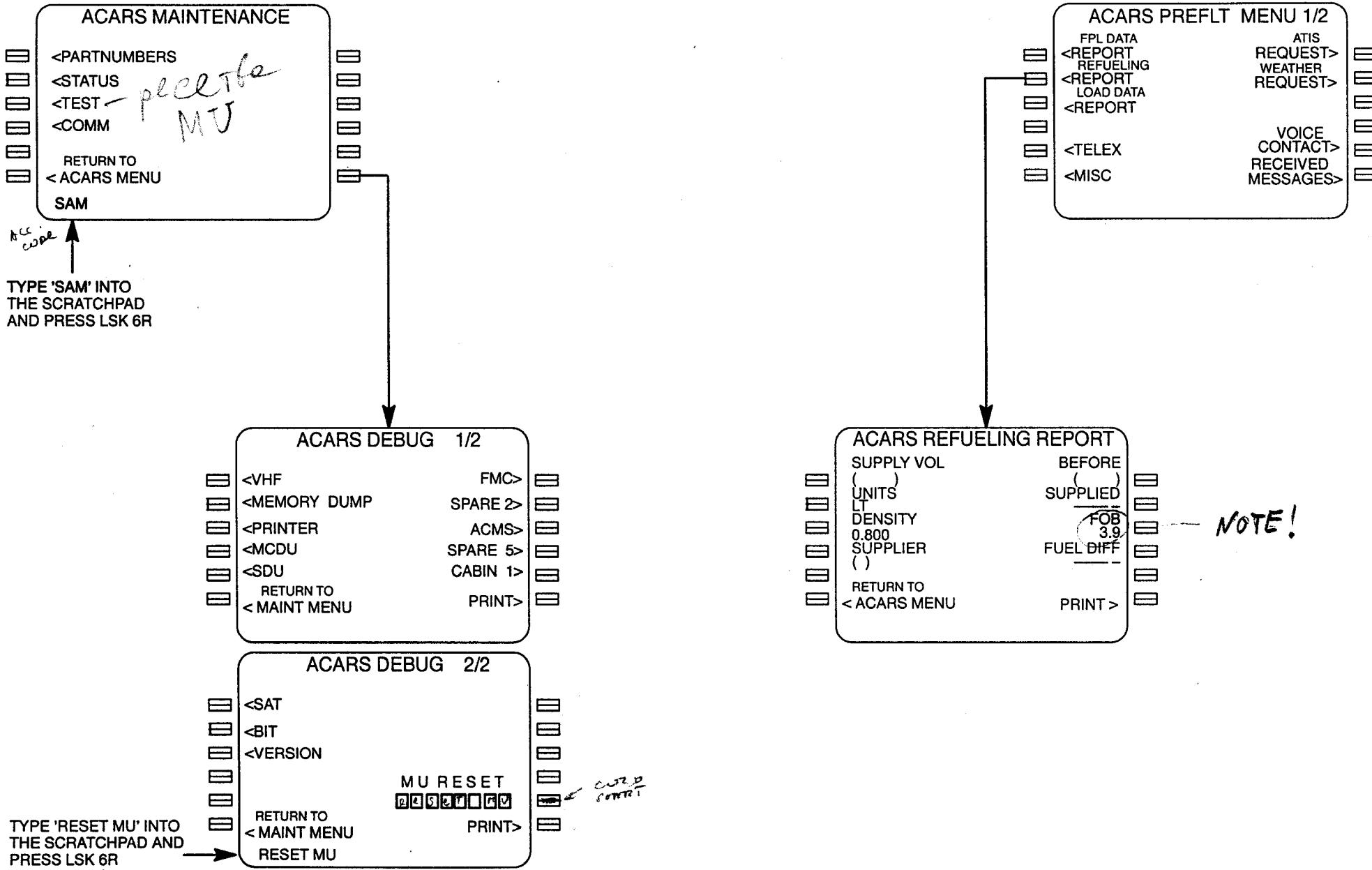


Figure 51 MCDU PAGES: MU RESET, REFUELING REPORT

ACARS TELEX

Sends a TELEX to a predefined or self entered (free telex) address. Enter text and press the SEND pushbutton.

ACARS Voice Contact Request

Sends a voice contact request to a predefined address (the manual selected VHF-2 frequency is part of the transmission data).

ACARS Received Messages

Shows all messages received by the ACARS MU, the latest received on top. Large letter are shown if the message has not been red nor printed, small letters if so.

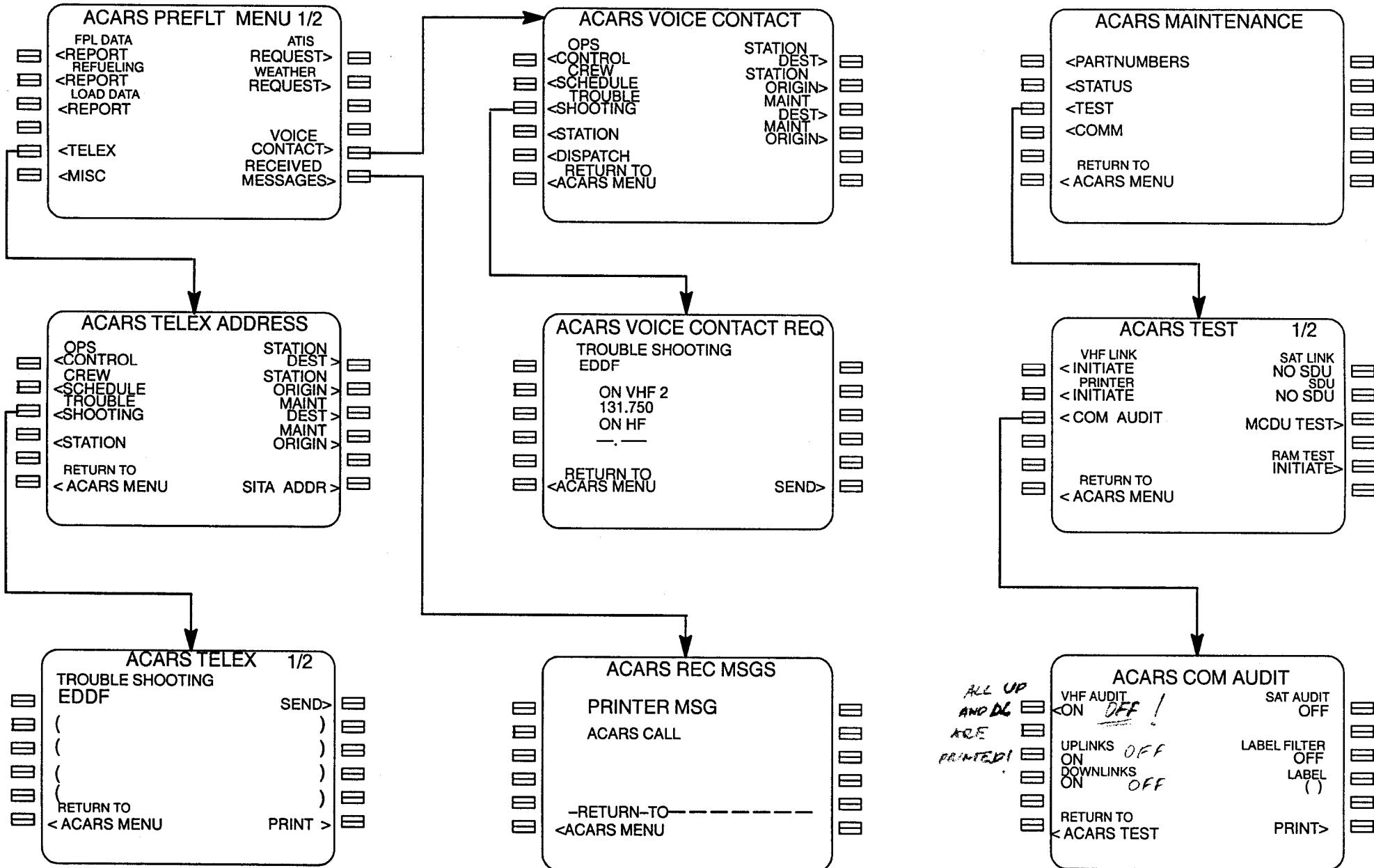


Figure 52 MCDU PAGES

OUT, OFF, ON, IN (OOOI) STATUS Pages

The OOOI reports are generated automatically by the associated sensors.

- OUT: Generation of the "off-block time" - time between OUT (first aircraft movement) and OFF (Air Ground Switch to Flight).
- OFF: Generation of the "airborne time" - Take Off.
- ON: Aircraft ~~Inding~~ *Landing*
- IN: A/C no movement and one door open.

PARAMETER DISPLAY

Shows special internal datas. Examples:

- 002 MU Partnummer
- 013 VHF frequency transmitted on a voice contact request
- 008 Aircraft Tailsign
- 220 FMGC active Data Base

VHF /SAT STATISTICS Pages

RX/TX Lines: Indication how many messages are received or transmitted in the respective OOOI phases.

NAKS (not acknowledged) TX/RX: Indication how many messages transmitted from the aircraft (TX) or transmitted from the ground station (RX) are not acknowledged by the opposite side.

DUP TX: Duplex mode

INC RX: no info, sorry.

NUMBER OF RETRIES :Number of messages transmitted by the airplane with no succes.

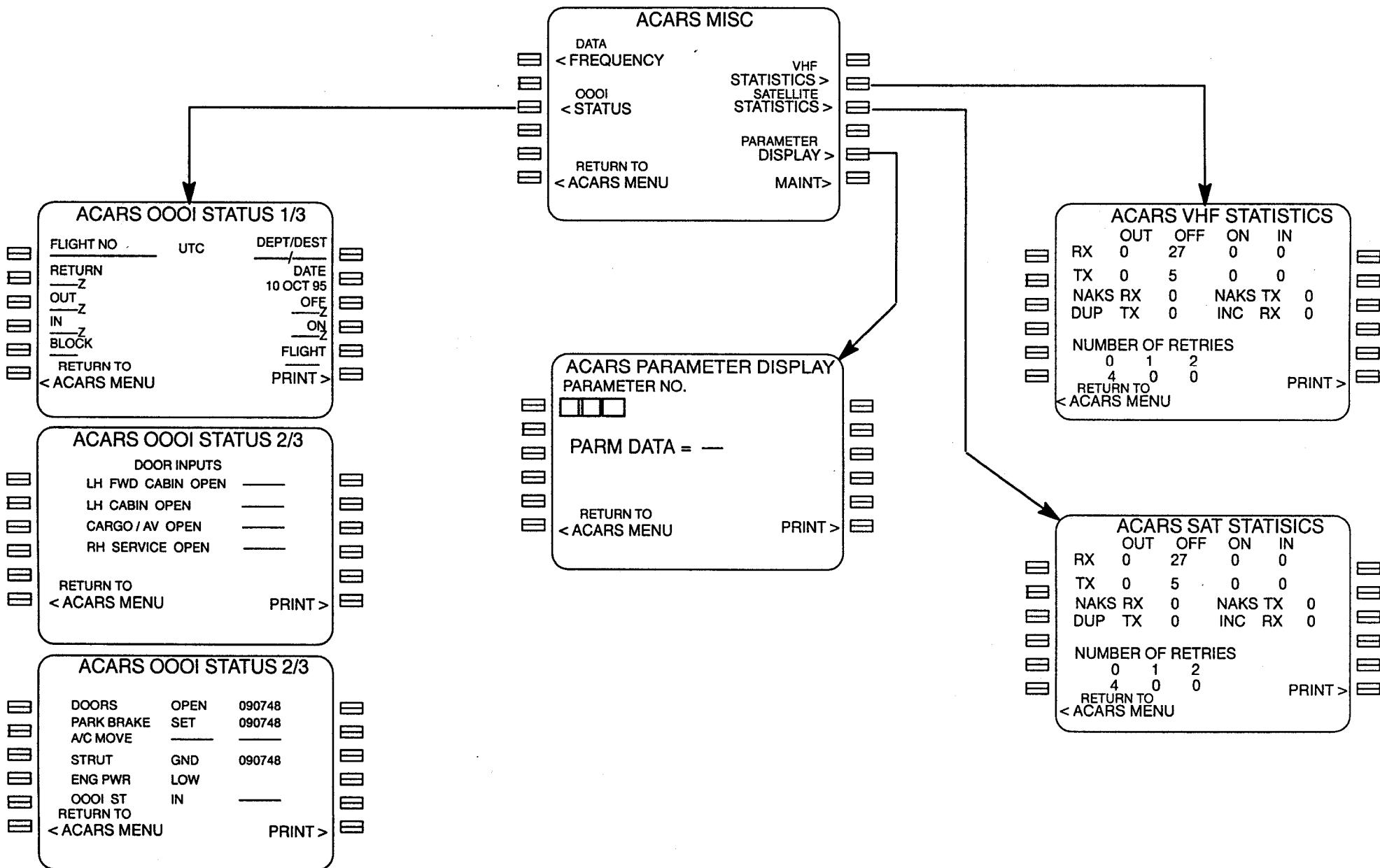


Figure 53 ACARS MCDU-PAGES

ACARS MU FRONT PANEL TEST

After installation, correct operation of the ACARS MU can be checked by using the following controls located on the MU frontface:

PASS/FAULT indicator lights

In normal operation, the lights indicate the actual status of the ACARS MU. In test mode, after a 3s indicator light test, the lights indicate the test result.

7 SEGMENT LED

If a test is activated and a failure is detected, the LED shows a fault code. Examples:

- 3: A/C registration missed (the MU did not receive the A/C registration)
- 2: A/C type mismatch (the A/C type defined in software is different to the pin program information)
- 1: bad H/W part number (the MU partnumber and the pin program information is different)

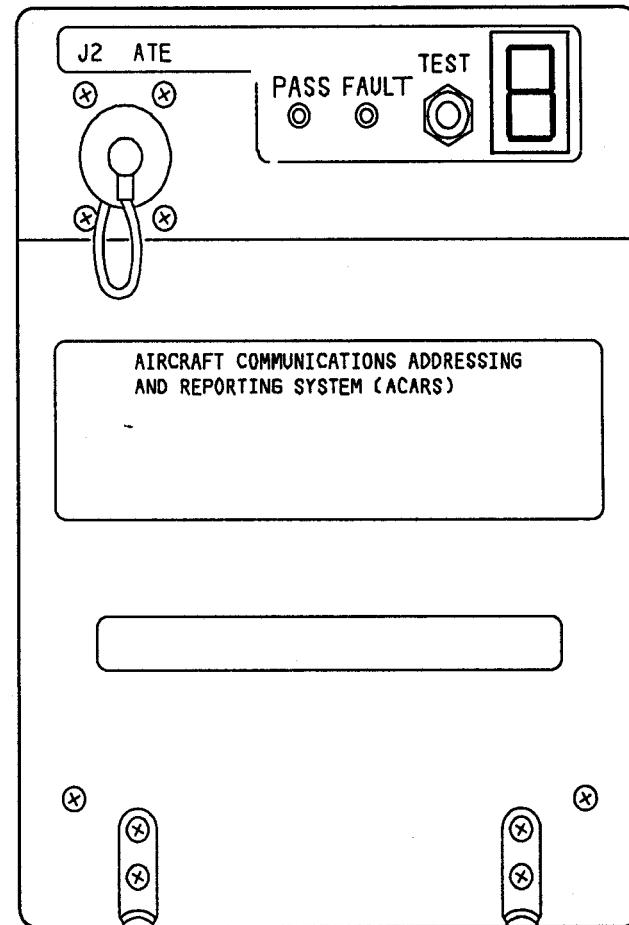
TEST pushbutton

When pressing the test pushbutton switch:

- a ACARS MU "Cold Start" is initiated.
- the LRU PASS and FAULT lights come on for 3s approximately to indicate correct operation.
- the red FAULT light goes off to indicate, that no fault is present. If the red FAULT light remains on and the green light goes off, the system is faulty and shows a fault code on the LED.

WARNING!

Pressing the test knob at the MU initiates a MU-coldstart! This resets all data the MU is presently working with, including data entered via the MCDU!!! /Additional programming is lost!). See also ACARS MU RESET!!!



MAINTENANCE TIPS / TROUBLESHOOTING

MCDU Message: NO COMM

- **Description:** The message NO COMM appears at the scratchpad on the MCDU.
- **Status:** A display of NO COMM does not necessarily indicate an aircraft failure. It does indicate that the data-link air/ground network was not completed. This can be the result of ground station problems or aircraft failures.
The ACARS transmits over the VHF-3 system. If this system is inoperative, or the VHF path between the airplane and the ground station is blocked, the system will go NO COMM.
- **Att. Maint.:**
 - Perform a CB-reset.
 - Perform a LINK test at the ACARS test page.
 - Check the frequency at the ACARS frequency page. Make sure that ACARS is set to the correct data link frequency (Europe: 131,725 Mc). !
 - Set ACARS in the VOICE mode. At the standby window of the RCP appears ACARS and at the scratchpad of the MCDU appears ACARS VOICE. Check the quality of the voice-connection with the ground operator.
 - Perform a ACARS MU RESET at the DEBUG Page 2/2.