

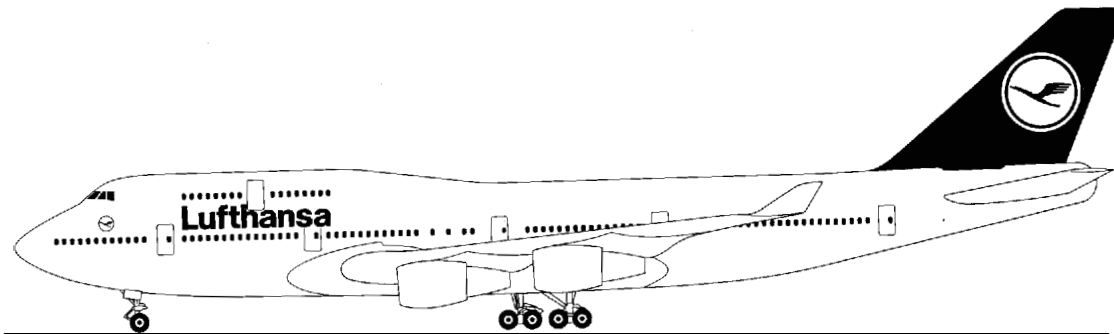


Lufthansa Technical Training

Training Manual B 747-400

ATA 34-16 Altitude Alert System

ATA Spec. 104 Level 3



Book No:

Lufthansa
Technical Training GmbH
Lufthansa Base

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ATA 34-16 ALTITUDE ALERT

ALTITUDE ALERT



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INTRODUCTION

The altitude alert system provides the flight crew with aural and visual indications when the airplane approaches (ADVISE) or deviates (ALERT) from the automatic flight control system (AFCS) mode control panel (MCP) selected altitude. The altitude alert function is performed by the crew alerting card in the modular avionics warning electronics assembly (MAWEA).

ALTITUDE ALERT

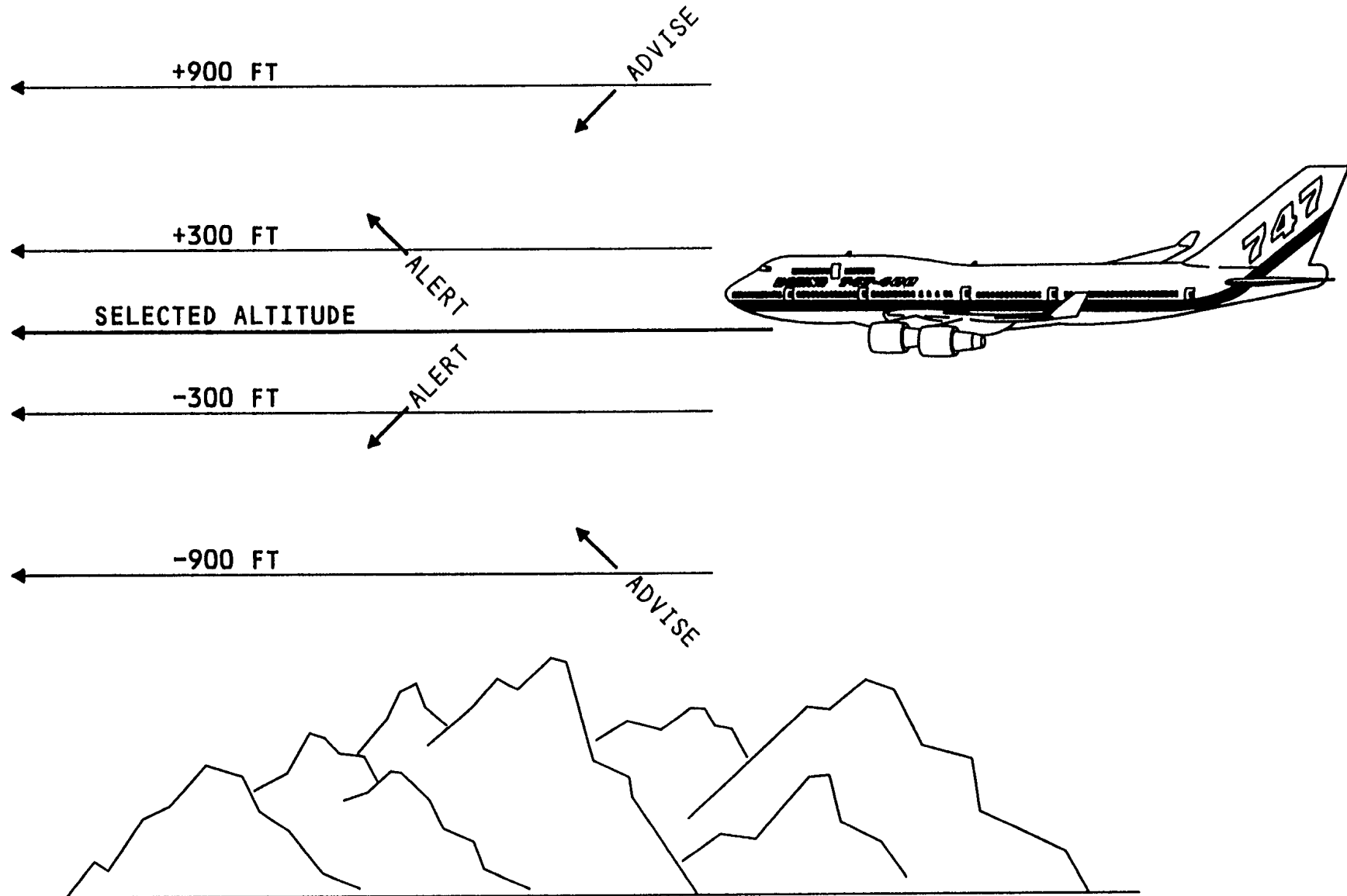


Figure 1 INTRODUCTION

ALTITUD ALERT



ALTITUDE ALERT SYSTEM

General

The altitude alert system provides the flight crew with visual indications on the primary flight display (PFD) when the airplane approaches the altitude selected on the mode control panel (MCP) (ADVISE). Visual alerts are provided on the PFD, main EICAS display and master caution lights when the airplane deviates from the selected altitude (ALERT). An aural warning accompanies the visual alert. The crew alerting card compares selected altitude from the MCP with baro-corrected altitude from the air data computers (ADCs). Failure of the altitude alert function is monitored on the auxiliary EICAS status page.

System Interface

Input signals to the crew alerting card are:

- Flaps in landing range
- Landing gear down and locked
- Parking brake set switch
- Captain's ADC source select
- ADC baro-corrected altitude
- Selected altitude, glideslope capture and FCC in command from the MCP

Outputs from the crew alerting card are:

- Altitude alert, altitude advise and altitude alert inoperative to the EIUs
- Altitude alert discrete to the aural synthesizer cards for a caution aural
- Maintenance data to the central maintenance computers

ALTITUD ALERT



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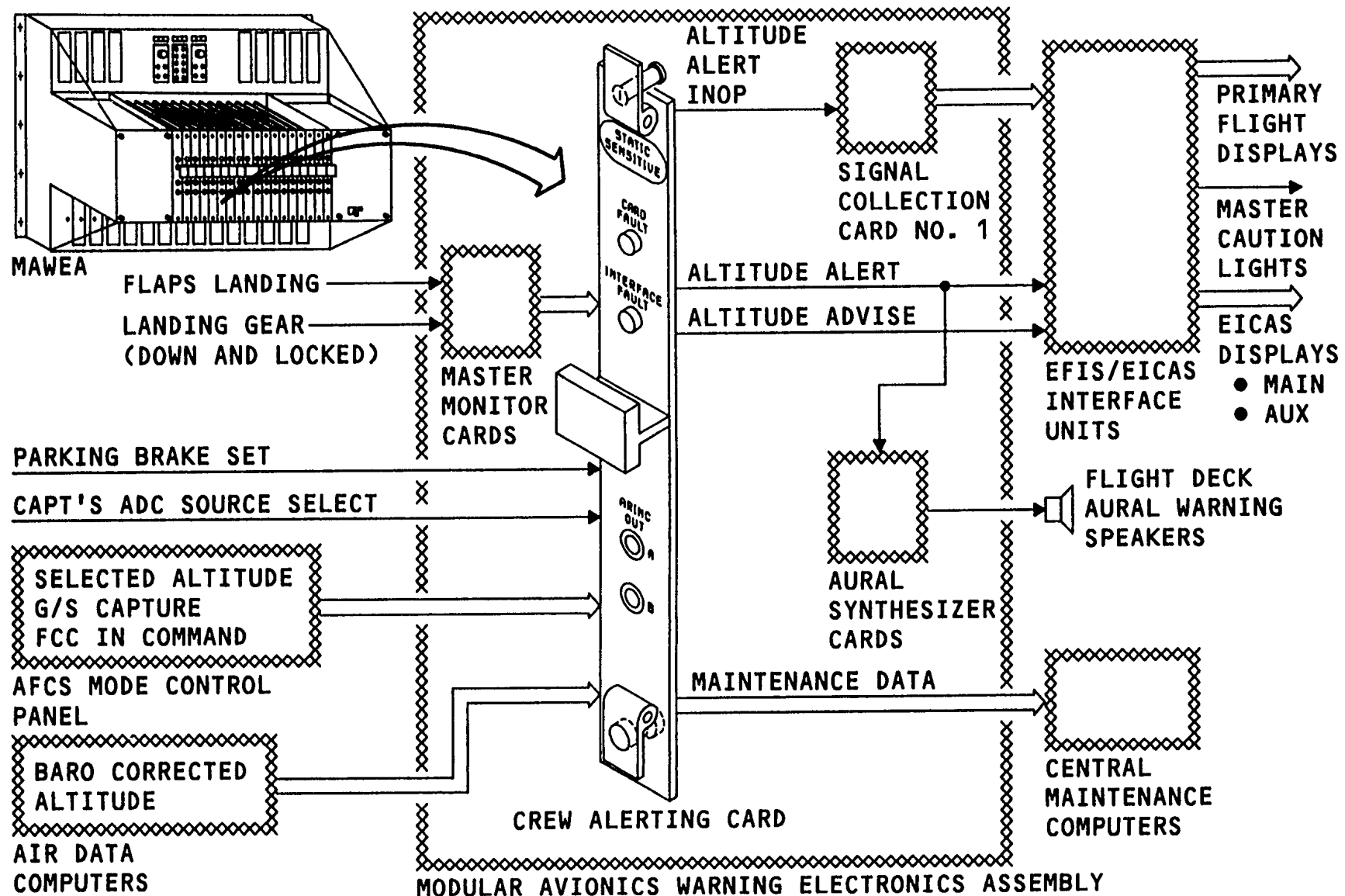


Figure 2 ALTITUDE ALERT SYSTEM

ALTITUDE ALERT



COMPONENT LOCATIONS

The main altitude alert system component is the crew alerting card installed in the MAWEA.

Interfacing components are:

- MAWEA PWR A circuit breaker
- MAWEA PWR B circuit breaker
- AURAL WARN L circuit breaker
- AURAL WARN R circuit breaker
- Captain's aural warning speaker
- First officer's aural warning speaker
- Captain's master caution light
- First officer's master caution light
- Captain's primary flight display
- Captain's ADC source select switch
- First officer's primary flight display
- AFCS mode control panel
- Main EICAS display
- Auxiliary EICAS display

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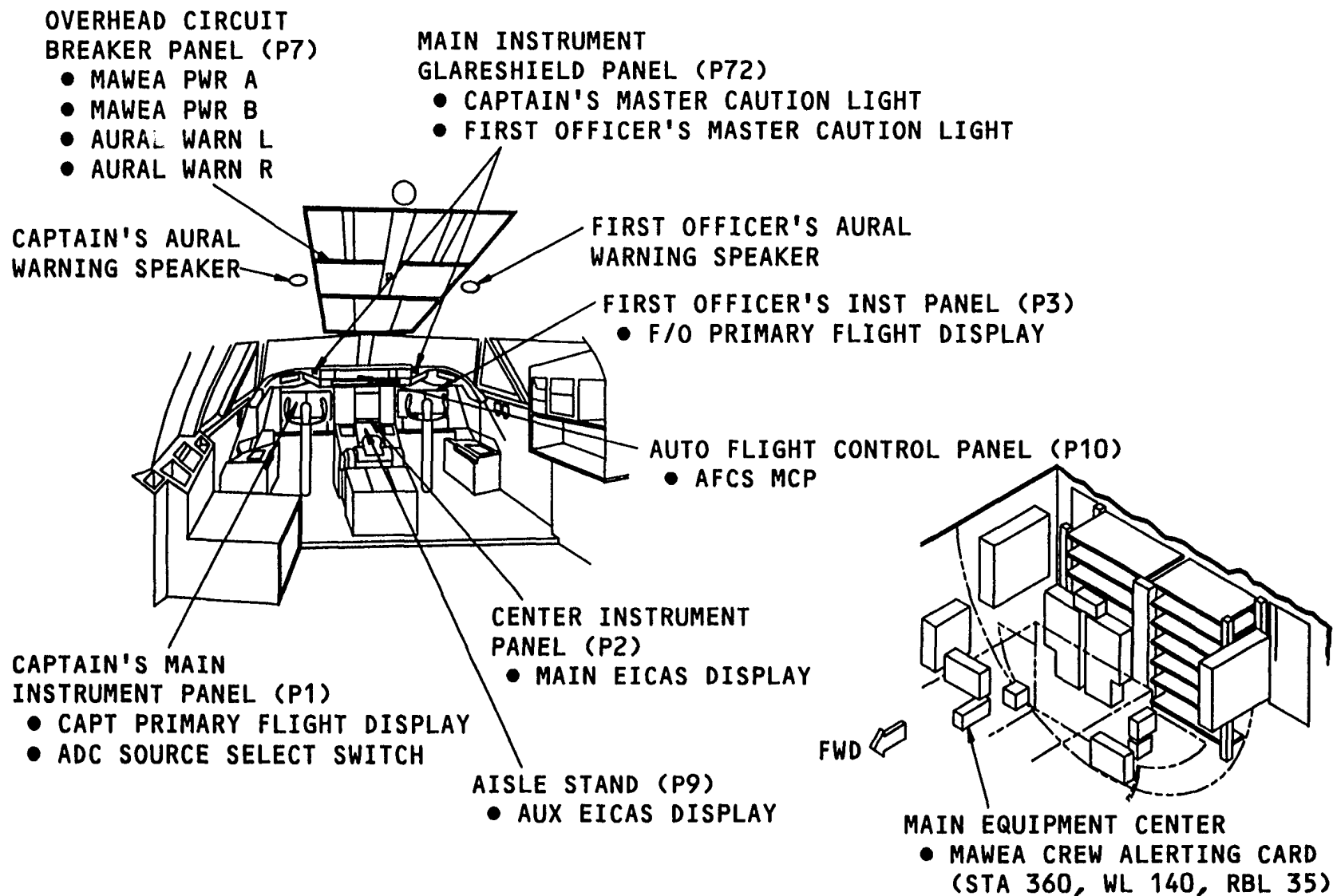


Figure 3 COMPONENT LOCATIONS



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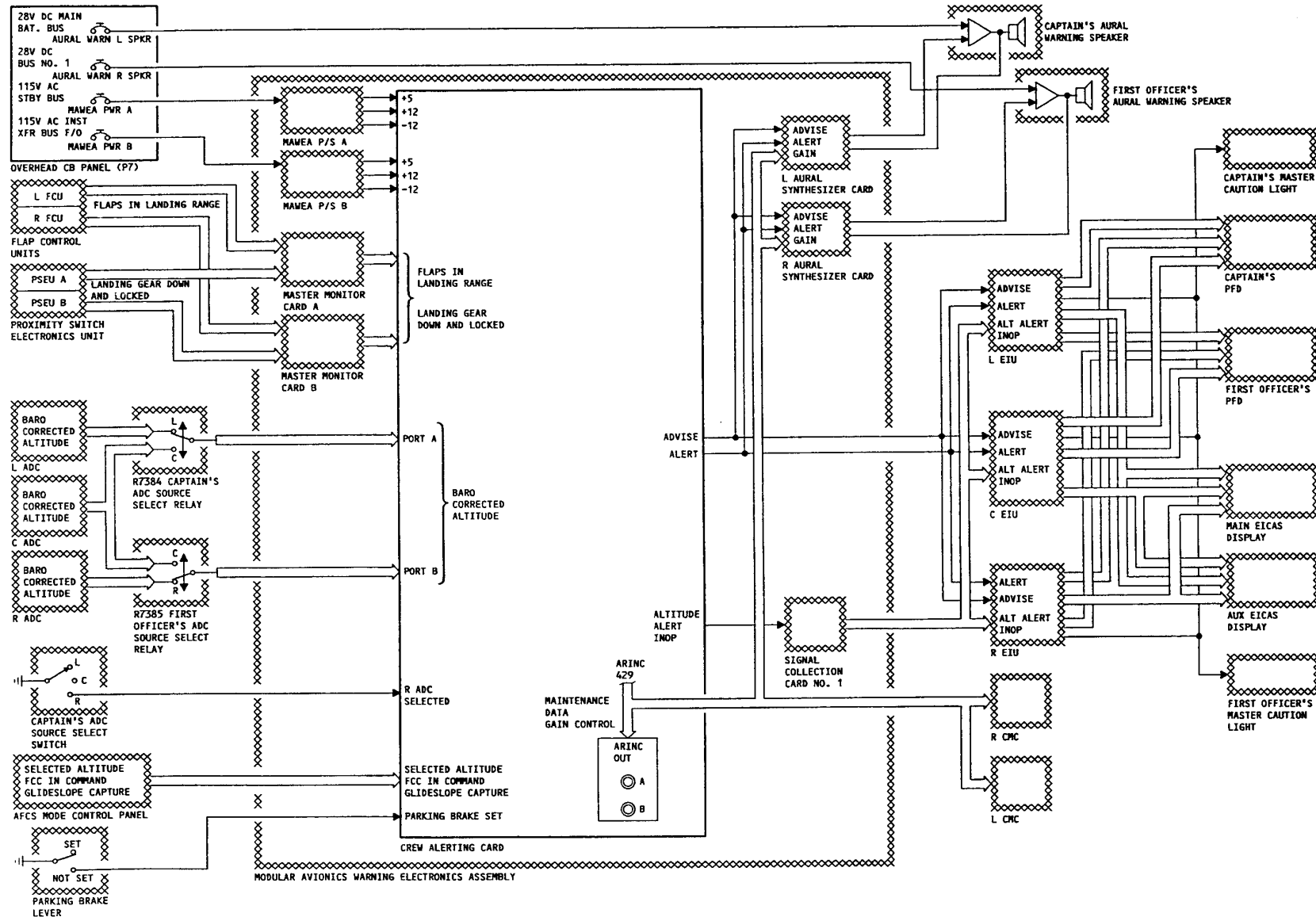


Figure 4 INTERFACE DIAGRAM

ALTITUDE ALERT



INPUTS - 1

Air Data Computer Inputs

The crew alerting card gets barocorrected altitude data on its port A and port B inputs.

Port A gets baro-corrected altitude from the:

- Left air data computer, or
- Center air data computer

The left ADC is the normal source to port A. The captain's ADC source select relay provides an alternate input from the center ADC.

Port B gets baro-corrected altitude from the:

- Right air data computer, or
- Center air data computer

The right ADC is the normal source to port B. The first officer's ADC source select relay provides an alternate input from the center ADC.

Captain's ADC Source Select Switch

The captain's ADC source select switch sends a port select discrete to the crew alerting card. The crew alerting card uses this discrete to select barocorrected altitude from port A or port B. With the switch in the left or center position, port A is selected. With the switch in the right position, port B is selected.

If a flight control computer (FCC) is in command, it overrides the port select discrete.

AFCS Mode Control Panel Inputs

The AFCS mode control panel (MCP) sends this data to the crew alerting card:

- Selected altitude
- AFCS glideslope capture
- Left, center or right FCC in command

ALTITUDE ALERT

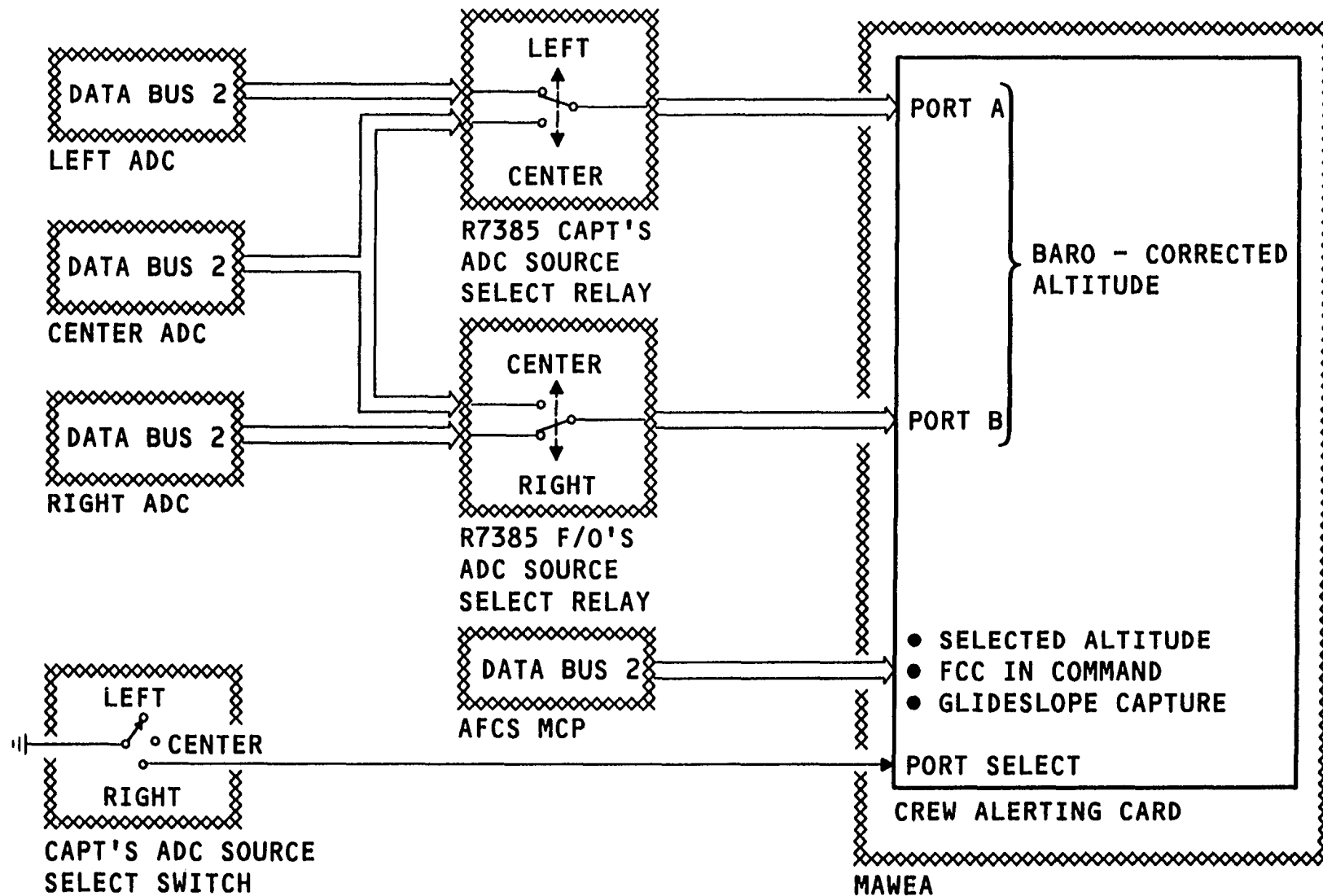


Figure 5 INPUTS - 1



ALTITUDE ALERT

INPUTS - 2

Electrical Power

The crew alerting card receives +5v dc, and +/- 12v dc from :

- MAWEA power supply A
- MAWEA power supply B

If one power supply fails, the other provides power to the crew alerting card.

Power supply module A receives 115v ac input from the standby bus.

Power supply module B receives 115v ac input from the first officer's instrument transfer bus.

Master Monitor Card Input

Master monitor cards A (MMA) and B (MMB) provide these inputs to the crew alerting card:

- Flaps in landing configuration
- Landing gear down and locked

The landing gear down and locked signal comes from the proximity switch electronics unit (PSEU).

The flaps in landing configuration

signal comes from the left and right flap control units (FCUs).

The altitude alert function is inhibited when the:

- Landing gear is down and locked, and the flaps are in landing configuration, or
- Glideslope is captured.

Parking Brake Switch

The SET status signal is provided by the parking brake switch. The set signal removes the altitude alert inhibit and allows an operational check of the altitude alert system.

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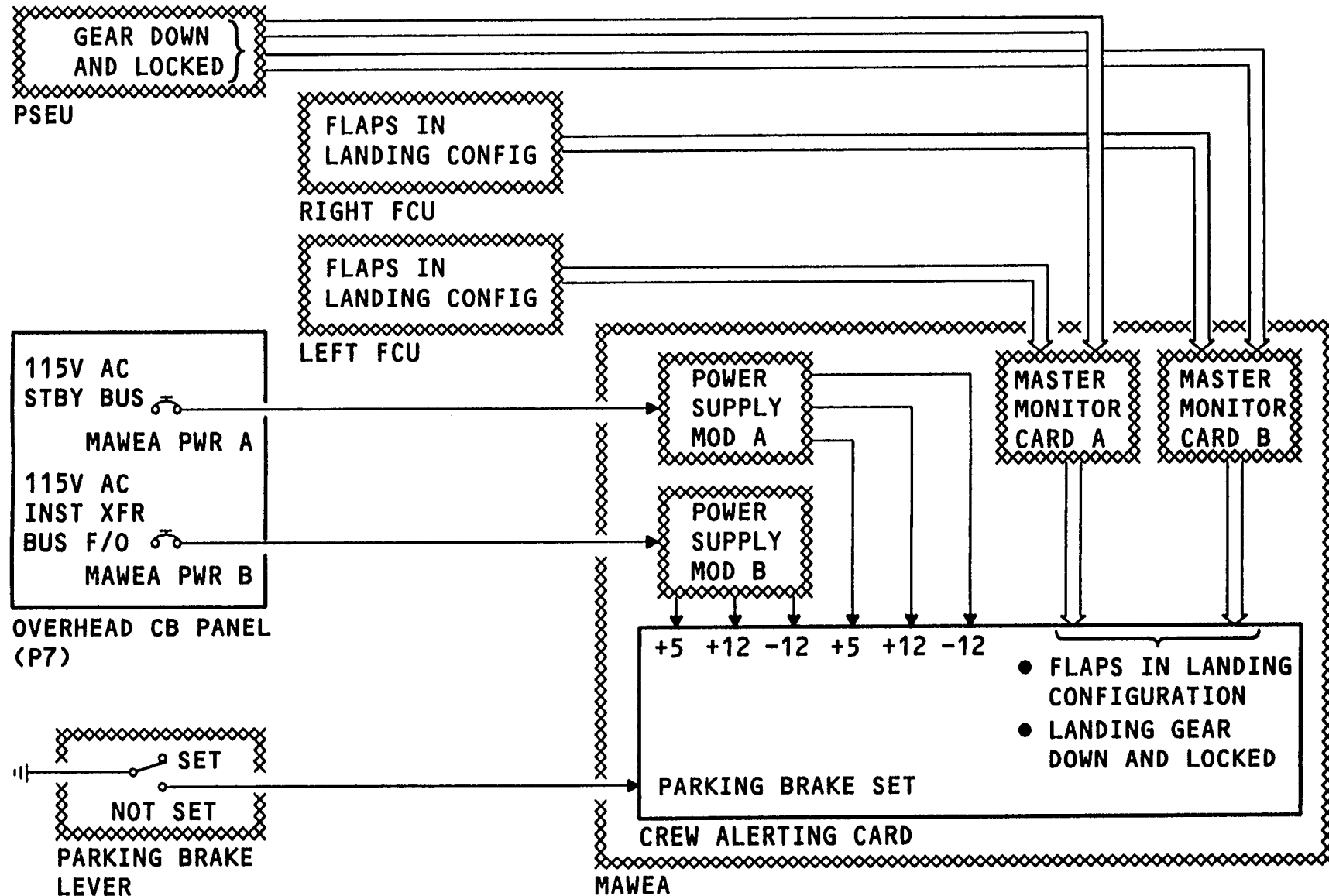


Figure 6 INPUTS - 2

ALTITUDE ALERT



OUTPUTS

ARINC 429

One ARINC 429 data bus from the crew alerting card provides output data for gain control and system status to:

- The left and right central maintenance computers (CMC)
- The left and right aural synthesizer card (ASC) in the MAWEA
- The ARINC 429 test jacks on the front of the crew alert card

Faults within the altitude alert system show on these CMC pages:

- Existing faults page
- Present legs fault page
- Fault history page

Discrete Outputs

Advise and alert discretes from the crew alerting card go to the right, center and left EFIS/EICAS interface units (EIU). The alert discrete also goes to the left and right aural synthesizer cards (ASC)

The discrete outputs to the EIUs provide PFD color and display change and an EICAS message display. Also, the EIUs control the master caution lights.

An ALT ALERT INOP signal is sent to the EIUs through the signal consolidation card (SCID) No.1. This signal will cause an ALT ALERT SYS status message to be shown on the auxiliary EICAS status page display.

The left and right ASCs provide these aural annunciations to the aural warning speakers:

- A level B aural sound (beep-beepbeep-beep) for 0.8 seconds during alert
- A 1000 Hz tone during the power-up bite test

Feedback from the aural warning speakers allows the ASC to do a check on speaker integrity during the power-up BITE test.

ALTITUDE ALERT

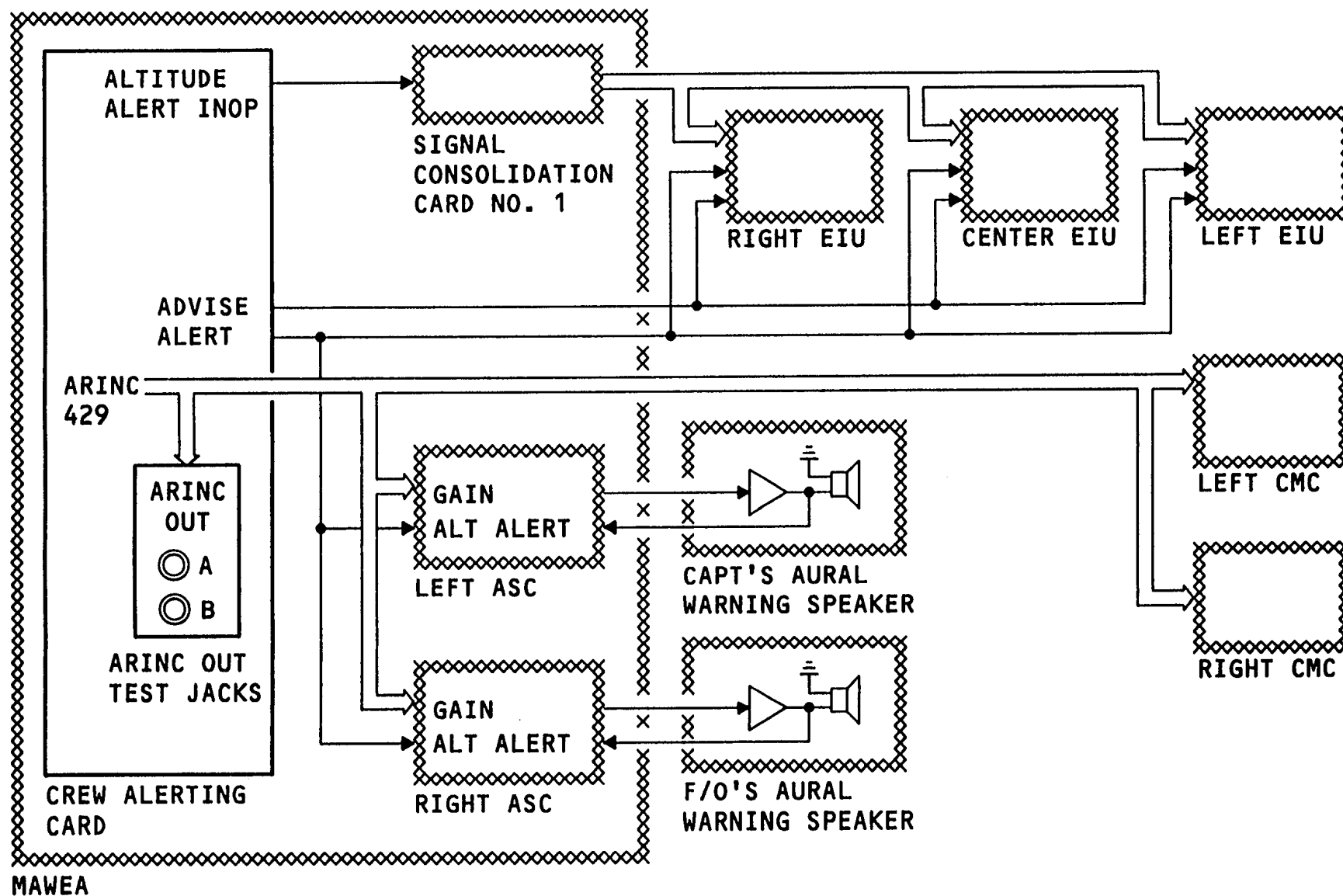


Figure 7 OUTPUTS

ALTITUDE ALERT



CREW ALERTING CARD

Description

The altitude alert system function is performed by the crew alerting card. This card is installed in the MAWEA. Power for this card is provided by the MAWEA power supplies.

On the front of the crew alerting card are:

- A red Light Emitting Diode (LED) that shows a card fault
- A yellow LED that shows an interface fault
- ARINC 429 test jacks
- Two card extraction tabs
- Two hold-down screws
- A carrying handle

Maintenance Practices

Before removal/installation of the crew alerting card, MAWEA PWR A and MAWEA PWR B circuit breakers must be pulled.

The two card extraction tabs allow for easy removal of the module.

CAUTION: STATIC SENSITIVE. DO NOT HANDLE BEFORE READING PROCEDURE FOR HANDLING ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (REF MM 20-41-01). CONTAINS DEVICES THAT CAN BE DAMAGED BY STATIC DISCHARGE.

ALTITUDE ALERT

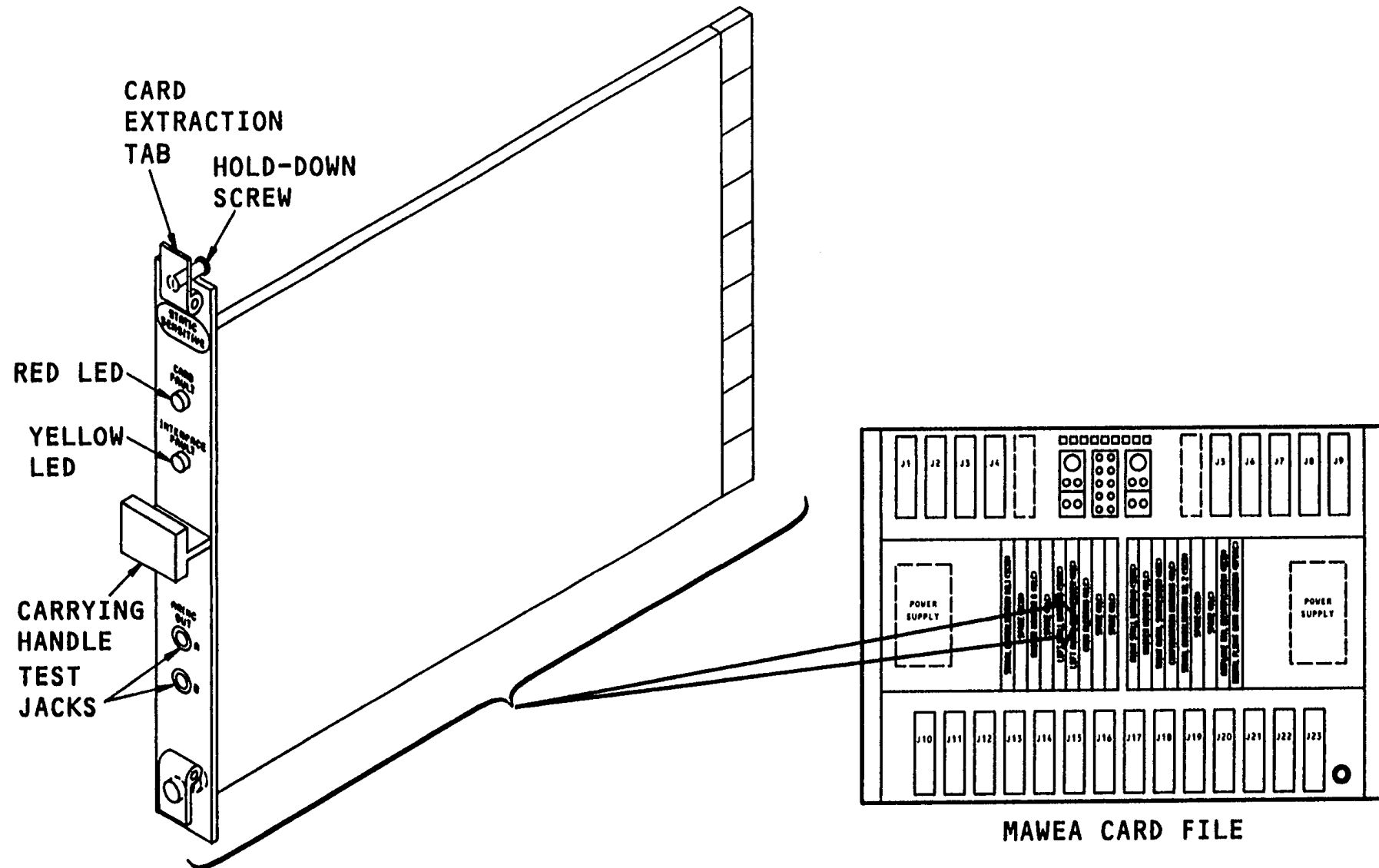


Figure 8 CREW ALERTING CARD

ALTITUDE ALERT



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MCP ALTITUDE SELECT

The altitude select control is on the AFCS mode control panel. The selected altitude shows above the select knob.

Rotation of the select knob changes the selected altitude. The selected altitude is the reference for aural and/or visual alert and advise functions.

ALTITUDE ALERT

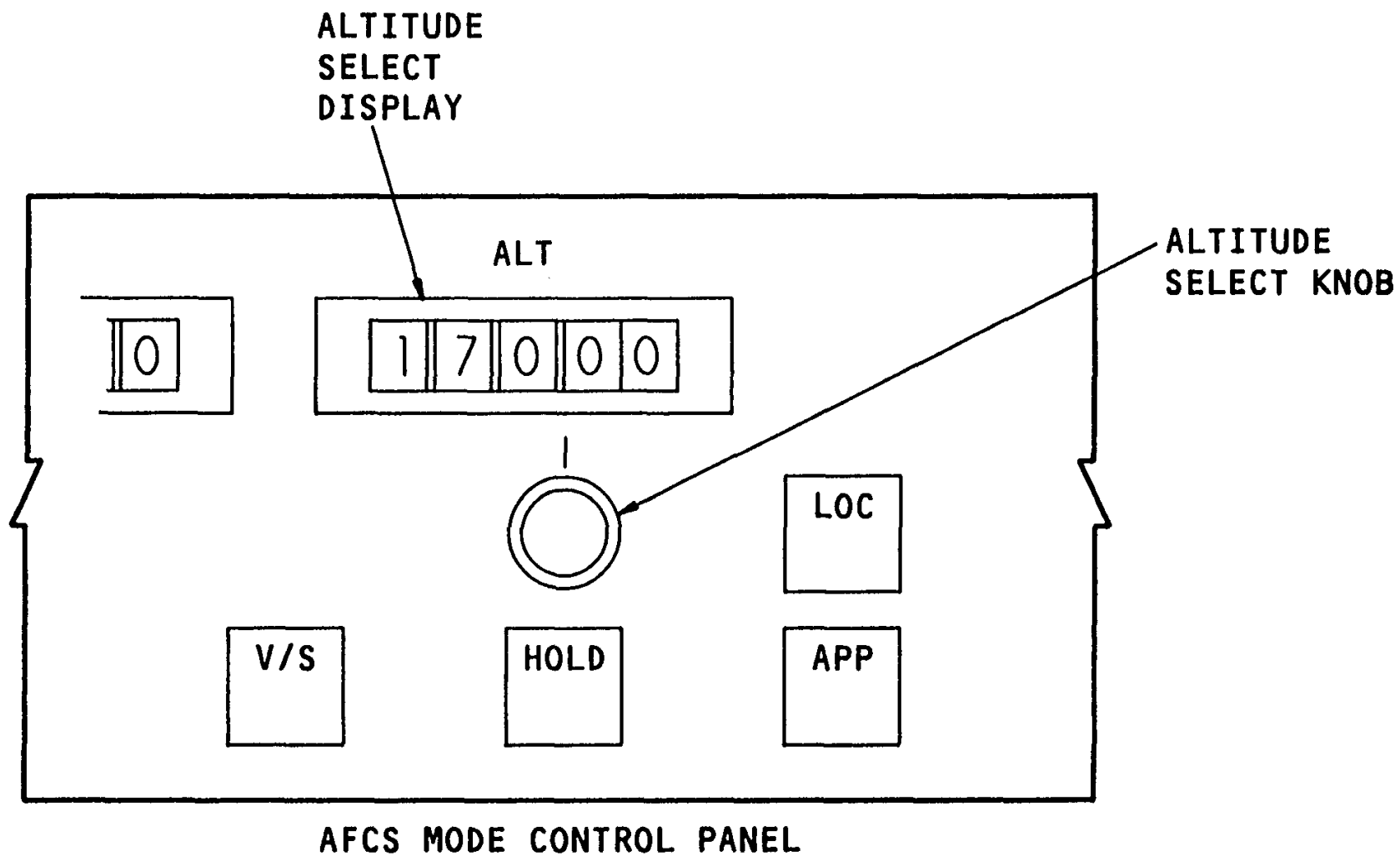


Figure 9 MCP ALTITUDE SELECT

ALTITUDE ALERT



PRIMARY FLIGHT DISPLAY

Selected Altitude Display

On the Primary Flight Display (PFD), AFCSselected altitude shows above the vertical altitude scale. The color of this display is magenta.

When the airplane is less than 900 feet but more than 300 feet from the selected altitude, the display is enclosed by a white box (advisory/approach mode only).

Selected Altitude Bug

The selected altitude bug is magenta. The bug points to the selected altitude when that altitude appears on the PFD altitude scale.

When selected altitude goes off the scale, half of the bug remains in view at the top or the bottom of the altitude scale.

Altitude Readout Box

The display is usually white, half intensity, single stroke except as noted in the following:

- White, full intensity, triple stroke width when the airplane is less than 900 feet but greater than 300 feet from the selected altitude (advisory/approach mode)
- Yellow, full intensity, double stroke width when the airplane goes more than 300 feet but less than 900 feet from the selected altitude (alert/deviation mode)

ALTITUDE ALERT

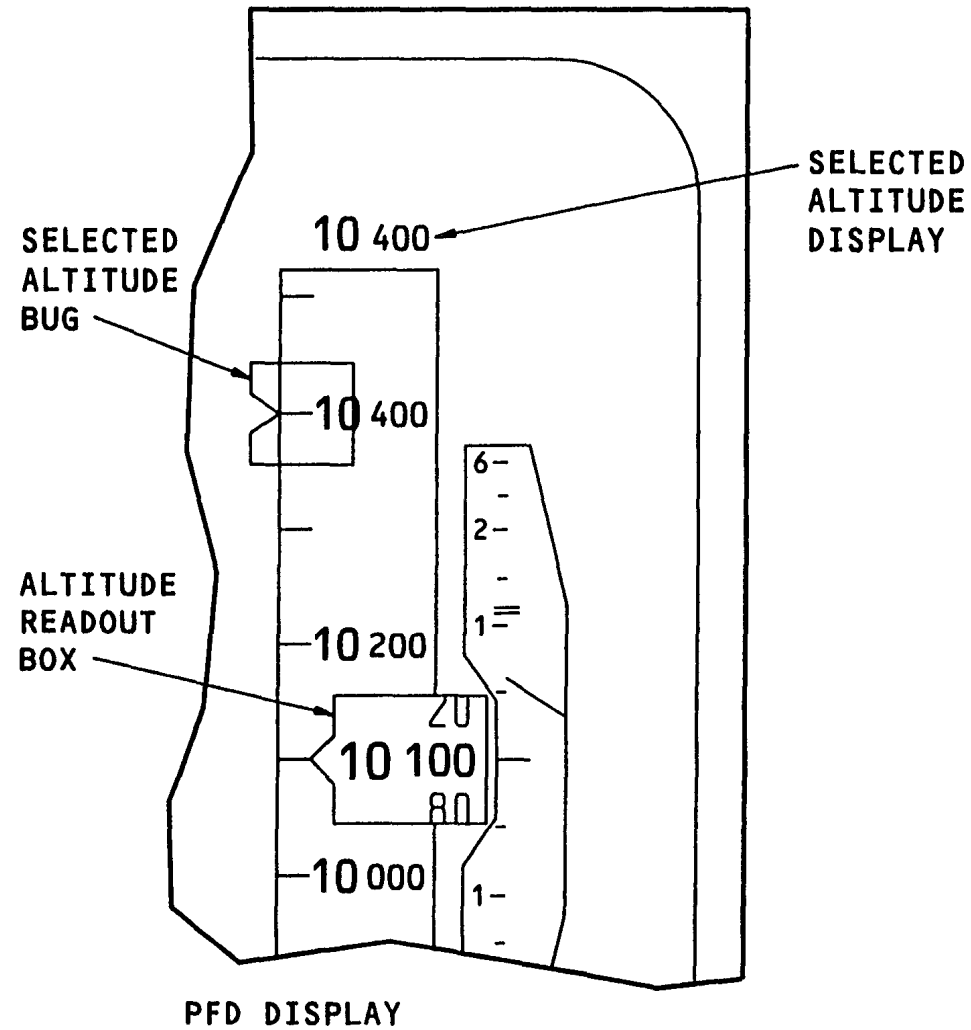


Figure 10 PRIMARY FLIGHT DISPLAY

ALTITUDE ALERT



CAUTION INDICATIONS

When the airplane goes more than 300 feet from the selected altitude:

- ALTITUDE ALERT message (amber) shows on the main EICAS display.
- Master caution lights (amber) turn on. May be reset by a push of either master caution light/switch.
- Caution aural (owl) sounds.

ALTITUDE ALERT

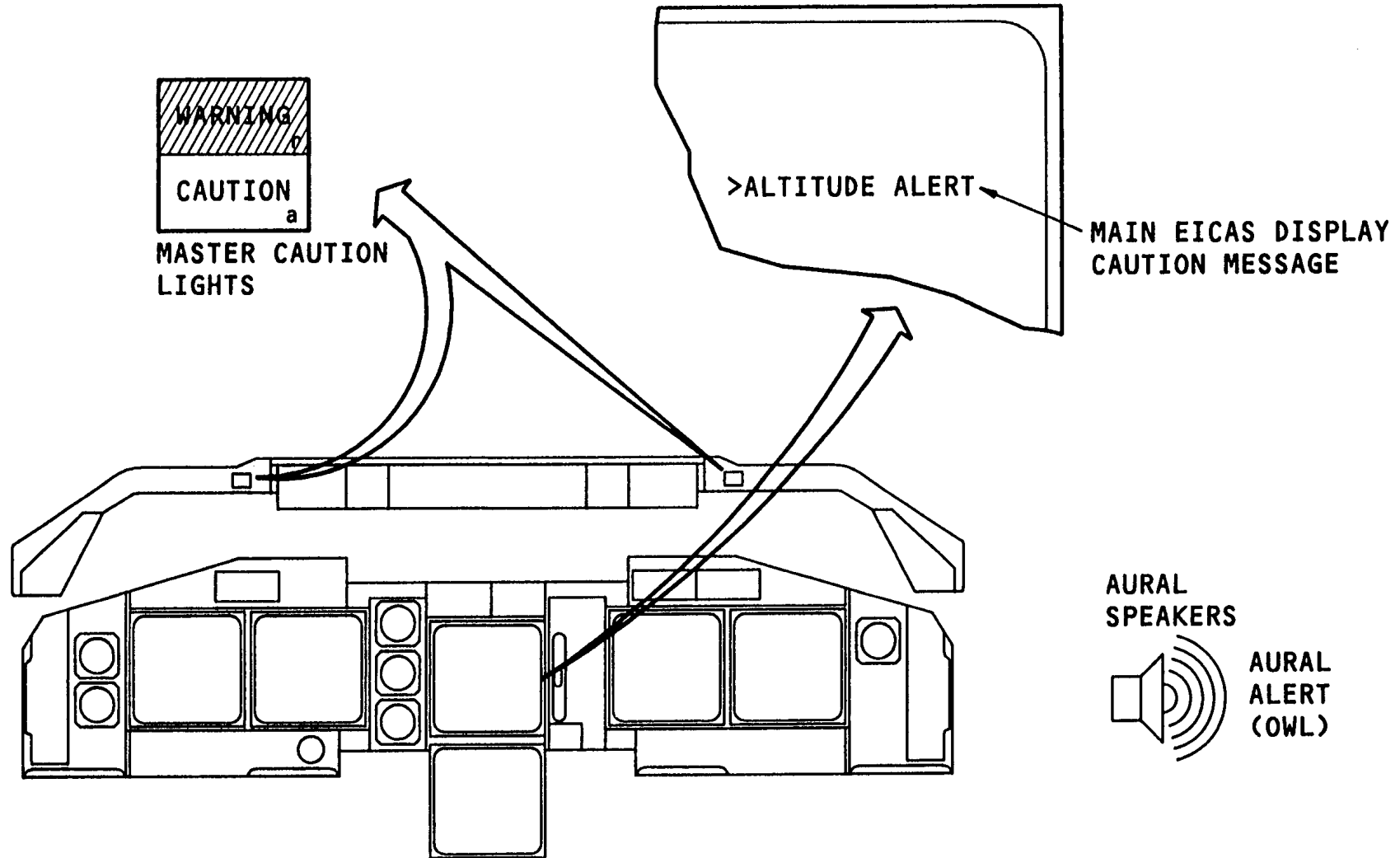


Figure 11 CAUTION INDICATIONS



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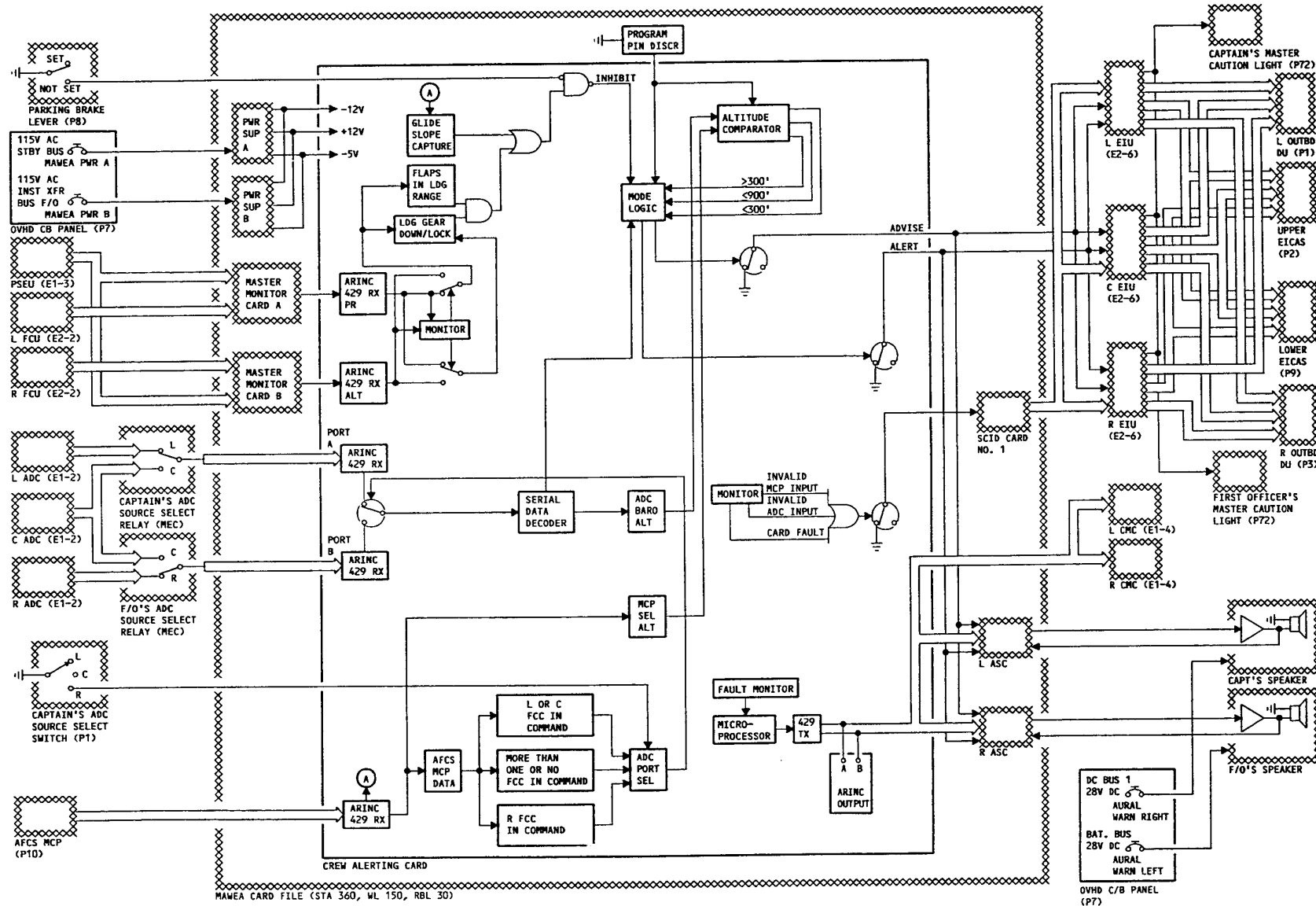


Figure 12 ALTITUDE ALERT – SCHEMATIC

ALTITUDE ALERT



ALTITUDE ALERT OPERATION

General

The altitude alert system provides the pilots with visual and aural alerts when an approach or deviation is made to/from the selected altitude on the AFCS MCP.

Approach/Advise Mode

The magenta selected altitude display will be enclosed by a white box when the airplane is less than 900 feet but more than 300 feet from the selected altitude. The white altitude readout box goes to a full intensity, triple stroked display.

Capture /Arm Mod

When the airplane is less than 300 feet from the selected altitude, the white box is removed and the altitude readout box returns to a normal display.

Deviation/Alert Mode

When the airplane departs from the selected altitude by 300 feet or more, a caution aural is heard, the master caution lights come on, and an amber ALTITUDE ALERT message shows on the main EICAS display. The altitude readout box on the PFD changes from white to a yellow box, full intensity, double stroked display. When the airplane returns to less than 300 feet:

- The EICAS message turns off
- The master caution lights turn off
- The altitude readout box returns to a normal display

When the airplane goes more than 900 feet above or below the selected altitude:

- The altitude readout box returns to a normal display.
- The EICAS ALTITUDE ALERT message turns off.
- The master caution lights turn off.

Inhibit Mode

The altitude alert cautions are inhibited:

- When the landing gear is down and locked and flaps are in landing range
- When there is an AFDS glide slope capture

Reset Mode

The altitude alert system will reset:

- When the airplane is at 900 feet above or below the selected altitude
- When the pilot changes the selected altitude on the AFCS MCP

When reset, the system is ready for the approach/advise mode.

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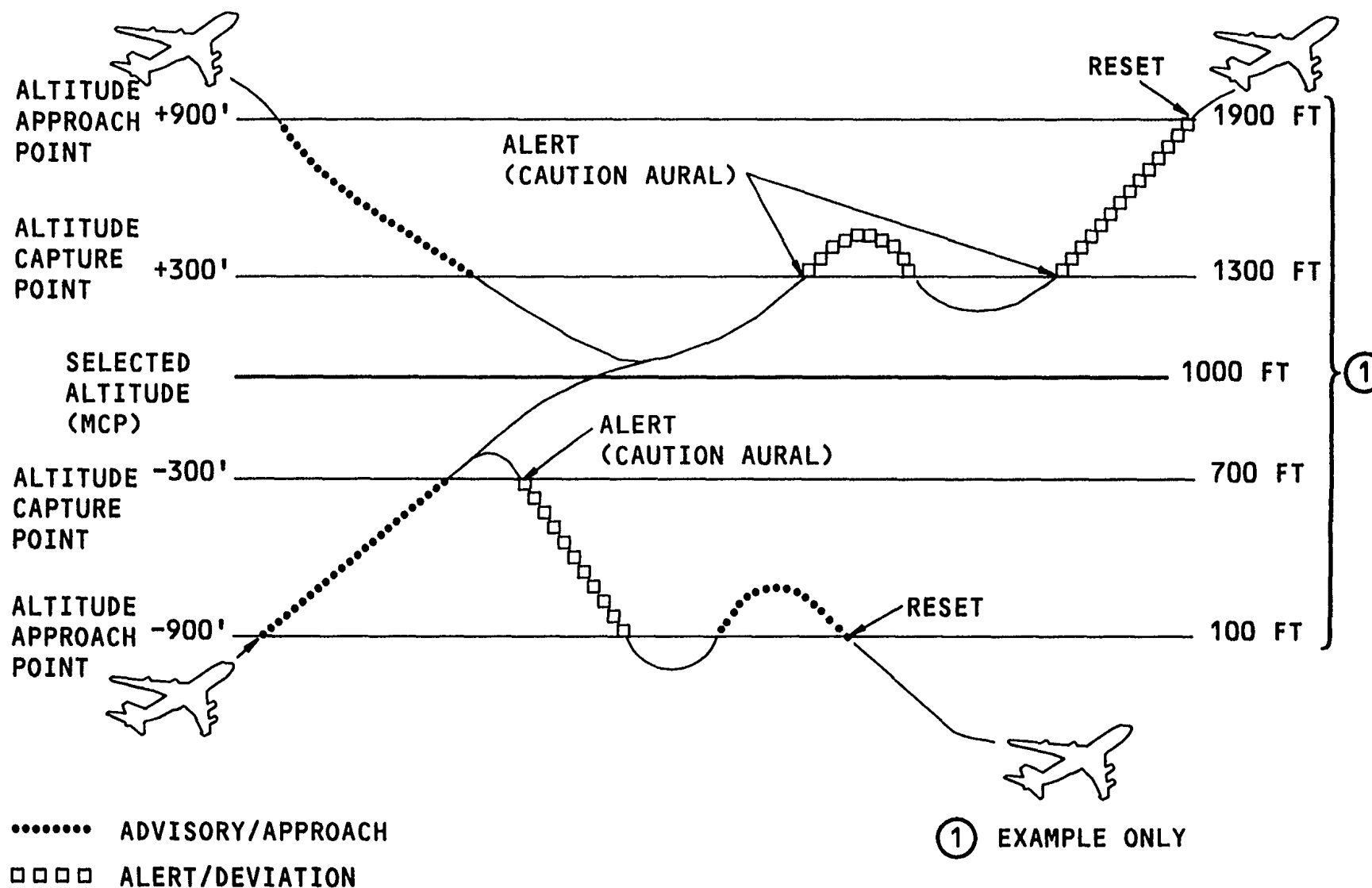


Figure 13 ALTITUDE ALERT OPERATION

ALTITUDE ALERT



CREW ALERTING CARD SCHEMATIC

ARINC 429 Inputs

There are three ARINC 429 receivers on the crew alerting card. one receiver is for AFDS data and the other two are for MMA and MMB data inputs. This information is:

- FCC in command
- Selected altitude
- G/S capture
- Flaps landing
- Landing gear down

Serial Data Decoder

The serial data decoder receives the left and right ADC data buses. It decodes the data word for left or right ADC baro altitude.

ADC Port Selection

This function selects the left or right ADC altitude determined by logic which uses the captains's source select switch discrete and FCC in command data from the AFCS MCP.

Altitude Comparator

This function compares the selected altitude with the baro-corrected altitude and sends these outputs:

- Greater than or equal to 300 feet from the selected altitude
- Less than or equal to 900 feet from the selected altitude
- Less than or equal to 300 feet from the selected altitude

Alert/Advise Logic

The alert/advise logic determines:

- If the airplane approaches the selected altitude (advise)
- If the airplane deviates from the selected altitude (alert)

An advise condition occurs when the airplane:

- Approaches the selected altitude
- Is less than or equal to 900 feet from the selected altitude
- Is greater than or equal to 300 feet from the selected altitude

An alert condition occurs when:

- The alert mode is armed
- The less-than-or-equal-to-900-feet logic is 1
- The greater-than-or-equal-to-300 feet logic is 1

Advise and alert discrete signals go to the EIUs and ASCs.

Inhibit Logic

The inhibit logic uses data from the AFCS MCPf MMA, and MMB to inhibit the altitude alert function of the crew alerting card. The inhibit starts when;

- Glide slope captures, or
- Flaps are in landing range and the landing gear is down

When the parking is brake set, the inhibit logic is off. This allows an operational check of the system on the ground.

Monitor Circuit

The monitor circuit monitors data received from the AFDS MCP and ADC for valid inputs. It also checks for internal faults of the crew alerting card. When a failure is detected:

- A discrete goes to SCID card #1 and then to the EIUs which show the EICAS message.
- An ARINC 429 output goes to the CMCs for fault reporting.

Automatic Aural Level Gain Control

The crew alerting card sends ARINC 429 data to the aural synthesizer cards which use the data to adjust the aural output level. Details about this function are covered in the MAWEA lesson.

ALTITUDE ALERT

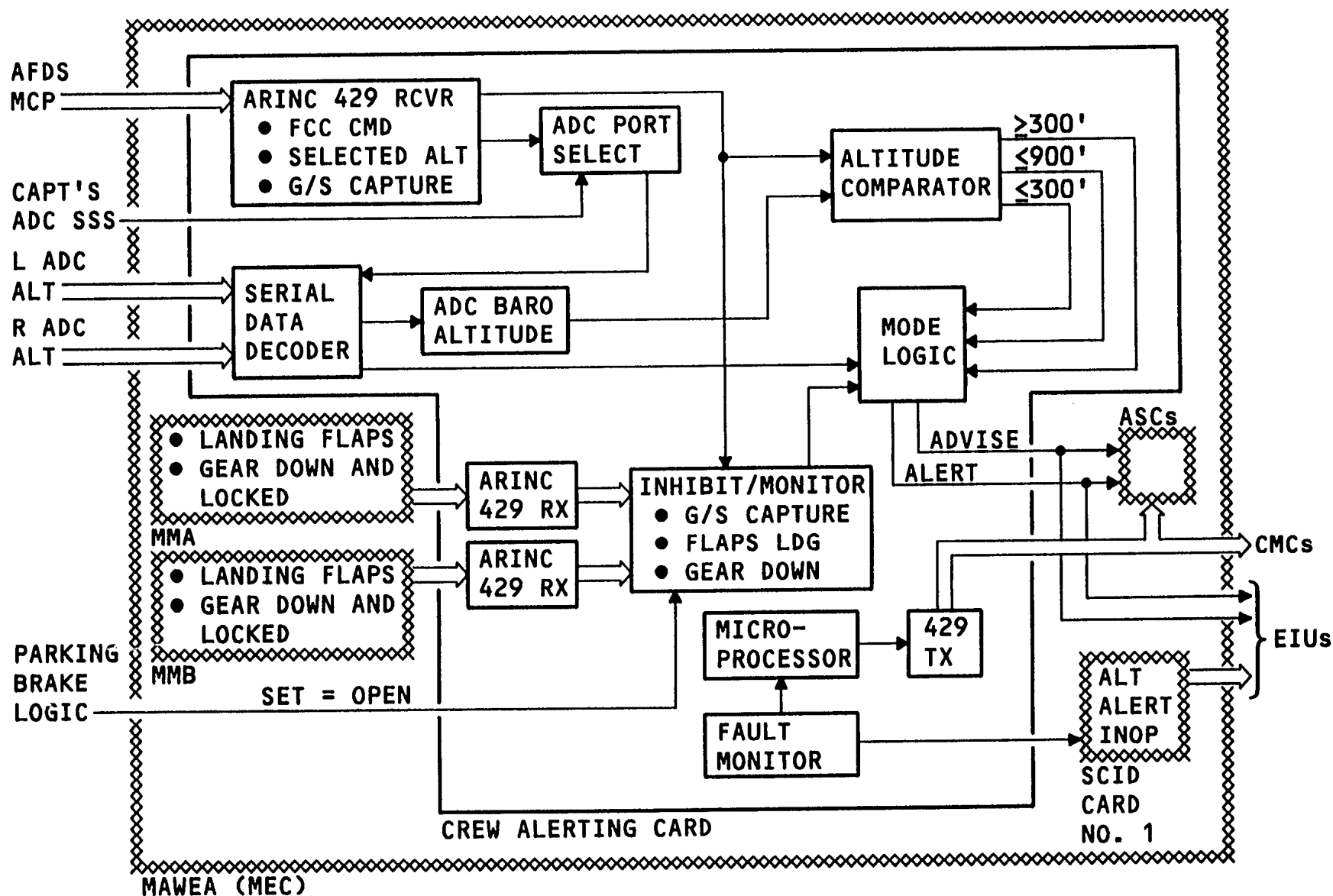


Figure 14 CREW ALERTING CARD SCHEMATIC

ALTITUDE ALERT



ADC INPUT PORT SELECT LOGIC

General

The crew alerting card gets barocorrected altitude data on its port A and port B inputs. The ADC input port select logic selects one of the ports for altitude data.

ADC Input Port Select Logic Inputs

The ADC input port select logic gets inputs from the AFCS mode control panel and the captain's ADC source select switch. The data the AFCS mode control panel sends is:

- No FCC in command
- Left, center or right FCC in command
- More than one FCC in command

The data the captain's ADC source select switch sends is:

- ADC left or center is set
- ADC right is set

ADC Input Port Selection

The captain's ADC source select switch selects the input port if:

- No FCC is in command, or
- More than one FCC is in command

With the switch in the right position, the logic selects port B. With the switch in the left or center position, the logic selects port A.

If only one FCC is in command, the logic overrides the switch input and selects a port based on which FCC is in command. If the right FCC is in command, the logic selects port B. If the left or center FCC is in command, the logic selects port A.

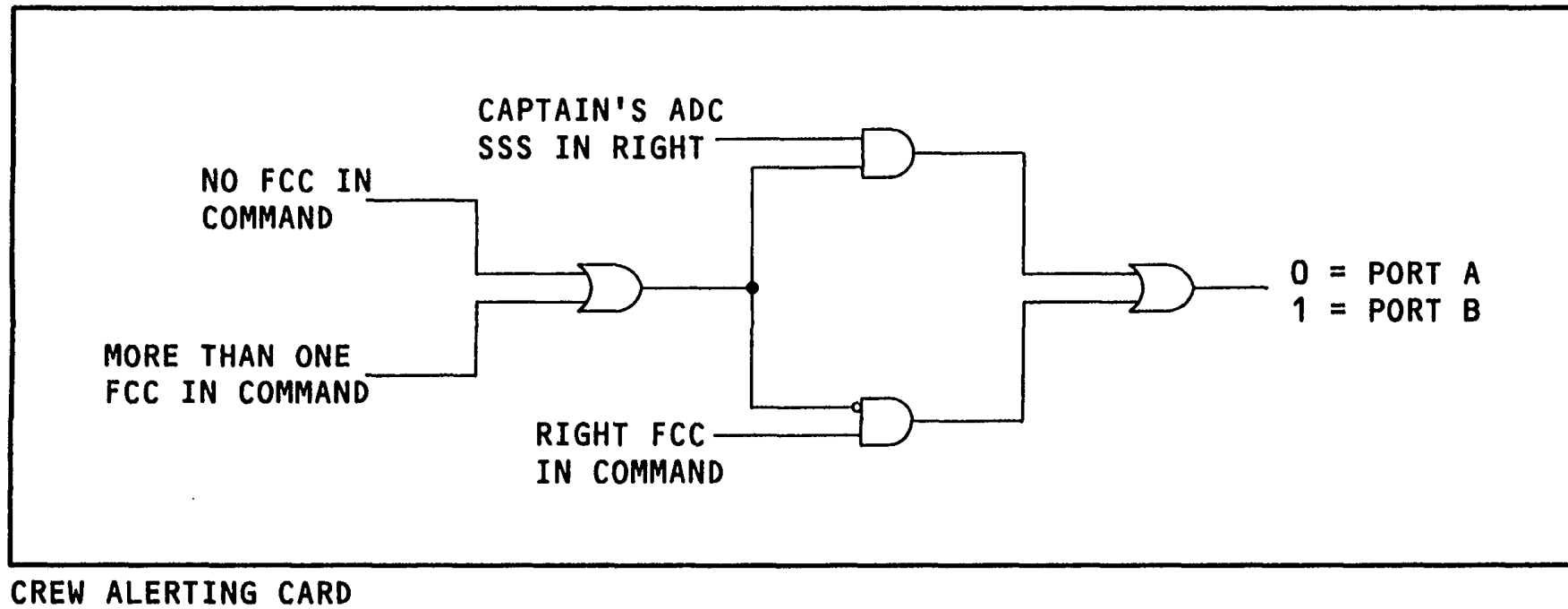


Figure 15 ADC INPUT PORT SELECT LOGIC

ALTITUDE ALERT



OPERATIONAL CHECK

Operational Check Preparation

The operational check is done on the ground with the landing gear down and locked and the parking brake set. The parking brake set overrides the normal alert inhibits. The AFCS MCP altitude select knob simulates an altitude difference to do a check of the advise and the alert functions.

Test

To do a check of the system, begin with the AFCS MCP altitude set to an altitude more than 900 feet above the barocorrected altitude. Then turn the altitude select knob toward the airplane baro-altitude. Monitor for correct operation. Continue to rotate the altitude select knob until the difference reduces to zero and then increases beyond the deviation threshold. Monitor for correct operation.

NOTE: TO ENABLE LEVEL B ALERT ANNUNCIATIONS DURING TEST, REMOVE THE EICAS ENGINE SHUTDOWN INHIBIT (REFERENCE MM 3416-00).

ALTITUDE ALERT



MODE	MODE CONTROL PANEL ALTITUDE SETTING	INDICATIONS			
		SELECTED ALTITUDE	ACTUAL ALTITUDE	AURAL	EICAS MESSAGE
APPROACH	BARO ALT + >900 FT	MAGENTA	NORMAL HALF INTENSITY	NONE	NONE
ADVISE	BARO ALT + ≤900 AND >300	MAGENTA IN A WHITE BOX	TRIPLE STROKE FULL INTENSITY	NONE	NONE
CAPTURE/ ARM	BARO ALT + ≤300	MAGENTA	NORMAL HALF INTENSITY	NONE	NONE
ALERT	BARO ALT + >300 AND ≤900	MAGENTA	YELLOW DOUBLE STROKE FULL INTENSITY	LEVEL B	>ALTITUDE ALERT
RESET/ APPROACH	BARO ALT + >900 FT	MAGENTA	NORMAL HALF INTENSITY	NONE	NONE

Figure 16 OPERATIONAL CHECK

ALTITUDE ALERT



FLIGHT DECK EFFECTS & CMC MESSAGES

General

This graphic summarizes the maintenance related flight deck effects and CMC messages.

Flight Deck Effects

- >ALTITUDE ALERT - Level B - (300 feet or more deviation above or below selected altitude).
- ALT ALERT SYS - Status - (Failure of altitude alert system functions or loss of input to IDS).

CMC Messages

The types of messages that show for the altitude alert system are:

- CREW ALERTING CARD 'PROGRAM PIN INPUT INVALID' (Invalid program pins)
- CREW ALERTING CARD FAIL (The altitude alert inop discrete to SCID card 1 = fail)
- CREW ALERTING CARD FAIL OR ADC-X -CREW ALERTING CARD BUS FAIL (Loss of ARINC 429 data from ADC-X to crew alerting card).
- MCP -- CREW ALERTING CARD BUS FAIL (Loss of ARINC 429 data from mode control panel to crew alerting card)
- CREW ALERTING CARD FAIL OR CREW ALERTING CARD OUTPUT BUS FAIL (Loss of ARINC 429 data from crew alerting card to the control maintenance computers and the aural synthesizer cards).
- SIGNAL COLLECTION -1 CARD FAIL OR OUTPUT BUS FAIL (Loss of ARINC 429 data from SCID card 1 to the left, center and right EIUs)
- EIU-Z FAIL OR SIGNAL COLLECTION - 1 CARD -- EIU-Z BUS FAIL (Only one EIU (EIU-Z) reports a loss of ARINC 429 data from SCID card 1)

NOTE: X = L (LEFT) OR R (RIGHT)
Z = L (LEFT), C (CENTER) OR R (RIGHT)


ALTITUDE ALERT

<u>FLIGHT DECK EFFECT</u>	<u>TYPE</u>	<u>DESCRIPTION</u>
>ALTITUDE ALERT	CAUTION MESSAGE	300 FEET OR MORE DEVIATION FROM SELECTED ALTITUDE
>ALT ALERT SYS ALT ALERT SYS	ADVISORY MESSAGE STATUS MESSAGE	FAILURE OF ALT ALERT SYSTEM OR LOSS OF INPUT TO IDS

CMC MESSAGES

CREW ALERTING CARD 'PROGRAM PIN INPUT INVALID'

CREW ALERTING CARD FAIL

CREW ALERTING CARD FAIL OR ADC-X ~ CREW ALERTING CARD BUS FAIL 

MCP ~ CREW ALERTING CARD BUS FAIL

CREW ALERTING CARD FAIL OR CREW ALERTING CARD OUTPUT BUS FAIL

SIGNAL COLLECTION-1 CARD FAIL OR OUTPUT BUS FAIL

EIU-Z FAIL OR SIGNAL COLLECTION-1 CARD ~ EIU-Z BUS FAIL 

X = L (LEFT) OR R (RIGHT)



Z = L (LEFT), C (CENTER) OR R (RIGHT)

Figure 17 FLIGHT DECK EFFECTS & CMC MESSAGES



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AFCS	-	AUTOMATIC FLIGHT CONTROL SYSTEM
ASC	-	AURAL SYNTHESIZER CARD
EIU	-	EFIS/EICAS INTERFACE UNIT
FCC	-	FLIGHT CONTROL COMPUTER
FCU	-	FLAP CONTROL UNIT
LED	-	LIGHT EMITTING DIODE
MAWEA	-	MODULAR AVIONICS WARNING AND ELECTRONICS ASSEMBLY
MCP	-	MODE CONTROL PANEL
MMA	-	MASTER MONITOR CARD A
MMB	-	MASTER MONITOR CARD B
PFD	-	PRIMARY FLIGHT DISPLAY
PSEU	-	PROXIMITY SWITCH ELECTRONICS UNIT
SCID	-	SIGNAL CONDITIONING CARD
SSS	-	SOURCE SELECT SWITCH

Figure 18 ABBREVIATIONS / ACRONYMS

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