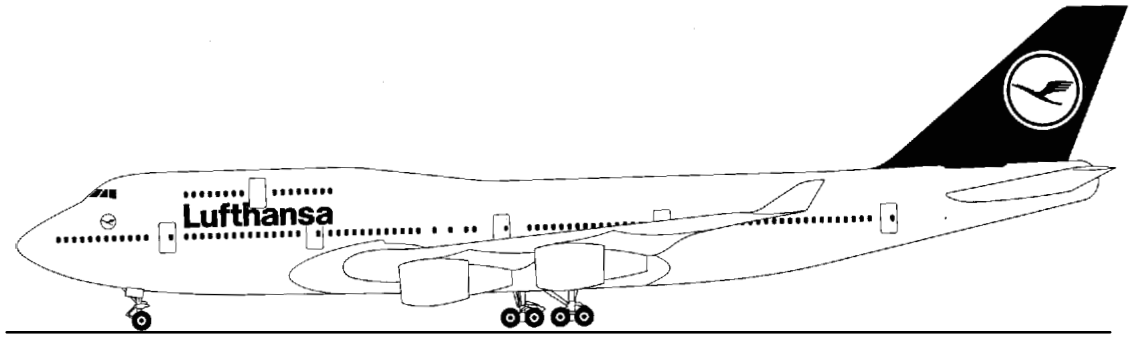
Lufthansa Technical Training

Training Manual B 747-400



ATA 31-50
MAWEA

ATA Spec. 104 Level III

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ATA 31 INDICATING/RECORDING SYSTEMS

31-50 CENTRAL WARNING SYSTEM

31-51 MODULARIZED AVIONICS WARNING ELECTRONIC ASSEMBLY (MAWEA)

INTRODUCTION

The central warning system provides the flight crew with

- visual,
- aural and
- tactile indications

of abnormal airplane system conditions.

The central warning system also consolidates and distributes miscellaneous signal inputs from airplane systems and sensors.

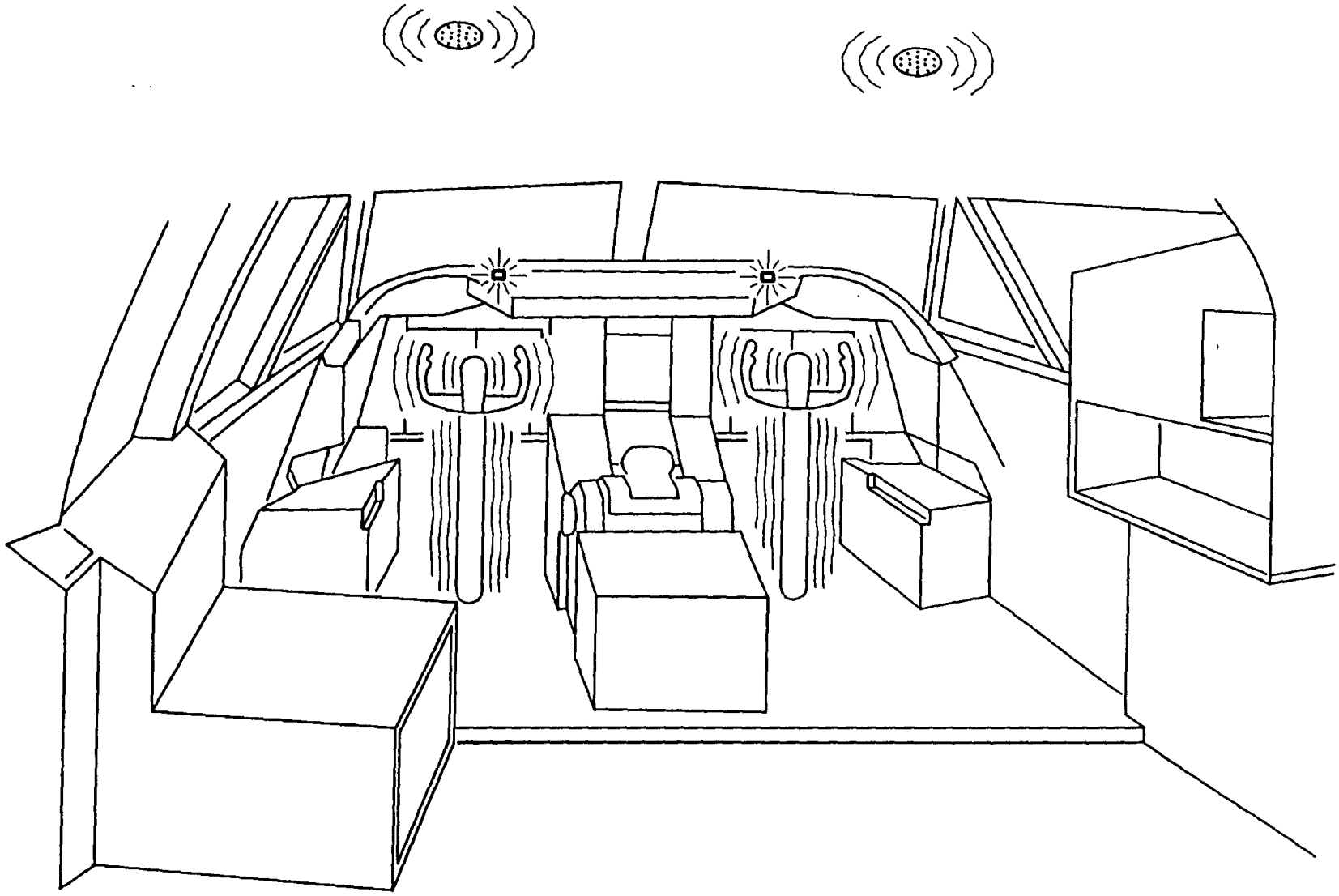

Figure 1 Central Warning System - Introduction

MAWEA

Input signals are supplied from airplane sensors, mechanical and avionics systems.

Signal processing is done in the modularized avionics warning electronics assembly (MAWEA).

Output functions include:

- Aural tones
- Voice messages
- Visual displays
- Stick shaker activation

Airplane data is sent to the flight data recorder. The central maintenance computers monitor the operating status of the aural warning system.

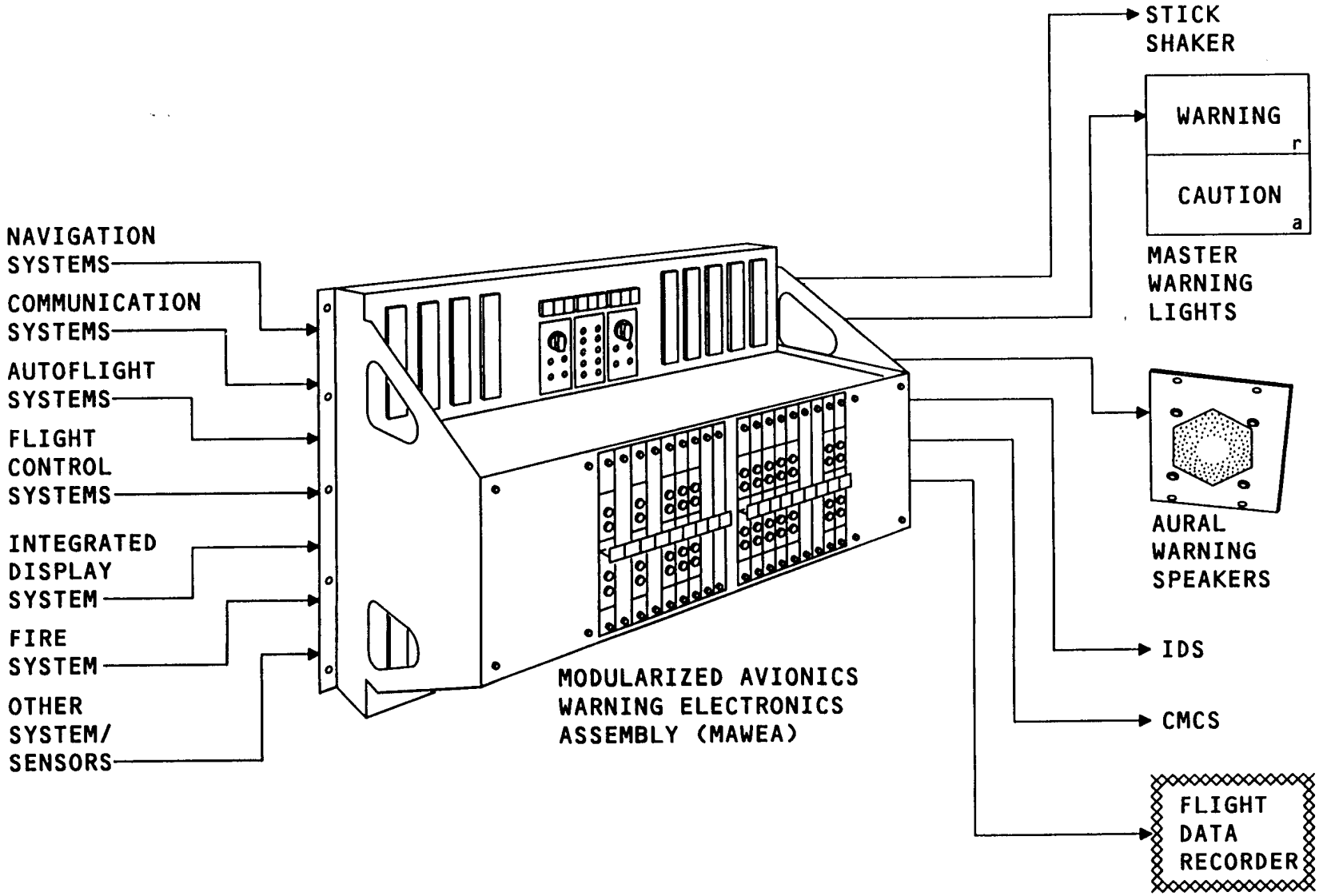

Figure 2 MAWEA

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FUNCTIONS

The aural warning system performs these functions:

- Fire warning
- Overspeed warning
- Cabin pressure warning
- Autopilot disconnect warning
- Takeoff configuration warning
- Landing configuration warning
- Speed brake alert
- Stabilizer green band indication
- Ground proximity and windshear warnings
- Level B aural generation
- Chime generation
- Glide slope antenna switching
- Passenger address volume control
- Passenger signs illumination
- Airplane identification
- Signal consolidation
- Stall warning
- Altitude alert

The stall warning function is covered in the flight controls lesson, and the altitude alert function is covered in the altitude alert lesson.

MAWEA FUNCTIONS

- FIRE WARNING
- OVERSPEED WARNING
- CABIN PRESSURE WARNING
- AUTOPILOT DISCONNECT WARNING
- TAKEOFF CONFIGURATION WARNING
- LANDING CONFIGURATION WARNING
- SPEED BRAKE ALERT
- STABILIZER GREEN BAND INDICATION
- GROUND PROXIMITY AND WINDSHEAR WARNINGS
- LEVEL B AURAL GENERATION
- CHIME GENERATION
- GLIDESLOPE ANTENNA SWITCHING
- PASSENGER ADDRESS VOLUME CONTROL
- PASSENGER SIGNS ILLUMINATION
- AIRPLANE IDENTIFICATION
- SIGNAL CONSOLIDATION
- STALL WARNING (COVERED IN FLIGHT CONTROLS)
- ALTITUDE ALERT (COVERED IN ALTITUDE ALERT)

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Figure 3 MAWEA Functions

COMPONENT LOCATIONS - FLIGHT DECK

The following components are located in the flight deck:

- Captain's aural warning speaker
- First officer's aural warning speaker
- Captain's master warning light
- First officer's master warning light
- Modularized avionics warning electronics assembly (MAWEA) power A circuit breaker
- MAWEA power B circuit breaker
- Left aural warning circuit breaker
- Right aural warning circuit breaker
- Spoiler handle deploy position switch
- Spoiler handle position switch

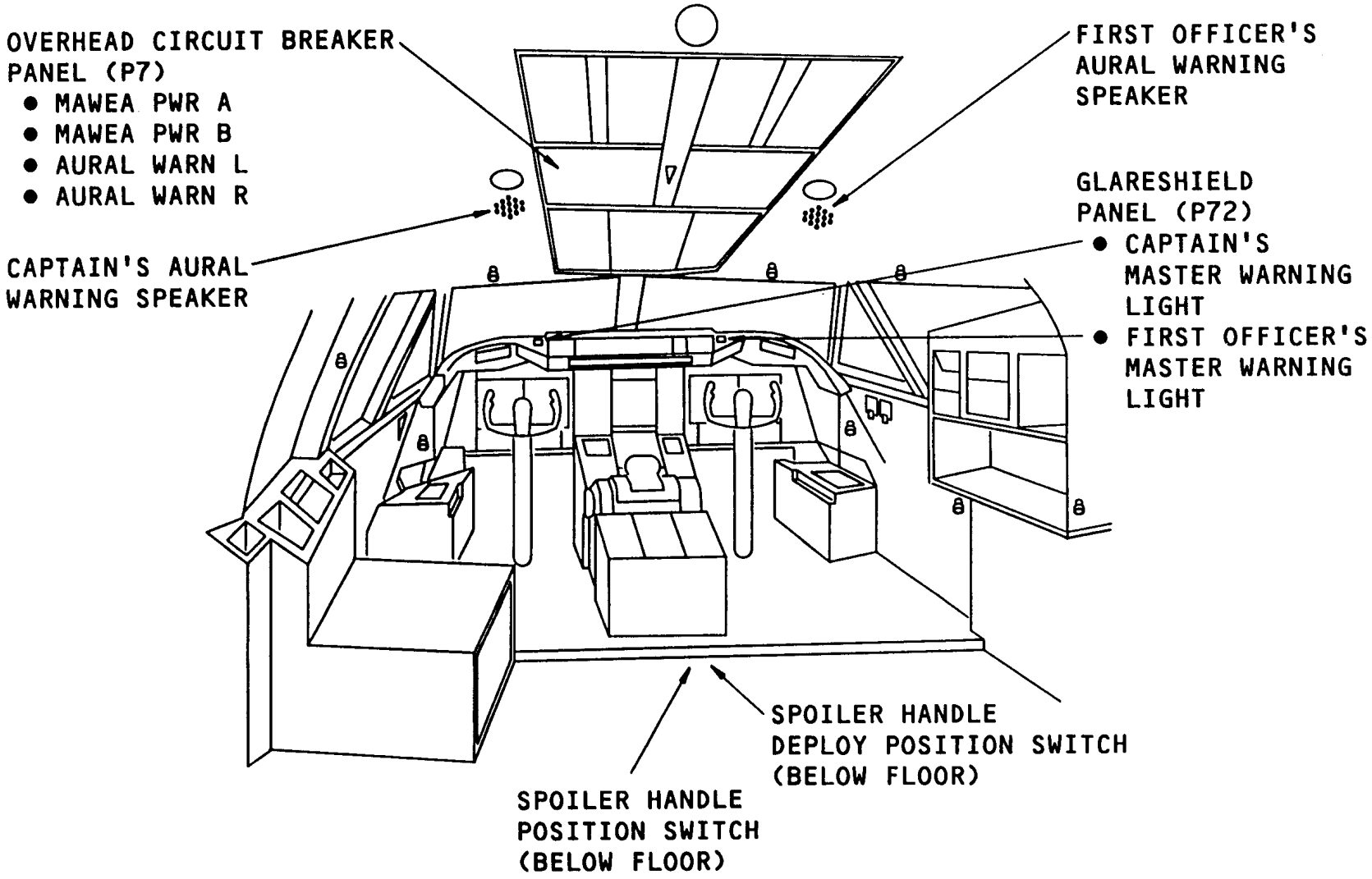

Figure 4 Component Locations - Flight Deck

MASTER WARNING LIGHTS

The red master warning lights are turned on by the master monitor cards in the modularized avionics warning electronics assembly (MAWEA) whenever a warning condition is detected.

The lights go out when pressed or when the warning condition no longer exists.

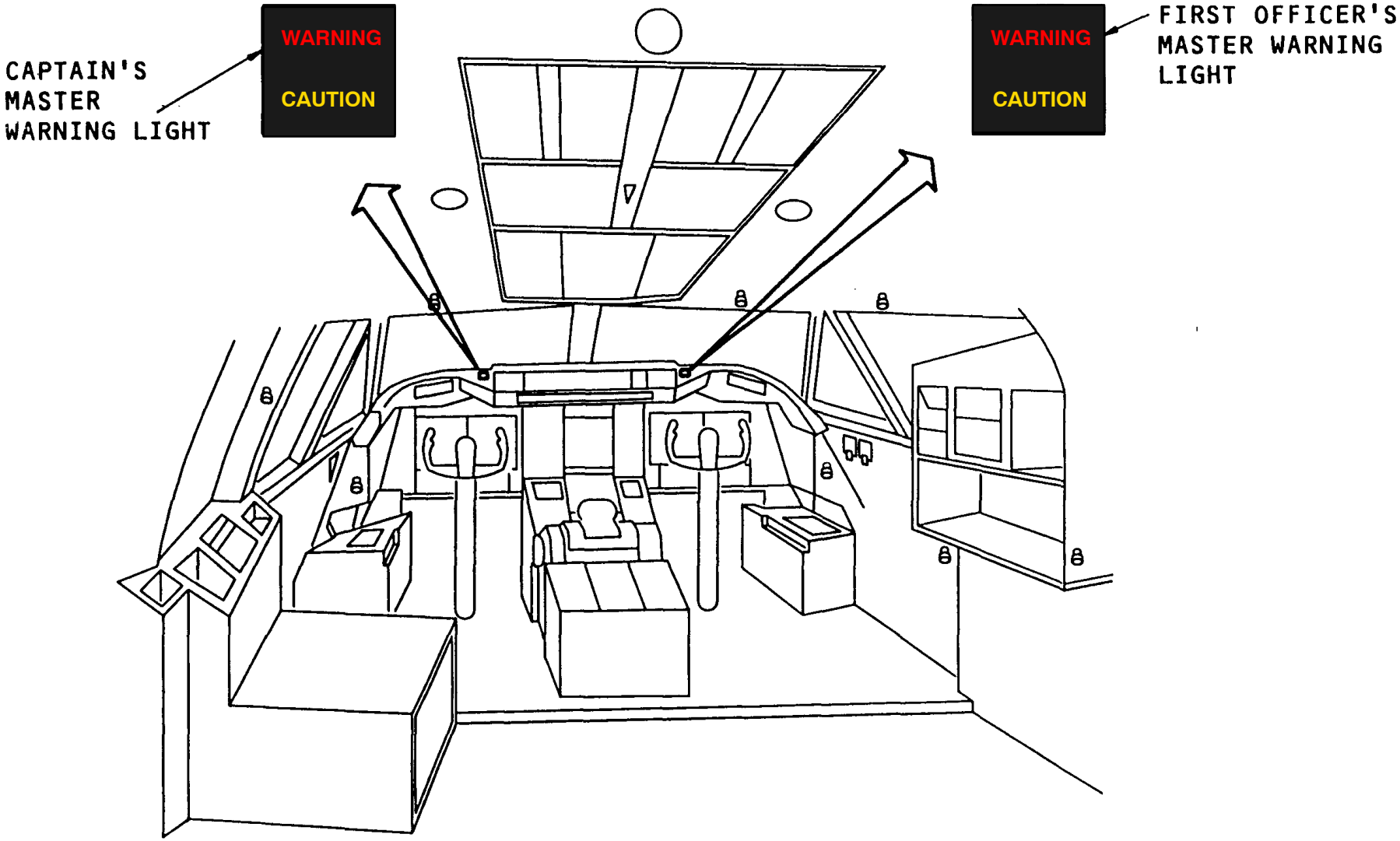

Figure 5 Master Warning Lights

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PILOTS' CONTROL STAND

These components are located on the pilots control stand:

- Stabilizer trim indicators
- Speed brake lever
- Flap lever
- Fuel control switches
- Parking brake handle
- Thrust levers

There are two stabilizer trim indicators. The stabilizer trim indicators show the stabilizer trim position. Each stabilizer trim indicator also has three green band indicator lamps:

- Nose down
- Mid band
- Nose up

The green band indicators show the correct stabilizer trim range for takeoff.

The speed brake lever deploys the speed brakes.

The flap lever sets the trailing edge and leading edge flap position.

There are four fuel control switches. One switch for each engine. The fuel control switches manually control fuel on/off commands.

The parking brake handle sets the parking brake.

There are four thrust levers, one for each engine.

The thrust levers set engine thrust.

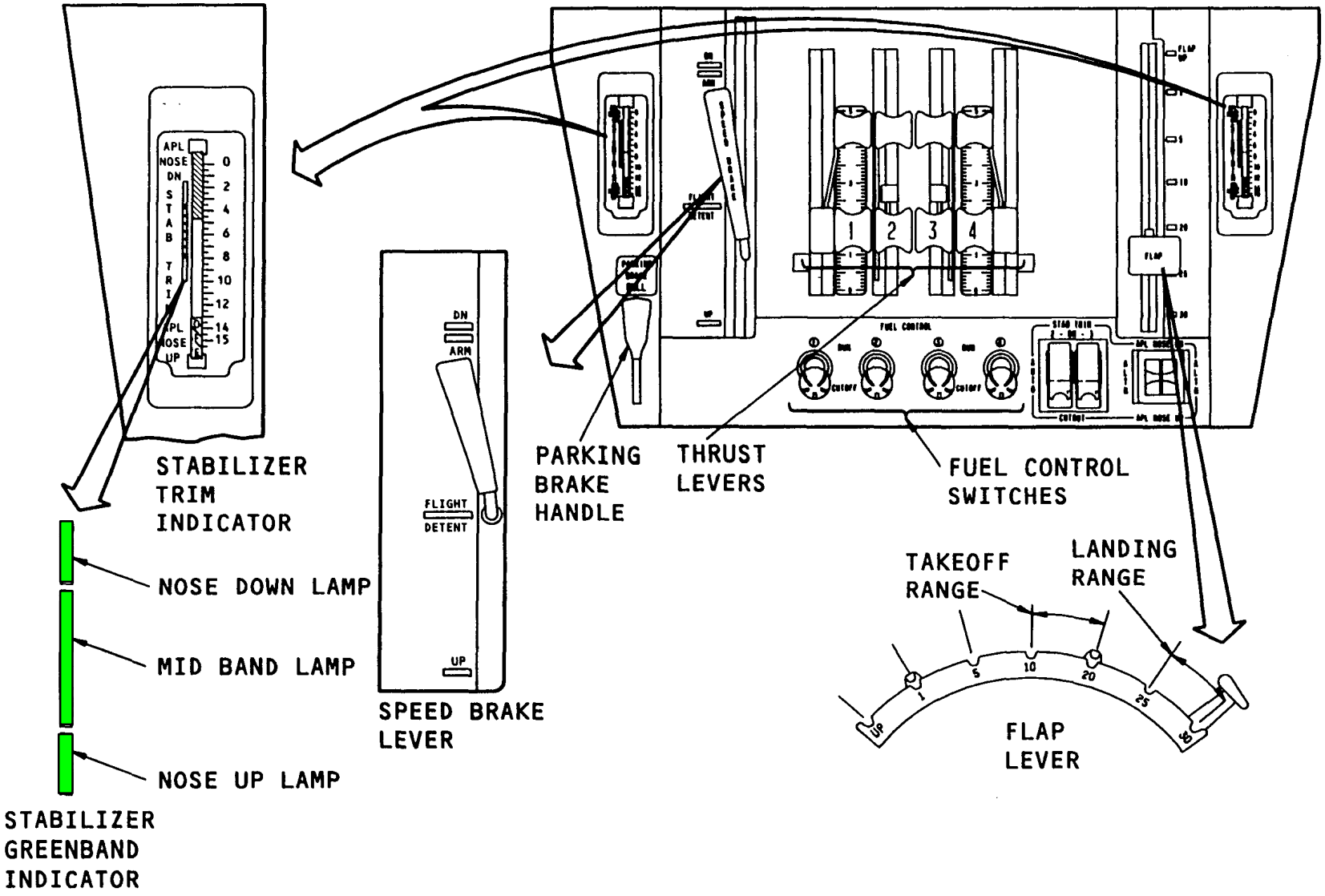


Figure 6 Pilots Control Stand

COMPONENT LOC - MAIN EQUIPMENT CENTER

The modularized avionics warning electronics assembly (MAWEA) is in the forward right portion of the main equipment center.

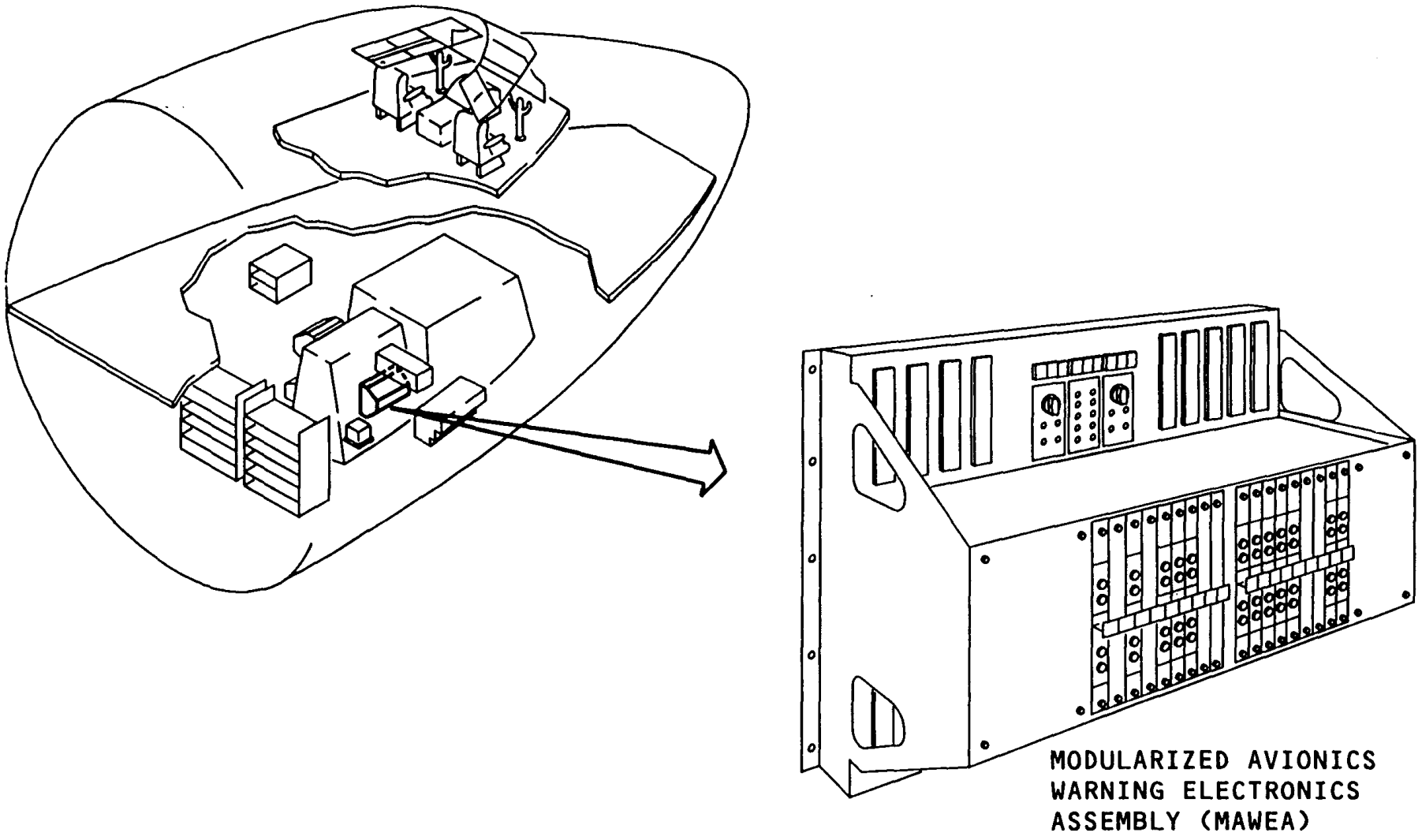


Figure 7 Component Location - Main Equipment Center

MAWEA ASSEMBLY

General

The modularized avionics warning electronics assembly (MAWEA) is a cardfile that contains cards which perform various functions.

There are four types of cards in the modularized avionics warning electronics assembly (MAWEA):

- Universal Logic Cards (ULCs)
- Aural Synthesizer Cards (ASCs)
- Signal Collection and Identification Cards (SCID)
- Digital Flight Data Acquisition Card (DFDAC)

The DFDAC is installed in the MAWEA for easy access. It does not have a warning function. The DFDAC is part of the flight recorder system.

Characteristics

The MAWEA is 29 inches x 20 inches x 14 inches in size (it does not fit in MCU size category), weighs 70 pounds, and contains up to 18 cards and two power supplies. The cards are readily accessible as there are no doors on front of the MAWEA. There are two panels secured by four screws which cover the power supplies.

There are 23 connectors mounted in the front of the MAWEA chassis. They allow the MAWEA to interface with other airplane systems.

A monitor panel on the front of the unit allows for monitoring the ARINC 429 inputs to the MAWEA and power supply voltages.

There is an electrostatic jack on the side of the MAWEA which allows for the use of a wrist strap when removing or installing any card. This prevents damage to the cards due to electrostatic discharges.

The unit is cooled by convection.

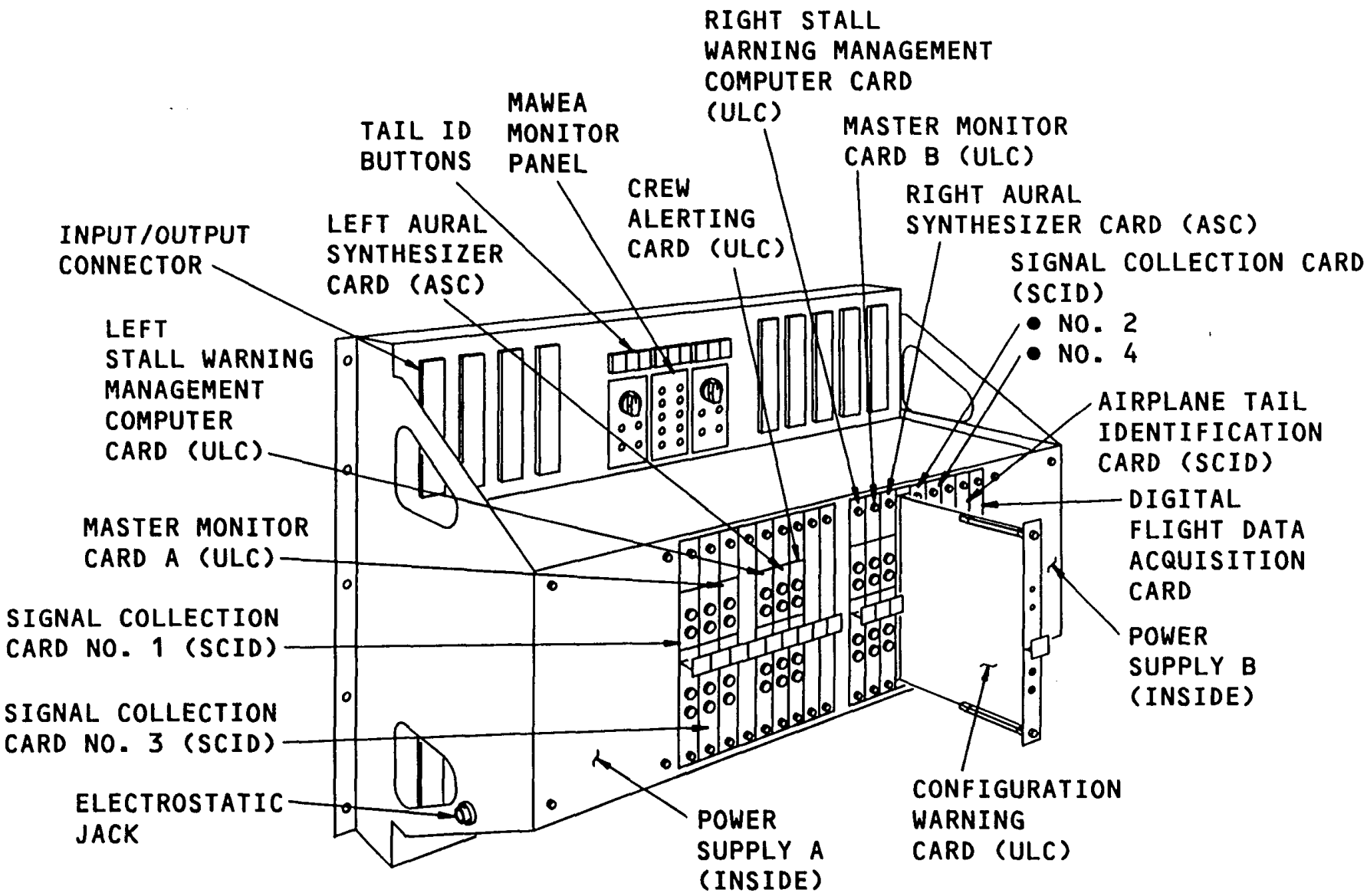


Figure 8 MAWEA Assembly

POWER SUPPLY INTERFACE

There are two power supplies in the modularized avionics warning electronics assembly (MAWEA) which provide identical inputs to each card in the MAWEA. Power supply A gets its power from the 115v ac standby bus.

Power supply B gets its power from the 115 V ac first officer's instrument transfer bus.

Each power supply sends dc voltages, a ground, and a reset pulse to each card in the MAWEA. The reset pulse is sent during power up or after a momentary shutdown.

In the event of a power supply failure a fail discrete is sent from the failed power supply to the MAWEA monitor panel. This discrete turns on one of two red LEDs on the MAWEA monitor panel indicating this condition.

The dc input voltages are monitored through the monitor jacks on the MAWEA monitor panel.

The aural warning speakers receive 28v dc.

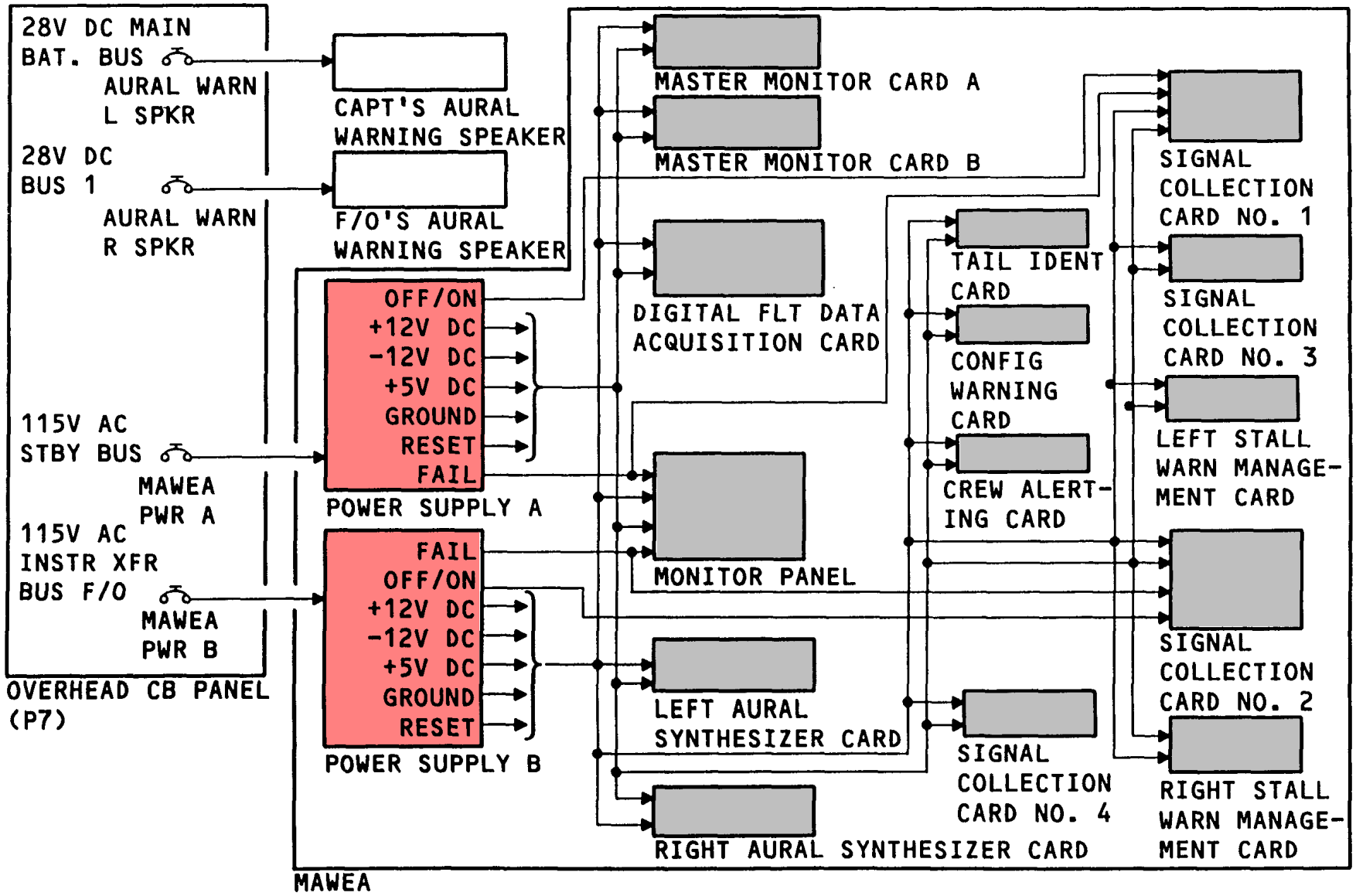


Figure 9 Power Supply Interface

POWER SUPPLIES FAULT MONITORING

Power

Power supply A receives 115v ac from circuit breaker MAWEA PWR A. Power supply B receives 115v ac from circuit breaker MAWEA PWR B.

Each power supply produces these outputs:

- +12v dc
- -12v dc
- +5v dc
- Signal ground
- Reset pulse

The power supplies send the outputs to all MAWEA cards. If one of the power supplies fail, operations are maintained, with one power supply.

Fault Monitoring

Power supply A sends 15v dc to signal collection card 1 anytime the 115v ac input is present. This indicates the power supply is on.

If power supply A loses its 115v ac input, the power supply sends a ground discrete to signal collection card 1, which indicates the power supply is off.

Each power supply continuously monitors its internal operation and output voltages. If power supply A detects a fault, it turns on FAIL lamp A on the MAWEA monitor panel and sends a discrete to signal collection card number 1.

Power supply B operates the same as power supply A, except the fail and on/off discretes go to signal collection card number 2.

Signal collection cards 1 and 2 convert the four power supply discretes to digital discretes and send them on an ARINC 429 bus to the EFIS/EICAS interface units (EIUs). Any of the four discretes will cause the EIUs to show the status message MAWEA PWR SUPPLY on the auxiliary EICAS display.

Reset

When power is first applied, each power supply sends a reset pulse to all MAWEA cards. When the MAWEA cards receive a reset pulse from both power supplies, they reset their microprocessors.

NOTE: WHEN APPLYING POWER TO THE MAWEA, BE SURE POWER IS FIRST APPLIED TO THE CAPTAIN'S AND FIRST OFFICER'S AURAL WARNING SPEAKERS. IF THIS IS NOT DONE, AN AURAL WARN SPKR STATUS MESSAGE WILL SHOW ON THE AUXILIARY EICAS DISPLAY.

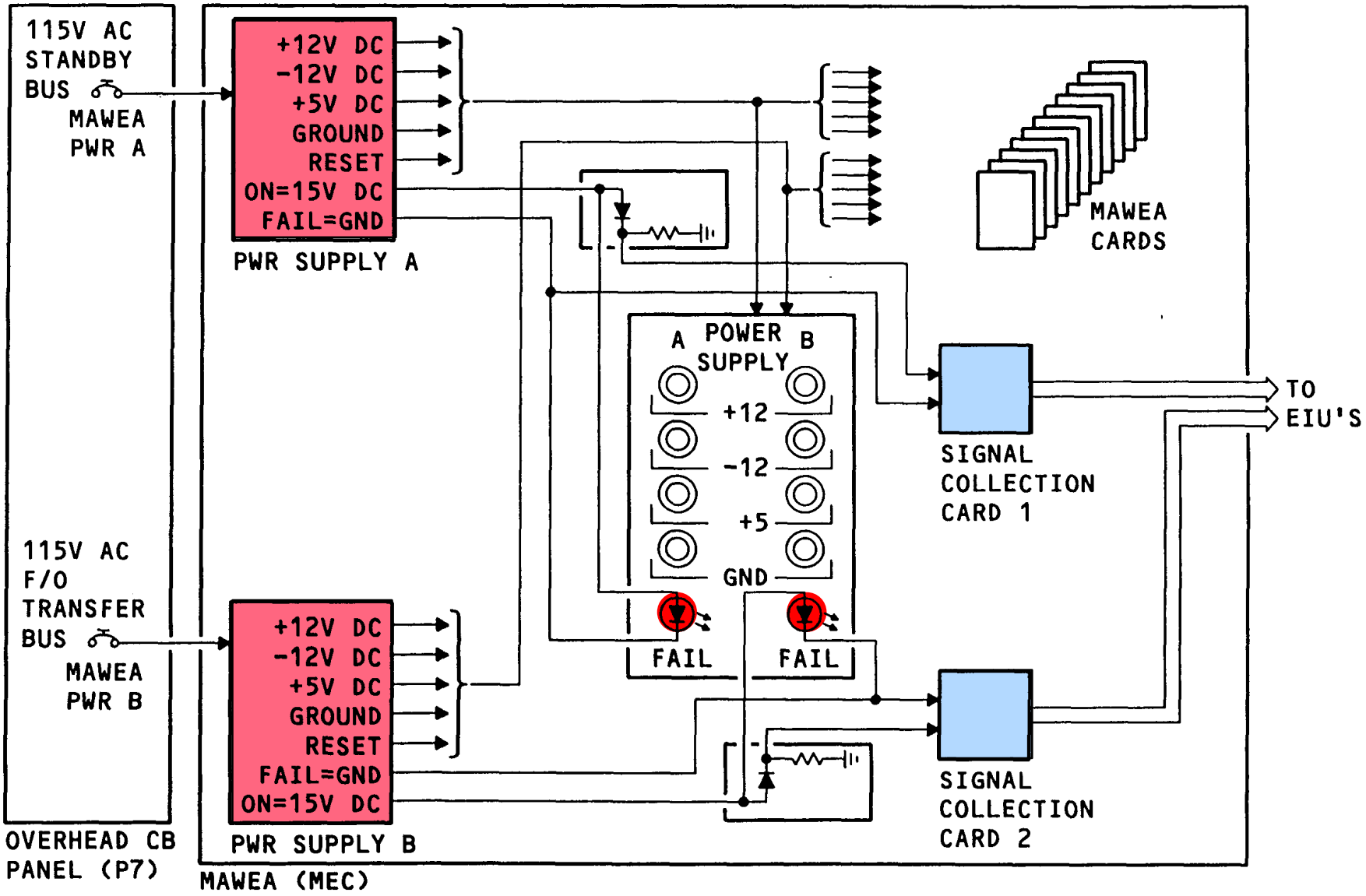


Figure 10 Power Supplies Fault Monitoring

POWER SUPPLIES

The two power supplies are identical and provide the same dc inputs to each card in the modularized avionics warning electronics assembly (MAWEA).

Two panels, each secured by four screws, must be removed before gaining access to the power supplies.

The power supplies are held in place by a center screw and two wedge clamps on the power supply sides.

CAUTION: STATIC SENSITIVE. DO NOT HANDLE BEFORE READING PROCEDURE FOR HANDLING ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (REF 20-41-02/201). CONTAINS DEVICES THAT CAN BE DAMAGED BY STATIC DISCHARGE.

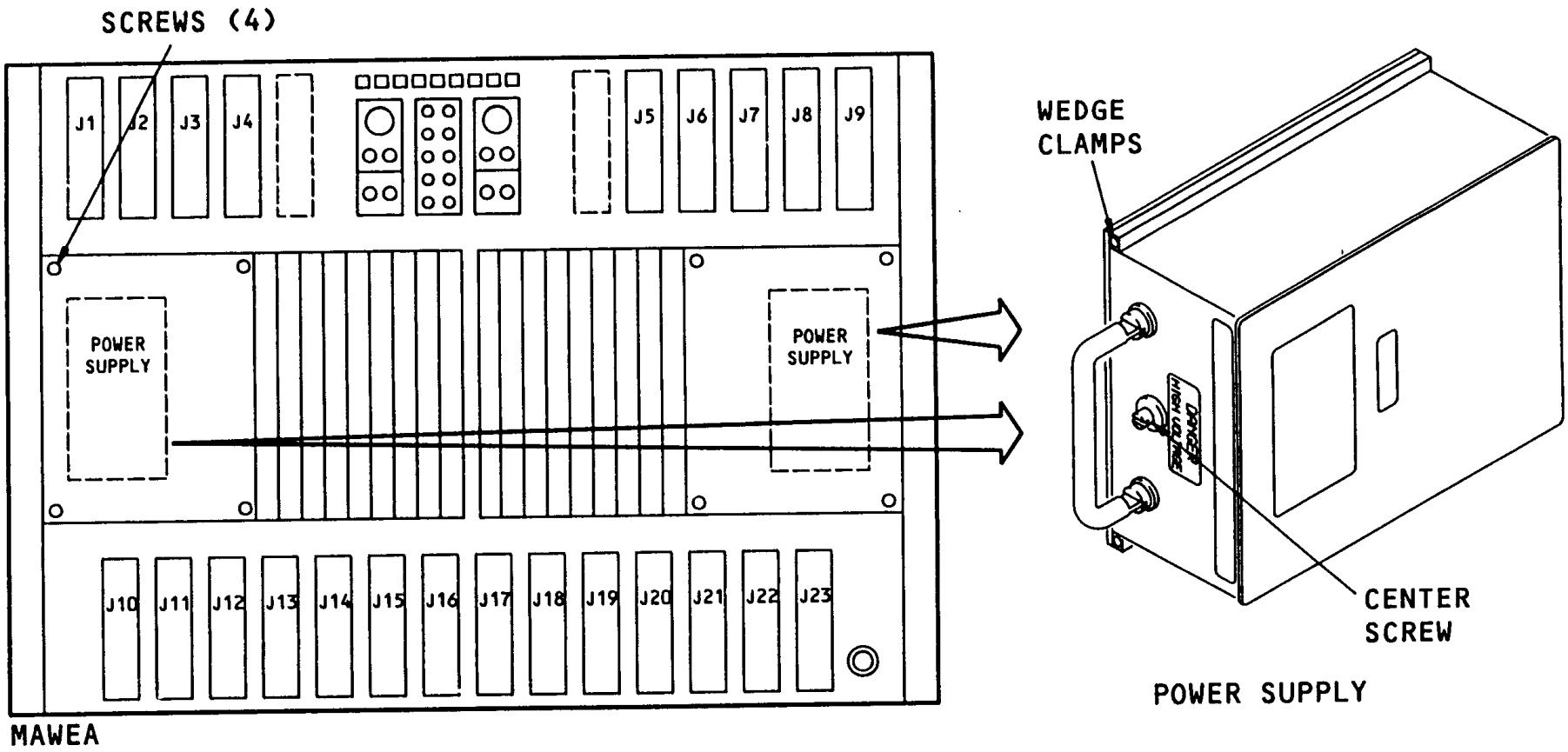


Figure 11 Power Supplies

MAWEA PRINTED CIRCUIT CARDS

Pin Programming

Only the ULCs and the SCIDs are pin programmed. By using pin programming, the ULC and the SCID cards can assume more than one identity based on their slot location in the MAWEA. For example, a ULC will behave as master monitor card A when installed in slot three, and as the crew alerting card when installed in slot seven. The card functions and types are:

- Master monitor cards A and B (ULC)
- Crew alerting card (ULC)
- Configuration warning card (ULC)
- Stall warning management cards (ULCs)
- Signal collection cards 1, 2, 3 and 4 (SCID).
- Tail identification card (SCID)

Master Monitor Cards A and B (MMA, MMB)

The master monitor cards perform the following functions:

- Collect all warning inputs.
- Provide outputs to the master warning lights.
- Provide outputs to the aural synthesizer cards.
- Route information derived from six ARINC 429 input buses to other MAWEA cards.

Aural Synthesizer Cards (ASC)

The aural synthesizer cards generate and amplify all warning aurals except windshear and ground proximity warnings which are amplified only.

The aural synthesizer card also amplifies the warning aurals from the TCAS (if TCAS installed).

Configuration Warning Card

The configuration warning card performs these functions:

Takeoff configuration warning

Landing configuration warning

Speedbrake alert

Stabilizer green band indication

Glide slope antenna switching

Crew Alerting Card

The crew alerting card performs these functions:

Flight crew chime aurals activation/inhibits

Passenger address volume control (passenger airplanes)

Illumination of fasten seat belts and no smoking signs (passenger airplanes)

Altitude alert

Audio output gain levels of ASC.

Tail Identification Card

The purpose of the airplane tail identification card is to decode the nine alpha-numeric buttons on the MAWEA monitor panel. The resulting airplane identification code is sent to the EIUs on an ARINC 429 bus.

Signal Collection Cards

The signal collection cards monitor the status of various discrete signals and route them on an ARINC 429 data bus to the EIUs.

These cards also have the capability of receiving two ARINC 429 data buses. The data received on those two data buses is collected into a single ARINC 429 data bus along with the discretes and sent to the EIUs.

Stall Warning Management Cards (SWMC)

The details of the stall warning management cards are covered in the Stall Warning System (AMM 27-32-00).

Digital Flight Data Acquisition Card (DFDAC)

The details of the DFDAC are covered in the Flight Recorder System (AMM 31-31-00).

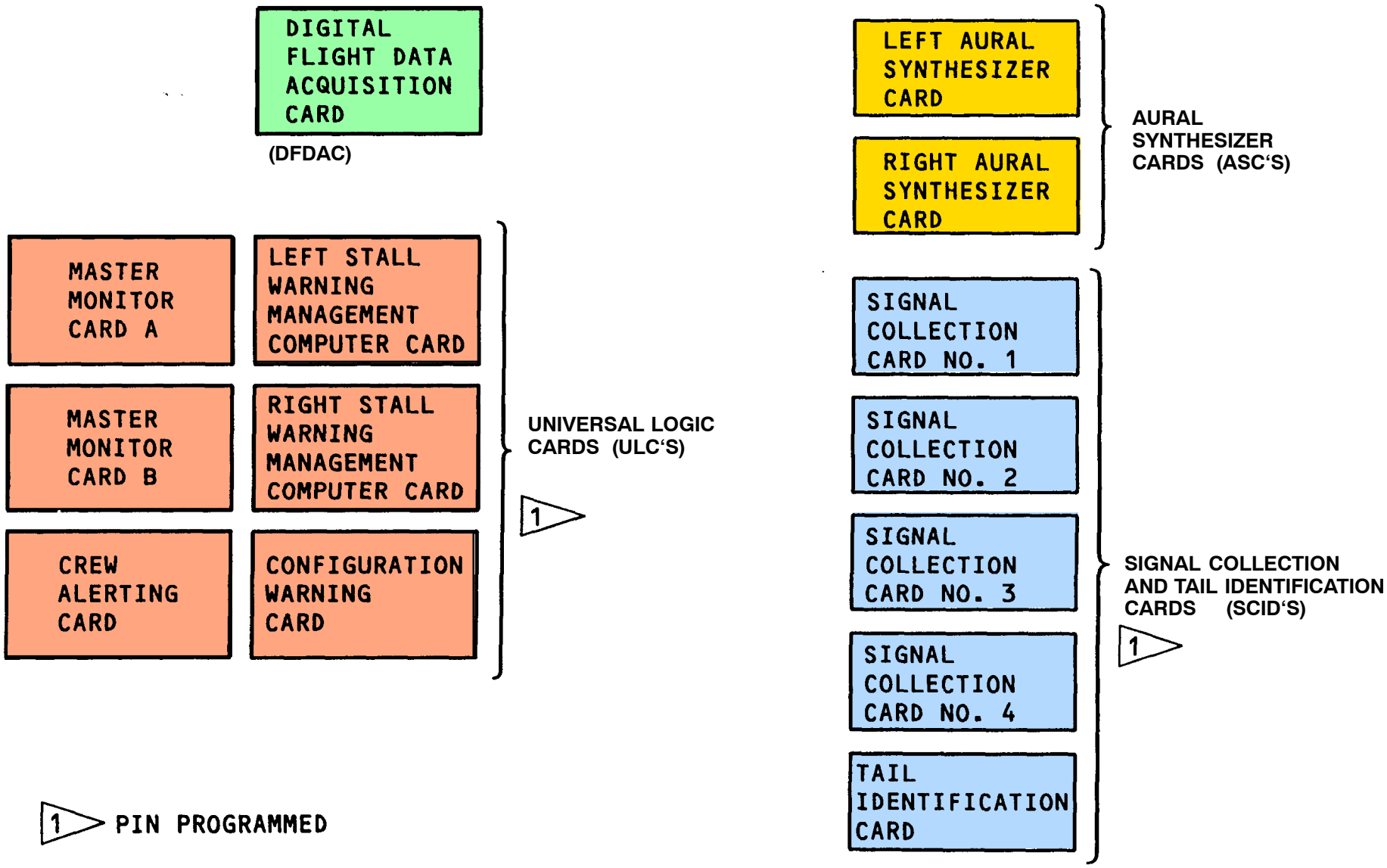


Figure 12 MAWEA Printed Circuit Cards

MASTER MONITOR & AURAL SYNTHESIZER CARDS

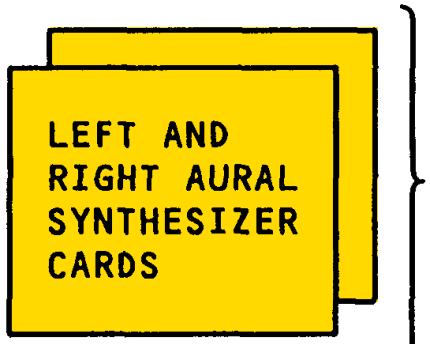
Aural Synthesizer Cards

The aural synthesizer cards generate and amplify all warning aurals except windshear and ground proximity warnings which are amplified only.

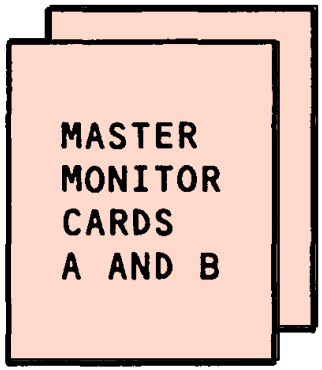
Master Monitor Cards

The master monitor cards receive all level A warnings. When a level A warning condition occurs, the system which detects the condition sends a discrete to master monitor cards A and B. The Master monitor cards turn the master warning lights on and send a discrete to the aural synthesizer cards. The aural synthesizer cards then produce the proper level A aural.

The master monitor cards also route information derived from six ARINC 429 input buses to other modularized avionics warning electronics assembly (MAWEA) cards.



- GENERATE AND AMPLIFY ALL WARNING AURALS EXCEPT GROUND PROXIMITY AND WINDSHEAR



- COLLECT ALL WARNING INPUTS
- PROVIDE OUTPUTS TO THE MASTER WARNING LIGHTS AND AURAL SYNTHESIZER CARDS
- ROUTE DIGITAL INFORMATION DERIVED FROM 6 DIGITAL INPUT BUSES ON ONE SINGLE BUS TO THE FOLLOWING:
  - CONFIGURATION WARNING CARD
  - CREW ALERTING CARD
  - LEFT AND RIGHT STALL WARNING MANAGEMENT CARDS 1
  - CMC'S

1 COVERED IN FLIGHT CONTROLS

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Figure 13 Master Monitor & Aural Synthesizer Cards

CONFIG WARNING & CREW ALERTING CARDS

Configuration Warning Card

The configuration warning card performs these functions:

- Takeoff configuration warning
- Landing configuration warning
- Speed brake alert
- Stabilizer green band indication
- Glideslope antenna switching

Crew Alerting Card

The crew alerting card performs these functions:

- Flight deck chime
- Passenger address volume control
- Illumination of fasten seat belts and no smoking signs
- Altitude alert

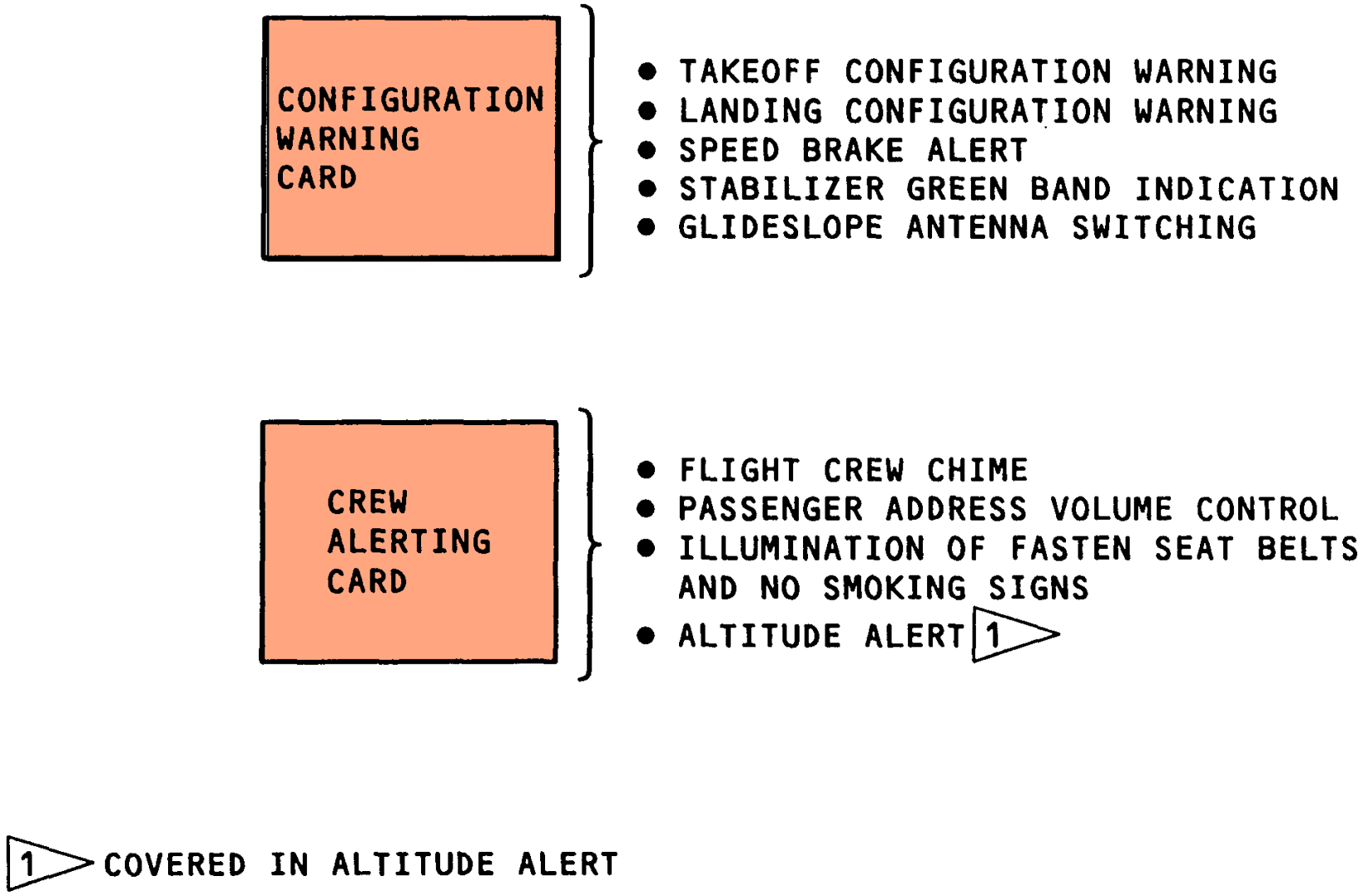

Figure 14 Config Warning & Crew Alerting Cards

TAIL ID -, SCID -, SWM -, & DFDA - CARDS

Tail Identification Card

The purpose of the airplane tail identification card is to decode the nine alpha-numeric buttons on the modularized avionics warning electronics assembly (MAWEA) monitor panel. The airplane identification code is sent to the EFIS/ EICAS interface units (EIUs) on an ARINC 429 data bus.

Signal Collection Cards

The signal collection cards monitor the status of various discrete signals and route them on an ARINC 429 data bus to the EIUs.

These cards also have the capability of receiving 2 ARINC 429 data buses. The data received on the two data buses is consolidated with the discrete inputs and sent to the EIUs on a single ARINC 429 data bus.

Stall Warning Management Cards

The stall warning management cards have these functions:

- Stick shaker motor activation for stall warnings
- Stick shaker motor activation for over rotation warnings
- Pitch limit parameter calculations
- Certain speed tape parameters calculations

The details of the stall warning management cards are covered in the flight controls lesson.

Digital Flight Data Acquisition Card (DFDAC)

The DFDAC gathers data from different systems, converts the data to a Harvard Biphase Data format and sends it to the flight recorder.

The details of the DFDAC are covered in the flight recorder lesson.

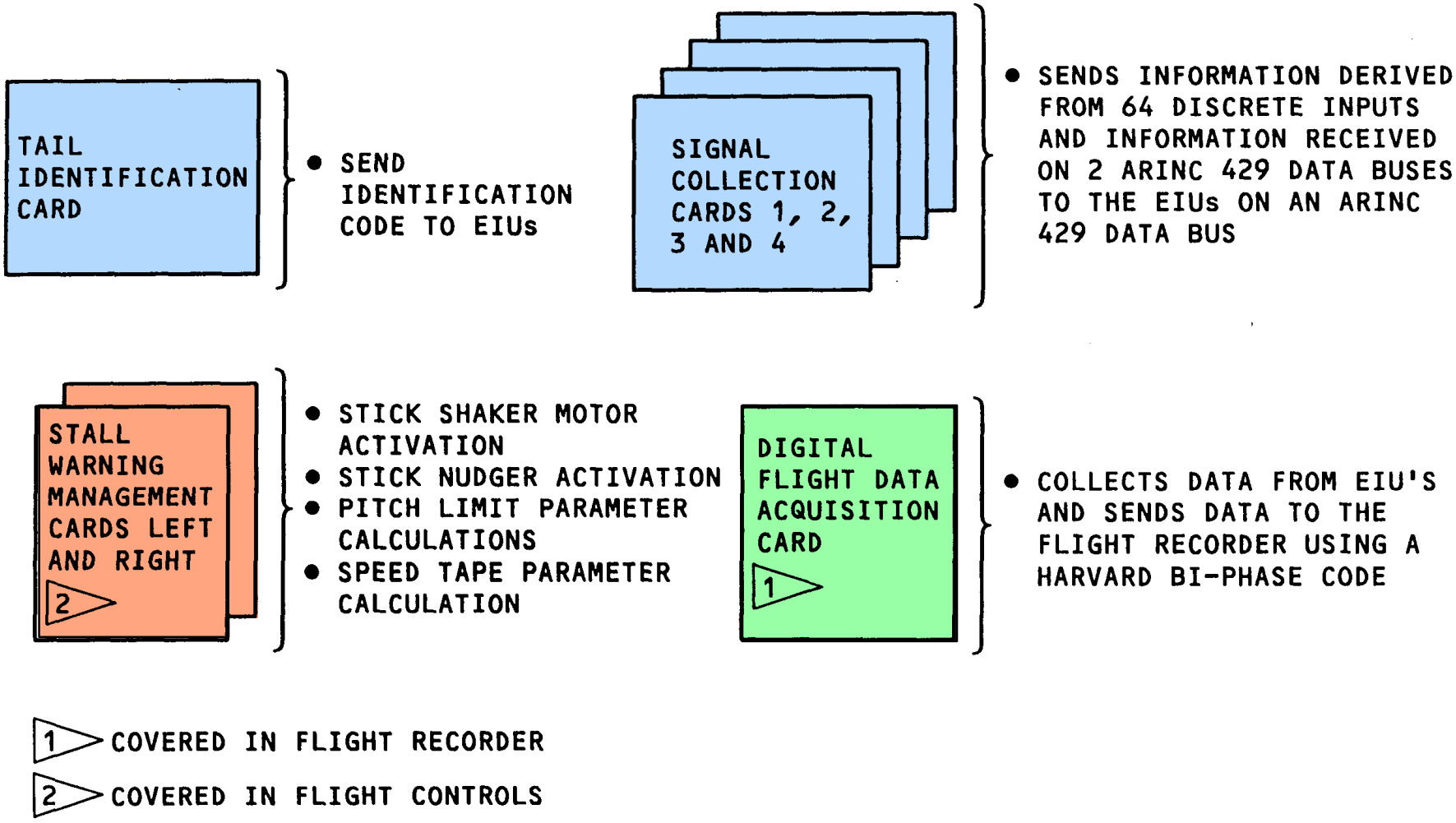

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Figure 15 Tail Id -, SCID -, SWM - & DFDA Cards

MAWEA PRINTED CIRCUIT CARDS

All of the modularized avionics warning electronics assembly (MAWEA) cards are microprocessor controlled and have these features:

- One red LED for displaying faults within the card
- One yellow LED for interface faults
- one pair of monitor jacks for monitoring the ARINC 429 output bus

Each card is held in place by two hold-down screws and two card removal tabs.

CAUTION: STATIC SENSITIVE. DO NOT HANDLE BEFORE READING PROCEDURE FOR HANDLING ELECTROSTATIC DISCHARGE SENSITIVE DEVICES (REF 20-41-02/201). CONTAINS DEVICES THAT CAN BE DAMAGED BY STATIC DISCHARGE.

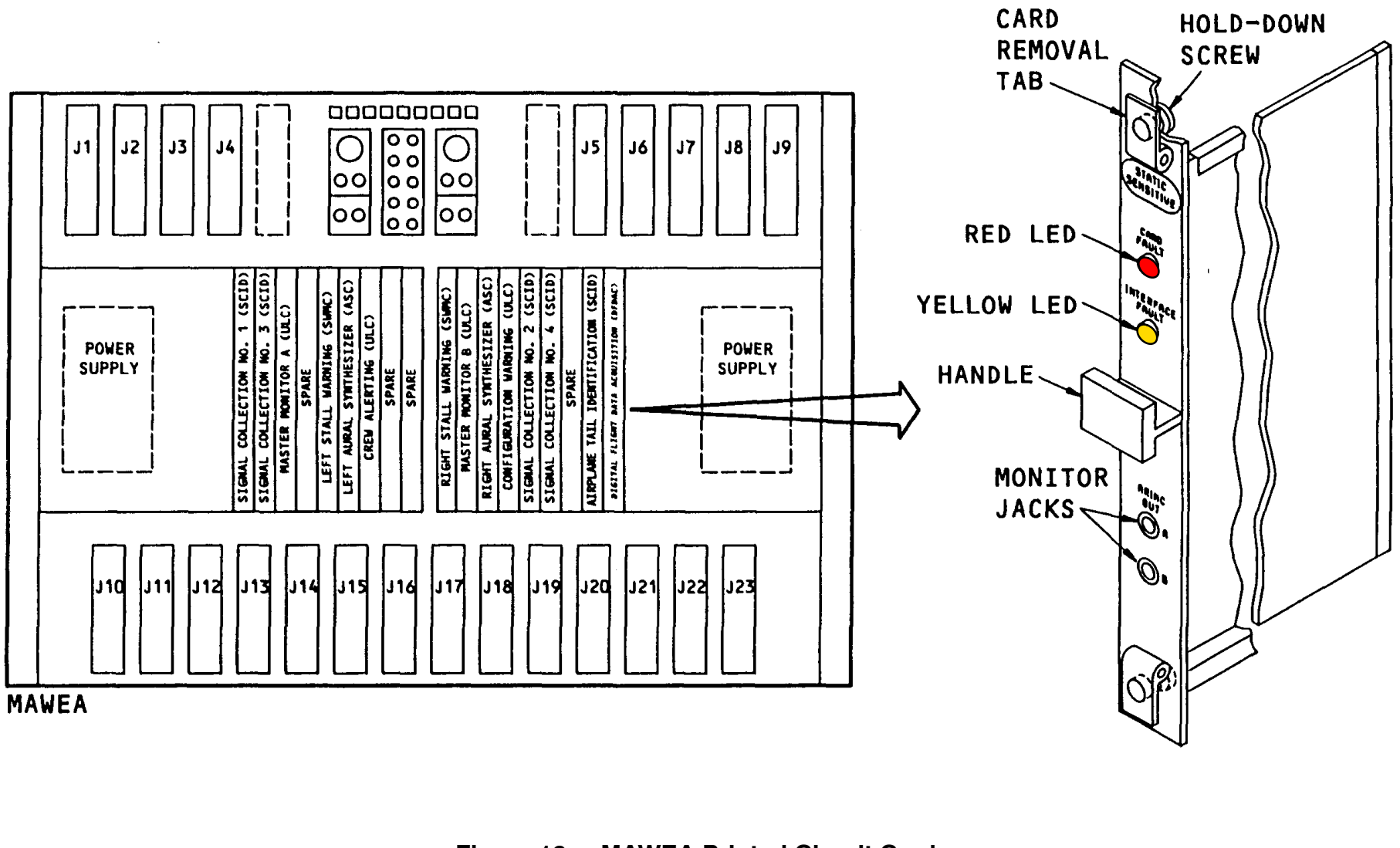


Figure 16 MAWEA Printed Circuit Cards

MAWEA MONITOR PANEL

A monitor panel is on the front of the modularized avionics warning electronics assembly (MAWEA). The panel contains:

- Jacks for monitoring the ARINC 429 inputs to the MAWEA.
- Jacks for monitoring the voltage outputs from the power supplies.
- Red lights (2) for power supply failure indication.
- Test jacks (4) for left stall warning (L STALL), right stall warning (R STALL), takeoff configuration (T/O CONFIG), landing configuration (LDG CONFIG) tests respectively. The tests are initiated by manually grounding the particular jack.
- Airplane identification code buttons (9) that determine the airplane identification code. The code is then sent to the EFIS/EICAS interface units (EIUs).
- Bus selector switches (2) used to select which system input is monitored through the ARINC 429 monitor jacks.

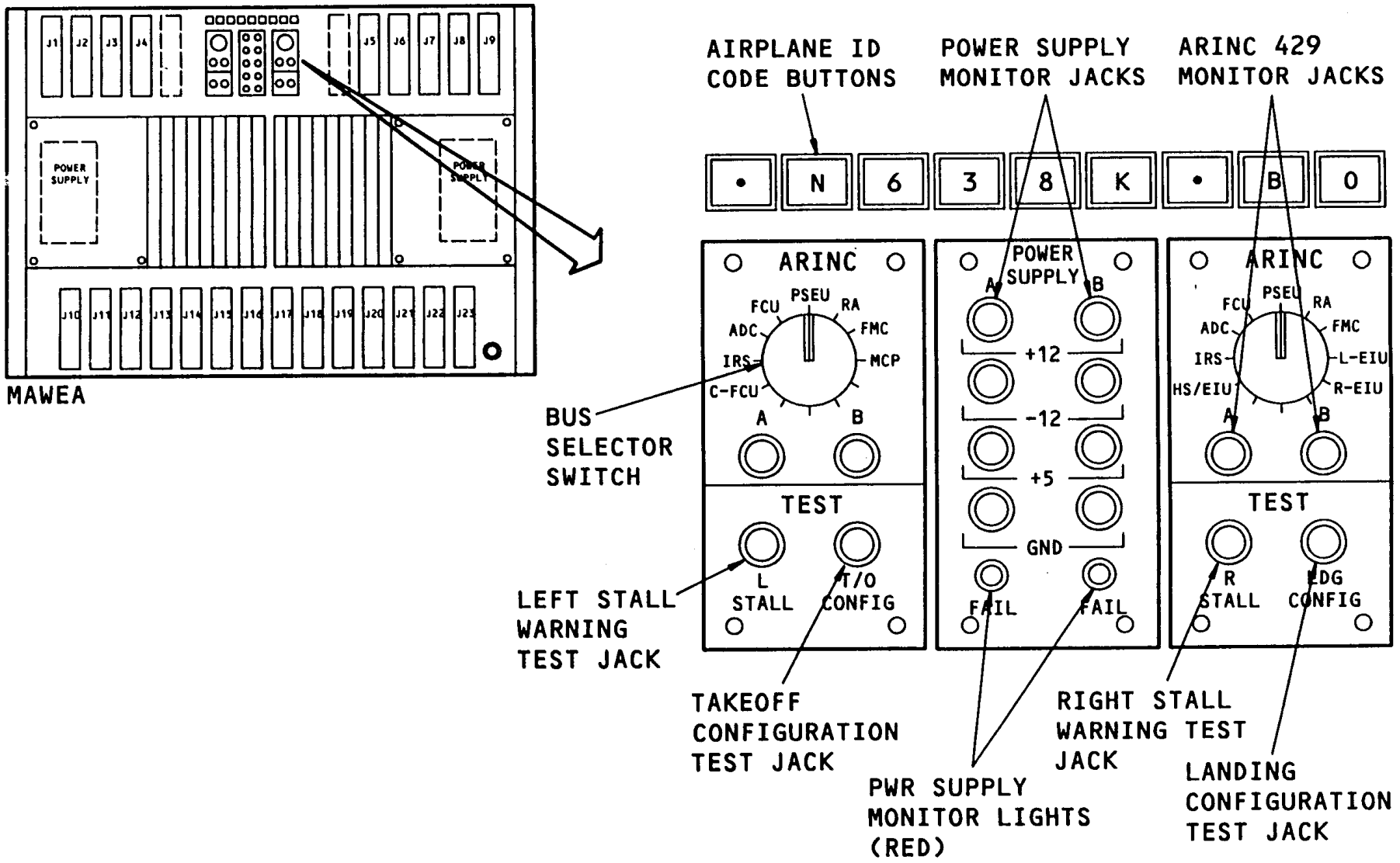


Figure 17 MAWEA Monitor Panel

AURAL SOUND TYPES

General

The aural synthesizer cards (ASCs) produce and amplify aural sounds. The types of aural sounds the ASCs produce are the:

Wailer, Siren, Firebell, Owl, Chime

Wailer

The ASCs produce a wailer sound when there is an autopilot disconnect. The wailer is a constant amplitude sound that varies in amplitude from 125 Hz to 325 Hz once every 400 msec. It is highest in priority.

Siren

The ASCs produce a siren for all other level A warning conditions except fire. The siren is two alternating tones at constant amplitude. one tone is 250 Hz and the other is 950 Hz. The siren is second highest in priority.

Firebell

The ASCs produce a firebell when there is a fire warning. It is a bell sound with a pause between bells. The firebell is third in priority.

Owl

The ASCs produce the owl sound for all level B conditions. The owl is four consecutive tone bursts. Each burst is 160 msec long with a constant amplitude and a varying frequency. The owl is fourth in priority.

Chime

Incoming calls cause the ASCs to generate a low chime aural. A low chime is a single-stroke 580 Hz tone with a decaying amplitude. A chime is lowest in priority.

GPWC

The ASCs do not produce ground proximity warning computer (GPWC) audio. The ASCs amplify GPWC audio. It has no priority and is superimposed onto all other ASC aurals.

AURAL WARNING SPEAKERS

There are two aural warning speakers:

- Captain's aural warning speaker
- First officer's aural warning speaker

The captain's aural warning speaker receives aural inputs from the left aural synthesizer card. The first officer's aural warning speaker receives aural inputs from right aural synthesizer card.

Each speaker receives 28v dc. The 28v dc powers an amplifier in the speaker module.

CAUTION: THE LOUDSPEAKER CIRCUIT BREAKERS MST BE CLOSED BEFORE THE MAWEA CIRCUIT BREAKERS ARE CLOSED. OTHERWISE A FAULT MESSAGE WILL APPEAR ON THE STATUS PAGE.

AURAL TYPES AND PRIORITY
1 - WAILER 2 - SIREN 3 - FIREBELL 4 - OWL 5 - CHIME

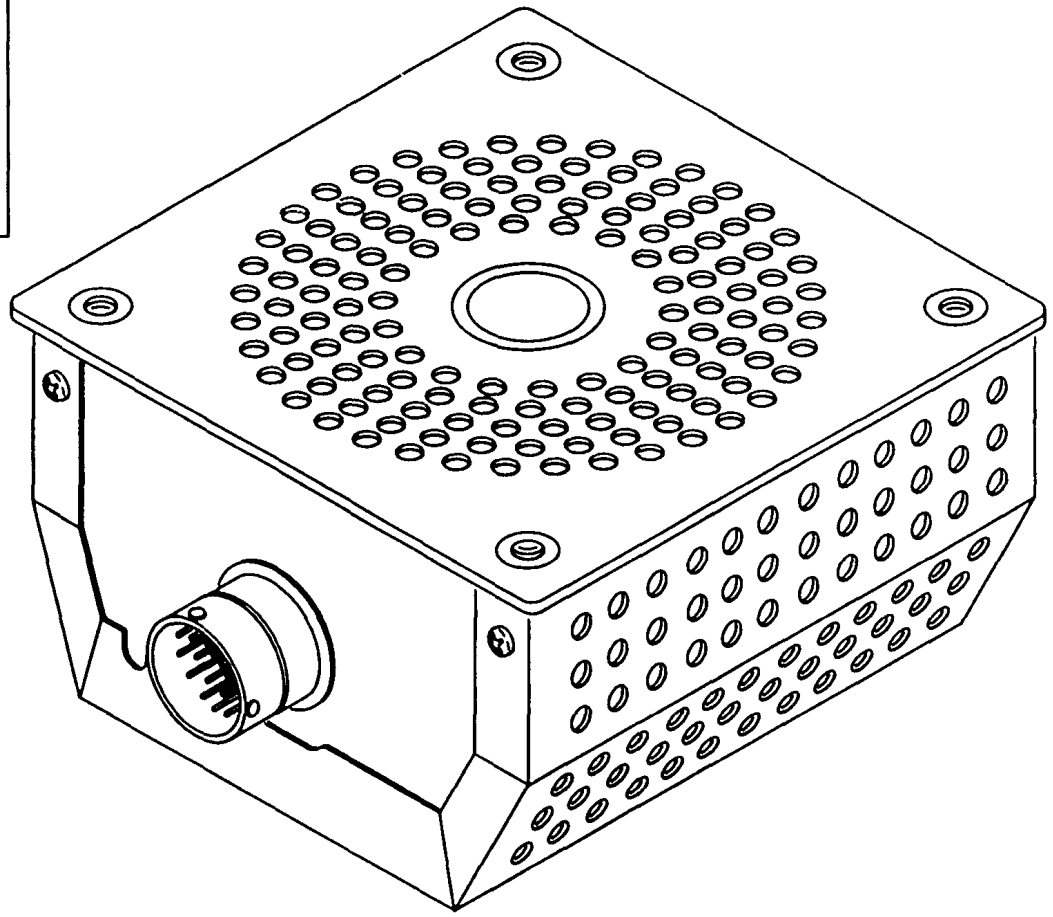


Figure 18 Aural Warning Speakers

GAIN CONTROL

General

Both aural synthesizer cards (ASC) have gain control circuits which regulate the aural output level. Two methods are used to accomplish this:

- Automatic gain control
- Program pin gain control

Automatic gain control is the primary method while the program pin method is secondary.

Automatic Gain Control

Automatic gain control is a function of flight parameter conditions as determined by the crew alerting card and digitally transmitted to the aural synthesizer cards.

Master monitor cards A and B receive digital flight parameter information, such as

airspeed,

altitude,

gear position,

flap position and

engine fuel valve position

from various systems.

This information is processed and digitally transferred to the crew alerting card. The crew alerting card also receives takeoff thrust discretes from the EFIS/EICAS interface units (EIUs).

The crew alerting card supplies the digital data to the left and right ASCs. Bit positions determine the overall gain value. The microprocessor looks at the value of these bits and sets the aural output level.

Program Pin Gain Control

Program pin gain control is used whenever there is a loss of ARINC 429 data from the crew alerting cards.

Program pins on the connectors of both ASCs determine the overall aural gain. The program pins are normally set for 0 db.

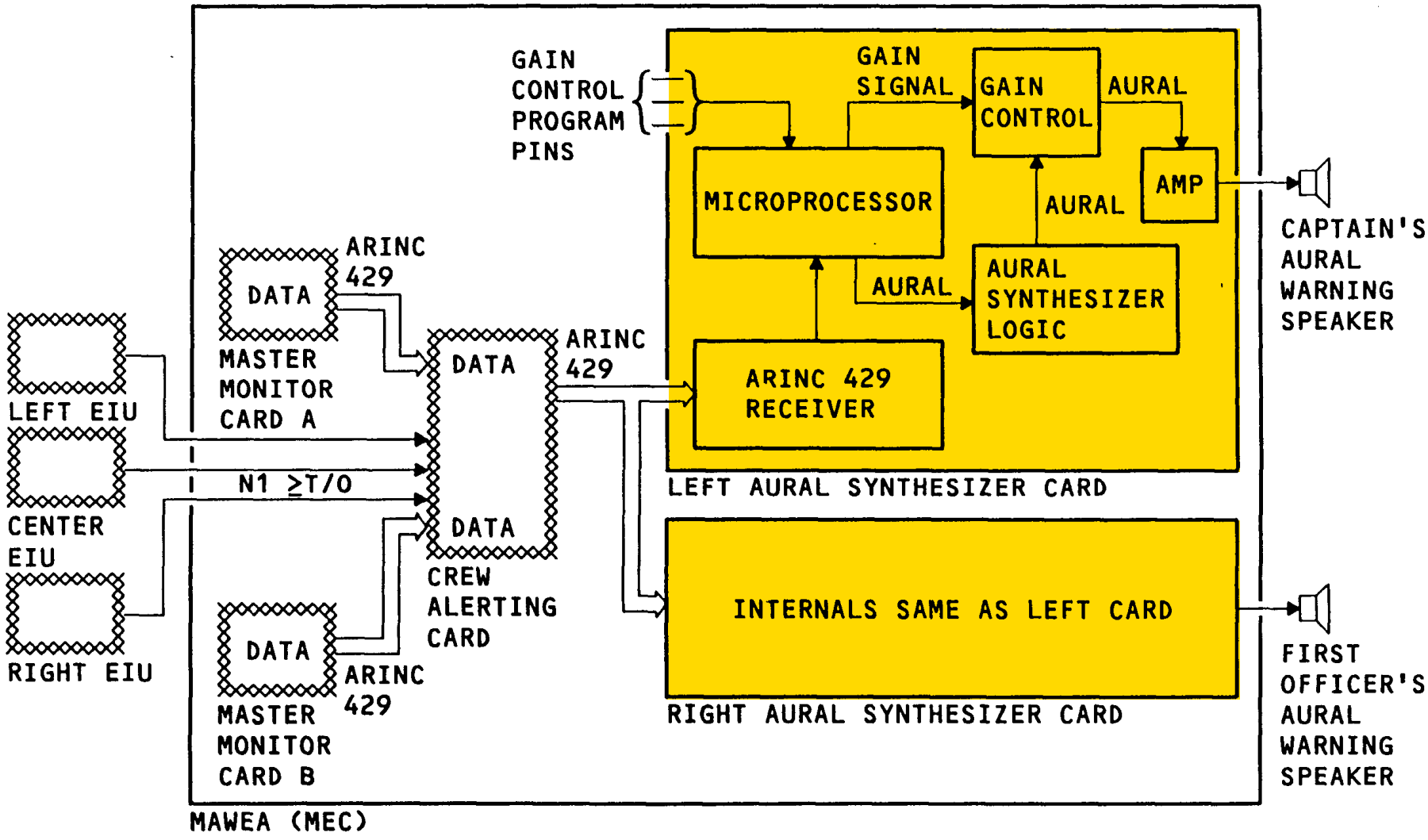


Figure 19 Gain Control

ALTERNATE AURAL INPUTS

General

Normally, the left aural synthesizer card drives the captain's aural warning speaker, while the right aural synthesizer card drives the first officer's aural warning speaker.

The aural synthesizer cards continuously monitor each other. In the event of a failure in one card the remaining card will drive both aural warning speakers.

Each aural synthesizer card produces a FAIL INDICATOR OUTPUT pulse every 100 ms. Each card continuously monitors the other card's pulses.

In the event of a failure of one card, the pulses from that card will stop. Thus, the other card is able to detect the failure.

Alternate Output

When a failure in one of the aural synthesizer cards occurs, the failed card:

- Stops generating the FAIL INDICATOR OUTPUT pulse
- Gives a STATUS message on the lower EICAS display
- Turns on the red LED on the-front of the card

The absence of the FAIL INDICATOR OUTPUT pulse causes the microprocessor in the operational aural synthesizer card to disable the inhibit logic. The operational aural synthesizer card sends generated aurals through the inhibit logic to the alternate aural input of the failed card. As long as the output amplifier of the failed card is still functional, both aural warning speakers will operate.

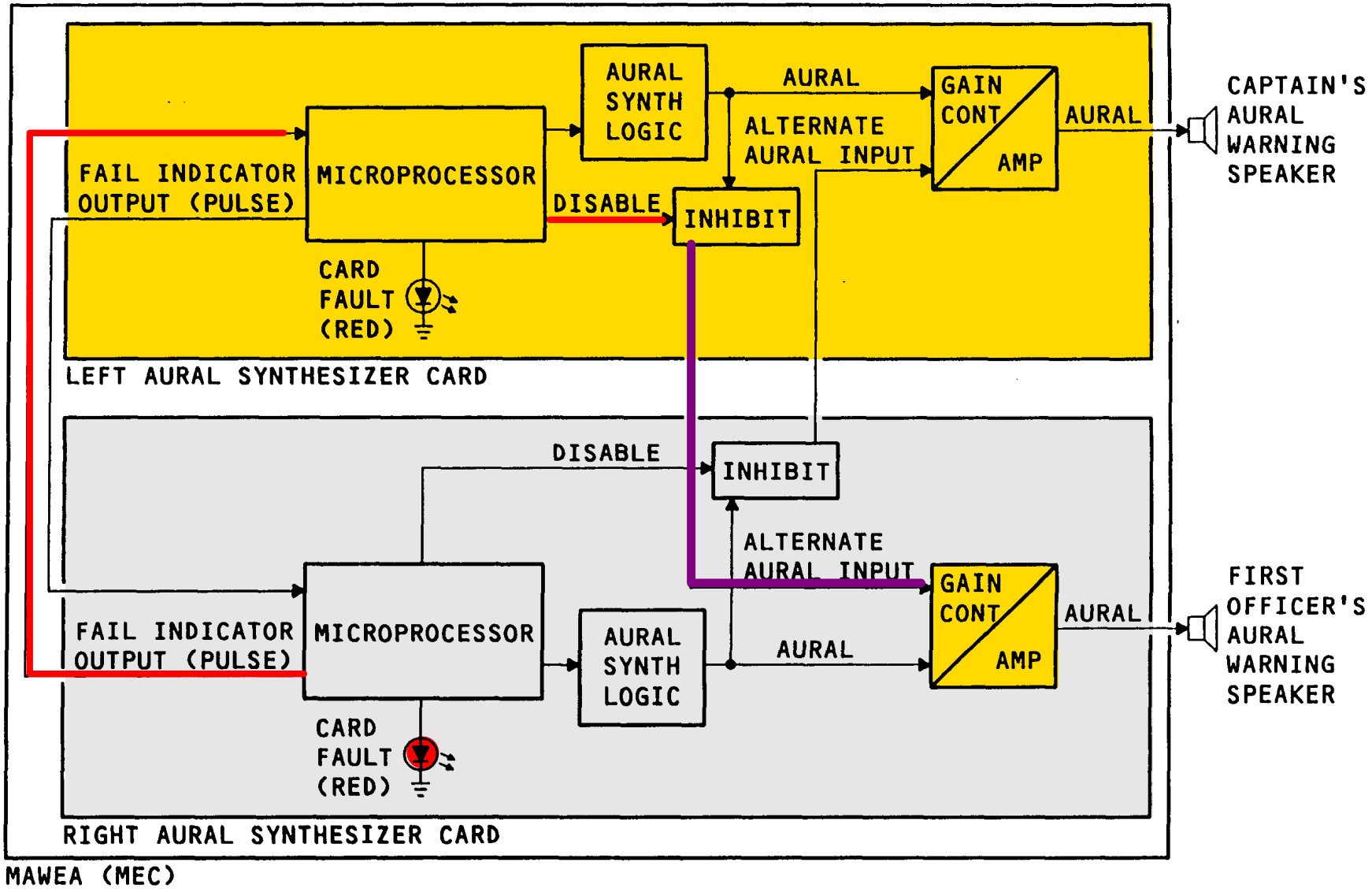


Figure 20 Alternate Aural Inputs

TAKEOFF CONFIGURATION WARNING INPUTS

General

The takeoff configuration warning is generated to alert the flight crew of an unsafe configuration during takeoff. The digital inputs used for the takeoff configuration warning are:

- Left and right flap control units (FCUs)
- Proximity switch electronics unit (PSEU)
- Left and right EFIS/EICAS interface unit (EIUs).

These components provide discrete information to the configuration warning card:

- Left, center, and right EIUs
- Spoiler handle position switch
- Parking brake switch
- Left and right central maintenance computers (CMCs)

FCUs

The FCUs provide the configuration warning card with leading and trailing

edge flap position and stabilizer position information. Before the stabilizer position is used by the takeoff warning function, the information is processed by the green band function to determine whether or not the stabilizer is in the takeoff range.

Information from the left FCU has priority. If it fails or becomes invalid, the right FCU is used.

PSEU

The PSEU provides two landing gear parameters:

Air/ground status

Body gear steering lock data

PSEU bus A supplies master monitor card A, while PSEU bus B supplies master monitor card B. Information from bus A has priority over bus B. If bus A fails or becomes invalid, bus B is used.

Master Monitor Cards

The master monitor cards send this data to the configuration warning card.

- Landing gear status
- Takeoff configuration warning enable
- Takeoff configuration warning enable inop

The master monitor cards provide a takeoff configuration warning enable only when a takeoff is feasible. The enable is sent as a digital discrete to the configuration warning card. The enable then goes to the arming logic within the configuration card.

The takeoff configuration warning enable inop is generated to prevent a takeoff configuration warning enable. This happens when, due to system failures, inadequate information is available to generate the takeoff configuration warning enable. The master monitor cards send the takeoff enable inop digital discrete to the configuration warning card. The discrete then goes to the arming logic to disarm the takeoff configuration warning.

EIUs

The EIUs provide two inputs:

- Takeoff thrust
- Fuel switch position

When any inboard engine (2 or 3.) has a N1 setting equal to or greater than takeoff thrust, the EIUs send a discrete to the configuration warning card. The takeoff thrust discrete goes to the arming logic when it is received from any EIU.

The left and right EIUs send fuel switch data on an ARINC 429 data bus to the configuration warning card. Fuel switches in the RUN position is the data being monitored. The left EIU has priority, if data from the left EIU fails or becomes invalid, the right EIU is used.

Spoiler Handle Position Switch

The spoiler handle position switch provides spoiler handle in the down detent position information.

Parking Brake Valve Open Relay

The parking brake valve open relay provides parking brake set, or released information.

CMCS

The CMCs provide a takeoff configuration test discrete when a takeoff configuration test is selected through any CDU. The same discrete is provided by manually grounding the T/O CONFIG test jack on the MAWEA monitor panel.

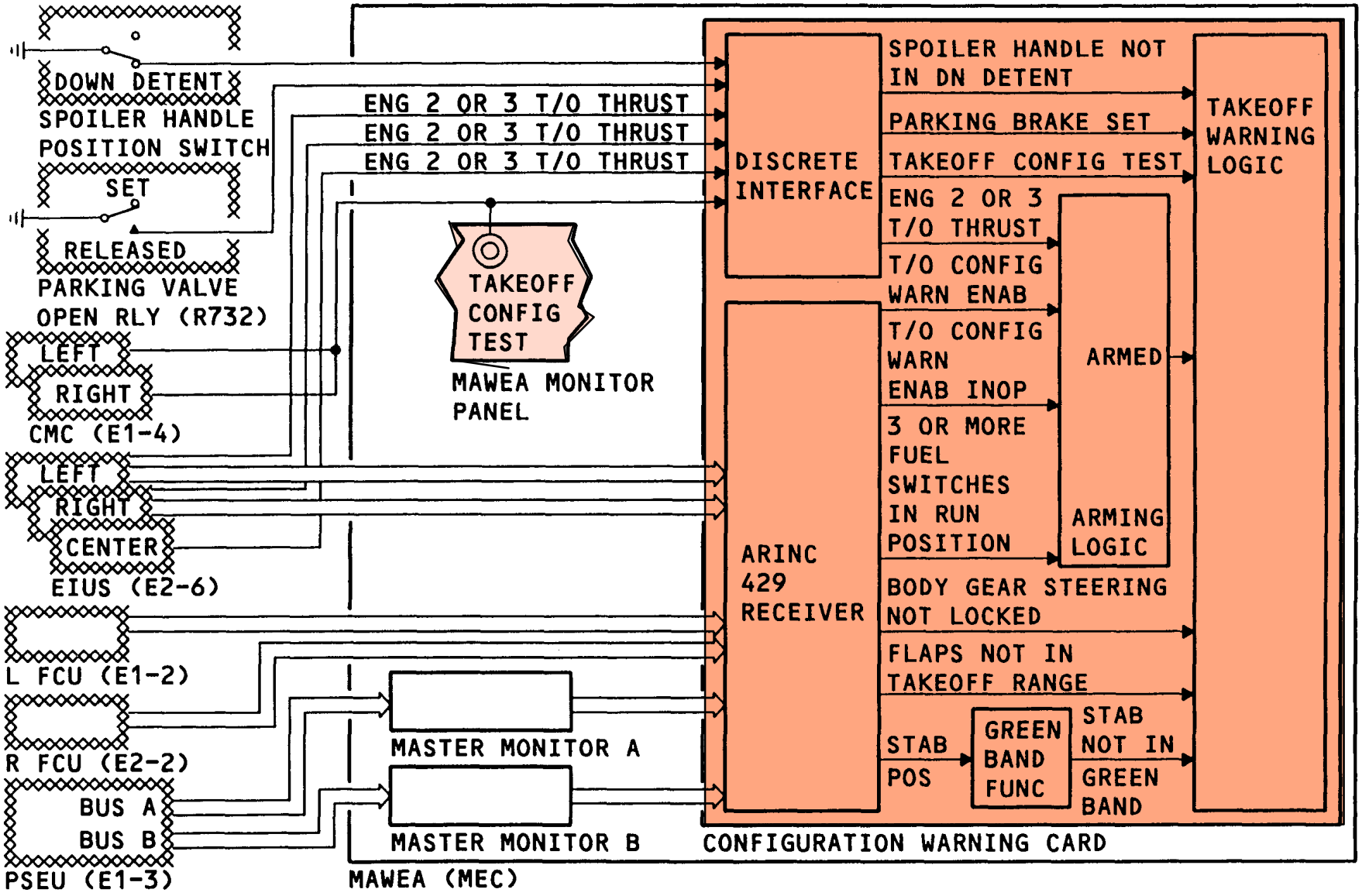


Figure 21 Takeoff Configuration Warning Inputs

SPOILER HANDLE DEPLOY POSITION SWITCH

The spoiler handle deploy position switch and the spoiler handle position switch are located below the aft electronics panel (P8). They are part of the speed brake drum mechanism. They provide discrete signals to the MAWEA.

Spoiler Handle Deploy Position Switch

The spoiler handle deploy position switch provides a discrete when the spoiler handle is past the armed position.

SPOILER HANDLE POSITION SWITCH

Spoiler Handle Position Switch

The spoiler handle position switch provides a discrete when the spoiler handle is in the down detent position.

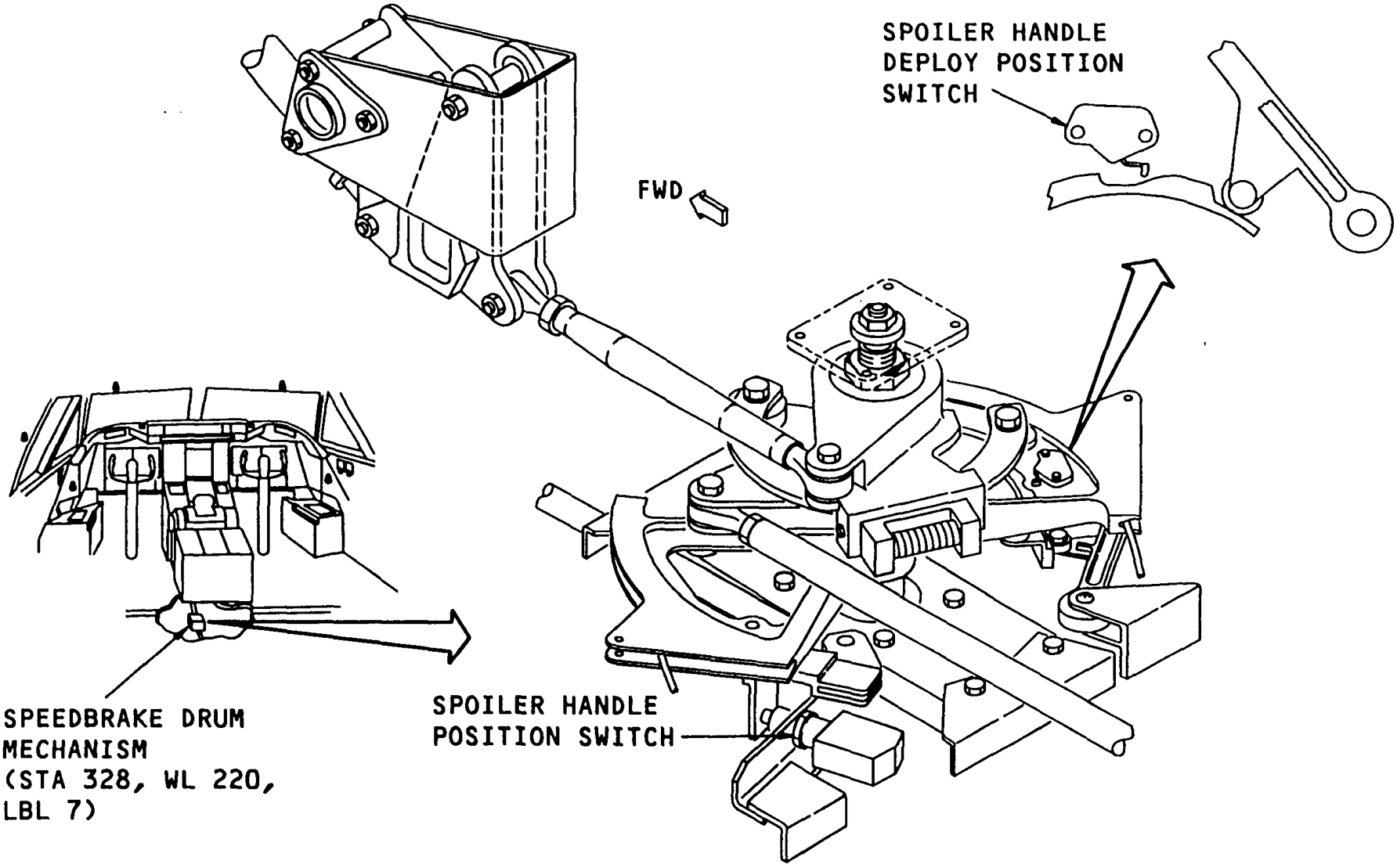


Figure 22 Spoiler Handle - & Deploy Position Switch

TAKEOFF CONFIGURATION WARNING OPERATION

Arming Logic

Four conditions must be true to arm the takeoff configuration warning logic:

- Takeoff configuration warning enable
- No takeoff configuration warning enable inop
- Three or more fuel switches in the RUN position
- Takeoff thrust on either engine 2 or 3

Takeoff Warning Logic

When the takeoff warning logic is armed, any of these five conditions cause a takeoff configuration warning:

- Parking brake set
- Spoiler handle not in the down detent
- Stabilizer not in greenband range
- Body gear steering not locked
- Flaps not in takeoff range

The flap control unit monitors flap handle position and actual flap position. If the flap handle position does not agree with the actual flap

position a takeoff configuration warning is generated.

Indications

When a takeoff configuration warning is generated, the configuration warning card sends these outputs:

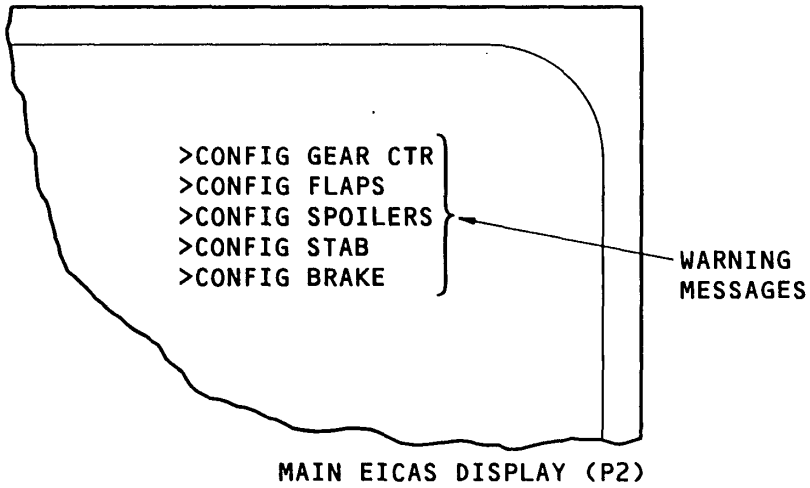
- A discrete output to master monitor card A and master monitor card B
- An ARINC 429 output to the left, center, and right EFIS/EICAS interface units (EIUs), indicating the unsafe configuration.

The master monitor cards turn on the master warning lights and send a discrete to the aural synthesizer cards. The aural synthesizer cards generate the siren.

The EIUs show the proper level A message on the main EICAS display.

Takeoff Configuration Warning Messages

These are the messages (level A) that show on the main EICAS display for an improper takeoff configuration warning:



Reset

The takeoff configuration warning is a non-resetable warning. Press either master warning light to extinguish the light. The siren will end if any of these conditions occur:

- Removal of the unsafe configuration
- Removal of the takeoff configuration warning enable
- T/O WARN Inhibit starts

Test

A takeoff configuration warning test can be started from either the MAWEA monitor panel or the central maintenance computer (CMC). When a test is started, a ground discrete is sent to the configuration warning card.

The discrete arms the takeoff warning logic. If an improper takeoff configuration is set, a takeoff configuration warning will be generated.

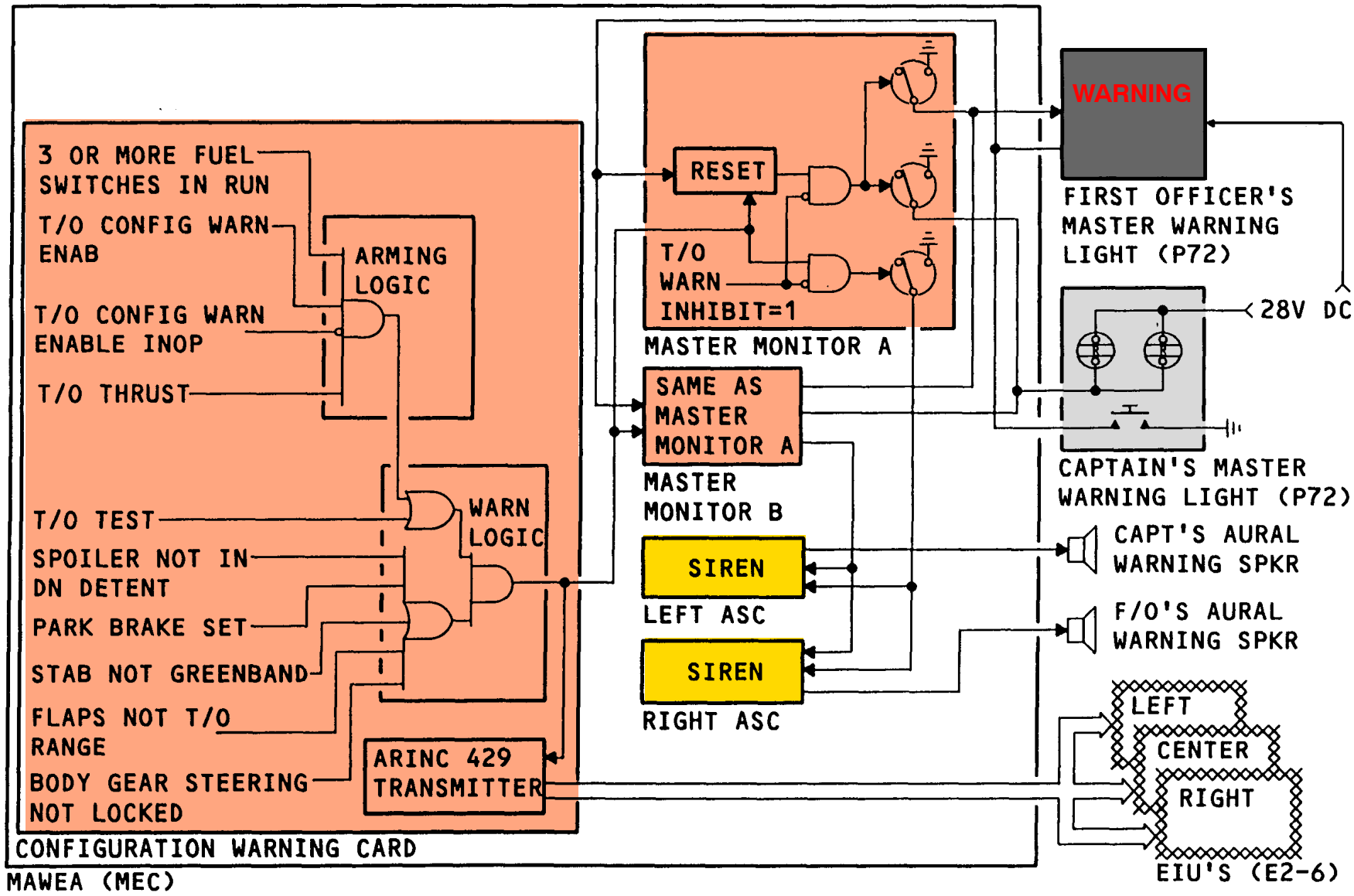


Figure 23 Takeoff Configuration Warning Operation

WARNING ARMING AND INHIBITS

Take-Off Warning

When takeoff thrust is applied, the takeoff warning is armed.

When the computed airspeed (VCAS) reaches the decision speed (V1), the:

- Takeoff warning is disarmed.
- Level A inhibit is started.
- Level A inhibit timer is started.
- Green band indicator lamps are extinguished.

If the V1 input from the FMCs is invalid then pitch angle is used instead. When the pitch angle equals five degrees the same conditions occur as V1.

Resettable Landing Configuration Warning Inhibition

When the landing gear is raised, a 140 second timer is started. The timer inhibits resettable landing configuration warnings from being generated.

When the radio altitude (RA) equals four hundred feet the level A inhibit is ended. Any active level A warnings will be generated.

If the radio altitude does not reach four hundred feet the inhibit will end twenty five seconds after the start of the inhibit.

The resettable landing warning inhibit ends 140 seconds after the landing gear was raised.

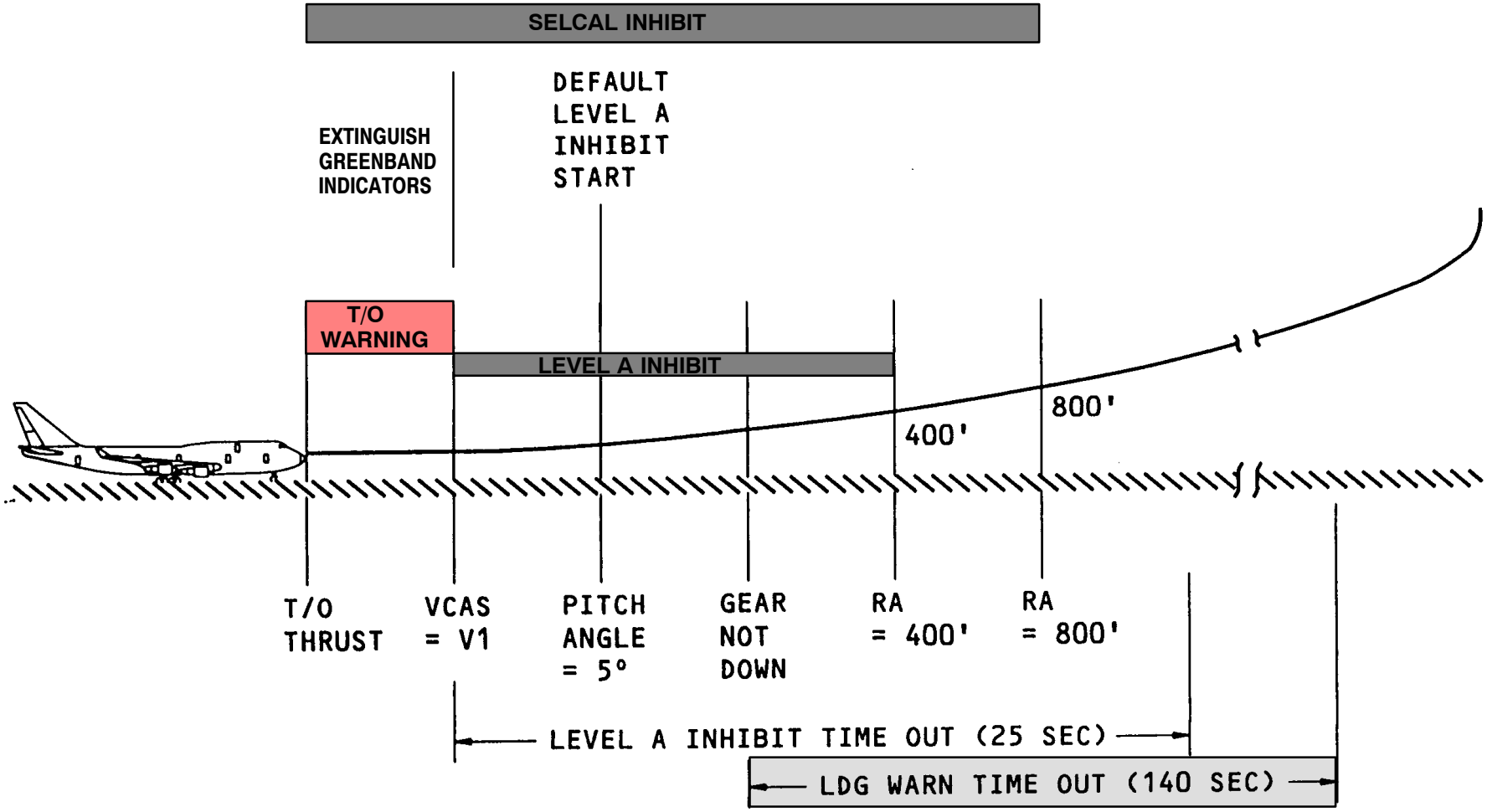


Figure 24 Warning Arming and Inhibits

LANDING CONFIGURATION WARNING INPUTS

General

The landing configuration warning alerts the flight crew that the landing gear is not down and locked when a landing is attempted.

These digital inputs are used by the configuration warning card to generate landing configuration warnings:

- Left and right flap control units (FCUs)
- Left and right EFIS-EICAS interface units (EIUs)
- Left and right radio altimeters (RAs)
- Proximity switch electronic unit (PSEU)

FCUs

The FCUs provide flap position information. Flaps in landing range (25 or 30 units) is the condition monitored.

Information from the left FCU has priority. If it fails or becomes

invalid, the right FCU provides flap information.

EIUs

The EIUs provide engine throttle levers position. Retarding any throttle to a position of less than 55 degrees thrust lever resolver angle (TLRA) is the condition monitored.

Information from the left EIU has priority. If it fails or becomes invalid, the right EIU throttle lever position information is used.

RAs

The left radio altimeter provides altitude information to master monitor card A. When an altitude of 800 feet or less is reached, master monitor card A sends a digital discrete to the configuration warning card.

A similar situation occurs with the right radio altimeter and master monitor card B.

Information from the left radio altimeter has priority over the right. If it fails or becomes invalid, the right radio altimeter provides radio altitude.

PSEU

Landing gear down and locked is the condition monitored from the PSEU.

Bus A provides landing gear information to master monitor card A. Master monitor card A sends a digital discrete to the configuration warning card when the landing gear is down and locked. A similar situation occurs with bus B and master monitor card B.

Information from bus A has priority over bus B. If it fails or becomes invalid, bus B provides landing gear information.

Master Warning Reset

Pushing either master warning light sends a discrete to:

- Master monitor cards A and B
- Configuration warning card

The master monitor cards reset the master warning lights for a nonresettable warning.

The configuration warning card resets the master warning lights and siren for a resettable warning.

MAWEA Monitor Panel

The MAWEA monitor panel sends a test discrete to the configurated warning card self test logic. This causes the configuration warning card to do a landing configuration self test.

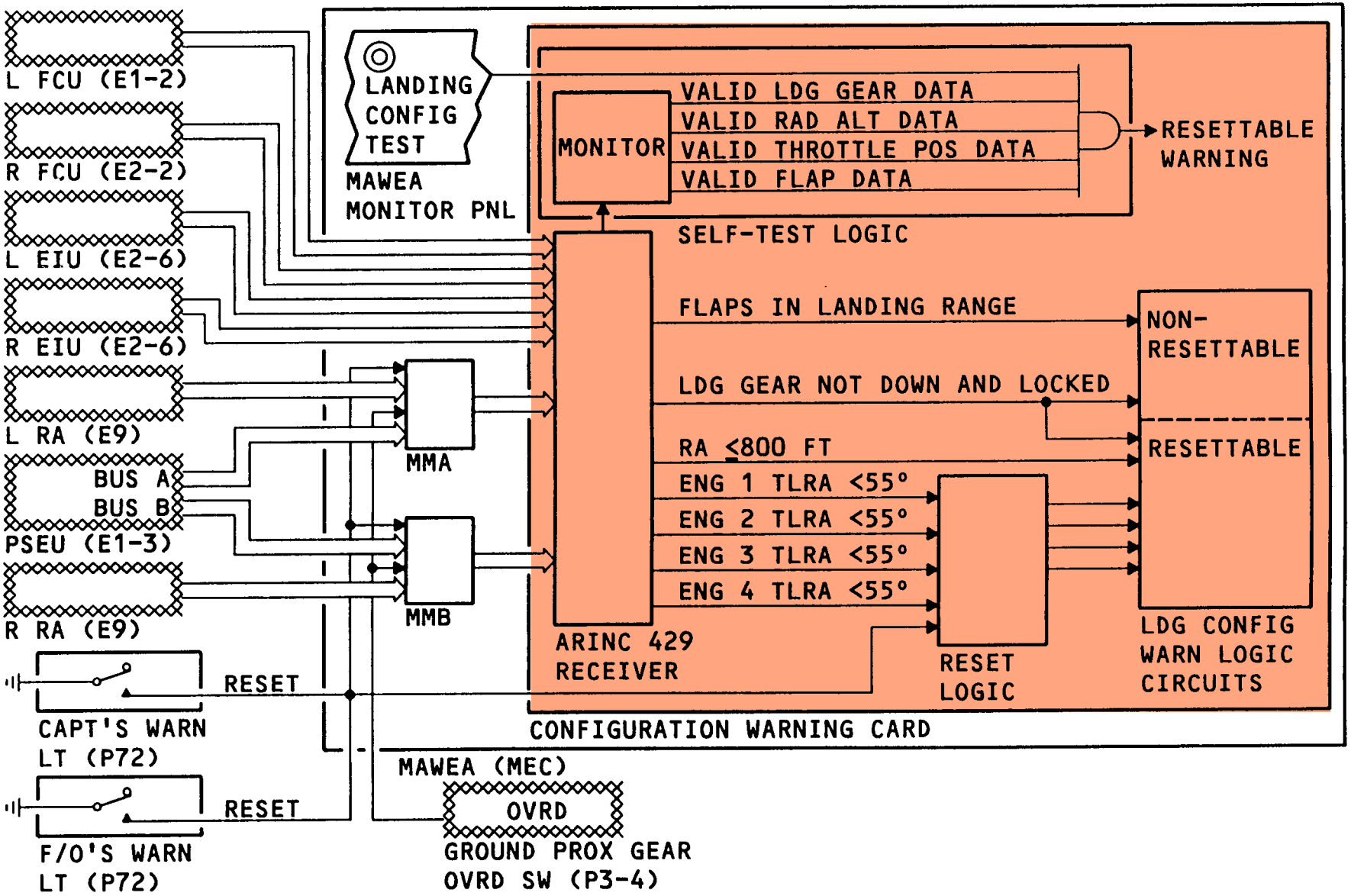


Figure 25 Landing Configuration Warning Inputs

LANDING CONFIGURATION WARNING OPS (NON-RESETTABLE WARNING)

A non-resettable landing configuration warning is issued when both of these conditions are true:

- The flaps are in the landing range (25 or 30 units)
- The landing gear is not down and locked.

A non-resettable warning discrete from the configuration warning card is sent to the:

- Master monitor cards A and B. This causes the master warning lights to illuminate and the aural synthesizer cards to generate the siren.
- EIUs, to show a level A CONFIG GEAR message on the main EICAS display

The elimination of the warning condition will remove the landing warning indications, including the EICAS CONFIG GEAR message.

Pushing the ground proximity configuration gear override switch sends a discrete to master monitor cards A and B. This discrete eliminates the siren aural. The EICAS CONFIG GEAR message will continue to show.

Pushing either master warning light will reset the master warning lights only.

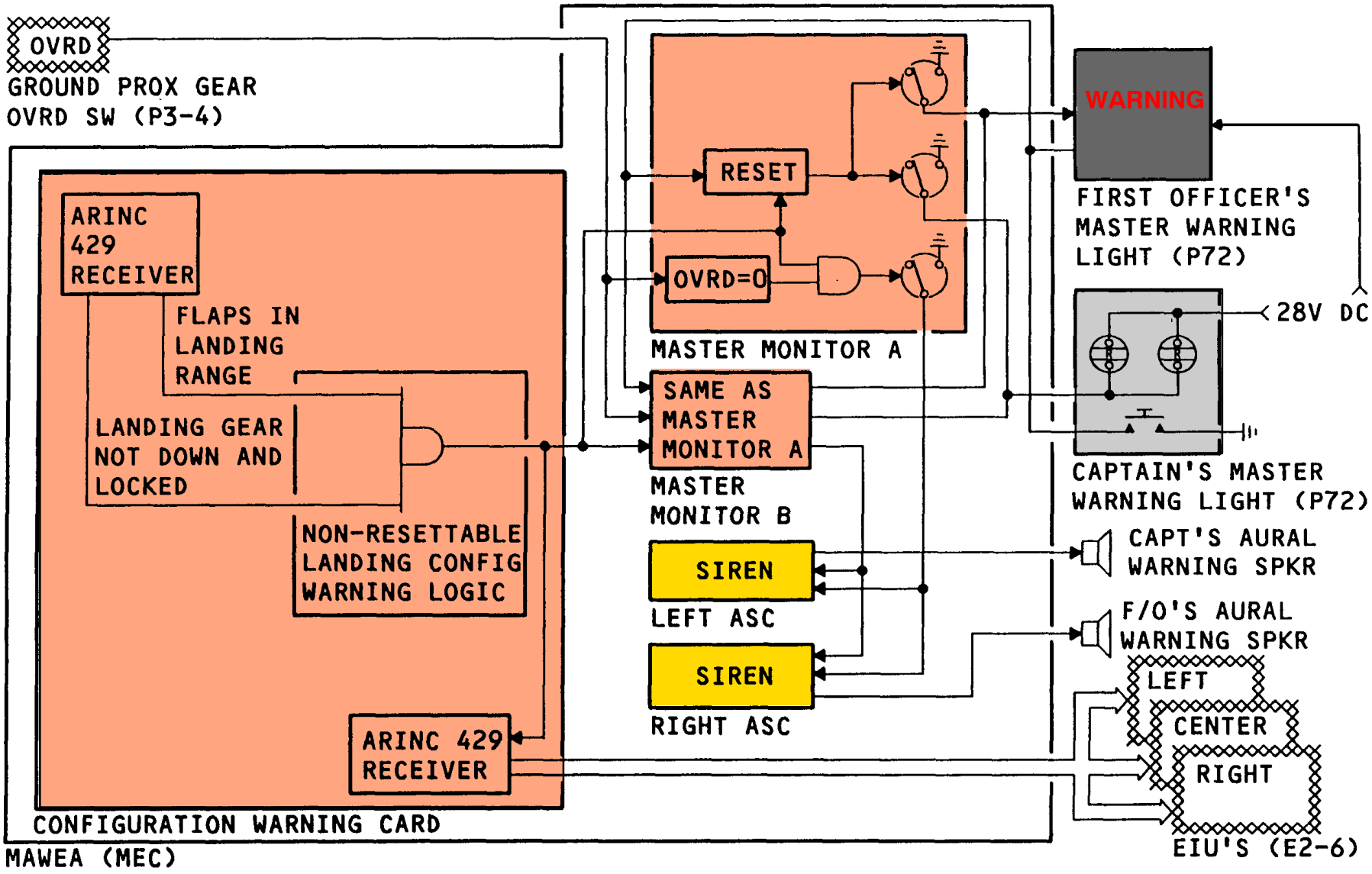


Figure 26 Landing Configuration Warning Ops (Non-resettable Warning)

LDG CONFIG WARN OPS RESETTABLE WARNING

A resettable landing configuration warning is generated if these three conditions are true:

- The radio altitude is 800 feet or less
- One or more engine throttles are retarded to less than 55 degrees thrust lever resolver angle (TLRA).
- The landing gear is not down and locked

A resettable warning discrete from the configuration warning card is sent to the:

- Master monitor cards A and B. This causes the master warning lights to illuminate and the aural synthesizer cards to generate the siren.
- EIUs to show a level A CONFIG GEAR message on the main EICAS display.

The warning annunciations stop when the situation is cleared by:

- Lowering the landing gear
- Climbing above 800 feet of radio altitude
- Advancing the retarded throttle(s)
- Pushing either master warning lights (the EICAS message remains displayed).

Reset

Pushing either master warning light resets any retarded throttle indication.

The resettable landing warning logic senses all throttles to be forward of 55 degrees (TLRA) and stops generating a warning.

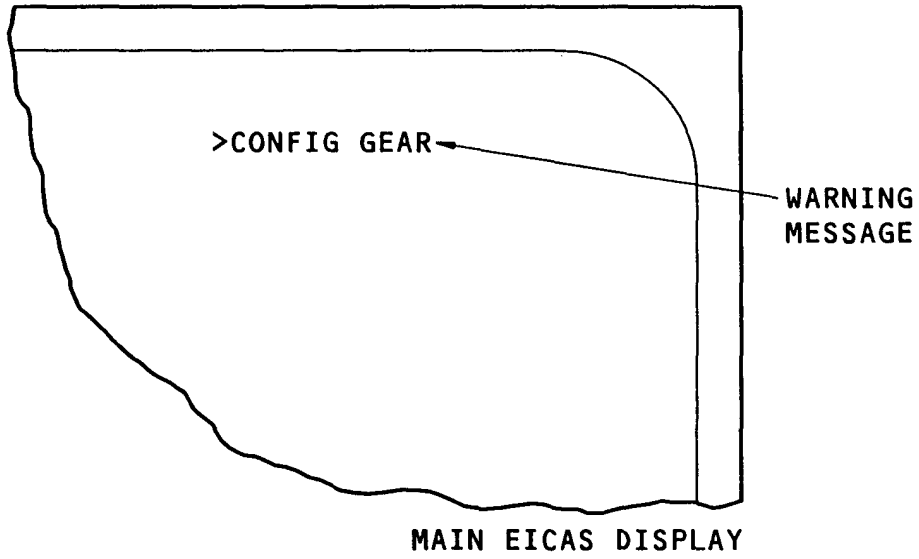
If a different throttle is retarded to 55 degrees (TLRA) or less, then a new warning will be generated.

Inhibit

A 140-second takeoff inhibit is issued beginning with gear retraction. This prevents the generation of a resettable landing configuration warning for that period. This allows enough time for the airplane to climb above 800 feet radio altitude without a warning being generated.

LANDING CONFIGURATION WARNING MESSAGE

When the configuration warning card detects a landing configuration warning condition, it sends a digital discrete to the EFIS/EICAS interface units (EIUs). The EIUs generate a level A warning message, CONFIG GEAR. It is shown on the main EICAS display.



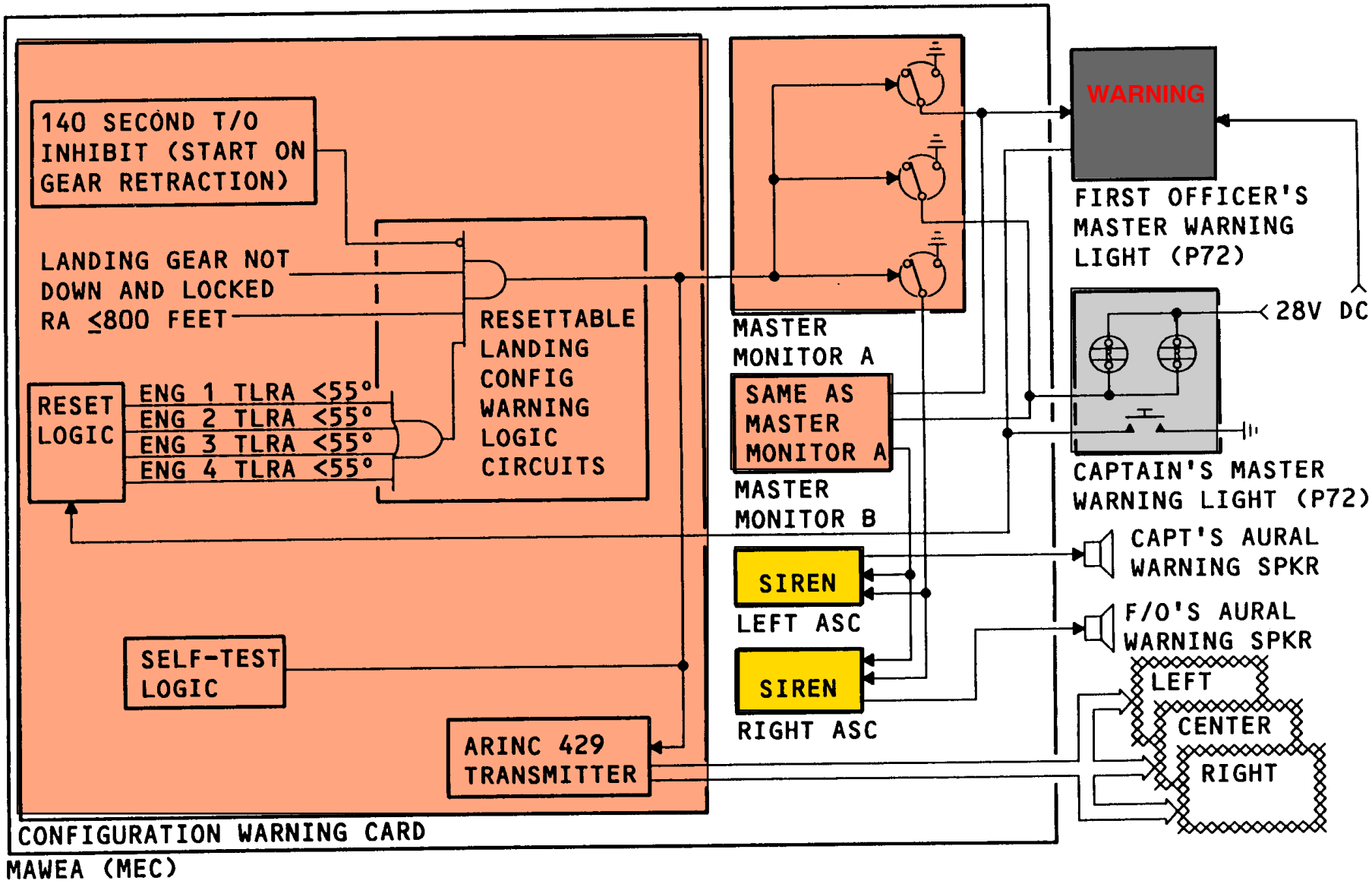


Figure 27 Ldg Config Warn Ops Resettable Warning

SPEED BRAKE ALERT FUNCTION

General

The speed brake alert function alerts the flight crew of an unsafe speed brake deployment. A speed brake alert is generated when the speed brake is deployed and any of these conditions are true:

- Radio altitude is between 15 and 800 feet
- Flaps are in landing range with radio altitude greater than 15 feet.
- Two or more throttle levers are advanced with radio altitude greater than 15 feet.

Inputs

The digital inputs used by the configuration warning card to provide speed brake alerts are from:

- Left and right radio altimeters
- Left and right flap control units (FCUs)
- Left and right EFIS-EICAS interface units (EIUs)

Components which provide discrete information to the configuration warning card are the:

- Spoiler handle deploy position switch
- MAWEA monitor panel

Radio Altimeters

The left radio altimeter provides altitude information to master monitor card A. When an altitude of 800 feet or less is reached, master monitor card A sets a bit on its output bus. The configuration warning card monitors the condition of this bit.

When an altitude of 15 feet or less is reached, master monitor card A sets a bit on its output bus. The configuration warning card monitors the condition of this bit.

A similar situation occurs with the right radio altimeter and master monitor card B.

Information from the left radio altimeter has priority over the right radio altimeter. If it fails or becomes invalid, the right radio altimeter will provide radio altitude.

FCUs

The FCUs provide flap position information. Flaps in landing range (25 or 30 units) is the condition monitored.

Information from the left FCU has priority. If it fails or becomes invalid, the right FCU provides flap information.

EIUs

The EIUs provide throttle lever position information. Advancing any throttle lever to a position of more than 43 degrees thrust lever resolver angle (TLRA) is the condition monitored. Information from the left EIU has priority. If it fails or

becomes invalid the right EIU provides throttle lever position information.

Spoiler Handle Deploy Position Switch

An input from the spoiler handle deploy position switch is used to determine if the spoilers (speed brakes) are deployed.

Processing

The information derived from the digital inputs is routed to the enable logic. An enable output is sent to the speed brake alert logic when any of these conditions are present:

- Radio altitude between 15 and 800 feet
- Flaps in landing range (25 or 30 units) and radio altitude is greater than 15 feet.
- Two or more throttle levers advanced beyond a TLRA of 43 degrees and radio altitude is greater than 15 feet.

If the speed brake alert logic receives an enable input when the speed brakes are deployed, then the configuration card sends:

- A discrete output to the left and right aural synthesizer cards.
- A digital discrete to the left, center, and right EIUs.

The aural synthesizer cards generate the owl sound and send it to the aural warning speakers.

The EIUs show the level B caution message SPEED BRAKES EXT, and then turn on the master caution lights.

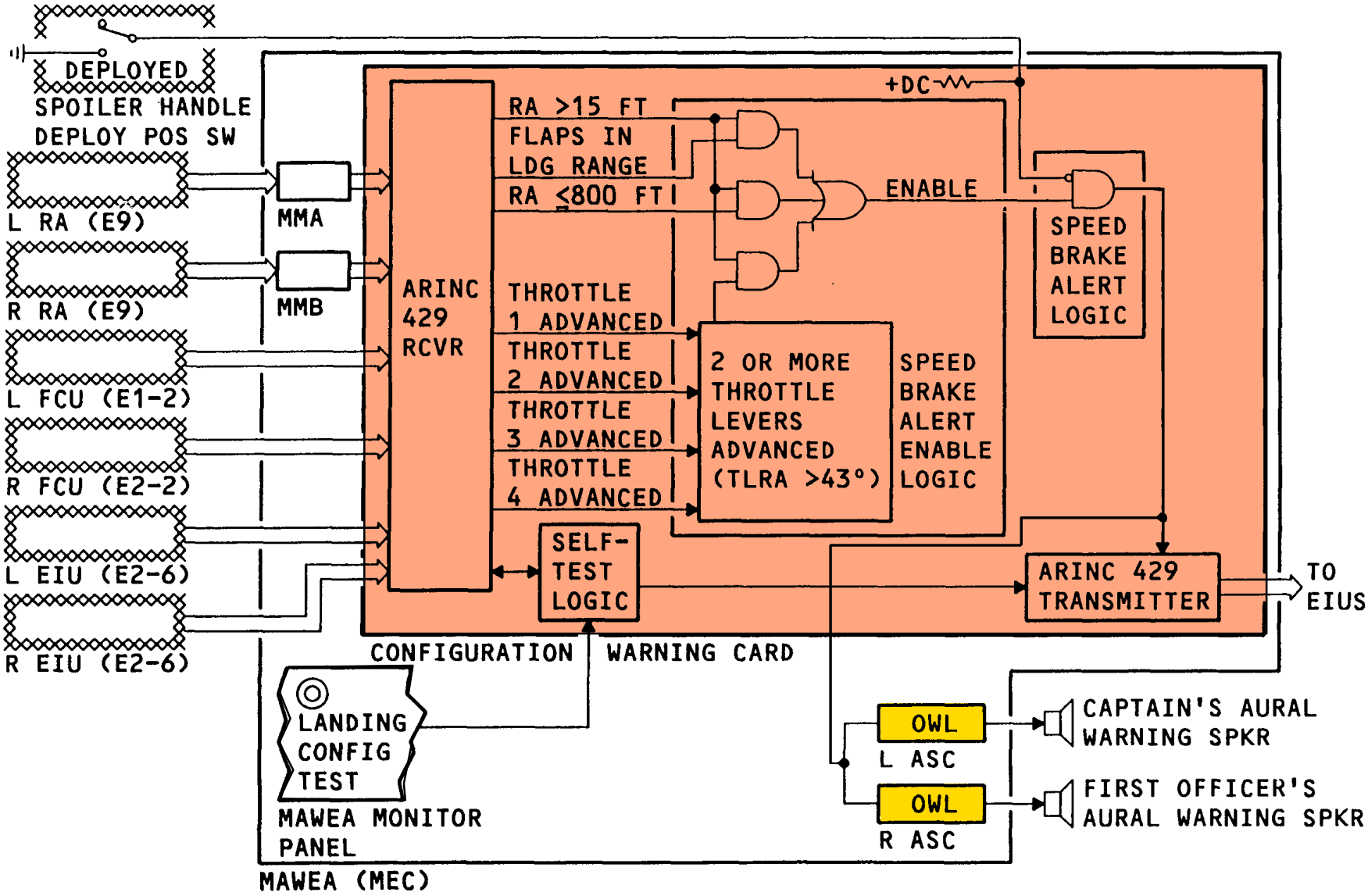


Figure 28 Speed Brake Alert Function

Test

When a landing warning test is initiated by manually grounding the LDG CONFIG jack on the MAWEA monitor panel, the configuration warning card:

- Checks that at least one of the radio altimeter inputs is available
- Checks that all four throttle positions are available from either EIU
- Checks that flap information is available from either FCU bus

If all of these conditions are satisfied and the spoiler handle deploy position switch input is active (speed brakes deployed), the speed brake alert discrete output is generated. This causes:

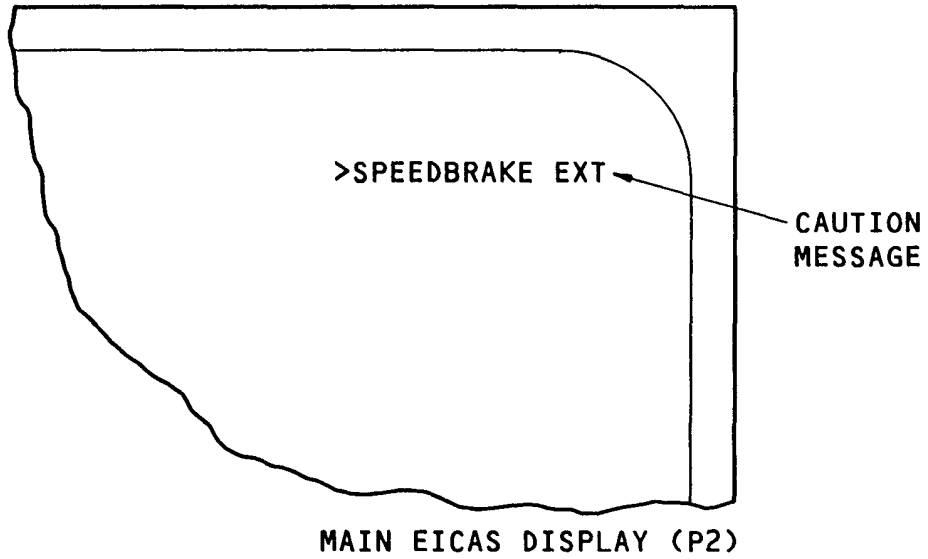
- The master caution lights illuminate
- The owl sound to be generated
- The level B SPEEDBRAKES EXT message to be shown on the main EICAS display

NOTE: THIS TEST ALSO DOES A LANDING CONFIGURATION WARNING TEST. SINCE THE SIREN AURAL IS HIGHER IN PRIORITY THAN THE OWL, THE OWL WILL BE DELAYED UNTIL THE SIREN IS RESET.

If there is a fault detected, the red or yellow LED (depending upon the fault) will illuminate.

SPEED BRAKE ALERT CAUTION MESSAGE

The level B caution message SPEEDBRAKE EXT is generated when a speed brake alert is generated.



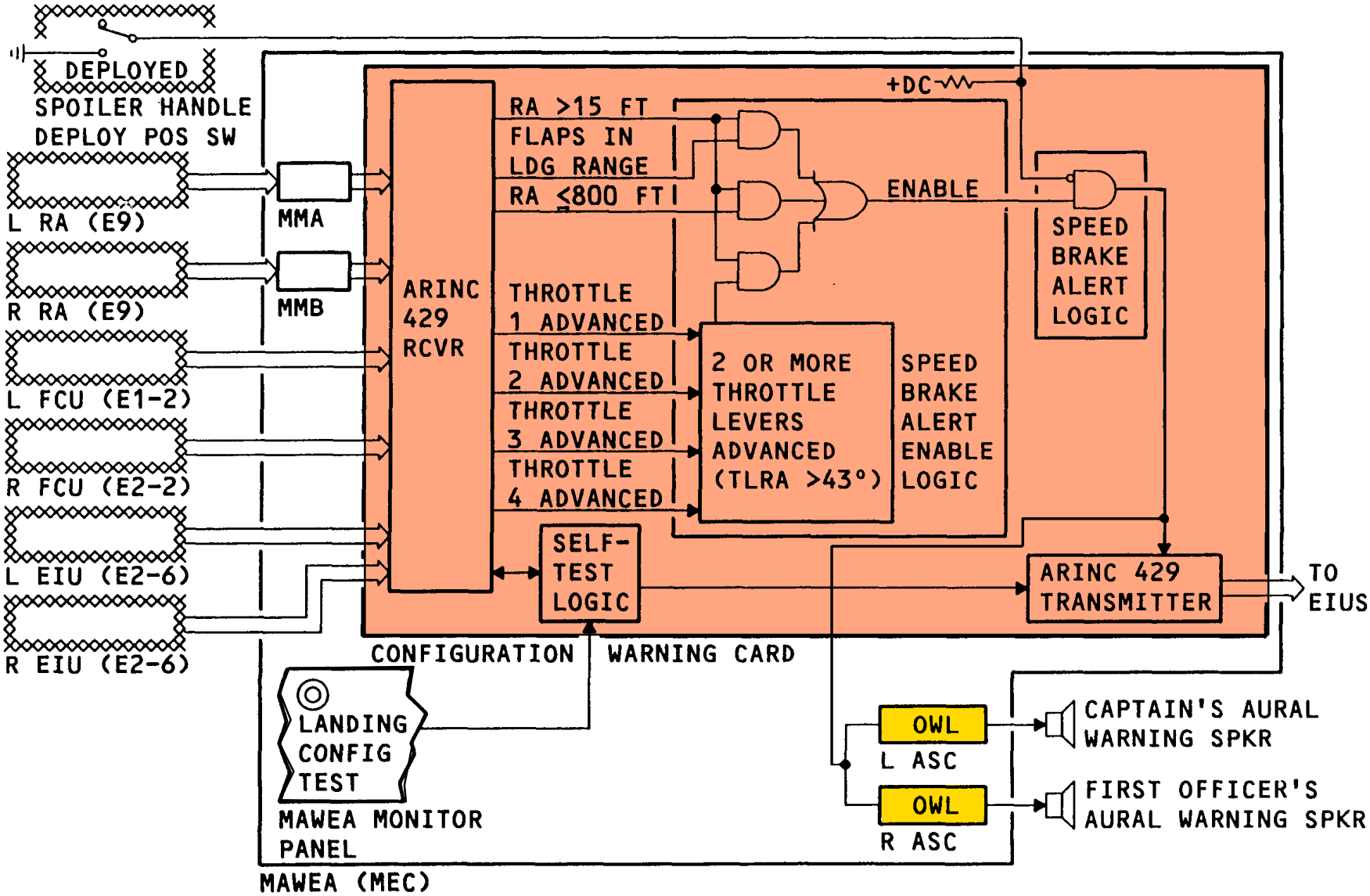


Figure 29 Speed Brake Alert Function

UNIVERSAL LOGIC CARDS - RESET AND BITE

General

The universal logic cards (ULCs) are:

- Master monitor cards, A and B
- Configuration warning card
- Crew alerting card
- Stall warning cards, left and right

When power is first applied, each power supply provides reset pulses to the ULCs. If the ULCs receive two reset pulses (one from each power supply), these two events occur:

- ULC microprocessors are reset
- Power up BITE is started

Power Up BITE

A power up BITE tests most of the ULC circuitry, and lasts approximately two seconds.

Full BITE

The ULCs conduct a full BITE when the airplane is on the ground. The master monitor cards determine if a full BITE is to be started or not. The master monitor cards conduct a full BITE and send full BITE enable discretes to all other MAWEA cards, if these conditions are true:

- Air/Gnd = Gnd
- Landing gear is down and locked
- Airspeed = 0

The proximity switch electronics unit (PSEU) sends air/ground and landing gear status to the master monitor cards. Bus A goes to master monitor card A. Bus B goes to master monitor card B.

The air data computers (ADCs) send airspeed data to the master monitor cards. The captain's ADC source select relay input goes to master monitor card A. The first officer's ADC source select relay input goes to master monitor card B.

During a full BITE both the red and yellow LEDs turn on to assure proper operation of the LEDs. If no fault is detected, the LEDs will go out after approximately twenty seconds. If a fault is detected, the appropriate LED remains on.

A full BITE tests all of the ULC circuitry. It activates output drivers and tests input receivers.

Internal Fault

If an internal fault is detected, the red CARD FAULT LED turns on.

Interface Fault

If an interface fault is detected, the yellow INTERFACE FAULT LED turns on.

Internal and Interface Fault

If both an internal and an interface fault is detected, then only the red CARD FAULT LED turns on.

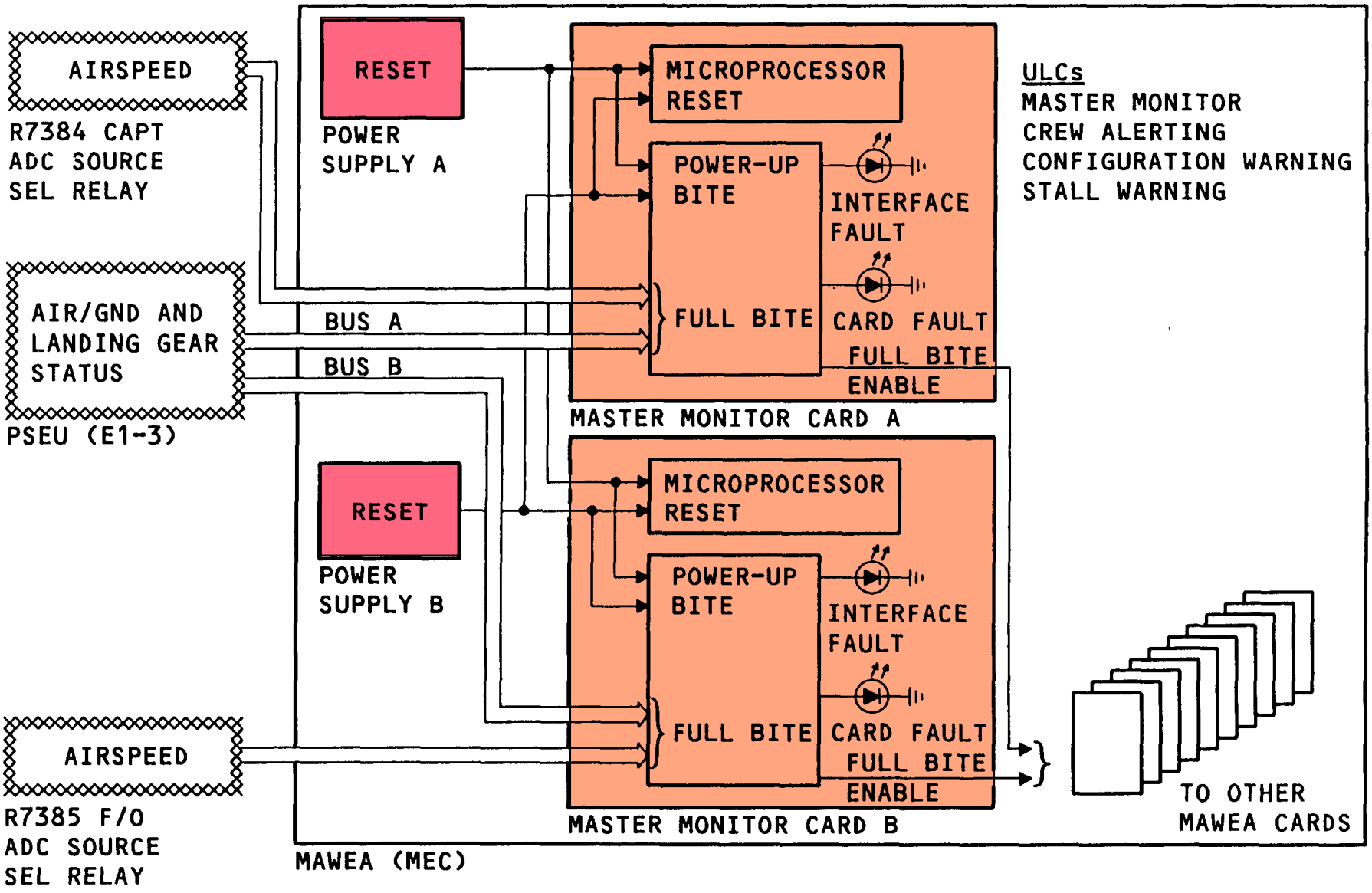


Figure 30 Universal Logic Cards (Reset and BITE)

AURAL SYNTHESIZER CARDS - RESET AND BITE

General

When power is first applied each power supply sends a pulse to the aural synthesizer cards (ASCs). If two reset pulses are received (one from each power supply), the ASCs reset their microprocessors and start a power up BITE.

Power Up BITE

A power up BITE tests most of the ASCs circuitry and lasts approximately three seconds.

Full BITE

When power is first applied, a full BITE is enabled only if master monitor cards A and B provide full BITE discretes. The full BITE starts after the power up BITE is complete.

During a full BITE, both the red and yellow LEDs turn on to assure proper operation of the LEDs. If no fault is detected, the LEDs will go out after approximately twenty seconds. If a fault is detected, the appropriate LED remains on.

A full BITE tests all the ASC circuitry. It activates output drivers and tests input receivers.

Speaker Test

Whenever power is first applied, a 1000 Hertz tone is generated by the aural synthesizer logic. This tone is sent to the aural warning speakers via the gain control and amplifier circuitry. This tests the aural output of the ASCs and the aural warning speakers.

Speaker return signals are sent back to the ASCs. Whenever this signal is not present, either during power up or normal operation, the yellow LED on the appropriate ASC shows.

Since the speakers are tested when power is first applied to the modularized avionics warning electronics assembly (MAWEA), a false fail indication will be generated if speaker power is not on.

Be sure that the AURAL WARNING L SPEAKER and AURAL WARNING R SPEAKER circuit breakers are on before applying power to the MAWEA.

Internal Fault

If an internal fault is detected, the red CARD FAULT LED will turn on.

Interface Fault

If an input fault is detected, the yellow INTERFACE FAULT LED will turn on.

Internal and Interface Fault

If both an internal and an input fault is detected, then only the red CARD FAULT LED turns on.

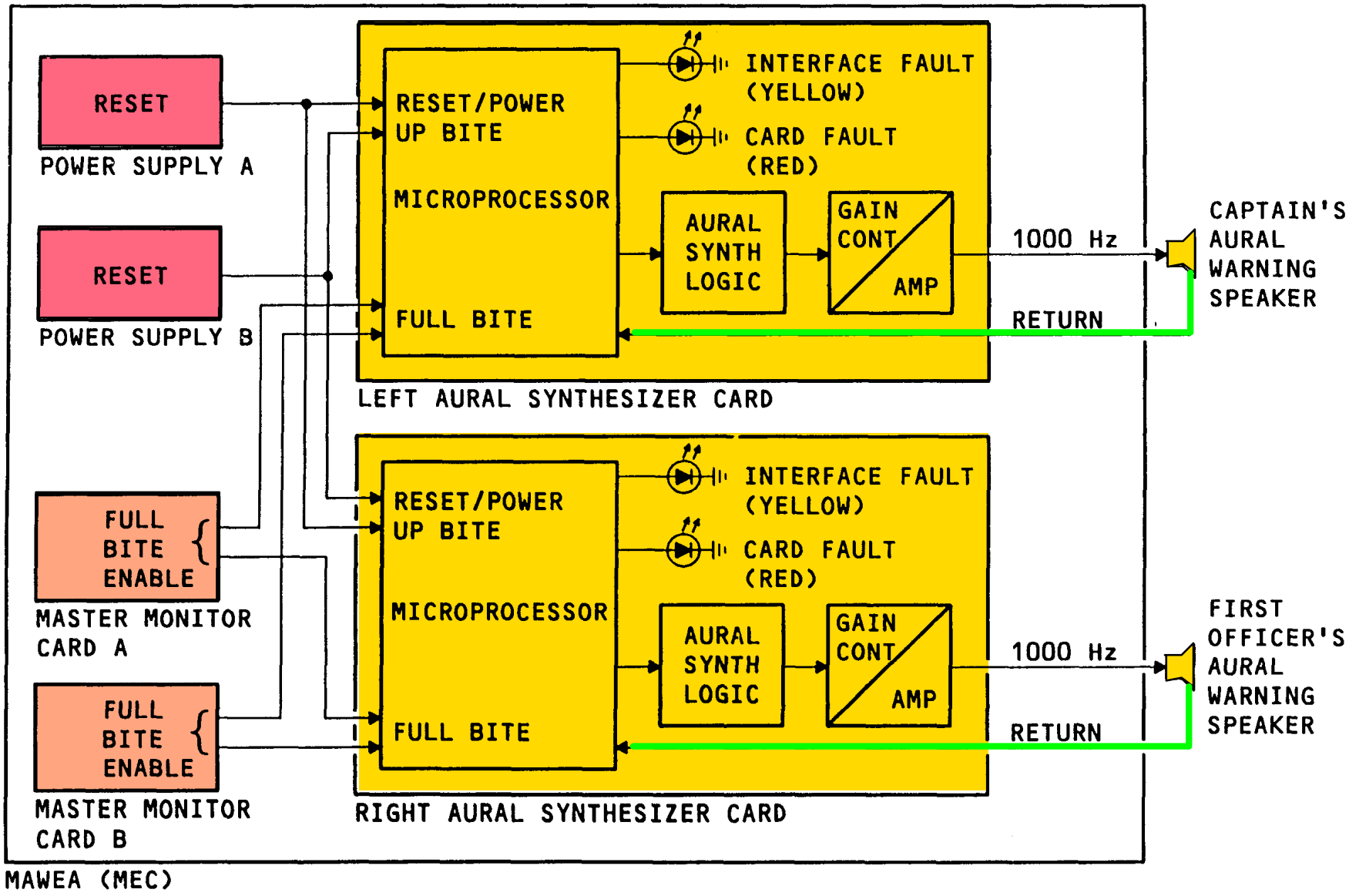


Figure 31 Aural Synthesizer Cards (Reset and BITE)

IDS FAULT MONITORING

General

The MAWEA sends outputs to the integrated display system (IDS) for system failures that cause EICAS messages to show.

Signal Collection Card No. 1

Signal collection card 1 receives discrete inputs for various system failures. Signal collection card 1 sends ARINC 429 data to the EFIS/EICAS interface units (EIUs). The data contains fault status information for:

- Left aural synthesizer card
- Captain's aural warning speaker
- Right aural synthesizer card
- First officer's aural warning speaker
- Crew alerting card, altitude alert functions
- Crew alerting card, passenger awareness functions
- Power supply A, failure
- Power supply A, off
- Signal collection card no. 1
- Signal Collection Card No. 2

Signal collection card 2 sends fault status information to the EIUs for:

- Power supply B, failure
- Power supply B, off
- Signal collection card 2

Configuration Warning card

The configuration warning card receives an ARINC 429 input from master monitor card A and master monitor card B. The master monitor cards send fault status information to the configuration warning card. The configuration warning card sends fault status information to the EIUs for:

- Master monitor card A
- Master monitor card B
- Configuration warning card

Other MAWEA cards

All other MAWEA cards send fault status information directly to the EIUs on an ARINC 429 bus.

EIUs

The EIUs receive fault data from the MAWEA. If a fault occurs, the EIUs generate the proper EICAS message and show it on the integrated display system.

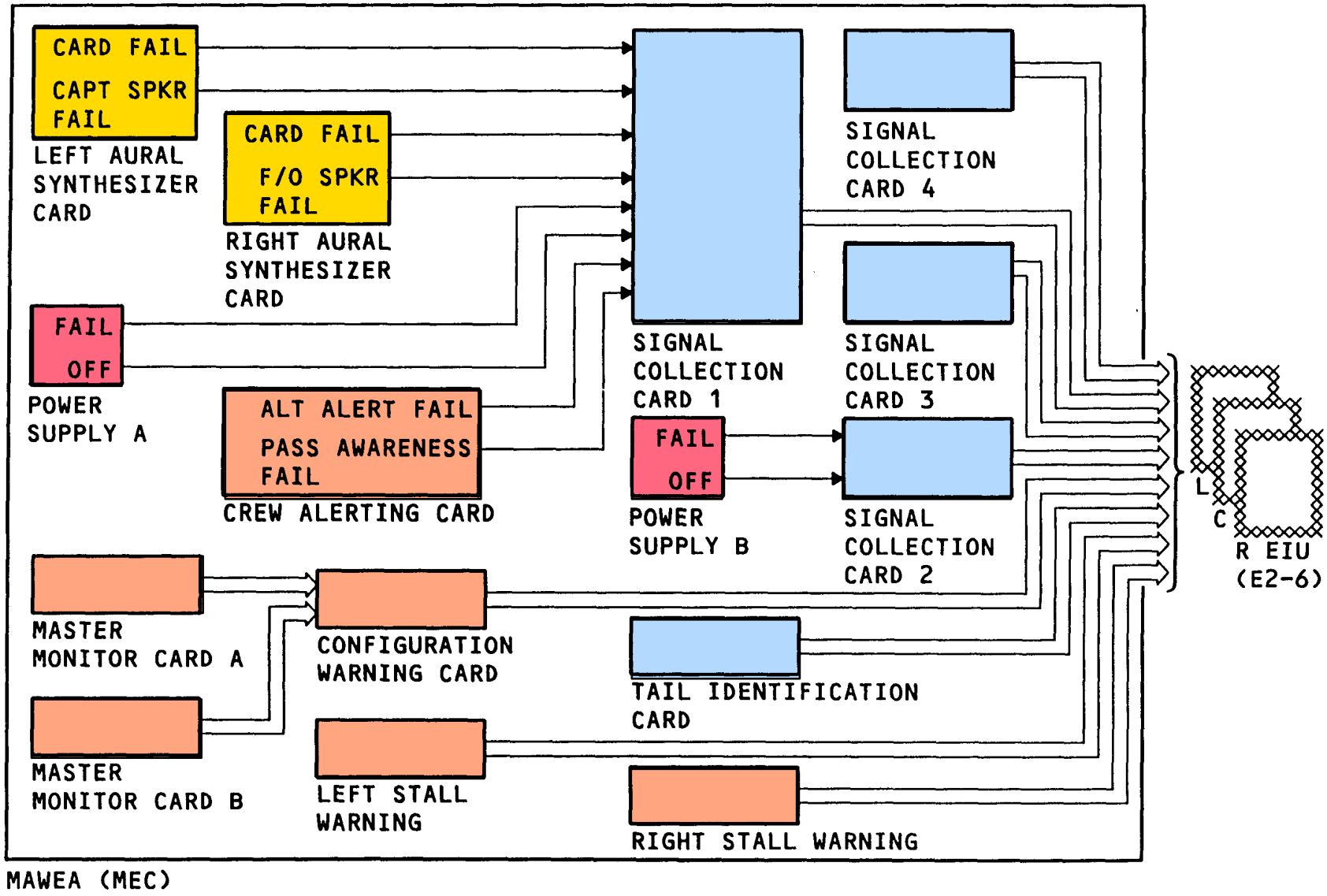


Figure 32 IDS Fault Monitoring

TAKEOFF CONFIG & GREEN BAND TEST - CMC

General

The takeoff configuration warning and green band test is a confidence test or a ground test that can be performed through the central maintenance computer (CMC).

Takeoff Configuration Warning Test

Both test pages on the control display unit (CDU) have a T/O WARNING prompt. Press the line select key next to this prompt to select the precondition page. The precondition page gives important information about the test. Start the test from the precondition page.

While the test is in progress, an improper takeoff configuration generates a warning.

The test lasts for 10 seconds. After 10 seconds pass, the simulation of takeoff configuration armed ends.

Green Band Test

The green band function is also tested during a takeoff warning test. When a takeoff warning test is started the green band logic checks there is at least one valid input for:

- Center of gravity (CG)
- Gross weight (GW)
- Thrust selection rating
- Fuel switch position for switches 1, 2, 3 and 4
- Stabilizer position

If valid inputs are available, the green band logic will turn on all green band indicator lamps if these two conditions are true:

- There is a takeoff warning enable.
- There is no takeoff thrust discrete from the EFIS/EICAS interface units (EIUs).

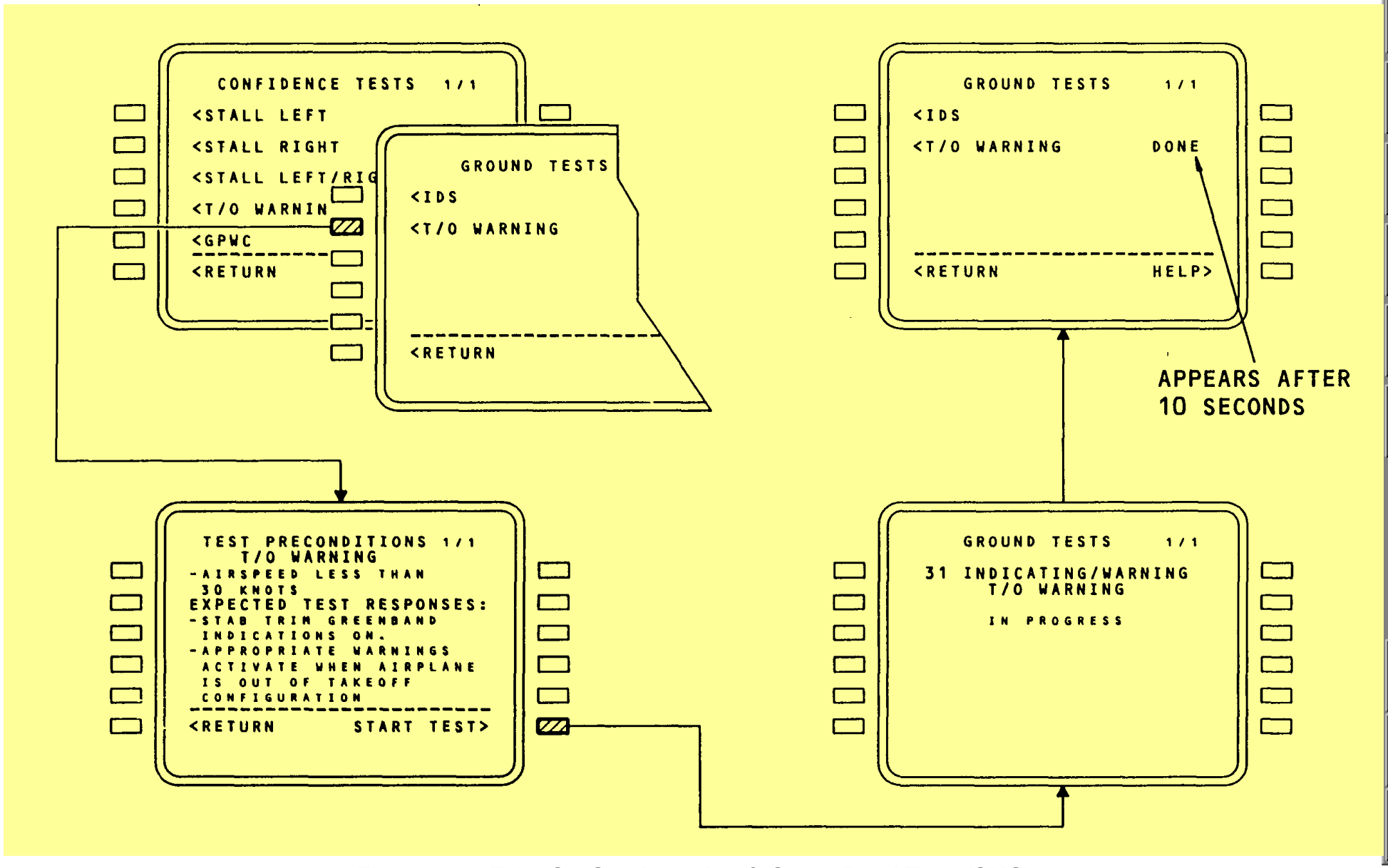


Figure 33 Take-Off Configuration & Green Band Test (CMC)

MAWEA MONITOR PANEL TESTS

TAKEOFF CONFIG WARNING, GREEN BAND TESTS

The takeoff configuration warning and green band test can be initiated at the modularized avionics warning electronics assembly (MAWEA) monitor panel by grounding the T/O CONFIG jack. This causes the same test condition as the central maintenance computer (CMC) test. However, the tests continue as long as the jack is grounded.

LDG CONFIG WARNING & SPD BRAKE ALERT TESTS

General

The landing configuration warning test provides a method of checking the capability of the modularized avionics warning electronics assembly (MAWEA) to provide a landing configuration warning and speed brake alert.

The landing configuration warning and speed brake alert test can be initiated at the MAWEA monitor panel by grounding the LDG CONFIG jack.

Landing Configuration Warning Test

When the landing configuration test is initiated, the configuration warning card:

- Checks that at least one of the proximity switch electronics unit (PSEU) inputs is available
- Checks that at least one of the radio altimeter inputs is available
- Checks that all four throttle positions are available from either EFIS/EICAS interface unit (EIU)
- Checks that flap information is available from either flap control unit (FCU) bus

If all of the above conditions are satisfied, the resettable warning is activated and:

- The master warning lights illuminate
- The siren aural is generated
- The level A CONFIG GEAR message is shown on the main EICAS display

Speedbrake Alert Test

When a landing configuration warning test is initiated by manually grounding the LDG CONFIG jack on the MAWEA monitor panel, the configuration warning card:

- Checks that at least one of the radio altimeter inputs is available
- Checks that all four throttle positions are available from either EIU
- Checks that flap information is available from either FCU bus

If all of these conditions are satisfied and the spoiler handle deploy position switch input is active (speed brakes deployed), the speed brake alert discrete output is generated. This causes:

- The master caution lights illuminate
- The owl sound to be generated
- The level B SPEEDBRAKES EXT message to be shown on the main EICAS display

NOTE: THIS TEST ALSO DOES A LANDING CONFIGURATION WARNING TEST. SINCE THE SIREN AURAL IS HIGHER IN PRIORITY THAN THE OWL, THE OWL WILL BE DELAYED UNTIL THE SIREN IS RESET.

If there is a fault detected, the red or yellow LED (depending upon the fault) turns on.

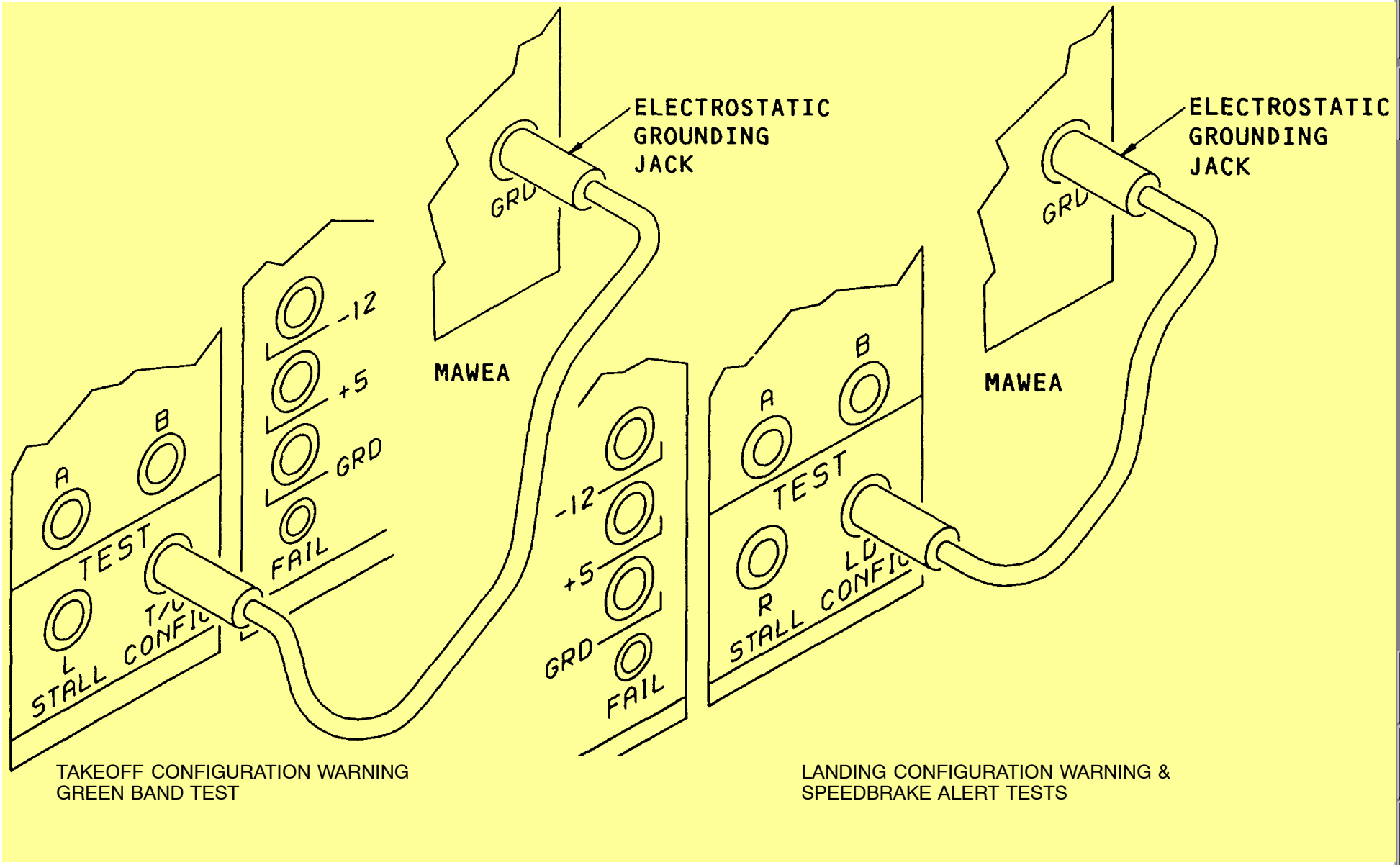


Figure 34 MAWEA Monitor Panel Tests

DIGITAL BUS MONITORING

A bus analyzer can be used to monitor ARINC 429 input data on the MAWEA monitor panel and output data on the front of the cards. Data can be received on the MAWEA monitor panel and on the ARINC output jacks on each card.

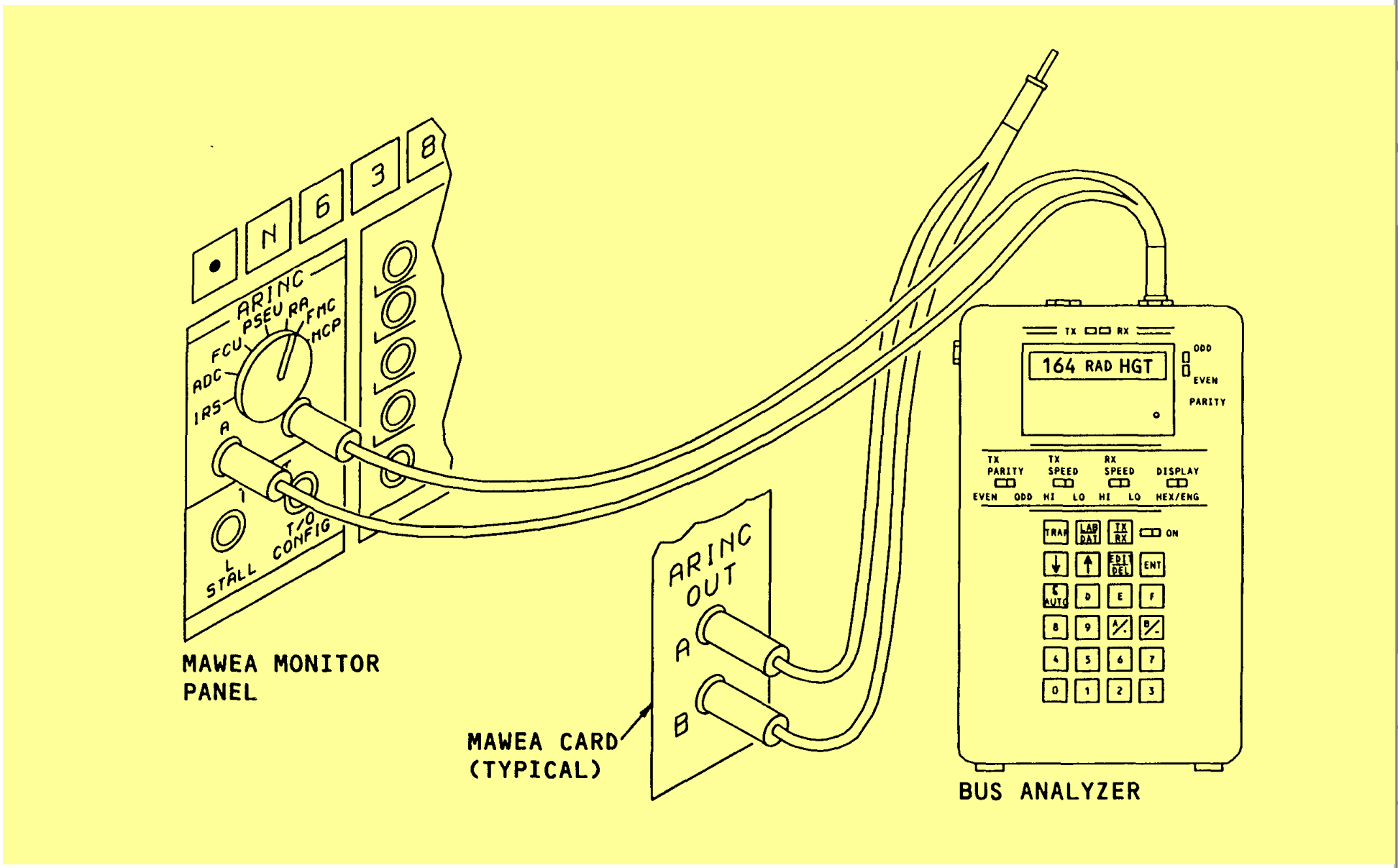


Figure 35 Digital Bus Monitoring

BACK
MMP
MAWEA
TOC
TOF
NEXT

WRIST STRAP

All of the modularized avionics warning electronics assembly (MAWEA) cards are electrostatic discharge sensitive equipment and are labeled accordingly. A wrist strap should always be used for removal and installation of the cards.

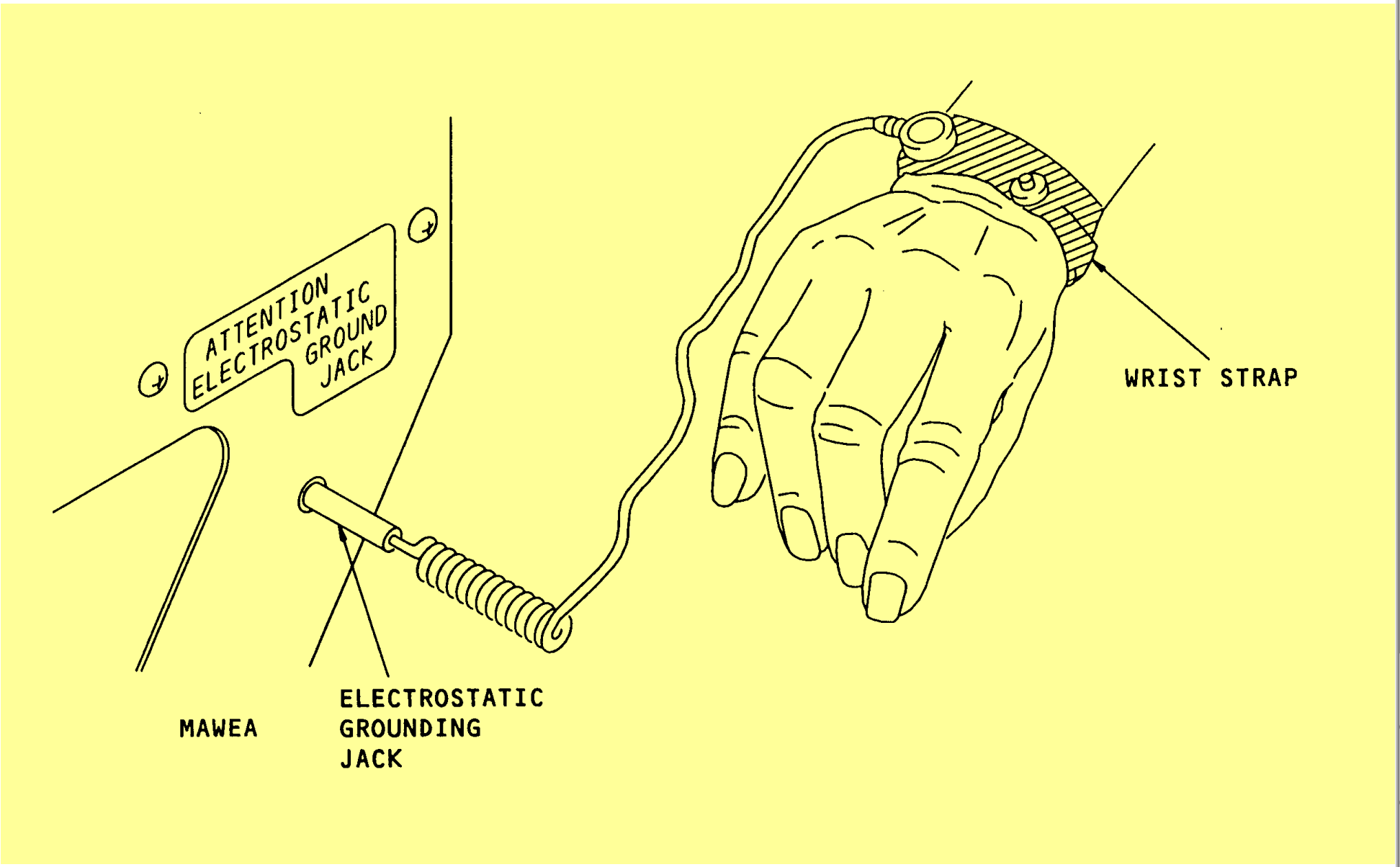


Figure 36 Wrist Strap

ABBREVIATION / ACRONYM LIST

ACARS	ARINC Communications Adressing And Reporting System
ADC	Air Data Computer
ASC	Aural Synthesizer Card
CG	Center of Gravity
EICAS	Engine Indicating and Crew Alerting System
EIU	EFIS/ EICAS Interface Unit
DFDAC	Digital Flight Data Aquisition Card
DH	Decision Height
FCC	Flight Control Computer
FCU	Flap Control Unit
GW	Gross Weight
IRU	Inertial Reference Unit
MAWEA	Modularized Avionics Warning Electronics Assembly
MCP	Mode control Panel
MMA	Master Monitor Card A
MMB	Master Monitor Card B
PSEU	Proximity Switch Electronics Unit
RA	Radio Altimeter
SCID	Signal Collection and Identification Card
TLRA	Thrust Lever Resolver Angle
T/O	Take-Off
ULC	Universal Logic Card
V1	Decision Speed

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