# CHAPTER

# 77

# Engine Indicating

## (CFM56 ENGINES (CFM56-7))

**CHAPTER 77**
**ENGINE INDICATING**



A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

# 77-EFFECTIVE PAGES


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## ENGINE INDICATING

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# ENGINE INDICATING



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## CHAPTER 77
## ENGINE INDICATING



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## CHAPTER 77
## ENGINE INDICATING



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## ENGINE INDICATING - INTRODUCTION

### Purpose

The engine indicating system continuously supplies engine data to the common display system (CDS). The engine indicating system has these subsystems:

- Low pressure rotor tachometer (N1)
- High pressure rotor tachometer (N2)
- Exhaust gas temperature (EGT)
- Airborne vibration monitoring (AVM).

The CDS usually shows engine data on two display units (DUs). One DU shows the primary engine display and the other shows the secondary engine display. The primary engine display usually shows on the upper center DU. The secondary engine display usually shows on the lower center DU. Engine data can also show on the inboard DUs.

### Abbreviations and Acronyms

- altn - alternate
- AVM - airborne vibration monitoring
- BITE - built-in test equipment

**AKS ALL PRE SB CFM56-7B 73-44**

- BSV - burner staging valve

**AKS ALL**

- CAS - calibrated air speed
- CDS - common display system
- CDU - control display unit
- chap - chapter
- DEU - display electronics unit
- DU - display unit
- EEC - electronic engine control
- EGT - exhaust gas temperature
- FDAU - flight data acquisition unit
- FDR - flight data recorder
- FFCCV - fan frame compressor case vertical (sensor)
- FMCS - flight management computer system
- FMV - fuel metering valve
- HPC - high pressure compressor
- HPT - high pressure turbine
- HPTACC - high pressure turbine active clearance control
- LPC - low pressure compressor
- LPT - low pressure turbine
- LPTACC - low pressure turbine active clearance control
- REV - thrust reverser sleeve position
- tach - tachometer
- TBV - transient bleed valve
- TRA - thrust resolver angle
- TRF - turbine rear frame
- UTC - universal time coordinate
- VBV - variable bleed valve
- VSV - variable stator vane
- vib - vibration


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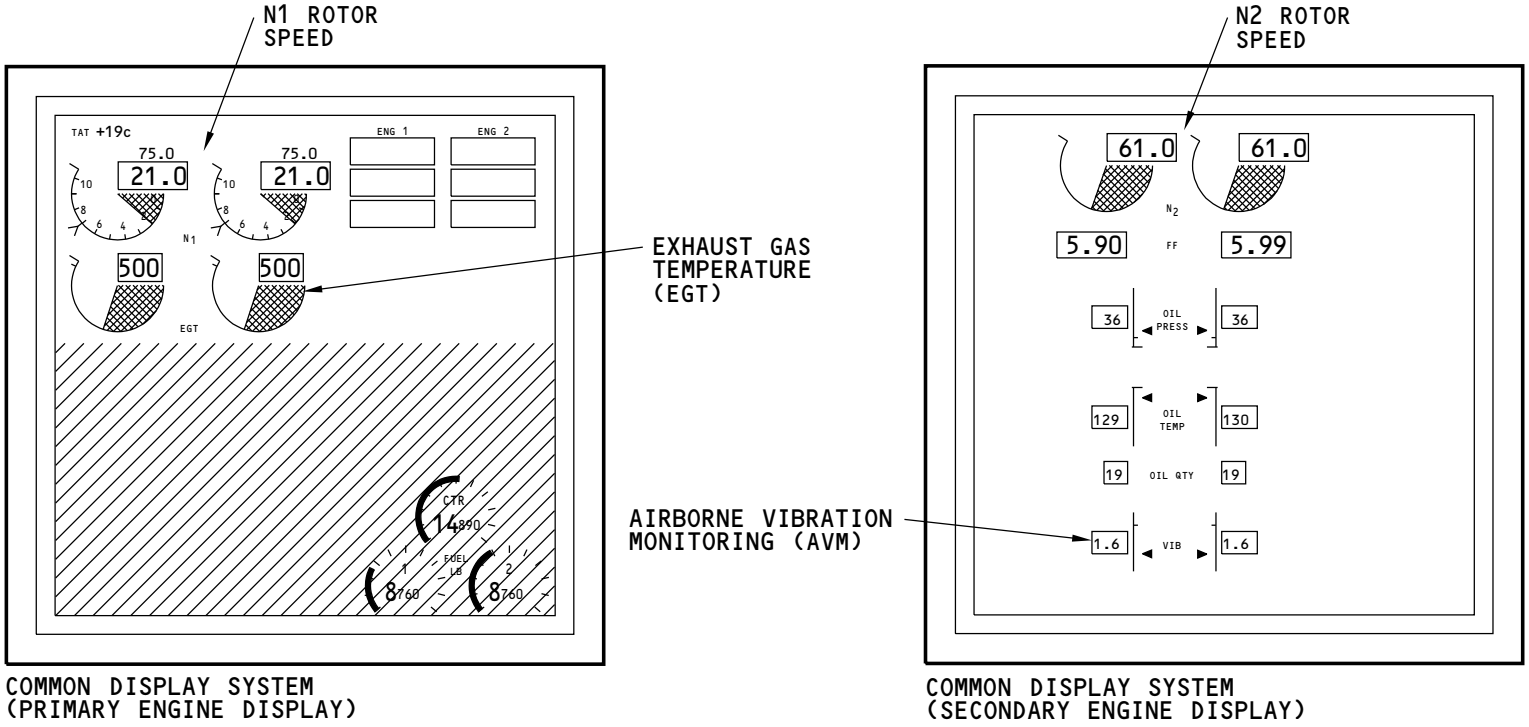


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**ENGINE INDICATING - INTRODUCTION**


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## ENGINE INDICATING - GENERAL DESCRIPTION

### General

The engine indicating system shows these parameters for each engine:

- Low pressure rotor speed (N1)
- High pressure rotor speed (N2)
- Exhaust gas temperature (EGT)
- Engine vibration.

### Electronic Engine Control

The electronic engine control (EEC) receives an analog input from these engine sensors:

- N1 speed sensor
- N2 speed sensor
- EGT probes (T49.5).

The EEC changes the analog signals to digital signals. The EEC sends the digital signals on an ARINC 429 data bus to the display electronics units (DEU)s.

### Airborne Vibration Monitoring Signal Conditioner

The airborne vibration monitoring (AVM) signal conditioner calculates and monitors vibration levels of each engine.

The AVM signal conditioner receives analog input from these engine sensors:

- N1 speed sensor
- N2 speed sensor
- Number 1 bearing vibration sensor
- Fan frame compressor case vertical vibration (FFCCV) sensor.

The DEUs and the flight data acquisition unit (FDAU) receive AVM information through an ARINC 429 data bus.

### DEUs

The DEUs use digital input from the EEC to show these engine parameters on the common display system (CDS):

- N1
- N2
- EGT.

The DEUs use their analog N1 and N2 signals as alternate inputs when the EEC does not have electrical power. EGT shows only when the EEC has electrical power. See the ENGINE FUEL AND CONTROL for more information about the EEC power sources. (SECTION 73-21)


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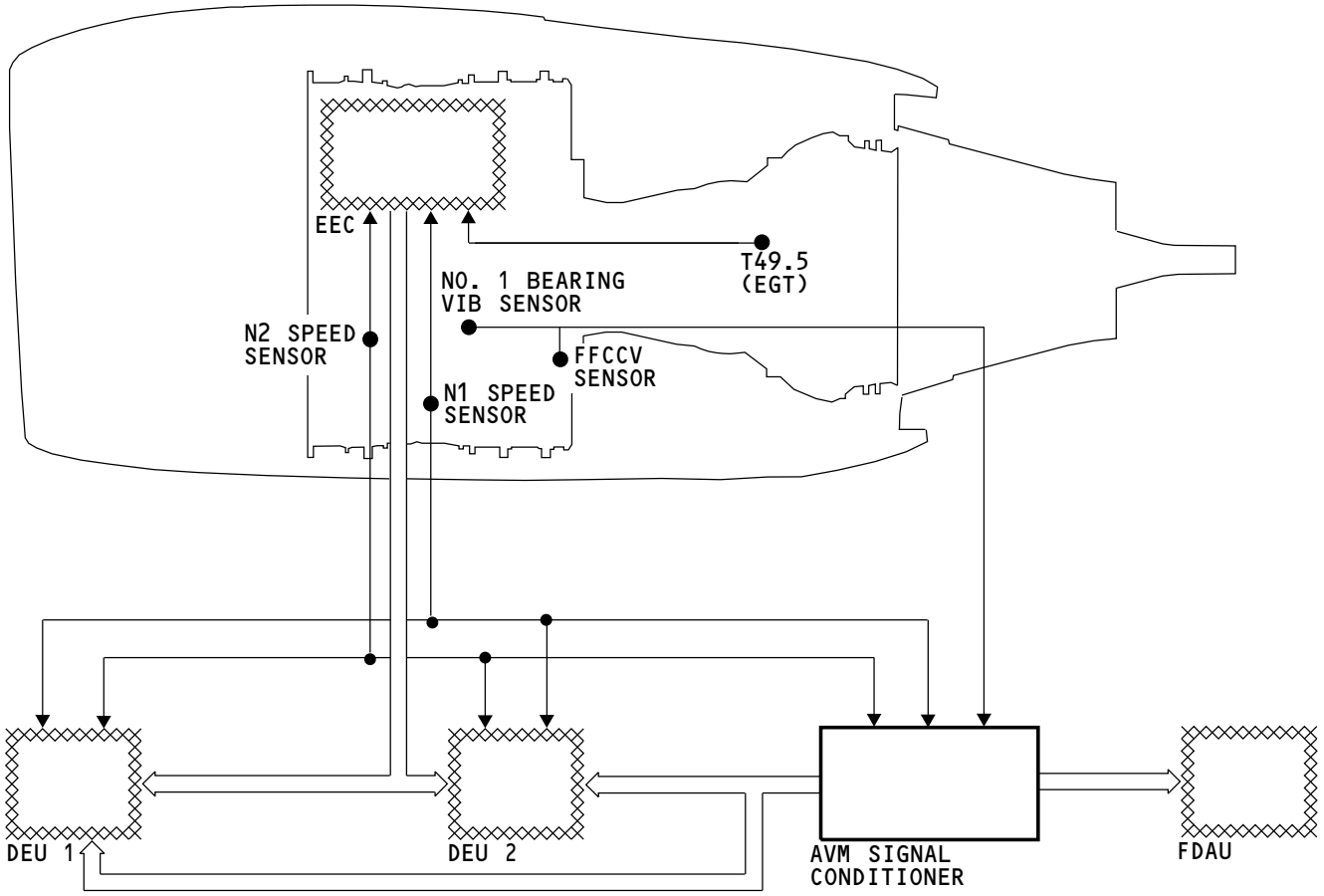


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**ENGINE INDICATING - GENERAL DESCRIPTION**


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# ENGINE INDICATING - TRAINING INFORMATION POINTS - ENGINE EXCEEDANCES

## General

The engine indicating system lets you see exceedance data for these engine parameters:

- N1
- N2
- EGT RED LIMIT
- EGT HOT START.

The exceedance data is important for maintenance practices. You find these actions in part II of the airplane maintenance manual (AMM). You need this information for selection of the correct maintenance action:

- Highest value (peak) of the parameter during the exceedance
- Time above redline limit.

If there is an exceedance stored in memory for the current flight leg, the box around the digital readout shows red when these conditions occur:

- Both start levers in the CUTOFF position
- Both engine start switches in the OFF position
- EEC BITE not in use
- N2 for both engines less than 10%.

The engine indicating system shows engine 2 data the same as engine 1.

The engine indicating system starts a new leg for exceedances when the airplane speed is more than 80 knots.

## ENGINE/EXCEED BITE Page

The ENGINE/EXCEED BITE page lets you pick engine BITE or EXCEEDANCES.

## EXCEEDANCE MENU

The EXCEEDANCE MENU page lets you see exceedance data for ENGINE 1 or ENGINE 2.

## Training Information Point

The DEUs keep exceedance data in non-volatile memory. These circuit breakers must be closed when you get exceedance data to make sure the data stored in each DEU is the same:

- DISPLAY, DEU 1 HOLDUP (P6 panel)
- DISPLAY, DEU 2 HOLDUP (P6 panel)
- DISPLAY, DEU 2 PRI (P6 Panel)
- DISPLAY, DEU 1 PRI (P18 panel).


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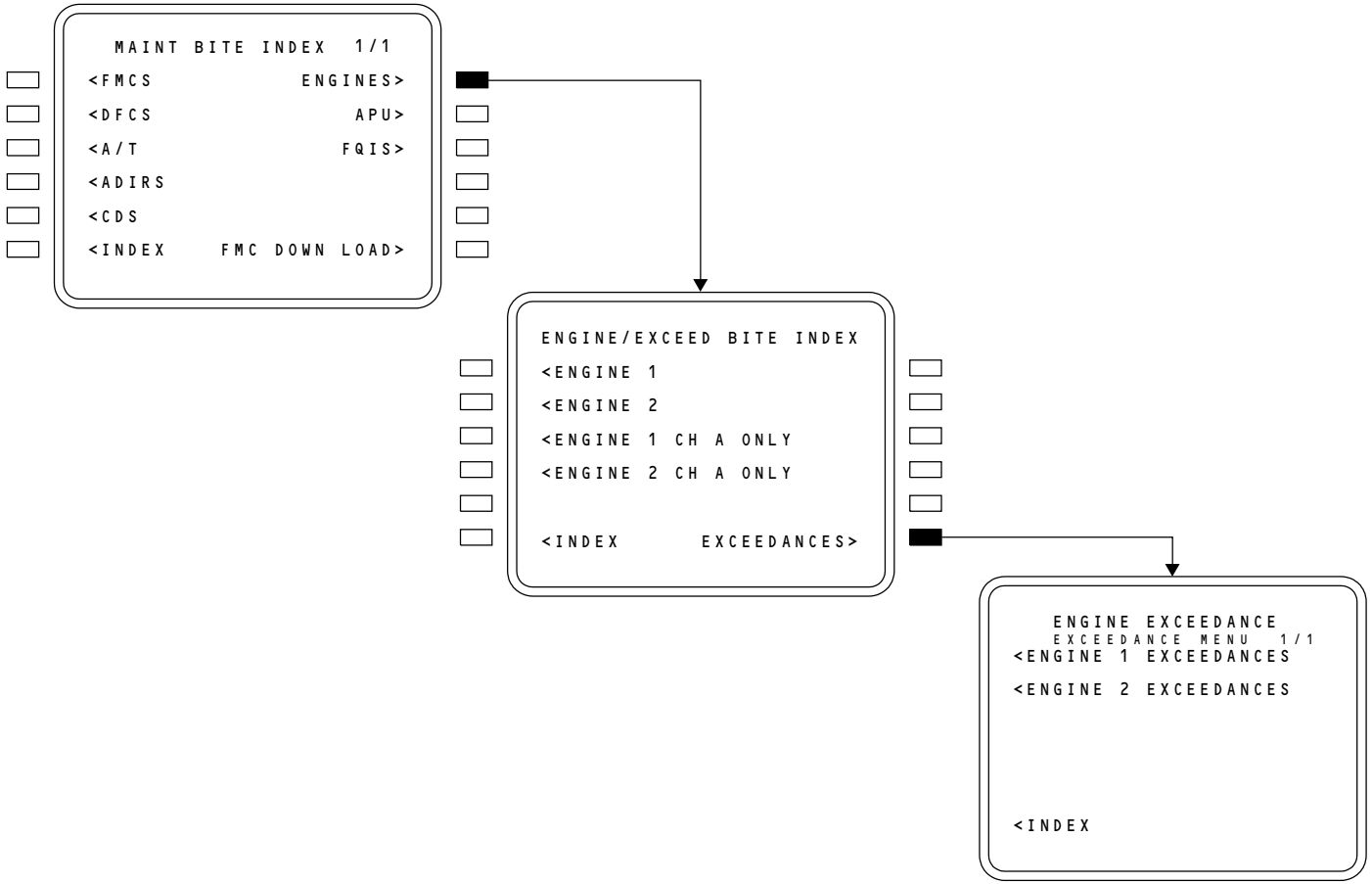


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**ENGINE INDICATING - TRAINING INFORMATION POINTS - ENGINE EXCEEDANCES**



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# ENGINE INDICATING - TRAINING INFORMATION POINTS - CURRENT EXCEEDANCES

## General

If there are current exceedances for engine 1, the CDU shows the ENGINE 1 CURRENT EXCEEDANCES SUMMARY page when you select ENGINE 1 on the EXCEEDANCE MENU. A current exceedance is an exceedance that occurs during the current leg and was not reset.

The engine indicating system starts a new leg for exceedances when the airplane speed is more than 80 knots.

The engine indicating system shows engine 2 data the same as engine 1. Only engine 1 exceedance CDU pages show on this page.

## ENGINE 1 CURRENT EXCEEDS SUMMARY Page

The CURRENT EXCEEDS SUMMARY page gives this data about the current exceedances:

- Exceedance type (N1 RED, N2 RED, EGT RED, EGT HOT START)
- TIME (total time of exceedances in the current leg for each type of exceedance)
- PEAK (highest peak value)
- QTY (number of exceedances).

## ENGINE 1 Menu Page

The ENGINE 1 menu page lets you select CURRENT EXCEEDANCES or FLIGHT LEG EXCEEDANCES. The CURRENT EXCEEDANCES selection shows you the CURRENT EXCEEDANCES SUMMARY page. The FLIGHT LEGS EXCEEDANCES selection shows you the ENG 1 EXCEEDS MENU.

## CURRENT EXCEEDANCES Page

The CURRENT EXCEEDANCES page gives more data about the exceedances stored in DEU memory. The DEUs hold up to 10 exceedances per flight leg.

The CURRENT EXCEEDANCES page gives this data for each exceedance stored in DEU memory:

- Exceedance type (N1, N2, EGT RED, or EGT HOT START)
- Highest parameter value
- Parameter redline value and total time over redline
- Flight number
- Flight date and time in universal coordinated time (UTC)
- Altitude and computed air speed (CAS) at the time of exceedance.

The CDU shows one exceedance on each page. The page number and total number of pages are at the right side on the second line of the CDU display.

Select the line select key next to RESET to reset the exceedance. When the exceedance is reset, the DEU does not show the data for this exceedance on the CURRENT EXCEEDANCE page.

## Training Information Point

You must follow the maintenance action in Part II of the Airplane Maintenance Manual (AMM) and reset all current exceedances to reset the red box on the primary engine display.


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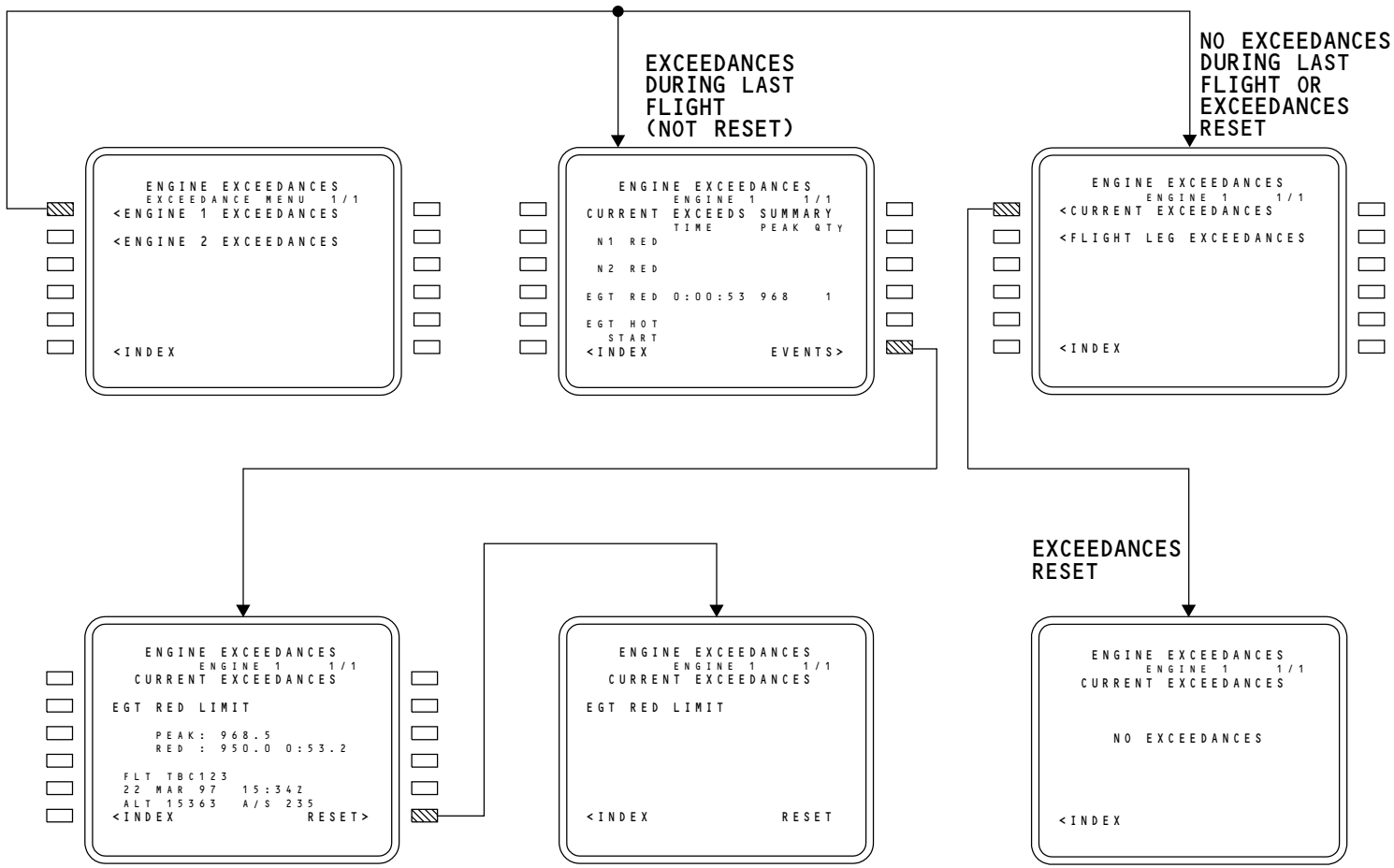


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## ENGINE INDICATING - TRAINING INFORMATION POINTS - FLIGHT LEG EXCEEDANCES

### ENG 1 EXCEEDS MENU

The ENG 1 EXCEEDS MENU gives a list of legs that had exceedances. The DEUs store up to 9 legs with exceedances. The DEU stores up to 10 exceedances per leg. The ENG 1 EXCEEDS MENU lists the legs with exceedances. The newest leg shows first. The ENG 1 EXCEEDS MENU also gives the number of exceedances stored for each leg.

If you select CURRENT EXCEEDANCES or FLIGHT LEG EXCEEDANCES and the DEU has no exceedances stored in memory, the CDU shows the NO EXCEEDANCES message.

If the exceedances occurred more than 99 legs ago, the CDU will show the exceedances occurred on leg 99. The DEU erases the oldest exceedance only when a tenth leg with exceedances occurs.

The ENG 1 EXCEEDS MENU shows up to 5 legs on the first page. If there are more than 5 legs with exceedances the other exceedances are shown on the second page. You see the page number for the data on the display and total number of pages on the right side of line 2.

You erase all exceedance data for engine 1 when you select BULK ERASE.

### ENG 1 EXCEEDS Page

The ENG 1 EXCEEDS page gives this data for each reset exceedance stored in DEU memory:

- Legs old
- Exceedance type (N1, N2, EGT RED or EGT HOT START)
- Highest parameter value (PEAK)
- Parameter redline value and total time over redline (RED)
- Flight number (FLT)
- Flight date and time in universal coordinated time (UTC)
- Altitude and computed air speed (CAS) at time of exceedance (ALT and A/S).

The CDU shows one exceedance on each page. You find the exceedance number and total number of exceedances for that leg at the right side of the second line of the CDU display.


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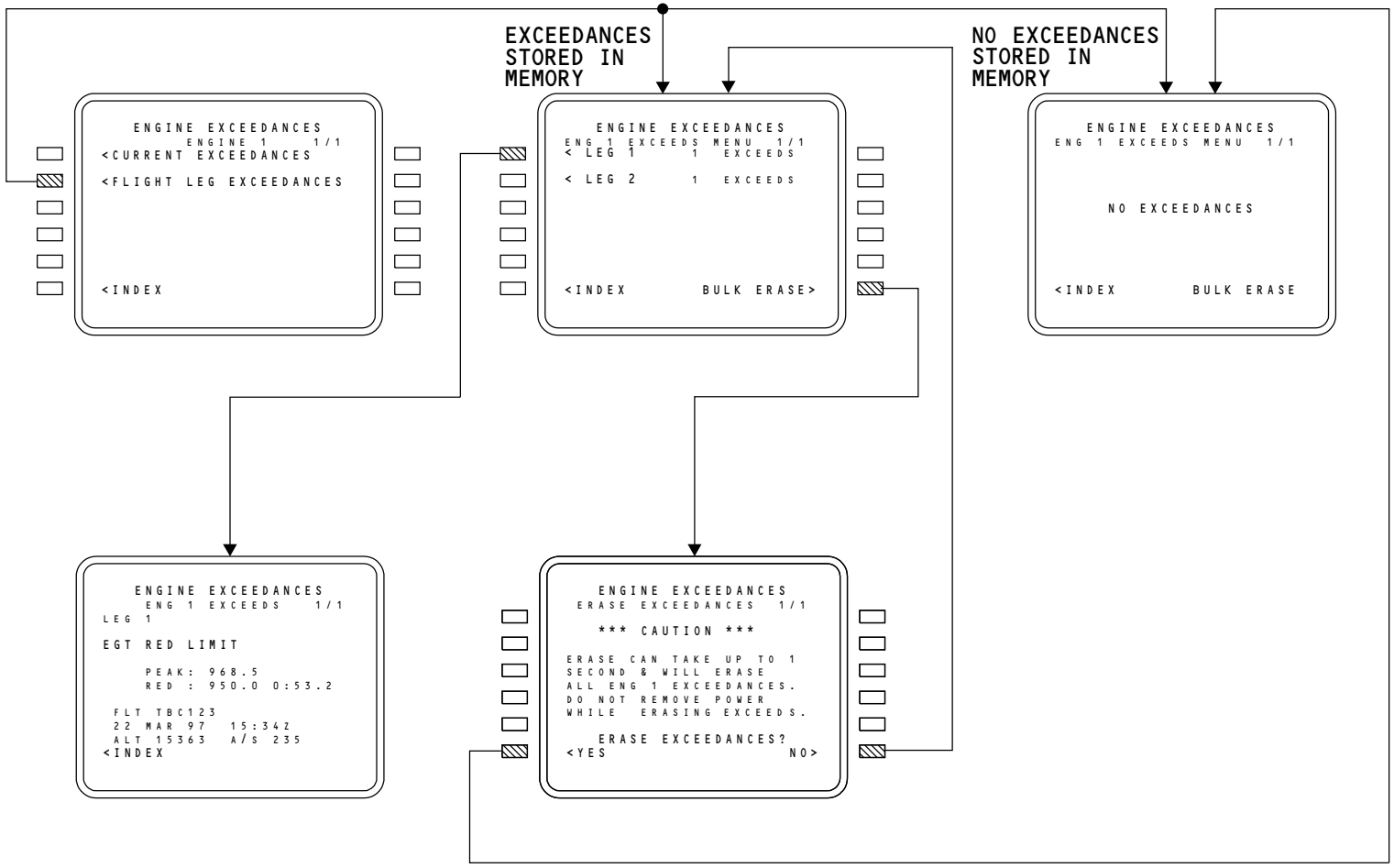


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**ENGINE INDICATING - TRAINING INFORMATION POINTS - FLIGHT LEG EXCEEDANCES**



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## ENGINE TACHOMETER SYSTEM - GENERAL DESCRIPTION

### Purpose

The engine tachometer system supplies the engine low pressure rotor (N1) and the engine high pressure rotor (N2) speed signals to these components:

- Electronic engine control (EEC)
- Display electronics units (DEUs)
- Engine airborne vibration monitoring (AVM) signal conditioner.

### General Description

The EEC receives two analog signals from each speed sensor. The EEC changes these analog signals to digital signals.

The EEC uses the two signals for channel A and channel B operation. Each channel sends data to each DEU on an ARINC 429 data bus.

Usually, the DEUs use input from the EEC to show N1 and N2 on the common display system (CDS). The DEUs can also use input directly from the speed sensors to show N1 and N2.

The AVM signal conditioner receives an analog input from the speed sensors to help calculate vibration levels. See the AVM system section for more information. (SECTION 77-31)


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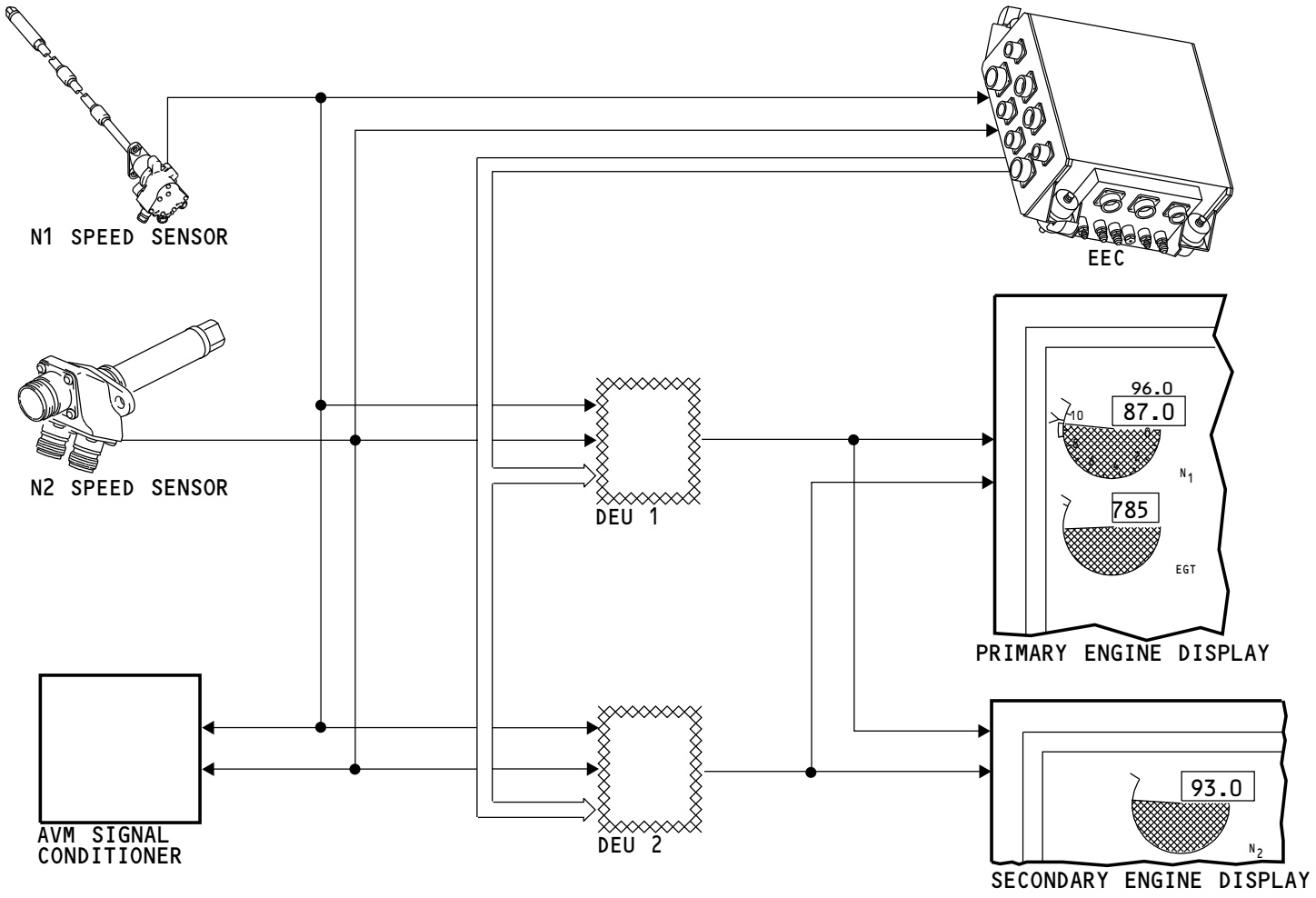


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**ENGINE TACHOMETER SYSTEM - GENERAL DESCRIPTION**


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## ENGINE TACHOMETER SYSTEM - N1 SPEED SENSOR

### Purpose

The N1 speed sensor supplies a low pressure rotor speed signal to these components:

- Electronic engine control (EEC)
- Display electronics units (DEU)s
- Airborne vibration monitoring (AVM) signal conditioner.

### Component Location

The N1 speed sensor is on the right side of the engine, just aft of the oil tank. You can only see the housing with the electrical connectors when the sensor is on the engine. You open the right fan cowl to get access to the N1 speed sensor.

### Physical Description

The N1 sensor has three independent sensing elements at its end. Each sensing element has a pole piece and an electrical winding around a magnet. The N1 sensor has three electrical connectors.

The two dampers prevent sensor vibration.

### Training Information Point

You must measure the clearance between the sensor flange and the fan frame sleeve before you tighten the two installation bolts.

**CAUTION:** MAKE SURE THE N1 SPEED SENSOR CLEARANCE IS IN LIMITS BEFORE YOU TIGHTEN THE TWO BOLTS. IF THE CLEARANCE IS NOT IN LIMITS, DAMAGE TO THE SENSOR CAN OCCUR.


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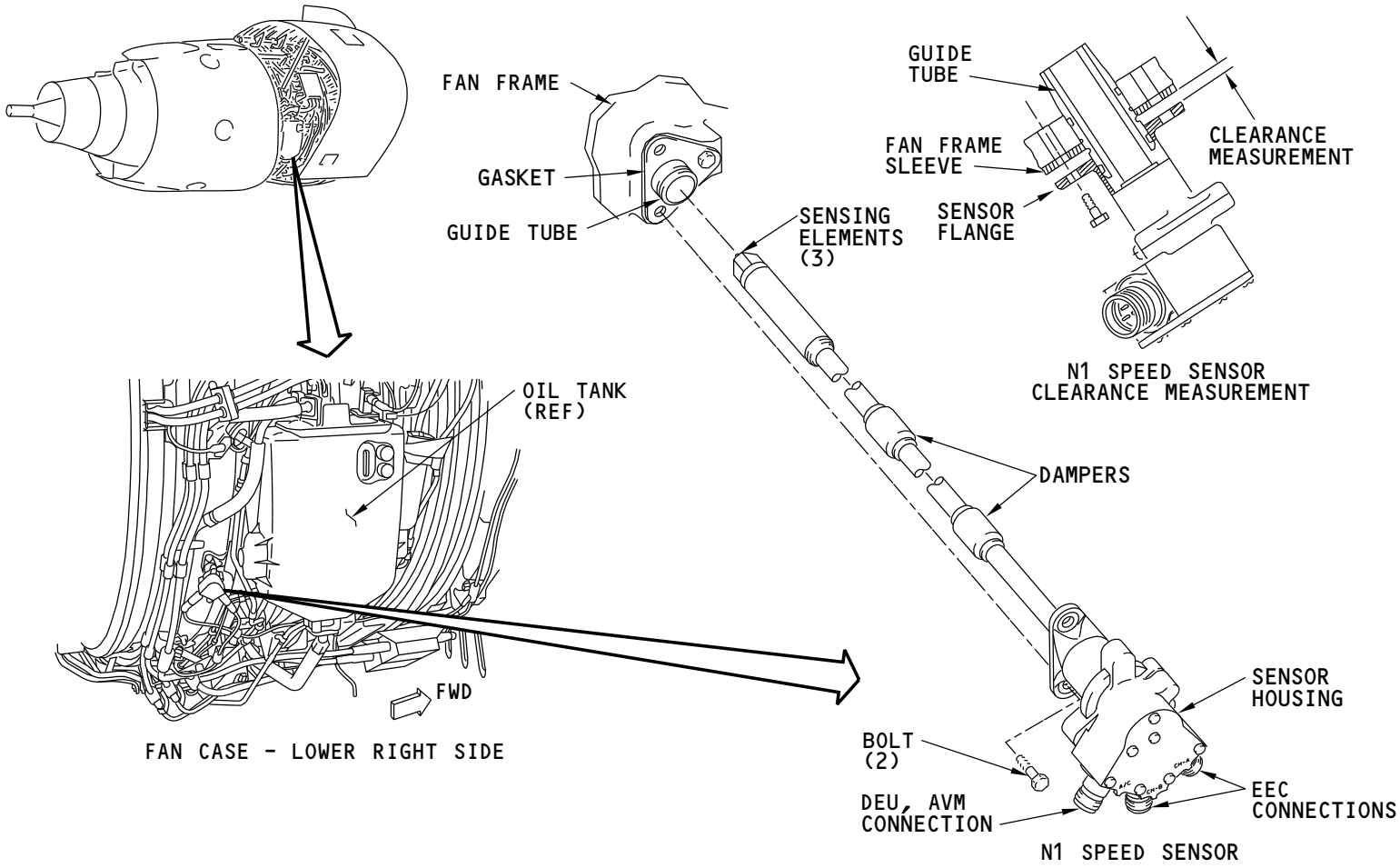


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**ENGINE TACHOMETER SYSTEM - N1 SPEED SENSOR**


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## ENGINE TACHOMETER SYSTEM - N2 SPEED SENSOR

### Purpose

The N2 speed sensor supplies the high pressure rotor speed signal to these components:

- Electronic engine control (EEC)
- Display electronics units (DEU)s
- Airborne vibration monitoring (AVM) signal conditioner.

### Component Location

The N2 speed sensor is on the forward face of the engine accessory gearbox (AGB). It is above the engine starter. You open the left fan cowl to get access to the N2 sensor.

### Physical Description

The N2 sensor has three independent sensing elements at its end. Each element has a pole piece and an electrical winding around a magnet. The N2 sensor has three electrical connectors.


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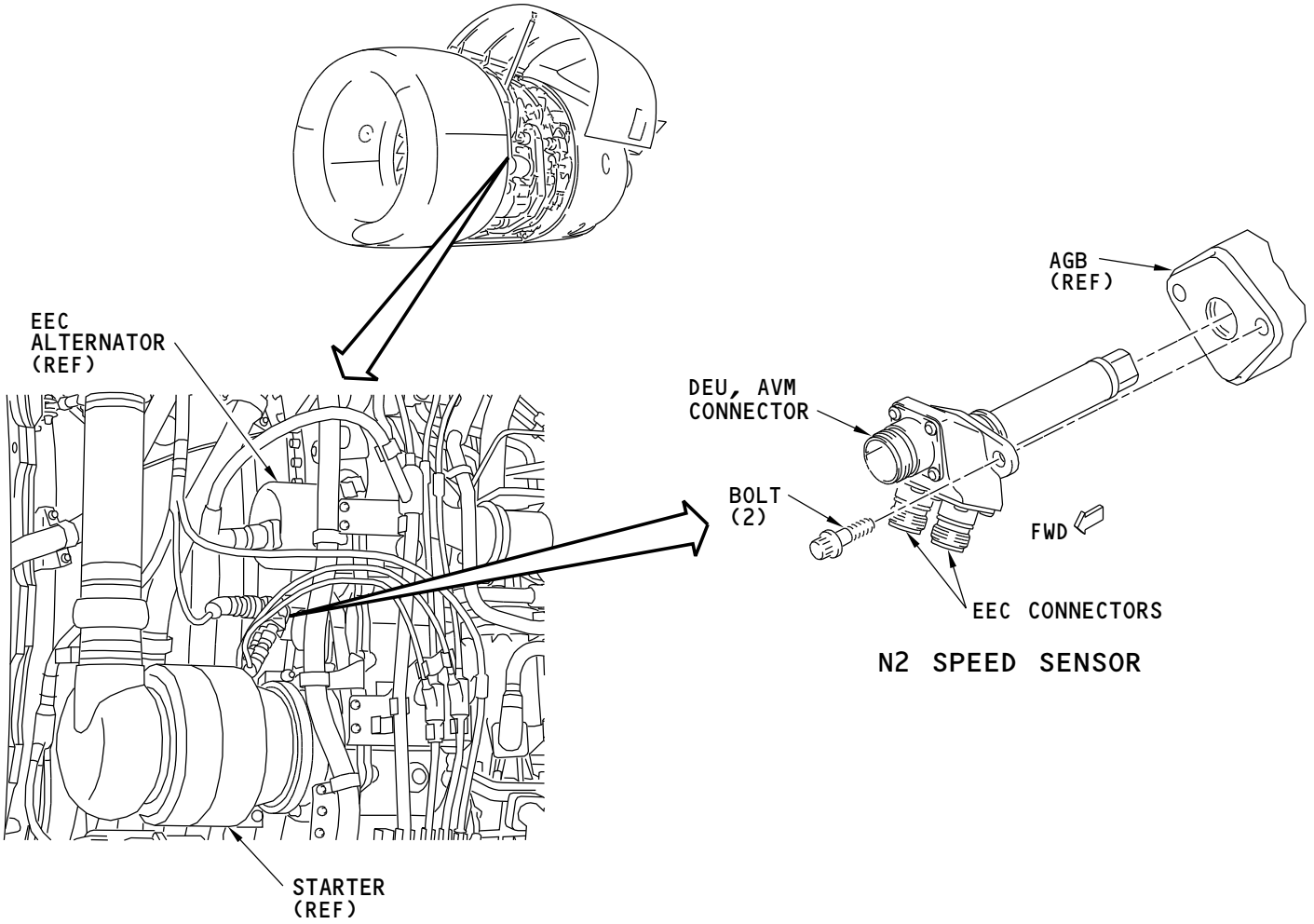


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**ENGINE TACHOMETER SYSTEM - N2 SPEED SENSOR**


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## ENGINE TACHOMETER SYSTEM - FUNCTIONAL DESCRIPTION

### General

The speed of the engine low pressure rotor shows in percent N1.

The speed of the engine high pressure rotor shows in percent N2.

Usually, the display electronics units (DEUs) use inputs from the electronic engine control (EEC) to show N1 and N2. The DEUs use the signals directly from the speed sensors if the EEC does not have electrical power.

### N1 Digital Readout and Pointer

The N1 digital readout shows the engine low pressure rotor speed. The DEUs use input from the EEC or the N1 speed sensor to show this value.

The digital readout and the box around the readout are white when N1 is below the N1 redline.

A pointer on a round dial also shows N1 speed. A shaded area follows this pointer. The pointer is usually white. The shaded area is usually gray.

These indications change to red when N1 is above the N1 redline:

- N1 digital readout
- Box around N1 digital readout
- N1 pointer
- Shaded area.

When N1 goes below redline, the indication goes back to normal color.

At engine shutdown, the box around the digital display changes to red if there was an N1 exceedance during engine operation.

### N1 Redline

The N1 redline shows the maximum certified engine low pressure rotor speed for the CFM56-7 engine. The redline shows in red. The EEC supplies the redline value.

### N1 Command Sector

The command sector shows the momentary difference between N1 and the N1 command. The thrust lever position sets the N1 command.

The N1 command shows at the top edge or the lower edge of the command sector. The N1 command shows at the top edge of the command sector if the engine speed must increase. It shows at the lower edge of the command sector if the engine speed must decrease.

The command sector and N1 command are white.

### N1 Reference Bug

The N1 reference bug shows the N1 thrust target manually set by the pilot. The bug can be set by the flight management computer system (FMCS). The N1 reference bug is green.

The N1 reference digital display shows the manually set N1 target. The display is white. This display does not show for an FMCS set target.

See the FMCS section for more information about the N1 target. (SECTION 34-61)

### N2 Digital Readout and Pointer

The N2 digital display shows the engine high pressure rotor speed. The DEUs use input from the EEC or the N2 speed sensor to show this value.

The digital display and box are white with N2 below the N2 redline.

A pointer on a round dial also shows N2 speed. A shaded area follows this pointer. The pointer is usually white. The shaded area is usually gray.

These indications change to red when N2 is above the N2 redline:

- N2 digital readout
- Box around N2 digital readout
- N2 pointer
- Shaded area.

When N2 goes below redline, the indication goes back to normal color.

At engine shutdown, the box around the digital display changes to red if there was an N2 exceedance during engine operation.



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## ENGINE TACHOMETER SYSTEM - FUNCTIONAL DESCRIPTION

### N2 Redline

The N2 redline shows the maximum certified engine high pressure rotor speed for the CFM56-7 engine. The EEC supplies this value. The redline shows in red.

### N1 and N2 Exceedances

The display electronic units (DEUs) hold N1 and N2 exceedance information. You use the control display units (CDUs) to see this information.

See the engine indicating chapter for more information on engine exceedances. (CHAPTER 77)

### Defective Speed Sensors

You can use the CDU to see speed sensor failures the EEC finds.

See the engine indicating chapter for more information on the EEC. (CHAPTER 77)

### Engine Failure Annunciation

The ENG FAIL message supplies an early warning of an engine malfunction. The message shows on the EGT display if these conditions occur in this order:

- Both engines speeds are at idle or above idle
- Both start levers are at the idle position, then
- The N2 speed decreases below idle.

The ENG FAIL message shows in amber.


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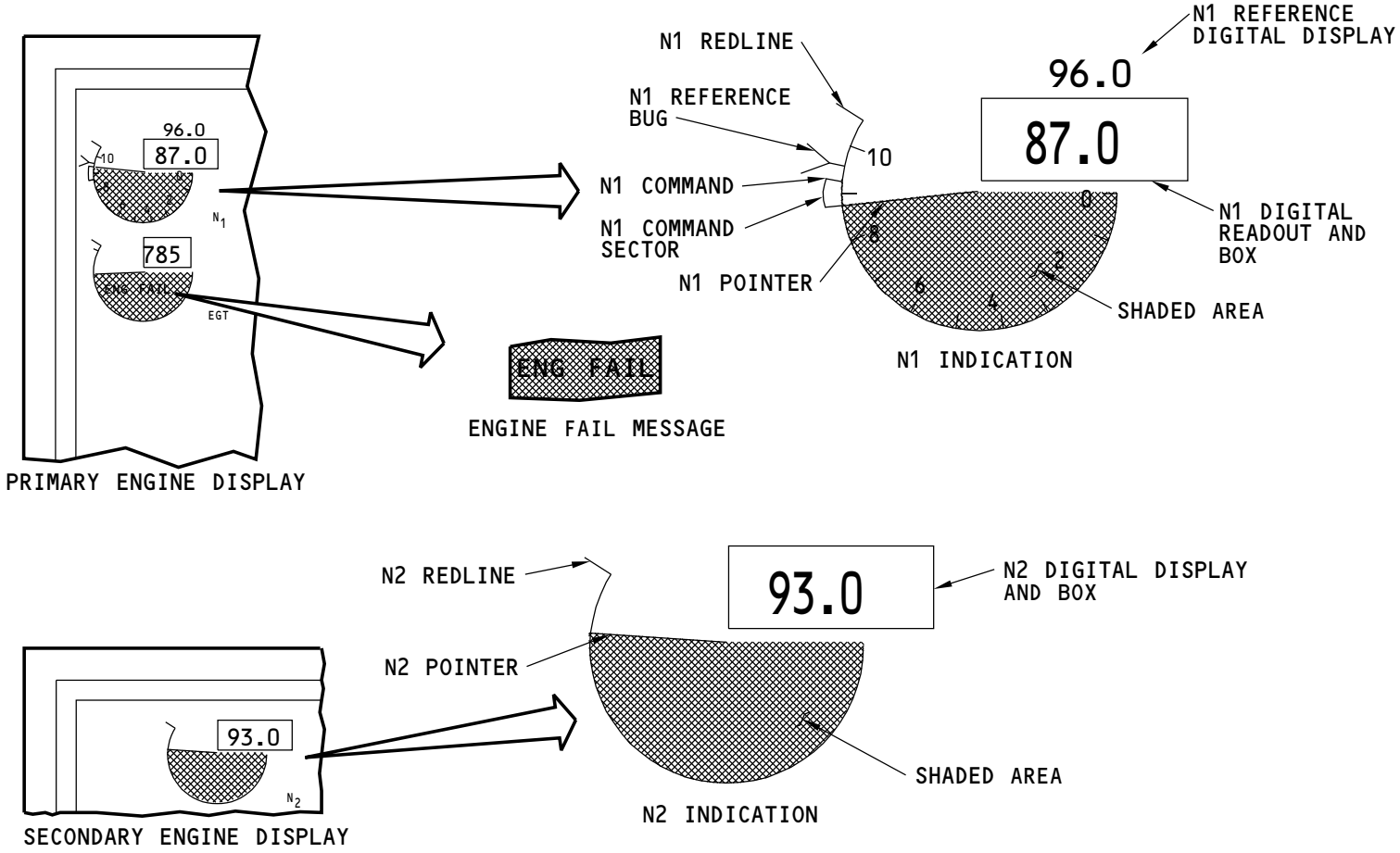


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**ENGINE TACHOMETER SYSTEM - FUNCTIONAL DESCRIPTION**


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# EXHAUST GAS TEMPERATURE (EGT) INDICATING SYSTEM - GENERAL DESCRIPTION

## Purpose

The exhaust gas temperature (EGT) indication system monitors the exhaust gas temperature at the second stage low pressure turbine nozzles.

## General Description

The EGT system has eight thermocouples and four T49.5 thermocouple harness assemblies. Each wire harness assembly has two thermocouples and supplies input to the electronic engine control (EEC).

The EEC uses EGT signals for these functions:

- Show EGT on the common display system (CDS)
- Engine hot start and wet start (no ignition) logic
- Low pressure turbine (LPT) cooling logic.

See the engine starting section for more information about engine hot and wet start logic. (SECTION 80-00)

See the air cooling section for more information about LPT cooling logic. (SECTION 75-20)

The EEC sends the EGT data to the display electronics units (DEU)s on an ARINC 429 bus.

The DEUs are part of the CDS. The DEUs usually show EGT on the upper center display unit. EGT can also show on the lower center and inboard display units.


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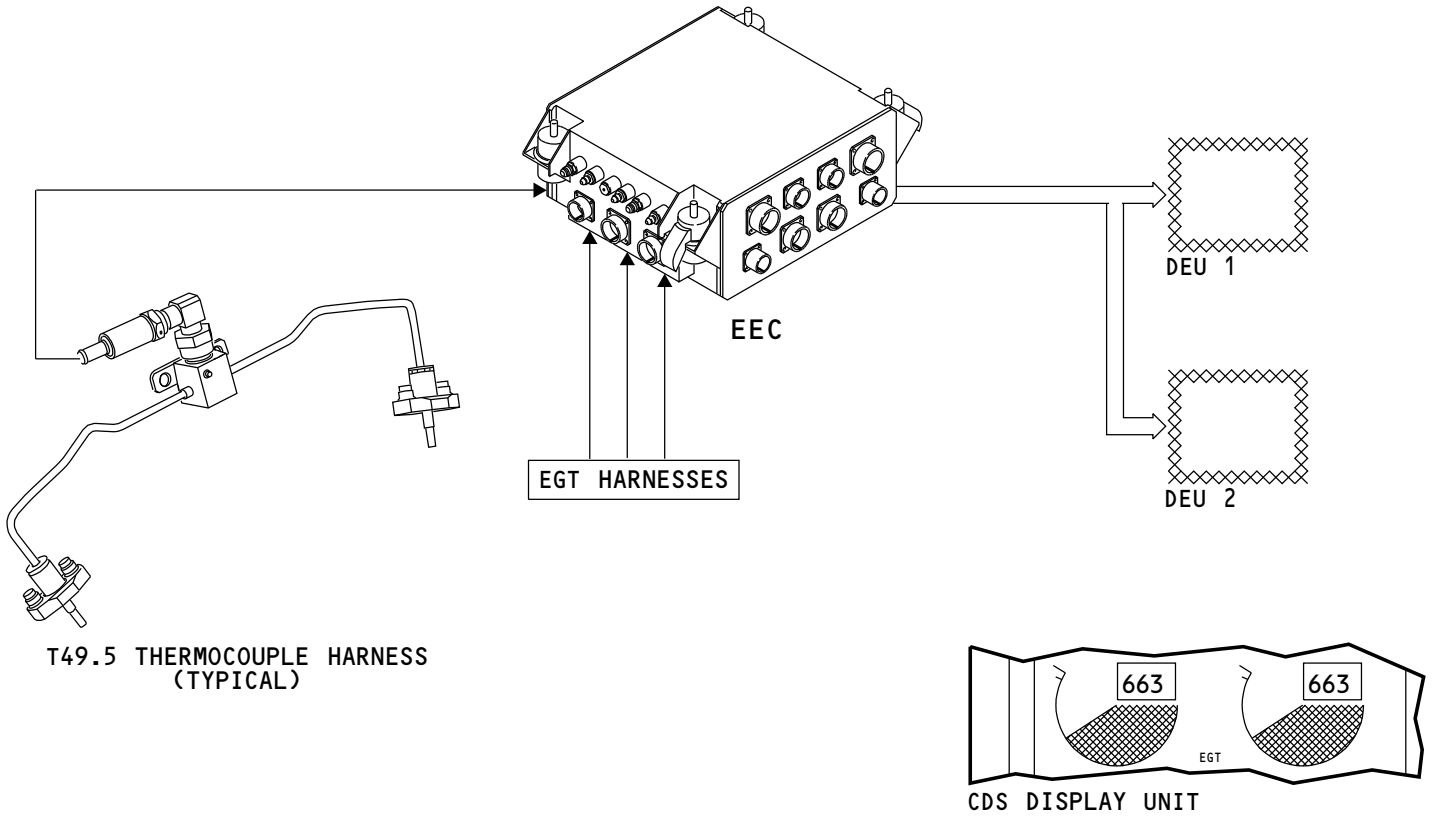


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**EXHAUST GAS TEMPERATURE (EGT) INDICATING SYSTEM - GENERAL DESCRIPTION**


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## EXHAUST GAS TEMPERATURE (EGT) INDICATING SYSTEM - EGT THERMOCOUPLES AND HARNESSES

### General

There are eight thermocouples and four T49.5 thermocouple harnesses on each engine. The T49.5 thermocouple harness includes these parts:

- Thermocouple (2)
- Tube (2)
- Junction box.

### Purpose

The EGT thermocouples supply analog signals which are proportional to the exhaust gas temperature.

The T49.5 thermocouple harnesses send the thermocouple signals to the EEC. The EEC uses these signals for engine control and indication.

### Component Locations

The thermocouples are inside the second stage nozzles of the low pressure turbine (LPT). Wires from the thermocouples go to the nearest junction box. The wires are inside a tube.

There are two T49.5 thermocouple harnesses on each side of the turbine case. A wire harness connects the EEC to the junction box near the thermocouples.

### Training Information Point

You replace the T49.5 thermocouple harness as a unit.


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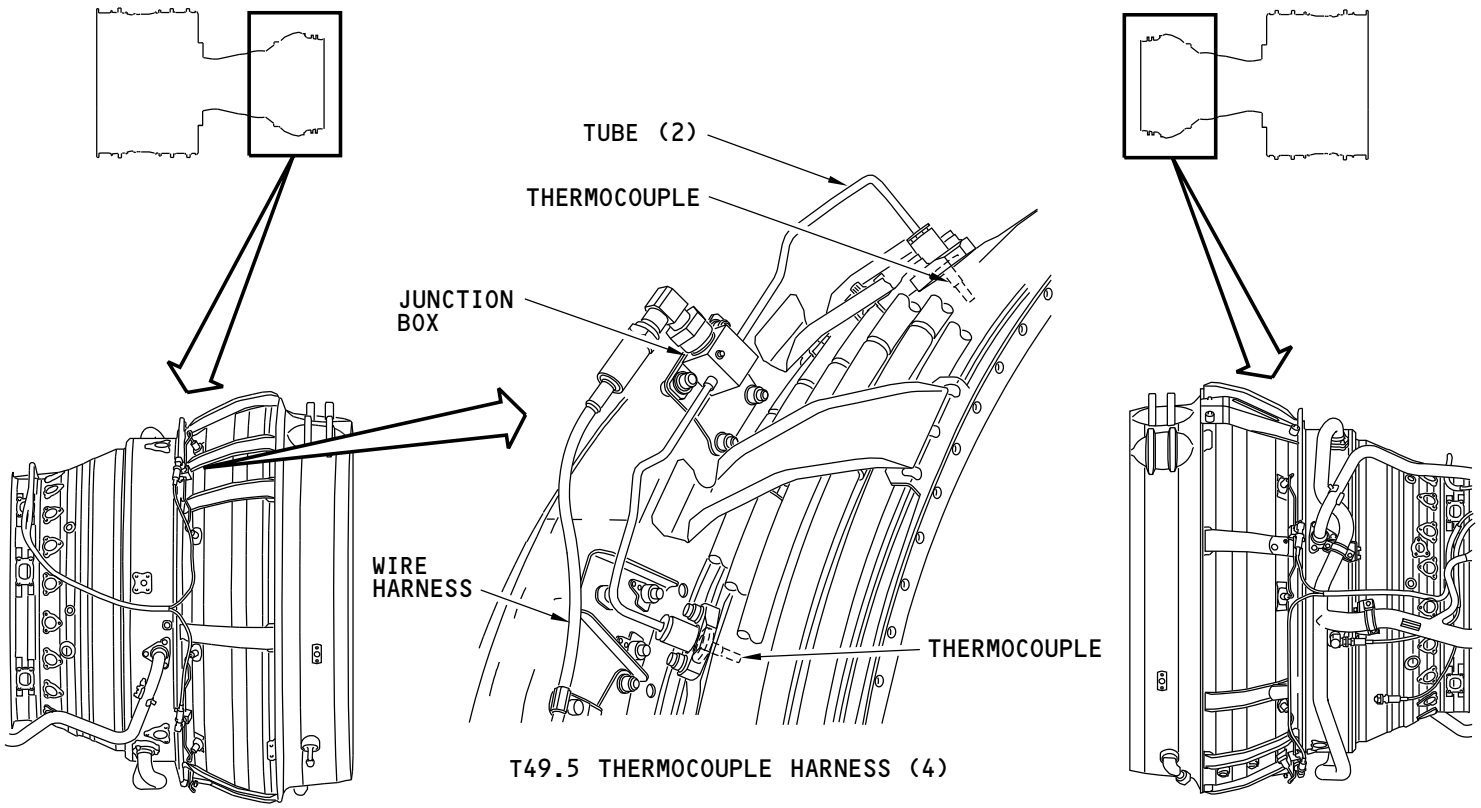


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**EXHAUST GAS TEMPERATURE (EGT) INDICATING SYSTEM - EGT THERMOCOUPLES AND HARNESSES**


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## EXHAUST GAS TEMPERATURE (EGT) INDICATING SYSTEM - FUNCTIONAL DESCRIPTION

### General

The engine electronic control (EEC) supplies the EGT signals to the DEUs to show on the common display system (CDS). The temperature that shows is an average from the eight thermocouples on the engine.

### EGT Digital Readout and Pointer

The EGT digital readout shows EGT in degrees celsius. The digital readout and the box around are usually white.

A pointer on a round dial also shows EGT. The dial does not have a scale. A shaded area follows the pointer. The pointer is usually white. The shaded area is usually gray.

These indications change to amber when the EGT is more than the EGT maximum continuous limit, but less than the EGT redline:

- EGT digital readout
- Box around the digital readout
- Pointer
- Shaded area.

During take-off, the amber band color change is inhibited for five minutes or until completion of take-off, whichever comes first. If one engine fails within the first five minutes of the amber band inhibit, the amber band color change inhibit will be extended to ten minutes for the operating engine.

These indications change to red when the EGT is more than the EGT redline:

- EGT digital readout
- Box around the digital readout
- Pointer
- Shaded area.

When the exhaust gas temperature goes back to the normal range, the indication color goes to white.

When the EEC deenergizes after engine shutdown, the box around the digital readout changes to red if EGT was more than redline during the engine operation.

The EEC deenergizes after an engine run, when N2 speed goes less than about 10 percent. When the EEC deenergizes, the digital readout, pointer, and shaded area go blank.

See the engine tachometer system section for more information the exceedance data display. (SECTION 77-11)

The EGT digital readout and box flash during an engine ground start if the EEC sees a possible hot start. This function does not work in flight. See the engine starting chapter for more information. (CHAPTER 80)

### EGT Maximum Continuous Limit and Amber Band

The EGT maximum continuous limit is the start of the EGT caution range. Continuous operation of an engine with EGT more than this value could cause damage to the engine. The EEC supplies the EGT maximum continuous limit value. The limit shows in amber.

The amber band is the EGT caution range. Continuous operation of an engine with EGT in this range could cause damage to the engine. The amber range shows as an arc between the maximum continuous limit and the EGT redline.

### EGT Start Redline

The EGT start redline is the maximum limit for the EGT during an engine start on the ground. The redline shows only during the ground start. The EGT start redline goes away when the engine goes to idle. This redline does not show in flight.

These indications change to red when the EGT is more than the EGT start redline during a ground start:

- EGT digital display
- Box around the digital display
- Pointer
- Shaded area.



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## EXHAUST GAS TEMPERATURE (EGT) INDICATING SYSTEM - FUNCTIONAL DESCRIPTION

The EEC stops fuel flow and ignition if EGT is more than the start redline during an engine start on the ground. See the engine starting chapter for more information. (CHAPTER 80)


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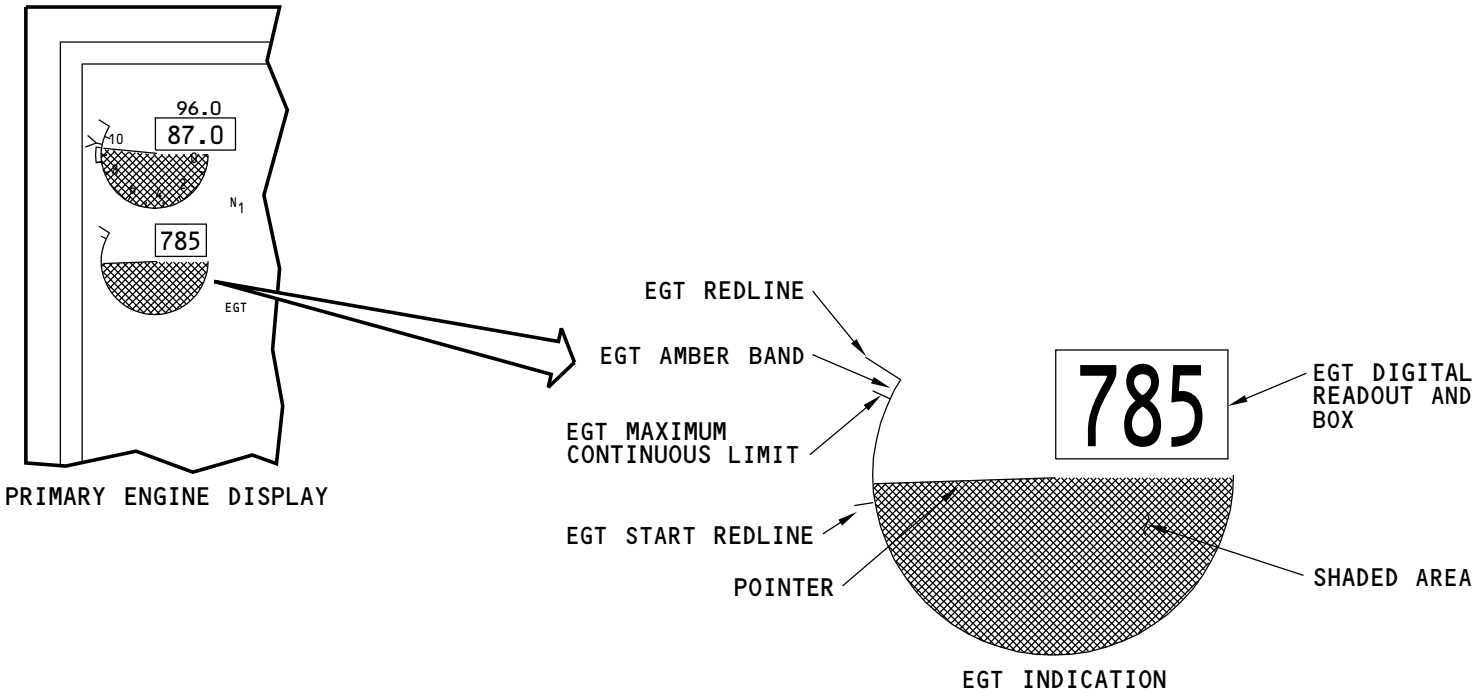


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**EXHAUST GAS TEMPERATURE (EGT) INDICATING SYSTEM - FUNCTIONAL DESCRIPTION**


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# AIRBORNE VIBRATION MONITORING (AVM) SYSTEM - GENERAL DESCRIPTION

## Purpose

The airborne vibration monitoring (AVM) system continuously supplies engine vibration levels to the CDS.

## General Description

The AVM system has these components:

- AVM signal conditioner
- A vibration sensor (accelerometer) near the forward end of the engine
- A vibration sensor (accelerometer) on the engine fan frame.

The signal conditioner uses the signals from these sensors to calculate the engine vibration levels:

- No. 1 bearing vibration sensor
- Fan frame compressor case vertical (FFCCV) vibration sensor
- N1 speed sensor
- N2 speed sensor.

The signal conditioner supplies the vibration data to the display electronics units (DEUs) and the flight data acquisition unit (FDAU). The engine vibration normally shows on the secondary engine display. The secondary engine display usually shows on the center lower display unit (P2).

The signal conditioner has built-in test equipment (BITE) to help you do these tasks:

- Troubleshooting system faults
- See and erase vibration data in AVM signal conditioner non-volatile memory
- Calculate a balance solution for engine vibration.

**AKS ALL; AIRPLANES WITH ADVANCED ENGINE VIBRATION MONITOR**

- Monitor the health of the #3 or #4 bearing

**AKS ALL**


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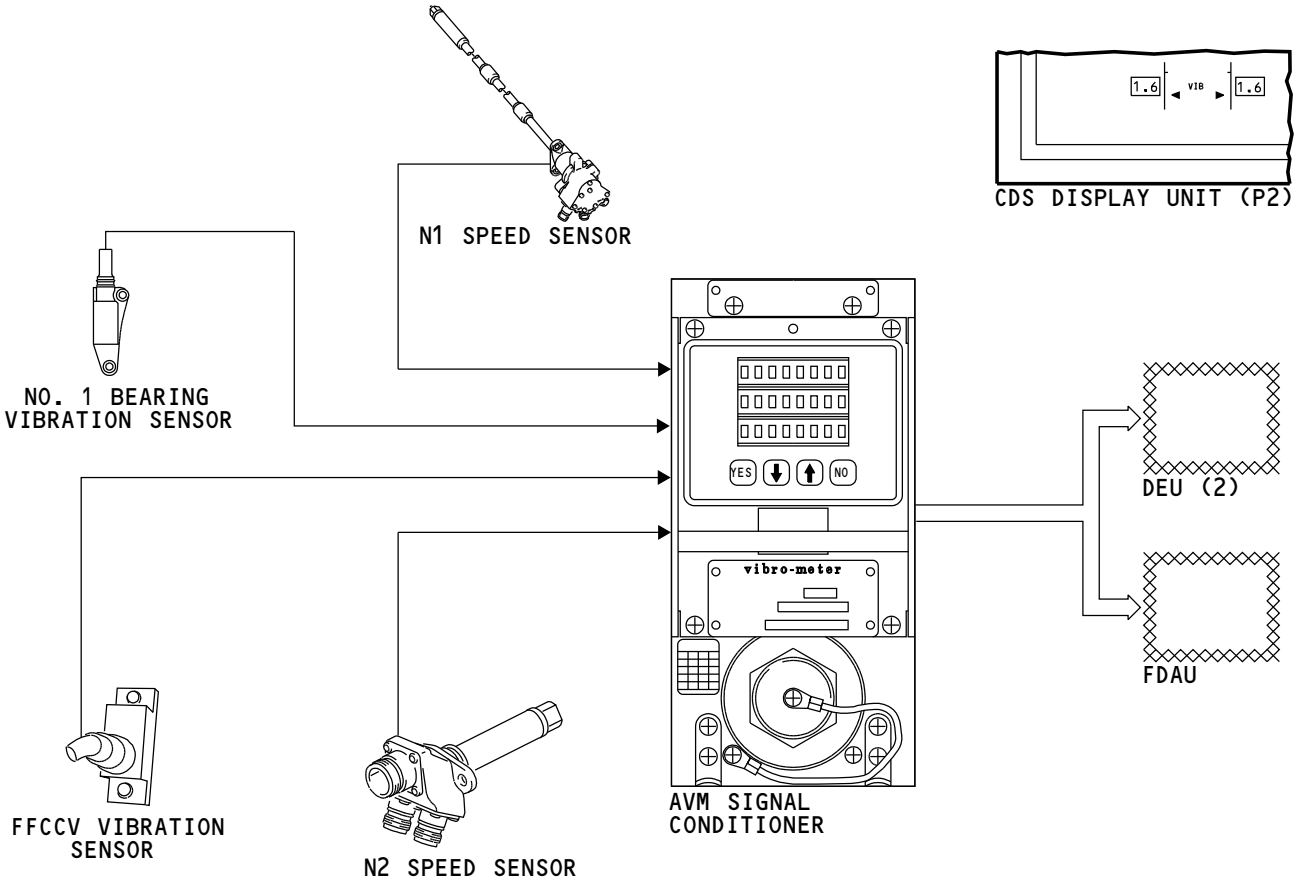


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**AIRBORNE VIBRATION MONITORING (AVM) SYSTEM - GENERAL DESCRIPTION**


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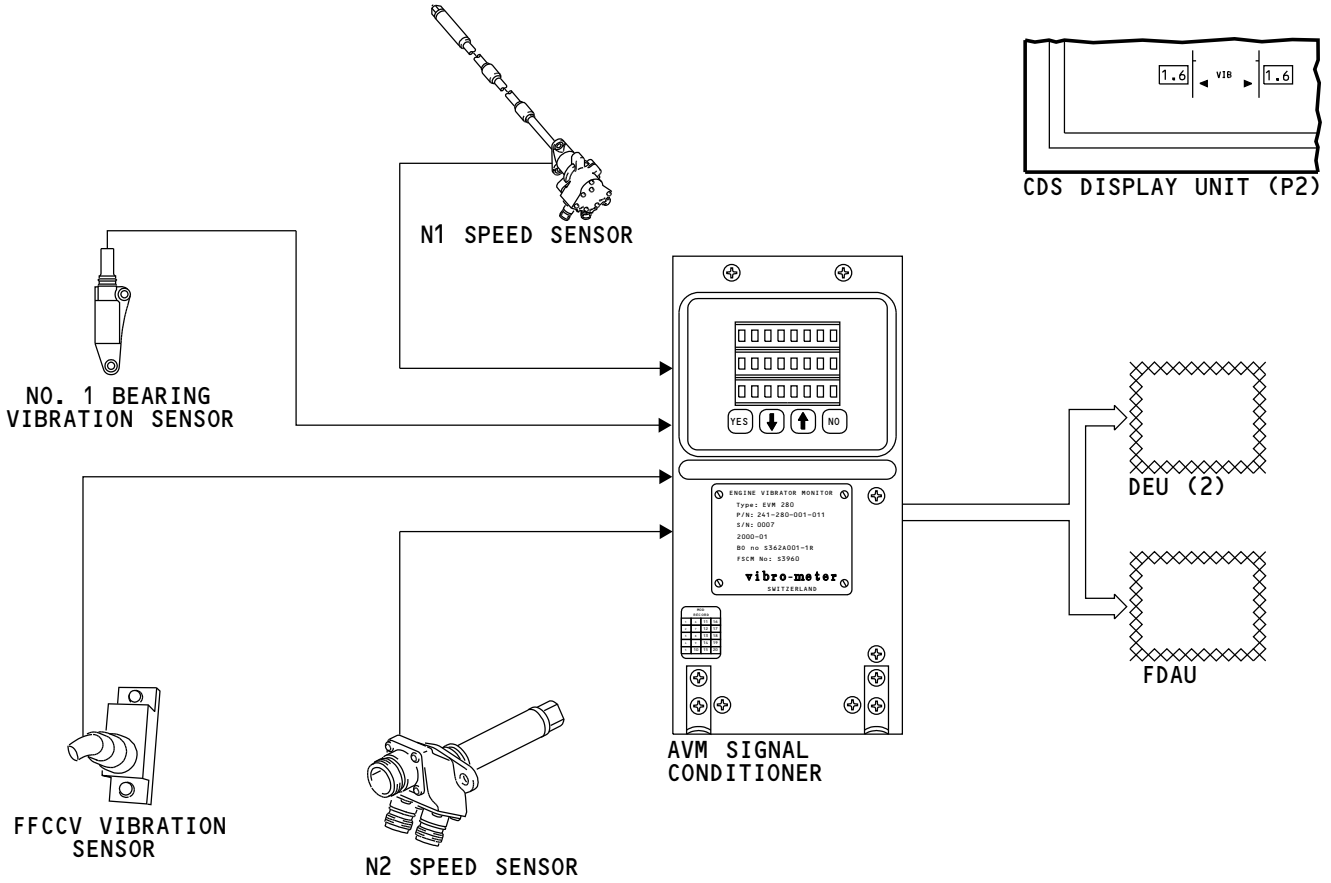


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**AIRBORNE VIBRATION MONITORING (AVM) SYSTEM - GENERAL DESCRIPTION**



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## AVM SYSTEM - COMPONENT LOCATION

### General

The AVM system has two vibration sensors (accelerometers) on the engine and one signal conditioner in the EE compartment.

### Vibration Sensors

The number 1 bearing vibration sensor is inside the engine. You cannot see this sensor with the engine on the airplane. You get access to this sensor during engine overhaul. An electrical connector attaches to this sensor wiring at the fan case. This connection is aft of the engine oil tank, just above the engine nameplate.

The fan frame compressor case vertical (FFCCV) vibration sensor is on the rear fan frame at the 3:00 position. You open the right fan cowl and the right thrust reverser cowl to get access to this sensor.

### AVM Signal Conditioner

The AVM signal conditioner is on the E3-2 shelf.


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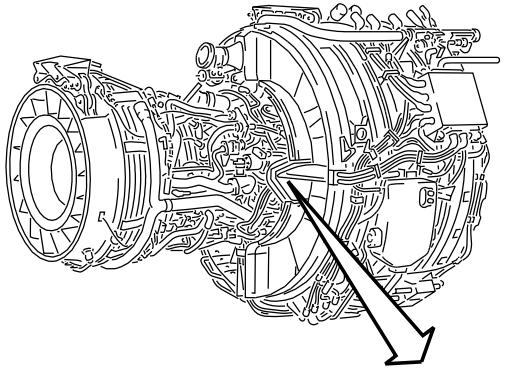
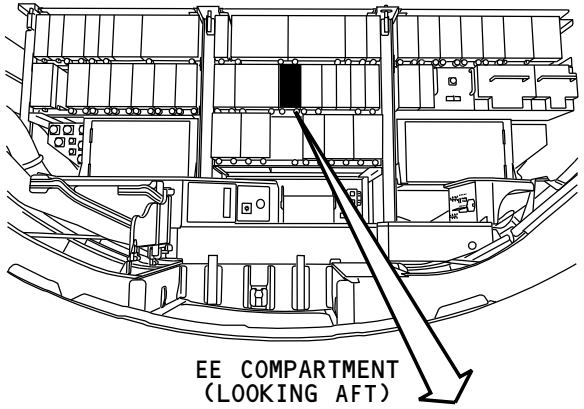
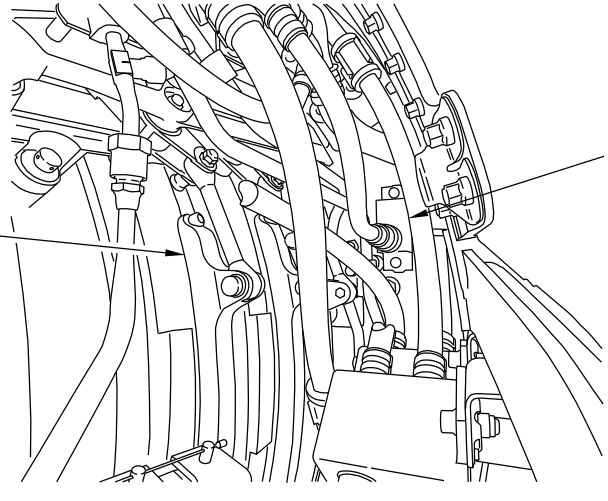
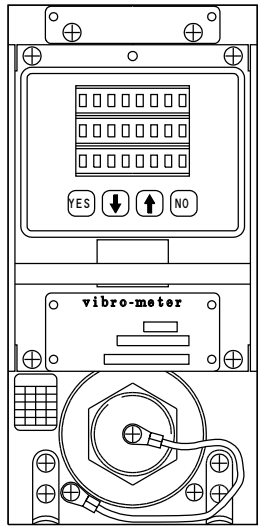





ENGINE 3:00 STRUT AREA 1

1 SOME COMPONENTS REMOVED FOR CLARITY.




AVM SIGNAL
CONDITIONER

M88074 S0004632407_V1

**AVM SYSTEM - COMPONENT LOCATION**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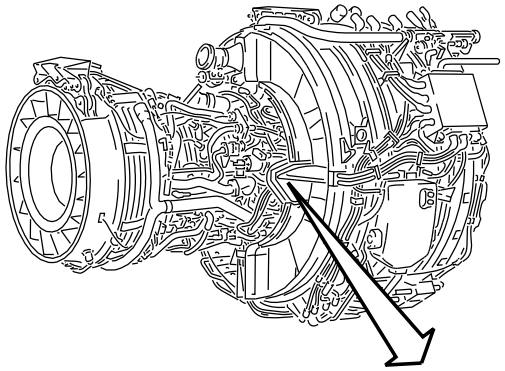
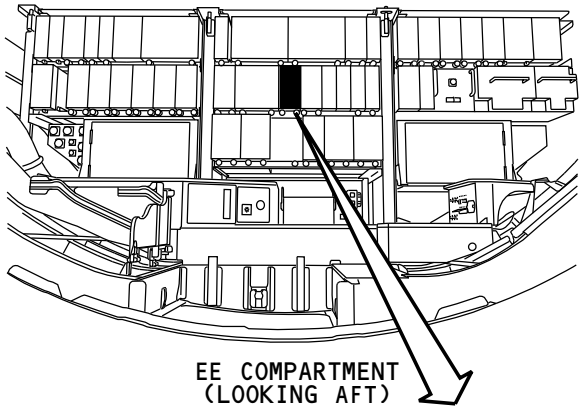
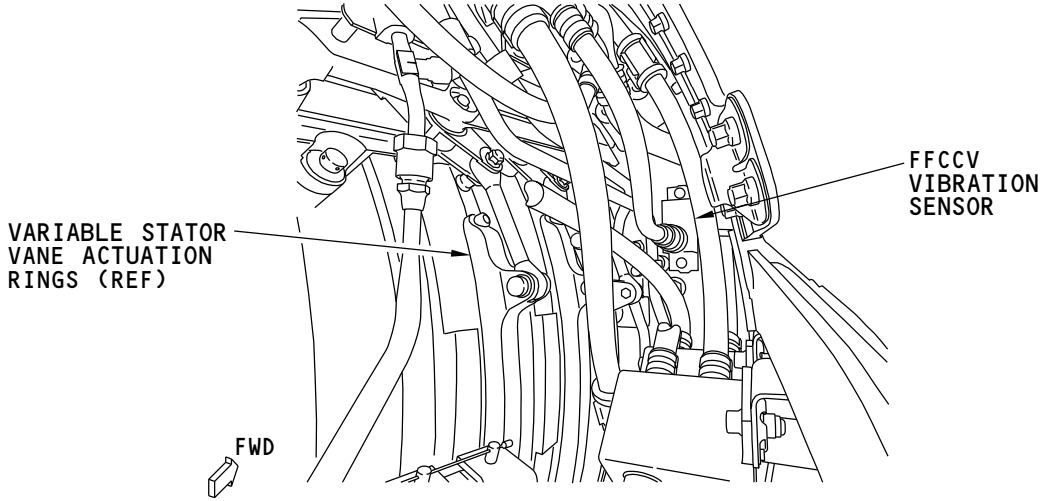
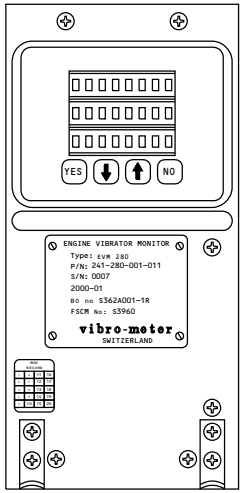





ENGINE 3:00 STRUT AREA 1




AVM SIGNAL
CONDITIONER

1 SOME COMPONENTS REMOVED FOR CLARITY.

M88076 S0004632409_V1

**AVM SYSTEM - COMPONENT LOCATION**



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## AVM SYSTEM - AVM SIGNAL CONDITIONER

### Purpose

The AVM signal conditioner has these functions:

- Calculates vibration of each engine and supplies a signal to the common display system (CDS)
- Keeps historical engine vibration data in memory for each engine
- Gives you vibration balance solutions that help you do engine trim balance operations
- Isolates AVM system failures and keeps failure data in memory.

**AKS ALL; AIRPLANES WITH ADVANCED ENGINE VIBRATION MONITOR**

- Gives detection of possible damage to the #3 and #4 bearing
- Gives external access to the data

**AKS ALL**

### General

The front face of the AVM signal conditioner has BITE that lets you do these functions:

- See or erase fault history data
- See or erase flight history data
- Operate the balance function
- Start an internal self test of the AVM signal conditioner.

The red LED display shows up to 3 lines of data, 8 characters wide. See the AVM SIGNAL CONDITIONER BITE -TIP pages in this section for more information.

### Vibration Calculations

The AVM signal conditioner continuously calculates vibration data for several areas of each engine. The highest vibration for each engine shows on the CDS.

The AVM signal conditioner uses inputs from these components to calculate vibration levels:

- Vibration sensors (2)
- N1 speed sensor
- N2 speed sensor.

The AVM signal conditioner continuously calculates vibration for these engine areas:

- Fan/low pressure compressor (LPC)
- High pressure compressor (HPC)
- High pressure turbine (HPT)
- Low pressure turbine (LPT).

### Engine Vibration Data History

The AVM signal conditioner holds engine vibration data information for the last 32 flights (engine cycles) of each engine. A new flight starts when one engine speed is more than 45 percent N2. The flight stops when both engines go less than 45 percent N2. You can see this data in the FLIGHT HISTORY MENU on the display. See the FLIGHT HISTORY - TIP page in this section for more information.

### Balance Function

The AVM signal conditioner uses engine vibration data (historical) in non-volatile memory to calculate one-plane (fan) and two-plane (fan and LPT) balance solutions. You use the BITE display and switches to operate the balance function and to see the solutions. See the BALANCE - TIP pages in this section for more information.

### AVM System BITE and Fault History

A test occurs each time the AVM signal conditioner gets initial electrical power or when you start a test from the SELF TEST MENU on the display. See the SELF TEST - TIPS page in this section for more information.

The AVM signal conditioner does a test to monitor these items:

- Internal circuits
- N1 signal from engine 1 and engine 2


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- N2 signal from engine 1 and engine 2.

The AVM signal conditioner keeps up to 32 fault (maintenance) messages in its non-volatile memory. You can see this data on the display in the FAULT HISTORY MENU. See the FAULT HISTORY - TIP page in this section for more information.

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**AEVM**

The AEVM signal conditioner can find signs of possible damage to the #3 or #4 bearing. To do this, it does an analysis of the frequency signatures sent from the #1 bearing vibration sensor. To monitor the data, use the AEVM menu on the display. The signal conditioner can also send the data to the aircraft condition and reporting system (ACARS), if installed

**AKS ALL**

**Data Access**

These are the two methods to see or erase the engine vibration data and fault history data:

- Use the front panel BITE and display
- Use an ARINC 429 databus analyzer and an optional test box.

The test box makes it easier for you to read and erase data when you use an ARINC 429 databus analyzer. You can use the databus analyzer without the test box.

See part 2 of the AMM or FIM for complete procedures.

**Data Access**

To get access to the engine vibration data, use the BITE switches and the front panel display. The display is activated when you push one of the four BITE switches.

See part 2 of the AMM or FIM for complete procedures.

**AKS ALL; AIRPLANES WITH ADVANCED ENGINE VIBRATION MONITOR**

You can also use a laptop computer with ground support software (GSS) to get access to the engine vibration data and AEVM system data.

See AMM II F77-33 for the GSS procedures

**AKS ALL**



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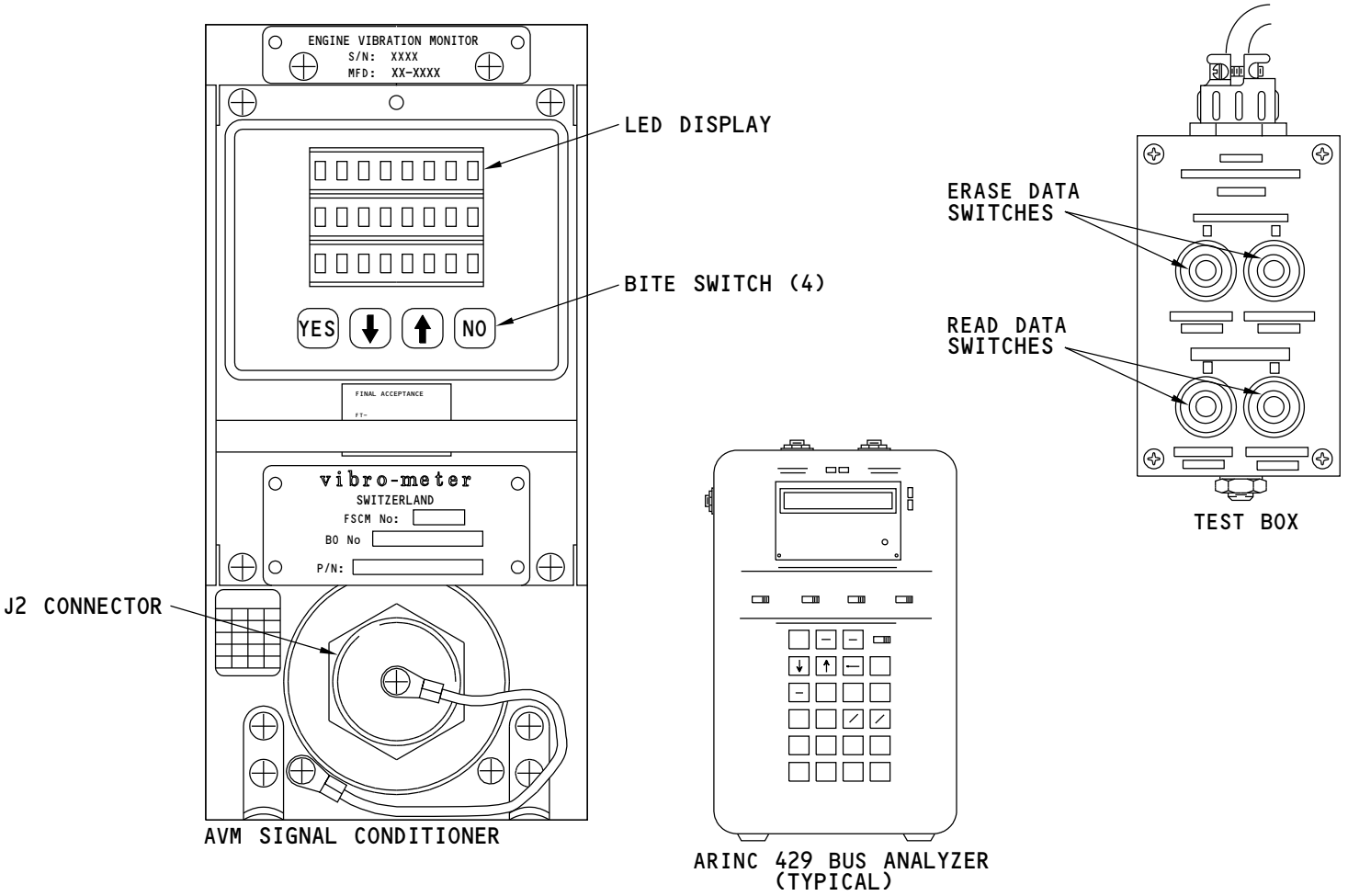


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**AVM SYSTEM - AVM SIGNAL CONDITIONER**


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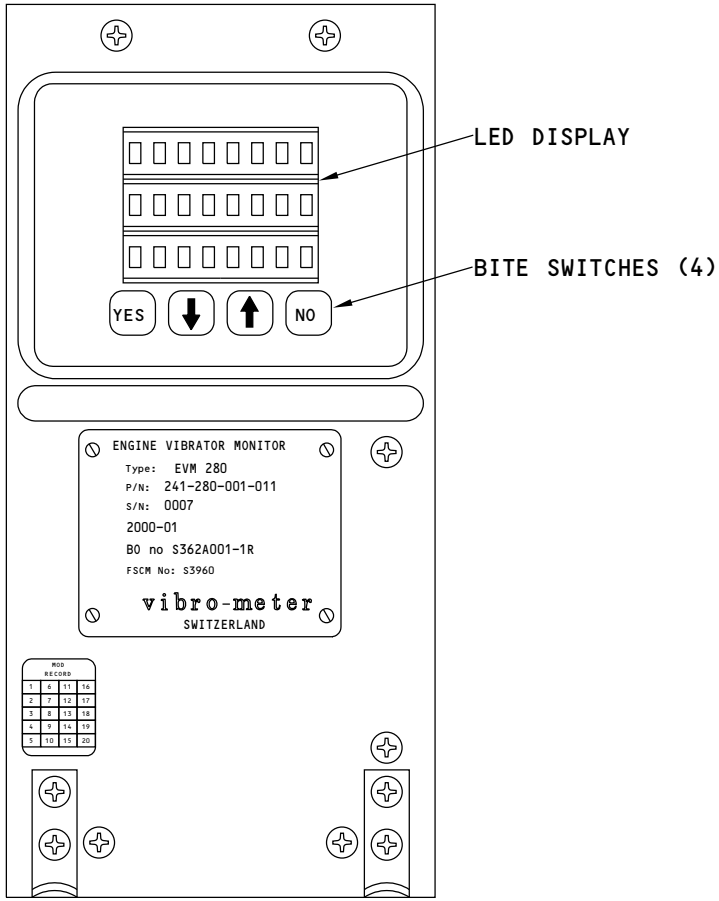


M88080 S0004632414_V1

**AVM SYSTEM - AVM SIGNAL CONDITIONER**


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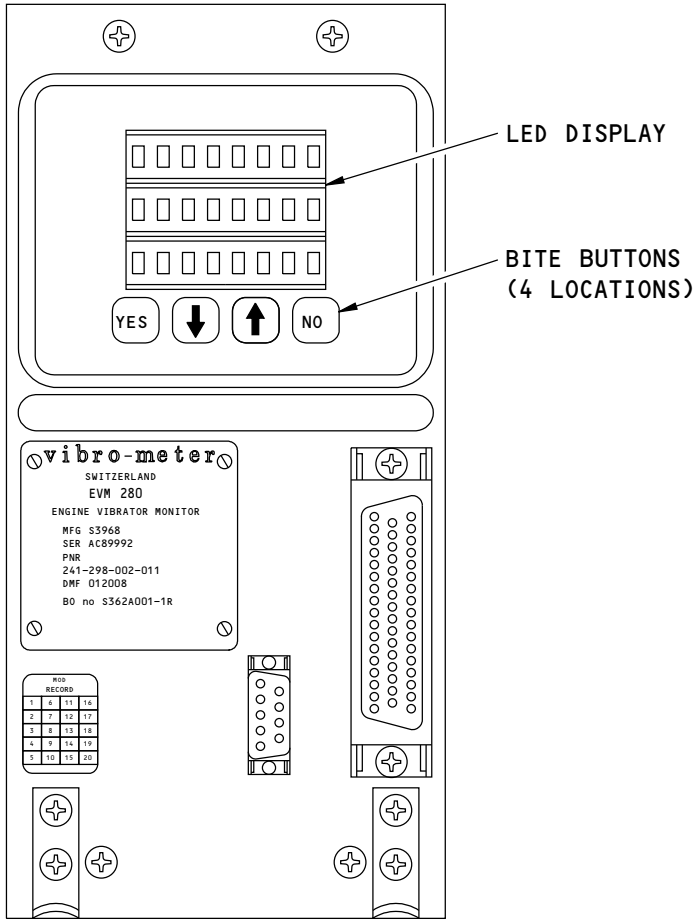


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**AVM SYSTEM - AEVM SIGNAL CONDITIONER**



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## AVM SYSTEM - FUNCTIONAL DESCRIPTION

### General

The AVM system uses these inputs to calculate engine vibration levels:

- N1 speed sensor
- N2 speed sensor
- No. 1 bearing vibration sensor
- Fan frame compressor case vertical (FFCCV) vibration sensor.

The highest engine vibration level for each engine continuously shows on the common display system (CDS). The AVM system also keeps system fault data and historical vibration data in its non-volatile memory.

### Vibration Sensors

The vibration sensors are self-exciting piezoelectric crystals. The sensors supply a small electrical signal output. The output level changes when the engine structure moves in the radial direction. The output difference is proportional to the vibration level of the engine.

You remove and replace the no. 1 bearing vibration sensor during an engine overhaul.

### AVM Signal Conditioner

The signal conditioner uses the speed sensor inputs and the vibration signals to calculate vibration levels for these engine components:

- Low pressure compressor (LPC)
- High pressure compressor (HPC)
- Low pressure turbine (LPT)
- High pressure turbine (HPT).

The highest vibration signal continuously goes to the DEUs on an ARINC 429 databus to show on the CDS. This information also goes to the flight data acquisition unit (FDAU). The FDAU sends the data to the flight data recorder.

The signal conditioner holds vibration data for the last 32 flights in its non-volatile memory. A new flight starts when both engines are less than 45 percent N2 and one engine goes more than 45 percent N2. A flight ends when both engines are less than 45 percent N2.

The signal conditioner also keeps AVM system fault codes in its non-volatile memory.

You use the BITE switches and display on the face of the signal conditioner to navigate through its BITE menus. You can see or erase fault data and in-flight vibration data. You also use the BITE to make the AVM signal conditioner calculate an engine balance solution. See the training information point pages in this section for more information about the BITE.

You can also get data or erase data with a data bus analyzer. See the section on the AVM signal conditioner for more information.

The program pins identify the engine model and the customer options.

The signal conditioner gets electrical power from the 115v ac transfer bus 2. An internal power supply changes the input to 24v dc.

**AKS ALL; AIRPLANES WITH ADVANCED ENGINE VIBRATION MONITOR**

The AEVM signal conditioner has algorithms that use the vibration data from the #1 bearing to calculate the vibration of the #3 and #4 bearing. The algorithms calculate when there can be damage to the bearings.

You can also use a laptop computer with ground support software (GSS) to get AEVM data. See the training information point pages in this section for more information about the BITE.

**AKS ALL**


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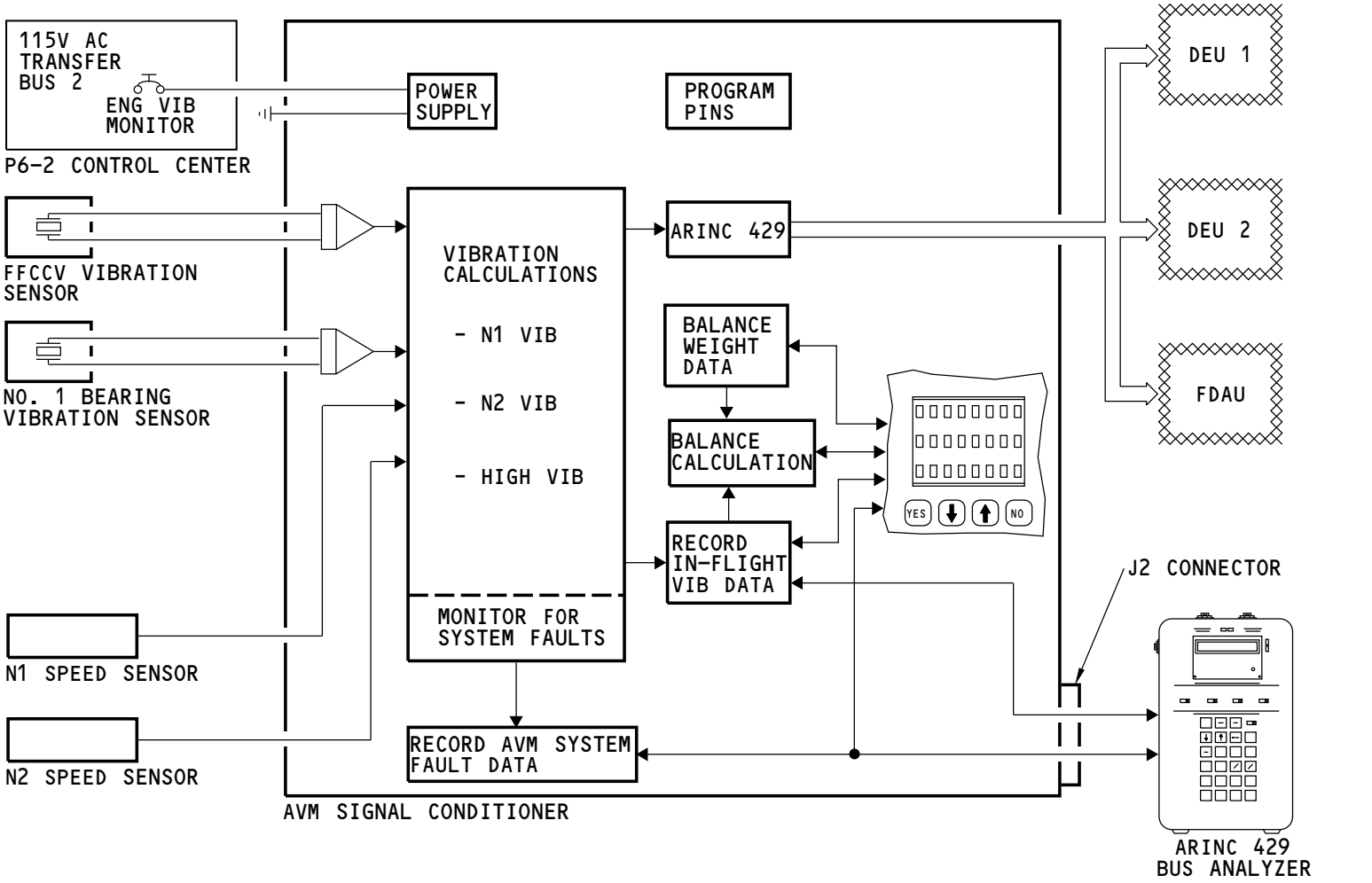


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**AVM SYSTEM - FUNCTIONAL DESCRIPTION**


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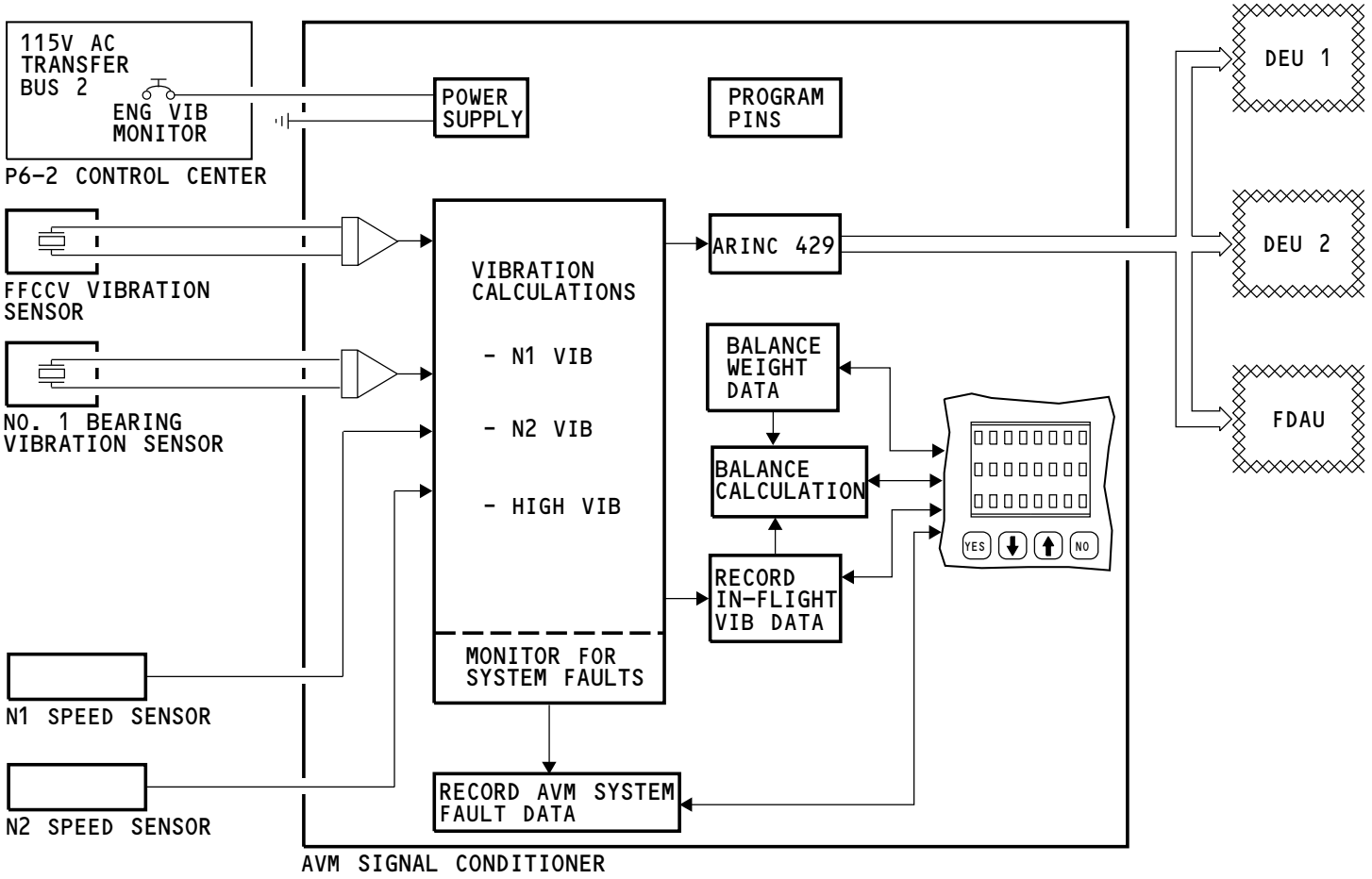


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**AVM SYSTEM - FUNCTIONAL DESCRIPTION**


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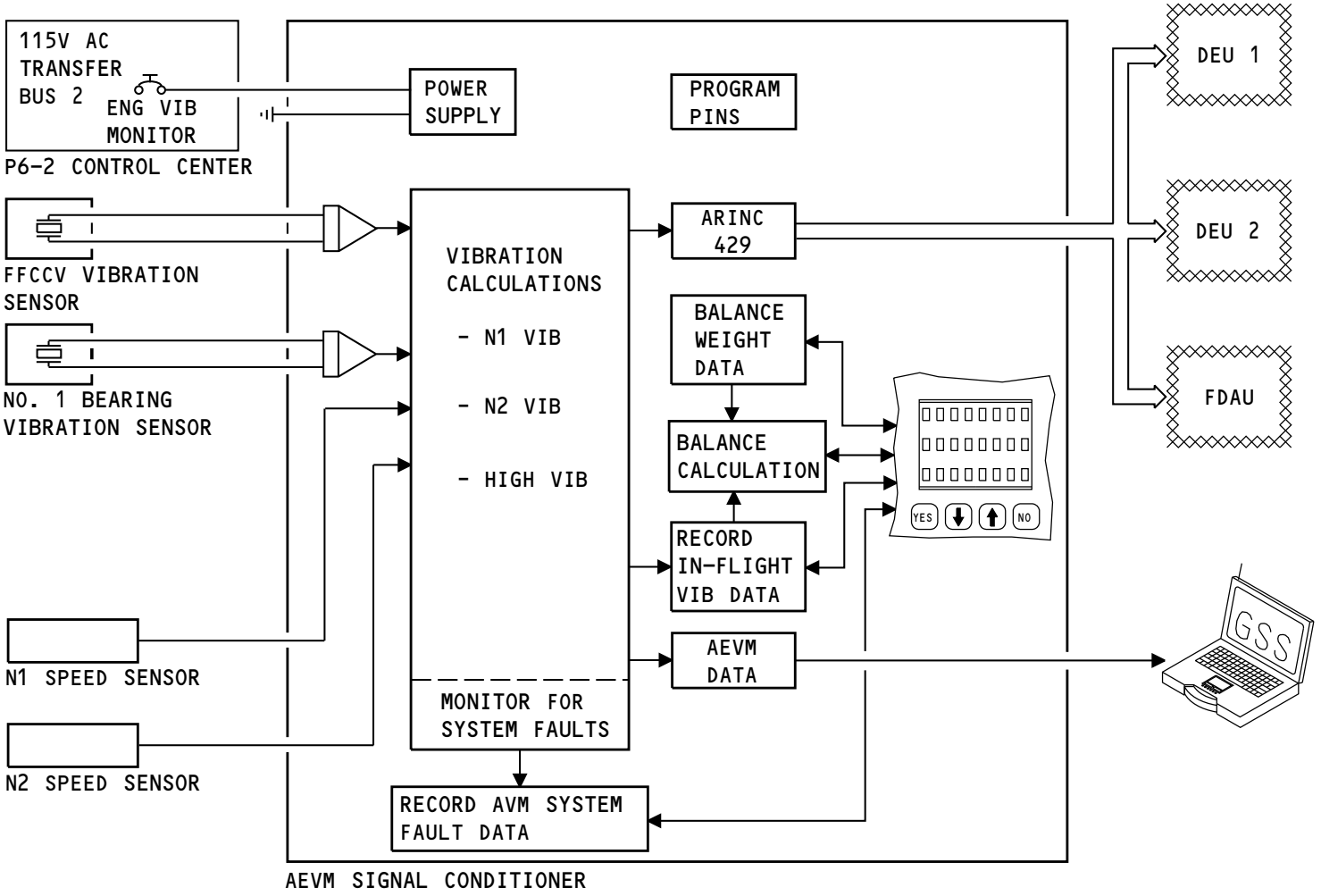


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**AVM SYSTEM - FUNCTIONAL DESCRIPTION**


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - MAIN MENU - TRAINING INFORMATION POINT

### General

The AVM signal conditioner has a front panel LED display and four BITE switches. You use the BITE switches for navigation through the BITE menus.

The display is normally off. The display comes on when you push any of the BITE switches and power is available. The display goes blank again in 15 minutes if you do not push any BITE switches.

The LED display is normally off. The display comes on when you push any of the four BITE switches and both engines are off. The display goes blank if one of these happens:

- No action on the push-buttons for 5 minutes
- One or both engines start
- YES switch is pushed at the TURN OFF DISPLAY? menu.

The BITE main menu has these five items:

- SELF TEST?
- FAULT HISTORY?
- FLIGHT HISTORY?
- BALANCE?

**AKS ALL; AIRPLANES WITH ADVANCED ENGINE VIBRATION MONITOR**

- AEVM?

**AKS ALL**

- TURN OFF DISPLAY?.

The BITE has a main menu with these four items:

- SELF TEST?
- FAULT HISTORY?
- FLIGHT HISTORY?
- BALANCE?.

The SELF TEST menu item shows when the display first comes on. Push the NO switch to go to the next menu item. Use the YES switch to enter the menu item. The BITE switches with the up arrow and down arrow are inactive at this level of the BITE menu.

The SELF TEST menu shows when the display first comes on. When you push the YES push-button, the self-test starts. When you push the NO switch, the next menu item shows. The BITE switches with the up arrow and down arrow are inactive at this level of the BITE menu. At the last menu, push the NO switch to return the display to the first menu.

Always follow the fault isolation manual (FIM) procedure and any necessary AMM procedures when you do AVM BITE.

### SELF TEST?

The SELF TEST? menu selection causes the AVM signal conditioner to do an internal self test. See the SELF TEST - TIP page that follows in this section for more information on this part of the BITE menu.

### FAULT HISTORY?

The FAULT HISTORY? menu selection lets you see fault (maintenance) messages that are in non-volatile memory. See the FAULT HISTORY - TIP page that follows in this section for more information on this part of the BITE menu.

### FLIGHT HISTORY?

The FLIGHT HISTORY? menu selection lets you see vibration data for the last 32 flights (cycles) for each engine. See the FLIGHT HISTORY - TIP page that follows in this section for more information on this part of the BITE menu.

### BALANCE?

The BALANCE? menu selection lets you do these tasks:

- See fan and LPT imbalance data for the last 6 flights (cycles)
- See and modify balance weight information in AVM non-volatile memory


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - MAIN MENU - TRAINING INFORMATION POINT

- Make the AVM signal conditioner calculate the balance solution for 1 plane (fan only)
- Make the AVM signal conditioner calculate the balance solution for 2 planes (fan and low pressure turbine).

See the BALANCE - TIP pages that follows in this section for more information this part of the BITE menu.

**AKS ALL; AIRPLANES WITH ADVANCED ENGINE VIBRATION MONITOR**

**AEVM?**

The AEVM? menu gives access to the condition monitoring data for the #3 or #4 bearing. CFM recommends that you examine this data after the first 30 flights of an engine installation. Then examine the data at each interval of 150 hours of engine operation. The AEVM can show one of these four levels of bearing health:

- Level 0: no message - the system operates correctly
- Level 3: Examine all chip detectors in less than 100-150 hours of interrogation. Download the AAVM data in less than 100-150 hours of interrogation and send the data to CFM. Continue to look for bearing messages at intervals of 150 hours
- Level 2: Examine all chip detectors in less than 25 hours of interrogation. Download the AAVM data in less than 25 hours of interrogation and send the data to CFM. Continue to look for bearing messages at intervals of 50-75 hours. Download the AAVM data each 450-550 hours.
- Level 1: Examine all chip detectors in less than three flights. Download the AAVM data in less than 25 hours of interrogation and send the data to CFM. Continue to look for bearing messages at intervals of 50-75 hours. Examine all chip detectors again each 50-75 hours.

When the AEVM signal conditioner gives a report of level 3, 2, or 1, CFM recommends that you do these steps:

- Do an inspection of the chip detectors
- Download the data from the AEVM
- Send the data to CFM for evaluation.

The program to monitor bearing condition is a recommendation from CFM and is not mandatory. An operator that follows this program can identify when the #3 or #4 bearing is near failure. This will usually help an engine change to be scheduled before an engine failure could cause the airplane to stop scheduled operation.

See the AEVM Menu - TIP pages that follows in this section for more information this part of the BITE menu.

**AKS ALL**

**TURN OFF DISPLAY?**

The TURN OFF DISPLAY? menu selection lets you exit the BITE test or go to the next menu. You exit the BITE menu and the display goes blank when you push the YES switch. The next menu, SELF TEST, shows when you push the NO switch.

**Training Information Point**

Although the 2 plane balance is a function of the AVM signal conditioner, it is not an approved maintenance procedure for the CFM56-7 engine. Refer to AMMII 71-00-00.


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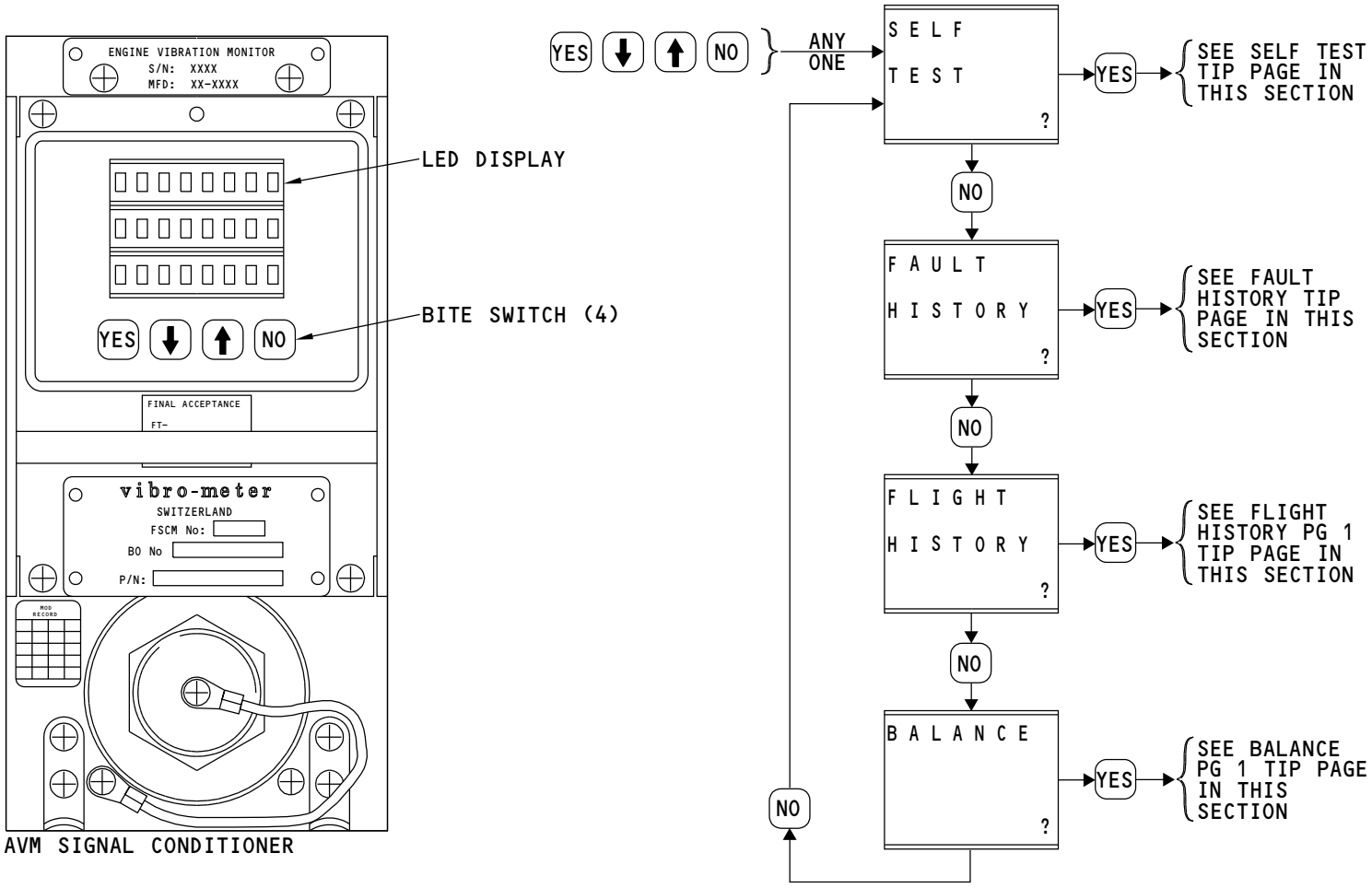


M88086 S0004632421_V1

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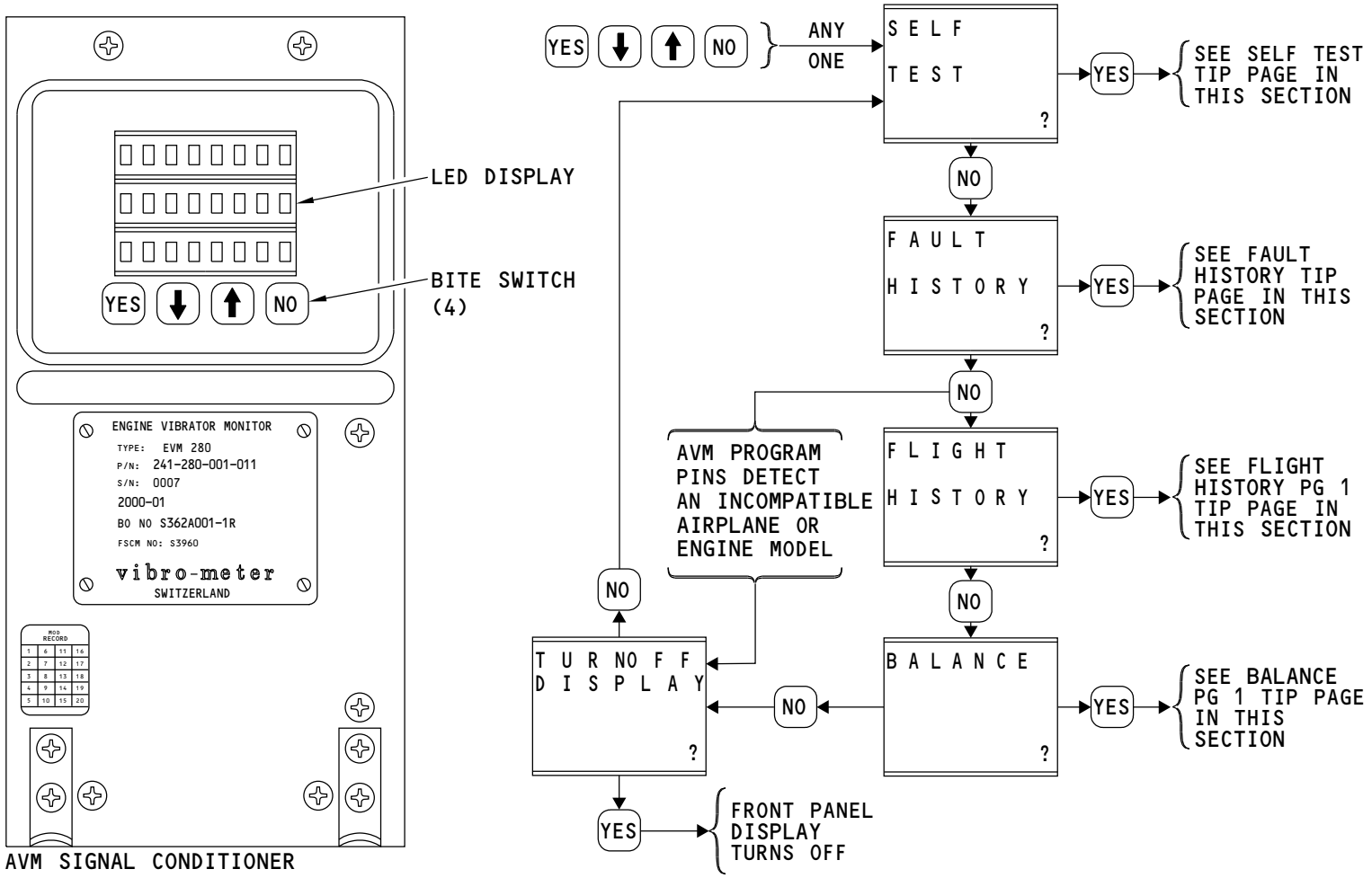


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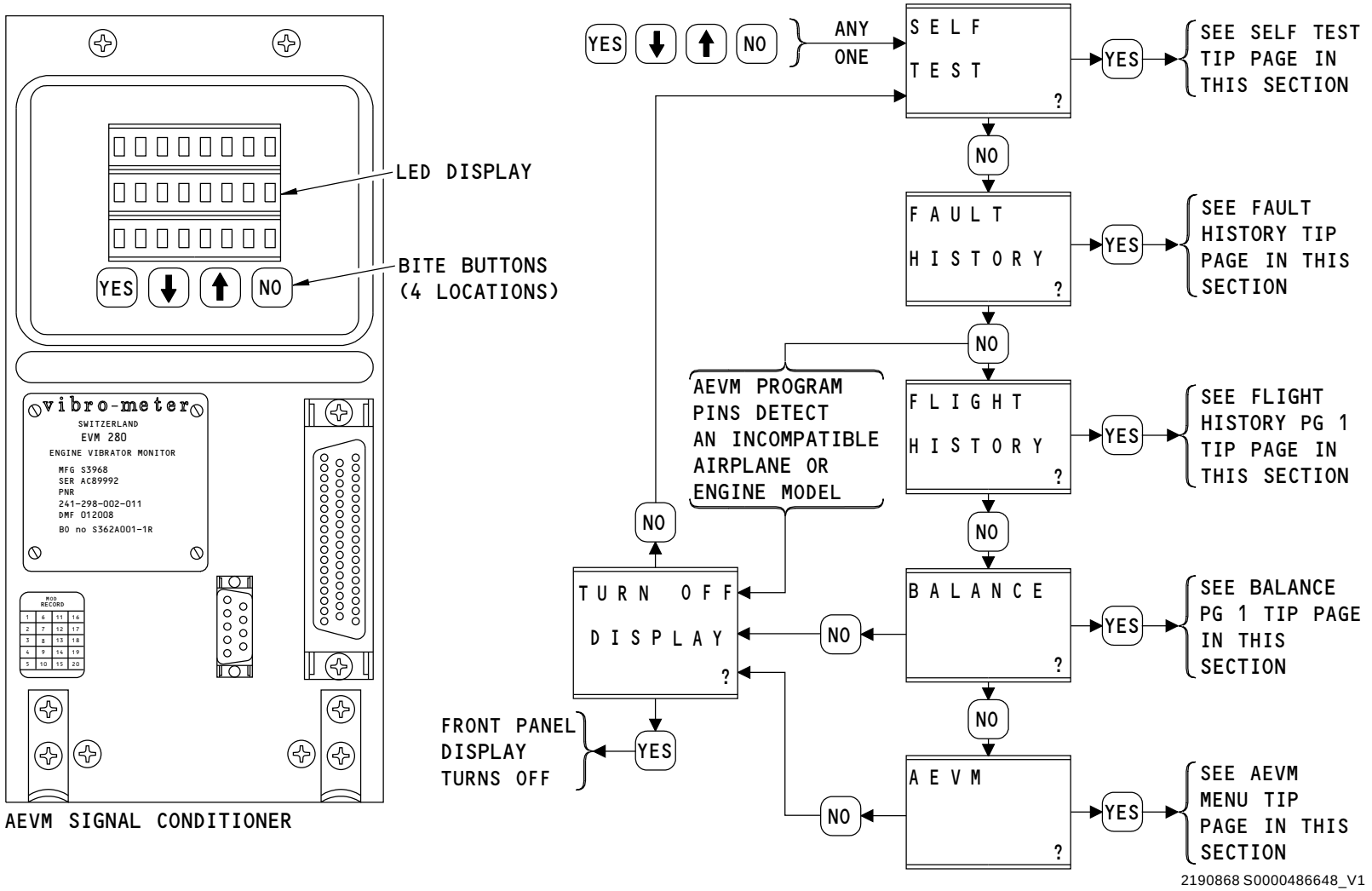


**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - MAIN MENU - TRAINING INFORMATION POINT**


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - SELF TEST - TRAINING INFORMATION POINT

### Purpose

The SELF TEST menu lets you start an internal test of the AVM. At the end of the test, the front panel shows all faults found during the test.

### General

You can make the AVM signal conditioner do an internal test from the SELF TEST menu. To start the test, push the YES switch from the SELF TEST display in the main menu.

To start the test, push the YES switch at the SELF TEST menu. The first display during the test shows this information:

- AVM part number
- Hardware version
- Software version
- Engine type.

The 0ss shows the software version. The HH shows the hardware version. The XXXXXXXX shows the engine type. It shows as CFM56-7B. If the AVM detects an incompatible airplane or engine type, a CONFIG FAULT message shows.

The first display during the test shows the signal conditioner part number. The HHH gives the hardware version. The SSS gives the software version.

The next display shows a message that the test is in progress. The test takes about 10 seconds.

The TEST OK message shows if the signal conditioner passes the test. The FAULTS DISPLAY? message shows if the AVM finds failures. The XX gives the number of faults found during the test. Push the up arrow switch or down arrow switch to see the fault messages (text). Push the NO switch to return to the main menu.

The TEST OK message shows if the signal conditioner passes the test. The FAULTS DISPLAY? message shows if the AVM finds failures. The XX gives the number of faults found during the test. To show the faults found, push the YES switch. Push the NO switch to return to the next choice FAULT HISTORY.


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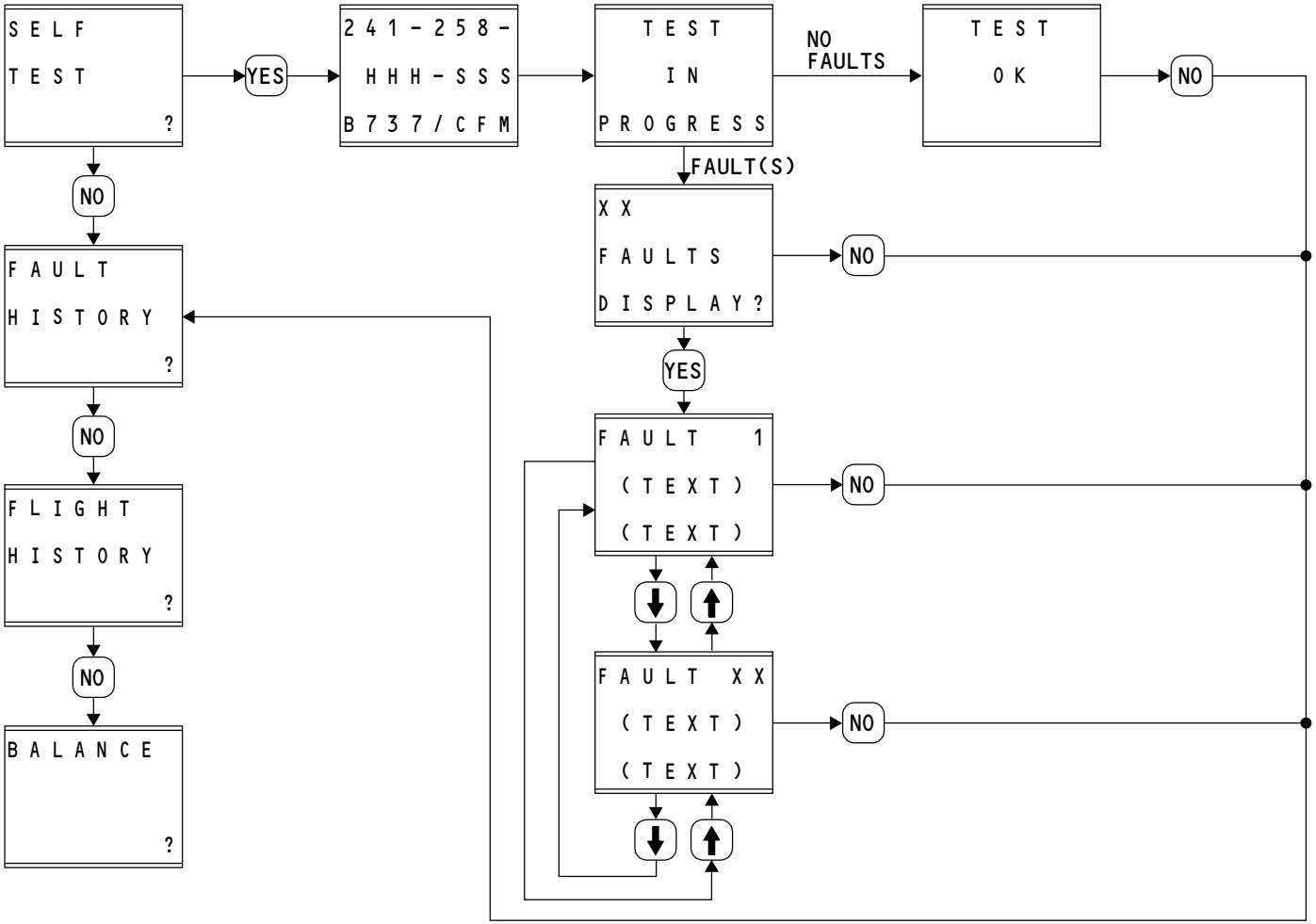


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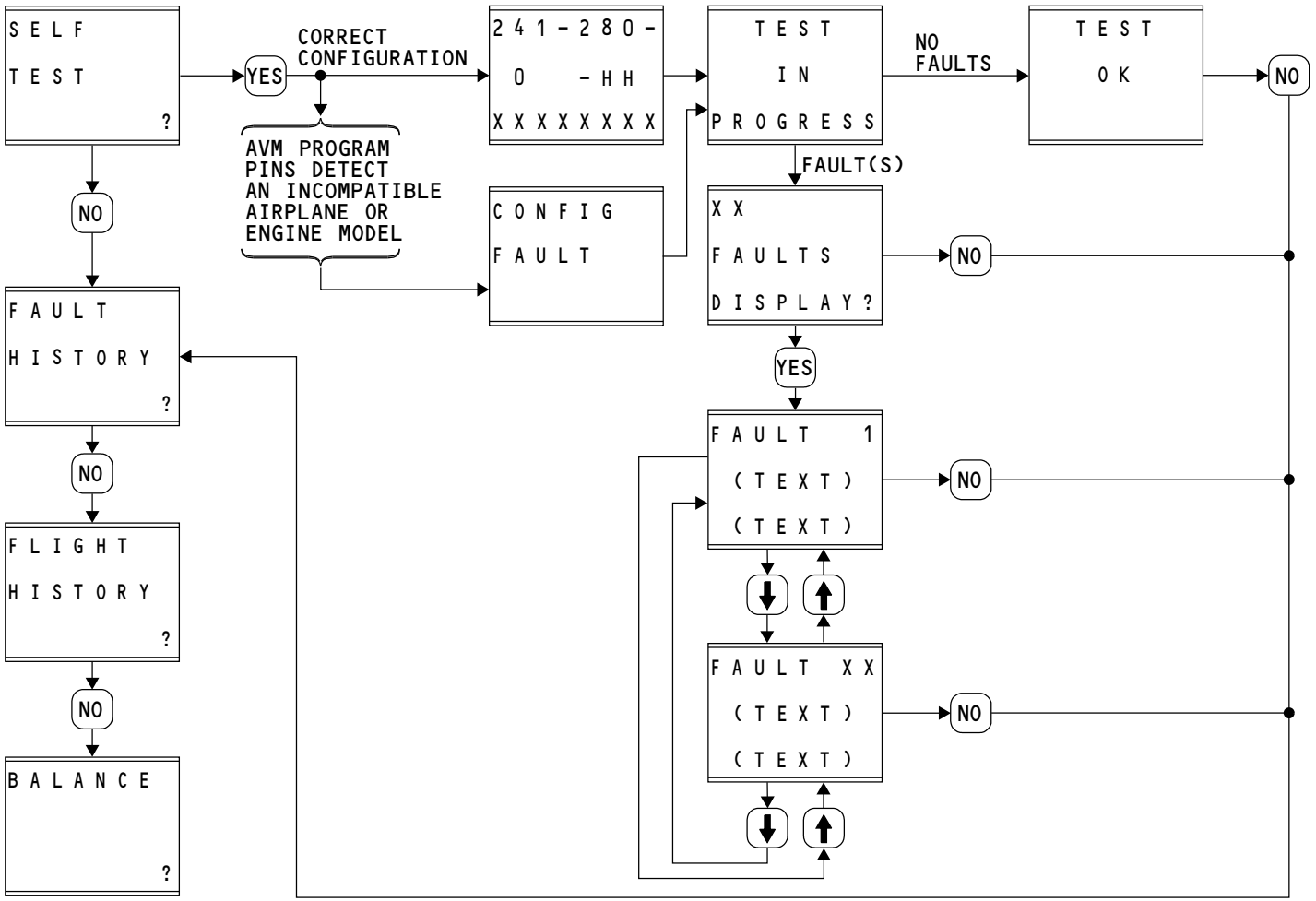


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - FAULT HISTORY - TRAINING INFORMATION POINT

### General

You select the FAULT HISTORY? item in the BITE main menu to see fault messages in non-volatile memory. The signal conditioner holds up to 32 fault (maintenance) messages in non-volatile memory. You also use this main menu item to erase fault messages.

One of two displays show after you push the YES BITE switch with FAULT HISTORY? on the display. The NO FAULT message shows if there no faults stored in memory. The FAULTS DISPLAY message shows if faults are stored or found during the self-test.

From the NO FAULT menu, push the NO switch to show the next main menu item, FLIGHT HISTORY. If there is an incompatible airplane or engine model, the FLIGHT HISTORY and BALANCE main menus are not active and the TURN OFF DISPLAY message shows.

The XX gives the number of faults. Push the up arrow switch or the down arrow switch to see the fault messages.

One of two displays show after you push the YES switch with FAULT HISTORY? on the display. The NO FAULT message shows if no faults are in memory. From here, push the NO switch to return to the main menu.

The FAULTS DISPLAY? message shows if the AVM has failures in memory. The XX gives the number of faults. Push the up arrow switch or the down arrow switch to see the fault messages.

CLEAR FAULTS MEMORY? shows after you push the NO switch from the XX FAULTS DISPLAY? or an individual fault message. Push the NO switch to return to the main menu and not erase the faults. Push the YES switch to erase the fault messages from memory. FAULTS MEMORY CLEARED shows after the memory is clear.


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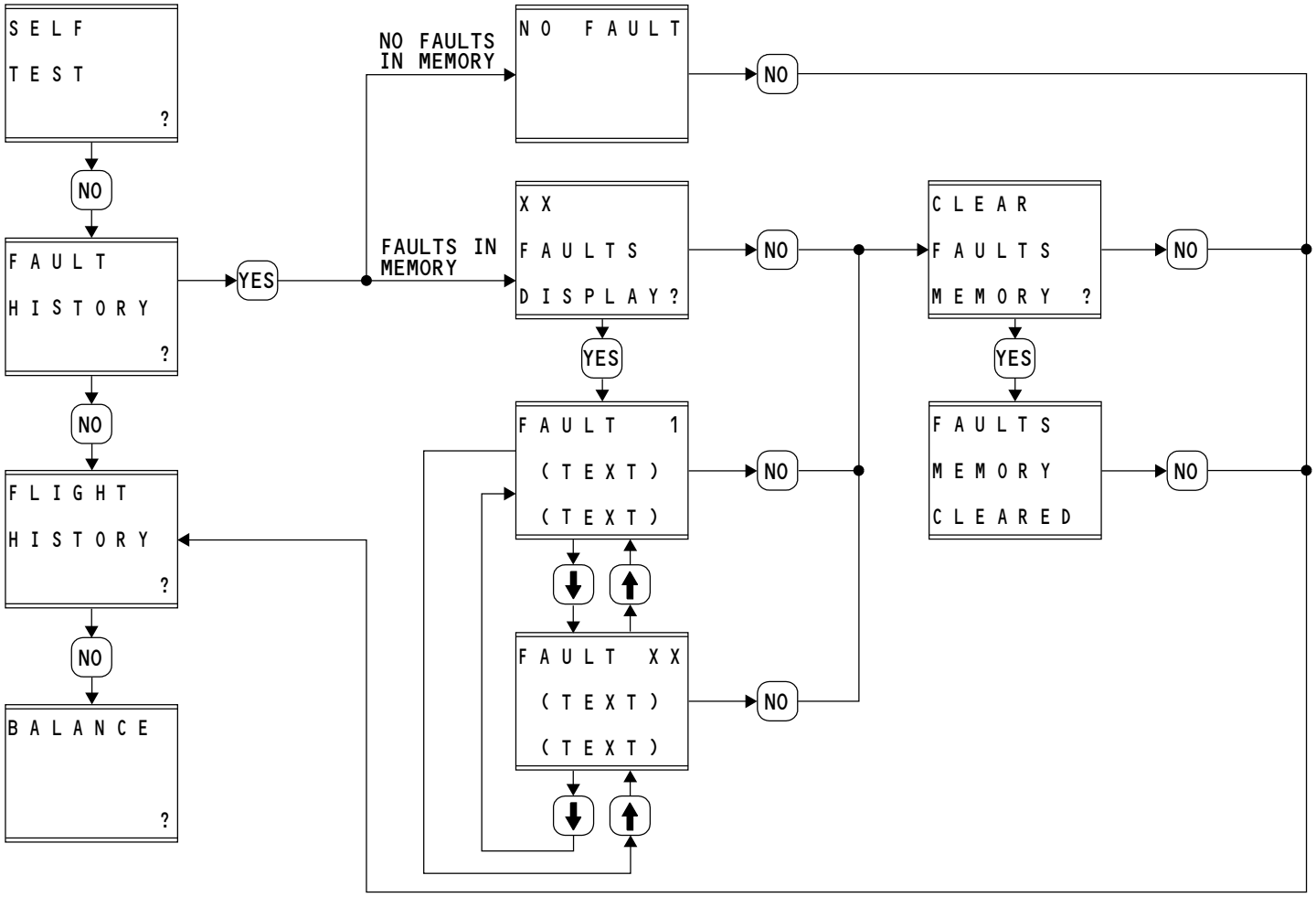


M88090 S0004632427_V1

**AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - FAULT HISTORY - TRAINING INFORMATION POINT**


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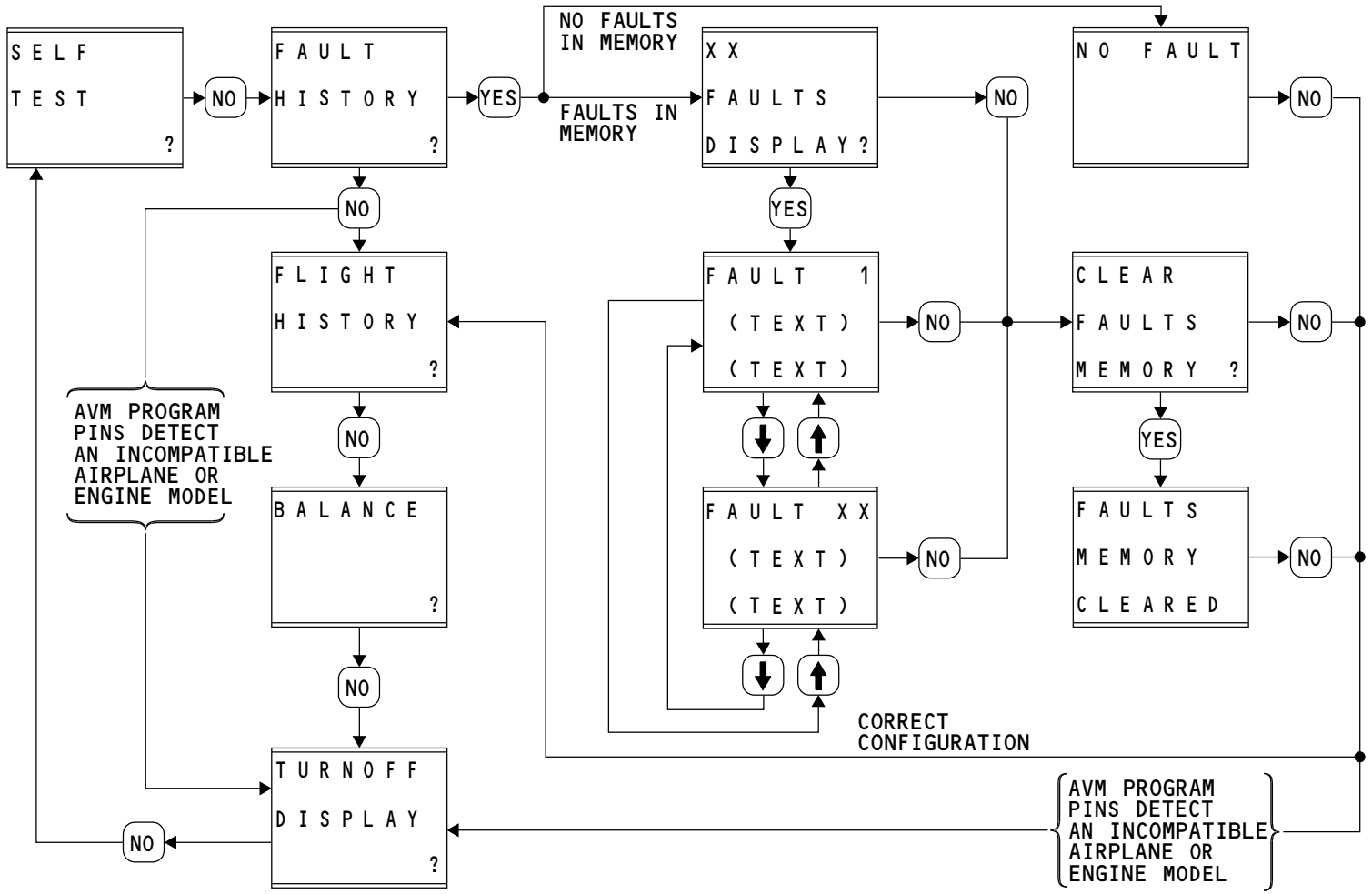


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**AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - FAULT HISTORY - TRAINING INFORMATION POINT**


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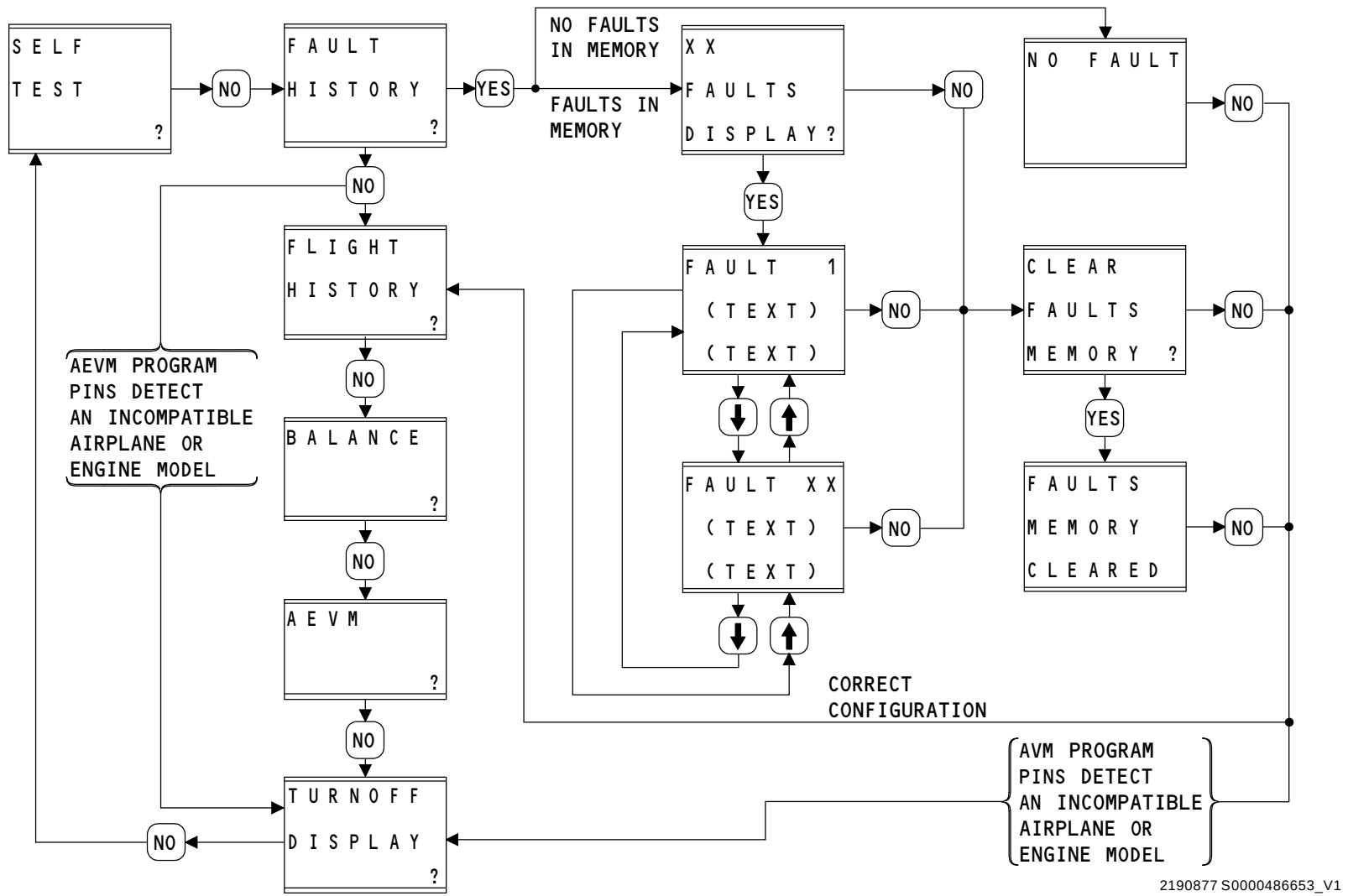


2190877 S0000486653_V1

**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - FAULT HISTORY - TRAINING**



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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - FLIGHT HISTORY PG 1 - TRAINING INFORMATION POINT

### General

You select YES at the FLIGHT HISTORY? item in the main menu to see vibration data for the last 32 flights (cycles) of each engine. The flight data is in AVM non-volatile memory. You use this main menu item to erase the flight data.

You select YES at the FLIGHT HISTORY? item in the main menu to see vibration data for the last 32 flights. The flight data is in AVM non-volatile memory. You use this main menu item to erase the flight data. When an incompatible airplane or engine type is detected the FLIGHT HISTORY and BALANCE menus will not show.

One of two displays show after you push the YES switch with FLIGHT HISTORY? on the display. The NO FLIGHT DATA message shows if there is no flight data in memory. Push the NO switch to return to the main menu.

The FLIGHTS DISPLAY? message shows if the AVM has vibration data in memory. The XX gives the number of flights for which data exists. You use the up arrow switch or the down arrow switch to go to a specific flight. Flight 0 (zero) is the last flight. Flight 31 is the oldest flight in memory. Push the YES switch to see the data for a specific flight. See FLIGHT HISTORY PG 2 for more information.

CLEAR FLIGHT MEMORY? shows after you push the NO switch from the XX FLIGHTS DISPLAY? or an individual flight display. Push the NO switch to return to the main menu and not erase the flight data from memory. Push the YES switch to erase the flight data from memory. FLIGHT MEMORY CLEARED shows after the data erases from non-volatile memory.


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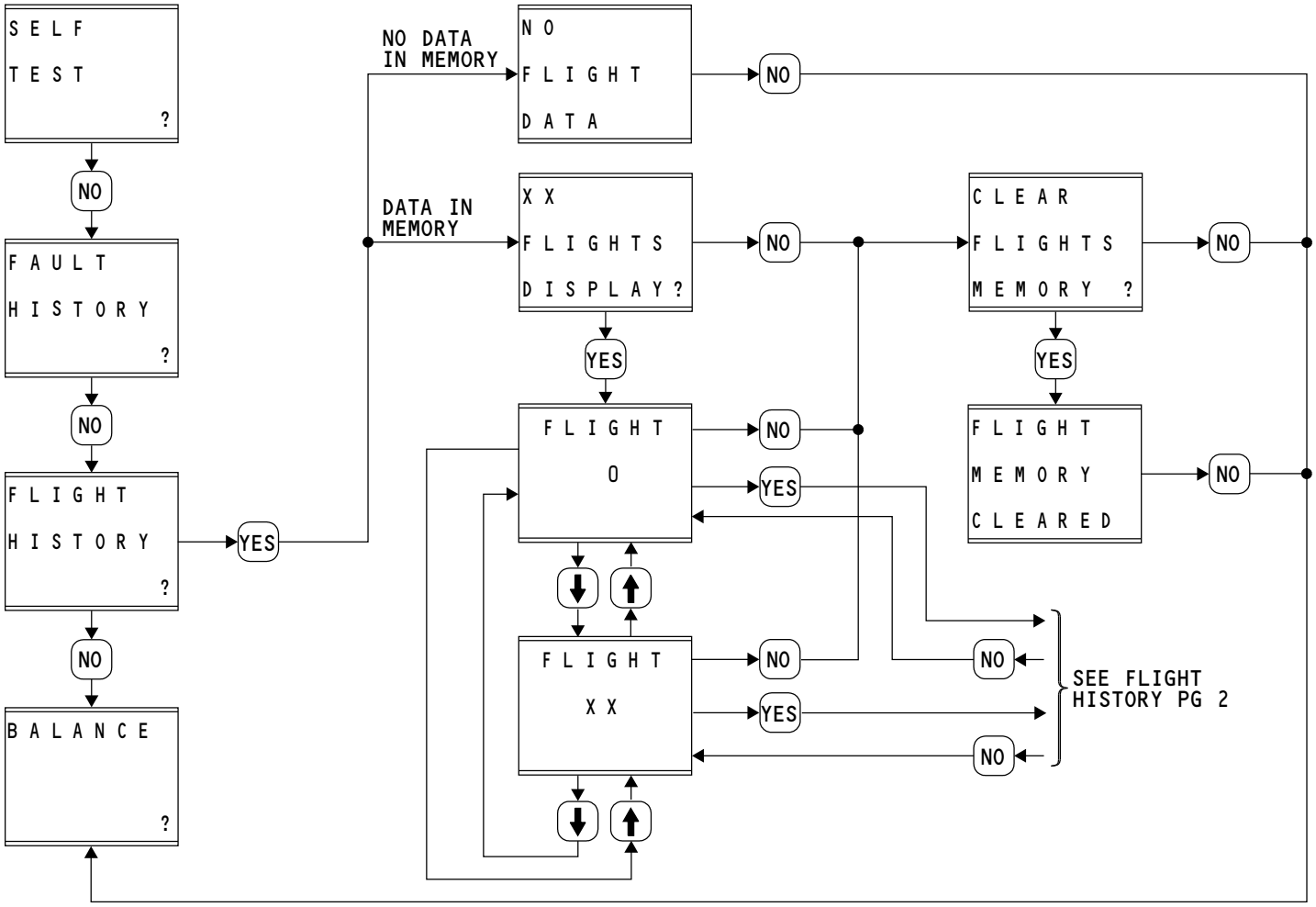


M88092 S0004632430_V1

**AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - FLIGHT HISTORY PG 1 - TRAINING INFORMATION POINT**


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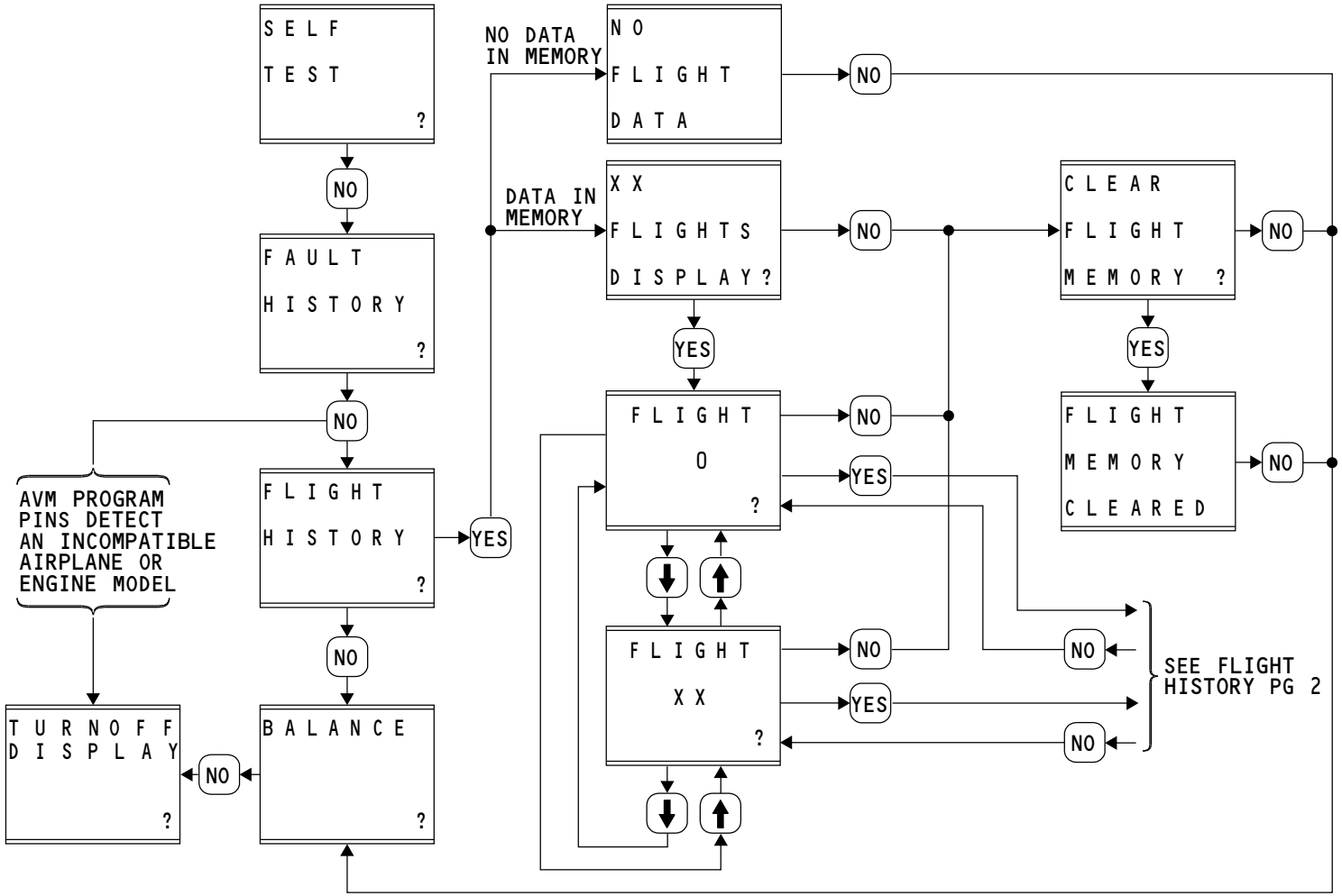


M88091 S0004632431_V1

**AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - FLIGHT HISTORY PG 1 - TRAINING INFORMATION POINT**


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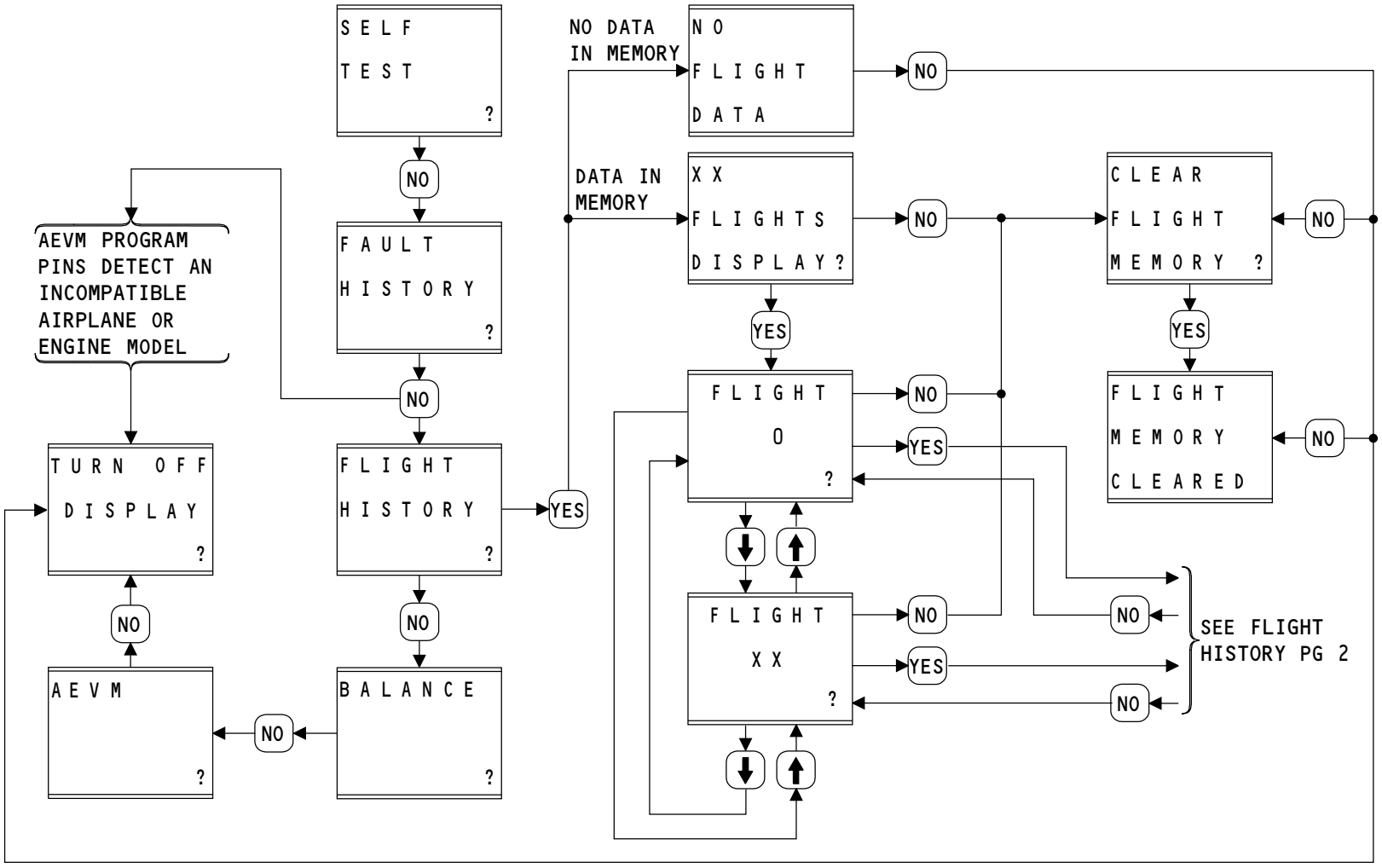


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**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - FLIGHT HISTORY PG 1 - TRAINING INFORMATION POINT**


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - FLIGHT HISTORY PG 2 - TRAINING INFORMATION POINT

**General**

Push the YES switch at the FLIGHT XX display to see vibration data for each engine for flight xx.

Data for engine number one shows first. The engine low pressure rotor speed (N1) and high pressure rotor speed (N2) show in percent. These values are a record of rotor speeds at the time the highest vibration was recorded in the flight.

Push the down arrow switch to see the maximum vibration levels for these areas of the engine:

- Fan
- High pressure compressor (HPC)
- High pressure turbine (HPT).

The vibration levels show in scalar units. These are the same units as vibration shows on the common display system (CDS).

Select the down arrow switch to see the highest vibration level of the low pressure turbine (LPT). The time when the highest overall vibration occurs shows on this display. The time shows in hours and is in reference to the start of the flight. See the AVM signal conditioner page for more information about conditions the signal conditioner uses to start and end a flight.

Push the NO switch from any of the engine 1 vibration displays to see engine 2 vibration data. The same type of vibration parameters show for engine 2. Push the NO switch from any of the engine 2 vibration displays to go back to the FLIGHT XX display in the flight history menu. See the previous page, FLIGHT HISTORY PG 1 for more information.

**General**

Push the YES switch at the FLIGHT XX display to see vibration data for each engine for flight xx.

Data for engine 1 shows first. FXX is the flight number. The highest vibration for N1 (FAN) and N2 (HPC) show in scalar units. N.NN is the vibration from accelerometer B.

Push the down arrow switch to see the rotor speeds and time that the highest vibration was recorded in flight. The time when the highest overall vibration occurs shows on this display. The time shows in hours and is in reference to the start of the flight. See the AVM signal conditioner page for more information about conditions the signal conditioner uses to start and end a flight.

Push the down arrow switch to see accelerometer A data. The highest vibration shows as N.NN for N1 (LPT) and N2 (HPT) in scalar units. Push the down arrow switch to see the rotor speeds and time.


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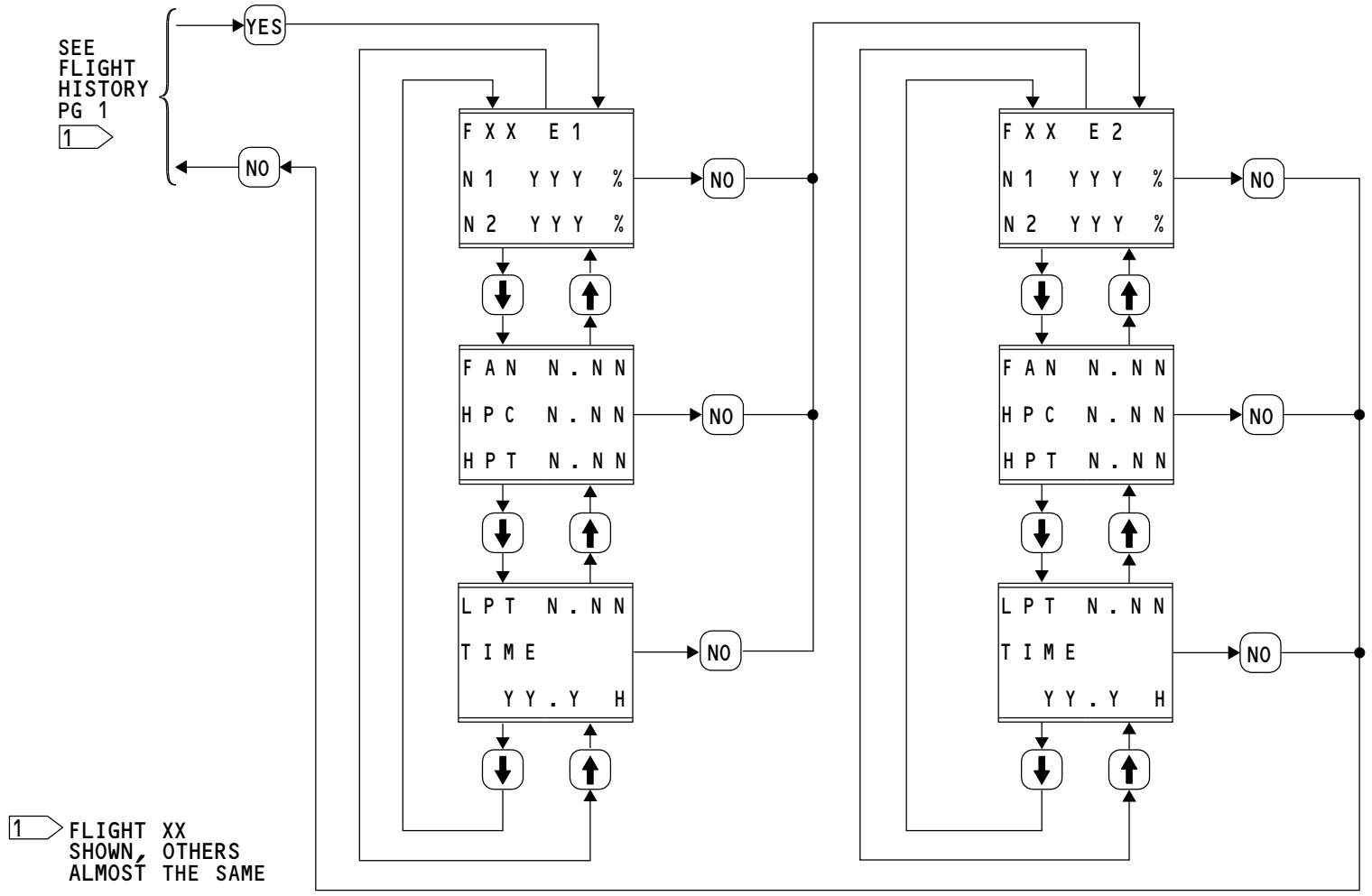


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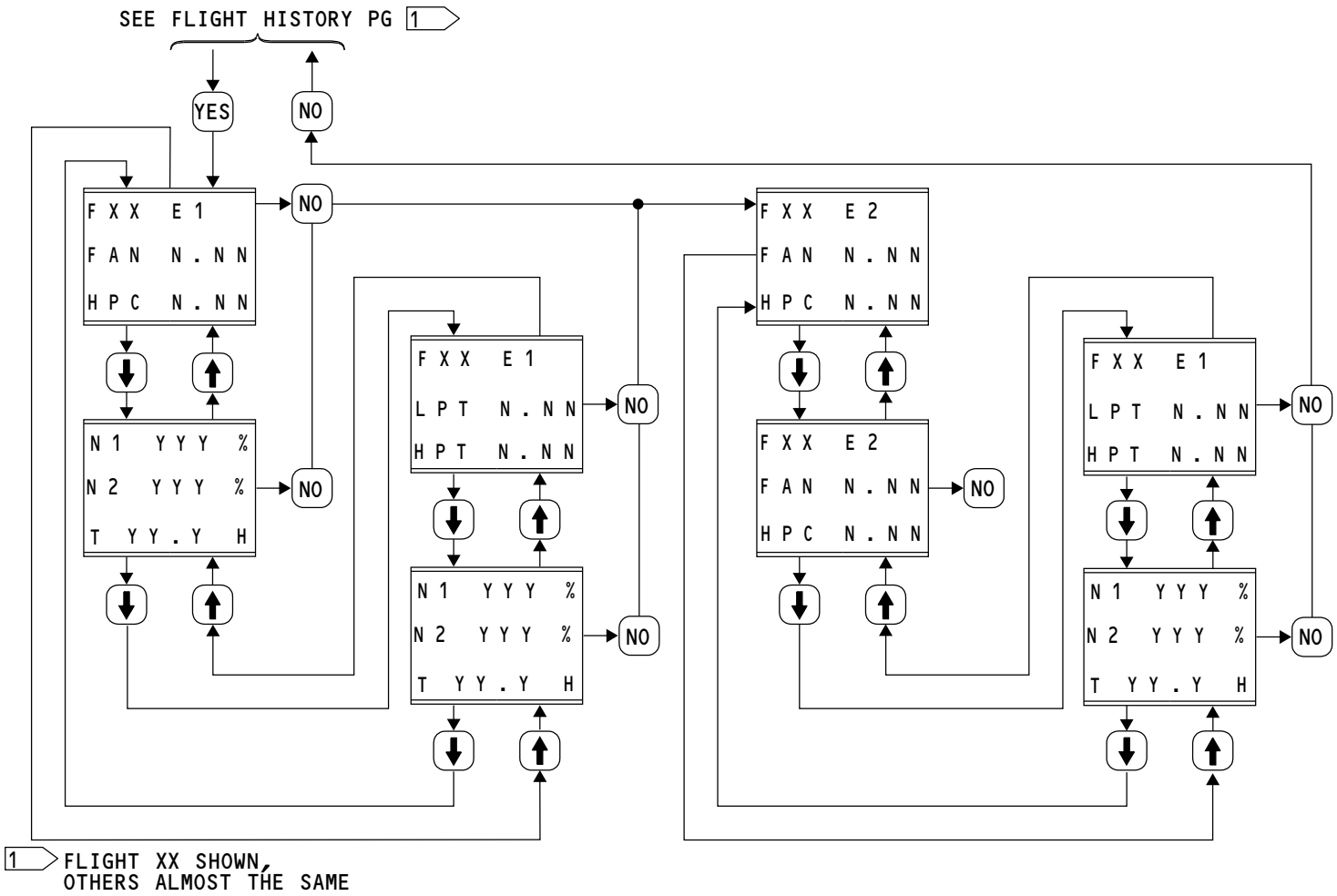


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 1 - TRAINING INFORMATION POINT

### General

Push the YES switch at the BALANCE? display in the main menu to get access to the balance menu.

Push the YES switch at the BALANCE? display in the main menu to get access to the balance menu. Push the NO switch to go to the next main menu, TURN OFF DISPLAY?

When the YES switch is pushed at the BALANCE? display the first display is BALANCE ENGINE 1?. Push the YES switch to get the balance menu for engine 1. Push the No switch at this display to show the balance information for engine 2.

The first display, BOEING GENERIC: BXX is a record of the group of coefficients that the AVM uses in the calculation of vibration data. The XX shows as a number between zero and 99. This display may also show as AIRLINE GENERIC: AXX. You do not change this information on the line.

Push the YES switch, from the BALANCE ENGINE 1? display to go to the IMBAL. DATA READ? option. This option lets you see vibration data for the last six flights. The only vibration data that shows for each engine is the fan and low pressure turbine. The AVM signal conditioner uses the data from one of these flights for the balance calculations. See BALANCE PG 2 for more information.

Push any of the BITE switches to go to the balance menu for engine 1. Push the NO switch to get to the balance menu for engine 2.

You push the YES switch, from the engine balance X display to go to the IMBAL DATA READ? option. This option lets you see vibration data for the last six flights (cycles) of each engine. Only vibration data for each engine fan and low pressure turbine shows. The AVM signal conditioner uses the data from one of these flights for the balance calculations. See BALANCE PG 2 for more information.

Use the HOLE CONFIG.? option to review or change engine balance weight data in AVM non-volatile memory. See BALANCE PG 3 for more information.

Use the WEIGHTS CONFIG.? option to review or change engine balance weight data in AVM non-volatile memory. See BALANCE PG 3 for more information.

Use the BALANCE 1 PLANE COMPUTE? option to have the AVM signal conditioner supply a balance solution for the engine fan. See BALANCE PG 4 for more information.

Use the BALANCE 2 PLANES COMPUTE? option to have the AVM signal conditioner supply balance solutions for the fan and the low pressure turbine (LPT) sections. See BALANCE PG 5 for more information.

### Training Information Point

Although the 2 plane balance is a function of the AVM signal conditioner, it is not an approved maintenance procedure for the CFM56-7 engine. Refer to AMMII 71-00-00.


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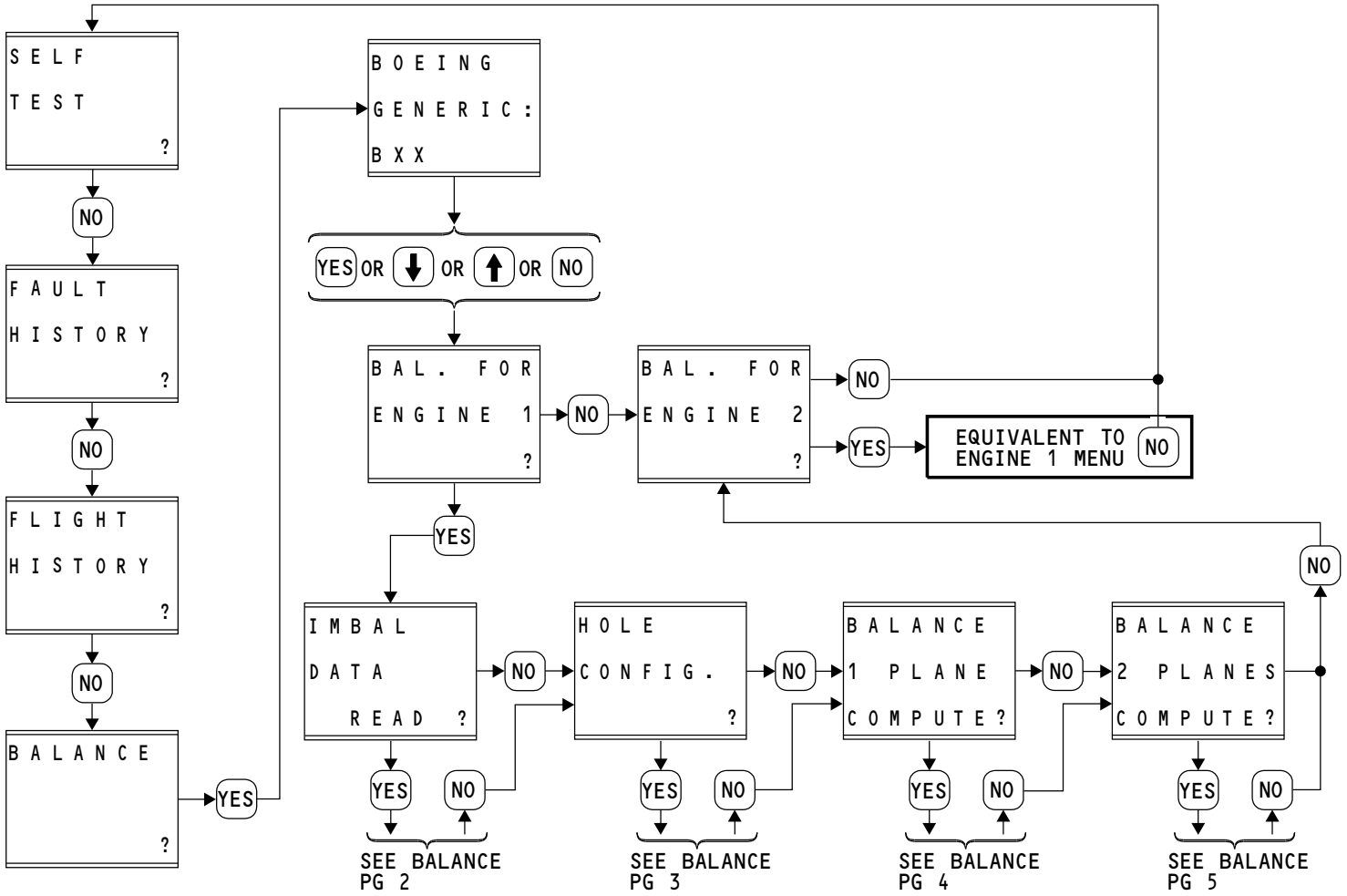


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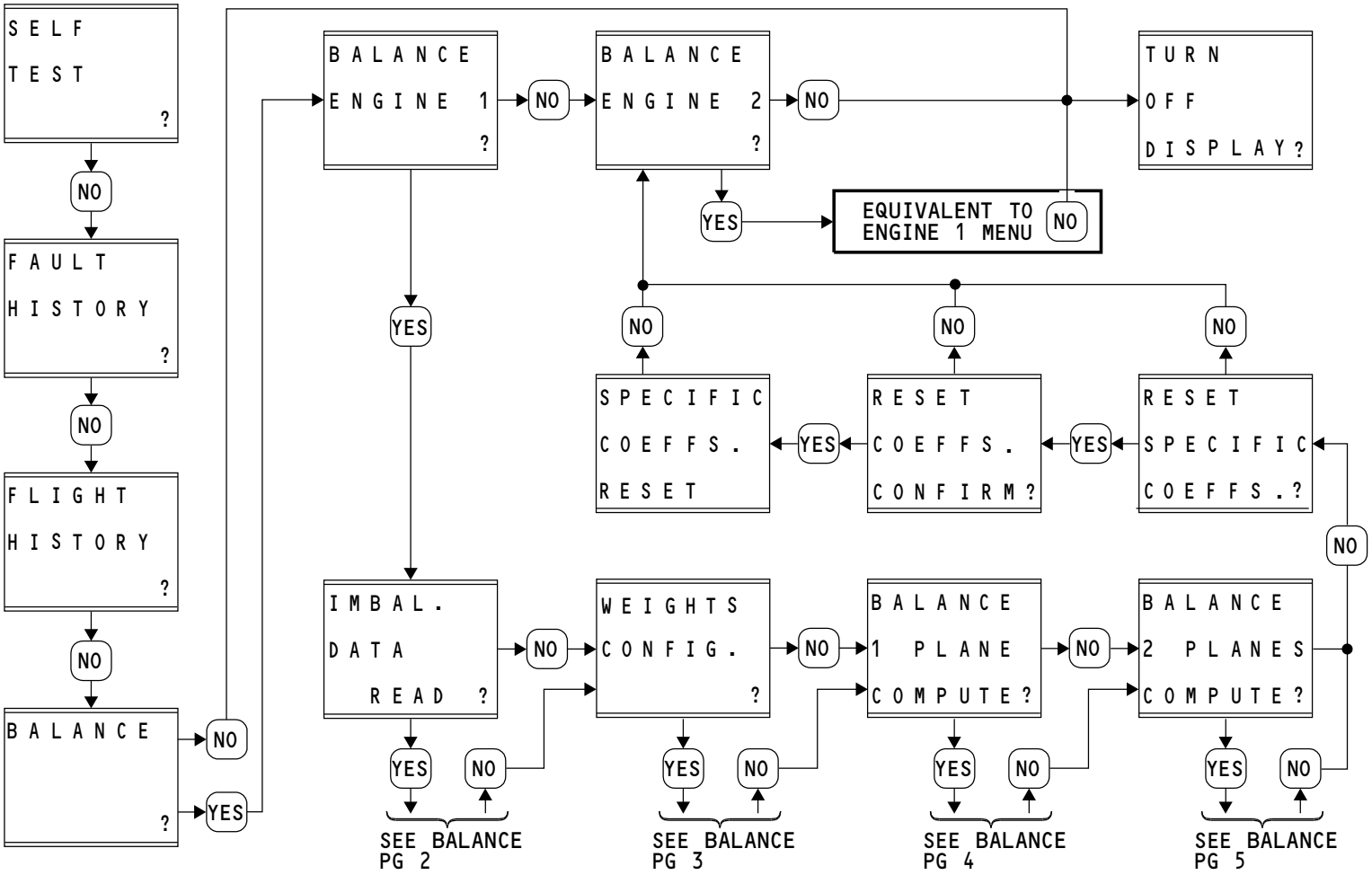


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 2 - TRAINING INFORMATION POINT

### General

Push the YES switch, from the BAL. FOR ENGINE X display to go to the IMBAL DATA READ? option. This option lets you see fan and low pressure turbine (LPT) vibration data for the last six flights (cycles) of the engine. The last flight is FLIGHT 0. The oldest flight is FLIGHT 5. Push the YES switch to see the data for the flight. NO IMBAL DATA shows if the non-volatile memory does not have any flight data.

The AVM signal conditioner makes a record of each engine highest vibration in six different N1 speed ranges. The N1 speed must be maintained for 5 seconds within the range for the AVM signal conditioner to record the vibration.

XX.X is the N1 speed at the highest vibration during the time the engine operated in the specific N1 range. N.NN is the fan displacement in mils (double amplitude). YYY is the phase angle (degrees) for the fan. M.MM is the LPT displacement in mils (double amplitude). ZZZ is the phase angle (degrees) for the LPT.

Use the up arrow switch and the down arrow switch to see the data for each range of N1. You push the NO switch to go to the HOLE CONFIG? display.

Use the up arrow switch and the down arrow switch to see the data for each range of N1. Push the NO switch to go to the WEIGHTS CONFIG? display.


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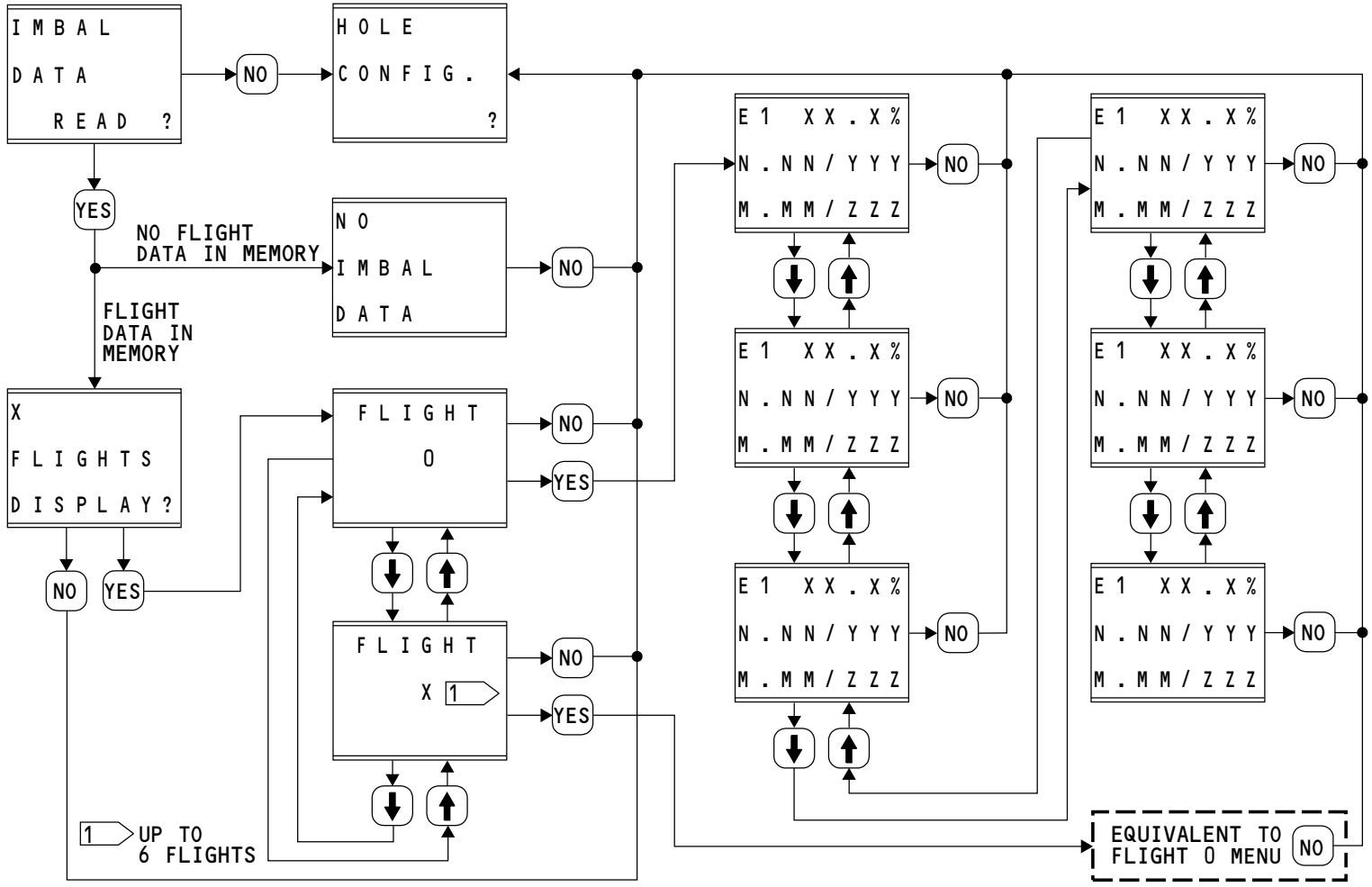


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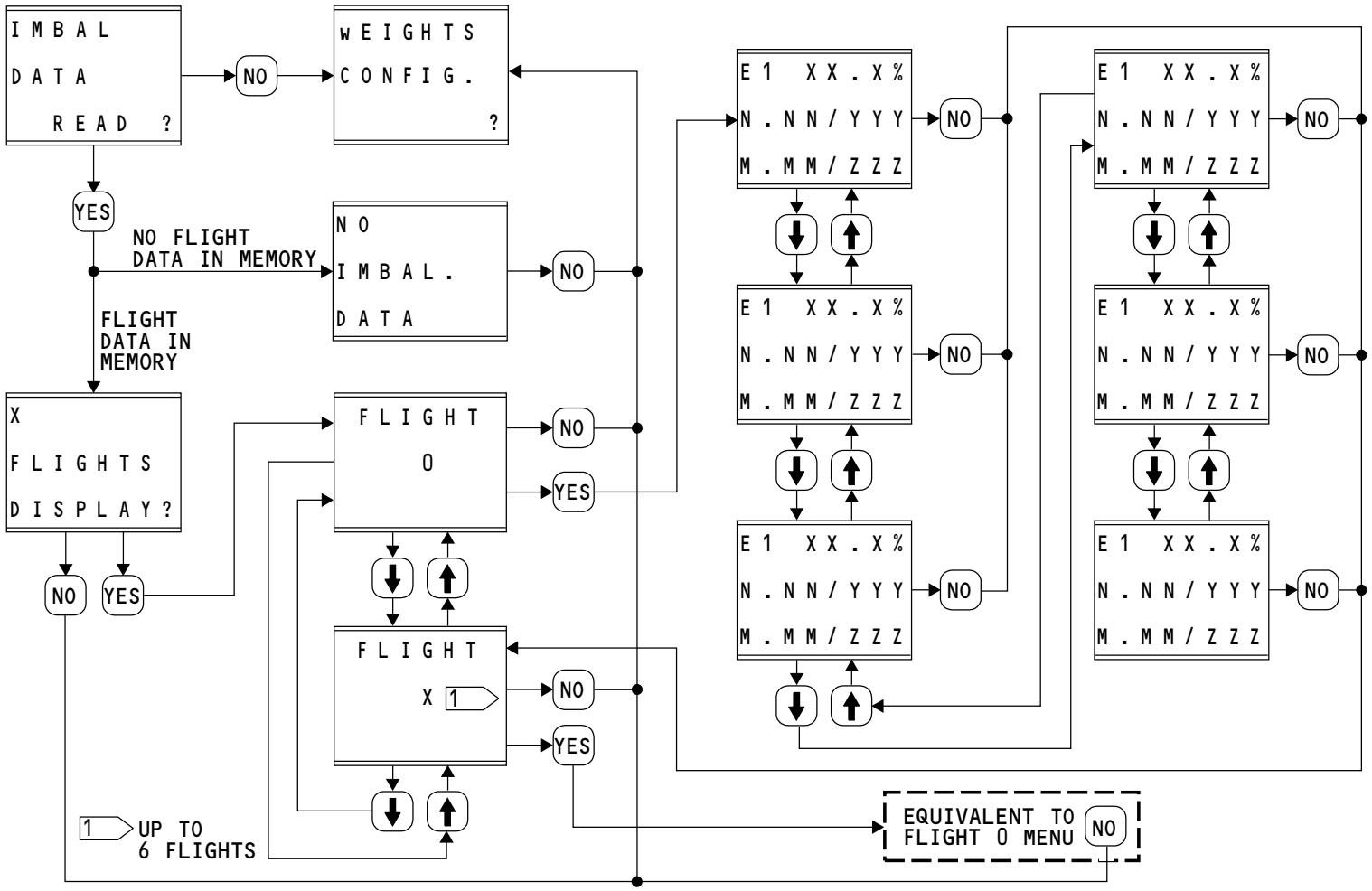


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 3 - TRAINING INFORMATION POINT

### General

Push the YES switch, from the HOLE CONFIG.? display to see or change (modify) balance weight data in the AVM signal conditioner memory. It is very important that you make sure the fan balance weight data (POX and location) in the AVM signal conditioner memory match the actual balance screws and positions on the engine. The AVM balance solution will not be accurate if the balance weight data does not agree.

Push the YES switch, from the WEIGHTS CONFIG.? display to see or change (modify) balance weight data in the AVM signal conditioner memory. It is very important that you make sure the fan balance weight data (XXXX and location) in the AVM signal conditioner memory match the actual balance screws and positions on the engine. The AVM balance solution will not be accurate if the balance weight data does not agree.

Push the YES switch from the READ CONFIG DATA? menu to see engine locations that the AVM signal conditioner believes has balance screws with a classification that are different than P07. The P07 balance screw is the initial balance screw.

Push the YES switch from the READ ACTUAL CONFIG.? menu to see locations at the engine that the AVM signal conditioner believes has balance screws with a classification that are different than P14. The initial balance screw is P14. Balance screws PO8 through P13 are measured by moment weight result. The moment weight result is the weight of each screw minus the moment weight of screw P14. If there is no weight in any location of the engine, the AVM shows the message, ALL LOC. ARE P14.

Then push the NO switch to go to the RESET ACTUAL CONFIG? menu. Push the YES switch to reset all of the balance weight data at all locations for that engine in AVM memory. A message will ask you if really want to reset the data in AVM memory. The initial balance screw is P07. Balance screws PO1 through P06 are measured by moment weight result. The moment weight result is the weight of each screw minus the moment weight of screw P07.

Push the NO switch to go to the RESET ACTUAL CONFIG? menu. Push the YES switch to reset the balance weight data at all locations for that engine in AVM memory. The next display shows SAVE NEW CONFIG?. To save the reset configuration, push the YES switch. To keep the old configuration, push the NO switch.

Use the MODIFY ACTUAL CONFIG.? menu to change individual balance weight data in AVM memory. Use up arrow switch and down arrow switch to change the weight classification (P01-P07) of the balance screw at the position. The AVM asks you if you are sure that you want to change the data in memory. Push the YES switch to save the change.

Use the MODIFY ACTUAL CONFIG.? menu to change individual balance weight data in AVM memory. Use the up arrow switch and down arrow switch to change the weight classification (P08-P14) of the balance screw at the position. The AVM asks you if you are sure that you want to change the data in memory. Push the YES switch to save the change.

### Training Information Point

Initial balance screw PO7 has a moment weight result of 0.0 gram-centimeter.

Initial balance screw P14 has a moment weight result of 0.0 gram-centimeter.



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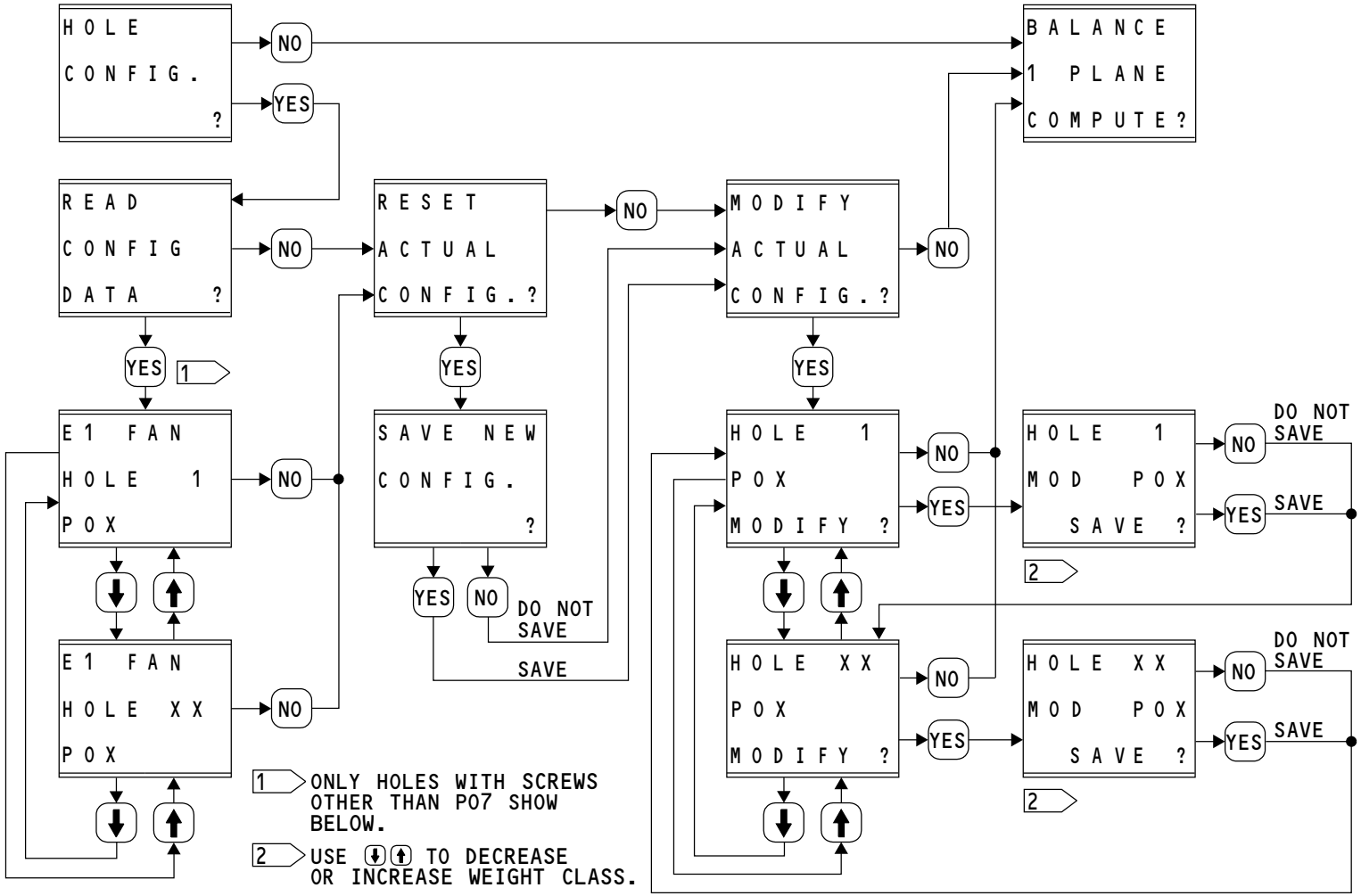


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**AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 3 - TRAINING INFORMATION POINT**


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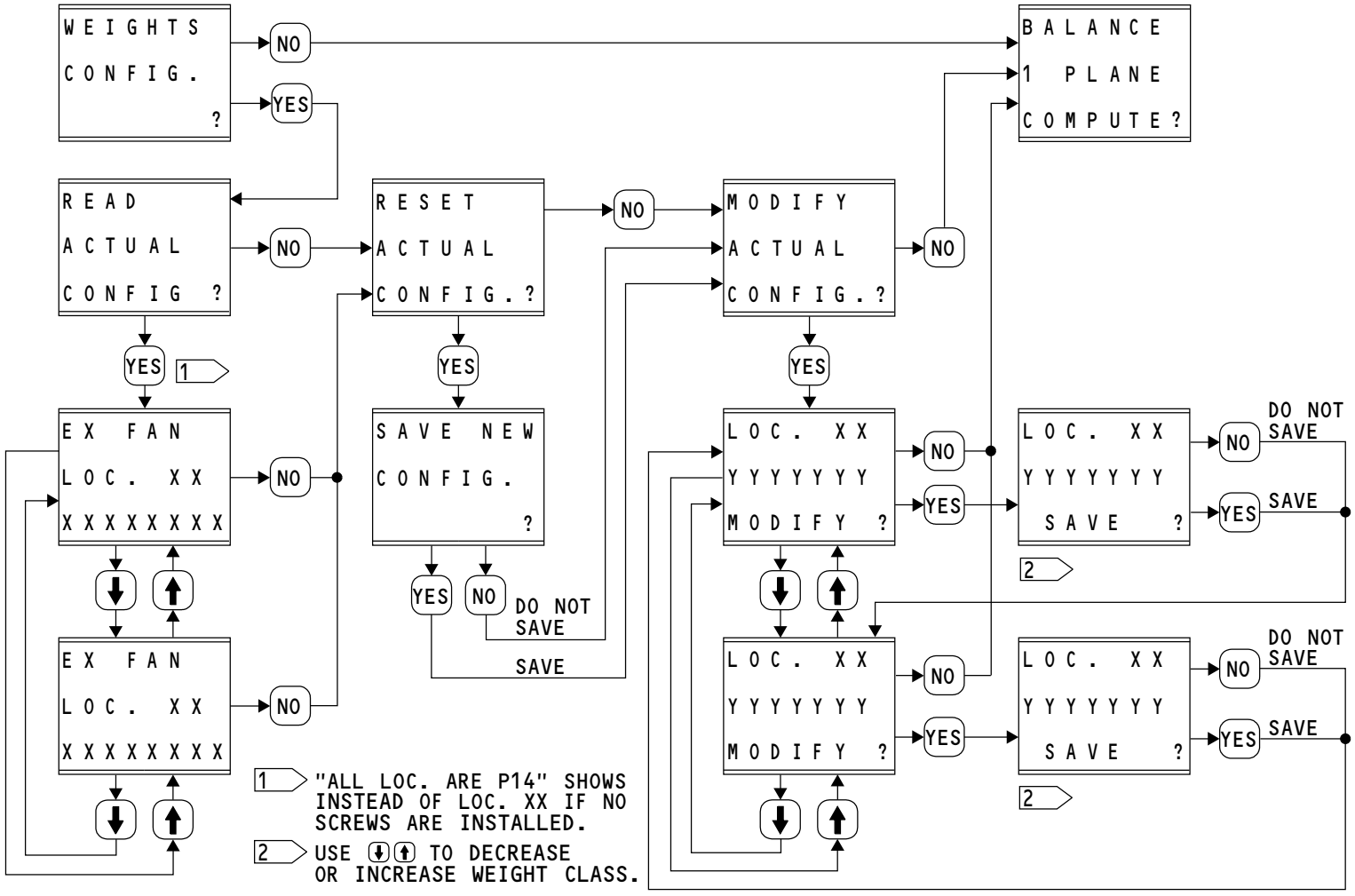


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**AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 3 - TRAINING INFORMATION POINT**


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 4 - TRAINING INFORMATION POINT

### General

Push the YES switch, from the BALANCE 1 PLANE COMPUTE? display to see the AVM signal conditioner supply a balance solution for the engine fan.

The X FLIGHTS DISPLAY? message shows if the AVM has flight history vibration data in memory. X is the total number of flights with vibration data that you may choose from to use in the balance function. The maximum number of flights to choose from is 6. Remember, you can look at the data of each individual flight in the IMBAL DATA READ? menu. See BALANCE PG 2 for more information.

Push the YES switch from the X FLIGHTS DISPLAY? message to go to the next display. This display shows information for flight zero (the last flight) in history. NNNN is the module vector of the fan in gram-centimeters. YYY is the phase of the fan vibration vector in degrees. MMMM is the module of the LPT vector in gram-centimeters. ZZZ is the phase of the LPT vibration vector in degrees. F0 tells you that this data is for flight zero. You push the down arrow switch to go to flight 1 data. You must select one flight (set of data) for the AVM signal conditioner to use in its calculation of the balance solution. Push the YES switch to select that flight. The BALANCE IN PROGRESS message shows during the balance calculations.

The SOLUTION FOUND DISPLAY? message tells you that the calculations are done. Three other messages are also possible. These are the messages that can show:

- NO CHANGE REQUIRED
- WEIGHT LIMIT EXCEEDED
- NO IMBAL DATA ACQUIRED.

Push YES from the SOLUTION FOUND DISPLAY? message to see the solutions. The balance screws you should remove and install shows for locations that require a change.

Push YES to save the new data in AVM memory only if you plan to follow the solution and remove and install appropriate balance screws. This makes sure that the balance weight data (weight classification and location) in AVM non-volatile memory agrees with the actual engine.

### Training Information Point

Although the 2 plane balance is a function of the AVM signal conditioner, it is not an approved maintenance procedure for the CFM56-7 engine. Refer to AMMII 71-00-00.

### General

Push the YES switch, from the BALANCE 1 PLANE COMPUTE? display to see the AVM signal conditioner supply a balance solution for the engine fan. There are two types of coefficient sets (multipliers), generic and specific. The generic coefficients are used by the AVM to calculate a balance solution. Specific coefficients are installed by the AVM manufacturer when necessary.

The first message that shows is XXXXXXXX GENERIC COEFFS. ?. Where X is the eight-character coefficient set identification number shows.

If no coefficients are recognized by the AVM, the identification number shows as "---------".

When you push the NO switch from the generic coefficients menu, the XXXXXXXX SPECIFIC COEFFS. ? message shows. Where X is the eight-character coefficient set identification number shows. You can reset the specific coefficients when they are no longer needed.

The COMPUTE IN PROGRESS MESSAGE shows when you push the YES switch from the XXXXXXXX GENERIC COEFFS. display. The X FLIGHTS DISPLAY ? message shows if the AVM has flight history vibration data in memory. X is the total number of flights with vibration data that you may choose from to use in the balance function. The maximum number of flights to choose from is 6. The NO BALANCE DATA message shows if there is no vibration data stored.



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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 4 - TRAINING INFORMATION POINT

Push the YES switch from the X FLIGHTS DISPLAY? message to go to the next display. This display shows information for flight zero (the last flight) in history. NNNN is fan balance weight solution in gram-centimeters. YYY is fan balance weight position in degrees. X/6 is the number of speed ranges with valid data (0 to 6). FX is the flight number (0 to 5). Push the down arrow switch to go to flight 1 data. You must select one flight (set of data) for the AVM signal conditioner to use in its calculation of the balance solution. Push the YES switch to select that flight. The BALANCE IN PROGRESS message shows during the balance calculations.

When the AVM balance calculation is complete, one of these messages show:

- SOLUTION FOUND DISPLAY?
- NO BAL. DATA ACQUIRED
- WEIGHT LIMIT EXCEEDED
- NO SOLUTION FOUND
- NO CHANGE REQUIRED.

Push YES from the SOLUTION FOUND DISPLAY? message to see the solutions. The balance screws you should remove or install shows for locations that require a change.

The DISPLAY SOLUTION AGAIN ? message shows after the last necessary change. Push the YES switch to see the balance solutions again. Push the No switch to go to the SAVE NEW CONFIG. ? menu.

Push YES to save the new data in AVM memory only if you plan to follow the solution and remove and install the appropriate balance screws. This makes sure that the balance weight data (weight classification and location) in AVM non-volatile memory agrees with the actual engine. If the new weight configuration is saved, the imbalance data for the last six flights will be cleared.


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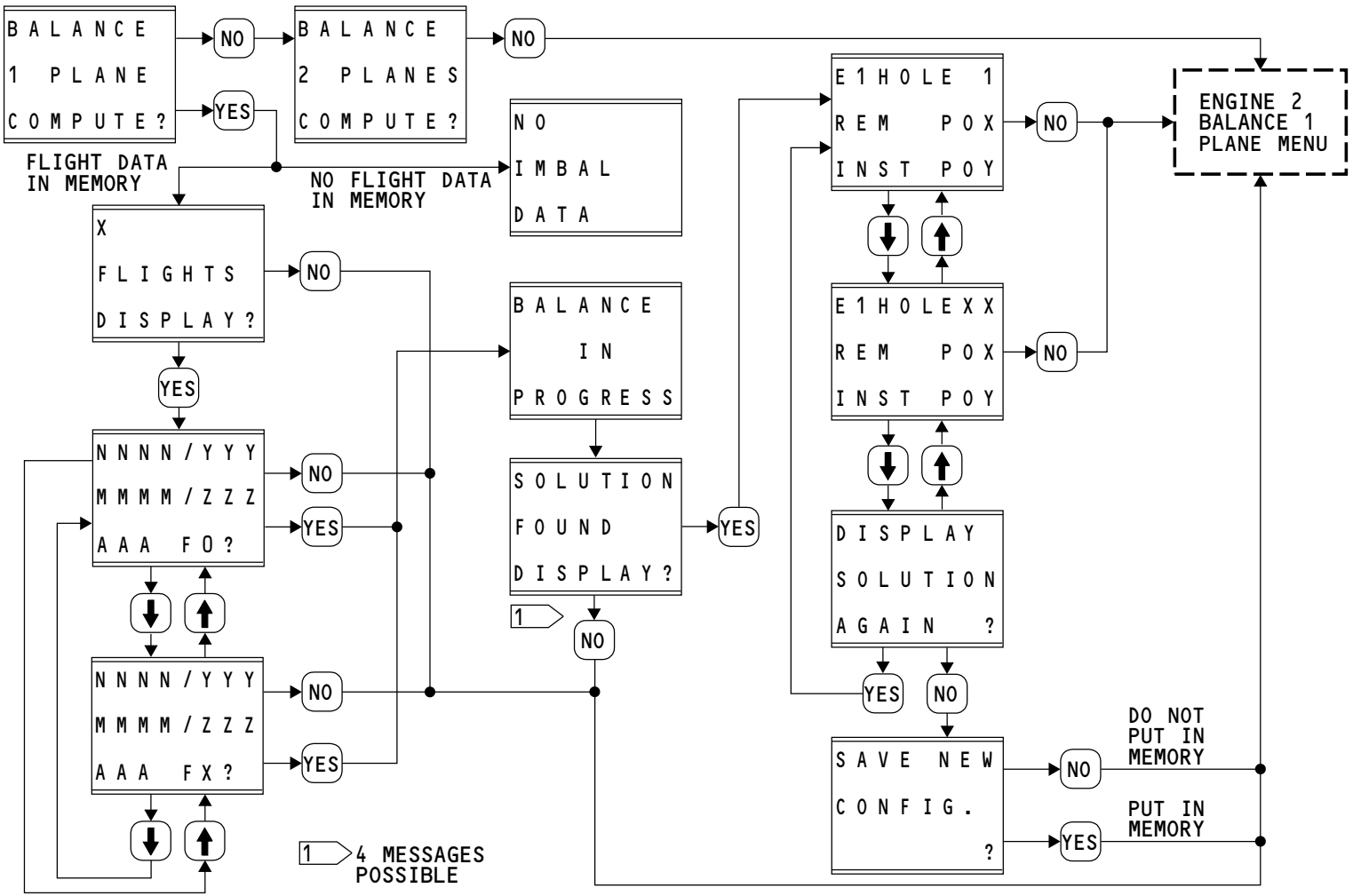


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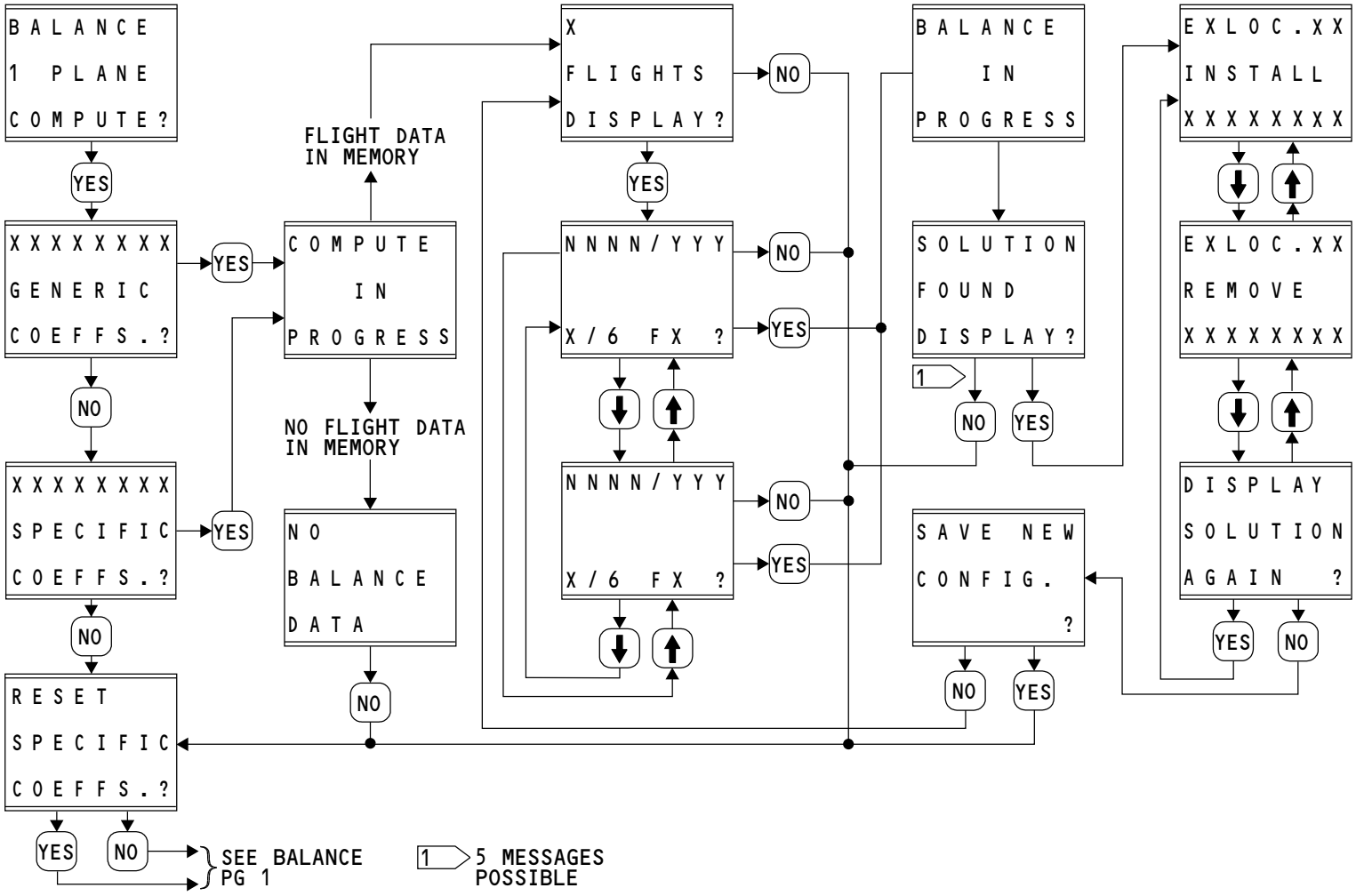


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**AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 4 - TRAINING INFORMATION POINT**


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## AVM SYSTEM - AVM SIGNAL CONDITIONER BITE - BALANCE PG 5 - TRAINING INFORMATION POINT

### General

Push the YES switch from the BALANCE 2 PLANE COMPUTE? display to have the AVM signal conditioner supply a balance solution for the engine fan and low pressure turbine (LPT).

The X FLIGHTS DISPLAY? message shows if the AVM has flight history vibration data in memory. X is the total number of flights with vibration data that you may chose from to use in balance function. The maximum number of flights to chose from is 6. You can look at the data of each individual flight in the IMBAL DATA READ? menu. See BALANCE PG 2 for more information.

Push the YES switch from the X FLIGHTS DISPLAY? message to go to the next display. This display shows information for flight zero (the last flight) in history. NNNN is the module vector of the fan in gram-centimeters. YYY is the phase of the fan vibration vector in degrees. MMMM is the module of the LPT vector in gram-centimeters. ZZZ is the phase of the LPT vibration vector in degrees. F0 tells you that this data is for flight zero. Push the YES switch to go to flight 1 data. You must select one flight (set of data) for the AVM signal conditioner to use in its calculation of the balance solution. Push the YES switch to select that flight. The BALANCE IN PROGRESS message shows during the balance calculations.

The SOLUTION FOUND DISPLAY? message shows to tell you that the calculations are done. There are three other messages are also possible. These are the messages that can show:

- NO CHANGE REQUIRED
- WEIGHT LIMIT EXCEEDED
- NO IMBAL DATA ACQUIRED.

Push YES from the SOLUTION FOUND DISPLAY? message to see the fan solution. The balance screws that you should remove and install at specific locations show. The LPT balance data follows the fan balance data. For the LPT, the necessary screws to add and their locations show.

Push YES to save the new data in AVM memory if you plan to follow the solution and remove and install appropriate balance screws. This makes sure that the fan balance weight data (weight classification and location) in AVM non-volatile memory agrees with the actual engine. The AVM does not save LPT weight data.

### General

Push the YES switch from the BALANCE 2 PLANE COMPUTE? display to see the AVM signal conditioner supply a balance solution for the engine fan and low pressure turbine (LPT). There are two types of coefficient sets (multipliers), generic and specific. The generic coefficients are used by the AVM to calculate a balance solution. Specific coefficients are installed by the AVM manufacturer when necessary.

The first message that shows is XXXXXXXX GENERIC COEFFS. ?. Where X is, the eight character coefficient set identification number shows.

If no coefficients are recognized by the AVM, the identification number shows as "---------".

When you push the NO switch from the generic coefficients menu, the XXXXXXXX SPECIFIC COEFFS. ? message shows. Where X is, the eight-character coefficient set identification number shows. You can reset the specific coefficients when they are no longer needed.

The COMPUTE IN PROGRESS MESSAGE shows when you push the YES switch from the XXXXXXXX GENERIC COEFFS. display. The X FLIGHTS DISPLAY ? message shows if the AVM has flight history vibration data in memory. X is the total number of flights with vibration data that you may chose from to use in the balance function. The maximum number of flights to choose from is 6. The NO BALANCE DATA message shows if there is no vibration data stored.


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Push the YES switch from the X FLIGHTS DISPLAY? message to go to the next display. This display shows information for flight zero (the last flight) in history. NNNN is fan balance weight solution in gram-centimeters. YYY is fan balance weight position in degrees. MMMM is LPT balance weight solution in grams-centimeters. ZZZ is LPT balance weight position in degrees. X/6 is the number of speed ranges with valid data (0 to 6). FX is the flight number (0 to 5). Push the down arrow switch to go to flight 1 data. You must select one flight (set of data) for the AVM signal conditioner to use in its calculation of the balance solution. Push the YES switch to select that flight. The BALANCE IN PROGRESS message shows during the balance calculations.

When the AVM balance calculation is complete, one of these messages shows:

- SOLUTION FOUND DISPLAY?
- NO BAL. DATA ACQUIRED
- WEIGHT LIMIT EXCEEDED
- NO SOLUTION FOUND
- NO CHANGE REQUIRED.

Push YES from the SOLUTION FOUND DISPLAY? message to see the solutions. The balance screws (classification) you should remove or install shows for locations that require a change.

The DISPLAY SOLUTION AGAIN ? message shows after the last necessary change. Push the YES switch to see the balance solutions again. Push the No switch to display the SAVE NEW CONFIG. ? menu.

Push YES to save the new data in AVM memory only if you plan to follow the solution and remove and install appropriate balance screws. This makes sure that the balance weight data (weight classification and location) in AVM non-volatile memory agrees with the engine. If the new weight configuration is saved, the imbalance data for the last 6 flights will clear.

**Training Information Point**

Although the 2 plane balance is a function of the AVM signal conditioner, it is not an approved maintenance procedure for the CFM56-7 engine. Refer to AMMII 71-00-00.



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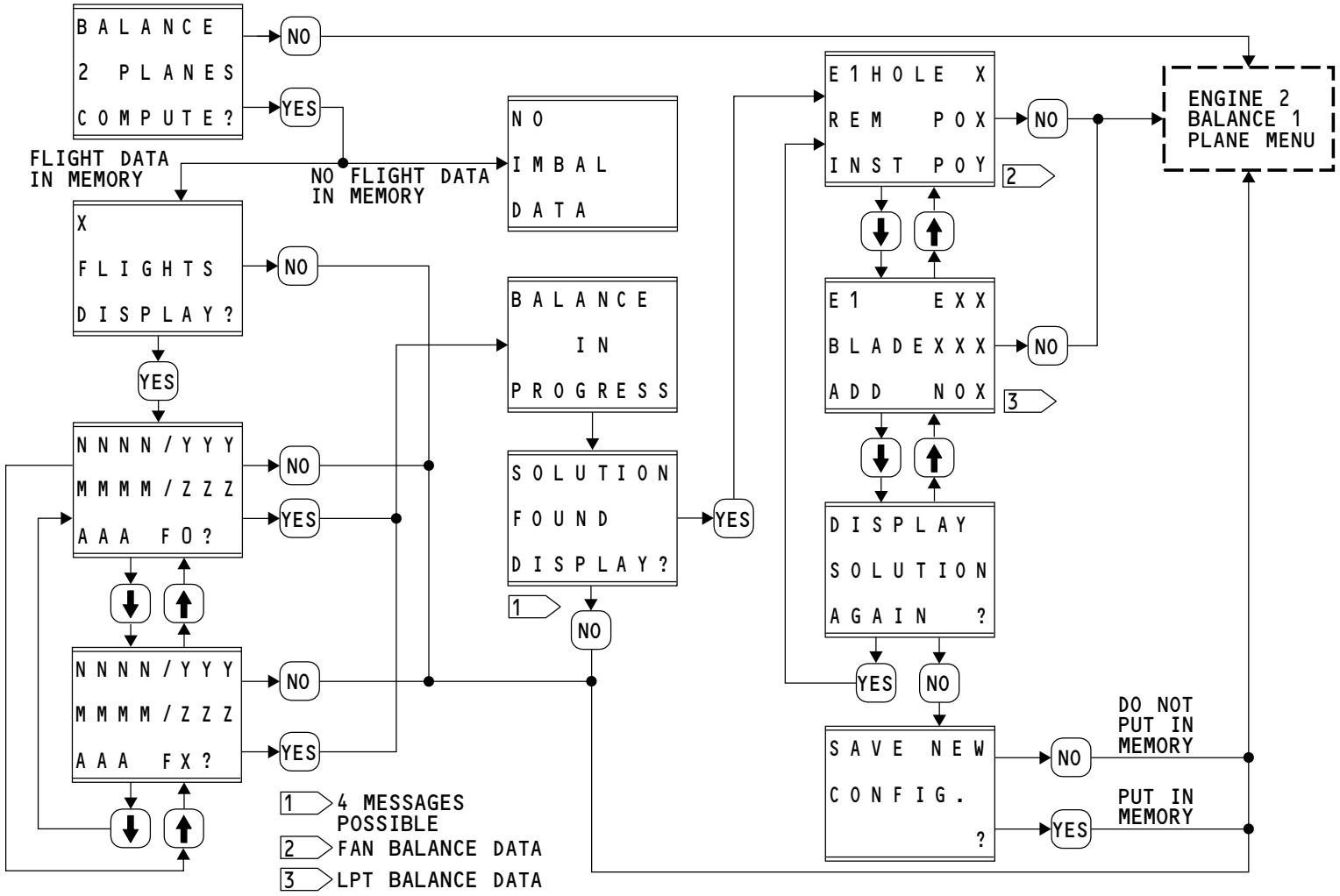


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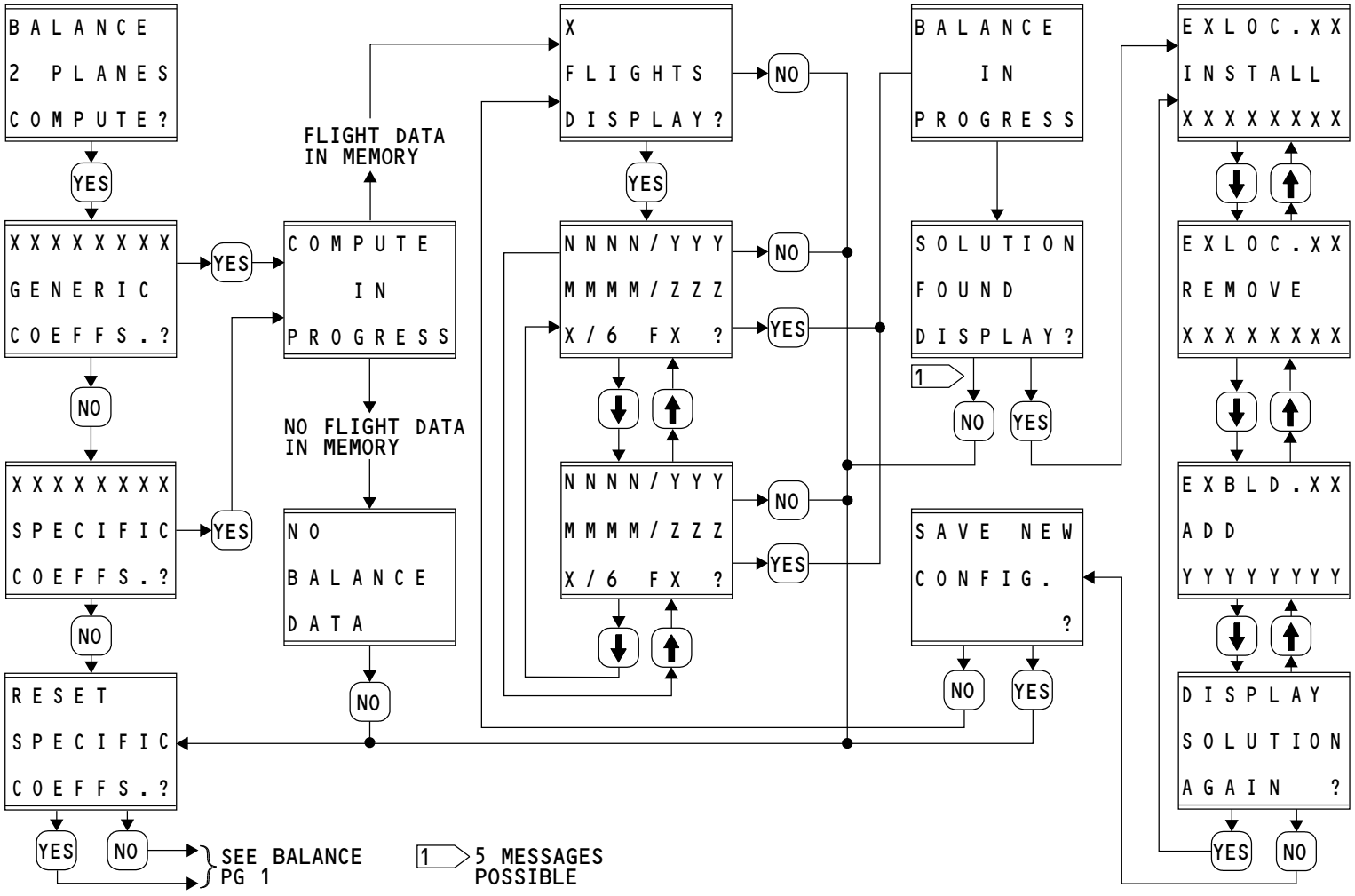


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## AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - AEVM MENU - TRAINING INFORMATION POINT

### General

The AEVM menu is the menu for the advanced function of the unit. The AEVM has these menus:

- AEVM MESSAGES
- CONFIG
- DATA
- ALTERN ACCEL WIRING.

Push the YES button at the AEVM? display in the main menu to go to the AEVM menu. Push the NO button to go to the TURN OFF DISPLAY? menu.

Use the AEVM MESSAGES? menu to display all bearing maintenance messages for the two engines in the non-volatile memory. See the AEVM MESSAGES - TIP page that follows in this section for more information on this part of the BITE menu.

Use the CONFIG? menu to review or change the AEVM software and configuration table in the AEVM non-volatile memory. See the CONFIG - TIP page that follows this section for more information on this part of the BITE menu.

Use the DATA? menu to review the flight number and total duration for each engine. See the DATA - TIP page that follows this section for more information on this part of the BITE menu.

Use the ALTERN ACCEL WIRING? menu selection to activate or deactivate the AEVM function which depends on the operation of vibration sensor for the #1 bearing. See the ALTERN ACCEL WIRING - TIP page that follows this section for more information on this part of the BITE menu.


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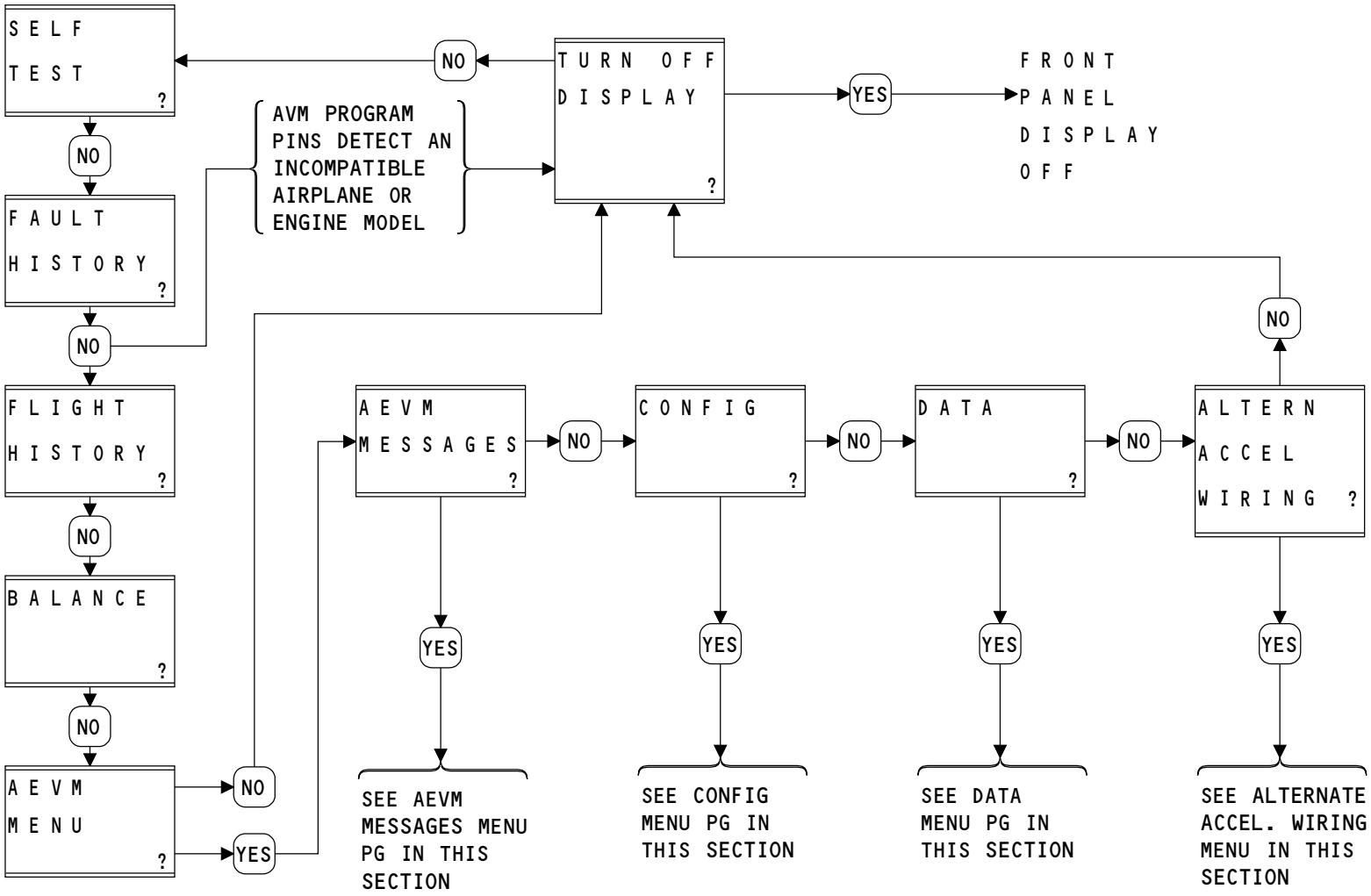


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**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - AEVM MENU - TRAINING INFORMATION POINT**



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## AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - AEVM MESSAGES - TRAINING INFORMATION POINT

### General

The AEVM MESSAGES? menu can show all of the maintenance messages stored in non-volatile memory for the bearings. Each maintenance message gives these data:

- The number of messages
- The name of the algorithm that found the defect and engine number
- The alarm level of the defect.

Push and release the YES button to see the AEVM messages. If there are no messages, the display will show NO MAINT MSG.

In the AEVM messages, the first line shows MSG 1/X and X is the number of messages. On the second line, the ALGO X is the name of the algorithm where X is 1, 2, or 3. EY is the engine number. E1 is engine number 1 and E2 is engine number 2. On the third line, Z is the bearing message level of 1, 2, or 3. LEVEL 1 is the most critical and LEVEL 3 is the least critical.



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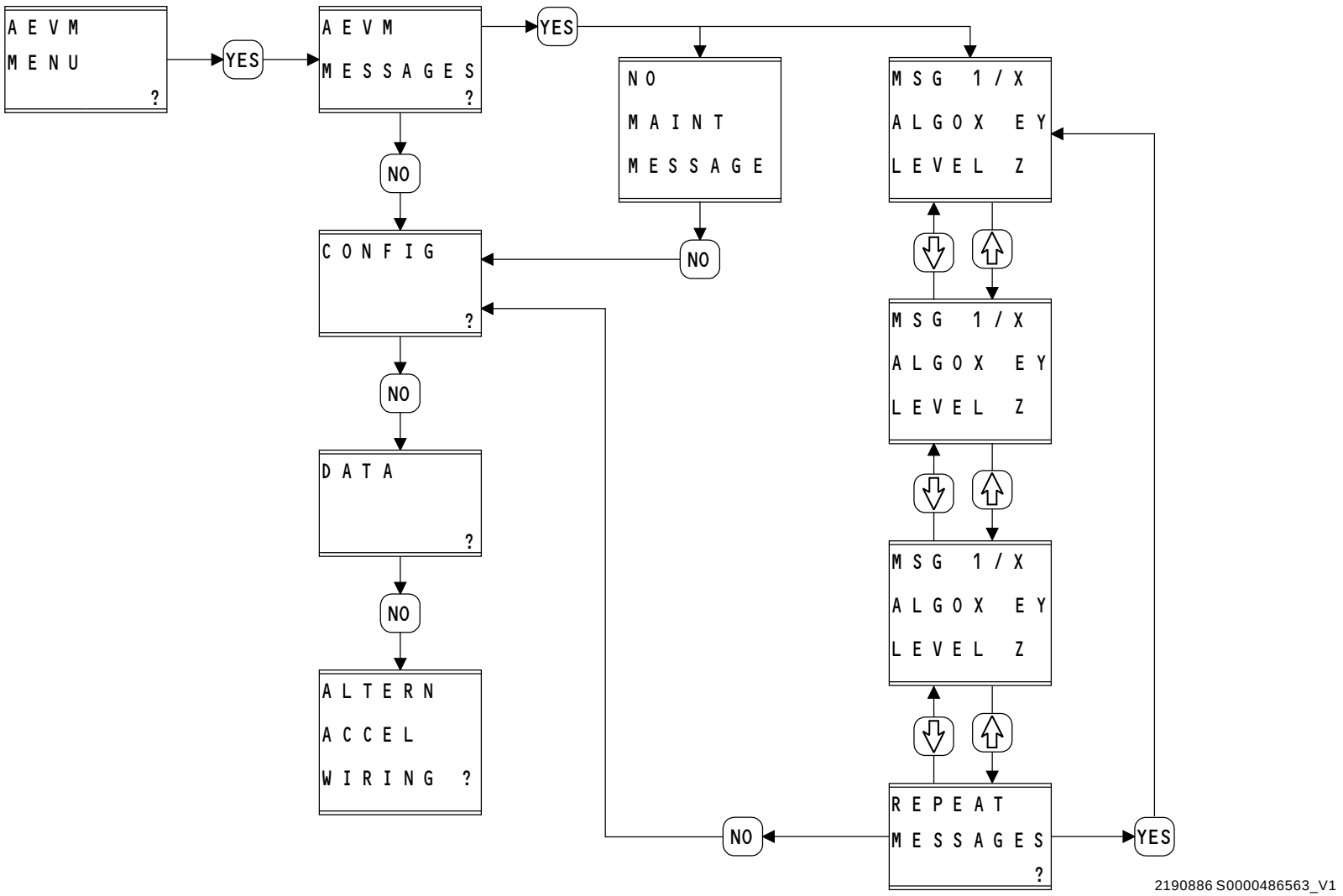


**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - AEVM MESSAGES - TRAINING INFORMATION POINT**


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## AVM SYSTEM - AEVM SIGNAL CONDITIONER - BITE - CONFIG - TRAINING INFORMATION POINT

### General

The CONFIG? menu will show the part numbers of the AEVM software and configuration table.

Push and release the YES button at the CONFIG? to see the configuration of the main software on the front display of the AEVM signal conditioner. Push the NO button to go to the DATA? menu.

MAIN SW 249-109-000-SSS is the part number of the main software, where SSS gives the software version. Push the down arrow button to see the configuration of the DPS software. Push the NO button to go to the DATA? menu.

DPS SW 249-110-000-SSS is the part number of the DPS software, where SSS gives the software version. Push the down arrow button to see the configuration of the DSP configuration table. Push the NO button to go to the DATA? menu.

CONF TBL 249-113-000-SSS is the part number of the DSP configuration table, where SSS gives the configuration table version. Push the down arrow button to see the main software configuration. Push the NO button to go to the DATA? menu.



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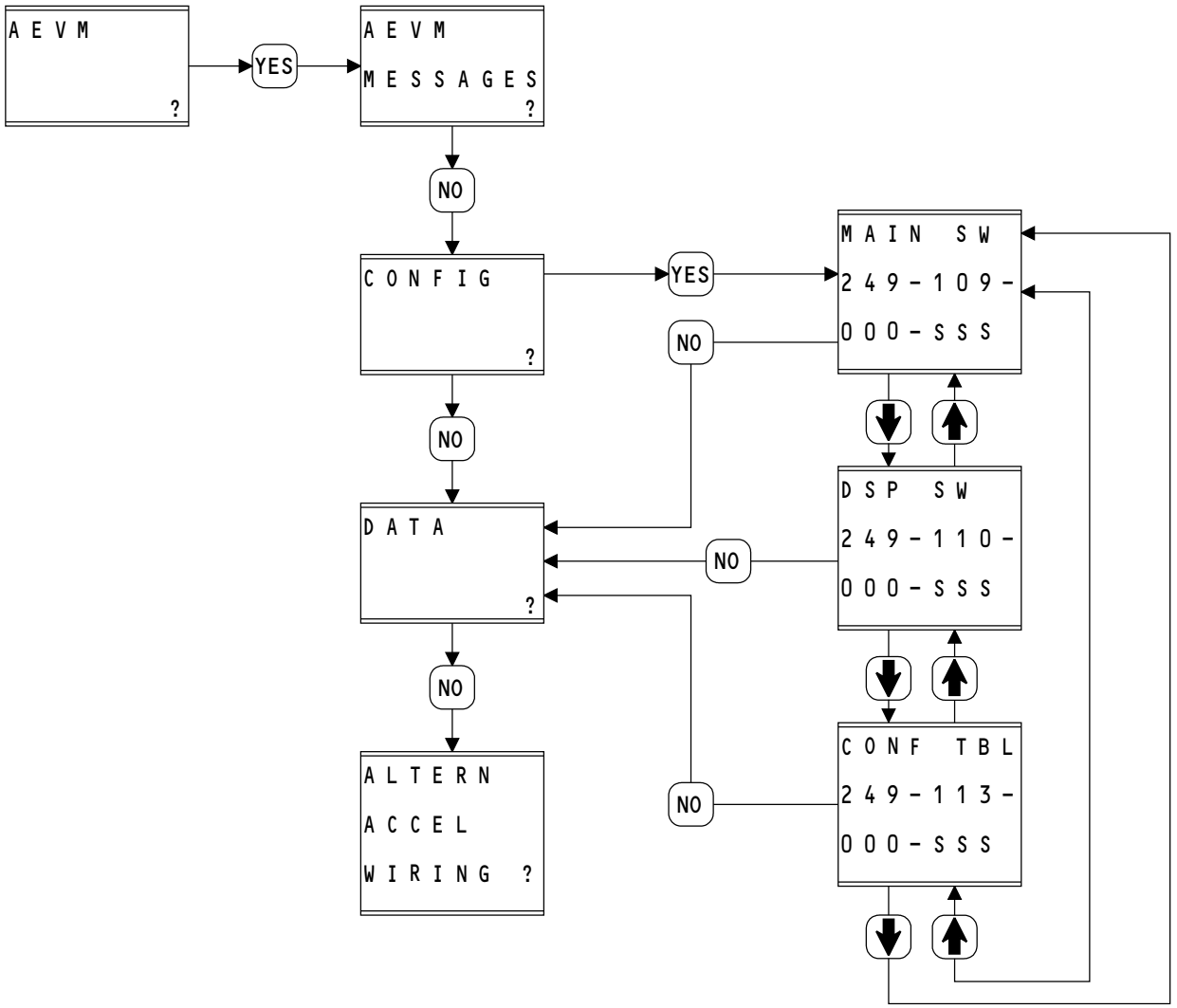


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**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - CONFIG - TRAINING INFORMATION POINT**


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## AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - DATA - TRAINING INFORMATION POINT

### General

The DATA? menu shows the flight number and the total flight duration for each engine. Push the YES button to see the data. Push the NO button to go to the ALTERN ACCEL WIRING? menu.

You can see these data:

- E1 FLIGHT - the number of flights for Engine 1
- E2 FLIGHT - the number of flights for Engine 2
- E1 DURATION - the total duration of all flights by Engine 1
- E2 DURATION - the total duration of all flights by Engine 2.

NBXXXXXX shows the total number of flights done since the last time that the data was erased.

hhhhh:MM shows the sum of the duration of all flights done since the last time that data was erased. The hhhhh are the hours and MM are the minutes.

NOTE: Use the Ground Support Software (GSS) to Erase the History of the AEVM. See the AMM II 77-31 for more information on the GSS.



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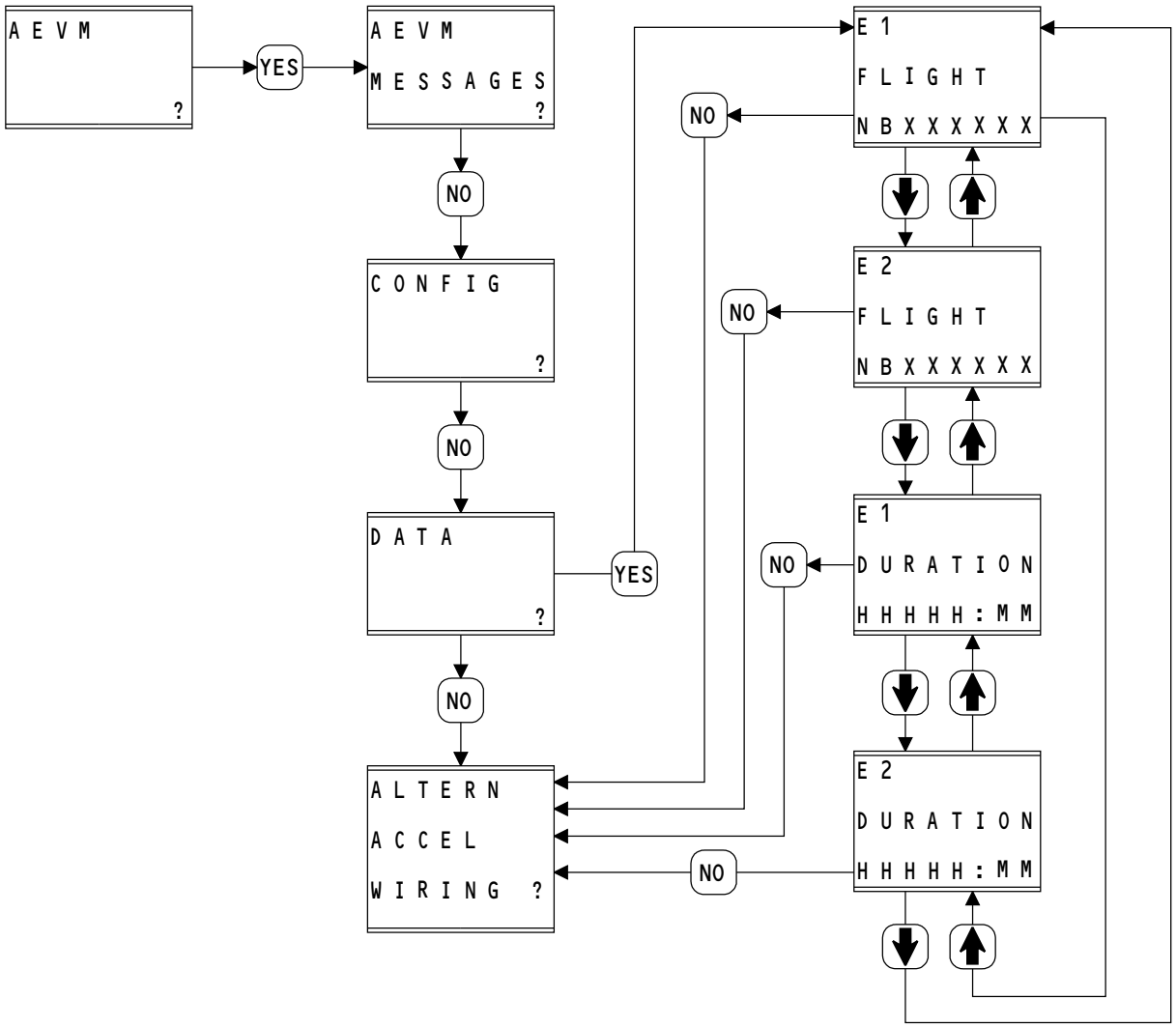


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**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - DATA - TRAINING INFORMATION POINT**


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## AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - ALTERN ACCEL WIRING - TRAINING INFORMATION POINT

### General

The ALTERN ACCEL WIRING? menu lets you set the signal conditioner to use the Standard or the Alternate Accelerometer. Push the YES button to see how the accelerometer is set for Engine 1. Push the NO button to go to the AEVM? menu.

E1 is engine number 1 and E2 is engine number 2.

The standard accelerometer is the vibration sensor for the #1 bearing. Push the YES button for the menu page that agrees with the condition of the vibration sensor for the #1 bearing.

NOTE: The default configuration is Standard Accelerometer Selected. The Alternate accelerometer is not installed for this airplane. The AEVM function only operates if the #1 bearing vibration sensor is connected.

For example, if the #1 bearing sensor on the engine is disconnected, push the NO button until you see the E1 ACCEL DISCON. SELECT? page. Push the YES button to make the signal conditioner stop the operation of the advanced AEVM function.



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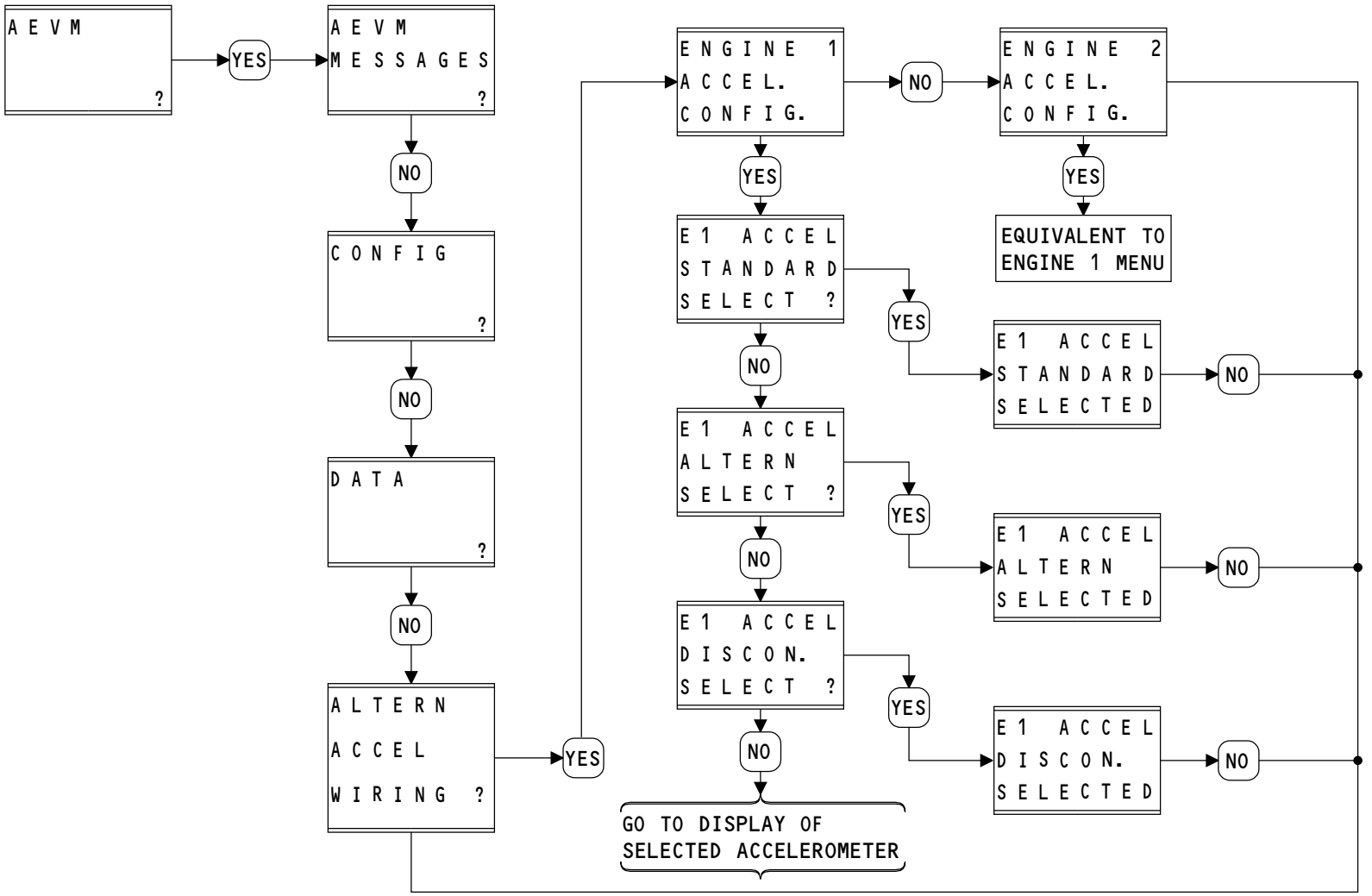


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**AVM SYSTEM - AEVM SIGNAL CONDITIONER BITE - ALTERN ACCEL WIRING - TRAINING INFORMATION POINT**


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