

Meggitt Avionics  
SERVICE INFORMATION  
LETTER No.52 ISSUE 2

# Meggitt Avionics

HAWKER BEECHCRAFT CORPORATION

SFD MK2 SYSTEM

TROUBLESHOOTING GUIDE

Part Number Applicability:  
39213 series SFD  
27101 or 27301 series ADU  
19004 series MHS

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This guide is designed to provide information to aid in the troubleshooting of the SFD system and details the various failure flags and possible external conditions which can cause failure flags to be displayed.

Annex A has been included at the request of the aircraft manufacturer for reference purposes.

#### ACRONYMS AND ABBREVIATIONS

ADU	Air Data Unit
AMLCD	Active Matrix Liquid Crystal Display
ARINC	Aeronautical Radio Incorporated
ATI	Air Transport Indicator
BAT	Battery
BIT	Built in Test
BNR	Binary
CAL	Calibration
CBIT	Continuous BIT
DC / dc	Direct Current
ft	Feet
GS	Glideslope
HDG	Heading
hPa / HP	Hectopascals
Hz	Hertz
IAS	Indicated Air Speed
IBIT	Initiated BIT
ILS	Instrument Landing System
IN	Inches
LOC	Localiser
M	Mach
MB	Millibar
MHS	Magnetic Heading Sensor
SBIT	Start-Up BIT
SFD	Secondary Flight Display
SFDS	Secondary Flight Display System
STD	Standard
V	Volts
VMO	Velocity Maximum Operating

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#### SUMMARY OF INSTRUMENT FUNCTIONS

The SFD is housed in a 3 ATI, and provides Attitude, Airdata, Heading, ILS to the operator.

The display consists of a backlit, Active Matrix Liquid Crystal Display, whose brightness is determined by a manually controlled voltage input and a bezel mounted ambient light sensor.

The parameters displayed are:

i) Attitude: Aircraft attitude display is achieved from the internally mounted 3 axis inertial sensor pack. These sensors provide pitch, roll and yaw data.

ii) Airdata: Pitot and Static inputs are received as ARINC 429 data from a 27101-01-01 or 27301-01-01 ADU displayed in the form of Airspeed, Mach, and Altitude. Barometric Corrected Altitude is also calculated using a barometric reference, set by the pilot on the bezel mounted rotary knob.

iii) ILS: ILS information is received as ARINC 429 data or by an analogue receiver, and is presented on selection of the ILS button (front bezel). The SFD also supports backcourse ILS; Glideslope is not displayed in this mode.

iv) Heading: Magnetic heading input is received as ARINC 429 data, and is referenced to the internal sensor pack to provide a stabilised heading output for display, with the cardinal points marked appropriately.

v) Built-In Test: The SFD has a built-in test (BIT) function.

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#### **IBIT**

The SFD Mk2 incorporates built in test equipment to assist the user in fault confirmation and system troubleshooting.

Note: Ensure manual lighting is set mod range (approx 2.5V) before running IBIT

BIT mode can be accessed when IAS is less than 40 knots, by making the following selections: Press and hold ILS button and press HP/IN button twice; within 2 seconds of ILS depression (this will display the BIT pages). To exit BIT release ILS button.

There are a total of 17 pages of IBIT data. The IBIT pages are automatically displayed sequentially in the following order until IBIT mode is exited:



IBIT Page

This page provides an IBIT intro and will display SFD IBIT for 0.5 seconds.

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data x = current aircraft data

Configuration Page

This page (displayed for 6 seconds) will display panel angle, software version, aircraft type, total run time, and total flight time data.

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IBIT Summary Page

This page (displayed for 3 seconds) will display unit status and a list of all the ARINC inputs to the unit. It will identify unit status and each input status as PASS/FAIL.

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Where 'X' can be from 1-8 flight cycles

Previous Flight Pages (1 to 8)

The unit stores up to 8 flight cycles, which are displayed on each of the eight Previous Flight Pages. Each page is displayed for 3 seconds and displays the same data format as the IBIT Summary Page. The pages are incremented from flight cycles of the SFD™ (Cold start followed by airspeed >100 knots).

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Colour mode Pages

There are six Colour Mode pages. Each page is displayed for 1.5 seconds and displays a solid colour of black, red, grey, blue, green and white in sequence. This figure shows the black colour mode page only).

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#### EXAMPLES OF POSSIBLE FAULT INDICATIONS

#### Blank Screen



Possible external causes for this include:

- No power to SFD.
- Check Aircraft SFD circuit breaker.
- Check for 28V at pin 4 and 28V return at pin 5.
- The SFD is in Program Mode (Pins 30 AND 33 grounded).

Otherwise, the problem is likely to be with the SFD itself.

NOTE: The screen will be blank for up to 22 seconds when powering up as the unit performs its BIT checks.

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**'PROGRAM PIN ERROR'**

Red text on black background in centre of screen



Possible external causes for this include:

- Aircraft wiring loom fault. Check for short or open circuits at pins 12,13,14,15,17.

**Note, the correct configuration must be checked against the Electronic Standby Instrument System, Wiring Interface drawing.**

Otherwise, the problem is likely to be with the SFD itself.

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#### 'ATTITUDE'

Red text on black background in centre of screen



Possible external causes for this include:

- Instrument moved excessively, greater than 100deg per second (can occur at any time). Airspeed, altitude and other data can still be displayed.

Otherwise, the problem is likely to be with the SFD itself.

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Red Cross replaces altitude tape, altitude digital readout blanked and red cross replaces airspeed tape, airspeed digital readout blanked



Possible external causes for this include:

- Air Data Unit (ADU) not connected.
- Incorrect ADU fitted, a 27101 or 27301 series part number unit is required, not a 27005 series.
- No Power to ADU. Check circuit breaker. Check for 28V at pin N and check 28V return at Pin P.
- Wiring problem with SFD check pins 24 and 25.
- Wiring problem with ADU check pins L and M.
- ADU faulty.
- Perform IBIT and check current status of ADU on third IBIT screen.

Otherwise the problem is likely to be with the SFD itself.

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'M.---' in red text in place of Mach reading



Possible external causes for this include:

- Airspeed in excess of 0.999 Mach.
- ADU fault, check whether airspeed and altitude are displayed.

Otherwise the problem is likely to be with the SFD itself.



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'HDG' in black text on a yellow rectangle within the heading tape



Heading Display is showing non-stabilized magnetic heading input.

Possible external causes for this include:

- Instrument moved excessively, greater than 100deg per second (can occur at any time). Airspeed, altitude and other data can still be displayed.

Otherwise the problem is likely to be with the SFD itself.

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'CAL' in black text on a yellow rectangle within the heading tape



Magnetometer (Heading Input) is in calibration mode. **For Calibration information refer to Annex B**

Possible external causes for this include:

- MHS powered up with Cal switch open circuit. Referring to Electronic Standby Instrument System, Wiring Interface drawing ensure the calibration switch is correctly short circuited at the maintenance panel.
- Wiring to MHS Cal pins is faulty. Check input to pins 7 and 8 on the MHS are short circuit.
- MHS Faulty.

**There is not likely to be a problem with the SFD that can cause this without a heading fail.**

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'LOC'

Red text on a black rectangle in a white box



Possible external causes for this include:

- ILS localizer data is not being received. This can be either from a digital (ARINC 429) or analogue source.
- Check circuit breakers for aircraft ILS radio.
- Check operation of ILS Localizer.
- Check Analogue Localizer signals at pins 31 and 32.
- Check Arinc 429 ILS at pins 10 and 11.
- Check Disc\_IN 1 (localizer valid) at pin 3.

Otherwise the problem is likely to be with the SFD itself.

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'G/S'

Red text on a black rectangle in a white box



Possible external causes for this include:

- ILS Glideslope data is not being received. This can be either from a digital (ARINC 429) or analogue source.
- Check circuit breakers for aircraft ILS radio.
- Check operation of ILS Glideslope.
- Check Analogue Glideslope signals at pins 8 and 9.
- Check Arinc 429 ILS at pins 10 and 11.
- Check Disc\_IN 2 (Glideslope valid) at pin 18.

Otherwise the problem is likely to be with the SFD itself.

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ANNEX A

CUSTOMER REQUESTED ADDITIONAL TECHNICAL INFORMATION

The information contained in Annex A is not intended for the aircraft operator but has been included at the request of the aircraft manufacturer for reference purposes.

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#### ARINC 429 Communications

#### ARINC Inputs

The unit accepts four ARINC inputs conforming to ARINC 429 as shown in Table 1.

Table 1 - ARINC Inputs

Input	Source
Input Bus 1 (low speed)	Not Used
Input Bus 2 (low speed)	Not Used
Input Bus 3 (low speed)	Air Data
Input Bus 4 (low speed)	Magnetic Heading Sensor

Applicable ARINC input messages are shown in Table 2.

Table 2 - Summary of ARINC Inputs

Signal name	Range	Max transmit interval (ms)	No of bits	Resolution	Units
Heading (Bus 4 label 014)	0-359.9	250 / 500	BCD, 4 SIG DIGITS, DISCRETE BIT 11	0.1	Degrees, BIT 11 = Compass Calibration Mode (1 = True)
Average uncorrected static pressure, Ps (Label 245 Bus 3)	0-2048	62.5 / 125	16 BNR	Note 1	mb
Impact Pressure, qci (Bus 3 Label 215)	0-512	62.5 / 125	14 BNR	Note 1	mb

Note 1 All BNR labels use two complement;  
Resolution = Range divided by  $2^N$  where N = No of Bits  
ARINC Outputs

The unit has two ARINC outputs conforming to ARINC 429-15 as shown in Table 3.

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Table 3 - ARINC Outputs

Output	Destination
Output Bus 1 (high speed)	BIT status, SFD parameter outputs
Output Bus 2 (low speed)	Not Used

Table 4 - Summary of ARINC Outputs

Signal name	Range	Max transmit interval (ms)	No of bits	Resolution	Units
Body roll rate, q (Bus 1 label 327)	± 128	20	13 BNR	Note 1	Deg/s
Body pitch rate, p (Bus 1 label 326)	± 128	20	13 BNR	Note 1	Deg/s
Body yaw rate, r (Bus 1 label 330)	± 128	20	13 BNR	Note 1	Deg/s
Roll attitude (Bus 1 label 325)	±180°	20	14 BNR	Note 1	Deg
Pitch attitude (Bus 1 label 324)	± 180	20	14 BNR	Note 1	Deg
Baro correction (Bus 1 label 235)	16-32	125	BCD, 5 SIG DIGITS	0.001	ins Hg
Calibrated airspeed(CAS) (Bus 1 label 206)	0-1024	125	14 BNR	Note 1	Knots
Pressure altitude (Bus 1 label 203)	± 131072	62.5	17 BNR	Note 1	ft
Baro corrected altitude (Bus 1 label 204)	± 131072	62.5	17 BNR	Note 1	ft
BIT Status Word 1 (Bus 1 label 271)	N/A	1000	N/A	N/A	N/A
BIT Status Word 2 (Bus 1 label 272)	N/A	1000	N/A	N/A	N/A

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Signal name	Range	Max transmit interval (ms)	No of bits	Resolution	Units
Magnetic Heading (Bus 1 label 014)	0-359.9	500	BCD 4 sig digits, DISCRETE BITS 11 and 12	0.1	Degrees, Bit 11 = Compass Calibration Mode (1 = True) BIT 12 = Mag Hdg Displayed (1 = True)
Mach (Bus 1 label 205)	0-4.096	125	16 BNR	Note 1	Mach

Note 1 All BNR labels use two complement; Resolution = Range divided by  $2^N$  where N = No of Bits

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#### Analogue Inputs

The unit accepts the analogue inputs as shown in Table 5.

Table 5 - Analogue Inputs

Signal name	Signal type	Source	Pin Nos
Manual lighting control	0 - 5 V (dc)	0-5V ac/dc Manual Lighting +Rtn Instrument panel, lighting control	1 + 2
Glideslope Deviation	±750mVdc	G/S_DEV +G/S_DEV_RTN 150mV = 0.175 DDM	8 + 9
Localiser Deviation	±750mVdc	LOC_DEV+LOC_DEV_RTN 150mV = 0.155 DDM	31 + 32

#### Discrete Inputs

The unit accepts the discrete inputs as shown in Table 6.

Table 6 - Discrete Inputs

Signal name	Source	Pin No	Input Characteristics	I/P True/Set	I/P False/Clear
Vmo/Mmo Select	Ventral Tank Fuel Level Switch	16	Open/Gnd	<+1.0V DC	>100 Kohms
Prog_pin_select/2	Backshell	15	Open/Gnd	<+1.0V DC	>100 Kohms
Prog_pin_select/4	Backshell	14	Open/Gnd	<+1.0V DC	>100 Kohms
Prog_pin_select/8	Backshell	13	Open/Gnd	<+1.0V DC	>100 Kohms
Prog_pin_select/16	Backshell	12	Open/Gnd	<+1.0V DC	>100 Kohms
Disc_IN1 (Localiser Valid)	ILS Receiver	3	Open/28V	>+15.5V	>100 Kohms
Disc_IN2 (Glideslope Valid)	ILS Receiver	18	Open/28V	>+15.5V	>100 Kohms
Disc_IN3 (ILS Tuned)	ILS Receiver	23	0V/28V	<+1.0V DC	>+15.5V DC
Heading Select	Backshell	29	Open/Gnd	<+1.0V DC	>100K ohms

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#### Electrical Connector

The connector is Type MIL-C-38999-SERIES II-14-35PN.

Pin connections and screening requirements for the SFD cable harness are shown in Table 7 below.

Table 7 - Electrical Connector

Pin	Signal NameDescription	Signal Type	I/O	Wire Type (Notel)
1	0-5V dc Manual Lighting	A/C Lighting Bus	Analogue	STP Wire A
2	0-5V dc Manual Lighting RTN	A/C Lighting Bus	Analogue	STP Wire B
3	Disc_IN1 (Localiser Valid)	ILS Receiver	Discrete	SW
4	28V dc	A/C 28V	Power	STP Wire A
5	28V dc GND RTN	A/C 0V28	Power	STP Wire B
6	Case Ground	A/C GND	Bonding	SW
7	Reserved	Not Connected		
8	G/S_DEV	ILS Receiver	Analogue	STP Wire A
9	G/S_DEV RTN	ILS Receiver	Analogue	STP Wire B
10	ARINC 429 Bus_1_IN A	Not Connected		
11	ARINC 429 Bus_1_IN B	Not Connected		
12	Prog_Pin_Sel/16	A/C Connector	Prog Pin	SW In Backshell
13	Prog_Pin_Sel/8	A/C Connector	Prog Pin	SW In Backshell
14	Prog_Pin_Sel/4	A/C Connector	Prog Pin	SW In Backshell
15	Prog_Pin_Sel/2	A/C Connector	Prog Pin	SW In Backshell
16	Vmo Select	A/C Connector	Prog Pin	SW In Backshell
17	Prog_Pin_Common	A/C Connector	Prog Pin	SW In Backshell
18	Disc_IN2 (G/S Valid)	ILS Receiver	Discrete	SW
19	ARINC 429 Bus_4_IN A	MHS	Digital Bus	STP Wire A
20	ARINC 429 Bus_4_IN B	MHS	Digital Bus	STP Wire B
21	Reserved	Not Connected		
22	Reserved	Not Connected		
23	Disc_IN3 (ILS Tuned)	ILS Receiver	Discrete	SW
24	ARINC 429 Bus_3_IN A	ADU	Digital Bus	STP Wire A
25	ARINC 429 Bus_3_IN B	ADU	Digital Bus	STP Wire B
26	ARINC 429 Bus_1_OUT A	SFD Parameters	Digital Bus	STP Wire A
27	ARINC 429 Bus_1_OUT B	SFD Parameters	Digital Bus	STP Wire B
28	Reserved	Not Connected		
29	Prog_Pin_Parity (Mag Select)	A/C Connector	Discrete	SW
30	Reserved	Not Connected		
31	LOC_DEV	ILS Receiver	Analogue	STP Wire A
32	LOC_DEV RTN	ILS Receiver	Analogue	STP Wire B
33	Reserved	Not Connected		
34	Reserved	Not Connected		
35	Reserved	Not Connected		
36	Spare (linked to case)	Not Connected		
37	Spare (linked to case)	Not Connected		

Note 1 Wire Types: STP - Screened Twisted Pair SW - Single Wire

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#### ANNEX B

#### MAGNETIC HEADING SENSOR CALIBRATION ADVICE.

#### **Overview of the MHS**

##### General

The MHS senses the earth's magnetic field and, from this, calculates Magnetic Heading. The magnetic heading is transmitted on an ARINC 429 serial data bus to other aircraft systems.

#### **Error Investigations**

##### Meggitt Avionics Observations

Most magnetic heading reading problems noted by Meggitt Avionics have been caused by one or more of the following:

- Fast turning during calibration; the aircraft turn should be no more than 6°/second during compass calibration
- Jerking during calibration; the aircraft turn should be maintained as smoothly as possible
- External disturbances to the magnetic field while on the Compass Rose (a large magnetic material mass, such as an external aircraft power generator, can have an important effect on the magnetic field even up to 15m away)
- Changes to the magnetic field due to nearby wiring, LRUs, moving control surfaces or cables etc.

##### Calibration Advice

The calibration algorithm in the MHS finds the peaks in the sensed magnetic field to give the hard iron compensation coefficients. Rapid turning or jerks during calibration can cause the peaks to be sensed incorrectly and, because of this, unsatisfactory calibration.

It is important to make sure the aircraft is accurately aligned to magnetic north before starting the calibration.

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#### Compass Calibration Procedure

NOTE: At the start of the calibration procedure the calibration data is reset. If the calibration procedure is then cancelled it will cause the MHS to send a No Computed Data (SSM = 1 0) transmission when normal mode is set and will continue to do so until calibration has been completed.

COMPASS CORRECTION CALIBRATION mode is set by powering up the MHS with the Calibration Switch inputs open circuit. The axis of the aircraft must be aligned as close as possible to magnetic north before switch on.

Calibration is done by turning the MHS installed aircraft continuously, at not more than 6 degrees/second, until the uncalibrated heading shows at least two complete turns of the instrument have occurred. During this procedure the positive and negative peak values of the sine and cosine waves, derived from the 3 axis magnetic and tilt data, is recorded. The aircraft will need to be turned between 720 to 1080 degrees.

The procedure is cancelled if errors prevent reliable calibration data being calculated. This will cause the MHS to send a No Computed Data (SSM = 1 0) transmission status for three seconds and show that the procedure has restarted.

During calibration the initial magnetic data from the start of the procedure is corrected and used to give a bearing to offset the instrument's axial displacement.

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During calibration the MHS will transmit data on its heading from North and will shift/move the heading by 105 degrees momentarily every second to show that it is in calibration mode. The MHS will also transmit the data with bit 11 of the ARINC 429 data word set to show that it is in calibration mode. This BIT causes the SFD to Display the yellow 'CAL' flag on the display.



SFD in Calibration Mode

When calibration is completed successfully the MHS transmits normal calibrated heading data with the ARINC transmission status set to Normal Data (SSM = 0 0) to show that the calibration has been successful.

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When calibration is complete the MHS heading should be compared with another magnetic heading instrument as a confidence check that acceptable accuracy has been achieved by the calibration procedure.

The MHS must be set to NORMAL mode before power is re-applied as if not the calibration data will be lost.

#### **Calibration Frequency**

Annual calibration of the Meggitt Avionics solid state MHS should not be necessary (as is standard policy for an analogue device).

Calibration of the Meggitt Avionics MHS is necessary if a replacement MHS is installed or if the operator thinks that the Heading indication is not accurate. MHS calibration may also be necessary if aircraft modification or installation of large ferrous replacement components (for example, engines) have had an effect on the permanent magnetic fields of the airframe.

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APPROVAL OF SERVICE INFORMATION LETTER

MEGGITT-AVIONICS K0100 - Approval

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