

Rockwell Collins, Inc.

HFS-2200

Users Manual



This manual provided to the FCC for product guidance, it should not be used by our OEM customers.

Scope:

This document will detail information required to install and use the HFS-2200 unit.

Introduction:

The Rockwell Collins® HFS-2200 HF Data Radio (HFDR) provides the means to process transmit and receive data as well as analog voice. The HFDR transceiver operates on frequencies spaced 100 Hz apart in the 2-30-MHz band. For compatibility with existing ARINC 719 installations the HFS-2200 provides single sideband suppressed carrier voice, amplitude modulated equivalent voice, selective calling (SELCAL™), and analog data functions. In addition to providing traditional HF radio functionality, the unit contains an internal data modem and controller for ARINC 753 compatibility. Voice transmission is compatible with current single sideband HF transceivers. Data transmission is compatible with ground HF transmitting and receiving systems, which use conventional HF transceivers and ARINC 635 compliant modems and controllers.

Mechanical Description

The HFS-2200 is packaged in an ARINC 600, 4 MCU configuration. The connector interface consists of rear panel mounted new installation concept (NIC) type 2 low insertion force connector. The top insert of the NIC connector is dedicated to service connections and test outputs, the middle insert for service and antenna coax connection, and the bottom insert for power inputs and outputs. The dust cover is a 3-sided tubular construction held on with screws around the rear connector shell.

The HFS-2200 is structured with formed aluminum members that include a front panel, a rear panel, a bottom panel, a top panel, a central partition that rigidly maintains the alignment of the other panels, and a swing-out side panel.

Design

The table below details the characteristics of the HFS-2200.

<u>CHARACTERISTIC</u>	<u>SPECIFICATION</u>
Weight	6.64 kg (14.6 lbs), max
Overall dimensions	Width - 128.5 mm (5.06 in), max Height - 200 mm (7.87 in), max Length - 382.0 mm (15.04 in), max
Test report reference	FAA TSO C-158, C-170
Design specification documents	ARINC 429 P1-17, 429 P2-16, 429 P3-18, 600-9, 604-1, 615-3, 635-5, 719-5, 753-3 RTCA DO-160E, DO-163, DO-178B, DO-265, DO 254 EUROCAE ED-14E, ED-12B, ED-80

Equipment Characteristics

Equipment Characteristics

The HFS-2200 conforms to the following equipment specifications listed in figure 6 according to DO-163, ARINC 635, ARINC 719-5, and ARINC 753-3.

<u>CHARACTERISTIC</u>	<u>SPECIFICATION</u>
Frequency range	Wide range select (MP-5J) grounded: 2.0000 to 29.9999 MHz Wide range select open: 2.8000 to 23.9999 MHz. Out-of-range selection indicated by aural tone when PTT is keyed.
Frequency channels	Wide: 280 000 for 100-Hz spacing 28 000 for 1-kHz spacing Narrow: 212 000 for 100-Hz spacing 21 200 for 1-kHz spacing
RF power output	RF power output is measured at the end of a 5 ft length of RG-8U transmission line when terminated with a 50 Ω resistive load.
SSB	400 W nominal peak envelope power +1.0, -1.5 dB (voice or data mode).
AME	125 W average, +1.0, -1.5 dB
Tune	70 to 100 W average
Data	125 W average, +1.0, -1.5 dB
Duty Cycle	20 % Maximum
RF Output load impedance	50 Ω
Audio input	
Microphone input	0.1 to 5.5 V rms, produces rated power, 150 Ω balanced
Analog data input	0.1 to 5.5 V rms, 600 Ω balanced. An audio input above 500 mv will key the transmitter. A 300 ms delay will occur after removal of the analog data.
Speech Processing	Modulation limiting is provided so the input signal can be increased to a level 10 dB above the preset value without the transmitter exceeding the

spectrum limits and without distortion of the data signals.

Modulation capability

AME

With signal at the adjusted level into microphone input, the HFS-2200 will provide a minimum of 75% modulation.

SSB

Power output of 400 W peak envelope power +1.0, -1.5 dB (voice or data mode) with input tones of 400, 1000, 1450, and 1800 Hz, four tone audio input at 0.2 V rms/tone.

Carrier level

SSB

The carrier is suppressed at least 40 dB below the rated peak envelope power with equal 0.25 V rms 1800 Hz and 400 Hz tones at microphone input.

NOTE: The average power ALC circuit is disabled during this test in order to achieve the 400 W pep nominal level.

AME

The carrier level is not more than 6 dB below the peak envelope power of the transmitter when the transmitter is modulated with a single 1 kHz tone.

Noise level

Peak amplitude of noise does not exceed 5% of the RF amplitude for an audio input of 2000 Hz at a level producing an RF output 6 dB below 400 W pep in SSB mode.

Frequency response

NMT +2.5, -6 dB with respect to level at 1 kHz, maximum variation in transmitter output power, at 6 dB below rated pep, with input audio varied from 350 to 2500 Hz.

Harmonics

All harmonically related spurious emissions will be at least 43 dB below full rated output when measured into a 50-ohm resistive load at full rated output power.

Non-harmonics	All non-harmonically related spurious emissions will be less than 25 microwatts (μW) when measured into a 50-ohm resistive load at full rated output power and more than 20 kHz frequency offset.
Frequency stability	$f_c \pm 20$ Hz maximum over all environmental conditions
Audio frequency distortion	In band harmonics NLT 20 dB below 400 Hz test tone with RF output 6 dB below 400 W pep
Sidetone	There are two sidetones provided by the HFDR; tune tone and transmit audio. The received audio/sidetone output, MP-1D, 1E, is factory adjustable from 5 to 40 mW maximum into 600 Ω . The factory setting of this output is 10 mW with a 1 kHz tone applied to the transmitter input.
Transmit to receive recovery time	With the squelch threshold set for 3 μV , the receiver will provide 90% of its output with an input level of 10 μV modulated 30% at 1000 Hz within 100 ms after the transmitter is unkeyed.
Receive-to-transmit delay time	Within 200 ms of the mic key line and key interlock becoming active, the transmitter power output is at least 90% of rated output.
Sensitivity	
SSB	1 μV for 10-dB (s+n)/n
AM	4 μV modulated 30% at 1000 Hz for a 10-dB (s+n)/n
Selectivity	
SSB	2-dB passband: $f_c + 350$ Hz to $f_c + 2500$ Hz; 35-dB stopband: f_c to $f_c - 300$ Hz and $f_c + 2900$ Hz to $f_c + 3300$ Hz;

	60 dB stopband: below $f_c - 300$ Hz and above $f_c + 3300$ Hz
AM	6-dB passband: $f_c \pm 2750$ Hz min; 60-dB stopband: $f_c \pm 6000$ Hz.
AGC characteristics	
AGC signal handling capability	Maximum 6-dB audio output variation for 5 μ V- to 100-mV RF input Maximum 2 dB variation of audio output for 100 mV to 1 V RF input level.
AGC time constants	Voice (SSB): Less than 50 ms attack time for 60 dB increase, 1.0 to 2.0 s decay time for 60 dB decrease. Data: Less than 10 ms attack time for 60 dB increase, 20-25 ms decay time for a 60 dB decrease.
SELCAL output	
Frequency response	Maximum 3-dB difference in levels between any two SELCAL tones between 300 to 1500 Hz
Output power	0.1 to 40 mW into 600 Ω
Harmonic distortion	NMT 5% SELCAL audio distortion at 0.5 V output into 600 ohms with 1000 μ V RF input signal modulated 30% at 1000 Hz.
Main audio output	Factory adjustable, 0.1 to 40 mW into 600 $\Omega \pm 20\%$ ohms. The output is isolated from ground and is open and short circuit protected. Output will operate normally after removal of the short or open. The factory sets the output to 10 mW at 1 kHz.
Source impedance	The audio output will present less than 20 ohms impedance to the load circuit under all power-on conditions.

	<p>The output presents less than 1000 ohms impedance to the load circuit when no power is applied to the unit. The source limits apply over the frequency range of 100 Hz to 6000 Hz.</p>
Output load level regulation	<p>With the output signal adjusted to 10 mW into 600 ohms at 1 kHz, the output voltage does not change more than 2 dB when the load is varied between 450 ohms and 2400 ohms and by not more than 6 dB when the load is varied between 200 ohms and 20,000 ohms. This is also true when tested using 350 and 2,500 Hz signals.</p>
Gain	<p>A standard input signal of not more than 2 μV will produce a receiver output not less than 10 mW into a 600 ohm \pm20% resistive load.</p>
Frequency response	<p>Not more than 4 dB variation (with respect to a 1 kHz reference level) in audio output when 1000 μV AM signal is modulated 30% from 300 to 2500 Hz. Frequencies above 3750 Hz are attenuated at least 20 dB.</p>
Distortion (AME Mode)	<p>With an input signal of 1 mV modulated with 1 kHz and the receiver gain adjusted to produce 10 mW into a 600 ohm resistive load, the total harmonic distortion will not exceed 5% with 30% modulation or 10% with 90% modulation (with the gain control reset to maintain the output at 10 mW), including effects of the noise limiter.</p>
Distortion (SSB Mode)	<p>Not more than 12% audio output harmonic distortion for 1000 μV USB single tone input signal in audio band 350 to 2500 Hz.</p>
Analog data output	<p>The analog data output is defined as the output provided on pins MP-1F and MP-1G. This output is not used for HF DL data. It is provided only for compatibility with previous ARINC 719 transceivers. The following specifications apply to this output.</p>

Output power	Factory adjustable, 0.1 mW to 40 mW into 600 \pm 20% ohms. The output is isolated from ground and is open and short circuit protected. Output will operate normally after removal of the short or open. The nominal output should be set to 0 dBm at 1 kHz.
Source impedance	The analog data output will present less than 20 ohms impedance to the load circuit under all power-on conditions. The output presents less than 1000 ohms impedance to the load circuit when no power is applied to the unit. The source limits apply over the frequency range of 100 Hz to 6000 Hz.
Output load level regulation	The output level is independent of the effects of the squelch and noise limiter circuits.
Frequency response	Not more than 4 dB variation (with respect to a 1 kHz reference level) in audio output when 1000 μ V AM signal is modulated 30% from 300 to 2500 Hz. Frequencies above 3750 Hz are attenuated at least 20 dB.
Distortion	With an input signal of 1 mV and the output level adjusted to 0 dBm into a 600 ohm resistive load, the total distortion will not exceed 5% in the SSB mode.
SSB intermodulation distortion	Third order products at least 50 dB below each of two test tones, from 1 μ V/tone to 20,000 μ V/tone, with audio level within 10 dB of rated output.
	For tone levels up to 100,000 μ V/tone the third order product is at least 30 dB below each of the test tones.
	With a 1.2 kHz single tone SSB signal applied, having any level from threshold sensitivity level to 100 mV, and with an interfering carrier applied 3 kHz higher in frequency than the desired signal carrier

frequency, it is possible to increase the level of this interfering carrier to a level corresponding to 100 mV before the 1.8 kHz intermodulation product equals the level of the 1.2 kHz desired signal output.

Cross-modulation distortion

When operating in the SSB suppressed carrier mode, with the simultaneous application of an SSB input signal at $f_c + 1000$ Hz and an undesired signal displaced 10 kHz from the desired signal, with 85% modulation at 400 Hz, the 400 Hz receiver output due to cross-modulation will be at least 10 dB below the reference tone under the following conditions:

<u>DESIRED</u>	<u>UNDESIRED</u>
<u>SIGNAL LEVEL</u>	<u>SIGNAL LEVEL</u>
20 μ V	1000
μ V	
2000 μ V	100,000 μ V

Image and spurious response

The input signal level required to produce an output signal plus noise-to-noise ratio of 6 dB must be at least 60 dB greater than that required with a standard SSB signal when the frequency of the input signal is varied over the range of 0.190 to 1260 MHz, excluding the range of $f_c - 1500$ Hz to $f_c + 4500$ Hz.

Desensitization

Not more than 6 dB reduction in rated output for 10 μ V desired in the presence of a 10,000 μ V unmodulated carrier with a frequency varied between 1.5 and 30 MHz, but excluding the range of $f_c - 3000$ Hz to $f_c + 6000$ Hz.

RF Sensitivity Control

The RF sensitivity control has a range of at least 50 dB.

Receiver Frequency Switching Time

Changing from one receive frequency to another frequency will not require more than 250 ms.

Squelch Control	USB threshold range adjustable from 2 to 50 μV AM threshold range adjustable from 5 to 50 μV
HF Data Link operation	
User data rate	300, 600, 1200, and 1800 bps
Modulation	M-ary phase shift keying depending on data rate of a carrier (RF +1440 Hz)
Forward error correction	1/2 for data rates 600 to 1800 bps 1/4 for data rate 300 bps
Interleaver time period	1.8 s or 4.2 s, all data rates
Equalizer	Implemented, trained by preamble and probe data
Bit scrambler	15 stage shift register
Prekey	249 ms, 448 2 PSK symbols
Preamble	295 ms, 531 2 PSK symbols
Data	3240 M-PSK symbols - 1.8 s interleaver
Frame structure	TDMA protocol

Electrical Characteristics

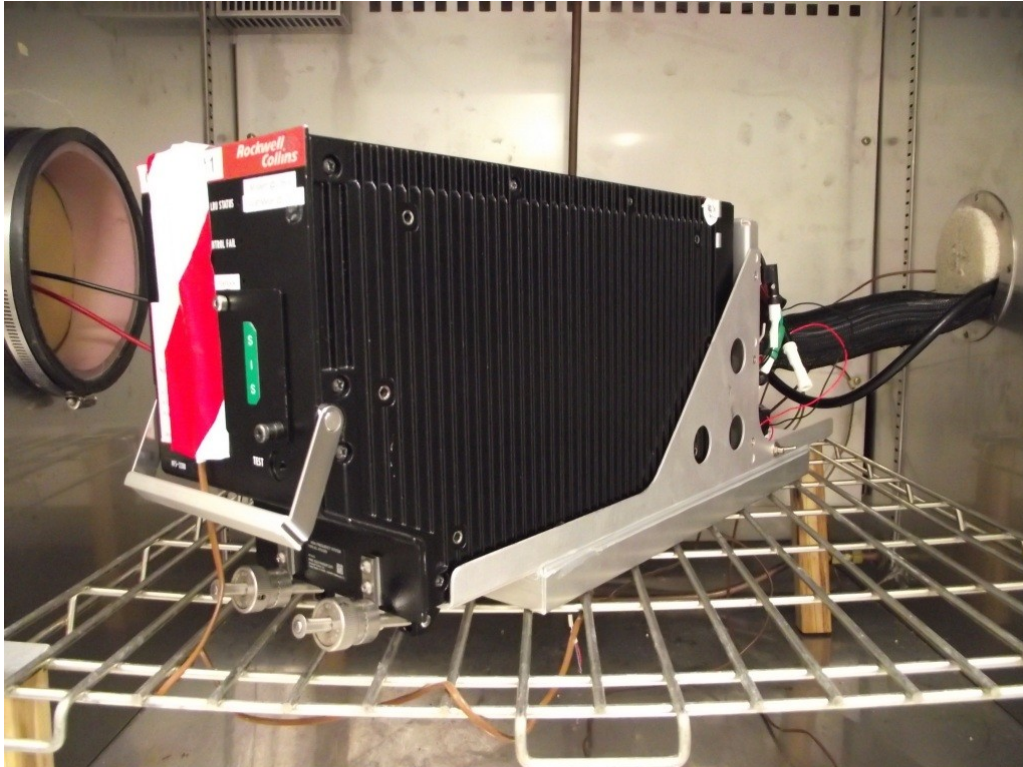
The HFS-2200 conforms to the following electrical specifications;

<u>CHARACTERISTIC</u>	<u>SPECIFICATION</u>
Voltage requirements	115 Vac $\pm 10\%$, 360 to 800 Hz, single-phase
Power input, receive	33 watts max
Power input, transmit	650 watts max
Power dissipation	540 watts max
Power Factor	not less than 0.95 during transmit
Power interrupt	200 ms transparency while receiving, 10 ms while transmitting

Installation:

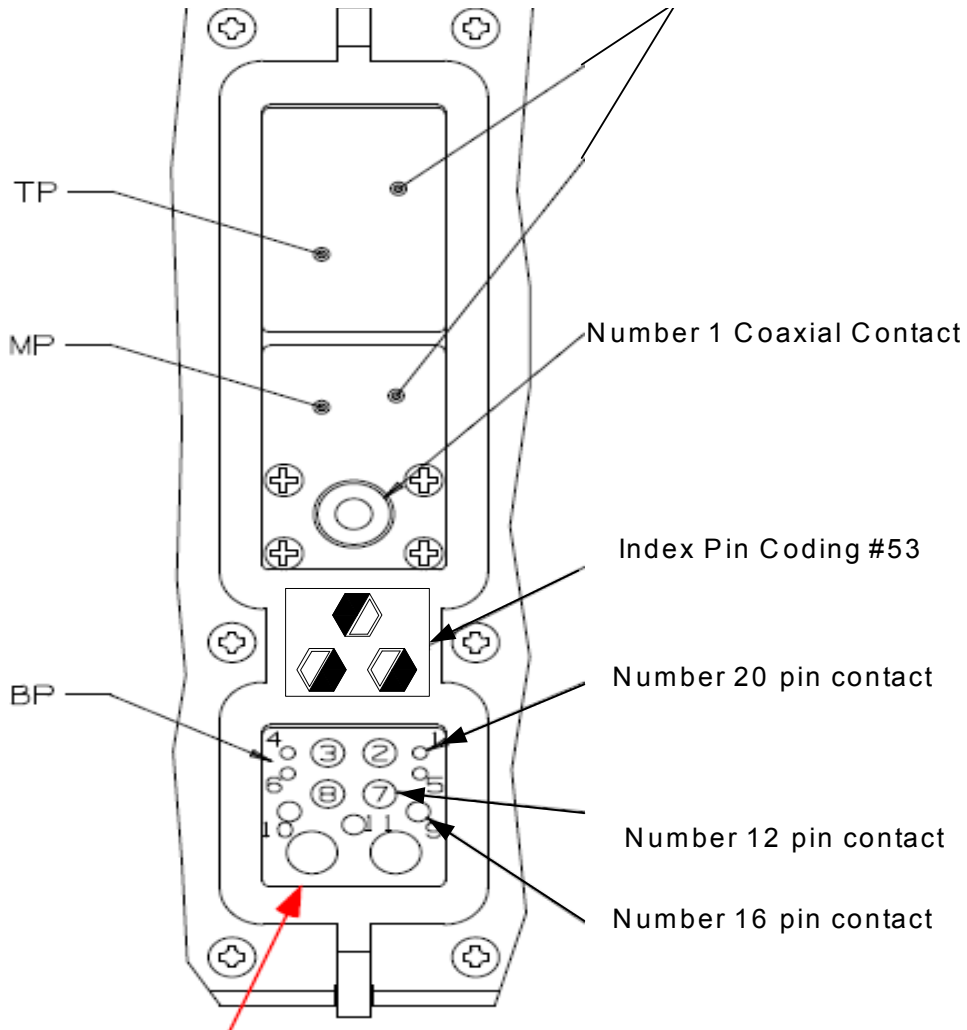
The picture below details the HFS-2200 unit mounted in the ARINC 600 4MCU mount. These type mounts have mechanical mechanisms to allow capture and restraint of the front feet of the unit. This restraint ensures the unit will not come loose from the mount and also that the ARINC defined connector does remain in contact with the rear pins.

The harness that connects the RMP to the VHF-2200 is defined by the aircraft manufacturer. The pinout is defined by the ARINC 753 and 719 standard to allow interchangeable product migration. The HFS-2200 pinout can be found below.



Rear Pin Out

Error! Reference source not found. The following pictures provide a generic depiction of the HFS-2200 rear connector. The top, middle and bottom insert will be defined later in this chapter.



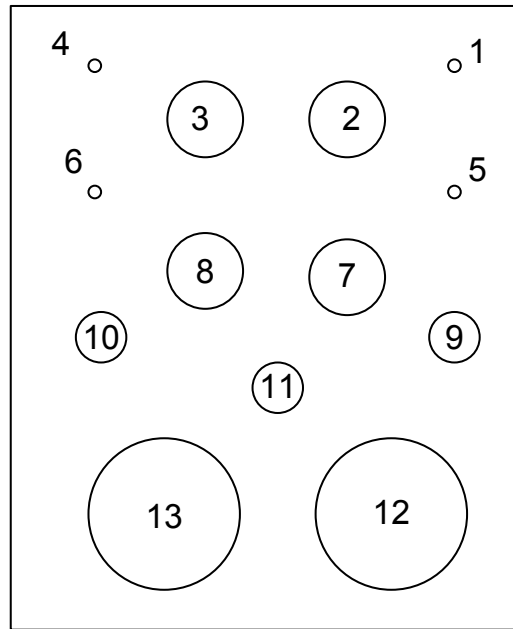
HFS-2200 Rear Connector Layout (not to scale)

	A	B	C	D	E	F	G	H	J	K
1	RS232 TX	RS232 RX	SPARE1	SPARE2	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved
2	RS232 Ground	ATE ID	ATE ID	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	Serial No. Load	MFG Reserved
3	Strap Even Parity	ICAO #1 429 Input A	ICAO #1 429 Input B	CFDS Mode A	CFDS Mode B	CFDS Mode C	HFDL TX Inhibit Sense Input	HFDL TX Inhibit Program Input	MFG Reserved	Opposite Side HFDL Mode Enabled
4	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Spare	MFG Reserved	MFG Spare	MFG Reserved
5	CMU #1/2 A429 Bus Speed Select	Air/Gnd Prog Discrete	FAX Input Reserved	FAX Input Reserved	FAX Output Reserved	FAX Output Reserved	HFDR Crosslink Output A	HFDR Crosslink Output B	HFDR Crosslink Input A	HFDR Crosslink Input B
6	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Spare	MFG Reserved	MFG Reserved	MFG Reserved
7	Time 429 Input A	Time 429 Input B	ICAO #2 429 Input A	ICAO #2 429 Input B	Position 429 Input A	Position 429 Input B	HFDL Mode Enable	Data Link Fault Discrete Output	HFDL TX Inhibit Override	Other Side PTT
8	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved
9	CMU #1 429 Input A	CMU #1 429 Input B	CMU 429 Output A	CMU 429 Output B	CMU #2 429 Input A	CMU #2 429 Input B	MFG Reserved	MFG Reserved	HFDL TX Inhibited Discrete Output	MFG Reserved
10	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	Double Beep
11	Data Loader 429 Input A	Data Loader 429 Input B	Data Loader 429 Output A	Data Loader 429 Output B	Data Load Discrete Input	ICAO ID 1 (MSB)	ICAO ID 2	ICAO ID 3	ICAO ID 4	ICAO ID 5
12	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved
13	ICAO ID 6	ICAO ID 7	ICAO ID 8	ICAO ID 9	ICAO ID 10	ICAO ID 11	ICAO ID 12	ICAO ID 13	ICAO ID 14	ICAO ID 15
14	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Reserved	MFG Spare	MFG Reserved	MFG Spare	Maintenance Mode
15	ICAO ID 16	ICAO ID 17	ICAO ID 18	ICAO ID 19	ICAO ID 20	ICAO ID 21	ICAO ID 22	ICAO ID 23	ICAO ID 24 (LSB)	ICAO Even Parity Strap

HFS-2200 Top Plug

	A	B	C	D	E	F	G	H	J	K
1	MIC Input - HI	MIC Input-LO	MIC PTT - HI IN / OUT	Audio/Sidetone Output - HI	Audio/Sidetone Output - LO	Analog Data Output - HI	Analog Data Output - LO	Analog Data Input - HI	Analog Data Input - LO	Analog Data Keyline
2	Reserved	Audio Ground	MIC PTT - LO	Voice/Analog Data Mode Select	Key Event Discrete Output	MIC Input- LO	753 Spare	753 Spare	Fuel Operations	Frequency Source Select
3	SSB/AM Discrete Input	LSB/USB Discrete Input	SELCAL Output - HI	SELCAL Output - LO	Tuning Port A 429 Input - A	Tuning Port A 429 Input - B	Tuning Port B 429 Input - A	Tuning Port B 429 Input - B	Frequency Port Select Input	Blower Control Input
4	CFDS 429 Input A	CFDS 429 Input B	CFDS 429 Output A	CFDS 429 Output B	Coupler Fault	RF Fault	Air/Ground Discrete Input	SDI Input #1	SDI Input #0	SDI / ICAO ID Common
5	Chopper Control	Rechannel Output HF RTS/CTS	Tune Power Input CPL RTS/CTS	On/Off Relay	RF Squelch	RF Sensitivity	753 Spare	Key Relay Interlock & Serial Data LO	Narrow / Wide Range Select	Reserved - Reentrant Tune A
6	Reserved - Reentrant Tune B	Reserved - Reentrant Tune C	Reserved - Reentrant Tune D	Reserved - Reentrant Tune E	Reserved - Reentrant Tune F	Reserved - Reentrant Tune G	Reserved - Reentrant Tune H	Reserved - Reentrant Tune J	Reserved - Reentrant Tune K	Reserved - Reentrant Tune L
7	Reserved - Reentrant Tune M	Reserved - Reentrant Tune N	Reserved - Reentrant Tune P	Reserved - Reentrant Tune R	Reserved - Reentrant Tune S	Reserved - Reentrant Tune T	Reserved - Reentrant Tune W	Reserved - Reentrant Tune X	Reserved - Reentrant Tune r	Reserved - Reentrant Tune j

HFS-2200 Middle Plug



HFS-2200 Bottom Plug View

Bottom Plug	
BP-1	Interlock Excitation 753 Serial Data HI
BP-2	115 VAC Input / Output
BP-3	115 VAC Input / Output
BP-4	115 VAC Input / Output
BP-5	115 VAC Input / Output
BP-6	AC Neutral
BP-7	AC Neutral
BP-8	AC Neutral
BP-9	115 VAC Input / Output
BP-10	Chassis Ground
BP-11	(unused)
BP-12	AFDX A Insert Reserve
BP-13	AFDX B Insert Reserve

HFS-2200 Bottom Plug Detail