HST-900 FCC Type Certification Report

815-4601-001 Rev -

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CAGEC 4V792

Notices and Signatures

Notices

This document is a paper representation of the master copy which is maintained in the Product Development Manager (PDM) database.

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Approval Signatures

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Revision History

Ver/Rev	Doc Chg #	Release Date	Originator	Reasons for Change
001/-			R. L. Breitwisch	

Forward

The following information is being submitted in compliance with Part 2 and Part 87 of Title 47, Code of Federal Regulations – Telecommunications, for certification of the Rockwell Collins High Speed Data Transceiver.

Type Number: HST-900
Collins Part Number: 822-1772-xxx
FCC ID: AJK8221772

The units tested for the purposes of this report were engineering units representative of production configurations.

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1 Product Description

1.1 Overview

The HST-900 is an additional unit designed to work with the existing SAT-906 SATCOM system. The original SATCOM system consists of the following previously FCC certified components:

Type Number	Name	Manufacturer	FCC ID
SDU-906-1 (1 channel version)	Satellite Data Unit	Rockwell Collins	AJKPN822-0309
SDU-906-2 (2 channel version)	Satellite Data Unit	Rockwell Collins	AJKPN822-0310
SDU-906-3 (3 channel version)	Satellite Data Unit	Rockwell Collins	AJKPN822-0311
SDU-906-4 (4 channel version)	Satellite Data Unit	Rockwell Collins	AJKPN822-0312
SDU-906-5 (5 channel version)	Satellite Data Unit	Rockwell Collins	AJKPN822-0313
SDU-906-6 (6 channel version)	Satellite Data Unit	Rockwell Collins	AJKPN822-0314
RFU-900	Radio Frequency Unit	Rockwell Collins	AJKPN822-8849
HPA-901A	High Power Amplifier	Rockwell Collins	AJKPN8220953
Antenna System		various	n/a

Table 1 – List of Equipment

The units listed above have all previously received FCC Type Certification. The SDU-906 and HPA-901A require software modifications to support the addition of the HST-900. The modifications do not result in changes that affect previously submitted test data for these units.

The changes necessary to add an HST-900 to the existing SAT-906 System are highlighted in the shaded area of the figure below:

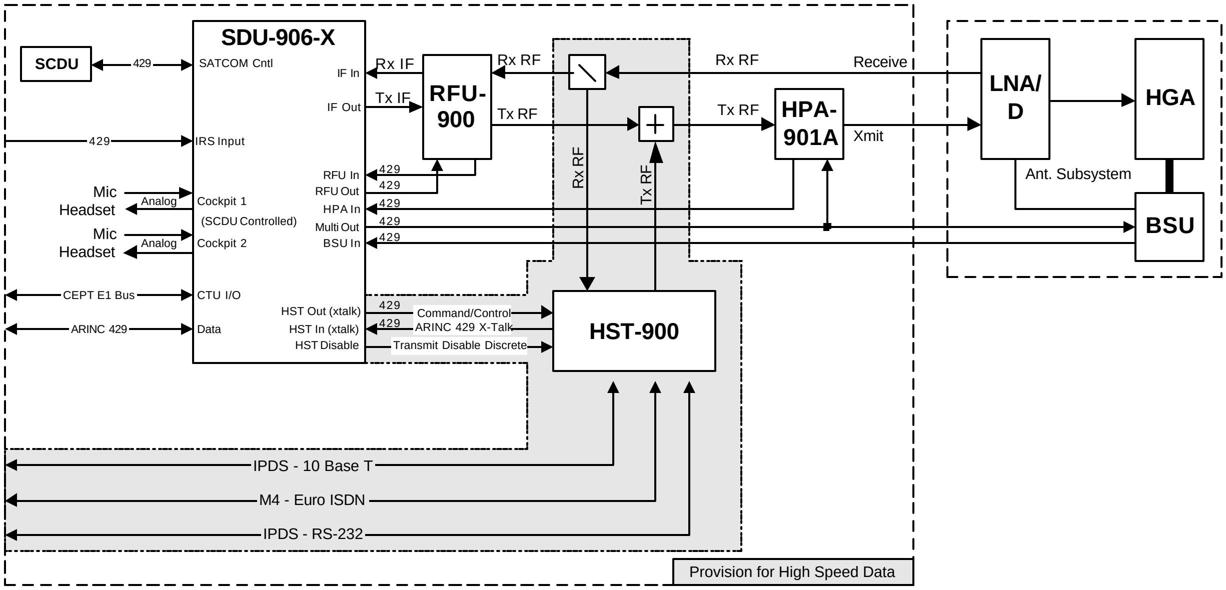

Figure 1 - SAT-906 System with HST-900

The HST-900 will add the INMARSAT Swift 64 service to the existing INMARSAT aeronautical services all ready supported by the SAT-906 system.

By incorporating the Swift 64 service from INMARSAT, the HST-900 High-Speed Transceiver will provide 64 kilobits per second connectivity using the existing SAT-906 antenna and high-power amplifier, HPA-901A. The HST-900 supplies interfaces to Ethernet, ISDN and RS-232 which will provide real time passenger e-mail and Internet access as well as the provisioning for other future high speed data applications such as real time cabin surveillance to the ground, file server and integrated information systems cockpit applications.

1.2 HST-900 Equipment Specifications

CHARACTERISTIC	SPECIFICATION
Digital interface	
Crosstalk Bus	High-speed ARINC 429 input and output
Ethernet User Interface	10 Base T input and output
ISDN User Interface	64 kbps ISDN Euro input and output
RS-232 User MPDS Interface	115.2 kbps RS-232 input and output
RS-232 Data Loader Port	115.2 kbps RS-232 input and output
Input characteristics	
Frequency range	1530.0 to 1559.0 MHz
Impedance	50 Ω nominal
Vswr	2.0:1 max
Signal input level	-100 dBm to -60 dBm
Output characteristics	
Frequency range	1626.5 to 1660.5 MHz
Impedance	50 Ω nominal
Load vswr	2.0:1 operational, infinite, survival
Output power	-6.5 dBm to 22 dBm in 0.5 dB increments

Table 2 – Equipment Specifications

1.3 HST-900 Hardware Overview

The diagram shows the major functional blocks of the HST-900 unit.

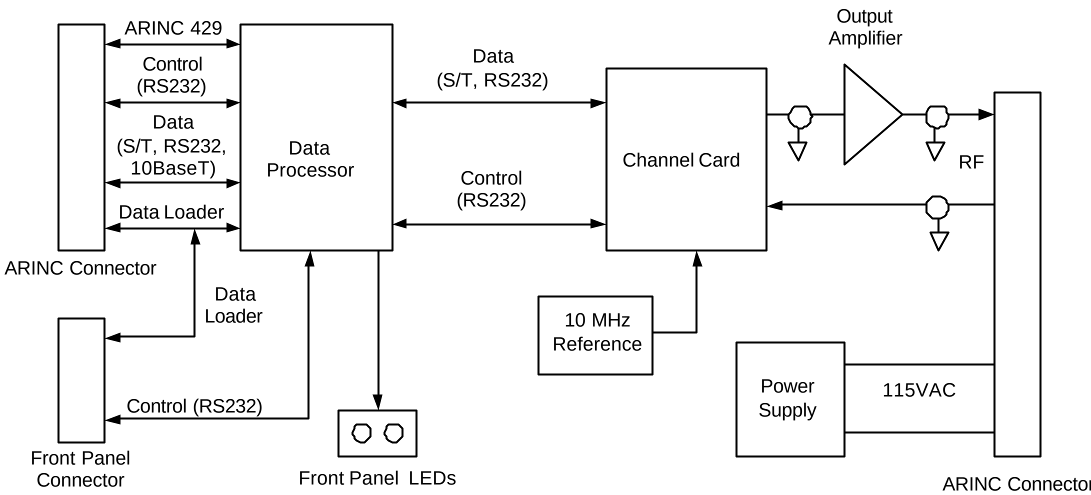

Figure 2 - HST-900 Functional Block Diagram

1.4 Mechanical

The HST-900 is housed in a 2-MCU-size unit with mounting requirements according to the ARINC600 specification. The HST-900 chassis is designed for either forced air or convection cooling. The front panel contains a data loader connector used to upload data to the HST-900 and set of LEDs to indicate unit status. It also contains a “self-test” button and corresponding LED indicators for active operator maintenance. A backplane assembly interfaces the Arinc 600 connector with the power supply, channel card, data processor card, and output amplifier. The HST-900 also contains an ovenized high stability crystal oscillator to provide a stable 10 MHz reference to the channel card.

1.5 Channel Card

The Channel Card contains the entire physical layer to L band and the protocols of an M4 terminal. In addition to the basic M4 (including MPDS) functionality, the Channel Card interfaces with the Data Processor for command and control functions. Interfaces between the Channel Card and the Data Processor fall into the broad categories of Operational, BITE, Maintenance and Test and Approval.

Data interfaces to the Channel Card are ISDN BRI S/T for circuit switched data and RS-232 for packet data (MPDS). Voice services shall not be supported.

1.6 Data Processor

The purpose of the Data Processor is twofold:

1.6.1 Control

The Data Processor shall mediate between the Channel Card and the SDU, performing protocol conversion as required ensuring proper control of the HST-900. It shall also provide configuration and testing capabilities.

1.6.2 User Data

The Data Processor shall provide data conversion between the ISDN and RS232 on the Channel Card and other interfaces as required (i.e., 10BaseT Ethernet). This may include providing OSI Layer 2 and Layer 3 services.

1.7 Power Supply

The Power Supply provides regulated power to the Channel Card, External Reference, Output Amplifier and Data Processor.

1.8 External Reference

The External Reference provides a stable 10 MHz reference signal to the Channel Card.

1.9 Output Amplifier

The Output Amplifier increases the power of the RF signal from the Channel Card to the required level.

1.10 Backplane

The Backplane is a passive module that provides interconnection between all other modules of the HST-900 and to the outside world.

2 Technical Report

2.1 Name and Address [2.1033(c)(1)]

The name and address of the manufacturer of the HST-900 High Speed Satellite Transceiver and applicant for certification is Rockwell Collins, Inc., 1300 Wilson Boulevard, Suite 200, Arlington, Virginia 22209.

2.2 FCC Identifier [2.1033(c)(2)]

FCC ID	Description
AJK8221772	**HIGH-SPEED SATCOM TRANSCEIVER** (HST-900)

2.3 Installation and Operation Manuals [2.1033(c)(3)]

Rockwell Collins does not supply operating instructions with the HST-900, which is designed to meet the requirements of ARINC 741 and RTCA DO-210D and is operated by trained pilots as part of the SATCOM system. Rockwell Collins does produce a comprehensive Installation Manual which, pursuant to agreement with FCC staff, is available upon request but is not included in this electronic exhibit.

2.4 Type or Types of Emission [2.1033(c)(4)]

The HST-900 utilizes the following types of emissions:

Data Rate	Symbol Rate	Modulation Type	Emission Designation
3000 bps	3000 sym/sec	Unfiltered BPSK	5K60G1D
134400 bps	33.6k sym/sec	16-QAM	40K0D1D 40K0D1E 40K0D1W

Table 3 – Emission Types

2.5 Frequency Range [2.1033(c)(5)]

The HST-900 transmitter frequency range is 1626.5 MHz to 1660.5 MHz. The receiver frequency range is 1530 MHz to 1559 MHz.

2.6 Range of Operating Power Values [2.1033(c)(6)]

The HST-900 channel has a maximum transmitter output power of 159 mW (22 dBm) for 134400 bps and 22.4 mW (13.5 dBm) for 3000 bps (measured at the antenna terminals). The HST-900 carrier transmit output power adjustment range is from 0 dB to –28.5 dB.

At a system level, this signal is amplified by the HPA and transmitted through the High Gain antenna. The SDU-906 considers the current antenna gain, and controls the HST-900 output level and HPA-901A gain in order to maintain the desired EIRP. The 3000 bps registration channel operates at a fixed EIRP of 14 dBW. The 134400 bps data channel is established at an initial EIRP of 22.5 dBW, and may be reduced by 2, 4 or 6 dB, depending on observed link margins.

Therefore, the power output at the antenna terminals (equivalent to the HPA output minus coax loss) varies depending on antenna gain, and may approach an absolute maximum of 60 Watts under conditions of low antenna gain.

2.7 Maximum Power Rating [2.1033(c)(7)]

According to Section 87.131, UHF aircraft earth stations with emission designator G1D, G1E, and G1W are permitted a maximum of 60 Watts per carrier. Although the HST - 900 transmits a signal with emission designator of D1D, D1E and D1W, it operates in the same frequency band and should logically be expected to conform to this requirement.

The HST-900 operates as an exciter in the system and does not determine the maximum output power. System gains are controlled by logic in the SDU-906 to maintain a desired EIRP. The desired EIRP for the 3000 bps control channel is 14 dBW. The initial EIRP for the 134400 bps channel is 22.5 dBW, and may be reduced to lesser levels if link margins warrant.

Under conditions of reduced antenna gain, the HPA-901A may be driven to its **maximum rated output power of 60 Watts** (combined output power of all carriers) in order to maintain the desired EIRP. If the antenna gain falls to the extent that the EIRP of all carriers can no longer be maintained without exceeding the rated output power of the HPA-901A, carriers are dropped according to priority to prevent overdriving the HPA.

2.8 DC Voltages and Currents [2.1033(c)(8)]

DC Supply Voltage	Maximum DC Supply Current	Typical Measured DC Supply Current
+12 VDC	1.8 A	1.5 A

2.9 Tune Up Procedure [2.1033(c)(9)]

The HST-900 transmitter does not require tune up during construction, maintenance or operation. The only adjustable component in the HST-900 is the High Stability Reference Oscillator, which is adjusted for proper frequency prior to unit assembly.

2.10 Schematics and Circuit Diagrams [2.1033(c)(10)]

All RF circuitry is contained on the channel card and RF Output module. The complete schematics for these modules are contained in **"*Attachment 1 – Circuit Diagrams*"**. The channel card and output driver card are interconnected as shown in Figure 2.

2.11 Nameplate Label Drawings [2.1033(c)(11)]

The proposed front panel nameplate content and location is contained in **"*Attachment 2 - Nameplate*".**

2.12 Equipment Photographs – External [2.1033(c)(12)]

Internal and external photographs of the HST-900 are contained in **"*Attachment 3 – Equipment Photographs*"**.

2.13 Digital Modulation System [2.1033(c)(13)]

The HST-900 utilizes two different modulation types as described below:

3000 BPS Digital Modulation
Used for registration and call setup / teardown.
Modulation: BPSK
Pulse Shape Filtering: None

The bit sequence from the FEC encoder modulates an intermediate frequency using BPSK. The intermediate frequency is then upconverted to L-band for transmission.

Bit Rate	Symbol Rate	Modulation Type
3000	3000	BPSK

134400 BPS (64000 BPS User Data Rate)
Used for user data communication.
Modulation: Square 16-QAM.
Pulse Shape Filtering: Square root raised cosine filter with roll-off factor of 0.25.

The 4-bit symbol sequence output from the FEC encoder is mapped into a square 16-QAM intermediate frequency and is then upconverted to L-band for transmission.

Bit Rate	Symbol Rate	Modulation Type
134400	33600	16-QAM

Note: This channel is commonly referred to as the 64000 bps (64K) channel, as this is the information data rate available to the user.

2.14 Required Measurements [2.1033(c)(14)]

The data required by 2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in 2.1041, is provided in Section 3 of this report.

3.0 Test Procedures and Results

3.1 Test Procedure and Compliance Matrix

The table below identifies the applicable sections of this document and its relationship between the Parts 2 and 87 requirements. The test diagrams, procedures and results are included listed sections of the report.

3.2 Test Requirements Matrix

Part 2	Part 87	Test Description Summary	Report
2.1046	87.131	RF Power Output	3.4
2.1047	87.141	Modulation Characteristics	3.5
2.1049	87.135	Occupied Bandwidth	3.6
2.1051	87.139	Spurious Emissions at Antenna Terminals	3.7
2.1053	87.139	Field Strength of Spurious Radiation	3.8
2.1055	87.133	Frequency Stability	3.9
N/A	87.187 (q)	Priority and Preemption	3.10

Table 4 - Test Requirements Matrix

3.3 Test Equipment

The test equipment used for each test is listed in the relevant test sections.

3.4 RF Power Output

3.4.1 FCC Requirements

The relevant FCC requirements being addressed by this test are:

Section 2.1046 (a)
For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the value of current and voltage on circuit elements specified in 2.1033 (c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

Section 87.131 Notes (1), (ii), (8)

Class of Station	Frequency Band	Authorized Emissions[9]	Maximum Power[1]
Aircraft Earth	UHF	G1D, G1E, G1W	60 Watts[8]

(1) The power is measured at the transmitter output terminals and the type of power is determined according to the emission designator as follows:

(ii) Peak envelope power (pX) for all emission designators other than those referred to in paragraph (I) of this note.

(8) Power may not exceed 60 watts per carrier. The maximum EIRP may not exceed 2000 watts per carrier.

3.4.2 Test Equipment List

Quantity	Item
1	MCDU with Cockpit telephone interface
1	SAT-906 Over the air test station with HST-900
1	SDU-906, pn 822-0314-101
1	RFU-900, pn 822-8849-100
1	HPA-901A, pn 822-0953-002(engineering unit)
1	HST-900, pn1110-A-0201
1	Ground telephone

3.4.3 Test Setup, Equipment and Results for RF Power Output

This test demonstrates the ability of the SAT-906 system to control the RF output power of the HST-900 to achieve the desired HPA output power and EIRP in the presence of Aero SATCOM carriers (generated by the SDU/RFU) under conditions of varying antenna gains.

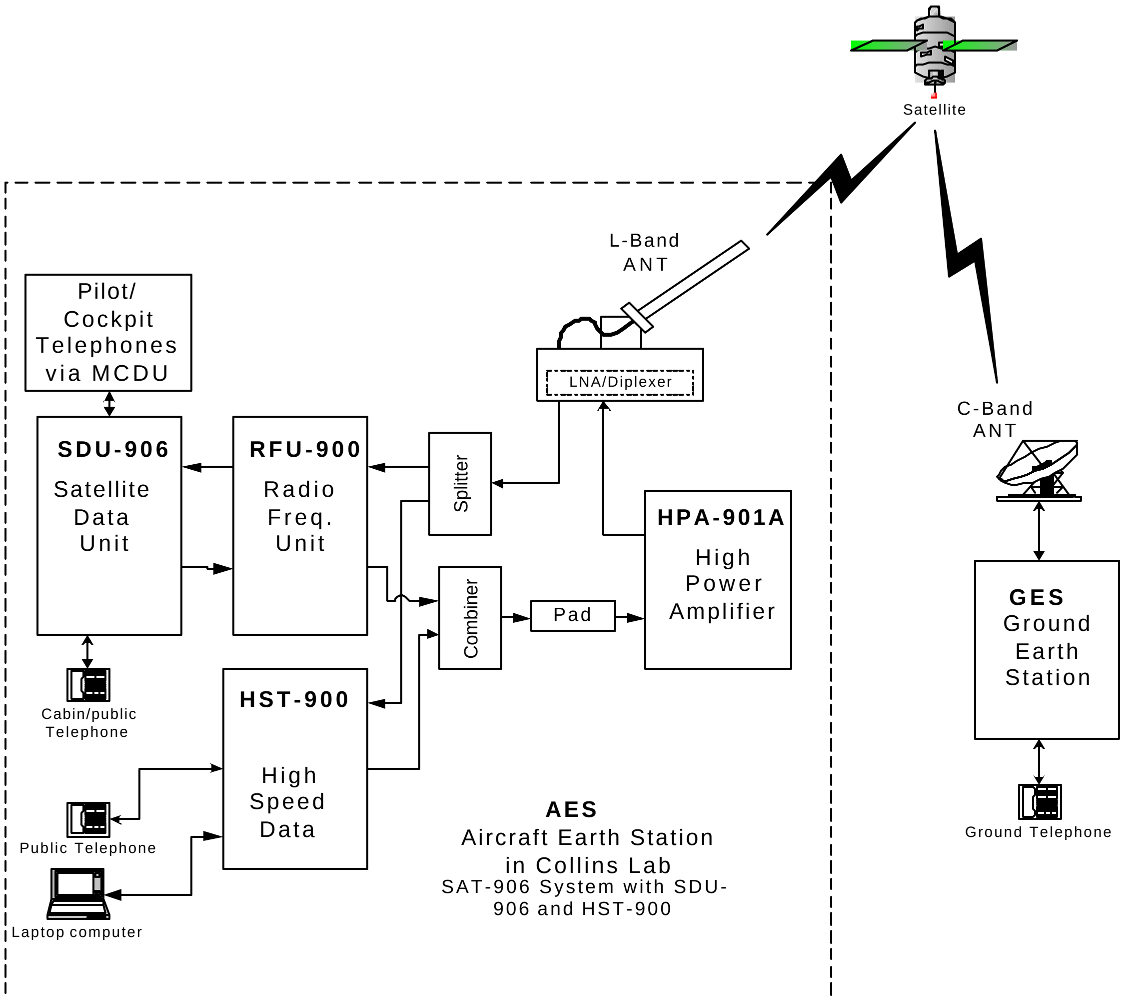

Figure 3 - RF Power Output Test Setup

Test Procedure

1. Measure the RFU to HPA loss of the test station. Enter into data sheet.
2. Measure the HST to HPA loss of the test station. Enter into data sheet.
3. On the SimPC, confirm that the antenna gain is 12 dB.
4. Apply power to all the LRUs.
5. Enter TEST on the HST trace PC, then =, then 29, then ESC. This step may be avoided if the HST trace is showing the available, requested, allocated and back off commands from the SDU.
6. Wait for HST to log onto the M4 network.
7. Enter test command 159 into the SDU to show the HPA reported output power.
8. Enter test command XX and YY in the SDU to set channel preferences 1 & 2 to 4800 and 4800 respectively.
9. Set up an M4 circuit and allow the HST output power to settle as per the LES power control commands. Note the following on the data sheet as the power settles:
    a. Antenna Gain
    b. Aero Call 1 EIRP
    c. Aero Call 2 EIRP
    d. HST Reported EIRP
    e. HPA Reported Output Power Level

10. Bring up a 4800 bps Aero circuit in the SAT-906 via the MCDU. Allow the power to settle as per the Aero GES power control commands. Note the following on the data sheet :
    a. Antenna Gain
    b. Aero Call 1 EIRP
    c. Aero Call 2 EIRP
    d. HST Reported EIRP
    e. HPA Reported Output Power Level
11. Bring up a 4800 bps Aero circuit in the SAT-906 via the MCDU. Allow the power to settle as per the Aero GES power control commands. Note the following on the data sheet :
    a. Antenna Gain
    b. Aero Call 1 EIRP
    c. Aero Call 2 EIRP
    d. HST Reported EIRP
    e. HPA Reported Output Power Level
12. Vary the antenna gain between a maximum of 15dB and a minimum of 8 dB. . Note the following on the data sheet for each antenna gain :
    a. Antenna Gain
    b. Aero Call 1 EIRP
    c. Aero Call 2 EIRP
    d. HST Reported EIRP
    e. HPA Reported Output Power Level

Max HPA out (dB) :	2								
Max Out dBW	18.02								
Max Out dBm :	48.02								
Ant to HPA Loss :	2.5								
HST max Out (dBm) :	22								
HST Offset (loss) :	0.07								
RFU to HPA Attn =	21.24	(measured)							
HST to HPA Attn =	21.31	(measured)							
		4800	**4800**			**Desired**	**MEASURED**		
Ant Gain	**Total EIRP**	**EIRP**	**EIRP**	**HST EIRP**	**HST Out**	**HPA Out**	**HPA Out**	**error**	**Pass/Fail**
dB	**dBW**	**Call 1**	**Call 2**	**dBW**	**dBm**	**dBm**	**dBm**	**dB**	**(+/- 1.0 dB)**
12	27.52	-100	-100	-100	-110.43	-4.00	-12.00	-8.00	Pass
12	27.52	-100	-100	14	3.57	34.50	34.60	0.10	Pass
12	27.52	-100	-100	22.5	12.07	43.00	42.80	-0.20	Pass
12	27.52	-100	-100	20.5	10.07	41.00	41.40	0.40	Pass
12	27.52	-100	-100	18.5	8.07	39.00	39.30	0.30	Pass
12	27.52	12.5	-100	18.5	8.07	39.97	40.30	0.33	Pass
12	27.52	11.5	-100	18.5	8.07	39.79	40.10	0.31	Pass
12	27.52	10.5	-100	18.5	8.07	39.64	40.00	0.36	Pass
12	27.52	10.5	12.5	18.5	8.07	40.49	41.00	0.51	Pass
12	27.52	10.5	11.5	18.5	8.07	40.33	40.80	0.47	Pass
12	27.52	10.5	10.5	18.5	8.07	40.20	40.60	0.40	Pass
13	28.52	10.5	10.5	18.5	7.07	39.20	39.60	0.40	Pass
14	29.52	10.5	10.5	18.5	6.07	38.20	38.60	0.40	Pass
15	30.52	10.5	10.5	18.5	5.07	37.20	37.70	0.50	Pass
16	31.52	10.5	10.5	18.5	4.07	36.20	36.50	0.30	Pass
15	30.52	10.5	10.5	18.5	5.07	37.20	37.40	0.20	Pass
14	29.52	10.5	10.5	18.5	6.07	38.20	38.30	0.10	Pass
13	28.52	10.5	10.5	18.5	7.07	39.20	39.30	0.10	Pass
12	27.52	10.5	10.5	18.5	8.07	40.20	40.30	0.10	Pass
11	26.52	10.5	10.5	18.5	9.07	41.20	41.20	0.00	Pass
10	25.52	10.5	10.5	18.5	10.07	42.20	42.30	0.10	Pass
9	24.52	10.5	10.5	18.5	11.07	43.20	43.40	0.20	Pass
8	23.52	10.5	10.5	18.5	12.07	44.20	44.30	0.10	Pass
9	24.52	10.5	10.5	18.5	11.07	43.20	43.40	0.20	Pass
10	25.52	10.5	10.5	18.5	10.07	42.20	42.40	0.20	Pass
11	26.52	10.5	10.5	18.5	9.07	41.20	41.30	0.10	Pass
12	27.52	10.5	10.5	18.5	8.07	40.20	40.40	0.20	Pass
12	27.52	10.5	-100	18.5	8.07	39.64	39.80	0.16	Pass
12	27.52	-100	-100	18.5	8.07	39.00	39.20	0.20	Pass
12	27.52	-100	-100	14	3.57	34.50	35.00	0.50	Pass
12	27.52	-100	-100	-100	-110.43	-4.00	-2.80	1.20	Pass

3.4.4 Test Results Discussion

Since the HST-900 drives a common High Power Amplifier, the actual output power is determined by the SDU-906 which controls system gains and ensures the desired output power at the antenna. The SDU-906 power control software is responsible for ensuring that the maximum HPA output power is limited to 60 Watts, and that the maximum EIRP cannot exceed 2000 Watts EIRP. The test results above verify that the HST-900 generates the correct power output, and allows the SDU-906 to control system gains and maintain the desired HPA power output. The power control software that prevents overdriving the 60 Watt HPA is contained in the SDU-906.

The 3000 bps BPSK modulation is classified as G1D and, as such, is an authorized emission under 87.131. The 134400 16-QAM waveform is classified as G1D, G1E, or G1W, depending on use. These three emission types are not presently listed as an authorized emission in the table of 87.131. A waiver to utilize these new emission types is being requested.

This test data demonstrates the system will comply with the maximum output power requirements of 87.131 for Aircraft Earth Stations.

3.5 Modulation Characteristics [2.1047(d)]

3.5.1 FCC Requirements
The relevant FCC requirements being addressed by this test are:

Section 2.1047 (d)
A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Section 87.141 (j)
Transmitters used at Aircraft earth stations must employ BPSK for transmission rates up to and including 2400 bits per second, and QPSK for higher rates.

3.5.2 Test Setup, Equipment and Results for Modulation Characteristics

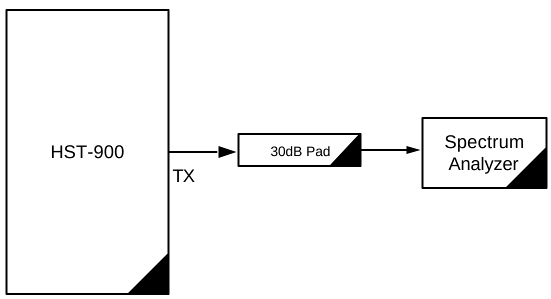

Figure 4 Modulation Characteristics Test Setup

Test Equipment for Modulation Characteristic

Equipment Name	*Recommended Equipment Model Number*	*Required For*
Spectrum Analyzer	R&S FSEB (or equivalent)	Measuring constellation diagrams

Modulation Characteristics Test Results
Date: 26 June 2002
Location: EMS Technologies, Ottawa, Canada
Model: HST-900
Serial number: 004
Test procedure: Configure the HST-900 to transmit a 3000 bps BPSK signal and measure the constellation diagram. Repeat this test while transmitting a 134400 bps 16-QAM signal.

3000 BPS BPSK

Figure shows the measured I/Q Constellation points for the transmitted 3000 BPS BPSK signal. The symbol rate is 3000 Hz.

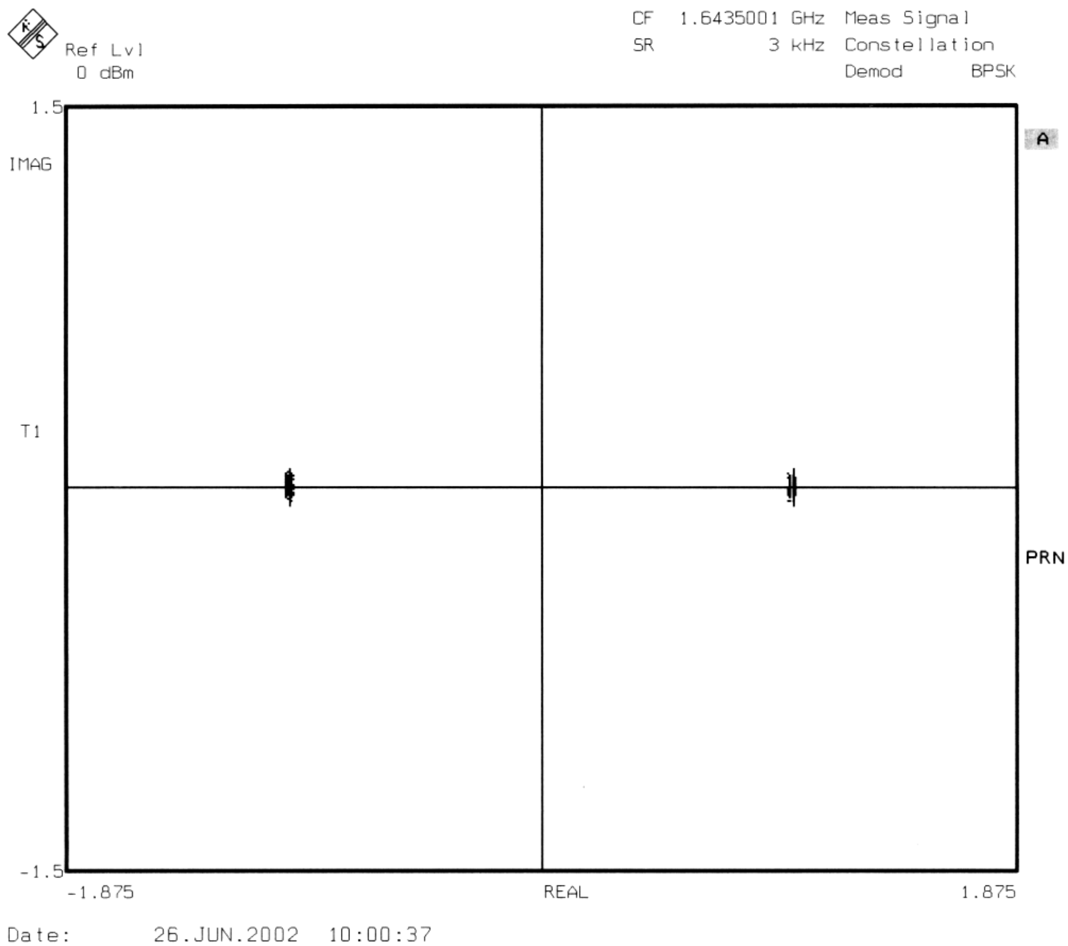

Figure 5 - 3000 bps BPSK I/Q Diagram

134400 BPS 16-QAM

The following figure shows the measured I/Q Constellation points for the transmitted 134400 BPS 16-QAM signal. The symbol rate is 33600 Hz.

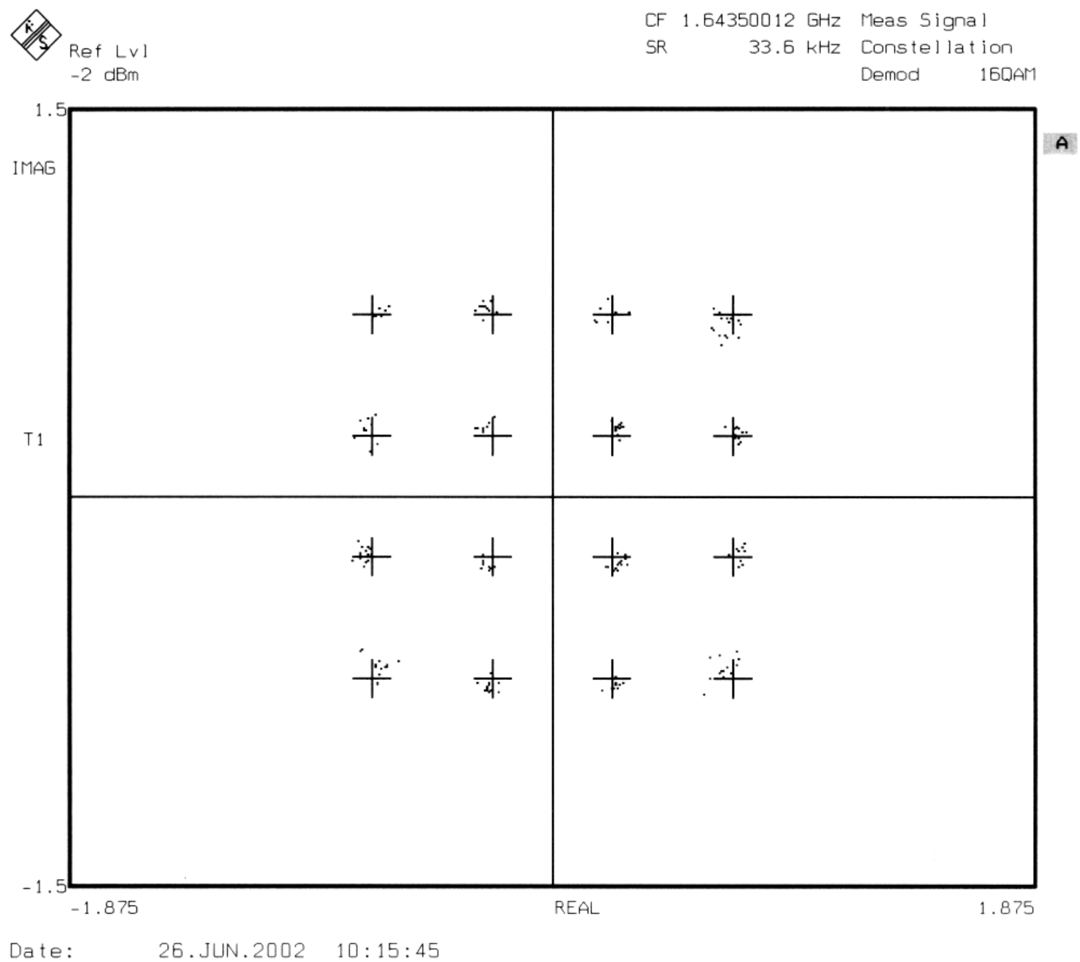

Figure 6 – 134400 bps 16-QAM I/Q Diagram

3.5.3 Test Results Discussion

The data rates and modulation characteristics of the new INMARSAT Swift64 service are not accommodated by the current Part 87 regulations, and conflict with the requirements of 87.141(j). These test results are provided to document the characteristics of the Swift64 modulation waveforms should a Waiver be granted to permit their use.

3.6 Occupied Bandwidth

3.6.1 FCC Requirements

Section 2.1049
The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable.

Section 2.1049 (h)
Transmitters employing digital modulation techniques – when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

Section 87.135 (a), (b), (c)
(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are equal to 0.5 percent of the total mean power of a given emission.

(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Section 87.137 (a), (b)
(a) The assignable emissions, corresponding emission designators and authorized bandwidths are as follows:

Class of emission	Emission Designator	Authorized Bandwidth (kilohertz)		
		Below 50 MHz	Above 50 MHz	Frequency Deviation
G1D[16]	21K0G1D		25	
G1E[16]	21K0G1E		25	
G1W[16]	21K0G1W		25	

[16] Authorized for use by Aircraft Earth Stations. Lower values of necessary and authorized bandwidth are permitted.

(b) For other emissions, an applicant must determine the emission designator by using Part 2 of this chapter.

3.6.2 Test Setup, Equipment and Results for Occupied Bandwidth

Test Setup
The HST-900 was tested with a Collins HPA-901A and measurements were made at the output of the HPA-901A.

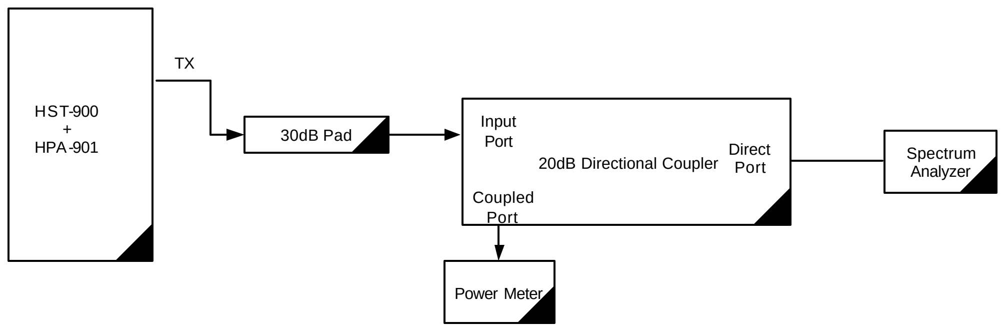

Figure 7 - Occupied Bandwidth Test Setup

Test Equipment for Occupied Bandwidth

Equipment Name	*Recommended Equipment Model Number*	*Required For*
Power Meter	HP437B (or equivalent)	Measuring RF Power in CW Mode
Spectrum Analyzer	R&S FSEB (or equivalent)	Measuring Output Spectrum
10dB fixed attenuator	ATM 5027-10(or equivalent)	Reducing RF Output Power to safe levels
20dB fixed attenuator	ATM 5027-20(or equivalent)	Reducing RF Output Power to safe levels
20dB Directional Coupler	HP778D (or equivalent)	Reducing RF Output Power to safe levels

Occupied Bandwidth Test Results
Date: 26 June 2002
Location: EMS Technologies, Ottawa, Canada
Model: HST-900
Serial number: 004
Test procedure: Generate a signal and measure occupied bandwidth.

3000 BPS

The occupied bandwidth is 26.85 kHz, as shown in the following plot:

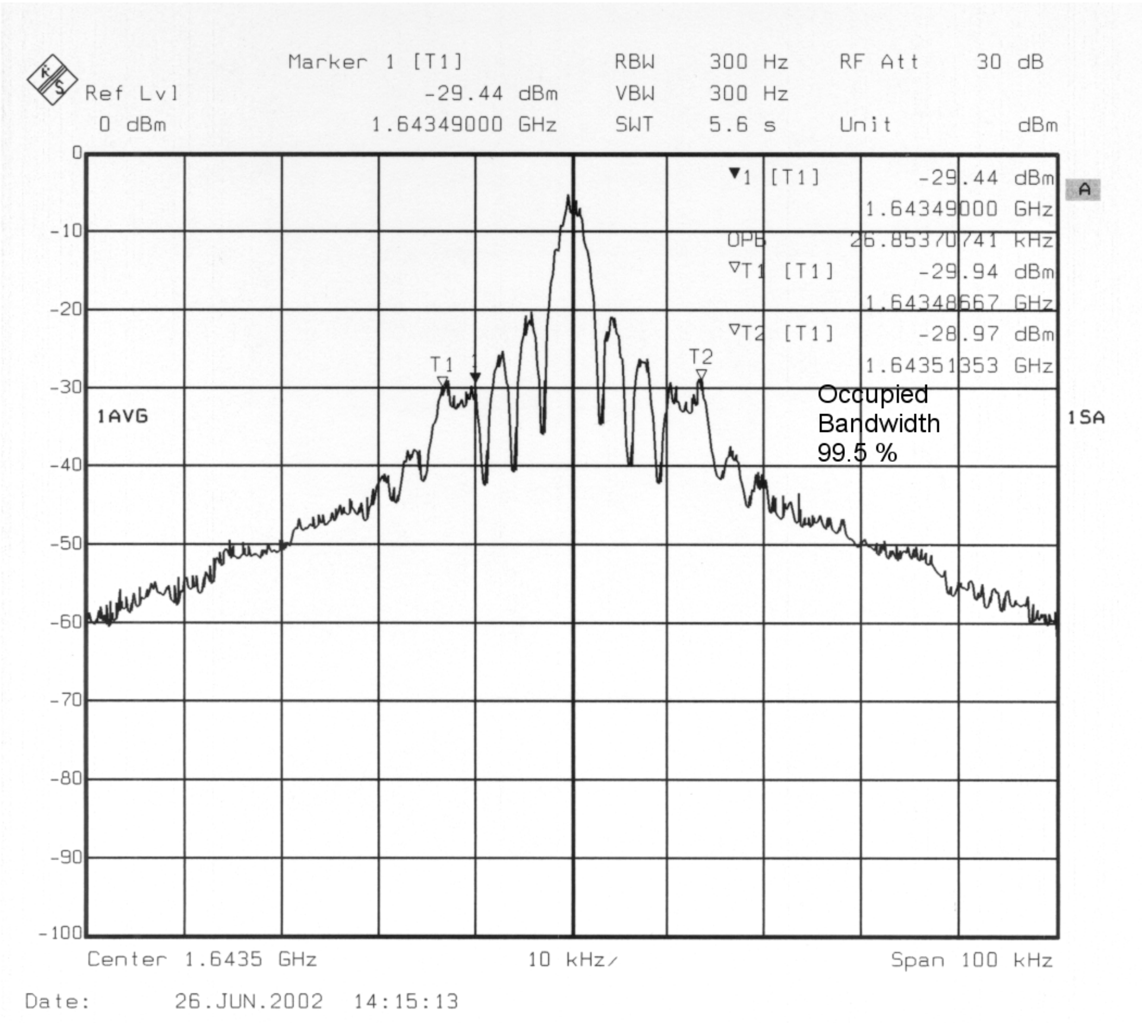

Figure 8 – Occupied Bandwidth 3000 bps

134400 BPS

The occupied bandwidth is 39.84 kHz, as shown in the following plot:

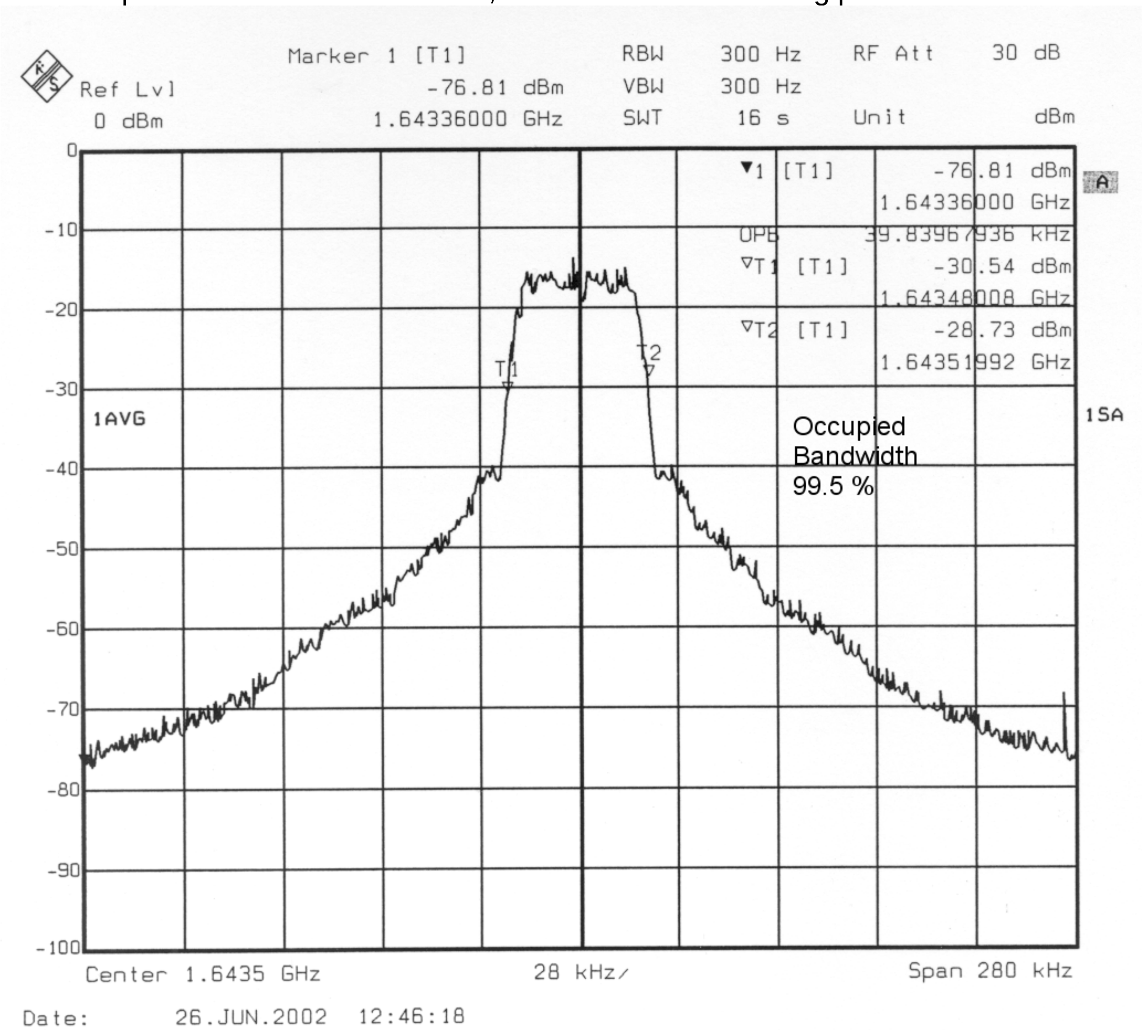

Figure 9 – Occupied Bandwidth 134400 bps

3.6.3 Test Results Discussion

The two emissions types used by the INMARSAT for the Swift64 service are not currently accommodated in the tables of 87.137(a). Specifically:

> The 3000 bps signaling channel which uses an unfiltered BPSK modulation has an occupied bandwidth measured at 26.85 kHz, exceeding the 25 kHz authorized bandwidths for G1D emissions.
>
> The 64000 bps 16-QAM user data channel has an occupied bandwidth measured at 39.84 kHz. This higher data rate emission type (D1D, D1E, D1W) is not accommodated by the table of 87.137.

Rockwell Collins intends to submit a Request for Waiver to accommodate these new emission types utilized by the INMARSAT Swift64 service and their associated occupied bandwidths.

3.7 Spurious Emissions at Antenna Terminals

3.7.1 FCC Requirements

Section 2.1051
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Section 2.1049 as appropriate. The magnitude of spurious emissions attenuated more than 20 dB below the permissible values need not be specified.

Section 87.139 (i) (1), (2), (3), (4)
(i) In case of conflict with other provisions of Section 87.139, the provisions of this paragraph shall govern for aircraft earth stations. When using G1D, G1E, or G1W emissions in the 1646.5 – 1660.5 MHz frequency band, the emissions must be attenuated as shown below.

(1) At rated output power, while transmitting a modulated single carrier, the composite spurious and noise output shall be attenuated below the mean power of the transmitter, pY, by at least:

Frequency (MHz)	Attenuation (dB) [1]
0.005 – 1559	83 or (65 + $10\log_{10}(pY)$), whichever is greater
1559 -18000	55 or (37 + $10\log_{10}(pY)$)[2], whichever is greater

1 these values are expressed in dB below the carrier referenced to a 4 kHz bandwidth and relative to the maximum emission envelope level.

[2] excluding the frequency band of +/- 35 kHz or +/- 4.00 x Symbol Rate, about the carrier frequency, whichever is the greater exclusion.

(2) For transmitters rated at 60 watts or less:
When transmitting two unmodulated carriers, each 3 dB below the rated power, the mean power of any intermodulation products must be at least 24 dB below the mean power of either carrier.

(3) The transmitter emission limit is a function of the modulation type and the Symbol Rate (SR). Symbol Rate is expressed in symbols per second.

(4) While transmitting a single modulated signal at the rated output power of the transmitter, the emissions must be attenuated below the maximum emission level by at least:

Frequency Offset (normalized SR)	Attenuation (dB)
+/- 0.75 x SR	0
+/- 1.40 x SR	20
+/- 2.80 x SR	40
+/- 4.00 x SR or +/- 35 kHz whichever is greater	Fm

where:
Fm = 55 or (37 + $10\log_{10}(pY)$), whichever is greater
SR = Symbol Rate
SR = 1 x channel rate for BPSK
SR = 0.5 x channel rate for QPSK

The mask shall be defined by drawing straight lines through the above points.

3.7.2 Test Setup, Equipment and Results for Spurious Emissions [Section 87.139 (i) (1)]

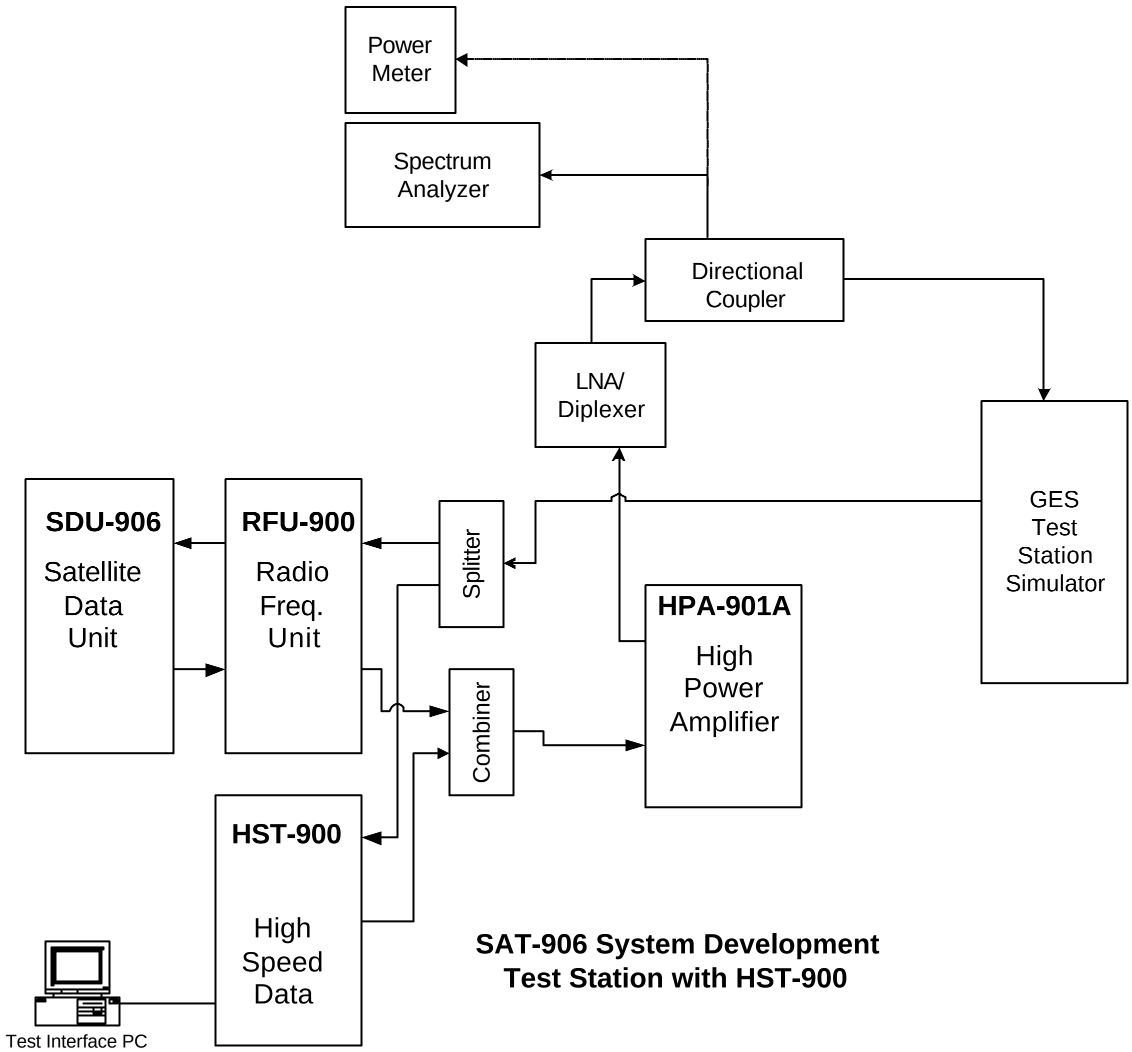

Figure 10 - Spurious Emissions Test Setup

Test Equipment for Spurious Emissions

Equipment Name	*Recommended Equipment Model Number*	*Required For*
HST-900	EMS pn 1110-A-0201	SAT-906 System Component
SDU-906	Collins pn 822-0314-100	SAT-906 System Component
RFU-900	Collins pn 822-8849-100	SAT-906 System Component
HPA-901A	Collins pn 822-0953-002 (engineering unit)	SAT-906 System Component
LNA/Diplexer	Ball Aerospace pn 511610-500	SAT-906 System Component
Splitter	Mini Circuits pn ZAPD-2-9	SAT-906 System Component
Combiner	Mini Circuits pn ZAPD-2-9	SAT-906 System Component
Directional Coupler	Narda 3002-10(or equivalent)	Coupler RF path to test equipment
Power Meter	HP437B (or equivalent)	Measuring RF Power
Spectrum Analyzer (up to 18GHz,LowNoise)	Agilent 8563EC (or equivalent)	Measuring Output Spectrum and Unwanted Emissions
GES Test Station	Collins Custom Design(RI 045633)	Simulate communications over satellite and ground earth station
Test Interface PC	IBM Compatible PC with custom interface SW to control HST-900 test modes	Set up HST-900 test mode

The HST-900 was tested within the SAT-906 system configuration which included a RFU-900, HPA-901A, and LNA/Diplexer as illustrated in Figure 10. Measurements were made at the output of the LNA/Diplexer. The HST-900 was set up to transmit at full power using the 16-QAM modulation. Since the modulation waveform is generated digitally using the same transmit path and components, the spurious performance is independent of the waveform being transmitted.

Test Results for Spurious Emissions

Date: August 24, 2002
Location: Rockwell Collins, Cedar Rapids, Iowa
Model: HST-900, sn001

Test Procedure for Spurious Emissions

1. Setup the equipment as shown in Figure 10.
2. Configure system for 12 dB antenna gain and allow SDU to log-on to GES simulator enable HST-900 channel card power up.
3. Use test interface PC to configure HST-900 for the maximum EIRP (22.5 dBm) using a CW signal to establish mean power reference level. [On RS232 interface, enter “TST”, at Menu 5 enter “U”-Initialize HST ODU registers, F-Set TX Frequency(1643.5 MHz), E-Request EIRP from SDU(22.5 dBW), M-Set Modulation Type(CW, C-continuous)]
4. Measure mean power with power meter and set spectrum analyzer to set base line reference level.
5. Use test interface PC to configure HST-900 for 16-QAM modulation at the maximum EIRP (22.5 dBm). [E-Request EIRP from SDU(22.5 dBW), M-Set Modulation Type(16-QAM, C-continuous)]
6. Measure mean power with power meter then connect spectrum analyzer and make measurements according to spectrum analyzer settings in table below.

Test Results for Spurious Emissions

Spectrum analyzer measurements were made according to the spectrum analyzer configurations in the following table. These measurements are included in Attachment 4.

Attachment 4 Figure Number	Frequency	Modulation/EIRP	Frequency Span	Resolution Bandwidth
Figure 1	0 – 1.5 GHz	16-QAM/22.5 dBW	-	3 kHz
Figure 2	1.5 – 2.5 GHz	16-QAM/22.5 dBW	-	10 kHz
Figure 3	2.0 – 22.0 GHz	16-QAM/22.5 dBW	-	30 kHz
Figure 4	Center	16-QAM/22.5 dBW	100 MHz	100 kHz
Figure 5	Center	16-QAM/22.5 dBW	10 MHz	30 kHz
Figure 6	Center	16-QAM/22.5 dBW	1 MHz	3 kHz
Figure 7	Center	16-QAM/22.5 dBW	500 kHz	3 kHz
Figure 8	Center	16-QAM/22.5 dBW	200 kHz	3 kHz
Figure 9	Center	16-QAM/22.5 dBW	100 kHz	3 kHz

Table 5 – Table of Emissions Data

Note on Measurement Bandwidths

The spectrum analyzer measures signal power in a particular "resolution bandwidth" as it sweeps across the selected frequency band and plots the data. If a wider bandwidth is used, more power is in that band and the point plotted is higher in amplitude. Section 87.139 (i) (1) footnote 1 states that "these values are expressed in dB below the carrier referenced to a 4 kHz bandwidth and relative to the maximum emission envelope level."

The appropriate pass/fail criteria to accommodate the different bandwidths used during measurements are as follows:

Frequency Range	Discrete Limit	Noise Limit (4kHz Bandwidth Equivalent)			
		3 kHz	10 kHz	30 kHz	100 kHz
0-1559 MHz	-83 dBc	-84.25 dBc	-79.02 dBc	-74.24 dBc	-63.18 dBc
1559 MHz–22 GHz	-55 dBc	-56.25 dBc	-51.02 dBc	-46.25 dBc	-41.02 dBc

For convenience, the limit line on each plot is the more severe of the discrete and broadband limits, In effect, it is the broadband limit of -56.25 dBc (-84.25 dBc) is shown on plots taken with a 3 kHz resolution bandwidth, and -55 dBc (-83 dBc) is shown for all plots with bandwidths greater than 4 kHz.

3.7.3 Test Setup, Equipment and Results for Intermodulation [Section 87.139 (i) (2)]

This section is not applicable to the HST-900 since it only has single channel capability. The SAT-906 system compliance was demonstrated in the previous HPA-901A certification report, FCC ID:AJKPN8220953.

3.7.4 Test Setup, Equipment and Results for Frequency Spectrum [Section 87.139 (i) (3) and (4)]

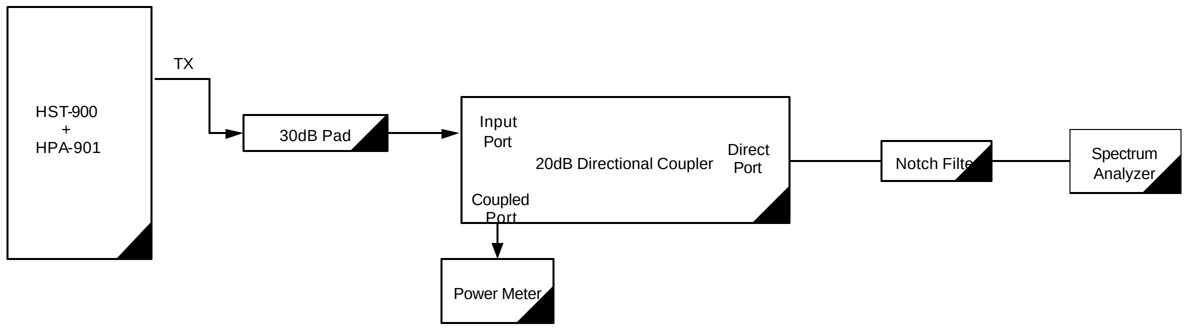

Figure 11 - Frequency Spectrum Test Setup

Note: The Notch Filter was removed for the following transmitter spectrum measurements.

Test Equipment for Frequency Spectrum

Equipment Name	*Recommended Equipment Model Number*	*Required For*
Power Meter	HP437B (or equivalent)	Measuring RF Power in CW Mode
Spectrum Analyzer (up to 18GHz, Low-Noise)	Agilent 8563EC (or equivalent)	Measuring Output Spectrum and Unwanted Emissions
Network Analyzer	HP8753D (or equivalent)	Measuring path losses
10dB fixed attenuator	ATM 5027-10(or equivalent)	Reducing RF Output Power to safe levels
20dB fixed attenuator	ATM 5027-20(or equivalent)	Reducing RF Output Power to safe levels
20dB Directional Coupler	HP778D (or equivalent)	Reducing RF Output Power to safe levels

Test Results for Frequency Spectrum

Date: 26 June 2002
Location: EMS Technologies, Ottawa, Canada
Model: HST-900
Serial number: 004
Test procedure: Generate a signal and display spectrum.

3000 BPS

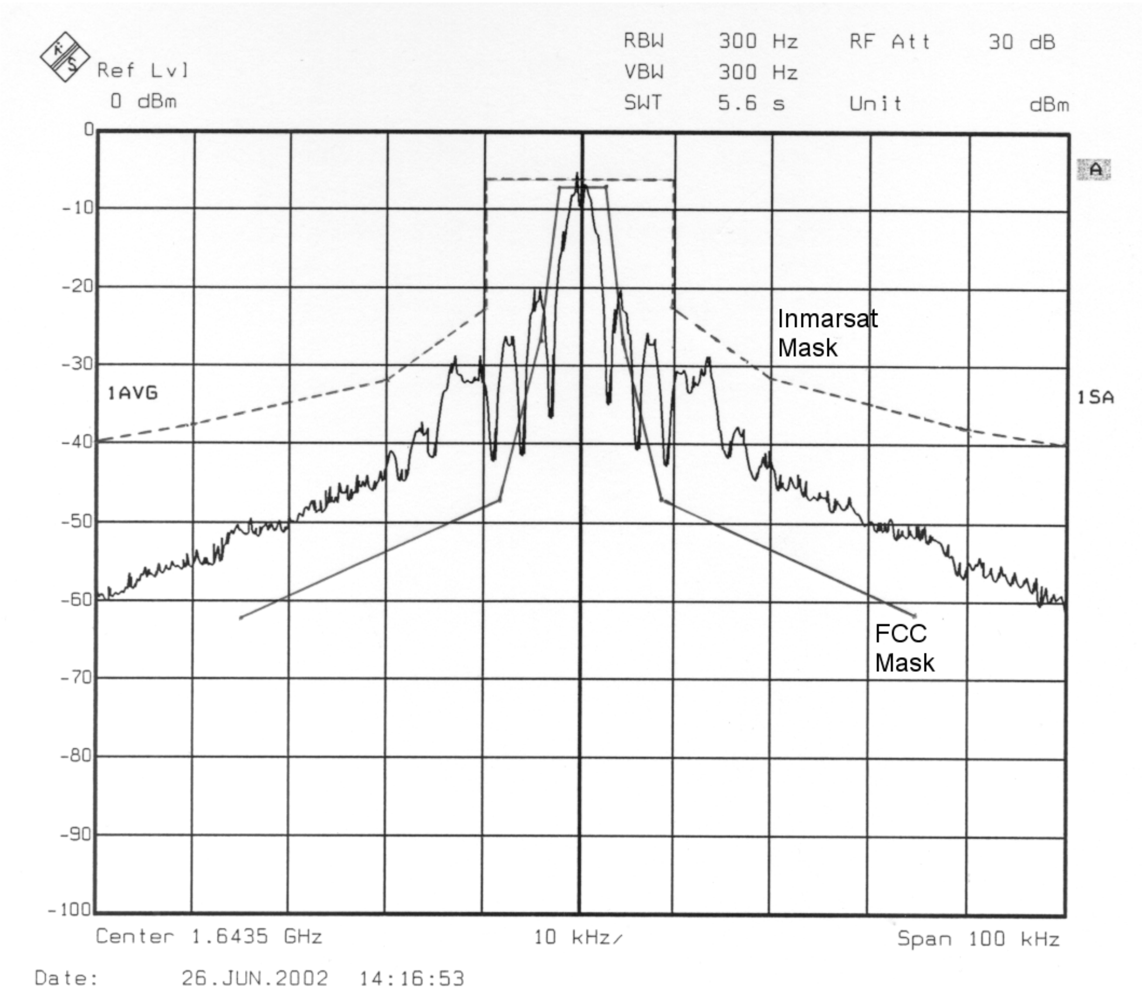

Figure 12 – 3000 bps Transmitter Spectrum

Note: Both the mask specified by 87.139 (i) (4) and the applicable INMARSAT requirements are shown above. Refer to the Section 3.7.5 for a discussion of the test results.

134400 BPS

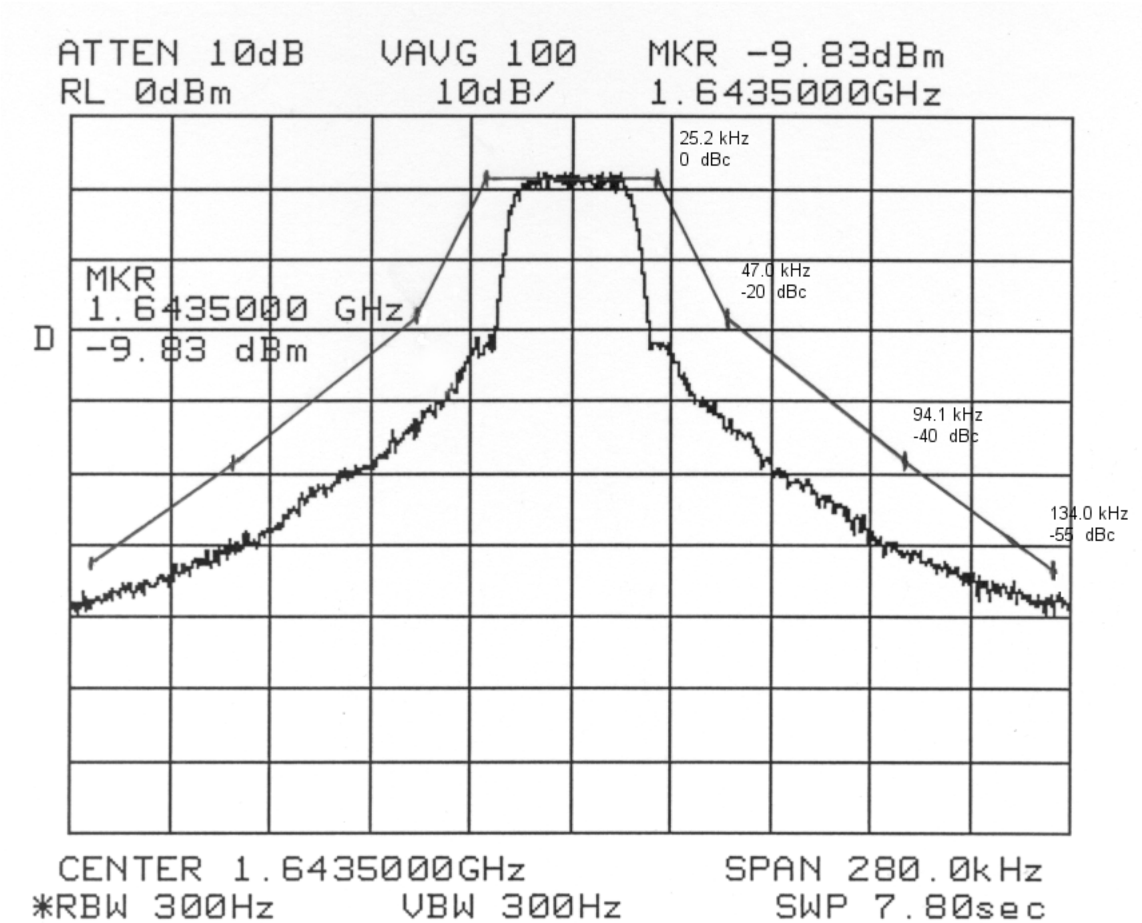

Figure 13 – 134400 bps Transmitter Spectrum

3.7.5 Test Results Discussion

Transmitter Spurious – 87.139 (i) (1)
The test results demonstrate that the transmitter is complaint with the provisions of this section. It is assumed that the requirements of this section should also apply to emission types D1D, D1E, and D1W, although these emission types are not specifically referenced in 87.139 (i).

Transmitter Intermodulation – 87.139 (i) (2)
The transmitter Intermodulation requirement in section 87.139 (i) (2) is not applicable to the HST-900 since it only capable of transmitting one carrier. The overall SAT-906 system compliance was demonstrated in the previous HPA-901A certification report, FCC ID:AJKPN8220953.

Transmitter Spectrum Mask – 87,139 (i) (4)
The 3000 bps modulation specified by INMARSAT is pure BPSK, and does not incorporate any raised cosine filtering. As a result, the spectrum shape is not compliant with 87.138 (i) (4). A Waiver request is anticipated to allow the use of this waveform as defined by INMARSAT.

The 134400 bps (64000bps user data rate) 16-QAM modulation is complaint with the mask, given the definition that the symbol rate is 33600 symbols per second. In this case, SR = 0.25 x channel rate for 16-QAM (4 information bits per symbol).

3.8 Field Strength of Spurious Radiation

3.8.1 FCC Requirements

Section 2.1053 (a), (b) (2) (3)
(a) Measurements shall be made to detect spurious emissions that may be *radiated* directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emissions. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible reflections, which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the radiated power output of the transmitter, assuming all emissions are radiated from half wave dipole antenna.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

Section 87.139 (i), (1)
(i) In case of conflict with other provisions of Section 87.139, the provisions of this paragraph shall govern for aircraft earth stations. When using G1D, G1E, or G1W emissions in the 1646.5 – 1660.5 MHz frequency band, the emissions must be attenuated as shown below.

(1) At rated output power, while transmitting a modulated single carrier, the composite spurious and noise output shall be attenuated below the mean power of the transmitter, pY, by at least:

Frequency (MHz)	Attenuation (dB) [1]
0.005 – 1559	83 or $(65 + 10\log_{10}(pY))$, whichever is greater
1559 -18000	55 or $(37 + 10\log_{10}(pY))$[2], whichever is greater

1 these values are expressed in dB below the carrier referenced to a 4 kHz bandwidth and relative to the maximum emission envelope level.

[2] excluding the frequency band of +/- 35 kHz or +/- 4.00 x Symbol Rate, about the carrier frequency, whichever is the greater exclusion.

3.8.2 Test Setup, Equipment and Results for Field Strength of Spurious Radiation [Section 87.139 (i) (1)]

The following procedure is derived from DO-160D, Section 21 and adapted for testing the requirements of section 87.139(i) of FCC Part 87. While RTCA DO-160D does not require testing above 6 GHz, the same setup and methodology was used to measure radiated emissions up to 18 GHz.

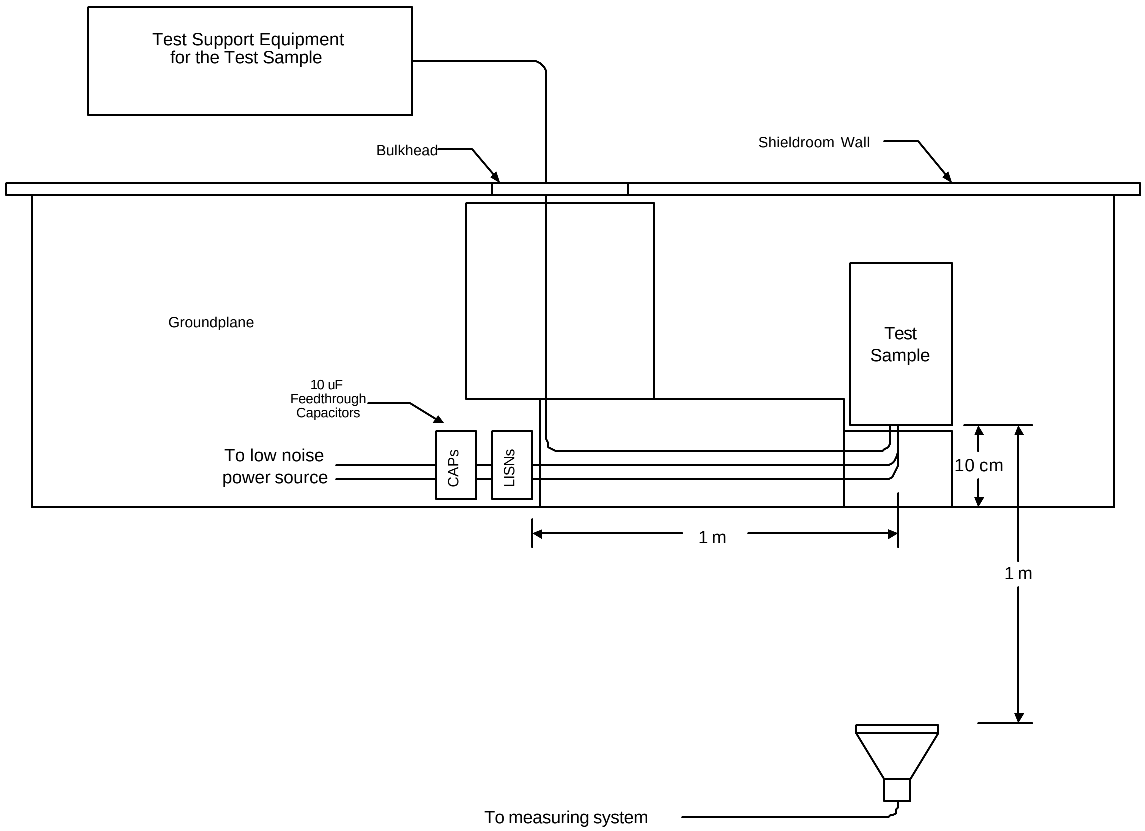

Figure 14 - Field Strength Test Setup

Notes:

1. Terminate all LISN monitor output terminals with 50 ohms.

2. DC Bond resistance between the ground plane and enclosure shall not exceed 2.5 milliohms.

3. The lengths of the power leads from the test sample to the LISNs shall not exceed 1 meter.

4. At least 1 meter of EUT cable is to be 10 cm from the front of the test bench and parallel to its front edge. Excess interconnect cable bundle length will be zigzagged at the back of the test bench, approximately 5 cm above the ground plane.

Test Conditions for Field Strength of Spurious Radiation

1. Set up the radiated emissions test equipment as shown in Figure 14.

2. HST-900 operation during radiated emissions measurements monitors digital I/O discretes and exercises the ARINC 429 buses, Ethernet and RS232 ports via loop-backs. An ISDN/L-band loopback is also activated.

Test Measurements for Field Strength of Spurious Radiation

1. Measure and record emissions over the range from 150 kHz to 18,000 MHz using the automated DO-160D emissions measurement system.

2. Change antennas as required.

Test Equipment for Field Strength of Spurious Radiation

Equipment	Manufacturer and Model Number	Frequency Range (Bandwidth)
Active whip	RVA-30	10 kHz to 30 MHz
Biconical	EMCO 3104C	25 MHz to 200 MHz
Conical Log Spiral	Stoddart 93490-1	200 MHz to 1 GHz
Double Ridged Guide	EMCO 3115	1 GHz to 18 GHz
Calibrated Cable	RG-400, Adams Russell	NA
LISN	Fischer, FCC-LISN-DO-160	100 kHz - 400 MHz
10 µf Capacitor	Solar 6512-106R	N/A
Spectrum Analyzer	Hewlett Packard, 8566B w/OPT 462	100 Hz - 22 GHz
Preselector	HP 85685A	20 Hz - 2 GHz
Printer	HP Laser Jet	NA
Computer	Gateway 2000	NA
Bus Extender	HP 37204	NA

Test Results for Field Strength of Spurious Radiation
Date: 1 -2 May 2002
Location: MPB, Ottawa, Canada
Model: HST-900
Serial number: 007
Test procedure: EMS-TS-1110-10022, Sect 2.8.2 and RTCA DO-160D, Sect 21.4.

Reference Field Level Calculations
According to Section 87.139 (i), the radiated spurious emissions are to be attenuated to the same degree as the spurious emissions at the antenna terminals. A reference field level was calculated for comparison with the measured narrow-band data and based on these requirements. The following assumptions were made for these calculations:

- The intended transmitted signal is radiated through a dipole antenna at 1-meter distance from the point at which the measurements are made.
- This distance is sufficiently greater than the distance at which the radial component of the E-field is negligible.
- The peak power available at the dipole antenna is calculated with maximum cable loss at the rated output power. This power would be 17.8 dBW (60 watts) – 2.5 dB (cable loss) = 15.3 dBW (33.7 watts).
- The duty cycle of the operation is 100%.
- Section 87.139(i) attenuation requirement is 83 dB below 1559 MHz and -55 dBc above 1559 MHz.

The calculation proceeded as follow:

For a half-wave dipole antenna in free space, in the direction of maximum radiation, the field strength is

$E = (49.2 * Pt)^{0.5} / R$

Where
R = distance in meters
Pt = transmitted power in watts

For a distance of R = 1 meter and the transmitted power of 33.7 watts, the field strength is calculated to be:

$E = (49.2 * 33.7)^{0.5} / 1$ = 40.7 Volts/meter = 40.7 * 10 6 Micro-Volts/meter = 148.40 dBuV/meter.

The maximum allowable field strength of the radiated spurious component is then:
152.2 dBuV/M - 83 dB = **69.2 dBuV/M** (.005 – 1559 MHz) and
152.2 dBuV/M - 55 dB = **97.2 dBuV/M** (1559 – 18000 MHz).

ATTACHMENT 5 – EMC PLOTS contains the test results as well as photographs documenting the test set-up. Note that the limit lines on all plots are those required for DO-160D.

3.8.3 Test Results Discussion

The plots in Attachment 5 indicate that the HST-900 easily exceeds the requirements for Aircraft Earth Stations.

3.9 Frequency Stability

3.9.1 FCC Requirements

Section 2.1055 (a) (2), (b), (d) (1) (3)

(a) (2) The frequency stability shall be measured with variation of ambient temperature from –20° to +50° centigrade for equipment licensed for use aboard aircraft in the Aviation Services under part 87 of FCC Code of Federal Regulations Title 47.

(b) The frequency measurements shall be made at the extremes and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying shall be shown.

(d) (1) (3) The frequency stability shall be measured with variation of primary supply voltage of 85 to 115 percent of the nominal value. The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Section 87.133

The carrier frequency of each station must be maintained within these tolerances:

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance
Band – 470 to 2450 MHz Aircraft Earth Station	320 Hz [1]

[1] For purposes of certification, a tolerance of 160 Hz applies to the reference oscillator of the AES transmitter. This is a bench test.

3.9.2 Test Setup, Equipment and Results for Frequency Stability [Section 87.133]

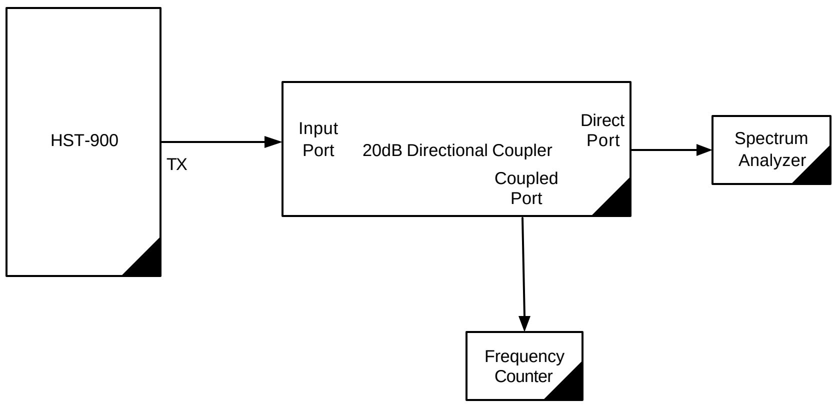

Figure 15 - Frequency Stability Test Setup

Test Equipment for Frequency Stability

Equipment Name	*Recommended Equipment Model Number*	*Required For*
Spectrum Analyzer	HP8560E (or equivalent)	Monitoring signal
Frequency Counter	EIP Model 545 (or equivalent)	Measuring Frequency
20dB Directional Coupler	HP7780 (or equivalent)	Reducing RF Output Power to safe levels

Test Results for Frequency Stability
Date: 24 June 2002
Location: EMS Technologies, Ottawa, Canada
Model: HST-900
Serial number: 004

Test procedure: 47 CFR 2.1055 (b) (c) (d).

Temperature	Supply voltage	Tolerance (Hz)
-20 to +50 C	85% - 115%	320

Test Results - Stability

Temperature (° C)	Voltage (Vac)	Frequency (Hz)	Error (Hz)
-20	97.8	1,643,500,184	184
-20	115	1,643,500,187	187
-20	132.3	1,643,500,184	184
-10	97.8	1,643,500,183	183
-10	115	1,643,500,184	184
-10	132.3	1,643,500,183	183
0	97.8	1,643,500,175	175
0	115	1,643,500,176	176
0	132.3	1,643,500,176	176
+10	97.8	1,643,500,159	159
+10	115	1,643,500,160	160
+10	132.3	1,643,500,160	160
+20	97.8	1,643,500,142	142
+20	115	1,643,500,143	143
+20	132.3	1,643,500,143	143
+30	97.8	1,643,500,134	134
+30	115	1,643,500,134	134
+30	132.3	1,643,500,133	133
+40	97.8	1,643,500,128	128
+40	115	1,643,500,126	126
+40	132.3	1,643,500,125	125
+50	97.8	1,643,500,121	121
+50	115	1,643,500,121	121
+50	132.3	1,643,500,122	122

Test Results – Warmup Time

As the HST-900 has an ovenized frequency reference, compliance with Section 2.1055 (c) is required. Upon power up the HST-900 is set to generate a carrier of 1643.500.000 Hz and the frequency recorded every minute. Warm up time, defined as the longest time required for the frequency to be within tolerance, is 3 minutes.

Temperature (° C)	Time (min)	Frequency (Hz)	Within tolerance
0	1	1,643,485,150	N
0	2	1,643,497,200	N
0	3	1,643,499,788	Y
0	4	1,643,500,187	Y
0	5	1,643,500,193	Y
0	6	1,643,500,193	Y
0	7	1,643,500,191	Y
0	8	1,643,500,190	Y
0	9	1,643,500,190	Y
0	10	1,643,500,191	Y
+30	1	1,643,498,487	N
+30	2	1,643,499,908	Y
+30	3	1,643,500,195	Y
+30	4	1,643,500,185	Y
+30	5	1,643,500,178	Y
+30	6	1,643,500,175	Y
+30	7	1,643,500,170	Y
+30	8	1,643,500,174	Y
+30	9	1,643,500,176	Y
+30	10	1,643,500,179	Y

3.9.3 Test Results Discussion

The HST-900 does not meet the FCC requirements for frequency accuracy. The INMARSAT standards allow for a relaxation of accuracy, due to the higher data rates used. The INMARSAT requirement is +/- 1250 Hz, which is easily met by the HST-900. A Waiver request is anticipated to permit the operation of equipment designed to meet +/- 1250 Hz frequency established by INMARSAT for this new service.

3.10 Priority and Preemption

An aircraft earth station, AES, equipped with both a SDU-906 and HST-900 share a common antenna and high power amplifier. The SDU internally reserves amplifier power so that higher priority data traffic such as ACARS has immediate availability to the AES channel and HPA power resources. In addition, both the AES and ground earth station manage voice calls based on the priority of the calls.

The priority, which is assigned to each call, as it originates, provides the basis for handling of the call within the AES and GES. These priorities are established and the requirements for their use are defined in Inmarsat System Definition Manual. Inmarsat also specifies a number of protocol tests, which must be completed to verify that the AES complies with the priority and preemption requirements.

For AES to GES calls, the pilot specifies the nature (priority) of the call as a part of the call set up procedure. If the AES resources are exhausted, the pilot is prompted to select whether to preempt a lower priority call, or have his call queued until resources are available. This operation is in “real time” in the sense that the pilot makes the decision at the time that the call is placed. If he elects to queue the call, he can later use the preempt feature if the situation warrants. Selection of the preemption feature will terminate lower priority calls which are in progress and to make resources available for the pilot’s higher priority call.

For GES to AES calls, the pilot involvement is not practical. As an upcoming call request is made to the AES, the SDU-906 examines the status of the current resources to determine if resources are available for an assignment. The processor also examines the status of the cockpit lines to determine their availability. If the incoming call priority is “Cockpit Safety” or greater and all resources are in use, lower priority calls will be terminated until resources are available to complete the call. If the cockpit line(s) are busy and the incoming call is of greater priority than one of calls currently placed, that call will be terminated and the resources will be used for the incoming call. In the event that call has the same or lower priority than the cockpit calls already placed, it will be rejected by the AES.

3.10.1 FCC Requirements

The discussion and test results shown in this section address and meet the requirements of the following FCC requirements:

Section 87.187 (q)

In the frequency bands 1549.500-1558.500 MHz and 1651.000-1660.000 MHz, the Aeronautical Mobile-Satellite requirements that cannot be accommodated in the distress and safety frequency bands 91554.0-1545.0 MHz) and 1645-1646.5 MHz) shall have priority access with real-time preemptive capability for communications in the Mobile-Satellite Service.

Section 87.189 (e)

Transmission of public correspondence must be suspended when such operation will delay or interfere with message pertaining to safety of life and property or regularity of flight, or when ordered by the captain of the aircraft.

3.10.3 Test Equipment List

Quantity	Item
1	MCDU with Cockpit telephone interface
1	SAT-906 Over the air test station with HST-900
1	SDU-906, pn 822-0314-101
1	RFU-900, pn 822-8849-100
1	HPA-901A, pn 822-0953-002(engineering unit)
1	HST-900, pn1110-A-0201
1	Ground telephone

3.10.4 Test Procedures Air-to-Ground

The purposes of these tests are:

(A) To verify the ability of the AES to preempt a HST-900 call with a higher priority cockpit call when sufficient resources are not available.

(B) To verify the ability of the GES to preempt a HST-900 call with a higher priority cockpit call when sufficient resources are not available.

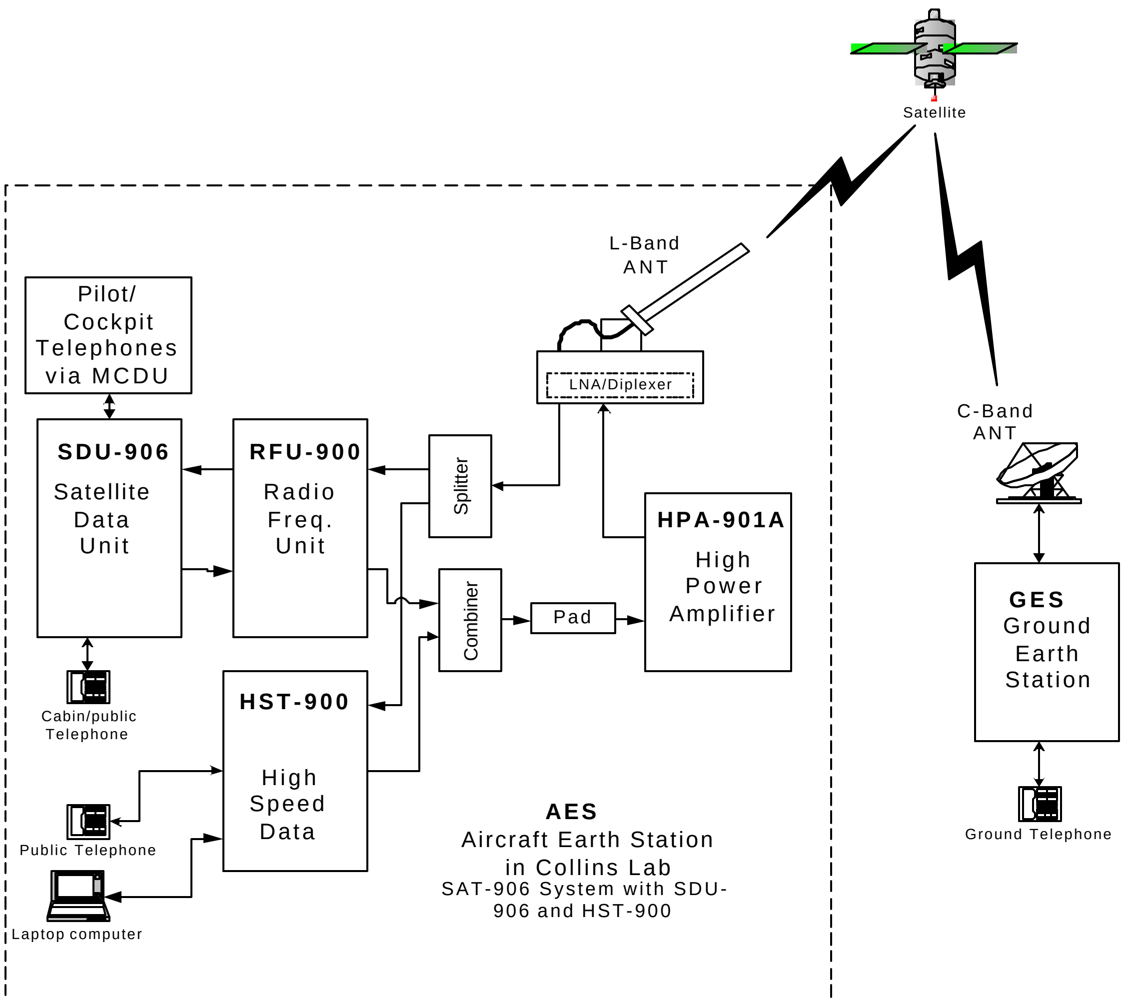

Figure 16 - Priority/Preemption Test Setup

PREEMPT TEST Air-To-Ground

7. Setup the equipment as shown in Figure 16.
8. Make a HST-900 ATG call to a lab phone by dialing 001319295XXXX#
9. When lab phone rings pick up. Verify voice quality to ground and from ground
10. Adjust antenna gain so that no resources are available to make an additional call.
11. Setup the MCDU to initiate a Q10 priority ATG cockpit voice call to a lab telephone.
12. Press *PREEMPT on the MCDU to initiate the cockpit voice call.
13. Verify the HST-900 call is disconnected and the cockpit call is initiated.
14. When the lab phone rings pick up. Verify voice quality to ground and through headset from ground
15. Verify sidetone is heard with the headset when talking into the mouthpiece
16. End the call from the air by pressing END CALL*
17. Verify call cleared, and that the cause code on the trace is LOC=0, CLASS=1, VALUE=0, S=CCITT_Q931
18. Hang up phones

PREEMPT TEST Ground-To-Air

19. Setup the equipment as shown in Figure 16
20. Make a HST-900 ATG call to a lab phone by dialing 001319295XXXX#
21. When lab phone rings pick up. Verify voice quality to ground and from ground
22. Adjust antenna gain so that no resources are available to make an additional call.
23. Make a cockpit voice Q10 priority GTA call using "Satellite Aircom Cockpit" service and Sprint card
24. Dial 9 1 800 877 8000 0 514 841 2102 [sprint pin number] 75202 8745 52627304
25. Press ANSWER* on the MCDU for voice 1
26. Verify the HST-900 call is disconnected
27. Verify voice quality to ground and through headset from ground
28. Verify sidetone is heard with the headset when talking into the mouthpiece
29. End call from the air by pressing END CALL*
30. Verify call cleared, and that the cause code on the trace is LOC=0, CLASS=1, VALUE=0, S=CCITT_Q931
31. Hang up phones

3.10.6 Test Results

Air-to-Ground Preemption Demonstrated (Pass/Fail) _Pass__

Ground-to-Air Preemption Demonstrated (Pass/Fail) _Pass__