Exhibit F
Test Report

NOTICE: The following software was used to produce this document: Microsoft Word 2003 SP2

Rockwell Collins, Inc.
400 Collins Rd. NE
Cedar Rapids, Iowa 52498

CAGEC 4V792

HST-2110B and HST-2120B FCC Type Certification Report

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-2110B

Collins Part Number: 822-2232-xxx

FCC ID: AJK8222232

And

Type Number: HST-2120B

Collins Part Number: 822-2234-xxx

FCC ID: AJK8222234

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

Table of Contents

List of Figures

List of Tables

1 Test Procedures and Results

1.1 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.

1.2 Test Requirements Matrix

Table 1 - 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

1.3 Test Equipment

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

1.4 RF Power Output

1.4.1 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.

1.4.2 Test Setup, Equipment and Results for RF Power Output

This test demonstrates the ability of the SRT-2100B system to control the RF output power of the HST-2110B to achieve the desired HPA output power and EIRP in the presence of Aero SATCOM carriers (generated by the SRT) under conditions of varying antenna gains.

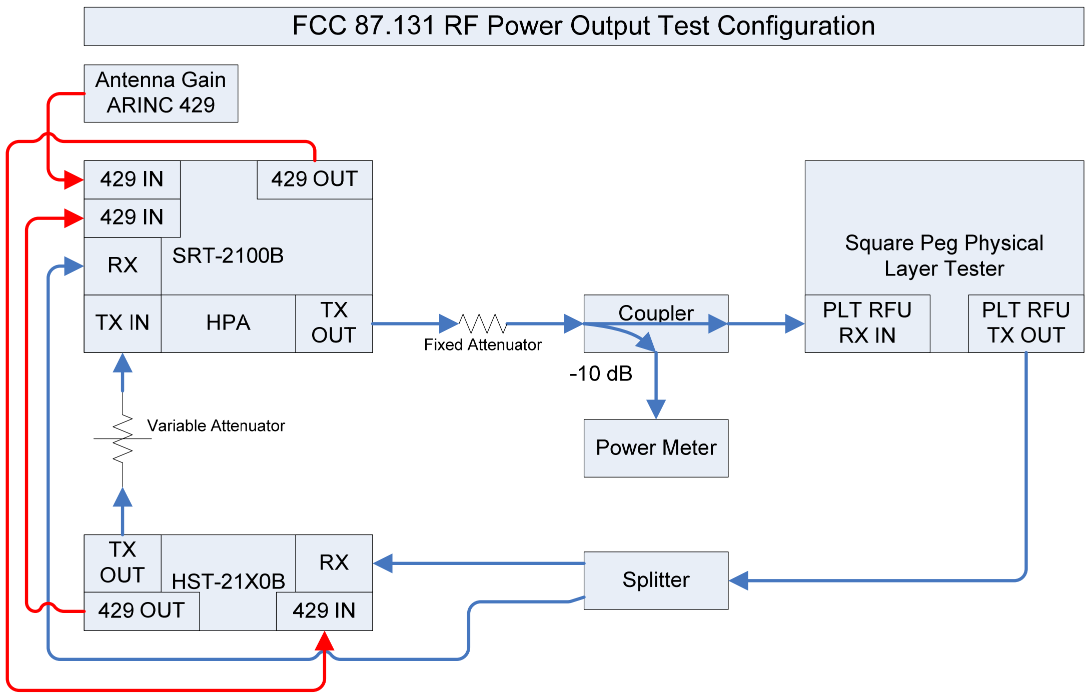

Figure 1 - RF Power Output Test Setup

Test Equipment for RF Power Output

Equipment Name	Recommended Equipment Model Number	Required For
SRT-2100B	Collins PN 822-1785-001	SAT-2100B System Component
HST-2120B DC	Collins PN 822-2234-010	SAT-2100B System Component
Physical Layer Tester	Square Peg EM-907532C-04	Simulating physical layer RF signals
Spectrum Analyzer	Agilent E4440	Measuring Output Spectrum
Variable Attenuator	Weinschel 910-20-11	Reducing RF Output Power to acceptable levels
30dB High Power Attenuator	Weinschel 58-30-34-LIM	Reducing RF Output Power to safe levels
10dB fixed attenuator	Weinschel 2	Reducing RF Output Power to safe levels

Test Procedure for Classic Aero/ Swift64

FCC Requirements detailed in sections 87.131 (RF Power Output) and 87.187(q) (Priority and Preemption) were tested with a combined procedure in which Classic Aero voice services were exercised in concert with Swift 64 services. During the test procedure the output EIRP of the Classic Aero voice services and Swift 64 data services were varied along with antenna gain in order to demonstrate accurate power control and, when necessary, the preemption of lower priority services in order to maintain output EIRP for higher priority services. The spreadsheet below documents the various conditions and records the predicted, measured and reported RF power output in order to demonstrate compliance.

Minimal Cable Loss				Nominal Cable Loss				Maximum Cable Loss		Total EIRP = Max OutdBW + Ant Gain - Ant to HPA Loss								
HPA ref (Watts)	45			HPA ref (Watts)	45			HPA ref (Watts)	45	HST1 Out = HST EIRP - Ant Gain + Ant to HPA Loss - 31 + HST Offset (Loss) + 30								
Max HPA out (dB) :	0			Max HPA out (dB	0			Max HPA out (dB) :	0									
Max Out dBW	16.53			Max Out dBW	16.53			Max Out dBW	16.53									
Max Out dBm :	46.53			Max Out dBm :	46.53			Max Out dBm :	46.53									
Ant to HPA Loss :	2			Ant to HPA Loss :	2			Ant to HPA Loss :	2									
HST max Out (dBm)	31.5			HST max Out (dB	31.5			HST max Out (dBm) :	31.5									
HST1 Offset (loss) :	-1.3			HST1 Offset (loss)	0.5			HST1 Offset (loss) :	1.4									
HST2 Offset (loss) :	-1.3			HST2 Offset (loss)	0.5			HST2 Offset (loss) :	1.4									
RFU to HPA Attn =	5	---------		RFU to HPA Attn :	5	-------		RFU to HPA Attn =	5	----------								
HST1 to HPA Attn =	3.7	0		HST1 to HPA Attn	5.5	1		HST1 to HPA Attn =	6.4	2								
HST2 to HPA Attn =	3.7	-----------		HST2 to HPA Attn	5.5	----------		HST2 to HPA Attn =	6.4	----------								
Nominal Cable Loss										Calculated	Actual	Calculated	Actual		Dual HST			
Ant Gain	Total EIRP	Data	EIRP	EIRP	Avail EIRP	HST1 EIRP	2 HST EIRP	HST1 Out	HST2 Out	Rpt Avail	Rpt Avail	Back Off	Back Off		Measured HPA Out	Computed HPA at output Trace	error	Pass/Fail
dB	dBW	dBW	Call 1	Call 2	dBW	dBW	dBW	dBm	dBm	dBW	dBW	dB	dB		dBm	dBm	dB	(+2.5/- 1.0 dB)
12	26.53	10.50	-100	-100	26.42	22.5	19.5	12.00	12.00	24.17	26.00	10.00	10.00	44.26	44.68	44.19	-0.07	PASS
12	26.53	10.50	-100	-100	26.42	20.5	17.5	10.00	10.00	25.14	26.50	10.00	10.00	42.26	42.65	42.38	0.12	PASS
12	26.53	10.50	-100	-100	26.42	18.5	15.5	8.00	8.00	25.66	27.00	10.00	10.00	40.26	40.74	39.91	-0.35	PASS
12	26.53	10.50	12.5	-100	26.24	18.5	15.5	8.00	8.00	25.44	26.50	10.00	10.00	40.94	41.29	40.73	-0.21	PASS
12	26.53	10.50	11.5	-100	26.28	18.5	15.5	8.00	8.00	25.49	26.50	10.00	10.00	40.81	41.11	40.40	-0.41	PASS
12	26.53	10.50	10.5	-100	26.31	18.5	15.5	8.00	8.00	25.52	26.50	10.00	10.00	40.70	41.11	40.40	-0.30	PASS
12	26.53	10.50	10.5	12.5	26.13	18.5	15.5	8.00	8.00	25.30	26.50	10.00	10.00	41.31	41.68	41.22	-0.09	PASS
12	26.53	10.50	10.5	11.5	26.16	18.5	15.5	8.00	8.00	25.35	26.50	10.00	10.00	41.19	41.55	41.06	-0.13	PASS
12	26.53	10.50	10.5	10.5	26.19	18.5	15.5	8.00	8.00	25.39	26.50	10.00	10.00	41.10	41.47	40.89	-0.21	PASS
13	27.53	10.50	10.5	10.5	27.27	18.5	15.5	7.00	7.00	26.65	28.00	11.00	10.50	40.10	40.54	39.91	-0.19	PASS
14	28.53	10.50	10.5	10.5	28.32	18.5	15.5	6.00	6.00	27.84	29.00	12.00	11.50	39.10	39.52	38.92	-0.18	PASS
15	29.53	10.50	10.5	10.5	29.37	18.5	15.5	5.00	5.00	28.99	30.00	13.00	12.50	38.10	38.56	37.93	-0.17	PASS
16	30.53	10.50	10.5	10.5	30.40	18.5	15.5	4.00	4.00	30.11	31.00	14.00	13.50	37.10	37.51	36.94	-0.16	PASS
11	25.53	10.50	10.5	10.5	25.10	18.5	15.5	9.00	9.00	24.03	25.50	9.00	8.50	42.10	42.37	42.21	0.11	PASS
10	24.53	10.50	10.5	10.5	23.98	18.5	15.5	10.00	10.00	22.54	24.00	8.00	7.50	43.10	43.37	43.20	0.10	PASS
9	23.53	10.50	10.5	10.5	22.83	18.5	15.5	11.00	11.00	20.83	22.50	7.00	6.50	44.10	44.40	44.19	0.09	PASS
8	22.53	10.50	10.5	10.5	21.63	18.5	15.5	12.00	12.00	18.73	21.00	6.00	5.50	45.10	45.41	45.01	-0.09	PASS
7	21.53	10.50	10.5	10.5	20.36	18.5	15.5	13.00	13.00	15.78	22.00	5.00	6.50	46.10	46.31	46.00	-0.10	PASS
6	HSD Preempted											4.00						

Test Procedure for Classic Aero/ SwiftBroadband

FCC Requirements detailed in sections 87.131 (RF Power Output) and 87.187(q) (Priority and Preemption) were tested with a combined procedure in which Classic Aero voice services were exercised in concert with Swift Broadband services. During the test procedure the output EIRP of the Classic Aero voice services was varied along with antenna gain in order to demonstrate accurate power control and, when necessary, the preemption of lower priority services in order to maintain output EIRP for higher priority services. The spreadsheet below documents the various conditions and records the predicted, measured and reported RF power output in order to demonstrate compliance.

RF Power Output Test Results

		High Priority	Low Priority	Public Priority					
	Ant Gain (dBi)	Aero Call 1 (dBW EIRP)	Aero Call 2 (dBW EIRP)	HST Allocated EIRP (dBW)	HST Reported EIRP (dBW)	Calculated HPA Output (dBm)	Reported HPA Output (dBm)	Measured HPA Output (dBm)	Power Accuracy Results (P/F)
	18.00	18.50	18.50	20.00	16.00	36.59	36.45	36.42	PASS
	17.00	18.50	17.50	20.00	16.00	37.22	37.11	37.27	PASS
	16.00	18.50	16.50	20.00	16.00	37.91	37.44	37.46	PASS
	15.00	18.50	15.50	20.00	16.00	38.65	38.26	38.22	PASS
	14.00	18.50	14.50	20.00	16.00	39.42	38.92	39.02	PASS
	13.00	18.50	13.50	20.00	16.00	40.24	39.41	39.74	PASS
	12.00	17.50	12.50	20.00	16.00	40.56	39.25	38.98	PASS
	11.00	16.50	11.50	20.00	16.00	40.94	39.41	39.31	PASS
	10.00	15.50	10.50	20.00	16.00	41.37	40.07	39.64	PASS
	9.00	14.50	10.50	20.00	16.00	41.99	41.06	41.21	PASS
	8.00	13.50	10.50	20.00	16.00	42.66	41.55	41.42	PASS
	7.00	12.50	10.50	20.00	16.00	43.38	42.38	42.30	PASS
HST Preempted	7.00	12.50	11.50	0.00	0.00	40.17	39.41	39.79	PASS
HST Preempted	7.00	16.50	18.50	0.00	0.00	45.66	45.84	45.82	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	46.07	46.16	46.17	PASS
Low Priority Call Preempted	7.00	18.50	0.00	0.00	0.00	43.62	43.69	43.70	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	46.07	46.16	46.17	PASS
HST Preempted	8.00	0.00	18.50	0.00	0.00	42.62	42.71	42.68	PASS
	9.00	0.00	18.50	20.00	16.00	43.48	44.35	44.17	PASS
	10.00	0.00	12.50	20.00	16.00	39.68	40.89	40.84	PASS
	11.00	0.00	12.50	20.00	16.00	38.68	39.91	39.33	PASS
	12.00	0.00	12.50	20.00	16.00	37.68	38.92	38.64	PASS
	13.00	0.00	12.50	20.00	16.00	36.68	37.93	37.82	PASS
	14.00	0.00	12.50	20.00	16.00	35.68	36.94	36.91	PASS
	15.00	0.00	12.50	20.00	16.00	34.68	36.28	35.89	PASS
	16.00	0.00	12.50	20.00	16.00	33.68	34.96	34.16	PASS
	17.00	0.00	12.50	20.00	16.00	32.68	34.14	32.74	PASS
	18.00	0.00	12.50	20.00	16.00	31.68	33.15	32.75	PASS

		High Priority	Low Priority	Public Priority						
	Ant Gain (dBi)	Aero Call 1 (dBW EIRP)	Aero Call 2 (dBW EIRP)	HST Allocated EIRP (dBW)	HST Reported EIRP (dBW)	Calculated HPA Output (Watts)	Measured HPA Output (Watts)	Available HPA Output (Watts)	Margin	Preemption Results (P/F)
	18.00	18.50	18.50	20.00	16.00	4.56	4.39	43.21	38.82	PASS
	17.00	18.50	17.50	20.00	16.00	5.28	5.33	42.74	37.41	PASS
	16.00	18.50	16.50	20.00	16.00	6.18	5.57	42.16	36.59	PASS
	15.00	18.50	15.50	20.00	16.00	7.32	6.64	41.42	34.78	PASS
	14.00	18.50	14.50	20.00	16.00	8.76	7.98	40.49	32.51	PASS
	13.00	18.50	13.50	20.00	16.00	10.56	9.42	39.33	29.91	PASS
	12.00	17.50	12.50	20.00	16.00	11.38	7.91	37.86	29.95	PASS
	11.00	16.50	11.50	20.00	16.00	12.41	8.53	36.01	27.48	PASS
	10.00	15.50	10.50	20.00	16.00	13.71	9.20	33.68	24.48	PASS
	9.00	14.50	10.50	20.00	16.00	15.81	13.21	30.75	17.54	PASS
	8.00	13.50	10.50	20.00	16.00	18.44	13.87	27.06	13.20	PASS
	7.00	12.50	10.50	20.00	16.00	21.76	16.98	22.42	5.44	PASS
HST Preempted	7.00	12.50	11.50	0.00	0.00	10.41	9.53	41.45	31.92	PASS
HST Preempted	7.00	16.50	18.50	0.00	0.00	36.83	38.19	41.45	3.26	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	40.49	41.40	41.45	0.05	PASS
Low Priority Call Preempted	7.00	18.50	0.00	0.00	0.00	23.02	23.44	41.45	18.01	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	40.49	41.40	41.45	0.05	PASS
HST Preempted	8.00	0.00	18.50	0.00	0.00	18.29	18.54	42.18	23.65	PASS
	9.00	0.00	18.50	20.00	16.00	22.27	26.12	30.75	4.63	PASS
	10.00	0.00	12.50	20.00	16.00	9.29	12.13	33.68	21.55	PASS
	11.00	0.00	12.50	20.00	16.00	7.38	8.57	36.01	27.44	PASS
	12.00	0.00	12.50	20.00	16.00	5.86	7.31	37.86	30.55	PASS
	13.00	0.00	12.50	20.00	16.00	4.65	6.05	39.33	33.27	PASS
	14.00	0.00	12.50	20.00	16.00	3.70	4.91	40.49	35.59	PASS
	15.00	0.00	12.50	20.00	16.00	2.94	3.88	41.42	37.54	PASS
	16.00	0.00	12.50	20.00	16.00	2.33	2.61	42.16	39.55	PASS
	17.00	0.00	12.50	20.00	16.00	1.85	1.88	42.74	40.86	PASS
	18.00	0.00	12.50	20.00	16.00	1.47	1.88	43.21	41.32	PASS

1.4.3 Test Results Discussion

Since the HST drives a common High Power Amplifier, the actual output power is determined by the SRT-2100B which controls system gains and ensures the desired output power at the antenna. The SRT-2100B power control software is responsible for ensuring that the maximum HPA output power is limited to 45 Watts, and that the maximum EIRP cannot exceed 2000 Watts EIRP. The test results above verify that the HST generates the correct power output, and allows the SRT-2100B to control system gains and maintain the desired HPA power output. The power control software that prevents overdriving the 45 Watt HPA is contained within the SRT-2100B.

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.

1.5 Modulation Characteristics [2.1047(d)]

1.5.1 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.

1.5.2 Test Setup, Equipment and Results for Modulation Characteristics

The HST-2120B was tested with a Collins SRT-2100B and measurements were made at the output of the SRT-2100B.

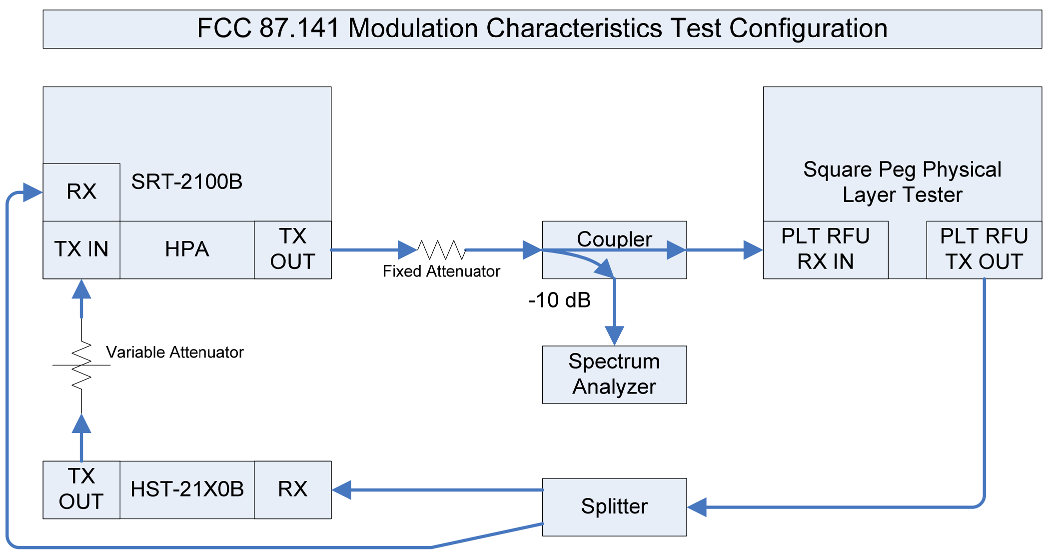

Figure 2 - Modulation Characteristics Test Setup

Test Equipment for Modulation Characteristic

Equipment Name	Recommended Equipment Model Number	Required For
SRT-2100B	Collins PN 822-1785-001	SAT-2100B System Component
HST-2120B DC	Collins PN 822-2234-010	SAT-2100B System Component
Physical Layer Tester	Square Peg EM-907532C-04	Simulating physical layer RF signals
Spectrum Analyzer	Agilent E4440	Measuring Output Spectrum
Variable Attenuator	Weinschel 910-20-11	Reducing RF Output Power to acceptable levels
30dB High Power Attenuator	Weinschel 58-30-34-LIM	Reducing RF Output Power to safe levels
10dB fixed attenuator	Weinschel 2	Reducing RF Output Power to safe levels
20dB Directional Coupler	Narda 3002-10	Reducing RF Output Power to safe levels
Splitter	Mini-Circuits ZAPD-2	Splitting RF signals

Modulation Characteristics Test Results

Date: March 2008

Location: Rockwell Collins, Cedar Rapids Iowa USA

Model: HST-2120B Serial number: 564

Model: SRT-2100B Serial number: 147362

The following plots below show the constellation diagram for Modulation Characteristics test.

3000 BPS BPSK Swift64

Figure 3 shows the measured I/Q constellation points for the transmitted 3000 bps BPSK Swift64 signal. The symbol rate is 3000 Hz.

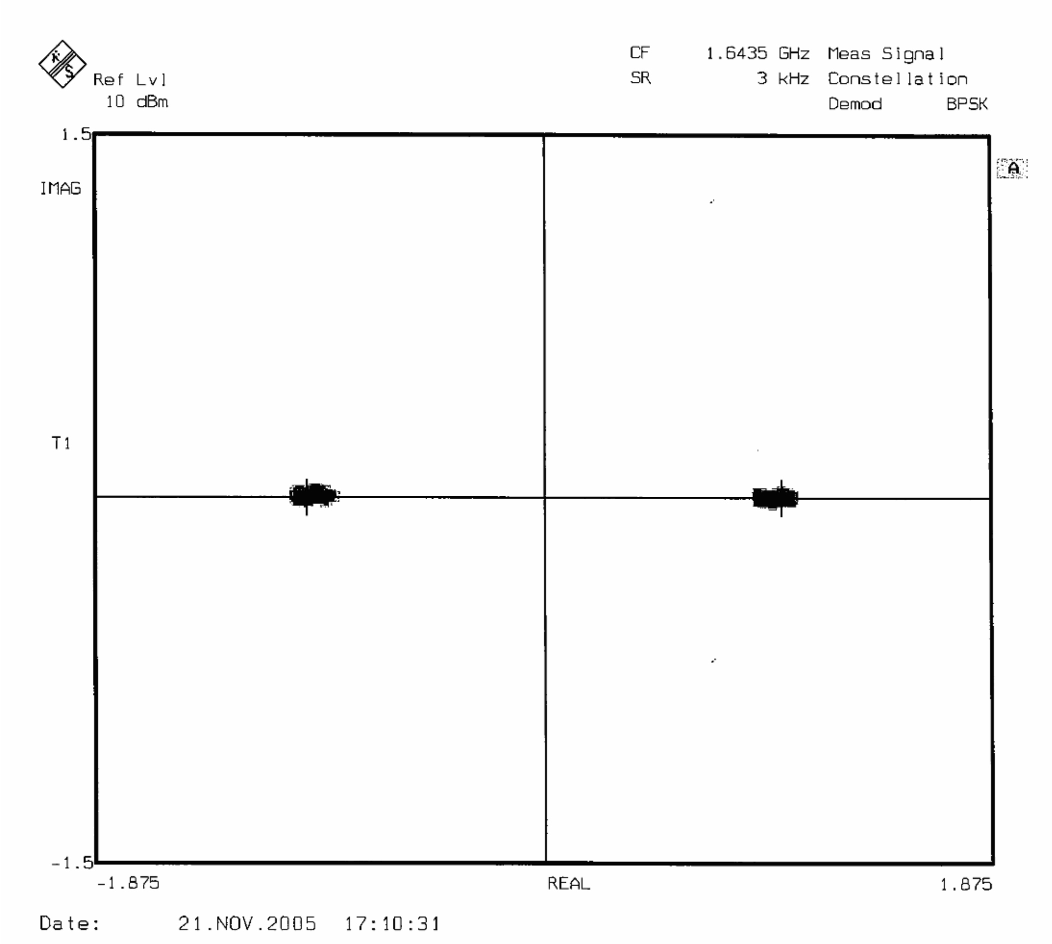

Figure 3 - 3000 bps BPSK Swift64 I/Q Diagram

134400 BPS 16-QAM Swift64

Figure 4 below shows the measured I/Q constellation points for the transmitted 134400 bps 16-QAM Swift64 signal. The symbol rate is 33600 Hz.

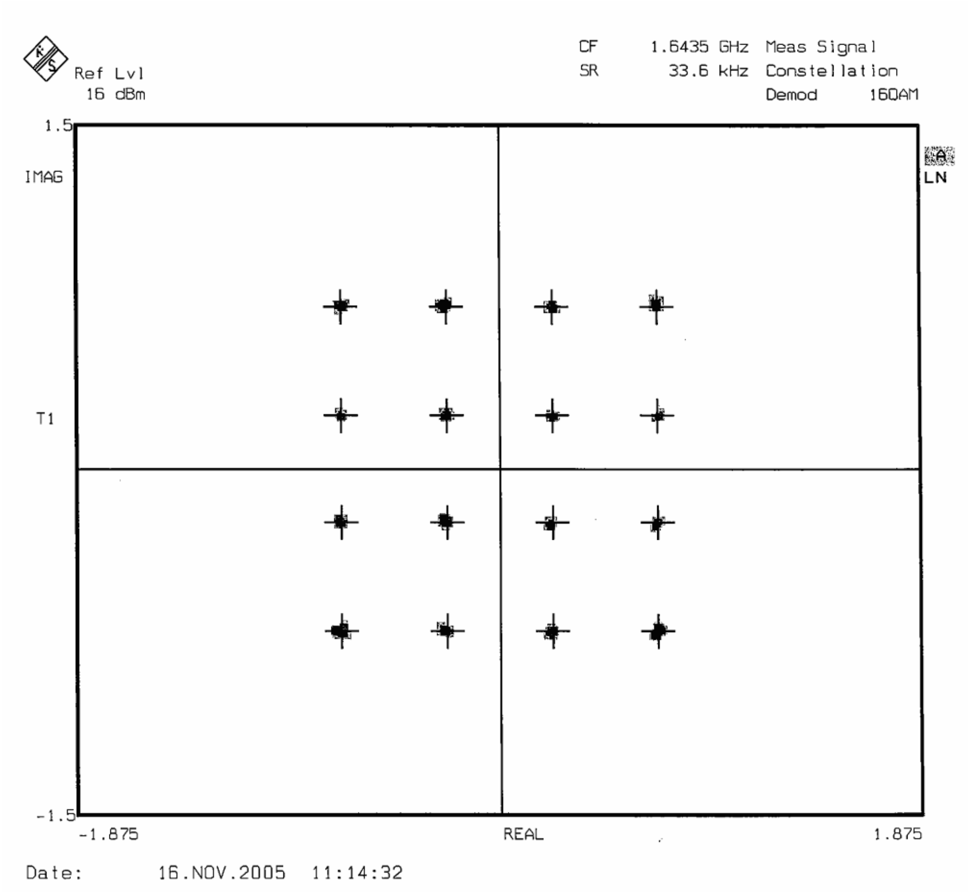

Figure 4 – 134400 bps 16-QAM Swift64 I/Q Diagram

T05QD - 16.8ksym/s QPSK SwiftBroadband

Figure 5 below shows the measured I/Q constellation points for the transmitted 16800 symbols per second QPSK signal.

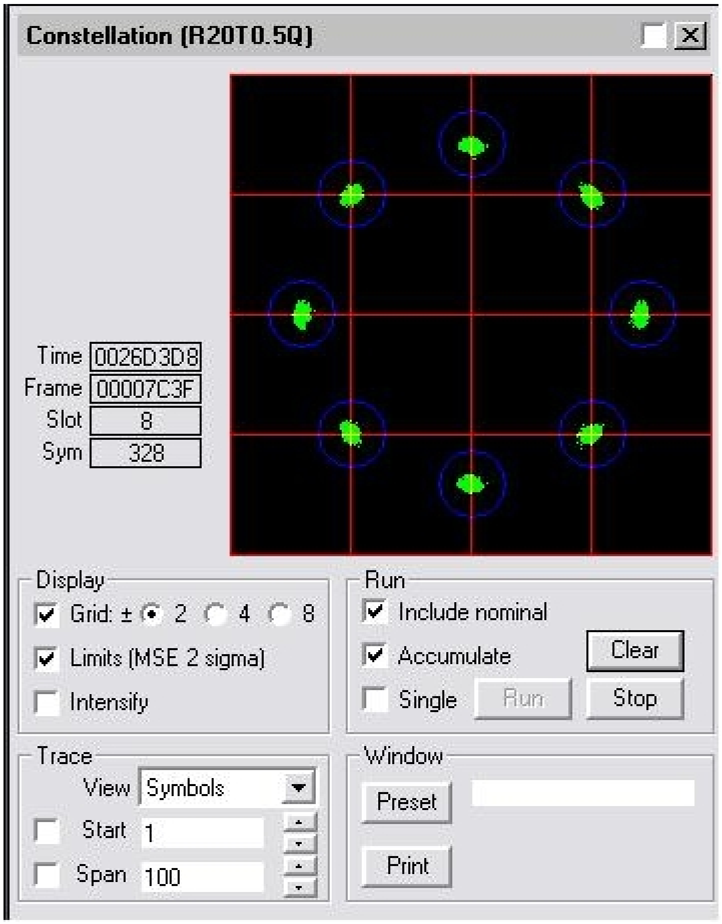

Figure 5 - 16.8ksym/s QPSK SwiftBroadband I/Q diagram

T1QD - 33.6ksym/s QPSK SwiftBroadband

Figure 6 below shows the measured I/Q constellation points for the transmitted 33600 symbols per second QPSK signal.

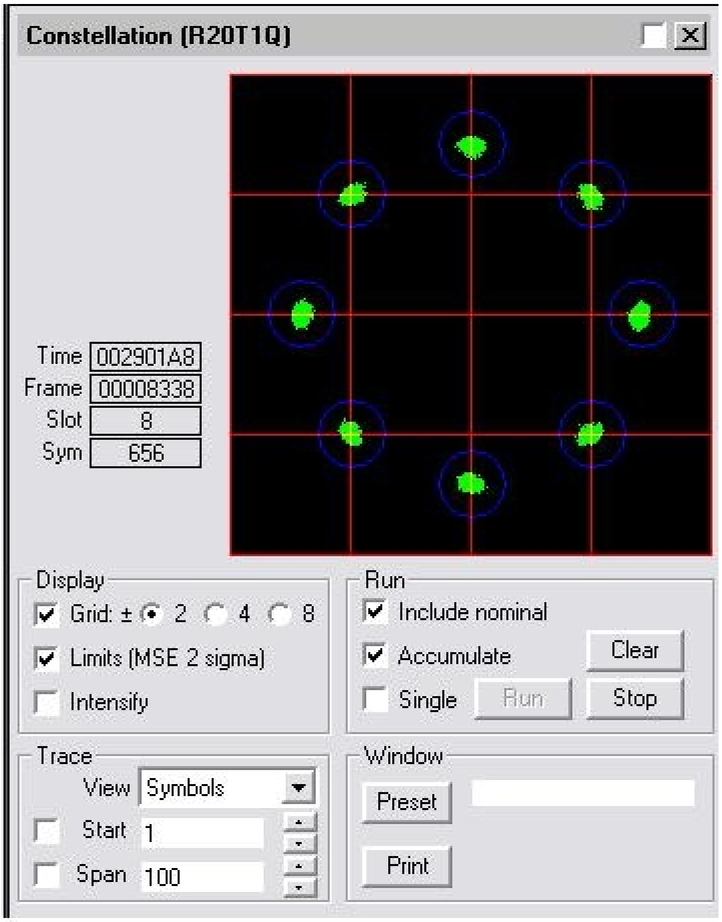

Figure 6 - 33.6ksym/s QPSK SwiftBroadband I/Q diagram

T2QD - 67.2ksym/s QPSK SwiftBroadband

Figure 7 below shows the measured I/Q constellation points for the transmitted 67200 symbols per second QPSK signal.

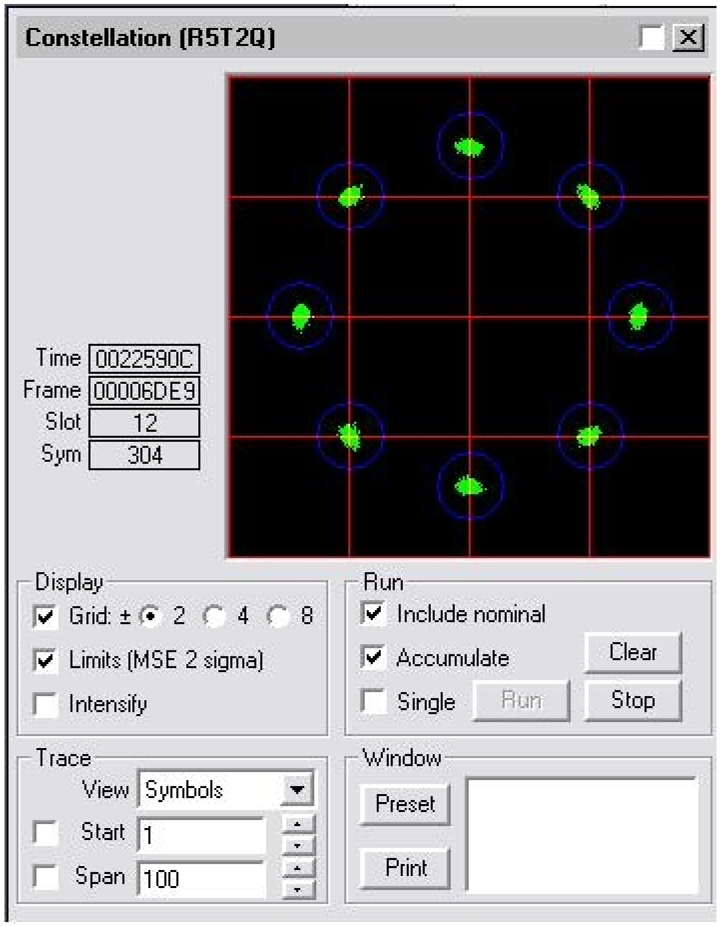

Figure 7 - 67.2ksym/s QPSK SwiftBroadband I/Q diagram

T45QD - 151.2ksym/s QPSK SwiftBroadband

Figure 8 below shows the measured I/Q constellation points for the transmitted 151200 symbols per second QPSK signal.

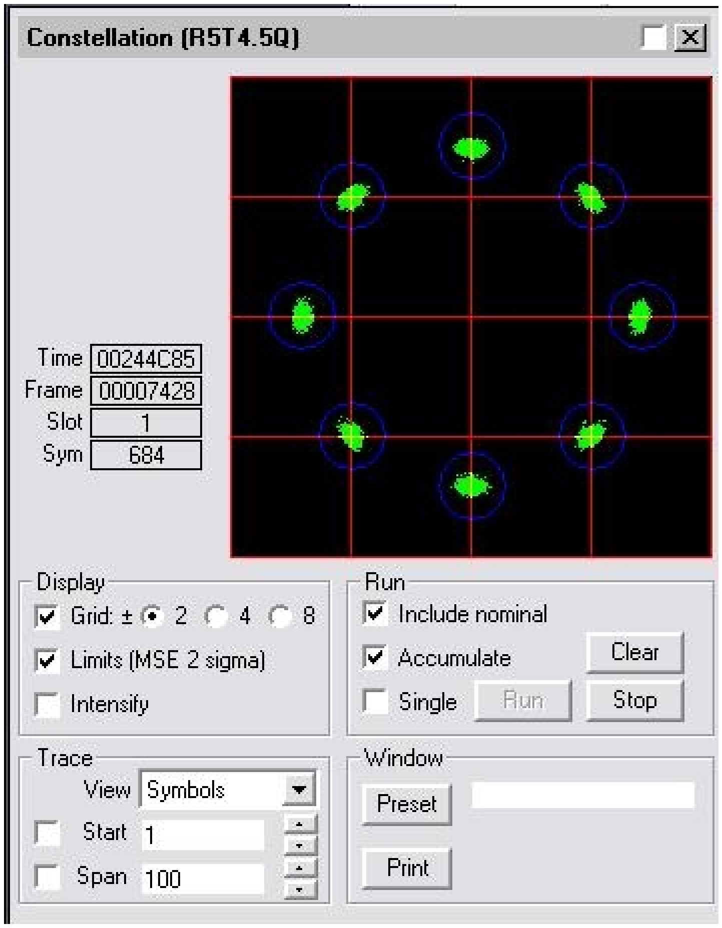

Figure 8 - 151.2ksym/s QPSK SwiftBroadband I/Q diagram

T1XD - 33.6ksym/s 16-QAM SwiftBroadband

Figure 9 below shows the measured I/Q constellation points for the transmitted 33600 symbols per second 16-QAM signal.

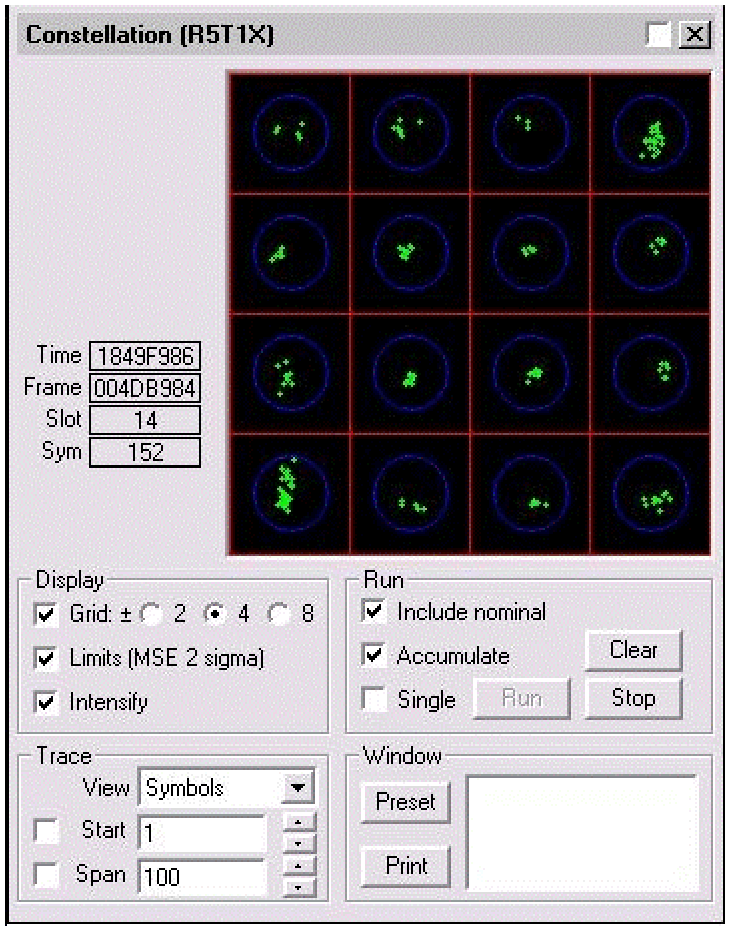

Figure 9 – 33.6ksym/s 16-QAM SwiftBroadband I/Q diagram

T2XD - 67.2ksym/s 16-QAM SwiftBroadband

Figure 10 below shows the measured I/Q constellation points for the transmitted 67200 symbols per second 16-QAM signal.

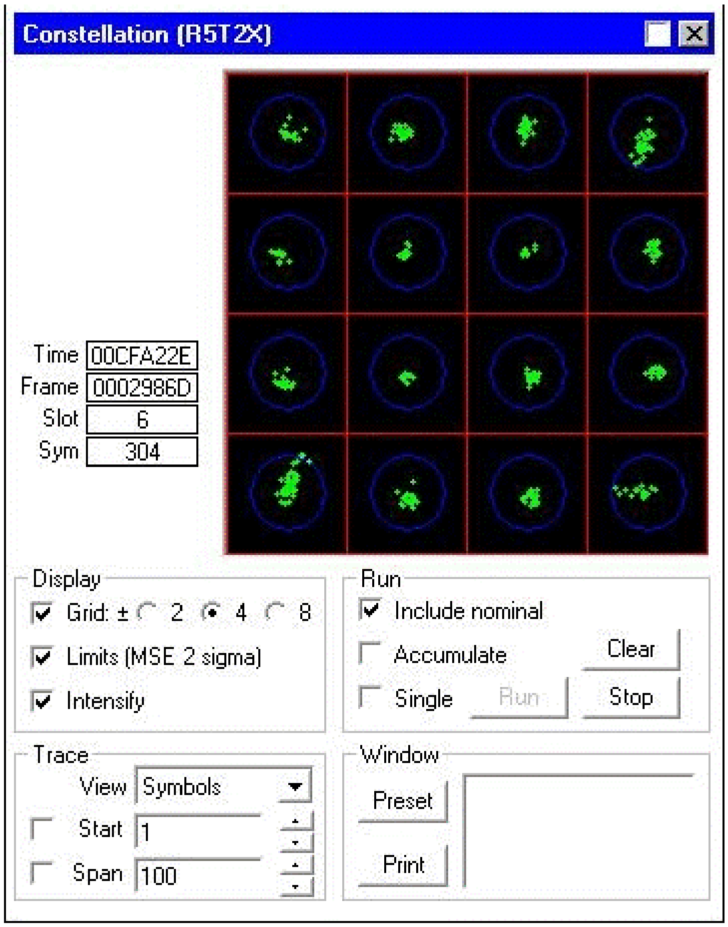

Figure 10 – 67.2ksym/s 16-QAM SwiftBroadband I/Q diagram

T45XD - 151.2ksym/s 16-QAM SwiftBroadband

Figure 11 below shows the measured I/Q constellation points for the transmitted 151200 symbols per second 16-QAM signal.

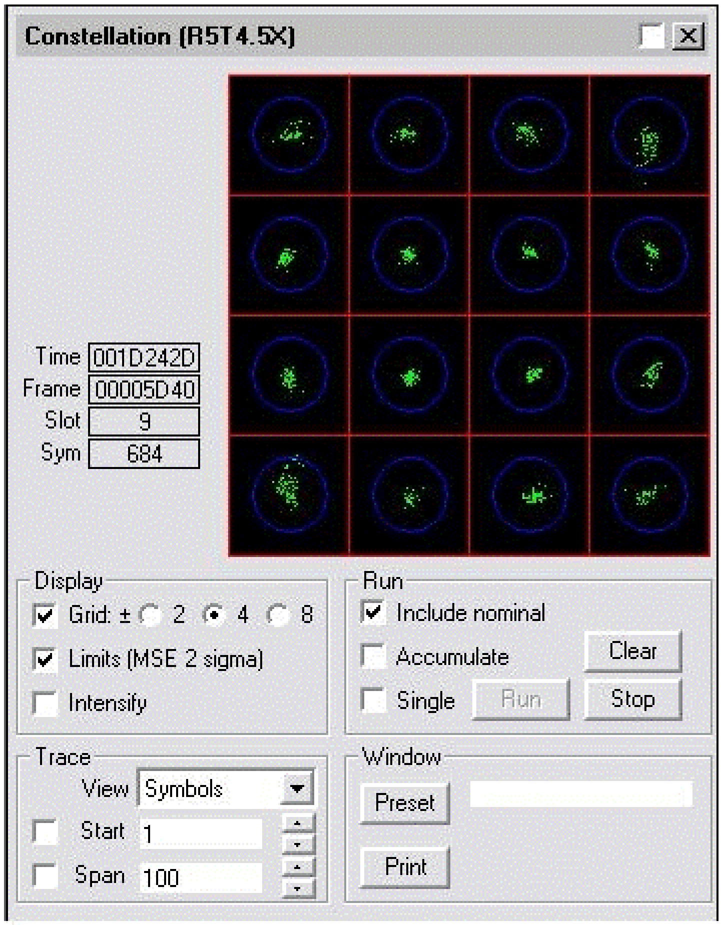

Figure 11 – 151.2ksym/s 16-QAM SwiftBroadband I/Q diagram

1.5.3 Test Results Discussion

The data rates and modulation characteristics of the new INMARSAT SwiftBroadband 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 SwiftBroadband modulation waveforms should a Waiver be granted to permit their use.

1.6 Occupied Bandwidth

1.6.1 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)

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.

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

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)

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	

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

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

1.6.2 Test Setup, Equipment and Results for Occupied Bandwidth

The HST-2120B was tested with a Collins SRT-2100B and measurements were made at the output of the SRT-2100B.

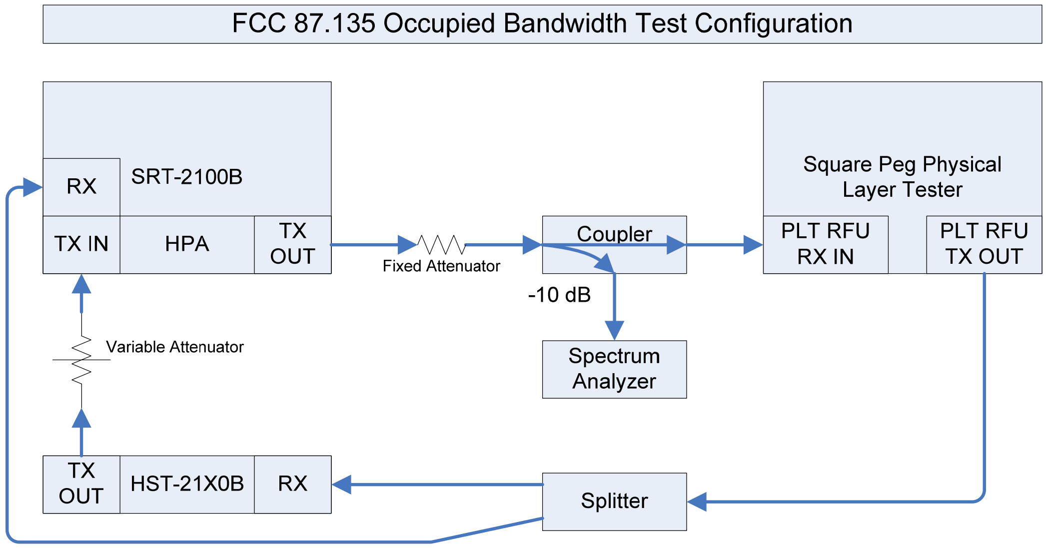

Figure 12 - Occupied Bandwidth Test Setup

Test Equipment for Occupied Bandwidth

Equipment Name	Recommended Equipment Model Number	Required For
SRT-2100B	Collins PN 822-1785-001	SAT-2100B System Component
HST-2120B DC	Collins PN 822-2234-010	SAT-2100B System Component
Physical Layer Tester	Square Peg EM-907532C-04	Simulating physical layer RF signals
Spectrum Analyzer	Agilent E4440	Measuring Output Spectrum
Variable Attenuator	Weinschel 910-20-11	Reducing RF Output Power to acceptable levels
30dB High Power Attenuator	Weinschel 58-30-34-LIM	Reducing RF Output Power to safe levels
10dB fixed attenuator	Weinschel 2	Reducing RF Output Power to safe levels

Occupied Bandwidth Test Results

Date: March 2008

Location: Rockwell Collins, Cedar Rapids Iowa USA

Model: HST-2120B Serial number: 564

Model: SRT-2100B Serial number: 147362

Test Procedure for Occupied Bandwidth Swift64

1. Connect the test equipment as shown in Figure 12
2. Apply power to the SRT-2100B and the HST-21X0B
3. Place the SRT-2100B into maintenance mode
4. Using the Hyper Terminal maintenance interface on the HST, power up the channel card and configure the HST to radiate the following signals with zero dB of channel card back off:

HST-21X0B Occupied Bandwidth Test Conditions			
Condition	**Modulation**	**Bit Rate (bps)**	**Frequency (MHz)**
1	BPSK	3,000	1626.50
2	BPSK	3,000	1643.50
3	BPSK	3,000	1660.50
4	16QAM	134,440	1626.50
5	16QAM	134,440	1643.50
6	16QAM	134,440	1660.50

5. Configure the spectrum analyzer to take occupied bandwidth measurements
6. Use the spectrum analyzer to take measurements using the settings detailed below for each of the conditions listed.

HST-21X0B Occupied Bandwidth Measurement Configuration				
Condition	**Freq. Span (KHz)**	**Resolution Bandwidth (Hz)**	**Occupied BW % Power**	**Trace Format**
1, 2, 3	100	300	99.00 %	Max Hold (10 sweeps minimum)
4, 5, 6	1000	3,000	99.00 %	Max Hold (10 sweeps minimum)

Test Procedure for Occupied Bandwidth SwiftBroadband

1. Connect the test equipment as shown in Figure 12
2. Apply power to the SRT-2100B and the HST-21X0B

3. Place the SRT-2100B into maintenance mode
4. Using the Hyper Terminal maintenance interface on the HST, force the power up of the HSTs Channel Card
5. Once the HSTs Channel Card is powered and connected via Ethernet to the Square Peg PLT, use the WinTerm application to place the Channel Card into MTR Test Mode
6. Start the BPLT application on the Square Peg PLT and run MTR test script MTR16a.scx
7. Using the interface provided by the test script, configure the HST to radiate the following signals:

HST-21X0B Occupied Bandwidth Test Conditions			
Condition	**Modulation**	**Bit Rate (bps)**	**Frequency (MHz)**
1	QPSK	33,600	1626.50
2	QPSK	33,600	1643.50
3	QPSK	33,600	1660.50
4	QPSK	67,200	1626.50
5	QPSK	67,200	1643.50
6	QPSK	67,200	1660.50
7	QPSK	134,400	1626.50
8	QPSK	134,400	1643.50
9	QPSK	134,400	1660.50
10	QPSK	302,400	1626.50
11	QPSK	302,400	1643.50
12	QPSK	302,400	1660.50
13	16QAM	134,400	1626.50
14	16QAM	134,400	1643.50
15	16QAM	134,400	1660.50
16	16QAM	268,800	1626.50
17	16QAM	268,800	1643.50
18	16QAM	268,800	1660.50
19	16QAM	604,800	1626.50
20	16QAM	604,800	1643.50
21	16QAM	604,800	1660.50

8. Configure the spectrum analyzer to take occupied bandwidth measurements
9. Use the spectrum analyzer to take measurements using the settings detailed below for each of the conditions listed.

HST-21X0B Occupied Bandwidth Measurement Configuration				
Condition	**Freq. Span (KHz)**	**Resolution Bandwidth (Hz)**	**Occupied BW % Power**	**Trace Format**
1, 2, 3	1,000	3,000	99.00 %	Max Hold (10 sweeps minimum)
4, 5, 6	1,000	3,000	99.00 %	Max Hold (10 sweeps minimum)
7, 8, 9	1,000	3,000	99.00 %	Max Hold (10 sweeps minimum)
10, 11, 12	1,000	3,000	99.00 %	Max Hold (10 sweeps minimum)
13, 14, 15	1,000	3,000	99.00 %	Max Hold (10 sweeps minimum)
16, 17, 18	1,000	3,000	99.00 %	Max Hold (10 sweeps minimum)
19, 20, 21	1,000	3,000	99.00 %	Max Hold (10 sweeps minimum)

3000 bps BPSK Swift64

The occupied bandwidth is 15.78 kHz, as shown in Figure 13 below.

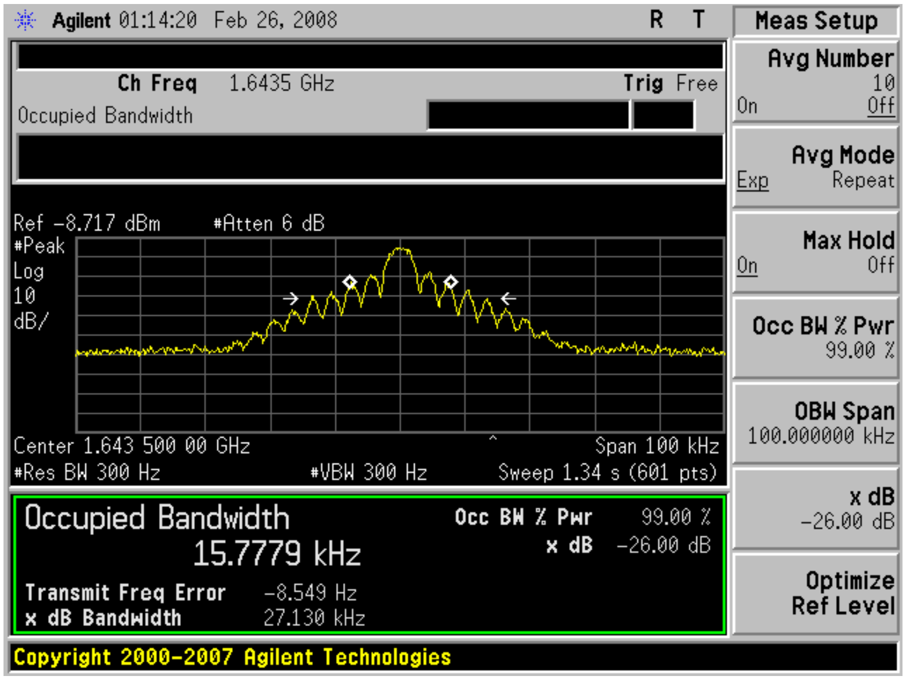

Figure 13 - Occupied Bandwidth of 3000bps BPSK Swift64 Signal

134400 bps 16-QAM Swift64

The occupied bandwidth is 41.77 kHz, as shown in Figure 14 below.

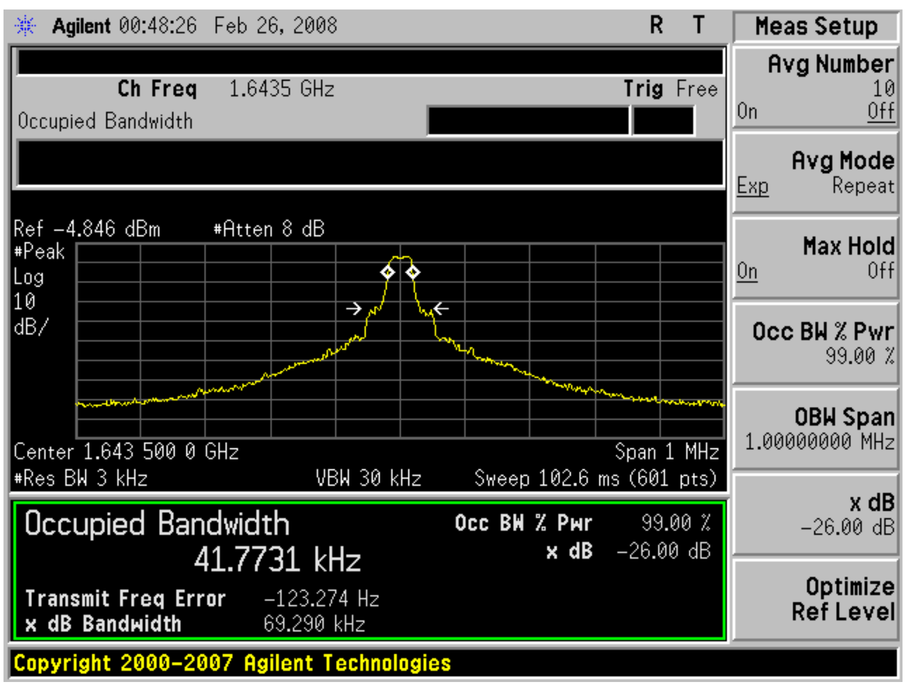

Figure 14 - Occupied Bandwidth of 134400 bps 16-QAM Swift64 Signal

33600 bps QPSK SwiftBroadband

The occupied bandwidth is 22.91 KHz, as shown in Figure 15 below.

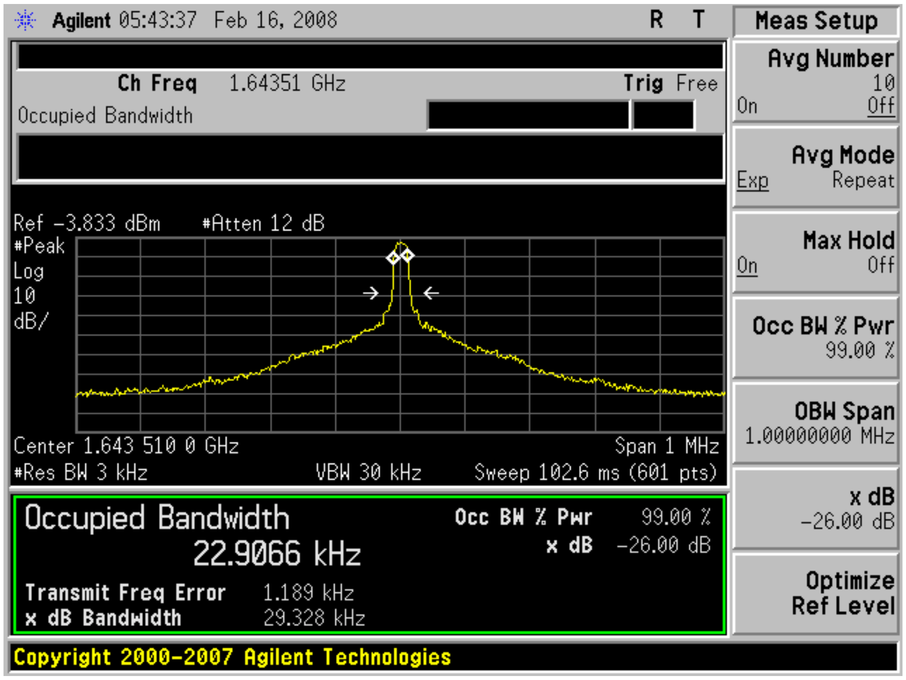

Figure 15 - Occupied Bandwidth of 33600 bps QPSK SwiftBroadband signal

67200 bps QPSK SwiftBroadband

The occupied bandwidth is 40.22 KHz, as shown in Figure 16 below.

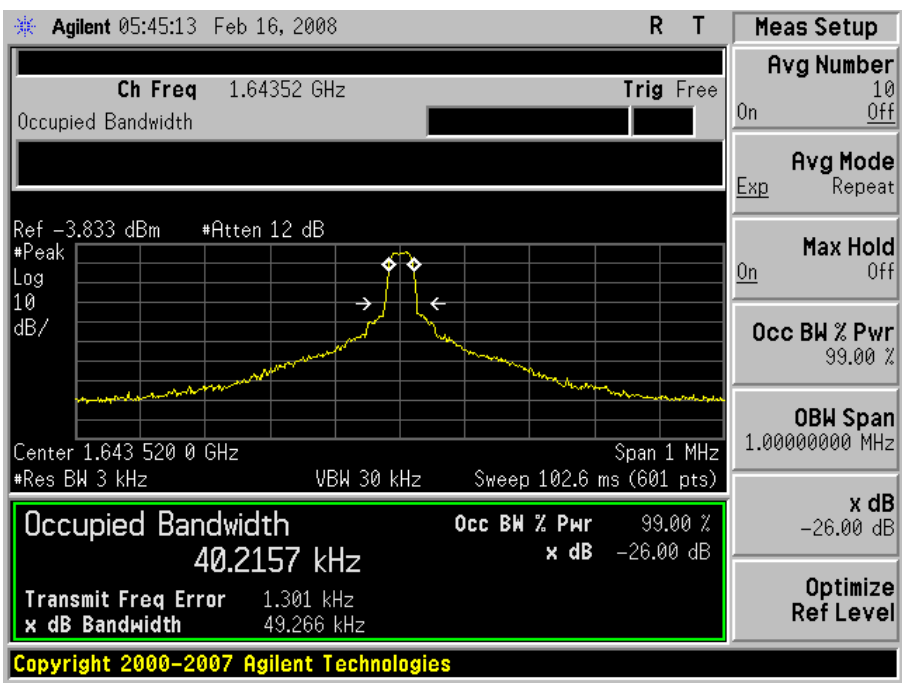

Figure 16 – Occupied Bandwidth of 67200 bps QPSK SwiftBroadband signal

134400 bps KSYM/S QPSK SwiftBroadband

The occupied bandwidth is 76.83 KHz, as shown in Figure 17 below.

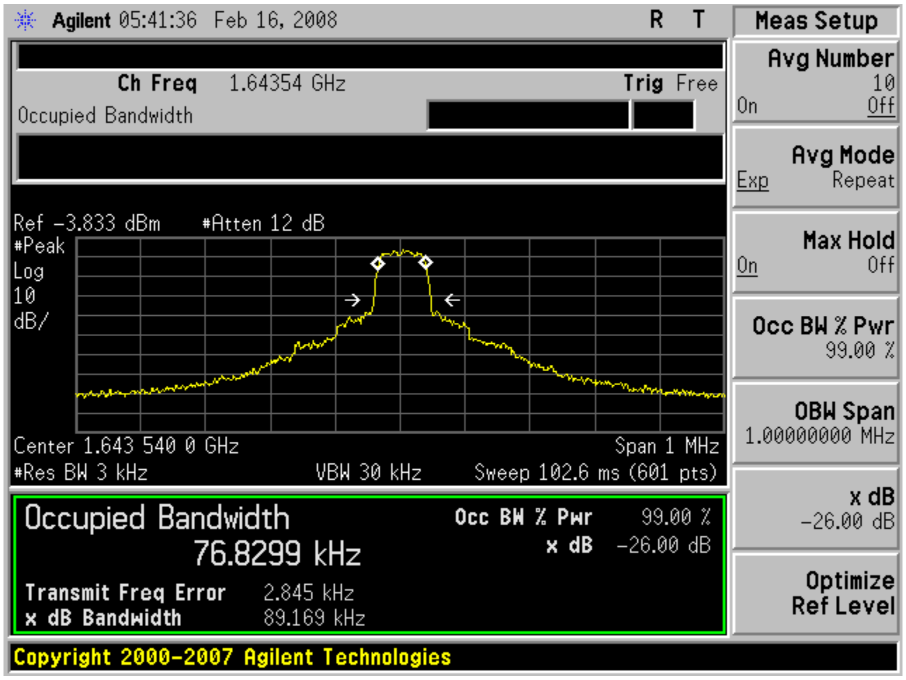

Figure 17 – Occupied Bandwidth of 134400 bps QPSK SwiftBroadband signal

302400 bps QPSK SwiftBroadband

The occupied bandwidth is 168.13 KHz, as shown in Figure 18 below.

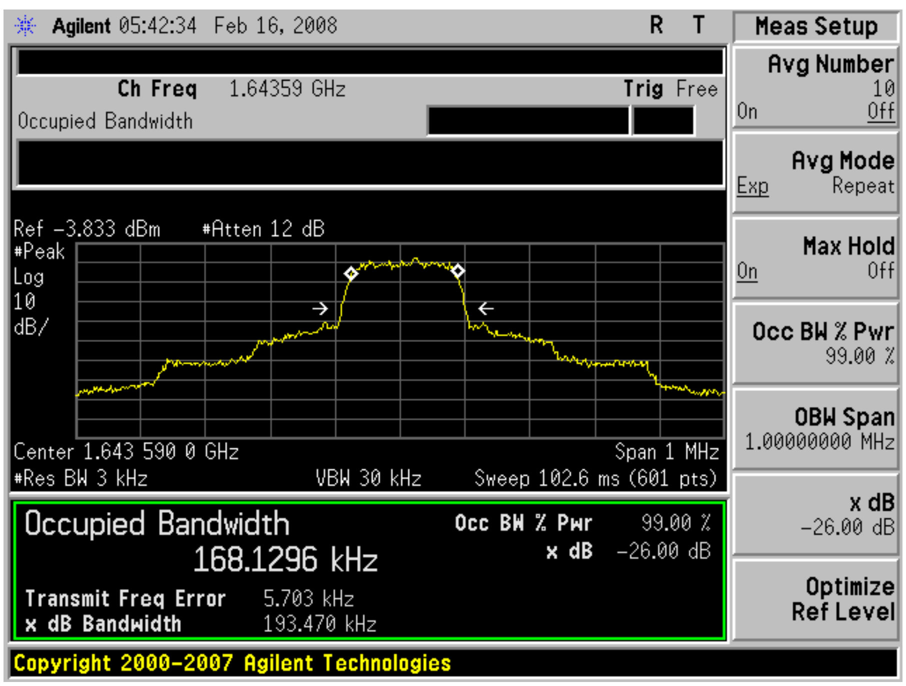

Figure 18 – Occupied Bandwidth of 302400 bps QPSK SwiftBroadband signal

134400 bps 16-QAM SwiftBroadband

The occupied bandwidth is 42.79 KHz, as shown in Figure 19 below.

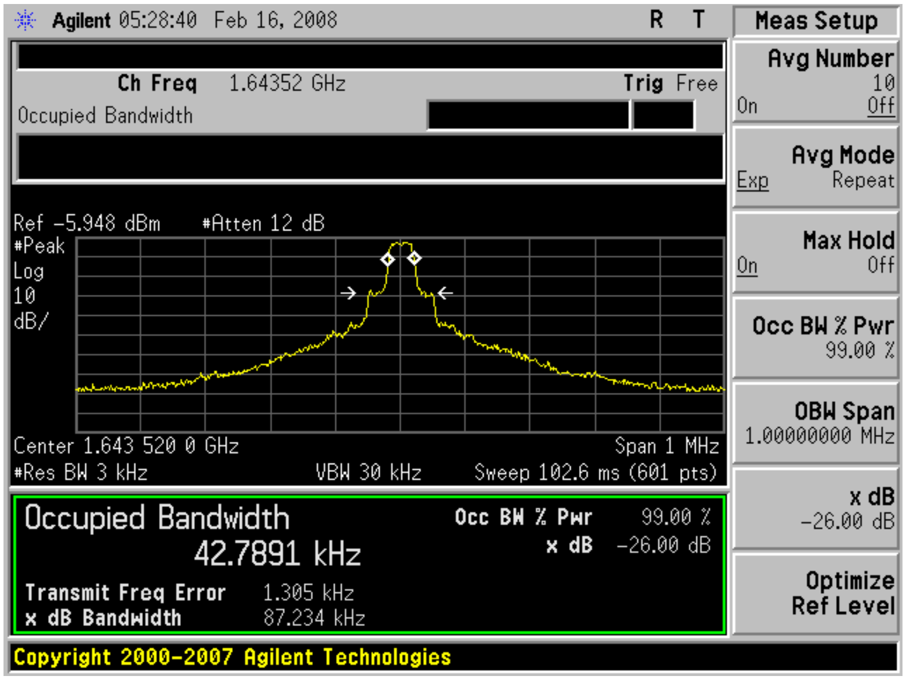

Figure 19 – Occupied Bandwidth of 134400 bps 16-QAM SwiftBroadband signal

268800 bps 16-QAM SwiftBroadband

The occupied bandwidth is 79.44 KHz, as shown in Figure 20 below.

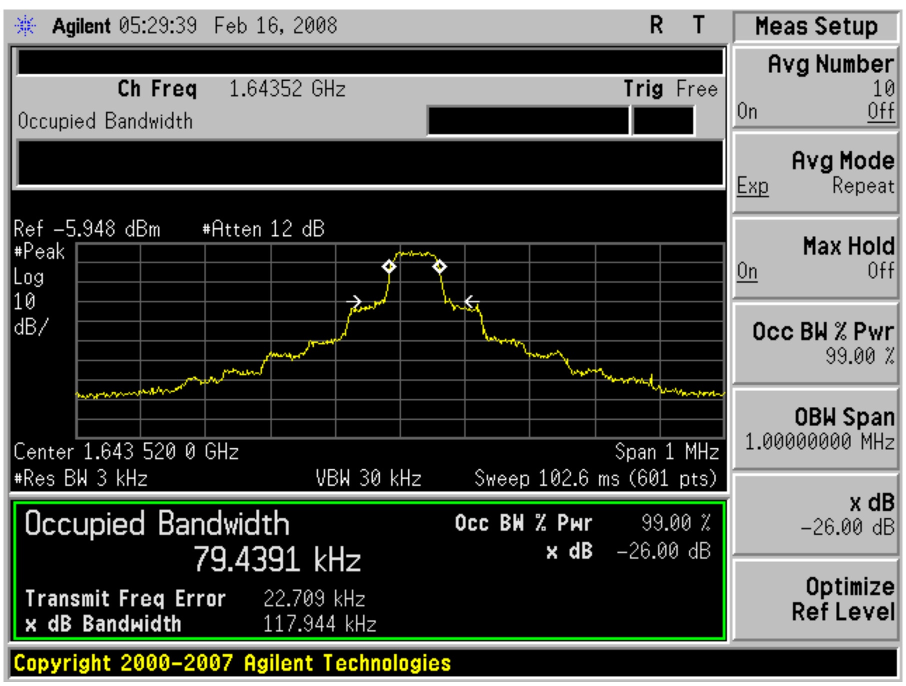

Figure 20 – Occupied Bandwidth of 268800 bps 16-QAM SwiftBroadband signal

604800 bps 16-QAM SwiftBroadband

The occupied bandwidth is 169.99 KHz, as shown in Figure 21 below.

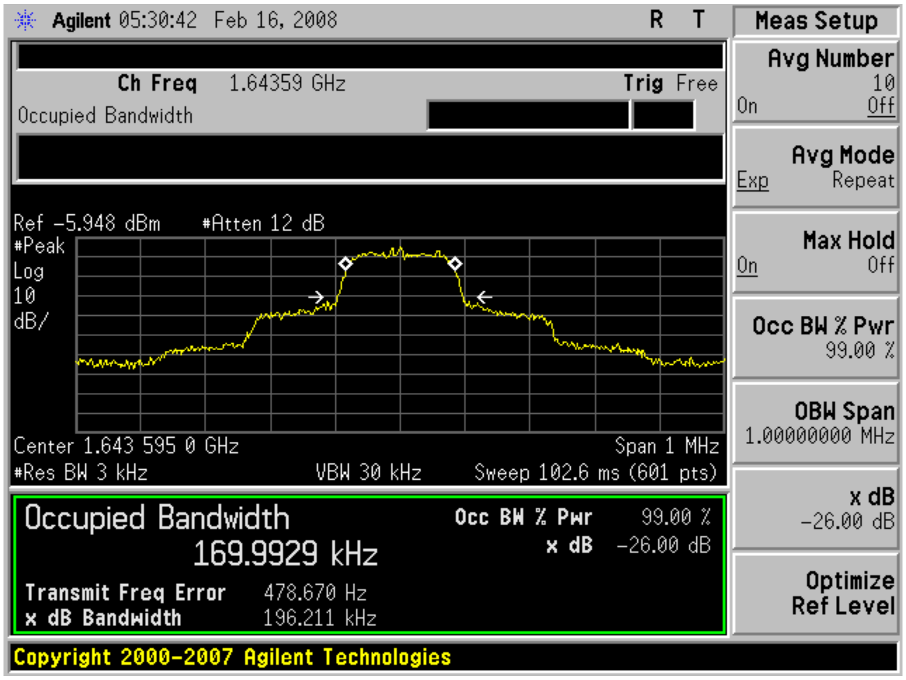

Figure 21 – Occupied Bandwidth of 604800 bps 16-QAM SwiftBroadband signal

1.6.3 Test Results Discussion

Some emissions types used by the INMARSAT for the Swift64 and SwiftBroadband service are not currently accommodated in the tables of 87.137(a). Specifically, they are: 134400 bps 16QAM Swift64, 67200 bps QPSK SwiftBroadband, 134400 bps QPSK SwiftBroadband, 302400 bps QPSK SwiftBroadband, 134400 bps 16QAM SwiftBroadband, 268800 bps 16QAM SwiftBroadband and 604800 bps 16QAM SwiftBroadband.

Rockwell Collins intends to submit a Request for Waiver to accommodate the higher data rate emission type utilized by the INMARSAT Swift64 and SwiftBroadband service and the associated occupied bandwidth.

1.7 Spurious Emissions at Antenna Terminals

1.7.1 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)

(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 by at least:

Frequency (MHz)	Attenuation (dB) [1]
0.01 – 1559	-135 dB/4 KHz
1525 – 1559	-203 dB/4 KHz
1559 – 1585	-155 dB/MHz
1585 – 1605	-143 dB/MHz
1605 – 1610	-117 dB/MHz
1610 – 1610.6	-95 dB/MHz
1610.6 – 1613.8	-80 dBW/MHz[3]
1613.8 – 1614	-95 dB/MHz
1614 – 1626.5	-70 dB/4 KHz
1626.5 – 1660	-70 dB/4 KHz[2,3,4]
1660 – 1670	-49.5dBW/20 KHz[2,3,4]
1670 – 1735	-60 dB/4 KHz
1735 – 12000	-105 dB/4 KHz
12000 – 18000	-70 dB/4 KHz

[1] These values are expressed in dB referenced to the carrier for the bandwidth indicated, and relative to the maximum emission envelope level, except where the attenuation is shown in dBW the attenuation is expressed in terms of absolute power referenced to the bandwidth indicated.

[2] Attenuation measured within the transmit band excludes the band +/- 35 kHz of the carrier frequency.

[3] This level is not applicable for intermodulation products.

[4] The upper limit for the excess power for any narrow-band spurious emission (excluding intermodulation products within a 30 KHz measurement bandwidth) shall be 10 dB above the power limit in this table.

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

(3) 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 +/- 1.40 x SR +/- 2.95 x SR	0 20 40

Where:

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.

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

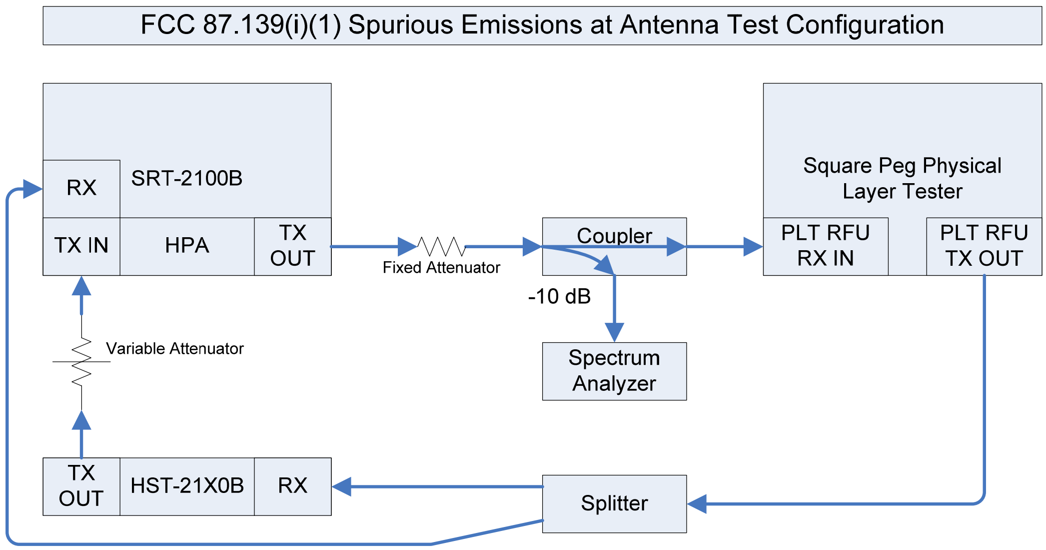

Figure 22 - Spurious Emissions Test Setup

Note on LNA/Diplexer

The Type F LNA/Diplexer contributes a significant amount to the spurious signal rejection of the SAT-2100 system with a HST-2110 or HST-2120. However, in order to accurately measure the performance of the HST, the D/LNA had to be removed for the tests performed in this section and the FCC emission limits adjusted to reflect required performance in the absence of a LNA/Diplexer. The LNA/Diplexer is normally purchased as part of the antenna subsystem, and is not manufactured by Rockwell Collins. The LNA/Diplexer rejection assumed is per the standards for a "Type F" diplexer as published in ARINC Characteristic 741.

To simplify testing, the measurement bandwidth was normalized to a 4 kHz measurement bandwidth.

Refer to the following table for the Pass/Fail criteria used during testing:

Frequency (MHz)	**FCC Limit Per 87.139(i)(1)**	**LNA/ Diplexer Rejection (dB)**	**Pass/Fail Criteria spurious plus noise dBc (45 W output)**	**Pass/Fail Criteria Noise @ 4 kHz bandwidth**
0.01 – 1525	-135 dB/4 KHz	80	-55 dBc/4 kHz	-55 dBc
1525 – 1559	-203 dB/4 KHz	120	-83 dBc/4 kHz	-83 dBc
1559 – 1585	-155 dB/MHz	100	-55 dBc/MHz	-79 dBc
1585 – 1605	-143 dB/MHz	88	-55 dBc/MHz	-79 dBc
1605 – 1610	-117 dB/MHz	62	-55 dBc/MHz	-79 dBc
1610 – 1610.6	-95 dB/MHz	40	-55 dBc/MHz	-79 dBc
1610.6 – 1613.8	-80 dBW/MHz	40	-56.5 dBc/MHz	-80.5 dBc
1613.8 – 1614	-95 dB/MHz	40	-55 dBc/MHz	-79 dBc
1614 – 1626.5	-70 dB/4 KHz	0	-70 dBc/4 KHz	-70 dBc
1626.5 – 1660	-70 dB/4 KHz	0	-70 dBc/4 KHz	-70 dBc
1660 – 1670	-49.5dBW/20 KHz	0	-66 dBc/20 KHz	-72 dBc
1670 – 1735	-60 dB/4 KHz	0	-60 dBc/4 KHz	-60 dBc
1735 – 12000	-105 dB/4 KHz	50	-55 dBc/4 KHz	-55 dBc
12000 – 18000	-70 dB/4 KHz	15	-55 dBc/4 KHz	-55 dBc

Conversion from dBW to dBc assumes maximum HPA output of 45 Watts = 16.5 dBW

Test Equipment for Spurious Emissions

Equipment Name	Recommended Equipment Model Number	Required For
SRT-2100B	Collins PN 822-1785-001	SAT-2100B System Component
HST-2110B AC HST-2120B DC	Collins PN 822-2232-020 Collins PN 822-2234-010	SAT-2100B System Component
Physical Layer Tester	Square Peg EM-907532C-04	Simulating physical layer RF signals
Spectrum Analyzer	Agilent E4440	Measuring Output Spectrum
Variable Attenuator	Weinschel 910-20-11	Reducing RF Output Power to acceptable levels
30dB High Power Attenuator	Weinschel 58-30-34-LIM	Reducing RF Output Power to safe levels
10dB fixed attenuator	Weinschel 2	Reducing RF Output Power to safe levels
20dB Directional Coupler	Narda 3002-10	Reducing RF Output Power to safe levels
Splitter	Mini-Circuits ZAPD-2	Splitting RF signals

The HST-2110/2120 was tested as a system with the SRT-2100. Measurements were made at the output of the HPA. The HST-2110/2120 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. The following procedure was run on both a HST-2110 AC and a HST-2120 DC in order to capture the differences between the AC and DC power supply.

Test Results for Spurious Emissions

Date: March 2008

Location: Rockwell Collins, Cedar Rapids, Iowa USA

Model: SRT-2100B Serial Number: 147362

HST-2110 AC Serial Number: 16CYLR

HST-2120 DC Serial Number: 564

Test Procedure for Spurious Emissions

1. Connect the test equipment as shown in Figure 22.
2. Apply power to the SRT-2100B and the HST-21X0B
3. Place the SRT-2100B into maintenance mode
4. Using the Hyper Terminal maintenance interface on the HST, force the power up of the HSTs Channel Card
5. Once the HSTs Channel Card is powered and connected via Ethernet to the Square Peg PLT, use the WinTerm application to place the Channel Card into MTR Test Mode
6. Start the BPLT application on the Square Peg PLT and run MTR test script MTR16a.scx
7. Using the interface provided by the test script, configure the HST to radiate the following signal:

HST-21X0B Spurious Emissions Test Conditions			
Condition	**Modulation**	**Bit Rate (bps)**	**Frequency (MHz)**
1	16QAM	604,800	1643.50

8. Adjust the Variable Attenuator between the HST's TX Output and the SRT's TX Input to obtain 46.5dBm of output power from the SRT's HPA.
9. Use the spectrum analyzer to take measurements using the settings detailed below for each of the conditions listed above.

HST-21X0B Spurious Emissions Measurement Configuration		
Start Freq. (MHz)	**Stop Freq. (MHz)**	**Resolution BW (Hz)**
100.00	1525.00	3,000
1525.00	1559.00	3,000
1559.00	1585.00	1,000,0000
1585.00	1605.00	1,000,0000
1610.00	1610.60	1,000,0000
1610.60	1613.80	1,000,0000
1613.80	1614.00	1,000,0000
1614.00	1626.50	3,000
1626.50	1660.00	3,000
1660.00	1670.00	20,000
1670.00	1735.00	3,000
1735.00	12000.00	3,000
12000.00	18000.00	3,000

Test Results for Spurious Emissions

Spectrum analyzer measurements were made according to the spectrum analyzer configurations in the following table for both the HST-2110B AC and the HST-2120B DC. These measurements are included in:

"Exhibit F1 – Spurious Emissions – HST-2110AC.pdf" and

"Exhibit F2 – Spurious Emissions – HST-2120DC.pdf".

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 4kHz bandwidth and relative to the maximum emission envelope level." Since some scans in the table above are taken with a 3 kHz resolution bandwidth, they contain 75% of the power that a 4kHz bandwidth measurement would have. Therefore, the correction factor in dB is:

$$10\log 10(4/3) = 1.25 \text{ dB.}$$

The data demonstrates that the HST-2110B and HST-2120B **meets all spurious emissions requirements** when used with the specified Type F LNA/Diplexer.

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

The HST-2120B was tested with a Collins SRT-2100B and measurements were made at the output of the SRT-2100B.

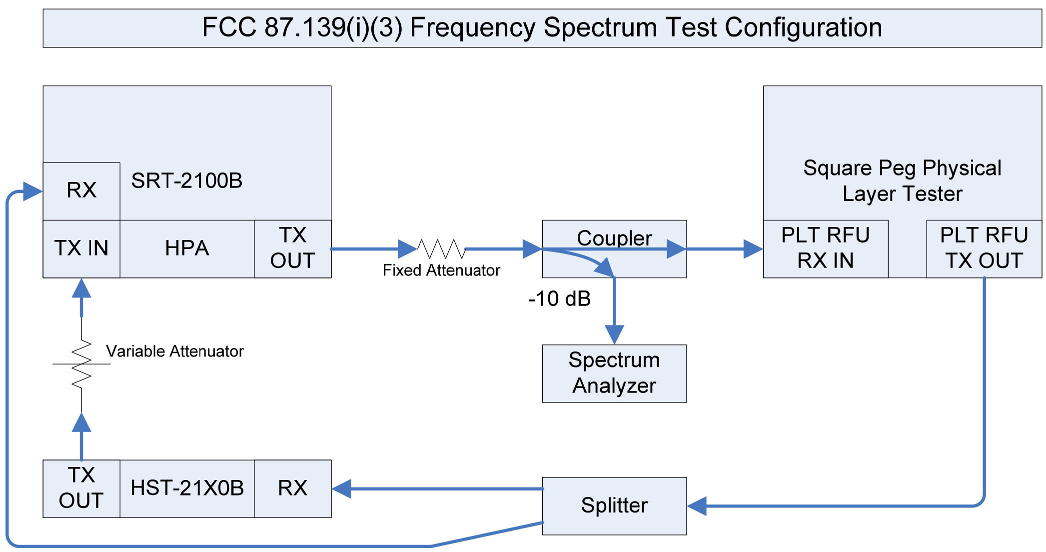

Figure 23 - Frequency Spectrum Test Setup

Test Equipment for Frequency Spectrum

Equipment Name	Recommended Equipment Model Number	Required For
SRT-2100B	Collins PN 822-1785-001	SAT-2100B System Component
HST-2110B AC	Collins PN 822-2232-020	SAT-2100B System Component
Physical Layer Tester	Square Peg EM-907532C-04	Simulating physical layer RF signals
Spectrum Analyzer	Agilent E4440	Measuring Output Spectrum
Variable Attenuator	Weinschel 910-20-11	Reducing RF Output Power to acceptable levels
30dB High Power Attenuator	Weinschel 58-30-34-LIM	Reducing RF Output Power to safe levels
10dB fixed attenuator	Weinschel 2	Reducing RF Output Power to safe levels
20dB Directional Coupler	Narda 3002-10	Reducing RF Output Power to safe levels
Splitter	Mini-Circuits ZAPD-2	Splitting RF signals

Test Results for Frequency Spectrum

Date: March 2008

Location: Rockwell Collins, Cedar Rapids Iowa - USA

Model: SRT-2100B Serial number: 147362

HST-2110B Serial number: 16CYLR

Test Procedure for Frequency Spectrum Swift64

1. Connect the test equipment as shown in Figure 23
2. Apply power to the SRT-2100B and the HST-21X0B
3. Place the SRT-2100B into maintenance mode
4. Using the IP application, configure the SRT-2100B to radiate an unmodulated carrier at 46.5 dBm with a center frequency of 1643.50 MHz
5. Set the spectrum analyzer to measure the carrier with a resolution bandwidth of 100 Hz
6. Set the power reference level of the spectrum analyzer to the peak of the measured carrier and use that reference for the remainder of the testing
7. Using the Hyper Terminal maintenance interface on the HST, power up the channel card and configure the HST to radiate the following signals with zero dB of channel card back off:

HST-21X0B Frequency Spectrum Test Conditions			
Condition	**Modulation**	**Symbol Rate (Sym/S)**	**Frequency (MHz)**
1	BPSK	3,000	1643.50
2	16QAM	33,600	1643.50

8. Adjust the Variable Attenuator between the HST's TX Output and the SRT's TX Input to obtain 46.5dBm of output power from the SRT's HPA.
9. Use the spectrum analyzer to take measurements using the settings detailed below for each of the conditions listed.

HST-21X0B Frequency Spectrum Measurement Configuration			
Condition	**Freq. Span (Hz) 2.95 * 4 * (Symbol Rate)**	**Number of Averages**	**Resolution Bandwidth (Hz)**
1	35,400	20	100
2	396,480	20	100

Test Procedure for Frequency Spectrum SwiftBroadband

1. Connect the test equipment as shown in Figure 23
2. Apply power to the SRT-2100B and the HST-21X0B
3. Place the SRT-2100B into maintenance mode
4. Using the IP application, configure the SRT-2100B to radiate an unmodulated carrier at 46.5 dBm with a center frequency of 1643.50 MHz
5. Set the spectrum analyzer to measure the carrier with a resolution bandwidth of 100 Hz
6. Set the power reference level of the spectrum analyzer to the peak of the measured carrier and use that reference for the remainder of the testing
7. Using the Hyper Terminal maintenance interface on the HST, force the power up of the HSTs Channel Card
8. Once the HSTs Channel Card is powered and connected via Ethernet to the Square Peg PLT, use the WinTerm application to place the Channel Card into MTR Test Mode
9. Start the BPLT application on the Square Peg PLT and run MTR test script MTR16a.scx
10. Using the interface provided by the test script, configure the HST to radiate the following signals:

HST-21X0B Frequency Spectrum Test Conditions			
Condition	**Modulation**	**Symbol Rate (Sym/S)**	**Frequency (MHz)**
1	QPSK	16,800	1643.50
2	QPSK	33,600	1643.50
3	QPSK	67,200	1643.50

4	QPSK	151,200	1643.50
5	16QAM	33,600	1643.50
6	16QAM	67,200	1643.50
7	16QAM	151,200	1643.50

11. Adjust the Variable Attenuator between the HST's TX Output and the SRT's TX Input to obtain 46.5dBm of output power from the SRT's HPA.
12. Use the spectrum analyzer to take measurements using the settings detailed below for each of the conditions listed.

SRT-2100B Frequency Spectrum Measurement Configuration			
Condition	**Freq. Span (Hz)** **2.95 * 4 * (Symbol Rate)**	**Number of Averages**	**Resolution Bandwidth (Hz)**
1	198,240	20	100
2	396,480	20	100
3	792,960	20	100
4	1,784,160	20	100
5	396,480	20	100
6	792,960	20	100
7	1,784,160	20	100

Test Results

3000 BPS BPSK Swift64

The frequency spectrum of 3000 bps BPSK Swift64 signal is shown in Figure 24 below along with the FCC spectrum mask and INMARSAT mask. Please refer to section 1.7.4 below for a discussion of this result.

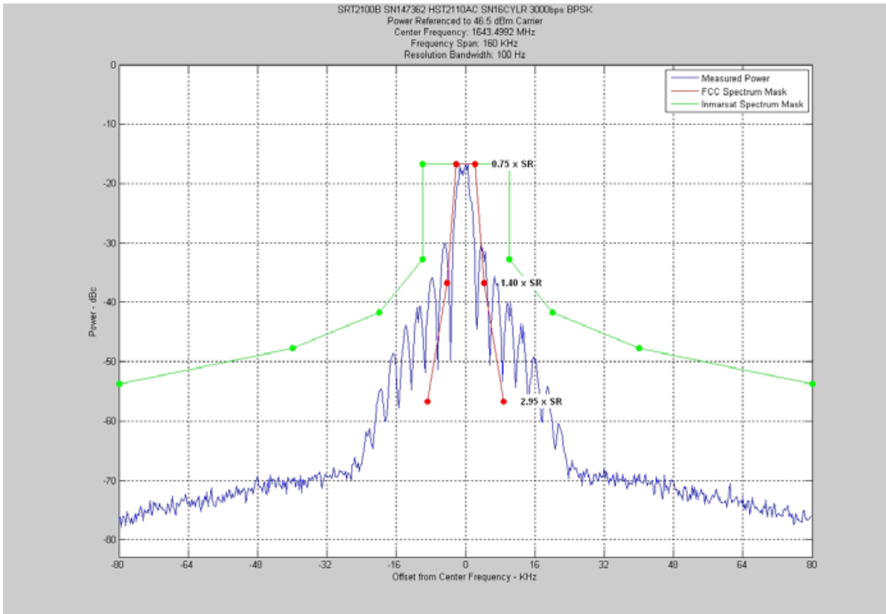

Figure 24 - Frequency Spectrum of 3000 bps BPSK Swift64 Transmitter

134400 BPS 16-QAM Swift64

The frequency spectrum of 134400 bps 16-QAM Swift64 signal is shown in Figure 25 below along with the FCC spectrum mask.

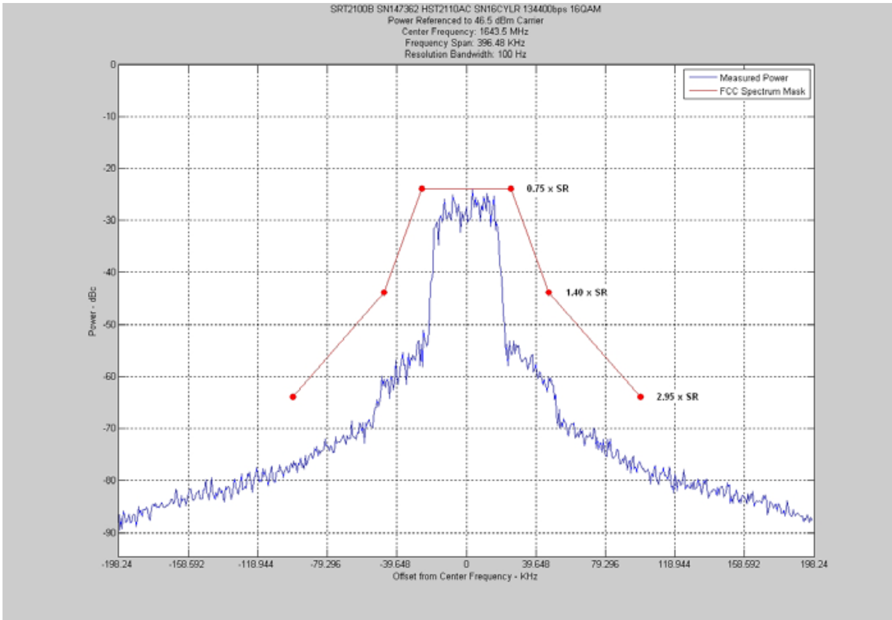

Figure 25 - Frequency Spectrum of 134400 bps 16-QAM Swift64 Transmitter

T05QD – 33600 BPS QPSK SwiftBroadband

The frequency spectrum of 33600 bps QPSK SwiftBroadband signal is shown in Figure 26 below along with the FCC spectrum mask.

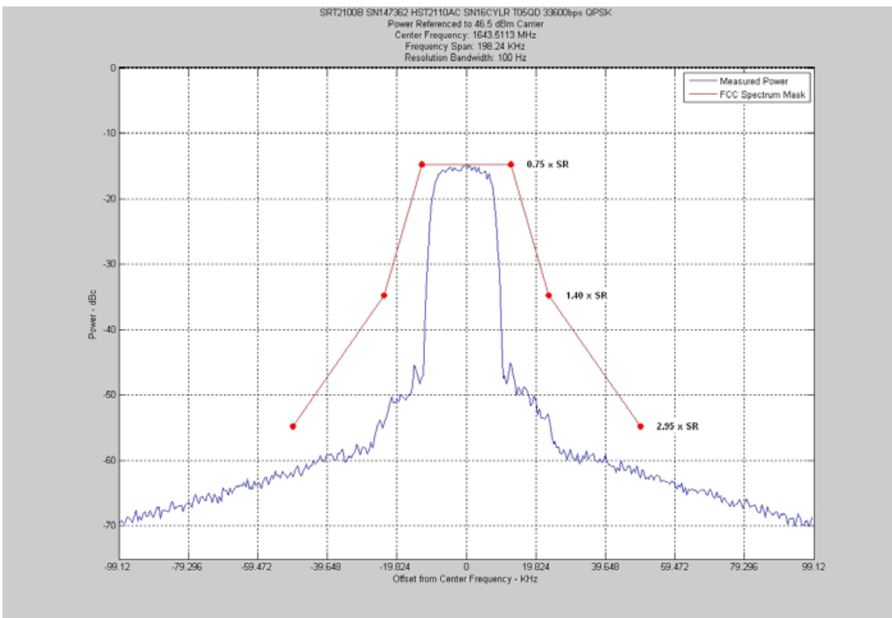

Figure 26 - Frequency Spectrum of 33600 bps QPSK SwiftBroadband Transmitter

T1QD – 67200 BPS QPSK SwiftBroadband

The frequency spectrum of 67200 bps QPSK SwiftBroadband signal is shown in Figure 27 below along with the FCC spectrum mask.

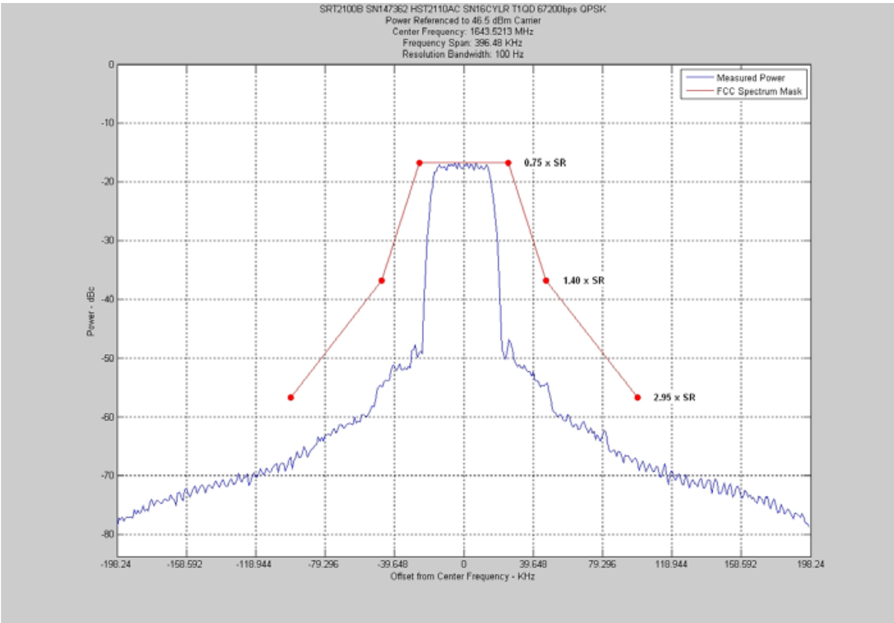

Figure 27 - Frequency Spectrum of 67200 bps QPSK SwiftBroadband Transmitter

T2QD – 134400 BPS QPSK SwiftBroadband

The frequency spectrum of 134400 bps QPSK SwiftBroadband signal is shown in Figure 28 below along with the FCC spectrum mask.

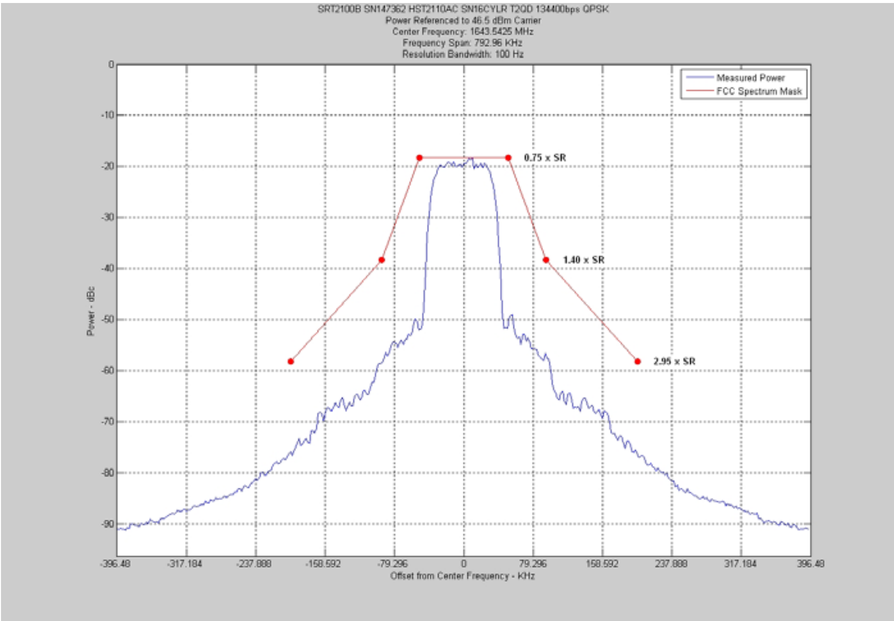

Figure 28 - Frequency Spectrum of 134400 bps QPSK SwiftBroadband Transmitter

T45QD 302400 BPS QPSK SwiftBroadband

The frequency spectrum of 302400 bps QPSK SwiftBroadband signal is shown in Figure 29 below along with the FCC spectrum mask.

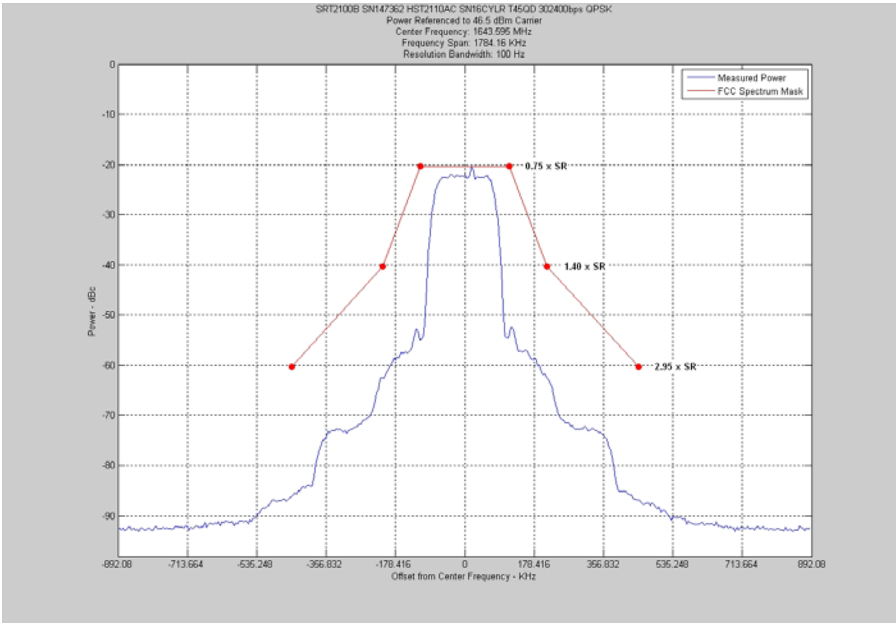

Figure 29 - Frequency Spectrum of 302400 bps QPSK SwiftBroadband Transmitter

T1XD – 134400 BPS 16-QAM SwiftBroadband

The frequency spectrum of 134400 bps 16-QAM SwiftBroadband signal is shown in Figure 30 below along with the FCC spectrum mask.

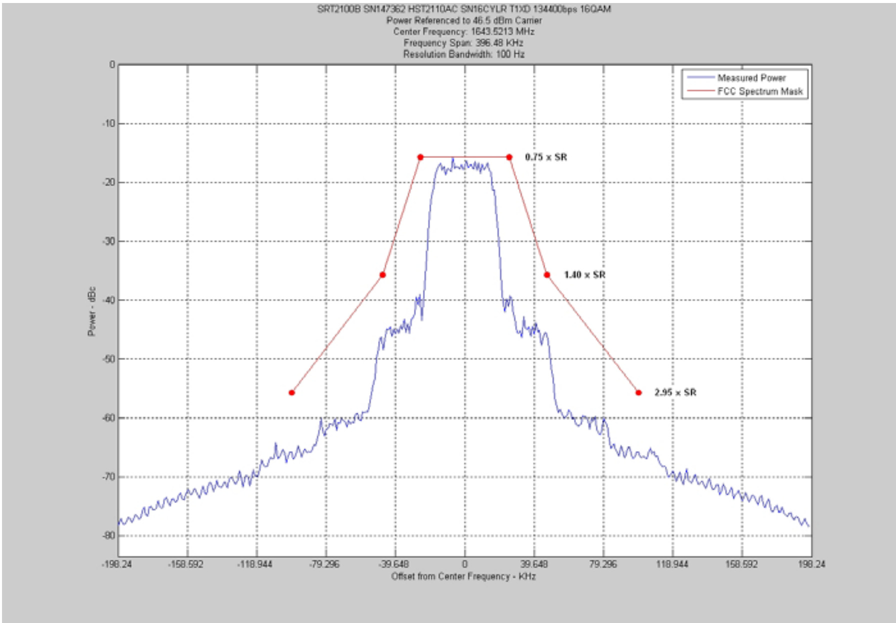

Figure 30 - Frequency Spectrum of 134400 bps 16-QAM SwiftBroadband Transmitter

T2XD – 268800 BPS 16-QAM SwiftBroadband

The frequency spectrum of 268800 bps 16-QAM SwiftBroadband signal is shown in Figure 31 below along with the FCC spectrum mask.

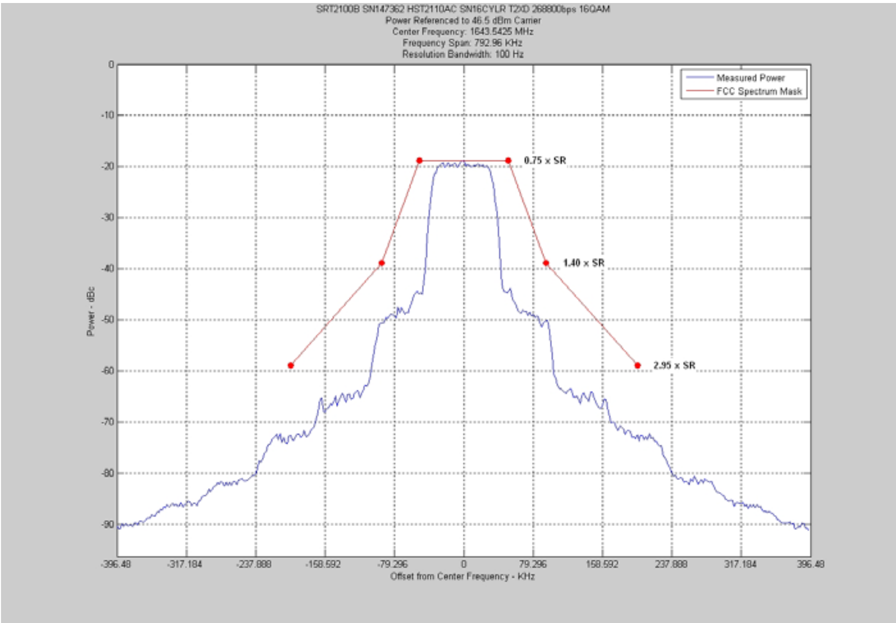

Figure 31 - Frequency Spectrum of 268800 bps 16-QAM SwiftBroadband Transmitter

T45XD – 604800 BPS 16-QAM SwiftBroadband

The frequency spectrum of 604800 bps 16-QAM SwiftBroadband signal is shown in Figure 32 below along with the FCC spectrum mask.

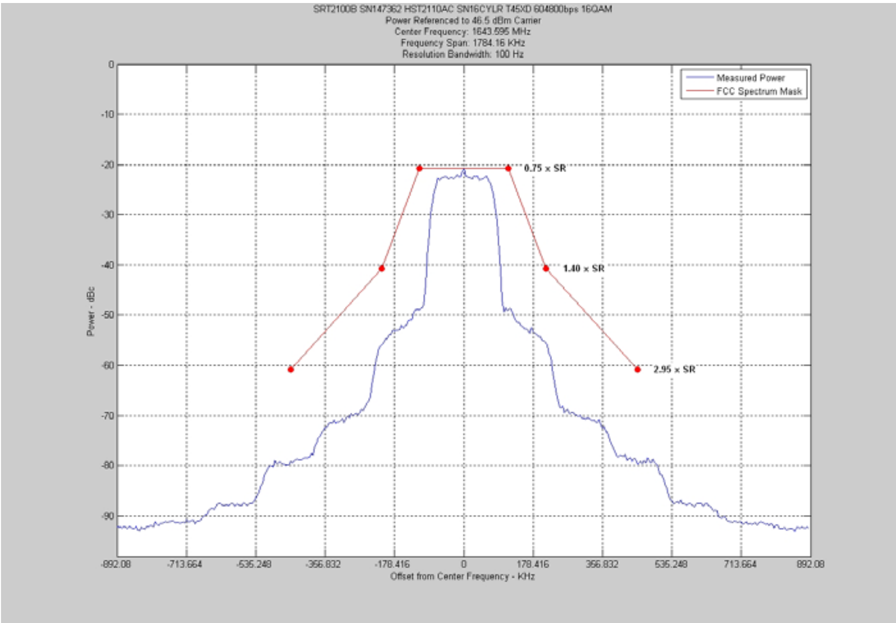

Figure 32 - Frequency Spectrum of 604800 bps 16-QAM SwiftBroadband Transmitter

1.7.4 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 Spectrum Mask – 87,139 (i) (3)

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) (3). Previously, the FCC granted a waiver request to Rockwell Collins to allow the use of this waveform as defined by INMARSAT.

All other results shown above are compliant with the FCC mask.

1.8 Field Strength of Spurious Radiation

This section is a resubmission of Rockwell Collins's previous approved FCC equipment authorization for HST-2110 (FCC ID AJK8222231) and HST-2120 (FCC ID AJK8222233).

The internal hardware of the HST-2110B and HST-2120B are the same as the HST-2110 and HST-2120. Although some RF emission differences are expected (caused by the new RF waveform to support the SwiftBroadband service), these differences are present at the transmitter output terminal and not from spurious radiation exiting the chassis of the HST-2110B and HST-2120B. Transmitter emission results are provided elsewhere in this report. Therefore, the field strength of spurious radiation test results are not impacted by the addition of SwiftBroadband.

1.8.1 FCC Requirements

Section 2.1053 (a), (b) (2)

(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 emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(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.

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 by at least:

Frequency (MHz)	Attenuation (dB) [1]
0.01 – 1559	-135 dB/4 KHz
1525 – 1559	-203 dB/4 KHz
1559 – 1585	-155 dB/MHz
1585 – 1605	-143 dB/MHz
1605 – 1610	-117 dB/MHz
1610 – 1610.6	-95 dB/MHz
1610.6 – 1613.8	-80 dBW/MHz[3]
1613.8 – 1614	-95 dB/MHz
1614 – 1626.5	-70 dB/4 KHz
1626.5 – 1660	-70 dB/4 KHz[2,3,4]
1660 – 1670	-49.5dBW/20 KHz[2,3,4]
1670 – 1735	-60 dB/4 KHz
1735 – 12000	-105 dB/4 KHz
12000 – 18000	-70 dB/4 KHz

[1] These values are expressed in dB referenced to the carrier for the bandwidth indicated, and relative to the maximum emission envelope level, except where the attenuation is shown in dBW the attenuation is expressed in terms of absolute power referenced to the bandwidth indicated.

[2] Attenuation measured within the transmit band excludes the band +/- 35 kHz of the carrier frequency.

[3] This level is not applicable for Intermodulation products.

[4] The upper limit for the excess power for any narrow band spurious emission (excluding Intermodulation products within a 30 kHz measurement bandwidth) shall be 10 dB above the power limit in this table.

1.8.2 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.

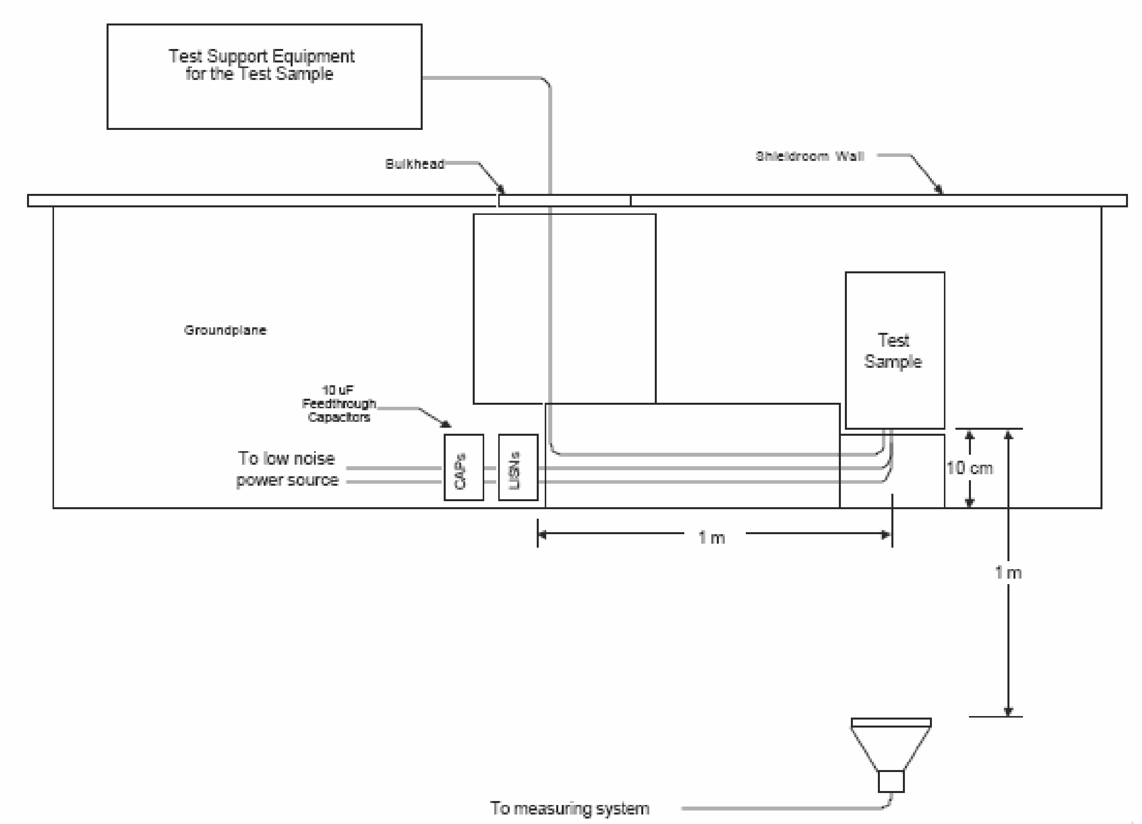

Figure 33 Field Strength Test Setup

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 33.
2. HST-2110/2120 operation during radiated emissions measurements monitors digital I/O discretes and exercises the ARINC 429 buses, Ethernet and RS232 ports via loopbacks. 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:

Location: MPB, Ottawa, Canada

Model: HST-2120

Serial number:

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 (45 watts) – 2.5 dB (cable loss) = 15.3 dBW (33.7 watts).
- The duty cycle of the operation is 100%.

The calculation proceeded as follows:

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 reference field strength of the desired signal 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.**

"***Exhibit F3 – Spurious Radiation.pdf"*** 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 RTCA DO-160D, Section 21.4, Category M.

1.8.3 Test Results Discussion

The FCC test procedures for emissions radiated from the equipment case and interconnecting cables is specified in 2.1053 "Measurements Required: Field Strength of Spurious Radiation." These procedures require demonstration of compliance with the same emissions limits specified in 87.139(i)(1). However, the limits of 87.139(i)(1) were recently updated to align with the requirements of RTCA DO-210D "Minimum Operational Performance Standards for Geosynchronous Orbit Aeronautical Mobile Satellite Services (AMSS) Avionics" (MOPS). This resulted in a change from the previous FCC attenuation limits of 83 dB (below 1559 MHz) and 55 dB (above 1559 MHz) to attenuations now as high as 203 dBc in the receive band (1525-1559 MHz). These new requirements are appropriate at the Satcom antenna terminals, since Satcom is a full duplex system and shares a single antenna. Most of the receiver/transmitter isolation to achieve this attenuation is provided by the LNA/Diplexer. Other attenuation requirements in the MOPS were established to protect any GPS receiver antenna mounted nearby on the aircraft and to protect radio astronomy. These limits assumed the Satcom antenna could exhibit in excess of 12 dB gain at these frequencies.

However, there is no practical reason to require these same attenuations from the equipment case and interconnecting cables. The equipment and cables are located internal to the aircraft fuselage, and the field strength of any spurious emission is not amplified by the gain of the antenna. None of the other electronic equipment that may be installed in the aircraft are tested to the levels of 87.139(i)(1).

Rockwell Collins is requesting a waiver of 87.139(i)(1) as applied to the field strength measurements of equipment and interconnecting cables specified in 2.1053. Rockwell Collins is requesting that the FCC accept compliance with the standard radiated field strength procedures and limits for equipment and interconnecting cables for equipment installed internal to aircraft fuselage as specified in RTCA DO-160D, Section 21, Category M.

The plots in **"*Exhibit F3 – Spurious Radiation.pdf*"** indicate that the HST-2110 and HST-2120 meets or exceeds the radiated emissions requirements of DO-160D, Section 21, Category M for electronic equipment installed internal to the fuselage.

1.9 Frequency Stability

This section is a resubmission of Rockwell Collins's previous approved FCC equipment authorization for HST-2110 (FCC ID AJK8222231) and HST-2120 (FCC ID AJK8222233).

The internal hardware of the HST-2110B and HST-2120B are the same as the HST-2110 and HST-2120. This includes the High Stability Reference (HSR) which produces frequency stability. Therefore, the Frequency Stability test results are not impacted by the addition of SwiftBroadband.

1.9.1 FCC Requirements

Section 2.1055 (a) (2), (b), (c) (1) (2), (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.

(c) (1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and +30° centigrade with no primary power applied.

(c)(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater.

(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.

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

1.9.2.1 Test Setup, Equipment and Results for Frequency Stability of the HST-2120 (DC)

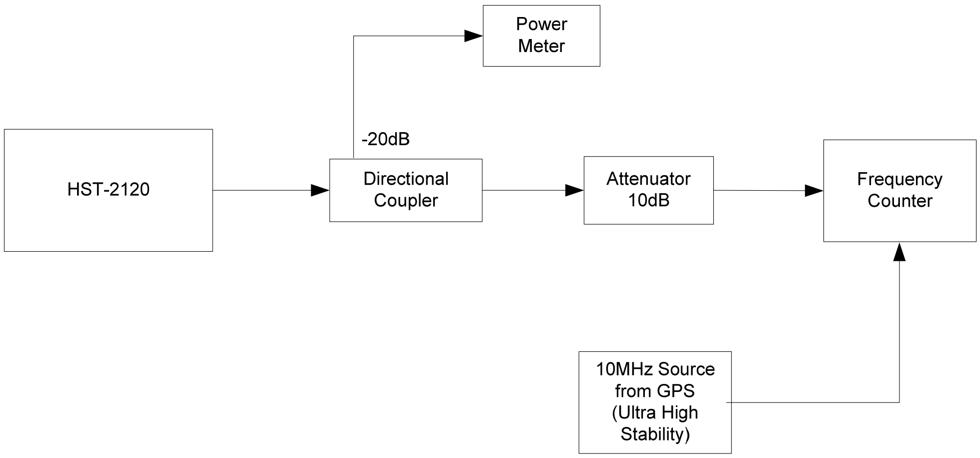

Figure 34 Frequency Stability Test Setup

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
10dB Attenuator	Narda 768-10 (or equivalent)	Reducing RF Output Power to safe levels

Test Results for Frequency Stability

Date: 16-Dec-2005

Location: EMS Technologies, Ottawa, Canada

Model: HST-2120

Serial number: 017

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 (VDc)	Frequency (Hz)	Error (Hz)	Pass/Fail
-20	23.8	1,643,500,093	93	Pass
-20	28	1,643,500,095	95	Pass
-20	32.2	1,643,500,097	97	Pass
-10	23.8	1,643,500,095	95	Pass
-10	28	1,643,500,093	93	Pass
-10	32.2	1,643,500,096	96	Pass
0	23.8	1,643,500,092	92	Pass
0	28	1,643,500,094	94	Pass
0	32.2	1,643,500,091	91	Pass
+10	23.8	1,643,500,094	94	Pass
+10	28	1,643,500,093	93	Pass
+10	32.2	1,643,500,092	92	Pass
+20	23.8	1,643,500,092	92	Pass
+20	28	1,643,500,091	91	Pass
+20	32.2	1,643,500,091	91	Pass
+30	23.8	1,643,500,089	89	Pass
+30	28	1,643,500,089	89	Pass
+30	32.2	1,643,500,090	90	Pass
+40	23.8	1,643,500,088	88	Pass
+40	28	1,643,500,087	87	Pass
+40	32.2	1,643,500,086	86	Pass
+50	23.8	1,643,500,084	84	Pass
+50	28	1,643,500,085	85	Pass
+50	32.2	1,643,500,085	85	Pass

Test Results – Warm-up Time

As the HST-2110 and HST-2120 have an ovenized frequency reference, compliance with Section 2.1055 (c) is required. The High Stability Reference oscillator and other frequency determining elements (including synthesizers) are identical for all versions of the HST.

Upon power up the HST-2120 is set to generate a carrier of 1643.500.000 MHz 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	1,643,497,028	N/A
0	2	1,643,500,136	N/A
0	3	1,643,500,093	Y
0	4	1,643,500,095	Y
0	5	1,643,500,094	Y
0	6	1,643,500,095	Y
0	7	1,643,500,092	Y
0	8	1,643,500,095	Y
0	9	1,643,500,096	Y
0	10	1,643,500,092	Y
+30	1	1,643,498,707	N/A
+30	2	1,643,500,102	N/A
+30	3	1,643,500,091	Y
+30	4	1,643,500,088	Y
+30	5	1,643,500,088	Y
+30	6	1,643,500,089	Y
+30	7	1,643,500,089	Y
+30	8	1,643,500,089	Y
+30	9	1,643,500,089	Y
+30	10	1,643,500,089	Y

1.9.2.2 Test Setup, Equipment and Results for Frequency Stability of the HST-2110 (AC)

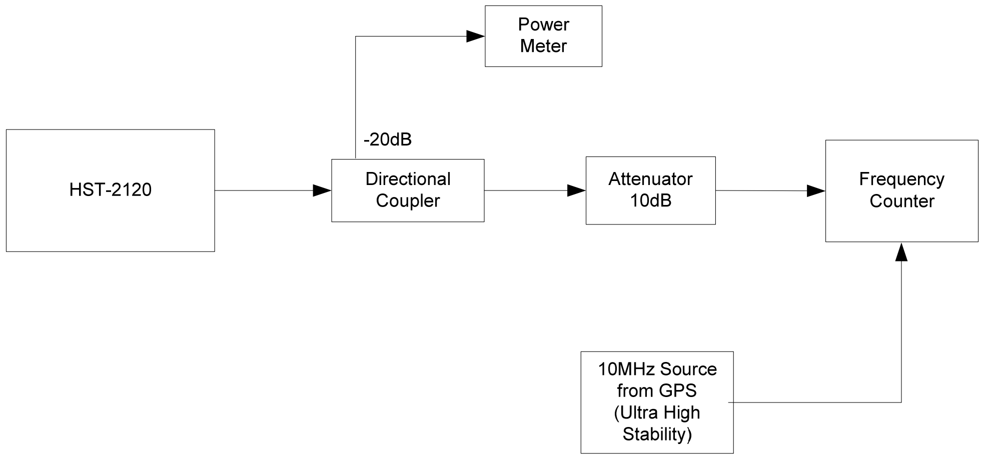

Figure 35 Frequency Stability Test Setup

Test Equipment for Frequency Stability

Equipment Name	**Recommended Equipment Model Number**	**Required For**
Power Meter	HP E4419B (or equivalent)	Monitoring signal level
Frequency Counter	EIP Model 545A (or equivalent)	Measuring Frequency
20dB Directional Coupler	HP778D (or equivalent)	Reducing RF Output Power to safe levels
10dB Attenuator	Narda 768-10 (or equivalent)	Reducing RF Output Power to safe levels
10 MHz Source from GPS (Ultra High Stability)	EndRun Technologies Model: Praecis Gfr P/N 3010-0010-000	10 MHz Reference for Frequency Counter

Test Results for Frequency Stability

Date: 10 May-2006 & 11May-2006

Location: EMS Technologies, Ottawa, Canada

Model: HST-2110 (AC)

Serial number: 300

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

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

Test Equipment:

Equipment Name	**Recommended Equipment Model Number**	**Serial Number** **CAL Due Date**
Power Meter	HP E4419B	GB43311611 14Mar2007
Frequency Counter	EIP Model 545A	00210 19Nov2006
20dB Directional Coupler	HP778D	13409 16Mar2007
10dB Attenuator	Narda 768-10 (or equivalent)	-
10 MHz Reference from GPS	EndRun Technologies Model: Praecis Gfr P/N: 3010-0010-000	04040017 Calibration Not required

Test Results - Stability

Temperature (° C)	Voltage (Vac)	Frequency (Hz)	Error (Hz)	Pass/Fail
-20	97.7	1,643,499,987	-13	Pass
-20	115	1,643,499,986	-14	Pass
-20	132.3	1,643,499,987	-13	Pass
-10	97.7	1,643, 499,985	-15	Pass
-10	115	1,643, 499,986	-14	Pass
-10	132.3	1,643, 499,986	-14	Pass
0	97.7	1,643, 499,984	-16	Pass
0	115	1,643, 499,985	-15	Pass
0	132.3	1,643, 499,985	-15	Pass
+10	97.7	1,643, 499,983	-17	Pass
+10	115	1,643, 499,983	-17	Pass
+10	132.3	1,643, 499,983	-17	Pass
+20	97.7	1,643,499,979	-21	Pass
+20	115	1,643, 499,978	-22	Pass
+20	132.3	1,643, 499,979	-21	Pass
+30	97.7	1,643, 499,977	-23	Pass
+30	115	1,643, 499,978	-22	Pass
+30	132.3	1,643, 499,977	-23	Pass
+40	97.7	1,643, 499,975	-25	Pass
+40	115	1,643, 499,976	-24	Pass
+40	132.3	1,643, 499,976	-24	Pass
+50	97.7	1,643, 499,974	-26	Pass
+50	115	1,643, 499,973	-27	Pass
+50	132.3	1,643, 499,973	-27	Pass

Test Results – Warm-up Time

As the HST-2110 (AC) has an ovenized frequency reference, compliance with Section 2.1055 (c) is required.

Upon power up, the HST-2110 (AC) was set to generate a carrier of 1643.500.000 MHz 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)	Pass/Fail
0	1	1,643,497,817	N/A
0	2	1,643,499,319	N/A
0	3	1,643,499,984	Y
0	4	1,643,499,985	Y
0	5	1,643,499,984	Y
0	6	1,643,499,984	Y
0	7	1,643,499,985	Y
0	8	1,643,499,984	Y
0	9	1,643,499,984	Y
0	10	1,643,499,985	Y
+30	1	1,643,499,898	N/A
+30	2	1,643,499,976	N/A
+30	3	1,643,499,978	Y
+30	4	1,643,499,978	Y
+30	5	1,643,499,977	Y
+30	6	1,643,499,977	Y
+30	7	1,643,499,977	Y
+30	8	1,643,499,977	Y
+30	9	1,643,499,977	Y
+30	10	1,643,499,978	Y

1.9.3 Test Results Discussion

The HST-2110 and HST-2120 meet the FCC requirements for frequency accuracy. However, when operated as a system with an SRT-2100, the actual transmit frequency is the sum of the SRT frequency reference error (+/- 160 Hz), and the HST frequency reference error. As a result, the actual transmit frequency error of the system may exceed the +/- 160 Hz reference oscillator requirement stated in 87.133. 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 SRT and HST as a system. A Waiver request is anticipated to permit the operation of equipment designed to meet +/- 1250 Hz frequency established by INMARSAT for this service.

1.10 Priority and Preemption

An aircraft earth station, AES, equipped with both a SRT-2100B and HST-2110B or HST-2120B share a common antenna and high power amplifier. The SRT 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 SRT-2100B 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.

1.10.1 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.

1.10.2 Test Equipment List

Equipment Name	Recommended Equipment Model Number	Required For
SRT-2100B	Collins PN 822-1785-001	SAT-2100B System Component
HST-2120B DC	Collins PN 822-2234-010	SAT-2100B System Component
Physical Layer Tester	Square Peg EM-907532C-04	Simulating physical layer RF signals
Power Meter	HP 438A	Measuring Output Power
Variable Attenuator	Weinschel 910-20-11	Reducing RF Output Power to acceptable levels
30dB High Power Attenuator	Weinschel 58-30-34-LIM	Reducing RF Output Power to safe levels
10dB fixed attenuator	Weinschel 2	Reducing RF Output Power to safe levels
20dB Directional Coupler	Narda 3002-10	Reducing RF Output Power to safe levels
Splitter	Mini-Circuits ZAPD-2	Splitting RF signals

1.10.3 Test Setup

The main purpose of these tests is to verify the ability of the AES to preempt a HST-21X0B call with a higher priority cockpit call when sufficient resources are not available.

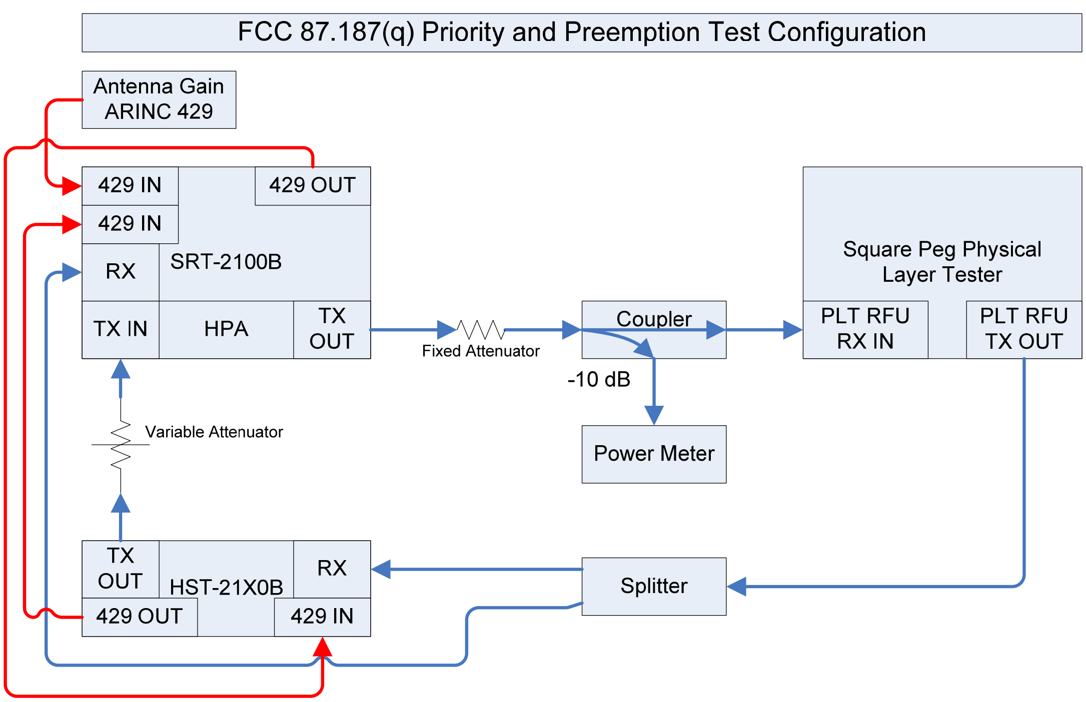

Figure 36 - Priority/Preemption Test Setup

Test Procedure for Classic Aero/ Swift64

FCC Requirements detailed in sections 87.131 (RF Power Output) and 87.187(q) (Priority and Preemption) were tested with a combined procedure in which Classic Aero voice services were exercised in concert with Swift 64 services. During the test procedure the output EIRP of the Classic Aero voice services and Swift 64 data services were varied along with antenna gain in order to demonstrate accurate power control and, when necessary, the preemption of lower priority services in order to maintain output EIRP for higher priority services. The spreadsheet below documents the various conditions and records the predicted, measured and reported RF power output in order to demonstrate compliance.

Minimal Cable Loss				Nominal Cable Loss				Maximum Cable Loss		
HPA ref (Watts)	45			HPA ref (Watts)	45			HPA ref (Watts)	45	Total EIRP = Max OutdBW + Ant Gain - Ant to HPA Loss
										HST1 Out = HST EIRP - Ant Gain + Ant to HPA Loss - 31 + HST Offset (Loss) + 30
Max HPA out (dB) :	0			Max HPA out (dB	0			Max HPA out (dB) :	0	
Max Out dBW	16.53			Max Out dBW	16.53			Max Out dBW	16.53	
Max Out dBm :	46.53			Max Out dBm :	46.53			Max Out dBm :	46.53	
Ant to HPA Loss :	2			Ant to HPA Loss :	2			Ant to HPA Loss :	2	
HST max Out (dBm)	31.5			HST max Out (dB	31.5			HST max Out (dBm) :	31.5	
HST1 Offset (loss) :	-1.3			HST1 Offset (loss)	0.5			HST1 Offset (loss) :	1.4	
HST2 Offset (loss) :	-1.3			HST2 Offset (loss)	0.5			HST2 Offset (loss) :	1.4	
RFU to HPA Attn =	5	---------		RFU to HPA Attn :	5	-------		RFU to HPA Attn =	5	----------
HST1 to HPA Attn =	3.7	0		HST1 to HPA Attn	5.5	1		HST1 to HPA Attn =	6.4	2
HST2 to HPA Attn =	3.7	-----------		HST2 to HPA Attn	5.5	----------		HST2 to HPA Attn =	6.4	----------

Nominal Cable Loss										Calculated	Actual	Calculated	Actual		Dual HST			
Ant Gain	Total EIRP	Data	EIRP	EIRP	Avail EIRP	HST1 EIRP	2 HST EIRP	HST1 Out	HST2 Out	Rpt Avail	Rpt Avail	Back Off	Back Off		Measured HPA Out	Computed HPA at output Trace	error	Pass/Fail
dB	dBW	dBW	Call 1	Call 2	dBW	dBW	dBW	dBm	dBm	dBW	dBW	dB	dB		dBm	dBm	dB	(+2.5/- 1.0 dB)
12	26.53	10.50	-100	-100	26.42	22.5	19.5	12.00	12.00	24.17	26.00	10.00	10.00	44.26	44.68	44.19	-0.07	PASS
12	26.53	10.50	-100	-100	26.42	20.5	17.5	10.00	10.00	25.14	26.50	10.00	10.00	42.26	42.65	42.38	0.12	PASS
12	26.53	10.50	-100	-100	26.42	18.5	15.5	8.00	8.00	25.66	27.00	10.00	10.00	40.26	40.74	39.91	-0.35	PASS
12	26.53	10.50	12.5	-100	26.24	18.5	15.5	8.00	8.00	25.44	26.50	10.00	10.00	40.94	41.29	40.73	-0.21	PASS
12	26.53	10.50	11.5	-100	26.28	18.5	15.5	8.00	8.00	25.49	26.50	10.00	10.00	40.81	41.11	40.40	-0.41	PASS
12	26.53	10.50	10.5	-100	26.31	18.5	15.5	8.00	8.00	25.52	26.50	10.00	10.00	40.70	41.11	40.40	-0.30	PASS
12	26.53	10.50	10.5	12.5	26.13	18.5	15.5	8.00	8.00	25.30	26.50	10.00	10.00	41.31	41.68	41.22	-0.09	PASS
12	26.53	10.50	10.5	11.5	26.16	18.5	15.5	8.00	8.00	25.35	26.50	10.00	10.00	41.19	41.55	41.06	-0.13	PASS
12	26.53	10.50	10.5	10.5	26.19	18.5	15.5	8.00	8.00	25.39	26.50	10.00	10.00	41.10	41.47	40.89	-0.21	PASS
13	27.53	10.50	10.5	10.5	27.27	18.5	15.5	7.00	7.00	26.65	28.00	11.00	10.50	40.10	40.54	39.91	-0.19	PASS
14	28.53	10.50	10.5	10.5	28.32	18.5	15.5	6.00	6.00	27.84	29.00	12.00	11.50	39.10	39.52	38.92	-0.18	PASS
15	29.53	10.50	10.5	10.5	29.37	18.5	15.5	5.00	5.00	28.99	30.00	13.00	12.50	38.10	38.56	37.93	-0.17	PASS
16	30.53	10.50	10.5	10.5	30.40	18.5	15.5	4.00	4.00	30.11	31.00	14.00	13.50	37.10	37.51	36.94	-0.16	PASS
11	25.53	10.50	10.5	10.5	25.10	18.5	15.5	9.00	9.00	24.03	25.50	9.00	8.50	42.10	42.37	42.21	0.11	PASS
10	24.53	10.50	10.5	10.5	23.98	18.5	15.5	10.00	10.00	22.54	24.00	8.00	7.50	43.10	43.37	43.20	0.10	PASS
9	23.53	10.50	10.5	10.5	22.83	18.5	15.5	11.00	11.00	20.83	22.50	7.00	6.50	44.10	44.40	44.19	0.09	PASS
8	22.53	10.50	10.5	10.5	21.63	18.5	15.5	12.00	12.00	18.73	21.00	6.00	5.50	45.10	45.41	45.01	-0.09	PASS
7	21.53	10.50	10.5	10.5	20.36	18.5	15.5	13.00	13.00	15.78	22.00	5.00	6.50	46.10	46.31	46.00	-0.10	PASS
6	HSD Preempted											4.00						

Test Procedure for Classic Aero/ SwiftBroadband

FCC Requirements detailed in sections 87.131 (RF Power Output) and 87.187(q) (Priority and Preemption) were tested with a combined procedure in which Classic Aero voice services were exercised in concert with Swift Broadband services. During the test procedure the output EIRP of the Classic Aero voice services was varied along with antenna gain in order to demonstrate accurate power control and, when necessary, the preemption of lower priority services in order to maintain output EIRP for higher priority services. The spreadsheet below documents the various conditions and records the predicted, measured and reported RF power output in order to demonstrate compliance.

		High Priority	Low Priority	Public Priority					
	Ant Gain (dBi)	Aero Call 1 (dBW EIRP)	Aero Call 2 (dBW EIRP)	HST Allocated EIRP (dBW)	HST Reported EIRP (dBW)	Calculated HPA Output (dBm)	Reported HPA Output (dBm)	Measured HPA Output (dBm)	Power Accuracy Results (P/F)
	18.00	18.50	18.50	20.00	16.00	36.59	36.45	36.42	PASS
	17.00	18.50	17.50	20.00	16.00	37.22	37.11	37.27	PASS
	16.00	18.50	16.50	20.00	16.00	37.91	37.44	37.46	PASS
	15.00	18.50	15.50	20.00	16.00	38.65	38.26	38.22	PASS
	14.00	18.50	14.50	20.00	16.00	39.42	38.92	39.02	PASS
	13.00	18.50	13.50	20.00	16.00	40.24	39.41	39.74	PASS
	12.00	17.50	12.50	20.00	16.00	40.56	39.25	38.98	PASS
	11.00	16.50	11.50	20.00	16.00	40.94	39.41	39.31	PASS
	10.00	15.50	10.50	20.00	16.00	41.37	40.07	39.64	PASS
	9.00	14.50	10.50	20.00	16.00	41.99	41.06	41.21	PASS
	8.00	13.50	10.50	20.00	16.00	42.66	41.55	41.42	PASS
	7.00	12.50	10.50	20.00	16.00	43.38	42.38	42.30	PASS
HST Preempted	7.00	12.50	11.50	0.00	0.00	40.17	39.41	39.79	PASS
HST Preempted	7.00	16.50	18.50	0.00	0.00	45.66	45.84	45.82	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	46.07	46.16	46.17	PASS
Low Priority Call Preempted	7.00	18.50	0.00	0.00	0.00	43.62	43.69	43.70	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	46.07	46.16	46.17	PASS
HST Preempted	8.00	0.00	18.50	0.00	0.00	42.62	42.71	42.68	PASS
	9.00	0.00	18.50	20.00	16.00	43.48	44.35	44.17	PASS
	10.00	0.00	12.50	20.00	16.00	39.68	40.89	40.84	PASS
	11.00	0.00	12.50	20.00	16.00	38.68	39.91	39.33	PASS
	12.00	0.00	12.50	20.00	16.00	37.68	38.92	38.64	PASS
	13.00	0.00	12.50	20.00	16.00	36.68	37.93	37.82	PASS
	14.00	0.00	12.50	20.00	16.00	35.68	36.94	36.91	PASS
	15.00	0.00	12.50	20.00	16.00	34.68	36.28	35.89	PASS
	16.00	0.00	12.50	20.00	16.00	33.68	34.96	34.16	PASS
	17.00	0.00	12.50	20.00	16.00	32.68	34.14	32.74	PASS
.	18.00	0.00	12.50	20.00	16.00	31.68	33.15	32.75	PASS

		High Priority	Low Priority	Public Priority						
	Ant Gain (dBi)	Aero Call 1 (dBW EIRP)	Aero Call 2 (dBW EIRP)	HST Allocated EIRP (dBW)	HST Reported EIRP (dBW)	Calculated HPA Output (Watts)	Measured HPA Output (Watts)	Available HPA Output (Watts)	Margin	Preemption Results (P/F)
	18.00	18.50	18.50	20.00	16.00	4.56	4.39	43.21	38.82	PASS
	17.00	18.50	17.50	20.00	16.00	5.28	5.33	42.74	37.41	PASS
	16.00	18.50	16.50	20.00	16.00	6.18	5.57	42.16	36.59	PASS
	15.00	18.50	15.50	20.00	16.00	7.32	6.64	41.42	34.78	PASS
	14.00	18.50	14.50	20.00	16.00	8.76	7.98	40.49	32.51	PASS
	13.00	18.50	13.50	20.00	16.00	10.56	9.42	39.33	29.91	PASS
	12.00	17.50	12.50	20.00	16.00	11.38	7.91	37.86	29.95	PASS
	11.00	16.50	11.50	20.00	16.00	12.41	8.53	36.01	27.48	PASS
	10.00	15.50	10.50	20.00	16.00	13.71	9.20	33.68	24.48	PASS
	9.00	14.50	10.50	20.00	16.00	15.81	13.21	30.75	17.54	PASS
	8.00	13.50	10.50	20.00	16.00	18.44	13.87	27.06	13.20	PASS
	7.00	12.50	10.50	20.00	16.00	21.76	16.98	22.42	5.44	PASS
HST Preempted	7.00	12.50	11.50	0.00	0.00	10.41	9.53	41.45	31.92	PASS
HST Preempted	7.00	16.50	18.50	0.00	0.00	36.83	38.19	41.45	3.26	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	40.49	41.40	41.45	0.05	PASS
Low Priority Call Preempted	7.00	18.50	0.00	0.00	0.00	23.02	23.44	41.45	18.01	PASS
HST Preempted	7.00	17.50	18.50	0.00	0.00	40.49	41.40	41.45	0.05	PASS
HST Preempted	8.00	0.00	18.50	0.00	0.00	18.29	18.54	42.18	23.65	PASS
	9.00	0.00	18.50	20.00	16.00	22.27	26.12	30.75	4.63	PASS
	10.00	0.00	12.50	20.00	16.00	9.29	12.13	33.68	21.55	PASS
	11.00	0.00	12.50	20.00	16.00	7.38	8.57	36.01	27.44	PASS
	12.00	0.00	12.50	20.00	16.00	5.86	7.31	37.86	30.55	PASS
	13.00	0.00	12.50	20.00	16.00	4.65	6.05	39.33	33.27	PASS
	14.00	0.00	12.50	20.00	16.00	3.70	4.91	40.49	35.59	PASS
	15.00	0.00	12.50	20.00	16.00	2.94	3.88	41.42	37.54	PASS
	16.00	0.00	12.50	20.00	16.00	2.33	2.61	42.16	39.55	PASS
	17.00	0.00	12.50	20.00	16.00	1.85	1.88	42.74	40.86	PASS
	18.00	0.00	12.50	20.00	16.00	1.47	1.88	43.21	41.32	PASS

1.10.4 Test Results Discussion

This test data demonstrates the system will comply with priority and preemption requirements of 87.137 (q) for Aircraft Earth Stations.