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Test Report

Prepared for: L-3 Aviation Products

Model: 228E5733-00

Description: AFIRS 228S Satellite Data Unit

Serial Number: N/A

FCC ID: IB2AFIRS228S0

To

FCC Part 25

Date of Issue: November 20, 2017

On the behalf of the applicant:	**L-3 Aviation Products** **PO Box 3041** **Sarasota, FL 34232**
Attention of:	**Dan Gross, Program Manager** **Ph: (941)371-0811** **E-Mail: Dan.Gross@L3T.com**

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Project No: p1790002

Alex Macon
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	10/20/17	Alex Macon	Original Document
2.0	11/14/17	Amanda Reed	Updated FCC ID
3.0	11/17/17	Alex Macon	Updated Ansi 63.4 version on page 5 Updated block diagram on page 10 Relocated output power plots under the output power procedure. Updated test procedure on page 11 Updated Equipment utilized list Added emission designator to page 5

Table of Contents

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The tests results contained within this test report all fall within our scope of accreditation, unless noted in the table below.

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IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

Standard Test Conditions and Engineering Practices

Unless otherwise indicated, the procedures contained in ANSI C63.4-2014 were observed during testing.

Prior to testing, the EUT was tuned up in accordance with the manufacturer's alignment procedures. All external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing.

Measurement results, unless otherwise noted, are worst case measurement.

Unless otherwise indicated in the specific measurement results, the ambient temperature was maintained within the range of 10º to 40ºC (50º to 104ºF) and the relative humidity levels were in the range of 10% to 90%.

Environmental Conditions		
Temperature (°C)	**Humidity (%)**	**Pressure (mbar)**
25.24	33.85	969.47

Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II; Part 2 and the following individual Parts: FCC Part 25 Satellite Communications.

Prior to testing the EUT was tuned up in accordance with the manufacturer's alignment procedures. All external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing.

Measurement results, unless otherwise noted, are worst case measurements.

EUT Description
Model: 228E5733-00
Description: AFIRS 228S Satellite Data Unit
Firmware: N/A
Software: N/A
Serial Number: N/A
Additional Information:
Iridium sitcom system used in aircrafts which utilizes an authorized emission designator of 41K7V7D and 41K7V7W

EUT Operation during Tests
The EUT was placed in a test mode by the manufacturer. The test mode allowed the device to transmit continuously on high mid and low channels.

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
25.204	Power Limits	Pass	
25.202(f)	Emissions Mask	Pass	
25.216(c)(g)(i) 25.202(f)	Emissions Limits for Mobile Earth Stations	Pass	
25.202(d)	Frequency Tolerance	Pass	

Power Limits

Engineer: Alex Macon

Test Date: 10/17/2017

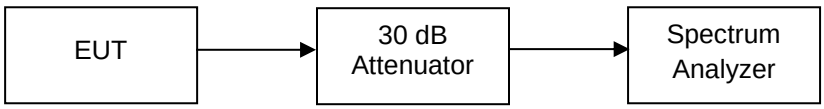
Test Procedure

The UUT was connected to a Spectrum analyzer through a 20 dB attenuator. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained. The EIRP is a summation of the conducted power and the antenna gain.

The following setting on spectrum analyzer is used for measuring average power of the fundamental:

1- Set span to at least 1.5 times the OBW
2- Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
3- Set VBW ≥ 3 × RBW
4- Set number of points in sweep ≥ 2 × span / RBW
5- Sweep time = auto-couple
6- Detector = RMS (power averaging)
8- Trace average at least 100 traces in power averaging (i.e., RMS) mode
9- Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with the band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

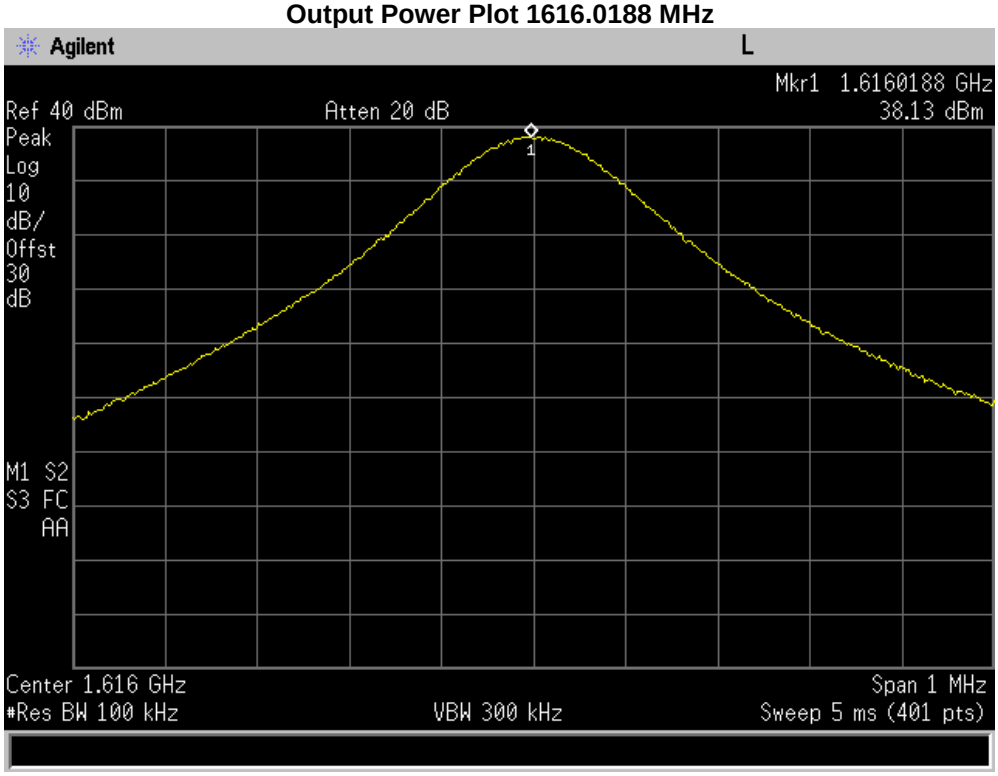
Test Setup



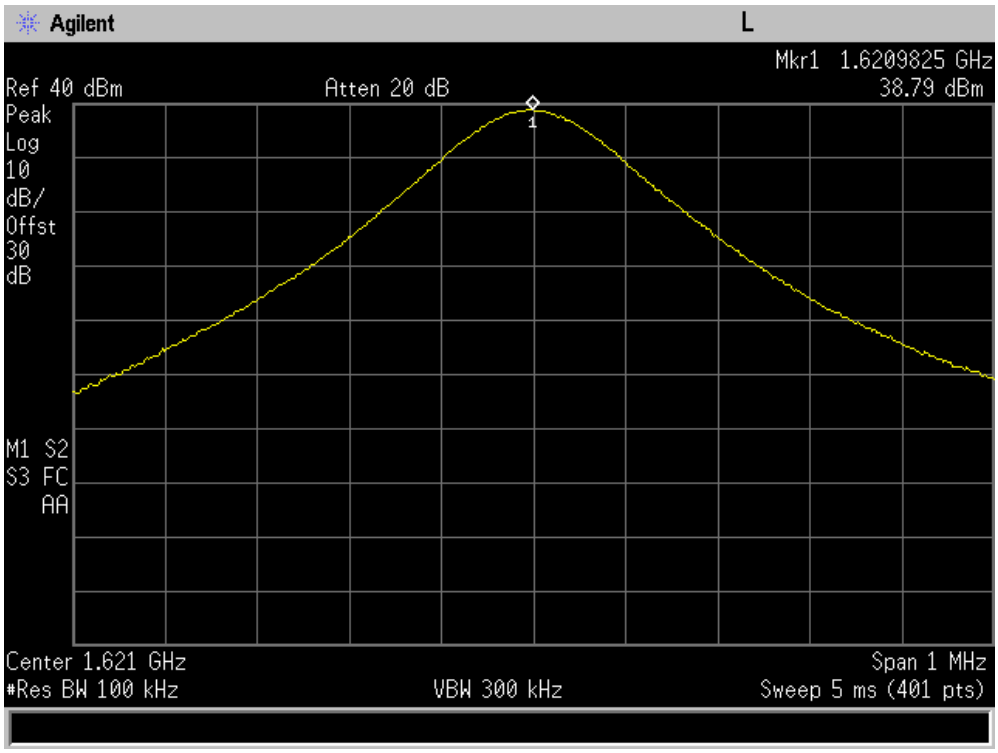
Transmitter Average Output Power

Tuned Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP Output Power (dBm)	Specification Limit
1616.0188	38.13	3	41.38	No limit for Mobile Earth Stations
1620.9825	38.79	3	41.79	No limit for Mobile Earth Stations
1625.950	38.63	3	41.63	No limit for Mobile Earth Stations

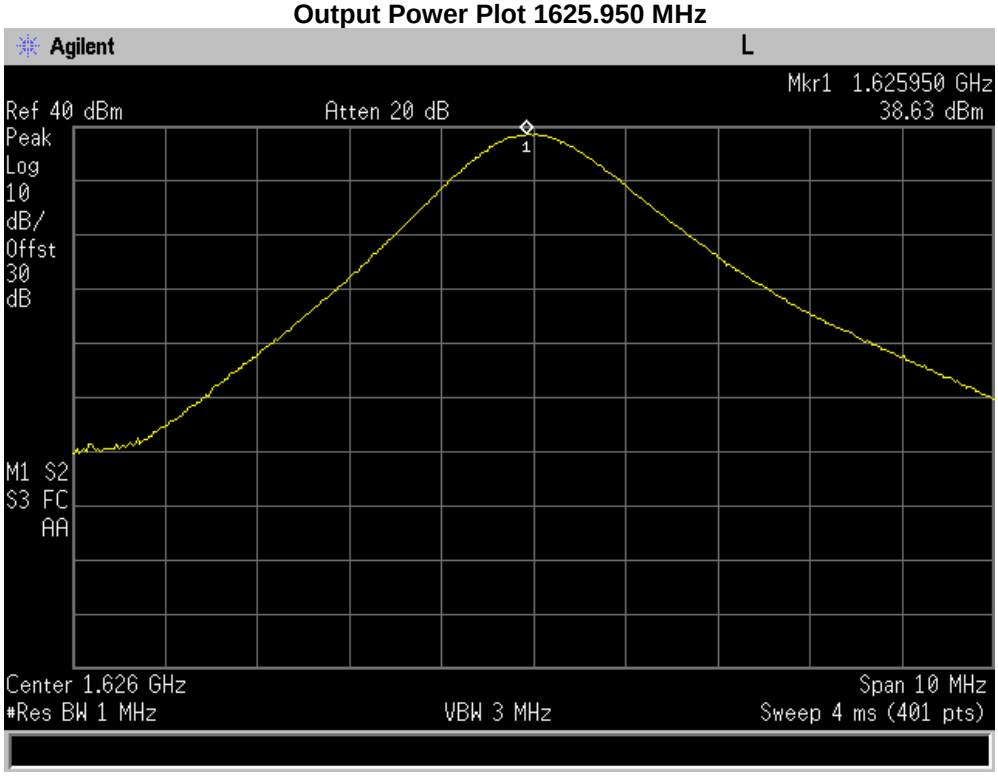
Output Power Plot 1616.0188 MHz



Output Power Plot 1620.9825 MHz



Output Power Plot 1625.950 MHz



Emissions Limitations for Mobile Earth Stations

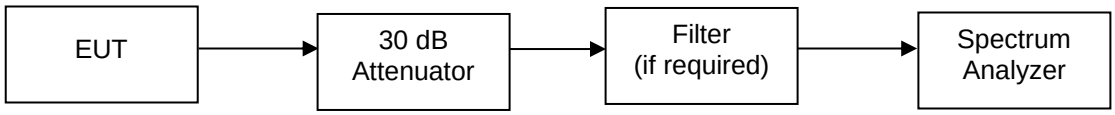
Engineer: Alex Macon

Test Date: 10/17/2017

Test Procedure

The EUT was connected directly to a spectrum analyzer and the conducted spurious emissions were measured to ensure that the EUT met the requirements specified. Only the worst-case emission at each frequency was reported. Notch and high pass filters were utilized to ensure that the fundamental power did not force the input of the spectrum analyzer into compressions. These losses in addition to cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained.

Test Setup



Emissions Limitations Summary Table

Tuned Frequency (MHz)	Result	Comments
1616.0188	Pass	See Plots
1620.9825	Pass	See Plots
1625.950	Pass	See Plots

See Annex A for test plots

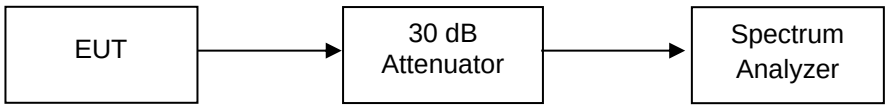
Occupied Bandwidth

Engineer: Alex Macon

Test Date: 10/17/2017

Test Procedure

The EUT was connected directly to a spectrum analyzer. The occupied bandwidth of the modulated output was measured and plotted. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained. ANSI C63.26 2015 section 5.4.4 was followed to obtain results.

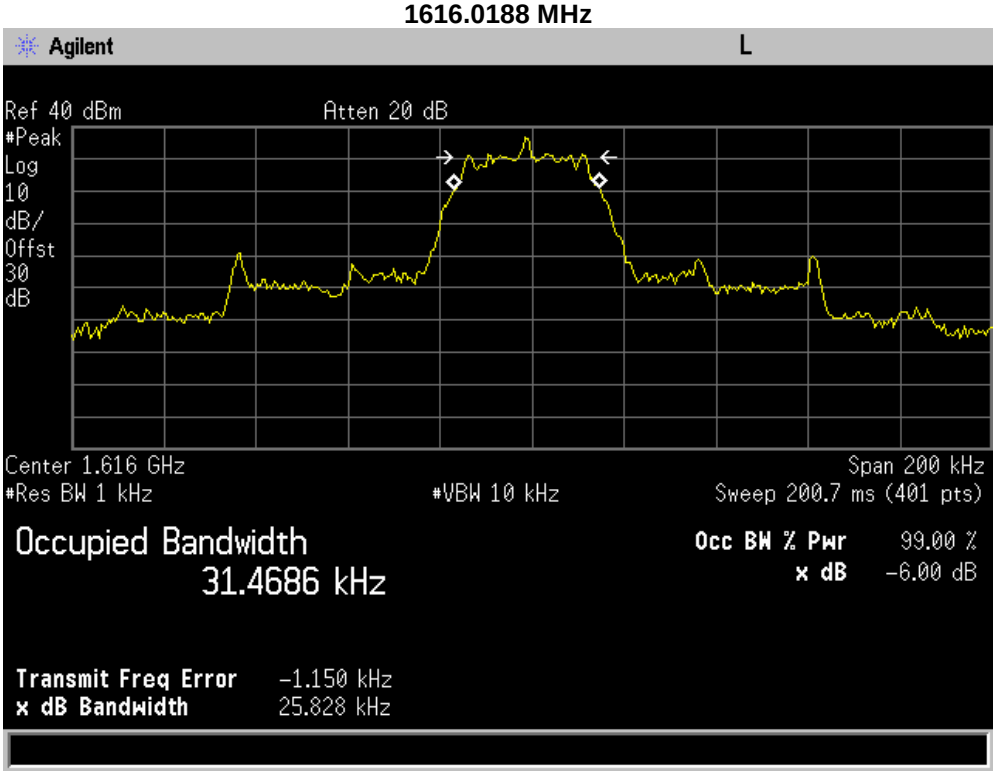


Note: There is no requirement for occupied bandwidth in Part 25 for Mobile Earth Stations. However, the emissions masks are based upon the occupied bandwidth. This information is reported for reference only.

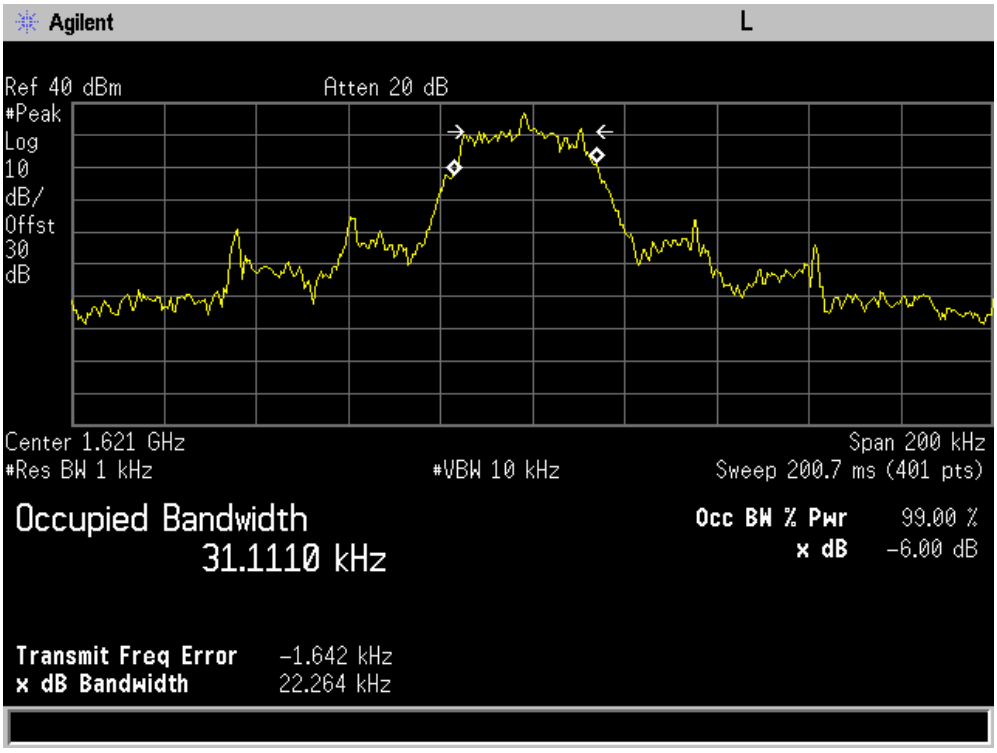
Test Results

Frequency (MHz)	Measured Bandwidth (kHz)
1616.0188	31.4686
1620.9825	31.1110
1625.950	31.9851

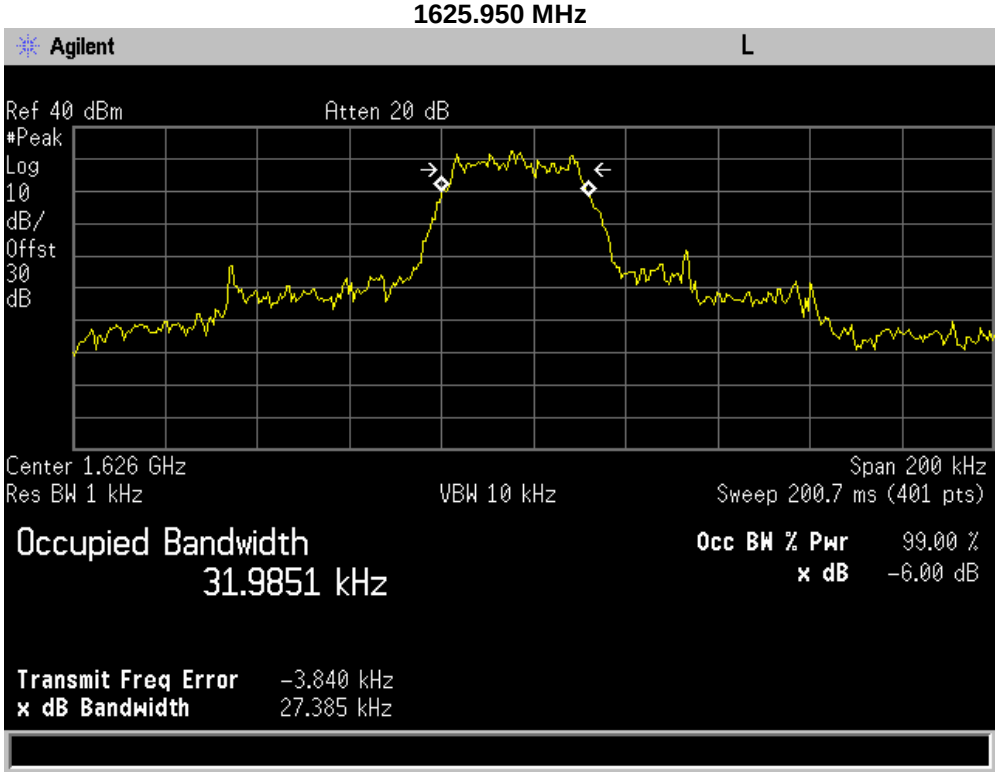
1616.0188 MHz



1620.9825 MHz



1625.950 MHz


Agilent
L
Ref 40 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
30
dB
Center 1.626 GHz
Res BW 1 kHz
VBW 10 kHz
Span 200 kHz
Sweep 200.7 ms (401 pts)
Occupied Bandwidth
31.9851 kHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error -3.840 kHz
x dB Bandwidth 27.385 kHz

Emission Masks

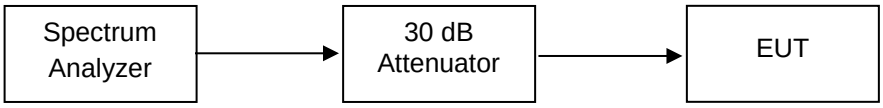
Engineer: Alex Macon

Test Date: 10/17/2017

Test Procedure

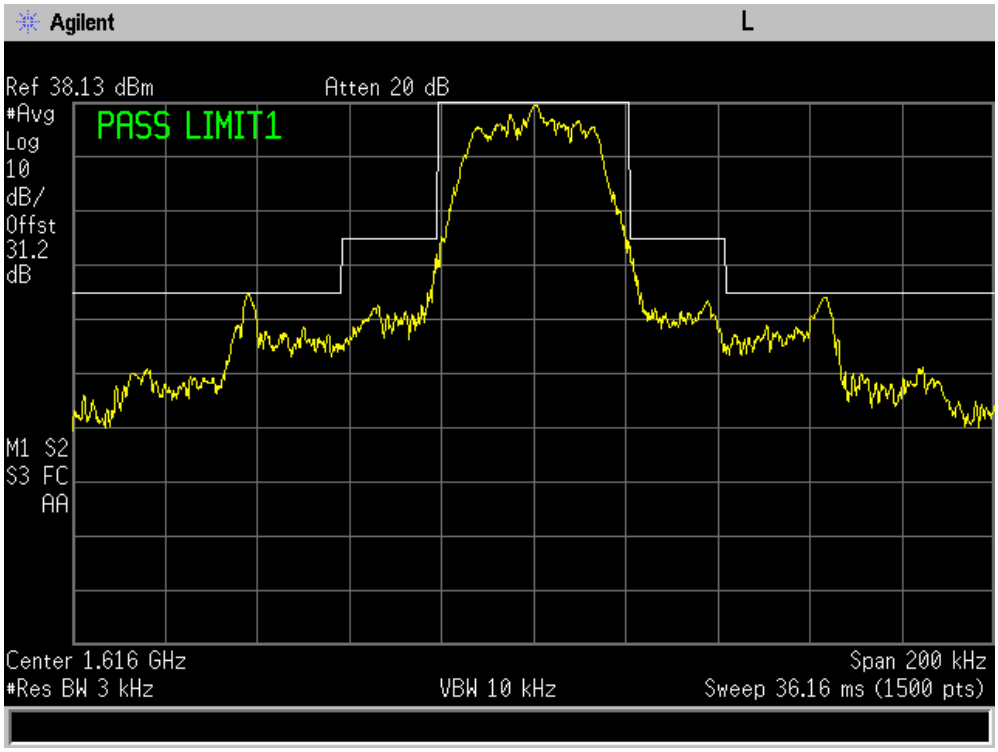
The EUT was connected directly to a spectrum analyzer to verify that the EUT met the requirements for emission mask. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained.

Test Setup

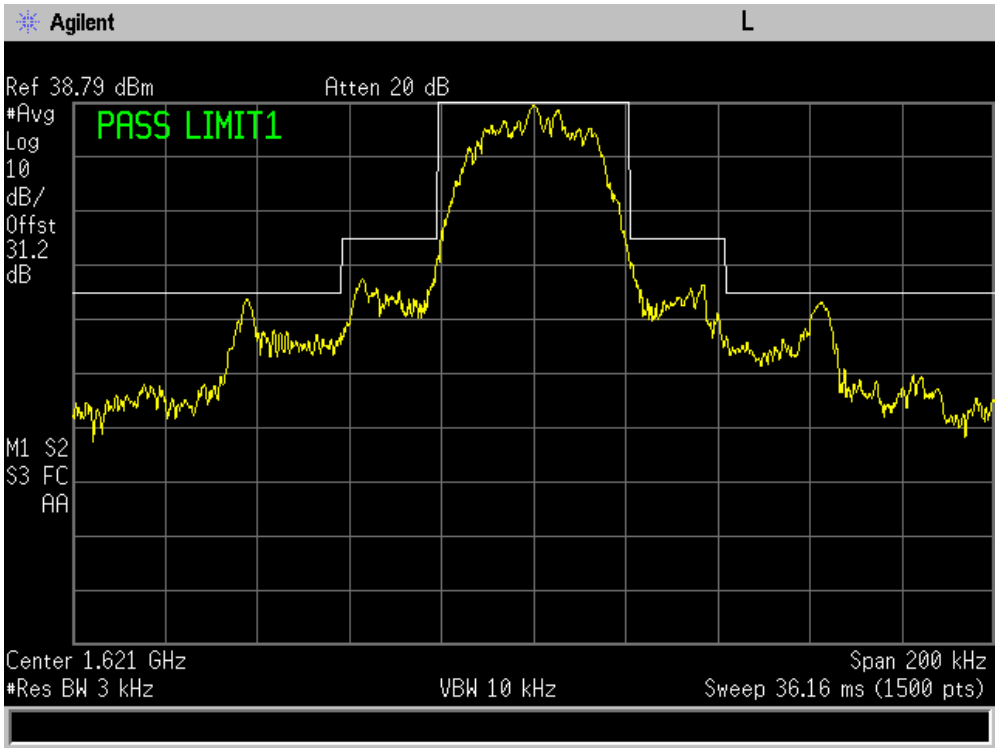


Emission Mask Plots

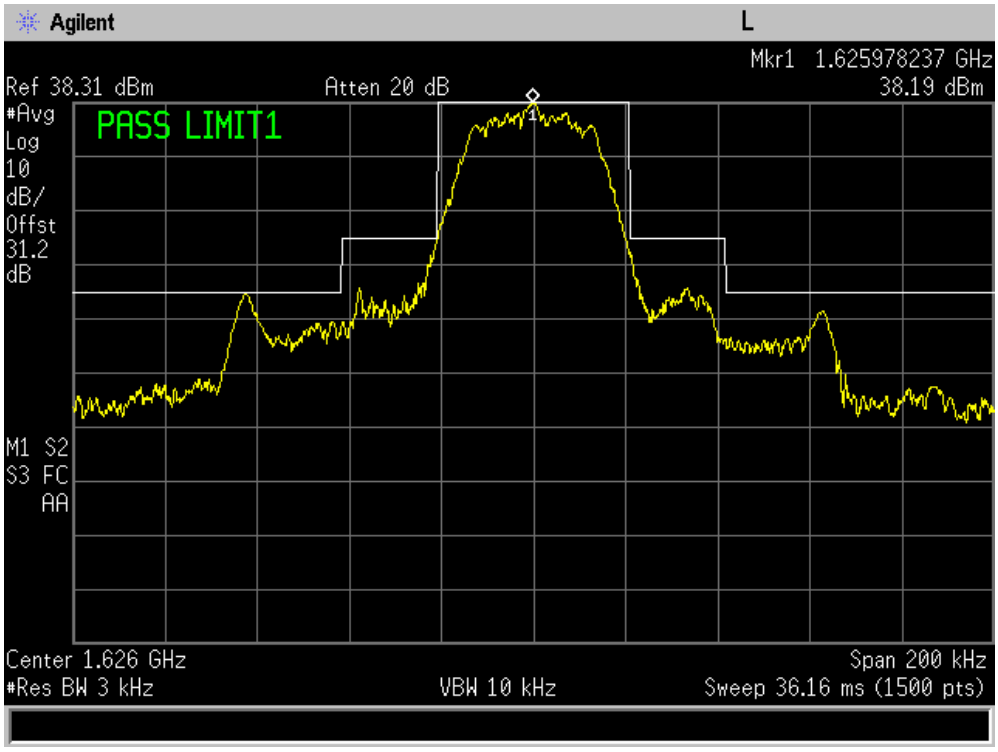
1616.0188 MHz Mask



1620.9825 MHz Mask



1625.950 MHz Mask



Frequency Tolerance (Temperature Variation)

Test Engineer: Alex Macon

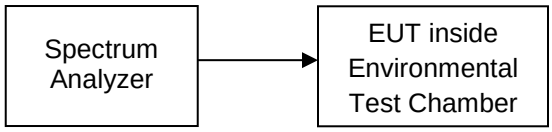
Test Date: 10/17/2017

Limit: 0.001%

Test Procedure

The EUT was placed inside an environmental test chamber, and connected to a spectrum analyzer. The span and RBW was adjusted for narrowband operation to ensure an accurate measurement of the CW signal.
The temperature was varied from –30 to +50°C in 10°C increments. After a 30-minute soak time the output frequency was measured. At 20°C the voltage was varied +/- 15% from the nominal voltage.

Test Setup

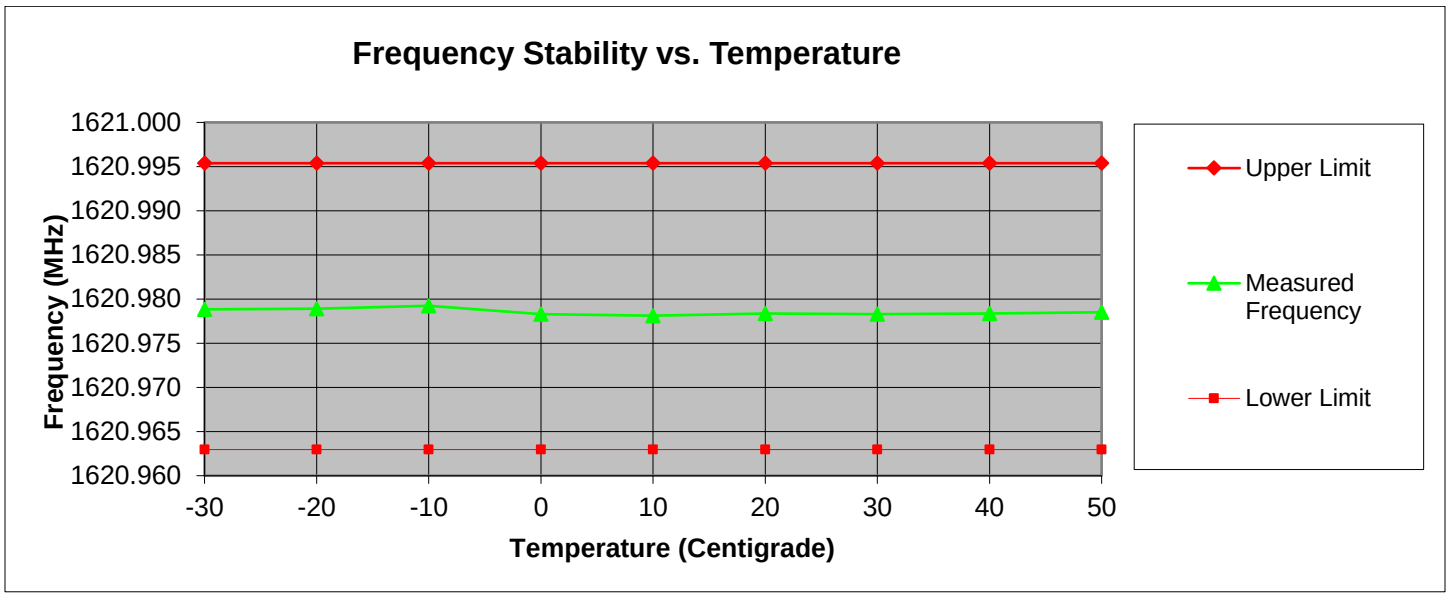


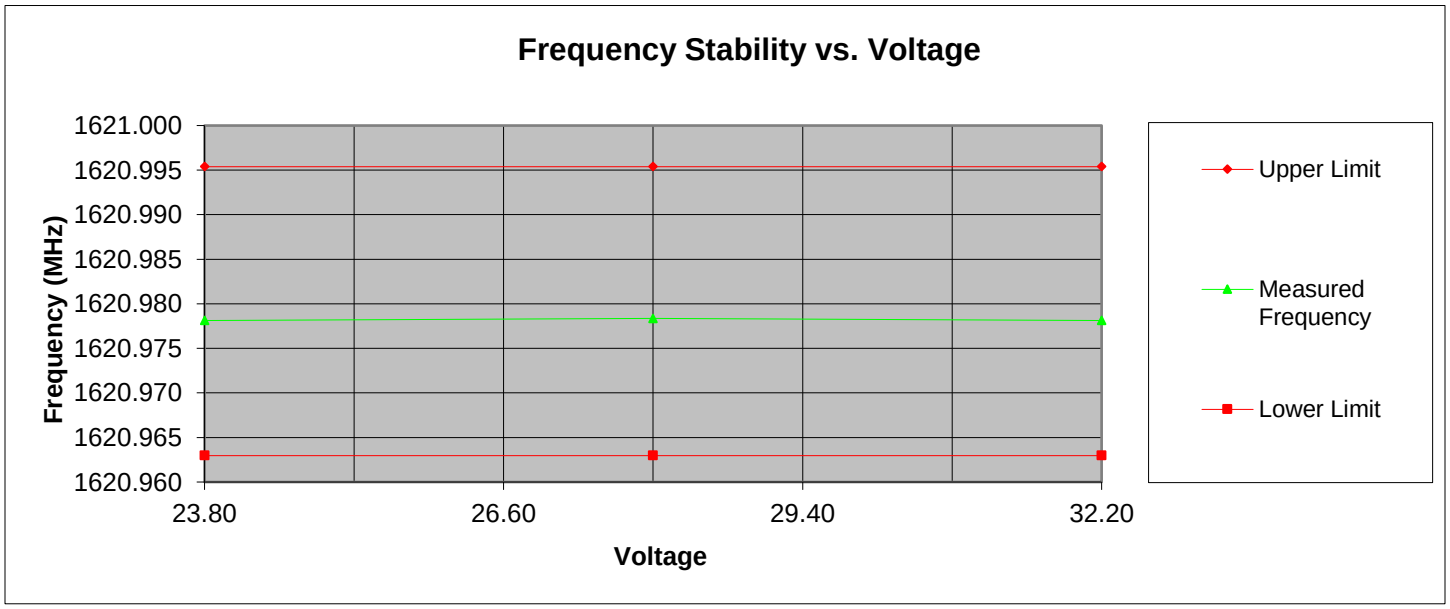
Frequency Versus Temperature

Tuned Frequency (MHz)	Frequency Tolerance %	Upper Limit (MHz)	Lower Limit (MHz)		Temperature centigrade	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
1620.98	0.0010	1620.9953798	1620.9629602		-30	1620.9788400	0.0165398	0.0158798
		1620.9953798	1620.9629602		-20	1620.9789200	0.0164598	0.0159598
		1620.9953798	1620.9629602		-10	1620.9792400	0.0161398	0.0162798
		1620.9953798	1620.9629602		0	1620.9782790	0.0171008	0.0153188
		1620.9953798	1620.9629602		10	1620.9781190	0.0172608	0.0151588
		1620.9953798	1620.9629602		20	1620.9783590	0.0170208	0.0153988
		1620.9953798	1620.9629602		30	1620.9782790	0.0171008	0.0153188
		1620.9953798	1620.9629602		40	1620.9783590	0.0170208	0.0153988
		1620.9953798	1620.9629602		50	1620.9785190	0.0168608	0.0155588

Frequency Versus Voltage

Tuned Frequency (MHz)	Frequency Tolerance %	Upper Limit (MHz)	Lower Limit (MHz)	Nominal Voltatge	Voltage	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
1620.98	0.0010	1620.9953798	1620.9629602	28.00	23.80	1620.9781190	-0.0172608	0.01515879
		1620.9953798	1620.9629602		28.00	1620.9783590	-0.0170208	0.01539879
		1620.9953798	1620.9629602		32.20	1620.9781190	-0.0172608	0.01515879


Frequency Stability vs. Temperature
1621.000
1620.995
1620.990
1620.985
1620.980
1620.975
1620.970
1620.965
1620.960
Frequency (MHz)
-30
-20
-10
0
10
20
30
40
50
Temperature (Centigrade)
Upper Limit
Measured Frequency
Lower Limit


Frequency Stability vs. Voltage
1621.000
1620.995
1620.990
1620.985
1620.980
1620.975
1620.970
1620.965
1620.960
Frequency (MHz)
23.80
26.60
29.40
32.20
Voltage
Upper Limit
Measured Frequency
Lower Limit

Field Strength of Spurious Radiation

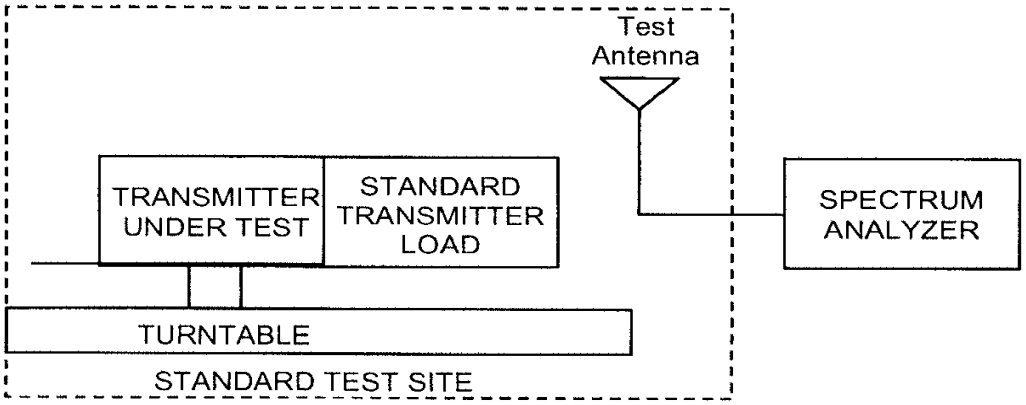
Test Engineer: Alex Macon

Test Date: 10/17/2017

Test Procedure

A) Connect the equipment as illustrated
B) Adjust the spectrum analyzer for the following settings:
    1) Resolution Bandwidth 100 kHz (< 1 GHZ), 1 MHZ (> 1GHz)
    2) Video Bandwidth ≥ 3 times Resolution Bandwidth, or 30 kHz
    3) Sweep Speed ≤2000 Hz/second
    4) Detector Mode = Mean or Average Power
C) Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non- radiating load that is placed on the turntable. The RF cable to this load should be of minimum length.
D) For each spurious measurement, the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to ± the test bandwidth (see section 1.3.4.4).
E) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
F) Repeat Step E) for each spurious frequency with the test antenna polarized vertically.

Test Setup



See Annex B for test plots

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	6/9/17	6/9/18
Spectrum Analyzer	Agilent	E4407B	i00331	10/19/16	10/19/17
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
EMI Analyzer	Agilent	E7405A	i00379	2/22/17	2/22/18
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
PSA Spectrum Analyzer	Agilent	E4445A	i00471	9/6/2017	9/6/2018
Temperature Chamber	Tenney	Tenney Jr	i00027	Verified on: 10/17/17	
Preamplifier	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT