Compliance Testing, LLC
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EMI, EMC, RF Testing Experts Since 1963

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Test Report

Prepared for: L-3 Communications

Model: 228E5733-00

Description: AFIRS228S Satellite Data Unit

FCC ID: IB2AFIRS228S

Serial Number: 000904810

To

FCC Part 25

Date of Issue: September 18, 2015

On the behalf of the applicant:	**L-3 Communications** **P. O. Box 3041** **Sarasota, FL 34232**
Attention of:	**Suzi Schulz, Program Manager** **Ph: (941) 371-0811 xt. 5781** **E-Mail: Suzanne.Schulz@L-3com.com**

Prepared By
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Project No: p1580015

Alex Macon
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	9/3/15	Alex Macon	Original Document

Table of Contents

ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009).

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

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

ACCREDITED
TESTING CERT
#2152.01

FCC Site Reg. #349717

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 C63.4-2009 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)**
23.2 – 25.1	32.4 – 41.2	967.5 – 971.2

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: AFIRS228S Satellite Data Unit
SN: 000904810
Firmware: N/A
Serial Number: 000904810
Additional Information:
Iridium satcom system used in aircrafts that incorporates the Iridium 9602N modem.

EUT Operation during Tests

EUT is placed into a modulated transmit mode which the manufacturer supplied.

Accessories: None

Cables: None

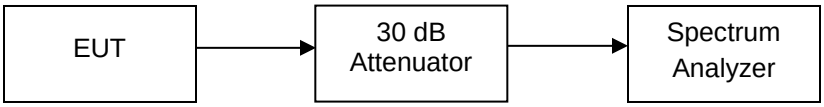
Modifications: None

Powerline
Engineer: Alex Macon
Test Date: 8/31/15

Test Procedure

The EUT was connected directly to a Spectrum Analyzer. The peak readings were taken and recorded in the following table.

Test Setup



Transmitter Output Power

Tuned Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP Output Power (dBm)	Specification Limit
1616.02	32.85	3.0	35.85	No limit for Earth Stations
1620.96	33.17	3.0	36.17	No limit for Earth Stations
1625.95	32.69	3.0	35.69	No limit for Earth Stations

Emissions Limitations for Mobile Earth Stations

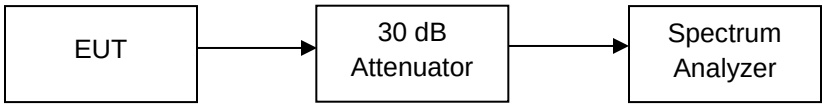
Engineer: Alex Macon

Test Date: 9/1/15

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. Section 25.202(f)(3)

Test Setup



Tuned Frequency (MHz)	Result	Comments
1616.02	Pass	See Plots
1620.96	Pass	See Plots
1625.95	Pass	See Plots

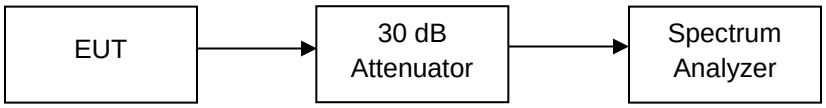
Plots are within Annex A

Emission Mask
Engineer: Alex Macon
Test Date: 9/1/15

Test Procedure

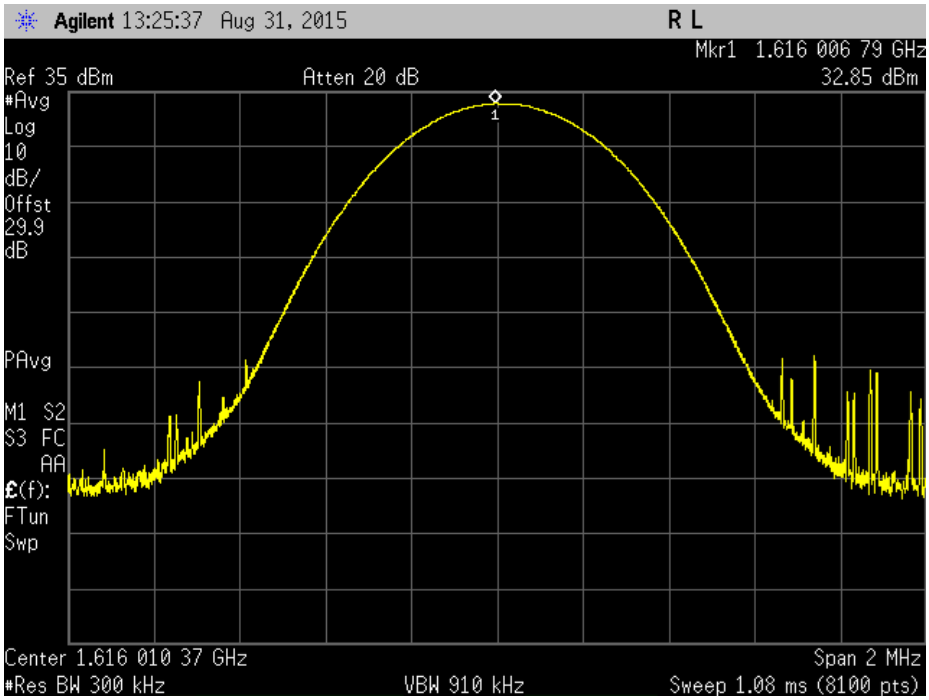
The EUT was connected directly to a spectrum analyzer to verify that the EUT met the requirements for emission mask. Attenuator and cable losses were input into the analyzer as a reference level offset to ensure accurate measurements were obtained. Section 25.202(f)

Test Setup

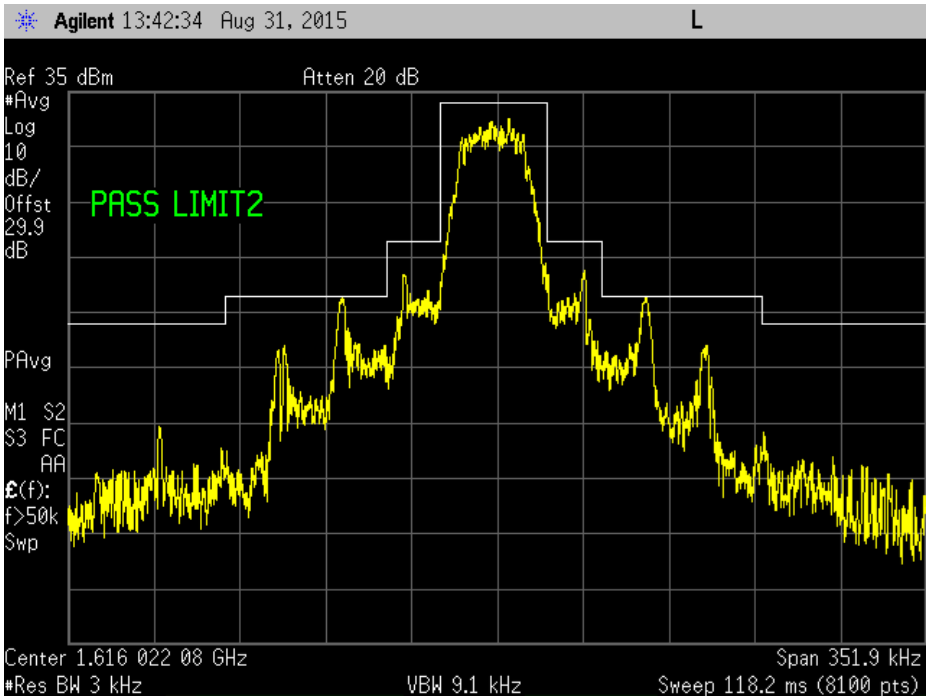


Emission Mask Plots

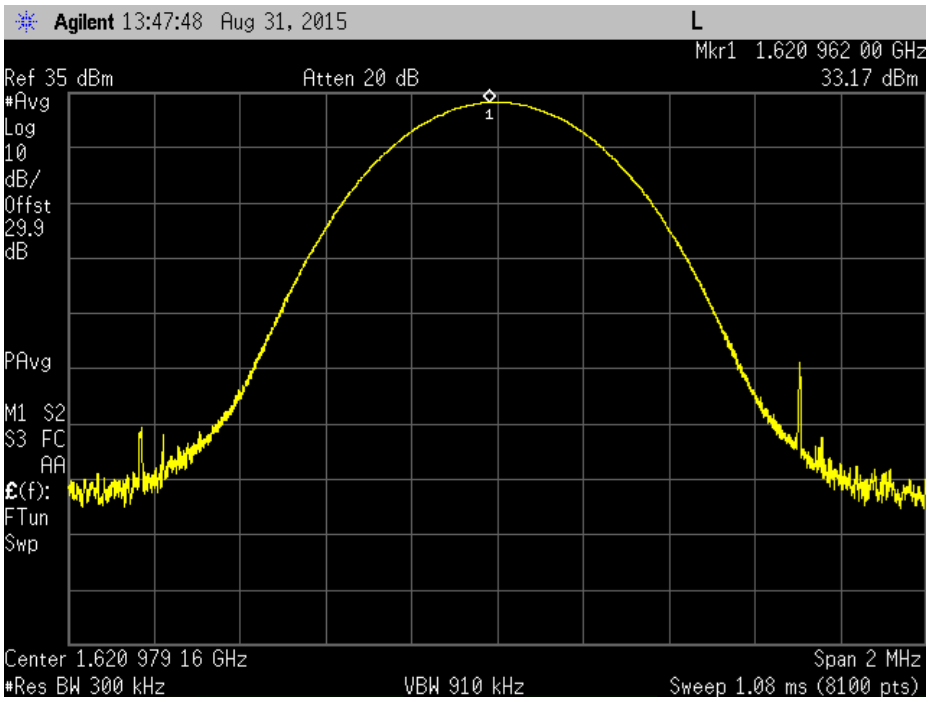
Low Channel Reference



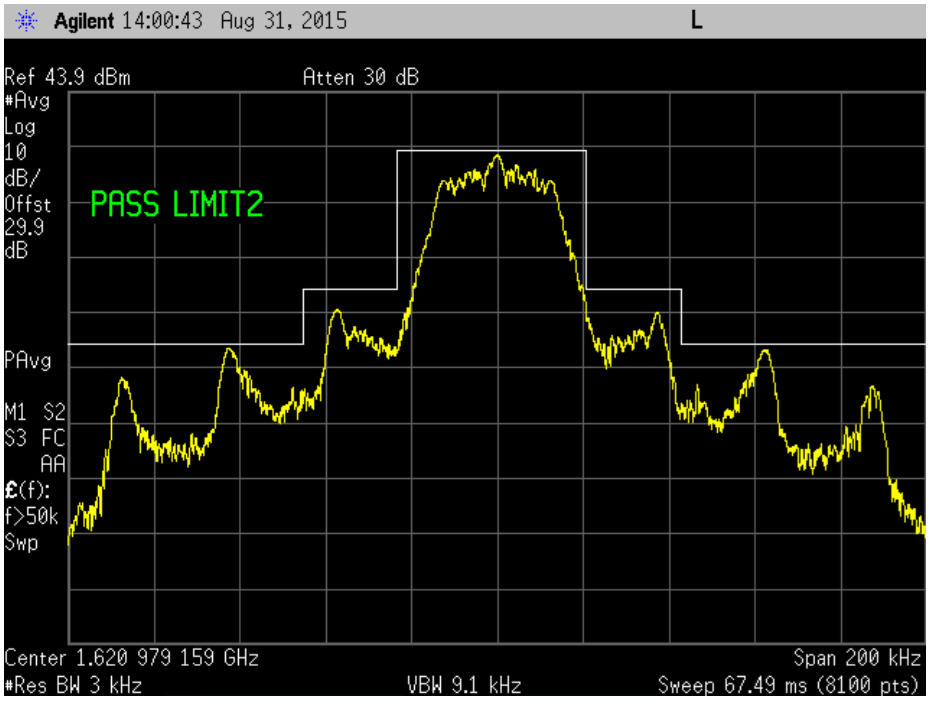
Low Channel Mask



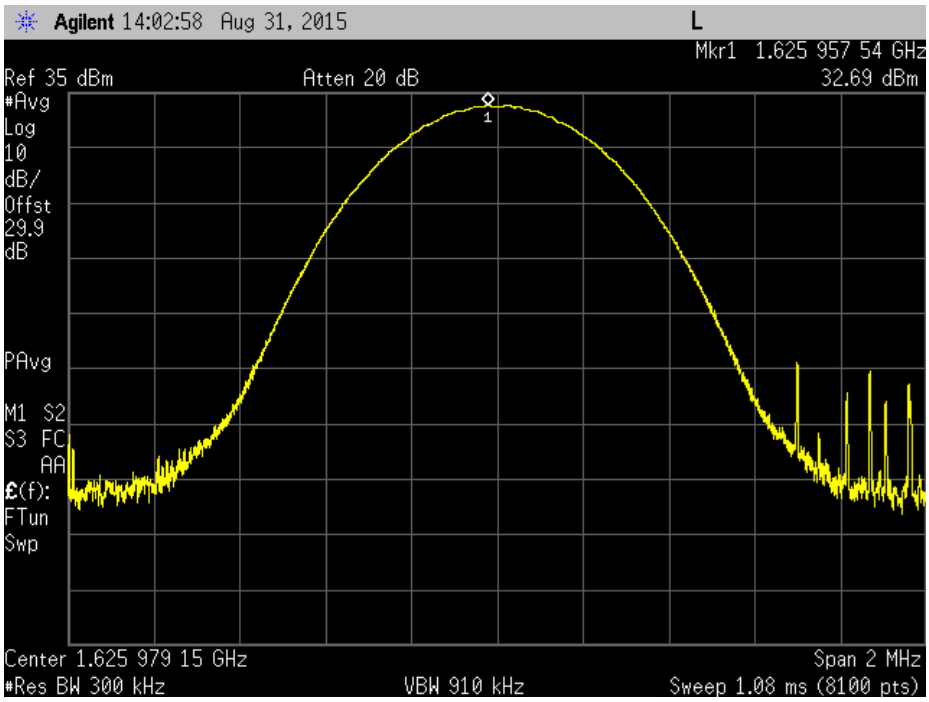
Mid Channel Reference



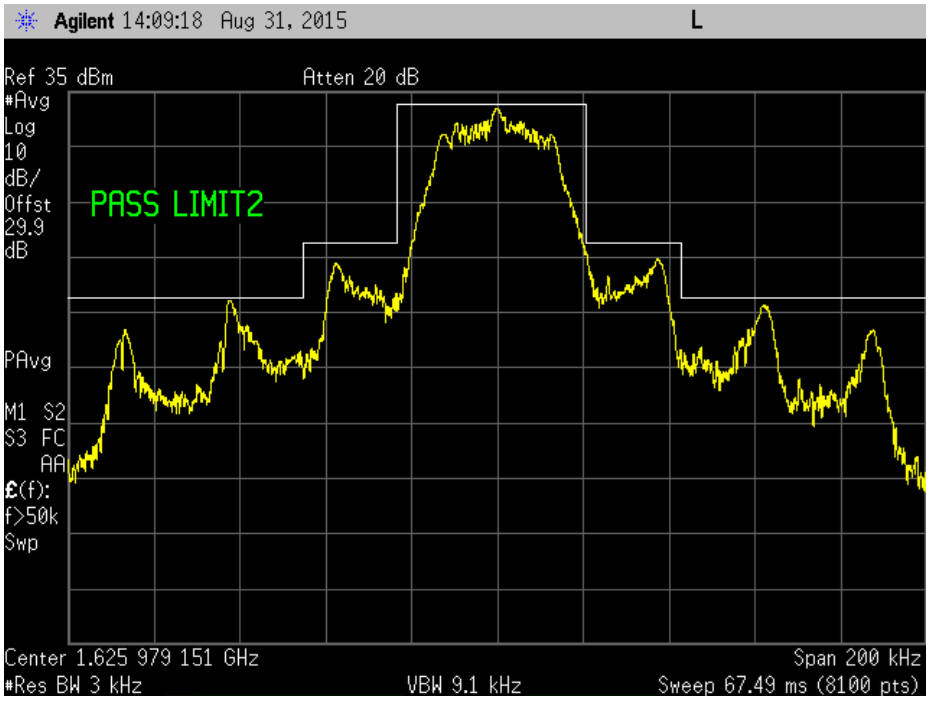
Mid Channel Mask



High Channel Reference



High Channel Mask



Emissions Limits for Mobile Earth Stations

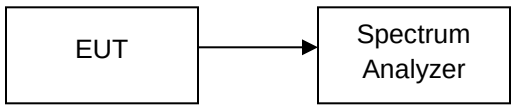
Engineer: Alex Macon

Test Date: 9/1/15

Test Procedure

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

Test Setup



Transmitter Unwanted Emissions See Annex A for Results

Frequency Tolerance (Temperature Variation)

Test Engineer: Alex Macon

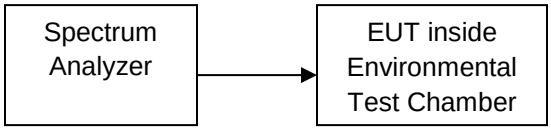
Test Date: 9/2/15

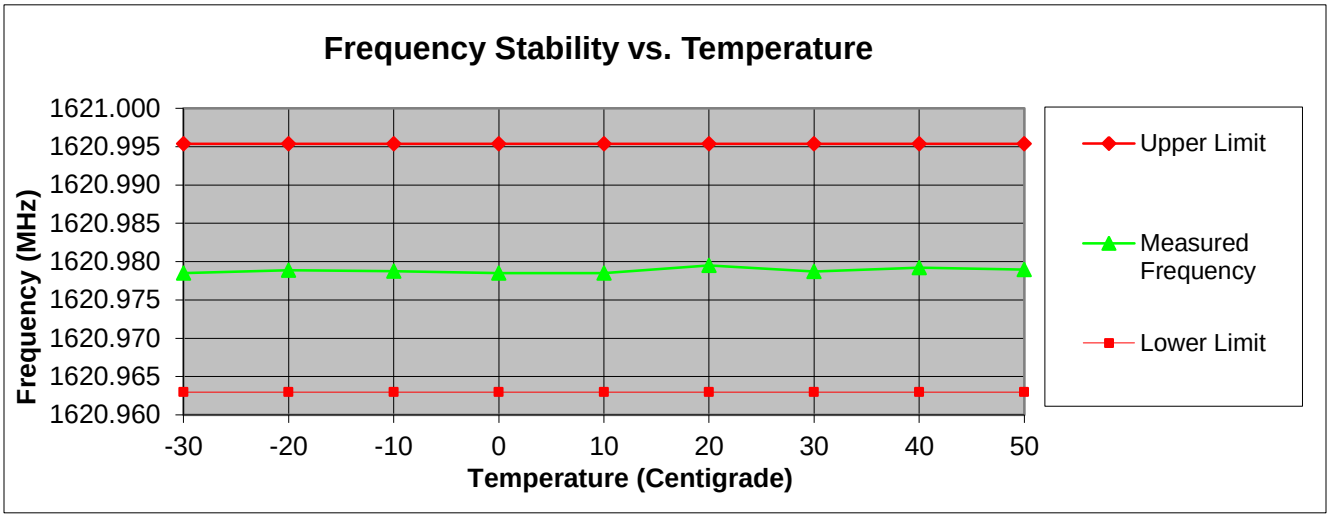
Limit: 0.001%

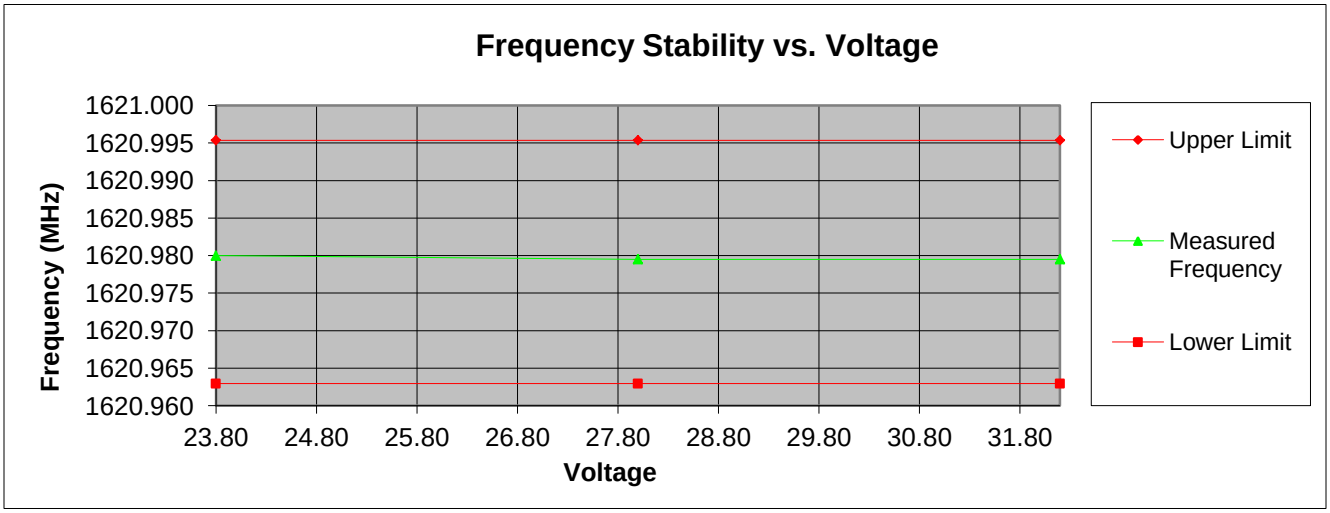
Test Procedure

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. Section 25.202(d)

Test Frequency: 1620.979159
Upper limit: 1620.9953688
Lower Limit: 1620.9629492







Field Strength of Spurious Radiation

Test Engineer: Alex Macon

Test Date: 9/2/15

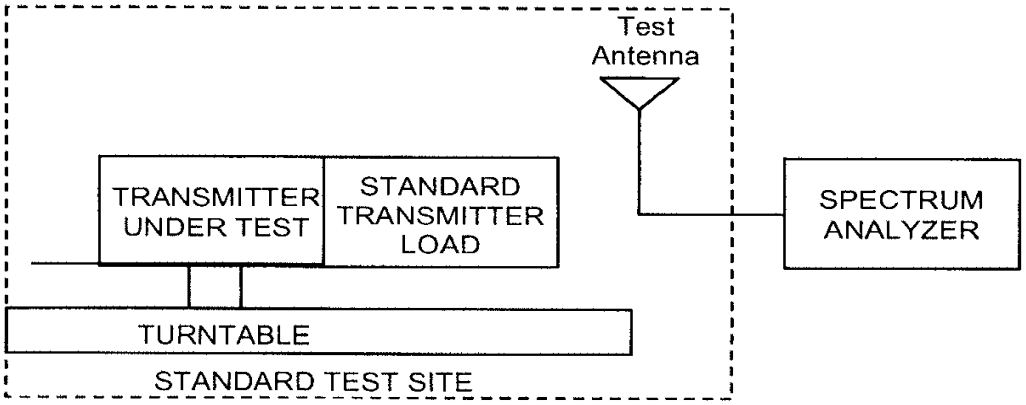
Test Procedure

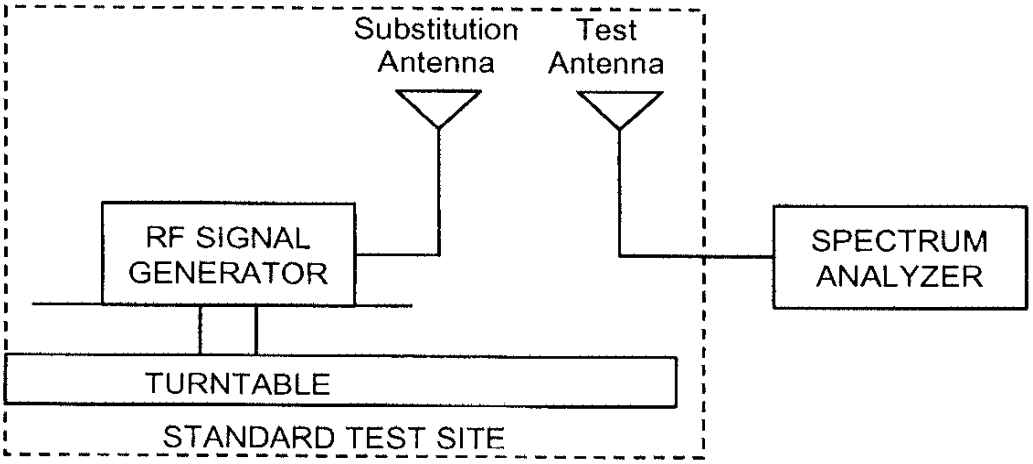
A) Connect the equipment as illustrated
B) Adjust the spectrum analyzer for the following settings:
    1) Resolution Bandwidth 100 kHz (< 1 GHZ), 1 MHZ (> 1GHz)
    2) Video Bandwidth ≥ 3 times Resolution Bandwidth, or 30 kHz
    3) Sweep Speed ≤2000 Hz/second
    4) Detector Mode = Mean or Average 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.
G) Reconnect the equipment as illustrated.
H) Keep the spectrum analyzer adjusted as in Step B).
I) Remove the transmitter and replace it with a substitution antenna (the antenna should be half wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.
J) Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
K) Repeat Step J) with both antennas vertically polarized for each spurious frequency.
L) Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in Steps J) and K) by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.
M) The levels recorded in Step L) are absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

Radiated spurious emissions dB = $10\log_{10}$ (TX power in watts/0.001) – the levels in Step I)

NOTE: It is permissible that the other antennas provided can be referenced to a dipole.

Test Setup


Test
Antenna
TRANSMITTER
UNDER TEST
STANDARD
TRANSMITTER
LOAD
SPECTRUM
ANALYZER
TURNTABLE
STANDARD TEST SITE


Substitution
Antenna
Test
Antenna
RF SIGNAL
GENERATOR
SPECTRUM
ANALYZER
TURNTABLE
STANDARD TEST SITE

Part 2 Test Results

Low Channel

Emission Frequency (GHz)	Measured Level (dBm)	Limit (dBm)	Result
3.233	-54.03	-13	Pass
4.848	-46.01	-13	Pass
6.464	-46.08	-13	Pass

High Channel

Emission Frequency (GHz)	Measured Level (dBm)	Limit (dBm)	Result
3.252	-55.91	-13	Pass
4.878	-48.54	-13	Pass
6.504	-50.91	-13	Pass

No other emissions were detected. All emissions were less than –25 dBm.

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Function Generator	HP	33120A	i00118	Verified on: 8/31/15	
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	5/8/14	5/8/16
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	4/1/15	4/1/16
Voltmeter	Fluke	87III	i00319	2/20/15	2/20/16
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/8/13	10/8/15
Power Supply	Yihua	PS 3010D	i00409	Verified on:8/31/15	
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	11/26/13	3/12/16
Spectrum Analyzer	Agilent	E4448A	S/N:MY46180566	12/1/2014	12/1/2016

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