



Product Service

**Choose certainty.
Add value.**

Report On

FCC and Industry Canada Testing of the
Iridium Core 9523N

In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry
Canada RSS-170 and Industry Canada RSS-GEN

COMMERCIAL-IN-CONFIDENCE

FCC ID: Q639523N
IC: 4629A-9523N

Document 75932207 Report 07 Issue 2

November 2015



Product Service

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuv-sud.co.uk

COMMERCIAL-IN-CONFIDENCE

REPORT ON

FCC and Industry Canada Testing of the
Iridium Core 9523N
In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2,
Industry Canada RSS-170 and Industry Canada RSS-GEN

Document 75932207 Report 07 Issue 2

November 2015

PREPARED FOR

Iridium Satellite LLC
1750 Tysons Boulevard
Suite 1400
McLean
VA 22102
United States

PREPARED BY

Natalie Bennett
Senior Administrator, Project Support

APPROVED BY

Simon Bennett
Authorised Signatory

DATED

13 November 2015

This report has been up-issued to Issue 2 to correct the manufacturer and model names.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

M Russell





CONTENTS

Section	Page No
1	REPORT SUMMARY 3
1.1	Introduction 4
1.2	Brief Summary of Results 5
1.3	Application Form 6
1.4	Product Information 8
1.5	Test Conditions 8
1.6	Deviations from the Standard 8
1.7	Modification Record 8
2	TEST DETAILS 9
2.1	Modulation Characteristics 10
2.2	Occupied Bandwidth 11
2.3	Frequency Tolerance 15
2.4	Spurious Emissions at Antenna Terminals 17
2.5	Radiated Spurious Emissions 25
2.6	Conducted Output Power 35
2.7	Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service 37
3	TEST EQUIPMENT USED 49
3.1	Test Equipment Used 50
3.2	Measurement Uncertainty 53
4	ACCREDITATION, DISCLAIMERS AND COPYRIGHT 54
4.1	Accreditation, Disclaimers and Copyright 55



Product Service

SECTION 1

REPORT SUMMARY

FCC and Industry Canada Testing of the
Iridium Core 9523N

In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and
Industry Canada RSS-GEN



Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC and Industry Canada Testing of the Iridium Core 9523N to the requirements of FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN.

Objective	To perform FCC and Industry Canada Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Iridium Satellite LLC
Model Number(s)	9523N
Serial Number(s)	30 24
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 25 (2014) FCC 47 CFR Part 2 (2014) Industry Canada RSS-170 (Issue 3, 2015) Industry Canada RSS-GEN (Issue 4, 2014)
Incoming Release Date	Application Form 13 October 2015
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	31734 5 October 2015
Start of Test	16 October 2015
Finish of Test	28 October 2015
Name of Engineer(s)	M Russell
Related Document(s)	ANSI C63.4 (2009)



1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and Industry Canada RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Pt 25	Pt 2	RSS-170	RSS-GEN			
Transmit							
2.1	-	2.1047(d)	-	-	Modulation Characteristics	-	
2.2	-	2.1049	-	6.6	Occupied Bandwidth	Pass	
2.3	25.202(d)	2.1055	5.2	-	Frequency Tolerance	Pass	
2.4	25.202(f)	2.1051	5.4.3.1	6.13	Spurious Emissions at Antenna Terminals	Pass	
2.5	25.202(f)	2.1053	5.4.3.1	6.13	Radiated Spurious Emissions	Pass	
2.6	25.204	-	5.3	-	Conducted Output Power	Pass	
2.7	25.216	-	5.4.3	-	Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service	Pass	



1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION	
Model Name/Number	Iridium Core 9523N
Part Number	9523N
Hardware Version	Rev B/V1 at modification state: P1638-CN-024 V0.8
Software Version	DB15006
FCC ID (if applicable)	Q639523N
Industry Canada ID (if applicable)	4629A-9523N
Technical Description (Please provide a brief description of the intended use of the equipment)	Voice and data satellite transceiver module.

POWER SOURCE	
☐ AC mains	State voltage
AC supply frequency (Hz)	
VAC	
Max Current	
Hz	
☐ Single phase	☐ Three phase
And / Or	
☒ External DC supply	
Nominal voltage	VBAT: 3.7V Max Current VBAT: A VBOOST: 0.5A 27V V VBOO ST: 2.0A
Extreme upper voltage	VBAT: 6.0V VBOOST: 35V V
Extreme lower voltage	VBAT: 3.2V VBOOST: 16V V
Battery	
☐ Nickel Cadmium	☐ Lead acid (Vehicle regulated)
☐ Alkaline	☐ Leclanche
☐ Lithium	☐ Other Details :
Volts nominal.	
End point voltage as quoted by equipment manufacturer	V

FREQUENCY INFORMATION	
Frequency Range	1616.0 to 1626.5 MHz
Channel Spacing (where applicable)	41.667kHz
Receiver Frequency Range (if different)	to MHz
Channel Spacing (if different)	
Test Frequencies*	Bottom 1616.02 0833 MHz Channel Number (if applicable) 1
	Middle 1621.02 0833 MHz Channel Number (if applicable) 121
	Top 1625.97 9167 MHz Channel Number (if applicable) 240
Intermediate Frequencies	0.2, 0.4, 0.6, 0.8, 16.8 MHz
Highest Internally Generated Frequency :	3252 MHz



Product Service

POWER CHARACTERISTICS			
Maximum TX power	6.607	W	
Minimum TX power	1.047	W (if variable)	
Is transmitter intended for :			
Continuous duty		☐ Yes	☒ No
Intermittent duty		☒ Yes	☐ No
If intermittent state DUTY CYCLE			
Transmitter ON	8.28m	seconds	
Transmitter OFF	81.72m	seconds	

ANTENNA CHARACTERISTICS					
☒	Antenna connector		State impedance	50	Ohm
☐	Temporary antenna connector		State impedance		Ohm
☐	Integral antenna	Type	State impedance		dBi
☒	External antenna	Type Passive	State impedance	3.0	dBi

MODULATION CHARACTERISTICS			
☐	Amplitude	☐	Frequency
☐	Phase	☒	Other (please provide details): DE-QPSK/DE-BPSK
Can the transmitter operate un-modulated?			☒ Yes ☐ No

CLASS OF EMISSION USED	
ITU designation or Class of Emission:	
1	41K7Q7W
(if applicable) 2	
(if applicable) 3	
If more than three classes of emission, list separately:	

BATTERY POWER SUPPLY	
Model name/number	Identification/Part number
Manufacturer	Country of Origin

ANCILLARIES (If applicable)	
Model name/number	Identification/Part number
Manufacturer	Country of Origin

EXTREME CONDITIONS			
Extreme test voltages (Max)	VBAT: V 6.0V VB00S T: 35V	Extreme test voltages (Mix)	V
Nominal DC Voltage	VBAT: V 3.7V VB00S T: 27V	DC Maximum Current	VBAT: A 0.5A VB00S T: 2.0A
Maximum temperature	+85 °C	Minimum temperature	-40 °C

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Name: Jonathan Jones
Position held: Senior Engineer

Date: 13/10/2015



Product Service

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Iridium Core 9523N. A full technical description can be found in the manufacturer's documentation.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a $V_{bat} = 3.7 \text{ V DC}$, $V_{boost} = 27.0 \text{ V DC}$ supply.

FCC Measurement Facility Registration Number
90987 Octagon House, Fareham Test Laboratory

Industry Canada Company Address Code
IC2932B-1 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standard were made during testing.

1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.



Product Service

SECTION 2

TEST DETAILS

FCC and Industry Canada Testing of the
Iridium Core 9523N

In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, Industry Canada RSS-170 and
Industry Canada RSS-GEN



2.1 MODULATION CHARACTERISTICS

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047(d)

2.1.2 Equipment Under Test

9523N

2.1.3 Test Results

Transmit, Modulation Characteristics, Customer Description

Traffic, broadcast, and ring alert channels use differentially encoded quaternary phase shift keyed (DE-QPSK) modulation with 40% square root raised cosine pulse shaping. The burst transmission rate is 25ksps or 50 kbps. The phase of the QPSK symbol states relative to the carrier phase is (Symbol State/Phase in deg): 00/0, 01/-90, 10/+90, 11/180. The acquisition channel uses differentially encoded binary phase shift keyed (DE-BPSK) with 40% square root raised cosine pulse shaping. The burst rate on these channels is 25 kbps. The sync channel uses 25 kbps DE-BPSK on the uplink and 50 kbps DE-QPSK on the downlink. Both with 40% square root raised cosine pulse shaping.

FCC 47 CFR Part 2, Limit Clause 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.

Industry Canada RSS-GEN, Limit Clause Annex A (i)(2)

The type of modulation, with a brief description giving any useful information to aid prospective users in understanding the device, such as (but not limited to) the bit rate and symbol rate.



Product Service

2.2 OCCUPIED BANDWIDTH

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049
Industry Canada RSS-GEN, Clause 6.6

2.2.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

2.2.3 Date of Test

28 October 2015

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Procedure

The EUT was connected to a spectrum analyser via a cable and attenuator. The EUT was configured to transmit on bottom, middle and top channels at maximum power. The settings of the analyser were configured with an RBW of 1.1 kHz and VBW of 3.3 kHz using a Peak detector and max hold. The Occupied bandwidth measurement function of the analyser was then utilized to make the measurement and the 99% occupied bandwidth was recorded.

2.2.6 Environmental Conditions

Ambient Temperature	24.6°C
Relative Humidity	40.8%



Product Service

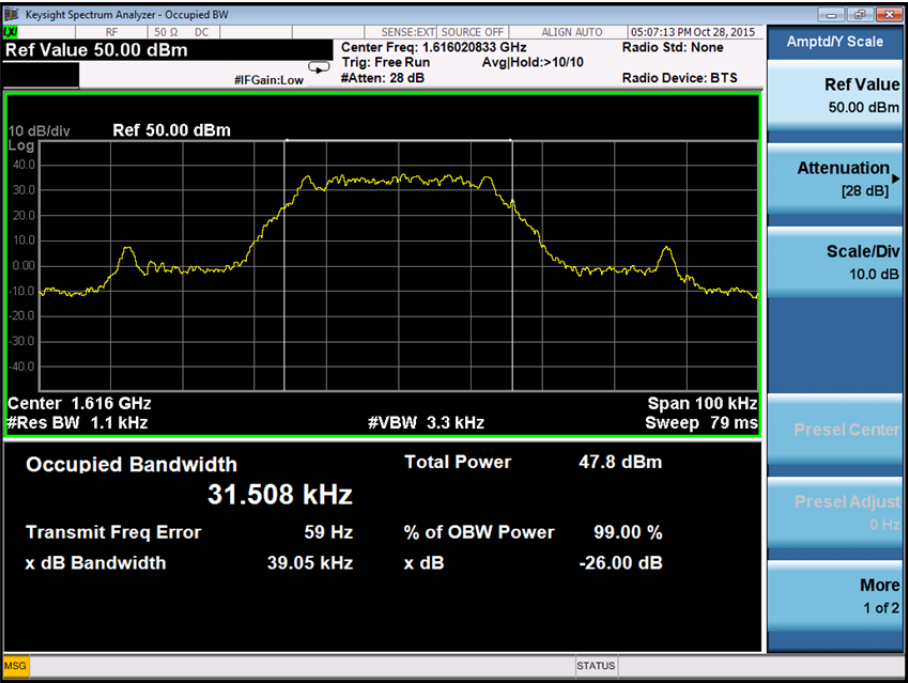
2.2.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, Occupied Bandwidth Results

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz
kHz	kHz	kHz
31.508	31.181	31.584

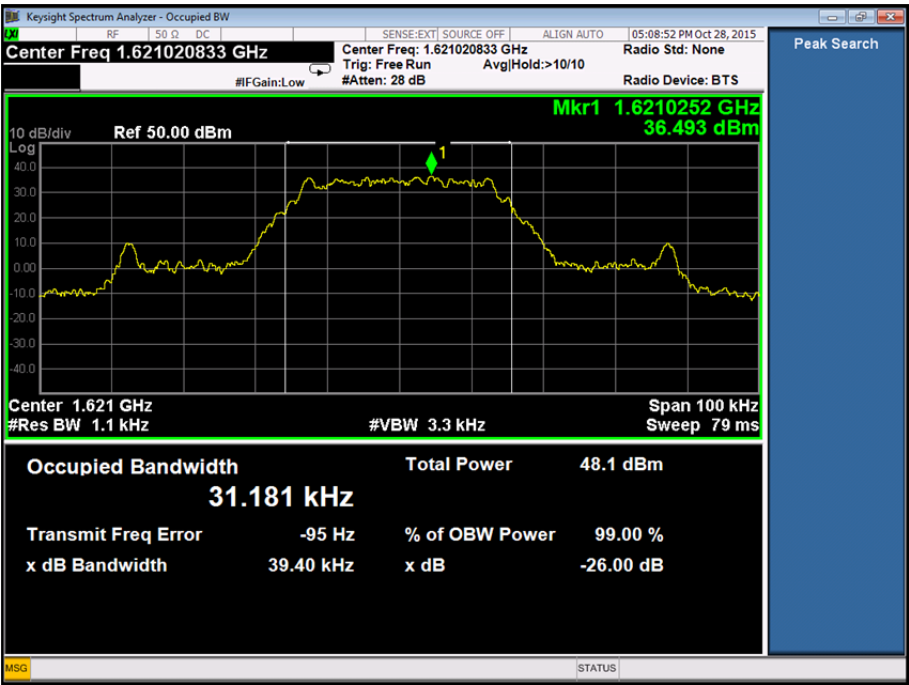
Transmit, 1616.020833 MHz, Occupied Bandwidth Plot



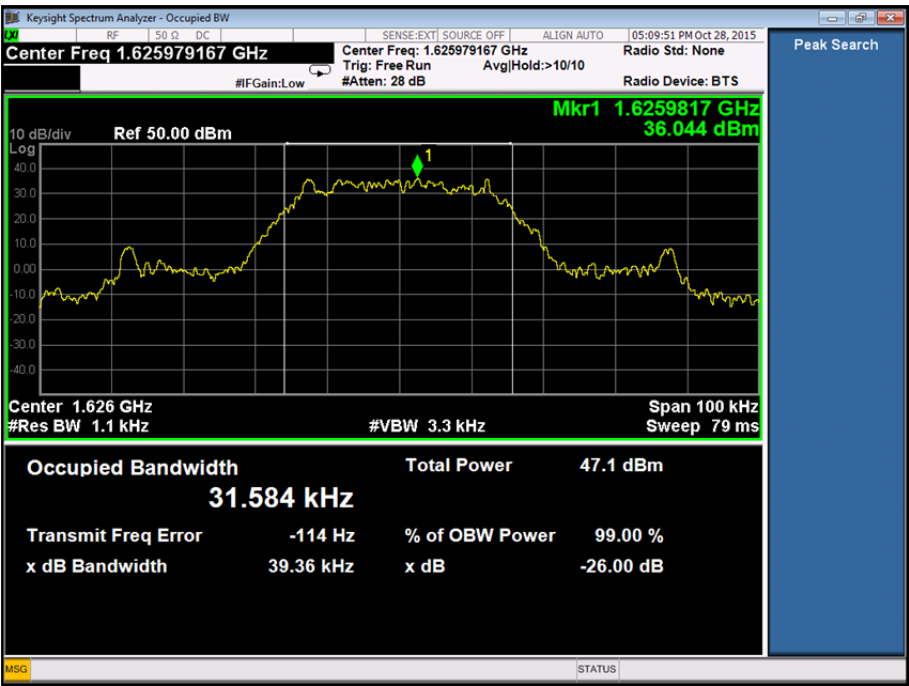


Product Service

Transmit, 1621.020833 MHz, Occupied Bandwidth Plot



Transmit, 1625.979167 MHz, Occupied Bandwidth Plot





Product Service

FCC 47 CFR Part 2, Limit Clause 2.1049

None specified.

Industry Canada RSS-GEN, Limit Clause

None specified.



Product Service

2.3 FREQUENCY TOLERANCE

2.3.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(d)
FCC 47 CFR Part 2, Clause 2.1055
Industry Canada RSS-170, Clause 5.2

2.3.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

2.3.3 Date of Test

20 October 2015 & 21 October 2015

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Procedure

The EUT was connected to a spectrum analyser via a cable and attenuator. The spectrum analyser's frequency reference was locked to an external 10 MHz frequency reference from a Rubidium standard. The EUT was set to transmit at maximum power with an unmodulated carrier. The unmodulated frequency was set +6.25 kHz offset from the middle channel.

For measurements of frequency variation with respect to temperature, the procedure as described in FCC 47 CFR Part 2, clause 2.1055 (b) was followed.

Variations in voltage were performed at the extreme voltage conditions as specified the manufacturer as these voltages exceeded the conditions specified in FCC 47 CFR Part 2, clause 2.1055(d).

2.3.6 Environmental Conditions

Ambient Temperature	24.1 - 24.2°C
Relative Humidity	38.6 - 44.6%



2.3.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, 1621.020833 MHz, Frequency Stability Under Temperature Variations Results

Temperature Interval	Frequency Error	
	%	ppm
-30 °C	-0.000066	-0.66
-20 °C	-0.000102	-1.02
-10 °C	-0.000143	-1.43
0 °C	-0.000164	-1.64
+10 °C	-0.000140	-1.40
+20 °C	-0.000153	-1.53
+30 °C	-0.000142	-1.42
+40 °C	-0.000149	-1.49
+50 °C	-0.000163	-1.63

Transmit, 1621.020833 MHz, Frequency Stability Under Voltage Variations Results

DC Voltage	Frequency Error	
	%	ppm
Vbat = 3.7 V DC, Vboost = 27.0 V DC	-0.000145	-1.45
Vbat = 3.2 V DC, Vboost = 16 V DC	-0.000150	-1.50
Vbat = 6.0 V DC, Vboost = 35.0 V DC	0.000047	0.47

FCC 47 CFR Part 2, Limit Clause 25.202(d)

Frequency tolerance, Earth stations. The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency.

Industry Canada RSS-170, Limit Clause 5.2

For mobile earth station equipment, the carrier frequency shall not depart from the reference frequency by more than ± 10 ppm.



2.4 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

2.4.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(f)
FCC 47 CFR Part 2, Clause 2.1051
Industry Canada RSS-170, Clause 5.4.3.1
Industry Canada RSS-GEN, Clause 6.13

2.4.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

2.4.3 Date of Test

16 October 2015 and 28 October 2015

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Procedure

For emissions removed less than 250 % of the authorised bandwidth:

The EUT was connected to a spectrum analyser via a cable and attenuator. The EUT was transmitting at maximum power, for bottom, middle and top channels. The EUT was modulated as stated in the manufactures application form. The path loss between the EUT and analyser was calibrated using a network analyser and entered in to the spectrum analyser as a reference level offset. The analyser was configured with an RBW and VBW of 1 kHz and 3 kHz respectively with the trace set to average using an RMS detector. $10\log(4) = 6$ dB was added to the reference level offset to make the result relative to any 4 kHz band as per the requirement in 25.202(f). The mask as specified in clause 25.202(f) was then applied using a necessary bandwidth of 41.667 kHz as declared by the manufacturer.

For emissions removed more than 250 % of the authorised bandwidth:

Conducted: A network analyser was used to measure the path loss and the worst case was entered as a reference level offset in to the spectrum analyser. The EUT was configured to maximum power on bottom, middle or top channel with modulation. The spectrum analyser was configured with an RBW and VBW of 1 MHz and 3 MHz respectively as this is worst case as opposed to 4 kHz RBW. The trace was set to average using an RMS detector with the gate settings configured so that average measurements were only performed over the active part of the burst.

2.4.6 Environmental Conditions

Ambient Temperature	23.8°C
Relative Humidity	42.1%

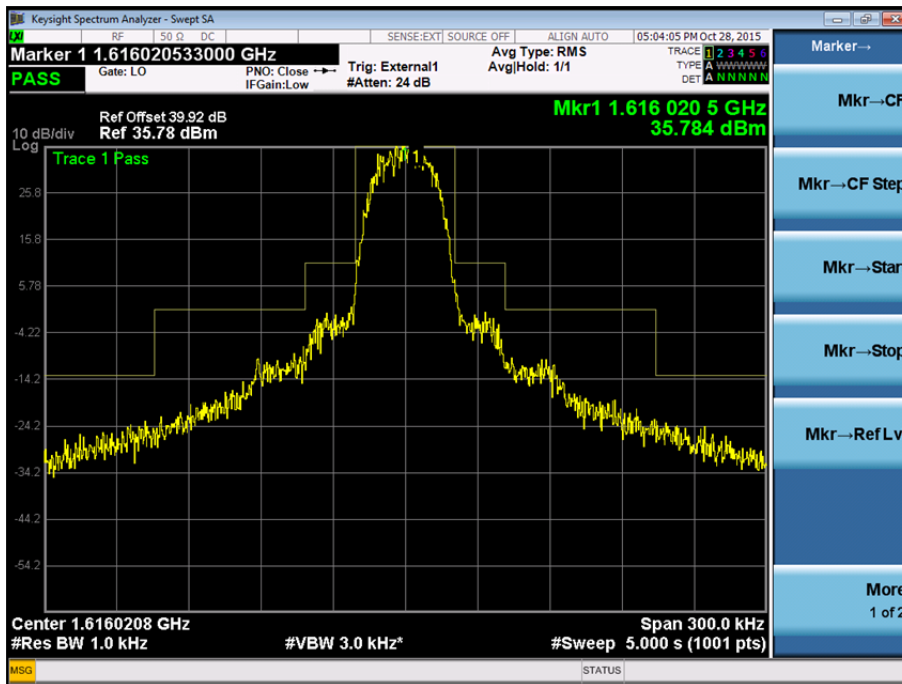


Product Service

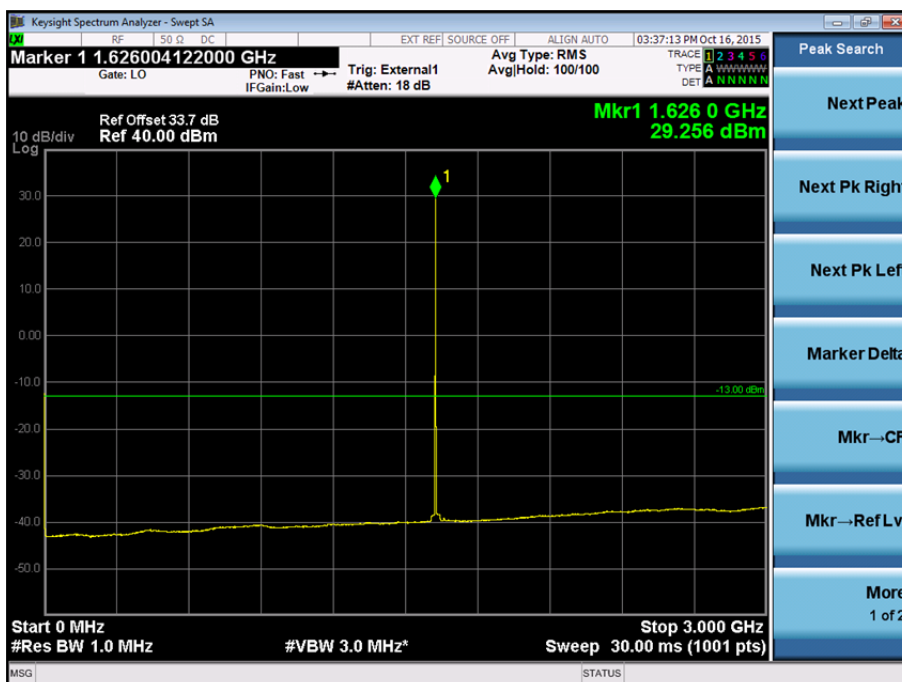
2.4.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, 1616.020833 MHz, Mask, Spurious Emissions at Antenna Terminals Plot



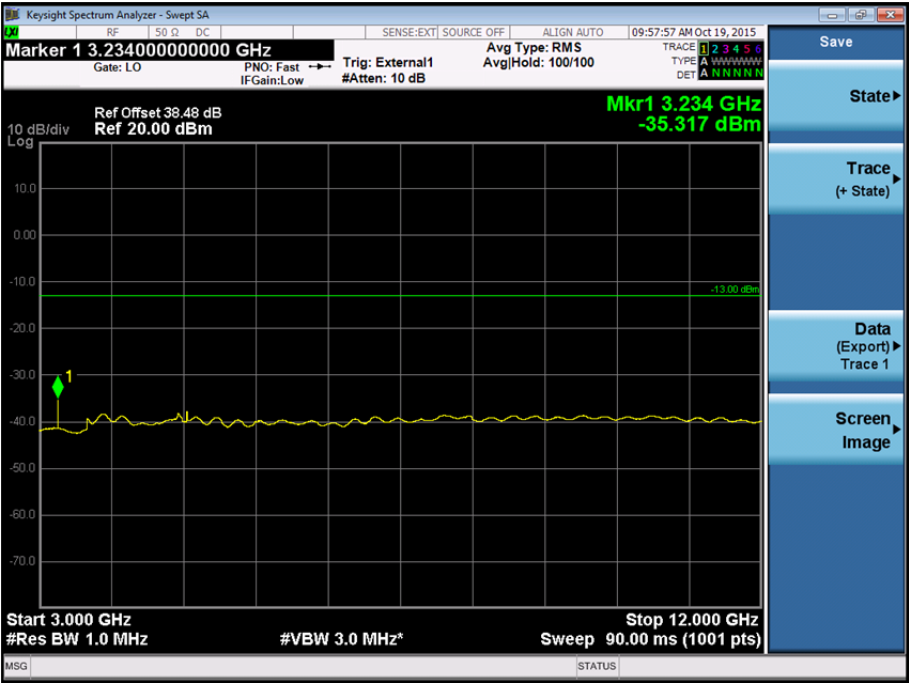
Transmit, 1616.020833 MHz, 9 kHz to 3 GHz, Spurious Emissions at Antenna Terminals Plot





Product Service

Transmit, 1616.020833 MHz, 3 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot



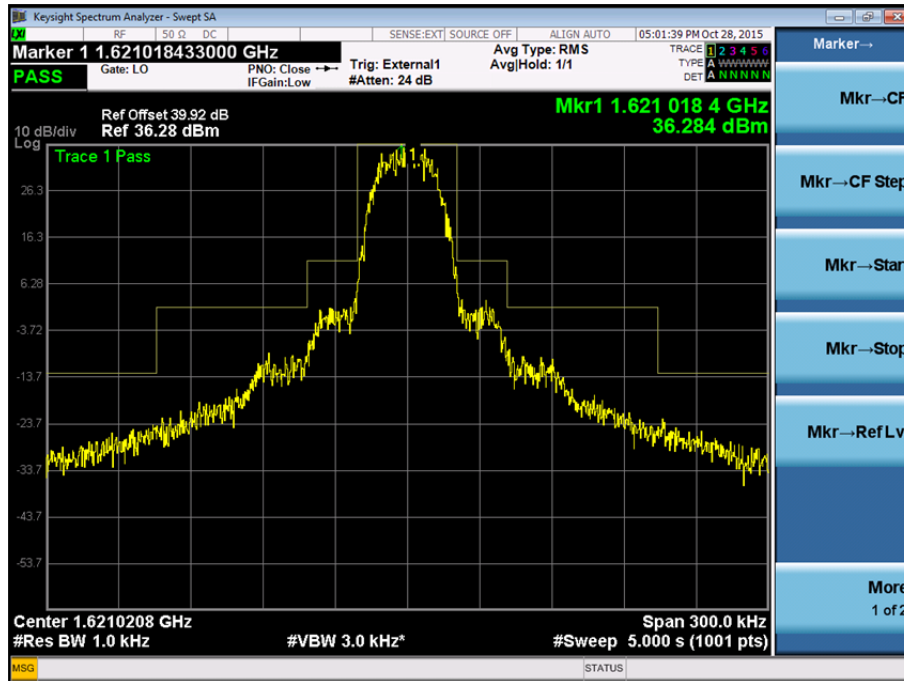
Transmit, 1616.020833 MHz, 12 GHz to 17 GHz, Spurious Emissions at Antenna Terminals Plot



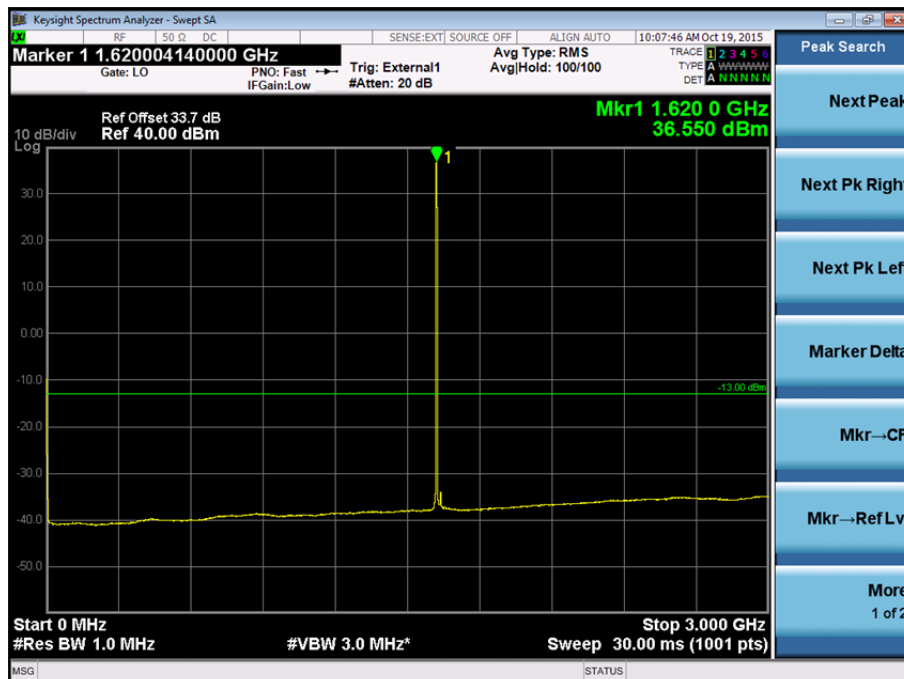


Product Service

Transmit, 1621.020833 MHz, Mask, Spurious Emissions at Antenna Terminals Plot



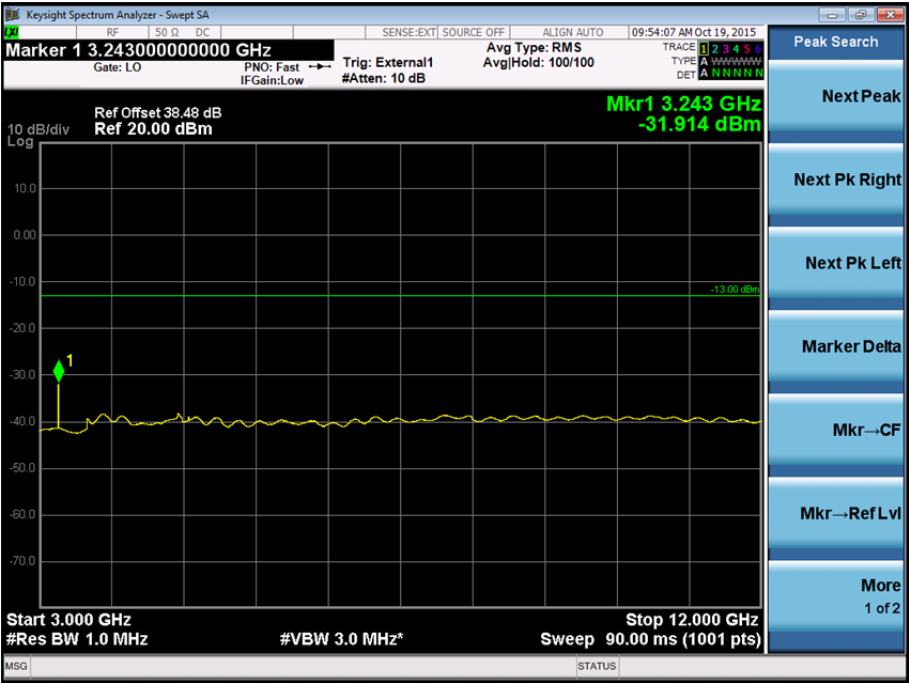
Transmit, 1621.020833 MHz, 9 kHz to 3 GHz, Spurious Emissions at Antenna Terminals Plot



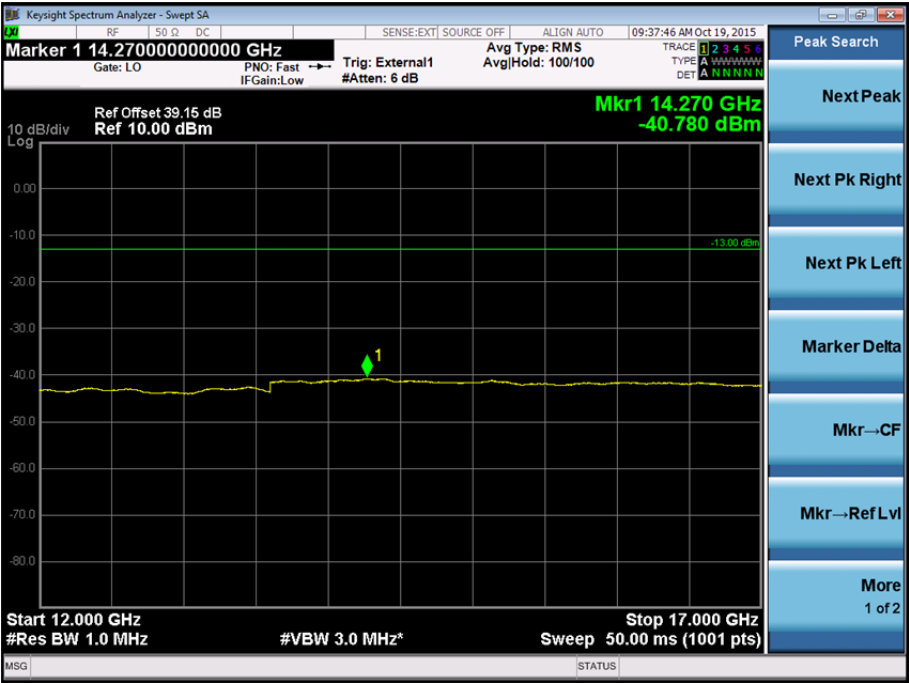


Product Service

Transmit, 1621.020833 MHz, 3 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot



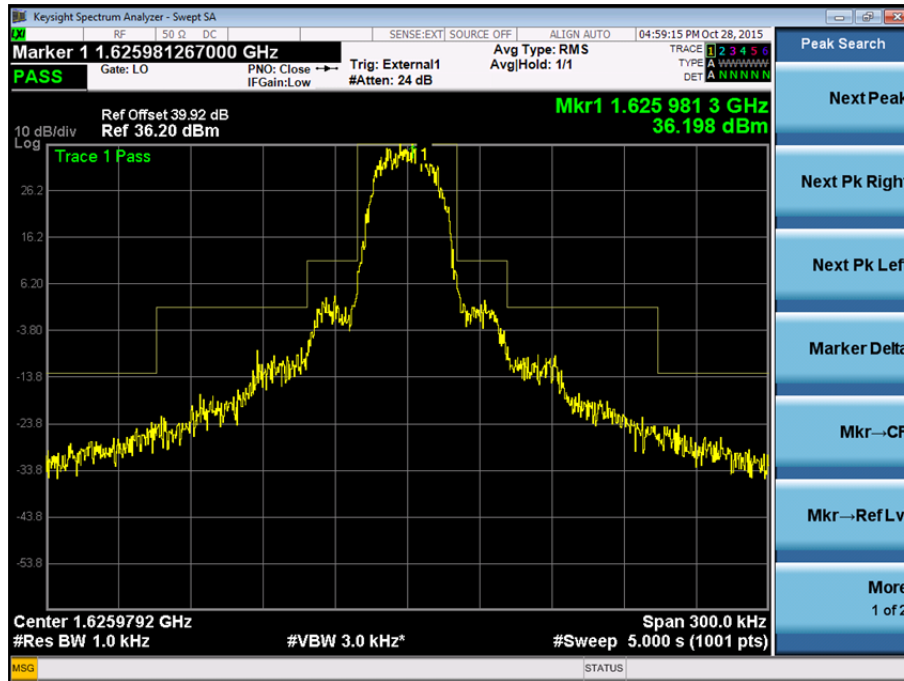
Transmit, 1621.020833 MHz, 12 GHz to 17 GHz, Spurious Emissions at Antenna Terminals Plot



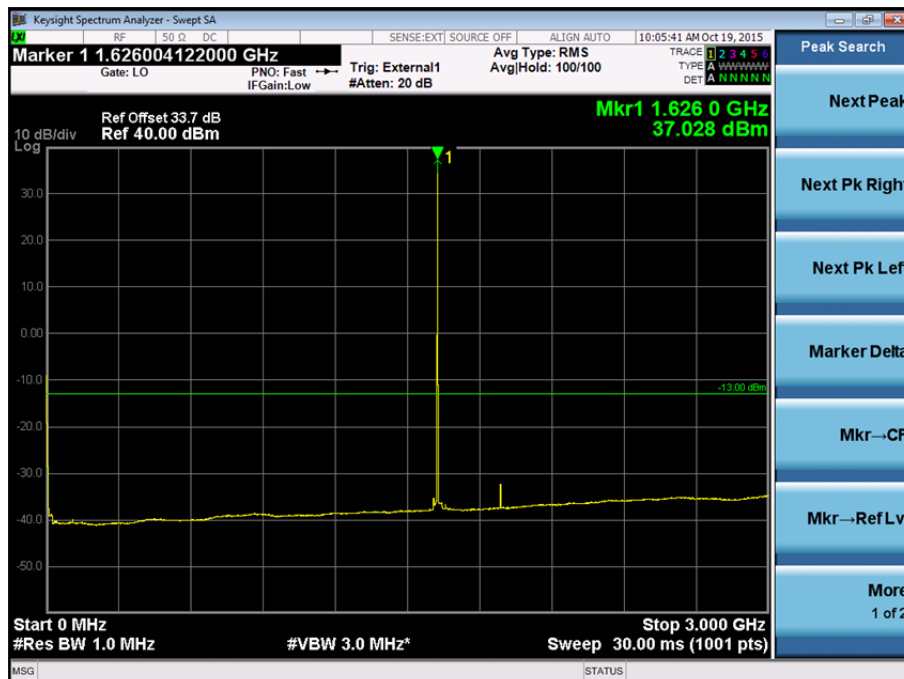


Product Service

Transmit, 1625.979167 MHz, Mask, Spurious Emissions at Antenna Terminals Plot



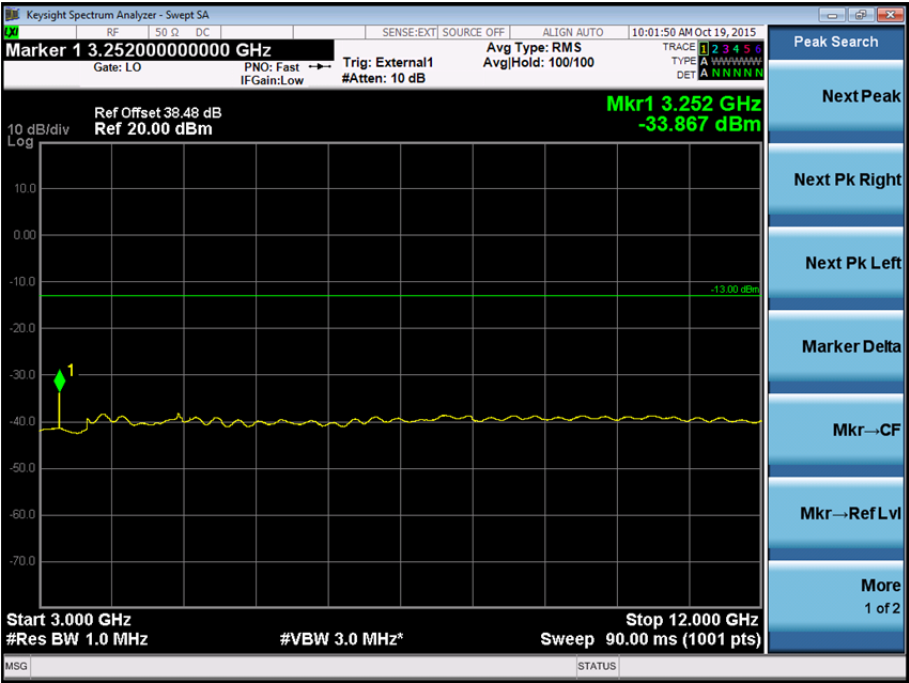
Transmit, 1625.979167 MHz, 9 kHz to 3 GHz, Spurious Emissions at Antenna Terminals Plot





Product Service

Transmit, 1625.979167 MHz, 3 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot



Transmit, 1625.979167 MHz, 12 GHz to 17 GHz, Spurious Emissions at Antenna Terminals Plot



FCC 47 CFR Part 2, Limit Clause 25.202(f)

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

- 1) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the authorised bandwidth;
- 2) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the authorised bandwidth;
- 3) $43 + 10 \log p$ (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the authorised bandwidth.

Industry Canada RSS-170, Limit Clause 5.4.3.1

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

- 1) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the occupied bandwidth or necessary bandwidth, whichever is greater
- 2) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the occupied bandwidth or necessary bandwidth, whichever is greater
- 3) $43 + 10 \log p$ (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the occupied bandwidth or necessary bandwidth, whichever is greater.



2.5 RADIATED SPURIOUS EMISSIONS

2.5.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(f)
FCC 47 CFR Part 2, Clause 2.1053
Industry Canada RSS-170, Clause 5.4.3.1
Industry Canada RSS-GEN, Clause 6.13

2.5.2 Equipment Under Test and Modification State

9523N S/N: 24 - Modification State 0

2.5.3 Date of Test

21 October 2015 & 25 October 2015

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Procedure

For radiated testing, a preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both horizontal and vertical Polarisation. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation. The plots shown in this report shows the characterisation of the EUT. A 100 kHz RBW was used for measurements as this is worst case compared to 4 kHz.

Using the information from the preliminary profiling of the EUT, the list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

The EUT was set to transmit on maximum power with both channels operating simultaneously.

For any emissions found the EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result was determined by a calculation using the signal generator level, antenna gain and cable loss.

The measurements were performed at a 3 m distance unless otherwise stated.

2.5.6 Environmental Conditions

Ambient Temperature	20.3 - 20.8°C
Relative Humidity	34.0 - 51.0%



Product Service

2.5.7 Test Results

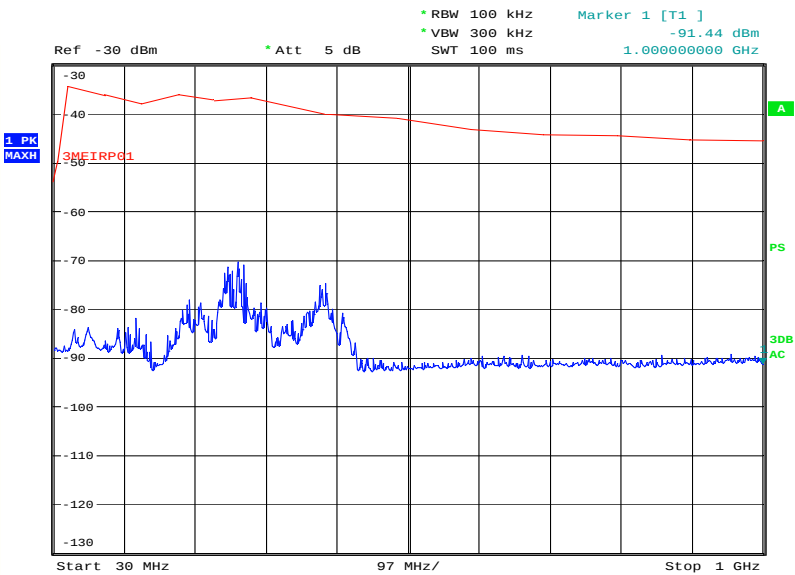
Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, 1616.020833 MHz, 30 MHz to 18 GHz, Radiated Spurious Emissions Results

Frequency (MHz)	Final Peak (dBm)
*	

* No emissions were detected within 10 dB of the limit.

Transmit, 1616.020833 MHz, 30 MHz to 1 GHz, Radiated Spurious Emissions Plot

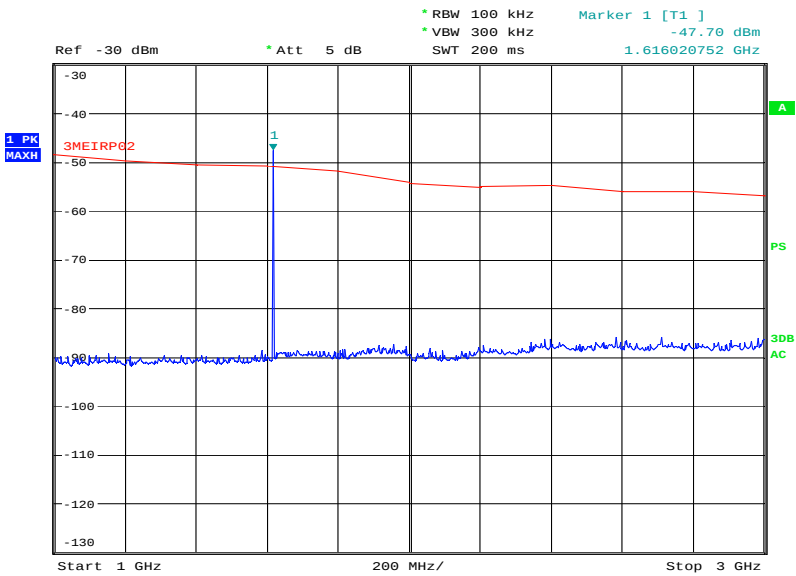


Date: 21.OCT.2015 18:56:48



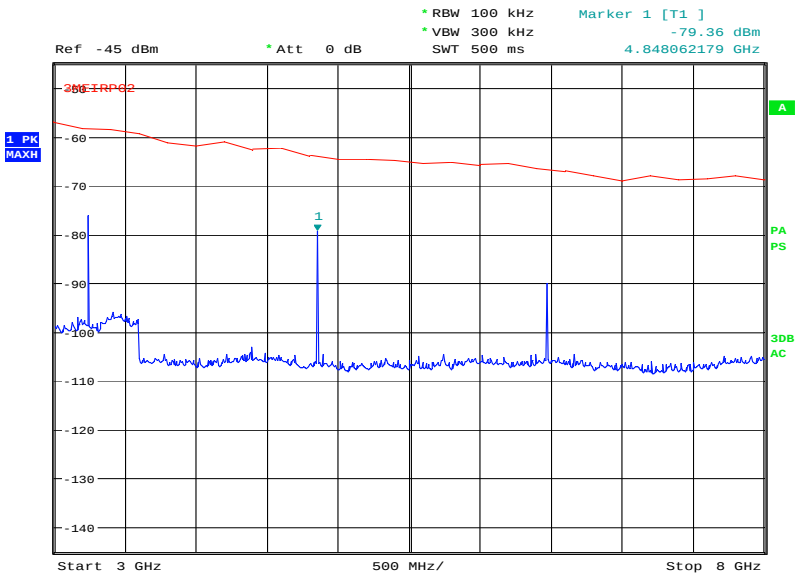
Product Service

Transmit, 1616.020833 MHz, 1 GHz to 3 GHz, Radiated Spurious Emissions Plot



Date: 21.OCT.2015 19:13:03

Transmit, 1616.020833 MHz, 3 GHz to 8 GHz, Radiated Spurious Emissions Plot

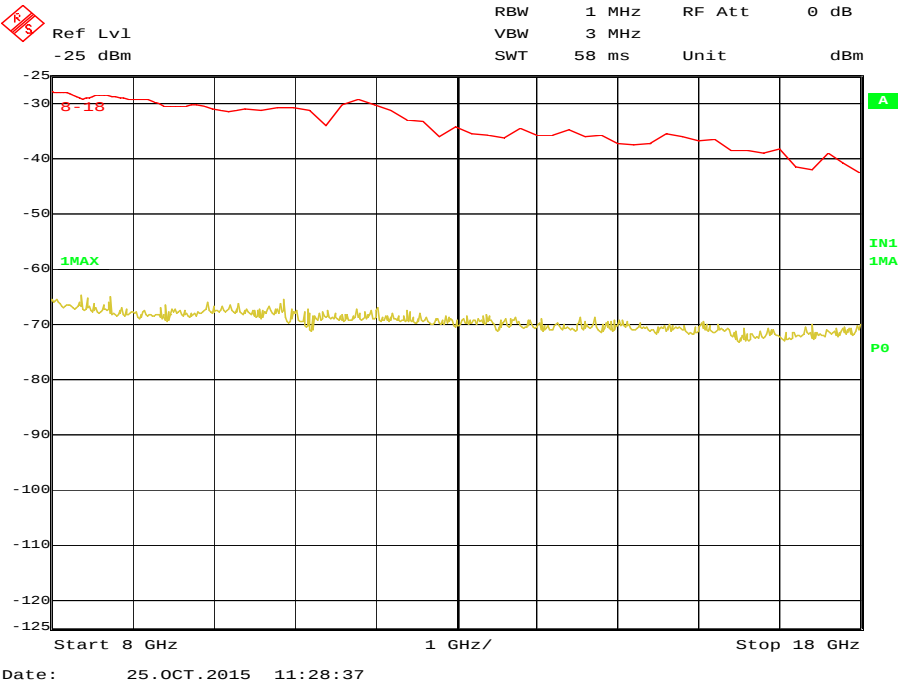


Date: 21.OCT.2015 21:50:27



Product Service

Transmit, 1616.020833 MHz, 8 GHz to 18 GHz, Radiated Spurious Emissions Plot





Product Service

Transmit, 1621.020833 MHz, 30 MHz to 18 GHz, Radiated Spurious Emissions Results

Frequency (MHz)	Final Peak (dBm)
*	

* No emissions were detected within 10 dB of the limit.

Transmit, 1621.020833 MHz, 30 MHz to 1 GHz, Radiated Spurious Emissions Plot

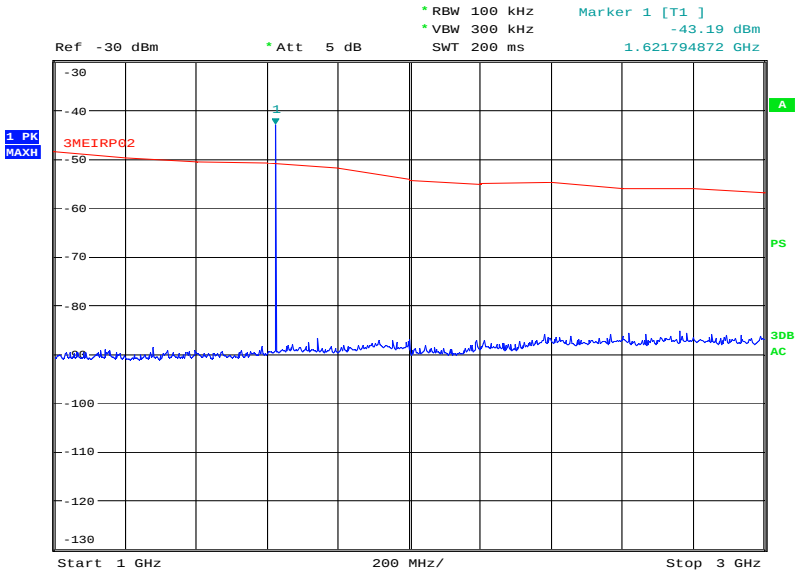


Date: 21.OCT.2015 19:23:04



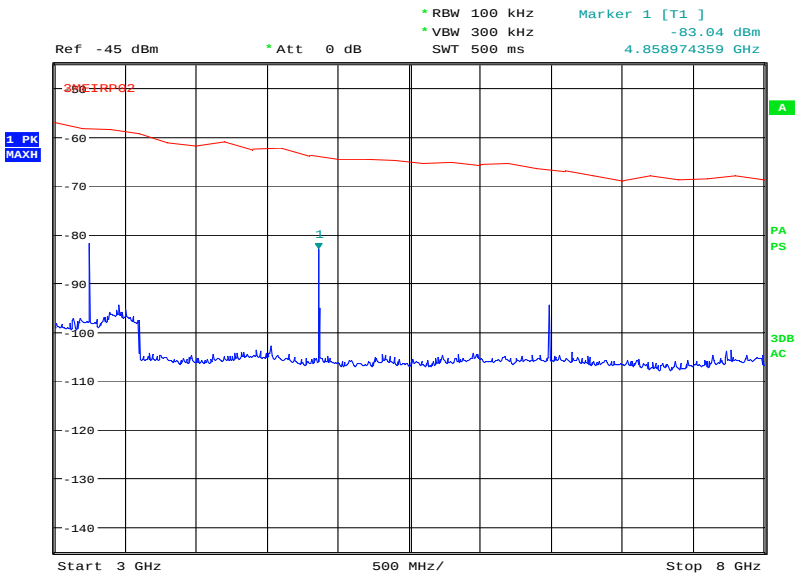
Product Service

Transmit, 1621.020833 MHz, 1 GHz to 3 GHz, Radiated Spurious Emissions Plot



Date: 21.OCT.2015 19:21:24

Transmit, 1621.020833 MHz, 3 GHz to 8 GHz, Radiated Spurious Emissions Plot

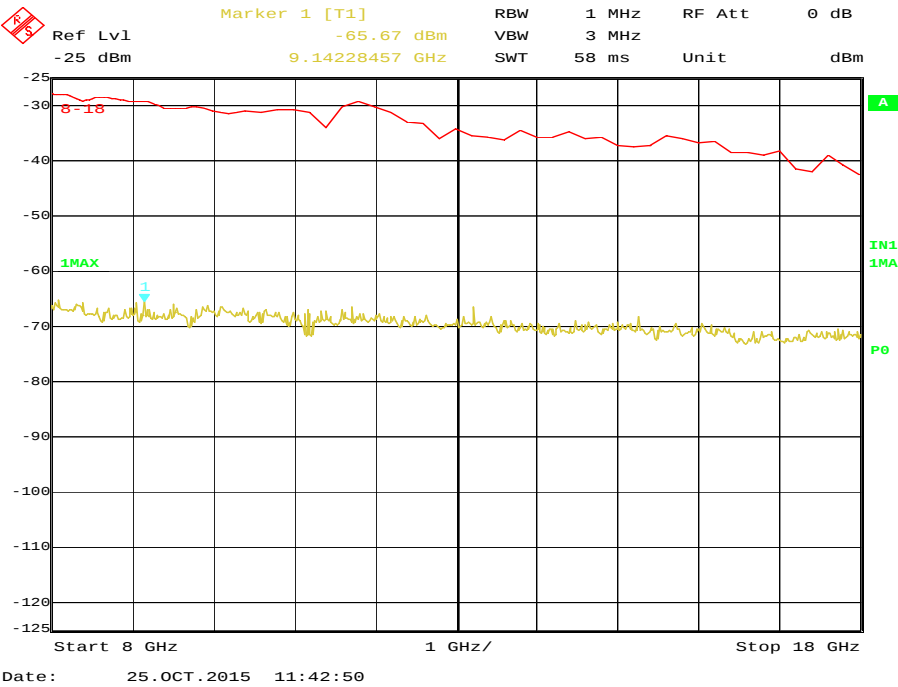


Date: 21.OCT.2015 20:56:19



Product Service

Transmit, 1621.020833 MHz, 8 GHz to 18 GHz, Radiated Spurious Emissions Plot





Product Service

Transmit, 1625.979167 MHz, 1 GHz to 18 GHz, Radiated Spurious Emissions Results

Frequency (MHz)	Final Peak (dBm)
4877.936	-20.18

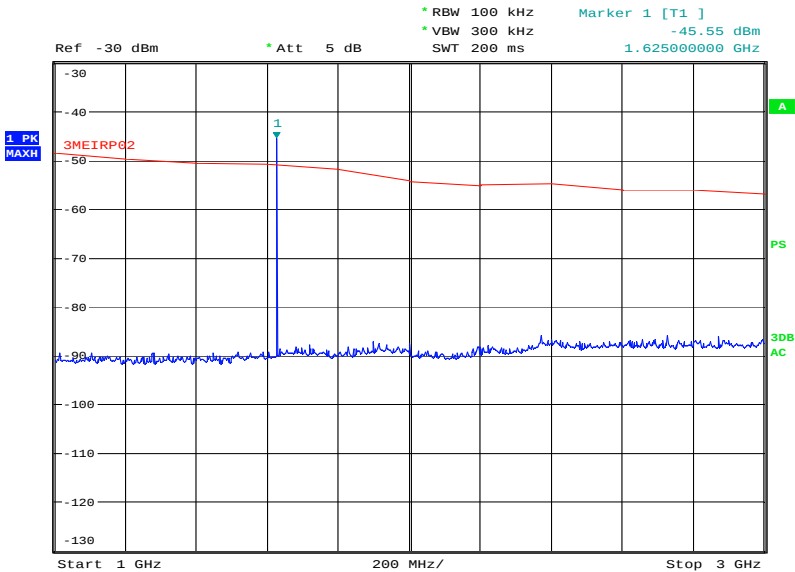
* No other emissions were detected within 10 dB of the limit.

Transmit, 1625.979167 MHz, 30 MHz to 1 GHz, Radiated Spurious Emissions Plot



Date: 21.OCT.2015 19:27:07

Transmit, 1625.979167 MHz, 1 GHz to 3 GHz, Radiated Spurious Emissions Plot

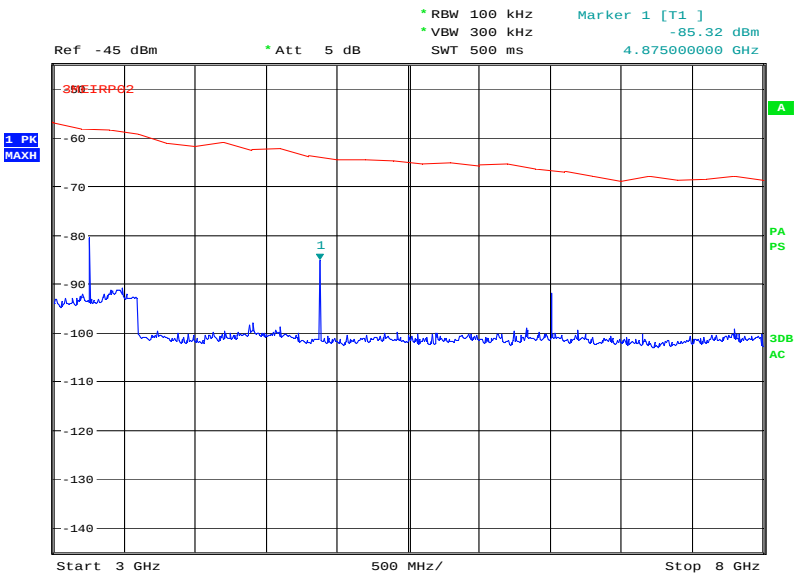


Date: 21.OCT.2015 19:28:47



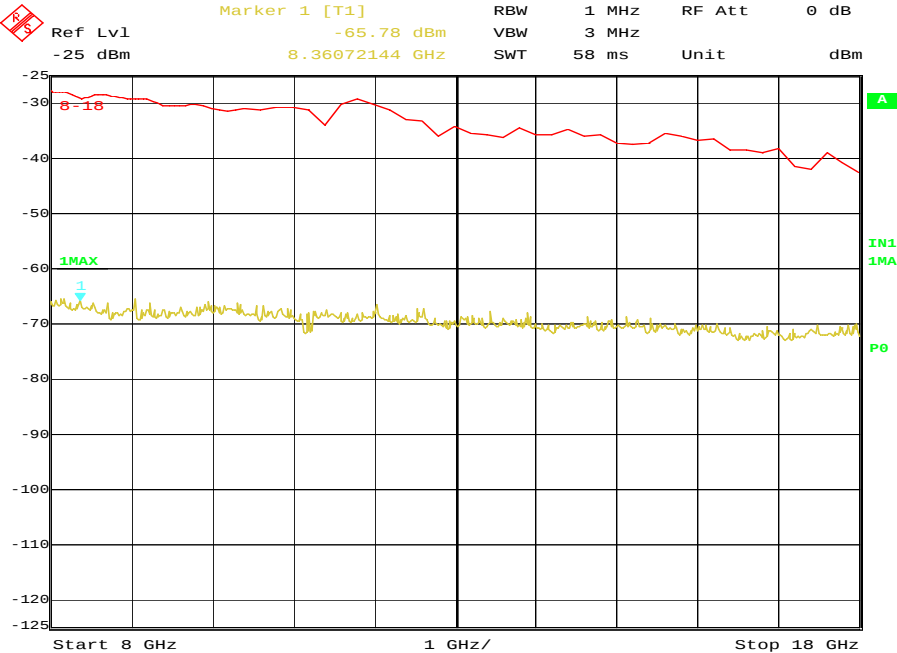
Product Service

Transmit, 1625.979167 MHz MHz, 3 GHz to 8 GHz, Radiated Spurious Emissions Plot



Date: 21.OCT.2015 20:01:29

Transmit, 1625.979167 MHz, 8 GHz to 18 GHz, Radiated Spurious Emissions Plot



Date: 25.OCT.2015 11:57:34

FCC 47 CFR Part 2, Limit Clause 25.202(f)

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

- 4) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the authorised bandwidth;
- 5) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the authorised bandwidth;
- 6) $43 + 10 \log p$ (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the authorised bandwidth.

Industry Canada RSS-170, Limit Clause 5.4.3.1

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

- 4) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the occupied bandwidth or necessary bandwidth, whichever is greater
- 5) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the occupied bandwidth or necessary bandwidth, whichever is greater
- 6) $43 + 10 \log p$ (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the occupied bandwidth or necessary bandwidth, whichever is greater.



Product Service

2.6 CONDUCTED OUTPUT POWER

2.6.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.204
Industry Canada RSS-170, Clause 5.3

2.6.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

2.6.3 Date of Test

16 October 2015

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Procedure

The EUT was connected to a spectrum analyser via a cable and 30dB attenuator. The path loss was measured using a network analyser and entered as a reference level offset into the instrumentation. The spectrum analyser was configured with an RBW of 3.9 kHz and VBW of 12 kHz. $10\log(4/3.9) = 0.11$ dB was added to the reference level offset to make the result relative to any 4 kHz band as per the requirement in 25.204(a). The transmit power was measured over the active part of the burst using an RMS detector, the spectrum analyser trace was set to average and the maximum result recorded. Results include 3 dBi antenna gain.

2.6.6 Environmental Conditions

Ambient Temperature	25.0°C
Relative Humidity	37.1%



Product Service

2.6.7 Test Results

Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmitter Output Power: 6.607 W

Transmit, EIRP, Conducted, Power Limits Results

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz
dBW	dBW	dBW
4.213	4.150	4.777

FCC 47 CFR Part 25, Limit Clause 25.204

+40 dBW in any 4 kHz band for $\theta \leq 0^\circ$

+40 + 3 θ dBW in any 4 kHz band for $0^\circ < \theta \leq 5^\circ$

For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.

Industry Canada RSS-170, Limit Clause 5.3

The application for MES certification shall state the MES e.i.r.p. that is necessary for satisfactory communication. The maximum permissible e.i.r.p. will be the stated necessary e.i.r.p. plus a 2 dB margin. If a detachable antenna is used, the certification application shall state the recommended antenna type and manufacturer, the antenna gain and the maximum transmitter output power at the antenna terminal.



Product Service

2.7 LIMITS ON EMISSIONS FROM MOBILE EARTH STATIONS FOR PROTECTION OF AERONAUTICAL RADIONAVIGATION-SATELLITE SERVICE

2.7.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.216
Industry Canada RSS-170, Clause 5.4.3

2.7.2 Equipment Under Test and Modification State

9523N S/N: 30 - Modification State 0

2.7.3 Date of Test

19 October 2015, 21 October 2015 & 28 October 2015

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Test Procedure

The EUT was set to transmit at maximum power using modulation as described in the manufacturers application form. The EUT was connected to a spectrum analyser via a cable and attenuator. The path loss was measured using a vector network analyser and entered as a reference level offset in the EUT. The gated trigger of the analyser was used so that average measurements were taken over at least a 2 ms period of the active burst. The spectrum analyser was adjusted to show the frequency range of interest on screen with an RBW & VBW of 1 MHz and 3 MHz respectfully with an RMS detector and average trace.

All emissions were investigated further to determine the bandwidth of the emission by reducing the RBW of the analyser to allow an approximation of the emission bandwidth of the spur. It was confirmed that all discrete emissions have a power density less than -80 dBW. Any emissions shown exceeding -80 dBW on the following plots were confirmed as broadband emissions (i.e. BW > 700Hz).

2.7.6 Environmental Conditions

Ambient Temperature	23.6 - 24.5°C
Relative Humidity	40.6 – 43.7%



Product Service

2.7.7 Test Results

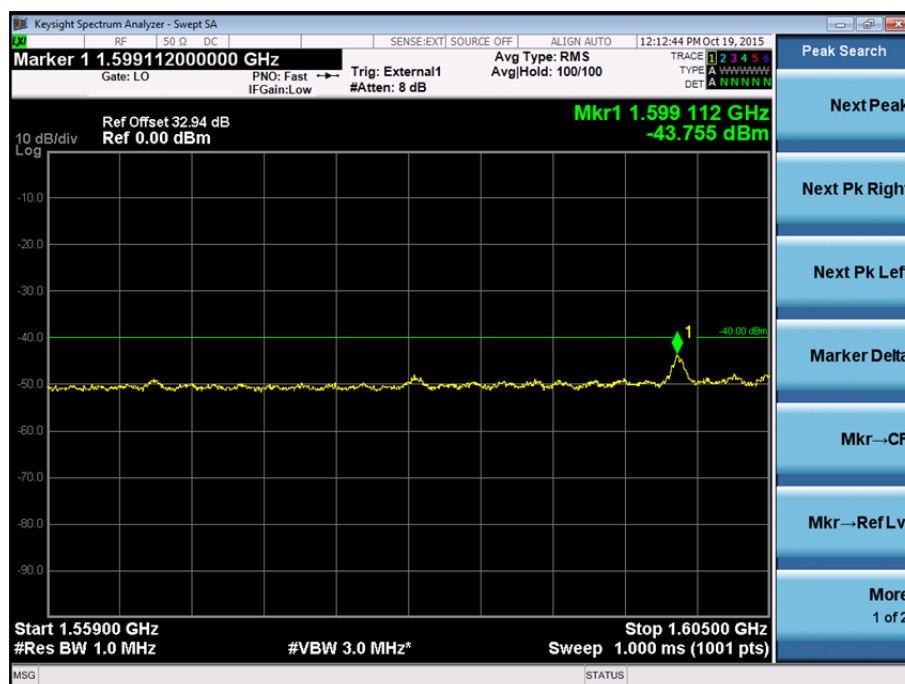
Vbat = 3.7 V DC, Vboost = 27.0 V DC Supply

Transmit, EIRP Density – Broadband Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Results

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz
dBW/MHz	dBW/MHz	dBW/MHz
*	*	*

* No emissions within 6 dB of the limit were observed.

Transmit, 1616.020833 MHz, EIRP Density – Broadband Emissions, 1559 MHz to 1605 MHz, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot





Product Service

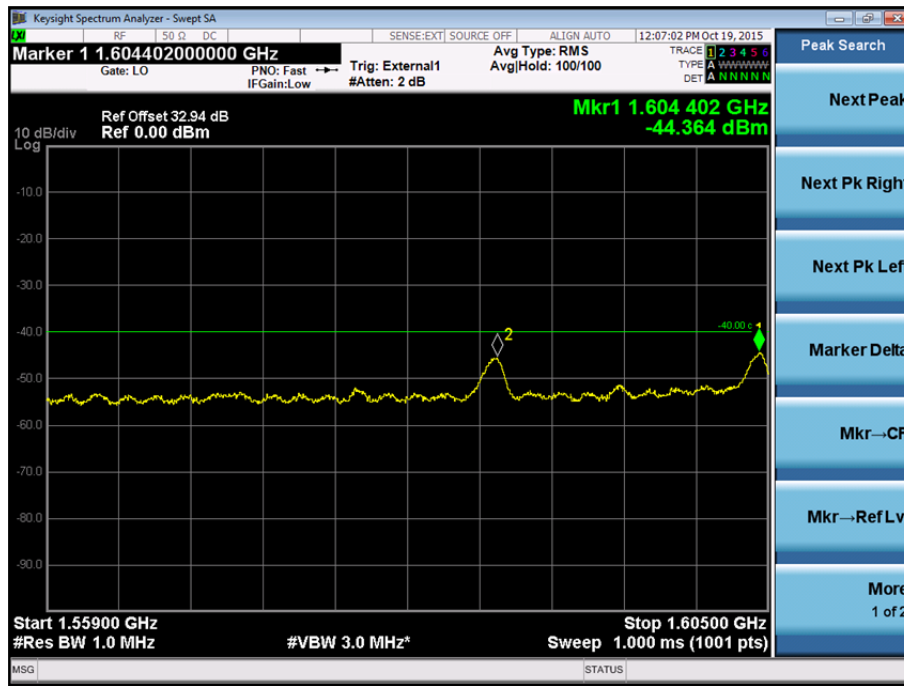
Transmit, 1616.020833 MHz, EIRP Density – Broadband Emissions, 1605 MHz to 1610 MHz,
Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-
Satellite Service Plot



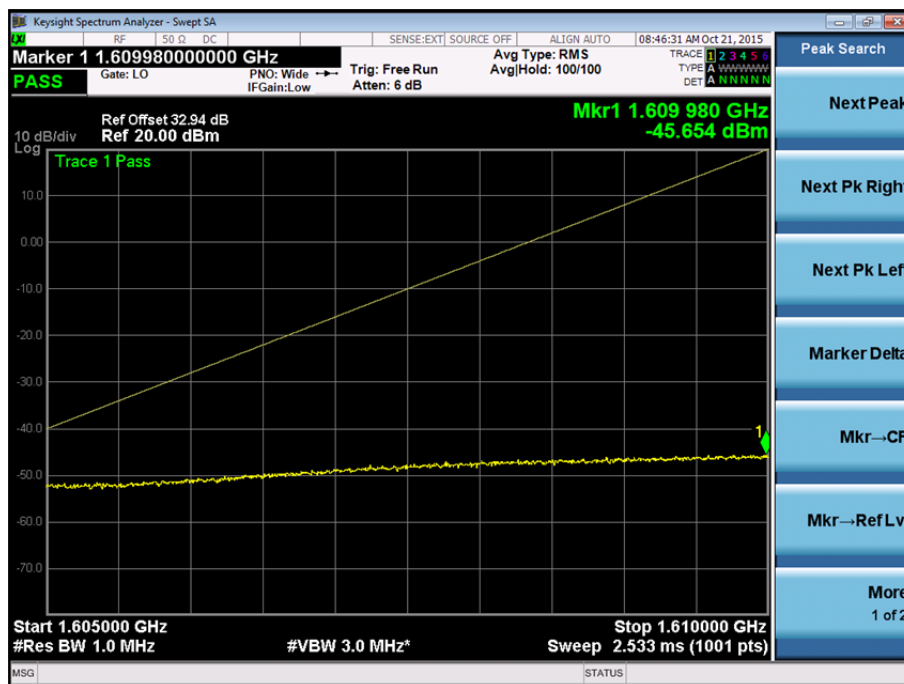


Product Service

Transmit, 1621.020833 MHz, EIRP Density – Broadband Emissions, 1559 MHz to 1605 MHz, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



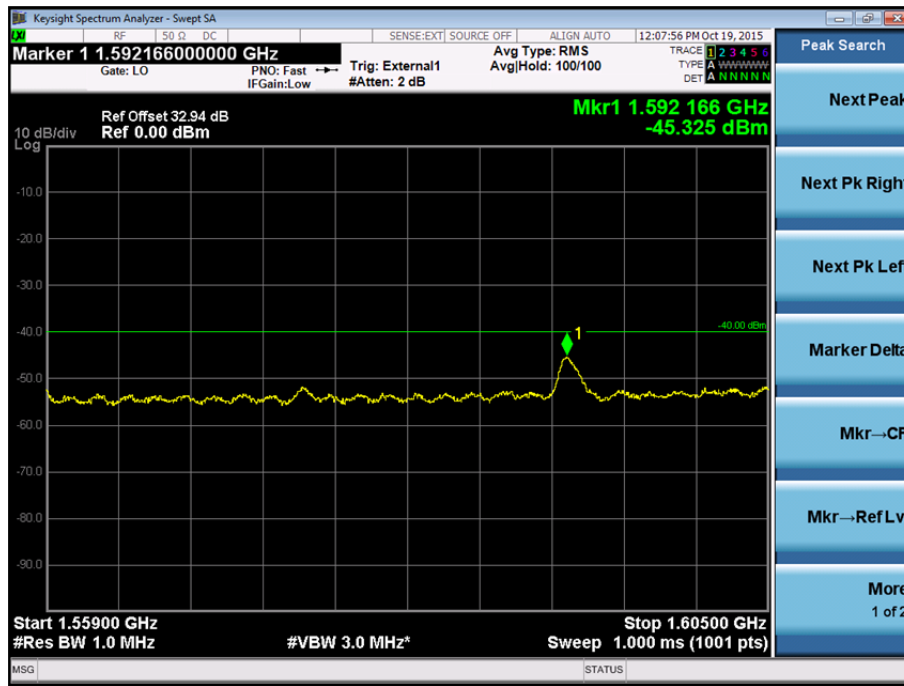
Transmit, 1621.020833 MHz, EIRP Density – Broadband Emissions, 1605 MHz to 1610 MHz, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



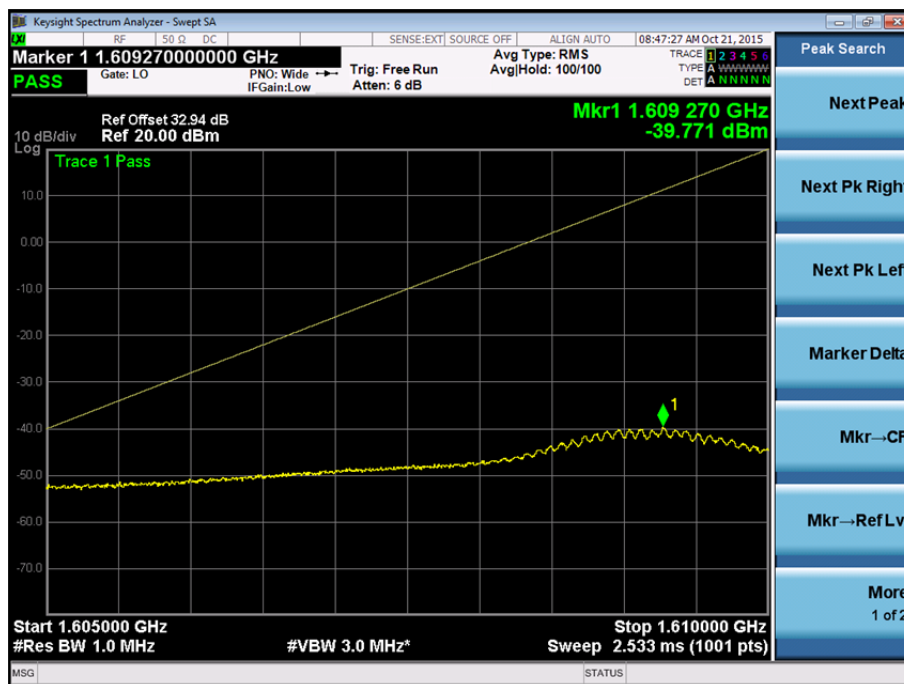


Product Service

Transmit, 1625.979167 MHz, EIRP Density – Broadband Emissions, 1559 MHz to 1605 MHz, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



Transmit, 1625.979167 MHz, EIRP Density – Broadband Emissions, 1605 MHz to 1610 MHz, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot





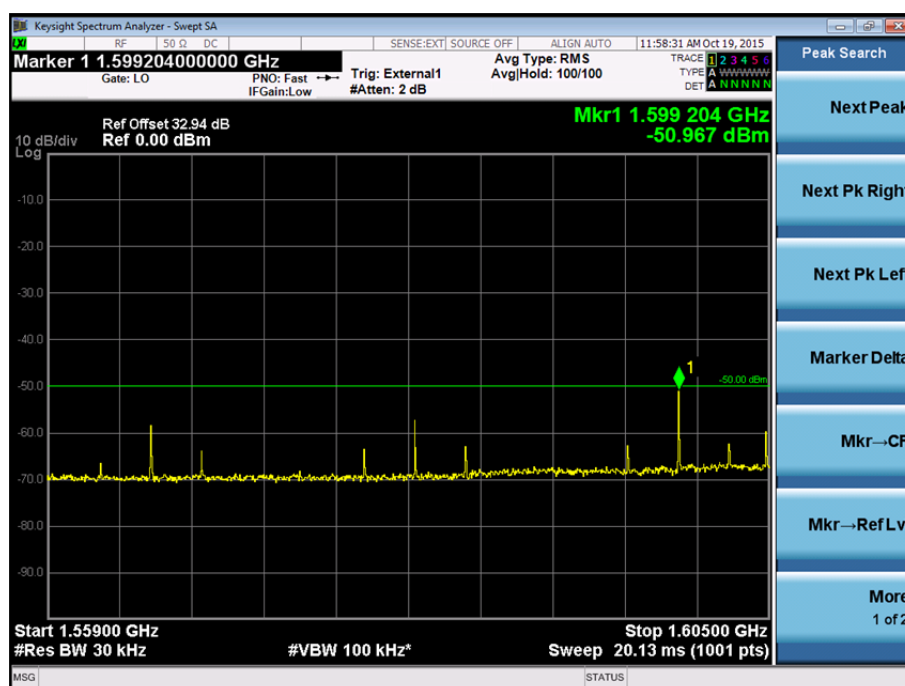
Product Service

Transmit, EIRP Density – Discrete Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Results

1616.020833 MHz	1621.020833 MHz	1625.979167 MHz
dBW/MHz	dBW/MHz	dBW/MHz
*	*	*

* No emissions within 6 dB of the limit were observed.

Transmit, 1616.020833 MHz, EIRP Density – Discrete Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot





Product Service

Transmit, 1616.020833 MHz, EIRP Density – Identified Discrete Emission, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot

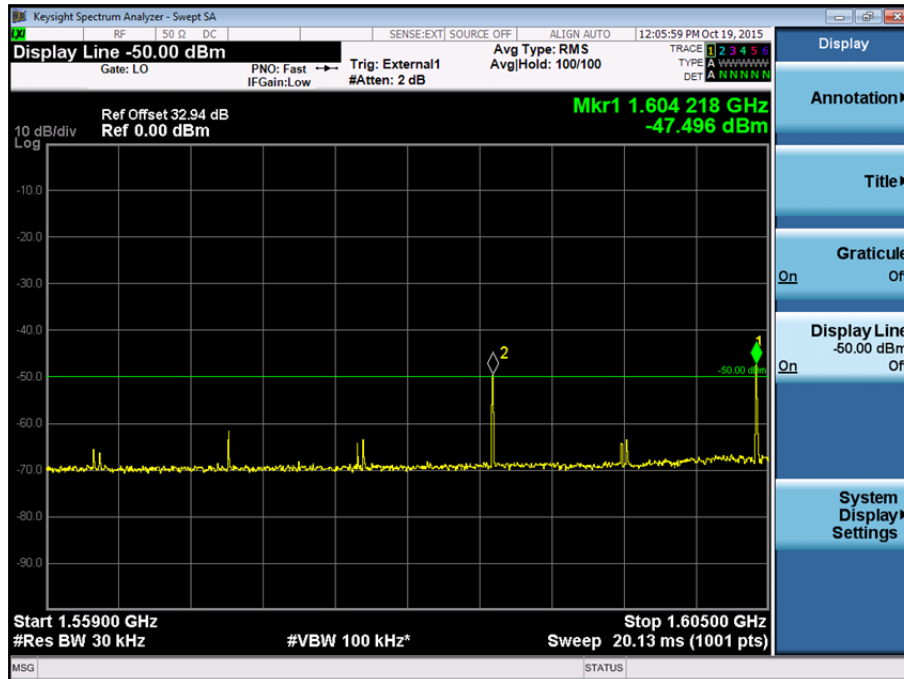


Note: The above plot is provided as evidence to show that the emission(s) observed are broadband in nature, i.e. Not discrete because the bandwidth is greater than 700 Hz.



Product Service

Transmit, 1621.020833 MHz, EIRP Density – Discrete Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



Transmit, 1621.020833 MHz, EIRP Density – Identified Discrete Emission 1, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot

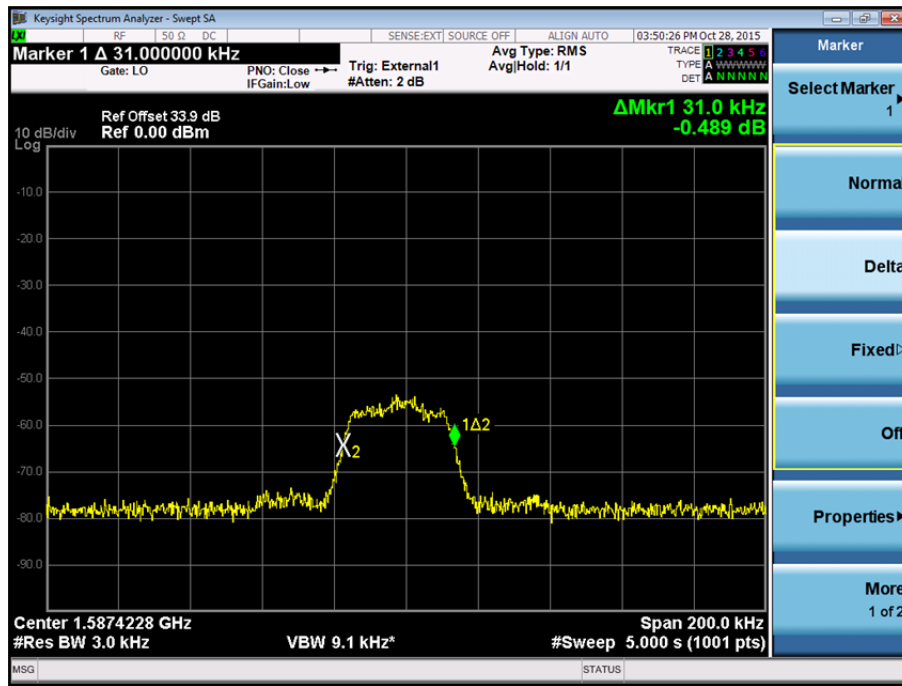


Note: The above plot is provided as evidence to show that the emission(s) observed are broadband in nature, i.e. Not discrete because the bandwidth is greater than 700 Hz.



Product Service

Transmit, 1621.020833 MHz, EIRP Density – Identified Discrete Emission 2, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot

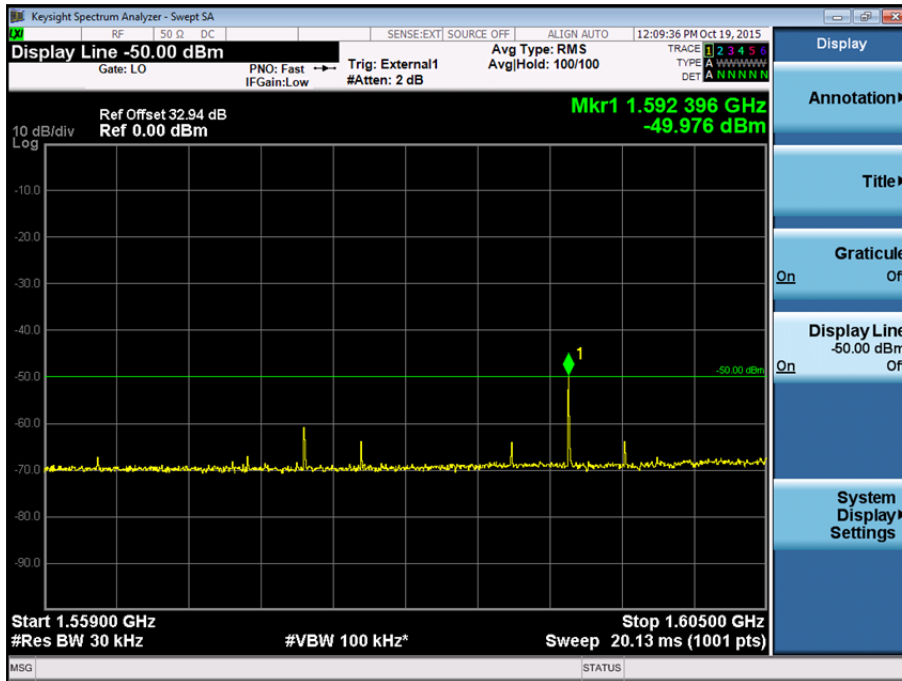


Note: The above plot is provided as evidence to show that the emission(s) observed are broadband in nature, i.e. Not discrete because the bandwidth is greater than 700 Hz.



Product Service

Transmit, 1625.979167 MHz, EIRP Density – Discrete Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



Transmit, 1625.979167 MHz, EIRP Density – Identified Discrete Emission 1, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



Note: The above plot is provided as evidence to show that the emission(s) observed are broadband in nature, i.e. Not discrete because the bandwidth is greater than 700 Hz.



Product Service

Transmit, EIRP Density – Carrier-off State Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service

1621.020833 MHz
dBW/MHz
-

* No emissions within 6 dB of the limit were observed.

Transmit, 1621.020833 MHz, EIRP Density – Carrier-off State Emissions, Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service Plot



FCC 47 CFR Part 25, Limit Clause 25.216

25.216(c) The e.i.r.p. density of emissions from mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1660.5 MHz shall not exceed -70 dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559–1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed -80 dBW, averaged over any 2 millisecond active transmission interval, in the 1559–1605 MHz band.

25.216(g) Mobile earth stations manufactured more than six months after FEDERAL REGISTER publication of the rule changes adopted in FCC 03–283 with assigned uplink frequencies in the 1610–1626.5 MHz band shall suppress the power density of emissions in the 1605–1610 MHz band-segment to an extent determined by linear interpolation from -70 dBW/MHz at 1605 MHz to -10 dBW/MHz at 1610 MHz averaged over any 2 millisecond active transmission interval. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from -80 dBW at 1605 MHz to -20 dBW at 1610 MHz, averaged over any 2 millisecond active transmission interval.

25.216(i) The e.i.r.p. density of carrier-off state emissions from mobile earth stations manufactured more than six months after FEDERAL REGISTER publication of the rule changes adopted in FCC 03–283 with assigned uplink frequencies between 1 and 3 GHz shall not exceed -80 dBW/MHz in the 1559–1610 MHz band averaged over any two millisecond interval.

Industry Canada RSS-170, Limit Clause 5.4.3.2Band 1610 to 1626.5 MHz

- -70 dBW/MHz at 1605 MHz, linearly interpolated to -10 dBW/MHz at 1610 MHz for broadband emissions.
- -80 dBW/MHz at 1605 MHz, linearly interpolated to -20 dBW/MHz at 1610 MHz for discrete emissions.

Band 1626.5 to 1660.5 MHz

- -70 dBW/MHz at 1605 MHz, linearly interpolated to -46 dBW/MHz at 1610 MHz for broadband emissions.
- -80 dBW/MHz at 1605 MHz, linearly interpolated to -56 dBW/MHz at 1610 MHz for discrete emissions.



Product Service

SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.2 - Occupied Bandwidth					
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Power Supply	Hewlett Packard	6104A	1948	-	TU
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016
Section 2.3 - Frequency Tolerance					
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Digital Temperature Indicator	Fluke	51	1385	12	23-Sep-2016
Power Supply	Hewlett Packard	6104A	1948	-	TU
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016
Section 2.4 - Spurious Emissions at Antenna Terminals					
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Power Supply	Hewlett Packard	6104A	1948	-	TU
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016



Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.5 - Radiated Emissions					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	29-Apr-2016
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	22	28-Nov-2015
Antenna (Bilog)	Schaffner	CBL6143	287	24	3-Feb-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Pre-Amplifier	Phase One	PS04-0086	1533	12	30-Jul-2016
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Supply	Hewlett Packard	6104A	1948	-	TU
EMI Test Receiver	Rohde & Schwarz	ESIB26	2028	12	16-Jun-2016
Hygrometer	Rotronic	A1	2138	12	3-Dec-2015
Multimeter	Iso-tech	IDM101	2417	12	29-Sep-2016
Filter (Hi Pass)	Lorch	9HP7-7000-SR	2833	12	5-Feb-2016
Power Supply	Farnell	LT30-2	2903	-	TU
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	11-Aug-2016
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	18-Feb-2016
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-2015
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4412	12	24-Mar-2016
2m K-Type Cable (Rx)	Scott Cables	KPS-1501-2000-KPS	4527	-	TU
0.5m SMA Cable (Rx)	Scott Cables	SLSLL18-SMSM-00.50M	4528	6	19-Feb-2016
Section 2.6 – Conducted Output Power					
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Power Supply	Hewlett Packard	6104A	1948	-	TU
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.7 - Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service					
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Power Supply	Hewlett Packard	6104A	1948	-	TU
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2015
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	16-Sep-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Function Generator	Thurlby Thandar Instruments	TG2000	3334	-	TU
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016

TU – Traceability Unscheduled

O/P MON – Output Monitored with Calibrated Equipment



3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	MU
Occupied Bandwidth	± 16.74 kHz
Modulation Characteristics	-
Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service	± 3.08 dB
Frequency Tolerance	± 3.54 Hz
Spurious Emissions at Antenna Terminals	± 3.08 dB
Conducted Output Power	± 0.70 dB
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 17 GHz: ± 6.3 dB



Product Service

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA
(Not UKAS Accredited).

This report must not be reproduced, except in its entirety, without the written permission of
TÜV SÜD Product Service

© 2015 TÜV SÜD Product Service