FCC and ISEDC Test Report

Iridium Satellite LLC
Transceiver Module, Model: Certus™ 9770

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

Add value.
Inspire trust.

Prepared for: IRIDIUM SATELLITE LLC
1750 Tysons Blvd Suite 1400
McLean
VA 22102
USA

FCC ID: Q639770 IC: 4629A-9770

COMMERCIAL-IN-CONFIDENCE

Document Number: 75946605-04 | Issue: 01

SIGNATURE			
Ryan Henley			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Ryan Henley	Sales Manager – RF and Telecom	Authorised Signatory	04 November 2019

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

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 ISEDC RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Francis Kane	04 November 2019	F Kane.
Testing	Graeme Lawler	04 November 2019	G Lawler.

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation
IC12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 25: 2018, FCC 47 CFR Part 2: 2018, Industry Canada RSS-170: Issue 3 (2015-07) and ISEDC RSS-GEN: Issue 5 A1 (2019-03) for the tests detailed in section 1.3.

DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2019 TÜV SÜD. This report relates only to the actual item/items tested.

ACCREDITATION

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).

TÜV SÜD
is a trading name of TUV SUD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire PO15 5RL
United Kingdom

Contents

1 Report Summary 2

1.1 Report Modification Record 2
1.2 Introduction 2
1.3 Brief Summary of Results 3
1.4 Application Form 5
1.5 Product Information 7
1.6 Deviations from the Standard 7
1.7 EUT Modification Record 7
1.8 Test Location 8

2 Test Details 9

2.1 Modulation Characteristics 9
2.2 Occupied Bandwidth 10
2.3 Frequency Tolerance 16
2.4 Spurious Emissions at Antenna Terminals 18
2.5 Equivalent Isotropic Radiated Power 30
2.6 Radiated Spurious Emissions 33
2.7 Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation Satellite Service 49

3 Photographs 57

3.1 Test Setup Photographs 57

4 Measurement Uncertainty 59

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	04 November 2019

Table 1

1.2 Introduction

Applicant	Iridium Satellite LLC
Manufacturer	Iridium Satellite LLC
Model Number(s)	Certus™ 9770
Serial Number(s)	Y0002N Y0002M
Hardware Version(s)	P3142-009a change note P3142-CN-017 v0.2
Software Version(s)	PPDO v0.2.1
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 25: 2018 FCC 47 CFR Part 2: 2018 Industry Canada RSS-170: Issue 3 (2015-07) ISEDC RSS-GEN: Issue 5 A1 (2019-03)
Order Number Date	59151 19-July-2019
Date of Receipt of EUT	19-August-2019 and 06-September-2019
Start of Test	22-August-2019
Finish of Test	08-September-2019
Name of Engineer(s)	Francis Kane and Graeme Lawler
Related Document(s)	ANSI C63.26 (2015)

1.3 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 ISEDC RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Part 25	Part 2	RSS-170	RSS-GEN			
Configuration and Mode: Iridium Transceiver - C1 modulation signal							
2.2	-	2.1049	-	6.7	Occupied Bandwidth	Pass	
2.3	25.202(d)	2.1055	5.2	6.11	Frequency Tolerance	Pass	
2.4	25.202(f)	2.1051	5.4.3.1	6.13	Spurious Emissions at Antenna Terminals	Pass	Tested within 250% of authorised BW only.
2.5	25.204	2.1046	5.3	6.12	Equivalent Isotropic Radiated Power	Pass	
Configuration and Mode: Iridium Transceiver - C2 modulation signal							
2.2	-	2.1049	-	6.7	Occupied Bandwidth	Pass	
2.4	25.202(f)	2.1051	5.4.3.1	6.13	Spurious Emissions at Antenna Terminals	Pass	Tested within 250% of authorised BW only.
2.5	25.204	2.1046	5.3	6.12	Equivalent Isotropic Radiated Power	Pass	
Configuration and Mode: Iridium Transceiver - C8 modulation signal							
2.2	-	2.1049	-	6.7	Occupied Bandwidth	Pass	
2.4	25.202(f)	2.1051	5.4.3.1	6.13	Spurious Emissions at Antenna Terminals	Pass	
2.6	25.202(f)	2.1051	5.4.3.1	6.13	Radiated Spurious Emissions	Pass	

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Part 25	Part 2	RSS-170	RSS-GEN			
2.5	25.204	2.1046	5.3	6.12	Equivalent Isotropic Radiated Power	Pass	
Configuration and Mode: Iridium Transceiver							
2.1	-	2.1047 (d)	-	-	Modulation Characteristics	Declaration	
2.7	25.216	-	5.4.3	-	Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation Satellite Service	Pass	

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	Transceiver module for connection to the Iridium satellite network
Manufacturer:	Iridium satellite LLC
Model:	CertusTM 9770
Part Number:	IRID0058PA3
Hardware Version:	P3142-009a change note P3142-CN-017 v0.2
Software Version:	PPDO v0.2.1
FCC ID (if applicable)	Q639770
IC ID (if applicable)	4629A-9770

Intentional Radiators

Technology	Iridium		
Frequency Band (MHz)	1616-1626.5		
Conducted Declared Output Power (dBm)	40		
Antenna Gain (dBi)	3		
Supported Bandwidth(s) (MHz)	36k,72k,288k		
Modulation Scheme(s)	QPSK		
ITU Emission Designator	41K7Q7W, 83K4Q7, 333K3Q7W		
Bottom Frequency (MHz)	C1: 1616.020833	C2: 1616.041667	C8: 1616.500000
Middle Frequency (MHz)	C1: 1621.020833	C2: 1621.041667	C8: 1621.166700
Top Frequency (MHz)	C1: 1625.979167	C2: 1625.958334	C8: 1625.833300

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	3.2 GHz
Lowest frequency generated or used in the device or on which the device operates or tunes	19.2 MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

AC Power Source

AC supply frequency: Click to edit (Hz)	
Click to edit V	Max current: Click to edit A
Single Phase ☐ Three Phase ☐	

DC Power Source

Nominal voltage: 12 V
Extreme upper voltage: 14.5 V
Extreme lower voltage: 9.5 V
Max current: 1.6. A

Battery Power Source

Voltage: Click to edit V
End-point voltage: Click or tap here to enter text V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*
Other ☐ Please detail: Click to edit

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☐

Temperature

Minimum temperature: -40 °C	Maximum temperature: +70 °C

Antenna Characteristics

Antenna connector ☒ State impedance 50 Ohm
Temporary antenna connector ☐ State impedance Click to edit Ohm
Integral antenna ☐ Type Click to edit State impedance Click to edit dBi
External antenna ☐ Type Click to edit State impedance Click to edit dBi

Ancillaries (if applicable)

Manufacturer: Click to edit	Part Number: Click to edit
Model: Click to edit	Country of Origin: Click to edit

I hereby declare that the information supplied is correct and complete.

Name: Les Nuttall
Position held: Snr Consultant
Date: 15/8/2019

1.5 Product Information

1.5.1 Technical Description

Transceiver module for connection to the Iridium satellite network.

1.6 Deviations from the Standard

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

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: Certus™ 9770: Serial Number: Y0002N			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: Certus™ 9770: Serial Number: Y0002M			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Iridium Transceiver - C1 modulation signal		
Occupied Bandwidth	Francis Kane	UKAS
Frequency Tolerance	Francis Kane	UKAS
Spurious Emissions at Antenna Terminals	Francis Kane	UKAS
Equivalent Isotropic Radiated Power	Francis Kane	UKAS
Configuration and Mode: Iridium Transceiver - C2 modulation signal		
Occupied Bandwidth	Francis Kane	UKAS
Spurious Emissions at Antenna Terminals	Francis Kane	UKAS
Equivalent Isotropic Radiated Power	Francis Kane	UKAS
Configuration and Mode: Iridium Transceiver - C8 modulation signal		
Occupied Bandwidth	Francis Kane	UKAS
Spurious Emissions at Antenna Terminals	Francis Kane	UKAS
Radiated Spurious Emissions	Graeme Lawler	UKAS
Equivalent Isotropic Radiated Power	Francis Kane	UKAS
Configuration and Mode: Iridium Transceiver		
Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation Satellite Service	Francis Kane	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Modulation Characteristics

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047 (d)

2.1.2 Equipment Under Test

Certus™ 9770

2.1.3 Test Results

Iridium Transceiver

The following description was provided by the manufacturer:

When operating its radio, multiple channel modulation schemes are used with selectable bandwidths.

Most of these channels use quaternary phase shift keyed (QPSK) modulation with 20 % (40 % for 25 kbps channels) square-root raised cosine pulse shaping, and a symbol transmission rate selected from 25 kbps, 30 kbps, 60 kbps, 120 kbps, or 240 kbps, depending on the channel operating bandwidth. The highest symbol rate traffic channel also uses a QPSK modulation scheme with 20 % square-root raised cosine pulse shaping, at a symbol transmission rate of 240 kbps.

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.

2.2 Occupied Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049
ISEDC RSS-GEN, Clause 6.7

2.2.2 Equipment Under Test and Modification State

Certus™ 9770, S/N: Y0002N - Modification State 0

2.2.3 Date of Test

22-August-2019

2.2.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.4.4.

2.2.5 Environmental Conditions

Ambient Temperature	22.8 - 23.1 °C
Relative Humidity	54.0 - 54.3 %

2.2.6 Test Results

Iridium Transceiver - C1 modulation signal

1616.020833 MHz	1625.979167 MHz
Occupied Bandwidth (kHz)	Occupied Bandwidth (kHz)
32.692	32.692

Table 5 - Occupied Bandwidth Results

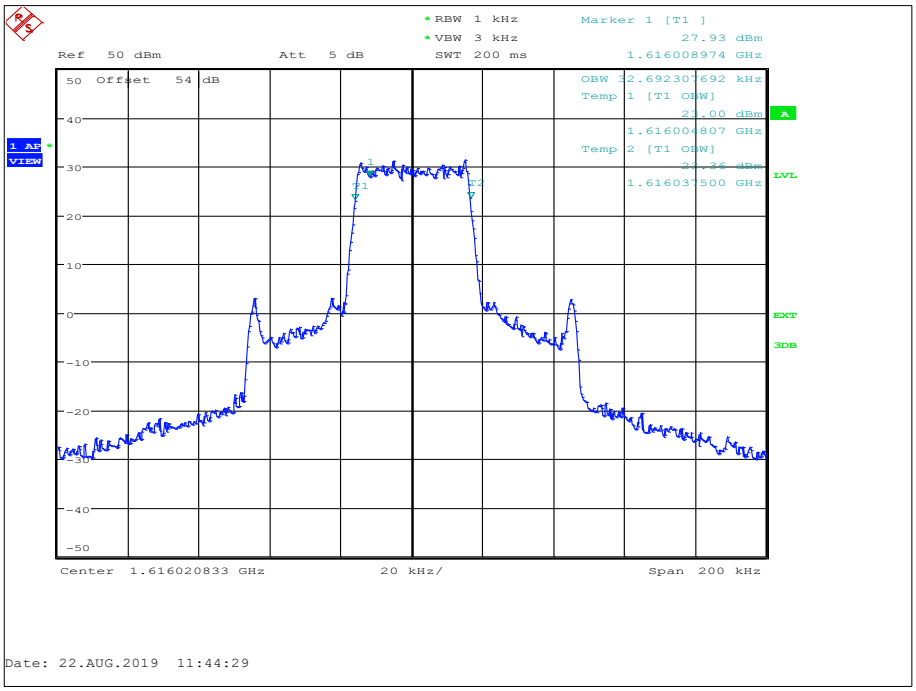

Figure 1 - 1616.020833 MHz

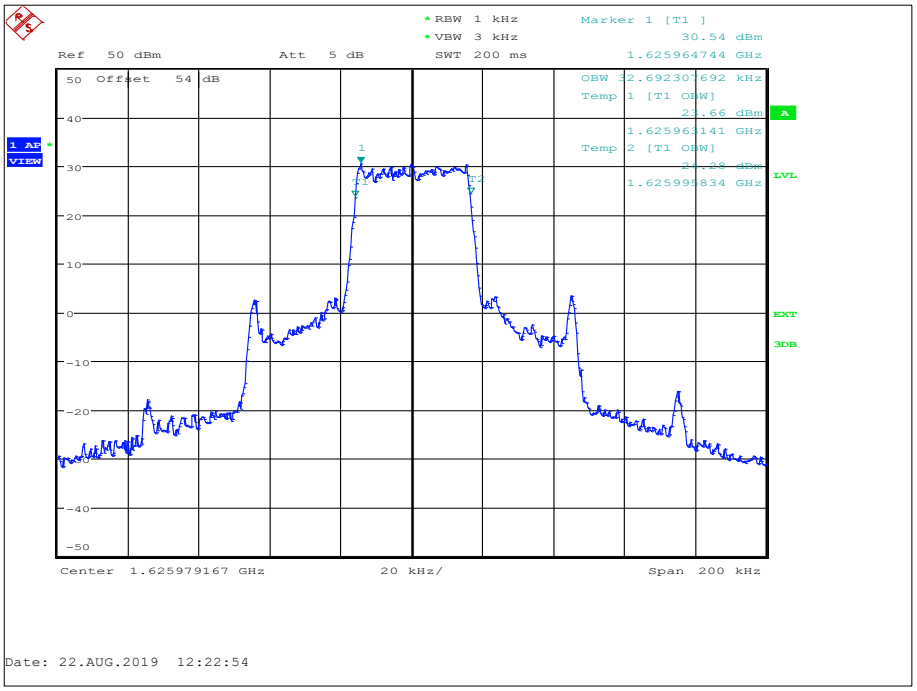

Figure 2 - 1625.979167 MHz

Iridium Transceiver - C2 modulation signal

1616.041667 MHz	1625.958334 MHz
Occupied Bandwidth (kHz)	Occupied Bandwidth (kHz)
65.705	65.064

Table 6 - Occupied Bandwidth Results

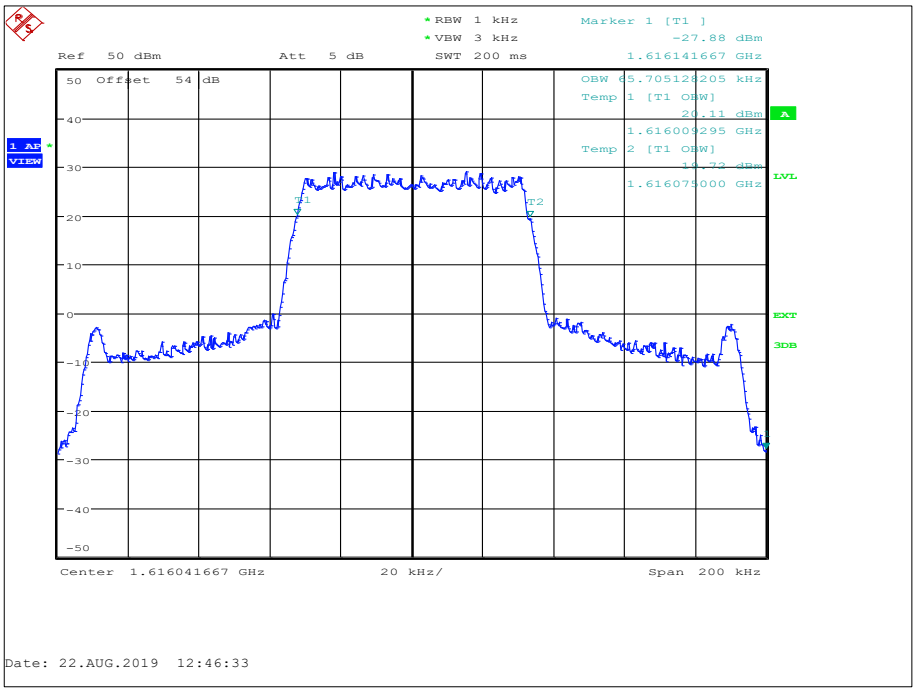

Figure 3 - 1616.041667 MHz

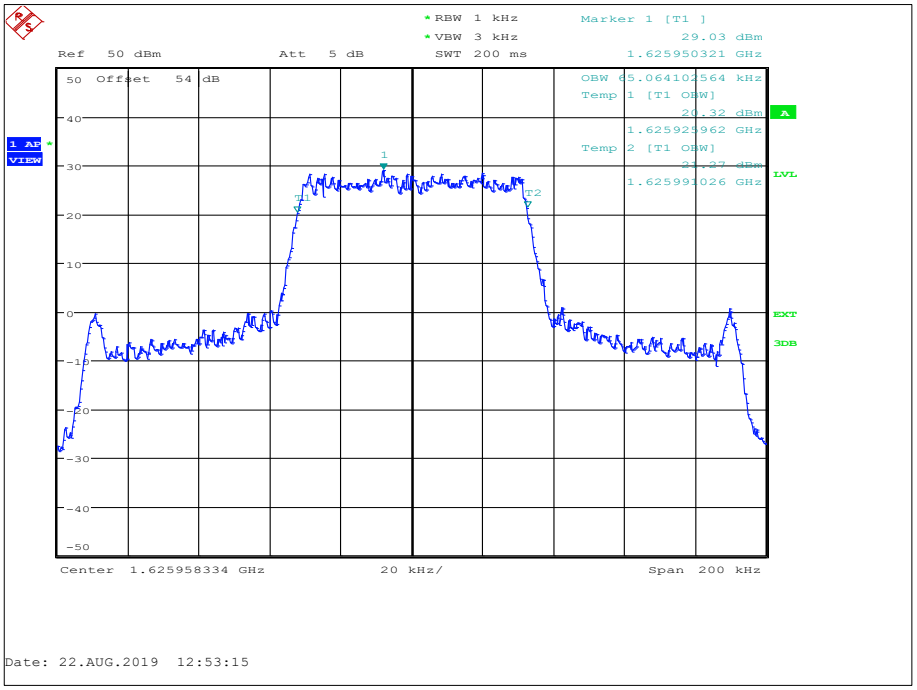

Figure 4 - 1625.958334 MHz

Iridium Transceiver - C8 modulation signal

1616.5000 MHz	1625.8333 MHz
Occupied Bandwidth (kHz)	Occupied Bandwidth (kHz)
259.615	260.417

Table 7 - Occupied Bandwidth Results

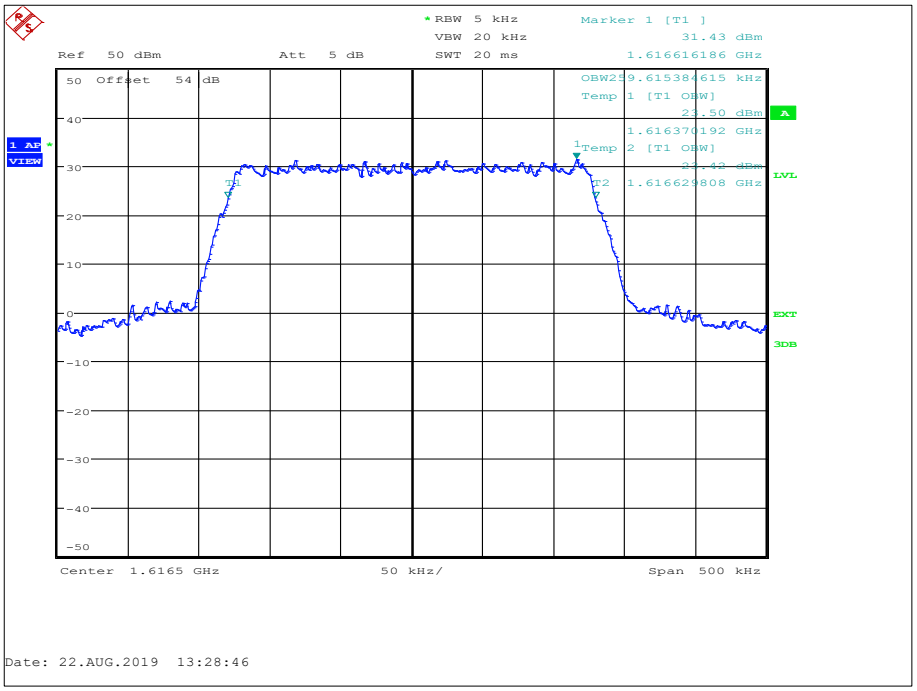

Figure 5 - 1616.5000 MHz

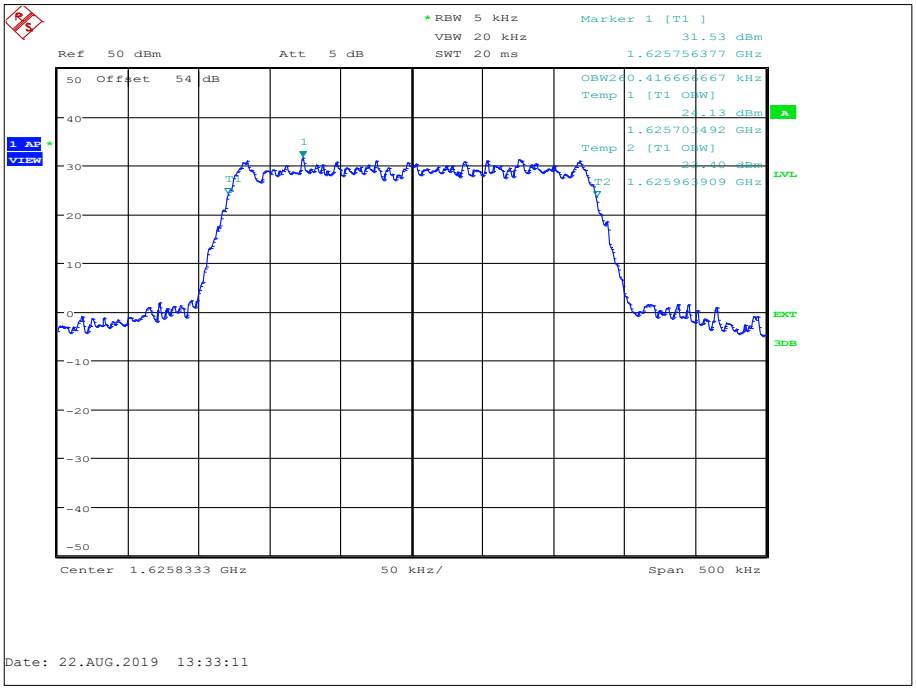

Figure 6 - 1625.8333 MHz

FCC 47 CFR Part 2, Limit Clause

None specified.

ISEDC RSS-GEN, Limit Clause

None specified.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	18-Mar-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Programmable Power Supply	Rohde & Schwarz	HMP2020	S/N: 101883-LF	-	O/P Mon

Table 8

O/P Mon – Output Monitored Using Calibrated Equipment

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

Certus™ 9770, S/N: Y0002N - Modification State 0

2.3.3 Date of Test

23-August-2019

2.3.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.6.

The measurement was made with the carrier modulated using a spectrum analyser. The mid-point frequency was determined from the upper and lower -10 dBc points.

2.3.5 Environmental Conditions

Ambient Temperature 24.3 °C
Relative Humidity 53.3 %

2.3.6 Test Results

Iridium Transceiver - C1 modulation signal

Temperature	1621.020833 MHz					
	9.5 V DC		12 V DC		14.5 V DC	
	Frequency Error (%)	Frequency Error (ppm)	Frequency Error (%)	Frequency Error (ppm)	Frequency Error (%)	Frequency Error (ppm)
-30.0°C	0.0000143	0.14312	0.0000183	0.18260	0.0000242	0.24244
-20.0°C	0.0000415	0.41517	0.0000420	0.42010	0.0000386	0.38555
-10.0°C	0.0000203	0.20296	0.0000188	0.18754	0.0000178	0.17767
0°C	0.0000015	0.01480	0.0000020	0.01974	0.0000025	0.02468
+10.0°C	0.0000015	0.11480	0.0000010	0.00987	0.0000010	0.00987
+20.0°C	0.0000035	0.03455	0.0000039	0.03948	0.0000025	0.02468
+30.0°C	0.0000444	0.44354	0.0000208	0.20789	0.0000188	0.18754
+40.0°C	0.0000803	0.80258	0.0000800	0.80011	0.0000805	0.80504
+50.0°C	0.0000366	0.36581	0.0000371	0.37075	0.0000361	0.36088

Table 9

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

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.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Programmable Power Supply	Rohde & Schwarz	HMP2020	S/N: 101883 -LF	-	O/P Mon

Table 10

O/P Mon – Output Monitored Using Calibrated Equipment

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
ISEDC RSS-GEN, Clause 6.13

2.4.2 Equipment Under Test and Modification State

Certus™ 9770, S/N: Y0002N - Modification State 0

2.4.3 Date of Test

04-September-2019

2.4.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.7.

Where a RBW > 4 kHz was used, this was considered worst case.

2.4.5 Environmental Conditions

Ambient Temperature	22.1 - 22.3 °C
Relative Humidity	42.3 - 44.6 %

2.4.6 Test Results

<u>Iridium Transceiver - C1</u>

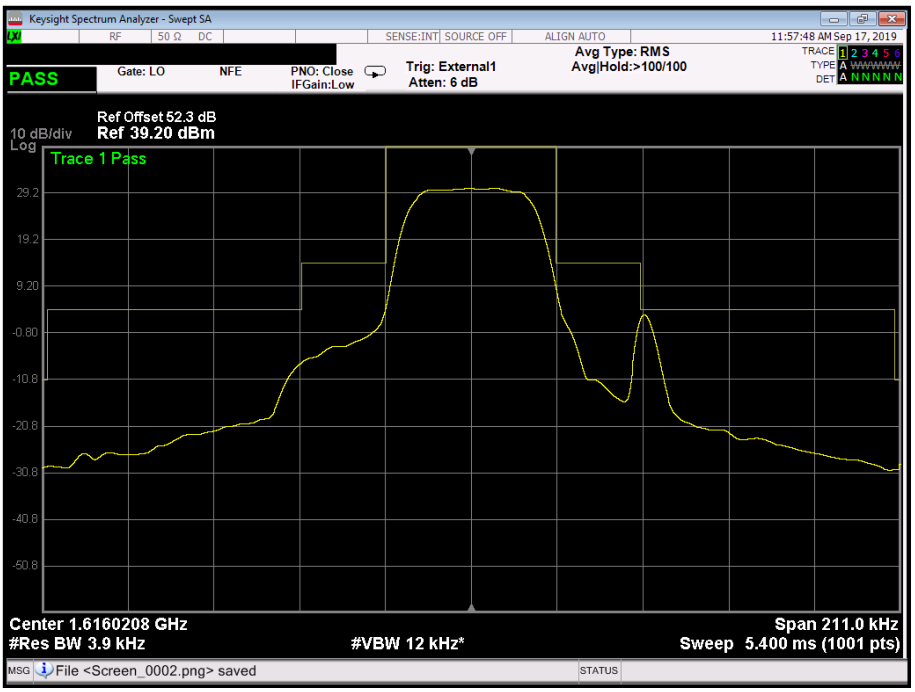

Figure 7 - 1616.020833 MHz - Emission Mask

Figure 8 - 1625.979167 MHz - Emission Mask

Iridium Transceiver - C2

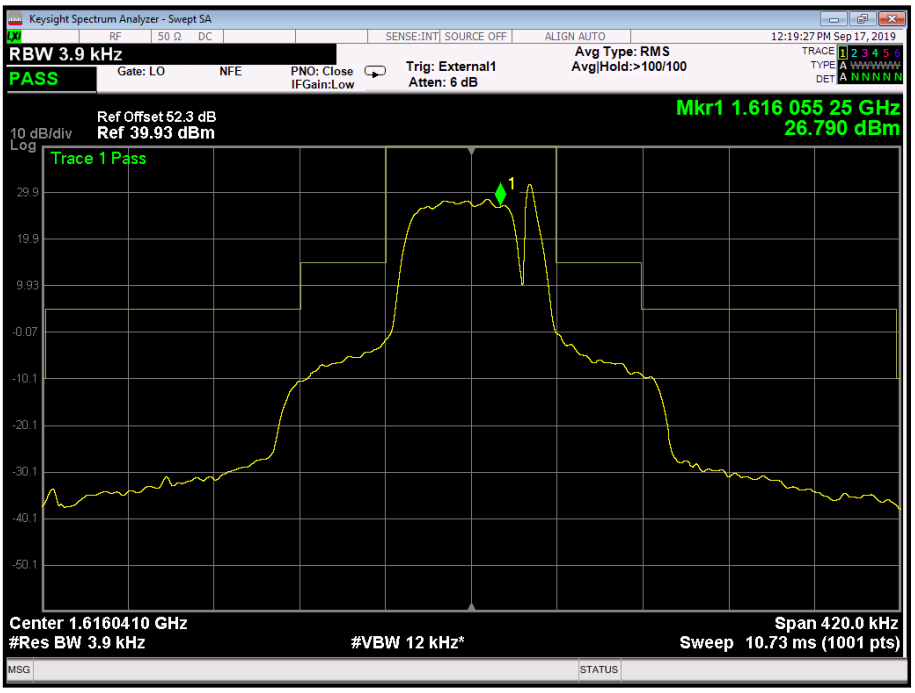

Figure 9 - 1616.041667 MHz - Emission Mask

Figure 10 - 1625.958334 MHz - Emission Mask

Iridium Transceiver - C8

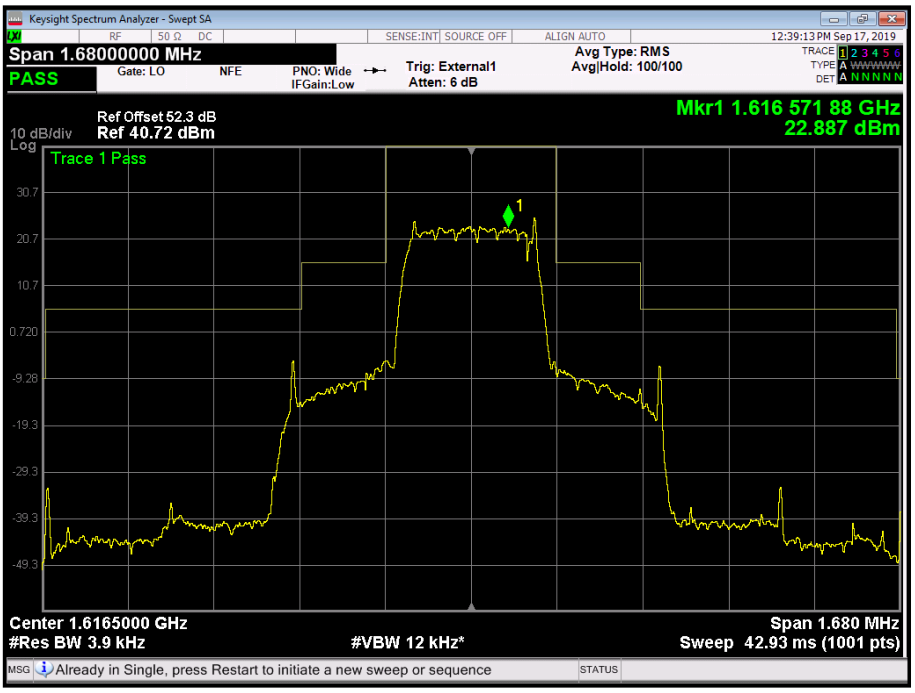

Figure 11 - 1616.5 MHz - Emission Mask

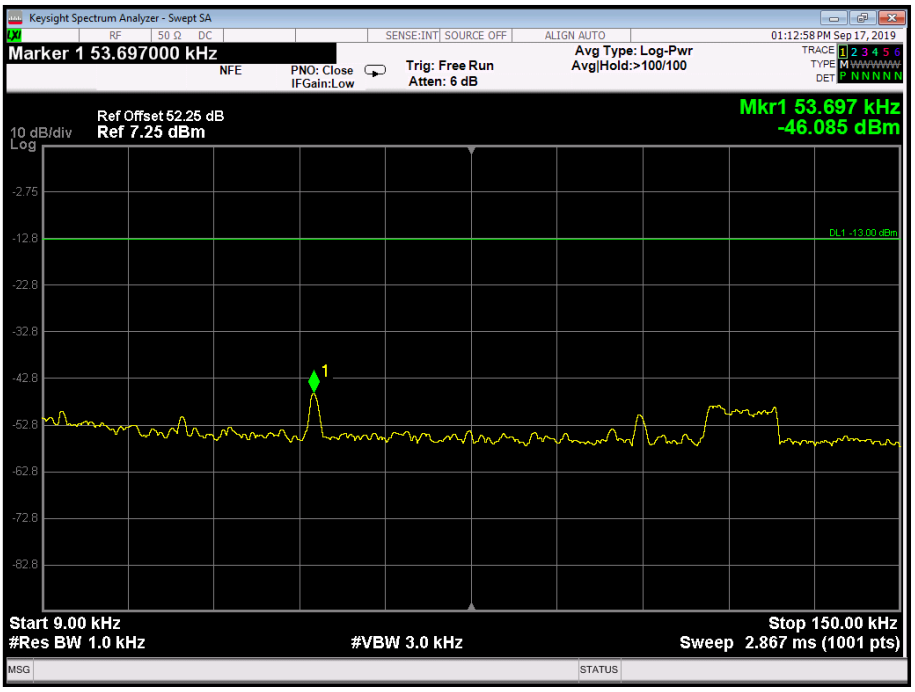

Figure 12 - 1616.5 MHz - 9 kHz to 150 kHz

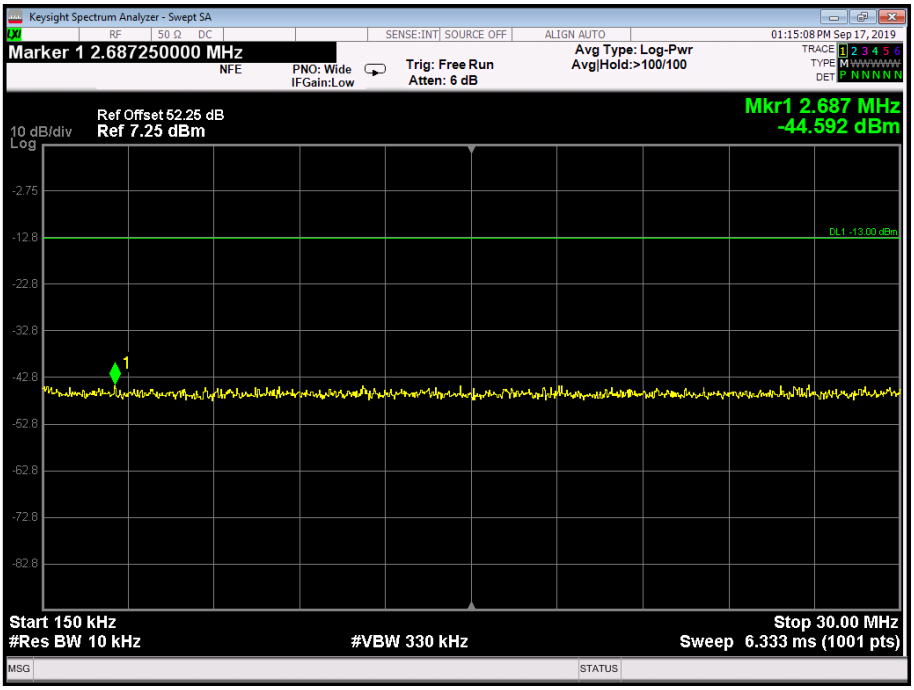

Figure 13 - 1616.5 MHz - 150 kHz to 30 MHz

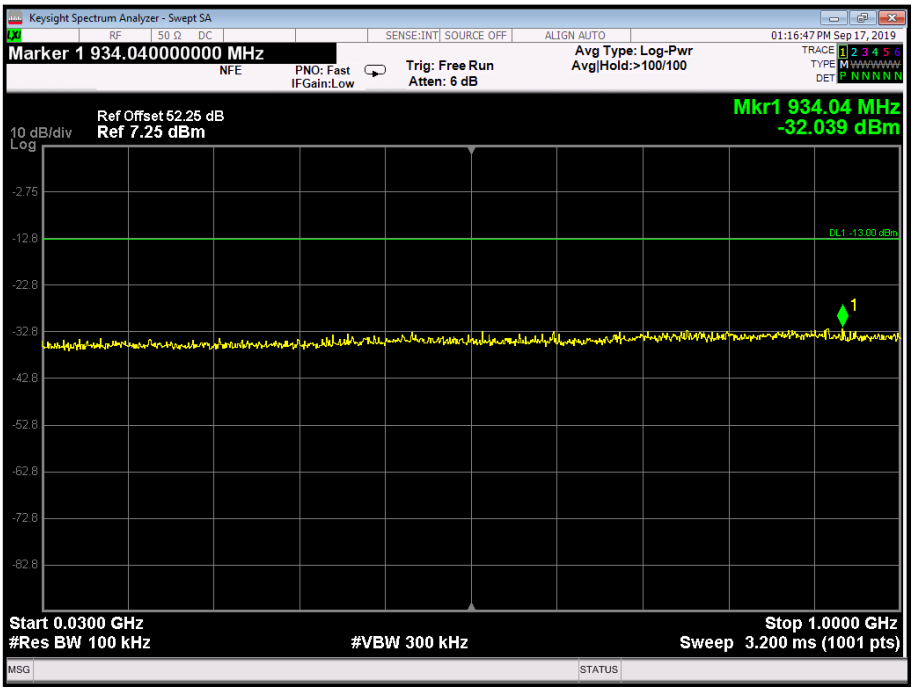

Figure 14 - 1616.5 MHz - 30 MHz to 1 GHz

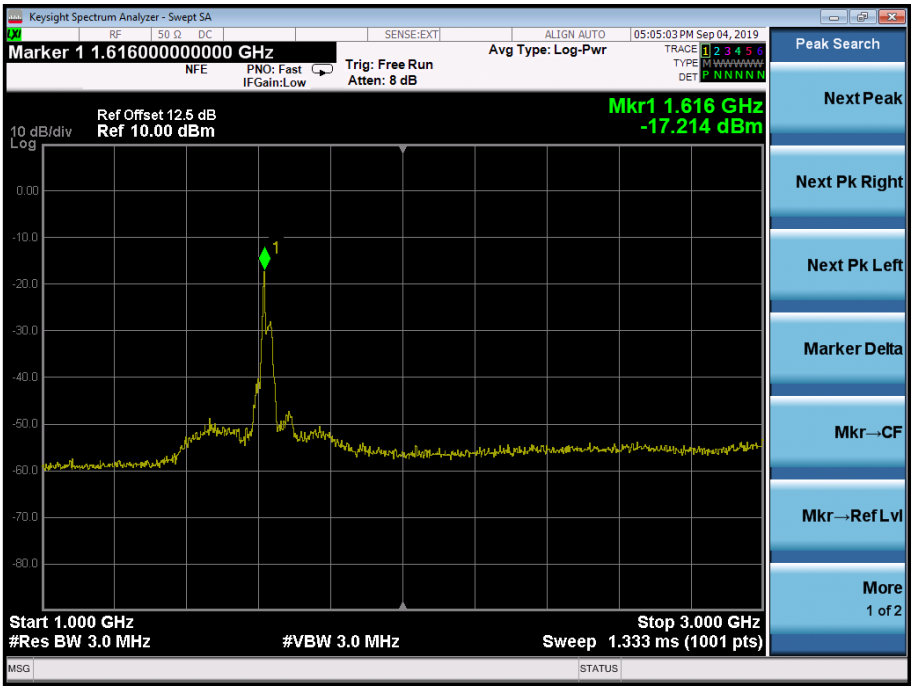

Figure 15 - 1616.5 MHz - 1 GHz to 3 GHz

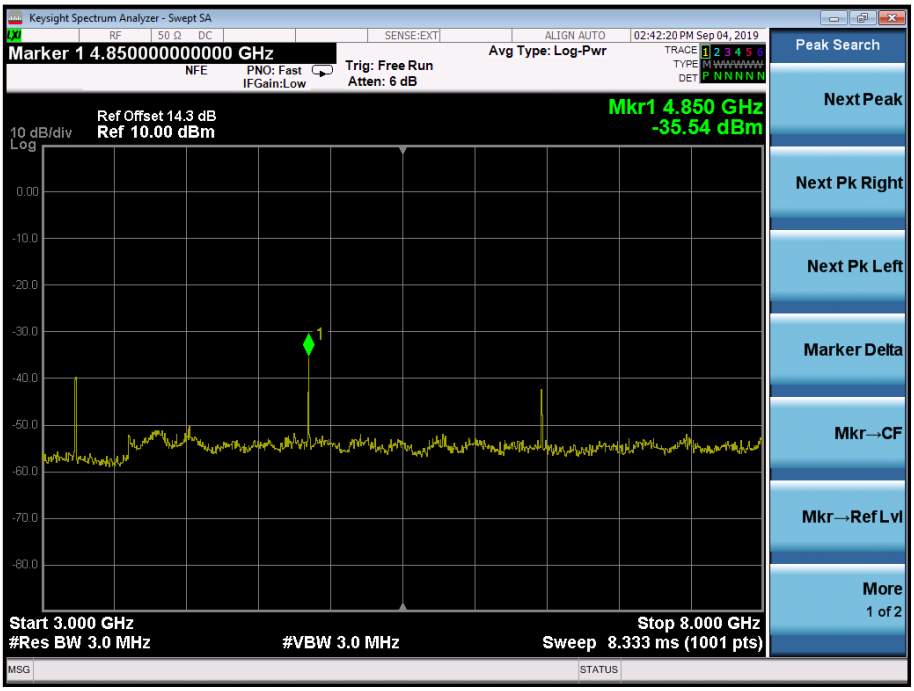

Figure 16 - 1616.5 MHz - 3 GHz to 8 GHz

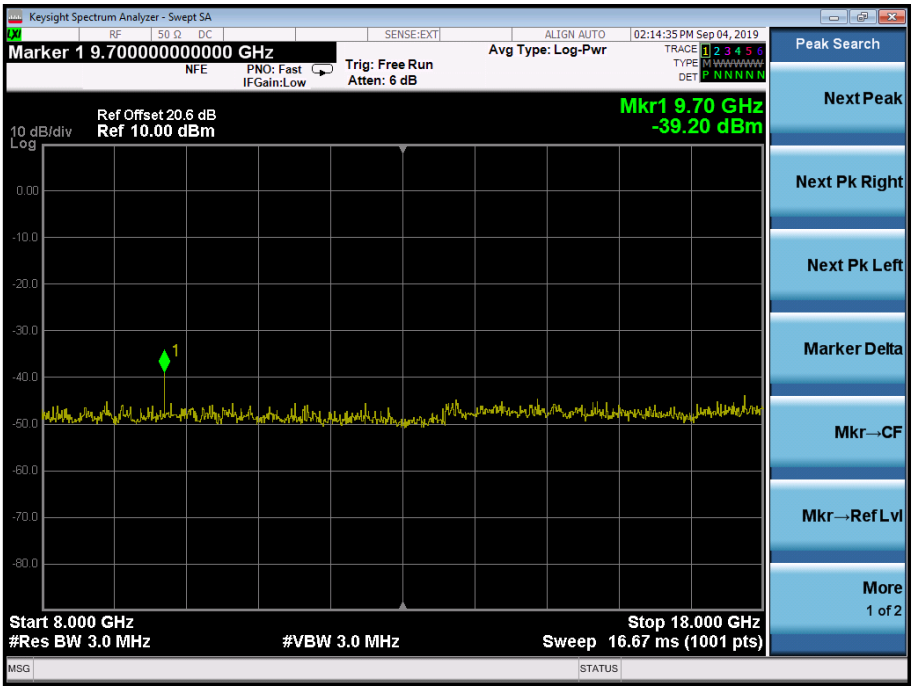

Figure 17 - 1616.5 MHz - 8 GHz to 18 GHz

Figure 18 - 1625.8333 MHz - Emission Mask

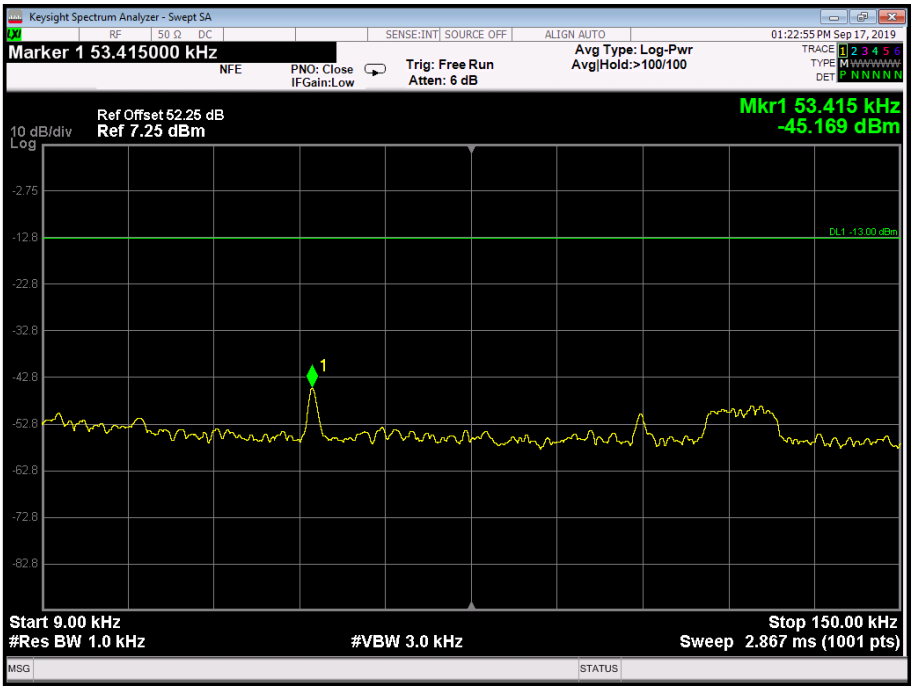

Figure 19 - 1625.8333 MHz - 9 kHz to 150 kHz

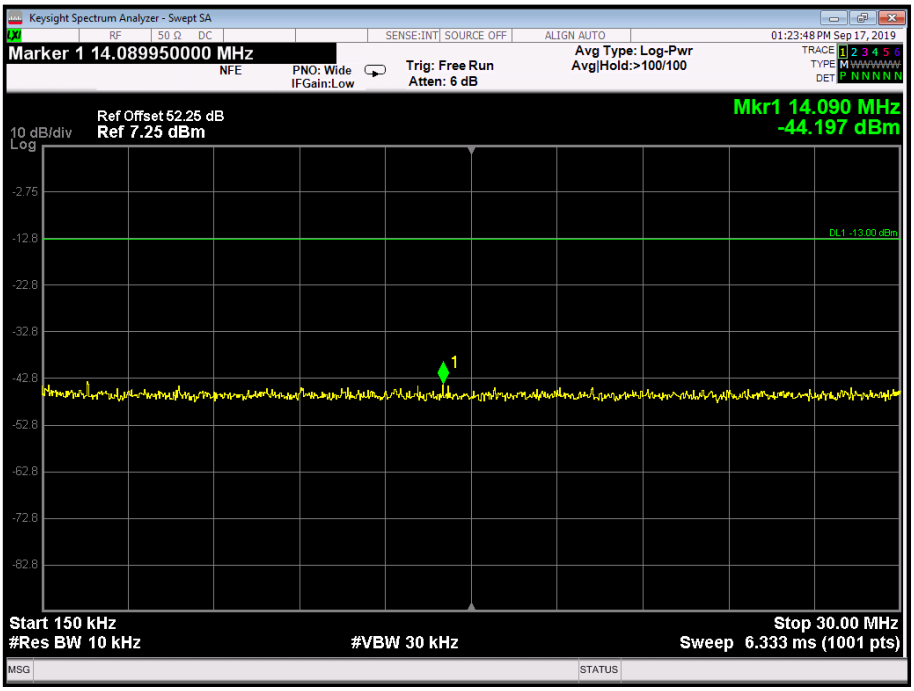

Figure 20 - 1625.8333 MHz - 150 kHz to 30 MHz

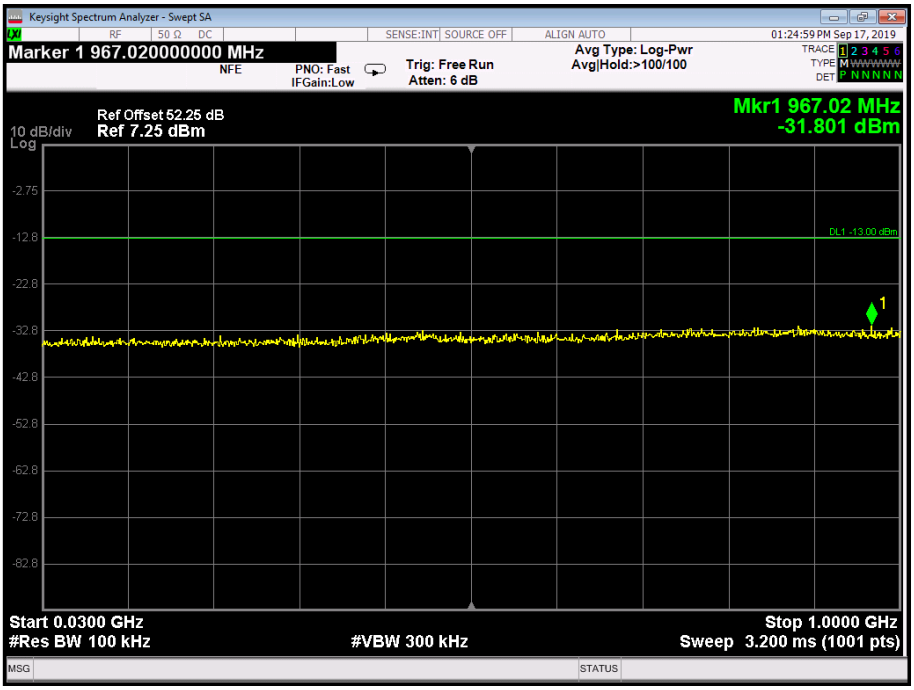

Figure 21 - 1625.8333 MHz - 30 MHz to 1 GHz

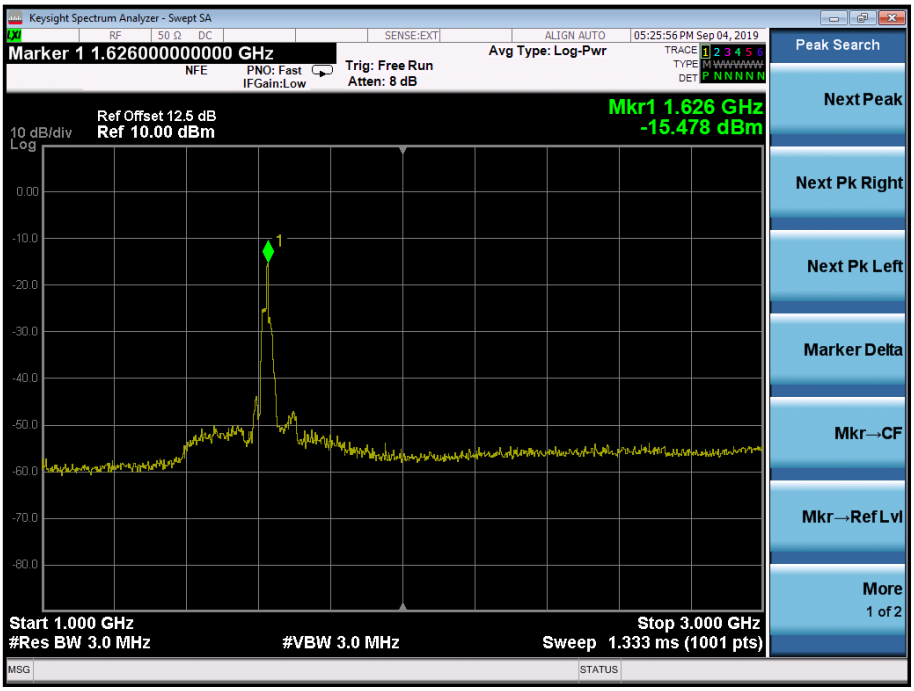

Figure 22 - 1625.8333 MHz - 1 GHz to 3 GHz

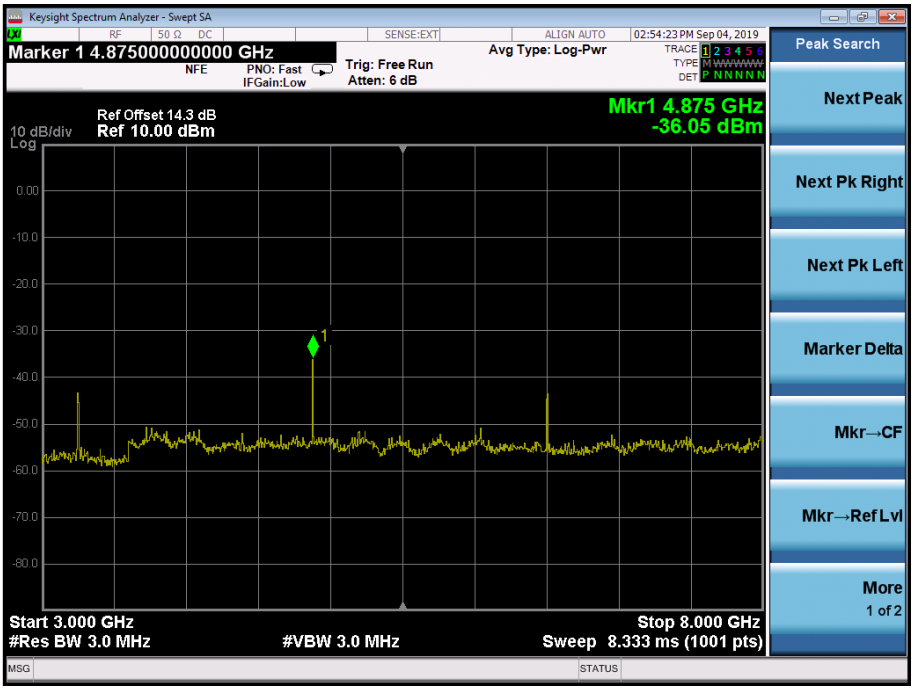

Figure 23 - 1625.8333 MHz - 3 GHz to 8 GHz

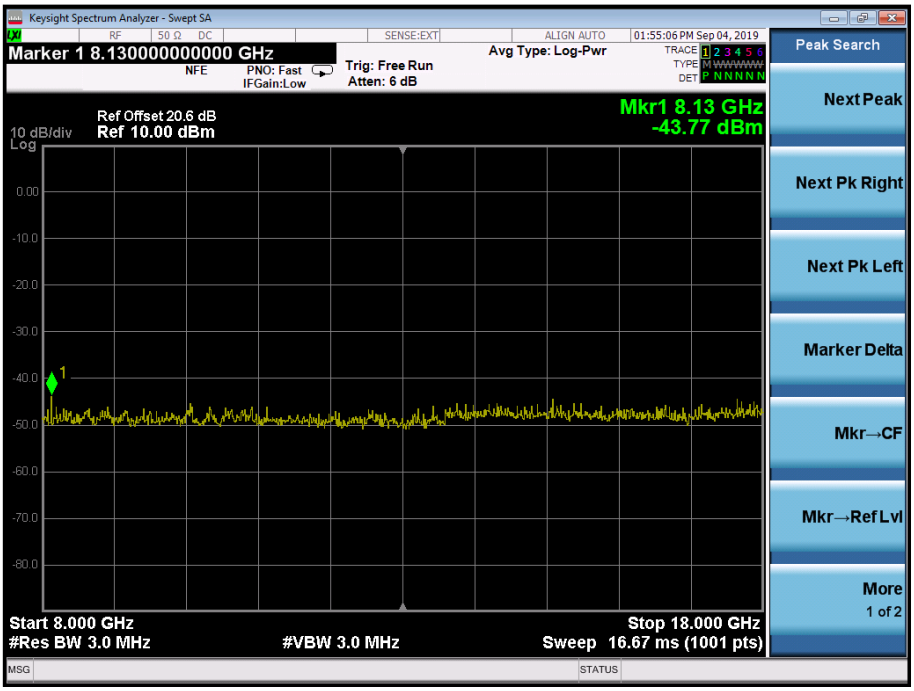

Figure 24 - 1625.8333 MHz - 8 GHz to 18 GHz

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.

2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Fluke	79 Series III	611	12	11-Sep-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Hygrometer	Rotronic	A1	1388	12	26-Jun-2020
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Kit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	08-Oct-2019
3 GHz High Pass Filter	Wainwright	WH KX12-2580-3000-18000-80SS	5220	12	15-Feb-2020
Programmable Power Supply	Rohde & Schwarz	HMP2020	S/N: 101883 -LF	-	O/P Mon

Table 11

O/P Mon – Output Monitored Using Calibrated Equipment

2.5 Equivalent Isotropic Radiated Power

2.5.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.204
FCC 47 CFR Part 2, Clause 2.1046
Industry Canada RSS-170, Clause 5.3
ISEDC RSS-GEN, Clause 6.12

2.5.2 Equipment Under Test and Modification State

Certus™ 9770, S/N: Y0002N - Modification State 0

2.5.3 Date of Test

22-August-2019

2.5.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.2.

The RBW was configured to 3 kHz and the reference level offset increased to account for the correction factor required to show the result as 4 kHz bandwidth. The correction factor was obtained using the following formula:

10Log(4/3) = 1.25 dB

The antenna gain was also included in the reference level offset.

2.5.5 Environmental Conditions

Ambient Temperature	23.7 °C
Relative Humidity	53.2 - 53.6 %

2.5.6 Test Results

Iridium Transceiver - C1 modulation signal

EIRP (dBm/4kHz)	
1616.020833 MHz	1625.979167 MHz
28.92	28.85

Table 12 - EIRP/4 kHz Results Table

1616.020833 MHz		1625.979167 MHz	
EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)
28.92	-11.08	28.85	-11.15

Table 13 - EIRP Results Table

Iridium Transceiver - C2 modulation signal

EIRP (dBm/4kHz)	
1616.041667 MHz	1625.958334 MHz
27.86	27.68

Table 14 - EIRP/4 kHz Results Table

1616.041667 MHz		1625.958334 MHz	
EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)
27.86	-12.14	27.68	-12.32

Table 15 - EIRP Results Table

Iridium Transceiver - C8 modulation signal

EIRP (dBm/4kHz)	
1616.5000 MHz	1625.8333 MHz
23.56	23.58

Table 16 - EIRP/4 kHz Results Table

1616.5000 MHz		1625.8333 MHz	
EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)
23.56	-16.44	23.58	-16.42

Table 17 - EIRP Results Table

FCC 47 CFR Part 25, Limit Clause 25.204

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

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.

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Programmable Power Supply	Rohde & Schwarz	HMP2020	S/N: 101883 -LF	-	O/P Mon

Table 18

O/P Mon – Output Monitored Using Calibrated Equipment

2.6 Radiated Spurious Emissions

2.6.1 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
ISEDC RSS-GEN, Clause 6.13

2.6.2 Equipment Under Test and Modification State

Certus™ 9770, S/N: Y0002M - Modification State 0

2.6.3 Date of Test

08-September-2019

2.6.4 Test Method

Testing was performed in accordance with ANSI C63.26, clause 5.5.

Prescans were performed using the Direct Field Strength method. Any emissions found to be within 10dB of the specification limit were formally measured using the Direct Field Strength method. The rule part limit of -13dBm was converted to a field strength limit using equation c) in ANSI C63.26, clause 5.2.7.

E (dBuV/m) = EIRP (dBm) - 20log(D) + 104.8 where D is the measurement distance.
For a measurement disatnce of 3 m:
E (dBuV/m) = -13 - 20log(3) + 104.8 = 82.2dBuV/m.

This limit line is found on the prescan plots.

The resolution bandwidth has been increased from the specified bandwidth of 4kHz to 1MHz to reduce the sweep times during prescans.

2.6.5 Environmental Conditions

Ambient Temperature	17.5 °C
Relative Humidity	55.0 - 55.5 %

2.6.6 Test Results

Iridium Transceiver - C8 modulation signal

Frequency (MHz)	Level (dBm)
*	

Table 19 - 1616.5000 MHz, 30 MHz to 1 GHz, Results Table

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

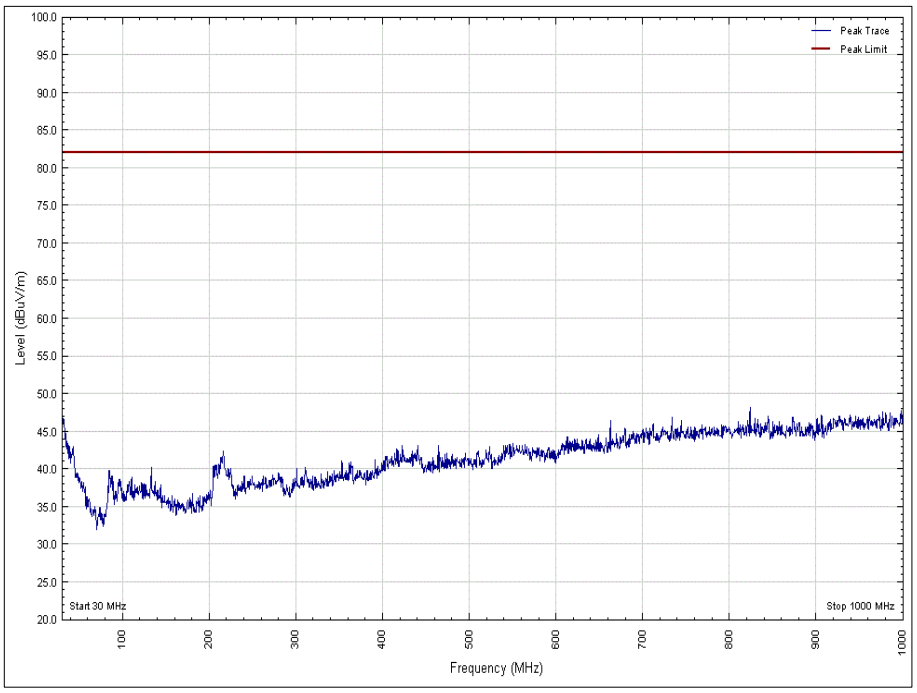

Figure 25 - 1616.5000 MHz, 30 MHz to 1 GHz
Polarisation: Vertical, EUT Orientation: X

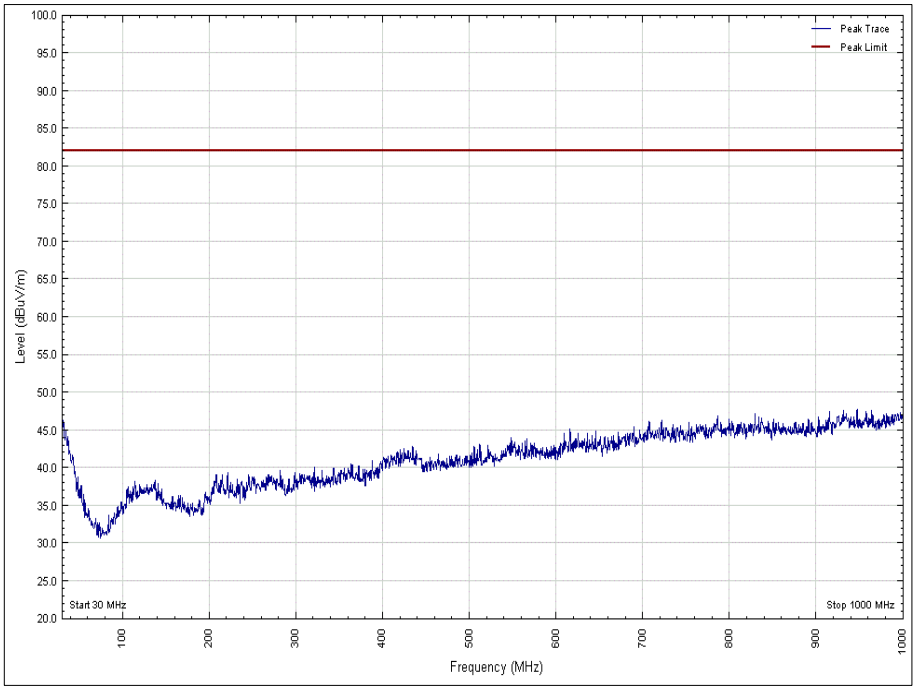

Figure 26 - 1616.5000 MHz, 30 MHz to 1 GHz
Polarisation: Horizontal, EUT Orientation: X

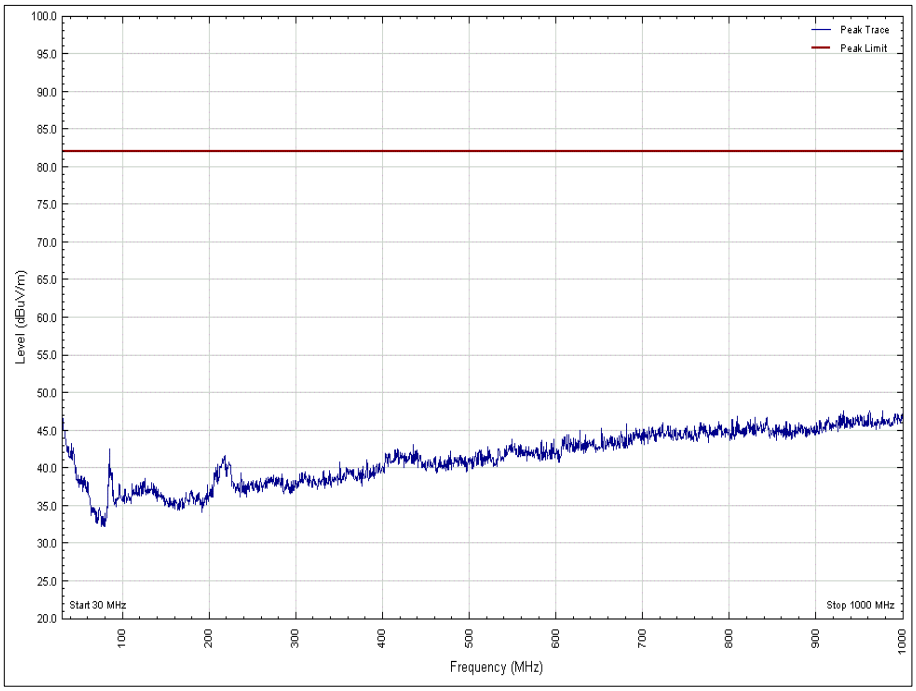

Figure 27 - 1616.5000 MHz, 30 MHz to 1 GHz
Polarisation: Vertical, EUT Orientation: Y

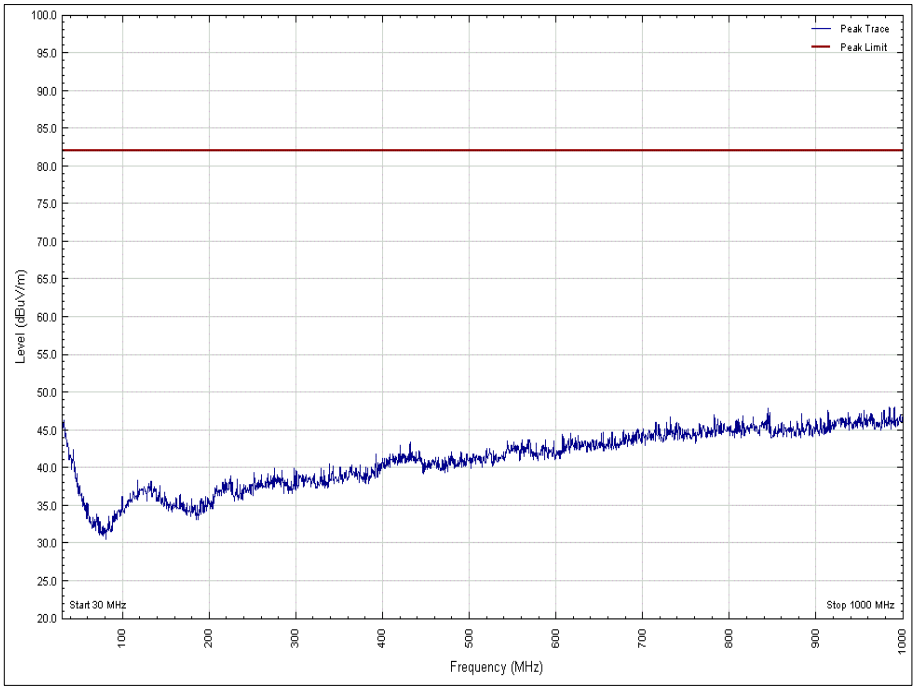

Figure 28 - 1616.5000 MHz, 30 MHz to 1 GHz
Polarisation: Horizontal, EUT Orientation: Y

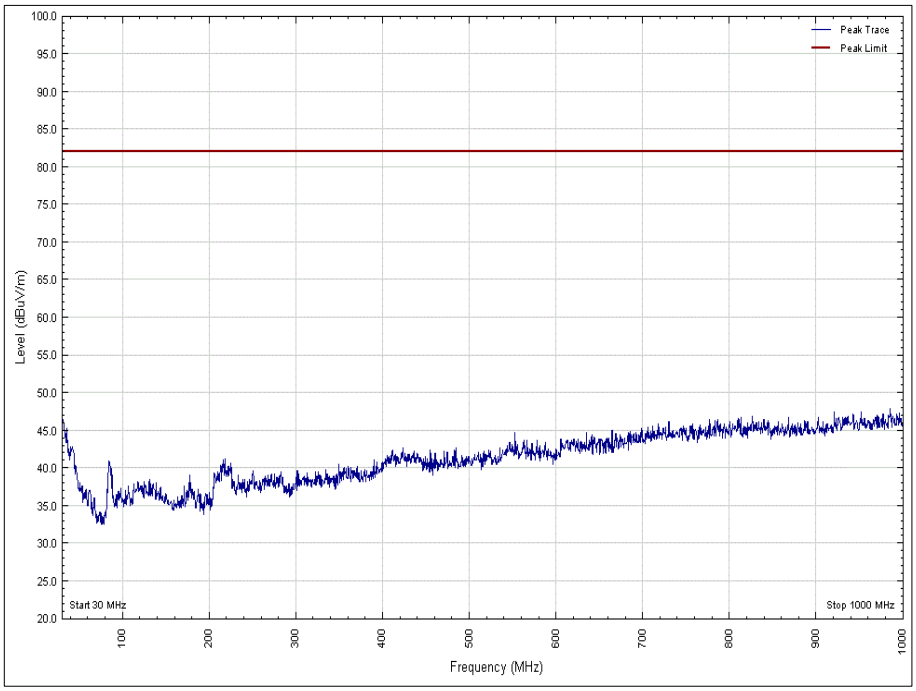

Figure 29 - 1616.5000 MHz, 30 MHz to 1 GHz
Polarisation: Vertical, EUT Orientation: Z

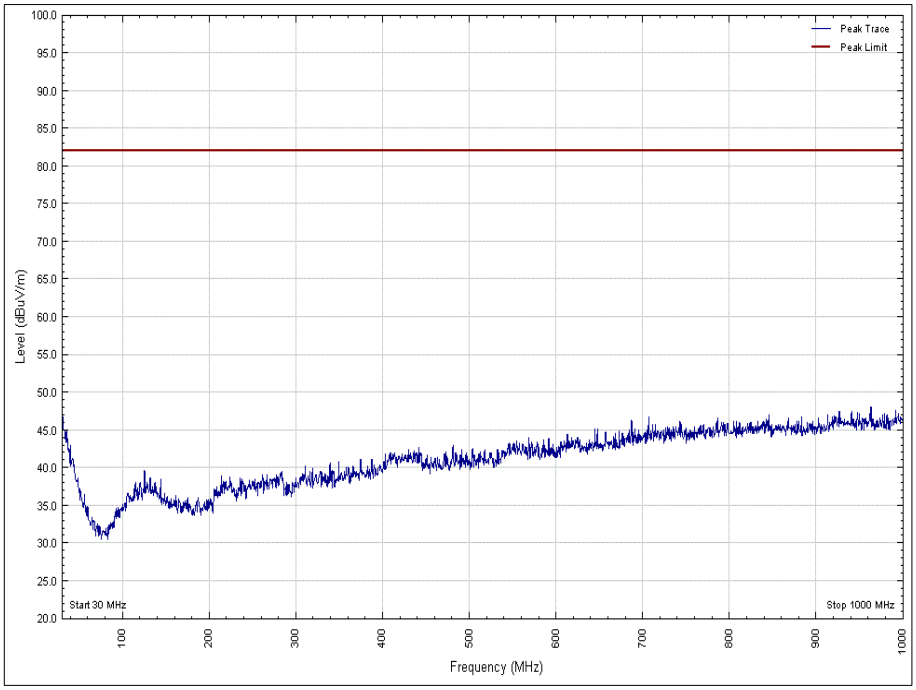

Figure 30 - 1616.5000 MHz , 30 MHz to 1 GHz
Polarisation: Horizontal, EUT Orientation: Z

Frequency (MHz)	Level (dBm)
*	

Table 20 - 1616.5000 MHz, 1 GHz to 18 GHz - Results Table

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

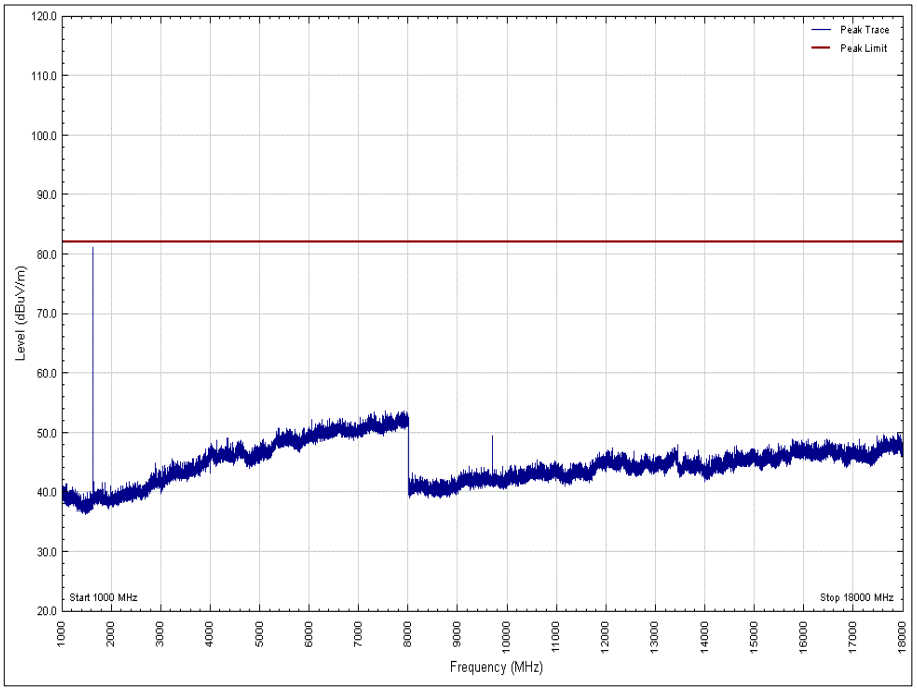

Figure 31 - 1616.5000 MHz - 1 GHz to 18 GHz
Polarity: Vertical, EUT Orientation: X

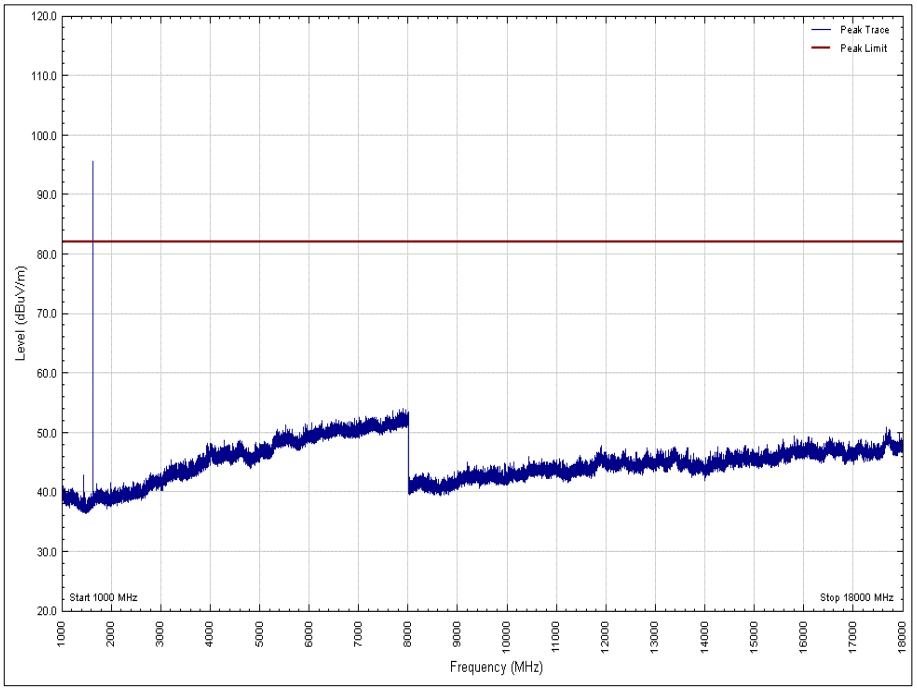

Figure 32 - 1616.5000 MHz - 1 GHz to 18 GHz
Polarity: Horizontal, EUT Orientation: X

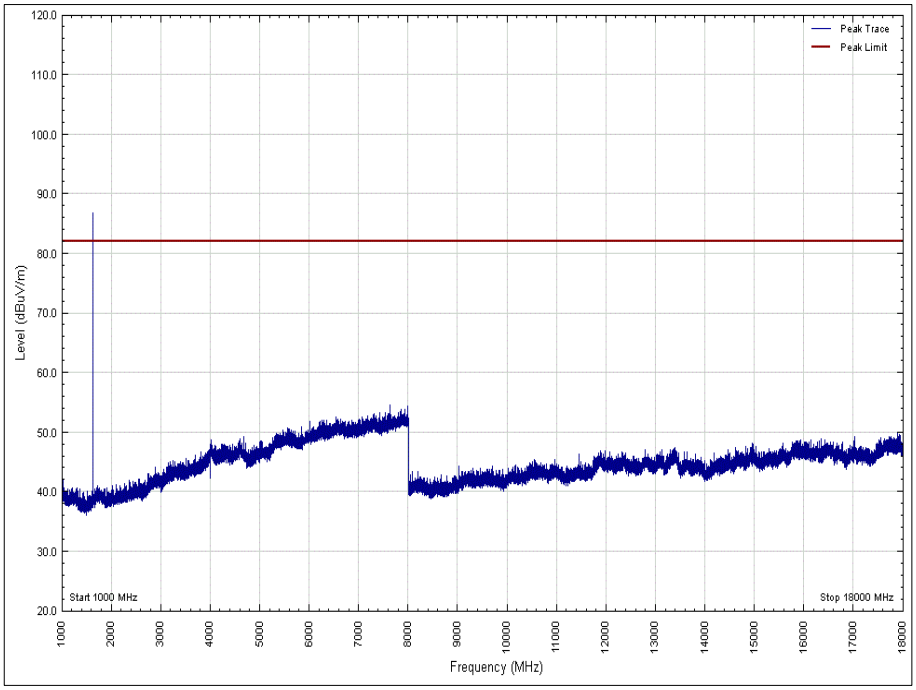

Figure 33 - 1616.5000 MHz - 1 GHz to 18 GHz
Polarity: Vertical, EUT Orientation: Y

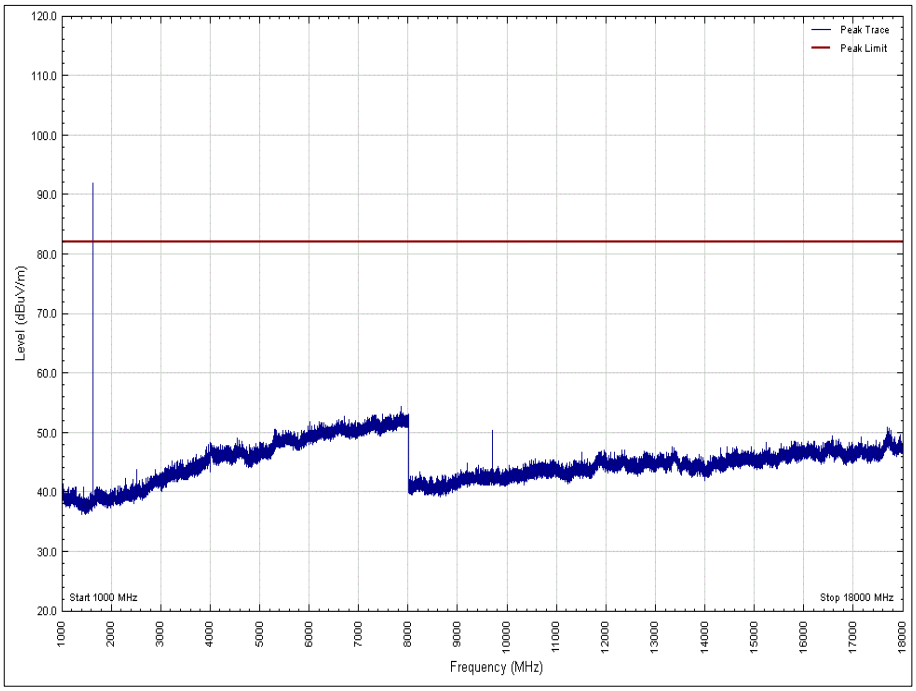

Figure 34 - 1616.5000 MHz - 1 GHz to 18 GHz
Polarity: Horizontal, EUT Orientation: Y

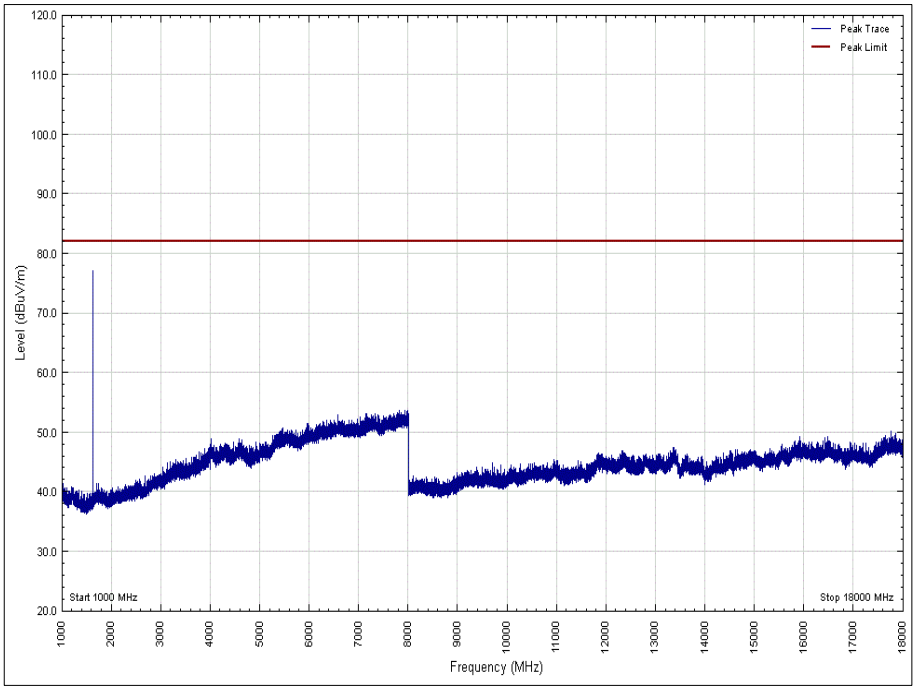

Figure 35 - 1616.5000 MHz - 1 GHz to 18 GHz
Polarity: Vertical, EUT Orientation: Z

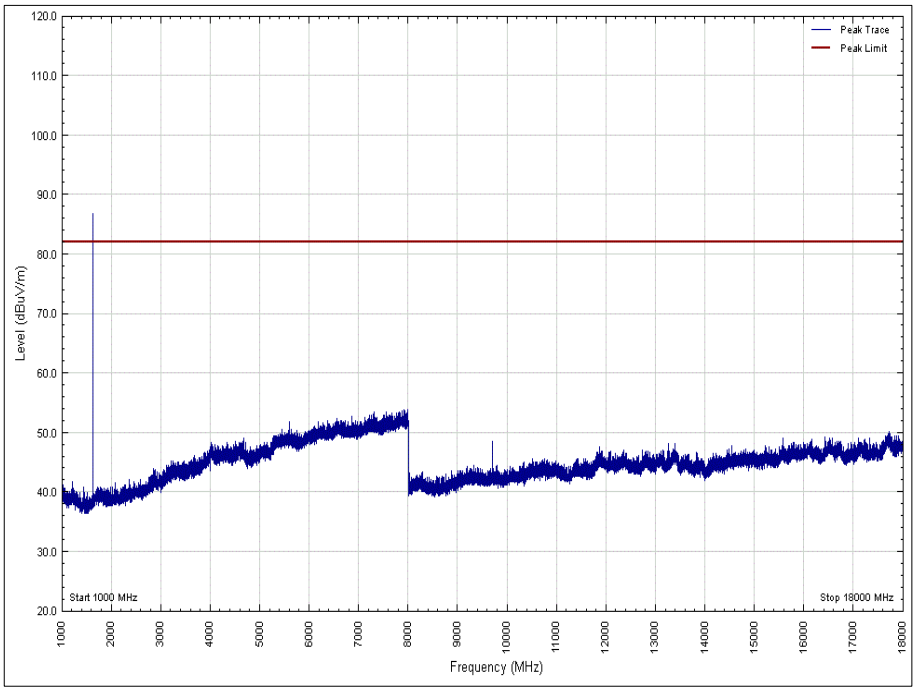

Figure 36 - 1616.5000 MHz - 1 GHz to 18 GHz
Polarity: Horizontal, EUT Orientation: Z

Frequency (MHz)	Level (dBm)
*	

Table 21 - 1625.8333 MHz, 30 MHz to 1 GHz, Results Table

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

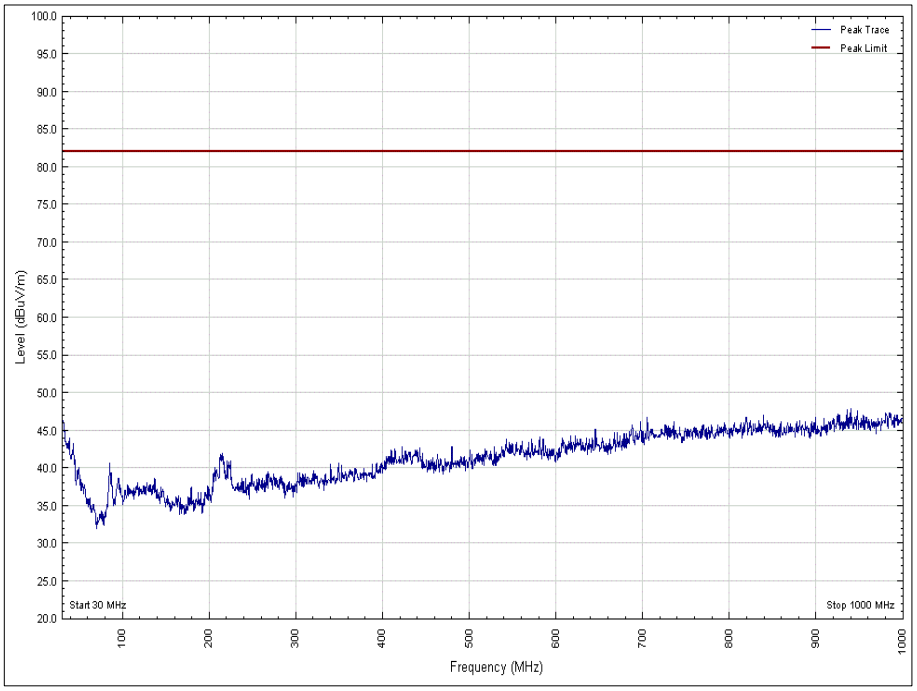

Figure 37 - 1625.8333 MHz, 30 MHz to 1 GHz
Polarisation: Vertical, EUT Orientation: X

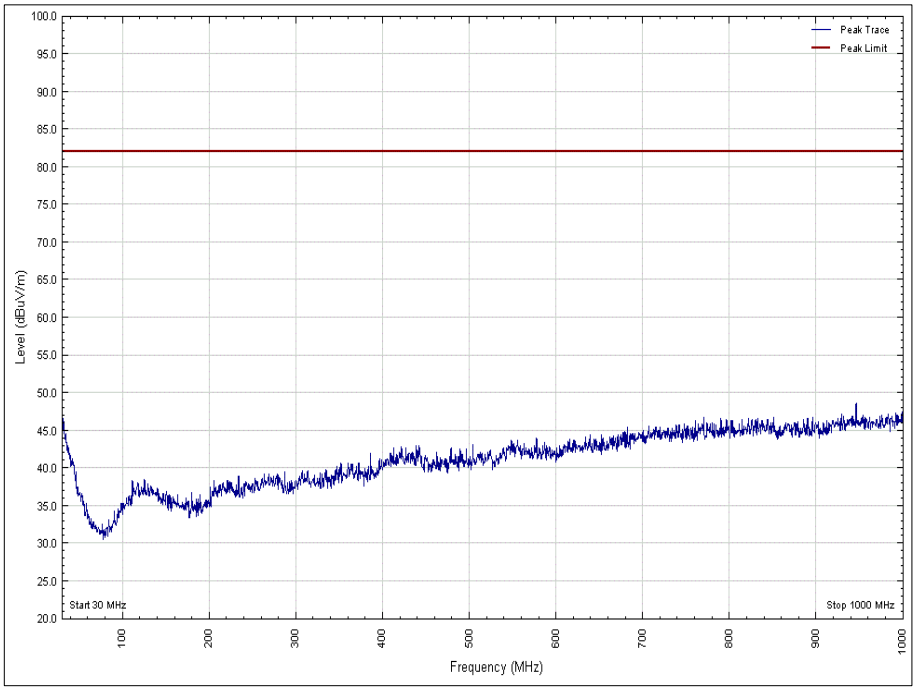

Figure 38 - 1625.8333 MHz, 30 MHz to 1 GHz
Polarisation: Horizontal, EUT Orientation: X

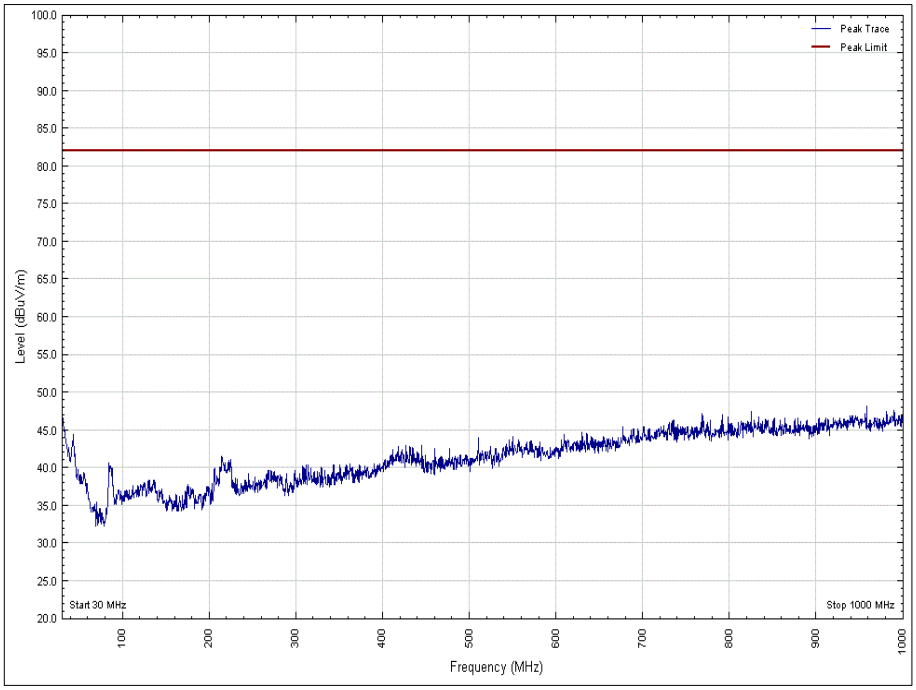

Figure 39 - 1625.8333 MHz, 30 MHz to 1 GHz
Polarisation: Vertical, EUT Orientation: Y

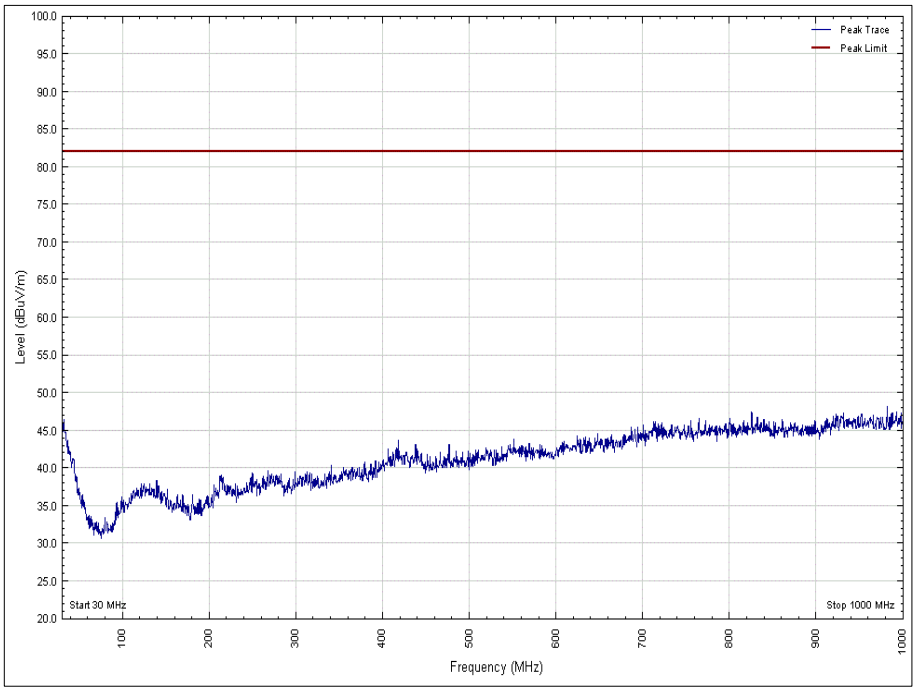

Figure 40 - 1625.8333 MHz, 30 MHz to 1 GHz
Polarisation: Horizontal, EUT Orientation: Y

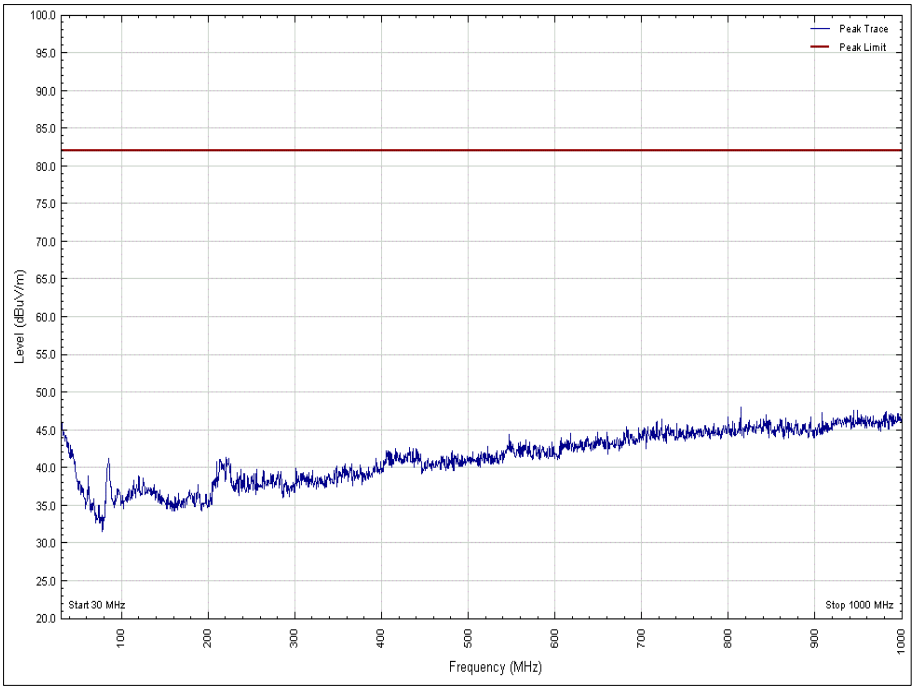

Figure 41 - 1625.8333 MHz, 30 MHz to 1 GHz
Polarisation: Vertical, EUT Orientation: Z

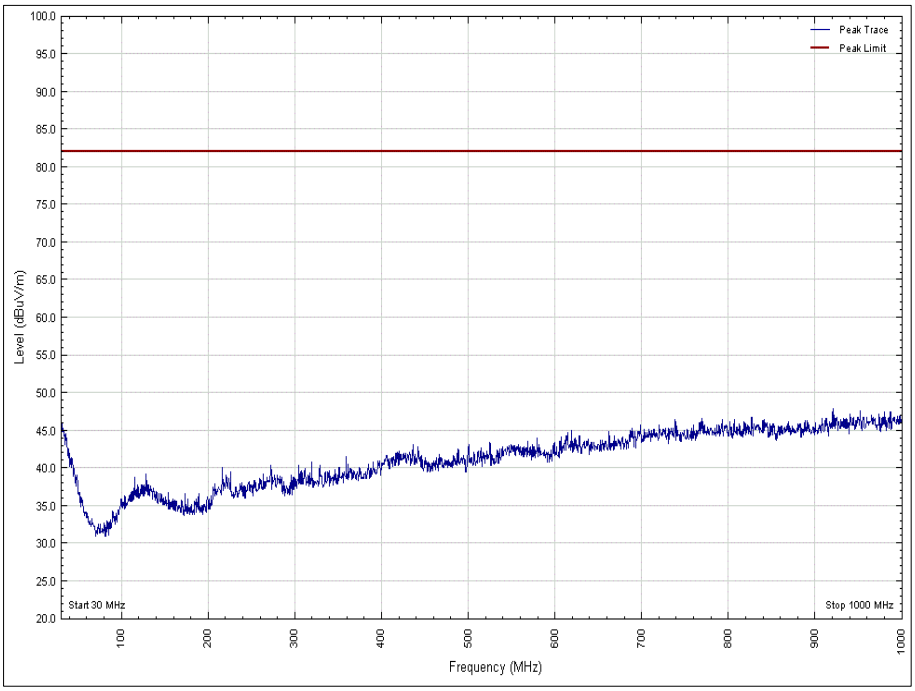

Figure 42 - 1625.8333 MHz, 30 MHz to 1 GHz
Polarisation: Horizontal, EUT Orientation: Z

Frequency (MHz)	Level (dBm)
*	

Table 22 - 1625.8333 MHz, 1 GHz to 18 GHz - Results Table

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

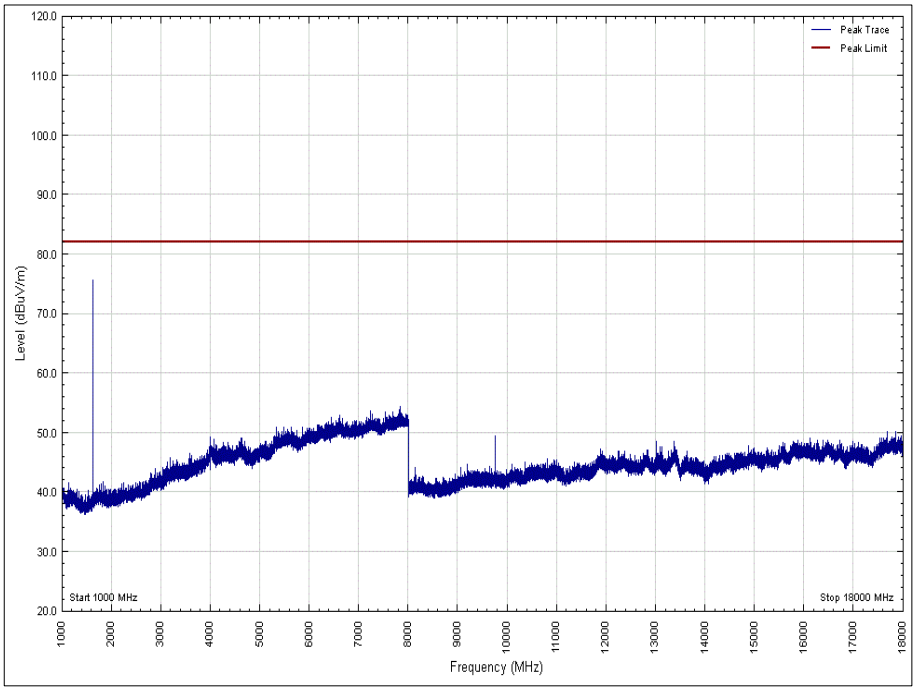

Figure 43 - 1625.8333 MHz - 1 GHz to 18 GHz
Polarity: Vertical, EUT Orientation: X

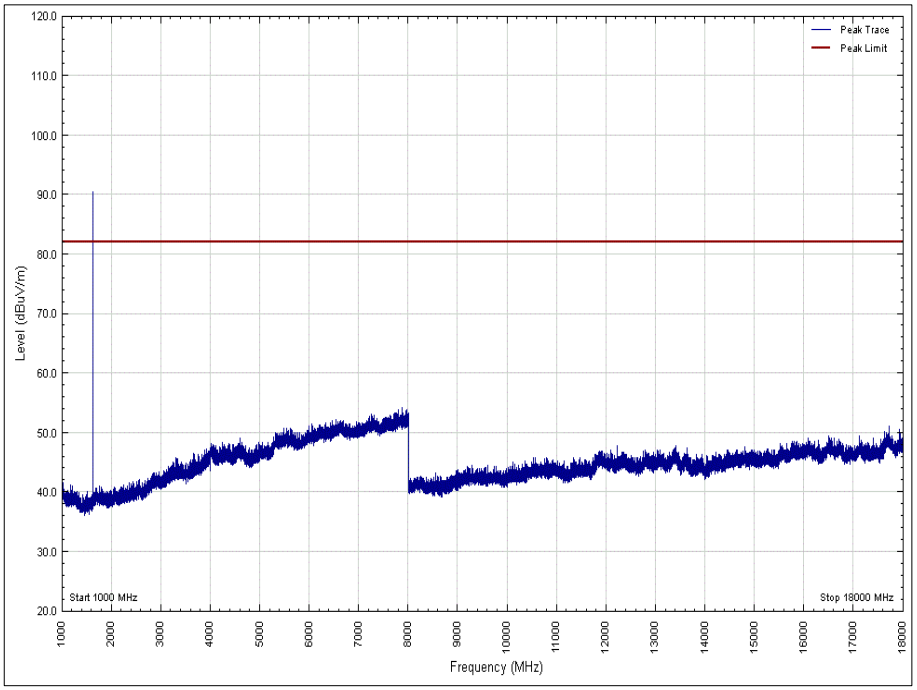

Figure 44 - 1625.8333 MHz - 1 GHz to 18 GHz
Polarity: Horizontal, EUT Orientation: X

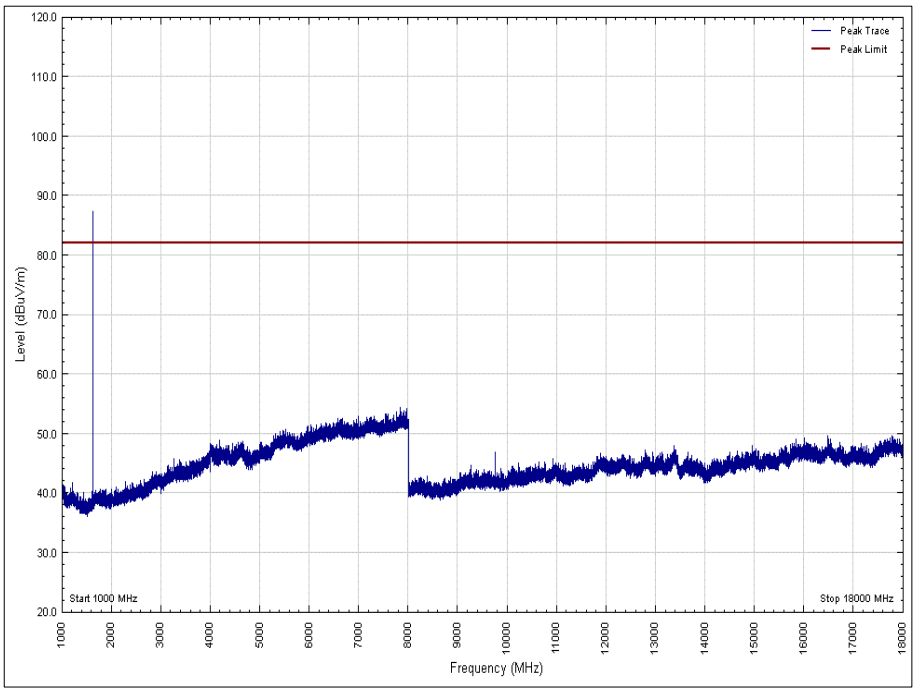

Figure 45 - 1625.8333 MHz - 1 GHz to 18 GHz
Polarity: Vertical, EUT Orientation: Y

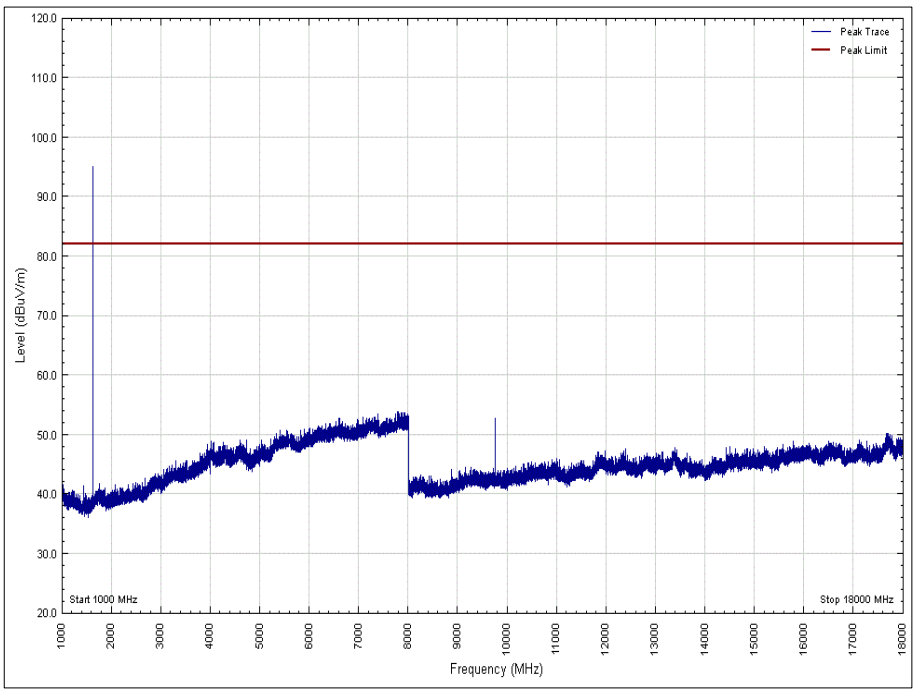

Figure 46 - 1625.8333 MHz - 1 GHz to 18 GHz
Polarity: Horizontal, EUT Orientation: Y

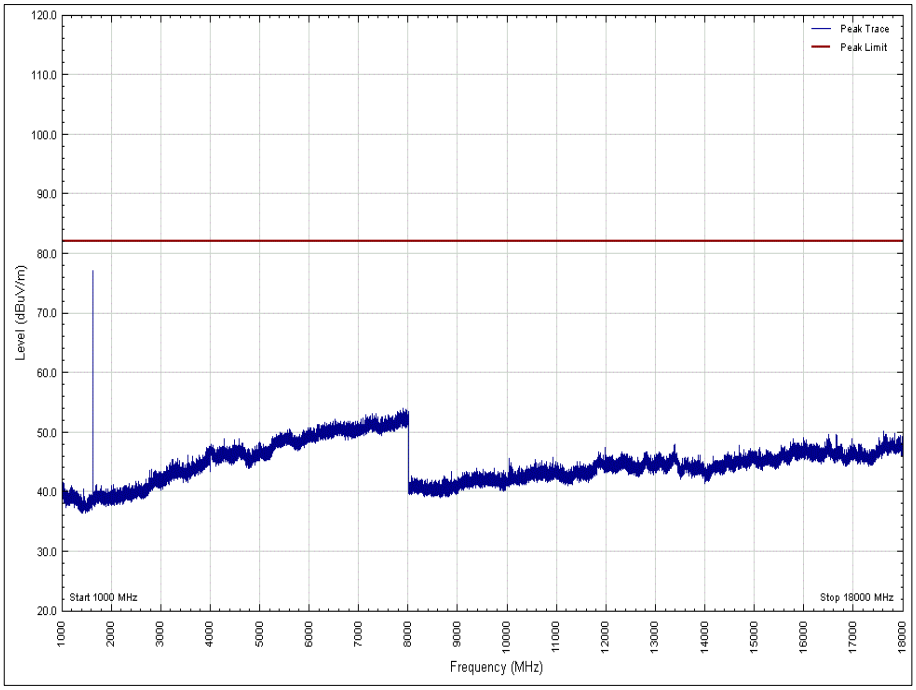

Figure 47 - 1625.8333 MHz - 1 GHz to 18 GHz
Polarity: Vertical, EUT Orientation: Z

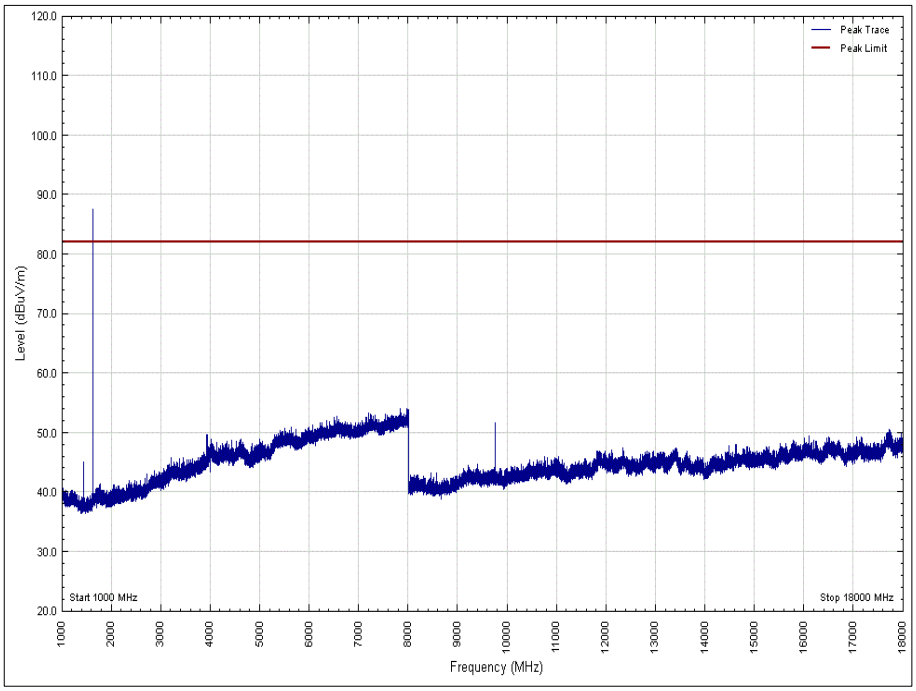

Figure 48 - 1625.8333 MHz - 1 GHz to 18 GHz
Polarity: Horizontal, EUT Orientation: Z

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:

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;
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;
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:

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;
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;
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.

2.6.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Pre-Amplifier	Phase One	PS04-0086	1533	12	08-Feb-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygromer	Rotronic	A1	2677	12	20-Feb-2020
Comb Generator	Schaffner	RSG1000	3034	-	TU
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Termination (50ohm)	Weinschel	1426-4	4325	12	27-Jun-2020
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	05-Mar-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	04-Oct-2019
EmX Software	TUV SUD	EmX	5125	-	Software
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	11-Dec-2019
Test Reciever (ESW)	Rohde & Schwarz	ESW44	5351	12	31-Jul-2020

Table 23

TU - Traceability Unscheduled

2.7 Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation 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

Certus™ 9770, S/N: Y0002N - Modification State 0

2.7.3 Date of Test

06-September-2019

2.7.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.7.

Broadband emissions were assessed using a 1 MHz bandwidth and discrete emissions using a 10 kHz bandwidth (as worst case).

2.7.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	53.3 %

2.7.6 Test Results

Iridium Transceiver - C8 modulation signal

Frequency (MHz)	Level (dBW)
*	

Table 24 - 1616.5000 MHz – Broadband Emission Results

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

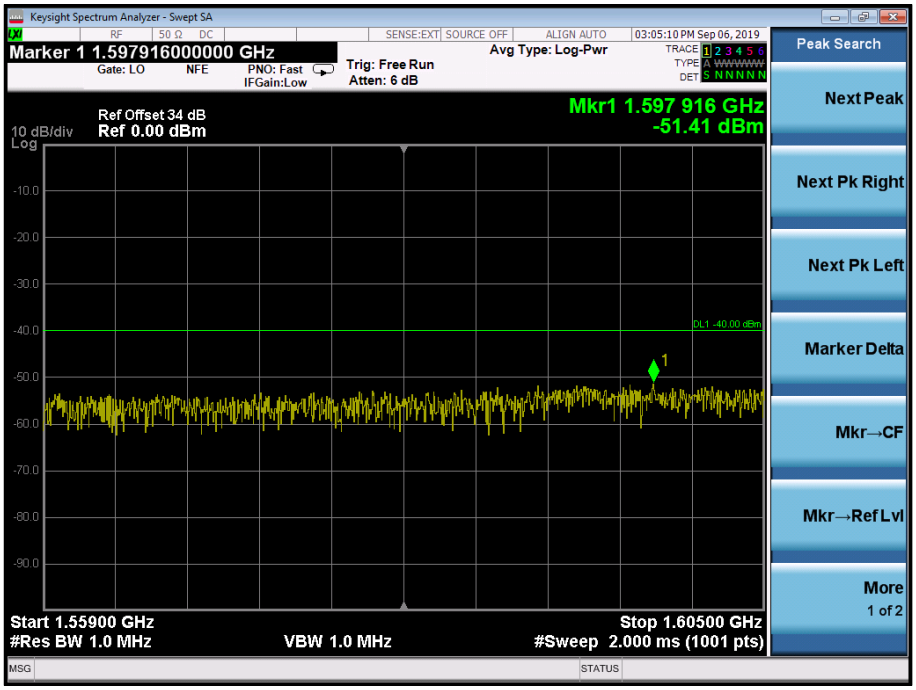

Figure 49 - 1616.5000 MHz – Broadband Emission Results

Frequency (MHz)	Level (dBW)
*	

Table 25 - 1616.5000 MHz – Discrete Emission Results

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

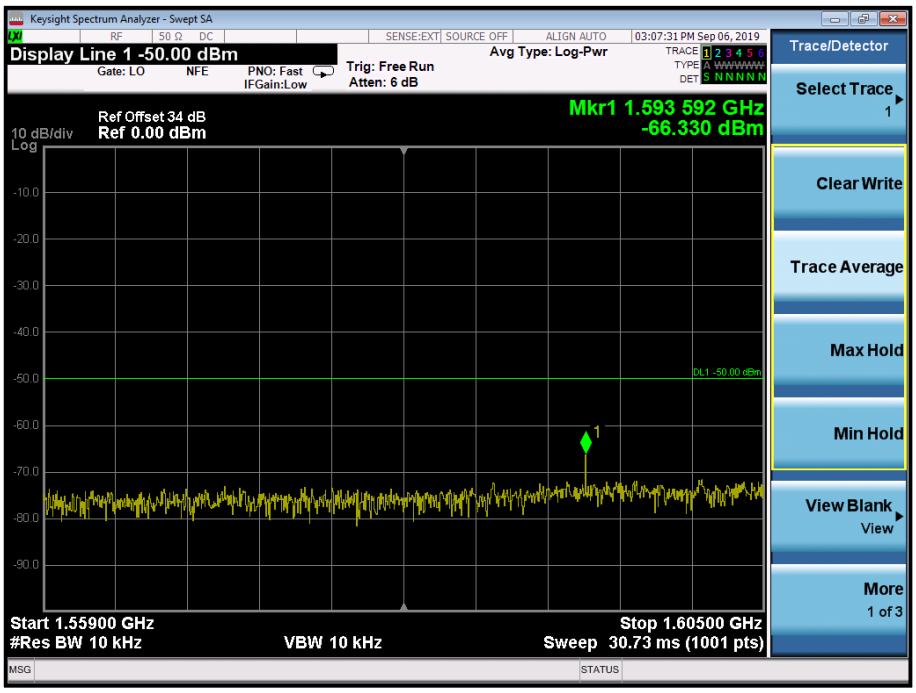

Figure 50 - 1616.5000 MHz – Discrete Emission Results

Frequency (MHz)	Level (dBW)
*	

Table 26 - 1625.8333 MHz – Broadband Emission Results

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

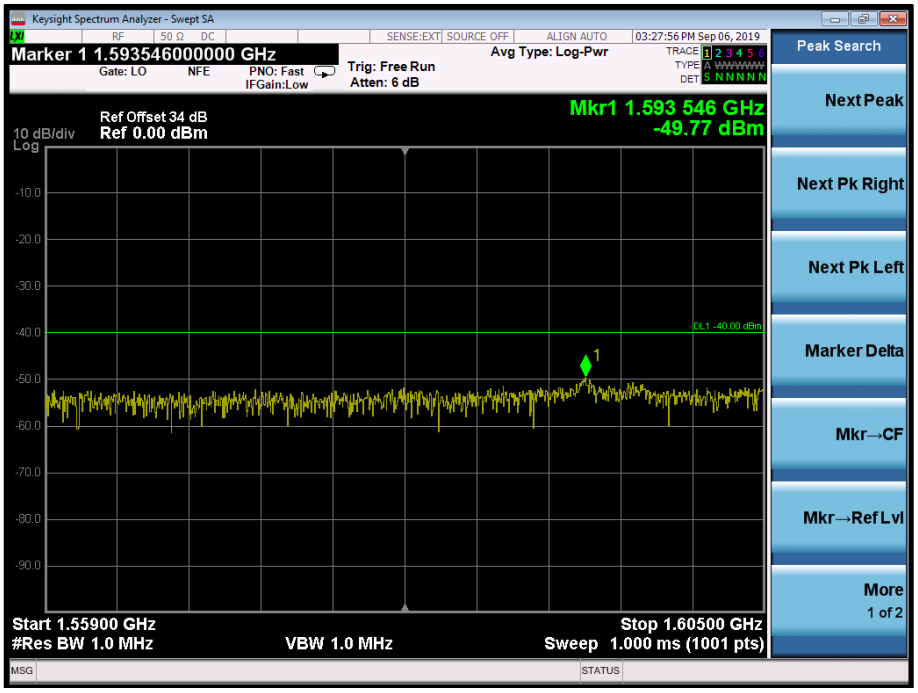

Figure 51 - 1625.8333 MHz – Broadband Emission Results

Frequency (MHz)	Level (dBW)
*	

Table 27 - 1625.8333 MHz – Discrete Emission Results

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

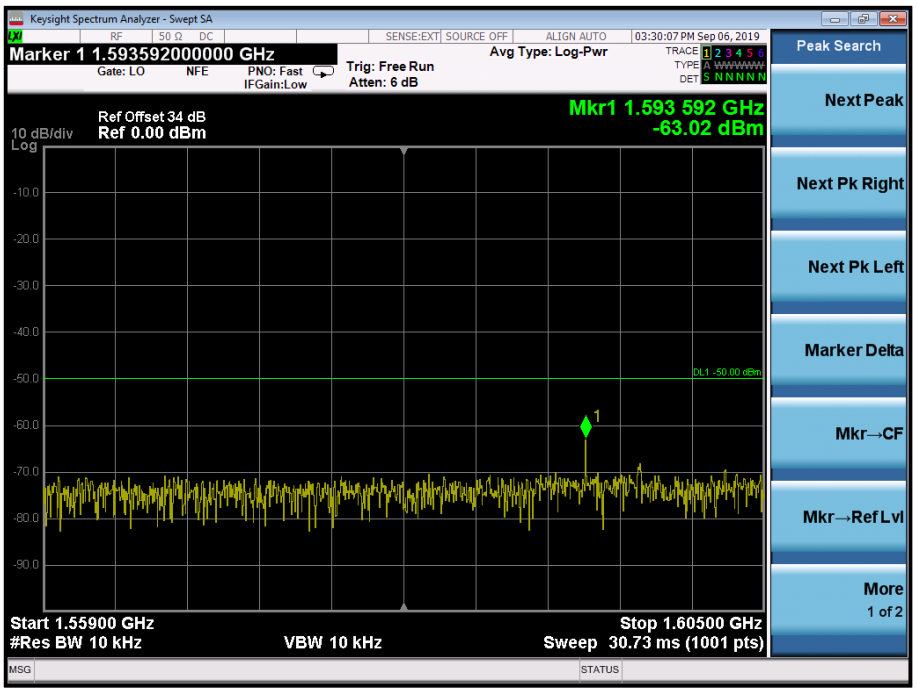

Figure 52 - 1625.8333 MHz – Discrete Emission Results

Frequency (MHz)	Level (dBW)
*	

Table 28 - Carrier-off state

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

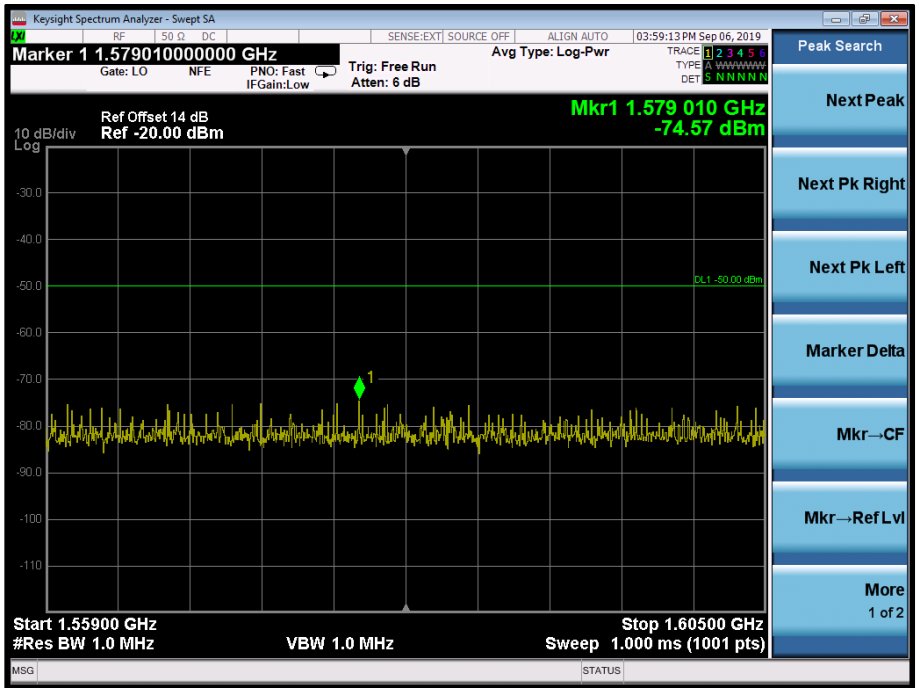

Figure 53 - Carrier-off state Emissions

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 5.4.3.2.1

Mobile earth stations with transmitting frequencies between 1610 MHz and 1626.5 MHz shall have the e.i.r.p. density of unwanted emissions in the band 1605-1610 MHz, averaged over any 2-ms active transmission interval, not exceed the following limits:

(1) –70 dBW/MHz at 1605 MHz, linearly interpolated to –10 dBW/MHz at 1610 MHz for broadband emissions; and

(2) –80 dBW/kHz at 1605 MHz, linearly interpolated to –20 dBW/kHz at 1610 MHz for discrete emissions.

2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Hygrometer	Rotronic	I-1000	3220	12	13-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4955	-	O/P Mon
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Programmable Power Supply	Rohde & Schwarz	HMP2020	S/N: 101883-LF	-	O/P Mon

Table 29

O/P Mon – Output Monitored using calibrated equipment.

3 Photographs

3.1 Test Setup Photographs

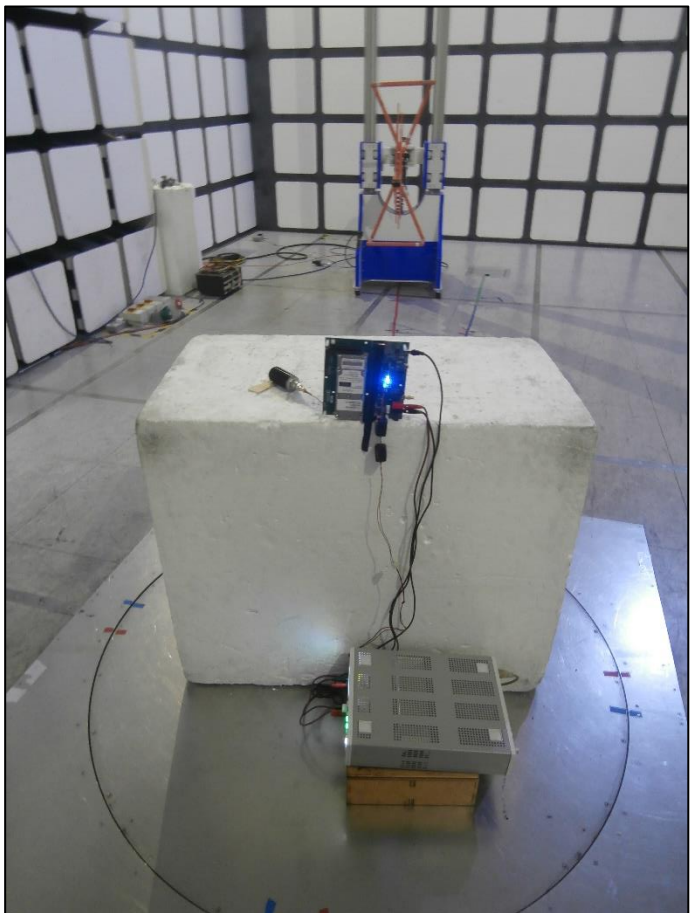

Figure 54 – Radiated Spurious Emissions - 30 MHz to 1 GHz

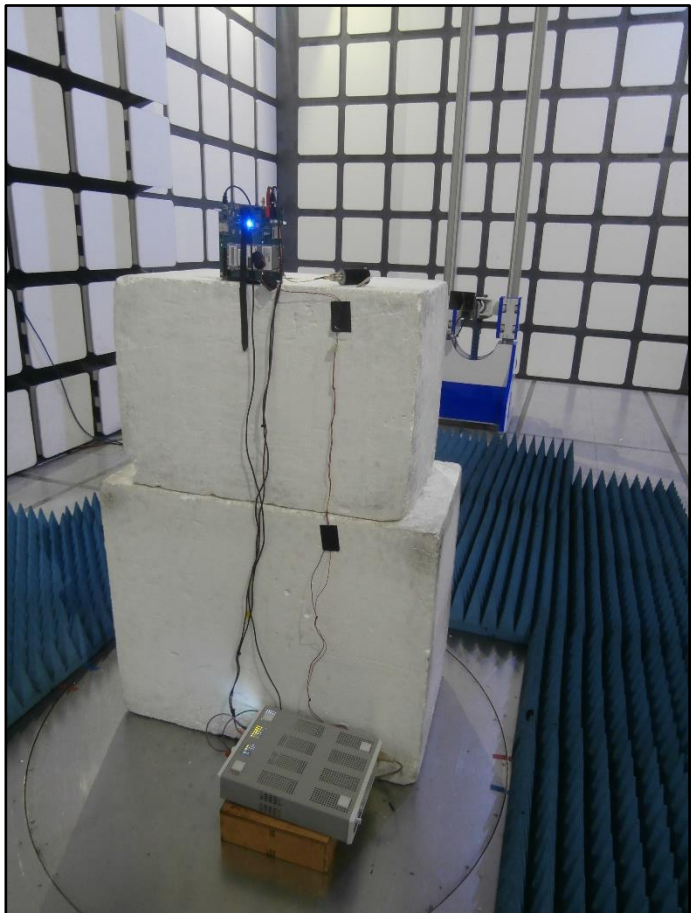

Figure 55 – Radiated Spurious Emissions - 1 GHz to 18 GHz

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation Satellite Service	Conducted: ± 3.45 dB Radiated: ± 6.3 dB
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 18 GHz: ± 6.3 dB
Equivalent Isotropic Radiated Power	Conducted: ± 3.2 dB Radiated: ± 6.3 dB (1 GHz to 18 GHz)
Spurious Emissions at Antenna Terminals	± 3.08 dB
Frequency Tolerance	± 3.54 Hz
Occupied Bandwidth	± 1871.96 Hz
Modulation Characteristics	-

Table 30