

FCC and ISSED Test Report

LARS THRANE A/S

LT-4200 Satellite Communications System

In accordance with FCC 47 CFR Part 2, FCC 47 CFR Part 25, ISSED RSS-170 and ISSED RSS-GEN (Iridium)

Prepared for: LARS THRANE A/S
Skovlytoften 33, Holte
DK-2840, DENMARK

FCC ID: 2A9Z4 - GC542298

IC: 24065 - 12224200



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Document 75956617-06 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	Chief Engineer (RF)	Authorised Signatory	01 March 2023

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 2, FCC 47 CFR Part 25, ISSED RSS-170 and ISSED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Neil Rousell	01 March 2023	
Testing	Roscoe Harrison	01 March 2023	

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

ISSED Accreditation

12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 2: 2021, FCC 47 CFR Part 25: 2021, ISSED RSS-170: Issue 3 (07-2015) and ISSED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.



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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	01-March-2023

Table 1

1.2 Introduction

Applicant	Lars Thrane A/S
Manufacturer	Lars Thrane A/S
Model Number(s)	LT-4200 Satellite Communications System comprising:
Part Number(s)	Control unit: LT-4210 Antenna: LT-4230 Handset: LT-3120
Serial Number(s)	Control unit (LT-4210): 00000126 Antenna (LT-4230): 01070006 Antenna (LT-4230): 01070003 Handset (LT-3120): not applicable to this standard
Hardware Version(s)	1.00
Software Version(s)	0.91
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 25: 2021 FCC 47 CFR Part 2: 2021 ISED RSS-170: Issue 3 (07-2015) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	188988 Rev:0
Date	16-September-2022
Date of Receipt of EUT	23-November-2022
Start of Test	01-December-2022
Finish of Test	22-December-2022
Name of Engineer(s)	Neil Rousell and Roscoe Harrison
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 2, FCC 47 CFR Part 25, ISSED RSS-170 and ISSED RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Part 2	Part 25	RSS-170	RSS-GEN			
Configuration and Mode: Iridium - DC powered							
2.1	2.1047 (d)	-	-	-	Modulation Characteristics	Declaration	
2.2	2.1049	-	-	6.7	Occupied Bandwidth	Satisfactory	
2.3	2.1055	25.202(d)	5.2	6.11	Frequency Tolerance	Pass	
2.4	2.1051	25.202(f)	5.4.3.1	6.13	Spurious Emissions at Antenna Terminals	Pass	
2.5	2.1046	25.204	5.3	6.12	Equivalent Isotropic Radiated Power	Pass	
2.6	-	25.216	5.4.3.2	-	Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation Satellite Service	Pass	
2.7	2.1053	25.202(f)	5.4.3.1	6.13	Radiated Spurious Emissions	Pass	

Table 2



1.4 Application Form

Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment including the technologies the product supports)</i>	The LT-4200 Satellite Communication System has voice and data capabilities with 100% global coverage provided by the Iridium Communication Network.		
Manufacturer:	Lars Thrane A/S		
Model:	LT-4200 Satellite Communications System		
Part Number:	Control Unit: LT-4210 Antenna Unit: LT-4230 Handset: LT-3120 Cradle: LT-3121		
Hardware Version:	1.00		
Software Version:	0.91		
FCC ID of the product under test – see guidance here	2A9Z4-GC542298		
IC ID of the product under test – see guidance here	24065-12224200		

Table 3

Intentional Radiators

Technology	Iridium	Bluetooth				
Frequency Range (MHz to MHz)	1616 to 1626.5 MHz	2402 – 2480 MHz				
Conducted Declared Output Power (dBm)	41.7	8.3				
Antenna Gain (dBi)	2.3	0.5				
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	Block1 & C1: 41.667 KHz, C2: 83.334 KHz, C8: 333.333 KHz, 2xC8: 666,666 KHz	1MHz				
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	DQPSK, QPSK	GFSK, $\pi/4$ DQPSK, 8DPSK				
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	41k7Q7W, 83k3Q7W, 333kQ7W, 666kQ7W	810KF7D, 1M31G7D, 1M03F7D				
Bottom Frequency (MHz)	1616.1667	2402				
Middle Frequency (MHz)	1621.1667	2441				
Top Frequency (MHz)	1625.8330	2480				

Table 4



Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	4.880 GHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768 kHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒	
Class B Digital Device (Use in residential environment only) ☐	

Table 5

AC Power Source

AC supply frequency:		Hz
Voltage		V
Max current:		A
Single Phase ☐ Three Phase ☐		

Table 6

DC Power Source

Nominal voltage:	24	V
Extreme upper voltage:	32.2	V
Extreme lower voltage:	19.2	V
Max current:	8.0	A

Table 7

Battery Power Source

Voltage:		V
End-point voltage:		V (Point at which the battery will terminate)
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ *(Vehicle regulated)		
Other ☐	Please detail:	

Table 8

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☐
---	--

Table 9

Temperature

Minimum temperature:	-40 ambient	°C
Maximum temperature:	+55 ambient	°C

Table 10



Cable Loss

Adapter Cable Loss (Conducted sample)		dB
--	--	----

Table 11

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:		Gain	2.3	dBi
External antenna ☐	Type:		Gain		dBi
For external antenna only: Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed ☐ Non-standard Antenna Jack ☐ All part 15 applications will need to show how the antenna gain was derived either from a manufacturer data sheet or a measurement. Where the gain of the antenna is inherently accounted for as a result of the measurement, such as field strength measurements on a part 15.249 or 15.231 device, so the gain does not necessarily need to be verified. However, enough information regarding the construction of the antenna shall be provided. Such information maybe photographs, length of wire antenna etc.					

Table 12

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

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

Name: Carsten Thomsen
Position held: CTO
Date: 18-01-2023



1.5 Product Information

1.5.1 Technical Description

The LT-4200 Satellite Communication System has voice and data capabilities with 100% global coverage provided by the Iridium Communication 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: LT-4210, Serial Number: 00000126			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: LT-4230, Serial Number: 01070006			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: LT-4230, Serial Number: 01070003			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 13



1.8 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Iridium - DC powered		
Occupied Bandwidth	Neil Rousell	UKAS
Frequency Tolerance	Neil Rousell	UKAS
Spurious Emissions at Antenna Terminals	Neil Rousell	UKAS
Equivalent Isotropic Radiated Power	Neil Rousell	UKAS
Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation Satellite Service	Neil Rousell	UKAS
Radiated Spurious Emissions	Roscoe Harrison	UKAS

Table 14

Office Address:

TÜV SÜD
Octagon House
Concorde Way
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 and Modification State

LT-4210, S/N: 00000126 - Modification State 0
LT-4230, S/N: 0170003 - Modification State 0

2.1.3 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.3.

2.1.4 Test Results

Iridium - DC powered

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
ISED RSS-GEN, Clause 6.7

2.2.2 Equipment Under Test and Modification State

LT-4230, S/N: 0170003 - Modification State 0

2.2.3 Date of Test

01-December-2022

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	20.9 °C
Relative Humidity	37.8 %



2.2.6 Test Results

Iridium - DC powered

99% Occupied Bandwidth (kHz)		
1616.3333 MHz	1621.3333 MHz	1625.6666 MHz
586.6	587.6	586.6

Table 15

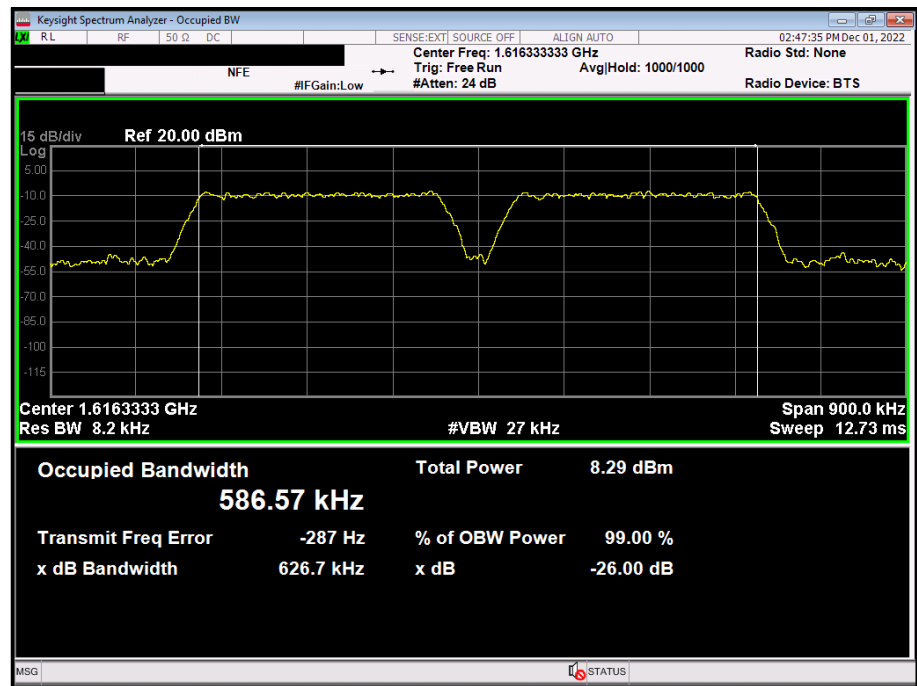


Table 16 - 1616.3333 MHz

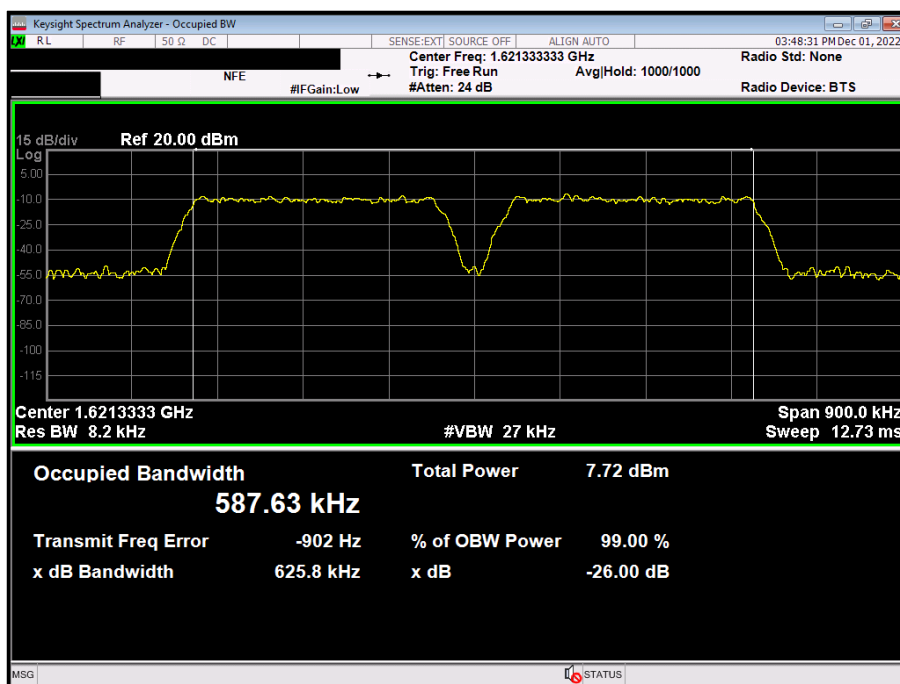


Table 17 - 1621.3333 MHz

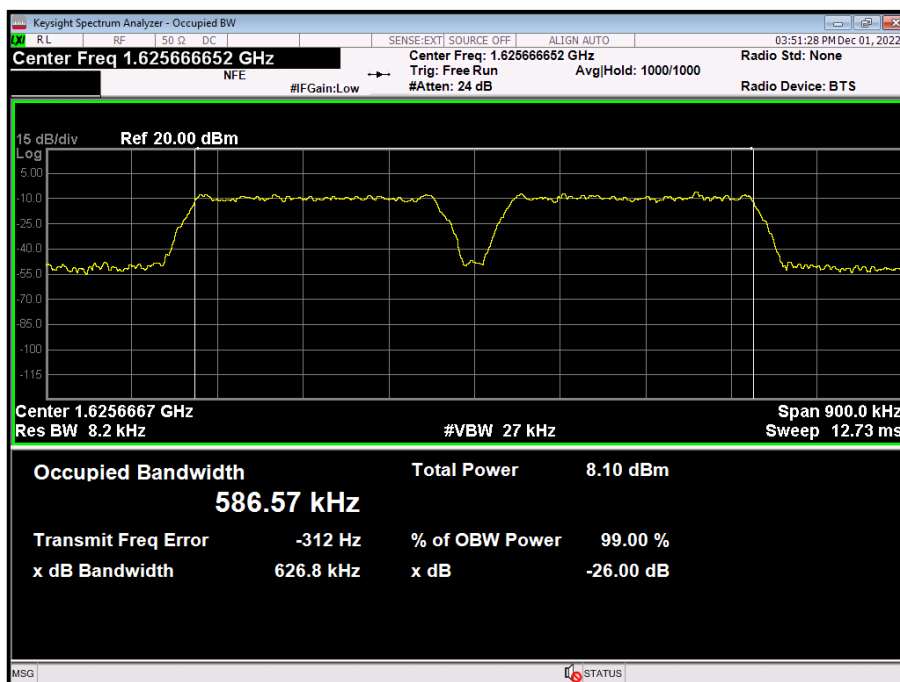


Table 18 - 1625.6666 MHz

FCC 47 CFR Part 2, Limit Clause 2.1049

None specified.

ISED RSS-GEN, Limit Clause

None specified.



2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Multimeter	Fluke	177	3833	12	16-Dec-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	05-Jan-2023
Attenuator 40dB 100W	Weinschel	48-40-43-LIM	5134	12	05-Jan-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023

Table 19

O/P Mon – Output Monitored using calibrated equipment



2.3 Frequency Tolerance

2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1055
FCC 47 CFR Part 25, Clause 25.202(d)
ISED RSS-170, Clause 5.2
ISED RSS-GEN, Clause, 6.11

2.3.2 Equipment Under Test and Modification State

LT-4230, S/N: 0170003 - Modification State 0

2.3.3 Date of Test

07-December-2022

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	18.0 °C
Relative Humidity	41.0 %



2.3.6 Test Results

Iridium - DC powered

1621.3333 MHz						
Temperature	19.2 VDC		24.0 VDC		31.2 VDC	
	Frequency Error (%)	Frequency Error (ppm)	Frequency Error (%)	Frequency Error (ppm)	Frequency Error (%)	Frequency Error (ppm)
-30.0°C	-	-	0.000070	0.70	-	-
-20°C	-	-	0.000102	1.02	-	-
-10°C	-	-	0.000092	0.92	-	-
0°C	-	-	0.000089	0.89	-	-
+10.0°C	-	-	0.000077	0.77	-	-
+20.0°C	0.000022	0.22	0.000019	0.19	0.000036	0.36
+30.0°C	-	-	0.000007	0.07	-	-
+40.0°C	-	-	-0.000018	-0.18	-	-
+50.0°C	-	-	-0.000033	-0.33	-	-

Table 20

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 MES equipment, the carrier frequency shall not drift 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 2.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Multimeter	Fluke	177	3833	12	16-Dec-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	05-Jan-2023
Attenuator 40dB 100W	Weinschel	48-40-43-LIM	5134	12	05-Jan-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023
Climatic Chamber	Weiss Technik	TempEvent T/180/40/3	5894	12	27-May-2023

Table 21

O/P Mon – Output Monitored using calibrated equipment



2.4 Spurious Emissions at Antenna Terminals

2.4.1 Specification Reference

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

2.4.2 Equipment Under Test and Modification State

LT-4230, S/N: 0170003 - Modification State 0

2.4.3 Date of Test

06-December-2022

2.4.4 Test Method

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

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

2.4.5 Environmental Conditions

Ambient Temperature	20.6 °C
Relative Humidity	39.3 %

2.4.6 Test Results

Iridium - DC powered

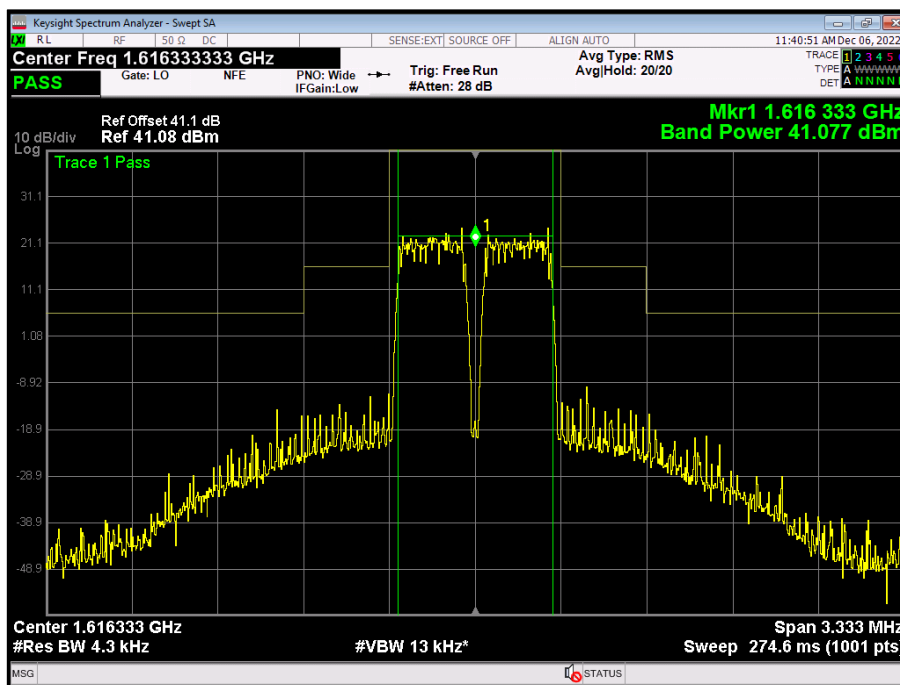


Table 22 - 1616.3333 MHz - Emission Mask

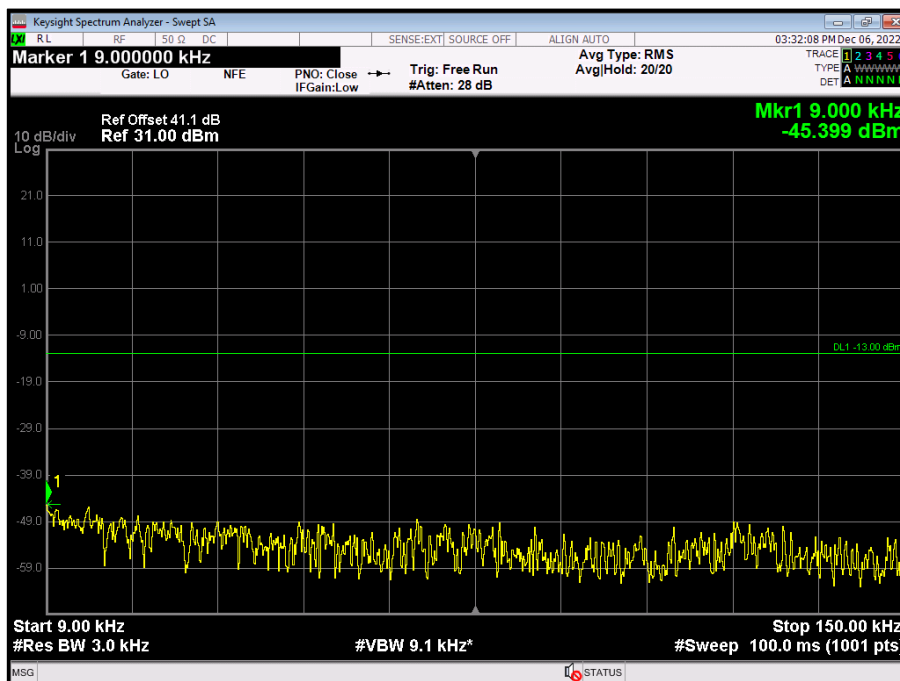


Table 23 - 1616.3333 MHz - 9 kHz to 150 kHz

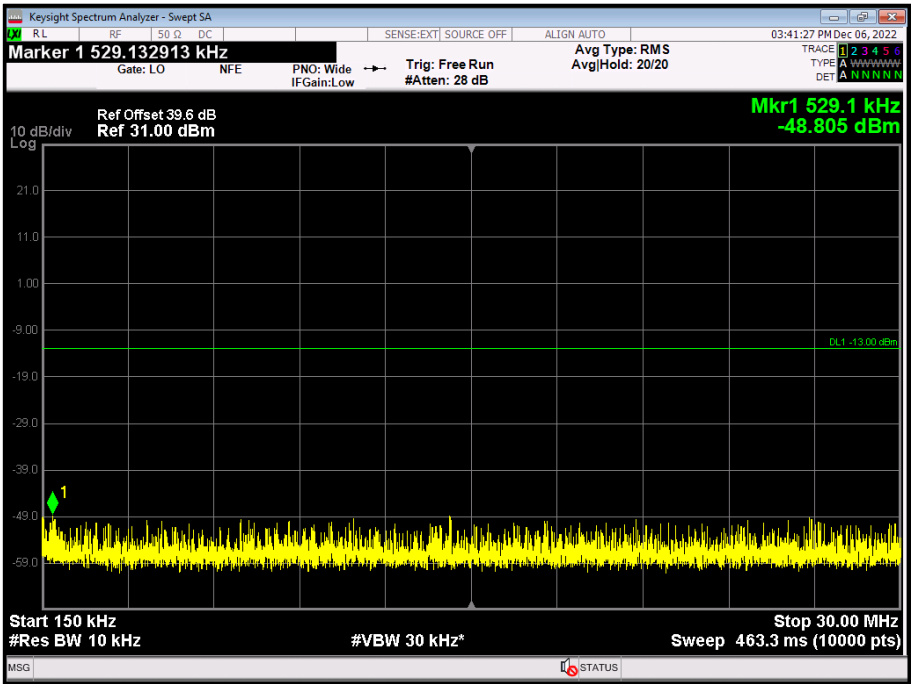


Table 24 - 1616.3333 MHz - 150 kHz to 30 MHz

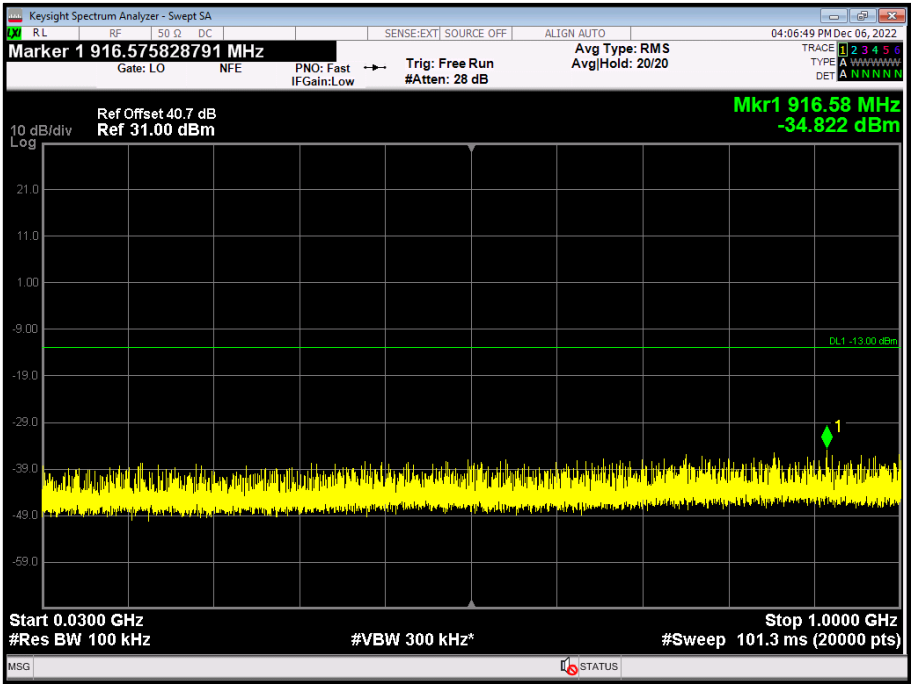


Table 25 - 1616.3333 MHz - 30 MHz to 1 GHz

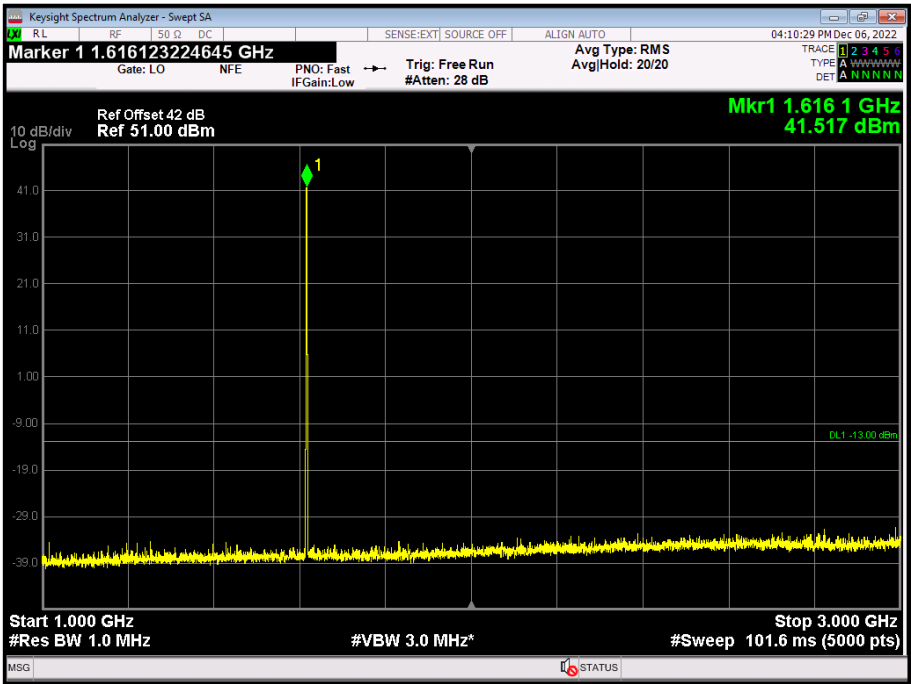


Table 26 - 1616.3333 MHz - 1 GHz to 3 GHz

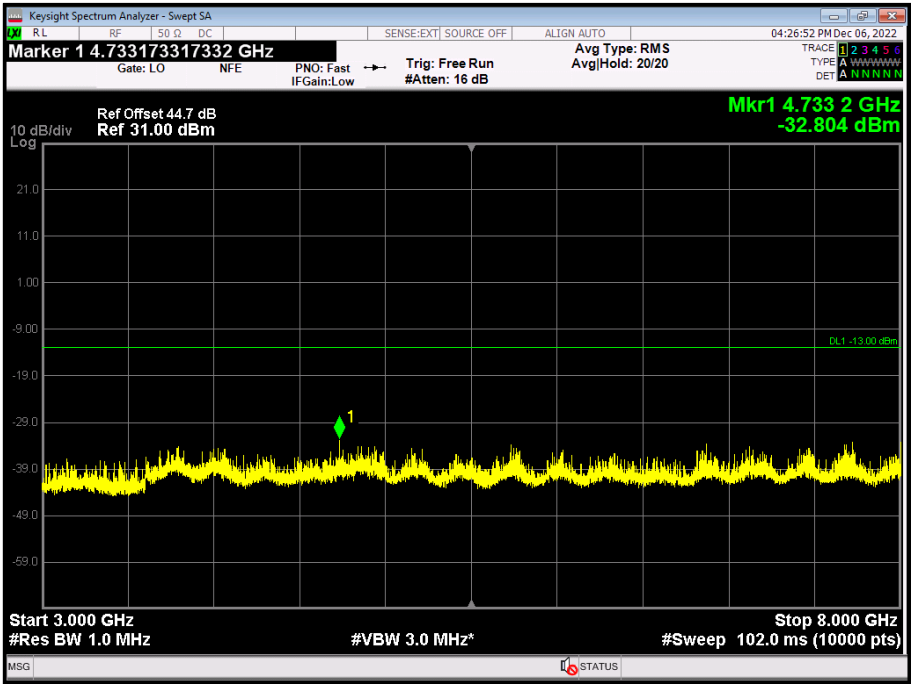


Table 27 - 1616.3333 MHz - 3 GHz to 8 GHz

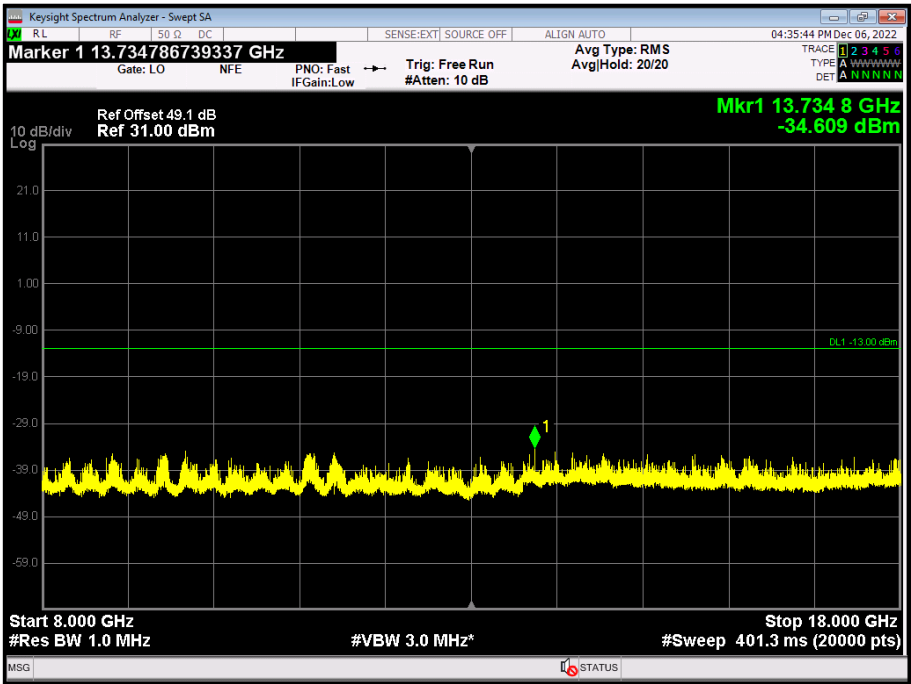


Table 28 - 1616.3333 MHz - 8 GHz to 18 GHz

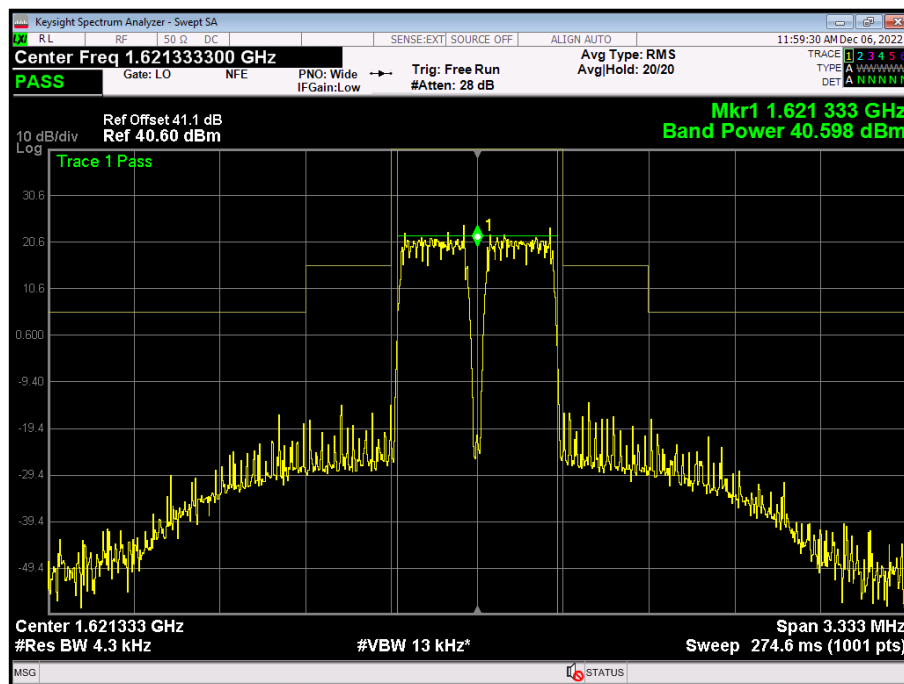


Table 29 - 1621.3333 MHz - Emission Mask

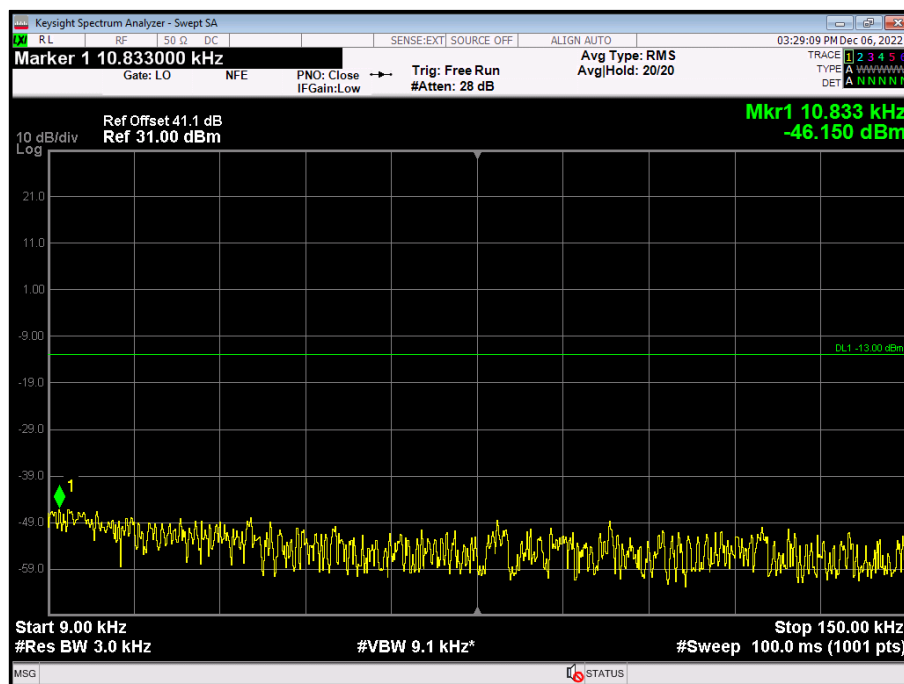


Table 30 - 1621.3333 MHz - 9 kHz to 150 kHz

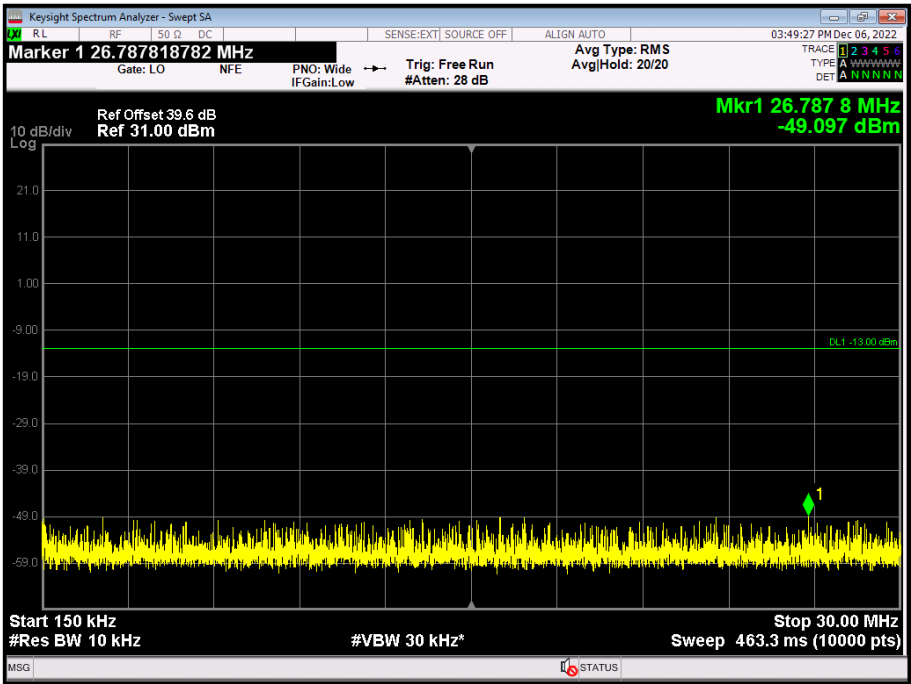


Table 31 - 1621.3333 MHz - 150 kHz to 30 MHz

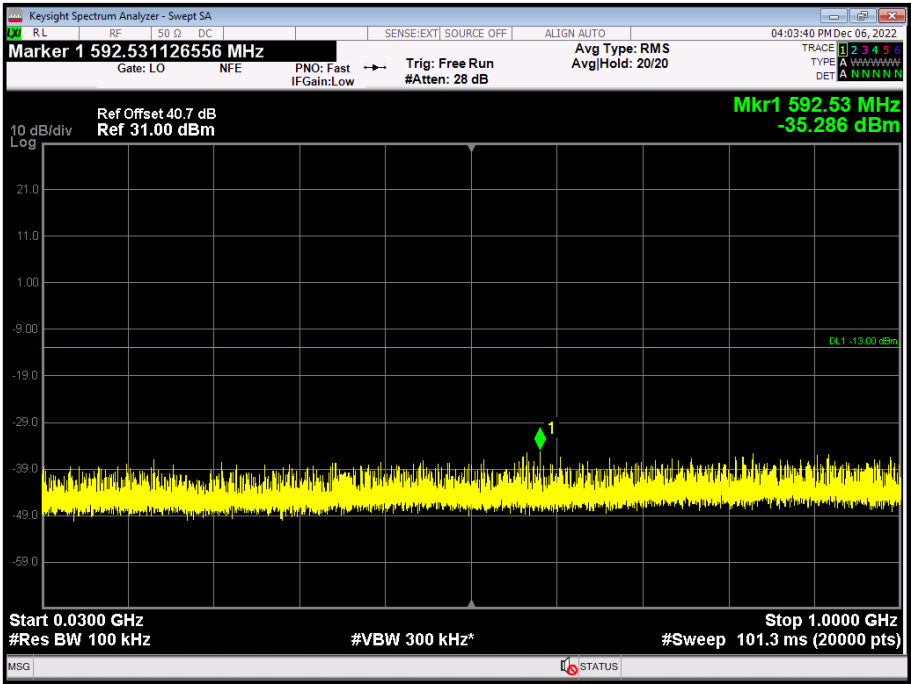


Table 32 - 1621.3333 MHz - 30 MHz to 1 GHz

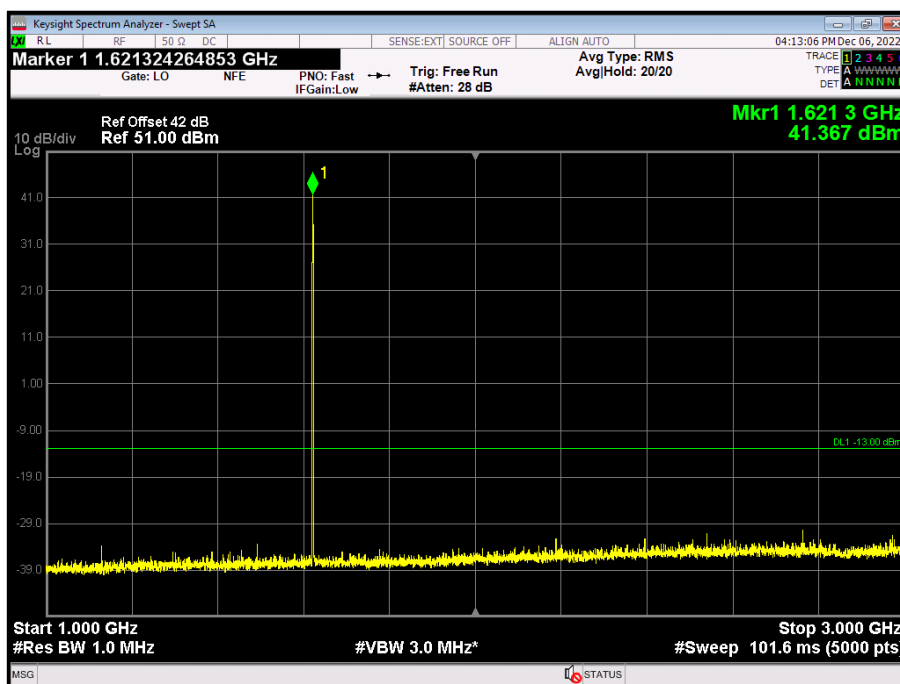


Table 33 - 1621.3333 MHz - 1 GHz to 3 GHz

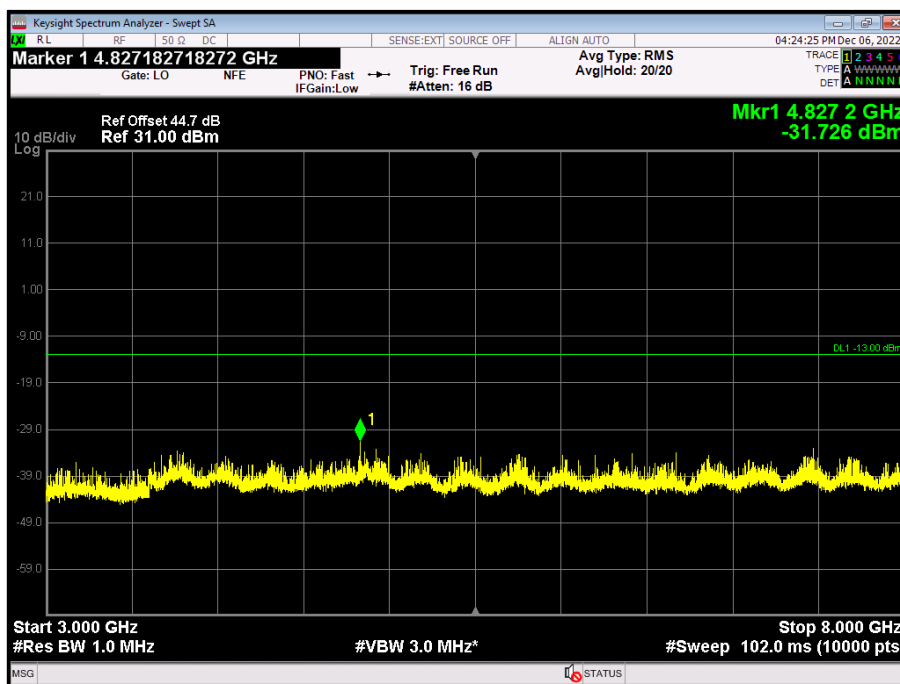


Table 34 - 1621.3333 MHz - 3 GHz to 8 GHz

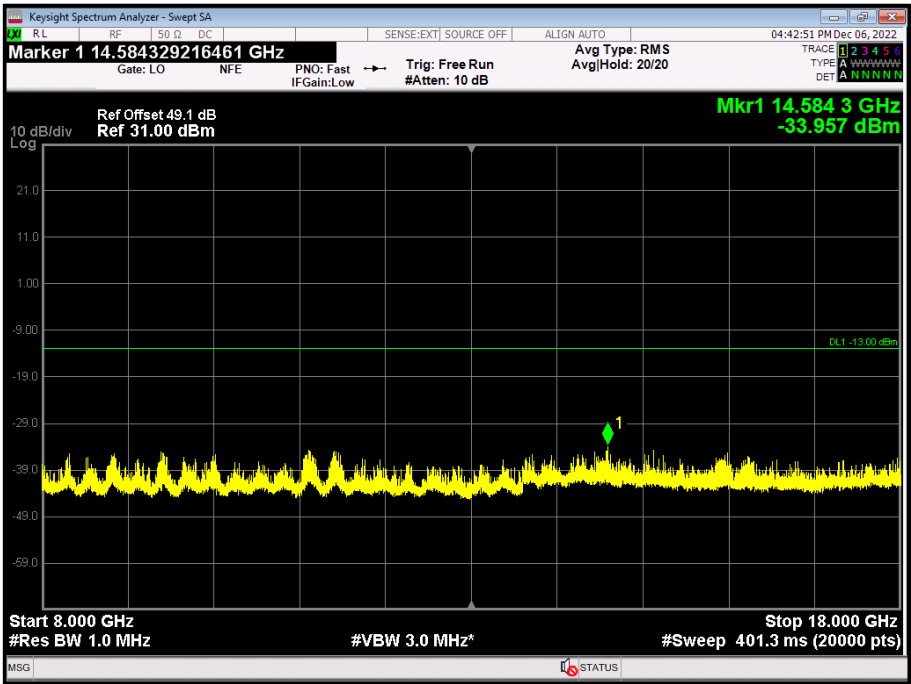


Table 35 - 1621.3333 MHz - 8 GHz to 18 GHz

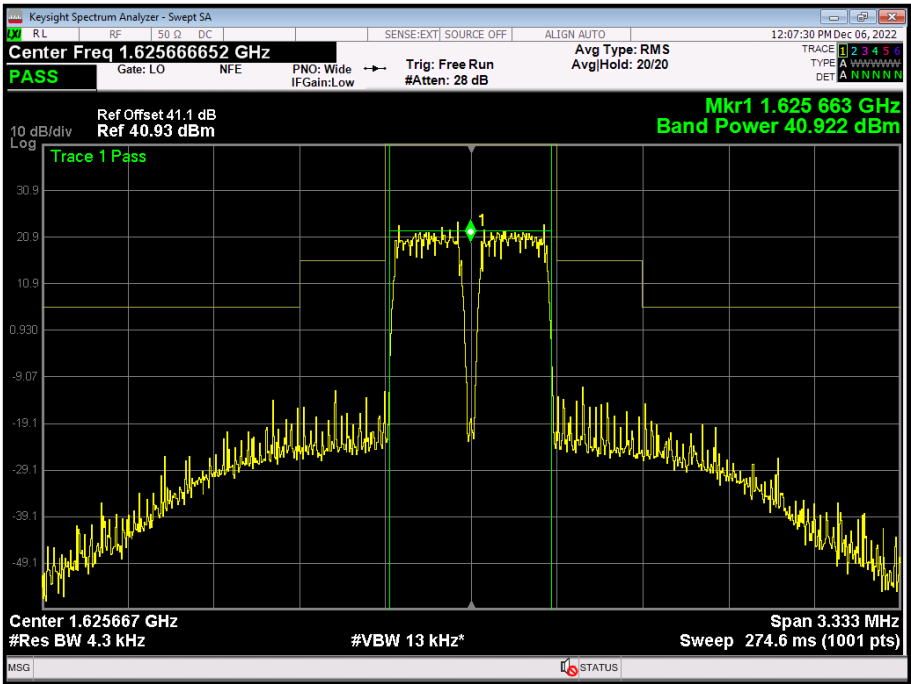


Table 36 - 1625.6666 MHz - Emission Mask

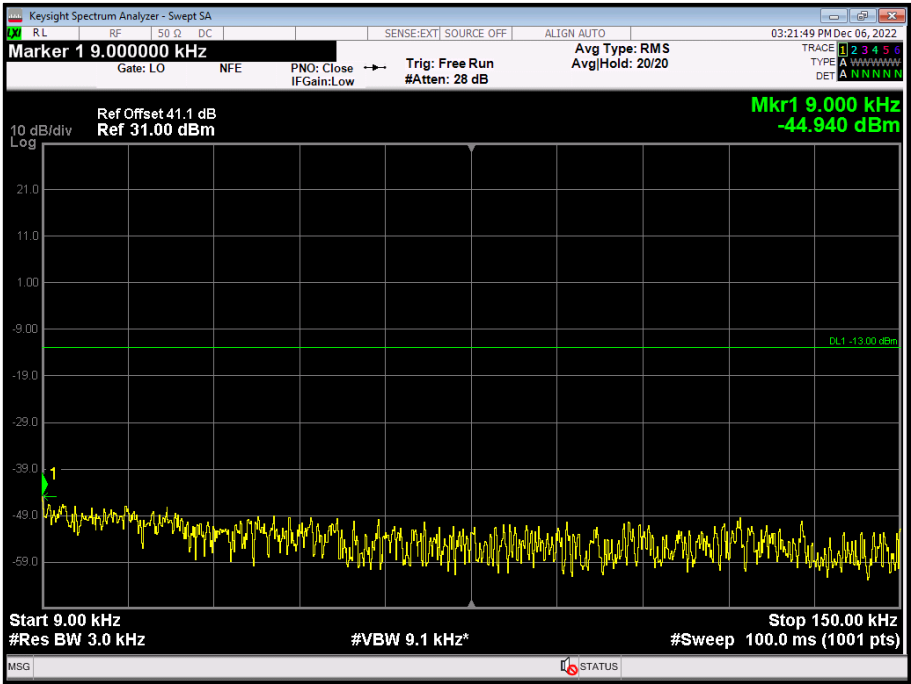


Table 37 - 1625.6666 MHz - 9 kHz to 150 kHz

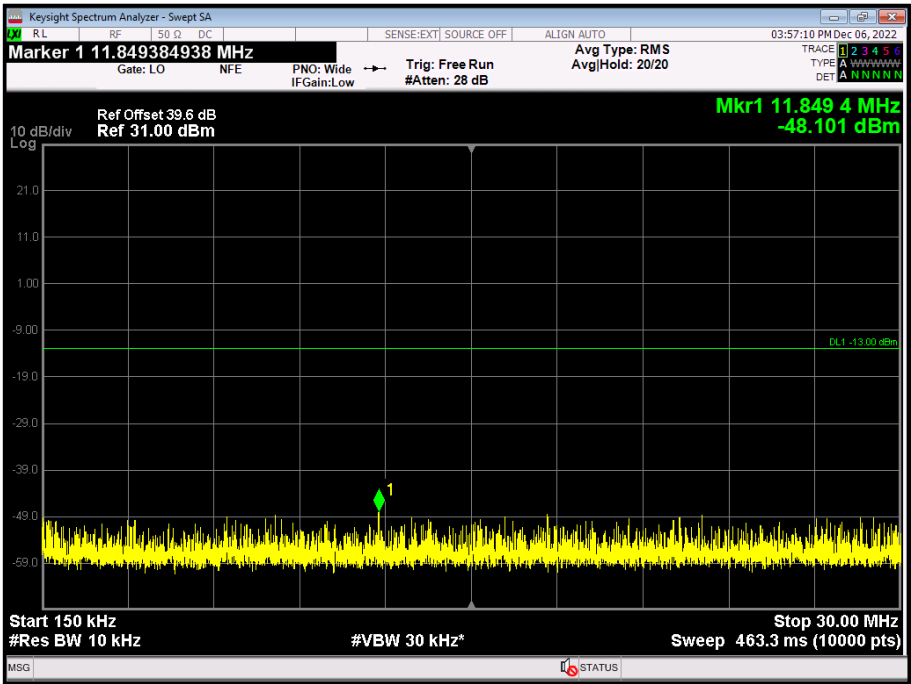


Table 38 - 1625.6666 MHz - 150 kHz to 30 MHz

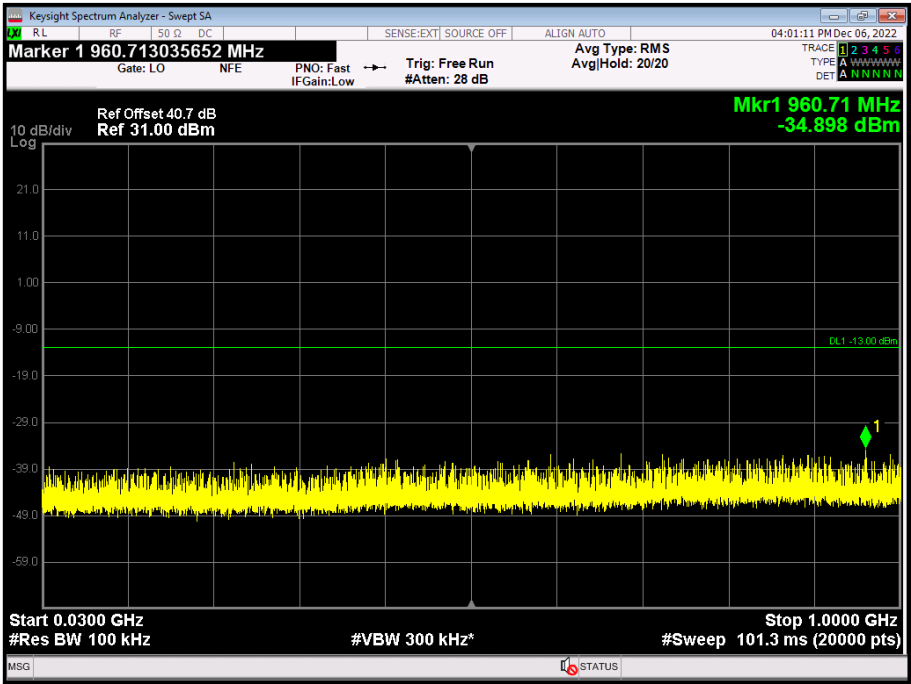


Table 39 - 1625.6666 MHz - 30 MHz to 1 GHz

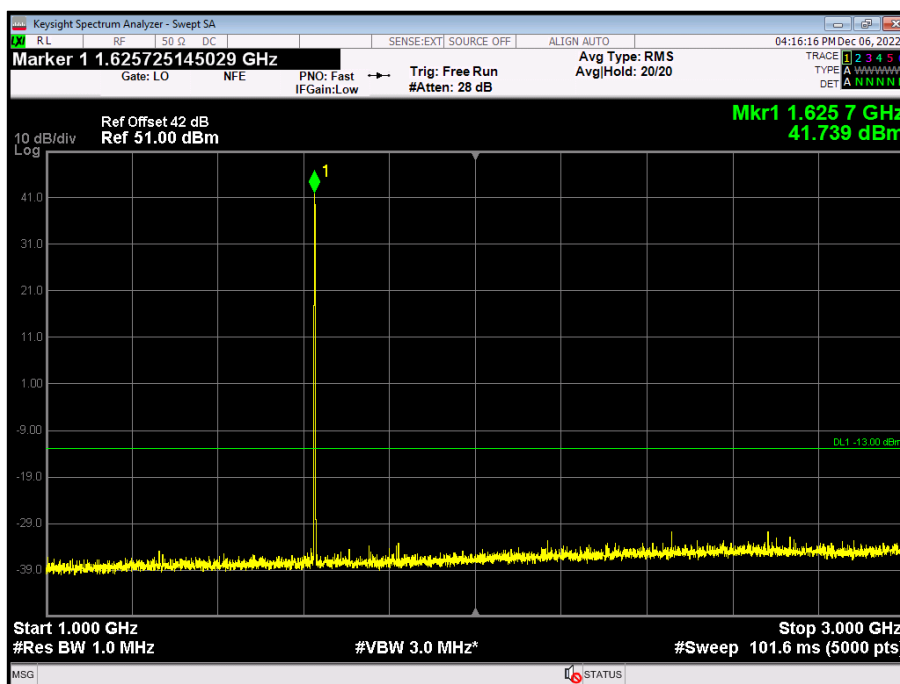


Table 40 - 1625.6666 MHz - 1 GHz to 3 GHz

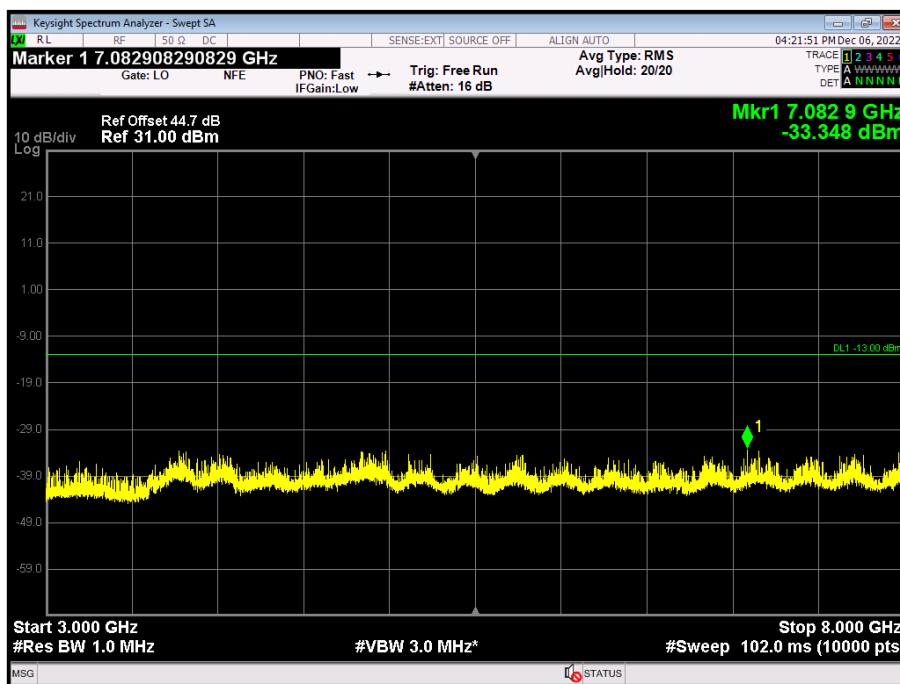


Table 41 - 1625.6666 MHz - 3 GHz to 8 GHz

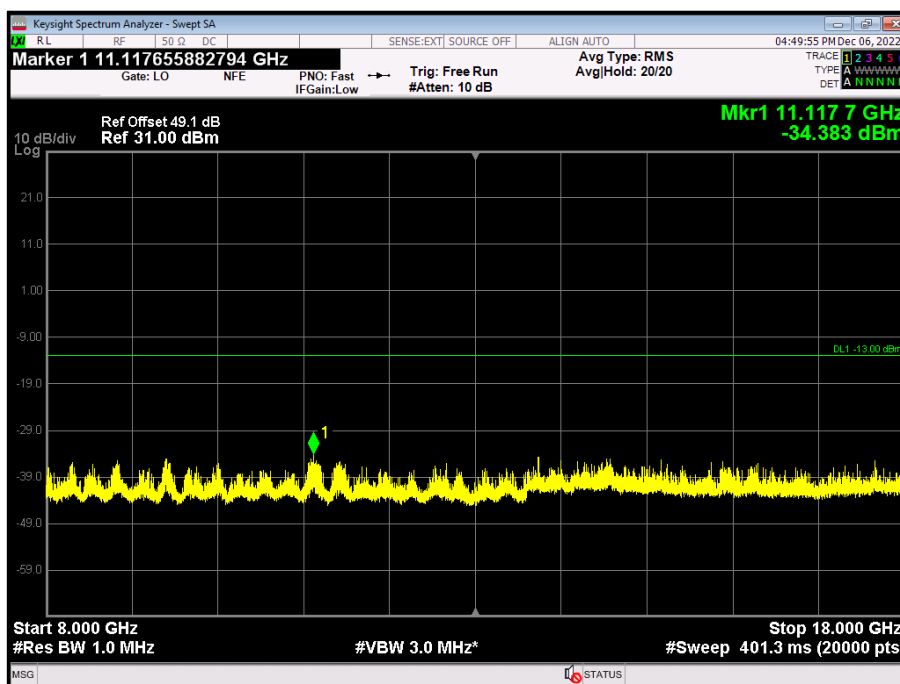


Table 42 - 1625.6666 MHz - 8 GHz to 18 GHz

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:

- 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

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.



2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	24-Feb-2023
Multimeter	Fluke	177	3833	12	16-Dec-2022
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Feb-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4411	12	13-Oct-2023
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	05-Jan-2023
Attenuator 40dB 100W	Weinschel	48-40-43-LIM	5134	12	05-Jan-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023

Table 43

O/P Mon – Output Monitored using calibrated equipment



2.5 Equivalent Isotropic Radiated Power

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

LT-4230, S/N: 0170003 - Modification State 0

2.5.3 Date of Test

02-December-2022

2.5.4 Test Method

Power Spectral Density measurements in a 4 kHz bandwidth were performed in accordance with ANSI C63.26, clause 5.2.3.5 (Peak-PSD).

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:

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

Total EIRP measurements were performed in accordance with ANSI C63.26, clause 5.2.4.4 (average power with integration).

The Antenna Gain was added to the measured Conducted Output Power to determine the EIRP.

2.5.5 Environmental Conditions

Ambient Temperature	21.1 °C
Relative Humidity	38.9 %



2.5.6 Test Results

Iridium - DC powered

EIRP (dBm/4kHz)		
1616.3333 MHz	1621.3333 MHz	1625.6666 MHz
35.5	34.2	33.7

Table 44 - EIRP/4 kHz Results Table

1616.3333 MHz		1621.3333 MHz		1625.6666 MHz	
EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)
43.5	-0.5	42.9	-1.1	43.4	-0.6

Table 45 - EIRP Results Table

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 5.3.2.

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 2.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	24-Feb-2023
Multimeter	Fluke	177	3833	12	16-Dec-2022
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Feb-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	05-Jan-2023
Attenuator 40dB 100W	Weinschel	48-40-43-LIM	5134	12	05-Jan-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023

Table 46

O/P Mon – Output Monitored using calibrated equipment



2.6 Limits on Emissions from Mobile Earth Stations for Protection of Aeronautical Radio Navigation Satellite Service

2.6.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.216
ISED RSS-170, Clause 5.4.3.2.

2.6.2 Equipment Under Test and Modification State

LT-4230, S/N: 0170003 - Modification State 0

2.6.3 Date of Test

20-December-2022

2.6.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.7 within the requirements of FCC CFR 47 Part 25, Clause 25.216 and Industry Canada RSS-170, clause 5.4.3.2.1.

2.6.5 Environmental Conditions

Ambient Temperature	21.9 °C
Relative Humidity	43.8 %



2.6.6 Test Results

Iridium - DC powered

Frequency (MHz)	Level (dBW)
*	

Table 47 - 1616.3333 MHz – Broadband Emission Results

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

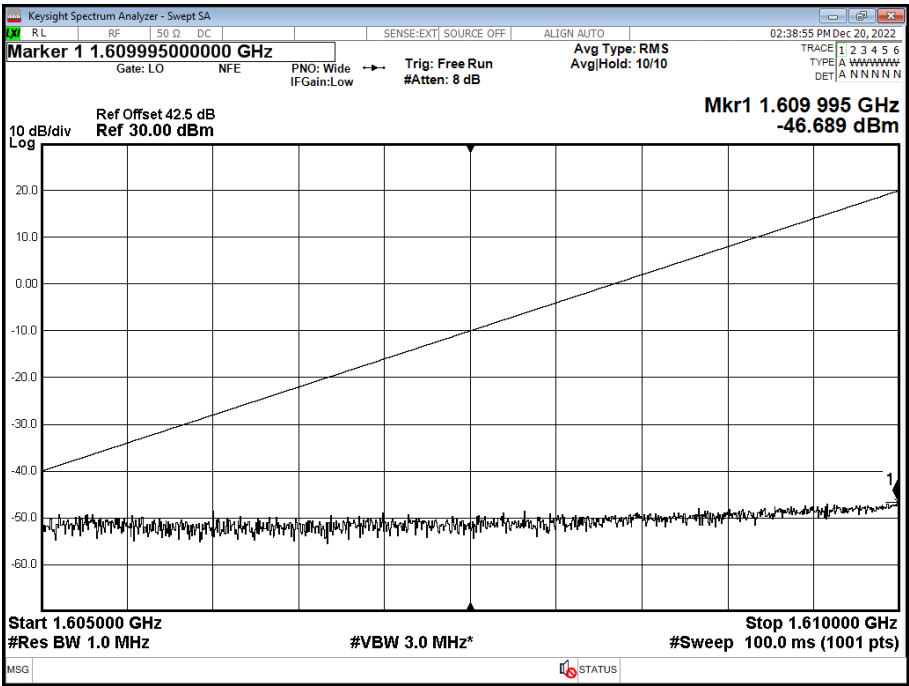


Table 48 - 1616.3333 MHz - Broadband Emission Results

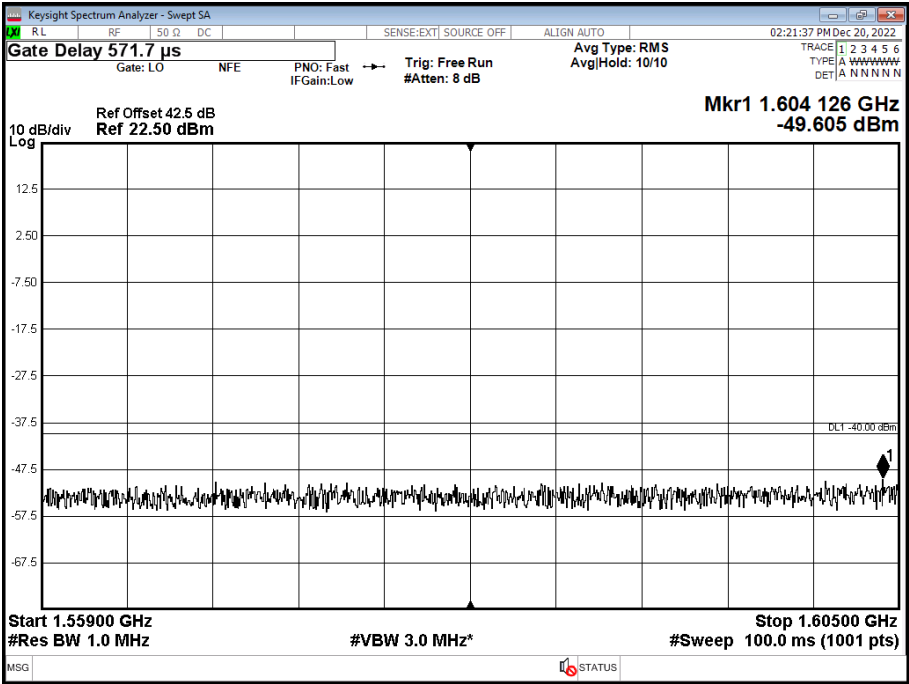


Table 49 - 1616.3333 MHz, 1559 MHz - 1605 MHz, Broadband Emission Results



Frequency (MHz)	Level (dBW)
*	

Table 50 - 1616.3333 MHz - Discrete Emission Results

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

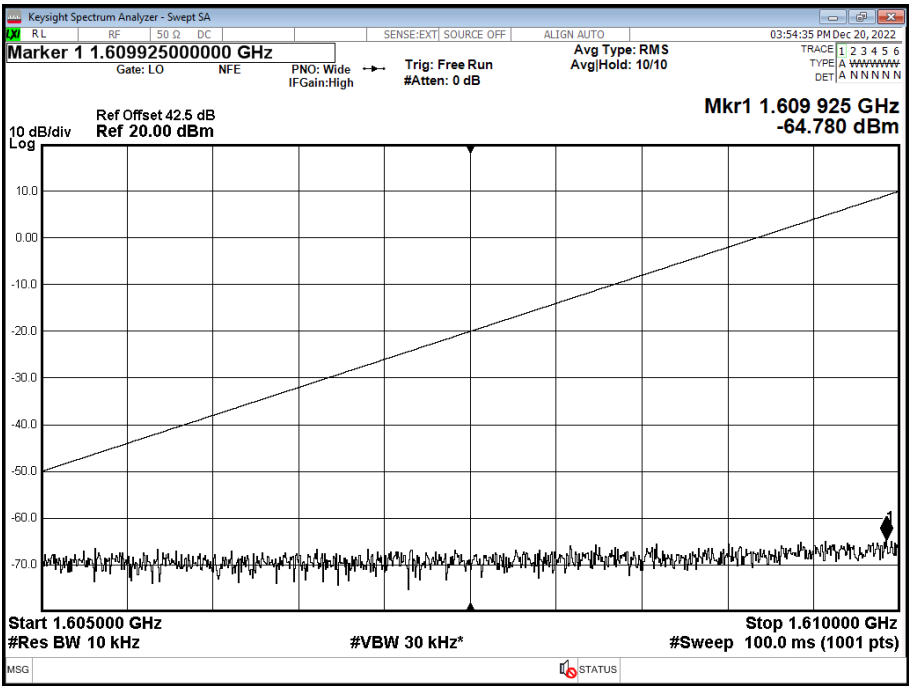


Table 51 - 1616.3333 MHz - Discrete Emission Results

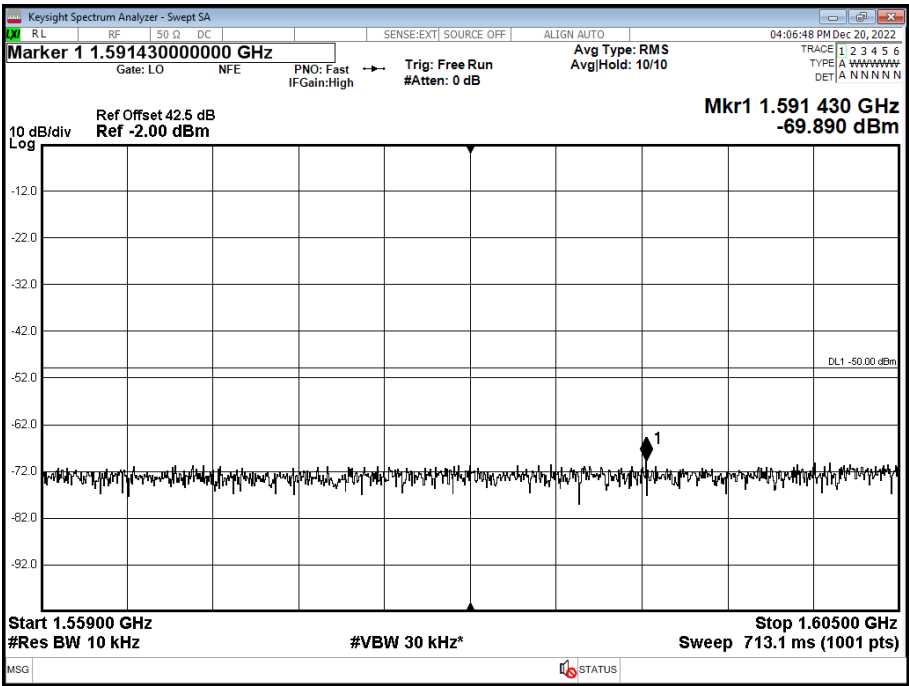


Table 52 - 1616.3333 MHz, 1559 MHz - 1605 MHz, Discrete Emission Results



Frequency (MHz)	Level (dBW)
*	

Table 53 - 1621.3333 MHz - Broadband Emission Results

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

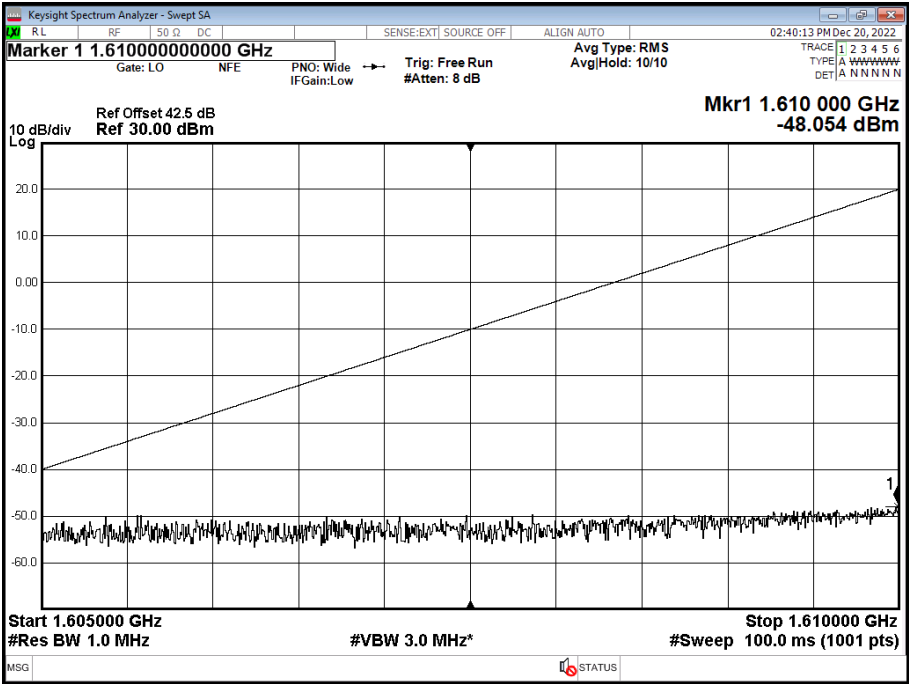


Table 54 - 1621.3333 MHz - Broadband Emission Results

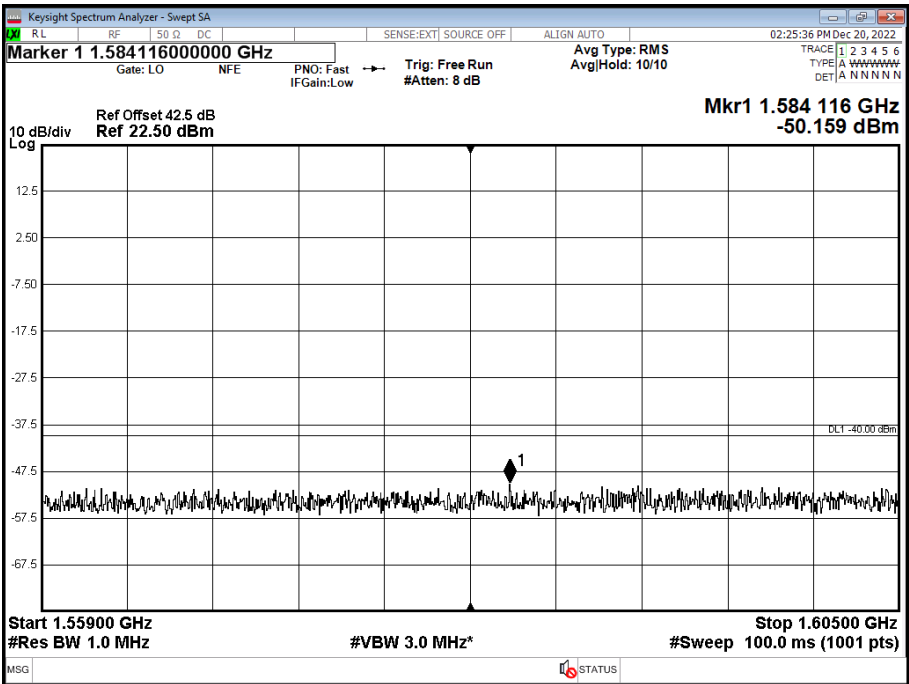


Table 55 - 1621.3333 MHz, 1559 MHz - 1605 MHz, Broadband Emission Results



Frequency (MHz)	Level (dBW)
*	

Table 56 - 1621.3333 MHz - Discrete Emission Results

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

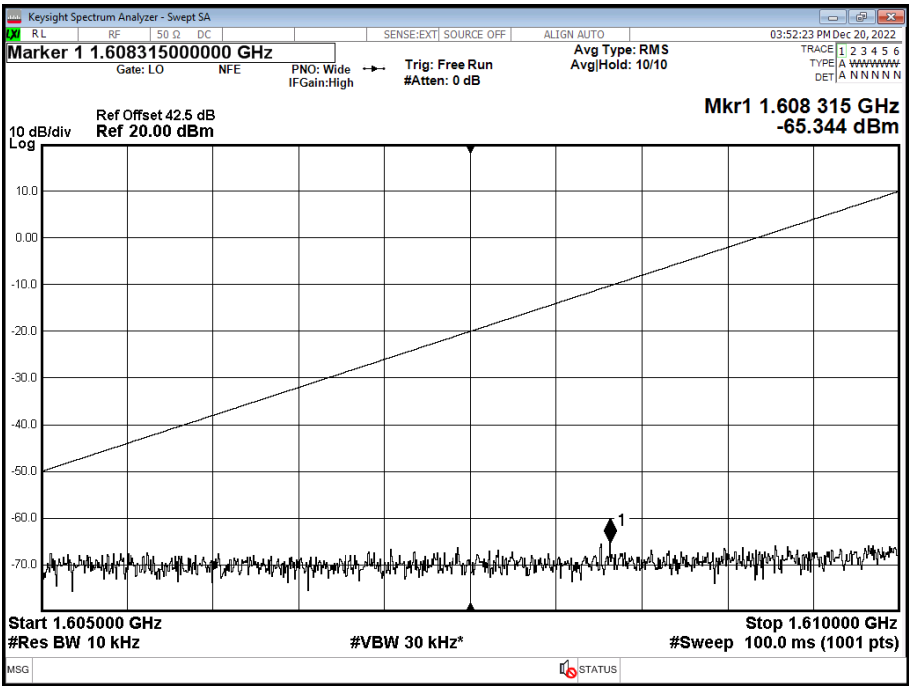


Table 57 - 1621.3333 MHz - Discrete Emission Results

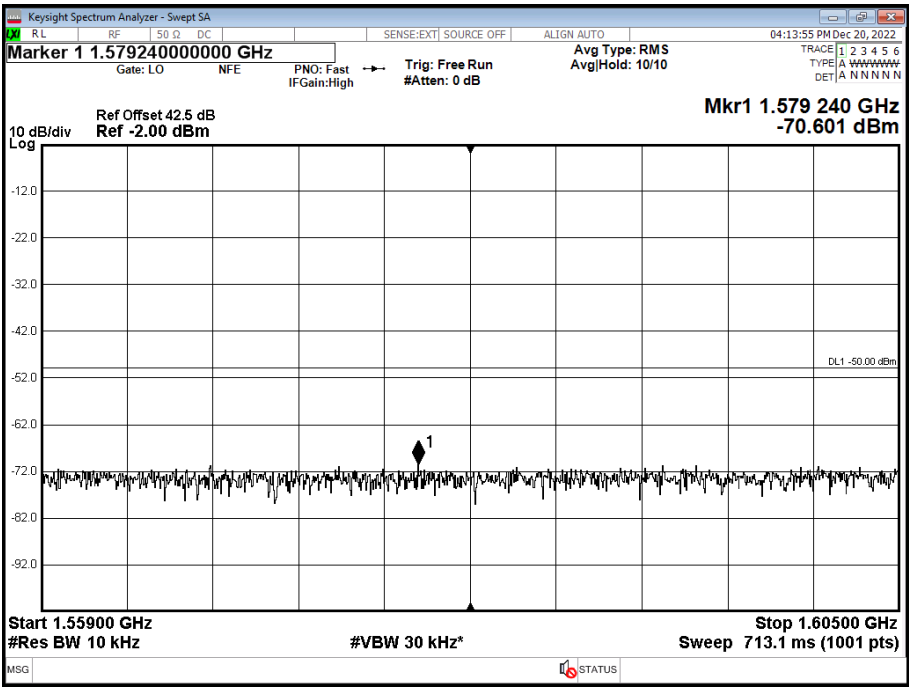


Table 58 - 1621.3333 MHz, 1559 MHz - 1605 MHz, Discrete Emission Results



Frequency (MHz)	Level (dBW)
*	

Table 59 - 1625.6666 MHz - Broadband Emission Results

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

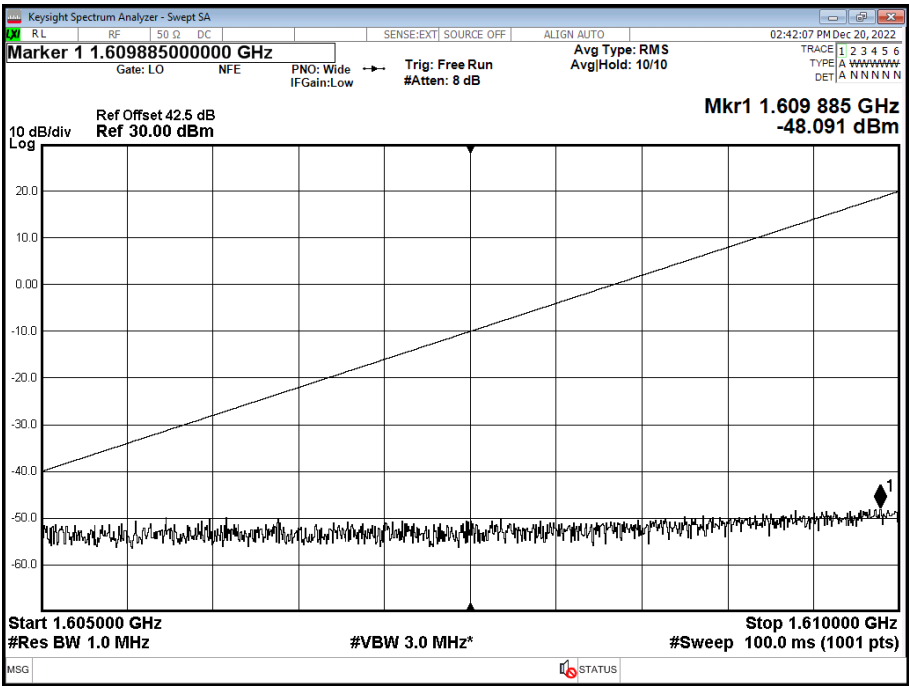


Table 60 - 1625.6666 MHz - Broadband Emission Results

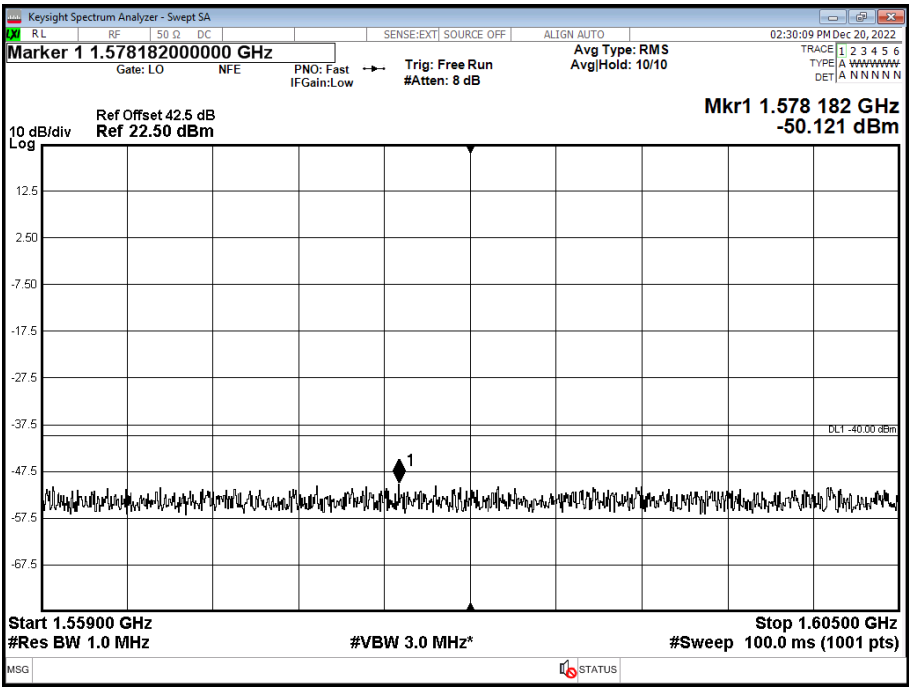


Table 61 - 1625.6666 MHz, 1559 MHz - 1605 MHz, Broadband Emission Results



Frequency (MHz)	Level (dBW)
*	

Table 62 - 1621.3333 MHz - Discrete Emission Results

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

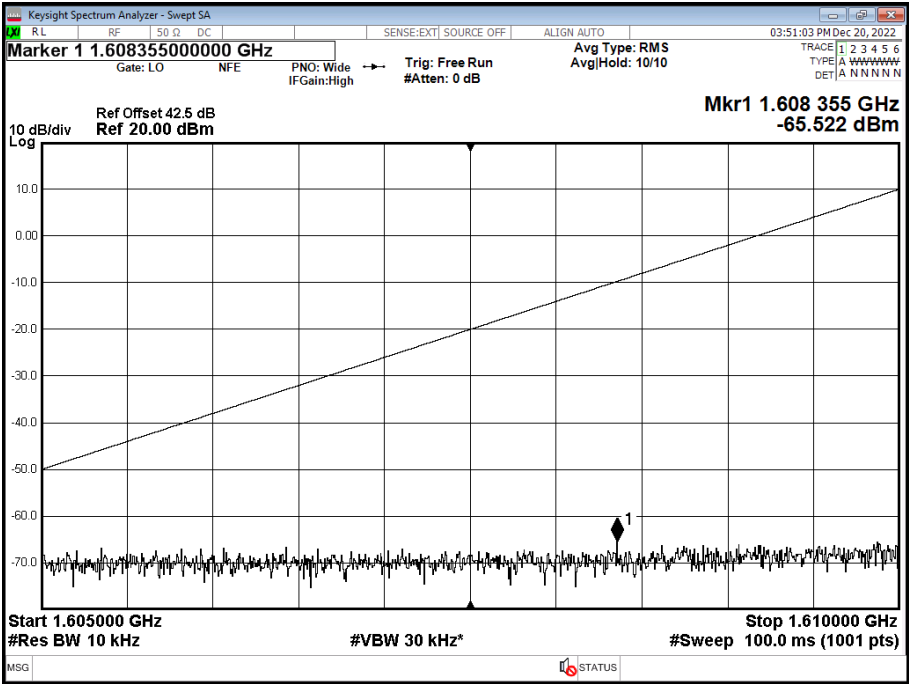


Table 63 - 1621.3333 MHz - Discrete Emission Results

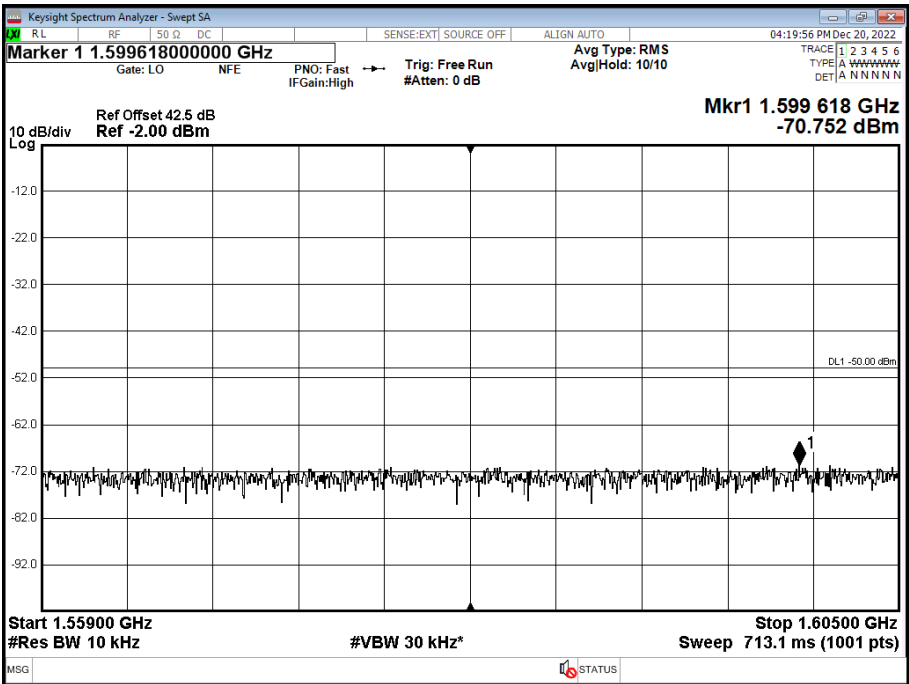


Table 64 - 1621.3333 MHz, 1559 MHz - 1605 MHz, Discrete Emission Results



Frequency (MHz)	Level (dBW)
*	

Table 65 - Carrier-off state

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

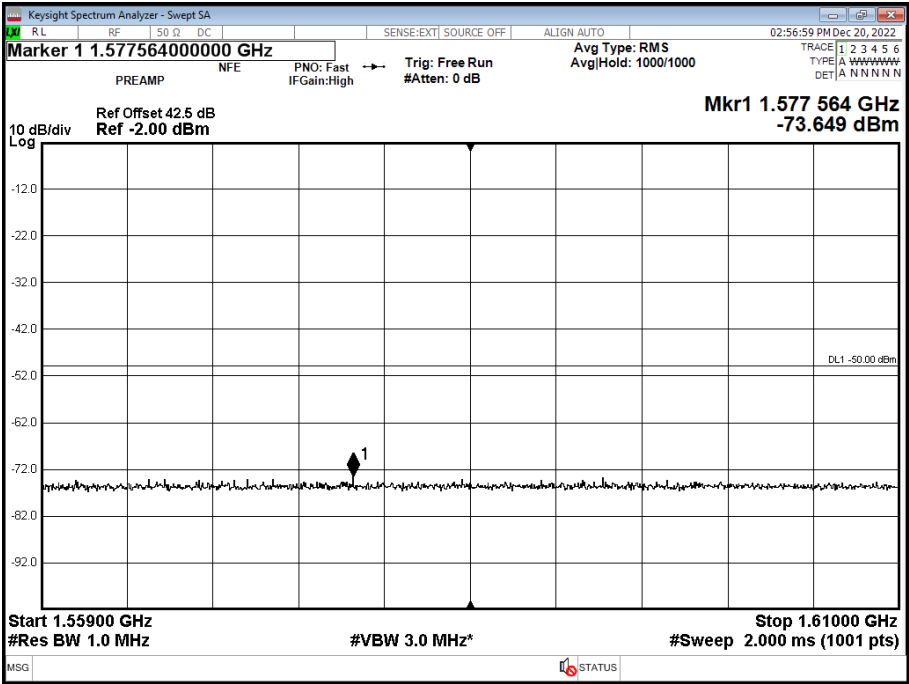


Table 66 - Carrier-off state Emissions

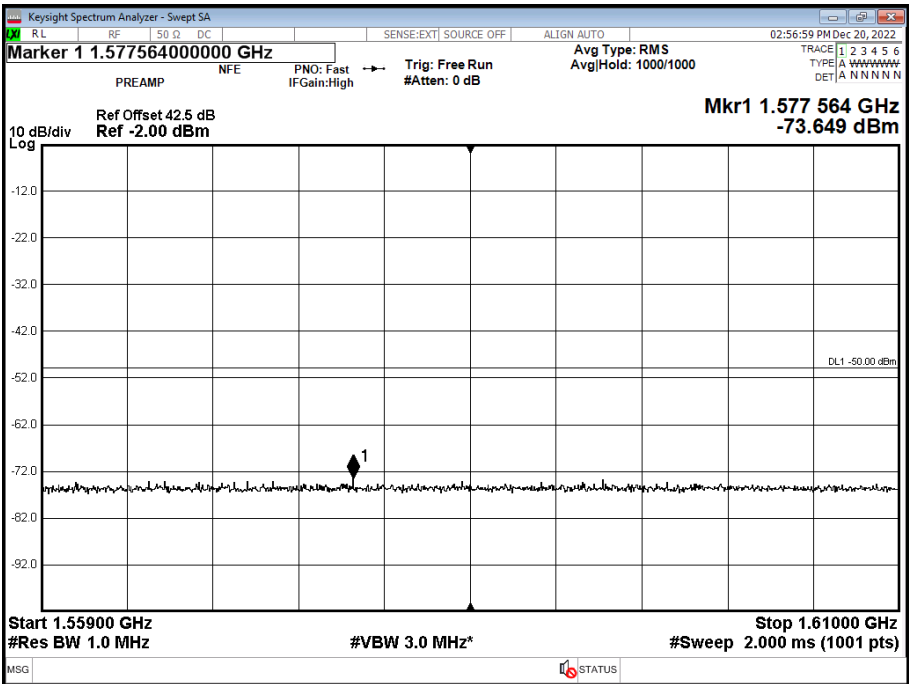


Table 67 - 1559 MHz - 1610 MHz, Carrier-off state Emissions



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.



2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Multimeter	Iso-tech	IDM101	2417	12	28-Nov-2023
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	24-Feb-2023
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Feb-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	05-Jan-2023
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 40dB 100W	Weinschel	48-40-43-LIM	5134	12	05-Jan-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023

Table 68

O/P Mon – Output Monitored using calibrated equipment



2.7 Radiated Spurious Emissions

2.7.1 Specification Reference

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

2.7.2 Equipment Under Test and Modification State

LT-4230, S/N: 01070006 - Modification State 0

2.7.3 Date of Test

13-December-2022 to 16-December-2022

2.7.4 Test Method

A preliminary profile of the Radiated Spurious 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 Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

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

Prescans and final measurements were performed using the direct field strength method.

Field strength measurements were performed and then converted to Equivalent Power Measurements in accordance with ANSI C63.26, Clause 5.2.7 equation c)

Example calculation:

$E \text{ (dBuV/m)} + 20\log(d) - 104.8 = \text{EIRP (dBm)}$ where (d) is the measurement distance.

$82.2 \text{ (dBuV/m)} + 20\log(3) - 104.8 = \text{EIRP (dBm)}$

$-13.0 = \text{EIRP (dBm)}$

2.7.5 Environmental Conditions

Ambient Temperature	16.7 - 18.2 °C
Relative Humidity	23.3 - 29.9 %



2.7.6 Test Results

Iridium - DC powered

Frequency (MHz)	Level (dBm)	Polarisation	Orientation
*			

Table 69 - 1616.3333 MHz, 30 MHz to 18GHz

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

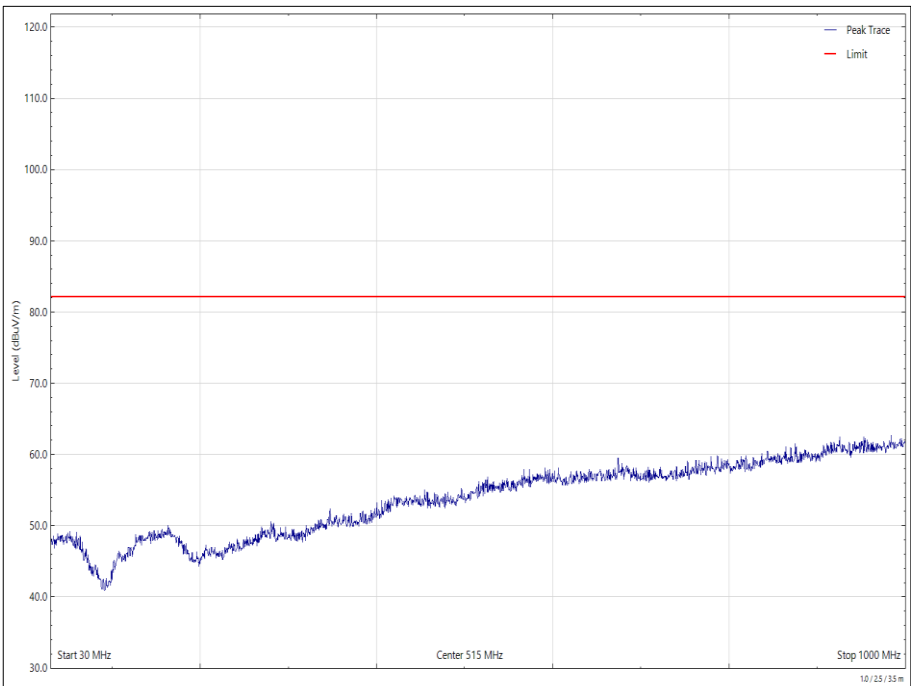


Table 70 - 1616.3333 MHz - 30 MHz to 1 GHz, Horizontal, X Orientation

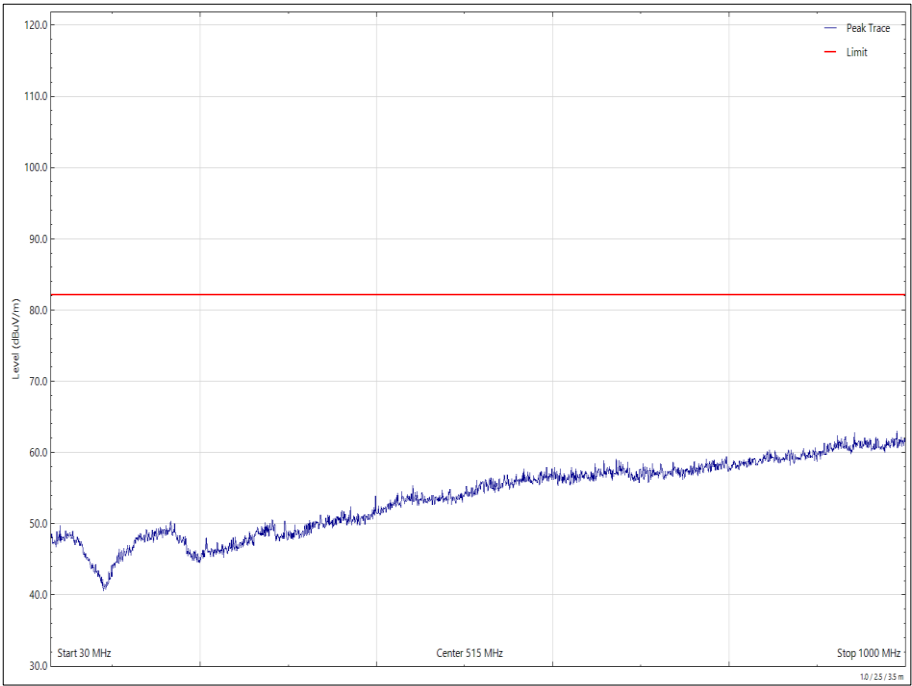


Table 71 - 1616.3333 MHz - 30 MHz to 1 GHz, Vertical, X Orientation

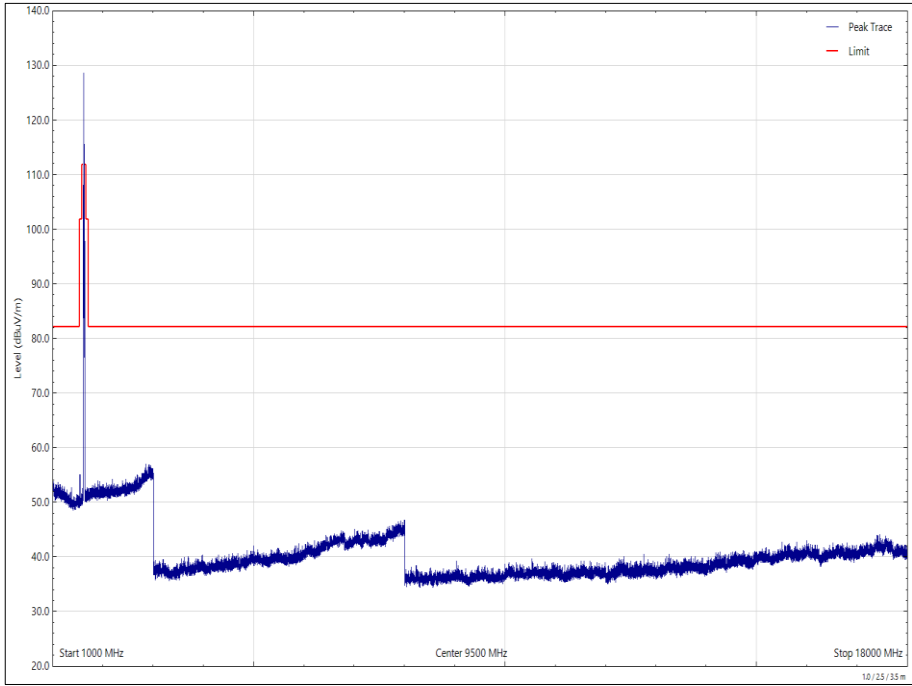


Table 72 - 1616.3333 MHz - 1 GHz to 18 GHz, Horizontal, X Orientation

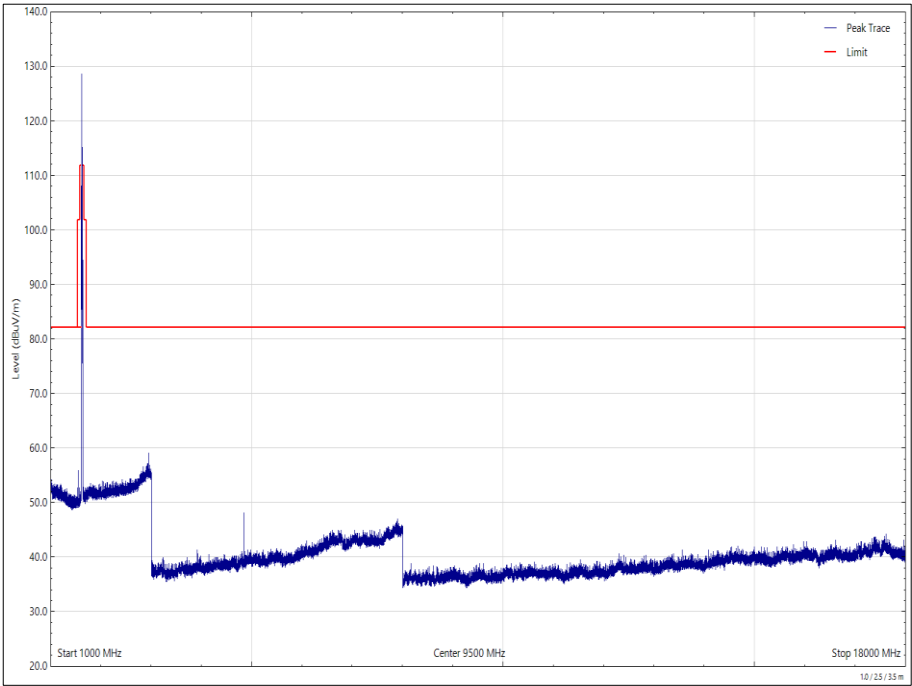


Table 73 - 1616.3333 MHz - 1 GHz to 18 GHz, Vertical, X Orientation



Frequency (MHz)	Level (dBm)	Polarisation	Orientation
*			

Table 74 - 1621.3333 MHz, 30 MHz to 18GHz

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

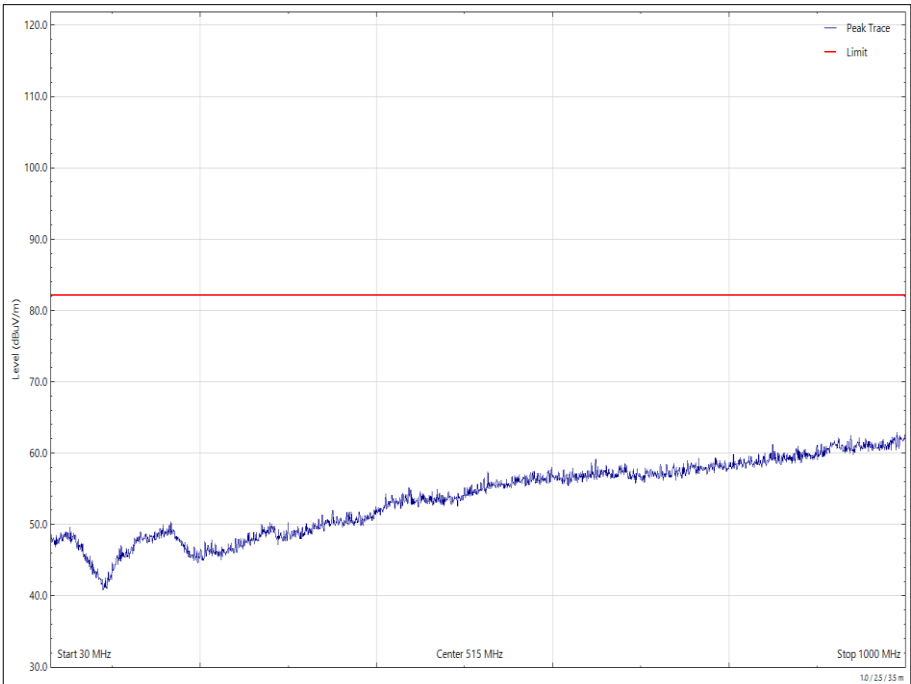


Table 75 - 1621.3333 MHz - 30 MHz to 1 GHz, Horizontal, X Orientation

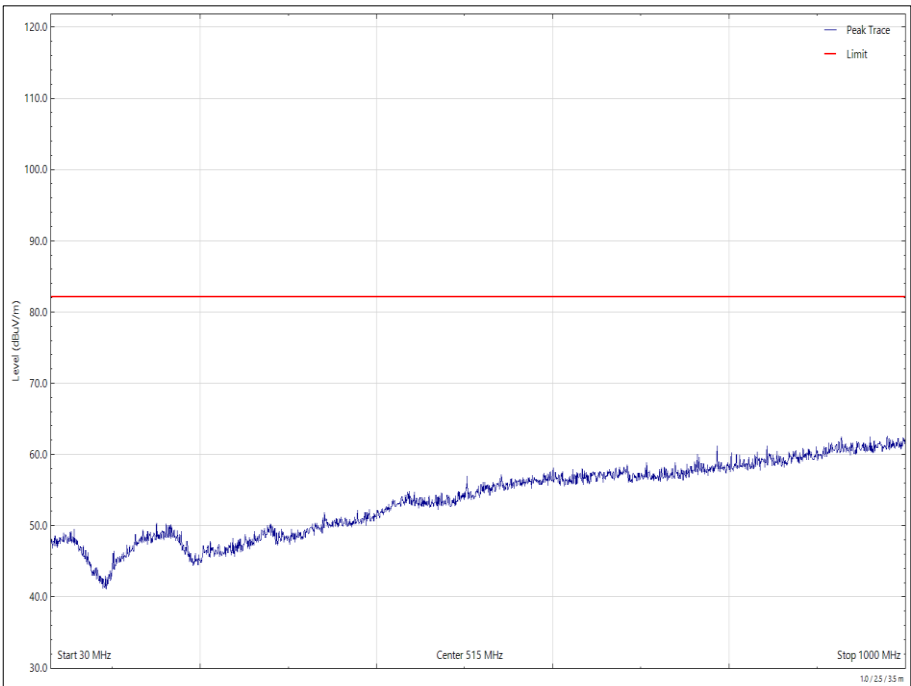


Table 76 - 1621.3333 MHz - 30 MHz to 1 GHz, Vertical, X Orientation

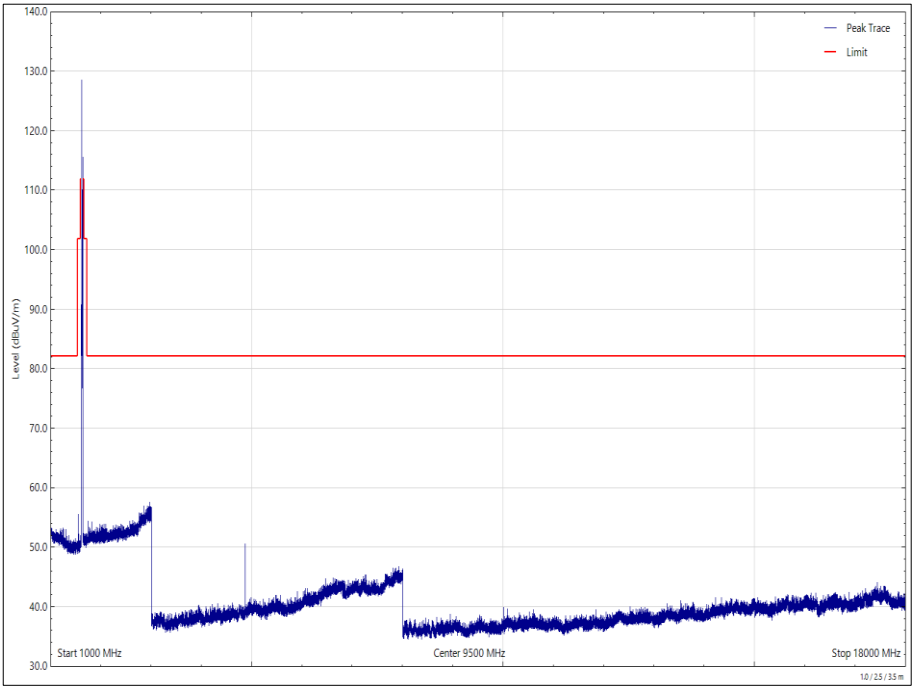


Table 77 - 1621.3333 MHz - 1 GHz to 18 GHz, Horizontal, X Orientation

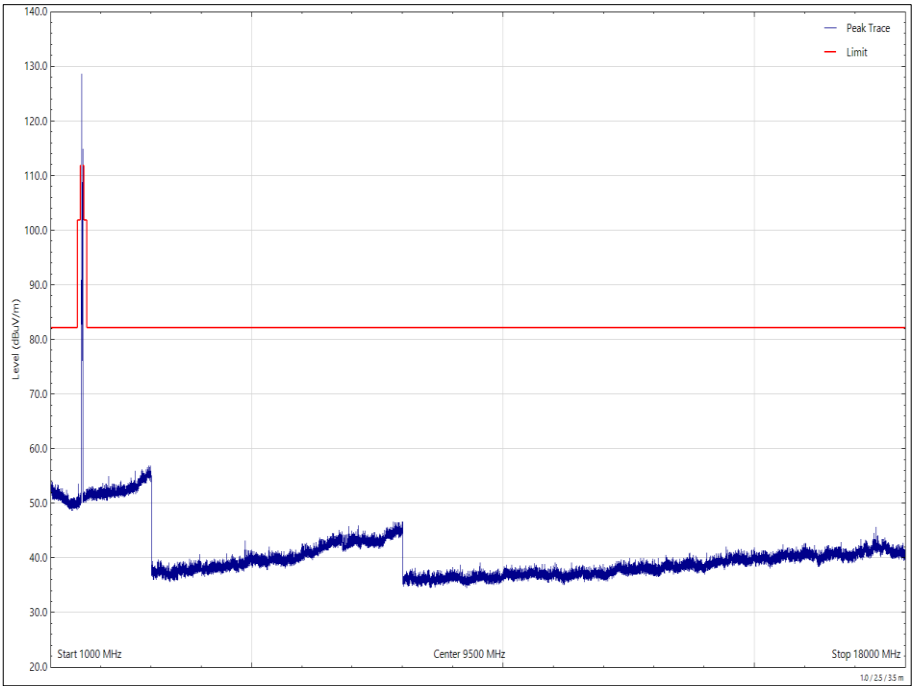


Table 78 - 1621.3333 MHz - 1 GHz to 18 GHz, Vertical, X Orientation



Frequency (MHz)	Level (dBm)	Polarisation	Orientation
*			

Table 79 - 1625.6666 MHz, 30 MHz to 18GHz

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

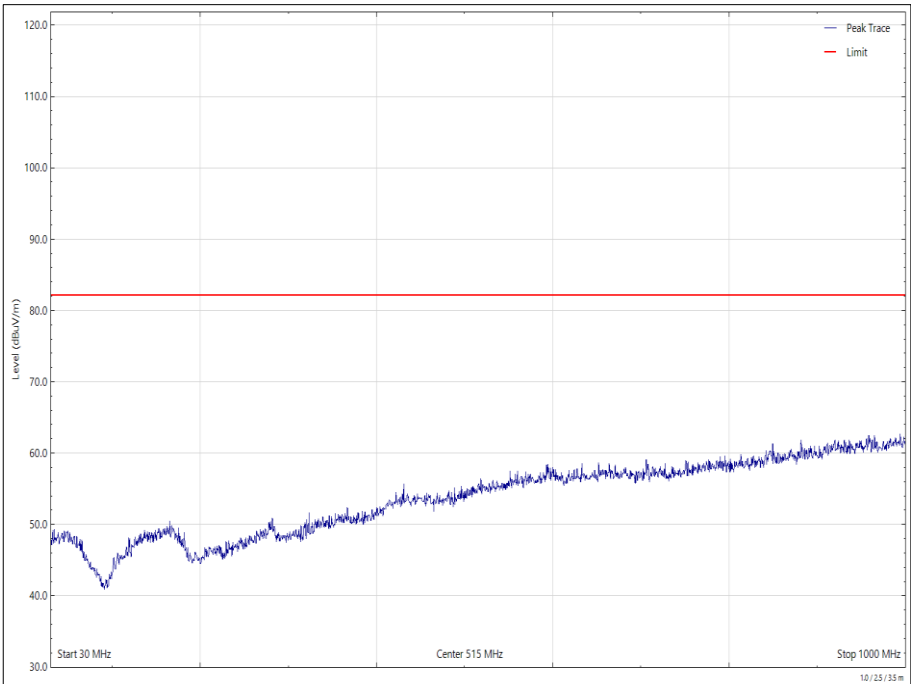


Table 80 - 1625.6666 MHz - 30 MHz to 1 GHz, Horizontal, X Orientation

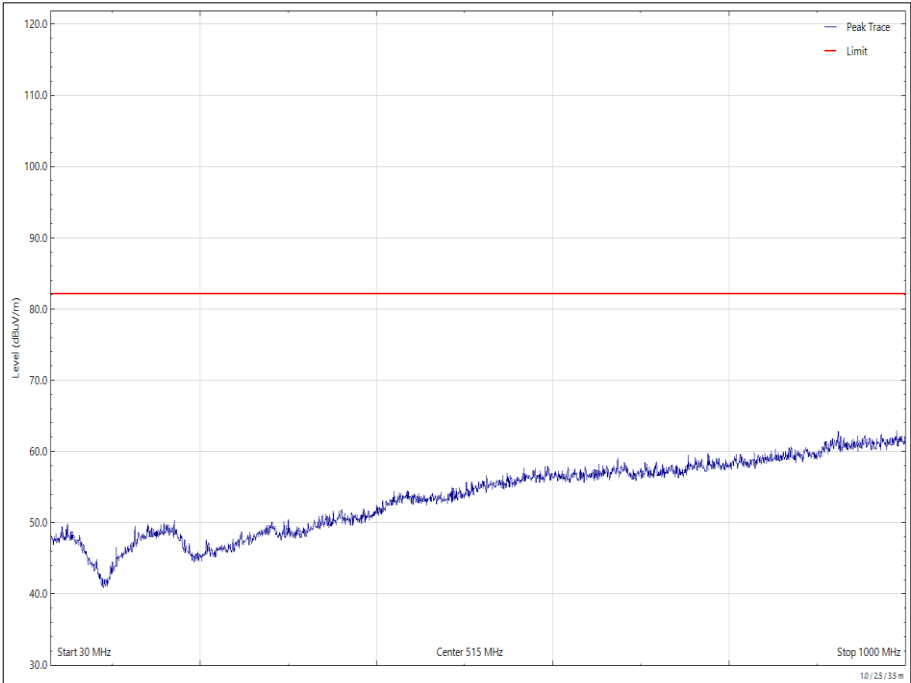


Table 81 - 1625.6666 MHz - 30 MHz to 1 GHz, Vertical, X Orientation

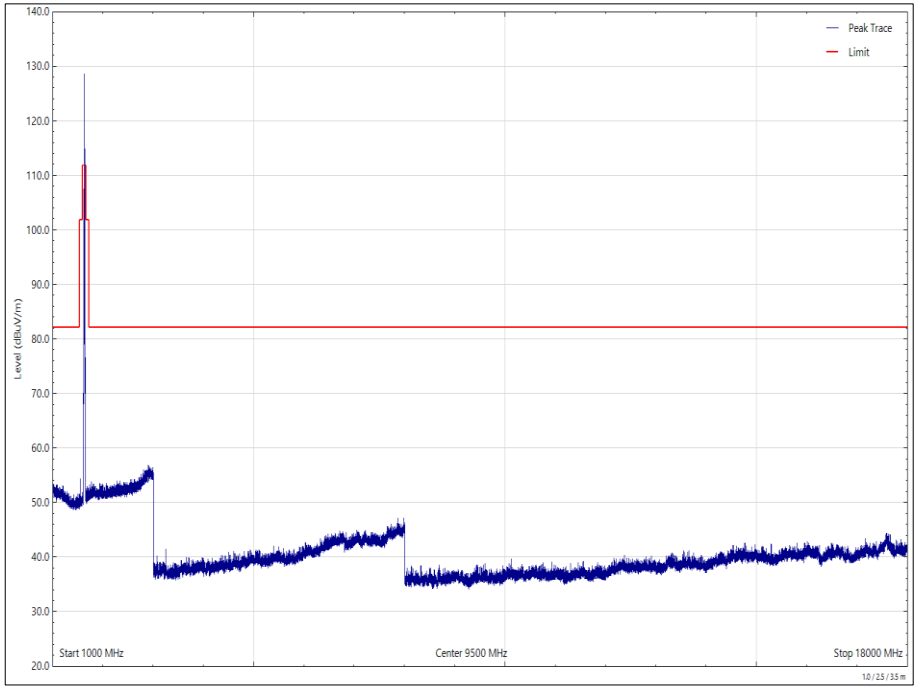


Table 82 - 1625.6666 MHz - 1 GHz to 18 GHz, Horizontal, X Orientation

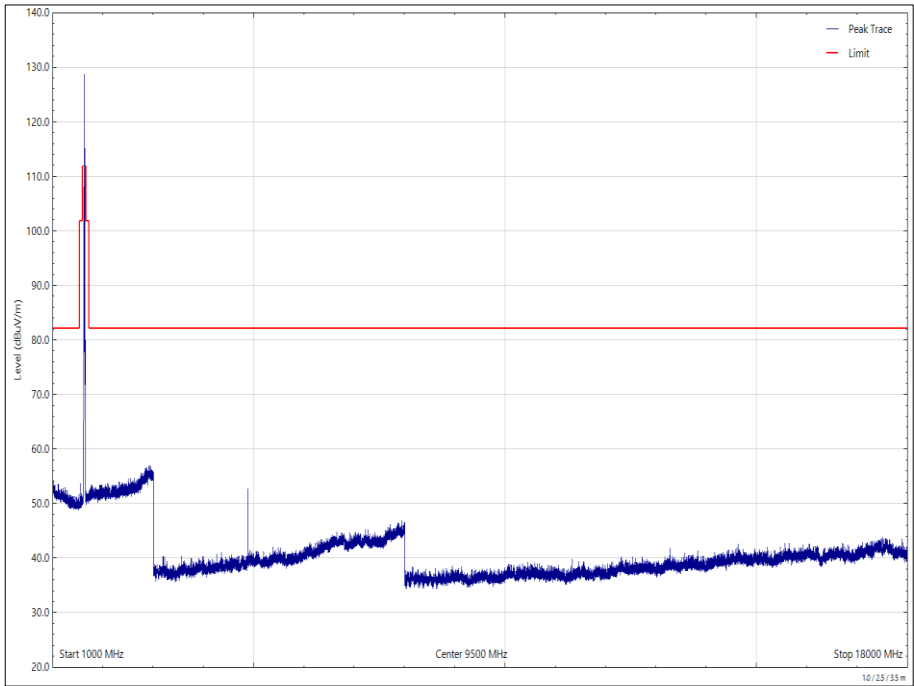


Table 83 - 1625.6666 MHz - 1 GHz to 3 GHz, Vertical, X Orientation



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.



2.7.7 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 Expiry Date
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Dual Power Supply (0-30V, 0-2A)	Farnell	LT30-2	3333	-	TU
True RMS Multimeter	Fluke	179	4007	12	18-Nov-2023
Cable (N-Type to N-Type, 2 m)	Florida Labs	NMS-235SP-78.8-NMS	4622	12	11-Aug-2023
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	28-May-2023
Emissions Software	TUV SUD	EmX V3.1.6 V.	5125	-	Software
3 GHz High pass filter	Wainwright	WHKX12-2580-3000-18000-80SS	5220	12	23-Mar-2023
Pre-Amplifier (1 GHz to 18 GHz)	Schwarzbeck	BBV 9718 C	5350	12	20-Oct-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5476	12	06-Oct-2023
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	12-Apr-2023
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	5519	12	07-Mar-2023
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	28-Apr-2023
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5596	12	25-Oct-2023
Antenna (DRG, 7.5 GHz to 18 GHz)	Schwarzbeck	HWRD750	5610	12	16-Oct-2023
1m K-Type Cable	Junkosha	MWX221/B	5908	12	14-Apr-2023
TRILOG Super Broadband Test Antenna	Schwarzbeck	VULB 9168	5942	24	03-Feb-2024
Attenuator 4dB	Pasternack	PE7074-4	6202	24	16-Jul-2024

Table 84

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Test Setup Photographs



Table 85 - Test Setup Photo - 30 MHz to 1 GHz

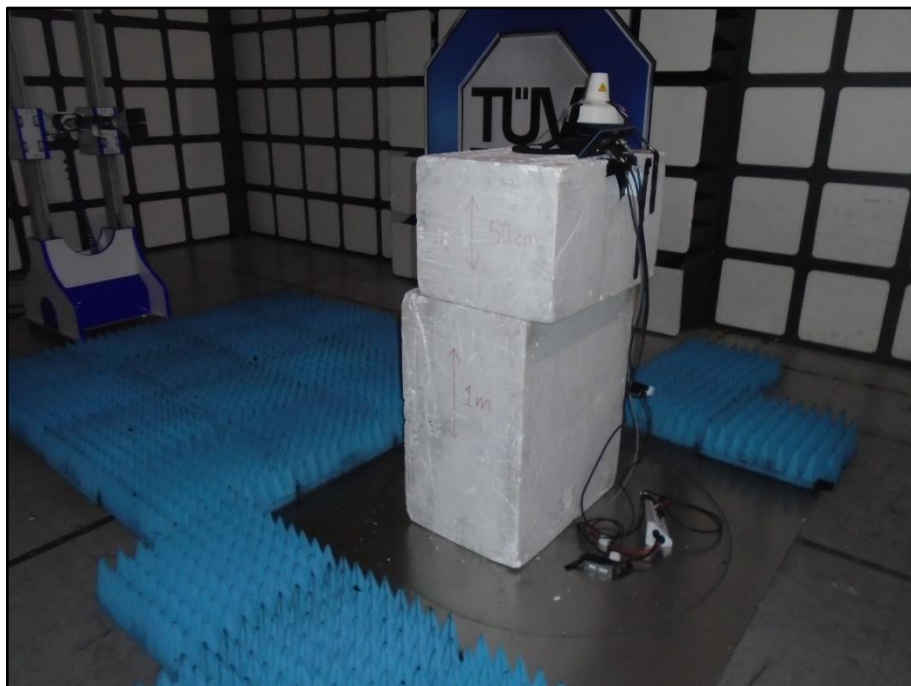


Table 86 - Test Setup Photo - 1 to 18 GHz



4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Modulation Characteristics	-
Occupied Bandwidth	± 16.74 kHz
Frequency Tolerance	± 3.54 Hz
Spurious Emissions at Antenna Terminals	± 3.08 dB
Equivalent Isotropic Radiated Power	Conducted: ± 3.2 dB Radiated: ± 6.3 dB (1 GHz to 18 GHz)
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

Table 87

Measurement Uncertainty Decision Rule – Accuracy Method

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.