FCC and ISED Test Report

Sepura Limited
Tetra radio, Model: SCG2221

In accordance with FCC 47 CFR Part 2, FCC 47 CFR Part 90, ISED RSS-119 and ISED RSS-GEN (TETRA)

Prepared for: Sepura Limited
9000 Cambridge Research Park
Beach Drive, Waterbeach, Cambridge
CB25 9TL, United Kingdom

FCC ID: XX6SCG2221M IC: 8739A-SCG2221ME

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Document 75956225-04 Issue 02

SIGNATURE			
Ryan Henley			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Ryan Henley	Business Development Manager	Authorised Signatory	30 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 90, ISED RSS-119 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Simon Bennett	30 March 2023	
Testing	Ahmad Javid	30 March 2023	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED 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 90: 2021, ISED RSS-119: Issue 12 (05-2015) and ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019) + A2 (02-2021) for the tests detailed in section 1.3.

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ACCREDITATION
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Contents

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	27-March-2023
2	Correct antenna gain in section 2.1.6.	30-March-2023

Table 1

1.2 Introduction

Applicant	Sepura Limited
Manufacturer	Sepura Limited
Model Number(s)	SCG2221
Serial Number(s)	1PR002230GP58OM
Hardware Version(s)	B Model
Software Version(s)	1807 007 10138
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 2: 2021 FCC 47 CFR Part 90: 2021 ISED RSS-119: Issue 12 (05-2015) ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019) + A2 (02-2021)
Order Number Date	PLC-PO023123-1 26-July-2022
Date of Receipt of EUT	07-November-2022
Start of Test	14-December-2022
Finish of Test	20-December-2022
Name of Engineer(s)	Simon Bennett and Ahmad Javid
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 90, ISED RSS-119 and ISED RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Part 2	Part 90	RSS-119	RSS-GEN			
Configuration and Mode: Tetra - 136 MHz to 174 MHz (ISEDC only)							
2.1			5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.26: 2015
2.2	-	-	5.5	6.7	Bandwidth Limitations	Pass	ANSI C63.26: 2015
2.3	-	-	5.8	6.13	Spurious Emissions at Antenna Terminals	Pass	ANSI C63.26: 2015
2.4	-	-	5.8	6.13	Radiated Spurious Emissions	Pass	ANSI C63.26: 2015
2.5	-	-	5.3	6.11	Frequency Stability	Pass	ANSI C63.26: 2015
2.6	-	-	5.9	-	Transient Frequency Behaviour	Pass	
2.7	-	-	5.2	-	Types of Emissions	Pass	
Configuration and Mode: Tetra - 150 MHz to 174 MHz (FCC and ISEDC)							
2.1	2.1046	90.205	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.26: 2015
2.2	2.1049	90.209	5.5	6.7	Bandwidth Limitations	Pass	ANSI C63.26: 2015
2.3	2.1051	90.210	5.8	6.13	Spurious Emissions at Antenna Terminals	Pass	ANSI C63.26: 2015
2.4	2.1053	90.210	5.8	6.13	Radiated Spurious Emissions	Pass	ANSI C63.26: 2015
2.5	2.1055	90.213	5.3	6.11	Frequency Stability	Pass	ANSI C63.26: 2015
2.6	-	90.214	5.9	-	Transient Frequency Behaviour	Pass	
2.7	2.1047	90.207	5.2	-	Types of Emissions	Pass	

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment including the technologies the product supports)*	The SCG2221 is a TETRA mobile radio in the SCG22 series of radios, operating in the VHF band, with TETRA operating frequencies 136-174 MHz. The SCG2221 supports GNSS, Bluetooth, Bluetooth LE, WLAN at 2.4 GHz and a range of accessories and ancillary equipment. The SCG2221 may be installed in a vehicle or in a desk mount unit.
Manufacturer:	Sepura Limited
Model:	SCG2221
Part Number:	SCG2221
Hardware Version:	B Model
Software Version:	1807 007 10138
FCC ID of the product under test – see guidance here	XX6SCG2221M
IC ID of the product under test – see guidance here	8739A-SCG2221ME

Table 3

Intentional Radiators

Technology	TETRA	Bluetooth	WLAN 802.11b	WLAN 802.11g	WLAN 802.11n	BLE
Frequency Range (MHz to MHz)	136-174	2402-2480	2412-2462	2412-2462	2412-2462	2402-2480
Conducted Declared Output Power (dBm)	40	7.5	17	17	17	7.5
Antenna Gain (dBi)	2	2.2	2.2	2.2	2.2	2.2
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	0.025	1	20	20	20	2
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	π/4 DQPSK	GFSK / π/4-DPSK / 8-DPSK	CCK / DBPSK / DQPSK	OFDM (BPSK / QPSK / 16-QAM / 64-QAM)	BPSK / QPSK / 16-QAM / 64-QAM)	GFSK
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	20K0DXW	1M01F1D 1M01G1D	19M7G1D	19M7G1D	19M7D1D	1M81F1D
Bottom Frequency (MHz)	136	2402	2412	2412	2412	2402
Middle Frequency (MHz)	155	2441	2437	2437	2437	2441
Top Frequency (MHz)	174	2480	2462	2462	2462	2480

Table 4

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	2480 MHz
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:	13.6	V
Extreme upper voltage:	15.6	V
Extreme lower voltage:	10.8	V
Max current:	4	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 . Unit does not charge	Yes ☐ No ☐

Table 9

Temperature

Minimum temperature:	-20	°C
Maximum temperature:	+60	°C

Table 10

Cable Loss

Adapter Cable Loss (Conducted sample)	N/A	dB

Table 11

Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☐	Type:		Gain		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:	Panorama Antennas	Part Number:	AFQNT-H5
Model:	TETRA antenna	Country of Origin:	UK
Manufacturer:	Microchip	Part Number:	RN-SMA-4
Model:	WLAN Antenna	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00063
Model:	GNSS Antenna	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-02012 rev001
Model:	Extended SCG Loudspeaker / IO USB Host lead	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-02014 rev001
Model:	Extended SCG Expansion Board Loudspeaker / 8 GPIO lead	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	Netgear GS105 ProSAFE Gigabit Switch
Model:	Netgear GS105 ProSAFE Gigabit Switch	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-02010
Model:	SCG Power/ignition Lead	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00069
Model:	Mobile Remote Cable 5.0M	Country of Origin:	Unknown

Manufacturer:	Sepura	Part Number:	300-00670
Model:	HBC Interface and Hands-free Box	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00079
Model:	Remote Microphone And Switch Set	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00292
Model:	Remote Microphone (Handsfree Kit) 3m	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-01801
Model:	Handset Based Console (HBC3)	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00062
Model:	Fist microphone	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-01808
Model:	SCC3 (colour console)	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-01961
Model:	CC VAC RSM (Long Cable)	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-00719
Model:	Loudspeaker	Country of Origin:	Unknown
Manufacturer:	Sepura	Part Number:	300-02009
Model:	USB Data/Programming Lead	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-02012
Model:	SCG Loudspeaker / IO USB Host lead	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-02014
Model:	SCG Expansion Board Loud Speaker / 8 GPIO Lead	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-00784
Model:	AMPS attachments	Country of Origin:	UK
Manufacturer:	Sepura	Part Number:	300-00068
Model:	Mobile Remote Cable 3.0M	Country of Origin:	UK

Table 13

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

Name: Chris Beecham
Position held: Conformance Engineer
Date: 14 October 2022

1.5 Product Information

1.5.1 Technical Description

The SCG2221 is a TETRA mobile radio in the SCG22 series of radios, operating in the VHF band, with TETRA operating frequencies 136-174 MHz. The SCG2221 supports GNSS, Bluetooth, Bluetooth LE, WLAN at 2.4 GHz and a range of accessories and ancillary equipment.

The SCG2221 may be installed in a vehicle or in a desk mount unit.

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: SCG2221, Serial Number: 1PR002230GP58OM			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 14

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: Tetra - 136 MHz to 174 MHz (ISEDC only)		
Maximum Conducted Output Power	Simon Bennett	UKAS
Bandwidth Limitations	Simon Bennett	UKAS
Spurious Emissions at Antenna Terminals	Simon Bennett	UKAS
Radiated Spurious Emissions	Ahmad Javid	UKAS
Frequency Stability	Simon Bennett	UKAS
Transient Frequency Behaviour	Simon Bennett	UKAS
Types of Emissions	Simon Bennett	UKAS
Configuration and Mode: Tetra - 150 MHz to 174 MHz (FCC and ISEDC)		
Maximum Conducted Output Power	Simon Bennett	UKAS
Bandwidth Limitations	Simon Bennett	UKAS
Spurious Emissions at Antenna Terminals	Simon Bennett	UKAS
Radiated Spurious Emissions	Ahmad Javid	UKAS
Frequency Stability	Simon Bennett	UKAS
Transient Frequency Behaviour	Simon Bennett	UKAS
Types of Emissions	Simon Bennett	UKAS

Table 15

Office Address:

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

2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 2. Clause 2.1046
FCC 47 CFR Part 90, Clause 90.205
ISED RSS-119, Clause 5.4
ISED RSS-GEN, Clause, 6.12

2.1.2 Equipment Under Test and Modification State

SCG2221, S/N: 1PR002230GP58OM - Modification State 0

2.1.3 Date of Test

14-December-2022

2.1.4 Test Method

The test was applied in accordance with the test method requirements of FCC 47 CFR Part 90, Industry Canada RSS-119, and ISED RSS-GEN with reference to ANSI C63.26, clause 5.2.4.2.

The EUT was configured to transmit on maximum power on the bottom, middle and top channels in burst mode. The EUT was connected to a Power Meter via a cable and 50 dB of attenuation. The path loss was measured using a network analyser and entered as an offset in the Power Meter. The Power Meter was set to trigger on the bursts and the average power recorded.

2.1.5 Environmental Conditions

Ambient Temperature	20.4 °C
Relative Humidity	30.0 %

2.1.6 Test Results

Tetra - 136 MHz to 174 MHz (ISEDC only)

Parameter	138.025 MHz	156.000 MHz	173.975 MHz
	Result (dBm)	Result (dBm)	Result (dBm)
Conducted Output Power (dBm)	39.44	39.39	39.38
Maximum Declared Conducted Output Power (dBm)	40.00	40.00	40.00
Δ (dB)	-0.56	-0.61	-0.62
Antenna Gain (dBd)	-0.15	-0.15	-0.15
ERP (dBm)	39.29	39.24	39.23

Table 16 - ERP

Tetra - 150 MHz to 174 MHz (FCC and ISEDC)

Parameter	150.025 MHz	162.000 MHz	173.975 MHz
	Result (dBm)	Result (dBm)	Result (dBm)
Conducted Output Power (dBm)	39.44	39.41	39.44
Maximum Declared Conducted Output Power (dBm)	40.00	40.00	40.00
Δ (dB)	-0.56	-0.59	-0.56
Antenna Gain (dBd)	-0.15	-0.15	-0.15
ERP (dBm)	39.29	39.26	39.29

Table 17 - ERP

FCC 47 CFR Part 90, Limit Clause 90.205

Frequency (MHz)	Limit
< 25	1000 W
25 to 50	300 W
72 to 76	300 W
150 to 174	Refer to 90.205 (d) of the specification
217 to 220	Refer to 90.259 of the specification
220 to 222	Refer to 90.729 of the specification
421 to 430	Refer to 90.279 of the specification
450 to 470	Refer to 90.205 (h) of the specification
470 to 512	Refer to 90.307 and 90.309 of the specification
758 to 775 and 788 to 805	Refer to 90.541 and 90.542 of the specification
806 to 824, 851 to 869, 869 to 901 and 935 to 940	Refer to 90.635 of the specification
902 to 927.25	LMS systems operating pursuant to subpart M of the specification : 30 W
927.25 to 928	LMS equipment: 300 W
929 to 930	Refer to 90.494 of the specification
1427 to 1429.5 and 1429.5 to 1432	Refer to 90.259 of the specification
2450 to 2483.5	5 W
4940 to 4990	Refer to 90.1215 of the specification
5850 to 5925	Refer to subpart M of the specification
All other frequency bands	On a case by case basis

Table 18 - FCC Limits for Maximum ERP

Industry Canada RSS-119, Limit Clause 5.4

The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications.

Frequency (MHz)	Transmitter Output Power (W)	
	Base/Fixed Equipment	Mobile Equipment
27.41-28 and 29.7-50	300	30
72-76	No limit	1
138-174	110	60
217-218 and 219-220	110	30*
220-222	See SRSP-512 for ERP limit	50
406.1-430 and 450-470	110	60
768-776 and 798-806	See SRSP-511 for ERP limit	30 3 W ERP for portable equipment
806-821/851-866 and 821-824/866-869	110	30
896-901/935-940	110	60
929-930/931-932	110	30
928-929/952-953 and 932-932.5/941-941.5	110	30
932.5-935/941.5-944	110	30
*Equipment is generally authorised for effective radiated power (ERP) of less than 5 W.		

Table 19 - Industry Canada Limits for Transmitter Output Power

2.1.7 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 Expires
Power Supply Unit	Farnell	H60-25	1092		O/P Mon
Multimeter	Iso-tech	IDM101	2417	12	28-Nov-2023
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	28-Jul-2023
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-Jul-2023
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	24-Feb-2023
P-Series Power Meter	Agilent Technologies	N1911A	3980	12	16-Nov-2023
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3982	12	16-Nov-2023
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Feb-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023

Table 20

O/P Mon – Output Monitored using calibrated equipment

2.2 Bandwidth Limitations

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049
FCC 47 CFR Part 90, Clause 90.209
ISED RSS-119, Clause 5.5
ISED RSS-GEN, Clause, 6.7

2.2.2 Equipment Under Test and Modification State

SCG2221, S/N: 1PR002230GP58OM - Modification State 0

2.2.3 Date of Test

14-December-2022

2.2.4 Test Method

The test was applied in accordance with the test method requirements of FCC 47 CFR Part 90, Industry Canada RSS-119, and ISED RSS-GEN with reference to ANSI C63.26, Clause 5.4.4.

The EUT was configured to transmit on maximum power on the bottom, middle and top channels in burst mode. The EUT was connected to a spectrum analyser via a cable and 50dB of attenuation. The path loss was measured using a network analyser and entered as a reference level offset in the spectrum analyser. The RBW of the spectrum analyser was set to 300 Hz and the video bandwidth to 1 kHz with the trace set to max hold using a peak detector and the result was recorded.

2.2.5 Environmental Conditions

Ambient Temperature	20.6 °C
Relative Humidity	31.9 %

2.2.6 Test Results

Tetra - 136 MHz to 174 MHz (ISEDC only)

138.025 MHz	156.000 MHz	173.975 MHz
19.107	19.134	19.149

Table 21 - Occupied Bandwidth Results

Figure 1 - 138.025 MHz Occupied Bandwidth

Figure 2 - 156.000 MHz Occupied Bandwidth

Figure 3 - 173.975 MHz Occupied Bandwidth

Tetra - 150 MHz to 174 MHz (FCC and ISEDC)

150.025 MHz	162.000 MHz	173.975 MHz
19.084	19.123	19.149

Table 22 - Occupied Bandwidth Results

Figure 4 - 150.025 MHz Occupied Bandwidth

Figure 5 - 162.000 MHz Occupied Bandwidth

Figure 6 - 173.975 MHz Occupied Bandwidth

FCC 47 CFR Part 90, Limit Clause 90.209

< 20 kHz

Industry Canada RSS-119, Limit Clause 5.5

The maximum permissible occupied bandwidth shall not exceed the authorized bandwidth specified in table 3 of the test specification for the equipment's frequency band as specified below.

< 20 kHz

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 Expires
Power Supply Unit	Farnell	H60-25	1092		O/P Mon
Multimeter	Iso-tech	IDM101	2417	12	28-Nov-2023
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	28-Jul-2023
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-Jul-2023
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	24-Feb-2023
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Feb-2023
EXA	Keysight Technologies	N9010B	4968	24	19-Jan-2024
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023

Table 23

O/P Mon – Output Monitored using calibrated equipment

2.3 Spurious Emissions at Antenna Terminals

2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1051
FCC 47 CFR Part 90, Clause 90.210
ISED RSS-119, Clause 5.8
ISED RSS-GEN, Clause, 6.13

2.3.2 Equipment Under Test and Modification State

SCG2221, S/N: 1PR002230GP58OM - Modification State 0

2.3.3 Date of Test

14-December-2022 to 15-December-2022

2.3.4 Test Method

For emissions where the frequency is removed less than 250 % of the authorised bandwidth measurements were performed conducted as follows:

The EUT was connected to a spectrum analyser via a cable and attenuator. The path loss between the EUT and analyser was calibrated using a network analyser and entered into the spectrum analyser as a reference level offset. The reference level for the mask was established by using the total power measurements. The RBW was set to 300 Hz, (at least 1 % of the emission bandwidth), with a VBW of 3 times RBW. An RMS detector was used, and the trace averaged. The EUT had a 23.7 % duty cycle and this was accounted for in the Reference Level Offset, (6.2 dB correction). The mask as per FCC 47 CFR Part 90.210 (b) was applied.

For emissions where the frequency is removed more than 250 % of the authorized bandwidth measurements were performed both conducted and radiated as follows:

Conducted: A network analyser was used to measure the path loss and the worst case was entered as a reference level offset into the spectrum analyser. The EUT was connected to a spectrum analyser via an attenuator, filter and cable. Between 9 kHz and 300 MHz a notch filter was used tuned to the frequency of the fundamental. Between 300 MHz and 2 GHz a 300 MHz high pass filter was used. The spectrum analyser was configured with an RBW of 100 kHz below 300 MHz and 1 MHz for frequencies greater than 300 MHz with the trace set to max hold using a peak detector.

2.3.5 Environmental Conditions

Ambient Temperature	20.6 - 21.1 °C
Relative Humidity	31.2 %

2.3.6 Test Results

Tetra - 136 MHz to 174 MHz (ISEDC only)

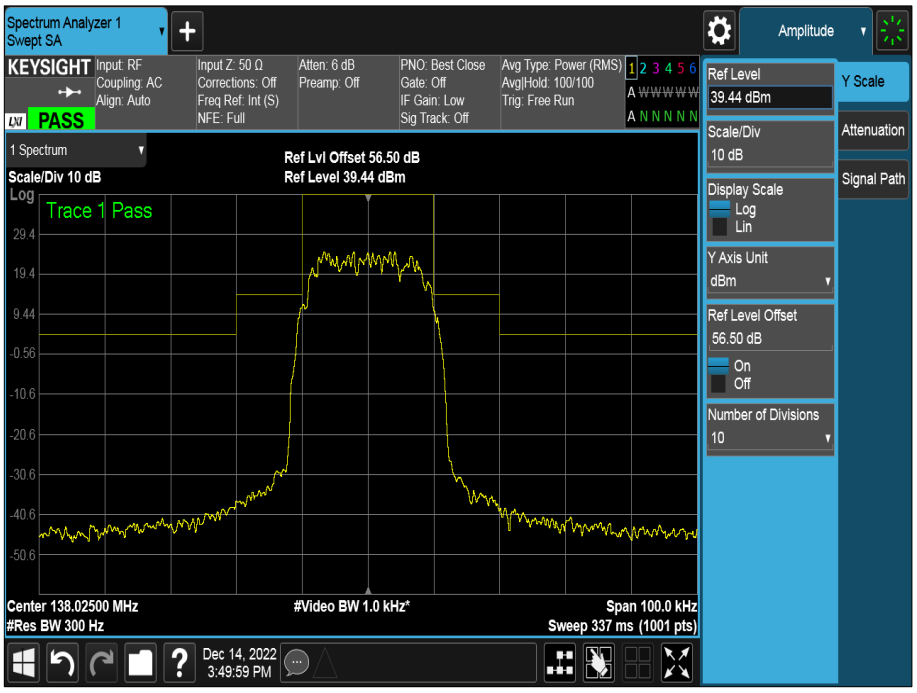

Figure 7 - 138.025 MHz, Transmitter Mask

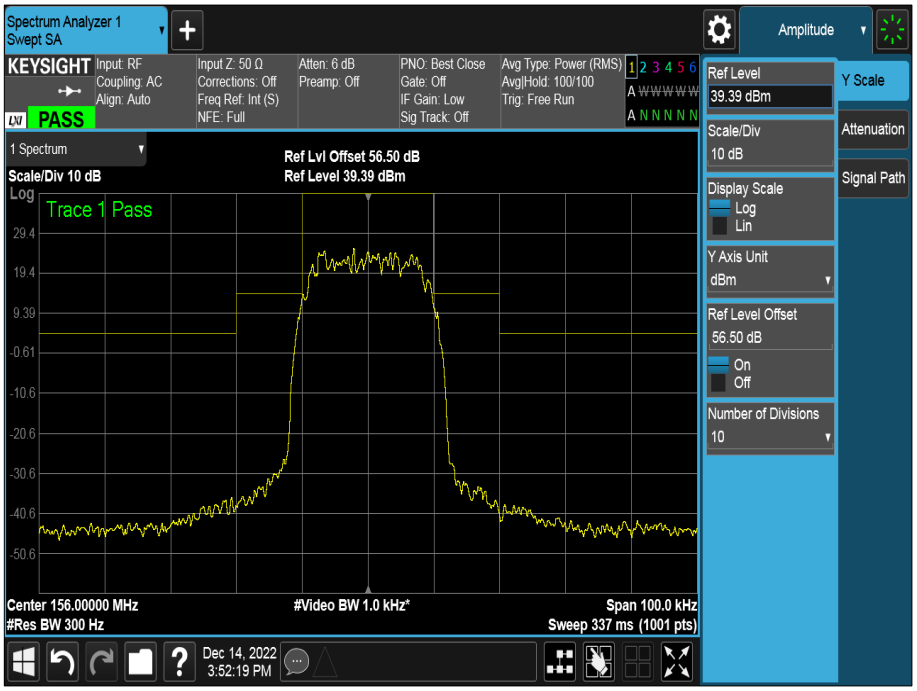

Figure 8 - 156.000 MHz, Transmitter Mask

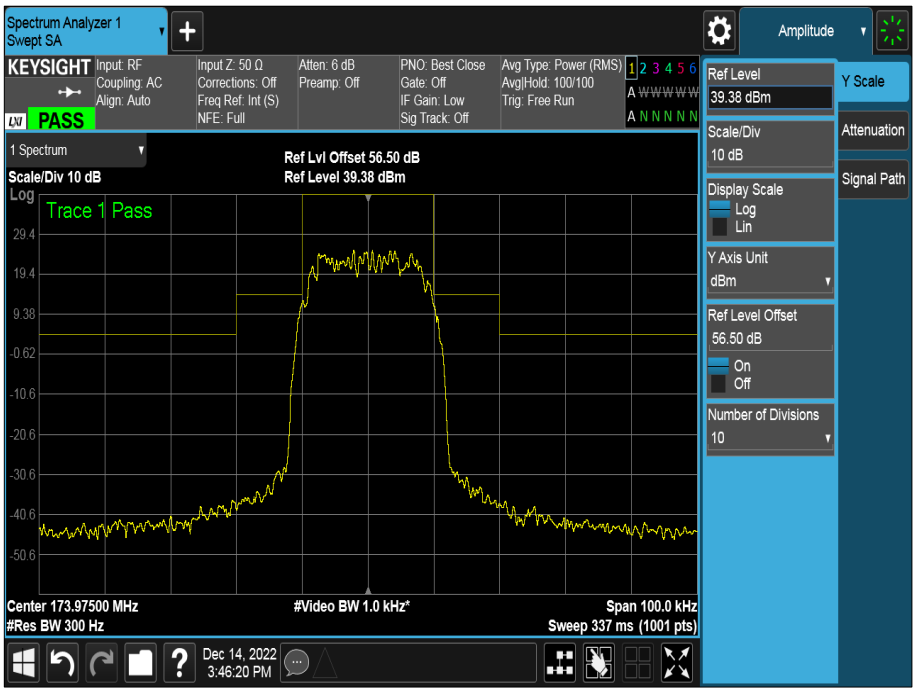

Figure 9 - 173.975 MHz, Transmitter Mask

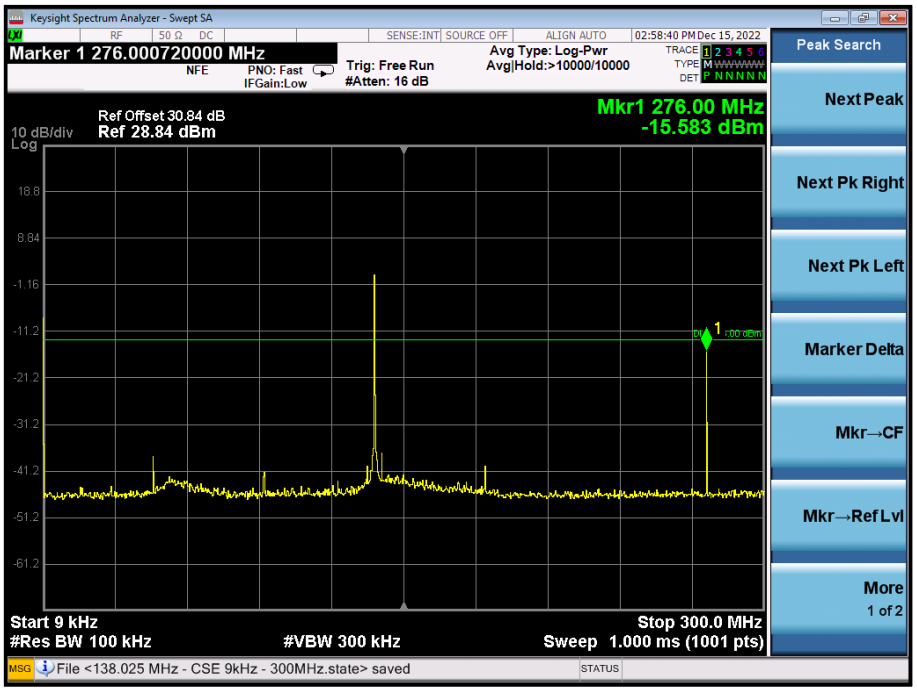

Figure 10 - 138.025 MHz, 9 kHz to 300 MHz

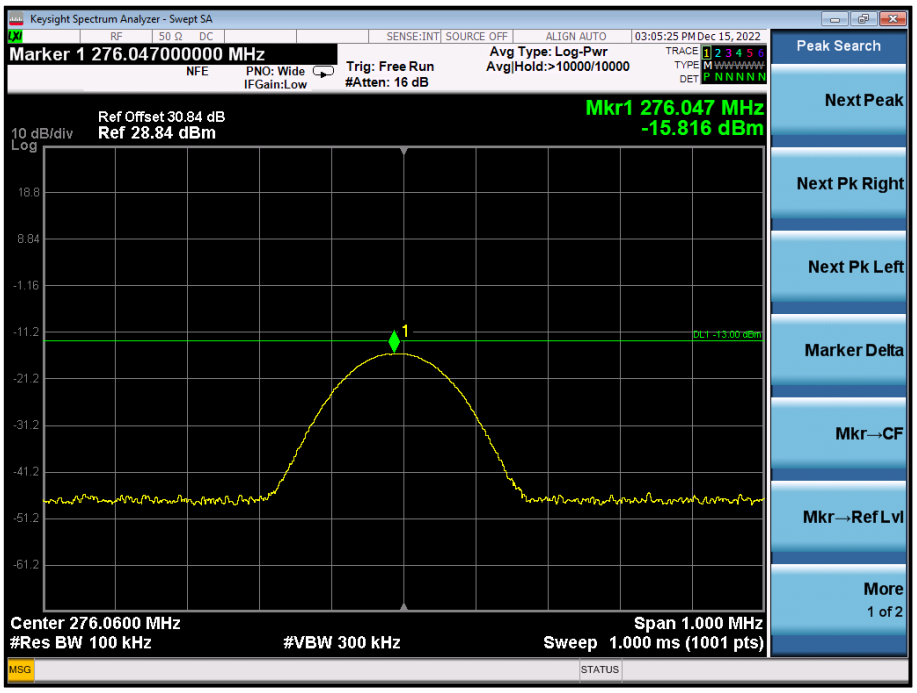

Figure 11 - 138.025 MHz, 2nd Harmonic - Zoom

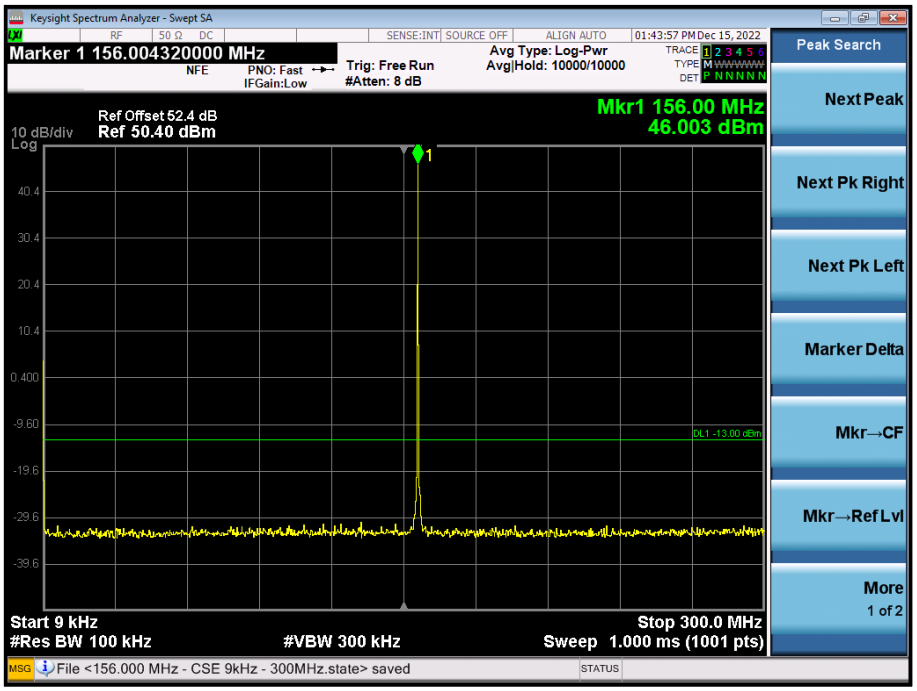

Figure 12 - 156.000 MHz, 9 kHz to 300 MHz

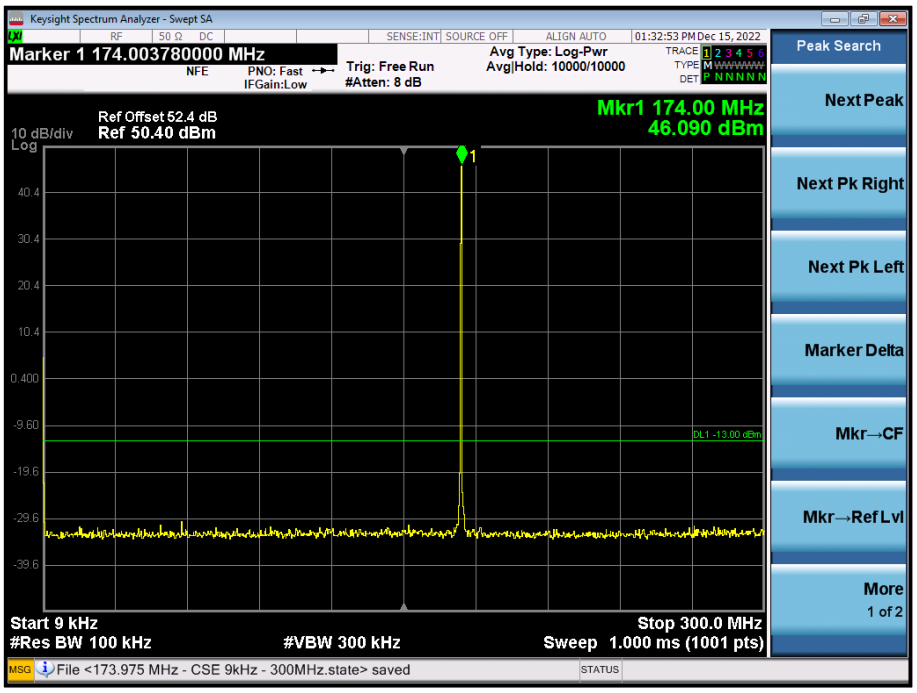

Figure 13 - 173.975 MHz - 9 kHz to 300 MHz

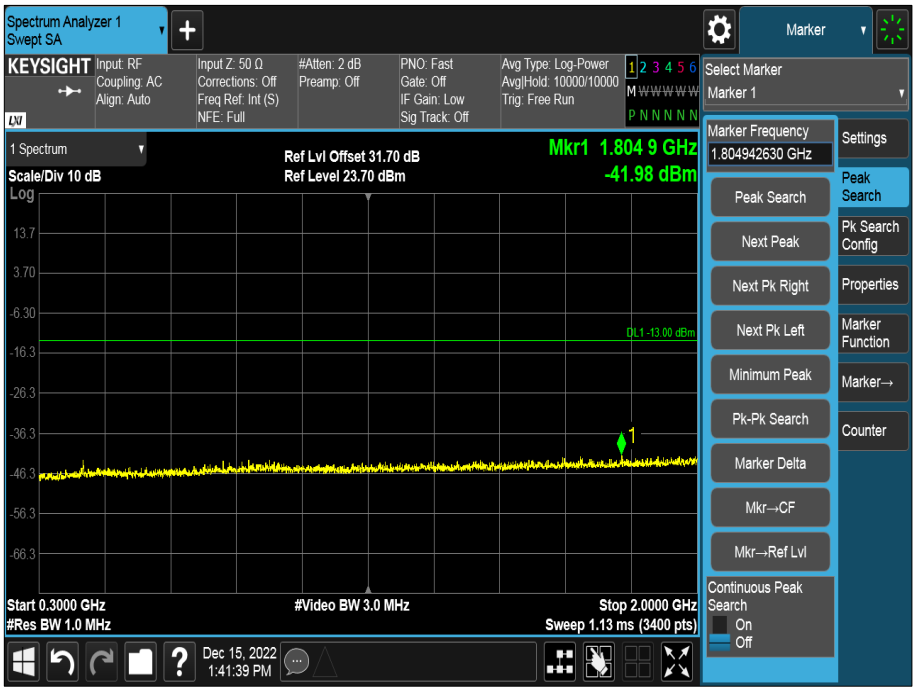

Figure 14 - 138.025 MHz, 300 MHz to 2000 MHz

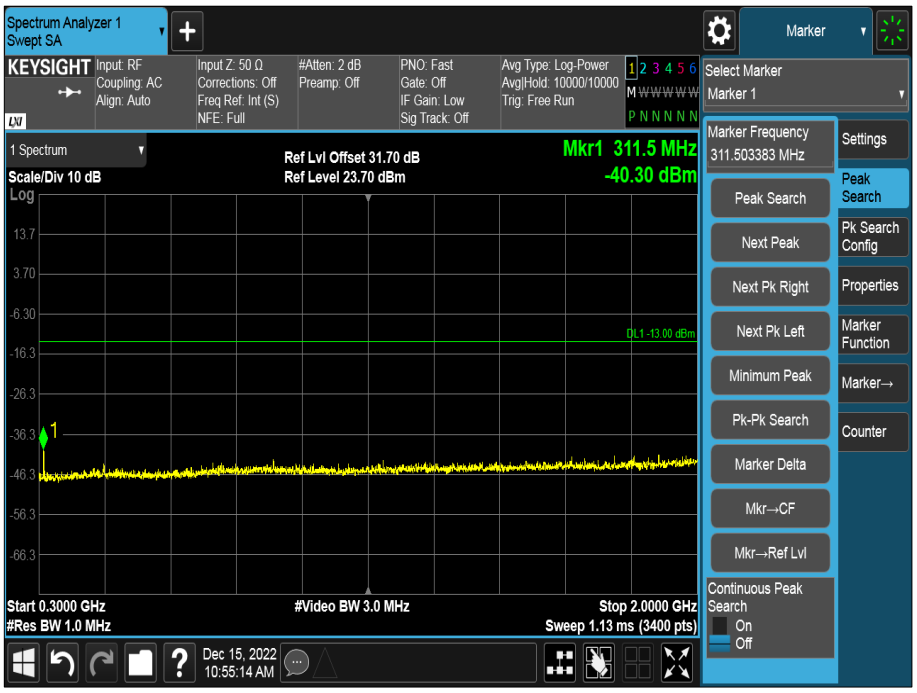

Figure 15 - 156.000 MHz, 300 MHz to 2000 MHz

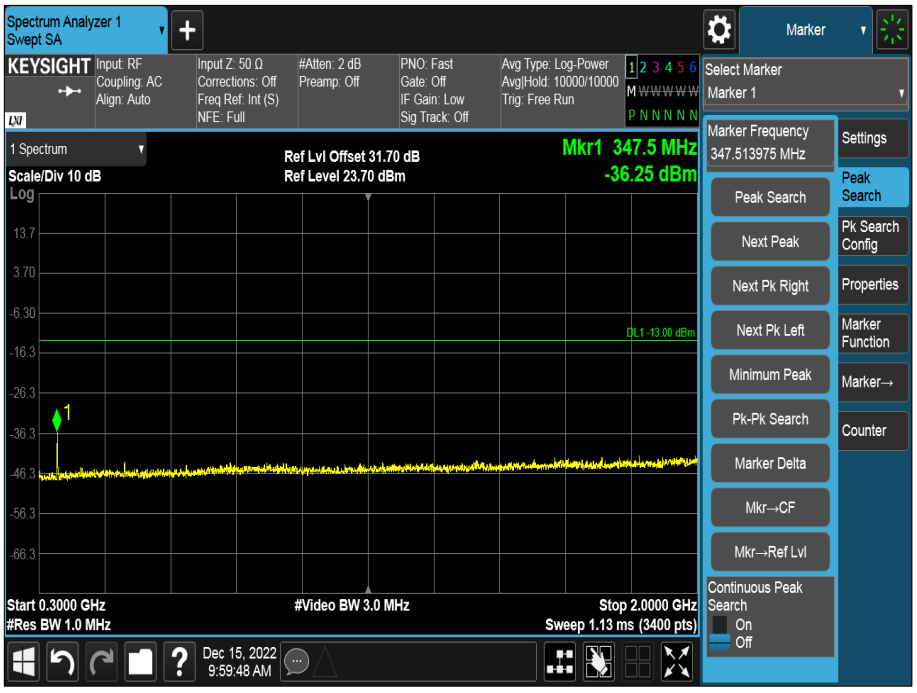

Figure 16 - 173.975 MHz - 300 MHz to 2000 MHz

Tetra - 150 MHz to 174 MHz (FCC and ISEDC)

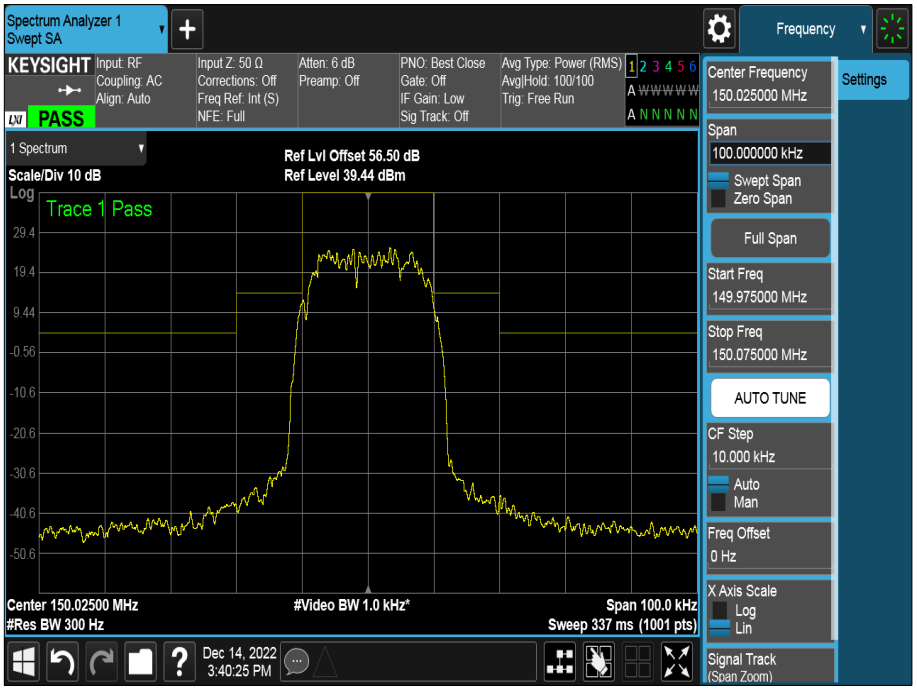

Figure 17 - 150.025 MHz, Transmitter Mask

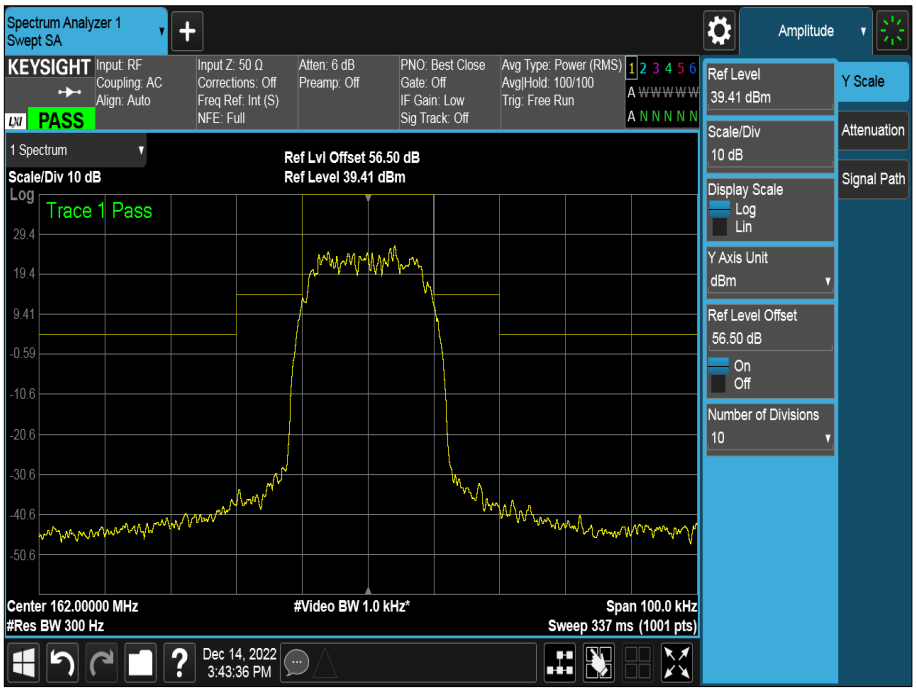

Figure 18 - 162.000 MHz, Transmitter Mask

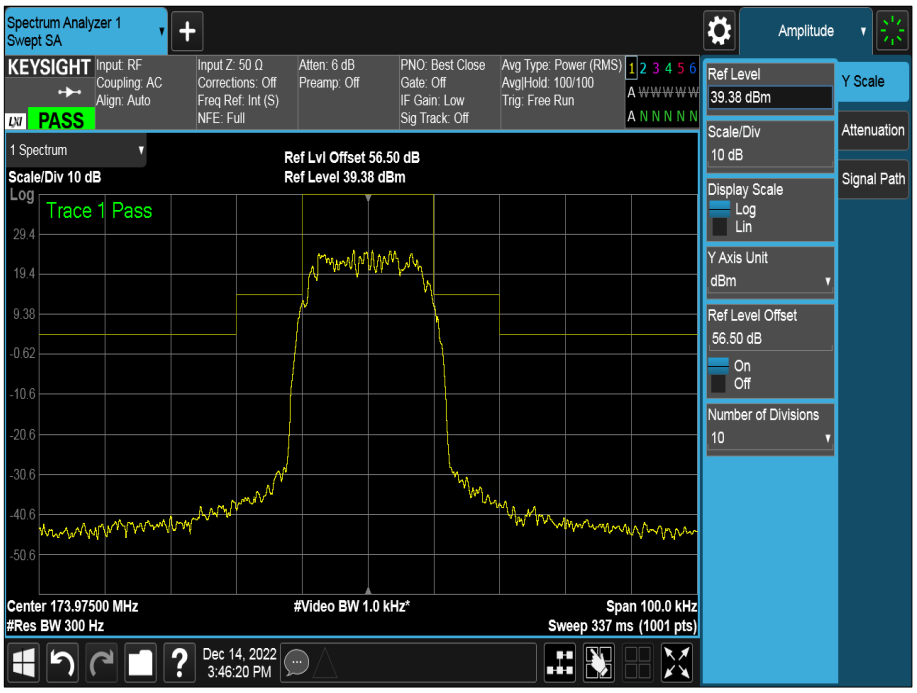

Figure 19 - 173.975 MHz, Transmitter Mask

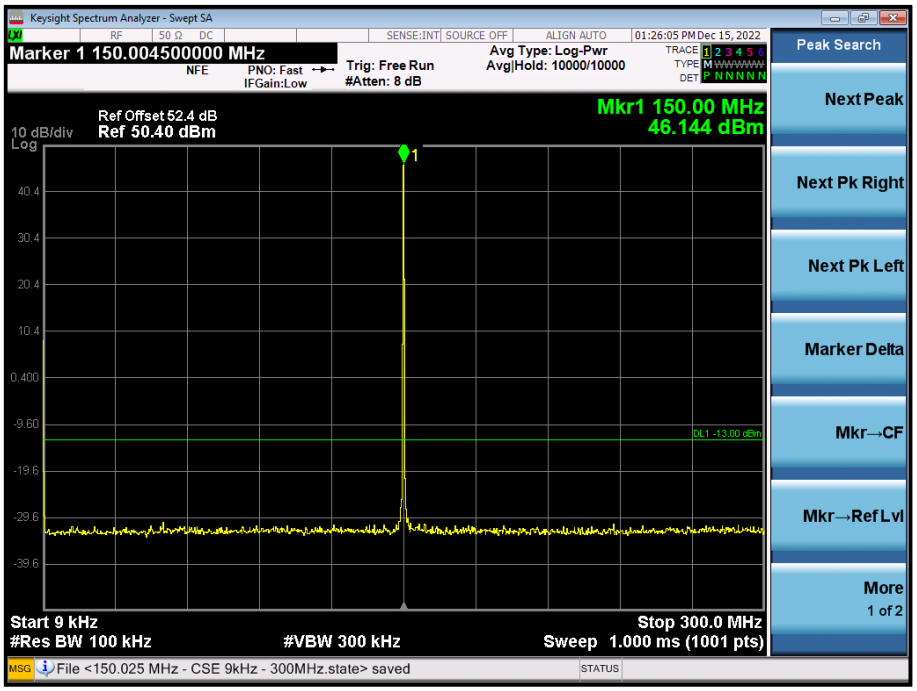

Figure 20 - 150.025 MHz, 9 kHz to 300 MHz

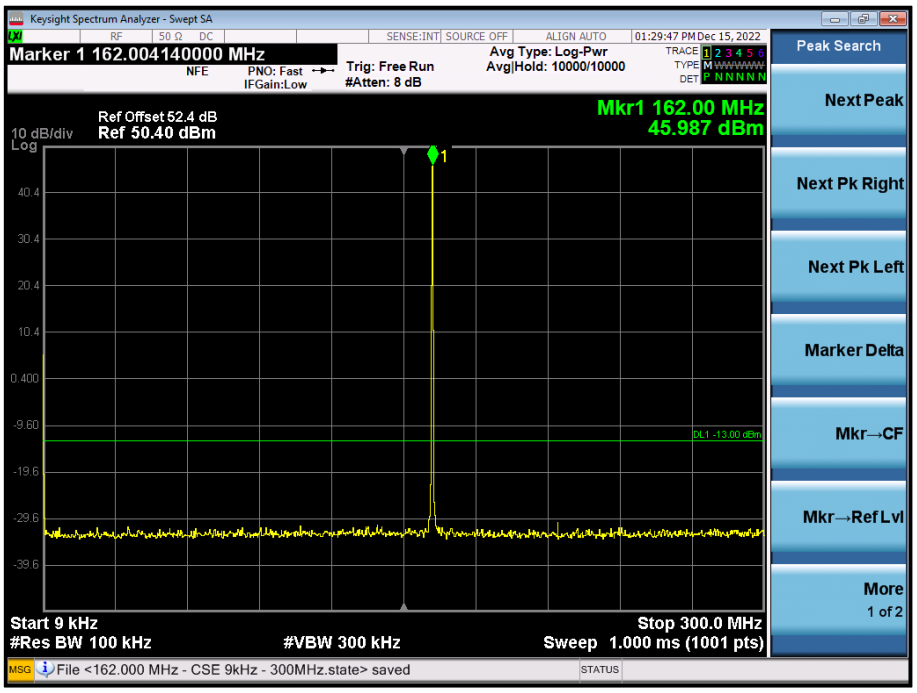

Figure 21 - 162.000 MHz, 9 kHz to 300 MHz

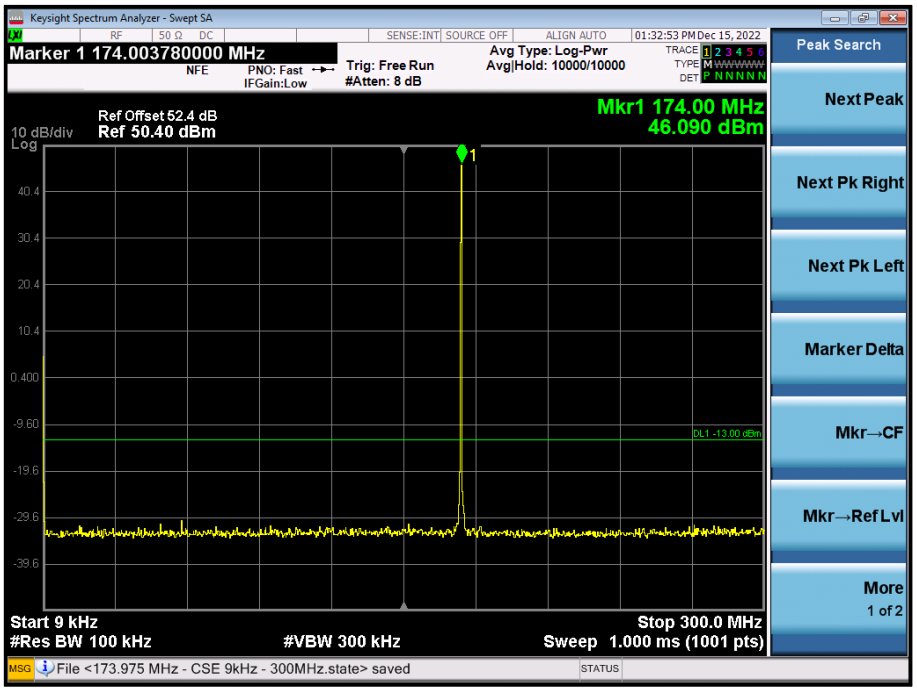

Figure 22 - 173.975 MHz - 9 kHz to 300 MHz

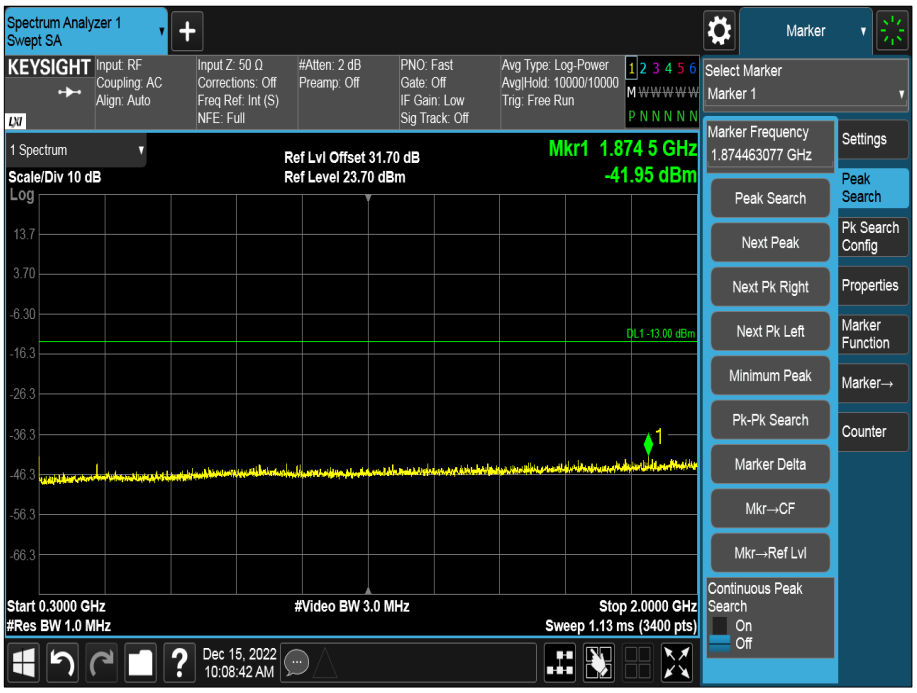

Figure 23 - 150.025 MHz, 300 MHz to 2 GHz

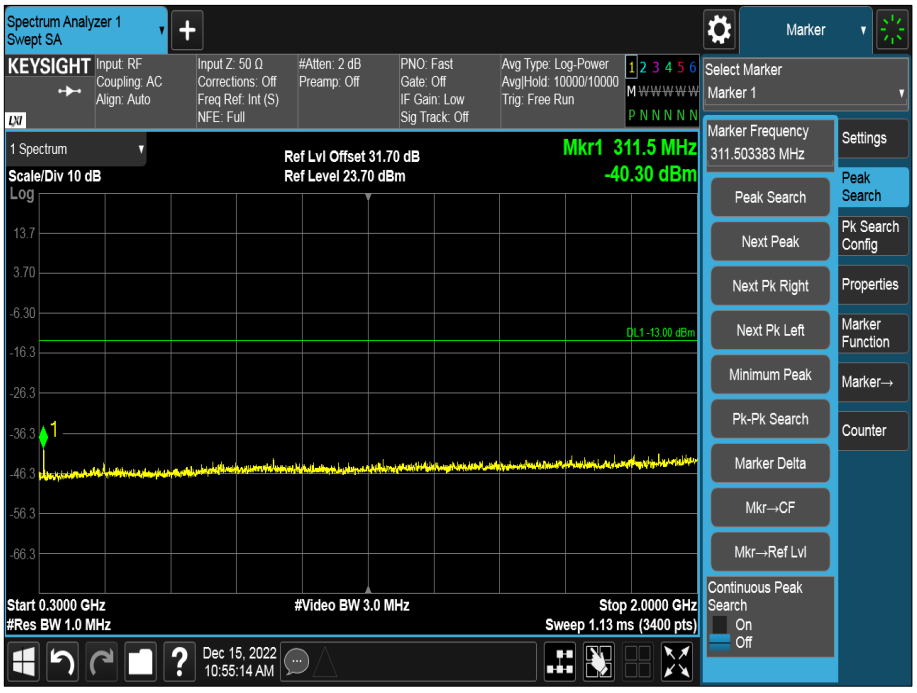

Figure 24 - 162.000 MHz, 300 MHz to 2 GHz

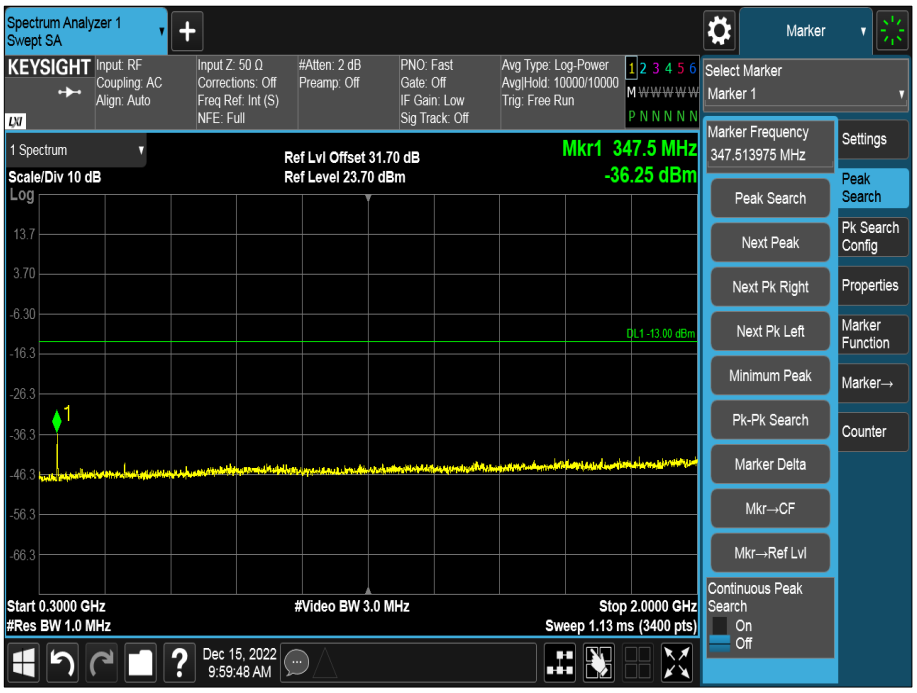

Figure 25 - 173.975 MHz - 300 MHz to 2 GHz

FCC 47 CFR Part 90, Limit Clause 90.210

The EUT shall comply with emission mask B as per FCC 47 CFR Part 90.210.

Industry Canada RSS-119, Limit Clause 5.8

The EUT shall comply with emission mask B as per Industry Canada RSS-119 clause 5.8.

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 Expires
Power Supply Unit	Farnell	H60-25	1092		O/P Mon
High Pass Filter	Mini-Circuits	NHP-300	1640	12	24-Mar-2023
Multimeter	Iso-tech	IDM101	2417	12	28-Nov-2023
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	28-Jul-2023
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-Jul-2023
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	TU
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	24-Feb-2023
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Feb-2023
EXA	Keysight Technologies	N9010B	4968	24	19-Jan-2024
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	25-Apr-2023

Table 24

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.4 Radiated Spurious Emissions

2.4.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1053
FCC 47 CFR Part 90, Clause 90.210
ISED RSS-119, Clause 5.8
ISED RSS-GEN, Clause 6.13

2.4.2 Equipment Under Test and Modification State

SCG2221, S/N: 1PR002230GP58OM - Modification State 0

2.4.3 Date of Test

15-December-2022 to 16-December-2022

2.4.4 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.

The regulatory limit of -13 dBm/MHz has been converted to a field strength limit in accordance with ANSI C63.26, clause 5.2.7 equation c)

Example calculation

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

E (dBuV/m) = -13 - 20log(3) + 104.8

E (dBuV/m) = 82.26

2.4.5 Test Setup Diagram

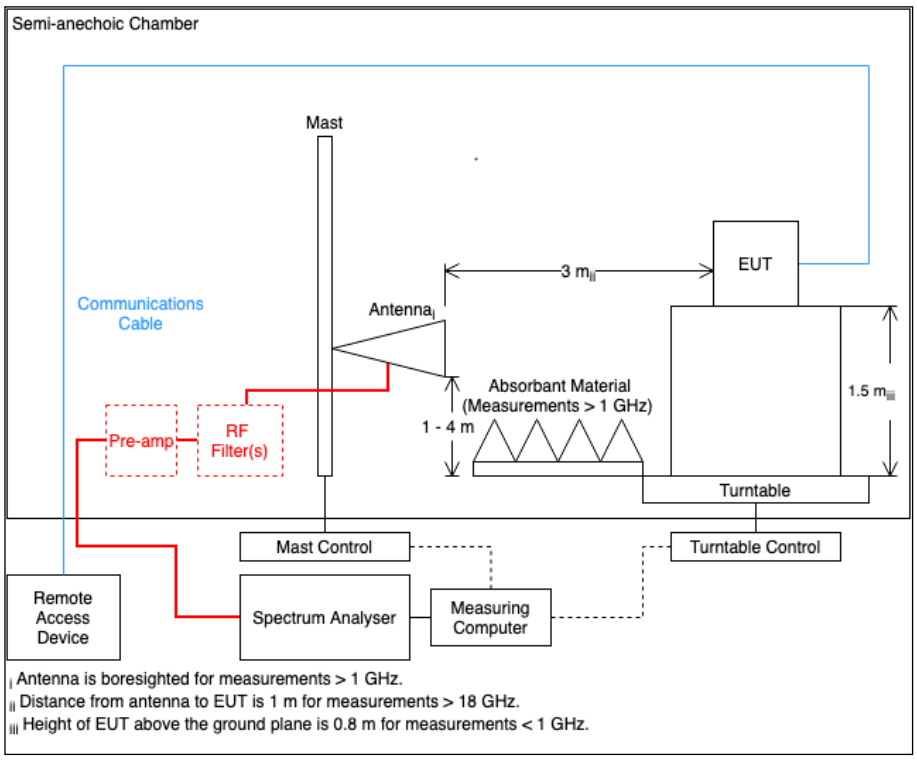

Figure 26

2.4.6 Environmental Conditions

Ambient Temperature	20.8 - 21.5 °C
Relative Humidity	31.6 - 34.6 %

2.4.7 Test Results

Tetra - 136 MHz to 174 MHz (ISEDC only)

Frequency (MHz)	Level (dBm)
*	

Table 25 - 138.025 MHz - Emissions Results

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

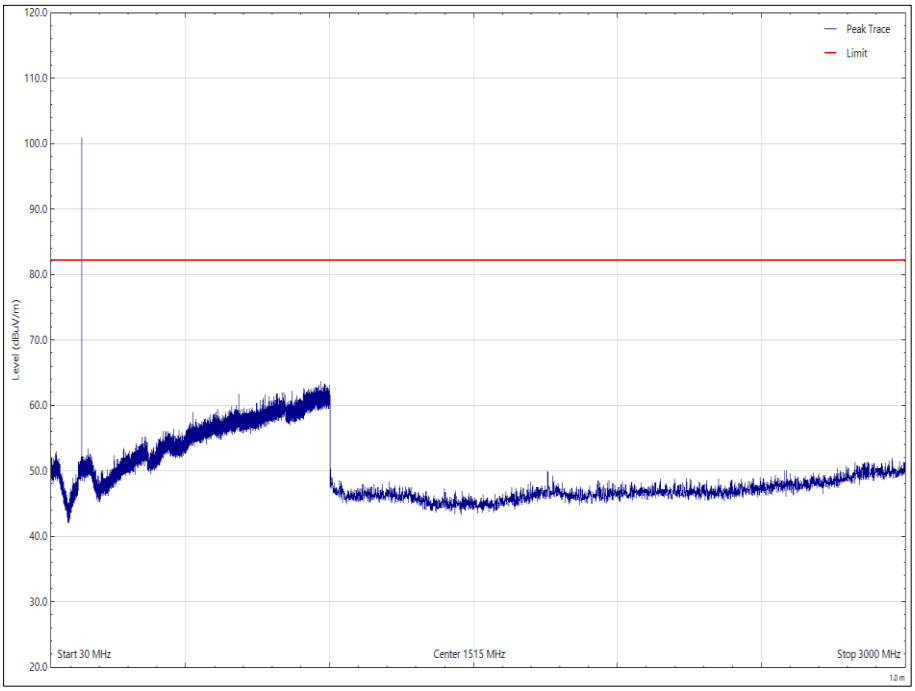

Figure 27 - 138.025 MHz - 30 MHz to 3 GHz - Horizontal

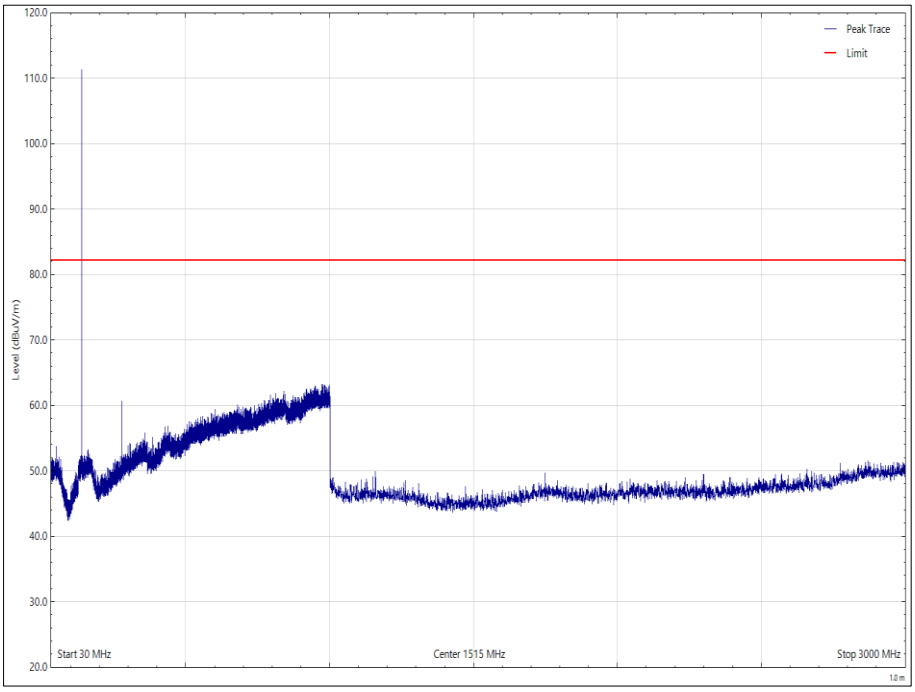

Figure 28 - 138.025 MHz - 30 MHz to 3 GHz - Vertical

Frequency (MHz)	Level (dBm)
*	

Table 26 - 156.000 MHz - Emissions Results

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

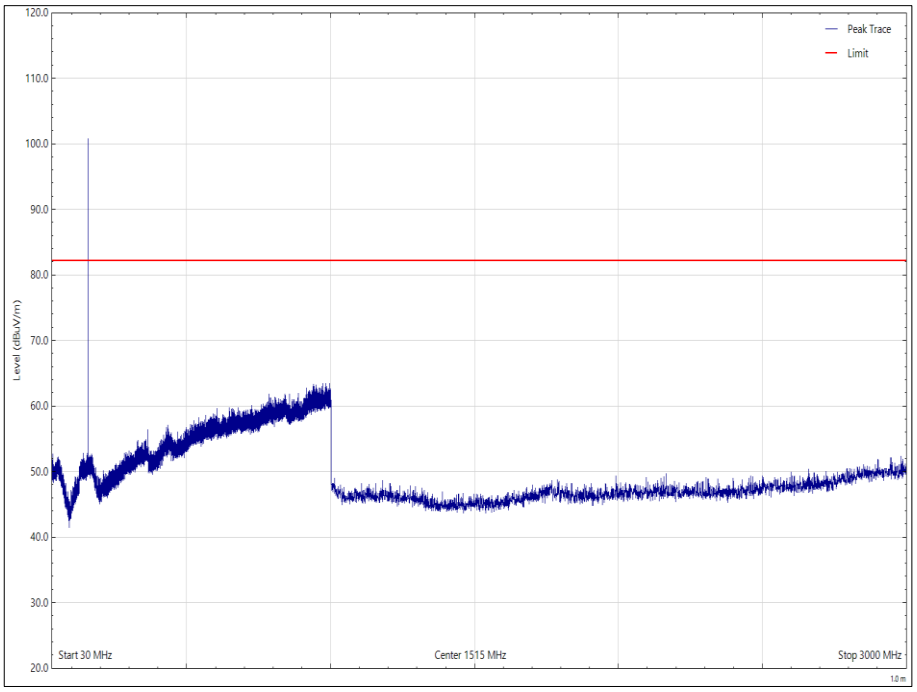

Figure 29 - 156.000 MHz - 30 MHz to 3 GHz - Horizontal

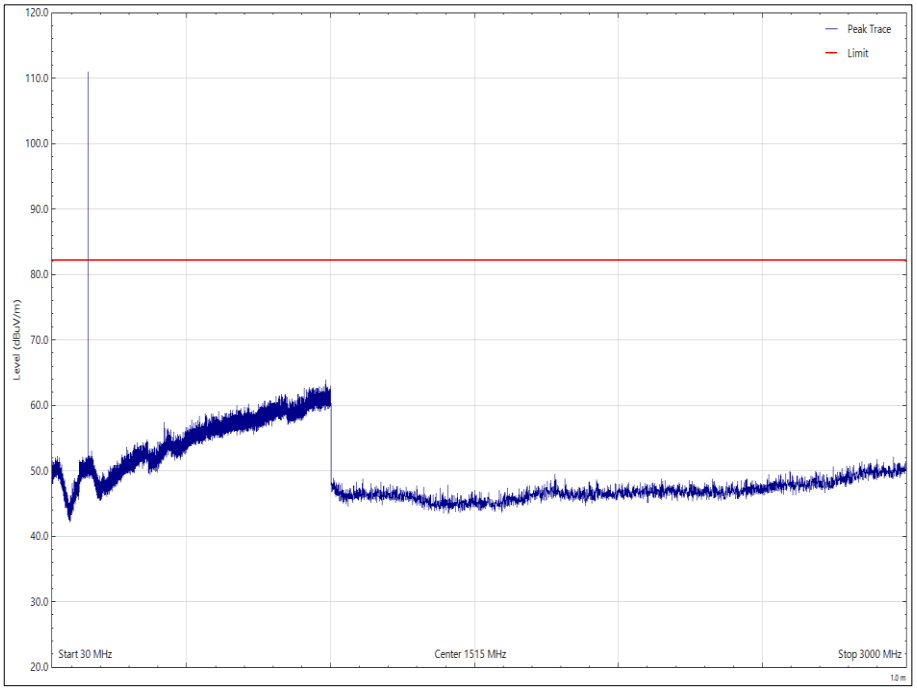

Figure 30 - 156.000 MHz - 30 MHz to 3 GHz - Vertical

Frequency (MHz)	Level (dBm)
*	

Table 27 - 173.975 MHz - Emissions Results

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

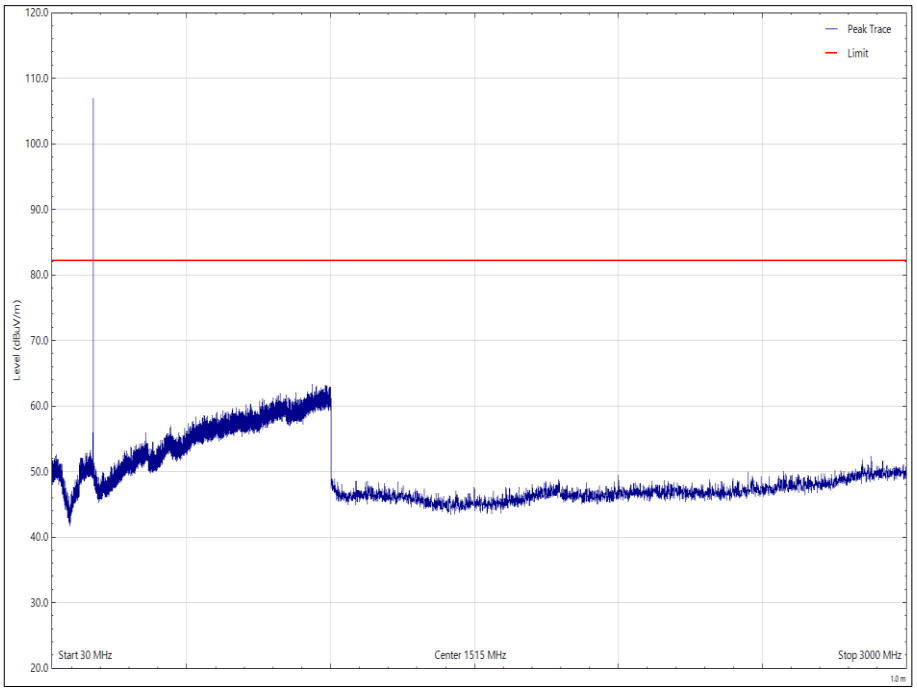

Figure 31 - 173.975 MHz - 30 MHz to 3 GHz - Horizontal

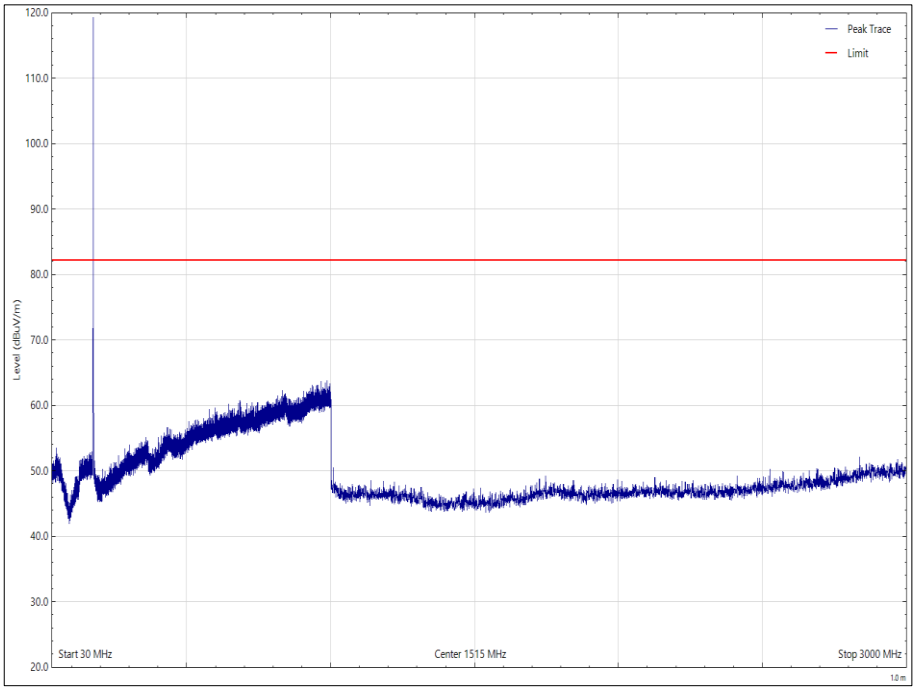

Figure 32 - 173.975 MHz - 30 MHz to 3 GHz - Vertical

Tetra - 150 MHz to 174 MHz (FCC and ISEDC)

Frequency (MHz)	Level (dBm)
*	

Table 28 - 150.025 MHz - Emissions Results

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

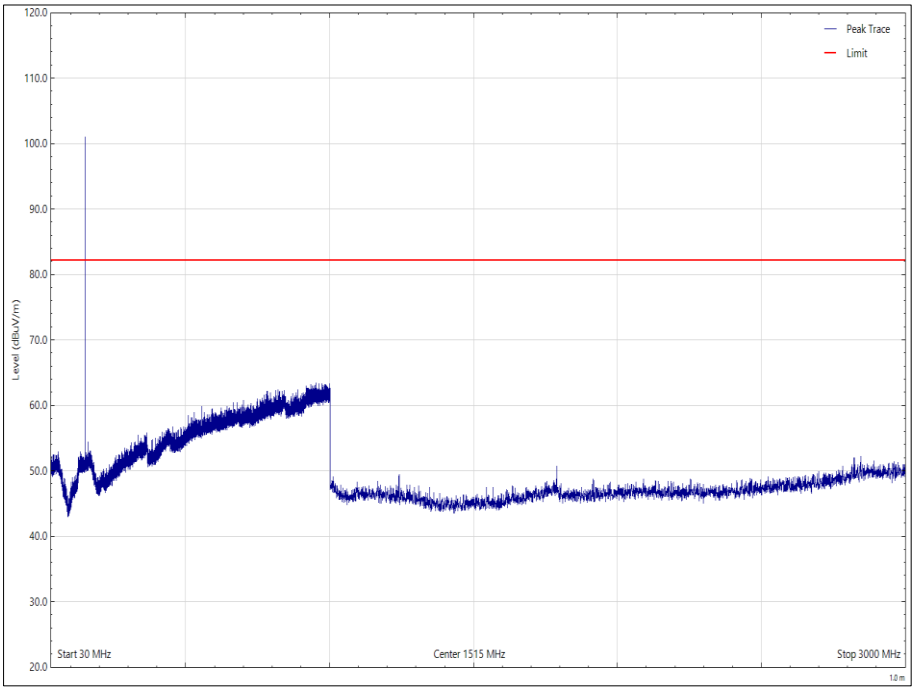

Figure 33 - 150.025 MHz - 30 MHz to 3 GHz - Horizontal

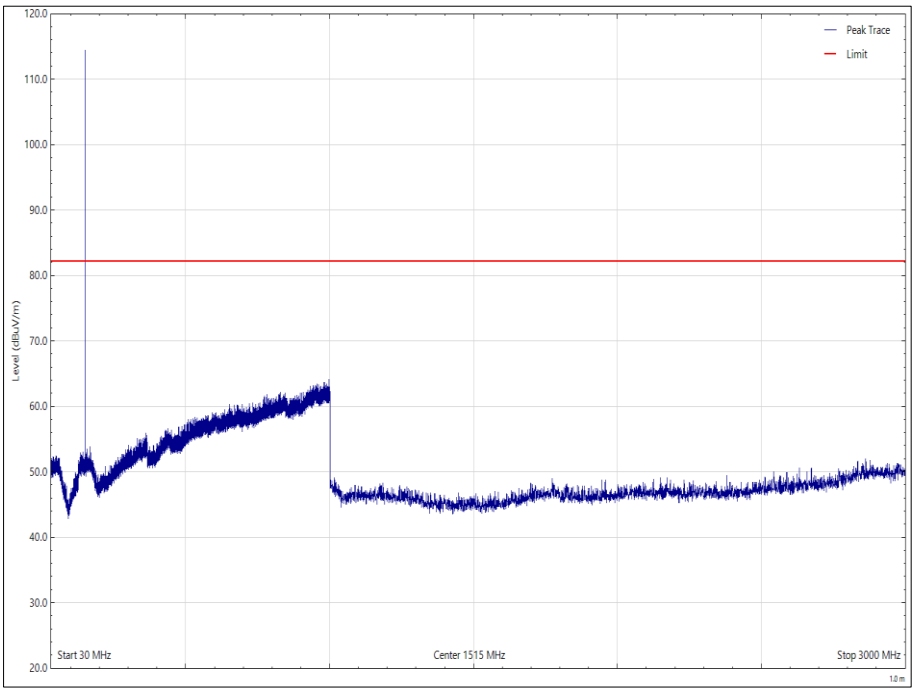

Figure 34 - 150.025 MHz - 30 MHz to 3 GHz - Vertical

Frequency (MHz)	Level (dBm)
*	

Table 29 - 162.000 MHz - Emissions Results

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

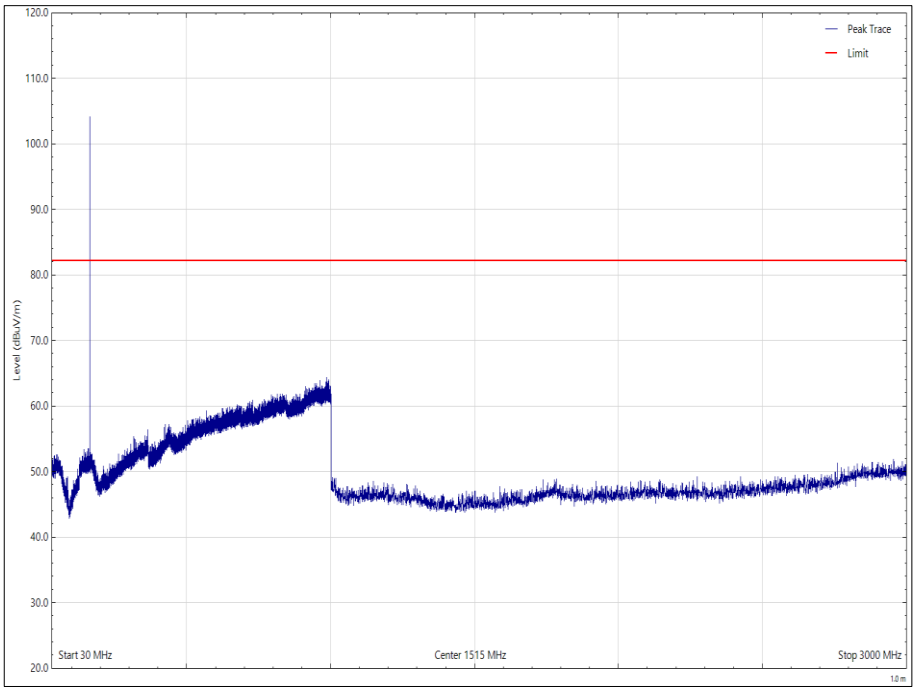

Figure 35 - 162.000 MHz - 30 MHz to 3 GHz - Horizontal

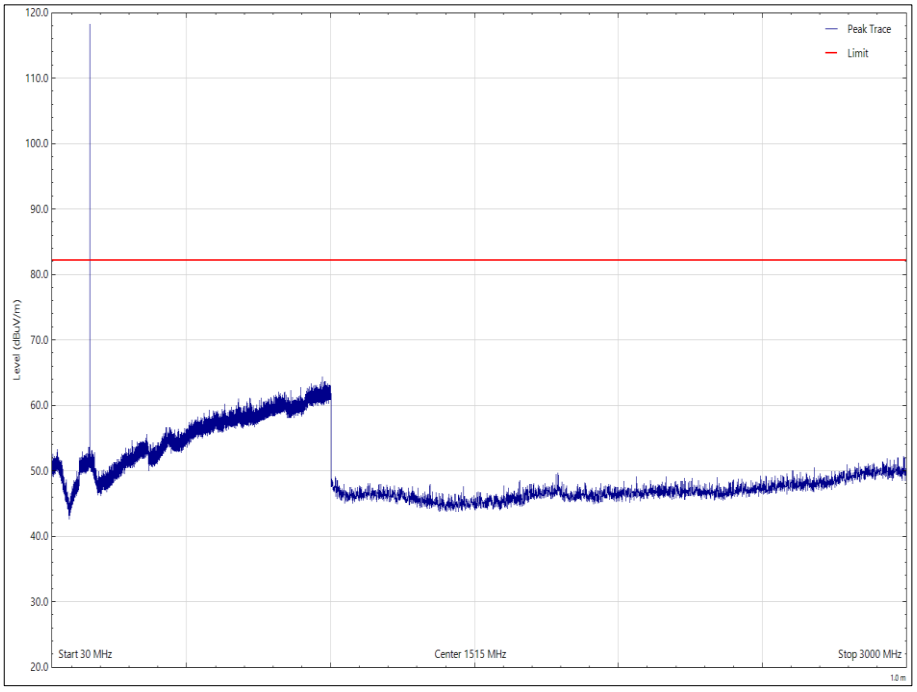

Figure 36 - 162.000 MHz - 30 MHz to 3 GHz - Vertical

Frequency (MHz)	Level (dBm)
*	

Table 30 - 173.975 MHz - Emissions Results

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

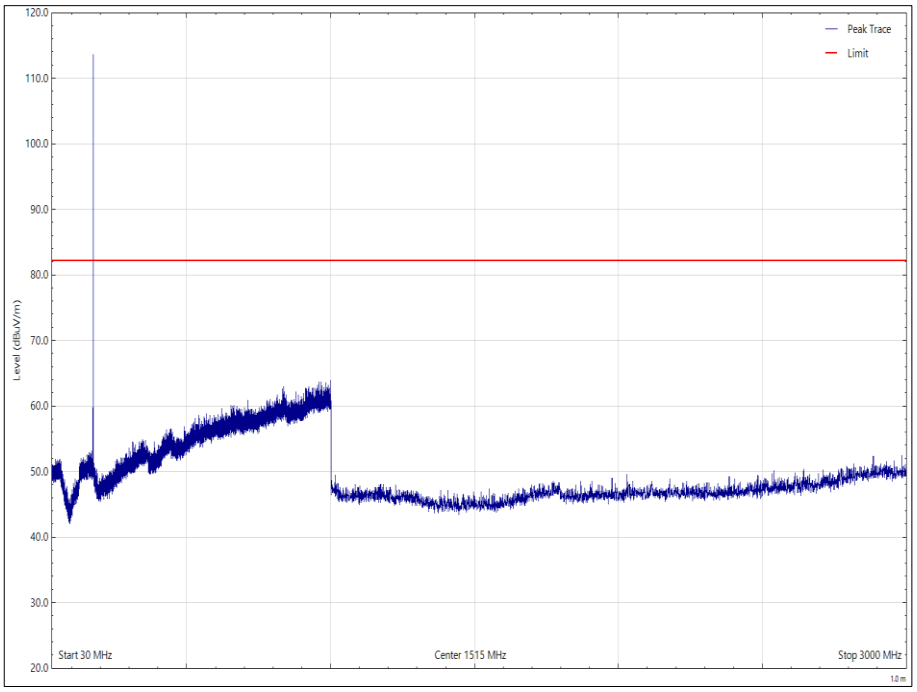

Figure 37 - 173.975 MHz - 30 MHz to 3 GHz - Horizontal

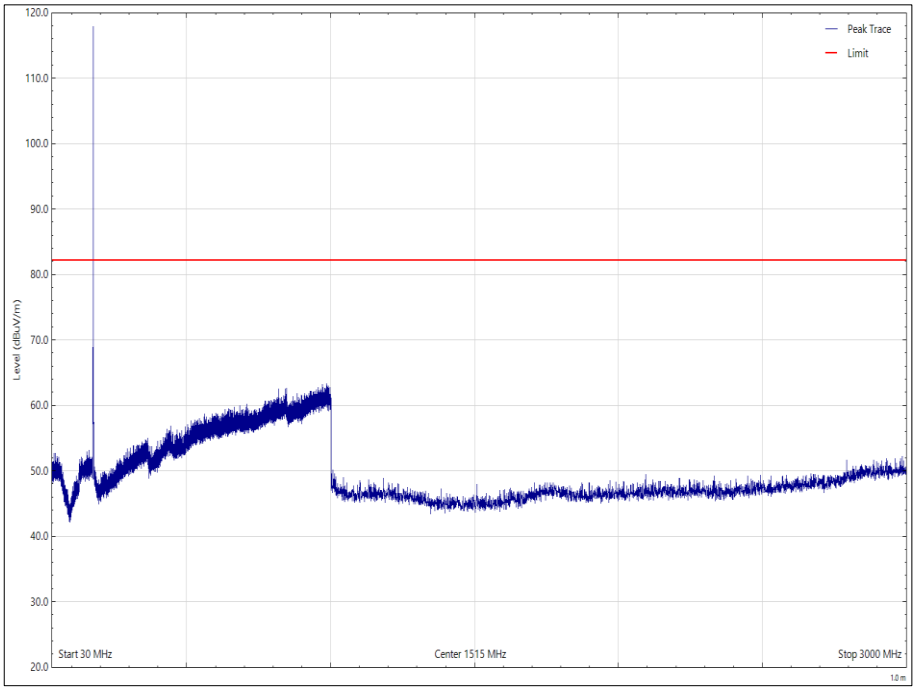

Figure 38 - 173.975 MHz - 30 MHz to 3 GHz - Vertical

FCC 47 CFR Part 90, Limit Clause 90.210

The EUT shall comply with emission mask B as per FCC 47 CFR Part 90.210.

Industry Canada RSS-119, Limit Clause 5.8

The EUT shall comply with emission mask B as per Industry Canada RSS-119 clause 5.8.

2.4.8 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Dual Power Supply Unit	Hewlett Packard	6253A	292	-	O/P Mon
True RMS Multimeter	Fluke	179	4006	12	29-Mar-2023
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	17-May-2023
Emissions Software	TUV SUD	EmX V3.1.6	5125	-	Software
RF Chamber 11	Rainford	Rainford	5136	36	24-Nov-2024
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	5215	12	28-May-2023
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	29-May-2023
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	07-Apr-2023
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5514	12	12-Apr-2023
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	12-Apr-2023
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2023
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5595	12	25-Oct-2023
Cable (K Type 2m)	Junkosha	MWX241-02000KMSKMS/B	5934	12	14-May-2023
TRILOG Super Broadband Test Antenna	Schwarzbeck	VULB 9168	5942	24	03-Feb-2024

Table 31

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.5 Frequency Stability

2.5.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1055
FCC 47 CFR Part 90, Clause 90.213
ISED RSS-119, Clause 5.3
ISED RSS-GEN, Clause, 6.11

2.5.2 Equipment Under Test and Modification State

SCG2221, S/N: 1PR002230GP58OM - Modification State 0

2.5.3 Date of Test

19-December-2022 to 20-December-2022

2.5.4 Test Method

This test was performed in accordance with ANSI C63.26, Clause 5.6. and the requirements of FCC 47 CFR Part 2, Clause 2.1055 (a)(1), (d)(1).

The EUT was set to transmit on maximum power with an unmodulated carrier on middle channels. The EUT was connected to a Frequency Counter using an external 10 MHz frequency reference. The difference between the frequency of the fundamental and the frequency of the assigned channel in accordance with the manufacturer's documentation was recorded. In accordance with FCC 47 CFR, Clause 2.1055, the temperature was varied from -30 °C to +50 °C in 10 ° steps at nominal voltage and at ambient temperature for both minimum and maximum voltage extremes.

2.5.5 Environmental Conditions

Ambient Temperature	21.7 - 22.9 °C
Relative Humidity	37.9 %

2.5.6 Test Results

Tetra - 136 MHz to 174 MHz (ISEDC only)

Voltage	Frequency Error (ppm)
	156.000 MHz
11.56 V DC	0.04
15.64 V DC	0.03

Table 32 - Frequency Stability Under Voltage Variations

Temperature	Frequency Error (ppm)
	156.000 MHz
+50.0 °C	0
+40.0 °C	0
+30.0 °C	-0.01
+20.0 °C	0.04
+10.0 °C	0.04
0 °C	-0.13
-10.0 °C	-0.10
-20.0 °C	-0.15
-30.0 °C	0.02

Table 33 - Frequency Stability Under Temperature Variations

Tetra - 150 MHz to 174 MHz (FCC and ISEDC)

Voltage	Frequency Error (ppm)
	162.000 MHz
11.56 V DC	0.05
15.64 V DC	0.04

Table 34 - Frequency Stability Under Voltage Variations

Temperature	Frequency Error (ppm)
	162.000 MHz
+50.0 °C	0
+40.0 °C	0
+30.0 °C	-0.01
+20.0 °C	0.05
+10.0 °C	0.05
0 °C	-0.13
-10.0 °C	-0.09
-20.0 °C	-0.15
-30.0 °C	0.01

Table 35 - Frequency Stability Under Temperature Variations

FCC 47 CFR Part 90, Limit Clause 90.213

5 ppm

Industry Canada RSS-199, Limit Clause 5.3

5 ppm

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 Expires
Counter	Hewlett Packard	53181A	159	12	02-Aug-2023
Power Supply Unit	Farnell	H60-25	1092		O/P Mon
Multimeter	Iso-tech	IDM101	2417	12	28-Nov-2023
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	28-Jul-2023
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-Jul-2023
Meter & T/C	R.S Components	Meter 615-8206 & Type K T/C	3612	12	14-Sep-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	12-May-2023

Table 36

O/P Mon – Output Monitored using calibrated equipment

2.6 Transient Frequency Behaviour

2.6.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.214
ISED RSS-119, Clause 5.9

2.6.2 Equipment Under Test and Modification State

SCG2221, S/N: 1PR002230GP58OM - Modification State 0

2.6.3 Date of Test

19-December-2022

2.6.4 Test Method

This test was performed on bottom, middle and top frequencies using an unmodulated carrier output from the EUT and measured on a spectrum analyser in accordance with TIA Standard 603 (Referenced in Industry Canada RSS-119, Clause 5.9).

The EUT configuration application used to transmit an unmodulated signal was 2.25 kHz higher than the nominal centre frequency of the channel. Therefore, the trace plots recorded were centred on 2.25 kHz higher than the bottom, middle and top nominal centre frequencies.

2.6.5 Environmental Conditions

Ambient Temperature	23.3 °C
Relative Humidity	44.8 %

2.6.6 Test Results

Tetra - 136 MHz to 174 MHz (ISEDC only)

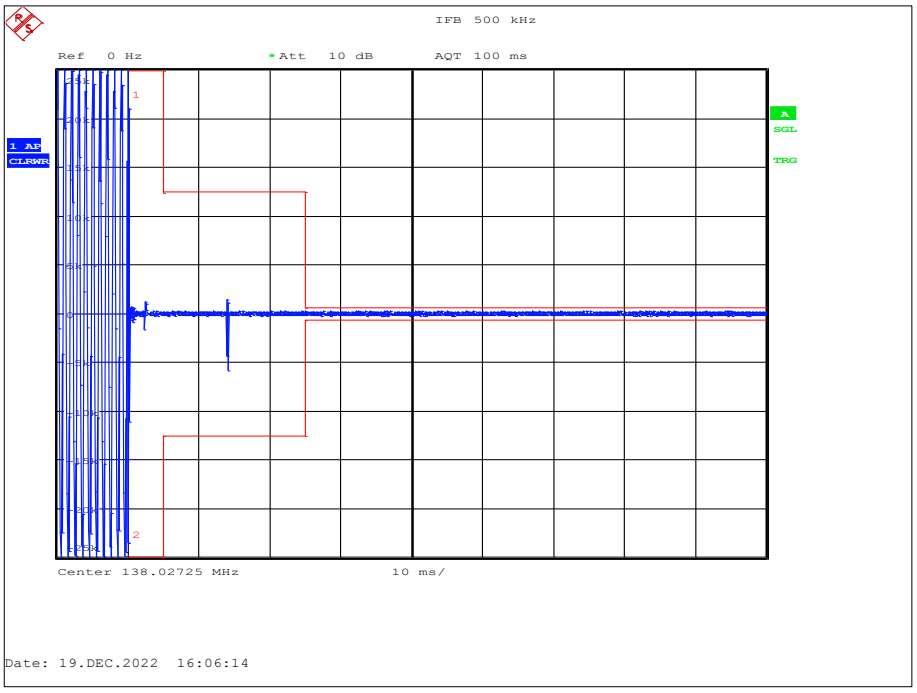

Figure 39 - 138.025 MHz, Switch On Transients

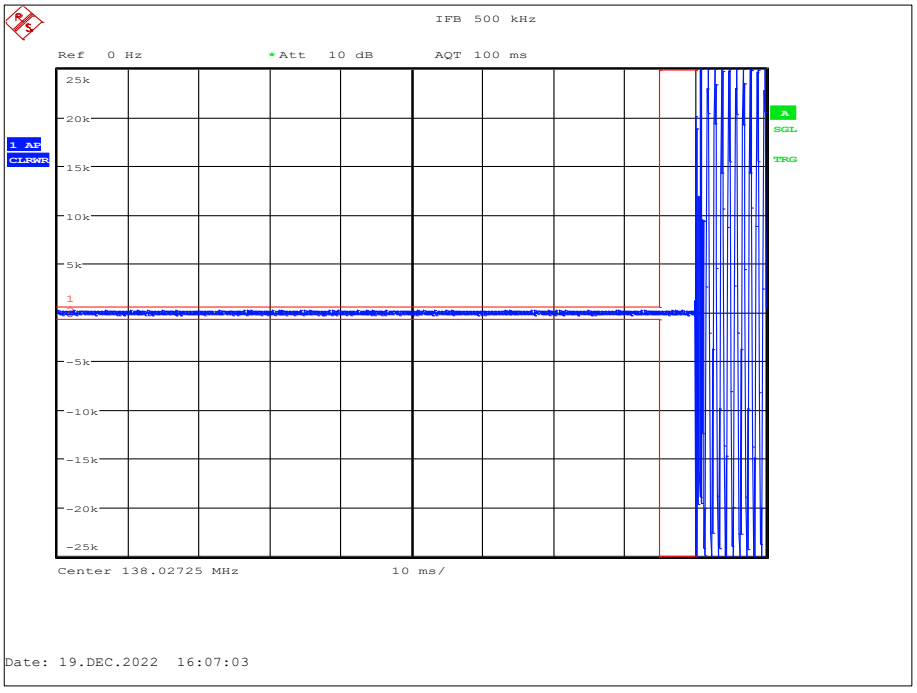

Figure 40- 138.025 MHz, Switch Off Transients

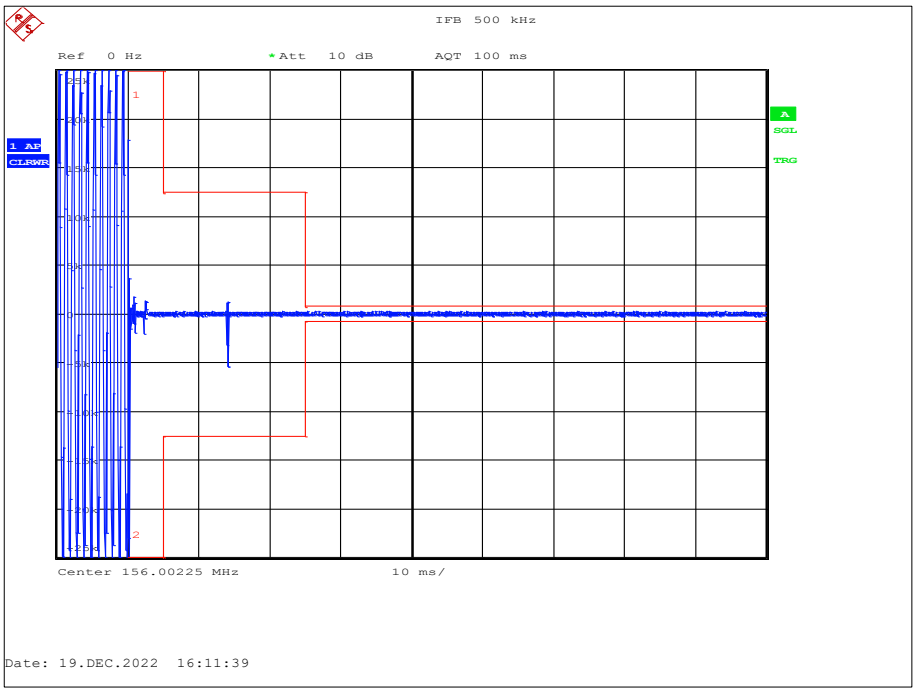

Figure 41 - 156.000 MHz, Switch On Transients

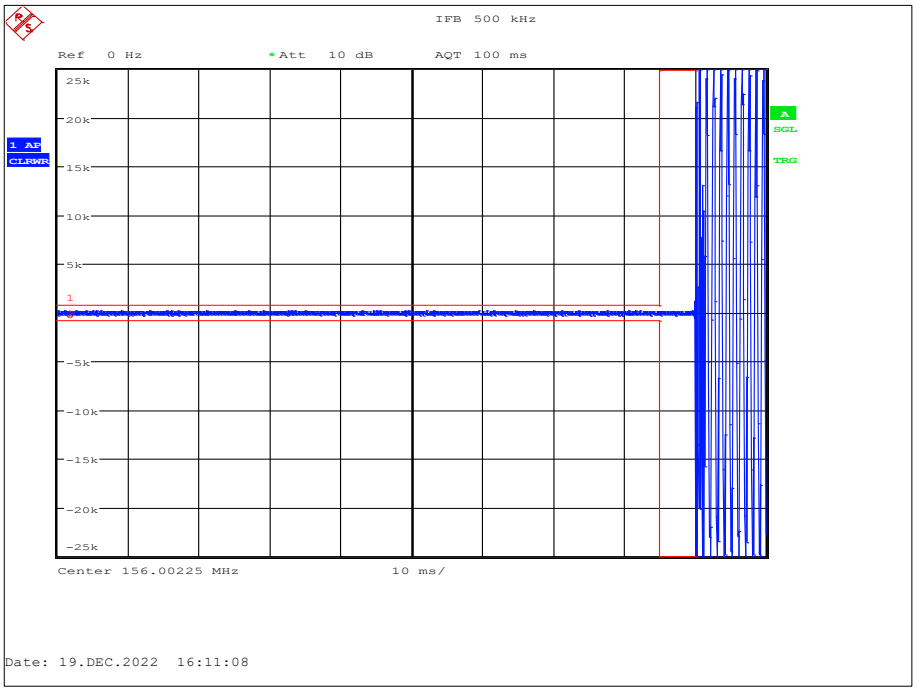

Figure 42- 156.000 MHz, Switch Off Transients

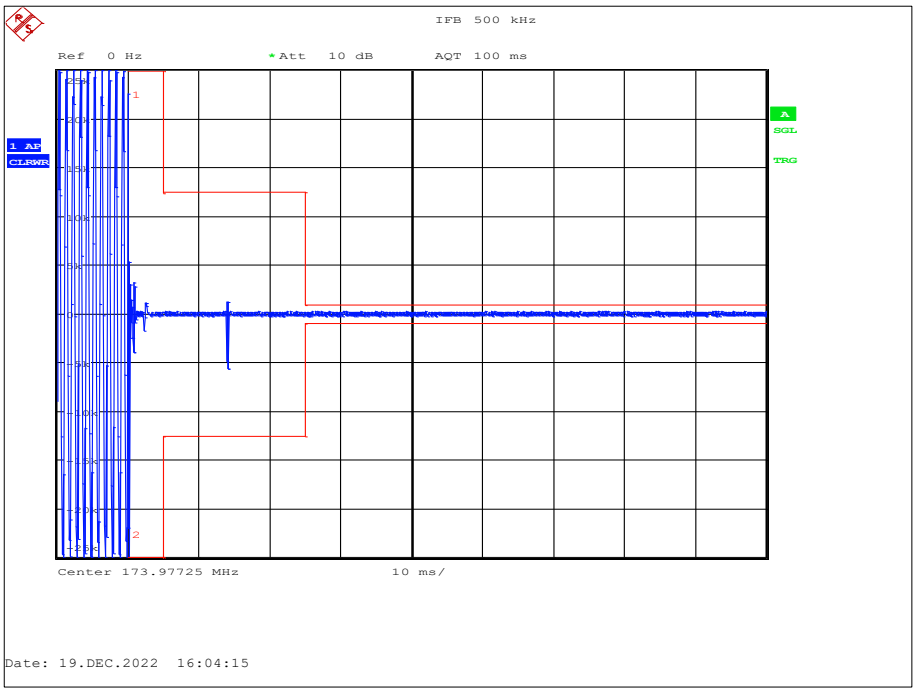

Figure 43 - 173.975 MHz, Switch On Transients

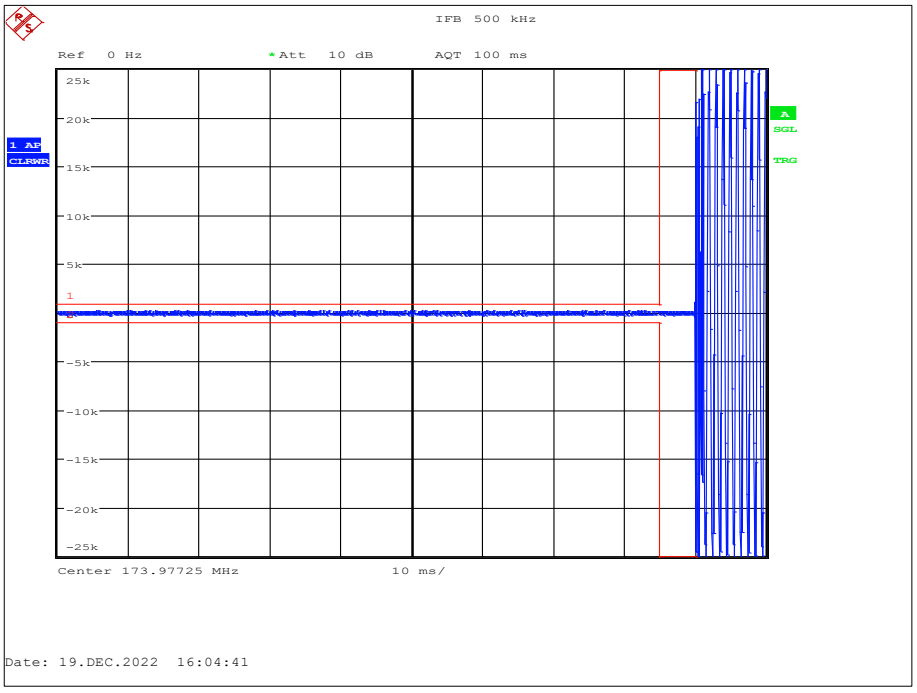

Figure 44- 173.975 MHz, Switch Off Transients

Tetra - 150 MHz to 174 MHz (FCC and ISEDC)

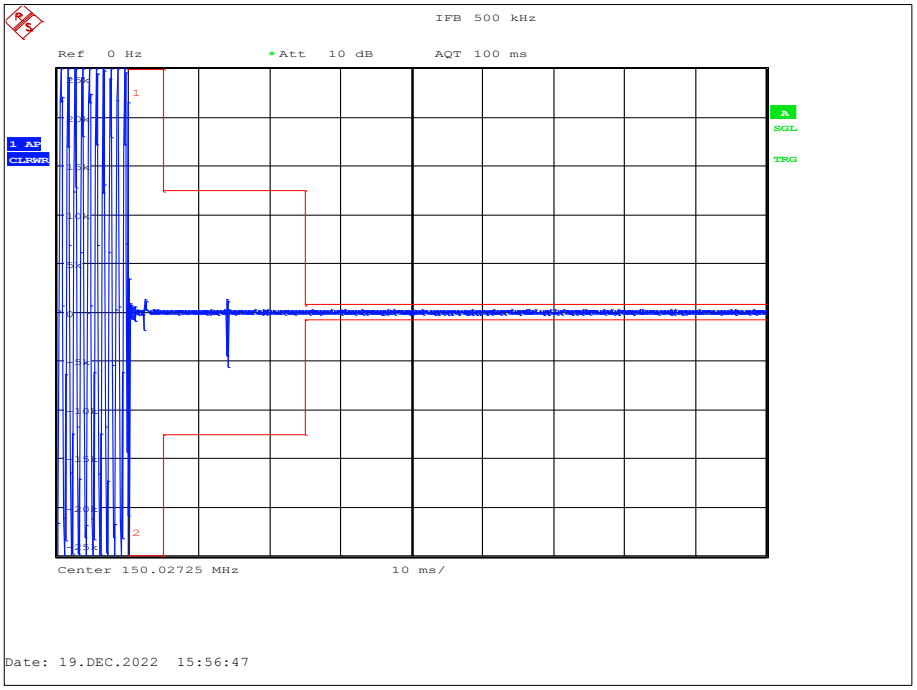

Figure 45 - 150.025 MHz, Switch On Transients

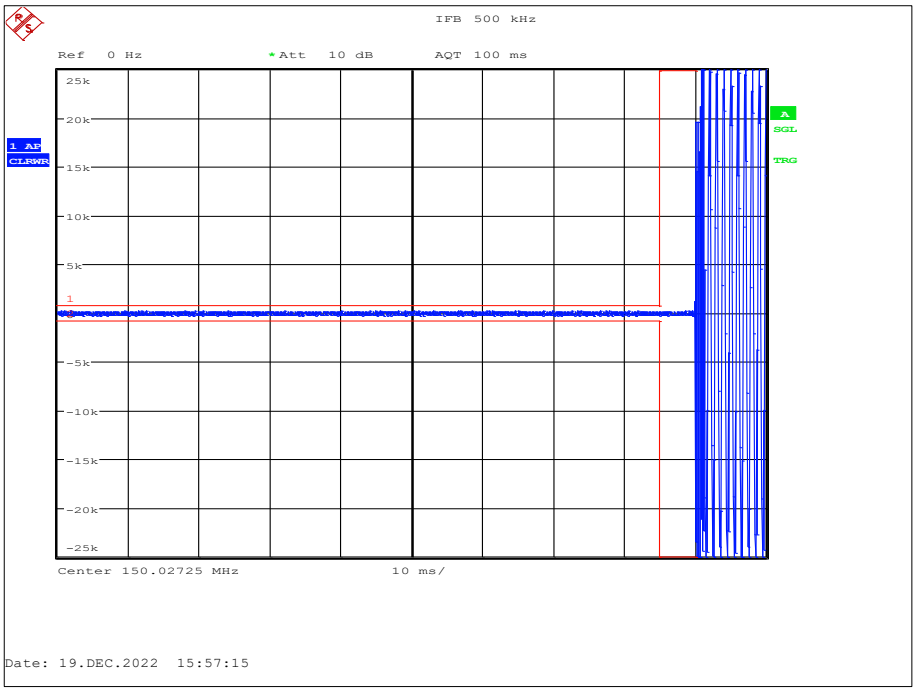

Figure 46- 150.025 MHz, Switch Off Transients

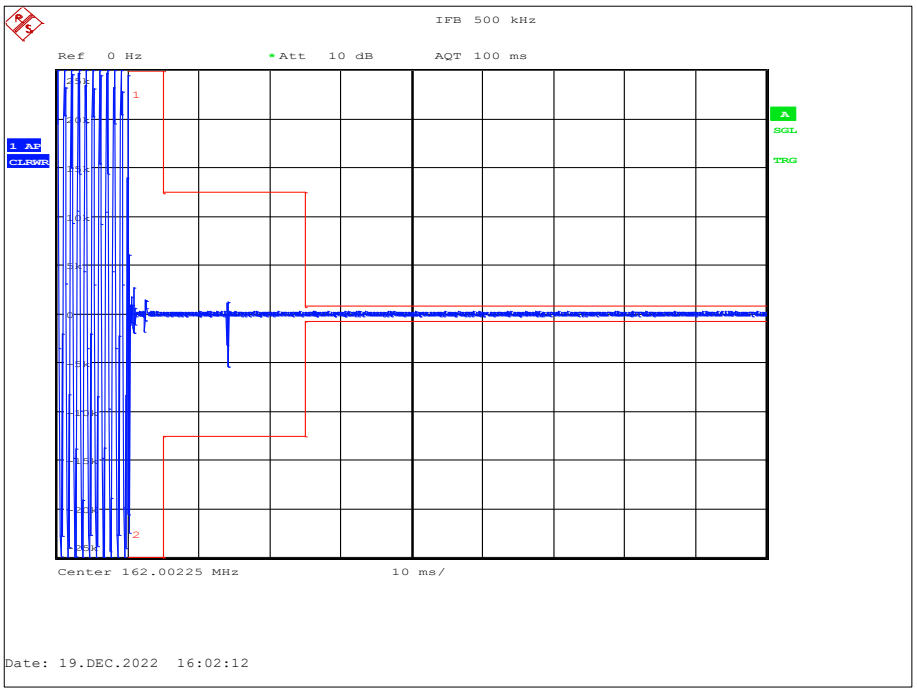

Figure 47 - 162.000 MHz, Switch On Transients

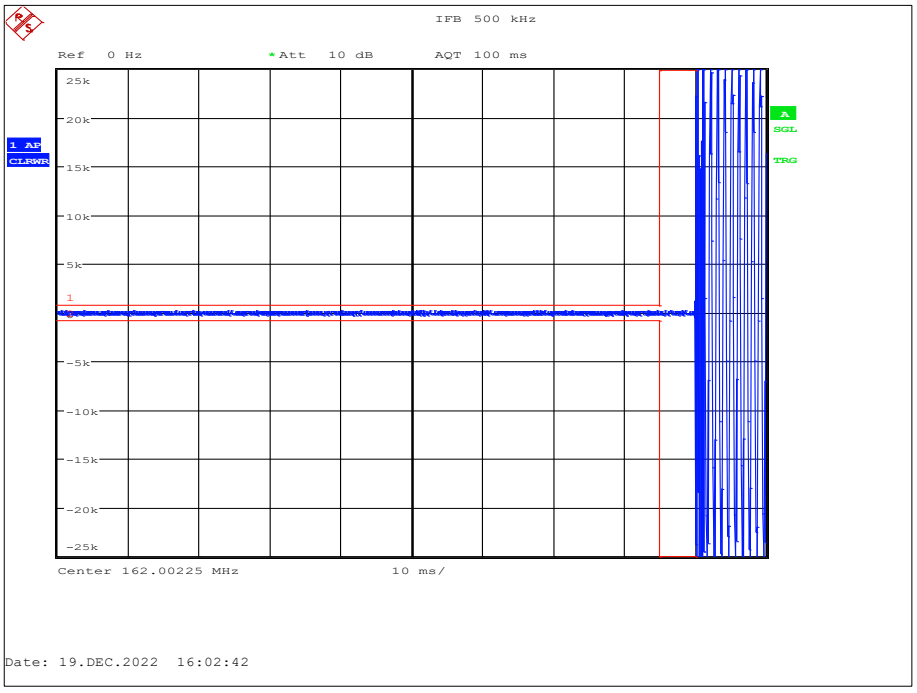

Figure 48- 162.000 MHz, Switch Off Transients

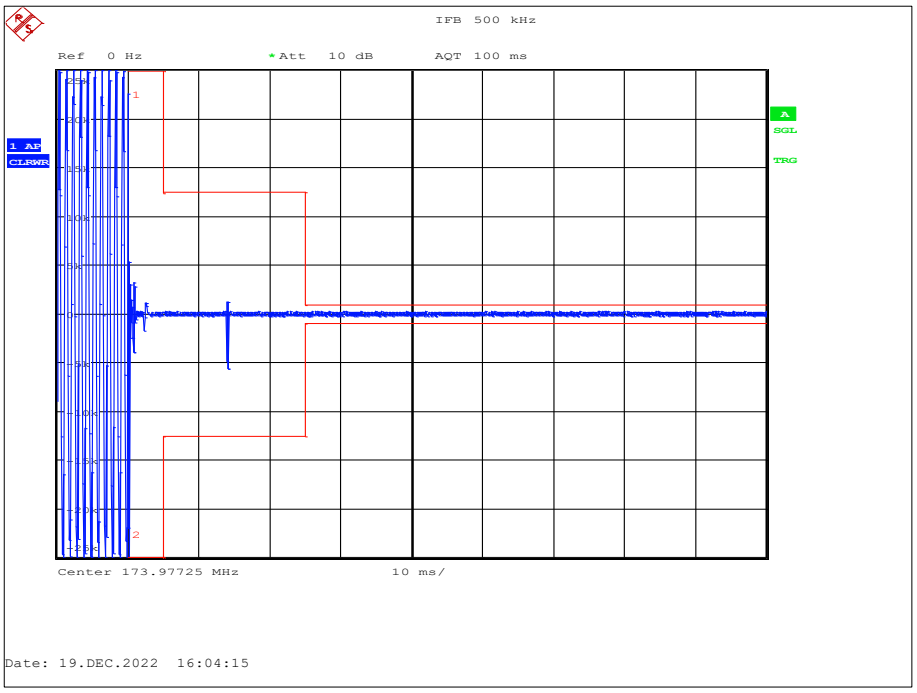

Figure 49 - 173.975 MHz, Switch On Transients

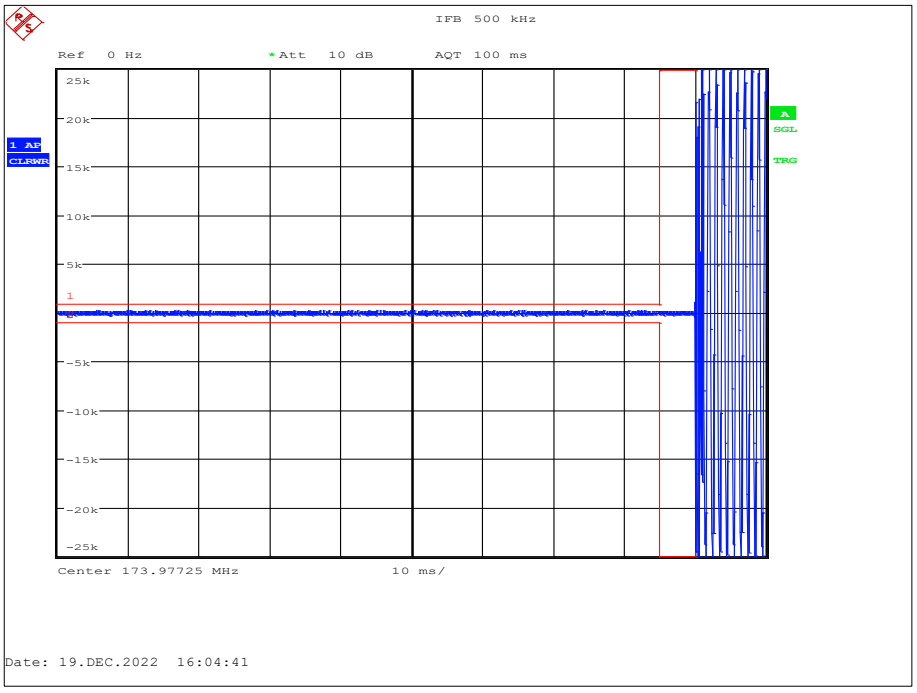

Figure 50 - 173.975 MHz, Switch Off Transients

FCC 47 CFR Part 90, Limit Clause 90.214

Time Interval	Maximum Frequency Difference	150 to 174 MHz	421 to 512 MHz
Transient Frequency Behaviour for Equipment Designed to Operate on 25 kHz Channels			
T_1	± 25.0 kHz	5.0 ms	10.0 ms
T_2	± 12.5 kHz	20.0 ms	25.0 ms
T_3	± 25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
T_1	± 12.5 kHz	5.0 ms	10.0 ms
T_2	± 6.25 kHz	20.0 ms	25.0 ms
T_3	± 12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 6.25 kHz Channels			
T_1	± 6.25 kHz	5.0 ms	10.0 ms
T_2	± 3.125 kHz	20.0 ms	25.0 ms
T_3	± 6.25 kHz	5.0 ms	10.0 ms

Table 37 - FCC Limits for Transient Frequency Behavior

Industry Canada RSS-119, Limit Clause 5.9

Channel Bandwidth (kHz)	Time Intervals	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138 to 174 MHz	406.1 to 512 MHz
25	t_1	±25	5	10
	t_2	±12.5	20	25
	t_3	±25	5	10
12.5	t_1	±12.5	5	10
	t_2	±6.25	20	25
	t_3	±12.5	5	10
6.25	t_1	±6.25	5	10
	t_2	±3.125	20	25
	t_3	±6.25	5	10

Table 38 - Industry Canada Limits for Transient Frequency Behavior

2.6.7 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 Expires
Power Divider	Weinschel	1506A	603	12	17-Oct-2023
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Signal Generator	Rohde & Schwarz	SMY 01	1389	12	12-May-2023
Multimeter	Iso-tech	IDM101	2417	12	28-Nov-2023
Hygrometer	Rotronic	I-1000	3068	12	21-Sep-2023
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-Jul-2023
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	27-Apr-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023

Table 39

O/P Mon – Output Monitored using calibrated equipment

2.7 Types of Emissions

2.7.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047
FCC 47 CFR Part 90, Clause 90.207
ISED RSS-119, Clause 5.2

2.7.2 Equipment Under Test and Modification State

SCG2221, S/N: 1PR002230GP58OM - Modification State 0

2.7.3 Date of Test

20-December-2022

2.7.4 Test Method

This test was performed on middle frequency using a modulated carrier output from the EUT and measured on a Spectrum Analyser. The Spectrum Analyser was set to the transmit frequency. The burst measurements were made in zero span mode and the frequency spectrum with a span sufficient to show the transmitters response. In addition, an IQ plot of the signal was measured. The trace plots were recorded and are shown below.

2.7.5 Environmental Conditions

Ambient Temperature	23.0 °C
Relative Humidity	35.6 %

2.7.6 Test Results

Tetra - 136 MHz to 174 MHz (ISEDC only)

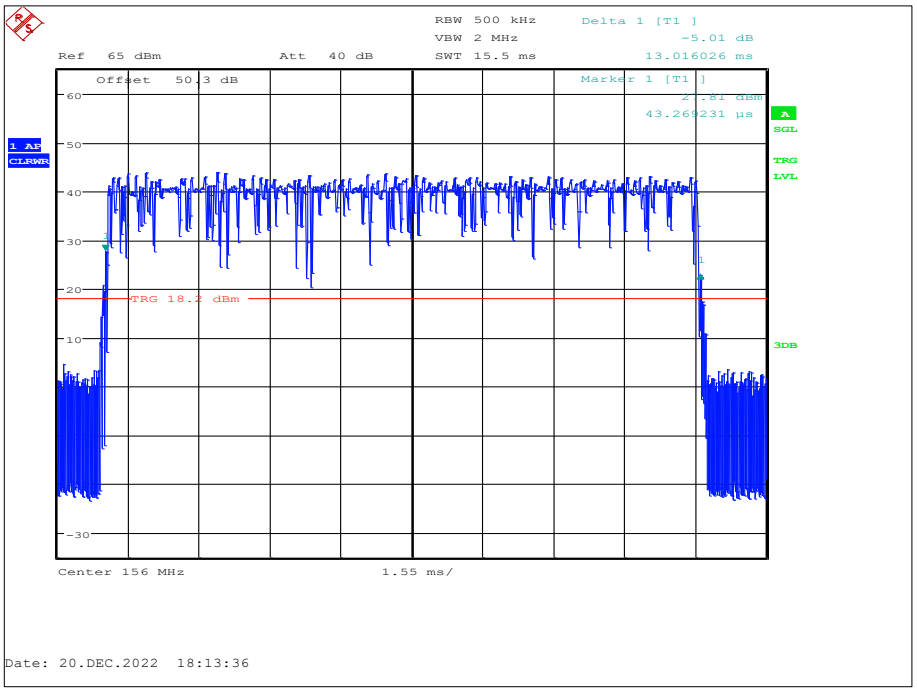

Figure 51 Burst Length

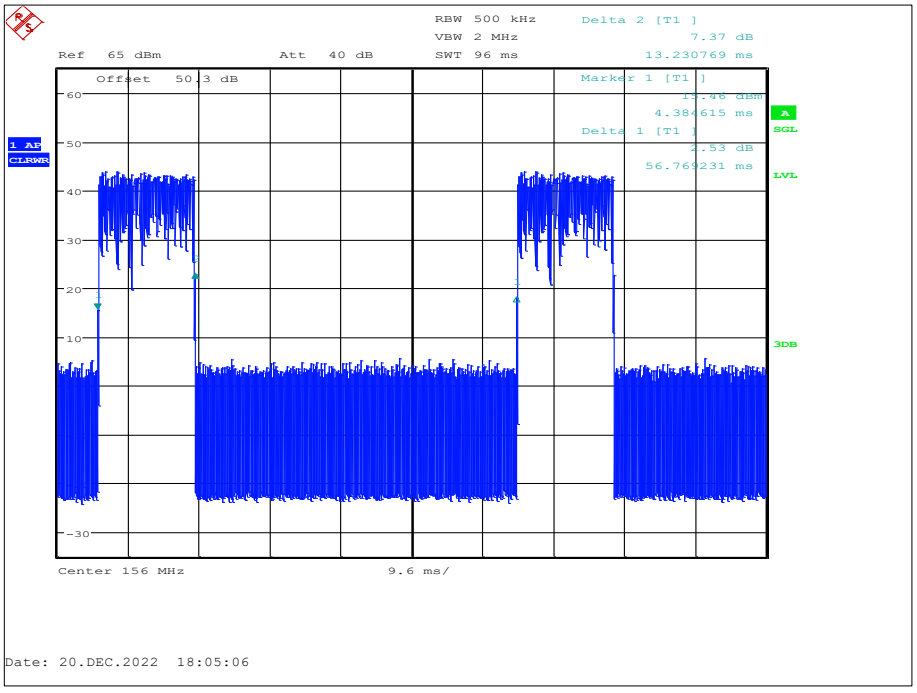

Figure 52 Transmission Characteristics

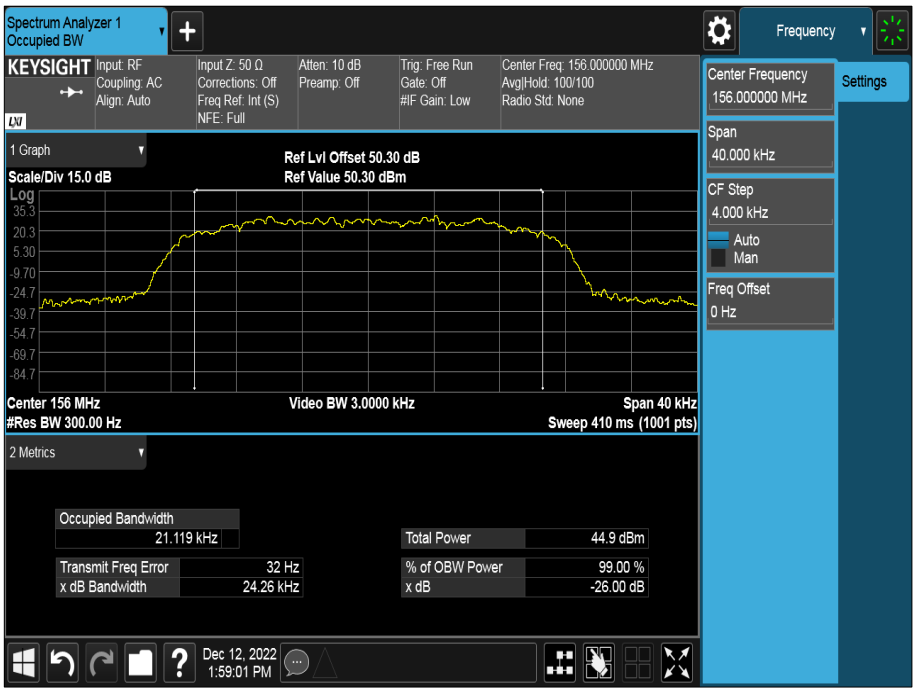

Figure 53 Spectrum Emission

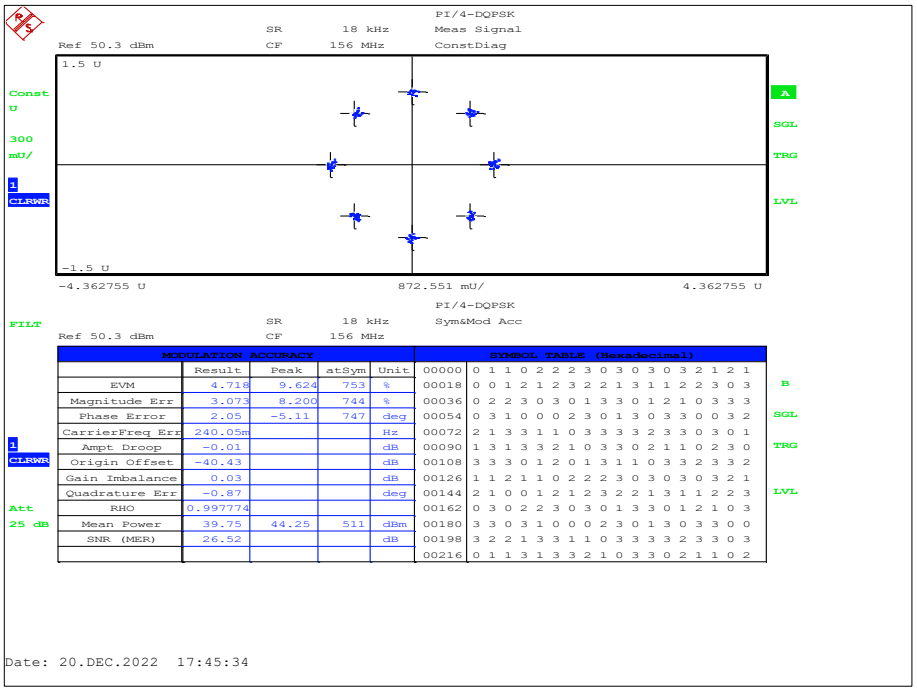

Figure 54 IQ Diagram

Tetra - 150 MHz to 174 MHz (FCC and ISEDC)

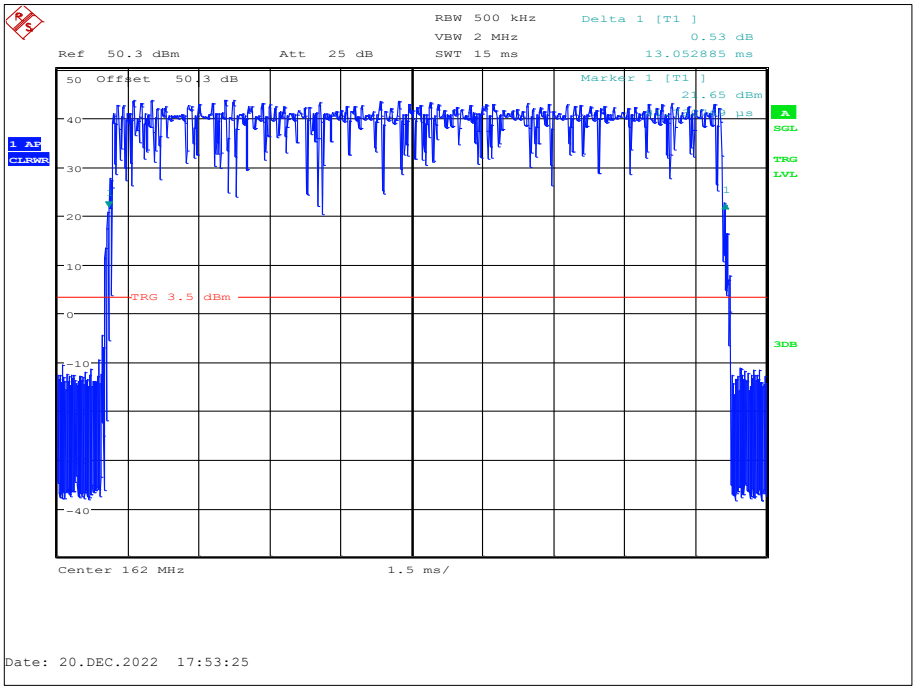

Figure 55 Burst Length

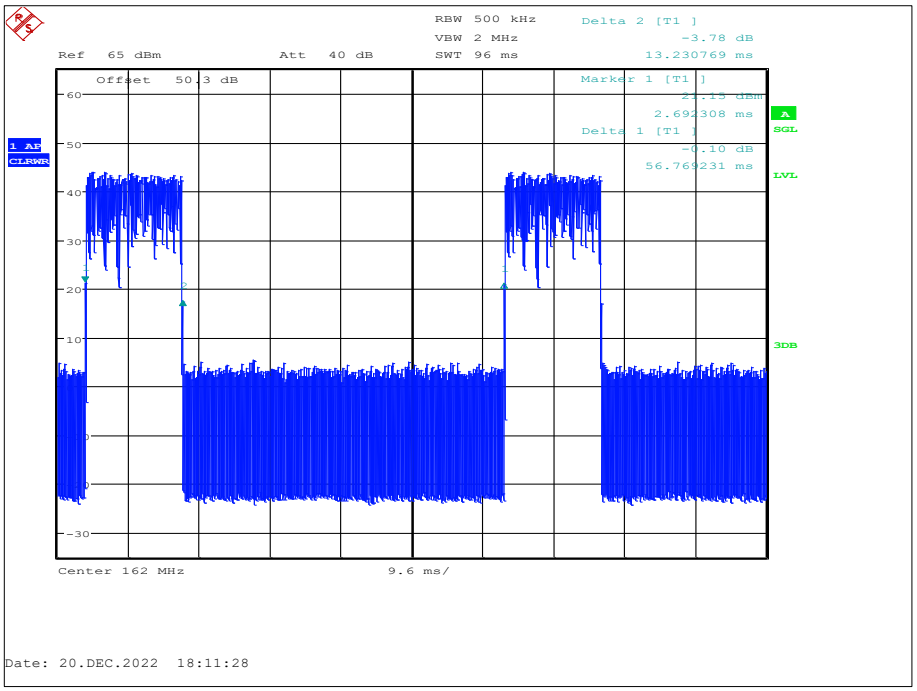

Figure 56 Transmission Characteristics

Figure 57 Spectrum Emission

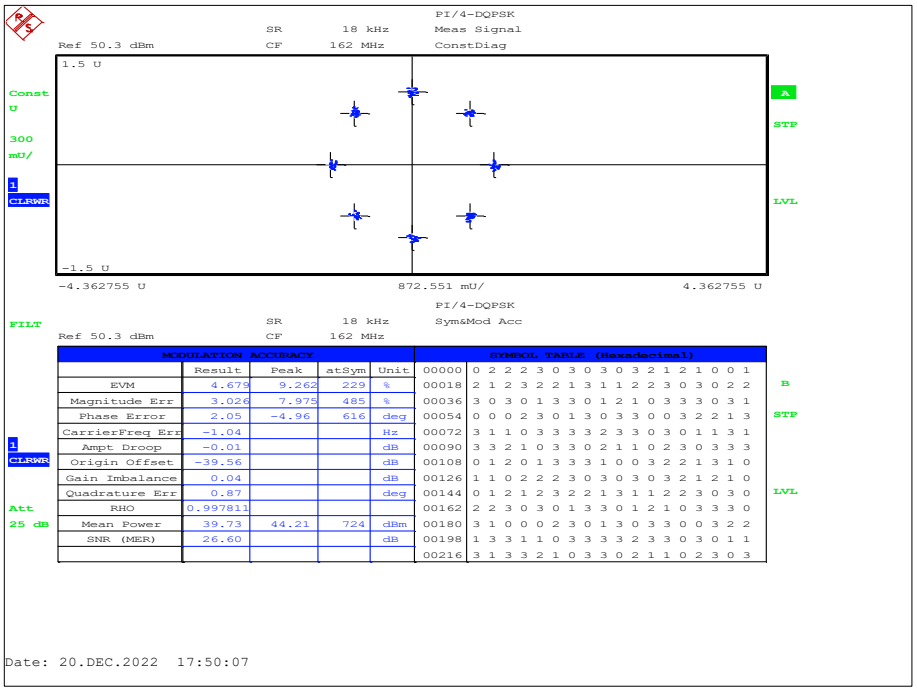

Figure 58 IQ Diagram

FCC 47 CFR Part 90, Limit Clause 90.207

As per FCC Part 90.207 (b) through (n).

FCC 47 CFR Part 2, Limit Clause 2.1047

Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

Industry Canada RSS-119, Limit Clause 5.3

Equipment that operates in the bands 768-776 MHz and 798-806 MHz shall use digital modulation. Mobile and portable transmitters that operate in these bands may have analogue modulation capability only as a secondary mode in addition to their primary digital mode. However, mobile and portable transmitters that operate only on the low-power channels as defined in SRSP-511 may employ any type of modulation.

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 Expires
Power Supply Unit	Farnell	H60-25	1092		O/P Mon
Multimeter	Iso-tech	IDM101	2417	12	28-Nov-2023
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	28-Jul-2023
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-Jul-2023
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	27-Apr-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
EXA	Keysight Technologies	N9010B	4968	24	19-Jan-2024

Table 40

O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Test Setup Photographs

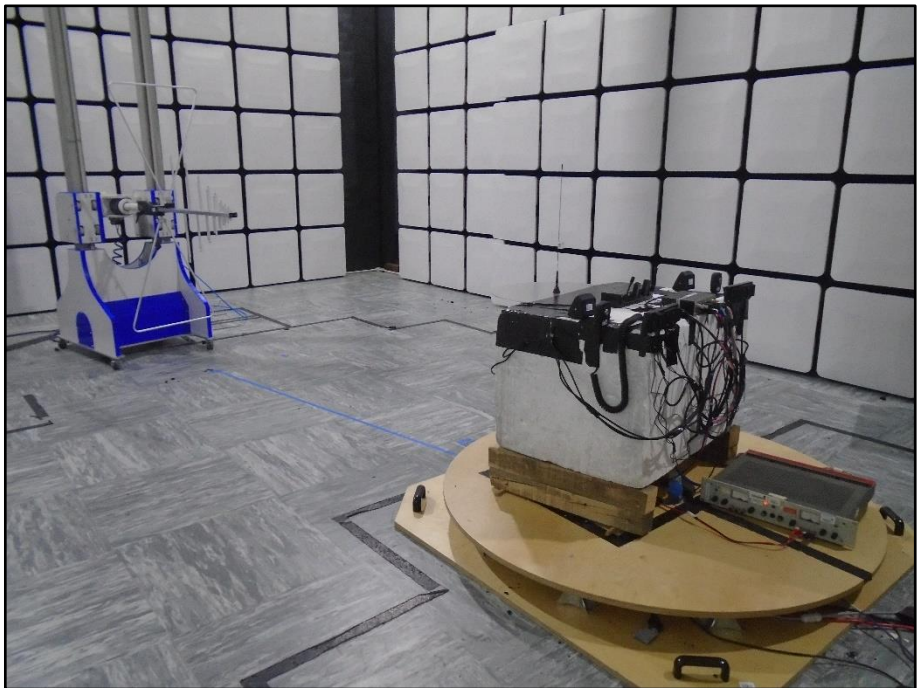

Figure 59 - 30 MHz to 1 GHz

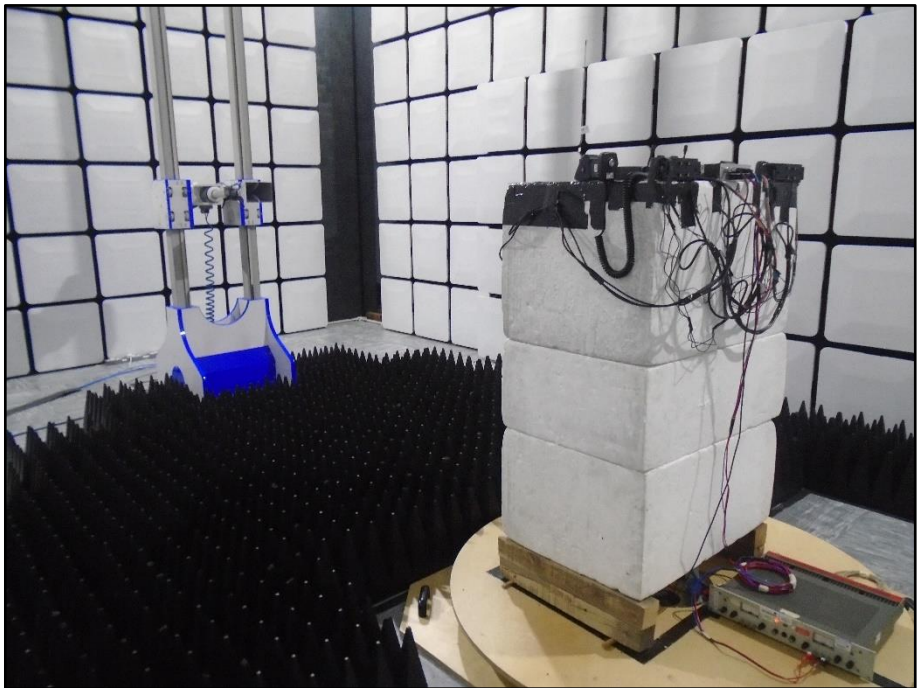

Figure 60 - 1 GHz to 3 GHz

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Bandwidth Limitations	± 58.05 Hz
Spurious Emissions at Antenna Terminals	± 3.45 dB
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 18 GHz: ± 6.3 dB
Frequency Stability	± 11 Hz
Transient Frequency Behaviour	± 0.2 Hz
Types of Emissions	-

Table 41

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.