

FCC and IC or ISED Test Report

DETNET SOUTH AFRICA (PTY) LTD
DGPS tagger, Model: CE4

In accordance with FCC 47 CFR Part 15C and
ISED RSS-247 and ISED RSS-GEN

Prepared for: Detnet South Africa (Pty) Ltd
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FCC ID: 2ARNH-18362211

IC: 24476-18362211

COMMERCIAL-IN-CONFIDENCE

Document 75949717-03 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	RF Team Leader	Authorised Signatory	10 May 2021

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 15C and ISED RSS-247 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	Callum Smith	10 May 2021	

FCC Accreditation
217472 Bearley Test Laboratory

Industry Canada Accreditation
2932E Bearley Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN: 2019, Issue 2 (02-2017) and Issue 5 (04-2018) + A1 (03-2019) for the tests detailed in section 1.3.



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ACCREDITATION

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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	10 May 2021

Table 1

1.2 Introduction

Applicant	DETNET SOUTH AFRICA (PTY) LTD
Manufacturer	DETNET SOUTH AFRICA (PTY) LTD
Model Number(s)	CE4
Serial Number(s)	183000010
Hardware Version(s)	V6
Software Version(s)	45232
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN: 2019, Issue 2 (02-2017) and Issue 5 (04-2018) + A1 (03-2019)
Order Number	4500432723
Date	05-August-2020
Date of Receipt of EUT	28-September-2020
Start of Test	18-January-2021
Finish of Test	25-January-2021
Name of Engineer(s)	Callum Smith
Related Document(s)	ANSI C63.10 (2013) KDB 996369 D04 Module Integration Guide v02 remove



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C and ISED RSS-247 and ISED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: Tagger - Battery powered - 915 MHz transmitter						
2.1	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.2	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)

Table 2



1.4 Application Form

Technical Description: <i>(Please provide a brief description of the intended use of the equipment including the technologies the product supports)</i>	Blasting control of electronic detonators		
Manufacturer:	DetNet South Africa Pty (Ltd)		
Model:	DGPS CE4 Tagger		
Part Number:	183000010		
Hardware Version:	V6		
Software Version:	45232		
FCC ID of the product under test – see guidance here	2ARNH-18362211		
IC ID of the product under test – see guidance here	24476-18362211		

Intentional Radiators

Technology	RF	WiFi	NFC
Frequency Range (MHz to MHz)	902-928	2412-2457	13.553-13.567
Conducted Declared Output Power (dBm)	27	18	6
Antenna Gain (dBi)	0	2.1	2.1
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	50	22	
Modulation Scheme(s) (e.g GFSK, QPSK etc)	GFSK	BPSK, QPSK, 16QAM, 64QAM	Point to point communication
ITU Emission Designator (see guidance here)	900MF1D	2G4G1D	13M5D1D
Bottom Frequency (MHz)	902.26	2412	-
Middle Frequency (MHz)	914.74	2437	13.56
Top Frequency (MHz)	927.74	2457	-

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

Name: Suzette Menezes
 Position held: Approvals Manager
 Date: 14-Aug-2020



1.5 Product Information

1.5.1 Technical Description

The Equipment under test (EUT) was a DetNet South Africa Pty (Ltd), a DGPS CE4 Tagger.

The primary function of the EUT is to be used as a Blasting control for electronic detonators.

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: CE4, Serial Number: 183000010			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Tagger - Battery powered - 915 MHz transmitter		
Authorised Band Edges	Callum Smith	UKAS
Spurious Radiated Emissions	Callum Smith	UKAS

Table 4

Office Address:

Snitterfield Road
Bearley
Stratford-upon-Avon
Warwickshire
CV37 0EX
United Kingdom



2 Test Details

2.1 Authorised Band Edges

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d),
ISED RSS-247 Clause 5.5

2.1.2 Equipment Under Test and Modification State

CE4, S/N: 183000010 - Modification State 0

2.1.3 Date of Test

19-January-2021 to 25-January-2021

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

Since compliance with the power limits were shown by a peak measurement, a 20 dBc limit was applied in accordance with FCC 47 CFR Part 15.247(d) and RSS-247 clause 5.5.

2.1.5 Environmental Conditions

Ambient Temperature 18.2 - 19.4 °C
Relative Humidity 49.6 - 50.2 %

2.1.6 Test Results

Tagger - Battery powered - 915 MHz transmitter

Mode	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	901.626	902	-42.21
Static	928.038	928	-44.64
Hopping	880.920	902	-36.03
Hopping	928.038	928	-45.49

Table 5 - Authorised Band Edge Results

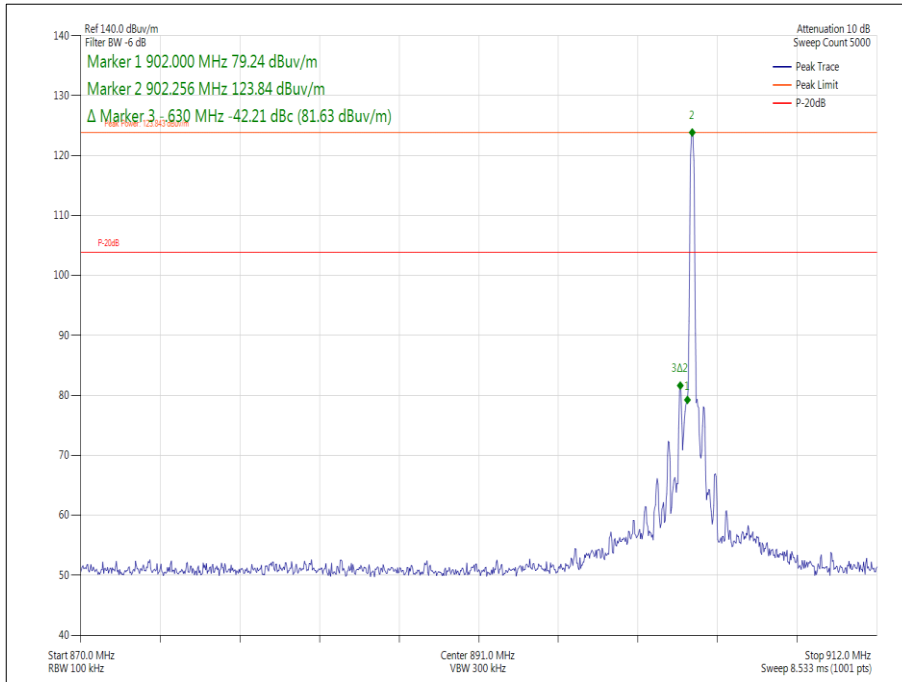


Figure 1 – Static - 902.26 MHz - Measured Frequency 901.63 MHz

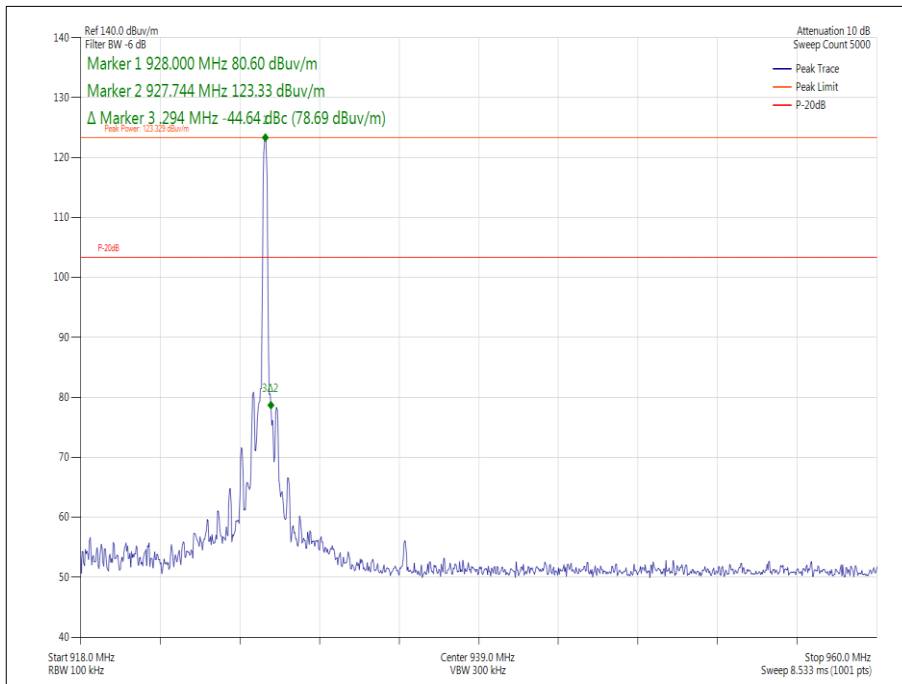


Figure 2 - Static 927.74 MHz - Measured Frequency 928.03 MHz

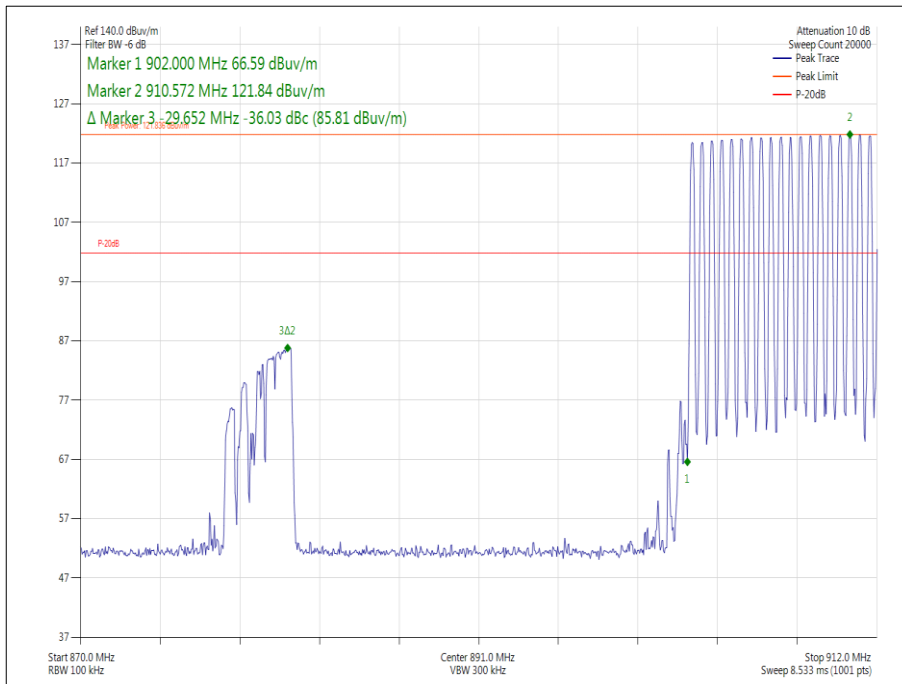


Figure 3 - Hopping - Measured Frequency 880.92 MHz

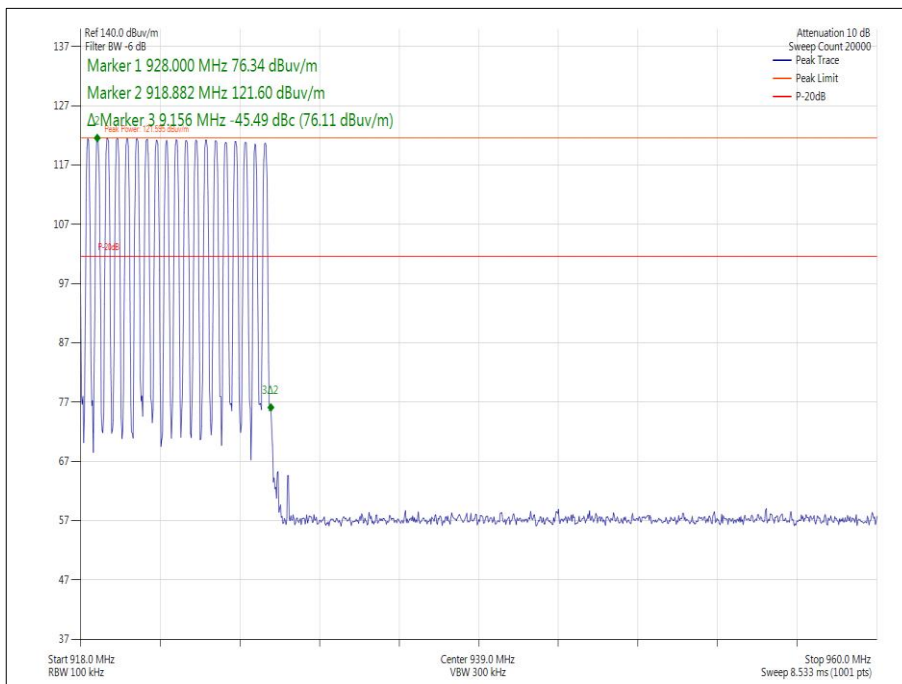


Figure 4 - Hopping - Measured Frequency 928.038 MHz



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

ISED RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.1.7 Test Location and Test Equipment Used

This test was carried out in Bearley EMC Chamber 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygromer	Rotronic	A2	1698	12	18-Nov-2021
Bilog Antenna	Schaffner	CBL6143	1858	24	10-Nov-2022
EMC 3m Semi Anechoic Chamber	Rainford	Hybrid	4160	36	16-Dec-2021
7m N-Type Cable	Teledyne Storm	SA90-195-7MTR	4168	12	10-Mar-2021
EMC Mast controller	Innco Systems	CONTROLLER CO3000	4728	-	TU
EMI Receiver	Keysight Technologies	N9038A MXE	4974	12	11-Feb-2021
EmX Emissions Software	TUV SUD	V2.1.1	5125	-	Software
Cable (18GHz N Type 3m)	Rosenberger	LU7-036-3000	5163	12	10-Dec-2021
Turntable Controller	Maturo	Maturo NCD	5275	-	TU
4dB Attenuator	Pasternack	PE7047-4	5647	24	10-Nov-2022

Table 6

TU - Traceability Unscheduled



2.2 Spurious Radiated Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247(d) and 15.205
ISED RSS-247, Clause 5.5
ISED RSS-GEN, Clause 6.13

2.2.2 Equipment Under Test and Modification State

CE4, S/N: 183000010 - Modification State 0

2.2.3 Date of Test

18-January-2021 to 20-January-2021

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6.

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. As the EUT could reasonable be used in multiple planes, pre-scans were performed with the EUT orientated in X, Y and Z planes from 30 MHz to 1 GHz. For measurements above 1 GHz, pre-scans were only performed in the plane resulting in the highest field strength of the fundamental.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.2.

The plots shown are the characterisation of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits within the restricted bands, shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$.

To determine the emission characteristic of the EUT above 18 GHz, the test antenna was swept over all faces of the EUT whilst observing a spectral display. The frequency of any emissions of interest was noted for formal measurement at the correct measurement distance of 1m. This procedure was repeated for all relevant transmit operating channels.

At a measurement distance of 1 meter the limit line was increased by $20 \cdot \text{LOG}(3/1) = 9.54$ dB.

Where formal measurements have been necessary, the results have been presented in the emissions table.

2.2.5 Example Test Setup Diagram

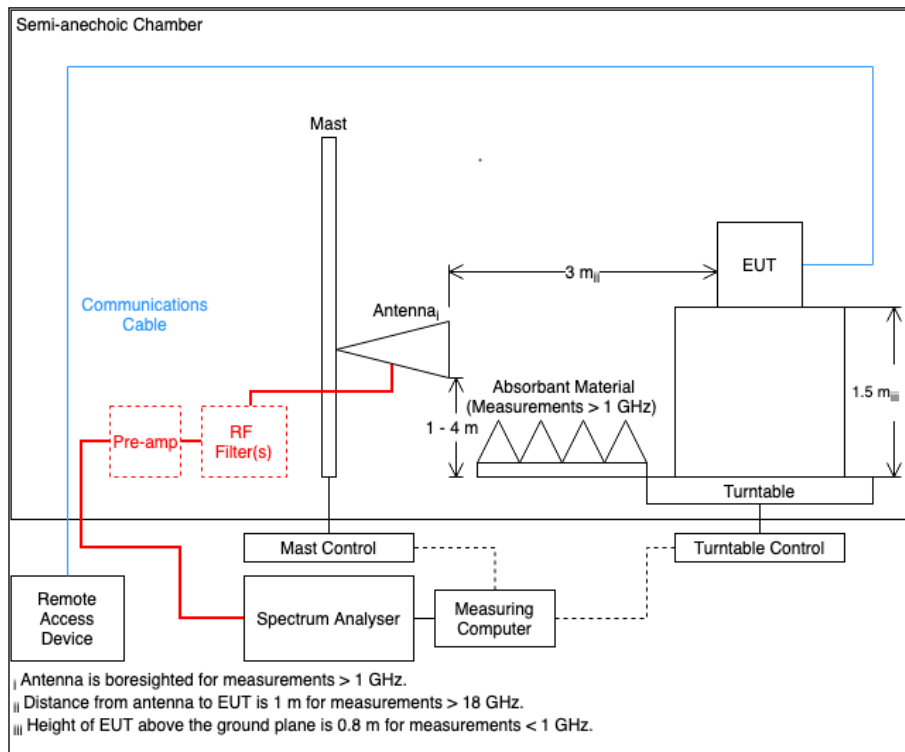


Figure 5

2.2.6 Environmental Conditions

Ambient Temperature 17.4 - 17.9 °C
 Relative Humidity 32.1 - 35.8 %

2.2.7 Test Results

Tagger - Battery powered - 915 MHz transmitter

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
323.993	39.8	46.0	-6.2	Q-Peak	360	150	Vertical	Z
267.778	34.9	46.0	-11.2	Q-Peak	168	100	Horizontal	Z

Table 7 - 902.26 MHz, 30 MHz to 1 GHz - Emission Results

No other emissions were detected within 6 dB of the limit within the restricted bands.

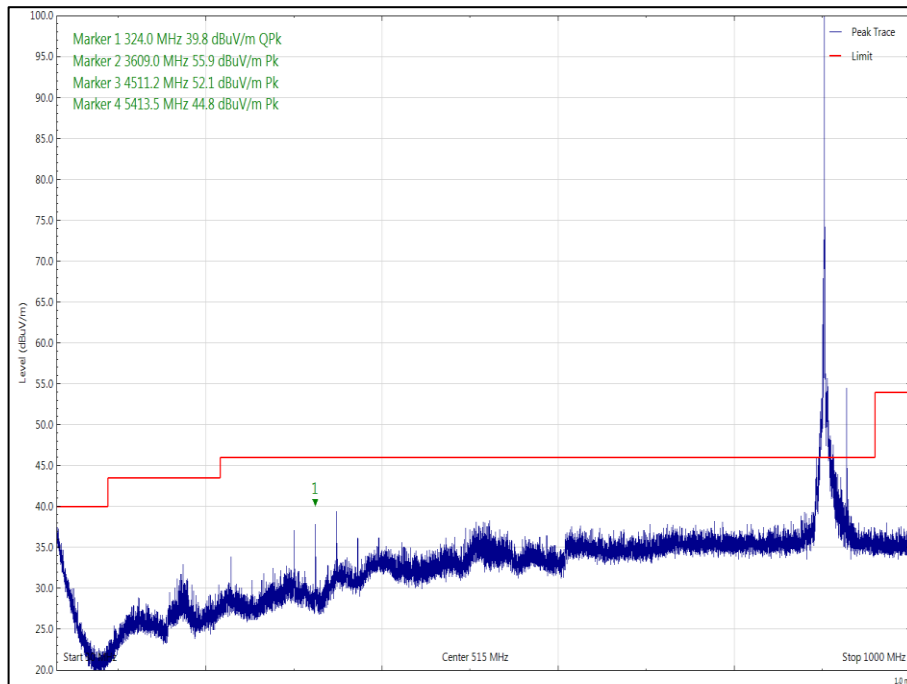


Figure 6 - 902.26 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

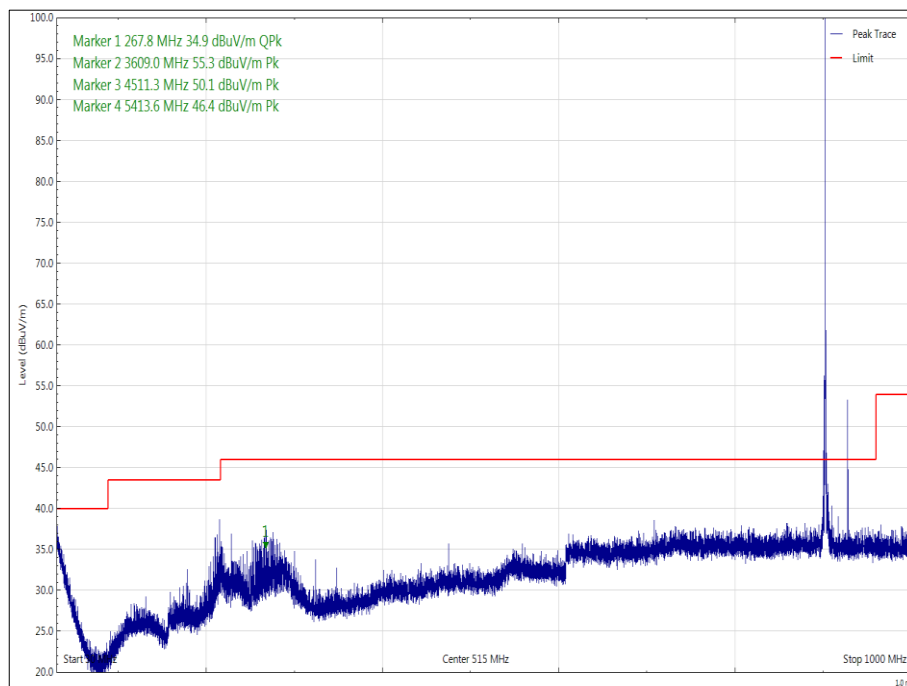


Figure 7 - 902.26 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation

1



Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
3608.971	55.9	74.0	-18.1	Peak	206	100	Vertical	Z
3609.063	36.4	54.0	-17.6	CISPR Average	206	100	Vertical	Z

Table 8 - 902.26 MHz, 1 GHz to 25 GHz Emissions Results

No other emissions were detected within 6 dB of the limit within the restricted bands. The 2nd and 8th harmonics do not fall in Restricted Bands and therefore were not measured.

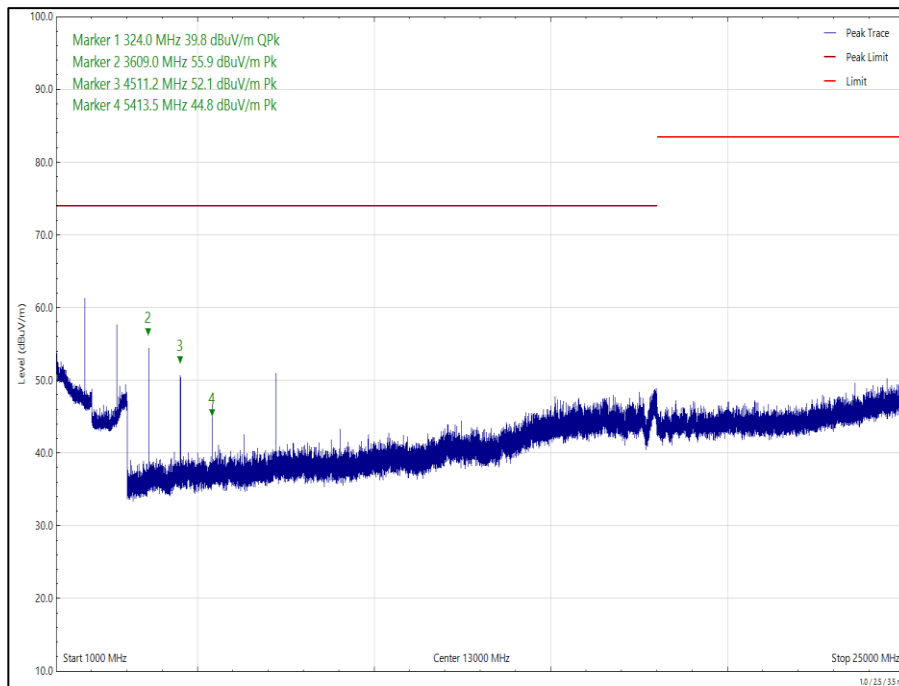


Figure 8 - 902.26 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation: - Peak

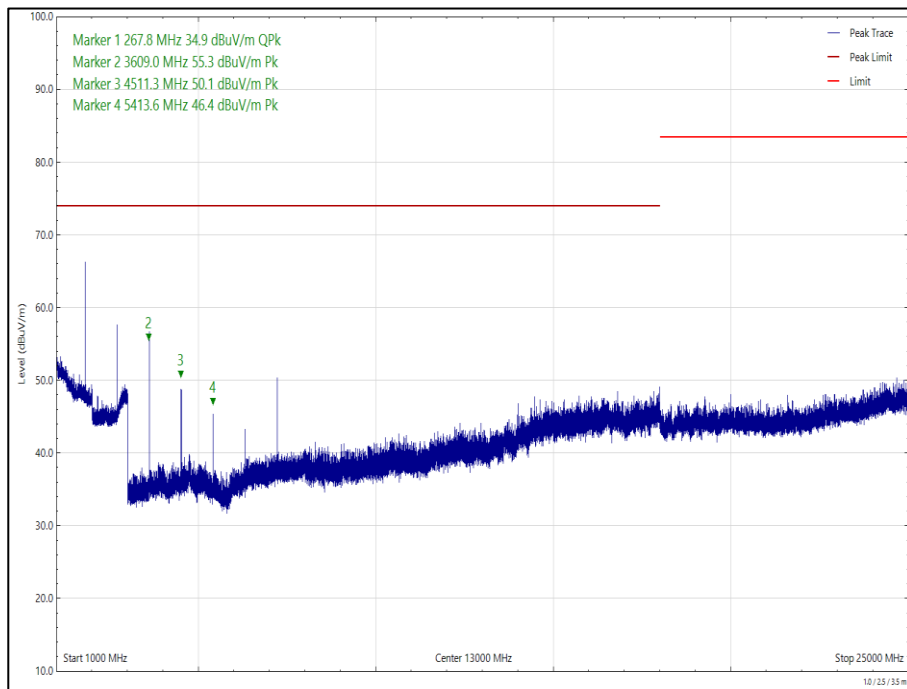


Figure 9 - 902.26 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation: - Peak

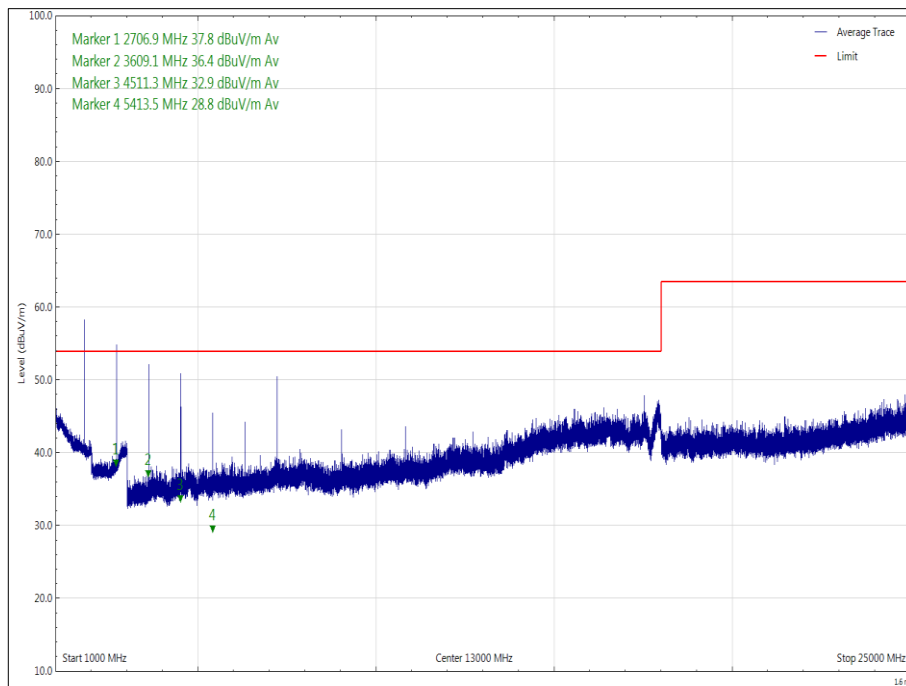


Figure 10 - 902.26 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation: - Average

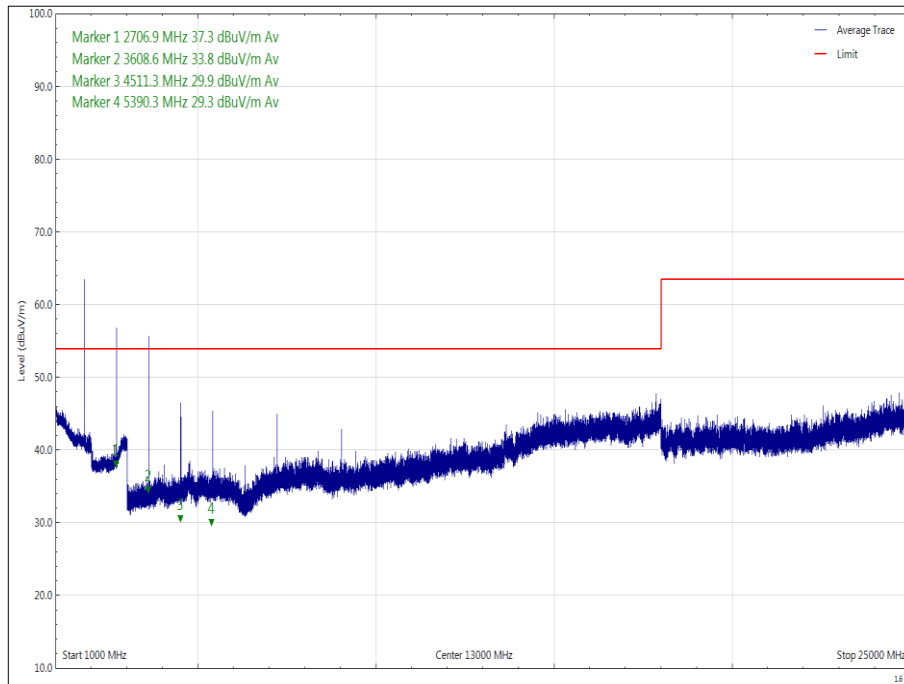


Figure 11 - 902.26 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation: - Average



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
399.478	32.1	46.0	-14.0	Q-Peak	197	131	Vertical	Z
228.006	37.7	46.0	-8.4	Q-Peak	139	100	Horizontal	Z
267.754	34.9	46.0	-11.1	Q-Peak	190	110	Horizontal	Z

Table 9 - 914.74 MHz, 30 MHz to 1 GHz - Emission Results

No other emissions were detected within 6 dB of the limit within the restricted bands.

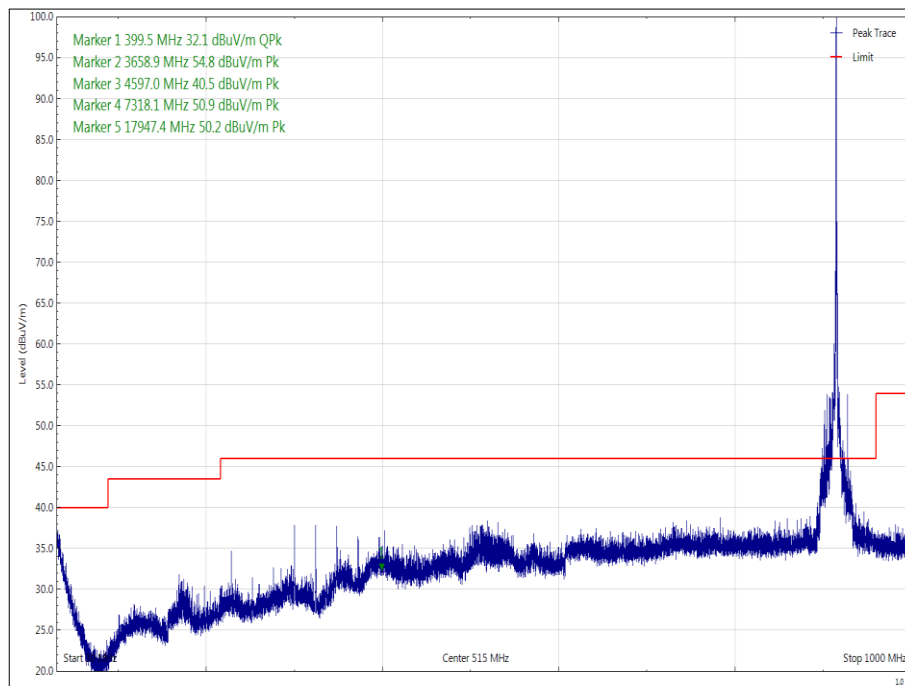


Figure 12 - 914.74 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

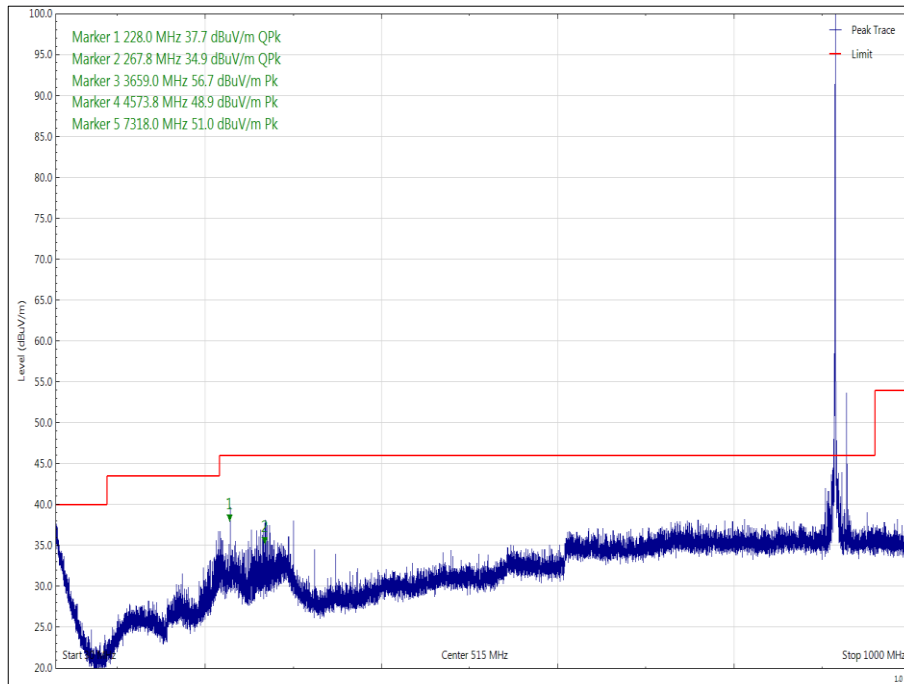


Figure 13 - 914.74 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
3658.936	54.8	74.0	-19.3	Peak	189	396	Vertical	Z
3659.003	38.6	54.0	-15.4	CISPR Average	189	396	Vertical	Z
17915.243	37.5	54.0	-16.5	CISPR Average	36	386	Vertical	Z
3658.903	34.7	54.0	-19.3	CISPR Average	307	110	Horizontal	Z
3659.001	56.7	74.0	-17.3	Peak	307	110	Horizontal	Z

Table 10 - 914.74 MHz - 1 GHz to 25 GHz Emissions Results

No other emissions were detected within 6 dB of the limit within the restricted bands. The 2nd and 8th harmonics do not fall in Restricted Bands and therefore were not measured.

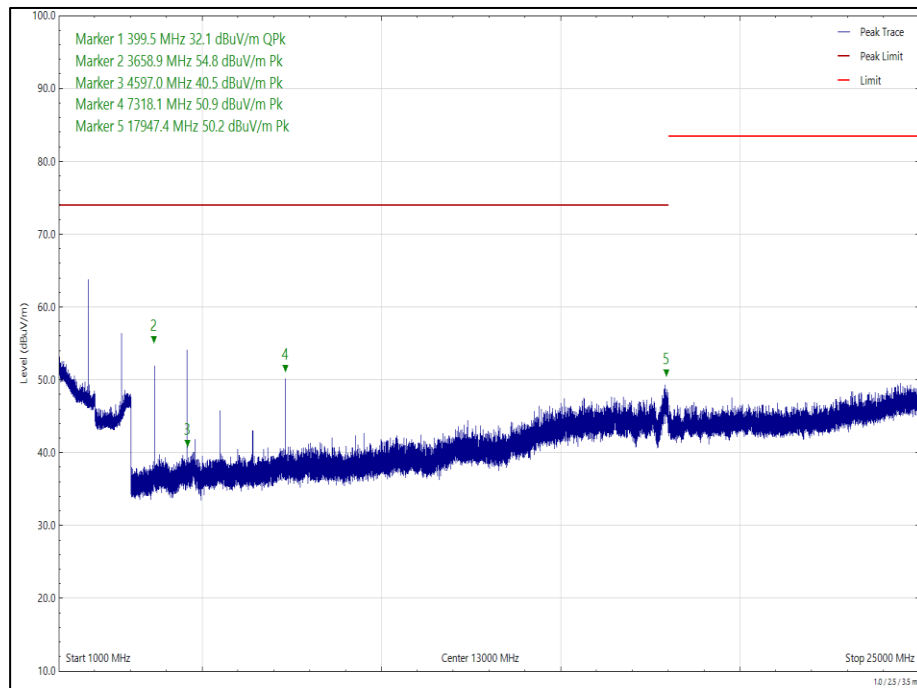


Figure 14 - 914.74 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Peak

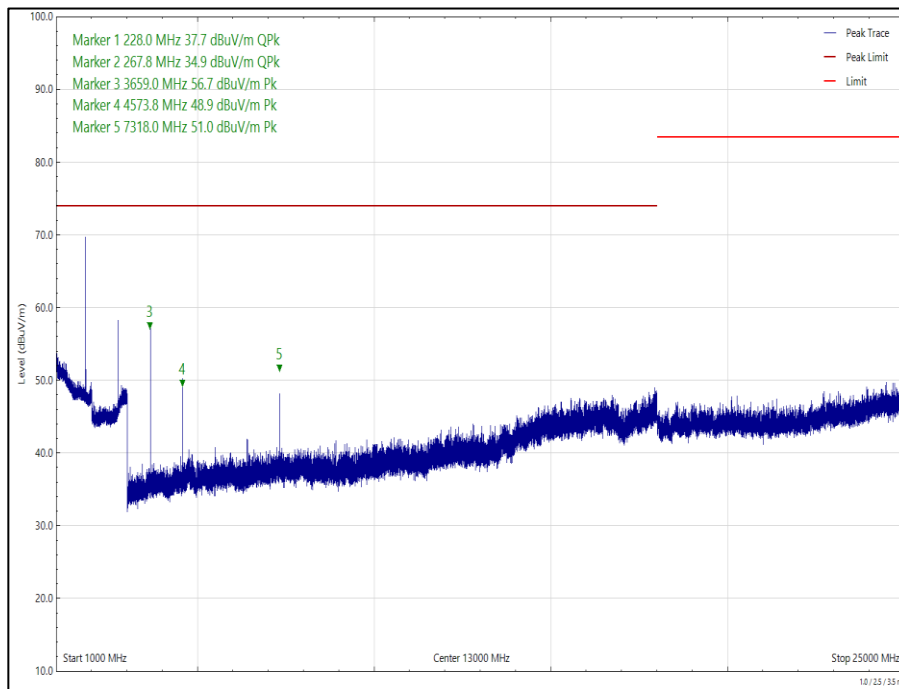


Figure 15 - 914.74 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Peak

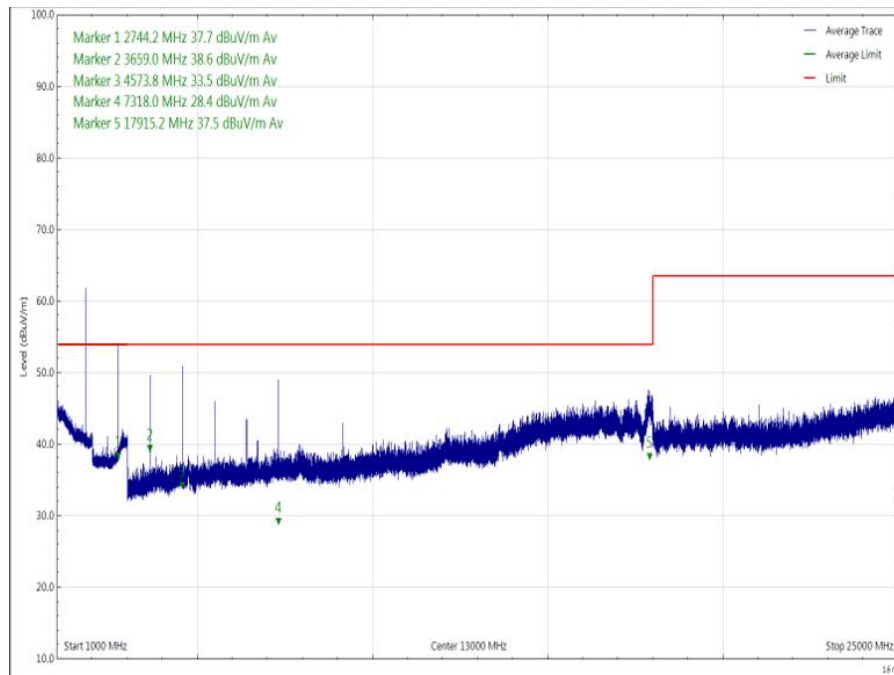


Figure 16 - 914.74 MHz - 1 GHz to 25 GHz, Polarity: Vertical, EUT Orientation: Z, Average

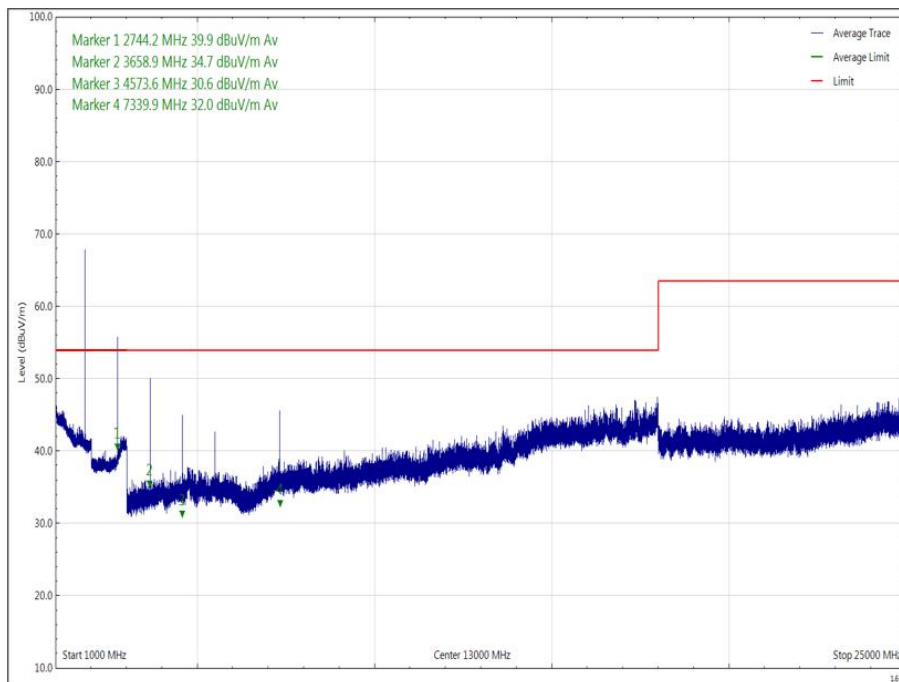


Figure 17 - 914.74 MHz - 1 GHz to 25 GHz, Polarity: Horizontal, EUT Orientation: Z, Average



Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
171.385	23.8	43.5	-19.7	Q-Peak	322	103	Vertical	Y
324.025	40.6	46.0	-5.4	Q-Peak	5	157	Vertical	Z
209.983	30.8	43.5	-12.7	Q-Peak	324	128	Horizontal	Z
233.410	33.3	46.0	-12.7	Q-Peak	122	100	Horizontal	Z
253.501	29.4	46.0	-16.6	Q-Peak	352	115	Horizontal	Z
269.473	30.4	46.0	-15.7	Q-Peak	52	112	Horizontal	Z
275.991	35.0	46.0	-11.0	Q-Peak	77	120	Horizontal	Z

Table 11 - 927.74 MHz, 30 MHz to 1 GHz - Emission Results

No other emissions were detected within 6 dB of the limit within the restricted bands.

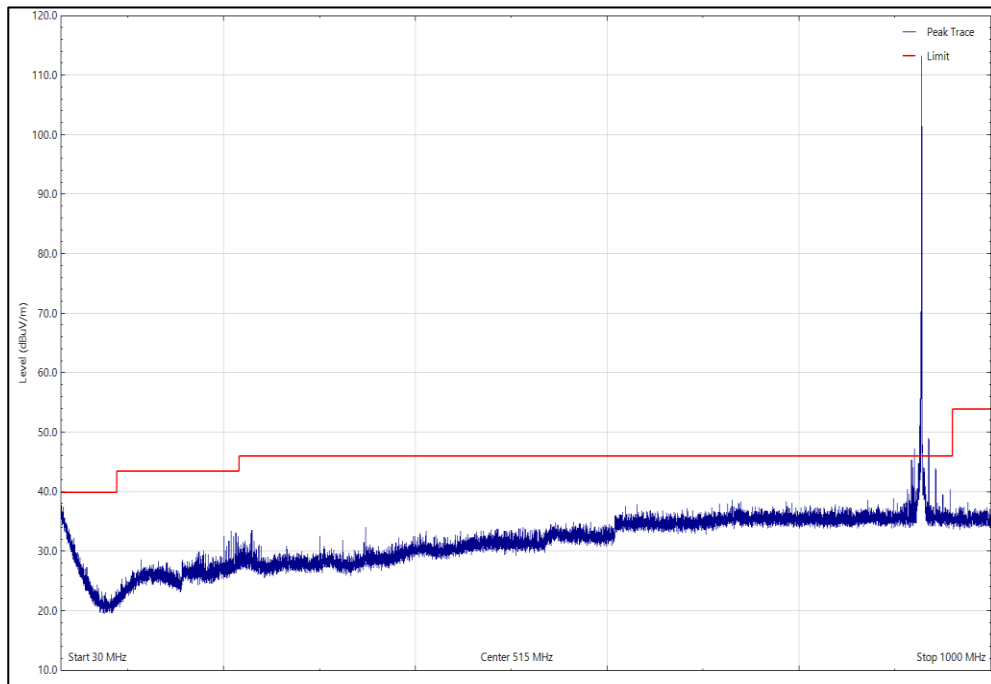


Figure 18 - 927.74 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

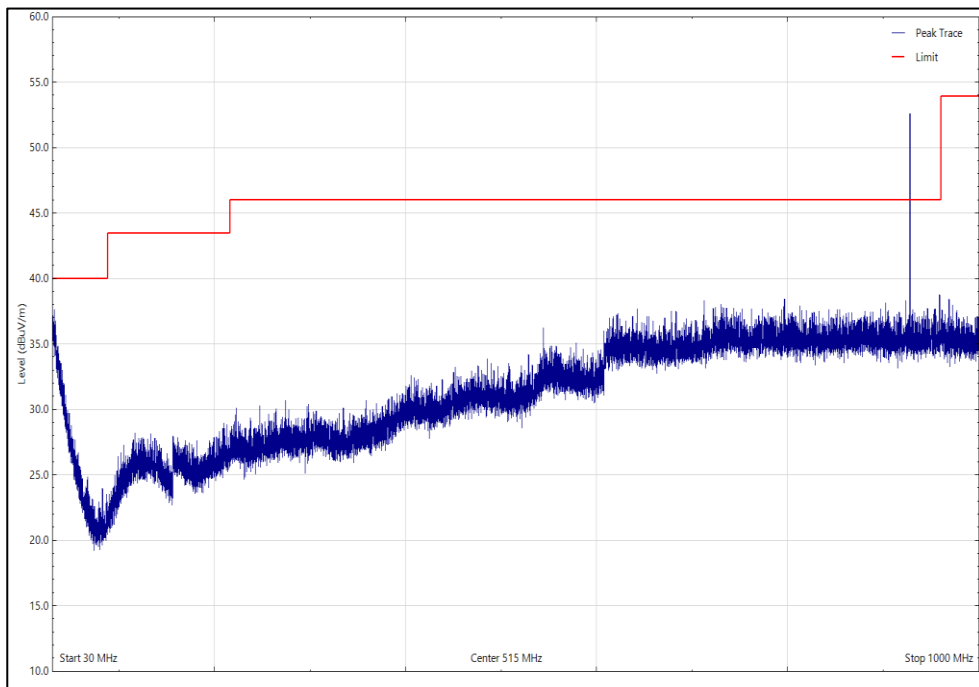


Figure 19 - 927.74 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

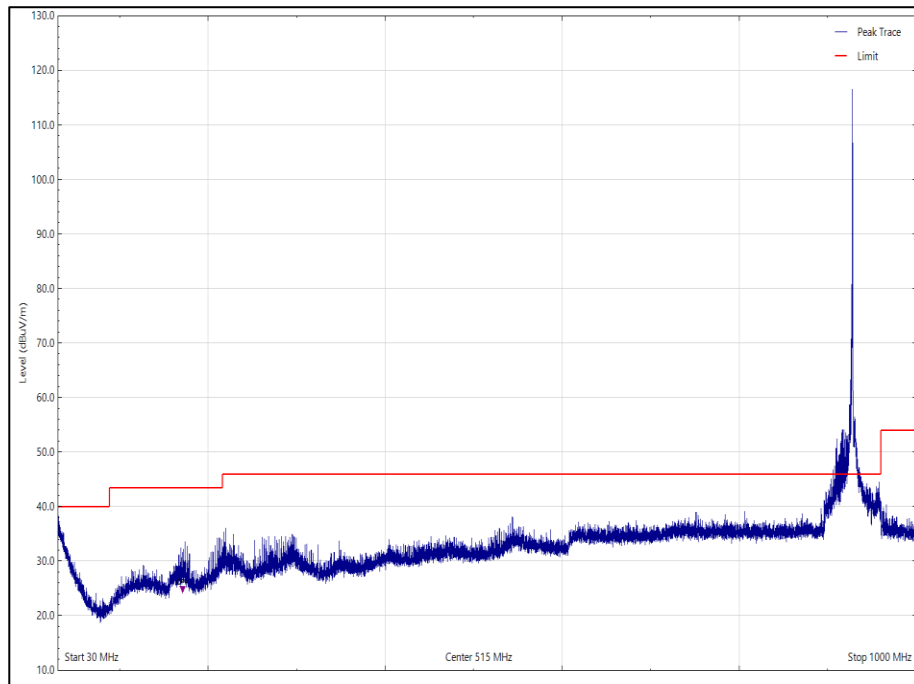


Figure 20 - 927.74 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation

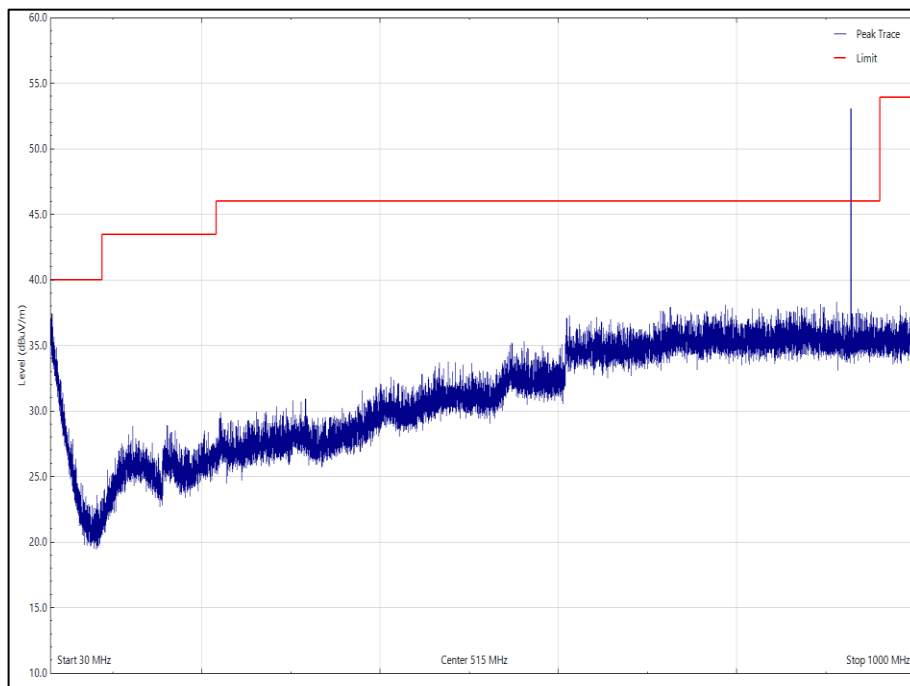


Figure 21 - 927.74 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation

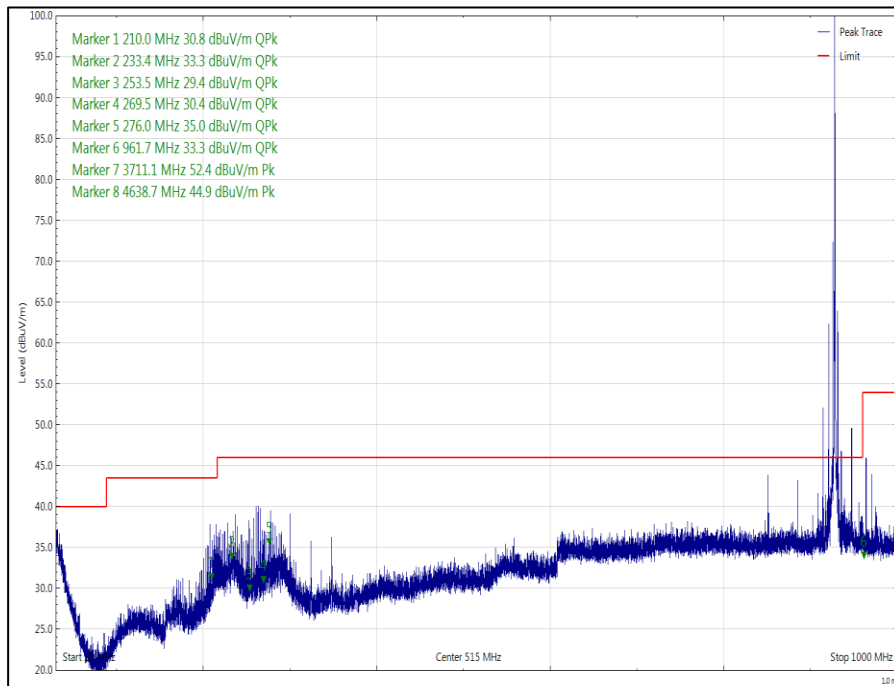


Figure 22 - 927.74 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

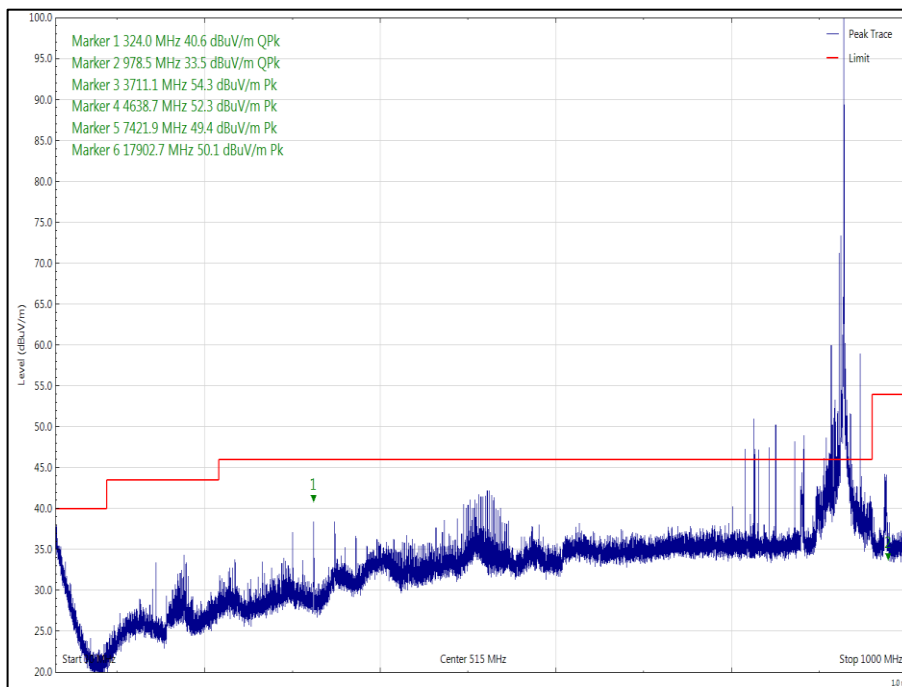


Figure 23 - 927.74 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
3710.864	34.4	54.0	-19.6	CISPR Average	15	291	Vertical	Z
3711.081	54.3	74.0	-19.7	Peak	15	291	Vertical	Z
17946.855	37.4	54.0	-16.6	CISPR Average	359	378	Vertical	Z

Table 12 - 927.74 MHz - 1 GHz to 25 GHz Emissions Results

No other emissions were detected within 6 dB of the limit within the restricted bands.

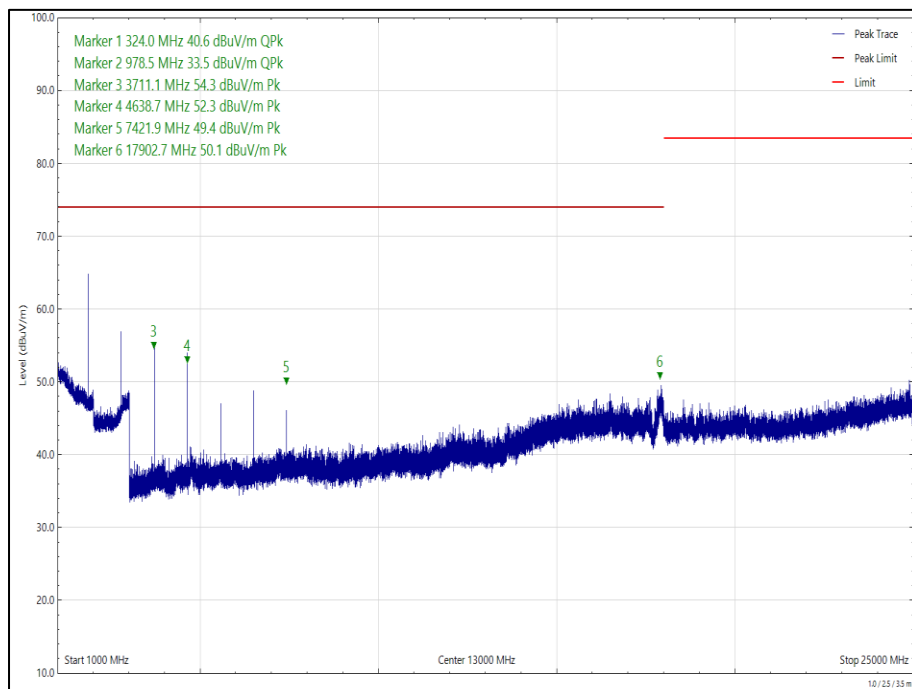


Figure 24 - 927.74 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation, Peak

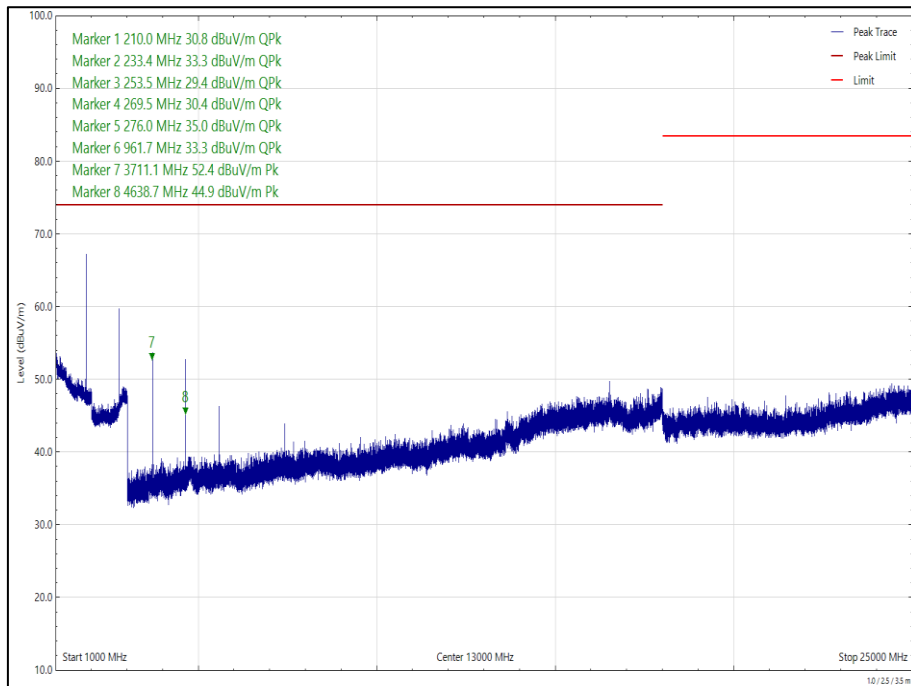


Figure 25 - 927.74 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation, Peak

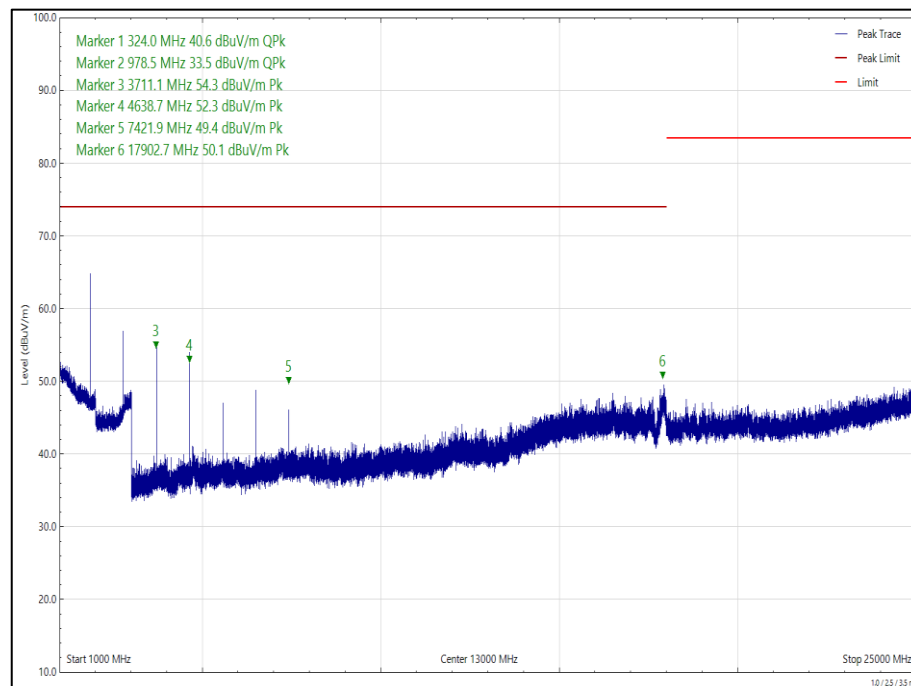


Figure 26 - 927.74 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation, Average

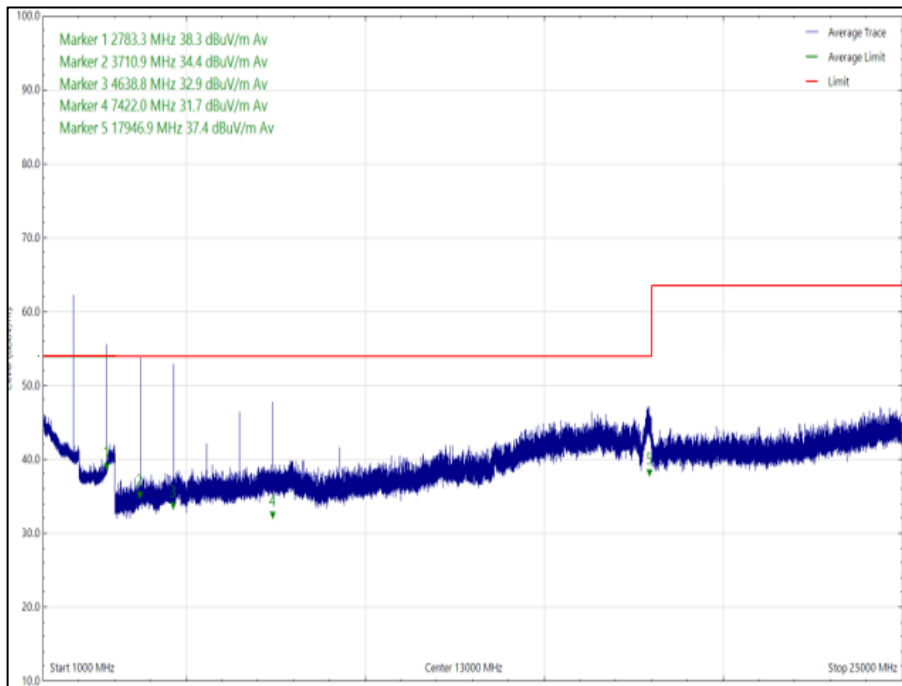


Figure 27 - 927.74 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation, Average

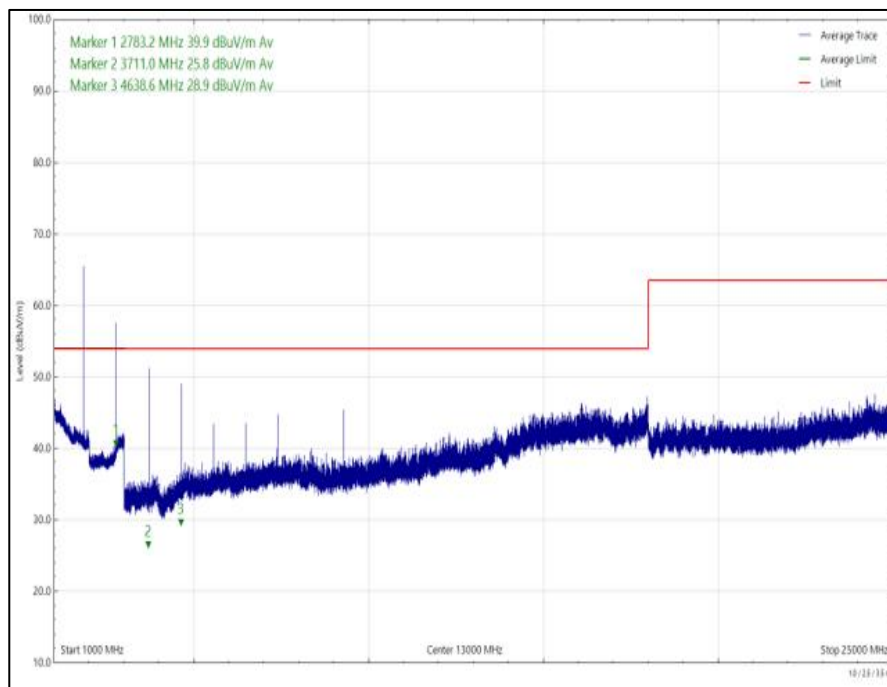


Figure 28 - 927.74 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation , Average



Figure 29 – Test Setup- 30 MHz to 1 GHz, X Orientation



Figure 30 – Test Setup- 30 MHz to 1 GHz, Y Orientation

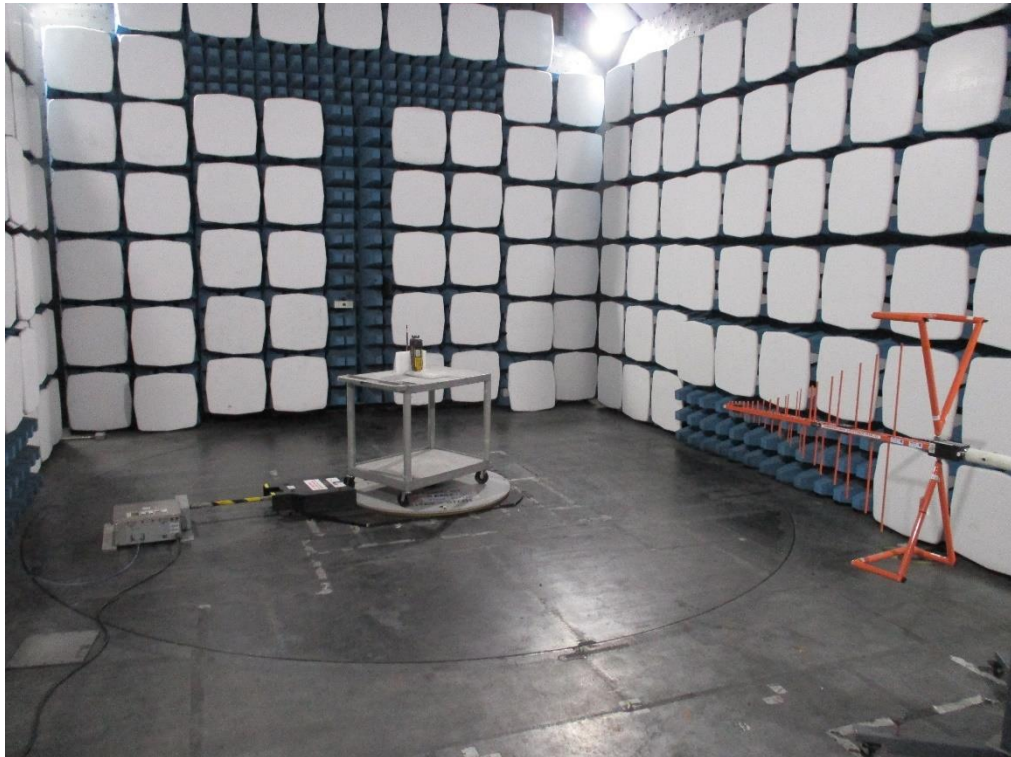


Figure 31 – Test Setup- 30 MHz to 1 GHz, Z Orientation

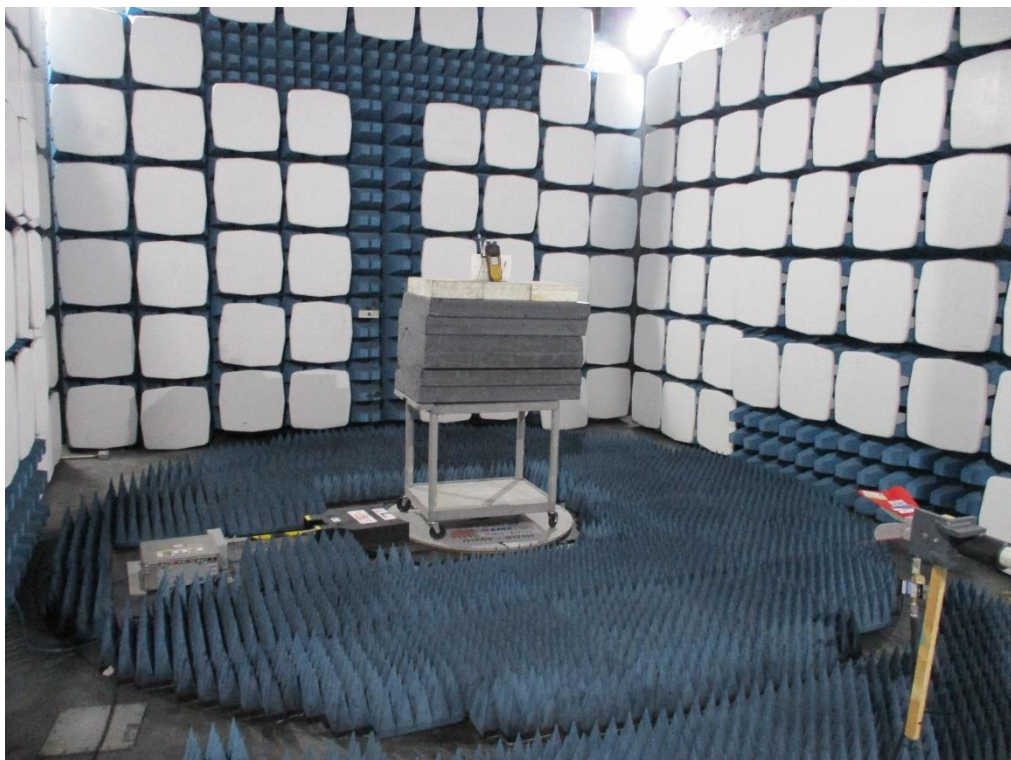


Figure 32 - Test Setup - 1 GHz to 18 GHz

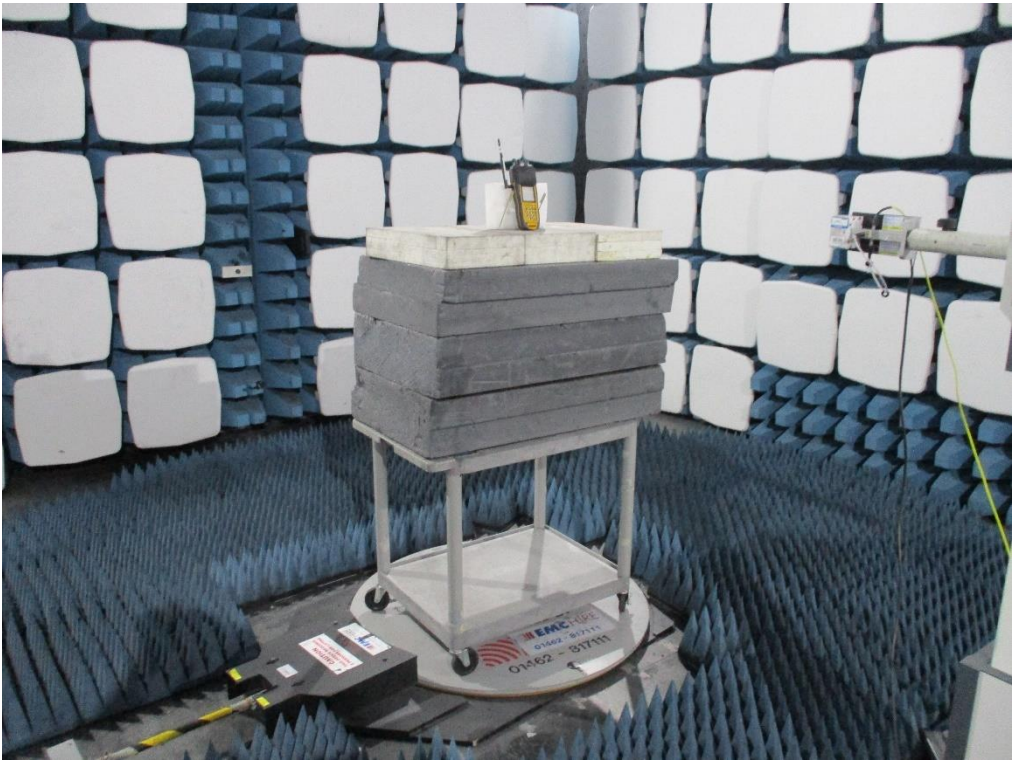


Figure 33 - Test Setup - 18 GHz to 25 GHz



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

ISED RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



2.2.8 Test Location and Test Equipment Used

This test was carried out in Bearley EMC Chamber 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygrometer	Rotronic	A2	1698	12	18-Nov-2021
Power Supply Unit	Farnell	H60-25	1709	-	TU
Bilog Antenna	Schaffner	CBL6143	1858	24	10-Nov-2022
EMI Test Receiver	Rohde & Schwarz	ESIB26	2028	12	14-Aug-2021
EMC 3m Semi Anechoic Chamber	Rainford	Hybrid	4160	36	16-Dec-2021
Digital Multimeter	Agilent Technologies	U1232A	4161	12	05-Jun-2021
7m N-Type Cable	Teledyne Storm	SA90-195-7MTR	4168	12	10-Mar-2021
1-8 GHz Amplifier	Wright Technologies	APS04-0085	4674	12	18-Aug-2021
8-18 GHz Amplifier	Wright Technologies	APS04-0086	4675	12	18-Aug-2021
EMC Mast controller	Innco Systems	CONTROLLER CO3000	4728	-	TU
1 - 18GHz DRG Horn	ETS-Lindgren	3117	4737	24	28-Jul-2021
EMI Receiver	Keysight Technologies	N9038A MXE	4974	12	11-Feb-2021
EmX Emissions Software	TUV SUD	V2.1.1	5125	-	Software
Cable (18GHz N Type 3m)	Rosenberger	LU7-036-3000	5163	12	10-Dec-2021
3 GHz High Pass Filter	RLC Electronics	F-100-3000-5-R	5228	12	07-Jul-2021
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	5232	12	10-Mar-2021
Broad-Band Horn Antenna 15-26.5(40)GHz	Schwarzbeck	BBHA 9170	5233	12	14-Oct-2021
Turntable Controller	Maturo	Maturo NCD	5275	-	TU
3m 40 GHz RF Cable	Scott Cables	KPS-1501-3000-KPS	5408	12	10-Dec-2021
4dB Attenuator	Pasternack	PE7047-4	5647	24	10-Nov-2022

Table 13

TU - Traceability Unscheduled



4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 14

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.