

# FCC and ISED Test Report

XYZ Reality Ltd

Model: Atom Hard Hat

In accordance with FCC 47 CFR Part 15C,  
ISED RSS-247 and ISED RSS-GEN  
(2.4 GHz Bluetooth Low Energy)



Add value.  
Inspire trust.

Prepared for: XYZ Reality Ltd  
Unit G0, G02, 338-346  
Goswell Road  
Angel  
Clerkenwell  
EC1V 7LQ  
United Kingdom

FCC ID: 2A3C5-TBA

IC: Not Applicable

## COMMERCIAL-IN-CONFIDENCE

Document 75952587-13 Issue 01

### SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	15 December 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, 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	Graeme Lawler	15 December 2021	
Testing	Daniel Cameron	15 December 2021	

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 15C: 2020, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) 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	15-December-2021

**Table 1**

### 1.2 Introduction

Applicant	XYZ Reality Ltd
Manufacturer	XYZ Reality Ltd
Model Number(s)	Atom Hard Hat
Serial Number(s)	Not serialised (Storix-ID 599374-99) and Not serialised (Storix-ID 599374-18)
Hardware Version(s)	Not Applicable
Software Version(s)	Windows Certification Build
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2020 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	XYZ0179
Date	21-June-2021
Date of Receipt of EUT	06-September-2021
Start of Test	07-September-2021
Finish of Test	28-September-2021
Name of Engineer(s)	Graeme Lawler and Daniel Cameron
Related Document(s)	ANSI C63.10 (2013)



### 1.3 Brief Summary of Results

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

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: Hard Hat - 2.4 GHz Bluetooth Low Energy						
-	15.203	-	-	Antenna Requirement	N/T	The device complies with the provisions of this section, as it uses permanently attached integral antennas.
2.1	15.205	-	8.10	Restricted Band Edges	Pass	
2.2	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	
2.4	15.247 (d) and 15.209	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	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>	Protective hard Hat with integrated eye protection and augmented reality			
Manufacturer:	XYZ Reality Ltd			
Model:	Atom Hard Hat			
Part Number:	XYZ-12-01			
Hardware Version:	Not Applicable			
Software Version:	Windows Certification Build			
FCC ID of the product under test – <a href="#">see guidance here</a>	2A3C5-TBA (contains FCC ID PD992260NG)			
IC ID of the product under test – <a href="#">see guidance here</a>	N/A (Contains IC 1000M-9260NG)			

**Table 3**  
Intentional Radiators

Technology	Bluetooth	BLE	WLAN 2.4 GHz	Proprietary ISM 2.4GHz
Frequency Range (MHz to MHz)	2402-2480	2402-2480	2412-2462	2402-2480
Conducted Declared Output Power (dBm)	5	5	19	0
Antenna Gain (dBi)	2.8	2.8	2.8	2.8
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	1	1	20 / 40	840
Modulation Scheme(s) (e.g GFSK, QPSK etc)	GFSK / π/4 DQPSK / 8-DPSK	GFSK	OFDM / OFDM-HT / CCK	GFSK / DQPSK
ITU Emission Designator <a href="#">(see guidance here)</a> (not mandatory for Part 15 devices)	1M00F1D	1M00F1D	20M3D1W / 40M3D1W	1M00F1D
Bottom Frequency (MHz)	2402	2402	2412	2402
Middle Frequency (MHz)	2441	2440	2437	2440
Top Frequency (MHz)	2480	2480	2472	2480

**Table 4**  
Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	
Lowest frequency generated or used in the device or on which the device operates or tunes	
Class A Digital Device (Use in commercial, industrial or business environment)	<input type="checkbox"/>
Class B Digital Device (Use in residential environment only)	<input checked="" type="checkbox"/>

**Table 5**



#### AC Power Source

AC supply frequency:		Hz
Voltage		V
Max current:		A
Single Phase <input type="checkbox"/> Three Phase <input type="checkbox"/>		

**Table 6**

#### DC Power Source

Nominal voltage:		V
Extreme upper voltage:		V
Extreme lower voltage:		V
Max current:		A

**Table 7**

#### Battery Power Source

Voltage:	7.4	V
End-point voltage:		V (Point at which the battery will terminate)
Alkaline <input type="checkbox"/> Leclanche <input type="checkbox"/> Lithium <input type="checkbox"/> Nickel Cadmium <input type="checkbox"/> Lead Acid* <input type="checkbox"/> *(Vehicle regulated)		
Other <input checked="" type="checkbox"/>	Please detail:	Li Ion

**Table 8**

#### Charging

Can the EUT transmit whilst being charged	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
---	---

**Table 9**

#### Temperature

Minimum temperature:	0	°C
Maximum temperature:	40	°C

**Table 10**

#### Cable Loss

Adapter Cable Loss (Conducted sample)	1.3	dB
---------------------------------------	-----	----

**Table 11**



### Antenna Characteristics

Antenna connector <input type="checkbox"/>			State impedance	50	Ohm
Temporary antenna connector <input type="checkbox"/>			State impedance		Ohm
Integral antenna <input checked="" type="checkbox"/>	Type:	Flexible	Gain	2.8	dBi
External antenna <input type="checkbox"/>	Type:		Gain		dBi
For external antenna only: Standard Antenna Jack <input type="checkbox"/> If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed <input type="checkbox"/> Non-standard Antenna Jack <input type="checkbox"/>					

**Table 12**

### Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

**Table 13**

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

Name: Dave Williams

Position held: Director of Engineering, DitroniX Ltd

Date: 04 November 2021



## 1.5 Product Information

### 1.5.1 Technical Description

Protective hard Hat with integrated eye protection and augmented reality.

### 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: Atom Hard Hat, Serial Number: Not serialised (Storix-ID 599374-18)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: Atom Hard Hat, Serial Number: Not serialised (Storix-ID 599374-99)			
0	As supplied by the customer	Not Applicable	Not Applicable

**Table 14**

### 1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Hard Hat - 2.4 GHz Bluetooth Low Energy		
Restricted Band Edges	Graeme Lawler	UKAS
Emission Bandwidth	Daniel Cameron	UKAS
Maximum Conducted Output Power	Daniel Cameron	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Power Spectral Density	Daniel Cameron	UKAS

**Table 15**

Office Address:

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



## 2 Test Details

### 2.1 Restricted Band Edges

#### 2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205  
ISED RSS-GEN, Clause 8.10

#### 2.1.2 Equipment Under Test and Modification State

Atom Hard Hat, S/N: Not serialised (Storix-ID 599374-18) - Modification State 0

#### 2.1.3 Date of Test

08-September-2021

#### 2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5. These are shown for information purposes and were used to determine the worst-case measurement point. Final average measurements were then taken in accordance with ANSI C63.10, clause 4.1.4.2.2 to obtain the measurement result recorded in the test results tables.

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

#### 2.1.5 Environmental Conditions

Ambient Temperature 21.1 °C

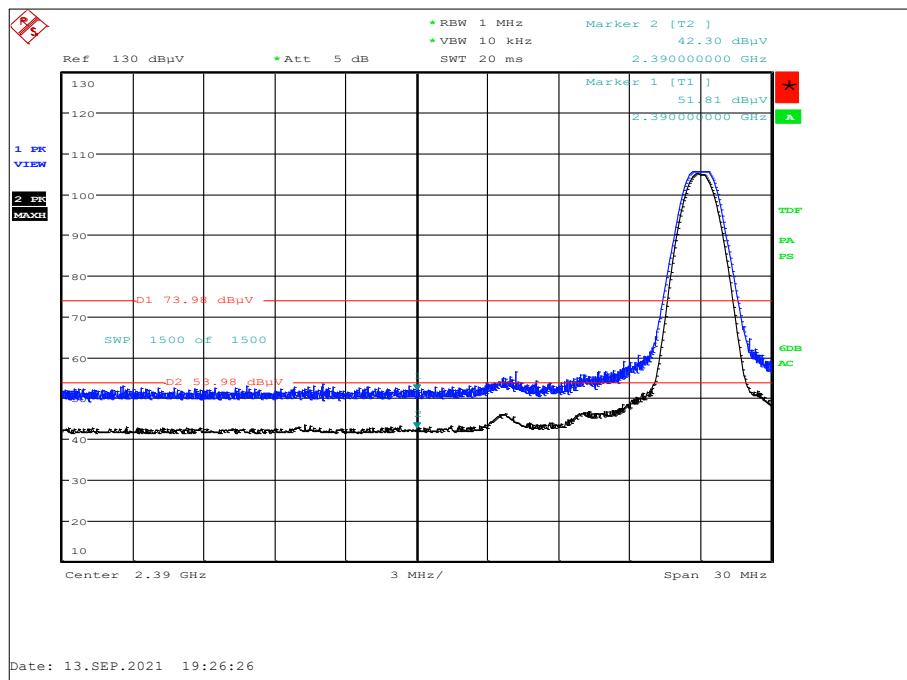
Relative Humidity 56.3 %

## 2.1.6 Test Results

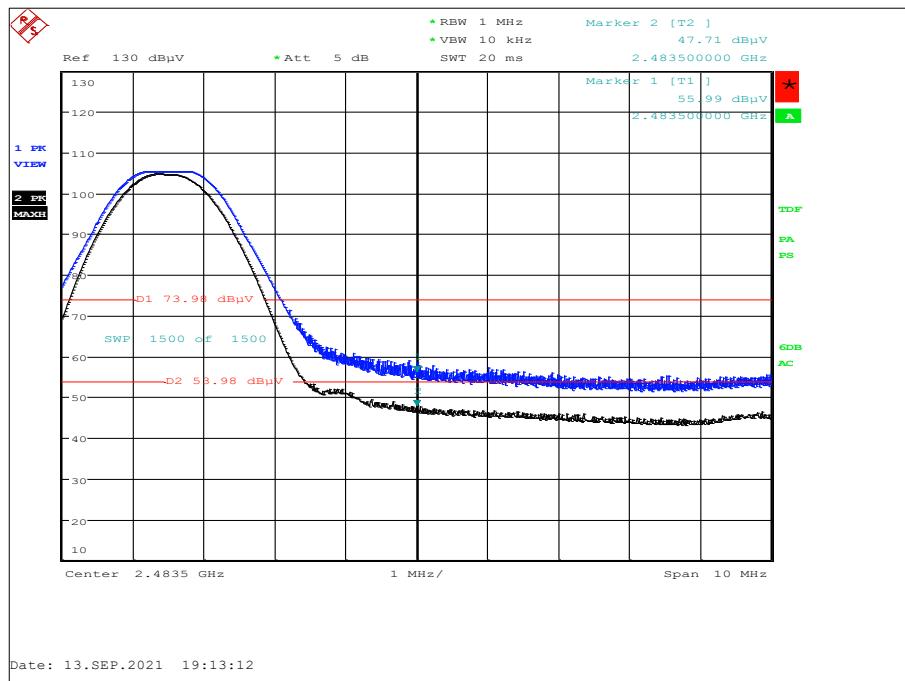
### Hard Hat - 2.4 GHz Bluetooth Low Energy

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dB $\mu$ V/m)	Average Level (dB $\mu$ V/m)
GFSK	2402	2390	51.81	37.20
GFSK	2480	2483.5	55.99	40.15

**Table 16**



**Figure 1 - GFSK - 2402 MHz - Band Edge Frequency 2390 MHz**



**Figure 2 - GFSK - 2480 MHz - Band Edge Frequency 2483.5 MHz**

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ( $\mu$ V/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

**Table 17**

ISED RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength ( $\mu$ V/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960*	500

**Table 18**

\*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.



### 2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
EmX Emissions Software	TÜV SUD	V2.1.11	5125	-	Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
8 Meter Cable	Teledyne	PR90-088-8MTR	5450	6	08-Mar-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo GmbH	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo GmbH	TAM 4.0-P	5613	-	TU
Turntable	Maturo GmbH	Turntable 1.5 SI-2t	5614	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

**Table 19**

TU - Traceability Unscheduled



## **2.2 Emission Bandwidth**

### **2.2.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)  
ISED RSS-247, Clause 5.2  
ISED RSS-GEN, Clause 6.7

### **2.2.2 Equipment Under Test and Modification State**

Atom Hard Hat, S/N: Not serialised (Storix-ID 599374-99) - Modification State 0

### **2.2.3 Date of Test**

28-September-2021

### **2.2.4 Test Method**

This test was performed in accordance with ANSI C63.10, clause 11.8.1 for 6 dB BW and 6.9.3 for 99% occupied bandwidth measurements.

### **2.2.5 Environmental Conditions**

Ambient Temperature 21.7 °C  
Relative Humidity 54.0 %



## 2.2.6 Test Results

### Hard Hat - 2.4 GHz Bluetooth Low Energy

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	GFSK (LE 1M)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A (A)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	6 dB Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2402	0.652	-	-	-	0.652	≥500.0
2426	0.656	-	-	-	0.656	≥500.0
2480	0.656	-	-	-	0.656	≥500.0

**Table 20 - 6 dB Bandwidth Results**

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2402	1.040	-	-	-	1.040	-
2426	1.032	-	-	-	1.032	-
2480	1.032	-	-	-	1.032	-

**Table 21 - 99% Bandwidth Results**



Figure 3 - A (A) 2402 MHz (CH37) 99% Bandwidth



Figure 4 - A (A) 2402 MHz (CH37) 6 dB Bandwidth



Figure 5 - A (A) 2426 MHz (CH38) 99% Bandwidth



Figure 6 - A (A) 2426 MHz (CH38) 6 dB Bandwidth



Figure 7 - A (A) 2480 MHz (CH39) 99% Bandwidth



Figure 8 - A (A) 2480 MHz (CH39) 6 dB Bandwidth



Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	GFSK (LE 2M)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A (A)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	6 dB Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2402	1.144	-	-	-	1.144	≥500.0
2426	1.144	-	-	-	1.144	≥500.0
2480	1.152	-	-	-	1.152	≥500.0

**Table 22 - 6 dB Bandwidth Results**

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2402	2.040	-	-	-	2.040	-
2426	2.040	-	-	-	2.040	-
2480	2.040	-	-	-	2.040	-

**Table 23 - 99% Bandwidth Results**



Figure 9 - A (A) 2402 MHz (CH37) 99% Bandwidth



Figure 10 - A (A) 2402 MHz (CH37) 6 dB Bandwidth



Figure 11 - A (A) 2426 MHz (CH38) 99% Bandwidth



Figure 12 - A (A) 2426 MHz (CH38) 6 dB Bandwidth



Figure 13 - A (A) 2480 MHz (CH39) 99% Bandwidth



Figure 14 - A (A) 2480 MHz (CH39) 6 dB Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISED RSS-247, Clause 5.2(a)

The minimum 6 dB Bandwidth shall be at least 500 kHz.



## 2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	03-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	03-Dec-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	12-Apr-2022
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	16-Apr-2022

**Table 24**



## **2.3 Maximum Conducted Output Power**

### **2.3.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (b)  
ISED RSS-247, Clause 5.4  
ISED RSS-GEN, Clause 6.12

### **2.3.2 Equipment Under Test and Modification State**

Atom Hard Hat, S/N: Not serialised (Storix-ID 599374-99) - Modification State 0

### **2.3.3 Date of Test**

28-September-2021

### **2.3.4 Test Method**

The test was performed in accordance with ANSI C63.10, clause 11.9.1.3.

### **2.3.5 Environmental Conditions**

Ambient Temperature	21.7 °C
Relative Humidity	54.0 %



### 2.3.6 Test Results

#### Hard Hat - 2.4 GHz Bluetooth Low Energy

Test Configuration				
Frequency Range:	2400-2483.5 MHz		Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(1) RSS-247 5.4 b)		Test Method(s):	C63.10 11.9.1.3
Additional Reference(s):	-			

DUT Configuration				
Mode:	GFSK (LE 1M)			Duty Cycle (%): 62.4
Antenna Configuration:	SISO			DCCF (dB): -
Active Port(s):	A (A)			Peak Antenna Gain (dBi): 2.80

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	$\Sigma$		
2402	6.58	-	-	-	-	30.00	-23.42
2426	7.12	-	-	-	-	30.00	-22.88
2480	6.84	-	-	-	-	30.00	-23.16

**Table 25 - FCC Maximum Conducted (peak) Output Power Results**

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	$\Sigma$					
2402	6.58	-	-	-	-	30.00	-23.42	9.38	36.00	-26.62
2426	7.12	-	-	-	-	30.00	-22.88	9.92	36.00	-26.08
2480	6.84	-	-	-	-	30.00	-23.16	9.64	36.00	-26.36

**Table 26 - ISED Maximum Conducted (peak) Output Power Results**



Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 11.9.1.3
Additional Reference(s):	-		

DUT Configuration			
Mode:	GFSK (LE 2M)	Duty Cycle (%):	33.2
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A (A)	Peak Antenna Gain (dBi):	2.80

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	$\Sigma$		
2402	6.72	-	-	-	-	30.00	-23.28
2426	7.13	-	-	-	-	30.00	-22.87
2480	6.84	-	-	-	-	30.00	-23.16

**Table 27 - FCC Maximum Conducted (peak) Output Power Results**

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	$\Sigma$					
2402	6.72	-	-	-	-	30.00	-23.28	9.52	36.00	-26.48
2426	7.13	-	-	-	-	30.00	-22.87	9.93	36.00	-26.07
2480	6.84	-	-	-	-	30.00	-23.16	9.64	36.00	-26.36

**Table 28 - ISED Maximum Conducted (peak) Output Power Results**

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

ISED RSS-247, Limit Clause 5.4 (b)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.



### 2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	03-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	03-Dec-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	12-Apr-2022
USB Power Sensor	Boonton	RTP5006	5184	12	19-Apr-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	16-Apr-2022

**Table 29**



## 2.4 Spurious Radiated Emissions

### 2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.209  
ISED RSS-247, Clause 3.3 and 5.5  
ISED RSS-GEN, Clause, 6.13 and 8.9

### 2.4.2 Equipment Under Test and Modification State

Atom Hard Hat, S/N: Not serialised (Storix-ID 599374-18) - Modification State 0

### 2.4.3 Date of Test

07-September-2021 to 27-September-2021

### 2.4.4 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. The EUT could be used in multiple planes, therefore, pre-scans were performed with the EUT orientated in X, Y and Z planes with reference to the ground plane.

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 11.12.2.5.2.

The plots shown are the characterisation of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dB $\mu$ V/m) when compared to 20 dB $\mu$ V/m 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 shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dB $\mu$ V/m to  $\mu$ V/m:

$10^{(Field\ Strength\ in\ dB\mu\text{V}/m/20)}$ .

At a measurement distance of 1 meter the limit line was increased by  $20 * \text{LOG}(3/1) = 9.54$  dB. Where formal measurements have been necessary, the results have been presented in the emissions table.

### 2.4.5 Environmental Conditions

Ambient Temperature 18.4 - 21.1 °C  
Relative Humidity 55.9 - 68.4 %

## 2.4.6 Example Test Setup Diagram

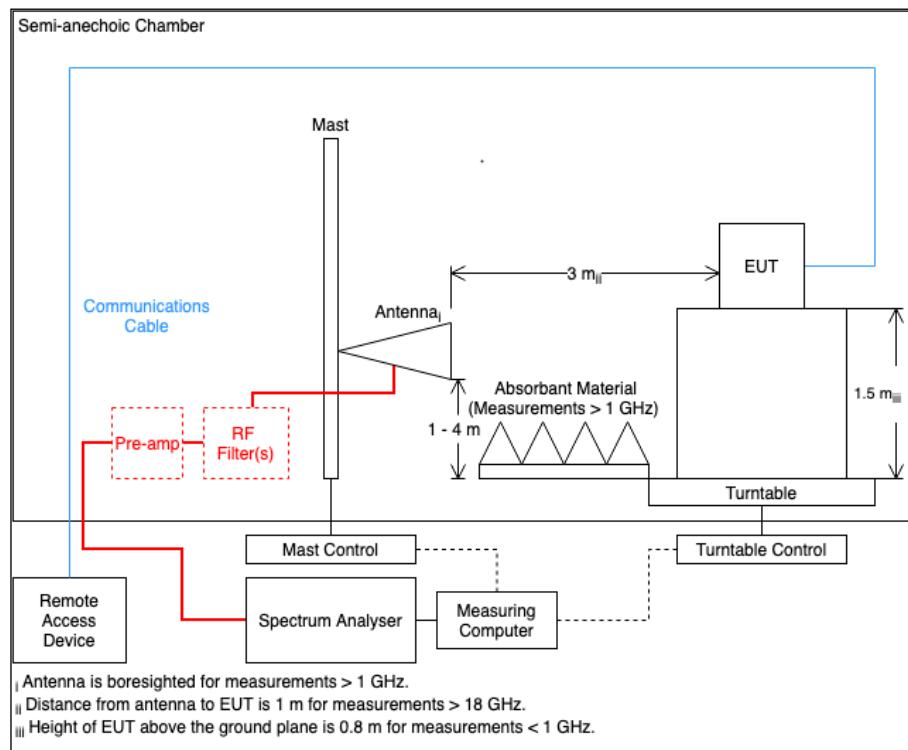


Figure 15

## 2.4.7 Test Results

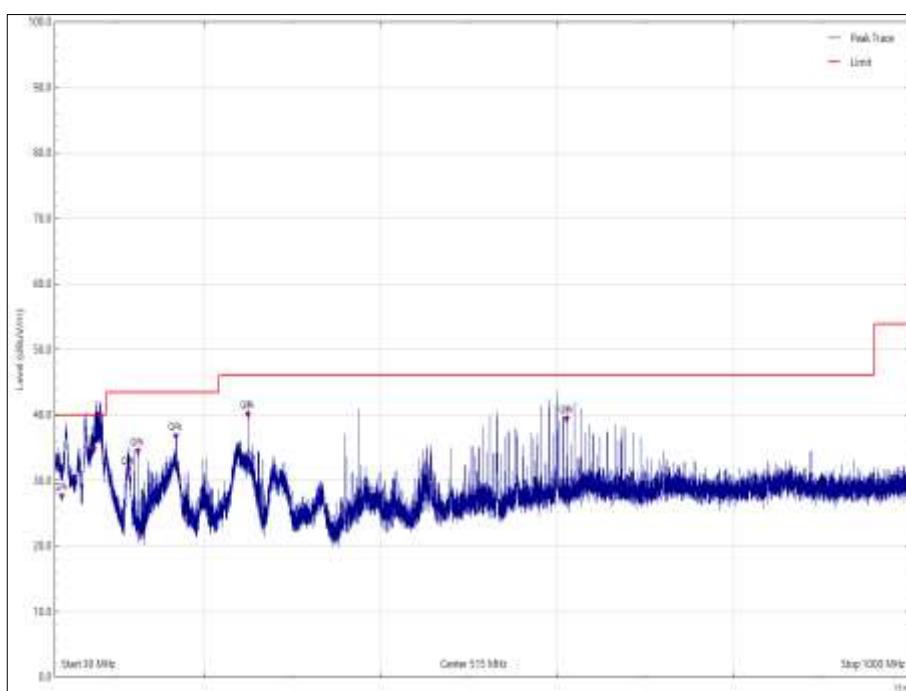
### Hard Hat - 2.4 GHz Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

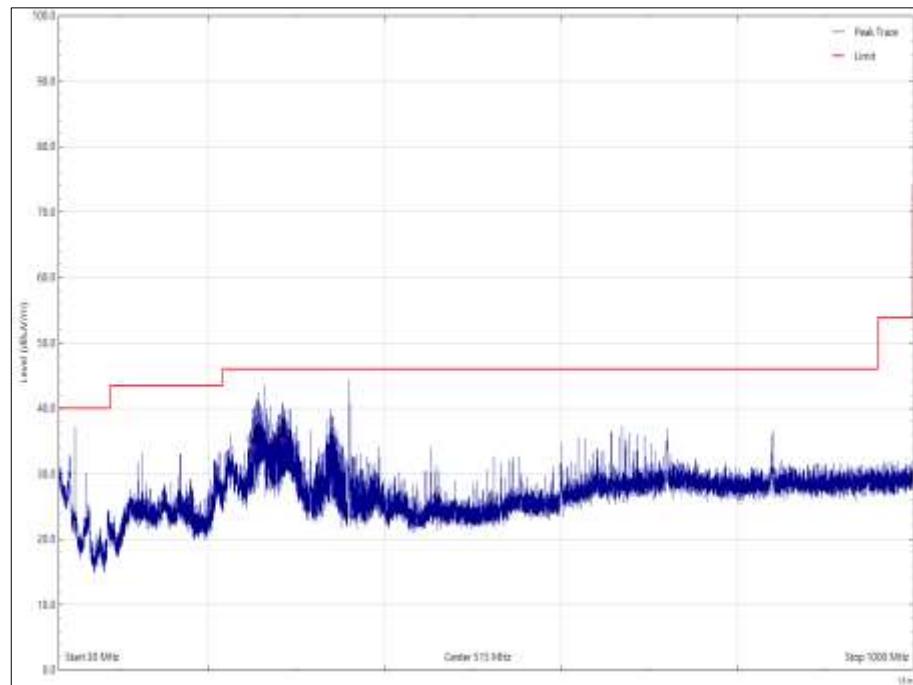
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
74.772	31.11	40.00	8.89	Q-Peak	222	100	Vertical	X
74.848	33.77	40.00	6.23	Q-Peak	128	142	Vertical	Z
125.016	33.72	43.52	9.80	Q-Peak	149	100	Vertical	Y
132.859	36.55	43.52	6.97	Q-Peak	214	253	Horizontal	Z
168.027	35.75	43.52	7.77	Q-Peak	360	100	Vertical	X
249.957	39.11	46.02	6.91	Q-Peak	215	104	Vertical	X
249.965	40.58	46.02	5.44	Q-Peak	228	102	Vertical	Z
249.972	36.94	46.02	9.08	Q-Peak	259	100	Vertical	Y
254.878	36.16	46.02	9.86	Q-Peak	254	100	Horizontal	Y
611.504	36.80	46.02	9.22	Q-Peak	132	100	Vertical	Z
611.523	39.00	46.02	7.02	Q-Peak	216	110	Horizontal	Y
611.536	38.20	46.02	7.82	Q-Peak	38	123	Horizontal	Z
611.554	38.40	46.02	7.62	Q-Peak	189	100	Vertical	X

**Table 30 - 2402 MHz, 30 MHz to 1 GHz**

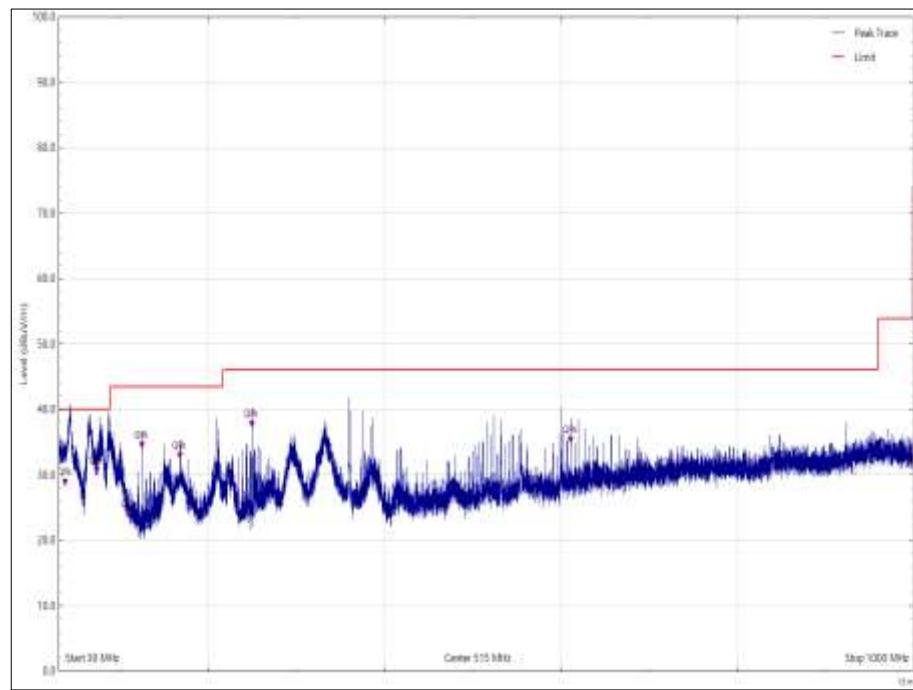
No other emissions were detected within 10 dB of the limit.



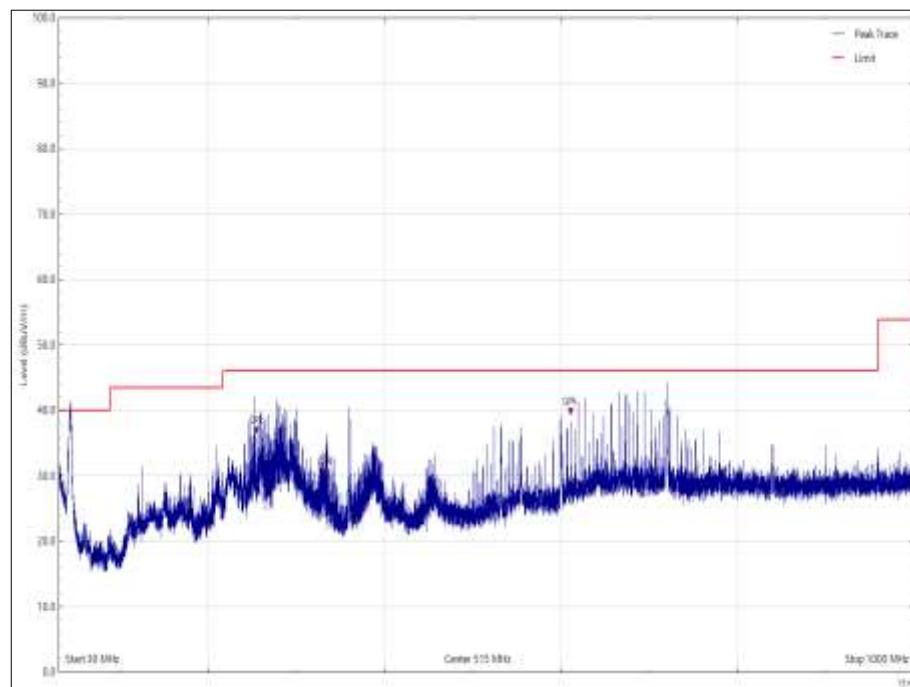
**Figure 16 - 2402 MHz, 30 MHz to 1 GHz, Vertical, X Orientation**



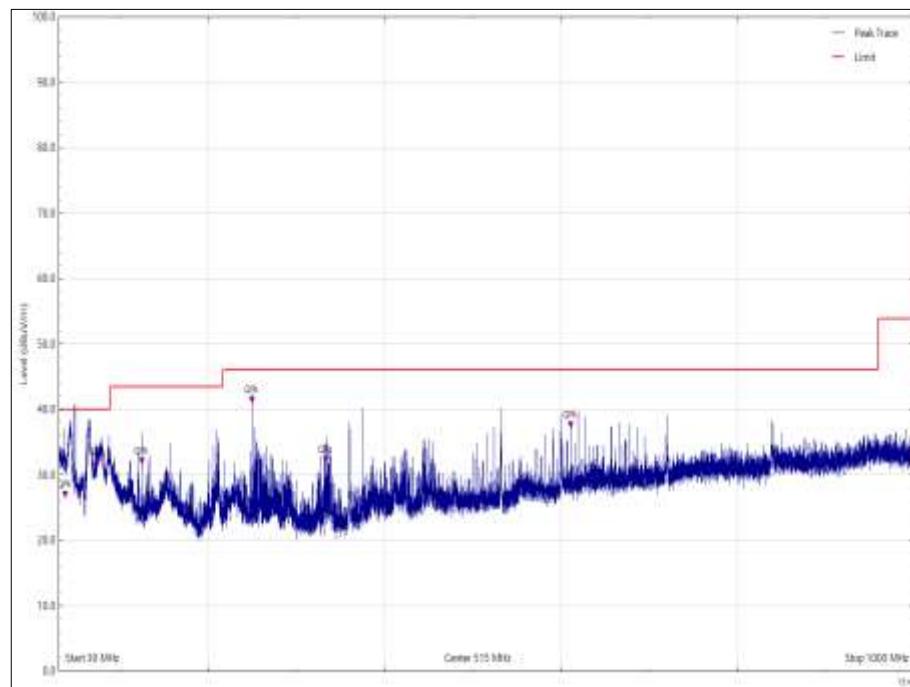
**Figure 17 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation**



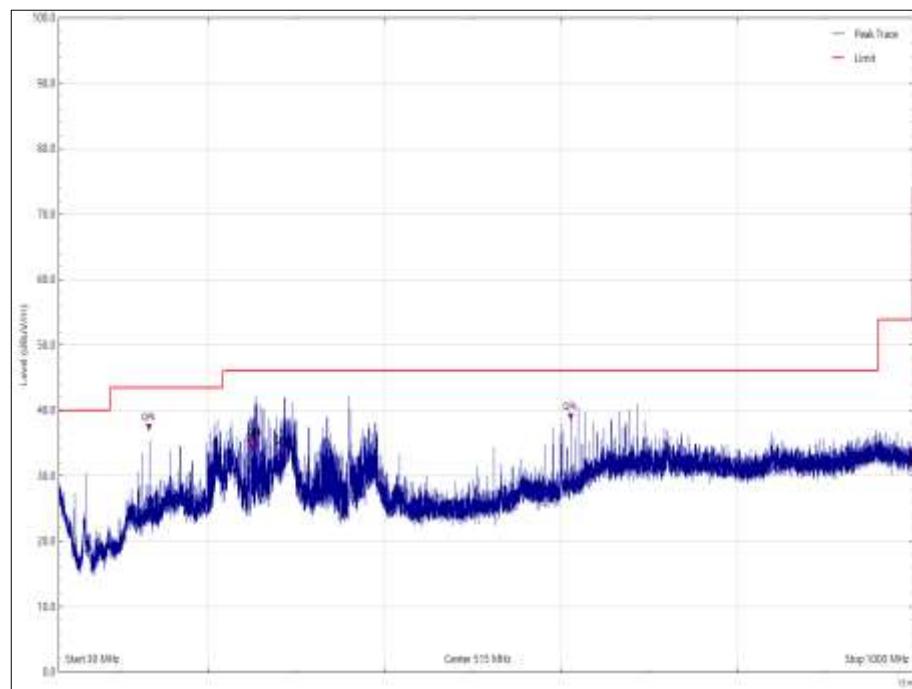
**Figure 18 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation**



**Figure 19 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation**



**Figure 20 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation**

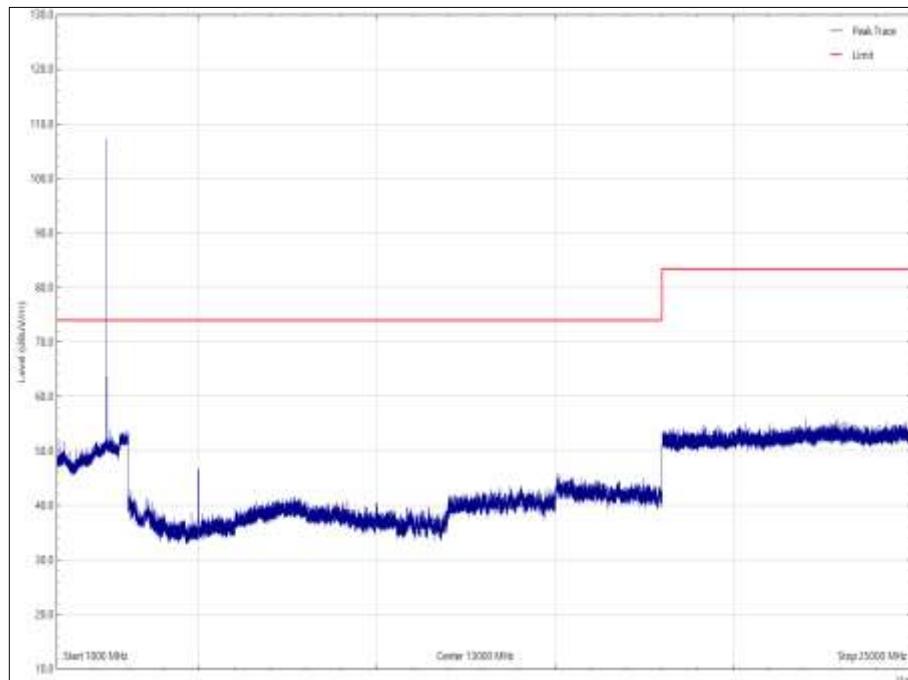


**Figure 21 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation**

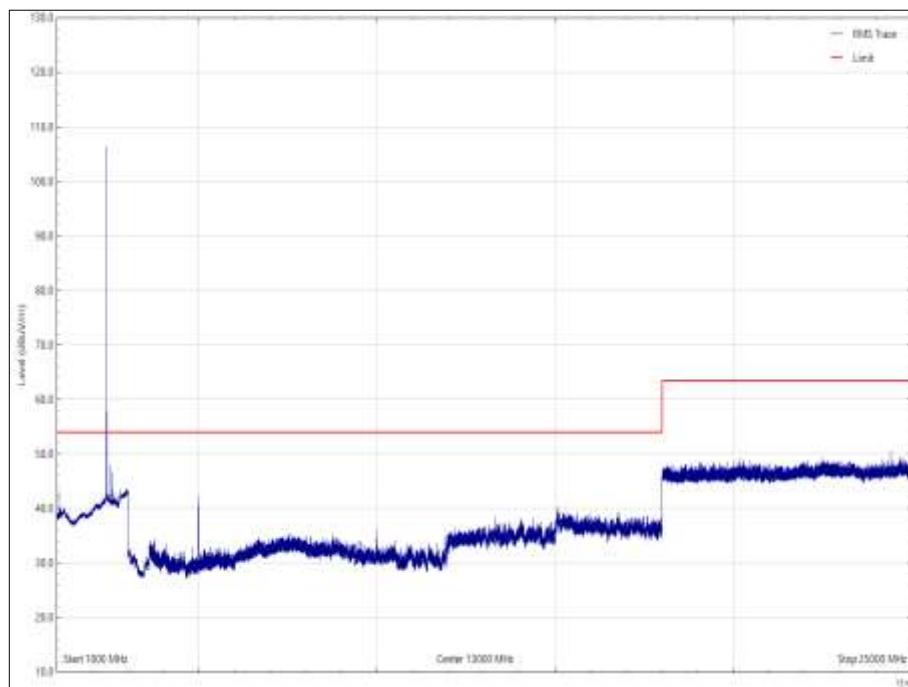
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

**Table 31 - 2402 MHz, 1 GHz to 25 GHz**

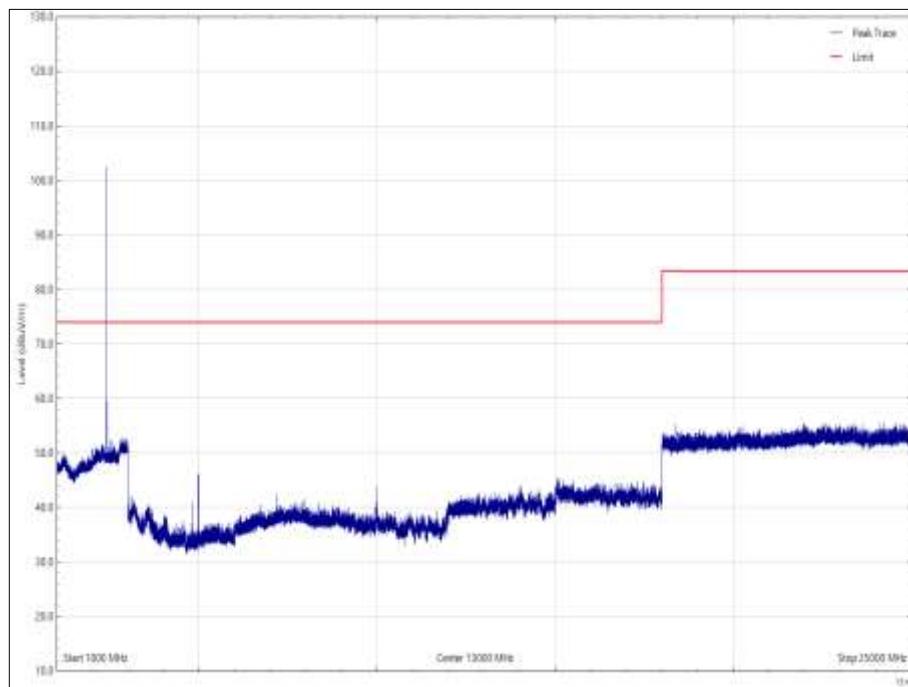
\*No emissions were detected within 10 dB of the limit.



**Figure 22 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation - Peak**



**Figure 23 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation - Average**



**Figure 24 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation - Peak**

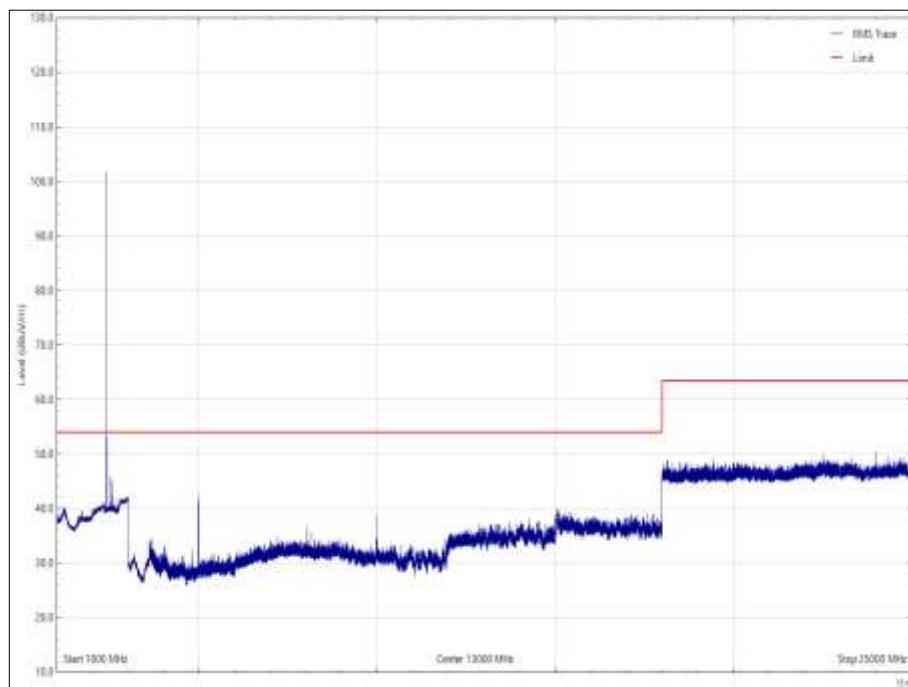


Figure 25 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation - Average

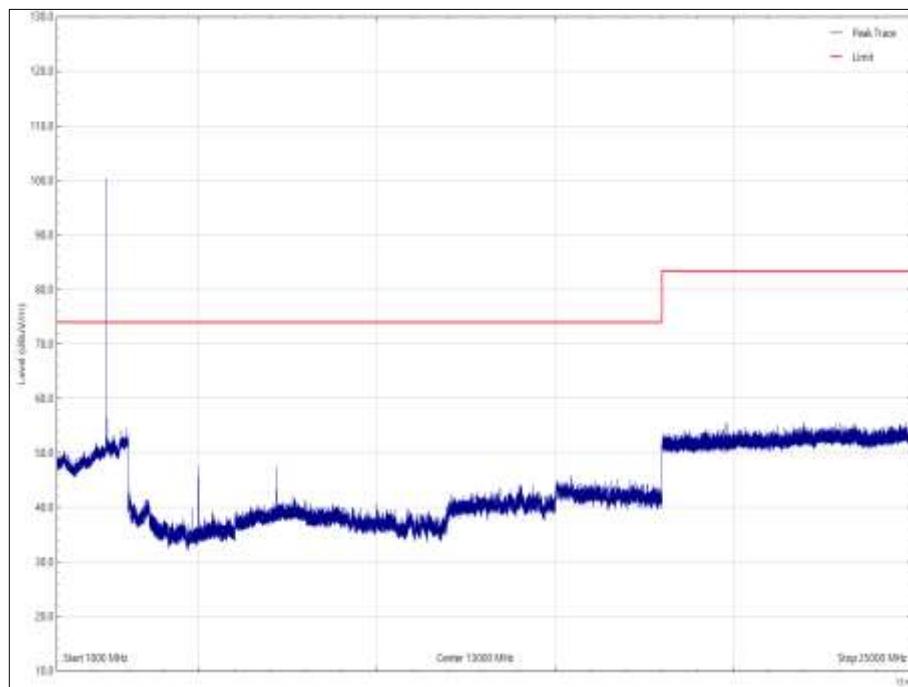
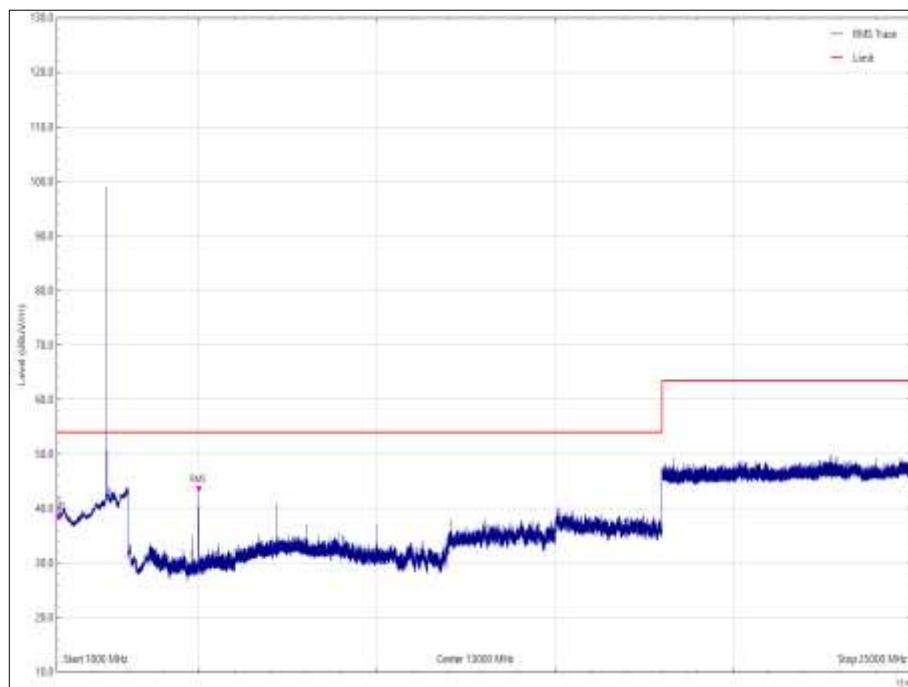
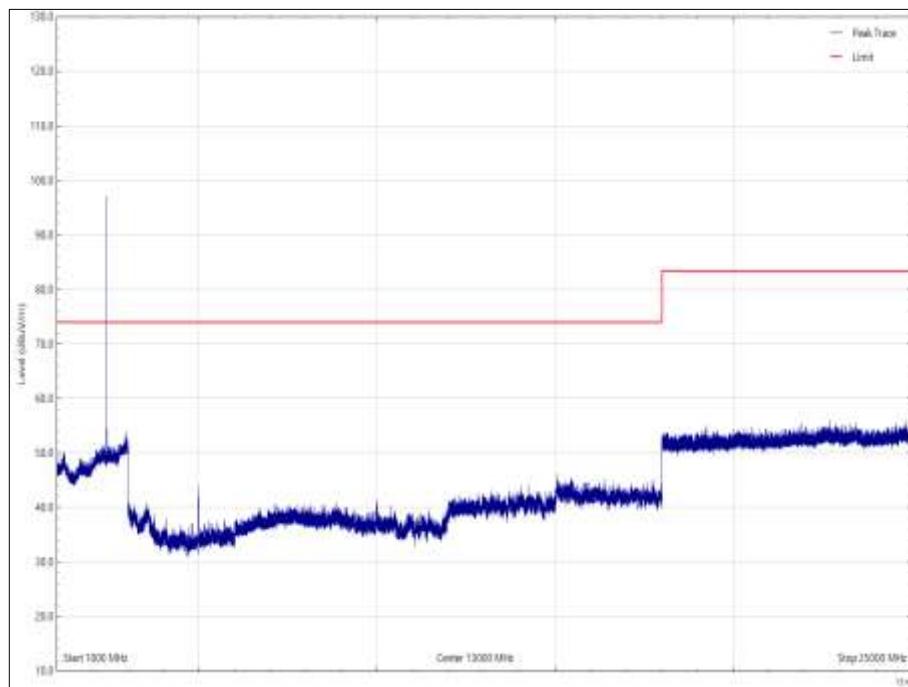


Figure 26 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation - Peak



**Figure 27 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation - Average**



**Figure 28 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation - Peak**

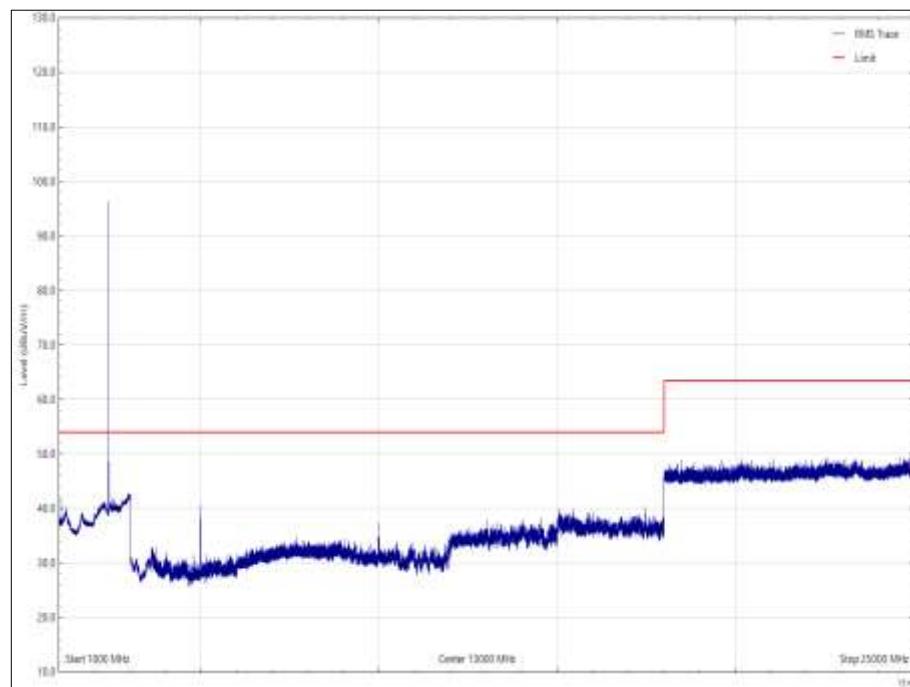


Figure 29 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation - Average

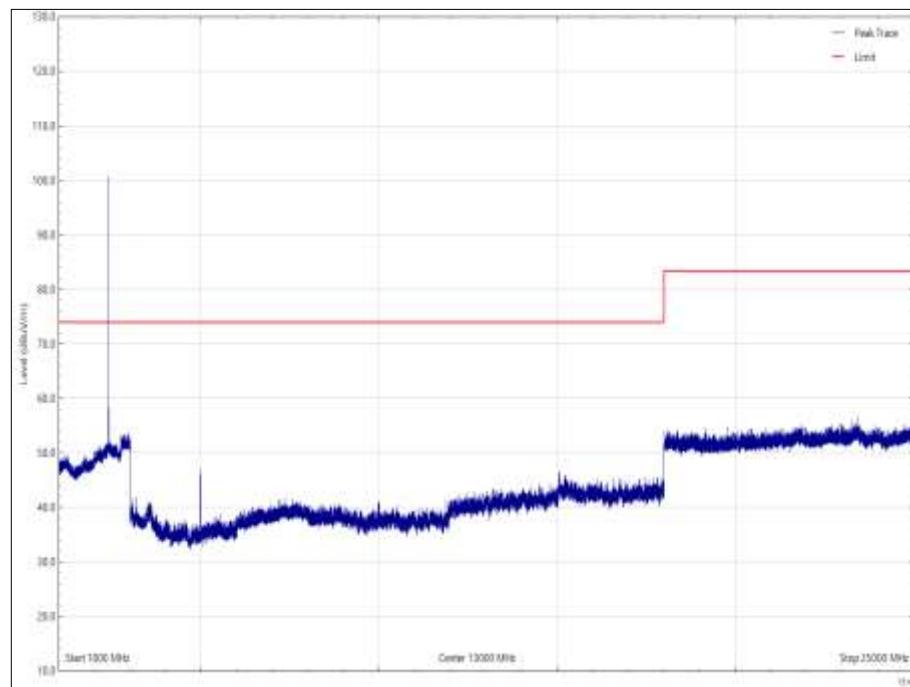
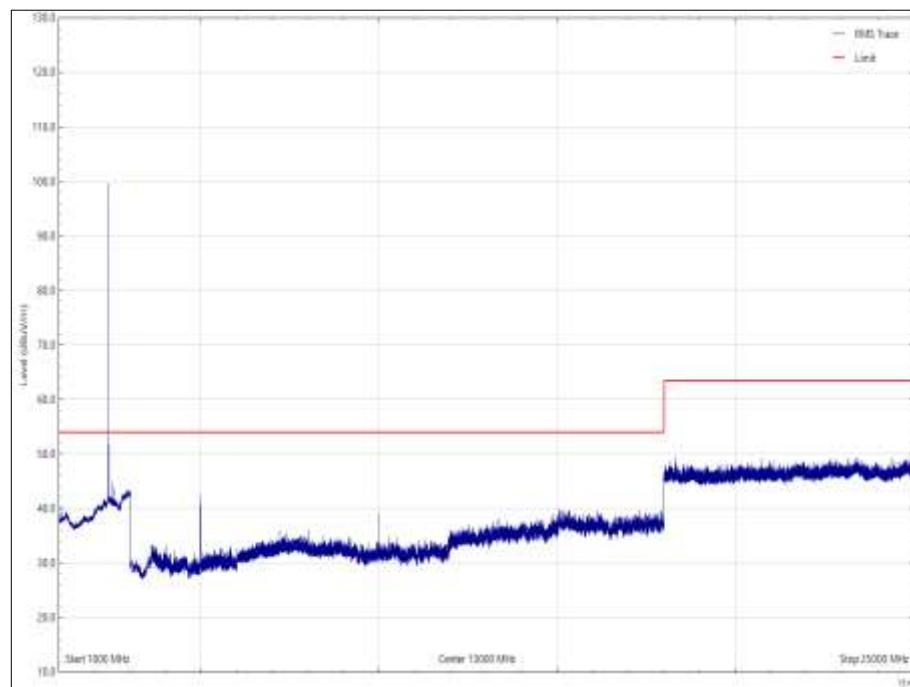
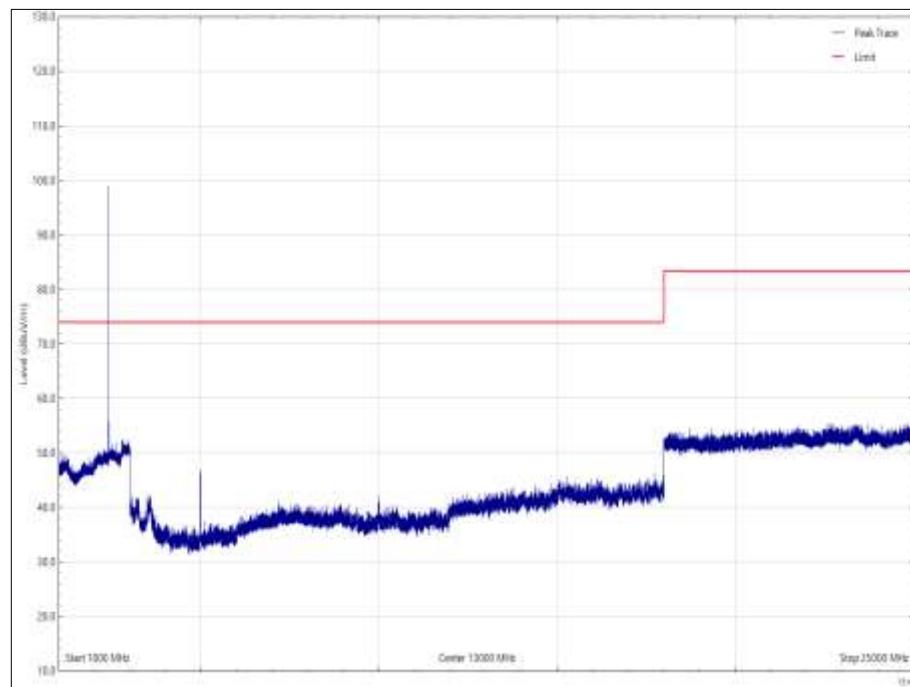


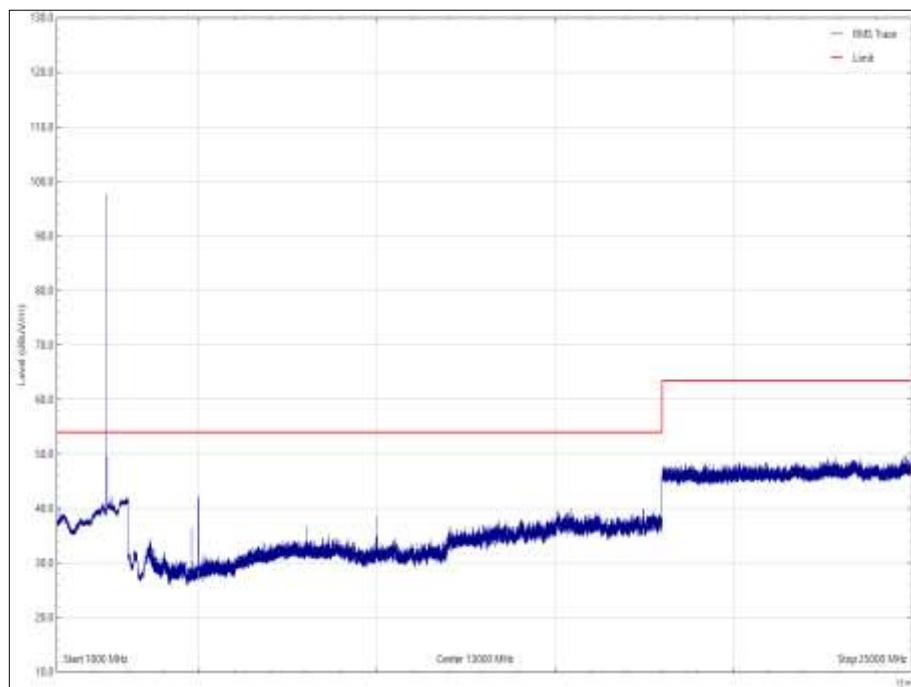
Figure 30 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation - Peak



**Figure 31 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation - Average**



**Figure 32 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation - Peak**

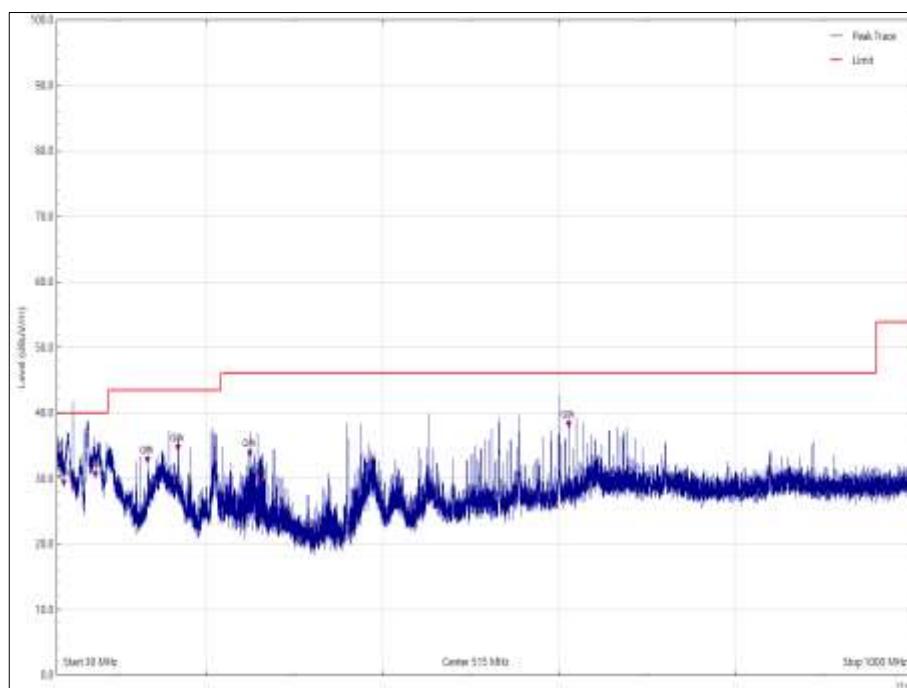


**Figure 33 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation - Average**

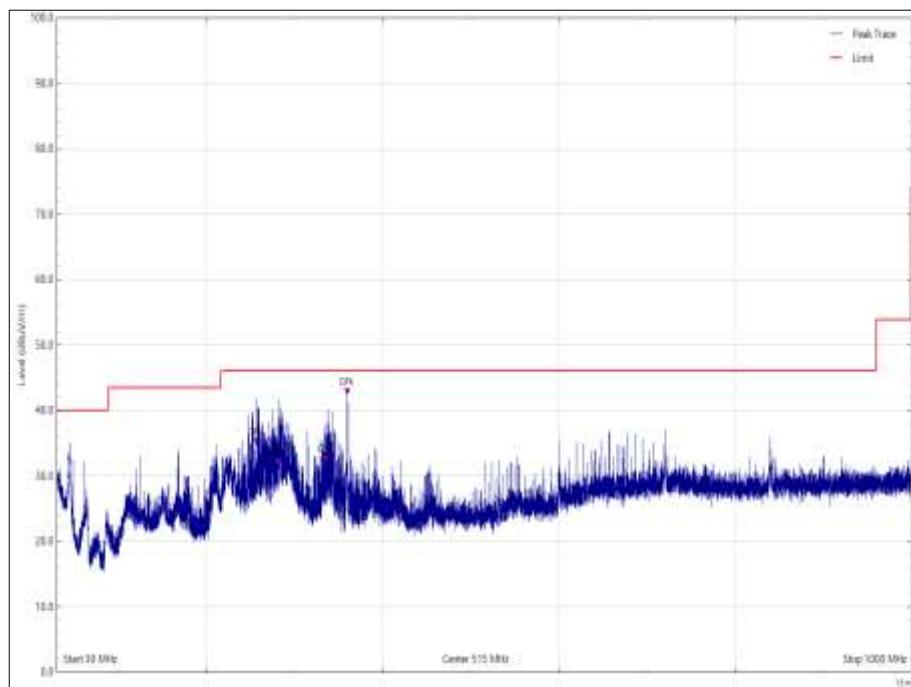
Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
125.017	34.76	43.52	8.76	Q-Peak	168	100	Vertical	Y
125.019	34.74	43.52	8.78	Q-Peak	213	100	Vertical	Z
133.101	36.76	43.52	6.76	Q-Peak	208	135	Horizontal	Z
167.982	33.87	43.52	9.65	Q-Peak	360	100	Vertical	X
249.976	36.26	46.02	9.76	Q-Peak	9	105	Horizontal	Z
250.018	37.44	46.02	8.58	Q-Peak	238	100	Vertical	Y
254.022	36.43	46.02	9.59	Q-Peak	285	100	Horizontal	Y
331.391	36.85	46.02	9.17	Q-Peak	0	100	Horizontal	Z
360.034	41.98	46.02	4.04	Q-Peak	332	100	Horizontal	X
611.501	36.84	46.02	9.18	Q-Peak	352	189	Horizontal	Z
611.505	38.57	46.02	7.45	Q-Peak	217	102	Horizontal	Y
611.523	38.34	46.02	7.68	Q-Peak	145	100	Vertical	Z
611.539	37.39	46.02	8.63	Q-Peak	121	100	Vertical	X

**Table 32 - 2442 MHz, 30 MHz to 1 GHz**

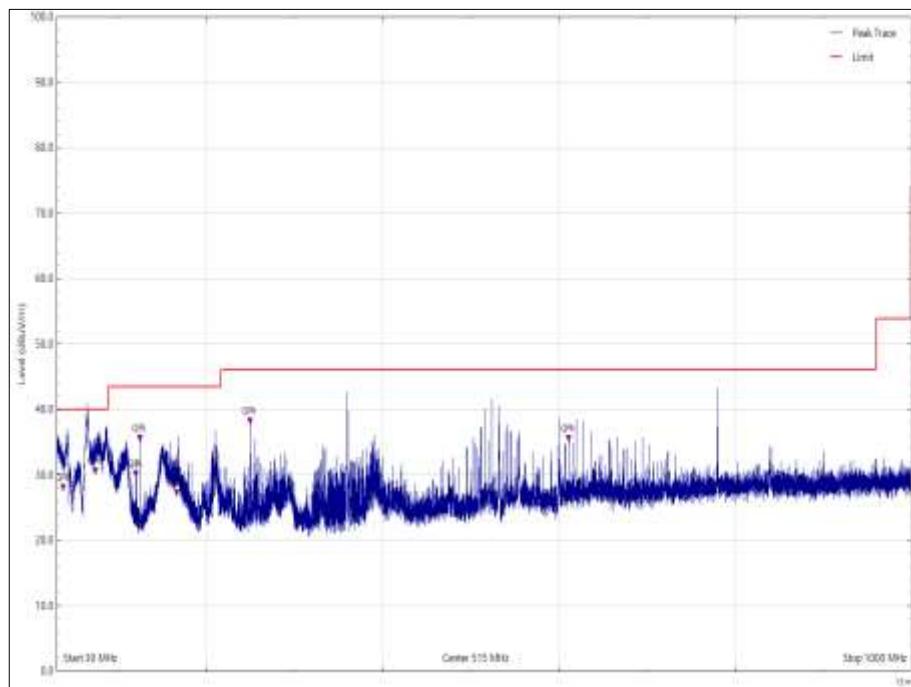
No other emissions were detected within 10 dB of the limit.



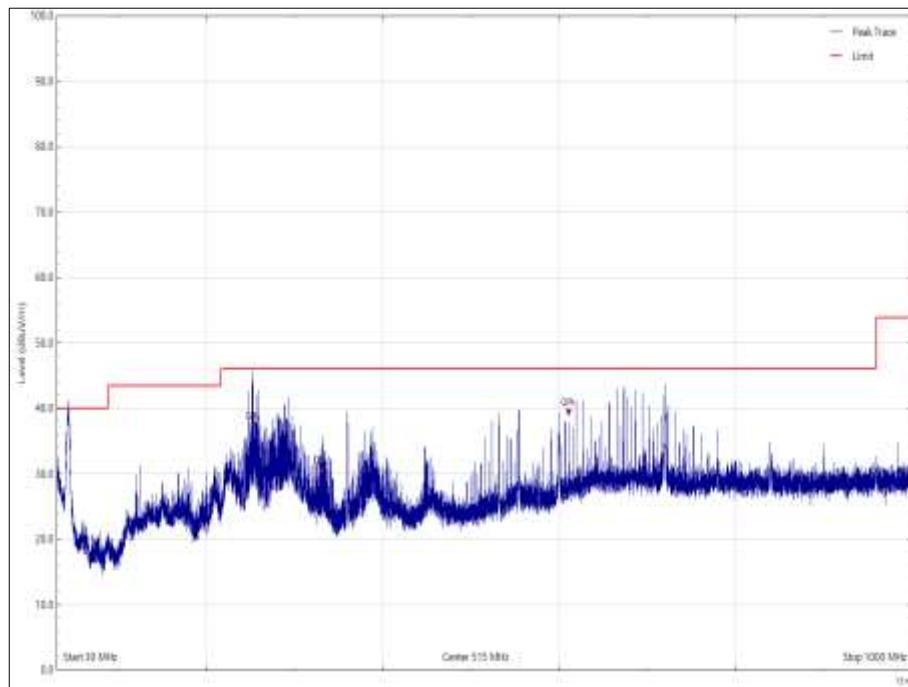
**Figure 34 - 2442 MHz, 30 MHz to 1 GHz, Vertical, X Orientation**



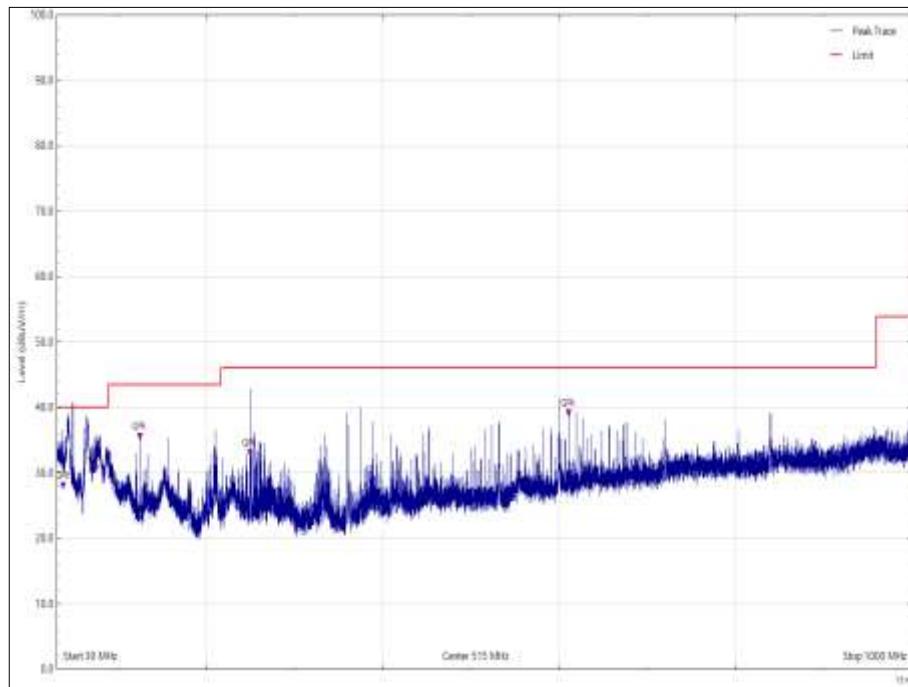
**Figure 35 - 2442 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation**



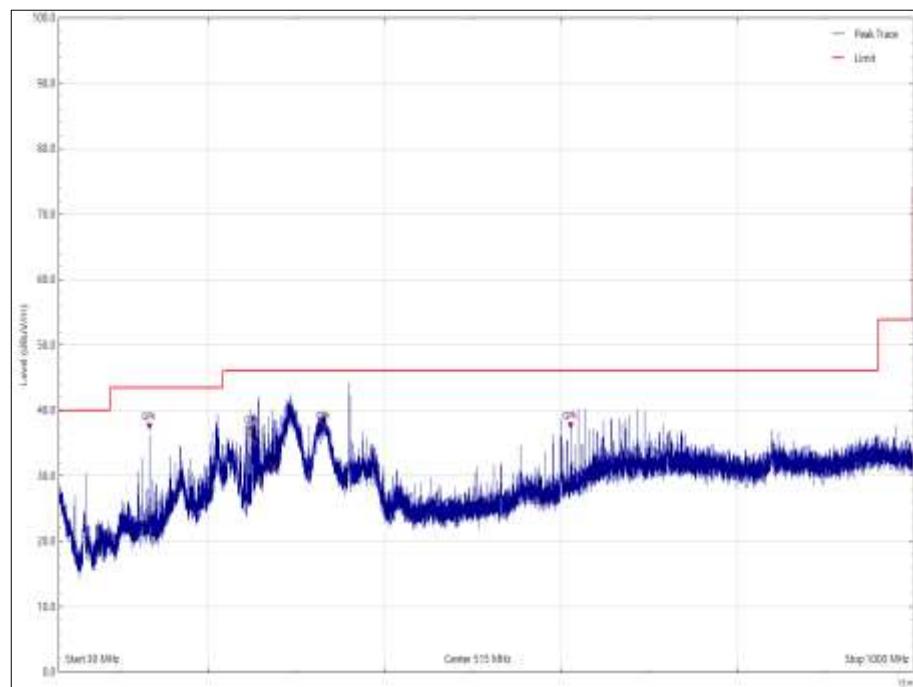
**Figure 36 - 2442 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation**



**Figure 37 - 2442 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation**



**Figure 38 - 2442 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation**



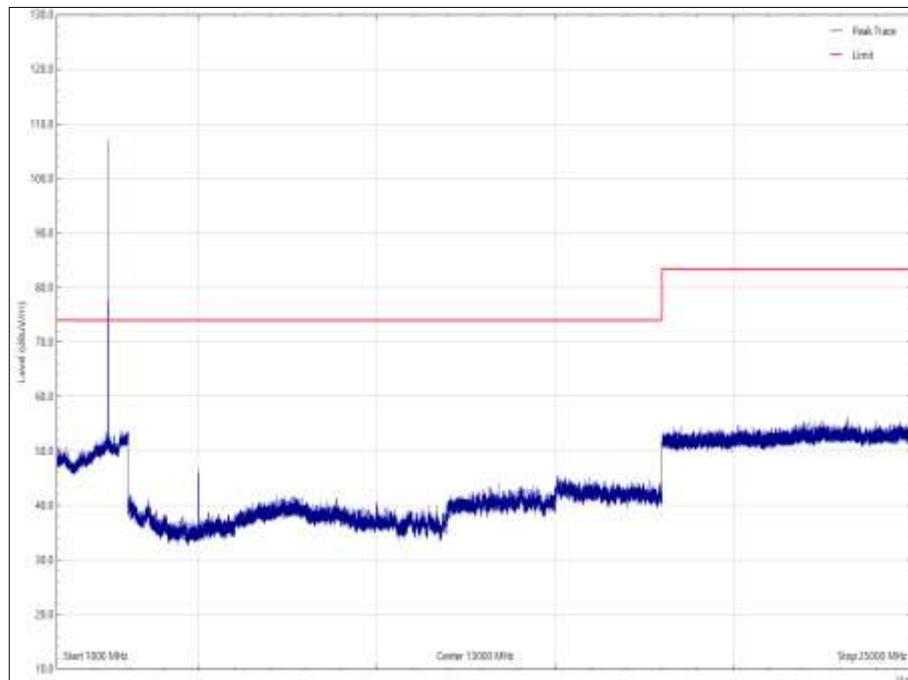
**Figure 39 - 2442 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation**



Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

**Table 33 - 2442 MHz - 1 GHz to 25 GHz**

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



**Figure 40 - 2442 MHz - 1 GHz to 25 GHz, Vertical, X Orientation - Peak**

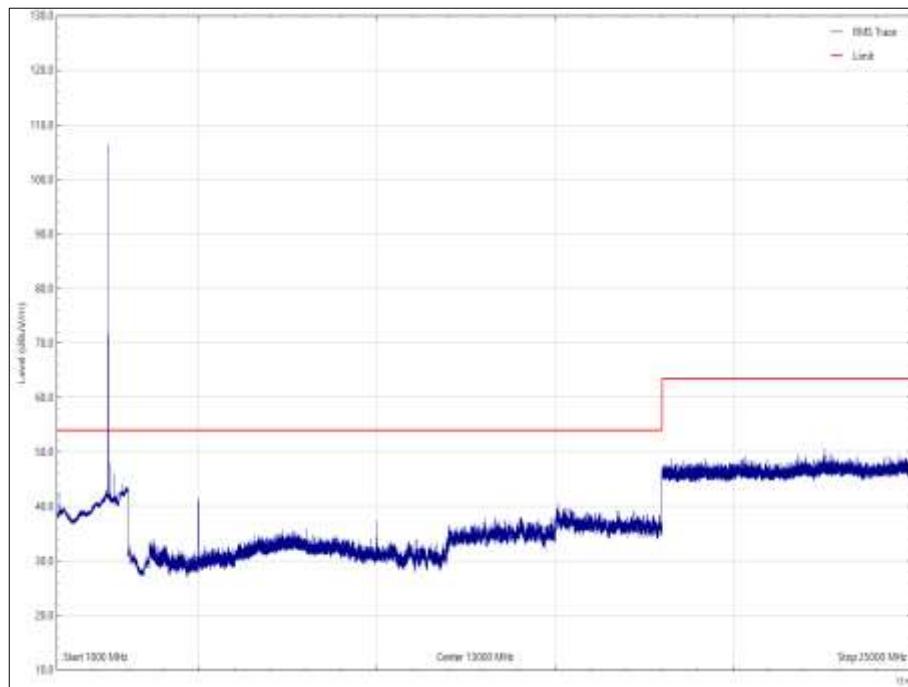


Figure 41 - 2442 MHz - 1 GHz to 25 GHz, Vertical, X Orientation - Average

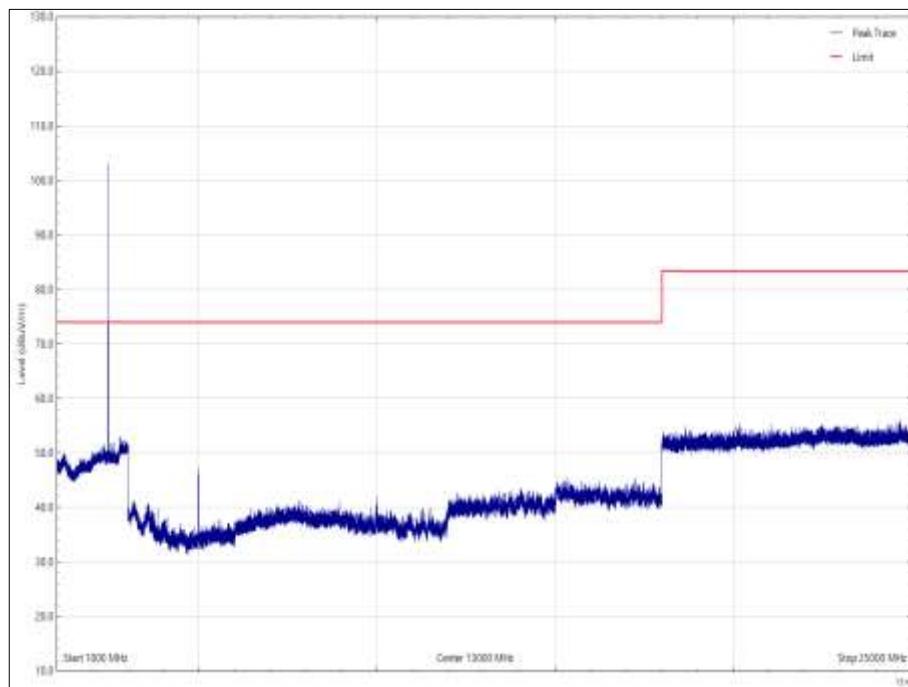


Figure 42 - 2442 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation - Peak

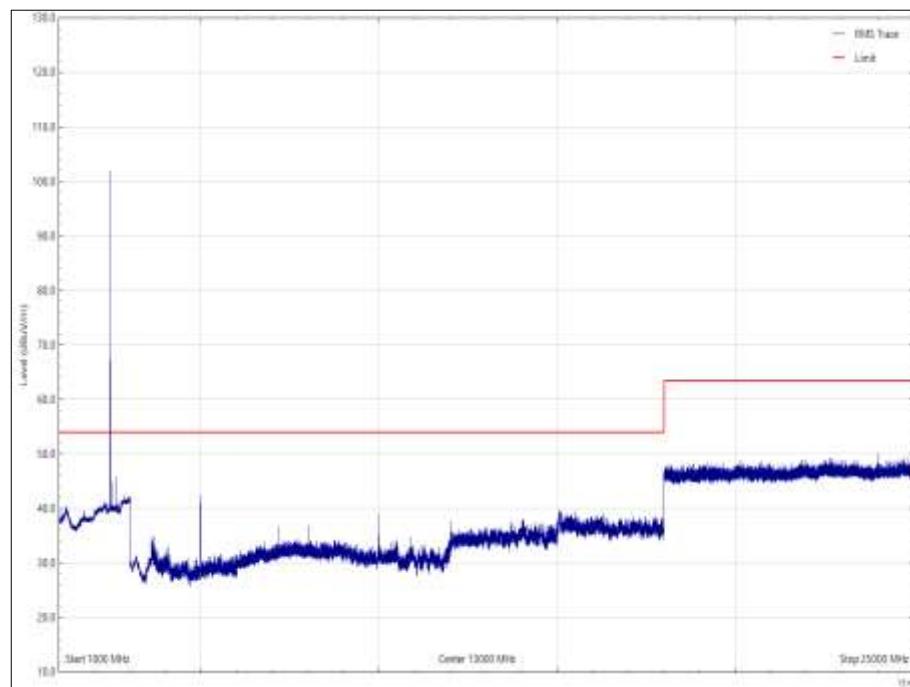


Figure 43 - 2442 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation - Average

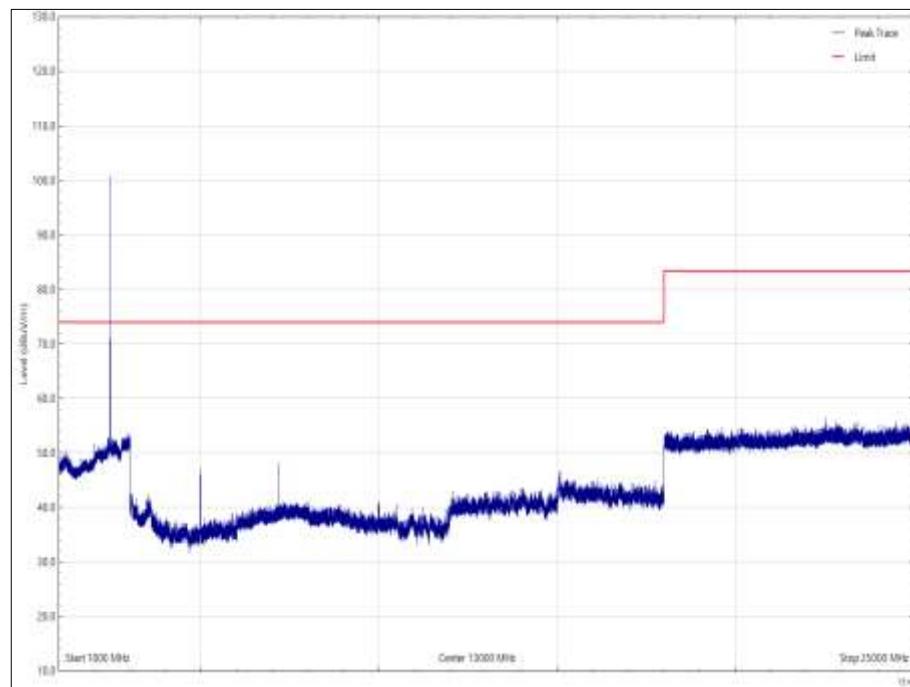


Figure 44 - 2442 MHz - 1 GHz to 25 GHz, Vertical, Y Orientation - Peak

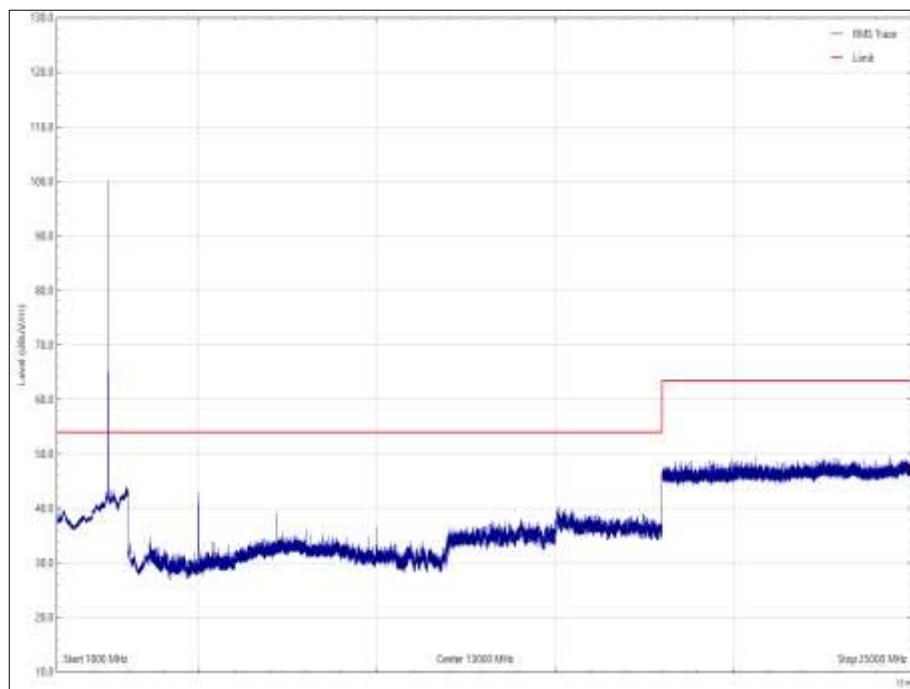


Figure 45 - 2442 MHz - 1 GHz to 25 GHz, Vertical, Y Orientation - Average

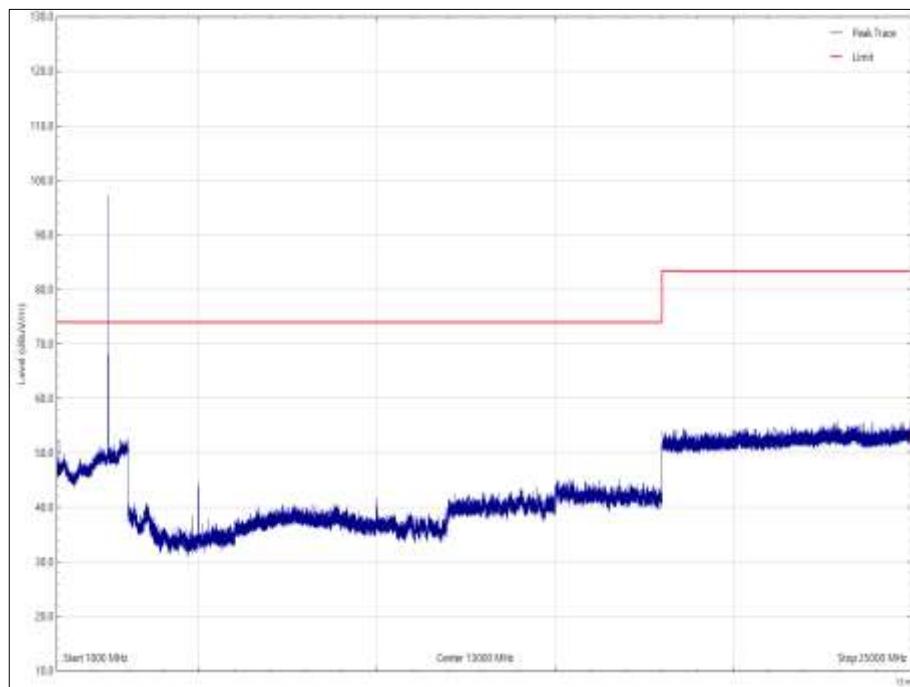


Figure 46 - 2442 MHz - 1 GHz to 25 GHz, Horizontal, Y Orientation - Peak

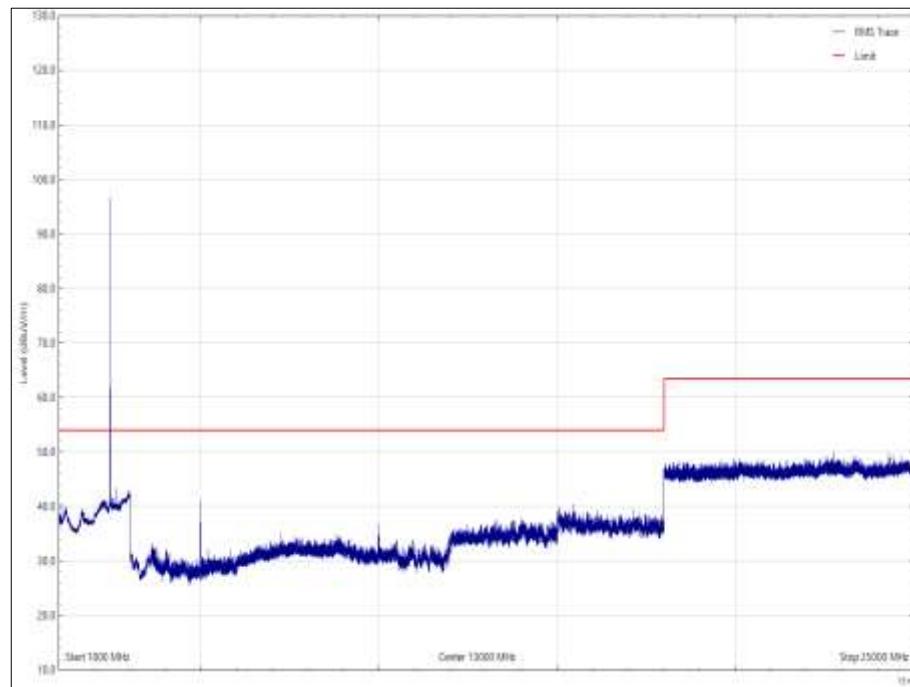


Figure 47 - 2442 MHz - 1 GHz to 25 GHz, Horizontal, Y Orientation - Average

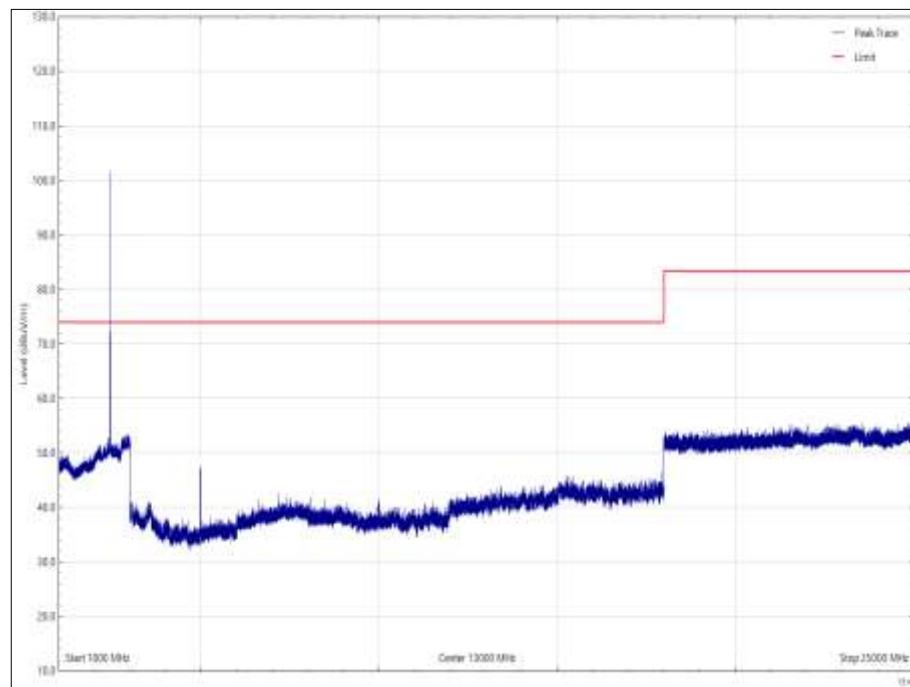


Figure 48 - 2442 MHz - 1 GHz to 25 GHz, Vertical, Z Orientation - Peak

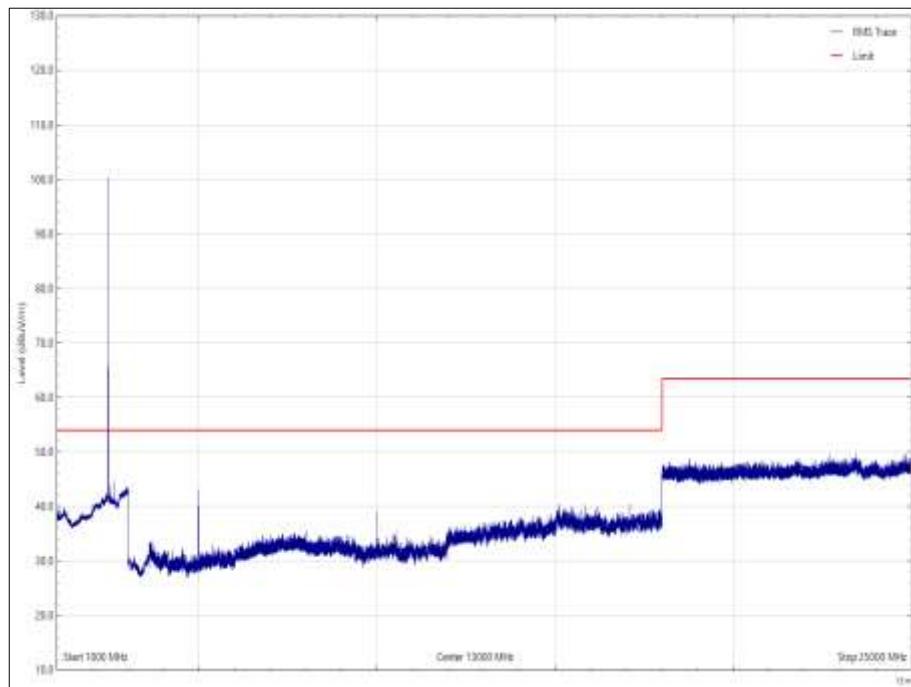


Figure 49 - 2442 MHz - 1 GHz to 25 GHz, Vertical, Z Orientation - Average

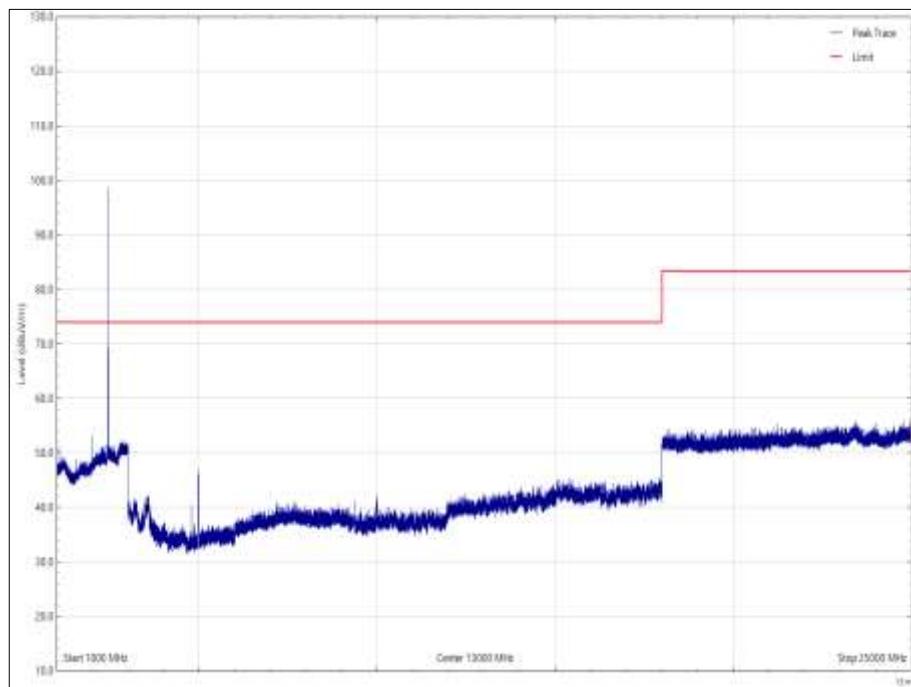


Figure 50 - 2442 MHz - 1 GHz to 25 GHz, Horizontal, Z Orientation - Peak

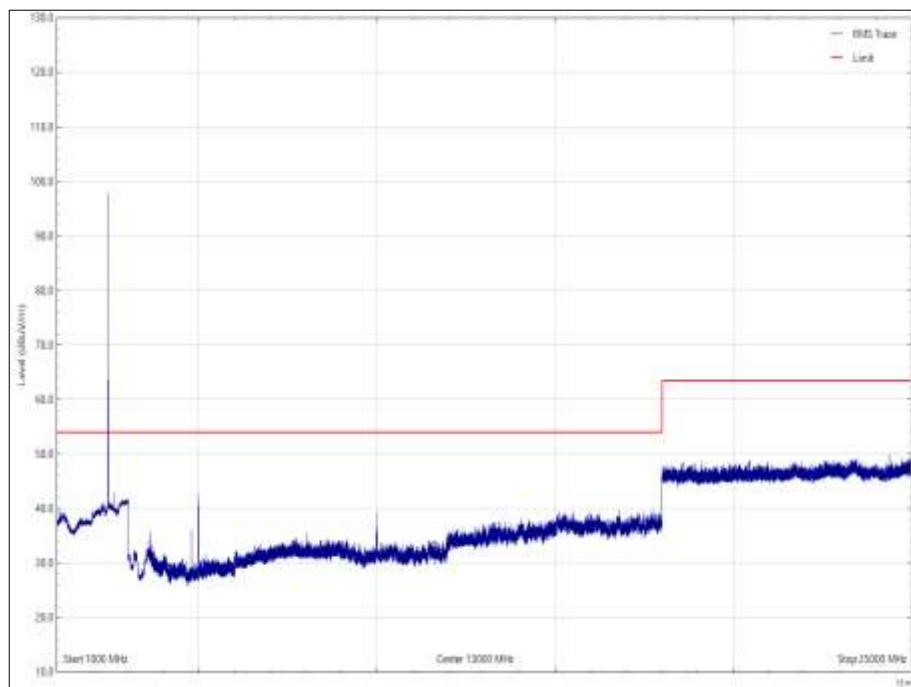
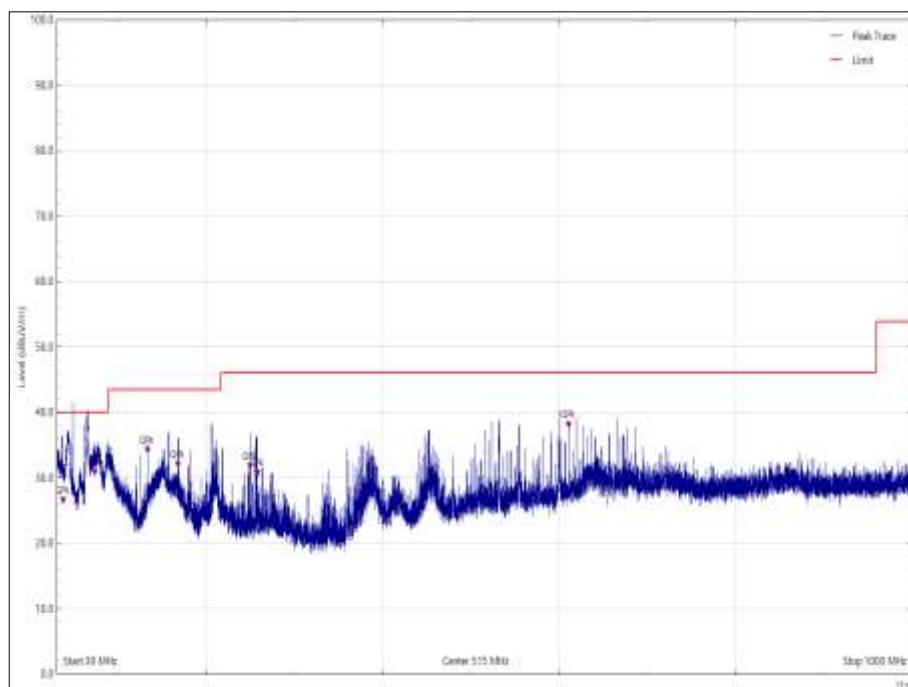


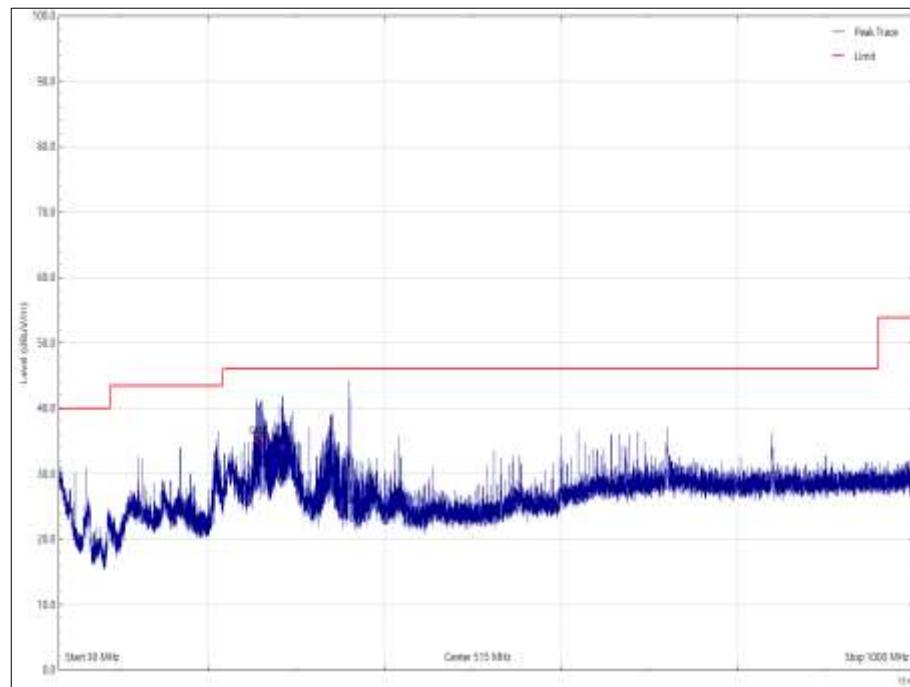
Figure 51 - 2442 MHz - 1 GHz to 25 GHz, Horizontal, Z Orientation - Average

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
74.957	35.03	40.00	4.97	Q-Peak	138	110	Vertical	Z
124.991	35.45	43.52	8.07	Q-Peak	198	100	Vertical	Z
125.002	34.88	43.52	8.64	Q-Peak	350	230	Horizontal	Y
133.071	37.29	43.52	6.23	Q-Peak	216	144	Horizontal	Z
249.970	40.81	46.02	5.21	Q-Peak	225	105	Vertical	Z
250.007	39.66	46.02	6.36	Q-Peak	202	100	Vertical	Y
332.797	37.31	46.02	8.71	Q-Peak	203	153	Vertical	Z
611.495	37.85	46.02	8.17	Q-Peak	36	123	Horizontal	Z
611.498	37.79	46.02	8.23	Q-Peak	144	100	Vertical	Z
611.512	37.28	46.02	8.74	Q-Peak	123	110	Vertical	X
611.546	38.40	46.02	7.62	Q-Peak	132	114	Horizontal	Y

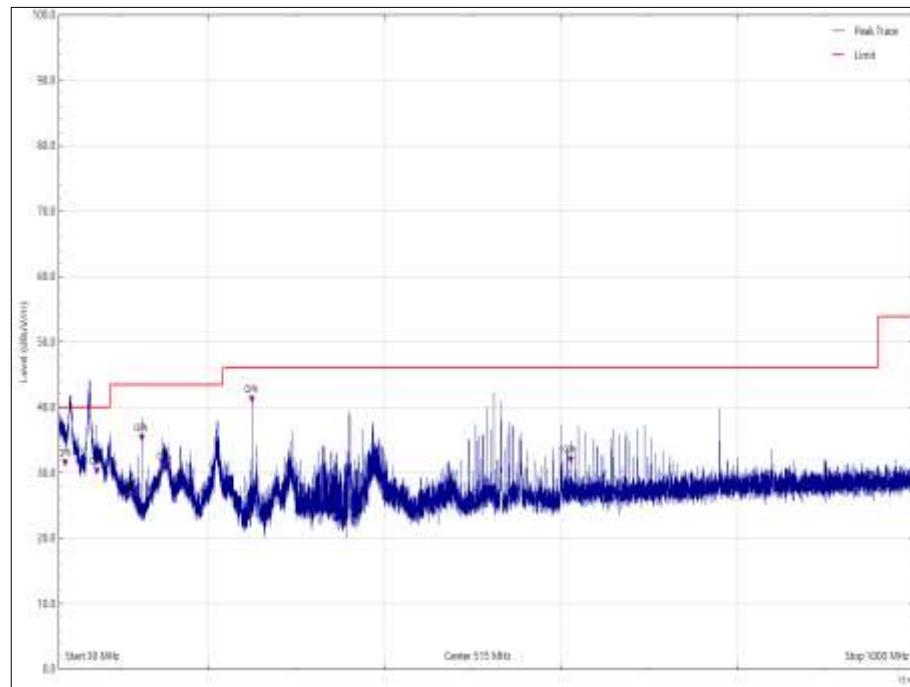
**Table 34 - 2480 MHz, 30 MHz to 1 GHz**

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

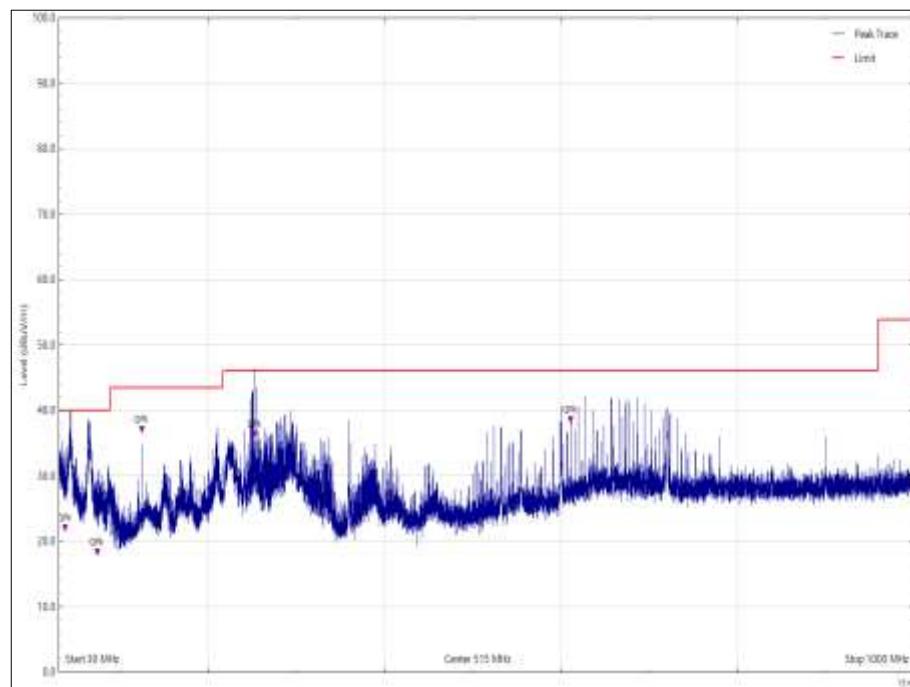




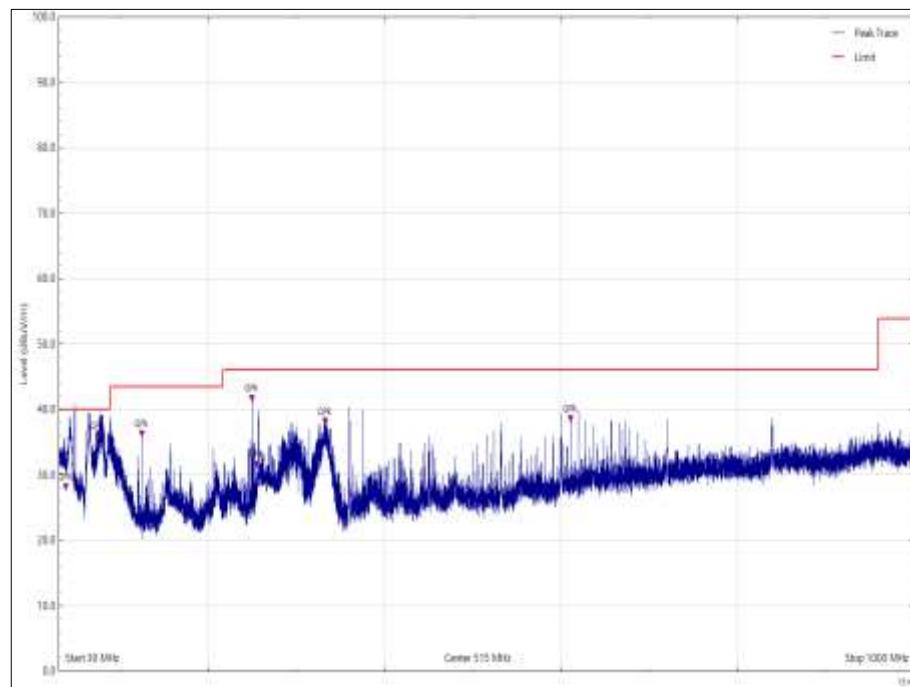
**Figure 53 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation**



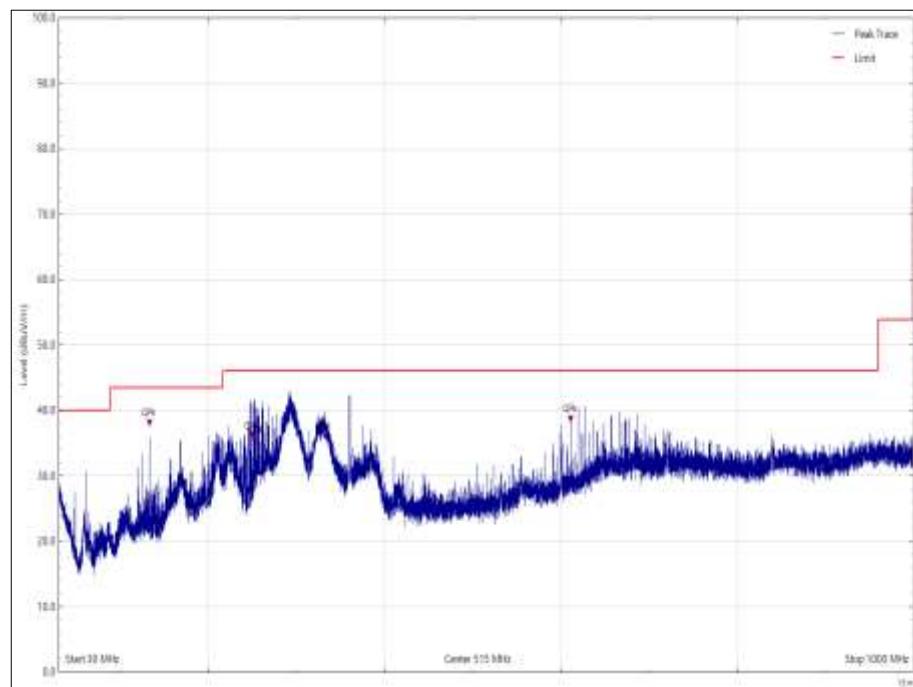
**Figure 54 - 2480 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation**



**Figure 55 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation**



**Figure 56 - 2480 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation**

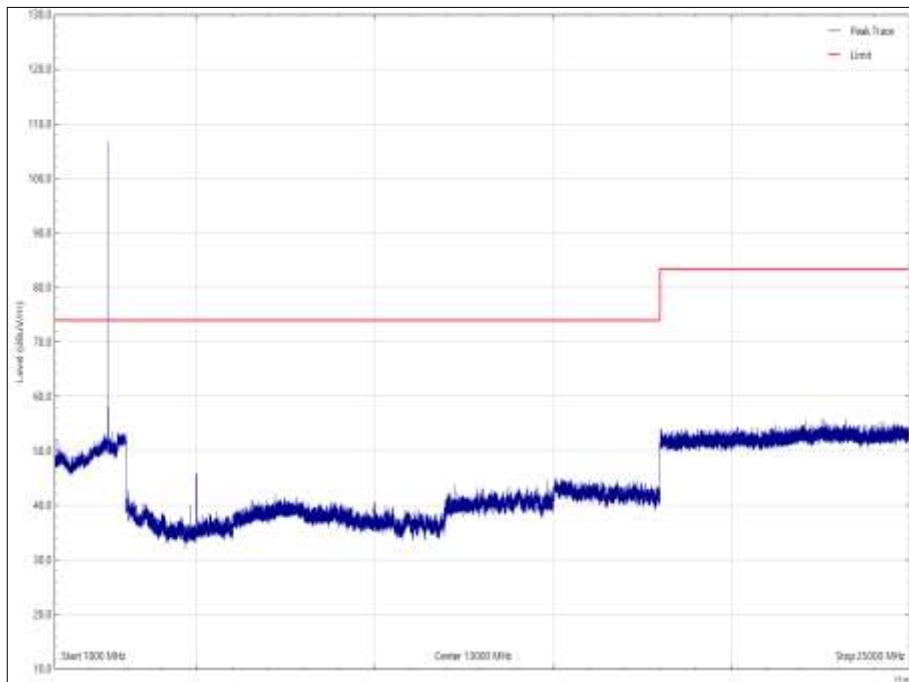


**Figure 57 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation**

Frequency (MHz)	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

**Table 35 - 2480 MHz - 1 GHz to 25 GHz**

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



**Figure 58 - 2480 MHz - 1 GHz to 25 GHz, Vertical, X Orientation - Peak**

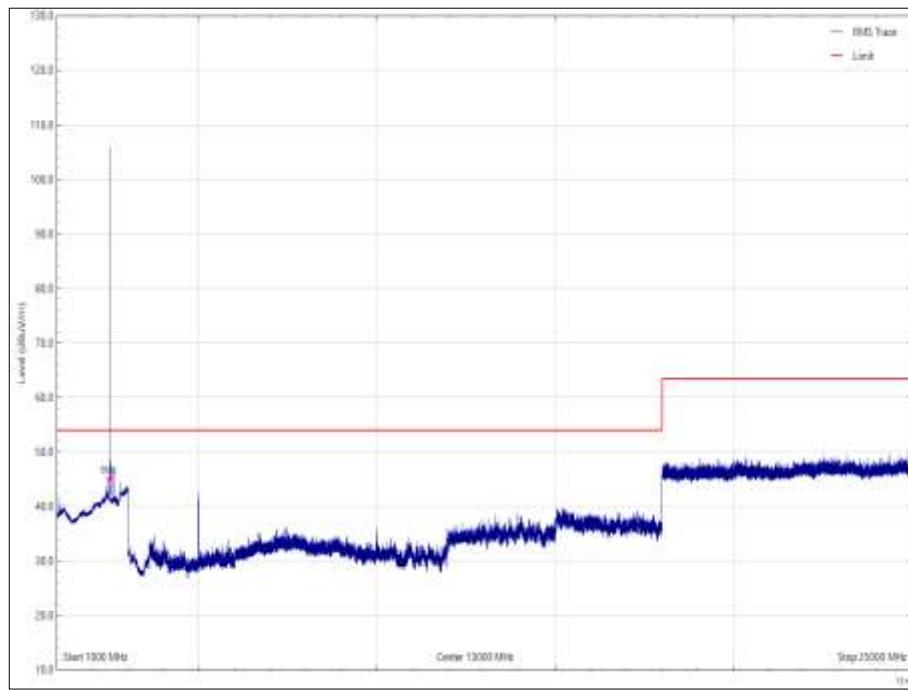


Figure 59 - 2480 MHz - 1 GHz to 25 GHz, Vertical, X Orientation - Average

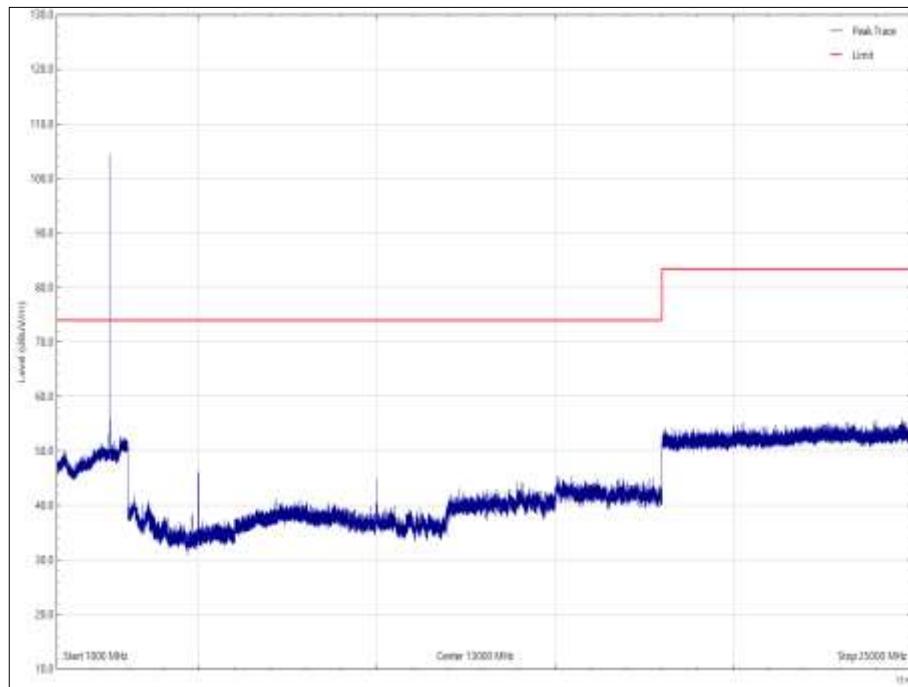


Figure 60 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation - Peak

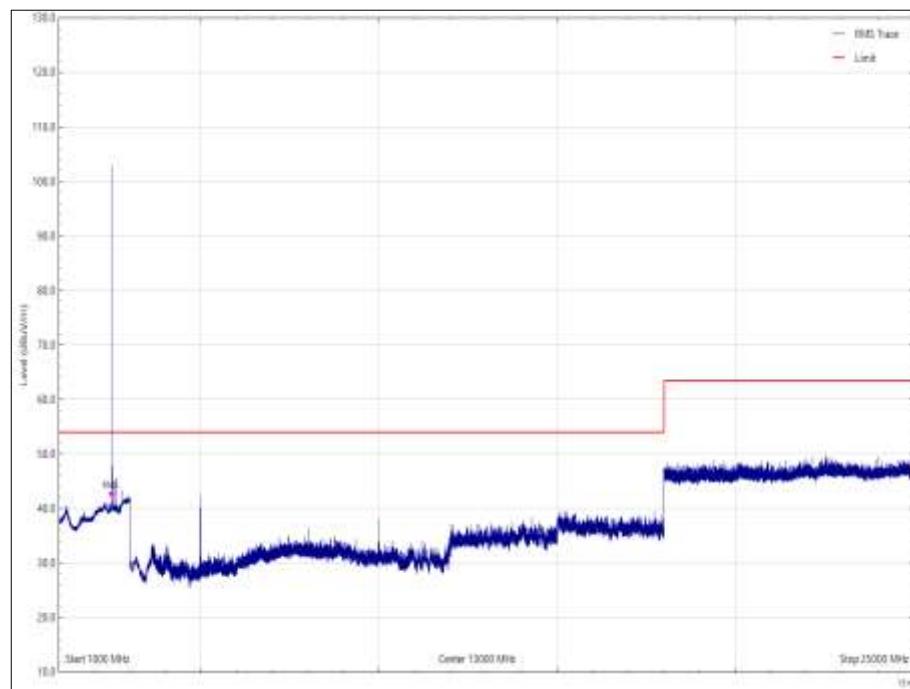


Figure 61 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, X Orientation - Average

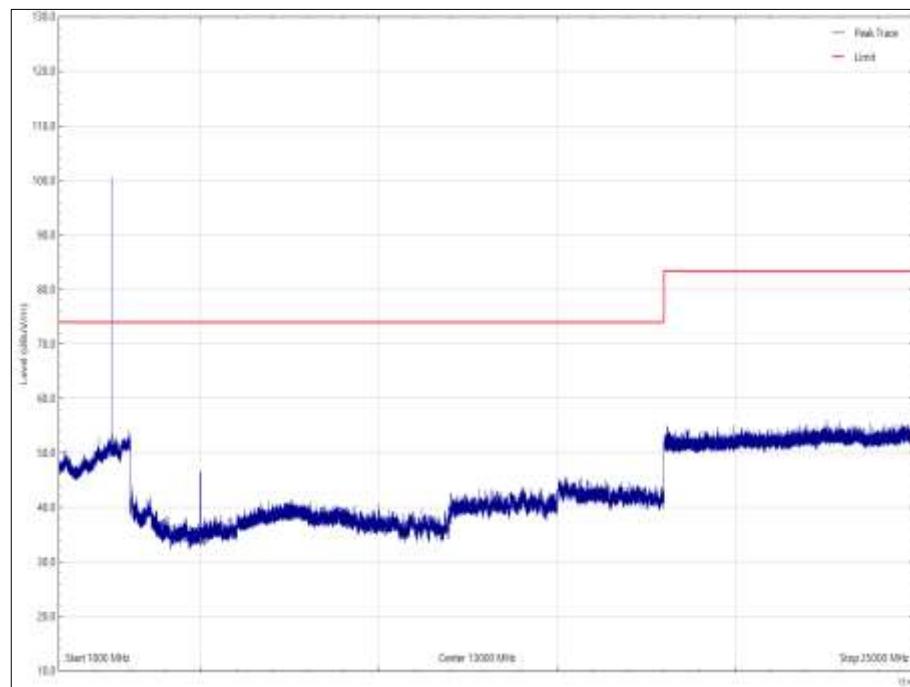


Figure 62 - 2480 MHz - 1 GHz to 25 GHz, Vertical, Y Orientation - Peak

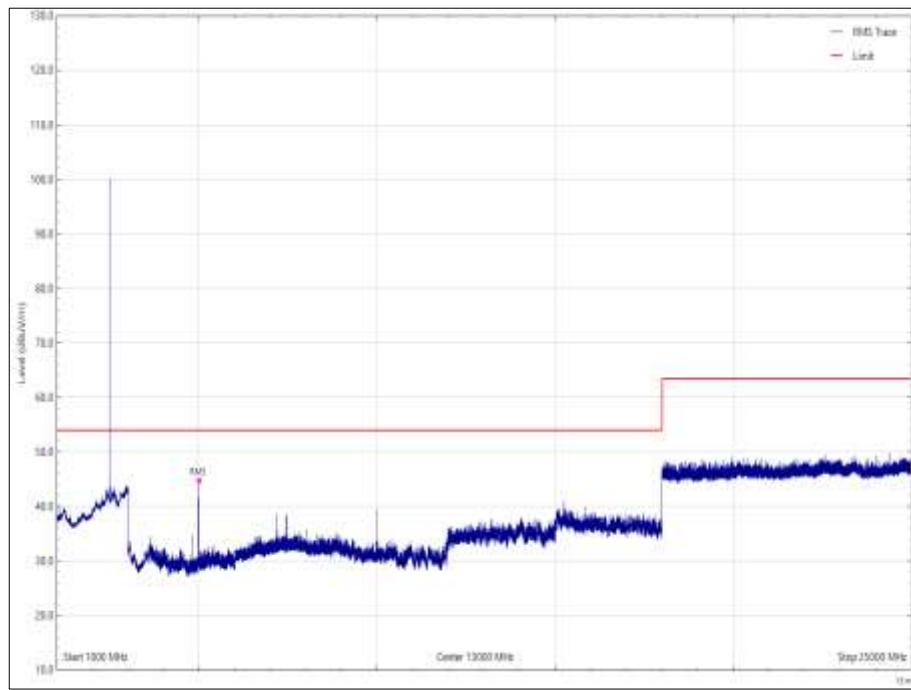


Figure 63 - 2480 MHz - 1 GHz to 25 GHz, Vertical, Y Orientation - Average

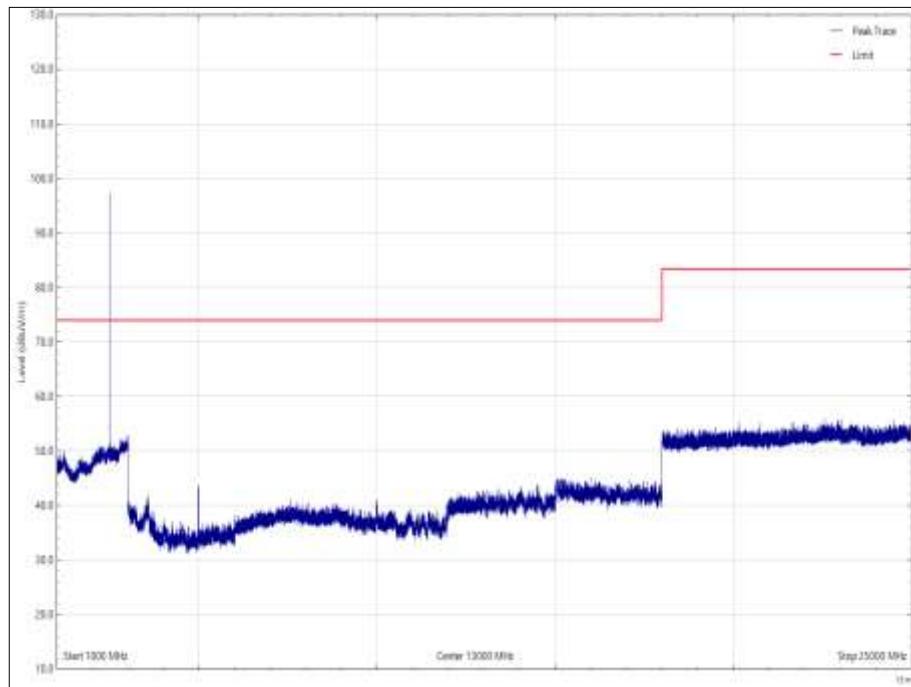


Figure 64 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, Y Orientation - Peak

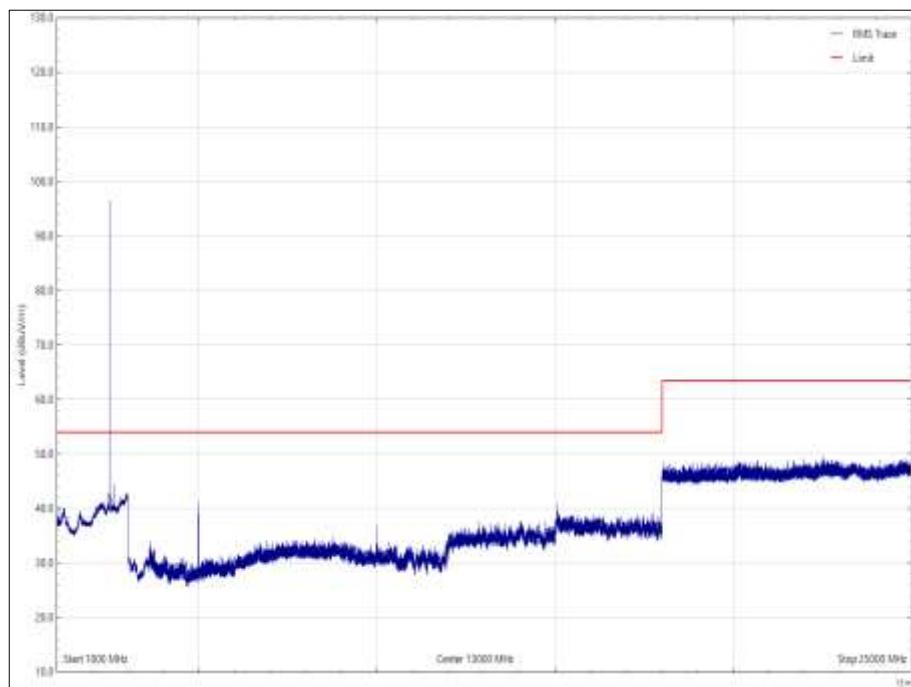


Figure 65 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, Y Orientation - Average

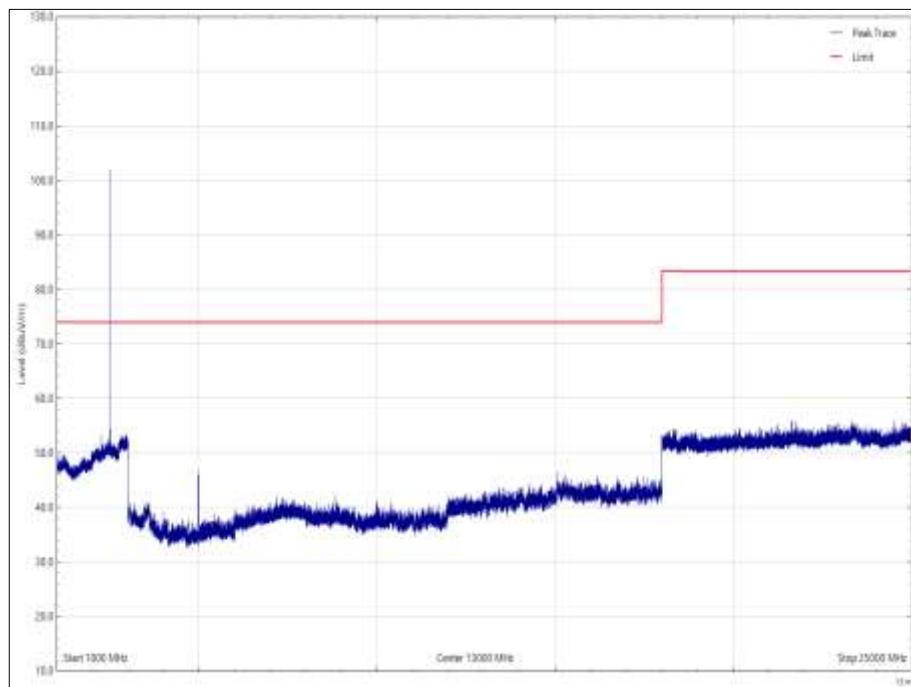


Figure 66 - 2480 MHz - 1 GHz to 25 GHz, Vertical, Z Orientation - Peak

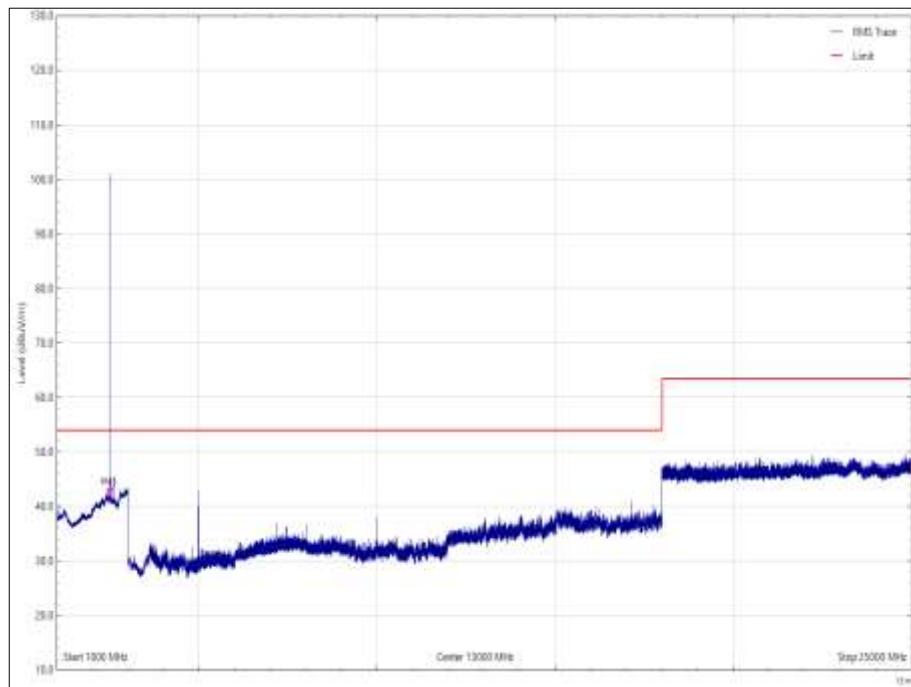


Figure 67 - 2480 MHz - 1 GHz to 25 GHz, Vertical, Z Orientation - Average

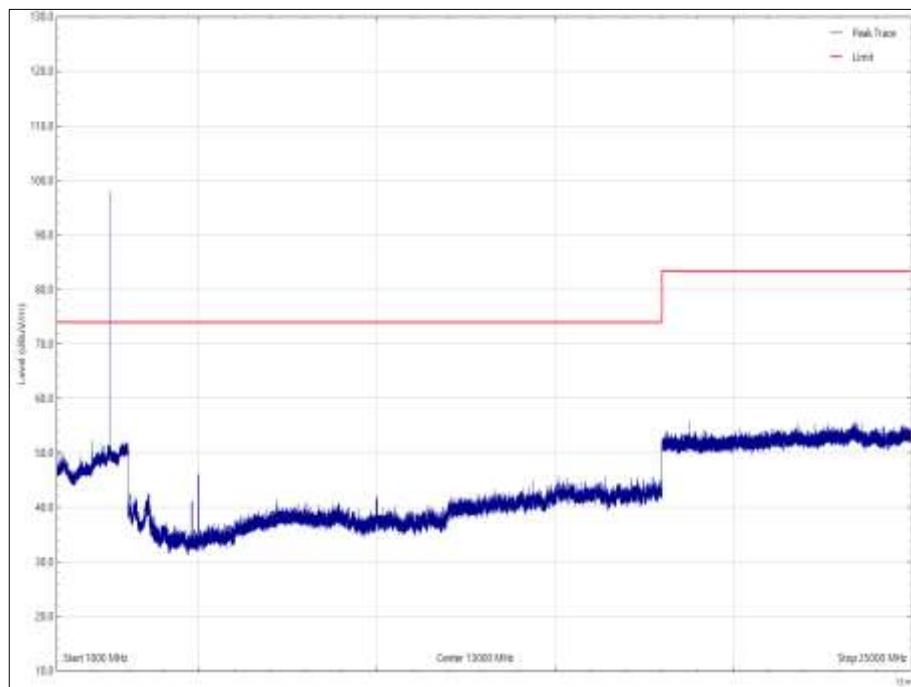
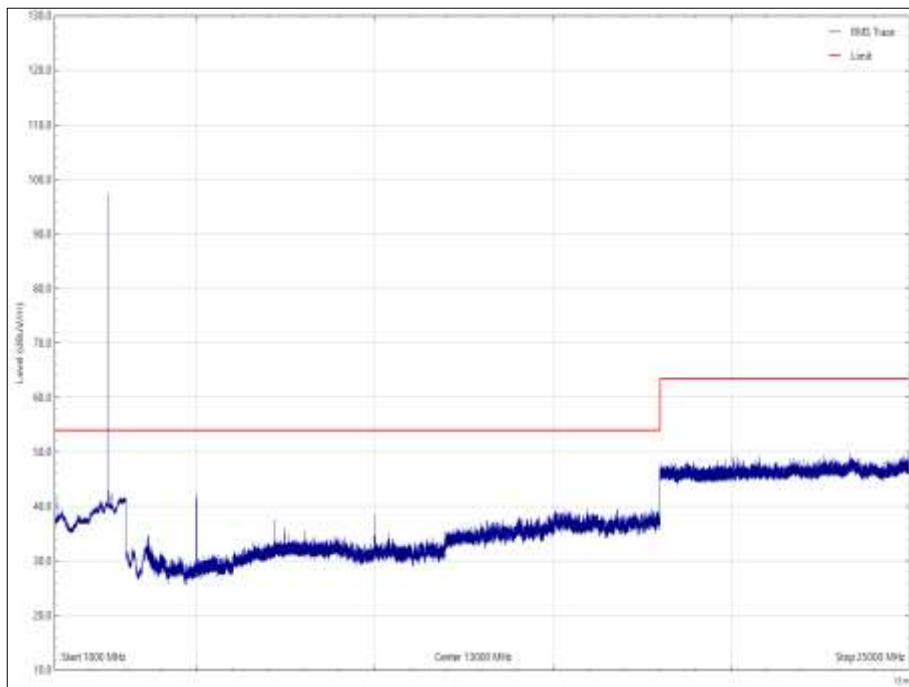


Figure 68 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, Z Orientation - Peak



**Figure 69 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, Z Orientation - Average**

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.

In addition, radiated emissions which fall in the restricted bands, as defined in RSS-GEN, clause 8.10, must also comply with the radiated emission limits specified in RSS-GEN clause 8.9.



## 2.4.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	27-Jul-2022
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	14-Oct-2022
Pre-Amplifier, (8 GHz to 18 GHz)	Phase One	PS04-0086	1533	12	05-Feb-2022
18GHz - 40GHz Pre-Amplifier	Phase One	PS04-0087	1534	12	02-Aug-2022
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Cable 1503 2M 2.92(P)m 2.92(P)m	Rhophase	KPS-1503A-2000-KPS	4293	12	16-Nov-2021
Cable (18 GHz)	Rosenberger	LU7-036-1000	5031	12	23-Jul-2022
EmX Emissions Software	TÜV SUD	V2.1.11	5125	-	Software
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5350	12	21-Sep-2021
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5350	12	22-Sep-2022
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
8 Meter Cable	Teledyne	PR90-088-8MTR	5450	6	08-Mar-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
1m K-Type Cable	Junkosha	MWX241-01000KMSKMS/A	5511	12	09-Apr-2022
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5548	12	07-May-2022
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5610	12	22-Sep-2021
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo GmbH	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo GmbH	TAM 4.0-P	5613	-	TU
Turntable	Maturo GmbH	Turntable 1.5 SI-2t	5614	-	TU
CBL 6111D 30-1000MHz Bi-Log Antenna	Teseq	CBL6111D	5615	24	16-Oct-2022
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

Table 36

TU - Traceability Unscheduled



## **2.5 Authorised Band Edges**

### **2.5.1 Specification Reference**

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

### **2.5.2 Equipment Under Test and Modification State**

Atom Hard Hat, S/N: Not serialised (Storix-ID 599374-18) - Modification State 0

### **2.5.3 Date of Test**

08-September-2021

### **2.5.4 Test Method**

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

### **2.5.5 Environmental Conditions**

Ambient Temperature 21.1 °C

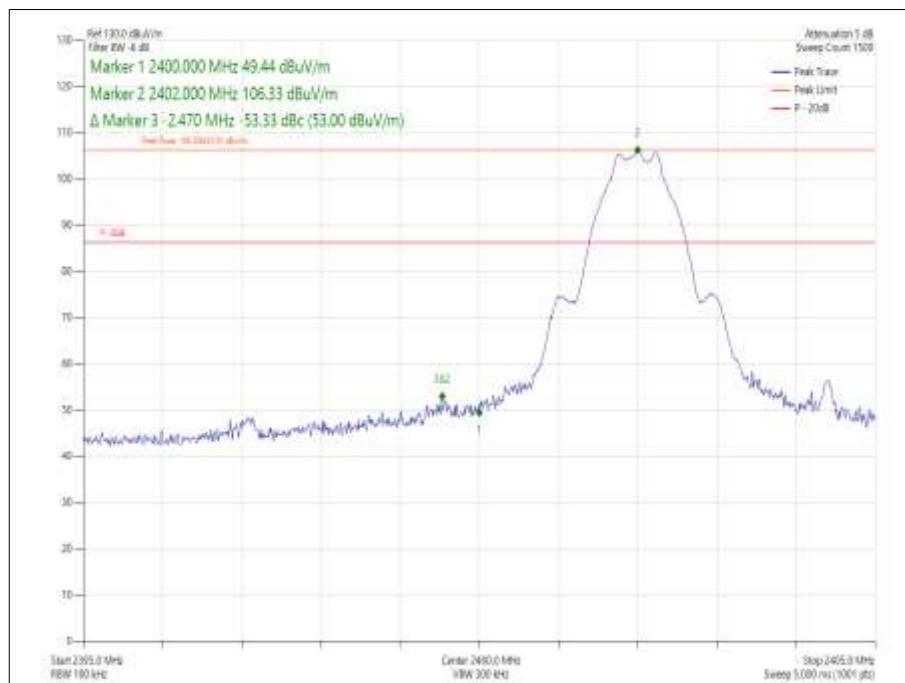
Relative Humidity 56.3 %

## 2.5.6 Test Results

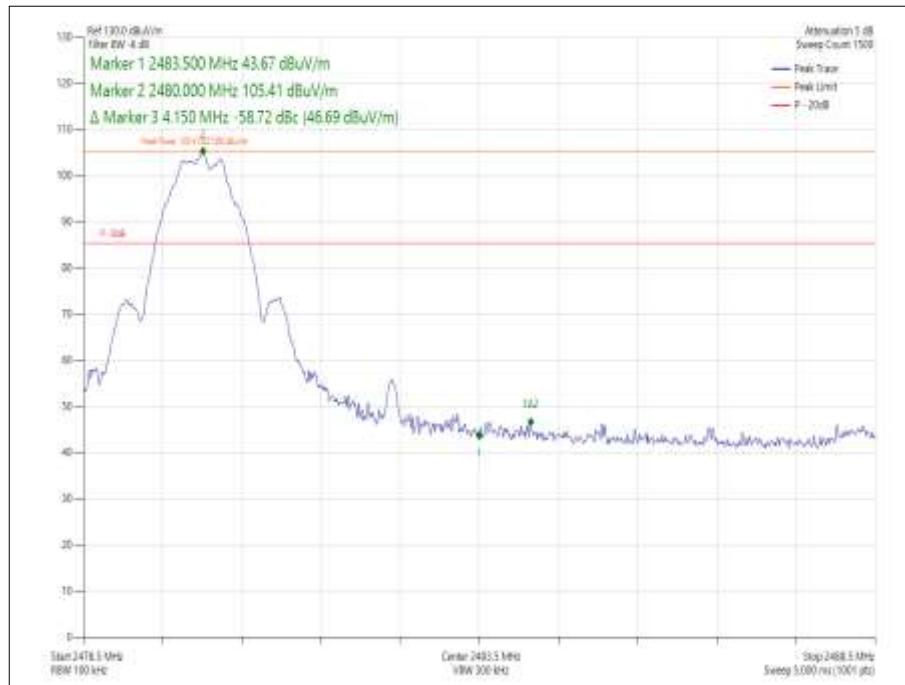
### Hard Hat - 2.4 GHz Bluetooth Low Energy

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	2402	2400	-53.33
GFSK	2480	2483.5	-58.72

**Table 37**



**Figure 70 - GFSK, 2402 MHz - Measured Frequency 2400 MHz**



**Figure 71 - GFSK, 2480 MHz - Measured Frequency 2483.5 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.



## 2.5.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
EmX Emissions Software	TUV SUD	V2.1.11	5125	-	Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
8 Meter Cable	Teledyne	PR90-088-8MTR	5450	6	08-Mar-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo GmbH	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo GmbH	TAM 4.0-P	5613	-	TU
Turntable	Maturo GmbH	Turntable 1.5 SI-2t	5614	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

**Table 38**

TU - Traceability Unscheduled



## **2.6 Power Spectral Density**

### **2.6.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (e)  
ISED RSS-247, Clause 5.2  
ISED RSS-GEN, Clause 6.12

### **2.6.2 Equipment Under Test and Modification State**

Atom Hard Hat, S/N: Not serialised (Storix-ID 599374-99) - Modification State 0

### **2.6.3 Date of Test**

28-September-2021

### **2.6.4 Test Method**

This test was performed in accordance with ANSI C63.10, clause 11.10.2.

### **2.6.5 Environmental Conditions**

Ambient Temperature	21.7 °C
Relative Humidity	54.0 %



## 2.6.6 Test Results

### Hard Hat - 2.4 GHz Bluetooth Low Energy

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (e) RSS-247 5.2 b)	Test Method(s):	C63.10 11.10.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	GFSK (LE 1M)	Duty Cycle (%):	62.4
Antenna Configuration:	SISO	DCCF (dB):	2.05
Active Port(s):	A (A)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	RBW (kHz)	PSD (dBm/RBW)					Limit (dBm/3 kHz)	Margin (dB)
		A	B	C	D	$\Sigma$		
2402	3.0	-8.61	-	-	-	-	8.00	-16.61
2426	3.0	-7.94	-	-	-	-	8.00	-15.94
2480	3.0	-8.04	-	-	-	-	8.00	-16.04

**Table 39 - Maximum Power Spectral Density Results**

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (e) RSS-247 5.2 b)	Test Method(s):	C63.10 11.10.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	GFSK (LE 2M)	Duty Cycle (%):	33.2
Antenna Configuration:	SISO	DCCF (dB):	4.79
Active Port(s):	A (A)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	RBW (kHz)	PSD (dBm/RBW)					Limit (dBm/3 kHz)	Margin (dB)
		A	B	C	D	$\Sigma$		
2402	3.0	-11.31	-	-	-	-	8.00	-19.31
2426	3.0	-11.13	-	-	-	-	8.00	-19.13
2480	3.0	-11.03	-	-	-	-	8.00	-19.03

**Table 40 - Maximum Power Spectral Density Results**



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

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

ISED RSS-247, Limit Clause 5.2(b)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

**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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	03-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	03-Dec-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	12-Apr-2022
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	16-Apr-2022

**Table 41**

### 3 Photographs

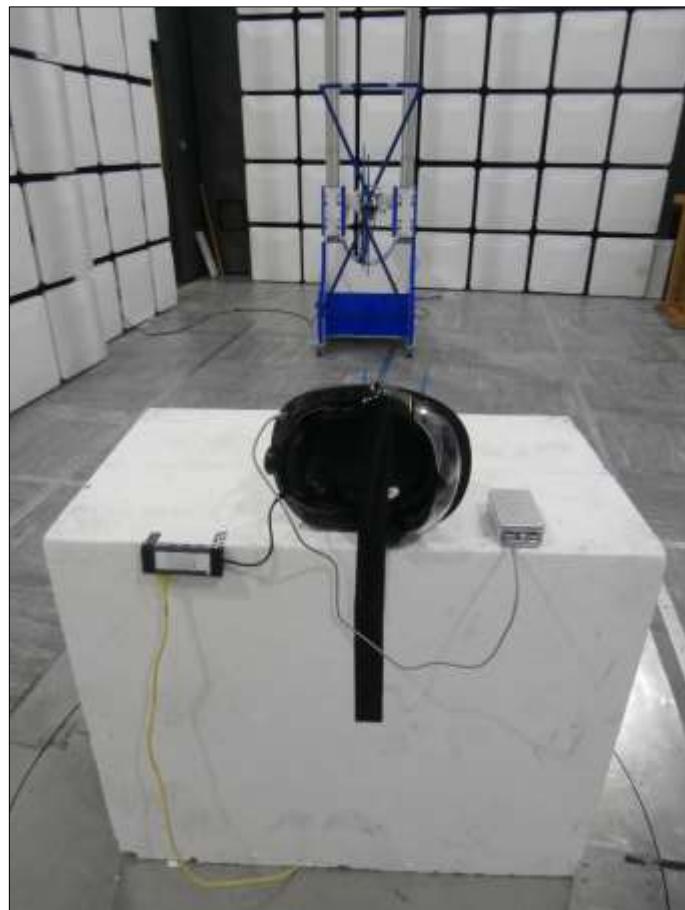
#### 3.1 Test Setup Photographs



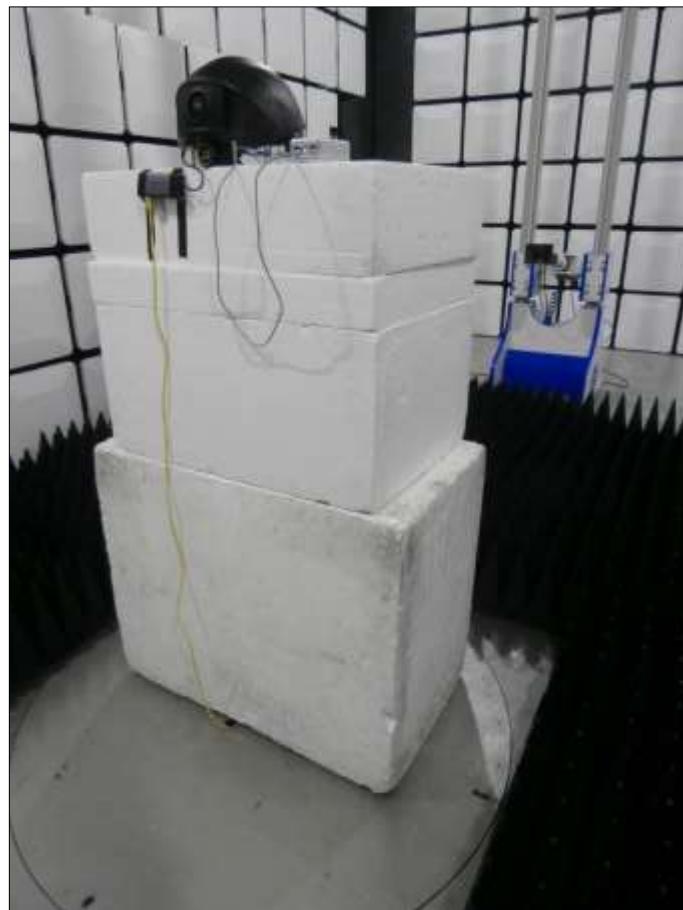
Figure 72 - Test Setup - 30 MHz to 1 GHz - X Orientation



**Figure 73 - Test Setup - 30 MHz to 1 GHz - Y Orientation**



**Figure 74 - Test Setup - 30 MHz to 1 GHz - Z Orientation**



**Figure 75 - Test Setup - 1 GHz to 18 GHz - X Orientation**



**Figure 76 - Test Setup - 1 GHz to 18 GHz - Y Orientation**



**Figure 77 - Test Setup - 1 GHz to 18 GHz - Z Orientation**



**Figure 78 - Test Setup - 18 GHz to 25 GHz - X Orientation**



**Figure 79 - Test Setup - 18 GHz to 25 GHz - Y Orientation**



**Figure 80 - Test Setup - 18 GHz to 25 GHz - Z Orientation**

## 4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Restricted Band Edges	30 MHz to 1 GHz: $\pm 5.2$ dB 1 GHz to 40 GHz: $\pm 6.3$ dB
Emission Bandwidth	$\pm 42.867$ kHz
Maximum Conducted Output Power	$\pm 3.2$ dB
Spurious Radiated Emissions	30 MHz to 1 GHz: $\pm 5.2$ dB 1 GHz to 40 GHz: $\pm 6.3$ dB
Authorised Band Edges	30 MHz to 1 GHz: $\pm 5.2$ dB 1 GHz to 40 GHz: $\pm 6.3$ dB
Power Spectral Density	$\pm 3.2$ dB

**Table 42**

### 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.