

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 (Simultaneous
Transmission)
(BLE, WLAN and Proprietary)

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



Add value.
Inspire trust.

FCC ID: 2A3C5-XYZ1201 (contains FCC ID PD992260NG)
IC: 28181XYZ1201 (Contains IC 1000M-9260NG)

COMMERCIAL-IN-CONFIDENCE

Document 75952587-21 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	11 February 2022

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	11 February 2022	

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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Contents

1	Report Summary	2
1.1	Report Modification Record.....	2
1.2	Introduction.....	2
1.3	Brief Summary of Results	3
1.4	Application Form	4
1.5	Product Information	7
1.6	Deviations from the Standard.....	7
1.7	EUT Modification Record	7
1.8	Test Location	7
2	Test Details	8
2.1	Radiated Spurious Emissions (Simultaneous Transmission)	8
3	Photographs	23
3.1	Test Setup Photographs	23
4	Measurement Uncertainty	32



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	11-February-2022

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 599374-117)
Hardware Version(s)	Not Applicable
Software Version(s)	Windows Certification Build
Number of Samples Tested	1
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-November-2021
Finish of Test	08-November-2021
Name of Engineer(s)	Graeme Lawler
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 (Simultaneous Transmission) 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, 2.4 GHz WLAN and 2.4 GHz proprietary device						
2.1	15.247 (d) and 15.205	3.3 and 5.5	6.13	Radiated Spurious Emissions (Simultaneous Transmission)	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)	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 – see guidance here	2A3C5-XYZ1201 (contains FCC ID PD992260NG)	
IC ID of the product under test – see guidance here	28181XYZ1201 (Contains IC 1000M-9260NG)	

Table 3

Intentional Radiators

Technology	Bluetooth LE	WLAN 2.4 GHz	Proprietary ISM 2.4GHz			
Frequency Range (MHz to MHz)	2402-2480	2412-2462	2402-2480			
Conducted Declared Output Power (dBm)	5.5 ± 2 dB	20 ± 1 dB	0			
Antenna Gain (dBi)	2.8	2.8	2.8			
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	1	20 / 40	1			
Modulation Scheme(s) (e.g GFSK, QPSK etc)	GFSK / DQPSK	OFDM / OFDM-HT / CCK	GFSK / DQPSK			
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	1M00F1D	20M3D1W / 40M3D1W	1M00F1D			
Bottom Frequency (MHz)	2402	2412	2402			
Middle Frequency (MHz)	2440	2437	2440			
Top Frequency (MHz)	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) ☐	
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:		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 ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ *(Vehicle regulated)		
Other ☒	Please detail:	Li Ion

Table 8

Charging

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

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 ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:	Flexible	Gain	2.8	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 ☐					

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 599374-117)			
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, 2.4 GHz WLAN and 2.4 GHz proprietary device		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS

Table 15

Office Address:

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



2 Test Details

2.1 Radiated Spurious Emissions (Simultaneous Transmission)

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247
ISED RSS-247, Clause 3.3 and 5.5
ISED RSS-GEN, Clause 6.13

2.1.2 Equipment Under Test and Modification State

Atom Hard Hat, S/N: Not serialised (Storix-ID 599374-117) - Modification State 0

2.1.3 Date of Test

07-November-2021 to 08-November-2021

2.1.4 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. For an EUT which could reasonably be used in multiple planes, 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. for emissions originating from the WLAN transmitter. For emissions originating from the Bluetooth or Proprietary transmitter, final measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3.

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 shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBμV/m to μV/m:

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

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.

2.1.5 Example Test Setup Diagram

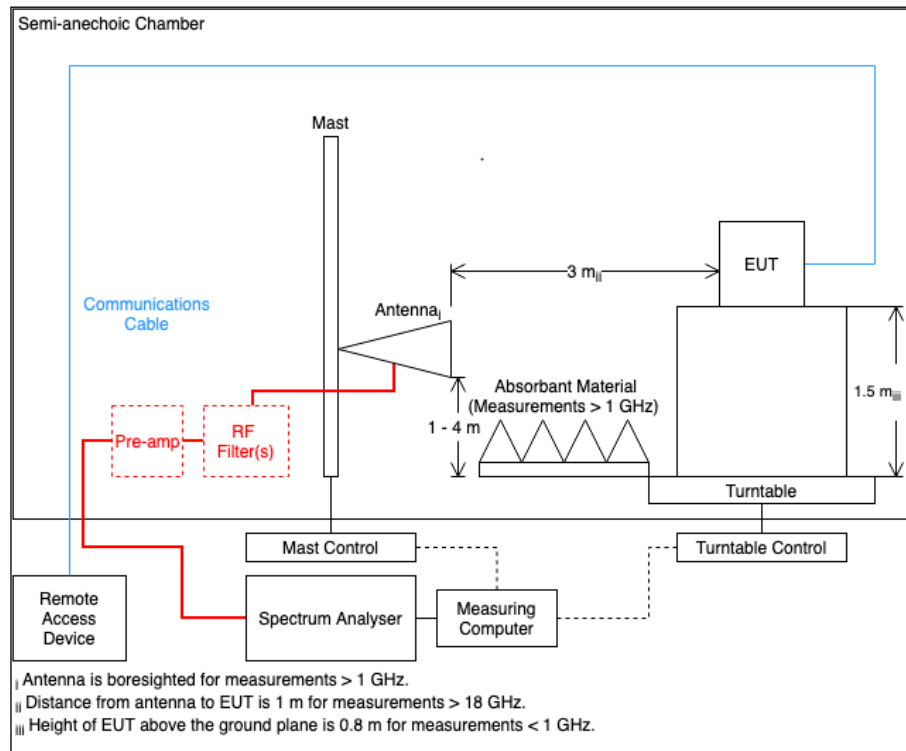


Figure 1

2.1.6 Environmental Conditions

Ambient Temperature	19.2 - 20.3 °C
Relative Humidity	44.9 - 46.8 %

2.1.7 Test Results

Hard Hat - 2.4 GHz Bluetooth, 2.4 GHz WLAN and 2.4 GHz proprietary device

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
38.120	27.2	40.0	-12.8	Q-Peak	255	100	Vertical
74.564	33.0	40.0	-7.0	Q-Peak	21	156	Vertical
125.011	32.2	43.5	-11.3	Q-Peak	261	110	Vertical
274.411	34.0	46.0	-12.0	Q-Peak	198	100	Horizontal
282.917	34.7	46.0	-11.4	Q-Peak	360	100	Horizontal
322.531	28.6	46.0	-17.4	Q-Peak	57	100	Horizontal
611.512	37.8	46.0	-8.2	Q-Peak	48	100	Vertical
4880.115	44.6	54.0	-9.4	Average	180	164	Vertical
7439.835	51.8	54.0	-2.2	Average	193	155	Vertical
7440.013	52.1	54.0	-1.9	Average	188	131	Horizontal

Table 16 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: X, 30 MHz to 25 GHz

No other emissions found within 6 dB of the limit.

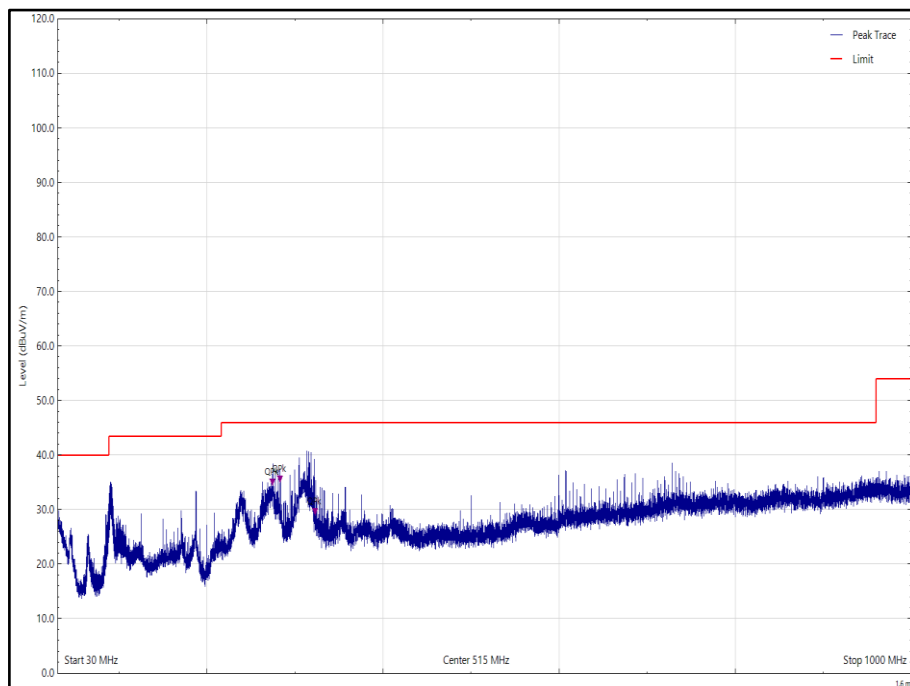


Figure 2 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: X, 30 MHz to 1 GHz, Horizontal (Peak)

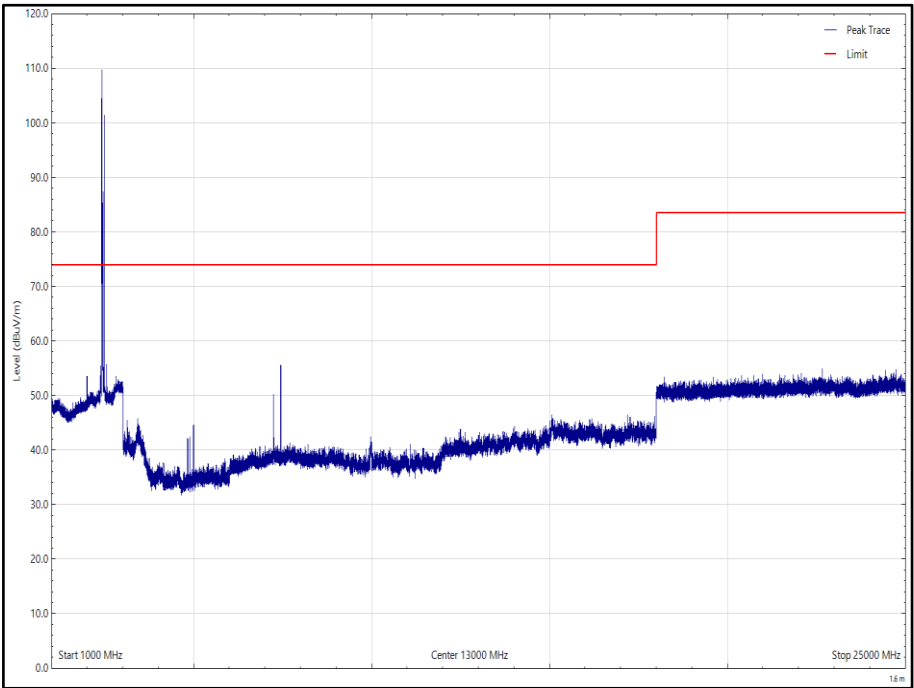


Figure 3 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: X, 1 GHz to 25 GHz, Horizontal (Peak)

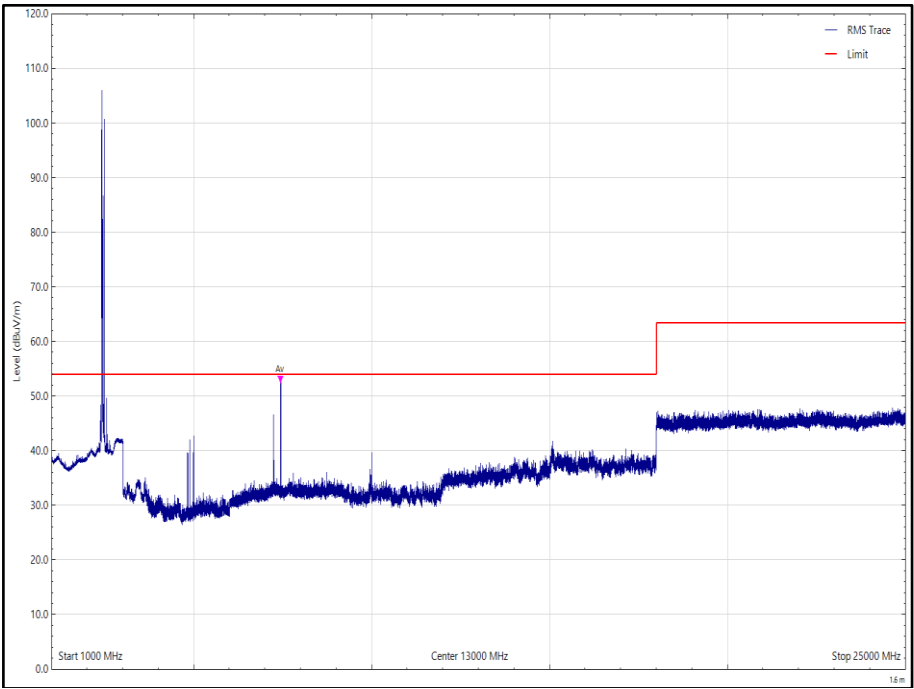


Figure 4 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: X, 1 GHz to 25 GHz, Horizontal (rms)

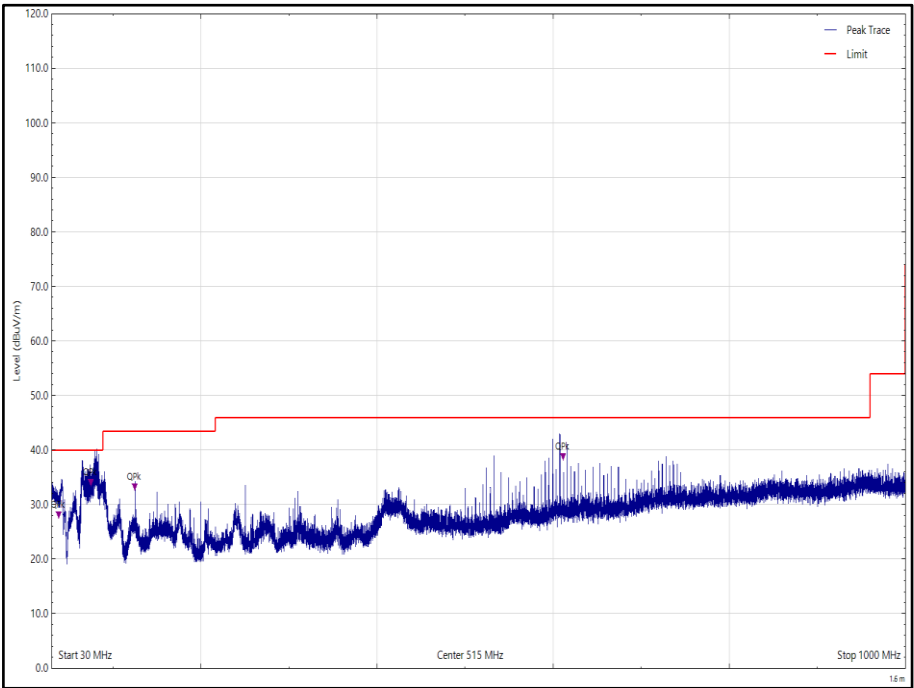


Figure 5 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: X, 30 MHz to 1 GHz, Vertical (Peak)

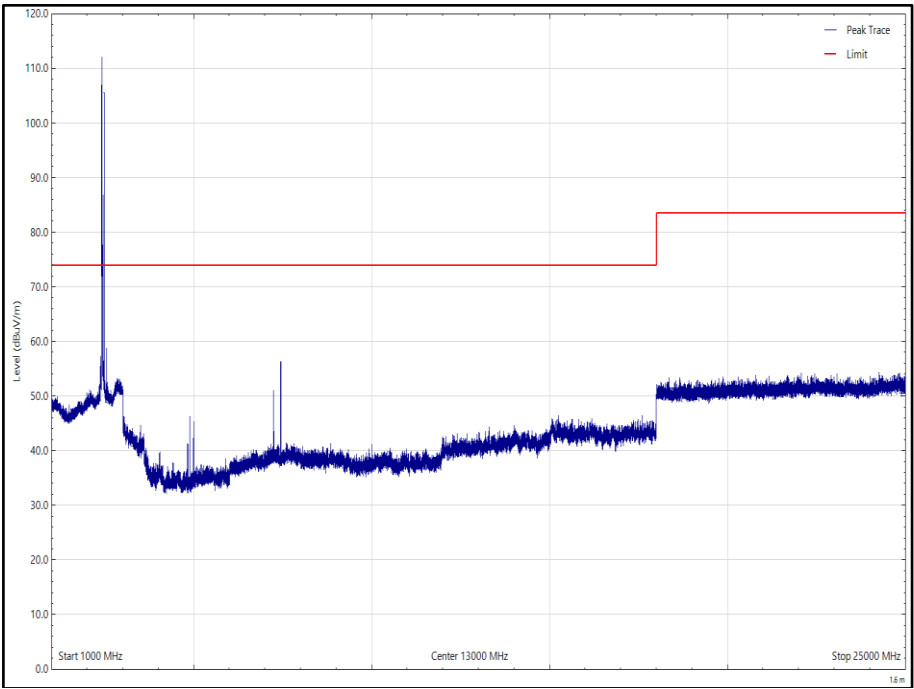


Figure 6 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: X, 1 GHz to 25 GHz, Vertical (Peak)

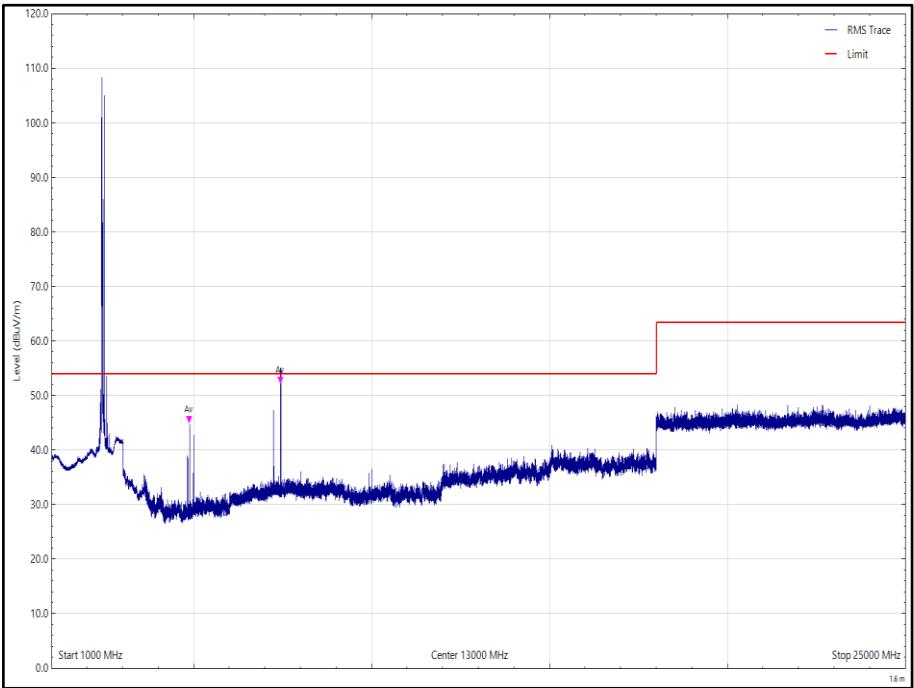


Figure 7 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: X, 1 GHz to 25 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
38.103	28.1	40.0	-11.9	Q-Peak	288	100	Vertical
73.161	33.0	40.0	-7.0	Q-Peak	341	111	Vertical
162.213	33.6	43.5	-9.9	Q-Peak	340	100	Vertical
246.066	34.6	46.0	-11.5	Q-Peak	285	195	Vertical
256.170	37.6	46.0	-8.4	Q-Peak	131	100	Horizontal
261.446	38.5	46.0	-7.5	Q-Peak	302	100	Horizontal
265.410	33.4	46.0	-12.7	Q-Peak	195	100	Vertical
266.366	38.6	46.0	-7.4	Q-Peak	135	100	Horizontal
282.903	40.8	46.0	-5.2	Q-Peak	99	100	Horizontal
2374.880	48.9	54.0	-5.1	RMS	204	125	Vertical
2375.453	48.0	54.0	-6.0	RMS	216	155	Horizontal
2385.549	48.8	54.0	-5.2	RMS	204	131	Vertical
4880.092	46.0	54.0	-8.0	Average	274	144	Vertical
4999.709	43.3	54.0	-10.7	RMS	159	128	Vertical
7439.914	52.9	54.0	-1.1	Average	255	219	Horizontal
7439.937	52.6	54.0	-1.4	Average	241	162	Vertical

Table 17 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Y, 30 MHz to 25 GHz

No other emissions found within 6 dB of the limit.

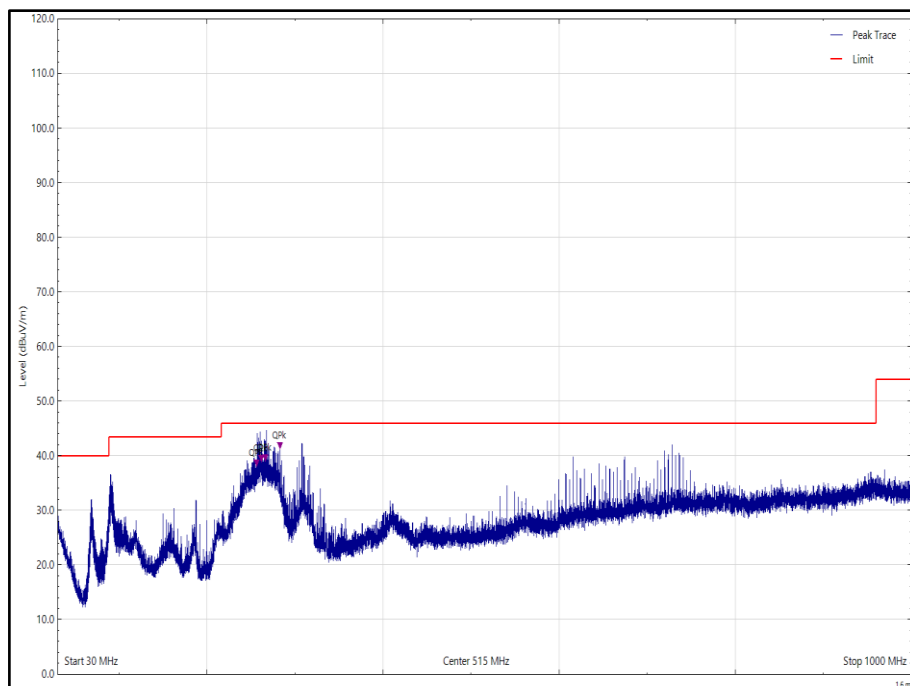


Figure 8 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Y, 30 MHz to 1 GHz, Horizontal (Peak)

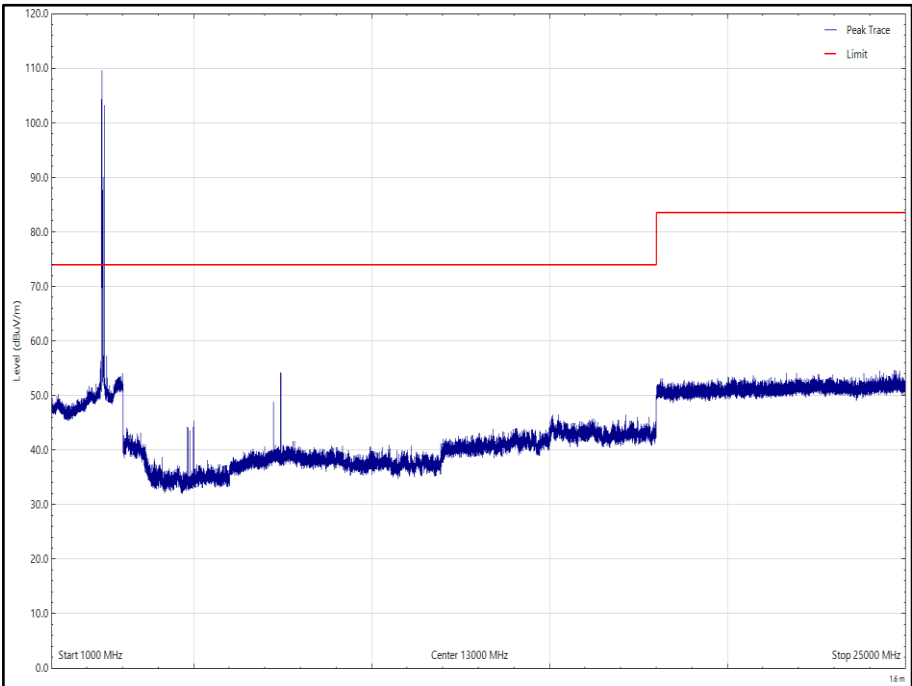


Figure 9 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Y, 1 GHz to 25 GHz, Horizontal (Peak)

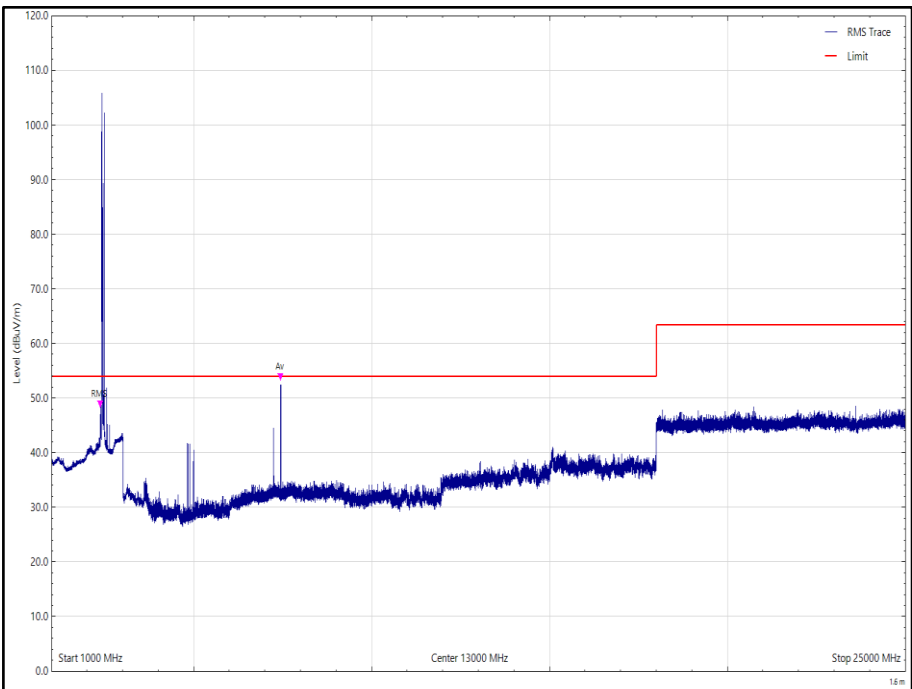


Figure 10 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Y, 1 GHz to 25 GHz, Horizontal (rms)

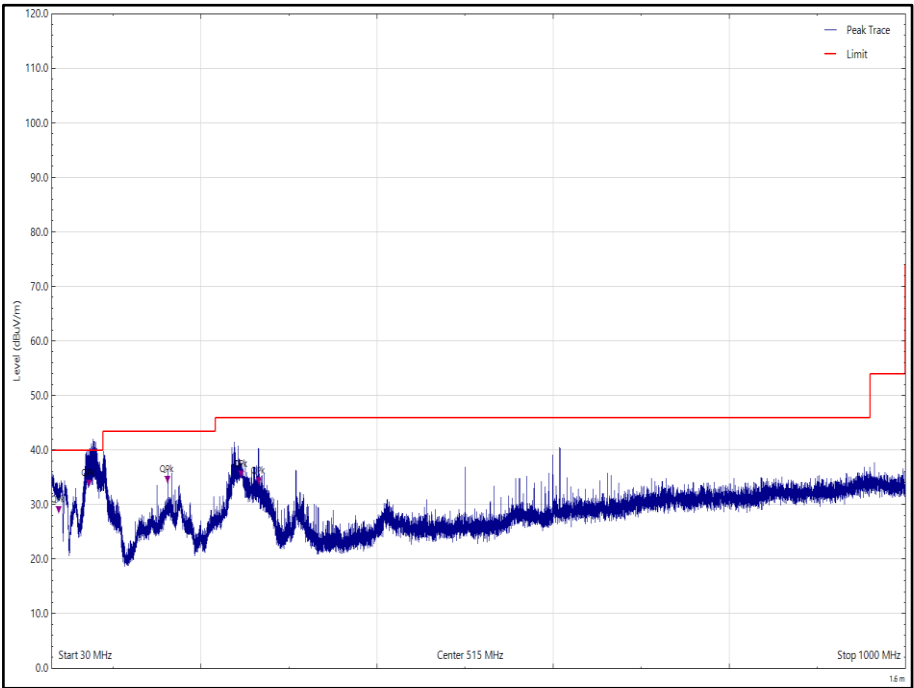


Figure 11 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Y, 30 MHz to 1 GHz, Vertical (Peak)

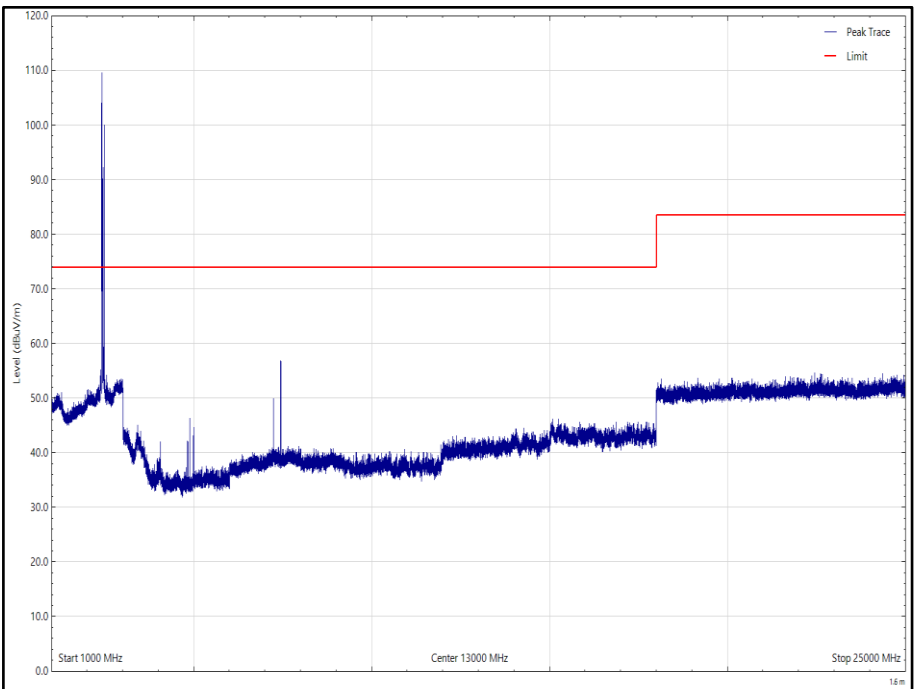


Figure 12 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Y, 1 GHz to 25 GHz, Vertical (Peak)

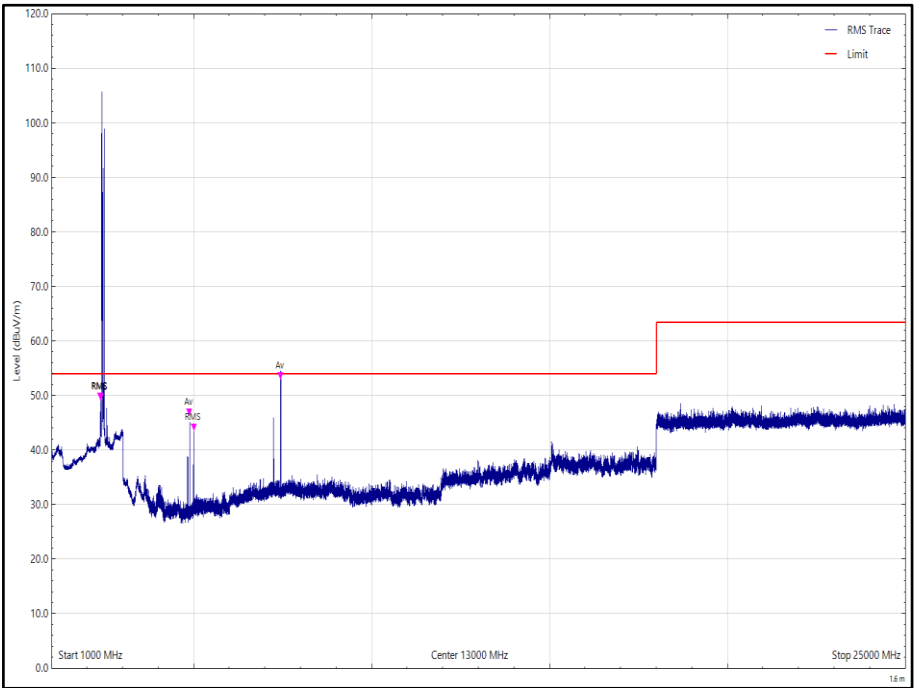


Figure 13 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Y, 1 GHz to 25 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
75.113	29.5	40.0	-10.5	Q-Peak	115	100	Vertical
241.637	35.8	46.0	-10.2	Q-Peak	321	110	Horizontal
275.185	32.8	46.0	-13.3	Q-Peak	171	100	Horizontal
327.890	31.1	46.0	-14.9	Q-Peak	245	100	Horizontal
2374.901	47.1	54.0	-6.9	RMS	279	155	Horizontal
4880.109	47.2	54.0	-6.8	Average	358	191	Horizontal
7439.878	52.5	54.0	-1.5	Average	272	167	Vertical
7439.897	52.4	54.0	-1.6	Average	289	224	Horizontal

Table 18 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Z, 30 MHz to 25 GHz

No other emissions found within 6 dB of the limit.

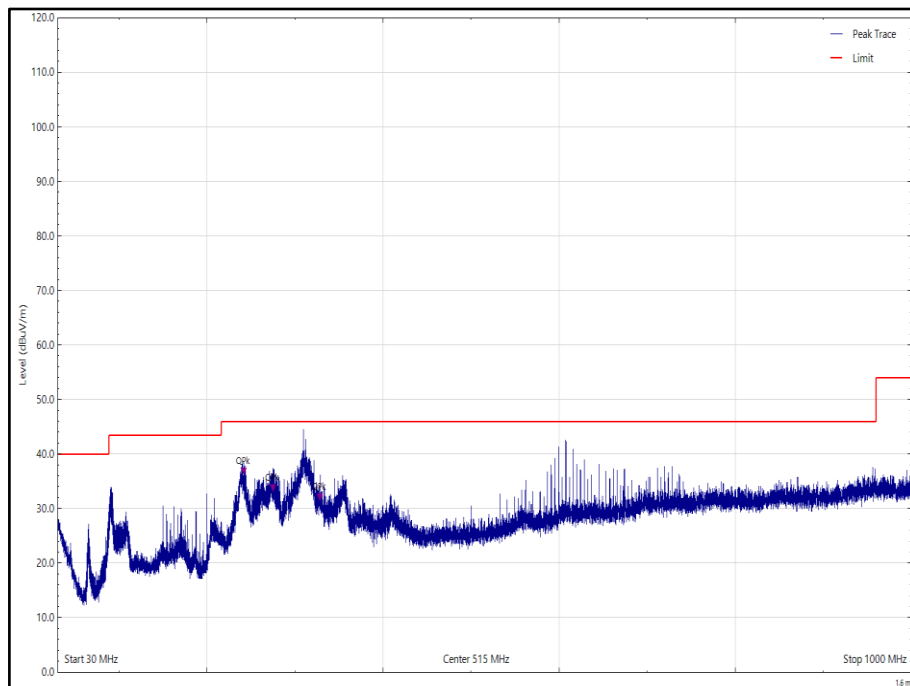


Figure 14 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Z, 30 MHz to 1 GHz, Horizontal (Peak)

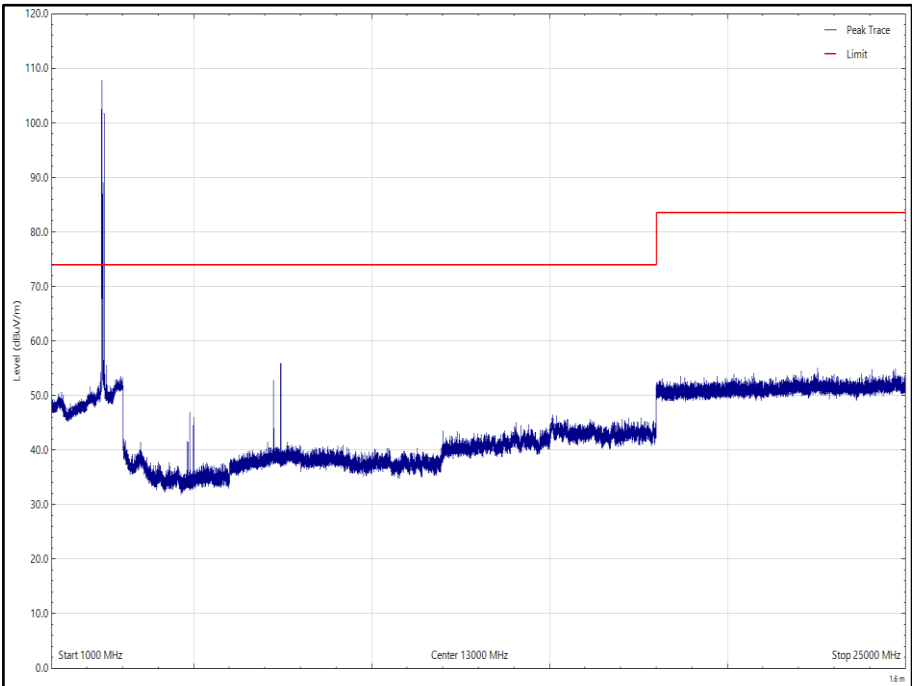


Figure 15 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Z, 1 GHz to 25 GHz, Horizontal (Peak)

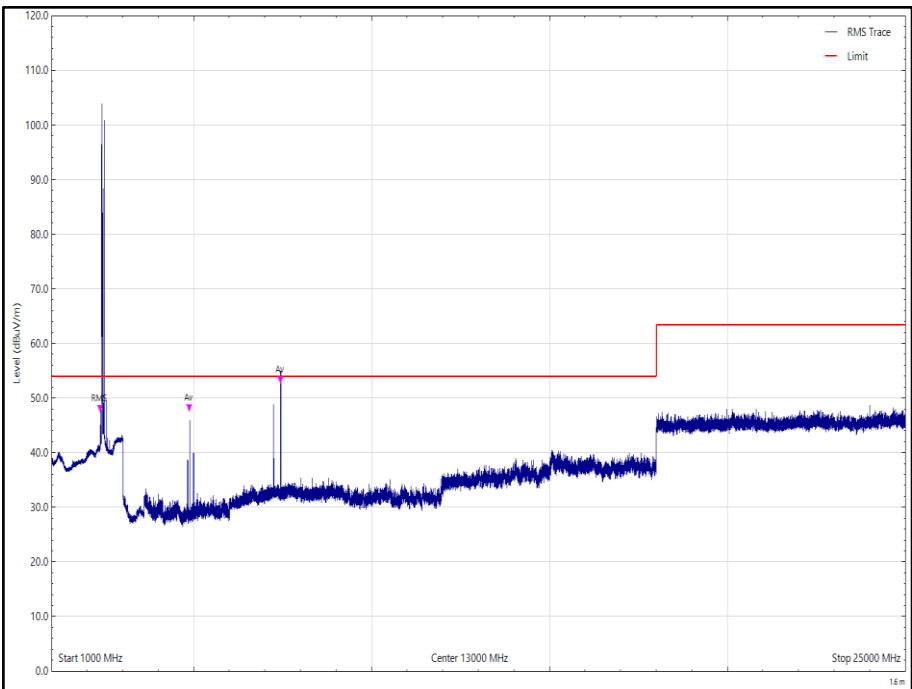


Figure 16 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Z, 1 GHz to 25 GHz, Horizontal (rms)

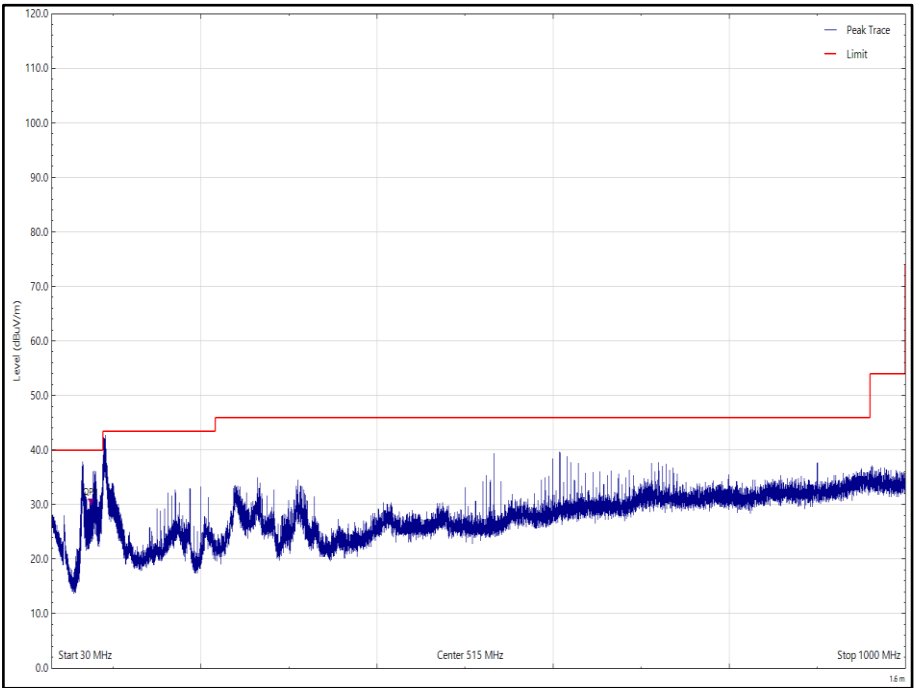


Figure 17 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Z, 30 MHz to 1 GHz, Vertical (Peak)

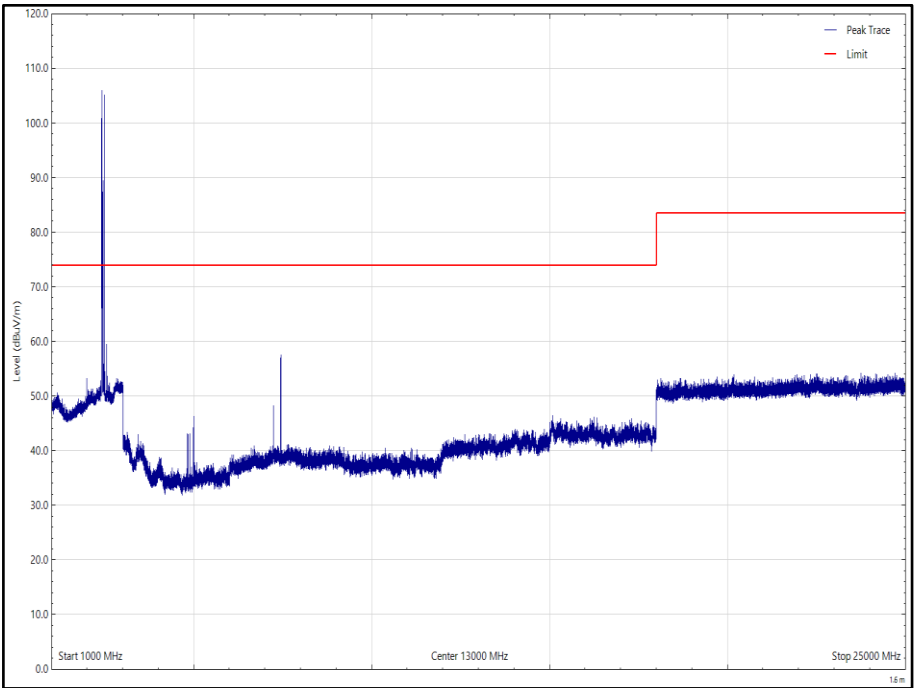


Figure 18 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Z, 1 GHz to 25 GHz, Vertical (Peak)

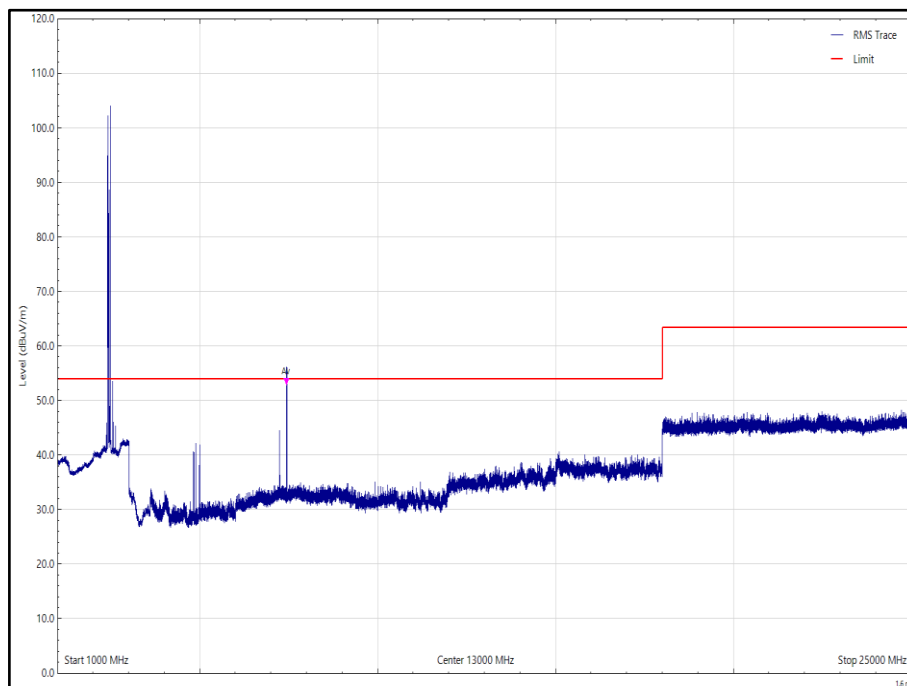


Figure 19 - 802.11b (2412 MHz), Proprietary ISM (2440 MHz), BLE (2480 MHz) - Orientation: Z, 1 GHz to 25 GHz, Vertical (rms)

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.



2.1.8 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 attenuator (Bilog, 30 MHz to 3 GHz)	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
Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Cable (K-Type to K-Type, 2 m)	Scott Cables	KPS-1501-2000-KPS	4526	6	06-Mar-2022
Cable (N-Type to N-Type, 1 m)	Rosenberger	LU7-036-1000	5031	12	23-Jul-2022
EmX Emissions Software	TUV SUD	V2.1.11	5125	-	Software
Pre-Amplifier (30 dB, 1 GHz to 18 GHz)	Schwarzbeck	BBV 9718 C	5350	12	22-Sep-2022
Cable (N-Type to N-Type, 8 m)	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	5512	12	09-Apr-2022
2m K Type Cable	Junkosha	MWX241-02000KMSKMS/A	5524	12	24-Mar-2022
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5548	12	07-May-2022
Antenna (DRG, 7.5 GHz to 18 GHz)	Schwarzbeck	HWRD750	5610	12	15-Oct-2022
Antenna (DRG, 1 GHz to 10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	15-Oct-2022
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023

Table 19

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs



Figure 20 - Test Setup - 30 MHz to 1 GHz - X Orientation

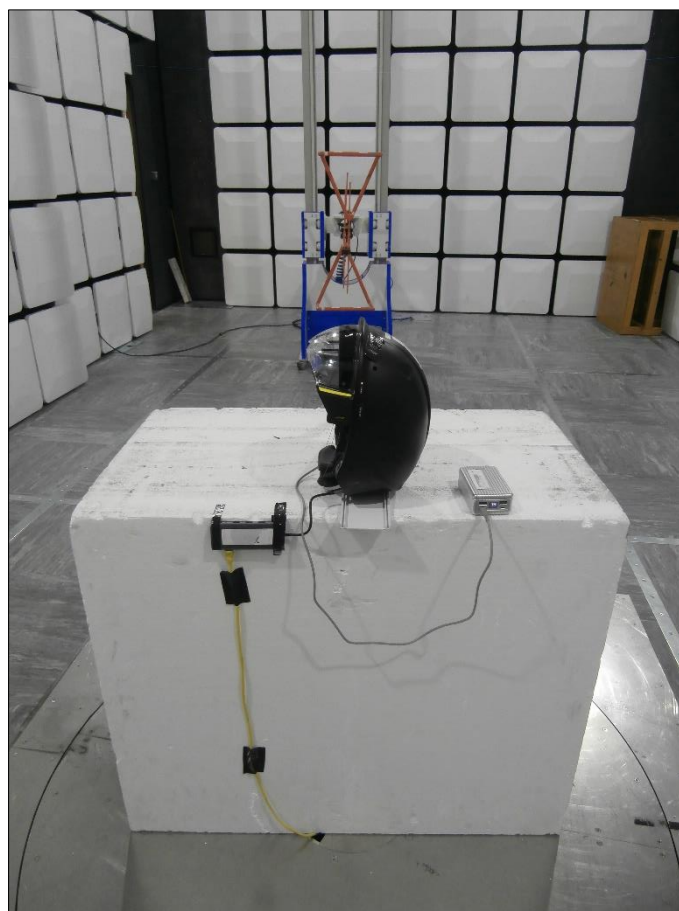


Figure 21 - Test Setup - 30 MHz to 1 GHz - Y Orientation

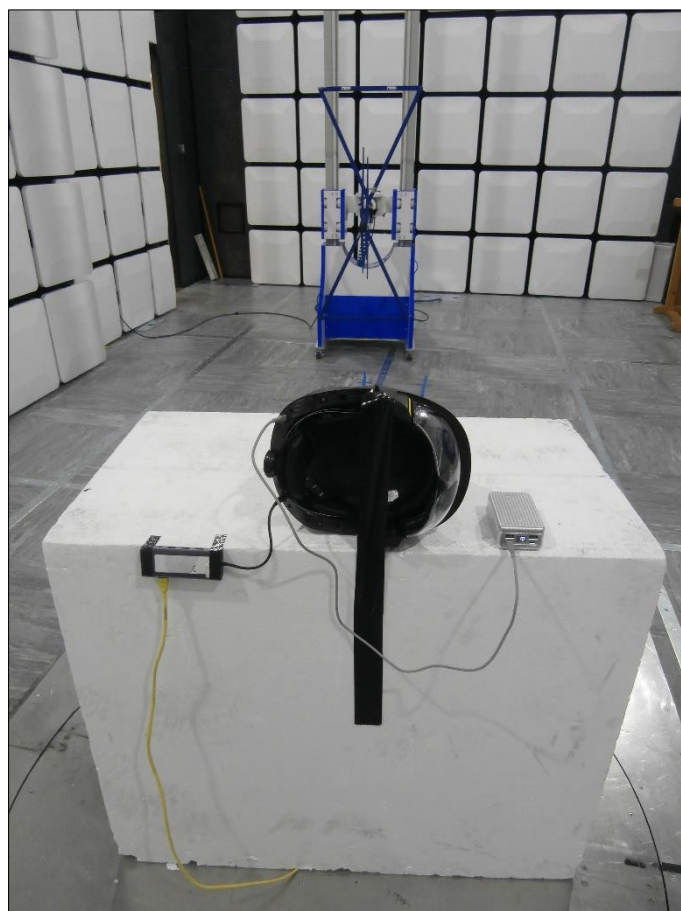


Figure 22 - Test Setup - 30 MHz to 1 GHz - Z Orientation

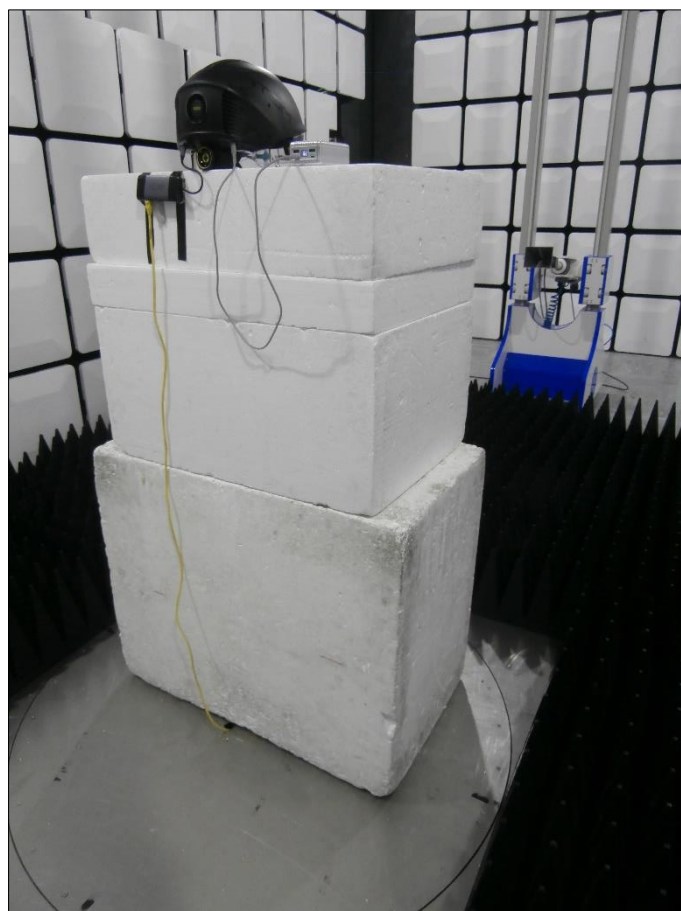


Figure 23 - Test Setup - 1 GHz to 18 GHz - X Orientation



Figure 24 - Test Setup - 1 GHz to 18 GHz - Y Orientation



Figure 25 - Test Setup - 1 GHz to 18 GHz - Z Orientation



Figure 26 - Test Setup - 18 GHz to 25 GHz - X Orientation



Figure 27 - Test Setup - 18 GHz to 25 GHz - Y Orientation



Figure 28 - 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
Radiated Spurious Emissions (Simultaneous Transmission)	30 MHz to 1 GHz: ± 5.2 dB
	1 GHz to 40 GHz: ± 6.3 dB

Table 20

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. (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.