

FCC and ISED Test Report

Shot Scope Technologies Ltd
Shot Scope, Model: H4

In accordance with FCC 47 CFR Part 15C
(2.4 GHz Bluetooth Low Energy)

Prepared for: Shot Scope Technologies Ltd
Unit 27, Castlebrae Business Centre
40 Pepper Place, Edinburgh
EH16 4BB
UNITED KINGDOM



Add value.
Inspire trust.

FCC ID: 2AHWR-SS05

COMMERCIAL-IN-CONFIDENCE

Document 75954182-01 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	02 March 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. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Graeme Lawler	02 March 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 for the tests detailed in section 1.3.



DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2022 TÜV SÜD. This report relates only to the actual item/items tested.

ACCREDITATION

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

TÜV SÜD
is a trading name of TÜV SÜD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TÜV SÜD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuvsud.com/en

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



Contents

1 Report Summary2

1.1 Report Modification Record.....2

1.2 Introduction.....2

1.3 Brief Summary of Results3

1.4 Application Form4

1.5 Product Information7

1.6 Deviations from the Standard.....7

1.7 EUT Modification Record7

1.8 Test Location.....7

2 Test Details8

2.1 Restricted Band Edges.....8

2.2 Spurious Radiated Emissions 12

2.3 Authorised Band Edges 48

3 Photographs 52

3.1 Test Setup Photographs 52

4 Measurement Uncertainty 61

ANNEX A Conducted Test Results from Project 75947856 Document 06..... A.2



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	02-March-2022

Table 1

1.2 Introduction

Applicant	Shot Scope Technologies Ltd
Manufacturer	Shot Scope Technologies Ltd
Model Number(s)	H4
Serial Number(s)	Not Serialised (FAR-0633998-002)
Hardware Version(s)	1.0
Software Version(s)	1.0
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2020
Order Number	PO-0071
Date	21-December-2021
Date of Receipt of EUT	31-January-2022
Start of Test	01-February-2022
Finish of Test	06-February-2022
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 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
	Part 15C			
Configuration and Mode: 2.4 GHz Bluetooth Low Energy				
2.1	15.205	Restricted Band Edges	Pass	
2.2	15.247 (d) and 15.209	Spurious Radiated Emissions	Pass	
2.3	15.247 (d)	Authorised Band Edges	Pass	

Table 2

Annex A contains the conducted results for Model: V3 SS03 report 75947856-06, for which the manufacturer has made the following declaration:

“Shot Scope H4 is electrically the same design as Shot Scope V3”

The original testing was performed in April 2020 in accordance with FCC 47 CFR Part 15C: 2019, therefore the test methods and limits were reviewed against the requirements of FCC 47 CFR Part 15C: 2020. This review confirmed there were no changes to methods or limits therefore the test results documented in Annex A, satisfy the requirements of FCC 47 CDR Part 15C: 2020.



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)	Shot Scope H4 is a handheld unit worn by golfers to provide distance information from their position to their target. It also tracks how far each golf shot is hit and what golf club was used.	
Manufacturer:	Shot Scope	
Model:	SS04	
Part Number:	H4	
Hardware Version:	1.0	
Software Version:	1.0	
FCC ID of the product under test – see guidance here	2AHWR-SS05	
IC ID of the product under test – see guidance here		

Table 3

Intentional Radiators

Technology	BLE					
Frequency Range (MHz to MHz)	2400 to 2483.5					
Conducted Declared Output Power (dBm)	-2					
Antenna Gain (dBi)	1.7					
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	2					
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	GFSK					
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	G1D					
Bottom Frequency (MHz)	2402					
Middle Frequency (MHz)	2440					
Top Frequency (MHz)	2480					

Table 4

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	32 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768 KHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒	
Class B Digital Device (Use in residential environment only) ☐	

Table 5



AC Power Source

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

Table 6

DC Power Source

Nominal voltage:	5	V
Extreme upper voltage:	5.5	V
Extreme lower voltage:	4.5	V
Max current:	0.1	A

Table 7

Battery Power Source

Voltage:	3.0 – 4.2	V
End-point voltage:	3.0	V (Point at which the battery will terminate)
Alkaline ☐ Leclanche ☐ Lithium ☒ Nickel Cadmium ☐ Lead Acid* ☐ *(Vehicle regulated)		
Other ☐	Please detail:	

Table 8

Charging

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

Table 9

Temperature

Minimum temperature:	0	°C
Maximum temperature:	50	°C

Table 10

Cable Loss

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

Table 11



Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:	Chip	Gain	1.7	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: Lewis Allison
Position held: Chief Technology Officer
Date: 31 January 2022



1.5 Product Information

1.5.1 Technical Description

Shot Scope H4 is a hand held unit worn by golfers to provide distance information from their position to their target. It also tracks how far each golf shot is hit and what golf club was used.

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: H4, Serial Number: Not Serialised (FAR-0633998-002)			
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: 2.4 GHz Bluetooth Low Energy		
Restricted Band Edges	Graeme Lawler	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Authorised Band Edges	Graeme Lawler	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

2.1.2 Equipment Under Test and Modification State

H4, S/N: Not Serialised (FAR-0633998-002) - Modification State 0

2.1.3 Date of Test

02-February-2022

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5 and 11.12.1.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 11.12.2.5.2. The values in the tables have duty cycle correction applied.

The following conversion can be applied to convert from dB μ V/m to μ V/m:

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

2.1.5 Environmental Conditions

Ambient Temperature	24.7 °C
Relative Humidity	28.2 %

2.1.6 Test Results

2.4 GHz Bluetooth Low Energy

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK	2402	2390	54.90	44.91
GFSK	2480	2483.5	55.84	45.71

Table 16

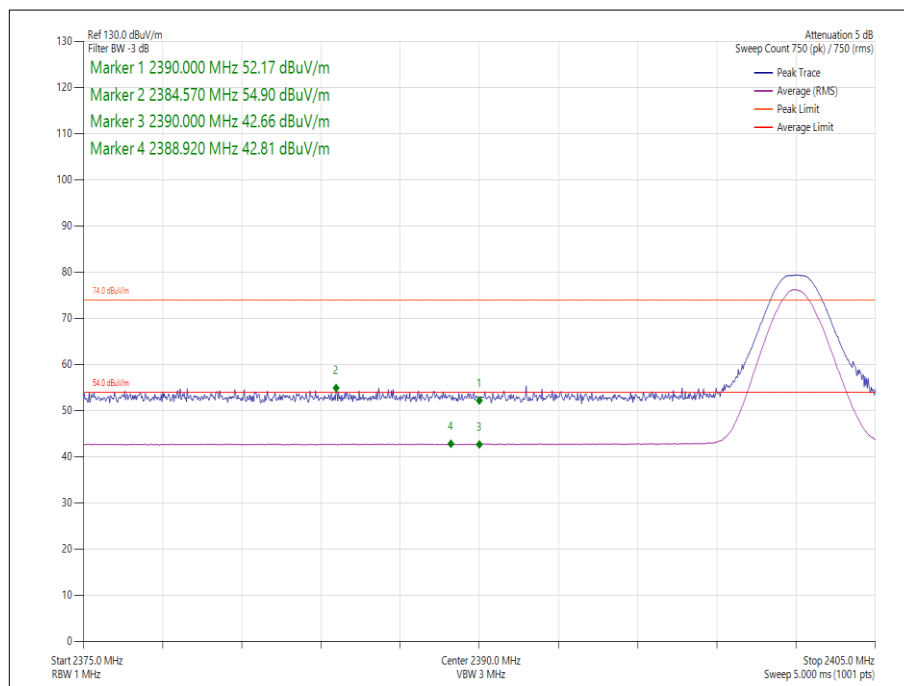


Figure 1 - GFSK - 2402 MHz - Band Edge Frequency 2390 MHz

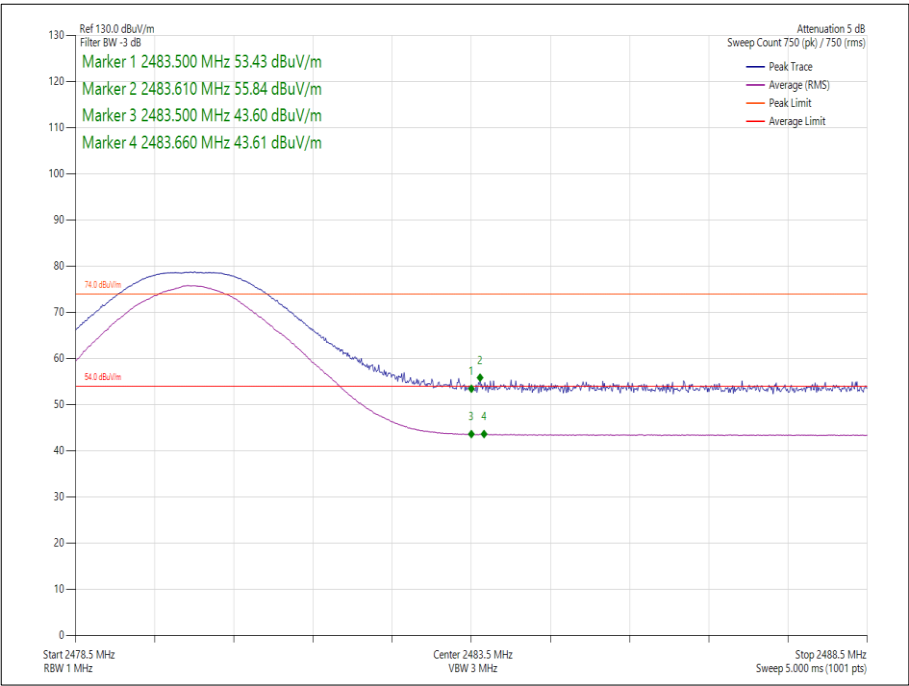


Figure 2 - GFSK - 2480 MHz - Band Edge Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

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

Table 17



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
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
Emissions Software	TUV SUD	EmX V2.1.11	5125	-	Software
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
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 18

TU - Traceability Unscheduled



2.2 Spurious Radiated Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.209

2.2.2 Equipment Under Test and Modification State

H4, S/N: Not Serialised (FAR-0633998-002) - Modification State 0

2.2.3 Date of Test

01-February-2022 to 06-February-2022

2.2.4 Test Method

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

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 11.12.2.5.2.

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. As the EUT was considered mobile/portable and therefore reasonable to 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.

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 dBuV/m to uV/m:

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

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.

Representative noise floor plots are presented for the bottom channel only.

Above 18 GHz, the measurement distance was reduced to 1 m. 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

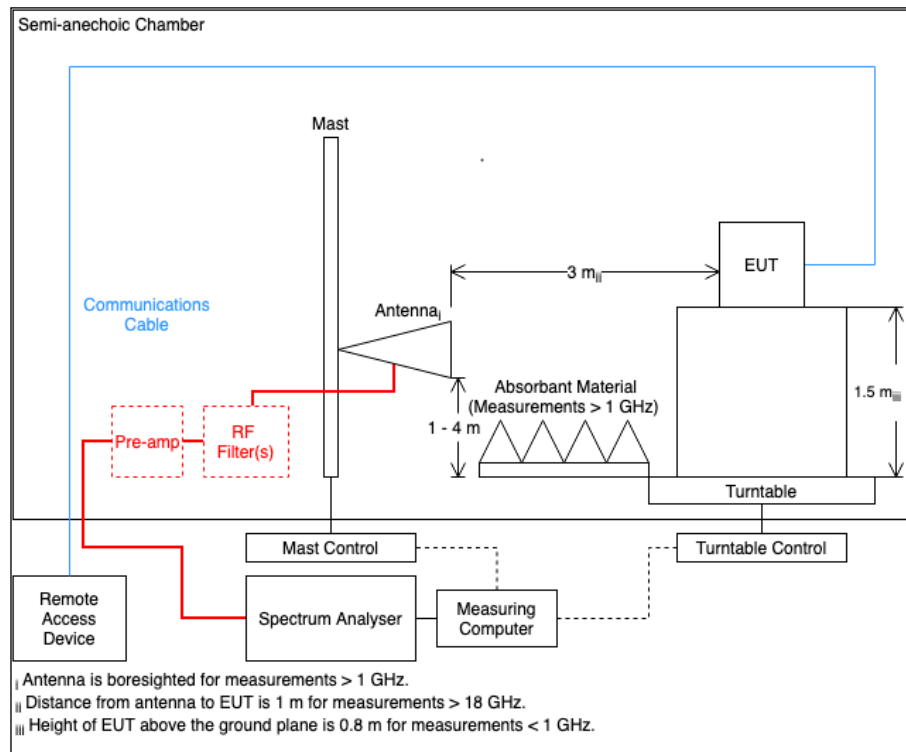


Figure 3

2.2.6 Environmental Conditions

Ambient Temperature	21.3 - 24.7 °C
Relative Humidity	28.2 - 39.8 %



2.2.7 Test Results

2.4 GHz Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 19 - 2402 MHz, 30 MHz to 1 GHz

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

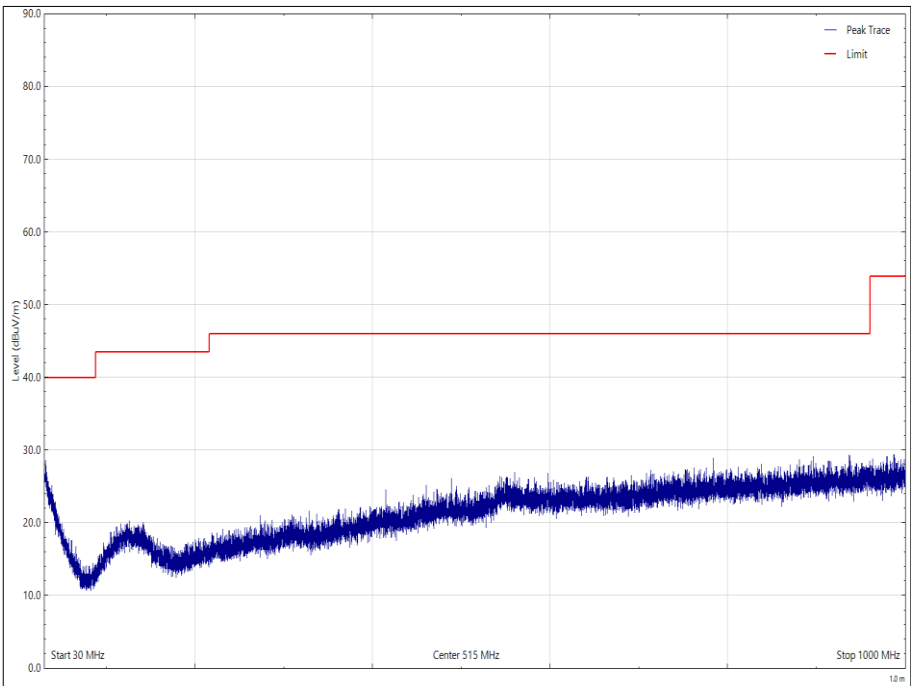


Figure 4 - 2402 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

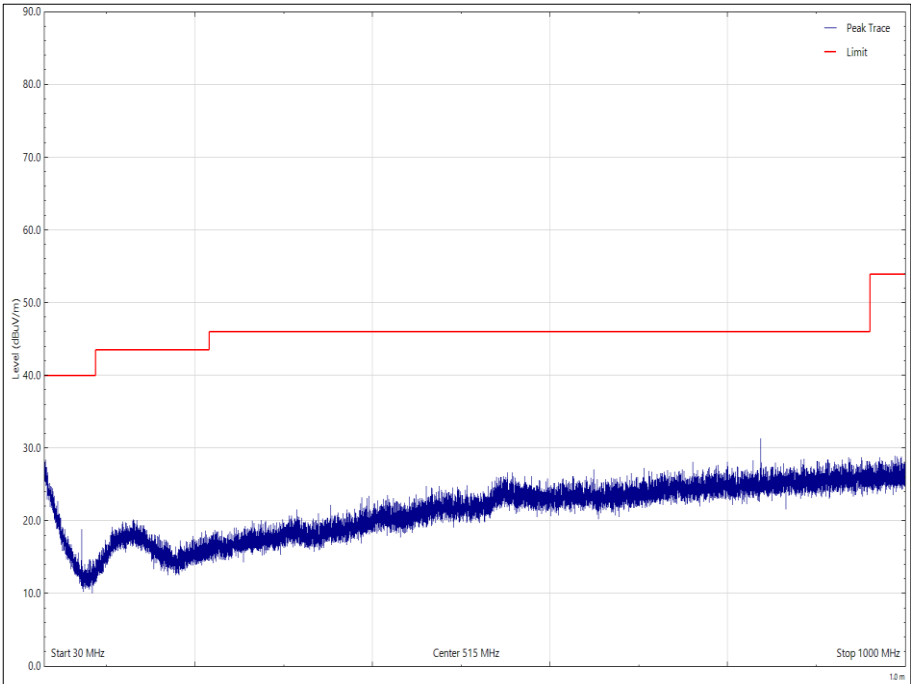


Figure 5 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

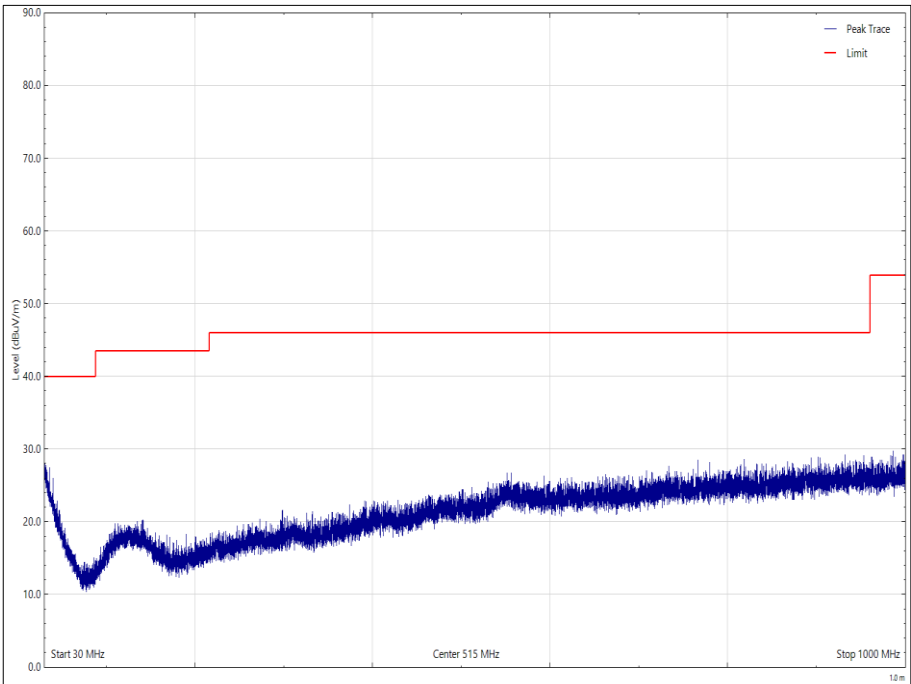


Figure 6 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation

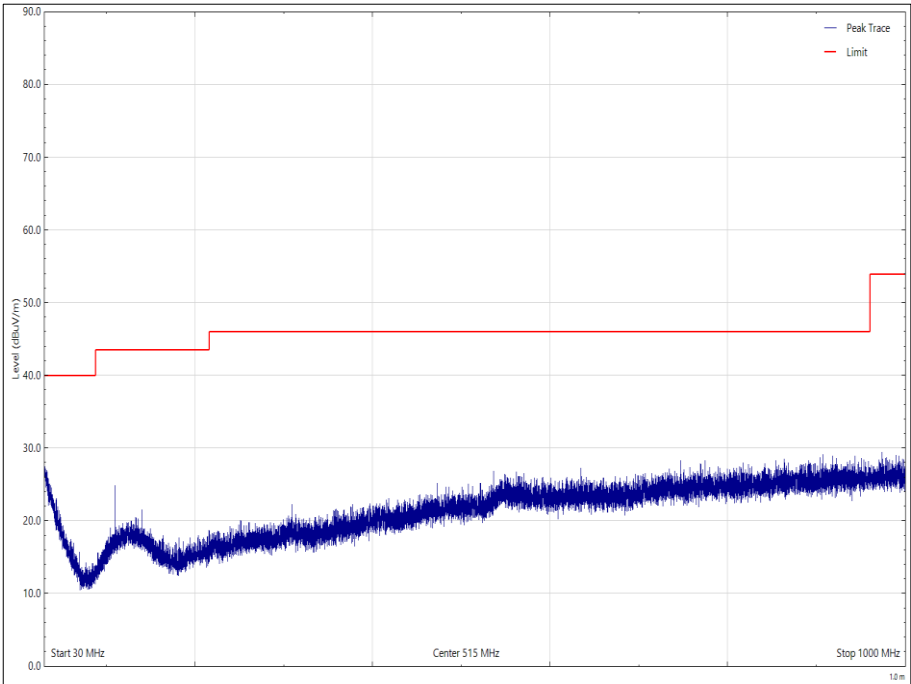


Figure 7 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation

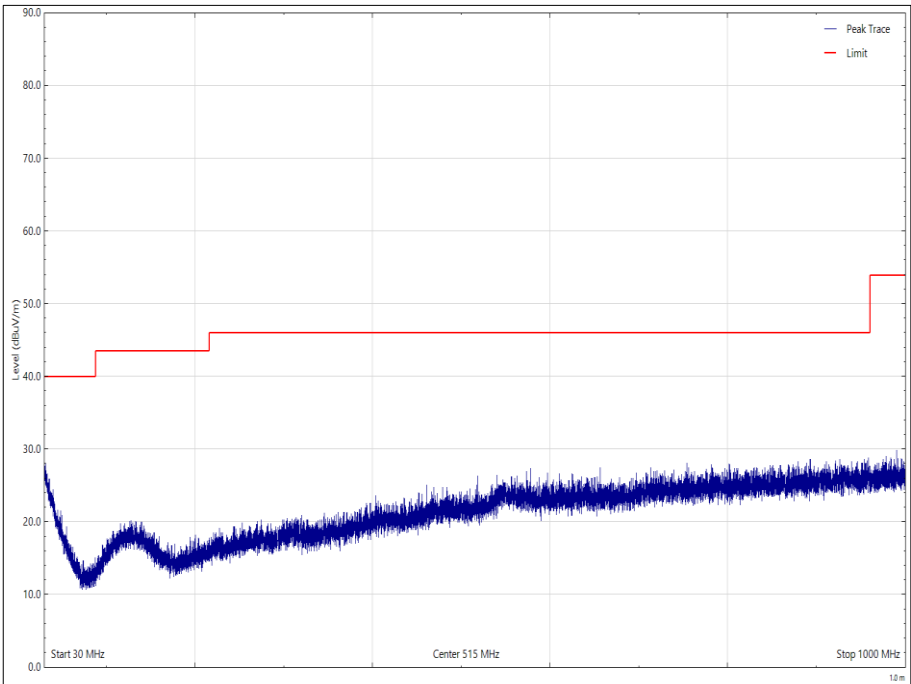


Figure 8 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

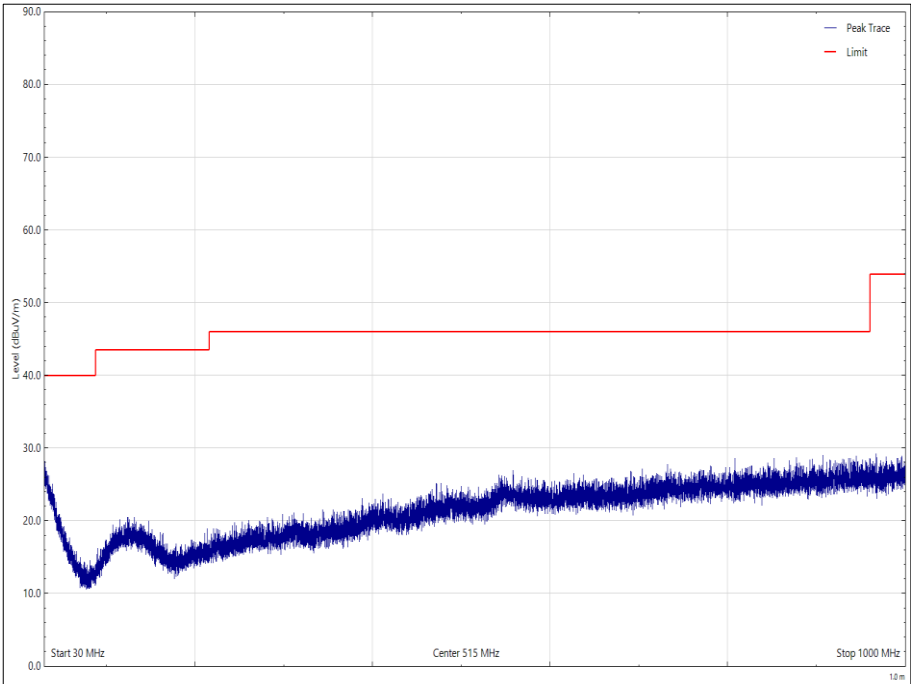


Figure 9 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 20 - 2402 MHz, 1 GHz to 25 GHz

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

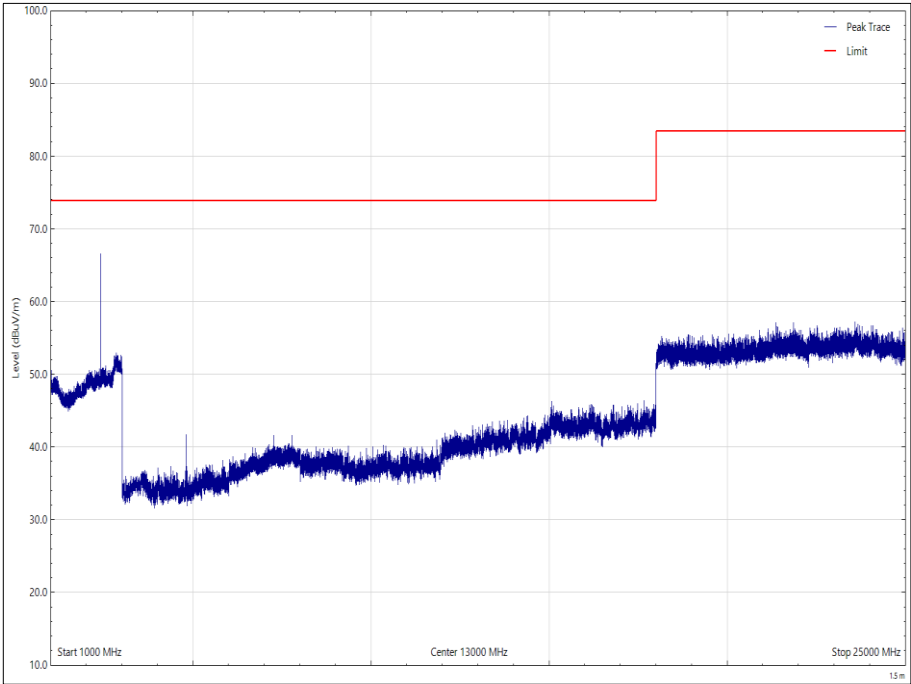


Figure 10 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation - Peak

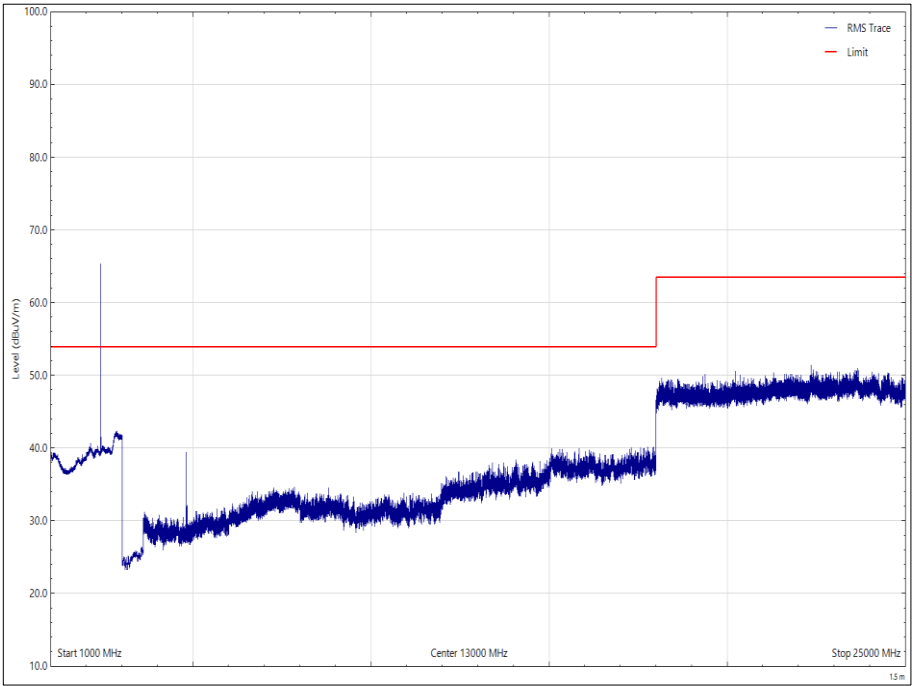


Figure 11 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation - Average

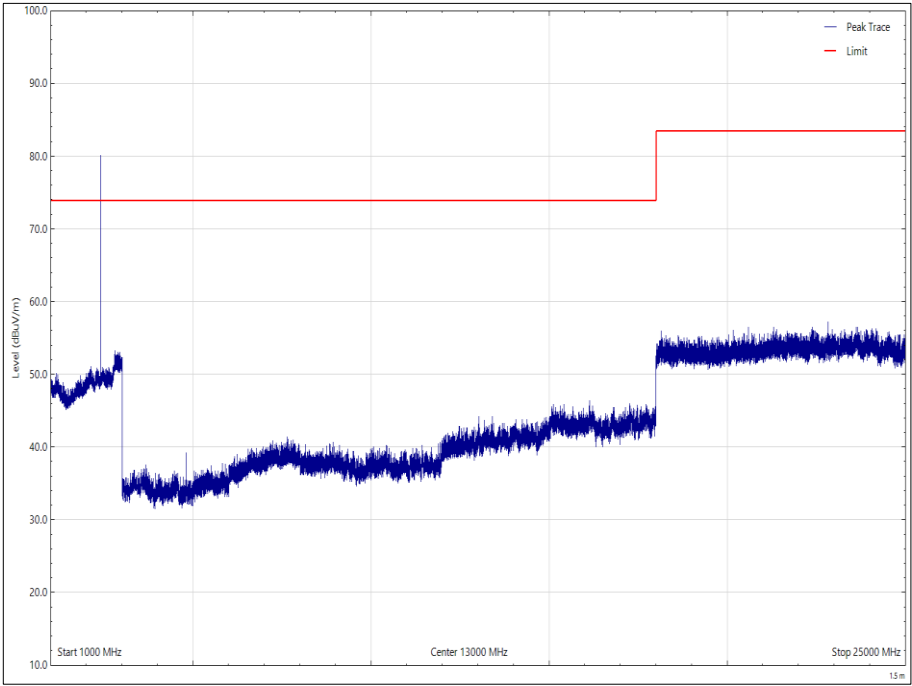


Figure 12 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation - Peak

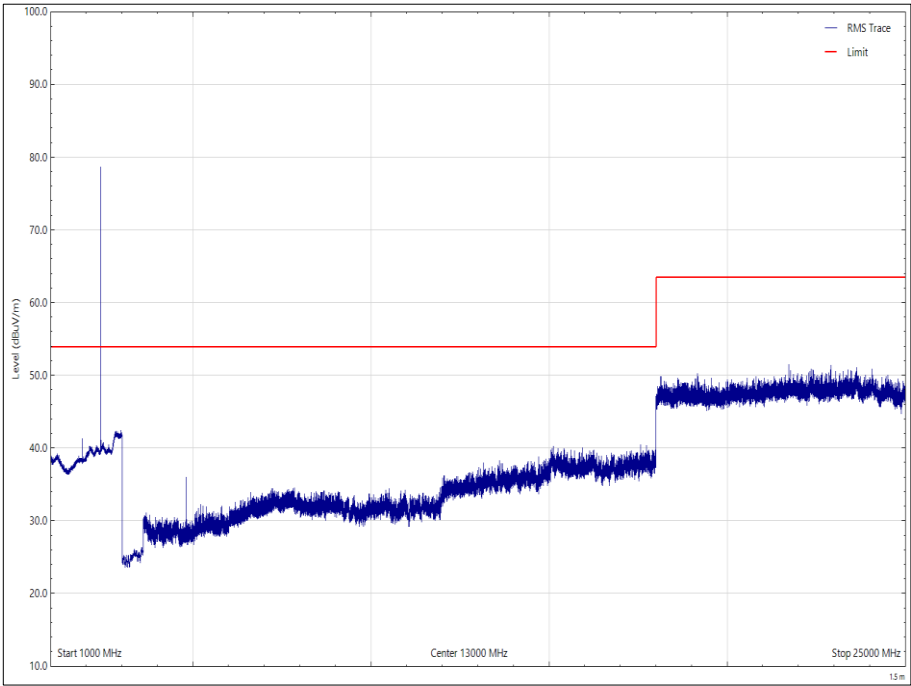


Figure 13 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation - Average

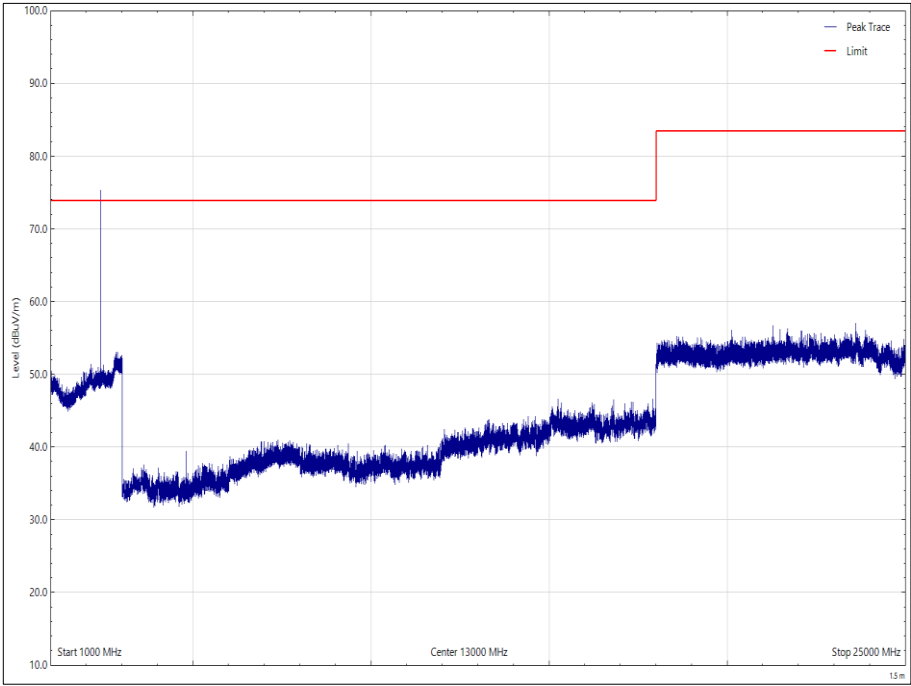


Figure 14 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation - Peak

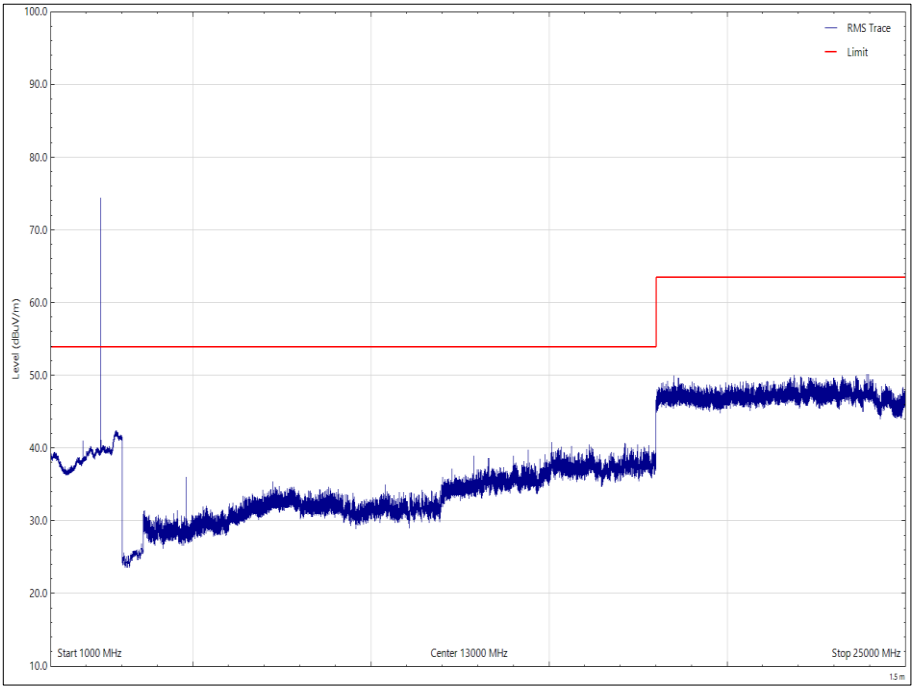


Figure 15 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation - Average

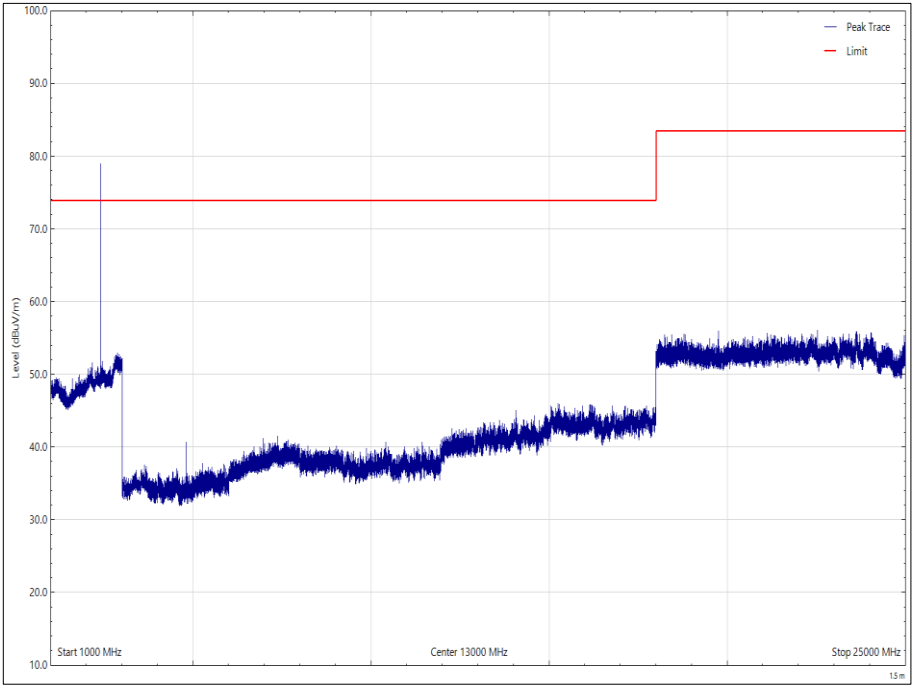


Figure 16 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation - Peak

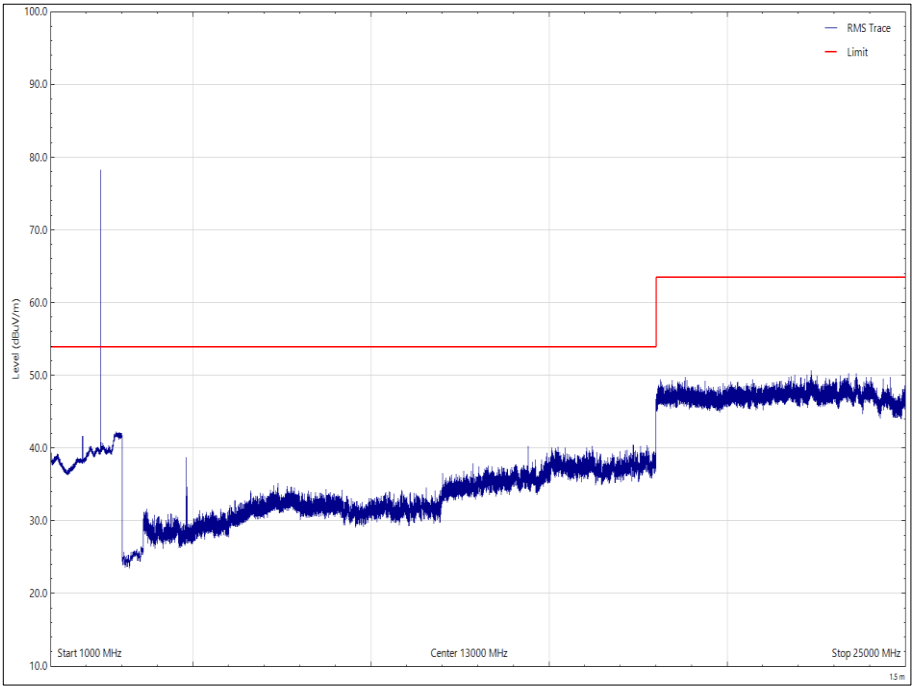


Figure 17 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation - Average

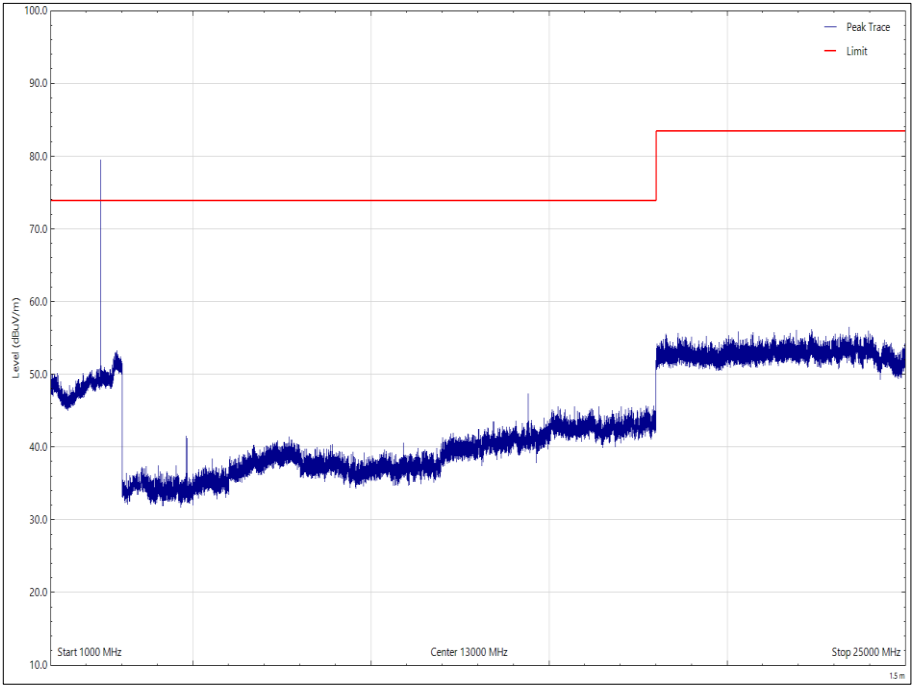


Figure 18 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation - Peak

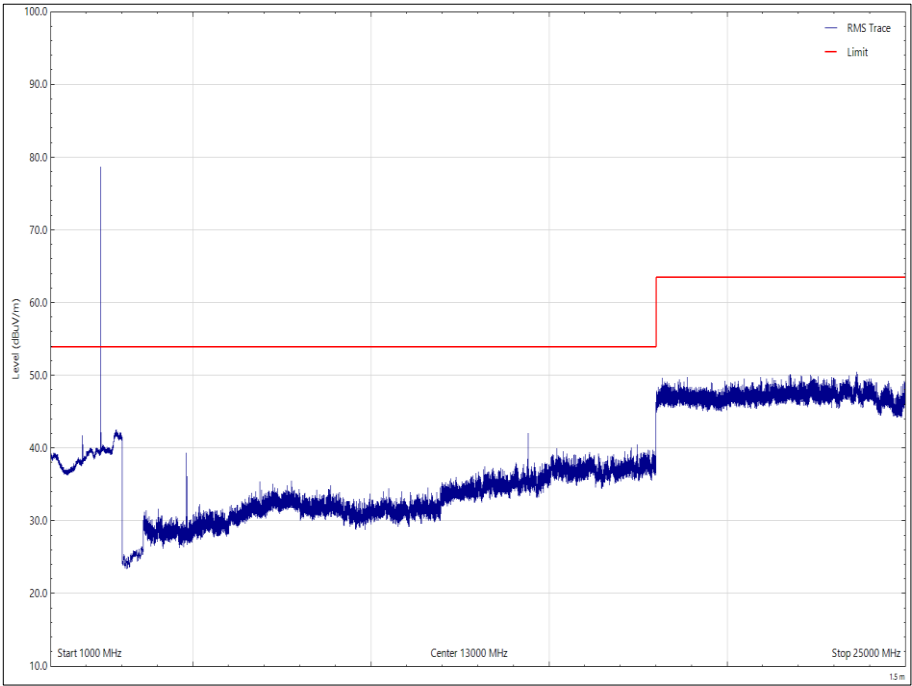


Figure 19 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation - Average

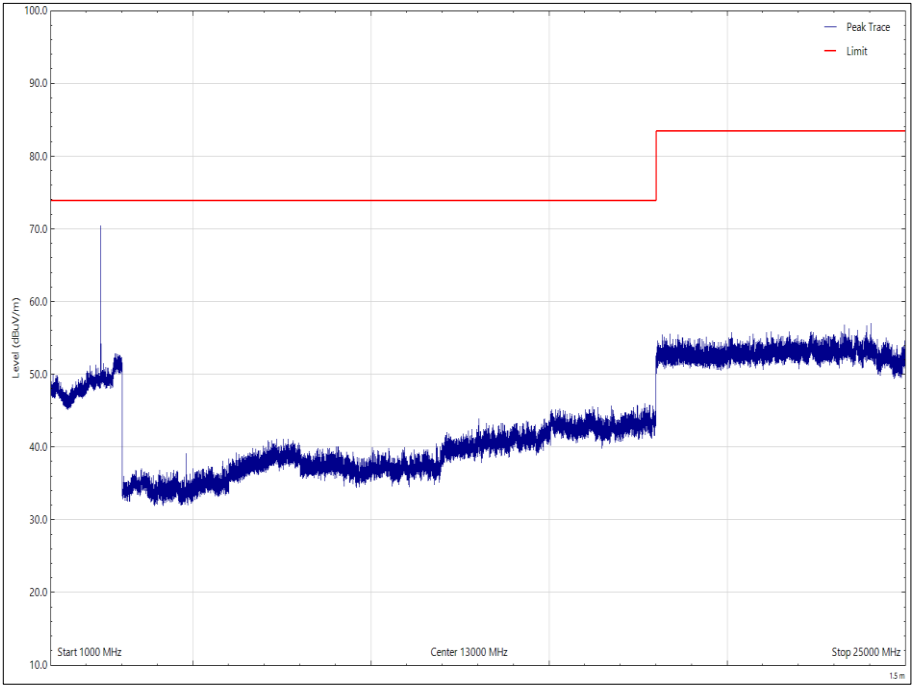


Figure 20 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation - Peak

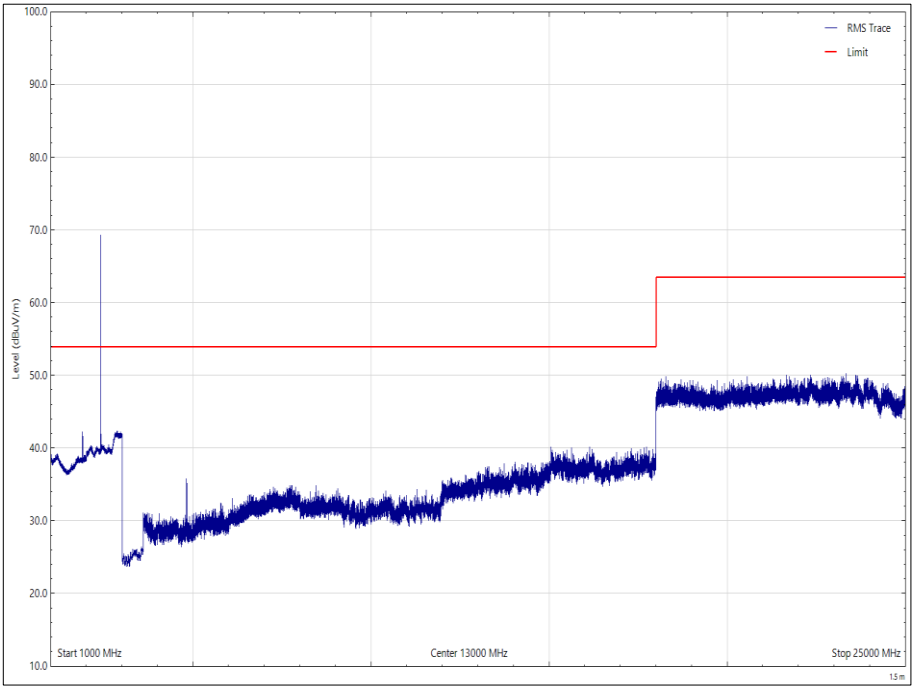


Figure 21 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation - Average



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 21 - 2440 MHz, 30 MHz to 1 GHz

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

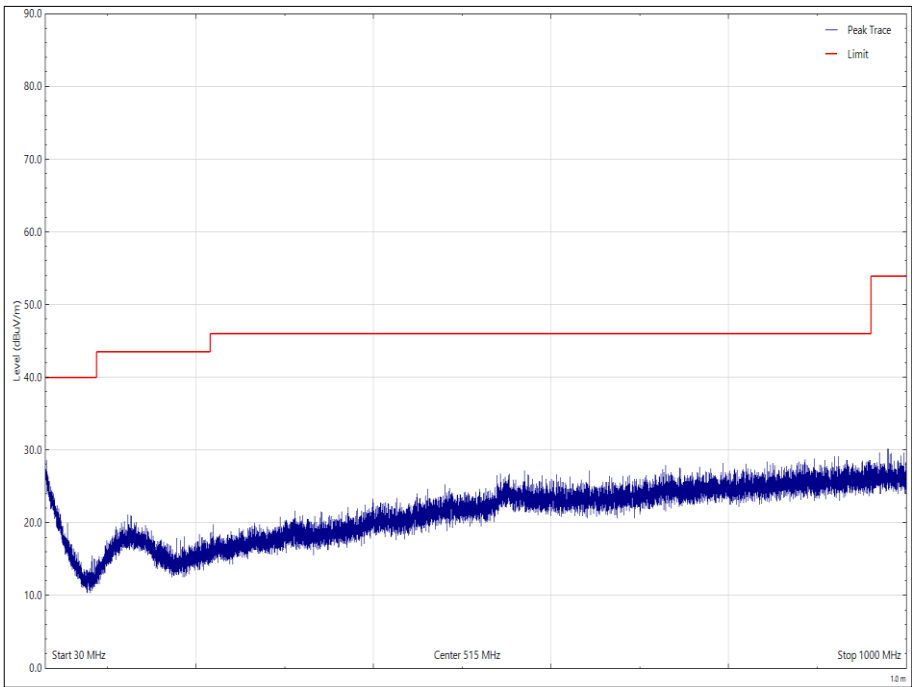


Figure 22 - 2440 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

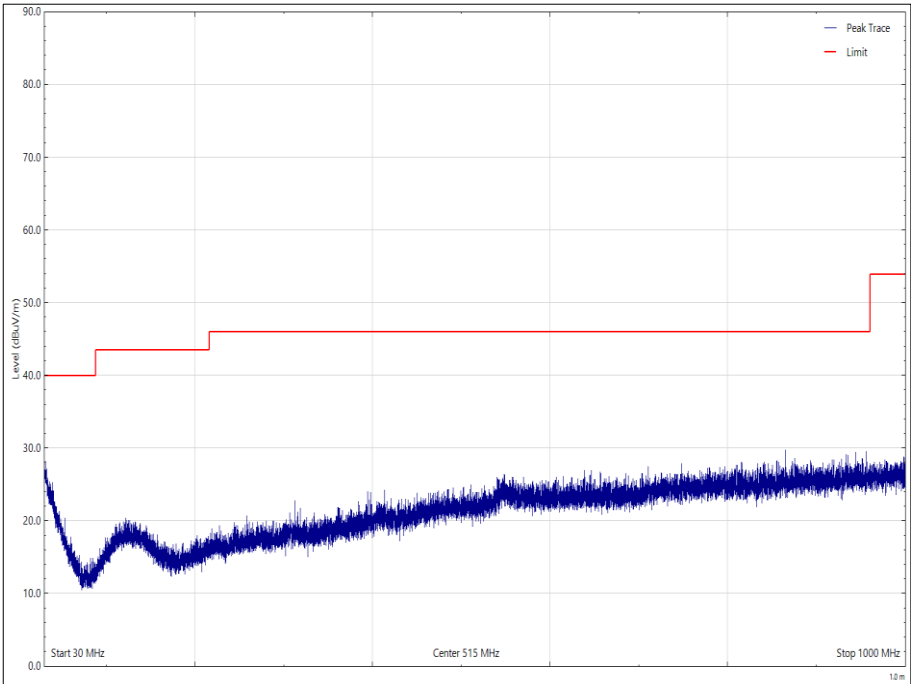


Figure 23 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

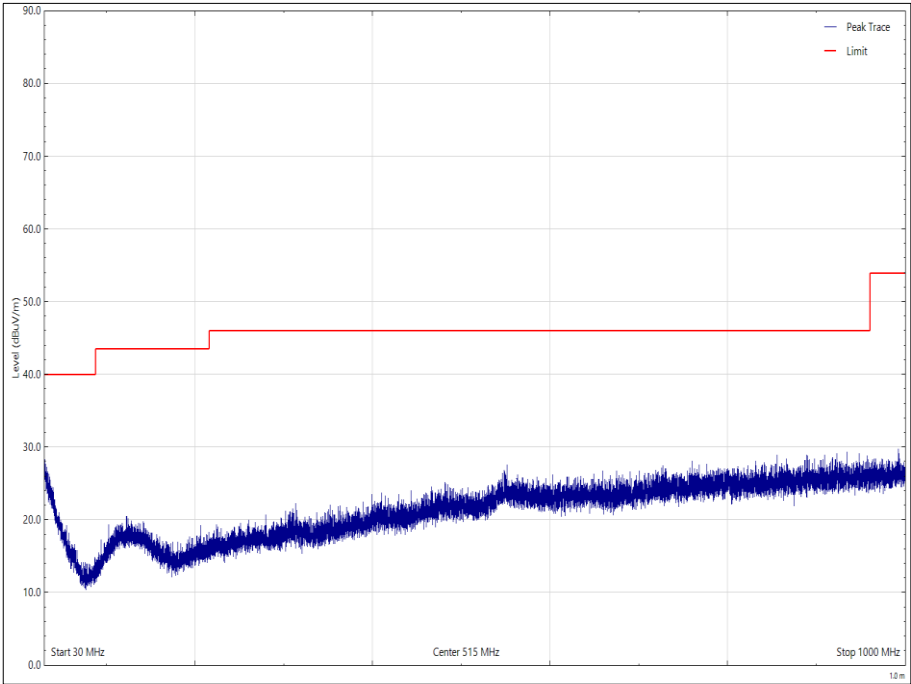


Figure 24 - 2440 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation

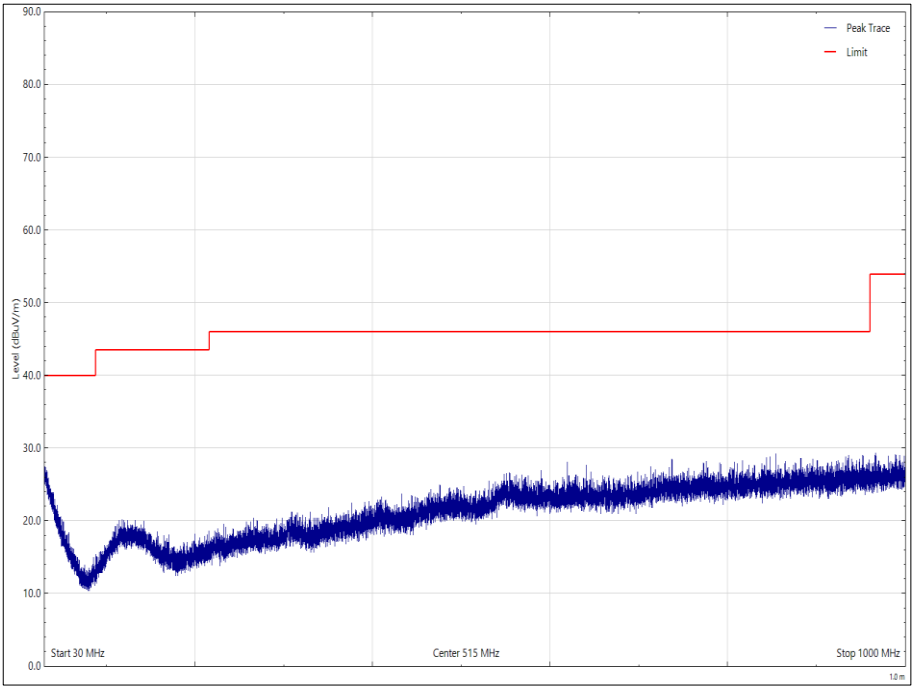


Figure 25 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation

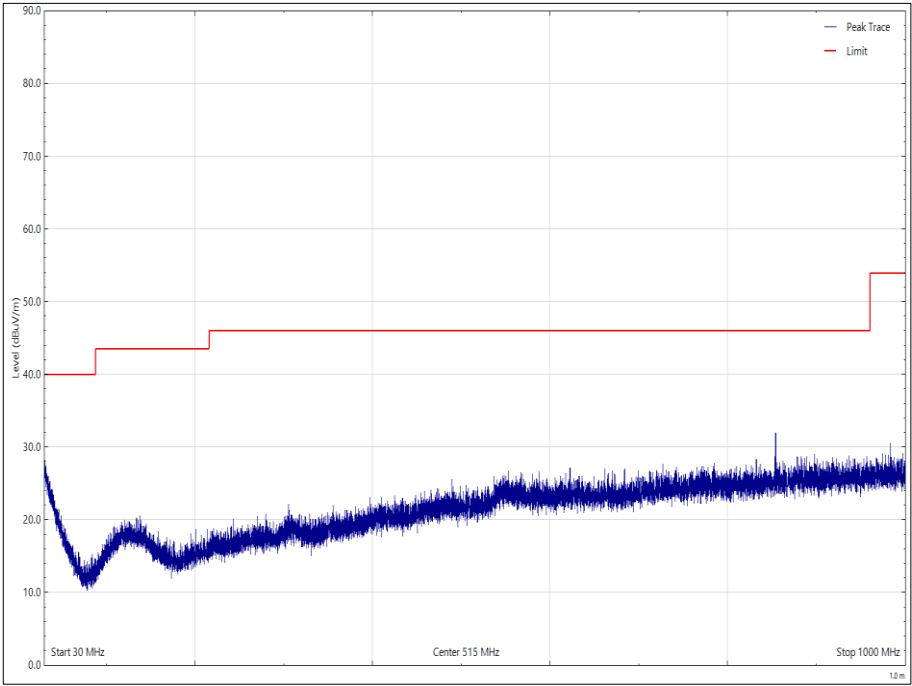


Figure 26 - 2440 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

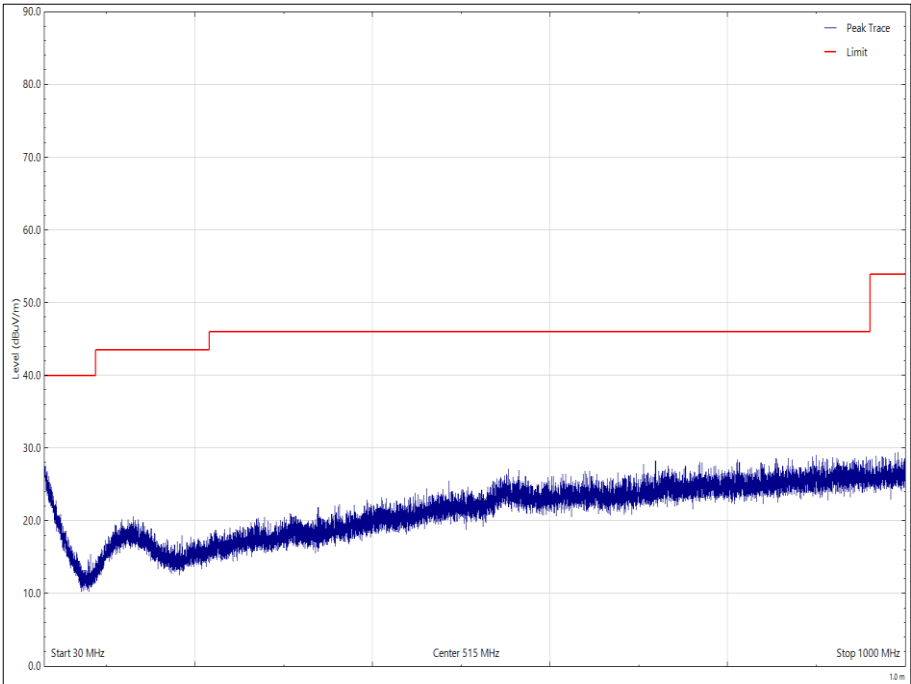


Figure 27 - 2440 MH, 30 MHz to 1 GHz, Horizontal, Z Orientation



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 22 - 2440 MHz - 1 GHz to 18 GHz

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

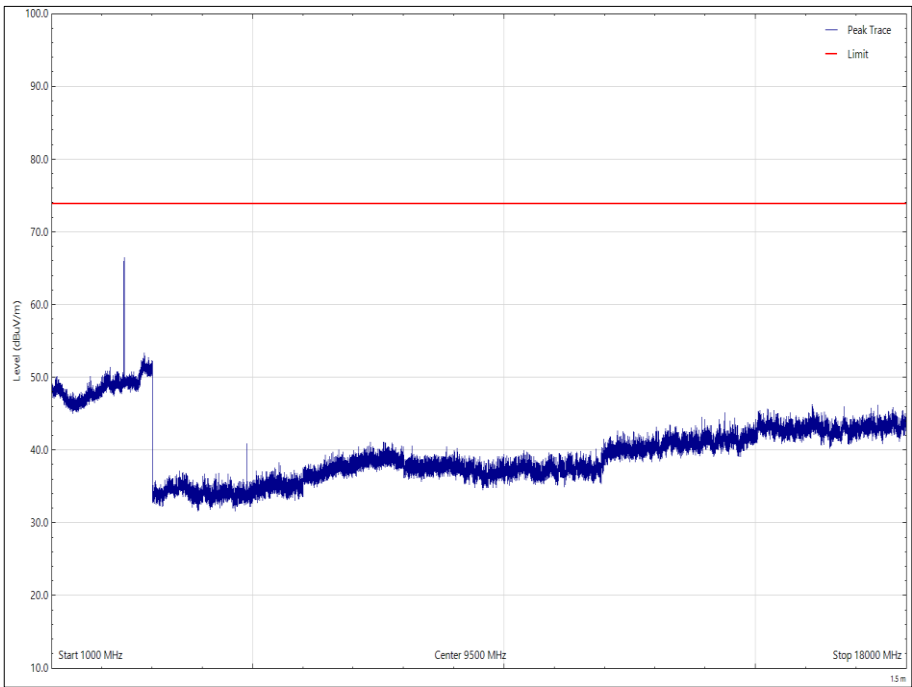


Figure 28 - 2440 MHz - 1 GHz to 18 GHz, Vertical, X Orientation - Peak

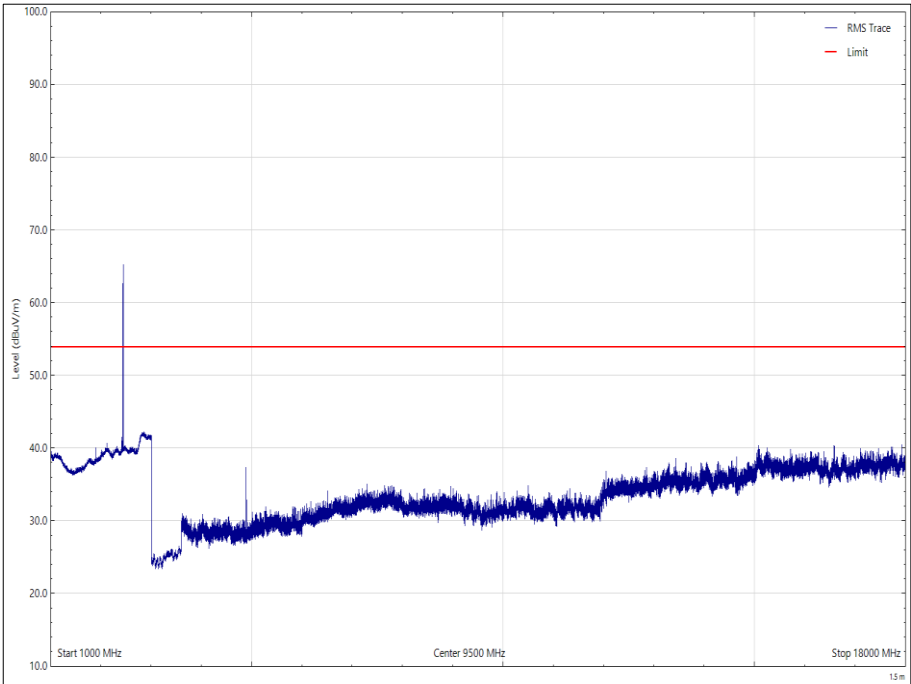


Figure 29 - 2440 MHz - 1 GHz to 18 GHz, Vertical, X Orientation - Average

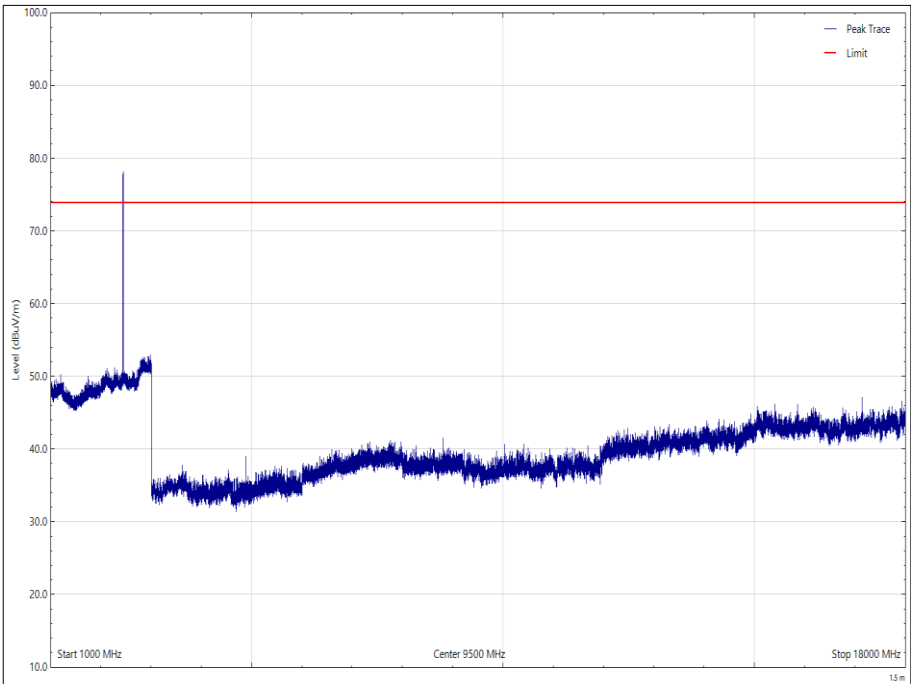


Figure 30 - 2440 MHz - 1 GHz to 18 GHz, Horizontal, X Orientation - Peak

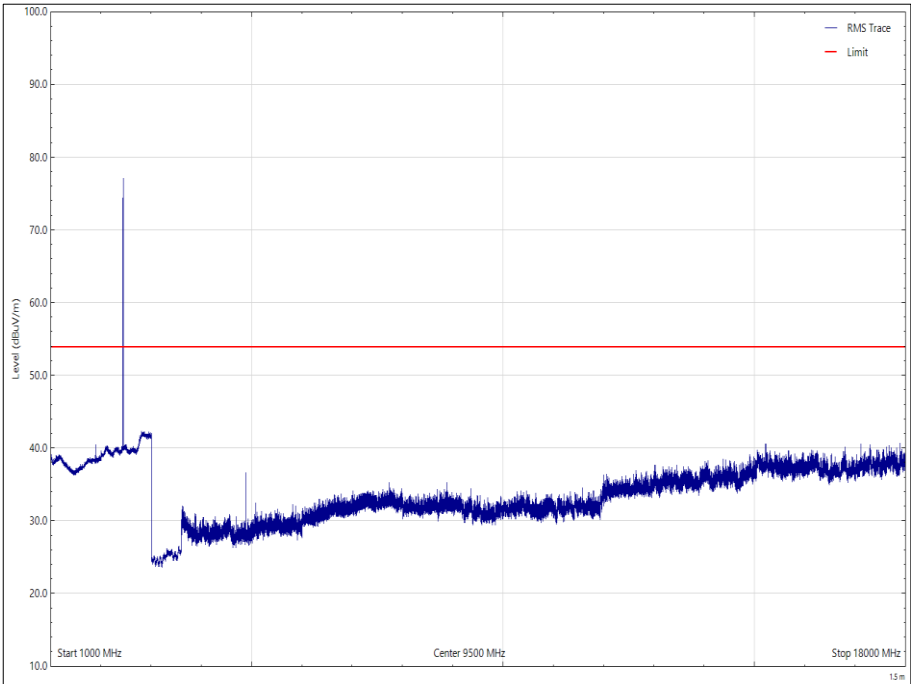


Figure 31 - 2440 MHz - 1 GHz to 18 GHz, Horizontal, X Orientation - Average

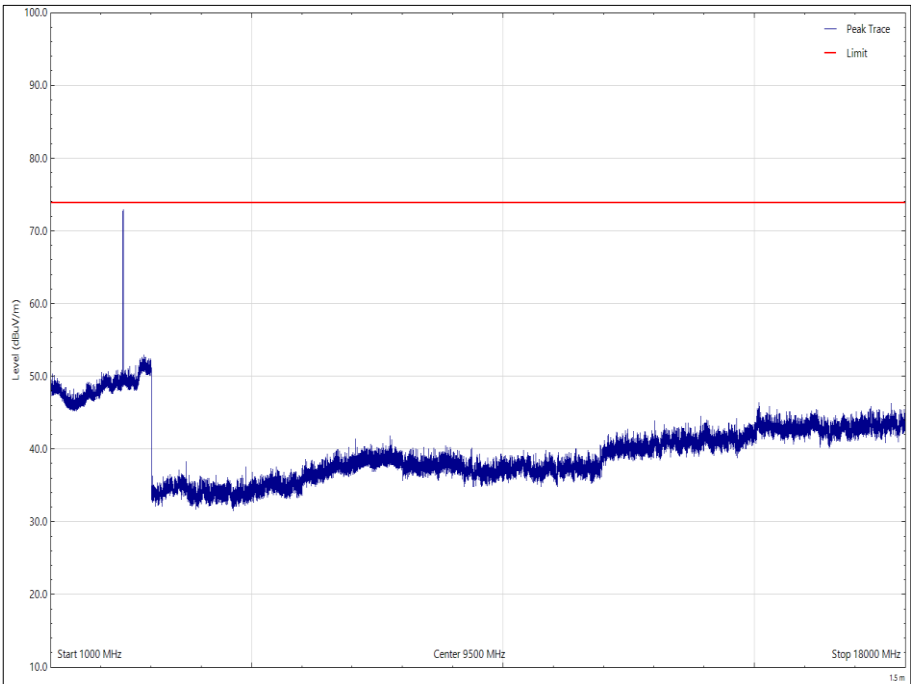


Figure 32 - 2440 MHz - 1 GHz to 18 GHz, Vertical, Y Orientation - Peak

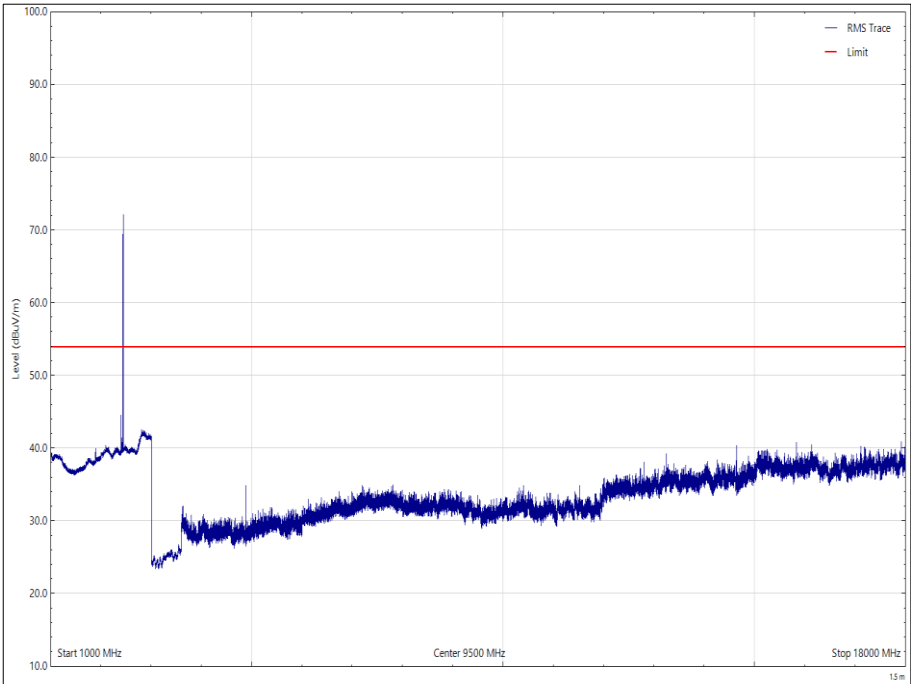


Figure 33 - 2440 MHz - 1 GHz to 18 GHz, Vertical, Y Orientation - Average

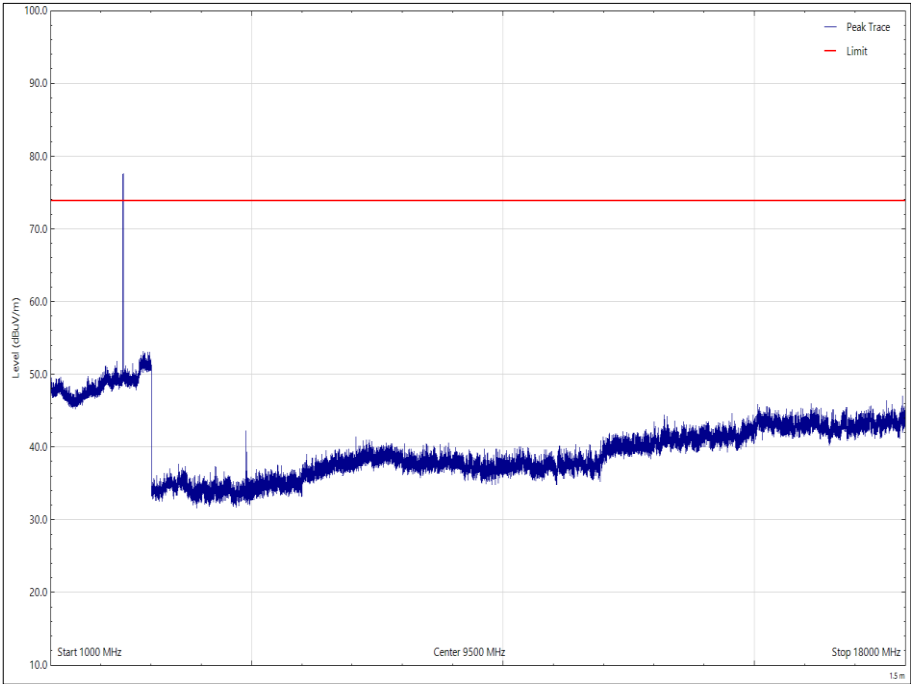


Figure 34 - 2440 MHz - 1 GHz to 18 GHz, Horizontal, Y Orientation - Peak

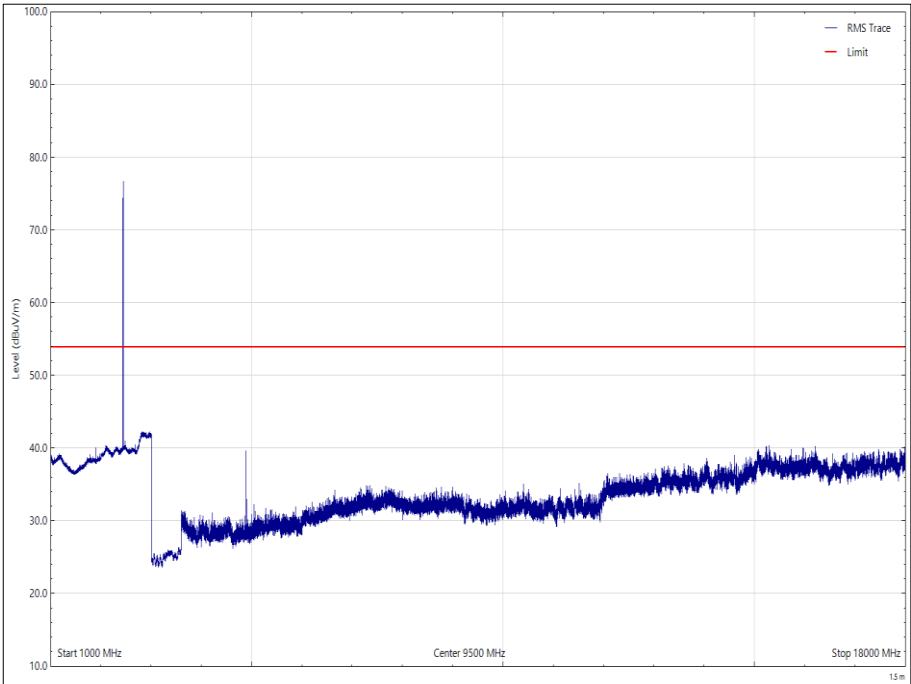


Figure 35 - 2440 MHz - 1 GHz to 18 GHz, Horizontal, Y Orientation - Average

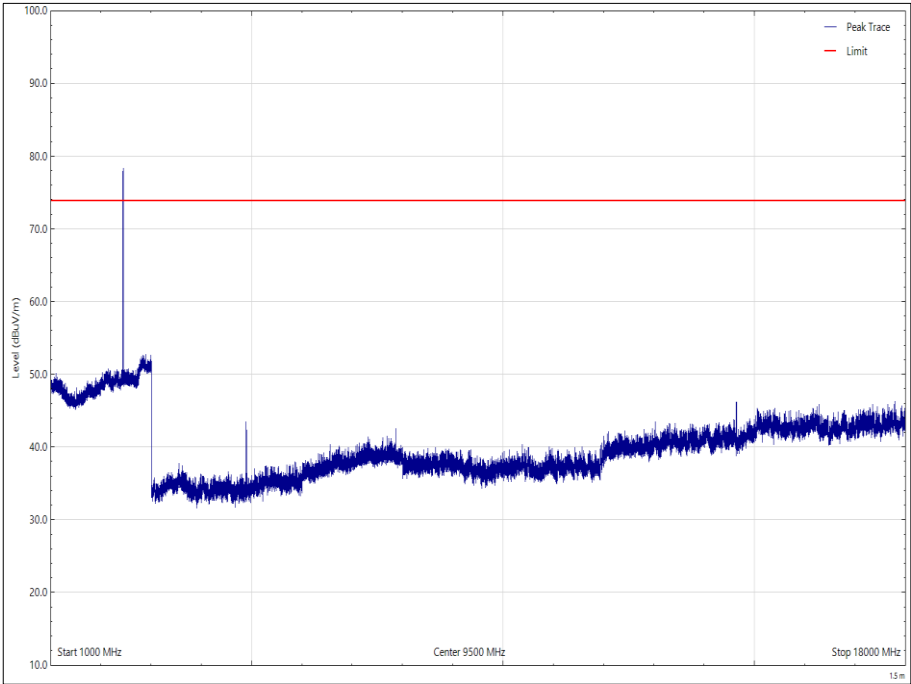


Figure 36 - 2440 MHz - 1 GHz to 18 GHz, Vertical, Z Orientation - Peak

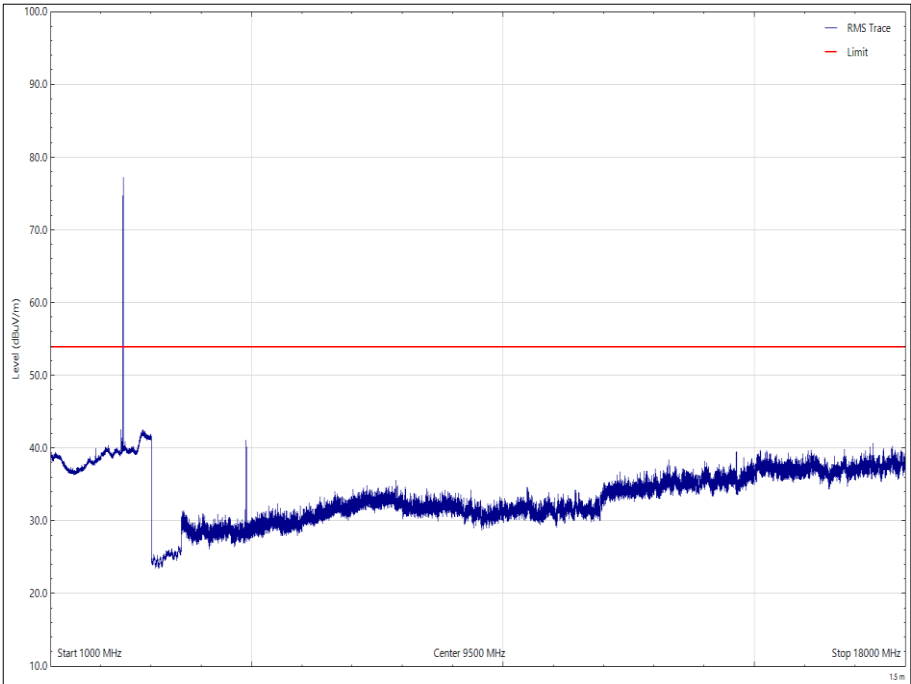


Figure 37 - 2440 MHz - 1 GHz to 18 GHz, Vertical, Z Orientation - Average

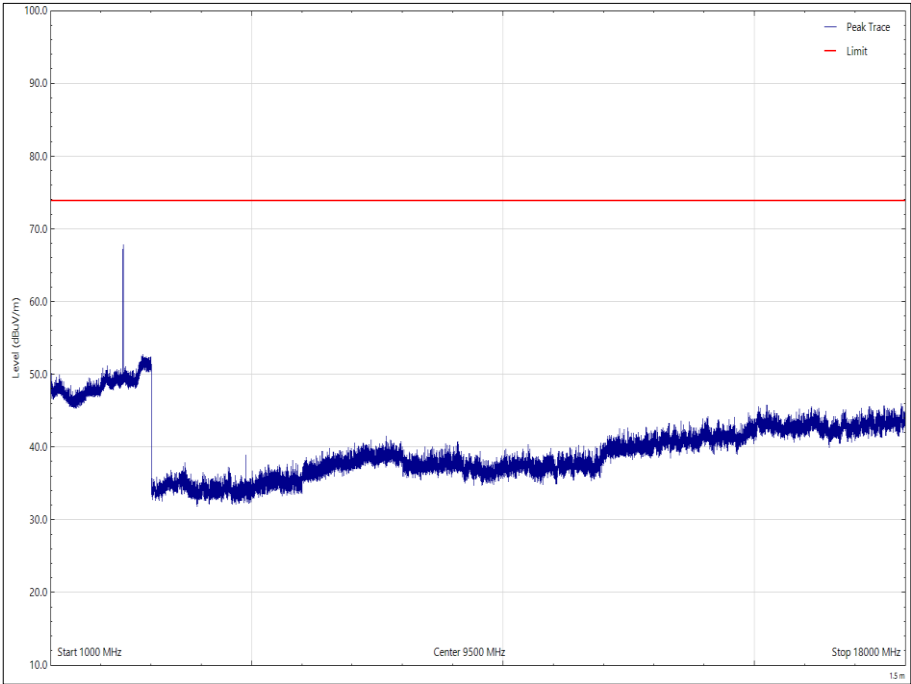


Figure 38 - 2440 MHz - 1 GHz to 18 GHz, Horizontal, Z Orientation - Peak

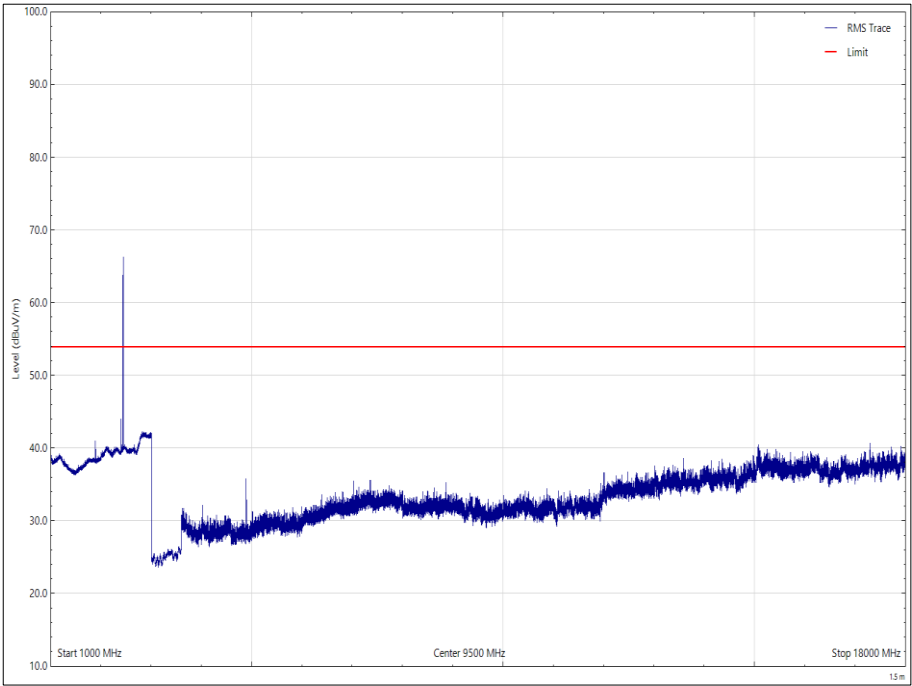


Figure 39 - 2440 MHz - 1 GHz to 18 GHz, Horizontal, Z Orientation - Average



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 23 - 2480 MHz, 30 MHz to 1 GHz

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

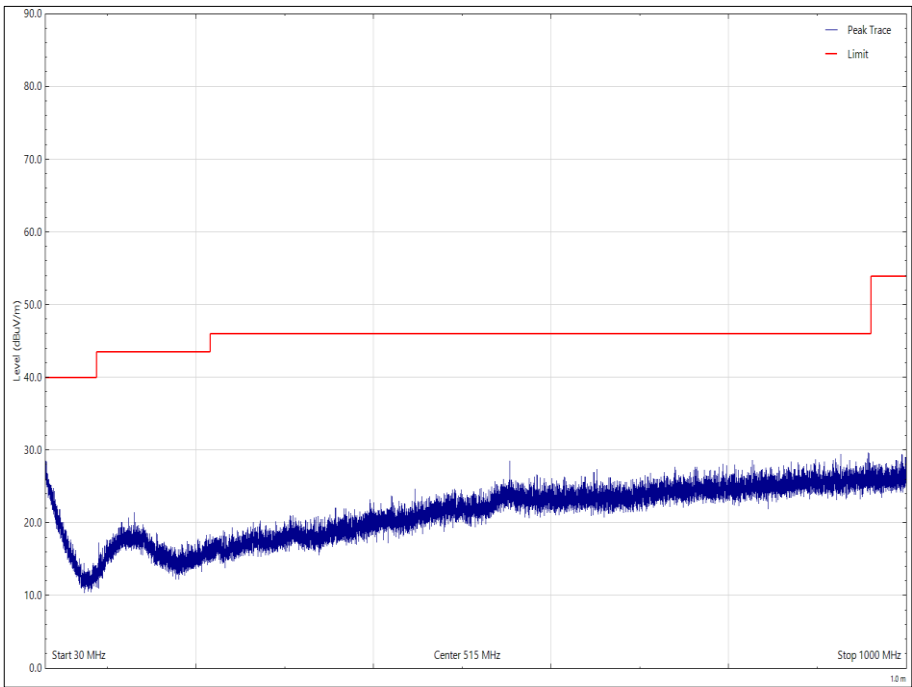


Figure 40 - 2480 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

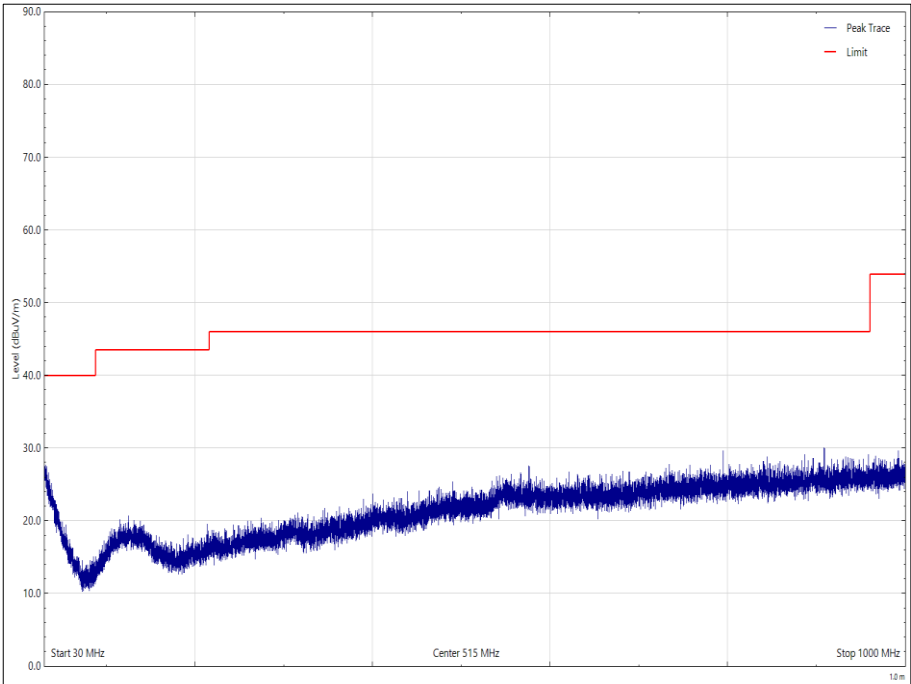


Figure 41 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

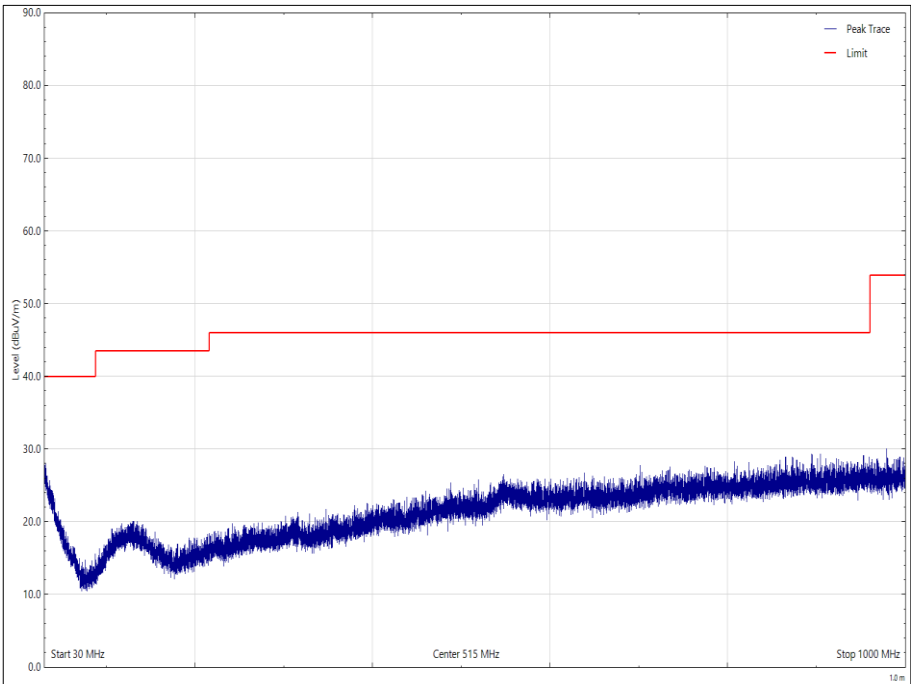


Figure 42 - 2480 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation

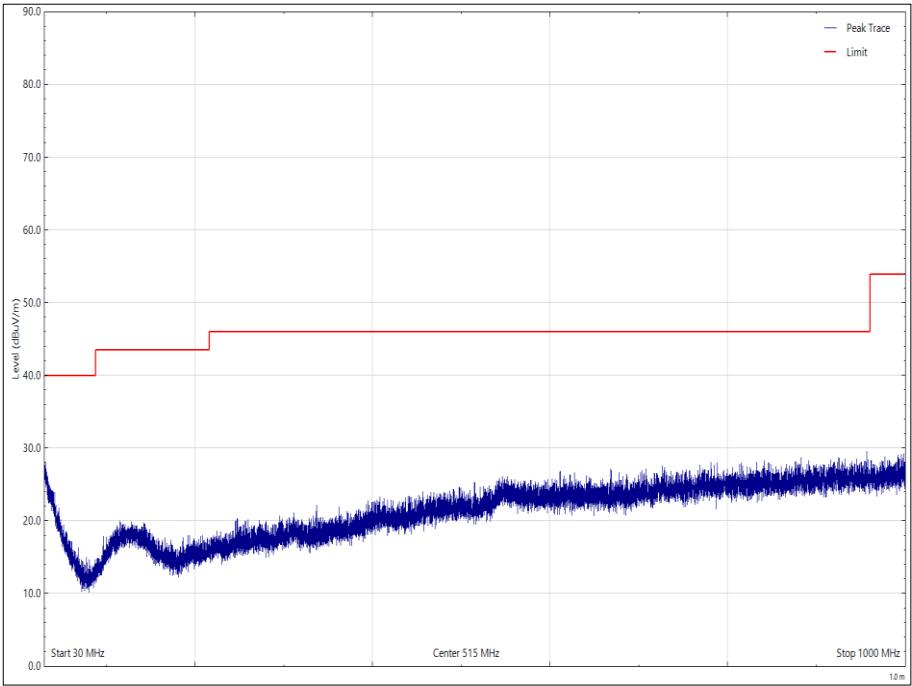


Figure 43 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation

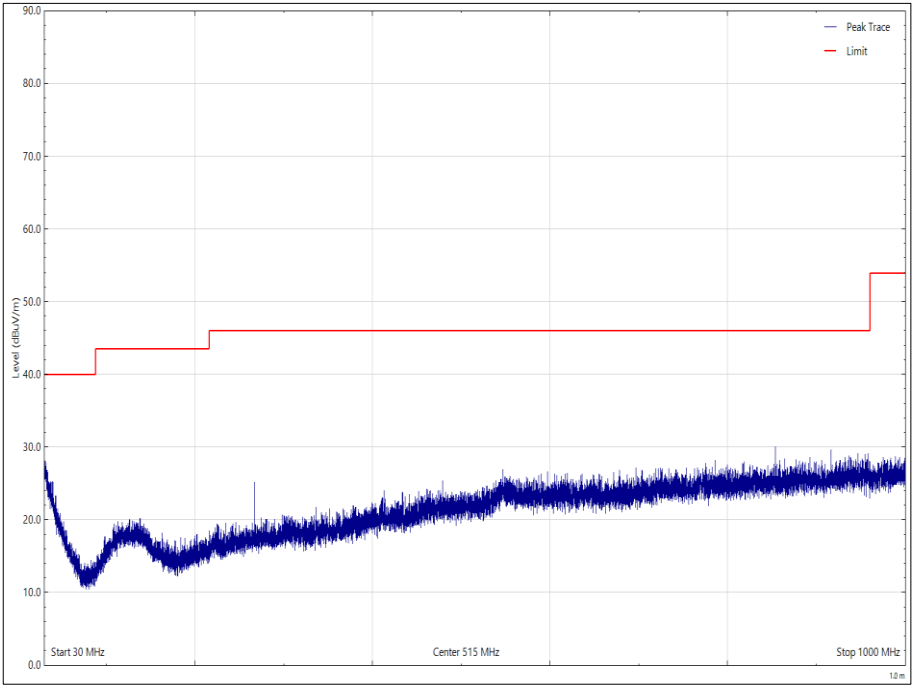


Figure 44 - 2480 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

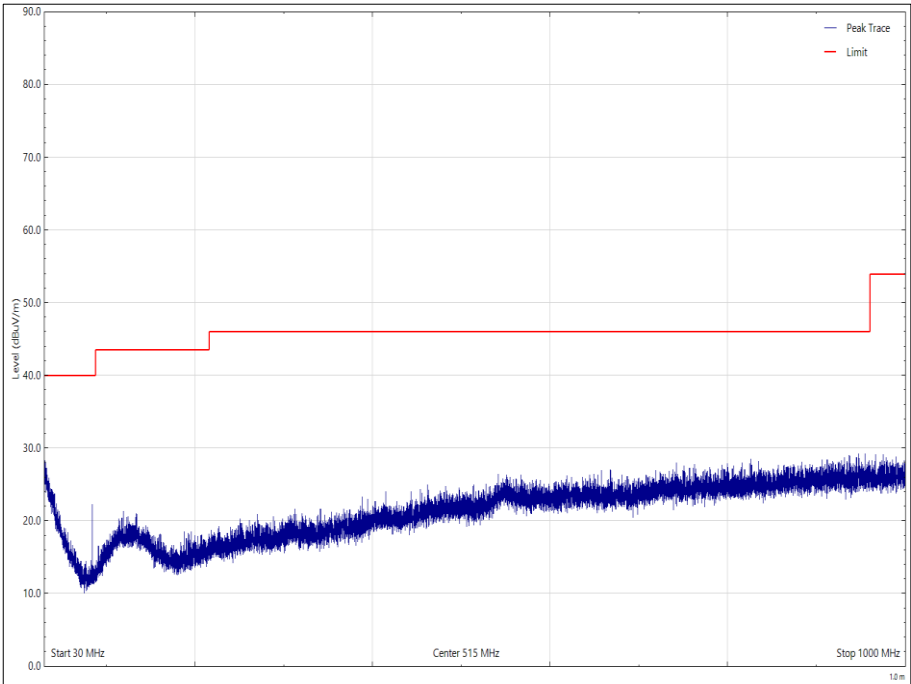


Figure 45 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation



Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 24 - 2480 MHz - 1 GHz to 18 GHz

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

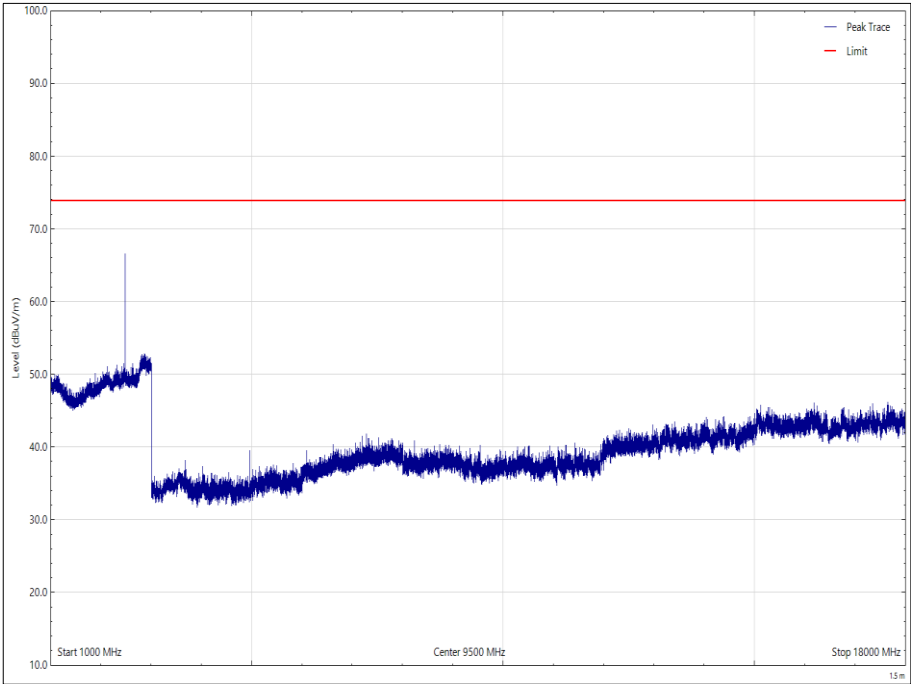


Figure 46 - 2480 MHz - 1 GHz to 18 GHz, Vertical, X Orientation - Peak

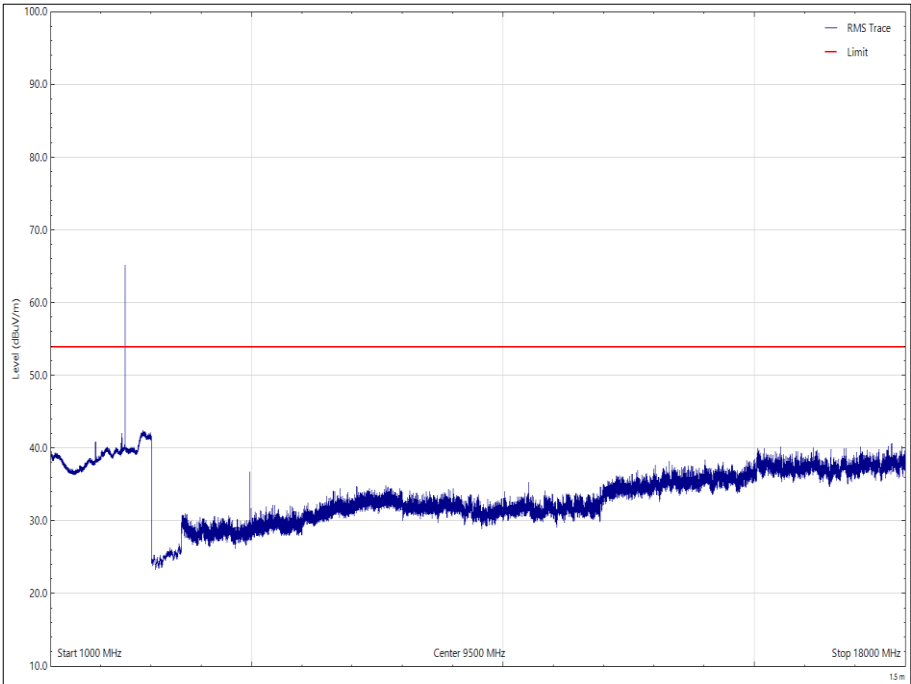


Figure 47 - 2480 MHz - 1 GHz to 18 GHz, Vertical, X Orientation - Average

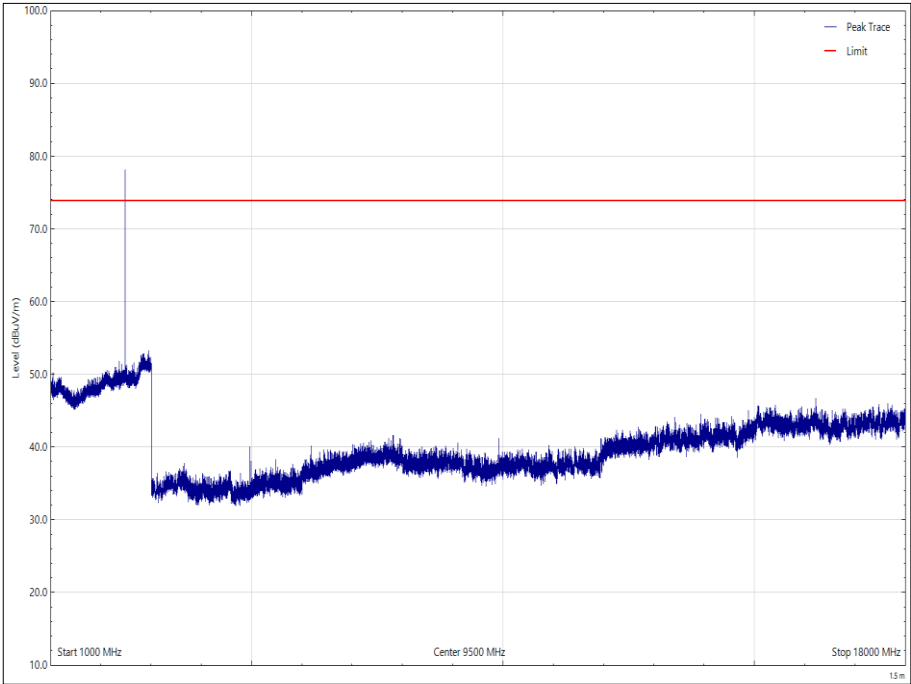


Figure 48 - 2480 MHz - 1 GHz to 18 GHz, Horizontal, X Orientation - Peak

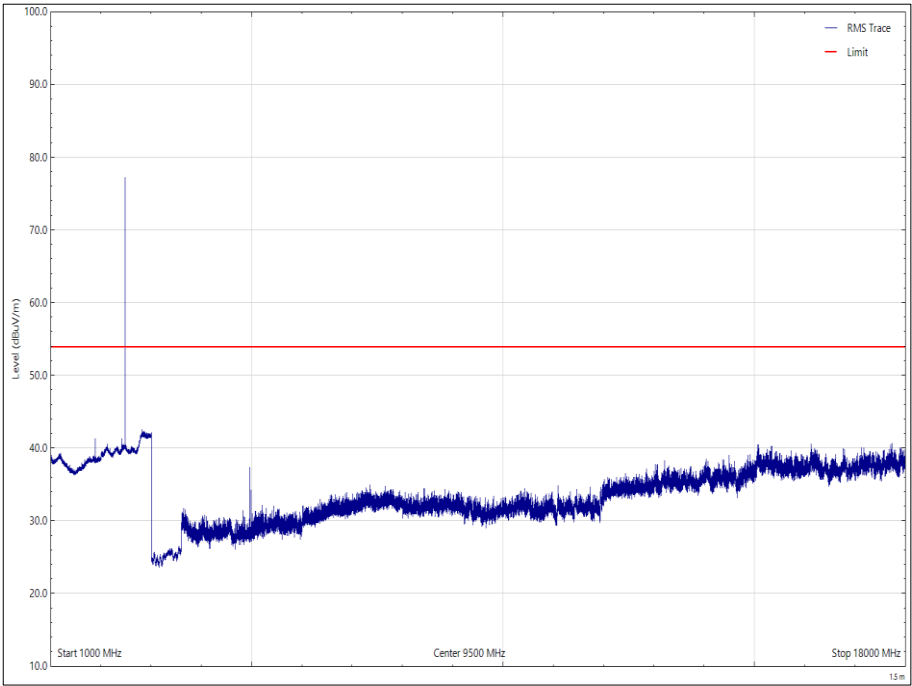


Figure 49 - 2480 MHz - 1 GHz to 18 GHz, Horizontal, X Orientation - Average

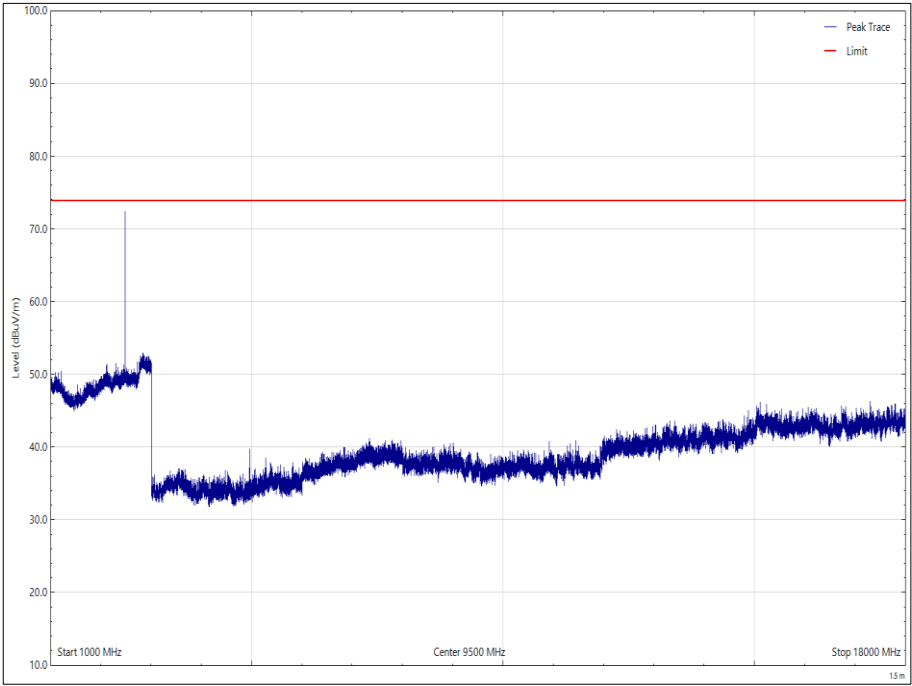


Figure 50 - 2480 MHz - 1 GHz to 18 GHz, Vertical, Y Orientation - Peak

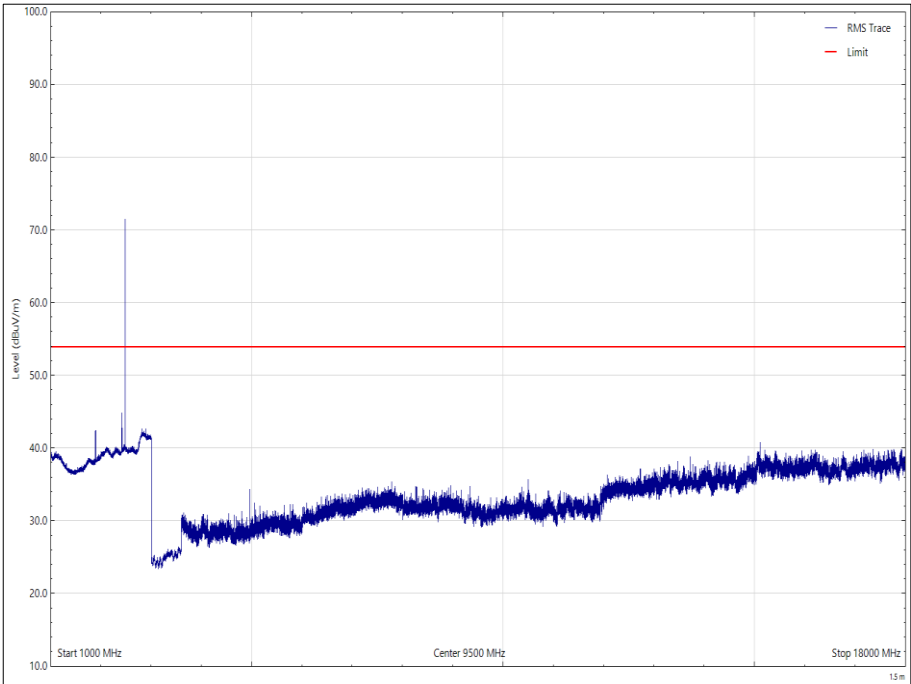


Figure 51 - 2480 MHz - 1 GHz to 18 GHz, Vertical, Y Orientation - Average

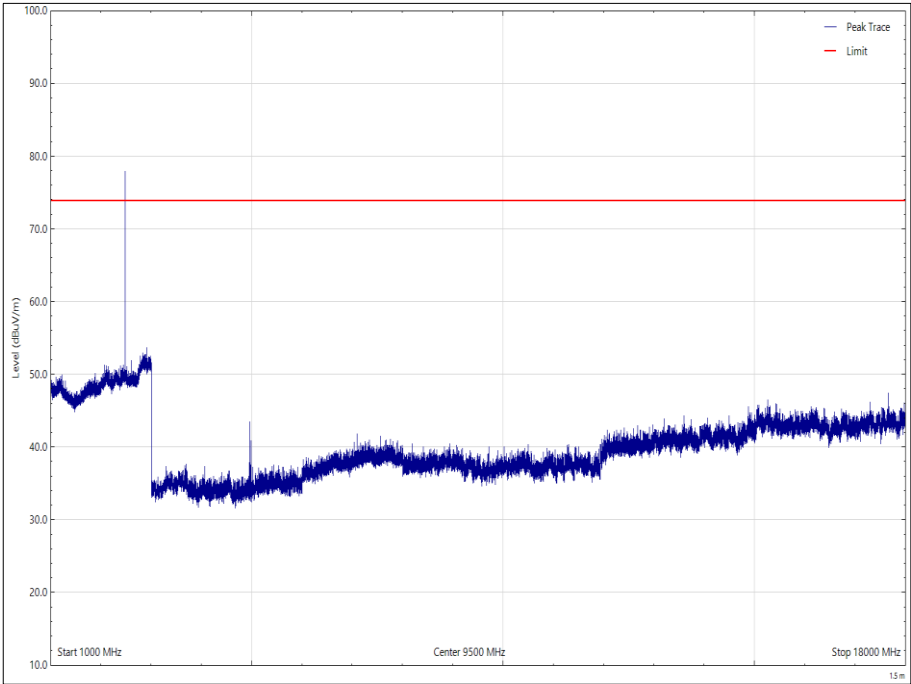


Figure 52 - 2480 MHz - 1 GHz to 18 GHz, Horizontal, Y Orientation - Peak

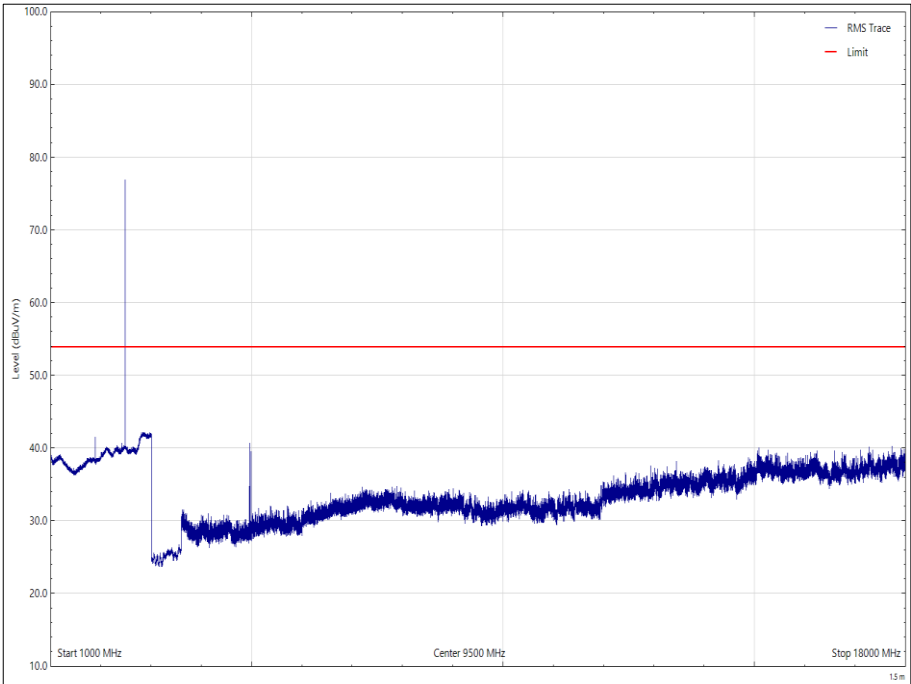


Figure 53 - 2480 MHz - 1 GHz to 18 GHz, Horizontal, Y Orientation - Average

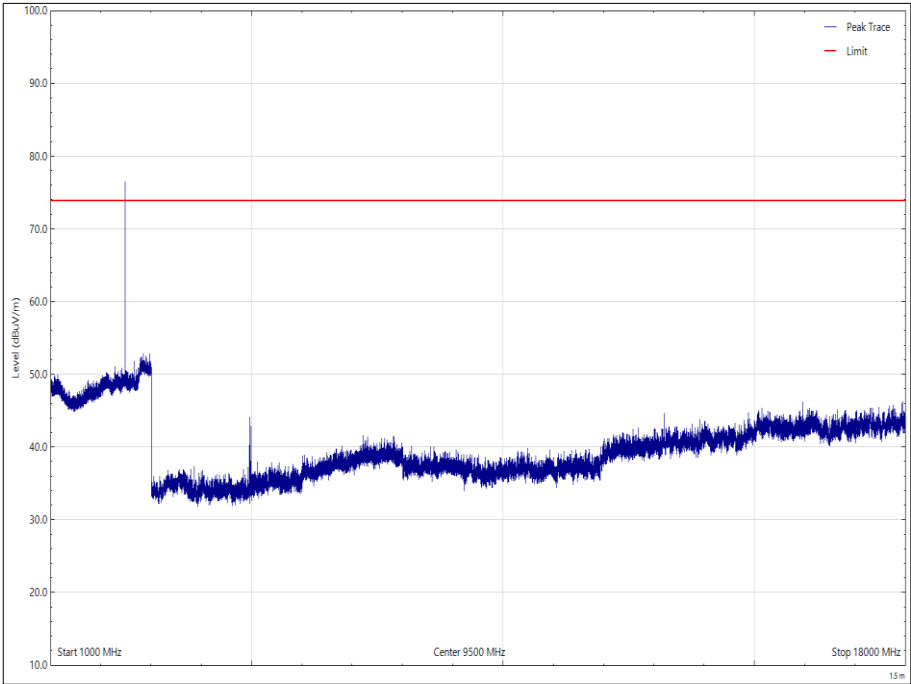


Figure 54 - 2480 MHz - 1 GHz to 18 GHz, Vertical, Z Orientation - Peak

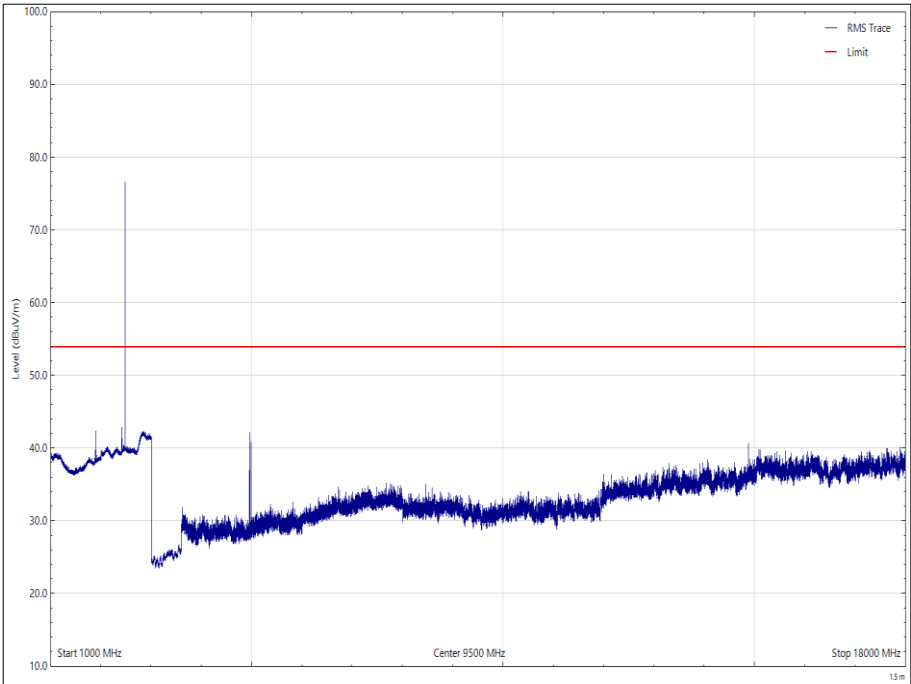


Figure 55 - 2480 MHz - 1 GHz to 18 GHz, Vertical, Z Orientation - Average

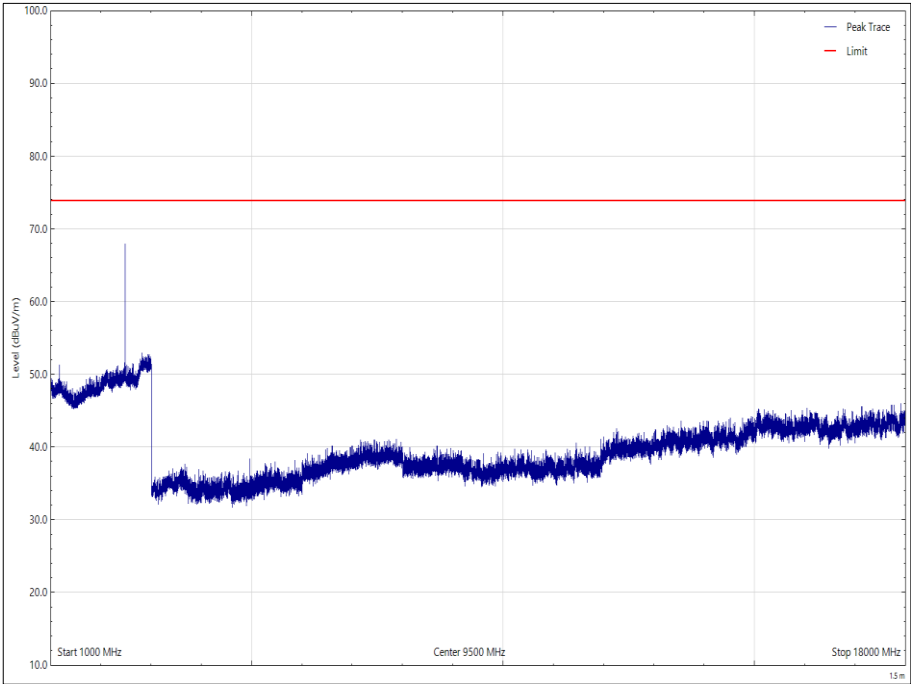


Figure 56 - 2480 MHz - 1 GHz to 18 GHz, Horizontal, Z Orientation - Peak

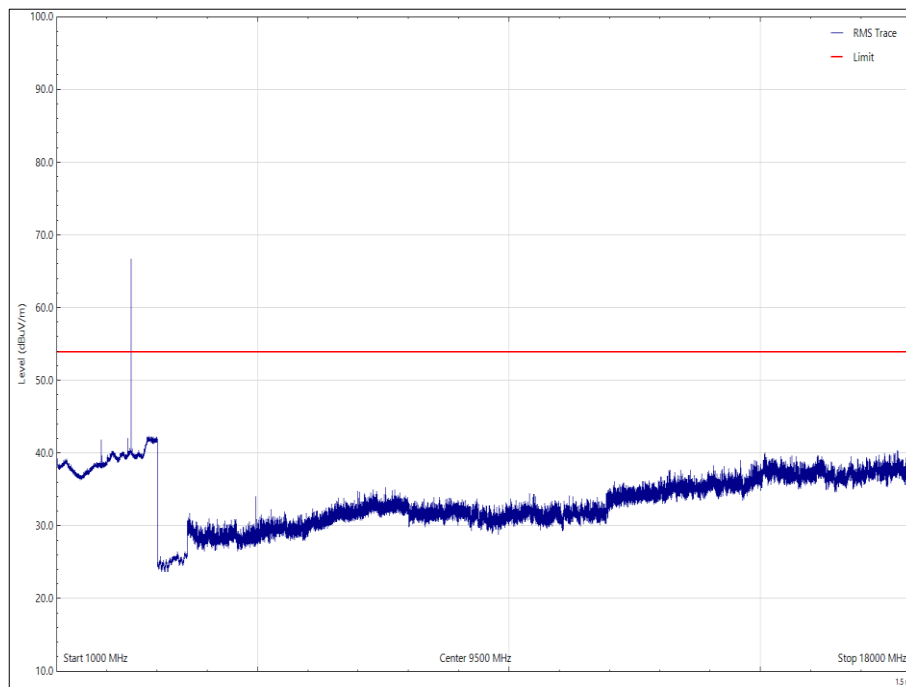


Figure 57 - 2480 MHz - 1 GHz to 18 GHz, Horizontal, Z Orientation - Average

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)



2.2.8 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 (DRG, 18 GHz to 40 GHz)	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
Pre-Amplifier (18 GHz to 40 GHz)	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
Emissions Software	TUV SUD	EmX V2.1.11	5125	-	Software
Pre-Amplifier (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
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 25

TU - Traceability Unscheduled



2.3 Authorised Band Edges

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test and Modification State

H4, S/N: Not Serialised (FAR-0633998-002) - Modification State 0

2.3.3 Date of Test

02-February-2022

2.3.4 Test Method

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

2.3.5 Environmental Conditions

Ambient Temperature	24.7 °C
Relative Humidity	28.2 %



2.3.6 Test Results

2.4 GHz Bluetooth Low Energy

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	2402	2400.0	-33.56
GFSK	2480	2483.5	-32.51

Table 26

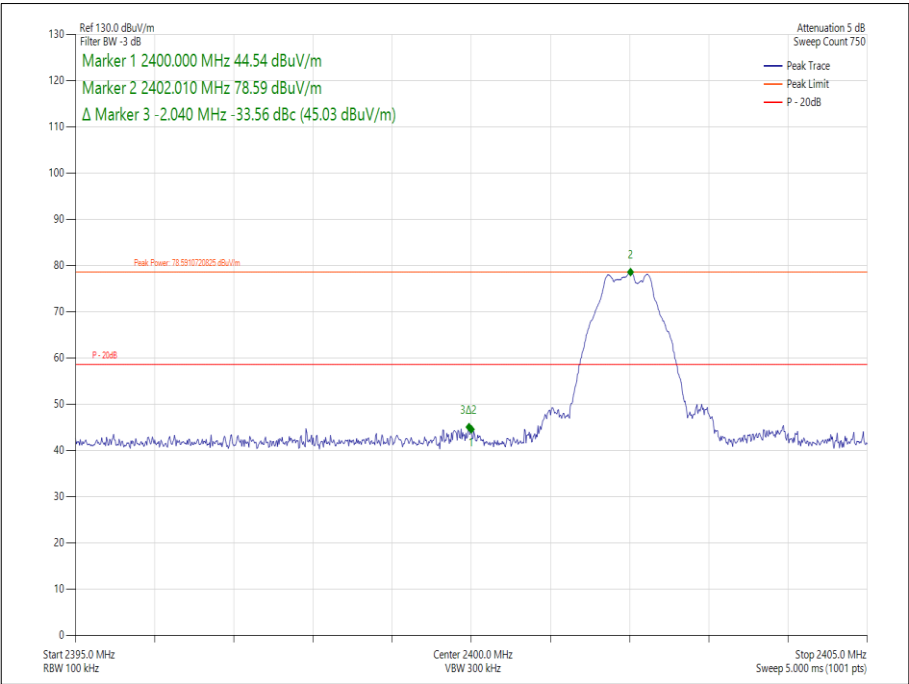


Figure 58 - GFSK, 2402 MHz - Measured Frequency 2390 MHz

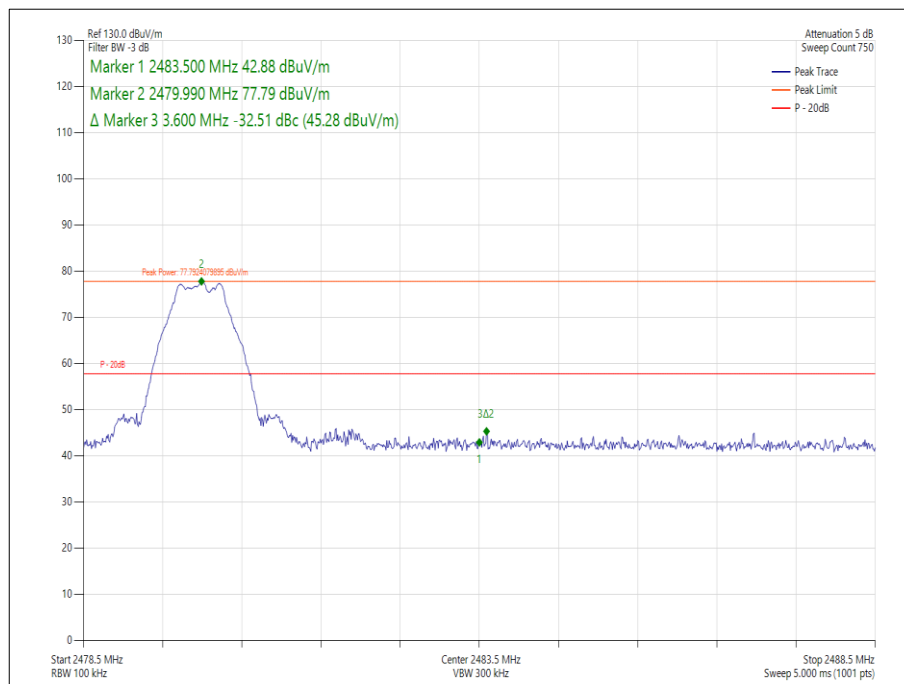


Figure 59 - GFSK, 2480 MHz - Measured Frequency 2483.5 MHz

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.



2.3.7 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
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
Emissions Software	TUV SUD	EmX V2.1.11	5125	-	Software
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
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 27

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs

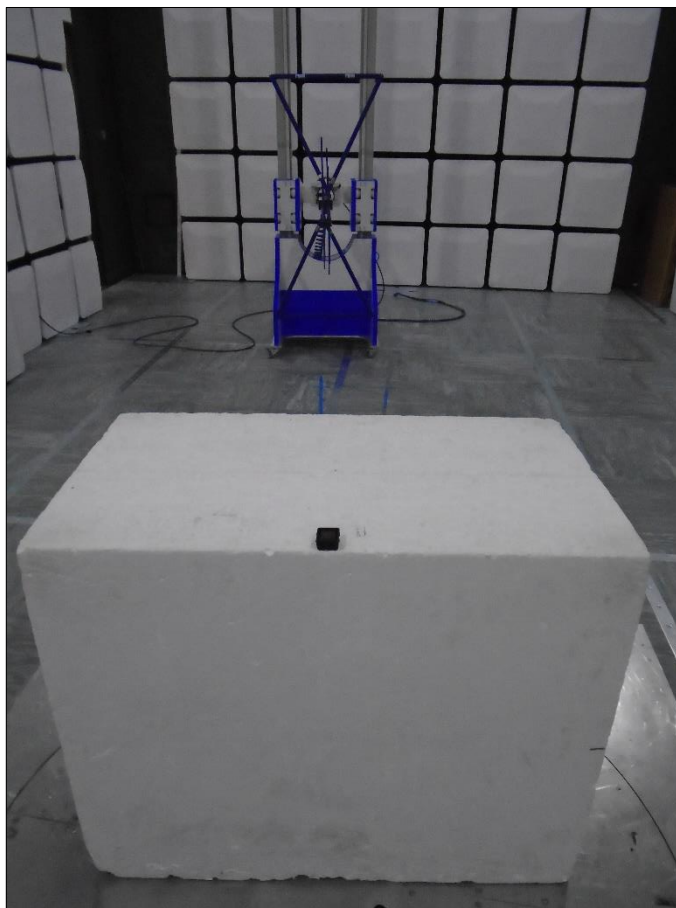


Figure 60 - Test Setup - 30 MHz to 1 GHz - X Orientation

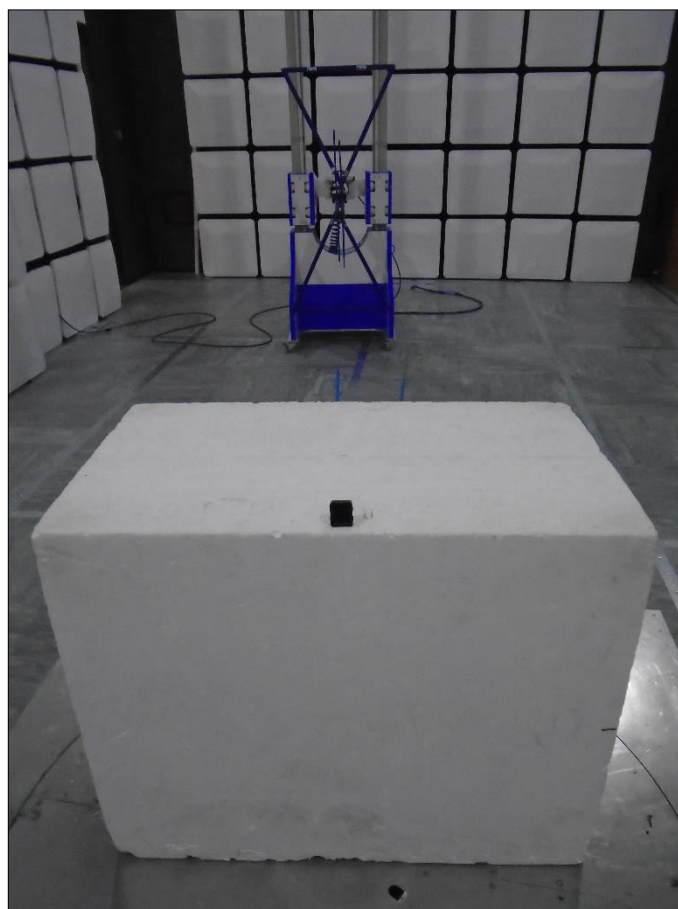


Figure 61 - Test Setup - 30 MHz to 1 GHz - Y Orientation

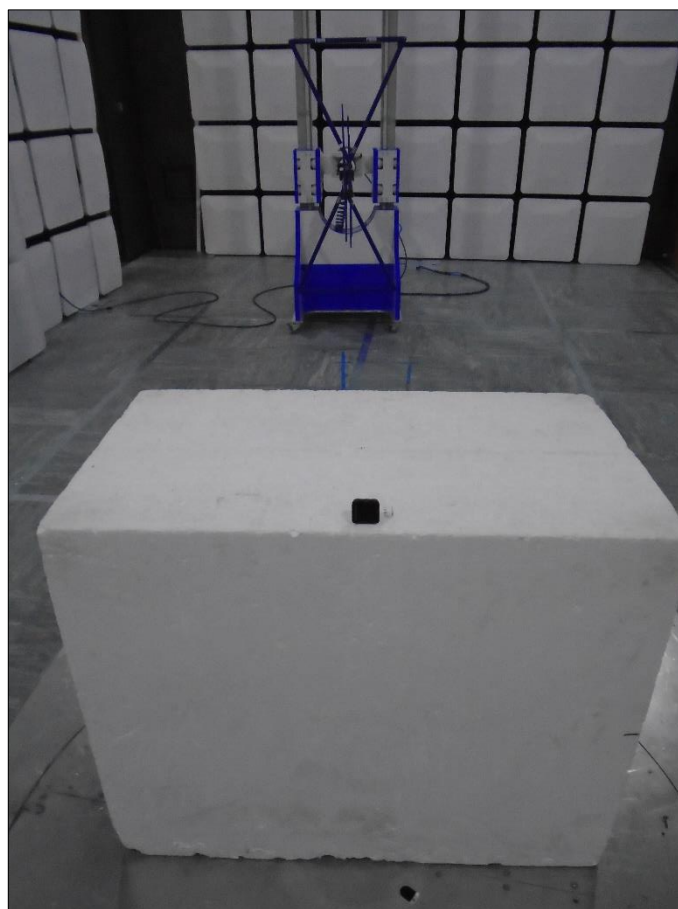


Figure 62 - Test Setup - 30 MHz to 1 GHz - Z Orientation

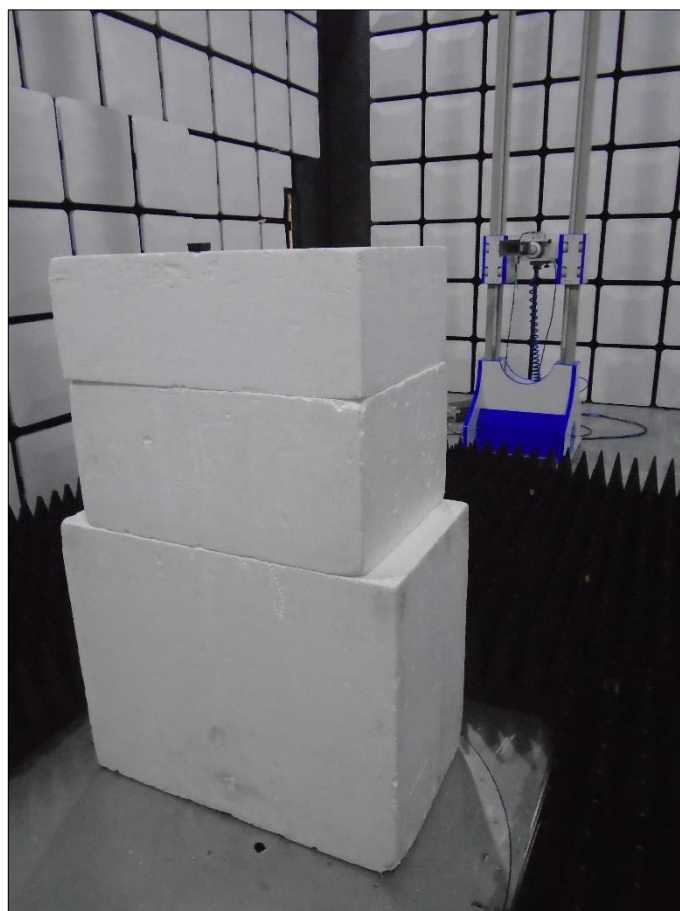


Figure 63 - Test Setup - 1 GHz to 18 GHz - X Orientation

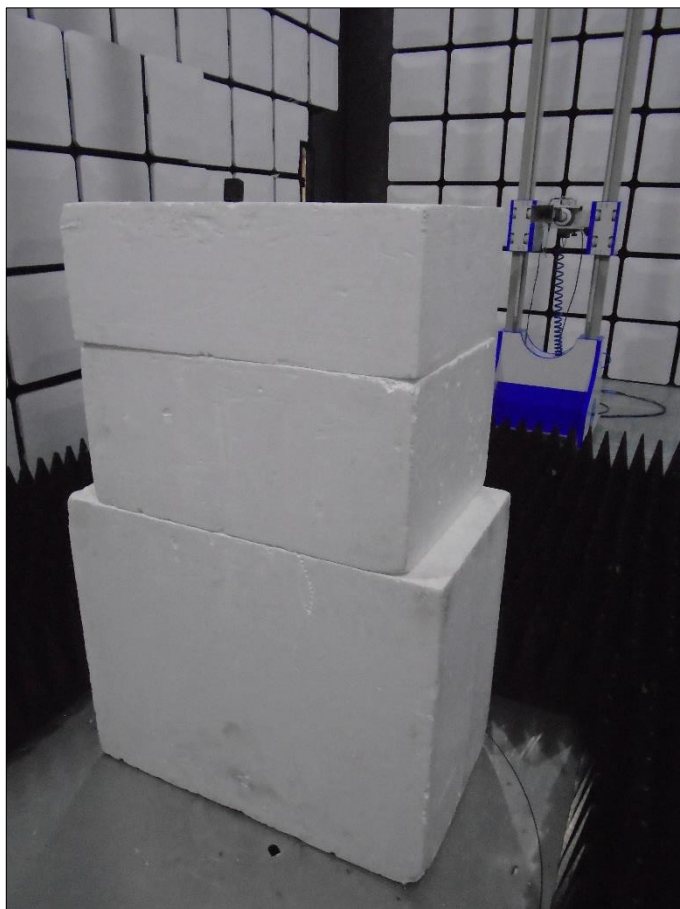


Figure 64 - Test Setup - 1 GHz to 18 GHz - Y Orientation



Figure 65 - Test Setup - 1 GHz to 18 GHz - Z Orientation



Figure 66 - Test Setup - 18 GHz to 25 GHz - X Orientation



Figure 67 - Test Setup - 18 GHz to 25 GHz - Y Orientation



Figure 68 - 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: ± 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
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 28

Measurement Uncertainty Decision Rule – Accuracy Method

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.



ANNEX A

Conducted Test Results from Project 75947856 Document 06



Emission Bandwidth

Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)

Equipment Under Test and Modification State

V3 SS03, S/N: Not serialised (0075947856-TSR0013) - Modification State 0

Date of Test

03-April-2020

Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.2.

Environmental Conditions

Ambient Temperature 25.7 °C

Relative Humidity 25.0 %

Test Results

Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2402	0.672	1.049
2440	0.680	1.050
2480	0.696	1.053

Table 29

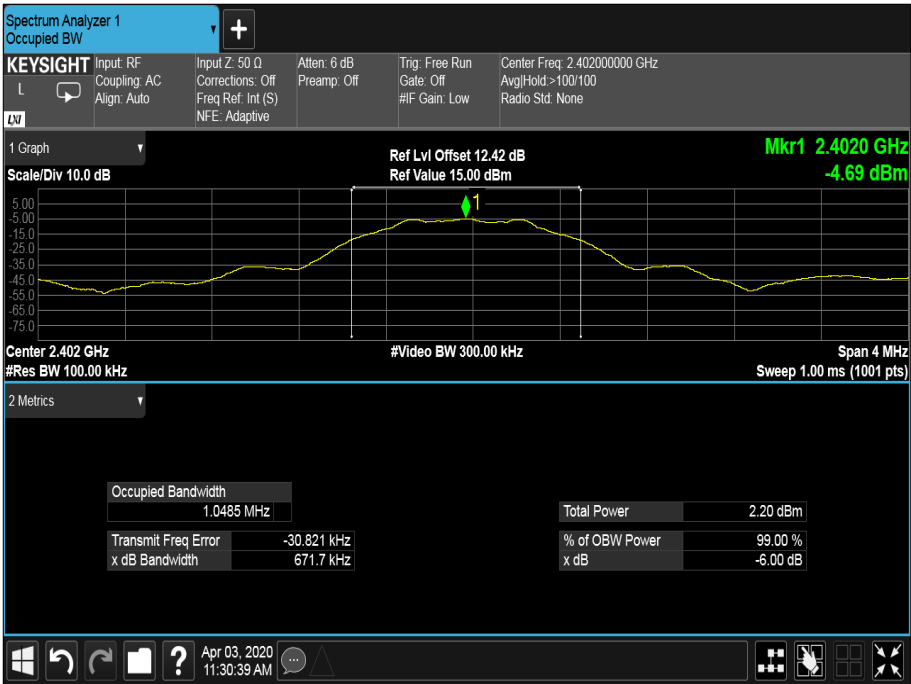


Figure 69 - 2402 MHz – 6 dB and 99% Occupied Bandwidth

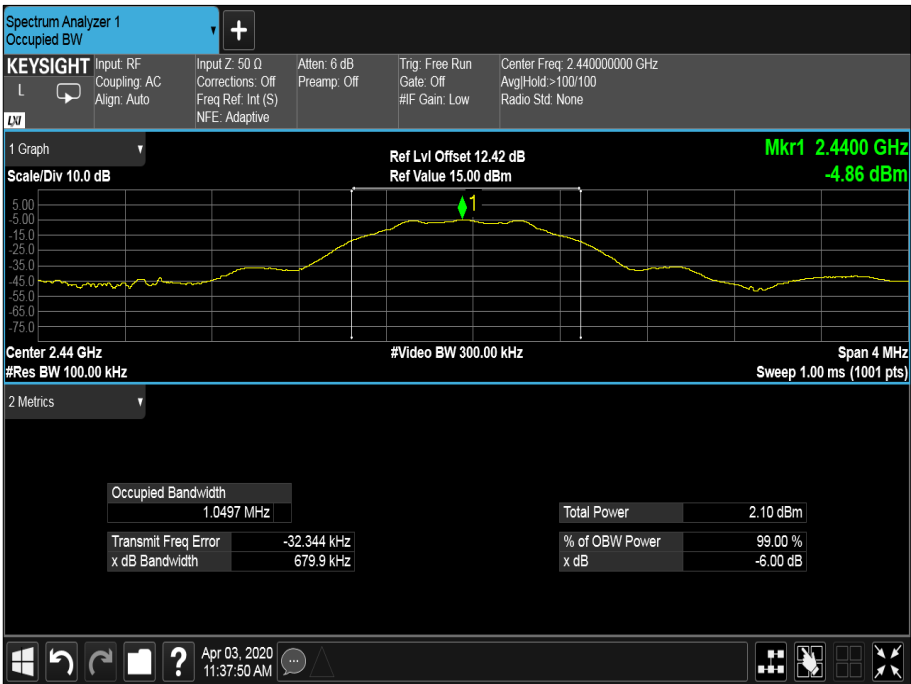


Figure 70 - 2440 MHz – 6 dB and 99% Occupied Bandwidth

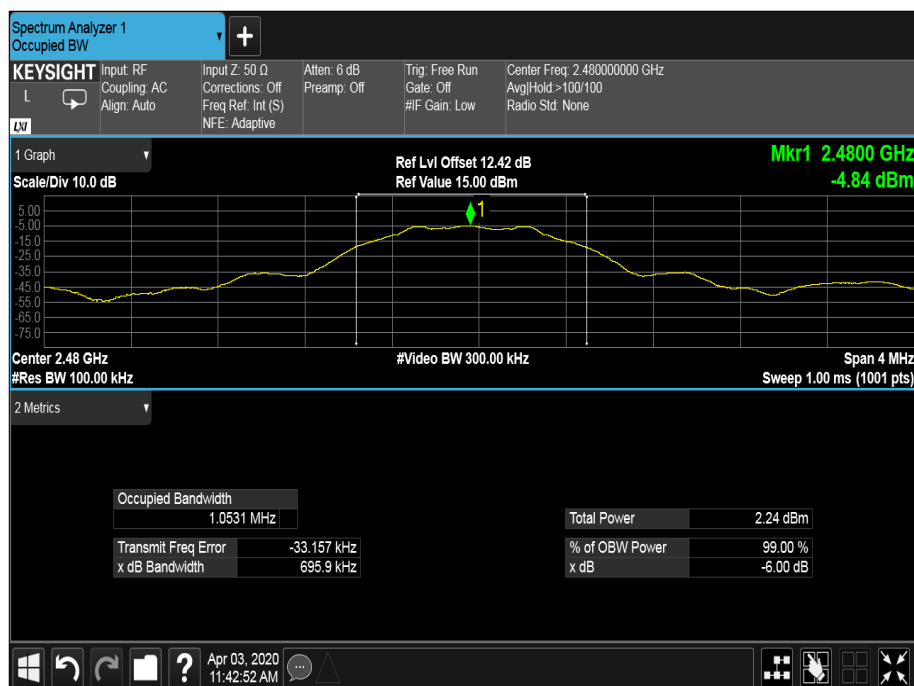


Figure 71 - 2480 MHz – 6 dB and 99% Occupied Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2)

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

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 Due
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5106	12	09-Dec-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 30

O/P Mon – Output Monitored using calibrated equipment



Power Spectral Density

Specification Reference

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

Equipment Under Test and Modification State

V3 SS03, S/N: Not serialised (0075947856-TSR0013) - Modification State 0

Date of Test

03-April-2020

Test Method

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

Environmental Conditions

Ambient Temperature 25.7 °C

Relative Humidity 25.0 %

Test Results

Bluetooth Low Energy

Modulation/Packet Type: GFSK/DH1

Frequency (MHz)	Power Spectral Density (dBm)
2402	-4.74
2440	-4.87
2480	-4.95

Table 31

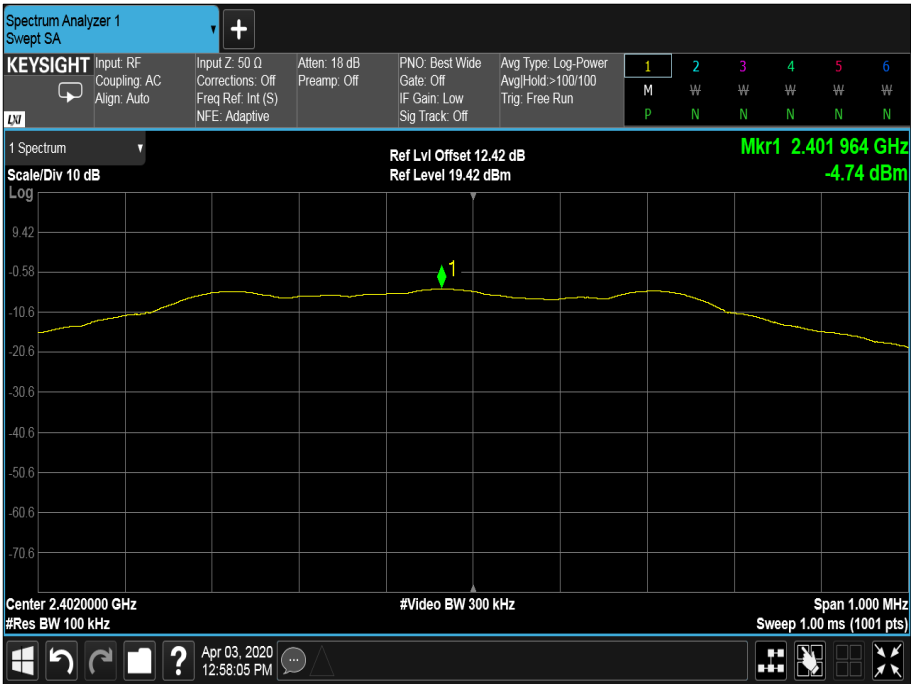


Figure 72 - 2402 MHz

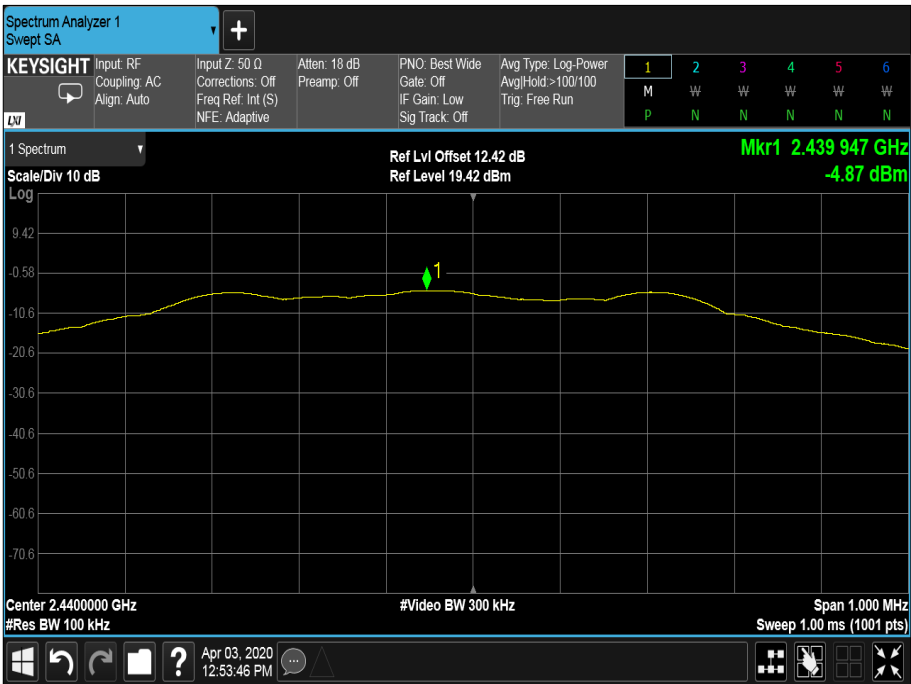


Figure 73 - 2440 MHz

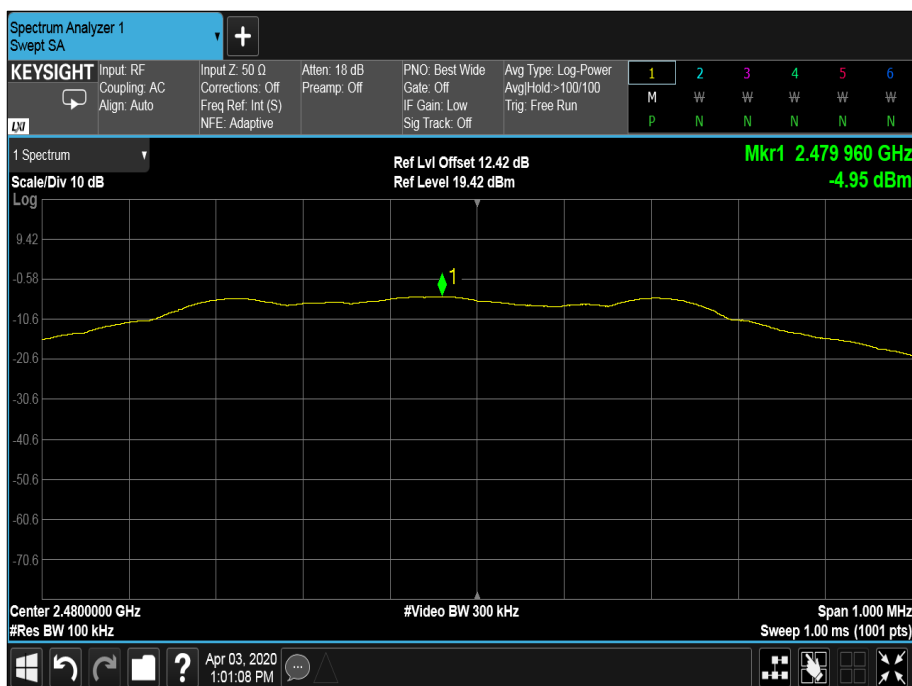


Figure 74 - 2480 MHz

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.

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 Due
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5106	12	09-Dec-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 32

O/P Mon – Output Monitored using calibrated equipment



Maximum Conducted Output Power

Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)

Equipment Under Test and Modification State

V3 SS03, S/N: Not serialised (0075947856-TSR0013) - Modification State 0

Date of Test

03-April-2020

Test Method

The test was performed in accordance with ANSI C63.10, clause 11.9.1.1.

Environmental Conditions

Ambient Temperature 25.7 °C

Relative Humidity 25.0 %

Test Results

Bluetooth Low Energy

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	-4.56	0.350
2440	-4.61	0.346
2480	-4.64	0.344

Table 33

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.



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 Due
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5106	12	09-Dec-2020
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020

Table 34

O/P Mon – Output Monitored using calibrated equipment