

FCC and ISED Test Report

Aguardio ApS

H2O Leak Sensor, Model: H2O Leak Sensor

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

Prepared for: Aguardio Aps
The Spring
Hasselager Allé 8
8260 Viby J
Denmark



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FCC ID: 2BCEP-400101 IC: 31231-400101

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Document 75958298-02 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	01 September 2023

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 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	Aakash Rawal	01 September 2023	
	Thomas Biddlecombe	01 September 2023	

FCC Accreditation

492497/UK2010 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, 2021, 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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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.....	8
2	Test Details	9
2.1	Restricted Band Edges	9
2.2	Spurious Radiated Emissions	13
2.3	Emission Bandwidth.....	44
2.4	Maximum Conducted Output Power	50
2.5	Authorised Band Edges	53
2.6	Power Spectral Density.....	56
3	Photographs	59
3.1	Test Setup Photographs	59
4	Measurement Uncertainty	64



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	01-September-2023

Table 1

1.2 Introduction

Applicant	TÜV SÜD Danmark ApS
Manufacturer	Aguardio ApS
Model Number(s)	H20 Leak Sensor
Serial Number(s)	Not Serialised (FAR-724725-003) Not Serialised (FAR-724725-004) Not Serialised (FAR-724725-008) Not Serialised (FAR-724725-010) Not Serialised (FAR-724725-013) Not Serialised (FAR-724725-015)
Hardware Version(s)	1.5B
Software Version(s)	1.0.1
Number of Samples Tested	6
Test Specification/Issue/Date	FCC 47 CFR Part 15C, 2021 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	Signed QAF detailing
Date	12-April-2023
Date of Receipt of EUT	24-April-2023
Start of Test	26-April-2023
Finish of Test	16-May-2023
Name of Engineer(s)	Aakash Rawal and Thomas Biddlecombe
Related Document(s)	ANSI C63.10 (2020) 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, ISSED RSS-247 and ISSED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz Bluetooth Low Energy - Leak Sensor						
	15.203	-	-	Antenna Requirement	N/T	The EUT meets the requirements of 15.203 as it uses permanently attached integral antennas.
2.1	15.205	3.3	8.10	Restricted Band Edges	Pass	
2.2	15.209 and 15.247 (d)	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	
2.4	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	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: (Please provide a brief description of the intended use of the equipment including the technologies the product supports)		The Aguadio Leak Sensor detects water leaks by measuring the temperature difference between the water inlet pipe temperature and the ambient room temperature. The difference in temperature triggers the alarm.	
Manufacturer:		Xtel Wireless ApS	
Model:		H2O Leak Sensor	
Part Number:		XT0184, 80018400	
Hardware Version:		1.5B	
Software Version:		1.0.1	
FCC ID of the product under test – see guidance here		2BCEP-400101	
IC ID of the product under test – see guidance here		31231-400101	
Device Category	Mobile ☐	Portable ☐	Fixed ☒
Equipment is fitted with an Audio Low Pass Filter		Yes ☐	No ☒

Table 3

Intentional Radiators

Technology	Bluetooth LE 5.1					
Frequency Range (MHz to MHz)	2400-2483.5					
Conducted Declared Output Power (dBm)	3					
Antenna Gain (dBi)	1.18					
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	1 MHz					
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	GFSK					
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	1M00GXW					
Bottom Frequency (MHz)	2402					
Middle Frequency (MHz)	2441					
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	32MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	16MHz
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:	3.6	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:	-10	°C
Maximum temperature:	55	°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:	Meander Monopole	Gain	1.18	dBi
External antenna ☐	Type:		Gain		dBi
For external antenna only: Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed ☐ Non-standard Antenna Jack ☐ All part 15 applications will need to show how the antenna gain was derived either from a manufacturer data sheet or a measurement. Where the gain of the antenna is inherently accounted for as a result of the measurement, such as field strength measurements on a part 15.249 or 15.231 device, so the gain does not necessarily need to be verified. However, enough information regarding the construction of the antenna shall be provided. Such information maybe photographs, length of wire antenna etc.					

Table 12

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

Table 13

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

Name: Thomas Munch-Laursen

Position held: CEO, Aguardio

Date: 11 August 2023



1.5 Product Information

1.5.1 Technical Description

The Aguardio Leak Sensor detects water leaks by measuring the temperature difference between the water inlet pipe temperature and the ambient room temperature. The difference in temperature triggers the alarm.

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: H20 Leak Sensor, Serial Number: Not Serialised (FAR-724725-003)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: H20 Leak Sensor, Serial Number: Not Serialised (FAR-724725-004)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: H20 Leak Sensor, Serial Number: Not Serialised (FAR-724725-008)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: H20 Leak Sensor, Serial Number: Not Serialised (FAR-724725-010)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: H20 Leak Sensor, Serial Number: Not Serialised (FAR-724725-013)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: H20 Leak Sensor, Serial Number: Not Serialised (FAR-724725-015)			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 14



1.8 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz Bluetooth Low Energy - Leak Sensor		
Restricted Band Edges	Aakash Rawal	UKAS
Spurious Radiated Emissions	Aakash Rawal	UKAS
Emission Bandwidth	Thomas Biddlecombe	UKAS
Maximum Conducted Output Power	Thomas Biddlecombe	UKAS
Authorised Band Edges	Aakash Rawal	UKAS
Power Spectral Density	Thomas Biddlecombe	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-247, Clause 3.3
ISED RSS-GEN, Clause 8.10

2.1.2 Equipment Under Test and Modification State

H20 Leak Sensor, S/N: Not Serialised (FAR-724725-004) - Modification State 0
H20 Leak Sensor, S/N: Not Serialised (FAR-724725-003) - Modification State 0

2.1.3 Date of Test

26-April-2023 to 28-April-2023

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

2.1.5 Environmental Conditions

Ambient Temperature	18.3 - 19.1 °C
Relative Humidity	33.5 - 40.4 %

2.1.6 Test Results

2.4 GHz Bluetooth Low Energy - Leak Sensor

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK	2402	2390	54.84	39.29
GFSK	2480	2483.5	61.47	47.83

Table 16

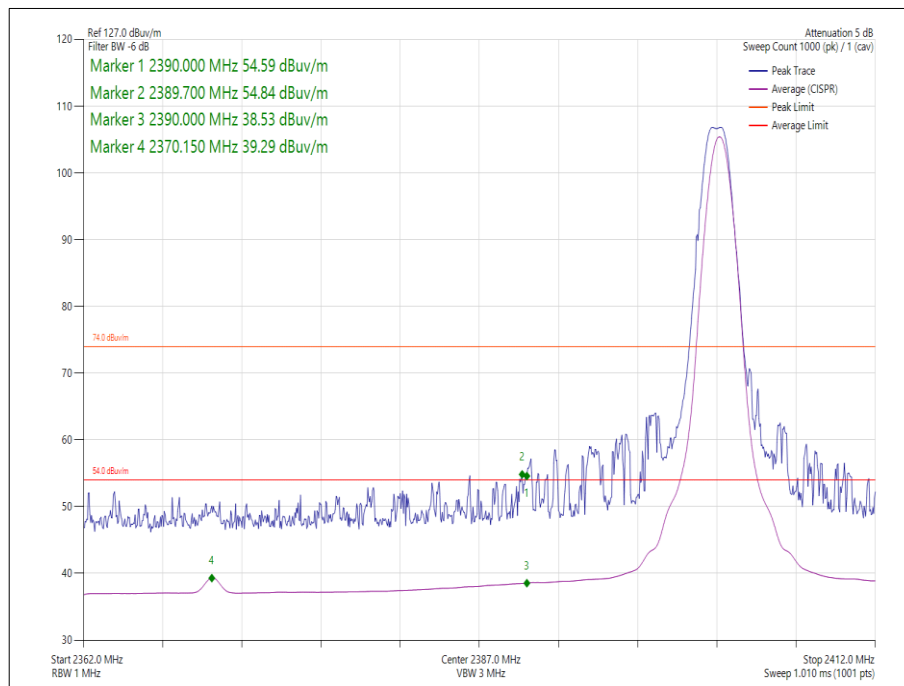


Figure 1 - GFSK - 2402 MHz - Band Edge Frequency 2390 MHz

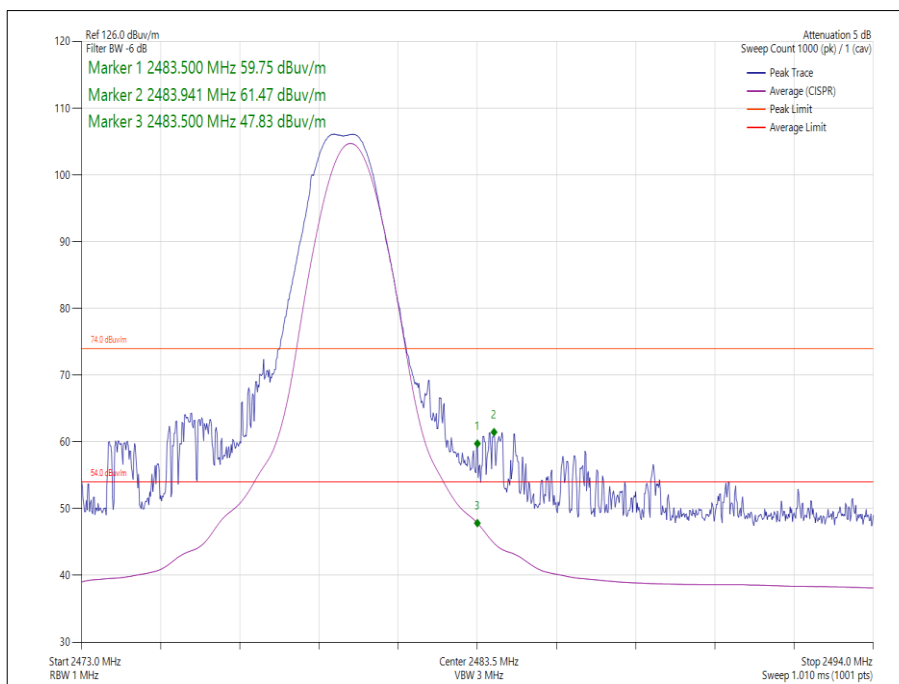


Figure 2 - GFSK - 2480 MHz - Band Edge Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ 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 ($\mu\text{V/m}$ 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 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	28-May-2023
Emissions Software	TUV SUD	EmX V3.1.11	5125	-	Software
Cable (K Type 2m)	Junkosha	MWX241-02000KMS	5421	12	08-Mar-2024
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5476	12	06-Oct-2023
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	19-May-2023
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	6330	12	16-Feb-2024

Table 19

TU - Traceability Unscheduled



2.2 Spurious Radiated Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.209 and 15.247 (d)
ISED RSS-247, Clause 3.5 and 5.5
ISED RSS-GEN, Clause 6.13 and 8.9

2.2.2 Equipment Under Test and Modification State

H20 Leak Sensor, S/N: Not Serialised (FAR-724725-003) - Modification State 0
H20 Leak Sensor, S/N: Not Serialised (FAR-724725-004) - Modification State 0
H20 Leak Sensor, S/N: Not Serialised (FAR-724725-008) - Modification State 0

2.2.3 Date of Test

26-April-2023 to 28-April-2023

2.2.4 Test Method

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

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. For an EUT which could reasonable 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 4.1.4.2.2.

The plots shown are the characterization 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:
 $10^{(\text{Field Strength in dBuV/m}/20)}$

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

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

2.2.5 Example Test Setup Diagram

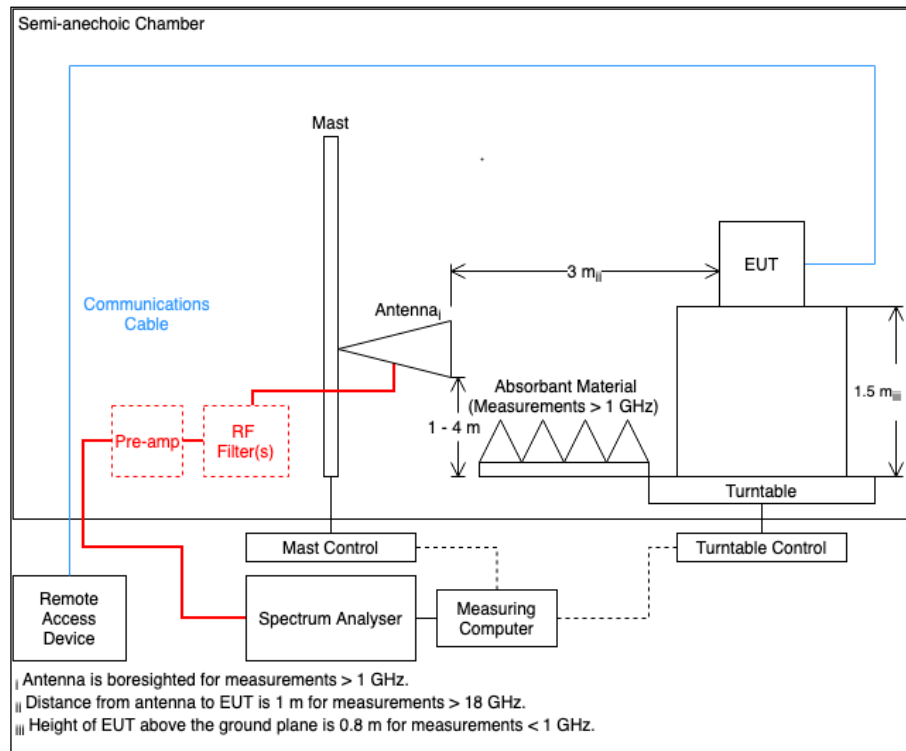


Figure 3

2.2.6 Environmental Conditions

Ambient Temperature	18.5 - 20.1 °C
Relative Humidity	41.5 - 53.1 %



2.2.7 Test Results

2.4 GHz Bluetooth Low Energy - Leak Sensor

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

Table 20 – X Orientation, 2402 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

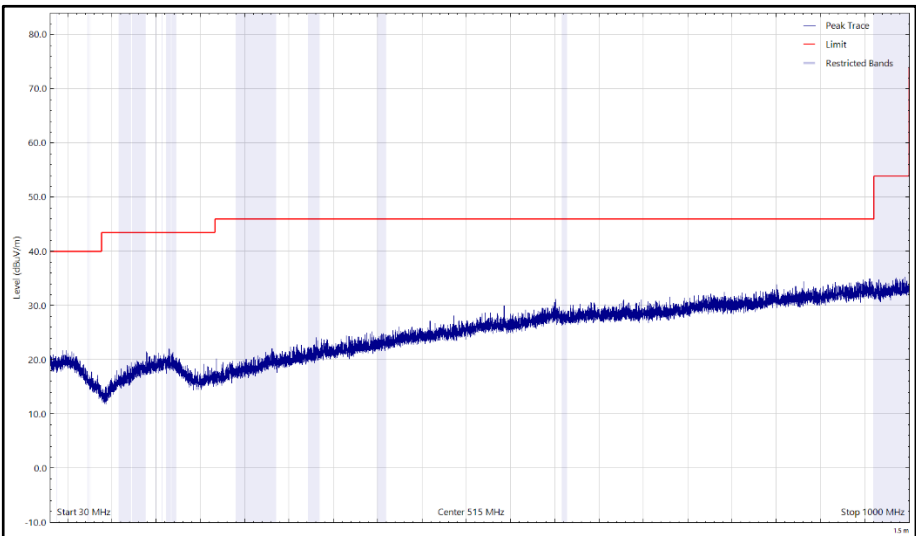


Figure 4 – X Orientation, 2402 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

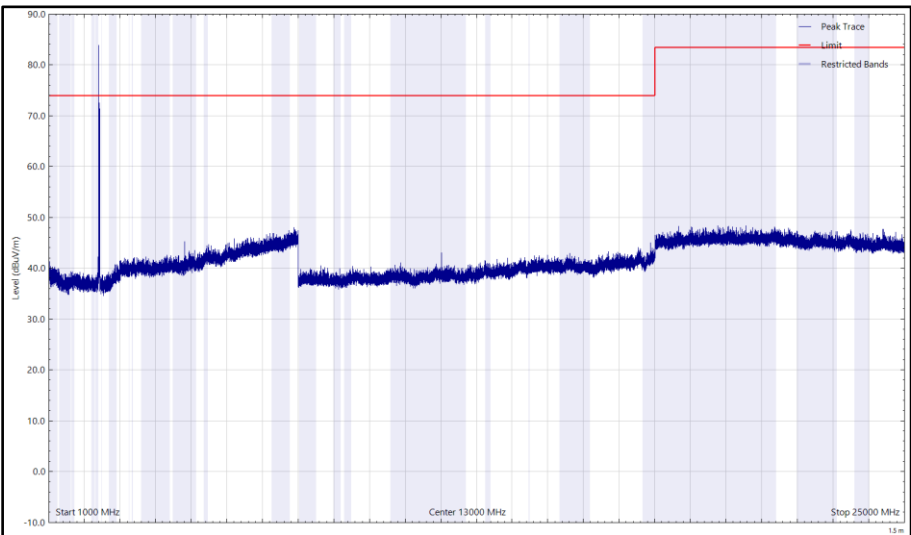


Figure 5 – X Orientation, 2402 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

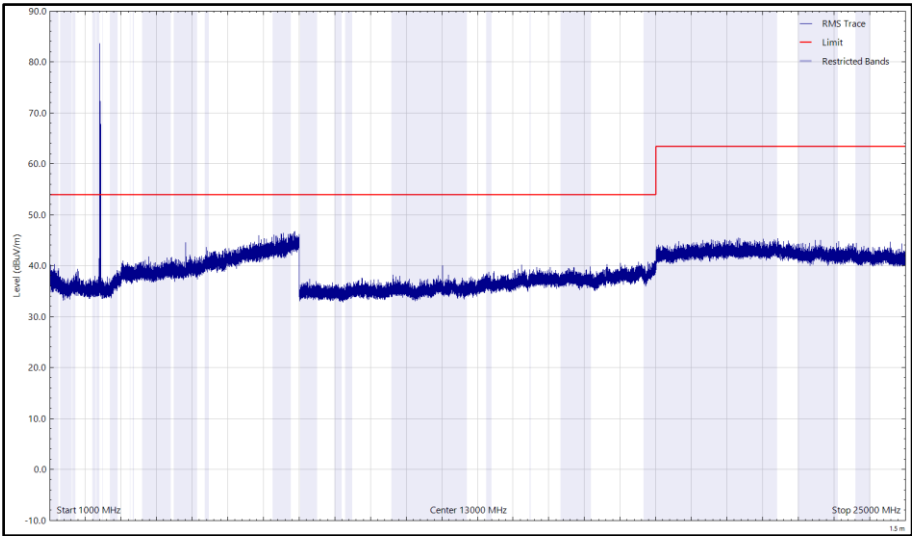


Figure 6 – X Orientation, 2402 MHz, 1 GHz to 25 GHz, Horizontal (rms)

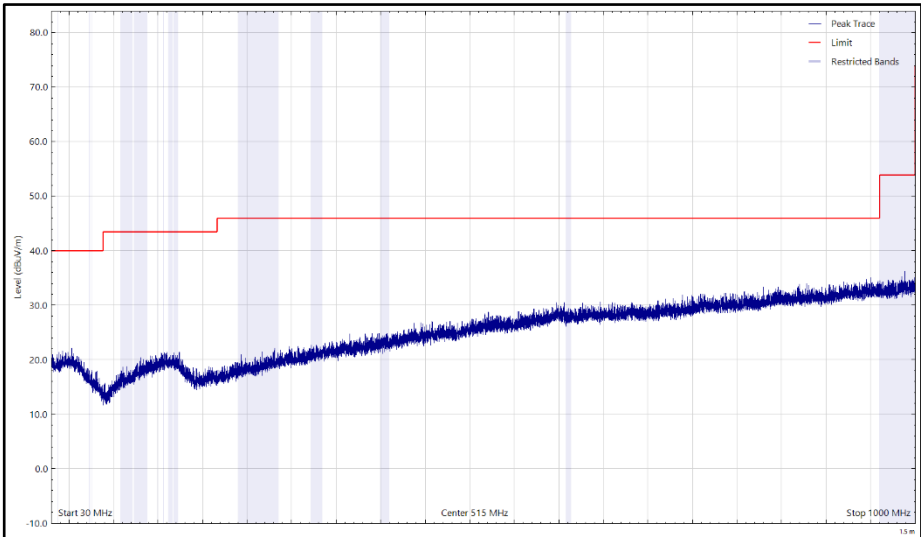


Figure 7 - X Orientation, 2402 MHz, 30 MHz to 1 GHz, Vertical (Peak)

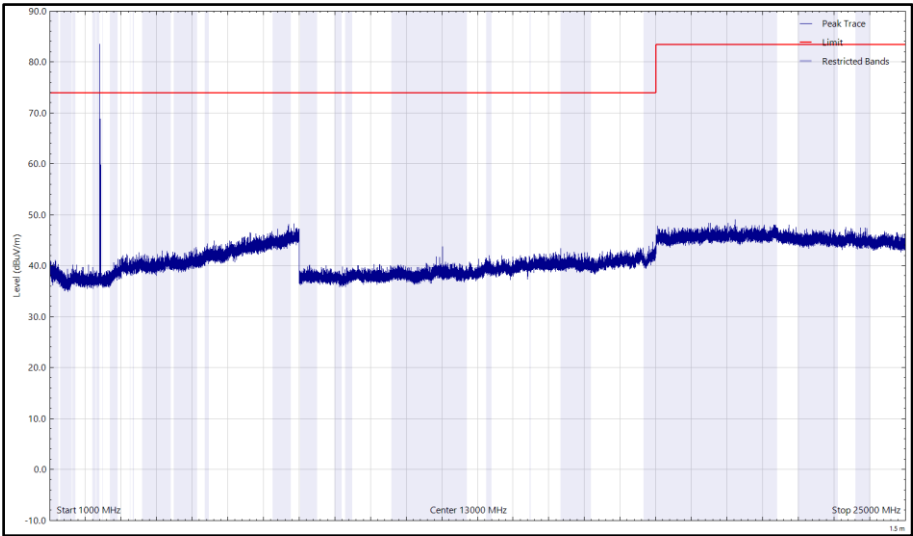


Figure 8 - X Orientation, 2402 MHz, 1 GHz to 25 GHz, Vertical (Peak)

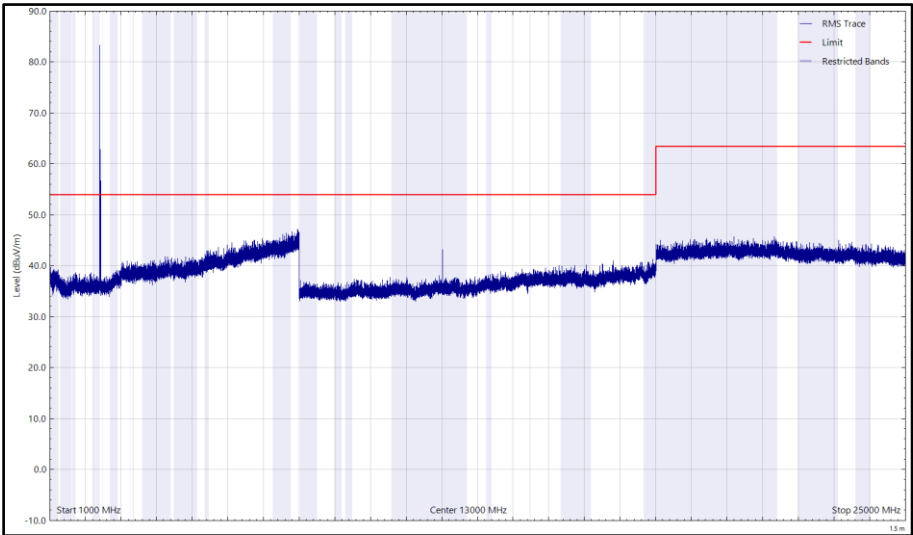


Figure 9 - X Orientation, 2402 MHz, 1 GHz to 25 GHz, Vertical (rms)



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

Table 21 - X Orientation, 2441 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

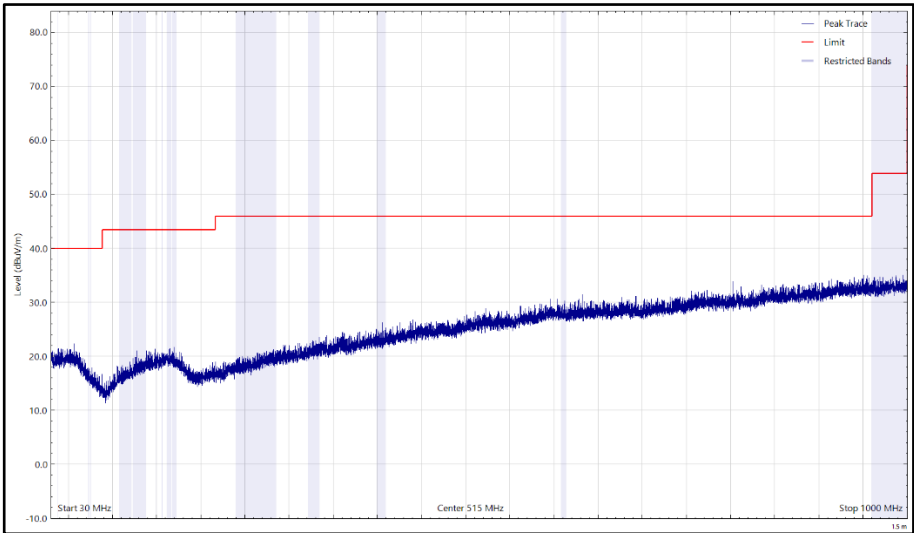


Figure 10 - X Orientation, 2441 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

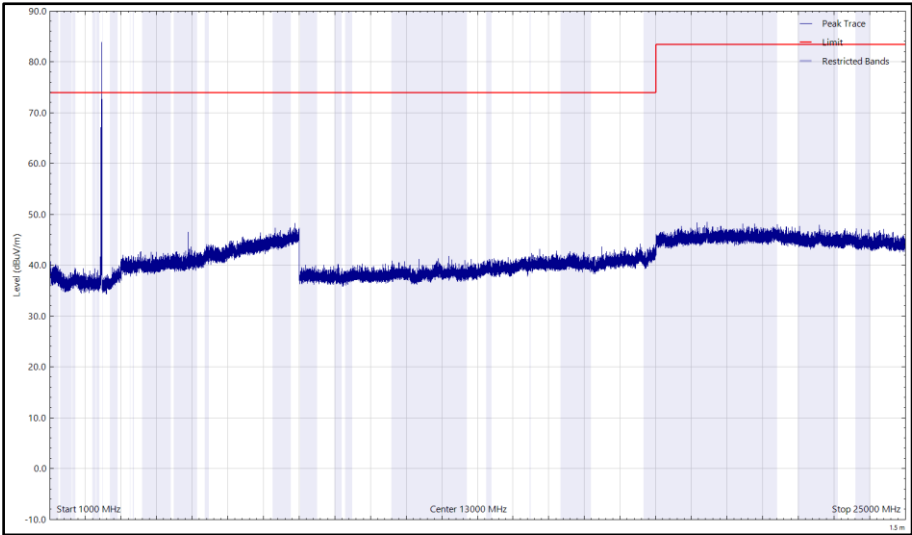


Figure 11 - X Orientation, 2441 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

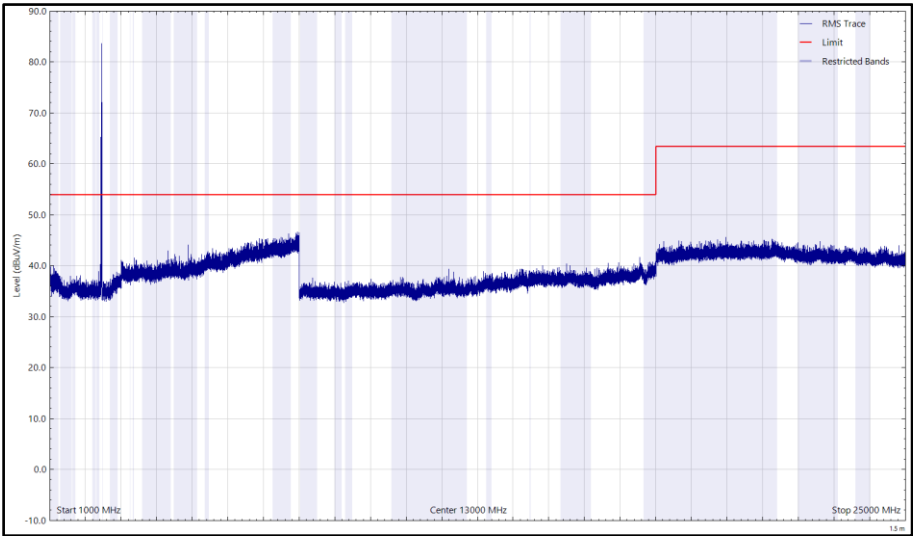


Figure 12 - X Orientation, 2441 MHz, 1 GHz to 25 GHz, Horizontal (rms)

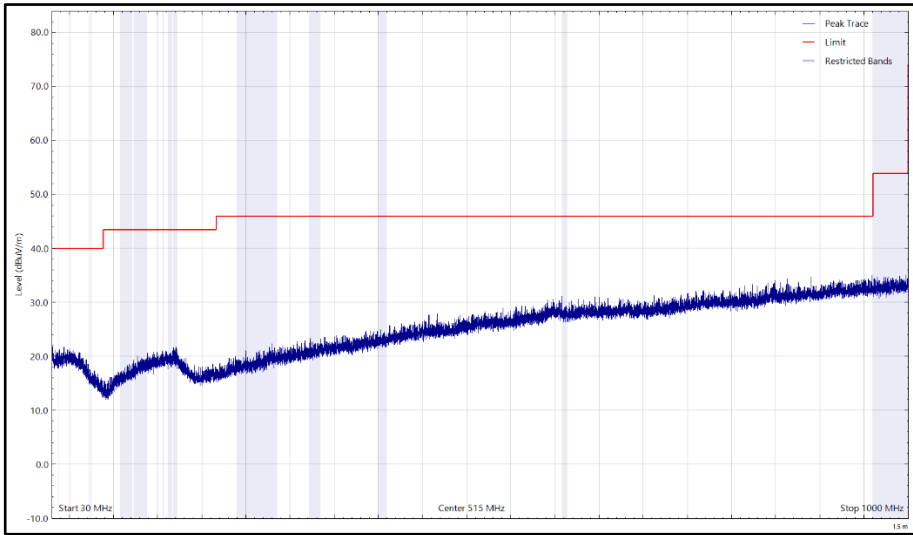


Figure 13 - X Orientation, 2441 MHz, 30 MHz to 1 GHz, Vertical (Peak)

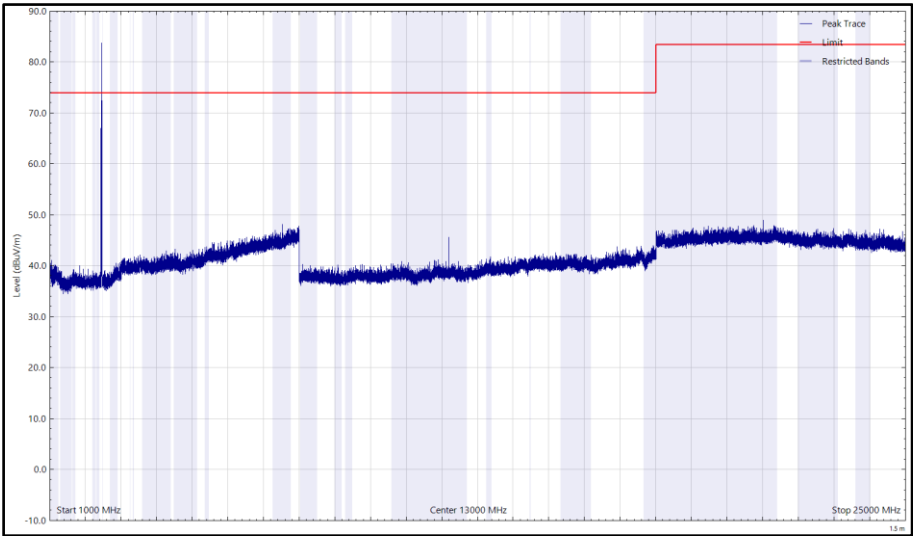


Figure 14 - X Orientation, 2441 MHz, 1 GHz to 25 GHz, Vertical (Peak)

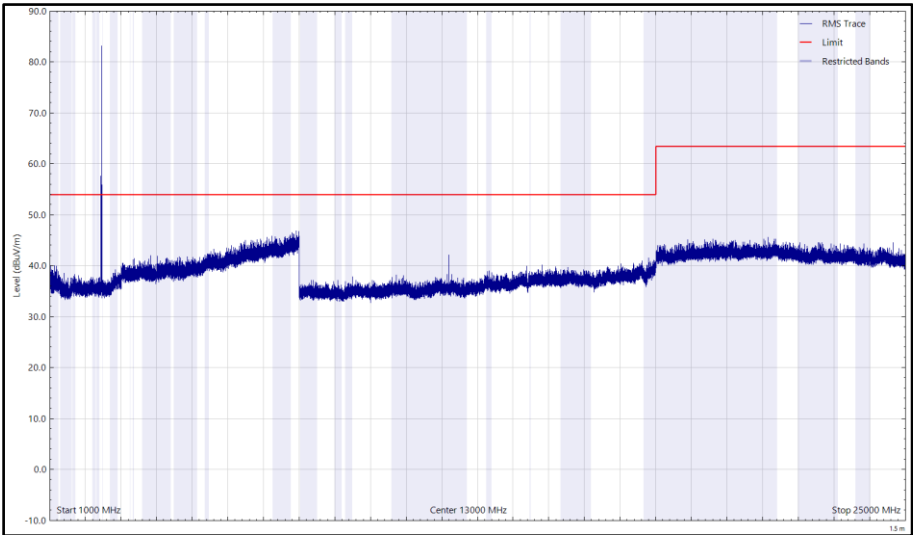


Figure 15 - X Orientation, 2441 MHz, 1 GHz to 25 GHz, Vertical (rms)



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

Table 22 - X Orientation, 2480 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

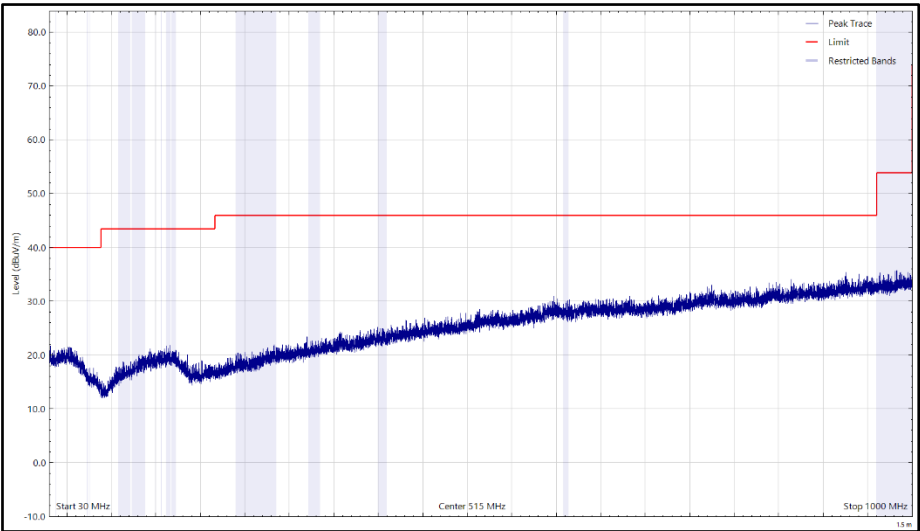


Figure 16 - X Orientation, 2480 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

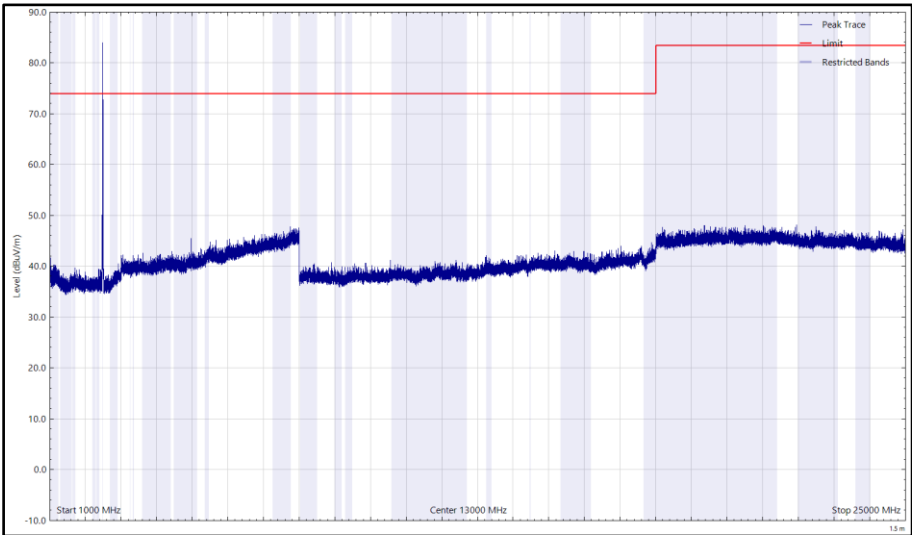


Figure 17 - X Orientation, 2480 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

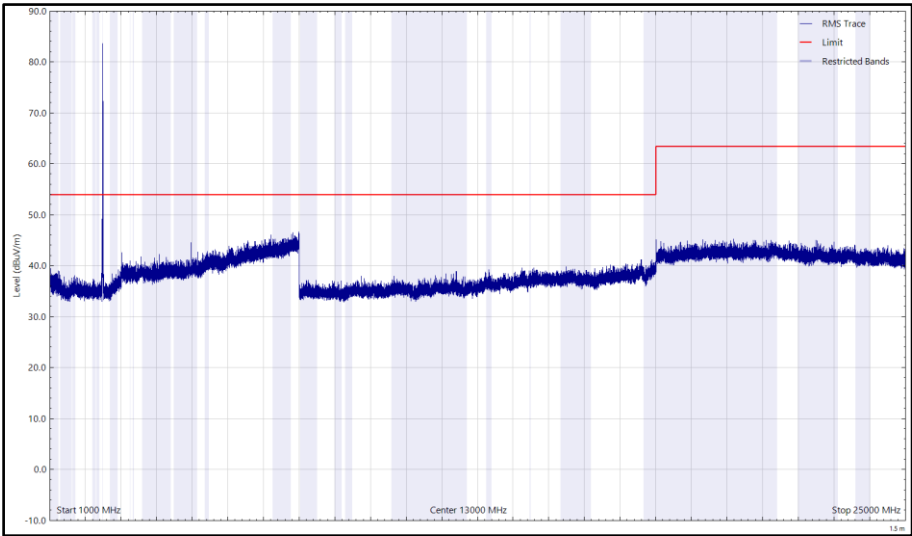


Figure 18 - X Orientation, 2480 MHz, 1 GHz to 25 GHz, Horizontal (rms)

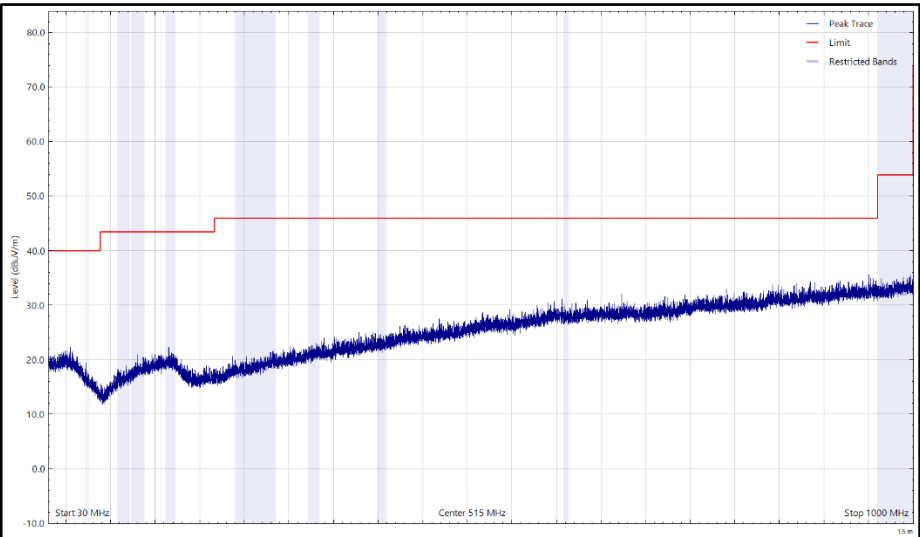


Figure 19 - X Orientation, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

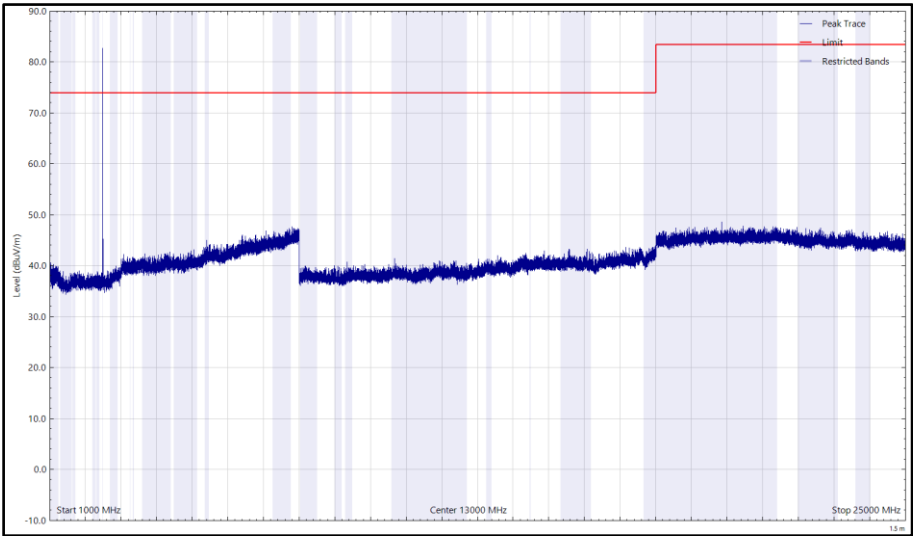


Figure 20 - X Orientation, 2480 MHz, 1 GHz to 25 GHz, Vertical (Peak)

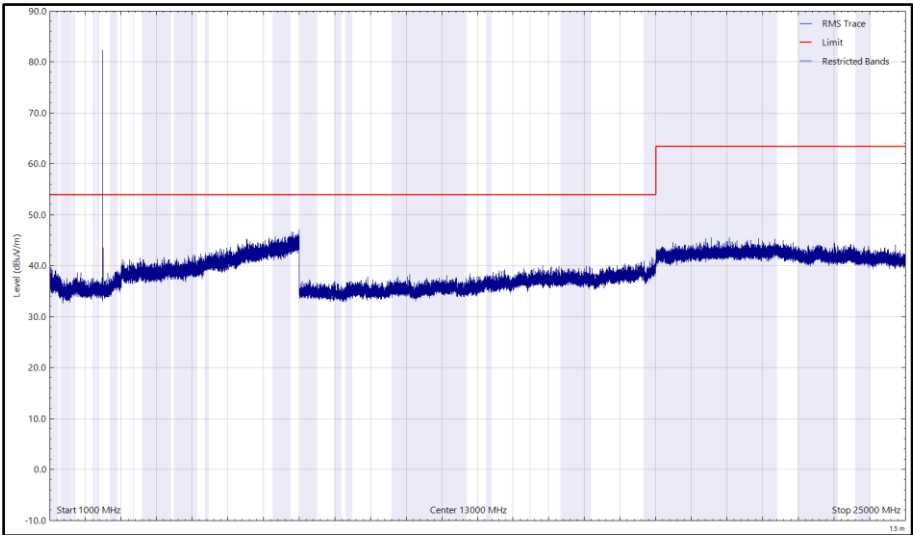


Figure 21 - X Orientation, 2480 MHz, 1 GHz to 25 GHz, Vertical (rms)



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

Table 23 - Y Orientation, 2402 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

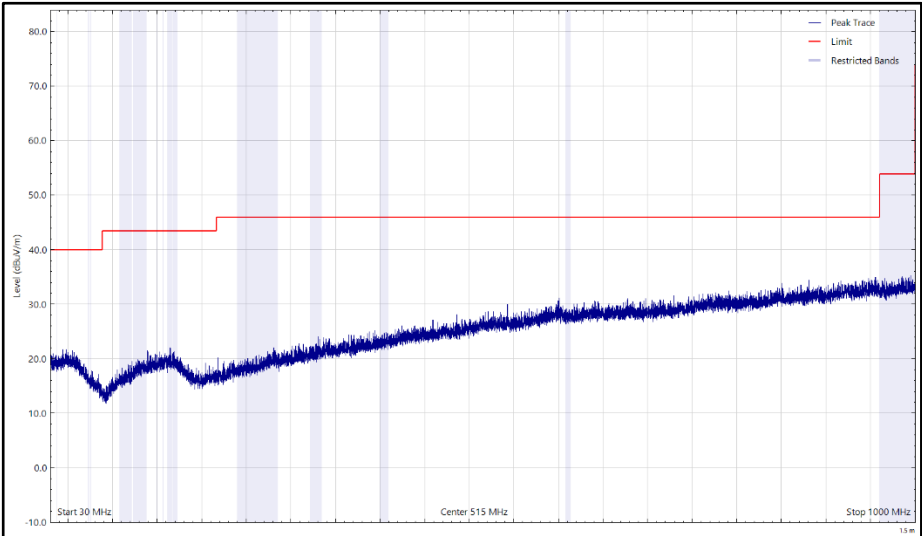


Figure 22 - Y Orientation, 2402 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

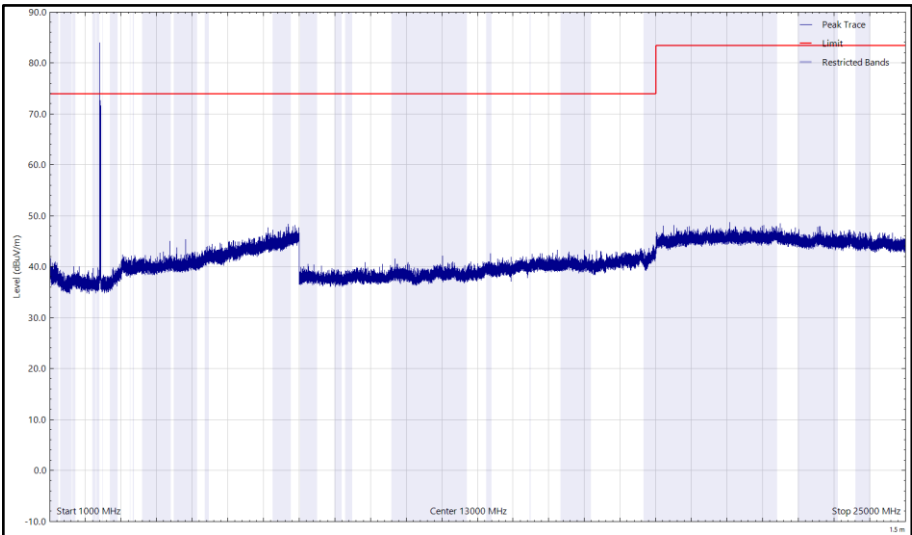


Figure 23 - Y Orientation, 2402 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

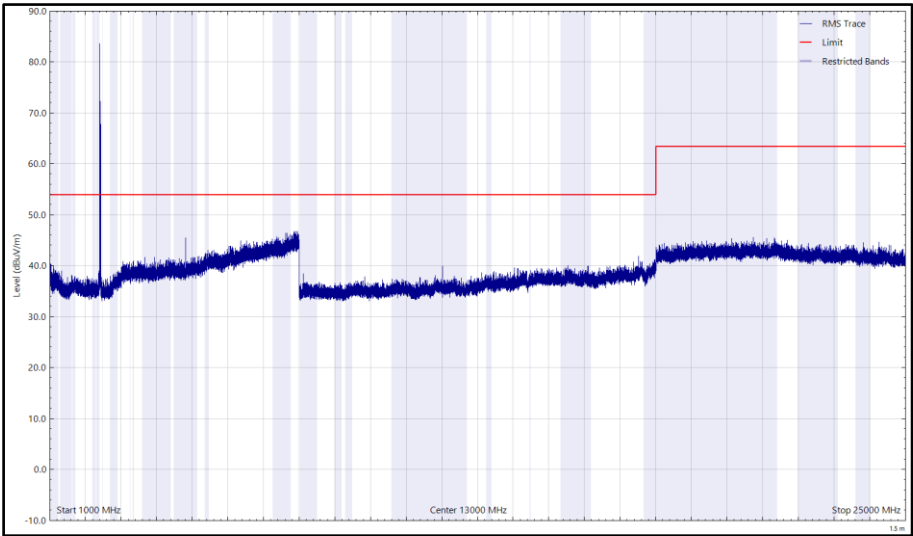


Figure 24 - Y Orientation, 2402 MHz, 1 GHz to 25 GHz, Horizontal (rms)

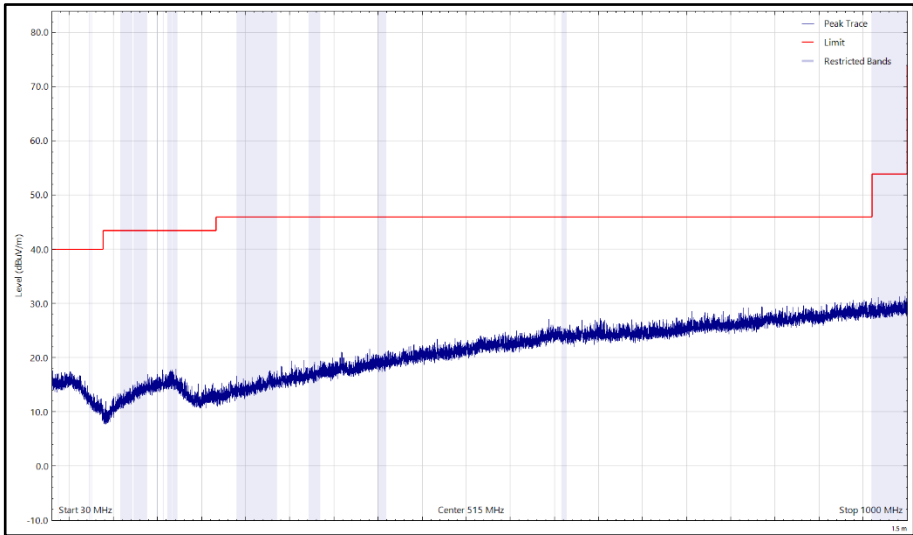


Figure 25 - Y Orientation, 2402 MHz, 30 MHz to 1 GHz, Vertical (Peak)

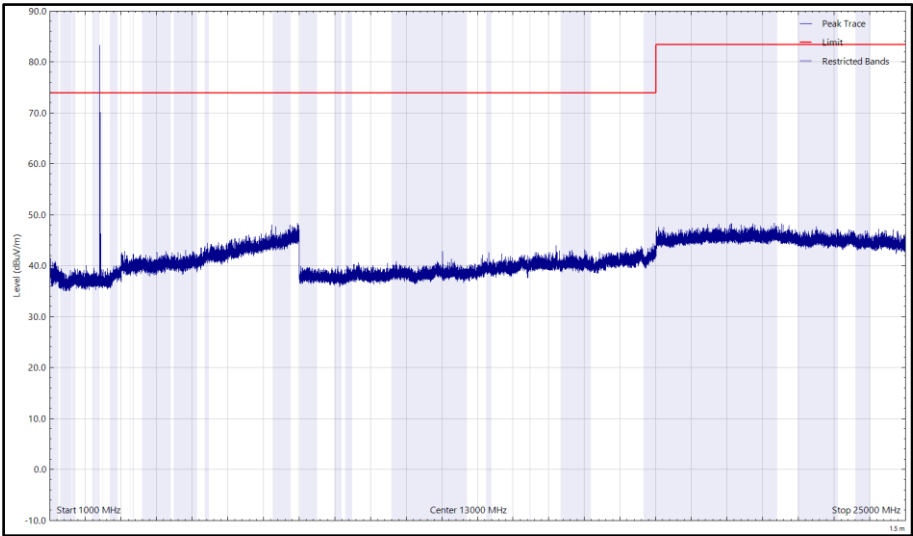


Figure 26 - Y Orientation, 2402 MHz, 1 GHz to 25 GHz, Vertical (Peak)

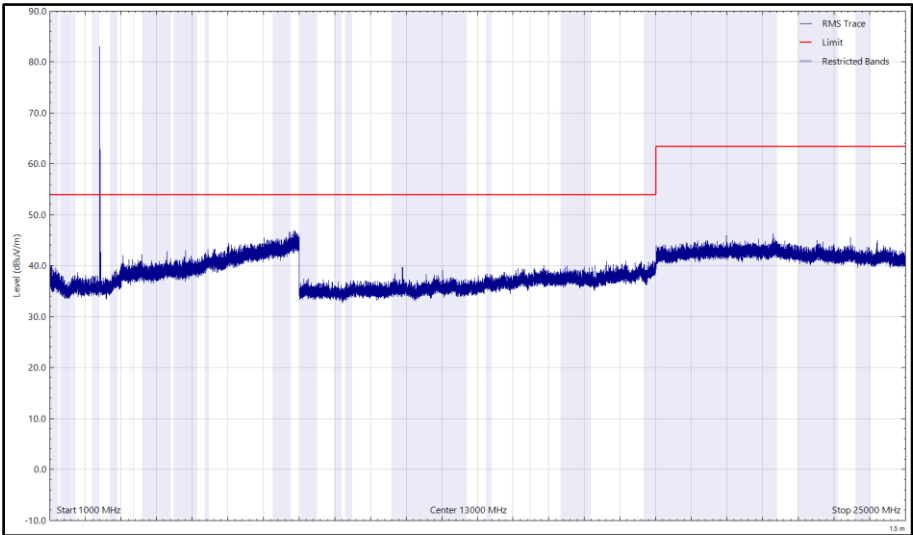


Figure 27 - Y Orientation, 2402 MHz, 1 GHz to 25 GHz, Vertical (rms)



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

Table 24 - Y Orientation, 2441 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

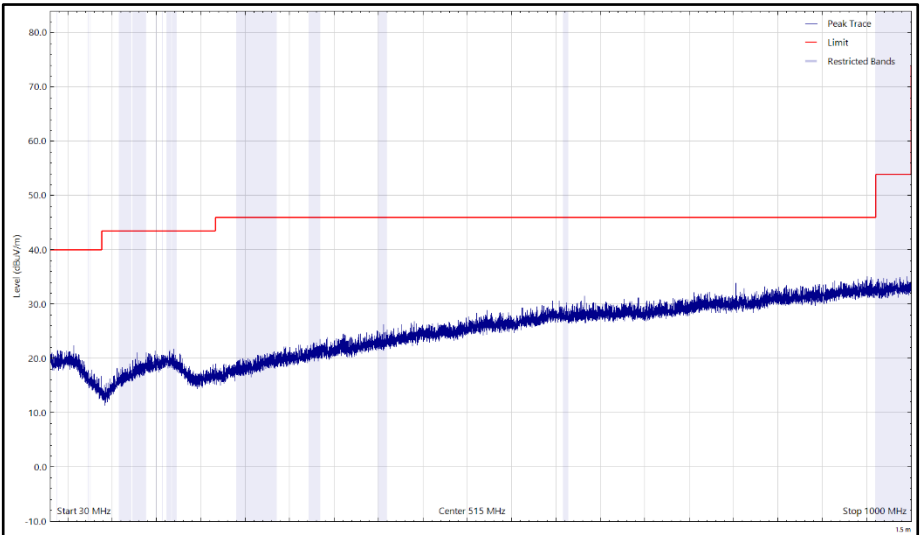


Figure 28 - Y Orientation, 2441 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

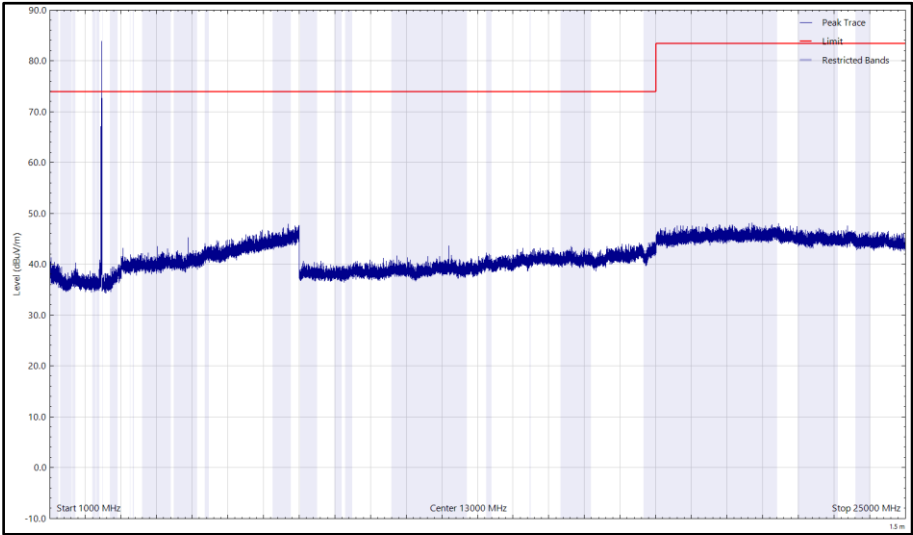


Figure 29 - Y Orientation, 2441 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

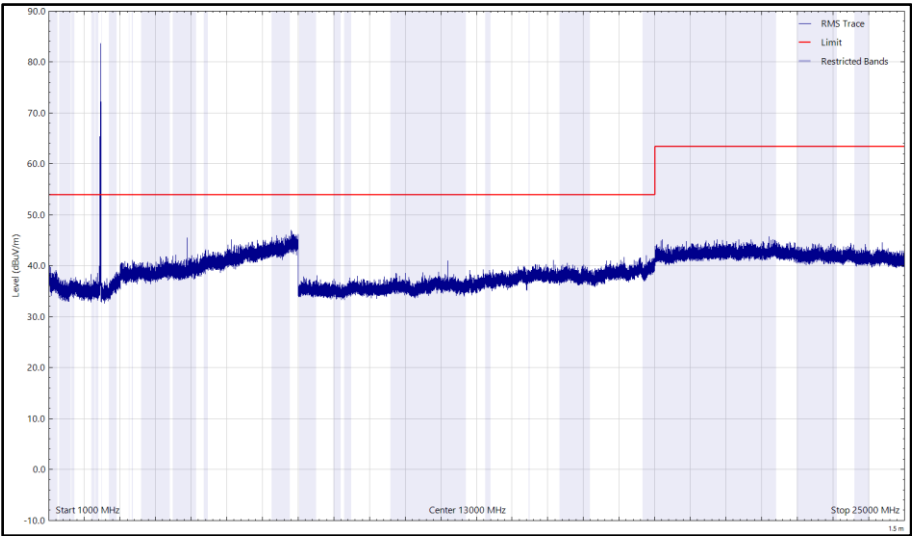


Figure 30 - Y Orientation, 2441 MHz, 1 GHz to 25 GHz, Horizontal (rms)

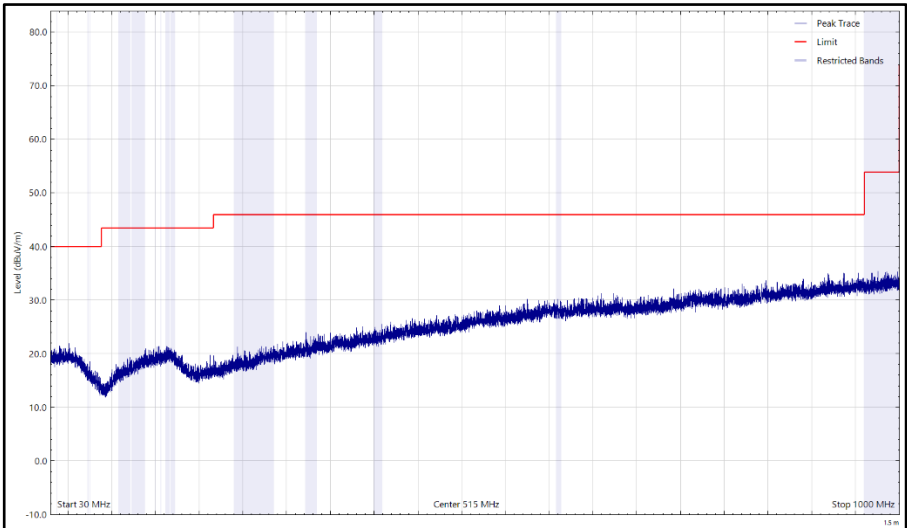


Figure 31 - Y Orientation, 2441 MHz, 30 MHz to 1 GHz, Vertical (Peak)

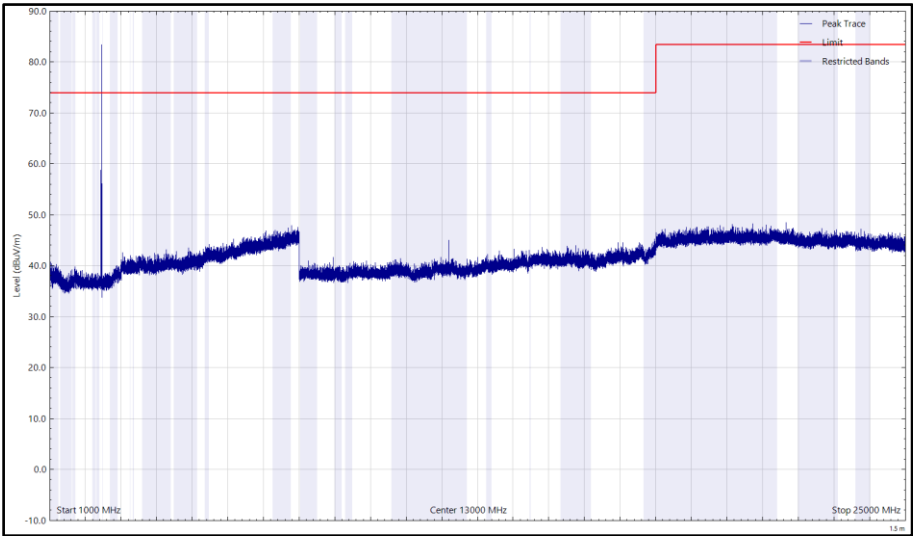


Figure 32 - Y Orientation, 2441 MHz, 1 GHz to 25 GHz, Vertical (Peak)

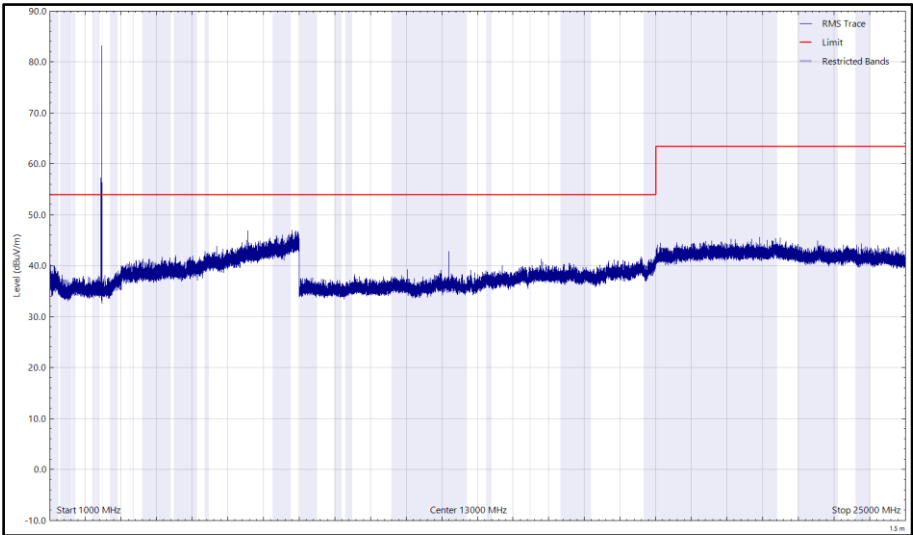


Figure 33 - Y Orientation, 2441 MHz, 1 GHz to 25 GHz, Vertical (rms)



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

Table 25 - Y Orientation, 2480 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

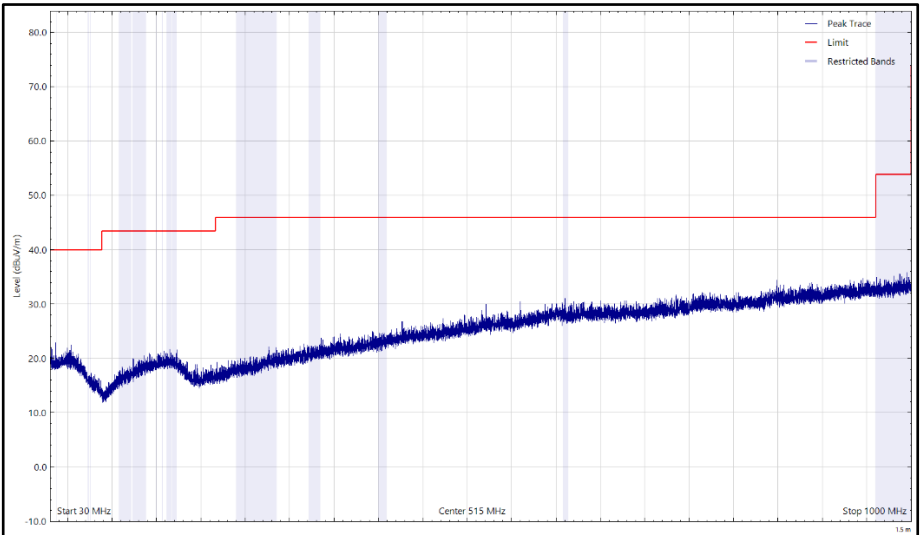


Figure 34 - Y Orientation, 2480 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

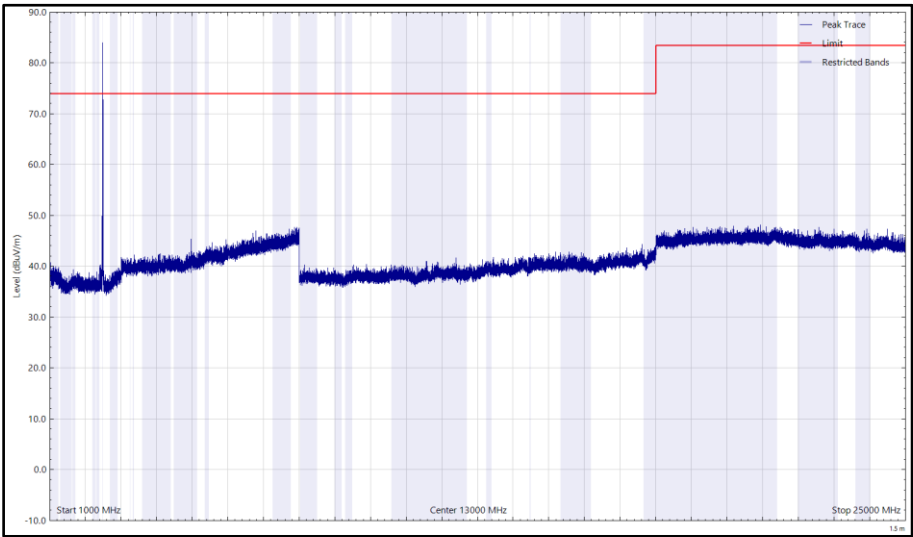


Figure 35 - Y Orientation, 2480 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

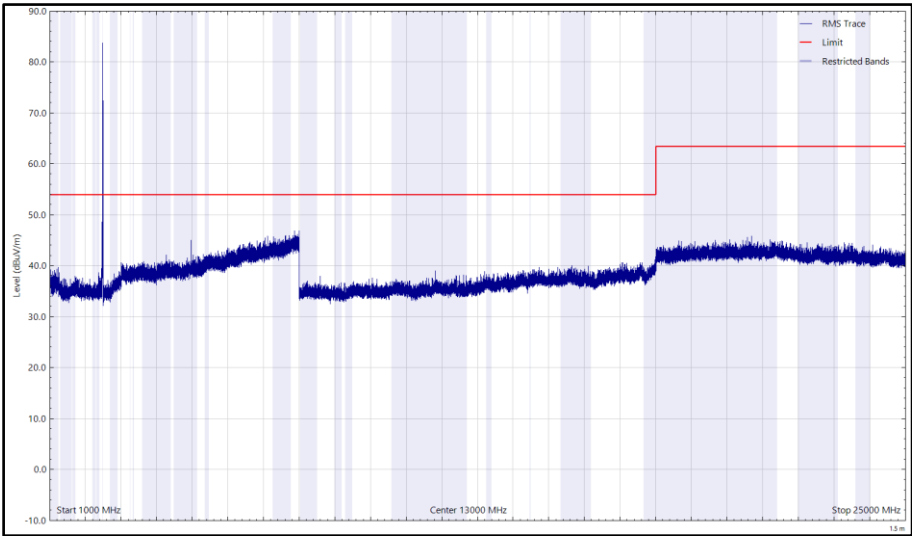


Figure 36 - Y Orientation, 2480 MHz, 1 GHz to 25 GHz, Horizontal (rms)

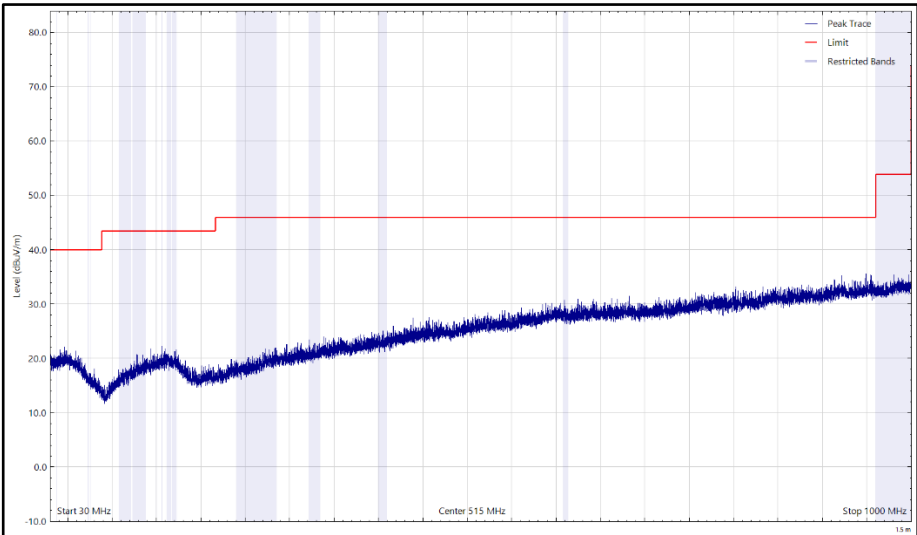


Figure 37 - Y Orientation, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

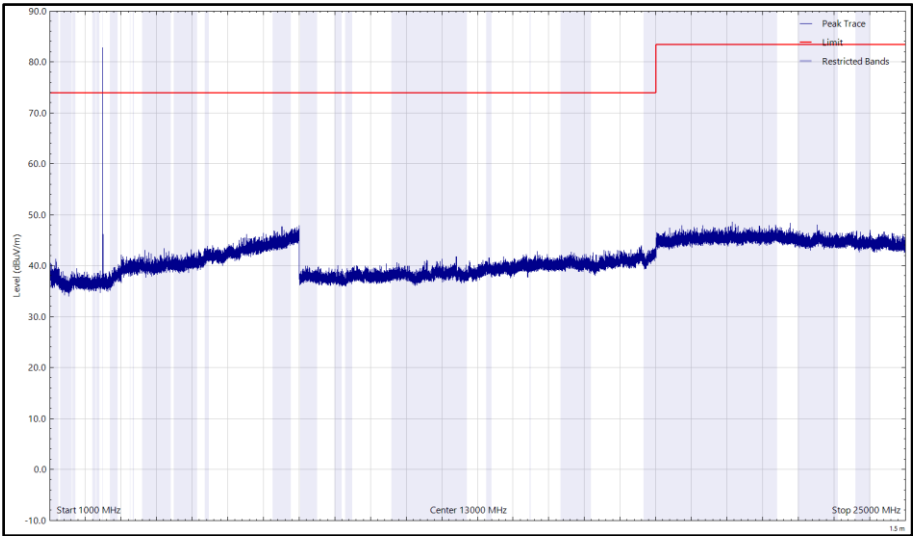


Figure 38 - Y Orientation, 2480 MHz, 1 GHz to 25 GHz, Vertical (Peak)

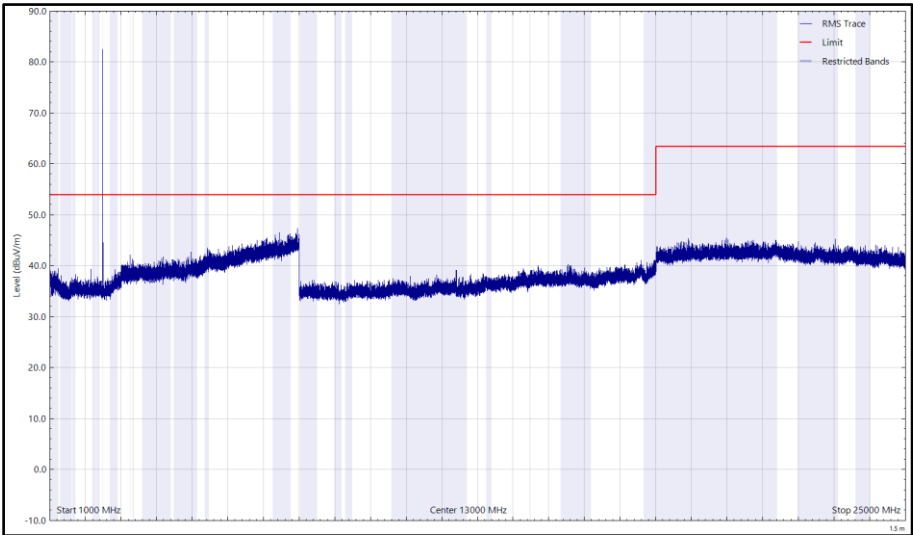


Figure 39 - Y Orientation, 2480 MHz, 1 GHz to 25 GHz, Vertical (rms)



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

Table 26 - Z Orientation, 2402 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

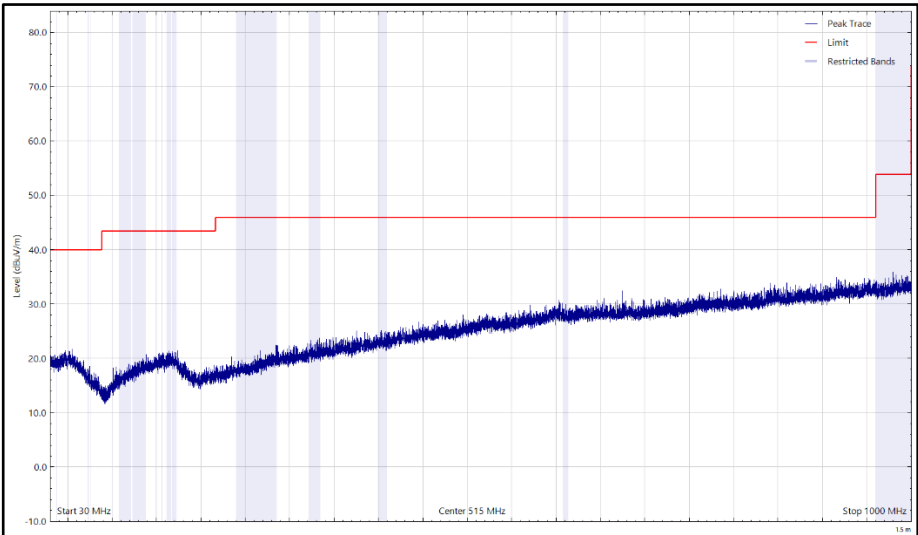


Figure 40 - Z Orientation, 2402 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

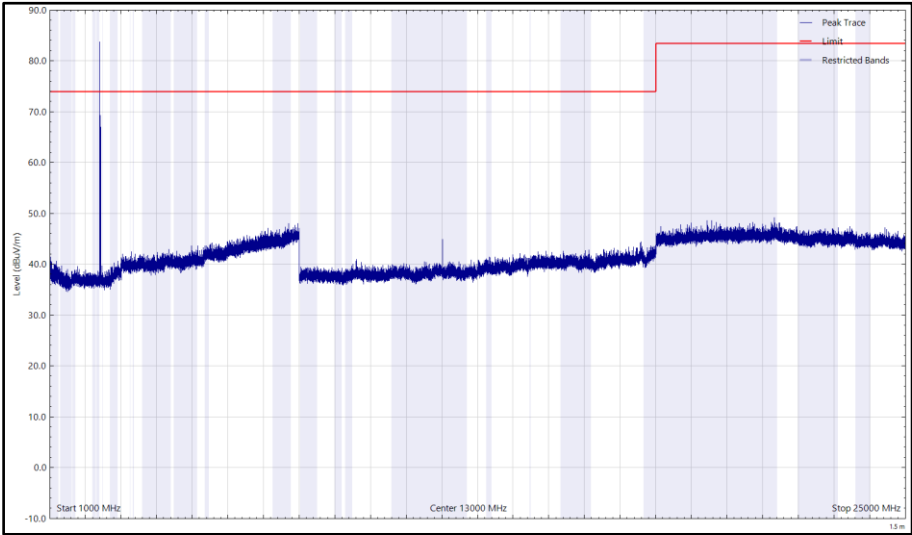


Figure 41 - Z Orientation, 2402 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

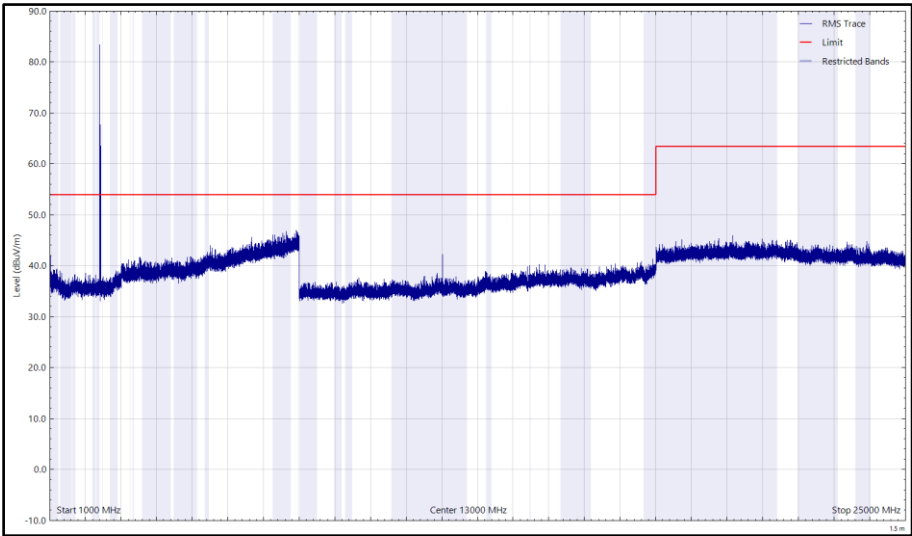


Figure 42 - Z Orientation, 2402 MHz, 1 GHz to 25 GHz, Horizontal (rms)

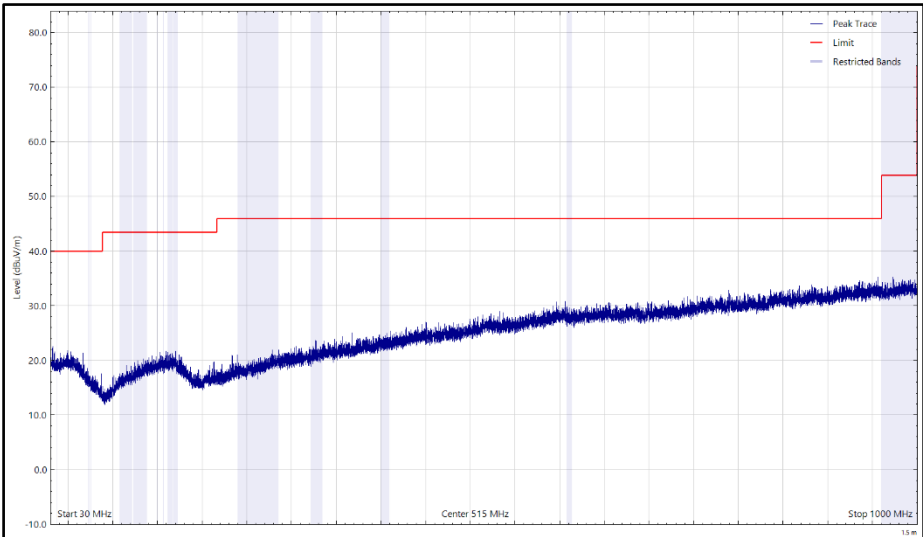


Figure 43 - Z Orientation, 2402 MHz, 30 MHz to 1 GHz, Vertical (Peak)

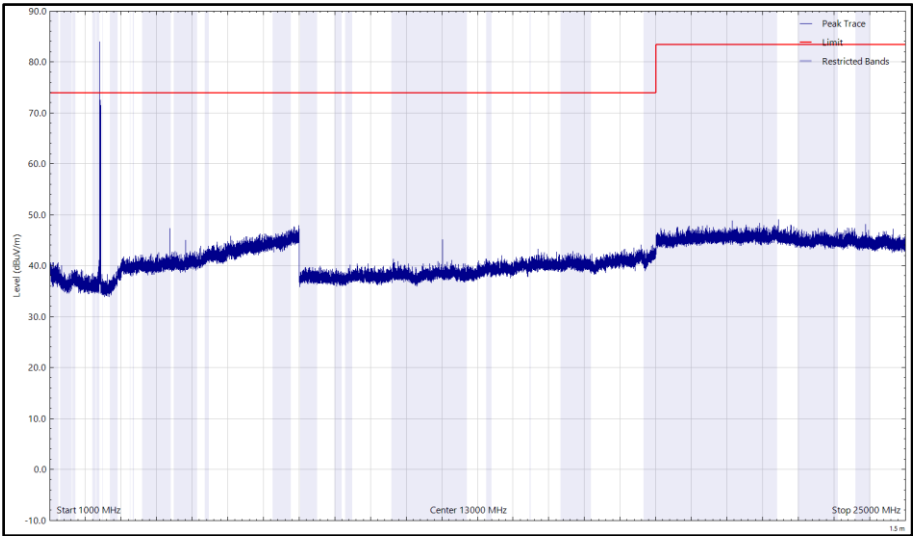


Figure 44 - Z Orientation, 2402 MHz, 1 GHz to 25 GHz, Vertical (Peak)

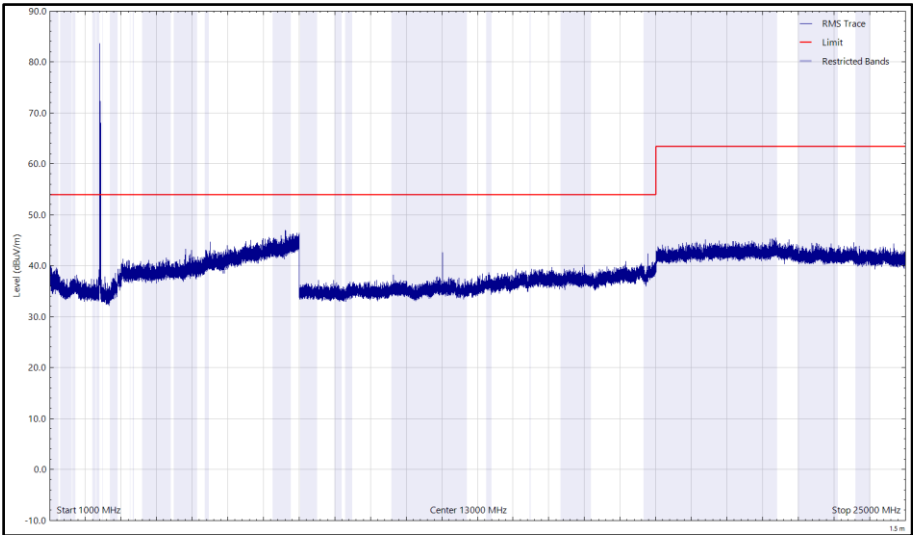


Figure 45 - Z Orientation, 2402 MHz, 1 GHz to 25 GHz, Vertical (rms)

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

Table 27 - Z Orientation, 2441 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

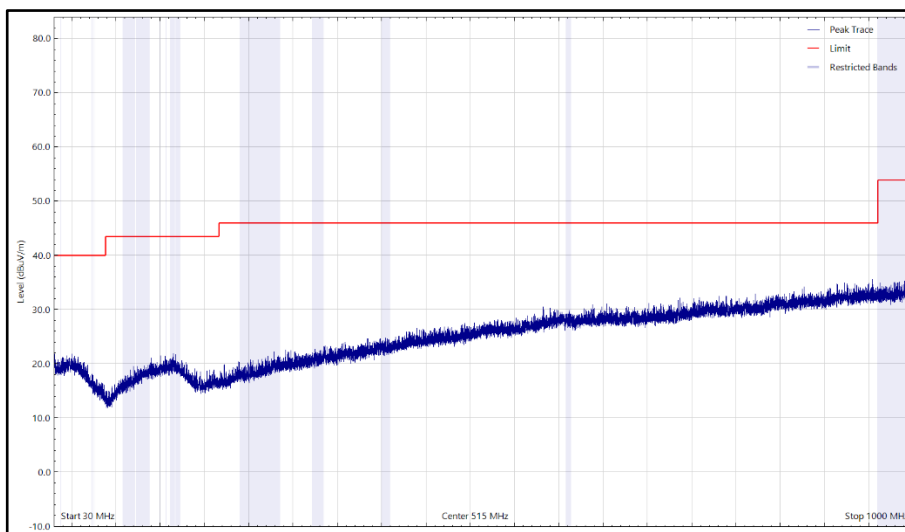


Figure 46 - Z Orientation, 2441 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

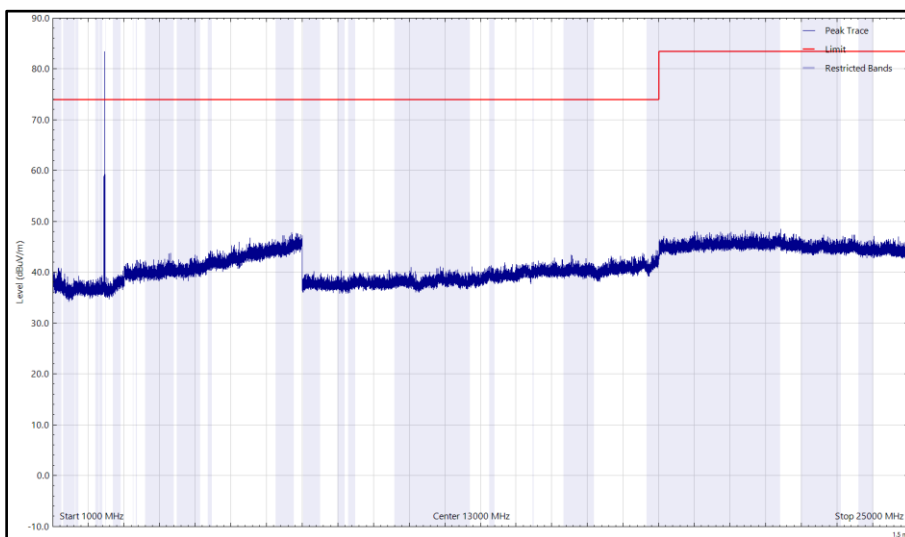


Figure 47 - Z Orientation, 2441 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

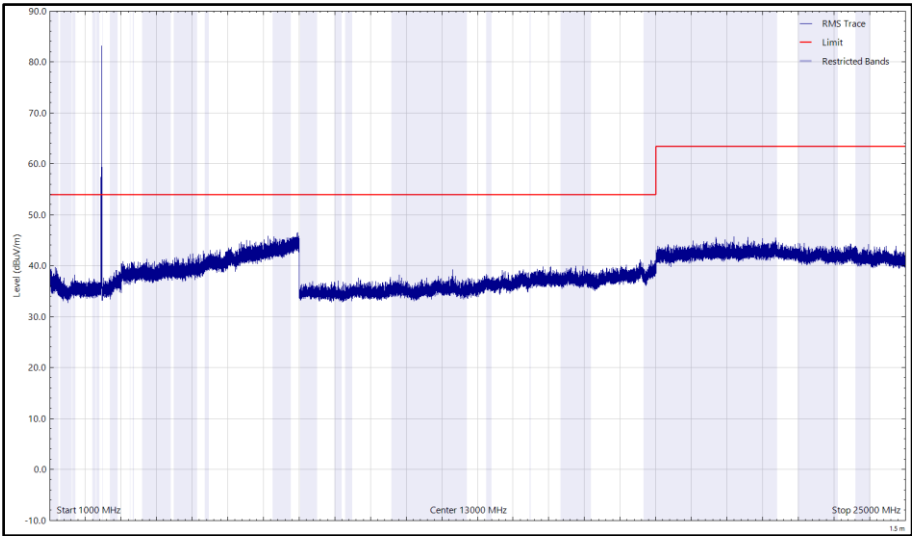


Figure 48 - Z Orientation, 2441 MHz, 1 GHz to 25 GHz, Horizontal (rms)

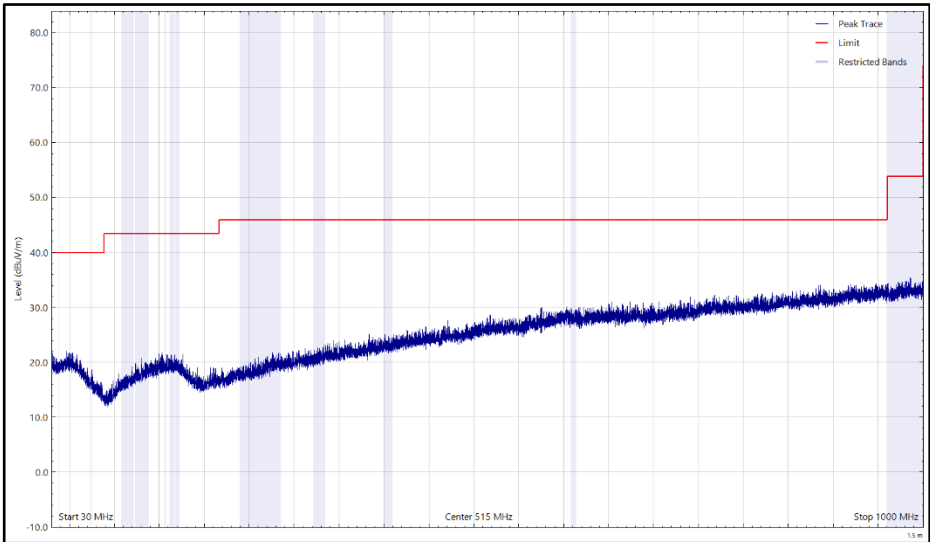


Figure 49 - Z Orientation, 2441 MHz, 30 MHz to 1 GHz, Vertical (Peak)

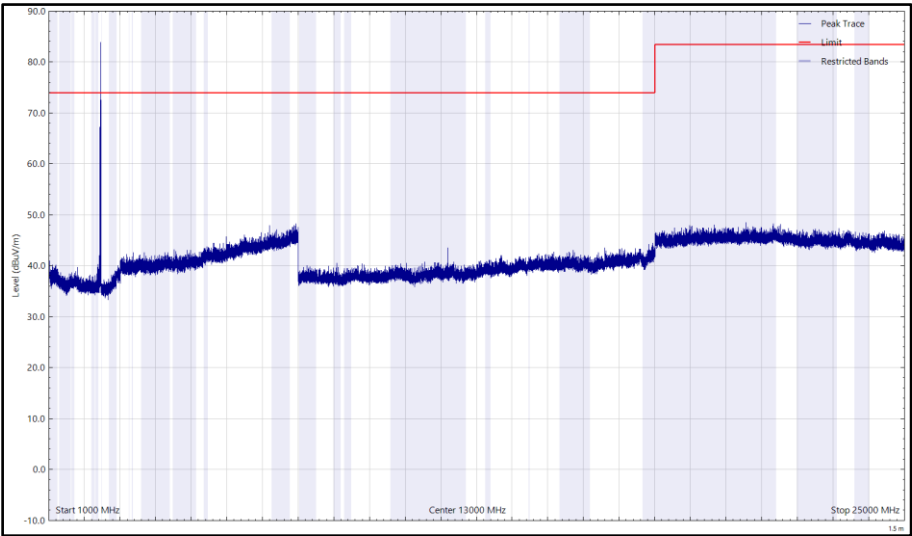


Figure 50 - Z Orientation, 2441 MHz, 1 GHz to 25 GHz, Vertical (Peak)

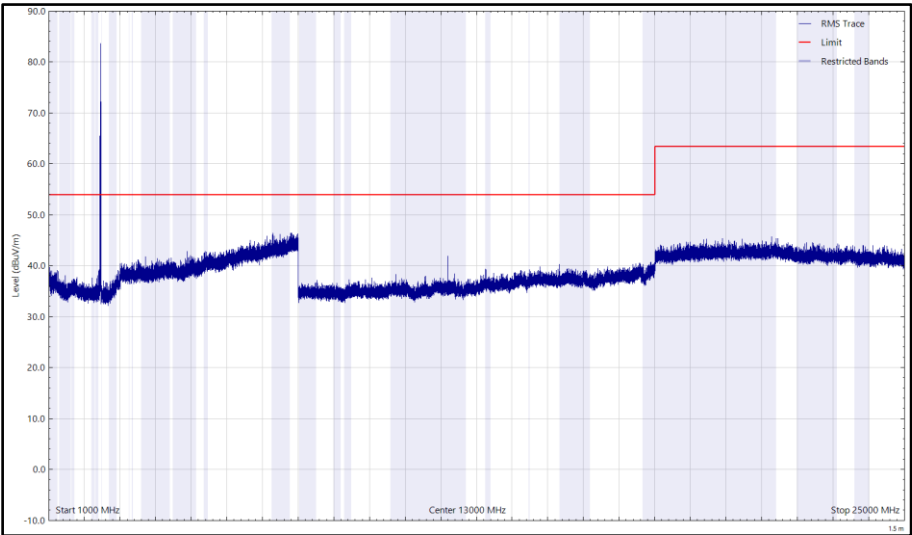


Figure 51 - Z Orientation, 2441 MHz, 1 GHz to 25 GHz, Vertical (rms)



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

Table 28 - Z Orientation, 2480 MHz, 30 MHz to 25 GHz

*No emissions found within 10 dB of the limit.

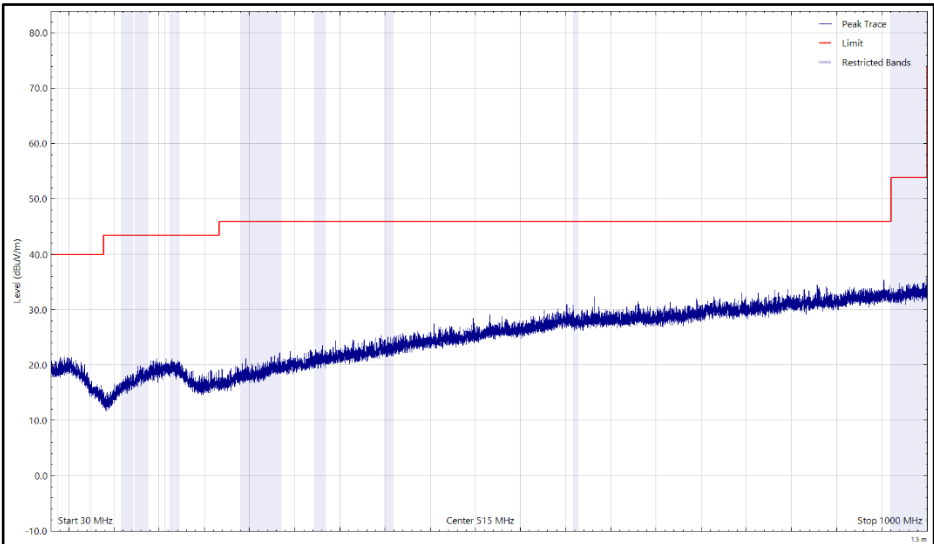


Figure 52 - Z Orientation, 2480 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

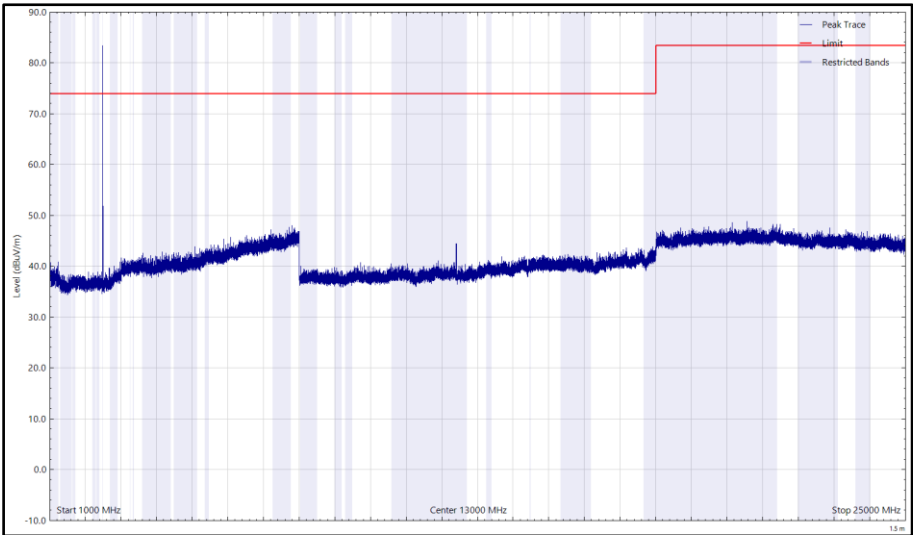


Figure 53 - Z Orientation, 2480 MHz, 1 GHz to 25 GHz, Horizontal (Peak)

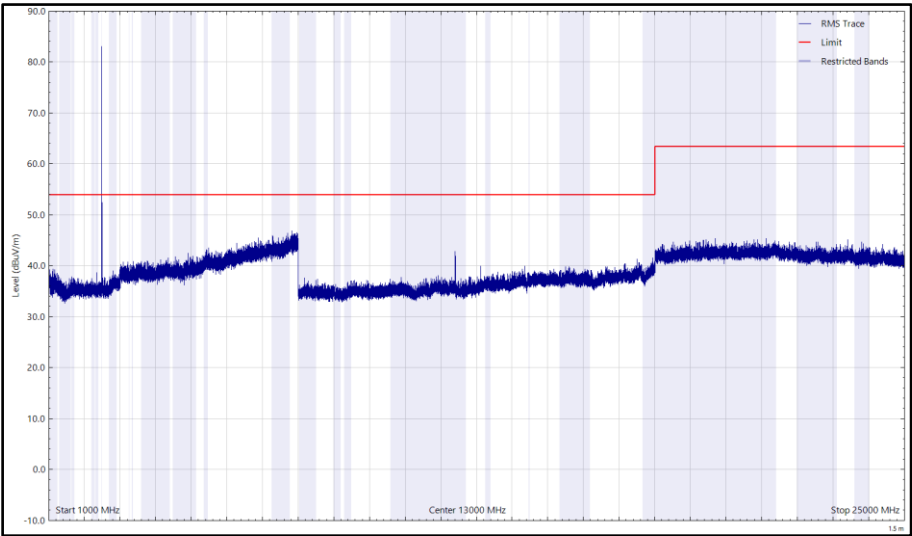


Figure 54 - Z Orientation, 2480 MHz, 1 GHz to 25 GHz, Horizontal (rms)

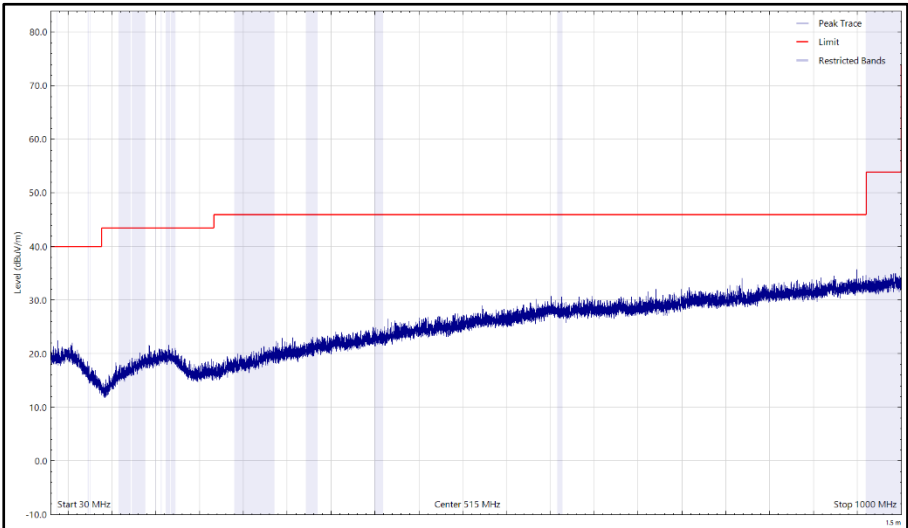


Figure 55 - Z Orientation, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

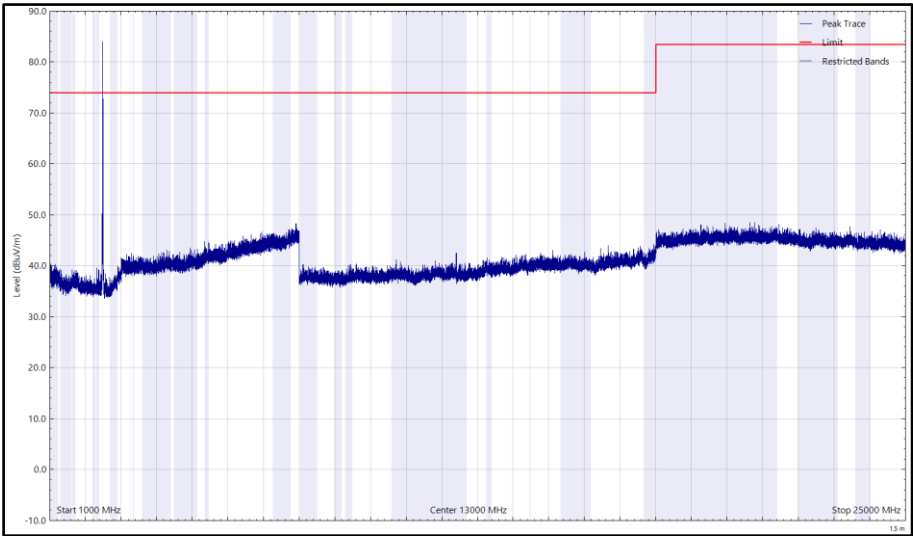


Figure 56 - Z Orientation, 2480 MHz, 1 GHz to 25 GHz, Vertical (Peak)

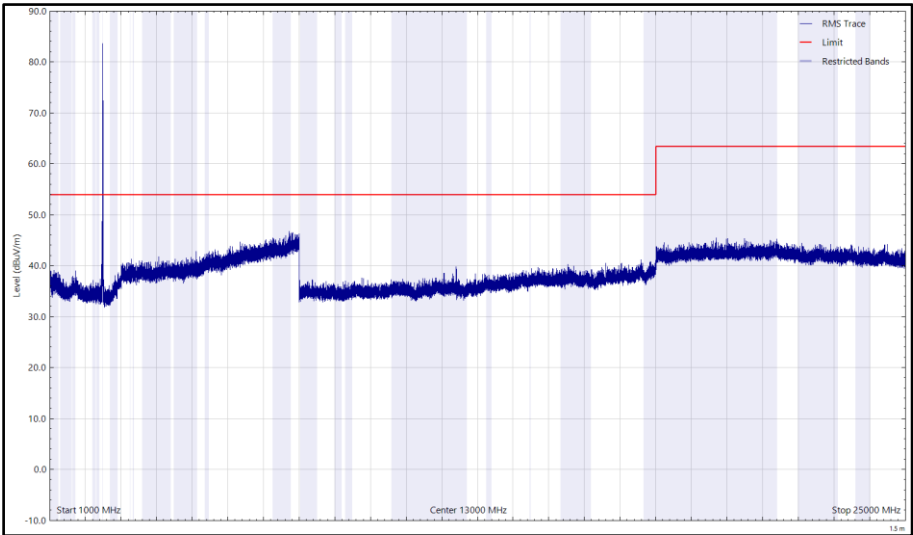


Figure 57 - Z Orientation, 2480 MHz, 1 GHz to 25 GHz, Vertical (rms)



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.



2.2.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Multimeter	Fluke	79 Series III	611	12	20-Dec-2023
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Dual Power Supply (0-30V, 0-2A)	Farnell	LT30-2	3333		TU
High Pass Filter (4GHz)	K&L Microwave	11SH10-4000/X18000-0/0	4599	12	13-Oct-2023
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	28-May-2023
Cable (40 GHz)	Rosenberger	LU1-001-1000	5022	12	29-Jan-2024
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	18-Dec-2023
Emissions Software	TUV SUD	EmX V3.1.11	5125	-	Software
Cable 2.92mm 1m	Junkosha	MWX241-01000KMS	5414	12	24-Jul-2023
Cable (K Type 2m)	Junkosha	MWX241-02000KMS	5421	12	08-Mar-2024
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	12	12-May-2023
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	19-May-2023
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5547	12	11-May-2023
1200 MHz Low Pass Filter (01)	Mini-Circuits	VLF-1200+	5559	12	23-May-2023
Antenna (DRG, 7.5 GHz to 18 GHz)	Schwarzbeck	HWRD750	5610	12	16-Oct-2023
3.5mm Cable (1m)	Junkosha	MWX221/B	5837	12	24-Jul-2023
TRILOG Super Broadband Test Antenna	Schwarzbeck	VULB 9168	5942	24	03-Feb-2024
Double Ridge Active Horn Antenna (18-40 GHz)	Com-Power	AHA-840	6189	24	02-Jun-2024
Attenuator 4dB	Pasternack	PE7074-4	6202	24	16-Jul-2024
Pre-Amplifier (8 - 18GHz)	Wright Technologies	APS06-0061	6306	12	06-Feb-2024
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	6330	12	16-Feb-2024

Table 29

TU - Traceability Unscheduled



2.3 Emission Bandwidth

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test and Modification State

H2O Leak Sensor, S/N: Not Serialised (FAR-724725-010) - Modification State 0
H2O Leak Sensor, S/N: Not Serialised (FAR-724725-013) - Modification State 0
H2O Leak Sensor, S/N: Not Serialised (FAR-724725-015) - Modification State 0

2.3.3 Date of Test

16-May-2023

2.3.4 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.

2.3.5 Environmental Conditions

Ambient Temperature	22.9 °C
Relative Humidity	32.8 %



2.3.6 Test Results

2.4 GHz Bluetooth Low Energy - Leak Sensor

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:	BLE 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	
2402	0.812	-	-	-	≥500.0
2440	0.868	-	-	-	≥500.0
2480	0.784	-	-	-	≥500.0

Table 30 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2402	1.100	-	-	-	-
2440	1.108	-	-	-	-
2480	1.088	-	-	-	-

Table 31 - 99% Bandwidth Results

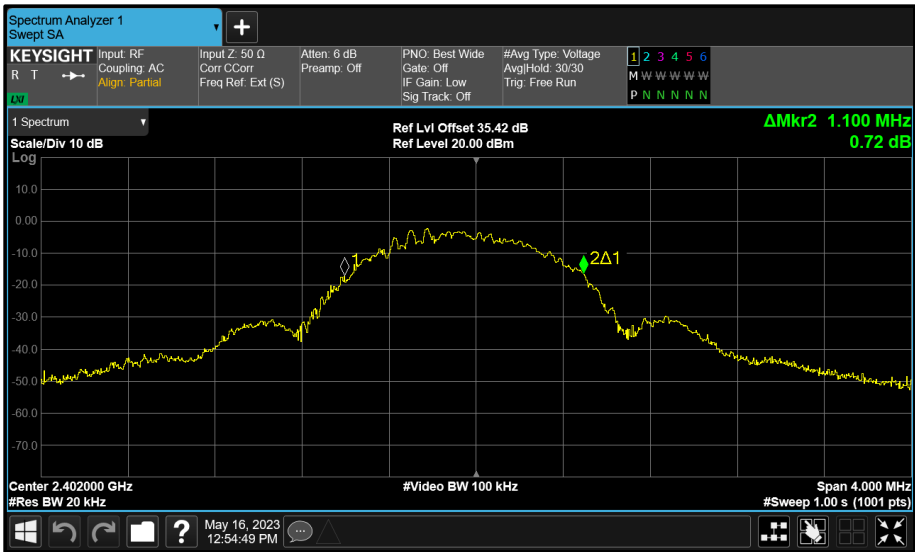


Figure 58 - A (A) 2402 MHz (CH37) 99% Bandwidth

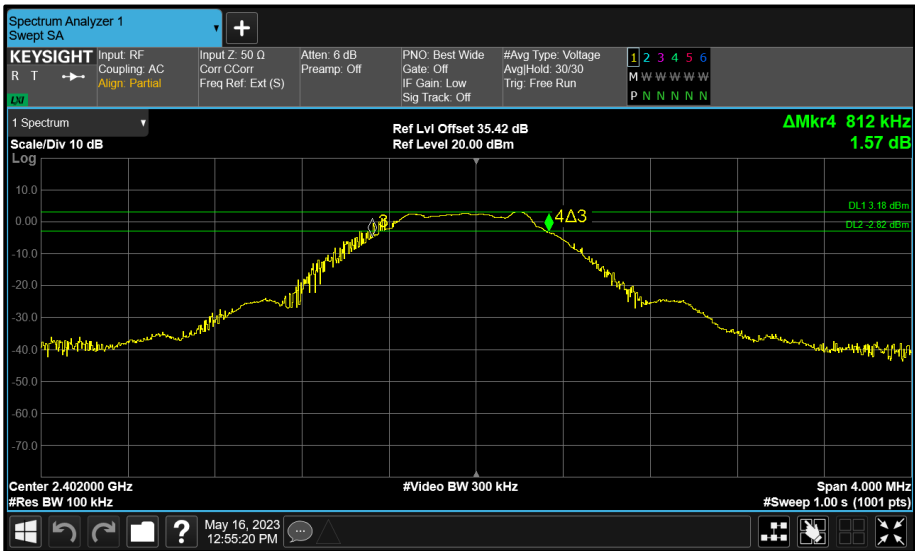


Figure 59 - A (A) 2402 MHz (CH37) 6 dB Bandwidth

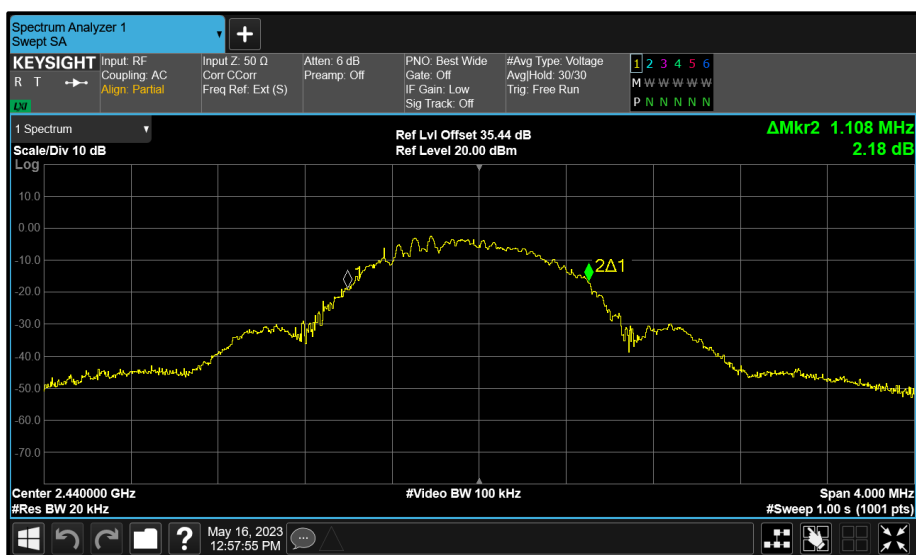


Figure 60 - A (A) 2440 MHz (CH17) 99% Bandwidth

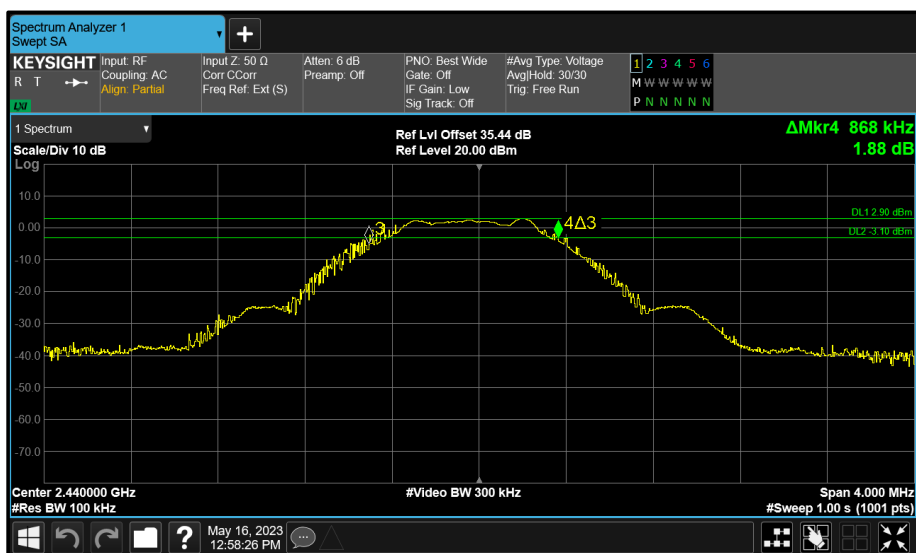


Figure 61 - A (A) 2440 MHz (CH17) 6 dB Bandwidth

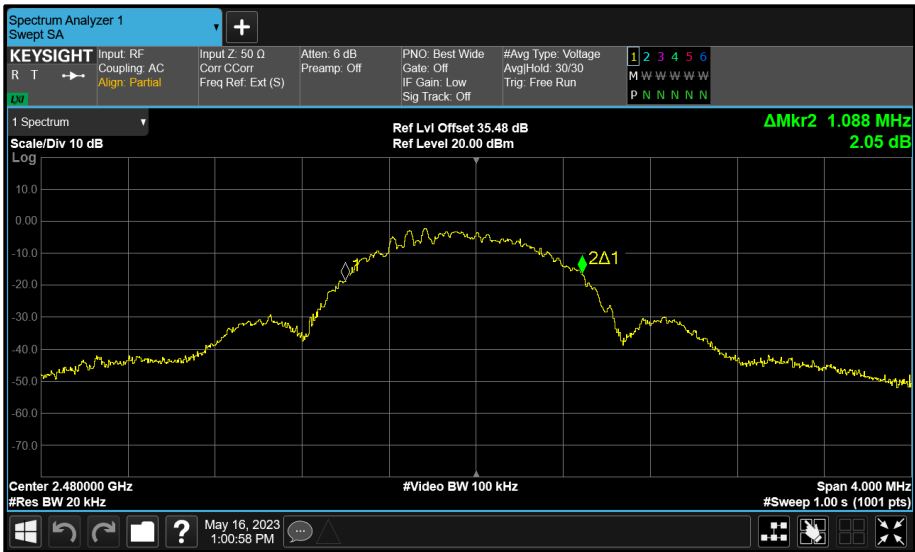


Figure 62 - A (A) 2480 MHz (CH39) 99% Bandwidth

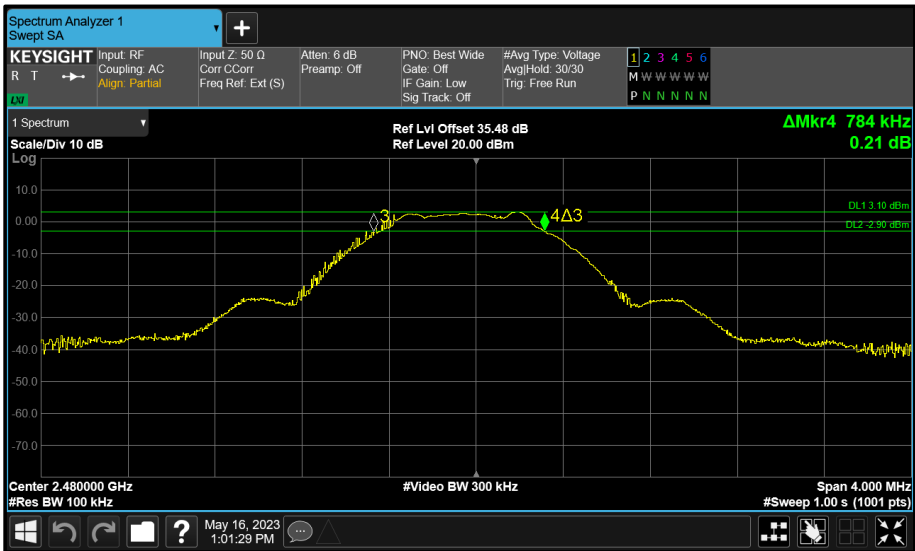


Figure 63 - A (A) 2480 MHz (CH39) 6 dB Bandwidth



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.

2.3.7 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
Hygrometer	Rotronic	I-1000	3220	12	15-Nov-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	13-Jul-2023
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	21-Mar-2024
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	5759	12	05-Jul-2023

Table 32



2.4 Maximum Conducted Output Power

2.4.1 Specification Reference

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

2.4.2 Equipment Under Test and Modification State

H2O Leak Sensor, S/N: Not Serialised (FAR-724725-010) - Modification State 0
H2O Leak Sensor, S/N: Not Serialised (FAR-724725-013) - Modification State 0
H2O Leak Sensor, S/N: Not Serialised (FAR-724725-015) - Modification State 0

2.4.3 Date of Test

16-May-2023

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.9.1.2 Method PKPM1.

2.4.5 Environmental Conditions

Ambient Temperature	22.9 °C
Relative Humidity	32.8 %



2.4.6 Test Results

2.4 GHz Bluetooth Low Energy - Leak Sensor

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(3) RSS-247 5.4 d)	Test Method(s):	C63.10 11.9.1.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	BLE GFSK (LE 1M)	Duty Cycle (%):	98.7
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A (A)	Peak Antenna Gain (dBi):	1.18

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	Σ		
2402	3.05	-	-	-	-	30.00	-26.95
2440	2.92	-	-	-	-	30.00	-27.08
2480	2.93	-	-	-	-	30.00	-27.07

Table 33 - 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	Σ					
2402	3.05	-	-	-	-	30.00	-26.95	4.23	36.00	-31.77
2440	2.92	-	-	-	-	30.00	-27.08	4.10	36.00	-31.90
2480	2.93	-	-	-	-	30.00	-27.07	4.11	36.00	-31.89

Table 34 - ISSED 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 (d)

For DTSSs 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.

2.4.7 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
Hygrometer	Rotronic	I-1000	3220	12	15-Nov-2023
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	5759	12	05-Jul-2023
USB Power Sensor	Boonton	RTP5008	5830	12	07-Jul-2023

Table 35



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

H2O Leak Sensor, S/N: Not Serialised (FAR-724725-004) - Modification State 0

2.5.3 Date of Test

26-April-2023 to 28-April-2023

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	18.3 °C
Relative Humidity	40.4 %

2.5.6 Test Results

2.4 GHz Bluetooth Low Energy - Leak Sensor

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	2402	2400	-43.49

Table 36

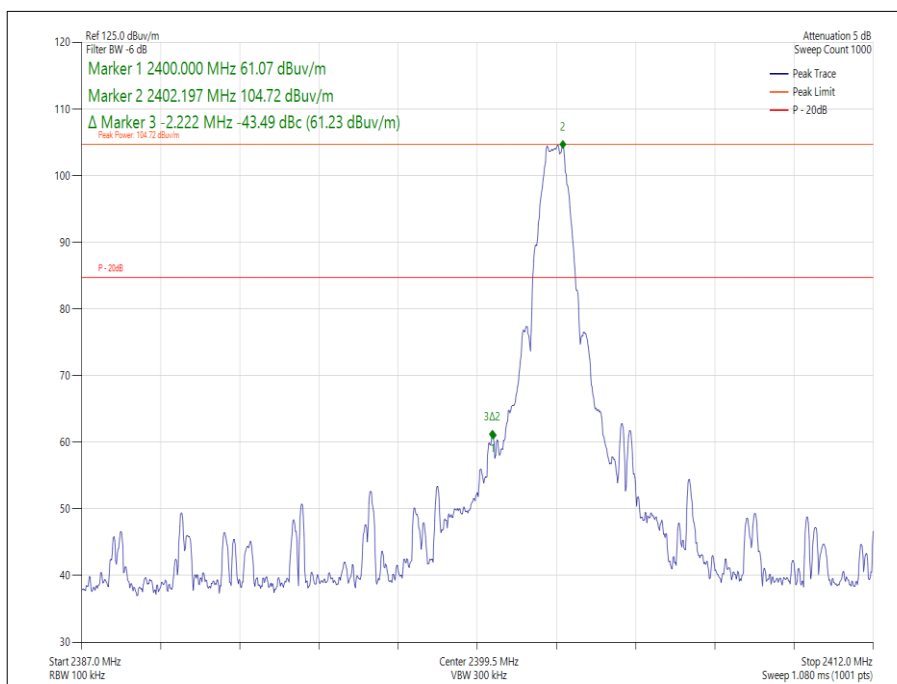


Figure 64 - GFSK, 2402 MHz - Band Edge Frequency 2400 MHz

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 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	28-May-2023
Emissions Software	TUV SUD	EmX V3.1.11	5125	-	Software
Cable (K Type 2m)	Junkosha	MWX241-02000KMS	5421	12	08-Mar-2024
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5476	12	06-Oct-2023
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	19-May-2023
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	6330	12	16-Feb-2024

Table 37

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

H2O Leak Sensor, S/N: Not Serialised (FAR-724725-010) - Modification State 0
H2O Leak Sensor, S/N: Not Serialised (FAR-724725-013) - Modification State 0
H2O Leak Sensor, S/N: Not Serialised (FAR-724725-015) - Modification State 0

2.6.3 Date of Test

16-May-2023

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	22.9 °C
Relative Humidity	32.8 %



2.6.6 Test Results

2.4 GHz Bluetooth Low Energy - Leak Sensor

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:	BLE GFSK (LE 1M)	Duty Cycle (%):	98.7
Antenna Configuration:	SISO	DCCF (dB):	-
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	Σ		
2402	3.0	-12.47	-	-	-	-	8.00	-20.47
2440	3.0	-12.50	-	-	-	-	8.00	-20.50
2480	3.0	-12.47	-	-	-	-	8.00	-20.47

Table 38 - 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
Hygrometer	Rotronic	I-1000	3220	12	15-Nov-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	13-Jul-2023
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	21-Mar-2024
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	5759	12	05-Jul-2023

Table 39

3 Photographs

3.1 Test Setup Photographs

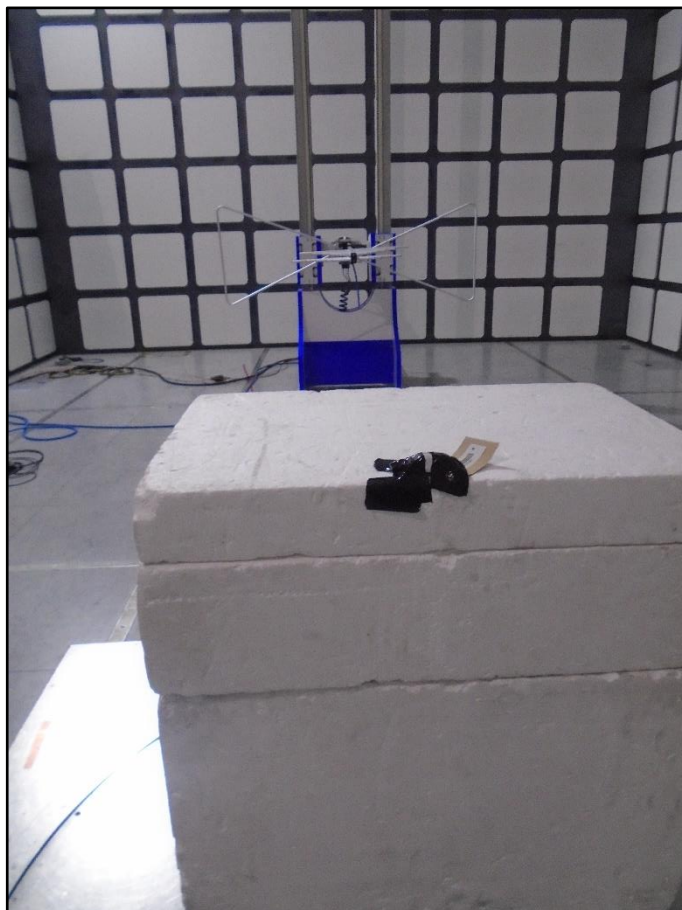


Figure 65 - Test Setup - 30 MHz to 1 GHz

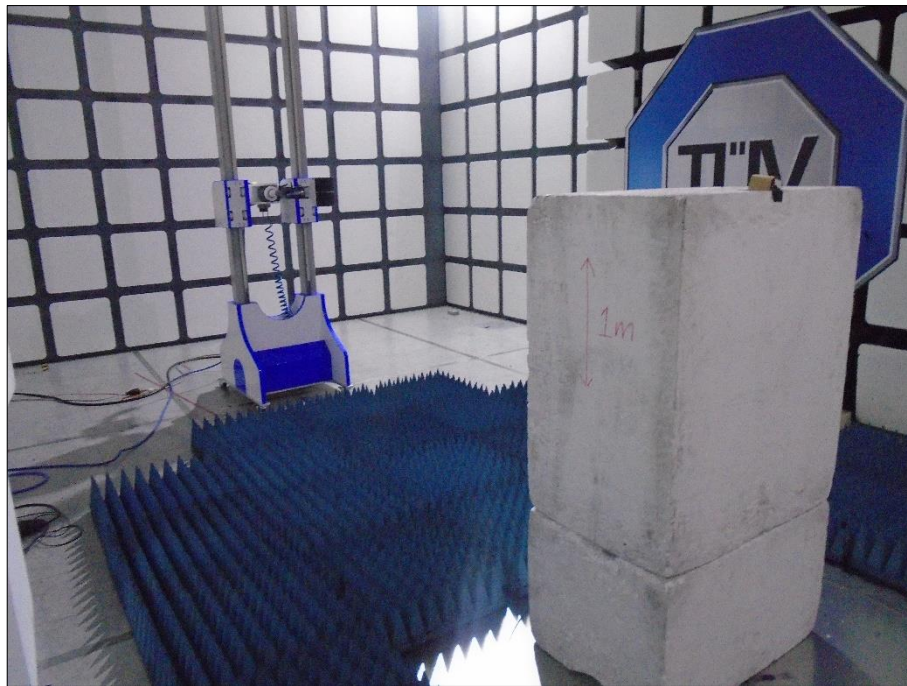


Figure 66 - Test Setup - 1 GHz to 8 GHz



Figure 67 - Test Setup - 8 GHz to 18 GHz



Figure 68 - Test Setup - 18 GHz to 25 GHz



Figure 69 - Test Setup - X Orientation



Figure 70 - Test Setup - Y Orientation



Figure 71 - Test Setup - 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
Emission Bandwidth	± 19.12 kHz by Lab
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Maximum Conducted Output Power	± 1.38 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Power Spectral Density	± 1.49 dB

Table 40

Measurement Uncertainty Decision Rule – Accuracy Method

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.