FCC Test Report

Shot Scope Technologies Ltd
GPS + Performance tracking watch,
Model: V3 SS03

In accordance with FCC 47 CFR Part 15C

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

FCC ID: 2AHWR-SS04

COMMERCIAL-IN-CONFIDENCE

Document 75947856-06 Issue 01

SIGNATURE			
			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	11 May 2020

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	11 May 2020	
Testing	Nandhini Mathivanan	11 May 2020	

FCC Accreditation
90987 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: 2019 for the tests detailed in section 1.3.

TÜV SÜD
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Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

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

Contents

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 May 2020

Table 1

1.2 Introduction

Applicant	Shot Scope Technologies Ltd
Manufacturer	Shot Scope Technologies Ltd
Model Number(s)	V3 SS03
Serial Number(s)	Not serialised (0075947856-TSR0004) Not serialised (0075947856-TSR0001) Not serialised (0075947856-TSR0013)
Hardware Version(s)	1.0
Software Version(s)	1.0
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2019
Order Number Date	2019-0069 TUV 06-January-2020
Date of Receipt of EUT	18-March-2020 and 01-April-2020
Start of Test	23-March-2020
Finish of Test	03-April-2020
Name of Engineer(s)	Graeme Lawler and Nandhini Mathivanan
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
Configuration and Mode: Bluetooth Low Energy				
2.1	15.247 (d)	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.2	15.247 (d) and 15.205	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.3	15.205	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.4	15.207	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2013)
2.5	15.247 (a)(2)	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.6	15.247 (e)	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.7	15.247 (b)	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	Shot Scope V3 is a watch 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:	SS03
Part Number:	V3
Hardware Version:	1.0
Software Version:	1.0
FCC ID (if applicable)	2AHWR-SS04
IC ID (if applicable)	Not Applicable

Intentional Radiators

Technology	BLE
Frequency Band (MHz)	2402 – 2480
Conducted Declared Output Power (dBm)	-2
Antenna Gain (dBi)	1.7
Supported Bandwidth(s) (MHz)	2
Modulation Scheme(s)	GFSK
ITU Emission Designator	1M05F1D
Bottom Frequency (MHz)	2402
Middle Frequency (MHz)	2440
Top Frequency (MHz)	2480

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	2480 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) ☒	

AC Power Source

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

DC Power Source

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

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:		

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☒

Temperature

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

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 ☐					

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

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

Name: Lewis Allison
Position held: Chief Technology Officer
Date: 20/03/20

1.5 Product Information

1.5.1 Technical Description

Shot Scope V3 is a watch 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: V3 SS03, Serial Number: Not serialised (0075947856-TSR0001)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: V3 SS03, Serial Number: Not serialised (0075947856-TSR0004)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: V3 SS03, Serial Number: Not serialised (0075947856-TSR0013)			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

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: Bluetooth Low Energy		
Authorised Band Edges	Graeme Lawler	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Restricted Band Edges	Graeme Lawler	UKAS
AC Power Line Conducted Emissions	Graeme Lawler	UKAS
Emission Bandwidth	Nandhini Mathivanan	UKAS
Power Spectral Density	Nandhini Mathivanan	UKAS
Maximum Conducted Output Power	Nandhini Mathivanan	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Authorised Band Edges

2.1.1 Specification Reference

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

2.1.2 Equipment Under Test and Modification State

V3 SS03, S/N: Not serialised (0075947856-TSR0004) - Modification State 0

2.1.3 Date of Test

23-March-2020

2.1.4 Test Method

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

2.1.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	27.1 %

2.1.6 Test Results

Bluetooth Low Energy

Modulation	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
GFSK	2402	2400	-38.35

Table 5

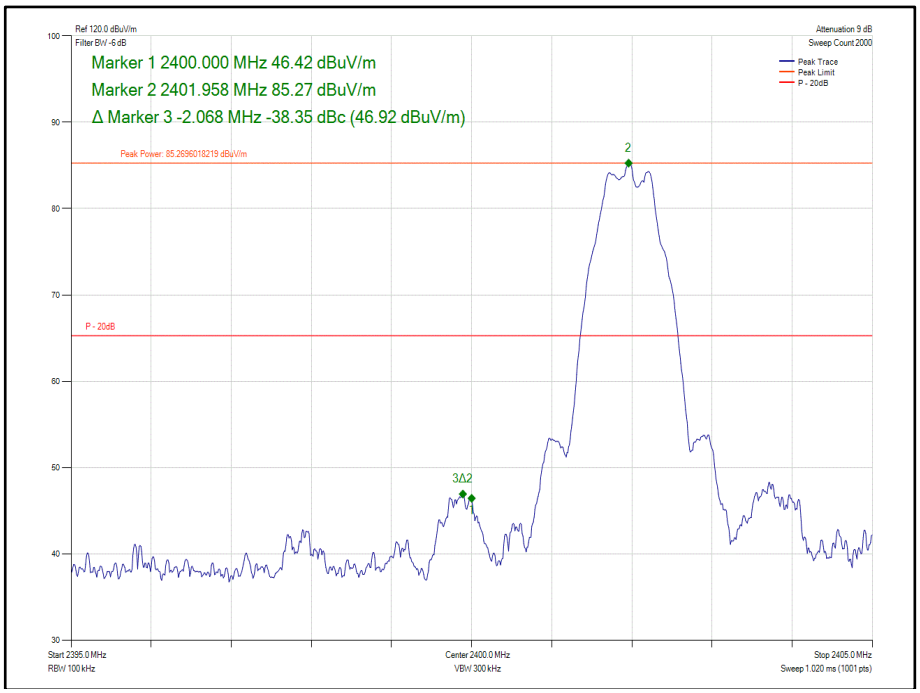

Figure 1 - GFSK - 2402 MHz - Measured Frequency 2400 MHz

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.

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 Due
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	6	09-Jun-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-2021
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
EmX Emissions Software	TUV SUD	EmX V.V1.5.8	5125	-	Software
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	06-Feb-2021

Table 6

TU – Traceability Unscheduled

2.2 Spurious Radiated Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205

2.2.2 Equipment Under Test and Modification State

V3 SS03, S/N: Not serialised (0075947856-TSR0004) - Modification State 0

2.2.3 Date of Test

23-March-2020 to 24-March-2020

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

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 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 dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

Above 18 GHz, the measurement distance was reduced to 1 meter and the limit line increased by 20*LOG(3/1) = 9.54 dB.

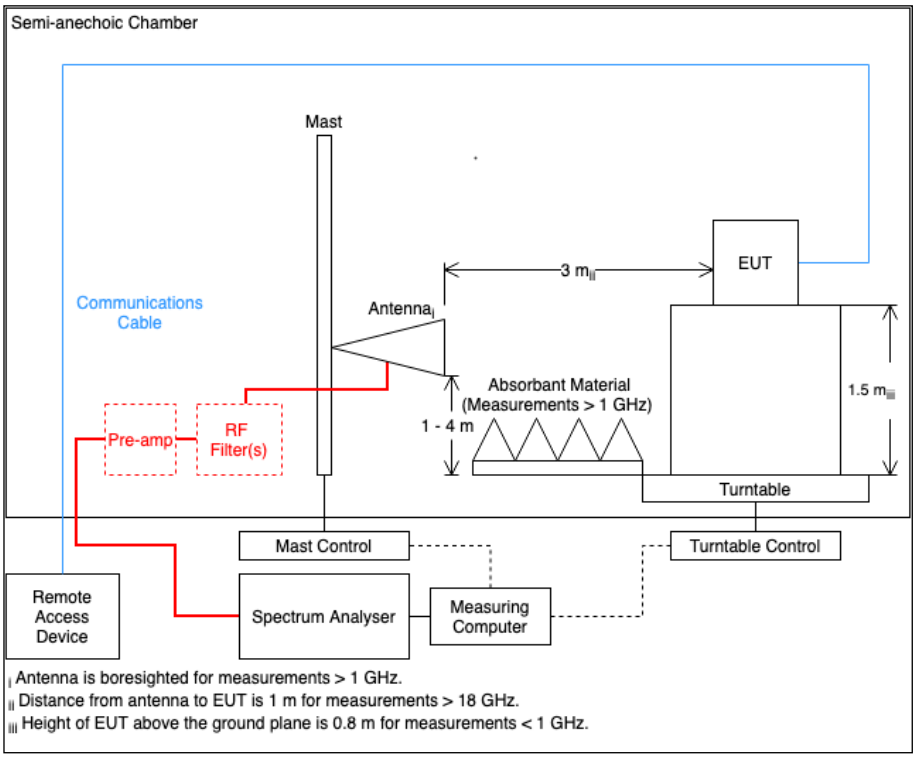

Figure 2 - Test Setup Diagram

2.2.5 Environmental Conditions

Ambient Temperature	19.7 - 20.8 °C
Relative Humidity	27.1 %

2.2.6 Test Results

Bluetooth Low Energy

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

Table 7 - 2402 MHz, 30 MHz to 1 GHz

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

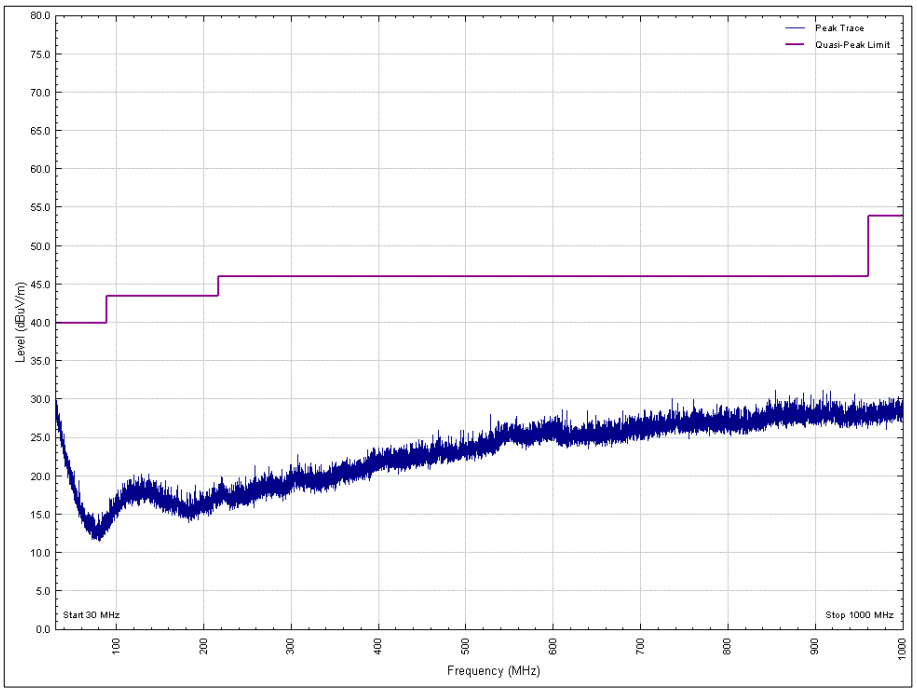

Figure 3 - 2402 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

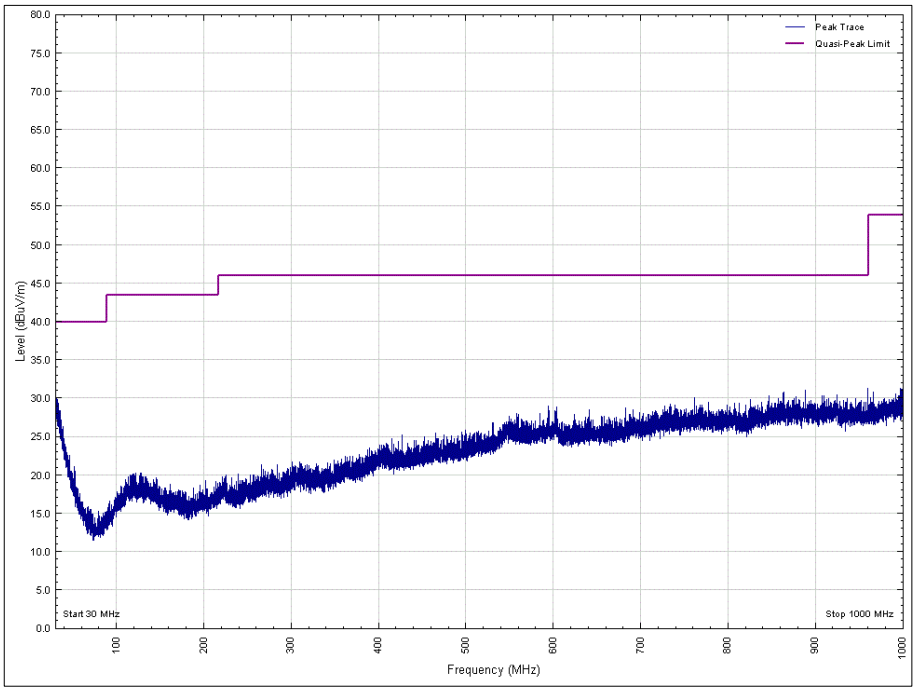

Figure 4 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

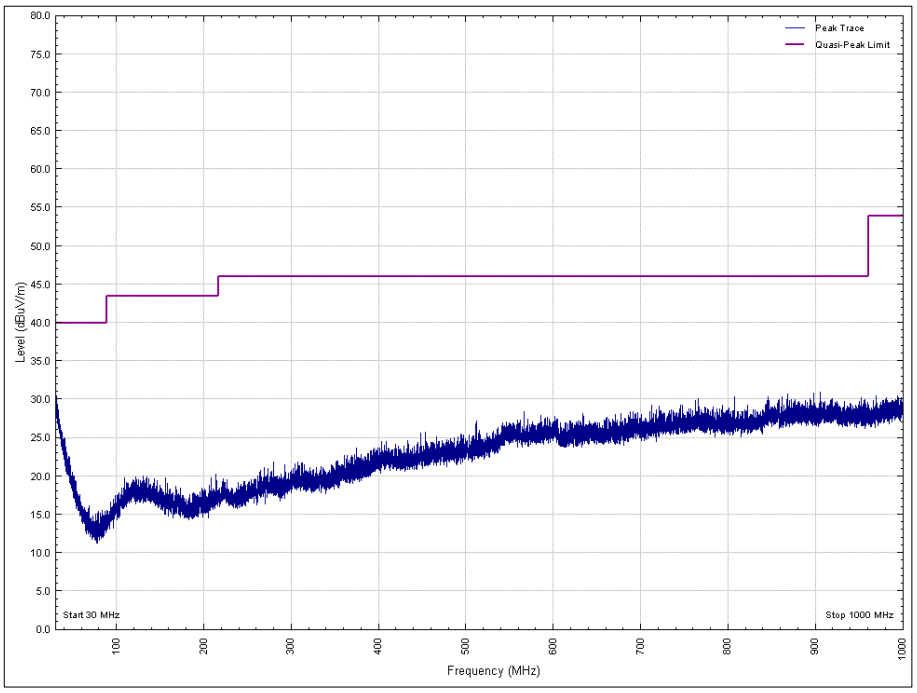

Figure 5 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation

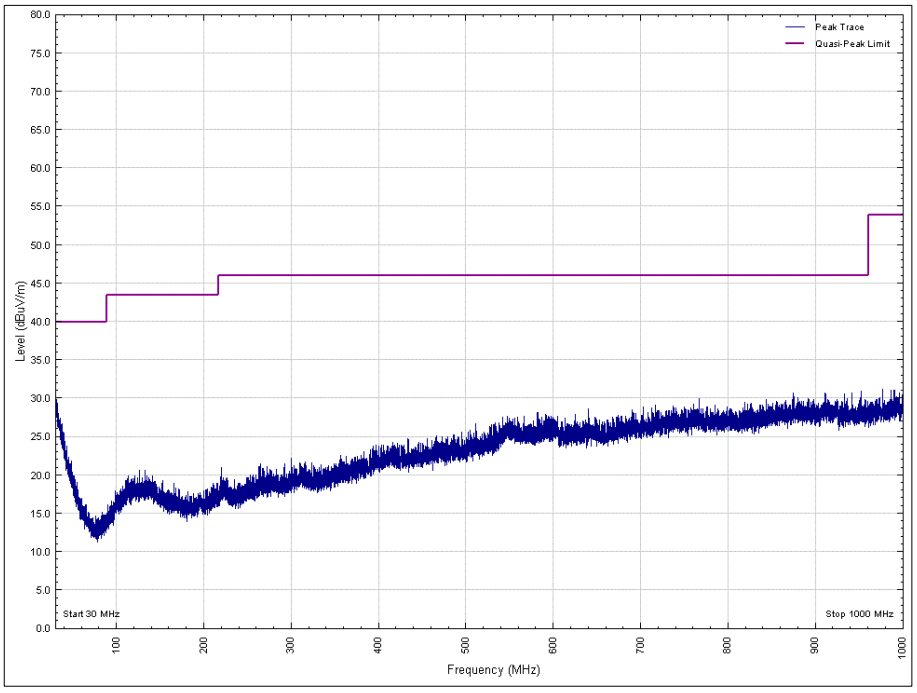

Figure 6 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation

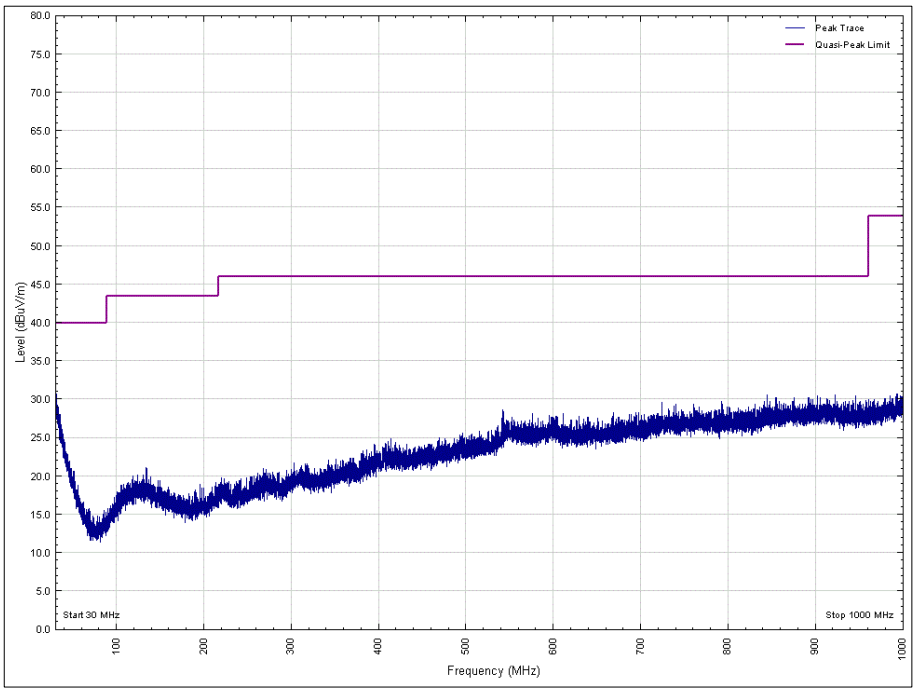

Figure 7 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

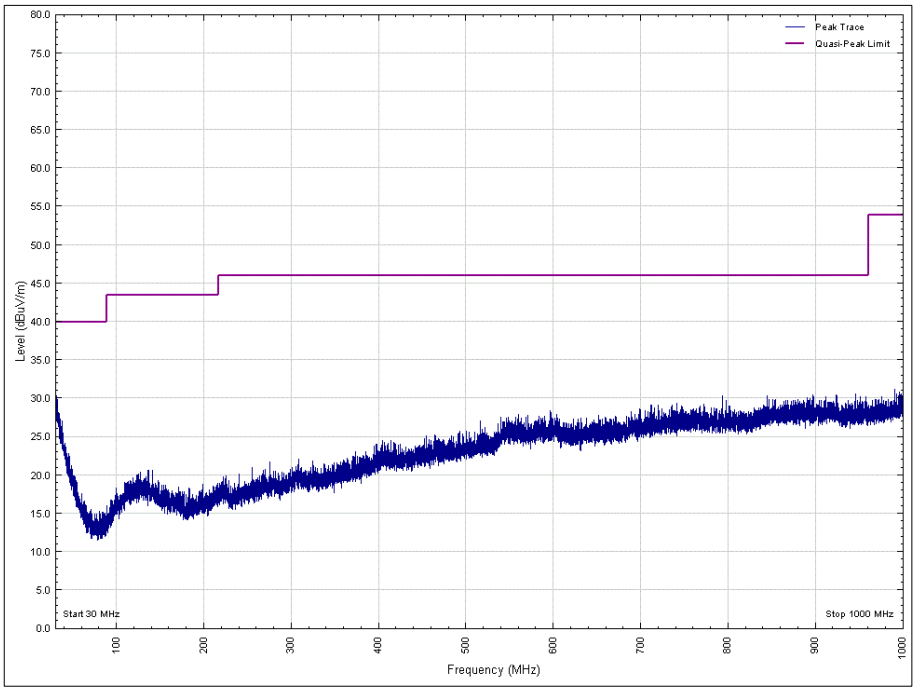

Figure 8 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation

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

Table 8 - 2402 MHz, 1 GHz to 25 GHz

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

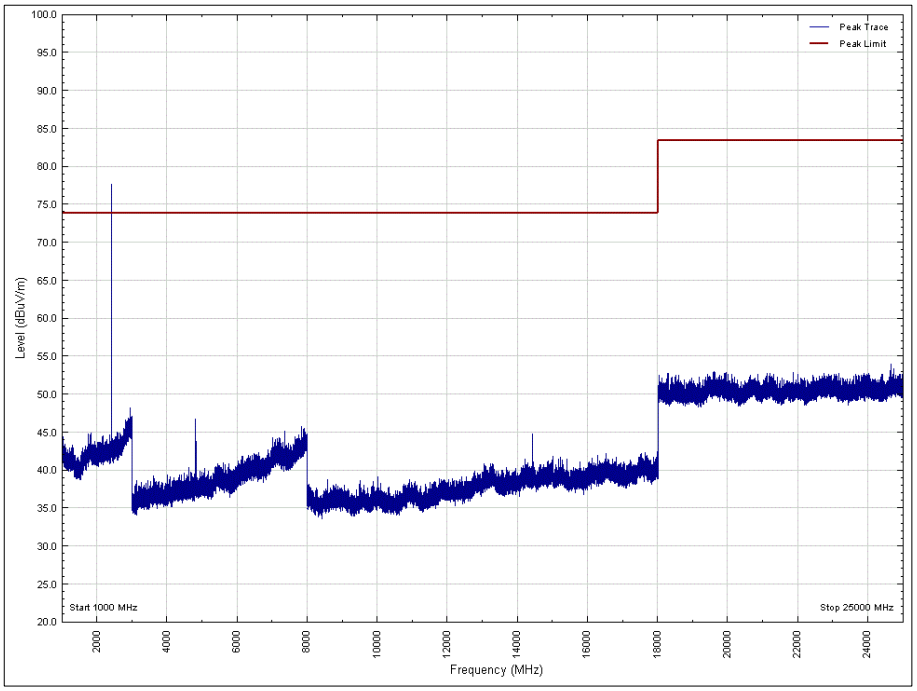

Figure 9 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation, Peak

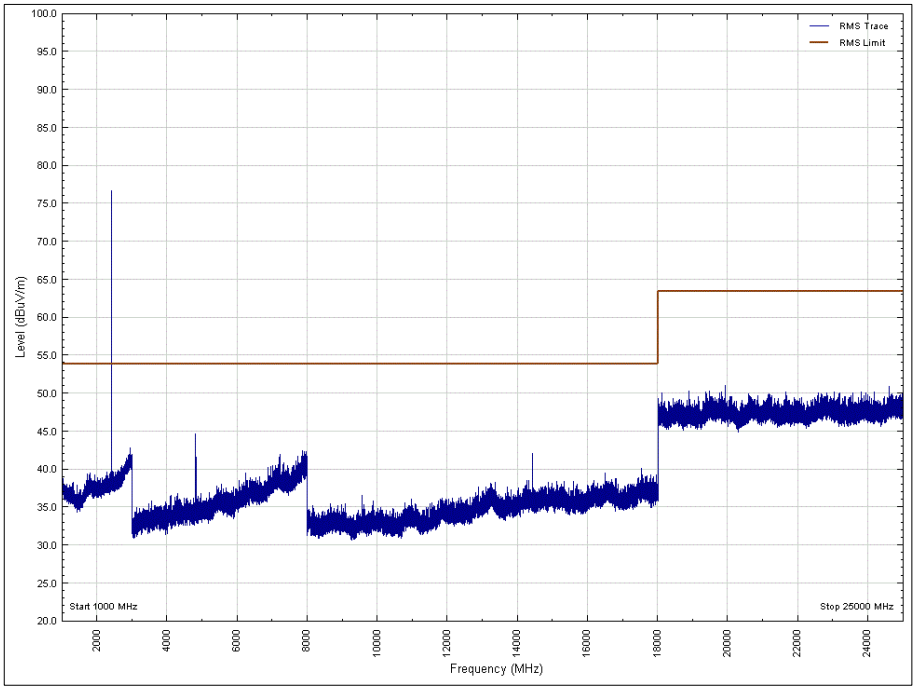

Figure 10 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation, Average

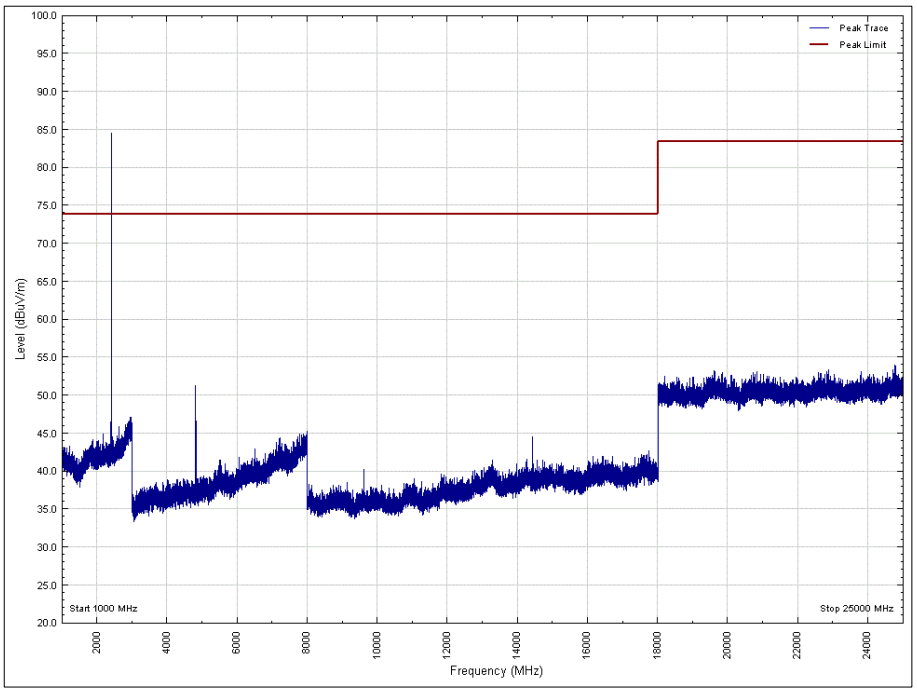

Figure 11 - 2402 MHz , 1 GHz to 25 GHz, Horizontal, X Orientation, Peak

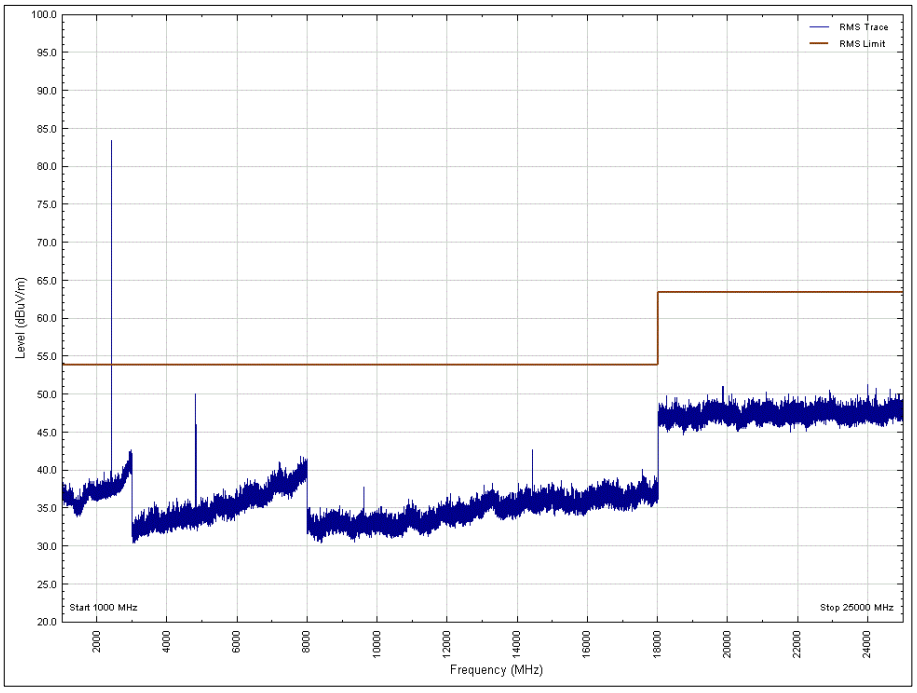

Figure 12 - 2402 MHz , 1 GHz to 25 GHz, Horizontal, X Orientation, Average

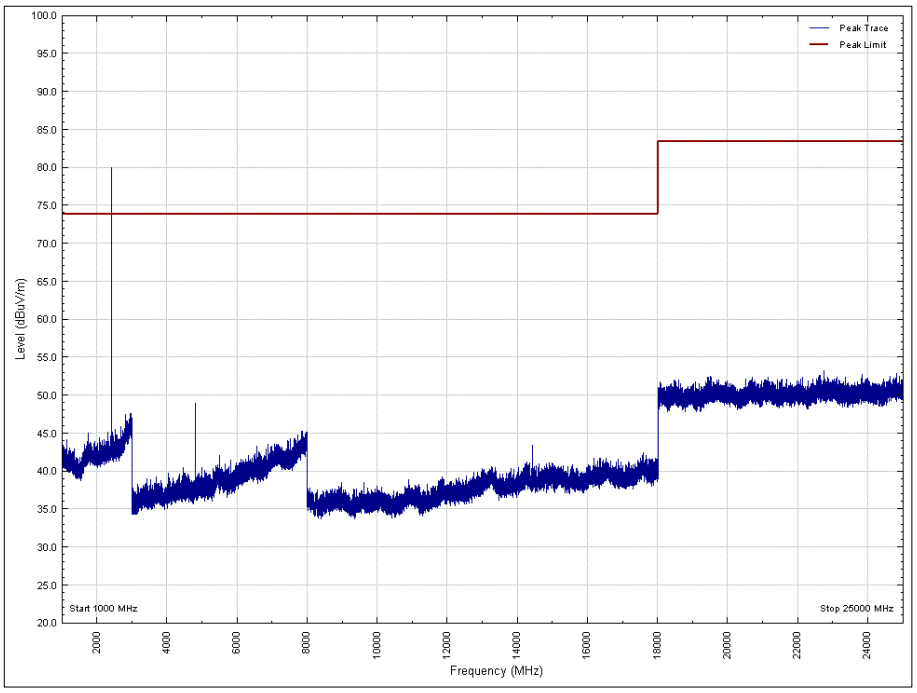

Figure 13 - 2402 MHz , 1 GHz to 25 GHz, Vertical, Y Orientation, Peak

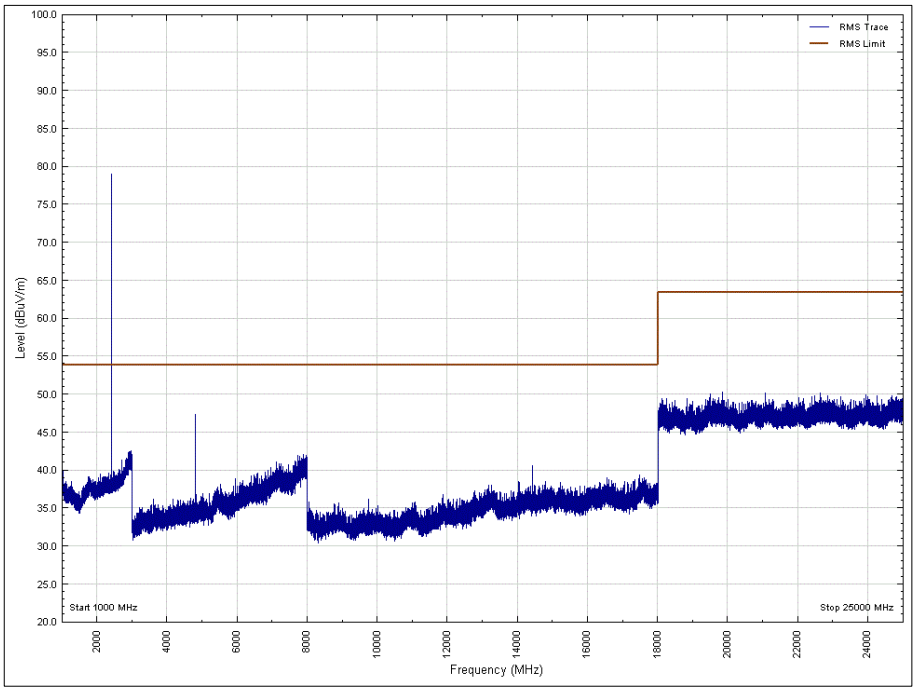

Figure 14 - 2402 MHz , 1 GHz to 25 GHz, Vertical, Y Orientation, Average

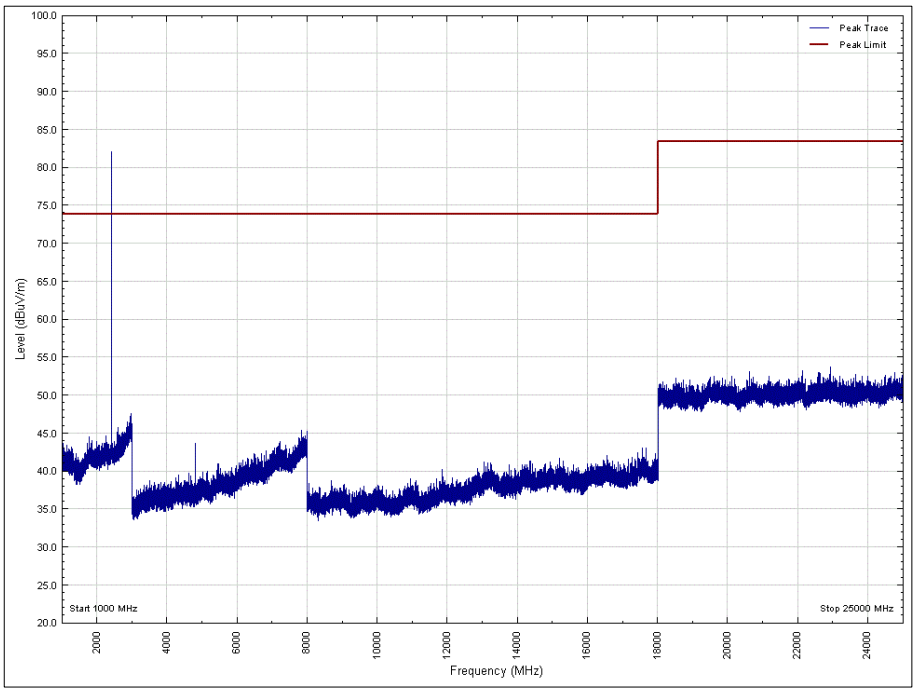

Figure 15 - 2402 MHz , 1 GHz to 25 GHz, Horizontal, Y Orientation, Peak

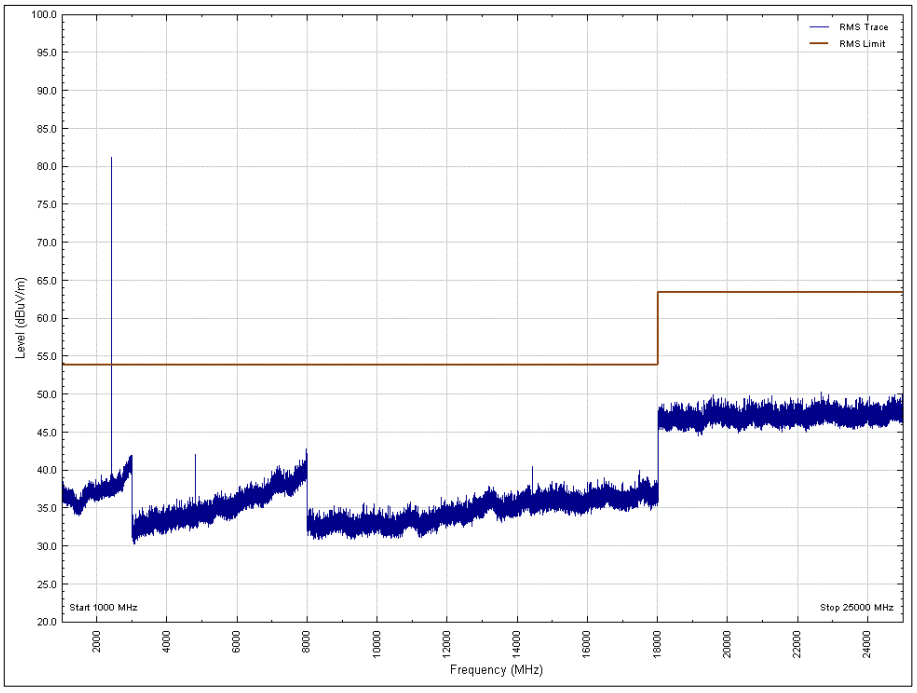

Figure 16 - 2402 MHz , 1 GHz to 25 GHz, Horizontal, Y Orientation, Average

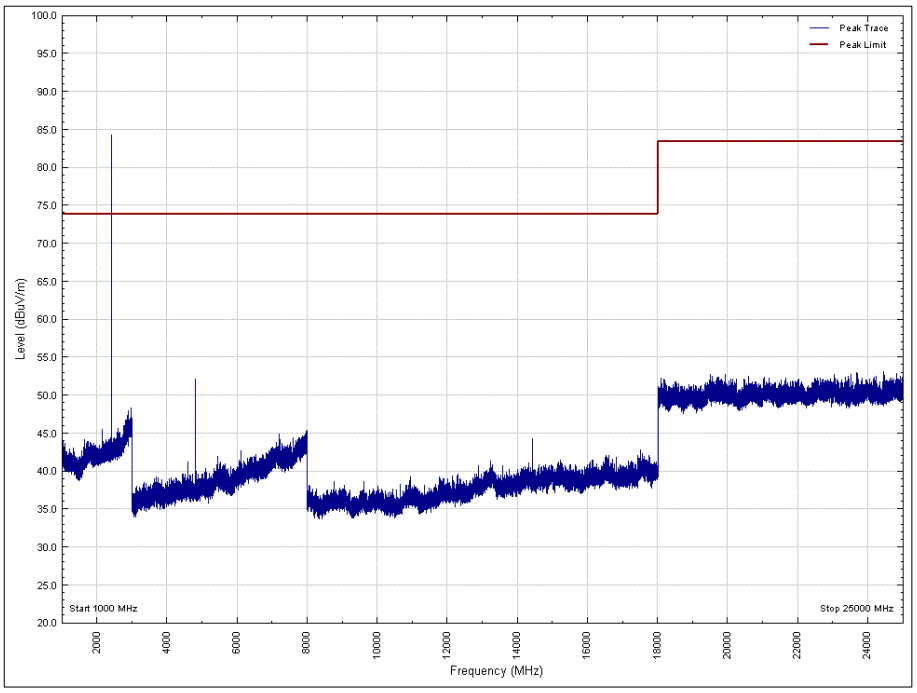

Figure 17 - 2402 MHz , 1 GHz to 25 GHz, Vertical, Z Orientation, Peak

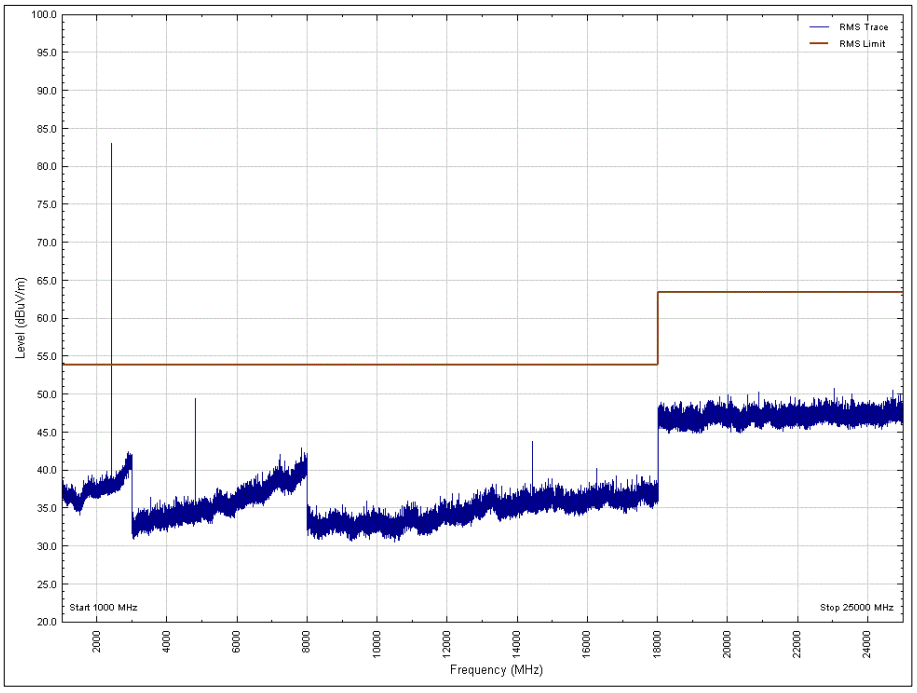

Figure 18 - 2402 MHz , 1 GHz to 25 GHz, Vertical, Z Orientation, Average

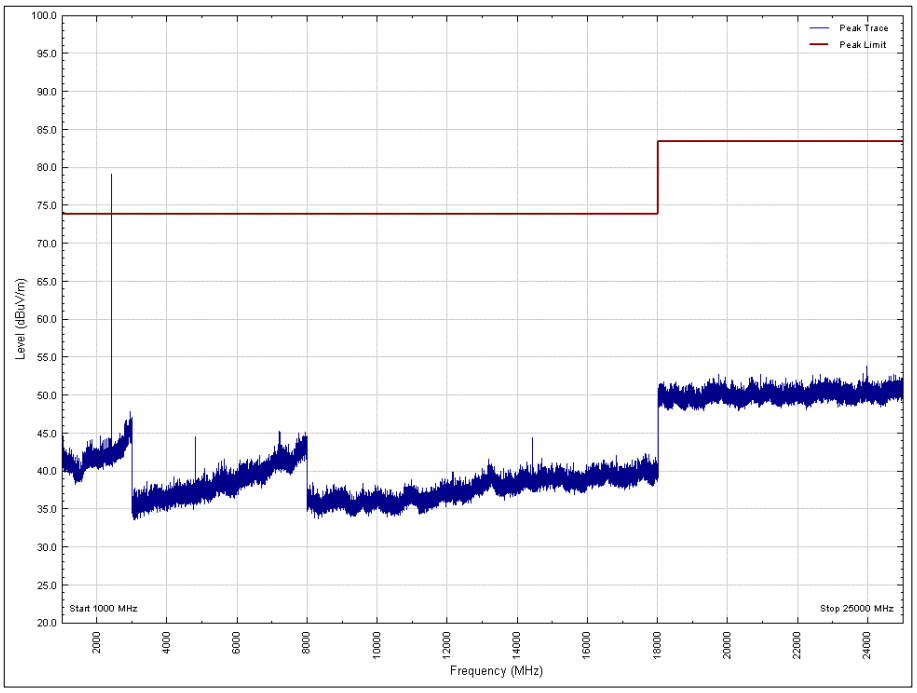

Figure 19 - 2402 MHz , 1 GHz to 25 GHz, Horizontal, Z Orientation, Peak

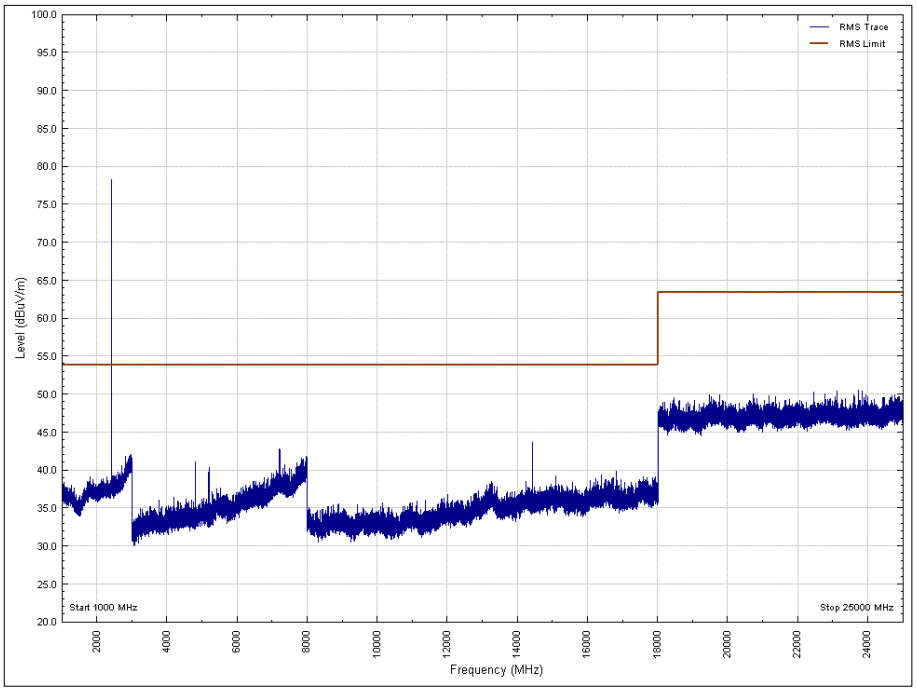

Figure 20 - 2402 MHz , 1 GHz to 25 GHz, Horizontal, Z Orientation, Average

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

Table 9 - 2440 MHz, 30 MHz to 1 GHz

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

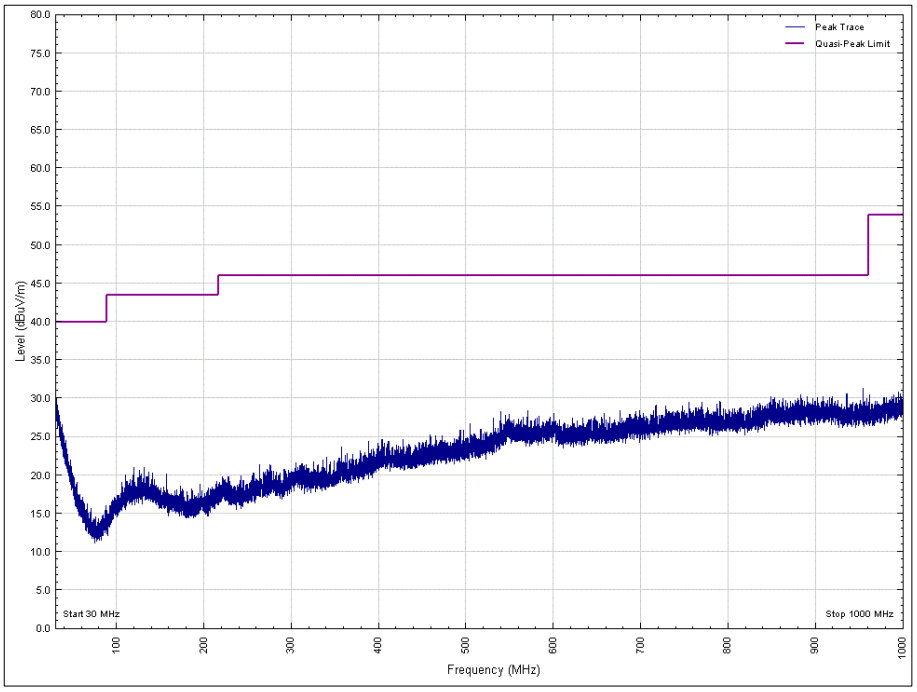

Figure 21 - 2440 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

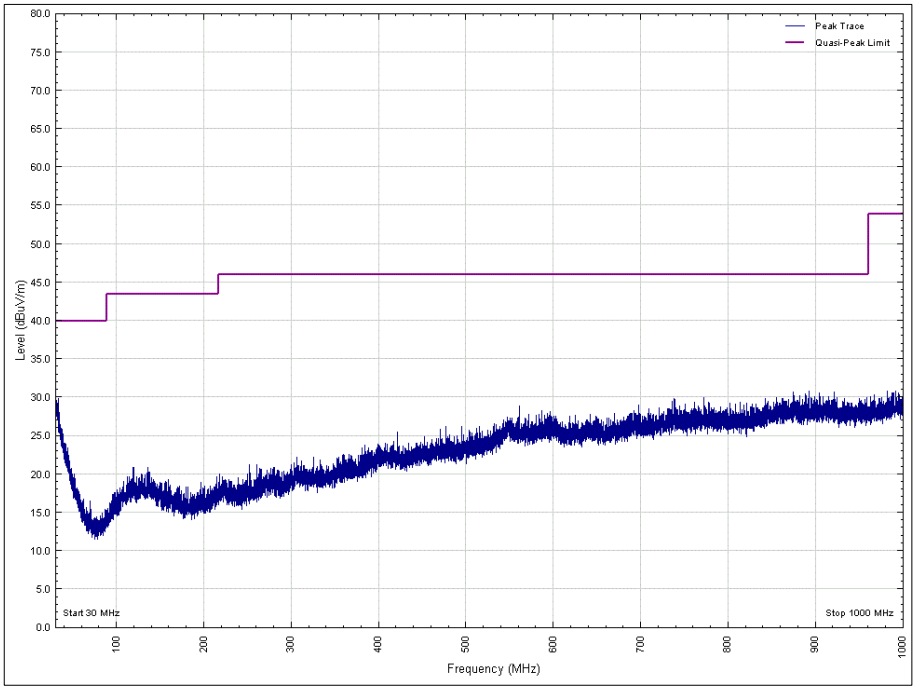

Figure 22 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

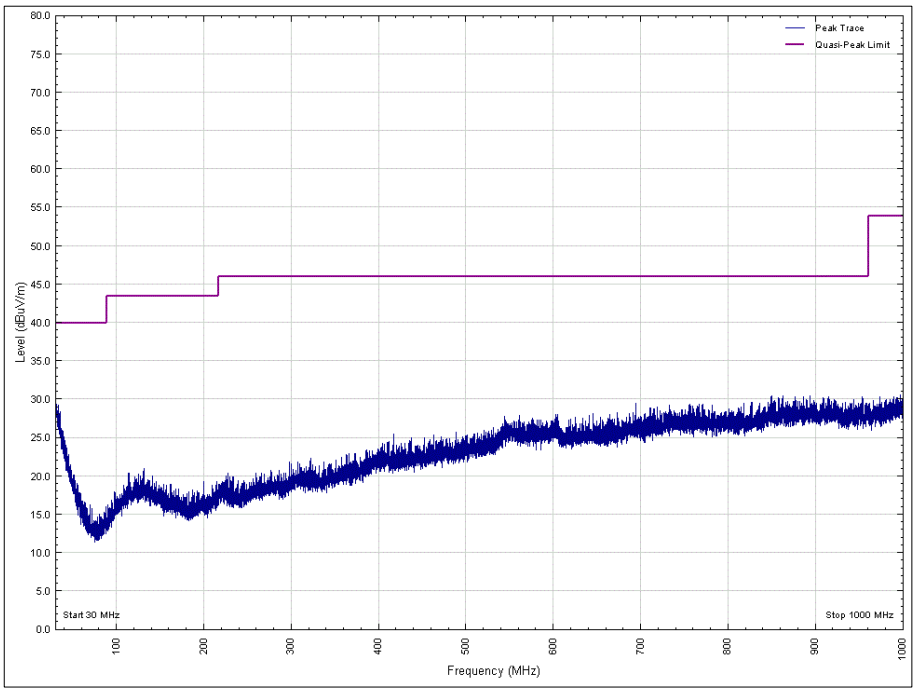

Figure 23 - 2440 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation

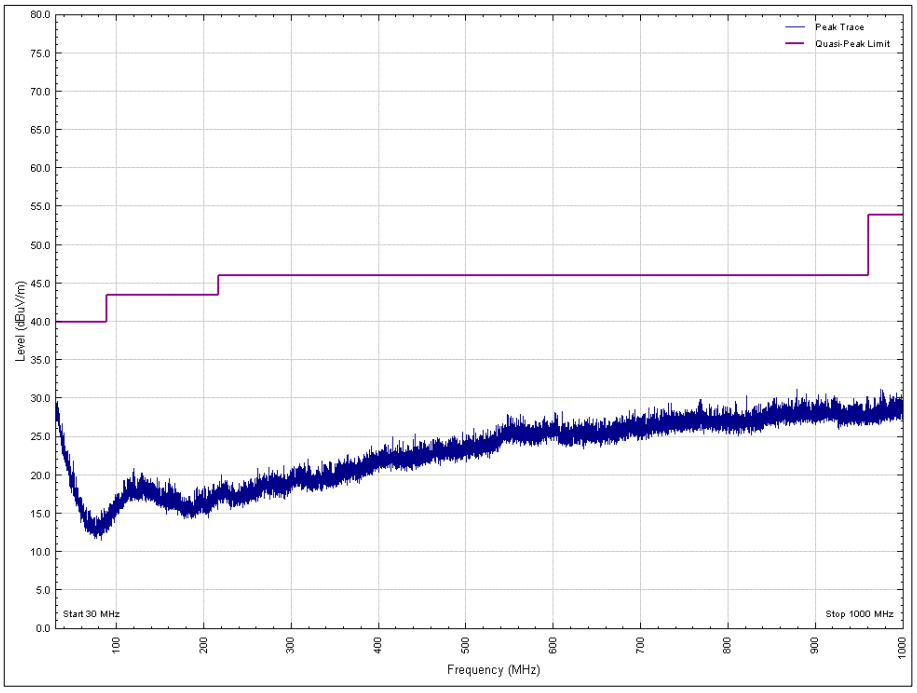

Figure 24 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation

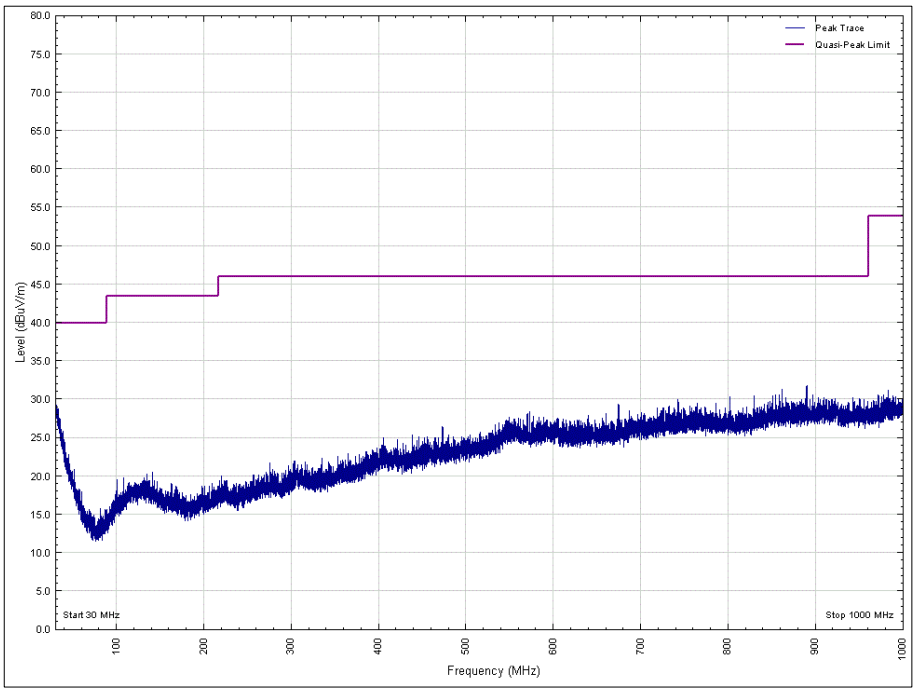

Figure 25 - 2440 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

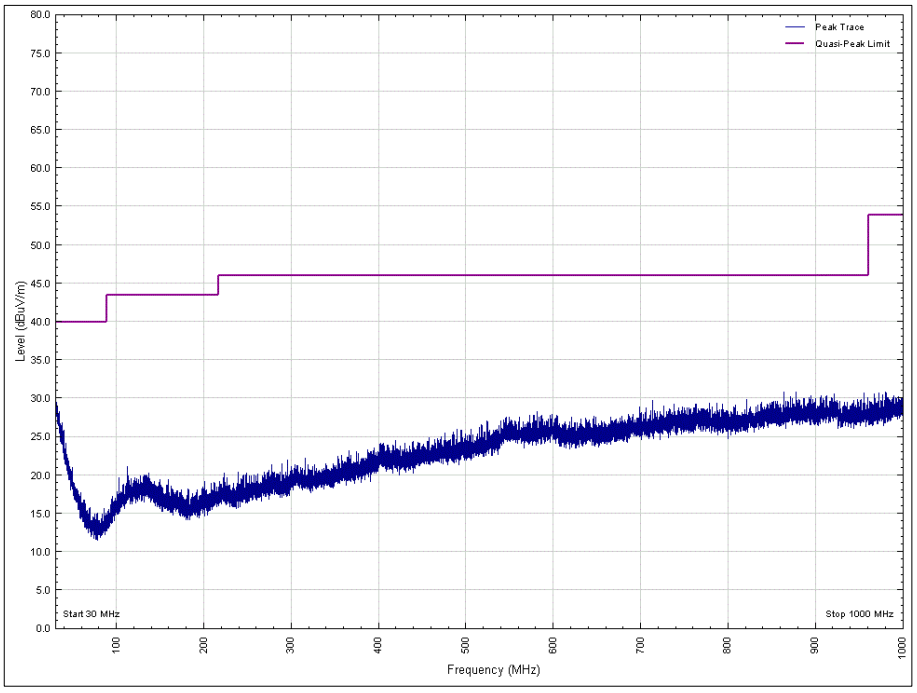

Figure 26 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation

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

Table 10 - 2440 MHz, 1 GHz to 25 GHz

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

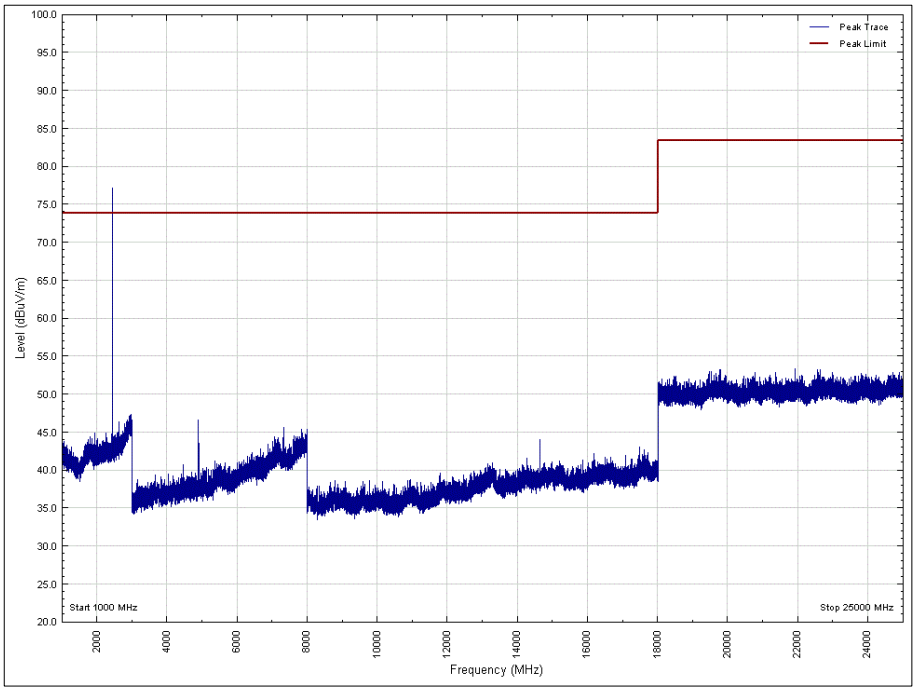

Figure 27 - 2440 MHz, 1 GHz to 25 GHz, Vertical, X Orientation, Peak

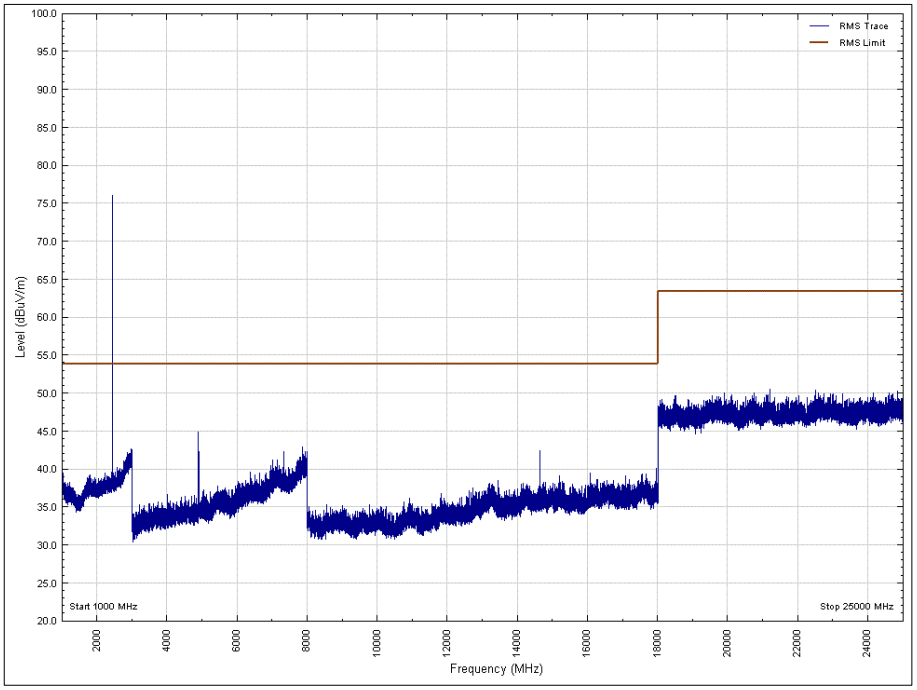

Figure 28 - 2440 MHz, 1 GHz to 25 GHz, Vertical, X Orientation, Average

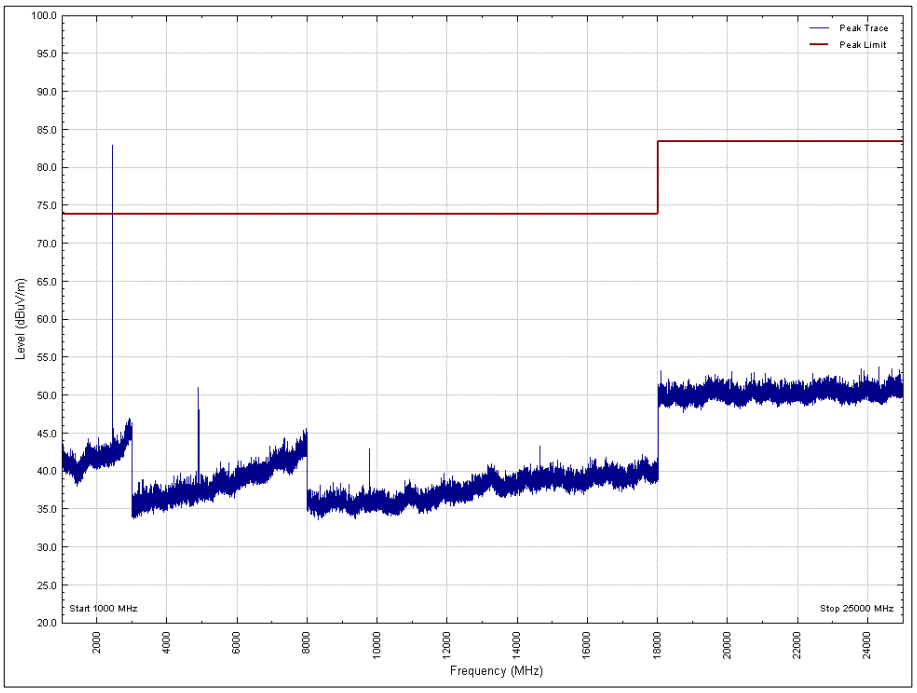

Figure 29 - 2440 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation, Peak

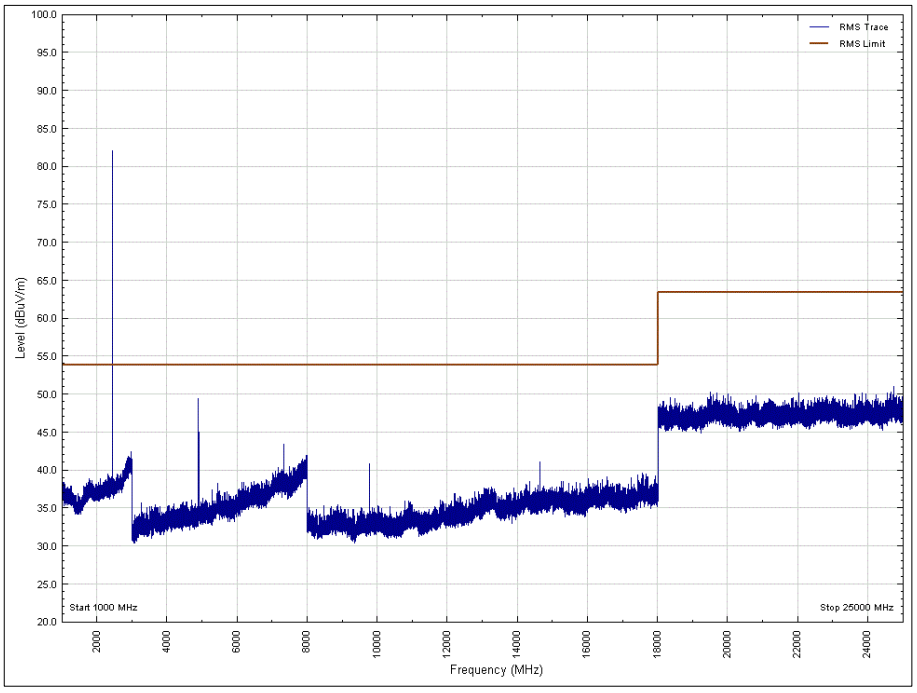

Figure 30 - 2440 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation, Average

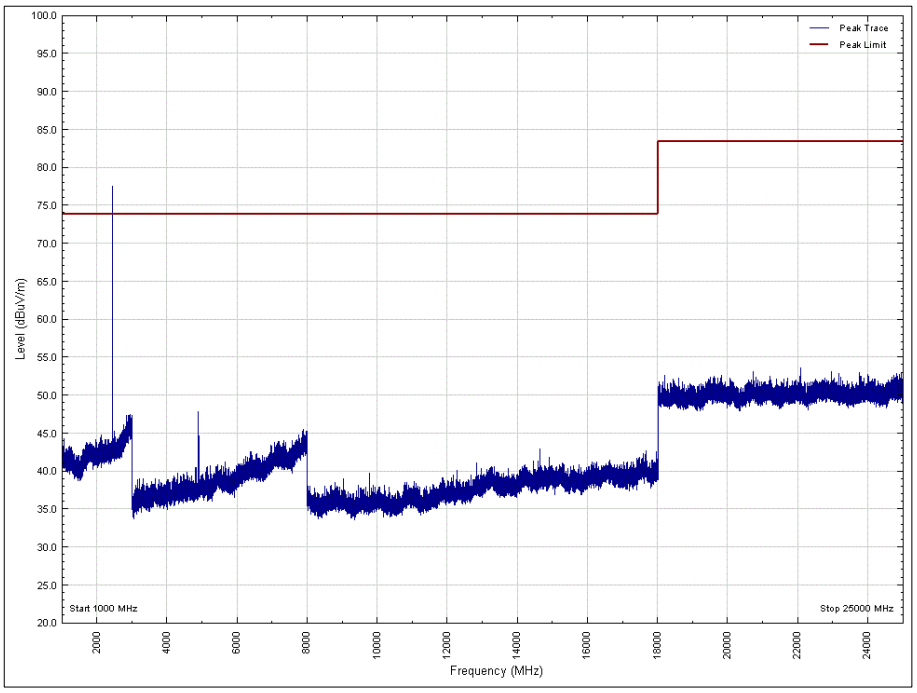

Figure 31 - 2440 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation, Peak

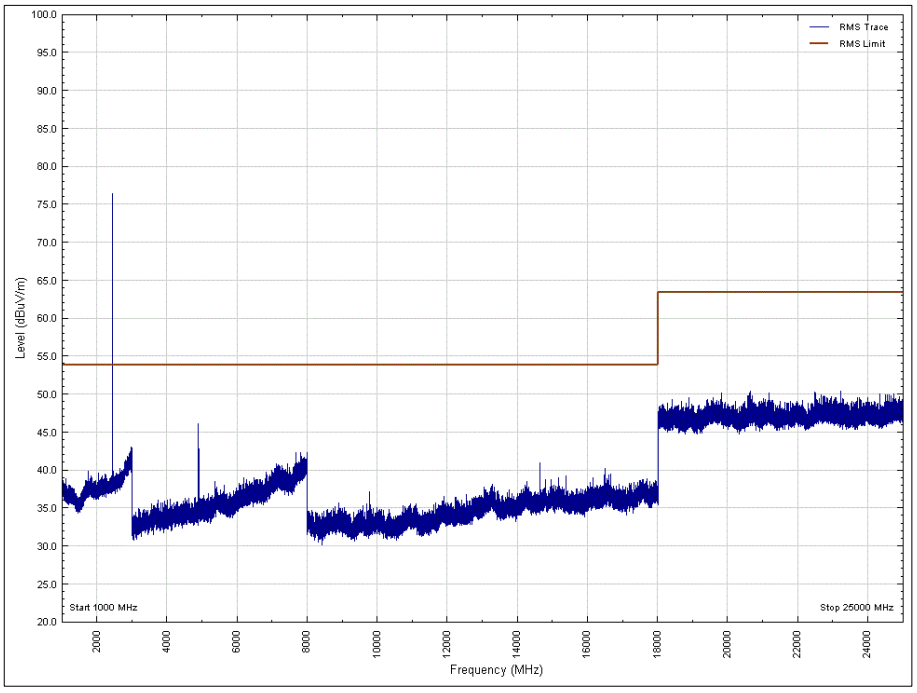

Figure 32 - 2440 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation, Average

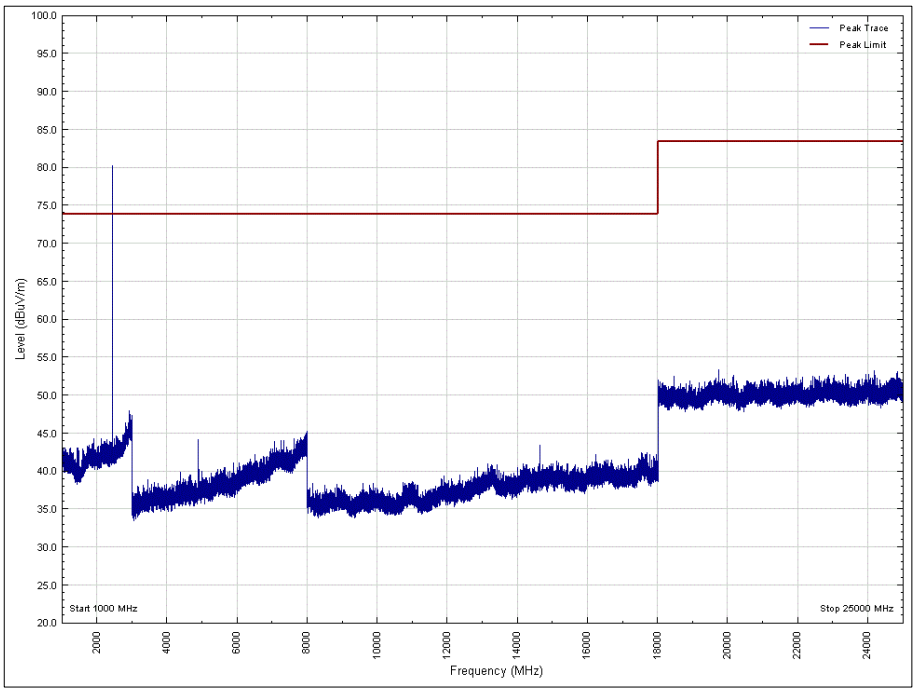

Figure 33 - 2440 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation, Peak

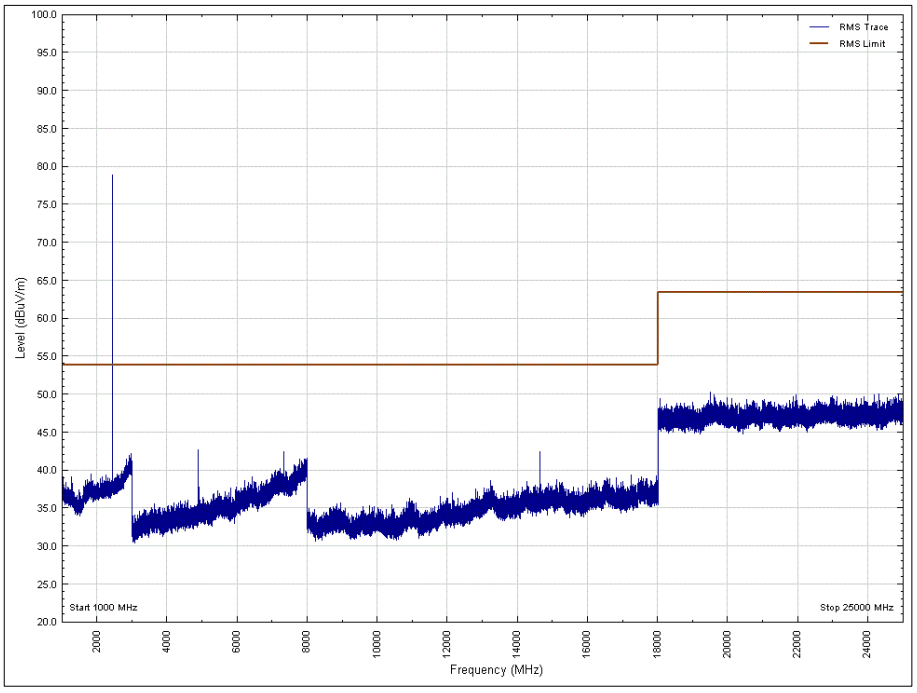

Figure 34 - 2440 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation, Average

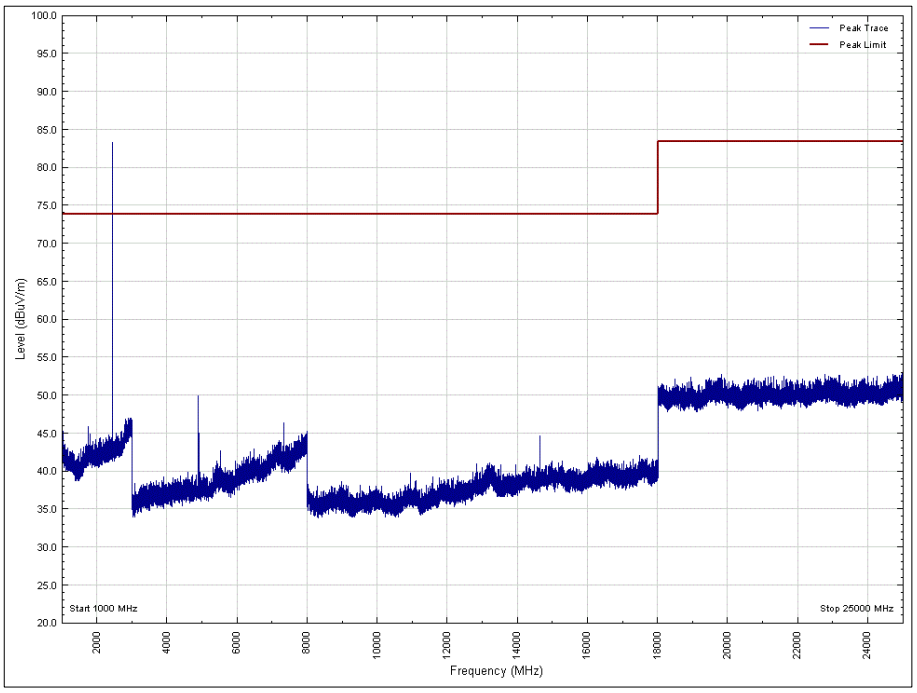

Figure 35 - 2440 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation, Peak

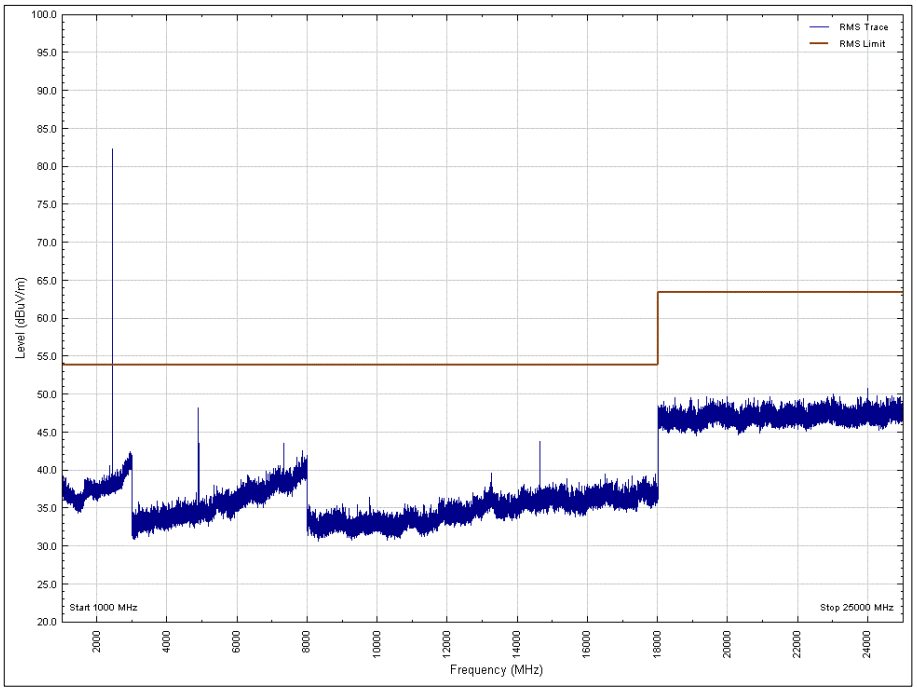

Figure 36 - 2440 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation, Average

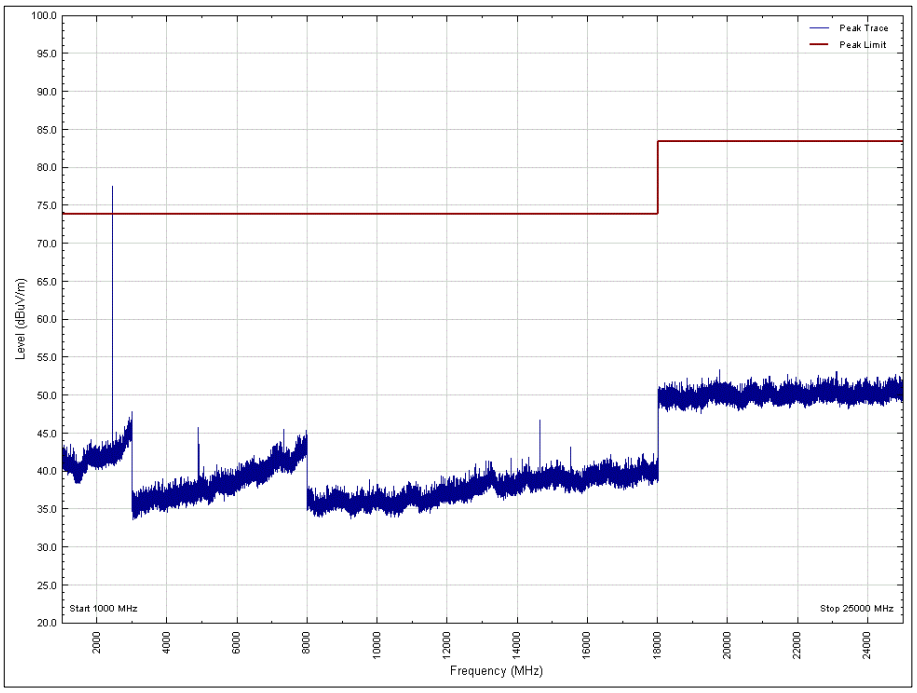

Figure 37 - 2440 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation, Peak

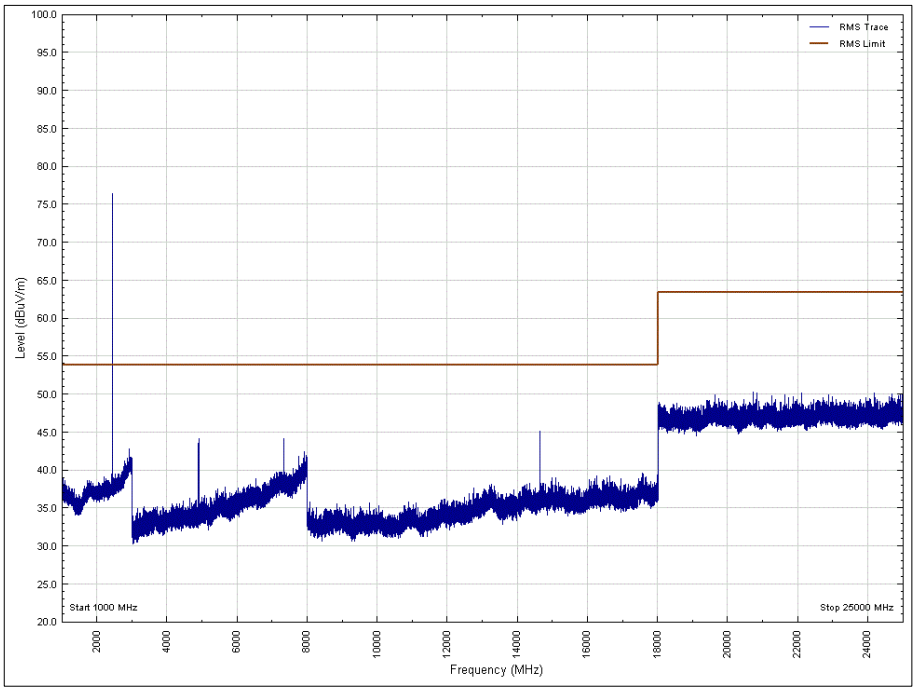

Figure 38 - 2440 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation, Average

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

Table 11 – 2480 MHz, 30 MHz to 1 GHz

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

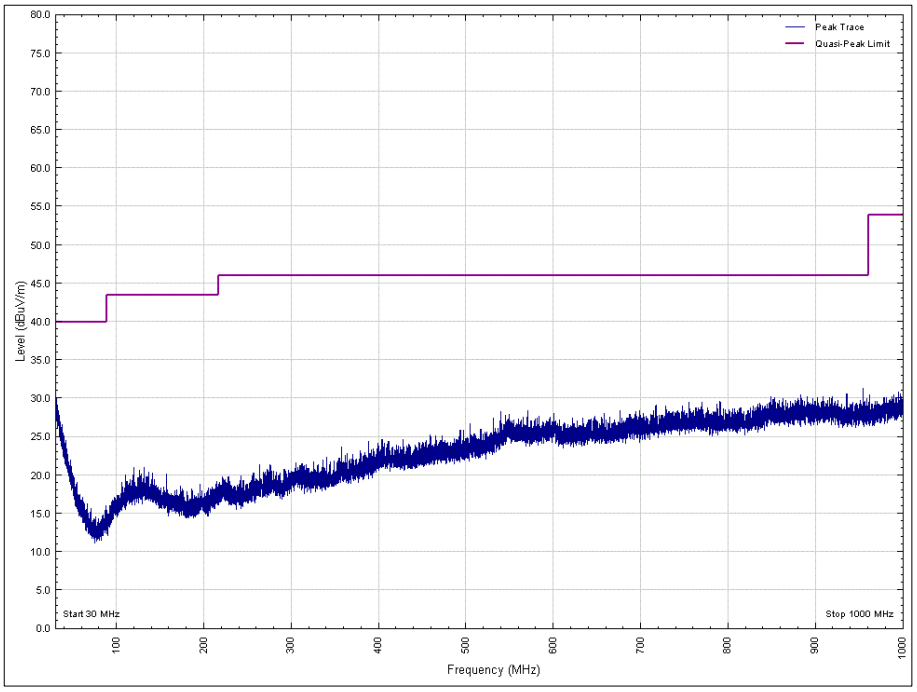

Figure 39 - 2480 MHz, 30 MHz to 1 GHz, Vertical, X Orientation

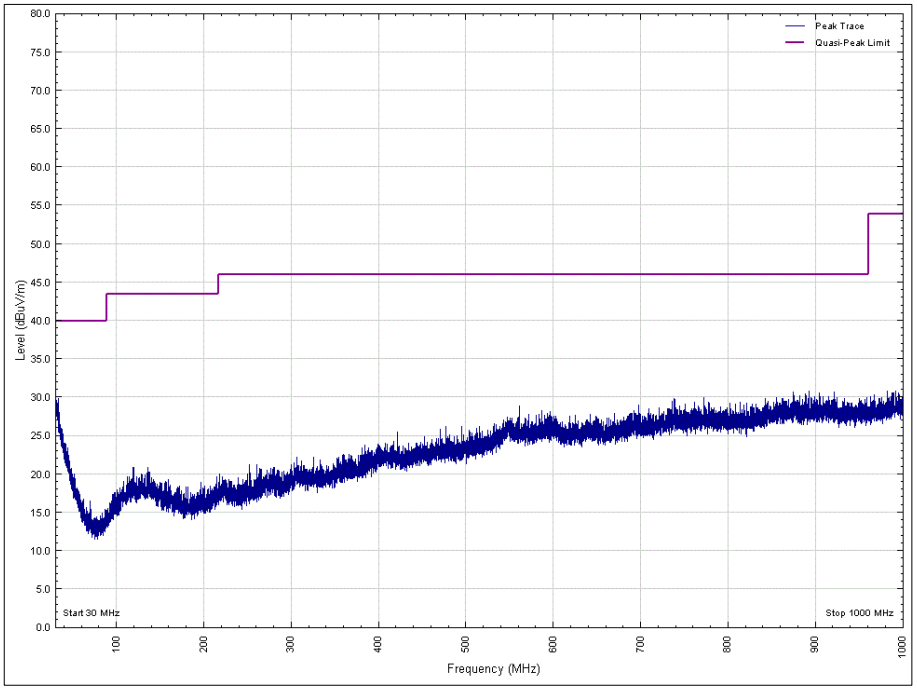

Figure 40 – 2480 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation

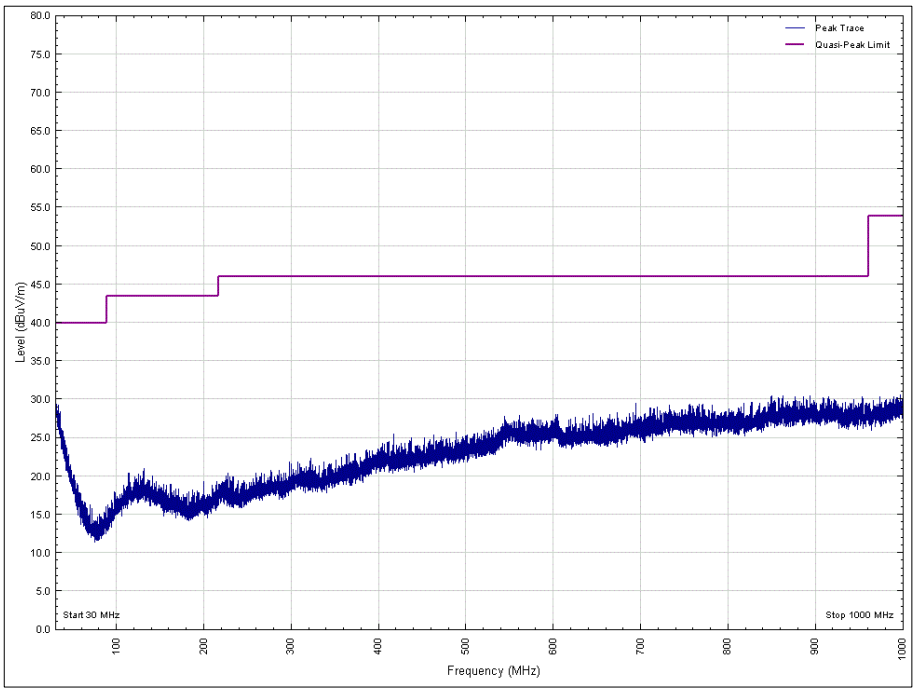

Figure 41 – 2480 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation

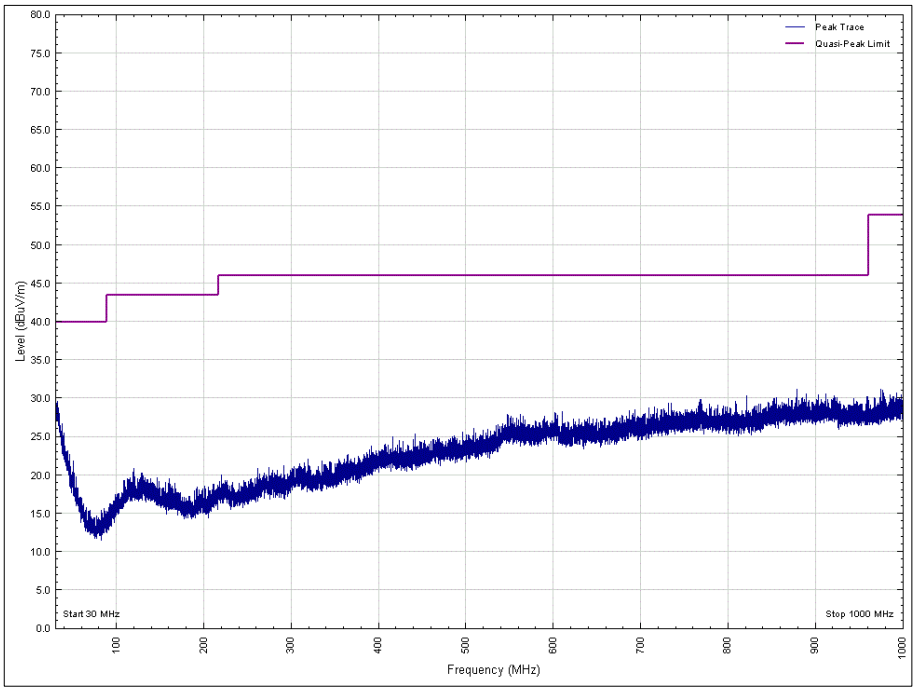

Figure 42 – 2480 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation

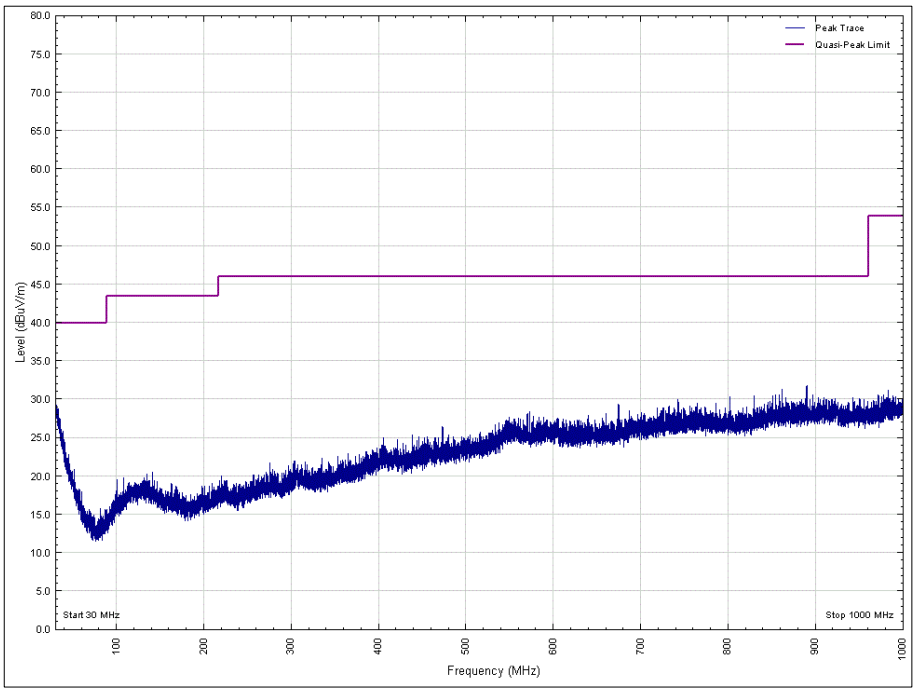

Figure 43 – 2480 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation

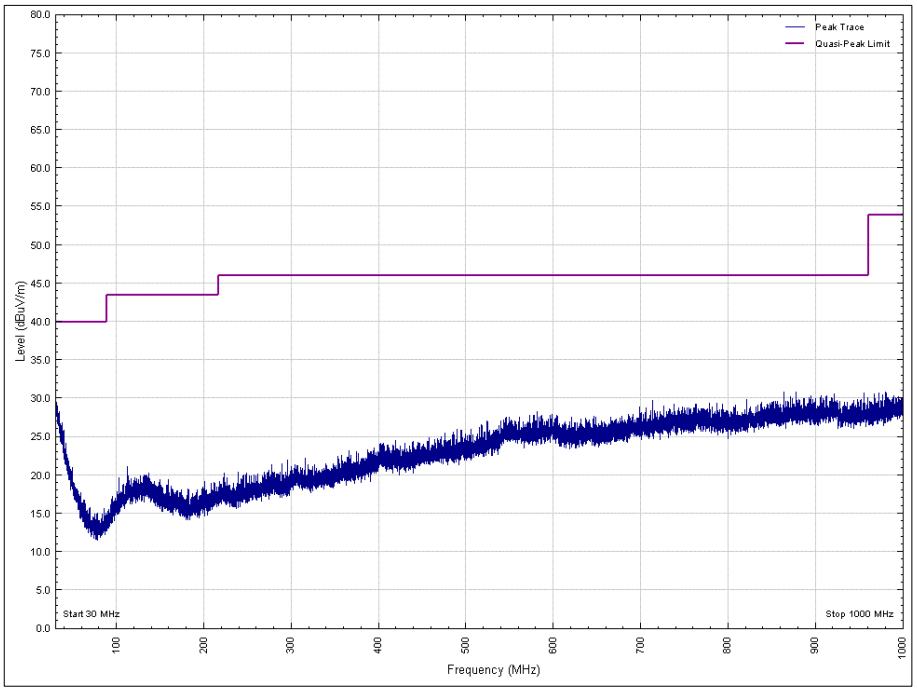

Figure 44 – 2480 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation

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

Table 12 - 2480 MHz , 1 GHz to 25 GHz

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

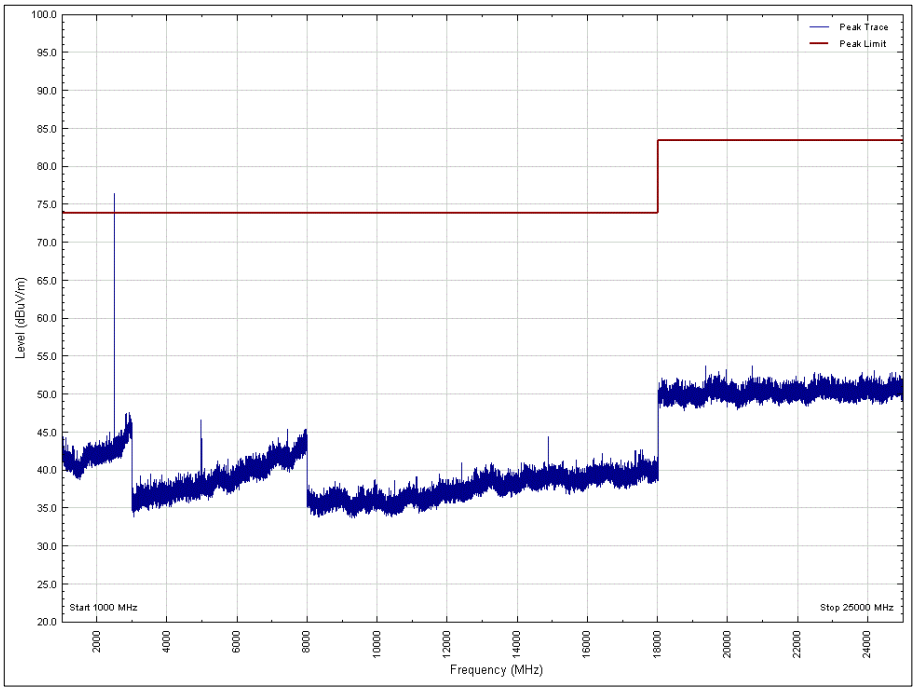

Figure 45 - 2480 MHz, 1 GHz to 25 GHz, Vertical, X Orientation, Peak

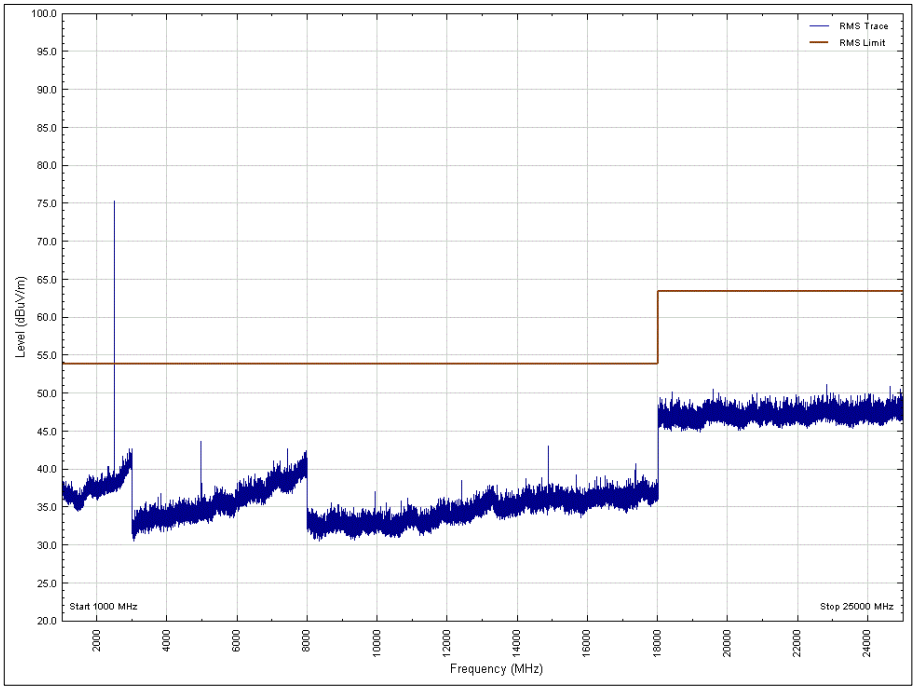

Figure 46 - 2480 MHz, 1 GHz to 25 GHz, Vertical, X Orientation, Average

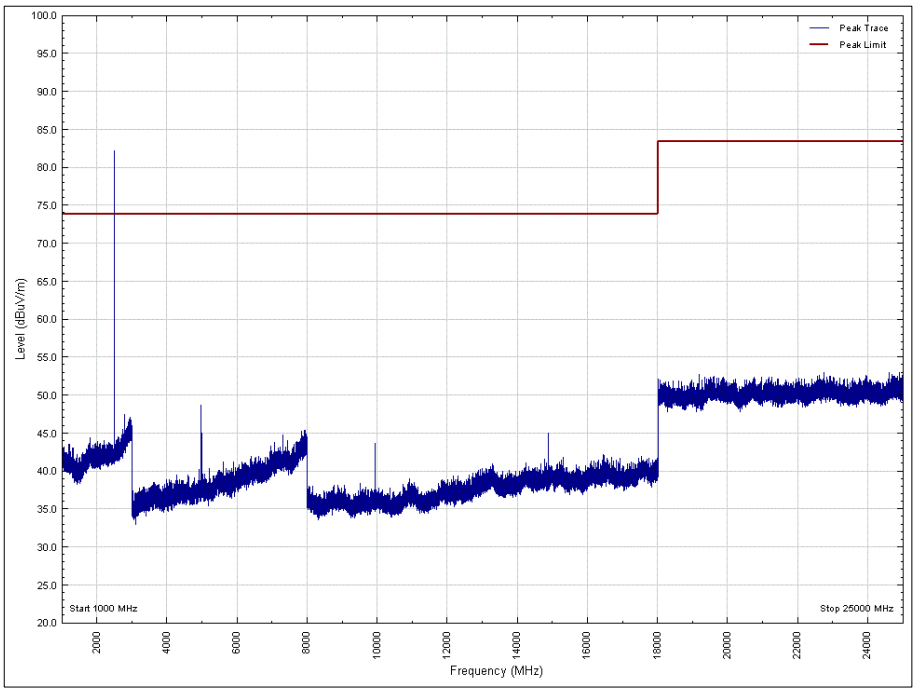

Figure 47 - 2480 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation, Peak

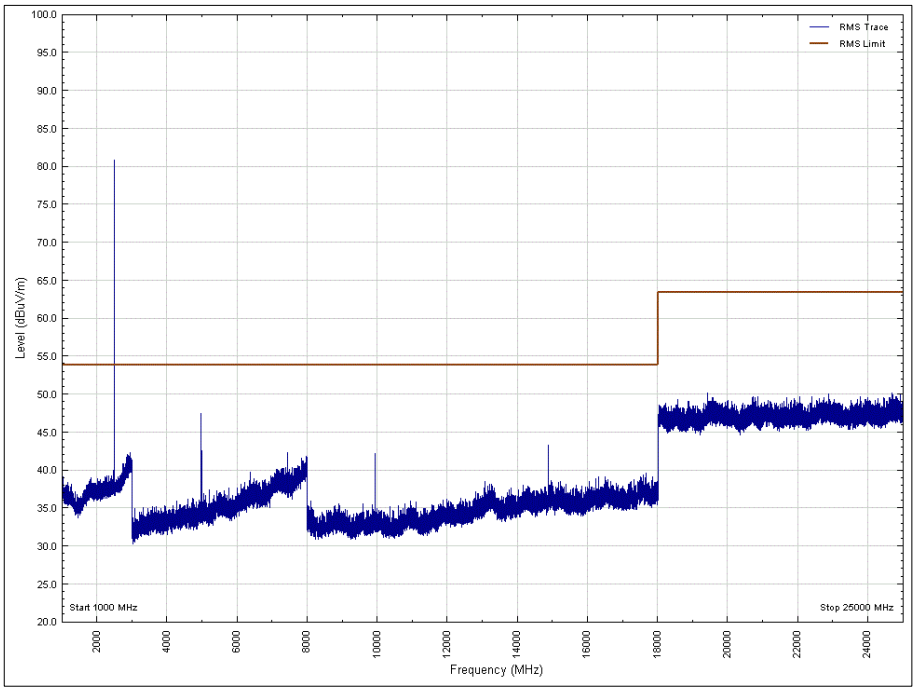

Figure 48 - 2480 MHz , 1 GHz to 25 GHz, Horizontal, X Orientation, Average

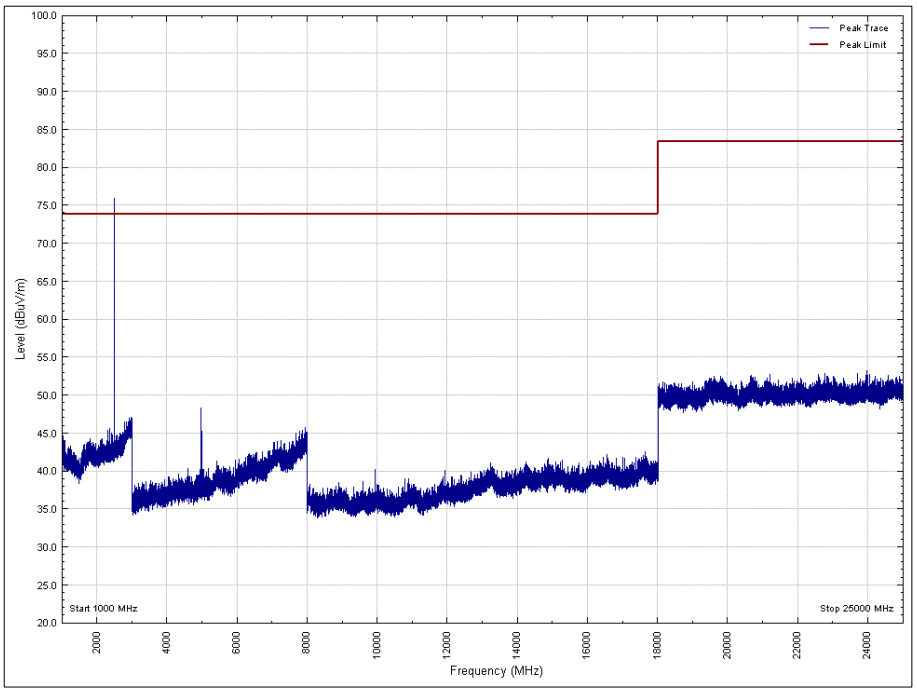

Figure 49 - 2480 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation, Peak

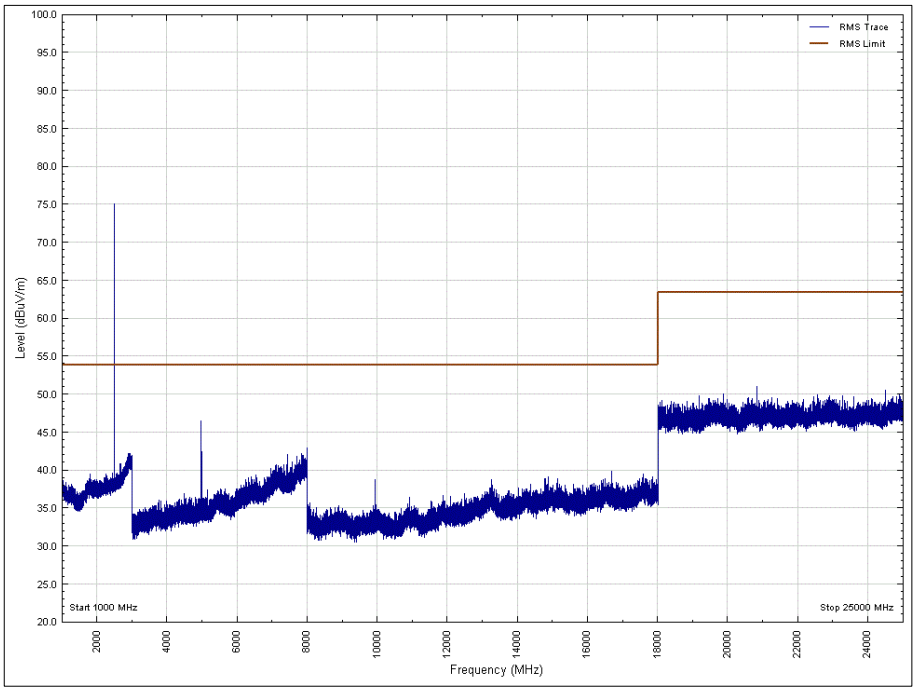

Figure 50 - 2480 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation, Average

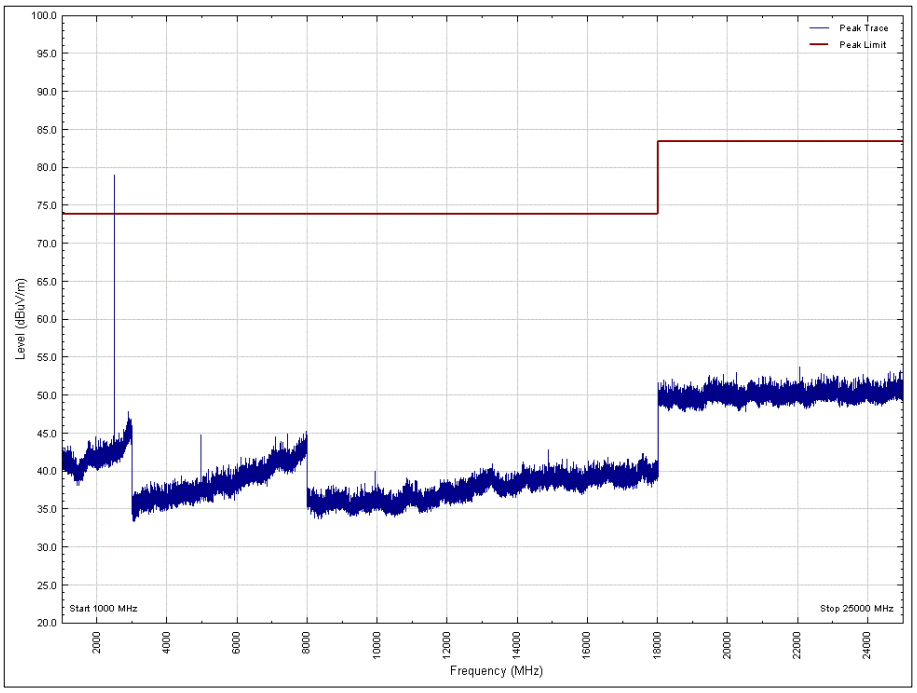

Figure 51 - 2480 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation, Peak

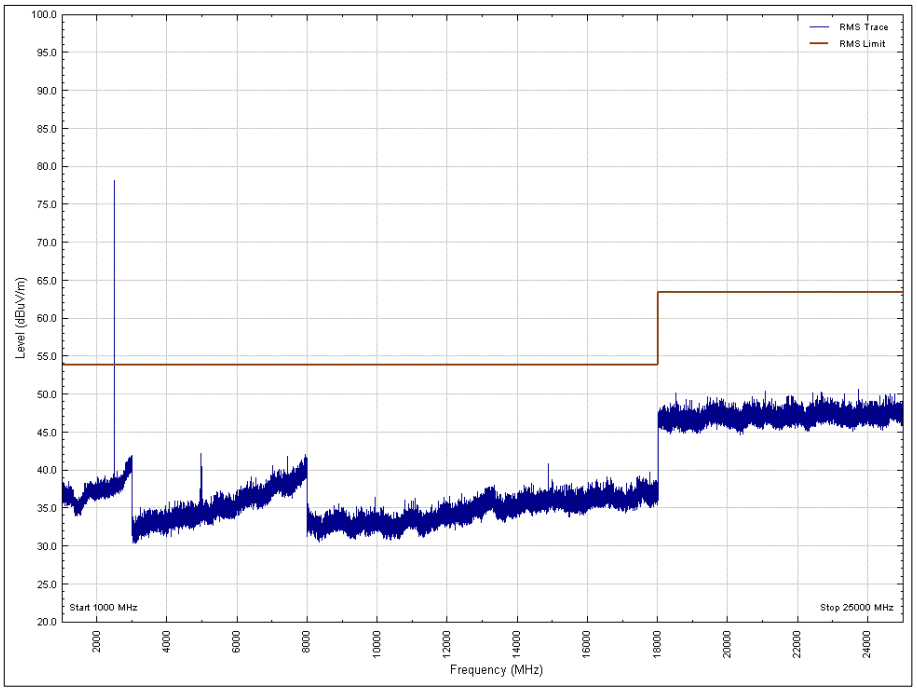

Figure 52 - 2480 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation, Average

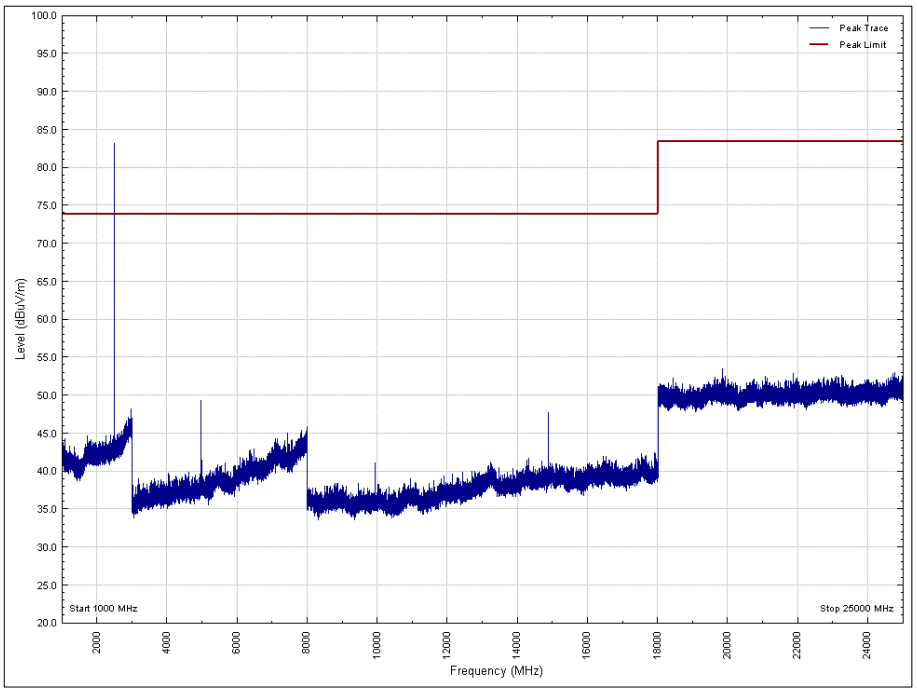

Figure 53 - 2480 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation, Peak

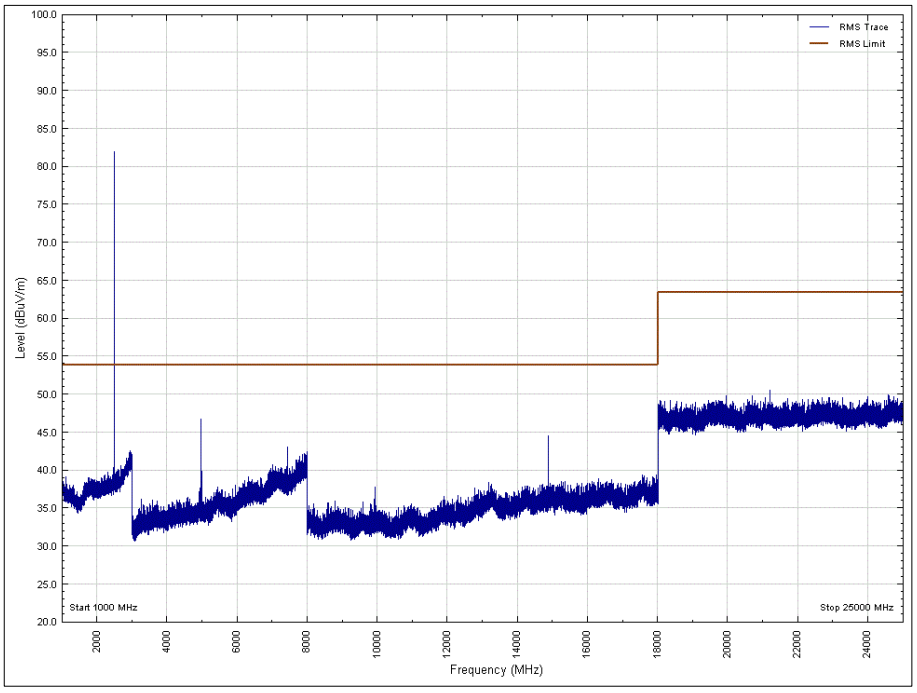

Figure 54 - 2480 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation, Average

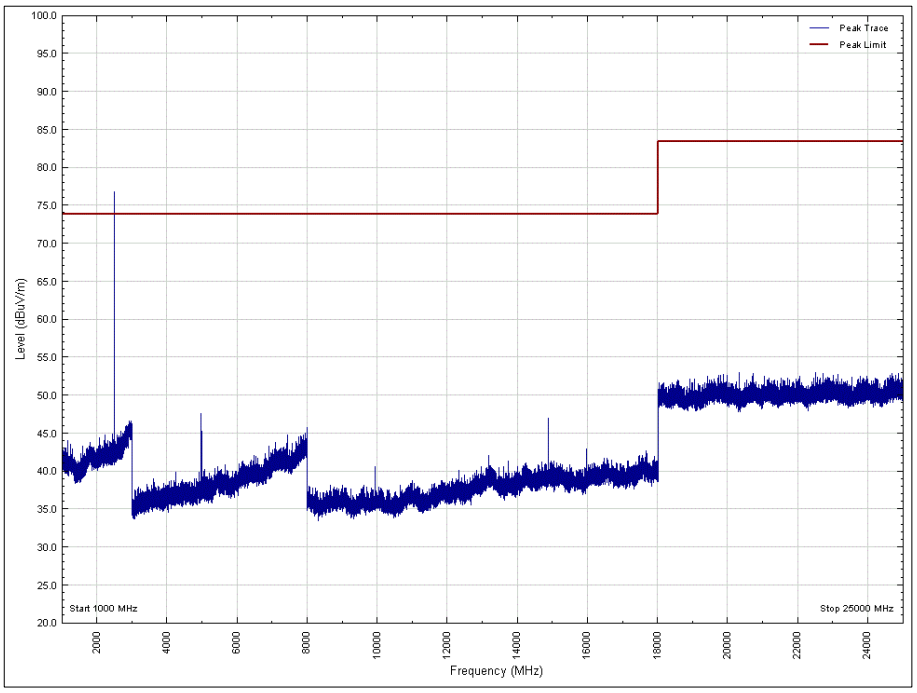

Figure 55 - 2480 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation, Peak

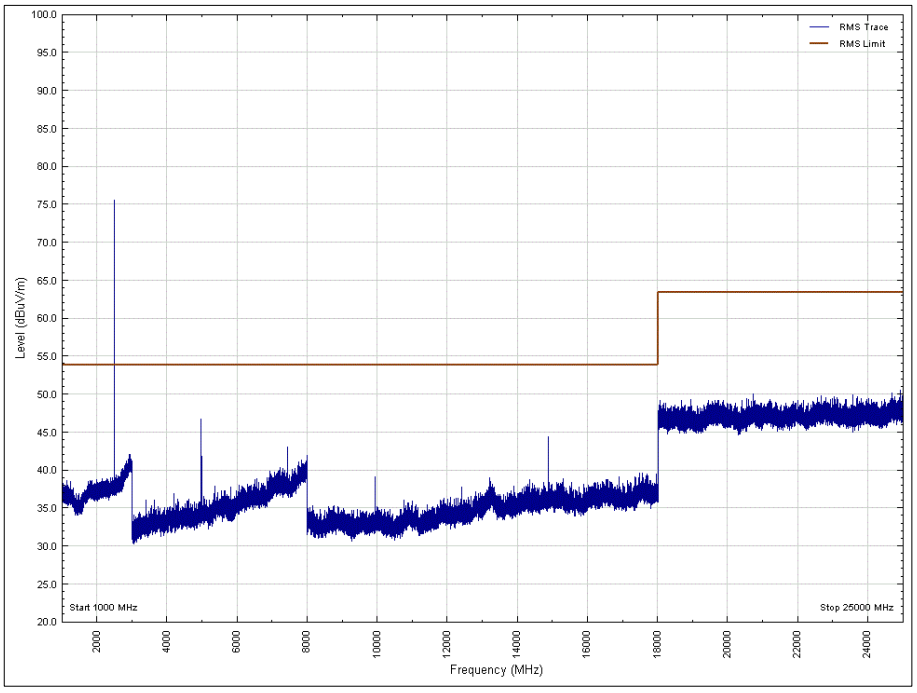

Figure 56 - 2480 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation, Average

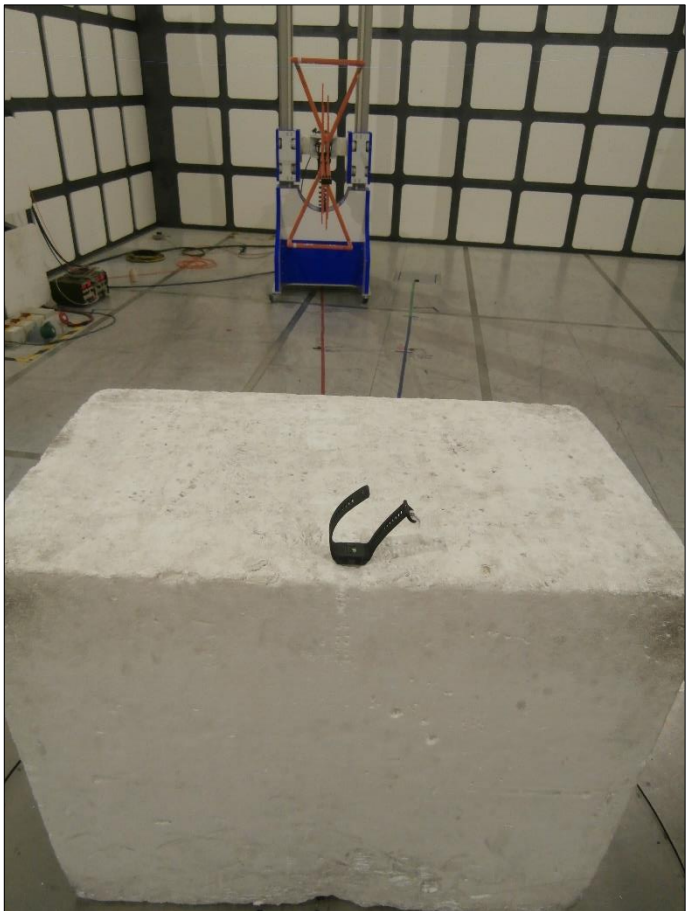

Figure 57 - Test Setup - 30 MHz to 1 GHz

Figure 58 - Test Setup - 1 GHz to 8 GHz

Figure 59 - Test Setup - 8 GHz to 18 GHz

Figure 60 - Test Setup - 18 GHz to 25 GHz

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

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

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

2.2.7 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 Due
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	02-May-2020
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	18-Feb-2021
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
'2.92mm' - '2.92mm' RF Cable (2m)	Rhophase	KPS-1503-2000-KPS	3695	12	11-Jun-2020
Cable 1503 2M 2.92(P)m 2.92(P)m	Rhophase	KPS-1503A-2000-KPS	4293	12	08-Nov-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-2021
4dB Attenuator	Pasternack	PE7047-4	4935	24	30-Sep-2021
8 GHz to 18 GHz Pre-Amplifier	Wright Technologies	PS06-0061	4971	12	23-Jan-2021
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
EmX Emissions Software	TUV SUD	EmX V.V1.5.8	5125	-	Software
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
3 GHz High Pass Filter	Wainright	WHKX12-2580-3000-18000-80SS	5220	12	O/P Mon
Antenna (DRG Horn 7.5-18GHz)	Schwarzbeck	HWRD750	5348	12	04-Sep-2020
1 GHz to 18 GHz Pre-Amplifier	Schwarzbeck	BBV 9718 C	5350	12	21-August-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	06-Feb-2021

Table 13

TU – Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.3 Restricted Band Edges

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205

2.3.2 Equipment Under Test and Modification State

V3 SS03, S/N: Not serialised (0075947856-TSR0004) - Modification State 0

2.3.3 Date of Test

23-March-2020

2.3.4 Test Method

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

Plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5. These are shown for information purposes and were used to determine the worst case measurement point. Final average measurements were then taken in accordance with ANSI C63.10, clause 11.12.2.5.2 to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

2.3.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	27.1 %

2.3.6 Test Results

Bluetooth Low Energy

Modulation	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
GFSK	2402	2400	50.57	38.96
GFSK	2480	2483.5	54.50	39.44

Table 14

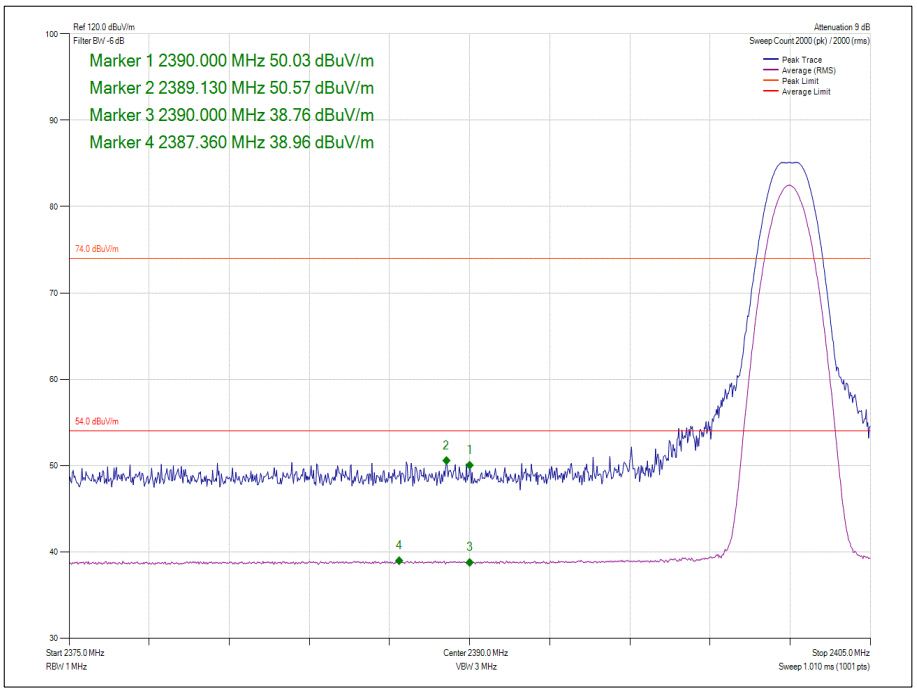

Figure 61 - GFSK - 2402 MHz - Measured Frequency 2400 MHz

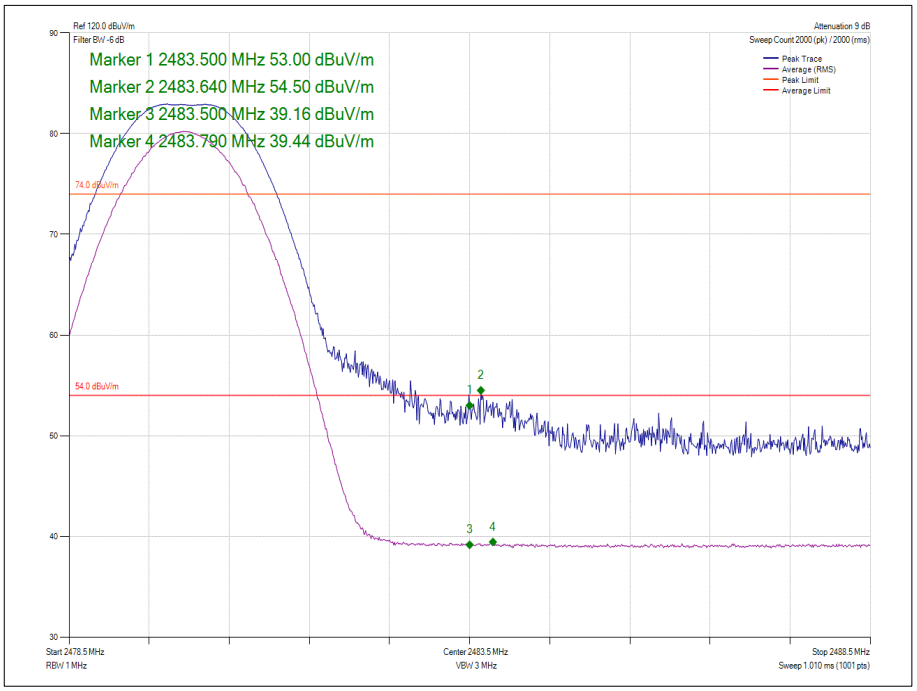

Figure 62 - GFSK - 2480 MHz - Measured Frequency 2483.5 MHz

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 15

2.3.7 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 Due
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	6	09-Jun-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-2021
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
EmX Emissions Software	TUV SUD	EmX V.V1.5.8	5125	-	Software
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	06-Feb-2021

Table 16

TU – Traceability Unscheduled

2.4 AC Power Line Conducted Emissions

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.207

2.4.2 Equipment Under Test and Modification State

V3 SS03, S/N: Not serialised (0075947856-TSR0001) - Modification State 0

2.4.3 Date of Test

01-April-2020

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.2.

2.4.5 Environmental Conditions

Ambient Temperature	21.4 °C
Relative Humidity	25.1 %

2.4.6 Test Results

Bluetooth Low Energy

Applied supply Voltage: 60 Hz
Applied supply frequency: 120 Vac

Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dB)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dB)
0.354	25.7	58.9	-33.2	15.5	48.9	-33.4
3.548	31.1	56.0	-24.9	18.4	46.0	-27.6
3.605	30.4	56.0	-25.6	17.2	46.0	-28.8
3.631	30.8	56.0	-25.2	17.2	46.0	-28.8
3.652	32.9	56.0	-23.1	18.2	46.0	-27.8
3.679	33.1	56.0	-22.9	18.4	46.0	-27.6

Table 17 - Neutral Line

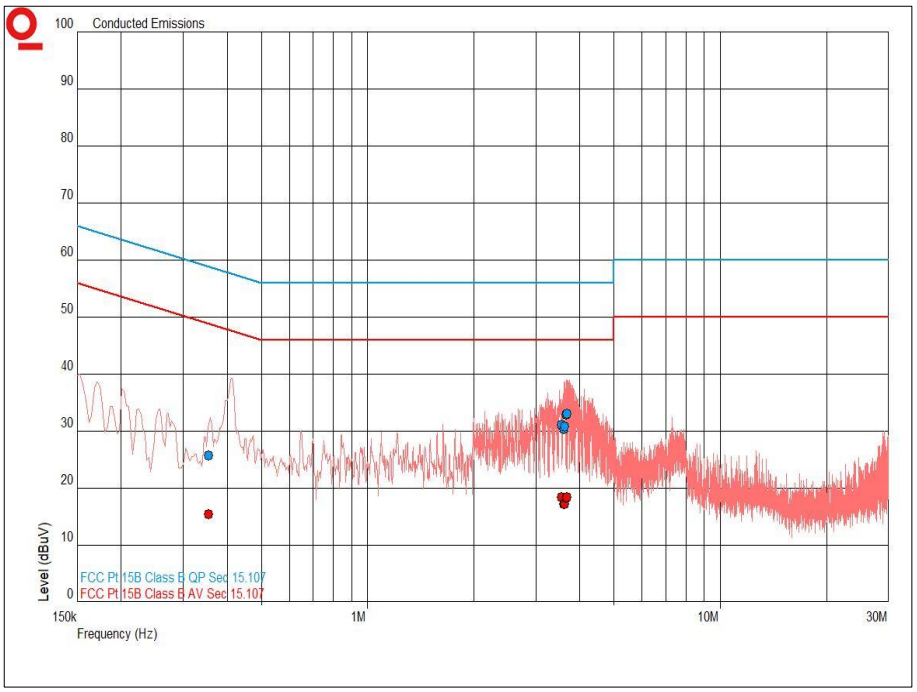

Figure 63 - Neutral Line - 150 kHz to 30 MHz

Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)
0.363	31.1	58.7	-27.5	22.9	48.7	-25.7
3.214	29.8	56.0	-26.2	17.7	46.0	-28.3
3.396	30.1	56.0	-25.9	16.8	46.0	-29.2
3.722	36.5	56.0	-19.5	23.7	46.0	-22.3
3.801	36.6	56.0	-19.4	25.0	46.0	-21.0
3.878	35.6	56.0	-20.4	25.1	46.0	-20.9

Table 18 - Live Line

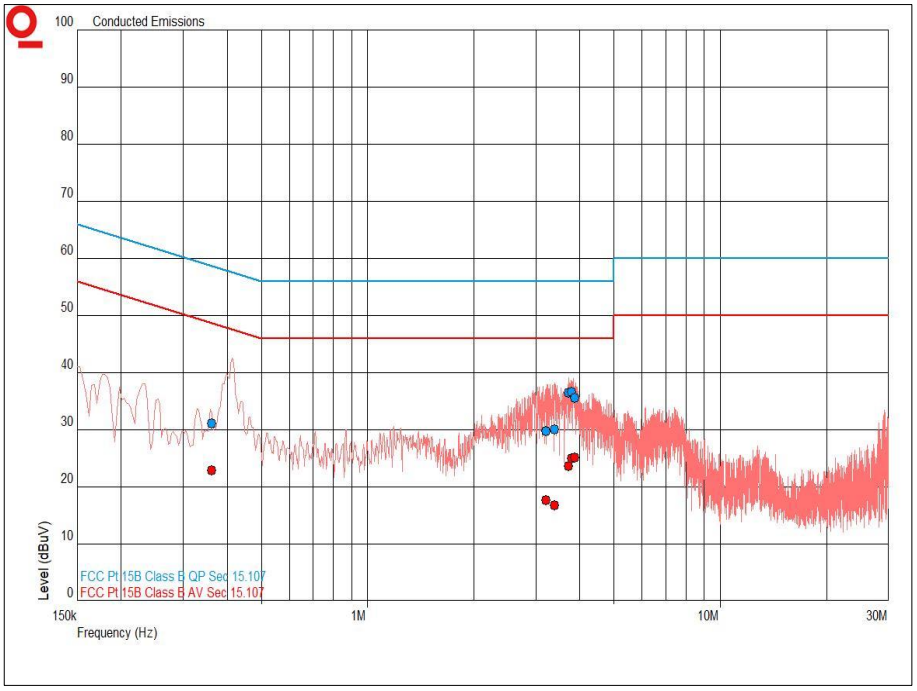

Figure 64 - Live Line - 150 kHz to 30 MHz

FCC 47 CFR Part 15, Limit Clause 15.207

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

Table 19

*Decreases with the logarithm of the frequency.

2.4.7 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 Due
Transient Limiter	Hewlett Packard	11947A	15	12	02-Oct-2020
LISN	Rohde & Schwarz	ESH3-Z5	1390	12	27-Jan-2021
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Compliance 5 Emissions	Teseq	V5.26.51 V.5.00.00	3275	-	Software
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	03-Jan-2021
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	16-Mar-2021

Table 20

2.5 Emission Bandwidth

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

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

2.5.3 Date of Test

03-April-2020

2.5.4 Test Method

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

2.5.5 Environmental Conditions

Ambient Temperature	25.7 °C
Relative Humidity	25.0 %

2.5.6 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 21

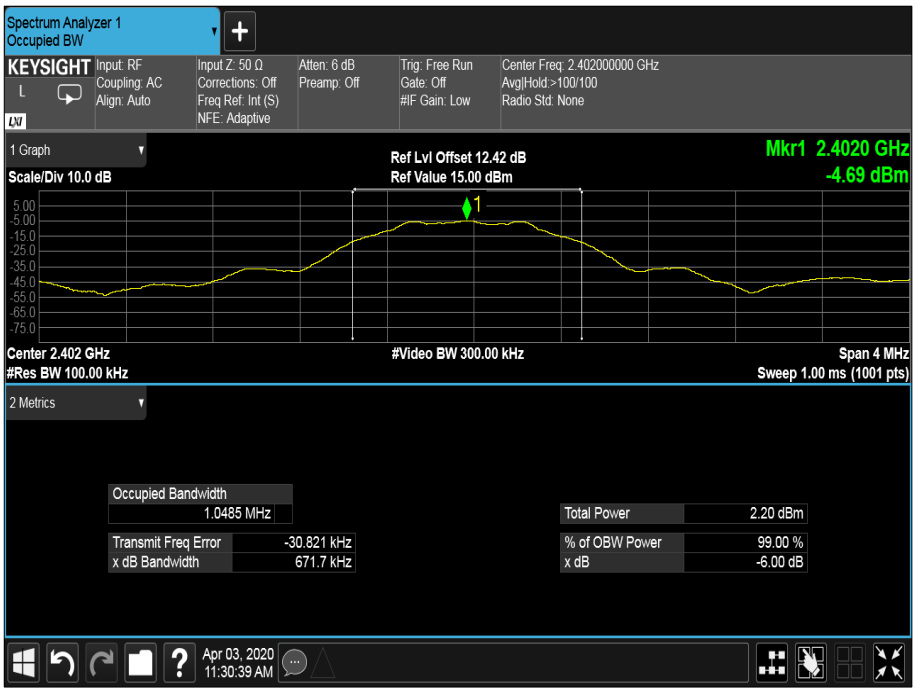

Figure 65 - 2402 MHz – 6 dB and 99% Occupied Bandwidth

Figure 66 - 2440 MHz – 6 dB and 99% Occupied Bandwidth

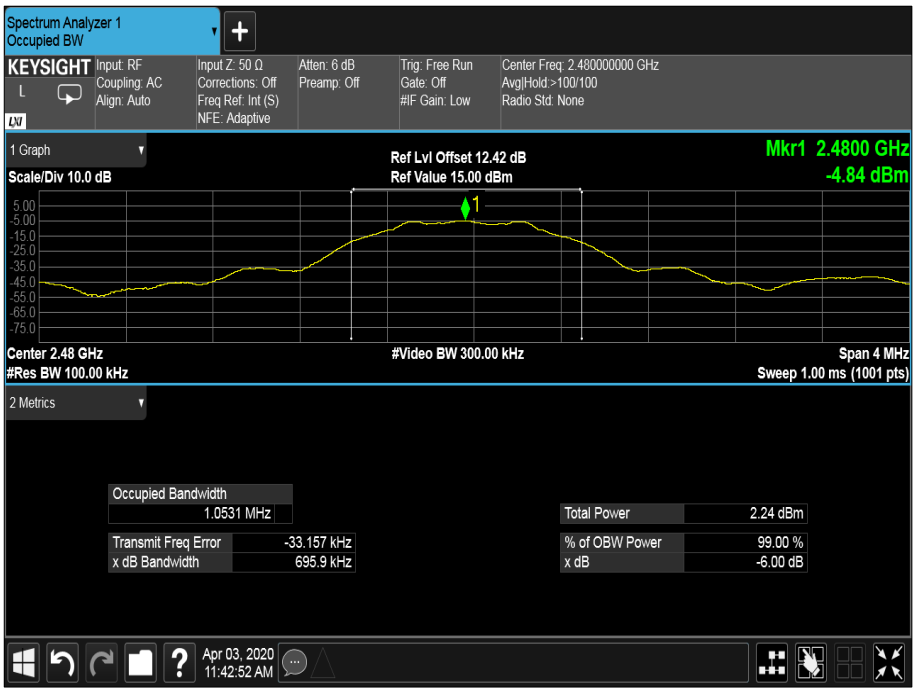

Figure 67 - 2480 MHz – 6 dB and 99% Occupied Bandwidth

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

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

2.5.7 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 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 22

O/P Mon – Output Monitored using calibrated equipment

2.6 Power Spectral Density

2.6.1 Specification Reference

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

2.6.2 Equipment Under Test and Modification State

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

2.6.3 Date of Test

03-April-2020

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	25.7 °C
Relative Humidity	25.0 %

2.6.6 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 23

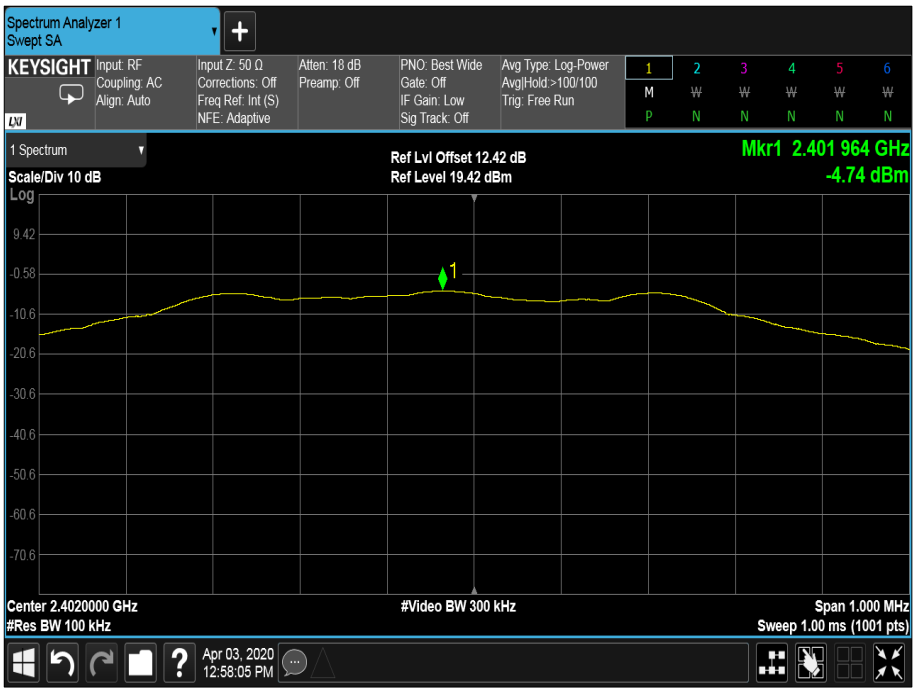

Figure 68 - 2402 MHz

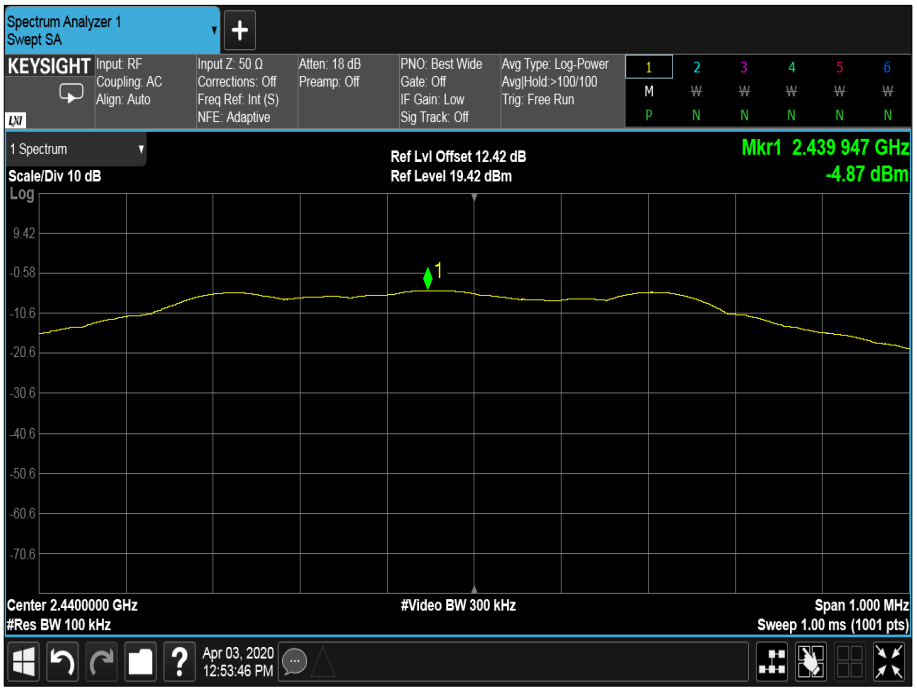

Figure 69 - 2440 MHz

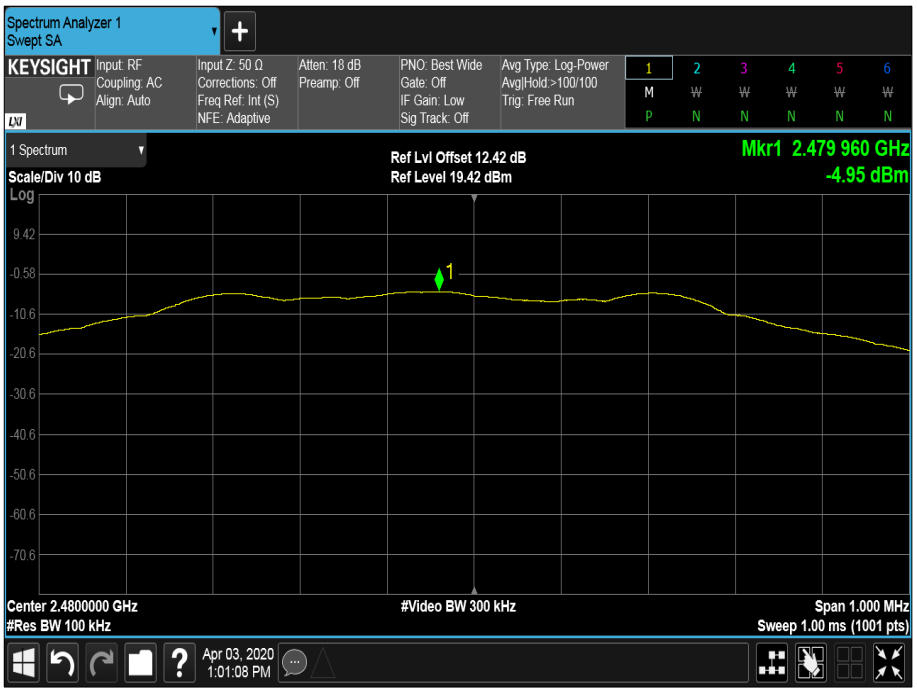

Figure 70 - 2480 MHz

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.

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 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 24

O/P Mon – Output Monitored using calibrated equipment

2.7 Maximum Conducted Output Power

2.7.1 Specification Reference

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

2.7.2 Equipment Under Test and Modification State

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

2.7.3 Date of Test

03-April-2020

2.7.4 Test Method

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

2.7.5 Environmental Conditions

Ambient Temperature	25.7 °C
Relative Humidity	25.0 %

2.7.6 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 25

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.

2.7.7 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 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 26

O/P Mon – Output Monitored using calibrated equipment

3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Power Spectral Density	± 3.2 dB
Emission Bandwidth	± 50.098 kHz
AC Power Line Conducted Emissions	150 kHz to 30 MHz, LISN, ±3.7 dB
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 27

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.