# FCC Test Report

## MiX Telematics International (Pty) Ltd
## Telematics Unit, Model: MiX 46MC-4G-B

## In accordance with FCC 47 CFR Part 15C

Prepared for: MiX Telematics Europe Ltd
Cherry Orchard North
Kembrey Business Park
Swindon
Wiltshire
SN2 8UH
United Kingdom

Add value.
Inspire trust.

FCC ID: 2AFMS-4XMCXG

## COMMERCIAL-IN-CONFIDENCE

Document 75948420-07 Issue 01

| SIGNATURE | | | |
|---|---|---|---|
| | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Stephen Marshall | Senior Engineer | Authorised Signatory | 06 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 | 06 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.

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TÜV SÜD
is a trading name of TUV SUD Ltd
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

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# 1 Report Summary

## 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

| Issue | Description of Change | Date of Issue |
|---|---|---|
| 1 | First Issue | 06 May 2020 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | MiX Telematics Europe Ltd |
| Manufacturer | MiX Telematics International (Pty) Ltd |
| Model Number(s) | MiX 46MC-4G-B |
| Manufacturer Declared Variant(s) | MiX 46MC-4G |
| Serial Number(s) | 53000102 |
| Hardware Version(s) | 1 |
| Software Version(s) | 48 |
| Number of Samples Tested | 1 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15C: 2019 |
| Order Number<br>Date | P0093369<br>20-February-2020 |
| Date of Receipt of EUT | 02-March-2020 |
| Start of Test | 02-March-2020 |
| Finish of Test | 08-March-2020 |
| 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 |
|---|---|---|---|---|
| Configuration and Mode: Bluetooth Low Energy transmitter | | | | |
| 2.1 | 15.247 (d) | Authorised Band Edges | Pass | ANSI C63.10 (2013) |
| 2.2 | 15.205 | Restricted Band Edges | Pass | ANSI C63.10 (2013) |
| 2.3 | 15.247 (d) and 15.205 | Spurious Radiated Emissions | Pass | ANSI C63.10 (2013) |
| - | 15.247 (a)(2) | 6 dB Bandwidth | N/T | Refer to document 75936634-08 for results |
| - | 15.247 (b)(3) | Maximum Conducted Output Power | N/T | Refer to document 75936634-08 for results |
| - | 15.247 (e) | Power Spectral Density | N/T | Refer to document 75936634-08 for results |

**Table 2**

N/T – Not Tested

*The manufacturer has declared the radio device is electrically identical and therefore the conducted results will be the same.

## 1.4 Application Form

### Equipment Description

| | |
|---|---|
| Technical Description:<br>*(Please provide a brief description of the intended use of the equipment)* | The MiX 46MC-4G is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, an LTE CAT M1 modem with 2G fall-back, a GNSS, an accelerometer, Low Energy Bluetooth, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and 434 / 915 MHz short range transceiver. |
| Manufacturer: | MiX Telematics International (Pty) Ltd. |
| Model: | MiX 46MC-4G; MiX 46MC-4G-B |
| Part Number: | 440FT0194; 440FT0195 |
| Hardware Version: | 1 |
| Software Version: | 4.8 |
| FCC ID (if applicable) | 2AFMS-4XMCXG |
| IC (if applicable) | |

### Intentional Radiators

| Technology | LTE Band 12 | LTE Band 13 | LTE Band 5 | LTE Band 4 | LTE Band 3 | LTE Band 2 | SRD915 | SRD2400 |
|---|---|---|---|---|---|---|---|---|
| Frequency Band (MHz) | 699-716 | 777-787 | 824-849 | 1710-1755 | 1710-1785 | 1880-1910 | 902-928 | 2400-2480 |
| Conducted Declared Output Power (dBm) | 23 | 23 | 23 | 23 | 23 | 23 | 20 | 7 |
| Antenna Gain (dBi) | 0.76 | 1.39 | 0.21 | 1.46 | 1.46 | 2.07 | 0 | 1.4 |
| Supported Bandwidth(s) (MHz) | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 0.025 | 1 |
| Modulation Scheme(s) | QPSK/ 16-QAM | QPSK/ 16-QAM | QPSK/ 16-QAM | QPSK/ 16-QAM | QPSK/ 16-QAM | QPSK/ 16-QAM | 2FSK | GFSK |
| ITU Emission Designator | 1M40W7D | 1M40W7D | 1M40W7D | 1M40W7D | 1M40W7D | 1M40W7D | 38K4F7D | 1M00G7D |
| Bottom Frequency (MHz) | 699 | 777 | 824 | 1710 | 1710 | 1850 | 902 | 2402 |
| Middle Frequency (MHz) | 707.5 | 782 | 836.5 | 1747.5 | 1747.5 | 1880 | 915 | 2440 |
| Top Frequency (MHz) | 716 | 787 | 849 | 1755 | 1785 | 1910 | 928 | 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 | 699 MHz |
| Class A Digital Device (Use in commercial, industrial or business environment) ☐<br>Class B Digital Device (Use in residential environment only) ☒ | |

## AC Power Source

| | | |
|---|---|---|
| AC supply frequency: | N/A | Hz |
| Voltage | N/A | V |
| Max current: | N/A | A |
| Single Phase ☐ Three Phase ☐ | | |

## DC Power Source

| | | |
|---|---|---|
| Nominal voltage: | 13.8/27.6 V DC | V |
| Extreme upper voltage: | 32 | V |
| Extreme lower voltage: | 10.5 | V |
| Max current: | 2A typical; 4.5A absolute max (7.5A Fused) | A |

## Battery Power Source

| | | |
|---|---|---|
| Voltage: | 3.2 | V |
| End-point voltage: | 3.2 | 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: | -20 | °C |
| Maximum temperature: | 60 | °C |

## Antenna Characteristics

| | | | | | |
|---|---|---|---|---|---|
| Antenna connector ☒ | | | State impedance | 50 | Ohm |
| Temporary antenna connector ☐ | | | State impedance | | Ohm |
| Integral antenna ☒ | Type: | LTE<br>BLE<br>SRD915<br>GNSS | Gain | 3<br>1.4<br>0<br>4 | dBi |
| External antenna ☒ | Type: | GNSS | Gain | 4 | dBi |
| For external antenna only:<br>Standard Antenna Jack ☒ If yes, describe how user is prohibited from changing antenna (if not professional installed):<br>Equipment is only ever professionally installed ☒<br>Non-standard Antenna Jack ☐ | | | | | |

Ancillaries (if applicable)

| | | | |
|---|---|---|---|
| Manufacturer: | MiX Telematics | Part Number: | 440FT0033 |
| Model: | Main Harness MP10 | Country of Origin: | South Africa |
| Manufacturer: | MiX Telematics | Part Number: | 440FT0032 |
| Model: | Code Plug Harness with Socket CP4 | Country of Origin: | South Africa |
| Manufacturer: | MiX Telematics | Part Number: | 440FT0931 |
| Model: | Serial Harness SR1 | Country of Origin: | South Africa |
| Manufacturer: | RF Design | Part Number: | 440FT0933 |
| Model: | External GNSS Antenna PA2 | Country of Origin: | South Africa |

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

Name: Ben van der Merwe
Position held: Senior RF Engineer
Date: 29 April 2020

## 1.5 Manufacturer's Declared Variant(s)

The following product variants (with part numbers) are available:

| Part ID | Official Name | Description |
|---|---|---|
| 440FT0194 | MiX 46MC-4G | MiX 4000 LTE with 2G fall back (Model 46MC-4G) Electronic Unit; with Magix 434MHz and 915MHz support. |
| 440FT0195 | MiX 46MC-4G-B | MiX 4000 LTE with 2G fall back (Model 46MC-4G-B) Electronic Unit with Battery (plugged in) with Magix 434MHz and 915MHz support. |

The variants MiX 46MC-4G and MiX 46MC-4G-B, present the same electrical, physical and electro mechanics characteristics, the same PCB (440AWZ124), layout and components.

The only difference between them is that the model MiX 46MC-4G-B has an internal backup battery, allowing the device to work after the disconnection of the vehicle´s battery.

## 1.6 Product Information

### 1.6.1 Technical Description

The MiX 46MC-4G is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, an LTE CAT M1 modem with 2G fall-back, a GNSS, an accelerometer, Bluetooth Low Energy, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and 434 / 915 MHz short range transceiver.

### 1.6.2 Equipment Under Test Power Settings

Authorized and Restricted Band Edges were performed at a power level setting of 10 dBm.

For Spurious Radiated Emissions, the power settings for the transmitter were set at the following.
Bottom channel (2402 MHz) = 1dBm
Middle channel (2440 MHz) = 5dBm
Top channel (2480 MHz) = 10 dBm

However, the conducted output power for the top channel in production software, will not be set above 6.45 dBm as reflected in the test results of the refenced report number 75936634-08.

## 1.7 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

## 1.8 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: MiX 46MC-4G-B, Serial Number: 53000102 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |

**Table 3**

## 1.9 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 transmitter | | |
| Authorised Band Edges | Graeme Lawler | UKAS |
| Restricted Band Edges | Graeme Lawler | UKAS |
| Spurious Radiated Emissions | Graeme Lawler | 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

MiX 46MC-4G-B, S/N: 53000102 - Modification State 0

### 2.1.3 Date of Test

02-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 19.4 °C
Relative Humidity 33.1 %

### 2.1.6 Test Results

Bluetooth Low Energy transmitter

| Modulation | Frequency (MHz) | Band Edge Frequency (MHz)) | Level (dBc) |
|---|---|---|---|
| GFSK | 2402 | 2400 | -57.10 |

**Table 5 - Authorised Band Edge Results**

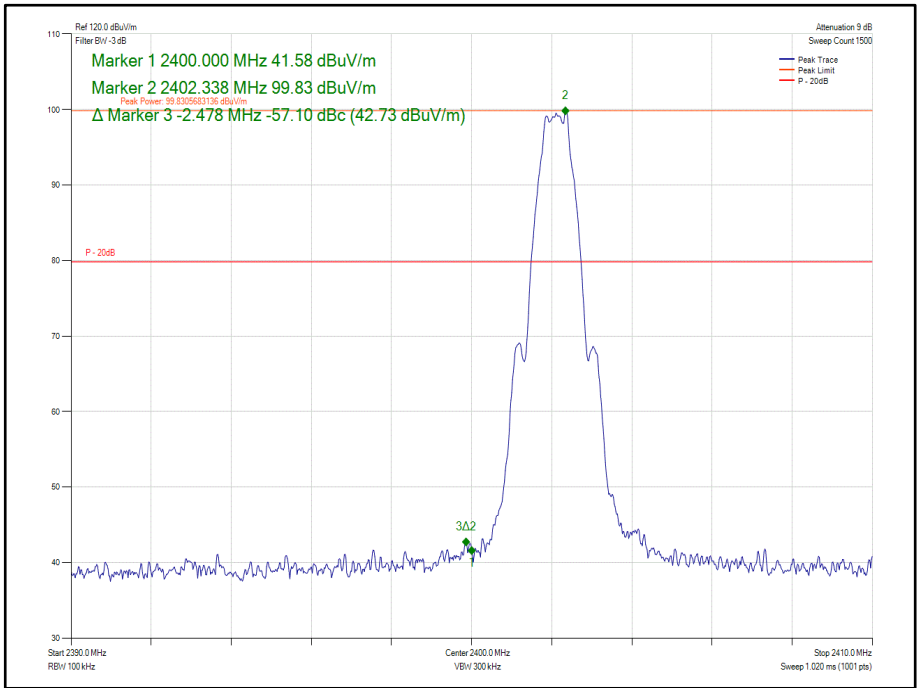


**Figure 1 – GFSK, 2402 MHz - Measured Frequency 2400 MHz**

<u>FCC 47 CFR Part 15, Limit Clause 15.247 (d)</u>

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 |
| DC Power Supply | Hewlett Packard | 6269B | 1909 | - | TU |
| Multimeter | Iso-tech | IDM101 | 2417 | 12 | 11-Nov-2020 |
| Antenna with permanent attenuator (Bilog) | Chase | CBL6143 | 2904 | 24 | 30-Sep-2021 |
| Comb Generator | Schaffner | RSG1000 | 3034 | - | 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 | 11-Mar-2020 |
| 4dB Attenuator | Pasternack | PE7047-4 | 4935 | 24 | 30-Sep-2021 |
| Hygrometer | Rotronic | HP21 | 4989 | 12 | 02-May-2020 |
| EmX Emissions Software | TUV SUD | EmX | 5125 | - | Software |
| 8 Meter Cable | Teledyne | PR90-088-8MTR | 5212 | 12 | 30-Aug-2020 |
| EMI Test Receiver | Rohde & Schwarz | ESW44 | 5382 | 12 | 08-Oct-2020 |

**Table 6**

TU - Traceability Unscheduled

## 2.2 Restricted Band Edges

### 2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205

### 2.2.2 Equipment Under Test and Modification State

MiX 46MC-4G-B, S/N: 53000102 - Modification State 0

### 2.2.3 Date of Test

02-March-2020

### 2.2.4 Test Method

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

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

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

### 2.2.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 19.4 °C |
| Relative Humidity | 33.1 % |

### 2.2.6 Test Results

Bluetooth Low Energy transmitter

| Modulation | Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBµV/m) | Average Level (dBµV/m) |
|---|---|---|---|---|
| GFSK | 2402 | 2390 | 51.54 | 40.44 |
| GFSK | 2480 | 2483.5 | 53.54 | 42.00 |

**Table 7 - Restricted Band Edge Results**

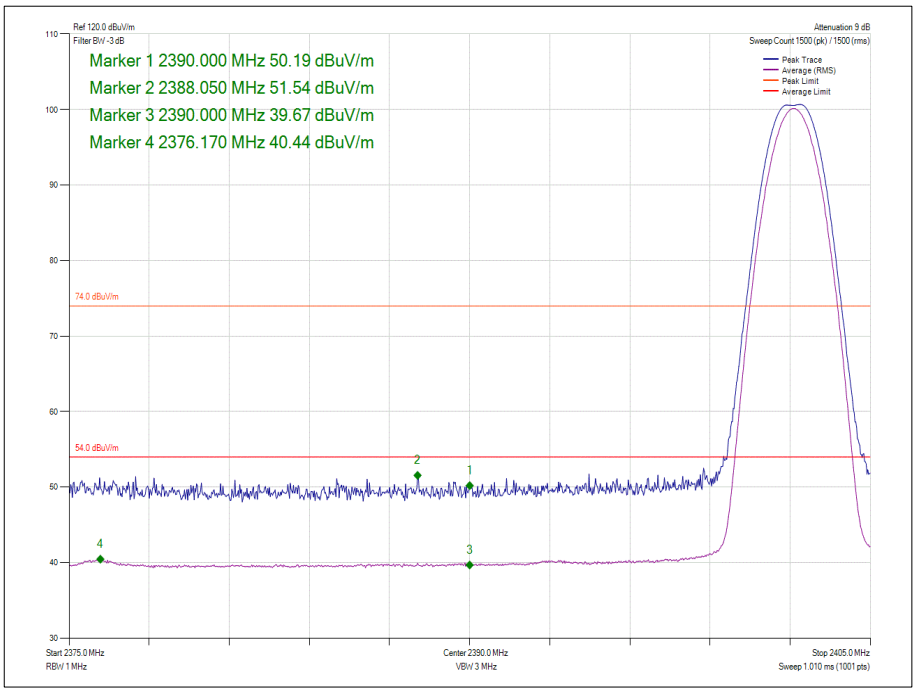


**Figure 2 - GFSK - 2402 MHz - Measured Frequency 2390 MHz**

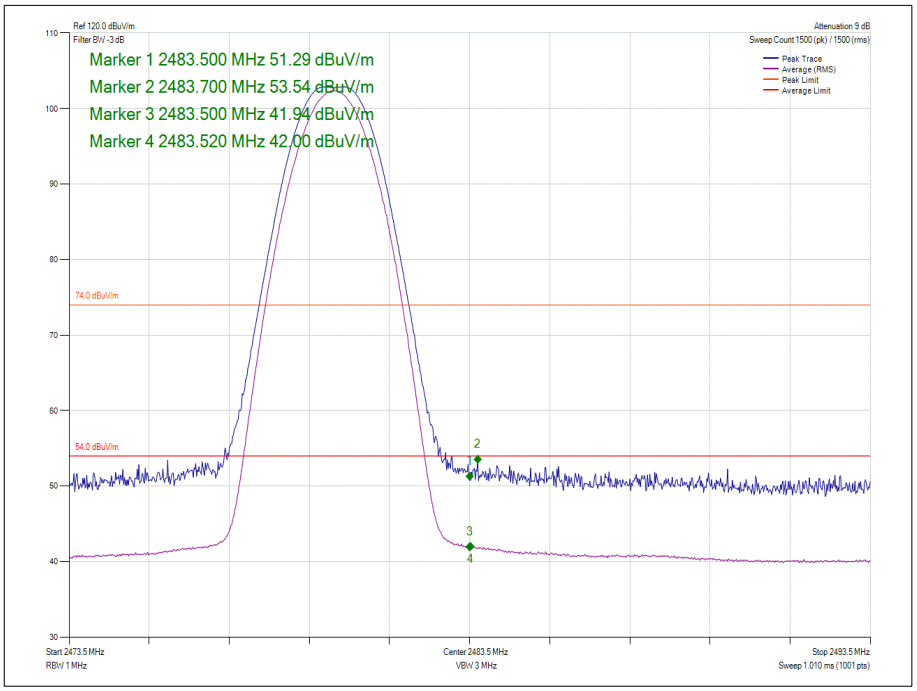


**Figure 3 - GFSK - 2480 MHz - Measured Frequency 2483.5 MHz**

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 8**

### 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 |
|---|---|---|---|---|---|
| Screened Room (5) | Rainford | Rainford | 1545 | 36 | 23-Jan-2021 |
| Turntable Controller | Inn-Co GmbH | CO 1000 | 1606 | - | TU |
| DC Power Supply | Hewlett Packard | 6269B | 1909 | - | TU |
| Multimeter | Iso-tech | IDM101 | 2417 | 12 | 11-Nov-2020 |
| Antenna with permanent attenuator (Bilog) | Chase | CBL6143 | 2904 | 24 | 30-Sep-2021 |
| Comb Generator | Schaffner | RSG1000 | 3034 | - | 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 | 11-Mar-2020 |
| 4dB Attenuator | Pasternack | PE7047-4 | 4935 | 24 | 30-Sep-2021 |
| Hygrometer | Rotronic | HP21 | 4989 | 12 | 02-May-2020 |
| EmX Emissions Software | TUV SUD | EmX | 5125 | - | Software |
| 8 Meter Cable | Teledyne | PR90-088-8MTR | 5212 | 12 | 30-Aug-2020 |
| EMI Test Receiver | Rohde & Schwarz | ESW44 | 5382 | 12 | 08-Oct-2020 |

**Table 9**

TU - Traceability Unscheduled

## 2.3 Spurious Radiated Emissions

### 2.3.1 Specification Reference

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

### 2.3.2 Equipment Under Test and Modification State

MiX 46MC-4G-B, S/N: 53000102 - Modification State 0

### 2.3.3 Date of Test

02-March-2020 to 08-March-2020

### 2.3.4 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.

Ports on the EUT were terminated with loads as described in ANSI C63.4, clause 6.2.4. For EUT's with multiple connectors of the same type, additional interconnecting cables were connected, and pre-scans performed to determine whether the level of the emissions were increased by >2 dB. 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.

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

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

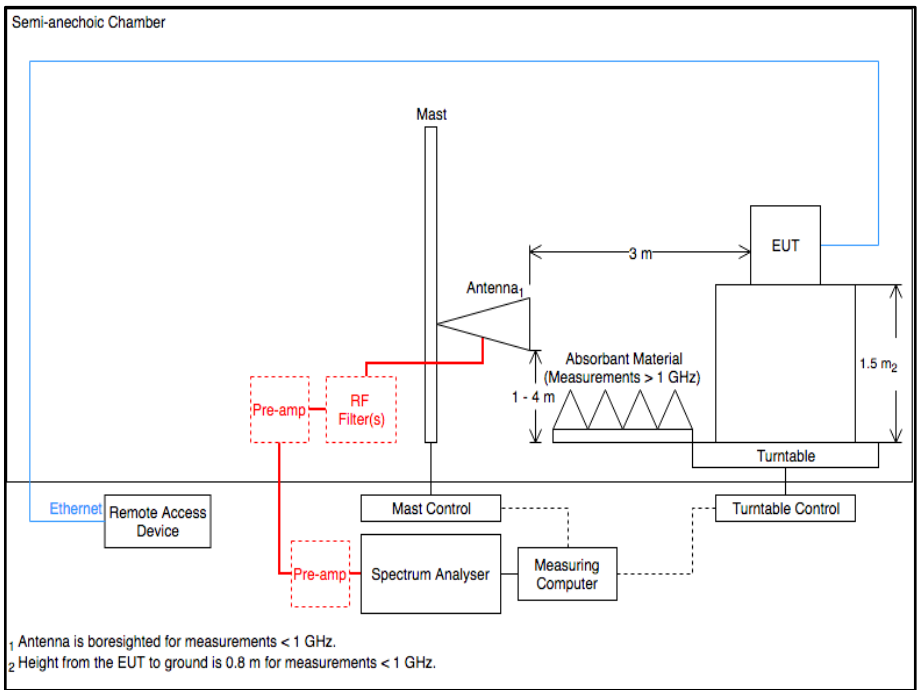


**Figure 4 - Radiated Emissions Test Setup Diagram**

### 2.3.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 19.4 - 22.1 °C |
| Relative Humidity | 32.9 - 33.1 % |

### 2.3.6 Test Results

Bluetooth Low Energy transmitter

Modulation/Packet Type: GFSK/DH1

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

**Table 10 - 2402 MHz, 30 MHz to 1 GHz - Emission Results**

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

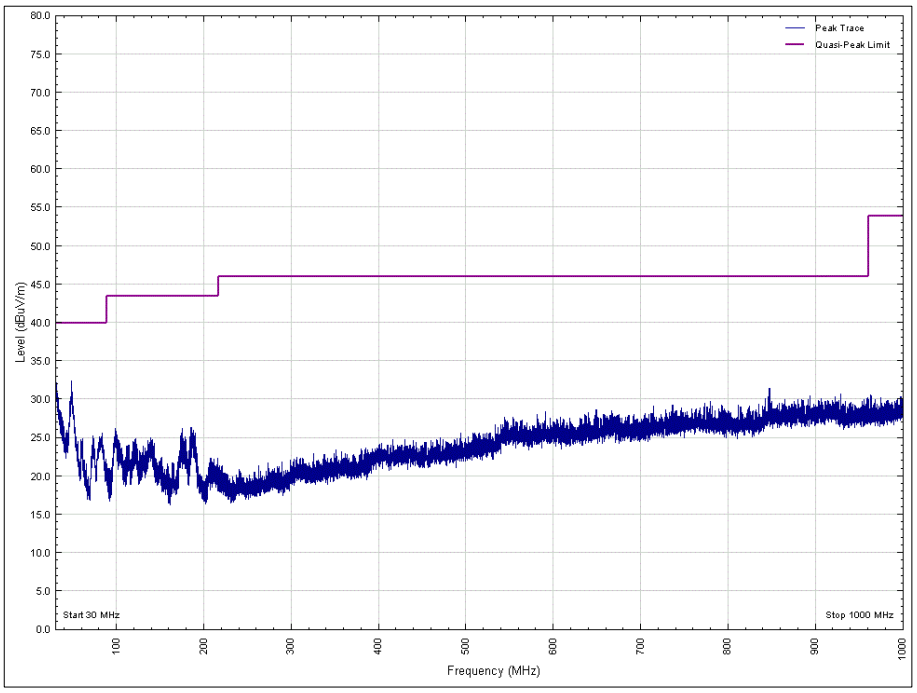


**Figure 5 - 2402 MHz, 30 MHz to 1 GHz, Vertical, X Orientation**

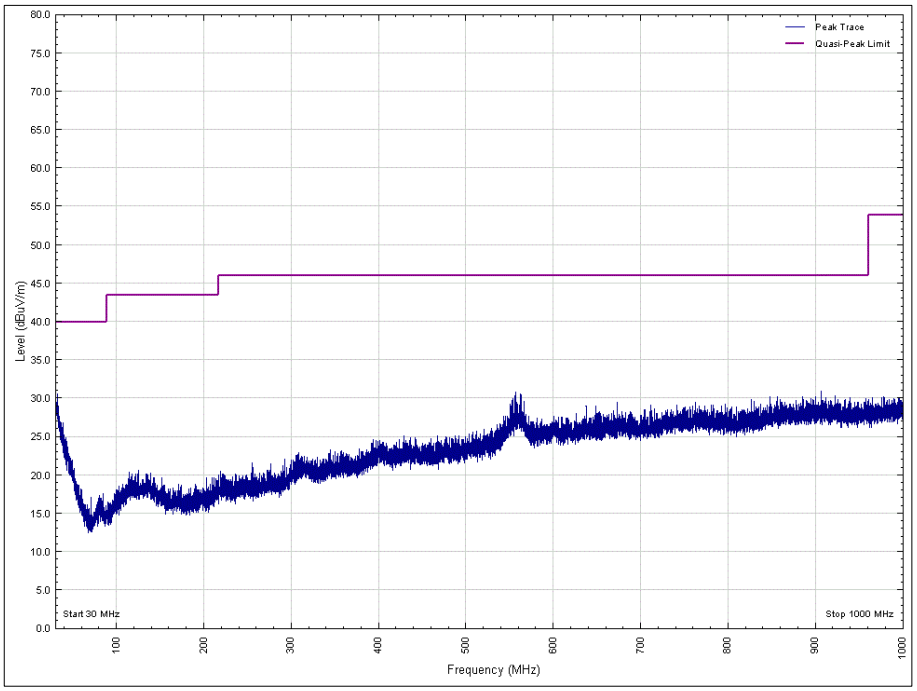


**Figure 6 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation**

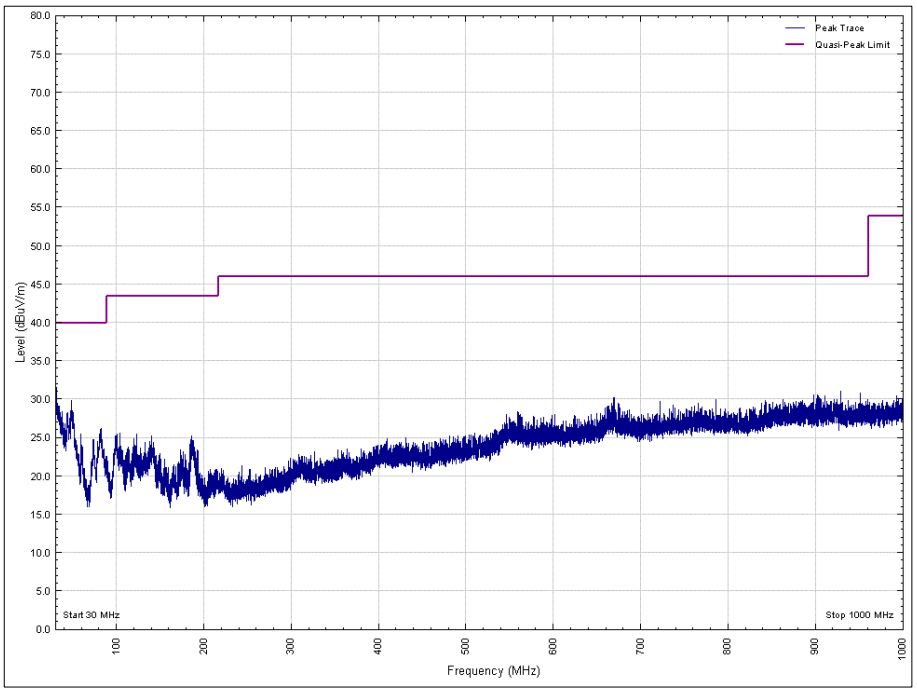


**Figure 7 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation**

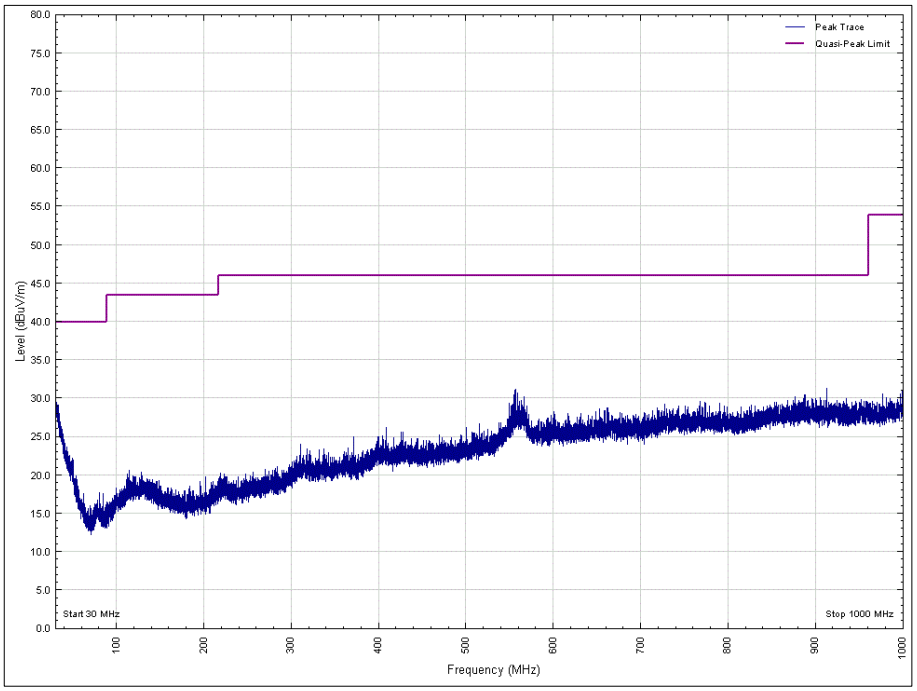


**Figure 8 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation**

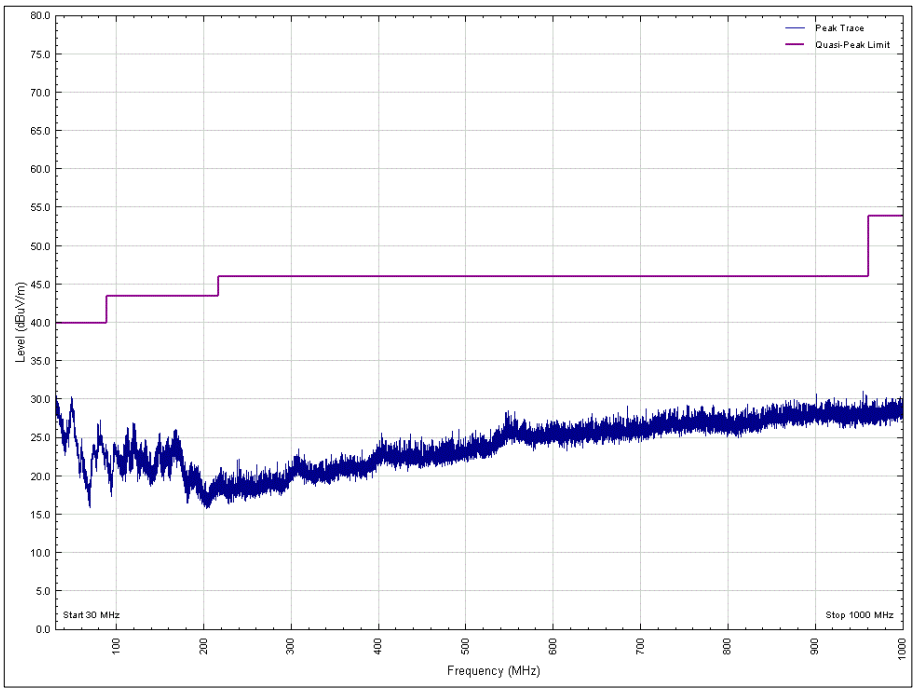


**Figure 9 - 2402 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation**

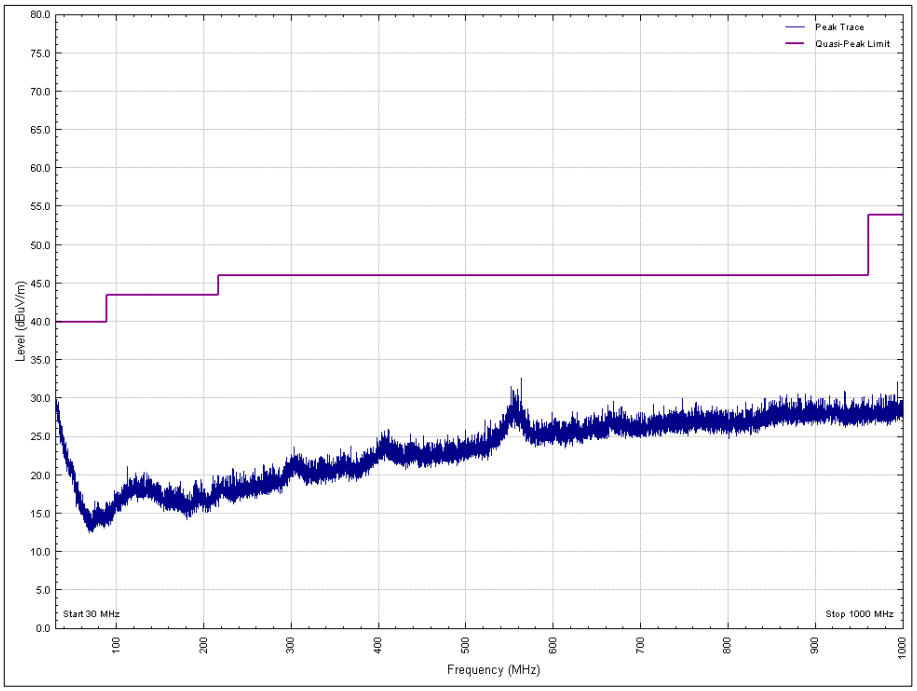


**Figure 10 - 2402 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation | Orientation |
|---|---|---|---|---|---|---|---|---|
| 4803.763 | 53.29 | 53.98 | 0.69 | CISPR Average | 230 | 331 | Vertical | Y |
| 4803.693 | 47.93 | 53.98 | 6.05 | CISPR Average | 221 | 162 | Horizontal | Y |
| 4803.734 | 50.72 | 53.98 | 3.26 | CISPR Average | 265 | 100 | Vertical | Z |
| 4803.793 | 46.79 | 53.98 | 7.19 | CISPR Average | 201 | 100 | Vertical | X |
| 4804.773 | 50.37 | 53.98 | 3.61 | CISPR Average | 299 | 276 | Horizontal | X |
| 4804.738 | 52.84 | 53.98 | 1.14 | CISPR Average | 223 | 262 | Horizontal | Z |

**Table 11 - 2402 MHz, 1 GHz to 25 GHz Emissions Results**

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

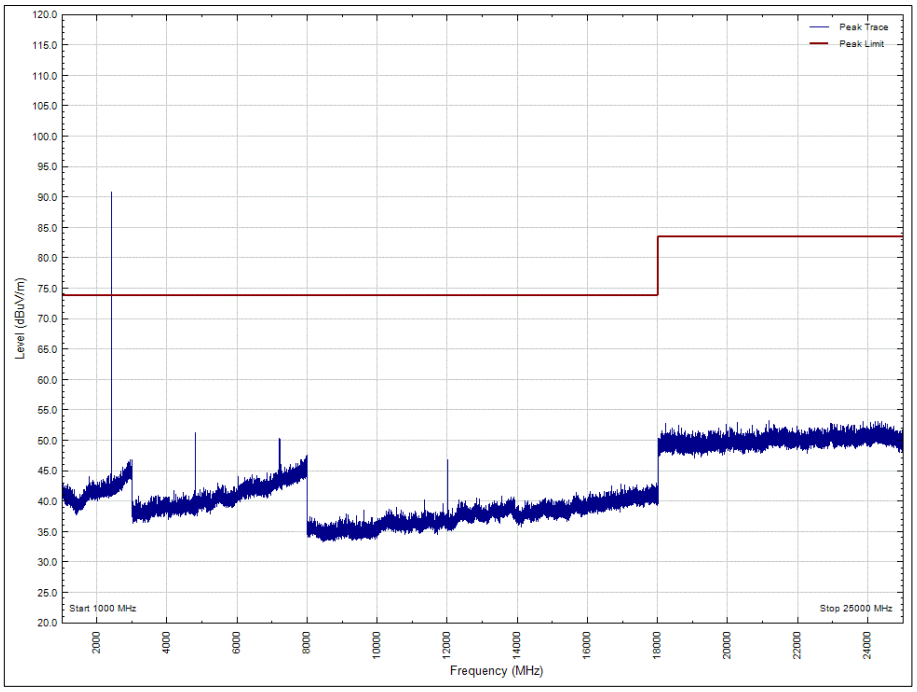


**Figure 11 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation: - Peak**

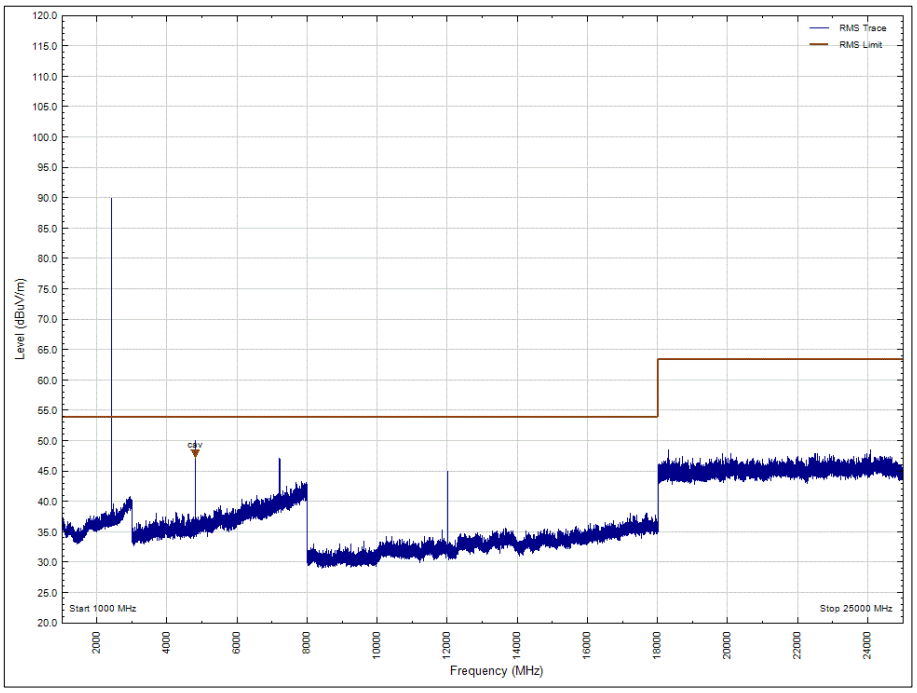


**Figure 12 - 2402 MHz, 1 GHz to 25 GHz, Vertical, X Orientation: - Average**

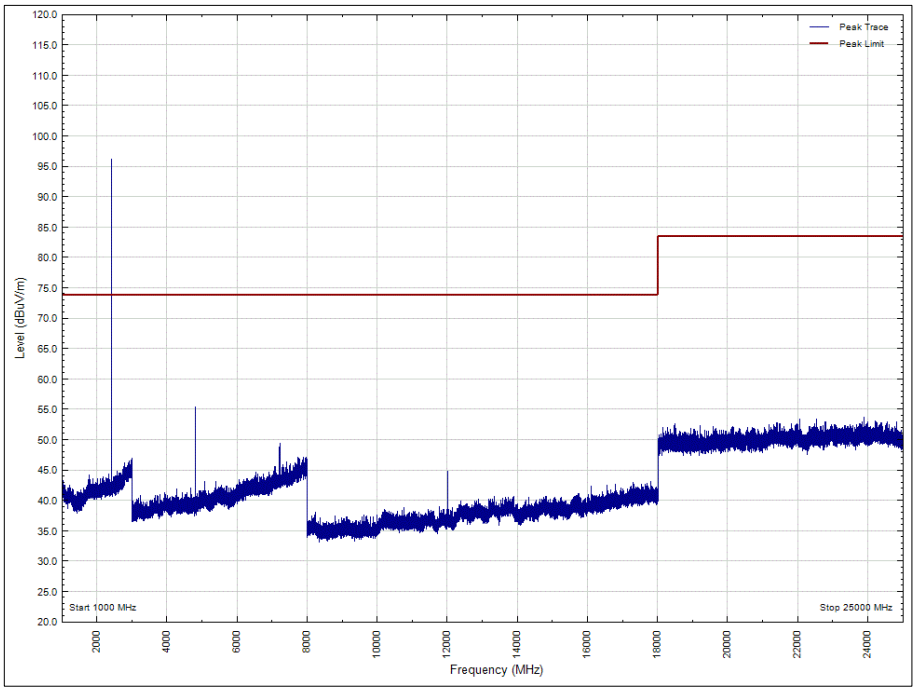


**Figure 13 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation: - Peak**

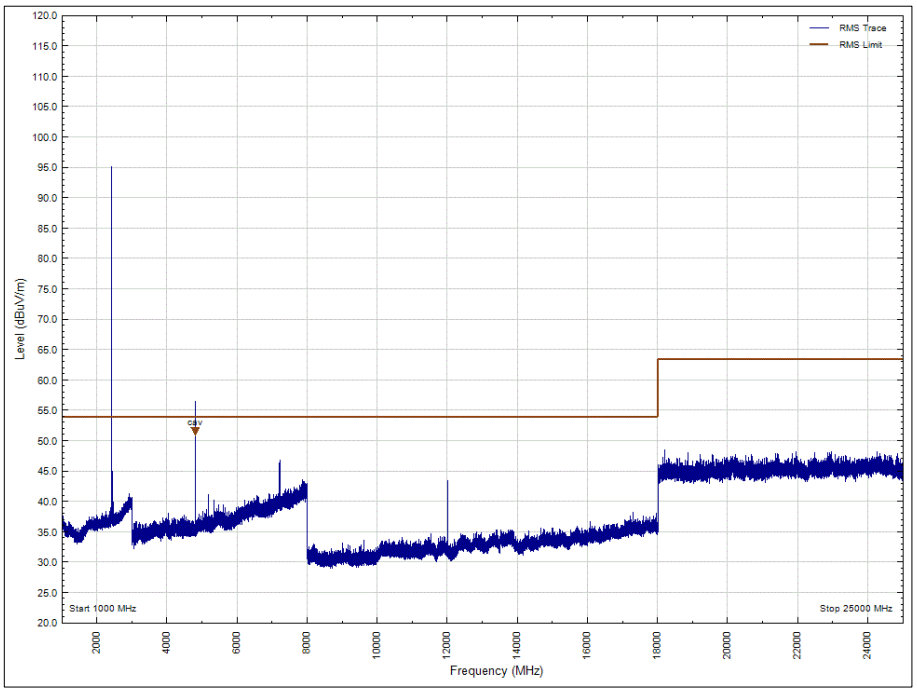


**Figure 14 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, X Orientation: - Average**

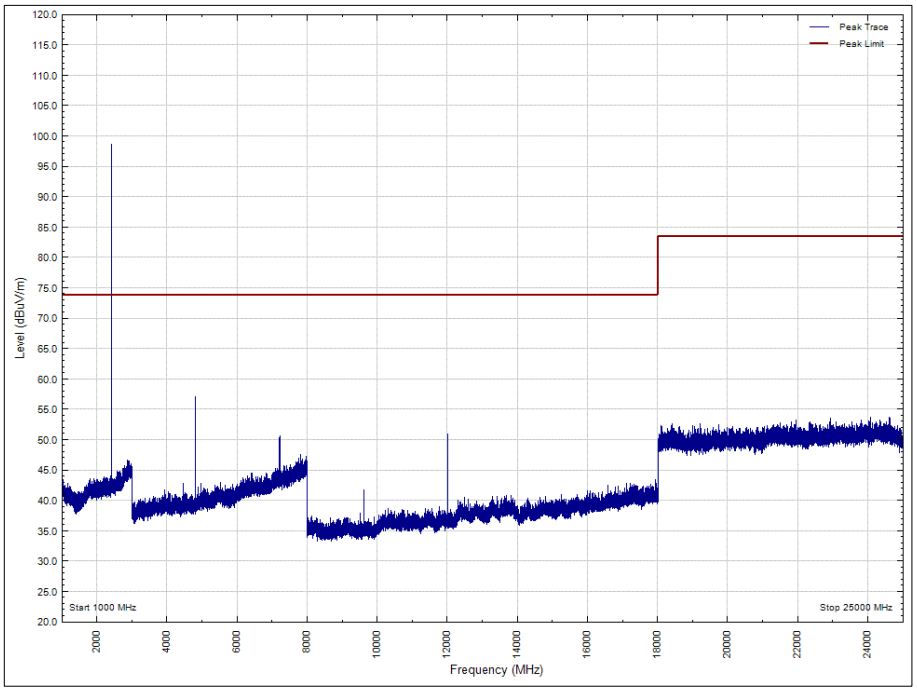


**Figure 15 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation: - Peak**

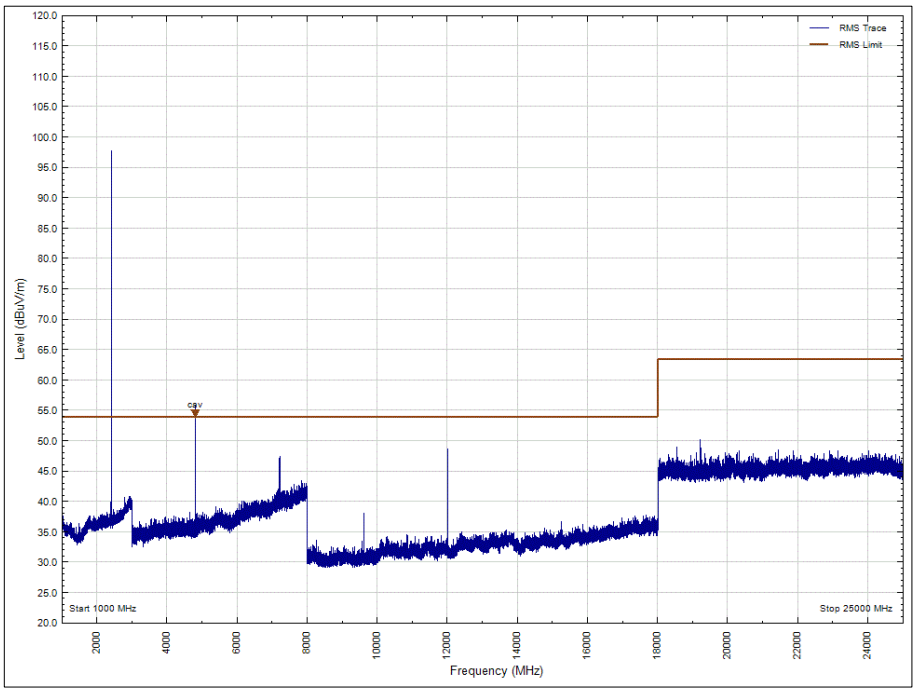


**Figure 16 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Y Orientation: - Average**

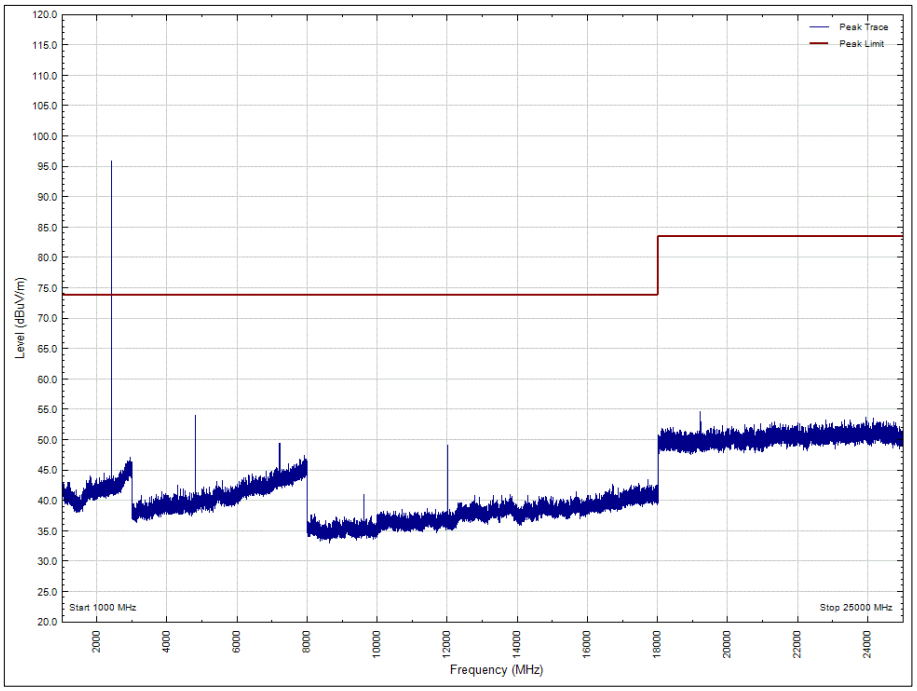


**Figure 17 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation: - Peak**

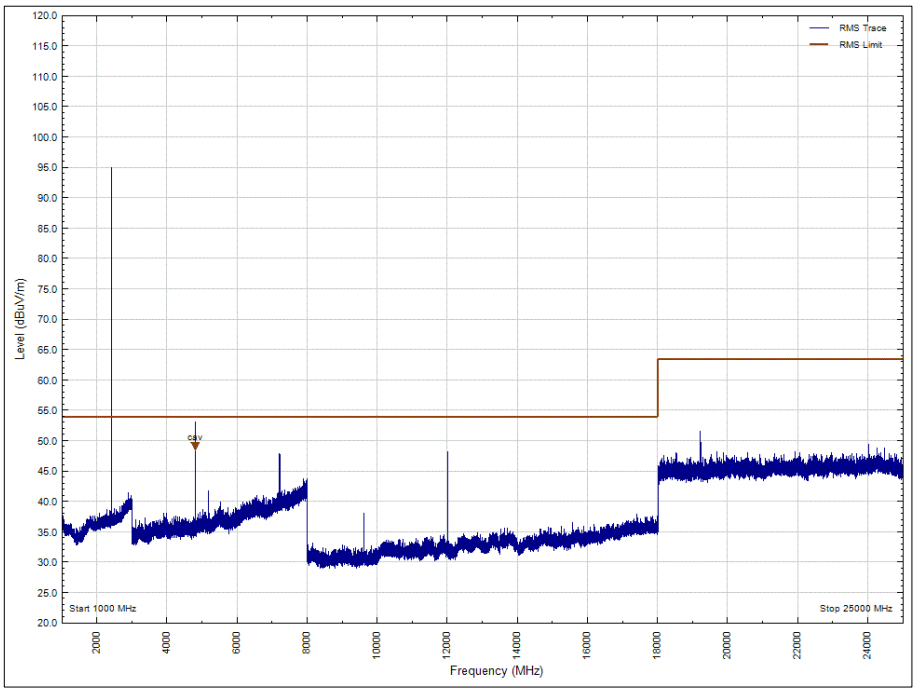


**Figure 18 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Y Orientation: - Average**

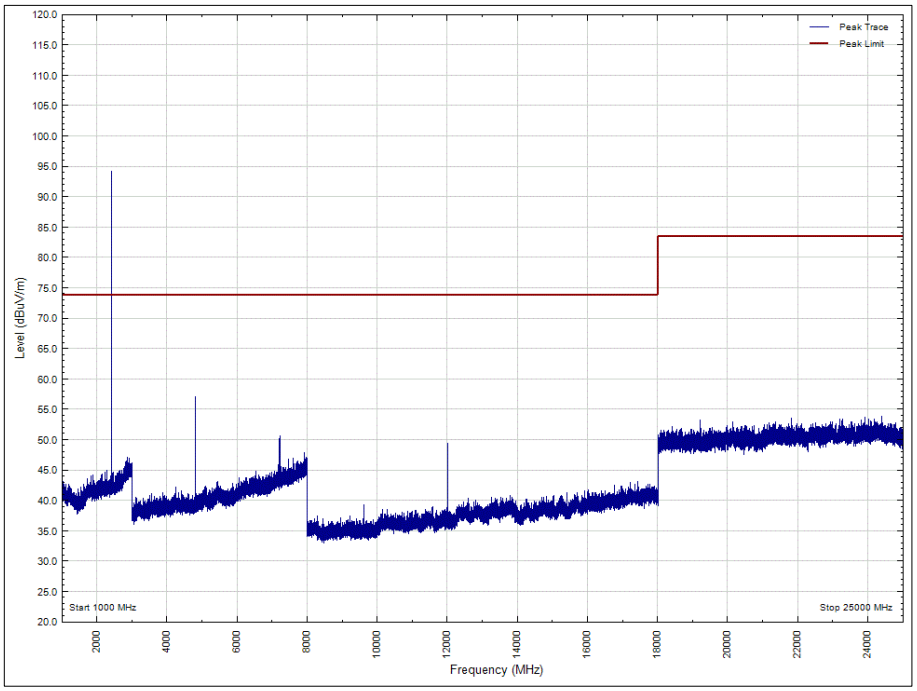


**Figure 19 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation: - Peak**

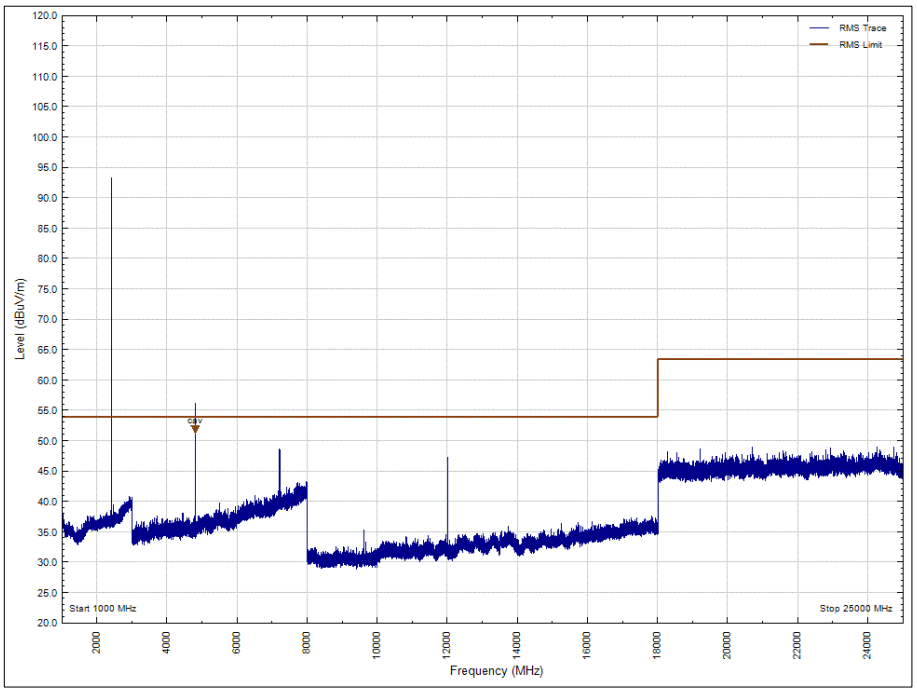


**Figure 20 - 2402 MHz, 1 GHz to 25 GHz, Vertical, Z Orientation: - Average**

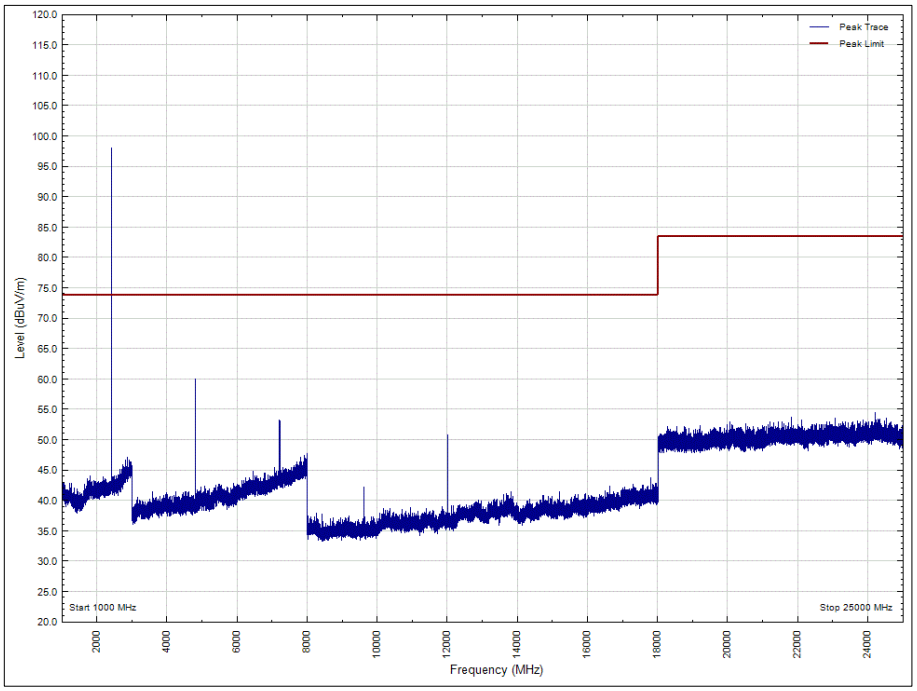


**Figure 21 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation: - Peak**

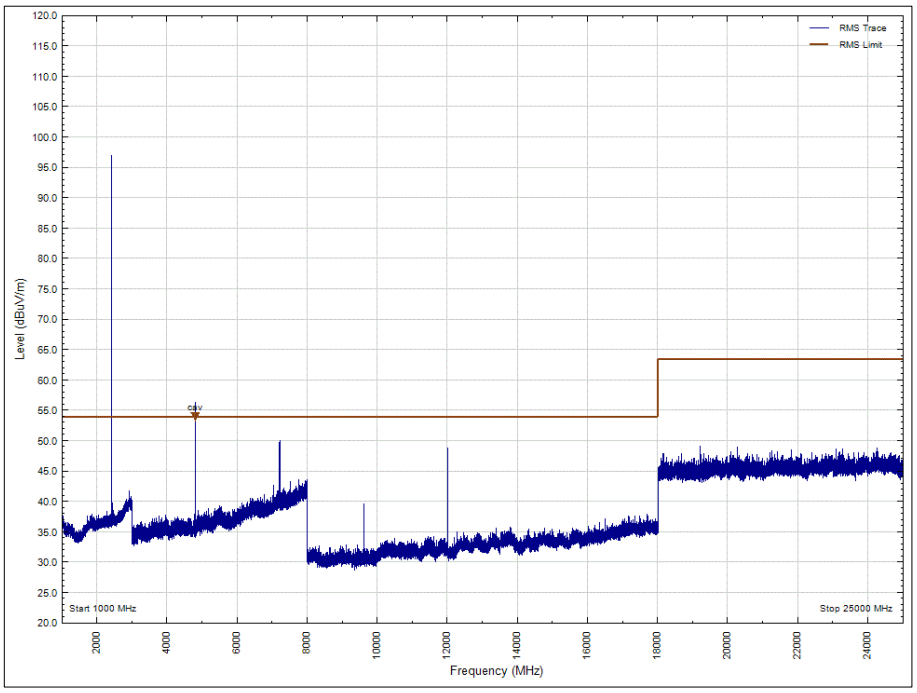


**Figure 22 - 2402 MHz, 1 GHz to 25 GHz, Horizontal, Z Orientation: - Average**

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

**Table 12 - 2440 MHz, 30 MHz to 1 GHz - Emission Results**

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

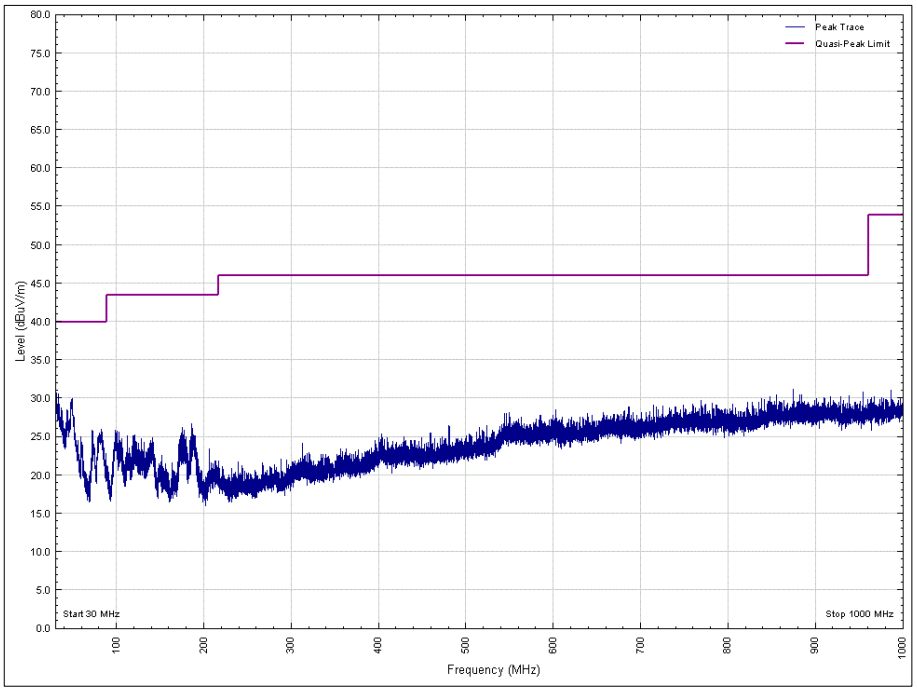


**Figure 23 - 2440 MHz, 30 MHz to 1 GHz, Vertical, X Orientation**

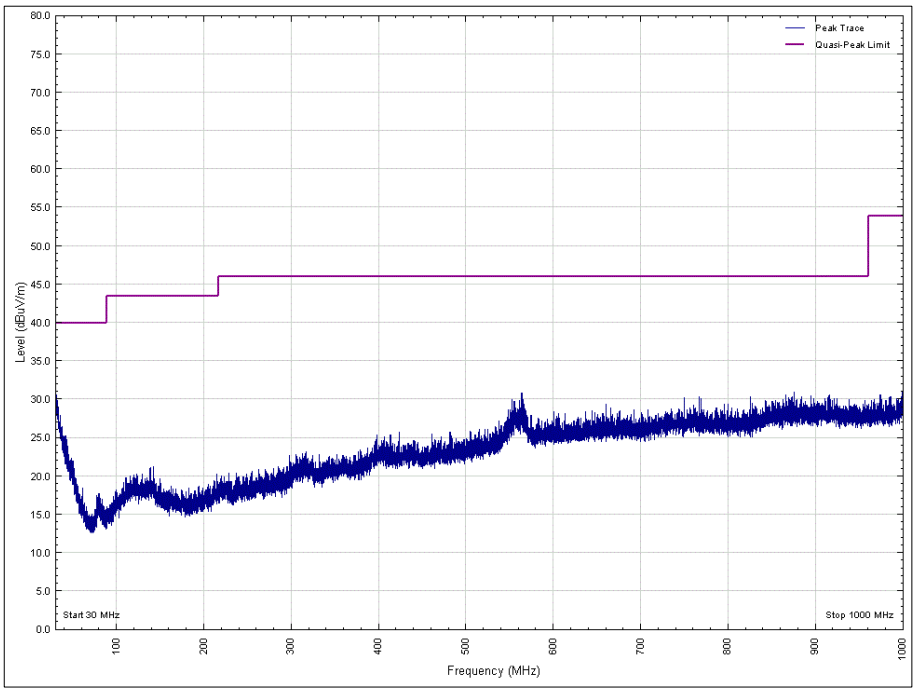


**Figure 24 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation**

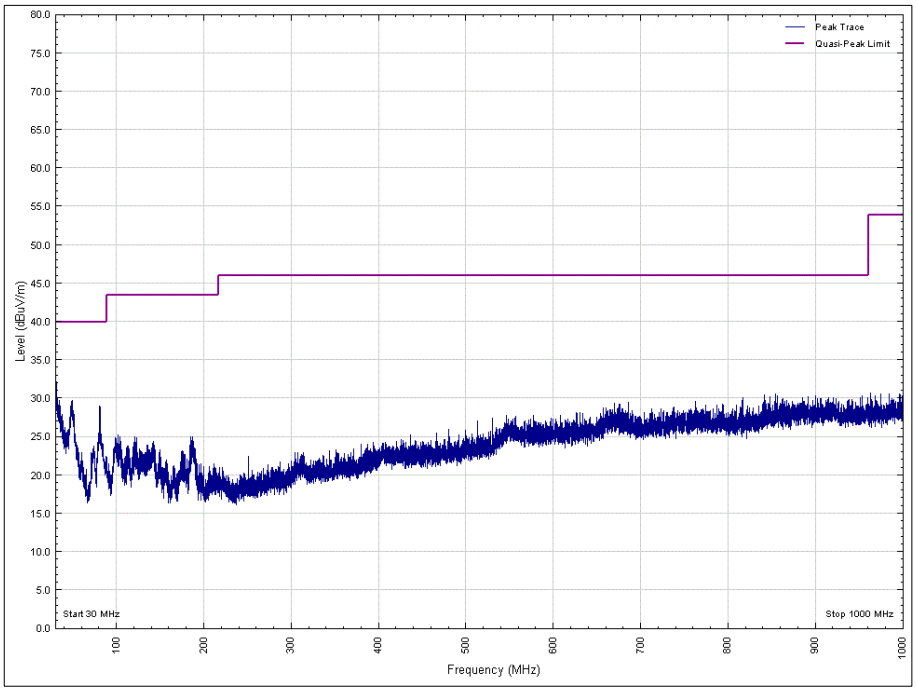


**Figure 25 - 2440 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation**

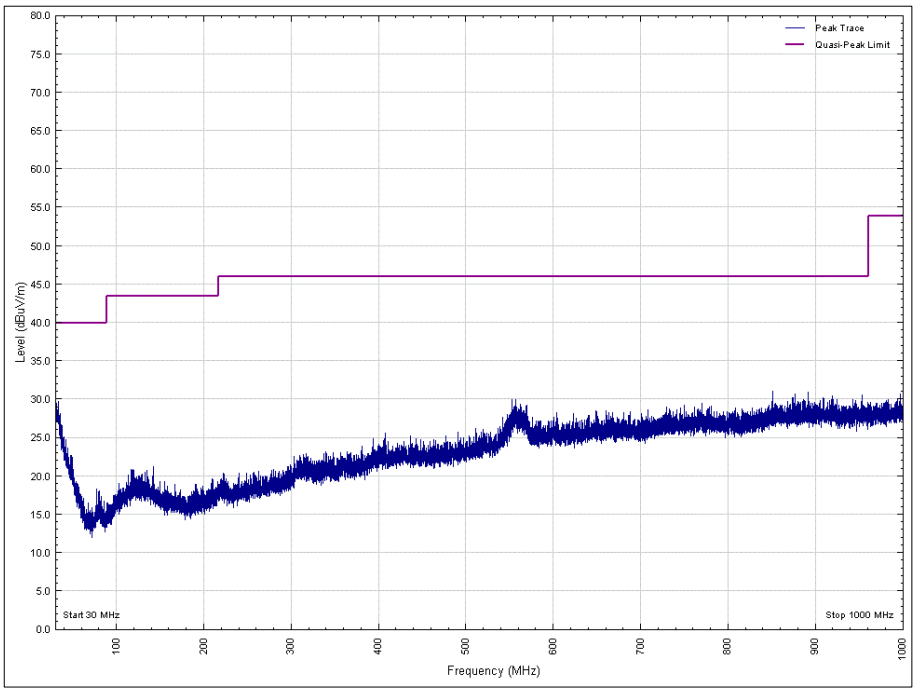


**Figure 26 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation**

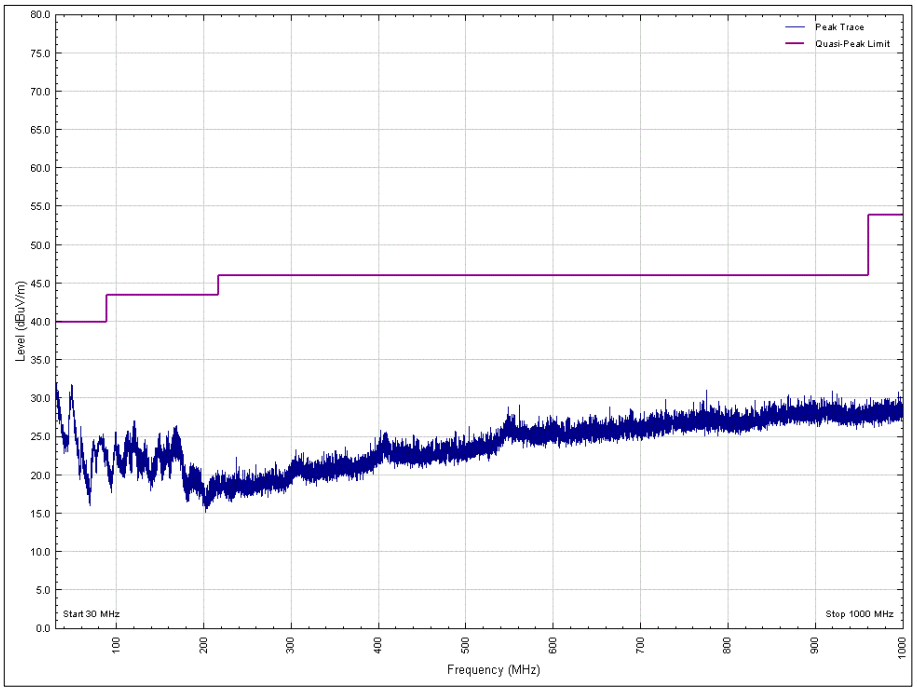


**Figure 27 - 2440 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation**

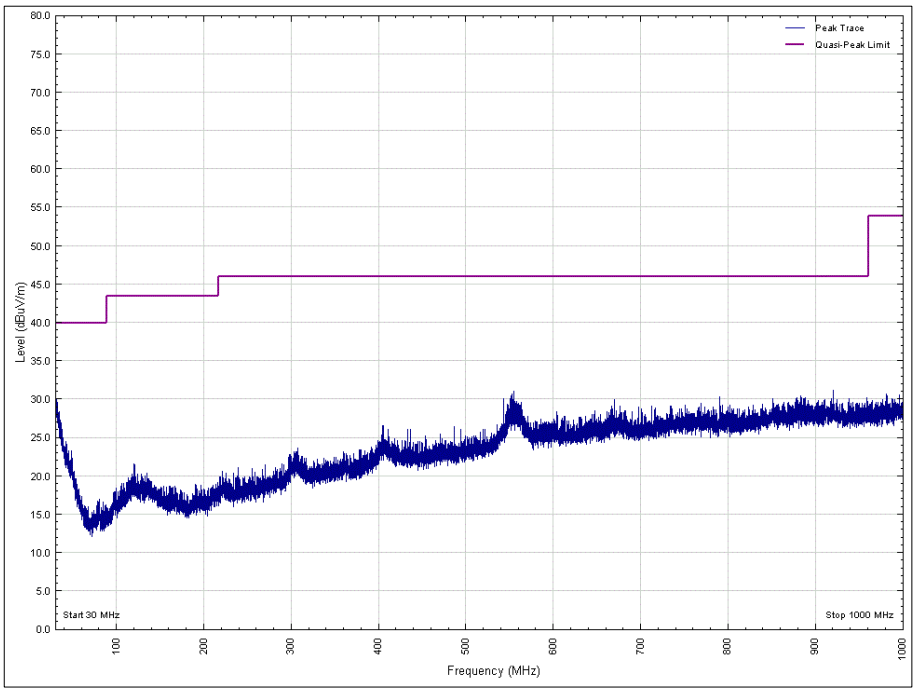


**Figure 28 - 2440 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation | Orientation |
|---|---|---|---|---|---|---|---|---|
| 4879.750 | 47.21 | 53.98 | 6.77 | CISPR Average | 264 | 100 | Vertical | X |
| 4880.711 | 50.87 | 53.98 | 3.11 | CISPR Average | 309 | 104 | Horizontal | X |
| 4879.770 | 51.80 | 53.98 | 2.18 | CISPR Average | 228 | 368 | Vertical | Y |
| 4879.640 | 46.97 | 53.98 | 7.01 | CISPR Average | 245 | 187 | Horizontal | Y |
| 4879.736 | 50.12 | 53.98 | 3.86 | CISPR Average | 267 | 112 | Vertical | Z |
| 4880.759 | 52.06 | 53.98 | 1.92 | CISPR Average | 237 | 219 | Horizontal | Z |
| 7321.166 | 46.92 | 53.98 | 7.06 | CISPR Average | 143 | 114 | Vertical | X |
| 7321.094 | 48.17 | 53.98 | 5.81 | CISPR Average | 16 | 222 | Vertical | Y |
| 7319.435 | 44.12 | 53.98 | 9.86 | CISPR Average | 201 | 100 | Horizontal | Y |
| 7321.040 | 48.09 | 53.98 | 5.89 | CISPR Average | 67 | 109 | Horizontal | Z |

**Table 13 - 2440 MHz - 1 GHz to 25 GHz Emissions Results**

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

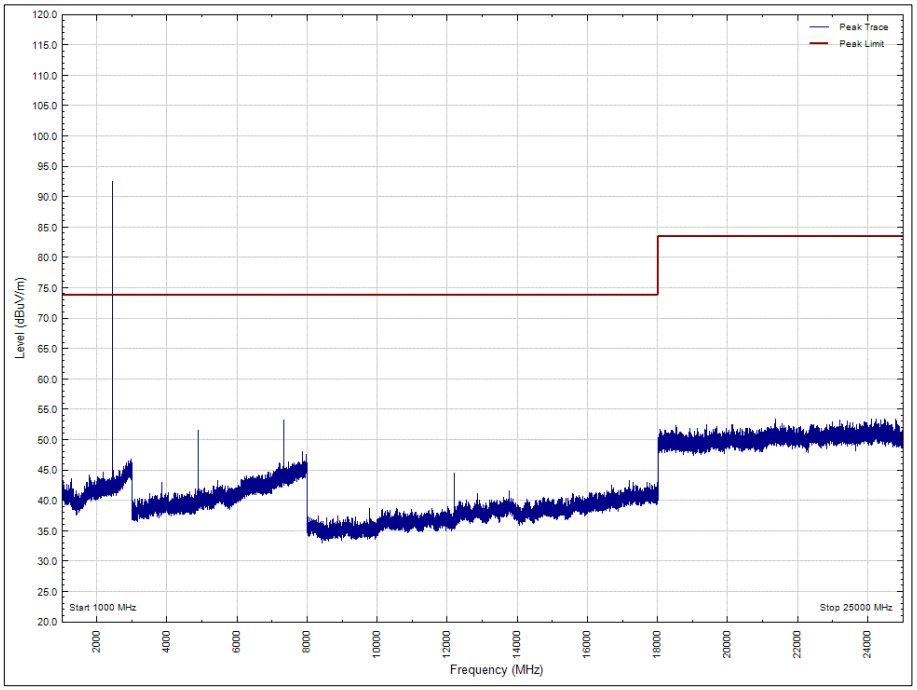


**Figure 29 - 2440 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: X, Peak**

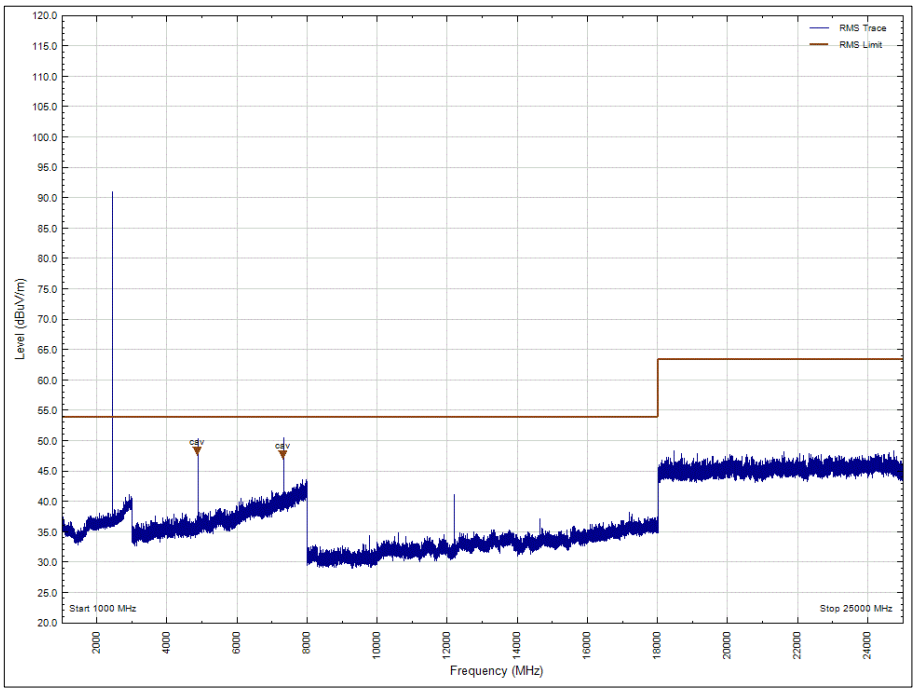


**Figure 30 - 2440 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: X, Average**

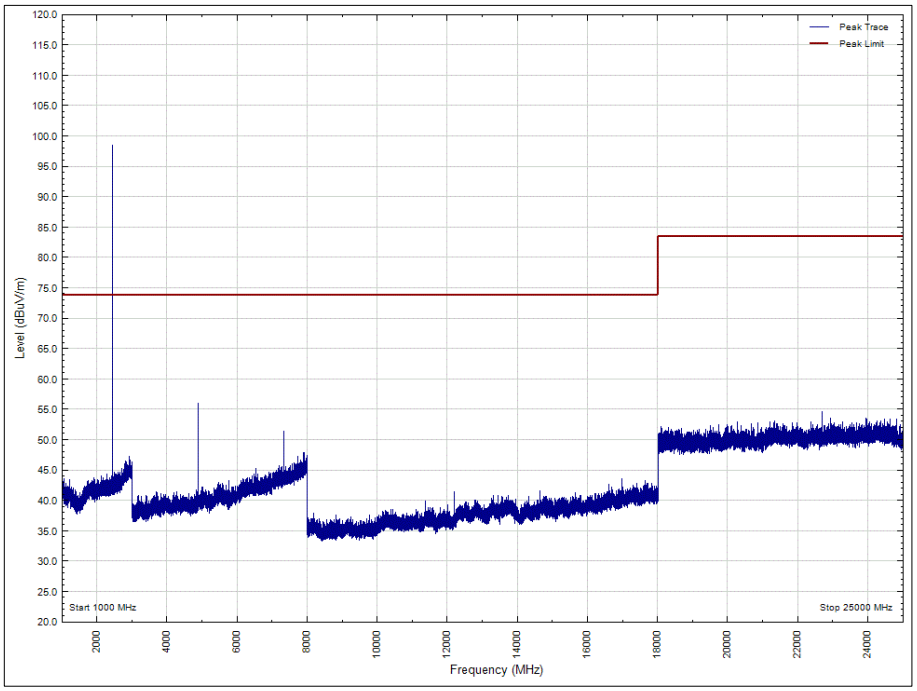


**Figure 31 - 2440 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: X, Peak**

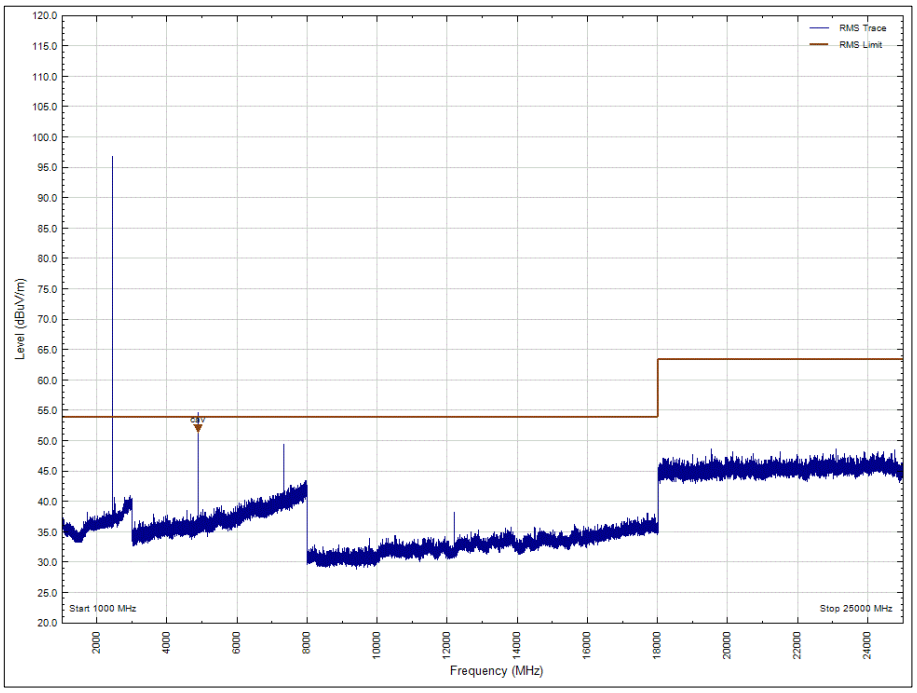


**Figure 32 - 2440 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: X, Average**

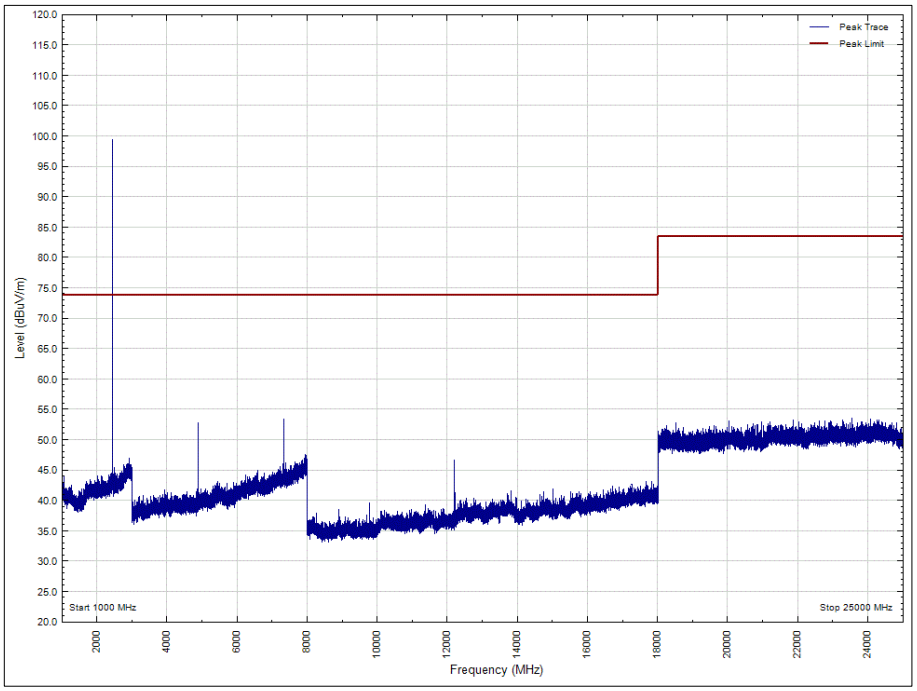


**Figure 33 - 2440 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Y, Peak**

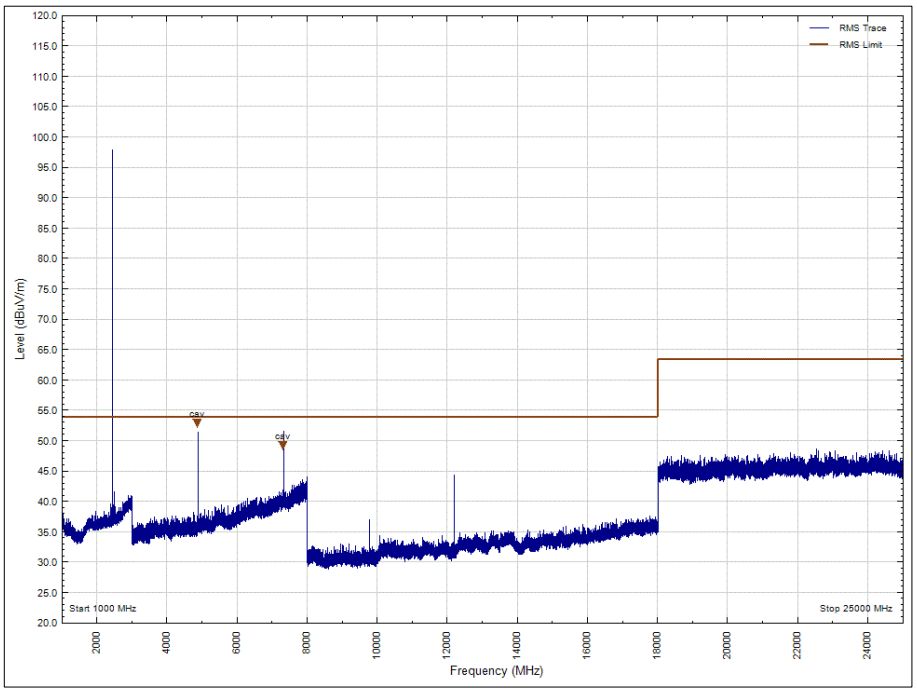


**Figure 34 - 2440 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Y, Average**

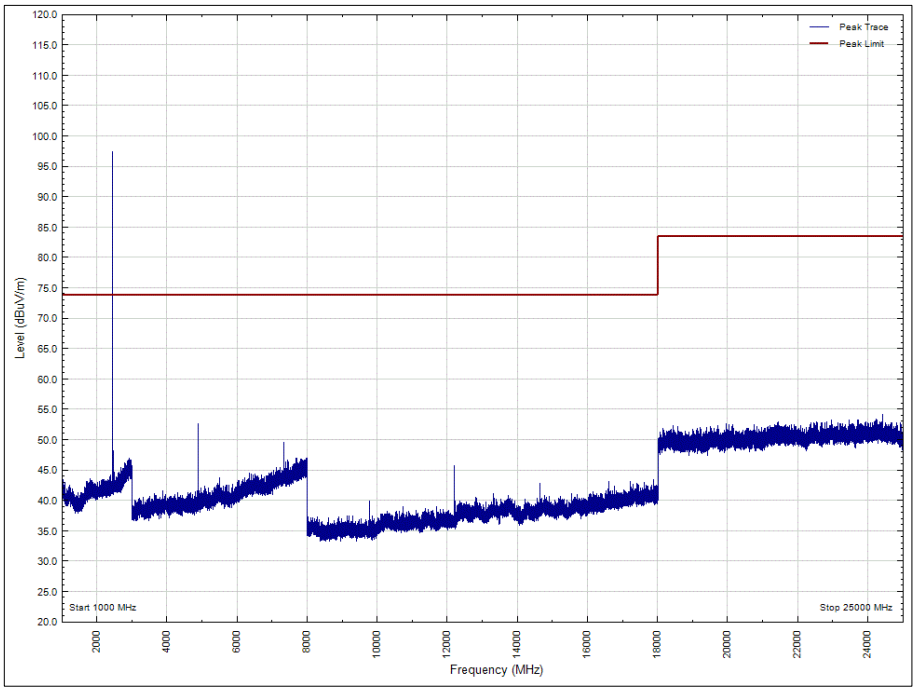


**Figure 35 - 2440 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Y, Peak**

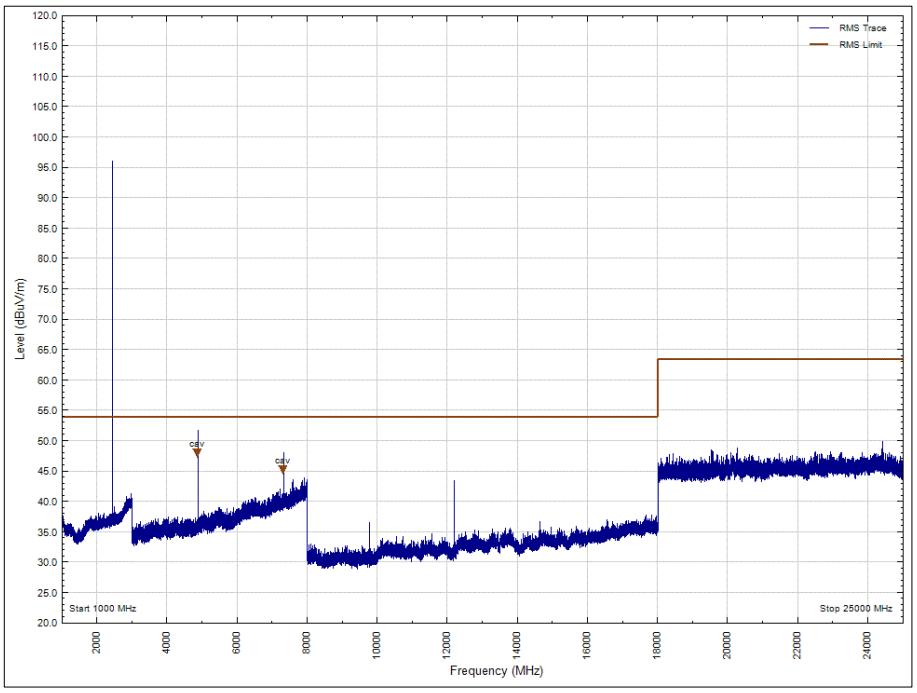


**Figure 36 - 2440 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Y, Average**

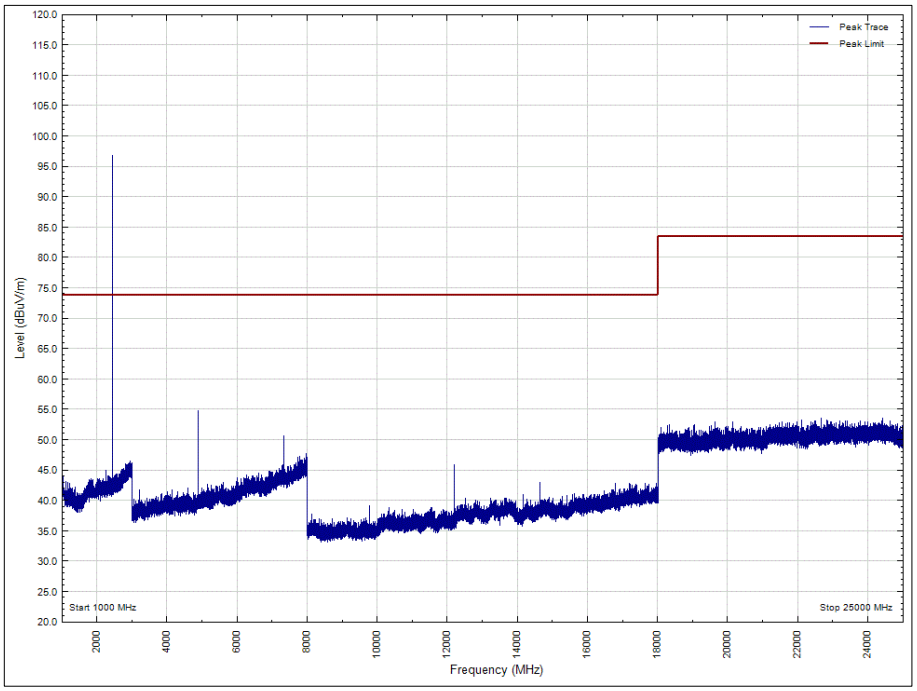


**Figure 37 - 2440 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Z, Peak**

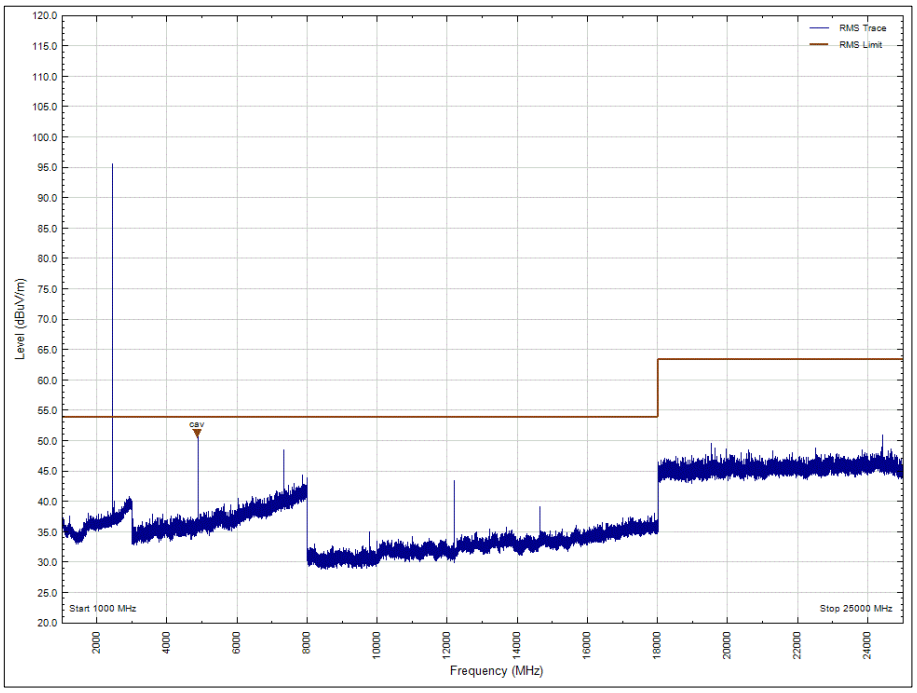


**Figure 38 - 2440 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Z, Average**

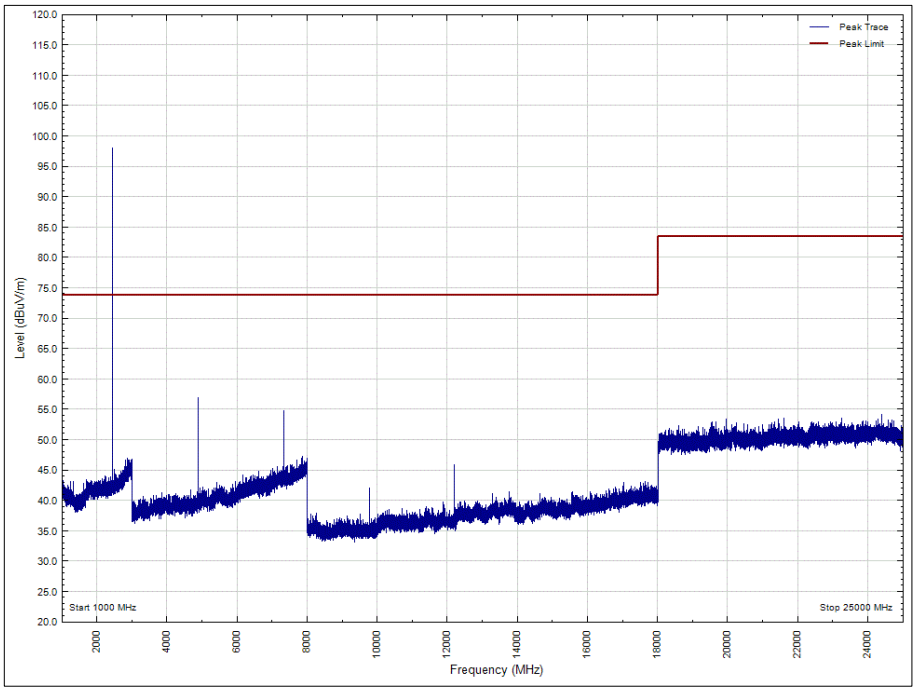


**Figure 39 - 2440 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Z, Peak**

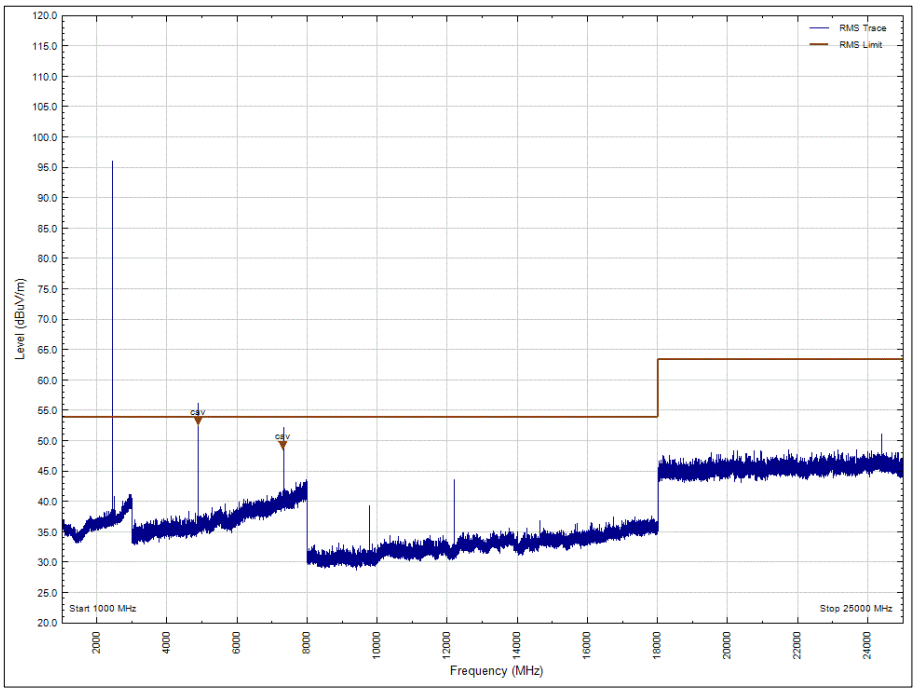


**Figure 40 - 2440 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Z, Average**

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

**Table 14 - 2480 MHz, 30 MHz to 1 GHz - Emission Results**

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

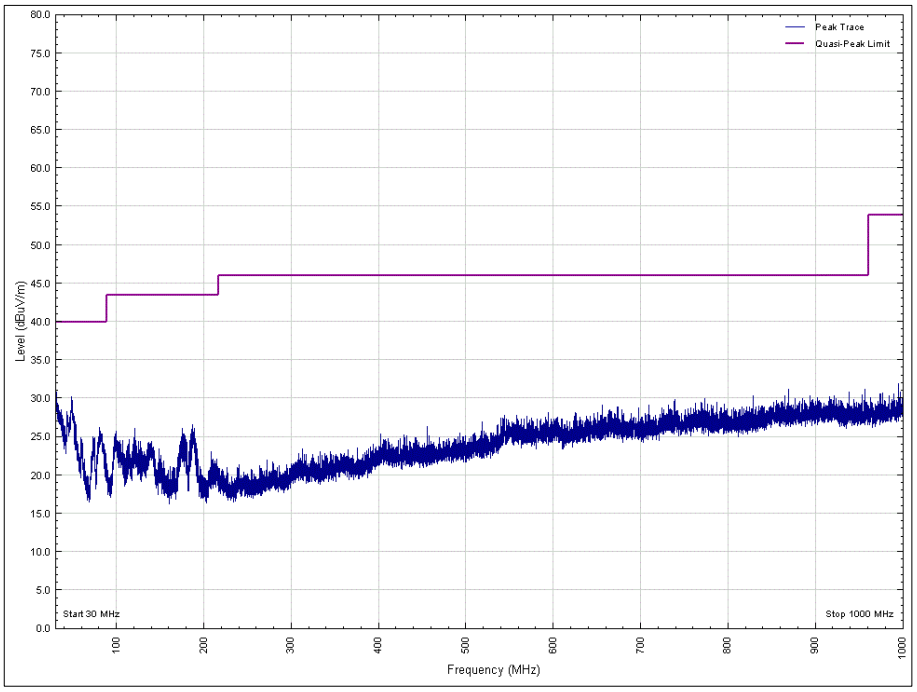


**Figure 41 - 2480 MHz, 30 MHz to 1 GHz, Vertical, X Orientation**

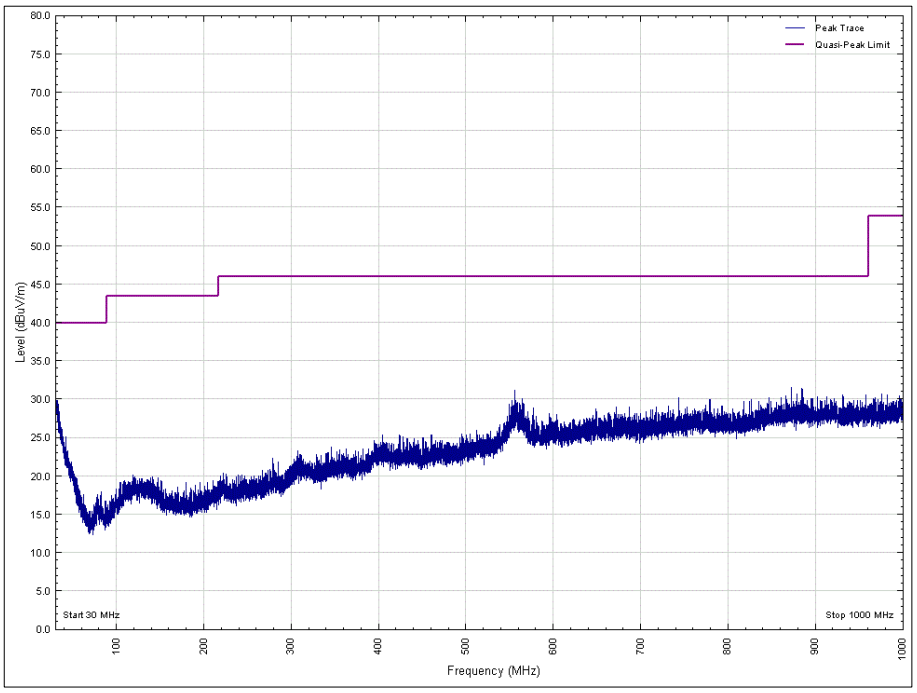


**Figure 42 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, X Orientation**

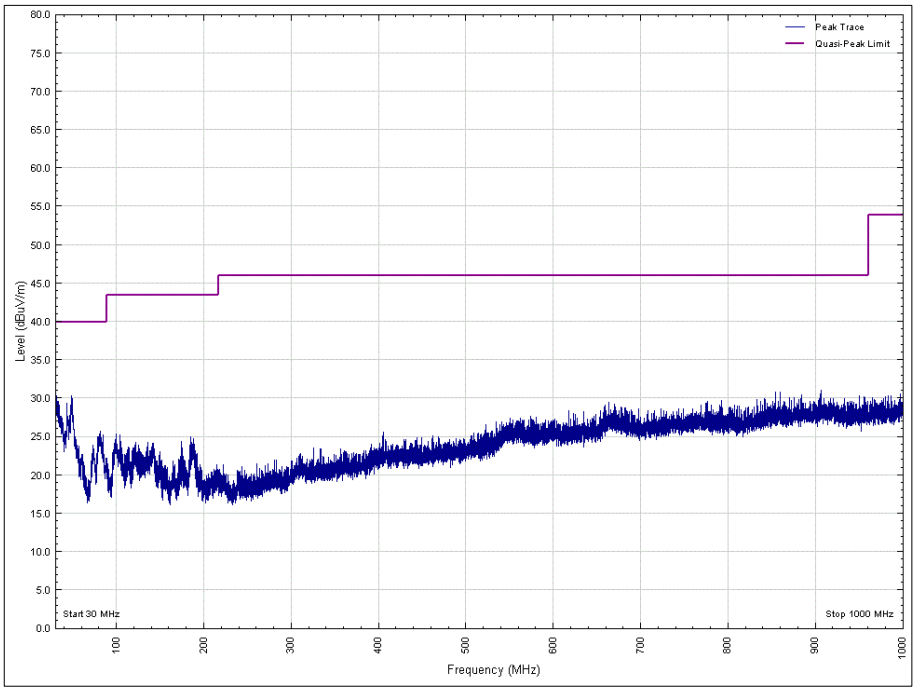


**Figure 43 - 2480 MHz, 30 MHz to 1 GHz, Vertical, Y Orientation**

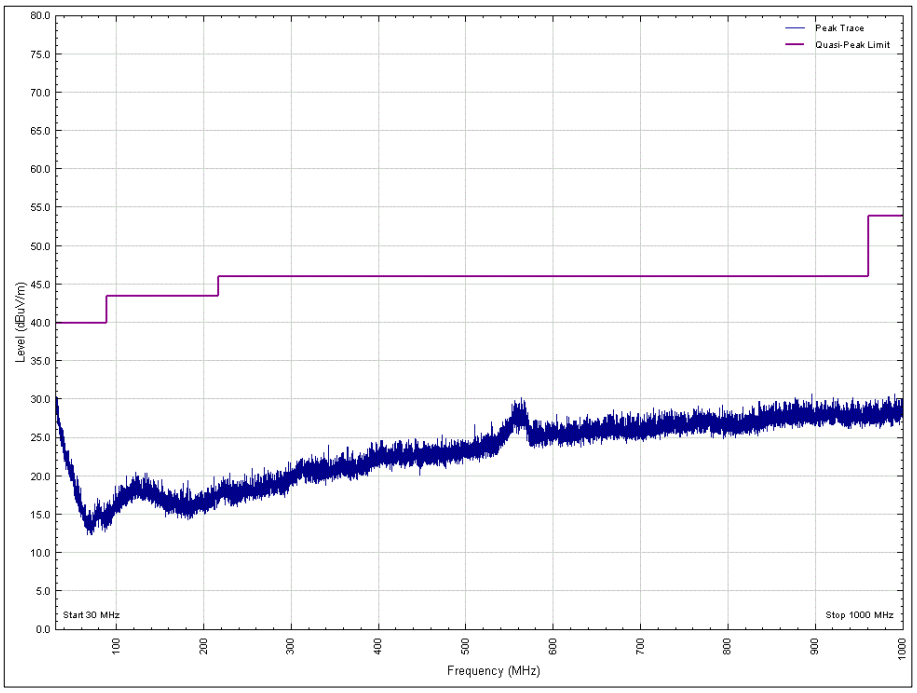


**Figure 44 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, Y Orientation**

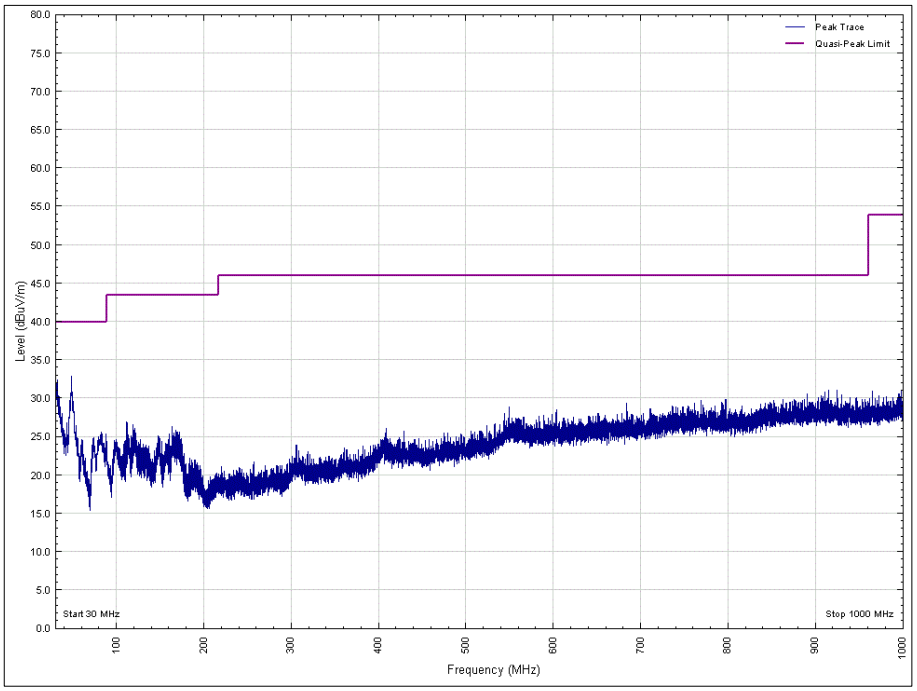


**Figure 45 - 2480 MHz, 30 MHz to 1 GHz, Vertical, Z Orientation**

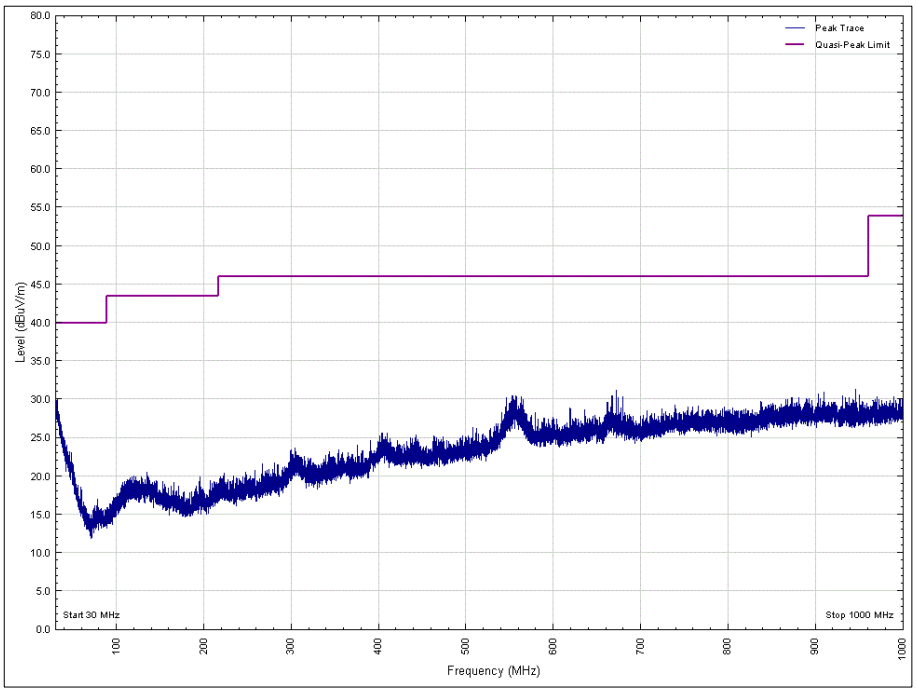


**Figure 46 - 2480 MHz, 30 MHz to 1 GHz, Horizontal, Z Orientation**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation | Orientation |
|---|---|---|---|---|---|---|---|---|
| 7441.166 | 47.17 | 53.98 | 6.81 | CISPR Average | 139 | 100 | Vertical | X |
| 7439.667 | 46.19 | 53.98 | 7.79 | CISPR Average | 40 | 103 | Horizontal | X |
| 7441.156 | 49.94 | 53.98 | 4.04 | CISPR Average | 16 | 225 | Vertical | Y |
| 7441.170 | 46.41 | 53.98 | 7.57 | CISPR Average | 129 | 166 | Horizontal | Y |
| 7439.685 | 47.23 | 53.98 | 6.75 | CISPR Average | 54 | 114 | Vertical | Z |
| 7441.143 | 51.25 | 53.98 | 2.73 | CISPR Average | 75 | 266 | Horizontal | Z |

**Table 15 - 2480 MHz - 1 GHz to 25 GHz Emissions Results**

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

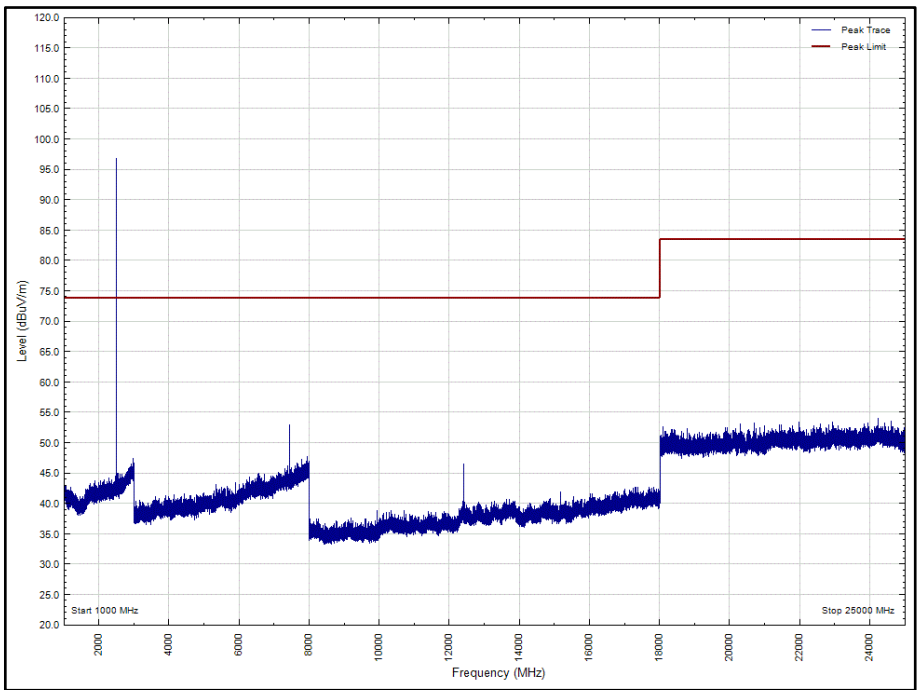


**Figure 47 - 2480 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: X, Peak**

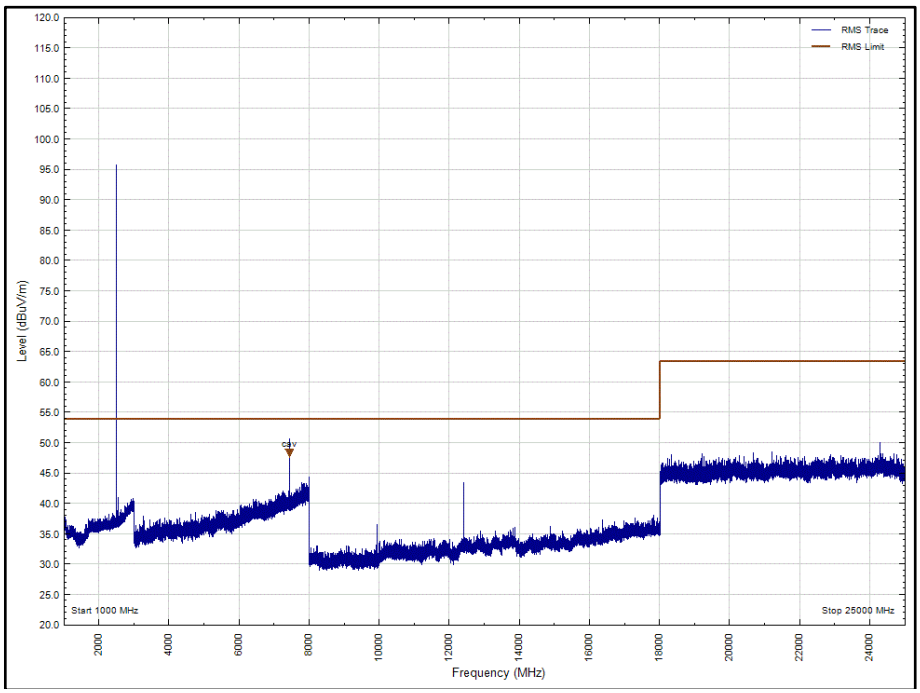


**Figure 48 - 2480 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: X, Average**

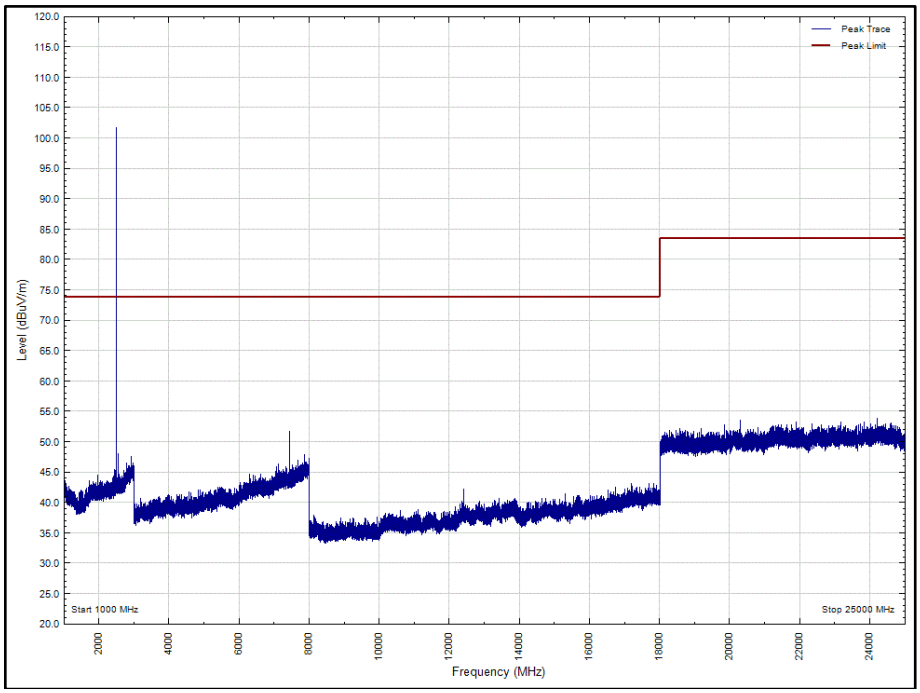


**Figure 49 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: X, Peak**

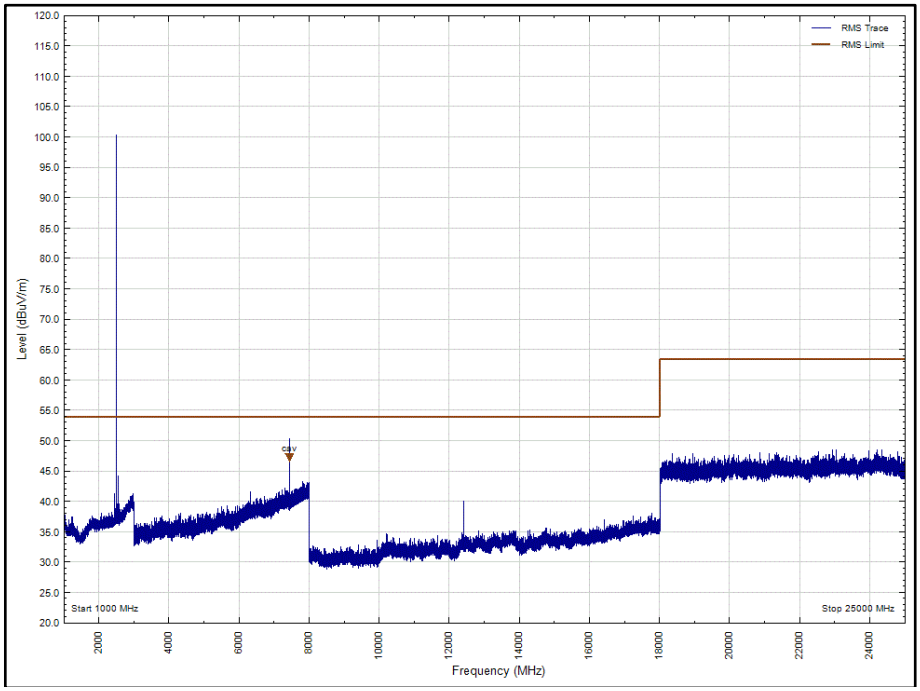


**Figure 50 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: X, Average**

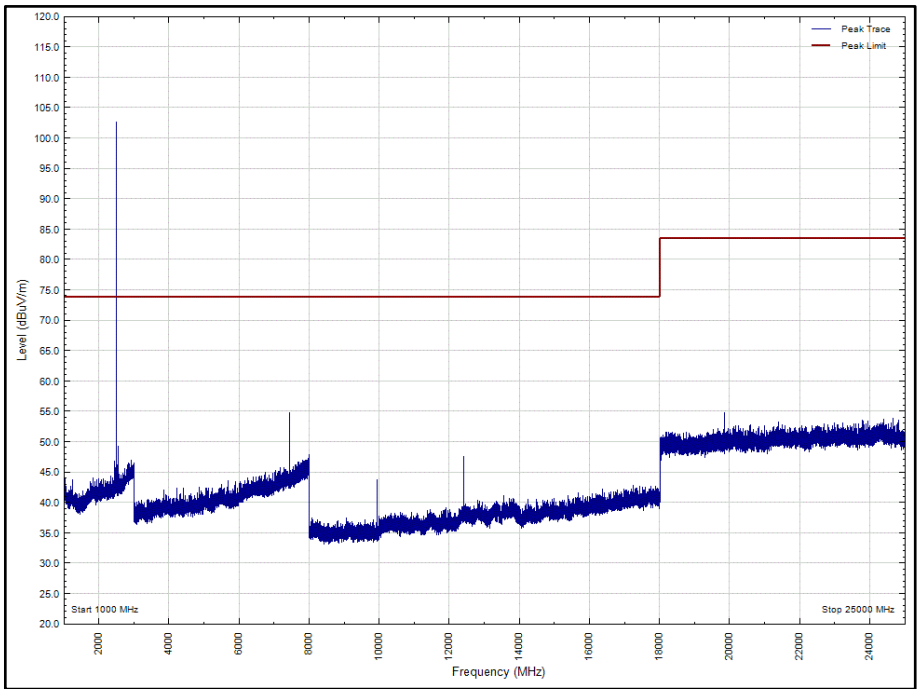


**Figure 51 - 2480 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Y, Peak**

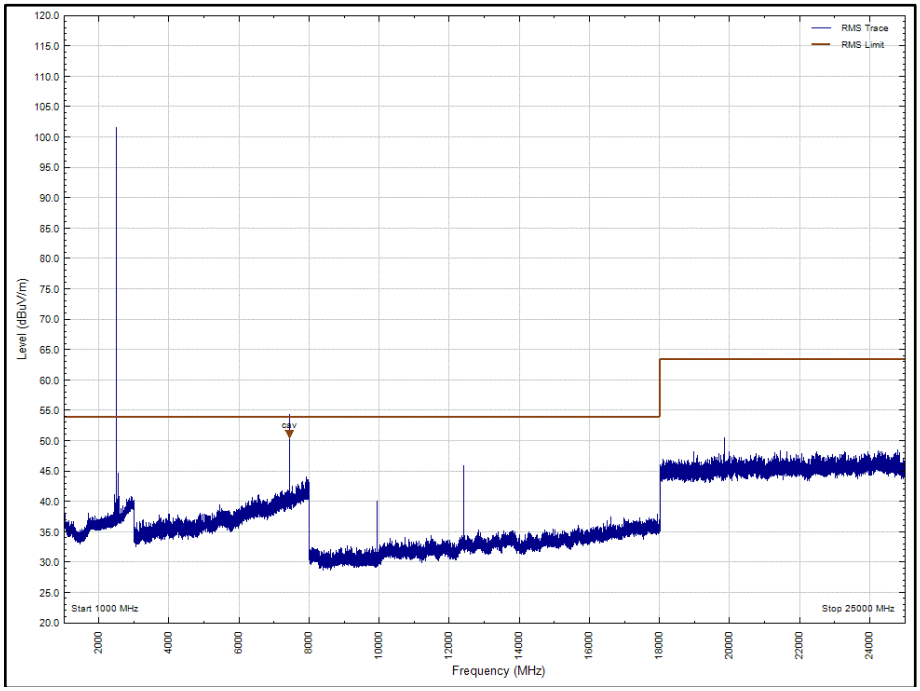


**Figure 52 - 2480 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Y, Average**

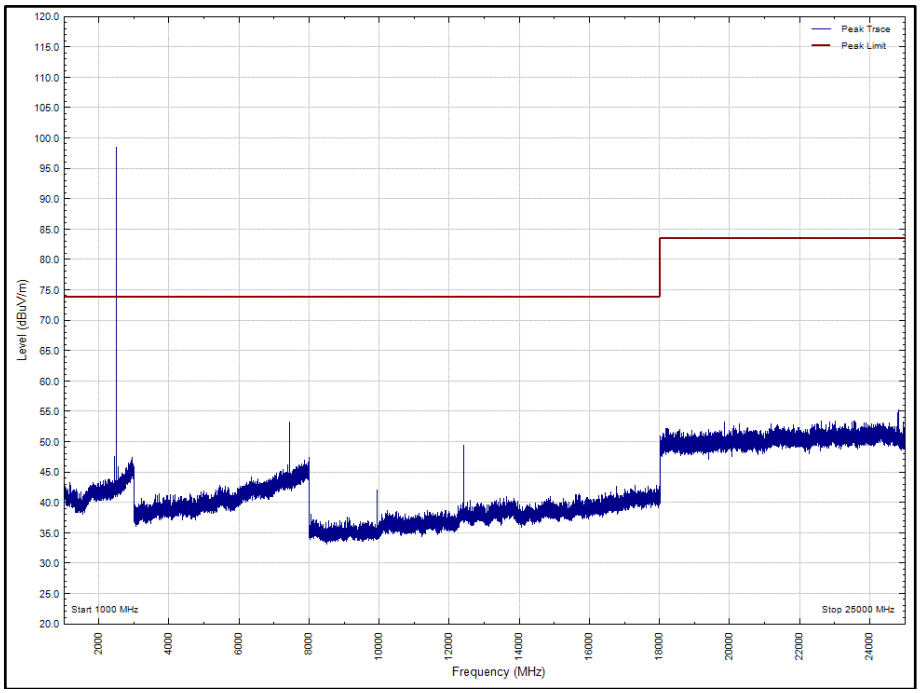


**Figure 53 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Y, Peak**

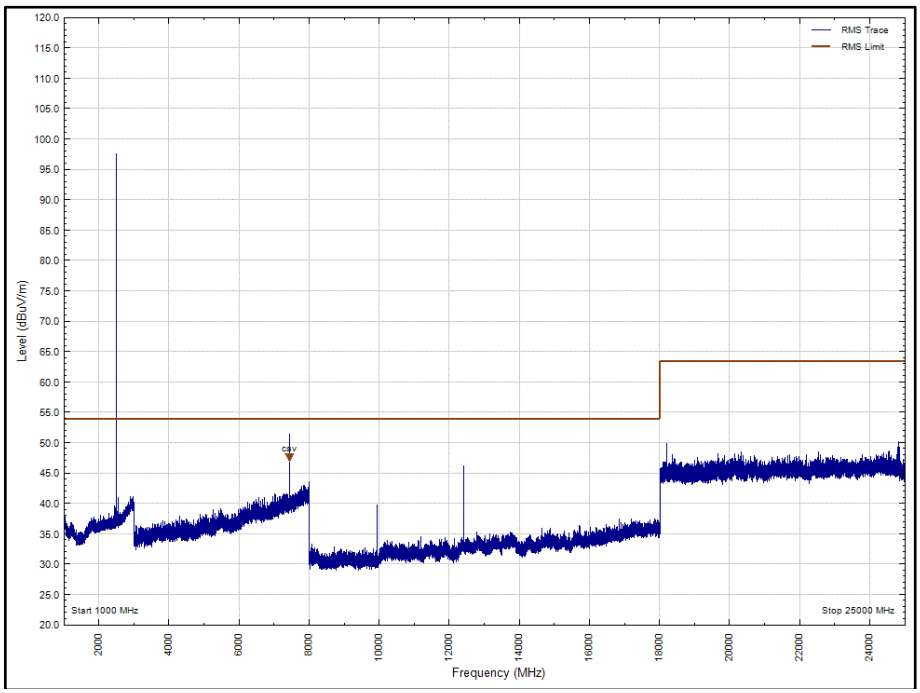


**Figure 54 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Y, Average**

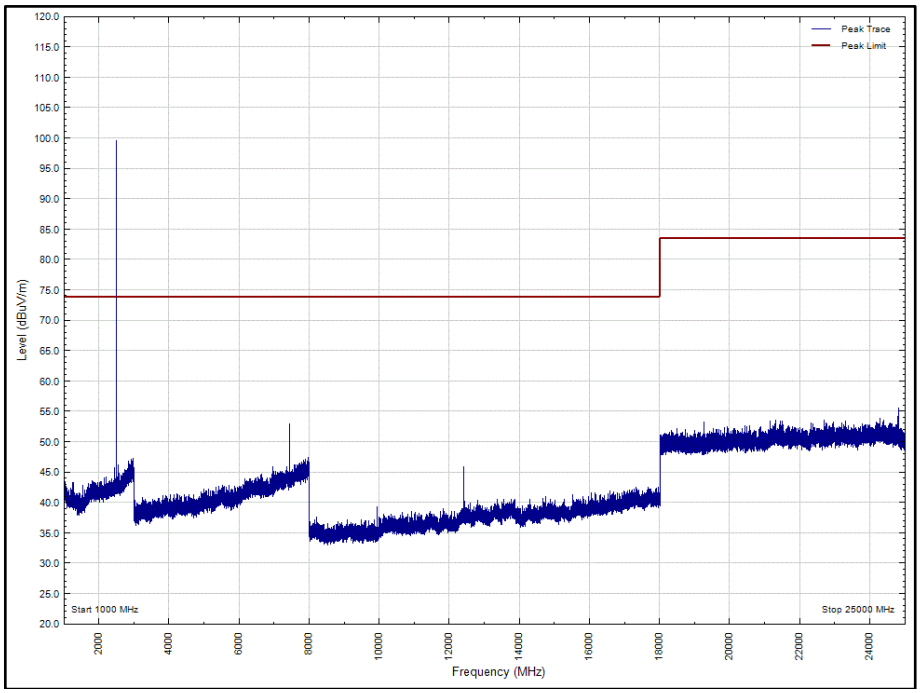


**Figure 55 - 2480 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Z, Peak**

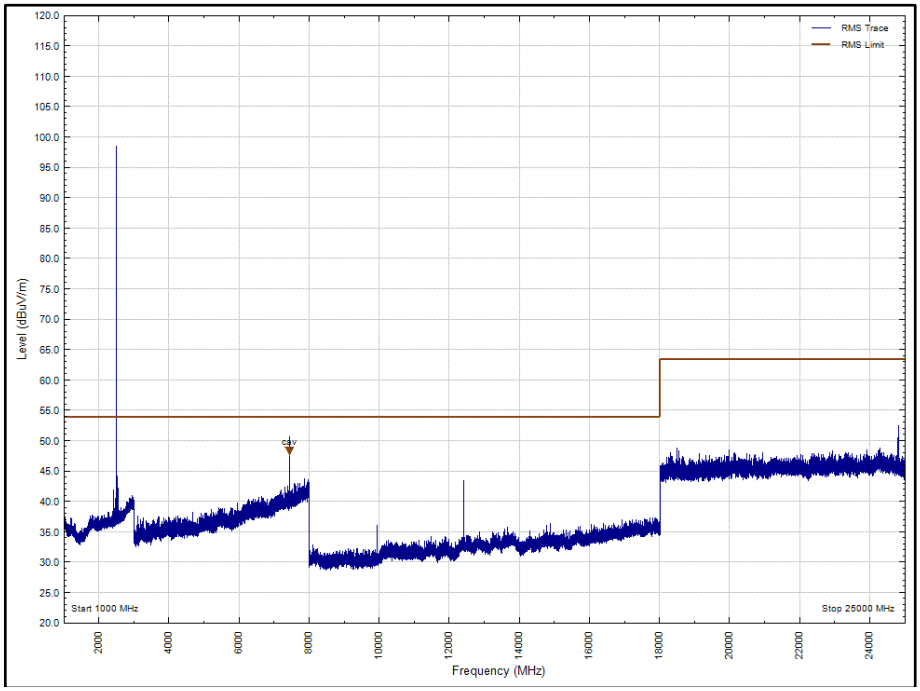


**Figure 56 - 2480 MHz - 1 GHz to 25 GHz, Vertical, EUT Orientation: Z, Average**

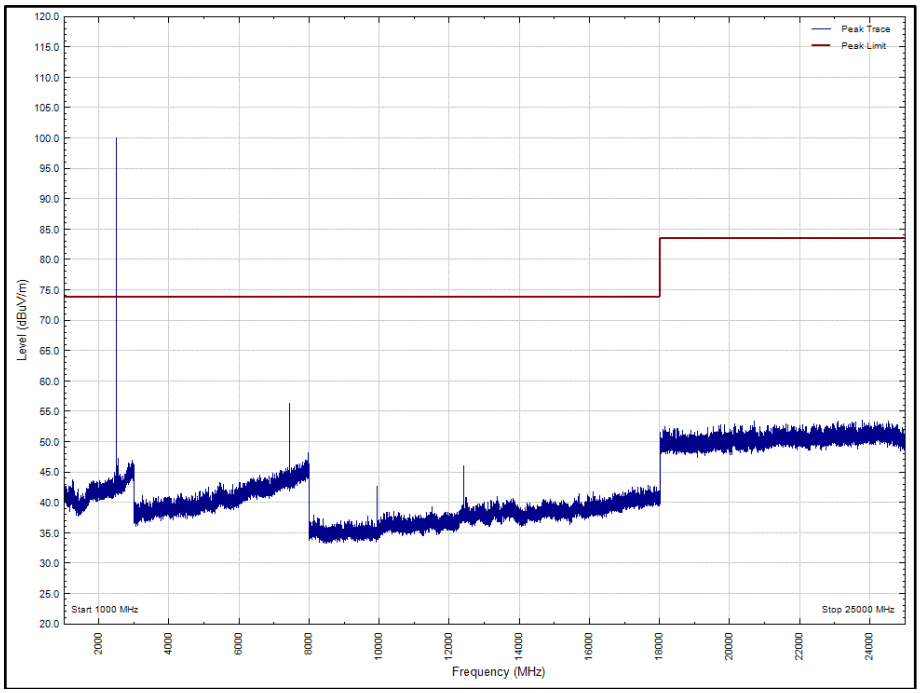


**Figure 57 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Z, Peak**

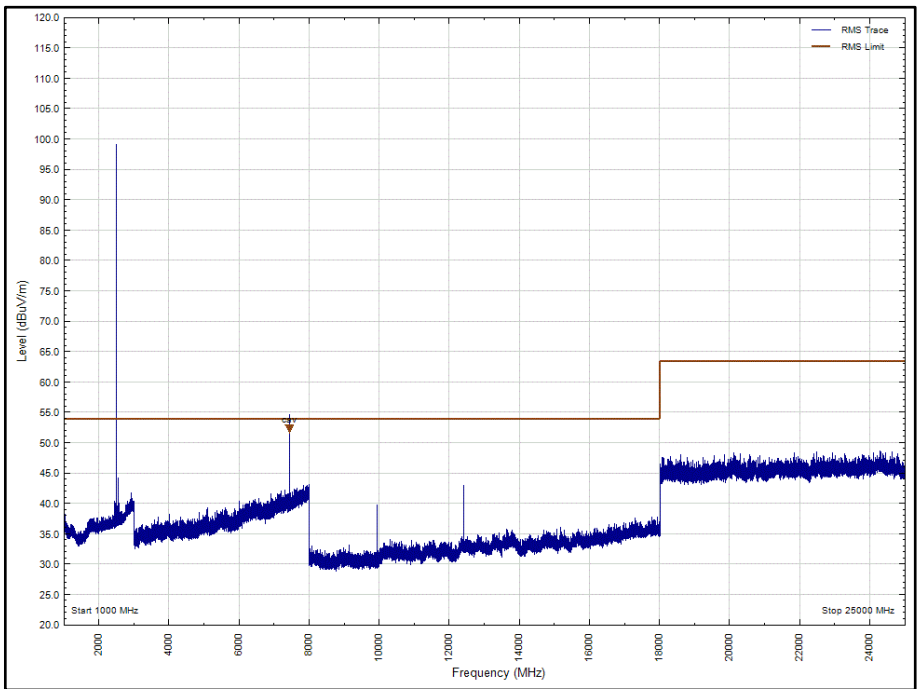


**Figure 58 - 2480 MHz - 1 GHz to 25 GHz, Horizontal, EUT Orientation: Z, Average**

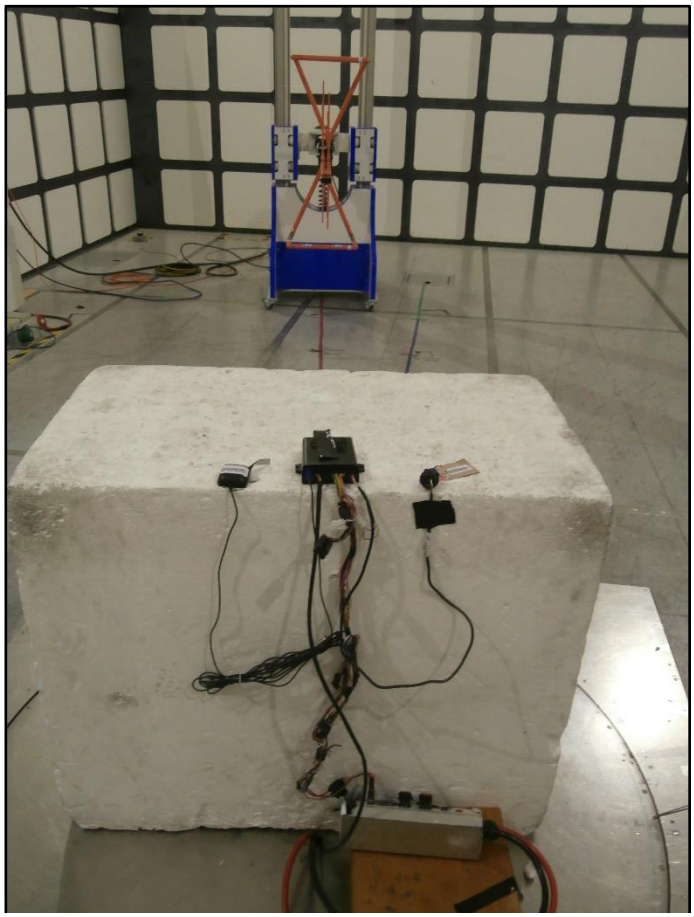

**Figure 59 - Test Setup – 30 MHz to 1 GHz – X Orientation**

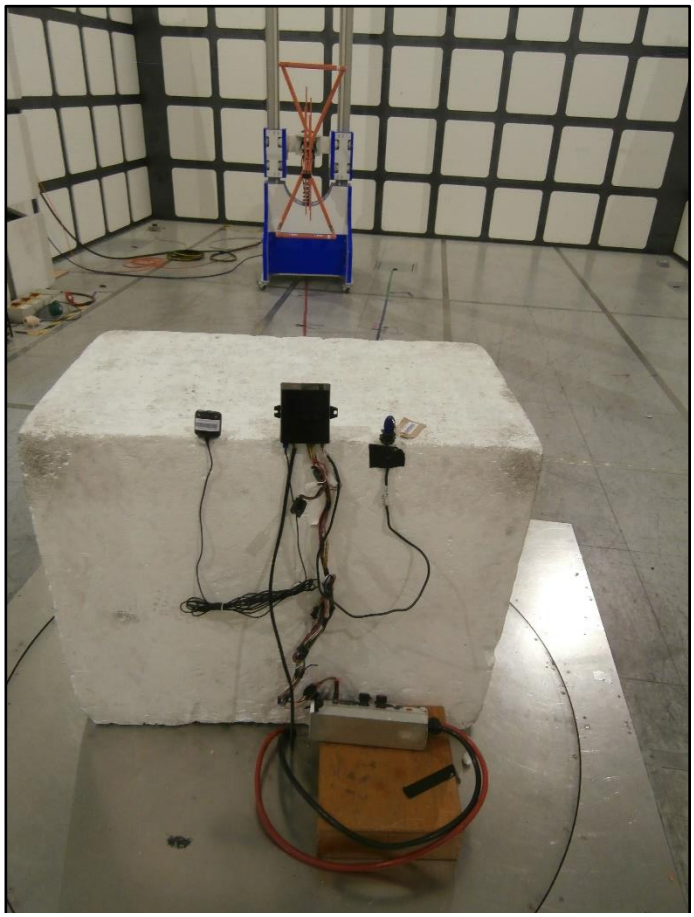

**Figure 60 - Test Setup - 30 MHz to 1 GHz – Y Orientation**

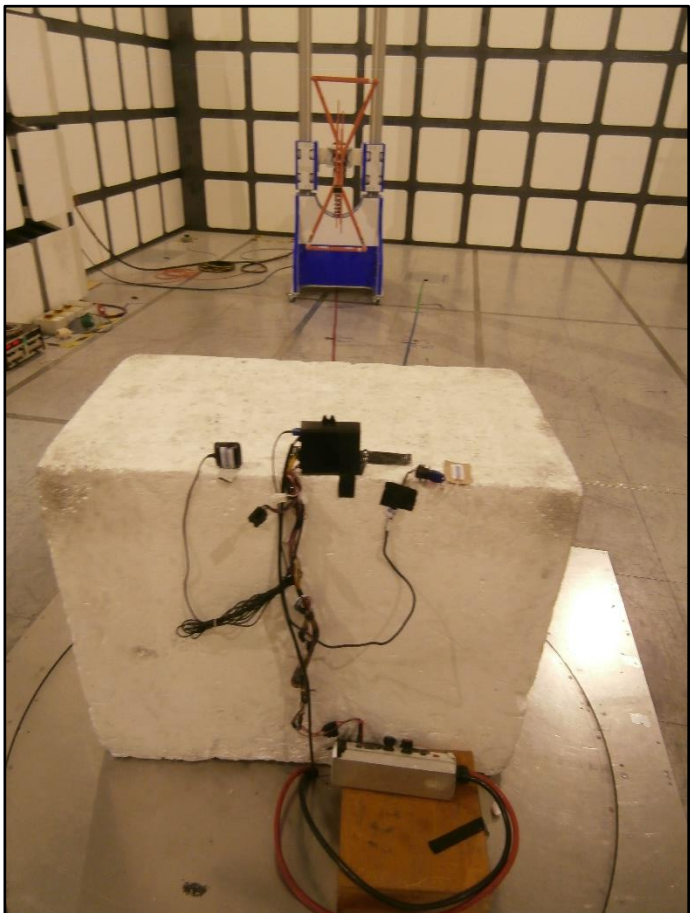

**Figure 61 - Test Setup - 30 MHz to 1 GHz – Z Orientation**

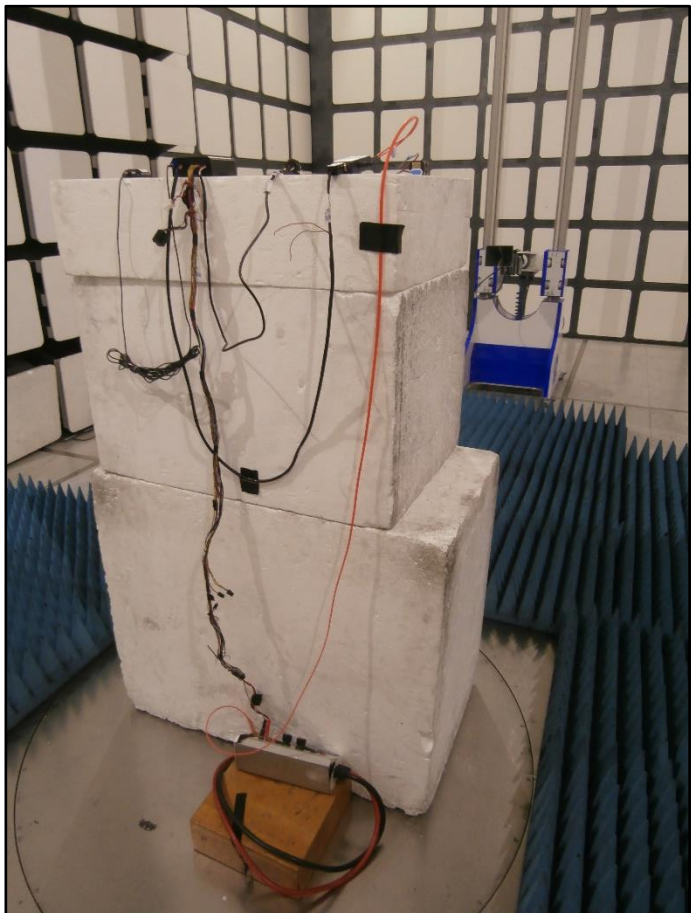

**Figure 62 - Test Setup - 1 GHz to 18 GHz – X Orientation**

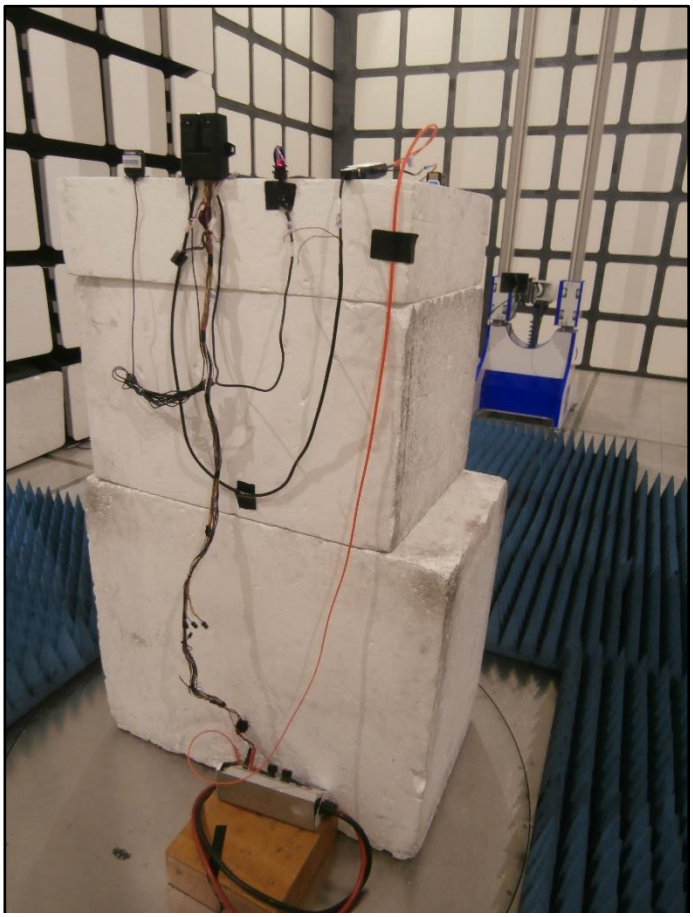

**Figure 63 - Test Setup - 1 GHz to 18 GHz – Y Orientation**

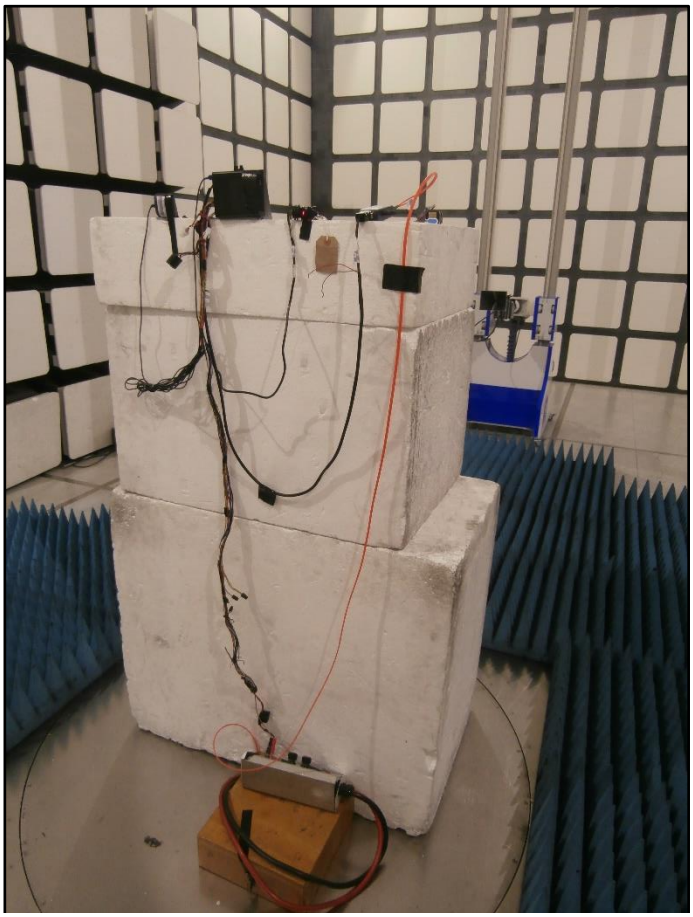

**Figure 64 - Test Setup - 1 GHz to 18 GHz – Z Orientation**

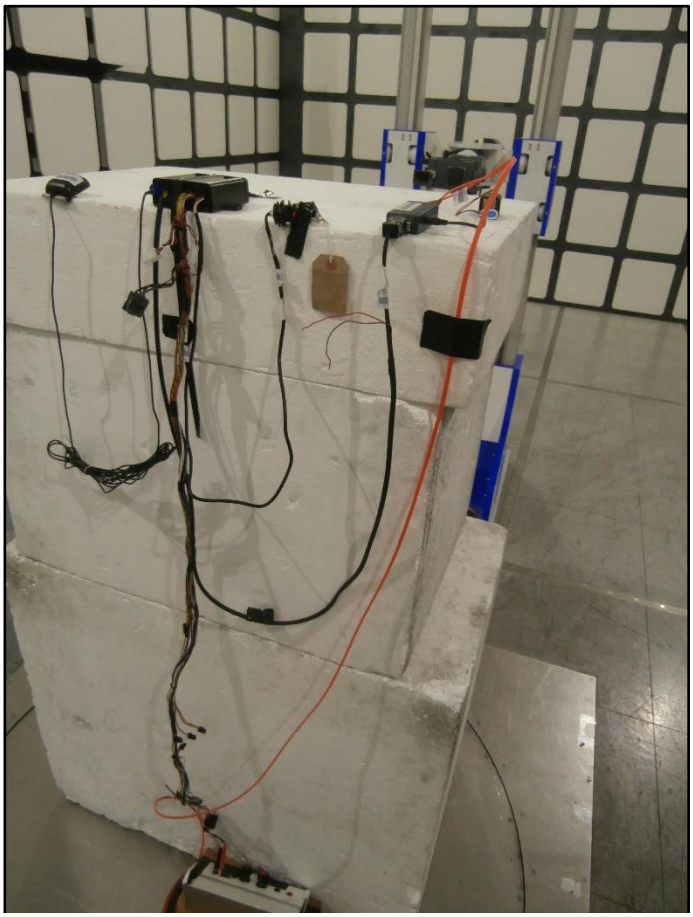

**Figure 65 - Test Setup - 18 GHz to 25 GHz – X Orientation**

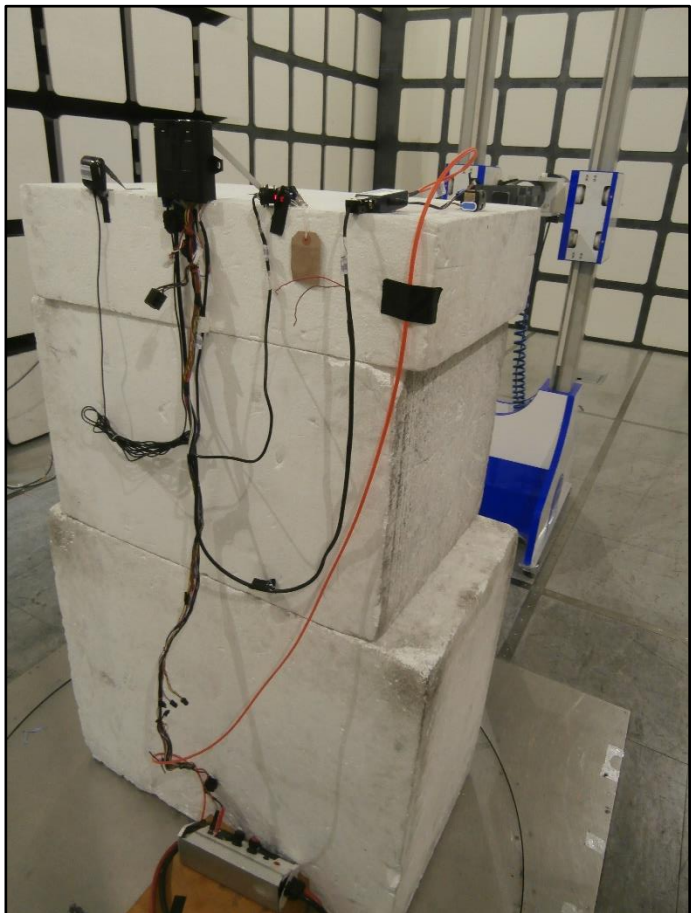

**Figure 66 - Test Setup - 18 GHz to 25 GHz – Y Orientation**

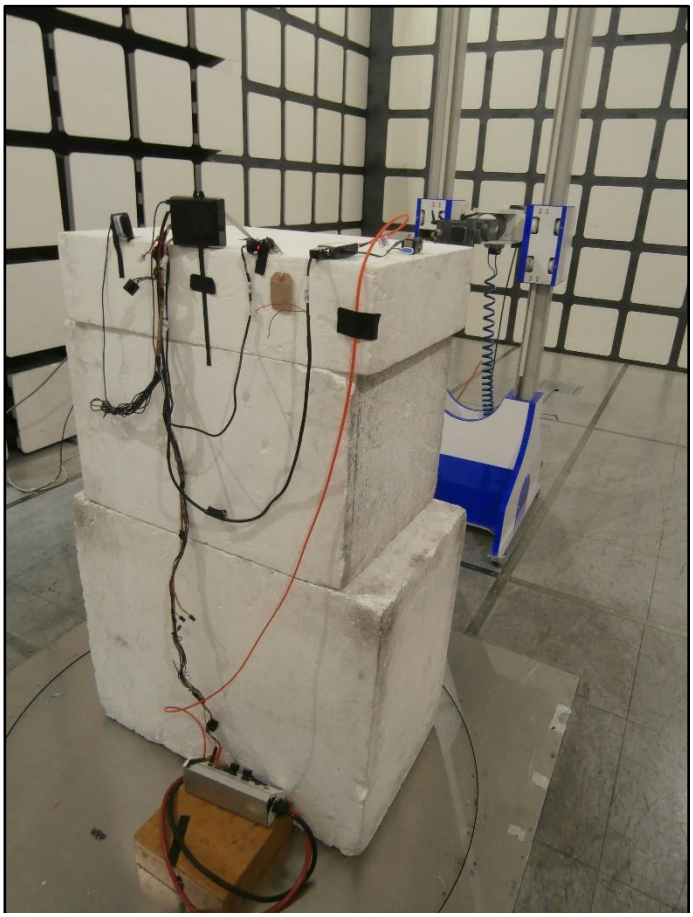

**Figure 67 - Test Setup - 18 GHz to 25 GHz – Z Orientation**

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)

### 2.3.7 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 |
|---|---|---|---|---|---|
| Antenna 18-40GHz (Double Ridge Guide) | Link Microtek Ltd | AM180HA-K-TU2 | 230 | 24 | 02-May-2020 |
| Pre-Amplifier | Phase One | PS04-0086 | 1533 | 12 | 04-Aug-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 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 11-Dec-2020 |
| DC Power Supply | Hewlett Packard | 6269B | 1909 | - | TU |
| Multimeter | Iso-tech | IDM101 | 2417 | 12 | 11-Nov-2020 |
| Antenna with permanent attenuator (Bilog) | Chase | CBL6143 | 2904 | 24 | 30-Sep-2021 |
| Comb Generator | Schaffner | RSG1000 | 3034 | - | TU |
| EMI Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 03-Jan-2021 |
| '2.92mm' - '2.92mm' RF Cable (2m) | Rhophase | KPS-1503-2000-KPS | 3695 | 12 | 11-Jun-2020 |
| 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 | 11-Mar-2020 |
| 4dB Attenuator | Pasternack | PE7047-4 | 4935 | 24 | 30-Sep-2021 |
| Hygrometer | Rotronic | HP21 | 4989 | 12 | 02-May-2020 |
| EmX Emissions Software | TUV SUD | EmX | 5125 | - | Software |
| 8 Meter Cable | Teledyne | PR90-088-8MTR | 5212 | 12 | 30-Aug-2020 |
| 3 GHz High pass filter | Wainwright | WHKX12-2580-3000-18000-80SS | 5220 | 12 | O/P Mon |
| Antenna (DRG Horn 7.5-18GHz) | Schwarzbeck | HWRD750 | 5348 | 12 | 04-Sep-2020 |
| Preamplifier (30dB 1GHz to 18GHz) | Schwarzbeck | BBV 9718 C | 5350 | 12 | 21-Aug-2020 |
| EMI Test Receiver | Rohde & Schwarz | ESW44 | 5382 | 12 | 08-Oct-2020 |

**Table 16**

TU - Traceability Unscheduled
O/P Mon – Output Monitored

# 3 Measurement Uncertainty

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

| Test Name | Measurement Uncertainty |
|---|---|
| Spurious Radiated Emissions | 30 MHz to 1 GHz: ± 5.2 dB<br>1 GHz to 40 GHz: ± 6.3 dB |
| Restricted Band Edges | 30 MHz to 1 GHz: ± 5.2 dB<br>1 GHz to 40 GHz: ± 6.3 dB |
| Authorised Band Edges | 30 MHz to 1 GHz: ± 5.2 dB<br>1 GHz to 40 GHz: ± 6.3 dB |

**Table 17**

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.