# Report on the FCC and IC Testing of:

## SureFlap Ltd
## Microchip Pet Feeder Connect. Model: iMPF

## In accordance with FCC 47 CFR Part 15C and Industry Canada RSS-247 and Industry Canada RSS-GEN

Prepared for: SureFlap Ltd, 7 The Irwin Centre, Scotland Road
Dry Drayton, Cambridge, Cambridgeshire
CD23 8AR, United Kingdom,

FCC ID: XO9-IMF00-001 IC: 8906A-IMPF0001

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## COMMERCIAL-IN-CONFIDENCE

Document Number: 75944242-07 | Issue: 02

| SIGNATURE | | | |
|---|---|---|---|
| NAME | JOB TITLE | RESPONSIBLE FOR | ISSUE DATE |
| Matt Russell | RF Team Leader | Authorised Signatory | 20 May 2019 |

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 and Industry Canada RSS-247 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

| SIGNATURE | | | |
|---|---|---|---|
| NAME | JOB TITLE | RESPONSIBLE FOR | ISSUE DATE |
| Mehadi Choudhury | Engineer | Testing | 20 May 2019 |
| Graeme Lawler | Engineer | Testing | 20 May 2019 |
| Mohammad Malik | Engineer | Testing | 20 May 2019 |

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation
IC2932B-1 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: 2017, Industry Canada RSS-247: Issue 2 (2017-02) and Industry Canada RSS-GEN: Issue 5 (April-2018) for the tests detailed in section 1.3.

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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 | 23 January 2019 |
| 2 | Change FCC ID from XO9-IMPF00-001 to XO9-IMF00-001 | 20 May 2019 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | SureFlap Ltd |
| Manufacturer | SureFlap Ltd |
| Model Number(s) | iMPF |
| Serial Number(s) | U001-0001174<br>U001-0001192 |
| Hardware Version(s) | 00818-DA_05 iMPF General Assembly (_05: revision 05) |
| Software Version(s) | Firmware 01233_FF (but special version for TUV SUD testing) |
| Number of Samples Tested | 2 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15C: 2017<br>Industry Canada RSS-247: Issue 2 (2017-02)<br>Industry Canada RSS-GEN: Issue 5 (April-2018) |
| Order Number<br>Date | 2745<br>07-November-2018 |
| Date of Receipt of EUT | 15-November-2018 and 13-November-2018 |
| Start of Test | 16-November-2018 |
| Finish of Test | 05-December-2018 |
| Name of Engineer(s) | Mehadi Choudhury, Graeme Lawler and Mohammad Malik |
| Related Document(s) | ANSI C63.10 (2013)<br>KDB 662911 D01 v02r02 |

## 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C and Industry Canada RSS-247 and Industry Canada RSS-GEN is shown below.

| Section | Specification Clause | | | Test Description | Result | Comments/Base Standard |
|---|---|---|---|---|---|---|
| | Part 15C | RSS-247 | RSS-GEN | | | |
| Configuration and Mode: 2.4 GHz (802.15.4 Proprietary) | | | | | | |
| 2.1 | 15.247 (b) | 5.4 | 6.12 | Maximum Conducted Output Power | Pass | ANSI C63.10 (2013) |
| 2.2 | 15.247 (e) | 5.2 | 6.12 | Power Spectral Density | Pass | ANSI C63.10 (2013) |
| 2.3 | 15.205 | - | 8.10 | Restricted Band Edges | Pass | ANSI C63.10 (2013) |
| 2.4 | 15.247 (d) | 5.5 | - | Authorised Band Edges | Pass | ANSI C63.10 (2013) |
| 2.5 | 15.247 (d) and 15.205 | 5.5 | 6.13 | Spurious Radiated Emissions | Pass | ANSI C63.10 (2013) |
| 2.6 | 15.247 (a)(2) | 5.2 | 6.7 | Emission Bandwidth | Pass | ANSI C63.10 (2013) |

**Table 2**

### 1.4 Application Form

| EQUIPMENT DESCRIPTION | |
|---|---|
| Model Name/Number | iMPF |
| Part Number | N/A |
| Hardware Version | 00818-DA_05 iMPF General Assembly (_05: revision 05) |
| Software Version | Firmware 01233_FF (but special version for TUV SUD testing) |
| FCC ID (if applicable) | XO9-IMF00-001 |
| Industry Canada ID (if applicable) | 8906A-IMPF0001 |
| Technical Description (Please provide a brief description of the intended use of the equipment) | Feeder connected by 2.4 GHz RF to a hub which is connected to the internet. Allows the conditional access to food based on the animal RFID tags. Usually situated on the floor in a kitchen.. |

| Types of Modulations used by the Equipment |
|---|
| ☐ FHSS |
| ☒ Other forms of modulation |
| **In case of FHSS Modulation** |
| In case of non-Adaptive Frequency Hopping equipment: |
| Number of Hopping Frequencies: |
| In case of Adaptive Frequency Hopping Equipment: |
| Maximum number of Hopping Frequencies: |
| Minimum number of Hopping Frequencies: |
| Dwell Time: |
| **Adaptive / non-adaptive equipment:** |
| ☒ non-adaptive Equipment |
| ☐ adaptive Equipment without the possibility to switch to a non-adaptive mode |
| ☐ adaptive Equipment which can also operate in a non-adaptive mode |
| **In case of adaptive equipment:** |
| The maximum Channel Occupancy Time implemented by the equipment: ms |
| ☐ The equipment has implemented an LBT based DAA mechanism |
| In case of equipment using modulation different from FHSS: |
| ☐ The equipment is Frame Based equipment |
| ☐ The equipment is Load Based equipment |
| ☐ The equipment can switch dynamically between Frame Based and Load Based equipment |
| The CCA time implemented by the equipment: µs |
| ☐ The equipment has implemented an non-LBT based DAA mechanism |
| ☐ The equipment can operate in more than one adaptive mode |

| | | |
|---|---|---|
| **In case of non-adaptive Equipment:** | | |
| The maximum RF Output Power (e.i.r.p.): 7.5 dBm | | |
| The maximum (corresponding) Duty Cycle: 1 % | | |
| Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared): | | |
| N/A | | |
| **The worst case operational mode for each of the following tests:** | | |
| RF Output Power: conducted 4.5 dBm | | |
| Power Spectral Density: | | |
| Duty cycle, Tx-Sequence, Tx-gap: 1% | | |
| Accumulated Transmit Time, Frequency Occupation & Hopping Sequence (only for FHSS equipment): | | |
| Hopping Frequency Separation (only for FHSS equipment): | | |
| Medium Utilisation: | | |
| Adaptivity & Receiver Blocking: | | |
| Nominal Channel Bandwidth: | | |
| Transmitter unwanted emissions in the OOB domain: | | |
| Transmitter unwanted emissions in the spurious domain: | | |
| Receiver spurious emissions: | | |
| **The different transmit operating modes (tick all that apply):** | | |
| ☒ | Operating mode 1: Single Antenna Equipment | |
| | ☒ | Equipment with only 1 antenna |
| | ☐ | Equipment with 2 diversity antennas but only 1 antenna active at any moment in time |
| where | ☐ | Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems) |
| ☐ | Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming | |
| | ☐ | Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode) |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1 |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2 |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 3 |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 4 |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 5 |
| *NOTE: Add more lines if more channel bandwidths are supported.* | | |
| ☐ | Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming | |
| | ☐ | Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode) |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1 |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2 |
| | ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 3 |

| | |
|---|---|
| ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 4 |
| ☐ | High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 5 |
| *NOTE: Add more lines if more channel bandwidths are supported.* | |

| **In case of Smart Antenna Systems:** |
|---|
| The number of Receive chains: |
| The number of Transmit chains: |
| ☐ symmetrical power distribution |
| ☐ asymmetrical power distribution |
| In case of beam forming, the maximum (additional) beam forming gain: dB |
| *NOTE: The additional beam forming gain does not include the basic gain of a single antenna.* |
| **Operating Frequency Range(s) of the equipment:** |
| Operating Frequency Range 1: 2425 MHz to 2480 MHz |
| Operating Frequency Range 2: MHz to MHz |
| Operating Frequency Range 3: MHz to MHz |
| *NOTE: Add more lines if more Frequency Ranges are supported.* |
| **Nominal Channel Bandwidth(s):** |
| Nominal Channel Bandwidth1: 2.5 MHz |
| Nominal Channel Bandwidth2: MHz |
| Nominal Channel Bandwidth3: MHz |
| Nominal Channel Bandwidth4: MHz |
| Nominal Channel Bandwidth5: MHz |
| *NOTE: Add more lines if more channel bandwidths are supported.* |
| **Type of Equipment (stand-alone, combined, plug-in radio device, etc.):** |
| ☒ Stand-alone |
| ☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment) |
| ☐ Plug-in radio device (Equipment intended for a variety of host systems) |
| ☐ Other |
| **The normal and extreme operating conditions that apply to the equipment:** |
| Normal operating conditions (if applicable): |
| Operating temperature: 25 °C |
| Other (please specify if applicable): |
| Extreme operating conditions: |
| Operating temperature range: Minimum 0 °C to Maximum 35 °C |
| Other (please specify if applicable): Minimum °C to Maximum °C |
| Details provided are for the: |
| ☒ stand-alone equipment |

| | |
|---|---|
| ☐ | combined (or host) equipment |
| ☐ | test jig |

| **The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:** | | | |
|---|---|---|---|
| Antenna Type: | | | |
| ☒ Integral Antenna (information to be provided in case of conducted measurements) | | | |
| Antenna Gain: 3 dBi | | | |
| If applicable, additional beamforming gain (excluding basic antenna gain): dB | | | |
| ☐ Temporary RF connector provided | | | |
| ☐ No temporary RF connector provided | | | |
| ☐ Dedicated Antennas (equipment with antenna connector) | | | |
| ☐ Single power level with corresponding antenna(s) | | | |
| ☐ Multiple power settings and corresponding antenna(s) | | | |
| Number of different Power Levels: 2 | | | |
| Power Level 1: 7.5 dBm | | | |
| Power Level 2: -1.5 dBm | | | |
| Power Level 3: dBm | | | |
| *NOTE 1: Add more lines in case the equipment has more power levels.* | | | |
| *NOTE 2: These power levels are conducted power levels (at antenna connector).* | | | |
| For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable | | | |
| Power Level 1: 4.5 dBm | | | |
| Number of antenna assemblies provided for this power level: | | | |
| **Assembly #** | **Gain (dBi)** | **e.i.r.p (dBm)** | **Part number or model number** |
| **1** | 3 | 7.5 | |
| **2** | | | |
| **3** | | | |
| **4** | | | |
| *NOTE: Add more rows in case more antenna assemblies are supported for this power level.* | | | |
| Power Level 2: -4.5 dBm | | | |
| Number of antenna assemblies provided for this power level: | | | |
| **Assembly #** | **Gain (dBi)** | **e.i.r.p (dBm)** | **Part number or model number** |
| **1** | 3 | -1.5 | |
| **2** | | | |
| **3** | | | |
| **4** | | | |
| *NOTE: Add more rows in case more antenna assemblies are supported for this power level.* | | | |

| Power Level 3: dBm | | | |
|---|---|---|---|
| Number of antenna assemblies provided for this power level: | | | |
| **Assembly #** | **Gain (dBi)** | **e.i.r.p (dBm)** | **Part number or model number** |
| **1** | | | |
| **2** | | | |
| **3** | | | |
| **4** | | | |
| *NOTE: Add more rows in case more antenna assemblies are supported for this power level.* | | | |

| **The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:** |
|---|
| Details provided are for the: |
| ☒ stand-alone equipment |
| ☐ combined (or host) equipment |
| ☐ test jig |
| Supply Voltage ☐ AC mains State AC voltage V |
| ☒ DC State DC voltage 6 V |
| In case of DC, indicate the type of power source |
| ☐ Internal Power Supply |
| ☐ External Power Supply or AC/DC adapter |
| ☒ Battery |
| ☐ Other: |
| **Describe the test modes available which can facilitate testing:** |
| described in separate document |
| **The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3] IEEE 802.15.4™ [i.4], proprietary, etc.):** |
| propriatary iEEE 802.15.4 |
| **If applicable, the statistical analysis referred in clause 5.4.1 q)** |
| To be provided as separate attachment |
| **If applicable, the statistical analysis referred in clause 5.4.1 r)** |
| To be provided as separate attachment |
| **Geo-location capability supported by the equipment:** |
| ☐ Yes |
| ☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user. |
| ☒ No |
| **Describe the minimum performance criteria that apply to the equipment (see clause 4.3.1.12.3 or 4.3.2.11.3)** |
| under imminity testing it should still stop intruder pets accessing food from the feeder |

| Combination for testing (see clause 5.3.2.3 of EN 300 328 V21.1) | |
|---|---|
| From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 5.4.1 m), specify the combination resulting in the highest e.i.r.p. for the radio equipment.<br><br>Unless otherwise specified in ETSI EN 300 328, this power setting is to be used for testing against the requirements of ETSI EN 300 328. In case there is more than one such conducted power setting resulting in the same (highest) e.i.r.p. level, the highest power setting is to be used for testing. See also ETS EN 300 328, clause 5.3.2.3 | |
| Highest overall e.i.r.p. value: 7.5 dBm | |
| Corresponding Antenna assembly gain: 3 dBi | Antenna Assembly #: n/a |
| Corresponding conducted power setting: n/a dBm (also the power level to be used for testing) | Listed as Power Setting #: n/a |
| **Additional information provided by the applicant** | |
| **Modulation** | |
| ITU Class(es) of emission: 2M50G1D | |
| Can the transmitter operate unmodulated? ☐ Yes ☒ No | |

| Duty Cycle |
|---|
| The transmitter is intended for: |
| ☐ Continuous duty |
| ☒ Intermittent duty |
| ☐ Continuous operation possible for testing purposes |
| **About the UUT** |
| ☐ The equipment submitted are representative production models |
| ☒ If not, the equipment submitted are pre-production models? |
| ☒ If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested |
| ☐ If not, supply full details |
| ☒ The equipment submitted is CE marked |
| **Additional items and/or supporting equipment provided** |
| ☒ Spare batteries (e.g. for portable equipment) |
| ☐ Battery charging device |
| ☐ External Power Supply or AC/DC adapter |
| ☐ Test Jig or interface box |
| ☐ RF test fixture (for equipment with integrated antennas) |
| ☐ Host System |
| Manufacturer |
| Model |
| Model Name |
| ☐ Combined equipment |
| Manufacturer |

| | |
|---|---|
| | Model |
| | Model Name |
| ☒ | User Manual |
| ☒ | Technical documentation (Handbook and circuit diagrams) |

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

Name: Nick Hill Position held: Managing Director
Date: 7th May 2019

## 1.5 Product Information

### 1.5.1 Technical Description

Feeder connected by 2.4 GHz RF to a hub which is connected to the internet. Allows the conditional access to food based on the animal RFID tags. Usually situated on the floor in a kitchen.

### 1.5.2 Test Setup Diagram(s)

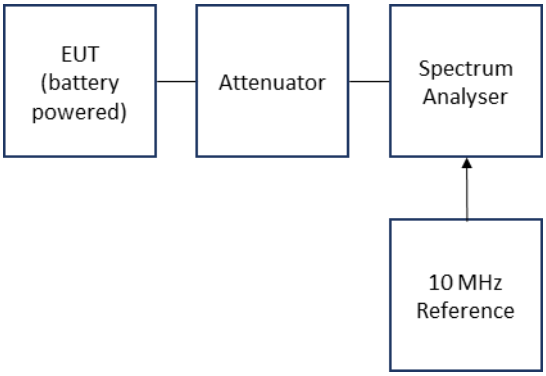


**Figure 1 - Conducted Tests**

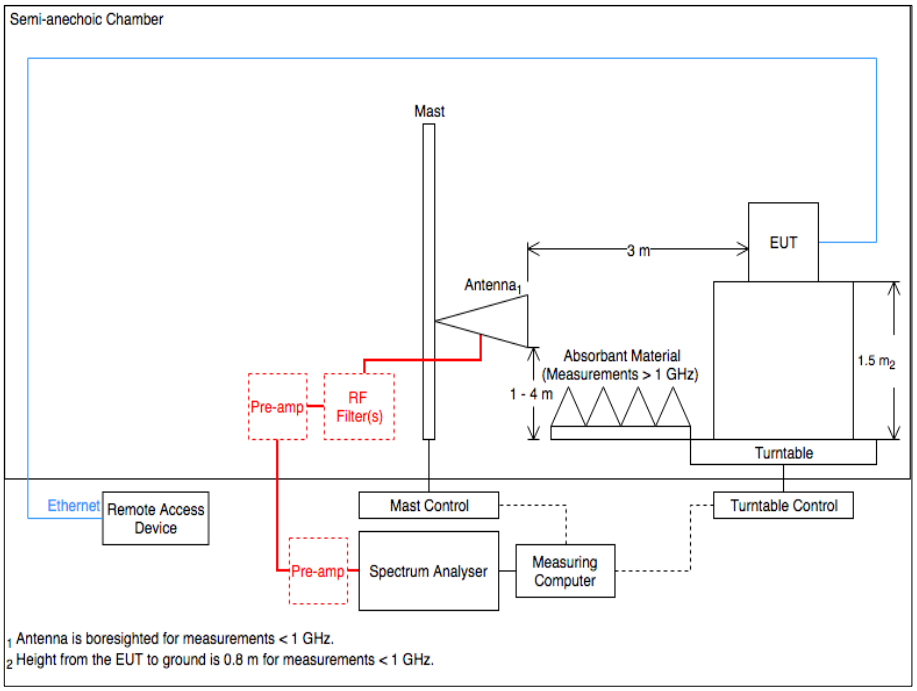


**Figure 2 - Radiated Spurious Emissions Setup**

### 1.5.3 EUT Configuration and Rationale for Radiated Spurious Emissions

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. Measurements were made with the EUT situated in a single axis.

## 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 |
|---|---|---|---|
| Serial Number: U001-0001192 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| Serial Number: U001-0001174 | | | |
| 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: 2.4 GHz (802.15.4 Proprietary) - | | |
| Maximum Conducted Output Power | Mehadi Choudhury | UKAS |
| Power Spectral Density | Mehadi Choudhury | UKAS |
| Restricted Band Edges | Graeme Lawler | UKAS |
| Authorised Band Edges | Graeme Lawler | UKAS |
| Spurious Radiated Emissions | Graeme Lawler and Mohammad Malik | UKAS |
| Emission Bandwidth | Mehadi Choudhury | UKAS |

**Table 4**

Office Address:

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

# 2 Test Details

## 2.1 Maximum Conducted Output Power

### 2.1.1 Specification Reference

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

### 2.1.2 Equipment Under Test and Modification State

iMPFWT, S/N: U001-0001174 - Modification State 0

### 2.1.3 Date of Test

16-November-2018

### 2.1.4 Test Method

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

### 2.1.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.0 °C |
| Relative Humidity | 47.9 % |

### 2.1.6 Test Results

2.4 GHz (802.15.4 Proprietary)

250 kbps

| Frequency (MHz) | Output Power | |
|---|---|---|
| | dBm | mW |
| 2425 | 4.05 | 2.54 |
| 2450 | 3.73 | 2.36 |
| 2480 | -4.34 | 0.37 |

**Table 5**

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.

Industry Canada RSS-247, Limit Clause 5.4 (d)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.

### 2.1.7 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 |
|---|---|---|---|---|---|
| Attenuator (20dB, 2W) | Pasternack | PE7004-20 | 2943 | 12 | 18-Jul-2019 |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 13-Sep-2019 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 17-Oct-2019 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 22-Oct-2019 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 16-Apr-2019 |
| EXA | Keysight Technologies | N9010B | 4969 | 24 | 21-Dec-2018 |
| Cable (40GHz | Rosenberger | LU1-001-2000 | 5024 | - | O/P Mon |

**Table 6**

O/P Mon – Output Monitored using calibrated equipment

## 2.2 Power Spectral Density

### 2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (e)
Industry Canada RSS-247, Clause 5.2
Industry Canada RSS-GEN, Clause 6.12

### 2.2.2 Equipment Under Test and Modification State

iMPFWT, S/N: U001-0001174 - Modification State 0

### 2.2.3 Date of Test

16-November-2018

### 2.2.4 Test Method

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

### 2.2.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.0 °C |
| Relative Humidity | 47.9 % |

### 2.2.6 Test Results

2.4 GHz (802.15.4 Proprietary)

| Frequency (MHz) | Power Spectral Density (dBm) |
|---|---|
| 2425 | 1.44 |
| 2450 | 0.88 |
| 2480 | -7.52 |

**Table 7 - Power Spectral Density**


**Table 8 – 2425 MHz**


**Table 9 – 2450 MHz**


**Table 10 – 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.

Industry Canada RSS-247, Limit Clause 5.2(b)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

### 2.2.7 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 |
|---|---|---|---|---|---|
| Attenuator (20dB, 2W) | Pasternack | PE7004-20 | 2943 | 12 | 18-Jul-2019 |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 13-Sep-2019 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 17-Oct-2019 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 22-Oct-2019 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 16-Apr-2019 |
| EXA | Keysight Technologies | N9010B | 4969 | 24 | 21-Dec-2018 |
| Cable (40GHz | Rosenberger | LU1-001-2000 | 5024 | - | O/P Mon |

**Table 11**

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
Industry Canada RSS-GEN, Clause 8.10

### 2.3.2 Equipment Under Test and Modification State

iMPFWT, S/N: U001-0001192 - Modification State 0

### 2.3.3 Date of Test

05-December-2018

### 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 4.1.4.2.3. 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).

### 2.3.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 19.8 °C |
| Relative Humidity | 55.8 % |

### 2.3.6 Test Results

2.4 GHz (802.15.4 Proprietary)

| Mode | Frequency (MHz) | Measured Frequency (MHz) | Peak Level (dBµV/m) | Average Level (dBµV/m) |
|---|---|---|---|---|
| Static | 2425 | 2390.0 | 57.12 | 43.58 |
| Static | 2480 | 2483.5 | 62.04 | 51.76 |

**Table 12**

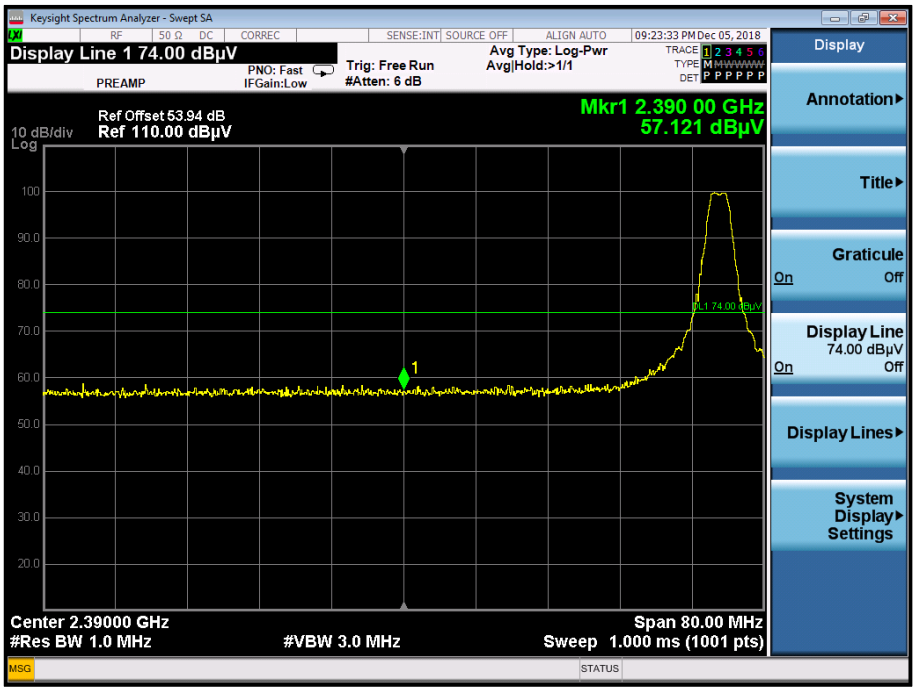


**Figure 3 - Static 2425 MHz - Measured Frequency 2390.0 MHz - Peak**

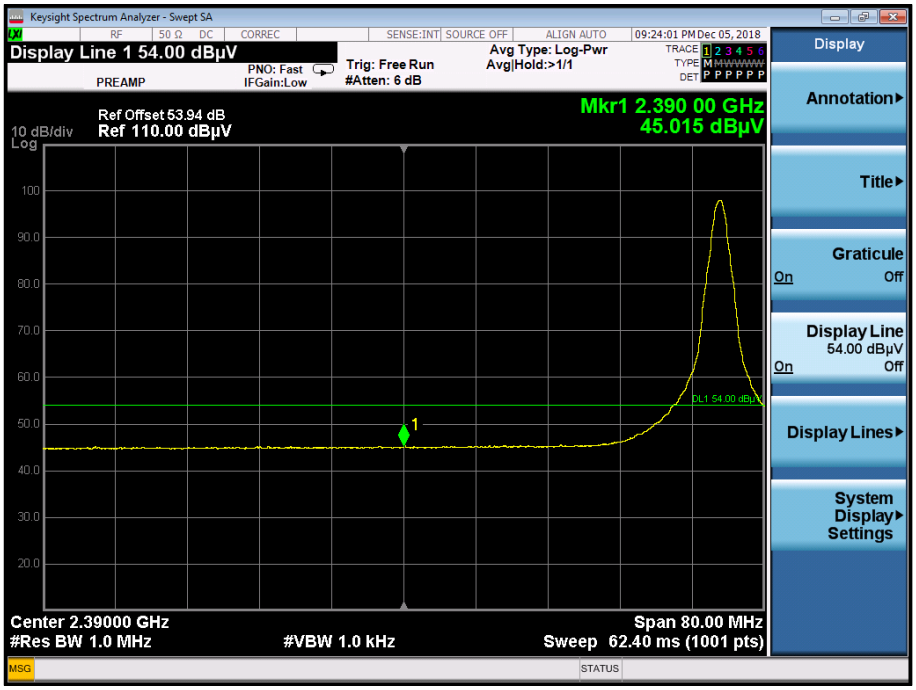


**Figure 4 - Static 2425 MHz - Measured Frequency 2390.0 MHz - Average**


**Figure 5 - Static 2480 MHz - Measured Frequency 2483.5 MHz - Peak**


**Figure 6 - Static 2480 MHz - Measured Frequency 2483.5 MHz - Average**

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 13**

Industry Canada RSS-GEN, Limit Clause 8.9

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

**Table 14**

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

### 2.3.7 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 (Rx, Km-Km 2m) | Scott Cables | KPS-1501-2000-KPS | 4526 | 6 | 26-Apr-2019 |
| Double Ridged Waveguide Horn Antenna | ETS-Lindgren | 3117 | 4722 | 12 | 01-Mar-2019 |
| Mast Controller | Maturo Gmbh | NCD | 4810 | - | TU |
| Tilt Antenna Mast | Maturo Gmbh | TAM 4.0-P | 4811 | - | TU |
| 9m N type RF cable | Rosenberger | 2303-0 9.0m PNm PNm | 4827 | 6 | 04-Jan-2019 |
| Hygrometer | Rotronic | HP21 | 4989 | 12 | 26-Apr-2019 |

**Table 15**

TU - Traceability Unscheduled

## 2.4 Authorised Band Edges

### 2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)
Industry Canada RSS-247, Clause 5.5

### 2.4.2 Equipment Under Test and Modification State

iMPFWT, S/N: U001-0001192 - Modification State 0

### 2.4.3 Date of Test

05-December-2018

### 2.4.4 Test Method

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

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

### 2.4.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 19.8 °C |
| Relative Humidity | 55.8 % |

### 2.4.6 Test Results

2.4 GHz (802.15.4 Proprietary)

| Mode | Frequency (MHz) | Measured Frequency (MHz) | Level (dBc) |
|---|---|---|---|
| Static | 2425 | 2400.0 | -50.83 |
| Static | 2480 | 2483.5 | -35.95 |

**Table 16**

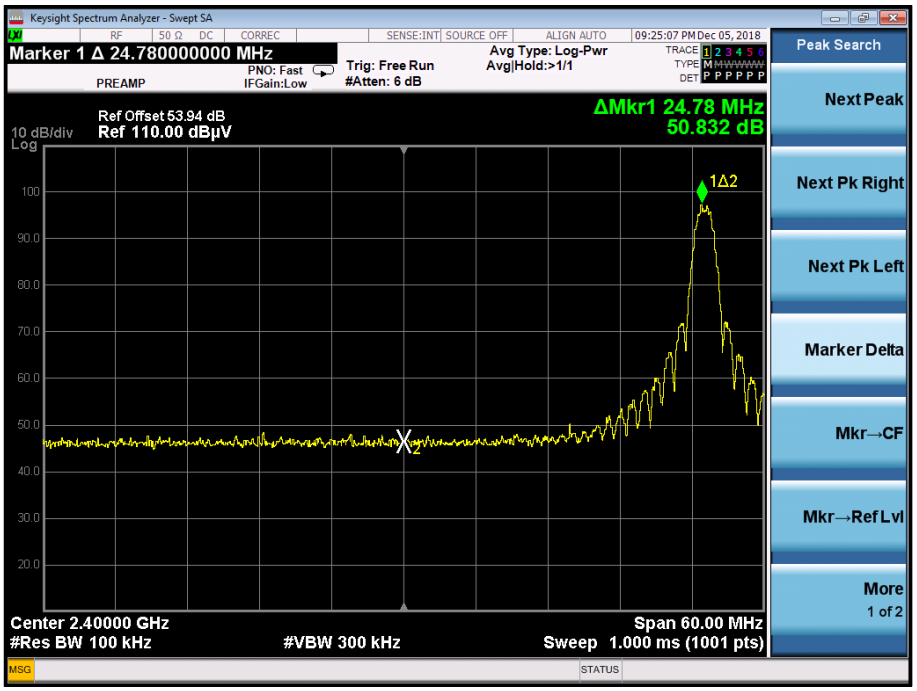


**Figure 7 - Static 2425 MHz - Measured Frequency 2400.0 MHz**


**Figure 8 - Static 2480 MHz - Measured Frequency 2483.5 MHz**

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

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

### 2.4.7 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 |
|---|---|---|---|---|---|
| Screened Room (5) | Rainford | Rainford | 1545 | 36 | 23-Jan-2021 |
| Turntable Controller | Inn-Co GmbH | CO 1000 | 1606 | - | TU |
| Cable (Rx, Km-Km 2m) | Scott Cables | KPS-1501-2000-KPS | 4526 | 6 | 26-Apr-2019 |
| Double Ridged Waveguide Horn Antenna | ETS-Lindgren | 3117 | 4722 | 12 | 01-Mar-2019 |
| Mast Controller | Maturo Gmbh | NCD | 4810 | - | TU |
| Tilt Antenna Mast | Maturo Gmbh | TAM 4.0-P | 4811 | - | TU |
| 9m N type RF cable | Rosenberger | 2303-0 9.0m PNm PNm | 4827 | 6 | 04-Jan-2019 |
| Hygrometer | Rotronic | HP21 | 4989 | 12 | 26-Apr-2019 |

**Table 17**

TU - Traceability Unscheduled

## 2.5 Spurious Radiated Emissions

### 2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
Industry Canada RSS-247, Clause 5.5
Industry Canada RSS-GEN, Clause 8.10

### 2.5.2 Equipment Under Test and Modification State

iMPFWT, S/N: U001-0001192 - Modification State 0

### 2.5.3 Date of Test

04-December-2018 to 05-December-2018

### 2.5.4 Test Method

This test was performed in accordance with ANSI C63.10-2013 clause 6.3, 6.5 and 6.6.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3 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).

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

### 2.5.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 19.8 °C |
| Relative Humidity | 55.8 % |

### 2.5.6 Test Results

2.4 GHz (802.15.4 Proprietary)

| Frequency (GHz) | Result (dBµV/m) | | Limit (dBµV/m) | | Margin (dBµV/m) | |
|---|---|---|---|---|---|---|
| | Peak | Average | Peak | Average | Peak | Average |
| * | | | | | | |

**Table 18 - 2425 MHz - 30 MHz to 1 GHz Emissions Results**

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

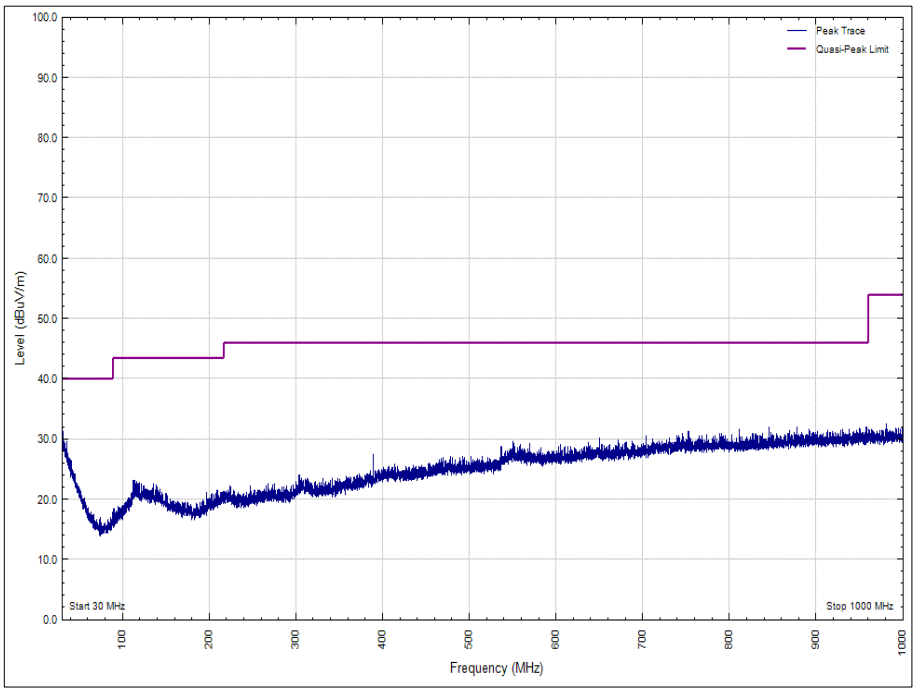


**Figure 9 – 2425 MHz - 30 MHz to 1 GHz, Polarity: Vertical**

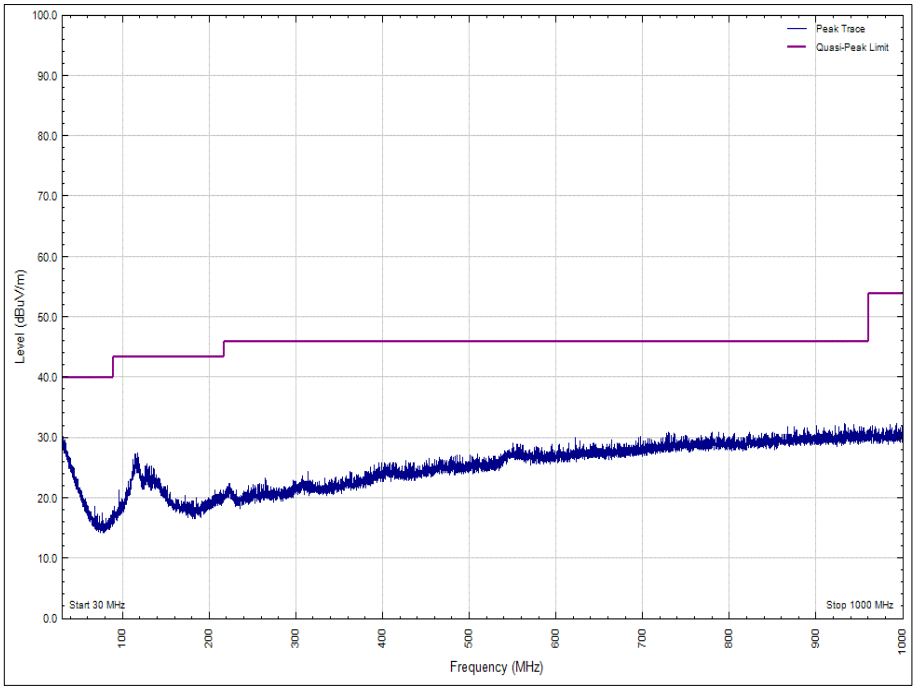


**Figure 10 – 2425 MHz - 30 MHz to 1 GHz, Polarity: Horizontal**

| Frequency (GHz) | Result (dBµV/m) | | Limit (dBµV/m) | | Margin (dBµV/m) | |
|---|---|---|---|---|---|---|
| | Peak | Average | Peak | Average | Peak | Average |
| * | | | | | | |

**Table 19 - 2425 MHz - 1 GHz to 25 GHz Emissions Results**

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

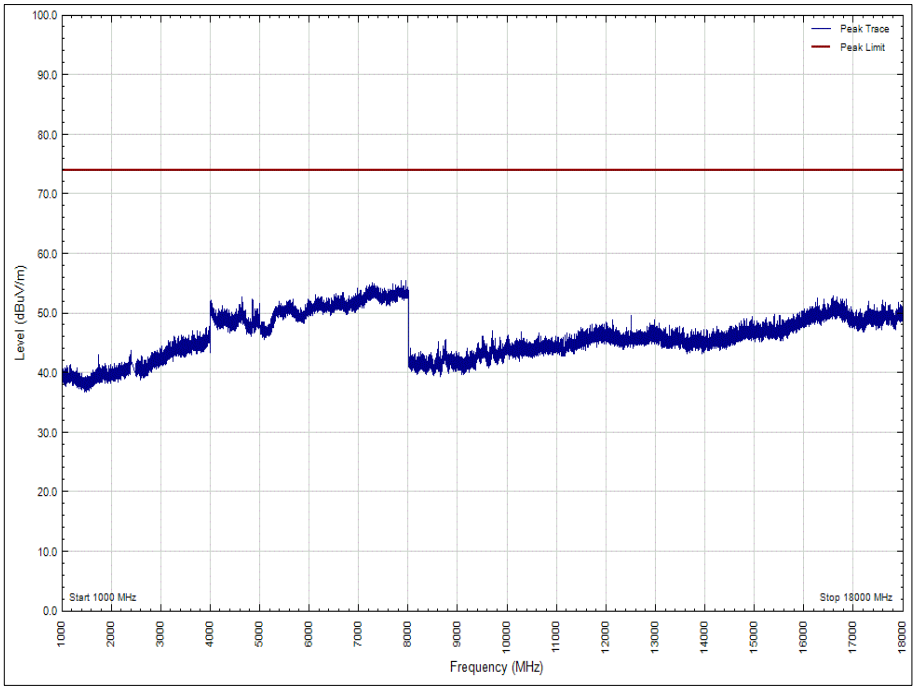


**Figure 11 - 2425 MHz - 1 GHz to 18 GHz Peak, Polarity: Vertical**

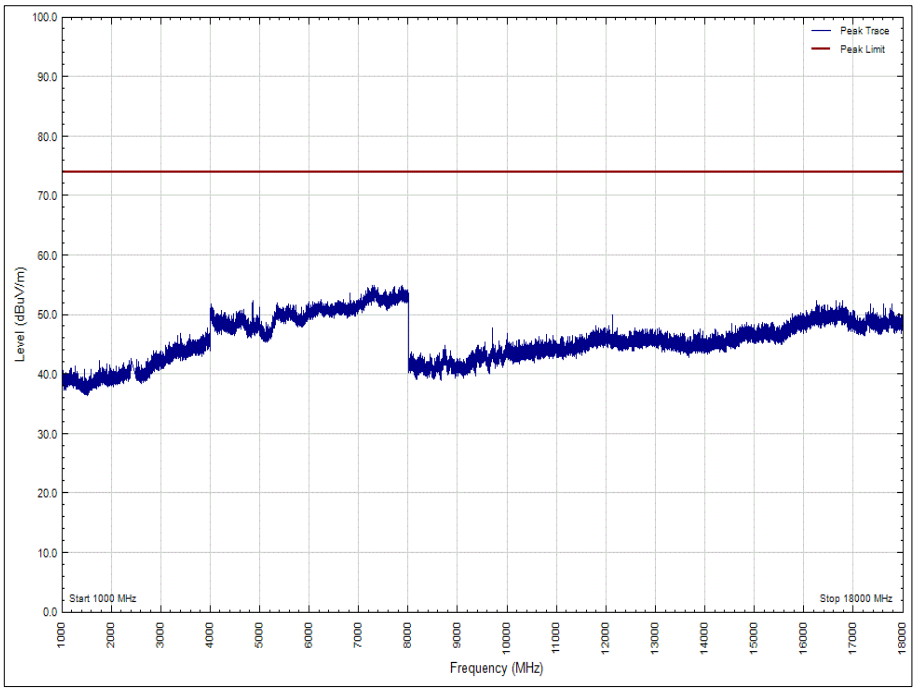


**Figure 12 - 2425 MHz - 1 GHz to 18 GHz Peak, Polarity: Horizontal**

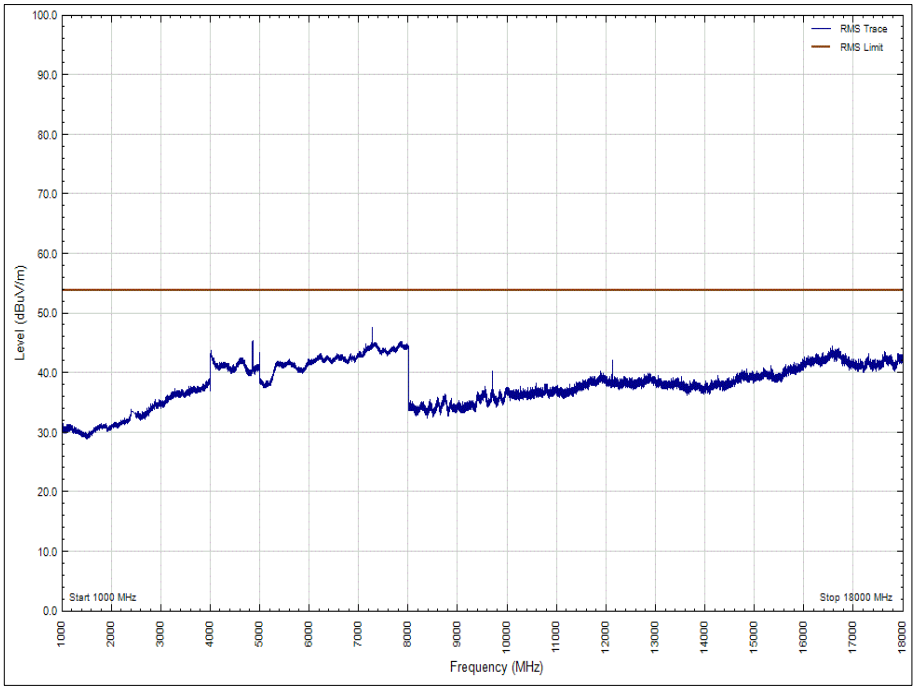


**Figure 13 - 2425 MHz - 1 GHz to 18 GHz Average, Polarity: Vertical**

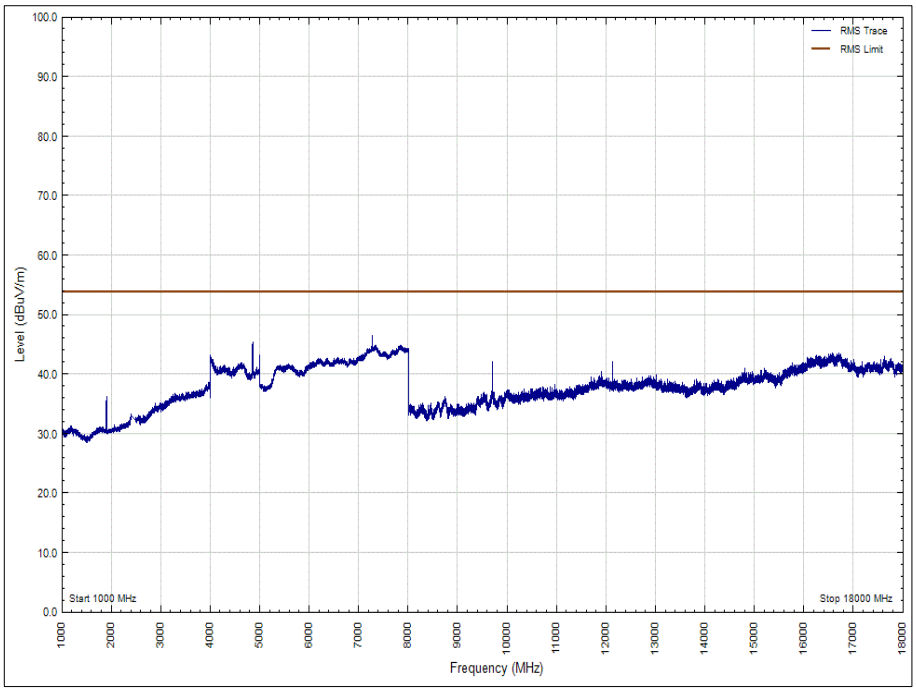


**Figure 14 - 2425 MHz - 1 GHz to 18 GHz Average, Polarity: Horizontal**

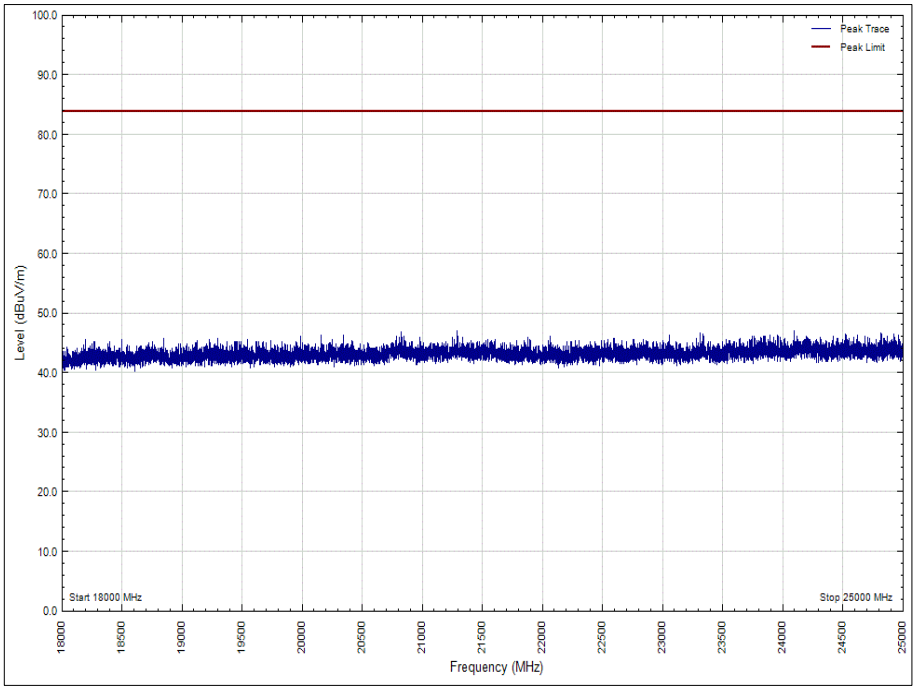


**Figure 15 - 2425 MHz - 18 GHz to 25 GHz Peak, Polarity: Vertical**

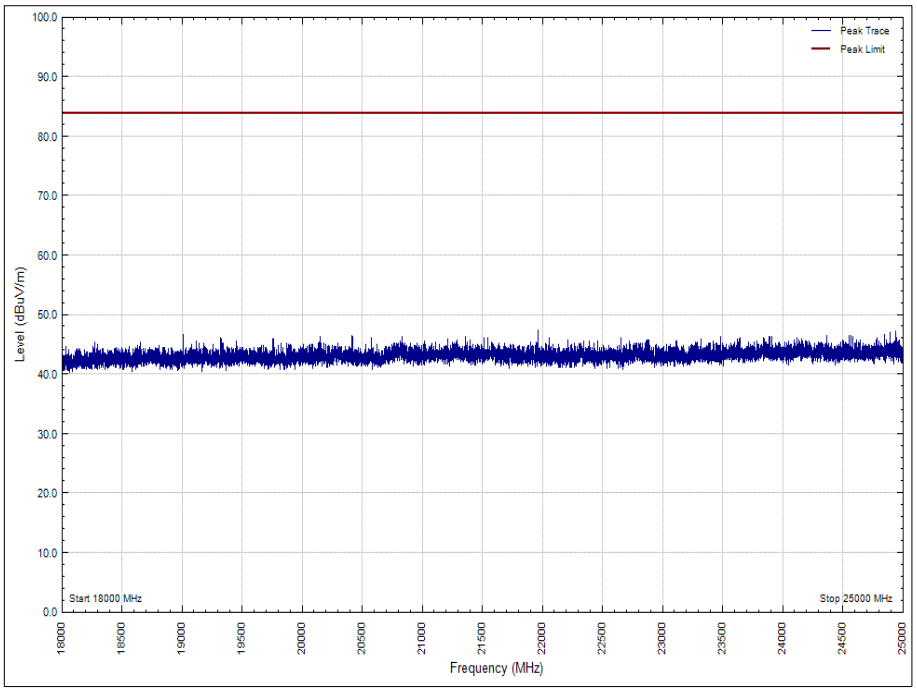


**Figure 16 - 2425 MHz - 18 GHz to 25 GHz Peak, Polarity: Horizontal**

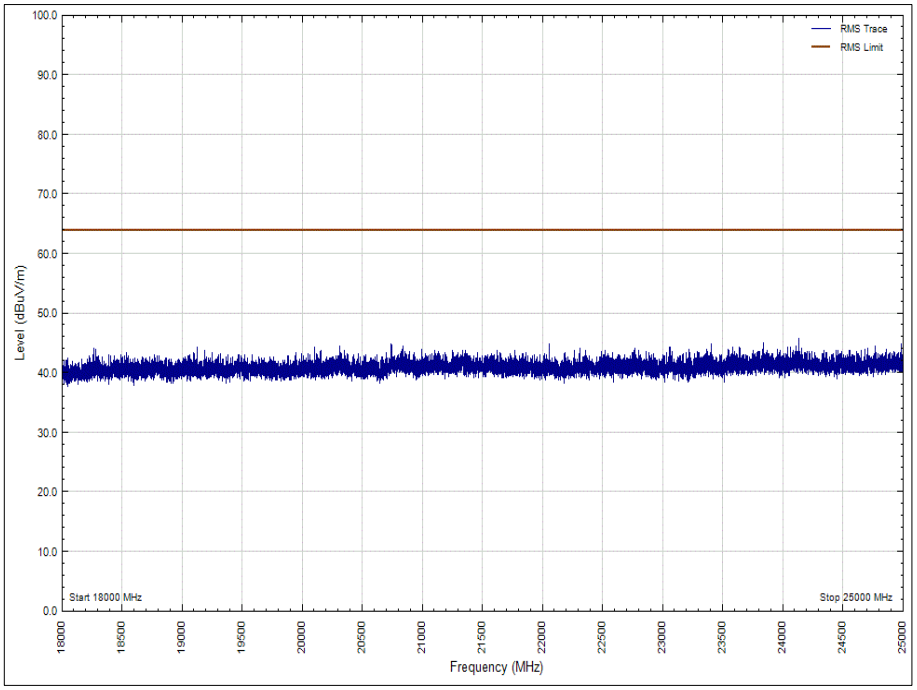


**Figure 17 - 2425 MHz - 18 GHz to 25 GHz Average, Polarity: Vertical**

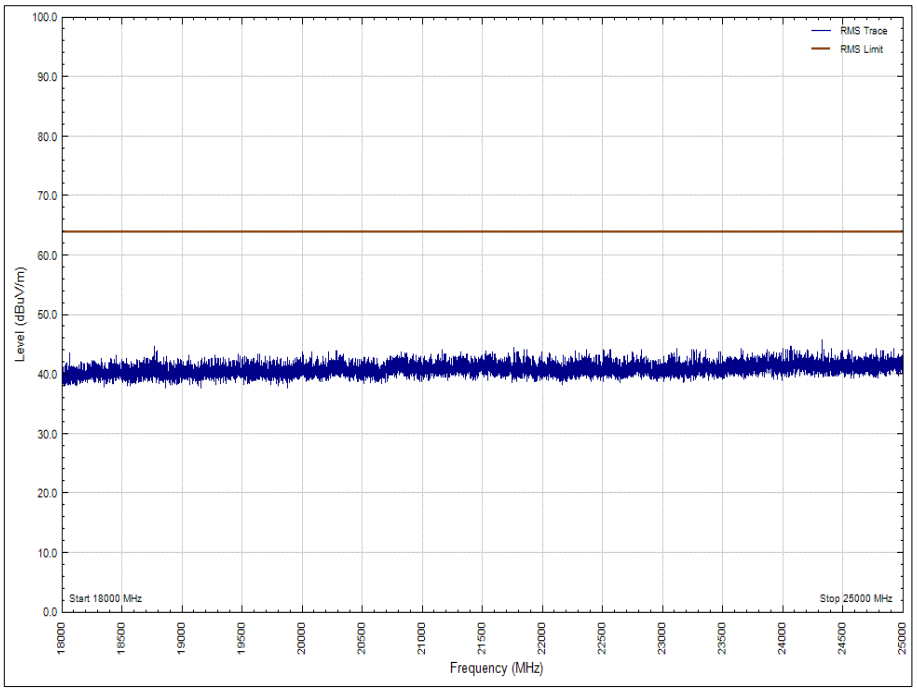


**Figure 18 - 2425 MHz - 18 GHz to 25 GHz Average, Polarity: Horizontal**

| Frequency (GHz) | Result (dBµV/m) | | Limit (dBµV/m) | | Margin (dBµV/m) | |
|---|---|---|---|---|---|---|
| | Peak | Average | Peak | Average | Peak | Average |
| * | | | | | | |

**Table 20 - 2450 MHz - 30 MHz to 1 GHz Emissions Results**

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

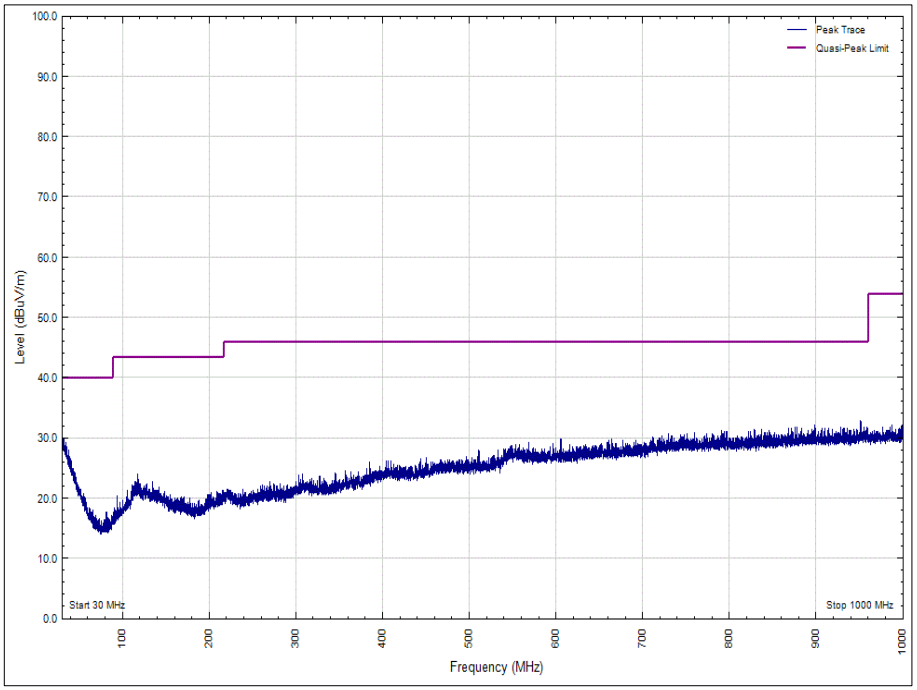


**Figure 19 – 2450 MHz - 30 MHz to 1 GHz, Polarity: Vertical**

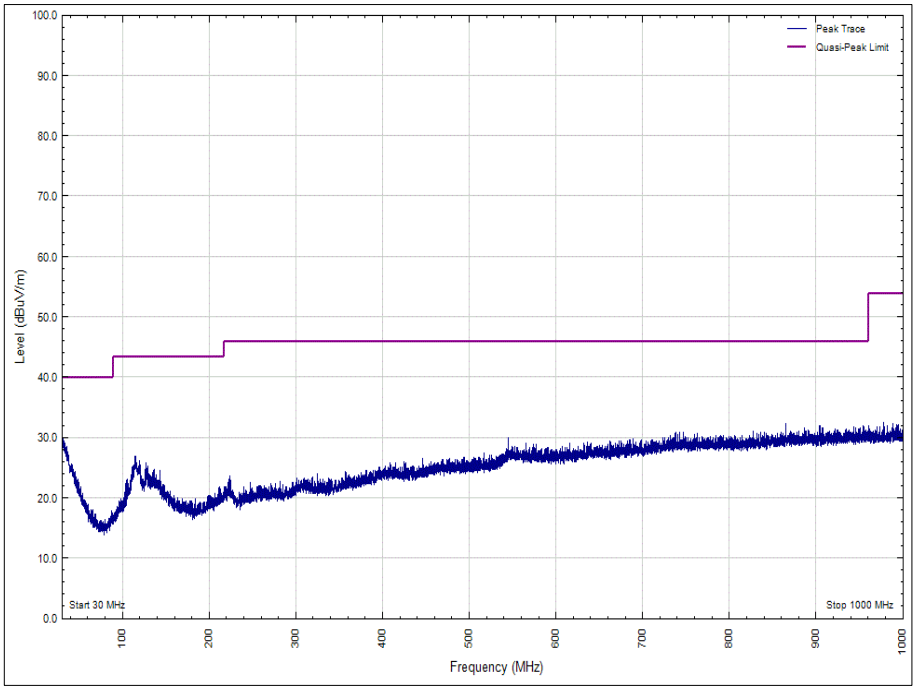


**Figure 20 – 2450 MHz - 30 MHz to 1 GHz, Polarity: Horizontal**

| Frequency (GHz) | Result (dBµV/m) | | Limit (dBµV/m) | | Margin (dBµV/m) | |
|---|---|---|---|---|---|---|
| | Peak | Average | Peak | Average | Peak | Average |
| * | | | | | | |

**Table 21 - 2450 MHz - 1 GHz to 25 GHz Emissions Results**

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

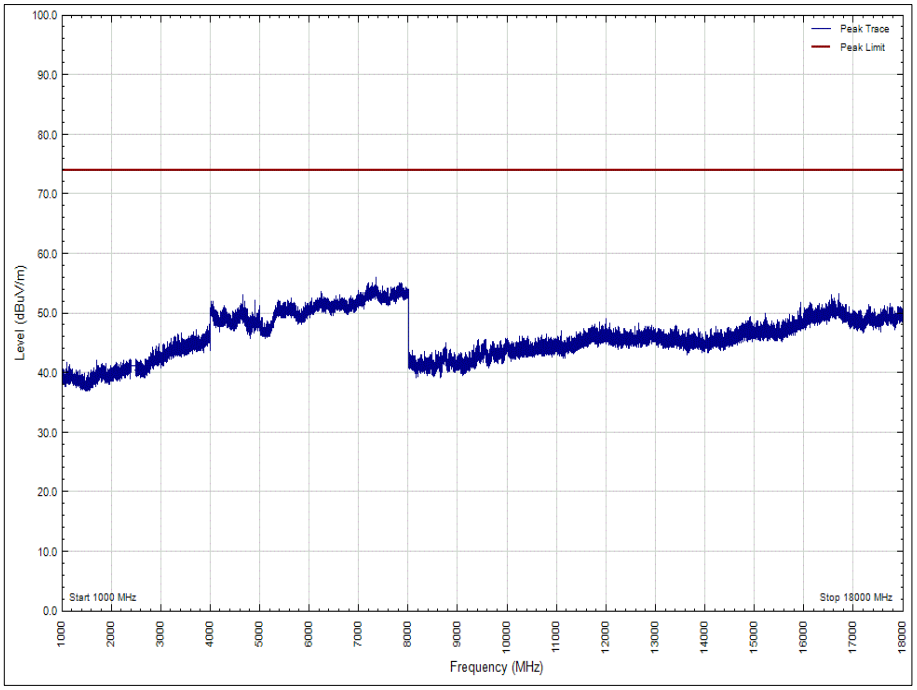


**Figure 21 - 2450 MHz - 1 GHz to 18 GHz Peak, Polarity: Vertical**

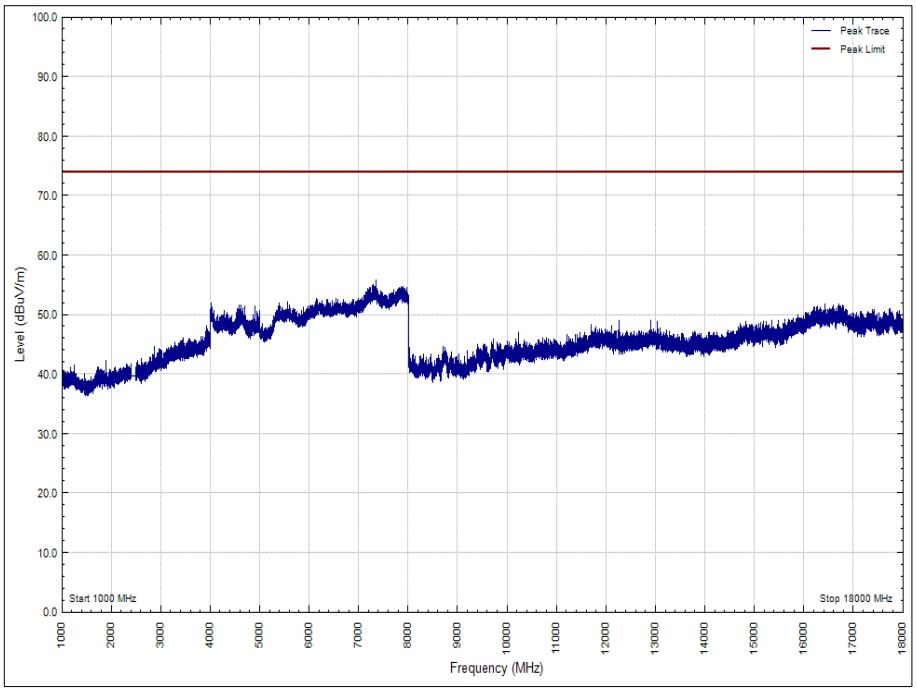


**Figure 22 - 2450 MHz - 1 GHz to 18 GHz Peak, Polarity: Horizontal**

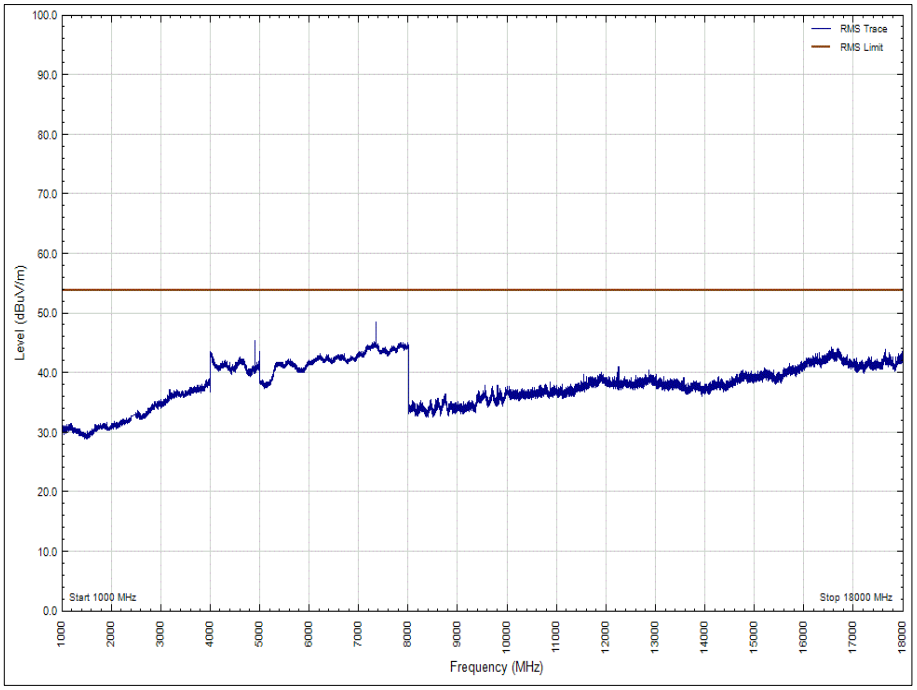


**Figure 23 - 2450 MHz - 1 GHz to 18 GHz Average, Polarity: Vertical**

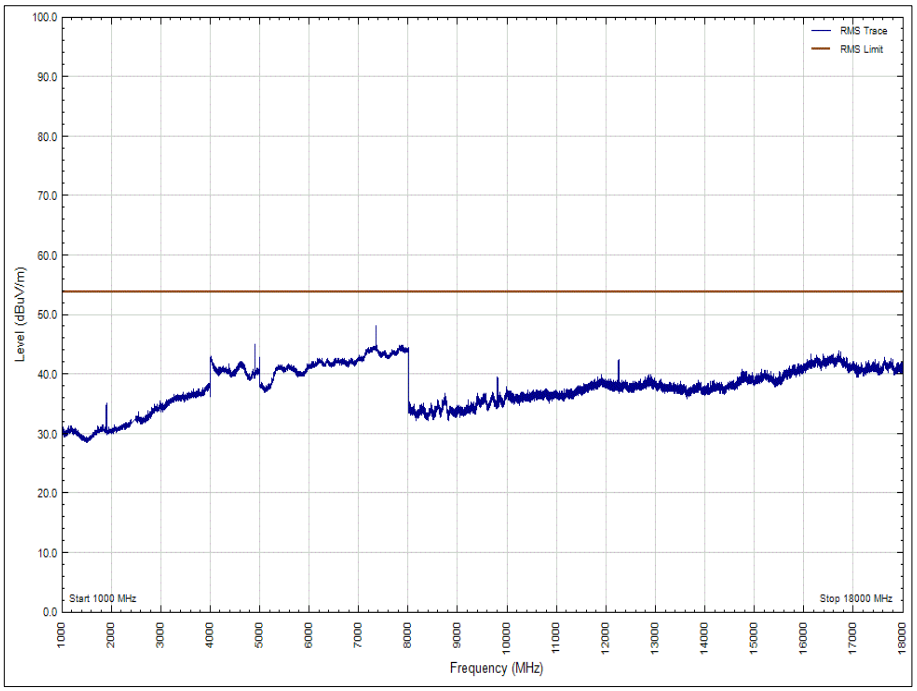


**Figure 24 - 2450 MHz - 1 GHz to 18 GHz Average, Polarity: Horizontal**

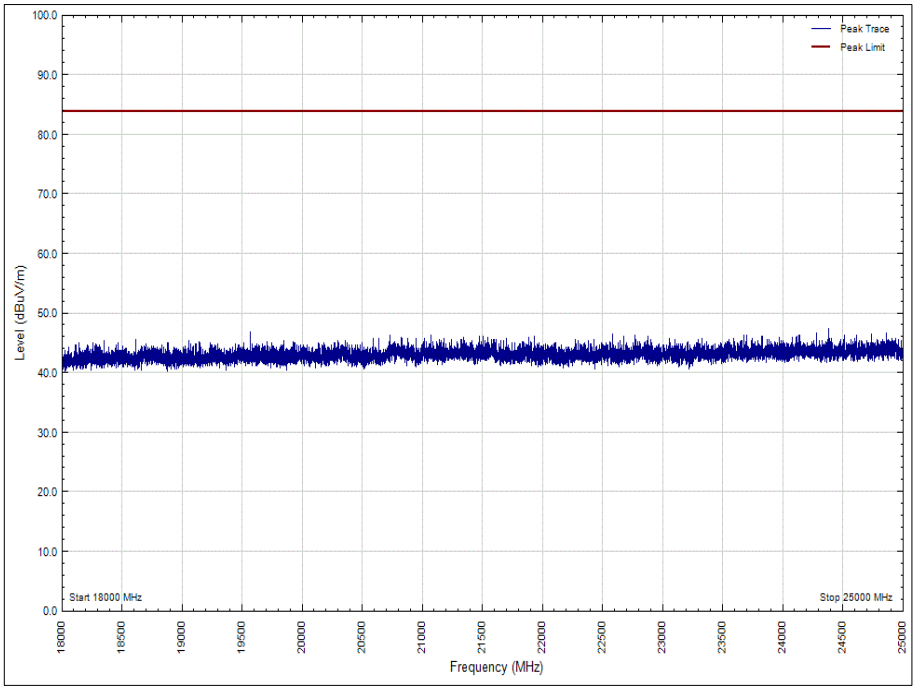


**Figure 25 - 2450 MHz - 18 GHz to 25 GHz Peak, Polarity: Vertical**

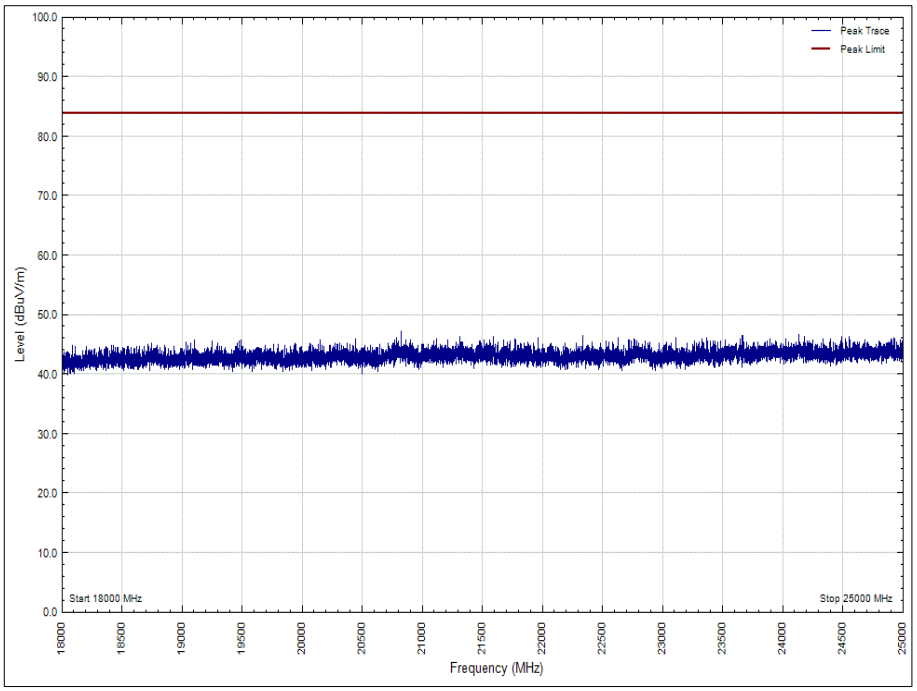


**Figure 26 - 2450 MHz - 18 GHz to 25 GHz Peak, Polarity: Horizontal**

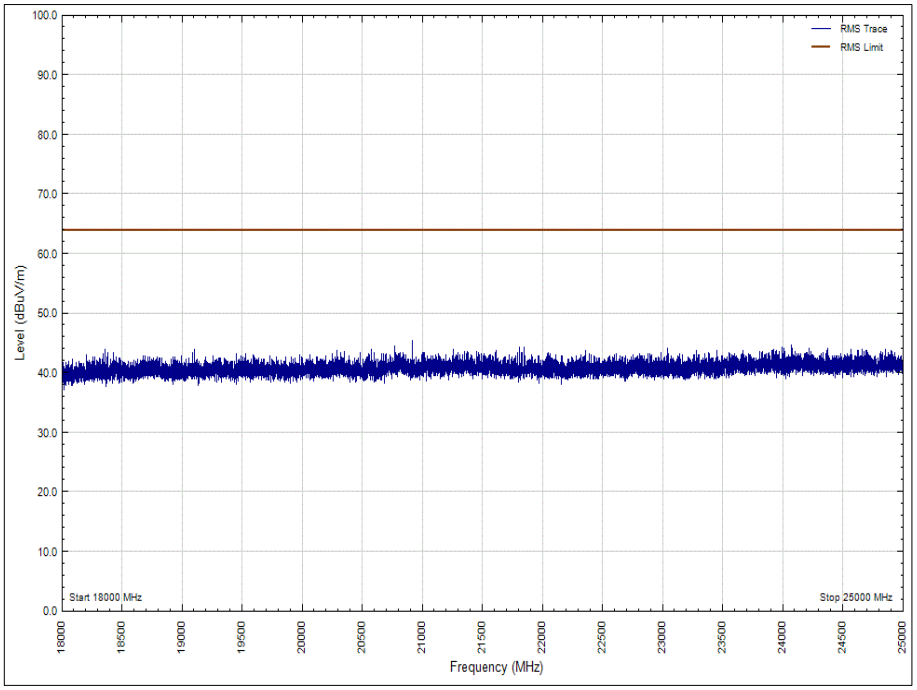


**Figure 27 - 2450 MHz - 18 GHz to 25 GHz Average, Polarity: Vertical**

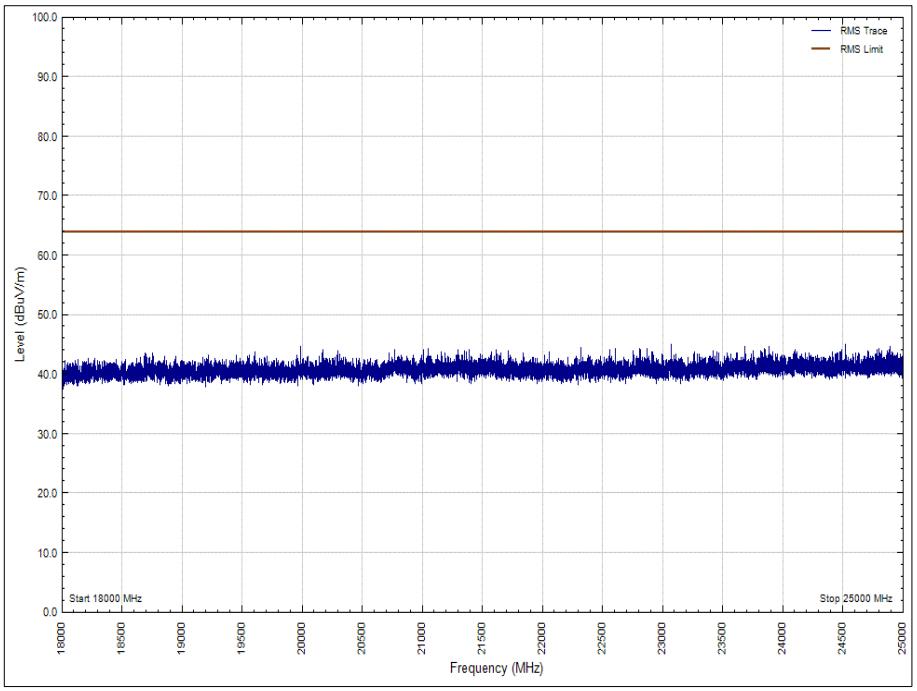


**Figure 28 - 2450 MHz - 18 GHz to 25 GHz Average, Polarity: Horizontal**

| Frequency (GHz) | Result (dBµV/m) | | Limit (dBµV/m) | | Margin (dBµV/m) | |
|---|---|---|---|---|---|---|
| | Peak | Average | Peak | Average | Peak | Average |
| * | | | | | | |

**Table 22 - 2480 MHz - 30 MHz to 1 GHz Emissions Results**

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

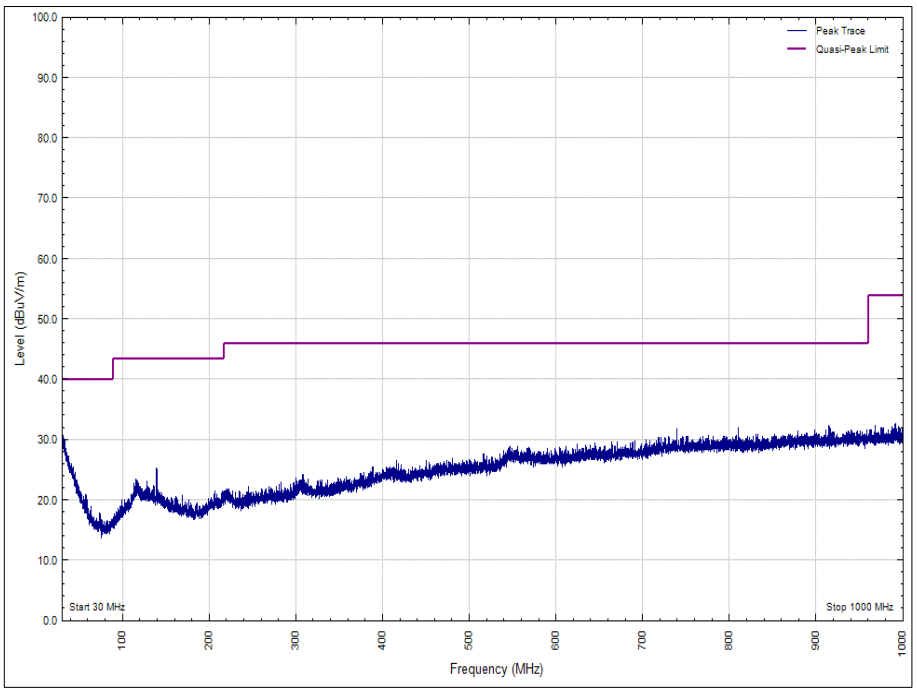


**Figure 29 – 2480 MHz - 30 MHz to 1 GHz, Polarity: Vertical**

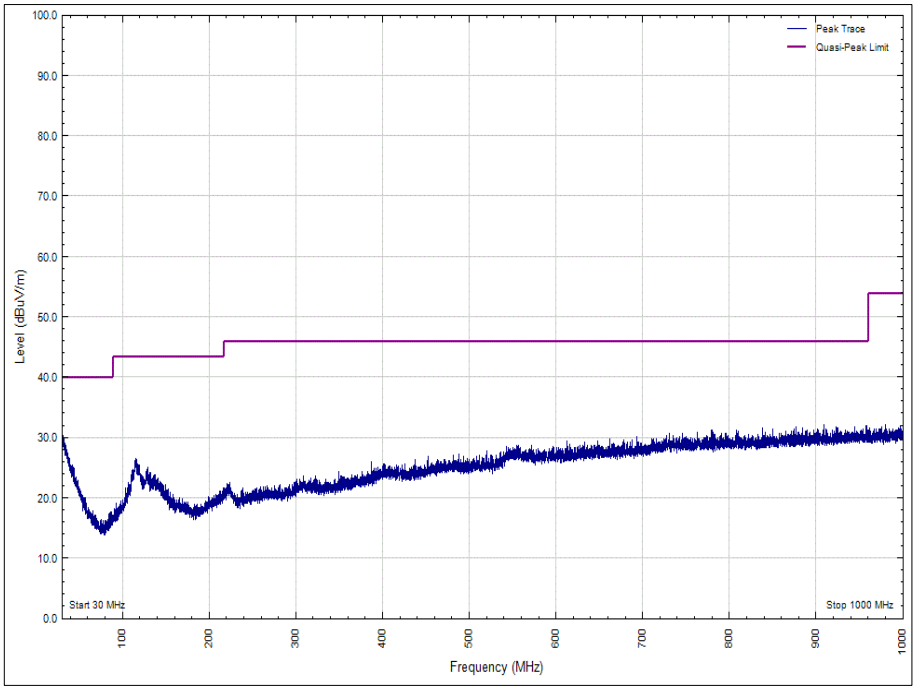


**Figure 30 – 2480 MHz - 30 MHz to 1 GHz, Polarity: Horizontal**

| Frequency (GHz) | Result (dBµV/m) | | Limit (dBµV/m) | | Margin (dBµV/m) | |
|---|---|---|---|---|---|---|
| | Peak | Average | Peak | Average | Peak | Average |
| * | | | | | | |

**Table 23 - 2480 MHz - 1 GHz to 25 GHz Emissions Results**

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

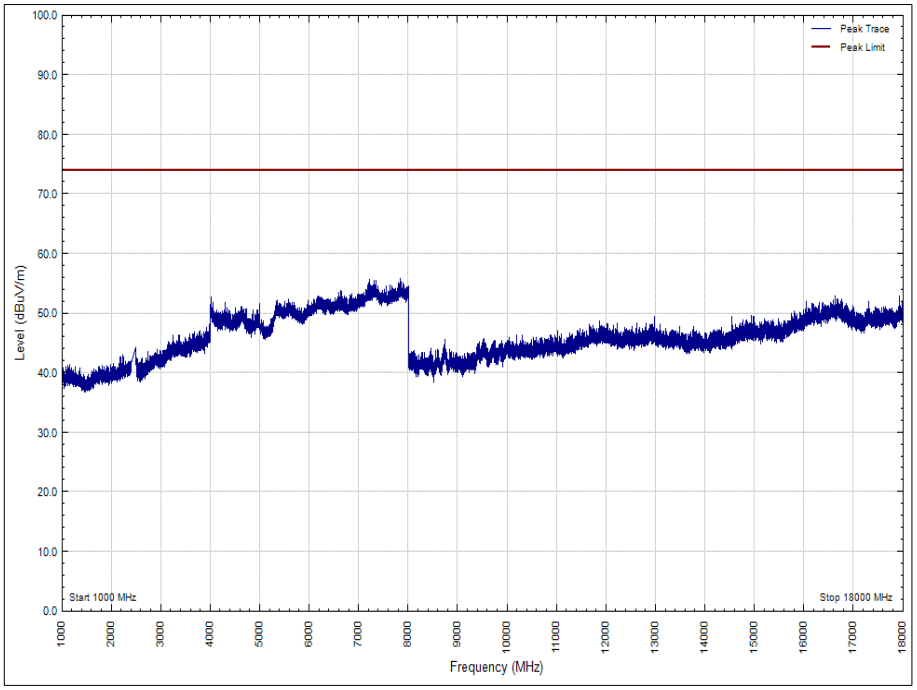


**Figure 31 - 2480 MHz - 1 GHz to 18 GHz Peak, Polarity: Vertical**

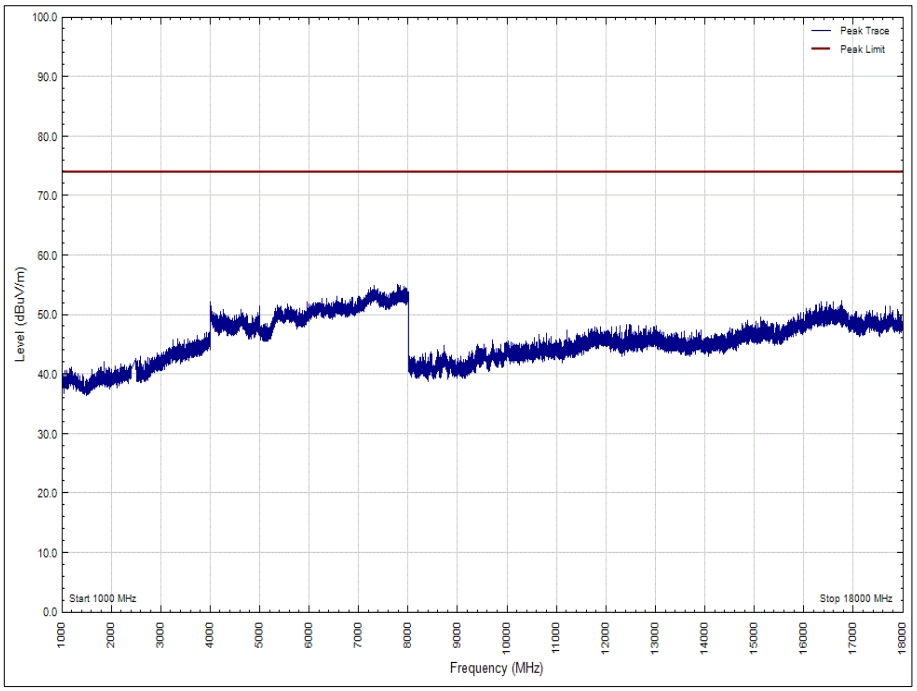


**Figure 32 - 2480 MHz - 1 GHz to 18 GHz Peak, Polarity: Horizontal**

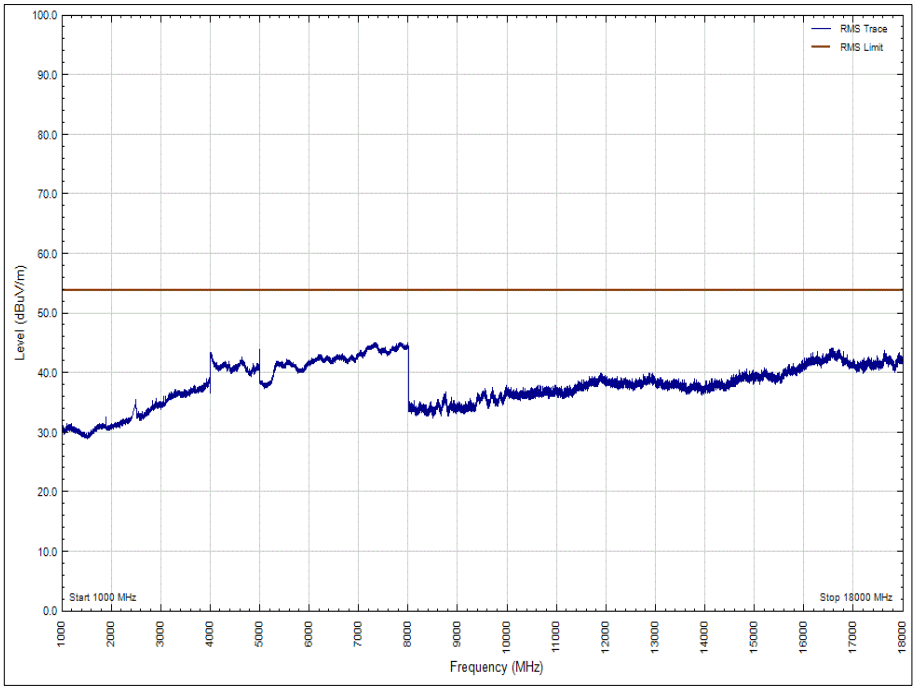


**Figure 33 - 2480 MHz - 1 GHz to 18 GHz Average, Polarity: Vertical**

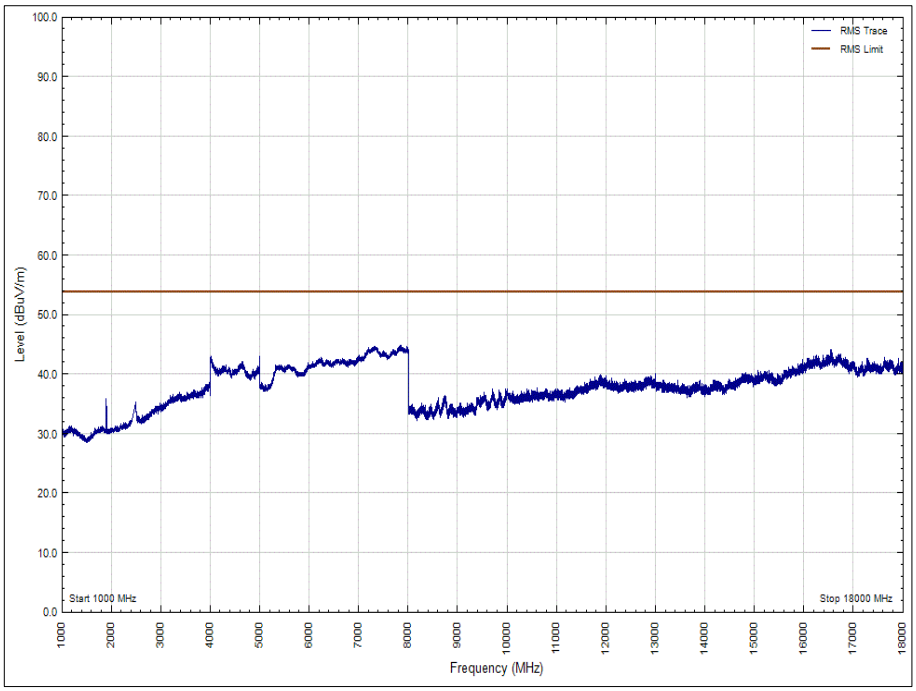


**Figure 34 - 2480 MHz - 1 GHz to 18 GHz Average, Polarity: Horizontal**

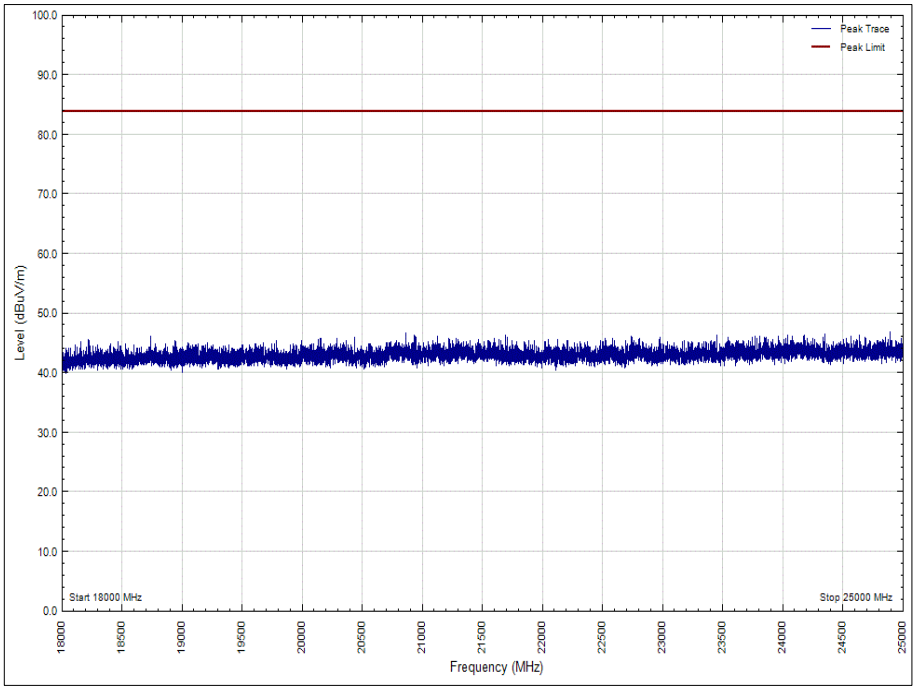


**Figure 35 - 2480 MHz - 18 GHz to 25 GHz Peak, Polarity: Vertical**

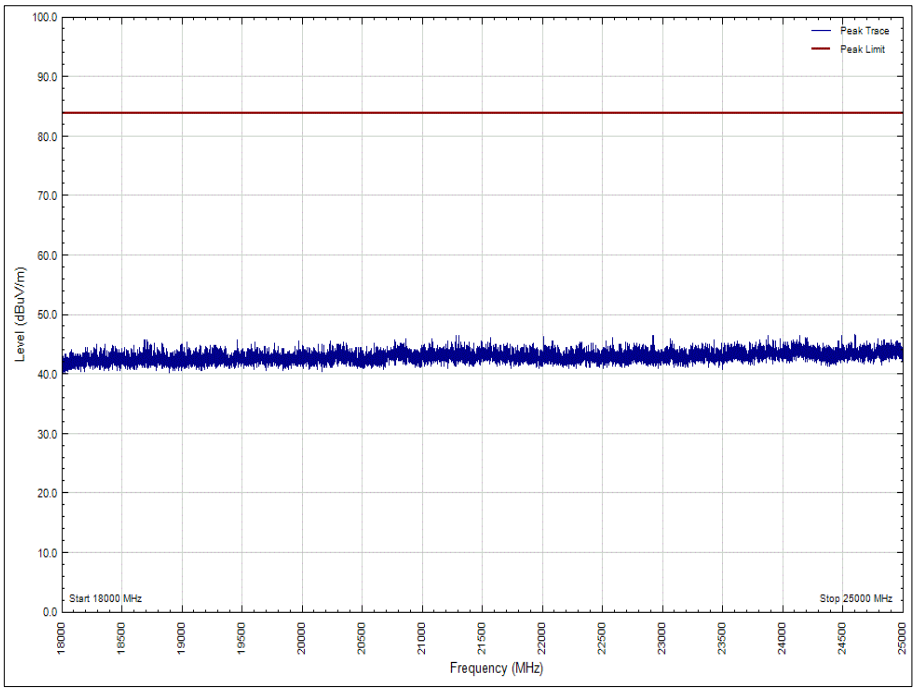


**Figure 36 - 2480 MHz - 18 GHz to 25 GHz Peak, Polarity: Horizontal**

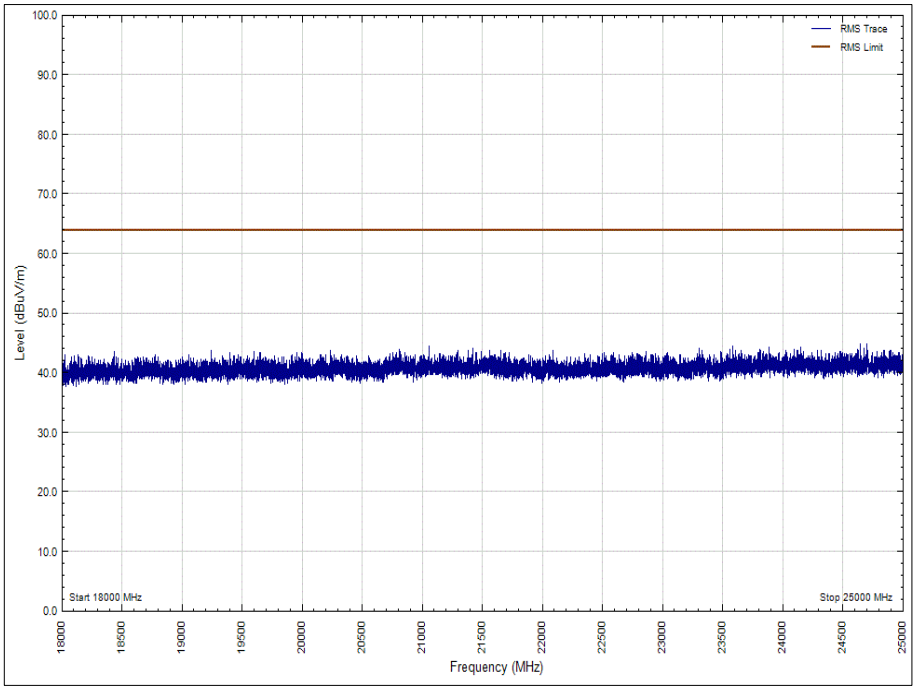


**Figure 37 - 2480 MHz - 18 GHz to 25 GHz Average, Polarity: Vertical**

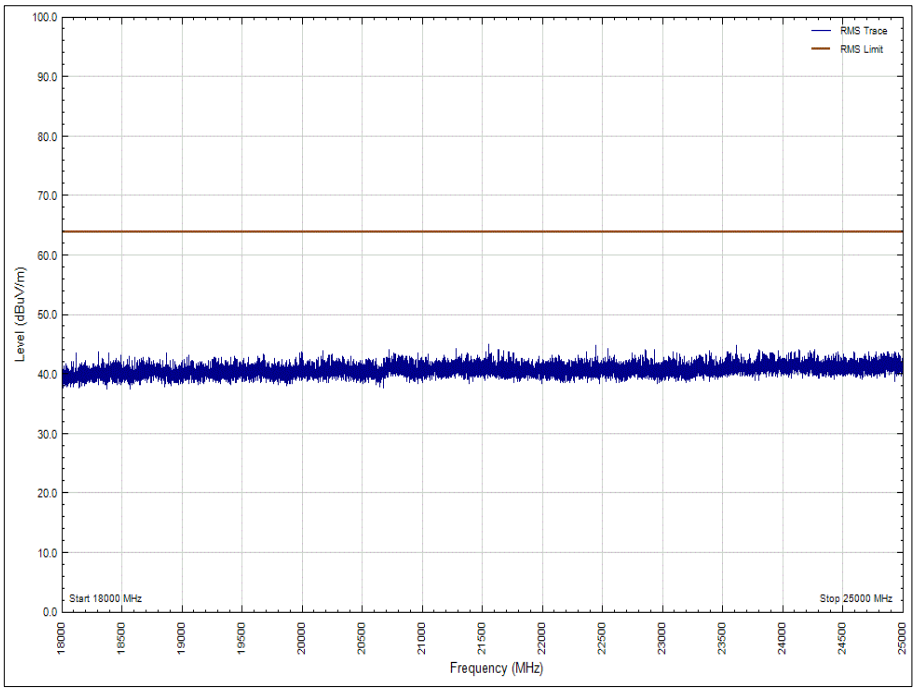


**Figure 38 - 2480 MHz - 18 GHz to 25 GHz Average, Polarity: Horizontal**

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)

Industry Canada RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

### 2.5.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration 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 | 02-Feb-2019 |
| 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 | 08-Aug-2019 |
| Comb Generator | Schaffner | RSG1000 | 3034 | - | TU |
| 1501A 4.0M Km Km Cable | Rhophase | KPS-1501A-4000-KPS | 4301 | 12 | 19-Feb-2019 |
| 1 metre K-Type Cable | Florida Labs | KMS-180SP-39.4-KMS | 4520 | 12 | 13-Feb-2019 |
| Cable (Rx, Km-Km 2m) | Scott Cables | KPS-1501-2000-KPS | 4526 | 6 | 26-Apr-2019 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4653 | 12 | 05-Feb-2019 |
| Mast Controller | Maturo Gmbh | NCD | 4810 | - | TU |
| Tilt Antenna Mast | Maturo Gmbh | TAM 4.0-P | 4811 | - | TU |
| 9m N type RF cable | Rosenberger | 2303-0 9.0m PNm PNm | 4827 | 6 | 04-Jan-2019 |
| 4dB Attenuator | Pasternack | PE7047-4 | 4935 | 24 | 28-Nov-2019 |
| Hygrometer | Rotronic | HP21 | 4989 | 12 | 26-Apr-2019 |

**Table 24**

TU - Traceability Unscheduled

## 2.6 Emission Bandwidth

### 2.6.1 Specification Reference

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

### 2.6.2 Equipment Under Test and Modification State

iMPFWT, S/N: U001-0001174 - Modification State 0

### 2.6.3 Date of Test

16-November-2018

### 2.6.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 11.8.2 for 6 dB bandwidth and Industry Canada RSS-GEN clause 6.7 for 99% occupied bandwidth.

### 2.6.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.0 °C |
| Relative Humidity | 47.9 % |

### 2.6.6 Test Results

2.4 GHz (802.15.4 Proprietary)

| Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
|---|---|---|
| 2425 | 1.58 | 2.46 |
| 2450 | 1.57 | 2.44 |
| 2800 | 1.68 | 2.52 |

**Table 25**

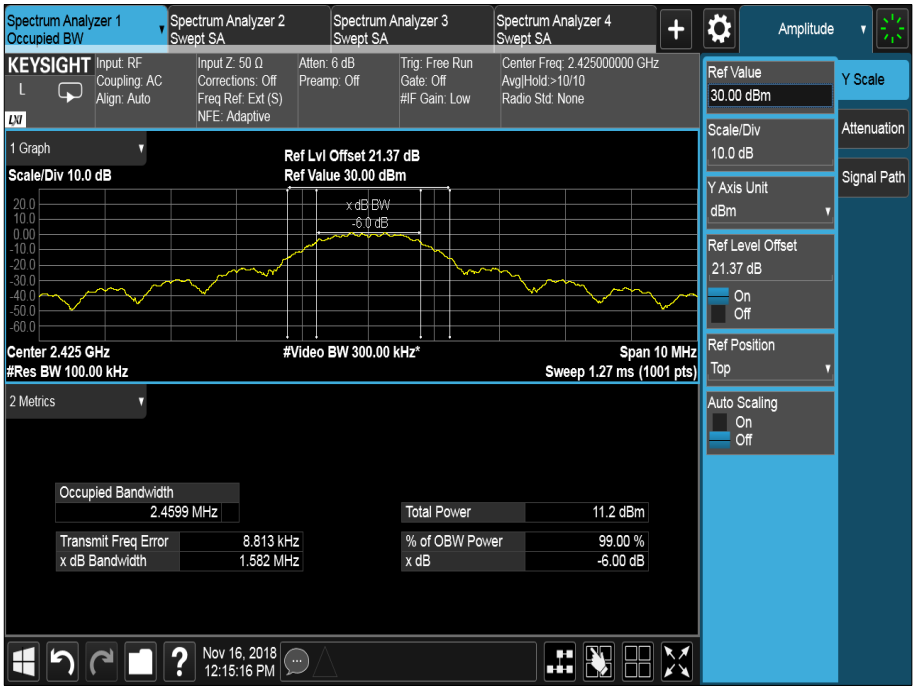


**Figure 39 - 2425 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth**

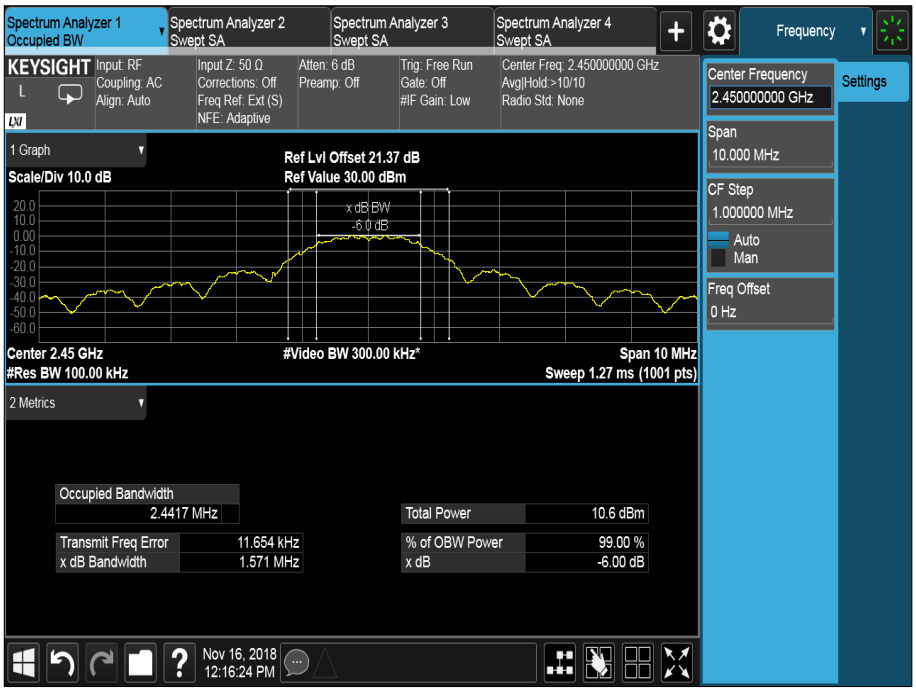


**Figure 40 - 2450 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth**

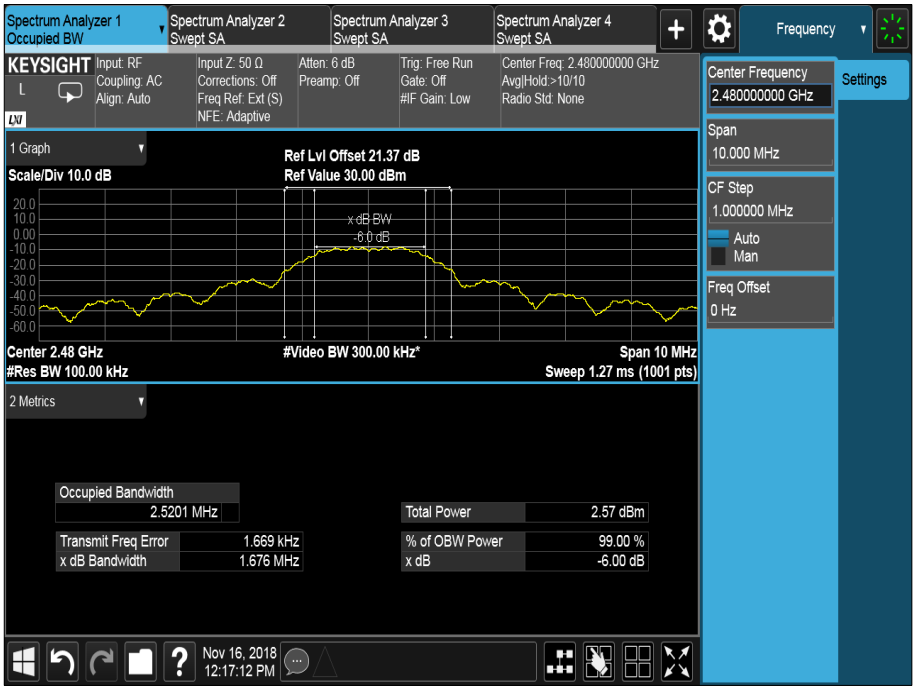


**Figure 41 - 2480 MHz – 6 dB Bandwidth and 99% Occupied Bandwidth**

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and Industry Canada RSS-247, Clause 5.2(a)

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

### 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 |
|---|---|---|---|---|---|
| Attenuator (20dB, 2W) | Pasternack | PE7004-20 | 2943 | 12 | 18-Jul-2019 |
| Hygrometer | Rotronic | I-1000 | 3220 | 12 | 13-Sep-2019 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 17-Oct-2019 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 22-Oct-2019 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 16-Apr-2019 |
| EXA | Keysight Technologies | N9010B | 4969 | 24 | 21-Dec-2018 |
| Cable (40GHz | Rosenberger | LU1-001-2000 | 5024 | - | O/P Mon |

**Table 26**

O/P Mon – Output Monitored using calibrated equipment

# 3 Photographs

## 3.1 Test Setup Photographs

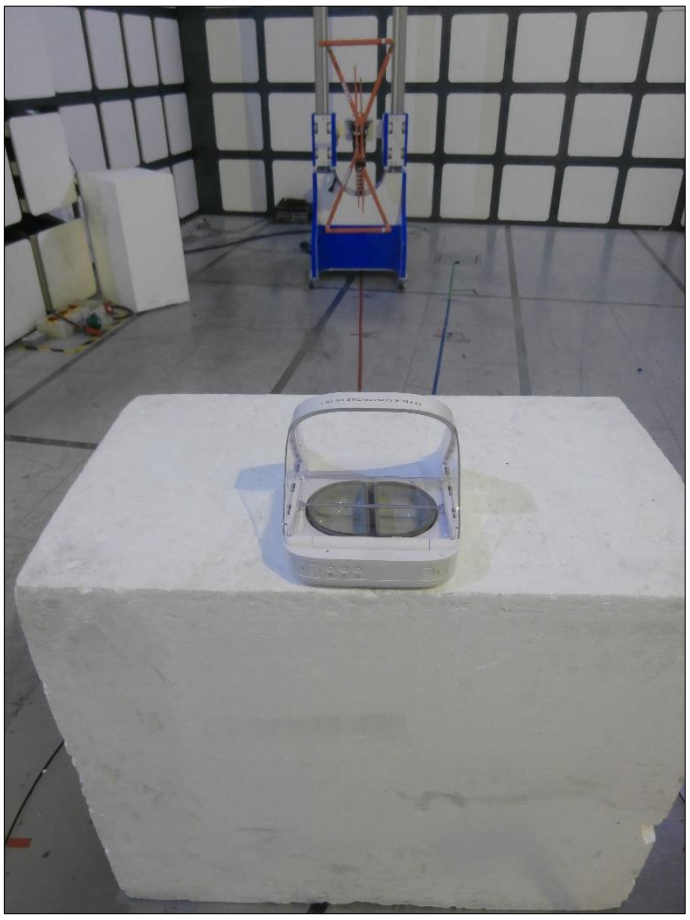

**Figure 42 - 30 MHz to 1 GHz**

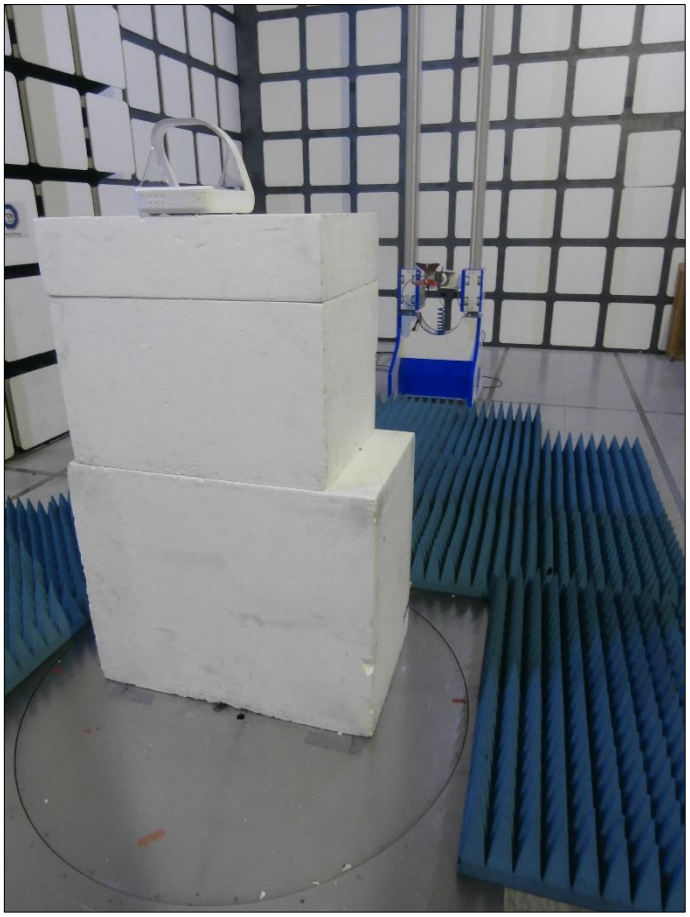

**Figure 43 - 1 GHz to 25 GHz**

# 4 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 |
| 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 |
| Spurious Radiated Emissions | 30 MHz to 1 GHz: ± 5.2 dB<br>1 GHz to 40 GHz: ± 6.3 dB |
| Emission Bandwidth | ± 85759.091 kHz |

**Table 27**