

# Report on the Testing of the Mitsubishi Electric US PAC-USWHS002-WF-2

In accordance with:  
FCC 47 CFR part 15.247  
ISED RSS-247 Issue 2, February 2017

Prepared for: MuRata Electronics North America  
2200 Lake Park Drive  
Smyrna, Georgia 30080 USA



America

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Inspire trust.**

## COMMERCIAL-IN-CONFIDENCE

Document Number: AT72185560.1C1

### SIGNATURE

A handwritten signature in black ink, appearing to read "Kirby Munroe".

| NAME         | JOB TITLE                                                                         | RESPONSIBLE FOR      | ISSUE DATE |
|--------------|-----------------------------------------------------------------------------------|----------------------|------------|
| Kirby Munroe | Wireless / EMC Technical and Certification<br>Manager, NA<br>TUV SUD America Inc. | Authorized Signatory | 5/1/2023   |

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

FCC Accreditation Designation Number US1233  
FCC Test Site Registration Number 967699  
Innovation, Science, and Economic Development Canada Lab Code 23932

### EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with the standards listed above.



A2LA Cert. No. 2955.09

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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.

**Table 1.1-1 – Modification Record**

| Issue | Description of Change | Date of Issue |
|-------|-----------------------|---------------|
| 0     | First Issue           | 2/2/2023      |
| 1     | Second Issue          | 5/1/2023      |

## 1.2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

|                               |                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Applicant                     | Rodney Olson                                                                                                                                                                                                                                                                                                                          |
| Applicant Company             | Mitsubishi Electric US                                                                                                                                                                                                                                                                                                                |
| Manufacturer                  | Murata Electronics North America                                                                                                                                                                                                                                                                                                      |
| Applicant's Email Address     | ROlson@hvac.mea.com                                                                                                                                                                                                                                                                                                                   |
| Model Name / Number           | PAC-USWHS002-WF-2                                                                                                                                                                                                                                                                                                                     |
| Serial Number                 | N/A                                                                                                                                                                                                                                                                                                                                   |
| FCC ID                        | 2AIGWFB004                                                                                                                                                                                                                                                                                                                            |
| ISED Certification Number     | 31190-WFB004                                                                                                                                                                                                                                                                                                                          |
| Hardware Version(s)           | 3                                                                                                                                                                                                                                                                                                                                     |
| Software Version(s)           | 3                                                                                                                                                                                                                                                                                                                                     |
| Number of Samples Tested      | 2                                                                                                                                                                                                                                                                                                                                     |
| Test Specification/Issue/Date | US Code of Federal REgulation (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2022<br>ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017. |
| Order Number                  | 72185560                                                                                                                                                                                                                                                                                                                              |
| Date of Receipt of EUT        | 12/12/2022                                                                                                                                                                                                                                                                                                                            |
| Start of Test                 | 12/12/2022                                                                                                                                                                                                                                                                                                                            |
| Finish of Test                | 1/5/2023                                                                                                                                                                                                                                                                                                                              |



Related Document(s)

ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device.

FCC OET KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules, April 2, 2019

US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2022.

ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1 (March 2019), Amendment 2 (February 2021)



### 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.247 and ISED Canada's RSS-247 is shown below.

**Table 1.3-1: Test Result Summary**

| Test Parameter                                              | Test Plan (Yes/No) | Test Result | FCC 47 CFR Rule Part | ISED Canada's RSS | Test Report Page No |
|-------------------------------------------------------------|--------------------|-------------|----------------------|-------------------|---------------------|
| Antenna Requirement                                         | Yes                | Pass        | 15.203, 15.204       | -----             | 11                  |
| 6 dB Bandwidth                                              | Yes                | Pass        | 15.247(a)(2)         | RSS-247 5.2(a)    | 19                  |
| 99% Bandwidth                                               | Yes                | Pass        | -----                | RSS-GEN 6.7       | 19                  |
| Fundamental Emission Output Power                           | Yes                | Pass        | 15.247(b)(3)         | RSS-247 5.4(d)    | 17                  |
| Band-Edge Compliance of RF Conducted Emissions              | Yes                | Pass        | 15.247(d)            | RSS-247 5.5       | 28                  |
| RF Conducted Spurious Emissions                             | Yes                | Pass        | 15.247(d)            | RSS-247 5.5       | 30                  |
| Radiated Spurious Emissions into Restricted Frequency Bands | Yes                | Pass        | 15.205, 15.209       | RSS-GEN 8.9, 8.10 | 32                  |
| Power Spectral Density                                      | Yes                | Pass        | 15.247(e)            | RSS-247 5.2(b)    | 25                  |
| AC Power Line Conducted Emissions                           | Yes                | Pass        | 15.207               | RSS-GEN 8.8       | 12                  |



## 1.4 Product Information

### 1.4.1 Technical Description

The PAC-USWHS002-WF-3 WIFI-BLE adapter is the third generation in its series. It wirelessly monitors and controls a MEUS HVAC unit via WIFI link. This device communicates wirelessly using either 802.11b/g/n WIFI mode or Bluetooth Smart (i.e. BLE) mode

**Table 1.4-1 – Wireless Technical Information**

| Detail                           | Description         |
|----------------------------------|---------------------|
| FCC ID                           | 2AIGWFB004          |
| ISED Canada Certification Number | 31190-WFB004        |
| Transceiver Model Name / Number  | PAC-USWHS002-WF-2   |
| Frequency Range (MHz)            | 2402 – 2480 MHz     |
| Modulation Format                | GFSK                |
| Number of Channels               | 40                  |
| Maximum Rated Power              | 10 dBm              |
| Data Rates                       | 1 Mbps              |
| Operating voltage                | 5VAC, 12 VAC        |
| Antenna Type / Gain:             | PCB Trace / 3.3 dBi |

A full description and detailed product specification details are available from the manufacturer.



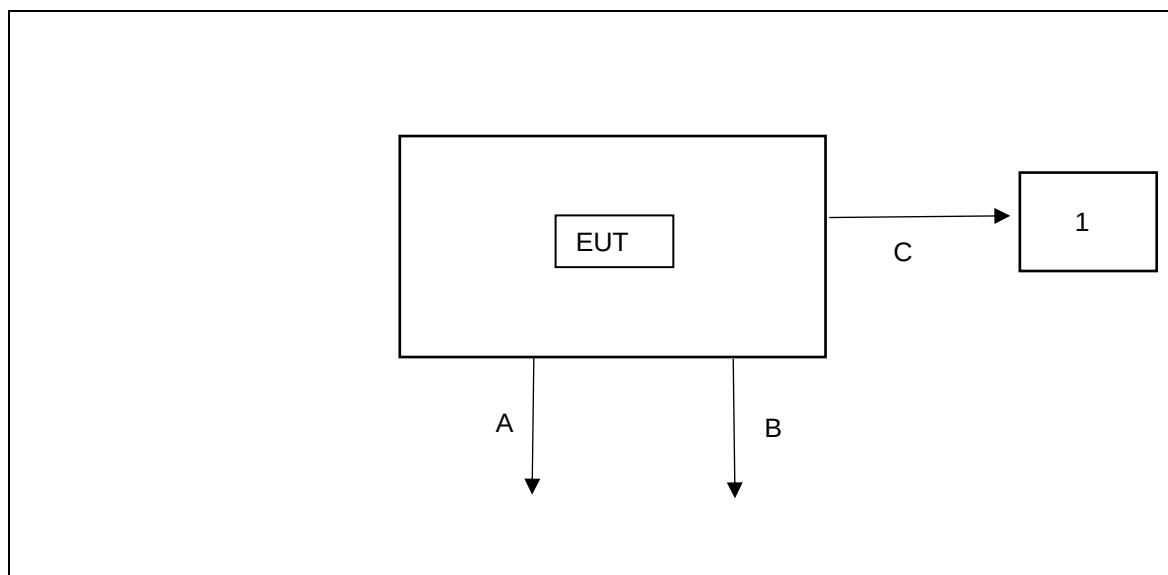
**Photo 1.4.1-1 – Front view of Radiated EUT**



**Photo 1.4.1-2 – Front view of Radiated EUT**



**Photo 1.4.1-3 – Front view of Conducted EUT**

**Figure 1.4.1-5 – Test Setup Block Diagram****Table 1.4.1-1 – Cable Descriptions**

| Item | Cable/Port                | Description                      |
|------|---------------------------|----------------------------------|
| A    | DC Power supply           | 12VDC power supply to EUT        |
| B    | Power supply Wall adapter | 5VAC Wall adapter                |
| C    | USB programming cable     | Used for BLE radio configuration |

**Table 1.4.1-2 – Support Equipment Descriptions**

| Item | Make/Model | Description              |
|------|------------|--------------------------|
| 1    | ThinkPad   | Laptop for configuration |





### 1.4.2 Modes of Operation

Module provides 1 mode of operation using BLE classifications as outlined below.

| Mode of Operation | Frequency Range (MHz) | Number of Channels | Stack / Mode | Data Rates Supported | Classification |
|-------------------|-----------------------|--------------------|--------------|----------------------|----------------|
| 1                 | 2402 – 2480           | 40                 | GFSK         | 1 Mbps               | BLE            |

### 1.4.3 Monitoring of Performance

For radiated emissions, the EUT was evaluated in multiple orientations and performed final on worst case orientation. See test setup photos for more information. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

For RF Conducted measurements, the EUT (standalone module) was connected to the test equipment with a temporary antenna port to SMA connector.

Power setting during test: 10 dBm

### 1.5 Deviations from the Standard

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

### 1.6 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

| Modification State | Description of Modification still fitted to EUT                      | Date Modification Fitted |
|--------------------|----------------------------------------------------------------------|--------------------------|
| 0                  | Initial State                                                        |                          |
| 1                  | Updated test setup pictures with host enclosure, IC ID & HVIN Number | 5/01/2023                |

The equipment was tested as provided without any modifications.



## 1.7 Test Location

TÜV SÜD conducted the following tests at our Alpharetta, GA test laboratory.

| Test Name                                                   | Name of Engineer(s)   | Accreditation |
|-------------------------------------------------------------|-----------------------|---------------|
| Antenna Requirement                                         | Divya Adusumilli      | A2LA          |
| AC Power Line Conducted Emissions                           | Divya Adusumilli      | A2LA          |
| Fundamental Emission Output Power                           | Divya Adusumilli      | A2LA          |
| 6dB / 99% Bandwidth                                         | Divya Adusumilli      | A2LA          |
| Band-Edge Compliance of RF Conducted Emissions              | Divya Adusumilli      | A2LA          |
| RF Conducted Spurious Emissions                             | Divya Adusumilli      | A2LA          |
| Radiated Spurious Emissions into Restricted Frequency Bands | Bhagyashree Chaudhary | A2LA          |
| Power Spectral Density                                      | Divya Adusumilli      | A2LA          |

Office address:  
TÜV SÜD America  
5945 Cabot Parkway, Suite 100  
Alpharetta, GA 30005, USA



## **2 Test Details**

### **2.1 Antenna Requirement**

#### **2.1.1 Specification Reference**

FCC Section: 15.203, 15.204

#### **2.1.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state "1", as noted in §1.6.

#### **2.1.3 Date of Observation**

12/12/2022

#### **2.1.4 Test Method**

N/A

#### **2.1.5 Environmental Conditions**

N/A

#### **2.1.6 Test Results**

The EUT utilizes the PCB trace antenna with 3.3 dBi which is internal to the enclosure and affixed to the PCB, therefore satisfying the requirements of Section 15.203.



## **2.2 Power Line Conducted Emissions**

### **2.2.1 Specification Reference**

FCC Section: 15.207  
ISED Canada: RSS-Gen 8.8

### **2.2.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state “1”, as noted in §1.6.

### **2.2.3 Date of Test**

1/5/2023

### **2.2.4 Test Method**

ANSI C63.10 section 6 was the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**

**Margin = Corrected Reading - Applicable Limit**

### **2.2.5 Environmental Conditions**

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

|                      |            |
|----------------------|------------|
| Ambient Temperature  | 24 °C      |
| Relative Humidity    | 43 %       |
| Atmospheric Pressure | 982.1 mbar |



## 2.2.6 Test Results

TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 1 Results

EUT Name - 72185560 Murata

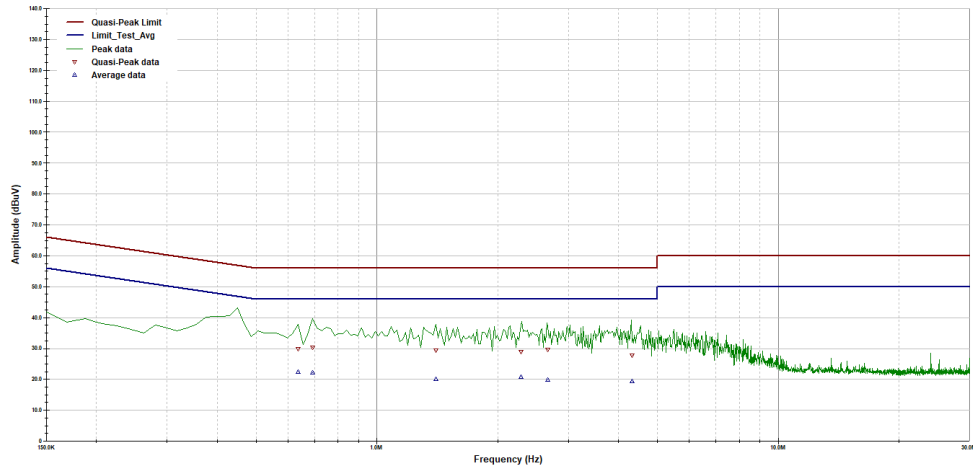
Model Number - MEUS Device

Part Number - N/A

Serial Number - N/A

Voltage - FCC/IC-Class B; 120Vac/60Hz

Operating Mode - Powered ON; BLE LCH Enabled



Operator: Divya

72185560 AC CE-BLE ON - 5V - LISN.ttl

Last Data Update 01:29:00 PM, Thursday, January 05, 2023

Temperature = 22°C

Relative Humidity = 36%

RF Bandwidth: 9kHz

VBW if Analyzer: 30kHz

Figure 2.2.6-1 – Graphical Results – AC Mains L1 Plot – 5V adapter

Table 2.2.6-1 – Conducted Emissions Results on the AC Power Port (L1) – 5V adapter

| Frequency (MHz) | Avg Limit | Avg Level Corr | Avg Level | Corr Fact. | Avg Margin | Result |
|-----------------|-----------|----------------|-----------|------------|------------|--------|
| 0.63            | 46        | 22.5           | 12.8      | 9.658      | -23.5      | PASS   |
| 0.69            | 46        | 22.2           | 12.5      | 9.661      | -23.8      | PASS   |
| 1.4             | 46        | 20             | 10.3      | 9.704      | -26        | PASS   |
| 2.29            | 46        | 20.8           | 11        | 9.781      | -25.2      | PASS   |
| 2.67            | 46        | 19.8           | 10        | 9.79       | -26.2      | PASS   |
| 4.32            | 46        | 19.4           | 9.6       | 9.78       | -26.6      | PASS   |

| Frequency (MHz) | QP Limit | QP Level Corr | QP Level | Corr Fact. | QP Margin | Result |
|-----------------|----------|---------------|----------|------------|-----------|--------|
| 0.63            | 56       | 29.9          | 20.2     | 9.658      | -26.1     | PASS   |
| 0.69            | 56       | 30.3          | 20.6     | 9.661      | -25.7     | PASS   |
| 1.4             | 56       | 29.5          | 19.8     | 9.704      | -26.5     | PASS   |
| 2.29            | 56       | 28.9          | 19.2     | 9.781      | -27.1     | PASS   |
| 2.67            | 56       | 29.6          | 19.8     | 9.79       | -26.4     | PASS   |
| 4.32            | 56       | 27.8          | 18       | 9.78       | -28.2     | PASS   |

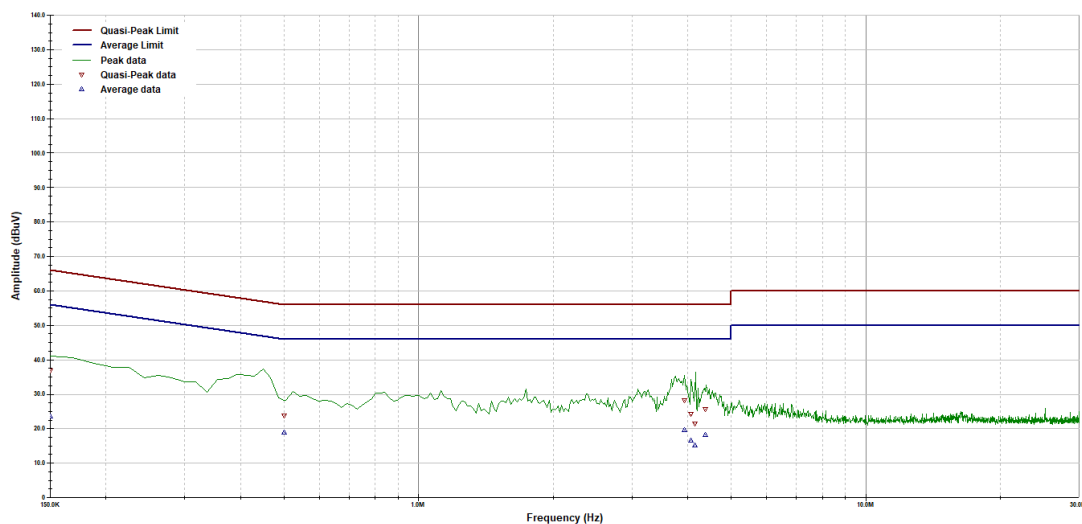


TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 2 Results

EUT Name - 72185560 Murata  
 Model Number - MEUS Device  
 Part Number - N/A  
 Serial Number - N/A  
 Voltage - FCC/IC Class B; 120Vac/60Hz  
 Operating Mode - Powered ON; BLE LCH Enabled



Operator: Divya

72185560 AC CE-BLE ON - 5V - LISN.tif

Last Data Update 01:39:49 PM, Thursday, January 05, 2023

Temperature = 22C  
 Relative Humidity = 36%

RF Bandwidth: 9kHz  
 VBW if Analyzer: 30kHz

Figure 2.2.6-2 – Graphical Results – AC Mains N Plot – 5V adapter

Table 2.2.6-2 – Conducted Emissions Results on the AC Power Port (N) – 5V adapter

| Frequency (MHz) | Avg Limit | Avg Level Corr | Avg Level | Corr Fact. | Avg Margin | Result |
|-----------------|-----------|----------------|-----------|------------|------------|--------|
| 0.15            | 56        | 23.4           | 13.8      | 9.675      | -32.6      | PASS   |
| 0.5             | 46        | 18.9           | 9.3       | 9.63       | -27.1      | PASS   |
| 3.93            | 46        | 19.5           | 9.7       | 9.8        | -26.5      | PASS   |
| 4.06            | 46        | 16.6           | 6.8       | 9.8        | -29.4      | PASS   |
| 4.15            | 46        | 15.1           | 5.3       | 9.8        | -30.9      | PASS   |
| 4.38            | 46        | 18.1           | 8.3       | 9.8        | -27.9      | PASS   |

| Frequency (MHz) | QP Limit | QP Level Corr | QP Level | Corr Fact. | QP Margin | Result |
|-----------------|----------|---------------|----------|------------|-----------|--------|
| 0.15            | 66       | 36.9          | 27.2     | 9.675      | -29.1     | PASS   |
| 0.5             | 56       | 23.9          | 14.3     | 9.63       | -32.1     | PASS   |
| 3.93            | 56       | 28.3          | 18.5     | 9.8        | -27.7     | PASS   |
| 4.06            | 56       | 24.1          | 14.3     | 9.8        | -31.9     | PASS   |
| 4.15            | 56       | 21.5          | 11.7     | 9.8        | -34.5     | PASS   |
| 4.38            | 56       | 25.6          | 15.8     | 9.8        | -30.4     | PASS   |



TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 1 Results

EUT Name - 72185560 Murata

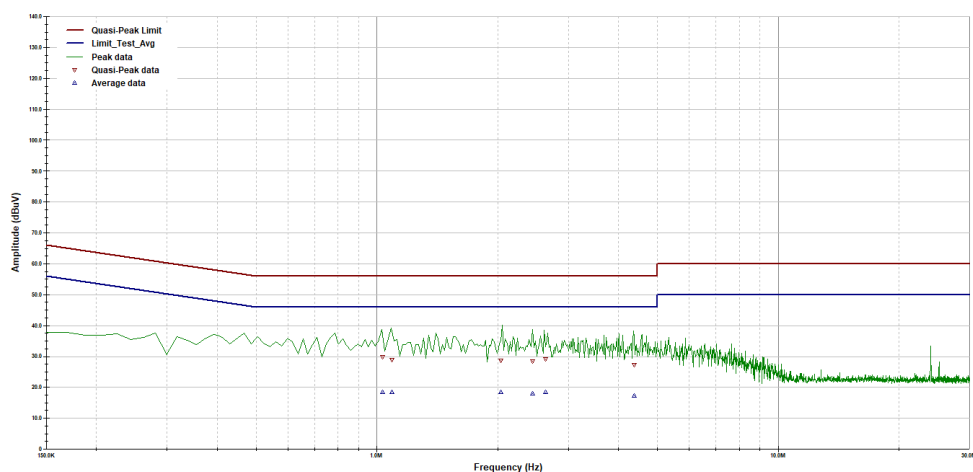
Model Number - MEUS Device

Part Number - N/A

Serial Number - N/A

Voltage - FCC/IC Class B; 120Vac/60Hz

Operating Mode - Powered ON; BLE LCH Enabled



Operator: Divya

72185560 AC CE-BLE ON - 12V - LISN.ii

Last Data Update 02:21:10 PM, Thursday, January 05, 2023

Temperature - 22C  
Relative Humidity - 36%RF Bandwidth: 9kHz  
VBW if Analyzer: 30kHz

Figure 2.2.6-3 – Graphical Results – AC Mains L1 Plot – 12V adapter

Table 2.2.6-3 – Conducted Emissions Results on the AC Power Port (L1) – 12V adapter

| Frequency (MHz) | Avg Limit | Avg Level Corr | Avg Level | Corr Fact. | Avg Margin | Result |
|-----------------|-----------|----------------|-----------|------------|------------|--------|
| 1.03            | 46        | 18.4           | 8.8       | 9.682      | -27.6      | PASS   |
| 1.09            | 46        | 18.4           | 8.8       | 9.685      | -27.6      | PASS   |
| 2.04            | 46        | 18.4           | 8.6       | 9.771      | -27.6      | PASS   |
| 2.44            | 46        | 17.9           | 8.1       | 9.788      | -28.1      | PASS   |
| 2.63            | 46        | 18.3           | 8.5       | 9.79       | -27.7      | PASS   |
| 4.38            | 46        | 17.2           | 7.4       | 9.78       | -28.8      | PASS   |

| Frequency (MHz) | QP Limit | QP Level Corr | QP Level | Corr Fact. | QP Margin | Result |
|-----------------|----------|---------------|----------|------------|-----------|--------|
| 1.03            | 56       | 29.9          | 20.2     | 9.682      | -26.1     | PASS   |
| 1.09            | 56       | 29            | 19.3     | 9.685      | -27       | PASS   |
| 2.04            | 56       | 28.8          | 19       | 9.771      | -27.2     | PASS   |
| 2.44            | 56       | 28.4          | 18.6     | 9.788      | -27.6     | PASS   |
| 2.63            | 56       | 29.1          | 19.3     | 9.79       | -26.9     | PASS   |
| 4.38            | 56       | 27.3          | 17.5     | 9.78       | -28.7     | PASS   |

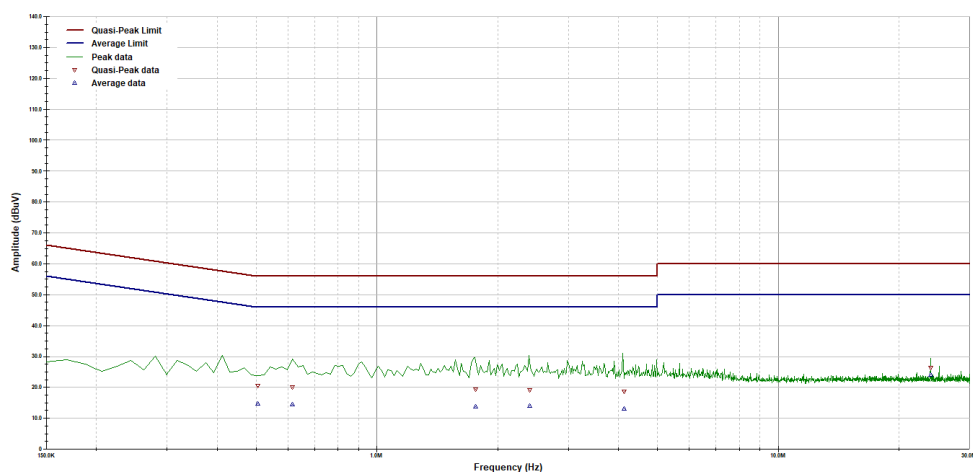


TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 2 Results

EUT Name - 72185560 Murata  
 Model Number - MEUS Device  
 Part Number - N/A  
 Serial Number - N/A  
 Voltage - FCC/IC Class B; 120Vac/60Hz  
 Operating Mode - Powered ON; BLE LCH Enabled



Operator: Divya

72185560 AC CE-BLE ON - 12V - LISN.ii

Last Data Update 02:42:17 PM, Thursday, January 05, 2023

Temperature - 22C  
 Relative Humidity - 36%  
 RF Bandwidth: 9kHz  
 VBW if Analyzer: 30kHz

Figure 2.2.6-4 – Graphical Results – AC Mains N Plot – 12V adapter

Table 2.2.6-4 – Conducted Emissions Results on the AC Power Port (N) – 12V adapter

| Frequency (MHz) | Avg Limit | Avg Level Corr | Avg Level | Corr Fact. | Avg Margin | Result |
|-----------------|-----------|----------------|-----------|------------|------------|--------|
| 0.5             | 46        | 14.6           | 5         | 9.63       | -31.4      | PASS   |
| 0.62            | 46        | 14.5           | 4.8       | 9.637      | -31.5      | PASS   |
| 1.76            | 46        | 13.7           | 4         | 9.741      | -32.3      | PASS   |
| 2.4             | 46        | 13.9           | 4.1       | 9.768      | -32.1      | PASS   |
| 4.13            | 46        | 13.2           | 3.4       | 9.8        | -32.8      | PASS   |
| 24              | 50        | 24.1           | 14        | 10.09      | -25.9      | PASS   |

| Frequency (MHz) | QP Limit | QP Level Corr | QP Level | Corr Fact. | QP Margin | Result |
|-----------------|----------|---------------|----------|------------|-----------|--------|
| 0.5             | 56       | 20.4          | 10.8     | 9.63       | -35.6     | PASS   |
| 0.62            | 56       | 20            | 10.3     | 9.637      | -36       | PASS   |
| 1.76            | 56       | 19.4          | 9.6      | 9.741      | -36.6     | PASS   |
| 2.4             | 56       | 19.2          | 9.4      | 9.768      | -36.8     | PASS   |
| 4.13            | 56       | 18.8          | 9        | 9.8        | -37.2     | PASS   |
| 24              | 60       | 26.4          | 16.3     | 10.09      | -33.6     | PASS   |





## **2.3 Fundamental Emission Output Power**

### **2.3.1 Specification Reference**

FCC Sections: 15.247(b)(3)  
ISED Canada: RSS-247 5.4(d)

### **2.3.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state "0", as noted in §1.6.

### **2.3.3 Date of Test**

12/12/2022

### **2.3.4 Test Method**

The maximum peak conducted output power may be measured using a broadband peak RF power meter with ANSI C63.10 Subclause 11.9.1.3. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

### **2.3.5 Environmental Conditions**

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

|                      |            |
|----------------------|------------|
| Ambient Temperature  | 24 °C      |
| Relative Humidity    | 43 %       |
| Atmospheric Pressure | 982.1 mbar |

### **2.3.6 Test Results**

**Test Summary: EUT was set to transmit mode.**

**Test Results: Pass**

See data below for detailed results.

**Table 2.3.6-1: RF Output Power**

| <b>Frequency<br/>[MHz]</b> | <b>Peak Output Power<br/>(dBm)</b> | <b>E.I.R.P<br/>(dBm)</b> | <b>Data Rate</b> |
|----------------------------|------------------------------------|--------------------------|------------------|
| 2402                       | 7.17                               | 10.47                    | 1 Mbps           |
| 2440                       | 7.42                               | 10.72                    | 1 Mbps           |
| 2480                       | 7.71                               | 11.01                    | 1 Mbps           |



## **2.4 6dB / 99% Bandwidth**

### **2.4.1 Specification Reference**

FCC Sections: 15.247(a)(2)  
ISED Canada: RSS-247 5.2(a), RSS-GEN 6.7

### **2.4.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state "0", as noted in §1.6.

### **2.4.3 Date of Test**

12/12/2022

### **2.4.4 Test Method**

The 6dB bandwidth was measured in accordance with the ANSI C63.10 Section 11.8. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to  $\geq 3$  times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth. A peak detector was used.

### **2.4.5 Environmental Conditions**

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

|                      |            |
|----------------------|------------|
| Ambient Temperature  | 24 °C      |
| Relative Humidity    | 43 %       |
| Atmospheric Pressure | 982.1 mbar |

### **2.4.6 Test Results**

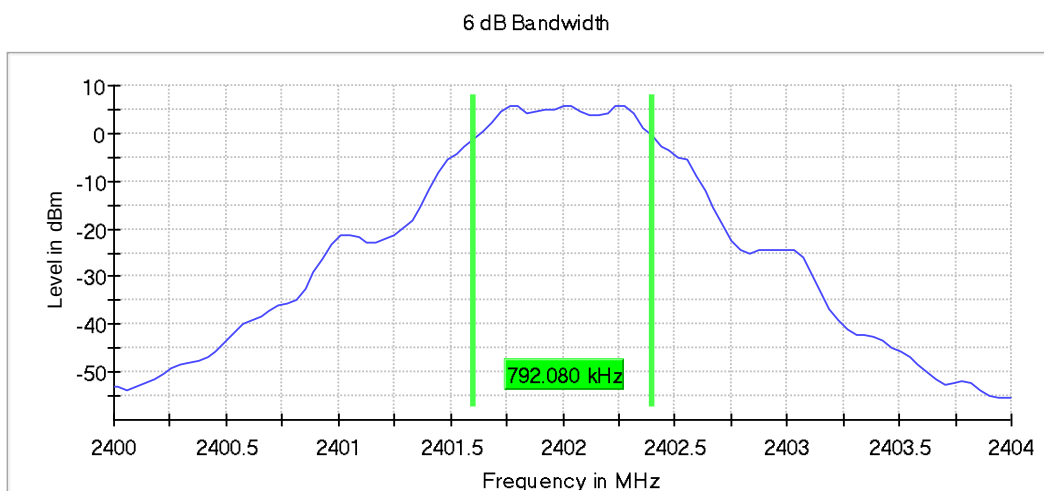
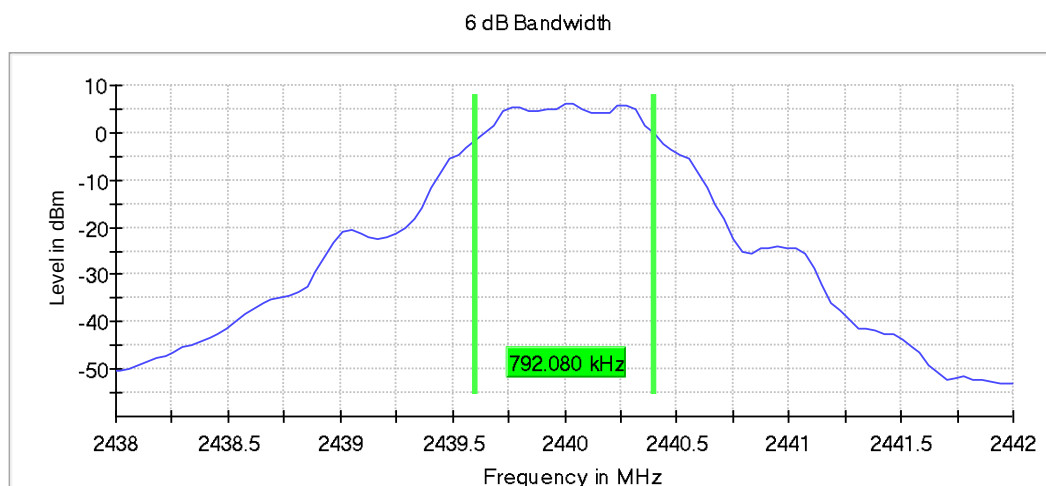
**Test Summary:** EUT was set to transmit mode.

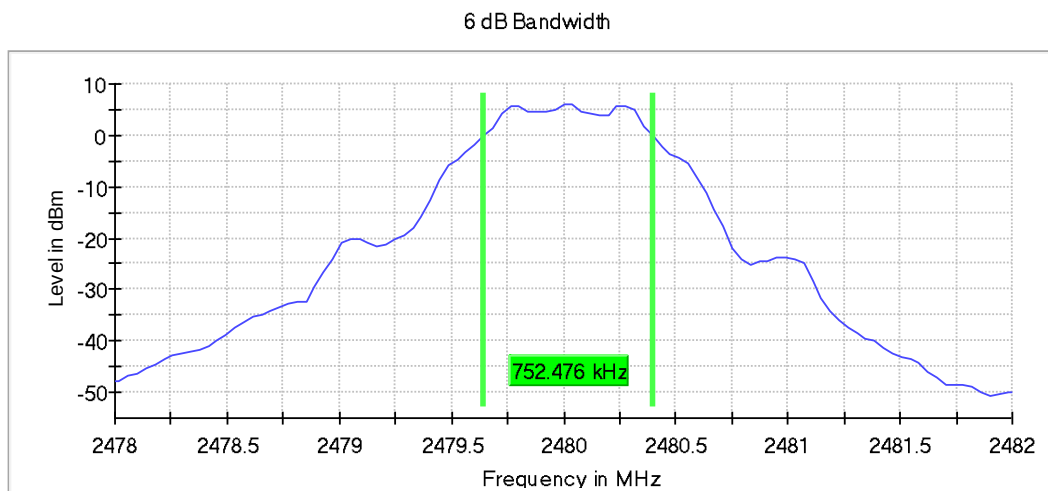
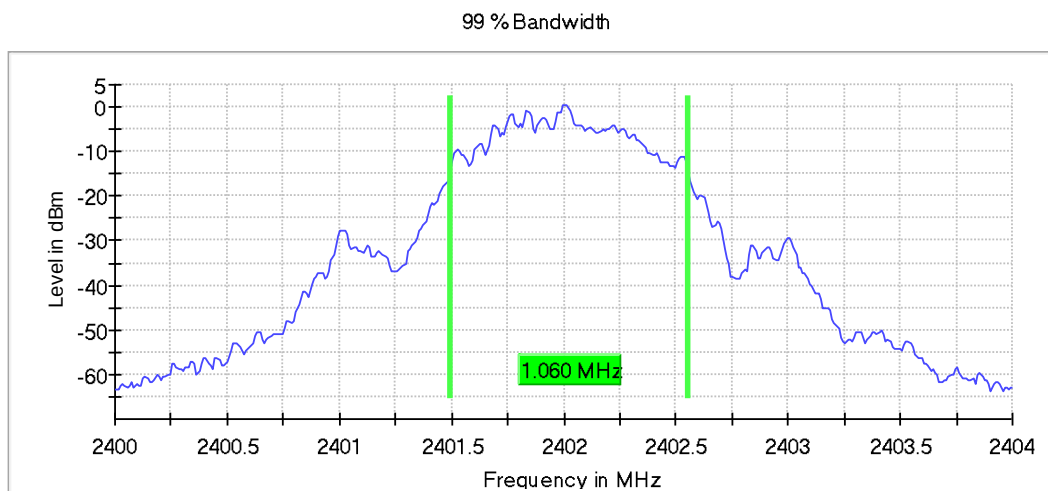
**Test Results:** Pass

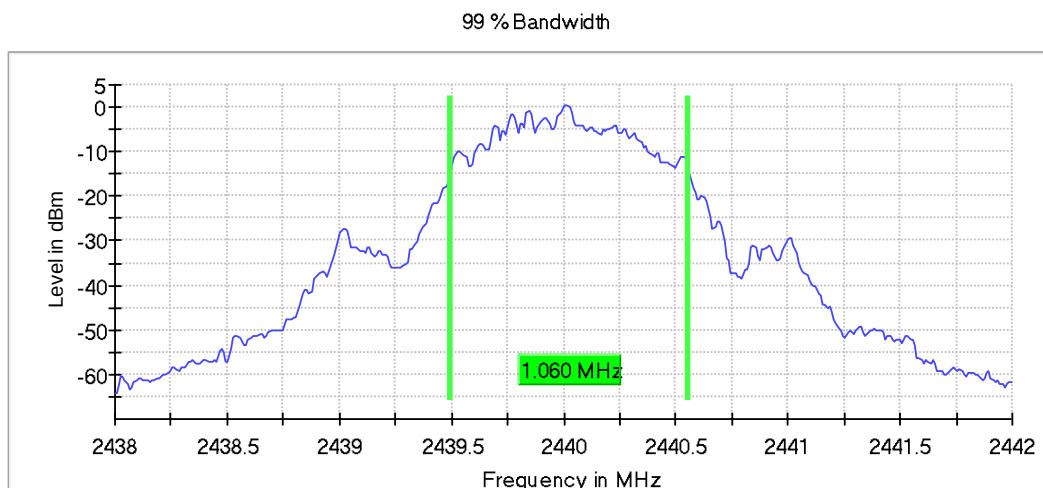
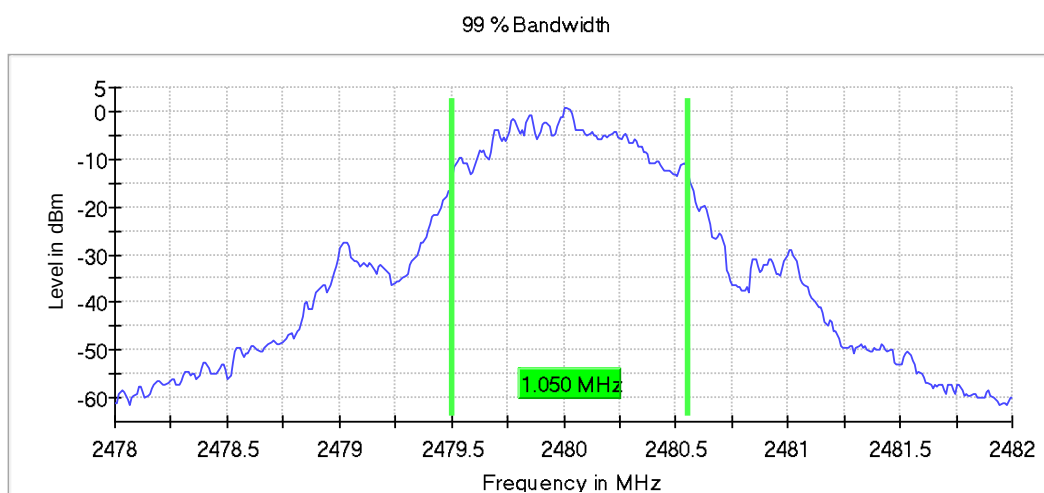
See data below for detailed results.

**Table 2.4.6-1: 6dB / 99% Bandwidth**

| Frequency [MHz] | 6dB Bandwidth (kHz) | 99% Bandwidth (MHz) | Data Rate |
|-----------------|---------------------|---------------------|-----------|
| 2402            | 792.080             | 1.060               | 1 Mbps    |
| 2440            | 792.080             | 1.060               | 1 Mbps    |
| 2480            | 752.476             | 1.050               | 1 Mbps    |

**Figure 2.4.6-1: 6 dB BW - LCH****Figure 2.4.6-2: 6 dB BW - MCH**

**Figure 2.4.6-3: 6 dB BW - HCH****Figure 2.4.6-4: 99% BW - LCH**

**Figure 2.4.6-5: 99% BW - MCH****Figure 2.4.6-6: 99% BW - HCH**

**Table 2.4.6-2: Sample Measurement Setting (6dB BW)**

| Setting               | Instrument Value | Target Value  |
|-----------------------|------------------|---------------|
| Start Frequency       | 2.40000 GHz      | 2.40000 GHz   |
| Stop Frequency        | 2.40400 GHz      | 2.40400 GHz   |
| Span                  | 4.000 MHz        | 4.000 MHz     |
| RBW                   | 100.000 kHz      | ~ 100.000 kHz |
| VBW                   | 300.000 kHz      | ~ 300.000 kHz |
| Sweep Points          | 101              | ~ 80          |
| Sweep time            | 18.938 $\mu$ s   | AUTO          |
| Reference Level       | 0.000 dBm        | 0.000 dBm     |
| Attenuation           | 15.000 dB        | AUTO          |
| Detector              | Max Peak         | Max Peak      |
| Sweep Count           | 100              | 100           |
| Filter                | 3 dB             | 3 dB          |
| Trace Mode            | Max Hold         | Max Hold      |
| Sweep type            | FFT              | AUTO          |
| Preamp                | off              | off           |
| Stable mode           | Trace            | Trace         |
| Stable value          | 0.50 dB          | 0.50 dB       |
| Run                   | 7 / max. 150     | max. 150      |
| Stable                | 5 / 5            | 5             |
| Max Stable Difference | 0.35 dB          | 0.50 dB       |

**Table 2.4.6-3: Sample Measurement Setting (99% BW)**

| Setting               | Instrument Value | Target Value  |
|-----------------------|------------------|---------------|
| Start Frequency       | 2.40000 GHz      | 2.40000 GHz   |
| Stop Frequency        | 2.40400 GHz      | 2.40400 GHz   |
| Span                  | 4.000 MHz        | 4.000 MHz     |
| RBW                   | 20.000 kHz       | >= 20.000 kHz |
| VBW                   | 100.000 kHz      | >= 60.000 kHz |
| Sweep Points          | 400              | ~ 400         |
| Sweep time            | 94.824 µs        | AUTO          |
| Reference Level       | 0.000 dBm        | 0.000 dBm     |
| Attenuation           | 20.000 dB        | AUTO          |
| Detector              | Max Peak         | Max Peak      |
| Sweep Count           | 100              | 100           |
| Filter                | 3 dB             | 3 dB          |
| Trace Mode            | Max Hold         | Max Hold      |
| Sweep type            | FFT              | AUTO          |
| Preamp                | off              | off           |
| Stable mode           | Trace            | Trace         |
| Stable value          | 0.30 dB          | 0.30 dB       |
| Run                   | 6 / max. 150     | max. 150      |
| Stable                | 3 / 3            | 3             |
| Max Stable Difference | 0.09 dB          | 0.30 dB       |





## **2.5 Maximum Power Spectral Density in the Fundamental Emission**

### **2.5.1 Specification Reference**

FCC Sections: 15.247(e)  
ISED Canada: RSS-247 5.2(b)

### **2.5.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state "0", as noted in §1.6.

### **2.5.3 Date of Test**

12/12/2022

### **2.5.4 Test Method**

The power spectral density was measured in accordance with the ANSI C63.10 Section 11.10.2. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 10 kHz. The Video Bandwidth (VBW) was set to 30 kHz. Span was set to 1.5 times the channel bandwidth. The trace was set to max hold with the peak detector active.

### **2.5.5 Environmental Conditions**

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

|                      |            |
|----------------------|------------|
| Ambient Temperature  | 24 °C      |
| Relative Humidity    | 43 %       |
| Atmospheric Pressure | 982.1 mbar |

### **2.5.6 Test Results**

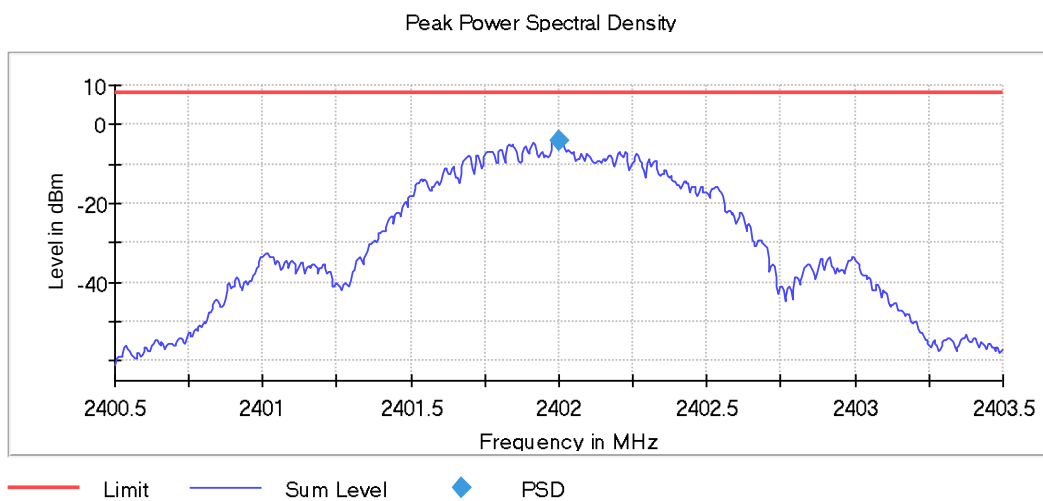
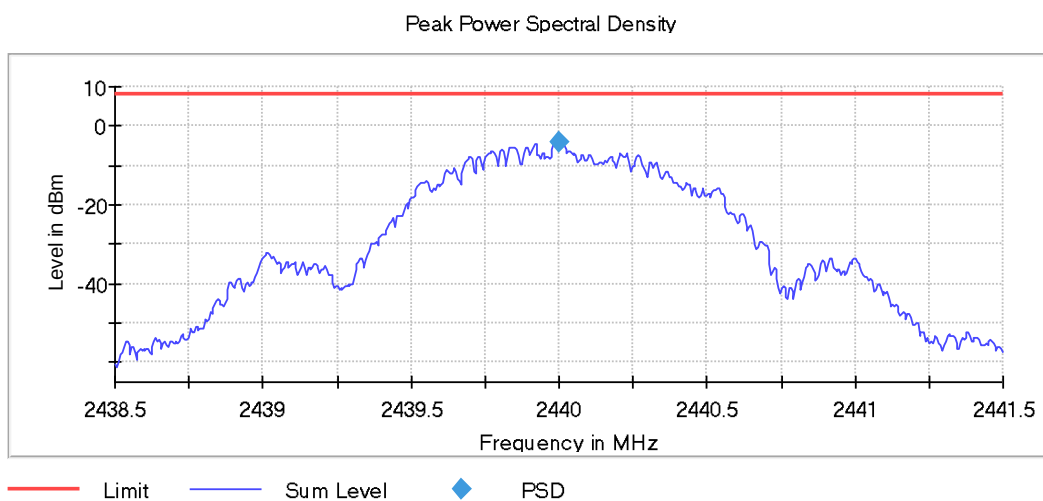
**Test Summary: EUT was set to transmit mode.**

**Test Results: Pass**

See data below for detailed results.

**Table 2.5.6-1: RF Power Spectral Density**

| Frequency [MHz] | PSD (dBm) | Data Rate |
|-----------------|-----------|-----------|
| 2402            | -4.290    | 1 Mbps    |
| 2440            | -4.102    | 1 Mbps    |
| 2480            | -4.028    | 1 Mbps    |

**Figure 2.5.6-1: PSD – LCH****Figure 2.5.6-2: PSD – MCH**

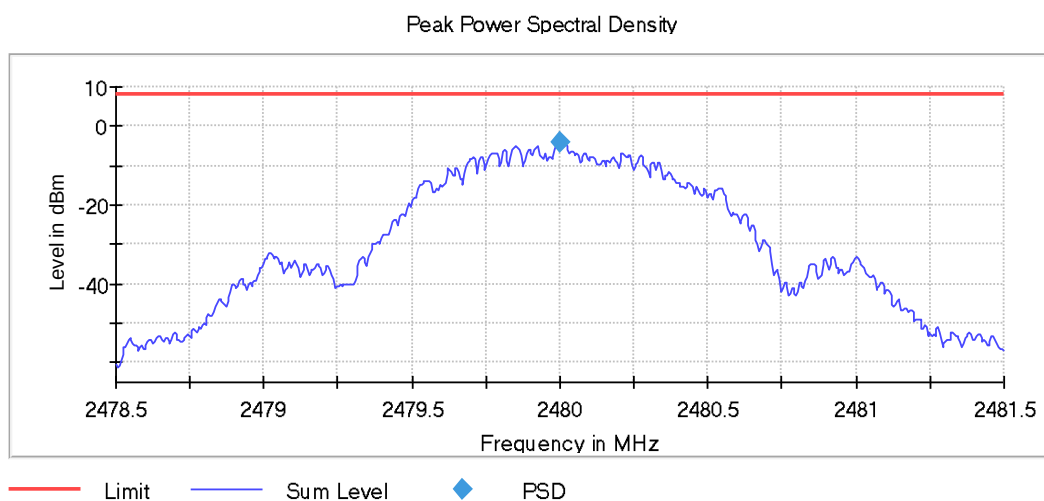


Figure 2.5.6-3: PSD – HCH

Table 2.5.6-2: Sample Measurement Settings (PSD)

| Setting               | Instrument Value | Target Value      |
|-----------------------|------------------|-------------------|
| Start Frequency       | 2.40050 GHz      | 2.40050 GHz       |
| Stop Frequency        | 2.40350 GHz      | 2.40350 GHz       |
| Span                  | 3.000 MHz        | 3.000 MHz         |
| RBW                   | 10.000 kHz       | $\leq 10.000$ kHz |
| VBW                   | 30.000 kHz       | $\geq 30.000$ kHz |
| Sweep Points          | 600              | ~ 600             |
| Sweep time            | 3.000 ms         | AUTO              |
| Reference Level       | 0.000 dBm        | 0.000 dBm         |
| Attenuation           | 20.000 dB        | AUTO              |
| Detector              | Max Peak         | Max Peak          |
| Sweep Count           | 100              | 100               |
| Filter                | 3 dB             | 3 dB              |
| Trace Mode            | Max Hold         | Max Hold          |
| Sweep type            | Sweep            | Sweep             |
| Preamp                | Off              | off               |
| Stable mode           | Trace            | Trace             |
| Stable value          | 0.50 dB          | 0.50 dB           |
| Run                   | 5 / max. 150     | max. 150          |
| Stable                | 2 / 2            | 2                 |
| Max Stable Difference | 0.24 dB          | 0.50 dB           |



## **2.6 Band-Edge Compliance of RF Conducted Emissions**

### **2.6.1 Specification Reference**

FCC Sections: 15.247(d)  
ISED Canada: RSS-247 5.5

### **2.6.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state "0", as noted in §1.6.

### **2.6.3 Date of Test**

12/12/2022

### **2.6.4 Test Method**

The unwanted emissions into non-restricted bands were measured conducted in accordance with ANSI C63.10 Section 11.11. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to  $\geq 300$  kHz. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit at the band edges.

### **2.6.5 Environmental Conditions**

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

|                      |            |
|----------------------|------------|
| Ambient Temperature  | 24 °C      |
| Relative Humidity    | 43 %       |
| Atmospheric Pressure | 982.1 mbar |

### **2.6.6 Test Results**

**Test Summary:** EUT was set to transmit mode.

**Test Results:** Pass

See data below for detailed results.

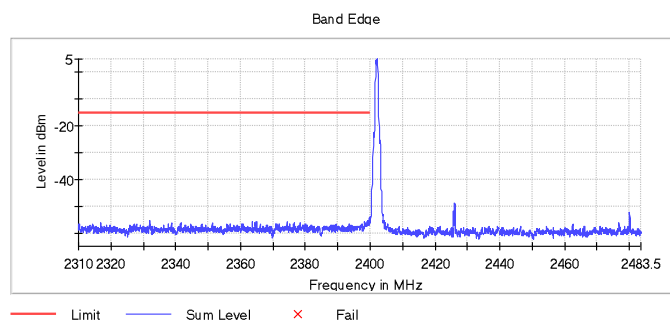


Figure 2.6.6-1: Lower Band-edge

Table 2.6.6-1: Lower Band-edge- Low Channel

| Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|-----------------|-------------|-------------|-------------|--------|
| 2399.825000     | -53.9       | 38.8        | -15.1       | PASS   |
| 2399.975000     | -53.9       | 38.8        | -15.1       | PASS   |
| 2399.875000     | -54.0       | 38.9        | -15.1       | PASS   |
| 2399.925000     | -54.4       | 39.3        | -15.1       | PASS   |
| 2399.775000     | -54.6       | 39.5        | -15.1       | PASS   |
| 2399.725000     | -55.1       | 40.1        | -15.1       | PASS   |
| 2399.275000     | -55.3       | 40.2        | -15.1       | PASS   |
| 2399.325000     | -55.3       | 40.2        | -15.1       | PASS   |
| 2331.875000     | -55.4       | 40.3        | -15.1       | PASS   |
| 2331.925000     | -55.6       | 40.5        | -15.1       | PASS   |
| 2364.875000     | -55.6       | 40.6        | -15.1       | PASS   |
| 2399.075000     | -55.7       | 40.7        | -15.1       | PASS   |
| 2374.325000     | -55.8       | 40.7        | -15.1       | PASS   |
| 2399.125000     | -55.8       | 40.7        | -15.1       | PASS   |
| 2398.275000     | -55.8       | 40.8        | -15.1       | PASS   |

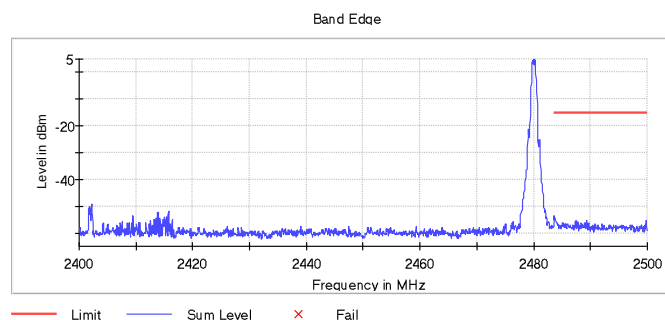


Figure 2.6.6-2: Upper Band-edge

Table 2.6.6-2: Upper Band-edge – High Channel

| Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|-----------------|-------------|-------------|-------------|--------|
| 2483.625000     | -53.7       | 38.6        | -15.1       | PASS   |
| 2483.575000     | -54.0       | 38.9        | -15.1       | PASS   |
| 2483.525000     | -54.1       | 39.0        | -15.1       | PASS   |
| 2483.725000     | -54.7       | 39.6        | -15.1       | PASS   |
| 2483.675000     | -54.9       | 39.8        | -15.1       | PASS   |
| 2483.775000     | -55.0       | 39.9        | -15.1       | PASS   |
| 2483.825000     | -55.0       | 39.9        | -15.1       | PASS   |
| 2483.875000     | -55.2       | 40.1        | -15.1       | PASS   |
| 2487.375000     | -55.3       | 40.2        | -15.1       | PASS   |
| 2499.775000     | -55.4       | 40.4        | -15.1       | PASS   |
| 2489.375000     | -55.5       | 40.4        | -15.1       | PASS   |
| 2499.825000     | -55.6       | 40.5        | -15.1       | PASS   |
| 2489.325000     | -55.6       | 40.6        | -15.1       | PASS   |
| 2483.975000     | -55.7       | 40.6        | -15.1       | PASS   |
| 2483.925000     | -55.7       | 40.6        | -15.1       | PASS   |



## **2.7 RF Conducted Spurious Emissions**

### **2.7.1 Specification Reference**

FCC Sections: 15.247(d)  
ISED Canada: RSS-247 5.5

### **2.7.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state "0", as noted in §1.6.

### **2.7.3 Date of Test**

12/12/2022

### **2.7.4 Test Method**

The unwanted emissions into non-restricted bands were measured conducted in accordance with ANSI C63.10 Section 11.11. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to  $\geq 300$  kHz. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit at the band edges. The spectrum span was then adjusted for the measurement of spurious emissions from 30MHz to 26GHz, 10 times the highest fundamental frequency.

### **2.7.5 Environmental Conditions**

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

|                      |            |
|----------------------|------------|
| Ambient Temperature  | 24 °C      |
| Relative Humidity    | 43 %       |
| Atmospheric Pressure | 982.1 mbar |

### **2.7.6 Test Results**

**Test Summary: EUT was set to transmit mode.**

**Test Results: Pass**

See data below for detailed results.

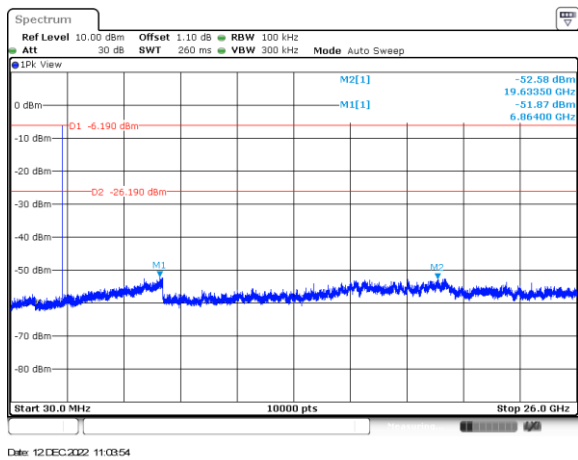


Figure 2.7.6-1: 30MHz – 26GHz – LCH

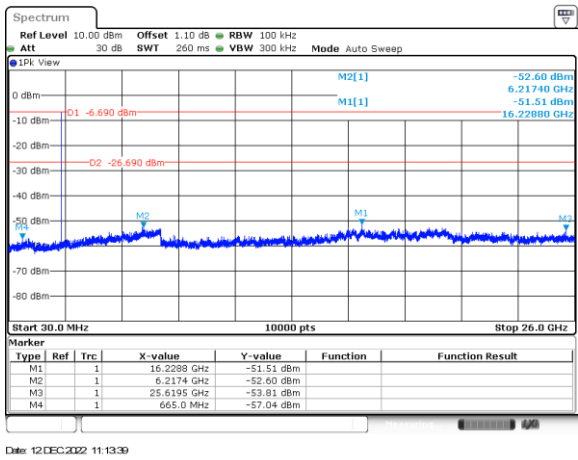


Figure 2.7.6-2: 30MHz – 26GHz – MCH

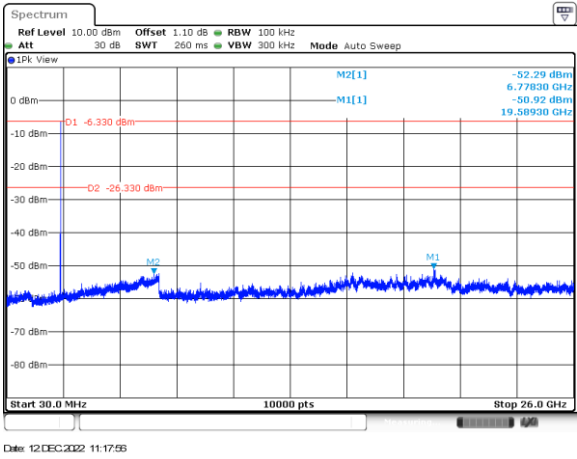


Figure 2.7.6-3: 30MHz – 26GHz – HCH



## **2.8 Radiated Spurious Emissions into Restricted Frequency Bands**

### **2.8.1 Specification Reference**

FCC Sections: 15.205, 15.209.  
ISED Canada RSS – Gen 8.9/8.10

### **2.8.2 Equipment Under Test and Modification State**

As shown in §1.4 with modification state “1”, as noted in §1.6.

### **2.8.3 Date of Test**

12/13/2022 to 12/16/2022

### **2.8.4 Test Method**

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency of 2.4 GHz. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 150 kHz, quasi-peak measurements were made using a resolution bandwidth RBW of 300 Hz and a video bandwidth VBW of 1 kHz and frequencies between 150 kHz and 30MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 10 kHz and a video bandwidth VBW of 30 kHz. For frequencies between 30 MHz and 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 100 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW of 1 MHz and VBW of 3 MHz

### **2.8.5 Environmental Conditions**

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

|                      |            |
|----------------------|------------|
| Ambient Temperature  | 24 °C      |
| Relative Humidity    | 43 %       |
| Atmospheric Pressure | 982.1 mbar |

### **2.8.6 Test Results**

**Test Summary: EUT was set to transmit mode.**

**Test Results: Pass**

See data below for detailed results.





Table 2.8.6-1: Radiated Spurious Emissions Tabulated Data

| Frequency             | Peak Value | QP/Avg Value | Peak Limit | QP/Avg Limit | Peak Margin | QP/Avg Margin | Polarity | Peak Limit Results | QP/Avg Limit Results |
|-----------------------|------------|--------------|------------|--------------|-------------|---------------|----------|--------------------|----------------------|
| MHz                   | dBμV/m     | dBμV/m       | dBμV/m     | Limit_Avg    | dB          | dB            | H/V      | Pass/Fail          | Pass/Fail            |
| <b>LCH - 2402 MHz</b> |            |              |            |              |             |               |          |                    |                      |
| 409.73                | ----       | 28.941       | ----       | 46           | ----        | -17.06        | H        | ----               | Pass                 |
| 4803.525              | 57.345     | 46.57        | 74         | 54           | -16.65      | -7.43         | H        | Pass               | Pass                 |
| 4803.525              | 51.889     | 39.668       | 74         | 54           | -22.11      | -14.33        | V        | Pass               | Pass                 |
| 12010.175             | 48.223     | 34.28        | 74         | 54           | -25.78      | -19.72        | H        | Pass               | Pass                 |
| 12009.75              | 48.3       | 34.249       | 74         | 54           | -25.7       | -19.75        | V        | Pass               | Pass                 |
| 19215.825             | 52.512     | 37.966       | 74         | 54           | -21.49      | -16.03        | H        | Pass               | Pass                 |
| 19216.025             | 51.978     | 37.956       | 74         | 54           | -22.02      | -16.04        | V        | Pass               | Pass                 |
| <b>MCH – 2440 MHz</b> |            |              |            |              |             |               |          |                    |                      |
| 4880.525              | 58.615     | 47.174       | 74         | 54           | -15.38      | -6.83         | H        | Pass               | Pass                 |
| 7320.8                | 52.347     | 38.604       | 74         | 54           | -21.65      | -15.4         | H        | Pass               | Pass                 |
| 4879.525              | 50.52      | 37.048       | 74         | 54           | -23.48      | -16.95        | V        | Pass               | Pass                 |
| 12199.9               | 48.743     | 34.157       | 74         | 54           | -25.26      | -19.84        | H        | Pass               | Pass                 |
| 12199.775             | 48.368     | 34.281       | 74         | 54           | -25.63      | -19.72        | V        | Pass               | Pass                 |
| 19519.85              | 52.992     | 38.597       | 74         | 54           | -21.01      | -15.4         | H        | Pass               | Pass                 |
| 19519.825             | 52.57      | 38.6         | 74         | 54           | -21.43      | -15.4         | V        | Pass               | Pass                 |
| <b>HCH – 2480 MHz</b> |            |              |            |              |             |               |          |                    |                      |
| 408.396               | ----       | 26.087       | ----       | 46           | ----        | -19.91        | V        | ----               | Pass                 |
| 4960.525              | 59.659     | 48.486       | 74         | 54           | -14.34      | -5.51         | H        | Pass               | Pass                 |
| 7439.3                | 51.363     | 38.211       | 74         | 54           | -22.64      | -15.79        | H        | Pass               | Pass                 |
| 4959.55               | 53.301     | 40.954       | 74         | 54           | -20.7       | -13.05        | V        | Pass               | Pass                 |
| 12399.975             | 48.665     | 34.436       | 74         | 54           | -25.33      | -19.56        | H        | Pass               | Pass                 |
| 12400.25              | 47.984     | 34.566       | 74         | 54           | -26.02      | -19.43        | V        | Pass               | Pass                 |
| 19839.825             | 53.525     | 39.814       | 74         | 54           | -20.48      | -14.19        | H        | Pass               | Pass                 |
| 22319.975             | 57.28      | 43.038       | 74         | 54           | -16.72      | -10.96        | H        | Pass               | Pass                 |
| 19839.85              | 53.598     | 39.821       | 74         | 54           | -20.4       | -14.18        | V        | Pass               | Pass                 |
| 22319.75              | 57.561     | 43.071       | 74         | 54           | -16.44      | -10.93        | V        | Pass               | Pass                 |



Table 2.8.6-2: Radiated Band-Edge Tabulated Data

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| LCH                |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2390               | 48.80           | 34.10   | H                            | -2.04                         | 46.76                       | 32.06   | 74.0              | 54.0    | 27.2           | 21.9    |
| 2390               | 48.10           | 33.60   | V                            | -2.04                         | 46.06                       | 31.56   | 74.0              | 54.0    | 27.9           | 22.4    |
| HCH                |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2483.5             | 61.90           | 40.40   | H                            | -1.78                         | 60.12                       | 38.62   | 74.0              | 54.0    | 13.9           | 15.4    |
| 2483.5             | 56.50           | 36.40   | V                            | -1.78                         | 54.72                       | 34.62   | 74.0              | 54.0    | 19.3           | 19.4    |

**Sample Calculation:**

$$R_c = R_u + CF_T$$

Where:

- $CF_T$  = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)  
 $R_u$  = Uncorrected Reading  
 $R_c$  = Corrected Level  
 AF = Antenna Factor  
 CA = Cable Attenuation  
 AG = Amplifier Gain  
 DC = Duty Cycle Correction Factor

**Example Calculation: Peak**

Corrected Level:  $61.90 + -1.78 = 60.12\text{dB}\mu\text{V/m}$   
 Margin:  $74\text{dB}\mu\text{V/m} - 60.12\text{dB}\mu\text{V/m} = 13.9\text{dB}$

**Example Calculation: Average**

Corrected Level:  $40.40 + -1.78 - 0 = 38.62\text{dB}\mu\text{V}$   
 Margin:  $54\text{dB}\mu\text{V} - 38.62\text{dB}\mu\text{V} = 15.4\text{dB}$

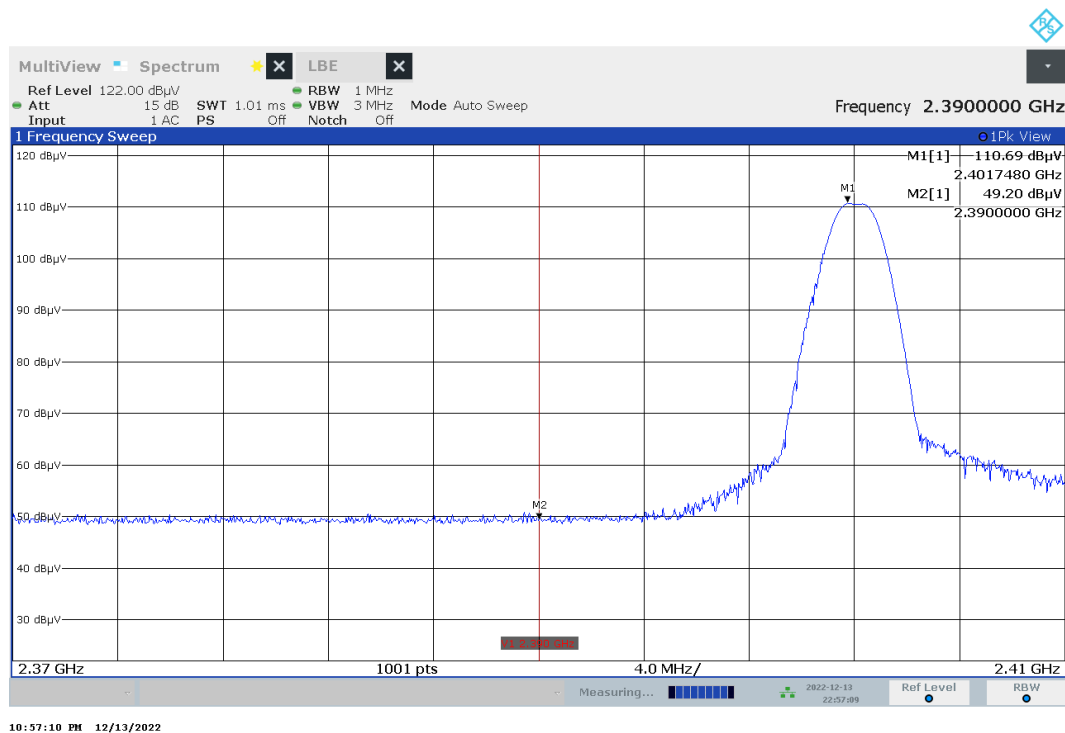


Figure 2.8.6-1: Reference plot Radiated Lower Band-edge – LCH

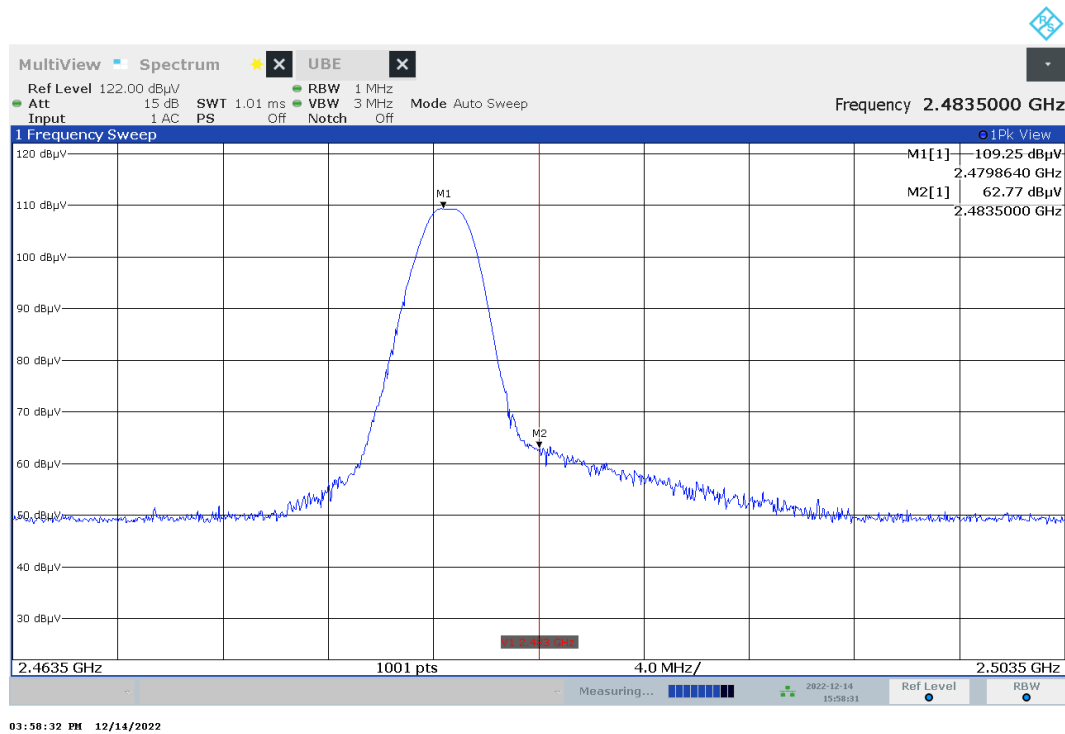


Figure 2.8.6-2: Reference plot Radiated Upper Band-edge – HCH

TUV EMC Lab

Radiated Emissions, Under 1GHz

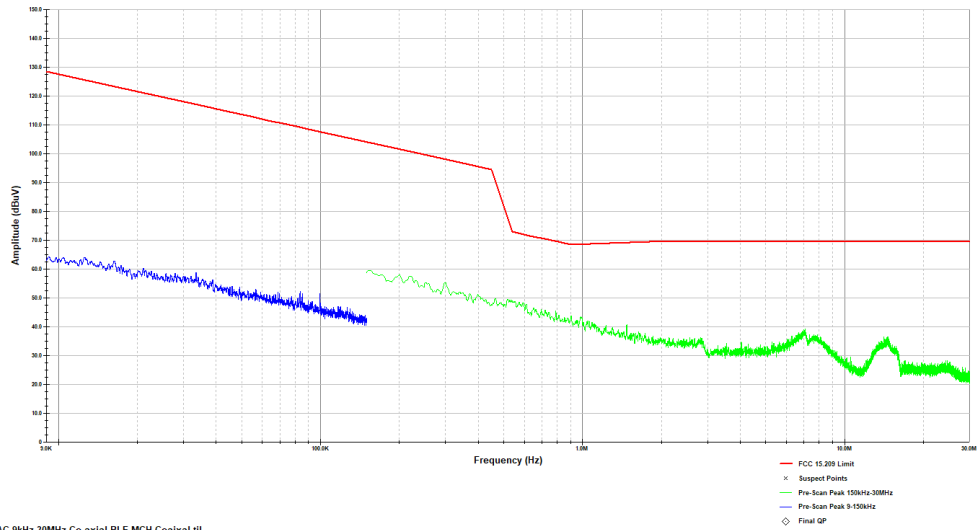
HV Graph

Company - 72185560 Murata

Model - MEUS Device

Config - BLE MCH

Operator - Shree



**Figure 2.8.6-3: Reference plot for Radiated Spurious Emissions – 9 kHz – 30 MHz - MCH**

Note: Emissions above the noise floor are ambient not associated with the EUT.

TUV EMC Lab

Radiated Emissions, Under 1GHz

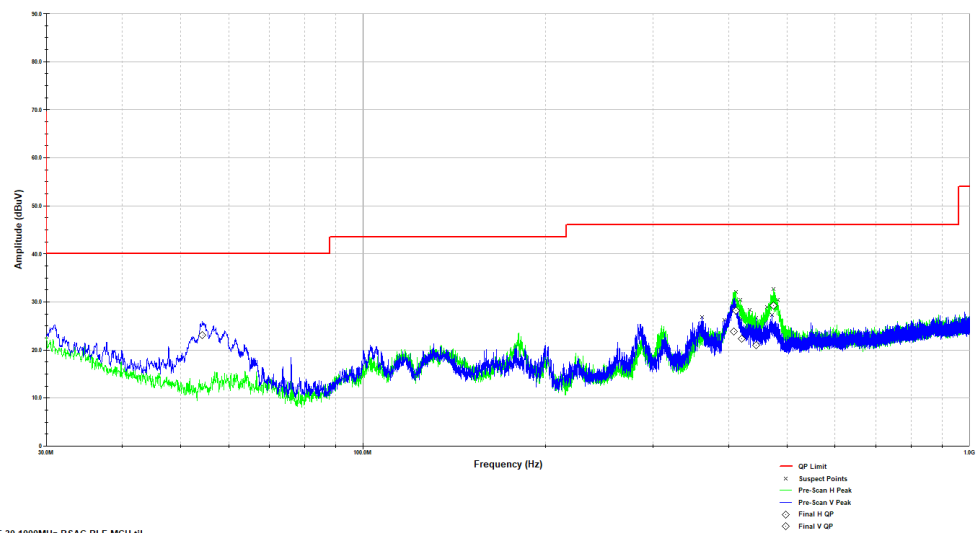
HV Graph

Company - 72185560 Murata

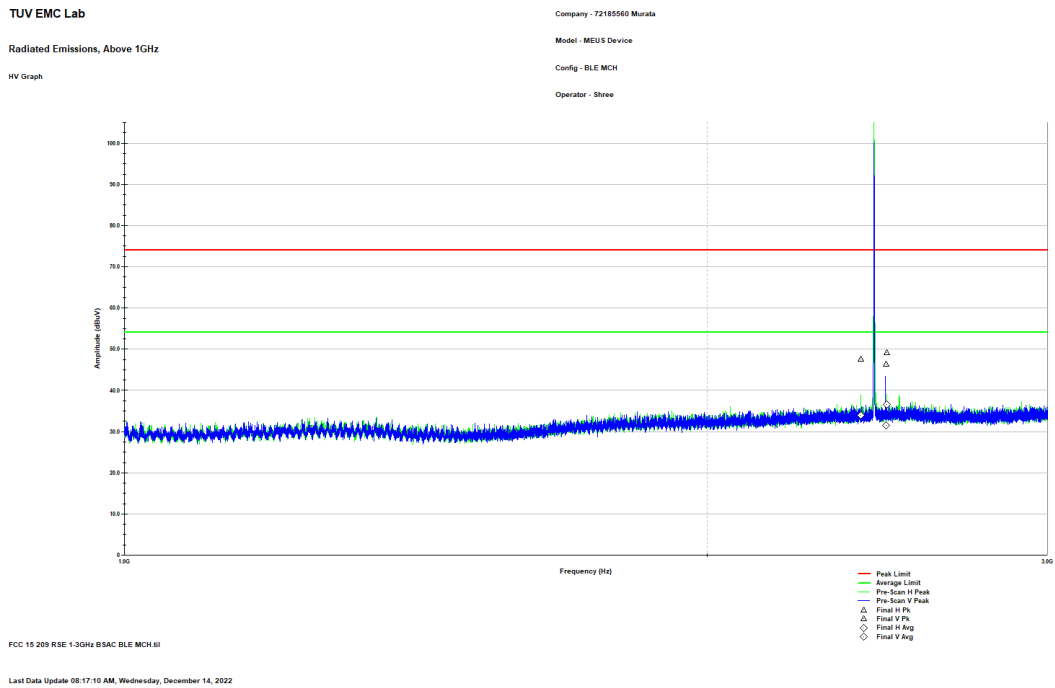
Model - MEUS Device

Config - BLE MCH

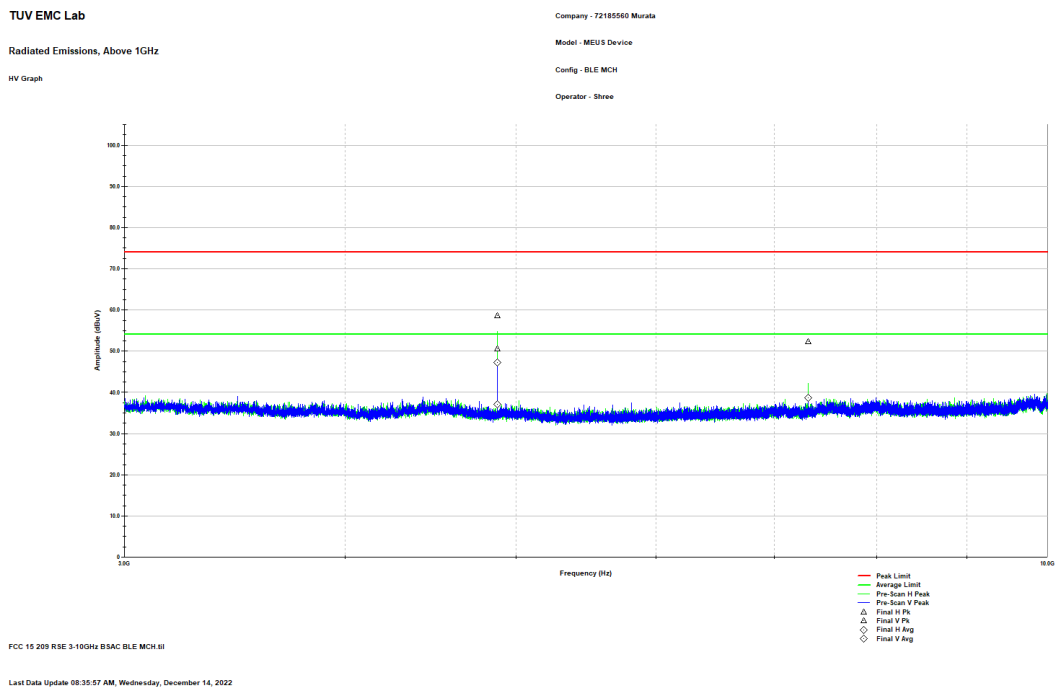
Operator - Shree



**Figure 2.8.6-4: Reference plot for Radiated Spurious Emissions – 30 MHz – 1 GHz – MCH**



**Figure 2.8.6-5: Reference plot for Radiated Spurious Emissions – 1 GHz – 3 GHz – MCH**  
 Note:Emission above limit line is fundamental frequency.



**Figure 2.8.6-6: Reference plot for Radiated Spurious Emissions – 3 GHz – 10 GHz – MCH**

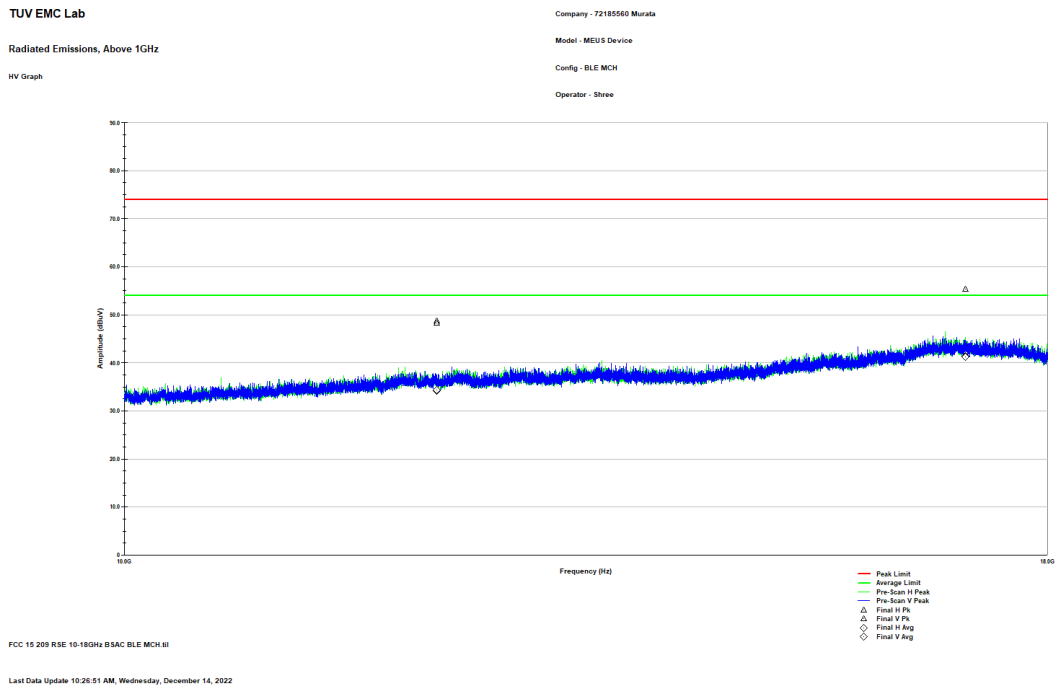


Figure 2.8.6-7: Reference plot for Radiated Spurious Emissions – 10 GHz – 18 GHz – MCH

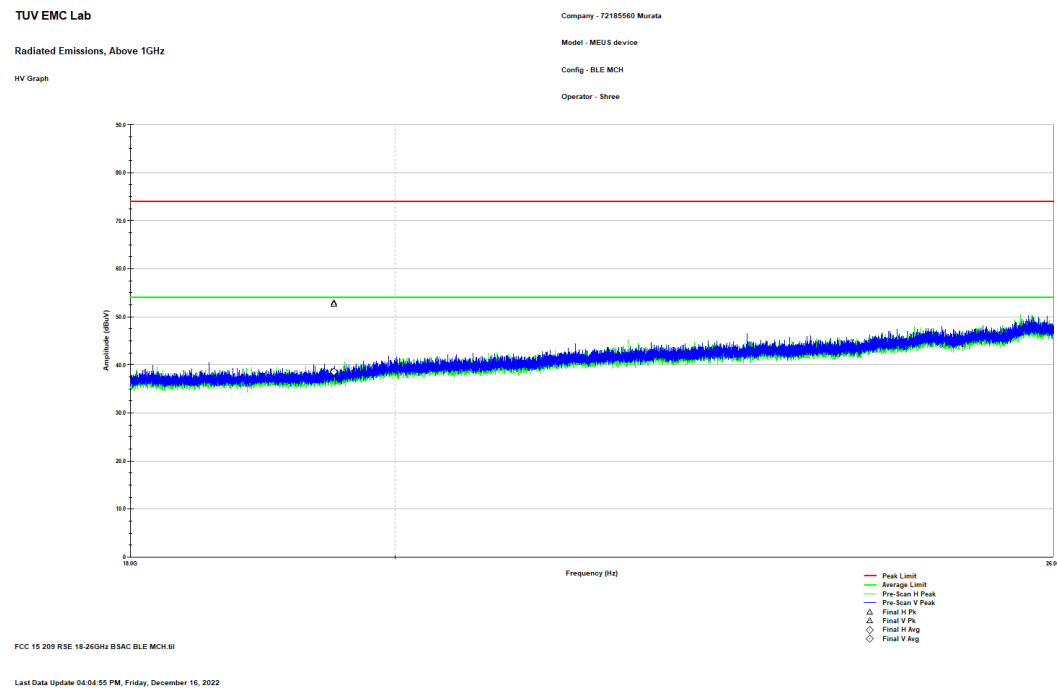


Figure 2.8.6-8: Reference plot for Radiated Spurious Emissions – 18 GHz – 26 GHz – H Polarity



## 2.9 Test Equipment Used

**Table 2.9-1 –Equipment List**

| Asset ID | Manufacturer             | Model         | Equipment Type                    | Serial Number | Last Calibration Date | Calibration Due Date |
|----------|--------------------------|---------------|-----------------------------------|---------------|-----------------------|----------------------|
| 628      | EMCO                     | 6502          | Loop antenna                      | 9407-2877     | 6/8/2021              | 6/8/2023             |
| 853      | Teseq                    | CBL6112D      | BiLog Antenna                     | 51616         | 7/15/2021             | 7/15/2023            |
| 884      | ETS Lindgren (EMCO)      | 3117          | DOUBLE-RIDGED GUIDE ANTENNA       | 240106        | 5/6/2021              | 5/6/2023             |
| 334      | Rohde & Schwarz          | 3160-09       | HF Antenna 18-26.5 GHz            | 45576         | 4/25/2022             | 5/25/2024            |
| 889      | Com Power                | PAM 103       | Pre-amplifier                     | 18020215      | 9/27/2022             | 9/27/2023            |
| 338      | Hewlett Packard          | 8449B         | High Frequency Pre-Amp            | 3008A01111    | 6/22/2021             | 6/22/2023            |
| 882      | Rohde & Schwarz          | ESW44         | ESW44 EMI TEST RECEIVER           | 101961        | 7/14/2022             | 7/14/2023            |
| 22       | Teledyne Storm Microwave | 90-195-456    | BSAC Cable                        | N/A           | 10/7/2022             | 10/7/2023            |
| 20       | Teledyne Storm Microwave | R-90-195-036  | BSAC Cable                        | N/A           | 7/12/2022             | 7/12/2023            |
| 21       | Teledyne Storm Microwave | R-90-195-072  | BSAC Cable                        | N/A           | 7/12/2022             | 7/12/2023            |
| 335      | Suhner Sucoflex          | SF-102A       | RF Cable                          | 882/2A        | 6/21/2022             | 6/21/2023            |
| 345      | Suhner Sucoflex          | 102A          | RF Cable                          | 1077/2A       | 6/21/2022             | 6/21/2023            |
| 432      | Microwave Circuits       | H3G020G4      | High pass Filter                  | 264066        | 6/9/2022              | 6/9/2023             |
| 827      | Rohde & Schwarz          | RF Cable set  | TS8997 Rack cable set             | N/A           | 12/20/2021            | 12/20/2022           |
| 622      | Rohde & Schwarz          | FSV40 (v3.40) | FSV Signal Analyzer 10Hz to 40GHz | 101338        | 10/05/2022            | 10/05/2023           |
| 872      | HP                       | E7402A        | EMI Receiver                      | US40240258    | 6/21/2022             | 6/21/2023            |
| 871      | ACS                      | n/a           | Conducted EMI Cable               | 871           | 4/1/2022              | 4/1/2023             |
| 3010     | Rohde & Schwarz          | ENV216        | Two-Line V-Network                | 3010          | 6/22/2022             | 6/22/2023            |

**N/A – Not Applicable**

### 3 Diagram of Test Set-ups

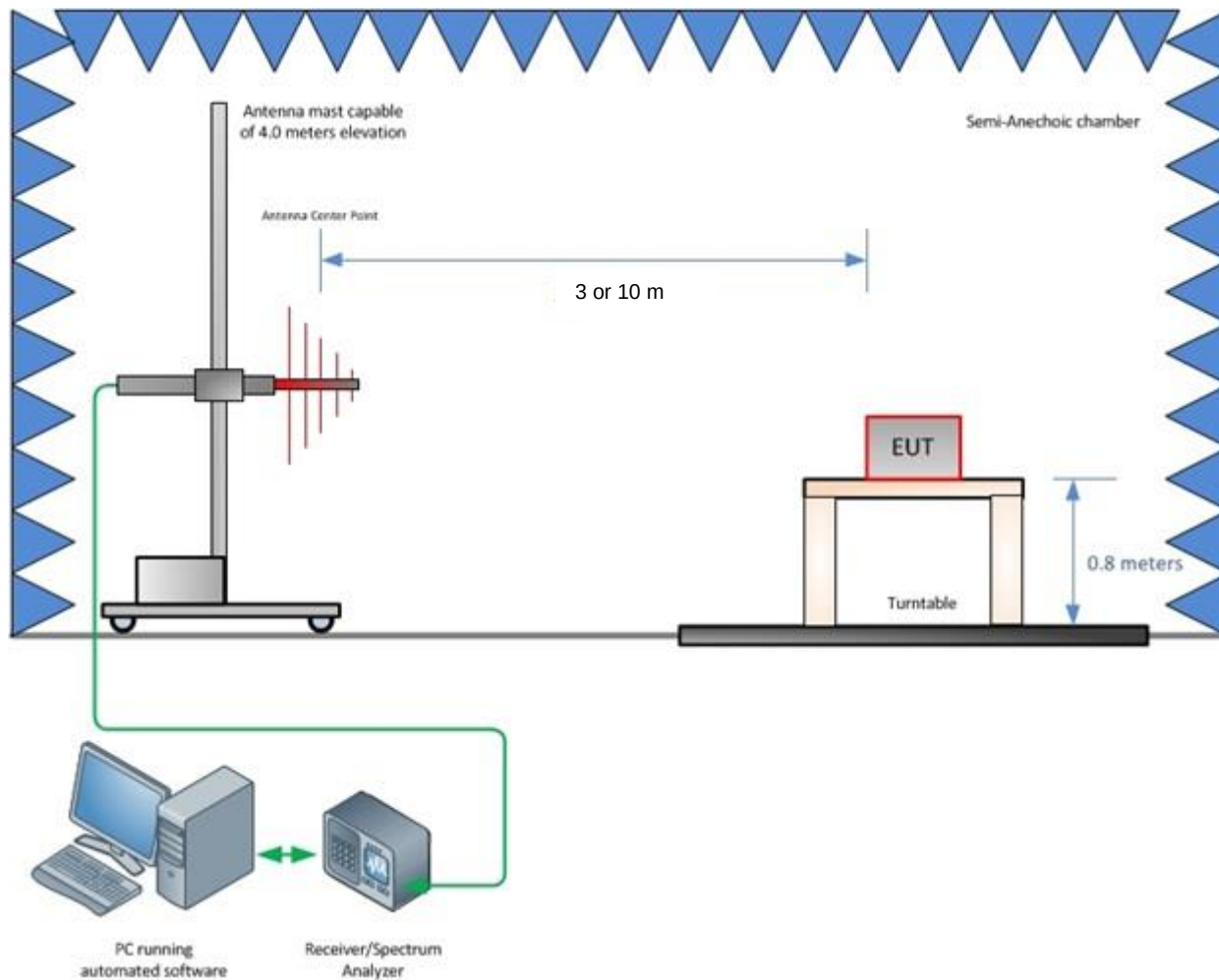


Figure 3-1 – Radiated Emissions Test Setup up to 1 GHz



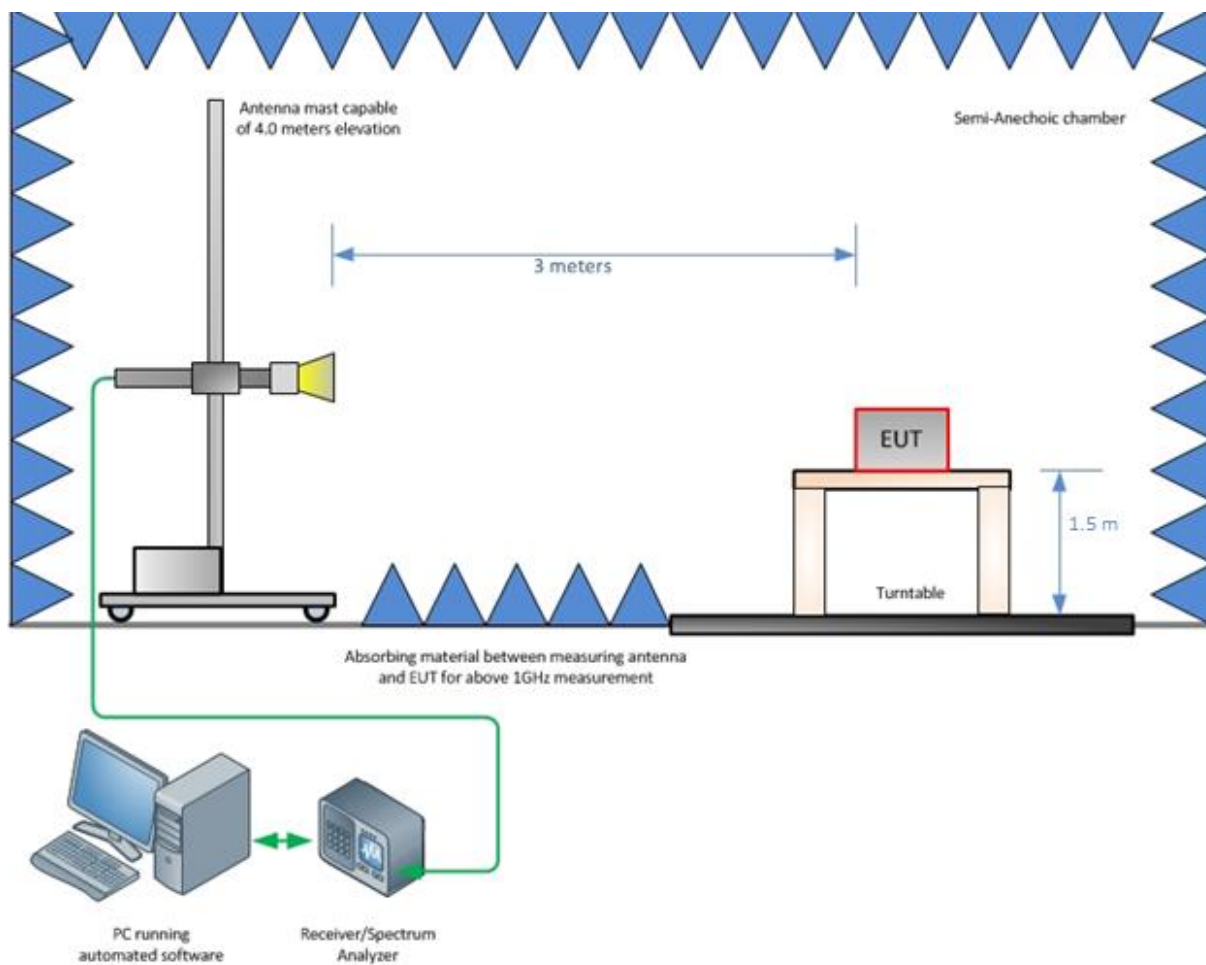


Figure 3-2 – Radiated Emissions Test Setup above 1 GHz

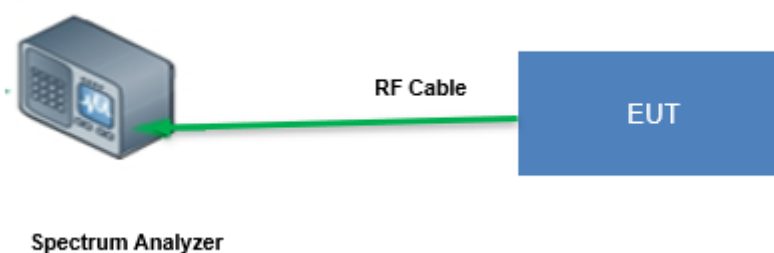


Figure 3-3 – Conducted Test Setup: Antenna Port measurement



## 4 Accreditation, Disclaimers and Copyright

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### STATEMENT OF MEASUREMENT UNCERTAINTY – Emissions

The expanded laboratory measurement uncertainty figures ( $U_{\text{Lab}}$ ) provided below correspond to an expansion factor (coverage factor)  $k = 1.96$  which provide confidence levels of 95%.

**Table 4-1: Estimation of Measurement Uncertainty**

| Parameter                               | $U_{\text{lab}}$                     |
|-----------------------------------------|--------------------------------------|
| Occupied Channel Bandwidth              | $\pm 0.009 \%$                       |
| RF Conducted Output Power               | $\pm 0.349 \text{ dB}$               |
| Power Spectral Density                  | $\pm 0.372 \text{ dB}$               |
| Antenna Port Conducted Emissions        | $\pm 1.264 \text{ dB}$               |
| Radiated Emissions $\leq 1 \text{ GHz}$ | $\pm 5.814 \text{ dB}$               |
| Radiated Emissions $> 1 \text{ GHz}$    | $\pm 4.318 \text{ dB}$               |
| Temperature                             | $\pm 0.860 \text{ }^{\circ}\text{C}$ |
| Radio Frequency                         | $\pm 2.832 \times 10^{-8}$           |
| AC Power Line Conducted Emissions       | $\pm 3.360 \text{ dB}$               |

### TEST EQUIPMENT

All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated to meet test method standard requirements and/or manufacturer's specifications