



|                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                                                                                                                                                                    |  |                                         |  |                                          |  |                                       |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------|--|------------------------------------------|--|---------------------------------------|--|
| <b>Prüfbericht-Nr.:</b><br>Test Report No.:                                                                                                                                                                                                                                                                                                                                                                                                    |  | <b>JP216XYU 002</b>                                                                                                                                                                |  | <b>Auftrags-Nr.:</b><br>Order No.:      |  | <b>150245576</b>                         |  | <b>Seite 1 von 55</b><br>Page 1 of 55 |  |
| <b>Kunden-Referenz-Nr.:</b><br>Client Reference No.:                                                                                                                                                                                                                                                                                                                                                                                           |  | N/A                                                                                                                                                                                |  | <b>Auftragsdatum:</b><br>Order Date:    |  | 2021-07-30                               |  |                                       |  |
| <b>Auftraggeber:</b><br>Client:                                                                                                                                                                                                                                                                                                                                                                                                                |  | New Japan Radio<br>1-1, Fukuoka 2-Chome Fujimino City Saitama, 356-8510 Japan                                                                                                      |  |                                         |  |                                          |  |                                       |  |
| <b>Prüfgegenstand:</b><br>Test Item:                                                                                                                                                                                                                                                                                                                                                                                                           |  | K-Band Doppler Sensor Module (Movement Sensor)                                                                                                                                     |  |                                         |  |                                          |  |                                       |  |
| <b>Bezeichnung / Typ-Nr.:</b><br>Identification / Type No.:                                                                                                                                                                                                                                                                                                                                                                                    |  | NJR4274                                                                                                                                                                            |  | <b>Serien-Nr.:</b><br>Serial No.:       |  | Sample01                                 |  |                                       |  |
| <b>Auftrags-Inhalt:</b><br>Order Content:                                                                                                                                                                                                                                                                                                                                                                                                      |  | Radio Testing                                                                                                                                                                      |  |                                         |  |                                          |  |                                       |  |
| <b>Prüfgrundlage:</b><br>Test Specification:                                                                                                                                                                                                                                                                                                                                                                                                   |  | FCC 47 CFR Part 15, Subpart C, Section 15.249<br>ANSI C63.10-2013<br><br>RSS-Gen (Issue 5): 2018+Amendment 1:2019<br>RSS-210 (Issue 10): 2019+Amendment 1:2020<br>ANSI C63.10-2013 |  |                                         |  |                                          |  |                                       |  |
| <b>Wareneingangsdatum:</b><br>Date of Receipt:                                                                                                                                                                                                                                                                                                                                                                                                 |  | 2021-09-14                                                                                                                                                                         |  | -/-                                     |  |                                          |  |                                       |  |
| <b>Prüfmuster-Nr.:</b><br>Test Sample No.:                                                                                                                                                                                                                                                                                                                                                                                                     |  | A003093437, A003095132                                                                                                                                                             |  |                                         |  |                                          |  |                                       |  |
| <b>Prüfzeitraum:</b><br>Testing Period:                                                                                                                                                                                                                                                                                                                                                                                                        |  | 2021-09-14 to 2021-12-20                                                                                                                                                           |  |                                         |  |                                          |  |                                       |  |
| <b>Ort der Prüfung:</b><br>Place of Testing:                                                                                                                                                                                                                                                                                                                                                                                                   |  | Yokohama EMC Laboratory                                                                                                                                                            |  |                                         |  |                                          |  |                                       |  |
| <b>Prüflaboratorium:</b><br>Testing Laboratory:                                                                                                                                                                                                                                                                                                                                                                                                |  | TÜV Rheinland Japan Ltd.                                                                                                                                                           |  |                                         |  |                                          |  |                                       |  |
| <b>Prüfergebnis*:</b><br>Test Result*:                                                                                                                                                                                                                                                                                                                                                                                                         |  | Pass                                                                                                                                                                               |  |                                         |  |                                          |  |                                       |  |
| <b>zusammengestellt von:</b><br>compiled by:                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                                                                                                                                                                    |  | <b>genehmigt von:</b><br>authorized by: |  |                                          |  |                                       |  |
| T. Nagata                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                                                                                                                                                                                    |  | P. Zhang                                |  |                                          |  |                                       |  |
| <b>Datum:</b><br>Date:                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                                                                                                                                                                                    |  | 2021-12-23                              |  | <b>Ausstellungsdatum:</b><br>Issue date: |  | 2021-12-23                            |  |
| Takeshi Nagata                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                                                                                                                                                                    |  |                                         |  | Pin Zhang                                |  |                                       |  |
| <b>Stellung / Position:</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                                                                                                                                                                                    |  | Inspector                               |  | <b>Stellung / Position:</b>              |  | Reviewer                              |  |
| <b>Sonstiges / Other:</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                                                                                                                                                                                    |  |                                         |  |                                          |  |                                       |  |
| <b>Zustand des Prüfgegenstandes bei Anlieferung:</b><br>Condition of the Test Item at Delivery:                                                                                                                                                                                                                                                                                                                                                |  |                                                                                                                                                                                    |  |                                         |  |                                          |  |                                       |  |
| Prüfmuster vollständig und unbeschädigt<br>Test item complete and undamaged                                                                                                                                                                                                                                                                                                                                                                    |  |                                                                                                                                                                                    |  |                                         |  |                                          |  |                                       |  |
| * Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet<br>* Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested                                                                                                                                                       |  |                                                                                                                                                                                    |  |                                         |  |                                          |  |                                       |  |
| <b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b><br>This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark. |  |                                                                                                                                                                                    |  |                                         |  |                                          |  |                                       |  |

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## REVISIONS

| Report No.   | Issue date | Changes / Remarks                                                |
|--------------|------------|------------------------------------------------------------------|
| JP216XYU 001 | 2021-11-18 | Original document (Test report for Intentional radiator aspects) |
| JP216XYU 002 | 2021-12-23 | Additional testing for fundamental                               |

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# 1. General Remarks

## 1.1 Test Specifications

**Table 1: Test Summary**

| Test                                                                                                                                                                                               | Specifications                                                                                                                                            | Result    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Emission:</b><br>FCC 47 CFR Part 15, Subpart C, Section 15.249<br>ANSI C63.10-2013<br>RSS-210 (Issue 10): 2019+Amendment 1:2020<br>RSS-Gen (Issue 5): 2018+Amendment 1:2019<br>ANSI C63.10-2013 |                                                                                                                                                           |           |
| Supply Voltage Requirements<br>FCC §15.31(e)                                                                                                                                                       | See the section 5.1.1.                                                                                                                                    | Pass      |
| Antenna Requirements<br>FCC §15.203                                                                                                                                                                | See the section 5.1.2.                                                                                                                                    | Pass      |
| Restricted Bands of Operation<br>FCC §15.205<br>RSS-Gen §8.10                                                                                                                                      | See the section 5.1.3.                                                                                                                                    | Pass      |
| Duty Cycle                                                                                                                                                                                         | -/-                                                                                                                                                       | Reference |
| 20dB Bandwidth<br>FCC §15.215 (c)                                                                                                                                                                  | 20dB bandwidth shall be contained within the designated frequency band.                                                                                   | Pass      |
| 99% Bandwidth<br>RSS-Gen §6.7 and §8.11                                                                                                                                                            | -/-                                                                                                                                                       | Reference |
| Field Strength of Fundamental Requirements<br>FCC §15.249(a), (c) and (e) and<br>RSS-210 §Annex B, B.10                                                                                            | 250mV/m (107.9dBuV/m) at 3m distance                                                                                                                      | Pass      |
| Radiated Spurious Emissions of Transmitter Requirements<br>FCC §15.209 and §15.249(a), (c) and (e)<br>RSS-210 §7.1, 7.2, 7.3, RSS-Gen §8.1 and RSS-210 §Annex B, B.10                              | 9kHz – 40GHz<br>40GHz – 100GHz<br>3m below 1GHz<br>3m above 1GHz<br>2 <sup>nd</sup> and 3 <sup>rd</sup> Harmonics:<br>2.5mV/m (67.9dBuV/m) at 3m distance | Pass      |
| Conducted Emission on AC Power Ports of Transmitter Requirements<br>FCC §15.207<br>RSS-Gen §8                                                                                                      | 150kHz - 30MHz                                                                                                                                            | Pass      |

## 1.2 Complementary Materials

There is no attachment to this test report.

## 2. Test Sites

### 2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center  
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The test facility is recognized by the Federal Communications Commission (FCC) as Accredited Testing Laboratory under designation number JP0017.

The test facility is recognized by Innovation, Science and Economic Development Canada (ISED) as Wireless Device Testing Laboratory under ISED number 3466B and CAB identifier JP0011.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2017.

### 2.2 List of Test and Measurement Instruments

**Table 2: List of Test and Measurement Equipment**

| Kind of Equipment                                                            | Manufacturer          | Model Name | Serial Number | Equip. ID | Cal. Interval | Cal. Date  | Next Cal.  |
|------------------------------------------------------------------------------|-----------------------|------------|---------------|-----------|---------------|------------|------------|
| <b>For Transmitter and Receiver Radiated Spurious Emission (above 40GHz)</b> |                       |            |               |           |               |            |            |
| Spectrum Analyzer                                                            | Agilent               | E4447A     | MY482500 05   | BT-8267   | 1 year        | 2020-12-14 | 2021-12-14 |
| Harmonic Mixer 40-60GHz                                                      | Agilent               | 11970U     | MY300302 22   | BT-8348   | 1 year        | 2020-12-02 | 2021-12-02 |
| Horn Antenna 40-60GHz (RX)                                                   | Custom Microwave Inc. | HO19R      | -/-           | BT-8334   | 1 year        | 2021-08-20 | 2022-08-20 |
| Harmonic Mixer 50-75GHz                                                      | Agilent               | 11970V     | MY300330 72   | BT-8367   | 1 year        | 2020-12-02 | 2021-12-02 |
| Horn Antenna 50-75GHz (RX)                                                   | Custom Microwave Inc. | HO15R      | -/-           | G18103 45 | 1 year        | 2021-08-20 | 2022-08-20 |
| Harmonic Mixer 75-110GHz                                                     | Agilent               | 11970W     | MY252104 62   | BT-8350   | 1 year        | 2020-12-02 | 2021-12-02 |
| Horn Antenna 75-110GHz (RX)                                                  | Custom Microwave Inc. | HO10R      | -/-           | G18103 44 | 1 year        | 2021-08-20 | 2022-08-20 |
| <b>For Power Port Conducted Emission (CE)</b>                                |                       |            |               |           |               |            |            |
| Conducted Emission Measurement Software                                      | Toyo Corporation      | EP9/CE     | Ver. 4.2.010  | RF-0810   | 1 year        | 2021-02-16 | 2022-02-16 |
| EMI Receiver                                                                 | Rohde & Schwarz       | ESU 8      | 100025        | RF-0020   | 1 year        | 2021-03-12 | 2022-03-12 |
| LISN                                                                         | Rohde & Schwarz       | ENV216     | 100276        | RF-0016   | 1 year        | 2021-05-19 | 2022-05-19 |

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| Kind of Equipment                                                            | Manufacturer     | Model Name       | Serial Number     | Equip. ID | Cal. Interval | Cal. Date  | Next Cal.  |
|------------------------------------------------------------------------------|------------------|------------------|-------------------|-----------|---------------|------------|------------|
| LISN                                                                         | Rohde & Schwarz  | ENV216           | 101958            | RF-0708   | 1 year        | 2021-05-19 | 2022-05-19 |
| <b>For Radiated Emission (RE)</b>                                            |                  |                  |                   |           |               |            |            |
| EMI Receiver                                                                 | Rohde & Schwarz  | ESU 8            | 100025            | RF-0020   | 1 year        | 2021-03-12 | 2022-03-12 |
| EMI Receiver                                                                 | Rohde & Schwarz  | ESU 40           | 100029            | RF-0021   | 1 year        | 2021-08-25 | 2022-08-25 |
| EMI Receiver                                                                 | Rohde & Schwarz  | ESW 44           | 101751            | RF-0809   | 1 year        | 2021-09-27 | 2022-09-27 |
| RF Selector (10m Chamber)                                                    | Toyo Corporation | NS4900           | 0703-182          | RF-0029   | 1 year        | 2021-02-16 | 2022-02-16 |
| Loop Antenna with Amplifier, 9kHz-30MHz                                      | Rohde & Schwarz  | HFH2-Z2          | 100139            | RF-0048   | 1 year        | 2021-04-27 | 2022-04-27 |
| Trilog Antenna No. 2, 30-1000MHz                                             | Schwarzbeck      | VULB 9168        | 9168-475          | RF-0462   | 1 year        | 2021-05-18 | 2022-05-18 |
| 5dB Attenuator                                                               | Pasternack       | PE7047-5         | -/-               | RF-0731   | 1 year        | 2021-05-18 | 2022-05-18 |
| Biconical Antenna, 30-300MHz                                                 | Schwarzbeck      | BBA9106-VHBB912  | 00235-00963       | RF-0784   | 1 year        | 2021-03-09 | 2022-03-09 |
| 5dB Attenuator                                                               | Pasternack       | PE7047-5         | -/-               | RF-0732   | 1 year        | 2021-03-09 | 2022-03-09 |
| Log-Periodic Antenna, 300-1000MHz                                            | Schwarzbeck      | UHALP 9108 A1    | UHALP 9108-A 0845 | RF-0287   | 1 year        | 2021-03-09 | 2022-03-09 |
| 3dB Attenuator                                                               | Pasternack       | PE7047-3         | -/-               | RF-0733   | 1 year        | 2021-03-09 | 2022-03-09 |
| Low Noise Preamplifier, 9kHz-1GHz                                            | TSJ              | MLA-10K01-B01-35 | 1370750           | RF-0253   | 1 year        | 2021-01-06 | 2022-01-06 |
| Low Pass Filter, DC-1GHz                                                     | R&K              | LP1000CH 3       | 12104001          | RF-0515   | 1 year        | 2021-01-06 | 2022-01-06 |
| Horn Antenna, 1-8GHz                                                         | Schwarzbeck      | BBHA 9120 D      | 1059              | RF-0553   | 1 year        | 2021-04-03 | 2022-04-03 |
| Microwave Preamplifier, 1-8GHz                                               | Toyo Corporation | TPA0108-40       | 0634              | RF-0052   | 1 year        | 2021-01-06 | 2022-01-06 |
| Horn Antenna with Preamplifier, 8-18GHz (RX)                                 | Toyo Corporation | HAP06-18W        | 00000025          | RF-0065   | 1 year        | 2021-04-03 | 2022-04-03 |
| High Pass Filter, 8-18GHz                                                    | Micro-Tronics    | HPM50107         | 006               | RF-0334   | 1 year        | 2021-04-03 | 2022-04-03 |
| Horn Antenna with Preamplifier, 18-26.5GHz (RX)                              | Toyo Corporation | HAP18-26N        | 00000010          | RF-0070   | 1 year        | 2021-04-03 | 2022-04-03 |
| Horn Antenna with Preamplifier, 26.5 -40GHz (RX)                             | Toyo Corporation | HAP26-40N        | 00000007          | RF-0069   | 1 year        | 2021-04-03 | 2022-04-03 |
| Preamplifier, 26.5-40GHz                                                     | Toyo Corporation | HAP2640-S        | -/-               | RF-0258   | 1 year        | 2021-03-17 | 2022-03-17 |
| <b>Constant Voltage Constant Frequency Stabilizers and Power Accessories</b> |                  |                  |                   |           |               |            |            |
| CVCF (Shielded Room)                                                         | NF Corporation   | ES2000S          | 9075612           | RF-0210   | 1 year        | 2021-03-12 | 2022-03-12 |
| CVCF Booster (Shielded Room)                                                 | NF Corporation   | ES2000B          | 9074403           | RF-0211   | 1 year        | 2021-03-12 | 2022-03-12 |
| CVCF (10m Chamber)                                                           | NF Corporation   | ES2000U          | 9067307           | RF-0212   | 1 year        | 2021-03-12 | 2022-03-12 |

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| Kind of Equipment          | Manufacturer    | Model Name | Serial Number | Equip. ID | Cal. Interval | Cal. Date  | Next Cal.  |
|----------------------------|-----------------|------------|---------------|-----------|---------------|------------|------------|
| CVCF Booster (10m Chamber) | NF Corporation  | ES2000B    | 9074408       | RF-0213   | 1 year        | 2021-03-12 | 2022-03-12 |
| DC Power Supply            | Hewlett Packard | 6653A      | 3640A03102    | RF-0004   | N/A           | N/A        | N/A        |
| DC Power Supply            | Agilent         | E3646A     | MY50350007    | RF-0412   | N/A           | N/A        | N/A        |
| True RMS Multimeter        | Fluke           | 87V        | 97680450      | RF-0282   | 1 year        | 2021-03-23 | 2022-03-23 |

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2017 has been confirmed before each testing.

## 2.3 Measurement Uncertainty

**Table 3: Emission Measurement Uncertainty**

| Measurement Type                          | Frequency      | Uncertainty                   |
|-------------------------------------------|----------------|-------------------------------|
| Conducted Emission on Power Ports         | 150kHz - 30MHz | ±2.0dB                        |
| Radiated Emission – Semi Anechoic Chamber | 30MHz - 1GHz   | ±3.8dB at 3m<br>±5.0dB at 10m |
|                                           | 1GHz - 40GHz   | ±4.5dB at 3m                  |
| Radiated Emission (MMW)                   | 40GHz - 50GHz  | ±4.6dB                        |
|                                           | 50GHz - 75GHz  | ±5.0dB                        |
|                                           | 75GHz – 110GHz | ±5.0dB                        |

Note:

The measurement instrumentation uncertainty (MIU) was determined according to CISPR 16-4-2. All MIU values mentioned in the above table are smaller than the uncertainty budgets specified by CISPR 16-4-2, therefore compliance for all emission measurements is deemed to occur if no measured disturbance level exceeds the disturbance limit.

## 3. General Product Information

### 3.1 Product Function and Intended Use

The **EUT** (**E**quipment **U**nder **T**est) is K-band movement sensor module based on the Doppler Effect. Although the module incorporates transmitter and receiver, they can only be operated simultaneously.

Since the receiver does not employ any local oscillator, the measurement signal is directly derived from the difference between the emitted and received frequency (homodyne system).

The module transmits a pair of un-modulated carrier of 24GHz at pulsed operation in a channel. Two types of duty cycle are used to optimize its power consumption.

### 3.2 Ratings and System Details

|                             |                                                          |
|-----------------------------|----------------------------------------------------------|
| Fundamental Field Strength: | 80.47dBµV/m @3m, Average                                 |
| Antenna gain:               | +6.5dBi Typ.                                             |
| Antenna type:               | Pattern antenna (printed on PCB)                         |
| Antenna mounting type:      | Internal                                                 |
| Frequency range:            | 24.00 - 24.25GHz                                         |
| Nominal Frequency:          | 24.057 – 24.244GHz                                       |
| Number of channels:         | 30 (*)                                                   |
| Modulation type:            | No modulation (*)                                        |
| FCC classification:         | DXX (Part 15 Low Power Communication Device Transmitter) |

|                          |         |
|--------------------------|---------|
| Input Voltage:           | DC 5.0V |
| Typical Nominal Voltage: | DC 5.0V |
| Input Current:           | 50mA    |
| Protection Class:        | III     |

|                 |                                                    |
|-----------------|----------------------------------------------------|
| Test voltage:   | DC 5.0V (For EUT)<br>AC 120V (For AC Adapter) (**) |
| Test frequency: | 60Hz (For AC Adapter) (**)                         |

Note:

(\*) The EUT transmits a pair of F1 and F2 non-modulated signal within one channel. Signal of F1 and F2 are alternatively transmitted in this channel, therefore, no simultaneous transmission is occurred.

(\*\*) One off-the-shelf AC Adapter was used.

### **3.3 Noise Generating and Noise Suppressing Parts**

The highest frequency generated or used by the EUT is 24.244GHz for fundamental component as intentional radiator portion.

### **3.4 Submitted Documents and Information**

Following document has been submitted by the client:

Instruction for the testing

Following information provided in this test report has been submitted by the client:

- client name and address;
- EUT identification, ratings, system details, and description of product function and intended use;
- information related to noise generating and noise suppressing parts (if any).

## **4. Test Setup and Operation Modes**

### **4.1 Test Methodology**

The test methodology used is based on the requirements of 47 CFR Part 15, sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209 and 15.249.

The test methods, which have been used, are based on ANSI C63.10.

For details, see under each test item.

### **4.2 Operation Modes**

The operation modes used for testing are:

- A. Transmitting and receiving at the lowest frequency Channel (24.057/24.072 GHz) with the highest Duty Cycle.
- B. Transmitting and receiving at the middle frequency Channel (24.157/24.172 GHz) with the highest Duty Cycle.
- C. Transmitting and receiving at the highest frequency Channel (24.229/24.244 GHz) with the highest Duty Cycle.

The operation modes can be coupled with the following configurations:

- 1. Normal mode
- 2. Low power consumption mode

Note: As the EUT transmits the same burst (i.e. the same Tx power with the same On-time) at the above mentioned configurations. Difference is their repetition time (Off-time), therefore, the highest duty cycle (Configuration 1) was chosen for the testing.

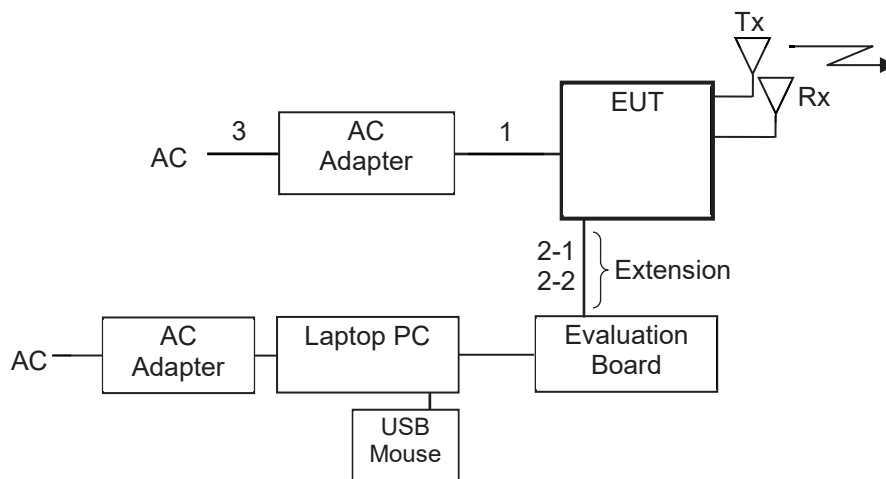
### **4.3 Physical Configuration for Testing**

The EUT was tested on a stand-alone basis and the test system was configured in a typical fashion (as a customer would normally use it).

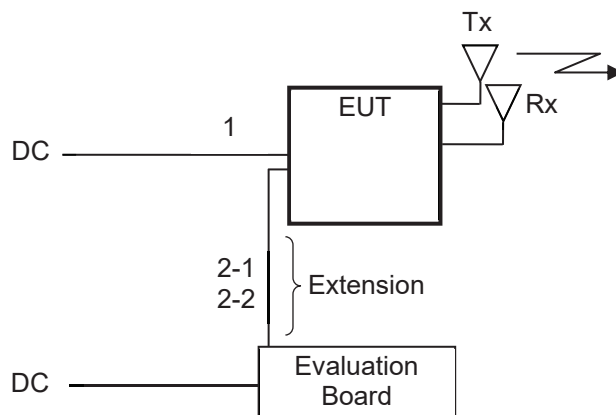
The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

## Figure 1: Block Diagram

### For AC Power Line Conducted Emission of Transmitter



### For Other Test Items of Transmitter



**Table 4: Interfaces present on the EUT**

| No.  | Interface               |            | Cable Length for Testing, Shielding | Interface Classification |
|------|-------------------------|------------|-------------------------------------|--------------------------|
| 1.   | DC cable                | for CE     | 1.2m, Un-shielded                   | DC input power port (*)  |
|      |                         | for others | 2.2m, Un-shielded                   |                          |
| 2-1. | Analog Range Setting    |            | 2.2m, Un-shielded                   | Signal port (*)          |
| 2-2. | Digital Output (Detect) |            | 2.2m, Un-shielded                   | Signal port (*)          |
| 3.   | AC cable (AC Adapter)   |            | 1.0m, Un-shielded                   | AC input power port      |

Note:

(\*) The EUT is directly plugged onto an end user's PCB. In order to enable testing as Stand-alone, interface cables were extended for the testing purpose.

For more details, refer to section: Photographs of the Test Set-Up.

## 4.4 Test Software

The EUT was provided by the manufacturer with suitable software to allow operation in all the required mode.

Software used for testing is:

- NJR4274viewer for compliance testing, version 1.0.0.0 by New Japan Radio

This software was running on the laptop computer connected to the EUT. It was used to enable the test operation mode listed in section 4.2 as appropriate.

## 4.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Laptop PC  
Manufacturer: Lenovo  
Model: ThinkPad L560  
Rated Voltage: DC 20V  
Input Current: Un-specified  
Protection Class: III  
Serial Number: B028858
2. Product: AC Adapter for Laptop PC  
Manufacturer: Lenovo  
Model: ADLX45NCC2A  
Rated Voltage: AC 100-240V  
Input Current: 1.3A  
Frequency: 50-60Hz  
Rated Voltage: DC 20V  
Output Current: 2.25A  
Protection Class: II  
Serial Number: 8SSA10E75794C1SG73W2583 REV:100
3. Product: USB Mouse  
Manufacturer: Lenovo  
Model: MO28UOB  
Rated Voltage: DC 5V  
Input Current: 100mA  
Protection Class: III  
Serial Number: 8SSM50G45918G68E1715

4. Product: AC Adapter for EUT  
Manufacturer: UNIFIVE  
Model: UNI318-0530  
Rated Voltage: AC 100-240V  
Input Current: 0.4A  
Frequency: 50/60Hz  
Output Voltage: DC 5.0V  
Output Current: 3.0A  
Protection Class: II  
Serial Number: L12-0430880
5. Product: Evaluation Board  
Manufacturer: New Japan Radio  
Model: R4234K-100-1.0  
Rated Voltage: DC 5V  
Protection Class: III

## 4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

## 5. Test Results RADIO

### 5.1 Technical Requirements

#### 5.1.1 Supply Voltage Requirements

**RESULT:** **Pass**

Requirements:

FCC §15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Verdict:

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the supply voltage requirements.

#### 5.1.2 Antenna Requirements

**RESULT:** **Pass**

Requirements:

FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The antenna is permanently attached to the PCB board and is not able to be replaced. Hence it complies with the antenna requirements.

### 5.1.3 Restricted Bands of Operation

**RESULT:**

**Pass**

Requirements:

FCC §15.205 and RSS-Gen §8.10

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT operation frequency range is 24.00 - 24.25GHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

## 5.2 Radiated Measurements

### 5.2.1 Duty Cycle

#### RESULT:

#### Reference

Date of testing: 2021-09-14, 2021-10-11, 2021-12-20

Ambient temperature: 22, 23, 25°C

Relative humidity: 59, 59, 35%

Atmospheric pressure: 1010, 1014, 1013hPa

Requirements:

N/A, this test item was performed as reference.

Test procedure:

ANSI C63.10-2013 §7.5

**Table 5: Duty Cycle**

| Mode |    | On Time<br>Duration [us] | Period of the Pulse<br>Train [us] | Duty Cycle<br>[%] | DCCF<br>[dB] |
|------|----|--------------------------|-----------------------------------|-------------------|--------------|
| A    | F1 | 48.1                     | 500.1                             | 9.618             | -20.34       |
|      | F2 | 47.5                     | 500.0                             | 9.500             | -20.45       |
| B    | F1 | 48.0                     | 500.1                             | 9.598             | -20.36       |
|      | F2 | 49.3                     | 500.1                             | 9.858             | -20.12       |
| C    | F1 | 48.9                     | 500.1                             | 9.778             | -20.19       |
|      | F2 | 48.3                     | 500.0                             | 9.660             | -20.30       |

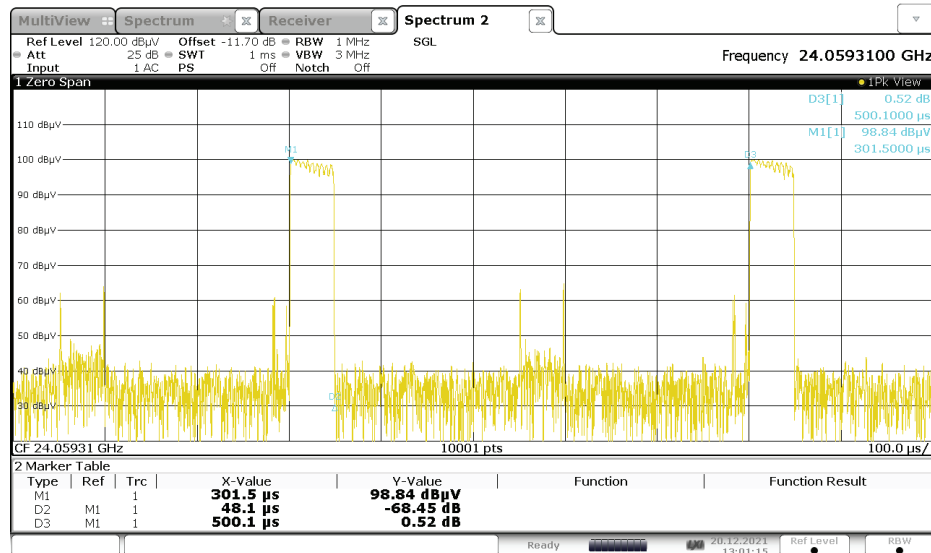
Note: **Duty Cycle Correction Factor** (hereinafter, DCCF) is calculated by the following formula;

$DCCF = 20 \times \log_{10}(\text{Duty Cycle})$ , where Duty Cycle is in dimensionless.

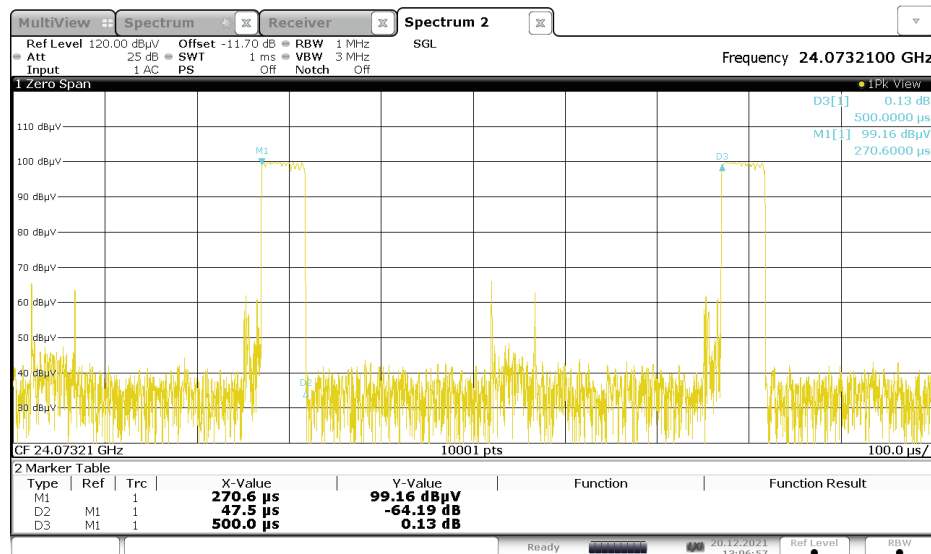
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Figure 2: Duty Cycle, Mode A



13:01:16 20.12.2021

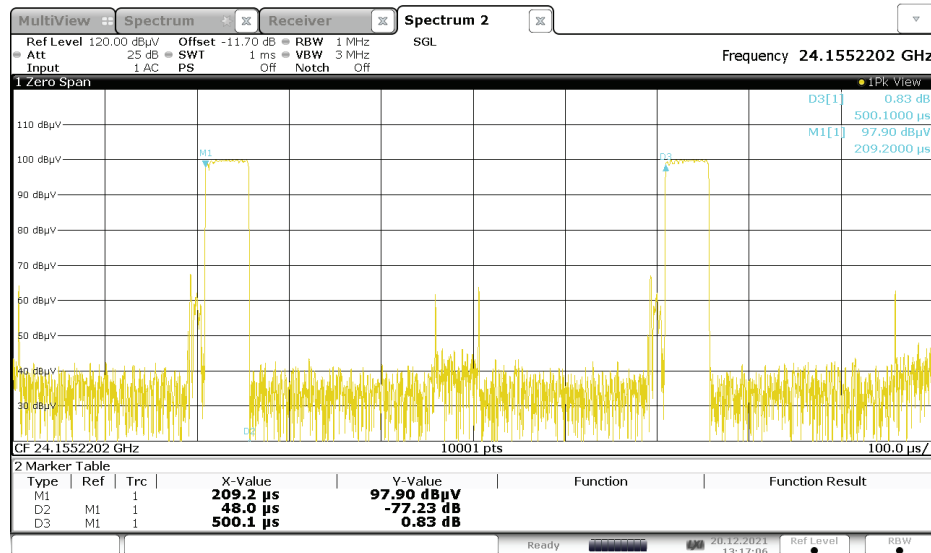


13:06:57 20.12.2021

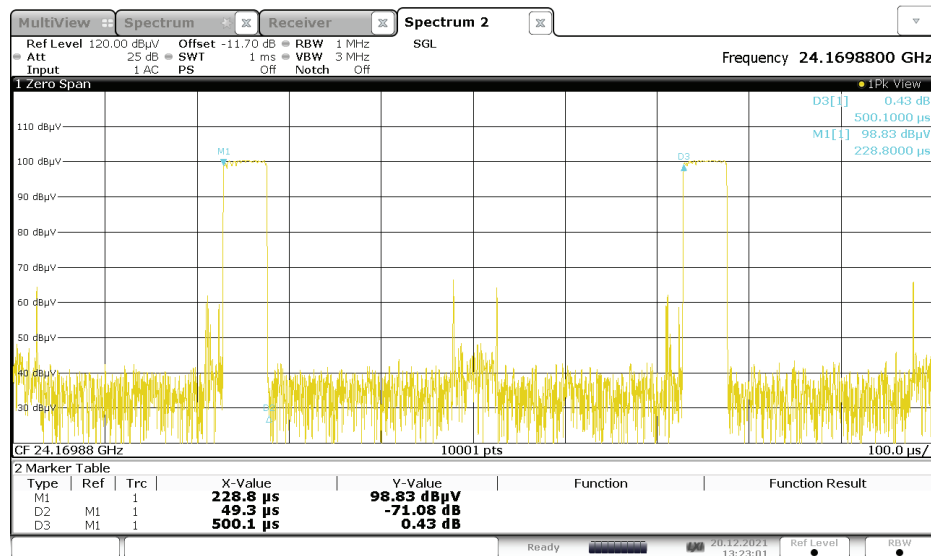
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Figure 3: Duty Cycle, Mode B

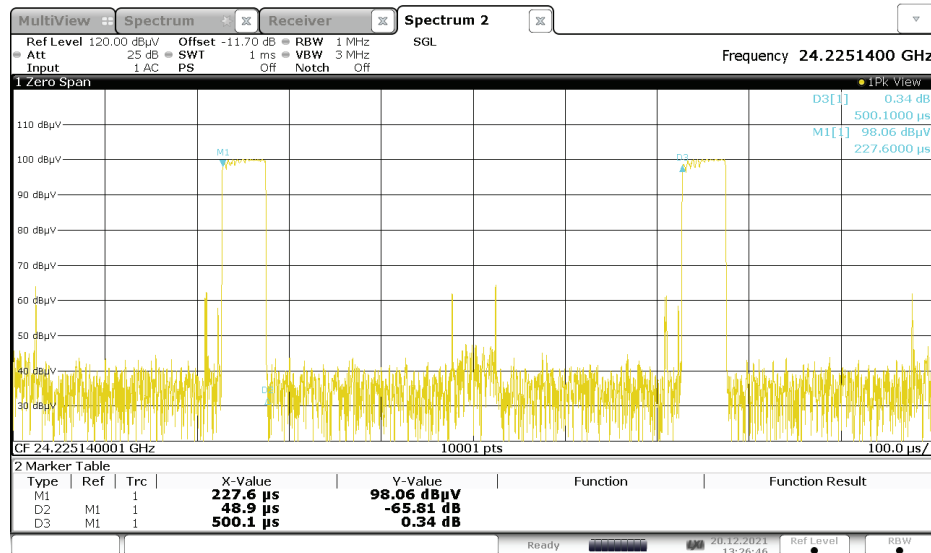


13:17:06 20.12.2021

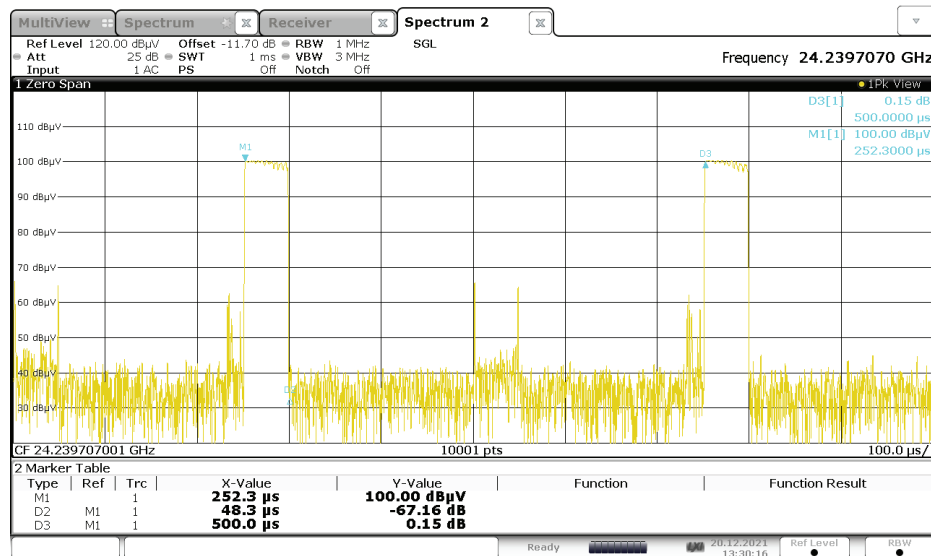


13:23:02 20.12.2021

Figure 4: Duty Cycle, Mode C



13:26:46 20.12.2021



13:30:17 20.12.2021

### 5.2.2 20dB Bandwidth

**RESULT:**

**Pass**

Date of testing: 2021-09-14, 2021-10-11, 2021-12-20

Ambient temperature: 22, 23, 25°C

Relative humidity: 59, 59, 35%

Atmospheric pressure: 1010, 1014, 1013hPa

Requirements:

FCC §15.215(c) and §15.249

The 20dB bandwidth of the emission shall be contained within the frequency band (24.00 - 24.25GHz) designated in the rule section under which the equipment is operated.

Test procedure:

ANSI C63.10 §6.9.2

The EUT was placed on non-conductive table raised 1.5m above the ground plane in a semi-anechoic chamber.

The 20dB bandwidth was measured with a horn antenna connected to a spectrum analyzer with the following settings:

- RBW = 50kHz, VBW = 200kHz, peak detector with Max Hold

Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

**Table 6: 20dB Bandwidth Edge Frequencies**

| Mode |    | 20dB Bandwidth Edge Side | Edge Frequency [GHz] | Limit [GHz] | Margin [MHz] |
|------|----|--------------------------|----------------------|-------------|--------------|
| A    | F1 | Lower side               | 24.058453100         | 24.00       | 58.453100    |
|      |    | Higher side              | 24.060177180         | 24.25       | 189.822820   |
| C    | F2 | Lower side               | 24.238793591         | 24.00       | 238.793591   |
|      |    | Higher side              | 24.240782391         | 24.25       | 9.217609     |

Note: Lower side of the Lowest Ch and Higher side of the Highest Ch were measured.

**Table 7: 20dB Bandwidth**

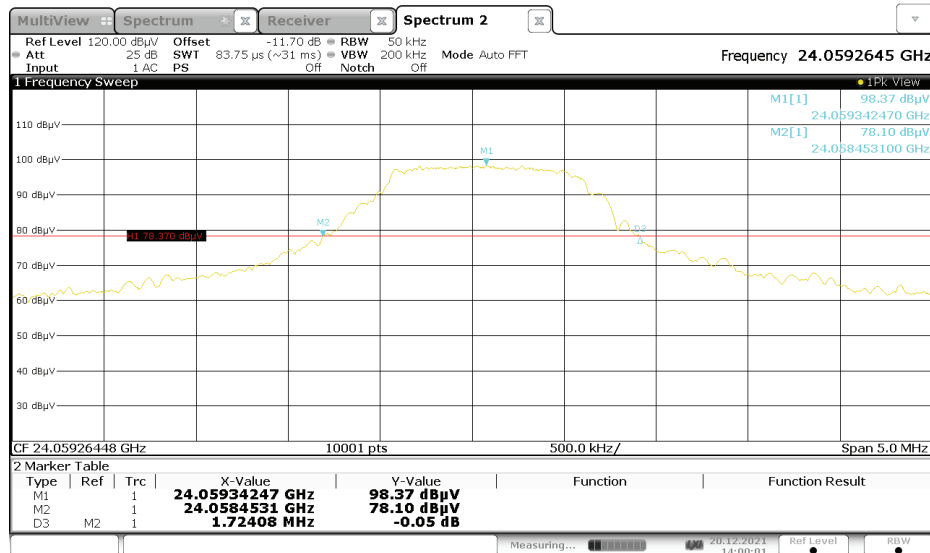
| Mode |    | 20dB Bandwidth [MHz] | RBW (kHz) | Ratio | Remark          |
|------|----|----------------------|-----------|-------|-----------------|
| A    | F1 | 1.72408              | 50        | 2.90% |                 |
|      | F2 | 1.75979              | 50        | 2.84% |                 |
| B    | F1 | 2.07405              | 50        | 2.41% | Highest 20dB BW |
|      | F2 | 1.76157              | 50        | 2.84% |                 |
| C    | F1 | 1.72882              | 50        | 2.89% |                 |
|      | F2 | 1.98880              | 50        | 2.51% |                 |

Note: Ratio was calculated in order to confirm its RBW setting at each measurement (i.e. 1% to 5%).

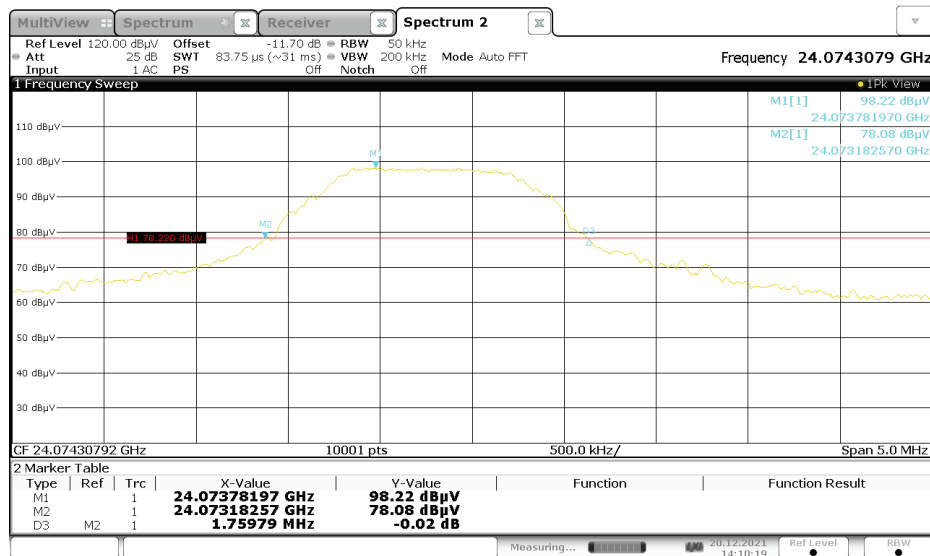
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**Figure 5: 20dB Bandwidth, Mode A**



14:00:02 20.12.2021

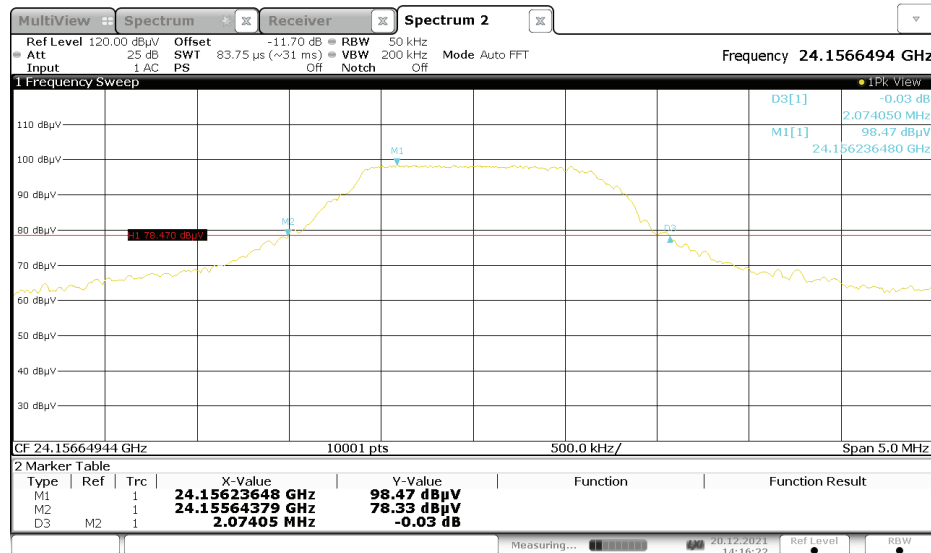


14:10:19 20.12.2021

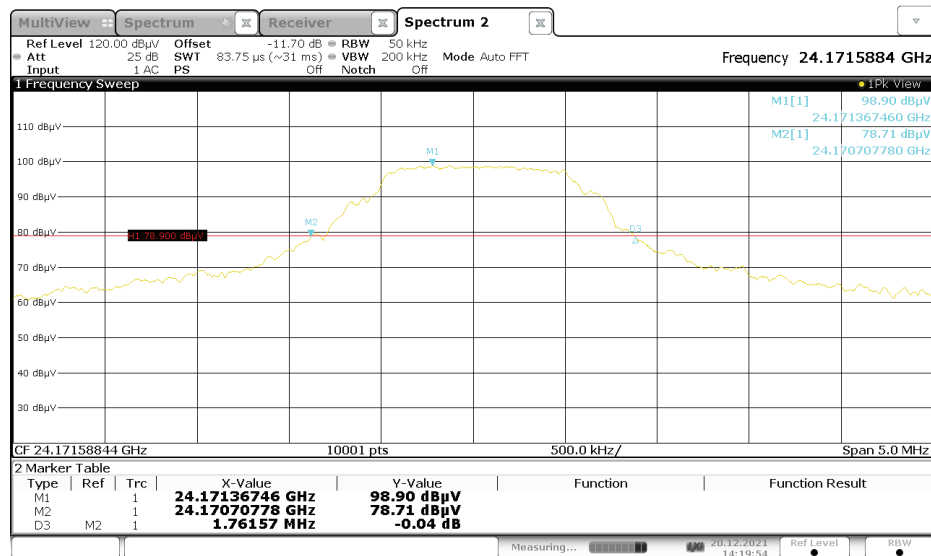
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**Figure 6: 20dB Bandwidth, Mode B**



14:16:22 20.12.2021

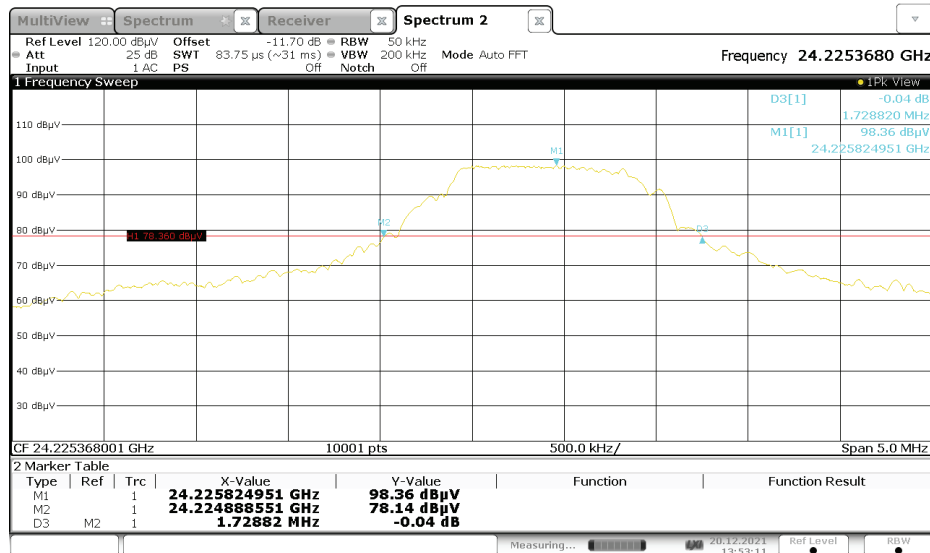


14:19:55 20.12.2021

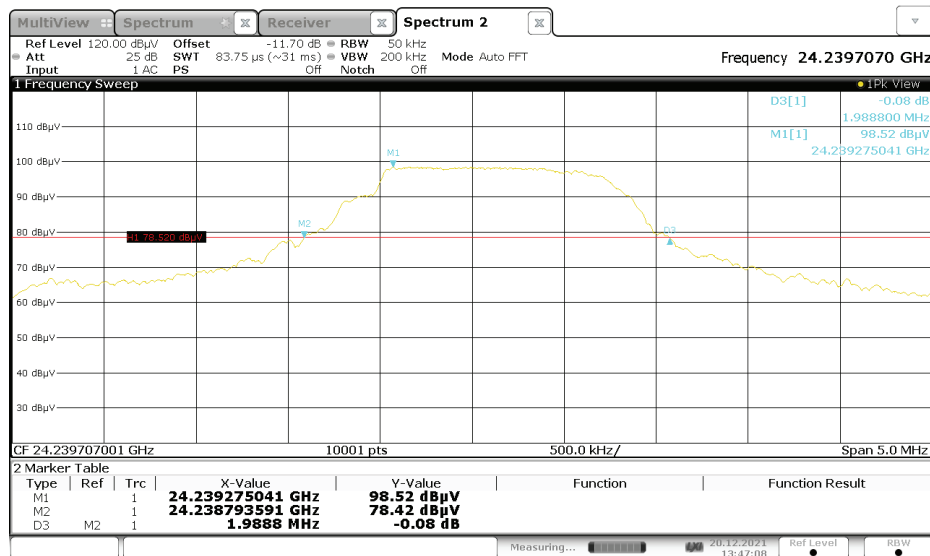
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**Figure 7: 20dB Bandwidth, Mode C**



13:53:12 20.12.2021



13:47:09 20.12.2021

### 5.2.3 99% Bandwidth

#### RESULT:

#### Reference

Date of testing: 2021-09-14, 2021-10-11, 2021-12-20

Ambient temperature: 22, 23, 25°C

Relative humidity: 59, 59, 35%

Atmospheric pressure: 1010, 1014, 1013hPa

RSS-Gen §6.7 and §8.11

The 99% bandwidth shall be reported and shall lie entirely outside the restricted bands and the prohibited TV bands of 54-72MHz, 76-88MHz, 174-216MHz, 470-608MHz and 614-806MHz, unless otherwise indicated.

Test procedure:

ANSI C63.10 §6.9.3

The EUT was placed on non-conductive table raised 1.5m above the ground plane in a semi-anechoic chamber.

The 99% bandwidth was measured with a horn antenna connected to a spectrum analyzer with the following settings:

- RBW = 50kHz, VBW = 200kHz, Sample detector with Max Hold

Markers were placed at the lowest and highest intersections of the trace by 99% OBW function to obtain the value of the emission bandwidth.

**Table 8: 99% Bandwidth Edge Frequencies**

| Mode | 99% Bandwidth Edge Side | Edge Frequency [GHz] | Limit [GHz] | Margin [MHz] |
|------|-------------------------|----------------------|-------------|--------------|
| A    | Lower side              | 24.058411415         | 24.00       | 58.411415    |
|      | Higher side             | 24.059978145         | 24.25       | 190.021855   |
| C    | Lower side              | 24.239336039         | 24.00       | 239.336039   |
|      | Higher side             | 24.240849522         | 24.25       | 9.150478     |

Note: Lower side of the Lowest Ch and Higher side of the Highest Ch were measured.

**Table 9: 99% Bandwidth**

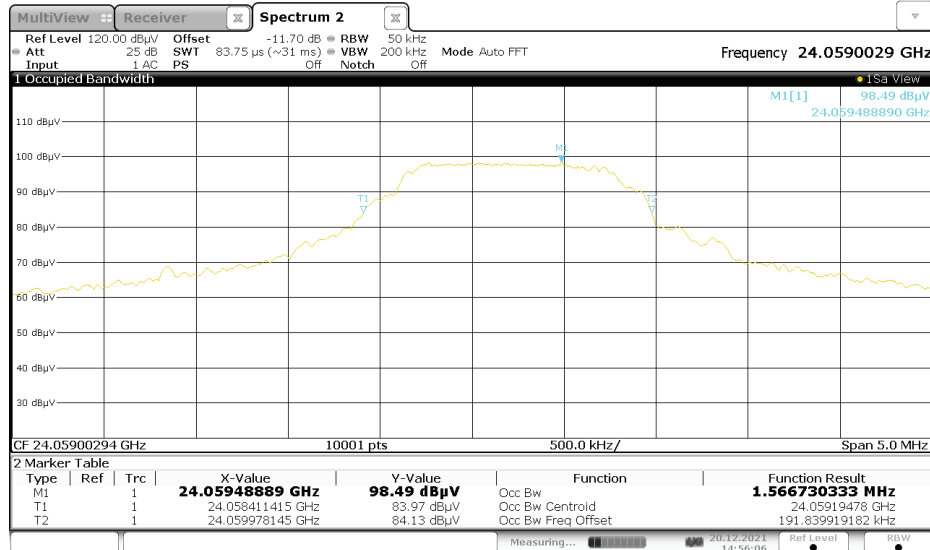
| Mode |    | 99% Bandwidth [MHz] | RBW (kHz) | Ratio | Remark          |
|------|----|---------------------|-----------|-------|-----------------|
| A    | F1 | 1.566730333         | 50        | 3.19% |                 |
|      | F2 | 1.536118234         | 50        | 3.25% |                 |
| B    | F1 | 1.537922441         | 50        | 3.25% |                 |
|      | F2 | 1.590624787         | 50        | 3.14% | Highest 99% OBW |
| C    | F1 | 1.491434115         | 50        | 3.35% |                 |
|      | F2 | 1.513483227         | 50        | 3.30% |                 |

Note: Ratio was calculated in order to confirm its RBW setting at each measurement (i.e. 1% to 5%). Gray shading data is the widest 99% OBW in this test report.

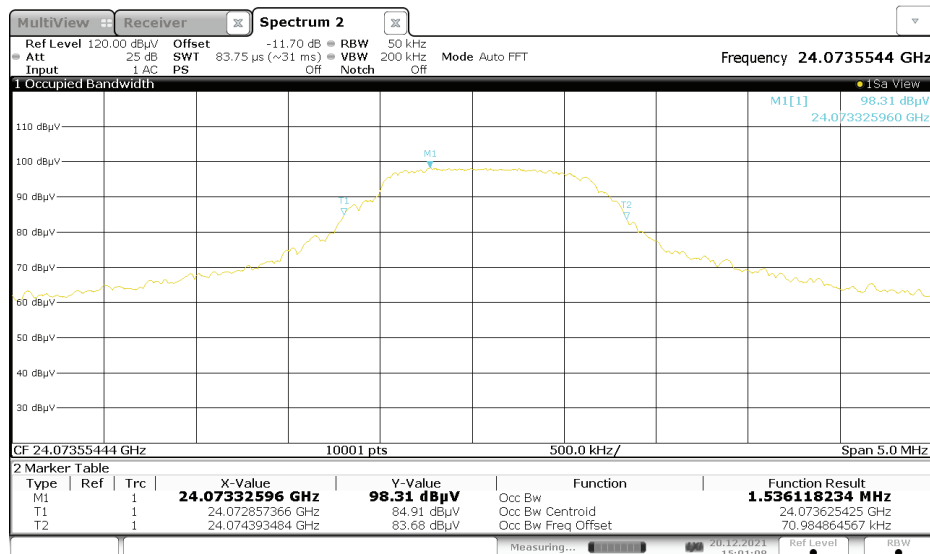
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**Figure 8: 99% Bandwidth, Mode A**



14:56:06 20.12.2021

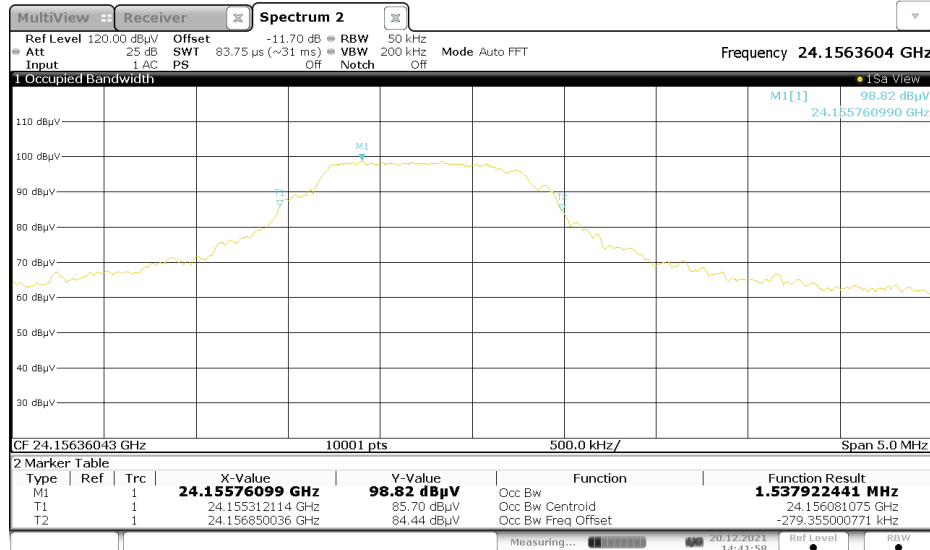


15:01:08 20.12.2021

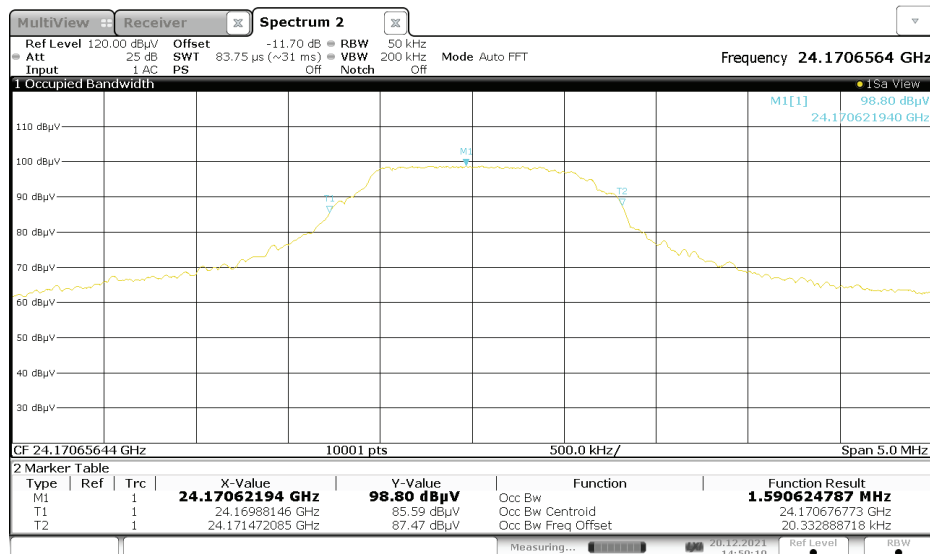
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**Figure 9: 99% Bandwidth, Mode B**



14:41:58 20.12.2021

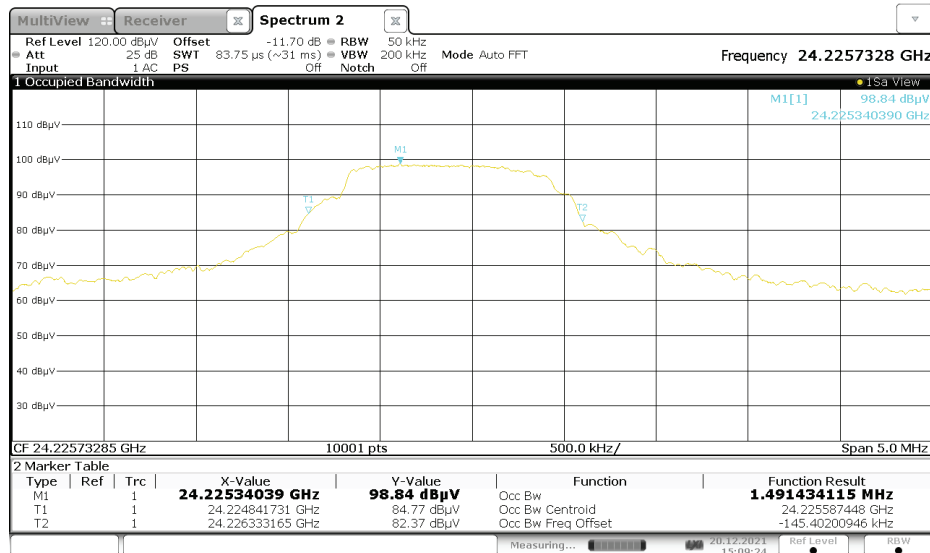


14:50:19 20.12.2021

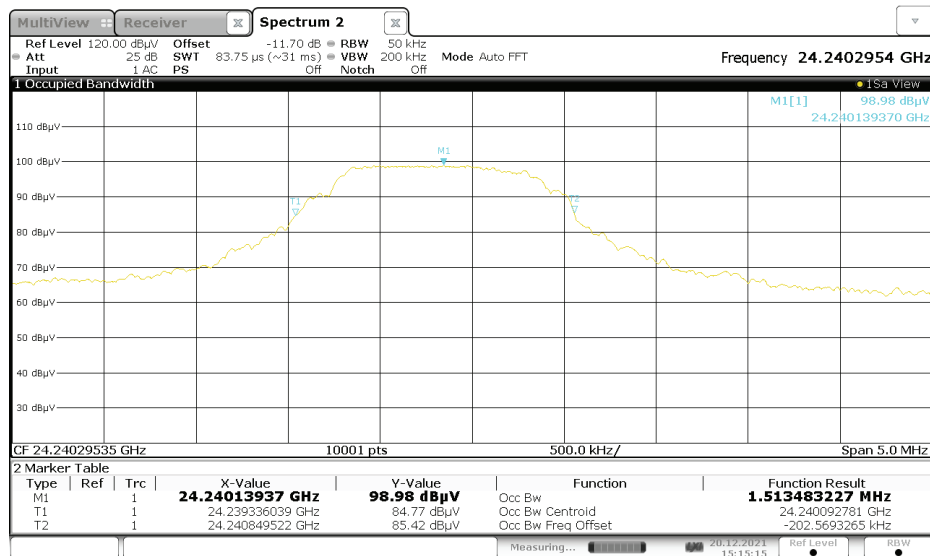
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**Figure 10: 99% Bandwidth, Mode C**



15:09:25 20.12.2021



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## 5.2.4 Field Strength of Fundamental

### RESULT:

**Pass**

Date of testing: 2021-09-14, 2021-10-11, 2021-12-20

Ambient temperature: 22, 23, 25°C

Relative humidity: 59, 59, 35%

Atmospheric pressure: 1010, 1014, 1013hPa

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Test mode applied: A, B, C

Test configuration applied: 1

#### Requirements:

FCC §15.249 (a), (c), (e) and RSS-210 Annex B, B.10

The field strength of fundamental shall not exceed the level specified in FCC 15.249 (a).  
The field strength of fundamental shall not exceed the level specified in RSS-210 Annex B.10, Table B2.

#### Test procedure:

ANSI C63.10 §6.3 and §6.6

The EUT was placed on a non-conductive table raised 1.5m above the ground plane for the fundamental measurements. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations for the three EUT orientations (X, Y, Z).

Measurements were performed using a spectrum analyzer with a suitable span to encompass the maximum point of the fundamental and using the following settings:

RBW = 3MHz, VBW = 10MHz, peak detector with Max Hold.

According to the ANSI C63.10 §4.1.4.2.4, average value was determined from the peak field strength with the DCCF.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

In the taken spectra in this section, the upper trace (Yellow) corresponds to the peak measurement. The lower trace (Green) is a reference plot corresponding to the average measurement.

**Table 10: Field Strength of Fundamental, Average Data**

| Mode | Frequency [GHz] | EUT / Ant. Orient. | Reading Level PK [dBμV] | Factor [dB/m] | DCCF [dB] | Average Level [dBμV/m] | Average Limit [dBμV/m] | Margin [dB] |
|------|-----------------|--------------------|-------------------------|---------------|-----------|------------------------|------------------------|-------------|
| A    | 24.05997630     | Y/V                | 111.83                  | -11.8         | -20.34    | 79.69                  | 107.96                 | 28.27       |
| A    | 24.07363440     | Y/V                | 111.69                  | -11.8         | -20.45    | 79.44                  | 107.96                 | 28.52       |
| B    | 24.15646730     | Y/V                | 111.96                  | -11.8         | -20.36    | 79.80                  | 107.96                 | 28.16       |
| B    | 24.17122870     | Y/V                | 112.39                  | -11.8         | -20.12    | 80.47                  | 107.96                 | 27.49       |
| C    | 24.22583980     | Y/V                | 111.98                  | -11.8         | -20.19    | 79.99                  | 107.96                 | 27.97       |
| C    | 24.24011680     | Y/V                | 112.33                  | -11.8         | -20.30    | 80.23                  | 107.96                 | 27.73       |

Note: Average limit in dBμV/m is calculated as follows: Average limit =  $20 \times \log_{10} (250000 \mu\text{V/m})$ .

Factor (Antenna, pre-Amp. and cables) and DCCF were applied to Reading Level PK in order to determine an average field strength level. See the section 5.2.1 of this test report for each observed duty cycle and their DCCF.

Average Level was calculated by the following formula;

- Average Level at 3m = Reading Level PK + Factor + DCCF

Gray shading data is the highest E-field strength in this test report.

**Table 11: Field Strength of Fundamental, Peak Data**

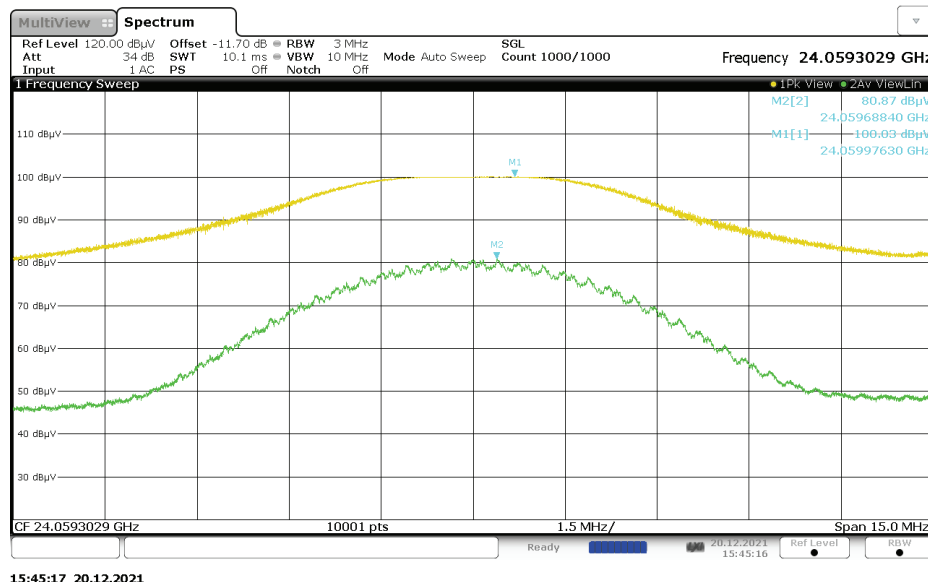
| Mode | Frequency [GHz] | EUT / Ant. Orient. | Reading Level PK [dBμV] | Factor [dB/m] | Peak Level [dBμV/m] | Peak Limit [dBμV/m] | Margin [dB] |
|------|-----------------|--------------------|-------------------------|---------------|---------------------|---------------------|-------------|
| A    | 24.05934870     | Y/V                | 111.83                  | -11.8         | 100.03              | 127.96              | 27.93       |
| A    | 24.07406980     | Y/V                | 111.69                  | -11.8         | 99.89               | 127.96              | 28.07       |
| B    | 24.15559620     | Y/V                | 111.96                  | -11.8         | 100.16              | 127.96              | 27.80       |
| B    | 24.16990830     | Y/V                | 112.39                  | -11.8         | 100.59              | 127.96              | 27.37       |
| C    | 24.22299500     | Y/V                | 111.98                  | -11.8         | 100.18              | 127.96              | 27.78       |
| C    | 24.23802000     | Y/V                | 112.33                  | -11.8         | 100.53              | 127.96              | 27.43       |

Note: Peak limit in dBμV/m is calculated as follows: Peak limit = Average limit + 20dB.

Peak Level was calculated by the following formula;

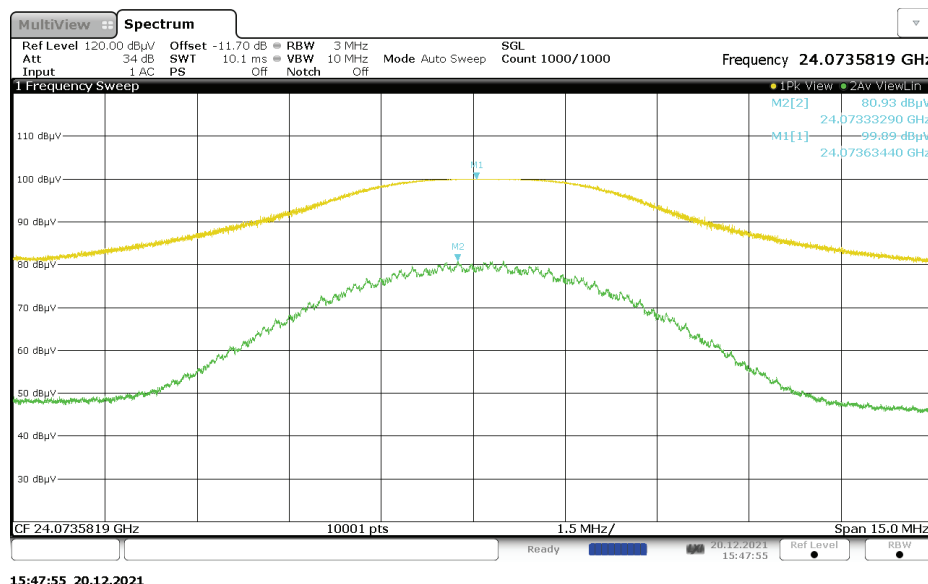
- Peak Level at 3m = Reading Level PK + Factor

**Figure 11: Field Strength of Fundamental, Spectral Diagram of F1, Mode A**



Note: The lower trace (Green) is a reference plot with trace averaging detector.

**Figure 12: Field Strength of Fundamental, Spectral Diagram of F2, Mode A**

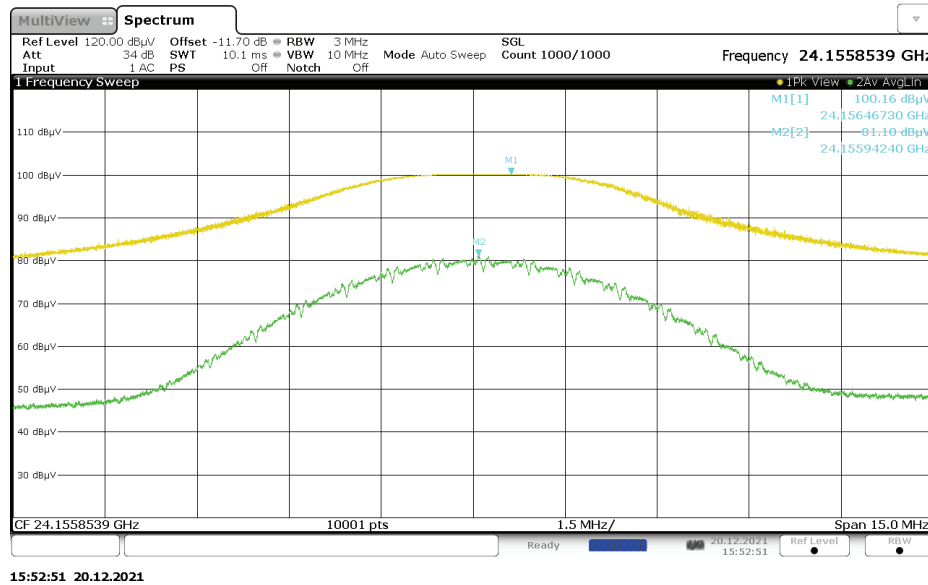


Note: The lower trace (Green) is a reference plot with trace averaging detector.

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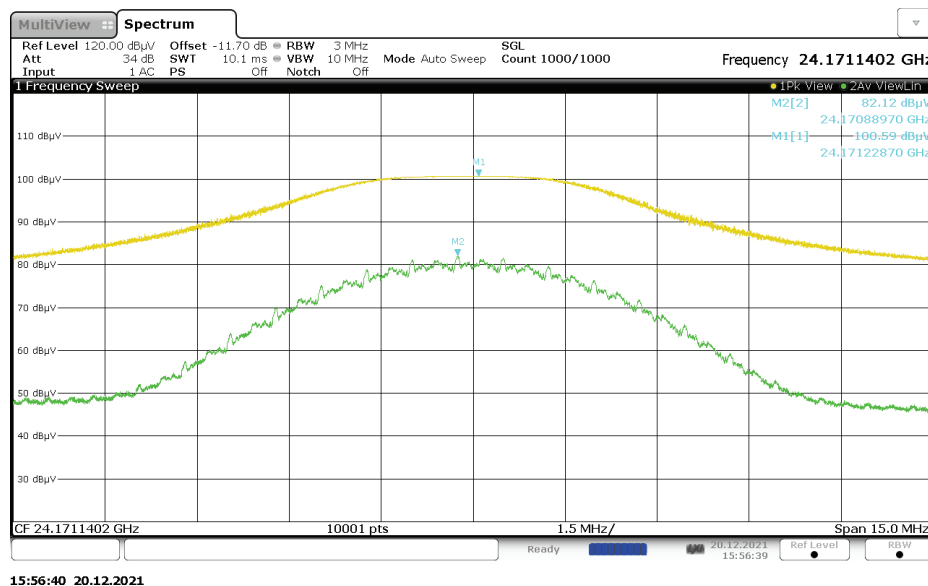
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**Figure 13: Field Strength of Fundamental, Spectral Diagram of F1, Mode B**



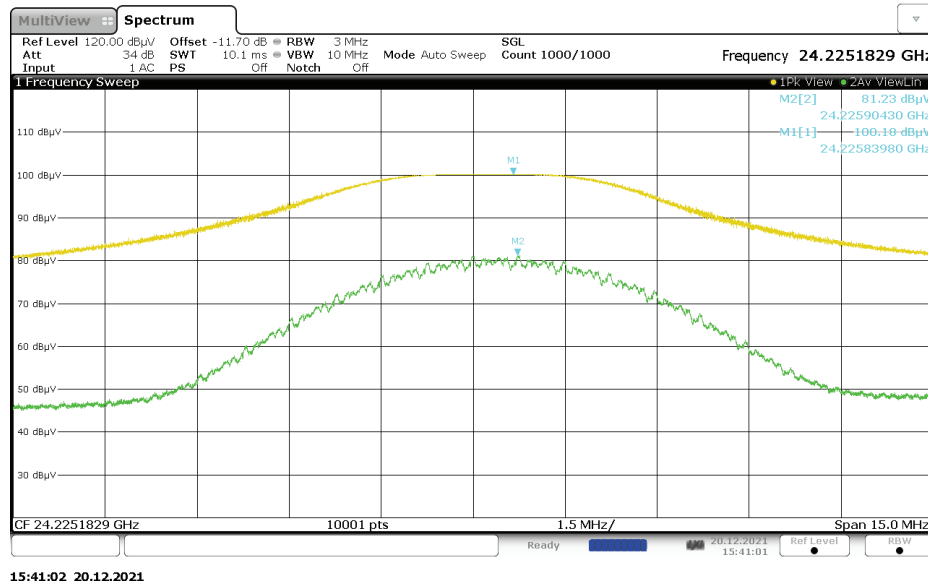
Note: The lower trace (Green) is a reference plot with trace averaging detector.

**Figure 14: Field Strength of Fundamental, Spectral Diagram of F2, Mode B**



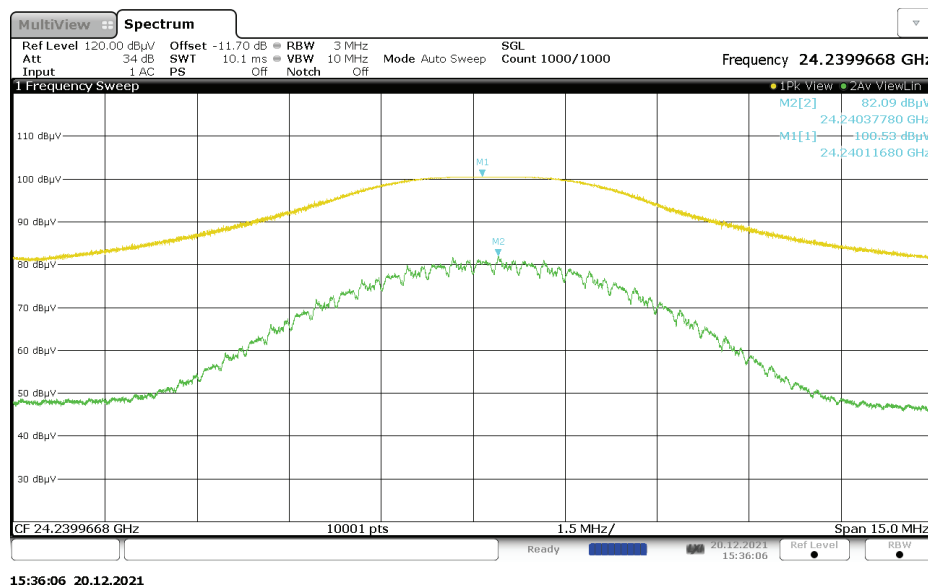
Note: The lower trace (Green) is a reference plot with trace averaging detector.

**Figure 15: Field Strength of Fundamental, Spectral Diagram of F1, Mode C**



Note: The lower trace (Green) is a reference plot with trace averaging detector.

**Figure 16: Field Strength of Fundamental, Spectral Diagram of F2, Mode C**



Note: The lower trace (Green) is a reference plot with trace averaging detector.

## 5.2.5 Radiated Spurious Emissions of Transmitter

### RESULT:

**Pass**

Date of testing: 2021-10-11, 2021-10-12, 2021-10-13  
2021-10-14

Ambient temperature: 23, 23, 20, 22°C  
Relative humidity: 59, 59, 58, 56%  
Atmospheric pressure: 1014, 1018, 1020, 1007hPa

Frequency range: 9kHz - 100GHz  
Equipment classification: Class B  
Measurement distance: 3m below 1GHz  
3m above 1GHz  
0.3m above 40GHz  
Kind of test site: Semi Anechoic Chamber

Test mode applied: A, B, C  
Test configuration applied: 1

#### Requirements:

FCC §15.205, §15.209, §15.249, RSS-Gen §8.9 and §8.10 and RSS-210 Annex B.

Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a) and RSS-Gen §8.10 (table 7), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen §8.9 (tables 5 and 6).

Radiated emissions which is outside of the authorized band, shall be attenuated by at least 50dBc or to the general emission, whichever is the lesser attenuation.

#### Test procedure:

ANSI C63.10 §6.3, 6.4, 6.5, 6.6, 6.10, 9 and RSS-Gen §6.13 and 8.1

The EUT was placed on a non-conductive table. The table height was 0.8m for measurements below 1GHz and 1.5m for measurements above 1GHz. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9kHz to 100GHz. Final radiated emission measurements were made at 3m distance below 40GHz and 0.3m above 40GHz.

At each frequency selected for final measurement, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For emissions between 30MHz and 1GHz, measurements were performed with a receiver operating in the CISPR quasi-peak detection mode. The receiver's 6dB bandwidth was set to 120kHz. For emissions above 1GHz, measurements were performed with a spectrum analyzer using the following settings: for peak field strength: RBW = 1MHz & VBW = 3MHz; for average field strength: RBW = 1MHz & VBW = 10Hz.

Absorbers have been placed on the floor between the EUT and the measuring antenna for testing above 1GHz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

No spurious emission was found in the range from 9kHz to 30MHz at 3m measurement distance.

No spurious emission other than the second harmonics was found in the range from 40 to 100GHz.

**Table 12: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A**

| Freq. [MHz] | EUT / Antenna Orientation | Reading QP [dBμV] | Factor [dB(1/m)] | Level QP [dBμV/m] | Limit [dBμV/m] | Margin QP [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 64.488      | Y/V                       | 42.0              | -21.9            | 20.1              | 40.0           | 19.9           | 388         | 359       |
| 64.495      | Y/H                       | 41.5              | -21.9            | 19.6              | 40.0           | 20.4           | 294         | 1         |
| 95.046      | Y/V                       | 41.7              | -26.5            | 15.2              | 43.5           | 28.3           | 366         | 359       |
| 185.248     | Y/V                       | 46.0              | -22.8            | 23.2              | 43.5           | 20.3           | 100         | 188       |
| 235.146     | Y/H                       | 41.3              | -22.2            | 19.1              | 46.0           | 26.9           | 144         | 180       |
| 916.588     | Y/V                       | 31.7              | -8.0             | 23.7              | 46.0           | 22.3           | 368         | 117       |

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

**Table 13: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A**

| Freq. [MHz] | EUT / Antenna Orientation | Reading AV [dBμV] | Factor [dB(1/m)] | Level AV [dBμV/m] | Limit [dBμV/m] | Margin AV [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 2169.184    | Y/V                       | 39.6              | -15.4            | 24.2              | 54.0           | 29.8           | 162         | 195       |
| 7313.726    | Y/H                       | 39.4              | -4.1             | 35.3              | 54.0           | 18.7           | 125         | 181       |
| 12024.080   | Y/H                       | 38.1              | -5.1             | 33.0              | 54.0           | 21.0           | 186         | 125       |
| 12025.721   | Y/V                       | 38.1              | -5.1             | 33.0              | 54.0           | 21.0           | 187         | 1         |
| 21832.752   | Y/H                       | 37.9              | -10.6            | 27.3              | 54.0           | 26.7           | 196         | 348       |
| 26451.532   | Y/V                       | 40.9              | -12.3            | 28.6              | 54.0           | 25.4           | 147         | 242       |
| 36011.964   | Y/V                       | 56.8              | -23.3            | 33.5              | 54.0           | 20.5           | 167         | 292       |

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

**Table 14: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode A**

| Freq. [MHz] | EUT / Antenna Orientation | Reading PK [dBμV] | Factor [dB(1/m)] | Level PK [dBμV/m] | Limit [dBμV/m] | Margin PK [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 2169.184    | Y/V                       | 53.5              | -15.4            | 38.2              | 74.0           | 35.8           | 162         | 195       |
| 7313.726    | Y/H                       | 53.6              | -4.1             | 49.5              | 74.0           | 24.5           | 125         | 181       |
| 12024.080   | Y/H                       | 53.3              | -5.1             | 48.2              | 74.0           | 25.8           | 186         | 125       |
| 12025.721   | Y/V                       | 53.0              | -5.1             | 47.9              | 74.0           | 26.1           | 187         | 1         |
| 21832.752   | Y/H                       | 52.7              | -10.6            | 42.1              | 74.0           | 31.9           | 196         | 348       |
| 26451.532   | Y/V                       | 55.6              | -12.3            | 43.3              | 74.0           | 30.7           | 147         | 242       |
| 36011.964   | Y/V                       | 71.7              | -23.3            | 48.4              | 74.0           | 25.6           | 167         | 292       |

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

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**Table 15: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode B**

| Freq. [MHz] | EUT / Antenna Orientation | Reading QP [dBμV] | Factor [dB(1/m)] | Level QP [dBμV/m] | Limit [dBμV/m] | Margin QP [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 54.077      | Y/V                       | 38.7              | -21.1            | 17.6              | 40.0           | 22.4           | 238         | 359       |
| 64.483      | Y/H                       | 42.0              | -21.9            | 20.1              | 40.0           | 19.9           | 384         | 1         |
| 64.483      | Y/V                       | 42.0              | -21.9            | 20.1              | 40.0           | 19.9           | 388         | 359       |
| 185.245     | Y/V                       | 46.2              | -22.8            | 23.4              | 43.5           | 20.1           | 100         | 182       |
| 235.150     | Y/H                       | 41.0              | -22.2            | 18.8              | 46.0           | 27.2           | 149         | 180       |
| 900.069     | Y/H                       | 35.7              | -8.2             | 27.5              | 46.0           | 18.5           | 105         | 243       |

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

**Table 16: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode B**

| Freq. [MHz] | EUT / Antenna Orientation | Reading AV [dBμV] | Factor [dB(1/m)] | Level AV [dBμV/m] | Limit [dBμV/m] | Margin AV [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 1699.753    | Y/V                       | 40.8              | -18.0            | 22.8              | 54.0           | 31.2           | 100         | 242       |
| 7232.292    | Y/H                       | 39.3              | -4.2             | 35.1              | 54.0           | 18.9           | 167         | 321       |
| 12082.345   | Y/V                       | 37.9              | -4.8             | 33.1              | 54.0           | 20.9           | 124         | 286       |
| 12085.101   | Y/H                       | 37.9              | -4.8             | 33.1              | 54.0           | 20.9           | 173         | 91        |
| 21637.918   | Y/H                       | 41.7              | -10.6            | 31.1              | 54.0           | 22.9           | 179         | 327       |
| 26413.302   | Y/V                       | 46.4              | -12.4            | 34.0              | 54.0           | 20.0           | 191         | 59        |
| 36043.112   | Y/V                       | 57.7              | -23.3            | 34.4              | 54.0           | 19.6           | 189         | 90        |

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

**Table 17: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode B**

| Freq. [MHz] | EUT / Antenna Orientation | Reading PK [dBμV] | Factor [dB(1/m)] | Level PK [dBμV/m] | Limit [dBμV/m] | Margin PK [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 1699.753    | Y/V                       | 55.0              | -18.0            | 37.0              | 74.0           | 37.0           | 100         | 242       |
| 7232.292    | Y/H                       | 54.1              | -4.2             | 49.9              | 74.0           | 24.1           | 167         | 321       |
| 12082.345   | Y/V                       | 52.3              | -4.8             | 47.4              | 74.0           | 26.6           | 124         | 286       |
| 12085.101   | Y/H                       | 52.5              | -4.8             | 47.7              | 74.0           | 26.3           | 173         | 91        |
| 21637.918   | Y/H                       | 56.0              | -10.6            | 45.3              | 74.0           | 28.7           | 179         | 327       |
| 26413.302   | Y/V                       | 61.2              | -12.4            | 48.8              | 74.0           | 25.2           | 191         | 59        |
| 36043.112   | Y/V                       | 73.1              | -23.3            | 49.8              | 74.0           | 24.2           | 189         | 90        |

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

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**Table 18: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode C**

| Freq. [MHz] | EUT / Antenna Orientation | Reading QP [dBμV] | Factor [dB(1/m)] | Level QP [dBμV/m] | Limit [dBμV/m] | Margin QP [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 64.472      | Y/H                       | 42.0              | -21.9            | 20.1              | 40.0           | 19.9           | 400         | 1         |
| 64.485      | Y/V                       | 42.0              | -21.9            | 20.1              | 40.0           | 19.9           | 395         | 1         |
| 185.247     | Y/H                       | 38.9              | -22.8            | 16.1              | 43.5           | 27.4           | 205         | 255       |
| 185.247     | Y/V                       | 46.3              | -22.8            | 23.5              | 43.5           | 20.0           | 100         | 182       |
| 235.148     | Y/H                       | 41.2              | -22.2            | 19.0              | 46.0           | 27.0           | 149         | 180       |
| 888.756     | Y/V                       | 32.0              | -8.5             | 23.5              | 46.0           | 22.5           | 257         | 315       |

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

**Table 19: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode C**

| Freq. [MHz] | EUT / Antenna Orientation | Reading AV [dBμV] | Factor [dB(1/m)] | Level AV [dBμV/m] | Limit [dBμV/m] | Margin AV [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 1699.851    | Y/V                       | 41.0              | -18.0            | 23.0              | 54.0           | 31.0           | 102         | 23        |
| 7184.289    | Y/H                       | 39.6              | -4.2             | 35.4              | 54.0           | 18.6           | 161         | 193       |
| 12122.844   | Y/H                       | 37.7              | -4.9             | 32.8              | 54.0           | 21.2           | 154         | 58        |
| 12127.382   | Y/V                       | 37.7              | -4.9             | 32.8              | 54.0           | 21.2           | 198         | 322       |
| 21462.088   | Y/V                       | 41.8              | -10.6            | 31.2              | 54.0           | 22.8           | 179         | 187       |
| 26379.048   | Y/H                       | 46.4              | -12.5            | 33.9              | 54.0           | 20.1           | 168         | 343       |
| 35823.344   | Y/V                       | 54.9              | -23.0            | 31.9              | 54.0           | 22.1           | 189         | 341       |

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

**Table 20: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Mode C**

| Freq. [MHz] | EUT / Antenna Orientation | Reading PK [dBμV] | Factor [dB(1/m)] | Level PK [dBμV/m] | Limit [dBμV/m] | Margin PK [dB] | Height [cm] | Angle [°] |
|-------------|---------------------------|-------------------|------------------|-------------------|----------------|----------------|-------------|-----------|
| 1699.851    | Y/V                       | 55.1              | -18.0            | 37.1              | 74.0           | 36.9           | 102         | 23        |
| 7184.289    | Y/H                       | 53.4              | -4.2             | 49.2              | 74.0           | 24.8           | 161         | 193       |
| 12122.844   | Y/H                       | 52.1              | -4.9             | 47.3              | 74.0           | 26.7           | 154         | 58        |
| 12127.382   | Y/V                       | 52.4              | -4.9             | 47.5              | 74.0           | 26.5           | 198         | 322       |
| 21462.088   | Y/V                       | 56.4              | -10.6            | 45.8              | 74.0           | 28.2           | 179         | 187       |
| 26379.048   | Y/H                       | 61.0              | -12.5            | 48.5              | 74.0           | 25.5           | 168         | 343       |
| 35823.344   | Y/V                       | 71.6              | -23.0            | 48.6              | 74.0           | 25.4           | 189         | 341       |

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log<sub>10</sub>(uV/m)

**Table 21: Radiated Emissions of the Harmonics of Fundamental, Average Data**

| Mode | Frequency [GHz] | EUT / Ant. Orientation | Reading PK (*) [dBμV/m] | Distance Conversion Factor [dB] | DCCF [dB] | Level AV at 3m [dBμV/m] | AV Limit at 3m [dBμV/m] | Margin AV [dB] |
|------|-----------------|------------------------|-------------------------|---------------------------------|-----------|-------------------------|-------------------------|----------------|
| A    | 48.11935950     | Y/V                    | 86.40                   | -20                             | -20.34    | 46.06                   | 67.95                   | 21.89          |
|      | 48.14907160     | Y/V                    | 86.22                   | -20                             | -20.45    | 45.77                   | 67.95                   | 22.18          |
| B    | 48.31123350     | Y/V                    | 84.62                   | -20                             | -20.36    | 44.26                   | 67.95                   | 23.69          |
|      | 48.34096980     | Y/V                    | 84.89                   | -20                             | -20.12    | 44.77                   | 67.95                   | 23.18          |
| C    | 48.44689050     | Y/V                    | 85.25                   | -20                             | -20.19    | 45.06                   | 67.95                   | 22.89          |
|      | 48.47696290     | Y/V                    | 86.18                   | -20                             | -20.30    | 45.88                   | 67.95                   | 22.07          |

Note: (\*) Distance Conversion Factor and DCCF were applied to Reading PK value in order to determine an average field strength level. See the section 5.2.1 of this test report for each observed duty cycle and their DCCF.

Distance Conversion Factor was calculated by the following formula;

- Distance conversion factor =  $20 \times \log_{10} (d / 3) = 20 \times \log_{10} (0.3 / 3) = -20$  [dB],  
where d = measurement distance in m

Level AV at 3m was calculated by the following formula;

- Level AV at 3m = Reading PK + Distance Conversion Factor + DCCF

3<sup>rd</sup> and 4<sup>th</sup> harmonics were not observed.

**Table 22: Radiated Emissions of the Harmonics of Fundamental, Peak Data**

| Mode | Frequency [GHz] | EUT / Ant. Orientation | Reading PK [dBμV/m] | Distance Conversion Factor [dB] | Level PK at 3m [dBμV/m] | PK Limit at 3m [dBμV/m] | Margin PK [dB] |
|------|-----------------|------------------------|---------------------|---------------------------------|-------------------------|-------------------------|----------------|
| A    | 48.11935950     | Y/V                    | 86.40               | -20                             | 66.40                   | 87.95                   | 21.55          |
|      | 48.14907160     | Y/V                    | 86.22               | -20                             | 66.22                   | 87.95                   | 21.73          |
| B    | 48.31123350     | Y/V                    | 84.62               | -20                             | 64.62                   | 87.95                   | 23.33          |
|      | 48.34096980     | Y/V                    | 84.89               | -20                             | 64.89                   | 87.95                   | 23.06          |
| C    | 48.44689050     | Y/V                    | 85.25               | -20                             | 65.25                   | 87.95                   | 22.70          |
|      | 48.47696290     | Y/V                    | 86.18               | -20                             | 66.18                   | 87.95                   | 21.77          |

Note: Distance Conversion Factor was calculated by the following formula;

- Distance conversion factor =  $20 \times \log_{10} (d / 3) = 20 \times \log_{10} (0.3 / 3) = -20$  [dB],  
where d = measurement distance in m

3<sup>rd</sup> and 4<sup>th</sup> harmonics were not observed.

**Table 23: Radiated Emissions at Band Edge, Average Data**

| Mode | Frequency [GHz] | EUT / Antenna Orientation | Level PK [dBµV/m] | DCCF [dB] | Level AV [dBµV/m] | Limit AV [dBµV/m] | Margin AV [dB] |
|------|-----------------|---------------------------|-------------------|-----------|-------------------|-------------------|----------------|
| A    | 23.995562       | Y/V                       | 54.77             | -20.34    | 34.43             | 54.0              | 19.57          |
| C    | 24.250686       | Y/V                       | 70.64             | -20.30    | 50.34             | 54.0              | 3.66 (*)       |

Note: The worst case was observed at vertical orientation and then was reported.

Average Level was calculated by the following formula;

- Average Level at 3m = Level PK + DCCF

(\*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

**Table 24: Radiated Emissions at Band Edge, Peak Data**

| Mode | Frequency [GHz] | EUT / Antenna Orientation | Level PK [dBµV/m] | Limit PK [dBµV/m] | Margin PK [dB] | Remark          |
|------|-----------------|---------------------------|-------------------|-------------------|----------------|-----------------|
| A    | 23.995562       | Y/V                       | 54.77             | 74.0              | 19.23          | Plot M1, Fig.17 |
| C    | 24.250686       | Y/V                       | 70.64             | 74.0              | 3.36 (*)       | Plot M3, Fig 18 |

Note: The worst case was observed at vertical orientation and then was reported.

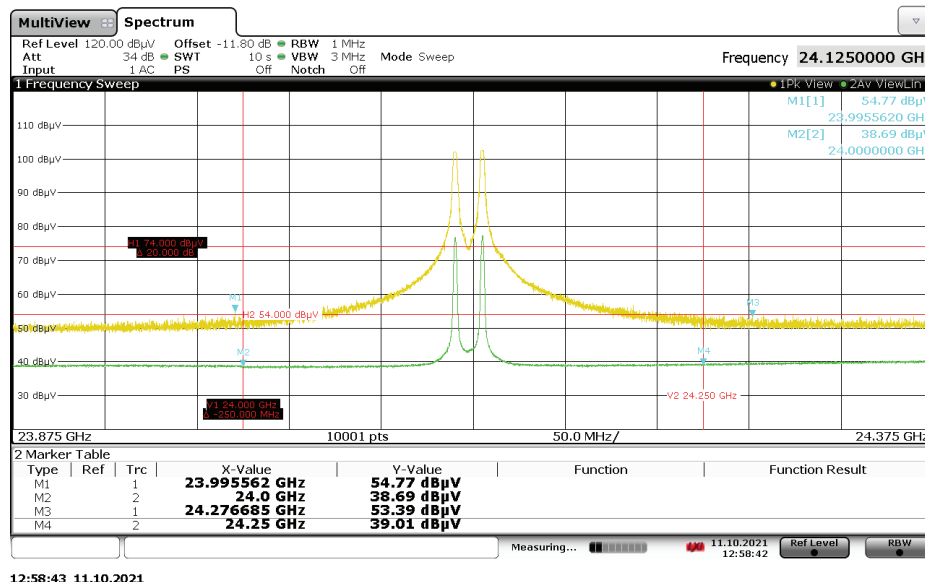
Gray shading data is the highest radiated spurious emission observed in this test report.

(\*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

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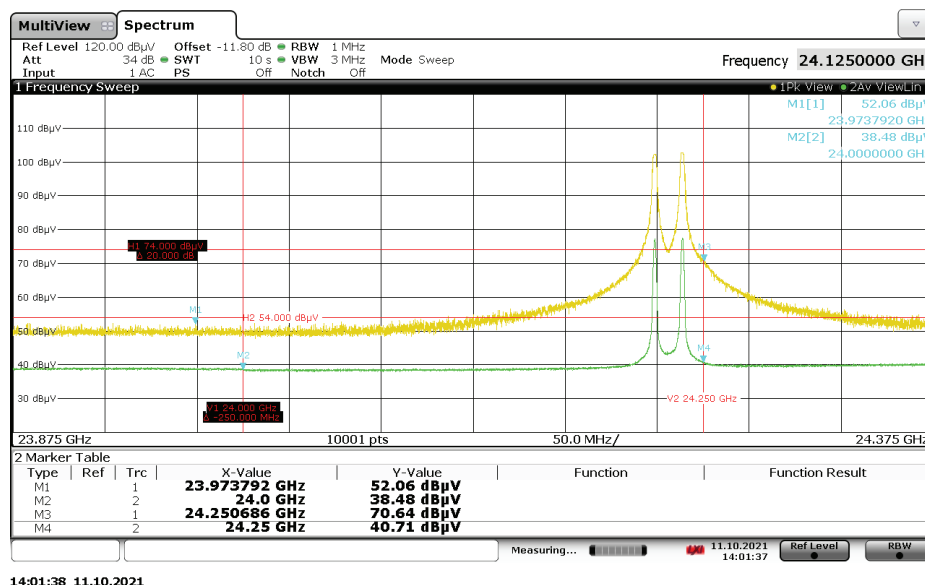
**Figure 17: Radiated Emissions at Band Edge, Spectral Diagram, Mode A**



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Note: The upper trace shows the peak value and the lower trace shows the average value. The lower trace (Green) is a reference plot. Adjacent Restricted-band is from 23.6 to 24.0GHz, therefore, Plots of M3 and M4 (i.e. above 24.25GHz) were taken as reference plot at this mode.

**Figure 18: Radiated Emissions at Band Edge, Spectral Diagram, Mode C**



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Note: The upper trace shows the peak value and the lower trace shows the average value. The lower trace (Green) is a reference plot. Authorized-band band edge is above 24.25GHz, therefore, Plots of M1 and M2 (i.e. below 24.00GHz) were taken as reference plot at this mode.

## 5.3 AC Power Line Conducted Measurements

### 5.3.1 AC Power Line Conducted Emission of Transmitter

**RESULT:**

**Pass**

Date of testing: 2021-10-15

Ambient temperature: 23°C

Relative humidity: 59%

Atmospheric pressure: 1012hPa

Frequency range: 0.15 - 30MHz

Equipment classification: Class B

Kind of test site: Shielded Room

Test mode applied: A, B, C

Test configuration applied: 1

**Requirements:**

FCC §15.207 and RSS-Gen §8.8

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC §15.207 and RSS-Gen §8.8 (table 4).

**Test procedure:**

ANSI C63.10 §6.2 and RSS-Gen §8.1

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The AC adapter of the EUT was connected to a Line Impedance Stabilization Network (LISN).

The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with a receiver operating in the CISPR quasi-peak and average detection modes. The receiver's 6dB bandwidth was set to 9kHz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

**Table 25: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode A**

| Freq. [MHz] | Phase | Reading QP [dBµV] | Reading AV [dBµV] | Factor [dB] | Level QP [dBµV] | Level AV [dBµV] | Limit QP [dBµV] | Limit AV [dBµV] | Margin QP [dB] | Margin AV [dB] |
|-------------|-------|-------------------|-------------------|-------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|
| 0.32300     | N     | 17.4              | -1.9              | 9.6         | 27.0            | 7.7             | 59.6            | 49.6            | 32.6           | 41.9           |
| 4.26100     | N     | 14.5              | 3.9               | 9.8         | 24.3            | 13.7            | 56.0            | 46.0            | 31.7           | 32.3           |
| 22.44800    | N     | 28.0              | 24.4              | 10.4        | 38.4            | 34.8            | 60.0            | 50.0            | 21.6           | 15.2           |
| 23.92400    | N     | 40.1              | 31.0              | 10.4        | 50.5            | 41.4            | 60.0            | 50.0            | 9.5            | 8.6            |
| 0.15600     | L1    | 19.6              | 2.6               | 9.6         | 29.2            | 12.2            | 65.7            | 55.7            | 36.5           | 43.5           |
| 4.52300     | L1    | 14.7              | 5.3               | 9.8         | 24.5            | 15.1            | 56.0            | 46.0            | 31.5           | 30.9           |
| 22.44700    | L1    | 27.4              | 24.1              | 10.2        | 37.6            | 34.3            | 60.0            | 50.0            | 22.4           | 15.7           |
| 23.86200    | L1    | 41.2              | 39.2              | 10.3        | 51.5            | 49.5            | 60.0            | 50.0            | 8.5            | 0.5 (*)        |

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

(\*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

Gray shading data is the highest conducted emission observed in this test report.

**Table 26: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode B**

| Freq. [MHz] | Phase | Reading QP [dBµV] | Reading AV [dBµV] | Factor [dB] | Level QP [dBµV] | Level AV [dBµV] | Limit QP [dBµV] | Limit AV [dBµV] | Margin QP [dB] | Margin AV [dB] |
|-------------|-------|-------------------|-------------------|-------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|
| 0.26200     | N     | 16.9              | 1.2               | 9.6         | 26.5            | 10.8            | 61.4            | 51.4            | 34.9           | 40.6           |
| 4.24700     | N     | 12.8              | 1.7               | 9.8         | 22.6            | 11.5            | 56.0            | 46.0            | 33.4           | 34.5           |
| 22.44700    | N     | 26.0              | 20.8              | 10.4        | 36.4            | 31.2            | 60.0            | 50.0            | 23.6           | 18.8           |
| 23.92400    | N     | 41.2              | 39.0              | 10.4        | 51.6            | 49.4            | 60.0            | 50.0            | 8.4            | 0.6 (*)        |
| 0.15300     | L1    | 18.8              | 1.5               | 9.6         | 28.4            | 11.1            | 65.8            | 55.8            | 37.4           | 44.7           |
| 4.52400     | L1    | 11.5              | 2.2               | 9.8         | 21.3            | 12.0            | 56.0            | 46.0            | 34.7           | 34.0           |
| 22.55300    | L1    | 27.2              | 24.5              | 10.2        | 37.4            | 34.7            | 60.0            | 50.0            | 22.6           | 15.3           |
| 23.92400    | L1    | 40.9              | 38.7              | 10.3        | 51.2            | 49.0            | 60.0            | 50.0            | 8.8            | 1.0 (*)        |

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

(\*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

**Table 27: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode C**

| Freq.<br>[MHz] | Phase | Reading<br>QP<br>[dBµV] | Reading<br>AV<br>[dBµV] | Factor<br>[dB] | Level<br>QP<br>[dBµV] | Level<br>AV<br>[dBµV] | Limit<br>QP<br>[dBµV] | Limit<br>AV<br>[dBµV] | Margin<br>QP<br>[dB] | Margin<br>AV<br>[dB] |
|----------------|-------|-------------------------|-------------------------|----------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------|----------------------|
| 0.18600        | N     | 17.2                    | -2.8                    | 9.6            | 26.8                  | 6.8                   | 64.2                  | 54.2                  | 37.4                 | 47.4                 |
| 13.24700       | N     | 25.6                    | 24.3                    | 10.1           | 35.7                  | 34.4                  | 60.0                  | 50.0                  | 24.3                 | 15.6                 |
| 22.55300       | N     | 28.0                    | 26.5                    | 10.4           | 38.4                  | 36.9                  | 60.0                  | 50.0                  | 21.6                 | 13.1                 |
| 23.86300       | N     | 40.6                    | 36.5                    | 10.4           | 51.0                  | 46.9                  | 60.0                  | 50.0                  | 9.0                  | 3.1                  |
| 0.17100        | L1    | 18.2                    | 1.3                     | 9.6            | 27.8                  | 10.9                  | 64.9                  | 54.9                  | 37.1                 | 44.0                 |
| 4.43300        | L1    | 5.2                     | -2.4                    | 9.8            | 15.0                  | 7.4                   | 56.0                  | 46.0                  | 41.0                 | 38.6                 |
| 22.44700       | L1    | 25.7                    | 21.2                    | 10.2           | 35.9                  | 31.4                  | 60.0                  | 50.0                  | 24.1                 | 18.6                 |
| 23.92500       | L1    | 41.1                    | 39.1                    | 10.3           | 51.4                  | 49.4                  | 60.0                  | 50.0                  | 8.6                  | 0.6 (*)              |

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

(\*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

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– End of test report –