# RADIO TEST REPORT

## Test Report No. 14964542H-A-R2

| | |
|---|---|
| **Customer** | **Fujitsu Component Limited** |
| **Description of EUT** | **Bluetooth Low Energy Enable Module** |
| **Model Number of EUT** | **FWM7BLZ23** |
| **FCC ID** | **SQK-7BLZ23** |
| **Test Regulation** | **FCC Part 15 Subpart C** |
| **Test Result** | **Complied** |
| **Issue Date** | **October 19, 2023** |
| **Remarks** | **-** |

| **Representative Test Engineer** | **Approved By** |
|---|---|
| Shousei Hamaguchi<br>Engineer | Takumi Shimada<br>Engineer |

CERTIFICATE 5107.02

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.

☒ There is no testing item of "Non-accreditation".

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# REVISION HISTORY

## Original Test Report No.: 14964542H-A

This report is a revised version of 14964542H-A-R1. 14964542H-A-R1 is replaced with this report.

| Revision | Test Report No. | Date | Page Revised Contents |
|---|---|---|---|
| - (Original) | 14964542H-A | October 6, 2023 | - |
| 1 | 14964542H-A-R1 | October 18, 2023 | Correction of Section 2.2 test date due to additional test<br>From September 14 to 20, 2023<br>To September 14 to October 17, 2023 |
| 1 | 14964542H-A-R1 | October 18, 2023 | Deletion of the following sentence from clause 3.1;<br>* Also the EUT complies with FCC Part 15 Subpart B. |
| 1 | 14964542H-A-R1 | October 18, 2023 | Correction of the “FCC Part 15.31 (e)” and “FCC Part 15.203/212 Antenna requirement” in Clause 3.2 |
| 1 | 14964542H-A-R1 | October 18, 2023 | The following changes in Section 4.1<br>- Power setting value correction and *a) addition<br>- the description of Maximum Peak Output Power correction and note *1) addition |
| 1 | 14964542H-A-R1 | October 18, 2023 | Addition of the data for Power setting value: -20 dBm to "Maximum Peak Output Power" and "Average Output Power" tests |
| 1 | 14964542H-A-R1 | October 18, 2023 | Addition of the Test Equipment due to additional test<br>MCC-67, MPM-12, MPM-17 |
| 2 | 14964542H-A-R2 | October 19, 2023 | Addition of the reason for omitting 2 Mbps in Section 4.1. (for Conducted Emission, Radiated Spurious Emission (Below 1 GHz), and Conducted Spurious Emission tests) |
| 2 | 14964542H-A-R2 | October 19, 2023 | Correction of the display digit number for Power setting value: -20dBm data of "Maximum Peak Output Power" and "Average Output Power" tests. |

## Reference: Abbreviations (Including words undescribed in this report)

| | | | |
|---|---|---|---|
| A2LA | The American Association for Laboratory Accreditation | ICES | Interference-Causing Equipment Standard |
| AC | Alternating Current | IEC | International Electrotechnical Commission |
| AFH | Adaptive Frequency Hopping | IEEE | Institute of Electrical and Electronics Engineers |
| AM | Amplitude Modulation | IF | Intermediate Frequency |
| Amp, AMP | Amplifier | ILAC | International Laboratory Accreditation Conference |
| ANSI | American National Standards Institute | ISED | Innovation, Science and Economic Development Canada |
| Ant, ANT | Antenna | ISO | International Organization for Standardization |
| AP | Access Point | JAB | Japan Accreditation Board |
| ASK | Amplitude Shift Keying | LAN | Local Area Network |
| Atten., ATT | Attenuator | LIMS | Laboratory Information Management System |
| AV | Average | MCS | Modulation and Coding Scheme |
| BPSK | Binary Phase-Shift Keying | MRA | Mutual Recognition Arrangement |
| BR | Bluetooth Basic Rate | N/A | Not Applicable |
| BT | Bluetooth | NIST | National Institute of Standards and Technology |
| BT LE | Bluetooth Low Energy | NS | No signal detect. |
| BW | BandWidth | NSA | Normalized Site Attenuation |
| Cal Int | Calibration Interval | NVLAP | National Voluntary Laboratory Accreditation Program |
| CCK | Complementary Code Keying | OBW | Occupied Band Width |
| Ch., CH | Channel | OFDM | Orthogonal Frequency Division Multiplexing |
| CISPR | Comite International Special des Perturbations Radioelectriques | P/M | Power meter |
| CW | Continuous Wave | PCB | Printed Circuit Board |
| DBPSK | Differential BPSK | PER | Packet Error Rate |
| DC | Direct Current | PHY | Physical Layer |
| D-factor | Distance factor | PK | Peak |
| DFS | Dynamic Frequency Selection | PN | Pseudo random Noise |
| DQPSK | Differential QPSK | PRBS | Pseudo-Random Bit Sequence |
| DSSS | Direct Sequence Spread Spectrum | PSD | Power Spectral Density |
| EDR | Enhanced Data Rate | QAM | Quadrature Amplitude Modulation |
| EIRP, e.i.r.p. | Equivalent Isotropically Radiated Power | QP | Quasi-Peak |
| EMC | ElectroMagnetic Compatibility | QPSK | Quadri-Phase Shift Keying |
| EMI | ElectroMagnetic Interference | RBW | Resolution Band Width |
| EN | European Norm | RDS | Radio Data System |
| ERP, e.r.p. | Effective Radiated Power | RE | Radio Equipment |
| EU | European Union | RF | Radio Frequency |
| EUT | Equipment Under Test | RMS | Root Mean Square |
| Fac. | Factor | RSS | Radio Standards Specifications |
| FCC | Federal Communications Commission | Rx | Receiving |
| FHSS | Frequency Hopping Spread Spectrum | SA, S/A | Spectrum Analyzer |
| FM | Frequency Modulation | SG | Signal Generator |
| Freq. | Frequency | SVSWR | Site-Voltage Standing Wave Ratio |
| FSK | Frequency Shift Keying | TR | Test Receiver |
| GFSK | Gaussian Frequency-Shift Keying | Tx | Transmitting |
| GNSS | Global Navigation Satellite System | VBW | Video BandWidth |
| GPS | Global Positioning System | Vert. | Vertical |
| Hori. | Horizontal | WLAN | Wireless LAN |

## CONTENTS PAGE

# SECTION 1: Customer Information

| | |
|---|---|
| Company Name | Fujitsu Component Limited |
| Address | Shinagawa Seaside Park Tower, 12-4, Higashi-shinagawa 4-chome, Shinagawa-ku, Tokyo, 140-8586, Japan |
| Telephone Number | +81-3-3450-1639 |
| Contact Person | Koichi Nishizawa |

The information provided from the customer is as follows;
- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

# SECTION 2: Equipment Under Test (EUT)

## 2.1 Identification of EUT

| | |
|---|---|
| Description | Bluetooth Low Energy Enable Module |
| Model Number | FWM7BLZ23 |
| Serial Number | Refer to SECTION 4.2 |
| Condition | Production prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification | No Modification by the test lab |
| Receipt Date | September 8, 2023 |
| Test Date | September 14 to October 17, 2023 |

## 2.2 Product Description

### General Specification

| | |
|---|---|
| Rating | DC 3.0 V (DC 1.7 V to DC 3.6 V) |
| Operating temperature | -40 deg. C to +85 deg. C |

### Radio Specification

**Bluetooth (Low Energy)**

| | |
|---|---|
| Equipment Type | Transceiver |
| Frequency of Operation | 2402 MHz to 2480 MHz |
| Type of Modulation | GFSK |
| Antenna Gain | -0.7 dBi |

# SECTION 3: Test Specification, Procedures & Results

## 3.1 Test Specification

| | |
|---|---|
| Test Specification | FCC Part 15 Subpart C<br>The latest version on the first day of the testing period |
| Title | FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators<br>Section 15.207 Conducted limits<br>Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz |

## 3.2 Procedures and Results

| Item | Test Procedure | Specification | Worst Margin | Results | Remarks |
|---|---|---|---|---|---|
| Conducted Emission | **FCC:** ANSI C63.10-2013 6. Standard test methods | **FCC:** Section 15.207 | 12.33 dB,<br>3.73400 MHz, AV<br>Phase N | Complied | - |
| | **ISED:** RSS-Gen 8.8 | **ISED:** RSS-Gen 8.8 | | | |
| 6dB Bandwidth | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section 15.247(a)(2) | See data. | Complied | Conducted |
| | **ISED:** - | **ISED:** RSS-247 5.2(a) | | | |
| Maximum Peak Output Power | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section 15.247(b)(3) | | Complied | Conducted |
| | **ISED:** RSS-Gen 6.12 | **ISED:** RSS-247 5.4(d) | | | |
| Power Density | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section 15.247(e) | | Complied | Conducted |
| | **ISED:** - | **ISED:** RSS-247 5.2(b) | | | |
| Spurious Emission Restricted Band Edges | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section15.247(d) | 0.4 dB<br>7206.0 MHz, AV | Complied | Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1) |
| | **ISED:** RSS-Gen 6.13 | **ISED:** RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10 | | | |

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.
* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

**FCC Part 15.31 (e)**

The RF Module has its own regulator.
The RF Module is constantly provided with voltage through the regulator regardless of input voltage.
Therefore, this EUT complies with the requirement.

**FCC Part 15.203/212 Antenna requirement**

The antenna is not removable from the EUT.
Therefore, the equipment complies with the antenna requirement of Section 15.203.

## 3.3 Addition to Standard

| Item | Test Procedure | Specification | Worst Margin | Results | Remarks |
|---|---|---|---|---|---|
| 99% Occupied Bandwidth | **ISED:** RSS-Gen 6.7 | **ISED:** - | N/A | - | Conducted |

Other than above, no addition, exclusion nor deviation has been made from the standard.

### 3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k$ = 2.

**Conducted emission**

| Item | Frequency Range | Unit | Calculated Uncertainty (+/-) |
|---|---|---|---|
| AMN (LISN) | 0.009 MHz to 0.15 MHz | dB | 3.7 |
| | 0.15 MHz to 30 MHz | dB | 3.3 |

**Radiated emission**

| Measurement distance | Frequency Range | | Unit | Calculated Uncertainty (+/-) |
|---|---|---|---|---|
| 3 m | 9 kHz to 30 MHz | | dB | 3.3 |
| 10 m | | | dB | 3.1 |
| 3 m | 30 MHz to 200 MHz | Horizontal | dB | 4.8 |
| | | Vertical | dB | 5.0 |
| | 200 MHz to 1000 MHz | Horizontal | dB | 5.1 |
| | | Vertical | dB | 6.2 |
| 10 m | 30 MHz to 200 MHz | Horizontal | dB | 4.8 |
| | | Vertical | dB | 4.8 |
| | 200 MHz to 1000 MHz | Horizontal | dB | 4.9 |
| | | Vertical | dB | 5.0 |
| 3 m | 1 GHz to 6 GHz | | dB | 4.9 |
| | 6 GHz to 18 GHz | | dB | 5.2 |
| 1 m | 10 GHz to 26.5 GHz | | dB | 5.5 |
| | 26.5 GHz to 40 GHz | | dB | 5.4 |
| 10 m | 1 GHz to 18 GHz | | dB | 5.3 |

**Antenna Terminal Conducted Tests**

| Item | Unit | Calculated Uncertainty (+/-) |
|---|---|---|
| Antenna Terminated Conducted Emission / Power Density / Burst Power | dB | 3.28 |
| Adjacent Channel Power (ACP) | dB | 2.27 |
| Bandwidth (OBW) | % | 0.96 |
| Time Readout (Time span upto 100 msec) | % | 0.11 |
| Time Readout (Time span upto 1000 msec) | % | 0.11 |
| Time Readout (Time span upto 60 sec) | % | 0.02 |
| Power Measurement (Power meter) | dB | 1.50 |
| Frequency Readout (Frequency counter) | ppm | 0.67 |
| Frequency Readout (Spectrum analyzer frequency readout function) | ppm | 1.61 |
| Temperature (Constant temperature bath) | deg. C | 0.78 |
| Humidity (Constant temperature bath) | %RH | 2.80 |
| Modulation Characteristics | % | 6.93 |
| Frequency for Mobile | ppm | 0.08 |

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan
Telephone: +81-596-24-8999
A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919
ISED Lab Company Number: 2973C / CAB identifier: JP0002

| Test site | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms | Maximum measurement distance |
|---|---|---|---|---|
| No.1 semi-anechoic chamber | 19.2 x 11.2 x 7.7 | 7.0 x 6.0 | No.1 Power source room | 10 m |
| No.2 semi-anechoic chamber | 7.5 x 5.8 x 5.2 | 4.0 x 4.0 | - | 3 m |
| No.3 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.3 Preparation room | 3 m |
| No.3 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.4 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.4 Preparation room | 3 m |
| No.4 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.5 semi-anechoic chamber | 6.0 x 6.0 x 3.9 | 6.0 x 6.0 | - | - |
| No.5 measurement room | 6.4 x 6.4 x 3.0 | 6.4 x 6.4 | - | - |
| No.6 shielded room | 4.0 x 4.5 x 2.7 | 4.0 x 4.5 | - | - |
| No.6 measurement room | 4.75 x 5.4 x 3.0 | 4.75 x 4.15 | - | - |
| No.7 shielded room | 4.7 x 7.5 x 2.7 | 4.7 x 7.5 | - | - |
| No.8 measurement room | 3.1 x 5.0 x 2.7 | 3.1 x 5.0 | - | - |
| No.9 measurement room | 8.8 x 4.6 x 2.8 | 2.4 x 2.4 | - | - |
| No.10 shielded room | 3.8 x 2.8 x 2.8 | 3.8 x 2.8 | - | - |
| No.11 measurement room | 4.0 x 3.4 x 2.5 | N/A | - | - |
| No.12 measurement room | 2.6 x 3.4 x 2.5 | N/A | - | - |
| Large Chamber | 16.9 x 22.1 x 10.17 | 16.9 x 22.1 | - | 10 m |
| Small Chamber | 5.3 x 6.69 x 3.59 | 5.3 x 6.69 | - | - |

* Size of vertical conducting plane (for Conducted Emission test): 2.0 x 3.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

### 3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

# SECTION 4: Operation of EUT during testing

## 4.1 Operating Mode(s)

| Mode | Remarks* |
|---|---|
| Bluetooth Low Energy (BT LE) Low Energy (LE) 1M-PHY<br>- Uncoded PHY (1 Mbps)<br>- Coded PHY (500 kbps)<br>- Coded PHY (125 kbps) | Maximum Packet Size, PRBS9 |
| Bluetooth (BT) Low Energy (LE) 2M-PHY<br>- Uncoded PHY (2 Mbps) | Maximum Packet Size, PRBS9 |
| *The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel). | |
| *Power of the EUT was set by the software as follows;<br>Power Setting: 8 dBm (all tests), -20 dBm (Maximum Peak Output Power test only) *a)<br>Software: Direct Test Mode Version: 2.1.0<br>(Date: 2023.06.15, Storage location: Driven by connected PC)<br><br>*This setting of software is the worst case.<br>Any conditions under the normal use do not exceed the condition of setting.<br>In addition, end users cannot change the settings of the output power of the product. | |

*a) All tests were performed with 8 dBm power setting as a representative which was the worst condition after having compared with other power settings.

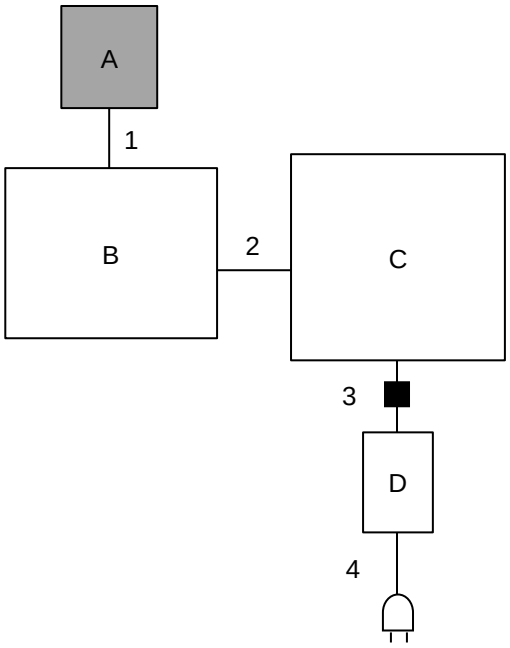
*The Details of Operating Mode(s)

| Test Item | Operating Mode | Tested Frequency |
|---|---|---|
| Maximum Peak Output Power | Tx BT LE<br>1M-PHY Uncoded PHY (1 Mbps) /<br>2M-PHY Uncoded PHY (2 Mbps) | 2402 MHz<br>2440 MHz<br>2480 MHz |
| | 1M-PHY Coded PHY (500 kbps) /<br>1M-PHY Coded PHY (125 kbps) / | 2402 MHz*1) |
| Conducted Emission,<br>Radiated Spurious Emission (Below 1 GHz),<br>Conducted Spurious Emission | Tx BT LE<br>1M-PHY Uncoded PHY (1 Mbps) *2), *3) | 2440 MHz |
| Radiated Spurious Emission (Above 1 GHz),<br>6dB Bandwidth,<br>Power Density,<br>99% Occupied Bandwidth | Tx BT LE<br>1M-PHY Uncoded PHY (1 Mbps) *4)<br>2M-PHY Uncoded PHY (2 Mbps) | 2402 MHz<br>2440 MHz<br>2480 MHz |

*1) For comparison with Uncoded PHY (1 Mbps), Coded PHY (500 kbps) and Coded PHY (125 kbps) were tested only with the channel of 2402 MHz as representative.
*2) Conducted emissions, Spurious emissions for frequencies below 1 GHz, and Conducted Spurious Emission were limited to the channel that had the highest power during the antenna terminal test, as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands.
*3) After the comparison between 1M-PHY Uncoded PHY (1 Mbps), Coded PHY (125 kbps), Coded PHY (500 kbps) and 2M-PHY Uncoded PHY (2 Mbps) all tests were performed with the 1M-PHY Uncoded PHY (1 Mbps) that had higher power as a representative.
*4) After the comparison between 1M-PHY Uncoded PHY (1 Mbps), Coded PHY (125 kbps) and Coded PHY (500 kbps) all tests were performed with the 1M-PHY Uncoded PHY (1 Mbps) that had higher power as a representative.

## 4.2 Configuration and Peripherals

**Conducted Spurious Emission / Radiated Spurious Emission tests**




AC 120 V / 60 Hz

■ : Standard Ferrite Core (detachable)

* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

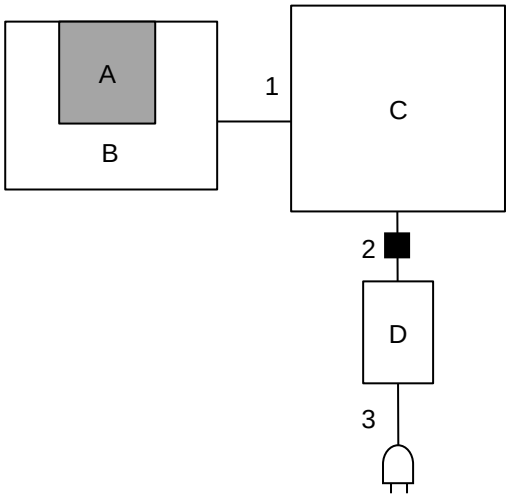
**Description of EUT and Support Equipment**

| No. | Item | Model number | Serial Number | Manufacturer | Remarks |
|---|---|---|---|---|---|
| A | Bluetooth Low Energy Enable Module | FWM7BLZ23 | 8 | Fujitsu Component Limited | EUT |
| B | Jig | - | - | Fujitsu Component Limited | - |
| C | Laptop PC | X1 Carbon | R9-OH8OBW 15/9 | LENOVO | - |
| D | AC Adapter | ADXL45NCC2A | 11S45N0299Z1ZS9 44B6KBR | LENOVO | - |

**List of Cables Used**

| No. | Name | Length (m) | Shield | | Remarks |
|---|---|---|---|---|---|
| | | | Cable | Connector | |
| 1 | Signal Cable | 0.2 | Unshielded | Unshielded | - |
| 2 | USB Cable | 1.0 | Shielded | Shielded | - |
| 3 | DC Cable | 1.7 | Unshielded | Unshielded | - |
| 4 | AC Cable | 1.0 | Unshielded | Unshielded | - |

**Antenna Terminal Conducted Tests**




AC 120 V / 60 Hz

■ : Standard Ferrite Core (detachable)

* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

**Description of EUT and Support Equipment**

| No. | Item | Model number | Serial Number | Manufacturer | Remarks |
|---|---|---|---|---|---|
| A | Bluetooth Low Energy Enable Module | FWM7BLZ23 | 2 | Fujitsu Component Limited | EUT |
| B | Jig | - | - | Fujitsu Component Limited | - |
| C | Laptop PC | X1 Carbon | R9-OH8OBW 15/9 | LENOVO | - |
| D | AC Adapter | ADXL45NCC2A | 11S45N0299Z1ZS9 44B6KBR | LENOVO | - |

**List of Cables Used**

| No. | Name | Length (m) | Shield | | Remarks |
|---|---|---|---|---|---|
| | | | Cable | Connector | |
| 1 | USB Cable | 1.0 | Shielded | Shielded | - |
| 2 | DC Cable | 1.7 | Unshielded | Unshielded | - |
| 3 | AC Cable | 1.0 | Unshielded | Unshielded | - |

## SECTION 5: Conducted Emission

**Test Procedure and Conditions**

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

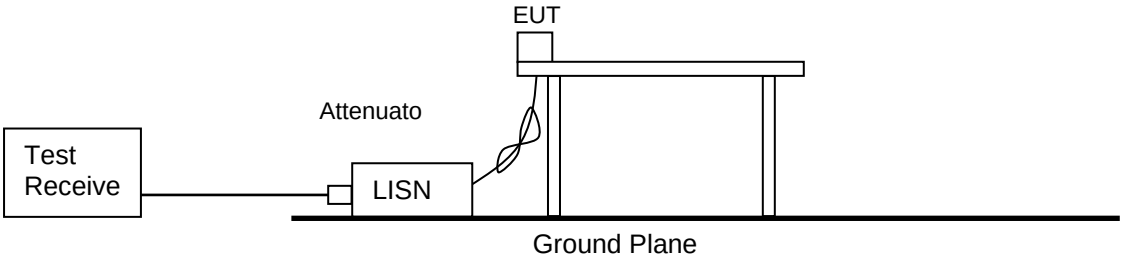
For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.
The EUT was connected to a LISN (Via AC adapter).
An overview sweep with peak detection has been performed.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

**Detector : QP and CISPR AV**
**Measurement Range : 0.15 MHz to 30 MHz**
**Test Data : APPENDIX**
**Test Result : Pass**

**Figure 1: Test Setup**



## SECTION 6: Radiated Spurious Emission

**Test Procedure**

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane. Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

**Test Antennas are used as below;**

| Frequency | Below 30 MHz | 30 MHz to 200 MHz | 200 MHz to 1 GHz | Above 1 GHz |
|---|---|---|---|---|
| Antenna Type | Loop | Biconical | Logperiodic | Horn |

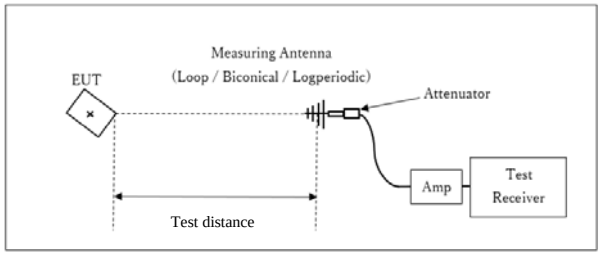
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

**20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).**

| Frequency | Below 1 GHz | Above 1 GHz | | 20 dBc |
|---|---|---|---|---|
| Instrument Used | Test Receiver | Spectrum Analyzer | | Spectrum Analyzer |
| Detector | QP | PK | AV | PK |
| IF Bandwidth | BW 120 kHz | RBW: 1 MHz<br>VBW: 3 MHz | 11.12.2.5.1<br>RBW: 1 MHz<br>VBW: 3 MHz<br>Detector:<br>Power Averaging (RMS)<br>Trace: 100 traces<br>11.12.2.5.2<br>The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results. | RBW: 100 kHz<br>VBW: 300 kHz |

**Figure 2: Test Setup**

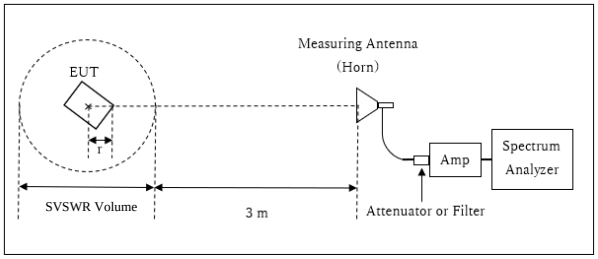
Below 1 GHz




× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



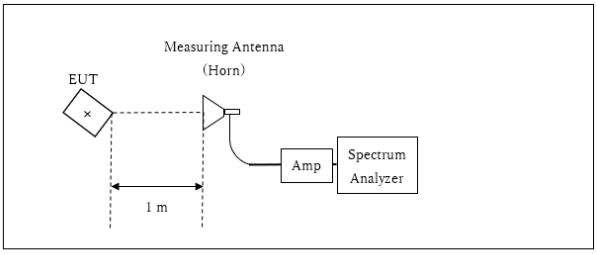

r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (4.0 m / 3.0 m) = 2.50 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 4.0 m

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.0 m

* The test was performed with r = 0.0 m since EUT is small and it was the rather conservative condition.

10 GHz to 26.5 GHz




× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 dB
*Test Distance: 1 m

The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

**Measurement Range : 30 MHz to 26.5 GHz**
**Test Data : APPENDIX**
**Test Result : Pass**

# SECTION 7: Antenna Terminal Conducted Tests

**Test Procedure**

The tests were made with below setting connected to the antenna port.

| Test | Span | RBW | VBW | Sweep time | Detector | Trace | Instrument Used |
|---|---|---|---|---|---|---|---|
| 6dB Bandwidth | 3 MHz | 100 kHz | 300 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| 99% Occupied Bandwidth *1) | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto | Peak | Max Hold | Spectrum Analyzer |
| Maximum Peak Output Power | - | - | - | Auto | Peak/ Average *2) | - | Power Meter (Sensor: 50 MHz BW) |
| Peak Power Density | 1.5 times the 6dB Bandwidth | 3 kHz | 10 kHz | Auto | Peak | Max Hold | Spectrum Analyzer *3) |
| Conducted Spurious Emission *4) *5) | 9 kHz to 150 kHz | 200 Hz | 620 Hz | Auto | Peak | Max Hold | Spectrum Analyzer |
| | 150 kHz to 30 MHz | 9.1 kHz | 27 kHz | | | | |

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)
*5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 - 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

The test results and limit are rounded off to two decimals place, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

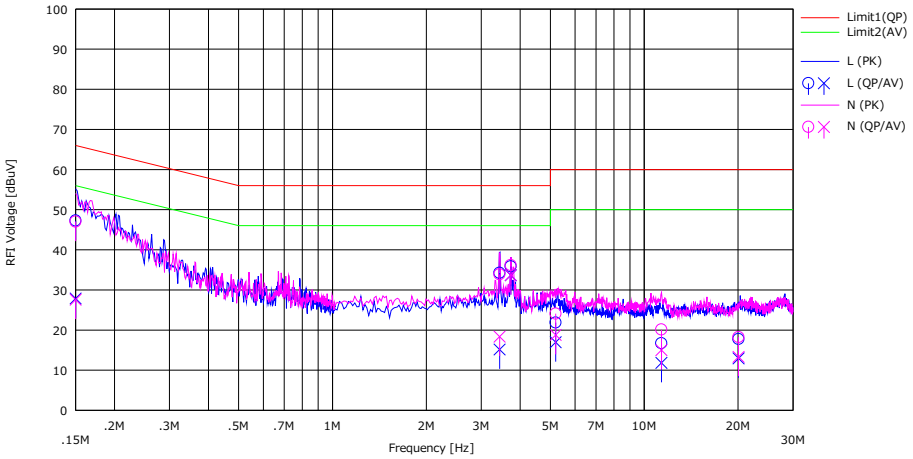
**Test Data : APPENDIX**
**Test Result : Pass**

# APPENDIX 1: Test Data

## Conducted Emission

| | |
|---|---|
| Test place | Ise EMC Lab. No.3 Semi Anechoic Chamber |
| Date | September 20, 2023 |
| Temperature / Humidity | 23 deg. C / 65 % RH |
| Engineer | Takafumi Noguchi |
| Mode | Tx BT LE 1M-PHY 2440 MHz |

Limit : FCC_Part 15 Subpart C(15.207)




| No. | Freq. | Reading ⟨QP⟩ | Reading ⟨AV⟩ | LISN | LOSS | Results ⟨QP⟩ | Results ⟨AV⟩ | Limit ⟨QP⟩ | Limit ⟨AV⟩ | Margin ⟨QP⟩ | Margin ⟨AV⟩ | Phase | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [MHz] | [dBuV] | [dBuV] | [dB] | [dB] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dB] | [dB] | | |
| 1 | 0.15000 | 34.10 | 14.70 | 0.03 | 13.13 | 47.26 | 27.86 | 66.00 | 56.00 | 18.74 | 28.14 | L | |
| 2 | 3.43760 | 20.80 | 1.70 | 0.09 | 13.35 | 34.24 | 15.14 | 56.00 | 46.00 | 21.76 | 30.86 | L | |
| 3 | 3.73400 | 22.40 | 20.20 | 0.10 | 13.36 | 35.86 | 33.66 | 56.00 | 46.00 | 20.14 | 12.34 | L | |
| 4 | 5.20100 | 8.30 | 3.40 | 0.13 | 13.43 | 21.86 | 16.96 | 60.00 | 50.00 | 38.14 | 33.04 | L | |
| 5 | 11.35740 | 2.80 | -2.10 | 0.29 | 13.62 | 16.71 | 11.81 | 60.00 | 50.00 | 43.29 | 38.19 | L | |
| 6 | 20.07800 | 3.50 | -1.30 | 0.42 | 13.83 | 17.75 | 12.95 | 60.00 | 50.00 | 42.25 | 37.05 | L | |
| 7 | 0.15000 | 33.80 | 14.40 | 0.06 | 13.13 | 46.99 | 27.59 | 66.00 | 56.00 | 19.01 | 28.41 | N | |
| 8 | 3.43760 | 20.40 | 4.90 | 0.11 | 13.35 | 33.86 | 18.36 | 56.00 | 46.00 | 22.14 | 27.64 | N | |
| 9 | 3.73400 | 22.70 | 20.20 | 0.11 | 13.36 | 36.17 | 33.67 | 56.00 | 46.00 | 19.83 | 12.33 | N | |
| 10 | 5.20012 | 10.50 | 5.20 | 0.14 | 13.43 | 24.07 | 18.77 | 60.00 | 50.00 | 35.93 | 31.23 | N | |
| 11 | 11.35728 | 6.20 | 1.10 | 0.29 | 13.62 | 20.11 | 15.01 | 60.00 | 50.00 | 39.89 | 34.99 | N | |
| 12 | 20.07916 | 4.00 | -0.90 | 0.39 | 13.83 | 18.22 | 13.32 | 60.00 | 50.00 | 41.78 | 36.68 | N | |

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

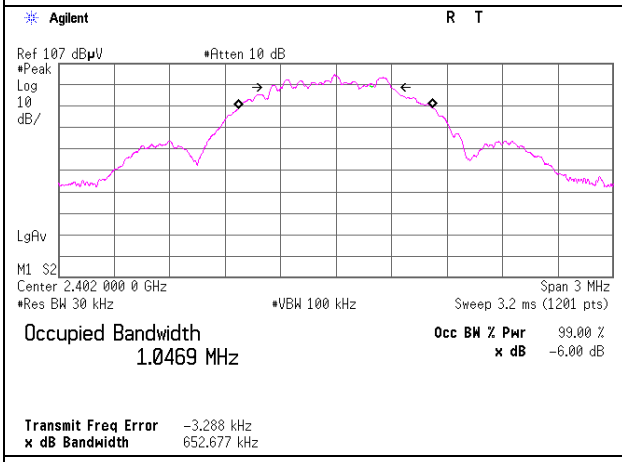
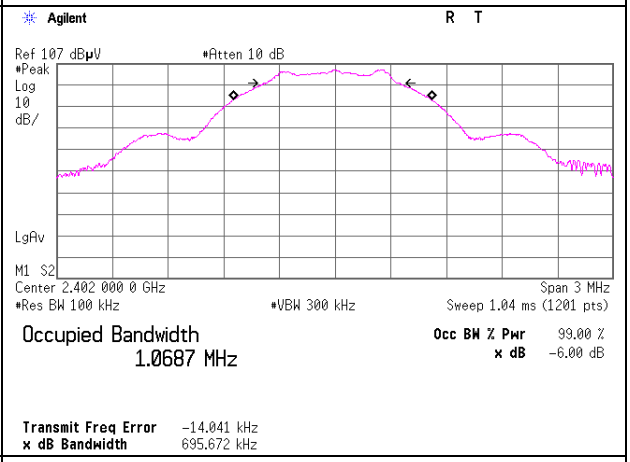
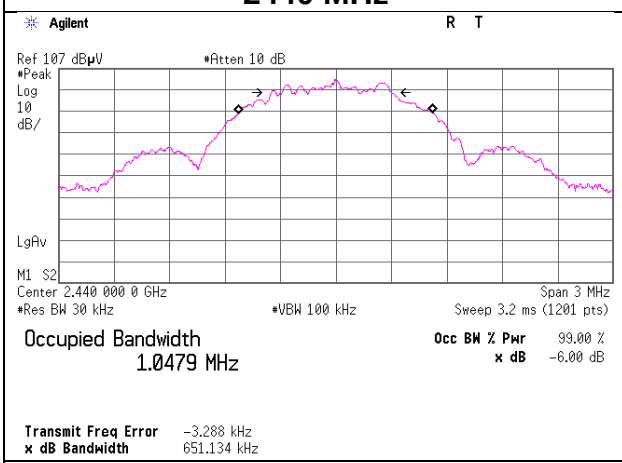
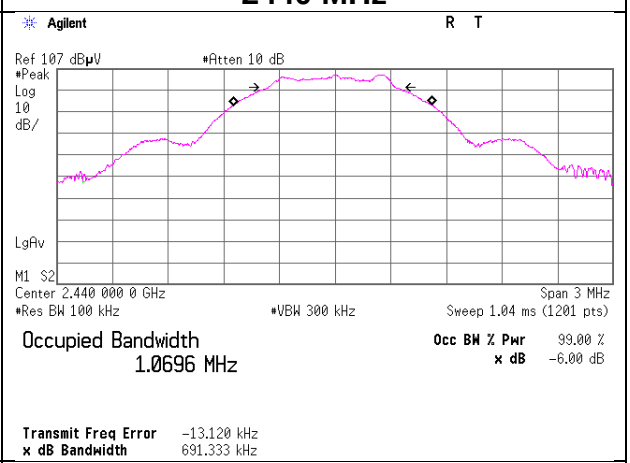
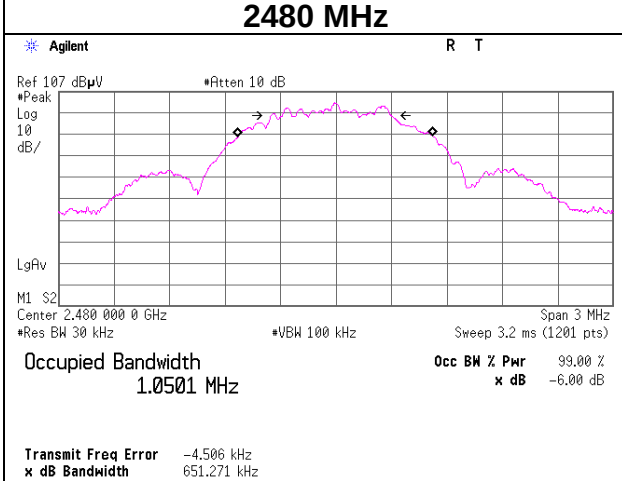
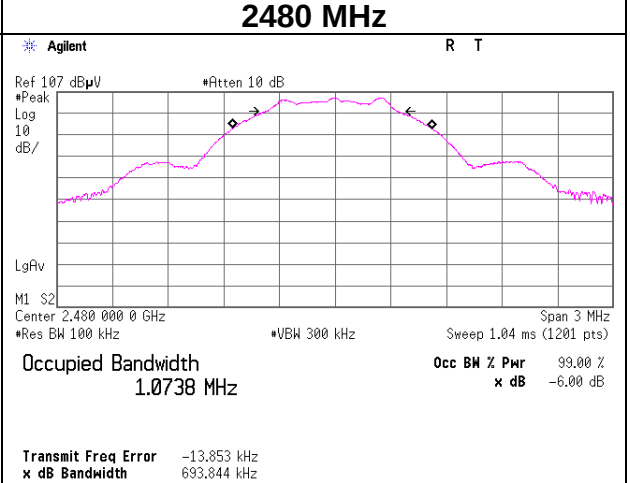
# 99 % Occupied Bandwidth and 6 dB Bandwidth

| | |
|---|---|
| Test place | Ise EMC Lab. No.6 Measurement Room |
| Date | September 14, 2023 |
| Temperature / Humidity | 23 deg. C / 47 % RH |
| Engineer | Shousei Hamaguchi |
| Mode | Tx BT LE |

| Mode | Frequency [MHz] | 99% Occupied Bandwidth [kHz] | 6dB Bandwidth [MHz] | Limit for 6dB Bandwidth [MHz] |
|---|---|---|---|---|
| 1M-PHY | 2402 | 1046.9 | 0.696 | > 0.5000 |
| | 2440 | 1047.9 | 0.691 | > 0.5000 |
| | 2480 | ***1050.1*** | 0.694 | > 0.5000 |
| 2M-PHY | 2402 | 2042.5 | 1.136 | > 0.5000 |
| | 2440 | 2048.8 | 1.159 | > 0.5000 |
| | 2480 | ***2055.0*** | 1.148 | > 0.5000 |

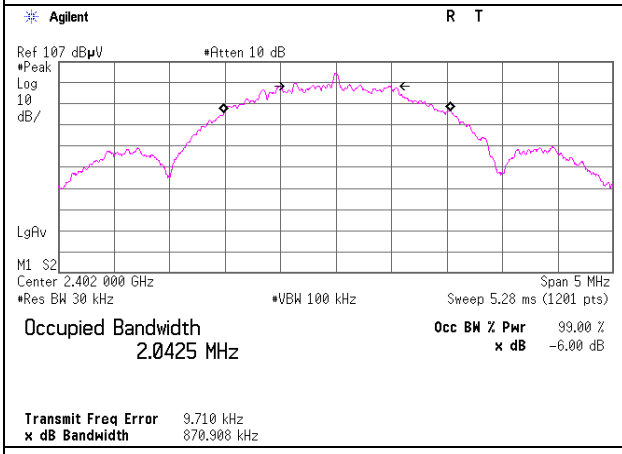
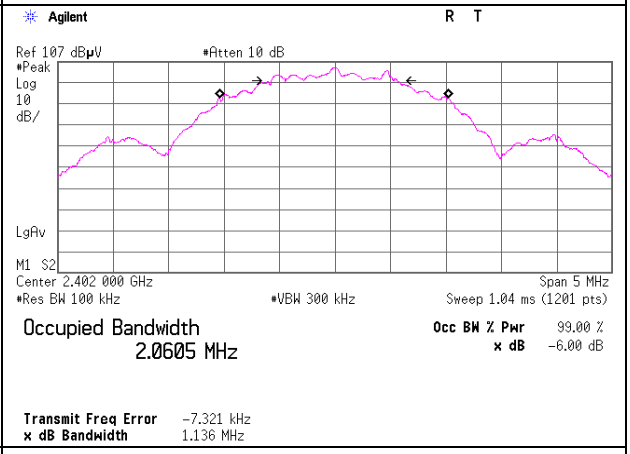
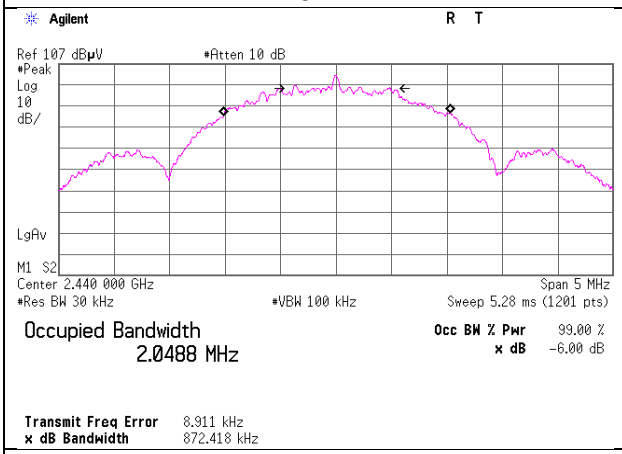
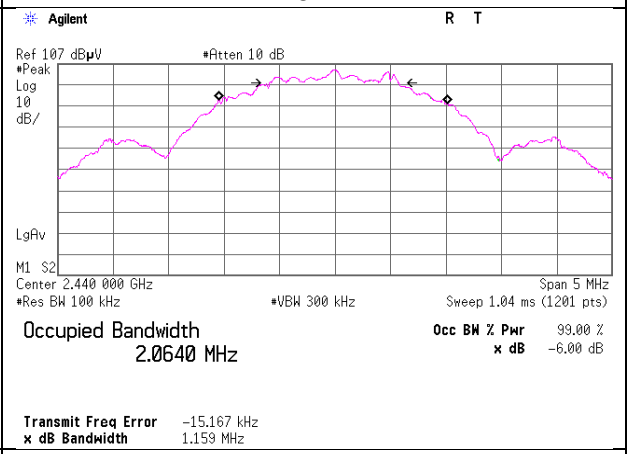
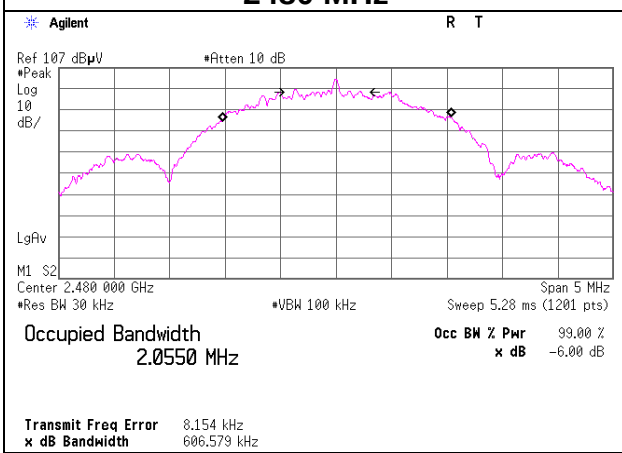
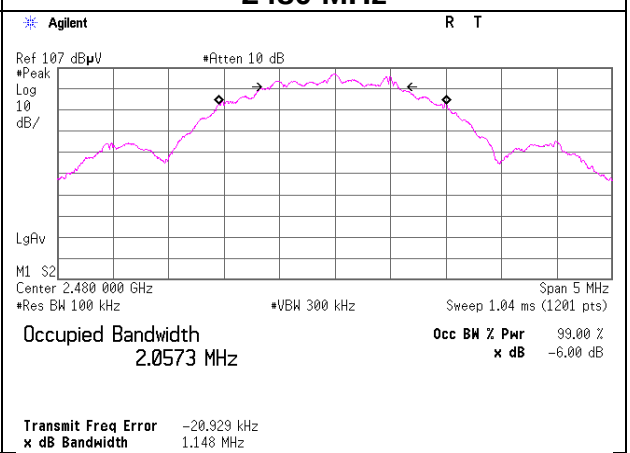
# 99 % Occupied Bandwidth and 6 dB Bandwidth

## 1M-PHY

| 99 % Occupied Bandwidth | 6 dB Bandwidth |
|---|---|
| 2402 MHz | 2402 MHz |
|  |  |
| 2440 MHz | 2440 MHz |
|  |  |
| 2480 MHz | 2480 MHz |
|  |  |

# 99 % Occupied Bandwidth and 6 dB Bandwidth

## 2M-PHY

| 99 % Occupied Bandwidth | 6 dB Bandwidth |
|---|---|
| **2402 MHz** | **2402 MHz** |
|  |  |
| **2440 MHz** | **2440 MHz** |
|  |  |
| **2480 MHz** | **2480 MHz** |
|  |  |

# Maximum Peak Output Power

| | | |
|---|---|---|
| Test place | Ise EMC Lab. No.6 Measurement Room | |
| Date | September 14, 2023 | October 17, 2023 |
| Temperature / Humidity | 23 deg. C / 47 % RH | 23 deg. C / 51 % RH |
| Engineer | Shousei Hamaguchi | Nachi Konegawa |
| Mode | Tx BT LE | |

## Setting value 8 dBm

1M-PHY Uncoded PHY (1 Mbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -3.02 | 1.18 | 9.74 | 7.90 | 6.17 | 30.00 | 1000 | 22.10 | -0.70 | 7.20 | 5.25 | 36.02 | 4000 | 28.82 |
| 2440 | -3.03 | 1.19 | 9.75 | ***7.91*** | ***6.18*** | 30.00 | 1000 | 22.09 | -0.70 | ***7.21*** | ***5.26*** | 36.02 | 4000 | 28.81 |
| 2480 | -3.07 | 1.20 | 9.75 | 7.88 | 6.14 | 30.00 | 1000 | 22.12 | -0.70 | 7.18 | 5.22 | 36.02 | 4000 | 28.84 |

1M-PHY Coded PHY (500 kbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -3.03 | 1.18 | 9.74 | ***7.89*** | ***6.15*** | 30.00 | 1000 | 22.11 | -0.70 | ***7.19*** | ***5.24*** | 36.02 | 4000 | 28.83 |

1M-PHY Coded PHY (125 kbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -3.03 | 1.18 | 9.74 | ***7.89*** | ***6.15*** | 30.00 | 1000 | 22.11 | -0.70 | ***7.19*** | ***5.24*** | 36.02 | 4000 | 28.83 |

2M-PHY Uncoded PHY (2 Mbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -3.03 | 1.18 | 9.74 | 7.89 | 6.15 | 30.00 | 1000 | 22.11 | -0.70 | 7.19 | 5.24 | 36.02 | 4000 | 28.83 |
| 2440 | -3.04 | 1.19 | 9.75 | ***7.90*** | 6.17 | 30.00 | 1000 | 22.10 | -0.70 | ***7.20*** | ***5.25*** | 36.02 | 4000 | 28.82 |
| 2480 | -3.08 | 1.20 | 9.75 | 7.87 | 6.12 | 30.00 | 1000 | 22.13 | -0.70 | 7.17 | 5.21 | 36.02 | 4000 | 28.85 |

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

## Setting value -20 dBm

1M-PHY Uncoded PHY (1 Mbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -18.54 | 1.65 | 0.00 | ***-16.89*** | ***0.020*** | 30.00 | 1000 | 46.89 | -0.70 | ***-17.59*** | ***0.017*** | 36.02 | 4000 | 53.61 |
| 2440 | -18.83 | 1.66 | 0.00 | -17.17 | 0.019 | 30.00 | 1000 | 47.17 | -0.70 | -17.87 | 0.016 | 36.02 | 4000 | 53.89 |
| 2480 | -18.90 | 1.67 | 0.00 | -17.23 | 0.019 | 30.00 | 1000 | 47.23 | -0.70 | -17.93 | 0.016 | 36.02 | 4000 | 53.95 |

1M-PHY Coded PHY (500 kbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -18.63 | 1.65 | 0.00 | ***-16.98*** | ***0.020*** | 30.00 | 1000 | 46.98 | -0.70 | ***-17.68*** | ***0.017*** | 36.02 | 4000 | 53.70 |

1M-PHY Coded PHY (125 kbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -18.65 | 1.65 | 0.00 | ***-17.00*** | ***0.020*** | 30.00 | 1000 | 47.00 | -0.70 | ***-17.70*** | ***0.017*** | 36.02 | 4000 | 53.72 |

2M-PHY Uncoded PHY (2 Mbps)

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power Result | | Conducted Power Limit | | Conducted Power Margin | Antenna Gain | e.i.r.p. for RSS-247 Result | | e.i.r.p. for RSS-247 Limit | | e.i.r.p. for RSS-247 Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -18.63 | 1.65 | 0.00 | ***-16.98*** | 0.020 | 30.00 | 1000 | 46.98 | -0.70 | ***-17.68*** | ***0.017*** | 36.02 | 4000 | 53.70 |
| 2440 | -18.82 | 1.66 | 0.00 | -17.16 | 0.019 | 30.00 | 1000 | 47.16 | -0.70 | -17.86 | 0.016 | 36.02 | 4000 | 53.88 |
| 2480 | -19.01 | 1.67 | 0.00 | -17.34 | 0.018 | 30.00 | 1000 | 47.34 | -0.70 | -18.04 | 0.016 | 36.02 | 4000 | 54.06 |

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

# Average Output Power
# (Reference data for RF Exposure)

| | | |
|---|---|---|
| Test place | Ise EMC Lab. No.6 Measurement Room | |
| Date | September 14, 2023 | October 17, 2023 |
| Temperature / Humidity | 23 deg. C / 47 % RH | 23 deg. C / 51 % RH |
| Engineer | Shousei Hamaguchi | Nachi Konegawa |
| Mode | Tx BT LE | |

## Setting value 8 dBm

1M-PHY

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2402 | -3.82 | 1.18 | 9.74 | 7.10 | 5.13 | 0.67 | 7.77 | 5.98 |
| 2440 | -3.83 | 1.19 | 9.75 | ***7.11*** | ***5.14*** | 0.67 | ***7.78*** | ***6.00*** |
| 2480 | -3.90 | 1.20 | 9.75 | 7.05 | 5.07 | 0.67 | 7.72 | 5.92 |

2M-PHY

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2402 | -5.55 | 1.18 | 9.74 | 5.37 | 3.44 | 2.39 | 7.76 | 5.97 |
| 2440 | -5.56 | 1.19 | 9.75 | ***5.38*** | ***3.45*** | 2.39 | ***7.77*** | ***5.98*** |
| 2480 | -5.60 | 1.20 | 9.75 | 5.35 | 3.43 | 2.39 | 7.74 | 5.94 |

Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

## Setting value -20 dBm

1M-PHY

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2402 | -22.22 | 1.65 | 0.00 | ***-20.57*** | ***0.009*** | 0.67 | ***-19.90*** | ***0.010*** |
| 2440 | -23.64 | 1.66 | 0.00 | -21.98 | 0.006 | 0.67 | -21.31 | 0.007 |
| 2480 | -23.94 | 1.67 | 0.00 | -22.27 | 0.006 | 0.67 | -21.60 | 0.007 |

2M-PHY

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [dBm] | [mW] |
| 2402 | -26.01 | 1.65 | 0.00 | ***-24.36*** | ***0.004*** | 2.39 | ***-21.97*** | ***0.006*** |
| 2440 | -26.44 | 1.66 | 0.00 | -24.78 | 0.003 | 2.39 | -22.39 | 0.006 |
| 2480 | -26.74 | 1.67 | 0.00 | -25.07 | 0.003 | 2.39 | -22.68 | 0.005 |

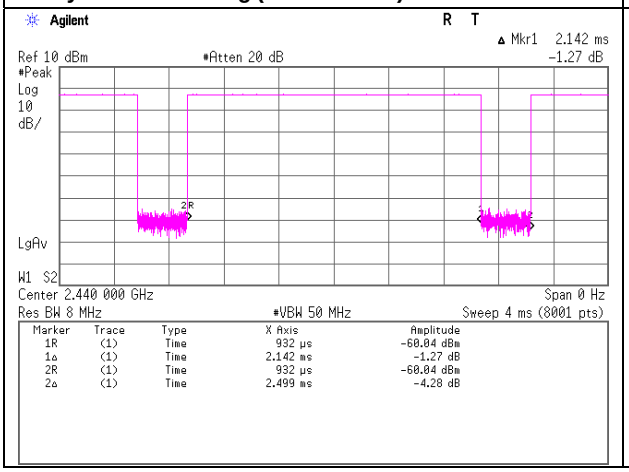
Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

# Burst rate confirmation

| | |
|---|---|
| Test place | Ise EMC Lab. No.6 Measurement Room |
| Date | September 14, 2023 |
| Temperature / Humidity | 23 deg. C / 47 % RH |
| Engineer | Shousei Hamaguchi |
| Mode | Tx BT LE |

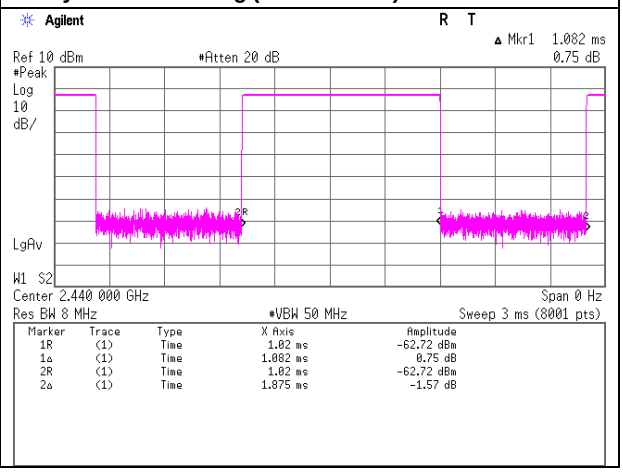
## BT LE 1M-PHY

| | |
|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.857** |
| **Tx on / (Tx on + Tx off) * 100 =** | **85.7 %** |
| **Duty factor = 10 * log (2.499 / 2.142) =** | **0.67 dB** |




## BT LE 2M-PHY

| | |
|---|---|
| **Tx on / (Tx on + Tx off) =** | **0.577** |
| **Tx on / (Tx on + Tx off) * 100 =** | **57.7 %** |
| **Duty factor = 10 * log (1.875 / 1.082) =** | **2.39 dB** |




* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

# Radiated Spurious Emission

| | | |
|---|---|---|
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | September 19, 2023 | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa | Takafumi Noguchi |
| | (1 GHz to 10 GHz) | (Above 10 GHz) |
| Mode | Tx BT LE 1M-PHY 2402 MHz | |

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2338.0 | 53.0 | 49.5 | 27.9 | 5.4 | 32.4 | 0.7 | 53.8 | 51.1 | 73.9 | 53.9 | 20.1 | 2.8 | |
| Hori. | 2390.0 | 43.9 | 35.2 | 27.7 | 5.5 | 32.4 | 0.7 | 44.6 | 36.6 | 73.9 | 53.9 | 29.3 | 17.3 | *1) |
| Hori. | 4804.0 | 43.9 | 35.2 | 31.5 | 7.6 | 31.4 | 0.7 | 51.5 | 43.5 | 73.9 | 53.9 | 22.4 | 10.4 | |
| Hori. | 7206.0 | 46.6 | 39.9 | 35.8 | 8.8 | 32.3 | 0.7 | 58.9 | 52.9 | 73.9 | 53.9 | 15.0 | 1.0 | |
| Hori. | 9608.0 | 43.1 | 32.8 | 38.8 | 9.3 | 32.9 | - | 58.2 | 47.9 | 73.9 | 53.9 | 15.7 | 6.0 | Floor noise |
| Vert. | 2338.0 | 51.6 | 48.4 | 27.9 | 5.4 | 32.4 | 0.7 | 52.5 | 50.0 | 73.9 | 53.9 | 21.4 | 3.9 | |
| Vert. | 2390.0 | 44.1 | 35.6 | 27.7 | 5.5 | 32.4 | 0.7 | 44.8 | 37.0 | 73.9 | 53.9 | 29.1 | 16.9 | *1) |
| Vert. | 4804.0 | 44.8 | 37.2 | 31.5 | 7.6 | 31.4 | 0.7 | 52.5 | 45.5 | 73.9 | 53.9 | 21.4 | 8.4 | |
| Vert. | 7206.0 | 47.8 | 40.5 | 35.8 | 8.8 | 32.3 | 0.7 | 60.1 | 53.5 | 73.9 | 53.9 | 13.8 | 0.4 | |
| Vert. | 9608.0 | 43.1 | 32.8 | 38.8 | 9.3 | 32.9 | - | 58.2 | 47.9 | 73.9 | 53.9 | 15.7 | 6.0 | Floor noise |

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

**20dBc Data Sheet**

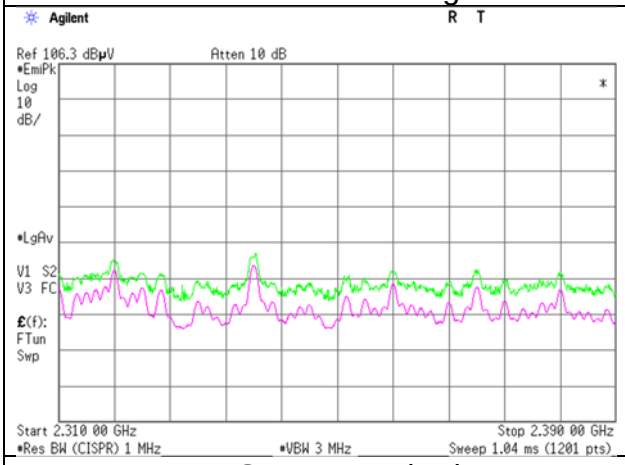
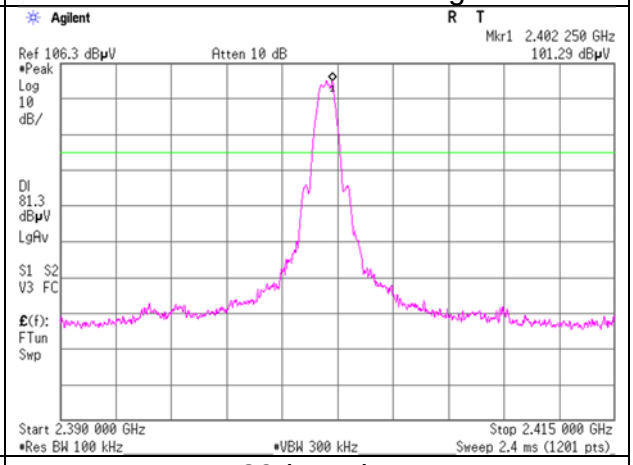
| Polarity [Hori/Vert] | Frequency [MHz] | Reading (PK) [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2402.0 | 101.3 | 27.6 | 5.5 | 32.4 | 102.0 | - | - | Carrier |
| Hori. | 2400.0 | 49.8 | 27.6 | 5.5 | 32.4 | 50.5 | 82.0 | 31.5 | |
| Vert. | 2402.0 | 100.7 | 27.6 | 5.5 | 32.4 | 101.4 | - | - | Carrier |
| Vert. | 2400.0 | 49.4 | 27.6 | 5.5 | 32.4 | 50.1 | 81.4 | 31.3 | |

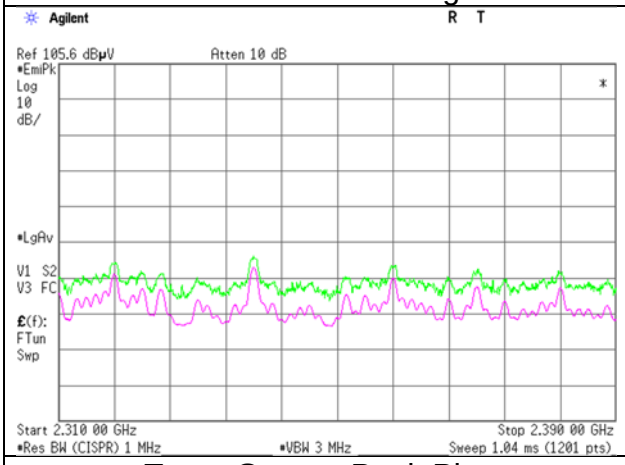
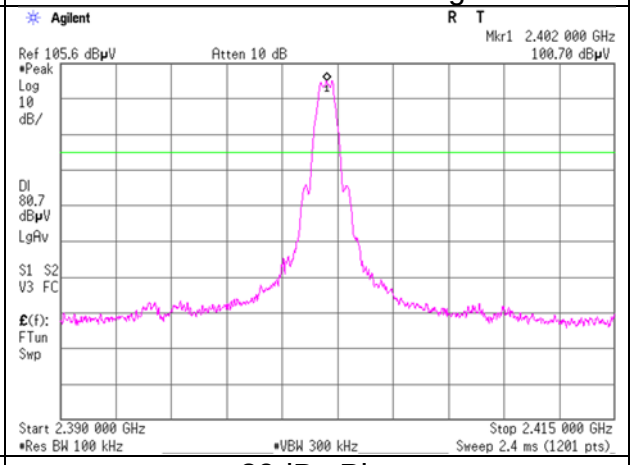
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

# Radiated Spurious Emission
## (Reference Plot for band-edge)

| | |
|---|---|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa |
| | (1 GHz to 10 GHz) |
| Mode | Tx BT LE 1M-PHY 2402 MHz |

| Horizontal | |
|---|---|
| Restricted-band band-edge Plot | Authorized-band band-edge Plot |
|  |  |
| Trace Green : Peak Plot<br>Trace Purple : Average Plot | 20dBc Plot |

| Vertical | |
|---|---|
| Restricted-band band-edge Plot | Authorized-band band-edge Plot |
|  |  |
| Trace Green : Peak Plot<br>Trace Purple : Average Plot | 20dBc Plot |

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

# Radiated Spurious Emission

| | | | |
|---|---|---|---|
| Test place | Ise EMC Lab. | | |
| Semi Anechoic Chamber | No.3 | No.3 | No.3 |
| Date | September 19, 2023 | September 19, 2023 | September 20, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 65 % RH |
| Engineer | Nachi Konegawa | Takafumi Noguchi | Nachi Konegawa |
| | (1 GHz to 10 GHz) | (Above 10 GHz) | (Below 1 GHz) |
| Mode | Tx BT LE 1M-PHY 2440 MHz | | |

| Polarity | Frequency | Reading (QP / PK) | Reading (AV) | Ant. Factor | Loss | Gain | Duty Factor | Result (QP / PK) | Result (AV) | Limit (QP / PK) | Limit (AV) | Margin (QP / PK) | Margin (AV) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [Hori/Vert] | [MHz] | [dBuV] | [dBuV] | [dB/m] | [dB] | [dB] | [dB] | [dBuV/m] | [dBuV/m] | [dBuV/m] | [dBuV/m] | [dB] | [dB] | |
| Hori. | 45.0 | 36.8 | - | 13.0 | 7.2 | 32.2 | - | 24.8 | - | 40.0 | - | 15.2 | - | |
| Hori. | 69.7 | 43.6 | - | 6.4 | 7.5 | 32.2 | - | 25.4 | - | 40.0 | - | 14.6 | - | |
| Hori. | 120.0 | 47.4 | - | 12.9 | 8.1 | 32.1 | - | 36.3 | - | 43.5 | - | 7.2 | - | |
| Hori. | 144.0 | 41.7 | - | 14.7 | 8.4 | 32.1 | - | 32.7 | - | 43.5 | - | 10.9 | - | |
| Hori. | 300.0 | 43.1 | - | 13.5 | 9.7 | 32.0 | - | 34.3 | - | 46.0 | - | 11.7 | - | |
| Hori. | 456.0 | 37.0 | - | 16.7 | 10.7 | 32.0 | - | 32.4 | - | 46.0 | - | 13.6 | - | |
| Hori. | 2375.8 | 53.8 | 50.4 | 27.7 | 5.5 | 32.4 | 0.7 | 54.6 | 51.9 | 73.9 | 53.9 | 19.3 | 2.0 | |
| Hori. | 4880.0 | 42.3 | 34.2 | 31.5 | 7.6 | 31.4 | 0.7 | 50.0 | 42.6 | 73.9 | 53.9 | 23.9 | 11.3 | |
| Hori. | 7320.0 | 46.7 | 39.8 | 36.0 | 8.8 | 32.3 | 0.7 | 59.2 | 52.9 | 73.9 | 53.9 | 14.7 | 1.0 | |
| Hori. | 9760.0 | 42.9 | 32.4 | 39.1 | 9.3 | 33.0 | - | 58.3 | 47.8 | 73.9 | 53.9 | 15.6 | 6.1 | Floor noise |
| Vert. | 45.0 | 46.8 | - | 13.0 | 7.2 | 32.2 | - | 34.8 | - | 40.0 | - | 5.2 | - | |
| Vert. | 69.7 | 48.8 | - | 6.4 | 7.5 | 32.2 | - | 30.6 | - | 40.0 | - | 9.4 | - | |
| Vert. | 120.0 | 42.4 | - | 12.9 | 8.1 | 32.1 | - | 31.3 | - | 43.5 | - | 12.2 | - | |
| Vert. | 144.0 | 31.8 | - | 14.7 | 8.4 | 32.1 | - | 22.8 | - | 43.5 | - | 20.8 | - | |
| Vert. | 300.0 | 33.4 | - | 13.5 | 9.7 | 32.0 | - | 24.6 | - | 46.0 | - | 21.4 | - | |
| Vert. | 444.0 | 35.0 | - | 16.4 | 10.6 | 32.0 | - | 30.0 | - | 46.0 | - | 16.0 | - | |
| Vert. | 2375.8 | 52.3 | 48.4 | 27.7 | 5.5 | 32.4 | 0.7 | 53.1 | 49.8 | 73.9 | 53.9 | 20.8 | 4.1 | |
| Vert. | 4880.0 | 42.1 | 34.5 | 31.5 | 7.6 | 31.4 | 0.7 | 49.8 | 42.8 | 73.9 | 53.9 | 24.1 | 11.1 | |
| Vert. | 7320.0 | 46.9 | 40.0 | 36.0 | 8.8 | 32.3 | 0.7 | 59.4 | 53.1 | 73.9 | 53.9 | 14.5 | 0.8 | |
| Vert. | 9760.0 | 42.9 | 32.4 | 39.1 | 9.3 | 33.0 | - | 58.3 | 47.8 | 73.9 | 53.9 | 15.6 | 6.1 | Floor noise |

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

| | | |
|---|---|---|
| Distance factor: | 1 GHz - 10 GHz | 20log (4 m / 3.0 m) = 2.5 dB |
| | 10 GHz - 26.5 GHz | 20log (1.0 m / 3.0 m) = -9.5 dB |

# Radiated Spurious Emission

| | | |
|---|---|---|
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | September 19, 2023 | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa | Takafumi Noguchi |
| | (1 GHz to 10 GHz) | (Above 10 GHz) |
| Mode | Tx BT LE 1M-PHY 2480 MHz | |

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2372.0 | 54.1 | 50.8 | 27.7 | 5.5 | 32.4 | 0.7 | 54.9 | 52.3 | 73.9 | 53.9 | 19.0 | 1.7 | |
| Hori. | 2483.5 | 49.5 | 37.4 | 27.5 | 5.5 | 32.4 | 0.7 | 50.2 | 38.7 | 73.9 | 53.9 | 23.7 | 15.2 | *1) |
| Hori. | 4960.0 | 44.0 | 36.3 | 31.6 | 7.6 | 31.4 | 0.7 | 51.8 | 44.8 | 73.9 | 53.9 | 22.1 | 9.1 | |
| Hori. | 7440.0 | 46.5 | 39.2 | 36.2 | 8.8 | 32.4 | 0.7 | 59.1 | 52.5 | 73.9 | 53.9 | 14.8 | 1.4 | |
| Hori. | 9920.0 | 43.6 | 35.1 | 39.1 | 9.3 | 33.1 | 0.7 | 59.0 | 51.2 | 73.9 | 53.9 | 14.9 | 2.7 | |
| Vert. | 2372.0 | 53.3 | 47.7 | 27.7 | 5.5 | 32.4 | 0.7 | 54.0 | 49.1 | 73.9 | 53.9 | 19.9 | 4.8 | |
| Vert. | 2483.5 | 48.4 | 36.5 | 27.5 | 5.5 | 32.4 | 0.7 | 49.1 | 37.9 | 73.9 | 53.9 | 24.8 | 16.0 | *1) |
| Vert. | 4960.0 | 43.6 | 35.5 | 31.6 | 7.6 | 31.4 | 0.7 | 51.4 | 44.0 | 73.9 | 53.9 | 22.5 | 9.9 | |
| Vert. | 7440.0 | 47.0 | 39.6 | 36.2 | 8.8 | 32.4 | 0.7 | 59.6 | 52.9 | 73.9 | 53.9 | 14.3 | 1.0 | |
| Vert. | 9920.0 | 44.4 | 36.8 | 39.1 | 9.3 | 33.1 | 0.7 | 59.8 | 52.8 | 73.9 | 53.9 | 14.2 | 1.1 | |

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

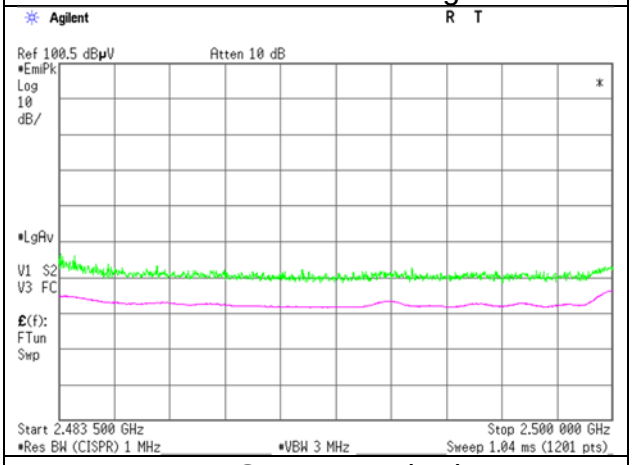
| | | |
|---|---|---|
| Distance factor: | 1 GHz - 10 GHz | 20log (4 m / 3.0 m) = 2.5 dB |
| | 10 GHz - 26.5 GHz | 20log (1.0 m / 3.0 m) = -9.5 dB |

# Radiated Spurious Emission
## (Reference Plot for band-edge)

| | |
|---|---|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa |
| | (1 GHz to 10 GHz) |
| Mode | Tx BT LE 1M-PHY 2480 MHz |

Horizontal

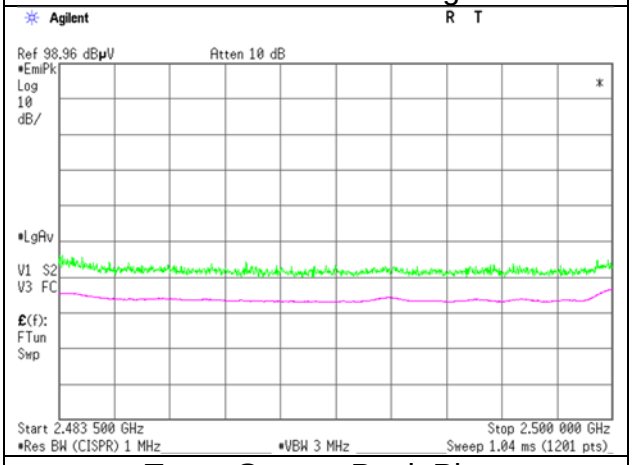
Restricted-band band-edge Plot




Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot




Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

# Radiated Spurious Emission

| | | |
|---|---|---|
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | September 19, 2023 | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa | Takafumi Noguchi |
| | (1 GHz to 10 GHz) | (Above 10 GHz) |
| Mode | Tx BT LE 2M-PHY 2402 MHz | |

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2338.0 | 51.7 | 46.7 | 27.9 | 5.4 | 32.4 | 2.4 | 52.5 | 50.0 | 73.9 | 53.9 | 21.4 | 3.9 | |
| Hori. | 2390.0 | 45.8 | 36.4 | 27.7 | 5.5 | 32.4 | 2.4 | 46.5 | 39.5 | 73.9 | 53.9 | 27.4 | 14.4 | *1) |
| Hori. | 4804.0 | 42.3 | 33.9 | 31.5 | 7.6 | 31.4 | 2.4 | 49.9 | 44.0 | 73.9 | 53.9 | 24.0 | 10.0 | |
| Hori. | 7206.0 | 46.4 | 38.4 | 35.8 | 8.8 | 32.3 | 2.4 | 58.8 | 53.1 | 73.9 | 53.9 | 15.2 | 0.8 | |
| Hori. | 9608.0 | 43.1 | 32.8 | 38.8 | 9.3 | 32.9 | - | 58.2 | 47.9 | 73.9 | 53.9 | 15.7 | 6.0 | Floor noise |
| Vert. | 2338.0 | 51.6 | 45.7 | 27.9 | 5.4 | 32.4 | 2.4 | 52.5 | 49.0 | 73.9 | 53.9 | 21.4 | 4.9 | |
| Vert. | 2390.0 | 45.6 | 36.2 | 27.7 | 5.5 | 32.4 | 2.4 | 46.3 | 39.3 | 73.9 | 53.9 | 27.6 | 14.6 | *1) |
| Vert. | 4804.0 | 43.0 | 35.0 | 31.5 | 7.6 | 31.4 | 2.4 | 50.6 | 45.0 | 73.9 | 53.9 | 23.3 | 8.9 | |
| Vert. | 7206.0 | 46.5 | 38.4 | 35.8 | 8.8 | 32.3 | 2.4 | 58.8 | 53.2 | 73.9 | 53.9 | 15.1 | 0.7 | |
| Vert. | 9608.0 | 43.1 | 32.8 | 38.8 | 9.3 | 32.9 | - | 58.2 | 47.9 | 73.9 | 53.9 | 15.7 | 6.0 | Floor noise |

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

**20dBc Data Sheet**

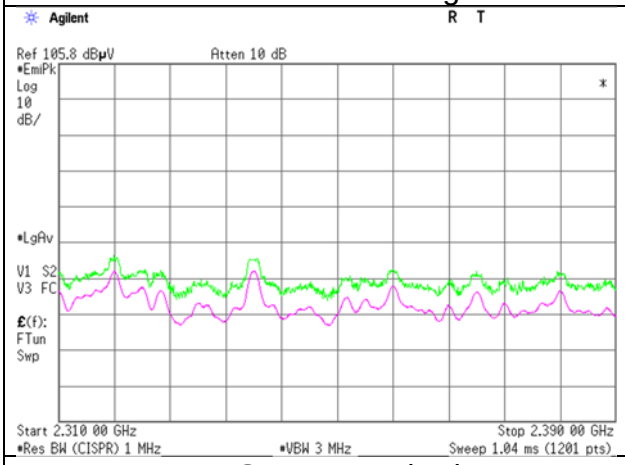
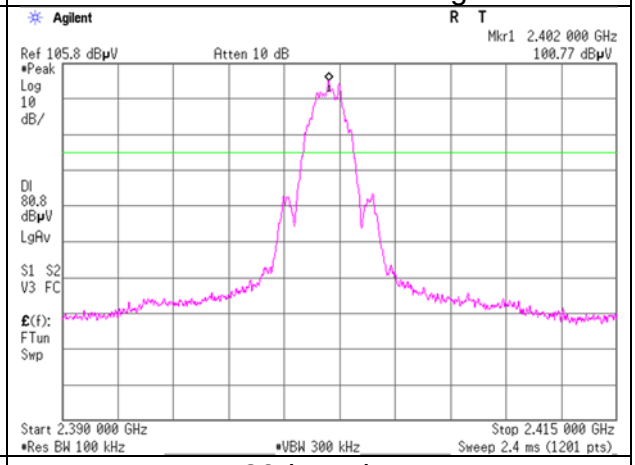
| Polarity [Hori/Vert] | Frequency [MHz] | Reading (PK) [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2402.0 | 100.8 | 27.6 | 5.5 | 32.4 | 101.5 | - | - | Carrier |
| Hori. | 2400.0 | 68.4 | 27.6 | 5.5 | 32.4 | 69.1 | 81.5 | 12.4 | |
| Vert. | 2402.0 | 100.5 | 27.6 | 5.5 | 32.4 | 101.2 | - | - | Carrier |
| Vert. | 2400.0 | 68.4 | 27.6 | 5.5 | 32.4 | 69.1 | 81.2 | 12.1 | |

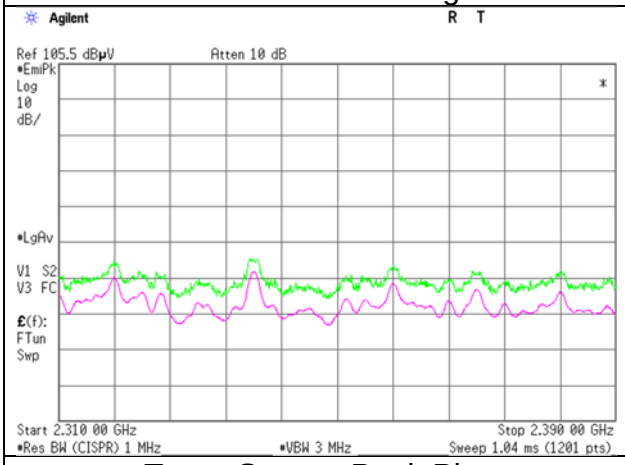
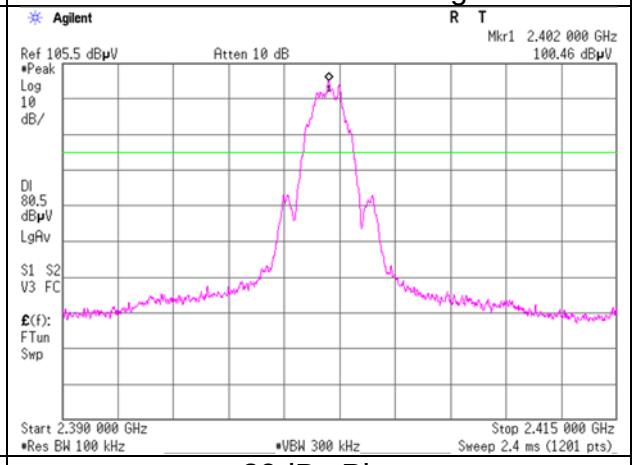
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

# Radiated Spurious Emission
## (Reference Plot for band-edge)

| | |
|---|---|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa |
| | (1 GHz to 10 GHz) |
| Mode | Tx BT LE 2M-PHY 2402 MHz |

| Horizontal | |
|---|---|
| Restricted-band band-edge Plot | Authorized-band band-edge Plot |
|  |  |
| Trace Green : Peak Plot<br>Trace Purple : Average Plot | 20dBc Plot |

| Vertical | |
|---|---|
| Restricted-band band-edge Plot | Authorized-band band-edge Plot |
|  |  |
| Trace Green : Peak Plot<br>Trace Purple : Average Plot | 20dBc Plot |

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

# Radiated Spurious Emission

| | | |
|---|---|---|
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | September 19, 2023 | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa | Takafumi Noguchi |
| | (1 GHz to 10 GHz) | (Above 10 GHz) |
| Mode | Tx BT LE 2M-PHY 2440 MHz | |

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2375.8 | 52.7 | 48.0 | 27.7 | 5.5 | 32.4 | 2.4 | 53.4 | 51.2 | 73.9 | 53.9 | 20.5 | 2.7 | |
| Hori. | 4880.0 | 41.0 | 32.9 | 31.5 | 7.6 | 31.4 | 2.4 | 48.7 | 43.0 | 73.9 | 53.9 | 25.2 | 10.9 | |
| Hori. | 7320.0 | 45.1 | 37.3 | 36.0 | 8.8 | 32.3 | 2.4 | 57.6 | 52.1 | 73.9 | 53.9 | 16.3 | 1.8 | |
| Hori. | 9760.0 | 42.9 | 32.4 | 39.1 | 9.3 | 33.0 | - | 58.3 | 47.8 | 73.9 | 53.9 | 15.6 | 6.1 | Floor noise |
| Vert. | 2375.8 | 53.6 | 48.9 | 27.7 | 5.5 | 32.4 | 2.4 | 54.4 | 52.0 | 73.9 | 53.9 | 19.5 | 1.9 | |
| Vert. | 4880.0 | 41.8 | 33.3 | 31.5 | 7.6 | 31.4 | 2.4 | 49.5 | 43.4 | 73.9 | 53.9 | 24.4 | 10.5 | |
| Vert. | 7320.0 | 46.8 | 37.9 | 36.0 | 8.8 | 32.3 | 2.4 | 59.2 | 52.7 | 73.9 | 53.9 | 14.7 | 1.2 | |
| Vert. | 9760.0 | 42.9 | 32.4 | 39.1 | 9.3 | 33.0 | - | 58.3 | 47.8 | 73.9 | 53.9 | 15.6 | 6.1 | Floor noise |

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

| | | |
|---|---|---|
| Distance factor: | 1 GHz - 10 GHz | 20log (4 m / 3.0 m) = 2.5 dB |
| | 10 GHz - 26.5 GHz | 20log (1.0 m / 3.0 m) = -9.5 dB |

# Radiated Spurious Emission

| | | |
|---|---|---|
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.3 | No.3 |
| Date | September 19, 2023 | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa | Takafumi Noguchi |
| | (1 GHz to 10 GHz) | (Above 10 GHz) |
| Mode | Tx BT LE 2M-PHY 2480 MHz | |

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2372.0 | 54.5 | 49.3 | 27.7 | 5.5 | 32.4 | 2.4 | 55.3 | 52.4 | 73.9 | 53.9 | 18.6 | 1.5 | |
| Hori. | 2483.5 | 50.4 | 40.6 | 27.5 | 5.5 | 32.4 | 2.4 | 51.1 | 43.7 | 73.9 | 53.9 | 22.8 | 10.2 | *1) |
| Hori. | 4960.0 | 42.5 | 35.0 | 31.6 | 7.6 | 31.4 | 2.4 | 50.4 | 45.3 | 73.9 | 53.9 | 23.5 | 8.6 | |
| Hori. | 7440.0 | 46.0 | 37.7 | 36.2 | 8.8 | 32.4 | 2.4 | 58.6 | 52.8 | 73.9 | 53.9 | 15.3 | 1.2 | |
| Hori. | 9920.0 | 43.6 | 34.5 | 39.1 | 9.3 | 33.1 | 2.4 | 59.0 | 52.3 | 73.9 | 53.9 | 14.9 | 1.6 | |
| Vert. | 2372.0 | 54.0 | 49.4 | 27.7 | 5.5 | 32.4 | 2.4 | 54.8 | 52.6 | 73.9 | 53.9 | 19.1 | 1.3 | |
| Vert. | 2483.5 | 49.7 | 39.6 | 27.5 | 5.5 | 32.4 | 2.4 | 50.4 | 42.7 | 73.9 | 53.9 | 23.5 | 11.2 | *1) |
| Vert. | 4960.0 | 42.8 | 34.1 | 31.6 | 7.6 | 31.4 | 2.4 | 50.6 | 44.3 | 73.9 | 53.9 | 23.3 | 9.6 | |
| Vert. | 7440.0 | 45.6 | 37.2 | 36.2 | 8.8 | 32.4 | 2.4 | 58.2 | 52.2 | 73.9 | 53.9 | 15.7 | 1.7 | |
| Vert. | 9920.0 | 44.1 | 35.5 | 39.1 | 9.3 | 33.1 | 2.4 | 59.5 | 53.3 | 73.9 | 53.9 | 14.4 | 0.6 | |

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

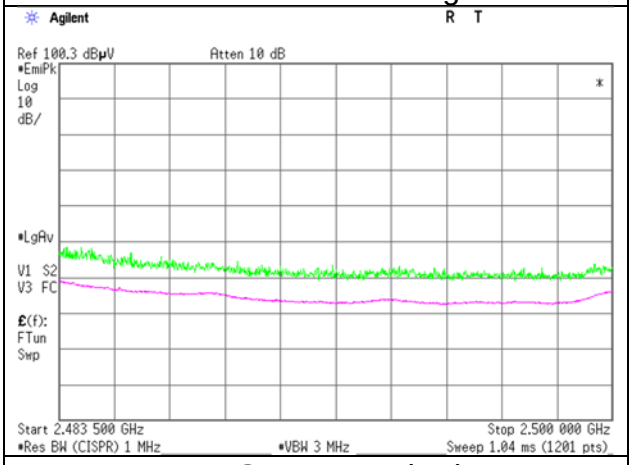
| | | |
|---|---|---|
| Distance factor: | 1 GHz - 10 GHz | 20log (4 m / 3.0 m) = 2.5 dB |
| | 10 GHz - 26.5 GHz | 20log (1.0 m / 3.0 m) = -9.5 dB |

# Radiated Spurious Emission
## (Reference Plot for band-edge)

| | |
|---|---|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | September 19, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH |
| Engineer | Nachi Konegawa |
| | (1 GHz to 10 GHz) |
| Mode | Tx BT LE 2M-PHY 2480 MHz |

Horizontal

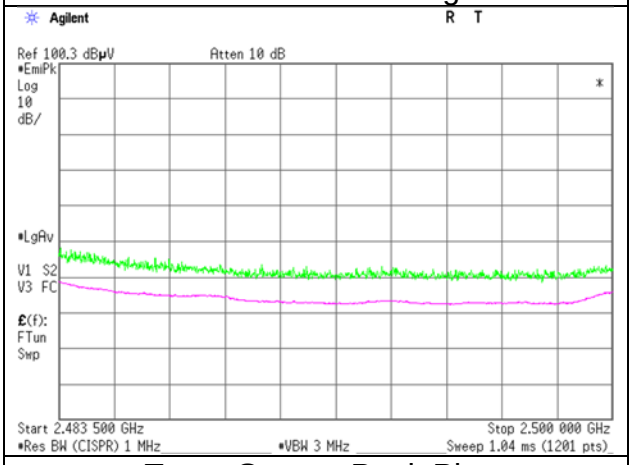
Restricted-band band-edge Plot




Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

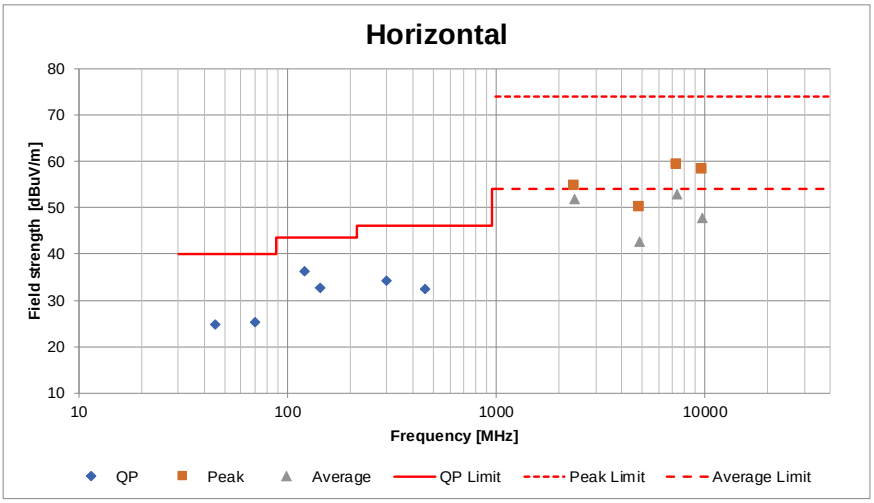


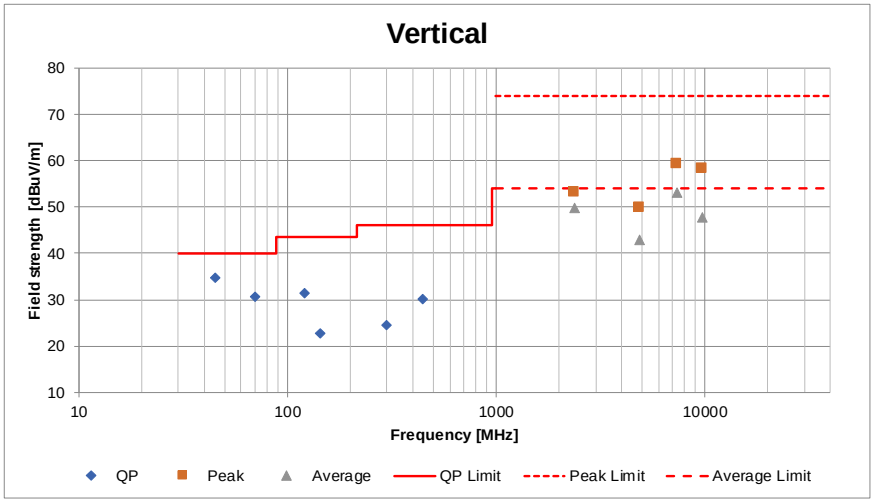

Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

# Radiated Spurious Emission
## (Plot data, Worst case mode for Maximum Peak Output Power)

| | | | |
|---|---|---|---|
| Test place | Ise EMC Lab. | | |
| Semi Anechoic Chamber | No.3 | No.3 | No.3 |
| Date | September 19, 2023 | September 19, 2023 | September 20, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 65 % RH |
| Engineer | Nachi Konegawa | Takafumi Noguchi | Nachi Konegawa |
| | (1 GHz to 10 GHz) | (Above 10 GHz) | (Below 1 GHz) |
| Mode | Tx BT LE 1M-PHY 2440 MHz | | |



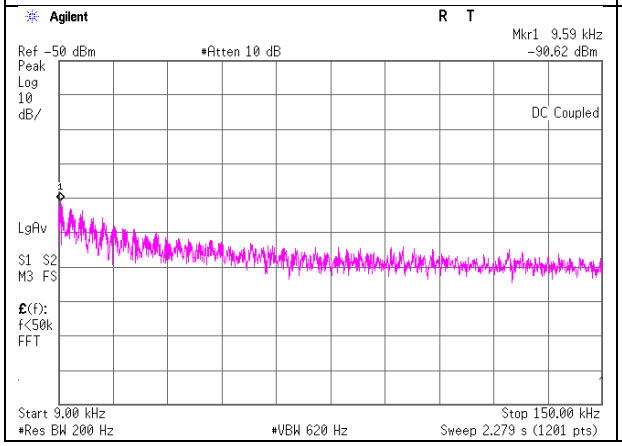




*These plots data contain sufficient number to show the trend of characteristic features for EUT.

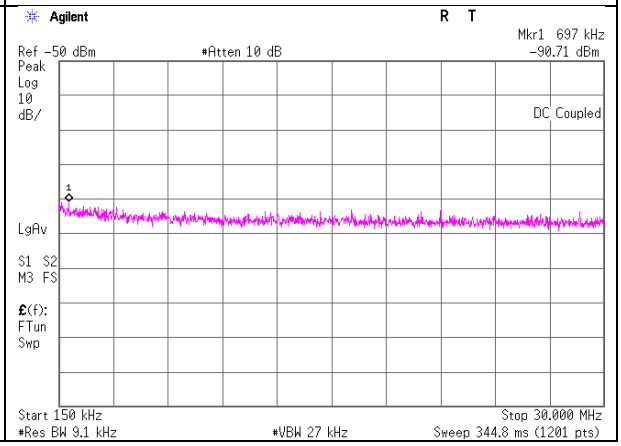
# Conducted Spurious Emission

| | |
|---|---|
| Test place | Ise EMC Lab. No.6 Measurement Room |
| Date | September 14, 2023 |
| Temperature / Humidity | 23 deg. C / 47 % RH |
| Engineer | Shousei Hamaguchi |
| Mode | Tx BT LE 1M-PHY 2440MHz |

## 9 kHz to 150 kHz




## 150 kHz to 30 MHz




| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain* [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9.59 | -90.6 | 0.30 | 9.7 | 2.0 | 1 | -78.7 | 300 | 6.0 | -17.4 | 47.9 | 65.3 | |
| 697.00 | -90.7 | 0.31 | 9.7 | 2.0 | 1 | -78.7 | 30 | 6.0 | 2.5 | 30.7 | 28.2 | |

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

# Power Density

| | |
|---|---|
| Test place | Ise EMC Lab. No.6 Measurement Room |
| Date | September 14, 2023 |
| Temperature / Humidity | 23 deg. C / 47 % RH |
| Engineer | Shousei Hamaguchi |
| Mode | Tx BT LE |

1M-PHY

| Freq. [MHz] | Reading [dBm / 3 kHz] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm / 3 kHz] | Limit [dBm / 3 kHz] | Margin [dB] |
|---|---|---|---|---|---|---|
| 2402 | -18.40 | 1.18 | 9.74 | -7.48 | 8.00 | 15.48 |
| 2440 | -18.38 | 1.19 | 9.75 | ***-7.44*** | 8.00 | 15.44 |
| 2480 | -18.50 | 1.20 | 9.75 | -7.55 | 8.00 | 15.55 |

2M-PHY

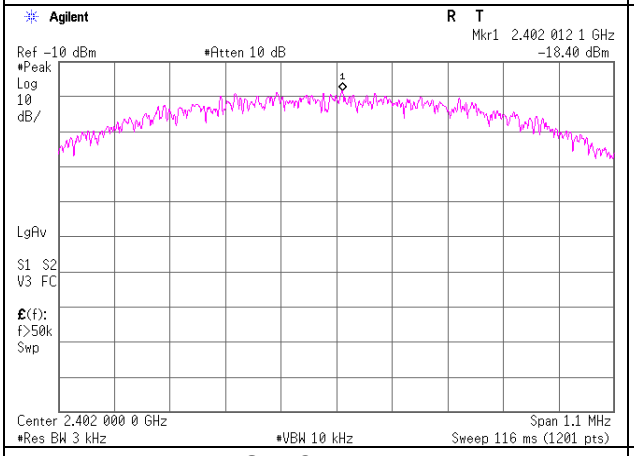
| Freq. [MHz] | Reading [dBm / 3 kHz] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm / 3 kHz] | Limit [dBm / 3 kHz] | Margin [dB] |
|---|---|---|---|---|---|---|
| 2402 | -20.40 | 1.18 | 9.74 | ***-9.48*** | 8.00 | 17.48 |
| 2440 | -20.59 | 1.19 | 9.75 | -9.65 | 8.00 | 17.65 |
| 2480 | -20.54 | 1.20 | 9.75 | -9.59 | 8.00 | 17.59 |

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

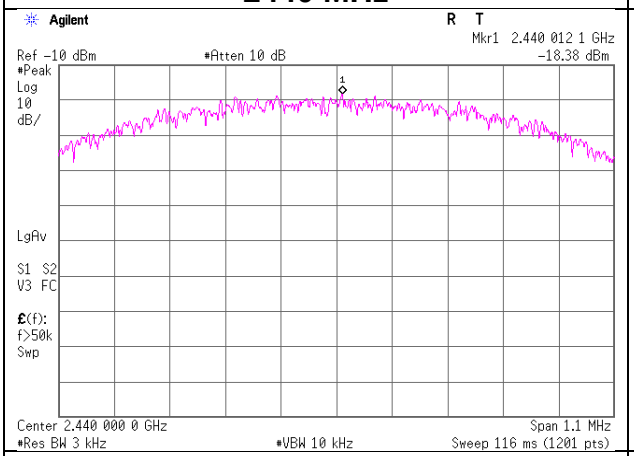
# Power Density

## 1M-PHY

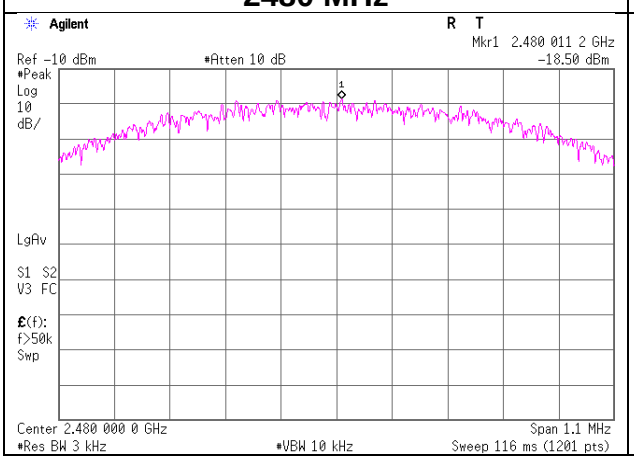
### 2402 MHz




### 2440 MHz

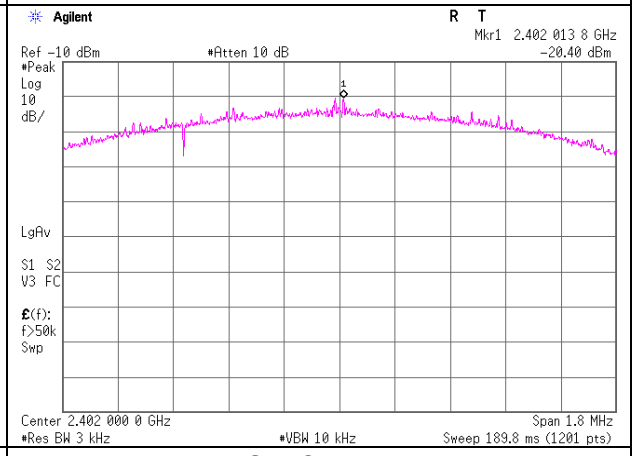



### 2480 MHz

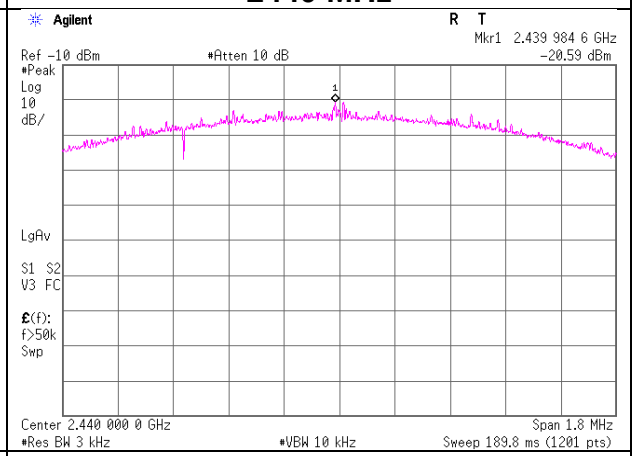



## 2M-PHY

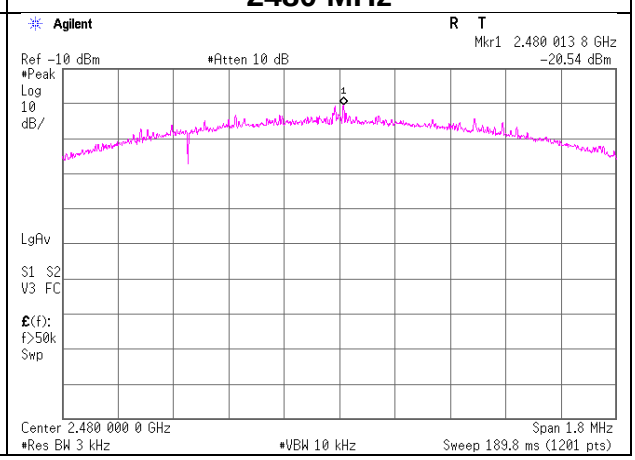
### 2402 MHz




### 2440 MHz




### 2480 MHz



# APPENDIX 2: Test Instruments

**Test Equipment**

| Test Item | Local ID | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Cal Int |
|---|---|---|---|---|---|---|---|---|
| CE | COTS-MEMI-02 | 178648 | EMI measurement program | TSJ (Techno Science Japan) | TEPTO-DV | - | - | - |
| CE | MAEC-03 | 142008 | AC3_Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 05/23/2022 | 24 |
| CE | MAT-67 | 141248 | Attenuator | JFW Industries, Inc. | 50FP-013H2 N | - | 12/22/2022 | 12 |
| CE | MCC-112 | 141216 | Coaxial cable | Fujikura/Suhner/TSJ | 5D-2W/SFM14/ sucoform141-PE/ 421-010/RFM-E321(SW) | -/00640 | 07/25/2023 | 12 |
| CE | MJM-16 | 142183 | Measure | KOMELON | KMC-36 | - | 10/03/2022 | 12 |
| CE | MLS-24 | 141358 | LISN(AMN) | Schwarzbeck Mess-Elektronik OHG | NSLK8127 | 8127-730 | 07/13/2023 | 12 |
| CE | MMM-08 | 141532 | DIGITAL HiTESTER | HIOKI E.E. CORPORATION | 3805 | 51201197 | 01/17/2023 | 12 |
| CE | MOS-13 | 141554 | Thermo-Hygrometer | CUSTOM. Inc | CTH-201 | 1301 | 01/13/2023 | 12 |
| CE | MTR-08 | 141949 | Test Receiver | Rohde & Schwarz | ESCI | 100767 | 05/17/2023 | 12 |
| RE | COTS-MEMI-02 | 178648 | EMI measurement program | TSJ (Techno Science Japan) | TEPTO-DV | - | - | - |
| RE | MAEC-03 | 142008 | AC3_Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 05/23/2022 | 24 |
| RE | MAEC-03-SVSWR | 142013 | AC3_Semi Anechoic Chamber(SVSWR) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 04/12/2023 | 24 |
| RE | MAT-95 | 142314 | Attenuator | Pasternack Enterprises | PE7390-6 | D/C 1504 | 06/23/2023 | 12 |
| RE | MBA-05 | 141425 | Biconical Antenna | Schwarzbeck Mess-Elektronik OHG | VHA9103+ BBA9106 | VHA 91031302 | 08/10/2023 | 12 |
| RE | MCC-265 | 234602 | Microwave Cable | Huber+Suhner | SF126E/11PC35/ 11PC35/ 1000M,5000M | 537063/126E / 537074/126E | 03/16/2023 | 12 |
| RE | MCC-51 | 141323 | Coaxial cable | UL Japan | - | - | 09/10/2023 | 12 |
| RE | MHA-16 | 141513 | Horn Antenna 15-40GHz | Schwarzbeck Mess-Elektronik OHG | BBHA9170 | BBHA9170306 | 07/19/2023 | 12 |
| RE | MHA-20 | 141507 | Horn Antenna 1-18GHz | Schwarzbeck Mess-Elektronik OHG | BBHA9120D | 258 | 11/14/2022 | 12 |
| RE | MHF-25 | 141232 | High Pass Filter 3.5-18.0GHz | UL Japan | HPF SELECTOR | 001 | 09/04/2023 | 12 |
| RE | MJM-16 | 142183 | Measure | KOMELON | KMC-36 | - | 10/03/2022 | 12 |
| RE | MLA-22 | 141266 | Logperiodic Antenna (200-1000MHz) | Schwarzbeck Mess-Elektronik OHG | VUSLP9111B | 9111B-191 | 08/10/2023 | 12 |
| RE | MMM-08 | 141532 | DIGITAL HiTESTER | HIOKI E.E. CORPORATION | 3805 | 51201197 | 01/17/2023 | 12 |
| RE | MOS-13 | 141554 | Thermo-Hygrometer | CUSTOM. Inc | CTH-201 | 1301 | 01/13/2023 | 12 |
| RE | MPA-11 | 141580 | MicroWave System Amplifier | Keysight Technologies Inc | 83017A | MY39500779 | 03/08/2023 | 12 |
| RE | MPA-13 | 141582 | Pre Amplifier | SONOMA INSTRUMENT | 310 | 260834 | 02/07/2023 | 12 |
| RE | MSA-03 | 141884 | Spectrum Analyzer | Keysight Technologies Inc | E4448A | MY44020357 | 03/13/2023 | 12 |
| RE | MTR-08 | 141949 | Test Receiver | Rohde & Schwarz | ESCI | 100767 | 05/17/2023 | 12 |
| AT | MAT-26 | 141244 | Attenuator(10dB) | Weinschel - API Technologies Corp | WA8-10-34 | A198 | 02/01/2023 | 12 |
| AT | MAT-89 | 141419 | Attenuator | Weinschel Associates | WA56-10 | 56100305 | 05/18/2023 | 12 |
| AT | MCC-245 | 197220 | Microwave cable | Huber+Suhner | SF126E/11PC35/ 11PC35/2000MM | 537003/126E | 03/08/2023 | 12 |
| AT | MCC-64 | 141327 | Coaxial Cable | UL Japan | - | - | 02/01/2023 | 12 |
| AT | MOS-14 | 141561 | Thermo-Hygrometer | CUSTOM. Inc | CTH-201 | 1401 | 01/13/2023 | 12 |
| AT | MPM-13 | 141810 | Power Meter | Anritsu Corporation | ML2495A | 824014 | 12/26/2022 | 12 |
| AT | MPSE-18 | 141832 | Power sensor | Anritsu Corporation | MA2411B | 738174 | 12/26/2022 | 12 |
| AT | MSA-14 | 141901 | Spectrum Analyzer | Keysight Technologies Inc | E4440A | MY48250080 | 01/16/2023 | 12 |
| AT | MCC-67 | 141329 | Microwave Cable 1G-40GHz | Suhner | SUCOFLEX102 | 28635/2 | 04/10/2023 | 12 |
| AT | MPM-12 | 141809 | Power Meter | Anritsu Corporation | ML2495A | 825002 | 05/26/2023 | 12 |
| AT | MPM-17 | 141813 | Power Meter | Raditeq (Formerly DARE!! Instruments) | RPR3006W | 14I00048SNO 081 | 10/04/2023 | 12 |

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

**The expiration date of the calibration is the end of the expired month.**
**As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.**

**All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.**

**Test item:**

**CE: Conducted Emission**
**RE: Radiated Emission**
**AT: Antenna Terminal Conducted test**