# RADIO TEST REPORT

## Test Report No. : 12931873H-A

| | | |
|---|---|---|
| **Applicant** | : | **Panasonic Avionics Corporation** |
| **Type of Equipment** | : | **Bluetooth v5 Dual-Mode USB Module** |
| **Model No.** | : | **R8U4FJ5168Z** |
| **FCC ID** | : | **U6YBT850** |
| **Test regulation** | : | **FCC Part 15 Subpart C: 2019**<br>**For Permissive Change**<br>*** Bluetooth Low Energy part**<br>**(Maximum Peak Output Power and Radiated Spurious Emission tests only)** |
| **Test Result** | : | **Complied (Refer to SECTION 3.2)** |

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. The information provided from the customer for this report is identified in SECTION 1.

**Date of test:** June 28 and 29, 2019

**Representative test engineer:**
Takumi Shimada
Engineer
Consumer Technology Division

**Approved by:**
Takayuki Shimada
Leader
Consumer Technology Division

NVLAP TESTING NVLAP LAB CODE 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address, http://japan.ul.com/resources/emc_accredited/

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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# REVISION HISTORY

## Original Test Report No.: 12931873H-A

| Revision | Test report No. | Date | Page revised | Contents |
|---|---|---|---|---|
| - (Original) | 12931873H-A | July 12, 2019 | - | - |

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**CONTENTS** **PAGE**

## SECTION 1: Customer information

| | | |
|---|---|---|
| Company Name | : | Panasonic Avionics Corporation |
| Address | : | 26200 Enterprise Way Lake Forest, CA 92630 USA |
| Telephone Number | : | +1-949-672-2000 |
| Facsimile Number | : | +1-949-462-7100 |
| Contact Person | : | David O'Reilly |

The information provided from the customer is as follows;
- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. 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 (E.U.T.)

### 2.1 Identification of E.U.T.

| | | |
|---|---|---|
| Type of Equipment | : | Bluetooth v5 Dual-Mode USB Module |
| Model No. | : | R8U4FJ5168Z |
| Serial No. | : | Refer to SECTION 4.2 |
| Rating | : | DC 3.3 V |
| Receipt Date of Sample (Information from test lab.) | : | May 28, 2019 |
| Country of Mass-production | : | Japan |
| Condition of EUT | : | Production prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification of EUT | : | No Modification by the test lab. |

### 2.2 Product Description

Model: R8U4FJ5168Z (referred to as the EUT in this report) is a Bluetooth v5 Dual-Mode USB Module.

**Radio Specification**

**[Bluetooth (Classic Bluetooth and BLE)]**

| | | |
|---|---|---|
| Radio Type | : | Transceiver |
| Frequency of Operation | : | 2402 MHz - 2480 MHz |
| Modulation | : | BT: FHSS (GFSK, π/4DQPSK, 8DPSK)<br>LE: GFSK |
| Channel spacing | | BT: 1 MHz<br>LE: 2 MHz |
| Antenna type | : | Microstrip Antenna |
| Antenna Gain | : | -3.4 dBi |
| Clock frequency (Maximum) | : | 40 MHz |

* This test report applies to Bluetooth Low Energy function (2402 MHz - 2480 MHz) except for Bluetooth with EDR.

<Contents of the change from original model>
Antenna of the EUT is new type.
The maximum output level of Bluetooth module is changed from +8dBm to +2dBm.
The radio specification except above is identical to the original.
Therefore only Radiated Spurious Emission test were performed in this report.
Additionally, only the information of modified antenna is described in this report.

# SECTION 3: Test specification, procedures & results

## 3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on June 4, 2019 and effective July 5, 2019 except 15.258

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

## 3.2 Procedures and results

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|---|---|---|---|---|
| Maximum Peak Output Power | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section 15.247(b)(3) | See data. | Complied a) | Conducted |
| | **IC:** RSS-Gen 6.12 | **IC:** RSS-247 5.4(d) | | | |
| Spurious Emission Restricted Band Edges | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 | **FCC:** Section15.247(d) | 11.4 dB 909.004 MHz, QP, Horizontal | Complied b) | Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1) |
| | **IC:** RSS-Gen 6.13 | **IC:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10 | | | |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*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.

a) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
b) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

Symbols:
Complied The data of this test item has enough margin, more than the measurement uncertainty.
Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

**FCC Part 15.31 (e)**
This EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

**FCC Part 15.203 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

No addition, exclusion nor deviation has been made from the standard.

## 3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

**Antenna Terminal test**

| Test Item | Uncertainty (+/-) |
|---|---|
| Maximum Peak Output Power / Average Output Power | 1.3 dB |

**Radiated emission**

| Measurement distance | Frequency range | Uncertainty (+/-) |
|---|---|---|
| 3 m | 9 kHz to 30 MHz | 3.3 dB |
| 10 m | | 3.2 dB |
| | | |
| 3 m | 30 MHz to 200 MHz (Horizontal) | 4.8 dB |
| | (Vertical) | 5.0 dB |
| | 200 MHz to 1000 MHz (Horizontal) | 5.2 dB |
| | (Vertical) | 6.3 dB |
| 10 m | 30 MHz to 200 MHz (Horizontal) | 4.8 dB |
| | (Vertical) | 4.9 dB |
| | 200 MHz to 1000 MHz (Horizontal) | 5.0 dB |
| | (Vertical) | 5.0 dB |
| | | |
| 3 m | 1 GHz to 6 GHz | 5.0 dB |
| | 6 GHz to 18 GHz | 5.3 dB |
| 1 m | 10 GHz to 26.5 GHz | 5.8 dB |
| | 26.5 GHz to 40 GHz | 5.8 dB |
| 10 m | 1 GHz to 18 GHz | 5.2 dB |

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
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| 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 | - | - |

### 3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

# SECTION 4: Operation of E.U.T. during testing

## 4.1 Operating Mode(s)

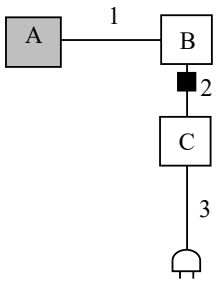
Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009.

| Mode | Remarks* |
|---|---|
| Bluetooth Low Energy (BT LE) | Maximum Packet Size, PRBS9 |
| *Transmitting duty was 100 % on all tests.<br>*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 settings: 2 dBm<br>Software: cybluetool ver Version 0.1.55.1<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. | |

*The details of Operating mode(s) for BT LE

| Test Item | Operating Mode | Tested frequency |
|---|---|---|
| Maximum Peak Output Power<br>Radiated Spurious Emission<br>(Below 1GHz/ Above 1GHz) | Tx BT LE | 2402 MHz<br>2440 MHz<br>2480 MHz |

## 4.2 Configuration and peripherals




AC 120 V / 60 Hz

■ : Standard Ferrite Core

* 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 v5 Dual-Mode USB Module | R8U4FD38302 | U6YBT800 | Panasonic Corporation | EUT |
| B | Laptop PC | CF-SZ5ADCVS | 6JKSA17867 | Panasonic Corporation | - |
| C | AC adaptor | CF-AA64L2C M1 | 64L2CM116904226A | Panasonic Corporation | - |

**List of cables used**

| No. | Name | Length (m) | Shield | | Remarks |
|---|---|---|---|---|---|
| | | | Cable | Connector | |
| 1 | USB Cable | 0.90 | Shielded | Shielded | - |
| 2 | DC Cable | 0.90 | Unshielded | Unshielded | - |
| 3 | AC Cable | 0.70 | Unshielded | Unshielded | - |

## SECTION 5: 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, 0.5 m by 1.0 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.

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.
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 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 | 30 MHz to 200 MHz | 200 MHz to 1 GHz | Above 1 GHz |
|---|---|---|---|
| Antenna Type | 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.

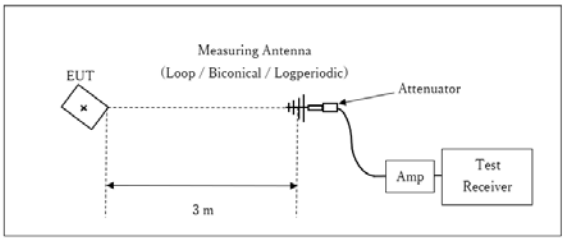
**20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).**

| Frequency | Below 1 GHz | Above 1 GHz | | 20 dBc |
|---|---|---|---|---|
| Instrument used | Test Receiver | Spectrum Analyzer | | Spectrum Analyzer |
| Detector | QP | PK | AV *1) | 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 |

*1) Average Power Measurement was performed based on ANSI C63.10-2013.

**Figure 2: Test Setup**

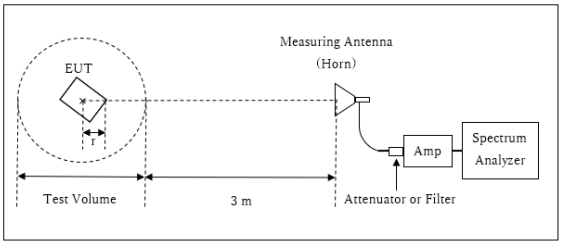
Below 1 GHz




× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

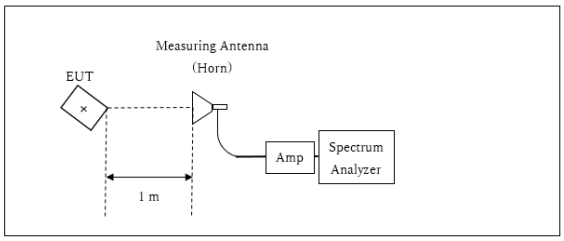



r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (4.0 m / 3.0 m) = 2.5 dB
* Test Distance: (3 + Test Volume /2) - r = 4.0 m

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

10 GHz - 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 - 26.5 GHz**
**Test data : APPENDIX**
**Test result : Pass**

## SECTION 6: 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 |
|---|---|---|---|---|---|---|---|
| Maximum Peak Output Power | - | - | - | Auto | Peak/ Average *1) | - | Power Meter (Sensor: 50 MHz BW) |
| *1) Reference data | | | | | | | |

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

## Maximum Peak Output Power

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. No.8 Measurement Room |
| Date | June 28, 2019 |
| Temperature / Humidity | 24 deg. C / 59 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE |

| | | | | Conducted Power | | | | | e.i.r.p. for RSS-247 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Reading | Cable Loss | Atten. Loss | Result | | Limit | | Margin | Antenna Gain | Result | | Limit | | Margin |
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 2402 | -8.91 | 0.03 | 10.09 | 1.21 | 1.32 | 30.00 | 1000 | 28.79 | -3.40 | -2.19 | 0.60 | 36.02 | 4000 | 38.21 |
| 2440 | -9.24 | 0.03 | 10.09 | 0.88 | 1.22 | 30.00 | 1000 | 29.12 | -3.40 | -2.52 | 0.56 | 36.02 | 4000 | 38.54 |
| 2480 | -9.68 | 0.03 | 10.09 | 0.44 | 1.11 | 30.00 | 1000 | 29.56 | -3.40 | -2.96 | 0.51 | 36.02 | 4000 | 38.98 |

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain
*The equipment and cables were not used for factor 0 dB of the data sheets.

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

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. No.8 Measurement Room |
| Date | June 28, 2019 |
| Temperature / Humidity | 24 deg. C / 59 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE |

| 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 | -9.35 | 0.03 | 10.09 | 0.77 | 1.19 | 0.00 | 0.77 | 1.19 |
| 2440 | -9.70 | 0.03 | 10.09 | 0.42 | 1.10 | 0.00 | 0.42 | 1.10 |
| 2480 | -10.17 | 0.03 | 10.09 | -0.05 | 0.99 | 0.00 | -0.05 | 0.99 |

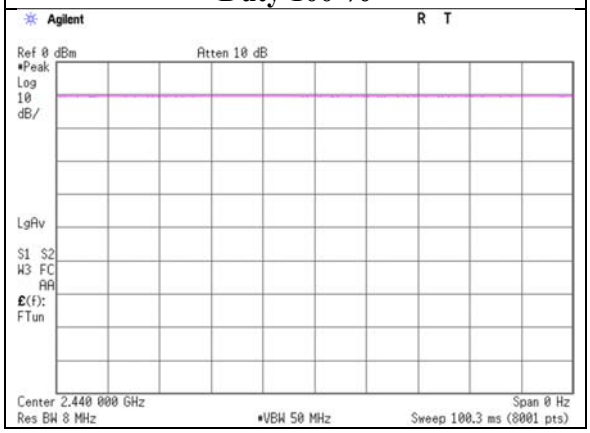
Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

*The equipment and cables were not used for factor 0 dB of the data sheets.

# Burst rate confirmation

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. No.8 Measurement Room |
| Date | June 28, 2019 |
| Temperature / Humidity | 24 deg. C / 59 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE |

**Duty 100 %**




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

# Radiated Spurious Emission

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | June 29, 2019 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE 2402 MHz |

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 31.463 | QP | 22.4 | 17.5 | 7.2 | 32.2 | - | 14.9 | 40.0 | 25.1 | |
| Hori. | 81.056 | QP | 32.3 | 6.7 | 8.0 | 32.2 | - | 14.8 | 40.0 | 25.2 | |
| Hori. | 174.082 | QP | 23.8 | 16.3 | 9.1 | 32.1 | - | 17.1 | 43.5 | 26.4 | |
| Hori. | 227.258 | QP | 32.5 | 11.3 | 9.6 | 32.0 | - | 21.3 | 46.0 | 24.7 | |
| Hori. | 480.000 | QP | 32.0 | 17.3 | 11.4 | 32.0 | - | 28.7 | 46.0 | 17.3 | |
| Hori. | 909.004 | QP | 29.6 | 22.1 | 13.8 | 30.9 | - | 34.6 | 46.0 | 11.4 | |
| Hori. | 2390.000 | PK | 41.8 | 27.8 | 5.5 | 32.8 | - | 42.4 | 73.9 | 31.5 | |
| Hori. | 4804.000 | PK | 40.2 | 31.7 | 7.7 | 31.8 | - | 47.7 | 73.9 | 26.2 | Floor noise |
| Hori. | 7206.000 | PK | 40.2 | 35.7 | 8.9 | 32.7 | - | 52.1 | 73.9 | 21.8 | Floor noise |
| Hori. | 9608.000 | PK | 40.8 | 38.6 | 9.4 | 33.3 | - | 55.6 | 73.9 | 18.4 | Floor noise |
| Hori. | 2390.000 | AV | 33.3 | 27.8 | 5.5 | 32.8 | - | 33.9 | 53.9 | 20.0 | |
| Hori. | 4804.000 | AV | 32.1 | 31.7 | 7.7 | 31.8 | - | 39.6 | 53.9 | 14.3 | Floor noise |
| Hori. | 7206.000 | AV | 32.8 | 35.7 | 8.9 | 32.7 | - | 44.7 | 53.9 | 9.2 | Floor noise |
| Hori. | 9608.000 | AV | 32.3 | 38.6 | 9.4 | 33.3 | - | 47.1 | 53.9 | 6.9 | Floor noise |
| Vert. | 36.463 | QP | 28.6 | 15.7 | 7.3 | 32.2 | - | 19.4 | 40.0 | 20.6 | |
| Vert. | 47.713 | QP | 34.1 | 11.7 | 7.5 | 32.2 | - | 21.1 | 40.0 | 18.9 | |
| Vert. | 79.992 | QP | 35.7 | 6.7 | 8.0 | 32.2 | - | 18.2 | 40.0 | 21.8 | |
| Vert. | 171.481 | QP | 25.6 | 15.9 | 9.0 | 32.1 | - | 18.4 | 43.5 | 25.1 | |
| Vert. | 303.008 | QP | 30.5 | 13.8 | 10.2 | 31.9 | - | 22.5 | 46.0 | 23.5 | |
| Vert. | 454.512 | QP | 31.5 | 16.6 | 11.2 | 32.0 | - | 27.4 | 46.0 | 18.6 | |
| Vert. | 2390.000 | PK | 41.1 | 27.8 | 5.5 | 32.8 | - | 41.7 | 73.9 | 32.2 | |
| Vert. | 4804.000 | PK | 38.8 | 31.7 | 7.7 | 31.8 | - | 46.3 | 73.9 | 27.6 | Floor noise |
| Vert. | 7206.000 | PK | 40.5 | 35.7 | 8.9 | 32.7 | - | 52.4 | 73.9 | 21.5 | Floor noise |
| Vert. | 9608.000 | PK | 40.8 | 38.6 | 9.4 | 33.3 | - | 55.6 | 73.9 | 18.4 | Floor noise |
| Vert. | 2390.000 | AV | 33.3 | 27.8 | 5.5 | 32.8 | - | 33.9 | 53.9 | 20.0 | |
| Vert. | 4804.000 | AV | 32.0 | 31.7 | 7.7 | 31.8 | - | 39.5 | 53.9 | 14.4 | Floor noise |
| Vert. | 7206.000 | AV | 32.8 | 35.7 | 8.9 | 32.7 | - | 44.7 | 53.9 | 9.2 | Floor noise |
| Vert. | 9608.000 | AV | 31.8 | 38.6 | 9.4 | 33.3 | - | 46.6 | 53.9 | 7.4 | Floor noise |

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

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

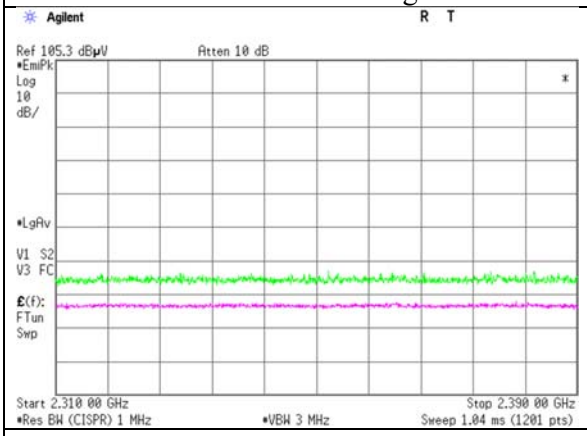
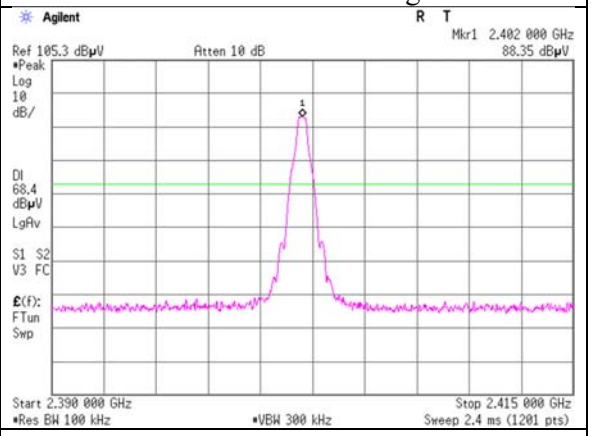
**20dBc Data Sheet**

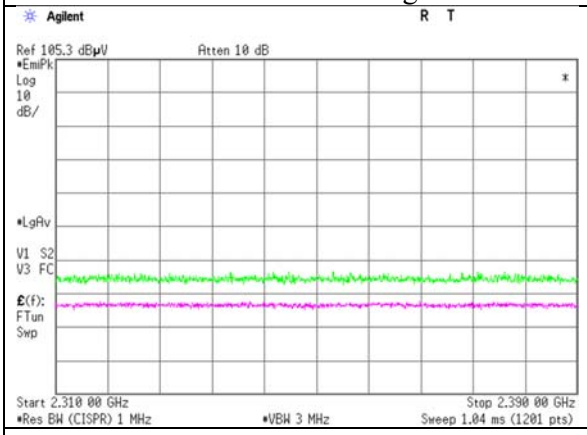
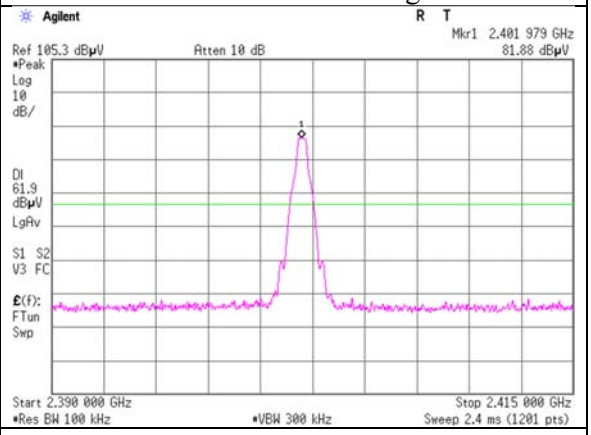
| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 2402.000 | PK | 88.4 | 27.8 | 5.6 | 32.7 | 89.0 | - | - | Carrier |
| Hori. | 2400.000 | PK | 34.6 | 27.8 | 5.6 | 32.7 | 35.2 | 69.0 | 33.8 | |
| Vert. | 2402.000 | PK | 81.9 | 27.8 | 5.6 | 32.7 | 82.5 | - | - | Carrier |
| Vert. | 2400.000 | PK | 30.4 | 27.8 | 5.6 | 32.7 | 31.0 | 62.5 | 31.5 | |

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

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

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | June 29, 2019 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE 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 was shown in tabular data.

# Radiated Spurious Emission

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | June 29, 2019 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE 2440 MHz |

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 32.334 | QP | 22.0 | 17.1 | 7.2 | 32.2 | - | 14.1 | 40.0 | 25.9 | |
| Hori. | 81.410 | QP | 30.5 | 6.8 | 8.0 | 32.2 | - | 13.1 | 40.0 | 26.9 | |
| Hori. | 152.844 | QP | 25.1 | 15.2 | 8.9 | 32.1 | - | 17.1 | 43.5 | 26.4 | |
| Hori. | 227.256 | QP | 32.4 | 11.3 | 9.6 | 32.0 | - | 21.2 | 46.0 | 24.8 | |
| Hori. | 606.010 | QP | 27.4 | 19.3 | 12.2 | 32.0 | - | 26.9 | 46.0 | 19.1 | |
| Hori. | 909.022 | QP | 28.9 | 22.1 | 13.8 | 30.9 | - | 33.9 | 46.0 | 12.1 | |
| Hori. | 4880.000 | PK | 40.5 | 31.7 | 7.7 | 31.8 | - | 48.1 | 73.9 | 25.8 | Floor noise |
| Hori. | 7320.000 | PK | 40.3 | 36.3 | 8.9 | 32.7 | - | 52.8 | 73.9 | 21.1 | Floor noise |
| Hori. | 9760.000 | PK | 40.6 | 39.1 | 9.4 | 33.4 | - | 55.7 | 73.9 | 18.2 | Floor noise |
| Hori. | 4880.000 | AV | 32.2 | 31.7 | 7.7 | 31.8 | - | 39.8 | 53.9 | 14.1 | Floor noise |
| Hori. | 7320.000 | AV | 32.5 | 36.3 | 8.9 | 32.7 | - | 45.0 | 53.9 | 8.9 | Floor noise |
| Hori. | 9760.000 | AV | 32.2 | 39.1 | 9.4 | 33.4 | - | 47.3 | 53.9 | 6.6 | Floor noise |
| Vert. | 35.937 | QP | 31.1 | 15.8 | 7.3 | 32.2 | - | 22.0 | 40.0 | 18.0 | |
| Vert. | 47.713 | QP | 34.0 | 11.7 | 7.5 | 32.2 | - | 21.0 | 40.0 | 19.0 | |
| Vert. | 80.799 | QP | 35.4 | 6.7 | 8.0 | 32.2 | - | 17.9 | 40.0 | 22.1 | |
| Vert. | 152.912 | QP | 27.5 | 15.2 | 8.9 | 32.1 | - | 19.5 | 43.5 | 24.0 | |
| Vert. | 303.008 | QP | 30.5 | 13.8 | 10.2 | 31.9 | - | 22.5 | 46.0 | 23.5 | |
| Vert. | 454.506 | QP | 31.6 | 16.6 | 11.2 | 32.0 | - | 27.5 | 46.0 | 18.5 | |
| Vert. | 4880.000 | PK | 38.5 | 31.7 | 7.7 | 31.8 | - | 46.1 | 73.9 | 27.8 | Floor noise |
| Vert. | 7320.000 | PK | 40.6 | 36.3 | 8.9 | 32.7 | - | 53.1 | 73.9 | 20.8 | Floor noise |
| Vert. | 9760.000 | PK | 40.7 | 39.1 | 9.4 | 33.4 | - | 55.8 | 73.9 | 18.1 | Floor noise |
| Vert. | 4880.000 | AV | 32.3 | 31.7 | 7.7 | 31.8 | - | 39.9 | 53.9 | 14.0 | Floor noise |
| Vert. | 7320.000 | AV | 32.4 | 36.3 | 8.9 | 32.7 | - | 44.9 | 53.9 | 9.0 | Floor noise |
| Vert. | 9760.000 | AV | 31.6 | 39.1 | 9.4 | 33.4 | - | 46.7 | 53.9 | 7.2 | Floor noise |

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | June 29, 2019 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE 2480 MHz |

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 31.340 | QP | 22.4 | 17.5 | 7.2 | 32.2 | - | 14.9 | 40.0 | 25.1 | |
| Hori. | 82.285 | QP | 33.9 | 7.0 | 8.1 | 32.2 | - | 16.7 | 40.0 | 23.3 | |
| Hori. | 152.420 | QP | 25.6 | 15.3 | 8.9 | 32.1 | - | 17.6 | 43.5 | 25.9 | |
| Hori. | 227.256 | QP | 32.4 | 11.3 | 9.6 | 32.0 | - | 21.2 | 46.0 | 24.8 | |
| Hori. | 480.000 | QP | 31.7 | 17.3 | 11.4 | 32.0 | - | 28.4 | 46.0 | 17.6 | |
| Hori. | 909.024 | QP | 29.0 | 22.1 | 13.8 | 30.9 | - | 34.0 | 46.0 | 12.0 | |
| Hori. | 2483.500 | PK | 43.1 | 27.5 | 5.6 | 32.7 | - | 43.5 | 73.9 | 30.4 | |
| Hori. | 4960.000 | PK | 40.7 | 31.8 | 7.7 | 31.8 | - | 48.4 | 73.9 | 25.5 | Floor noise |
| Hori. | 7440.000 | PK | 40.5 | 36.6 | 8.9 | 32.7 | - | 53.3 | 73.9 | 20.6 | Floor noise |
| Hori. | 9920.000 | PK | 40.3 | 39.1 | 9.4 | 33.4 | - | 55.4 | 73.9 | 18.6 | Floor noise |
| Hori. | 2483.500 | AV | 32.2 | 27.5 | 5.6 | 32.7 | - | 32.6 | 53.9 | 21.3 | |
| Hori. | 4960.000 | AV | 32.5 | 31.8 | 7.7 | 31.8 | - | 40.2 | 53.9 | 13.7 | Floor noise |
| Hori. | 7440.000 | AV | 32.2 | 36.6 | 8.9 | 32.7 | - | 45.0 | 53.9 | 8.9 | Floor noise |
| Hori. | 9920.000 | AV | 31.7 | 39.1 | 9.4 | 33.4 | - | 46.8 | 53.9 | 7.2 | Floor noise |
| Vert. | 36.640 | QP | 30.2 | 15.6 | 7.3 | 32.2 | - | 20.9 | 40.0 | 19.1 | |
| Vert. | 48.195 | QP | 34.1 | 11.5 | 7.5 | 32.2 | - | 21.0 | 40.0 | 19.0 | |
| Vert. | 82.162 | QP | 35.3 | 6.9 | 8.1 | 32.2 | - | 18.1 | 40.0 | 21.9 | |
| Vert. | 152.804 | QP | 27.7 | 15.2 | 8.9 | 32.1 | - | 19.7 | 43.5 | 23.8 | |
| Vert. | 303.005 | QP | 30.6 | 13.8 | 10.2 | 31.9 | - | 22.6 | 46.0 | 23.4 | |
| Vert. | 454.502 | QP | 31.6 | 16.6 | 11.2 | 32.0 | - | 27.5 | 46.0 | 18.5 | |
| Vert. | 2483.500 | PK | 38.6 | 27.5 | 5.6 | 32.7 | - | 39.0 | 73.9 | 34.9 | |
| Vert. | 4960.000 | PK | 39.2 | 31.8 | 7.7 | 31.8 | - | 46.9 | 73.9 | 27.0 | Floor noise |
| Vert. | 7440.000 | PK | 40.5 | 36.6 | 8.9 | 32.7 | - | 53.3 | 73.9 | 20.6 | Floor noise |
| Vert. | 9920.000 | PK | 41.0 | 39.1 | 9.4 | 33.4 | - | 56.1 | 73.9 | 17.9 | Floor noise |
| Vert. | 2483.500 | AV | 32.3 | 27.5 | 5.6 | 32.7 | - | 32.7 | 53.9 | 21.2 | |
| Vert. | 4960.000 | AV | 32.5 | 31.8 | 7.7 | 31.8 | - | 40.2 | 53.9 | 13.7 | Floor noise |
| Vert. | 7440.000 | AV | 32.1 | 36.6 | 8.9 | 32.7 | - | 44.9 | 53.9 | 9.0 | Floor noise |
| Vert. | 9920.000 | AV | 31.7 | 39.1 | 9.4 | 33.4 | - | 46.8 | 53.9 | 7.2 | Floor noise |

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

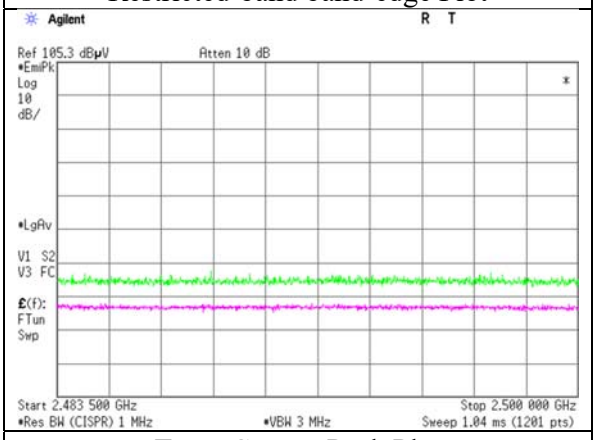
Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | June 29, 2019 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE 2480 MHz |

Horizontal

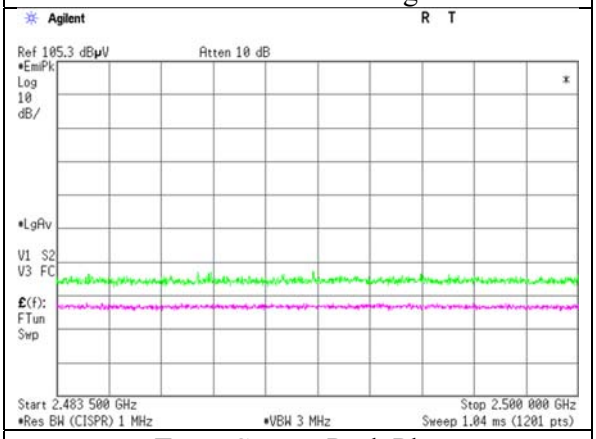
Restricted-band band-edge Plot




Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

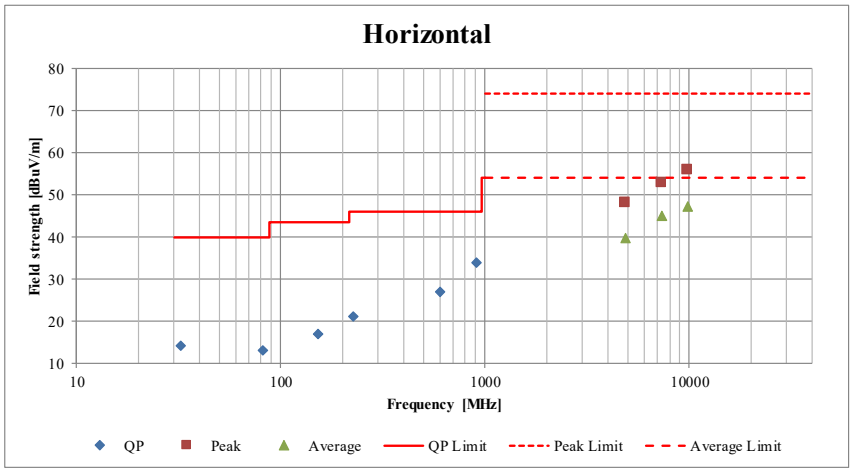


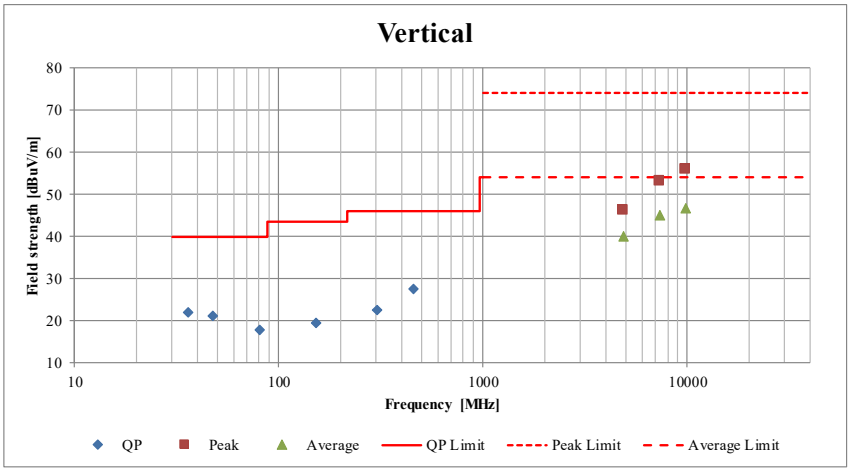

Trace Green : Peak Plot
Trace Purple : Average Plot

* 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)

| | |
|---|---|
| Report No. | 12931873H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.3 |
| Date | June 29, 2019 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takumi Shimada |
| Mode | Tx BT LE 2440 MHz |




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

# APPENDIX 2: Test instruments

**Test Instruments**

| Test Item | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Calibration Due Date | Cal Int |
|---|---|---|---|---|---|---|---|---|
| AT | 141840 | Power sensor | ANRITSU | MA2411B | 11737 | 10/16/2018 | 10/31/2019 | 12 |
| AT | 141805 | Power Meter | ANRITSU | ML2495A | 6K00003338 | 10/16/2018 | 10/31/2019 | 12 |
| AT | 141173 | Attenuator(10dB) (above1GHz) | HIROSE ELECTRIC CO.,LTD. | AT-110 | - | 12/17/2018 | 12/31/2019 | 12 |
| AT | 141903 | Spectrum Analyzer | AGILENT | E4440A | MY46186390 | 09/20/2018 | 09/30/2019 | 12 |
| AT | 141567 | Thermo-Hygrometer | CUSTOM | CTH-201 | 0008 | 01/11/2019 | 01/31/2020 | 12 |
| RE | 142285 | Antenna Tilt Jig | Intelligent System Engineering Co., Ltd | Antenna Tilt Jig | T-0003 | - | - | - |
| RE | 141949 | Test Receiver | Rohde & Schwarz | ESCI | 100767 | 08/06/2018 | 08/31/2019 | 12 |
| RE | 141582 | Pre Amplifier | SONOMA INSTRUMENT | 310 | 260834 | 02/08/2019 | 02/29/2020 | 12 |
| RE | 141323 | Coaxial cable | UL Japan | - | - | 07/03/2018 | 07/31/2019 | 12 |
| RE | 141331 | Attenuator(6dB) | TME | UFA-01 | - | 02/05/2019 | 02/29/2020 | 12 |
| RE | 141424 | Biconical Antenna | Schwarzbeck | BBA9106 | 1915 | 05/24/2019 | 05/31/2020 | 12 |
| RE | 141266 | Logperiodic Antenna(200-1000MHz) | Schwarzbeck | VUSLP9111B | 911B-191 | 03/25/2019 | 03/31/2020 | 12 |
| RE | 141532 | DIGITAL HiTESTER | HIOKI | 3805 | 51201197 | 01/29/2019 | 01/31/2020 | 12 |
| RE | 142183 | Measure | KOMELON | KMC-36 | - | - | - | - |
| RE | 142008 | AC3_Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 06/26/2018 | 06/30/2020 | 24 |
| RE | 142013 | AC3_Semi Anechoic Chamber(SVSWR) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 04/08/2019 | 04/30/2021 | 24 |
| RE | 141554 | Thermo-Hygrometer | CUSTOM | CTH-180 | 1301 | 01/11/2019 | 01/31/2020 | 12 |
| RE | 141513 | Horn Antenna 15-40GHz | Schwarzbeck | BBHA9170 | BBHA9170306 | 05/10/2019 | 05/31/2020 | 12 |
| RE | 141507 | Horn Antenna 1-18GHz | Schwarzbeck | BBHA9120D | 258 | 05/10/2019 | 05/31/2020 | 12 |
| RE | 177964 | Microwave Cable | Junkosha INC. | MMX221 | 1901S329(1m)/ 1902S579(5m) | 03/05/2019 | 03/31/2020 | 12 |
| RE | 141901 | Spectrum Analyzer | AGILENT | E4440A | MY48250080 | 10/04/2018 | 10/31/2019 | 12 |
| RE | 141580 | MicroWave System Amplifier | AGILENT | 83017A | MY39500779 | 03/05/2019 | 03/31/2020 | 12 |
| RE | 141232 | High Pass Filter 3.5-18.0GHz | UL Japan | HPF SELECTOR | 001 | 09/19/2018 | 09/30/2019 | 12 |

***Hyphens for Last Calibration Date, Calibration Due 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.**
**All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.**

**As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.**

**Test item:** **RE: Radiated Emission test**
**AT: Antenna Terminal Conducted test**

## APPENDIX 3: Photographs of test setup

### Radiated Spurious Emission

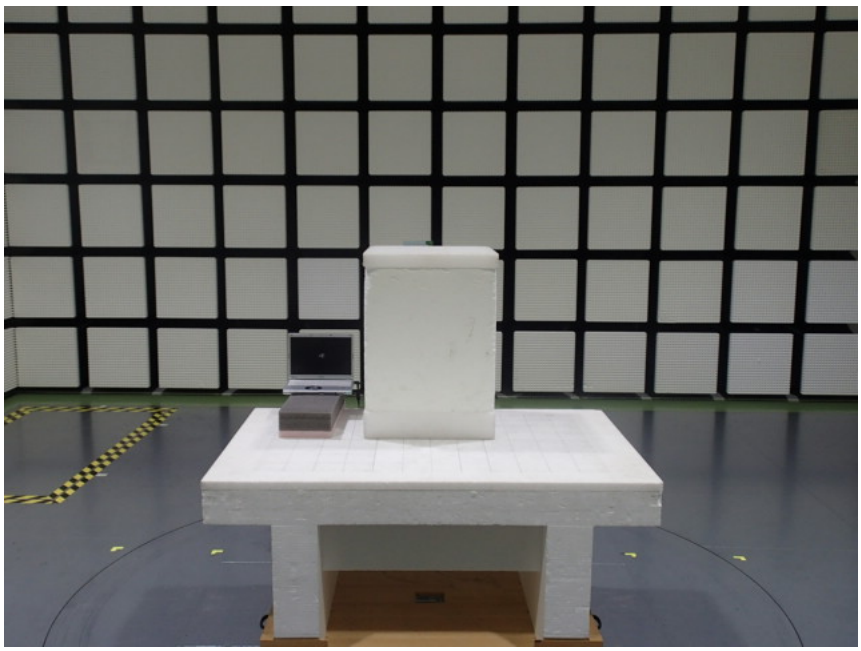


**Photo 1**

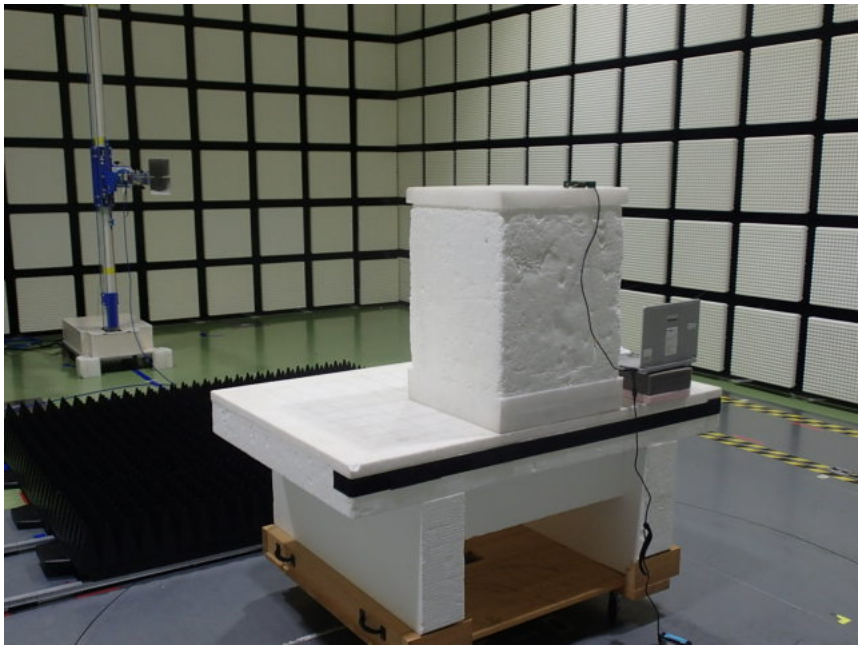
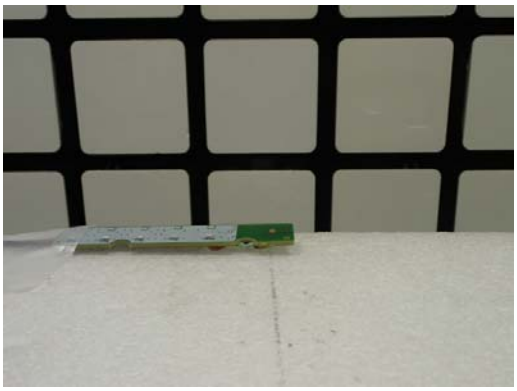


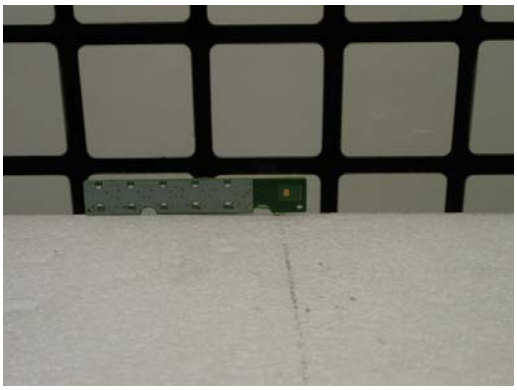
**Photo 2**

**Worst Case Position**
**Below 1GHz (Horizontal: X-axis/ Vertical:X-axis)**
**Above 1GHz (Horizontal: X-axis/ Vertical:X-axis)**

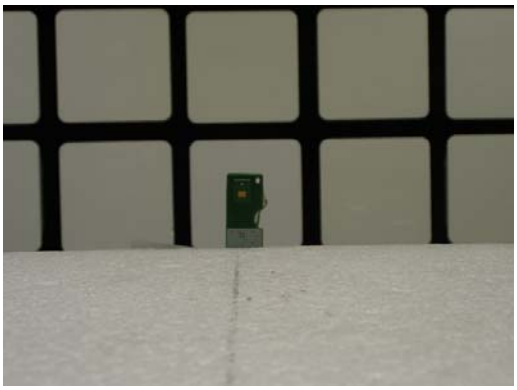
**X-axis**



**Y-axis**



**Z-axis**



**End of Report**