



# RADIO TEST REPORT

Test Report No. : 11350077H-B-R1

**Applicant** : Murata Manufacturing Co., Ltd.

**Type of Equipment** : Communication Module

**Model No.** : LBEE5UW1FS

**FCC ID** : VPYLB1FS

**Test regulation** : FCC Part 15 Subpart C: 2016  
\* Bluetooth part  
(Class II permissive change)  
\*Radiated Spurious Emission test only

**Test Result** : Complied

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 must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11350077H-B. 11350077H-B is replaced with this report.

**Date of test:** June 29 to July 13, 2016

**Representative test engineer:**

  
Satofumi Matsuyama  
Engineer  
Consumer Technology Division

**Approved by:**

  
Takayuki Shimada  
Engineer  
Consumer Technology Division



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/](http://japan.ul.com/resources/emc_accredited/)

**UL Japan, Inc.**

**Ise EMC Lab.**

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13-EM-F0429

## REVISION HISTORY

**Original Test Report No.: 11350077H-B**

[illegible]

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## **SECTION 1: Customer information**

|                  |   |                                                            |
|------------------|---|------------------------------------------------------------|
| Company Name     | : | Murata Manufacturing Co., Ltd.                             |
| Address          | : | 1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan |
| Telephone Number | : | +81-75-955-6736                                            |
| Facsimile Number | : | +81-75-955-6634                                            |
| Contact Person   | : | Motoo Hayashi                                              |

## **SECTION 2: Equipment under test (E.U.T.)**

### **.1 Identification of E.U.T.**

|                            |   |                                                                                           |
|----------------------------|---|-------------------------------------------------------------------------------------------|
| Type of Equipment          | : | Communication Module                                                                      |
| Model No.                  | : | LBEE5UW1FS                                                                                |
| Serial No.                 | : | Refer to Section 4, Clause 4.2                                                            |
| Rating                     | : | DC 3.3 V                                                                                  |
| Receipt Date of Sample     | : | June 24, 2016                                                                             |
| Country of Mass-production | : | Japan and China                                                                           |
| 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: LBEE5UW1FS (referred to as the EUT in this report) is a Communication Module.

### **General Specification**

|                                    |   |                                                     |
|------------------------------------|---|-----------------------------------------------------|
| Clock frequency(ies) in the system | : | BT/WLAN-Ref: 37.4 MHz, LPO: 32.768 kHz, CPU: 26 MHz |
| Operating temperature              | : | -10 deg. C to +50 deg. C                            |

## **Radio Specification**

### **WLAN (IEEE802.11b/g/n-20)**

|                                |                        |
|--------------------------------|------------------------|
| Equipment Type                 | Transceiver            |
| Frequency of Operation         | 2412-2462MHz           |
| Type of Modulation             | DSSS, OFDM             |
| Bandwidth & Channel spacing    | 20MHz & 5MHz           |
| Method of frequency generation | Synthesizer            |
| Power Supply (inner)           | DC 1.2 V               |
| Antenna Type                   | Pattern Antenna        |
| Antenna Gain                   | -0.5 dBi: 109 mm cable |

### **Bluetooth (Ver. 4.1 with EDR function)**

|                                |                                                   |
|--------------------------------|---------------------------------------------------|
| Equipment Type                 | Transceiver                                       |
| Frequency of Operation         | 2402-2480MHz                                      |
| Type of Modulation             | BT: FHSS (GFSK, $\pi/4$ DQPSK, 8DPSK)<br>LE: GFSK |
| Bandwidth & Channel spacing    | BT: 1MHz & 1MHz<br>LE: 2MHz & 2MHz                |
| Method of frequency generation | Synthesizer                                       |
| Power Supply (inner)           | DC 1.2 V                                          |
| Antenna Type                   | Pattern Antenna                                   |
| Antenna Gain                   | -0.5 dBi: 109 mm cable                            |

\*This test report applies for Bluetooth part.

<Contents of the change from original model>

Test Report Number of original model is 10936450H-B-R1 (issued by UL Japan, Inc.).

Specification was changed from the original model as follows:

\*Antenna of the EUT was modified.

The radio specification is identical to the original.

Therefore only Radiated Spurious Emission test was 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 April 6, 2016.

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                                         |
|------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------|----------|-------------------------------------------------|
| Spurious Emission & Band Edge Compliance | FCC: FCC Public Notice DA 00-705<br>IC: RSS-Gen 6.13 | FCC: Section15.247(d)<br>IC: RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10 | 6.2 dB<br>660.001 MHz, QP, Hori. | Complied | Conducted/<br>Radiated<br>(above 30 MHz)<br>*1) |

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).

\* 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 (DC 1.2V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

#### **FCC Part 15.203 Antenna requirement**

The EUT has a unique antenna connector (Microwave Coaxial Connector (MM5829-2700) on the Module). Therefore the equipment complies with the requirement of Section 15.203/212.

### 3.3 Addition to standard

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

### 3.4 Uncertainty

#### EMI

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

| Test distance | Radiated emission<br>(+dB)<br>9 kHz - 30 MHz |
|---------------|----------------------------------------------|
| 3m            | 3.8 dB                                       |
| 10m           | 3.7 dB                                       |

| Polarity   | Radiated emission (Below 1GHz) |               |              |               |
|------------|--------------------------------|---------------|--------------|---------------|
|            | (3 m*)(+dB)                    |               | (10 m*)(+dB) |               |
|            | 30 – 200 MHz                   | 200 – 1000MHz | 30 – 200 MHz | 200 – 1000MHz |
| Horizontal | 4.9 dB                         | 5.2 dB        | 4.9 dB       | 5.0 dB        |
| Vertical   | 4.6 dB                         | 5.9 dB        | 5.0 dB       | 5.0 dB        |

| Radiated emission |           |               |              |              |
|-------------------|-----------|---------------|--------------|--------------|
| (3 m*)(+dB)       |           | (1 m*)(+dB)   |              | (10 m*)(+dB) |
| 1 – 6GHz          | 6 – 18GHz | 10 – 26.5 GHz | 26.5 – 40GHz | 1 -18 GHz    |
| 5.1 dB            | 5.3 dB    | 5.1 dB        | 5.1 dB       | 5.3 dB       |

\*Measurement distance

#### Radiated emission test

The data listed in this test report has enough margin, more than the site margin.

### 3.5 Test Location

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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

| Test site                  | IC Registration Number | 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 | 2973C-1                | 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 | 2973C-2                | 7.5 x 5.8 x 5.2            | 4.0 x 4.0                                                        | -                      | 3 m                          |
| No.3 semi-anechoic chamber | 2973C-3                | 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 | 2973C-4                | 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.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            | N/A                                                              | -                      | -                            |
| No.9 measurement room      | -                      | 8.8 x 4.6 x 2.8            | 2.4 x 2.4                                                        | -                      | -                            |
| No.11 measurement room     | -                      | 6.2 x 4.7 x 3.0            | 4.8 x 4.6                                                        | -                      | -                            |

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

Refer to APPENDIX.

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

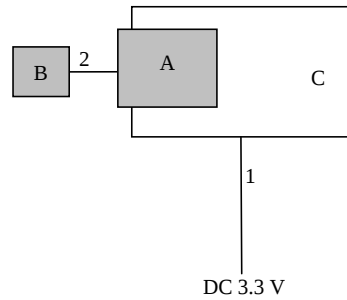
### **4.1 Operating Mode(s)**

Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

| Test Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Mode                       | Tested frequency                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------|
| Spurious Emission<br>(Radiated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Tx (Hopping Off) DH5, 3DH5 | 2402 MHz<br>2441 MHz<br>2480 MHz |
| <p>*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test)</p> <p>*2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative.</p> <p>* It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all test items based on Bluetooth Core specification.</p> <p>*The power value of the EUT was set for testing as follows (setting value might be different from product specification value);<br/>Power settings: 6 dBm<br/>Software: MFG Tool v1.0 and Bluetooth Test Tool 1.8.9.3</p> <p>*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.</p> |                            |                                  |

## 4.2 Configuration and peripherals



\* 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   | Communication Module | LBEE5UW1FS   | 00003eee2b    | Murata Manufacturing Co., Ltd. | EUT     |
| B   | Antenna              | Type1CH      | 001           | Murata Manufacturing Co., Ltd. | EUT     |
| C   | Jig Board            | P2ML4233     | -             | Murata Manufacturing Co., Ltd. | -       |

### List of cables used

| No. | Name          | Length (m) | Shield     |            | Remarks |
|-----|---------------|------------|------------|------------|---------|
|     |               |            | Cable      | Connector  |         |
| 1   | DC Cable      | 1.800      | Unshielded | Unshielded | -       |
| 2   | Antenna Cable | 0.109      | Shielded   | Shielded   | -       |

## **SECTION 6: Radiated Spurious Emission**

### **Test Procedure**

[For below 1GHz]

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 1GHz]

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 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    | 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                           | PK                                                                                         |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz                                                                   | RBW: 1 MHz<br>VBW: 10 Hz *1) | RBW: 100 kHz<br>VBW: 300 kHz                                                               |
| Test Distance   | 3 m           | 4.0 m *2) (1 GHz – 10 GHz),<br>4.45 m *3) (1 GHz – 10 GHz),<br>1 m *4) (10 GHz – 26.5 GHz) |                              | 4.0 m *2) (1 GHz – 10 GHz),<br>4.45 m *3) (1 GHz – 10 GHz),<br>1 m *4) (10 GHz – 26.5 GHz) |

\*1) Although DA 00-705 accepts VBW = 10 Hz for AV measurements, it was confirmed that superfluous smoothing was not performed.

\*2) Distance Factor:  $20 \times \log (4.0 \text{ m} / 3.0 \text{ m}) = 2.5 \text{ dB}$  for No.1 Semi Anechoic Chamber

\*3) Distance Factor:  $20 \times \log (4.45 \text{ m} / 3.0 \text{ m}) = 3.43 \text{ dB}$  for No.3 Semi Anechoic Chamber

\*4) Distance Factor:  $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT (Module and Antenna) 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 M - 26.5 GHz  
**Test data** : APPENDIX  
**Test result** : Pass

## APPENDIX 1: Test data

### Radiated Spurious Emission

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber  
Report No. : 11350077H  
Date : July 11, 2016 July 13, 2016 July 13, 2016  
Temperature / Humidity : 25 deg. C / 64 % RH 24 deg. C / 66 % RH 24 deg. C / 68 % RH  
Engineer : Satofumi Matsuyama Kazuya Yoshioka Masafumi Niwa  
(1-10GHz) (10-26.5GHz) (Below 1GHz)  
Mode : Tx, Hopping Off, DH5 2402 MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|-------------|
| Hori     | 480.002         | QP       | 32.7           | 17.2            | 11.9      | 38.4      | 23.4            | 46.0           | 22.6        |             |
| Hori     | 540.002         | QP       | 36.1           | 18.2            | 12.3      | 38.3      | 28.3            | 46.0           | 17.7        |             |
| Hori     | 600.002         | QP       | 35.4           | 19.0            | 12.6      | 38.3      | 28.7            | 46.0           | 17.3        |             |
| Hori     | 660.002         | QP       | 45.2           | 19.5            | 13.0      | 38.3      | 39.4            | 46.0           | 6.6         |             |
| Hori     | 780.003         | QP       | 36.0           | 20.6            | 13.7      | 38.4      | 31.9            | 46.0           | 14.1        |             |
| Hori     | 840.003         | QP       | 31.9           | 21.3            | 14.0      | 38.2      | 29.0            | 46.0           | 17.0        |             |
| Hori     | 2390.000        | PK       | 45.3           | 27.1            | 5.8       | 36.3      | 41.9            | 73.9           | 32.0        |             |
| Hori     | 4804.000        | PK       | 44.5           | 31.0            | 8.1       | 35.6      | 48.0            | 73.9           | 25.9        | Floor noise |
| Hori     | 7206.000        | PK       | 44.1           | 35.7            | 9.3       | 35.8      | 53.3            | 73.9           | 20.6        | Floor noise |
| Hori     | 9608.000        | PK       | 45.1           | 37.3            | 10.1      | 36.2      | 56.3            | 73.9           | 17.6        | Floor noise |
| Hori     | 2390.000        | AV       | 33.3           | 27.1            | 5.8       | 36.3      | 29.9            | 53.9           | 24.0        |             |
| Hori     | 4804.000        | AV       | 30.9           | 31.0            | 8.1       | 35.6      | 34.4            | 53.9           | 19.5        | Floor noise |
| Hori     | 7206.000        | AV       | 31.1           | 35.7            | 9.3       | 35.8      | 40.3            | 53.9           | 13.6        | Floor noise |
| Hori     | 9608.000        | AV       | 32.5           | 37.3            | 10.1      | 36.2      | 43.7            | 53.9           | 10.2        | Floor noise |
| Vert     | 60.000          | QP       | 38.0           | 7.4             | 7.8       | 39.0      | 14.2            | 40.0           | 25.8        |             |
| Vert     | 105.271         | QP       | 33.6           | 10.7            | 8.5       | 39.2      | 13.6            | 43.5           | 29.9        |             |
| Vert     | 540.002         | QP       | 38.7           | 18.2            | 12.3      | 38.3      | 30.9            | 46.0           | 15.1        |             |
| Vert     | 629.406         | QP       | 37.0           | 19.2            | 12.8      | 38.3      | 30.7            | 46.0           | 15.3        |             |
| Vert     | 660.002         | QP       | 42.3           | 19.5            | 13.0      | 38.3      | 36.5            | 46.0           | 9.5         |             |
| Vert     | 780.003         | QP       | 35.0           | 20.6            | 13.7      | 38.4      | 30.9            | 46.0           | 15.1        |             |
| Vert     | 2390.000        | PK       | 46.0           | 27.1            | 5.8       | 36.3      | 42.6            | 73.9           | 31.3        |             |
| Vert     | 4804.000        | PK       | 43.6           | 31.0            | 8.1       | 35.6      | 47.1            | 73.9           | 26.8        | Floor noise |
| Vert     | 7206.000        | PK       | 43.5           | 35.7            | 9.3       | 35.8      | 52.7            | 73.9           | 21.2        | Floor noise |
| Vert     | 9608.000        | PK       | 44.9           | 37.3            | 10.1      | 36.2      | 56.1            | 73.9           | 17.8        | Floor noise |
| Vert     | 2390.000        | AV       | 33.1           | 27.1            | 5.8       | 36.3      | 29.7            | 53.9           | 24.2        |             |
| Vert     | 4804.000        | AV       | 30.9           | 31.0            | 8.1       | 35.6      | 34.4            | 53.9           | 19.5        | Floor noise |
| Vert     | 7206.000        | AV       | 31.1           | 35.7            | 9.3       | 35.8      | 40.3            | 53.9           | 13.6        | Floor noise |
| Vert     | 9608.000        | AV       | 32.5           | 37.3            | 10.1      | 36.2      | 43.7            | 53.9           | 10.2        | 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  $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

\*These results have sufficient margin without taking account Dwell time factor.

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       | 106.7          | 27.1              | 5.8       | 36.3      | 103.3           | -              | -           | Carrier |
| Hori     | 2400.000        | PK       | 47.8           | 27.1              | 5.8       | 36.3      | 44.4            | 83.3           | 38.9        |         |
| Vert     | 2402.000        | PK       | 104.6          | 27.1              | 5.8       | 36.3      | 101.2           | -              | -           | Carrier |
| Vert     | 2400.000        | PK       | 44.9           | 27.1              | 5.8       | 36.3      | 41.5            | 81.2           | 39.7        |         |

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

UL Japan, Inc.

Ise EMC Lab.

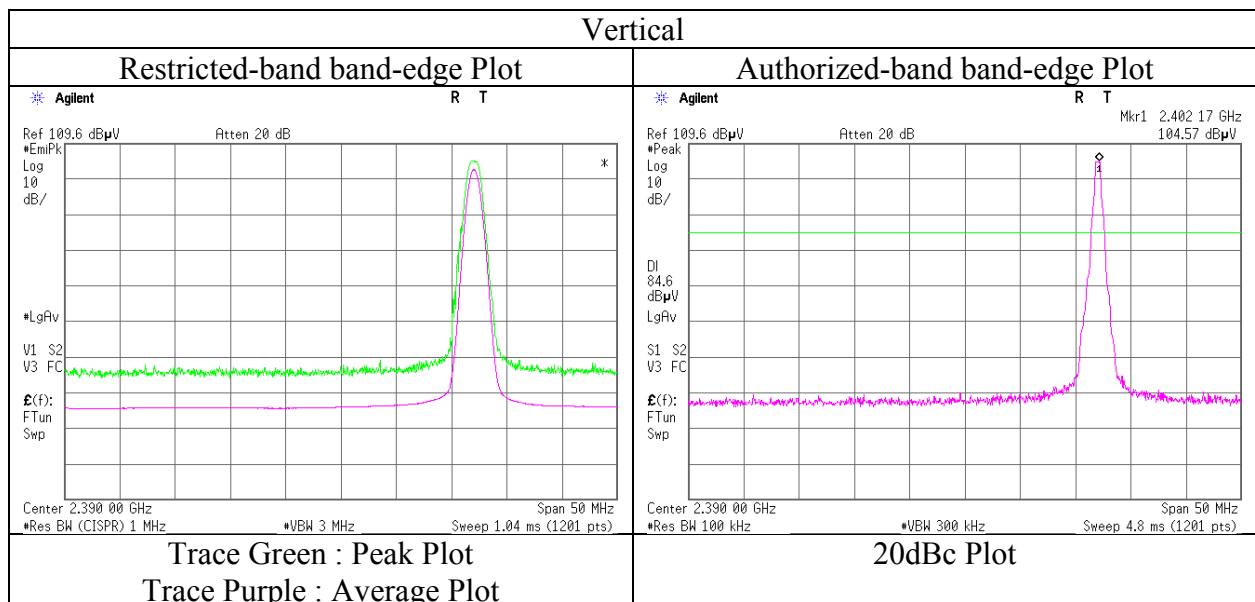
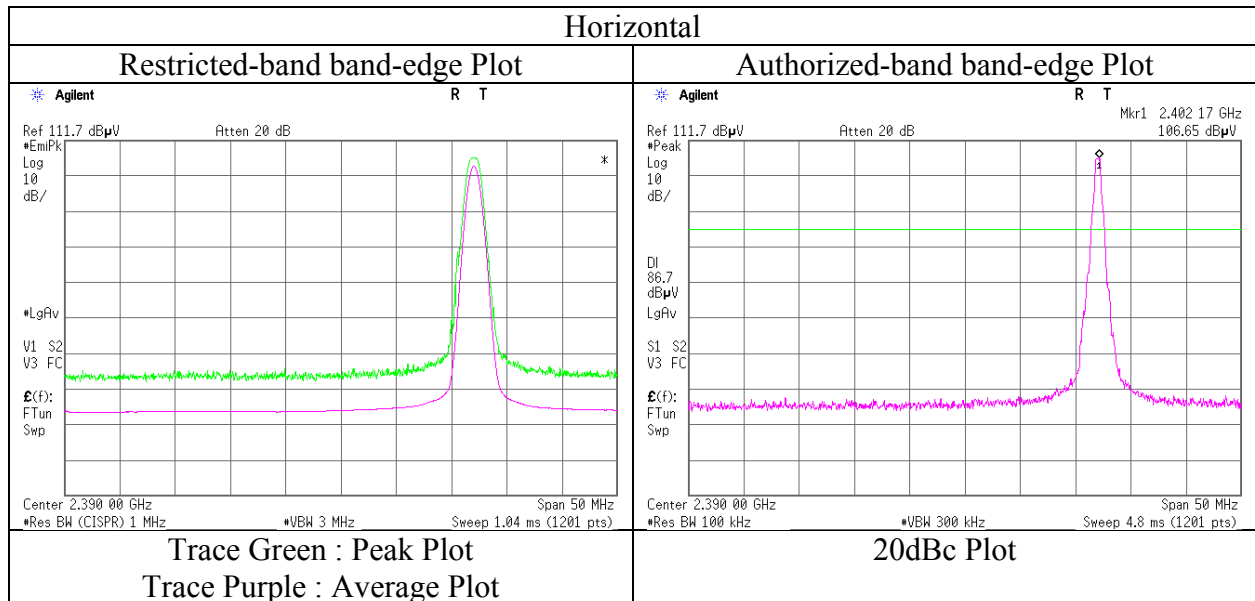
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## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                                         |
|------------------------|-----------------------------------------|
| Test place             | Ise EMC Lab. No.1 Semi Anechoic Chamber |
| Report No.             | 11350077H                               |
| Date                   | July 11, 2016                           |
| Temperature / Humidity | 25 deg. C / 64 % RH                     |
| Engineer               | Satofumi Matsuyama                      |
| Mode                   | Tx, Hopping Off, DH5 2402 MHz           |



\* Final result of restricted band edge was shown in tabular data.

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## Radiated Spurious Emission

|                        |                                         |                                 |                               |
|------------------------|-----------------------------------------|---------------------------------|-------------------------------|
| Test place             | Ise EMC Lab. No.1 Semi Anechoic Chamber |                                 |                               |
| Report No.             | 11350077H                               |                                 |                               |
| Date                   | July 11, 2016                           | July 13, 2016                   | July 13, 2016                 |
| Temperature / Humidity | 25 deg. C / 64 % RH                     | 24 deg. C / 66 % RH             | 24 deg. C / 68 % RH           |
| Engineer               | Satofumi Matsuyama<br>(1-10GHz)         | Kazuya Yoshioka<br>(10-26.5GHz) | Masafumi Niwa<br>(Below 1GHz) |
| Mode                   | Tx, Hopping Off, DH5 2441 MHz           |                                 |                               |

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|-------------|
| Hori     | 480.000            | QP       | 32.6              | 17.2               | 11.9         | 38.4         | 23.3               | 46.0              | 22.7           |             |
| Hori     | 540.005            | QP       | 36.4              | 18.2               | 12.3         | 38.3         | 28.6               | 46.0              | 17.4           |             |
| Hori     | 600.001            | QP       | 35.3              | 19.0               | 12.6         | 38.3         | 28.6               | 46.0              | 17.4           |             |
| Hori     | 660.001            | QP       | 45.6              | 19.5               | 13.0         | 38.3         | 39.8               | 46.0              | 6.2            |             |
| Hori     | 780.002            | QP       | 36.2              | 20.6               | 13.7         | 38.4         | 32.1               | 46.0              | 13.9           |             |
| Hori     | 840.001            | QP       | 32.0              | 21.3               | 14.0         | 38.2         | 29.1               | 46.0              | 16.9           |             |
| Hori     | 4882.000           | PK       | 43.5              | 31.2               | 8.1          | 35.5         | 47.3               | 73.9              | 26.6           | Floor noise |
| Hori     | 7323.000           | PK       | 43.6              | 35.6               | 9.3          | 35.8         | 52.7               | 73.9              | 21.2           | Floor noise |
| Hori     | 9764.000           | PK       | 44.8              | 37.2               | 10.2         | 36.3         | 55.9               | 73.9              | 18.0           | Floor noise |
| Hori     | 4882.000           | AV       | 30.8              | 31.2               | 8.1          | 35.5         | 34.6               | 53.9              | 19.3           | Floor noise |
| Hori     | 7323.000           | AV       | 31.1              | 35.6               | 9.3          | 35.8         | 40.2               | 53.9              | 13.7           | Floor noise |
| Hori     | 9764.000           | AV       | 32.0              | 37.2               | 10.2         | 36.3         | 43.1               | 53.9              | 10.8           | Floor noise |
| Vert     | 60.021             | QP       | 38.2              | 7.4                | 7.8          | 39.0         | 14.4               | 40.0              | 25.6           |             |
| Vert     | 105.272            | QP       | 33.8              | 10.7               | 8.5          | 39.2         | 13.8               | 43.5              | 29.7           |             |
| Vert     | 540.002            | QP       | 38.6              | 18.2               | 12.3         | 38.3         | 30.8               | 46.0              | 15.2           |             |
| Vert     | 629.424            | QP       | 37.3              | 19.2               | 12.8         | 38.3         | 31.0               | 46.0              | 15.0           |             |
| Vert     | 660.001            | QP       | 42.2              | 19.5               | 13.0         | 38.3         | 36.4               | 46.0              | 9.6            |             |
| Vert     | 780.001            | QP       | 35.2              | 20.6               | 13.7         | 38.4         | 31.1               | 46.0              | 14.9           |             |
| Vert     | 4882.000           | PK       | 43.8              | 31.2               | 8.1          | 35.5         | 47.6               | 73.9              | 26.3           | Floor noise |
| Vert     | 7323.000           | PK       | 43.7              | 35.6               | 9.3          | 35.8         | 52.8               | 73.9              | 21.1           | Floor noise |
| Vert     | 9764.000           | PK       | 44.5              | 37.2               | 10.2         | 36.3         | 55.6               | 73.9              | 18.3           | Floor noise |
| Vert     | 4882.000           | AV       | 30.8              | 31.2               | 8.1          | 35.5         | 34.6               | 53.9              | 19.3           | Floor noise |
| Vert     | 7323.000           | AV       | 31.1              | 35.6               | 9.3          | 35.8         | 40.2               | 53.9              | 13.7           | Floor noise |
| Vert     | 9764.000           | AV       | 32.0              | 37.2               | 10.2         | 36.3         | 43.1               | 53.9              | 10.8           | 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       $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$   
                                 10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

## Radiated Spurious Emission

|                        |                                         |                                 |                               |
|------------------------|-----------------------------------------|---------------------------------|-------------------------------|
| Test place             | Ise EMC Lab. No.1 Semi Anechoic Chamber |                                 |                               |
| Report No.             | 11350077H                               |                                 |                               |
| Date                   | July 11, 2016                           | July 13, 2016                   | July 13, 2016                 |
| Temperature / Humidity | 25 deg. C / 64 % RH                     | 24 deg. C / 66 % RH             | 24 deg. C / 68 % RH           |
| Engineer               | Satofumi Matsuyama<br>(1-10GHz)         | Kazuya Yoshioka<br>(10-26.5GHz) | Masafumi Niwa<br>(Below 1GHz) |
| Mode                   | Tx, Hopping Off, DH5 2480 MHz           |                                 |                               |

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|-------------|
| Hori     | 480.005            | QP       | 32.5              | 17.2               | 11.9         | 38.4         | 23.2               | 46.0              | 22.8           |             |
| Hori     | 540.004            | QP       | 36.0              | 18.2               | 12.3         | 38.3         | 28.2               | 46.0              | 17.8           |             |
| Hori     | 600.005            | QP       | 35.1              | 19.0               | 12.6         | 38.3         | 28.4               | 46.0              | 17.6           |             |
| Hori     | 660.002            | QP       | 45.3              | 19.5               | 13.0         | 38.3         | 39.5               | 46.0              | 6.5            |             |
| Hori     | 780.001            | QP       | 36.1              | 20.6               | 13.7         | 38.4         | 32.0               | 46.0              | 14.0           |             |
| Hori     | 840.006            | QP       | 32.4              | 21.3               | 14.0         | 38.2         | 29.5               | 46.0              | 16.5           |             |
| Hori     | 2483.500           | PK       | 50.8              | 27.2               | 5.8          | 36.3         | 47.5               | 73.9              | 26.4           |             |
| Hori     | 4960.000           | PK       | 44.5              | 31.4               | 8.0          | 35.5         | 48.4               | 73.9              | 25.5           | Floor noise |
| Hori     | 7440.000           | PK       | 43.7              | 35.6               | 9.2          | 35.8         | 52.7               | 73.9              | 21.2           | Floor noise |
| Hori     | 9920.000           | PK       | 44.8              | 37.1               | 10.2         | 36.3         | 55.8               | 73.9              | 18.1           | Floor noise |
| Hori     | 2483.500           | AV       | 38.6              | 27.2               | 5.8          | 36.3         | 35.3               | 53.9              | 18.6           |             |
| Hori     | 4960.000           | AV       | 31.5              | 31.4               | 8.0          | 35.5         | 35.4               | 53.9              | 18.5           | Floor noise |
| Hori     | 7440.000           | AV       | 31.5              | 35.6               | 9.2          | 35.8         | 40.5               | 53.9              | 13.4           | Floor noise |
| Hori     | 9920.000           | AV       | 32.2              | 37.1               | 10.2         | 36.3         | 43.2               | 53.9              | 10.7           | Floor noise |
| Vert     | 60.000             | QP       | 38.2              | 7.4                | 7.8          | 39.0         | 14.4               | 40.0              | 25.6           |             |
| Vert     | 105.270            | QP       | 33.3              | 10.7               | 8.5          | 39.2         | 13.3               | 43.5              | 30.2           |             |
| Vert     | 540.004            | QP       | 38.8              | 18.2               | 12.3         | 38.3         | 31.0               | 46.0              | 15.0           |             |
| Vert     | 629.402            | QP       | 36.8              | 19.2               | 12.8         | 38.3         | 30.5               | 46.0              | 15.5           |             |
| Vert     | 660.002            | QP       | 42.4              | 19.5               | 13.0         | 38.3         | 36.6               | 46.0              | 9.4            |             |
| Vert     | 780.001            | QP       | 34.9              | 20.6               | 13.7         | 38.4         | 30.8               | 46.0              | 15.2           |             |
| Vert     | 2483.500           | PK       | 50.6              | 27.2               | 5.8          | 36.3         | 47.3               | 73.9              | 26.6           |             |
| Vert     | 4960.000           | PK       | 43.7              | 31.4               | 8.0          | 35.5         | 47.6               | 73.9              | 26.3           | Floor noise |
| Vert     | 7440.000           | PK       | 44.2              | 35.6               | 9.2          | 35.8         | 53.2               | 73.9              | 20.7           | Floor noise |
| Vert     | 9920.000           | PK       | 44.7              | 37.1               | 10.2         | 36.3         | 55.7               | 73.9              | 18.2           | Floor noise |
| Vert     | 2483.500           | AV       | 38.3              | 27.2               | 5.8          | 36.3         | 35.0               | 53.9              | 18.9           |             |
| Vert     | 4960.000           | AV       | 31.5              | 31.4               | 8.0          | 35.5         | 35.4               | 53.9              | 18.5           | Floor noise |
| Vert     | 7440.000           | AV       | 31.5              | 35.6               | 9.2          | 35.8         | 40.5               | 53.9              | 13.4           | Floor noise |
| Vert     | 9920.000           | AV       | 32.2              | 37.1               | 10.2         | 36.3         | 43.2               | 53.9              | 10.7           | Floor noise |

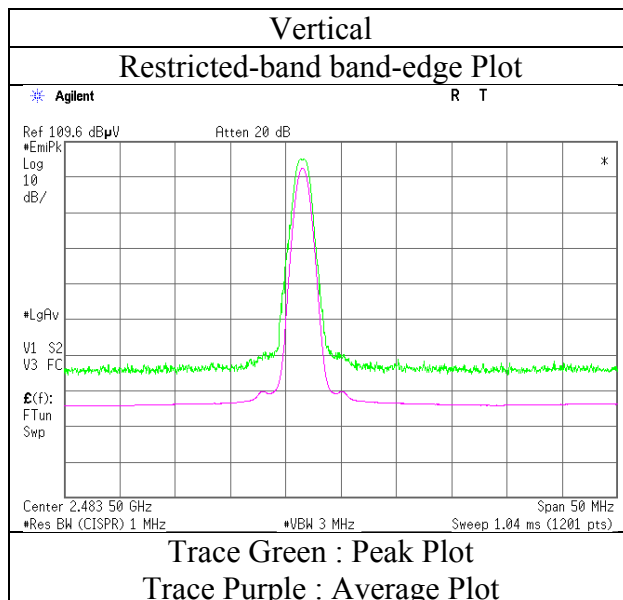
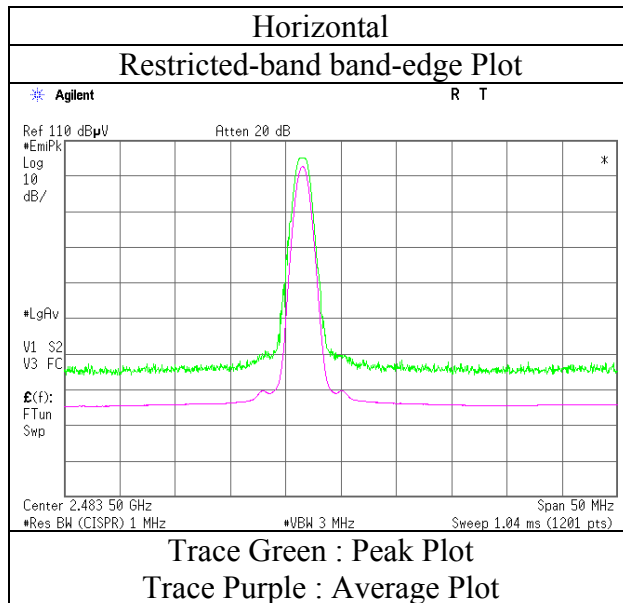
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

\*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 (4.0 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. No.1 Semi Anechoic Chamber |
| Report No.             | 11350077H                               |
| Date                   | July 11, 2016                           |
| Temperature / Humidity | 25 deg. C / 64 % RH                     |
| Engineer               | Satofumi Matsuyama                      |
| Mode                   | Tx, Hopping Off, DH5 2480 MHz           |



\* Final result of restricted band edge was shown in tabular data.

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## Radiated Spurious Emission

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber  
Report No. : 11350077H  
Date : June 29, 2016  
Temperature / Humidity : 23 deg. C / 69 % RH  
Engineer : Tomoki Matsui  
Mode : Tx, Hopping Off, 3DH5 2402 MHz

June 29, 2016  
23 deg. C / 72 % RH  
Satorfumi Matsuyama  
(Above 10GHz)

June 30, 2016  
23 deg. C / 62 % RH  
Tomoki Matsui  
(Below 1GHz)

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|-------------|
| Hori     | 360.000         | QP       | 36.4           | 14.8            | 10.3      | 31.9      | 29.6            | 46.0           | 16.4        |             |
| Hori     | 480.000         | QP       | 32.4           | 17.2            | 11.0      | 31.9      | 28.7            | 46.0           | 17.3        |             |
| Hori     | 600.000         | QP       | 35.1           | 19.1            | 11.9      | 32.0      | 34.1            | 46.0           | 11.9        |             |
| Hori     | 720.000         | QP       | 33.2           | 20.0            | 12.5      | 32.0      | 33.7            | 46.0           | 12.3        |             |
| Hori     | 780.000         | QP       | 32.0           | 20.6            | 12.8      | 31.6      | 33.8            | 46.0           | 12.2        |             |
| Hori     | 840.000         | QP       | 28.7           | 21.3            | 13.1      | 31.3      | 31.8            | 46.0           | 14.2        |             |
| Hori     | 2390.000        | PK       | 42.6           | 26.7            | 6.7       | 32.7      | 43.3            | 73.9           | 30.6        |             |
| Hori     | 4804.000        | PK       | 41.7           | 31.0            | 9.0       | 31.8      | 49.9            | 73.9           | 24.0        | Floor noise |
| Hori     | 7206.000        | PK       | 43.4           | 35.7            | 10.2      | 32.6      | 56.7            | 73.9           | 17.2        | Floor noise |
| Hori     | 9608.000        | PK       | 45.0           | 37.2            | 10.9      | 33.2      | 59.9            | 73.9           | 14.0        | Floor noise |
| Hori     | 2390.000        | AV       | 30.2           | 26.7            | 6.7       | 32.7      | 30.9            | 53.9           | 23.0        |             |
| Hori     | 4804.000        | AV       | 29.0           | 31.0            | 9.0       | 31.8      | 37.2            | 53.9           | 16.7        | Floor noise |
| Hori     | 7206.000        | AV       | 30.7           | 35.7            | 10.2      | 32.6      | 44.0            | 53.9           | 9.9         | Floor noise |
| Hori     | 9608.000        | AV       | 32.5           | 37.2            | 10.9      | 33.2      | 47.4            | 53.9           | 6.5         | Floor noise |
| Vert     | 420.000         | QP       | 29.0           | 16.0            | 10.7      | 31.9      | 23.8            | 46.0           | 22.2        |             |
| Vert     | 480.000         | QP       | 32.4           | 17.2            | 11.0      | 31.9      | 28.7            | 46.0           | 17.3        |             |
| Vert     | 600.000         | QP       | 32.3           | 19.1            | 11.9      | 32.0      | 31.3            | 46.0           | 14.7        |             |
| Vert     | 642.140         | QP       | 29.1           | 19.4            | 12.1      | 32.1      | 28.5            | 46.0           | 17.5        |             |
| Vert     | 660.000         | QP       | 29.8           | 19.5            | 12.2      | 32.1      | 29.4            | 46.0           | 16.6        |             |
| Vert     | 780.000         | QP       | 26.7           | 20.6            | 12.8      | 31.6      | 28.5            | 46.0           | 17.5        |             |
| Vert     | 2390.000        | PK       | 42.5           | 26.7            | 6.7       | 32.7      | 43.2            | 73.9           | 30.7        |             |
| Vert     | 4804.000        | PK       | 41.8           | 31.0            | 9.0       | 31.8      | 50.0            | 73.9           | 23.9        | Floor noise |
| Vert     | 7206.000        | PK       | 43.3           | 35.7            | 10.2      | 32.6      | 56.6            | 73.9           | 17.3        | Floor noise |
| Vert     | 9608.000        | PK       | 44.4           | 37.2            | 10.9      | 33.2      | 59.3            | 73.9           | 14.6        | Floor noise |
| Vert     | 2390.000        | AV       | 30.0           | 26.7            | 6.7       | 32.7      | 30.7            | 53.9           | 23.2        |             |
| Vert     | 4804.000        | AV       | 29.0           | 31.0            | 9.0       | 31.8      | 37.2            | 53.9           | 16.7        | Floor noise |
| Vert     | 7206.000        | AV       | 30.7           | 35.7            | 10.2      | 32.6      | 44.0            | 53.9           | 9.9         | Floor noise |
| Vert     | 9608.000        | AV       | 32.5           | 37.2            | 10.9      | 33.2      | 47.4            | 53.9           | 6.5         | 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  $20\log(4.45\text{ m} / 3.0\text{ m}) = 3.43\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

**\*These results have sufficient margin without taking account Dwell time factor.**

**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       | 98.6           | 26.7              | 6.7       | 32.7      | 99.3            | -              | -           | Carrier |
| Hori     | 2400.000        | PK       | 41.1           | 26.7              | 6.7       | 32.7      | 41.8            | 79.3           | 37.5        |         |
| Vert     | 2402.000        | PK       | 95.5           | 26.7              | 6.7       | 32.7      | 96.2            | -              | -           | Carrier |
| Vert     | 2400.000        | PK       | 38.7           | 26.7              | 6.7       | 32.7      | 39.4            | 76.2           | 36.8        |         |

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

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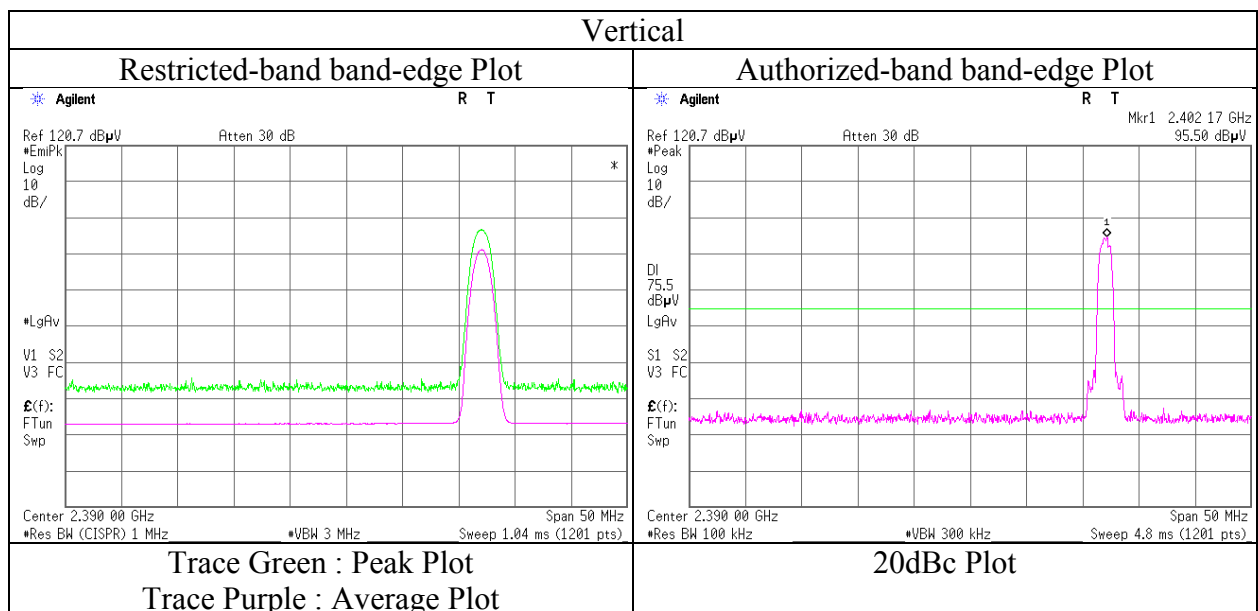
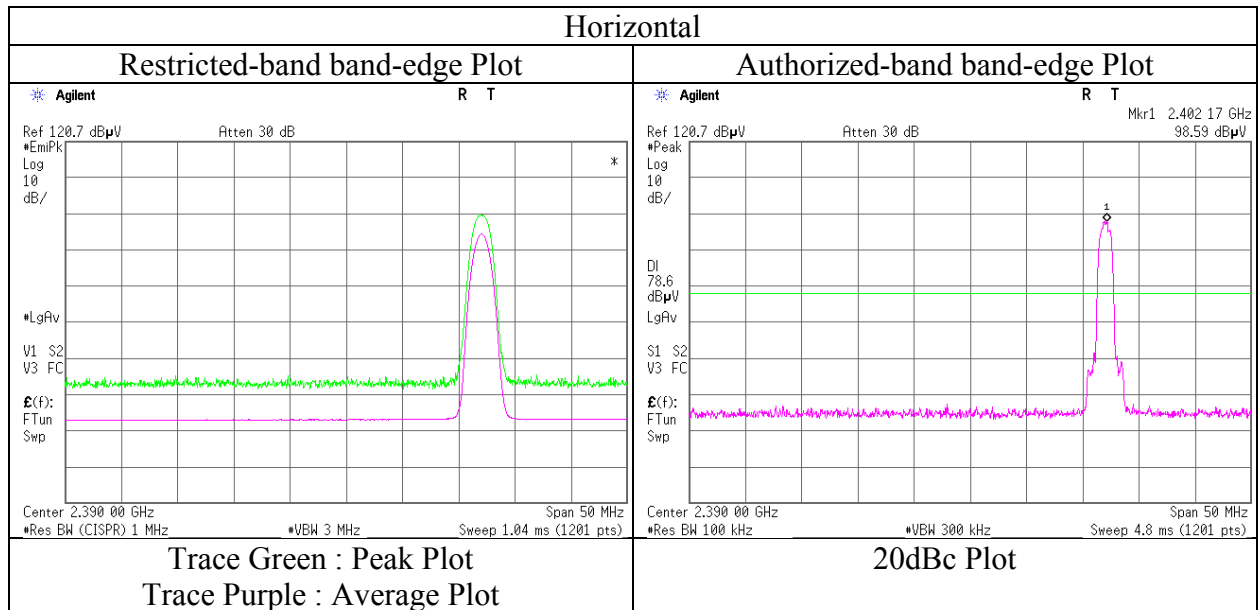
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## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                                         |
|------------------------|-----------------------------------------|
| Test place             | Ise EMC Lab. No.3 Semi Anechoic Chamber |
| Report No.             | 11350077H                               |
| Date                   | June 29, 2016                           |
| Temperature / Humidity | 23 deg. C / 69 % RH                     |
| Engineer               | Tomoki Matsui                           |
|                        | (1-10GHz)                               |
| Mode                   | Tx, Hopping Off, 3DH5 2402 MHz          |



\* Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

|                        |                                         |                     |                     |
|------------------------|-----------------------------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab. No.3 Semi Anechoic Chamber |                     |                     |
| Report No.             | 11350077H                               |                     |                     |
| Date                   | June 29, 2016                           | June 29, 2016       | June 30, 2016       |
| Temperature / Humidity | 23 deg. C / 69 % RH                     | 23 deg. C / 72 % RH | 23 deg. C / 62 % RH |
| Engineer               | Tomoki Matsui                           | Satofumi Matsuyama  | Tomoki Matsui       |
|                        | (1-10GHz)                               | (Above 10GHz)       | (Below 1GHz)        |
| Mode                   | Tx, Hopping Off, 3DH5 2441 MHz          |                     |                     |

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|-------------|
| Hori     | 360.000            | QP       | 36.9              | 14.8               | 10.3         | 31.9         | 30.1               | 46.0              | 15.9           |             |
| Hori     | 480.000            | QP       | 32.7              | 17.2               | 11.0         | 31.9         | 29.0               | 46.0              | 17.0           |             |
| Hori     | 600.000            | QP       | 34.3              | 19.1               | 11.9         | 32.0         | 33.3               | 46.0              | 12.7           |             |
| Hori     | 720.000            | QP       | 33.7              | 20.0               | 12.5         | 32.0         | 34.2               | 46.0              | 11.8           |             |
| Hori     | 780.000            | QP       | 32.3              | 20.6               | 12.8         | 31.6         | 34.1               | 46.0              | 11.9           |             |
| Hori     | 840.000            | QP       | 29.3              | 21.3               | 13.1         | 31.3         | 32.4               | 46.0              | 13.6           |             |
| Hori     | 4882.000           | PK       | 41.3              | 31.3               | 9.0          | 31.7         | 49.9               | 73.9              | 24.0           | Floor noise |
| Hori     | 7323.000           | PK       | 42.0              | 35.6               | 10.2         | 32.6         | 55.2               | 73.9              | 18.7           | Floor noise |
| Hori     | 9764.000           | PK       | 44.9              | 37.2               | 10.9         | 33.3         | 59.7               | 73.9              | 14.2           | Floor noise |
| Hori     | 4882.000           | AV       | 28.8              | 31.3               | 9.0          | 31.7         | 37.4               | 53.9              | 16.5           | Floor noise |
| Hori     | 7323.000           | AV       | 30.1              | 35.6               | 10.2         | 32.6         | 43.3               | 53.9              | 10.6           | Floor noise |
| Hori     | 9764.000           | AV       | 32.0              | 37.2               | 10.9         | 33.3         | 46.8               | 53.9              | 7.1            | Floor noise |
| Vert     | 420.000            | QP       | 31.0              | 16.0               | 10.7         | 31.9         | 25.8               | 46.0              | 20.2           |             |
| Vert     | 480.000            | QP       | 32.4              | 17.2               | 11.0         | 31.9         | 28.7               | 46.0              | 17.3           |             |
| Vert     | 600.000            | QP       | 31.5              | 19.1               | 11.9         | 32.0         | 30.5               | 46.0              | 15.5           |             |
| Vert     | 642.140            | QP       | 29.0              | 19.4               | 12.1         | 32.1         | 28.4               | 46.0              | 17.6           |             |
| Vert     | 660.000            | QP       | 29.4              | 19.5               | 12.2         | 32.1         | 29.0               | 46.0              | 17.0           |             |
| Vert     | 780.000            | QP       | 27.2              | 20.6               | 12.8         | 31.6         | 29.0               | 46.0              | 17.0           |             |
| Vert     | 4882.000           | PK       | 41.4              | 31.3               | 9.0          | 31.7         | 50.0               | 73.9              | 23.9           | Floor noise |
| Vert     | 7323.000           | PK       | 42.0              | 35.6               | 10.2         | 32.6         | 55.2               | 73.9              | 18.7           | Floor noise |
| Vert     | 9764.000           | PK       | 45.0              | 37.2               | 10.9         | 33.3         | 59.8               | 73.9              | 14.1           | Floor noise |
| Vert     | 4882.000           | AV       | 28.8              | 31.3               | 9.0          | 31.7         | 37.4               | 53.9              | 16.5           | Floor noise |
| Vert     | 7323.000           | AV       | 30.1              | 35.6               | 10.2         | 32.6         | 43.3               | 53.9              | 10.6           | Floor noise |
| Vert     | 9764.000           | AV       | 32.0              | 37.2               | 10.9         | 33.3         | 46.8               | 53.9              | 7.1            | 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      $20\log(4.45 \text{ m} / 3.0 \text{ m}) = 3.43 \text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

## Radiated Spurious Emission

|                        |                                         |                     |                     |
|------------------------|-----------------------------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab. No.3 Semi Anechoic Chamber |                     |                     |
| Report No.             | 11350077H                               |                     |                     |
| Date                   | June 29, 2016                           | June 29, 2016       | June 30, 2016       |
| Temperature / Humidity | 23 deg. C / 69 % RH                     | 23 deg. C / 72 % RH | 23 deg. C / 62 % RH |
| Engineer               | Tomoki Matsui                           | Satofumi Matsuyama  | Tomoki Matsui       |
|                        | (1-10GHz)                               | (Above 10GHz)       | (Below 1GHz)        |
| Mode                   | Tx, Hopping Off, 3DH5 2480 MHz          |                     |                     |

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|-------------|
| Hori     | 360.000         | QP       | 37.9           | 14.8            | 10.3      | 31.9      | 31.1            | 46.0           | 14.9        |             |
| Hori     | 480.000         | QP       | 33.1           | 17.2            | 11.0      | 31.9      | 29.4            | 46.0           | 16.6        |             |
| Hori     | 600.000         | QP       | 34.5           | 19.1            | 11.9      | 32.0      | 33.5            | 46.0           | 12.5        |             |
| Hori     | 720.000         | QP       | 34.5           | 20.0            | 12.5      | 32.0      | 35.0            | 46.0           | 11.0        |             |
| Hori     | 780.000         | QP       | 32.2           | 20.6            | 12.8      | 31.6      | 34.0            | 46.0           | 12.0        |             |
| Hori     | 840.000         | QP       | 29.1           | 21.3            | 13.1      | 31.3      | 32.2            | 46.0           | 13.8        |             |
| Hori     | 2483.500        | PK       | 47.1           | 26.8            | 6.8       | 32.6      | 48.1            | 73.9           | 25.8        |             |
| Hori     | 4960.000        | PK       | 41.2           | 31.5            | 8.9       | 31.7      | 49.9            | 73.9           | 24.0        | Floor noise |
| Hori     | 7440.000        | PK       | 42.7           | 35.5            | 10.2      | 32.7      | 55.7            | 73.9           | 18.2        | Floor noise |
| Hori     | 9920.000        | PK       | 43.7           | 37.2            | 11.0      | 33.4      | 58.5            | 73.9           | 15.4        | Floor noise |
| Hori     | 2483.500        | AV       | 33.2           | 26.8            | 6.8       | 32.6      | 34.2            | 53.9           | 19.7        |             |
| Hori     | 4960.000        | AV       | 29.0           | 31.5            | 8.9       | 31.7      | 37.7            | 53.9           | 16.2        | Floor noise |
| Hori     | 7440.000        | AV       | 30.0           | 35.5            | 10.2      | 32.7      | 43.0            | 53.9           | 10.9        | Floor noise |
| Hori     | 9920.000        | AV       | 31.6           | 37.2            | 11.0      | 33.4      | 46.4            | 53.9           | 7.5         | Floor noise |
| Vert     | 420.000         | QP       | 30.4           | 16.0            | 10.7      | 31.9      | 25.2            | 46.0           | 20.8        |             |
| Vert     | 480.000         | QP       | 32.4           | 17.2            | 11.0      | 31.9      | 28.7            | 46.0           | 17.3        |             |
| Vert     | 600.000         | QP       | 31.7           | 19.1            | 11.9      | 32.0      | 30.7            | 46.0           | 15.3        |             |
| Vert     | 642.140         | QP       | 28.8           | 19.4            | 12.1      | 32.1      | 28.2            | 46.0           | 17.8        |             |
| Vert     | 660.000         | QP       | 28.8           | 19.5            | 12.2      | 32.1      | 28.4            | 46.0           | 17.6        |             |
| Vert     | 780.000         | QP       | 27.1           | 20.6            | 12.8      | 31.6      | 28.9            | 46.0           | 17.1        |             |
| Vert     | 2483.500        | PK       | 45.0           | 26.8            | 6.8       | 32.6      | 46.0            | 73.9           | 27.9        |             |
| Vert     | 4960.000        | PK       | 41.4           | 31.5            | 8.9       | 31.7      | 50.1            | 73.9           | 23.8        | Floor noise |
| Vert     | 7440.000        | PK       | 42.7           | 35.5            | 10.2      | 32.7      | 55.7            | 73.9           | 18.2        | Floor noise |
| Vert     | 9920.000        | PK       | 43.4           | 37.2            | 11.0      | 33.4      | 58.2            | 73.9           | 15.7        | Floor noise |
| Vert     | 2483.500        | AV       | 31.9           | 26.8            | 6.8       | 32.6      | 32.9            | 53.9           | 21.0        |             |
| Vert     | 4960.000        | AV       | 29.0           | 31.5            | 8.9       | 31.7      | 37.7            | 53.9           | 16.2        | Floor noise |
| Vert     | 7440.000        | AV       | 30.0           | 35.5            | 10.2      | 32.7      | 43.0            | 53.9           | 10.9        | Floor noise |
| Vert     | 9920.000        | AV       | 31.6           | 37.2            | 11.0      | 33.4      | 46.4            | 53.9           | 7.5         | Floor noise |

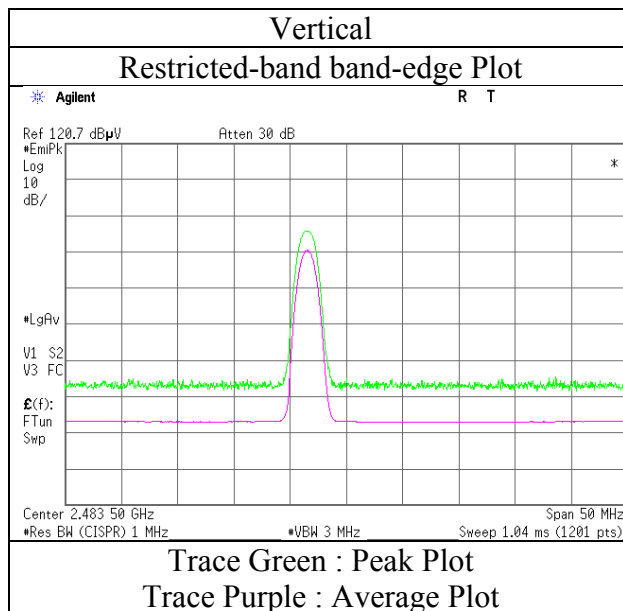
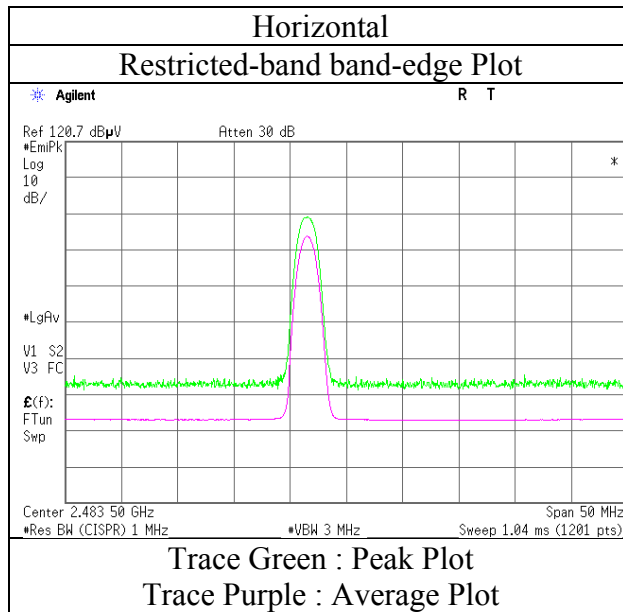
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

Distance factor: 1 GHz - 10 GHz  $20\log(4.45\text{ m} / 3.0\text{ m}) = 3.43\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber  
Report No. : 11350077H  
Date : June 29, 2016  
Temperature / Humidity : 23 deg. C / 69 % RH  
Engineer : Tomoki Matsui  
(1-10GHz)  
Mode : Tx, Hopping Off, 3DH5 2480 MHz



\* Final result of restricted band edge was shown in tabular data.

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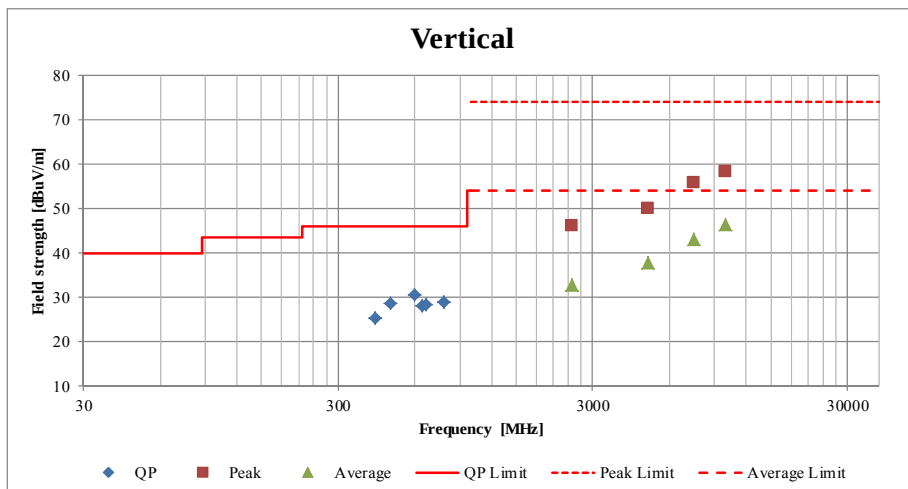
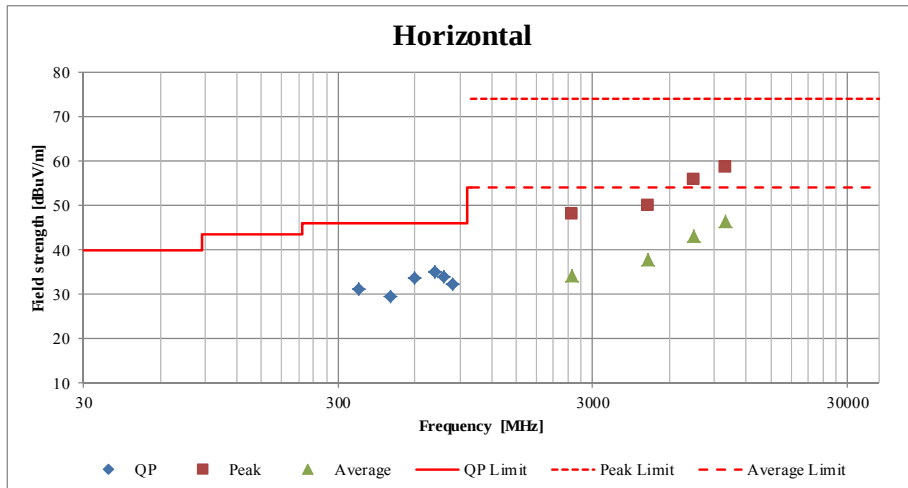
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## Radiated Spurious Emission (Plot data, Worst case)

|                        |                                         |                     |                     |
|------------------------|-----------------------------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab. No.3 Semi Anechoic Chamber |                     |                     |
| Report No.             | 11350077H                               |                     |                     |
| Date                   | June 29, 2016                           | June 29, 2016       | June 30, 2016       |
| Temperature / Humidity | 23 deg. C / 69 % RH                     | 23 deg. C / 72 % RH | 23 deg. C / 62 % RH |
| Engineer               | Tomoki Matsui                           | Satofumi Matsuyama  | Tomoki Matsui       |
|                        | (1-10GHz)                               | (Above 10GHz)       | (Below 1GHz)        |
| Mode                   | Tx, Hopping Off, 3DH5 2480 MHz          |                     |                     |



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

## APPENDIX 2: Test instruments

### Test equipment

| Control No. | Instrument                       | Manufacturer              | Model No                  | Serial No                   | Test Item | Calibration Date *<br>Interval(month) |
|-------------|----------------------------------|---------------------------|---------------------------|-----------------------------|-----------|---------------------------------------|
| MAEC-03     | Semi Anechoic Chamber(NSA)       | TDK                       | Semi Anechoic Chamber 3m  | DA-10005                    | RE        | 2015/10/01 * 12                       |
| MOS-13      | Thermo-Hygrometer                | Custom                    | CTH-180                   | 1301                        | RE        | 2016/01/21 * 12                       |
| MJM-16      | Measure                          | KOMELON                   | KMC-36                    | -                           | RE        | -                                     |
| COTS-MEMI   | EMI measurement program          | TSJ                       | TEPTO-DV                  | -                           | RE        | -                                     |
| MSA-04      | Spectrum Analyzer                | Agilent                   | E4448A                    | US44300523                  | RE        | 2015/11/06 * 12                       |
| MHA-20      | Horn Antenna 1-18GHz             | Schwarzbeck               | BBHA9120D                 | 258                         | RE        | 2016/05/29 * 12                       |
| MCC-167     | Microwave Cable                  | Junkosha                  | MWX221                    | 1404S374(1m) / 1405S074(5m) | RE        | 2016/05/20 * 12                       |
| MPA-11      | MicroWave System Amplifier       | Agilent                   | 83017A                    | MY39500779                  | RE        | 2016/03/24 * 12                       |
| MHA-16      | Horn Antenna 15-40GHz            | Schwarzbeck               | BBHA9170                  | BBHA9170306                 | RE        | 2016/05/29 * 12                       |
| MMM-08      | DIGITAL HiTESTER                 | Hioki                     | 3805                      | 051201197                   | RE        | 2016/01/13 * 12                       |
| MHF-25      | High Pass Filter 3.5-18.0GHz     | UL Japan                  | HPF SELECTOR              | 001                         | RE        | 2015/09/16 * 12                       |
| MTR-08      | Test Receiver                    | Rohde & Schwarz           | ESCI                      | 100767                      | RE        | 2015/09/02 * 12                       |
| MBA-03      | Biconical Antenna                | Schwarzbeck               | BBA9106                   | 1915                        | RE        | 2015/10/11 * 12                       |
| MLA-22      | Logperiodic Antenna(200-1000MHz) | Schwarzbeck               | VUSLP9111B                | 911B-191                    | RE        | 2016/01/30 * 12                       |
| MCC-51      | Coaxial cable                    | UL Japan                  | -                         | -                           | RE        | 2015/07/13 * 12                       |
| MAT-70      | Attenuator(6dB)                  | Agilent                   | 8491A-006                 | MY52460153                  | RE        | 2016/04/05 * 12                       |
| MPA-13      | Pre Amplifier                    | SONOMA INSTRUMENT         | 310                       | 260834                      | RE        | 2016/03/24 * 12                       |
| MAEC-01     | Semi Anechoic Chamber(NSA)       | TDK                       | Semi Anechoic Chamber 10m | DA-06881                    | RE        | 2015/09/19 * 12                       |
| MOS-27      | Thermo-Hygrometer                | CUSTOM                    | CTH-201                   | A08Q26                      | RE        | 2016/01/21 * 12                       |
| MJM-25      | Measure                          | KOMELON                   | KMC-36                    | -                           | RE        | -                                     |
| MHA-05      | Horn Antenna 1-18GHz             | Schwarzbeck               | BBHA9120D                 | 253                         | RE        | 2016/05/29 * 12                       |
| MPA-01      | Pre Amplifier                    | Agilent                   | 8449B                     | 3008A01671                  | RE        | 2016/02/26 * 12                       |
| MCC-165     | Microwave Cable                  | Junkosha                  | MWX221                    | 1203S213(1m) / 1311S166(5m) | RE        | 2015/11/10 * 12                       |
| MMM-03      | Digital Tester                   | Fluke                     | FLUKE 26-3                | 78030621                    | RE        | 2015/08/19 * 12                       |
| MRENT-126   | Spectrum Analyzer                | KEYSIGHT                  | E4440A                    | MY46185516                  | RE        | 2016/07/01 * 12                       |
| MHA-01      | Horn Antenna 18-26.5GHz          | EMCO                      | 3160-09                   | 1266                        | RE        | 2016/06/24 * 12                       |
| MCC-168     | Microwave Cable                  | Junkosha                  | MWX221                    | 1408S016(1m) / 1409S492(5m) | RE        | 2015/09/24 * 12                       |
| MHF-18      | High Pass Filter 3.5-18.0GHz     | TOKIMEC                   | TF323DCA                  | 7002                        | RE        | 2015/09/15 * 12                       |
| MTR-09      | EMI Test Receiver                | Rohde & Schwarz           | ESU26                     | 100412                      | RE        | 2016/06/25 * 12                       |
| KBA-05      | Biconical Antenna                | Schwarzbeck               | BBA9106                   | 2513                        | RE        | 2015/11/02 * 12                       |
| MLA-20      | Logperiodic Antenna(200-1000MHz) | Schwarzbeck               | VUSLP9111B                | 911B-189                    | RE        | 2016/01/30 * 12                       |
| MAT-08      | Attenuator(6dB)                  | Weinschel Corp            | 2                         | BK7971                      | RE        | 2015/11/10 * 12                       |
| MCC-02      | Coaxial Cable                    | Suhner/storm/Agilent/T SJ | -                         | -                           | RE        | 2015/09/29 * 12                       |
| MPA-19      | Pre Amplifier                    | MITEQ                     | MLA-10K01-B01-35          | 1237616                     | RE        | 2016/02/25 * 12                       |

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

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