



# **RADIO TEST REPORT**

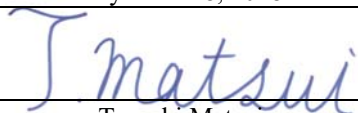
**Test Report No. : 12069761H-A-R1**

**Applicant** : **Komatsu Ltd.**  
**Type of Equipment** : **KOMTRAX terminal**  
**Model No.** : **KDTG105**  
**FCC ID** : **X4QKDTG105**  
**Test regulation** : **FCC Part 15 Subpart C: 2018**  
**Test Result** : **Complied**

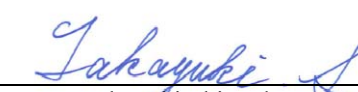
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3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative 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. This report is a revised version of 12069761H-A. 12069761H-A is replaced with this report.

**Date of test:** July 11 to 18, 2018

**Representative test engineer:**

  
Tomoki Matsui  
Engineer  
Consumer Technology Division

**Approved by:**

  
Takayuki Shimada  
Leader  
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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13-EM-F0429



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## **SECTION 1: Customer information**

Company Name : Komatsu Ltd.  
Address : 3-25-1 Shinomiya, Hiratsuka-Shi, Kanagawa-Ken, 254-8555 Japan  
Telephone Number : +81-463-22-8758  
Facsimile Number : +81-463-22-8586  
Contact Person : Onagi Miku

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

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

Type of Equipment : KOMTRAX terminal  
Model No. : KDTG105  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 10 V to 30 V  
Receipt Date of Sample : July 10, 2018  
Country of Mass-production : Japan  
Condition of EUT : Production prototype  
(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: KDTG105 (referred to as the EUT in this report) is a KOMTRAX terminal.

## **Radio Specification**

### **Specification of Wireless LAN (IEEE802.11b/g/a/n-20)**

| Type of radio                      | IEEE802.11b                 | IEEE802.11g/n<br>(20 M band)           |
|------------------------------------|-----------------------------|--|
| Radio Type                         | Transceiver                 |  |
| Frequency of operation             | 2412 MHz - 2462 MHz         | 2412 MHz - 2462 MHz                    |
| Type of modulation                 | DSSS<br>(CCK, DQPSK, DBPSK) | OFDM-CCK<br>(64QAM, 16QAM, QPSK, BPSK) |
| Channel spacing                    | 5 MHz                       |  |
| Antenna type                       | Pattern Antenna             |  |
| Antenna Gain                       | 4.08 dBi                    |  |
| Clock frequency(ies) in the system | 26 MHz                      |  |

## **SECTION 3: Test specification, procedures & results**

### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C

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   |
|---|---|--|---|----------|---|
| Conducted Emission  | FCC: ANSI C63.10-2013<br>6. Standard test methods<br>-----<br>IC: RSS-Gen 8.8 | FCC: Section 15.207<br>-----<br>IC: RSS-Gen 8.8                                  | N/A *1)   | N/A      | -   |
| 6dB Bandwidth   | FCC: KDB 558074 D01 DTS Meas<br>Guidance v04<br>-----<br>IC: -                | FCC: Section<br>15.247(a)(2)<br>-----<br>IC: RSS-247 5.2(a)                      | See data.   | Complied | Conducted   |
| Maximum Peak<br>Output Power  | FCC: KDB 558074 D01 DTS Meas<br>Guidance v04<br>-----<br>IC: RSS-Gen 6.12     | FCC: Section<br>15.247(b)(3)<br>-----<br>IC: RSS-247 5.4(d)                      |   | Complied | Conducted   |
| Power Density   | FCC: KDB 558074 D01 DTS Meas<br>Guidance v04<br>-----<br>IC: -                | FCC: Section 15.247(e)<br>-----<br>IC: RSS-247 5.2(b)                            |   | Complied | Conducted   |
| Spurious Emission<br>Restricted Band Edges  | FCC: KDB 558074 D01 DTS Meas<br>Guidance v04<br>IC: RSS-Gen 6.13              | FCC: Section15.247(d)<br>-----<br>IC: RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10 | 3.0 dB<br>749.982 MHz, QP, Hori/<br>4824.000 MHz, AV, Vert. | Complied | Conducted<br>(below 30 MHz)/<br>Radiated<br>(above 30 MHz)<br>*2) |
| Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.<br>*1) The test is not applicable since the EUT does not have AC ports.<br>*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7. |   |  |   |          |   |

\* 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**

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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### 3.3 Addition to standard

| Item                   | Test Procedure  | Specification | Worst margin | Results  | Remarks   |
|------------------------|-----------------|---------------|--------------|----------|-----------|
| 99% Occupied Bandwidth | IC: RSS-Gen 6.6 | IC: -         | N/A          | Complied | Conducted |

Other than above, 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  $k=2$ .

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#### 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            |

#### Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

### 3.5 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

| 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  | -                      | -                            |

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

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

Refer to APPENDIX.

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## **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

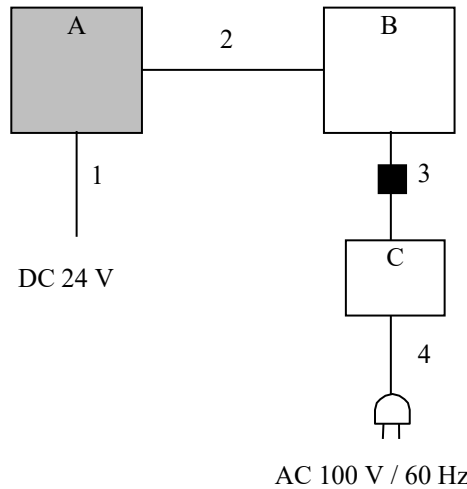
| Mode  | Remarks*     |
|---|--------------|
| IEEE 802.11b (11b)  | 11 Mbps, PN9 |
| IEEE 802.11g (11g)  | 12 Mbps, PN9 |
| IEEE 802.11n 20 MHz BW (11n-20)   | MCS 0, PN9   |
| *The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)   |              |
| *Power of the EUT was set by the software as follows (setting value might be different from product specification value);<br>Power settings: WLAN: 11b: 17 dBm,<br>11g: 15 dBm,<br>11n: 15 dBm<br>Software: Tera Term Ver 4.9.2<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)

| Test Item   | Operating Mode                | Tested frequency                 |
|---|-------------------------------|----------------------------------|
| Radiated Spurious Emission<br>(Above 1 GHz)   | 11b Tx<br>11g Tx *1)          | 2412 MHz<br>2437 MHz<br>2462 MHz |
|   | 11n-20 Tx *2)                 | 2412 MHz<br>2462 MHz             |
| Radiated Spurious Emission<br>(Below 1 GHz)   | 11g Tx *3)                    | 2437 MHz                         |
| 6dB Bandwidth<br>Maximum Peak Output Power<br>Power Density<br>99% Occupied Bandwidth   | 11b Tx<br>11g Tx<br>11n-20 Tx | 2412 MHz<br>2437 MHz<br>2462 MHz |
| *1) Since 11g and 11n-20 have the same modulation method and no differences in transmitting specification, test was performed on the representative mode that had the highest output power.<br>*2) Only band edge test was tested on this mode, because the 11g Tx mode had the higher power at antenna terminal test.<br>*3) The mode was tested as a representative, because it had the highest power at antenna terminal test. |                               |                                  |



## 4.2 Configuration and peripherals



■ : 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   | KOMTRAX terminal | KDTG105                                | 782626310A00001006 *1)<br>782626310A00001003 *2) | Komatsu Ltd. | EUT     |
| B   | Laptop PC        | CF-N8HWCDPS                            | 9LKSA04258 *1)<br>10CKSA09265 *2)                | Panasonic    | -       |
| C   | AC Adapter       | CF-AA6372B M4 *1)<br>CF-AA6372B M6 *2) | 6372BM409X14190B *1)<br>6372BM610X10953E *2)     | Panasonic    | -       |

\*1) Used for Antenna Terminal conducted test

\*2) Used for Radiated Emission test

### List of cables used

| No. | Name         | Length (m) | Shield     |            | Remarks |
|-----|--------------|------------|------------|------------|---------|
|     |              |            | Cable      | Connector  |         |
| 1   | DC Cable     | 3.3        | Unshielded | Unshielded | -       |
| 2   | Signal Cable | 3.3        | Unshielded | Unshielded | -       |
| 3   | DC Cable     | 1.1        | Unshielded | Unshielded | -       |
| 4   | AC Cable     | 0.9        | Unshielded | Unshielded | -       |

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## **SECTION 5: Radiated Spurious Emission**

### **Test Procedure**

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[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 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 *1)   | PK                          |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz | Average Power Method:<br>RBW: 1 MHz<br>VBW: 3 MHz<br>Detector:<br>Power Averaging (RMS)<br>Trace: 100 traces<br>If duty cycle was less than 98%, a duty factor was added to the results. | RBW: 100 kHz<br>VBW: 300kHz |

\*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

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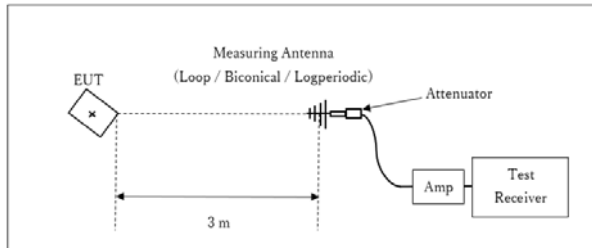
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**Figure 1: Test Setup**

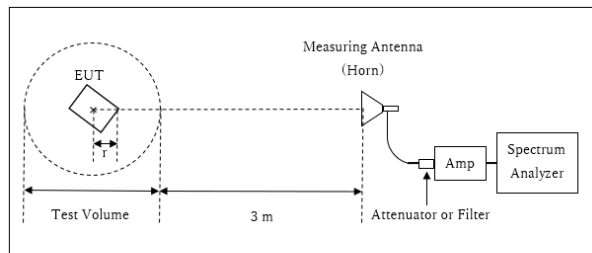
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor:  $20 \times \log (3.75 \text{ m} / 3.0 \text{ m}) = 1.94 \text{ dB}$

\* Test Distance:  $(3 + \text{Test Volume} / 2) - r = 3.75 \text{ m}$

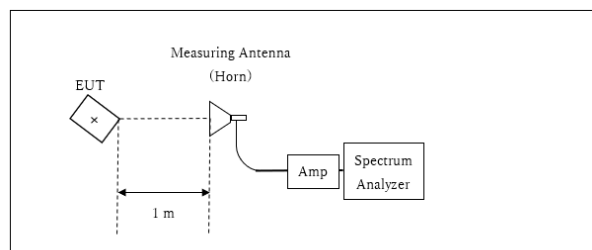
Test Volume : 1.5 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.0 \text{ m}$

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

10 GHz - 26.5 GHz



x : Center of turn table

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

\* 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                 |
|--|---|-----------------|--------------------|------------|-------------------|----------|---------------------------------|
| 6dB Bandwidth  | 20 MHz                                  | 100 kHz         | 300 kHz            | Auto       | Peak              | Max Hold | Spectrum Analyzer               |
| 99% Occupied Bandwidth *1)   | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto       | Peak              | Max Hold | Spectrum Analyzer               |
| Maximum Peak Output Power  | -                                       | -               | -                  | Auto       | Peak/ Average *2) | -        | Power Meter (Sensor: 50 MHz BW) |
| Peak Power Density   | 1.5 times the 6dB Bandwidth             | 3 kHz           | 10 kHz             | Auto       | Peak              | Max Hold | Spectrum Analyzer *3)           |
| Conducted Spurious Emission *4)  | 9kHz to 150kHz                          | 200 Hz          | 620 Hz             | Auto       | Peak              | Max Hold | Spectrum Analyzer               |
|  | 150kHz to 30MHz                         | 9.1 kHz         | 27 kHz             |            |                   |          |                                 |
| *1) Peak hold was applied as Worst-case measurement.<br>*2) Reference data<br>*3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04".<br>*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.<br>Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart.<br>(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz). |   |                 |                    |            |                   |          |                                 |

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

|                    |                   |
|--------------------|-------------------|
| <b>Test data</b>   | <b>: APPENDIX</b> |
| <b>Test result</b> | <b>: Pass</b>     |

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## **APPENDIX 1: Test data**

### **6 dB Bandwidth and 99 % Occupied Bandwidth**

Report No. 12069761H  
Test place Ise EMC Lab. No.6 Shielded Room  
Date July 11, 2018  
Temperature / Humidity 25.5 deg. C / 57 % RH  
Engineer Tomoki Matsui  
Mode Tx

| Mode   | Frequency<br>[MHz] | 99% Occupied<br>Bandwidth<br>[kHz] | 6dB Bandwidth<br>[MHz] | Limit for<br>6dB Bandwidth<br>[MHz] |
|--------|--------------------|------------------------------------|------------------------|-------------------------------------|
| 11b    | 2412               | 15340.0                            | 9.606                  | > 0.5000                            |
|        | 2437               | 15301.7                            | 9.596                  | > 0.5000                            |
|        | 2462               | 15312.4                            | 9.601                  | > 0.5000                            |
| 11g    | 2412               | 16790.0                            | 16.324                 | > 0.5000                            |
|        | 2437               | 16816.1                            | 16.309                 | > 0.5000                            |
|        | 2462               | 16810.3                            | 16.305                 | > 0.5000                            |
| 11n-20 | 2412               | 17869.7                            | 16.992                 | > 0.5000                            |
|        | 2437               | 17865.2                            | 16.911                 | > 0.5000                            |
|        | 2462               | 17858.0                            | 17.040                 | > 0.5000                            |

## 6dB Bandwidth



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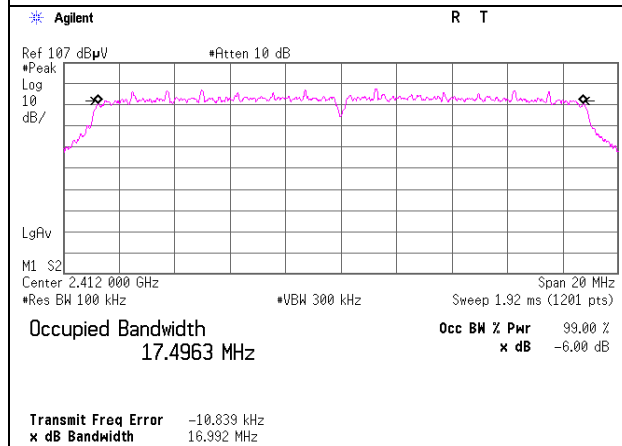
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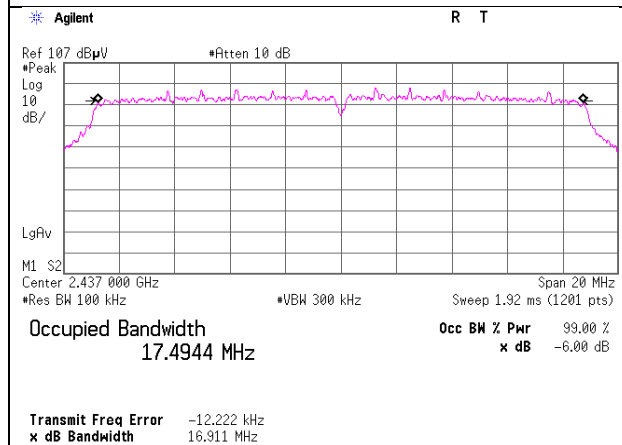
## 6dB Bandwidth

11n-20

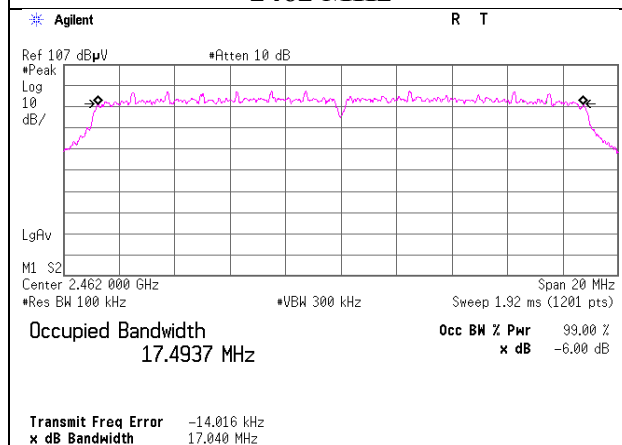
2412 MHz



2437 MHz



2462 MHz



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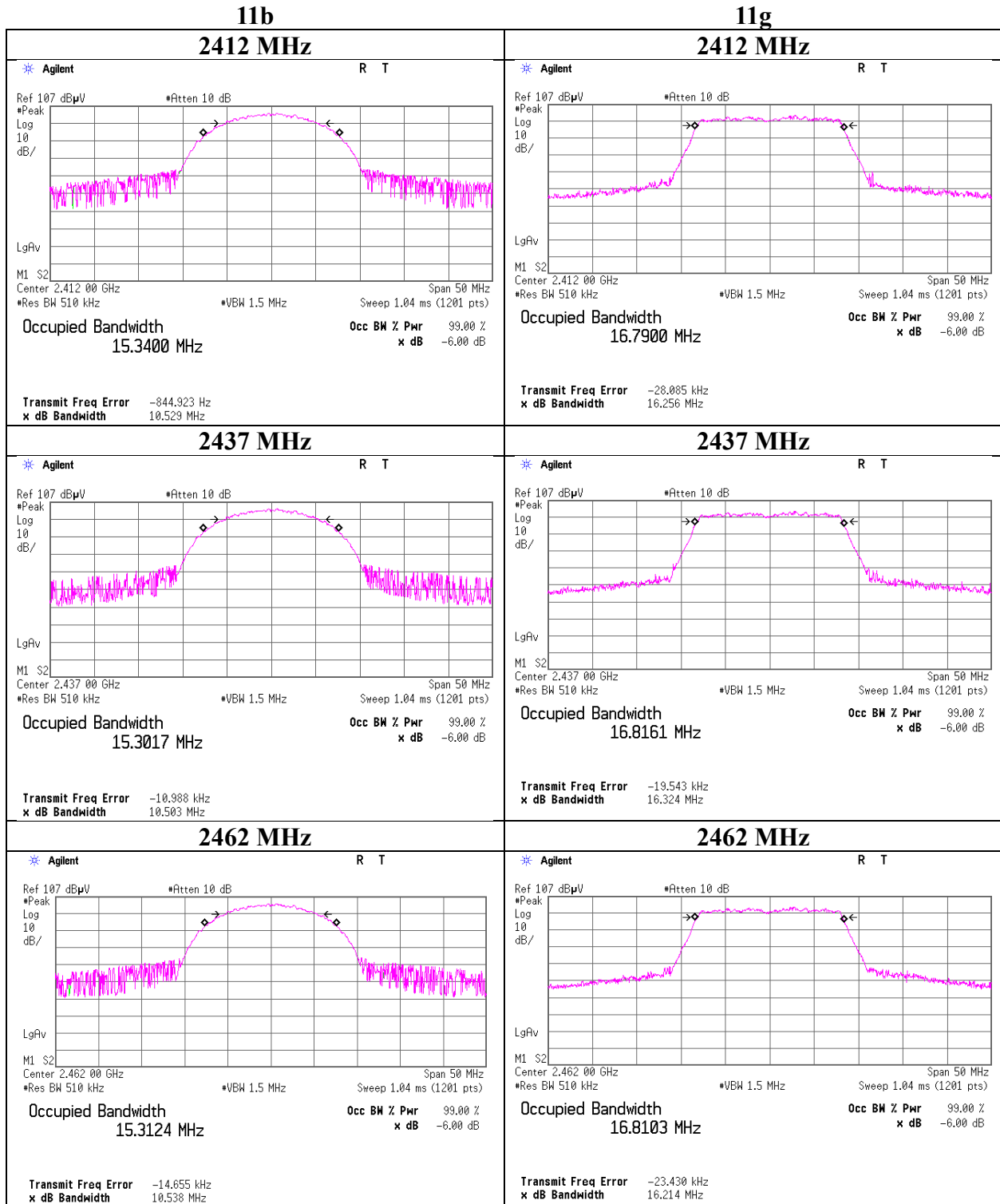
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## 99 % Occupied Bandwidth



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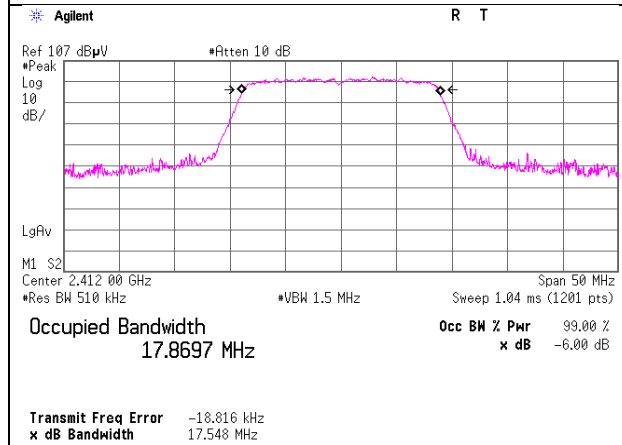
Telephone : +81 596 24 8999

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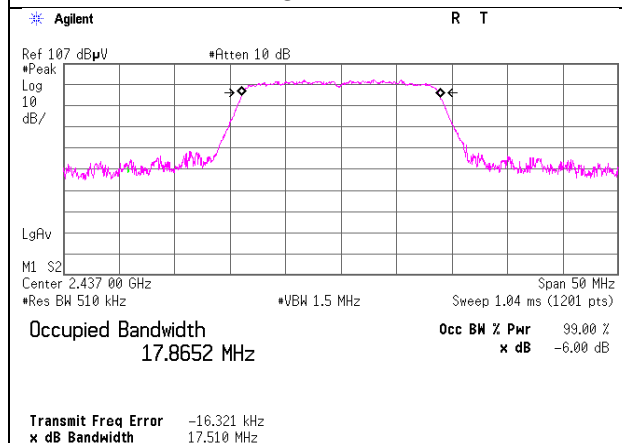
## 99 % Occupied Bandwidth

11n-20

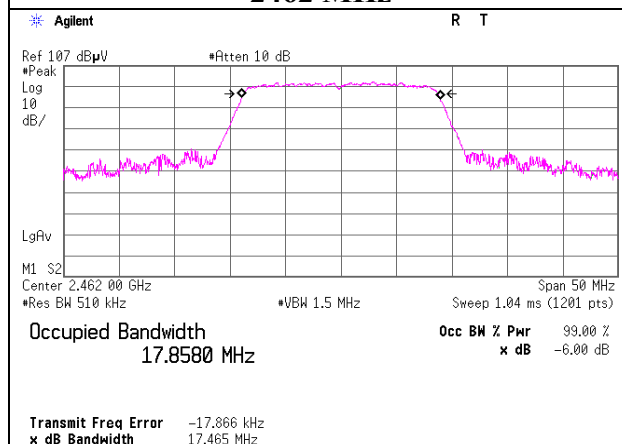
2412 MHz



2437 MHz



2462 MHz



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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Maximum Peak Output Power

Report No. 12069761H  
Test place Ise EMC Lab. No.6 Shielded Room  
Date July 11, 2017  
Temperature / Humidity 25.5 deg. C / 57 % RH  
Engineer Tomoki Matsui  
Mode Tx 11b

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power |       |       |      |        | e.i.r.p. for RSS-247 |        |       |       |      |        |
|-------|---------|------------|-------------|-----------------|-------|-------|------|--------|----------------------|--------|-------|-------|------|--------|
|       |         |            |             | Result          |       | Limit |      | Margin | Antenna Gain         | Result |       | Limit |      | Margin |
|       |         |            |             | [dBm]           | [mW]  | [dBm] | [mW] |        |                      | [dBm]  | [mW]  | [dBm] | [mW] |        |
| 2412  | 2.90    | 1.43       | 10.04       | 14.37           | 27.35 | 30.00 | 1000 | 15.63  | 4.08                 | 18.45  | 69.98 | 36.02 | 4000 | 17.57  |
| 2437  | 2.94    | 1.43       | 10.04       | 14.41           | 27.61 | 30.00 | 1000 | 15.59  | 4.08                 | 18.49  | 70.63 | 36.02 | 4000 | 17.53  |
| 2462  | 2.87    | 1.44       | 10.04       | 14.35           | 27.23 | 30.00 | 1000 | 15.65  | 4.08                 | 18.43  | 69.66 | 36.02 | 4000 | 17.59  |

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437MHz

| Rate   | Reading | Remark |
|--------|---------|--------|
| [Mbps] | [dBm]   |        |
| 1      | 2.70    |        |
| 2      | 2.75    |        |
| 5.5    | 2.73    |        |
| 11     | 2.78    | *      |

\*: Worst Rate

All comparison were carried out on same frequency and measurement factors.

## Maximum Peak Output Power

Report No. 12069761H  
Test place Ise EMC Lab. No.6 Shielded Room  
Date July 11, 2018  
Temperature / Humidity 25.5 deg. C / 57 % RH  
Engineer Tomoki Matsui  
Mode Tx 11g

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Conducted Power |        |       |      |        | e.i.r.p. for RSS-247 |        |        |       |      |        |
|----------------|------------------|-----------------------|------------------------|-----------------|--------|-------|------|--------|----------------------|--------|--------|-------|------|--------|
|                |                  |                       |                        | Result          |        | Limit |      | Margin | Antenna<br>Gain      | Result |        | Limit |      | Margin |
|                |                  |                       |                        | [dBm]           | [mW]   | [dBm] | [mW] | [dB]   | [dBi]                | [dBm]  | [mW]   | [dBm] | [mW] | [dB]   |
| 2412           | 8.99             | 1.43                  | 10.04                  | 20.46           | 111.17 | 30.00 | 1000 | 9.54   | 4.08                 | 24.54  | 284.45 | 36.02 | 4000 | 11.48  |
| 2437           | 9.23             | 1.43                  | 10.04                  | 20.70           | 117.49 | 30.00 | 1000 | 9.30   | 4.08                 | 24.78  | 300.61 | 36.02 | 4000 | 11.24  |
| 2462           | 8.76             | 1.44                  | 10.04                  | 20.24           | 105.68 | 30.00 | 1000 | 9.76   | 4.08                 | 24.32  | 270.40 | 36.02 | 4000 | 11.70  |

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

| Rate   | Reading | Remark |
|--------|---------|--------|
| [Mbps] | [dBm]   |        |
| 6      | 8.35    |        |
| 9      | 8.28    |        |
| 12     | 8.54    | *      |
| 18     | 8.19    |        |
| 24     | 8.41    |        |
| 36     | 8.29    |        |
| 48     | 8.28    |        |
| 54     | 8.25    |        |

\*: Worst Rate

All comparison were carried out on same frequency and measurement factors.

**UL Japan, Inc.**

**Ise EMC Lab.**

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## Maximum Peak Output Power

Report No. 12069761H  
Test place Ise EMC Lab. No.6 Shielded Room  
Date July 11, 2018  
Temperature / Humidity 25.5 deg. C / 57 % RH  
Engineer Tomoki Matsui  
Mode Tx 11n-20

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Conducted Power |        |       |      |        | e.i.r.p. for RSS-247 |        |        |       |      |        |
|----------------|------------------|-----------------------|------------------------|-----------------|--------|-------|------|--------|----------------------|--------|--------|-------|------|--------|
|                |                  |                       |                        | Result          |        | Limit |      | Margin | Antenna<br>Gain      | Result |        | Limit |      | Margin |
|                |                  |                       |                        | [dBm]           | [mW]   | [dBm] | [mW] | [dB]   | [dBi]                | [dBm]  | [mW]   | [dBm] | [mW] | [dB]   |
| 2412           | 8.87             | 1.43                  | 10.04                  | 20.34           | 108.14 | 30.00 | 1000 | 9.66   | 4.08                 | 24.42  | 276.69 | 36.02 | 4000 | 11.60  |
| 2437           | 8.56             | 1.43                  | 10.04                  | 20.03           | 100.69 | 30.00 | 1000 | 9.97   | 4.08                 | 24.11  | 257.63 | 36.02 | 4000 | 11.91  |
| 2462           | 8.35             | 1.44                  | 10.04                  | 19.83           | 96.16  | 30.00 | 1000 | 10.17  | 4.08                 | 23.91  | 246.04 | 36.02 | 4000 | 12.11  |

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

| MCS<br>Number | Reading<br>[dBm] | Remark |
|---------------|------------------|--------|
| 0             | 8.69             | *      |
| 1             | 8.38             |        |
| 2             | 8.46             |        |
| 3             | 8.31             |        |
| 4             | 8.06             |        |
| 5             | 6.58             |        |
| 6             | 7.17             |        |
| 7             | 6.57             |        |

\* Worst MCS

All comparison were carried out on same frequency and measurement factors.

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

Report No. 12069761H  
Test place Ise EMC Lab. No.6 Shielded Room  
Date July 11, 2018  
Temperature / Humidity 25.5 deg. C / 57 % RH  
Engineer Tomoki Matsui  
Mode Tx

**11b 1 Mbps**

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>(Time average) |       | Duty<br>factor<br>[dB] | Result<br>(Burst power average) |       |
|----------------|------------------|-----------------------|------------------------|--------------------------|-------|------------------------|---------------------------------|-------|
|                |                  |                       |                        | [dBm]                    | [mW]  |                        | [dBm]                           | [mW]  |
| 2412           | 0.71             | 1.43                  | 10.04                  | 12.18                    | 16.52 | 0.00                   | 12.18                           | 16.52 |
| 2437           | 0.80             | 1.43                  | 10.04                  | 12.27                    | 16.87 | 0.00                   | 12.27                           | 16.87 |
| 2462           | 0.90             | 1.44                  | 10.04                  | 12.38                    | 17.30 | 0.00                   | 12.38                           | 17.30 |

**11g 6 Mbps**

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>(Time average) |       | Duty<br>factor<br>[dB] | Result<br>(Burst power average) |       |
|----------------|------------------|-----------------------|------------------------|--------------------------|-------|------------------------|---------------------------------|-------|
|                |                  |                       |                        | [dBm]                    | [mW]  |                        | [dBm]                           | [mW]  |
| 2412           | -1.06            | 1.43                  | 10.04                  | 10.41                    | 10.99 | 0.04                   | 10.45                           | 11.09 |
| 2437           | -0.99            | 1.43                  | 10.04                  | 10.48                    | 11.17 | 0.04                   | 10.52                           | 11.27 |
| 2462           | -0.93            | 1.44                  | 10.04                  | 10.55                    | 11.35 | 0.04                   | 10.59                           | 11.46 |

**11n-20 MCS 0**

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>(Time average) |       | Duty<br>factor<br>[dB] | Result<br>(Burst power average) |       |
|----------------|------------------|-----------------------|------------------------|--------------------------|-------|------------------------|---------------------------------|-------|
|                |                  |                       |                        | [dBm]                    | [mW]  |                        | [dBm]                           | [mW]  |
| 2412           | -1.16            | 1.43                  | 10.04                  | 10.31                    | 10.74 | 0.04                   | 10.35                           | 10.84 |
| 2437           | -1.16            | 1.43                  | 10.04                  | 10.31                    | 10.74 | 0.04                   | 10.35                           | 10.84 |
| 2462           | -1.02            | 1.44                  | 10.04                  | 10.46                    | 11.12 | 0.04                   | 10.50                           | 11.22 |

Sample Calculation:

Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

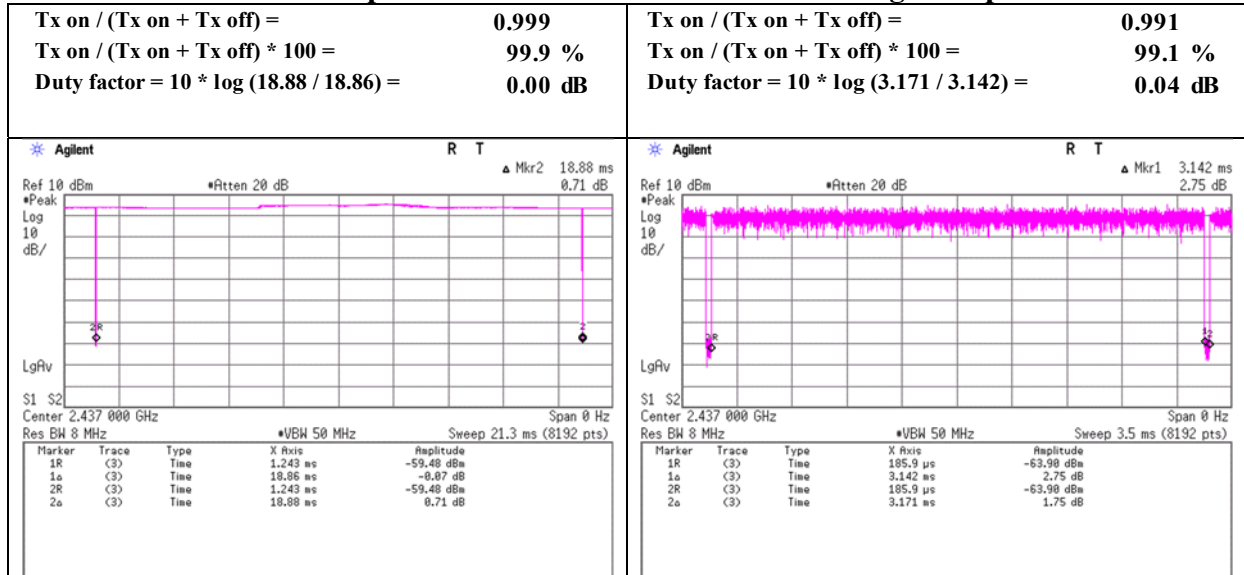
Result (Burst power average) = Time average + Duty factor

**The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.**

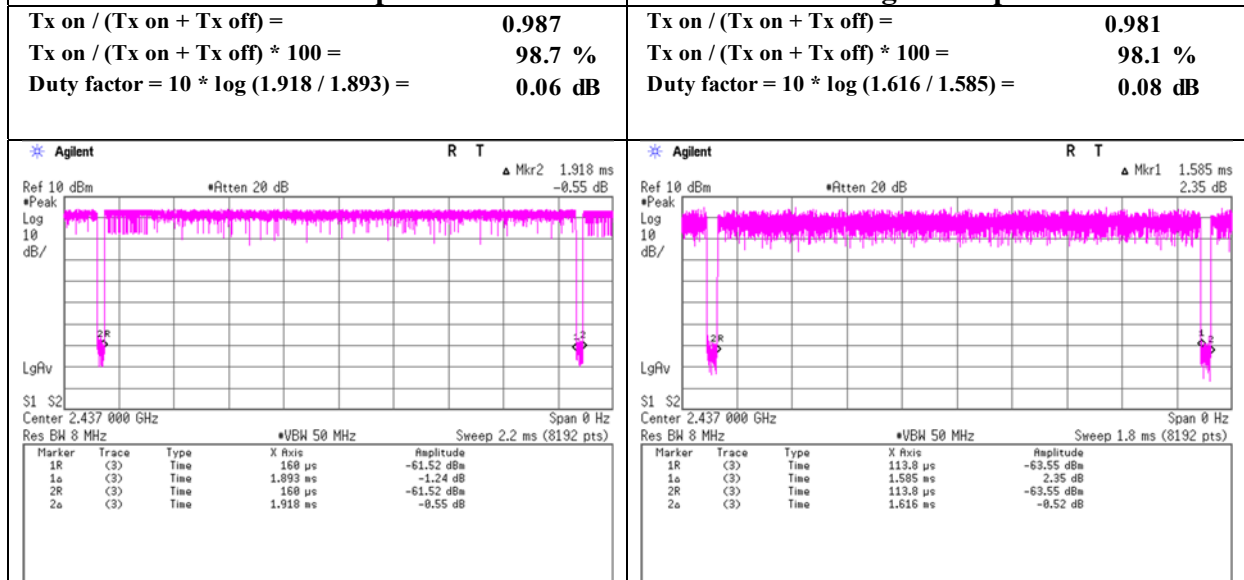
## Burst rate confirmation

Report No. 12069761H  
Test place Ise EMC Lab. No.6 Shielded Room  
Date July 12, 2018  
Temperature / Humidity 25.5 deg. C / 57 % RH  
Engineer Tomoki Matsui  
Mode Tx

### 11b 1 Mbps



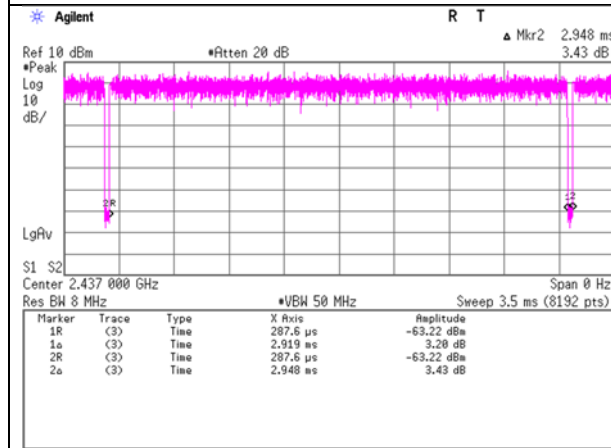
### 11b 11 Mbps



## Burst rate confirmation

### 11n-20 MCS 0

$\text{Tx on} / (\text{Tx on} + \text{Tx off}) = 0.990$   
 $\text{Tx on} / (\text{Tx on} + \text{Tx off}) * 100 = 99.0 \%$   
 $\text{Duty factor} = 10 * \log (2.948 / 2.919) = 0.04 \text{ dB}$



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



## Radiated Spurious Emission

Report No. 12069761H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date July 18, 2018  
Temperature / Humidity 23 deg. C / 49 % RH  
Engineer Junki Nagatomi  
(1 GHz - 10 GHz)  
Mode Tx 11b 2412 MHz  
No.2  
July 18, 2018  
23 deg. C / 49 % RH  
Takumi Shimada  
(10 GHz - 26.5 GHz)

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori     | 1499.998           | PK       | 57.7              | 26.0               | 4.5          | 35.0         | -                   | 53.2               | 73.9              | 20.7           |             |
| Hori     | 2281.430           | PK       | 52.4              | 27.6               | 5.0          | 34.5         | -                   | 50.5               | 73.9              | 23.4           |             |
| Hori     | 2390.000           | PK       | 66.6              | 27.7               | 5.0          | 34.4         | -                   | 64.9               | 73.9              | 9.0            |             |
| Hori     | 2690.000           | PK       | 53.7              | 28.3               | 5.2          | 34.4         | -                   | 52.8               | 73.9              | 21.1           |             |
| Hori     | 4824.000           | PK       | 53.4              | 31.3               | 7.3          | 33.7         | -                   | 58.3               | 73.9              | 15.6           |             |
| Hori     | 7236.000           | PK       | 48.4              | 35.6               | 8.7          | 33.6         | -                   | 59.1               | 73.9              | 14.8           | Floor noise |
| Hori     | 1499.998           | AV       | 54.9              | 26.0               | 4.5          | 35.0         | -                   | 50.4               | 53.9              | 3.5            |             |
| Hori     | 2281.430           | AV       | 44.2              | 27.6               | 5.0          | 34.5         | -                   | 42.3               | 53.9              | 11.6           |             |
| Hori     | 2390.000           | AV       | 47.2              | 27.7               | 5.0          | 34.4         | -                   | 45.5               | 53.9              | 8.4            |             |
| Hori     | 2690.000           | AV       | 45.1              | 28.3               | 5.2          | 34.4         | -                   | 44.2               | 53.9              | 9.7            |             |
| Hori     | 4824.000           | AV       | 45.6              | 31.3               | 7.3          | 33.7         | -                   | 50.5               | 53.9              | 3.4            |             |
| Hori     | 7236.000           | AV       | 35.2              | 35.6               | 8.7          | 33.6         | -                   | 45.9               | 53.9              | 8.0            | Floor noise |
| Vert     | 1499.998           | PK       | 55.0              | 26.0               | 4.5          | 35.0         | -                   | 50.5               | 73.9              | 23.4           |             |
| Vert     | 2281.430           | PK       | 50.3              | 27.6               | 5.0          | 34.5         | -                   | 48.4               | 73.9              | 25.5           |             |
| Vert     | 2390.000           | PK       | 65.8              | 27.7               | 5.0          | 34.4         | -                   | 64.1               | 73.9              | 9.8            |             |
| Vert     | 2690.000           | PK       | 52.8              | 28.3               | 5.2          | 34.4         | -                   | 51.9               | 73.9              | 22.0           |             |
| Vert     | 4824.000           | PK       | 53.1              | 31.3               | 7.3          | 33.7         | -                   | 58.0               | 73.9              | 15.9           |             |
| Vert     | 7236.000           | PK       | 43.3              | 35.6               | 8.7          | 33.6         | -                   | 54.0               | 73.9              | 19.9           | Floor noise |
| Vert     | 1499.998           | AV       | 51.8              | 26.0               | 4.5          | 35.0         | -                   | 47.3               | 53.9              | 6.6            |             |
| Vert     | 2281.430           | AV       | 42.1              | 27.6               | 5.0          | 34.5         | -                   | 40.2               | 53.9              | 13.7           |             |
| Vert     | 2390.000           | AV       | 46.6              | 27.7               | 5.0          | 34.4         | -                   | 44.9               | 53.9              | 9.0            |             |
| Vert     | 2690.000           | AV       | 44.2              | 28.3               | 5.2          | 34.4         | -                   | 43.3               | 53.9              | 10.6           |             |
| Vert     | 4824.000           | AV       | 46.0              | 31.3               | 7.3          | 33.7         | -                   | 50.9               | 53.9              | 3.0            |             |
| Vert     | 7236.000           | AV       | 35.1              | 35.6               | 8.7          | 33.6         | -                   | 45.8               | 53.9              | 8.1            | 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 20log (3.75 m / 3.0 m) = 1.94 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori     | 2412.000           | PK       | 100.8             | 27.6                    | 5.0          | 34.4         | 99.0               | -                 | -              | Carrier |
| Hori     | 2400.000           | PK       | 55.3              | 27.8                    | 5.0          | 34.4         | 53.7               | 79.0              | 25.3           |         |
| Hori     | 9648.000           | PK       | 37.7              | 38.4                    | 8.6          | 33.9         | 50.8               | 79.0              | 28.2           |         |
| Vert     | 2412.000           | PK       | 99.6              | 27.6                    | 5.0          | 34.4         | 97.8               | -                 | -              | Carrier |
| Vert     | 2400.000           | PK       | 54.3              | 27.8                    | 5.0          | 34.4         | 52.7               | 77.8              | 25.1           |         |
| Vert     | 9648.000           | PK       | 39.4              | 38.4                    | 8.6          | 33.9         | 52.5               | 77.8              | 25.3           |         |

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

**UL Japan, Inc.**

**Ise EMC Lab.**

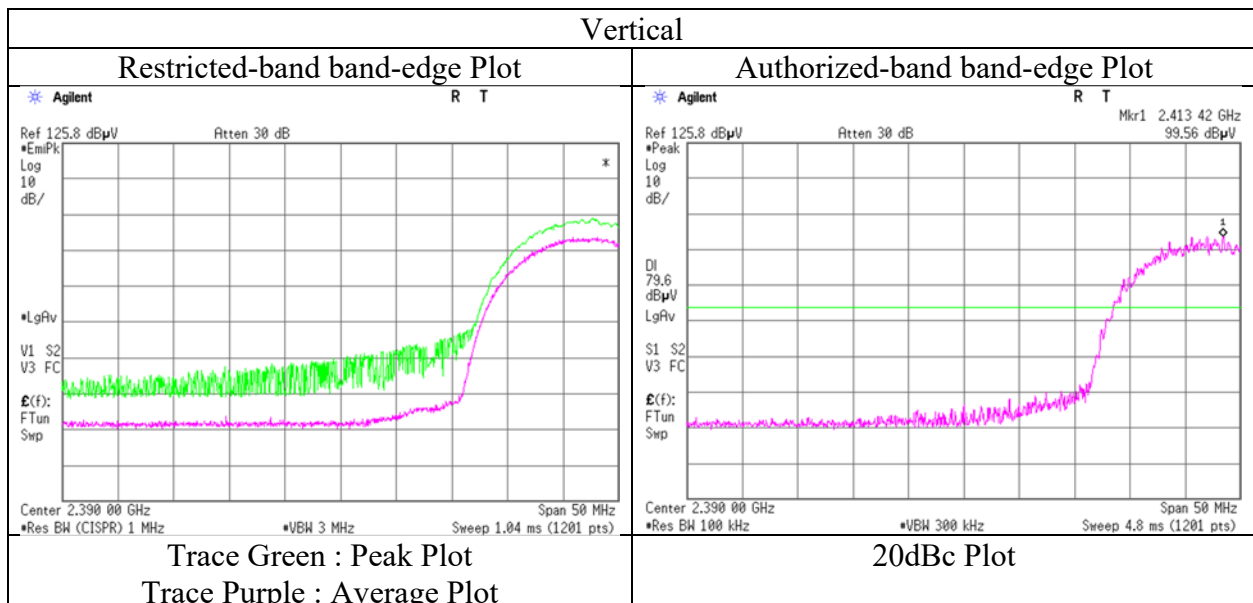
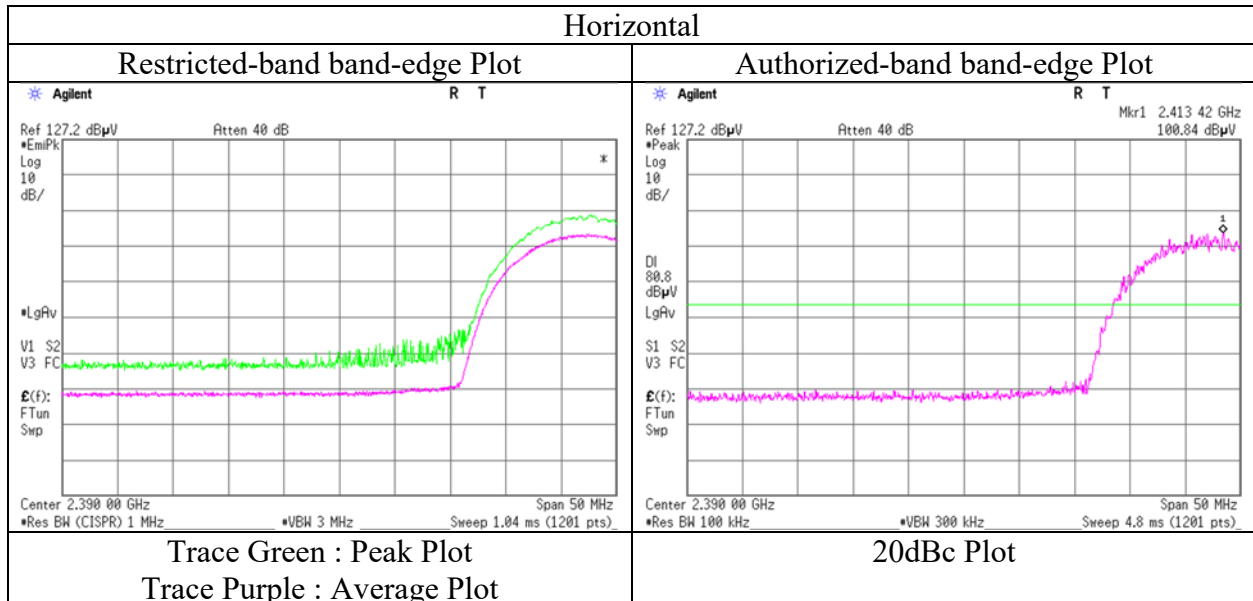
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Telephone : +81 596 24 8999

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

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | July 18, 2018       |
| Temperature / Humidity | 23 deg. C / 49 % RH |
| Engineer               | Junki Nagatomi      |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11b 2412 MHz     |



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

**UL Japan, Inc.**

**Ise EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

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## Radiated Spurious Emission

Report No. 12069761H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date July 18, 2018  
Temperature / Humidity 23 deg. C / 49 % RH  
Engineer Junki Nagatomi  
(1 GHz - 10 GHz) Takumi Shimada  
(10 GHz - 26.5 GHz)  
Mode Tx 11b 2437 MHz

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori     | 1499.998           | PK       | 56.9              | 26.0               | 4.5          | 35.0         | -                   | 52.4               | 73.9              | 21.5           |             |
| Hori     | 2281.021           | PK       | 51.2              | 27.6               | 5.0          | 34.5         | -                   | 49.3               | 73.9              | 24.6           |             |
| Hori     | 2690.000           | PK       | 54.2              | 28.3               | 5.2          | 34.4         | -                   | 53.3               | 73.9              | 20.6           |             |
| Hori     | 4874.000           | PK       | 52.2              | 31.5               | 7.3          | 33.7         | -                   | 57.3               | 73.9              | 16.6           |             |
| Hori     | 7311.000           | PK       | 43.8              | 35.9               | 8.7          | 33.6         | -                   | 54.8               | 73.9              | 19.1           | Floor noise |
| Hori     | 1499.998           | AV       | 54.8              | 26.0               | 4.5          | 35.0         | -                   | 50.3               | 53.9              | 3.6            |             |
| Hori     | 2281.021           | AV       | 41.7              | 27.6               | 5.0          | 34.5         | -                   | 39.8               | 53.9              | 14.1           |             |
| Hori     | 2690.000           | AV       | 45.3              | 28.3               | 5.2          | 34.4         | -                   | 44.4               | 53.9              | 9.5            |             |
| Hori     | 4874.000           | AV       | 43.5              | 31.5               | 7.3          | 33.7         | -                   | 48.6               | 53.9              | 5.3            |             |
| Hori     | 7311.000           | AV       | 34.7              | 35.9               | 8.7          | 33.6         | -                   | 45.7               | 53.9              | 8.2            | Floor noise |
| Vert     | 1499.998           | PK       | 54.9              | 26.0               | 4.5          | 35.0         | -                   | 50.4               | 73.9              | 23.5           |             |
| Vert     | 2281.021           | PK       | 50.5              | 27.6               | 5.0          | 34.5         | -                   | 48.6               | 73.9              | 25.3           |             |
| Vert     | 2690.000           | PK       | 53.9              | 28.3               | 5.2          | 34.4         | -                   | 53.0               | 73.9              | 20.9           |             |
| Vert     | 4874.000           | PK       | 52.3              | 31.5               | 7.3          | 33.7         | -                   | 57.4               | 73.9              | 16.5           |             |
| Vert     | 7311.000           | PK       | 43.7              | 35.9               | 8.7          | 33.6         | -                   | 54.7               | 73.9              | 19.2           | Floor noise |
| Vert     | 1499.998           | AV       | 52.4              | 26.0               | 4.5          | 35.0         | -                   | 47.9               | 53.9              | 6.0            |             |
| Vert     | 2281.021           | AV       | 42.3              | 27.6               | 5.0          | 34.5         | -                   | 40.4               | 53.9              | 13.5           |             |
| Vert     | 2690.000           | AV       | 44.6              | 28.3               | 5.2          | 34.4         | -                   | 43.7               | 53.9              | 10.2           |             |
| Vert     | 4874.000           | AV       | 43.5              | 31.5               | 7.3          | 33.7         | -                   | 48.6               | 53.9              | 5.3            |             |
| Vert     | 7311.000           | AV       | 34.8              | 35.9               | 8.7          | 33.6         | -                   | 45.8               | 53.9              | 8.1            | 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 20log(3.75 m / 3.0 m) = 1.94 dB  
10 GHz - 26.5 GHz 20log(1.0 m / 3.0 m) = -9.5 dB

### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori     | 2437.000           | PK       | 100.4             | 27.4                    | 5.1          | 34.4         | 98.5               | -                 | -              | Carrier |
| Hori     | 9748.000           | PK       | 37.8              | 38.6                    | 8.6          | 34.0         | 51.0               | 78.5              | 27.5           |         |
| Vert     | 2437.000           | PK       | 99.7              | 27.4                    | 5.1          | 34.4         | 97.8               | -                 | -              | Carrier |
| Vert     | 9748.000           | PK       | 40.4              | 38.6                    | 8.6          | 34.0         | 53.6               | 77.8              | 24.2           |         |

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

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**Ise EMC Lab.**

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## Radiated Spurious Emission

Report No. 12069761H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date July 18, 2018  
Temperature / Humidity 23 deg. C / 49 % RH  
Engineer Junki Nagatomi  
(1 GHz - 10 GHz) Takumi Shimada  
(10 GHz - 26.5 GHz)  
Mode Tx 11b 2462 MHz

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori     | 1499.998           | PK       | 58.2              | 26.0               | 4.5          | 35.0         | -                   | 53.7               | 73.9              | 20.2           |             |
| Hori     | 2281.301           | PK       | 51.0              | 27.6               | 5.0          | 34.5         | -                   | 49.1               | 73.9              | 24.8           |             |
| Hori     | 2483.500           | PK       | 69.0              | 27.5               | 5.1          | 34.4         | -                   | 67.2               | 73.9              | 6.7            |             |
| Hori     | 2690.000           | PK       | 53.3              | 28.3               | 5.2          | 34.4         | -                   | 52.4               | 73.9              | 21.5           |             |
| Hori     | 4924.000           | PK       | 49.8              | 31.6               | 7.4          | 33.7         | -                   | 55.1               | 73.9              | 18.8           |             |
| Hori     | 7386.000           | PK       | 47.0              | 36.1               | 8.7          | 33.6         | -                   | 58.2               | 73.9              | 15.7           | Floor noise |
| Hori     | 1499.998           | AV       | 54.8              | 26.0               | 4.5          | 35.0         | -                   | 50.3               | 53.9              | 3.6            |             |
| Hori     | 2281.301           | AV       | 41.3              | 27.6               | 5.0          | 34.5         | -                   | 39.4               | 53.9              | 14.5           |             |
| Hori     | 2483.500           | AV       | 48.7              | 27.5               | 5.1          | 34.4         | -                   | 46.9               | 53.9              | 7.0            |             |
| Hori     | 2690.000           | AV       | 45.1              | 28.3               | 5.2          | 34.4         | -                   | 44.2               | 53.9              | 9.7            |             |
| Hori     | 4924.000           | AV       | 37.7              | 31.6               | 7.4          | 33.7         | -                   | 43.0               | 53.9              | 10.9           |             |
| Hori     | 7386.000           | AV       | 36.1              | 36.1               | 8.7          | 33.6         | -                   | 47.3               | 53.9              | 6.6            | Floor noise |
| Vert     | 1499.998           | PK       | 55.3              | 26.0               | 4.5          | 35.0         | -                   | 50.8               | 73.9              | 23.1           |             |
| Vert     | 2281.301           | PK       | 52.1              | 27.6               | 5.0          | 34.5         | -                   | 50.2               | 73.9              | 23.7           |             |
| Vert     | 2483.500           | PK       | 69.0              | 27.5               | 5.1          | 34.4         | -                   | 67.2               | 73.9              | 6.7            |             |
| Vert     | 2690.000           | PK       | 53.6              | 28.3               | 5.2          | 34.4         | -                   | 52.7               | 73.9              | 21.2           |             |
| Vert     | 4924.000           | PK       | 44.6              | 31.6               | 7.4          | 33.7         | -                   | 49.9               | 73.9              | 24.0           |             |
| Vert     | 7386.000           | PK       | 42.6              | 36.1               | 8.7          | 33.6         | -                   | 53.8               | 73.9              | 20.1           | Floor noise |
| Vert     | 1499.998           | AV       | 52.8              | 26.0               | 4.5          | 35.0         | -                   | 48.3               | 53.9              | 5.6            |             |
| Vert     | 2281.301           | AV       | 42.0              | 27.6               | 5.0          | 34.5         | -                   | 40.1               | 53.9              | 13.8           |             |
| Vert     | 2483.500           | AV       | 48.9              | 27.5               | 5.1          | 34.4         | -                   | 47.1               | 53.9              | 6.8            |             |
| Vert     | 2690.000           | AV       | 44.6              | 28.3               | 5.2          | 34.4         | -                   | 43.7               | 53.9              | 10.2           |             |
| Vert     | 4924.000           | AV       | 34.7              | 31.6               | 7.4          | 33.7         | -                   | 40.0               | 53.9              | 13.9           |             |
| Vert     | 7386.000           | AV       | 32.3              | 36.1               | 8.7          | 33.6         | -                   | 43.5               | 53.9              | 10.4           | 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 (3.75 m / 3.0 m) = 1.94 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori     | 2462.000           | PK       | 100.3             | 27.3                    | 5.1          | 34.4         | 98.3               | -                 | -              | Carrier |
| Hori     | 9848.000           | PK       | 38.3              | 38.6                    | 8.6          | 34.0         | 51.5               | 78.3              | 26.8           |         |
| Vert     | 2462.000           | PK       | 100.3             | 27.3                    | 5.1          | 34.4         | 98.3               | -                 | -              | Carrier |
| Vert     | 9848.000           | PK       | 40.5              | 38.6                    | 8.6          | 34.0         | 53.7               | 78.3              | 24.6           |         |

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

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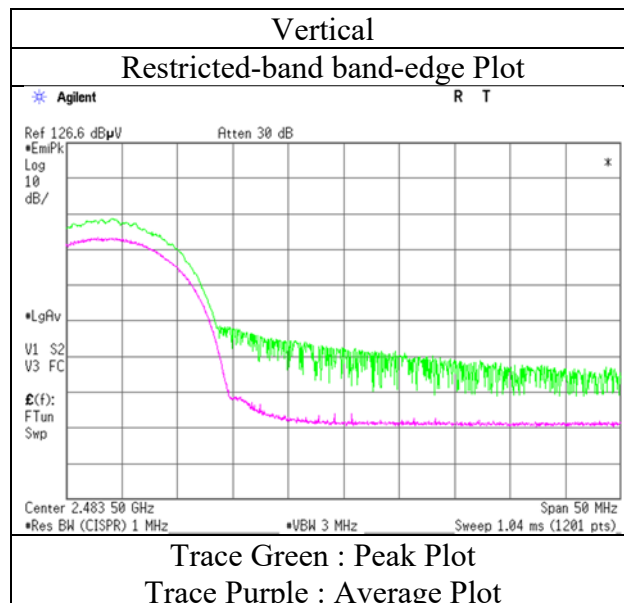
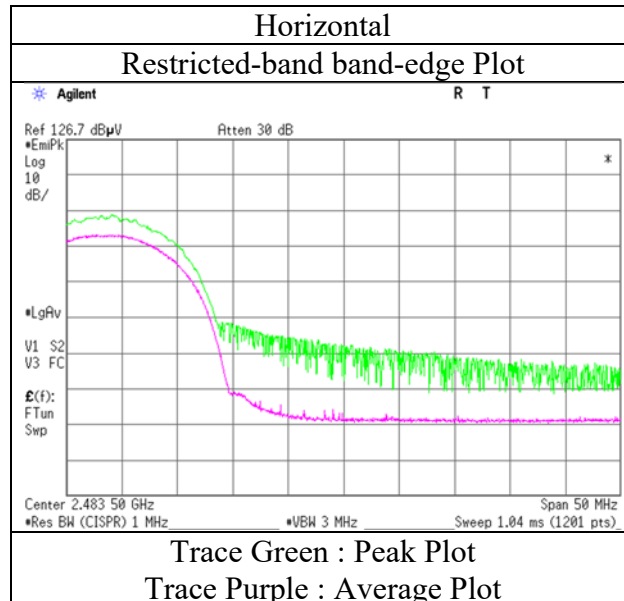
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## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                     |
|------------------------|---------------------|
| Report No.             | 12069761H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | July 18, 2018       |
| Temperature / Humidity | 23 deg. C / 49 % RH |
| Engineer               | Junki Nagatomi      |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11b 2462 MHz     |



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

## Radiated Spurious Emission

Report No. 12069761H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date July 18, 2018  
Temperature / Humidity 23 deg. C / 49 % RH  
Engineer Junki Nagatomi  
(1 GHz - 10 GHz)  
Mode Tx 11g 2412 MHz

No.2  
July 18, 2018  
23 deg. C / 49 % RH  
Takumi Shimada  
(10 GHz - 26.5 GHz)

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori     | 1499.998           | PK       | 56.7              | 26.0               | 4.5          | 35.0         | -                   | 52.2               | 73.9              | 21.7           |             |
| Hori     | 2282.763           | PK       | 53.6              | 27.6               | 5.0          | 34.5         | -                   | 51.7               | 73.9              | 22.2           |             |
| Hori     | 2390.000           | PK       | 58.1              | 27.7               | 5.0          | 34.4         | -                   | 56.4               | 73.9              | 17.5           |             |
| Hori     | 2690.000           | PK       | 55.0              | 28.3               | 5.2          | 34.4         | -                   | 54.1               | 73.9              | 19.8           |             |
| Hori     | 4824.000           | PK       | 48.4              | 31.3               | 7.3          | 33.7         | -                   | 53.3               | 73.9              | 20.6           |             |
| Hori     | 7236.000           | PK       | 41.7              | 35.6               | 8.7          | 33.6         | -                   | 52.4               | 73.9              | 21.5           | Floor noise |
| Hori     | 1499.998           | AV       | 54.5              | 26.0               | 4.5          | 35.0         | -                   | 50.0               | 53.9              | 3.9            |             |
| Hori     | 2282.763           | AV       | 45.6              | 27.6               | 5.0          | 34.5         | -                   | 43.7               | 53.9              | 10.2           |             |
| Hori     | 2390.000           | AV       | 45.7              | 27.7               | 5.0          | 34.4         | -                   | 44.0               | 53.9              | 9.9            |             |
| Hori     | 2690.000           | AV       | 46.4              | 28.3               | 5.2          | 34.4         | -                   | 45.5               | 53.9              | 8.4            |             |
| Hori     | 4824.000           | AV       | 38.6              | 31.3               | 7.3          | 33.7         | -                   | 43.5               | 53.9              | 10.4           |             |
| Hori     | 7236.000           | AV       | 33.1              | 35.6               | 8.7          | 33.6         | -                   | 43.8               | 53.9              | 10.1           | Floor noise |
| Vert     | 1499.998           | PK       | 56.0              | 26.0               | 4.5          | 35.0         | -                   | 51.5               | 73.9              | 22.4           |             |
| Vert     | 2282.763           | PK       | 51.6              | 27.6               | 5.0          | 34.5         | -                   | 49.7               | 73.9              | 24.2           |             |
| Vert     | 2390.000           | PK       | 58.2              | 27.7               | 5.0          | 34.4         | -                   | 56.5               | 73.9              | 17.4           |             |
| Vert     | 2690.000           | PK       | 54.6              | 28.3               | 5.2          | 34.4         | -                   | 53.7               | 73.9              | 20.2           |             |
| Vert     | 4824.000           | PK       | 47.9              | 31.3               | 7.3          | 33.7         | -                   | 52.8               | 73.9              | 21.1           |             |
| Vert     | 7236.000           | PK       | 46.2              | 35.6               | 8.7          | 33.6         | -                   | 56.9               | 73.9              | 17.0           | Floor noise |
| Vert     | 1499.998           | AV       | 52.7              | 26.0               | 4.5          | 35.0         | -                   | 48.2               | 53.9              | 5.7            |             |
| Vert     | 2282.763           | AV       | 43.1              | 27.6               | 5.0          | 34.5         | -                   | 41.2               | 53.9              | 12.7           |             |
| Vert     | 2390.000           | AV       | 47.7              | 27.7               | 5.0          | 34.4         | -                   | 46.0               | 53.9              | 7.9            |             |
| Vert     | 2690.000           | AV       | 45.6              | 28.3               | 5.2          | 34.4         | -                   | 44.7               | 53.9              | 9.2            |             |
| Vert     | 4824.000           | AV       | 40.8              | 31.3               | 7.3          | 33.7         | -                   | 45.7               | 53.9              | 8.2            |             |
| Vert     | 7236.000           | AV       | 34.9              | 35.6               | 8.7          | 33.6         | -                   | 45.6               | 53.9              | 8.3            | 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 (3.75 m / 3.0 m) = 1.94 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori     | 2412.000           | PK       | 96.1              | 27.6                    | 5.0          | 34.4         | 94.3               | -                 | -              | Carrier |
| Hori     | 2400.000           | PK       | 56.1              | 27.8                    | 5.0          | 34.4         | 54.5               | 74.3              | 19.8           |         |
| Hori     | 9648.000           | PK       | 37.7              | 38.4                    | 8.6          | 33.9         | 50.8               | 74.3              | 23.5           |         |
| Vert     | 2412.000           | PK       | 95.6              | 27.6                    | 5.0          | 34.4         | 93.8               | -                 | -              | Carrier |
| Vert     | 2400.000           | PK       | 55.2              | 27.8                    | 5.0          | 34.4         | 53.6               | 73.8              | 20.2           |         |
| Vert     | 9648.000           | PK       | 39.4              | 38.4                    | 8.6          | 33.9         | 52.5               | 73.8              | 21.3           |         |

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

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**Ise EMC Lab.**

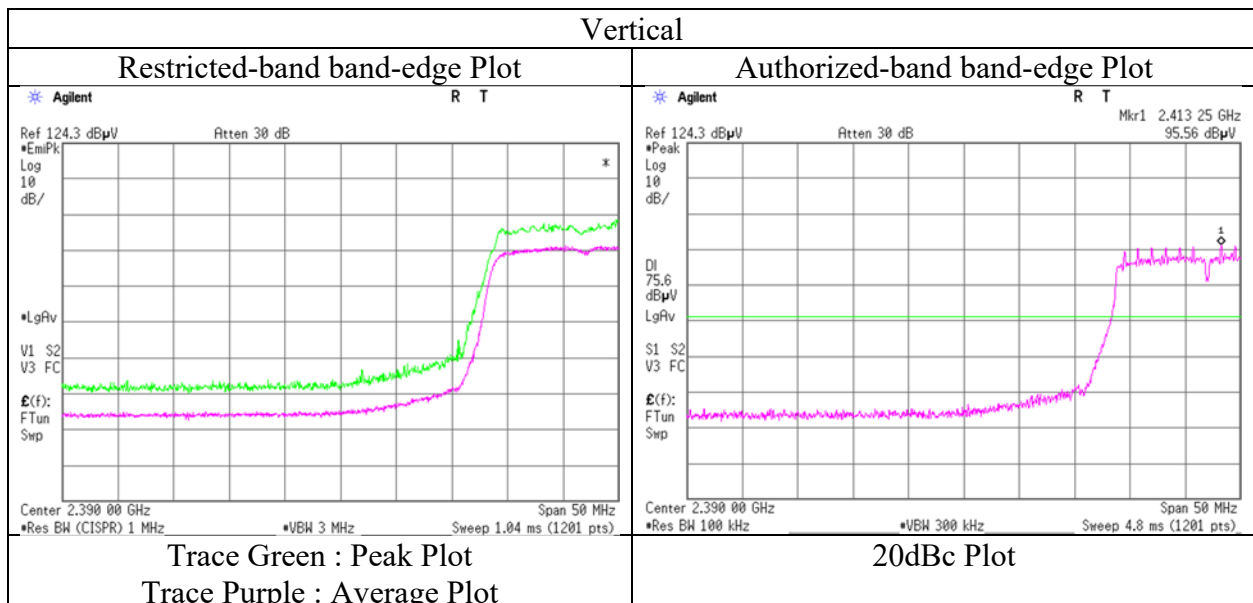
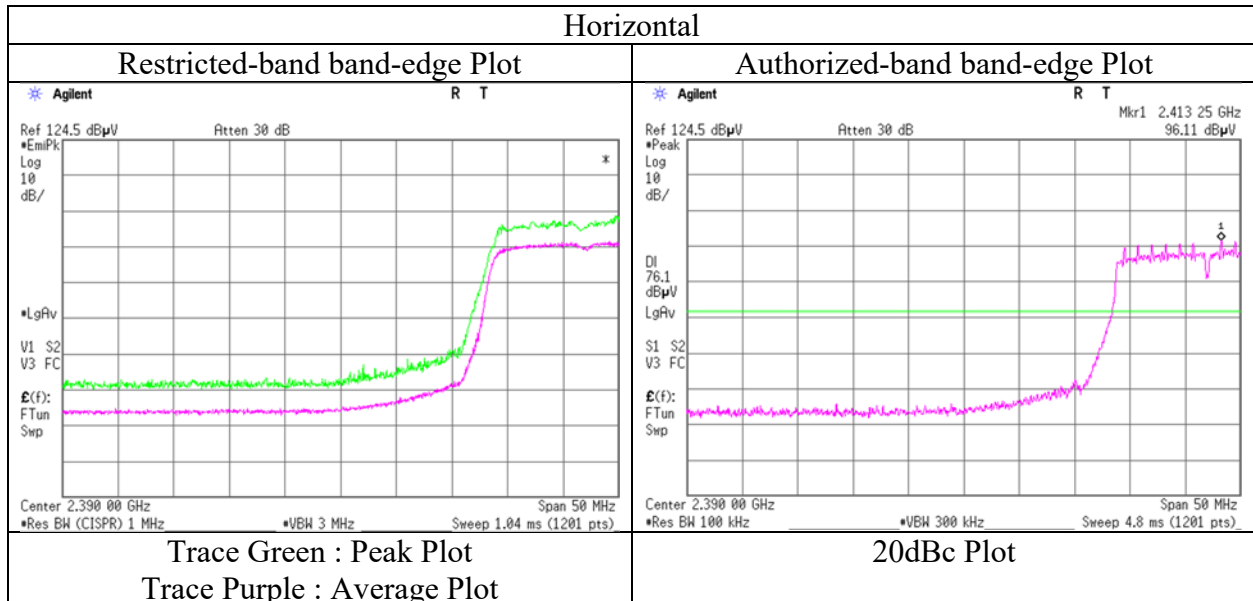
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## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                     |
|------------------------|---------------------|
| Report No.             | 12069761H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | July 18, 2018       |
| Temperature / Humidity | 23 deg. C / 49 % RH |
| Engineer               | Junki Nagatomi      |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11g 2412 MHz     |



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

**UL Japan, Inc.**

**Ise EMC Lab.**

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## Radiated Spurious Emission

|                        |                     |                     |                     |
|------------------------|---------------------|---------------------|---------------------|
| Report No.             | 12069761H           |                     |                     |
| Test place             | Ise EMC Lab.        |                     |                     |
| Semi Anechoic Chamber  | No.2                | No.2                | No.2                |
| Date                   | July 18, 2018       | July 18, 2018       | July 18, 2018       |
| Temperature / Humidity | 23 deg. C / 49 % RH | 23 deg. C / 49 % RH | 23 deg. C / 61 % RH |
| Engineer               | Junki Nagatomi      | Takumi Shimada      | Junki Nagatomi      |
|                        | (1 GHz - 10 GHz)    | (10 GHz - 26.5 GHz) | (Below 1 GHz)       |
| Mode                   | Tx 11g 2437 MHz     |                     |                     |

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori     | 69.121             | QP       | 55.6              | 6.6                | 7.8          | 38.9         | -                   | 31.1               | 40.0              | 8.9            |             |
| Hori     | 85.509             | QP       | 44.9              | 7.2                | 8.0          | 38.9         | -                   | 21.2               | 40.0              | 18.8           |             |
| Hori     | 148.122            | QP       | 44.6              | 14.8               | 8.7          | 39.0         | -                   | 29.1               | 43.5              | 14.4           |             |
| Hori     | 250.001            | QP       | 49.3              | 11.8               | 9.6          | 38.9         | -                   | 31.8               | 46.0              | 14.2           |             |
| Hori     | 349.890            | QP       | 40.3              | 15.0               | 10.3         | 38.7         | -                   | 26.9               | 46.0              | 19.1           |             |
| Hori     | 749.982            | QP       | 48.5              | 20.2               | 12.5         | 38.2         | -                   | 43.0               | 46.0              | 3.0            |             |
| Hori     | 767.992            | QP       | 42.1              | 20.4               | 12.6         | 38.2         | -                   | 36.9               | 46.0              | 9.1            |             |
| Hori     | 1499.998           | PK       | 57.2              | 26.0               | 4.5          | 35.0         | -                   | 52.7               | 73.9              | 21.2           |             |
| Hori     | 2281.733           | PK       | 53.5              | 27.6               | 5.0          | 34.5         | -                   | 51.6               | 73.9              | 22.3           |             |
| Hori     | 2690.000           | PK       | 54.3              | 28.3               | 5.2          | 34.4         | -                   | 53.4               | 73.9              | 20.5           |             |
| Hori     | 4874.000           | PK       | 47.3              | 31.5               | 7.3          | 33.7         | -                   | 52.4               | 73.9              | 21.5           |             |
| Hori     | 7311.000           | PK       | 43.8              | 35.9               | 8.7          | 33.6         | -                   | 54.8               | 73.9              | 19.1           | Floor noise |
| Hori     | 1499.998           | AV       | 54.9              | 26.0               | 4.5          | 35.0         | -                   | 50.4               | 53.9              | 3.5            |             |
| Hori     | 2281.733           | AV       | 45.2              | 27.6               | 5.0          | 34.5         | -                   | 43.3               | 53.9              | 10.6           |             |
| Hori     | 2690.000           | AV       | 46.3              | 28.3               | 5.2          | 34.4         | -                   | 45.4               | 53.9              | 8.5            |             |
| Hori     | 4874.000           | AV       | 39.1              | 31.5               | 7.3          | 33.7         | -                   | 44.2               | 53.9              | 9.7            |             |
| Hori     | 7311.000           | AV       | 34.9              | 35.9               | 8.7          | 33.6         | -                   | 45.9               | 53.9              | 8.0            | Floor noise |
| Vert     | 69.120             | QP       | 59.4              | 6.6                | 7.8          | 38.9         | -                   | 34.9               | 40.0              | 5.1            |             |
| Vert     | 85.499             | QP       | 57.8              | 7.2                | 8.0          | 38.9         | -                   | 34.1               | 40.0              | 5.9            |             |
| Vert     | 149.000            | QP       | 48.8              | 14.9               | 8.7          | 39.0         | -                   | 33.4               | 43.5              | 10.1           |             |
| Vert     | 250.001            | QP       | 49.2              | 11.8               | 9.6          | 38.9         | -                   | 31.7               | 46.0              | 14.3           |             |
| Vert     | 294.310            | QP       | 43.8              | 13.4               | 9.9          | 38.8         | -                   | 28.3               | 46.0              | 17.7           |             |
| Vert     | 749.982            | QP       | 46.0              | 20.2               | 12.5         | 38.2         | -                   | 40.5               | 46.0              | 5.5            |             |
| Vert     | 767.992            | QP       | 41.7              | 20.4               | 12.6         | 38.2         | -                   | 36.5               | 46.0              | 9.5            |             |
| Vert     | 1499.998           | PK       | 54.7              | 26.0               | 4.5          | 35.0         | -                   | 50.2               | 73.9              | 23.7           |             |
| Vert     | 2281.733           | PK       | 53.6              | 27.6               | 5.0          | 34.5         | -                   | 51.7               | 73.9              | 22.2           |             |
| Vert     | 2690.000           | PK       | 55.5              | 28.3               | 5.2          | 34.4         | -                   | 54.6               | 73.9              | 19.3           |             |
| Vert     | 4874.000           | PK       | 47.7              | 31.5               | 7.3          | 33.7         | -                   | 52.8               | 73.9              | 21.1           |             |
| Vert     | 7311.000           | PK       | 43.3              | 35.9               | 8.7          | 33.6         | -                   | 54.3               | 73.9              | 19.6           | Floor noise |
| Vert     | 1499.998           | AV       | 52.2              | 26.0               | 4.5          | 35.0         | -                   | 47.7               | 53.9              | 6.2            |             |
| Vert     | 2281.733           | AV       | 45.4              | 27.6               | 5.0          | 34.5         | -                   | 43.5               | 53.9              | 10.4           |             |
| Vert     | 2690.000           | AV       | 45.5              | 28.3               | 5.2          | 34.4         | -                   | 44.6               | 53.9              | 9.3            |             |
| Vert     | 4874.000           | AV       | 39.5              | 31.5               | 7.3          | 33.7         | -                   | 44.6               | 53.9              | 9.3            |             |
| Vert     | 7311.000           | AV       | 34.6              | 35.9               | 8.7          | 33.6         | -                   | 45.6               | 53.9              | 8.3            | 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       $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori     | 2437.000           | PK       | 95.1              | 27.4                    | 5.1          | 34.4         | 93.2               | -                 | -              | Carrier |
| Hori     | 9748.000           | PK       | 37.3              | 38.6                    | 8.6          | 34.0         | 50.5               | 73.2              | 22.7           |         |
| Vert     | 2437.000           | PK       | 96.0              | 27.4                    | 5.1          | 34.4         | 94.1               | -                 | -              | Carrier |
| Vert     | 9748.000           | PK       | 40.0              | 38.6                    | 8.6          | 34.0         | 53.2               | 74.1              | 20.9           |         |

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

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## Radiated Spurious Emission

Report No. 12069761H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date July 18, 2018  
Temperature / Humidity 23 deg. C / 49 % RH  
Engineer Takumi Shimada  
(1 GHz - 10 GHz) (10 GHz - 26.5 GHz)  
Mode Tx 11g 2462 MHz

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori     | 1499.998           | PK       | 57.7              | 26.0               | 4.5          | 35.0         | -                   | 53.2               | 73.9              | 20.7           |             |
| Hori     | 2299.920           | PK       | 50.6              | 27.6               | 5.0          | 34.4         | -                   | 48.8               | 73.9              | 25.1           |             |
| Hori     | 2483.500           | PK       | 65.9              | 27.5               | 5.1          | 34.4         | -                   | 64.1               | 73.9              | 9.8            |             |
| Hori     | 2690.000           | PK       | 54.7              | 28.3               | 5.2          | 34.4         | -                   | 53.8               | 73.9              | 20.1           |             |
| Hori     | 4924.000           | PK       | 43.4              | 31.6               | 6.6          | 33.7         | -                   | 47.9               | 73.9              | 26.0           |             |
| Hori     | 7386.000           | PK       | 42.3              | 36.1               | 7.8          | 33.6         | -                   | 52.6               | 73.9              | 21.3           | Floor noise |
| Hori     | 1499.998           | AV       | 54.6              | 26.0               | 4.5          | 35.0         | -                   | 50.1               | 53.9              | 3.8            |             |
| Hori     | 2299.920           | AV       | 41.1              | 27.6               | 5.0          | 34.4         | -                   | 39.3               | 53.9              | 14.6           |             |
| Hori     | 2483.500           | AV       | 45.2              | 27.5               | 5.1          | 34.4         | -                   | 43.4               | 53.9              | 10.5           |             |
| Hori     | 2690.000           | AV       | 41.5              | 28.3               | 5.2          | 34.4         | -                   | 40.6               | 53.9              | 13.3           |             |
| Hori     | 4924.000           | AV       | 31.1              | 31.6               | 6.6          | 33.7         | -                   | 35.6               | 53.9              | 18.3           |             |
| Hori     | 7386.000           | AV       | 29.6              | 36.1               | 7.8          | 33.6         | -                   | 39.9               | 53.9              | 14.0           | Floor noise |
| Vert     | 1499.998           | PK       | 54.8              | 26.0               | 4.5          | 35.0         | -                   | 50.3               | 73.9              | 23.6           |             |
| Vert     | 2299.920           | PK       | 49.8              | 27.6               | 5.0          | 34.4         | -                   | 48.0               | 73.9              | 25.9           |             |
| Vert     | 2483.500           | PK       | 66.7              | 27.5               | 5.1          | 34.4         | -                   | 64.9               | 73.9              | 9.0            |             |
| Vert     | 2690.000           | PK       | 52.1              | 28.3               | 5.2          | 34.4         | -                   | 51.2               | 73.9              | 22.7           |             |
| Vert     | 4924.000           | PK       | 44.4              | 31.6               | 6.6          | 33.7         | -                   | 48.9               | 73.9              | 25.0           |             |
| Vert     | 7386.000           | PK       | 42.6              | 36.1               | 8.7          | 33.6         | -                   | 53.8               | 73.9              | 20.1           | Floor noise |
| Vert     | 1499.998           | AV       | 52.5              | 26.0               | 4.5          | 35.0         | -                   | 48.0               | 53.9              | 5.9            |             |
| Vert     | 2299.920           | AV       | 40.5              | 27.6               | 5.0          | 34.4         | -                   | 38.7               | 53.9              | 15.2           |             |
| Vert     | 2483.500           | AV       | 48.5              | 27.5               | 5.1          | 34.4         | -                   | 46.7               | 53.9              | 7.2            |             |
| Vert     | 2690.000           | AV       | 42.5              | 28.3               | 5.2          | 34.4         | -                   | 41.6               | 53.9              | 12.3           |             |
| Vert     | 4924.000           | AV       | 33.6              | 31.6               | 6.6          | 33.7         | -                   | 38.1               | 53.9              | 15.8           |             |
| Vert     | 7386.000           | AV       | 32.1              | 36.1               | 7.8          | 33.6         | -                   | 42.4               | 53.9              | 11.5           | 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  $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori     | 2462.000           | PK       | 92.5              | 27.3                    | 5.1          | 34.4         | 90.5               | -                 | -              | Carrier |
| Hori     | 9848.000           | PK       | 37.4              | 38.6                    | 8.6          | 34.0         | 50.6               | 70.5              | 19.9           |         |
| Vert     | 2462.000           | PK       | 93.1              | 27.3                    | 5.1          | 34.4         | 91.1               | -                 | -              | Carrier |
| Vert     | 9848.000           | PK       | 39.0              | 38.6                    | 8.6          | 34.0         | 52.2               | 71.1              | 18.9           |         |

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

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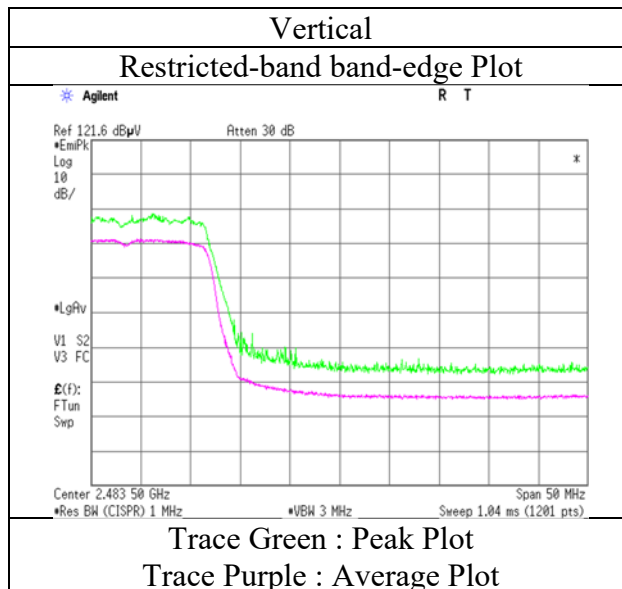
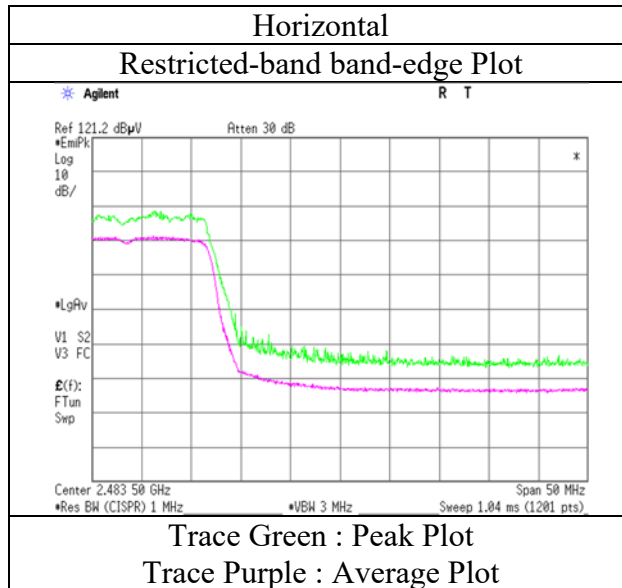
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## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                     |
|------------------------|---------------------|
| Report No.             | 12069761H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | July 18, 2018       |
| Temperature / Humidity | 23 deg. C / 49 % RH |
| Engineer               | Takumi Shimada      |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11g 2462 MHz     |



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

## Radiated Spurious Emission

Report No. 12069761H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date July 18, 2018  
Temperature / Humidity 23 deg. C / 49 % RH  
Engineer Junki Nagatomi  
(1 GHz - 10 GHz)  
Mode Tx 11n-20 2412 MHz

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|--------|
| Hori     | 2390.000           | PK       | 57.8              | 27.7               | 5.0          | 34.4         | -                   | 56.1               | 73.9              | 17.8           |        |
| Hori     | 2390.000           | AV       | 45.3              | 27.7               | 5.0          | 34.4         | -                   | 43.6               | 53.9              | 10.3           |        |
| Vert     | 2390.000           | PK       | 58.0              | 27.7               | 5.0          | 34.4         | -                   | 56.3               | 73.9              | 17.6           |        |
| Vert     | 2390.000           | AV       | 47.2              | 27.7               | 5.0          | 34.4         | -                   | 45.5               | 53.9              | 8.4            |        |

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 (3.75 m / 3.0 m) = 1.94 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

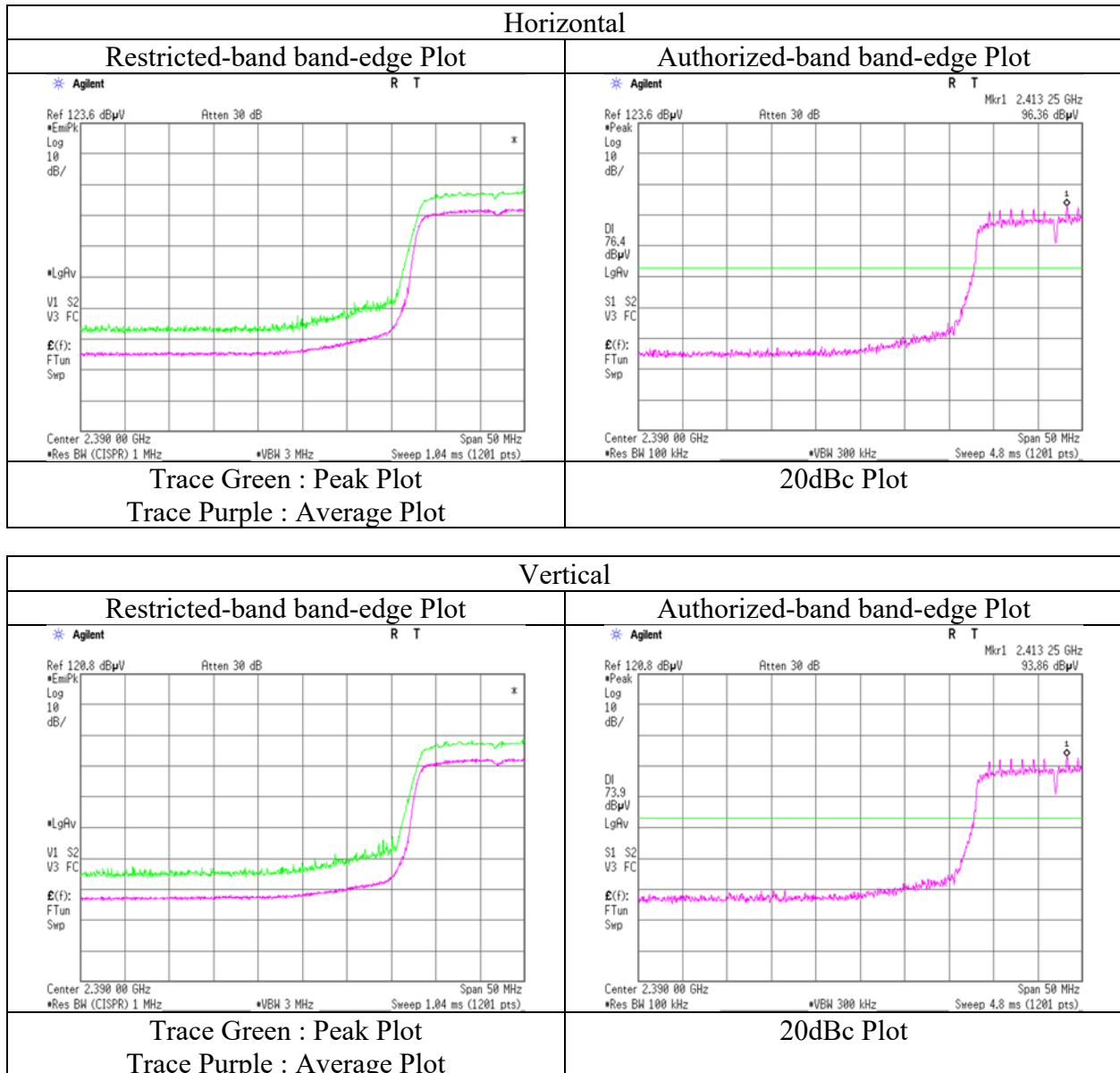
### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori     | 2412.000           | PK       | 96.4              | 27.6                    | 5.0          | 34.4         | 94.6               | -                 | -              | Carrier |
| Hori     | 2400.000           | PK       | 56.0              | 27.8                    | 5.0          | 34.4         | 54.4               | 74.6              | 20.2           |         |
| Vert     | 2412.000           | PK       | 93.9              | 27.6                    | 5.0          | 34.4         | 92.1               | -                 | -              | Carrier |
| Vert     | 2400.000           | PK       | 55.3              | 27.8                    | 5.0          | 34.4         | 53.7               | 72.1              | 18.4           |         |

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

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

|                        |                     |
|------------------------|---------------------|
| Report No.             | 12069761H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | July 18, 2018       |
| Temperature / Humidity | 23 deg. C / 49 % RH |
| Engineer               | Takumi Shimada      |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11n-20 2412 MHz  |



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

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## Radiated Spurious Emission

Report No. 12069761H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date July 18, 2018  
Temperature / Humidity 23 deg. C / 49 % RH  
Engineer Takumi Shimada  
(1 GHz - 10 GHz)  
Mode Tx 11n-20 2462 MHz

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|--------|
| Hori     | 2483.500           | PK       | 66.3              | 27.5               | 5.1          | 34.4         | -                   | 64.5               | 73.9              | 9.4            |        |
| Hori     | 2483.500           | AV       | 45.1              | 27.5               | 5.1          | 34.4         | -                   | 43.3               | 53.9              | 10.6           |        |
| Vert     | 2483.500           | PK       | 66.3              | 27.5               | 5.1          | 34.4         | -                   | 64.5               | 73.9              | 9.4            |        |
| Vert     | 2483.500           | AV       | 48.3              | 27.5               | 5.1          | 34.4         | -                   | 46.5               | 53.9              | 7.4            |        |

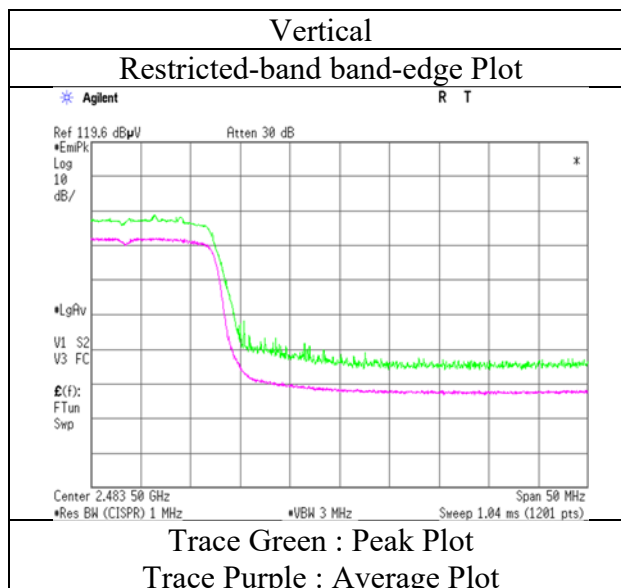
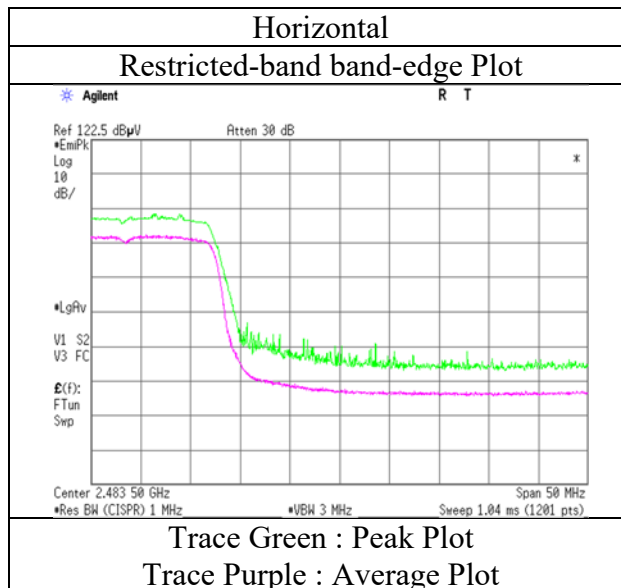
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

Distance factor: 1 GHz - 10 GHz  $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$   
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)

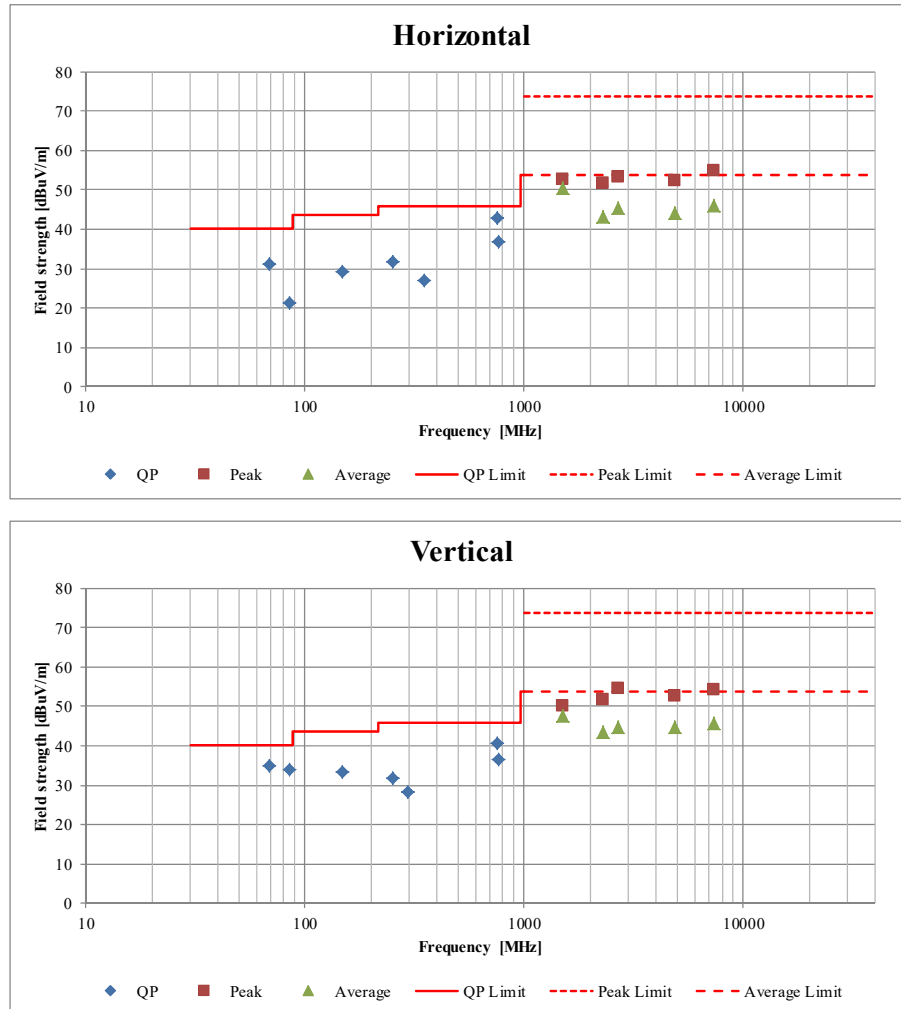
|                        |                     |
|------------------------|---------------------|
| Report No.             | 12069761H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | July 18, 2018       |
| Temperature / Humidity | 23 deg. C / 49 % RH |
| Engineer               | Takumi Shimada      |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11n-20 2462 MHz  |



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

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

|                        |                     |                     |                     |
|------------------------|---------------------|---------------------|---------------------|
| Report No.             | 12069761H           | No.2                | No.2                |
| Test place             | Ise EMC Lab.        | July 18, 2018       | July 18, 2018       |
| Semi Anechoic Chamber  | No.2                | 23 deg. C / 49 % RH | 23 deg. C / 61 % RH |
| Date                   | July 18, 2018       | Junki Nagatomi      | Junki Nagatomi      |
| Temperature / Humidity | 23 deg. C / 49 % RH | Takumi Shimada      | (Below 1 GHz)       |
| Engineer               | Junki Nagatomi      | (1 GHz - 10 GHz)    | (10 GHz - 26.5 GHz) |
| Mode                   | Tx 11g 2437 MHz     |                     |                     |



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

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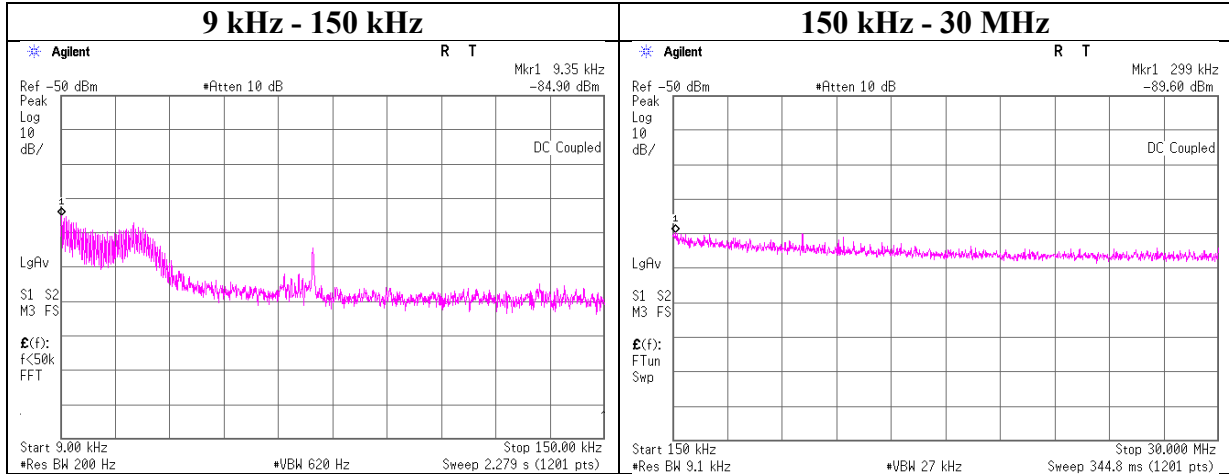
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## Conducted Spurious Emission

|                        |                                 |
|------------------------|---------------------------------|
| Report No.             | 12069761H                       |
| Test place             | Ise EMC Lab. No.6 Shielded Room |
| Date                   | July 12, 2018                   |
| Temperature / Humidity | 25.5 deg. C / 57 % RH           |
| Engineer               | Tomoki Matsui                   |
| Mode                   | Tx 11g 2437 MHz                 |



| Frequency<br>[kHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Attenuator<br>Loss<br>[dB] | Antenna<br>Gain<br>[dBi] | N<br>(Number<br>of Output) | EIRP<br>[dBm] | Distance<br>[m] | Ground<br>bounce<br>[dB] | E<br>(field strength)<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|--------------------|------------------|-----------------------|----------------------------|--------------------------|----------------------------|---------------|-----------------|--------------------------|-----------------------------------|-------------------|----------------|--------|
| 9.35               | -84.9            | 0.10                  | 9.9                        | 4.08                     | 1                          | -70.8         | 300             | 6.0                      | -9.6                              | 48.1              | 57.7           |        |
| 299.00             | -89.6            | 0.10                  | 9.9                        | 4.08                     | 1                          | -75.5         | 300             | 6.0                      | -14.3                             | 18.0              | 32.3           |        |

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

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

N: Number of output

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### Power Density

Report No. 12069761H  
Test place Ise EMC Lab. No.6 Shielded Room  
Date July 12, 2018  
Temperature / Humidity 25.5 deg. C / 57 % RH  
Engineer Tomoki Matsui  
Mode Tx

#### 11b

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>[dBm] | Limit<br>[dBm] | Margin<br>[dB] |
|----------------|------------------|-----------------------|------------------------|-----------------|----------------|----------------|
| 2412.00        | -8.69            | 1.43                  | 10.04                  | 2.78            | 8.00           | 5.22           |
| 2437.00        | -8.24            | 1.43                  | 10.04                  | 3.23            | 8.00           | 4.77           |
| 2462.00        | -8.49            | 1.44                  | 10.04                  | 2.99            | 8.00           | 5.01           |

#### 11g

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>[dBm] | Limit<br>[dBm] | Margin<br>[dB] |
|----------------|------------------|-----------------------|------------------------|-----------------|----------------|----------------|
| 2412.00        | -27.61           | 1.43                  | 10.04                  | -16.14          | 8.00           | 24.14          |
| 2437.00        | -27.89           | 1.43                  | 10.04                  | -16.42          | 8.00           | 24.42          |
| 2462.00        | -27.16           | 1.44                  | 10.04                  | -15.68          | 8.00           | 23.68          |

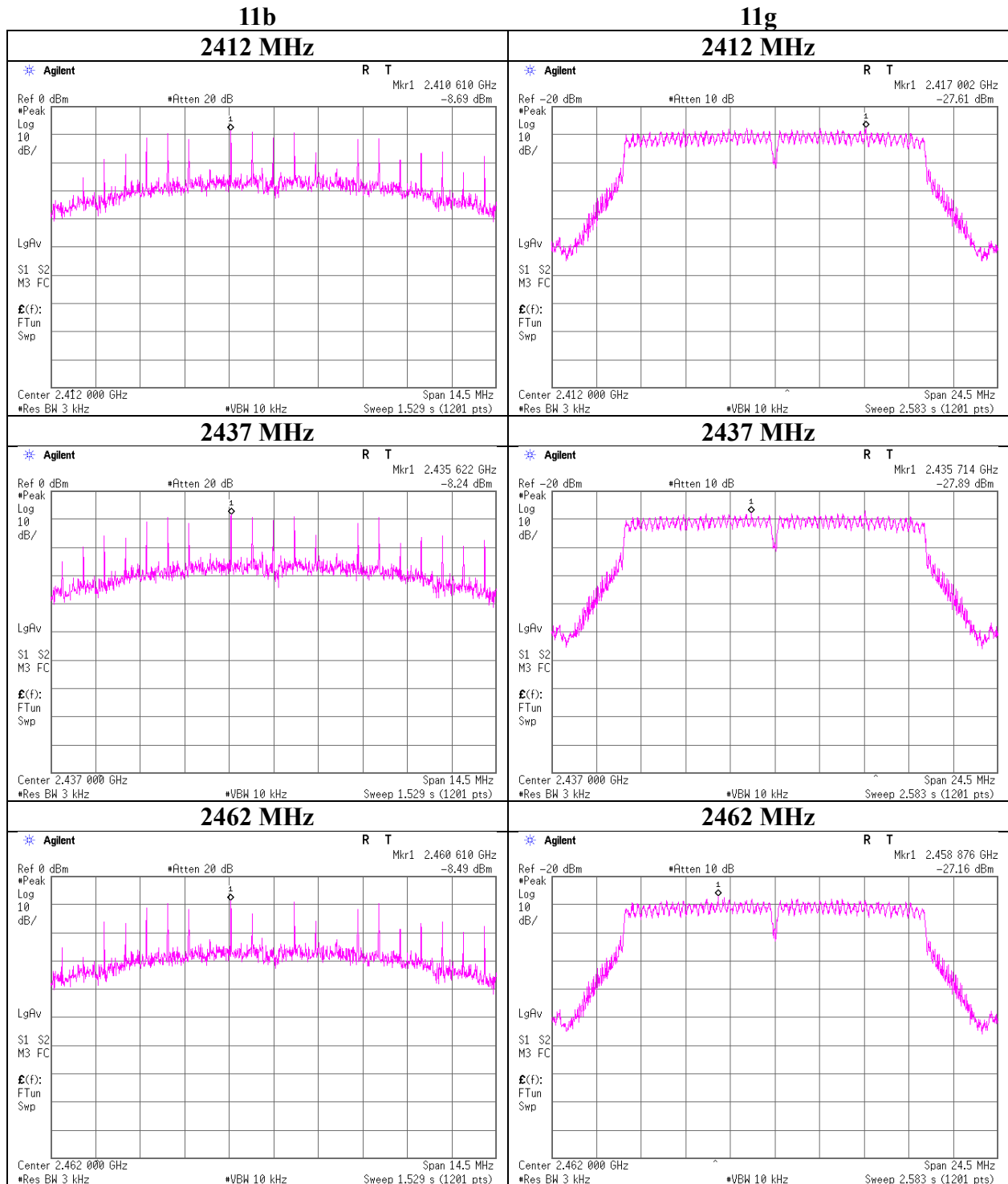
#### 11n-20

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>[dBm] | Limit<br>[dBm] | Margin<br>[dB] |
|----------------|------------------|-----------------------|------------------------|-----------------|----------------|----------------|
| 2412.00        | -28.49           | 1.43                  | 10.04                  | -17.02          | 8.00           | 25.02          |
| 2437.00        | -26.49           | 1.43                  | 10.04                  | -15.02          | 8.00           | 23.02          |
| 2462.00        | -26.76           | 1.44                  | 10.04                  | -15.28          | 8.00           | 23.28          |

Sample Calculation:

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

## Power Density



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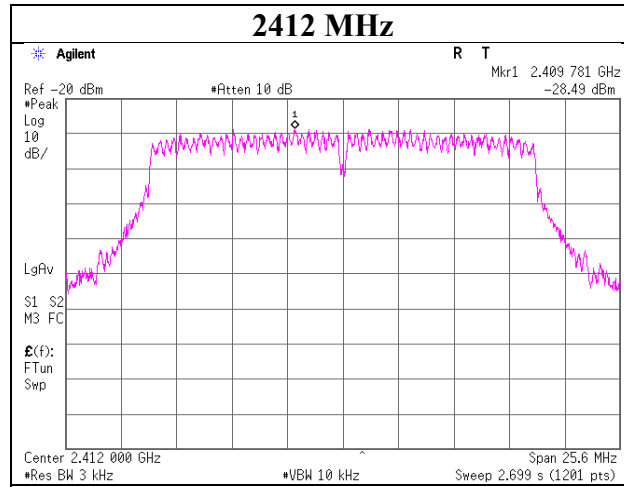
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

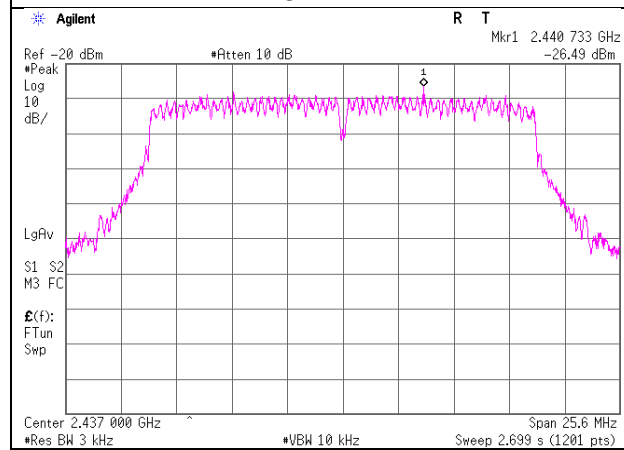
## Power Density

11n-20

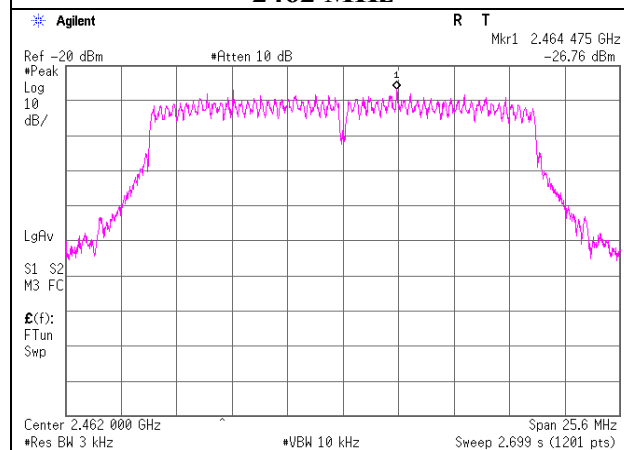
2412 MHz



2437 MHz



2462 MHz



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## APPENDIX 2: Test instruments

### Test Instruments

| Test Item | LIMS ID | Description                      | Manufacturer      | Model                    | Serial                        | Last Calibration Date | Calibration Due Date | Cal Int |
|-----------|---------|----------------------------------|-------------------|--------------------------|-------------------------------|-----------------------|----------------------|---------|
| AT        | 141809  | Power Meter                      | ANRITSU           | ML2495A                  | 825002                        | 5/21/2018             | 5/31/2019            | 12      |
| AT        | 141830  | Power sensor                     | ANRITSU           | MA2411B                  | 738285                        | 5/21/2018             | 5/31/2019            | 12      |
| AT        | 160318  | REGULATED DC POWER SUPPLY        | TEXIO             | PW16-2ATP                | GJR810407                     | -                     | -                    | -       |
| AT        | 141156  | Attenuator(10dB)                 | Weinschel Corp    | 2                        | BL1173                        | 11/14/2017            | 11/30/2018           | 12      |
| AT        | 141547  | DIGITAL HiTESTER                 | HIOKI             | 3805                     | 60500120                      | 2/7/2018              | 2/28/2019            | 12      |
| AT        | 90289   | Thermo-Hygrometer                | CUSTOM            | CTH-201                  | 5                             | 1/24/2018             | 1/31/2019            | 12      |
| AT        | 141903  | Spectrum Analyzer                | AGILENT           | E4440A                   | MY46186390                    | 9/20/2017             | 9/30/2018            | 12      |
| AT        | 141269  | Attenuator(10dB) 1-18GHz         | Orient Microwave  | BX10-0476-00             | -                             | 3/12/2018             | 3/31/2019            | 12      |
| AT        | 141328  | Microwave Cable 1G-40GHz         | Suhner            | SUCOFLEX102              | 28636/2                       | 4/24/2018             | 4/30/2019            | 12      |
| RE        | 141232  | High Pass Filter 3.5-18.0GHz     | UL Japan          | HPF SELECTOR             | 001                           | 9/22/2017             | 9/30/2018            | 12      |
| RE        | 141152  | EMI measurement program          | TSJ               | TEPTO-DV                 | -                             | -                     | -                    | -       |
| RE        | 141542  | Digital Tester                   | Fluke Corporation | FLUKE 26-3               | 78030611                      | 8/7/2017              | 8/31/2018            | 12      |
| RE        | 141579  | Pre Amplifier                    | AGILENT           | 8449B                    | 3008A02142                    | 1/23/2018             | 1/31/2019            | 12      |
| RE        | 141392  | Microwave Cable                  | Junkosha          | MWX221                   | 1604S253(1 m) / 1608S087(5 m) | 8/4/2017              | 8/31/2018            | 12      |
| RE        | 141512  | Horn Antenna 1-18GHz             | Schwarzbeck       | BBHA9120D                | 254                           | 6/6/2018              | 6/30/2019            | 12      |
| RE        | 141884  | Spectrum Analyzer                | AGILENT           | E4448A                   | MY44020357                    | 11/7/2017             | 11/30/2018           | 12      |
| RE        | 142182  | Measure                          | KOMELON           | KMC-36                   | -                             | -                     | -                    | -       |
| RE        | 142004  | AC2_Semi Anechoic Chamber(NSA)   | TDK               | Semi Anechoic Chamber 3m | DA-06902                      | -                     | 8/31/2018            | 12      |
| RE        | 141556  | Thermo-Hygrometer                | CUSTOM            | CTH-201                  | 0003                          | 12/21/2017            | 12/31/2018           | 12      |
| RE        | 148898  | Attenuator                       | KEYSIGHT          | 8491A                    | MY52462282                    | 10/12/2017            | 10/31/2018           | 12      |
| RE        | 141503  | Horn Antenna 18-26.5GHz          | EMCO              | Sep-60                   | 1265                          | 6/6/2018              | 6/30/2019            | 12      |
| RE        | 141267  | Logperiodic Antenna(200-1000MHz) | Schwarzbeck       | VUSLP9111B               | 911B-192                      | 6/1/2018              | 6/30/2019            | 12      |
| RE        | 141425  | Biconical Antenna                | Schwarzbeck       | BBA9106                  | 1302                          | 6/1/2018              | 6/30/2019            | 12      |
| RE        | 141397  | Coaxial Cable                    | UL Japan          | -                        | -                             | 6/13/2018             | 6/30/2019            | 12      |
| RE        | 142227  | Measure                          | KOMELON           | KMC-36                   | -                             | -                     | -                    | -       |
| RE        | 141562  | Thermo-Hygrometer                | CUSTOM            | CTH-180                  | 1501                          | 1/24/2018             | 1/31/2019            | 12      |
| RE        | 142011  | AC4_Semi Anechoic Chamber(NSA)   | TDK               | Semi Anechoic Chamber 3m | DA-10005                      | 6/28/2018             | 6/30/2020            | 24      |
| RE        | 141152  | EMI measurement program          | TSJ               | TEPTO-DV                 | -                             | -                     | -                    | -       |
| RE        | 141951  | EMI Test Receiver                | Rohde & Schwarz   | ESR26                    | 101408                        | 1/30/2018             | 1/31/2019            | 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

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