



# RADIO TEST REPORT

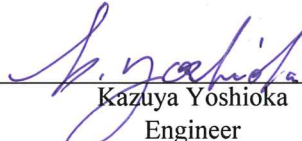
**Test Report No. : 11201777H-A**

**Applicant** : KEYENCE CORPORATION  
**Type of Equipment** : Handheld Mobile Computer  
**Model No.** : BT-W100GA  
**FCC ID** : RF41395C  
**Test regulation** : FCC Part 15 Subpart C: 2016  
\* WLAN part  
**Test Result** : Complied

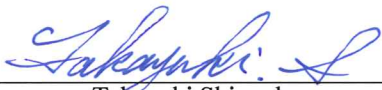
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**Date of test:** April 11 to May 12, 2016

**Representative test engineer:**

  
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13-EM-F0429



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**Radio Specification**

Radio Type : Transceiver  
Power Supply (inner) : DC 1.8 V / DC 3.3 V

|                        | IEEE802.11b *1)             | IEEE802.11g/n (20 M band) *1)       | IEEE802.11a/n (20 M band)                                                                                       | IEEE802.11n (40 M band)                                                                   |
|------------------------|-----------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Frequency of operation | 2412 MHz - 2462 MHz         | 2412 MHz - 2462 MHz                 | 5180 MHz - 5240 MHz<br>5280 MHz - 5320 MHz<br>5500 MHz - 5580 MHz<br>5660 MHz - 5700 MHz<br>5745 MHz - 5825 MHz | 5190 MHz - 5230 MHz<br>5310 MHz<br>5510 MHz - 5550 MHz<br>5670 MHz<br>5755 MHz - 5795 MHz |
| Type of modulation     | DSSS (CCK, DQPSK, DBPSK)    | OFDM-CCK (64QAM, 16QAM, QPSK, BPSK) | OFDM (64QAM, 16QAM, QPSK, BPSK)                                                                                 |                                                                                           |
| Channel spacing        | 5MHz                        |                                     | 20MHz                                                                                                           | 40MHz                                                                                     |
| Antenna type           | Multilayer Monopole Antenna |                                     |                                                                                                                 |                                                                                           |
| Antenna Connector type | Soldering                   |                                     |                                                                                                                 |                                                                                           |
| Antenna Gain           | 2.1 dBi (2.4 GHz)           |                                     | 2.4 dBi (5 GHz)                                                                                                 |                                                                                           |

|                        | Bluetooth Ver.2.1 with EDR function |
|------------------------|-------------------------------------|
| Frequency of operation | 2402 MHz - 2480 MHz                 |
| Type of modulation     | FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK) |
| Channel spacing        | 1 MHz                               |
| Antenna type           | Multilayer Monopole Antenna         |
| Antenna Connector type | Soldering                           |
| Antenna Gain           | 2.1 dBi                             |

\*1) This test report applies to WLAN (2.4 GHz band) part.  
\*Wireless LAN and Bluetooth do not transmit simultaneously.

**Variant model**

This model has a variant model: BT-W155GA.

BT-W100GA is a Laser-type handy scanner. BT-W155GA is a Camera-type handy scanner.

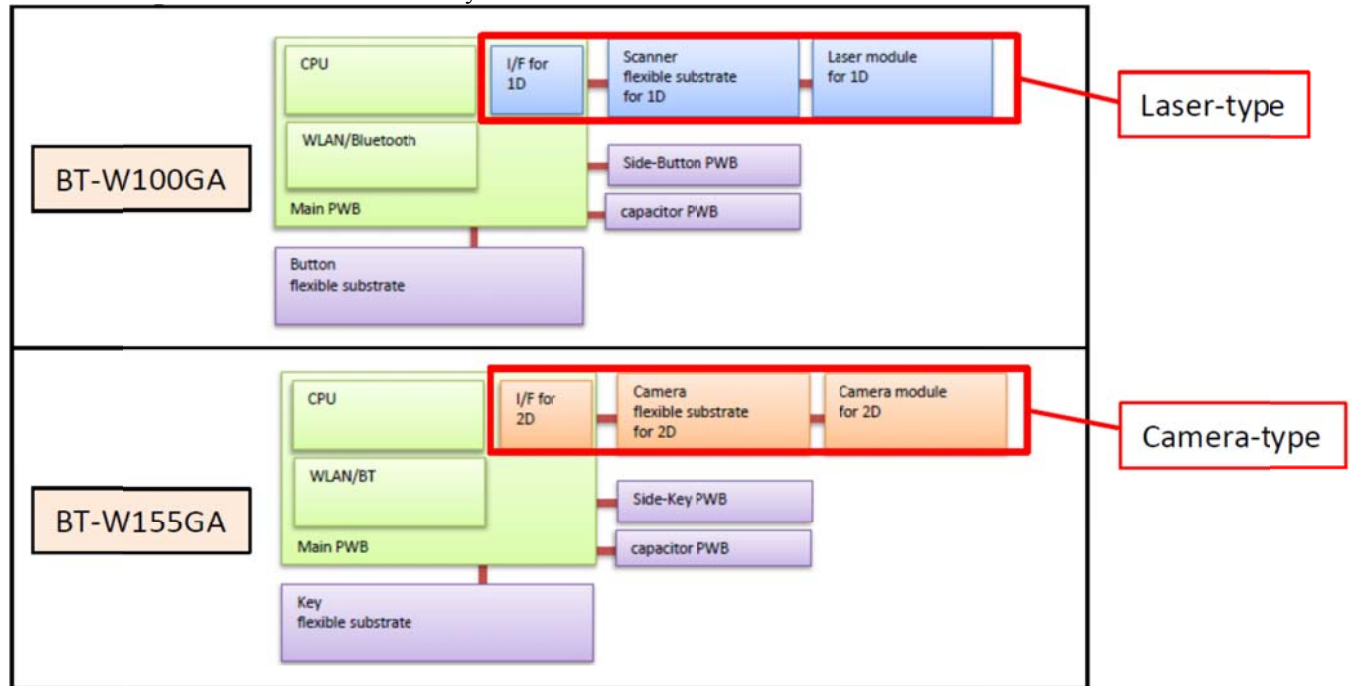
The schematic differences between BT-W100GA and BT-W155GA are the following diagrams.

Circuit design related with WLAN/Bluetooth is same between 2 models.

These difference cause no influence to radio specification.

There was no degradation of EMC characteristic.

Therefore we can consider them electrically identical.



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

### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C  
FCC part 15 final revised on April 6, 2016.

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

### **3.2 Procedures and results**

| Item                                       | Test Procedure                                                                | Specification                                                                    | Worst margin                                                   | Results  | Remarks                                                           |
|--------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------|----------|-------------------------------------------------------------------|
| 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                                  | QP<br>20.4 dB, 0.66000 MHz, L<br>AV<br>16.1 dB, 0.66000 MHz, N | Complied | -                                                                 |
| 6dB Bandwidth                              | FCC: KDB 558074 D01 DTS Meas<br>Guidance v03r05<br>-----<br>IC: -             | FCC: Section<br>15.247(a)(2)<br>-----<br>IC: RSS-247 5.2(1)                      | See data.                                                      | Complied | Conducted                                                         |
| Maximum Peak<br>Output Power               | FCC: KDB 558074 D01 DTS Meas<br>Guidance v03r05<br>-----<br>IC: RSS-Gen 6.12  | FCC: Section<br>15.247(b)(3)<br>-----<br>IC: RSS-247 5.4(4)                      |                                                                | Complied | Conducted                                                         |
| Power Density                              | FCC: KDB 558074 D01 DTS Meas<br>Guidance v03r05<br>-----<br>IC: -             | FCC: Section 15.247(e)<br>-----<br>IC: RSS-247 5.2(2)                            |                                                                | Complied | Conducted                                                         |
| Spurious Emission<br>Restricted Band Edges | FCC: KDB 558074 D01 DTS Meas<br>Guidance v03r05<br>-----<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 | 1.1 dB<br>4874.000 MHz, AV,<br>Horizontal                      | Complied | Conducted<br>(below 30 MHz)/<br>Radiated<br>(above 30 MHz)<br>*1) |

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

\*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v03r05 12.2.7.

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

#### **FCC Part 15.31 (e)**

The test was performed with the New Battery (DC 4.2 V) and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. 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          | -       | 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  $k = 2$ .

| Antenna terminal test Uncertainty (+/-) |             |                                      |               |                |                    |                   |               |
|-----------------------------------------|-------------|--------------------------------------|---------------|----------------|--------------------|-------------------|---------------|
| Power meter                             |             | Conducted emission and Power density |               |                | Conducted emission |                   | Channel power |
| Below 1 GHz                             | Above 1 GHz | Below 1 GHz                          | 1 GHz - 3 GHz | 3 GHz - 18 GHz | 18 GHz - 26.5 GHz  | 26.5 GHz - 40 GHz |               |
| 0.9 dB                                  | 1.0 dB      | 1.4 dB                               | 1.7 dB        | 2.8 dB         | 2.8 dB             | 2.9 dB            | 2.6 dB        |

| Frequency range | Conducted emission using AMN(LISN) (+dB) |
|-----------------|------------------------------------------|
| 0.009 – 0.15MHz | 3.5 dB                                   |
| 0.15 – 30MHz    | 2.9 dB                                   |

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

| Radiated emission |           |               |               |              |
|-------------------|-----------|---------------|---------------|--------------|
| (3 m*)(+dB)       |           | (1 m*)(+dB)   | (0.5 m*)(+dB) | (10 m*)(+dB) |
| 1 – 6GHz          | 6 – 18GHz | 10 – 26.5 GHz | 26.5 – 40GHz  | 1 -18 GHz    |
| 5.1 dB            | 5.3 dB    | 5.1 dB        | 5.1 dB        | 5.3 dB       |

\*Measurement distance

#### Conducted Emission test

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

#### 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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| Test site                  | IC Registration Number | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms            | Maximum measurement distance |
|----------------------------|------------------------|----------------------------|------------------------------------------------------------------|------------------------|------------------------------|
| No.1 semi-anechoic chamber | 2973C-1                | 19.2 x 11.2 x 7.7          | 7.0 x 6.0                                                        | No.1 Power source room | 10 m                         |
| No.2 semi-anechoic chamber | 2973C-2                | 7.5 x 5.8 x 5.2            | 4.0 x 4.0                                                        | -                      | 3 m                          |
| No.3 semi-anechoic chamber | 2973C-3                | 12.0 x 8.5 x 5.9           | 6.8 x 5.75                                                       | No.3 Preparation room  | 3 m                          |
| No.3 shielded room         | -                      | 4.0 x 6.0 x 2.7            | N/A                                                              | -                      | -                            |
| No.4 semi-anechoic chamber | 2973C-4                | 12.0 x 8.5 x 5.9           | 6.8 x 5.75                                                       | No.4 Preparation room  | 3 m                          |
| No.4 shielded room         | -                      | 4.0 x 6.0 x 2.7            | N/A                                                              | -                      | -                            |
| No.5 semi-anechoic chamber | -                      | 6.0 x 6.0 x 3.9            | 6.0 x 6.0                                                        | -                      | -                            |
| No.6 shielded room         | -                      | 4.0 x 4.5 x 2.7            | 4.0 x 4.5                                                        | -                      | -                            |
| No.6 measurement room      | -                      | 4.75 x 5.4 x 3.0           | 4.75 x 4.15                                                      | -                      | -                            |
| No.7 shielded room         | -                      | 4.7 x 7.5 x 2.7            | 4.7 x 7.5                                                        | -                      | -                            |
| No.8 measurement room      | -                      | 3.1 x 5.0 x 2.7            | N/A                                                              | -                      | -                            |
| No.9 measurement room      | -                      | 8.8 x 4.6 x 2.8            | 2.4 x 2.4                                                        | -                      | -                            |
| No.11 measurement room     | -                      | 6.2 x 4.7 x 3.0            | 4.8 x 4.6                                                        | -                      | -                            |

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

Refer to APPENDIX.

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

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

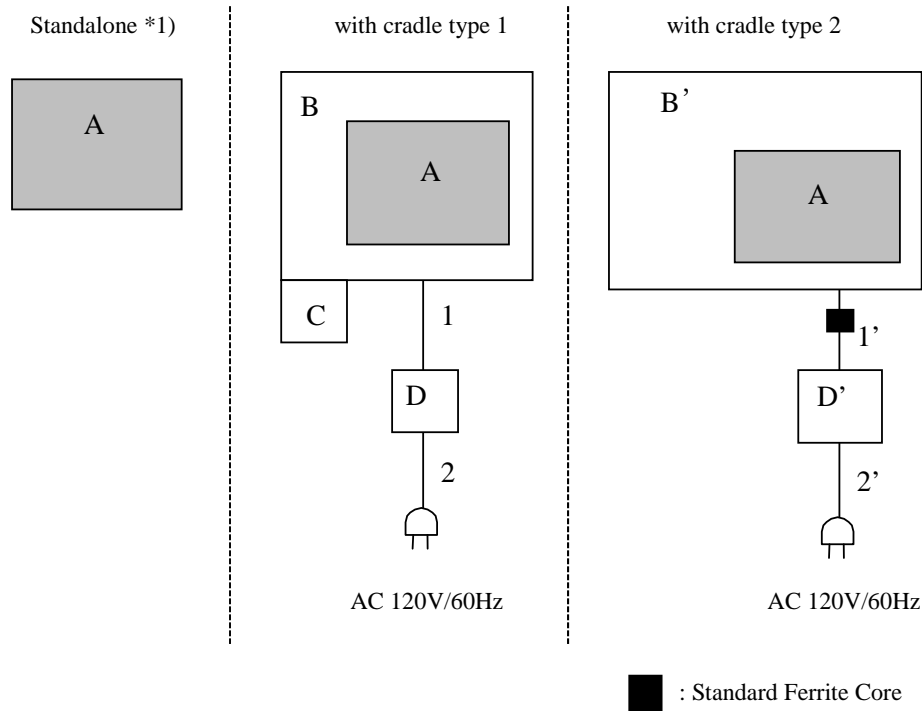
Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

| <b>Mode</b>                                                                                                                                                                                                                                                                                                                                              | <b>Remarks*</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| IEEE 802.11b (11b)                                                                                                                                                                                                                                                                                                                                       | 2 Mbps, PN9     |
| IEEE 802.11g (11g)                                                                                                                                                                                                                                                                                                                                       | 24 Mbps, PN9    |
| IEEE 802.11n SISO 20 MHz BW (11n-20)                                                                                                                                                                                                                                                                                                                     | MCS 1, PN9      |
| *Transmitting duty was 100 % on all tests.<br>*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)                                                                                                                                                                                                    |                 |
| *Power of the EUT was set by the software as follows;<br>Power settings: 11b 12 dBm, 11g/n-20 13 dBm<br>Software: calibrateG<br><br>*This setting of software is the worst case.<br>Any conditions under the normal use do not exceed the condition of setting.<br>In addition, end users cannot change the settings of the output power of the product. |                 |

\*The details of Operating mode(s)

| <b>Test Item</b>                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Operating Mode</b>         | <b>Tested frequency</b>          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------|
| Conducted Emission,<br>Radiated Spurious Emission (Below 1 GHz),<br>Conducted Spurious Emission                                                                                                                                                                                                                                                                                                                                       | 11g Tx *1)                    | 2462 MHz                         |
| Radiated Spurious Emission (Above 1 GHz)                                                                                                                                                                                                                                                                                                                                                                                              | 11b Tx                        | 2412 MHz                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                       | 11g Tx *2)                    | 2437 MHz                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                       | 11n-20 Tx *3)                 | 2462 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) The mode was tested as a representative, because it had the highest power at antenna terminal test.<br>*2) 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 peak output power<br>*3) Only band edge test was tested on this mode, because the 11g Tx mode had the higher power at antenna terminal test. |                               |                                  |

## 4.2 Configuration and peripherals



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

### Description of EUT

| No. | Item                     | Model number | Serial number                  | Manufacturer              | Remarks |
|-----|--------------------------|--------------|--------------------------------|---------------------------|---------|
| A   | Handheld Mobile Computer | BT-W100GA    | #2A610011 *1)<br>#2A610012 *2) | KEYENCE CORPORATION       | EUT     |
| B   | Cradle                   | BT-WUC1U     | #2A610250                      | KEYENCE CORPORATION       | *3)     |
| B'  | Cradle                   | BT-WUC14     | -                              | KEYENCE CORPORATION       | -       |
| C   | USB Memory               | OP-87502     | -                              | KEYENCE CORPORATION       | -       |
| D   | AC Adaptor               | OP-88020     | -                              | KEYENCE CORPORATION       | -       |
| D'  | AC Adaptor               | SEE60N2-16-0 | ES057                          | Sanken Electric Co., Ltd. | -       |

\*1) Used for Antenna terminal conducted tests

\*2) Used for all tests except for Antenna terminal conducted tests

\*3) Used for Conducted emission test as a representative

### List of cables used

| No. | Name     | Length (m) | Shield     |            | Remarks |
|-----|----------|------------|------------|------------|---------|
|     |          |            | Cable      | Connector  |         |
| 1   | DC Cable | 1.8        | Unshielded | Unshielded | -       |
| 1'  | DC Cable | 1.3        | Unshielded | Unshielded | -       |
| 2   | AC Cable | 2.0        | Unshielded | Unshielded | -       |
| 2'  | AC Cable | 2.0        | Unshielded | Unshielded | -       |

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## **SECTION 5: Conducted Emission**

### **Test Procedure and conditions**

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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

#### For the tests on EUT with other peripherals (as a whole system)

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

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

**Detector** : QP and CISPR AV  
**Measurement range** : 0.15 MHz – 30 MHz  
**Test data** : APPENDIX  
**Test result** : Pass

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

### **Test Procedure**

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "558074 D01 DTS Meas Guidance v03r05".

[For below 1GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

### **Test Antennas are used as below;**

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

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

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

|                 |               |                                                           |                                                                                                                                 |                                                           |
|-----------------|---------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Frequency       | Below 1 GHz   | Above 1 GHz                                               |                                                                                                                                 | 20 dBc                                                    |
| Instrument used | Test Receiver | Spectrum Analyzer                                         |                                                                                                                                 | Spectrum Analyzer                                         |
| Detector        | QP            | PK                                                        | AV *3)                                                                                                                          | PK                                                        |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz                                  | Average Power Method:<br><u>12.2.5.1</u><br>RBW: 1 MHz<br>VBW: 3 MHz<br>Detector:<br>Power Averaging (RMS)<br>Trace: 100 traces | RBW: 100 kHz<br>VBW: 300kHz                               |
| Test Distance   | 3m            | 4.5 m *1) (1 GHz - 10GHz),<br>1 m *2) (10 GHz - 26.5 GHz) |                                                                                                                                 | 4.5 m *1) (1 GHz - 10GHz),<br>1 m *2) (10 GHz - 26.5 GHz) |

\*1) Distance Factor:  $20 \times \log(4.5 \text{ m} / 3.0 \text{ m}) = 3.5 \text{ dB}$

\*2) Distance Factor:  $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

\*3) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r05"

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- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT, EUT on the cradle Type1 and Type2 to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

**Measurement range** : 30 M - 40 GHz  
**Test data** : APPENDIX  
**Test result** : Pass

## **SECTION 7: Antenna Terminal Conducted Tests**

### **Test Procedure**

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

| <b>Test</b>                     | <b>Span</b>                             | <b>RBW</b>      | <b>VBW</b>         | <b>Sweep time</b> | <b>Detector</b>  | <b>Trace</b> | <b>Instrument used</b>          |
|---------------------------------|-----------------------------------------|-----------------|--------------------|-------------------|------------------|--------------|---------------------------------|
| 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.  
\*2) Reference data  
\*3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v03r05".  
\*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart. (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.

**Test data** : **APPENDIX**  
**Test result** : **Pass**

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**APPENDIX 1: Test data**

**Conducted Emission**

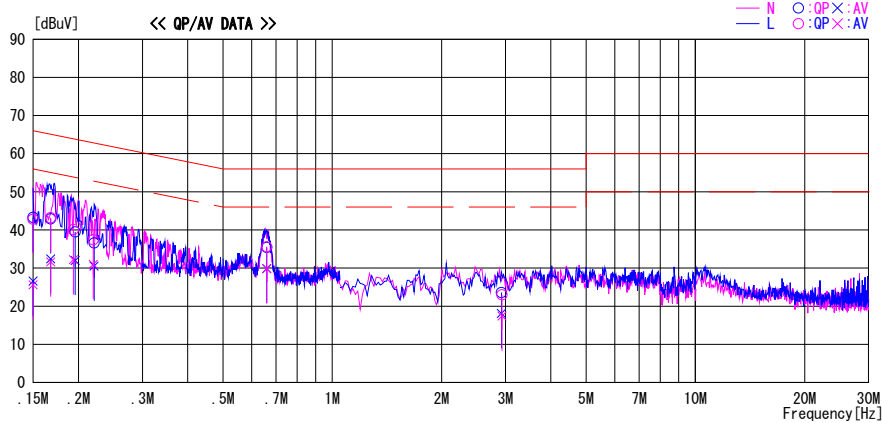
**DATA OF CONDUCTED EMISSION TEST**

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber  
Date : 04/15/2016

Report No. : 11201777H  
Temp./Humi. : 23deg. C / 43% RH  
Engineer : Hiroyuki Furutaka

Mode / Remarks : WLAN 11g 24Mbps 2462MHz

LIMIT : FCC15.207 QP  
FCC15.207 AV



| Frequency<br>[MHz] | Reading Level |              | Corr.<br>Factor<br>[dB] | Results      |              | Limit        |              | Margin     |            | Phase | Comment |
|--------------------|---------------|--------------|-------------------------|--------------|--------------|--------------|--------------|------------|------------|-------|---------|
|                    | QP<br>[dBuV]  | AV<br>[dBuV] |                         | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dB] | AV<br>[dB] |       |         |
| 0.15000            | 30.1          | 13.4         | 13.2                    | 43.3         | 26.6         | 66.0         | 56.0         | 22.7       | 29.4       | N     |         |
| 0.15000            | 29.6          | 12.4         | 13.2                    | 42.8         | 25.6         | 66.0         | 56.0         | 23.2       | 30.4       | L     |         |
| 0.16764            | 30.0          | 18.4         | 13.2                    | 43.2         | 31.6         | 65.1         | 55.1         | 21.9       | 23.5       | L     |         |
| 0.16765            | 29.7          | 19.2         | 13.2                    | 42.9         | 32.4         | 65.1         | 55.1         | 22.2       | 22.7       | N     |         |
| 0.19370            | 26.9          | 19.0         | 13.2                    | 40.1         | 32.2         | 63.9         | 53.9         | 23.8       | 21.7       | L     |         |
| 0.19585            | 26.3          | 18.8         | 13.2                    | 39.5         | 32.0         | 63.8         | 53.8         | 24.3       | 21.8       | N     |         |
| 0.21967            | 24.1          | 17.7         | 13.3                    | 37.4         | 31.0         | 62.8         | 52.8         | 25.4       | 21.8       | L     |         |
| 0.22086            | 23.3          | 17.2         | 13.3                    | 36.6         | 30.5         | 62.8         | 52.8         | 26.2       | 22.3       | N     |         |
| 0.66000            | 22.0          | 16.5         | 13.4                    | 35.4         | 29.9         | 56.0         | 46.0         | 20.6       | 16.1       | N     |         |
| 0.66000            | 22.2          | 16.4         | 13.4                    | 35.6         | 29.8         | 56.0         | 46.0         | 20.4       | 16.2       | L     |         |
| 2.92323            | 9.8           | 4.3          | 13.8                    | 23.6         | 18.1         | 56.0         | 46.0         | 32.4       | 27.9       | N     |         |
| 2.93420            | 9.2           | 3.6          | 13.8                    | 23.0         | 17.4         | 56.0         | 46.0         | 33.0       | 28.6       | L     |         |

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

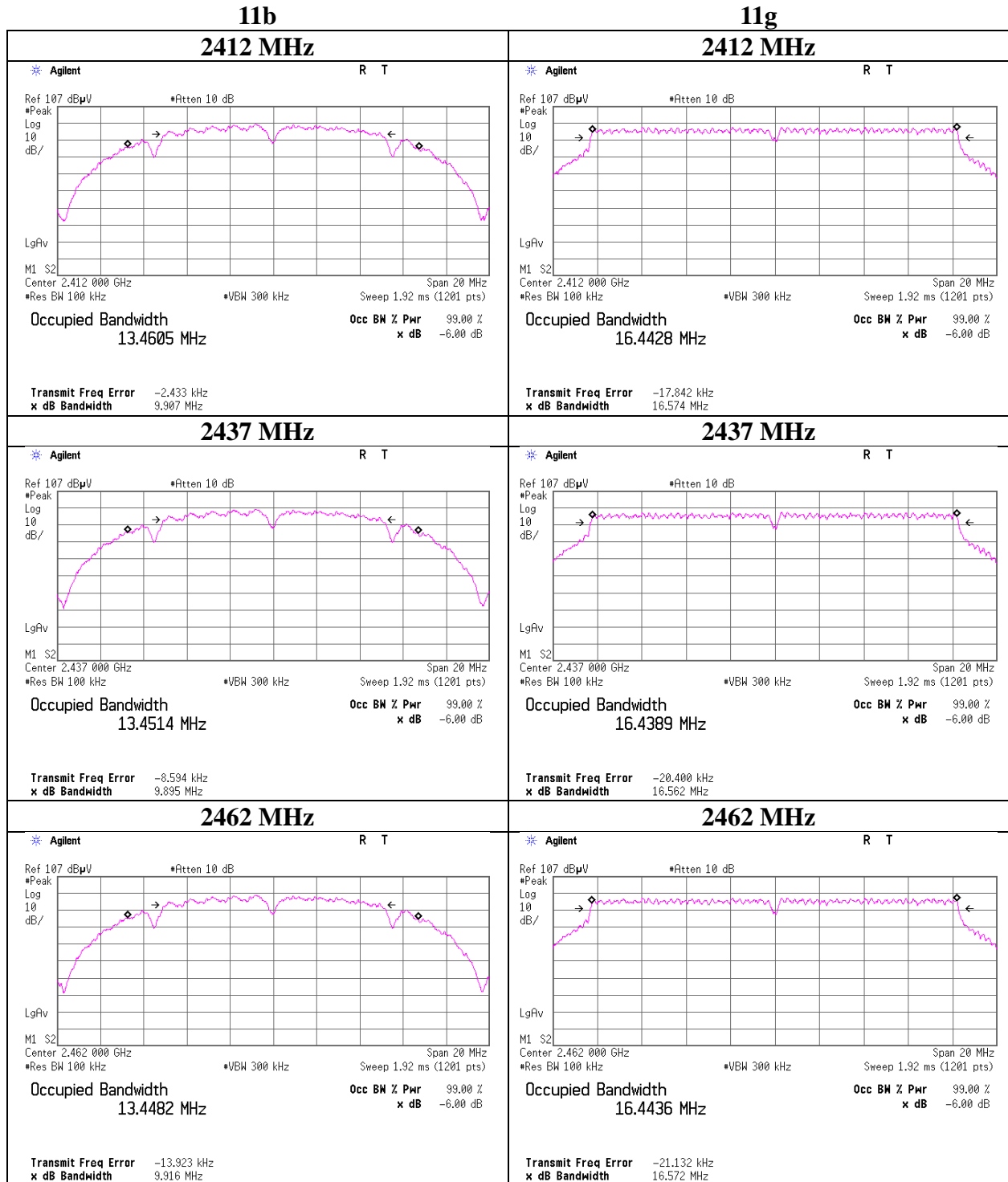


### 6dB Bandwidth

Test place Ise EMC Lab. No.6 Measurement Room  
Report No. 11201777H  
Date April 14, 2016  
Temperature / Humidity 26 deg. C / 51 % RH  
Engineer Masafumi Niwa  
Mode Tx

| Mode   | Frequency<br>[MHz] | 6dB Bandwidth<br>[MHz] | Limit<br>[kHz] |
|--------|--------------------|------------------------|----------------|
| 11b    | 2412               | 9.907                  | > 500          |
|        | 2437               | 9.895                  | > 500          |
|        | 2462               | 9.916                  | > 500          |
| 11g    | 2412               | 16.574                 | > 500          |
|        | 2437               | 16.562                 | > 500          |
|        | 2462               | 16.572                 | > 500          |
| 11n-20 | 2412               | 17.821                 | > 500          |
|        | 2437               | 17.821                 | > 500          |
|        | 2462               | 17.814                 | > 500          |

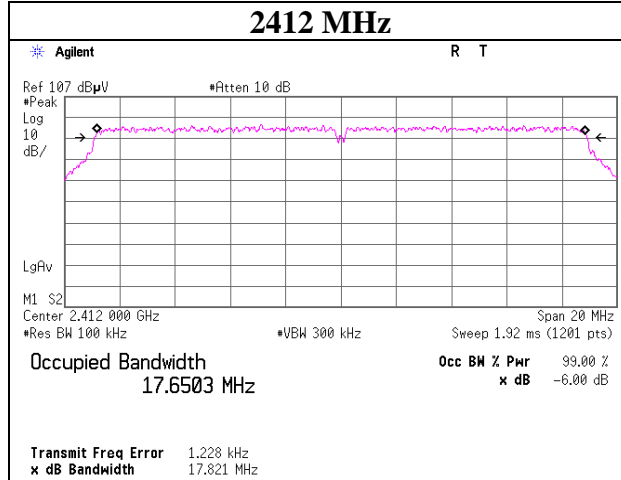
**6dB Bandwidth**



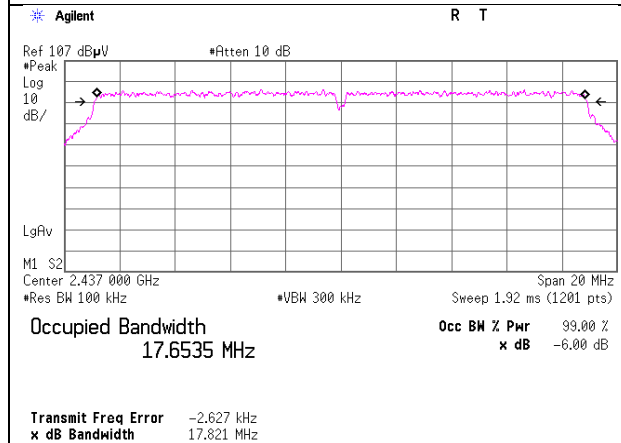
## 6dB Bandwidth

**11n-20**

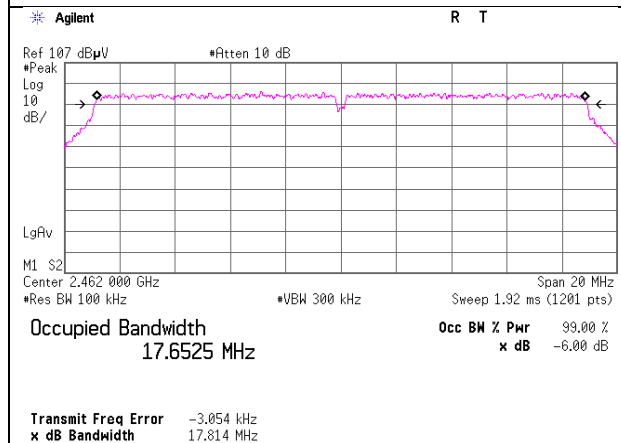
**2412 MHz**



**2437 MHz**



**2462 MHz**



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### Maximum Peak Output Power

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Report No.             | 11201777H                          |
| Date                   | April 12, 2016                     |
| Temperature / Humidity | 24 deg. C / 31 % RH                |
| Engineer               | Masafumi Niwa                      |
| Mode                   | Tx 11b                             |

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result |       | Limit |      | Margin<br>[dB] |
|----------------|------------------|-----------------------|------------------------|--------|-------|-------|------|----------------|
|                |                  |                       |                        | [dBm]  | [mW]  | [dBm] | [mW] |                |
| 2412           | 1.91             | 1.89                  | 10.03                  | 13.83  | 24.15 | 30.00 | 1000 | 16.17          |
| 2437           | 2.01             | 1.91                  | 10.03                  | 13.95  | 24.83 | 30.00 | 1000 | 16.05          |
| 2462           | 1.84             | 1.91                  | 10.03                  | 13.78  | 23.88 | 30.00 | 1000 | 16.22          |

Sample Calculation:

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

2437MHz

| Rate   | Reading | Remark |
|--------|---------|--------|
| [Mbps] | [dBm]   |        |
| 1      | 1.82    |        |
| 2      | 1.88    | *      |
| 5.5    | 1.26    |        |
| 11     | 1.87    |        |

\*: Worst Rate

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

### Maximum Peak Output Power

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Report No.             | 11201777H                          |
| Date                   | April 12, 2016                     |
| Temperature / Humidity | 24 deg. C / 31 % RH                |
| Engineer               | Masafumi Niwa                      |
| Mode                   | Tx 11g                             |

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result |        | Limit |      | Margin<br>[dB] |
|----------------|------------------|-----------------------|------------------------|--------|--------|-------|------|----------------|
|                |                  |                       |                        | [dBm]  | [mW]   | [dBm] | [mW] |                |
| 2412           | 9.78             | 1.89                  | 10.03                  | 21.70  | 147.91 | 30.00 | 1000 | 8.30           |
| 2437           | 9.75             | 1.91                  | 10.03                  | 21.69  | 147.57 | 30.00 | 1000 | 8.31           |
| 2462           | 9.98             | 1.91                  | 10.03                  | 21.92  | 155.60 | 30.00 | 1000 | 8.08           |

Sample Calculation:

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

2437 MHz

| Rate<br>[Mbps] | Reading<br>[dBm] | Remark |
|----------------|------------------|--------|
| 6              | 9.01             |        |
| 9              | 8.77             |        |
| 12             | 9.08             |        |
| 18             | 9.04             |        |
| 24             | 9.79             | *      |
| 36             | 9.35             |        |
| 48             | 9.14             |        |
| 54             | 9.41             |        |

\*: Worst Rate

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

### Maximum Peak Output Power

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Report No.             | 11201777H                          |
| Date                   | April 12, 2016                     |
| Temperature / Humidity | 24 deg. C / 31 % RH                |
| Engineer               | Masafumi Niwa                      |
| Mode                   | Tx 11n-20                          |

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result |        | Limit |      | Margin<br>[dB] |
|----------------|------------------|-----------------------|------------------------|--------|--------|-------|------|----------------|
|                |                  |                       |                        | [dBm]  | [mW]   | [dBm] | [mW] |                |
| 2412           | 8.65             | 1.89                  | 10.03                  | 20.57  | 114.02 | 30.00 | 1000 | 9.43           |
| 2437           | 8.47             | 1.91                  | 10.03                  | 20.41  | 109.90 | 30.00 | 1000 | 9.59           |
| 2462           | 8.54             | 1.91                  | 10.03                  | 20.48  | 111.69 | 30.00 | 1000 | 9.52           |

Sample Calculation:

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

2437 MHz

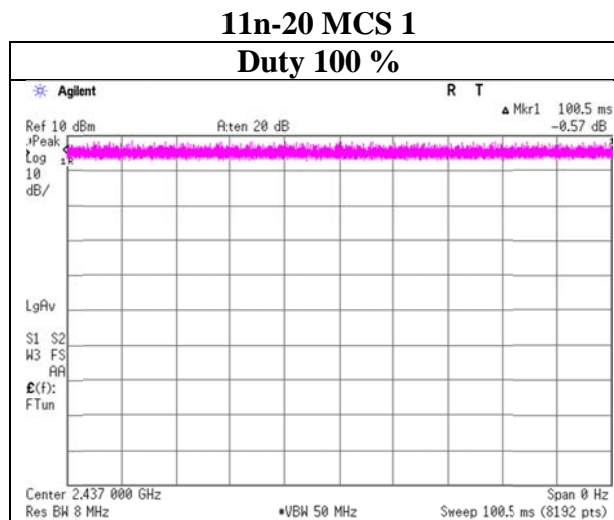
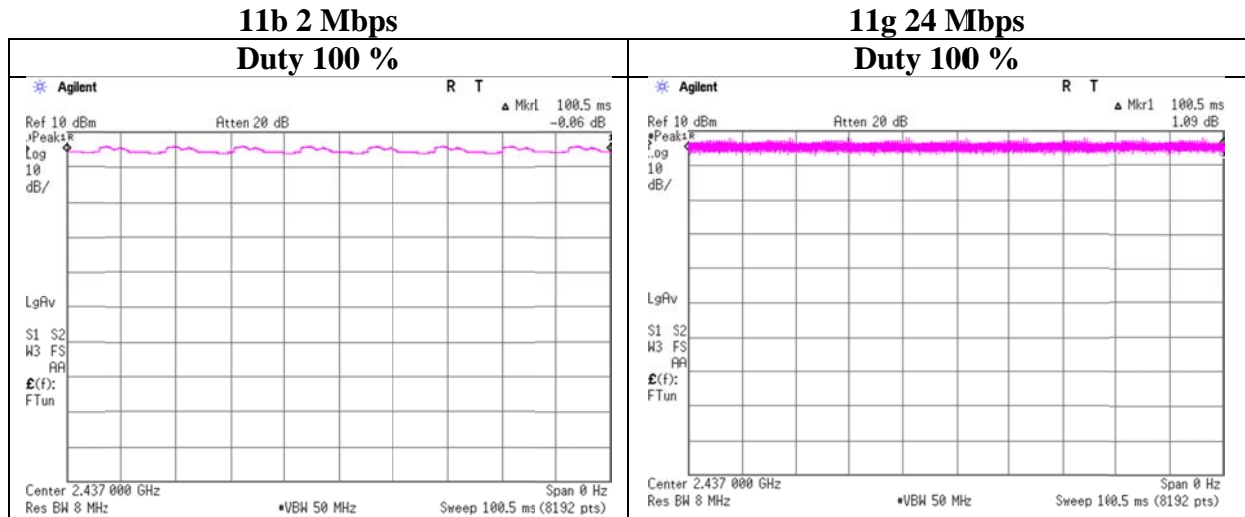
| MCS<br>Number | Reading<br>[dBm] | Remark |
|---------------|------------------|--------|
| 0             | 8.52             |        |
| 1             | 8.53             | *      |
| 2             | 8.45             |        |
| 3             | 8.44             |        |
| 4             | 8.46             |        |
| 5             | 8.42             |        |
| 6             | 8.52             |        |
| 7             | 8.46             |        |

\* Worst MCS

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

### Burst rate confirmation

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Report No.             | 11201777H                          |
| Date                   | April 14, 2016                     |
| Temperature / Humidity | 26 deg. C / 51 % RH                |
| Engineer               | Masafumi Niwa                      |
| Mode                   | Tx                                 |



## Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 11201777H  
Date : April 11, 2016      April 20, 2016      April 25, 2016  
Temperature / Humidity : 23 deg. C / 35 % RH      20deg. C / 33 % RH      25deg. C / 43 % RH  
Engineer : Kazuya Yoshioka      Tomoki Matsui      Takafumi Noguchi  
              (1 GHz - 10 GHz)      (10 GHz - 18 GHz)      (18 GHz - 26.5 GHz)  
Mode : Tx 11b 2412 MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|-------------|
| Hori     | 2390.000        | PK       | 41.5           | 27.9            | 6.8       | 32.1      | 44.1            | 73.9           | 29.8        |             |
| Hori     | 4824.000        | PK       | 44.8           | 32.9            | 9.2       | 31.3      | 55.6            | 73.9           | 18.3        |             |
| Hori     | 7236.000        | PK       | 40.4           | 36.8            | 10.4      | 32.6      | 55.0            | 73.9           | 18.9        | Floor noise |
| Hori     | 9648.000        | PK       | 41.0           | 38.1            | 9.7       | 32.6      | 56.2            | 73.9           | 17.7        | Floor noise |
| Hori     | 2390.000        | AV       | 33.9           | 27.9            | 6.8       | 32.1      | 36.5            | 53.9           | 17.4        |             |
| Hori     | 4824.000        | AV       | 38.6           | 32.9            | 9.2       | 31.3      | 49.4            | 53.9           | 4.5         |             |
| Hori     | 7236.000        | AV       | 30.2           | 36.8            | 10.4      | 32.6      | 44.8            | 53.9           | 9.1         | Floor noise |
| Hori     | 9648.000        | AV       | 31.0           | 38.1            | 9.7       | 32.6      | 46.2            | 53.9           | 7.7         | Floor noise |
| Vert     | 2390.000        | PK       | 41.0           | 27.9            | 6.8       | 32.1      | 43.6            | 73.9           | 30.3        |             |
| Vert     | 4824.000        | PK       | 43.7           | 32.9            | 9.2       | 31.3      | 54.5            | 73.9           | 19.4        |             |
| Vert     | 7236.000        | PK       | 40.6           | 36.8            | 10.4      | 32.6      | 55.2            | 73.9           | 18.7        | Floor noise |
| Vert     | 9648.000        | PK       | 41.3           | 38.1            | 9.7       | 32.6      | 56.5            | 73.9           | 17.4        | Floor noise |
| Vert     | 2390.000        | AV       | 31.3           | 27.9            | 6.8       | 32.1      | 33.9            | 53.9           | 20.0        |             |
| Vert     | 4824.000        | AV       | 39.0           | 32.9            | 9.2       | 31.3      | 49.8            | 53.9           | 4.1         |             |
| Vert     | 7236.000        | AV       | 30.2           | 36.8            | 10.4      | 32.6      | 44.8            | 53.9           | 9.1         | Floor noise |
| Vert     | 9648.000        | AV       | 31.0           | 38.1            | 9.7       | 32.6      | 46.2            | 53.9           | 7.7         | Floor noise |

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

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

Distance factor:      1 GHz - 10 GHz      20log (4.5m / 3.0 m) = 3.53 dB  
                              10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

### 20dBc Data Sheet

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark  |
|----------|-----------------|----------|----------------|-------------------|-----------|-----------|-----------------|----------------|-------------|---------|
| Hori     | 2412.000        | PK       | 87.0           | 26.9              | 6.7       | 32.7      | 87.9            | -              | -           | Carrier |
| Hori     | 2400.000        | PK       | 46.1           | 26.9              | 6.7       | 32.7      | 47.0            | 67.9           | 20.9        |         |
| Vert     | 2412.000        | PK       | 84.2           | 26.9              | 6.7       | 32.7      | 85.1            | -              | -           | Carrier |
| Vert     | 2400.000        | PK       | 47.6           | 26.9              | 6.7       | 32.7      | 48.5            | 65.1           | 16.6        |         |

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

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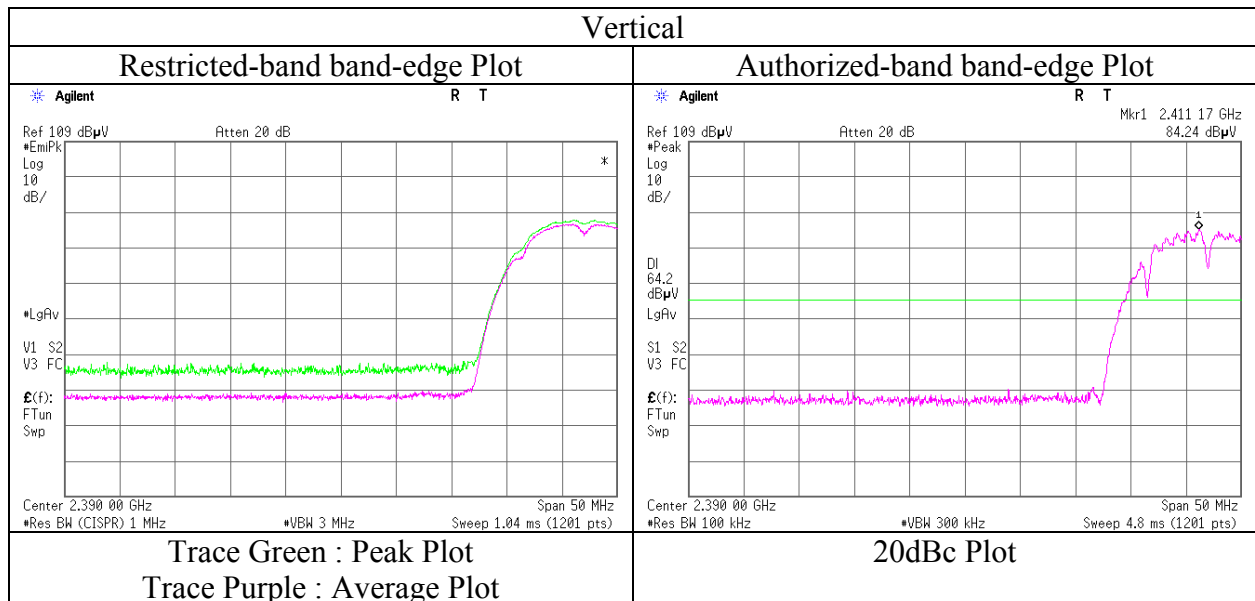
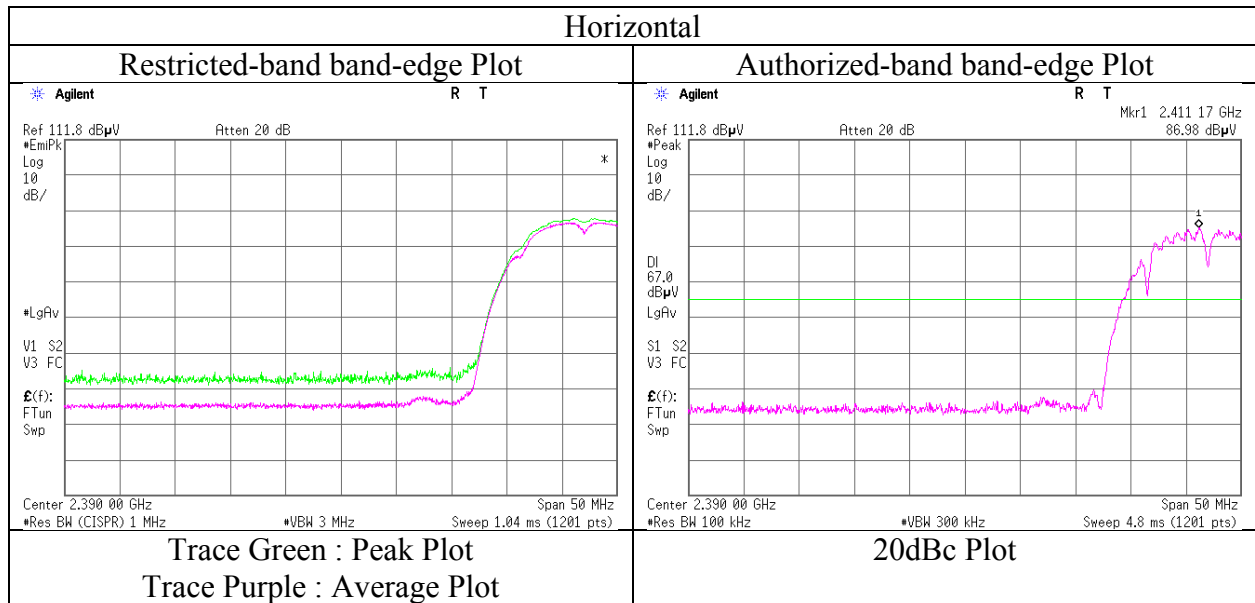
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Facsimile : +81 596 24 8124



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

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 11201777H  
Date : April 11, 2016  
Temperature / Humidity : 23 deg. C / 35 % RH  
Engineer : Kazuya Yoshioka  
Mode : Tx 11b 2412 MHz



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

**UL Japan, Inc.**

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Facsimile : +81 596 24 8124

## Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 11201777H  
Date : April 11, 2016                      April 20, 2016                      April 25, 2016  
Temperature / Humidity : 23 deg. C / 35 % RH      20deg. C / 33 % RH      25deg. C / 43 % RH  
Engineer : Kazuya Yoshioka              Tomoki Matsui              Takafumi Noguchi  
                  (1 GHz - 10 GHz)              (10 GHz - 18 GHz)              (18 GHz - 26.5 GHz)  
Mode : Tx 11b 2437 MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|-------------|
| Hori     | 4874.000        | PK       | 46.3           | 33.1            | 9.2       | 31.3      | 57.3            | 73.9           | 16.6        |             |
| Hori     | 7311.000        | PK       | 39.4           | 36.8            | 10.4      | 32.6      | 54.0            | 73.9           | 19.9        | Floor noise |
| Hori     | 9748.000        | PK       | 40.6           | 38.2            | 9.7       | 32.7      | 55.8            | 73.9           | 18.1        | Floor noise |
| Hori     | 4874.000        | AV       | 41.8           | 33.1            | 9.2       | 31.3      | 52.8            | 53.9           | 1.1         |             |
| Hori     | 7311.000        | AV       | 31.9           | 36.8            | 10.4      | 32.6      | 46.5            | 53.9           | 7.4         | Floor noise |
| Hori     | 9748.000        | AV       | 32.6           | 38.2            | 9.7       | 32.7      | 47.8            | 53.9           | 6.1         | Floor noise |
| Vert     | 4874.000        | PK       | 45.6           | 33.1            | 9.2       | 31.3      | 56.6            | 73.9           | 17.3        |             |
| Vert     | 7311.000        | PK       | 39.8           | 36.8            | 10.4      | 32.6      | 54.4            | 73.9           | 19.5        | Floor noise |
| Vert     | 9748.000        | PK       | 40.8           | 38.2            | 9.7       | 32.7      | 56.0            | 73.9           | 17.9        | Floor noise |
| Vert     | 4874.000        | AV       | 41.4           | 33.1            | 9.2       | 31.3      | 52.4            | 53.9           | 1.5         |             |
| Vert     | 7311.000        | AV       | 31.9           | 36.8            | 10.4      | 32.6      | 46.5            | 53.9           | 7.4         | Floor noise |
| Vert     | 9748.000        | AV       | 32.6           | 38.2            | 9.7       | 32.7      | 47.8            | 53.9           | 6.1         | Floor noise |

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

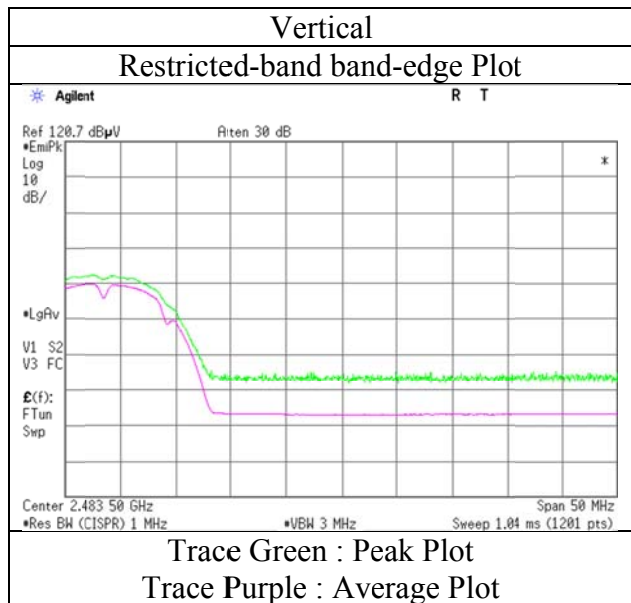
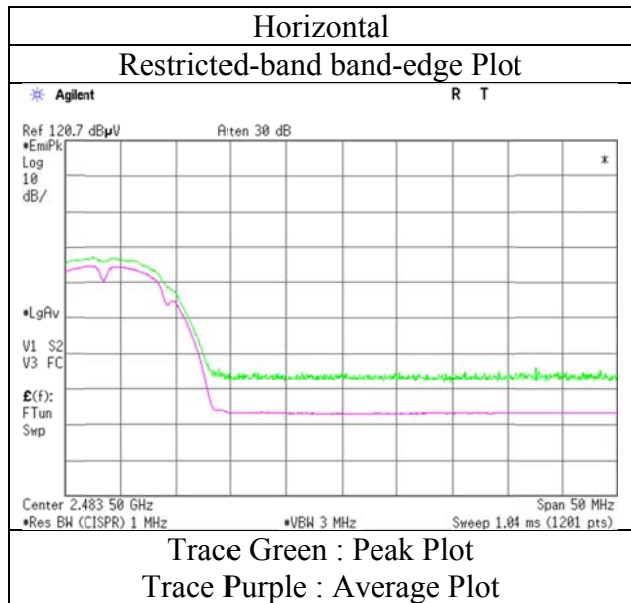
\*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor:      1 GHz - 10 GHz      20log (4.5m / 3.0 m) = 3.53 dB  
                                  10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB



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

|                        |                                         |
|------------------------|-----------------------------------------|
| Test place             | Ise EMC Lab. No.4 Semi Anechoic Chamber |
| Report No.             | 11201777H                               |
| Date                   | April 12, 2016                          |
| Temperature / Humidity | 20 deg. C / 40 % RH                     |
| Engineer               | Shinichi Miyazono                       |
| Mode                   | Tx 11b 2462 MHz                         |

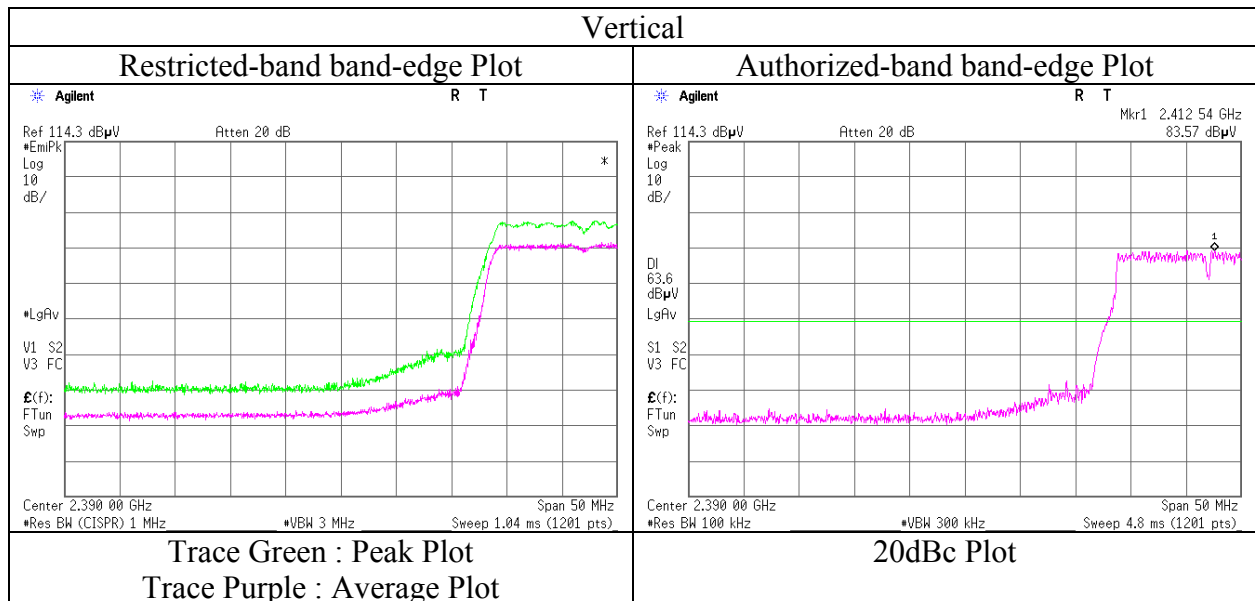
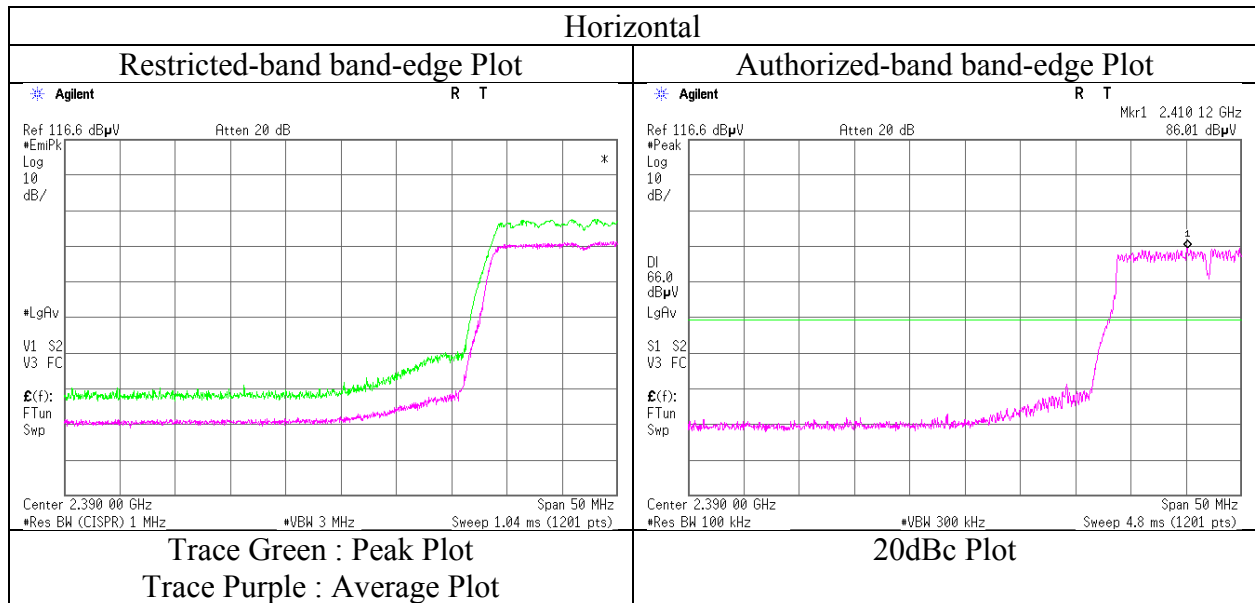


\* Final result of restricted band edge was shown in tabular data.



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

|                        |                                         |
|------------------------|-----------------------------------------|
| Test place             | Ise EMC Lab. No.4 Semi Anechoic Chamber |
| Report No.             | 11201777H                               |
| Date                   | April 12, 2016                          |
| Temperature / Humidity | 20 deg. C / 40 % RH                     |
| Engineer               | Kazuya Yoshioka                         |
| Mode                   | Tx 11g 2412 MHz                         |



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

**UL Japan, Inc.**

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Facsimile : +81 596 24 8124



## Radiated Spurious Emission

Test place Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. 11201777H  
Date April 12, 2016 April 20, 2016 April 22, 2016 April 25, 2016  
Temperature / Humidity 20 deg. C / 40 % RH 20deg. C / 33 % RH 22deg. C / 51 % RH 25deg. C / 43 % RH  
Engineer Kazuya Yoshioka Tomoki Matsui Kazuya Yoshioka Takafumi Noguchi  
(1 GHz - 10 GHz) (10 GHz - 18 GHz) (Below 1 GHz) (18 GHz - 26.5 GHz)  
Mode Tx 11g 2462 MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|-------------|
| Hori     | 76.559          | QP       | 36.9           | 6.4             | 7.8       | 32.1      | 19.0            | 40.0           | 21.0        |             |
| Hori     | 85.491          | QP       | 39.9           | 7.6             | 7.9       | 32.1      | 23.3            | 40.0           | 16.7        |             |
| Hori     | 142.490         | QP       | 35.2           | 14.6            | 8.6       | 32.0      | 26.4            | 43.5           | 17.1        |             |
| Hori     | 161.499         | QP       | 37.5           | 15.4            | 8.8       | 32.0      | 29.7            | 43.5           | 13.8        |             |
| Hori     | 180.511         | QP       | 35.8           | 16.1            | 8.9       | 32.0      | 28.8            | 43.5           | 14.7        |             |
| Hori     | 277.400         | QP       | 34.3           | 13.0            | 9.7       | 31.8      | 25.2            | 46.0           | 20.8        |             |
| Hori     | 2483.500        | PK       | 46.7           | 28.1            | 6.9       | 32.1      | 49.6            | 73.9           | 24.3        |             |
| Hori     | 4924.000        | PK       | 43.7           | 33.3            | 9.3       | 31.3      | 55.0            | 73.9           | 18.9        |             |
| Hori     | 7386.000        | PK       | 40.4           | 36.8            | 10.4      | 32.6      | 55.0            | 73.9           | 18.9        | Floor noise |
| Hori     | 9848.000        | PK       | 40.3           | 38.2            | 11.2      | 32.7      | 57.0            | 73.9           | 16.9        | Floor noise |
| Hori     | 2483.500        | AV       | 35.0           | 28.1            | 6.9       | 32.1      | 37.9            | 53.9           | 16.0        |             |
| Hori     | 4924.000        | AV       | 33.0           | 33.3            | 9.3       | 31.3      | 44.3            | 53.9           | 9.6         |             |
| Hori     | 7386.000        | AV       | 30.2           | 36.8            | 10.4      | 32.6      | 44.8            | 53.9           | 9.1         | Floor noise |
| Hori     | 9848.000        | AV       | 30.2           | 38.2            | 11.2      | 32.7      | 46.9            | 53.9           | 7.0         | Floor noise |
| Vert     | 77.517          | QP       | 48.6           | 6.5             | 7.8       | 32.1      | 30.8            | 40.0           | 9.2         |             |
| Vert     | 85.503          | QP       | 51.1           | 7.6             | 7.9       | 32.1      | 34.5            | 40.0           | 5.5         |             |
| Vert     | 142.506         | QP       | 41.3           | 14.6            | 8.6       | 32.0      | 32.5            | 43.5           | 11.0        |             |
| Vert     | 161.500         | QP       | 42.1           | 15.4            | 8.8       | 32.0      | 34.3            | 43.5           | 9.2         |             |
| Vert     | 180.475         | QP       | 40.1           | 16.1            | 8.9       | 32.0      | 33.1            | 43.5           | 10.4        |             |
| Vert     | 265.820         | QP       | 38.6           | 12.7            | 9.6       | 31.9      | 29.0            | 46.0           | 17.0        |             |
| Vert     | 2483.500        | PK       | 45.8           | 28.1            | 6.9       | 32.1      | 48.7            | 73.9           | 25.2        |             |
| Vert     | 4924.000        | PK       | 42.4           | 33.3            | 9.3       | 31.3      | 53.7            | 73.9           | 20.2        |             |
| Vert     | 7386.000        | PK       | 40.7           | 36.8            | 10.4      | 32.6      | 55.3            | 73.9           | 18.6        | Floor noise |
| Vert     | 9848.000        | PK       | 40.4           | 38.2            | 11.2      | 32.7      | 57.1            | 73.9           | 16.8        | Floor noise |
| Vert     | 2483.500        | AV       | 35.6           | 28.1            | 6.9       | 32.1      | 38.5            | 53.9           | 15.4        |             |
| Vert     | 4924.000        | AV       | 32.5           | 33.3            | 9.3       | 31.3      | 43.8            | 53.9           | 10.1        |             |
| Vert     | 7386.000        | AV       | 30.2           | 36.8            | 10.4      | 32.6      | 44.8            | 53.9           | 9.1         | Floor noise |
| Vert     | 9848.000        | AV       | 30.2           | 38.2            | 11.2      | 32.7      | 46.9            | 53.9           | 7.0         | Floor noise |

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

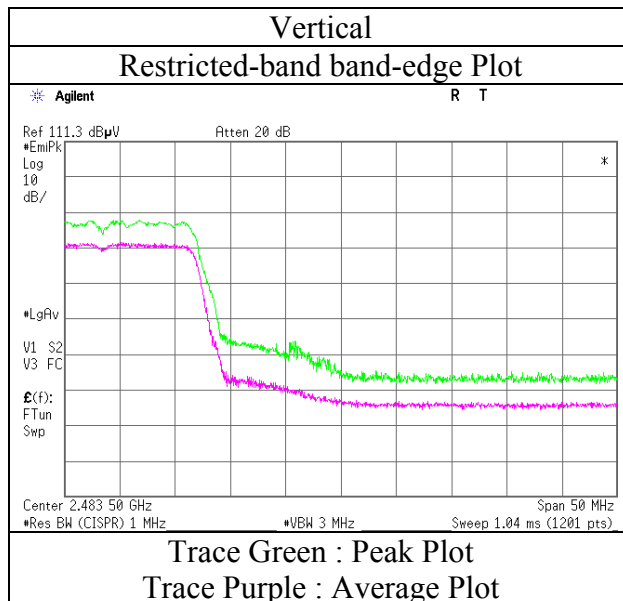
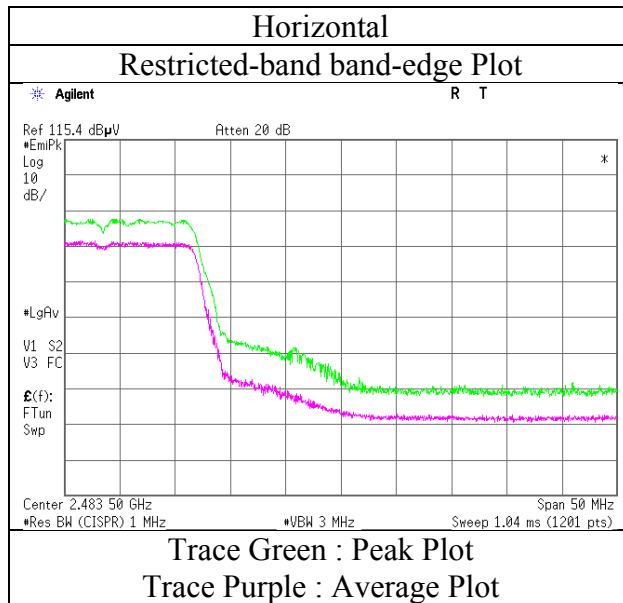
\*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (4.5m / 3.0 m) = 3.53 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB



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

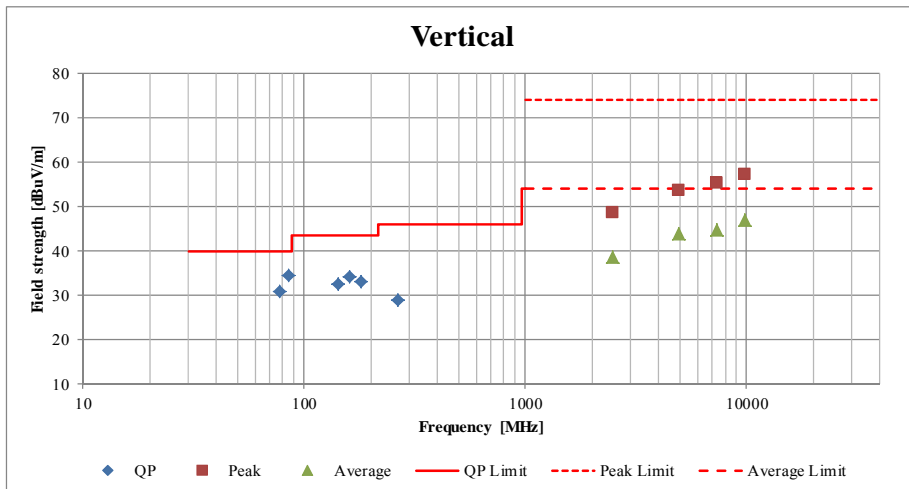
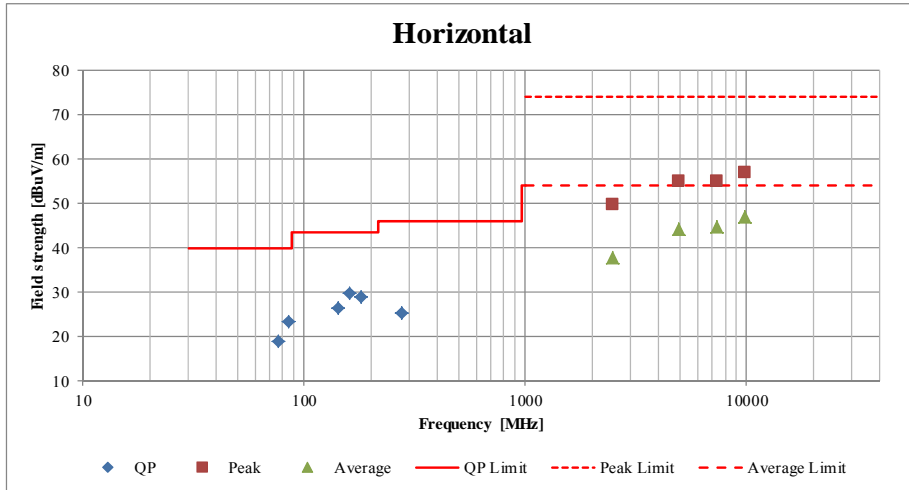
Test place Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. 11201777H  
Date April 12, 2016  
Temperature / Humidity 20 deg. C / 40 % RH  
Engineer Kazuya Yoshioka  
Mode Tx 11g 2462 MHz



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

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

|                        |                                         |                                    |                                  |                                         |
|------------------------|-----------------------------------------|------------------------------------|----------------------------------|-----------------------------------------|
| Test place             | Ise EMC Lab. No.4 Semi Anechoic Chamber |                                    |                                  |                                         |
| Report No.             | 11201777H                               |                                    |                                  |                                         |
| Date                   | April 12, 2016                          | April 20, 2016                     | April 22, 2016                   | April 25, 2016                          |
| Temperature / Humidity | 20 deg. C / 40 % RH                     | 20deg. C / 33 % RH                 | 22deg. C / 51 % RH               | 25deg. C / 43 % RH                      |
| Engineer               | Kazuya Yoshioka<br>(1 GHz - 10 GHz)     | Tomoki Matsui<br>(10 GHz - 18 GHz) | Kazuya Yoshioka<br>(Below 1 GHz) | Takafumi Noguchi<br>(18 GHz - 26.5 GHz) |
| Mode                   | Tx 11g 2462 MHz                         |                                    |                                  |                                         |



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

## Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 11201777H  
Date : April 12, 2016  
Temperature / Humidity : 20 deg. C / 40 % RH  
Engineer : Kazuya Yoshioka  
(1 GHz – 10 GHz)  
Mode : Tx 11n-20 2412 MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|--------|
| Hori     | 2390.000        | PK       | 48.0           | 27.9            | 6.8       | 32.1      | 50.6            | 73.9           | 23.3        |        |
| Hori     | 2390.000        | AV       | 34.0           | 27.9            | 6.8       | 32.1      | 36.6            | 53.9           | 17.3        |        |
| Vert     | 2390.000        | PK       | 47.0           | 27.9            | 6.8       | 32.1      | 49.6            | 73.9           | 24.3        |        |
| Vert     | 2390.000        | AV       | 35.2           | 27.9            | 6.8       | 32.1      | 37.8            | 53.9           | 16.1        |        |

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

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

Distance factor: 1 GHz - 10 GHz  $20\log(4.5\text{m} / 3.0\text{m}) = 3.53\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{m} / 3.0\text{m}) = -9.5\text{ dB}$

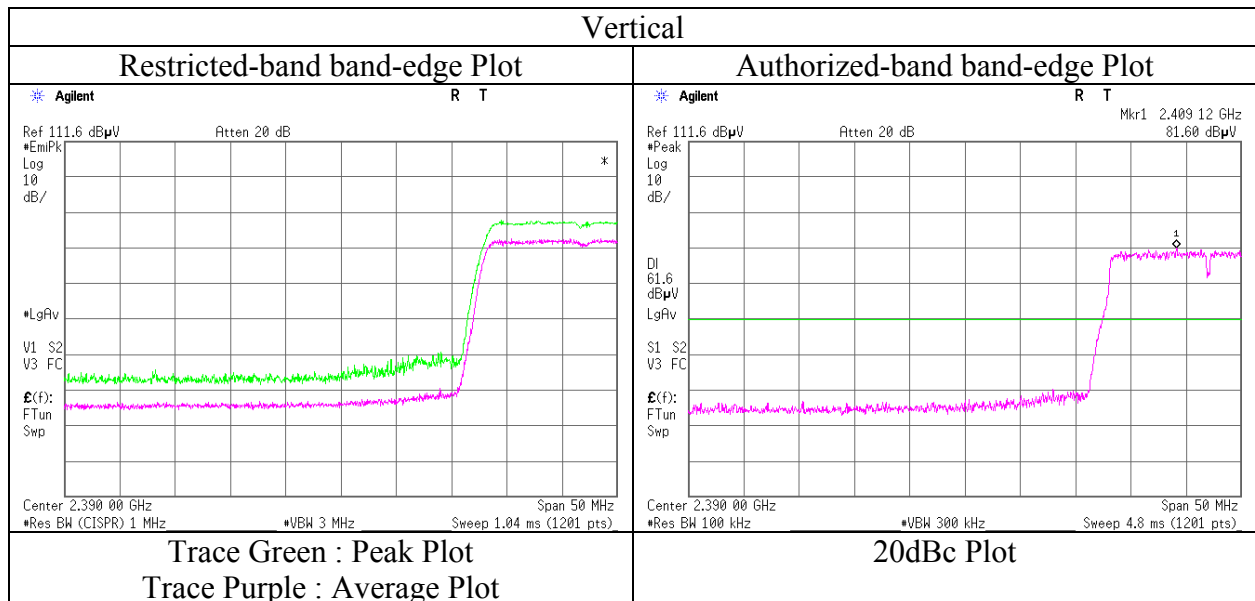
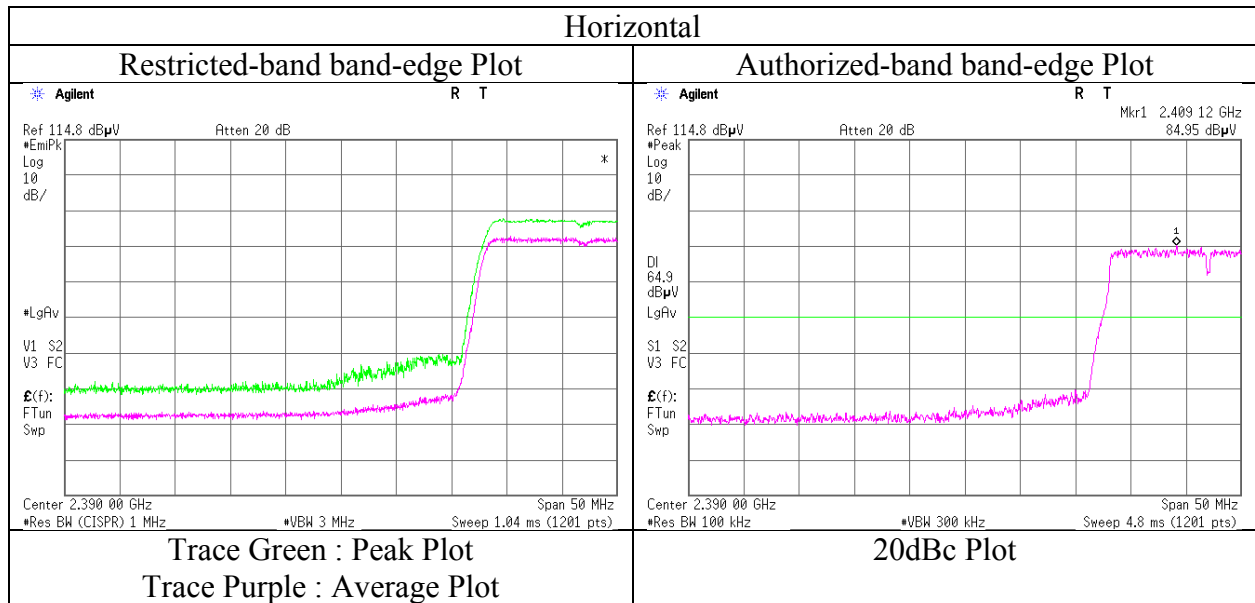
### 20dBc Data Sheet

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark  |
|----------|-----------------|----------|----------------|-------------------|-----------|-----------|-----------------|----------------|-------------|---------|
| Hori     | 2412.000        | PK       | 85.0           | 28.0              | 6.8       | 32.1      | 87.7            | -              | -           | Carrier |
| Hori     | 2400.000        | PK       | 42.0           | 28.0              | 6.8       | 32.1      | 44.7            | 67.7           | 23.0        |         |
| Vert     | 2412.000        | PK       | 81.6           | 28.0              | 6.8       | 32.1      | 84.3            | -              | -           | Carrier |
| Vert     | 2400.000        | PK       | 37.0           | 28.0              | 6.8       | 32.1      | 39.7            | 64.3           | 24.6        |         |

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

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

|                        |                                         |
|------------------------|-----------------------------------------|
| Test place             | Ise EMC Lab. No.4 Semi Anechoic Chamber |
| Report No.             | 11201777H                               |
| Date                   | April 12, 2016                          |
| Temperature / Humidity | 20 deg. C / 40 % RH                     |
| Engineer               | Kazuya Yoshioka                         |
| Mode                   | Tx 11n-20 2412 MHz                      |



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

## Radiated Spurious Emission

Test place Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. 11201777H  
Date April 12, 2016  
Temperature / Humidity 20 deg. C / 40 % RH  
Engineer Kazuya Yoshioka  
(1 GHz – 10 GHz)  
Mode Tx 11n-20 2462 MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|--------|
| Hori     | 2483.500        | PK       | 48.5           | 28.1            | 6.9       | 32.1      | 51.4            | 73.9           | 22.5        |        |
| Hori     | 2483.500        | AV       | 32.6           | 28.1            | 6.9       | 32.1      | 35.5            | 53.9           | 18.4        |        |
| Vert     | 2483.500        | PK       | 47.7           | 28.1            | 6.9       | 32.1      | 50.6            | 73.9           | 23.3        |        |
| Vert     | 2483.500        | AV       | 37.4           | 28.1            | 6.9       | 32.1      | 40.3            | 53.9           | 13.6        |        |

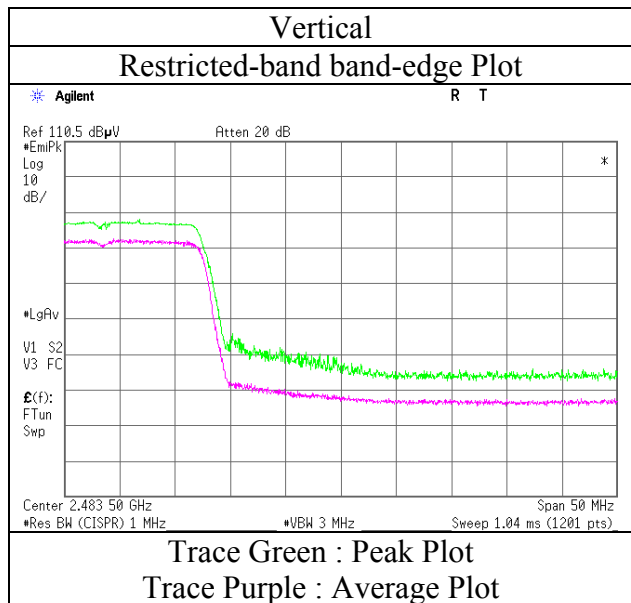
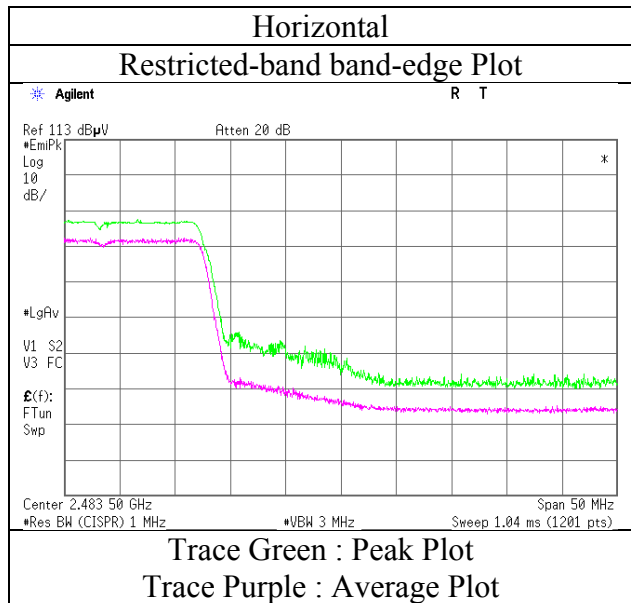
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

Distance factor: 1 GHz - 10 GHz  $20\log(4.5\text{m} / 3.0\text{m}) = 3.53\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{m} / 3.0\text{m}) = -9.5\text{ dB}$

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

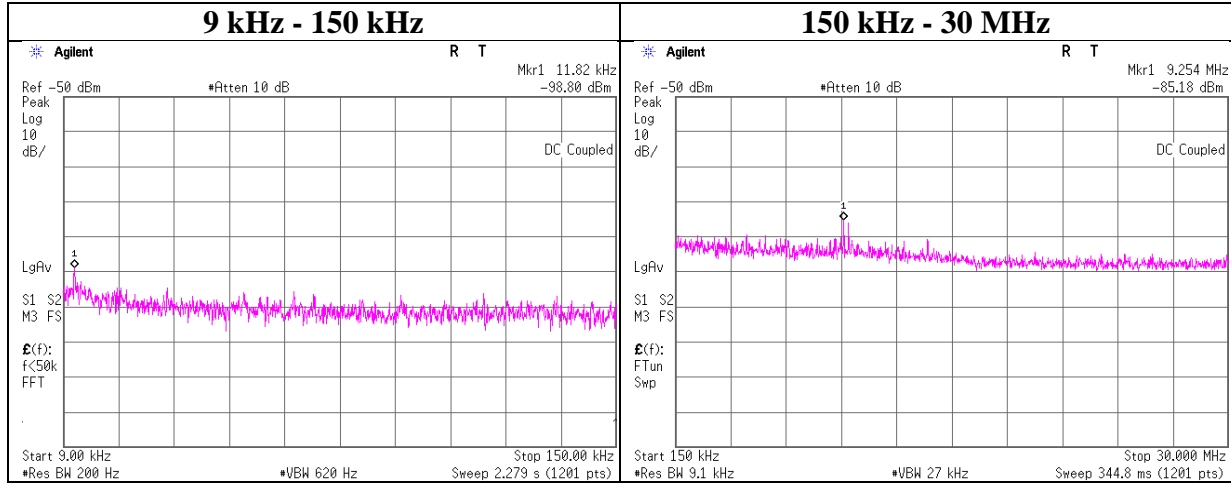
|                        |                                         |
|------------------------|-----------------------------------------|
| Test place             | Ise EMC Lab. No.4 Semi Anechoic Chamber |
| Report No.             | 11201777H                               |
| Date                   | April 12, 2016                          |
| Temperature / Humidity | 20 deg. C / 40 % RH                     |
| Engineer               | Kazuya Yoshioka                         |
| Mode                   | Tx 11n-20 2462 MHz                      |



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

## Conducted Spurious Emission

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Report No.             | 11201777H                          |
| Date                   | April 14, 2016                     |
| Temperature / Humidity | 26 deg. C / 51 % RH                |
| Engineer               | Masafumi Niwa                      |
| Mode                   | Tx 11g 2462 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 |
|--------------------|------------------|-----------------------|----------------------------|--------------------------|----------------------------|---------------|-----------------|--------------------------|-----------------------------------|-------------------|----------------|--------|
| 11.82              | -98.8            | 0.01                  | 9.8                        | 2.1                      | 1                          | -86.9         | 300             | 6.0                      | -25.6                             | 46.1              | 71.7           |        |
| 9254.00            | -85.2            | 0.01                  | 9.9                        | 2.1                      | 1                          | -73.1         | 30              | 6.0                      | 8.1                               | 29.5              | 21.4           |        |

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

$$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$$

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### Power Density

Test place Ise EMC Lab. No.6 Measurement Room  
Report No. 11201777H  
Date April 14, 2016  
Temperature / Humidity 26 deg. C / 51 % RH  
Engineer Masafumi Niwa  
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        | -22.45           | 0.98                  | 10.03                  | -11.44          | 8.00           | 19.44          |
| 2437.00        | -22.56           | 0.99                  | 10.03                  | -11.54          | 8.00           | 19.54          |
| 2462.00        | -22.81           | 1.00                  | 10.03                  | -11.78          | 8.00           | 19.78          |

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        | -25.41           | 0.98                  | 10.03                  | -14.40          | 8.00           | 22.40          |
| 2437.00        | -25.48           | 0.99                  | 10.03                  | -14.46          | 8.00           | 22.46          |
| 2462.00        | -25.68           | 1.00                  | 10.03                  | -14.65          | 8.00           | 22.65          |

11n-20

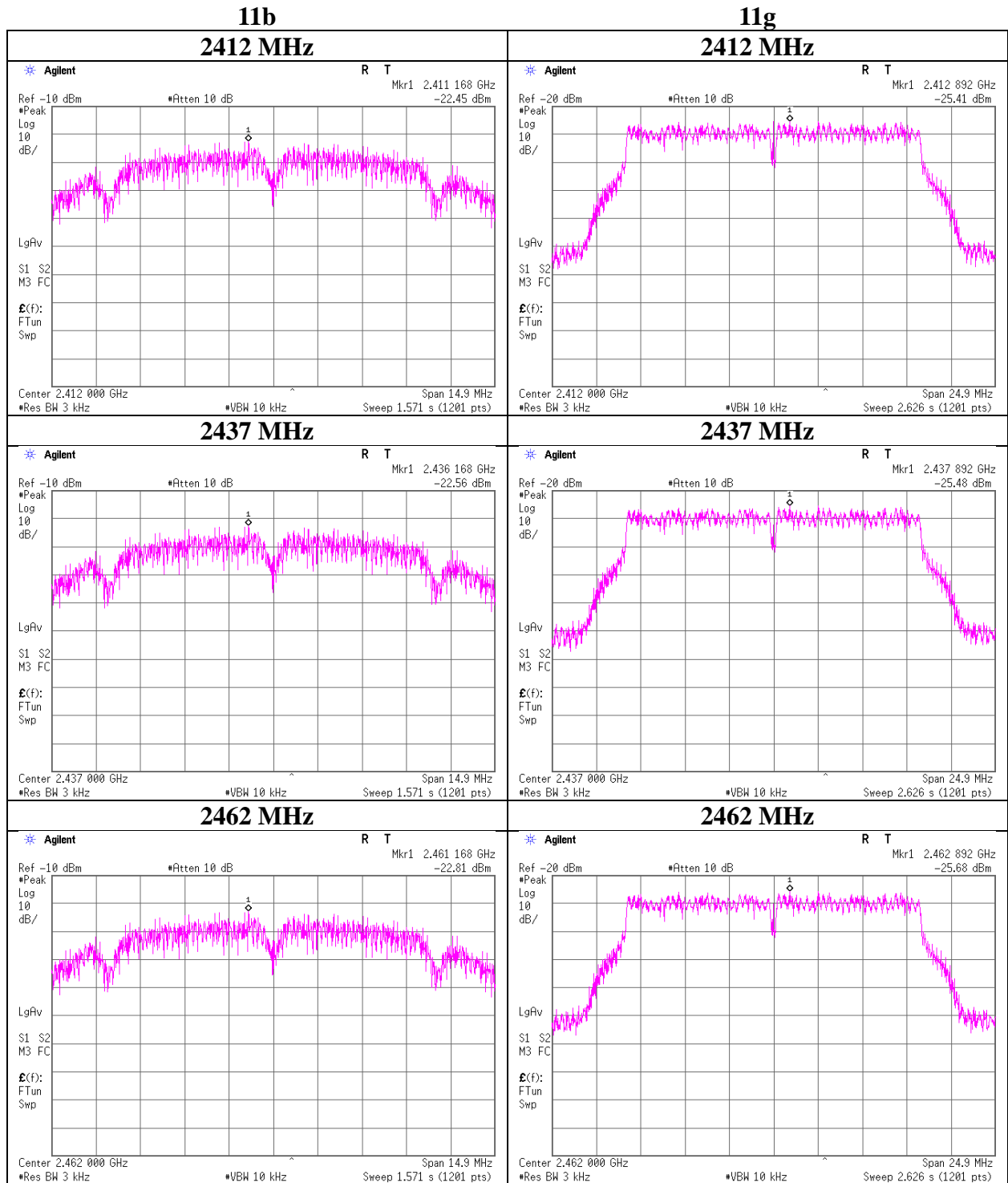
| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>[dBm] | Limit<br>[dBm] | Margin<br>[dB] |
|----------------|------------------|-----------------------|------------------------|-----------------|----------------|----------------|
| 2412.00        | -25.85           | 0.98                  | 10.03                  | -14.84          | 8.00           | 22.84          |
| 2437.00        | -27.84           | 0.99                  | 10.03                  | -16.82          | 8.00           | 24.82          |
| 2462.00        | -27.10           | 1.00                  | 10.03                  | -16.07          | 8.00           | 24.07          |

Sample Calculation:

Result = Reading + Cable Loss + Attenuator



**Power Density**



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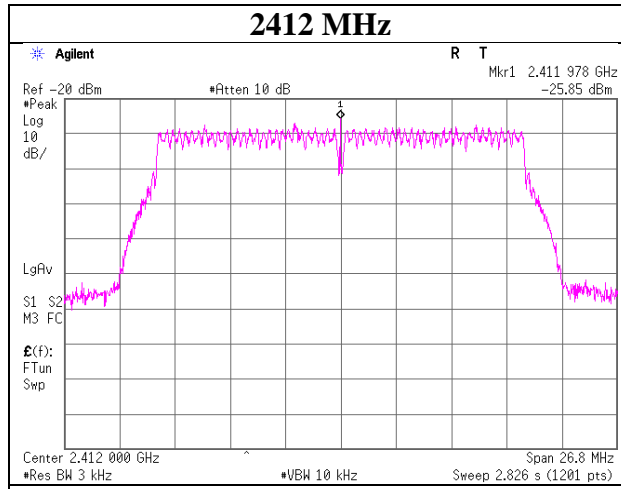
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Power Density

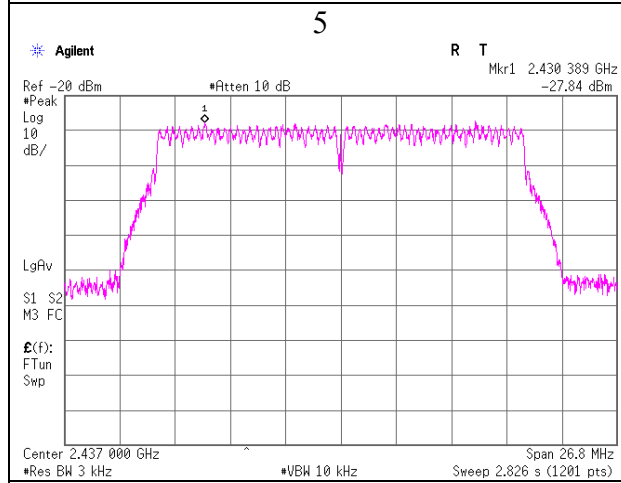
11n-20

2412 MHz

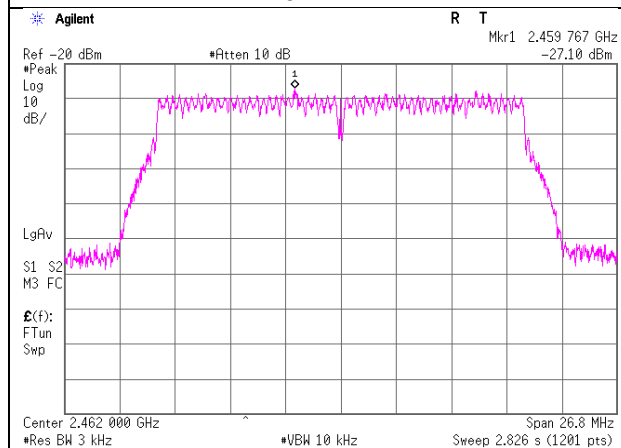


2437 MHz

5



2462 MHz



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Ise EMC Lab.

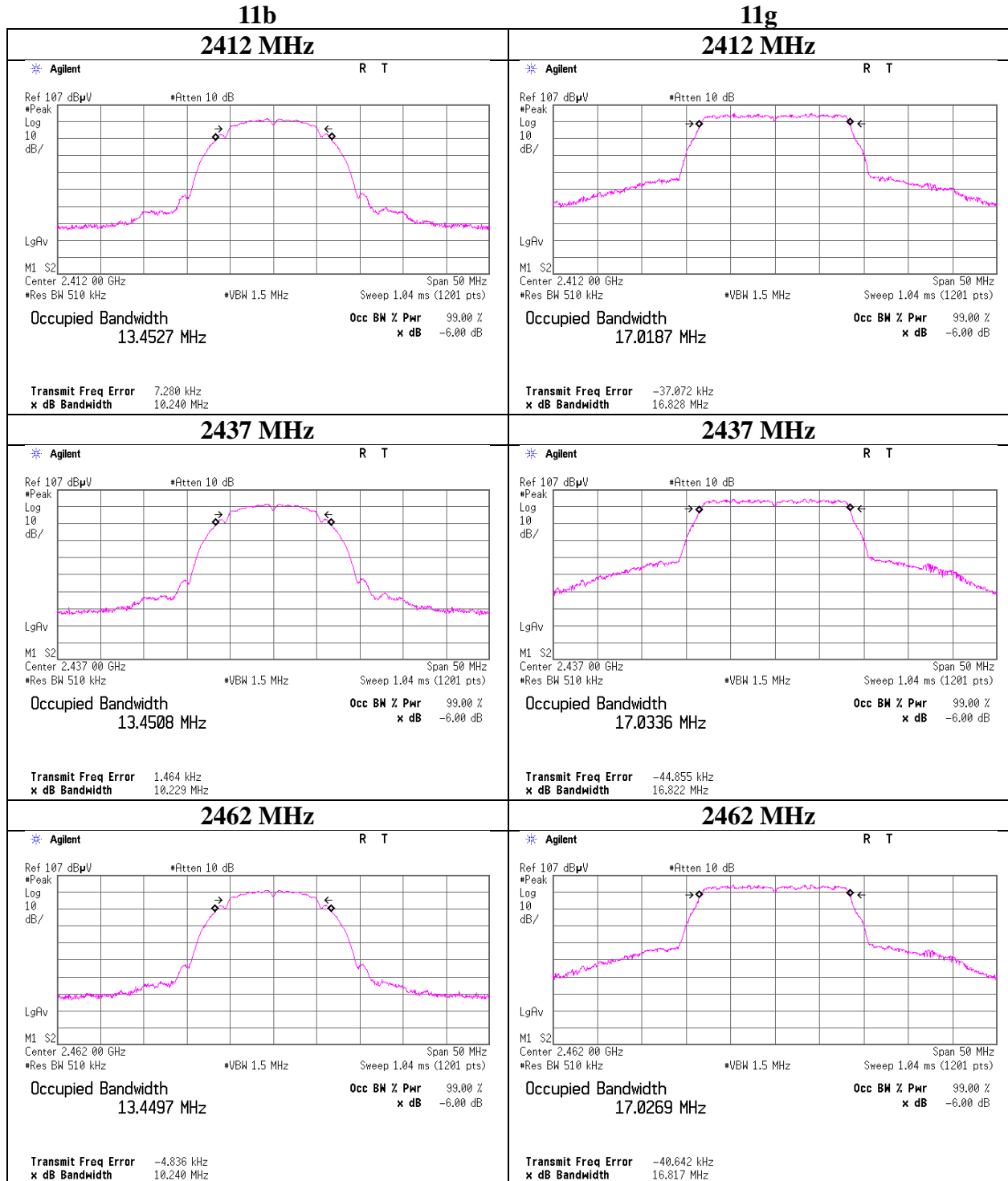
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## 99% Occupied Bandwidth

|                                                                                |                                                                                                                 |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Test place<br>Report No.<br>Date<br>Temperature / Humidity<br>Engineer<br>Mode | Ise EMC Lab. No.6 Measurement Room<br>11201777H<br>April 14, 2016<br>26 deg. C / 51 % RH<br>Masafumi Niwa<br>Tx |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|



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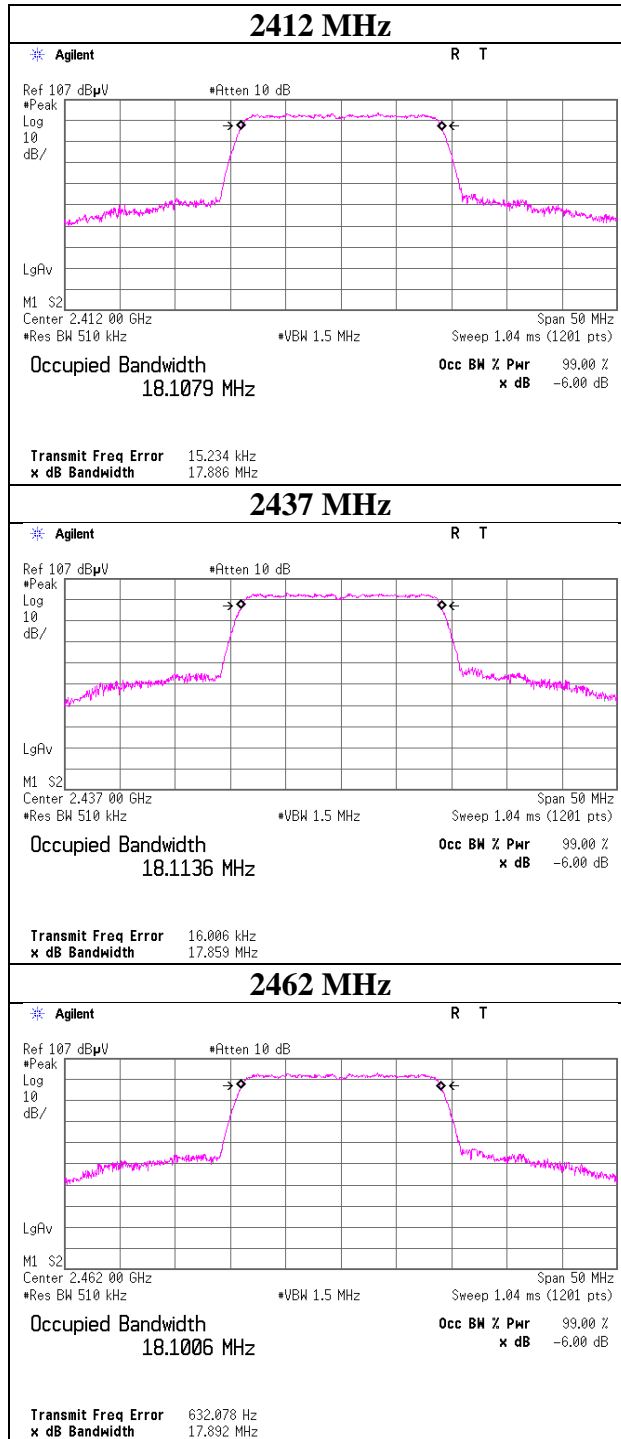
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## 99% Occupied Bandwidth

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Report No.             | 11201777H                          |
| Date                   | April 14, 2016                     |
| Temperature / Humidity | 26 deg. C / 51 % RH                |
| Engineer               | Masafumi Niwa                      |
| Mode                   | Tx                                 |

### 11n-20



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## **APPENDIX 2: Test instruments**

### **Test equipment**

| Control No. | Instrument                       | Manufacturer         | Model No                                                           | Serial No                       | Test Item | Calibration Date *<br>Interval(month) |
|-------------|----------------------------------|----------------------|--------------------------------------------------------------------|---------------------------------|-----------|---------------------------------------|
| MAEC-04     | Semi Anechoic Chamber(NSA)       | TDK                  | Semi Anechoic Chamber 3m                                           | DA-10005                        | RE        | 2015/10/02 * 12                       |
| MOS-15      | Thermo-Hygrometer                | Custom               | CTH-180                                                            | 1501                            | RE        | 2016/01/21 * 12                       |
| MJM-26      | Measure                          | KOMELON              | KMC-36                                                             | -                               | RE        | -                                     |
| COTS-MEMI   | EMI measurement program          | TSJ                  | TEPTO-DV                                                           | -                               | RE,CE     | -                                     |
| MSA-04      | Spectrum Analyzer                | Agilent              | E4448A                                                             | US44300523                      | RE        | 2015/11/06 * 12                       |
| MHA-21      | Horn Antenna 1-18GHz             | Schwarzbeck          | BBHA9120D                                                          | 9120D-557                       | RE        | 2015/08/10 * 12                       |
| MCC-141     | Microwave Cable                  | Junkosha             | MWX221                                                             | 1305S002R(1m)<br>/ 1405S146(5m) | RE        | 2015/06/22 * 12                       |
| MPA-12      | MicroWave System Amplifier       | Agilent              | 83017A                                                             | 00650                           | RE        | 2015/10/01 * 12                       |
| MMM-10      | DIGITAL HiTESTER                 | Hioki                | 3805                                                               | 051201148                       | RE        | 2016/01/18 * 12                       |
| MHF-26      | High Pass Filter 3.5-18.0GHz     | UL Japan             | HPF SELECTOR                                                       | 002                             | RE        | 2015/09/17 * 12                       |
| MHF-06      | High Pass Filter 3.5-24GHz       | TOKIMEC              | TF323DCA                                                           | 601                             | RE        | 2015/05/15 * 12                       |
| MAEC-01     | Semi Anechoic Chamber(NSA)       | TDK                  | Semi Anechoic Chamber 10m                                          | DA-06881                        | CE        | 2015/09/19 * 12                       |
| MOS-27      | Thermo-Hygrometer                | CUSTOM               | CTH-201                                                            | A08Q26                          | CE        | 2016/01/21 * 12                       |
| MJM-25      | Measure                          | KOMELON              | KMC-36                                                             | -                               | CE        | -                                     |
| MTR-09      | EMI Test Receiver                | Rohde & Schwarz      | ESU26                                                              | 100412                          | CE        | 2015/06/08 * 12                       |
| MLS-25      | LISN(AMN)                        | Schwarzbeck          | NSLK8127                                                           | 8127-731                        | CE        | 2015/07/17 * 12                       |
| MCC-03      | Coaxial Cable                    | Fujikura/Suhner/TSJ  | 5D-2W(20m)/<br>3D-2W(7.5m)/<br>RG400u(1.5m)/<br>RFM-E421(Switcher) | -/01068<br>(Switcher)           | CE        | 2015/09/29 * 12                       |
| MAT-64      | Attenuator(13dB)                 | JFW Industries, Inc. | 50FP-013H2 N                                                       | -                               | CE        | 2016/01/14 * 12                       |
| MMM-03      | Digital Tester                   | Fluke                | FLUKE 26-3                                                         | 78030621                        | CE        | 2015/08/19 * 12                       |
| MSA-03      | Spectrum Analyzer                | Agilent              | E4448A                                                             | MY44020357                      | RE        | 2015/05/18 * 12                       |
| MTR-10      | EMI Test Receiver                | Rohde & Schwarz      | ESR26                                                              | 101408                          | RE        | 2016/01/29 * 12                       |
| MBA-05      | Biconical Antenna                | Schwarzbeck          | BBA9106                                                            | 1302                            | RE        | 2015/11/02 * 12                       |
| MLA-23      | Logperiodic Antenna(200-1000MHz) | Schwarzbeck          | VUSLP9111B                                                         | 911B-192                        | RE        | 2016/01/30 * 12                       |
| MCC-50      | Coaxial Cable                    | UL Japan             | -                                                                  | -                               | RE        | 2015/06/19 * 12                       |
| MAT-68      | Attenuator                       | Anritsu              | MP721B                                                             | 6200961025                      | RE        | 2015/11/12 * 12                       |
| MPA-14      | Pre Amplifier                    | SONOMA INSTRUMENT    | 310                                                                | 260833                          | RE        | 2016/03/18 * 12                       |
| MHA-17      | Horn Antenna 15-40GHz            | Schwarzbeck          | BBHA9170                                                           | BBHA9170307                     | RE        | 2015/06/06 * 12                       |
| MOS-14      | Thermo-Hygrometer                | Custom               | CTH-201                                                            | 1401                            | AT        | 2016/01/21 * 12                       |
| MPM-16      | Power Meter                      | Agilent              | 8990B                                                              | MY51000271                      | AT        | 2016/04/07 * 12                       |
| MPSE-23     | Power sensor                     | Agilent              | N1923A                                                             | MY54070004                      | AT        | 2016/04/07 * 12                       |
| MCC-144     | Microwave Cable                  | Junkosha             | MWX221                                                             | 1207S407                        | AT        | 2015/08/06 * 12                       |
| MAT-22      | Attenuator(10dB) 1-18GHz         | Orient Microwave     | BX10-0476-00                                                       | -                               | AT        | 2016/03/18 * 12                       |
| MSA-14      | Spectrum Analyzer                | Agilent              | E4440A                                                             | MY48250080                      | AT        | 2015/10/07 * 12                       |
| MAT-10      | Attenuator(10dB)                 | Weinschel Corp       | 2                                                                  | BL1173                          | AT        | 2015/11/10 * 12                       |
| MCC-163     | Microwave Cable                  | Murata               | MXGS83RK3000                                                       | -                               | AT        | 2015/11/10 * 12                       |

### **UL Japan, Inc.**

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