




# RADIO TEST REPORT

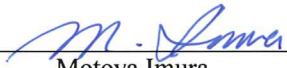
Test Report No. : 10903739H-A

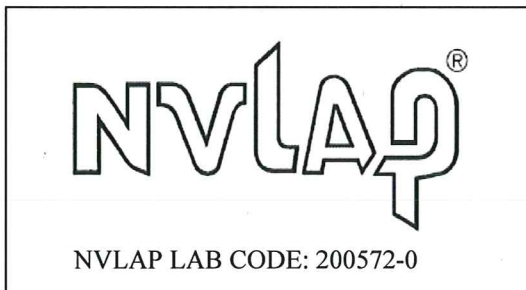
**Applicant** : DENSO CORPORATION  
**Type of Equipment** : Blind Spot Monitor Sensor  
**Model No.** : DNSRR001  
**FCC ID** : HYQDNSRR001  
**Test regulation** : FCC Part 15 Subpart C: 2015  
**Test Result** : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)

**Date of test:** August 6 to September 3, 2015

**Representative test engineer:**   
Hironobu Ohnishi  
Engineer  
Consumer Technology Division

**Approved by:**   
Motoya Imura  
Engineer  
Consumer Technology Division



This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.  
\*As for the range of Accreditation in NVLAP, you may refer to the WEB address,  
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13-EM-F0429



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**CONTENTS** **PAGE**

---

**SECTION 1: Customer information** ..... 4  
**SECTION 2: Equipment under test (E.U.T.)**..... 4  
**SECTION 3: Test specification, procedures & results**..... 5  
**SECTION 4: Operation of E.U.T. during testing**..... 8  
**SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission)**10  
**SECTION 6: 20dB Bandwidth, 99% Occupied Bandwidth and Duty Cycle**..... 12  
**APPENDIX 1: Test data**..... 13  
    Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission).....13  
    20dB Bandwidth, 99% Occupied Bandwidth .....20  
    Duty Cycle .....23  
**APPENDIX 2: Test Instruments** ..... 25  
**APPENDIX 3: Photographs of test setup** ..... 27  
    Radiated Emission (Fundamental emission).....27  
    Radiated Emission (Spurious emission) .....28

## **SECTION 1: Customer information**

Company Name : DENSO CORPORATION  
Address : 1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan  
Telephone Number : +81-566-61-4724  
Facsimile Number : +81-566-25-4683  
Contact Person : Junshi Utsu

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

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

Type of Equipment : Blind Spot Monitor Sensor  
Model No. : DNSRR001  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 12 V (Car battery)  
Receipt Date of Sample : August 6, 2015  
Country of Mass-production : Japan  
Condition of EUT : Engineering 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**

This Radar Sensor (DNSRR001) is a vehicle-mounted field disturbance sensor which uses millimeter wave for detecting obstacles located diagonally backward.

### **General Specification**

Clock frequency(ies) in the system : Microcomputer: 240 MHz

### **Radio Specification**

Radio Type : Transceiver  
Frequency of Operation : 24.15 GHz  
Modulation : Frequency modulation  
Antenna Type : Internal Antenna  
Antenna Connector : None  
Antenna Gain : 9.3dBi (Broad beam), 12.5dBi (Narrow beam)  
Steerable Antenna : Electronically  
Usage location : Vehicle-mounted  
Power Supply (inner) : DC 3.3 V

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

### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C: 2015, final revised on September 8, 2015

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators  
Section 15.207 Conducted limits  
Section 15.249 Operation within the bands 902-928MHz,  
2400-2483.5MHz, 5725-5875MHz and 24.0-24.25GHz

\* The revision on September 8, 2015 does not affect the test specification applied to the EUT.

### **3.2 Procedures and results**

| <b>Item</b>                                     | <b>Test Procedure</b>  | <b>Specification</b>   | <b>Deviation</b> | <b>Worst margin</b>  | <b>Results</b> |
|---|--|--|------------------|--|----------------|
| Conducted Emission                              | <b>FCC:</b> ANSI C63.4-2009<br>7. AC powerline conducted emission measurements<br><b>IC:</b> RSS-Gen 8.8 | <b>FCC:</b> Section 15.207<br><b>IC:</b> RSS-Gen 8.8   | N/A              | -  | N/A *1)        |
| Electric Field Strength of Fundamental Emission | ANSI C63.4:2009<br>13. Measurement of intentional radiators<br><b>IC:</b> RSS-Gen 6.12                   | <b>FCC:</b> Section 15.249(a)(c)(e)<br><b>IC:</b> RSS-310 3.10   | N/A              | 8.3 dB<br>24150.00 MHz, Horizontal,<br>(Peak with Duty factor)<br>Narrow beam (Left / Right) | Complied       |
| Electric Field Strength of Spurious Emission    | ANSI C63.4:2009<br>13. Measurement of intentional radiators<br><b>IC:</b> RSS-Gen 6.13                   | <b>FCC:</b> Section 15.205(a)(b)(d)<br>Section 15.209(a)<br>Section 15.249(a)(c)(d)(e)<br><b>IC:</b> RSS-310 3.10<br>RSS-Gen 8.9 | N/A              | 3.0 dB<br>24250.00 MHz, Horizontal,<br>(Peak with Duty factor)<br>Narrow beam (Right)        | Complied       |
| 20 dB Bandwidth                                 | ANSI C63.4:2009<br>13. Measurement of intentional radiators<br><b>IC:</b> -                              | <b>FCC:</b> Section 15.215<br><b>IC:</b> Reference data  | N/A              | See data.  | Complied       |
| Frequency Tolerance                             | ANSI C63.4:2009<br>13. Measurement of intentional radiators<br><b>IC:</b> -                              | <b>FCC:</b> Section 15.249(b)<br><b>IC:</b> -  | N/A              | -  | N/A *2)        |
| 99 % Occupied Bandwidth                         | <b>FCC:</b> -<br><b>IC:</b> RSS-Gen 6.6  | <b>FCC:</b> Reference data<br><b>IC:</b> -   | N/A              | See data.  | Complied       |

\*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

\*2) The test is not applicable since the EUT does not operate with Fixed point-to-point operation within 24.05 GHz to 24.25 GHz.

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

Millimeter wave measurement was performed accordance with FCC KDB 200443 (MILLIMETER WAVE TEST PROCEDURES).

\*In case any questions arise about test procedure, ANSI C63.4: 2009 is also referred.

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**FCC Part 15.31 (e)**

The EUT provides stable voltage (DC 3.3 V) constantly to the RF part regardless of input voltage. Instead of a new battery, DC power supply was used for the test.

That does not affect to the test result, therefore the 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.

**3.3 Addition to standard**

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.

| Test room<br>(semi-anechoic chamber) | Radiated emission |                  |                 |                |                 |                   |                   |
|--------------------------------------|-------------------|------------------|-----------------|----------------|-----------------|-------------------|-------------------|
|                                      | (3m*)(+dB)        |                  |                 |                | (1m*)(+dB)      |                   | (0.5m*)(+dB)      |
|                                      | 9kHz<br>-30MHz    | 30MHz<br>-300MHz | 300MHz<br>-1GHz | 1GHz<br>-10GHz | 10GHz<br>-18GHz | 18GHz<br>-26.5GHz | 26.5GHz<br>-40GHz |
| No.1                                 | 4.3dB             | 5.1 dB           | 6.2 dB          | 5.5dB          | 5.8dB           | 5.8dB             | 4.3dB             |
| No.2                                 | 4.2dB             | 5.1 dB           | 6.2 dB          | 5.4dB          | 5.7dB           | 5.9dB             | 5.6dB             |
| No.3                                 | 4.4dB             | 5.1 dB           | 6.3 dB          | 5.2dB          | 5.5dB           | 5.8dB             | 5.5dB             |
| No.4                                 | 4.7dB             | 5.3 dB           | 6.3 dB          | 5.3dB          | 5.7dB           | 5.9dB             | 5.5dB             |

\*3m/1m/0.5m = Measurement distance

| Radiated emission (+dB) |        |
|-------------------------|--------|
| 40 GHz - 50 GHz         | 4.0 dB |
| 50 GHz - 75 GHz         | 5.2 dB |
| 75 GHz - 110 GHz        | 5.6 dB |

**Radiated emission test (1m and 3m)**

[Electric Field Strength of Fundamental Emission]

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

[Electric Field Strength of Spurious Emission]

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

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### 3.5 Test Location

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|                            | IC Registration Number | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms            |
|----------------------------|------------------------|----------------------------|--|------------------------|
| No.1 semi-anechoic chamber | 2973C-1                | 19.2 x 11.2 x 7.7m         | 7.0 x 6.0m   | No.1 Power source room |
| No.2 semi-anechoic chamber | 2973C-2                | 7.5 x 5.8 x 5.2m           | 4.0 x 4.0m   | -                      |
| No.3 semi-anechoic chamber | 2973C-3                | 12.0 x 8.5 x 5.9m          | 6.8 x 5.75m  | No.3 Preparation room  |
| No.3 shielded room         | -                      | 4.0 x 6.0 x 2.7m           | N/A  | -                      |
| No.4 semi-anechoic chamber | 2973C-4                | 12.0 x 8.5 x 5.9m          | 6.8 x 5.75m  | No.4 Preparation room  |
| No.4 shielded room         | -                      | 4.0 x 6.0 x 2.7m           | N/A  | -                      |
| No.5 semi-anechoic chamber | -                      | 6.0 x 6.0 x 3.9m           | 6.0 x 6.0m   | -                      |
| No.6 shielded room         | -                      | 4.0 x 4.5 x 2.7m           | 4.0 x 4.5 m  | -                      |
| No.6 measurement room      | -                      | 4.75 x 5.4 x 3.0m          | 4.75 x 4.15 m  | -                      |
| No.7 shielded room         | -                      | 4.7 x 7.5 x 2.7m           | 4.7 x 7.5m   | -                      |
| No.8 measurement room      | -                      | 3.1 x 5.0 x 2.7m           | N/A  | -                      |
| No.9 measurement room      | -                      | 8.0 x 4.6 x 2.8m           | 2.4 x 2.4m   | -                      |
| No.11 measurement room     | -                      | 6.2 x 4.7 x 3.0m           | 4.8 x 4.6m   | -                      |

\* Size of vertical conducting plane (for Conducted Emission test) : 2.0 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.

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

### **4.1 Operating Modes**

| <b>Test Item</b>   | <b>Mode</b>            | <b>Tested frequency</b> |
|--|------------------------|-------------------------|
| Electric Field Strength of Fundamental Emission  | Transmitting mode (Tx) | 24.15 GHz               |
| Electric Field Strength of Spurious Emission   |                        |                         |
| 20 dB Bandwidth  | Beam setting *1)       | FSK setting *2)         |
| 99 % Occupied Bandwidth  | - Broad beam           | - 24.06 GHz             |
|  | - Narrow beam (Left)   | - 24.15 GHz             |
|  | - Narrow beam (Right)  | - 24.24 GHz             |
| <p>*1) This EUT has three transmission beam patterns. The tests were performed in these three patterns.</p> <p>*2) There are FM and FSK modulation part in one transmission burst. The FSK modulation hopped to any frequencies per 80 ms in actual operation.<br/> The FSK frequency was fixed to lowest (24.06 GHz), middle (24.15 GHz) or highest (24.24 GHz) for the purpose of bandwidth measurement. The FSK frequency was fixed to lowest or highest for the purpose of band-edge measurement. As for other tests, it was fixed to middle frequency.</p> <p>The system was configured in typical fashion (as a customer would normally use it) for testing.</p> <p>*EUT has the power settings by the software as follows;<br/> Power Settings: Same as Production model<br/> Software: mwr_denso_24g_t739</p> <p>*This setting of software is the worst case.<br/> Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.</p> |                        |                         |

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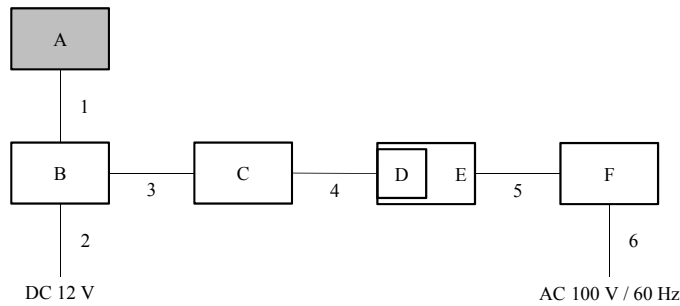
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## 4.2 Configuration and peripherals



\* 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   | Blind Spot Monitor Sensor | DNSRR001      | 3200          | DENSO CORPORATION | EUT     |
| B   | Jig Box                   | -             | -             | DENSO CORPORATION | -       |
| C   | CAN Cab                   | 251           | -             | Vector            | -       |
| D   | CANCardXL                 | 007100        | 046663        | Vector            | -       |
| E   | Laptop                    | PSSESN-0G301R | 2E061592H     | TOSHIBA           | -       |
| F   | AC Adapter                | PA3755U-1ACA  | G71C000A5410  | TOSHIBA           | -       |

### List of cables used

| No. | Name                | Length (m) | Shield     |            | Remarks |
|-----|---------------------|------------|------------|------------|---------|
|     |                     |            | Cable      | Connector  |         |
| 1   | Signal and DC Cable | 3.0        | Unshielded | Unshielded | -       |
| 2   | DC cable            | 1.0        | Unshielded | Unshielded | -       |
| 3   | Signal cable        | 0.4        | Unshielded | Unshielded | -       |
| 4   | Signal cable        | 0.3        | Shielded   | Shielded   | -       |
| 5   | DC cable            | 1.8        | Unshielded | Unshielded | -       |
| 6   | AC cable            | 0.9        | Unshielded | Unshielded | -       |

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**SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission)**

**Test Procedure and conditions**

**[Up to 40 GHz]**

EUT was placed on an urethane platform of nominal size, 0.5 m by 1.0 m raised 0.8 m (9 kHz - 10 GHz), 0.5 m by 0.5 m raised 1.5 m (10 GHz - 40 GHz) above the conducting ground plane.

The EUT was set on the center of the tabletop.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.

Photographs of the set up are shown in Appendix 1.

The Radiated Electric Field Strength has been measured on Semi anechoic chamber with a ground plane and at a distance of 3 m.

The measuring antenna height was varied between 1 m and 4 m (frequency 9 kHz – 30 MHz: loop antenna was fixed height at 1.0 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.

The radiated emission measurements were made with the following detector function of the test receiver/spectrum analyzer.

**Test Antennas are used as below;**

|              |              |                   |                  |             |
|--------------|--------------|-------------------|------------------|-------------|
| Frequency    | Below 30 MHz | 30 MHz to 300 MHz | 300 MHz to 1 GHz | Above 1 GHz |
| Antenna Type | Loop         | Biconical         | Logperiodic      | Horn        |

|                 |                 |                  |                |  |   |
|-----------------|-----------------|------------------|----------------|--|---|
| Frequency       | 9 kHz – 150 kHz | 150 kHz – 30 MHz | 30 MHz – 1 GHz | 1 GHz – 40 GHz   |   |
| Instrument used | Test Receiver   | Test Receiver    | Test Receiver  | Spectrum Analyzer  |   |
| Detector        | QP, Average     | QP, Average      | QP             | Peak   | Average *1)   |
| IF Bandwidth    | BW 200 Hz       | BW 9 kHz         | BW 120 kHz     | RBW: 1 MHz<br>VBW: 3 MHz   | Pulsed emission<br>- RBW: 1 MHz<br>- Peak with duty<br><br>Other than above<br>- RBW: 1 MHz<br>- VBW: 10 Hz |
| Test Distance   | 3 m             | 3 m              | 3 m            | 3 m (below 10 GHz),<br>1 m*2) (10 GHz-26.5 GHz),<br>0.5 m*3) (26.5 GHz-40 GHz) |   |

\*1) For Pulsed emission (Fundamental and band-edge): The Average value was calculated by reducing Duty factor from Peak (Peak value – Duty factor). For Duty factor, please refer to page Duty factor measurement. Other than pulsed emission, aVBW was set to 10 Hz and linear voltage average mode was used.

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

\*3) Distance Factor:  $20 \times \log(3.0 \text{ m} / 0.5 \text{ m}) = 15.6 \text{ dB}$

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**[About fundamental measurement]**

The carrier levels were confirmed at maximum direction of transmission. The maximum direction was searched under carefully since beam-widths are narrow.

The carrier levels were measured in the far field. The distance of the far field was calculated from follow equation.

$$r = \frac{2D^2}{\lambda}$$

where

*r* is the distance from the radiating element of the EUT to the edge of the far field, in m  
*D* is the largest dimension of both the radiating element and the test antenna (horn), in m  
(The antenna aperture size of test antenna was used for this calculation.)  
*Lambda* is the wavelength of the emission under investigation [ $300 / f(\text{MHz})$ ], in m

| Frequency | Lambda | Maximum Dimension | Far Field Boundary |
|-----------|--------|-------------------|--------------------|
| [GHz]     | [m]    | [m]               | <i>r</i> [m]       |
| 24.250    | 0.012  | 0.058             | 0.544              |

**[Above 40 GHz]**

The test was performed based on “MILLIMETER WAVE TEST PROCEDURES”. The EUT was placed on an urethane platform, raised 1.5 m above the conducting ground plane. The measurements were performed on handheld method.

Set spectrum analyzer RBW, VBW, span, etc., to the proper values. Note these values. Enable two traces—one set to “clear write,” and the other set to “max hold.” Begin hand-held measurements with the test antenna (horn) at a distance of 1 m from the EUT in a horizontally polarized position. Slowly adjust its position, entirely covering the plane 1 m from the EUT. Observation of the two active traces on the spectrum analyzer will allow refined horn positioning at the point(s) of maximum field intensity. Repeat with the horn in a vertically polarized position. If the emission cannot be detected at 1 m, reduce the RBW to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

Note the maximum level indicated on the spectrum analyzer. Adjust this level, if necessary, by the antenna gain, conversion loss of the external mixer and gain of LNA used, at the frequency under investigation. Calculate the field strength of the emission at the measurement distance from the Friis’ transmission equation.

| Frequency   | 40 GHz – 50 GHz | 50 GHz – 75 GHz | 75 GHz – 100 GHz |
|---|-----------------|-----------------|------------------|
| Final measurement distance with 1 MHz Peak detector | 0.5 m           | 0.05 m          | 0.05 m           |

| Detector     | Peak                     | Average *1)   |   |
|--------------|--------------------------|---|---|
| IF Bandwidth | RBW: 1 MHz<br>VBW: 3 MHz | Pulsed emission<br>- RBW: 1 MHz<br>- Peak with duty | Other than pulsed<br>- RBW: 1 MHz<br>- VBW: 10 Hz |

\*1) For Pulsed emission (2nd harmonics): The Average value was calculated by reducing Duty factor from Peak (Peak value – Duty factor). For Duty factor, please refer to page Duty factor measurement. Other than pulsed emission, aVBW was set to 10 Hz and linear voltage average mode was used.

The test was made on EUT at the normal use position.

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

**Measurement range** : 9 kHz – 100 GHz  
**Test data** : APPENDIX  
**Test result** : Pass

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## **SECTION 6: 20dB Bandwidth, 99% Occupied Bandwidth and Duty Cycle**

### **Test Procedure**

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

| <b>Test</b>             | <b>Span</b>   | <b>RBW</b>                     | <b>VBW</b>                      | <b>Sweep</b>          | <b>Detector</b> | <b>Trace</b>    | <b>Instrument used</b> |
|-------------------------|---|--------------------------------|---------------------------------|-----------------------|-----------------|-----------------|------------------------|
| 20 dB Bandwidth         | 600 MHz   | 2 MHz                          | 6 MHz                           | 70 sec                | Peak            | Max Hold        | Spectrum Analyzer      |
| 99 % Occupied Bandwidth | 600 MHz,<br>Enough width to<br>display emission<br>skirts | 2 MHz,<br>1 % to 5 %<br>of OBW | 6 MHz,<br>Three times<br>of RBW | 70 sec                | Peak<br>*1)     | Max Hold<br>*2) | Spectrum Analyzer      |
| Duty Cycle              | -   | -                              | -                               | 50 msec /<br>200 msec | -               | Single          | Oscilloscope           |

\*1) Peak detector was applied as Worst-case measurement.

\*2) The measurement was performed with Max Hold since the duty cycle was not 100 %.

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

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**APPENDIX 1: Test data**

**Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)**

|                        |                             |                             |                             |                             |                             |                             |
|------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Report No.             | 10903739H                   |                             |                             |                             |                             |                             |
| Test place             | Ise EMC Lab.                |                             |                             |                             |                             |                             |
|                        | No. 4 Semi Anechoic Chamber | No. 4 Semi Anechoic Chamber | No. 3 Semi Anechoic Chamber | No. 3 Semi Anechoic Chamber | No. 3 Semi Anechoic Chamber | No. 3 Semi Anechoic Chamber |
| Date                   | 08/06/2015                  | 08/24/2015                  | 08/31/2015                  | 09/02/2015                  | 09/03/2015                  |                             |
| Temperature / Humidity | 24 deg. C / 59 % RH         | 25 deg. C / 64 % RH         | 24 deg. C / 71 % RH         | 24 deg. C / 66 % RH         | 24 deg. C / 69 % RH         |                             |
| Engineer               | Hironobu Ohnishi            |                             |                             |                             |                             |                             |
| Mode                   | Tx 24.15 GHz, Broad beam    |                             |                             |                             |                             |                             |

**[Fundamental, band-edge and 2nd harmonics]**

**Peak**

| Frequency [MHz] | Detector | Reading [dBuV] |      | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result (3 m) [dBuV/m] |      | Limit (3 m) [dBuV/m] | Margin [dB] |      | Remark<br>Inside or Outside of Restricted Bands |
|-----------------|----------|----------------|------|-------------------|-----------|-----------|------------------|-----------------------|------|----------------------|-------------|------|---|
|                 |          | Hor            | Ver  |                   |           |           |                  | Hor                   | Ver  |                      | Hor         | Ver  |   |
| 24000.00        | PK       | 47.9           | 46.9 | 39.1              | -0.3      | 30.6      | -                | 56.1                  | 55.1 | 73.9                 | 17.8        | 18.8 | Inside  |
| 24150.00        | PK       | 97.9           | 68.9 | 39.0              | -0.2      | 30.5      | -                | 106.2                 | 77.2 | 127.9                | 21.7        | 50.7 | Fundamental                                     |
| 24250.00        | PK       | 49.2           | 47.6 | 39.0              | -0.2      | 30.4      | -                | 57.6                  | 56.0 | 73.9                 | 16.3        | 17.9 | Outside   |
| 48300.72        | PK       | 44.8           | 44.9 | 40.4              | -7.6      | 18.4      | -                | 59.2                  | 59.3 | 87.9                 | 28.7        | 28.6 | Inside  |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier)

**Peak with Duty factor**

| Frequency [MHz] | Detector | Reading [dBuV] |      | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] |      | Limit [dBuV/m] | Margin [dB] |      | Remark      |
|-----------------|----------|----------------|------|-------------------|-----------|-----------|------------------|-----------------|------|----------------|-------------|------|-------------|
|                 |          | Hor            | Ver  |                   |           |           |                  | Hor             | Ver  |                | Hor         | Ver  |             |
| 24000.00        | PK       | 47.9           | 46.9 | 39.1              | -0.3      | 30.6      | -6.8             | 49.3            | 48.3 | 53.9           | 4.6         | 5.6  | Inside      |
| 24150.00        | PK       | 97.9           | 68.9 | 39.0              | -0.2      | 30.5      | -6.8             | 99.4            | 70.4 | 107.9          | 8.5         | 37.5 | Fundamental |
| 24250.00        | PK       | 49.2           | 47.6 | 39.0              | -0.2      | 30.4      | -6.8             | 50.8            | 49.2 | 53.9           | 3.1         | 4.7  | Outside     |
| 48300.72        | PK       | 44.8           | 44.9 | 40.4              | -7.6      | 18.4      | -6.8             | 52.4            | 52.5 | 67.9           | 15.5        | 15.4 | Inside      |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

**[Spurious emissions other than above]**

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark        |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|---------------|
| Hori     | 38.00           | QP       | 22.8           | 14.9            | 7.2       | 32.1      | 12.8            | 40.0           | 27.2        |               |
| Hori     | 120.00          | QP       | 23.3           | 12.9            | 8.3       | 32.0      | 12.5            | 43.5           | 31.0        |               |
| Hori     | 240.00          | QP       | 22.7           | 17.1            | 9.4       | 31.8      | 17.4            | 46.0           | 28.6        |               |
| Hori     | 480.00          | QP       | 23.0           | 19.2            | 11.1      | 31.9      | 21.4            | 46.0           | 24.6        |               |
| Hori     | 720.00          | QP       | 23.2           | 22.5            | 12.4      | 32.1      | 26.0            | 46.0           | 20.0        |               |
| Hori     | 960.00          | QP       | 23.0           | 25.9            | 13.6      | 30.9      | 31.6            | 46.0           | 14.4        |               |
| Hori     | 72451.00        | PK       | 12.6           | 41.7            | 13.6      | 4.9       | 63.0            | 87.9           | 24.9        | NS            |
| Hori     | 96601.44        | PK       | 15.7           | 45.6            | 8.2       | 28.9      | 40.6            | 73.9           | 33.3        | NS            |
| Hori     | 72451.00        | AV       | -0.1           | 41.7            | 13.6      | 4.9       | 50.3            | 67.9           | 17.6        | NS, VBW 10 Hz |
| Hori     | 96601.44        | AV       | 2.6            | 45.6            | 8.2       | 28.9      | 27.5            | 53.9           | 26.4        | NS, VBW 10 Hz |
| Vert     | 38.00           | QP       | 22.8           | 14.9            | 7.2       | 32.1      | 12.8            | 40.0           | 27.2        |               |
| Vert     | 120.00          | QP       | 23.3           | 12.9            | 8.3       | 32.0      | 12.5            | 43.5           | 31.0        |               |
| Vert     | 240.00          | QP       | 22.7           | 17.1            | 9.4       | 31.8      | 17.4            | 46.0           | 28.6        |               |
| Vert     | 480.00          | QP       | 23.0           | 19.2            | 11.1      | 31.9      | 21.4            | 46.0           | 24.6        |               |
| Vert     | 720.00          | QP       | 23.1           | 22.5            | 12.4      | 32.1      | 25.9            | 46.0           | 20.1        |               |
| Vert     | 960.00          | QP       | 23.0           | 25.9            | 13.6      | 30.9      | 31.6            | 46.0           | 14.4        |               |
| Vert     | 72451.00        | PK       | 13.1           | 41.7            | 13.6      | 4.9       | 63.5            | 87.9           | 24.4        | NS            |
| Vert     | 96601.44        | PK       | 15.1           | 45.6            | 8.2       | 28.9      | 40.0            | 73.9           | 33.9        | NS            |
| Vert     | 72451.00        | AV       | -0.1           | 41.7            | 13.6      | 4.9       | 50.3            | 67.9           | 17.6        | NS, VBW 10 Hz |
| Vert     | 96601.44        | AV       | 2.6            | 45.6            | 8.2       | 28.9      | 27.5            | 53.9           | 26.4        | NS, VBW 10 Hz |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Mixer(above 50 GHz)-Distance factor(above 10 GHz)) - Gain(Amplifier)

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

\*NS: No signal detected.

Distance factor: 10 GHz - 26.5 GHz  $20\log(3.0\text{ m} / 1.0\text{ m}) = 9.5\text{ dB}$   
26.5 GHz - 40 GHz  $20\log(3.0\text{ m} / 0.5\text{ m}) = 15.6\text{ dB}$   
Above 50 GHz  $20\log(3.0\text{ m} / 0.05\text{ m}) = 35.6\text{ dB}$

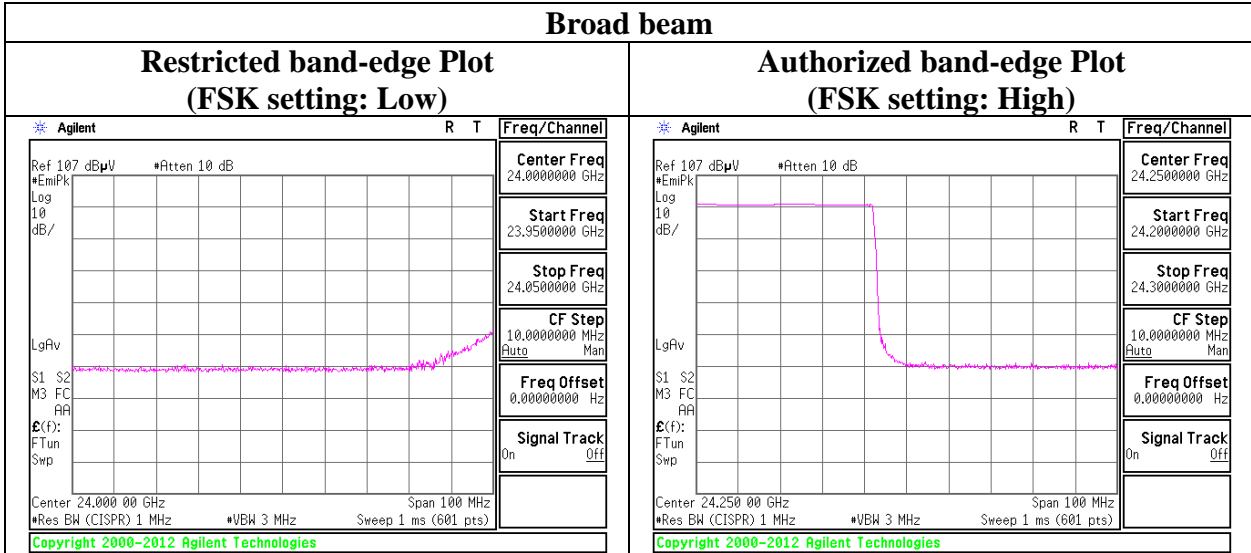
There are FM and FSK modulation part in one transmission burst. The FSK modulation hops to any frequencies per 80 ms in actual operation. The FSK frequency was fixed to lowest (24.06 GHz) or highest (24.24 GHz) for the purpose of band-edge measurement.

**UL Japan, Inc.**  
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**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

Test place : Ise EMC Lab. No. 4 Semi Anechoic Chamber  
Report No. : 10903739H  
Date : 08/07/2015  
Temperature / Humidity : 24 deg. C / 57 % RH  
Engineer : Hironobu Ohnishi  
Mode : Tx 24.15 GHz, Broad beam



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

**Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)**

Report No. 10903739H  
Test place Ise EMC Lab.  
No. 4 Semi Anechoic Chamber No. 4 Semi Anechoic Chamber No. 3 Semi Anechoic Chamber No. 3 Semi Anechoic Chamber No. 3 Semi Anechoic Chamber  
Date 08/06/2015 08/24/2015 08/31/2015 09/02/2015 09/03/2015  
Temperature / Humidity 24 deg. C / 59 % RH 25 deg. C / 64 % RH 24 deg. C / 71 % RH 24 deg. C / 66 % RH 24 deg. C / 69 % RH  
18 GHz - 26.5 GHz 30 MHz - 18 GHz 26.5 GHz - 50 GHz 50 GHz - 100 GHz 9 kHz - 30 MHz  
Engineer Hironobu Ohnishi  
Mode Tx 24.15 GHz, Narrow beam (Left)

**[Fundamental, band-edge and 2nd harmonics]**

Peak

| Frequency [MHz] | Detector | Reading [dBuV] |      | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result (3 m) [dBuV/m] |      | Limit (3 m) dBuV/m | Margin [dB] |      | Remark Inside or Outside of Restricted Bands |
|-----------------|----------|----------------|------|-------------------|-----------|-----------|------------------|-----------------------|------|--------------------|-------------|------|--|
|                 |          | Hor            | Ver  |                   |           |           |                  | Hor                   | Ver  |                    | Hor         | Ver  |  |
| 24000.00        | PK       | 47.5           | 47.0 | 39.1              | -0.3      | 30.6      | -                | 55.7                  | 55.2 | 73.9               | 18.2        | 18.7 | Inside                                       |
| 24150.00        | PK       | 98.1           | 71.0 | 39.0              | -0.2      | 30.5      | -                | 106.4                 | 79.3 | 127.9              | 21.5        | 48.6 | Fundamental                                  |
| 24250.00        | PK       | 48.7           | 48.0 | 39.0              | -0.2      | 30.4      | -                | 57.1                  | 56.4 | 73.9               | 16.8        | 17.5 | Outside                                      |
| 48300.72        | PK       | 44.9           | 44.2 | 40.4              | -7.6      | 18.4      | -                | 59.3                  | 58.6 | 87.9               | 28.6        | 29.3 | Inside                                       |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier)

Peak with Duty factor

| Frequency [MHz] | Detector | Reading [dBuV] |      | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] |      | Limit dBuV/m | Margin [dB] |      | Remark      |
|-----------------|----------|----------------|------|-------------------|-----------|-----------|------------------|-----------------|------|--------------|-------------|------|-------------|
|                 |          | Hor            | Ver  |                   |           |           |                  | Hor             | Ver  |              | Hor         | Ver  |             |
| 24000.00        | PK       | 47.5           | 47.0 | 39.1              | -0.3      | 30.6      | -6.8             | 48.9            | 48.4 | 53.9         | 5.0         | 5.5  | Inside      |
| 24150.00        | PK       | 98.1           | 71.0 | 39.0              | -0.2      | 30.5      | -6.8             | 99.6            | 72.5 | 107.9        | 8.3         | 35.4 | Fundamental |
| 24250.00        | PK       | 48.7           | 48.0 | 39.0              | -0.2      | 30.4      | -6.8             | 50.3            | 49.6 | 53.9         | 3.6         | 4.3  | Outside     |
| 48300.72        | PK       | 44.9           | 44.2 | 40.4              | -7.6      | 18.4      | -6.8             | 52.5            | 51.8 | 67.9         | 15.4        | 16.1 | Inside      |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

**[Spurious emissions other than above]**

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark       |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|--------------|
| Hori     | 38.00           | QP       | 22.9           | 14.9            | 7.2       | 32.1      | 12.9            | 40.0           | 27.1        |              |
| Hori     | 120.00          | QP       | 23.2           | 12.9            | 8.3       | 32.0      | 12.4            | 43.5           | 31.1        |              |
| Hori     | 240.00          | QP       | 22.7           | 17.1            | 9.4       | 31.8      | 17.4            | 46.0           | 28.6        |              |
| Hori     | 480.00          | QP       | 23.0           | 19.2            | 11.1      | 31.9      | 21.4            | 46.0           | 24.6        |              |
| Hori     | 720.00          | QP       | 23.1           | 22.5            | 12.4      | 32.1      | 25.9            | 46.0           | 20.1        |              |
| Hori     | 960.00          | QP       | 23.0           | 25.9            | 13.6      | 30.9      | 31.6            | 46.0           | 14.4        |              |
| Hori     | 72451.00        | PK       | 12.1           | 41.7            | 13.6      | 4.9       | 62.5            | 87.9           | 25.4        | NS           |
| Hori     | 96601.44        | PK       | 15.0           | 45.6            | 8.2       | 28.9      | 39.9            | 73.9           | 34.0        | NS           |
| Hori     | 72451.00        | AV       | -0.1           | 41.7            | 13.6      | 4.9       | 50.3            | 67.9           | 17.6        | NS, VBW 10Hz |
| Hori     | 96601.44        | AV       | 2.6            | 45.6            | 8.2       | 28.9      | 27.5            | 53.9           | 26.4        | NS, VBW 10Hz |
| Vert     | 38.00           | QP       | 22.8           | 14.9            | 7.2       | 32.1      | 12.8            | 40.0           | 27.2        |              |
| Vert     | 120.00          | QP       | 23.3           | 12.9            | 8.3       | 32.0      | 12.5            | 43.5           | 31.0        |              |
| Vert     | 240.00          | QP       | 22.7           | 17.1            | 9.4       | 31.8      | 17.4            | 46.0           | 28.6        |              |
| Vert     | 480.00          | QP       | 22.9           | 19.2            | 11.1      | 31.9      | 21.3            | 46.0           | 24.7        |              |
| Vert     | 720.00          | QP       | 23.1           | 22.5            | 12.4      | 32.1      | 25.9            | 46.0           | 20.1        |              |
| Vert     | 960.00          | QP       | 23.1           | 25.9            | 13.6      | 30.9      | 31.7            | 46.0           | 14.3        |              |
| Vert     | 72451.00        | PK       | 12.5           | 41.7            | 13.6      | 4.9       | 62.9            | 87.9           | 25.0        | NS           |
| Vert     | 96601.44        | PK       | 15.5           | 45.6            | 8.2       | 28.9      | 40.4            | 73.9           | 33.5        | NS           |
| Vert     | 72451.00        | AV       | -0.1           | 41.7            | 13.6      | 4.9       | 50.3            | 67.9           | 17.6        | NS, VBW 10Hz |
| Vert     | 96601.44        | AV       | 2.6            | 45.6            | 8.2       | 28.9      | 27.5            | 53.9           | 26.4        | NS, VBW 10Hz |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Mixer(above 50 GHz)-Distance factor(above 10 GHz)) - Gain(Amplifier)

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

\*NS: No signal detected.

Distance factor:  
10 GHz - 26.5 GHz 20log (3.0 m / 1.0 m) = 9.5 dB  
26.5 GHz - 40 GHz 20log (3.0 m / 0.5 m) = 15.6 dB  
Above 50 GHz 20log (3.0 m / 0.05 m) = 35.6 dB

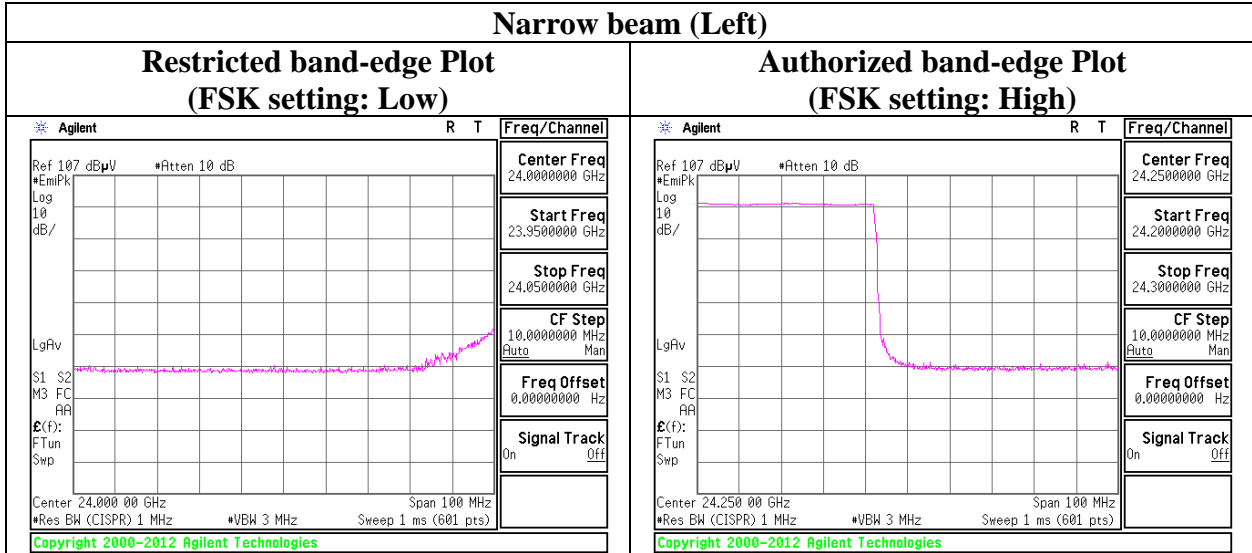
There are FM and FSK modulation part in one transmission burst. The FSK modulation hops to any frequencies per 80 ms in actual operation. The FSK frequency was fixed to lowest (24.06 GHz) or highest (24.24 GHz) for the purpose of band-edge measurement.

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

Test place : Ise EMC Lab. No. 4 Semi Anechoic Chamber  
Report No. : 10903739H  
Date : 08/07/2015  
Temperature / Humidity : 24 deg. C / 57 % RH  
Engineer : Hironobu Ohnishi  
Mode : Tx 24.15 GHz, Narrow beam (Left)



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



## Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

Report No. 10903739H  
Test place Ise EMC Lab.  
No. 4 Semi Anechoic Chamber    No. 4 Semi Anechoic Chamber    No. 3 Semi Anechoic Chamber    No. 3 Semi Anechoic Chamber    No. 3 Semi Anechoic Chamber  
Date 08/06/2015    08/24/2015    08/31/2015    09/02/2015    09/03/2015  
Temperature / Humidity 24 deg. C / 59 % RH    25 deg. C / 64 % RH    24 deg. C / 71 % RH    24 deg. C / 66 % RH    24 deg. C / 69 % RH  
18 GHz - 26.5 GHz    30 MHz - 18 GHz    26.5 GHz - 50 GHz    50 GHz - 100 GHz    9 kHz - 30 MHz  
Engineer Hironobu Ohnishi  
Mode Tx 24.15 GHz, Narrow beam (Right)

### [Fundamental, band-edge and 2nd harmonics]

**Peak**

| Frequency<br>[MHz] | Detector | Reading<br>[dBuV] |      | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result (3 m)<br>[dBuV/m] |      | Limit<br>(3 m)<br>dBuV/m | Margin<br>[dB] |      | Remark<br>Inside or Outside<br>of Restricted Bands |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------------|------|--------------------------|----------------|------|--|
|                    |          | Hor               | Ver  |                         |              |              |                        | Hor                      | Ver  |                          | Hor            | Ver  |  |
| 24000.00           | PK       | 47.1              | 46.6 | 39.1                    | -0.3         | 30.6         | -                      | 55.3                     | 54.8 | 73.9                     | 18.6           | 19.1 | Inside   |
| 24150.00           | PK       | 98.1              | 73.1 | 39.0                    | -0.2         | 30.5         | -                      | 106.4                    | 81.4 | 127.9                    | 21.5           | 46.5 | Fundamental  |
| 24250.00           | PK       | 49.3              | 47.6 | 39.0                    | -0.2         | 30.4         | -                      | 57.7                     | 56.0 | 73.9                     | 16.2           | 17.9 | Outside  |
| 48300.72           | PK       | 44.1              | 44.7 | 40.4                    | -7.6         | 18.4         | -                      | 58.5                     | 59.1 | 87.9                     | 29.4           | 28.8 | Inside   |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier)

**Peak with Duty factor**

| Frequency<br>[MHz] | Detector | Reading<br>[dBuV] |      | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] |      | Limit<br>dBuV/m | Margin<br>[dB] |      | Remark      |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-----------------|----------------|------|-------------|
|                    |          | Hor               | Ver  |                         |              |              |                        | Hor                | Ver  |                 | Hor            | Ver  |             |
| 24000.00           | PK       | 47.1              | 46.6 | 39.1                    | -0.3         | 30.6         | -6.8                   | 48.5               | 48.0 | 53.9            | 5.4            | 5.9  | Inside      |
| 24150.00           | PK       | 98.1              | 73.1 | 39.0                    | -0.2         | 30.5         | -6.8                   | 99.6               | 74.6 | 107.9           | 8.3            | 33.3 | Fundamental |
| 24250.00           | PK       | 49.3              | 47.6 | 39.0                    | -0.2         | 30.4         | -6.8                   | 50.9               | 49.2 | 53.9            | 3.0            | 4.7  | Outside     |
| 48300.72           | PK       | 44.1              | 44.7 | 40.4                    | -7.6         | 18.4         | -6.8                   | 51.7               | 52.3 | 67.9            | 16.2           | 15.6 | Inside      |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

### [Spurious emissions other than above]

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark       |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------------|
| Hori     | 38.00              | QP       | 23.0              | 14.9               | 7.2          | 32.1         | 13.0               | 40.0              | 27.0           |              |
| Hori     | 120.00             | QP       | 23.3              | 12.9               | 8.3          | 32.0         | 12.5               | 43.5              | 31.0           |              |
| Hori     | 240.00             | QP       | 22.6              | 17.1               | 9.4          | 31.8         | 17.3               | 46.0              | 28.7           |              |
| Hori     | 480.00             | QP       | 23.1              | 19.2               | 11.1         | 31.9         | 21.5               | 46.0              | 24.5           |              |
| Hori     | 720.00             | QP       | 23.1              | 22.5               | 12.4         | 32.1         | 25.9               | 46.0              | 20.1           |              |
| Hori     | 960.00             | QP       | 23.0              | 25.9               | 13.6         | 30.9         | 31.6               | 46.0              | 14.4           |              |
| Hori     | 72451.00           | PK       | 12.0              | 41.7               | 13.6         | 4.9          | 62.4               | 87.9              | 25.5           | NS           |
| Hori     | 96601.44           | PK       | 15.7              | 45.6               | 8.2          | 28.9         | 40.6               | 73.9              | 33.3           | NS           |
| Hori     | 72451.00           | AV       | -0.1              | 41.7               | 13.6         | 4.9          | 50.3               | 67.9              | 17.6           | NS, VBW 10Hz |
| Hori     | 96601.44           | AV       | 2.6               | 45.6               | 8.2          | 28.9         | 27.5               | 53.9              | 26.4           | NS, VBW 10Hz |
| Vert     | 38.00              | QP       | 23.0              | 14.9               | 7.2          | 32.1         | 13.0               | 40.0              | 27.0           |              |
| Vert     | 120.00             | QP       | 23.3              | 12.9               | 8.3          | 32.0         | 12.5               | 43.5              | 31.0           |              |
| Vert     | 240.00             | QP       | 22.7              | 17.1               | 9.4          | 31.8         | 17.4               | 46.0              | 28.6           |              |
| Vert     | 480.00             | QP       | 23.0              | 19.2               | 11.1         | 31.9         | 21.4               | 46.0              | 24.6           |              |
| Vert     | 720.00             | QP       | 23.1              | 22.5               | 12.4         | 32.1         | 25.9               | 46.0              | 20.1           |              |
| Vert     | 960.00             | QP       | 23.0              | 25.9               | 13.6         | 30.9         | 31.6               | 46.0              | 14.4           |              |
| Vert     | 72451.00           | PK       | 11.6              | 41.7               | 13.6         | 4.9          | 62.0               | 87.9              | 25.9           | NS           |
| Vert     | 96601.44           | PK       | 15.1              | 45.6               | 8.2          | 28.9         | 40.0               | 73.9              | 33.9           | NS           |
| Vert     | 72451.00           | AV       | -0.1              | 41.7               | 13.6         | 4.9          | 50.3               | 67.9              | 17.6           | NS, VBW 10Hz |
| Vert     | 96601.44           | AV       | 2.6               | 45.6               | 8.2          | 28.9         | 27.5               | 53.9              | 26.4           | NS, VBW 10Hz |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Mixer(above 50 GHz)-Distance factor(above 10 GHz)) - Gain(Amplifier)

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

\*NS: No signal detected.

Distance factor:  
10 GHz - 26.5 GHz    20log(3.0 m / 1.0 m) = 9.5 dB  
26.5 GHz - 40 GHz    20log(3.0 m / 0.5 m) = 15.6 dB  
Above 50 GHz        20log(3.0 m / 0.05 m) = 35.6 dB

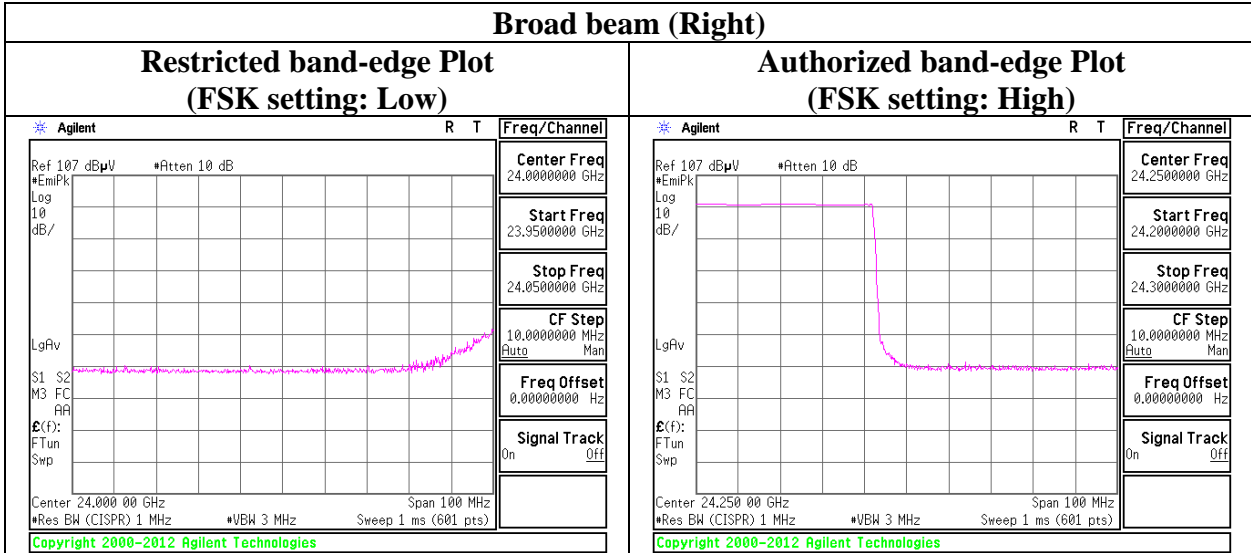
There are FM and FSK modulation part in one transmission burst. The FSK modulation hops to any frequencies per 80 ms in actual operation. The FSK frequency was fixed to lowest (24.06 GHz) or highest (24.24 GHz) for the purpose of band-edge measurement.

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

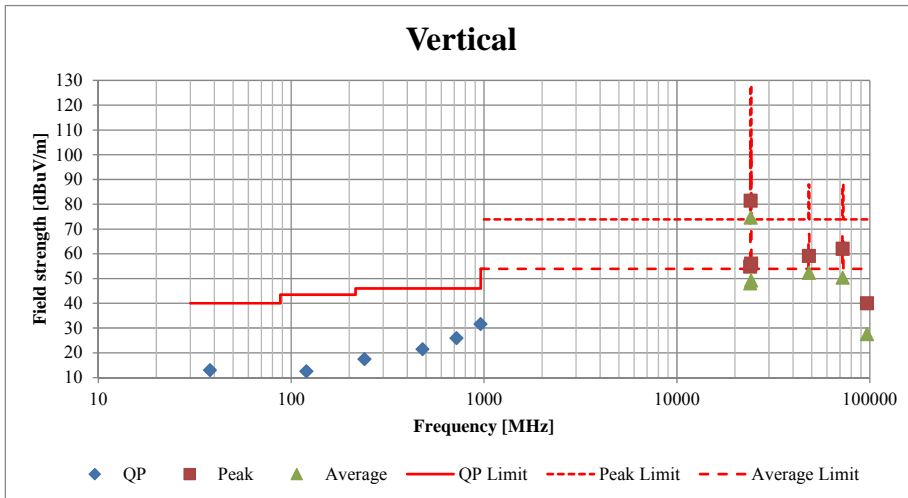
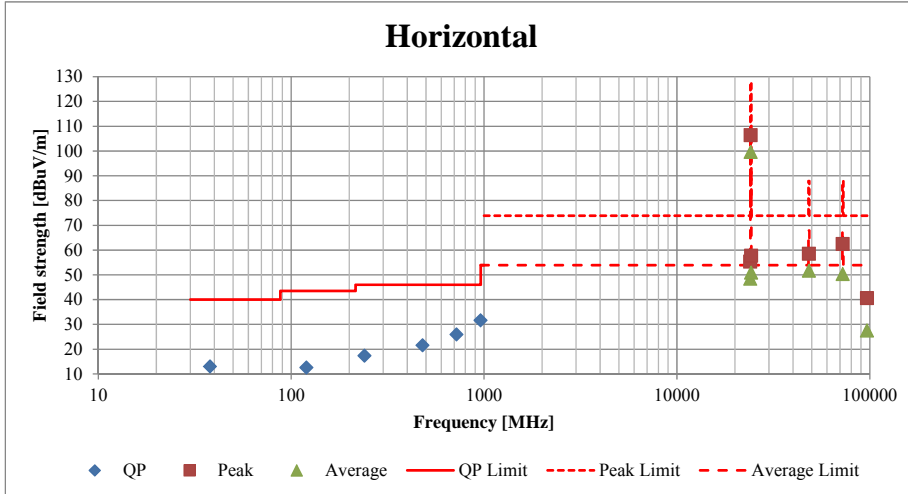
Test place : Ise EMC Lab. No. 4 Semi Anechoic Chamber  
Report No. : 10903739H  
Date : 08/07/2015  
Temperature / Humidity : 24 deg. C / 57 % RH  
Engineer : Hironobu Ohnishi  
Mode : Tx 24.15 GHz, Narrow beam (Right)



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

**Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)**

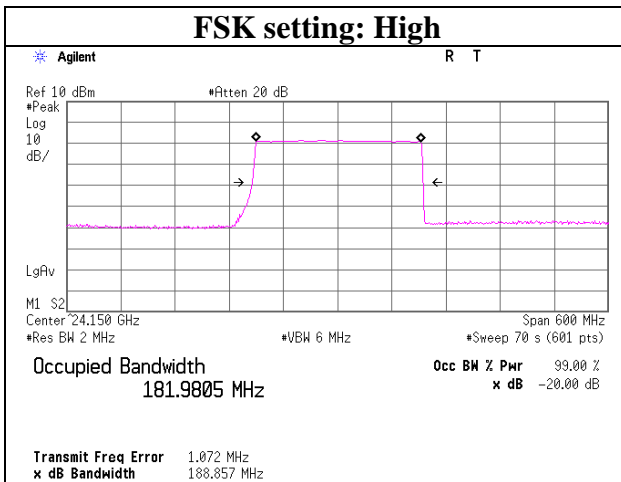
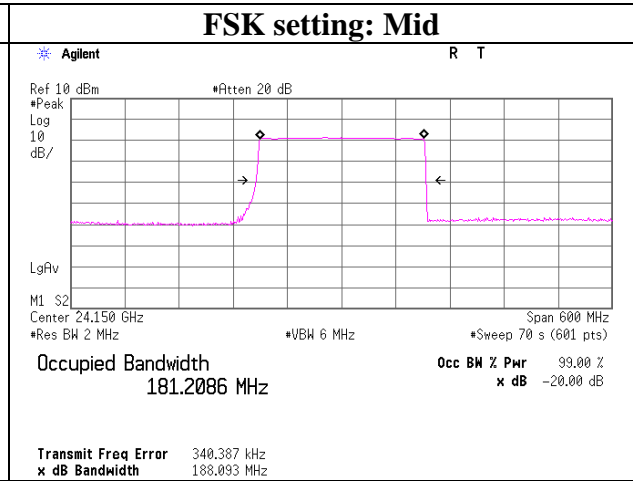
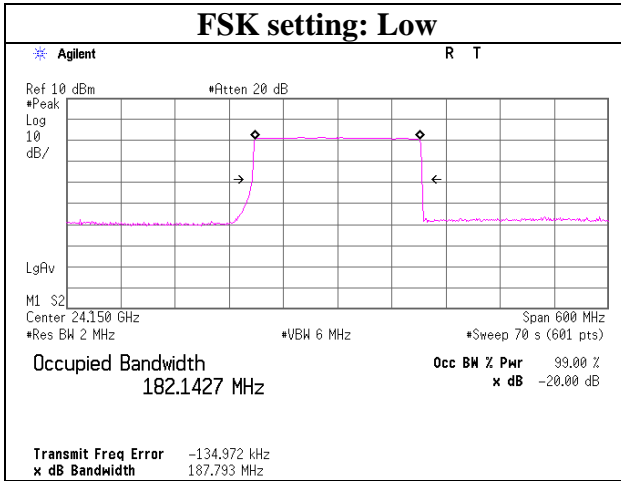
|               |                                   |                  |                   |                  |                  |
|---------------|-----------------------------------|------------------|-------------------|------------------|------------------|
| Report No.    | 10903739H                         |                  |                   |                  |                  |
| Test place    | Ise EMC Lab.                      |                  |                   |                  |                  |
|               | No. 4 Semi                        | No. 4 Semi       | No. 3 Semi        | No. 3 Semi       | No. 3 Semi       |
|               | Anechoic Chamber                  | Anechoic Chamber | Anechoic Chamber  | Anechoic Chamber | Anechoic Chamber |
| Date          | 08/06/2015                        | 08/24/2015       | 08/31/2015        | 09/02/2015       | 09/03/2015       |
| Temperature / | 24 deg. C /                       | 25 deg. C /      | 24 deg. C /       | 24 deg. C /      | 24 deg. C /      |
| Humidity      | 59 % RH                           | 64 % RH          | 71 % RH           | 66 % RH          | 69 % RH          |
|               | 18 GHz - 26.5 GHz                 | 30 MHz - 18 GHz  | 26.5 GHz - 50 GHz | 50 GHz - 100 GHz | 9 kHz - 30 MHz   |
| Engineer      | Hironobu Ohnishi                  |                  |                   |                  |                  |
| Mode          | Tx 24.15 GHz, Narrow beam (Right) |                  |                   |                  |                  |



**20dB Bandwidth, 99% Occupied Bandwidth**

Test place : Ise EMC Lab. No. 4 Semi Anechoic Chamber  
 Report No. : 10903739H  
 Date : 08/07/2015  
 Temperature/ Humidity : 24 deg. C / 57 % RH  
 Engineer : Hironobu Ohnishi  
 Mode : Tx 24.15 GHz, Broad beam

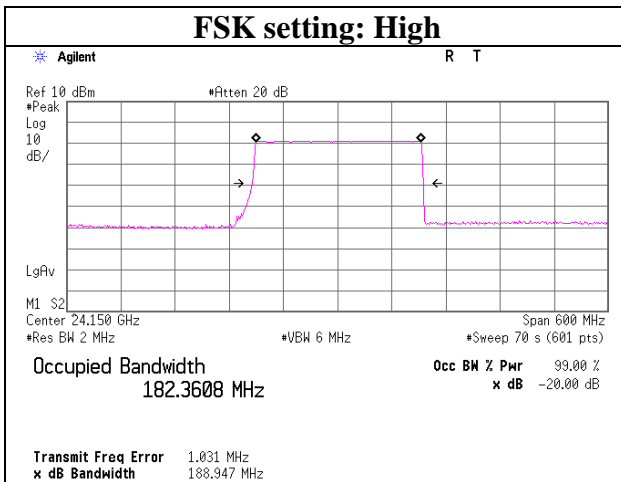
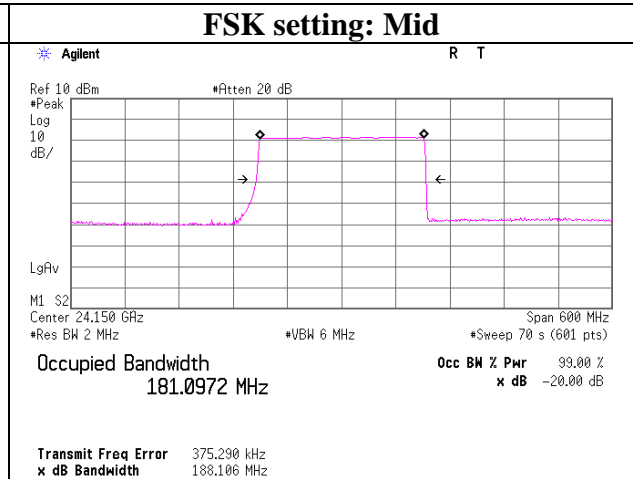
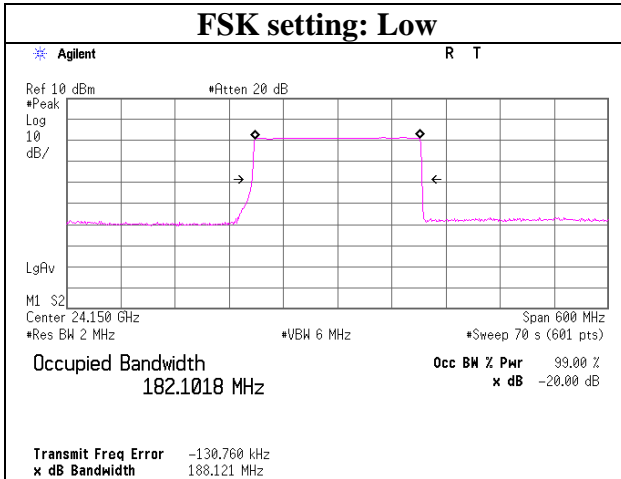
| Frequency<br>[GHz] | FSK setting<br>[GHz] | 20 dB<br>Bandwidth<br>[MHz] | 99% Occupied<br>Bandwidth<br>[MHz] |
|--------------------|----------------------|-----------------------------|------------------------------------|
| 24.15              | 24.06                | 187.793                     | 182.1427                           |
| 24.15              | 24.15                | 188.093                     | 181.2086                           |
| 24.15              | 24.24                | 188.857                     | 181.9805                           |



**20dB Bandwidth, 99% Occupied Bandwidth**

Test place : Ise EMC Lab. No. 4 Semi Anechoic Chamber  
Report No. : 10903739H  
Date : 08/07/2015  
Temperature/ Humidity : 24 deg. C / 57 % RH  
Engineer : Hironobu Ohnishi  
Mode : Tx 24.15 GHz, Narrow beam (Left)

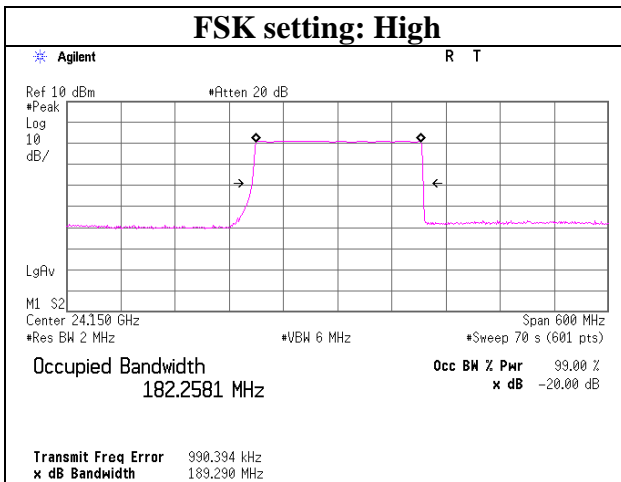
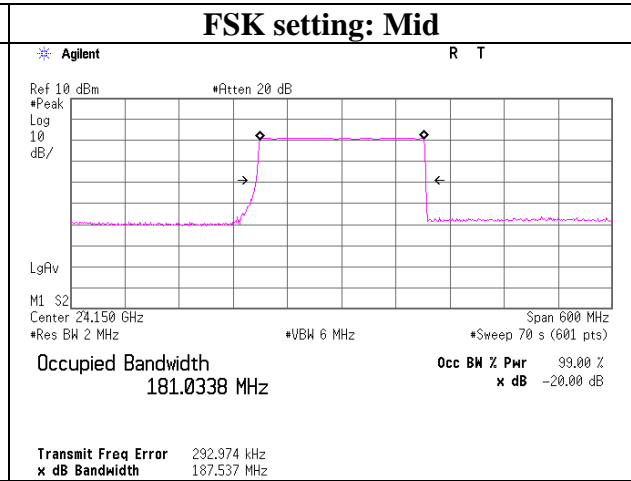
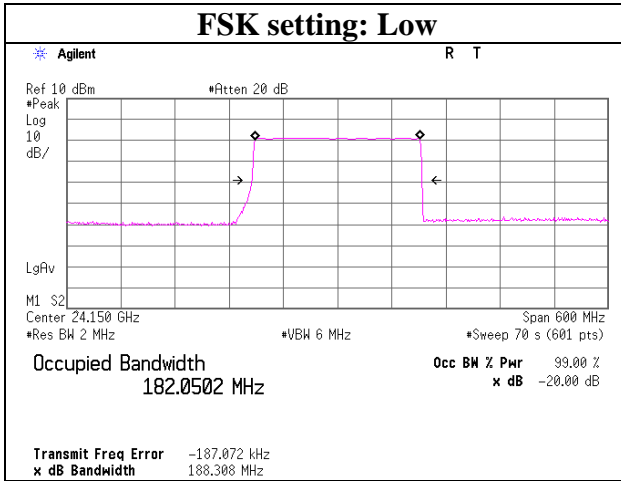
| Frequency<br>[GHz] | FSK setting<br>[GHz] | 20 dB<br>Bandwidth<br>[MHz] | 99% Occupied<br>Bandwidth<br>[MHz] |
|--------------------|----------------------|-----------------------------|------------------------------------|
| 24.15              | 24.06                | 188.121                     | 182.1018                           |
| 24.15              | 24.15                | 188.106                     | 181.0972                           |
| 24.15              | 24.24                | 188.947                     | 182.3608                           |



**20dB Bandwidth, 99% Occupied Bandwidth**

Test place : Ise EMC Lab. No. 4 Semi Anechoic Chamber  
Report No. : 10903739H  
Date : 08/07/2015  
Temperature/ Humidity : 24 deg. C / 57 % RH  
Engineer : Hironobu Ohnishi  
Mode : Tx 24.15 GHz, Narrow beam (Right)

| Frequency<br>[GHz] | FSK setting<br>[GHz] | 20 dB<br>Bandwidth<br>[MHz] | 99% Occupied<br>Bandwidth<br>[MHz] |
|--------------------|----------------------|-----------------------------|------------------------------------|
| 24.15              | 24.06                | 188.308                     | 182.0502                           |
| 24.15              | 24.15                | 187.537                     | 181.0338                           |
| 24.15              | 24.24                | 189.290                     | 182.2581                           |



### Duty Cycle

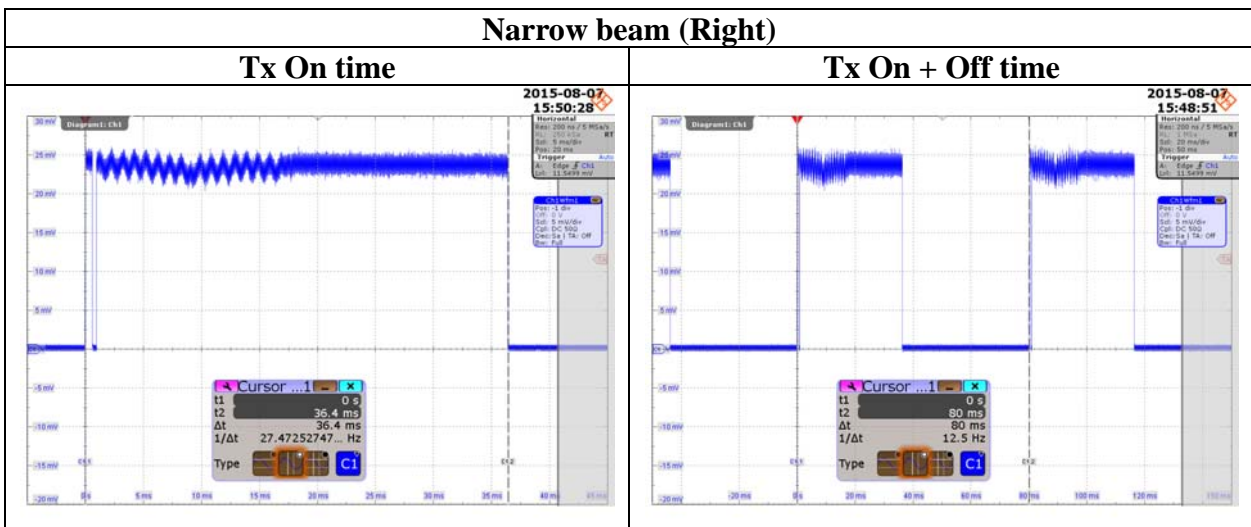
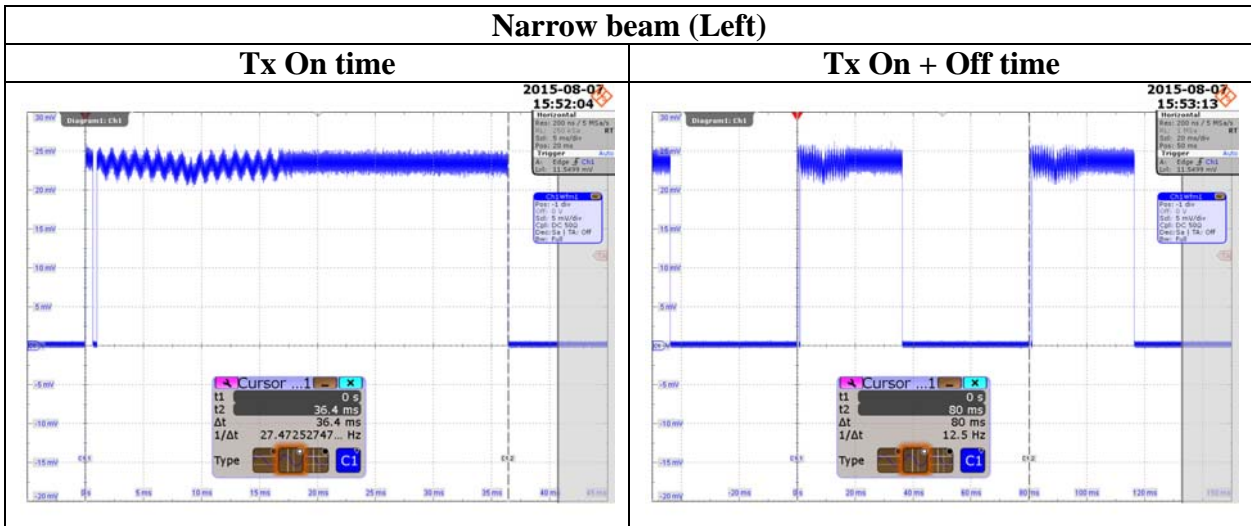
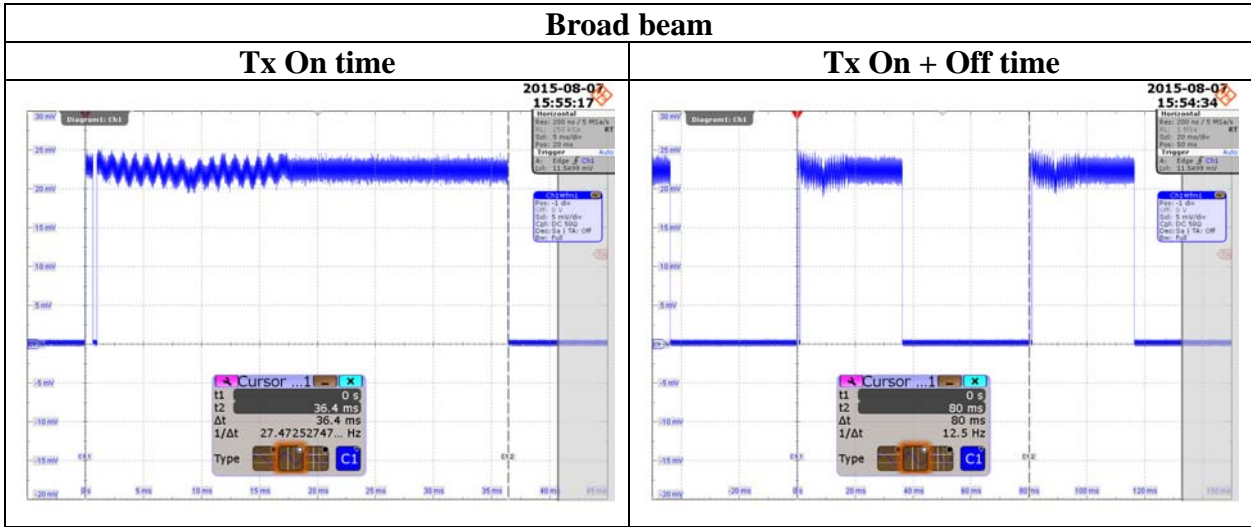
Test place Ise EMC Lab. No. 4 Semi Anechoic Chamber  
Report No. 10903739H  
Date 08/07/2015  
Temperature/ Humidity 24 deg. C / 57 % RH  
Engineer Hironobu Ohnishi  
Mode Tx 24.15 GHz

| Mode                | Tx On time<br>[ms] | Tx On + Off time<br>[ms] | Duty factor<br>[dB] |
|---------------------|--------------------|--------------------------|---------------------|
| Broad beam          | 36.4               | 80.0                     | -6.8                |
| Narrow beam (Left)  | 36.4               | 80.0                     | -6.8                |
| Narrow beam (Right) | 36.4               | 80.0                     | -6.8                |

Duty factor =  $20 * \log (\text{Tx On time} / \text{Tx On} + \text{Off time})$

This Duty Cycle is the worst case. Transmitting time does not exceed it.

## Duty Cycle





## APPENDIX 2: Test Instruments

### EMI test equipment (1/2)

| 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        | 2015/02/26 * 12                       |
| MOS-15      | Thermo-Hygrometer                | Custom                  | CTH-180                  | 1501                            | RE        | 2015/01/13 * 12                       |
| MJM-23      | Measure                          | ASKUL                   | -                        | -                               | RE        | -                                     |
| MLDM-04     | Digital laser distance meter     | BOSCH                   | DLE 50                   | 781422774                       | RE        | 2013/06/26 * 36                       |
| MMM-10      | DIGITAL HiTESTER                 | Hioki                   | 3805                     | 051201148                       | RE        | 2015/01/16 * 12                       |
| COTS-MEMI   | EMI measurement program          | TSJ                     | TEPTO-DV                 | -                               | RE        |                                       |
| MSA-04      | Spectrum Analyzer                | Agilent                 | E4448A                   | US44300523                      | RE        | 2014/11/12 * 12                       |
| MCC-141     | Microwave Cable                  | Junkosha                | MWX221                   | 1305S002R(1m) /<br>1405S146(5m) | RE        | 2015/06/22 * 12                       |
| MPA-11      | MicroWave System Amplifier       | Agilent                 | 83017A                   | MY39500779                      | RE        | 2015/03/19 * 12                       |
| MHA-17      | Horn Antenna 15-40GHz            | Schwarzbeck             | BBHA9170                 | BBHA9170307                     | RE        | 2015/06/06 * 12                       |
| MDO-07      | Digital Oscilloscope             | Rohde & Schwarz         | RTO1004                  | 200354                          | RE        | 2015/07/10 * 12                       |
| MDT-05      | Detector                         | HEROTEK, INC.           | DT1840P                  | 484823                          | RE        | Pre Check                             |
| MTR-01      | Test Receiver                    | Rohde & Schwarz         | ESI40                    | 100084                          | RE        | 2014/11/10 * 12                       |
| MBA-05      | Biconical Antenna                | Schwarzbeck             | BBA9106                  | 1302                            | RE        | 2014/11/22 * 12                       |
| MLA-08      | Logperiodic Antenna              | Schwarzbeck             | UKLP9140-A               | N/A                             | RE        | 2014/11/22 * 12                       |
| MCC-50      | Coaxial Cable                    | UL Japan                | -                        | -                               | RE        | 2015/06/19 * 12                       |
| MAT-68      | Attenuator                       | Anritsu                 | MP721B                   | 6200961025                      | RE        | 2014/11/11 * 12                       |
| MPA-14      | Pre Amplifier                    | SONOMA INSTRUMENT       | 310                      | 260833                          | RE        | 2015/03/09 * 12                       |
| MHA-06      | Horn Antenna 1-18GHz             | Schwarzbeck             | BBHA9120D                | 254                             | RE        | 2015/02/05 * 12                       |
| MPA-12      | MicroWave System Amplifier       | Agilent                 | 83017A                   | MY39500780                      | RE        | 2015/03/12 * 12                       |
| MAEC-03     | Semi Anechoic Chamber(NSA)       | TDK                     | Semi Anechoic Chamber 3m | DA-10005                        | RE        | 2015/02/19 * 12                       |
| MOS-13      | Thermo-Hygrometer                | Custom                  | CTH-180                  | 1301                            | RE        | 2015/01/13 * 12                       |
| MJM-16      | Measure                          | KOMELON                 | KMC-36                   | -                               | RE        | -                                     |
| MMM-08      | DIGITAL HiTESTER                 | Hioki                   | 3805                     | 051201197                       | RE        | 2015/01/16 * 12                       |
| MSA-10      | Spectrum Analyzer                | Agilent                 | E4448A                   | MY46180655                      | RE        | 2015/02/26 * 12                       |
| MCC-140     | Microwave Cable                  | Junkosha                | J12J101596-00            | JAN-31-12-001                   | RE        | 2015/02/23 * 12                       |
| MPA-03      | Microwave System Power Amplifier | Agilent                 | 83050A                   | 3950M00205                      | RE        | 2015/06/02 * 12                       |
| MHA-03      | Horn Antenna 26.5-40GHz          | EMCO                    | 3160-10                  | 1150                            | RE        | 2015/06/06 * 12                       |
| MPA-07      | Pre Amplifier                    | UNITEK ELECTROBICS INC. | Amp1G                    | 20040901                        | RE        | 2015/06/25 * 12                       |
| MHA-09      | Horn Antenna                     | WiseWave                | ARH1523-02               | 10766-01                        | RE        | 2014/10/31 * 12                       |
| MPA-08      | Pre Amplifier                    | WiseWave                | ALN-61226028-51          | 11576-01-071                    | RE        | 2015/08/25 * 12                       |
| MMX-01      | Preselected Millimeter Mixer     | Agilent                 | 11974V-E01               | 3001A00412                      | RE        | 2015/06/29 * 12                       |
| MHA-11      | Horn Antenna                     | WiseWave                | ARH1023-02               | 10766-01                        | RE        | 2014/10/31 * 12                       |
| MPA-18      | Pre Amplifier                    | AmTechs Corporation     | LNA-7511025              | 9601                            | RE        | 2015/08/25 * 12                       |
| MMX-02      | Harmonic Mixer                   | Agilent                 | 11970W                   | 2521 A01909                     | RE        | 2015/06/29 * 12                       |

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**EMI test equipment (2/2)**

| Control No. | Instrument      | Manufacturer         | Model No  | Serial No  | Test Item | Calibration Date *<br>Interval(month) |
|-------------|-----------------|----------------------|---|------------|-----------|---------------------------------------|
| MCC-135     | Microwave Cable | HUBER+SUHNER         | SUCOFLEX102   | 37511/2    | RE        | 2015/08/04 * 12                       |
| MCC-136     | Microwave Cable | HUBER+SUHNER         | SUCOFLEX102   | 37512/2    | RE        | 2015/08/04 * 12                       |
| MTR-03      | Test Receiver   | Rohde & Schwarz      | ESCI  | 100300     | RE        | 2015/06/08 * 12                       |
| MLPA-01     | Loop Antenna    | Rohde & Schwarz      | HFH2-Z2   | 100017     | RE        | 2014/10/04 * 12                       |
| MCC-112     | Coaxial cable   | Fujikura/Suhner/TSJ  | 5D-2W(10m)/<br>SFM141(3m)/<br>sucoform141-PE(1m)/<br>421-010(1.5m)/<br>RFM-E321(Switcher) | -/00640    | RE        | 2015/07/02 * 12                       |
| MCC-143     | Coaxial Cable   | UL Japan             | -   | -          | RE        | 2015/06/24 * 12                       |
| MPA-13      | Pre Amplifier   | SONOMA<br>INSTRUMENT | 310   | 260834     | RE        | 2015/03/10 * 12                       |
| MAT-70      | Attenuator(6dB) | Agilent              | 8491A-006   | MY52460153 | RE        | 2015/04/08 * 12                       |

The expiration date of the calibration is the end of the expired month.

**[Below 40 GHz]**

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

**[Above 40 GHz]**

Acceptance criteria for untraceable equipment was formulated according to ISO/IEC 17025 5.6.2.2.2, and the regular inspection was performed based on it annually.

For 40 GHz – 110 GHz, power sensor is calibrated by manufacturer, and the measured calibration data is used as in-house reference. The calibration data by manufacturer is checked for acceptance by a calorie meter except for some frequency bands. Electric power is checked with the calorie meter by measuring resistance and voltage of reference resistor.

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, Bandwidth and Duty cycle tests**

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