



# **RADIO TEST REPORT**

**Test Report No. : 11350077H-B-R1**

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

**Type of Equipment** : Communication Module

**Model No.** : LBEE5UW1FS

**FCC ID** : VPYLB1FS

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

**Test Result** : Complied

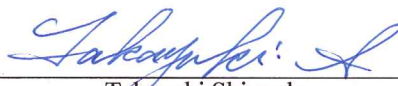
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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
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6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11350077H-B. 11350077H-B is replaced with this report.

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

**Representative test engineer:**

  
Satofumi Matsuyama  
Engineer  
Consumer Technology Division

**Approved by:**

  
Takayuki Shimada  
Engineer  
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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

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13-EM-F0429

## REVISION HISTORY

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

[illegible]

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## **SECTION 1: Customer information**

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

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

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

Type of Equipment	:	Communication Module
Model No.	:	LBEE5UW1FS
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.3 V
Receipt Date of Sample	:	June 24, 2016
Country of Mass-production	:	Japan and China
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

### **2.2 Product Description**

Model: LBEE5UW1FS (referred to as the EUT in this report) is a Communication Module.

### **General Specification**

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

## **Radio Specification**

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

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

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

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

\*This test report applies for Bluetooth part.

<Contents of the change from original model>

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

Specification was changed from the original model as follows:

\*Antenna of the EUT was modified.

The radio specification is identical to the original.

Therefore only Radiated Spurious Emission test was performed in this report.

Additionally, only the information of modified antenna is described in this report.

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

#### **3.1 Test Specification**

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

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

#### **3.2 Procedures and results**

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Spurious Emission & Band Edge Compliance	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.13	FCC: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	6.2 dB 660.001 MHz, QP, Hori.	Complied	Conducted/ Radiated (above 30 MHz) *1)

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

\*1) Radiated test was selected over 30 MHz based on section 15.247(d).

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

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

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

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

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

### 3.3 Addition to standard

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

### 3.4 Uncertainty

#### EMI

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

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

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

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

\*Measurement distance

#### Radiated emission test

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

### 3.5 Test Location

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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.

**UL Japan, Inc.**

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

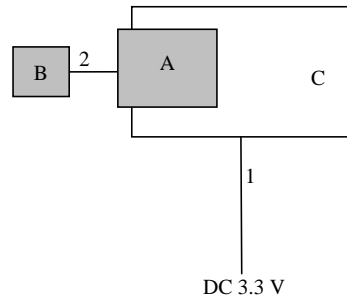
### **4.1 Operating Mode(s)**

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

Details of Operating Mode(s)

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

## 4.2 Configuration and peripherals



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

### Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Communication Module	LBEE5UW1FS	00003eee2b	Murata Manufacturing Co., Ltd.	EUT
B	Antenna	Type1CH	001	Murata Manufacturing Co., Ltd.	EUT
C	Jig Board	P2ML4233	-	Murata Manufacturing Co., Ltd.	-

### List of cables used

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

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

### **Test Procedure**

[For below 1GHz]

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

[For above 1GHz]

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

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

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

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

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

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

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

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

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz *1)	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	4.0 m *2) (1 GHz – 10 GHz), 4.45 m *3) (1 GHz – 10 GHz), 1 m *4) (10 GHz – 26.5 GHz)		4.0 m *2) (1 GHz – 10 GHz), 4.45 m *3) (1 GHz – 10 GHz), 1 m *4) (10 GHz – 26.5 GHz)

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

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

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

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

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT (Module and Antenna) to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

<b>Measurement range</b>	<b>: 30 M - 26.5 GHz</b>
<b>Test data</b>	<b>: APPENDIX</b>
<b>Test result</b>	<b>: Pass</b>

## APPENDIX 1: Test data

### Radiated Spurious Emission

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

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

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

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

Distance factor: 1 GHz - 10 GHz  $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	106.7	27.1	5.8	36.3	103.3	-	-	Carrier
Hori	2400.000	PK	47.8	27.1	5.8	36.3	44.4	83.3	38.9	
Vert	2402.000	PK	104.6	27.1	5.8	36.3	101.2	-	-	Carrier
Vert	2400.000	PK	44.9	27.1	5.8	36.3	41.5	81.2	39.7	

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

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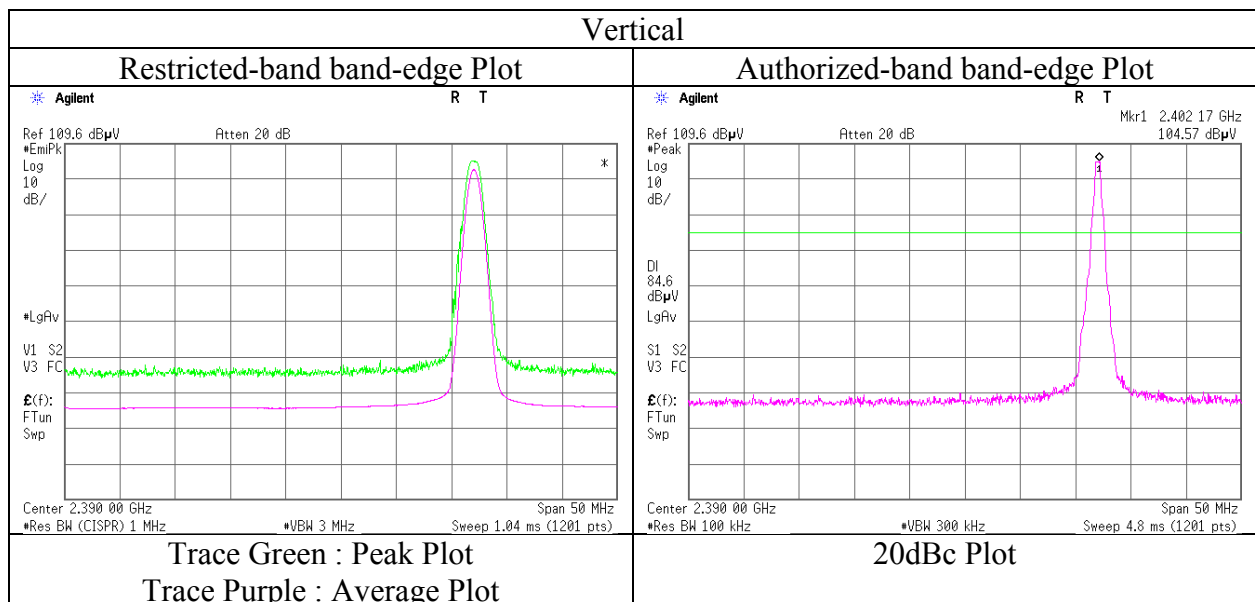
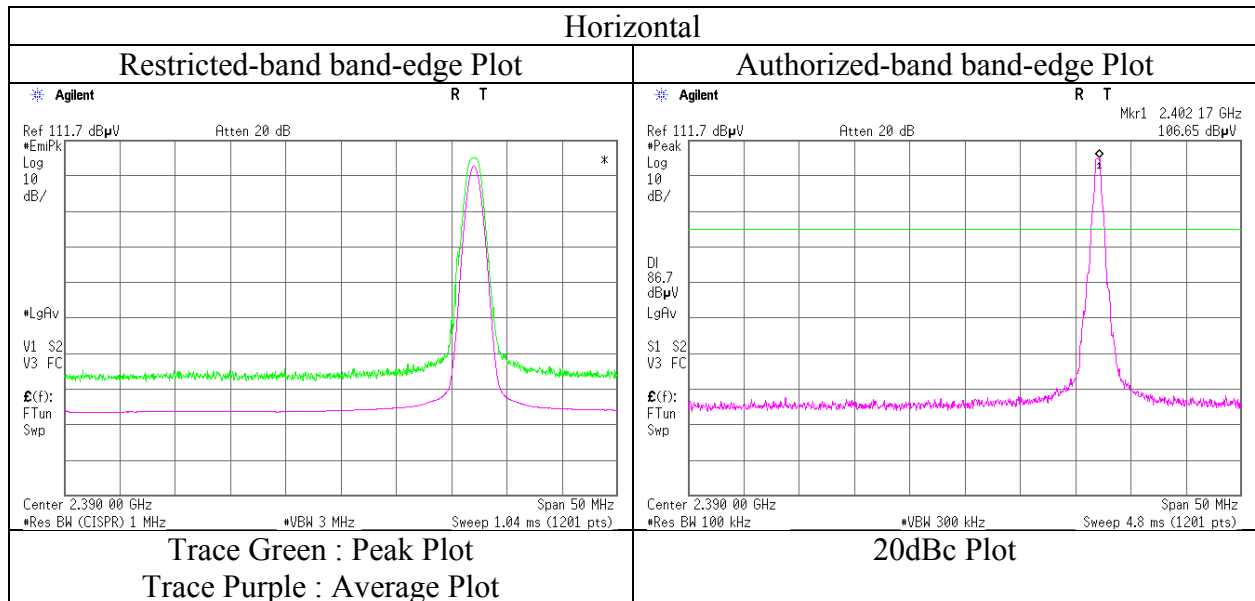
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## Radiated Spurious Emission (Reference Plot for band-edge)

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



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

**UL Japan, Inc.**

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## Radiated Spurious Emission

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

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

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

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

Distance factor:      1 GHz - 10 GHz       $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$   
                                 10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

## Radiated Spurious Emission

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

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

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

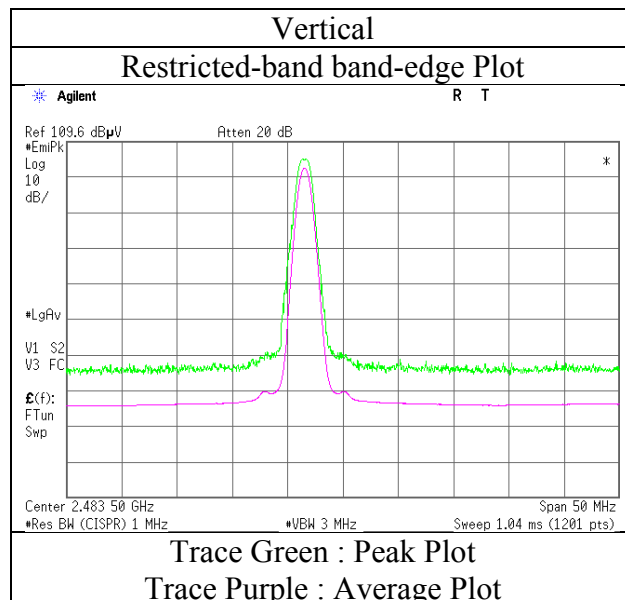
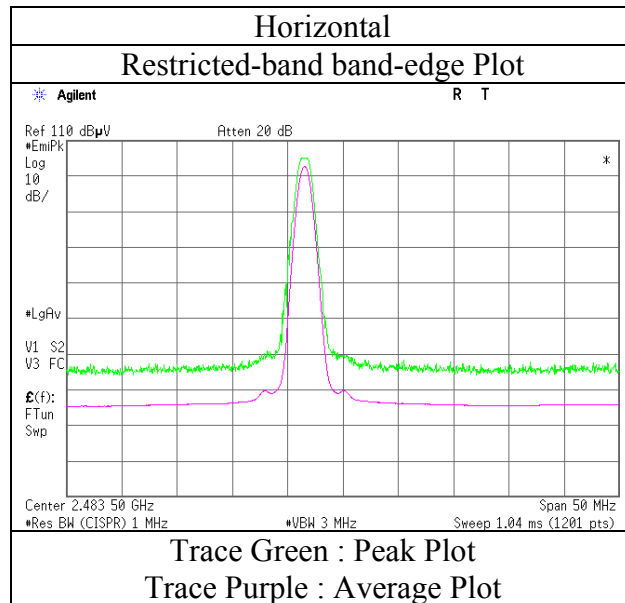
\*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor:      1 GHz - 10 GHz      20log (4.0 m / 3.0 m) = 2.5 dB  
                             10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB



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

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11350077H
Date	July 11, 2016
Temperature / Humidity	25 deg. C / 64 % RH
Engineer	Satofumi Matsuyama
Mode	Tx, Hopping Off, DH5 2480 MHz



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

## Radiated Spurious Emission

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

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

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

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

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

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

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

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

**20dBc Data Sheet**

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	98.6	26.7	6.7	32.7	99.3	-	-	Carrier
Hori	2400.000	PK	41.1	26.7	6.7	32.7	41.8	79.3	37.5	
Vert	2402.000	PK	95.5	26.7	6.7	32.7	96.2	-	-	Carrier
Vert	2400.000	PK	38.7	26.7	6.7	32.7	39.4	76.2	36.8	

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

**UL Japan, Inc.**

**Ise EMC Lab.**

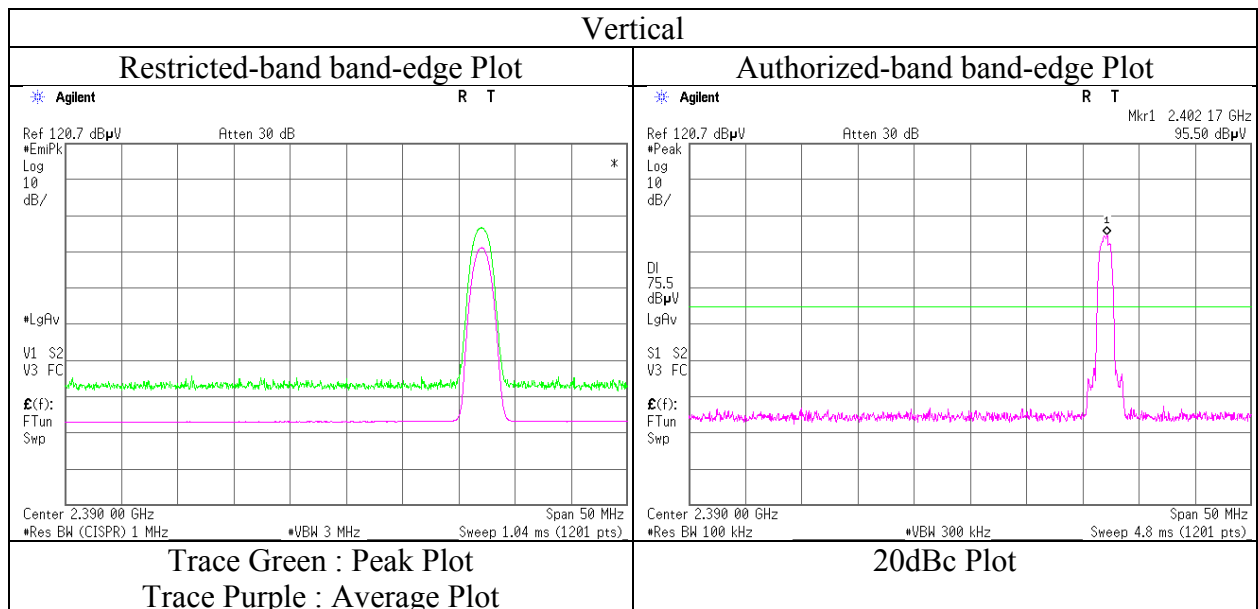
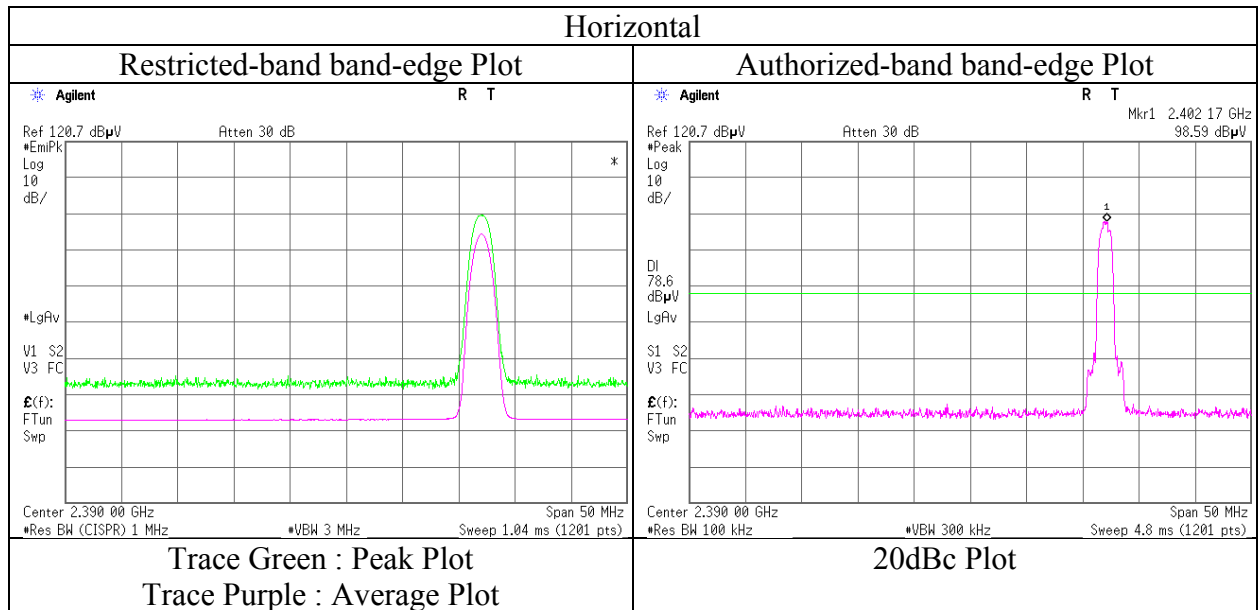
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

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



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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Radiated Spurious Emission

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

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

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

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

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

## Radiated Spurious Emission

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

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

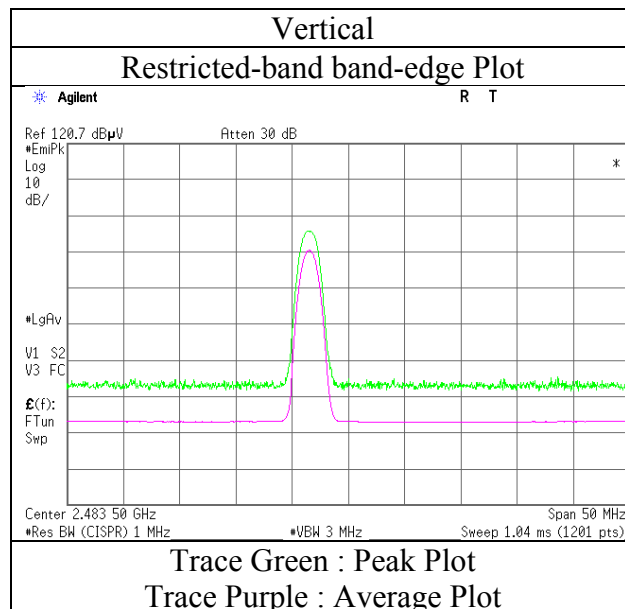
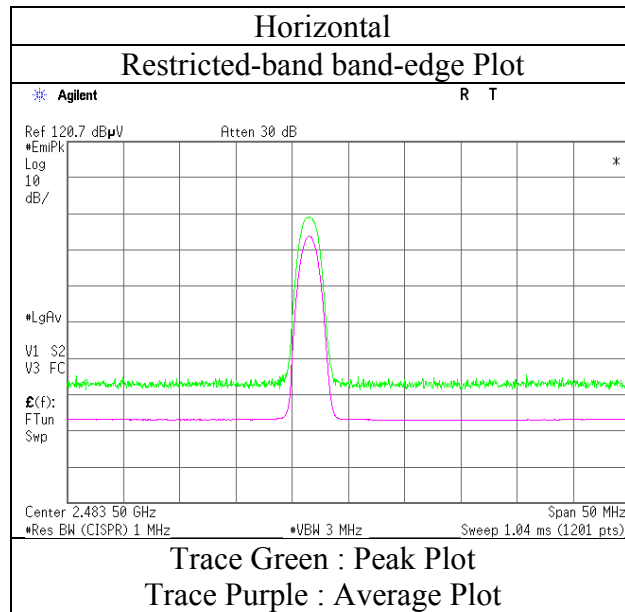
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

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

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

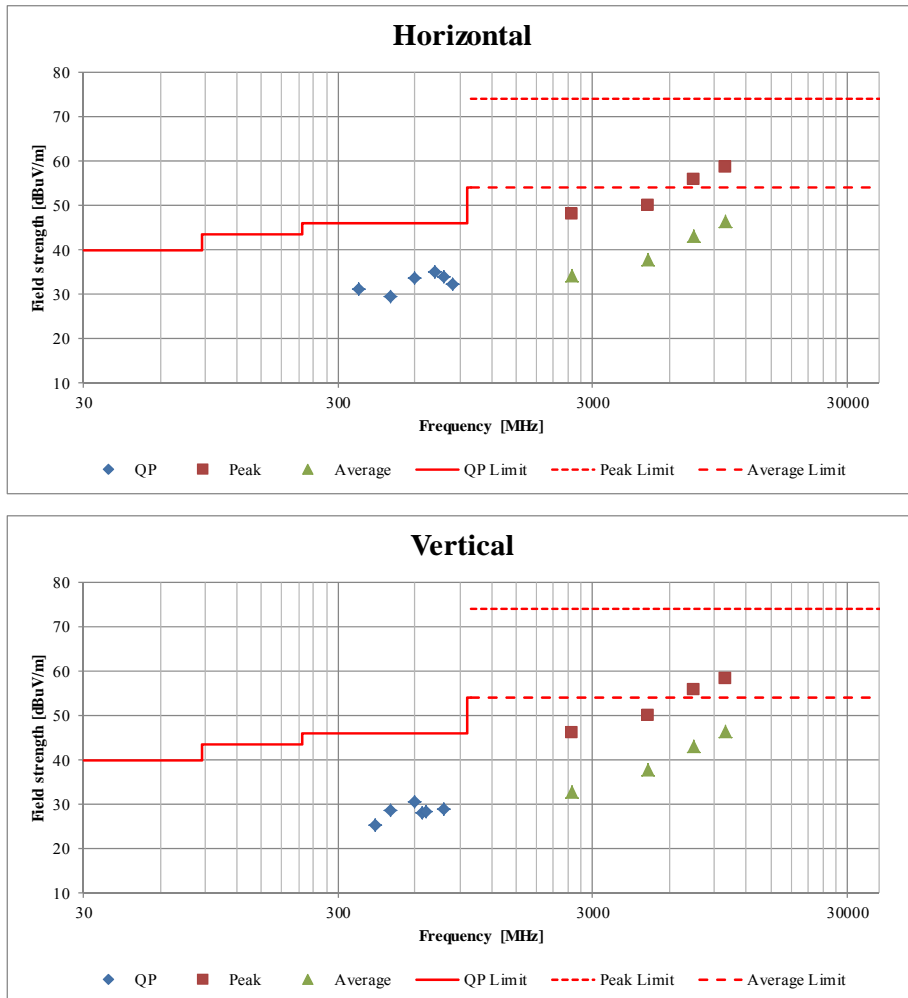
Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber  
Report No. : 11350077H  
Date : June 29, 2016  
Temperature / Humidity : 23 deg. C / 69 % RH  
Engineer : Tomoki Matsui  
(1-10GHz)  
Mode : Tx, Hopping Off, 3DH5 2480 MHz



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

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

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



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

## APPENDIX 2: Test instruments

### Test equipment

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

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

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

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

Test Item: RE: Radiated Emission test

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