



RADIO TEST REPORT

Test Report No. : 11350077H-A-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
*WLAN, Bluetooth Low Energy parts
(Class II permissive change)
*Radiated Spurious Emission test only
Test Result : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11350077H-A. 11350077H-A is replaced with this report.

Date of test: June 29 to July 13, 2016

Representative test engineer:

S. Matsuyama

Satofumi Matsuyama

Engineer

Consumer Technology Division

Approved by:

Takayuki Shimada

Takayuki Shimada

Engineer

Consumer Technology Division



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

UL Japan, Inc.

Ise EMC Lab.

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 11350077H-A

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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.)

2.1 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 WLAN and Bluetooth Low Energy parts.

<Contents of the change from original model>

Test Report Number of original model is 10936450H-A-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 Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v03r05	FCC: Section15.247(d)	1.4 dB 2483.500 MHz, AV, Hori.	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)
	IC: RSS-Gen 6.13	IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

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

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

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

FCC Part 15.31 (e)

This EUT provides stable voltage (DC 1.2 V) 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 ($\pm$ dB) 9 kHz - 30 MHz
3m	3.8 dB
10m	3.7 dB

Polarity	Radiated emission (Below 1GHz)			
	(3 m*)($\pm$ dB)		(10 m*)($\pm$ 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*)($\pm$ dB)		(1 m*)($\pm$ dB)		(10 m*)($\pm$ 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

Radiated emission test

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

3.5 Test Location

UL Japan, Inc. Ise EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

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

Mode	Remarks*
IEEE 802.11b (11b)	11 Mbps, PN9
IEEE 802.11g (11g)	54 Mbps, PN9
IEEE 802.11n SISO 20MHz BW (11n-20)	MCS 6, PN9
Bluetooth(BT) Low Energy (LE)	Maximum Packet Size, PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Low Channel)	
*The power value of the EUT was set for testing as follows (setting value might be different from product specification value); Power settings: WLAN 9 dBm BT LE 5 dBm Software: MFG Tool v1.0 *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.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Spurious Emission above 1GHz (Radiated)	11b Tx	2412MHz
	11g Tx *2)	2437MHz
		2462MHz
	BT LE Tx	2402MHz
		2440MHz
		2480MHz
Band edge of Spurious Emission above 1GHz (Radiated)	11n-20 Tx *3)	2412MHz
		2462MHz
Spurious Emission below 1GHz (Radiated)	11g Tx *1)	2412MHz
	BT LE Tx	2402MHz
		2440MHz
		2480MHz

*1) The operating mode and tested frequency were tested as a representative, because it had the highest power at antenna terminal test.

*2) Since 11g and 11n-20 have the same modulation method and no differences in transmitting specification, test was performed on the representative mode that had the highest peak output power

*3) Only band edge test was tested on this mode, because the 11g Tx mode had the higher power at antenna terminal test.

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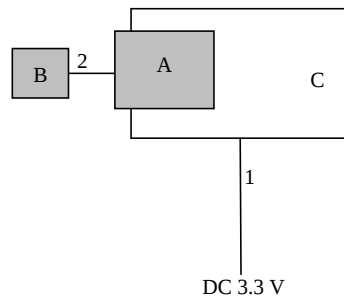
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4.2 Configuration and peripherals



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

Description of EUT 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

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

[For below 1 GHz]

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

[For above 1 GHz]

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

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

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

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

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

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

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

Test Antennas are used as below;

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *4)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces If duty cycle was less than 98%, a duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	4.0 m *1) (1 GHz – 10 GHz), 4.45 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)		4.0 m *1) (1 GHz – 10 GHz), 4.45 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)

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

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

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

*4) Average Power Measurement was performed based on 6. 0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r05"

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

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

Measurement range	: 30 M - 26.5 GHz
Test data	: APPENDIX
Test result	: Pass

APPENDIX 1: Test data

Radiated Spurious Emission

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 11350077H
Date : July 11, 2016 July 13, 2016
Temperature / Humidity : 25 deg. C / 64 % RH 24 deg. C / 66 % RH
Engineer : Satofumi Matsuyama Kazuya Yoshioka
(1-10GHz) (10-26.5GHz)
Mode : Tx 11b 2412 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2390.000	PK	48.6	27.1	5.8	36.3	-	45.2	73.9	28.7	
Hori	4824.000	PK	42.6	31.1	8.1	35.6	-	46.2	73.9	27.7	Floor noise
Hori	7236.000	PK	41.2	35.7	9.3	35.8	-	50.4	73.9	23.5	Floor noise
Hori	9648.000	PK	44.8	37.3	10.1	36.2	-	56.0	73.9	17.9	Floor noise
Hori	2390.000	AV	39.9	27.1	5.8	36.3	0.4	36.9	53.9	17.0	*1)
Hori	4824.000	AV	34.5	31.1	8.1	35.6	-	38.1	53.9	15.8	Floor noise
Hori	7236.000	AV	34.1	35.7	9.3	35.8	-	43.3	53.9	10.6	Floor noise
Hori	9648.000	AV	36.1	37.3	10.1	36.2	-	47.3	53.9	6.6	Floor noise
Vert	2390.000	PK	48.9	27.1	5.8	36.3	-	45.5	73.9	28.4	
Vert	4824.000	PK	43.1	31.1	8.1	35.6	-	46.7	73.9	27.2	Floor noise
Vert	7236.000	PK	42.7	35.7	9.3	35.8	-	51.9	73.9	22.0	Floor noise
Vert	9648.000	PK	45.1	37.3	10.1	36.2	-	56.3	73.9	17.6	Floor noise
Vert	2390.000	AV	40.0	27.1	5.8	36.3	0.4	37.0	53.9	16.9	*1)
Vert	4824.000	AV	34.5	31.1	8.1	35.6	-	38.1	53.9	15.8	Floor noise
Vert	7236.000	AV	34.1	35.7	9.3	35.8	-	43.3	53.9	10.6	Floor noise
Vert	9648.000	AV	36.1	37.3	10.1	36.2	-	47.3	53.9	6.6	Floor noise

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

*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 $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*1) Not Out of Band emission(Leakage Power)

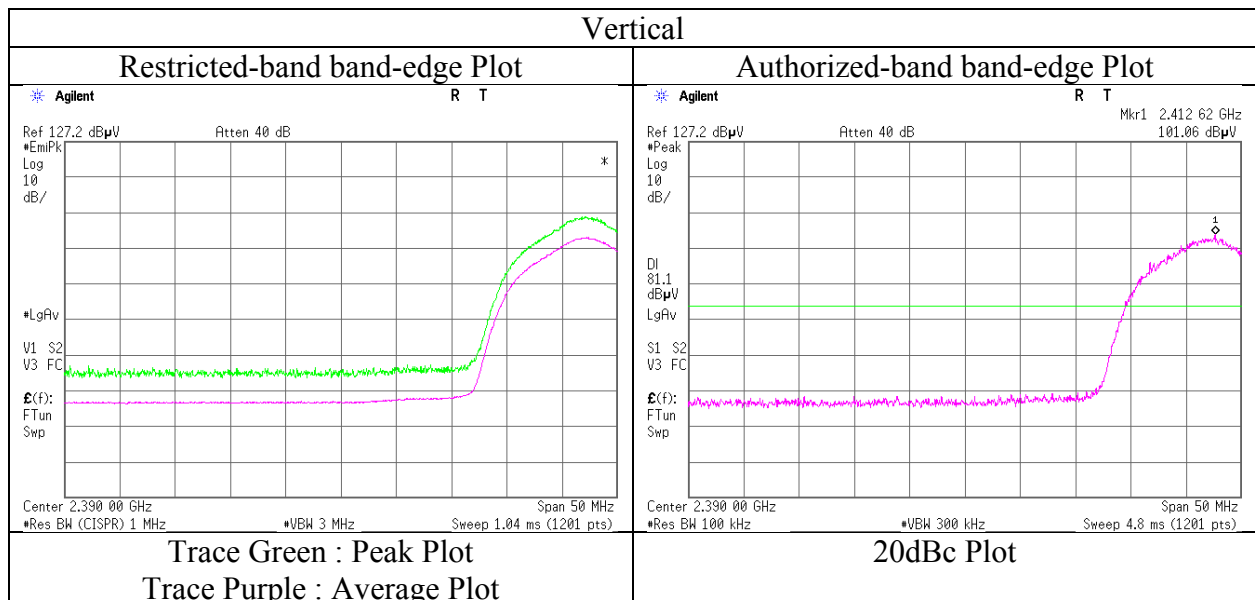
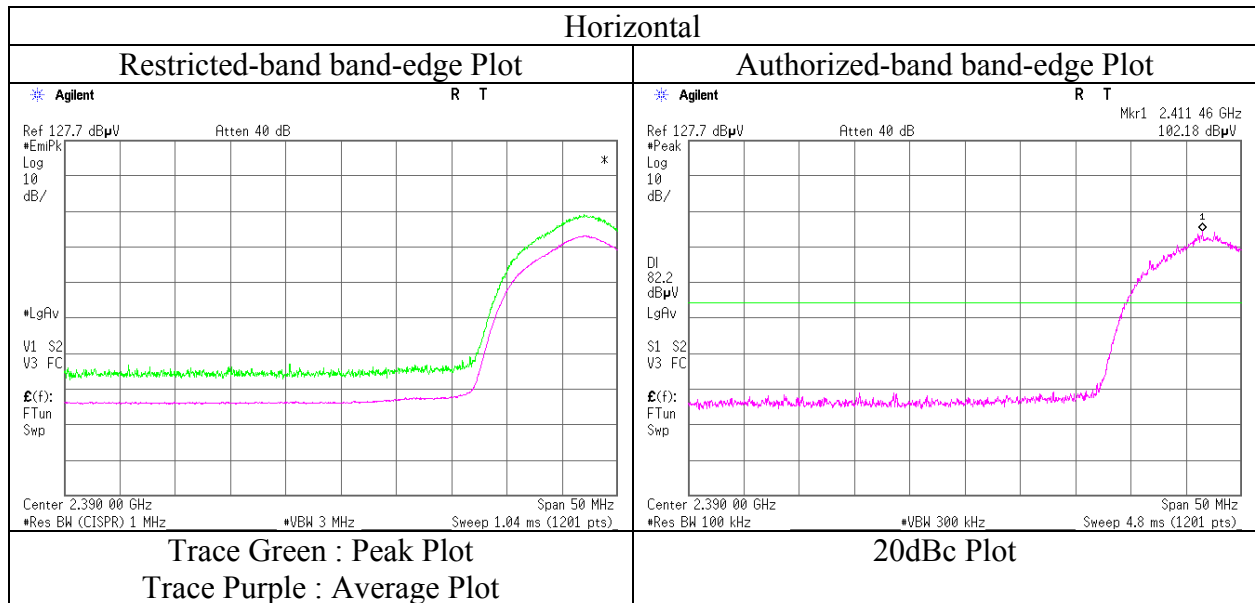
20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	101.3	27.1	5.8	36.3	97.9	-	-	Carrier
Hori	2400.000	PK	51.3	27.1	5.8	36.3	47.9	77.9	30.0	
Vert	2412.000	PK	101.9	27.1	5.8	36.3	98.5	-	-	Carrier
Vert	2400.000	PK	51.8	27.1	5.8	36.3	48.4	78.5	30.1	

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

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11350077H
Date	July 11, 2016
Temperature / Humidity	25 deg. C / 64 % RH
Engineer	Satofumi Matsuyama
Mode	Tx 11b 2412 MHz



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

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 11350077H
Date : July 11, 2016 July 13, 2016
Temperature / Humidity : 25 deg. C / 64 % RH 24 deg. C / 66 % RH
Engineer : Satofumi Matsuyama Kazuya Yoshioka
(1-10GHz) (10-26.5GHz)
Mode : Tx 11b 2437 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4874.000	PK	43.1	31.2	8.1	35.5	-	46.9	73.9	27.0	Floor noise
Hori	7311.000	PK	43.6	35.6	9.3	35.8	-	52.7	73.9	21.2	Floor noise
Hori	9748.000	PK	43.9	37.2	10.2	36.3	-	55.0	73.9	18.9	Floor noise
Hori	4874.000	AV	33.9	31.2	8.1	35.5	-	37.7	53.9	16.2	Floor noise
Hori	7311.000	AV	34.8	35.6	9.3	35.8	-	43.9	53.9	10.0	Floor noise
Hori	9748.000	AV	35.3	37.2	10.2	36.3	-	46.4	53.9	7.5	Floor noise
Vert	4874.000	PK	42.7	31.2	8.1	35.5	-	46.5	73.9	27.4	Floor noise
Vert	7311.000	PK	43.2	35.6	9.3	35.8	-	52.3	73.9	21.6	Floor noise
Vert	9748.000	PK	44.2	37.2	10.2	36.3	-	55.3	73.9	18.6	Floor noise
Vert	4874.000	AV	33.9	31.2	8.1	35.5	-	37.7	53.9	16.2	Floor noise
Vert	7311.000	AV	34.8	35.6	9.3	35.8	-	43.9	53.9	10.0	Floor noise
Vert	9748.000	AV	35.3	37.2	10.2	36.3	-	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 $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
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
Temperature / Humidity : 25 deg. C / 64 % RH 24 deg. C / 66 % RH
Engineer : Satofumi Matsuyama Kazuya Yoshioka
(1-10GHz) (10-26.5GHz)
Mode : Tx 11b 2462 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2483.500	PK	48.2	27.2	5.8	36.3	-	44.9	73.9	29.0	
Hori	4924.000	PK	42.9	31.3	8.0	35.5	-	46.7	73.9	27.2	Floor noise
Hori	7386.000	PK	43.4	35.6	9.2	35.8	-	52.4	73.9	21.5	Floor noise
Hori	9848.000	PK	43.6	37.1	10.2	36.3	-	54.6	73.9	19.3	Floor noise
Hori	2483.500	AV	38.7	27.2	5.8	36.3	0.4	35.8	53.9	18.1	*1)
Hori	4924.000	AV	37.6	31.3	8.0	35.5	-	41.4	53.9	12.5	Floor noise
Hori	7386.000	AV	34.7	35.6	9.2	35.8	-	43.7	53.9	10.2	Floor noise
Hori	9848.000	AV	35.4	37.1	10.2	36.3	-	46.4	53.9	7.5	Floor noise
Vert	2483.500	PK	47.9	27.2	5.8	36.3	-	44.6	73.9	29.3	
Vert	4924.000	PK	42.4	31.3	8.0	35.5	-	46.2	73.9	27.7	Floor noise
Vert	7386.000	PK	43.3	35.6	9.2	35.8	-	52.3	73.9	21.6	Floor noise
Vert	9848.000	PK	43.7	37.1	10.2	36.3	-	54.7	73.9	19.2	Floor noise
Vert	2483.500	AV	38.2	27.2	5.8	36.3	0.4	35.3	53.9	18.6	*1)
Vert	4924.000	AV	37.6	31.3	8.0	35.5	-	41.4	53.9	12.5	Floor noise
Vert	7386.000	AV	34.7	35.6	9.2	35.8	-	43.7	53.9	10.2	Floor noise
Vert	9848.000	AV	35.4	37.1	10.2	36.3	-	46.4	53.9	7.5	Floor noise

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

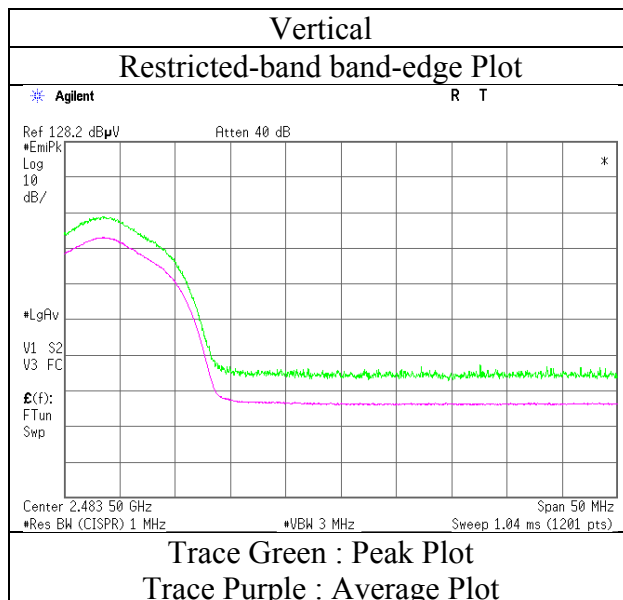
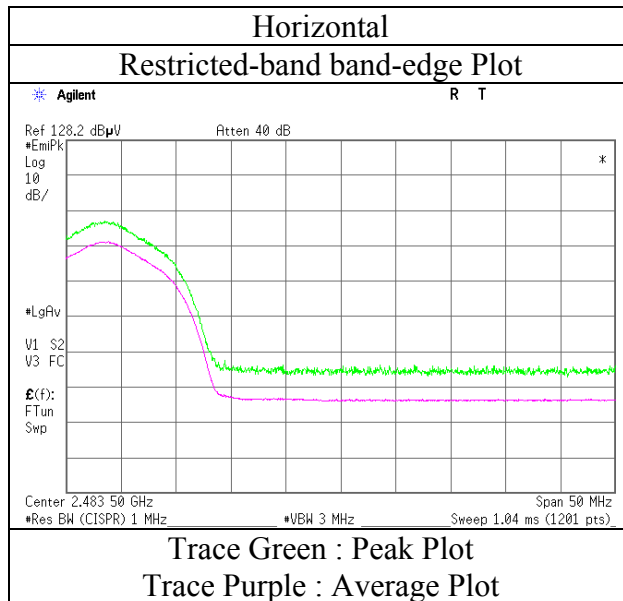
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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

*1) Not Out of Band emission(Leakage Power)

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 11b 2462 MHz



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

Radiated Spurious Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber		
Report No.	11350077H		
Date	June 29, 2016	June 29, 2016	June 30, 2016
Temperature / Humidity	23 deg. C / 69 % RH	23 deg. C / 72 % RH	23 deg. C / 62 % RH
Engineer	Tomoki Matsui	Satofumi Matsuyama	Tomoki Matsui
	(1-10GHz)	(Above 10GHz)	(Below 1GHz)
Mode	Tx 11g 2412 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	360.000	QP	34.9	14.8	10.3	31.9	-	28.1	46.0	17.9	
Hori	480.000	QP	31.8	17.2	11.0	31.9	-	28.1	46.0	17.9	
Hori	600.000	QP	34.8	19.1	11.9	32.0	-	33.8	46.0	12.2	
Hori	660.000	QP	36.5	19.5	12.2	32.1	-	36.1	46.0	9.9	
Hori	780.000	QP	31.7	20.6	12.8	31.6	-	33.5	46.0	12.5	
Hori	840.000	QP	27.9	21.3	13.1	31.3	-	31.0	46.0	15.0	
Hori	2390.000	PK	63.3	26.7	6.7	32.7	-	64.0	73.9	9.9	
Hori	3618.000	PK	43.4	28.6	7.6	32.1	-	47.5	73.9	26.4	
Hori	4824.000	PK	39.9	31.1	9.0	31.8	-	48.2	73.9	25.7	Floor noise
Hori	7236.000	PK	41.2	35.7	10.2	32.6	-	54.5	73.9	19.4	Floor noise
Hori	9648.000	PK	43.4	37.2	9.5	33.3	-	56.8	73.9	17.1	Floor noise
Hori	2390.000	AV	48.7	26.7	6.7	32.7	1.8	51.2	53.9	2.7	*1)
Hori	3618.000	AV	36.1	28.6	7.6	32.1	-	40.2	53.9	13.7	
Hori	4824.000	AV	31.2	31.1	9.0	31.8	-	39.5	53.9	14.4	Floor noise
Hori	7236.000	AV	32.8	35.7	10.2	32.6	-	46.1	53.9	7.8	Floor noise
Hori	9648.000	AV	33.8	37.2	9.5	33.3	-	47.2	53.9	6.7	Floor noise
Vert	360.000	QP	27.6	14.8	10.3	31.9	-	20.8	46.0	25.2	
Vert	480.000	QP	33.0	17.2	11.0	31.9	-	29.3	46.0	16.7	
Vert	600.000	QP	32.0	19.1	11.9	32.0	-	31.0	46.0	15.0	
Vert	660.000	QP	31.4	19.5	12.2	32.1	-	31.0	46.0	15.0	
Vert	780.000	QP	25.6	20.6	12.8	31.6	-	27.4	46.0	18.6	
Vert	840.000	QP	23.9	21.3	13.1	31.3	-	27.0	46.0	19.0	
Vert	2390.000	PK	61.9	26.7	6.7	32.7	-	62.6	73.9	11.3	
Vert	3618.000	PK	42.0	28.6	7.6	32.1	-	46.1	73.9	27.8	
Vert	4824.000	PK	39.8	31.1	9.0	31.8	-	48.1	73.9	25.8	Floor noise
Vert	7236.000	PK	40.5	35.7	10.2	32.6	-	53.8	73.9	20.1	Floor noise
Vert	9648.000	PK	43.5	37.2	9.5	33.3	-	56.9	73.9	17.0	Floor noise
Vert	2390.000	AV	46.4	26.7	6.7	32.7	1.8	48.9	53.9	5.0	*1)
Vert	3618.000	AV	35.5	28.6	7.6	32.1	-	39.6	53.9	14.3	
Vert	4824.000	AV	31.1	31.1	9.0	31.8	-	39.4	53.9	14.5	Floor noise
Vert	7236.000	AV	32.6	35.7	10.2	32.6	-	45.9	53.9	8.0	Floor noise
Vert	9648.000	AV	34.0	37.2	9.5	33.3	-	47.4	53.9	6.5	Floor noise

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

*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 $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	97.1	26.7	6.7	32.7	97.8	-	-	Carrier
Hori	2400.000	PK	60.7	26.7	6.7	32.7	61.4	77.8	16.4	
Vert	2412.000	PK	94.4	26.7	6.7	32.7	95.1	-	-	Carrier
Vert	2400.000	PK	58.2	26.7	6.7	32.7	58.9	75.1	16.2	

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

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Ise EMC Lab.

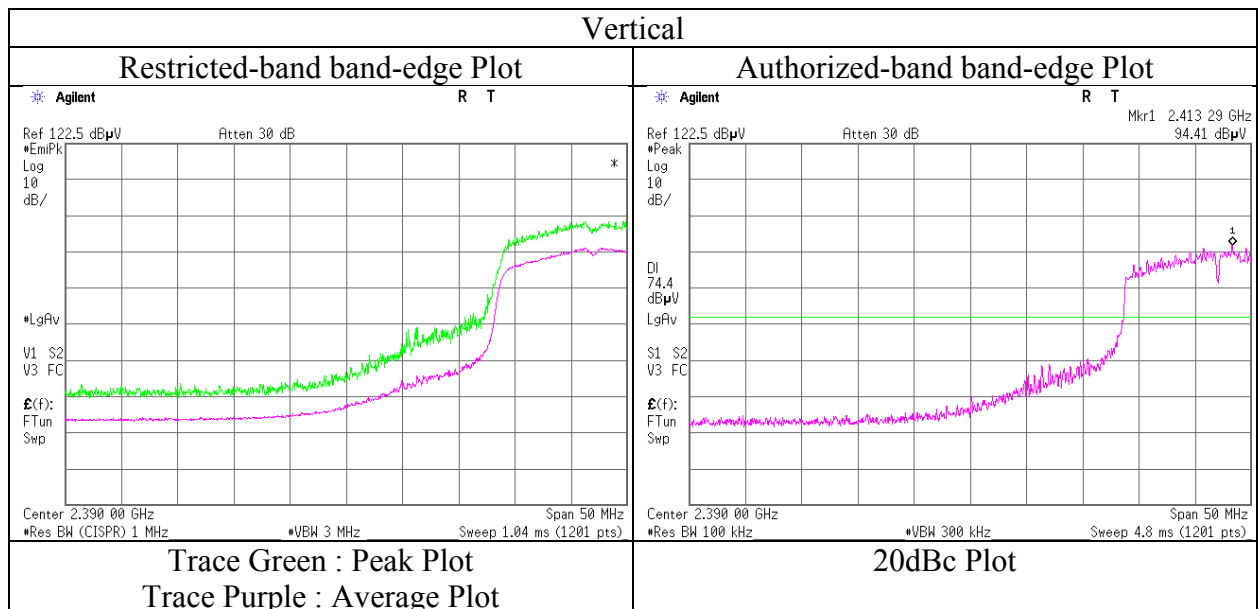
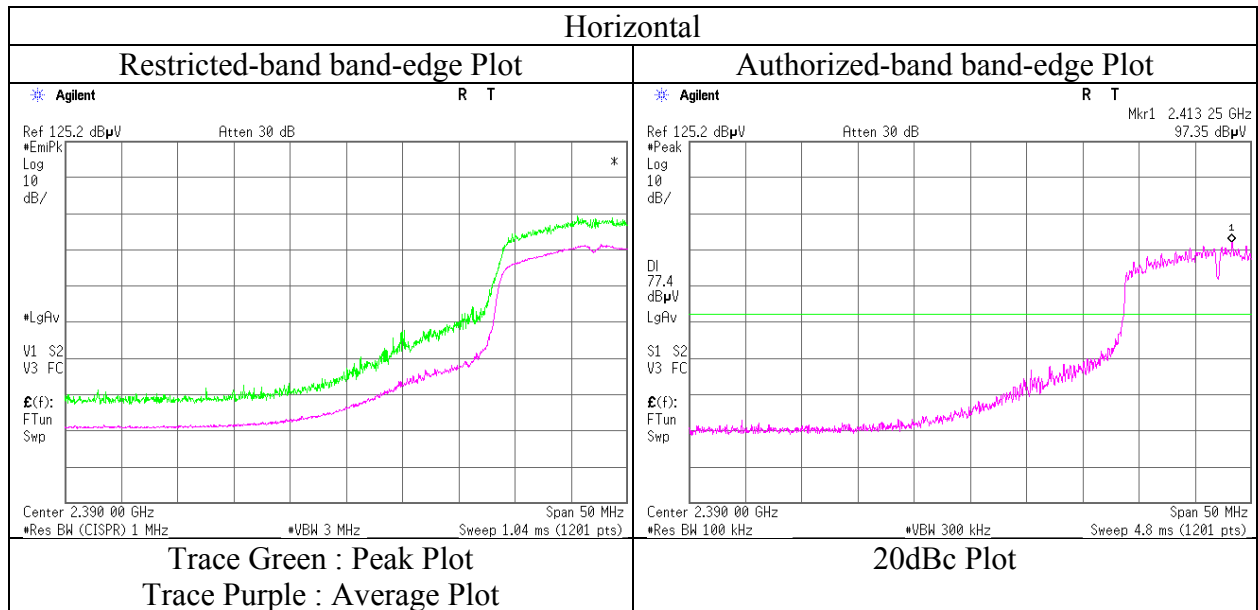
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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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 11g 2412 MHz



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

UL Japan, Inc.

Ise EMC Lab.

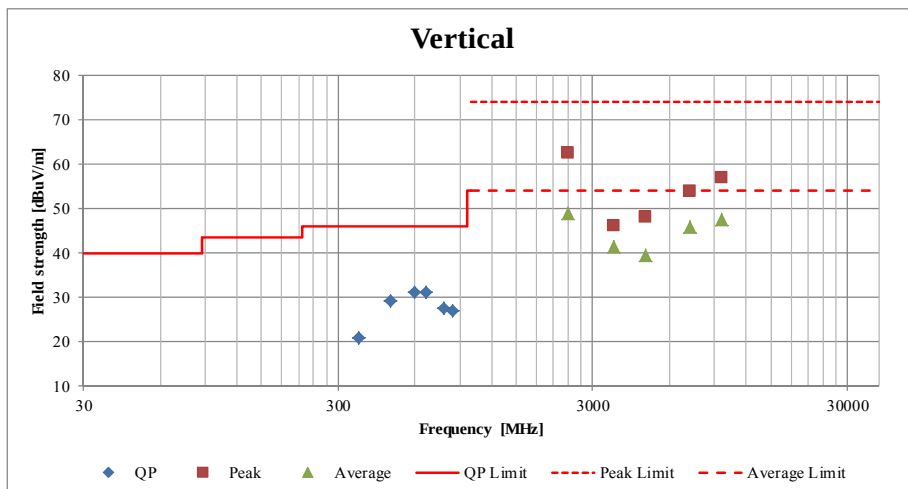
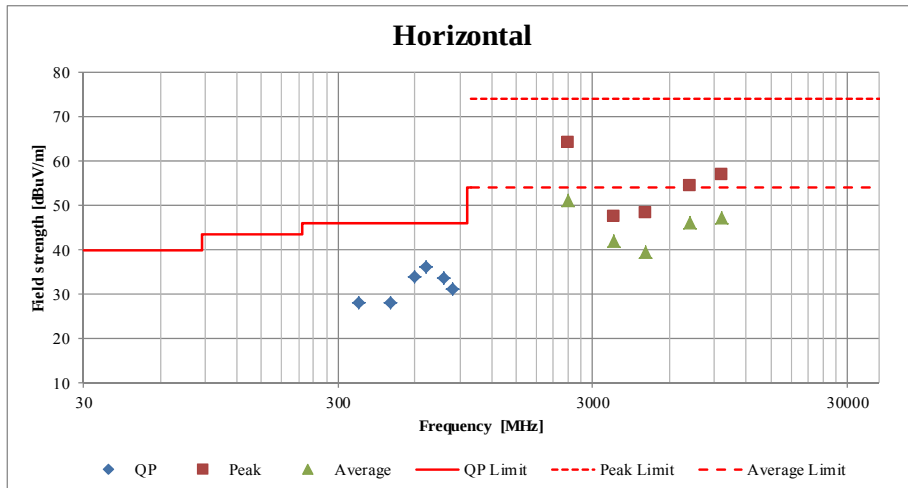
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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 (1-10GHz)	Satofumi Matsuyama (Above 10GHz)	Tomoki Matsui (Below 1GHz)
Mode	Tx 11g 2412 MHz		



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

Radiated Spurious Emission

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11350077H
Date : June 29, 2016
Temperature / Humidity : 23 deg. C / 69 % RH
Engineer : Tomoki Matsui
Mode : Tx 11g 2437 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	3655.517	PK	42.8	28.7	7.6	32.1	-	47.0	73.9	26.9	
Hori	4874.000	PK	40.0	31.2	9.0	31.7	-	48.5	73.9	25.4	Floor noise
Hori	7311.000	PK	40.3	35.6	10.2	32.6	-	53.5	73.9	20.4	Floor noise
Hori	9748.000	PK	42.8	37.2	9.5	33.3	-	56.2	73.9	17.7	Floor noise
Hori	3655.517	AV	35.6	28.7	7.6	32.1	-	39.8	53.9	14.1	
Hori	4874.000	AV	31.2	31.2	9.0	31.7	-	39.7	53.9	14.2	Floor noise
Hori	7311.000	AV	32.1	35.6	10.2	32.6	-	45.3	53.9	8.6	Floor noise
Hori	9748.000	AV	34.1	37.2	9.5	33.3	-	47.5	53.9	6.4	Floor noise
Vert	3655.517	PK	43.2	28.7	7.6	32.1	-	47.4	73.9	26.5	
Vert	4874.000	PK	39.8	31.2	9.0	31.7	-	48.3	73.9	25.6	Floor noise
Vert	7311.000	PK	40.4	35.6	10.2	32.6	-	53.6	73.9	20.3	Floor noise
Vert	9748.000	PK	43.3	37.2	9.5	33.3	-	56.7	73.9	17.2	Floor noise
Vert	3655.517	AV	36.0	28.7	7.6	32.1	-	40.2	53.9	13.7	
Vert	4874.000	AV	31.2	31.2	9.0	31.7	-	39.7	53.9	14.2	Floor noise
Vert	7311.000	AV	31.9	35.6	10.2	32.6	-	45.1	53.9	8.8	Floor noise
Vert	9748.000	AV	34.2	37.2	9.5	33.3	-	47.6	53.9	6.3	Floor noise

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

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

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

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 11g 2462 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2483.500	PK	62.2	26.8	6.8	32.6	-	63.2	73.9	10.7	
Hori	3693.016	PK	42.3	28.7	7.6	32.1	-	46.5	73.9	27.4	
Hori	4924.000	PK	39.4	31.4	8.9	31.7	-	48.0	73.9	25.9	Floor noise
Hori	7386.000	PK	40.3	35.5	10.1	32.7	-	53.2	73.9	20.7	Floor noise
Hori	9848.000	PK	43.2	37.2	9.5	33.3	-	56.6	73.9	17.3	Floor noise
Hori	2483.500	AV	46.9	26.8	6.8	32.6	1.8	49.7	53.9	4.2	*1),*2)
Hori	3693.016	AV	35.7	28.7	7.6	32.1	-	39.9	53.9	14.0	
Hori	4924.000	AV	30.6	31.4	8.9	31.7	-	39.2	53.9	14.7	Floor noise
Hori	7386.000	AV	31.6	35.5	10.1	32.7	-	44.5	53.9	9.4	Floor noise
Hori	9848.000	AV	34.3	37.2	9.5	33.3	-	47.7	53.9	6.2	Floor noise
Vert	2483.500	PK	59.7	26.8	6.8	32.6	-	60.7	73.9	13.2	
Vert	3693.016	PK	44.6	28.7	7.6	32.1	-	48.8	73.9	25.1	
Vert	4924.000	PK	40.3	31.4	8.9	31.7	-	48.9	73.9	25.0	Floor noise
Vert	7386.000	PK	40.0	35.5	10.1	32.7	-	52.9	73.9	21.0	Floor noise
Vert	9848.000	PK	42.5	37.2	9.5	33.3	-	55.9	73.9	18.0	Floor noise
Vert	2483.500	AV	47.6	26.8	6.8	32.6	1.8	50.4	53.9	3.5	*1)
Vert	3693.016	AV	36.7	28.7	7.6	32.1	-	40.9	53.9	13.0	
Vert	4924.000	AV	30.8	31.4	8.9	31.7	-	39.4	53.9	14.5	Floor noise
Vert	7386.000	AV	32.1	35.5	10.1	32.7	-	45.0	53.9	8.9	Floor noise
Vert	9848.000	AV	34.3	37.2	9.5	33.3	-	47.7	53.9	6.2	Floor noise

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

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

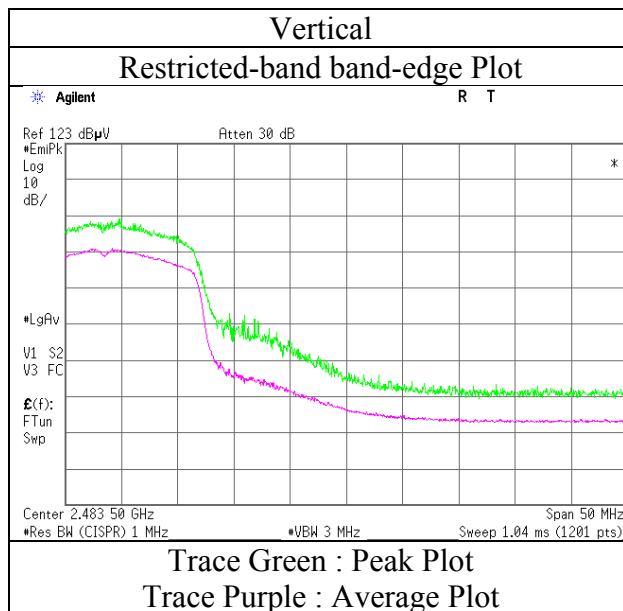
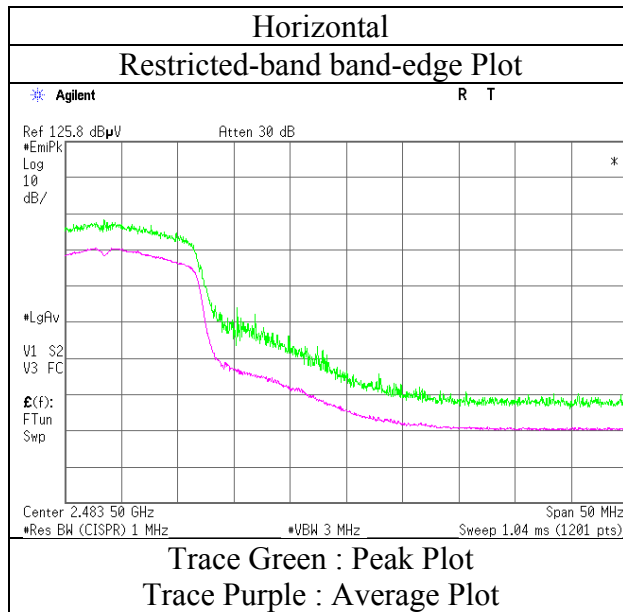
Distance factor: 1 GHz - 10 GHz $20\log(4.45\text{ m} / 3.0\text{ m}) = 3.43\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*1) Not Out of Band emission(Leakage Power)

*2) Integration method

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 11g 2462 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
	(1-10GHz)
Mode	Tx 11n-20 2412 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2390.000	PK	60.9	26.7	6.7	32.7	-	61.6	73.9	12.3	
Hori	2390.000	AV	48.0	26.7	6.7	32.7	1.8	50.5	53.9	3.4	*1)
Vert	2390.000	PK	59.8	26.7	6.7	32.7	-	60.5	73.9	13.4	
Vert	2390.000	AV	47.1	26.7	6.7	32.7	1.8	49.6	53.9	4.3	*1)

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

*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 $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*1) Not Out of Band emission(Leakage Power)

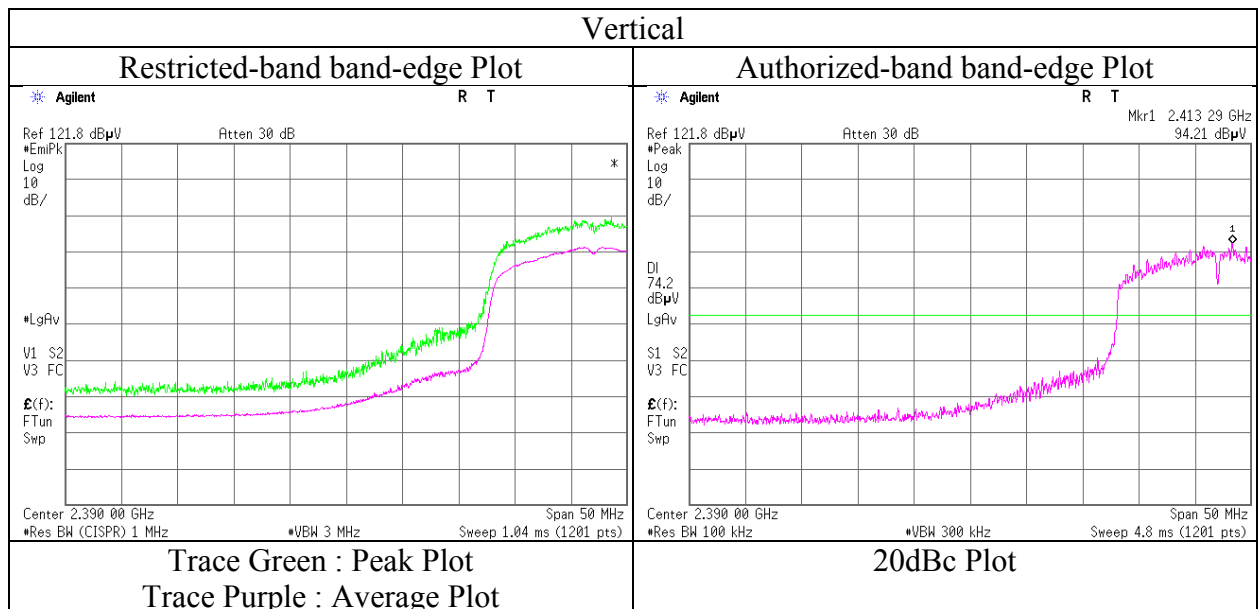
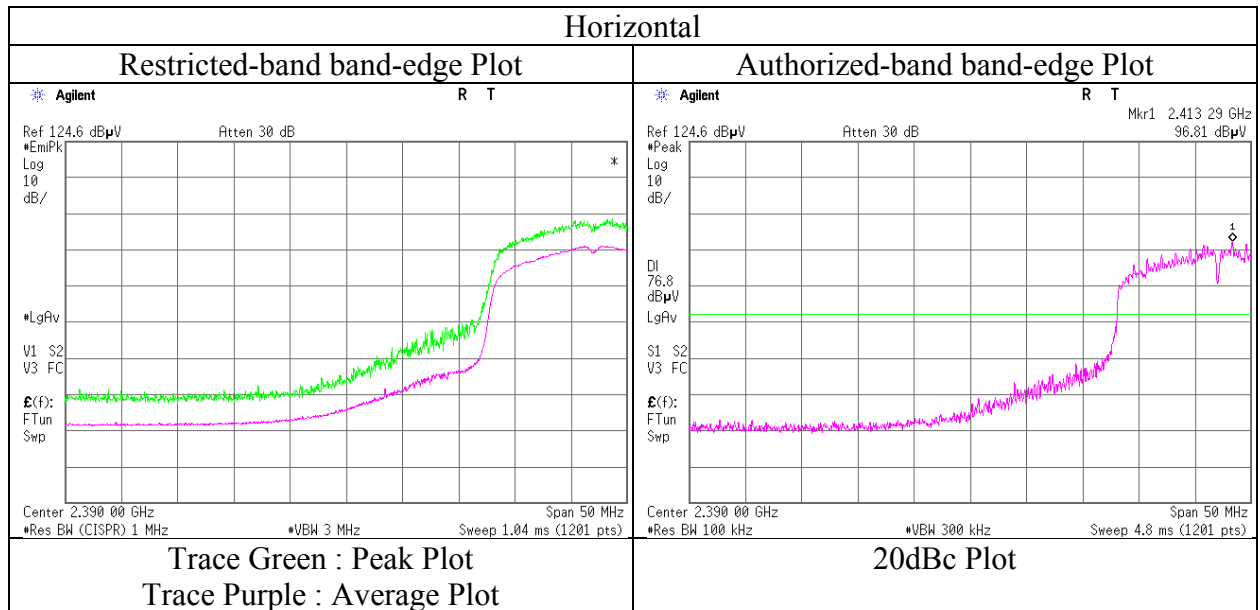
20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	96.8	26.7	6.7	32.7	97.5	-	-	Carrier
Hori	2400.000	PK	61.4	26.7	6.7	32.7	62.1	77.5	15.4	
Vert	2412.000	PK	94.2	26.7	6.7	32.7	94.9	-	-	Carrier
Vert	2400.000	PK	59.2	26.7	6.7	32.7	59.9	74.9	15.0	

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

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.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 11n-20 2412 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

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 11n-20 2462 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2483.500	PK	65.0	26.8	6.8	32.6	-	66.0	73.9	7.9	
Hori	2483.500	AV	49.7	26.8	6.8	32.6	1.8	52.5	53.9	1.4	*1)
Vert	2483.500	PK	62.5	26.8	6.8	32.6	-	63.5	73.9	10.4	
Vert	2483.500	AV	48.1	26.8	6.8	32.6	1.8	50.9	53.9	3.0	*1)

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

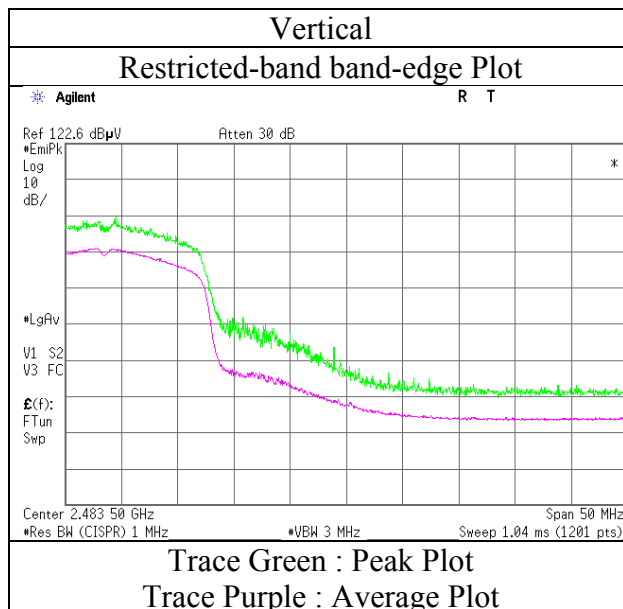
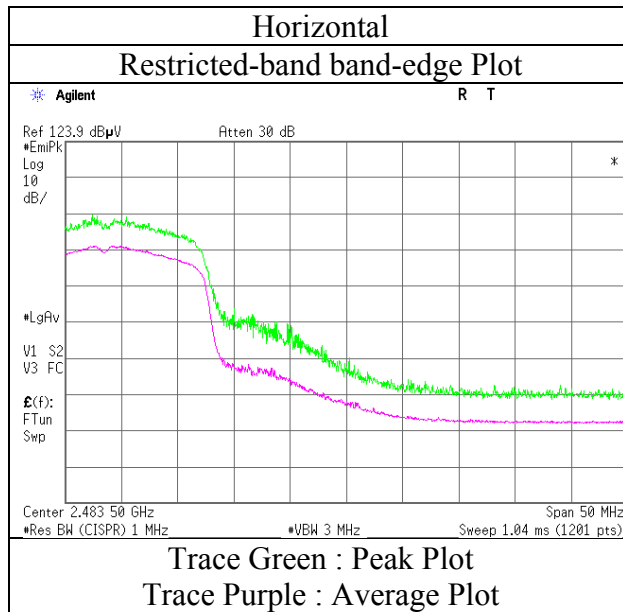
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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

*1) Not Out of Band emission(Leakage Power)

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 11n-20 2462 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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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 30, 2016
Temperature / Humidity : 23 deg. C / 72 % RH 23 deg. C / 62 % RH
Engineer : Satofumi Matsuyama Tomoki Matsui
(Above 1GHz) (Below 1GHz)
Mode : Tx BT LE 2402 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	360.000	QP	35.8	14.8	10.3	31.9	-	29.0	46.0	17.0	
Hori	480.000	QP	33.3	17.2	11.0	31.9	-	29.6	46.0	16.4	
Hori	600.000	QP	35.3	19.1	11.9	32.0	-	34.3	46.0	11.7	
Hori	720.000	QP	33.6	20.0	12.5	32.0	-	34.1	46.0	11.9	
Hori	780.000	QP	31.7	20.6	12.8	31.6	-	33.5	46.0	12.5	
Hori	840.000	QP	28.5	21.3	13.1	31.3	-	31.6	46.0	14.4	
Hori	2390.000	PK	43.9	26.7	6.7	32.7	-	44.6	73.9	29.3	
Hori	4804.000	PK	41.6	31.0	9.0	31.8	-	49.8	73.9	24.1	Floor noise
Hori	7206.000	PK	43.6	35.7	10.2	32.6	-	56.9	73.9	17.0	Floor noise
Hori	9608.000	PK	46.0	37.2	10.9	33.2	-	60.9	73.9	13.0	Floor noise
Hori	2390.000	AV	33.8	26.7	6.7	32.7	1.8	36.3	53.9	17.6	*1)
Hori	4804.000	AV	28.7	31.0	9.0	31.8	-	36.9	53.9	17.0	Floor noise
Hori	7206.000	AV	30.6	35.7	10.2	32.6	-	43.9	53.9	10.0	Floor noise
Hori	9608.000	AV	32.2	37.2	10.9	33.2	-	47.1	53.9	6.8	Floor noise
Vert	420.000	QP	28.5	16.0	10.7	31.9	-	23.3	46.0	22.7	
Vert	480.000	QP	32.6	17.2	11.0	31.9	-	28.9	46.0	17.1	
Vert	600.000	QP	32.5	19.1	11.9	32.0	-	31.5	46.0	14.5	
Vert	642.140	QP	27.9	19.4	12.1	32.1	-	27.3	46.0	18.7	
Vert	660.000	QP	28.6	19.5	12.2	32.1	-	28.2	46.0	17.8	
Vert	780.000	QP	27.1	20.6	12.8	31.6	-	28.9	46.0	17.1	
Vert	2390.000	PK	42.8	26.7	6.7	32.7	-	43.5	73.9	30.4	
Vert	4804.000	PK	41.9	31.0	9.0	31.8	-	50.1	73.9	23.8	Floor noise
Vert	7206.000	PK	43.5	35.7	10.2	32.6	-	56.8	73.9	17.1	Floor noise
Vert	9608.000	PK	45.9	37.2	10.9	33.2	-	60.8	73.9	13.1	Floor noise
Vert	2390.000	AV	33.5	26.7	6.7	32.7	1.8	36.0	53.9	17.9	*1)
Vert	4804.000	AV	28.7	31.0	9.0	31.8	-	36.9	53.9	17.0	Floor noise
Vert	7206.000	AV	30.6	35.7	10.2	32.6	-	43.9	53.9	10.0	Floor noise
Vert	9608.000	AV	32.2	37.2	10.9	33.2	-	47.1	53.9	6.8	Floor noise

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

*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 $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*1) Not Out of Band emission(Leakage Power)

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	102.0	26.7	6.7	32.7	102.7	-	-	Carrier
Hori	2400.000	PK	44.4	26.7	6.7	32.7	45.1	82.7	37.6	
Vert	2402.000	PK	98.2	26.7	6.7	32.7	98.9	-	-	Carrier
Vert	2400.000	PK	41.8	26.7	6.7	32.7	42.5	78.9	36.4	

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

UL Japan, Inc.

Ise EMC Lab.

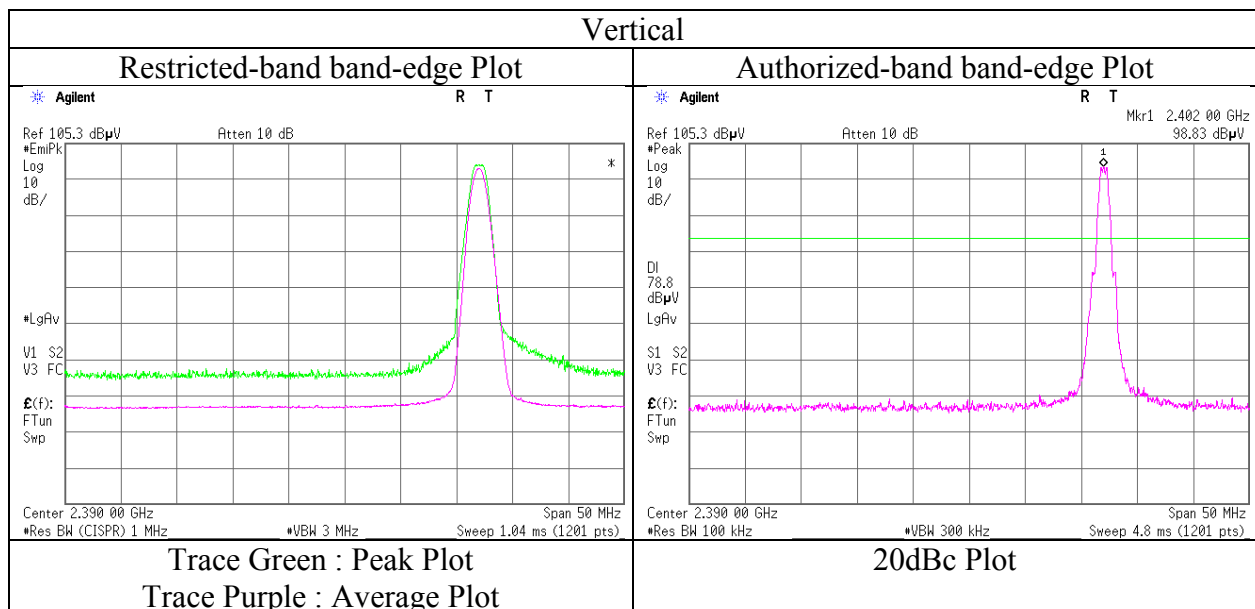
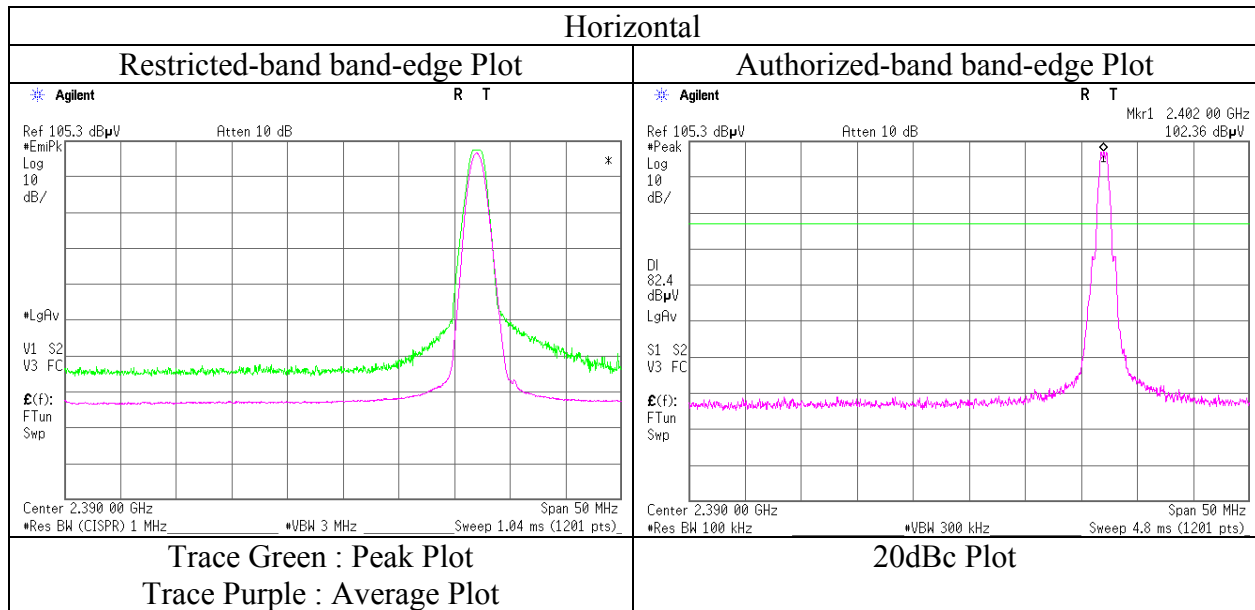
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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 / 72 % RH
Engineer	Satofumi Matsuyama
Mode	Tx BT LE 2402 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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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 30, 2016
Temperature / Humidity : 23 deg. C / 72 % RH 23 deg. C / 62 % RH
Engineer : Satofumi Matsuyama Tomoki Matsui
(Above 1GHz) (Below 1GHz)
Mode : Tx BT LE 2440 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	360.000	QP	35.7	14.8	10.3	31.9	-	28.9	46.0	17.1	
Hori	480.000	QP	33.4	17.2	11.0	31.9	-	29.7	46.0	16.3	
Hori	600.000	QP	35.3	19.1	11.9	32.0	-	34.3	46.0	11.7	
Hori	720.000	QP	32.6	20.0	12.5	32.0	-	33.1	46.0	12.9	
Hori	780.000	QP	32.1	20.6	12.8	31.6	-	33.9	46.0	12.1	
Hori	840.000	QP	28.8	21.3	13.1	31.3	-	31.9	46.0	14.1	
Hori	4880.000	PK	41.2	31.3	9.0	31.7	-	49.8	73.9	24.1	Floor noise
Hori	7320.000	PK	42.8	35.6	10.2	32.6	-	56.0	73.9	17.9	Floor noise
Hori	9760.000	PK	43.7	37.2	10.9	33.3	-	58.5	73.9	15.4	Floor noise
Hori	4880.000	AV	29.1	31.3	9.0	31.7	-	37.7	53.9	16.2	Floor noise
Hori	7320.000	AV	30.8	35.6	10.2	32.6	-	44.0	53.9	9.9	Floor noise
Hori	9760.000	AV	32.3	37.2	10.9	33.3	-	47.1	53.9	6.8	Floor noise
Vert	420.000	QP	26.7	16.0	10.7	31.9	-	21.5	46.0	24.5	
Vert	480.000	QP	32.8	17.2	11.0	31.9	-	29.1	46.0	16.9	
Vert	600.000	QP	32.1	19.1	11.9	32.0	-	31.1	46.0	14.9	
Vert	642.140	QP	27.8	19.4	12.1	32.1	-	27.2	46.0	18.8	
Vert	660.000	QP	30.0	19.5	12.2	32.1	-	29.6	46.0	16.4	
Vert	780.000	QP	26.8	20.6	12.8	31.6	-	28.6	46.0	17.4	
Vert	4880.000	PK	41.1	31.3	9.0	31.7	-	49.7	73.9	24.2	Floor noise
Vert	7320.000	PK	41.9	35.6	10.2	32.6	-	55.1	73.9	18.8	Floor noise
Vert	9760.000	PK	43.2	37.2	10.9	33.3	-	58.0	73.9	15.9	Floor noise
Vert	4880.000	AV	29.1	31.3	9.0	31.7	-	37.7	53.9	16.2	Floor noise
Vert	7320.000	AV	30.8	35.6	10.2	32.6	-	44.0	53.9	9.9	Floor noise
Vert	9760.000	AV	32.3	37.2	10.9	33.3	-	47.1	53.9	6.8	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 $20\log(4.45\text{ m} / 3.0\text{ m}) = 3.43\text{ dB}$
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 30, 2016
Temperature / Humidity : 23 deg. C / 72 % RH 23 deg. C / 62 % RH
Engineer : Satofumi Matsuyama Tomoki Matsui
(Above 1GHz) (Below 1GHz)
Mode : Tx BT LE 2480 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	360.000	QP	37.1	14.8	10.3	31.9	-	30.3	46.0	15.7	
Hori	480.000	QP	32.5	17.2	11.0	31.9	-	28.8	46.0	17.2	
Hori	600.000	QP	35.2	19.1	11.9	32.0	-	34.2	46.0	11.8	
Hori	720.000	QP	33.4	20.0	12.5	32.0	-	33.9	46.0	12.1	
Hori	780.000	QP	32.2	20.6	12.8	31.6	-	34.0	46.0	12.0	
Hori	840.000	QP	28.7	21.3	13.1	31.3	-	31.8	46.0	14.2	
Hori	2483.500	PK	54.6	26.8	6.8	32.6	-	55.6	73.9	18.3	
Hori	4960.000	PK	41.4	31.5	8.9	31.7	-	50.1	73.9	23.8	Floor noise
Hori	7440.000	PK	43.3	35.5	10.2	32.7	-	56.3	73.9	17.6	Floor noise
Hori	9920.000	PK	44.4	37.2	11.0	33.4	-	59.2	73.9	14.7	Floor noise
Hori	2483.500	AV	41.3	26.8	6.8	32.6	1.8	44.1	53.9	9.8	*1)
Hori	4960.000	AV	29.7	31.5	8.9	31.7	-	38.4	53.9	15.5	Floor noise
Hori	7440.000	AV	30.3	35.5	10.2	32.7	-	43.3	53.9	10.6	Floor noise
Hori	9920.000	AV	32.0	37.2	11.0	33.4	-	46.8	53.9	7.1	Floor noise
Vert	420.000	QP	27.2	16.0	10.7	31.9	-	22.0	46.0	24.0	
Vert	480.000	QP	33.1	17.2	11.0	31.9	-	29.4	46.0	16.6	
Vert	600.000	QP	31.8	19.1	11.9	32.0	-	30.8	46.0	15.2	
Vert	642.140	QP	27.9	19.4	12.1	32.1	-	27.3	46.0	18.7	
Vert	660.000	QP	30.4	19.5	12.2	32.1	-	30.0	46.0	16.0	
Vert	780.000	QP	26.9	20.6	12.8	31.6	-	28.7	46.0	17.3	
Vert	2483.500	PK	53.5	26.8	6.8	32.6	-	54.5	73.9	19.4	
Vert	4960.000	PK	41.6	31.5	8.9	31.7	-	50.3	73.9	23.6	Floor noise
Vert	7440.000	PK	43.3	35.5	10.2	32.7	-	56.3	73.9	17.6	Floor noise
Vert	9920.000	PK	44.5	37.2	11.0	33.4	-	59.3	73.9	14.6	Floor noise
Vert	2483.500	AV	38.2	26.8	6.8	32.6	1.8	41.0	53.9	12.9	*1)
Vert	4960.000	AV	29.7	31.5	8.9	31.7	-	38.4	53.9	15.5	Floor noise
Vert	7440.000	AV	30.3	35.5	10.2	32.7	-	43.3	53.9	10.6	Floor noise
Vert	9920.000	AV	32.0	37.2	11.0	33.4	-	46.8	53.9	7.1	Floor noise

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

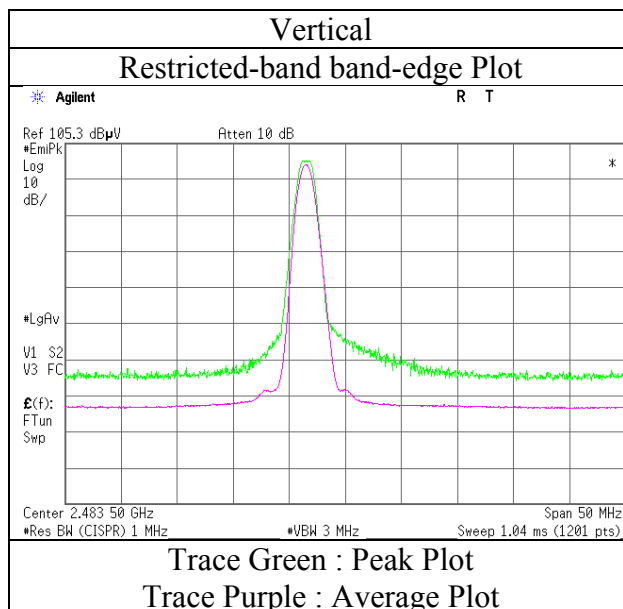
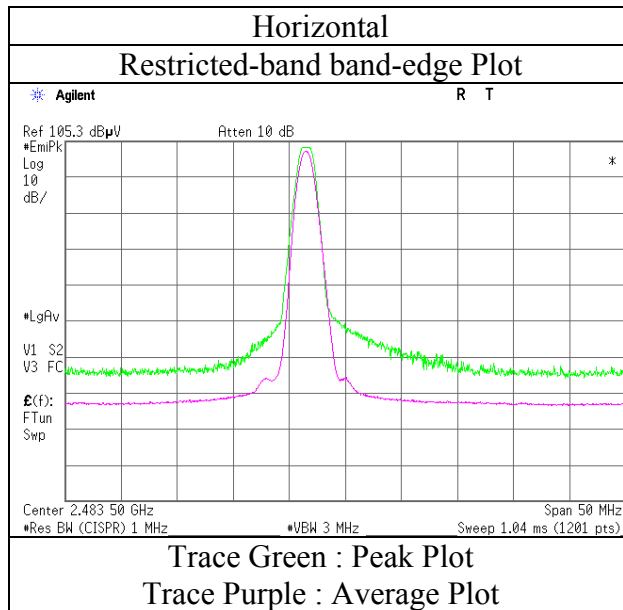
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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

*1) Not Out of Band emission(Leakage Power)

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

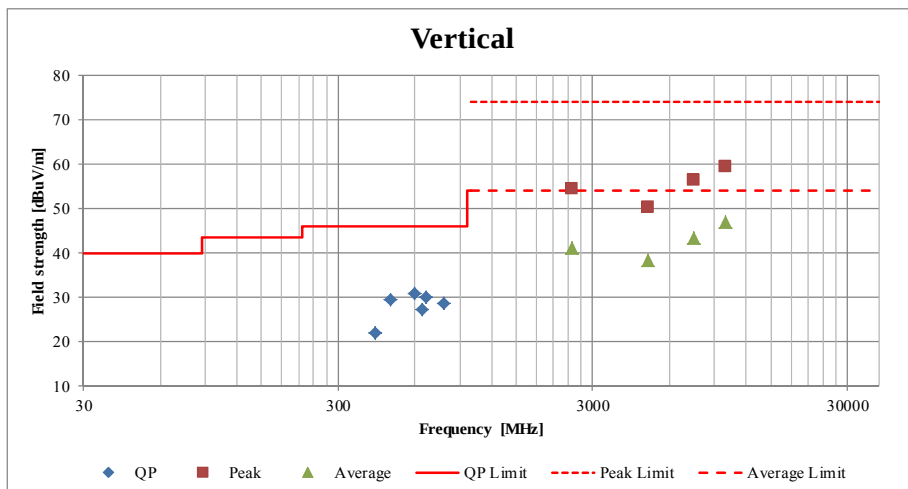
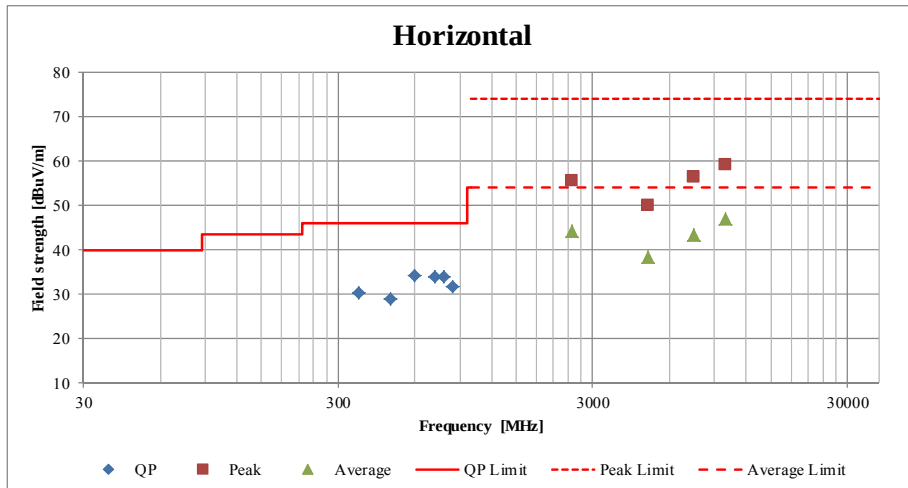
Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11350077H
Date : June 29, 2016
Temperature / Humidity : 23 deg. C / 72 % RH
Engineer : Satofumi Matsuyama
Mode : Tx BT LE 2480 MHz



* 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 30, 2016	
Temperature / Humidity	23 deg. C / 72 % RH	23 deg. C / 62 % RH	
Engineer	Satofumi Matsuyama (Above 1GHz)	Tomoki Matsui (Below 1GHz)	
Mode	Tx BT LE 2480 MHz		

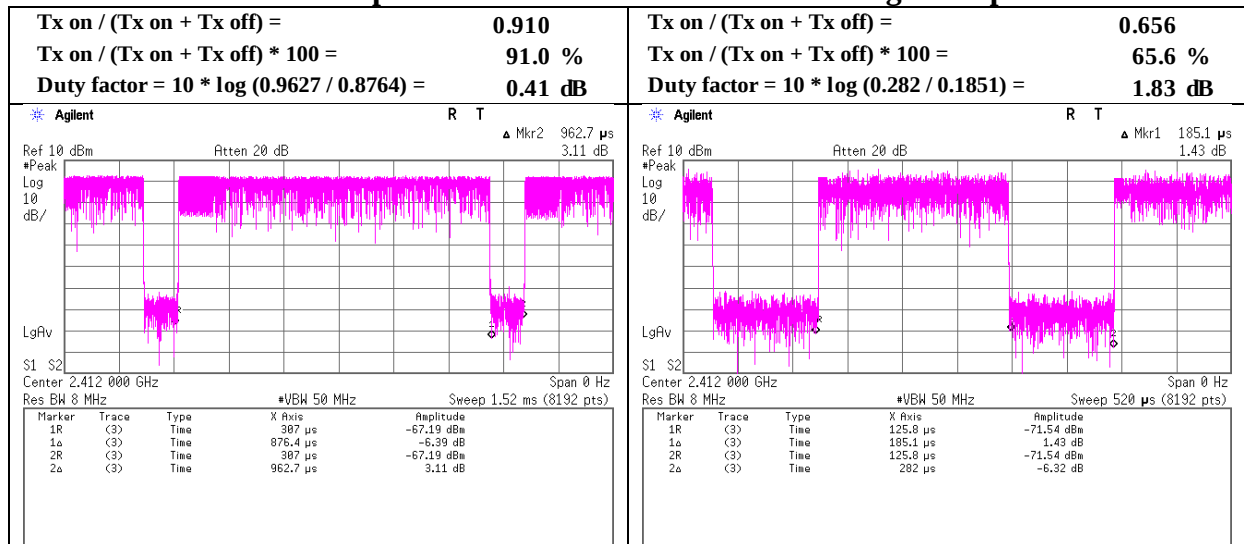


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

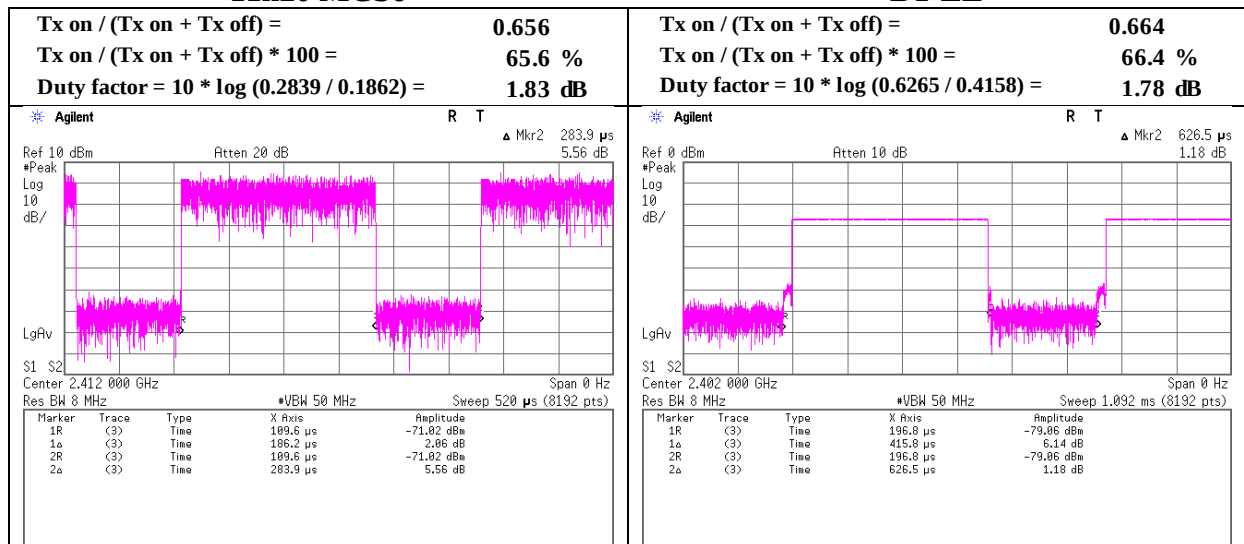
Burst rate confirmation

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11350077H
Date : June 30, 2016
Temperature / Humidity : 23 deg. C / 62 % RH
Engineer : Tomoki Matsui
Mode : Tx

11b 11Mbps



11n20 MCS6



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

UL Japan, Inc.

Ise EMC Lab.

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