



RADIO TEST REPORT

Test Report No. : 12007719H-A-R2

Applicant : Murata Manufacturing Co., Ltd.
Type of Equipment : Communication Module
Model No. : Type1JS
FCC ID : VPYLB1JS955
Test regulation : FCC Part 15 Subpart C: 2017
For Permissive Change
(Radiated Spurious Emission tests only)

Test Result : Complied

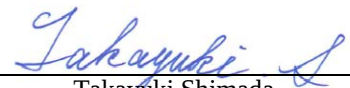
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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not 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 12007719H-A-R1. 12007719H-A-R1 is replaced with this report.

Date of test: October 24 to November 11, 2017

Representative test engineer:


Masafumi Niwa
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,
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.: 12007719H-A

[illegible]

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on September 20, 2017 and effective October 20, 2017

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

* The revision on November 2, 2017, does not affect the test specification applied to the EUT.

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 v04	FCC: Section15.247(d)	17.5 dB 2483.500 MHz, AV, Hori.	Complied	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 v04 12.2.7.					

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

FCC Part 15.31 (e)

The worst case stable voltage was provided to the EUT during the all tests.
And maximum and minimum voltage were provided to the EUT during the output power measurement test.
Therefore, the EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The antenna is not removable from the EUT.
Therefore, the equipment complies with the antenna requirement of Section 15.203.

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 $k=2$.

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Antenna terminal test	Uncertainty (+/-)
RF output power	1.2 dB
Antenna terminal conducted emission / Power density / Burst power	3.1 dB
Adjacent channel power / Channel power	
Below 3 GHz	1.8 dB
3 GHz to 6 GHz	2.7 dB

Frequency range	Conducted emission using AMN(LISN) (+/-)
0.009 MHz - 0.15 MHz	3.1 dB
0.15 MHz - 30 MHz	2.5 dB

Test distance	Radiated emission (+/-) 9 kHz - 30 MHz
3 m	3.8 dB
10 m	3.6 dB

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*) (+/-)		(10 m*) (+/-)	
	30 MHz - 200 MHz	200 MHz - 1000 MHz	30 MHz - 200 MHz	200 MHz - 1000 MHz
Horizontal	5.0 dB	5.3 dB	5.0 dB	5.0 dB
Vertical	5.2 dB	6.3 dB	5.0 dB	5.0 dB

Radiated emission (Above 1 GHz)				
(3 m*) (+/-)		(1 m*) (+/-)		(10 m*) (+/-)
1 GHz - 6 GHz	6 GHz - 18 GHz	10 GHz - 26.5 GHz	26.5 GHz - 40 GHz	1 GHz - 18 GHz
5.2 dB	5.5 dB	5.5 dB	5.4 dB	5.5 dB

*Measurement distance

Radiated emission test

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

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3.5 Test Location

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Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124
NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

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

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m x 2.0 m 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 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 20 MHz BW (11n-20)	MCS 0, PN9
Bluetooth Low Energy (BT LE)	Maximum Packet Size, PRBS9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*EUT has the power settings by the software as follows (power setting value might be different from product specification value); Power settings: WLAN: 11b: Setting Parameter value 8, 11g: Setting Parameter value 8, 11n: Setting Parameter value 8 BT LE: Setting Parameter value 05 Software: CPM_P162170_F159430 *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.	

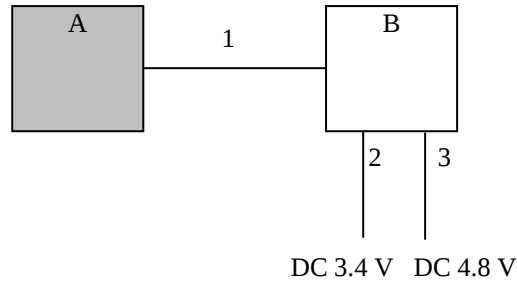
*The details of Operating mode(s) for WLAN

Test Item	Operating Mode	Tested frequency
Radiated Spurious Emission (Below 1GHz)	Tx 11n-20 *1)	2462 MHz
Radiated Spurious Emission (Above 1GHz)	Tx 11b Tx 11n-20 *2)	2412 MHz 2437 MHz 2462 MHz
*1) The mode was 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 output power.		

*The details of Operating mode(s) for BT LE

Test Item	Operating Mode	Tested frequency
Radiated Spurious Emission	Tx BT LE	2402 MHz 2440 MHz 2480 MHz

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	Communication Module	Type1JS	SS161213M	Murata Manufacturing Co., Ltd.	EUT
B	Jig	-	-	Murata Manufacturing Co., Ltd.	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.07	Unshielded	Unshielded	-
2	DC Cable	1.50	Unshielded	Unshielded	-
3	DC Cable	1.50	Unshielded	Unshielded	-

SECTION 5: Radiated Spurious Emission

Test Procedure

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

[For below 1 GHz]

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

[For above 1 GHz]

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

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

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

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

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

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

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

Test Antennas are used as below;

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz 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	3.75 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)		3.75 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)

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

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

*3) 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 to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

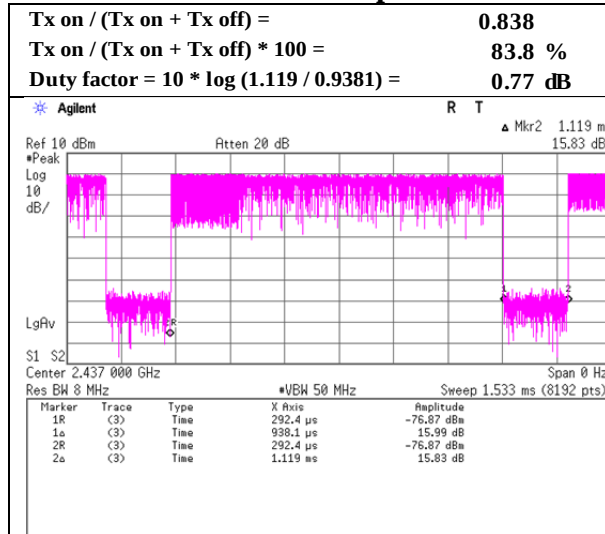
Measurement range	: 30 MHz - 26.5 GHz
Test data	: APPENDIX
Test result	: Pass

APPENDIX 1: Test data

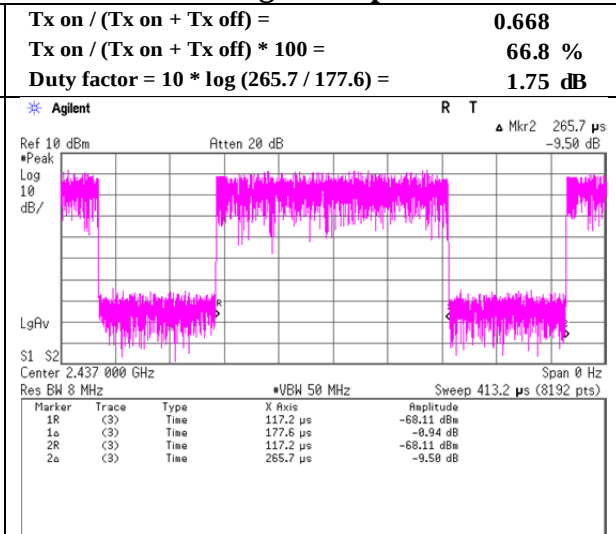
Burst rate confirmation

Test place : Ise EMC Lab. No.11 Measurement Room
Report No. : 12007719H
Date : October 24, 2017
Temperature / Humidity : 21 deg. C / 42 % RH
Engineer : Takafumi Noguchi
Mode : Tx

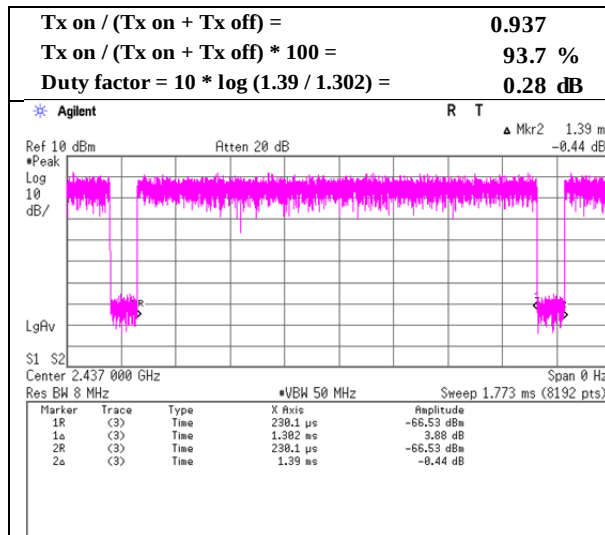
11b 11 Mbps



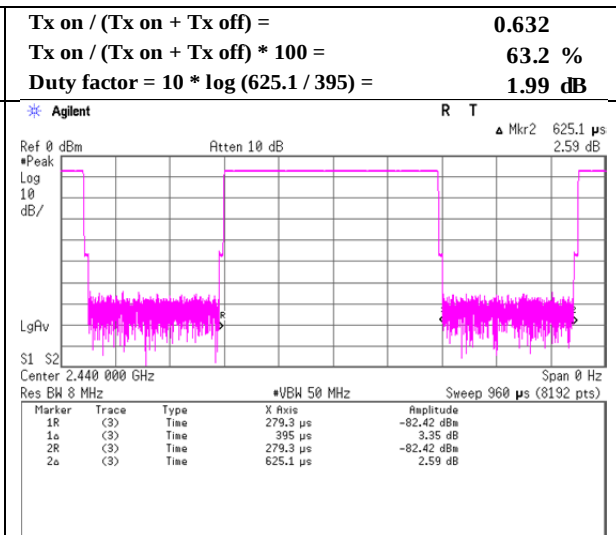
11g 54 Mbps



11n-20 MCS 0



BT LE



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

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Radiated Spurious Emission

Report No.	12007719H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	November 10, 2017	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH	22 deg. C / 48 % RH
Engineer	Takumi Shimada	Masafumi Niwa
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
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	44.1	27.0	5.1	34.6	-	41.6	73.9	32.3	
Hori	4824.000	PK	43.3	31.3	7.4	33.8	-	48.2	73.9	25.7	Floor noise
Hori	7236.000	PK	44.3	35.7	8.8	33.9	-	54.9	73.9	19.0	Floor noise
Hori	9648.000	PK	46.4	38.2	9.5	34.5	-	59.6	73.9	14.3	Floor noise
Hori	2390.000	AV	33.6	27.0	5.1	34.6	0.8	31.9	53.9	22.0	*1)
Hori	4824.000	AV	33.5	31.3	7.4	33.8	-	38.4	53.9	15.5	Floor noise
Hori	7236.000	AV	33.9	35.7	8.8	33.9	-	44.5	53.9	9.4	Floor noise
Hori	9648.000	AV	34.3	38.2	9.5	34.5	-	47.5	53.9	6.4	Floor noise
Vert	2390.000	PK	46.9	27.0	5.1	34.6	-	44.4	73.9	29.5	
Vert	4824.000	PK	44.4	31.3	7.4	33.8	-	49.3	73.9	24.6	Floor noise
Vert	7236.000	PK	44.8	35.7	8.8	33.9	-	55.4	73.9	18.5	Floor noise
Vert	9648.000	PK	45.8	38.2	9.5	34.5	-	59.0	73.9	14.9	Floor noise
Vert	2390.000	AV	33.9	27.0	5.1	34.6	0.8	32.2	53.9	21.7	*1)
Vert	4824.000	AV	33.2	31.3	7.4	33.8	-	38.1	53.9	15.8	Floor noise
Vert	7236.000	AV	33.8	35.7	8.8	33.9	-	44.4	53.9	9.5	Floor noise
Vert	9648.000	AV	34.2	38.2	9.5	34.5	-	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 $20\log(3.75 \text{ m} / 3.0 \text{ m}) = 1.94 \text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

*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	91.5	27.0	5.1	34.6	89.0	-	-	Carrier
Hori	2400.000	PK	42.9	27.0	5.1	34.6	40.4	69.0	28.6	
Vert	2412.000	PK	91.4	27.0	5.1	34.6	88.9	-	-	Carrier
Vert	2400.000	PK	40.8	27.0	5.1	34.6	38.3	68.9	30.6	

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

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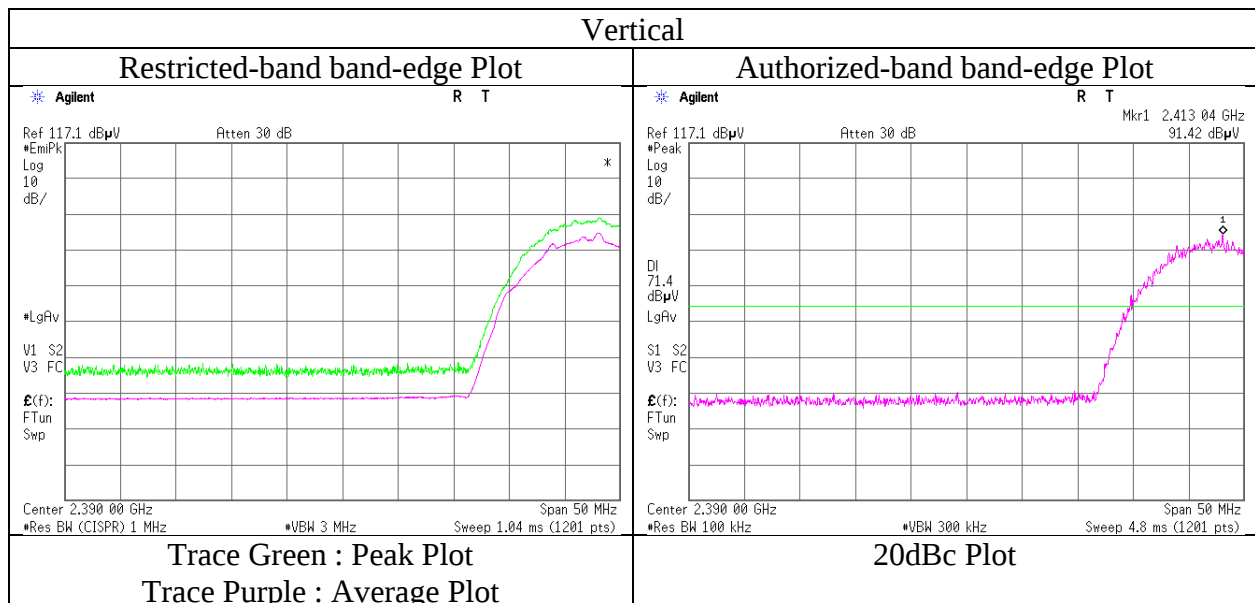
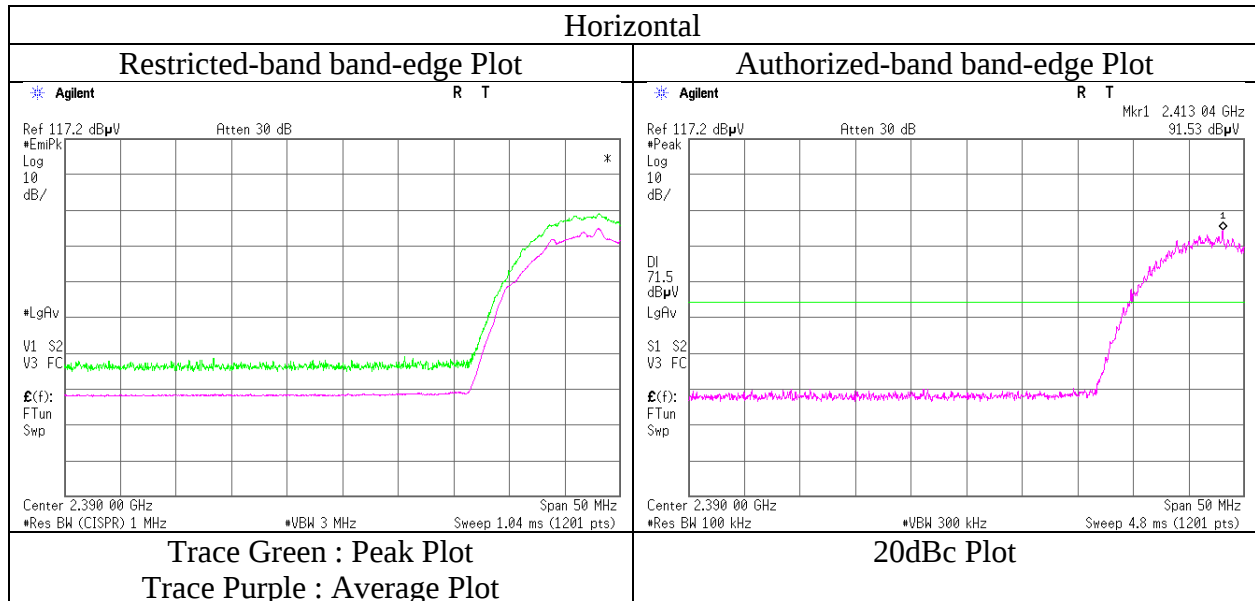
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12007719H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH
Engineer	Takumi Shimada
	(1 GHz - 10 GHz)
Mode	Tx 11b 2412MHz



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

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Radiated Spurious Emission

Report No.	12007719H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	November 11, 2017	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH	22 deg. C / 48 % RH
Engineer	Takumi Shimada	Masafumi Niwa
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
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	43.6	31.4	7.4	33.8	-	48.6	73.9	25.3	Floor noise
Hori	7311.000	PK	46.1	35.7	8.8	33.9	-	56.7	73.9	17.2	Floor noise
Hori	9748.000	PK	46.4	38.2	9.4	34.5	-	59.5	73.9	14.4	Floor noise
Hori	4874.000	AV	33.9	31.4	7.4	33.8	-	38.9	53.9	15.0	Floor noise
Hori	7311.000	AV	34.3	35.7	8.8	33.9	-	44.9	53.9	9.0	Floor noise
Hori	9748.000	AV	34.6	38.2	9.4	34.5	-	47.7	53.9	6.2	Floor noise
Vert	4874.000	PK	43.3	31.4	7.4	33.8	-	48.3	73.9	25.6	Floor noise
Vert	7311.000	PK	44.0	35.7	8.8	33.9	-	54.6	73.9	19.3	Floor noise
Vert	9748.000	PK	46.1	38.2	9.4	34.5	-	59.2	73.9	14.7	Floor noise
Vert	4874.000	AV	33.6	31.4	7.4	33.8	-	38.6	53.9	15.3	Floor noise
Vert	7311.000	AV	34.2	35.7	8.8	33.9	-	44.8	53.9	9.1	Floor noise
Vert	9748.000	AV	34.6	38.2	9.4	34.5	-	47.7	53.9	6.2	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 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

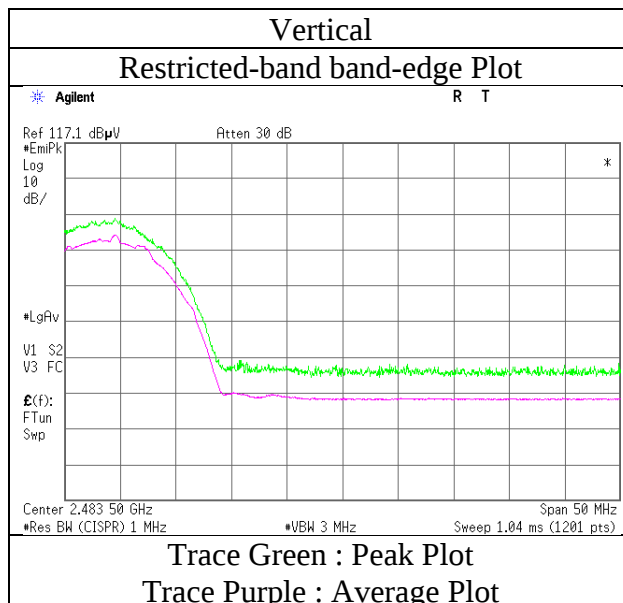
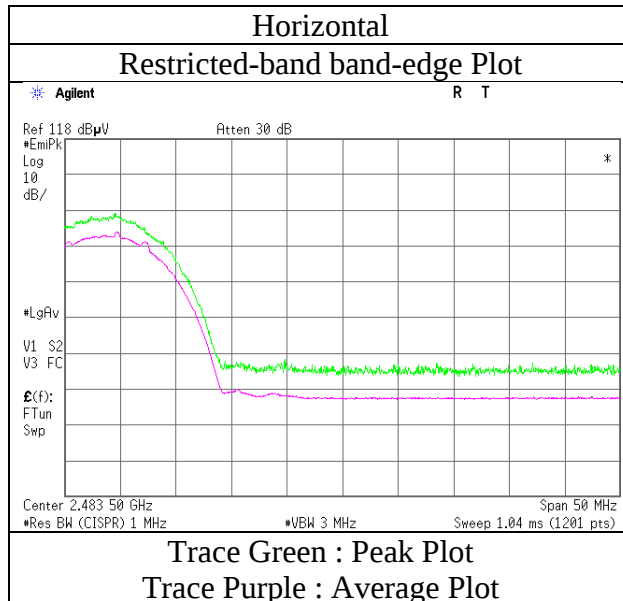
Mode

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

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12007719H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH
Engineer	Takumi Shimada
	(1 GHz - 10 GHz)
Mode	Tx 11b 2462 MHz



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

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Radiated Spurious Emission

Report No.	12007719H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	November 11, 2017	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH	22 deg. C / 48 % RH
Engineer	Takumi Shimada	Masafumi Niwa
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
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	48.3	27.0	5.1	34.6	-	45.8	73.9	28.1	
Hori	4824.000	PK	43.2	31.3	7.4	33.8	-	48.1	73.9	25.8	Floor noise
Hori	7236.000	PK	43.7	35.7	8.8	33.9	-	54.3	73.9	19.6	Floor noise
Hori	9648.000	PK	46.0	38.2	9.5	34.5	-	59.2	73.9	14.7	Floor noise
Hori	2390.000	AV	35.5	27.0	5.1	34.6	0.3	33.3	53.9	20.6	*1)
Hori	4824.000	AV	33.4	31.3	7.4	33.8	-	38.3	53.9	15.6	Floor noise
Hori	7236.000	AV	34.1	35.7	8.8	33.9	-	44.7	53.9	9.2	Floor noise
Hori	9648.000	AV	34.5	38.2	9.5	34.5	-	47.7	53.9	6.2	Floor noise
Vert	2390.000	PK	48.3	27.0	5.1	34.6	-	45.8	73.9	28.1	
Vert	4824.000	PK	42.7	31.3	7.4	33.8	-	47.6	73.9	26.3	Floor noise
Vert	7236.000	PK	44.0	35.7	8.8	33.9	-	54.6	73.9	19.3	Floor noise
Vert	9648.000	PK	46.0	38.2	9.5	34.5	-	59.2	73.9	14.7	Floor noise
Vert	2390.000	AV	35.7	27.0	5.1	34.6	0.3	33.5	53.9	20.4	*1)
Vert	4824.000	AV	32.2	31.3	7.4	33.8	-	37.1	53.9	16.8	Floor noise
Vert	7236.000	AV	33.0	35.7	8.8	33.9	-	43.6	53.9	10.3	Floor noise
Vert	9648.000	AV	34.3	38.2	9.5	34.5	-	47.5	53.9	6.4	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(3.75 m / 3.0 m) = 1.94 dB
 10 GHz - 26.5 GHz 20log(1.0 m / 3.0 m) = -9.5 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	90.3	27.0	5.1	34.6	87.8	-	-	Carrier
Hori	2400.000	PK	45.8	27.0	5.1	34.6	43.3	67.8	24.5	
Vert	2412.000	PK	90.4	27.0	5.1	34.6	87.9	-	-	Carrier
Vert	2400.000	PK	48.7	27.0	5.1	34.6	46.2	67.9	21.7	

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

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Ise EMC Lab.

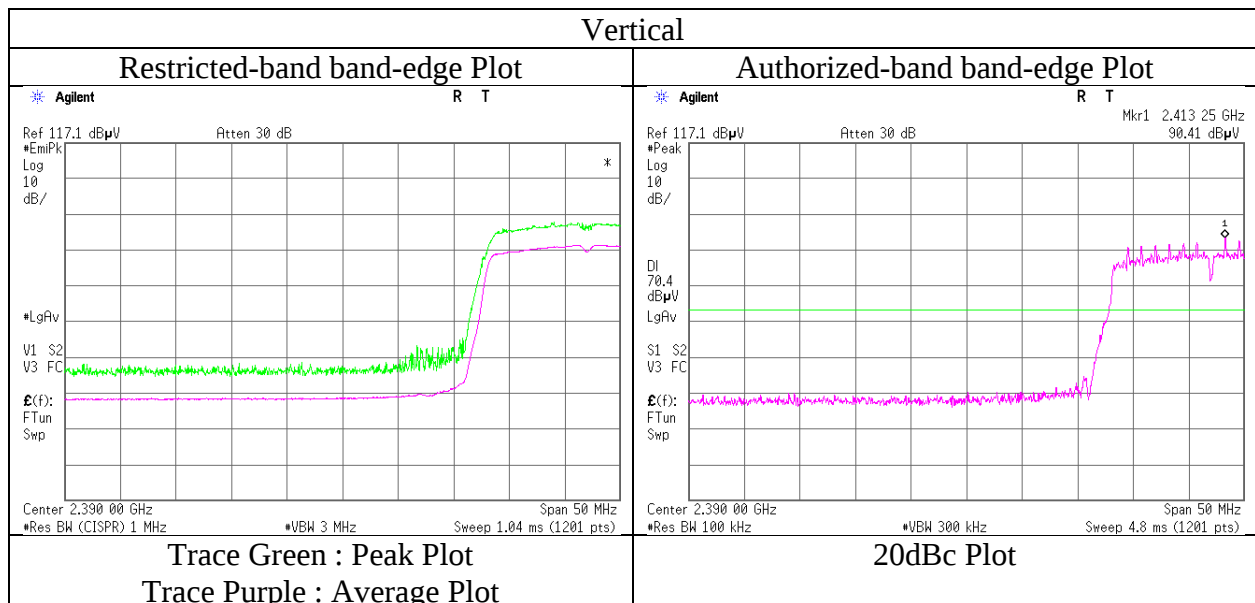
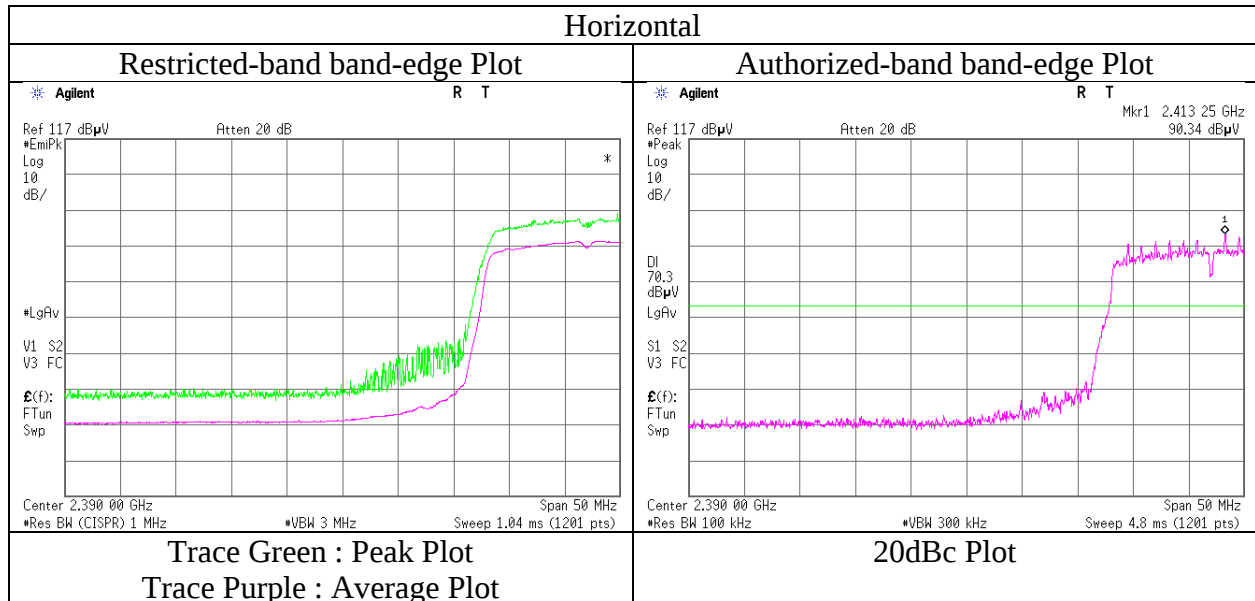
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12007719H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH
Engineer	Takumi Shimada
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No.	12007719H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	November 11, 2017	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH	22 deg. C / 48 % RH
Engineer	Takumi Shimada	Masafumi Niwa
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx 11n-20 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	42.9	31.4	7.4	33.8	-	47.9	73.9	26.0	Floor noise
Hori	7311.000	PK	43.4	35.7	8.8	33.9	-	54.0	73.9	19.9	Floor noise
Hori	9748.000	PK	46.0	38.2	9.4	34.5	-	59.1	73.9	14.8	Floor noise
Hori	4874.000	AV	33.9	31.4	7.4	33.8	-	38.9	53.9	15.0	Floor noise
Hori	7311.000	AV	34.7	35.7	8.8	33.9	-	45.3	53.9	8.6	Floor noise
Hori	9748.000	AV	34.5	38.2	9.4	34.5	-	47.6	53.9	6.3	Floor noise
Vert	4874.000	PK	43.2	31.4	7.4	33.8	-	48.2	73.9	25.7	Floor noise
Vert	7311.000	PK	43.6	35.7	8.8	33.9	-	54.2	73.9	19.7	Floor noise
Vert	9748.000	PK	45.0	38.2	9.4	34.5	-	58.1	73.9	15.8	Floor noise
Vert	4874.000	AV	33.6	31.4	7.4	33.8	-	38.6	53.9	15.3	Floor noise
Vert	7311.000	AV	34.2	35.7	8.8	33.9	-	44.8	53.9	9.1	Floor noise
Vert	9748.000	AV	34.6	38.2	9.4	34.5	-	47.7	53.9	6.2	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 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

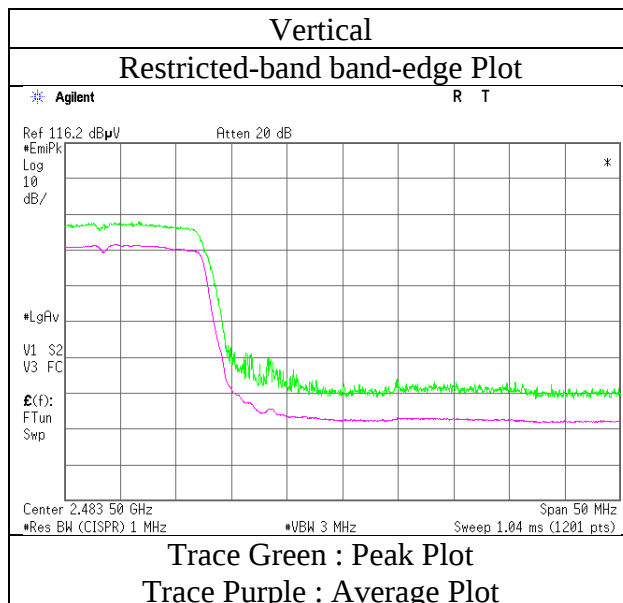
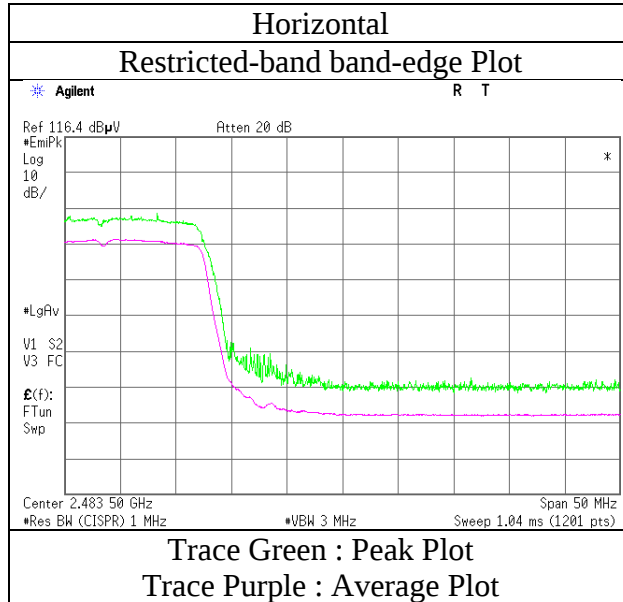
Mode Tx 11n-20 2462 MHz

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

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12007719H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH
Engineer	Takumi Shimada
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 MHz



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

UL Japan, Inc.

Ise EMC Lab.

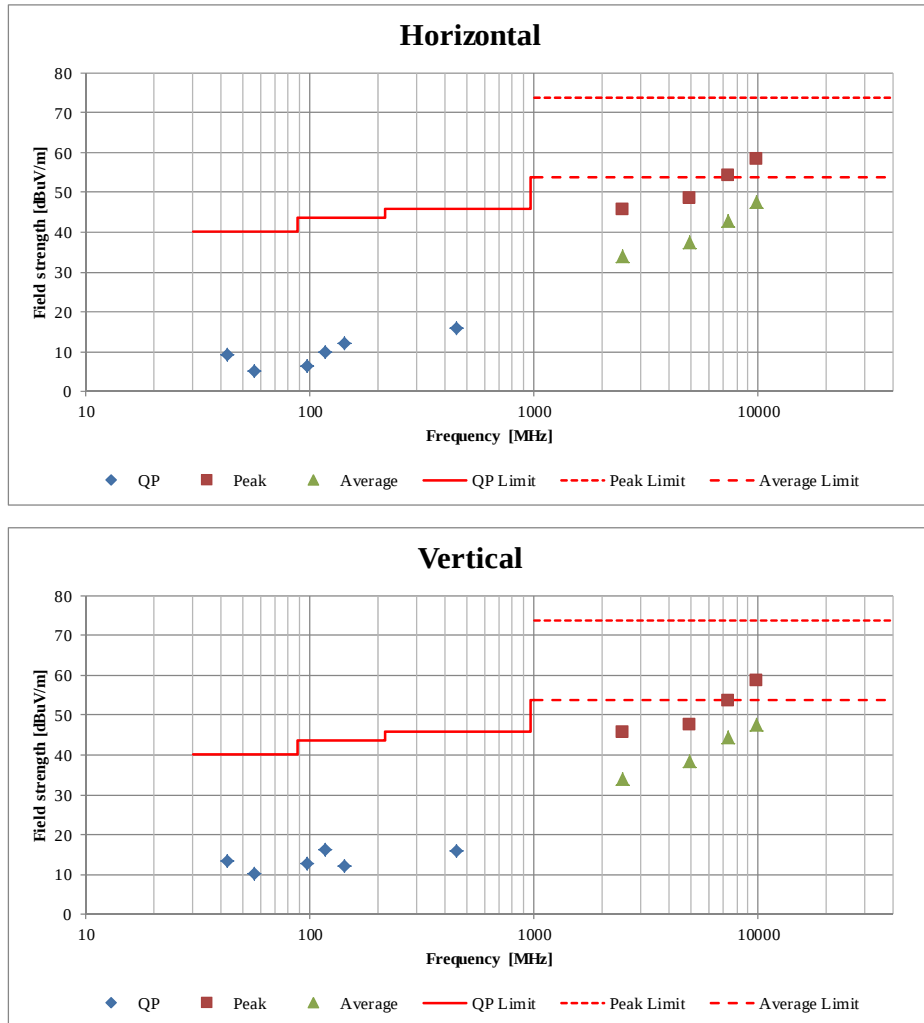
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Radiated Spurious Emission (Plot data, Worst case)

Report No.	12007719H	No.2	No.4
Test place	Ise EMC Lab.	November 11, 2017	November 11, 2017
Semi Anechoic Chamber	No.2	November 11, 2017	November 11, 2017
Date	November 11, 2017	November 11, 2017	November 11, 2017
Temperature / Humidity	24 deg. C / 35 % RH	22 deg. C / 48 % RH	21 deg. C / 43 % RH
Engineer	Takumi Shimada	Masafumi Niwa	Masafumi Niwa
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx 11n-20 2462 MHz		



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

Radiated Spurious Emission

Report No. 12007719H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date November 11, 2017
Temperature / Humidity 22 deg. C / 48 % RH
Engineer Masafumi Niwa
(Above 1 GHz)
Mode Tx BT LE 2402 MHz
No.4
November 11, 2017
21 deg. C / 43 % RH
Masafumi Niwa
(Below 1 GHz)

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	43.934	QP	20.9	12.9	7.4	32.1	-	9.1	40.0	30.9	
Hori	56.479	QP	20.9	8.5	7.6	32.1	-	4.9	40.0	35.1	
Hori	63.921	QP	21.1	6.9	7.7	32.1	-	3.6	40.0	36.4	
Hori	85.234	QP	21.1	7.6	8.0	32.1	-	4.6	40.0	35.4	
Hori	115.082	QP	21.2	12.1	8.3	32.0	-	9.6	43.5	33.9	
Hori	449.158	QP	20.3	16.7	10.9	32.1	-	15.8	46.0	30.2	
Hori	2390.000	PK	44.1	27.0	5.1	34.6	-	41.6	73.9	32.3	
Hori	4804.000	PK	43.1	31.3	7.4	33.8	-	48.0	73.9	25.9	Floor noise
Hori	7206.000	PK	44.1	35.6	8.7	33.9	-	54.5	73.9	19.4	Floor noise
Hori	9608.000	PK	45.6	38.2	9.5	34.5	-	58.8	73.9	15.1	Floor noise
Hori	2390.000	AV	36.2	27.0	5.1	34.6	2.0	35.7	53.9	18.2	*1)
Hori	4804.000	AV	34.6	31.3	7.4	33.8	-	39.5	53.9	14.4	Floor noise
Hori	7206.000	AV	35.1	35.6	8.7	33.9	-	45.5	53.9	8.4	Floor noise
Hori	9608.000	AV	34.5	38.2	9.5	34.5	-	47.7	53.9	6.2	Floor noise
Vert	43.934	QP	26.6	12.9	7.4	32.1	-	14.8	40.0	25.2	
Vert	56.479	QP	25.8	8.5	7.6	32.1	-	9.8	40.0	30.2	
Vert	63.921	QP	25.1	6.9	7.7	32.1	-	7.6	40.0	32.4	
Vert	85.234	QP	22.4	7.6	8.0	32.1	-	5.9	40.0	34.1	
Vert	115.082	QP	26.8	12.1	8.3	32.0	-	15.2	43.5	28.3	
Vert	449.124	QP	20.4	16.7	10.9	32.1	-	15.9	46.0	30.1	
Vert	2390.000	PK	44.5	27.0	5.1	34.6	-	42.0	73.9	31.9	
Vert	4804.000	PK	43.2	31.3	7.4	33.8	-	48.1	73.9	25.8	Floor noise
Vert	7206.000	PK	44.0	35.6	8.7	33.9	-	54.4	73.9	19.5	Floor noise
Vert	9608.000	PK	45.4	38.2	9.5	34.5	-	58.6	73.9	15.3	Floor noise
Vert	2390.000	AV	36.0	27.0	5.1	34.6	2.0	35.5	53.9	18.4	*1)
Vert	4804.000	AV	34.4	31.3	7.4	33.8	-	39.3	53.9	14.6	Floor noise
Vert	7206.000	AV	35.3	35.6	8.7	33.9	-	45.7	53.9	8.2	Floor noise
Vert	9608.000	AV	34.4	38.2	9.5	34.5	-	47.6	53.9	6.3	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 (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

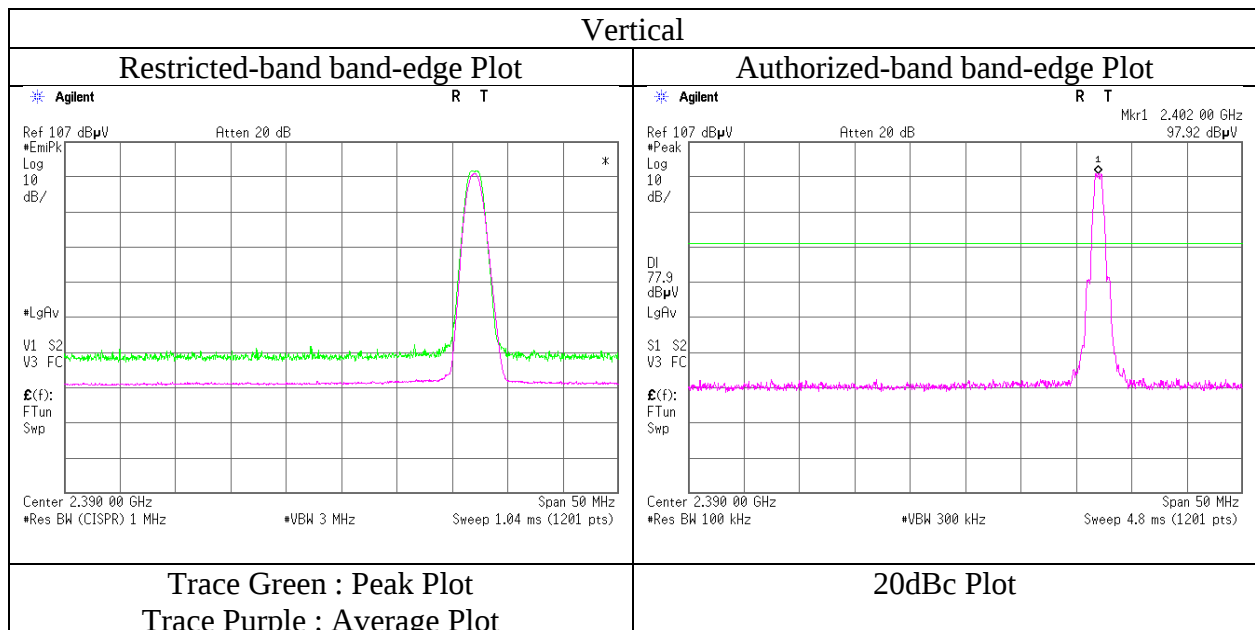
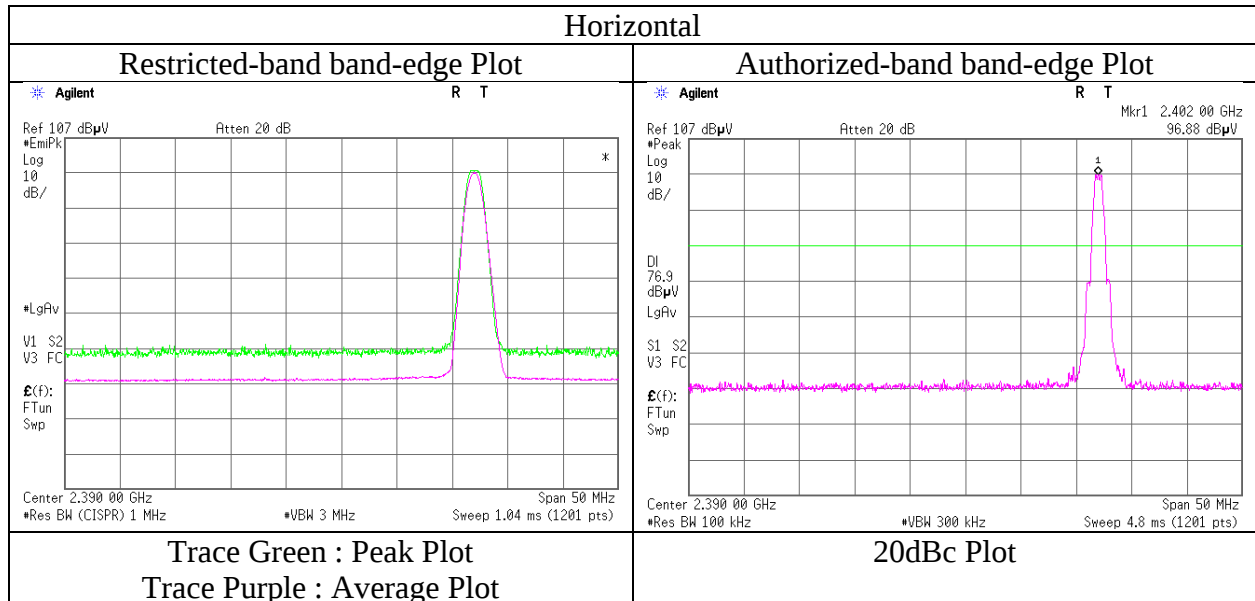
20dBc Data Sheet

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	96.9	27.0	5.1	34.6	94.4	-	-	Carrier
Hori	2400.000	PK	40.0	27.0	5.1	34.6	37.5	74.4	36.9	
Vert	2402.000	PK	97.9	27.0	5.1	34.6	95.4	-	-	Carrier
Vert	2400.000	PK	41.2	27.0	5.1	34.6	38.7	75.4	36.7	

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12007719H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 11, 2017
Temperature / Humidity	22 deg. C / 48 % RH
Engineer	Masafumi Niwa
	(1 GHz - 10 GHz)
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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Radiated Spurious Emission

Report No.	12007719H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.4
Date	November 11, 2017	November 11, 2017
Temperature / Humidity	22 deg. C / 48 % RH	21 deg. C / 43 % RH
Engineer	Masafumi Niwa (Above 1 GHz)	Masafumi Niwa (Below 1 GHz)
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	43.923	QP	20.8	12.9	7.4	32.1	-	9.0	40.0	31.0	
Hori	56.532	QP	20.9	8.5	7.6	32.1	-	4.9	40.0	35.1	
Hori	63.912	QP	21.2	6.9	7.7	32.1	-	3.7	40.0	36.3	
Hori	95.705	QP	21.3	9.4	8.1	32.1	-	6.7	43.5	36.8	
Hori	114.922	QP	21.1	12.1	8.3	32.0	-	9.5	43.5	34.0	
Hori	449.112	QP	20.3	16.7	10.9	32.1	-	15.8	46.0	30.2	
Hori	4880.000	PK	43.2	31.4	7.4	33.8	-	48.2	73.9	25.7	Floor noise
Hori	7320.000	PK	43.8	35.8	8.8	33.9	-	54.5	73.9	19.4	Floor noise
Hori	9760.000	PK	45.4	38.2	9.4	34.5	-	58.5	73.9	15.4	Floor noise
Hori	4880.000	AV	34.8	31.4	7.4	33.8	-	39.8	53.9	14.1	Floor noise
Hori	7320.000	AV	34.8	35.8	8.8	33.9	-	45.5	53.9	8.4	Floor noise
Hori	9760.000	AV	34.3	38.2	9.4	34.5	-	47.4	53.9	6.5	Floor noise
Vert	43.923	QP	26.4	12.9	7.4	32.1	-	14.6	40.0	25.4	
Vert	56.532	QP	26.7	8.5	7.6	32.1	-	10.7	40.0	29.3	
Vert	63.912	QP	25.3	6.9	7.7	32.1	-	7.8	40.0	32.2	
Vert	95.705	QP	25.9	9.4	8.1	32.1	-	11.3	43.5	32.2	
Vert	114.922	QP	26.3	12.1	8.3	32.0	-	14.7	43.5	28.8	
Vert	449.112	QP	20.4	16.7	10.9	32.1	-	15.9	46.0	30.1	
Vert	4880.000	PK	43.0	31.4	7.4	33.8	-	48.0	73.9	25.9	Floor noise
Vert	7320.000	PK	43.7	35.8	8.8	33.9	-	54.4	73.9	19.5	Floor noise
Vert	9760.000	PK	45.3	38.2	9.4	34.5	-	58.4	73.9	15.5	Floor noise
Vert	4880.000	AV	35.0	31.4	7.4	33.8	-	40.0	53.9	13.9	Floor noise
Vert	7320.000	AV	34.7	35.8	8.8	33.9	-	45.4	53.9	8.5	Floor noise
Vert	9760.000	AV	34.5	38.2	9.4	34.5	-	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 (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	12007719H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.4
Date	November 11, 2017	November 11, 2017
Temperature / Humidity	22 deg. C / 48 % RH	21 deg. C / 43 % RH
Engineer	Masafumi Niwa (Above 1 GHz)	Masafumi Niwa (Below 1 GHz)
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	43.923	QP	20.7	12.9	7.4	32.1	-	8.9	40.0	31.1	
Hori	57.557	QP	20.8	8.2	7.6	32.1	-	4.5	40.0	35.5	
Hori	64.245	QP	21.3	6.8	7.7	32.1	-	3.7	40.0	36.3	
Hori	94.601	QP	21.2	9.2	8.1	32.1	-	6.4	43.5	37.1	
Hori	116.190	QP	21.1	12.2	8.3	32.0	-	9.6	43.5	33.9	
Hori	449.112	QP	20.4	16.7	10.9	32.1	-	15.9	46.0	30.1	
Hori	2483.500	PK	45.6	27.0	5.2	34.6	-	43.2	73.9	30.7	
Hori	4960.000	PK	43.6	31.6	7.5	33.8	-	48.9	73.9	25.0	Floor noise
Hori	7440.000	PK	43.0	35.9	8.7	34.0	-	53.6	73.9	20.3	Floor noise
Hori	9920.000	PK	45.1	38.2	9.5	34.6	-	58.2	73.9	15.7	Floor noise
Hori	2483.500	AV	36.8	27.0	5.2	34.6	2.0	36.4	53.9	17.5	*1)
Hori	4960.000	AV	34.4	31.6	7.5	33.8	-	39.7	53.9	14.2	Floor noise
Hori	7440.000	AV	35.1	35.9	8.7	34.0	-	45.7	53.9	8.2	Floor noise
Hori	9920.000	AV	34.3	38.2	9.5	34.6	-	47.4	53.9	6.5	Floor noise
Vert	43.923	QP	25.8	12.9	7.4	32.1	-	14.0	40.0	26.0	
Vert	57.557	QP	27.3	8.2	7.6	32.1	-	11.0	40.0	29.0	
Vert	64.245	QP	24.7	6.8	7.7	32.1	-	7.1	40.0	32.9	
Vert	94.601	QP	24.8	9.2	8.1	32.1	-	10.0	43.5	33.5	
Vert	116.190	QP	26.5	12.2	8.3	32.0	-	15.0	43.5	28.5	
Vert	449.112	QP	20.4	16.7	10.9	32.1	-	15.9	46.0	30.1	
Vert	2483.500	PK	45.6	27.0	5.2	34.6	-	43.2	73.9	30.7	
Vert	4960.000	PK	43.3	31.6	7.5	33.8	-	48.6	73.9	25.3	Floor noise
Vert	7440.000	PK	43.3	35.9	8.7	34.0	-	53.9	73.9	20.0	Floor noise
Vert	9920.000	PK	45.2	38.2	9.5	34.6	-	58.3	73.9	15.6	Floor noise
Vert	2483.500	AV	36.6	27.0	5.2	34.6	2.0	36.2	53.9	17.7	*1)
Vert	4960.000	AV	34.2	31.6	7.5	33.8	-	39.5	53.9	14.4	Floor noise
Vert	7440.000	AV	35.3	35.9	8.7	34.0	-	45.9	53.9	8.0	Floor noise
Vert	9920.000	AV	34.3	38.2	9.5	34.6	-	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

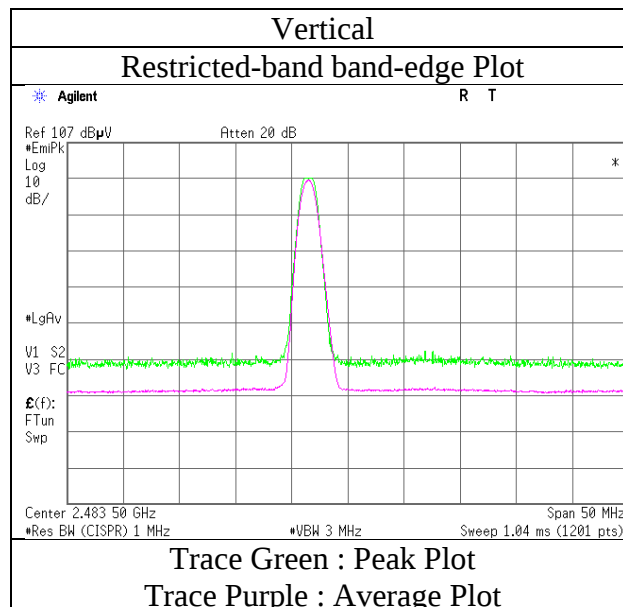
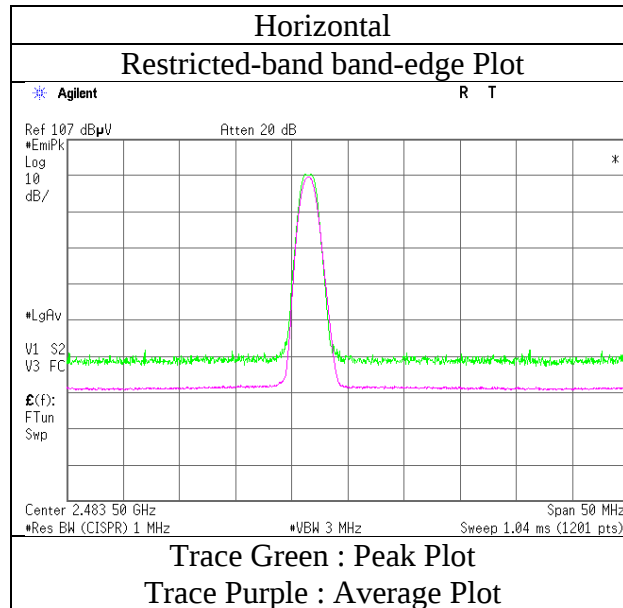
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12007719H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 11, 2017
Temperature / Humidity	22 deg. C / 48 % RH
Engineer	Masafumi Niwa
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2480 MHz



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

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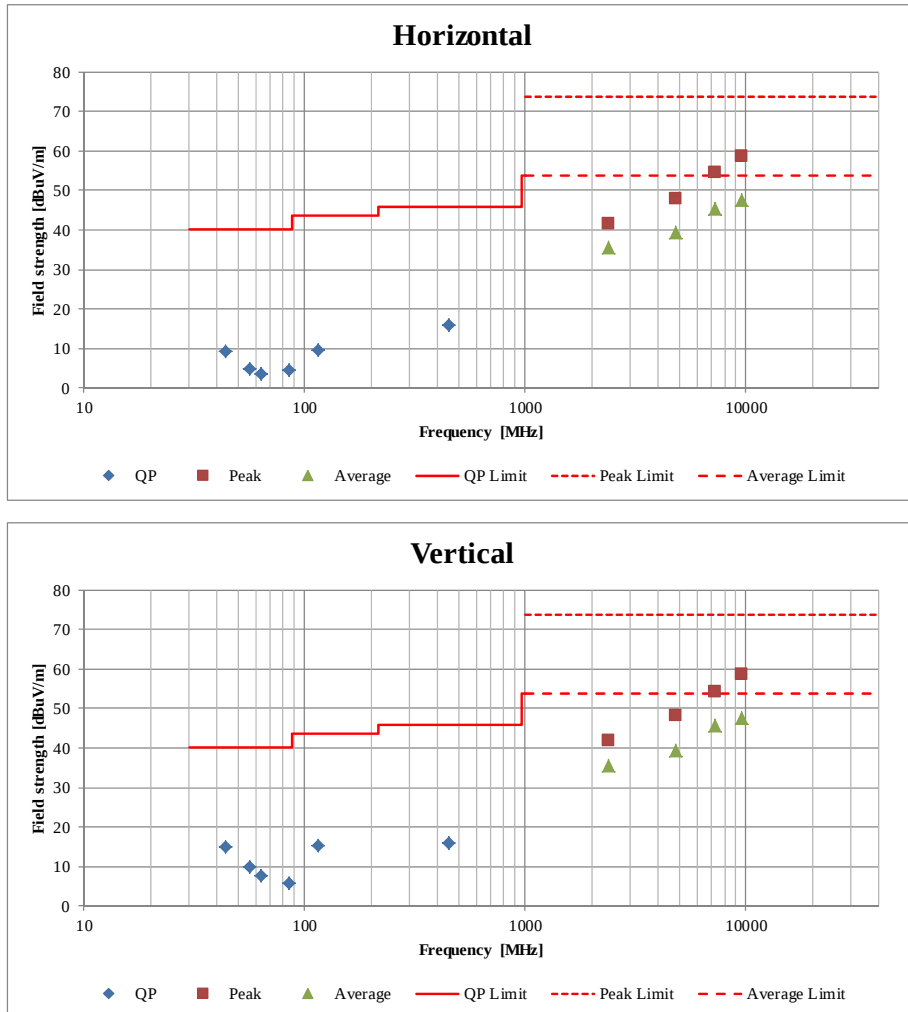
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Radiated Spurious Emission (Plot data, Worst case)

Report No.	12007719H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.4
Date	November 11, 2017	November 11, 2017
Temperature / Humidity	22 deg. C / 48 % RH	21 deg. C / 43 % RH
Engineer	Masafumi Niwa (Above 1GHz)	Masafumi Niwa (Below 1GHz)
Mode	Tx BT LE 2402 MHz	



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

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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAT-58	Attenuator(10dB)	Suhner	6810.19.A	-	AT	2016/12/15 * 12
MSA-15	Spectrum Analyzer	Agilent	E4440A	MY46187105	AT	2017/10/16 * 12
MOS-19	Thermo-Hygrometer	Custom	CTH-201	0001	AT	2016/12/13 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2017/10/30 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE	2017/01/20 * 12
MJM-26	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-10	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	RE	2017/01/12 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2016/11/23 * 12
MLA-23	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	RE	2017/01/26 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2017/06/26 * 12
MAT-97	Attenuator	KEYSIGHT	8491A	MY52462282	RE	2017/10/12 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2017/03/27 * 12
MMM-10	DIGITAL HiTESTER	Hioki	3805	051201148	RE	2017/01/19 * 12
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2017/08/31 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2016/12/13 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2016/11/10 * 12
MHA-06	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	RE	2017/02/24 * 12
MCC-216	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	RE	2017/08/04 * 12
MPA-10	Pre Amplifier	Agilent	8449B	3008A02142	RE	2017/01/16 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2017/06/30 * 12
MMM-01	Digital Tester	Fluke	FLUKE 26-3	78030611	RE	2017/08/07 * 12
MHF-26	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	RE	2017/09/11 * 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
AT: Antenna Terminal Conducted test

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