



RADIO TEST REPORT

Test Report No. : 12749447H-A-R1

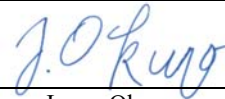
Applicant : **Panasonic Corporation of North America**
Type of Equipment : **Common Trigger Box**
Model No. : **WV-TW37003**
FCC ID : **ACJ9TAWV-TW37003**
Test regulation : **FCC Part 15 Subpart C: 2019**
For Permissive Change
(Radiated Spurious Emission tests only)
*** WLAN, Bluetooth Low Energy part**

Test Result : **Complied (Refer to SECTION 3.2)**

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 covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. 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.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12749447H-A. 12749447H-A is replaced with this report.

Date of test: June 27 to July 13, 2019

Representative test engineer:



Junya Okuno
Engineer

Consumer Technology Division

Approved by:



Tsubasa Takayama
Leader

Consumer Technology Division



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

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 12749447H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12749447H-A	July 30, 2019	-	-
1	12749447H-A-R1	November 8, 2019	P 9	Addition of operating mode and tested frequency for 11n-20 in Clasue 4.1 (The details of Operating mode(s))
1	12749447H-A-R1	November 8, 2019	P 10	Correction of configuration and peripherals in Clasue 4.2

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CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	6
SECTION 4: Operation of E.U.T. during testing.....	9
SECTION 5: Radiated Spurious Emission	11
APPENDIX 1: Test data	13
Radiated Spurious Emission	13
APPENDIX 2: Test instruments	34
APPENDIX 3: Photographs of test setup	35
Radiated Spurious Emission	35
Worst Case Position	36

SECTION 1: Customer information

Applicant

Company Name	:	Panasonic Corporation of North America
Address	:	Two Riverfront Plaza, Newark, NJ 07102-5490
Telephone Number	:	+1-201-348-7724
Facsimile Number	:	+1-201-392-4564
Contact Person	:	Vir Angelo Lontoc

Manufacturer

Company Name	:	Panasonic i-PRO Sensing Solutions Co., Ltd.
Address	:	4-1-62, Minoshima, Hakata-ku, Fukuoka 812-8531, Japan
Telephone Number	:	+81-50-3380-1971
Facsimile Number	:	+81-50-3380-2002
Contact Person	:	Katsumi Yano

***Remarks:**

Panasonic Corporation of North America designates Panasonic i-PRO Sensing Solutions Co., Ltd. as manufacturer of the product (Common Trigger Box).

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and

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

2.1 Identification of E.U.T.

Type of Equipment	:	Common Trigger Box
Model No.	:	WV-TW37003
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 12 V, DC 24 V
Receipt Date of Sample (Information from test lab.)	:	June 26, 2019
Country of Mass-production	:	Japan
Condition of EUT	:	Production model
Modification of EUT	:	No Modification by the test lab

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2.2 Product Description

Model: WV-TW37003 (referred to as the EUT in this report) is a Common Trigger Box.

Radio Specification

Radio Type : Transceiver
Clock frequency (crystal) : 37.4 MHz

	IEEE802.11b	IEEE802.11g/n (20 M band)	IEEE802.11a/n/ac (20 M band)	IEEE802.11n/ac (40 M band)	IEEE802.11ac (80 M band)
Frequency of operation	2412 MHz to 2462 MHz ^{*1)}	2412 MHz to 2462 MHz ^{*1)}	5745 MHz to 5825 MHz	5755 MHz 5795 MHz	5775 MHz
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK, 256QAM(IEEE802.11ac only))		
Channel spacing	5MHz		20MHz	40MHz	80MHz
Antenna type	Patterned dipole antenna				
Antenna Connector type	RP-SMA Jack (Female)				
Antenna Gain	3.7 dBi (2.4 GHz Band), -4.2 dBi (5 GHz Band)				

	Bluetooth Ver.4.1 with EDR function / Bluetooth Low Energy ^{*1)}
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	BT: FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK) LE: GFSK
Channel spacing	BT: 1 MHz LE: 2 MHz
Antenna type	Patterned dipole antenna
Antenna Connector type	RP-SMA Jack (Female)
Antenna Gain	3.7 dBi

*1) This test report applies to WLAN (2.4 GHz Band only) and Bluetooth Low Energy.

*Wireless LAN and Bluetooth do not transmit simultaneously.

<Contents of the change from original model>

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 were performed in this report.

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

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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 July 19, 2019 and effective August 19, 2019 except 15.258

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 revisions made after testing date do not affect the test specification applied to the EUT.

** The customer has declared that the EUT has complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section15.247(d)	0.3 dB 2390.000 MHz, AV, Vert.	Complied# a)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) (*1)
	ISED: RSS-Gen 6.13	ISED: 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 15.247 Meas Guidance v05r02 8.5 and 8.6.					
a) Refer to APPENDIX 1 (data of Radiated Spurious Emission)					
Symbols:					
Complied		The data of this test item has enough margin, more than the measurement uncertainty.			
Complied#		The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.			

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

FCC Part 15.31 (e)

The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage. The test was performed with DC 12.0 V by using DC power supply.

That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The EUT has a unique coupling/antenna connector (RP-SMA Jack). Therefore the equipment complies with the requirement of 15.203.

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3.3 Addition to standard

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

3.4 Uncertainty

EMI

There is no applicable rule of uncertainty in this applied standard. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

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

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Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		5.0 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		4.9 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.0 dB
		5.0 dB
3 m	1 GHz to 6 GHz	5.0 dB
	6 GHz to 18 GHz	5.3 dB
1 m	10 GHz to 26.5 GHz	5.8 dB
	26.5 GHz to 40 GHz	5.8 dB
10 m	1 GHz to 18 GHz	5.2 dB

3.5 Test Location

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*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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Test site	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	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	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	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	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.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
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	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-

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)	6 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 0 (Short GI), PN9
Bluetooth Low Energy (BT LE)	-
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid 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: Same as production model BT LE: 2 dBm Software: TeraTerm Version4.9.2 *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
Radiated Spurious Emission (Below 1GHz)	11g Tx *1)	2462 MHz
	BT LE Tx	2402 MHz
		2440 MHz
		2480 MHz
Radiated Spurious Emission (Above 1GHz)	11b Tx	2412 MHz
	11g Tx *2)	2437 MHz
		2462 MHz
	11n-20 Tx *3)	2412 MHz
		2462 MHz
	BT LE Tx	2402 MHz
		2440 MHz
		2480 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 peak output power.

*3) 11n-20 was only tested for band-edge.

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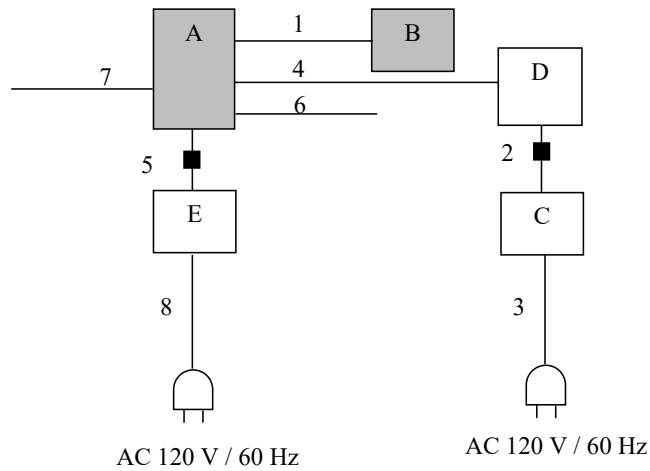
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4.2 Configuration and peripherals



■ : Standard Ferrite Core

* 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	Common Trigger Box	WV-TW37003	RGA0019	Panasonic i-PRO Sensing Solutions Co., Ltd.	EUT
B	Antenna	AP-PAN-W-M-S2-RP-RA-WH-15	-	Airgain	EUT
C	AC Adapter	CF-AA1653AM2	-	Panasonic	-
D	Laptop PC	CF-N8	0CKSA09265	Panasonic	-
E	AC Adapter	CF-AA1625A M4	SEB55N2-16.0C	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna Cable	4.5	Shielded	Shielded	-
2	DC Cable	1.3	Unshielded	Unshielded	-
3	AC Cable	1.8	Unshielded	Unshielded	-
4	LAN Cable	3.0	Unshielded	Unshielded	-
5	DC Cable	1.2	Unshielded	Unshielded	-
6	Flat Cable	0.7	Unshielded	Unshielded	-
7	Signal Cable	1.0	Unshielded	Unshielded	-
8	AC Cable	1.8	Unshielded	Unshielded	-

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SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[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(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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	11.12.2.5.1 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces 11.12.2.5.2 The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results.	RBW: 100 kHz VBW: 300 kHz

*1) Average Power Measurement was performed based on ANSI C63.10-2013.

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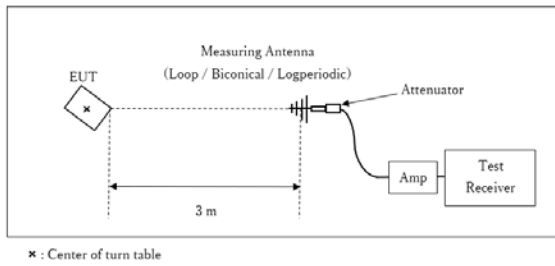
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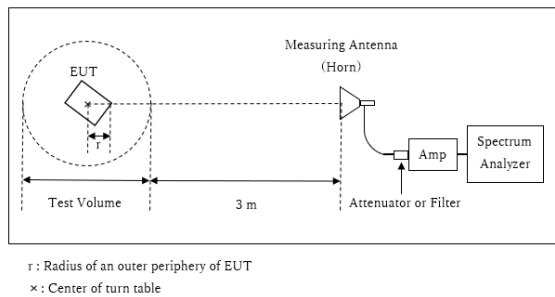
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 10 GHz



Distance Factor: $20 \times \log (3.6 \text{ m} / 3.0 \text{ m}) = 1.59 \text{ dB}$

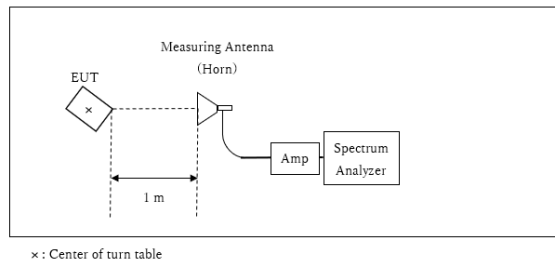
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.6 \text{ m}$

Test Volume : 1.5 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

r = 0.15 m

10 GHz - 26.5 GHz



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

*Test Distance: 1 m

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT (Common Trigger Box 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 MHz - 26.5 GHz
Test data	: APPENDIX
Test result	: Pass

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APPENDIX 1: Test data

Radiated Spurious Emission

Report No.	12749447H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	June 27, 2019	July 13, 2019
Temperature / Humidity	23 deg. C / 65 % RH	23 deg. C / 70 % RH
Engineer	Koji Yamamoto	Junya Okuno
	(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	49.6	27.3	4.8	34.3	-	47.4	73.9	26.5	
Hori.	4824.000	PK	42.8	31.6	6.9	33.5	-	47.8	73.9	26.1	Floor noise
Hori.	7236.000	PK	43.5	36.2	8.2	33.4	-	54.6	73.9	19.4	Floor noise
Hori.	9648.000	PK	44.8	38.8	8.8	33.8	-	58.6	73.9	15.3	Floor noise
Hori.	2390.000	AV	39.2	27.3	4.8	34.3	0.5	37.5	53.9	16.5	*1)
Hori.	4824.000	AV	33.1	31.6	6.9	33.5	-	38.1	53.9	15.8	Floor noise
Hori.	7236.000	AV	33.5	36.2	8.2	33.4	-	44.5	53.9	9.4	Floor noise
Hori.	9648.000	AV	33.5	38.8	8.8	33.8	-	47.2	53.9	6.7	Floor noise
Vert.	2390.000	PK	58.1	27.3	4.8	34.3	-	55.9	73.9	18.0	
Vert.	4824.000	PK	43.4	31.6	6.9	33.5	-	48.5	73.9	25.4	Floor noise
Vert.	7236.000	PK	42.3	36.2	8.2	33.4	-	53.3	73.9	20.6	Floor noise
Vert.	9648.000	PK	43.2	38.8	8.8	33.8	-	56.9	73.9	17.0	Floor noise
Vert.	2390.000	AV	48.2	27.3	4.8	34.3	0.5	46.5	53.9	7.4	*1)
Vert.	4824.000	AV	33.1	31.6	6.9	33.5	-	38.2	53.9	15.8	Floor noise
Vert.	7236.000	AV	33.7	36.2	8.2	33.4	-	44.7	53.9	9.2	Floor noise
Vert.	9648.000	AV	33.8	38.8	8.8	33.8	-	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 $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$

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	100.4	27.1	4.8	34.3	98.0	-	-	Carrier
Hori	2400.000	PK	55.6	27.0	4.8	34.3	53.1	78.0	24.9	
Vert	2412.000	PK	105.2	27.1	4.8	34.3	102.8	-	-	Carrier
Vert	2400.000	PK	66.5	27.0	4.8	34.3	64.0	82.8	18.8	

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

Distance factor: 1 GHz - 10 GHz $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$

10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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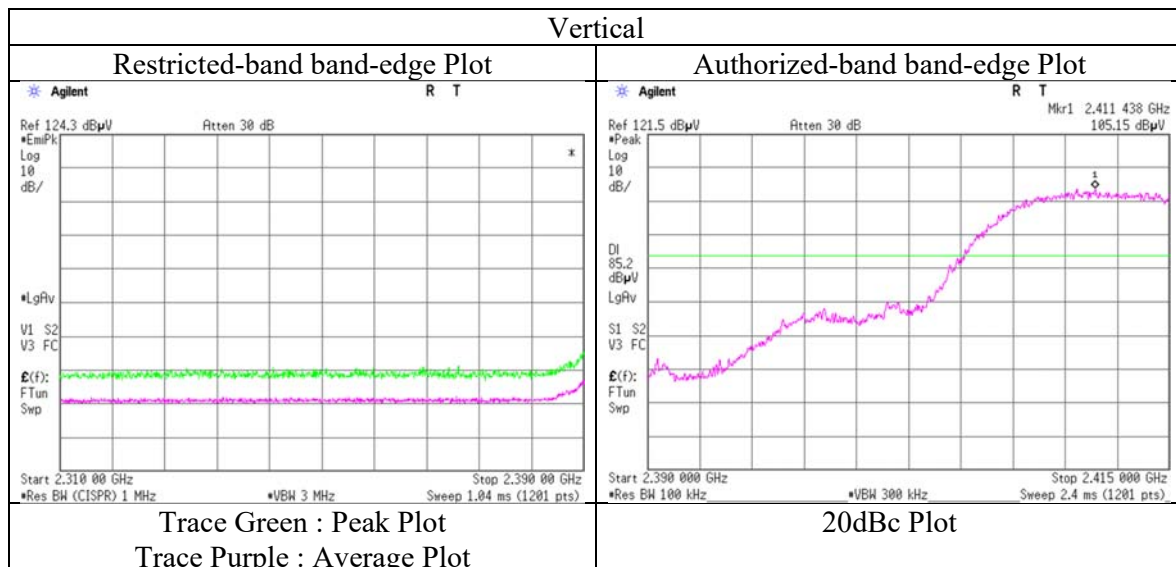
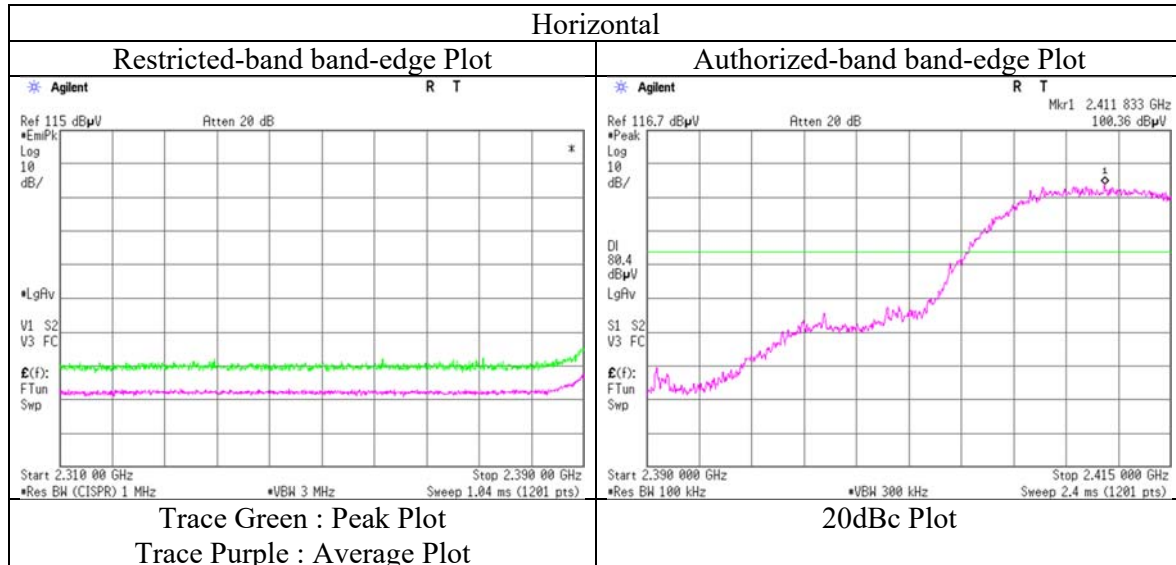
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 9, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx 11b 2412 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12749447H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	June 27, 2019	July 13, 2019
Temperature / Humidity	23 deg. C / 65 % RH	23 deg. C / 70 % RH
Engineer	Koji Yamamoto	Junya Okuno
	(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	48.3	31.7	6.9	33.5	-	53.4	73.9	20.5	Floor noise
Hori.	7311.000	PK	50.2	36.0	8.2	33.5	-	61.0	73.9	12.9	Floor noise
Hori.	9748.000	PK	49.0	38.8	8.8	33.8	-	62.7	73.9	11.2	Floor noise
Hori.	4874.000	AV	33.1	31.7	6.9	33.5	-	38.3	53.9	15.6	Floor noise
Hori.	7311.000	AV	33.2	36.0	8.2	33.5	-	44.0	53.9	9.9	Floor noise
Hori.	9748.000	AV	33.8	38.8	8.8	33.8	-	47.5	53.9	6.4	Floor noise
Vert.	4874.000	PK	46.7	31.7	6.9	33.5	-	51.9	73.9	22.0	Floor noise
Vert.	7311.000	PK	48.8	36.0	8.2	33.5	-	59.6	73.9	14.3	Floor noise
Vert.	9748.000	PK	49.0	38.8	8.8	33.8	-	62.7	73.9	11.2	Floor noise
Vert.	4874.000	AV	33.1	31.7	6.9	33.5	-	38.3	53.9	15.6	Floor noise
Vert.	7311.000	AV	33.8	36.0	8.2	33.5	-	44.6	53.9	9.3	Floor noise
Vert.	9748.000	AV	33.4	38.8	8.8	33.8	-	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 $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No.	12749447H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	June 27, 2019	July 13, 2019
Temperature / Humidity	23 deg. C / 65 % RH	23 deg. C / 70 % RH
Engineer	Koji Yamamoto	Junya Okuno
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
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	52.3	28.1	4.9	34.2	-	51.0	73.9	22.9	
Hori.	4924.000	PK	42.2	31.8	6.9	33.5	-	47.5	73.9	26.4	Floor noise
Hori.	7386.000	PK	42.5	36.2	8.2	33.5	-	53.5	73.9	20.4	Floor noise
Hori.	9848.000	PK	43.8	38.7	8.8	33.8	-	57.4	73.9	16.6	Floor noise
Hori.	2483.500	AV	43.6	28.1	4.9	34.2	0.5	42.8	53.9	11.1	*1)
Hori.	4924.000	AV	33.4	31.8	6.9	33.5	-	38.7	53.9	15.2	Floor noise
Hori.	7386.000	AV	34.1	36.2	8.2	33.5	-	45.1	53.9	8.8	Floor noise
Hori.	9848.000	AV	33.2	38.7	8.8	33.8	-	46.8	53.9	7.1	Floor noise
Vert.	2483.500	PK	56.8	28.1	4.9	34.2	-	55.5	73.9	18.4	
Vert.	4924.000	PK	42.9	31.8	6.9	33.5	-	48.1	73.9	25.8	Floor noise
Vert.	7386.000	PK	43.8	36.2	8.2	33.5	-	54.8	73.9	19.1	Floor noise
Vert.	9848.000	PK	43.4	38.7	8.8	33.8	-	57.0	73.9	16.9	Floor noise
Vert.	2483.500	AV	49.2	28.1	4.9	34.2	0.5	48.4	53.9	5.5	*1)
Vert.	4924.000	AV	34.2	31.8	6.9	33.5	-	39.5	53.9	14.4	Floor noise
Vert.	7386.000	AV	33.4	36.2	8.2	33.5	-	44.3	53.9	9.6	Floor noise
Vert.	9848.000	AV	33.6	38.7	8.8	33.8	-	47.2	53.9	6.7	Floor noise

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

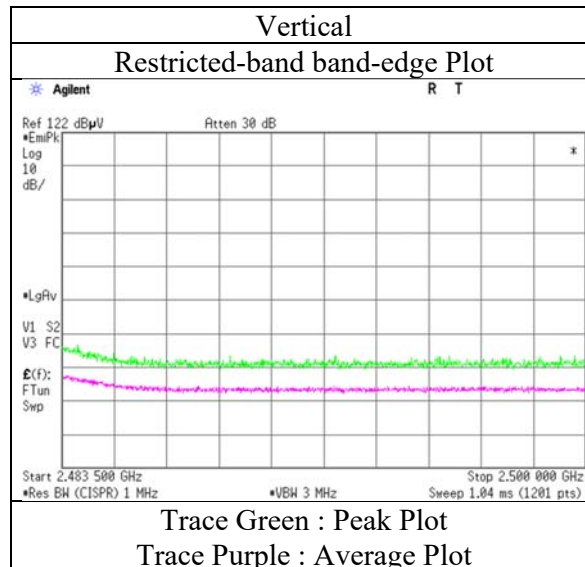
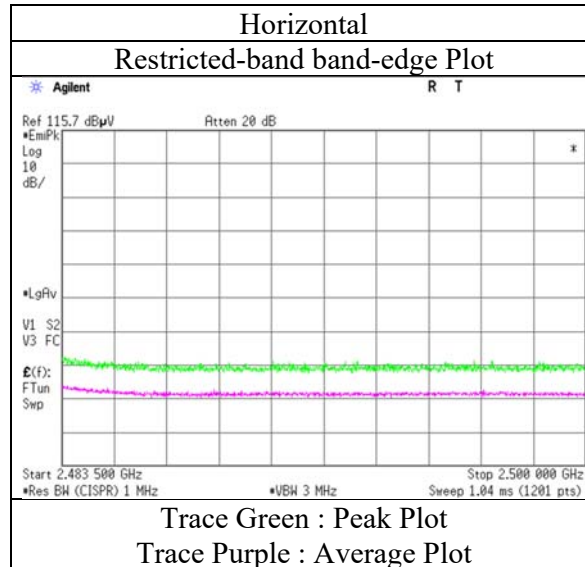
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$
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)

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 9, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx 11b 2462 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12749447H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	June 28, 2019	July 13, 2019
Temperature / Humidity	23 deg. C / 63 % RH	23 deg. C / 70 % RH
Engineer	Koji Yamamoto	Junya Okuno
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
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.	2390.000	PK	58.1	27.3	4.8	34.3	-	55.9	73.9	18.0	
Hori.	4824.000	PK	42.8	31.6	6.9	33.5	-	47.8	73.9	26.1	Floor noise
Hori.	7236.000	PK	43.5	36.2	8.2	33.4	-	54.6	73.9	19.4	Floor noise
Hori.	9648.000	PK	44.8	38.8	8.8	33.8	-	58.6	73.9	15.3	Floor noise
Hori.	2390.000	AV	43.1	27.3	4.8	34.3	0.3	41.2	53.9	12.7	*1)
Hori.	4824.000	AV	33.1	31.6	6.9	33.5	-	38.1	53.9	15.8	Floor noise
Hori.	7236.000	AV	33.5	36.2	8.2	33.4	-	44.5	53.9	9.4	Floor noise
Hori.	9648.000	AV	33.5	38.8	8.8	33.8	-	47.2	53.9	6.7	Floor noise
Vert.	2390.000	PK	62.2	27.3	4.8	34.3	-	60.0	73.9	13.9	
Vert.	4824.000	PK	43.4	31.6	6.9	33.5	-	48.5	73.9	25.4	Floor noise
Vert.	7236.000	PK	42.3	36.2	8.2	33.4	-	53.3	73.9	20.6	Floor noise
Vert.	9648.000	PK	43.2	38.8	8.8	33.8	-	56.9	73.9	17.0	Floor noise
Vert.	2390.000	AV	55.5	27.3	4.8	34.3	0.3	53.6	53.9	0.3	*1)
Vert.	4824.000	AV	33.1	31.6	6.9	33.5	-	38.2	53.9	15.8	Floor noise
Vert.	7236.000	AV	33.7	36.2	8.2	33.4	-	44.7	53.9	9.2	Floor noise
Vert.	9648.000	AV	33.8	38.8	8.8	33.8	-	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 (3.6 m / 3.0 m) = 1.59 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	93.3	27.1	4.8	34.3	90.9	-	-	Carrier
Hori	2400.000	PK	55.6	27.0	4.8	34.3	53.1	70.9	17.8	
Vert	2412.000	PK	100.2	27.1	4.8	34.3	97.8	-	-	Carrier
Vert	2400.000	PK	66.5	27.0	4.8	34.3	64.0	77.8	13.8	

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

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Ise EMC Lab.

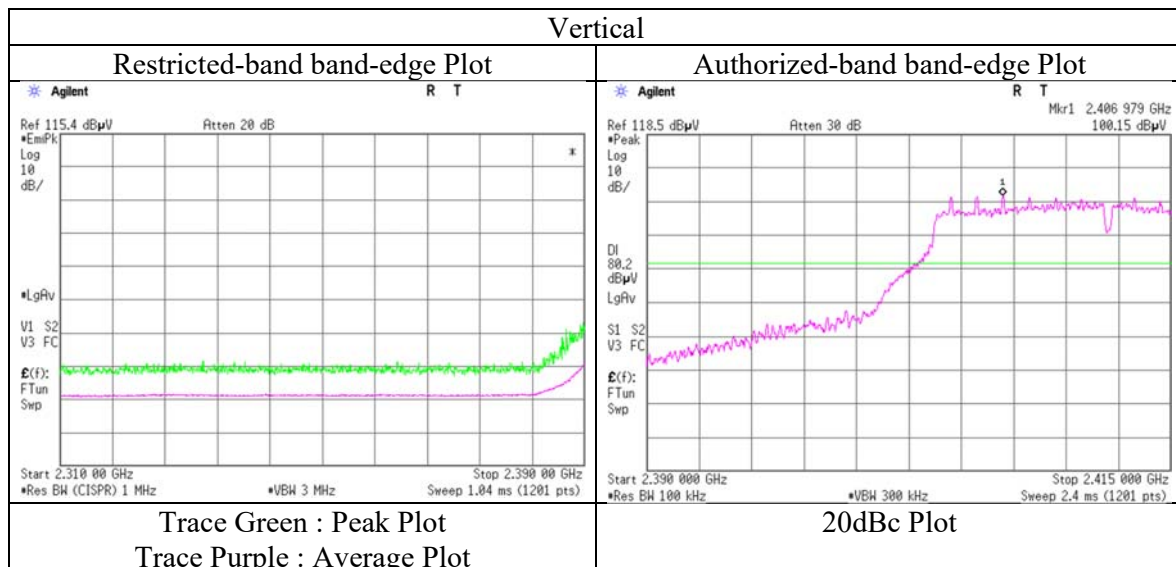
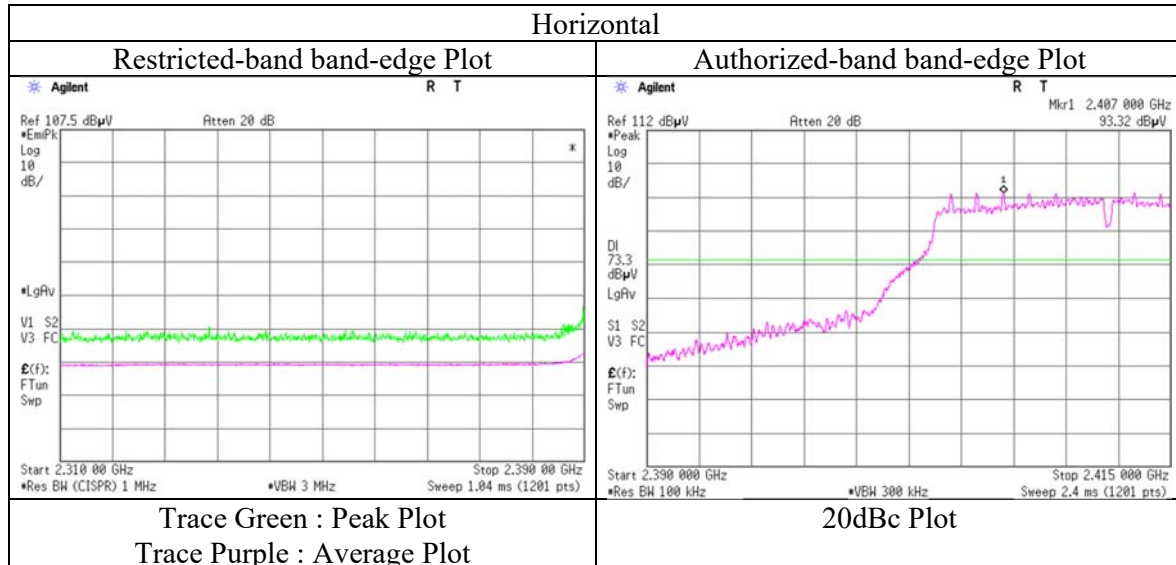
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 9, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx 11g 2412 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12749447H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	June 28, 2019	July 13, 2019
Temperature / Humidity	23 deg. C / 63 % RH	23 deg. C / 70 % RH
Engineer	Koji Yamamoto	Junya Okuno
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
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.	4874.000	PK	43.0	31.7	6.9	33.5	-	48.2	73.9	25.7	Floor noise
Hori.	7311.000	PK	43.3	36.0	8.2	33.5	-	54.1	73.9	19.8	Floor noise
Hori.	9748.000	PK	44.5	38.8	8.8	33.8	-	58.2	73.9	15.7	Floor noise
Hori.	4874.000	AV	33.2	31.7	6.9	33.5	-	38.3	53.9	15.6	Floor noise
Hori.	7311.000	AV	33.4	36.0	8.2	33.5	-	44.2	53.9	9.7	Floor noise
Hori.	9748.000	AV	33.9	38.8	8.8	33.8	-	47.6	53.9	6.3	Floor noise
Vert.	4874.000	PK	42.7	31.7	6.9	33.5	-	47.9	73.9	26.0	Floor noise
Vert.	7311.000	PK	43.1	36.0	8.2	33.5	-	53.9	73.9	20.0	Floor noise
Vert.	9748.000	PK	44.0	38.8	8.8	33.8	-	57.7	73.9	16.2	Floor noise
Vert.	4874.000	AV	33.0	31.7	6.9	33.5	-	38.2	53.9	15.7	Floor noise
Vert.	7311.000	AV	33.3	36.0	8.2	33.5	-	44.1	53.9	9.8	Floor noise
Vert.	9748.000	AV	33.8	38.8	8.8	33.8	-	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 $20\log(3.6 \text{ m} / 3.0 \text{ m}) = 1.59 \text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

Radiated Spurious Emission

Report No. 12749447H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date June 28, 2019 No.2
Temperature / Humidity 23 deg. C / 63 % RH July 13, 2019
Engineer Koji Yamamoto Junya Okuno
(1 GHz - 10 GHz) (10 GHz - 26.5 GHz)
(Below 1 GHz)

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.	62.229	QP	44.0	6.9	7.1	30.4	-	27.6	40.0	12.4	
Hori.	94.389	QP	41.4	9.1	7.4	30.3	-	27.6	43.5	15.9	
Hori.	399.996	QP	45.4	15.6	9.6	29.7	-	40.9	46.0	5.2	
Hori.	449.983	QP	47.2	16.4	9.6	29.9	-	43.3	46.0	2.7	
Hori.	480.010	QP	42.1	17.1	9.7	29.9	-	39.0	46.0	7.0	
Hori.	499.996	QP	45.9	17.7	9.8	30.0	-	43.4	46.0	2.6	
Hori.	549.999	QP	44.8	17.9	10.0	29.9	-	42.8	46.0	3.2	
Hori.	2483.500	PK	60.6	28.1	4.9	34.2	-	59.3	73.9	14.6	
Hori.	4924.000	PK	42.6	31.8	6.9	33.5	-	47.9	73.9	26.0	Floor noise
Hori.	7386.000	PK	43.7	36.2	8.2	33.5	-	54.7	73.9	19.3	Floor noise
Hori.	9848.000	PK	43.2	38.7	8.8	33.8	-	56.7	73.9	17.2	Floor noise
Hori.	2483.500	AV	46.3	28.1	4.9	34.2	0.3	45.3	53.9	8.6	*1)
Hori.	4924.000	AV	32.9	31.8	6.9	33.5	-	38.1	53.9	15.8	Floor noise
Hori.	7386.000	AV	33.3	36.2	8.2	33.5	-	44.2	53.9	9.7	Floor noise
Hori.	9848.000	AV	33.6	38.7	8.8	33.8	-	47.2	53.9	6.7	Floor noise
Vert.	62.229	QP	48.9	6.9	7.1	30.4	-	32.5	40.0	7.5	
Vert.	96.323	QP	47.9	9.5	7.4	30.3	-	34.5	43.5	9.0	
Vert.	399.995	QP	43.3	15.6	9.6	29.7	-	38.8	46.0	7.3	
Vert.	450.000	QP	35.6	16.4	9.6	29.9	-	31.8	46.0	14.3	
Vert.	480.010	QP	35.6	17.1	9.7	29.9	-	32.5	46.0	13.5	
Vert.	499.992	QP	42.7	17.7	9.8	30.0	-	40.2	46.0	5.8	
Vert.	550.004	QP	41.5	17.9	10.0	29.8	-	39.5	46.0	6.5	
Vert.	2483.500	PK	66.2	28.1	4.9	34.2	-	65.0	73.9	8.9	
Vert.	4924.000	PK	42.7	31.8	6.9	33.5	-	48.0	73.9	25.9	Floor noise
Vert.	7386.000	PK	42.2	36.2	8.2	33.5	-	53.2	73.9	20.7	Floor noise
Vert.	9848.000	PK	43.3	38.7	8.8	33.8	-	56.9	73.9	17.0	Floor noise
Vert.	2483.500	AV	52.1	28.1	4.9	34.2	0.3	51.1	53.9	2.8	*1)
Vert.	4924.000	AV	32.9	31.8	6.9	33.5	-	38.2	53.9	15.7	Floor noise
Vert.	7386.000	AV	33.3	36.2	8.2	33.5	-	44.2	53.9	9.7	Floor noise
Vert.	9848.000	AV	33.6	38.7	8.8	33.8	-	47.2	53.9	6.7	Floor noise

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

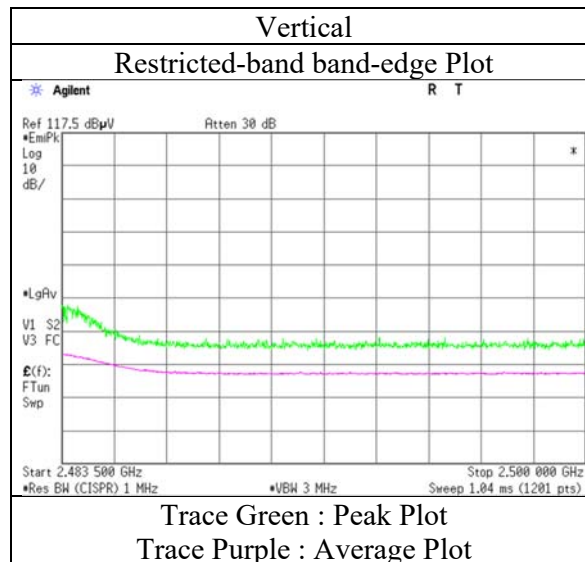
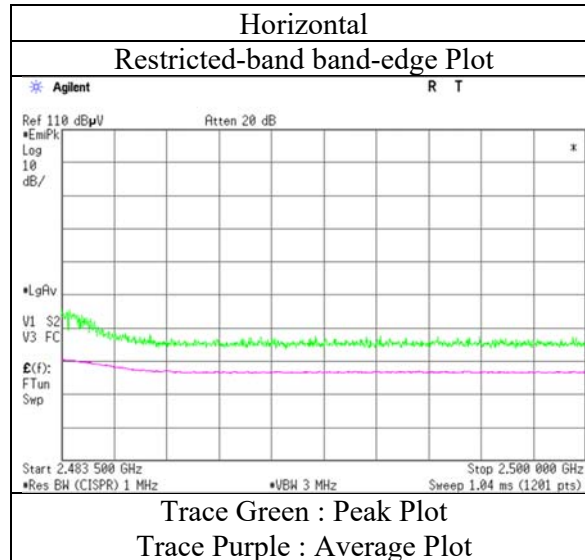
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$
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)

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 9, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx 11g 2462 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No. 12749447H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date June 28, 2019
Temperature / Humidity 23 deg. C / 63 % RH
Engineer Koji Yamamoto
(1 GHz - 10 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	61.4	27.3	4.8	34.3	-	59.2	73.9	14.7	
Hori.	2390.000	AV	50.3	27.3	4.8	34.3	0.4	48.5	53.9	5.4	*1)
Vert.	2390.000	PK	68.7	27.3	4.8	34.3	-	66.5	73.9	7.4	
Vert.	2390.000	AV	52.0	27.3	4.8	34.3	0.4	50.2	53.9	3.7	*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 $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$
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	94.7	27.1	4.8	34.3	92.3	-	-	Carrier
Hori	2400.000	PK	58.4	27.0	4.8	34.3	55.9	72.3	16.4	
Vert	2412.000	PK	100.4	27.1	4.8	34.3	98.0	-	-	Carrier
Vert	2400.000	PK	65.3	27.0	4.8	34.3	62.8	78.0	15.2	

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

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Ise EMC Lab.

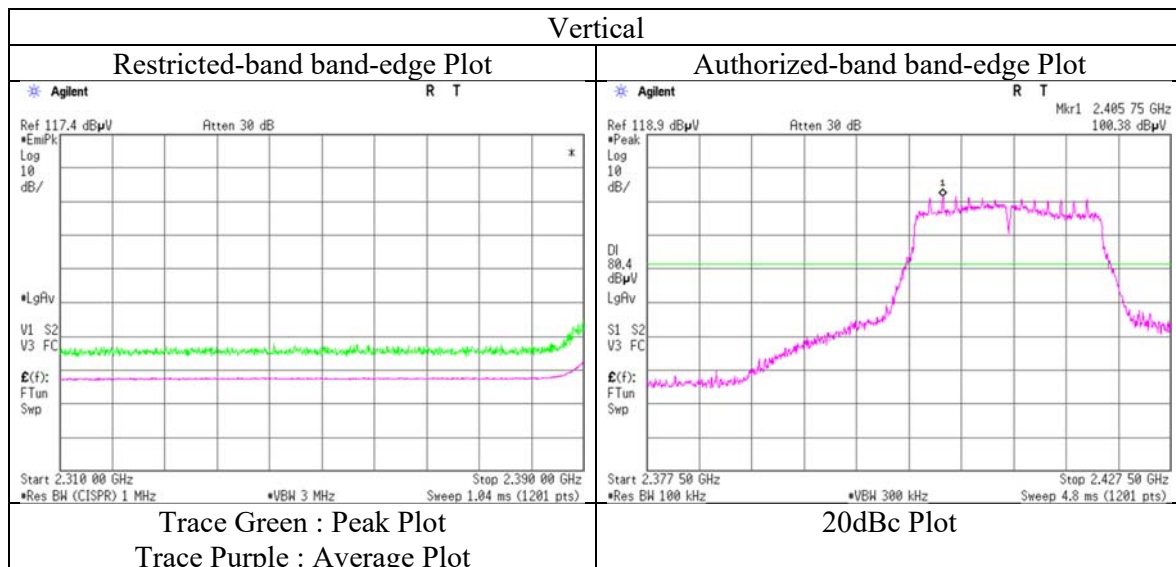
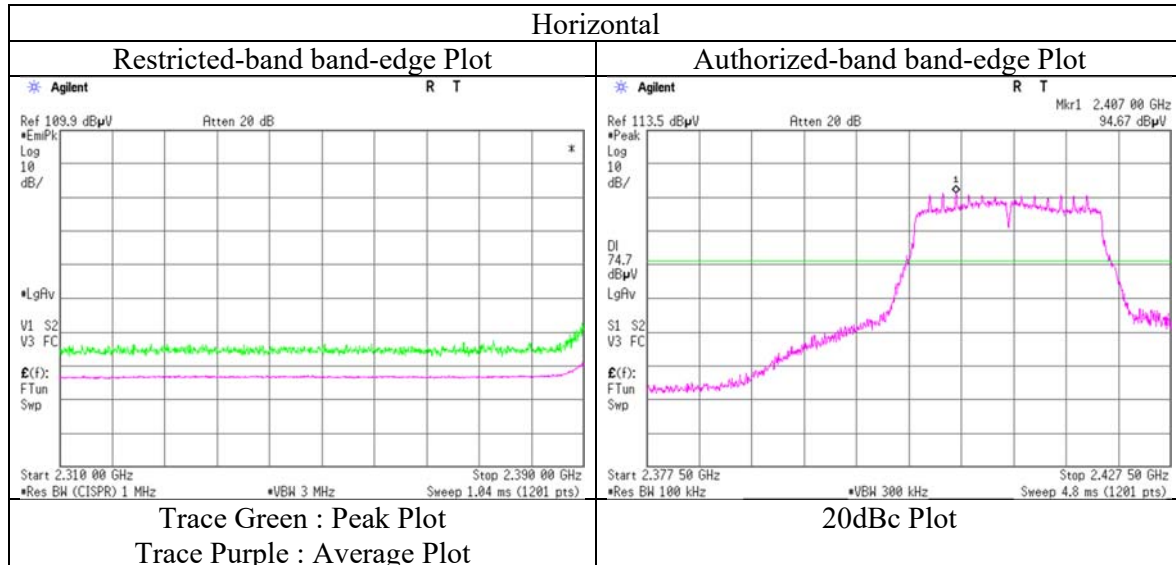
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 9, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	June 28, 2019
Temperature / Humidity	23 deg. C / 63 % RH
Engineer	Koji Yamamoto
	(1 GHz - 10 GHz)
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	64.9	28.1	4.9	34.2	-	63.6	73.9	10.3	
Hori.	2483.500	AV	44.7	28.1	4.9	34.2	0.4	43.7	53.9	10.2	*1)
Vert.	2483.500	PK	69.4	28.1	4.9	34.2	-	68.1	73.9	5.8	
Vert.	2483.500	AV	51.2	28.1	4.9	34.2	0.4	50.3	53.9	3.6	*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 $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$
 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)

UL Japan, Inc.

Ise EMC Lab.

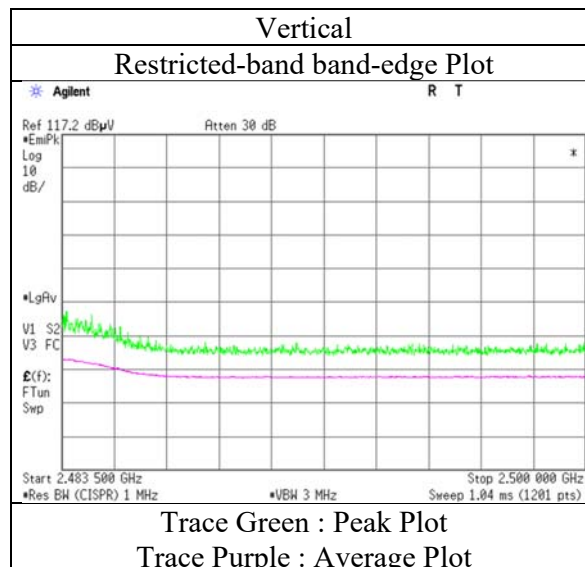
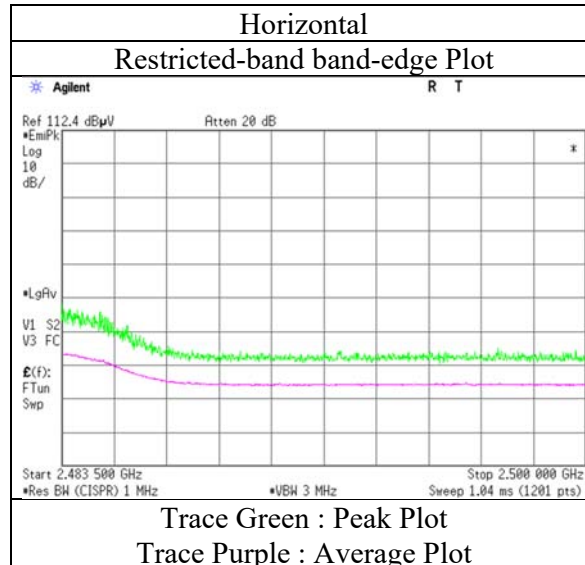
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 9, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2462 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No. 12749447H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date June 27, 2019 No.2
Temperature / Humidity 24 deg. C / 60 % RH 23 deg. C / 70 % RH
Engineer Junya Okuno
(1 GHz - 10 GHz) (10 GHz - 26.5 GHz)
(Below 1 GHz)

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.	62.224	QP	40.6	6.9	7.1	30.4	-	24.2	40.0	15.8	
Hori.	94.386	QP	41.1	9.1	7.4	30.3	-	27.3	43.5	16.2	
Hori.	400.001	QP	45.3	15.6	9.6	29.7	-	40.8	46.0	5.3	
Hori.	449.990	QP	48.4	16.4	9.6	29.9	-	44.5	46.0	1.5	
Hori.	480.011	QP	43.0	17.1	9.7	29.9	-	39.9	46.0	6.1	
Hori.	500.008	QP	47.1	17.7	9.8	30.0	-	44.6	46.0	1.4	
Hori.	550.001	QP	44.7	17.9	10.0	29.9	-	42.7	46.0	3.3	
Hori.	624.986	QP	39.2	19.6	10.3	29.6	-	39.5	46.0	6.5	
Hori.	2390.000	PK	44.4	27.3	4.8	34.3	-	42.2	73.9	31.7	
Hori.	4804.000	PK	42.2	31.6	6.9	33.5	-	47.3	73.9	26.6	Floor noise
Hori.	7206.000	PK	43.4	36.4	8.2	33.4	-	54.6	73.9	19.3	Floor noise
Hori.	9608.000	PK	43.5	38.5	8.8	33.8	-	57.0	73.9	16.9	Floor noise
Hori.	2390.000	AV	34.6	27.3	4.8	34.3	3.6	36.0	53.9	17.9	*1)
Hori.	4804.000	AV	33.9	31.6	6.9	33.5	-	39.0	53.9	15.0	Floor noise
Hori.	7206.000	AV	34.5	36.4	8.2	33.4	-	45.7	53.9	8.2	Floor noise
Hori.	9608.000	AV	34.3	38.5	8.8	33.8	-	47.8	53.9	6.1	Floor noise
Vert.	58.748	QP	46.5	7.9	7.1	30.4	-	31.0	40.0	9.0	
Vert.	96.325	QP	47.8	9.5	7.4	30.3	-	34.4	43.5	9.1	
Vert.	399.998	QP	41.2	15.6	9.6	29.7	-	36.7	46.0	9.4	
Vert.	449.997	QP	39.6	16.4	9.6	29.9	-	35.8	46.0	10.3	
Vert.	480.020	QP	35.5	17.1	9.7	29.9	-	32.4	46.0	13.6	
Vert.	500.002	QP	41.7	17.7	9.8	30.0	-	39.2	46.0	6.8	
Vert.	550.005	QP	41.3	17.9	10.0	29.8	-	39.3	46.0	6.7	
Vert.	624.991	QP	40.1	19.6	10.3	29.6	-	40.4	46.0	5.6	
Vert.	2390.000	PK	44.2	27.3	4.8	34.3	-	42.0	73.9	31.9	
Vert.	4804.000	PK	42.5	31.6	6.9	33.5	-	47.5	73.9	26.4	Floor noise
Vert.	7206.000	PK	42.5	36.4	8.2	33.4	-	53.7	73.9	20.2	Floor noise
Vert.	9608.000	PK	43.7	38.5	8.8	33.8	-	57.2	73.9	16.7	Floor noise
Vert.	2390.000	AV	33.4	27.3	4.8	34.3	3.6	34.8	53.9	19.1	*1)
Vert.	4804.000	AV	32.0	31.6	6.9	33.5	-	37.0	53.9	16.9	Floor noise
Vert.	7206.000	AV	32.3	36.4	8.2	33.4	-	43.5	53.9	10.4	Floor noise
Vert.	9608.000	AV	33.4	38.5	8.8	33.8	-	46.9	53.9	7.0	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 $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$

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	100.9	27.0	4.8	34.3	98.5	-	-	Carrier
Hori.	2400.000	PK	43.0	27.0	4.8	34.3	40.5	78.5	38.0	
Vert.	2402.000	PK	101.8	27.0	4.8	34.3	99.4	-	-	Carrier
Vert.	2400.000	PK	45.2	27.0	4.8	34.3	42.7	79.4	36.7	

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

Distance factor: 1 GHz - 10 GHz $20\log(3.6\text{ m} / 3.0\text{ m}) = 1.59\text{ dB}$

10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

UL Japan, Inc.

Ise EMC Lab.

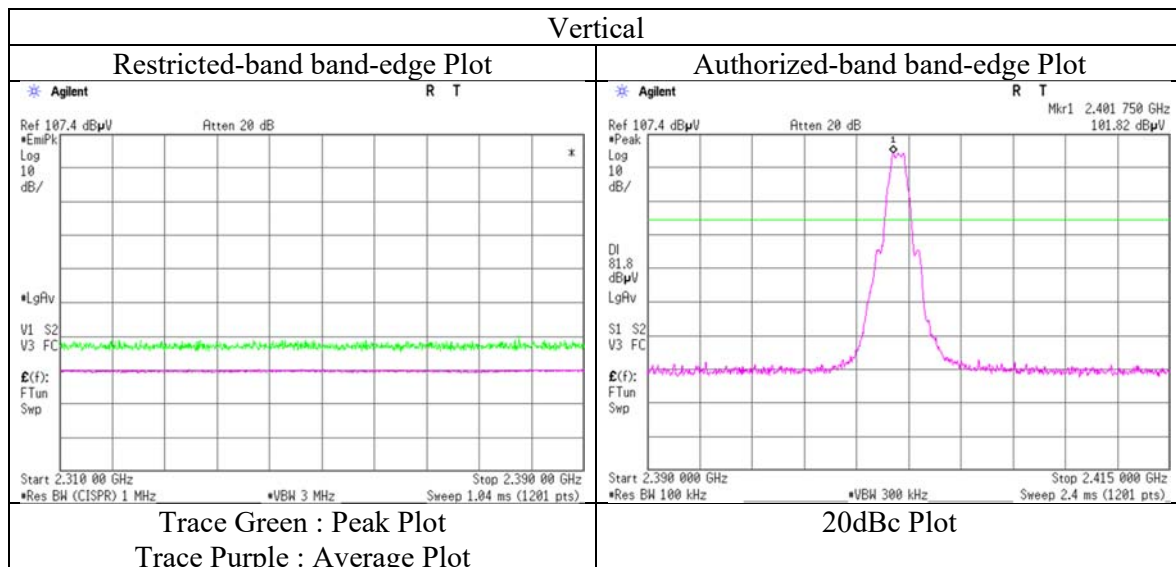
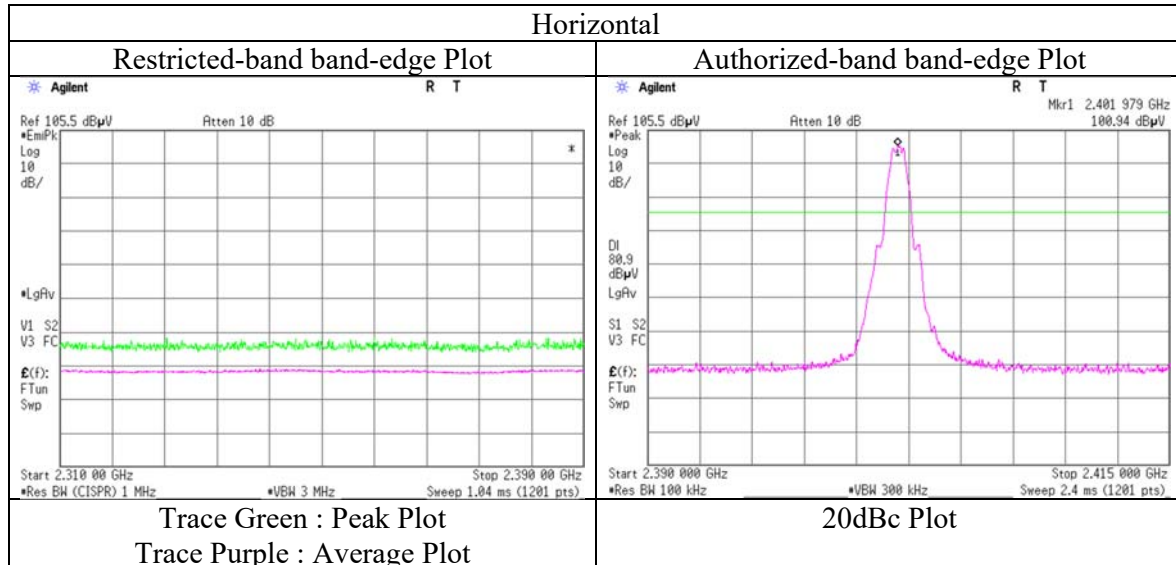
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	June 27, 2019
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No. 12749447H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date June 27, 2019 No.2
Temperature / Humidity 24 deg. C / 60 % RH July 13, 2019
Engineer Junya Okuno 23 deg. C / 70 % RH
(1 GHz - 10 GHz) Junya Okuno
(10 GHz - 26.5 GHz)
(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.	62.223	QP	40.7	6.9	7.1	30.4	-	24.3	40.0	15.7	
Hori.	94.388	QP	41.2	9.1	7.4	30.3	-	27.4	43.5	16.1	
Hori.	400.002	QP	45.1	15.6	9.6	29.7	-	40.6	46.0	5.5	
Hori.	450.004	QP	48.2	16.4	9.6	29.9	-	44.4	46.0	1.6	
Hori.	480.018	QP	42.8	17.1	9.7	29.9	-	39.7	46.0	6.3	
Hori.	499.998	QP	47.4	17.7	9.8	30.0	-	44.9	46.0	1.1	
Hori.	550.004	QP	44.9	17.9	10.0	29.8	-	42.9	46.0	3.1	
Hori.	624.989	QP	39.3	19.6	10.3	29.6	-	39.6	46.0	6.4	
Hori.	4880.000	PK	41.6	31.7	6.9	33.5	-	46.8	73.9	27.1	Floor noise
Hori.	7320.000	PK	42.5	36.0	8.2	33.5	-	53.4	73.9	20.6	Floor noise
Hori.	9760.000	PK	42.2	38.8	8.8	33.8	-	55.9	73.9	18.0	Floor noise
Hori.	4880.000	AV	33.9	31.7	6.9	33.5	-	39.0	53.9	14.9	Floor noise
Hori.	7320.000	AV	33.9	36.0	8.2	33.5	-	44.7	53.9	9.2	Floor noise
Hori.	9760.000	AV	34.1	38.8	8.8	33.8	-	47.8	53.9	6.1	Floor noise
Vert.	58.743	QP	46.4	7.9	7.1	30.4	-	30.9	40.0	9.1	
Vert.	96.342	QP	47.9	9.5	7.4	30.3	-	34.5	43.5	9.0	
Vert.	400.005	QP	41.4	15.6	9.6	29.7	-	36.9	46.0	9.2	
Vert.	450.000	QP	39.7	16.4	9.6	29.9	-	35.9	46.0	10.2	
Vert.	480.018	QP	35.6	17.1	9.7	29.9	-	32.5	46.0	13.5	
Vert.	499.998	QP	41.7	17.7	9.8	30.0	-	39.2	46.0	6.8	
Vert.	550.004	QP	41.2	17.9	10.0	29.8	-	39.2	46.0	6.8	
Vert.	625.001	QP	40.0	19.6	10.3	29.6	-	40.3	46.0	5.7	
Vert.	4880.000	PK	41.7	31.7	6.9	33.5	-	46.9	73.9	27.0	Floor noise
Vert.	7320.000	PK	42.4	36.0	8.2	33.5	-	53.2	73.9	20.7	Floor noise
Vert.	9760.000	PK	43.0	38.8	8.8	33.8	-	56.7	73.9	17.2	Floor noise
Vert.	4880.000	AV	33.7	31.7	6.9	33.5	-	38.9	53.9	15.0	Floor noise
Vert.	7320.000	AV	34.0	36.0	8.2	33.5	-	44.8	53.9	9.1	Floor noise
Vert.	9760.000	AV	34.1	38.8	8.8	33.8	-	47.8	53.9	6.1	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No. 12749447H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date June 27, 2019 No.2
Temperature / Humidity 24 deg. C / 60 % RH July 13, 2019
Engineer Junya Okuno 23 deg. C / 70 % RH
(1 GHz - 10 GHz) Junya Okuno
(10 GHz - 26.5 GHz)
(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.	62.225	QP	40.8	6.9	7.1	30.4	-	24.4	40.0	15.6	
Hori.	94.391	QP	41.1	9.1	7.4	30.3	-	27.3	43.5	16.2	
Hori.	400.000	QP	45.0	15.6	9.6	29.7	-	40.5	46.0	5.6	
Hori.	449.995	QP	48.0	16.4	9.6	29.9	-	44.1	46.0	1.9	
Hori.	480.032	QP	42.7	17.1	9.7	29.9	-	39.6	46.0	6.4	
Hori.	500.001	QP	47.3	17.7	9.8	30.0	-	44.8	46.0	1.2	
Hori.	550.000	QP	44.9	17.9	10.0	29.9	-	42.9	46.0	3.1	
Hori.	624.985	QP	39.4	19.6	10.3	29.6	-	39.7	46.0	6.3	
Hori.	2483.500	PK	45.2	28.1	4.9	34.2	-	43.9	73.9	30.0	
Hori.	4960.000	PK	41.6	31.9	6.9	33.5	-	46.9	73.9	27.0	Floor noise
Hori.	7440.000	PK	42.0	36.3	8.2	33.5	-	53.1	73.9	20.8	Floor noise
Hori.	9920.000	PK	42.5	38.7	8.8	33.8	-	56.2	73.9	17.7	Floor noise
Hori.	2483.500	AV	35.9	28.1	4.9	34.2	3.6	38.2	53.9	15.7	*1)
Hori.	4960.000	AV	33.5	31.9	6.9	33.5	-	38.9	53.9	15.0	Floor noise
Hori.	7440.000	AV	33.9	36.3	8.2	33.5	-	44.9	53.9	9.0	Floor noise
Hori.	9920.000	AV	34.0	38.7	8.8	33.8	-	47.7	53.9	6.2	Floor noise
Vert.	58.741	QP	46.4	7.9	7.1	30.4	-	30.9	40.0	9.1	
Vert.	98.421	QP	47.9	9.8	7.5	30.3	-	34.9	43.5	8.7	
Vert.	400.001	QP	41.2	15.6	9.6	29.7	-	36.7	46.0	9.4	
Vert.	449.997	QP	39.6	16.4	9.6	29.9	-	35.8	46.0	10.3	
Vert.	480.032	QP	35.4	17.1	9.7	29.9	-	32.3	46.0	13.7	
Vert.	500.001	QP	41.8	17.7	9.8	30.0	-	39.3	46.0	6.7	
Vert.	550.002	QP	41.1	17.9	10.0	29.8	-	39.1	46.0	6.9	
Vert.	625.003	QP	40.2	19.6	10.3	29.6	-	40.5	46.0	5.5	
Vert.	2383.500	PK	44.3	27.4	4.8	34.3	-	42.2	73.9	31.7	
Vert.	4960.000	PK	41.4	31.9	6.9	33.5	-	46.8	73.9	27.1	Floor noise
Vert.	7440.000	PK	41.8	36.3	8.2	33.5	-	52.9	73.9	21.0	Floor noise
Vert.	9920.000	PK	42.6	38.7	8.8	33.8	-	56.2	73.9	17.7	Floor noise
Vert.	2383.500	AV	33.8	27.4	4.8	34.3	3.6	35.4	53.9	18.5	
Vert.	4960.000	AV	33.5	31.9	6.9	33.5	-	38.9	53.9	15.0	Floor noise
Vert.	7440.000	AV	33.5	36.3	8.2	33.5	-	44.6	53.9	9.3	Floor noise
Vert.	9920.000	AV	34.0	38.7	8.8	33.8	-	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 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

UL Japan, Inc.

Ise EMC Lab.

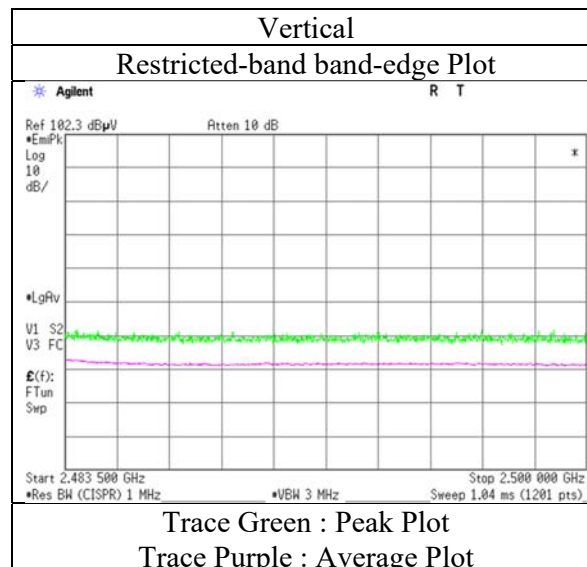
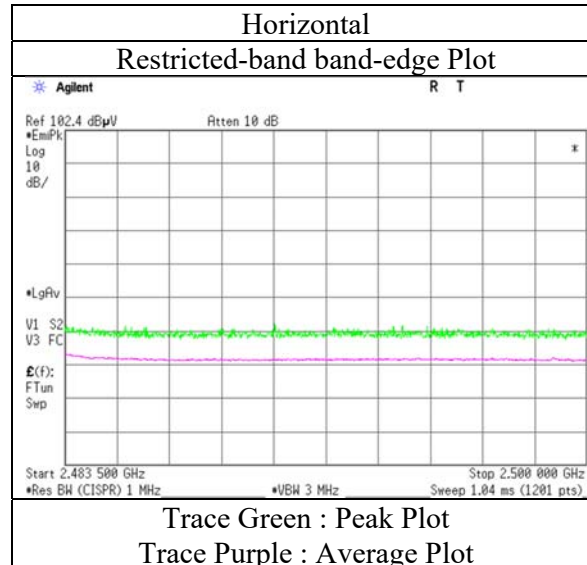
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

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Radiated Spurious Emission (Reference Plot for band-edge)

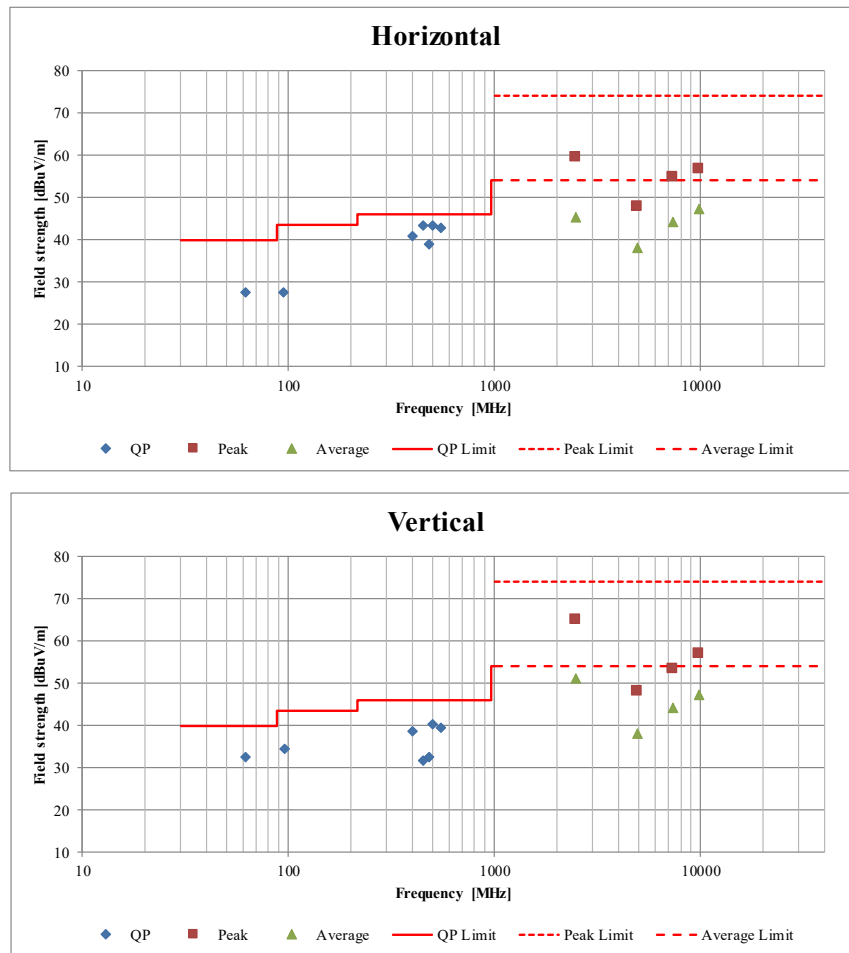
Report No.	12749447H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	June 27, 2019
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Junya Okuno
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2480 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission (Plot data, Worst case)

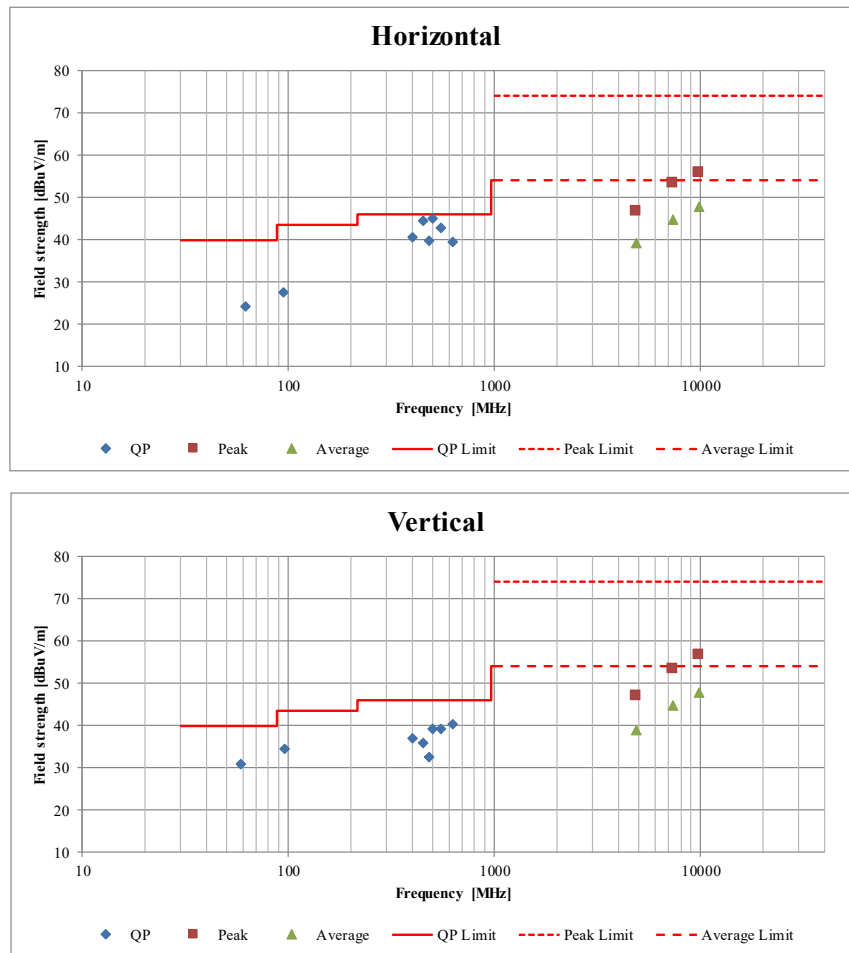
Report No.	12749447H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	June 28, 2019	July 13, 2019
Temperature / Humidity	23 deg. C / 63 % RH	23 deg. C / 70 % RH
Engineer	Koji Yamamoto (1 GHz - 10 GHz)	Junya Okuno (10 GHz - 26.5 GHz) (Below 1 GHz)
Mode	Tx 11g 2462 MHz	



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

Radiated Spurious Emission (Plot data, Worst case)

Report No.	12749447H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	June 27, 2019	July 13, 2019
Temperature / Humidity	24 deg. C / 60 % RH	23 deg. C / 70 % RH
Engineer	Junya Okuno	Junya Okuno
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
		(Below 1 GHz)
Mode	Tx BT LE 2440 MHz	



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

APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141884	Spectrum Analyzer	AGILENT	E4448A	MY44020357	03/13/2019	03/31/2020	12
RE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/05/2018	12/31/2019	12
RE	141579	Pre Amplifier	AGILENT	8449B	3008A02142	01/21/2019	01/31/2020	12
RE	141392	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	08/08/2018	08/31/2019	12
RE	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/01/2019	04/30/2021	24
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	05/09/2019	05/31/2020	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/21/2018	08/31/2019	12
RE	142228	Measure	KOMELON	KMC-36	-	-	-	-
RE	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/08/2018	08/31/2019	12
RE	141578	Pre Amplifier	AGILENT	8447D	2944A10845	09/19/2018	09/30/2019	12
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/19/2018	09/30/2019	12
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	05/10/2019	05/31/2020	12
RE	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	03/25/2019	03/31/2020	12
RE	141899	Spectrum Analyzer	AGILENT	E4448A	MY46180655	08/10/2018	08/31/2019	12
RE	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/05/2018	11/30/2019	12
RE	141427	Biconical Antenna	Schwarzbeck	VHA9103B	8031	04/12/2019	04/30/2020	12
RE	141317	Coaxial Cable	Fujikura/Agilent	-	-	07/18/2019	07/31/2020	12
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	06/29/2018	06/30/2020	24

*Hyphens for Last Calibration Date, Calibration Due Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

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