



RADIO TEST REPORT

Test Report No. : 12022019H-B-R2

Applicant : Sony Corporation
Type of Equipment : DIGITAL WIRELESS TRANSMITTER
Model No. : DWT-B03R
FCC ID : AK8DWTB03R
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
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6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 12022019H-B-R1. 12022019H-B-R1 is replaced with this report.

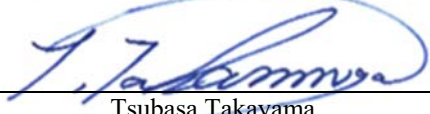
Date of test: November 15, 2017 to April 4, 2018

Representative test engineer:


Tomoyuki Nakayama
Engineer

Consumer Technology Division

Approved by:


Tsubasa Takayama
Leader

Consumer Technology Division



NVLAP LAB CODE: 200572-0

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SECTION 1: Customer information

Company Name	:	Sony Global Manufacturing & Operations Corporation
Address	:	8-4, Shiomi, Kisarazu-shi, Chiba, 292-0834 Japan
Telephone Number	:	+81-438-37-4704
Contact Person	:	Youhei Hisano

***Remarks**

Sony Global Manufacturing & Operations Corporation (Subsidiary Company Name) is on behalf of the applicant: Sony Corporation.

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

2.1 Identification of E.U.T.

Type of Equipment	:	DIGITAL WIRELESS TRANSMITTER
Model No.	:	DWT-B03R
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.6 V (Li-ion Batt pack: NP-BX1)
Receipt Date of Sample	:	November 9, 2017
Country of Mass-production	:	Japan
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: DWT-B03R (referred to as the EUT in this report) is a DIGITAL WIRELESS TRANSMITTER.

General Specification

Clock frequency(ies) in the system	:	X400	8 MHz
		X202	12.288 MHz
		X900	16 MHz
		X800 (TCXO)	19.2 MHz
		IC620, 630, 730, 740	1250 kHz - 1500 kHz
		IC720	1300 kHz
		IC202	600 kHz - 1000 kHz
		IC690	250 kHz
		VCO820 (VCO: change by a transmission frequency)	470.125 MHz - 607.875 MHz
			614.125 MHz - 615.875 MHz

Radio Specification (Radio microphone part)

Radio type	:	Transmitter
Modulation type	:	$\pi/4$ shift QPSK
Emission designator	:	192KG1D, 192KG1E
Channel spacing	:	25 kHz
Frequency of operation	:	470.125 MHz - 607.875 MHz 614.125 MHz - 615.875 MHz
RF power	:	25 mW / 10 mW / 2 mW (470.125 MHz - 607.875 MHz) 10 mW / 2 mW (614.125 MHz - 615.875 MHz)
Antenna type	:	$\lambda/4$ flexible wire
Antenna gain	:	2.14 dBi max
Power Supply (radio part input)	:	DC 2.8 V, DC 3.1 V, DC 5.2 V
AF Specification	:	20 Hz - 22000 Hz, Maximum input: -22 dBu (MIC level, ATT 0 dB)
Operating temperature	:	0 deg. C to 50 deg. C

Radio Specification (RF remote part)

Radio Type	:	Transceiver
Modulation type	:	DSSS
Frequency of Operation	:	2405 MHz to 2480 MHz
Channel spacing	:	5 MHz
Method of frequency generation	:	Synthesizer
Power Supply (radio part input)	:	DC 2.8 V
Antenna Type	:	Chip antenna
Antenna Gain	:	-1.0 dBi max
Operating temperature	:	0 deg. C to 50 deg. C

*This test report applies to RF remote part.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

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.

** Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	-	N/A *1)	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	5.7 dB 2483.500 MHz, Horizontal / Vertical, AV	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

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

*1) Although the EUT is connected to the AC line through the charger, this test was not performed, because the power supply of the EUT turned off during charging.

*2) 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 EUT is a battery-operated device and test was performed with the full-charged battery.

Also, stable voltage (DC 2.8 V) constantly provided to RF part regardless of EUT's input voltage.

Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.

Therefore, the equipment complies with the antenna requirement of Section 15.203.

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	N/A	-	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

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

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.

3.5 Test Location

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 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 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

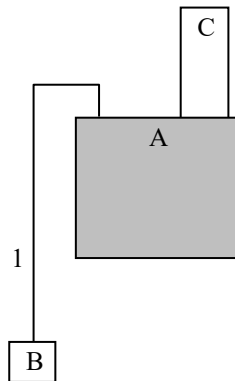
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Tested frequency
Transmitting (Tx)	2405 MHz 2440 MHz 2480 MHz
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows; Power settings: 0 dBm Software: 0.01 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting.	

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	DIGITAL WIRELESS TRANSMITTER	DWT-B03R	No.16	Sony Corporation	EUT
B	Lavalier Microphone	ECM-77LM	No.2	Sony Corporation	-
C	Antenna	1-522-048-11	001	MUSASHIDENSHI,CO.LTD	*1)

*1) This antenna is only used for wireless microphone transmitter.

DTS antenna (Model: 1-754-963-11, chip antenna) is mounted inside of EUT.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Microphone Cable	1.6	Shielded	Shielded	-

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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	4 m *2) (1 GHz - 10 GHz), 1 m *3) (10 GHz - 26.5 GHz)		4 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: $20 \times \log(4.0 \text{ m} / 3.0 \text{ m}) = 2.50\text{dB}$

*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

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	5 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1 kHz	27 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04". *4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz)							

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

Test data : APPENDIX
Test result : Pass

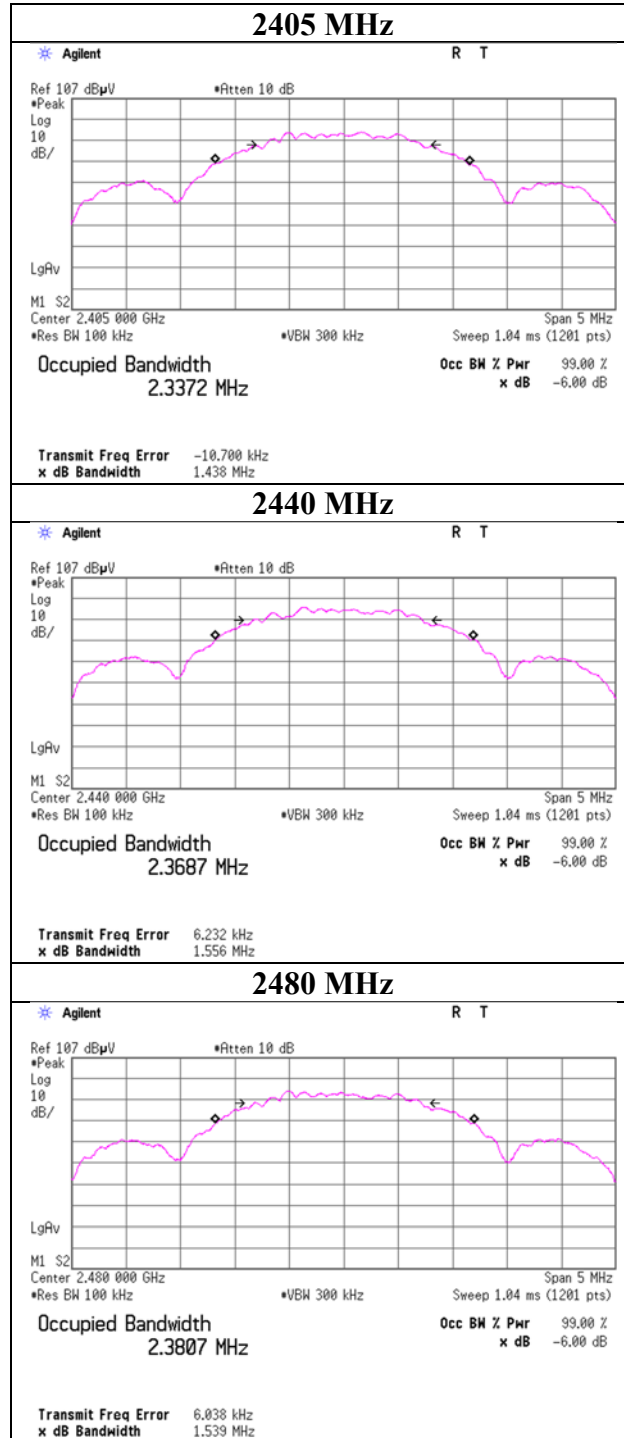
APPENDIX 1: Test data

6dB Bandwidth

Test place Ise EMC Lab. No.6 Measurement Room
Report No. 12022019H
Date November 22, 2017
Temperature / Humidity 22 deg. C / 39 % RH
Engineer Tomoyuki Nakayama
Mode Tx

Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2405	1.438	> 500
2440	1.556	> 500
2480	1.539	> 500

6dB Bandwidth



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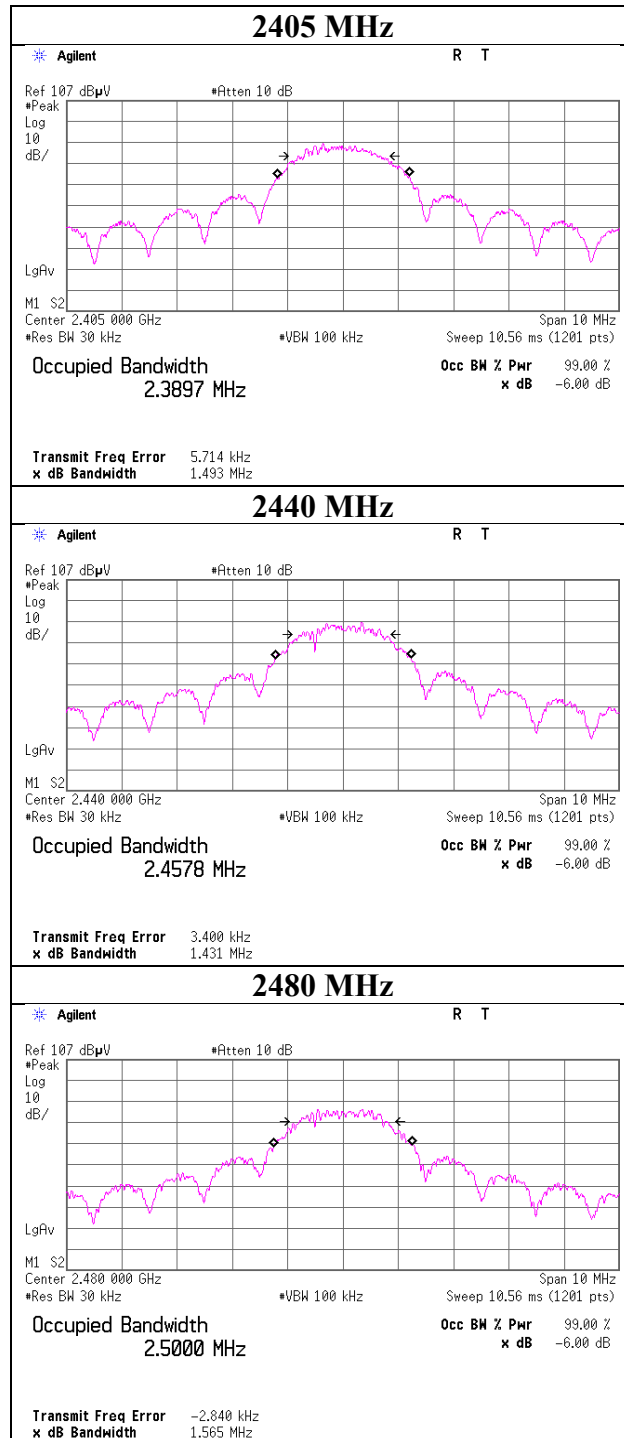
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99%Occupied Bandwidth

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	12022019H
Date	November 22, 2017
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoyuki Nakayama
Mode	Tx



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Maximum Peak Output Power

Test place Ise EMC Lab. No.6 Measurement Room
Report No. 12022019H
Date November 22, 2017
Temperature / Humidity 22 deg. C / 39 % RH
Engineer Tomoyuki Nakayama
Mode Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2405	-2.09	0.30	0.00	-1.79	0.66	30.00	1000	31.79
2440	0.24	0.30	0.00	0.54	1.13	30.00	1000	29.46
2480	-1.81	0.30	0.00	-1.51	0.71	30.00	1000	31.51

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

*The equipment and cables were not used for factor 0 dB of the data sheets.

Average Output Power
(Reference data for RF Exposure / SAR testing)

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	12022019H
Date	November 22, 2017
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoyuki Nakayama
Mode	Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2405	-2.23	0.30	0.00	-1.93	0.64	0.00	-1.93	0.64
2440	0.17	0.30	0.00	0.47	1.11	0.00	0.47	1.11
2480	-1.93	0.30	0.00	-1.63	0.69	0.00	-1.63	0.69

Sample Calculation:

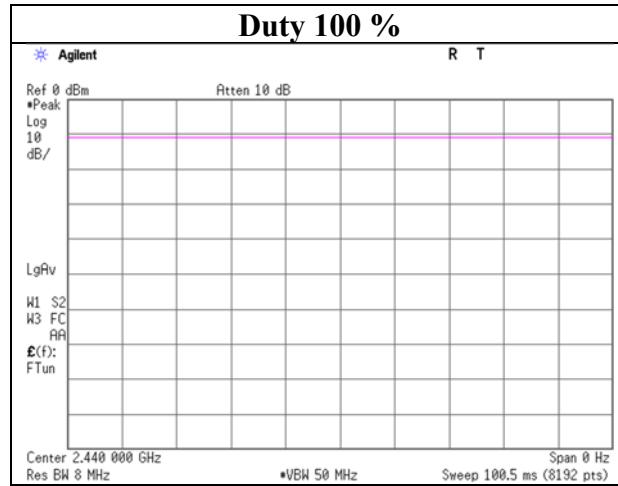
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Time average + Duty factor

*The equipment and cables were not used for factor 0 dB of the data sheets.

Burst rate confirmation

Test place	Ise EMC Lab. No.6 Measurement Room	
Report No.	12022019H	
Date	November 22, 2017	April 4, 2018
Temperature / Humidity	24 deg. C / 43 % RH	23 deg. C / 44 % RH
Engineer	Yuta Moriya	Koji Yamamoto
Mode	Tx	



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

Radiated Spurious Emission

Report No.	12022019H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	November 15, 2017	November 15, 2017	November 16, 2017
Temperature / Humidity	21 deg. C / 45 % RH	22 deg. C / 41 % RH	21 deg. C / 40 % RH
Engineer	Ryota Yamanaka (1 GHz - 10 GHz)	Koji Yamamoto (10 GHz - 26.5 GHz)	Tomoki Matsui (Below 1 GHz)
Mode	Tx 2405MHz		

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	40.476	QP	20.0	14.3	7.3	32.1	-	9.5	40.0	30.5	
Hori	118.293	QP	19.7	12.7	8.4	32.0	-	8.8	43.5	34.7	
Hori	149.178	QP	19.5	14.9	8.7	32.0	-	11.1	43.5	32.4	
Hori	522.359	QP	24.8	18.0	11.4	32.1	-	22.1	46.0	23.9	
Hori	728.594	QP	19.6	20.0	12.3	32.0	-	19.9	46.0	26.1	
Hori	855.159	QP	19.1	21.4	12.9	31.3	-	22.1	46.0	23.9	
Hori	2390.000	PK	42.4	27.4	5.9	32.1	-	43.6	73.9	30.3	
Hori	4810.000	PK	40.8	31.7	8.1	31.3	-	49.3	73.9	24.6	Floor noise
Hori	7215.000	PK	42.7	36.5	9.5	32.4	-	56.3	73.9	17.6	Floor noise
Hori	9620.000	PK	42.0	38.0	10.2	32.6	-	57.6	73.9	16.3	Floor noise
Hori	2390.000	AV	32.1	27.4	5.9	32.1	-	33.3	53.9	20.6	
Hori	4810.000	AV	31.8	31.7	8.1	31.3	-	40.3	53.9	13.6	Floor noise
Hori	7215.000	AV	33.6	36.5	9.5	32.4	-	47.2	53.9	6.7	Floor noise
Hori	9620.000	AV	32.1	38.0	10.2	32.6	-	47.7	53.9	6.2	Floor noise
Vert	40.476	QP	20.0	14.3	7.3	32.1	-	9.5	40.0	30.5	
Vert	118.293	QP	19.7	12.7	8.4	32.0	-	8.8	43.5	34.7	
Vert	149.178	QP	19.4	14.9	8.7	32.0	-	11.0	43.5	32.5	
Vert	522.359	QP	19.0	18.0	11.4	32.1	-	16.3	46.0	29.7	
Vert	728.594	QP	19.6	20.0	12.3	32.0	-	19.9	46.0	26.1	
Vert	855.159	QP	19.1	21.4	12.9	31.3	-	22.1	46.0	23.9	
Vert	2390.000	PK	43.1	27.4	5.9	32.1	-	44.3	73.9	29.6	
Vert	4810.000	PK	40.4	31.7	8.1	31.3	-	48.9	73.9	25.0	Floor noise
Vert	7215.000	PK	41.5	36.5	9.5	32.4	-	55.1	73.9	18.8	Floor noise
Vert	9620.000	PK	41.8	38.0	10.2	32.6	-	57.4	73.9	16.5	Floor noise
Vert	2390.000	AV	33.4	27.4	5.9	32.1	-	34.6	53.9	19.3	
Vert	4810.000	AV	32.3	31.7	8.1	31.3	-	40.8	53.9	13.1	Floor noise
Vert	7215.000	AV	33.6	36.5	9.5	32.4	-	47.2	53.9	6.7	Floor noise
Vert	9620.000	AV	32.0	38.0	10.2	32.6	-	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 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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	2405.000	PK	84.8	27.4	5.9	32.1	86.0	-	-	Carrier
Hori	2400.000	PK	46.3	27.4	5.9	32.1	47.5	66.0	18.5	Carrier
Vert	2405.000	PK	84.7	27.4	5.9	32.1	85.9	-	-	Carrier
Vert	2400.000	PK	43.3	27.4	5.9	32.1	44.5	65.9	21.4	

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

Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5dB

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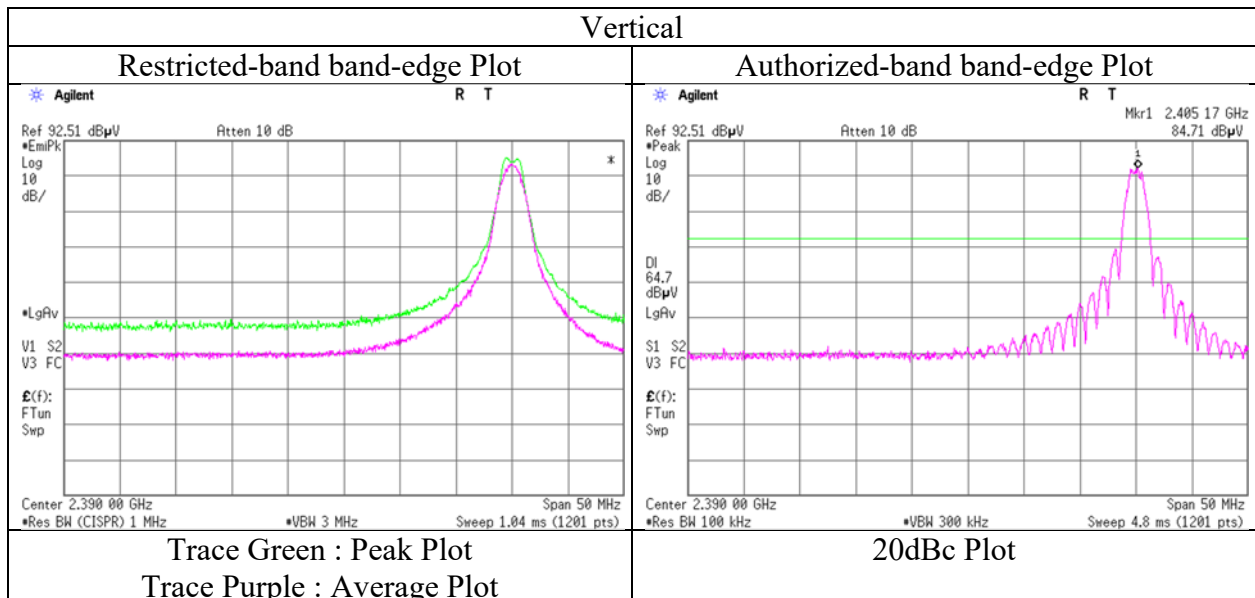
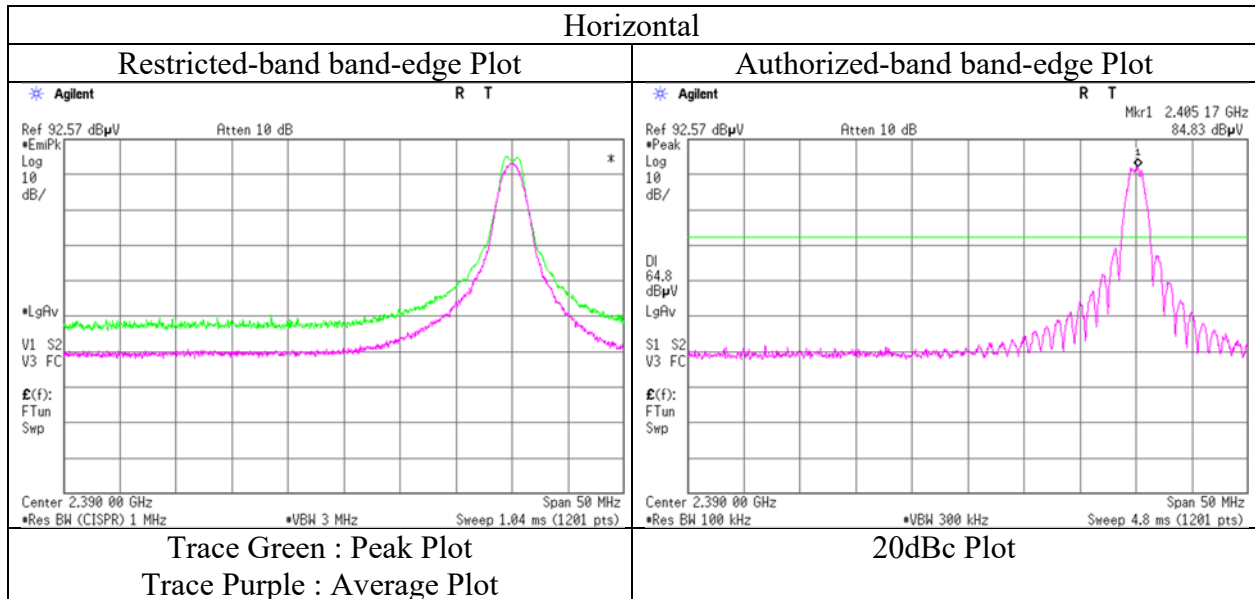
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12022019H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	November 15, 2017
Temperature / Humidity	21 deg. C / 45 % RH
Engineer	Ryota Yamanaka
	(1 GHz - 10 GHz)
Mode	Tx 2405 MHz



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

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Ise EMC Lab.

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Radiated Spurious Emission

Report No.	12022019H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	November 15, 2017	November 15, 2017	November 16, 2017
Temperature / Humidity	21 deg. C / 45 % RH	22 deg. C / 41 % RH	21 deg. C / 40 % RH
Engineer	Ryota Yamanaka (1 GHz - 10 GHz)	Koji Yamamoto (10 GHz - 26.5 GHz)	Tomoki Matsui (Below 1 GHz)
Mode	Tx 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	40.476	QP	19.8	14.3	7.3	32.1	-	9.3	40.0	30.7	
Hori	118.293	QP	19.7	12.7	8.4	32.0	-	8.8	43.5	34.7	
Hori	167.221	QP	19.7	15.8	8.8	32.0	-	12.3	43.5	31.2	
Hori	522.369	QP	25.1	18.0	11.4	32.1	-	22.4	46.0	23.6	
Hori	728.594	QP	19.6	20.0	12.3	32.0	-	19.9	46.0	26.1	
Hori	855.159	QP	19.2	21.4	12.9	31.3	-	22.2	46.0	23.8	
Hori	4880.000	PK	42.0	31.9	8.2	31.2	-	50.9	73.9	23.0	Floor noise
Hori	7320.000	PK	43.0	36.6	9.5	32.4	-	56.7	73.9	17.2	Floor noise
Hori	9760.000	PK	42.7	38.1	10.2	32.7	-	58.3	73.9	15.6	Floor noise
Hori	4880.000	AV	31.9	31.9	8.2	31.2	-	40.8	53.9	13.1	Floor noise
Hori	7320.000	AV	33.6	36.6	9.5	32.4	-	47.3	53.9	6.6	Floor noise
Hori	9760.000	AV	31.9	38.1	10.2	32.7	-	47.5	53.9	6.4	Floor noise
Vert	40.476	QP	19.9	14.3	7.3	32.1	-	9.4	40.0	30.6	
Vert	118.293	QP	19.7	12.7	8.4	32.0	-	8.8	43.5	34.7	
Vert	167.221	QP	19.6	15.8	8.8	32.0	-	12.2	43.5	31.3	
Vert	522.369	QP	21.2	18.0	11.4	32.1	-	18.5	46.0	27.5	
Vert	728.594	QP	19.7	20.0	12.3	32.0	-	20.0	46.0	26.0	
Vert	855.159	QP	19.2	21.4	12.9	31.3	-	22.2	46.0	23.8	
Vert	4880.000	PK	40.5	31.9	8.2	31.2	-	49.4	73.9	24.5	Floor noise
Vert	7320.000	PK	42.0	36.6	8.7	32.4	-	54.9	73.9	19.0	Floor noise
Vert	9760.000	PK	42.8	38.1	10.2	32.7	-	58.4	73.9	15.5	Floor noise
Vert	4880.000	AV	31.8	31.9	8.2	31.2	-	40.7	53.9	13.2	Floor noise
Vert	7320.000	AV	33.8	36.6	9.5	32.4	-	47.5	53.9	6.4	Floor noise
Vert	9760.000	AV	32.1	38.1	10.2	32.7	-	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 $20\log(4\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission

Report No.	12022019H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	November 15, 2017	November 15, 2017	November 16, 2017
Temperature / Humidity	21 deg. C / 45 % RH	22 deg. C / 41 % RH	21 deg. C / 40 % RH
Engineer	Ryota Yamanaka	Koji Yamamoto	Tomoki Matsui
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx 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	40.476	QP	20.1	14.3	7.3	32.1	-	9.6	40.0	30.4	
Hori	118.293	QP	19.5	12.7	8.4	32.0	-	8.6	43.5	34.9	
Hori	167.221	QP	19.8	15.8	8.8	32.0	-	12.4	43.5	31.1	
Hori	522.367	QP	25.0	18.0	11.4	32.1	-	22.3	46.0	23.7	
Hori	728.701	QP	19.6	20.0	12.3	32.0	-	19.9	46.0	26.1	
Hori	855.159	QP	19.1	21.4	12.9	31.3	-	22.1	46.0	23.9	
Hori	2483.500	PK	51.9	27.5	5.9	32.0	-	53.3	73.9	20.6	
Hori	4960.000	PK	40.9	32.2	7.4	31.2	-	49.3	73.9	24.6	Floor noise
Hori	7440.000	PK	42.4	36.8	8.8	32.5	-	55.5	73.9	18.4	Floor noise
Hori	9920.000	PK	41.6	38.2	9.6	32.8	-	56.6	73.9	17.3	Floor noise
Hori	2483.500	AV	46.8	27.5	5.9	32.0	-	48.2	53.9	5.7	
Hori	4960.000	AV	31.7	32.2	7.4	31.2	-	40.1	53.9	13.8	Floor noise
Hori	7440.000	AV	33.8	36.8	8.8	32.5	-	46.9	53.9	7.0	Floor noise
Hori	9920.000	AV	32.4	38.2	9.6	32.8	-	47.4	53.9	6.5	Floor noise
Vert	40.476	QP	20.0	14.3	7.3	32.1	-	9.5	40.0	30.5	
Vert	118.293	QP	19.7	12.7	8.4	32.0	-	8.8	43.5	34.7	
Vert	167.221	QP	19.7	15.8	8.8	32.0	-	12.3	43.5	31.2	
Vert	522.367	QP	21.5	18.0	11.4	32.1	-	18.8	46.0	27.2	
Vert	728.701	QP	19.7	20.0	12.3	32.0	-	20.0	46.0	26.0	
Vert	855.159	QP	19.1	21.4	12.9	31.3	-	22.1	46.0	23.9	
Vert	2483.500	PK	51.8	27.5	5.9	32.0	-	53.2	73.9	20.7	
Vert	4960.000	PK	42.4	32.2	7.4	31.2	-	50.8	73.9	23.1	Floor noise
Vert	7440.000	PK	39.8	36.8	8.8	32.5	-	52.9	73.9	21.0	Floor noise
Vert	9920.000	PK	42.8	38.2	9.6	32.8	-	57.8	73.9	16.1	Floor noise
Vert	2483.500	AV	46.8	27.5	5.9	32.0	-	48.2	53.9	5.7	
Vert	4960.000	AV	34.3	32.2	7.4	31.2	-	42.7	53.9	11.2	Floor noise
Vert	7440.000	AV	31.8	36.8	8.8	32.5	-	44.9	53.9	9.0	Floor noise
Vert	9920.000	AV	32.3	38.2	9.6	32.8	-	47.3	53.9	6.6	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 m / 3.0 m) = 2.5 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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Ise EMC Lab.

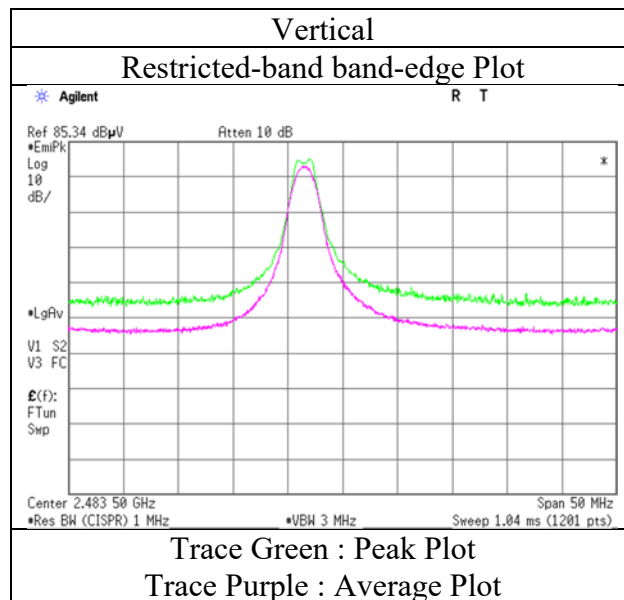
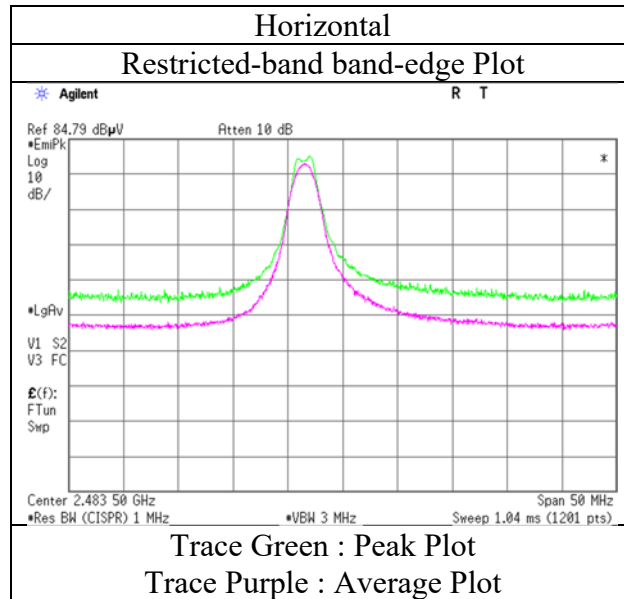
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Radiated Spurious Emission (Reference Plot for band-edge)

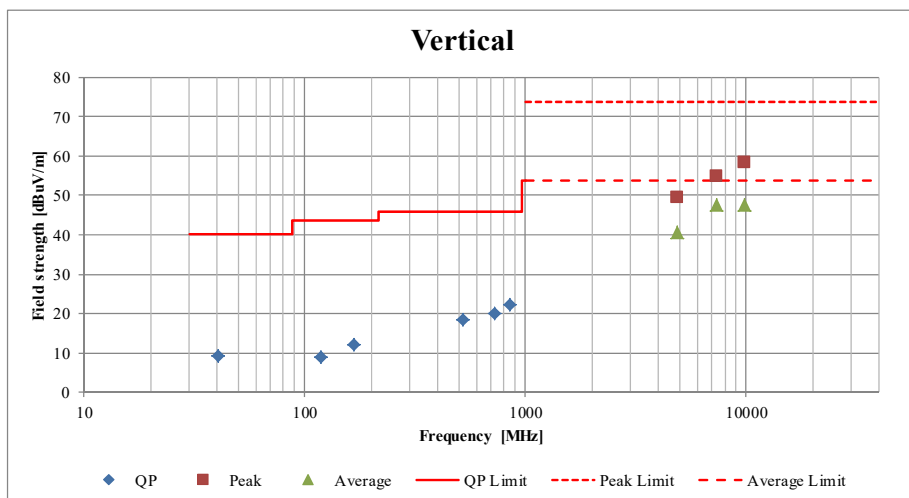
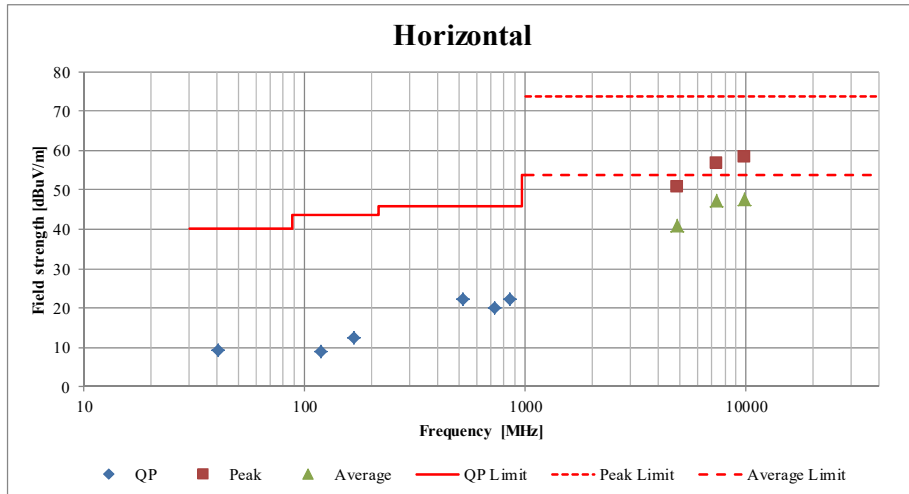
Report No.	12022019H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	November 15, 2017
Temperature / Humidity	21 deg. C / 45 % RH
Engineer	Ryota Yamanaka (1 GHz - 10 GHz)
Mode	Tx 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

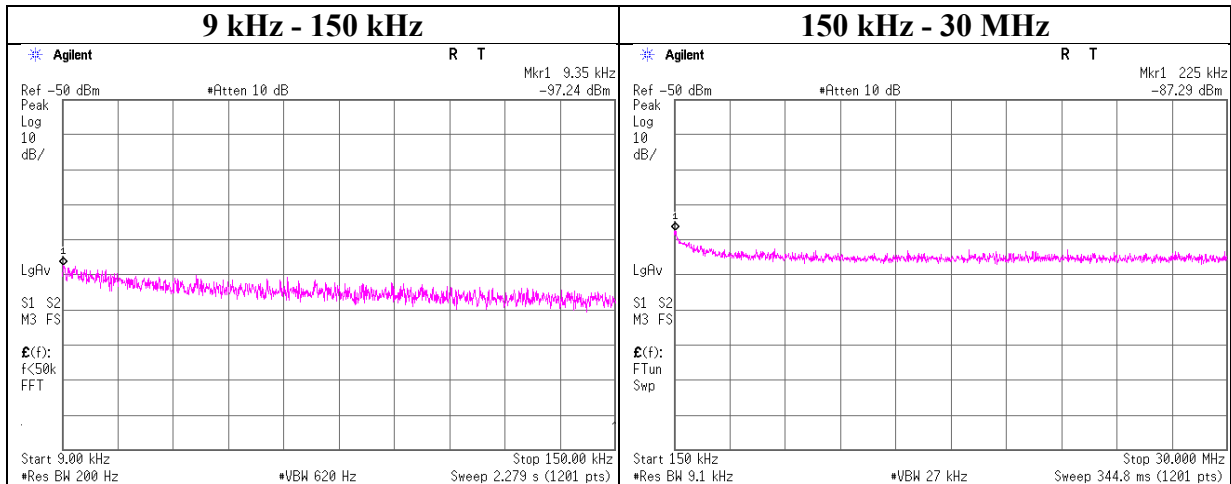
Report No.	12022019H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	November 15, 2017	November 15, 2017	November 16, 2017
Temperature / Humidity	21 deg. C / 45 % RH	22 deg. C / 41 % RH	21 deg. C / 40 % RH
Engineer	Ryota Yamanaka (1 GHz - 10 GHz)	Koji Yamamoto (10 GHz - 26.5 GHz)	Tomoki Matsui (Below 1 GHz)
Mode	Tx 2440 MHz		



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

Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	12022019H
Date	November 22, 2017
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoyuki Nakayama
Mode	Tx 2405 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.35	-97.2	0.31	9.8	2.0	1	-85.1	300	6.0	-23.8	48.1	71.9	
225.00	-87.3	0.30	9.8	2.0	1	-75.2	300	6.0	-13.9	20.5	34.4	

$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log(\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

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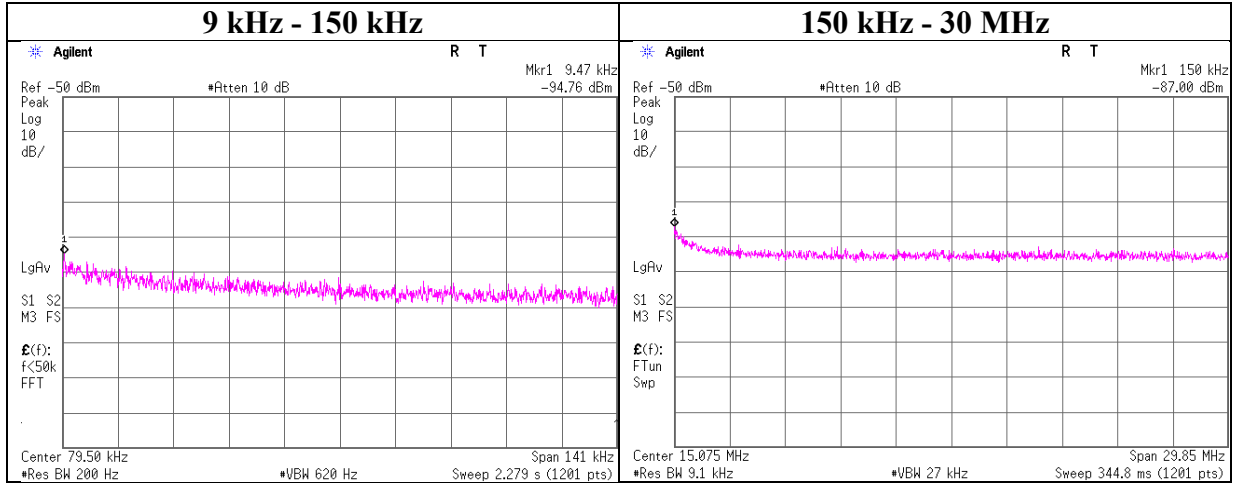
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Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	12022019H
Date	November 22, 2017
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoyuki Nakayama
Mode	Tx 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.47	-94.8	0.31	9.8	2.0	1	-82.6	300	6.0	-21.4	48.0	69.4	
150.00	-87.0	0.30	9.8	2.0	1	-74.9	300	6.0	-13.6	24.0	37.6	

$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

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Ise EMC Lab.

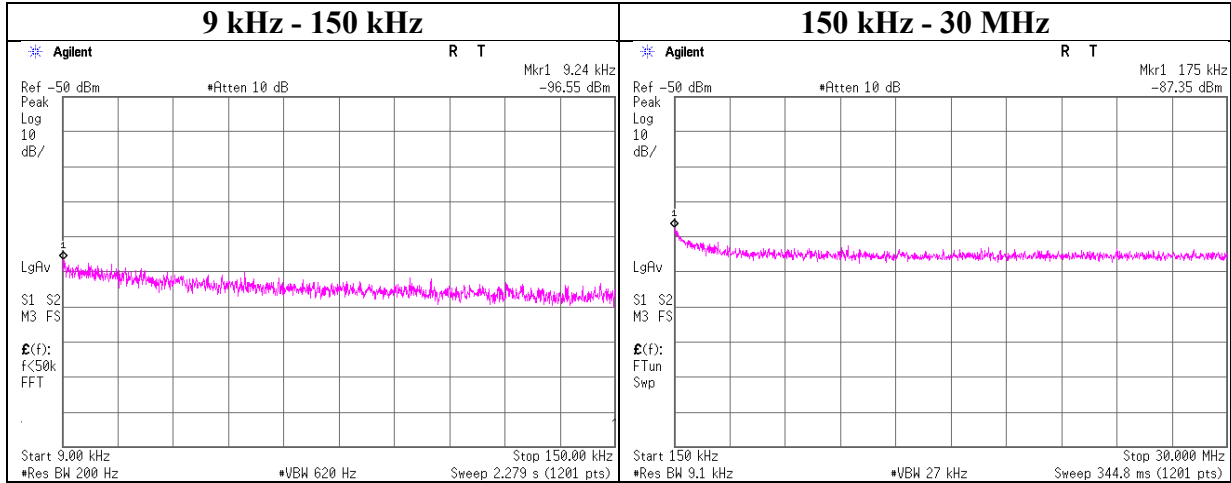
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Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	12022019H
Date	November 22, 2017
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoyuki Nakayama
Mode	Tx 2480 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.24	-96.6	0.31	9.8	2.0	1	-84.4	300	6.0	-23.2	48.2	71.4	
175.00	-87.4	0.30	9.8	2.0	1	-75.2	300	6.0	-14.0	22.7	36.7	

$E [dBuV/m] = EIRP [dBm] - 20 \log (Distance [m]) + Ground\ bounce [dB] + 104.8 [dBuV/m]$

$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

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Power Density

Test place Ise EMC Lab. No.6 Measurement Room
Report No. 12022019H
Date November 22, 2017
Temperature / Humidity 22 deg. C / 39 % RH
Engineer Tomoyuki Nakayama
Mode Tx

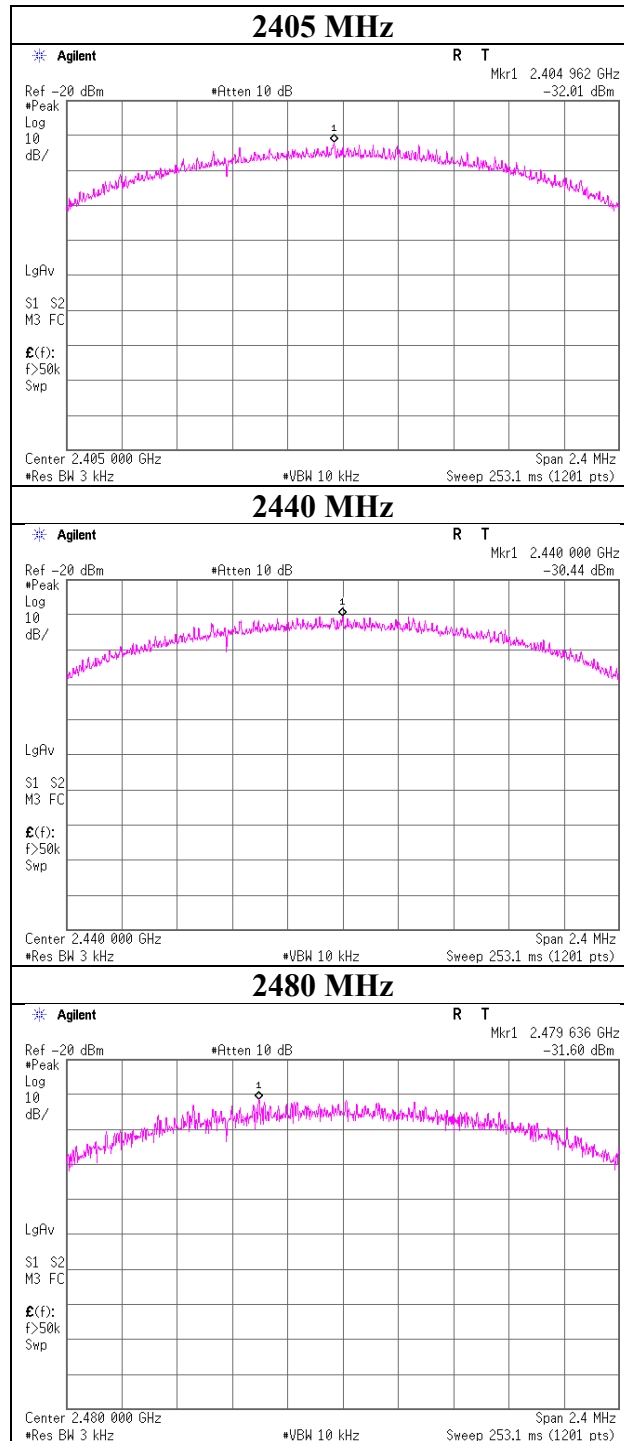
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2405.00	-32.01	1.20	10.09	-20.72	8.00	28.72
2440.00	-30.44	1.21	10.09	-19.14	8.00	27.14
2480.00	-31.60	1.22	10.09	-20.29	8.00	28.29

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

*The equipment and cables were not used for factor 0 dB of the data sheets.

Power Density



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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
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	-
MSA-13	Spectrum Analyzer	Agilent	E4440A	MY46185823	RE	2017/11/16 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2017/09/15 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	RE	2017/06/23 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	00650	RE	2017/10/06 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2017/06/30 * 12
MMM-10	DIGITAL HiTESTER	Hioki	3805	051201148	RE	2017/01/19 * 12
MHF-26	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	RE	2017/09/11 * 12
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
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	AT	2017/11/07 * 12
MBM-10	Barometer	Sunoh	SBR121	832	AT	2016/12/12 * 36
MJM-24	Measure	ASKUL	-	-	AT	-
MOS-14	Thermo-Hygrometer	Custom	CTH-201	1401	AT	2017/01/20 * 12
MAT-23	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2017/03/21 * 12
MCC-173	Microwave Cable	Junkosha	MWX221	1409S496	AT	2017/03/13 * 12
MPM-12	Power Meter	Anritsu	ML2495A	825002	AT	2017/06/20 * 12
MPSE-17	Power sensor	Anritsu	MA2411B	738285	AT	2017/06/20 * 12
MCC-64	Coaxial Cable	UL Japan	-	-	AT	2017/03/24 * 12
MAT-10	Attenuator(10dB)	Weinschel Corp	2	BL1173	AT	2017/11/14 * 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

UL Japan, Inc.

Ise EMC Lab.

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