



RADIO TEST REPORT

Test Report No. : 12205053H-A-R2

Applicant : Bose Corporation
Type of Equipment : Powered sound bar with wireless link
Model No. : 424096
FCC ID : A94424096
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied

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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 12205053H-A-R1. 12205053H-A-R1 is replaced with this report.

Date of test: March 8 and 9, 2018

Representative test engineer:

T. Nakagawa

Tomohisa Nakagawa
Engineer
Consumer Technology Division

Approved by:

Takayuki S.

Takayuki Shimada
Leader
Consumer Technology Division



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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12205053H-A

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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.....	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Conducted Emission.....	11
SECTION 6: Radiated Spurious Emission	12
SECTION 7: Antenna Terminal Conducted Tests.....	15
APPENDIX 1: Test data	16
Conducted Emission	16
6 dB Bandwidth and 99 % Occupied Bandwidth.....	18
Maximum Peak Output Power	21
Average Output Power	22
Radiated Spurious Emission	24
Conducted Spurious Emission	30
Power Density	33
APPENDIX 2: Test instruments	35
APPENDIX 3: Photographs of test setup	36
Conducted Emission	36
Radiated Spurious Emission	37

SECTION 1: Customer information

Company Name	:	Bose Corporation
Address	:	100 Mountain. Rd Framingham, MA 01701 United States
Contact Person	:	Mark Hetherman

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

2.1 Identification of E.U.T.

Type of Equipment	:	Powered sound bar with wireless link
Model No.	:	424096
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 24 V, 1.875 A AC 100 V to 240 V , 50 Hz / 60 Hz (AC Adapter)
Receipt Date of Sample	:	March 6, 2018
Country of Mass-production	:	Malaysia
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: 424096 (referred to as the EUT in this report) is a Powered sound bar with wireless link.

Radio Specification

Bluetooth Low Energy

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Antenna type	:	Flexible antenna
Antenna Gain	:	-5.4 dBi
Clock frequency (Maximum)	:	48 MHz

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 revision on March 12, 2018, does not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods	FCC: Section 15.207	QP 18.5 dB 0.63342 MHz, L AV 20.3 dB 0.63342 MHz, L	Complied	-
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8			
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section 15.247(a)(2)	See data.	Complied	Conducted
	IC: -	IC: RSS-247 5.2(a)			
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section 15.247(b)(3)		Complied	Conducted
	IC: RSS-Gen 6.12	IC: RSS-247 5.4(d)			
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section 15.247(e)		Complied	Conducted
	IC: -	IC: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section15.247(d)	9.2 dB 86.787 MHz, Horizontal, QP	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)
	IC: RSS-Gen 6.13	IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

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

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05 8.5 and 8.6.

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

FCC Part 15.31 (e)

This EUT provides stable voltage constantly to RF Module regardless of 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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Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.8 dB
	0.15 MHz to 30 MHz	3.4 dB

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)	4.8 dB
	(Vertical)	5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
	(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	4.9 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
	(Vertical)	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

Antenna Terminal test

Test Item	Uncertainty (+/-)
RF output power	1.3 dB
Antenna terminal conducted emission / Power density / Burst power	2.7 dB
Adjacent channel power / Channel power	
Below 3 GHz	1.9 dB
3 GHz to 6 GHz	2.1 dB

Conducted Emission test

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

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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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.

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

4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth (BT) Low Energy (LE)	Maximum Packet Size, PRBS9
*Transmitting duty was 100 % on all tests. *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: 12 Software: BLEBridge: V0.05-57-gd57a022 *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
Conducted Emission, 6dB Bandwidth, 99% Occupied Bandwidth, Maximum Peak Output Power, Spurious Emission (Radiated / Conducted), Power Density,	Tx BT LE	2402 MHz 2440 MHz 2480 MHz

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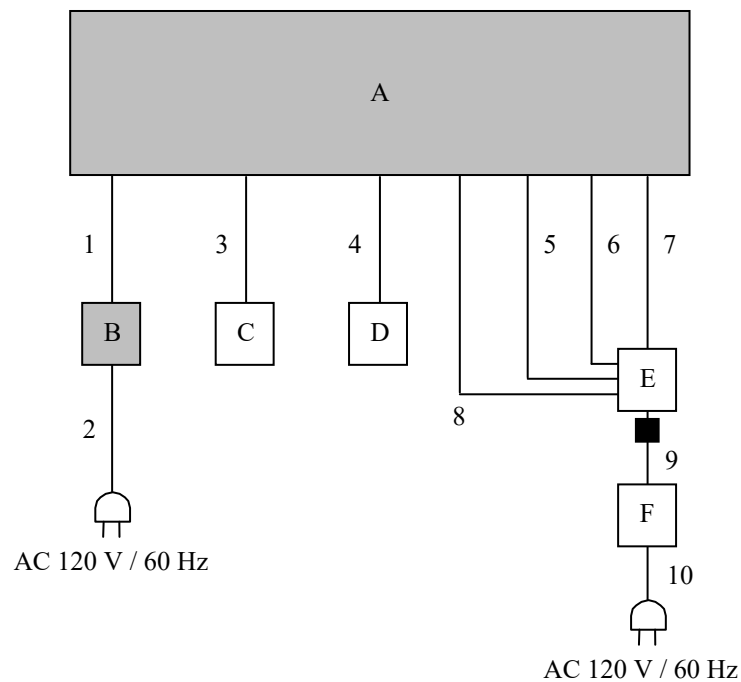
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4.2 Configuration and peripherals

[Except for Antenna Terminal Conducted test]



* 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	Powered sound bar with wireless link	424096	078335P80360168AE	BOSE	EUT
B	AC Adapter	DT24V-1.8C-DC	077926280040173AE	BOSE	EUT
C	Bose ADAPTiQ® headset	TPK-638011-0010	-	BOSE	-
D	Microphone	-	-	FUJITSU	-
E	Laptop PC	CF-N8HWCDPS	0CKSA09265	Panasonic	-
F	AC Adapter	CF-AA6372B	6372BM610X10953E	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.5	Unshielded	Unshielded	-
2	AC Cable	1.4	Unshielded	Unshielded	-
3	Audio Cable	6.9	Shielded	Shielded	-
4	Audio Cable	1.6	Shielded	Shielded	-
5	Audio Cable	1.7	Shielded	Shielded	-
6	LAN Cable	3.0	Unshielded	Unshielded	-
7	USB Cable	1.5	Shielded	Shielded	-
8	HDMI Cable	3.0	Shielded	Shielded	-
9	DC Cable	1.1	Unshielded	Unshielded	-
10	AC Cable	0.9	Unshielded	Unshielded	-

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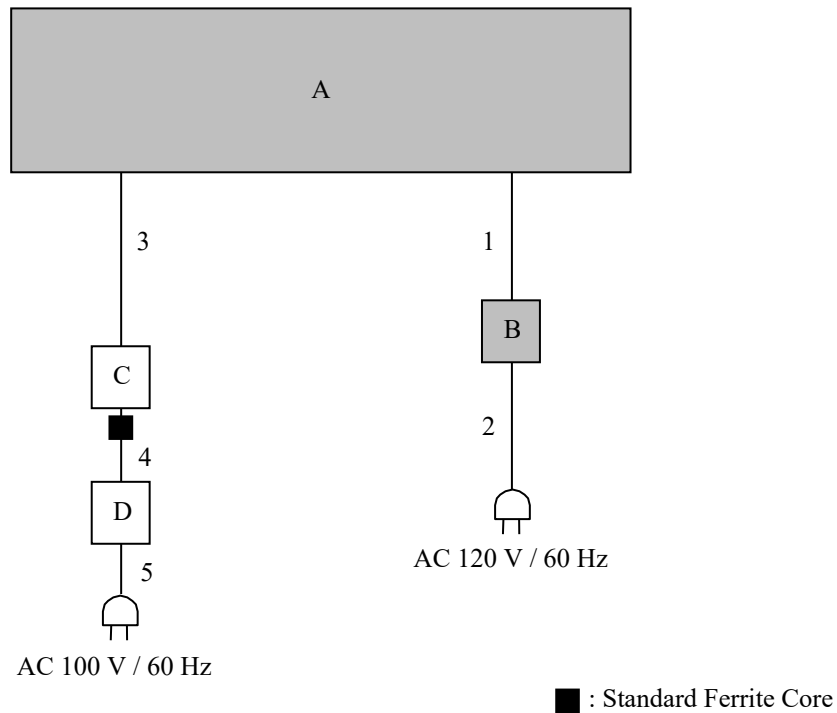
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[For Antenna Terminal Conducted test]



* 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	Powered sound bar with wireless link	424096	078335P80360342AE	BOSE	EUT
B	AC Adapter	DT24V-1.8C-DC	077926280040173AE	BOSE	EUT
E	Laptop PC	CF-N8HWCDPS	0BKSA07449	Panasonic	-
F	AC Adapter	CF-AA6372B	6372BM409X17298B	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.5	Unshielded	Unshielded	-
2	AC Cable	1.4	Unshielded	Unshielded	-
3	Signal Cable	1.8	Shielded	Shielded	-
4	DC Cable	1.0	Unshielded	Unshielded	-
5	AC Cable	0.9	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

1) For the tests on EUT with other peripherals (as a whole system)

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

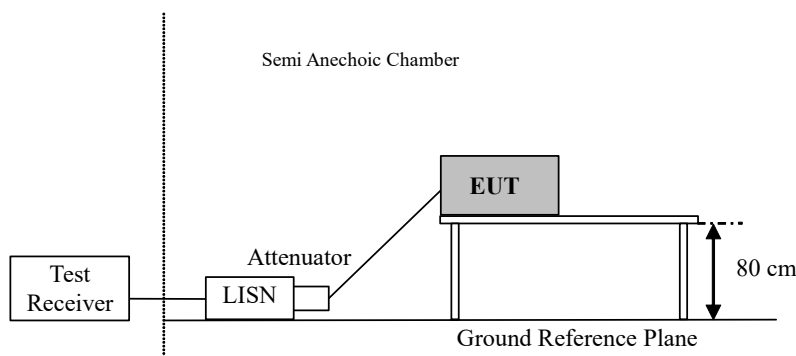
The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

Detector	: QP and CISPR AV
Measurement range	: 0.15 MHz - 30 MHz
Test data	: APPENDIX
Test result	: Pass

Figure 1: Test Setup



SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05".

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 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 1.0 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.

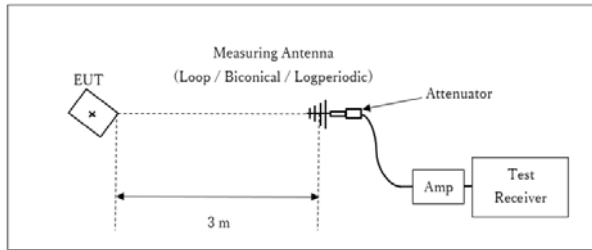
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

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

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

Figure 2: Test Setup

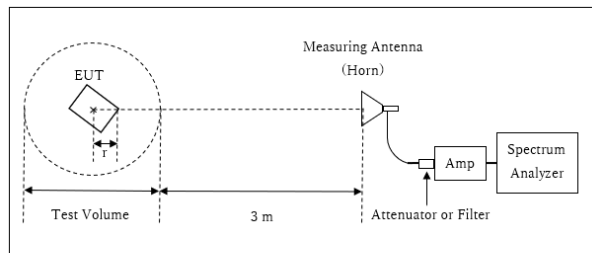
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log (4.1 \text{ m} / 3.0 \text{ m}) = 2.72 \text{ dB}$

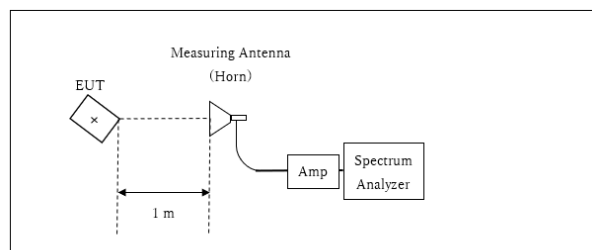
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 4.1 \text{ m}$

Test Volume : 3 m

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

$r = 0.4 \text{ m}$

10 GHz - 26.5 GHz



x : Center of turn table

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

*Test Distance: 1 m

The test was made on EUT at the normal use position.

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 7: 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	3 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 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013". *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 low enough 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

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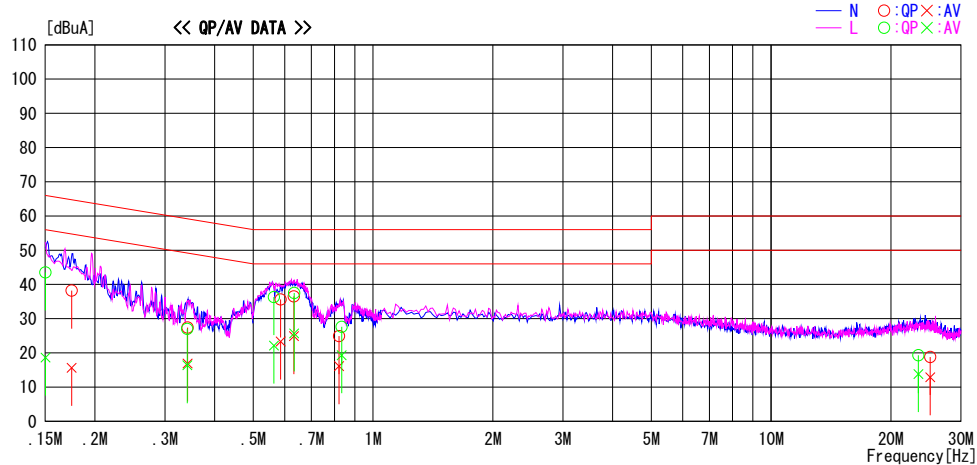
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APPENDIX 1: Test data

Conducted Emission

Report No. 12205053H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date March 9, 2018
Temperature / Humidity 23 deg. C / 41 % RH
Engineer Tomohisa Nakagawa
Mode Tx BT LE 2402 MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuA]	AV [dBuA]	QP [dBuA]	AV [dBuA]	QP [dB]	AV [dB]		
0.17483	25.0	2.4	13.2	38.2	15.6	64.7	54.7	26.5	39.1	N	
0.34195	14.2	3.7	13.2	27.4	16.9	59.2	49.2	31.8	32.3	N	
0.58614	22.3	10.0	13.3	35.6	23.3	56.0	46.0	20.4	22.7	N	
0.63264	23.2	11.6	13.3	36.5	24.9	56.0	46.0	19.5	21.1	N	
0.82115	11.6	2.8	13.3	24.9	16.1	56.0	46.0	31.1	29.9	N	
25.11200	4.3	-1.6	14.5	18.8	12.9	60.0	50.0	41.2	37.1	N	
0.15034	30.3	5.4	13.2	43.5	18.6	66.0	56.0	22.5	37.4	L	
0.34145	13.8	3.2	13.2	27.0	16.4	59.2	49.2	32.2	32.8	L	
0.56355	23.0	8.8	13.3	36.3	22.1	56.0	46.0	19.7	23.9	L	
0.63342	24.2	12.4	13.3	37.5	25.7	56.0	46.0	18.5	20.3	L	
0.83424	14.3	6.0	13.3	27.6	19.3	56.0	46.0	28.4	26.7	L	
23.45775	4.8	-0.7	14.5	19.3	13.8	60.0	50.0	40.7	36.2	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + CABLE + ATT)
Except for the above table: adequate margin data below the limits.

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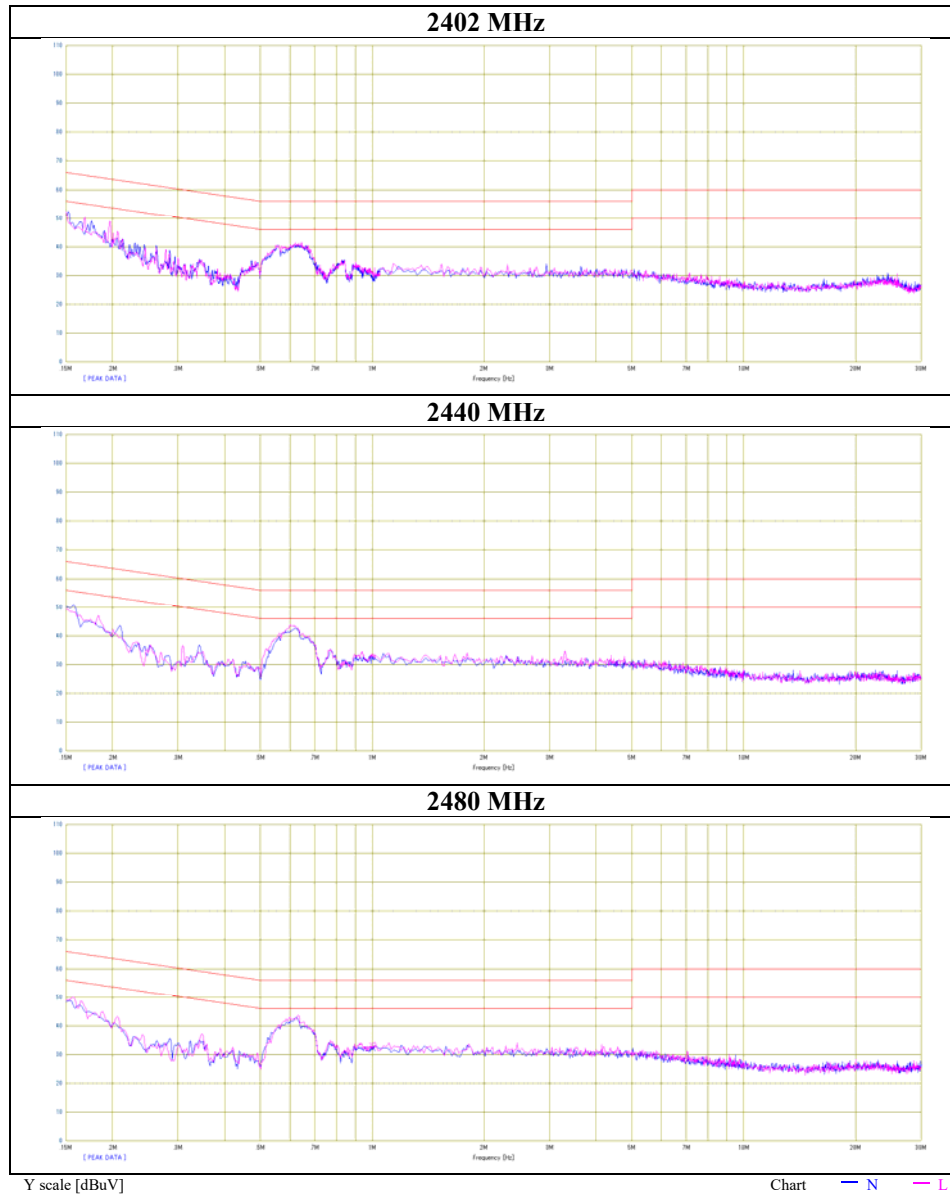
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Conducted Emission

Report No. 12205053H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date March 9, 2018
Temperature / Humidity 23 deg. C / 41 % RH
Engineer Tomohisa Nakagawa
Mode Tx BT LE



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6 dB Bandwidth and 99 % Occupied Bandwidth

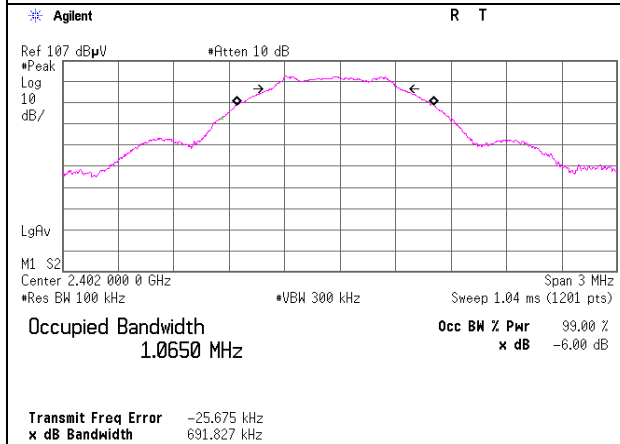
Report No. 12205053H
Test place Ise EMC Lab. No.3 Measurement Room
Date March 9, 2018
Temperature / Humidity 23 deg. C / 38 % RH
Engineer Yuta Moriya
Mode Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BTLE	2402	1051.2	0.692	> 0.5000
	2440	1060.4	0.702	> 0.5000
	2480	1077.9	0.740	> 0.5000

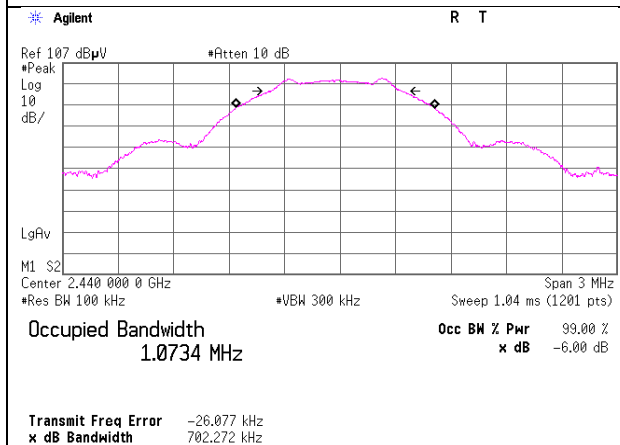
6dB Bandwidth

BT LE

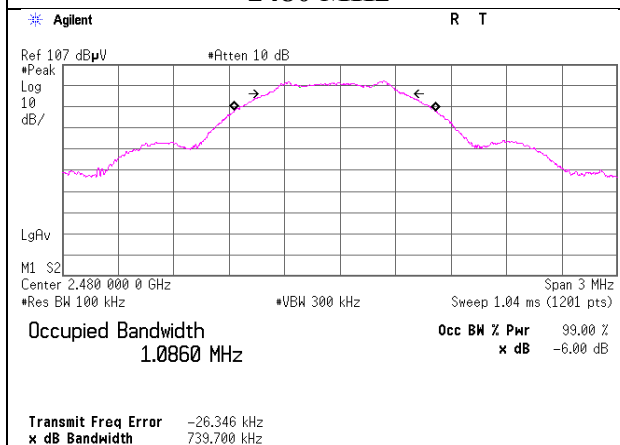
2402 MHz



2440 MHz



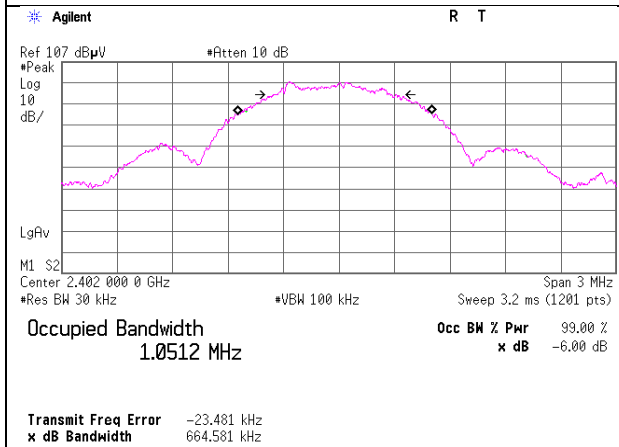
2480 MHz



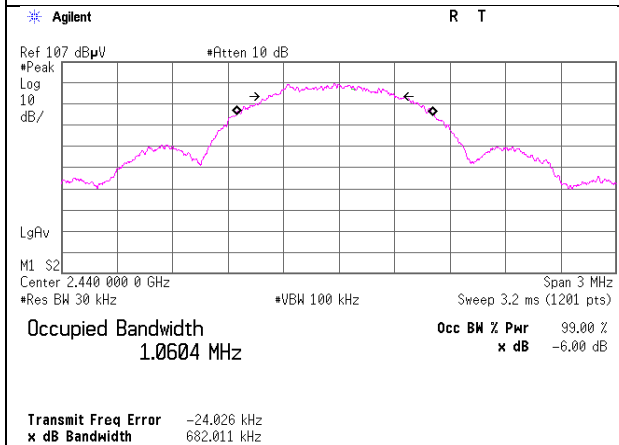
99%Occupied Bandwidth

BT LE

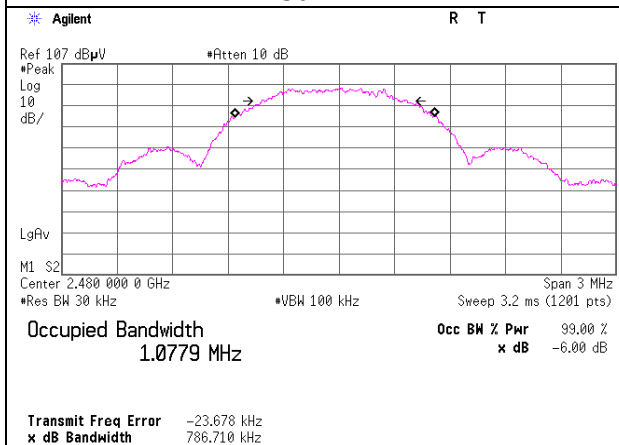
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No. 12205053H
Test place Ise EMC Lab. No.3 Measurement Room
Date March 8, 2018
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Yuta Moriya
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-5.90	0.56	9.51	4.17	2.61	30.00	1000	25.83
2440	-6.04	0.57	9.51	4.04	2.54	30.00	1000	25.96
2480	-6.28	0.57	9.51	3.80	2.40	30.00	1000	26.20

Sample Calculation:

Result = Reading + Cable Loss + 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)

Report No. 12205053H
Test place Ise EMC Lab. No.3 Measurement Room
Date March 8, 2018
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Yuta Moriya
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result	
				[dBm]	[mW]
2402	-6.04	0.56	9.51	4.03	2.53
2440	-6.19	0.57	9.51	3.89	2.45
2480	-6.43	0.57	9.51	3.65	2.32

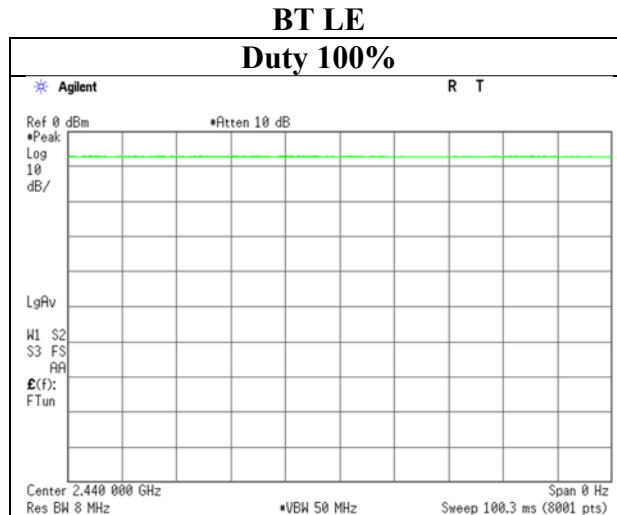
Sample Calculation:

Result = Reading + Cable Loss + Attenuator Loss

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

Burst rate confirmation

Report No. 12205053H
Test place Ise EMC Lab. No.3 Measurement Room
Date March 9, 2018
Temperature / Humidity 23 deg. C / 38 % RH
Engineer Yuta Moriya
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. 12205053H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date March 8, 2018 No.3
Temperature / Humidity 25 deg. C / 37 % RH March 9, 2018
Engineer Takafumi Noguchi 23 deg. C / 41 % RH
Tomohisa Nakagawa
(Above 1 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	66.510	QP	40.6	6.5	7.7	32.2	-	22.6	40.0	17.4	
Hori	86.780	QP	46.0	7.9	8.0	32.2	-	29.7	40.0	10.3	
Hori	92.814	QP	40.0	8.9	8.1	32.2	-	24.8	43.5	18.7	
Hori	178.184	QP	36.9	16.3	9.0	32.1	-	30.1	43.5	13.4	
Hori	313.410	QP	35.9	13.6	10.1	32.0	-	27.6	46.0	18.4	
Hori	998.661	QP	29.7	22.3	14.0	30.5	-	35.5	53.9	18.4	
Hori	2390.000	PK	42.6	27.7	5.9	32.4	-	43.8	73.9	30.1	
Hori	4804.000	PK	41.6	31.6	8.2	31.4	-	50.0	73.9	23.9	
Hori	7206.000	PK	41.5	36.0	8.1	32.1	-	53.5	73.9	20.4	Floor noise
Hori	9608.000	PK	41.3	38.5	9.2	32.9	-	56.1	73.9	17.8	Floor noise
Hori	2390.000	AV	34.0	27.7	5.9	32.4	-	35.2	53.9	18.7	
Hori	4804.000	AV	33.4	31.6	8.2	31.4	-	41.8	53.9	12.1	
Hori	7206.000	AV	32.3	36.0	8.1	32.1	-	44.3	53.9	9.6	Floor noise
Hori	9608.000	AV	32.3	38.5	9.2	32.9	-	47.1	53.9	6.8	Floor noise
Vert	37.650	QP	35.3	14.9	7.3	32.2	-	25.3	40.0	14.7	
Vert	66.789	QP	41.3	6.4	7.7	32.2	-	23.2	40.0	16.8	
Vert	82.327	QP	42.3	7.1	8.0	32.2	-	25.2	40.0	14.8	
Vert	178.751	QP	37.4	16.3	9.0	32.1	-	30.6	43.5	12.9	
Vert	307.334	QP	33.3	13.5	10.1	32.0	-	24.9	46.0	21.1	
Vert	994.661	QP	23.3	22.3	13.9	30.5	-	29.0	53.9	24.9	
Vert	2390.000	PK	42.6	27.7	5.9	32.4	-	43.8	73.9	30.1	
Vert	4804.000	PK	42.2	31.6	8.2	31.4	-	50.6	73.9	23.3	
Vert	7206.000	PK	41.5	36.0	8.1	32.1	-	53.5	73.9	20.4	Floor noise
Vert	9608.000	PK	41.2	38.5	9.2	32.9	-	56.0	73.9	17.9	Floor noise
Vert	2390.000	AV	34.1	27.7	5.9	32.4	-	35.3	53.9	18.6	
Vert	4804.000	AV	33.9	31.6	8.2	31.4	-	42.3	53.9	11.6	
Vert	7206.000	AV	32.3	36.0	8.1	32.1	-	44.3	53.9	9.6	Floor noise
Vert	9608.000	AV	32.3	38.5	9.2	32.9	-	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 20log (4.1 m / 3.0 m) = 2.72 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

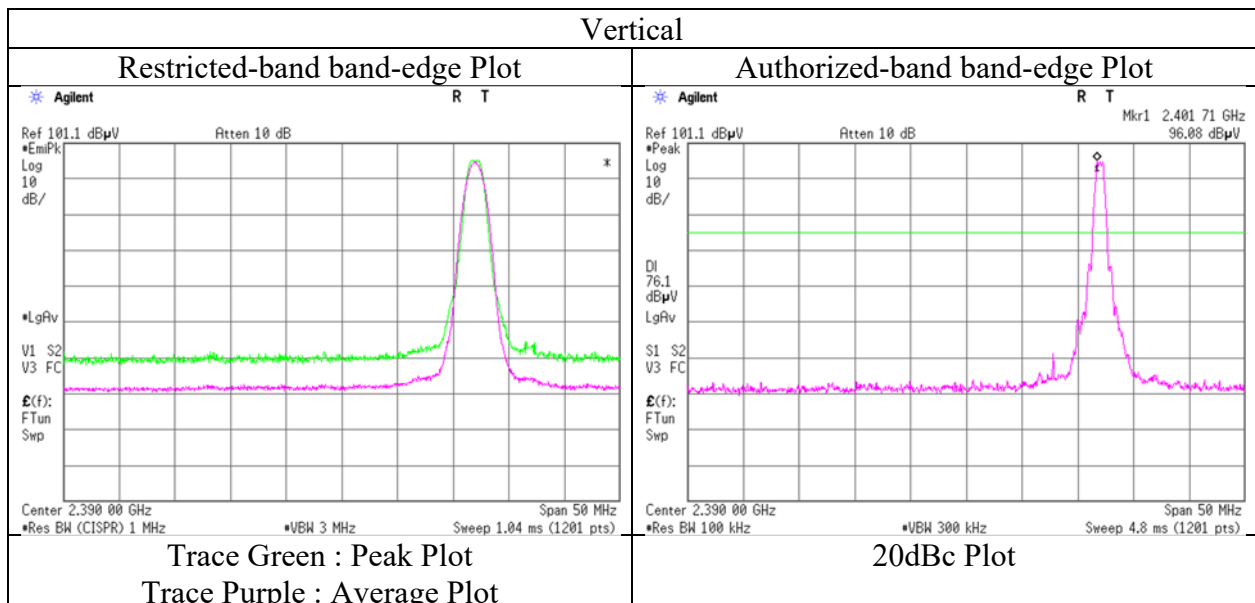
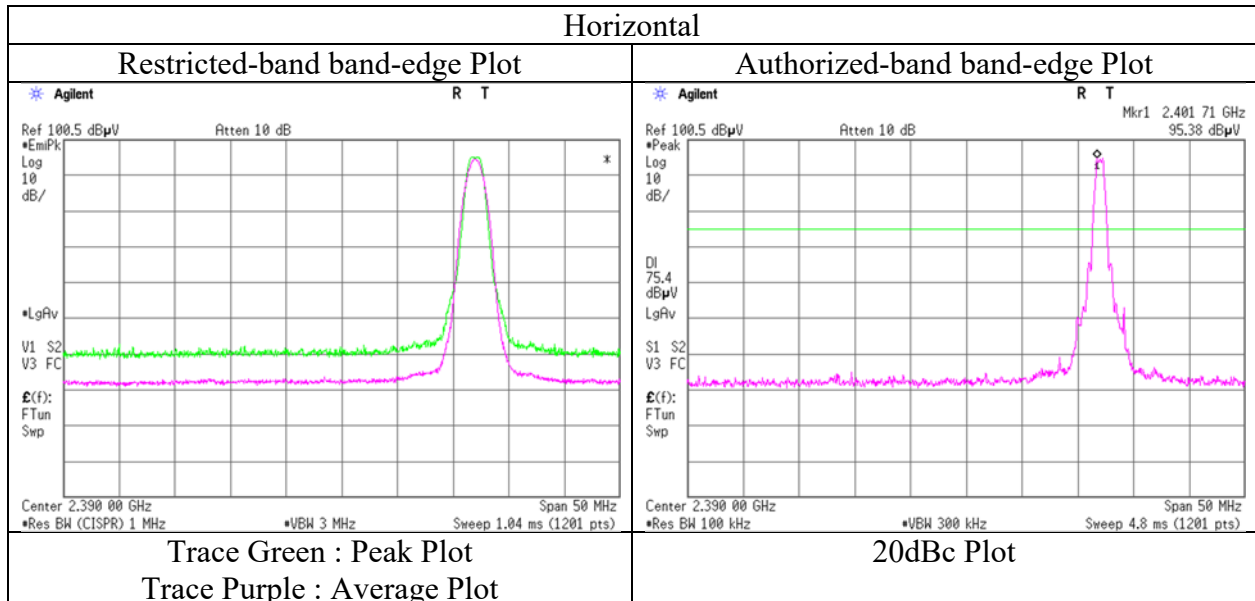
20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	95.4	27.7	6.0	32.4	96.7	-	-	Carrier
Hori	2400.000	PK	54.3	27.7	6.0	32.4	55.6	76.7	21.1	
Vert	2402.000	PK	96.1	27.7	6.0	32.4	97.4	-	-	Carrier
Vert	2400.000	PK	54.6	27.7	6.0	32.4	55.9	77.4	21.5	

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.	12205053H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	March 8, 2018
Temperature / Humidity	25 deg. C / 37 % RH
Engineer	Takafumi Noguchi (Above 1 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.	12205053H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 8, 2018	March 9, 2018
Temperature / Humidity	25 deg. C / 37 % RH	23 deg. C / 41 % RH
Engineer	Takafumi Noguchi (Above 1 GHz)	Tomohisa Nakagawa (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	66.510	QP	37.5	6.5	7.7	32.2	-	19.5	40.0	20.5	
Hori	86.787	QP	47.1	7.9	8.0	32.2	-	30.8	40.0	9.2	
Hori	92.814	QP	39.7	8.9	8.1	32.2	-	24.5	43.5	19.0	
Hori	178.184	QP	36.8	16.3	9.0	32.1	-	30.0	43.5	13.5	
Hori	313.210	QP	36.1	13.6	10.1	32.0	-	27.8	46.0	18.2	
Hori	998.418	QP	27.3	22.3	14.0	30.5	-	33.1	53.9	20.8	
Hori	4880.000	PK	43.2	31.9	8.2	31.4	-	51.9	73.9	22.0	
Hori	7320.000	PK	41.2	36.2	8.1	32.2	-	53.3	73.9	20.6	Floor noise
Hori	9760.000	PK	40.6	38.7	9.3	33.0	-	55.6	73.9	18.3	Floor noise
Hori	4880.000	AV	34.9	31.9	8.2	31.4	-	43.6	53.9	10.3	
Hori	7320.000	AV	32.3	36.2	8.1	32.2	-	44.4	53.9	9.5	Floor noise
Hori	9760.000	AV	31.9	38.7	9.3	33.0	-	46.9	53.9	7.0	Floor noise
Vert	37.590	QP	35.0	15.0	7.3	32.2	-	25.1	40.0	14.9	
Vert	65.849	QP	41.3	6.6	7.7	32.2	-	23.4	40.0	16.6	
Vert	82.327	QP	40.4	7.1	8.0	32.2	-	23.3	40.0	16.7	
Vert	178.610	QP	36.9	16.3	9.0	32.1	-	30.1	43.5	13.4	
Vert	307.334	QP	34.3	13.5	10.1	32.0	-	25.9	46.0	20.1	
Vert	994.661	QP	29.3	22.3	13.9	30.5	-	35.0	53.9	18.9	
Vert	4880.000	PK	43.3	31.9	8.2	31.4	-	52.0	73.9	21.9	
Vert	7320.000	PK	41.2	36.2	8.1	32.2	-	53.3	73.9	20.6	Floor noise
Vert	9760.000	PK	40.7	38.7	9.3	33.0	-	55.7	73.9	18.2	Floor noise
Vert	4880.000	AV	34.9	31.9	8.2	31.4	-	43.6	53.9	10.3	
Vert	7320.000	AV	32.3	36.2	8.1	32.2	-	44.4	53.9	9.5	Floor noise
Vert	9760.000	AV	32.0	38.7	9.3	33.0	-	47.0	53.9	6.9	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 (4.1 m / 3.0 m) = 2.72 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No. 12205053H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date March 8, 2018 No.3
Temperature / Humidity 25 deg. C / 37 % RH 23 deg. C / 41 % RH
Engineer Takafumi Noguchi Tomohisa Nakagawa
(Above 1 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	66.352	QP	36.3	6.5	7.7	32.2	-	18.3	40.0	21.7	
Hori	86.787	QP	46.6	7.9	8.0	32.2	-	30.3	40.0	9.7	
Hori	92.766	QP	41.7	8.9	8.1	32.2	-	26.5	43.5	17.0	
Hori	178.184	QP	34.9	16.3	9.0	32.1	-	28.1	43.5	15.4	
Hori	313.680	QP	36.4	13.6	10.1	32.0	-	28.1	46.0	17.9	
Hori	995.823	QP	22.5	22.3	14.0	30.5	-	28.3	53.9	25.6	
Hori	2483.500	PK	44.3	27.8	6.0	32.4	-	45.7	73.9	28.2	
Hori	4960.000	PK	41.9	32.1	8.3	31.3	-	51.0	73.9	22.9	
Hori	7440.000	PK	41.3	36.4	8.1	32.2	-	53.6	73.9	20.3	Floor noise
Hori	9920.000	PK	41.0	38.9	9.3	33.1	-	56.1	73.9	17.8	Floor noise
Hori	2483.500	AV	35.6	27.8	6.0	32.4	-	37.0	53.9	16.9	
Hori	4960.000	AV	34.0	32.1	8.3	31.3	-	43.1	53.9	10.8	
Hori	7440.000	AV	32.5	36.4	8.1	32.2	-	44.8	53.9	9.1	Floor noise
Hori	9920.000	AV	32.3	38.9	9.3	33.1	-	47.4	53.9	6.5	Floor noise
Vert	37.630	QP	34.6	14.9	7.3	32.2	-	24.6	40.0	15.4	
Vert	65.849	QP	43.8	6.6	7.7	32.2	-	25.9	40.0	14.1	
Vert	82.327	QP	45.2	7.1	8.0	32.2	-	28.1	40.0	11.9	
Vert	178.610	QP	36.4	16.3	9.0	32.1	-	29.6	43.5	13.9	
Vert	307.334	QP	33.7	13.5	10.1	32.0	-	25.3	46.0	20.7	
Vert	994.661	QP	26.7	22.3	13.9	30.5	-	32.4	53.9	21.5	
Vert	2483.500	PK	44.1	27.8	6.0	32.4	-	45.5	73.9	28.4	
Vert	4960.000	PK	43.2	32.1	8.3	31.3	-	52.3	73.9	21.6	
Vert	7440.000	PK	41.4	36.4	8.1	32.2	-	53.7	73.9	20.2	Floor noise
Vert	9920.000	PK	41.0	38.9	9.3	33.1	-	56.1	73.9	17.8	Floor noise
Vert	2483.500	AV	35.4	27.8	6.0	32.4	-	36.8	53.9	17.1	
Vert	4960.000	AV	35.3	32.1	8.3	31.3	-	44.4	53.9	9.5	
Vert	7440.000	AV	32.4	36.4	8.1	32.2	-	44.7	53.9	9.2	Floor noise
Vert	9920.000	AV	32.3	38.9	9.3	33.1	-	47.4	53.9	6.5	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (4.1 m / 3.0 m) = 2.72 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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Ise EMC Lab.

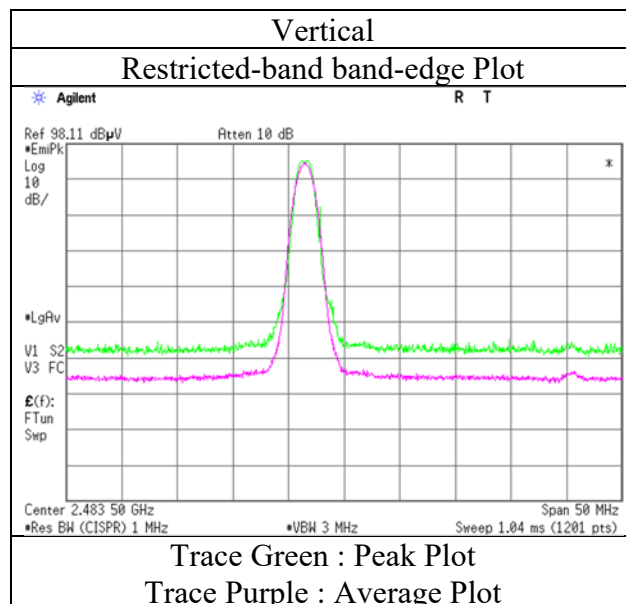
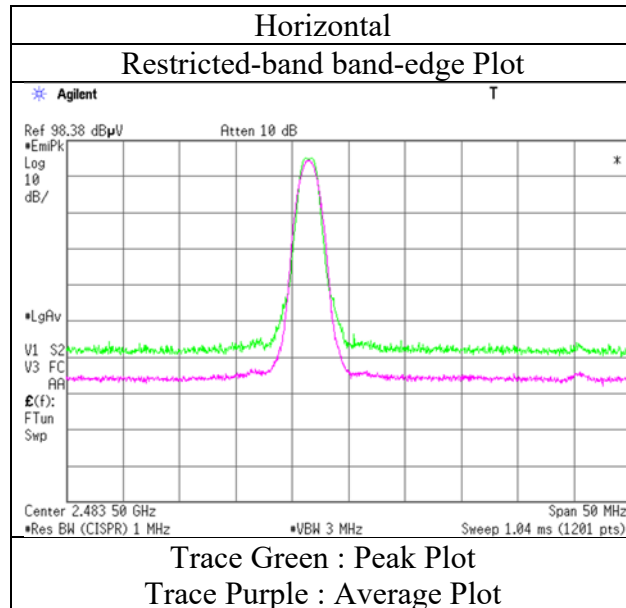
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Radiated Spurious Emission (Reference Plot for band-edge)

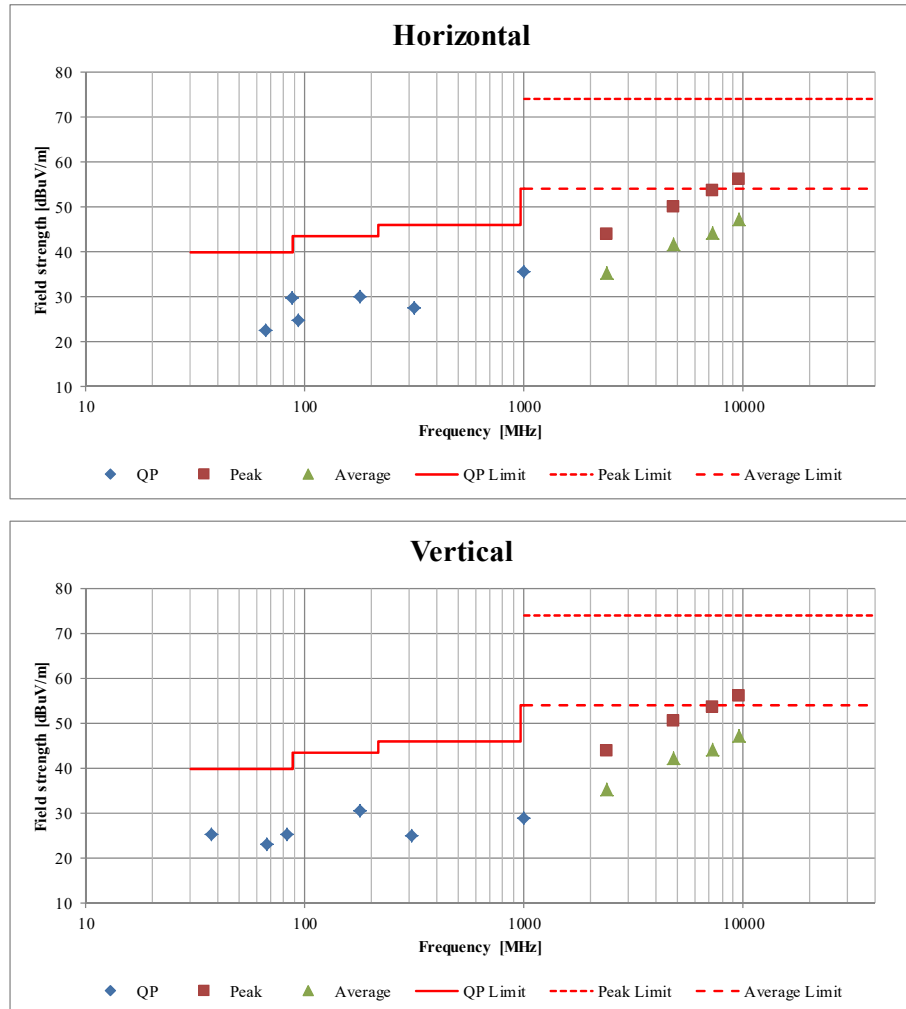
Report No.	12205053H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	March 8, 2018
Temperature / Humidity	25 deg. C / 37 % RH
Engineer	Takafumi Noguchi (Above 1 GHz)
Mode	Tx BT LE 2480 MHz



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

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

Report No.	12205053H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 8, 2018	March 9, 2018
Temperature / Humidity	25 deg. C / 37 % RH	23 deg. C / 41 % RH
Engineer	Takafumi Noguchi (Above 1 GHz)	Tomohisa Nakagawa (Below 1 GHz)
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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Ise EMC Lab.

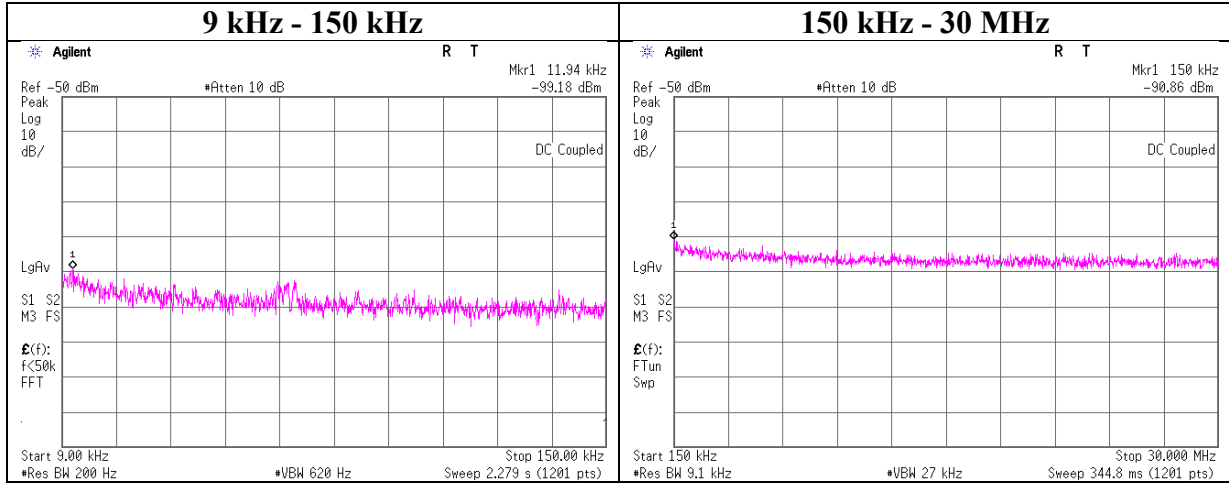
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

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Conducted Spurious Emission

Report No.	12205053H
Test place	Ise EMC Lab. No.3 Measurement Room
Date	March 9, 2018
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE 2402 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
11.94	-99.2	0.01	9.8	2.0	1	-87.3	300	6.0	-26.1	46.0	72.1	
150.00	-90.9	0.00	9.8	2.0	1	-79.0	300	6.0	-17.8	24.0	41.8	

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

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

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.

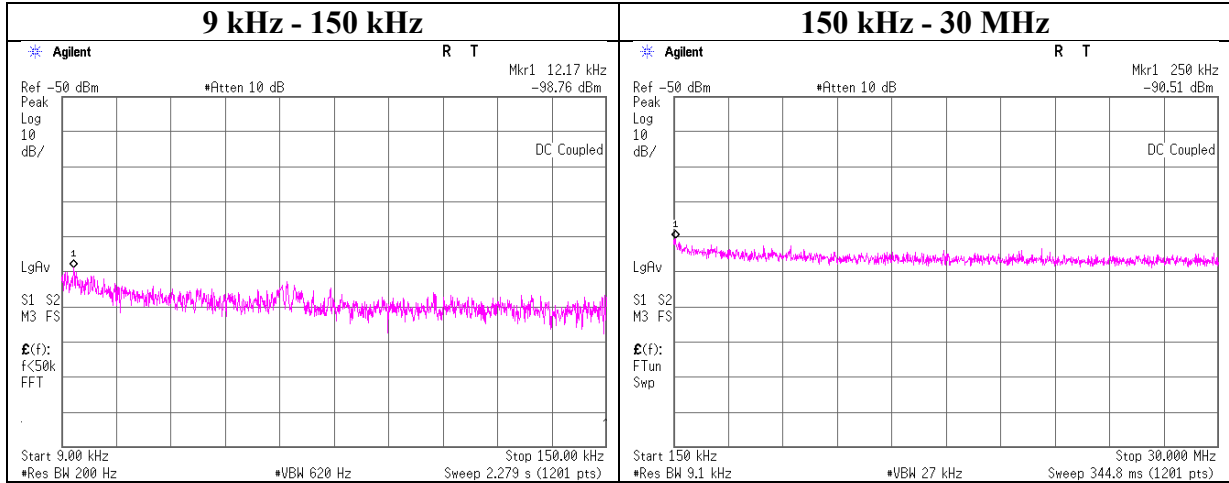
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Conducted Spurious Emission

Report No.	12205053H
Test place	Ise EMC Lab. No.3 Measurement Room
Date	March 9, 2018
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE 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
12.17	-98.8	0.01	9.8	2.0	1	-86.9	300	6.0	-25.7	45.8	71.5	
250.00	-90.5	0.00	9.8	2.0	1	-78.7	300	6.0	-17.4	19.6	37.0	

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

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

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.

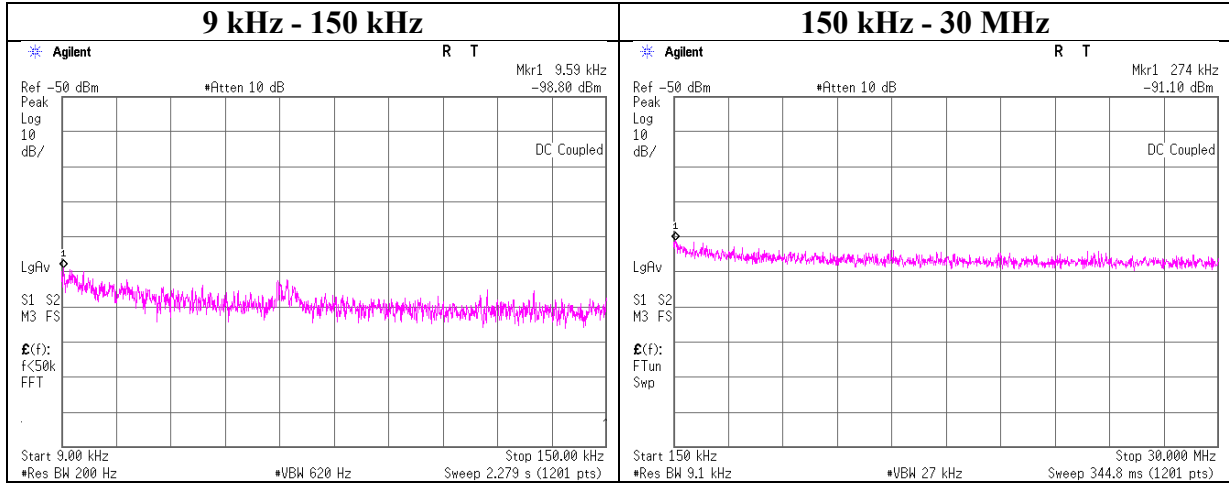
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12205053H
Test place Ise EMC Lab. No.3 Measurement Room
Date March 9, 2018
Temperature / Humidity 23 deg. C / 38 % RH
Engineer Yuta Moriya
Mode Tx BT LE 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
9.59	-98.8	0.01	9.8	2.0	1	-87.0	300	6.0	-25.7	47.9	73.6	
274.00	-91.1	0.00	9.9	2.0	1	-79.2	300	6.0	-17.9	18.8	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.

UL Japan, Inc.

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Power Density

Report No. 12205053H
Test place Ise EMC Lab. No.3 Measurement Room
Date March 9, 2018
Temperature / Humidity 23 deg. C / 38 % RH
Engineer Yuta Moriya
Mode Tx

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402.00	-17.82	1.85	9.51	-6.46	8.00	14.46
2440.00	-17.99	1.87	9.51	-6.61	8.00	14.61
2480.00	-17.51	1.89	9.51	-6.11	8.00	14.11

Sample Calculation:

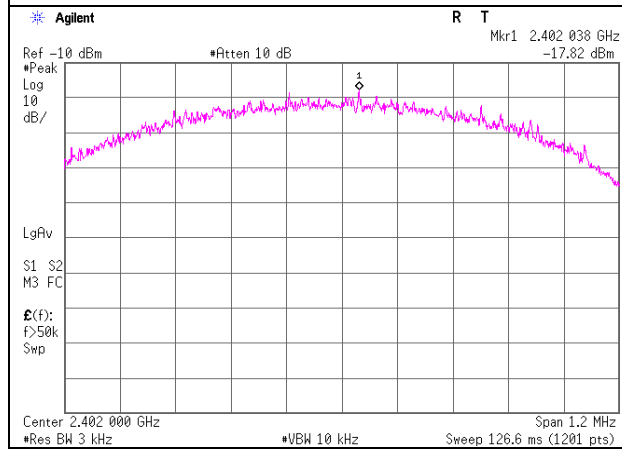
Result = Reading + Cable Loss + Attenuator Loss

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

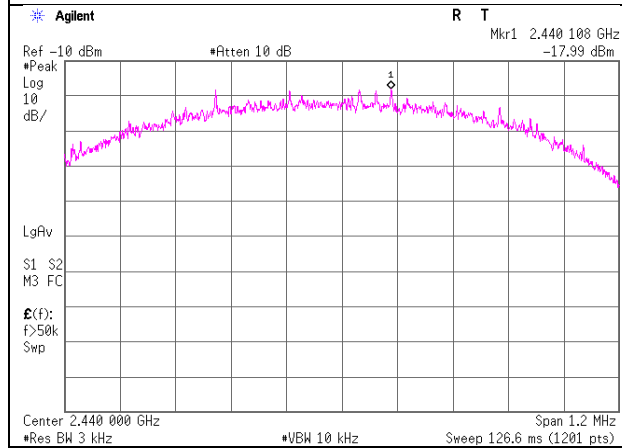
Power Density

BT LE

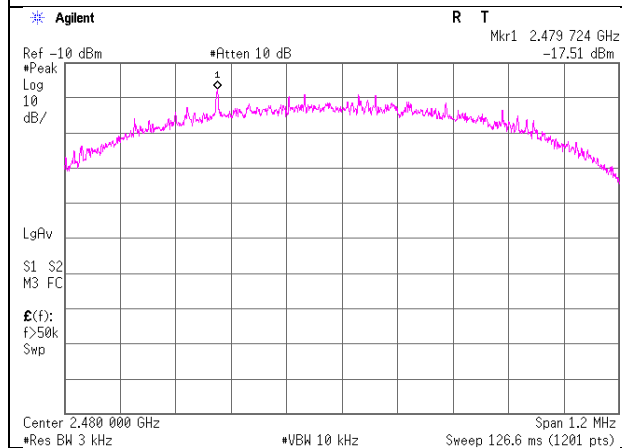
2402 MHz



2440 MHz



2480 MHz



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APPENDIX 2: Test instruments

Test Instruments

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE/CE	2017/10/31 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE/AT/CE	2018/01/24 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE/CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE/CE	2017/11/07 * 12
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2017/05/22 * 12
MCC-167	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	RE	2017/05/29 * 12
MPA-11	MicroWave System Amplifier	Agilent	83017A	MY39500779	RE	2017/03/21 * 12
MHA-16	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	RE	2017/05/14 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE/AT/CE	2018/01/09 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2017/09/22 * 12
MCC-138	Microwave cable	HUBER+SUHNER	SUCOFLEX 102	37953/2	AT	2017/10/06 * 12
MAT-90	Attenuator	Weinschel Associates	WA56-10	56100306	AT	2017/06/12 * 12
MSA-13	Spectrum Analyzer	Agilent	E4440A	MY46185823	AT	2017/11/16 * 12
MPM-08	Power Meter	Anritsu	ML2495A	6K00003338	AT	2017/10/13 * 12
MPSE-11	Power sensor	Anritsu	MA2411B	011737	AT	2017/10/13 * 12
MCC-209	Microwave Cable	RS Components	R-132G7210200CD	-	AT	2017/04/05 * 12
MAT-10	Attenuator(10dB)	Weinschel Corp	2	BL1173	AT	2017/11/14 * 12
MCC-64	Coaxial Cable	UL Japan	-	-	AT	2017/03/24 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE/CE	2017/08/22 * 12
MLS-23	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	CE(EUT)	2017/07/24 * 12
MLS-24	LISN(AMN)	Schwarzbeck	NSLK8127	8127-730	CE(AE)	2017/07/20 * 12
MTA-31	Terminator	TME	CT-01	-	CE	2017/12/11 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ suoform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	CE	2017/07/12 * 12
MAT-66	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2017/12/19 * 12
MTA-28	Terminator	TME	CT-01	-	CE	2017/11/09 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2017/10/02 * 12
MLA-22	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	RE	2018/01/30 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2017/07/12 * 12
MAT-98	Attenuator	KEYSIGHT	8491A	MY52462349	RE	2017/12/14 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2017/03/27 * 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: CE: Conducted Emission test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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