



RADIO TEST REPORT

Test Report No. : 11997604H-A-R1

Applicant : OMRON HEALTHCARE Co., Ltd.
Type of Equipment : Blood Pressure Monitor
Model No. : HEM-6232T
FCC ID : Q6ZHEM6232T
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.
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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 11997604H-A. 11997604H-A is replaced with this report.

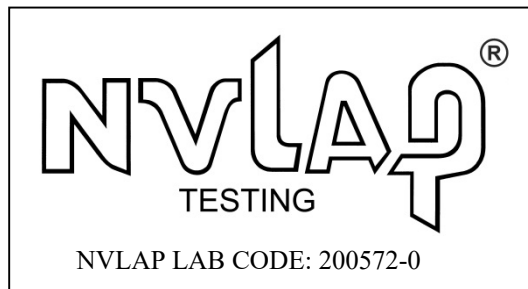
Date of test: November 6 to 16, 2017

Representative test engineer:

Takumi Shimada
Engineer
Consumer Technology Division

Approved by:

Takayuki Shimada
Leader
Consumer Technology Division



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13-EM-F0429

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SECTION 1: Customer information

Company Name : OMRON HEALTHCARE Co., Ltd.
Address : 53, Kunotsubo, Terado-cho, Muko, KYOTO, 617-0002 Japan
Telephone Number : +81-75-925-2045
Facsimile Number : +81-75-925-2046
Contact Person : Yoshinori Tsurumi

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

2.1 Identification of E.U.T.

Type of Equipment : Blood Pressure Monitor
Model No. : HEM-6232T
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3 V
Receipt Date of Sample : November 1, 2017
Country of Mass-production : Japan, China, Vietnam
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: HEM-6232T (referred to as the EUT in this report) is a Blood Pressure Monitor.

Variant model: HEM-6231T

Difference between EUT and variant model is whether device has operation switch on blood pressure operation part.

Circuit of RF part is identical.

General Specification

Clock frequency(ies) in the system : 32.768 kHz
26 MHz

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Power Supply (radio part input) : DC 1.2 V
Antenna type : Chip Antenna
Antenna Gain : 5.05 dBi

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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 February 2, 2018 and effective March 5, 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 February 2, 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 IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	N/A *1)	N/A	-
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: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	5.3 dB (4804.000 MHz, Horizontal, 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) This test is not applicable since the EUT is battery operation device.

*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 test was performed with the full-charged battery and the stable voltage (DC 1.2 V) was supplied to the RF part during the tests. Therefore, the 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.

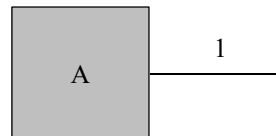
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

4 Bluetooth Low Energy (BT LE): Transmitting (Tx), Payload: PRBS9

Test Item	Operating Mode	Tested frequency
6dB Bandwidth Maximum Peak Output Power Power Density Spurious Emission 99% Occupied Bandwidth	BT LE	2402 MHz 2440 MHz 2480 MHz
*Power of the EUT was set by the software as follows; Power settings: 0 dBm Software: Serial Command Explorer 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.		

4.2 Configuration and peripherals



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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Blood Pressure Monitor	HEM-6232T	201709003120L *1) 201709003118L *2)	OMRON HEALTHCARE Co., Ltd.	EUT

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Signal Cable	0.2	Unshielded	Unshielded	-

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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: $20 \times \log(4.0 \text{ m} / 3.0 \text{ m}) = 2.5 \text{ dB}$

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

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- 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	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 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

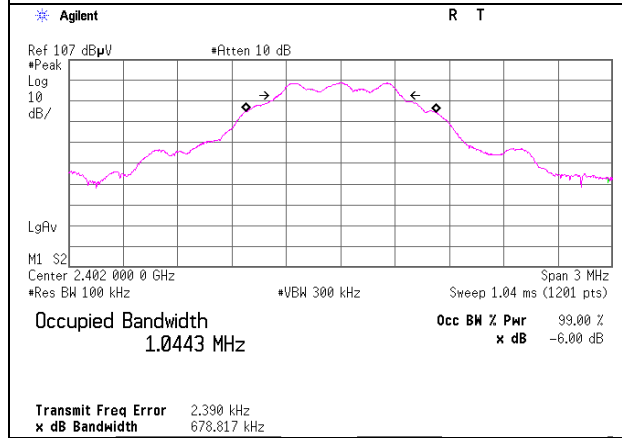
Test place Ise EMC Lab. No.11 Measurement Room
Report No. 11997604H
Date November 6, 2017
Temperature / Humidity 25 deg. C / 28 % RH
Engineer Yuta Moriya
Mode Tx BT LE

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
BT LE	2402	0.679	> 500
	2440	0.670	> 500
	2480	0.674	> 500

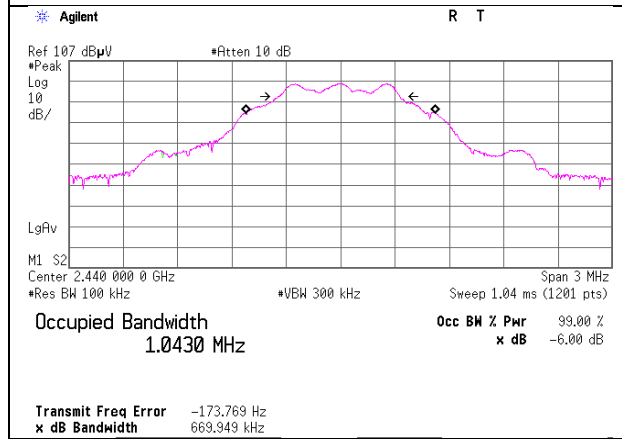
6dB Bandwidth

BT LE

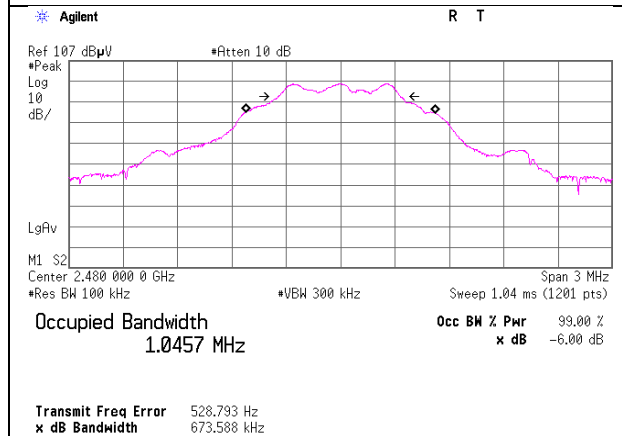
2402 MHz



2440 MHz



2480 MHz



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Maximum Peak Output Power

Test place : Ise EMC Lab. No.11 Measurement Room
Report No. : 11997604H
Date : November 6, 2017
Temperature / Humidity : 25 deg. C / 28 % 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	-11.18	1.07	10.05	-0.06	0.99	30.00	1000	30.06
2440	-11.10	1.07	10.05	0.02	1.00	30.00	1000	29.98
2480	-11.06	1.08	10.05	0.07	1.02	30.00	1000	29.93

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.11 Measurement Room
Report No. : 11997604H
Date : November 6, 2017
Temperature / Humidity : 25 deg. C / 28 % RH
Engineer : Yuta Moriya
Mode : Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-16.68	1.07	10.05	-5.56	0.28	4.95	-0.61	0.87
2440	-16.61	1.07	10.05	-5.49	0.28	4.95	-0.54	0.88
2480	-16.56	1.08	10.05	-5.43	0.29	4.95	-0.48	0.90

Sample Calculation:

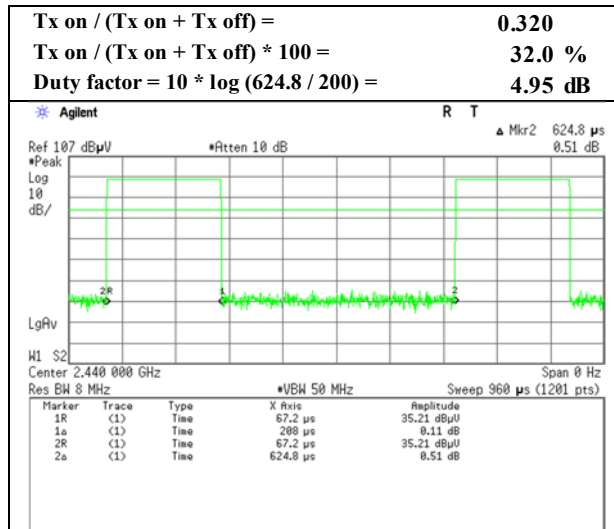
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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.11 Measurement Room
Report No.	11997604H
Date	November 6, 2017
Temperature / Humidity	25 deg. C / 28 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE



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

Radiated Spurious Emission

Report No.	11997604H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.3
Date	November 9, 2017	November 16, 2017
Temperature / Humidity	24 deg. C / 30 % RH	24 deg. C / 36 % RH
Engineer	Takumi Shimada	Hiroyuki Furutaka
	(Below 1GHz)	(Above 1GHz)
Mode	Tx BT LE 2402MHz	

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	31.983	QP	24.8	17.1	6.7	30.5	-	18.1	40.0	21.9	
Hori	188.951	QP	23.7	16.3	8.1	29.7	-	18.4	43.5	25.1	
Hori	477.335	QP	23.7	17.3	9.6	29.9	-	20.7	46.0	25.3	
Hori	577.334	QP	23.6	18.8	10.1	29.8	-	22.7	46.0	23.3	
Hori	794.664	QP	22.4	20.8	10.9	28.7	-	25.4	46.0	20.6	
Hori	894.663	QP	22.1	22.1	11.2	28.1	-	27.3	46.0	18.7	
Hori	2388.852	PK	50.6	27.7	5.7	32.4	-	51.6	73.9	22.3	
Hori	2390.000	PK	46.0	27.7	5.7	32.4	-	47.0	73.9	26.9	
Hori	4804.000	PK	43.8	31.6	8.0	31.4	-	52.0	73.9	21.9	
Hori	7206.000	PK	42.6	36.0	9.4	32.1	-	55.9	73.9	18.0	Floor noise
Hori	9608.000	PK	42.3	38.5	9.9	32.9	-	57.8	73.9	16.1	Floor noise
Hori	2388.852	AV	34.6	27.7	5.7	32.4	5.0	40.6	53.9	13.4	
Hori	2390.000	AV	33.4	27.7	5.7	32.4	5.0	39.4	53.9	14.6	*1)
Hori	4804.000	AV	34.6	31.6	8.0	31.4	5.0	47.8	53.9	6.1	
Hori	7206.000	AV	33.7	36.0	9.4	32.1	-	47.0	53.9	6.9	Floor noise
Hori	9608.000	AV	32.1	38.5	9.9	32.9	-	47.6	53.9	6.3	Floor noise
Vert	31.983	QP	24.8	17.1	6.7	30.5	-	18.1	40.0	21.9	
Vert	188.951	QP	23.6	16.3	8.1	29.7	-	18.3	43.5	25.2	
Vert	477.335	QP	23.6	17.3	9.6	29.9	-	20.6	46.0	25.4	
Vert	577.334	QP	23.5	18.8	10.1	29.8	-	22.6	46.0	23.4	
Vert	794.664	QP	22.4	20.8	10.9	28.7	-	25.4	46.0	20.6	
Vert	894.663	QP	22.1	22.1	11.2	28.1	-	27.3	46.0	18.7	
Vert	2388.740	PK	51.2	27.7	5.7	32.4	-	52.2	73.9	21.7	
Vert	2390.000	PK	46.6	27.7	5.7	32.4	-	47.6	73.9	26.3	
Vert	4804.000	PK	44.6	31.6	8.0	31.4	-	52.8	73.9	21.1	
Vert	7206.000	PK	42.7	36.0	9.4	32.1	-	56.0	73.9	17.9	Floor noise
Vert	9608.000	PK	42.0	38.5	9.9	32.9	-	57.5	73.9	16.4	Floor noise
Vert	2388.740	AV	35.2	27.7	5.7	32.4	5.0	41.2	53.9	12.8	
Vert	2390.000	AV	33.8	27.7	5.7	32.4	5.0	39.8	53.9	14.2	*1)
Vert	4804.000	AV	35.5	31.6	8.0	31.4	5.0	48.7	53.9	5.3	
Vert	7206.000	AV	33.6	36.0	9.4	32.1	-	46.9	53.9	7.0	Floor noise
Vert	9608.000	AV	31.9	38.5	9.9	32.9	-	47.4	53.9	6.5	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.50\text{ dB}$
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	91.4	27.7	5.8	32.4	92.5	-	-	Carrier
Hori	2400.000	PK	46.5	27.7	5.8	32.4	47.6	72.5	24.9	
Vert	2402.000	PK	91.2	27.7	5.8	32.4	92.3	-	-	Carrier
Vert	2400.000	PK	46.0	27.7	5.8	32.4	47.1	72.3	25.2	

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

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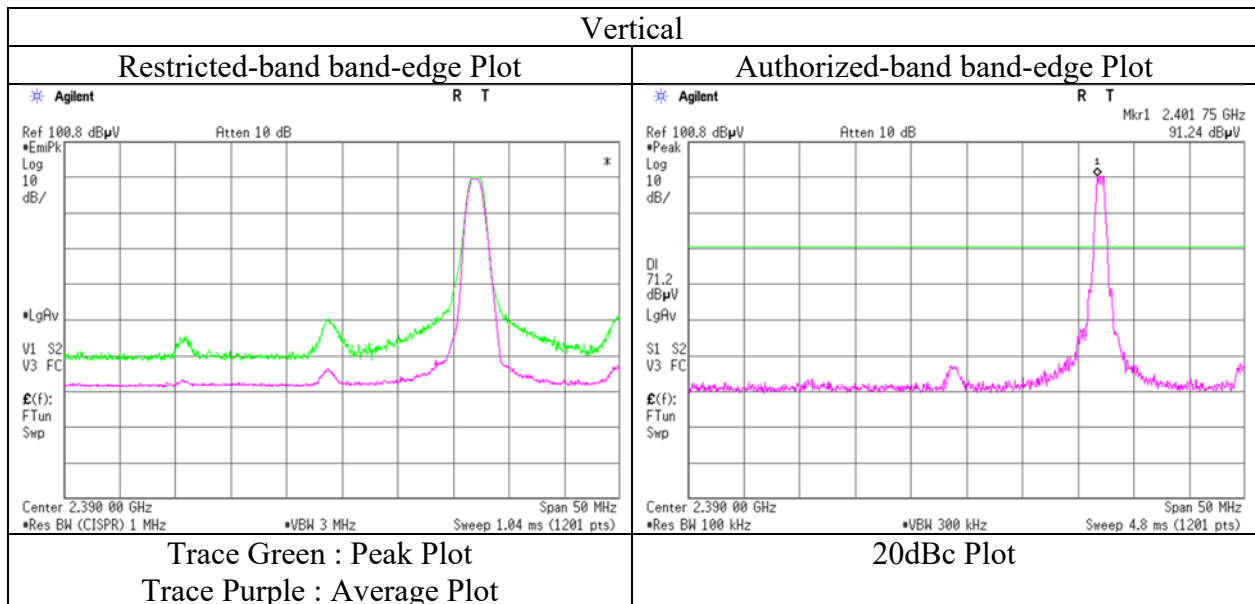
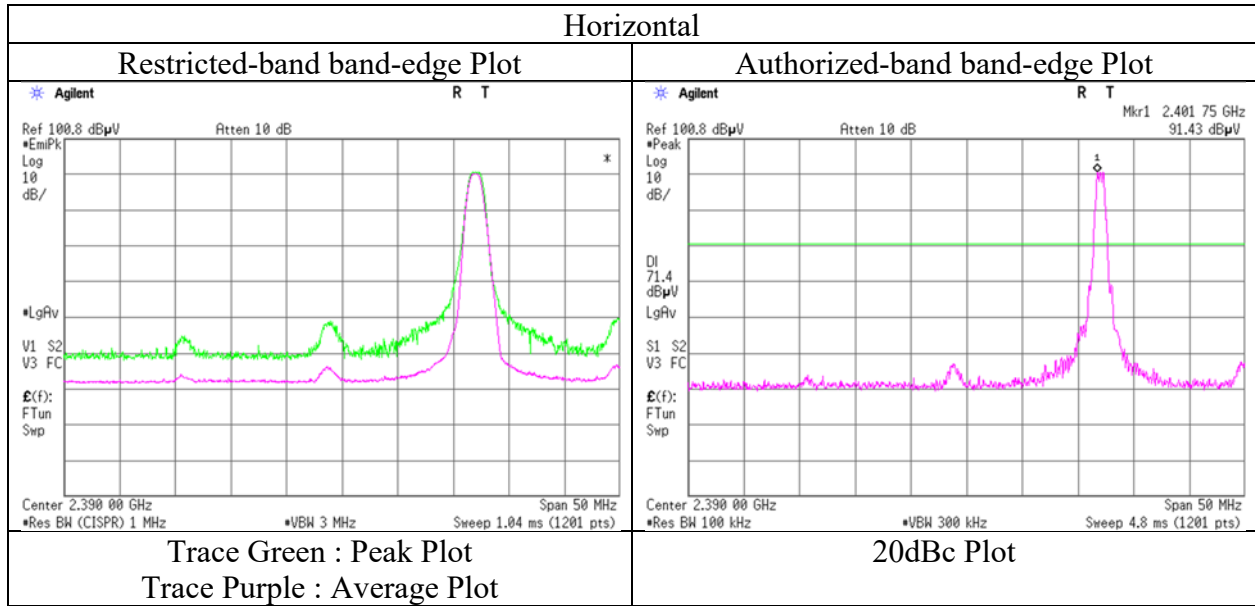
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 11997604H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date November 16, 2017
Temperature / Humidity 24 deg. C / 36 % RH
Engineer Hiroyuki Furutaka
Mode Tx BT LE 2402 MHz



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

Radiated Spurious Emission

Report No.	11997604H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.3
Date	November 9, 2017	November 16, 2017
Temperature / Humidity	24 deg. C / 30 % RH	24 deg. C / 36 % RH
Engineer	Takumi Shimada (Below 1GHz)	Hiroyuki Furutaka (Above 1GHz)
Mode	Tx BT LE 2440 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	31.983	QP	24.7	17.1	6.7	30.5	-	18.0	40.0	22.0	
Hori	188.951	QP	23.6	16.3	8.1	29.7	-	18.3	43.5	25.2	
Hori	477.335	QP	23.6	17.3	9.6	29.9	-	20.6	46.0	25.4	
Hori	577.334	QP	23.6	18.8	10.1	29.8	-	22.7	46.0	23.3	
Hori	794.664	QP	22.5	20.8	10.9	28.7	-	25.5	46.0	20.5	
Hori	894.663	QP	22.1	22.1	11.2	28.1	-	27.3	46.0	18.7	
Hori	4880.000	PK	43.3	31.9	8.0	31.4	-	51.8	73.9	22.1	
Hori	7320.000	PK	42.5	36.2	9.4	32.2	-	55.9	73.9	18.0	Floor noise
Hori	9760.000	PK	42.2	38.7	10.0	33.0	-	57.9	73.9	16.0	Floor noise
Hori	4880.000	AV	34.7	31.9	8.0	31.4	5.0	48.2	53.9	5.8	
Hori	7320.000	AV	33.6	36.2	9.4	32.2	-	47.0	53.9	6.9	Floor noise
Hori	9760.000	AV	32.0	38.7	10.0	33.0	-	47.7	53.9	6.2	Floor noise
Vert	31.983	QP	24.8	17.1	6.7	30.5	-	18.1	40.0	21.9	
Vert	188.951	QP	23.5	16.3	8.1	29.7	-	18.2	43.5	25.3	
Vert	477.335	QP	23.7	17.3	9.6	29.9	-	20.7	46.0	25.3	
Vert	577.334	QP	23.6	18.8	10.1	29.8	-	22.7	46.0	23.3	
Vert	794.664	QP	22.4	20.8	10.9	28.7	-	25.4	46.0	20.6	
Vert	894.663	QP	22.2	22.1	11.2	28.1	-	27.4	46.0	18.6	
Vert	4880.000	PK	44.1	31.9	8.0	31.4	-	52.6	73.9	21.3	
Vert	7320.000	PK	42.6	36.2	9.4	32.2	-	56.0	73.9	17.9	Floor noise
Vert	9760.000	PK	41.8	38.7	10.0	33.0	-	57.5	73.9	16.4	Floor noise
Vert	4880.000	AV	34.7	31.9	8.0	31.4	5.0	48.2	53.9	5.8	
Vert	7320.000	AV	33.5	36.2	9.4	32.2	-	46.9	53.9	7.0	Floor noise
Vert	9760.000	AV	31.7	38.7	10.0	33.0	-	47.4	53.9	6.5	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20Log (4.0 m / 3.0 m) = 2.50 dB
 10 GHz - 26.5 GHz 20Log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	11997604H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.3
Date	November 9, 2017	November 16, 2017
Temperature / Humidity	24 deg. C / 30 % RH	24 deg. C / 36 % RH
Engineer	Takumi Shimada (Below 1GHz)	Hiroyuki Furutaka (Above 1GHz)
Mode	Tx BT LE 2480 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	31.983	QP	24.8	17.1	6.7	30.5	-	18.1	40.0	21.9	
Hori	188.951	QP	23.7	16.3	8.1	29.7	-	18.4	43.5	25.1	
Hori	477.335	QP	23.7	17.3	9.6	29.9	-	20.7	46.0	25.3	
Hori	577.334	QP	23.7	18.8	10.1	29.8	-	22.8	46.0	23.2	
Hori	794.664	QP	22.4	20.8	10.9	28.7	-	25.4	46.0	20.6	
Hori	894.663	QP	22.2	22.1	11.2	28.1	-	27.4	46.0	18.6	
Hori	2483.500	PK	49.8	27.8	5.8	32.4	-	51.0	73.9	22.9	
Hori	2492.785	PK	52.6	27.8	5.8	32.4	-	53.8	73.9	20.1	
Hori	4960.000	PK	43.9	32.1	8.1	31.3	-	52.8	73.9	21.1	
Hori	7440.000	PK	42.8	36.4	9.3	32.2	-	56.3	73.9	17.6	Floor noise
Hori	9920.000	PK	42.4	38.9	10.0	33.1	-	58.2	73.9	15.7	Floor noise
Hori	2483.500	AV	34.8	27.8	5.8	32.4	5.0	41.0	53.9	13.0	*1)
Hori	2492.785	AV	36.5	27.8	5.8	32.4	5.0	42.7	53.9	11.3	
Hori	4960.000	AV	34.0	32.1	8.1	31.3	5.0	47.9	53.9	6.1	
Hori	7440.000	AV	34.0	36.4	9.3	32.2	-	47.5	53.9	6.4	Floor noise
Hori	9920.000	AV	32.0	38.9	10.0	33.1	-	47.8	53.9	6.1	Floor noise
Vert	31.983	QP	24.8	17.1	6.7	30.5	-	18.1	40.0	21.9	
Vert	188.951	QP	23.7	16.3	8.1	29.7	-	18.4	43.5	25.1	
Vert	477.335	QP	23.8	17.3	9.6	29.9	-	20.8	46.0	25.2	
Vert	577.334	QP	23.6	18.8	10.1	29.8	-	22.7	46.0	23.3	
Vert	794.664	QP	22.5	20.8	10.9	28.7	-	25.5	46.0	20.5	
Vert	894.663	QP	22.1	22.1	11.2	28.1	-	27.3	46.0	18.7	
Vert	2483.500	PK	50.3	27.8	5.8	32.4	-	51.5	73.9	22.4	
Vert	2492.785	PK	53.6	27.8	5.8	32.4	-	54.8	73.9	19.1	
Vert	4960.000	PK	42.6	32.1	8.1	31.3	-	51.5	73.9	22.4	
Vert	7440.000	PK	42.8	36.4	9.3	32.2	-	56.3	73.9	17.6	Floor noise
Vert	9920.000	PK	42.1	38.9	10.0	33.1	-	57.9	73.9	16.0	Floor noise
Vert	2483.500	AV	36.0	27.8	5.8	32.4	5.0	42.2	53.9	11.8	*1)
Vert	2492.785	AV	36.8	27.8	5.8	32.4	5.0	43.0	53.9	11.0	
Vert	4960.000	AV	33.5	32.1	8.1	31.3	5.0	47.4	53.9	6.6	
Vert	7440.000	AV	33.7	36.4	9.3	32.2	-	47.2	53.9	6.7	Floor noise
Vert	9920.000	AV	32.0	38.9	10.0	33.1	-	47.8	53.9	6.1	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.50 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

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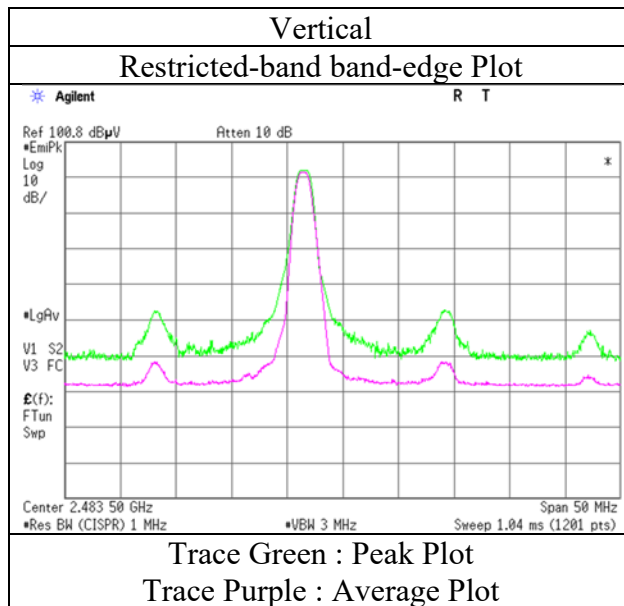
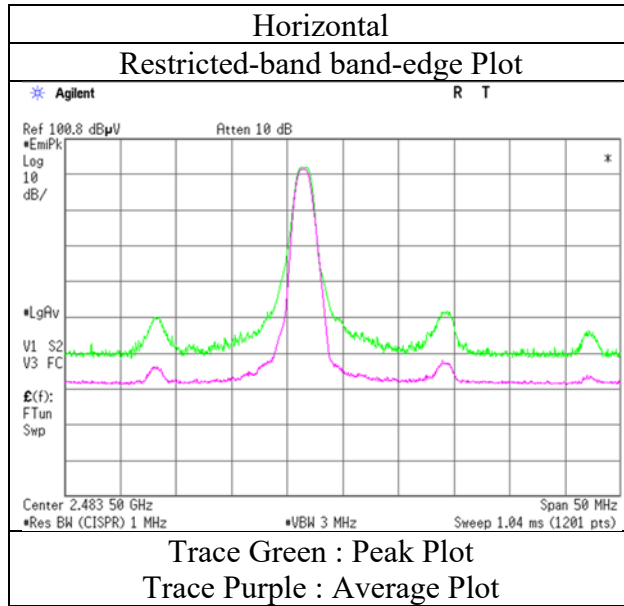
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 11997604H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date November 16, 2017
Temperature / Humidity 24 deg. C / 36 % RH
Engineer Hiroyuki Furutaka
Mode Tx BT LE 2480 MHz



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

UL Japan, Inc.

Ise EMC Lab.

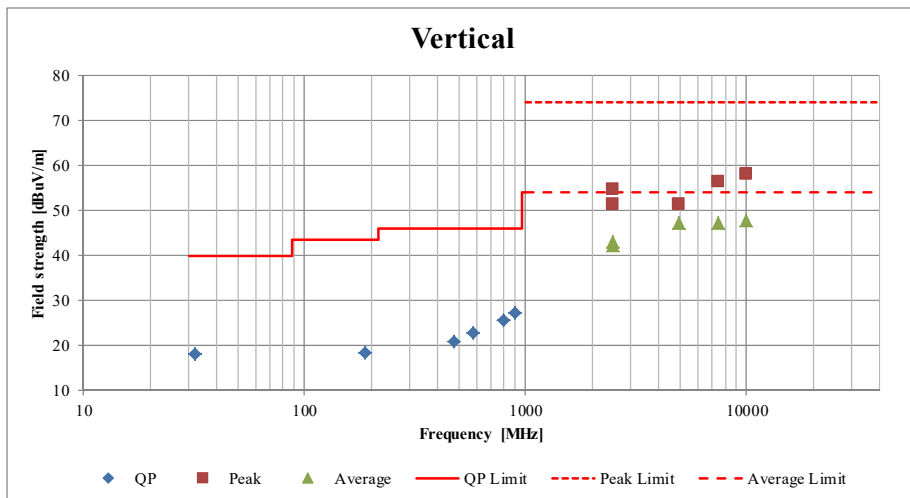
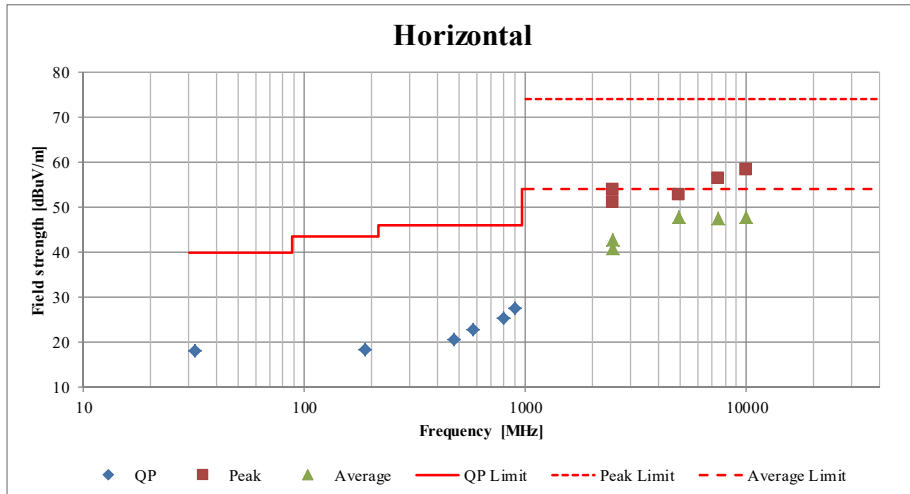
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Radiated Spurious Emission
(Plot data, Worst case)

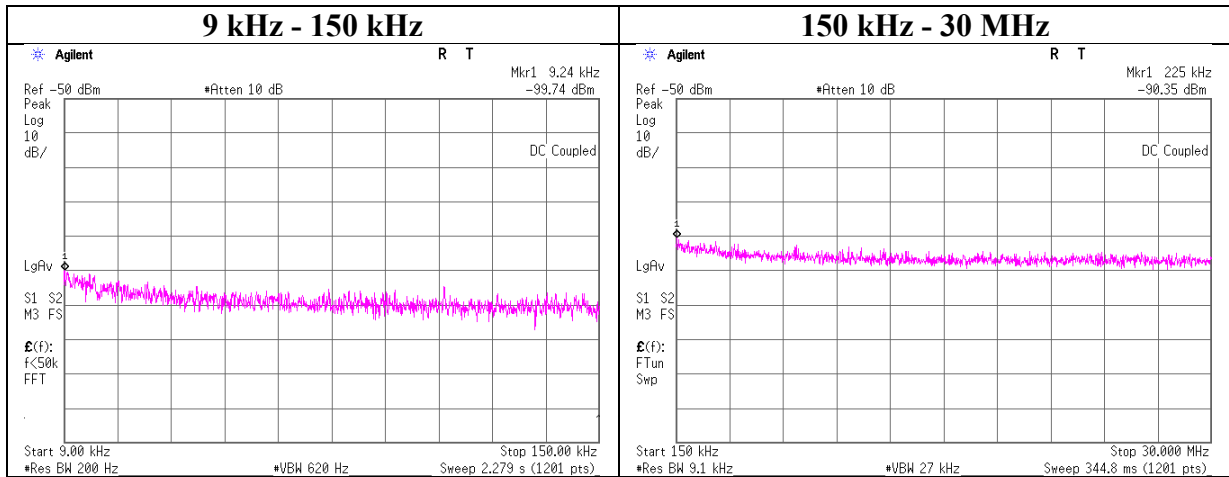
Report No.	11997604H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.2
Date	November 16, 2017	November 9, 2017
Temperature / Humidity	24 deg. C / 36 % RH	24 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka (Above 1GHz)	Takumi Shimada (Below 1GHz)
Mode	Tx BT LE 2480 MHz	



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

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11997604H
Date	November 6, 2017
Temperature / Humidity	25 deg. C / 28 % 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
9.24	-99.7	0.11	10.2	5.1	1	-84.4	300	6.0	-23.1	48.2	71.3	
225.00	-90.4	0.10	10.2	5.1	1	-75.0	300	6.0	-13.8	20.5	34.3	

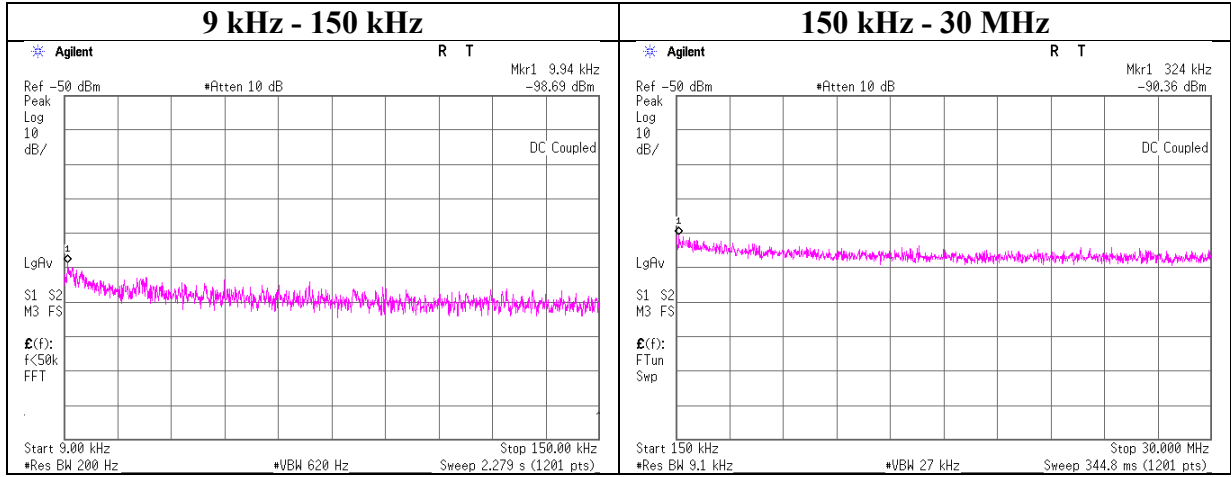
$$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$$

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

N: Number of output

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11997604H
Date	November 6, 2017
Temperature / Humidity	25 deg. C / 28 % 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
9.94	-98.7	0.11	10.2	5.1	1	-83.3	300	6.0	-22.1	47.6	69.7	
324.00	-90.4	0.11	10.2	5.1	1	-75.0	300	6.0	-13.8	17.3	31.1	

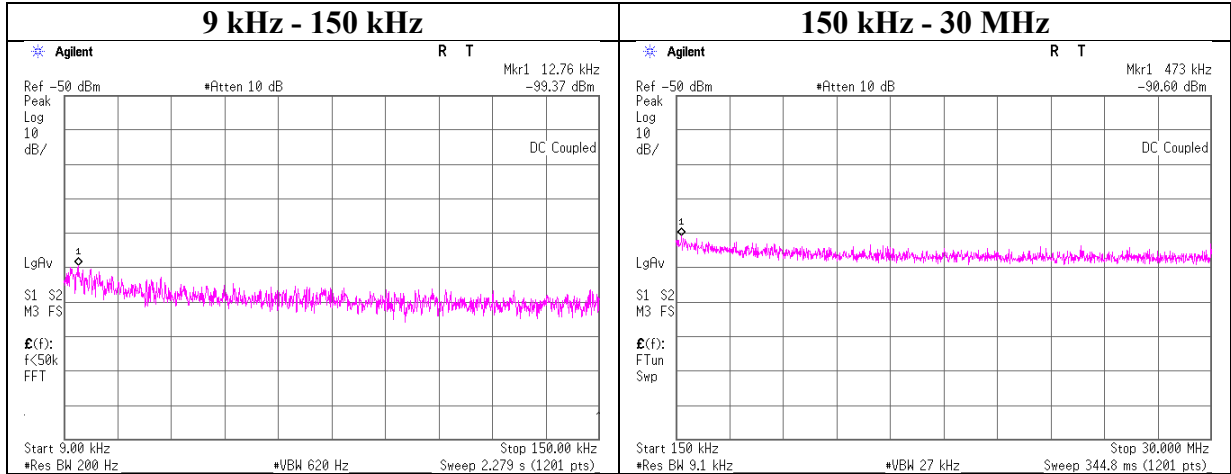
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11997604H
Date	November 6, 2017
Temperature / Humidity	25 deg. C / 28 % 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
12.76	-99.4	0.11	10.2	5.1	1	-84.0	300	6.0	-22.8	45.4	68.2	
473.00	-90.6	0.11	10.2	5.1	1	-75.3	300	6.0	-14.0	14.1	28.1	

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

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

N: Number of output

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Power Density

Test place Ise EMC Lab. No.11 Measurement Room
Report No. 11997604H
Date November 6, 2017
Temperature / Humidity 25 deg. C / 28 % RH
Engineer Yuta Moriya
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-25.44	1.07	10.05	-14.32	8.00	22.32
2440.00	-25.34	1.07	10.05	-14.22	8.00	22.22
2480.00	-25.31	1.08	10.05	-14.18	8.00	22.18

Sample Calculation:

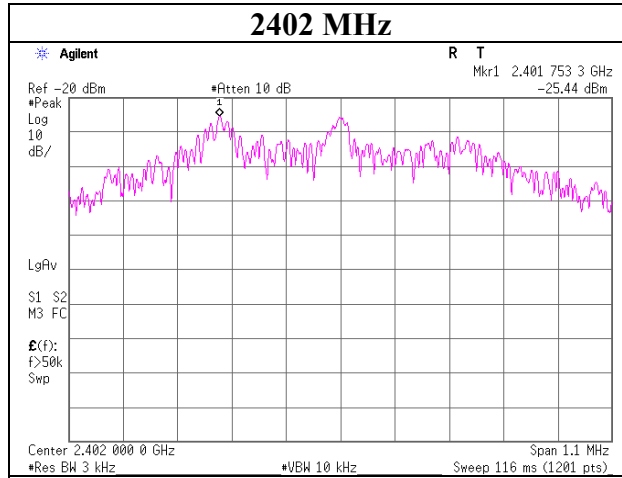
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

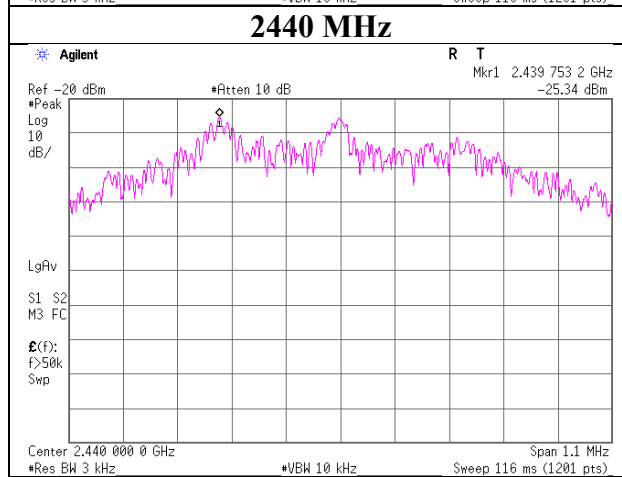
Power Density

BT LE

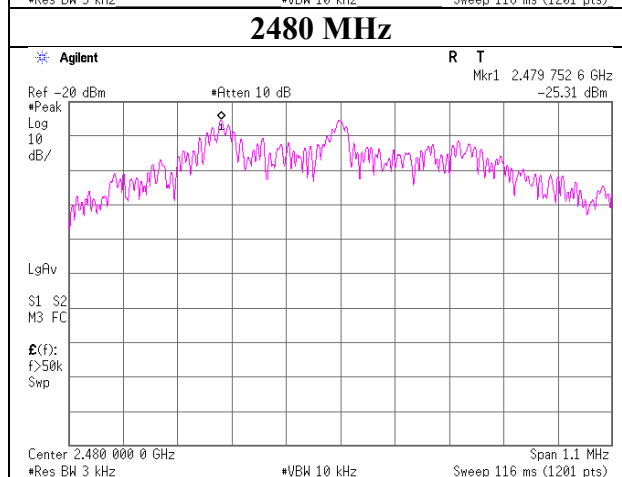
2402 MHz



2440 MHz



2480 MHz



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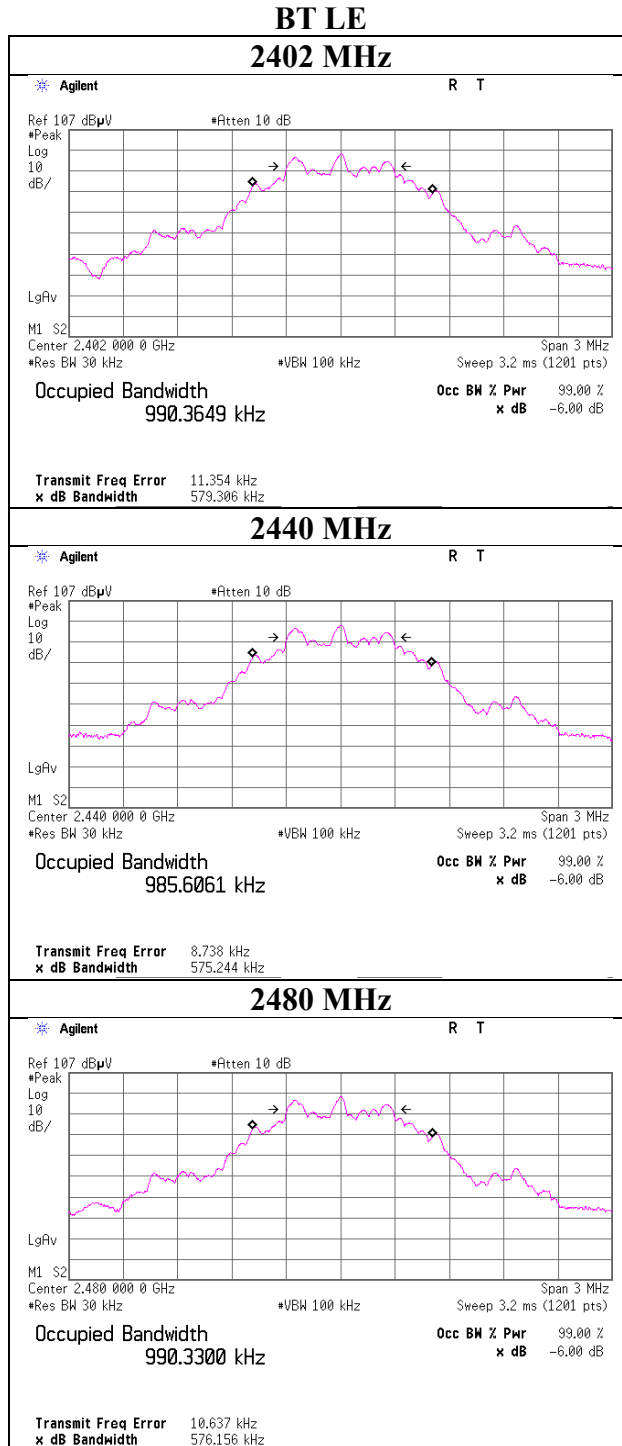
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99% Occupied Bandwidth

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11997604H
Date	November 6, 2017
Temperature / Humidity	25 deg. C / 28 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE



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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MSA-13	Spectrum Analyzer	Agilent	E4440A	MY46185823	AT	2017/06/21 * 12
MPM-16	Power Meter	Agilent	8990B	MY51000271	AT	2017/04/28 * 12
MPSE-22	Power sensor	Agilent	N1923A	MY54070003	AT	2017/04/28 * 12
MCC-144	Microwave Cable	Junkosha	MWX221	1207S407	AT	2017/08/02 * 12
MAT-57	Attenuator(10dB)	Suhner	6810.19.A	-	AT	2016/12/15 * 12
MAT-33	Attenuator(10dB)	JFW	50FP-010-H2	43608 46-202-1	AT	2017/03/17 * 12
MCC-64	Coaxial Cable	UL Japan	-	-	AT	2017/03/24 * 12
MOS-19	Thermo-Hygrometer	Custom	CTH-201	0001	AT	2016/12/13 * 12
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2017/10/31 * 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-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2017/08/22 * 12
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2017/05/22 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2017/09/22 * 12
MCC-167	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	RE	2017/05/29 * 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
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2017/08/31 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2016/12/13 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2016/11/10 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2017/08/21 * 12
MBA-08	Biconical Antenna	Schwarzbeck	VHA9103B	08031	RE	2017/09/13 * 12
MLA-21	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	RE	2017/01/05 * 12
MCC-12	Coaxial Cable	Fujikura/Agilent	-	-	RE	2017/02/24 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2016/11/28 * 12
MPA-09	Pre Amplifier	Agilent	8447D	2944A10845	RE	2017/09/27 * 12
MMM-01	Digital Tester	Fluke	FLUKE 26-3	78030611	RE	2017/08/07 * 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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