



RADIO TEST REPORT

Test Report No. : 12634949H-A-R2

Applicant : Fujitsu Component Limited
Type of Equipment : Bluetooth Low Energy Module
Model No. : FWM7BLZ20B
FCC ID : SQK-7BLZ20
Test regulation : FCC Part 15 Subpart C: 2018
For Permissive Change
Test Result : Complied (Refer to Section 3.2)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12634949H-A-R1. 12634949H-A-R1 is replaced with this report.

Date of test: December 5, 2018 to January 23, 2019

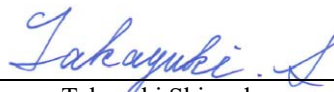
Representative test engineer:



Junki Nagatomi
Engineer

Consumer Technology Division

Approved by:



Takayuki Shimada
Leader

Consumer Technology Division



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.

*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

13-EM-F0429

Ise EMC Lab.

Telephone : +81 596 24 8999

CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	5
a) Refer to Appendix 1 (Data of Conducted Emission)	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Conducted Emission.....	10
SECTION 6: Radiated Spurious Emission	11
SECTION 7: Antenna Terminal Conducted Tests.....	13
APPENDIX 1: Test data	14
Conducted Emission	14
6 dB Bandwidth and 99 % Occupied Bandwidth.....	16
Maximum Peak Output Power	19
Average Output Power	20
Radiated Spurious Emission	22
Conducted Spurious Emission	28
Power Density	31
APPENDIX 2: Test instruments	33
APPENDIX 3: Photographs of test setup	34
Conducted Emission	34
Radiated Spurious Emission	35
Worst Case Position	36

SECTION 1: Customer information

Company Name	:	Fujitsu Component Limited
Address	:	1174, Oaza Suzaka, Suzaka-shi, Nagano, 382-0076, Japan
Telephone Number	:	+81-26 248-7993
Facsimile Number	:	+81-26-248-2840
Contact Person	:	Masafumi Chiba

The information provided from the customer is as follows;

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

* The laboratory is exempted from liability of any test results affected from the information in SECTION 2 and 4.

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

2.1 Identification of E.U.T.

Type of Equipment	:	Bluetooth Low Energy Module
Model No.	:	FWM7BLZ20B
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.0 V (DC 1.7 to 3.6 V)
Receipt Date of Sample (Information from test lab.)	:	December 3, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production 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: FWM7BLZ20B (referred to as the EUT in this report) is a Bluetooth Low Energy Module.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Antenna type	:	Mono-pole antenna
Antenna Gain	:	-0.4 dBi
Clock frequency (Maximum)	:	32 MHz
Operating temperature	:	-40 deg. C to +85 deg. C

<Contents of the change from original model>

Test Report Number of original model is 11451821H-A-R1 (issued by UL Japan, Inc.).

Specification was changed from the original model as follows:

RF bandwidth of 2 MHz was added.

The other radio specification is identical to the original.

Therefore, tests were only performed on 2M-PHY mode in this report.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz,
2400-2483.5 MHz, and 5725-5850 MHz

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

3.2 Procedures and results

Item	Test Procedure	Specification	Test Method	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	-	QP 6.5 dB, 0.19432 MHz, N AV 17.0 dB, 0.19432 MHz, N	Complied a)	-
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	Conducted	See data.	Complied b)	-
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)	Conducted		Complied c)	-
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)	Conducted		Complied d)	-
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	Conducted (below 30 MHz)/ Radiated (above 30 MHz)	2.1 dB 7320.00 MHz, AV, Hori.	Complied# e), f)	*1)

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.

a) Refer to Appendix 1 (Data of Conducted Emission)

b) Refer to Appendix 1 (Data of 6 dB Bandwidth and 99 % Occupied Bandwidth)

c) Refer to Appendix 1 (Data of Maximum Peak Output Power)

d) Refer to Appendix 1 (Data of Power Density)

e) Refer to Appendix 1 (Data of Radiated Spurious Emission)

f) Refer to Appendix 1 (Data of Conducted Spurious Emission)

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

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

FCC Part 15.31 (e)

This EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 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.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

3.3 Addition to standard

Item	Test Procedure	Specification	Test Method	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	Conducted	N/A	Complied a)	-
a) Refer to Appendix 1 (Data of 6 dB Bandwidth and 99 % Occupied Bandwidth)						
Symbols:						
Complied	The data of this test item has enough margin, more than the measurement uncertainty.					
Complied#	The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.					

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

3.4 Uncertainty

EMI

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

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

Use EMC Lab.

Antenna Terminal test

Test Item	Uncertainty (+/-)
6 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %
Maximum Peak Output Power / Average Output Power	1.3 dB
Burst Rate	0.10 %
Power Density	2.7 dB
Conducted Spurious Emission	2.7 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
		5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
		4.9 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
		5.0 dB
3 m	1 GHz to 6 GHz	5.0 dB
	6 GHz to 18 GHz	5.3 dB
1 m	10 GHz to 26.5 GHz	5.8 dB
	26.5 GHz to 40 GHz	5.8 dB
10 m	1 GHz to 18 GHz	5.2 dB

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

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

Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

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	3.1 x 5.0	-	-
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.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

4.1 Operating Mode(s)

Bluetooth (BT) Low Energy (LE):

Mode	Remarks*
Bluetooth (BT) Low Energy (LE) 2M-PHY	Maximum Packet Size, PRBS9
*Power of the EUT was set by the software as follows; Power settings: High power : 4 dBm Low Power : -20 dBm Software: BLZ20B_DTM_v2.0.0 *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 Maximum Peak Output Power Power Density 99% Occupied Bandwidth Spurious Emission(Radiated / Conducted)	Tx BLE 2M-PHY	2402 MHz 2440 MHz 2480 MHz

UL Japan, Inc.

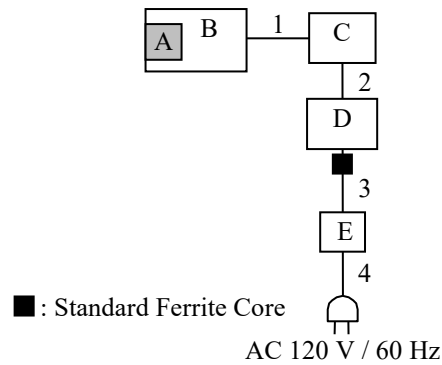
Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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	Bluetooth Low Energy Module	FWM7BLZ20B	1	Fujitsu Component Limited	EUT
B	Jig	-	-	Fujitsu Component Limited	-
C	Jig	-	-	Fujitsu Component Limited	-
D	Laptop PC	CF-N8HWCDPS	0BKSA07449	Panasonic	-
E	AC Adapter	CF-AA6372B	6372BM409X17298B	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.2	Unshielded	Unshielded	-
2	USB Cable	2.0	Shielded	Shielded	-
3	DC Cable	1.1	Unshielded	Unshielded	-
4	AC Cable	1.0 for CE* 0.9 for other tests	Unshielded	Unshielded	-

*CE: Conducted emission

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.

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.

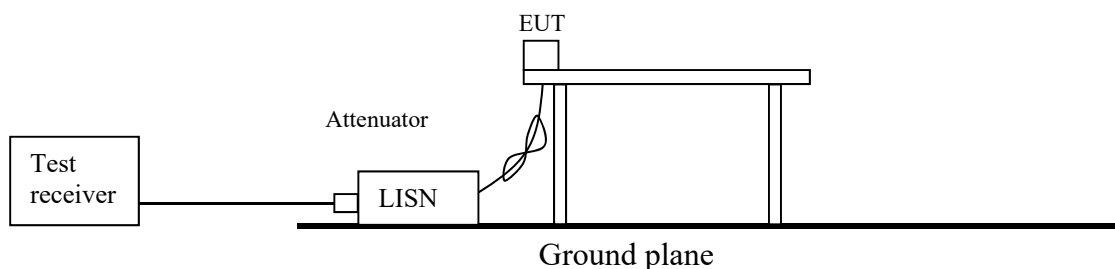
The EUT was connected to a LISN (AMN).

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, 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

UL Japan, Inc.

Ise EMC Lab.

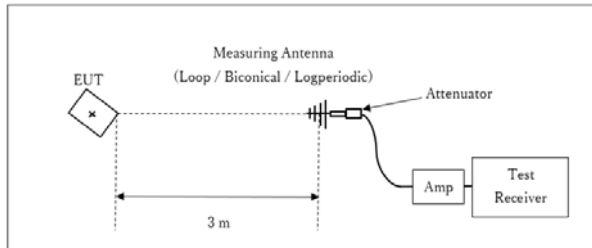
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Figure 2: Test Setup

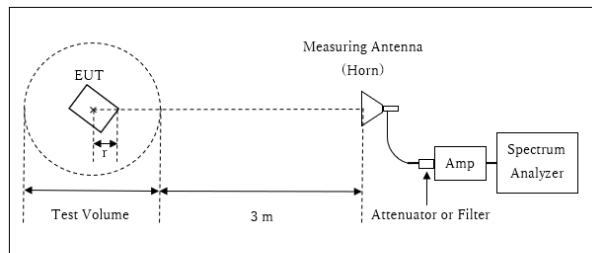
Below 1 GHz



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

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.75 \text{ m}$

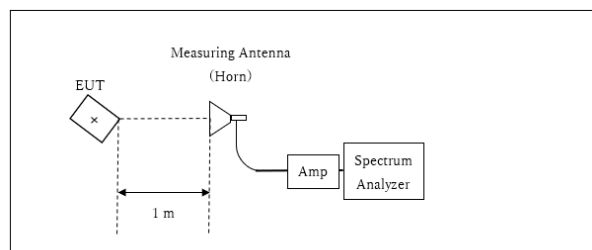
Test Volume : 1.5 m

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

$r = 0.0 \text{ m}$

* The test was performed with $r = 0.0 \text{ m}$ since EUT is small and it was the rather conservative condition.

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 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 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	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 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 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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

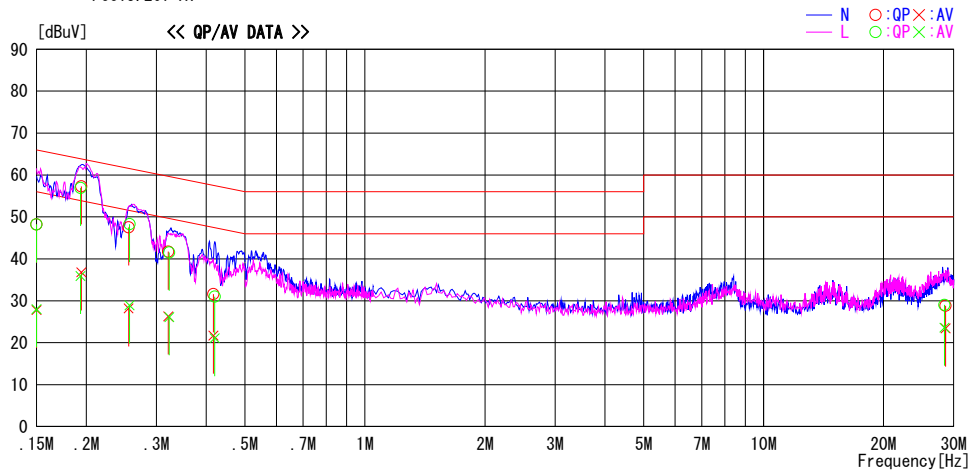
Facsimile : +81 596 24 8124

APPENDIX 1: Test data

Conducted Emission

Report No. 12634949H
Test place Ise EMC Lab. No.2 Semi Anechoic Chamber
Date December 9, 2018 (Night)
Temperature / Humidity 24 deg. C / 30 % RH
Engineer Junki Nagatomi
Mode Tx BT LE 2480 MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15000	34.9	14.5	13.3	48.2	27.8	66.0	56.0	17.8	28.2	N	
0.19432	44.1	23.6	13.2	57.3	36.8	63.8	53.8	6.5	17.0	N	
0.25541	34.3	15.0	13.2	47.5	28.2	61.6	51.6	14.1	23.4	N	
0.32124	28.4	13.0	13.3	41.7	26.3	59.7	49.7	18.0	23.4	N	
0.41662	18.3	8.4	13.3	31.6	21.7	57.5	47.5	25.9	25.8	N	
28.61620	13.7	8.3	15.1	28.8	23.4	60.0	50.0	31.2	26.6	N	
0.15000	34.9	14.7	13.3	48.2	28.0	66.0	56.0	17.8	28.0	L	
0.19350	43.7	22.7	13.2	56.9	35.9	63.9	53.9	7.0	18.0	L	
0.25692	35.1	15.7	13.2	48.3	28.9	61.5	51.5	13.2	22.6	L	
0.32304	28.2	12.8	13.3	41.5	26.1	59.6	49.6	18.1	23.5	L	
0.42004	17.7	7.8	13.3	31.0	21.1	57.4	47.4	26.4	26.3	L	
28.41840	13.9	8.5	15.1	29.0	23.6	60.0	50.0	31.0	26.4	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.

UL Japan, Inc.

Ise EMC Lab.

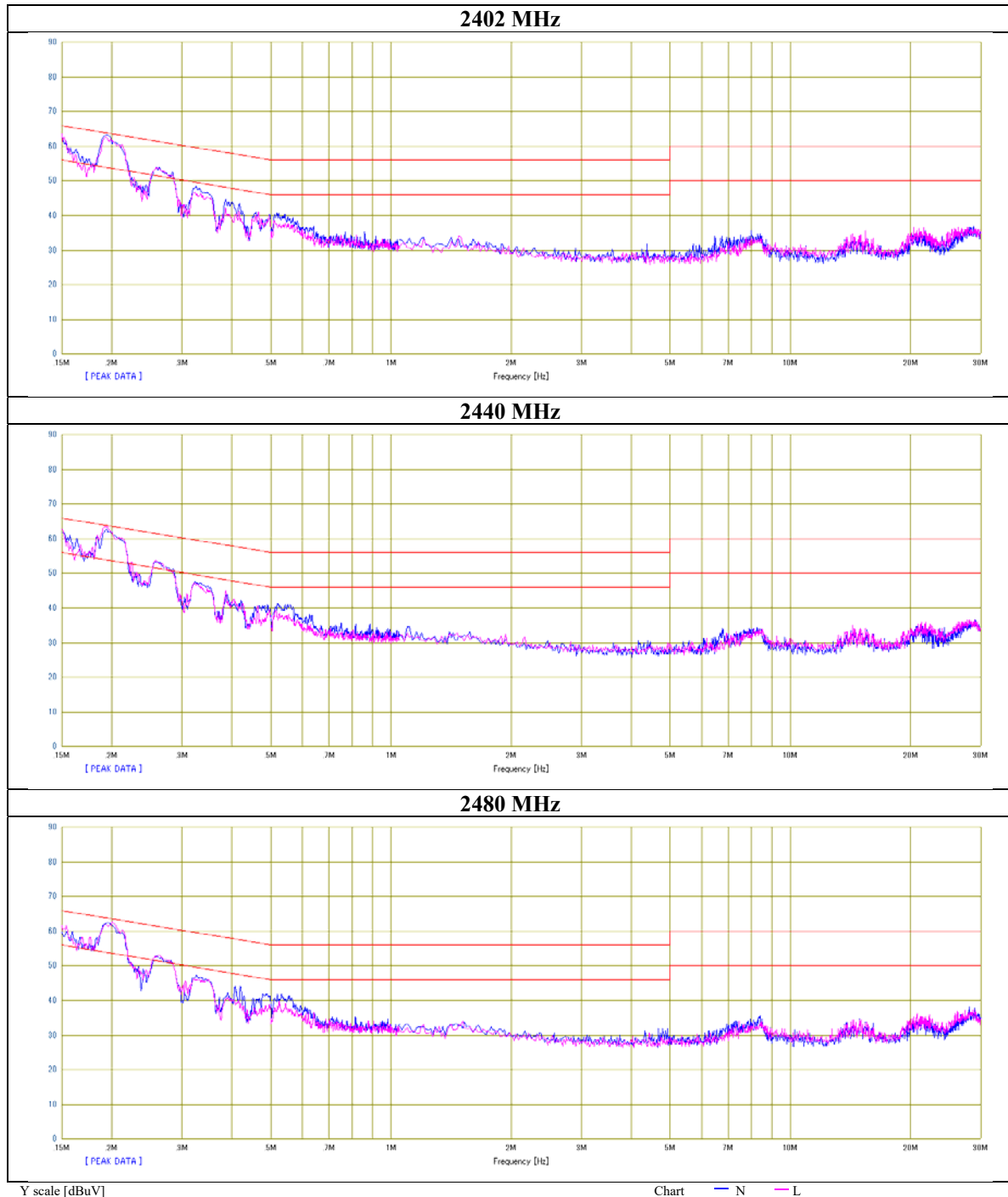
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Emission

Report No. 12634949H
Test place Ise EMC Lab. No.2 Semi Anechoic Chamber
Date December 9, 2018 (Night)
Temperature / Humidity 24 deg. C / 30 % RH
Engineer Junki Nagatomi
Mode Tx BT LE



UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

6 dB Bandwidth and 99 % Occupied Bandwidth

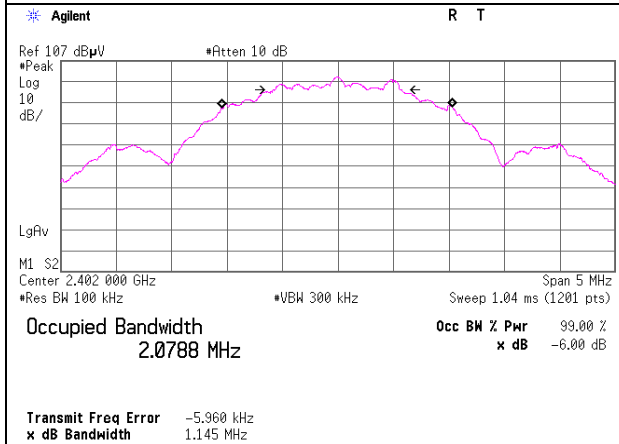
Report No. 12634949H
Test place Ise EMC Lab. No.8 Measurement Room
Date December 5, 2018
Temperature / Humidity 23 deg. C / 48 % RH
Engineer Junki Nagatomi
Mode Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BLE	2402	2064.600	1.145	> 0.5000
	2440	2073.900	1.175	> 0.5000
	2480	2077.300	1.175	> 0.5000

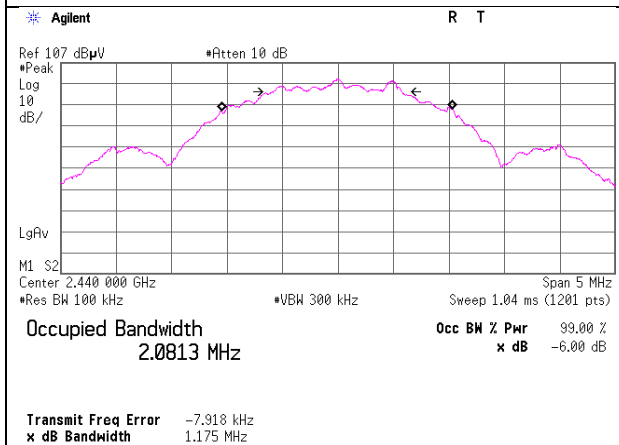
6dB Bandwidth

BT LE

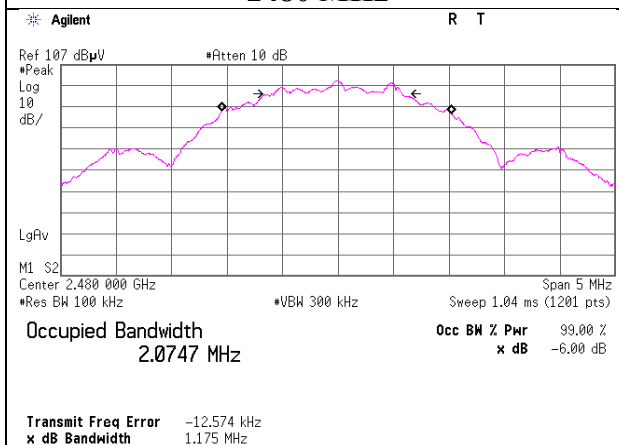
2402 MHz



2440 MHz



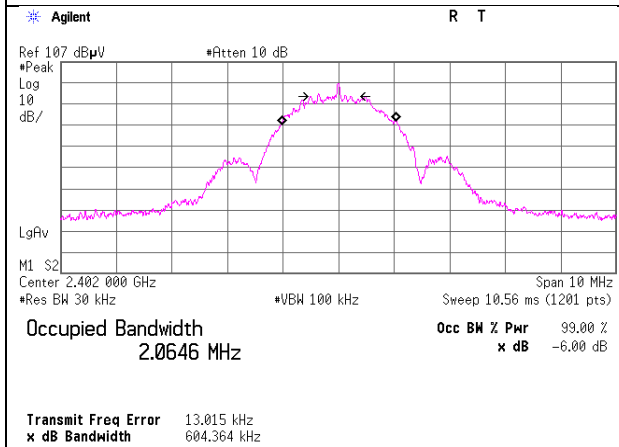
2480 MHz



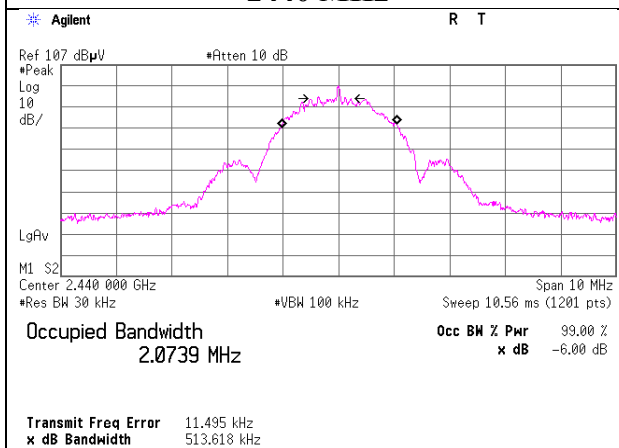
99%Occupied Bandwidth

BT LE

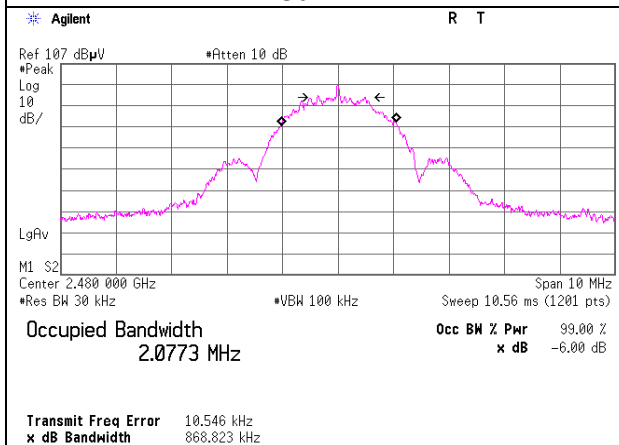
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No. 12634949H
Test place Ise EMC Lab. No.8 Measurement Room
Date December 5, 2018 January 23, 2019
Temperature / Humidity 23 deg. C / 48 % RH 25 deg. C / 40 % RH
Engineer Junki Nagatomi Tomoki Matsui
Mode Tx BT LE

Highest Power setting (4dBm)				Conducted Power					e.i.r.p. for RSS-247					
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-7.99	0.30	10.04	2.35	1.72	30.00	1000.00	27.65	-0.40	1.95	1.57	36.02	4000.00	34.07
2440	-7.86	0.30	10.04	2.48	1.77	30.00	1000.00	27.52	-0.40	2.08	1.61	36.02	4000.00	33.94
2480	-7.79	0.30	10.04	2.55	1.80	30.00	1000.00	27.45	-0.40	2.15	1.64	36.02	4000.00	33.87

Lowest Power setting (-20dBm)				Conducted Power					e.i.r.p. for RSS-247					
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-19.02	0.30	0.00	-18.72	0.013	30.00	1000.00	48.72	-0.40	-19.12	0.012	36.02	4000.00	55.14
2440	-18.74	0.30	0.00	-18.44	0.014	30.00	1000.00	48.44	-0.40	-18.84	0.013	36.02	4000.00	54.86
2480	-18.51	0.30	0.00	-18.21	0.015	30.00	1000.00	48.21	-0.40	-18.61	0.014	36.02	4000.00	54.63

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Average Output Power

(Reference data for RF Exposure / SAR testing)

Report No.	12634949H		
Test place	Ise EMC Lab. No.8 Measurement Room		
Date	December 5, 2018	January 23, 2019	
Temperature / Humidity	23 deg. C / 48 % RH	25 deg. C / 40 % RH	
Engineer	Junki Nagatomi	Tomoki Matsui	
Mode	Tx BT LE		

Highest Power setting (4dBm)

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	-10.51	0.30	10.04	-0.17	0.96	2.38	2.21	1.66
2440	-10.47	0.30	10.04	-0.13	0.97	2.38	2.25	1.68
2480	-10.34	0.30	10.04	0.00	1.00	2.38	2.38	1.73

Lowest Power setting (-20dBm)

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	-23.39	0.30	0.00	-23.09	0.005	2.38	-20.71	0.008
2440	-22.89	0.30	0.00	-22.59	0.006	2.38	-20.21	0.010
2480	-22.53	0.30	0.00	-22.23	0.006	2.38	-19.85	0.010

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.

UL Japan, Inc.

Ise EMC Lab.

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

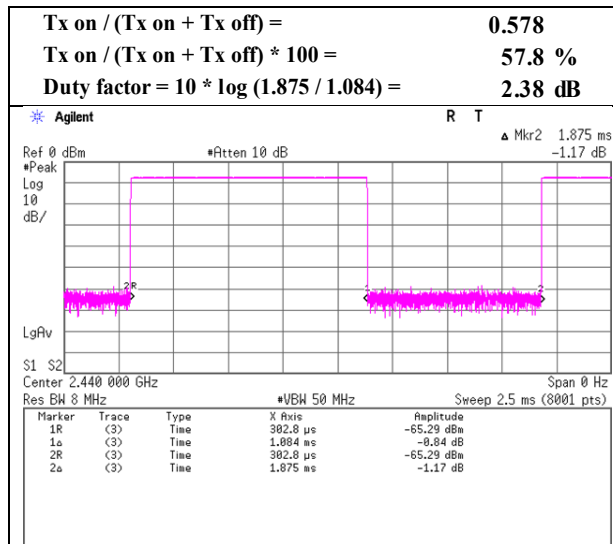
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Burst rate confirmation

Report No. 12634949H
Test place Ise EMC Lab. No.8 Measurement Room
Date December 5, 2018
Temperature / Humidity 23 deg. C / 48 % RH
Engineer Junki Nagatomi
Mode Tx BT LE

BLE



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

Radiated Spurious Emission

Report No. 12634949H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date December 8, 2018 No.2 December 9, 2018 No.3 December 13, 2018 (Night)
Temperature / Humidity 20 deg. C / 30 % RH 23 deg. C / 35 % RH 24 deg. C / 34 % RH
Engineer Takafumi Noguchi Takumi Shimada Junki Nagatomi
(1 GHz - 10 GHz) (10 GHz - 26.5 GHz) (Below 1 GHz)
Mode Tx BT LE 2402 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	120.018	QP	42.7	12.8	8.4	32.1	-	31.8	43.5	11.7	
Hori	129.240	QP	39.0	13.8	8.5	32.1	-	29.2	43.5	14.3	
Hori	168.008	QP	38.6	15.9	8.9	32.0	-	31.4	43.5	12.1	
Hori	247.410	QP	42.4	11.8	9.6	32.0	-	31.8	46.0	14.2	
Hori	300.072	QP	35.1	13.7	10.1	32.0	-	26.9	46.0	19.1	
Hori	432.012	QP	34.3	16.5	11.0	32.0	-	29.8	46.0	16.2	
Hori	2390.000	PK	46.6	27.7	5.1	34.4	-	45.0	73.9	28.9	
Hori	4804.000	PK	48.2	31.2	7.2	33.7	-	52.9	73.9	21.0	
Hori	7206.000	PK	47.2	35.5	8.6	33.6	-	57.7	73.9	16.2	
Hori	9608.000	PK	42.2	38.4	8.1	33.9	-	54.8	73.9	19.1	Floor noise
Hori	2390.000	AV	36.0	27.7	5.1	34.4	2.4	36.8	53.9	17.1	*1)
Hori	4804.000	AV	39.6	31.2	7.2	33.7	2.4	46.7	53.9	7.2	
Hori	7206.000	AV	38.8	35.5	8.6	33.6	2.4	51.7	53.9	2.2	
Hori	9608.000	AV	34.0	38.4	8.1	33.9	-	46.6	53.9	7.3	Floor noise
Vert	50.520	QP	49.0	11.0	7.5	32.1	-	35.4	40.0	4.6	
Vert	60.051	QP	35.3	7.9	7.6	32.1	-	18.7	40.0	21.3	
Vert	94.009	QP	43.6	9.2	8.1	32.1	-	28.8	43.5	14.7	
Vert	120.021	QP	47.5	12.8	8.4	32.1	-	36.6	43.5	6.9	
Vert	129.252	QP	44.7	13.8	8.5	32.1	-	34.9	43.5	8.6	
Vert	168.003	QP	40.6	15.9	8.9	32.0	-	33.4	43.5	10.1	
Vert	2390.000	PK	46.1	27.7	5.1	34.4	-	44.5	73.9	29.4	
Vert	4804.000	PK	48.3	31.2	7.2	33.7	-	53.0	73.9	20.9	
Vert	7206.000	PK	46.8	35.5	8.6	33.6	-	57.3	73.9	16.6	
Vert	9608.000	PK	42.1	38.4	8.1	33.9	-	54.7	73.9	19.2	Floor noise
Vert	2390.000	AV	36.4	27.7	5.1	34.4	2.4	37.2	53.9	16.7	*1)
Vert	4804.000	AV	39.6	31.2	7.2	33.7	2.4	46.7	53.9	7.2	
Vert	7206.000	AV	38.3	35.5	8.6	33.6	2.4	51.2	53.9	2.7	
Vert	9608.000	AV	34.2	38.4	8.1	33.9	-	46.8	53.9	7.1	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 $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$

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

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

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	96.2	27.7	5.1	34.4	94.6	-	-	Carrier
Hori	2400.000	PK	64.4	27.8	5.1	34.4	62.9	74.6	11.7	
Vert	2402.000	PK	97.4	27.7	5.1	34.4	95.8	-	-	Carrier
Vert	2400.000	PK	65.7	27.8	5.1	34.4	64.2	75.8	11.6	

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

Distance factor: 1 GHz - 10 GHz $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$

UL Japan, Inc.

Ise EMC Lab.

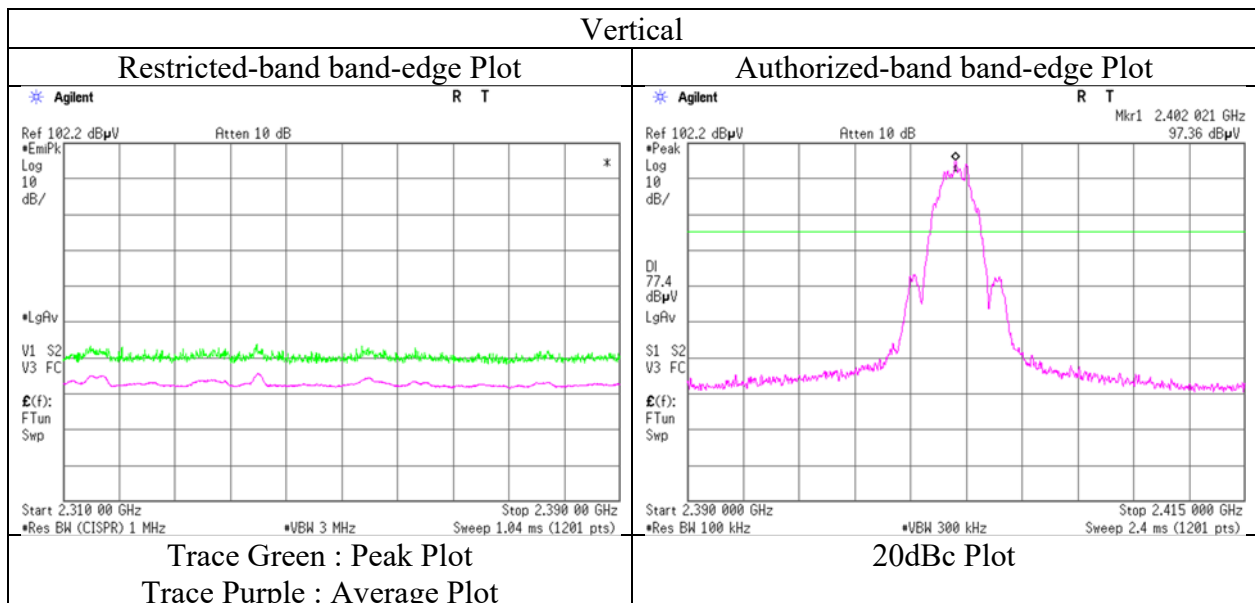
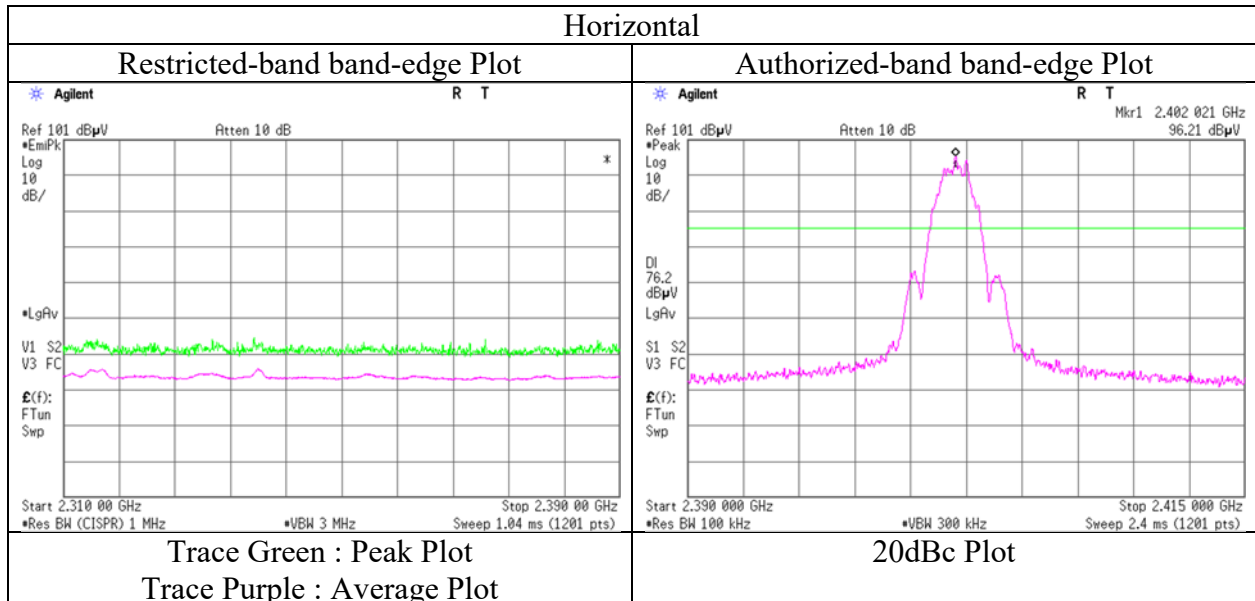
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12634949H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	December 8, 2018
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Takafumi Noguchi
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2402 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission

Report No.	12634949H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.3
Date	December 8, 2018	December 9, 2018	December 13, 2018 (Night)
Temperature / Humidity	20 deg. C / 30 % RH	23 deg. C / 35 % RH	24 deg. C / 34 % RH
Engineer	Takafumi Noguchi	Takumi Shimada	Junki Nagatomi
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx BT LE 2440 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	120.008	QP	41.3	12.8	8.4	32.1	-	30.4	43.5	13.1	
Hori	129.250	QP	37.8	13.8	8.5	32.1	-	28.0	43.5	15.5	
Hori	168.001	QP	36.9	15.9	8.9	32.0	-	29.7	43.5	13.8	
Hori	252.021	QP	40.0	12.0	9.7	32.0	-	29.7	46.0	16.3	
Hori	299.891	QP	35.2	13.7	10.1	32.0	-	27.0	46.0	19.0	
Hori	432.072	QP	33.3	16.5	11.0	32.0	-	28.8	46.0	17.2	
Hori	4880.000	PK	49.2	31.5	7.3	33.7	-	54.3	73.9	19.6	
Hori	7320.000	PK	46.8	35.9	8.5	33.6	-	57.6	73.9	16.3	
Hori	9760.000	PK	41.3	38.6	8.1	34.0	-	54.0	73.9	19.9	Floor noise
Hori	4880.000	AV	41.9	31.5	7.3	33.7	2.4	49.4	53.9	4.5	
Hori	7320.000	AV	38.6	35.9	8.5	33.6	2.4	51.8	53.9	2.1	
Hori	9760.000	AV	32.3	38.6	8.1	34.0	-	45.0	53.9	8.9	Floor noise
Vert	50.612	QP	48.2	11.0	7.5	32.1	-	34.6	40.0	5.4	
Vert	59.897	QP	37.2	7.9	7.6	32.1	-	20.6	40.0	19.4	
Vert	93.291	QP	43.4	9.1	8.1	32.1	-	28.5	43.5	15.0	
Vert	120.024	QP	46.8	12.8	8.4	32.1	-	35.9	43.5	7.6	
Vert	129.196	QP	44.2	13.8	8.5	32.1	-	34.4	43.5	9.1	
Vert	169.005	QP	38.7	15.9	8.9	32.0	-	31.5	43.5	12.0	
Vert	4880.000	PK	48.5	31.5	7.3	33.7	-	53.6	73.9	20.3	
Vert	7320.000	PK	45.3	35.9	8.5	33.6	-	56.1	73.9	17.8	
Vert	9760.000	PK	41.3	38.6	8.1	34.0	-	54.0	73.9	19.9	Floor noise
Vert	4880.000	AV	40.5	31.5	7.3	33.7	2.4	48.0	53.9	5.9	
Vert	7320.000	AV	37.0	35.9	8.5	33.6	2.4	50.2	53.9	3.7	
Vert	9760.000	AV	32.2	38.6	8.1	34.0	-	44.9	53.9	9.0	Floor noise

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

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

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

Radiated Spurious Emission

Report No.	12634949H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.3
Date	December 8, 2018	December 9, 2018	December 13, 2018 (Night)
Temperature / Humidity	20 deg. C / 30 % RH	23 deg. C / 35 % RH	24 deg. C / 34 % RH
Engineer	Takafumi Noguchi (1 GHz - 10 GHz)	Takumi Shimada (10 GHz - 26.5 GHz)	Junki Nagatomi (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	120.012	QP	42.6	12.8	8.4	32.1	-	31.7	43.5	11.8	
Hori	129.237	QP	39.2	13.8	8.5	32.1	-	29.4	43.5	14.1	
Hori	168.012	QP	38.4	15.9	8.9	32.0	-	31.2	43.5	12.3	
Hori	252.021	QP	42.3	12.0	9.7	32.0	-	32.0	46.0	14.0	
Hori	299.839	QP	34.9	13.7	10.1	32.0	-	26.7	46.0	19.3	
Hori	432.069	QP	33.6	16.5	11.0	32.0	-	29.1	46.0	16.9	
Hori	2483.500	PK	53.4	27.5	5.1	34.4	-	51.6	73.9	22.3	
Hori	4960.000	PK	49.3	31.7	7.3	33.7	-	54.6	73.9	19.3	
Hori	7440.000	PK	44.1	36.1	8.6	33.6	-	55.2	73.9	18.7	
Hori	9920.000	PK	41.4	38.5	8.2	34.0	-	54.1	73.9	19.8	Floor noise
Hori	2483.500	AV	40.8	27.5	5.1	34.4	2.4	41.4	53.9	12.5	*1)
Hori	4960.000	AV	41.0	31.7	7.3	33.7	2.4	48.7	53.9	5.2	
Hori	7440.000	AV	34.4	36.1	8.6	33.6	2.4	47.9	53.9	6.0	
Hori	9920.000	AV	33.0	38.5	8.2	34.0	-	45.7	53.9	8.2	Floor noise
Vert	50.240	QP	48.4	11.2	7.5	32.1	-	35.0	40.0	5.0	
Vert	59.998	QP	36.8	7.9	7.6	32.1	-	20.2	40.0	19.8	
Vert	93.511	QP	42.2	9.1	8.1	32.1	-	27.3	43.5	16.2	
Vert	120.012	QP	47.1	12.8	8.4	32.1	-	36.2	43.5	7.3	
Vert	129.243	QP	44.5	13.8	8.5	32.1	-	34.7	43.5	8.8	
Vert	168.012	QP	40.7	15.9	8.9	32.0	-	33.5	43.5	10.0	
Vert	2483.500	PK	54.0	27.5	5.1	34.4	-	52.2	73.9	21.7	
Vert	4960.000	PK	47.2	31.7	7.3	33.7	-	52.5	73.9	21.4	
Vert	7440.000	PK	42.5	36.1	8.6	33.6	-	53.6	73.9	20.3	
Vert	9920.000	PK	41.5	38.5	8.2	34.0	-	54.2	73.9	19.7	Floor noise
Vert	2483.500	AV	41.3	27.5	5.1	34.4	2.4	41.9	53.9	12.0	*1)
Vert	4960.000	AV	39.2	31.7	7.3	33.7	2.4	46.9	53.9	7.0	
Vert	7440.000	AV	33.7	36.1	8.6	33.6	2.4	47.2	53.9	6.7	
Vert	9920.000	AV	33.1	38.5	8.2	34.0	-	45.8	53.9	8.1	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).

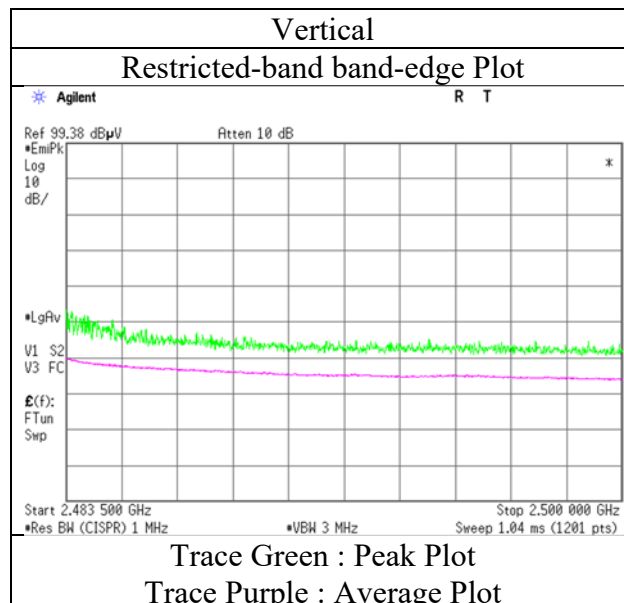
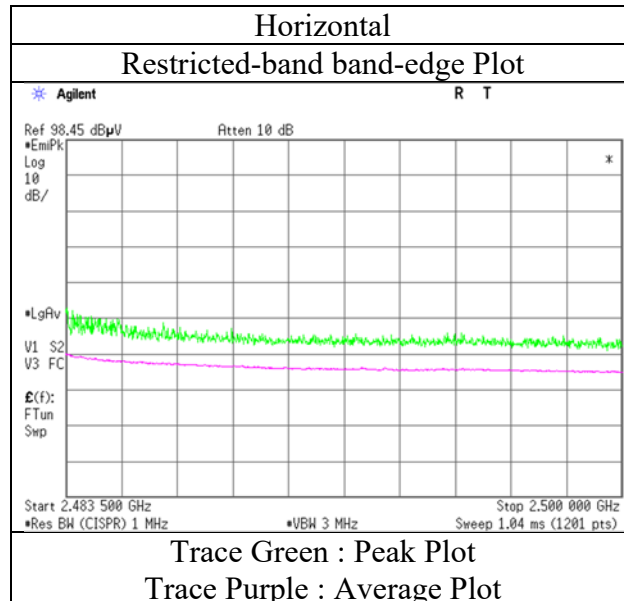
Distance factor: 1 GHz - 10 GHz $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$

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

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12634949H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	December 8, 2018
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Takafumi Noguchi
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2480 MHz



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

UL Japan, Inc.

Ise EMC Lab.

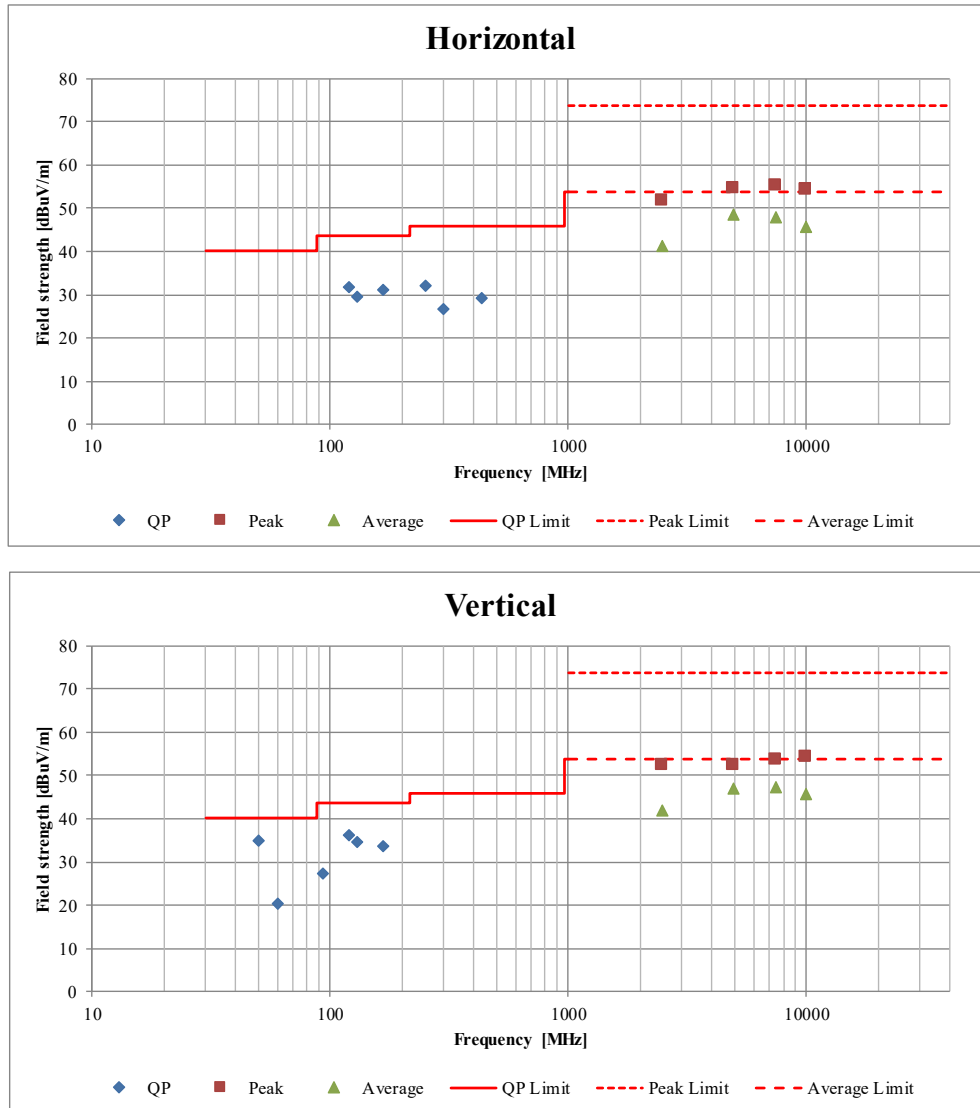
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	12634949H	No.2	No.3
Test place	Ise EMC Lab.	December 9, 2018	December 13, 2018 (Night)
Semi Anechoic Chamber	No.2	December 9, 2018	December 13, 2018 (Night)
Date	December 8, 2018	December 9, 2018	December 13, 2018 (Night)
Temperature / Humidity	20 deg. C / 30 % RH	23 deg. C / 35 % RH	24 deg. C / 34 % RH
Engineer	Takafumi Noguchi	Takumi Shimada	Junki Nagatomi
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx BT LE 2480 MHz		



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

UL Japan, Inc.

Ise EMC Lab.

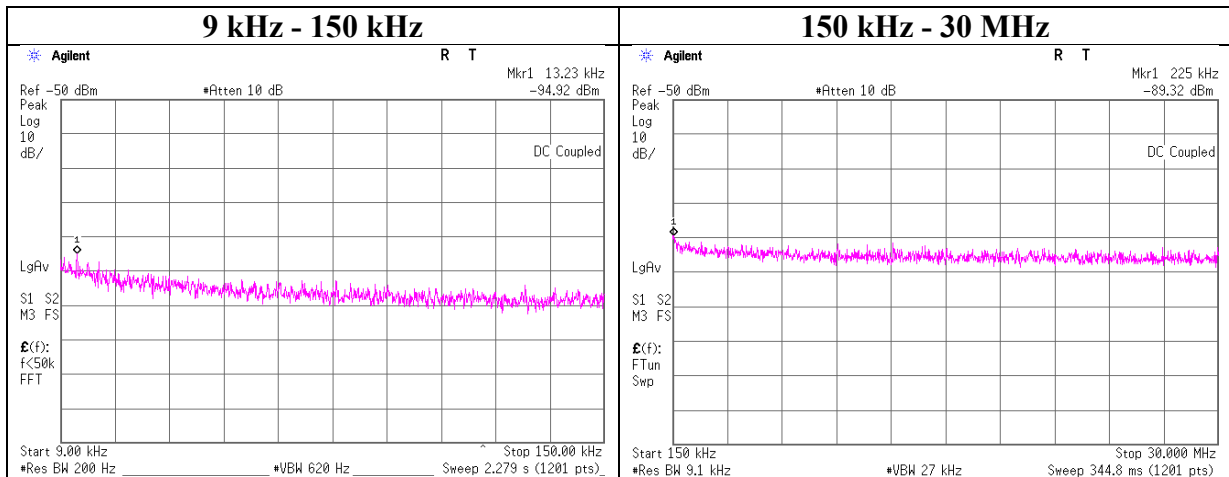
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12634949H
Test place Ise EMC Lab. No.8 Measurement Room
Date December 5, 2018
Temperature / Humidity 23 deg. C / 48 % RH
Engineer Junki Nagatomi
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
13.23	-94.9	0.30	9.7	2.0	1	-82.9	300	6.0	-21.7	45.1	66.8	
225.00	-89.3	0.30	9.7	2.0	1	-77.3	300	6.0	-16.1	20.5	36.6	

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

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

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.

UL Japan, Inc.

Ise EMC Lab.

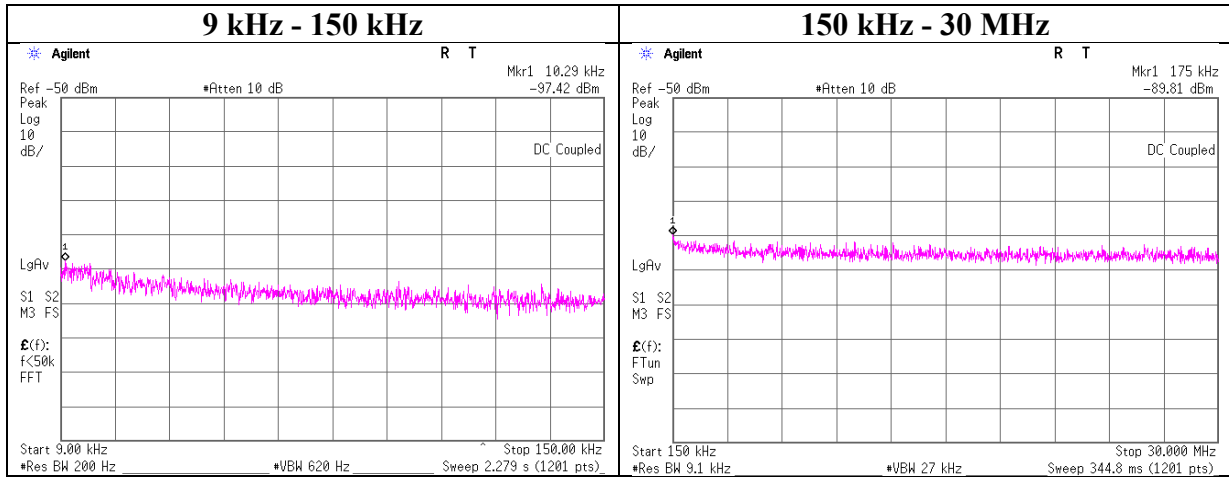
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12634949H
Test place Ise EMC Lab. No.8 Measurement Room
Date December 5, 2018
Temperature / Humidity 23 deg. C / 48 % RH
Engineer Junki Nagatomi
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
10.29	-97.4	0.30	9.7	2.0	1	-85.4	300	6.0	-24.2	47.3	71.5	
175.00	-89.8	0.30	9.7	2.0	1	-77.8	300	6.0	-16.6	22.7	39.3	

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

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

N: Number of output

*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.

Ise EMC Lab.

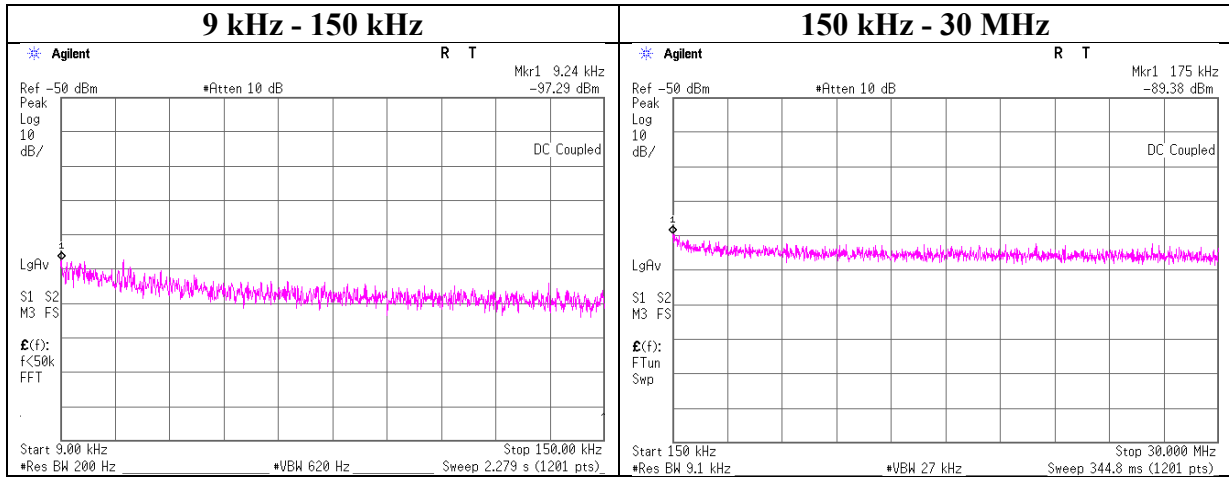
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	12634949H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 5, 2018
Temperature / Humidity	23 deg. C / 48 % RH
Engineer	Junki Nagatomi
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
9.24	-97.3	0.30	9.7	2.0	1	-85.3	300	6.0	-24.0	48.2	72.2	
175.00	-89.4	0.30	9.7	2.0	1	-77.4	300	6.0	-16.1	22.7	38.8	

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

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

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.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Power Density

Report No. 12634949H
Test place Ise EMC Lab. No.8 Measurement Room
Date December 5, 2018
Temperature / Humidity 23 deg. C / 48 % RH
Engineer Junki Nagatomi
Mode Tx BT LE

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402.00	-25.25	0.30	10.04	-14.91	8.00	22.91
2440.00	-25.16	0.30	10.04	-14.82	8.00	22.82
2480.00	-25.28	0.30	10.04	-14.94	8.00	22.94

Sample Calculation:

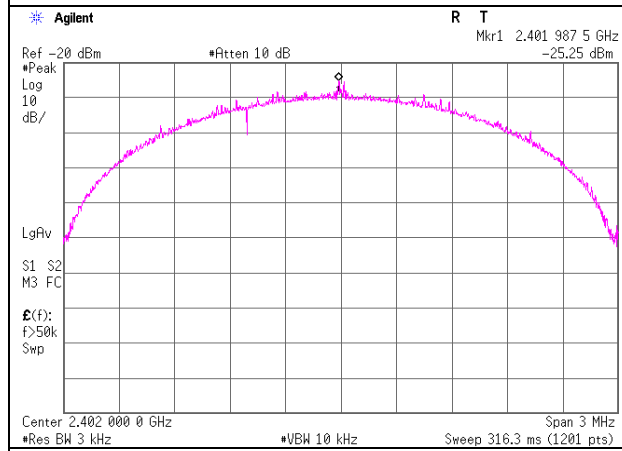
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

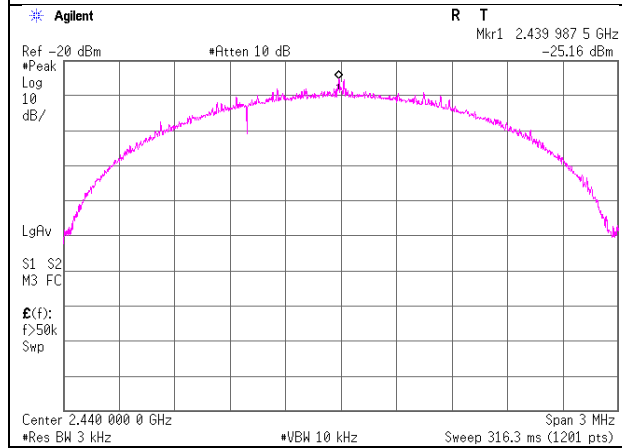
Power Density

BLE

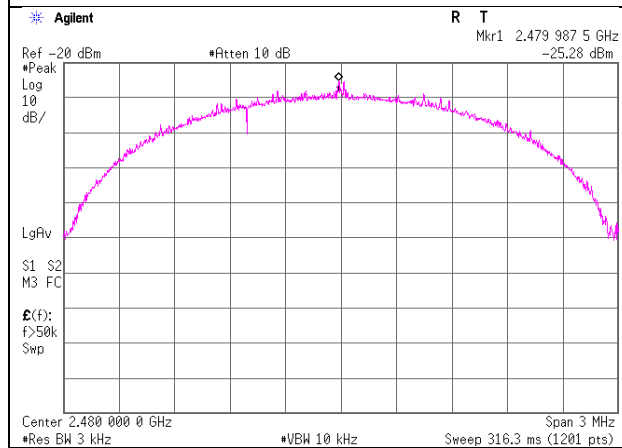
2402 MHz



2440 MHz



2480 MHz



UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
AT	141806	Power Meter	ANRITSU	ML2495A	6K00003348	10/31/2018	10/31/2019	12
AT	141841	Power sensor	ANRITSU	MA2411B	11598	10/31/2018	10/31/2019	12
AT	141567	Thermo-Hygrometer	CUSTOM	CTH-201	0008	01/24/2018	01/31/2019	12
AT	141244	Attenuator(10dB)	WEINSCHTEL	WA8-10-34	A198	02/28/2018	02/28/2019	12
AT	141269	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	03/12/2018	03/31/2019	12
AT,RE	141902	Spectrum Analyzer	AGILENT	E4440A	MY46187105	10/04/2018	10/31/2019	12
RE	141579	Pre Amplifier	AGILENT	8449B	3008A02142	01/23/2018	01/31/2019	12
RE	141392	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	08/08/2018	08/31/2019	12
RE,CE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/05/2018	12/31/2019	12
RE	141404	High Pass Filter 3.5-24GHz	TOKIMEC	TF323DCA	601	05/14/2018	05/31/2019	12
RE	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/01/2018	04/30/2019	12
RE,CE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/21/2018	08/31/2019	12
RE,CE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	06/06/2018	06/30/2019	12
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/19/2018	09/30/2019	12
RE,CE	142228	Measure	KOMELON	KMC-36	-	-	-	-
RE	141503	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	06/06/2018	06/30/2019	12
CE	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/06/2018	12/31/2019	12
CE	141222	Coaxial Cable	FUJIKURA	3D-2W(12m)/5D-2W(5m)/ 5D-2W(0.8m)/5D-2W(1m)	-	02/23/2018	02/28/2019	12
CE	141357	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	07/24/2018	07/31/2019	12
RE,CE	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/08/2018	08/31/2019	12
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/26/2018	06/30/2020	24
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/18/2017	12/31/2018	12
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/24/2018	01/31/2019	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/09/2018	01/31/2019	12
RE	141424	Biconical Antenna	Schwarzbeck	BBA9106	1915	06/04/2018	06/30/2019	12
RE	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	06/04/2018	06/30/2019	12
RE	141323	Coaxial cable	UL Japan	-	-	07/03/2018	07/31/2019	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/27/2018	02/28/2019	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/06/2018	08/31/2019	12

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

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test item: CE: Conducted Emission test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124