RADIO TEST REPORT

Test Report No. : 12729321M-A-R1

Applicant	:	**MIWA LOCK CO., LTD.**
Type of Equipment	:	**BLE board**
Model No.	:	**V2HT**
FCC ID	:	**VBU-V2HT**
Test regulation	:	**FCC Part 15 Subpart C: 2019**
Test Result	:	**Complied (Refer to SECTION 3.2)**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by any agency of the Federal Government.
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. The all test items in this test report are conducted by UL Japan, Inc. Kashima EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 12729321M-A. 12729321M-A is replaced with this report.

Date of test: February 19 - March 12, 2019

Representative test operator:

Kazuhiro Ando
Engineer
Consumer Technology Division

Approved by :

Tomoyuki Yamashita
Leader
Consumer Technology Division

JAB Testing RTL02610

☐ 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.
Kashima EMC Lab.
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan
Telephone : +81 478 88 6500
Facsimile : +81 478 82 3373

REVISION HISTORY

Original Test Report No.: 12729321M-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12729321M-A	April 3, 2019	-	-
1	12729321M-A-R1	June 17, 2019	P.1, 5	Updated FCC version
1	12729321M-A-R1	June 17, 2019	P.10	Addition of explanatory note for tilt
1	12729321M-A-R1	June 17, 2019	P.11	Correction of test volume (1 GHz - 10 GHz) from 3.0 m to 2.0 m
1	12729321M-A-R1	June 17, 2019	P.19, 30	Correction of calculating formula
1	12729321M-A-R1	June 17, 2019	P.21-26	Correction of test place from No.6 to No.10
1	12729321M-A-R1	June 17, 2019	P.31	Correction of test equipment's last calibration date and calibration due date (LIMS ID:143456)

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	MIWA LOCK CO., LTD.
Address	:	3-1-12 Shiba, Minato-ku, Tokyo, 105-8510 JAPAN
Telephone Number	:	+81-3-4330-3069
Facsimile Number	:	+81-3-3455-2437
Contact Person	:	Keiji Iwata

The information provided from the customer is as follows;
- Applicant, Type of Equipment, Model No., FCC ID 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 above information in SECTION 2 and 4.

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

2.1 Identification of E.U.T.

Type of Equipment	:	BLE board
Model No.	:	V2HT
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.15 - 3.6 V
Receipt Date of Sample (Information from test lab.)	:	February 22, 2019
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: V2HT (referred to as the EUT in this report) is a BLE board.

Radio Specification

[Bluetooth Low Energy]

Equipment Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Type of Modulation	:	GFSK
Antenna Type	:	PCB Antenna
Antenna Gain	:	2.25 dBi
Clock frequency (Maximum)	:	64 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on June 4, 2019 and effective July 5, 2019 except 15.258
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

* The revision on June 4, 2019, 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** 37.6 dB, 0.47206 MHz, L (BT LE 2402 MHz) **AV** 30.5 dB, 0.40958 MHz, N (BT LE 2480 MHz)	Complied a)	-
	IC: RSS-Gen 8.8	**IC:** RSS-Gen 8.8			
6dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(a)(2)	See data.	Complied b)	Conducted
	IC: -	**IC:** RSS-247 5.2(a)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(b)(3)		Complied c)	Conducted
	IC: RSS-Gen 6.12	**IC:** RSS-247 5.4(d)			
Power Density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(e)		Complied d)	Conducted
	IC: -	**IC:** RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	4.3 dB 7206.00 MHz, AV, Hori. (BT LE 2402 MHz)	Complied# e), f)	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 v05r02 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 Conducted Spurious Emission)
f) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

Symbols:
Complied The data of this test item has enough margin, more than the measurement uncertainty.
Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

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

FCC Part 15.31 (e)
This EUT provides the 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 15.203/212.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	RSS-Gen 6.7	**IC:** -	N/A	- a)	Conducted
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422. 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 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.

Conducted emission

Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
0.15 MHz to 30 MHz	3.4 dB	3.2dB

Radiated emission

Measurement distance	Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	Not Defined	3.0 dB
	30 MHz to 200 MHz	6.3 dB	5.2 dB
	200 MHz to 1000 MHz		6.2 dB
	1 GHz to 6 GHz	5.2 dB	4.7 dB
	6 GHz to 18 GHz	5.5 dB	5.1 dB
	18 GHz to 40 GHz	Not Defined	5.4 dB
1 m	1 GHz to 18 GHz	Not Defined	5.2 dB
	18 GHz to 40 GHz		5.5 dB

Antenna Terminal test

Test Item	Required Uncertainty (+/-)	Uncertainty (+/-)
6 dB Bandwidth / 99 % Occupied Bandwidth	Not Defined	1.6 %
Maximum Peak Output Power	0.75 dB	0.74 dB
Average Output Power		0.74 dB
Burst Rate	Not Defined	0.012 %
Power Density	4 dB	2.2 dB
Conducted Spurious Emission (9 kHz to 30 MHz)	4 dB	2.2 dB

3.5 Test Location

UL Japan, Inc. Kashima EMC Lab.
1614 Mushihata, Katori-shi, Chiba-ken, 289-0341 JAPAN
Telephone: +81 478 88 6500, Facsimile: +81 478 82 3373
JAB Accreditation No.:RTL02610 / FCC Test Firm Registration Number: 910230

Test site	ISED Assigned Code	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Open site	4659A-1	6.0 x 5.5 x 2.5	20 x 40	10 m
No.5 Open site	4659A-5	8.6 x 7.1 x 2.4	18 x 23	10 m
No.1 Shielded room	4659A-1	5.4 x 4.5 x 2.3	-	-
No.3 Shielded room	-	5.4 x 3.6 x 2.3	-	-
No.4 Shielded Room	-	6.1 x 6.1 x 3.1	-	-
No.5 Shielded Room	4659A-5	4.2 x 3.1 x 2.5	-	-
No.3 Fully Anechoic Chamber	-	7.0 x 3.5 x 3.5	-	-
No.6 Semi-anechoic Chamber	4659A-6	8.5 x 5.5 x 5.2	-	3 m
No.10 Semi-anechoic Chamber	4659A-10	18.4 x 9.9 x 7.7	-	10 m
No.11 Semi-anechoic Chamber	4659A-7	9.0 x 6.5 x 5.2	-	3 m
No.1 Measurement room	-	5.0 x 3.7 x 2.6	-	-
No.2 Measurement room	-	4.3 x 4.4 x 2.7	-	-
No.3 Measurement room	-	4.5 x 5.3 x 2.7	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

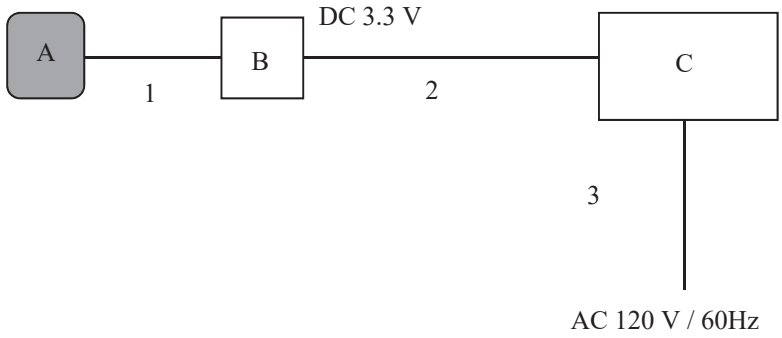
Mode	Frequency	Remarks*
Bluetooth Low Energy (BT LE)	2402 MHz, 2440 MHz, 2480 MHz	PRBS9

*Power of the EUT was set by the software as follows;
- Power Setting: Fixed
- Software: DTM Tool for BTS04 (DLE) ver.:0.0.8.1

*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.

Test Item	Operating Mode	Tested frequency
Spurious Emission 6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	Tx BT LE	2402 MHz 2440 MHz 2480 MHz

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	BLE board	V2HT	F02 *1) HT4 *2)	MIWA LOCK CO.,LTD.	EUT
B	Control board	-	-	MIWA LOCK CO.,LTD.	-
C	DC Power Supply	GSV3000	60646742	DIAMOND ANTENNA	-

*1) Used for Antenna Terminal conducted test
*2) Used for Conducted Emission test and Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.16	Unshielded	Unshielded	-
2	DC Cable	0.6 + 1.2	Unshielded	Unshielded	
3	AC Cable	1.7	Unshielded	Unshielded	

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a wooden table of nominal size, 1.0 m by 2.0 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.

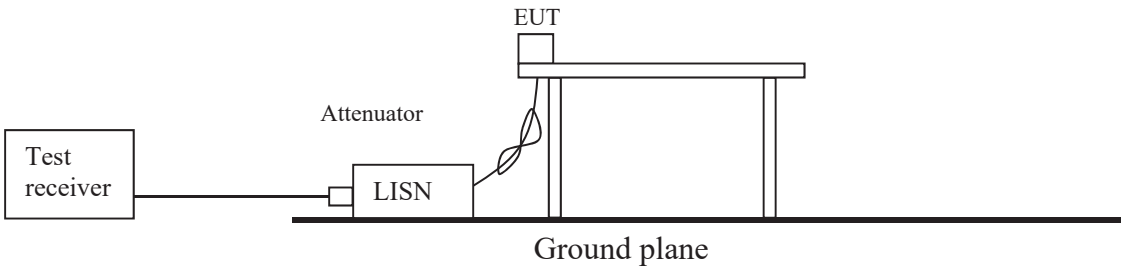
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected 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 v05r02".

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 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 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.
Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.
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	Below 1 GHz	Above 1 GHz
Antenna Type	Hybrid	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.

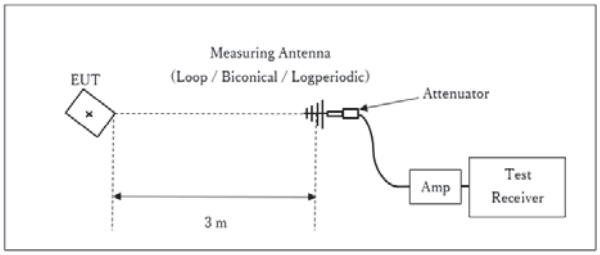
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

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

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

Figure 2: Test Setup

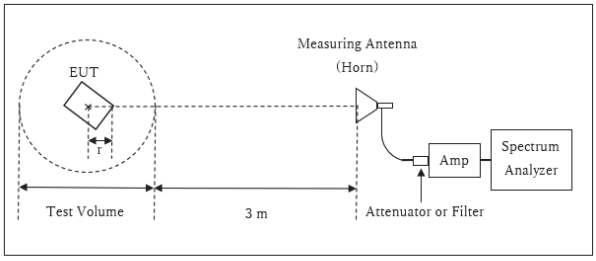
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

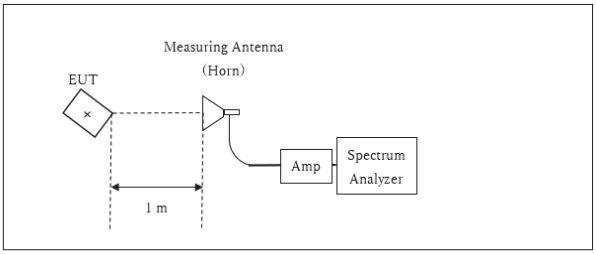


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.98 m / 3.0 m) = 2.5 dB
* Test Distance: (3 + Test Volume /2) - r = 3.98 m

Test Volume : 2.0 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.02 m

10 GHz - 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 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	10 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: 160 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 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	10 kHz	30 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 = 10 kHz)

The test results and limit are rounded off to two decimals place, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

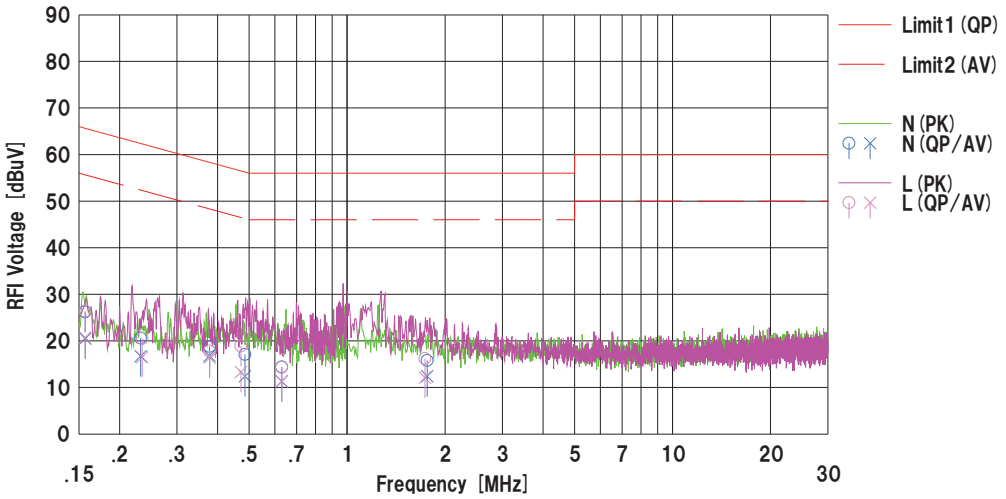
UL Japan, Inc. Kashima EMC Lab. No.1 Shielded Room
Date : 2019/03/12

Mode : Tx BLE 2402MHz
Order No. : 12729321M
Power : DC 3.3V
Temp./Humi. : 21deg.C. / 41%RH

Remarks : -

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Tested by : Kazuhiro Ando



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15679	16.0	10.3	10.2	26.2	20.5	65.6	55.6	39.4	35.1	N	
2	0.23207	10.4	6.5	10.2	20.6	16.7	62.4	52.4	41.8	35.7	N	
3	0.37785	8.6	6.6	10.2	18.8	16.8	58.3	48.3	39.5	31.5	N	
4	0.48551	6.8	2.1	10.3	17.1	12.4	56.2	46.2	39.1	33.8	N	
5	0.62982	4.1	1.0	10.3	14.4	11.3	56.0	46.0	41.6	34.7	N	
6	1.76351	5.4	2.0	10.4	15.8	12.4	56.0	46.0	40.2	33.6	N	
7	0.15670	16.2	10.5	10.2	26.4	20.7	65.6	55.6	39.2	34.9	L	
8	0.23472	10.3	6.3	10.2	20.5	16.5	62.3	52.3	41.8	35.8	L	
9	0.37811	7.6	6.2	10.2	17.8	16.4	58.3	48.3	40.5	31.9	L	
10	0.47206	8.6	3.0	10.3	18.9	13.3	56.5	46.5	37.6	33.2	L	
11	0.62979	4.0	1.0	10.3	14.3	11.3	56.0	46.0	41.7	34.7	L	
12	1.73457	5.8	1.7	10.4	16.2	12.1	56.0	46.0	39.8	33.9	L	

Calculation:Result [dBuV] =Reading [dBuV] +C.Fac (LISN+Cable) [dB]
LISN:CLS-03

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

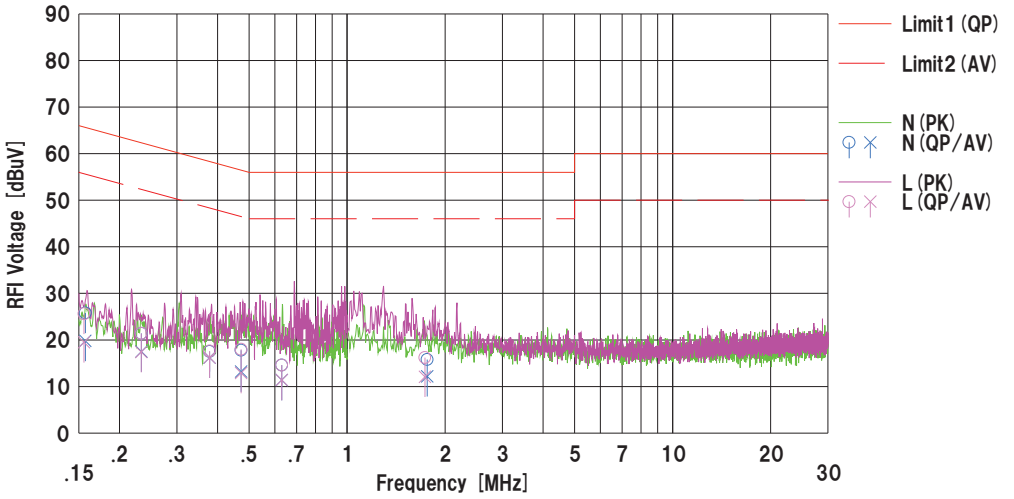
UL Japan, Inc. Kashima EMC Lab. No.1 Shielded Room
Date : 2019/03/12

Mode : Tx BLE 2440MHz
Order No. : 12729321M
Power : DC 3.3V
Temp./Humi. : 21deg.C. / 41%RH

Remarks : -

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Tested by : Kazuhiro Ando



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15706	15.6	9.6	10.2	25.8	19.8	65.6	55.6	39.8	35.8	N	
2	0.23351	11.2	7.3	10.2	21.4	17.5	62.3	52.3	40.9	34.8	N	
3	0.37799	7.3	6.0	10.2	17.5	16.2	58.3	48.3	40.8	32.1	N	
4	0.47274	7.5	2.9	10.3	17.8	13.2	56.5	46.5	38.7	33.3	N	
5	0.63002	4.3	1.1	10.3	14.6	11.4	56.0	46.0	41.4	34.6	N	
6	1.76242	5.4	1.8	10.4	15.8	12.2	56.0	46.0	40.2	33.8	N	
7	0.15556	15.4	9.3	10.2	25.6	19.5	65.7	55.7	40.1	36.2	L	
8	0.23332	11.2	7.2	10.2	21.4	17.4	62.3	52.3	40.9	34.9	L	
9	0.37811	7.4	6.0	10.2	17.6	16.2	58.3	48.3	40.7	32.1	L	
10	0.47266	7.7	2.6	10.3	18.0	12.9	56.5	46.5	38.5	33.6	L	
11	0.63005	4.3	1.1	10.3	14.6	11.4	56.0	46.0	41.4	34.6	L	
12	1.73457	5.8	1.7	10.4	16.2	12.1	56.0	46.0	39.8	33.9	L	

Calculation:Result [dBuV] =Reading [dBuV] +C.Fac (LISN+Cable) [dB]
LISN:CLS-03

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

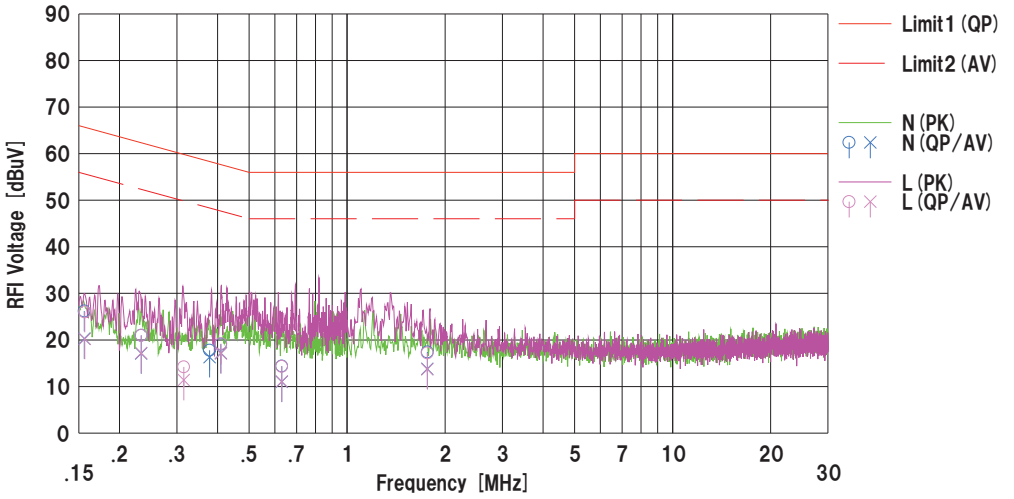
UL Japan, Inc. Kashima EMC Lab. No.1 Shielded Room
Date : 2019/03/12

Mode : Tx BLE 2480MHz
Order No. : 12729321M
Power : DC 3.3V
Temp./Humi. : 21deg.C. / 41%RH

Remarks : -

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Tested by : Kazuhiro Ando



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15595	16.0	10.1	10.2	26.2	20.3	65.7	55.7	39.5	35.4	N	
2	0.23321	10.8	6.9	10.2	21.0	17.1	62.3	52.3	41.3	35.2	N	
3	0.37802	7.6	6.1	10.2	17.8	16.3	58.3	48.3	40.5	32.0	N	
4	0.40958	8.8	6.9	10.3	19.1	17.2	57.7	47.7	38.6	30.5	N	
5	0.63003	4.1	0.7	10.3	14.4	11.0	56.0	46.0	41.6	35.0	N	
6	1.76415	7.0	3.4	10.4	17.4	13.8	56.0	46.0	38.6	32.2	N	
7	0.15642	15.8	10.0	10.2	26.0	20.2	65.7	55.7	39.7	35.5	L	
8	0.23311	10.8	7.0	10.2	21.0	17.2	62.3	52.3	41.3	35.1	L	
9	0.31495	4.0	1.2	10.2	14.2	11.4	59.8	49.8	45.6	38.4	L	
10	0.40975	8.9	6.8	10.3	19.2	17.1	57.7	47.7	38.5	30.6	L	
11	0.63006	4.0	0.8	10.3	14.3	11.1	56.0	46.0	41.7	34.9	L	
12	1.76419	6.8	3.3	10.4	17.2	13.7	56.0	46.0	38.8	32.3	L	

Calculation:Result [dBuV] =Reading [dBuV] +C.Fac (LISN+Cable) [dB]
LISN:CLS-03

6 dB Bandwidth and 99 % Occupied Bandwidth

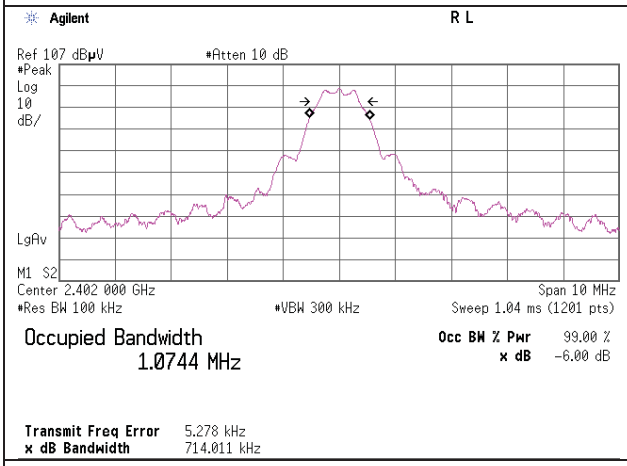
Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BT LE	2402	1052.3	0.714	> 0.5000
	2440	1053.8	0.713	> 0.5000
	2480	1057.6	0.723	> 0.5000

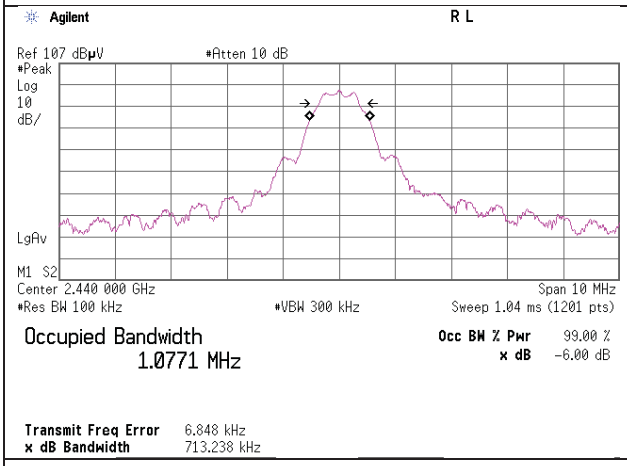
6 dB Bandwidth and 99 % Occupied Bandwidth

6 dB Bandwidth

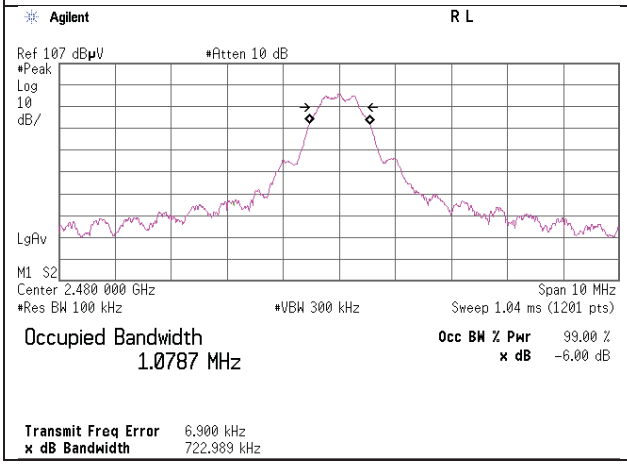
2402 MHz



2440 MHz

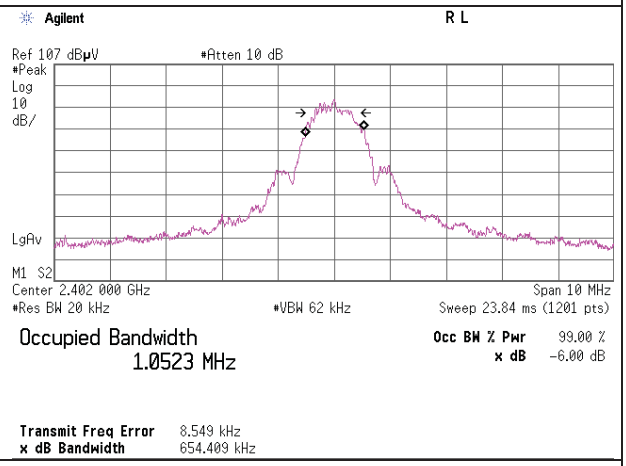


2480 MHz

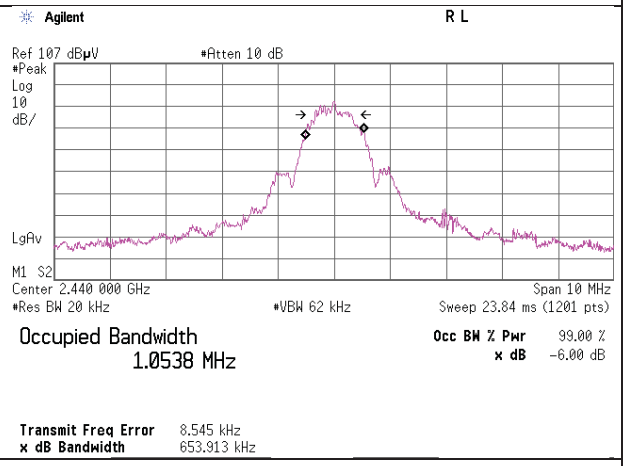


99 % Occupied Bandwidth

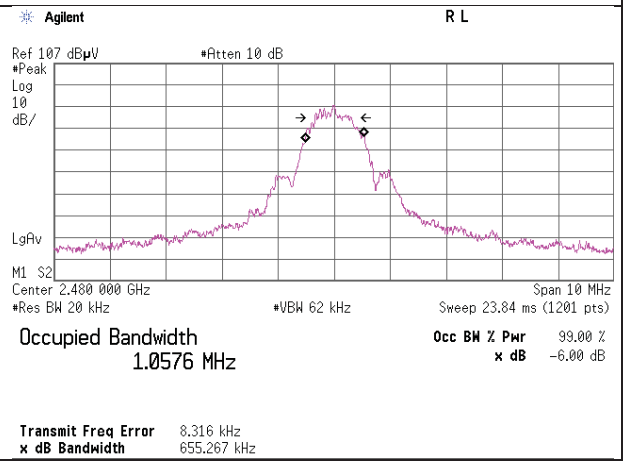
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-10.90	1.66	10.04	0.80	1.20	30.00	1000	29.20	2.25	3.05	2.02	36.02	4000	32.97
2440	-12.02	1.67	10.05	-0.30	0.93	30.00	1000	30.30	2.25	1.95	1.57	36.02	4000	34.07
2480	-13.29	1.68	10.05	-1.56	0.70	30.00	1000	31.56	2.25	0.69	1.17	36.02	4000	35.33

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Average Output Power
(Reference data for RF Exposure)

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE

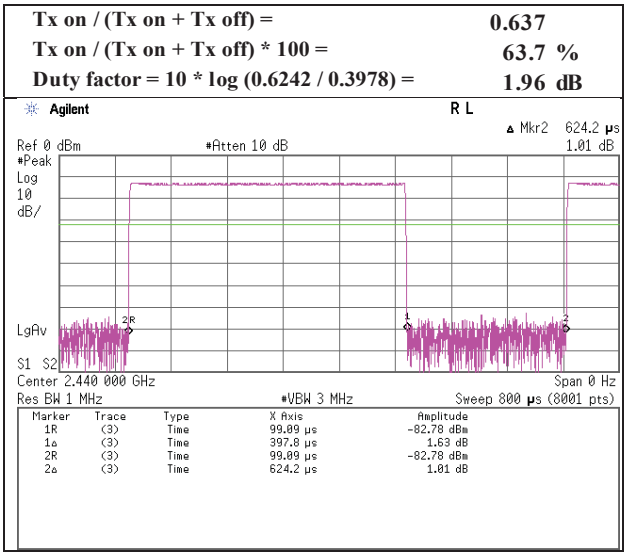
Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-13.40	1.66	10.04	-1.70	0.68	1.96	0.26	1.06
2440	-14.66	1.67	10.05	-2.94	0.51	1.96	-0.98	0.80
2480	-16.10	1.68	10.05	-4.37	0.37	1.96	-2.41	0.57

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

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
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.	12729321M-A-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.6		
Date	March 12, 2019	March 9, 2019	March 11, 2019
Temperature / Humidity	21 deg. C / 44 % RH	20 deg. C / 45 % RH	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.10	12.70	3.90	32.50	0.00	6.20	40.00	33.8	100	0	
Hori.	64.000	QP	22.40	12.70	4.30	32.50	0.00	6.90	40.00	33.1	100	0	
Hori.	96.000	QP	22.20	8.40	4.70	32.50	0.00	2.80	43.50	40.7	100	0	
Hori.	2390.000	PK	50.00	27.60	13.90	44.50	2.50	49.50	73.90	24.4	175	0	
Hori.	4804.000	PK	58.60	32.70	6.00	46.10	2.50	53.70	73.90	20.2	131	334	
Hori.	7206.000	PK	52.80	37.20	7.30	44.70	2.50	55.10	73.90	18.8	128	294	
Hori.	9608.000	PK	45.80	38.10	8.30	42.60	2.50	52.10	73.90	21.8	150	0	Floor noise
Vert.	32.000	QP	22.10	12.70	3.90	32.50	0.00	6.20	40.00	33.8	100	0	
Vert.	64.000	QP	27.80	12.70	4.30	32.50	0.00	12.30	40.00	27.7	100	0	
Vert.	96.000	QP	22.20	8.40	4.70	32.50	0.00	2.80	43.50	40.7	100	0	
Vert.	2390.000	PK	50.50	27.60	13.90	44.50	2.50	50.00	73.90	23.9	150	350	
Vert.	4804.000	PK	56.30	32.70	6.00	46.10	2.50	51.40	73.90	22.5	257	285	
Vert.	7206.000	PK	53.30	37.20	7.30	44.70	2.50	55.60	73.90	**18.3**	146	171	
Vert.	9608.000	PK	46.60	38.10	8.30	42.60	2.50	52.90	73.90	21.0	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.98 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	40.00	27.60	13.90	44.50	1.96	2.50	41.46	53.90	12.4	*1)
Hori.	4804.000	AV	49.60	32.70	6.00	46.10	1.96	2.50	46.66	53.90	7.2	
Hori.	7206.000	AV	45.30	37.20	7.30	44.70	1.96	2.50	49.56	53.90	**4.3**	
Hori.	9608.000	AV	36.70	38.10	8.30	42.60	1.96	2.50	44.96	53.90	8.9	Floor noise
Vert.	2390.000	AV	39.00	27.60	13.90	44.50	1.96	2.50	40.46	53.90	13.4	*1)
Vert.	4804.000	AV	49.10	32.70	6.00	46.10	1.96	2.50	46.16	53.90	7.7	
Vert.	7206.000	AV	43.50	37.20	7.30	44.70	1.96	2.50	47.76	53.90	6.1	
Vert.	9608.000	AV	35.30	38.10	8.30	42.60	1.96	2.50	43.56	53.90	10.3	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amprifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.98 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB
Duty factor refer to "Duty factor Calculation chart" sheet.
*1) Not out of band emission (Leakage Power)

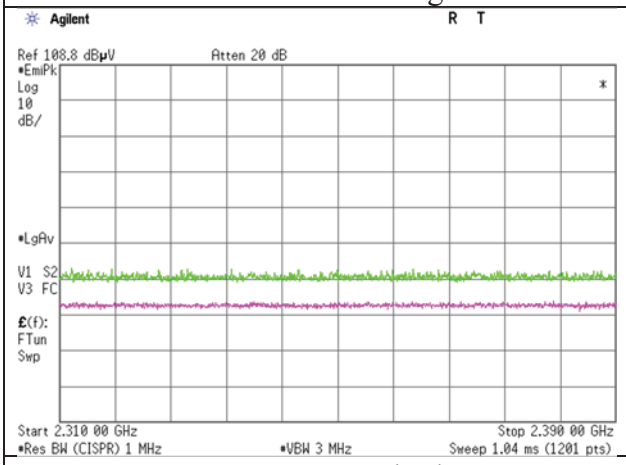
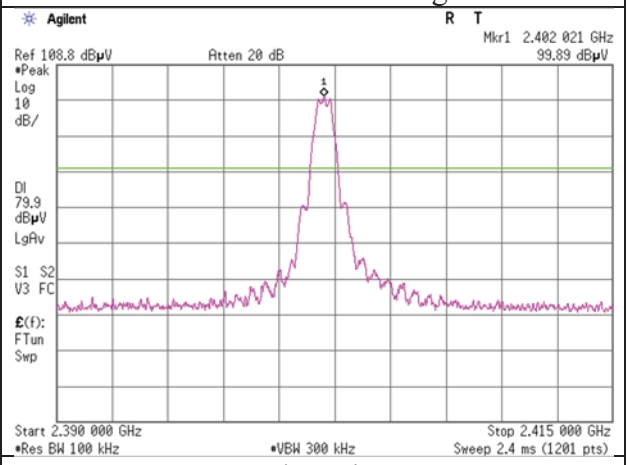
20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

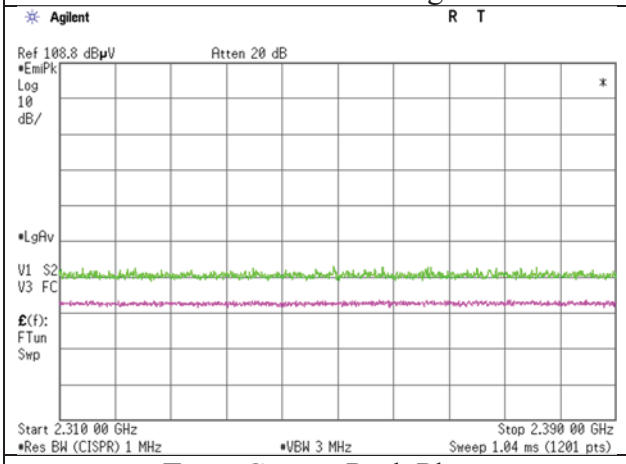
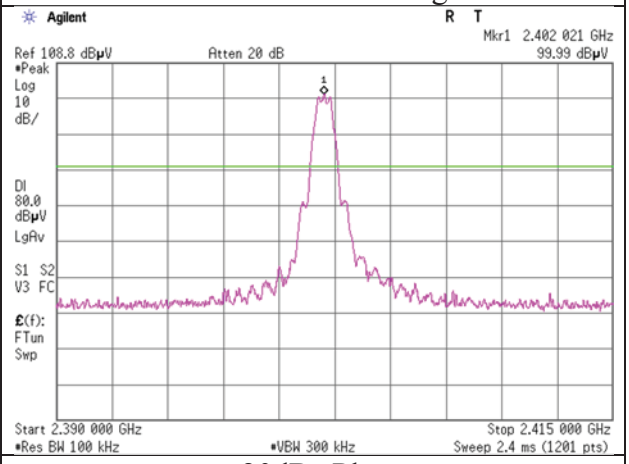
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	99.90	27.60	14.00	44.50	2.50	99.50	-	-	Carrier
Hori.	2400.000	PK	52.00	27.60	14.00	44.50	2.50	51.60	79.50	27.9	
Vert.	2402.000	PK	99.90	27.60	14.00	44.50	2.50	99.50	-	-	Carrier
Vert.	2400.000	PK	50.70	27.60	14.00	44.50	2.50	50.30	79.50	29.2	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.98 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.6
Date	March 9, 2019
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Hiromitsu Tanabe (1 GHz - 10 GHz)
Mode	Tx BT LE 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Report No.	12729321M-A-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.6		
Date	March 12, 2019	March 9, 2019	March 11, 2019
Temperature / Humidity	21 deg. C / 44 % RH	20 deg. C / 45 % RH	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2440 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.10	12.70	3.90	32.50	0.00	6.20	40.00	33.8	100	0	
Hori.	64.000	QP	22.40	12.70	4.30	32.50	0.00	6.90	40.00	33.1	100	0	
Hori.	96.000	QP	22.10	8.40	4.70	32.50	0.00	2.70	43.50	40.8	100	0	
Hori.	4880.000	PK	55.00	32.70	6.00	46.10	2.50	50.10	73.90	23.8	123	329	
Hori.	7320.000	PK	51.30	37.40	7.30	44.50	2.50	54.00	73.90	19.9	161	55	
Hori.	9760.000	PK	47.00	38.10	8.30	42.50	2.50	53.40	73.90	20.5	150	0	Floor noise
Vert.	32.000	QP	22.10	12.70	3.90	32.50	0.00	6.20	40.00	33.8	100	0	
Vert.	64.000	QP	27.90	12.70	4.30	32.50	0.00	12.40	40.00	27.6	100	0	
Vert.	96.000	QP	22.30	8.40	4.70	32.50	0.00	2.90	43.50	40.6	100	0	
Vert.	4880.000	PK	54.70	32.70	6.00	46.10	2.50	49.80	73.90	24.1	148	300	
Vert.	7320.000	PK	52.20	37.40	7.30	44.50	2.50	54.90	73.90	**19.0**	124	144	
Vert.	9760.000	PK	46.80	38.10	8.30	42.50	2.50	53.20	73.90	20.7	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.98 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	44.30	32.70	6.00	46.10	1.96	2.50	41.36	53.90	12.5	
Hori.	7320.000	AV	41.70	37.40	7.30	44.50	1.96	2.50	46.36	53.90	**7.5**	
Hori.	9760.000	AV	35.30	38.10	8.30	42.50	1.96	2.50	43.66	53.90	10.2	Floor noise
Vert.	4880.000	AV	44.30	32.70	6.00	46.10	1.96	2.50	41.36	53.90	12.5	
Vert.	7320.000	AV	37.50	37.40	7.30	44.50	1.96	2.50	42.16	53.90	11.7	
Vert.	9760.000	AV	35.10	38.10	8.30	42.50	1.96	2.50	43.46	53.90	10.4	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amprifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.98 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB
Duty factor refer to "Duty factor Calculation chart" sheet.
*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission

Report No.	12729321M-A-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.6		
Date	March 12, 2019	March 9, 2019	March 11, 2019
Temperature / Humidity	21 deg. C / 44 % RH	20 deg. C / 45 % RH	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.00	12.70	3.90	32.50	0.00	6.10	40.00	33.9	100	0	
Hori.	64.000	QP	22.40	12.70	4.30	32.50	0.00	6.90	40.00	33.1	100	0	
Hori.	96.000	QP	22.00	8.40	4.70	32.50	0.00	2.60	43.50	40.9	100	0	
Hori.	2483.500	PK	60.00	27.90	14.00	44.50	2.50	59.90	73.90	14.0	178	7	
Hori.	4960.000	PK	52.70	32.70	6.10	46.20	2.50	47.80	73.90	26.1	119	200	
Hori.	7440.000	PK	51.50	37.50	7.40	44.30	2.50	54.60	73.90	19.3	185	3	
Hori.	9920.000	PK	46.10	38.30	8.40	42.50	2.50	52.80	73.90	21.1	150	0	Floor noise
Vert.	32.000	QP	22.30	12.70	3.90	32.50	0.00	6.40	40.00	33.6	100	0	
Vert.	64.000	QP	27.80	12.70	4.30	32.50	0.00	12.30	40.00	27.7	100	0	
Vert.	96.000	QP	22.20	8.40	4.70	32.50	0.00	2.80	43.50	40.7	100	0	
Vert.	2483.500	PK	61.40	27.90	14.00	44.50	2.50	61.30	73.90	**12.6**	210	10	
Vert.	4960.000	PK	53.20	32.70	6.10	46.20	2.50	48.30	73.90	25.6	170	297	
Vert.	7440.000	PK	51.00	37.50	7.40	44.30	2.50	54.10	73.90	19.8	162	56	
Vert.	9920.000	PK	45.70	38.30	8.40	42.50	2.50	52.40	73.90	21.5	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.98 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	42.00	27.90	14.00	44.50	1.96	2.50	43.86	53.90	10.0	*1)
Hori.	4960.000	AV	42.00	32.70	6.10	46.20	1.96	2.50	39.06	53.90	14.8	
Hori.	7440.000	AV	40.90	37.50	7.40	44.30	1.96	2.50	45.96	53.90	**7.9**	
Hori.	9920.000	AV	35.00	38.30	8.40	42.50	1.96	2.50	43.66	53.90	10.2	Floor noise
Vert.	2483.500	AV	42.40	27.90	14.00	44.50	1.96	2.50	44.26	53.90	9.6	*1)
Vert.	4960.000	AV	42.50	32.70	6.10	46.20	1.96	2.50	39.56	53.90	14.3	
Vert.	7440.000	AV	40.50	37.50	7.40	44.30	1.96	2.50	45.56	53.90	8.3	
Vert.	9920.000	AV	35.30	38.30	8.40	42.50	1.96	2.50	43.96	53.90	9.9	Floor noise

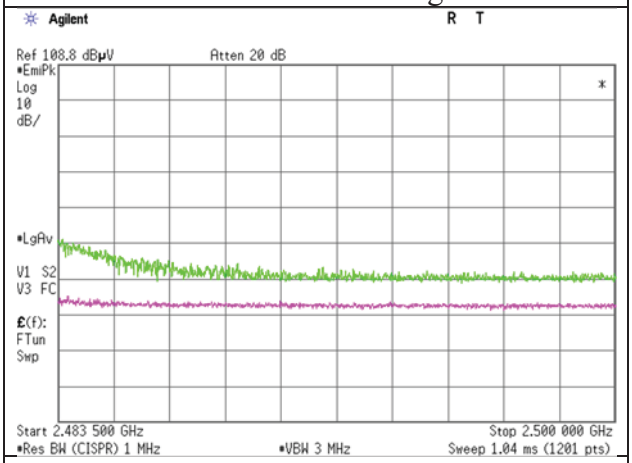
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amprifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.98 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB
Duty factor refer to "Duty factor Calculation chart" sheet.
*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.6
Date	March 9, 2019
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Hiromitsu Tanabe (1 GHz - 10 GHz)
Mode	Tx BT LE 2480 MHz

Horizontal

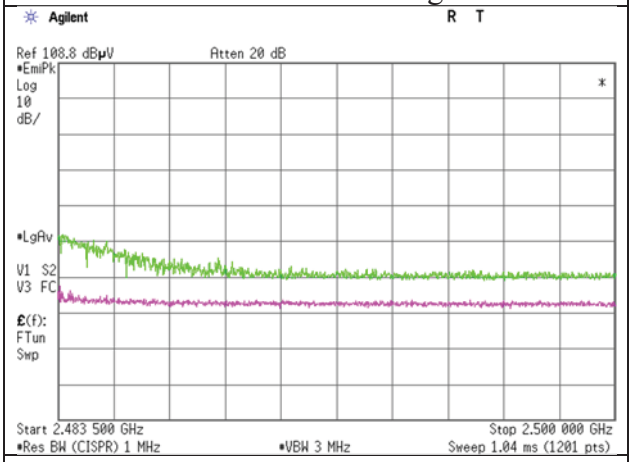
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

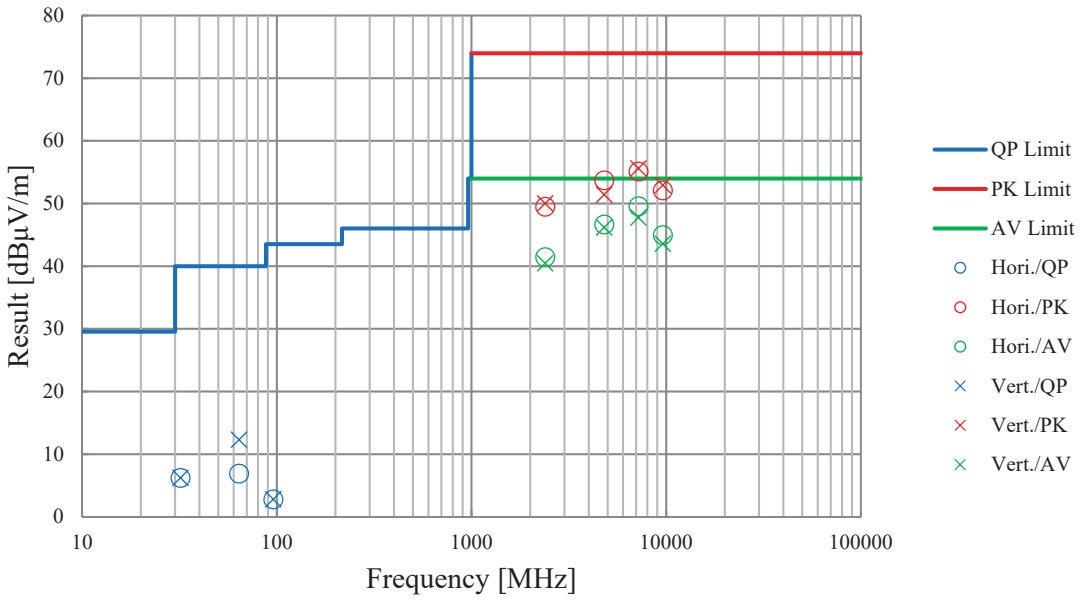


Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	12729321M-A-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.6		
Date	March 12, 2019	March 9, 2019	March 11, 2019
Temperature / Humidity	21 deg. C / 44 % RH	20 deg. C / 45 % RH	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2402 MHz		

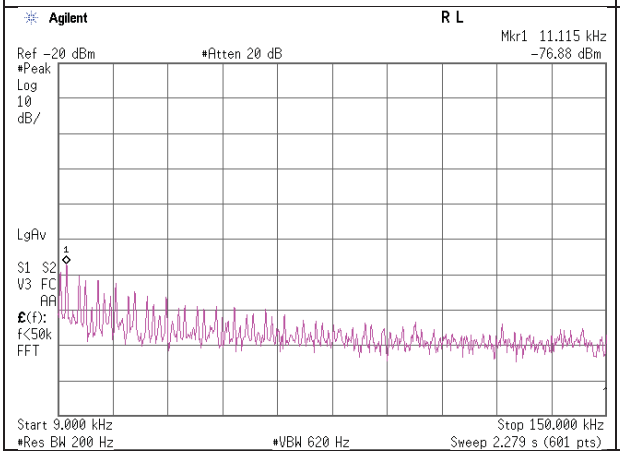


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

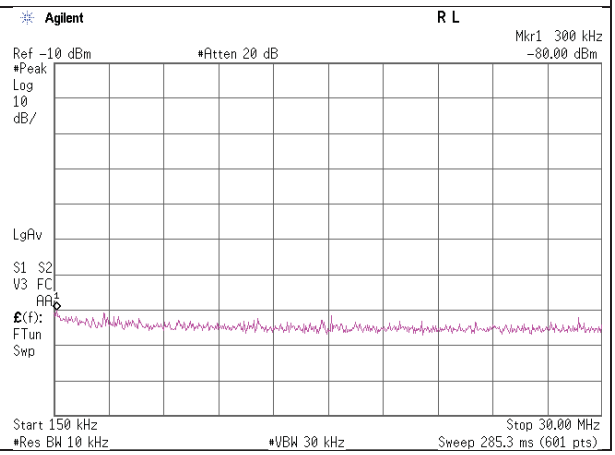
Conducted Spurious Emission

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE 2402 MHz

9 kHz - 150 kHz



150 kHz - 30 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
11.12	-76.9	0.01	9.9	2.25	1	-64.7	300	6.0	-3.4	46.6	50.0	
300.00	-80.0	0.02	9.9	2.25	1	-67.8	300	6.0	-6.5	18.0	24.5	

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

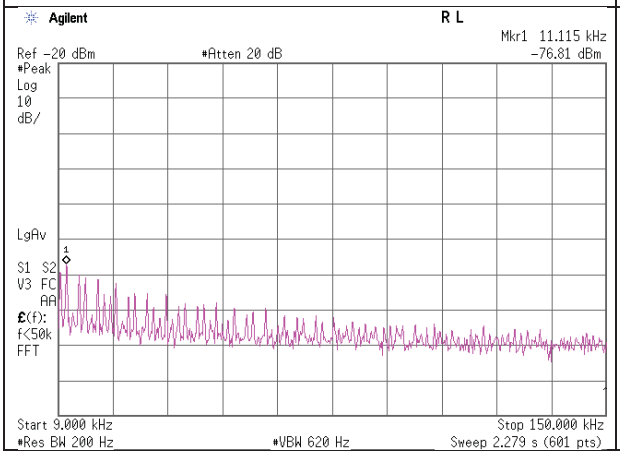
EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

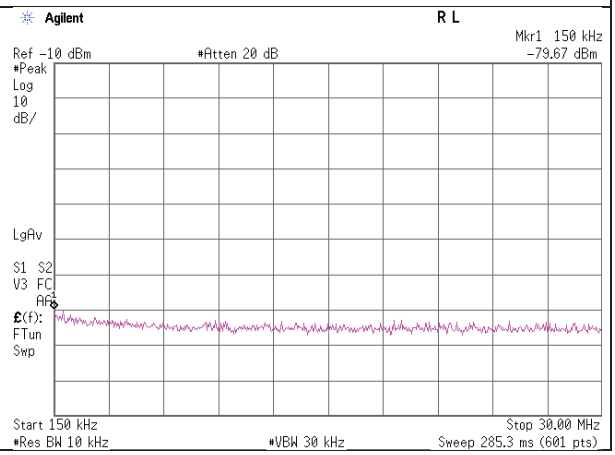
Conducted Spurious Emission

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE 2440 MHz

9 kHz - 150 kHz



150 kHz - 30 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
11.12	-76.8	0.01	9.9	2.25	1	-64.6	300	6.0	-3.4	46.6	50.0	
150.00	-79.7	0.01	9.9	2.25	1	-67.5	300	6.0	-6.2	24.0	30.2	

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

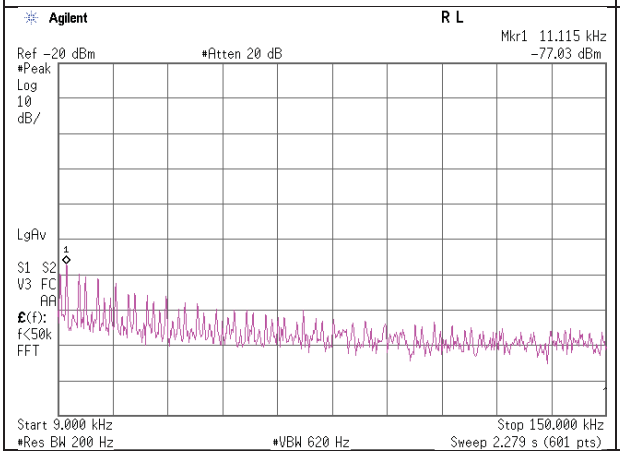
EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

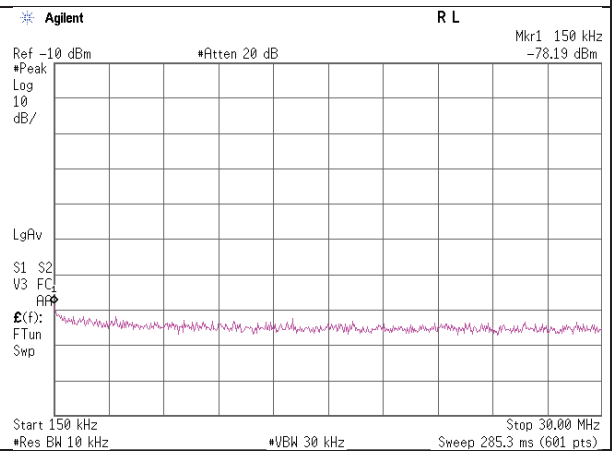
Conducted Spurious Emission

Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE 2480 MHz

9 kHz - 150 kHz



150 kHz - 30 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
11.12	-77.0	0.01	9.9	2.25	1	-64.8	300	6.0	-3.6	46.6	50.2	
150.00	-78.2	0.01	9.9	2.25	1	-66.0	300	6.0	-4.7	24.0	28.7	

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

Power Density

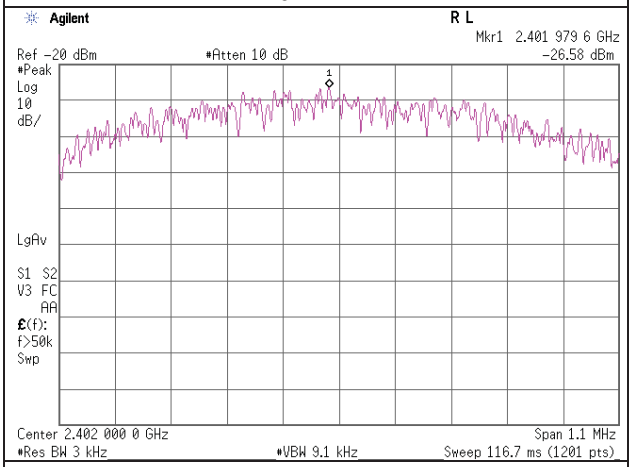
Report No.	12729321M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	February 19, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-26.59	1.66	10.04	-14.89	8.00	22.89
2440.00	-28.01	1.67	10.05	-16.29	8.00	24.29
2480.00	-29.37	1.68	10.05	-17.64	8.00	25.64

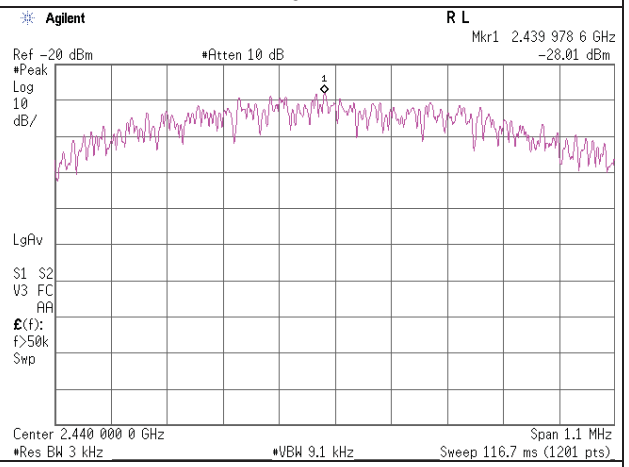
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

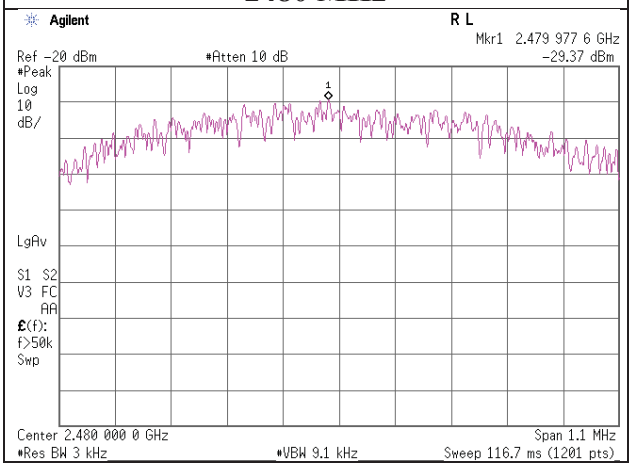
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
CE	144195	Test Receiver	Rohde & Schwarz	ESCI	100053	2018/09/28	2019/09/30	12
CE	143155	Coaxial Cable	Fujikura,Fujikura,Fujikura,Fujikura	5D-2W,5D-2W,5D-2W,5D-2W	-	2018/07/25	2019/07/31	12
CE	143499	A.M.N.	Rohde & Schwarz	ESH3-Z5	829567/010	2018/07/10	2019/07/31	12
RE	143107	Coaxial Cable	Fujikura,Suhner,Suhner,Agilent,Suhner,-,Suhner	15DSFA,SF106,SF104,8496B+8494B,SF1	MY41110308,2550A11724(Step Att)	2018/12/19	2019/12/31	12
RE	143122	LOGBICON	Schwarzbeck	VULB 9168	508	2018/04/05	2019/04/30	12
RE	143053	3dB Fixed Atten.	TAMAGAWA	UFA-01	none	2018/04/11	2019/04/30	12
RE	142929	Pre-Amplifier	SONOMA INSTRUMENT	310N	240505	2018/11/21	2019/11/29	12
RE	144193	Test Receiver	Rohde & Schwarz	ESU40	100426	2018/04/10	2019/04/30	12
RE(GHz)	142990	Micro Wave Cable	Shuner	SUCOFLEX104A	MY1477/4A	2018/05/25	2019/05/31	12
RE(GHz)	143643	Spectrum Analyzer	AGILENT	E4448A	MY52490024	2018/05/23	2019/05/31	12
RE(GHz)	143642	Spectrum Analyzer	AGILENT	N9030A	MY53310670 Version A.13.12	2018/05/25	2019/05/31	12
RE(GHz)	142939	Pre-Amplifier	Micro Wave Factory	MPR-1G26.5-35	161398	2018/05/18	2019/05/31	12
RE(GHz)	143111	Micro Wave Cable	Junkosha	MWX221	MRA-12-14-148	2018/05/25	2019/05/31	12
RE(GHz)	143016	10dB Fixed Atten.	WEINSCHEL	54A-10	56246	2018/05/21	2019/05/31	12
RE(GHz)	143459	HPF	MICRO-TRONICS	HPM50111-02	008	2018/05/22	2019/05/31	12
RE(GHz)	143456	Double Ridged Wave Guide	ETS-Lindgren	3115	00204573	2019/02/04	2020/02/29	12
RE(GHz)	143438	Double Ridged Horn	ETS-Lindgren	3160-09	00166043	2018/06/26	2019/06/30	12
RE(GHz)	142937	Pre-Amplifier	TOYO	HAP18-26W	00000035	2018/06/26	2019/06/30	12
RE(GHz)	143113	Micro Wave Cable	Suhner	SUCOFLEX104	MY588/4	2018/07/10	2019/07/31	12
EMI	144209	Digital Multimeter	Fluke Corporation	FLK-83-V	17610192	2018/10/01	2019/10/31	12
EMI	143129	Barometer	Sunoh	SBR-151	000017	2018/11/26	2021/11/30	36
EMI	143538	Temperature & Humidity Indicator	HIOKI	3641/9680-50	070727010/070799296	2018/05/24	2019/05/31	12
EMI	143667	Ruler	TAJIMA	L25-55	-	-	-	-
EMI	142901	EMI Software	TSJ	TEPTO-DV(RE,CE,MF,PE)	Ver.3.3	-	-	-
AT	143537	Temperature & Humidity Indicator	A&D	AD-5681	6975761	2018/07/18	2019/07/31	12
AT	144220	Digital Multimeter	Fluke Corporation	87-3	85220051	2018/10/01	2019/10/31	12
AT	143606	Power Sensor	AGILENT	N1923A	MY54070024	2018/06/20	2019/06/30	12
AT	143588	Peak Power Analyzer	AGILENT	8990B	MY51000276	2018/06/20	2019/06/30	12
AT	143110	Micro Wave Cable	Suhner	SUCOFLEX102	MY3773/2	2018/05/25	2019/05/31	12
AT	143023	10dB Fixed Atten.	WEINSCHEL	54A-10	56251	2018/05/21	2019/05/31	12
AT	143643	Spectrum Analyzer	AGILENT	E4448A	MY52490024	2018/05/23	2019/05/31	12

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

The expiration date of the calibration is the end of the expired month.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

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

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