



RADIO TEST REPORT

Test Report No. : 12083953M-A

Applicant : **Sony Corporation**
Type of Equipment : **REMOTE COMMANDER**
Model No. : **LSPX-A1R**
FCC ID : **AK8LSPXA1R**
Test regulation : **FCC Part 15 Subpart C: 2018**
Test Result : **Complied**

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. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
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)

Date of test: January 10 - 14, 2018

Representative test operator:

K. Ando

Kazuhiro Ando
Engineer
Consumer Technology Division

Approved by :

T. Yamashita

Tomoyuki Yamashita
Leader
Consumer Technology Division



- 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

CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Radiated Spurious Emission	9
SECTION 6: Antenna Terminal Conducted Tests.....	11
APPENDIX 1: Test data	12
6 dB Bandwidth and 99 % Occupied Bandwidth.....	12
Maximum Peak Output Power	14
Average Output Power	15
Radiated Spurious Emission	17
Conducted Spurious Emission	23
Power Density	26
APPENDIX 2: Test instruments	28
APPENDIX 3: Photographs of test setup	29
Radiated Spurious Emission	29
Worst Case Position	30

SECTION 1: Customer information

Company Name : Sony Corporation
Address : 1-7-1 Konan, Minato-ku, Tokyo 108-0075, Japan
Telephone Number : +81-50-3141-6214
Facsimile Number : +81-50-3750-6540
Contact Person : Ryo Takata

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

2.1 Identification of E.U.T.

Type of Equipment : REMOTE COMMANDER
Model No. : LSPX-A1R
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3 V
Receipt Date of Sample : January 9, 2018
Country of Mass-production : China
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: LSPX-A1R (referred to as the EUT in this report) is a REMOTE COMMANDER.

General Specification

Clock frequency(ies) in the system : 32 MHz

Radio Specification

[BLE (Bluetooth Low Energy)]

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : FHSS, GFSK
Power Supply (radio part input) : DC 1.7 V – 3.6 V (Internal regulator: DC 1.3 V)
Antenna type : $\lambda/4$ mono pole (reverse F type)
Antenna Gain : 1.56 dBi (Peak(Max))

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on January 2, 2018 and effective February 1, 2018
* The revision on January 2, 2018, does not affect the test specification applied to the EUT.

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

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ----- IC: RSS-Gen 8.8	FCC: Section 15.207 ----- IC: RSS-Gen 8.8	-	N/A	*1)
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04 ----- IC: -	FCC: Section 15.247(a)(2) ----- IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04 ----- IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) ----- IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04 ----- IC: -	FCC: Section 15.247(e) ----- IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.13	FCC: Section15.247(d) ----- IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	4.7 dB 4960.000 MHz, AV, Hori. Tx BT LE 2480 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

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

*1) The test is not applicable since the EUT is battery operated device.

*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7.

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

FCC Part 15.31 (e)

The test was performed with the New Battery during the tests. Therefore, the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because it is printed on the circuit board. Therefore the equipment complies with the requirement.

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

3.3 Addition to standard

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

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

3.4 Uncertainty

EMI

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

Item	Uncertainty (+/-)	
Radiated emission (Measurement distance: 3 m)	30 MHz - 200 MHz	4.5 dB
	200 MHz - 1 GHz	5.8 dB
	1 GHz - 6 GHz	5.1 dB
	6 GHz - 18 GHz	5.4 dB
Radiated emission (Measurement distance: 1 m)	18 GHz - 26.5 GHz	5.4 dB

Item	Uncertainty (+/-)
Power measurement above 1 GHz	0.7 dB
Spurious emissions, Power density measurement (below 1 GHz)	0.9 dB
Spurious emissions, Power density measurement (1 GHz - 3 GHz)	1.5 dB
Spurious emissions, Power density measurement (3 GHz - 18 GHz)	2.2 dB
Frequency measurement	5.3×10^{-6}
Bandwidth measurement	2.0 dB
Duty cycle and Time measurement	0.012%

Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

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 Certification Number	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.2 Open site	4659A-2	4.4 x 4.4 x 2.15	18 x 20	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.2 Shielded room	4659A-2	3.6 x 2.7 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	-	4.3 x 4.4 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	2402 MHz, 2440 MHz, 2480 MHz	PRBS9
<p>*Power of the EUT was set by the software as follows; - Power Setting: 0 dBm - Software: DTM Tool for BTS04 (DLE) ver.:0.0.8.1</p> <p>*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.</p>		

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

A: EUT

* 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	REMOTE COMMANDER	LSPX-A1R	1B14 *1) 1B28 *2)	Sony Corporation	EUT

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

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

SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 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.

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	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: 300 kHz
Test Distance	3 m	4.42 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)		4.42 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)

*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

*2) Distance Factor: $20 \times \log(4.42 \text{ m} / 3.0 \text{ m}) = 3.4 \text{ dB}$

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

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

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

Measurement range : 30 MHz - 26.5 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	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 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04".

*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 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.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

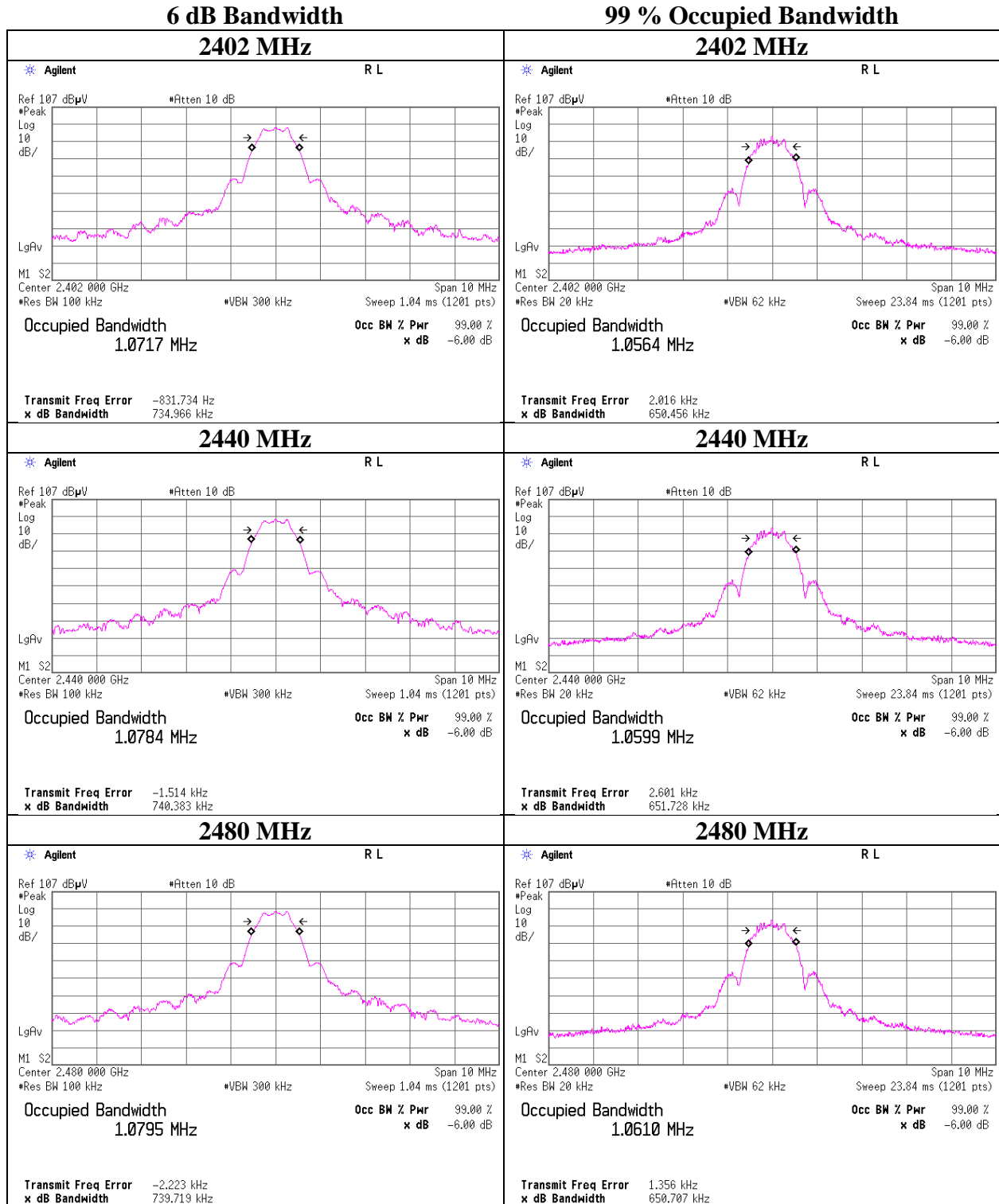
APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

Test place Kashima EMC Lab. No.2 Measurement Room
Report No. 12083953M-A
Date January 10, 2018
Temperature / Humidity 20 deg. C / 38 % 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	1056.4	0.735	> 0.5000
	2440	1059.9	0.740	> 0.5000
	2480	1061.0	0.740	> 0.5000

6 dB Bandwidth and 99 % Occupied Bandwidth



Maximum Peak Output Power

Test place Kashima EMC Lab. No.2 Measurement Room
Report No. 12083953M-A
Date January 10, 2018
Temperature / Humidity 20 deg. C / 38 % RH
Engineer Kazuhiro Ando
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-11.44	1.45	10.04	0.05	1.01	30.00	1000	29.95
2440	-11.17	1.45	10.04	0.32	1.08	30.00	1000	29.68
2480	-11.08	1.45	10.04	0.41	1.10	30.00	1000	29.59

Sample Calculation:

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

Average Output Power
(Reference data for RF Exposure)

Test place Kashima EMC Lab. No.2 Measurement Room
Report No. 12083953M-A
Date January 10, 2018
Temperature / Humidity 20 deg. C / 38 % RH
Engineer Kazuhiro Ando
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-12.68	1.45	10.04	-1.19	0.76	0.67	-0.52	0.89
2440	-12.39	1.45	10.04	-0.90	0.81	0.67	-0.23	0.95
2480	-12.28	1.45	10.04	-0.79	0.83	0.67	-0.12	0.97

Sample Calculation:

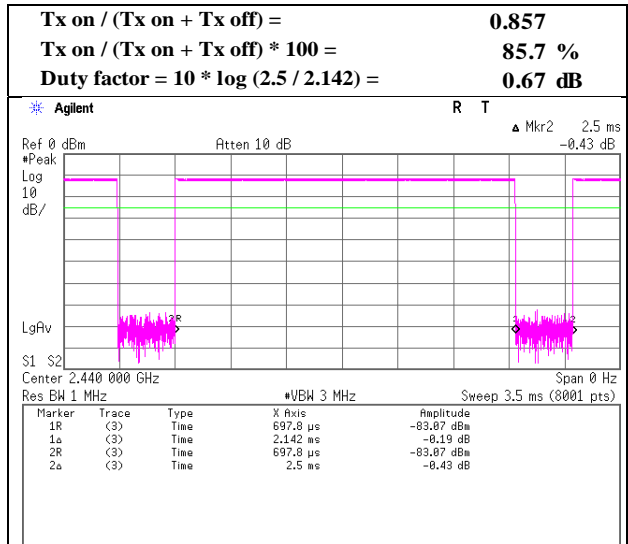
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

Burst rate confirmation

Test place	Kashima EMC Lab. No.2 Measurement Room
Report No.	12083953M-A
Date	January 10, 2018
Temperature / Humidity	20 deg. C / 38 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE

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.	12083953M-A		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.10	No.10	No.10
Date	January 14, 2018	January 13, 2018	January 14, 2018
Temperature / Humidity	19 deg. C / 42 % RH	18 deg. C / 40 % RH	19 deg. C / 42 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 18 GHz)	(18 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.	45.673	QP	20.80	13.70	4.50	26.80	0.00	12.20	40.00	27.8	180	140	
Hori.	2390.000	PK	46.00	27.60	13.80	42.00	3.40	48.80	73.90	25.1	158	355	
Hori.	4804.000	PK	55.20	31.20	5.70	41.70	3.40	53.80	73.90	20.1	161	125	
Hori.	7206.000	PK	48.00	36.30	7.20	40.90	3.40	54.00	73.90	19.9	145	137	
Hori.	9608.000	PK	43.50	38.90	8.30	39.60	3.40	54.50	73.90	19.4	150	0	Floor noise
Vert.	30.000	QP	19.20	12.60	4.20	26.90	0.00	9.10	40.00	30.9	100	225	
Vert.	45.623	QP	23.90	13.70	4.50	26.80	0.00	15.30	40.00	24.7	100	0	
Vert.	67.187	QP	19.50	12.10	4.80	26.80	0.00	9.60	40.00	30.4	100	0	
Vert.	91.248	QP	18.70	7.80	5.20	26.70	0.00	5.00	43.50	38.5	100	0	
Vert.	165.325	QP	17.90	13.30	6.00	26.40	0.00	10.80	43.50	32.7	100	0	
Vert.	2390.000	PK	45.00	27.60	13.80	42.00	3.40	47.80	73.90	26.1	178	270	
Vert.	4804.000	PK	53.40	31.20	5.70	41.70	3.40	52.00	73.90	21.9	135	22	
Vert.	7206.000	PK	47.50	36.30	7.20	40.90	3.40	53.50	73.90	20.4	148	183	
Vert.	9608.000	PK	43.00	38.90	8.30	39.60	3.40	54.00	73.90	19.9	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(4.42\text{ m} / 3.0\text{ m}) = 3.4\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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	35.10	27.60	13.80	42.00	0.67	3.40	38.57	53.90	15.3	*1)
Hori.	4804.000	AV	48.40	31.20	5.70	41.70	0.67	3.40	47.67	53.90	6.2	
Hori.	7206.000	AV	37.30	36.30	7.20	40.90	0.67	3.40	43.97	53.90	9.9	
Hori.	9608.000	AV	33.00	38.90	8.30	39.60	0.67	3.40	44.67	53.90	9.2	Floor noise
Vert.	2390.000	AV	35.30	27.60	13.80	42.00	0.67	3.40	38.77	53.90	15.1	*1)
Vert.	4804.000	AV	47.90	31.20	5.70	41.70	0.67	3.40	47.17	53.90	6.7	
Vert.	7206.000	AV	37.70	36.30	7.20	40.90	0.67	3.40	44.37	53.90	9.5	
Vert.	9608.000	AV	33.00	38.90	8.30	39.60	0.67	3.40	44.67	53.90	9.2	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(4.42\text{ m} / 3.0\text{ m}) = 3.4\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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	92.60	27.50	13.80	42.00	3.40	95.30	-	-	Carrier
Hori.	2400.000	PK	43.70	27.50	13.80	42.00	3.40	46.40	75.30	28.9	
Vert.	2402.000	PK	92.50	27.50	13.80	42.00	3.40	95.20	-	-	Carrier
Vert.	2400.000	PK	44.00	27.50	13.80	42.00	3.40	46.70	75.20	28.5	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(4.42\text{ m} / 3.0\text{ m}) = 3.4\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

UL Japan, Inc.

Kashima EMC Lab.

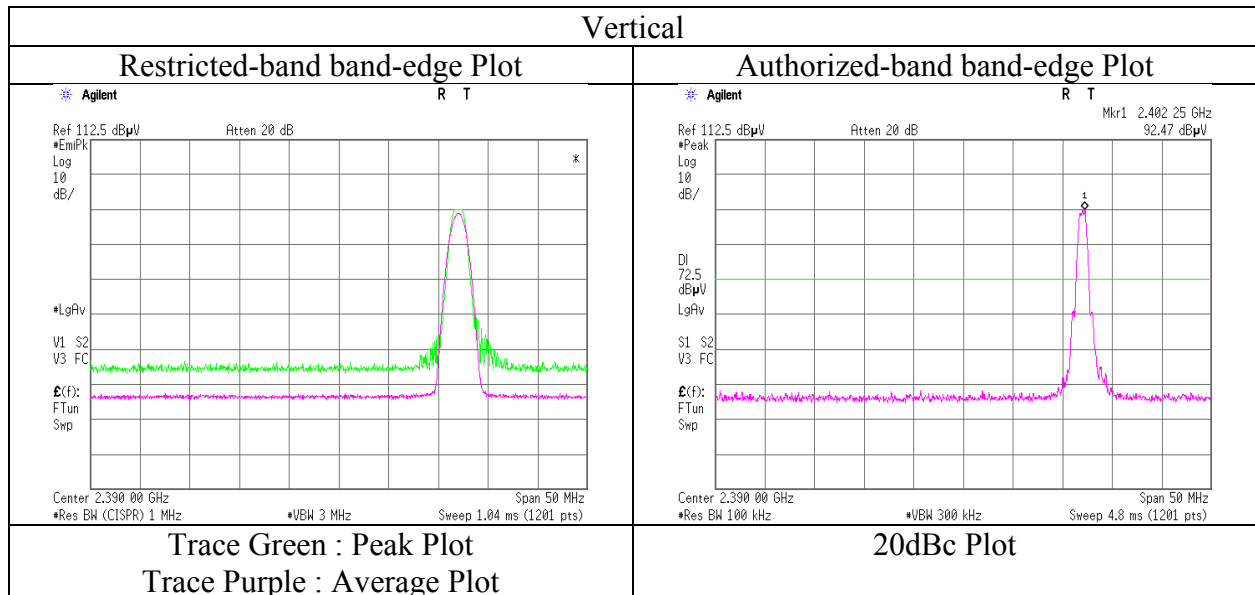
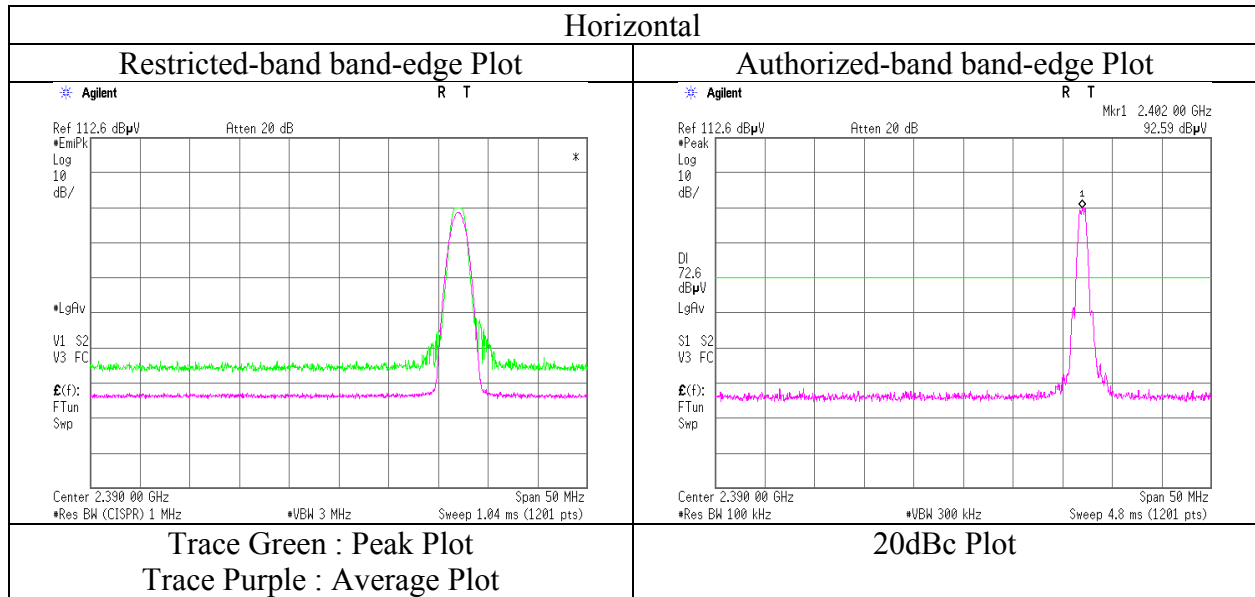
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12083953M-A
Test place Kashima EMC Lab.
Semi Anechoic Chamber No.10
Date January 13, 2018
Temperature / Humidity 18 deg. C / 40 % RH
Engineer Hiromitsu Tanabe
(1 GHz - 18 GHz)
Mode Tx BT LE 2402 MHz



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

Radiated Spurious Emission

Report No.	12083953M-A		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.10	No.10	No.10
Date	January 14, 2018	January 13, 2018	January 14, 2018
Temperature / Humidity	19 deg. C / 42 % RH	18 deg. C / 40 % RH	19 deg. C / 42 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 18 GHz)	(18 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.	45.636	QP	20.50	13.70	4.50	26.80	0.00	11.90	40.00	28.1	180	150	
Hori.	4880.000	PK	54.20	31.30	5.80	41.70	3.40	53.00	73.90	20.9	153	143	
Hori.	7320.000	PK	48.20	36.40	7.20	40.80	3.40	54.40	73.90	19.5	147	135	
Hori.	9760.000	PK	43.00	39.50	8.30	39.50	3.40	54.70	73.90	19.2	150	0	Floor noise
Vert.	30.000	QP	19.10	12.60	4.20	26.90	0.00	9.00	40.00	31.0	100	300	
Vert.	45.604	QP	23.60	13.70	4.50	26.80	0.00	15.00	40.00	25.0	100	350	
Vert.	67.071	QP	19.70	12.10	4.80	26.80	0.00	9.80	40.00	30.2	100	0	
Vert.	98.232	QP	18.50	8.60	5.30	26.70	0.00	5.70	43.50	37.8	100	0	
Vert.	165.957	QP	17.70	13.20	6.00	26.40	0.00	10.50	43.50	33.0	100	0	
Vert.	4880.000	PK	53.90	31.30	5.80	41.70	3.40	52.70	73.90	21.2	135	50	
Vert.	7320.000	PK	47.50	36.40	7.20	40.80	3.40	53.70	73.90	20.2	148	186	
Vert.	9760.000	PK	43.00	39.50	8.30	39.50	3.40	54.70	73.90	19.2	100	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(4.42\text{ m} / 3.0\text{ m}) = 3.4\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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	47.30	31.30	5.80	41.70	0.67	3.40	46.77	53.90	7.1	
Hori.	7320.000	AV	38.40	36.40	7.20	40.80	0.67	3.40	45.27	53.90	8.6	
Hori.	9760.000	AV	31.00	39.50	8.30	39.50	0.67	3.40	43.37	53.90	10.5	Floor noise
Vert.	4880.000	AV	47.30	31.30	5.80	41.70	0.67	3.40	46.77	53.90	7.1	
Vert.	7320.000	AV	37.70	36.40	7.20	40.80	0.67	3.40	44.57	53.90	9.3	
Vert.	9760.000	AV	31.00	39.50	8.30	39.50	0.67	3.40	43.37	53.90	10.5	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(4.42\text{ m} / 3.0\text{ m}) = 3.4\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission

Report No.	12083953M-A		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.10	No.10	No.10
Date	January 14, 2018	January 13, 2018	January 14, 2018
Temperature / Humidity	19 deg. C / 42 % RH	18 deg. C / 40 % RH	19 deg. C / 42 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 18 GHz)	(18 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.	45.677	QP	20.60	13.70	4.50	26.80	0.00	12.00	40.00	28.0	180	140	
Hori.	2483.500	PK	50.90	27.40	13.80	41.90	3.40	53.60	73.90	20.3	180	355	
Hori.	4960.000	PK	54.20	31.30	5.80	41.70	3.40	53.00	73.90	20.9	164	139	
Hori.	7440.000	PK	48.30	36.70	7.30	40.80	3.40	54.90	73.90	19.0	155	147	
Hori.	9920.000	PK	43.50	39.40	8.40	39.30	3.40	55.40	73.90	18.5	150	0	Floor noise
Vert.	30.000	QP	19.10	12.60	4.20	26.90	0.00	9.00	40.00	31.0	100	90	
Vert.	45.711	QP	23.40	13.70	4.50	26.80	0.00	14.80	40.00	25.2	100	350	
Vert.	67.298	QP	19.50	12.10	4.80	26.80	0.00	9.60	40.00	30.4	100	0	
Vert.	92.602	QP	18.60	7.90	5.20	26.70	0.00	5.00	43.50	38.5	100	0	
Vert.	165.666	QP	17.80	13.30	6.00	26.40	0.00	10.70	43.50	32.8	100	0	
Vert.	2483.500	PK	51.70	27.40	13.80	41.90	3.40	54.40	73.90	19.5	167	300	
Vert.	4960.000	PK	54.40	31.30	5.80	41.70	3.40	53.20	73.90	20.7	140	38	
Vert.	7440.000	PK	47.60	36.70	7.30	40.80	3.40	54.20	73.90	19.7	148	189	
Vert.	9920.000	PK	42.80	39.40	8.40	39.30	3.40	54.70	73.90	19.2	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log(4.42 m / 3.0 m) = 3.4 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	35.40	27.40	13.80	41.90	0.67	3.40	38.77	53.90	15.1	*1)
Hori.	4960.000	AV	49.70	31.30	5.80	41.70	0.67	3.40	49.17	53.90	4.7	
Hori.	7440.000	AV	38.80	36.70	7.30	40.80	0.67	3.40	46.07	53.90	7.8	
Hori.	9920.000	AV	32.30	39.40	8.40	39.30	0.67	3.40	44.87	53.90	9.0	Floor noise
Vert.	2483.500	AV	35.40	27.40	13.80	41.90	0.67	3.40	38.77	53.90	15.1	*1)
Vert.	4960.000	AV	47.70	31.30	5.80	41.70	0.67	3.40	47.17	53.90	6.7	
Vert.	7440.000	AV	38.30	36.70	7.30	40.80	0.67	3.40	45.57	53.90	8.3	
Vert.	9920.000	AV	32.40	39.40	8.40	39.30	0.67	3.40	44.97	53.90	8.9	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log(4.42 m / 3.0 m) = 3.4 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)

UL Japan, Inc.

Kashima EMC Lab.

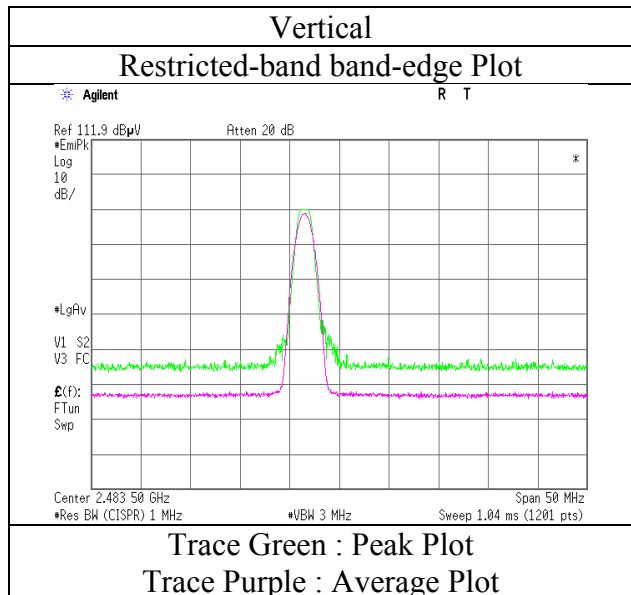
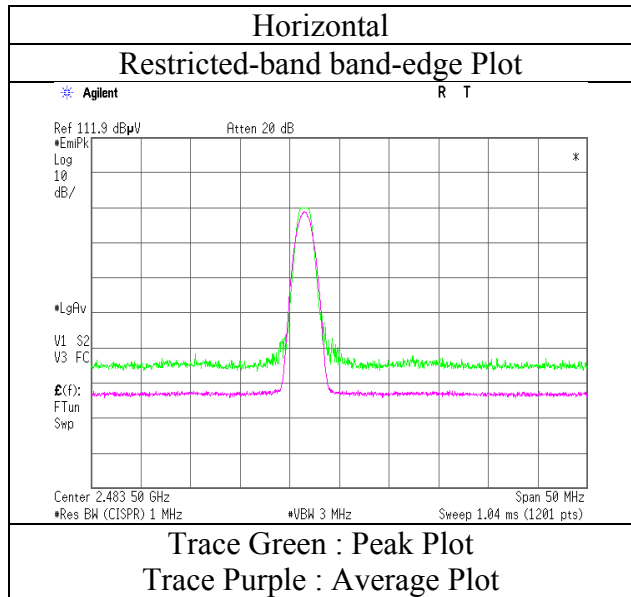
1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission
(Reference Plot for band-edge)

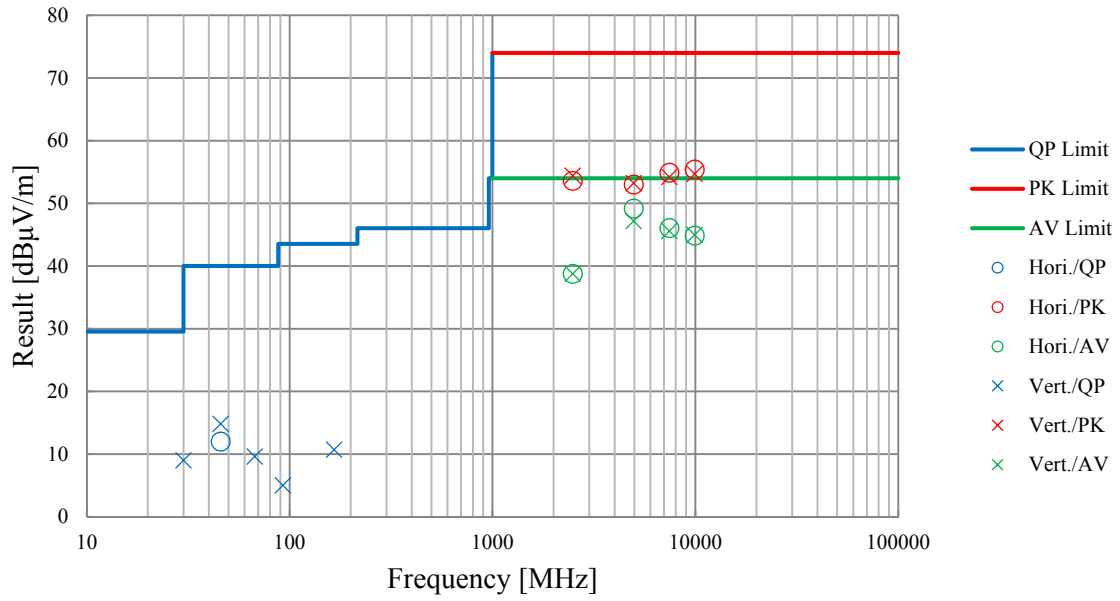
Report No. 12083953M-A
Test place Kashima EMC Lab.
Semi Anechoic Chamber No.10
Date January 13, 2018
Temperature / Humidity 18 deg. C / 40 % RH
Engineer Hiromitsu Tanabe
(1 GHz - 18 GHz)
Mode Tx BT LE 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

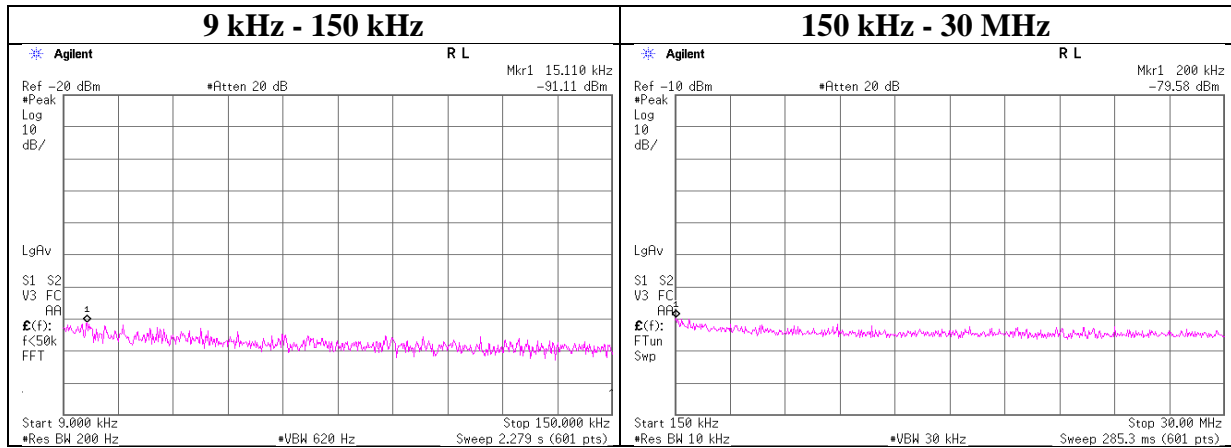
Report No.	12083953M-A		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.10	No.10	No.10
Date	January 14, 2018	January 13, 2018	January 14, 2018
Temperature / Humidity	19 deg. C / 42 % RH	18 deg. C / 40 % RH	19 deg. C / 42 % RH
Engineer	Kazuhiro Ando	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz - 1000 MHz)	(1 GHz - 18 GHz)	(18 GHz - 26.5 GHz)
Mode	Tx BT LE 2480 MHz		



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

Conducted Spurious Emission

Test place : Kashima EMC Lab. No.2 Measurement Room
 Report No. : 12083953M-A
 Date : January 10, 2018
 Temperature / Humidity : 20 deg. C / 38 % RH
 Engineer : Kazuhiro Ando
 Mode : Tx BT LE 2402MHz



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
15.11	-91.1	0.01	9.9	2.0	1	-79.2	300	6.0	-17.9	44.0	61.9	
200.00	-79.6	0.01	9.9	2.0	1	-67.6	300	6.0	-6.4	21.5	27.9	

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

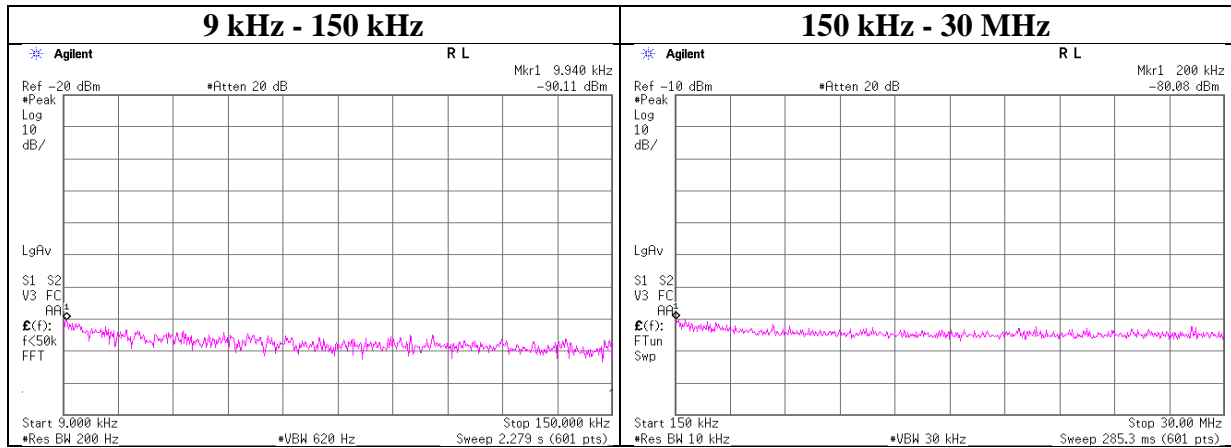
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

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.

Conducted Spurious Emission

Test place	Kashima EMC Lab. No.2 Measurement Room
Report No.	12083953M-A
Date	January 10, 2018
Temperature / Humidity	20 deg. C / 38 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE 2440MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.94	-90.1	0.01	9.9	2.0	1	-78.2	300	6.0	-16.9	47.6	64.5	
200.00	-80.1	0.01	9.9	2.0	1	-68.1	300	6.0	-6.9	21.5	28.4	

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

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

N: Number of output

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

UL Japan, Inc.

Kashima EMC Lab.

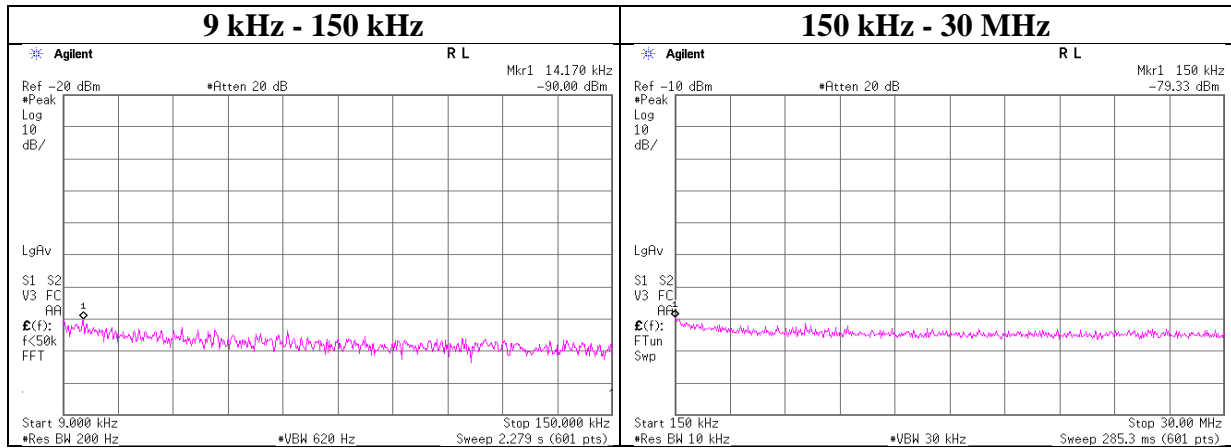
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Conducted Spurious Emission

Test place	Kashima EMC Lab. No.2 Measurement Room
Report No.	12083953M-A
Date	January 10, 2018
Temperature / Humidity	20 deg. C / 38 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE 2480MHz



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
14.17	-90.0	0.01	9.9	2.0	1	-78.0	300	6.0	-16.8	44.5	61.3	
150.00	-79.3	0.01	9.9	2.0	1	-67.4	300	6.0	-6.1	24.0	30.1	

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

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

N: Number of output

*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.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Power Density

Test place Kashima EMC Lab. No.2 Measurement Room
Report No. 12083953M-A
Date January 10, 2018
Temperature / Humidity 20 deg. C / 38 % 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	-27.56	1.45	10.04	-16.07	8.00	24.07
2440.00	-27.72	1.45	10.04	-16.23	8.00	24.23
2480.00	-27.23	1.45	10.04	-15.74	8.00	23.74

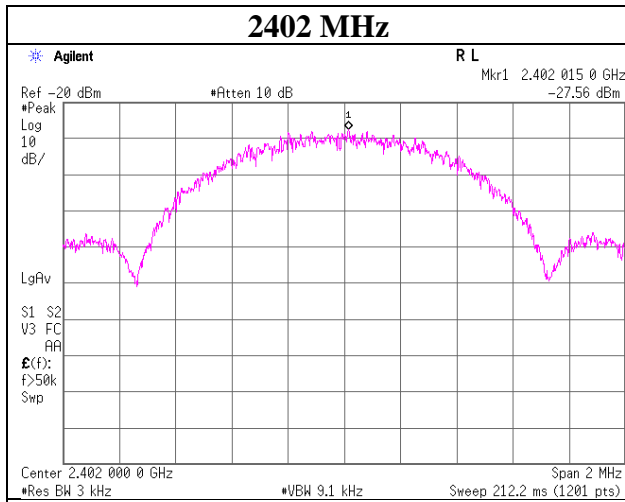
Sample Calculation:

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

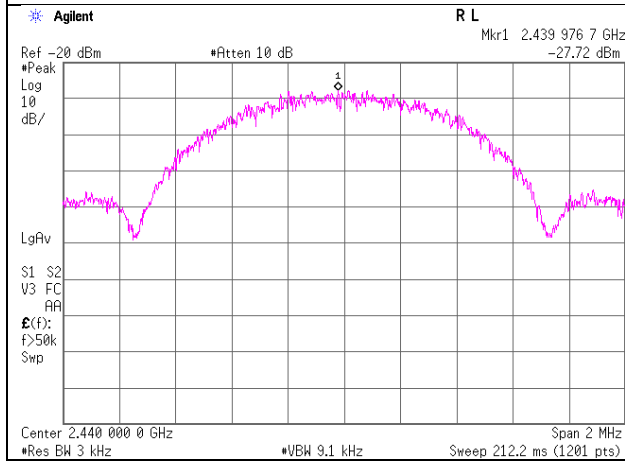
Power Density

BT LE

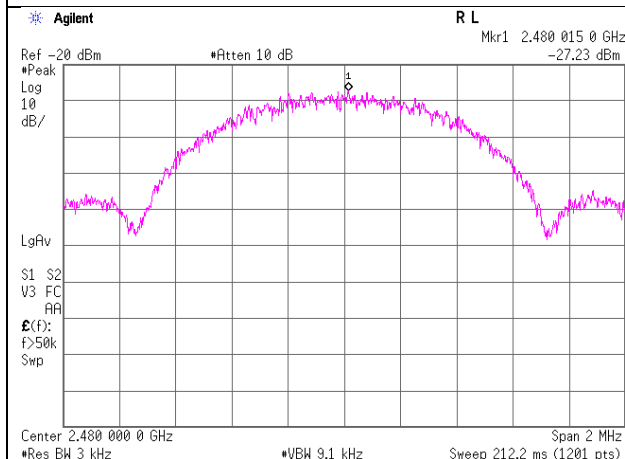
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test Instruments

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
CTR-09	Test Receiver	Agilent	N9038A	MY53290016 Version A.14.03	RE	2017/06/27 * 12
CBL-08	LOGBICON	Schwarzbeck	VULB 9168	343	RE	2017/04/10 * 12
CAT3-04	3dB Fixed Atten.	TAMAGAWA	UFA-01	none	RE	2017/09/04 * 12
CCC-S10-R(2/4/CAT S-11/5/6/7/8/11/12)	Coaxial Cable	Fujikura,Fujikura,Agilent,Fujikura,Fujikura,Fujikura,Fujikura	5D-2W,5D-2W,8494A,5D-2W,5D-2W,5D-2W,5D-2W,5D-2W	MY41110200(Step Att)	RE	2017/08/25 * 12
CAF-08	Pre-Amplifier	Hewlett Packard	8447D	2944A09041	RE	2017/08/25 * 12
CSCL-13	Ruler	Tajima	L19-55	none	RE	-
COS-10	Temperature & Humidity Indicator	HIOKI	3641/9680-50	090999895/090905406	RE	2017/05/16 * 12
CTS-14	Digital Multimeter	FLUKE	115	994460954	RE	2017/10/02 * 12
COTS-CE MI-02	EMI Software	TSJ	TEPTO-DV(RE,CE,MF,PE)	Ver, RE: 2.5.0131, CE: 2.5.0131, ME: 2.5.0129, PE: 2.5.0129	RE	-
CHA-20	Broad Band Horn	Schwarzbeck	BBHA 9120D	9120D-1270	RE	2017/06/15 * 12
CAF-18	Pre-Amplifier	TOYO	TPA0118-36	A-1001	RE	2017/11/02 * 12
CCC-G09	Micro Wave Cable	Junkosha	MWX221	1407S222	RE	2017/11/02 * 12
CCC-G10	Micro Wave Cable	Junkosha	MWX221	J12J102343-00	RE	2017/11/02 * 12
CCC-W09	Micro Wave Cable	SUHNER	SUCOFLEX104	MY588/4	RE	2017/07/18 * 12
CSA-07	Spectrum Analyzer	Agilent	E4448A	MY52490024 Version A.11.21	RE/AT	2017/05/31 * 12
CHA-07	Double Ridged Horn	ETS-Lindgren	3160-09	00166043	RE	2017/06/27 * 12
CAF-19	Pre-Amplifier	TOYO	HAP18-26W	00000035	RE	2017/06/28 * 12
CAT10-16	10dB Fixed Atten.	Weinschel	54A-10	56246	RE	2017/05/19 * 12
CHF-03	HPF	Micro-Tronics	HPM50111-02	008	RE	2017/05/19 * 12
CAT10-17	10dB Fixed Atten.	Weinschel	54A-10	56251	AT	2017/05/19 * 12
CCC-W01	Micro Wave Cable	SUHNER	SUCOFLEX102	MY3662/2	AT	2017/05/19 * 12
CPM-16	Peak Power Analyzer	Agilent	8990B	MY51000276	AT	2017/06/09 * 12
CPSO-24	Power Sensor	Agilent	N1923A	MY54070024	AT	2017/06/09 * 12
COS-05	Temperature & Humidity Indicator	A&D	AD-5681	6975761	AT	2017/07/20 * 12
CTS-18	Digital Multimeter	FLUKE	87-3	85220051	AT	2017/09/11 * 12

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

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

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

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

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373