



RADIO TEST REPORT

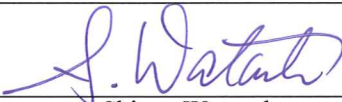
Test Report No. : 11233381H

Applicant : ALPS ELECTRIC CO., LTD.
Type of Equipment : JINS MEME
Model No. : WGA-15A
FCC ID : CWTCVAAW0A
Test regulation : FCC Part 15 Subpart C: 2015
Test Result : Complied

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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 above regulation.
4. The test results in this 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 NVLAP, NIST, or 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)

Date of test: April 27 to May 11, 2016

Representative test engineer:


Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:


Tsubasa Takayama
Engineer
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 11233381H

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SECTION 1: Customer information

Company Name	:	ALPS ELECTRIC CO., LTD.
Address	:	6-3-36, Furukawanakazato, Osaki-city, Miyagi-pref. 989-6181 JAPAN
Telephone Number	:	+81-229-24-6341
Facsimile Number	:	+81-229-24-7016
Contact Person	:	Yuji Ouchi

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

2.1 Identification of E.U.T.

Type of Equipment	:	JINS MEME
Model No.	:	WGA-15A
Serial No.	:	Refer to Clause 4.2
Rating	:	DC 5.0 V
Receipt Date of Sample	:	April 25, 2016
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: WGA-15A (referred to as the EUT in this report) is a JINS MEME.

General Specification

Clock frequency(ies) in the system	:	32.768 kHz (Crystal), 16 MHz (Crystal), 25 MHz (CPU)
------------------------------------	---	--

Radio Specification

Bluetooth Low Energy (Ver.4.0+EDR/LE Dual mode)

Equipment Type	:	Transceiver
Frequency of Operation	:	2402 - 2480MHz
Type of Modulation	:	GFSK
Power Supply (inner)	:	DC 3.0 V
Antenna Type	:	Monopole Antenna
Antenna Gain	:	0.9 dBi
Operating Temperature	:	0 deg. C to +40 deg. C

Model No. WGA-15A(main model) has variant model No. WGD-15A.
The difference of the main model and variant model

Model	Electrical components	Mechanical components	CPU firm ware	Engraved mark
WGD-15A (Variant model)	Same	Same	Difference with main model that following details	Difference only printing

WGA-15A (Main model)

It transmits data at 100 Hz cycle in Bluetooth connection.
Data to be transmitted sends the value of the sensor data.

WGD-15A

It transmits data at 20 Hz cycle in Bluetooth connection.
Data to be transmitted inside calculates the sensor data (walking detection, and so detect the movement of the eye) and send the results.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2015, final revised on November 23, 2015
 *Some parts are effective on and after December 17, 2015 or December 23, 2015. The revision 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

* The EUT complies with FCC Part 15 Subpart B: 2015, final revised on November 23, 2015.

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	QP 22.7 dB, 0.35950 MHz, L AV 17.2 dB, 0.35950 MHz, L	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(1)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(4)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(2)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	3.2 dB 9608.00 MHz, AV, Vertical	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *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 DTS Meas Guidance v03r05 12.2.7.

* 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 (DC 3.0V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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3.3 Addition to standard

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

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

3.4 Uncertainty

EMI

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

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Antenna terminal test Uncertainty (+/-)							
Power meter		Conducted emission and Power density			Conducted emission		Channel power
Below 1 GHz	Above 1 GHz	Below 1 GHz	1 GHz - 3 GHz	3 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz	
0.9 dB	1.0 dB	1.4 dB	1.7 dB	2.8 dB	2.8 dB	2.9 dB	2.6 dB

Frequency range	Conducted emission using AMN(LISN) (+dB)
0.009 – 0.15MHz	3.5 dB
0.15 – 30MHz	2.9 dB

Test distance	Radiated emission (+dB) 9 kHz - 30 MHz
3m	3.8 dB
10m	3.7 dB

Polarity	Radiated emission (Below 1GHz)			
	(3 m*)(+dB)		(10 m*)(+dB)	
	30 – 200 MHz	200 – 1000MHz	30 – 200 MHz	200 – 1000MHz
Horizontal	4.9 dB	5.2 dB	4.9 dB	5.0 dB
Vertical	4.6 dB	5.9 dB	5.0 dB	5.0 dB

Radiated emission				
(3 m*)(+dB)		(1 m*)(+dB)	(0.5 m*)(+dB)	(10 m*)(+dB)
1 – 6GHz	6 – 18GHz	10 – 26.5 GHz	26.5 – 40GHz	1 -18 GHz
5.1 dB	5.3 dB	5.1 dB	5.1 dB	5.3 dB

*Measurement distance

Conducted Emission test

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

Radiated emission test

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

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3.5 Test Location

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Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	N/A	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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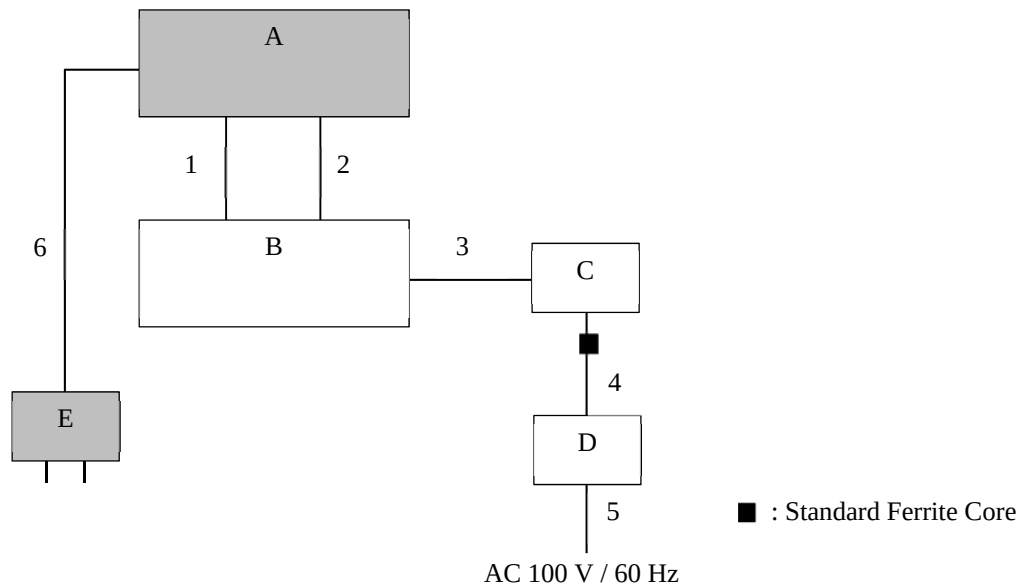
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Bluetooth (BT) Low Energy (LE): Transmitting (Tx)

Test Item	Operating Mode	Tested Frequency
Conducted Emission Spurious Emission 6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	Tx BT LE	2402MHz 2440MHz 2480MHz
*Power of the EUT was set by the software as follows; Power settings: 0dBm Software: application: ALPS_Dialog_DLL_exe.exe (custom) firmware: cust_prod_test_ES5_ALPS_PIO_3060_test_P45.hex (custom) This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	JINS MEME	WGA-15A	CVAA1704-D *1) CVAA1704-E *2)	ALPS ELECTRIC CO., LTD.	EUT
B	Jig board	-	-	-	-
C	Laptop PC	CF-N8HWCDPS	0BKSA08702	Panasonic	-
D	AC Adapter	CF-AA6372B MA	6372BM409121200B	Panasonic	-
E	AC adapter	GCF305S-0510BC	1509-0009047	GV CFECHNOLOGY CO., LTD	EUT

*1) Used for Radiated emission Test only.

*2) Used for Antenna Terminal Conducted Tests only.

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	2.6	Unshielded	Unshielded	-
2	Signal Cable	2.6	Unshielded	Unshielded	-
3	USB Cable	1.8	Shielded	Shielded	-
4	DC Cable	1.1	Unshielded	Unshielded	-
5	AC Cable	0.9	Unshielded	Unshielded	-
6	USB Cable	0.9	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

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

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

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

SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "558074 D01 DTS Meas Guidance v03r05".

[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	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	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 *3)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: <u>12.2.5.1</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	3 m *1) (1 GHz – 10 GHz), 1 m *2) (10 GHz – 26.5 GHz)		3 m *1) (1 GHz – 10 GHz), 1 m *2) (10 GHz – 26.5 GHz)

*1) Distance Factor: $20 \times \log(4.5 \text{ m} / 3.0 \text{ m}) = 3.53 \text{ dB}$

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

*3) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r05"

- 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.

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Charging condition and Battery operating condition were confirmed at pre check.
The tests were performed with the worst condition.

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

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

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1 kHz	27 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v03r05". *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.							

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

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

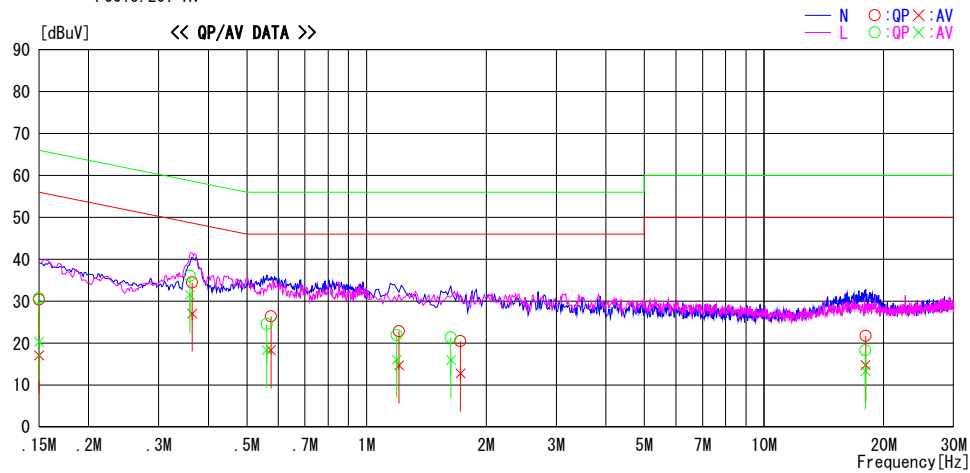
UL Japan, Inc. Ise EMC Lab. No.2 Semi Anechoic Chamber
Date : 2016/05/11

Report No. : 11233381H

Temp./Humi. : 24deg. C / 45% RH
Engineer : Shinichi Miyazono

Mode / Remarks : Tx BTLE 2402MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15000	17.0	3.8	13.3	30.3	17.1	66.0	56.0	35.7	38.9	N	
0.36435	21.2	13.8	13.3	34.5	27.1	58.6	48.6	24.2	21.5	N	
0.57445	13.0	4.9	13.4	26.4	18.3	56.0	46.0	29.6	27.7	N	
1.20772	9.3	1.2	13.5	22.8	14.7	56.0	46.0	33.2	31.3	N	
1.72280	7.0	-0.7	13.5	20.5	12.8	56.0	46.0	35.5	33.2	N	
18.01200	5.5	-1.5	16.3	21.8	14.8	60.0	50.0	38.3	35.2	N	
0.15000	17.4	7.0	13.3	30.7	20.3	66.0	56.0	35.3	35.7	L	
0.35950	22.7	18.2	13.3	36.0	31.5	58.7	48.7	22.7	17.2	L	
0.56073	11.2	4.9	13.4	24.6	18.3	56.0	46.0	31.4	27.7	L	
1.19172	8.5	2.7	13.4	21.9	16.1	56.0	46.0	34.1	29.9	L	
1.62920	7.9	2.5	13.5	21.4	16.0	56.0	46.0	34.6	30.0	L	
17.97520	2.0	-3.0	16.3	18.3	13.3	60.0	50.0	41.7	36.7	L	

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

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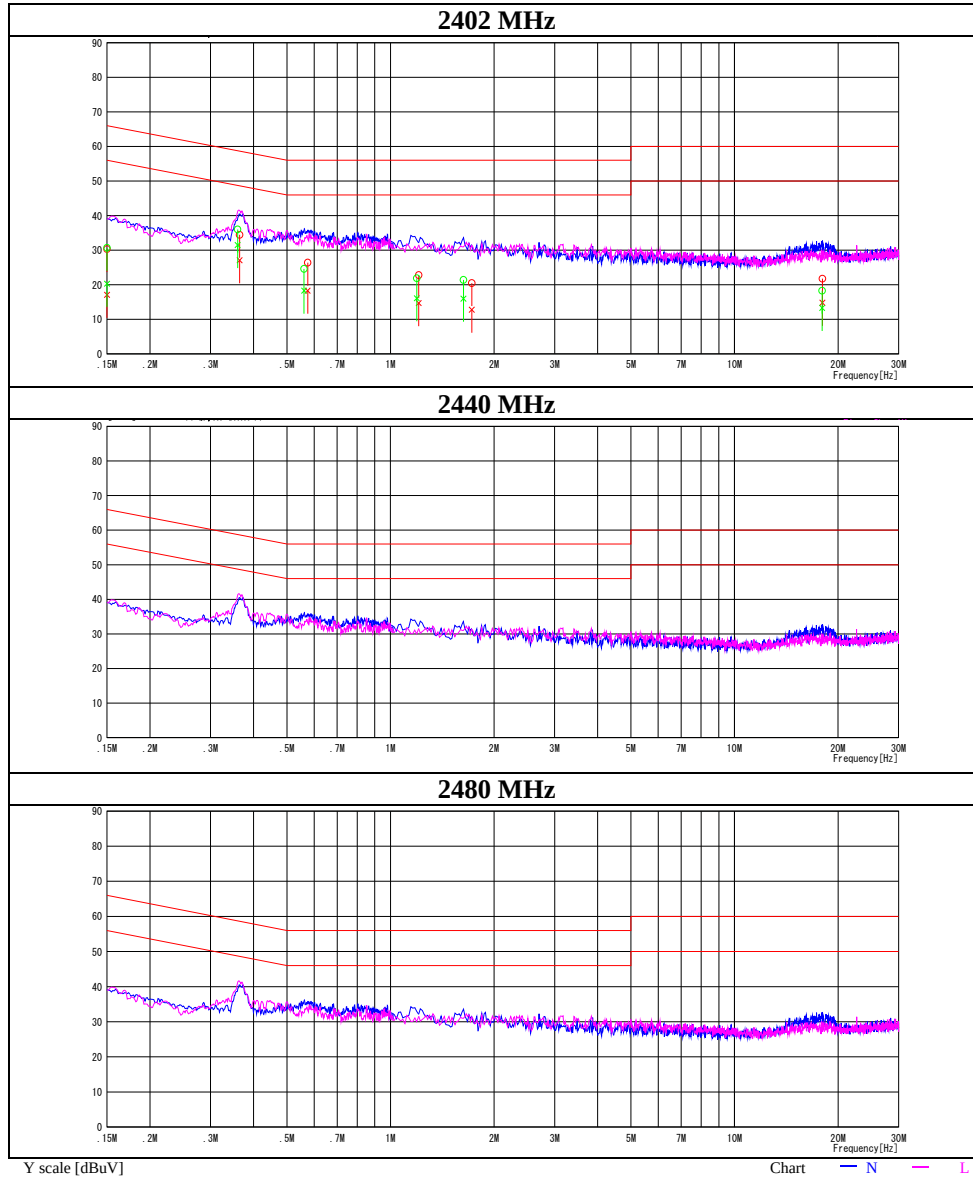
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Conducted Emission

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 11233381H
Date : May 11, 2016
Temperature / Humidity : 24 deg. C / 45 % RH
Engineer : Shinichi Miyazono
Mode : Tx BT LE



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6dB Bandwidth

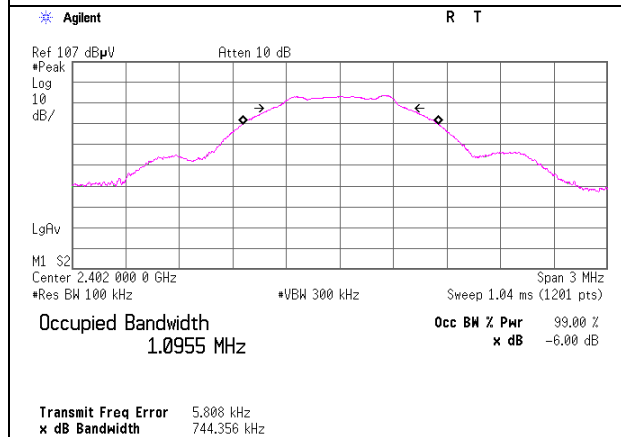
Test place Ise EMC Lab. No.6 Measurement Room
Report No. 11233381H
Date April 27, 2016
Temperature / Humidity 23 deg. C / 50 % RH
Engineer Shinya Watanabe
Mode Tx BT LE

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
BT LE	2402	0.744	> 500
	2440	0.738	> 500
	2480	0.731	> 500

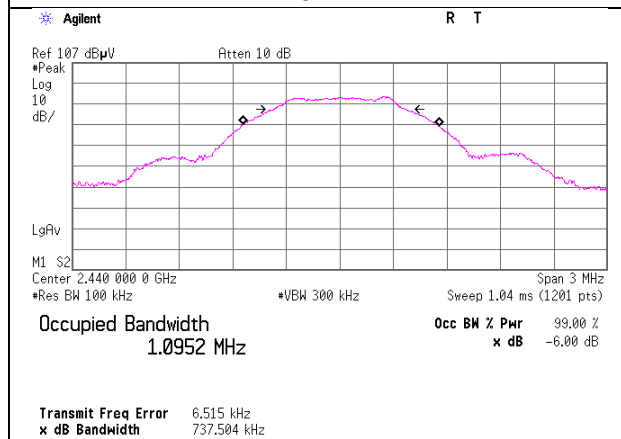
6dB Bandwidth

BT LE

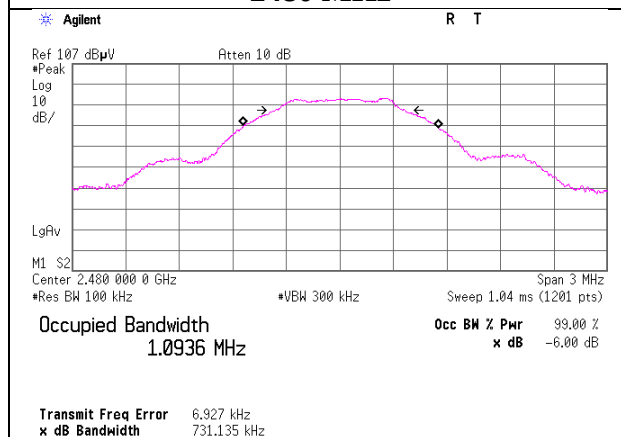
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place Ise EMC Lab. No.6 Measurement Room
Report No. 11233381H
Date April 27, 2016
Temperature / Humidity 23 deg. C / 50 % RH
Engineer Shinya Watanabe
Mode Tx BT LE

BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-14.13	0.60	10.03	-3.50	0.45	30.00	1000	33.50
2440	-14.60	0.60	10.03	-3.97	0.40	30.00	1000	33.97
2480	-15.07	0.60	10.03	-4.44	0.36	30.00	1000	34.44

Sample Calculation:

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

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

Average Output Power
(Reference data for RF Exposure / SAR testing)

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11233381H
Date	April 27, 2016
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Shinya Watanabe
Mode	Tx BT LE

BTLE

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	-15.85	0.60	10.03	-5.22	0.30	0.00	-5.22	0.30
2440	-15.40	0.60	10.03	-4.77	0.33	0.00	-4.77	0.33
2480	-15.92	0.60	10.03	-5.29	0.30	0.00	-5.29	0.30

Sample Calculation:

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

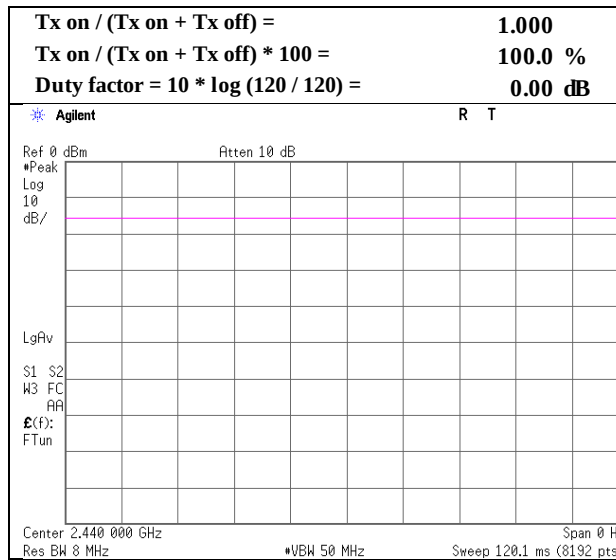
Result (Burst power average) = Time average + Duty factor

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

Burst rate confirmation

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11233381H
Date	April 27, 2016
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Shinya Watanabe
Mode	Tx BT LE

BTLE



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Radiated Spurious Emission

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber	
Report No.	11233381H	
Date	April 29, 2016	May 1, 2016
Temperature / Humidity	22 deg. C / 41 % RH	23 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka	Hiroyuki Furutaka
	Above 1GHz	Below 1GHz
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	138.850	QP	24.4	14.4	8.5	32.0	-	15.3	43.5	28.2	
Hori	240.000	QP	24.6	12.1	9.4	31.9	-	14.2	46.0	31.8	
Hori	285.996	QP	23.7	13.2	9.8	31.8	-	14.9	46.0	31.1	
Hori	309.100	QP	25.1	13.7	10.0	31.8	-	17.0	46.0	29.0	
Hori	342.000	QP	26.6	14.4	10.2	31.9	-	19.3	46.0	26.7	
Hori	359.998	QP	29.3	14.8	10.3	32.0	-	22.4	46.0	23.6	
Hori	2390.000	PK	42.0	27.9	6.8	32.1	-	44.6	73.9	29.3	
Hori	4804.000	PK	42.1	32.8	9.2	31.3	-	52.8	73.9	21.1	
Hori	7206.000	PK	42.4	36.8	10.4	32.6	-	57.0	73.9	16.9	
Hori	9608.000	PK	43.0	38.1	11.1	32.6	-	59.6	73.9	14.3	
Hori	2390.000	AV	33.2	27.9	6.8	32.1	-	35.8	53.9	18.1	
Hori	4804.000	AV	33.9	32.8	9.2	31.3	-	44.6	53.9	9.3	
Hori	7206.000	AV	34.6	36.8	10.4	32.6	-	49.2	53.9	4.7	
Hori	9608.000	AV	33.7	38.1	11.1	32.6	-	50.3	53.9	3.6	
Vert	35.119	QP	25.4	15.7	7.2	32.1	-	16.2	40.0	23.8	
Vert	50.006	QP	30.6	10.6	7.4	32.1	-	16.5	40.0	23.5	
Vert	60.000	QP	37.9	7.5	7.6	32.1	-	20.9	40.0	19.1	
Vert	64.000	QP	33.6	6.9	7.6	32.1	-	16.0	40.0	24.0	
Vert	168.000	QP	28.5	15.6	8.8	32.0	-	20.9	43.5	22.6	
Vert	240.000	QP	27.8	12.1	9.4	31.9	-	17.4	46.0	28.6	
Vert	2390.000	PK	41.1	27.9	6.8	32.1	-	43.7	73.9	30.2	
Vert	4804.000	PK	44.2	32.8	9.2	31.3	-	54.9	73.9	19.0	
Vert	7206.000	PK	43.0	36.8	10.4	32.6	-	57.6	73.9	16.3	
Vert	9608.000	PK	42.0	38.1	11.1	32.6	-	58.6	73.9	15.3	
Vert	2390.000	AV	33.3	27.9	6.8	32.1	-	35.9	53.9	18.0	
Vert	4804.000	AV	35.7	32.8	9.2	31.3	-	46.4	53.9	7.5	
Vert	7206.000	AV	34.0	36.8	10.4	32.6	-	48.6	53.9	5.3	
Vert	9608.000	AV	34.1	38.1	11.1	32.6	-	50.7	53.9	3.2	

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

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

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 1 GHz - 10 GHz 20log (4.5m / 3.0 m) = 3.53 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	82.2	28.0	6.8	32.1	84.9	-	-	Carrier
Hori	2400.000	PK	36.0	28.0	6.8	32.1	38.7	64.9	26.2	
Vert	2402.000	PK	80.9	28.0	6.8	32.1	83.6	-	-	Carrier
Vert	2400.000	PK	37.5	28.0	6.8	32.1	40.2	63.6	23.4	

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

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Ise EMC Lab.

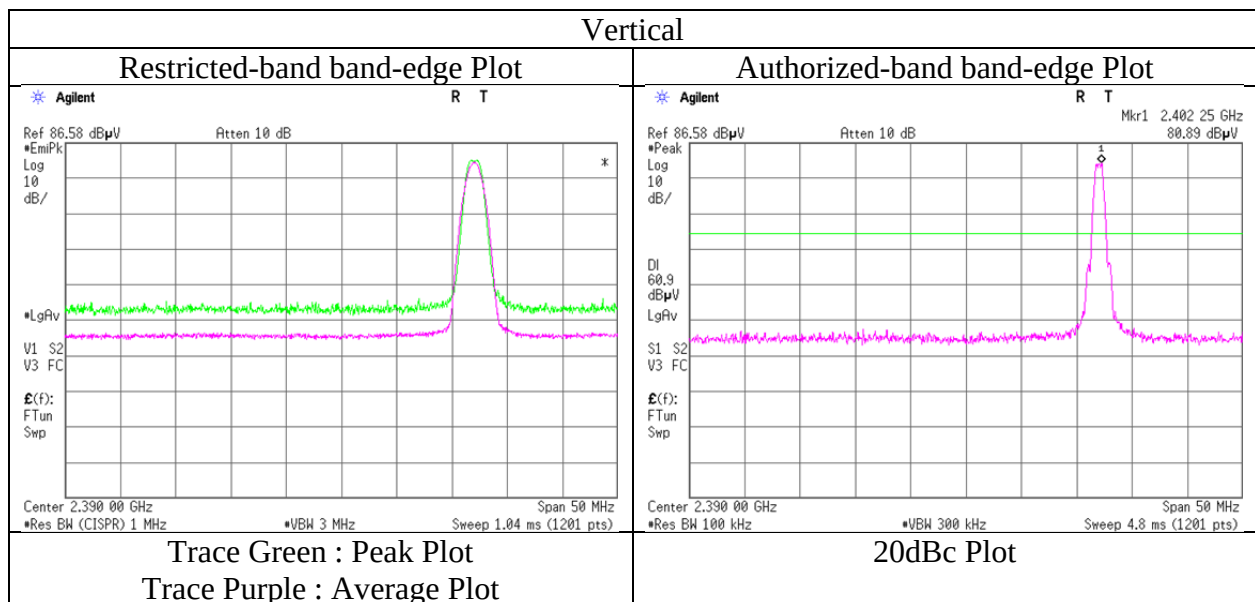
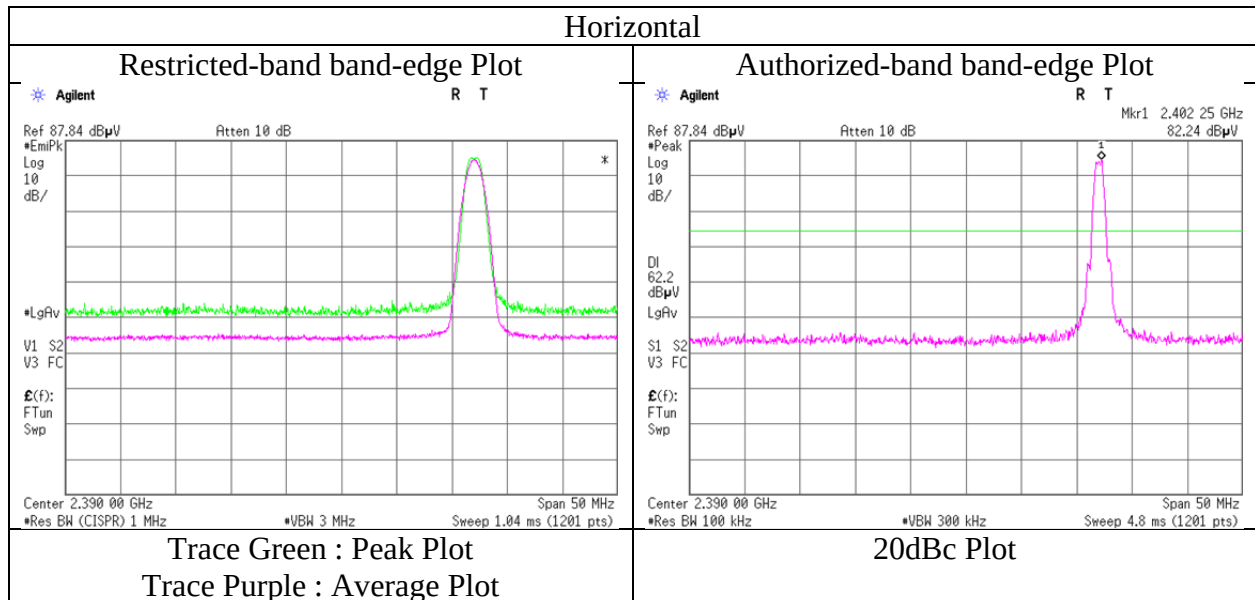
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Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11233381H
Date	April 29, 2016
Temperature / Humidity	22 deg. C / 41 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2402MHz



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

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Radiated Spurious Emission

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11233381H
Date	April 29, 2016 May 1, 2016
Temperature / Humidity	22 deg. C / 41 % RH 23 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka Hiroyuki Furutaka
	Above 1GHz Below 1GHz
Mode	Tx BT LE 2440 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	138.900	QP	24.6	14.4	8.5	32.0	-	15.5	43.5	28.0	
Hori	240.000	QP	24.7	12.1	9.4	31.9	-	14.3	46.0	31.7	
Hori	282.883	QP	26.4	13.1	9.8	31.8	-	17.5	46.0	28.5	
Hori	299.996	QP	27.4	13.4	9.9	31.8	-	18.9	46.0	27.1	
Hori	342.000	QP	24.5	14.4	10.2	31.9	-	17.2	46.0	28.8	
Hori	359.997	QP	28.7	14.8	10.3	32.0	-	21.8	46.0	24.2	
Hori	4880.000	PK	42.8	33.1	9.3	31.3	-	53.9	73.9	20.0	
Hori	7320.000	PK	42.3	36.8	10.4	32.6	-	56.9	73.9	17.0	Floor Noise
Hori	9760.000	PK	42.8	38.2	11.2	32.7	-	59.5	73.9	14.4	Floor Noise
Hori	4880.000	AV	35.5	33.1	9.3	31.3	-	46.6	53.9	7.3	
Hori	7320.000	AV	34.4	36.8	10.4	32.6	-	49.0	53.9	4.9	Floor Noise
Hori	9760.000	AV	33.5	38.2	11.2	32.7	-	50.2	53.9	3.7	Floor Noise
Vert	35.118	QP	25.2	15.7	7.2	32.1	-	16.0	40.0	24.0	
Vert	50.000	QP	30.4	10.7	7.4	32.1	-	16.4	40.0	23.6	
Vert	60.000	QP	37.8	7.5	7.6	32.1	-	20.8	40.0	19.2	
Vert	64.000	QP	33.5	6.9	7.6	32.1	-	15.9	40.0	24.1	
Vert	167.000	QP	27.3	15.6	8.8	32.0	-	19.7	43.5	23.8	
Vert	283.639	QP	30.2	13.1	9.8	31.8	-	21.3	46.0	24.7	
Vert	4880.000	PK	43.1	33.1	9.3	31.3	-	54.2	73.9	19.7	
Vert	7320.000	PK	43.1	36.8	10.4	32.6	-	57.7	73.9	16.2	Floor Noise
Vert	9760.000	PK	41.8	38.2	11.2	32.7	-	58.5	73.9	15.4	Floor Noise
Vert	4880.000	AV	35.8	33.1	9.3	31.3	-	46.9	53.9	7.0	
Vert	7320.000	AV	33.8	36.8	10.4	32.6	-	48.4	53.9	5.5	Floor Noise
Vert	9760.000	AV	34.0	38.2	11.2	32.7	-	50.7	53.9	3.2	Floor Noise

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

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

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 1 GHz - 10 GHz 20log (4.5m / 3.0 m) = 3.53 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber	
Report No.	11233381H	
Date	April 30, 2016	May 1, 2016
Temperature / Humidity	23 deg. C / 43 % RH	23 deg. C / 42 % RH
Engineer	Hiroyuki Furutaka	Hiroyuki Furutaka
	Above 1GHz	Below 1GHz
Mode	Tx BT LE 2480 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	138.898	QP	25.0	14.4	8.5	32.0	-	15.9	43.5	27.6	
Hori	240.000	QP	24.9	12.1	9.4	31.9	-	14.5	46.0	31.5	
Hori	282.884	QP	26.9	13.1	9.8	31.8	-	18.0	46.0	28.0	
Hori	299.996	QP	27.6	13.4	9.9	31.8	-	19.1	46.0	26.9	
Hori	342.000	QP	24.7	14.4	10.2	31.9	-	17.4	46.0	28.6	
Hori	360.000	QP	28.7	14.8	10.3	32.0	-	21.8	46.0	24.2	
Hori	2483.500	PK	42.0	28.1	6.9	32.1	-	44.9	73.9	29.0	
Hori	4960.000	PK	43.0	33.4	9.3	31.2	-	54.5	73.9	19.4	
Hori	7440.000	PK	42.6	36.8	10.4	32.7	-	57.1	73.9	16.8	Floor Noise
Hori	9920.000	PK	42.8	38.3	11.2	32.8	-	59.5	73.9	14.4	Floor Noise
Hori	2483.500	AV	34.0	28.1	6.9	32.1	-	36.9	53.9	17.0	
Hori	4960.000	AV	35.0	33.4	9.3	31.2	-	46.5	53.9	7.4	
Hori	7440.000	AV	33.7	36.8	10.4	32.7	-	48.2	53.9	5.7	Floor Noise
Hori	9920.000	AV	33.3	38.3	11.2	32.8	-	50.0	53.9	3.9	Floor Noise
Vert	35.200	QP	25.4	15.7	7.2	32.1	-	16.2	40.0	23.8	
Vert	50.000	QP	30.6	10.7	7.4	32.1	-	16.6	40.0	23.4	
Vert	60.000	QP	37.9	7.5	7.6	32.1	-	20.9	40.0	19.1	
Vert	64.000	QP	33.9	6.9	7.6	32.1	-	16.3	40.0	23.7	
Vert	167.000	QP	27.8	15.6	8.8	32.0	-	20.2	43.5	23.3	
Vert	283.700	QP	30.4	13.1	9.8	31.8	-	21.5	46.0	24.5	
Vert	2483.500	PK	42.4	28.1	6.9	32.1	-	45.3	73.9	28.6	
Vert	4960.000	PK	42.7	33.4	9.3	31.2	-	54.2	73.9	19.7	
Vert	7440.000	PK	42.4	36.8	10.4	32.7	-	56.9	73.9	17.0	Floor Noise
Vert	9920.000	PK	42.0	36.8	10.4	32.7	-	56.5	73.9	17.4	Floor Noise
Vert	2483.500	AV	34.0	28.1	6.9	32.1	-	36.9	53.9	17.0	
Vert	4960.000	AV	33.8	33.4	9.3	31.2	-	45.3	53.9	8.6	
Vert	7440.000	AV	33.5	36.8	10.4	32.7	-	48.0	53.9	5.9	Floor Noise
Vert	9920.000	AV	33.3	36.8	10.4	32.7	-	47.8	53.9	6.1	Floor Noise

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

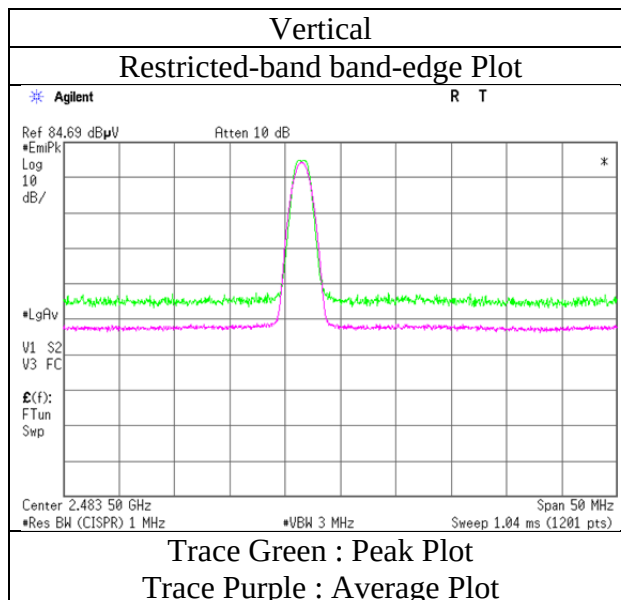
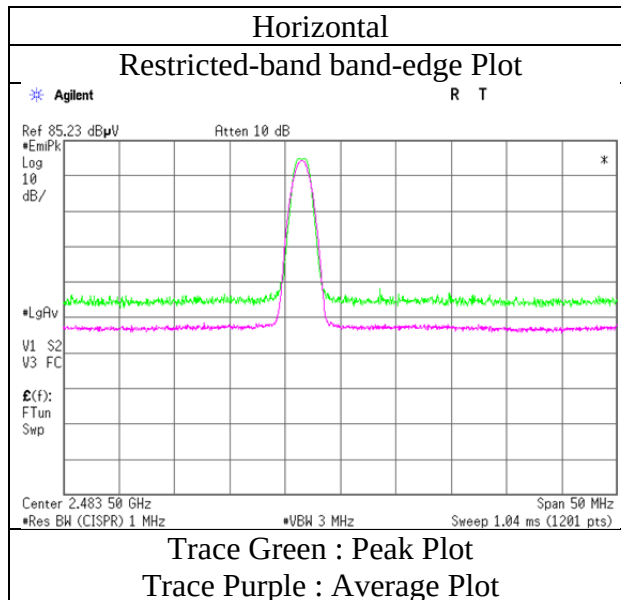
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 1 GHz - 10 GHz $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.53\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission (Reference Plot for band-edge)

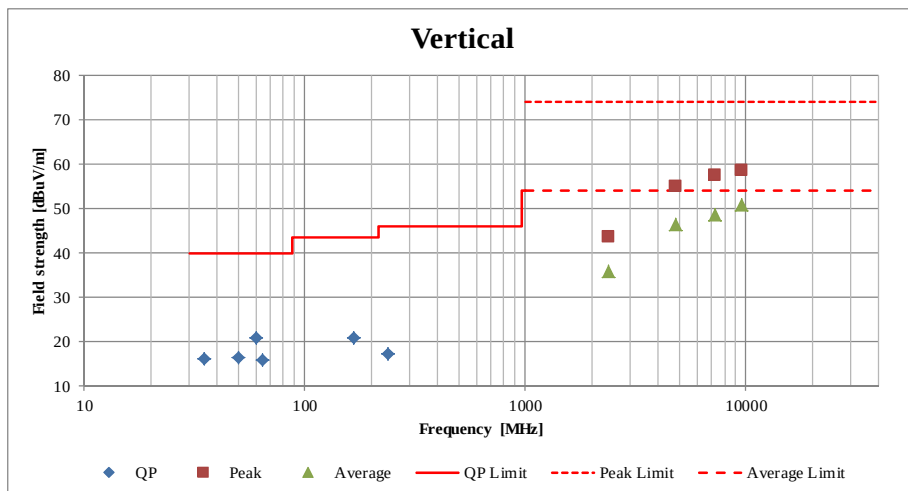
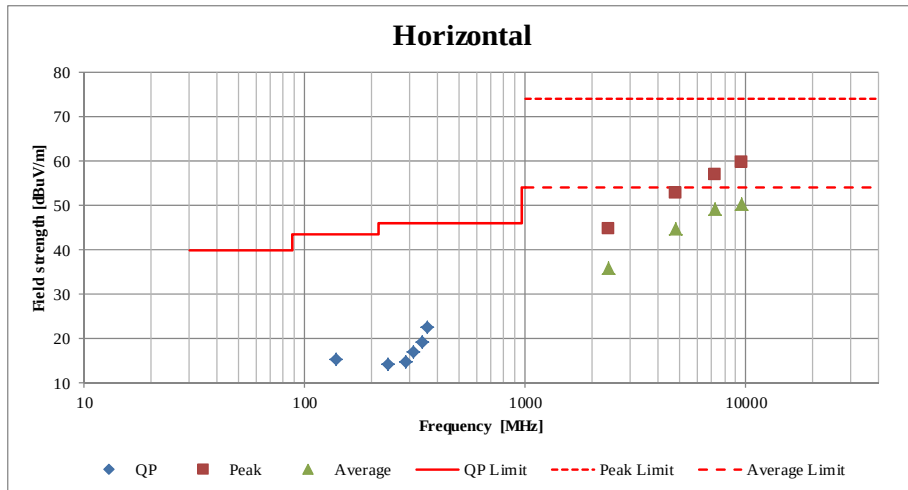
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11233381H
Date	April 30, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2480 MHz



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

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

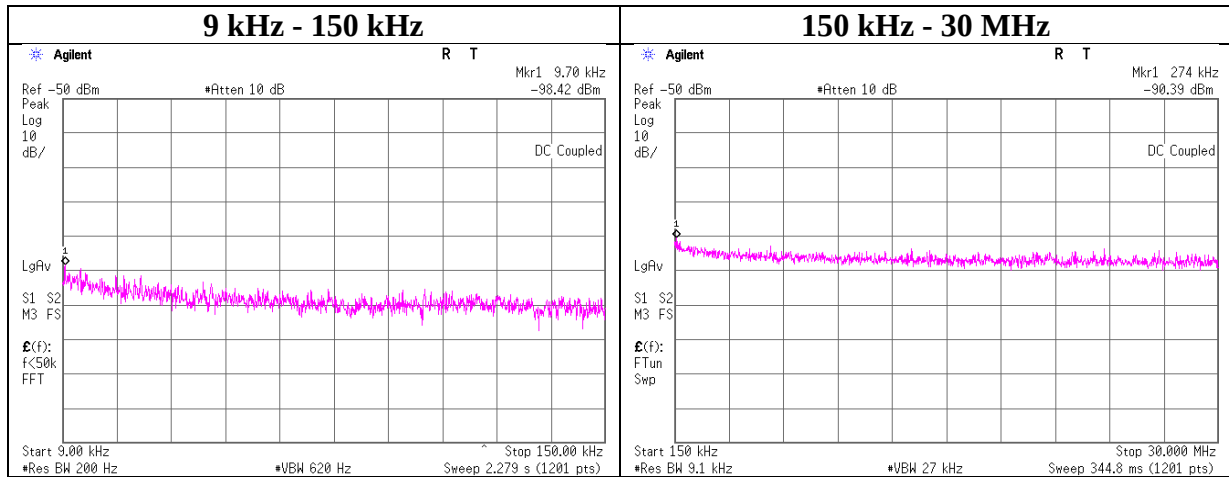
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber		
Report No.	11233381H		
Date	April 29, 2016	May 1, 2016	
Temperature / Humidity	22 deg. C / 41 % RH	23 deg. C / 37 % RH	
Engineer	Hiroyuki Furutaka	Hiroyuki Furutaka	
	Above 1GHz	Below 1GHz	
Mode	Tx BT LE 2402 MHz		



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

Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11233381H
Date	April 27, 2016
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Shinya Watanabe
Mode	Tx BT LE 2402MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]	[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
11.58	-98.4	0.60	10.0	0.9	-86.9	300	6.0	-25.6	46.3	71.9	
150.00	-90.4	0.60	10.0	0.9	-78.9	300	6.0	-17.6	24.0	41.6	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

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Ise EMC Lab.

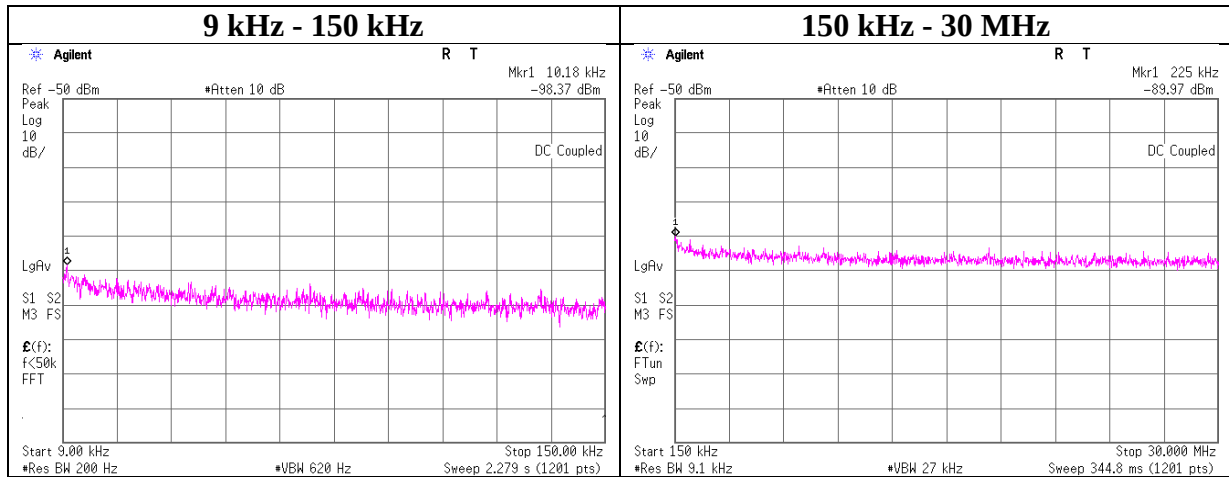
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Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11233381H
Date	April 27, 2016
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Shinya Watanabe
Mode	Tx BT LE 2440MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]	[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
12.88	-98.4	0.60	10.0	0.9	-86.9	300	6.0	-25.6	45.4	71.0	
150.00	-90.0	0.60	10.0	0.9	-78.5	300	6.0	-17.2	24.0	41.2	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

UL Japan, Inc.

Ise EMC Lab.

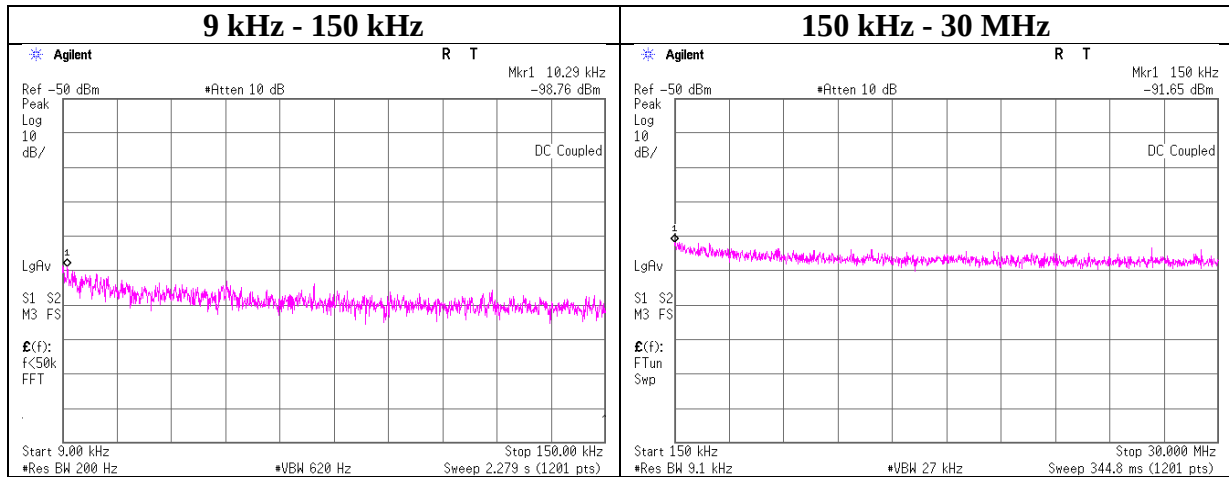
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Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11233381H
Date	April 27, 2016
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Shinya Watanabe
Mode	Tx BT LE 2480MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]	[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
11.00	-98.8	0.60	10.0	0.9	-87.3	300	6.0	-26.0	46.7	72.7	
150.00	-91.7	0.60	10.0	0.9	-80.2	300	6.0	-18.9	24.0	42.9	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

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Power Density

Test place Ise EMC Lab. No.6 Measurement Room
Report No. 11233381H
Date April 27, 2016
Temperature / Humidity 23 deg. C / 50 % RH
Engineer Shinya Watanabe
Mode Tx BT LE

BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-32.75	0.60	10.03	-22.12	8.00	30.12
2440.00	-32.73	0.60	10.03	-22.10	8.00	30.10
2480.00	-32.12	0.60	10.03	-21.49	8.00	29.49

Sample Calculation:

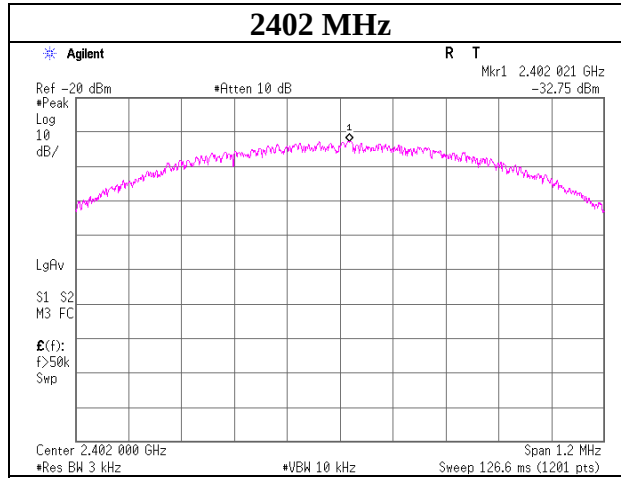
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

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

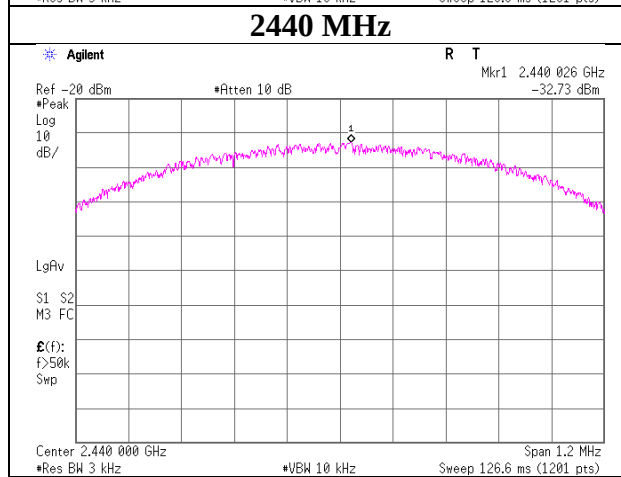
Power Density

BL TE

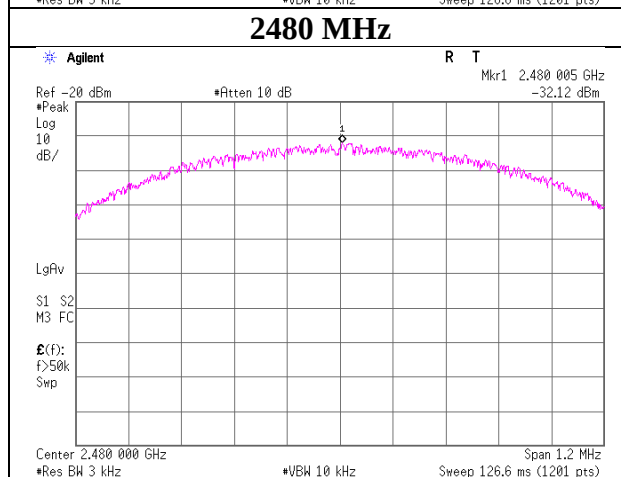
2402 MHz



2440 MHz



2480 MHz



UL Japan, Inc.

Ise EMC Lab.

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Telephone : +81 596 24 8999

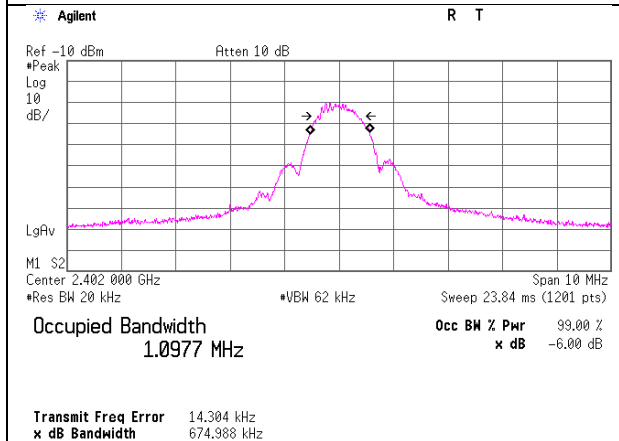
Facsimile : +81 596 24 8124

99%Occupied Bandwidth

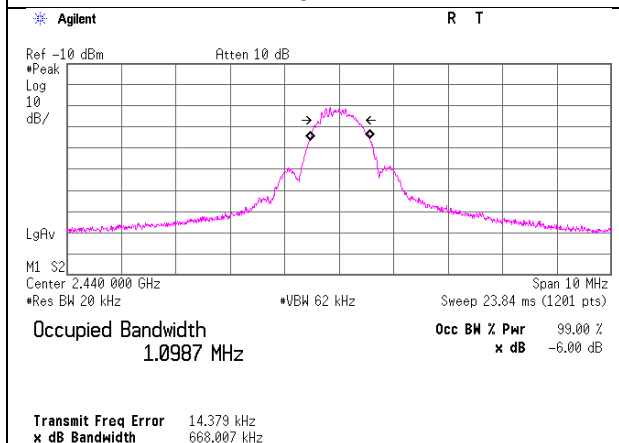
Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11233381H
Date	April 27, 2016
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Shinya Watanabe
Mode	Tx BT LE

BT LE

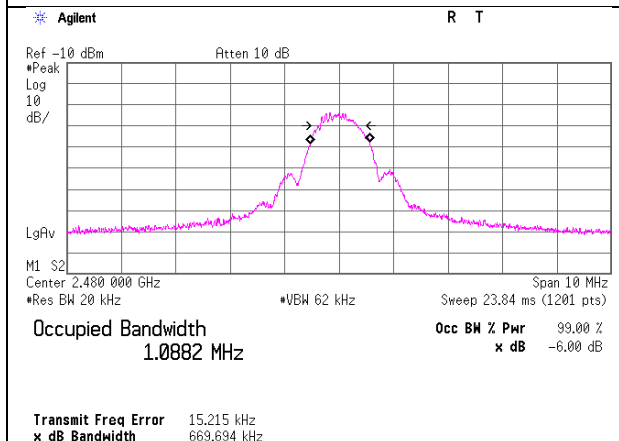
2402 MHz



2440 MHz



2480 MHz



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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	CE	-
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	CE	2015/07/01 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	CE	2016/01/21 * 12
MJM-14	Measure	KOMELON	KMC-36	-	CE	-
MSA-14	Spectrum Analyzer	Agilent	E4440A	MY48250080	CE	2015/10/07 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	CE	2015/10/11 * 12
MLS-23	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	CE(EUT)	2015/07/10 * 12
MCC-13	Coaxial Cable	Fujikura	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	CE	2016/02/08 * 12
MAT-65	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2016/01/14 * 12
MMM-01	Digital Tester	Fluke	FLUKE 26-3	78030611	CE	2015/08/19 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2015/10/02 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE	2016/01/21 * 12
MJM-26	Measure	KOMELON	KMC-36	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2015/05/18 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2015/08/10 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	RE	2015/06/22 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	00650	RE	2015/10/01 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2015/06/06 * 12
MMM-10	DIGITAL HiTESTER	Hioki	3805	051201148	RE	2016/01/18 * 12
MHF-26	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	RE	2015/09/17 * 12
MTR-10	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	RE	2016/01/29 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2015/11/02 * 12
MLA-23	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	RE	2016/01/30 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2015/06/19 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2015/11/12 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2016/03/18 * 12
MOS-14	Thermo-Hygrometer	Custom	CTH-201	1401	AT	2016/01/21 * 12
MSA-16	Spectrum Analyzer	Agilent	E4440A	MY46186390	AT	2016/02/08 * 12
MPSE-18	Power sensor	Anritsu	MA2411B	0738174	AT	2015/11/11 * 12
MPM-13	Power Meter	Anritsu	ML2495A	0824014	AT	2015/11/11 * 12
MAT-22	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2016/03/18 * 12

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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 disturbance voltage