



Test report No. : 10814099H-A-R1
Page : 1 of 34
Issued date : July 21, 2015
Revised date : July 27, 2015
FCC ID : 2AE35M1REV3

RADIO TEST REPORT

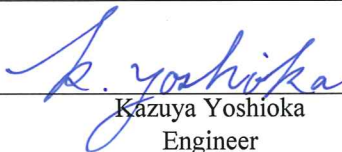
Test Report No. : 10814099H-A-R1

Applicant : QUICCO SOUND CORPORATION
Type of Equipment : WIRELESS MIDI INTERFACE
Model No. : mi.1
FCC ID : 2AE35M1REV3
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)
7. This report is a revised version of 10814099H-A. 10814099H-A is replaced with this report.

Date of test: June 26 to 28, 2015

Representative test engineer:


Kazuya Yoshioka
Engineer

Consumer Technology Division

Approved by:


Takayuki Shimada
Engineer

Consumer Technology Division



NVLAP LAB CODE: 200572-0

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<http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap>

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13-EM-F0429

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SECTION 1: Customer information

Company Name	: QUICCO SOUND CORPORATION
Address	: B-2 Hamamatsu Miyakoda Incubate Center, 3-3-1, Shinmiyakoda 1-chome, Kita-ku Hamamatsu Shizuoka 431-2103 Japan
Telephone Number	: +81-53-525-6107
Contact Person	: Takeshi Ando

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

2.1 Identification of E.U.T.

Type of Equipment	: WIRELESS MIDI INTERFACE
Model No.	: mi.1
Serial No.	: Refer to Section 4, Clause 4.2
Rating	: DC 3.0 V
Receipt Date of Sample	: June 10, 2015
Country of Mass-production	: Japan and China
Condition of EUT	: Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	: No Modification by the test lab

2.2 Product Description

Model: mi.1 (referred to as the EUT in this report) is a WIRELESS MIDI INTERFACE.
The WIRELESS MIDI INTERFACE (Model No.: mi.1) can make wireless communication with Digital Piano and iOS Device on 2402 - 2480 MHz.

General Specification

Clock frequency(ies) in the system : 16MHz

Radio Specification

Bluetooth Low Energy

Equipment Type	: Transceiver
Frequency of Operation	: 2402-2480MHz
Type of Modulation	: GFSK
Power Supply (inner)	: DC 3.0 V
Antenna Type	: Multilayer Monopole Antenna
Antenna Gain	: 0.9 dBi
Operating Temperature	: +5 deg. C to +40 deg. C

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2015, final revised on June 12, 2015 and effective July 13, 2015

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 12, 2015 does not affect the test specification applied to the EUT.

* The EUT complies with FCC Part 15 Subpart B: 2015, final revised on January 21, 2015.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.4-2009 7. AC powerline Conducted Emission measurements IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	QP 27.3 dB, 0.15152 MHz, N AV 34.7 dB, 0.56157 MHz, L	Complied	-
6dB Bandwidth	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: -	FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-210 A8.4(4)		Complied	Conducted
Power Density	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: -	FCC: Section 15.247 (e) IC: RSS-210 A8.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: RSS-Gen 6.13	FCC: Section15.247(d) IC: RSS-210 A8.5 RSS-Gen 8.9 RSS-Gen 8.10	10.1 dB 4804.000 MHz, PK, Horizontal	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 12.2.7.

* In case any questions arise about test procedure, ANSI C63.4: 2009 is also referred.

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FCC Part 15.31 (e)

This EUT provides stable voltage (DC 3.0 V) constantly to RF part 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.

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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Test site (semi anechoic chamber)	Conducted emission Uncertainty (+/-)			
	No. 1	No. 2	No. 3	No. 4
150 kHz - 30 MHz	3.5 dB	3.5 dB	3.4 dB	3.5 dB

Test site (semi anechoic chamber)	Radiated emission Uncertainty (+/-)						
	Measurement distance: 3 m				1 m		0.5 m
	9 kHz - 30 MHz	30 MHz - 300 MHz	300 MHz - 1 GHz	1 GHz - 10 GHz	10 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz
No. 1	4.3 dB	5.5 dB	6.3 dB	5.5 dB	5.8 dB	5.8 dB	4.3 dB
No. 2	4.2 dB	5.4 dB	6.3 dB	5.4 dB	5.7 dB	5.9 dB	5.6 dB
No. 3	4.4 dB	5.4 dB	6.4 dB	5.2 dB	5.5 dB	5.8 dB	5.5 dB
No. 4	4.7 dB	5.6 dB	6.4 dB	5.3 dB	5.7 dB	5.9 dB	5.5 dB

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	
0.7 dB	1.5 dB	1.5 dB	1.7 dB	2.8 dB	2.8 dB	2.9 dB	

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 test report has enough margin, more than the site margin.

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.

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

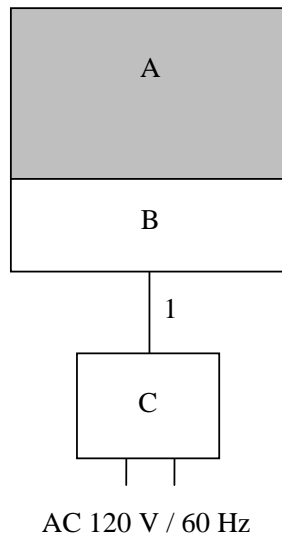
4.1 Operating Mode(s)

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

Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Conducted Emission Spurious Emission 6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	BT LE Tx	2402MHz 2442MHz 2480MHz
*The power value of the EUT was set for testing as follows (setting value might be different from product specification value);		
Power settings:		0dBm
Software:		<Normal operating> m1_test_radio_rx_tx_EN300328 v3.0 <Fixed frequency> rev3_test_radio_tx_high rev3_test_radio_tx_low rev3_test_radio_rx_high rev3_test_radio_rx_low
*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	Remarks
A	WIRELESS MIDI INTERFACE	mi.1	001 *1) 801 *2) 802 *3) 803 *4)	QUICCO SOUND CORPORATION	EUT
B	Jig	-	-	QUICCO SOUND CORPORATION	-
C	Switching Power Supply	AD-D50P100	-	Xiamen UME Electronics	-

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test (2402 MHz).

*3) Used for Radiated Emission test (2442 MHz).

*4) Used for Radiated Emission test (2480 MHz).

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.8	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

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 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 v03r03".

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.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 300 MHz	300 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *2)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: <u>12.2.5.2</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz
Test Distance	3m	3 m (below 10 GHz), 1 m *1) (above 10 GHz)		3 m (below 10 GHz), 1 m *1) (above 10 GHz)

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

*2) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r03".

- 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 M - 26.5 GHz
Test data	: APPENDIX
Test result	: Pass

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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
Conducted Spurious Emission *3)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1 kHz	27 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) 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

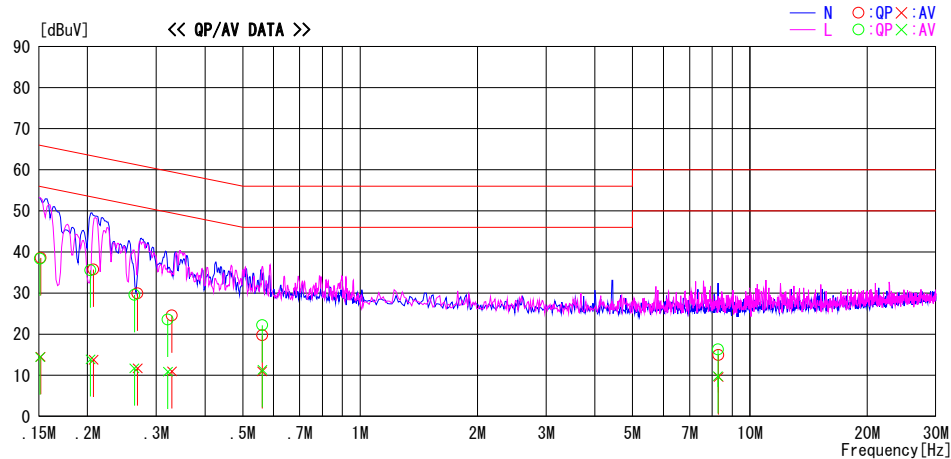
UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2015/06/28

Report No. : 10814099H

Temp./Humi. : 23deg. C / 62% RH
Engineer : Takumi Shimada

Mode / Remarks : BT LE Tx 2442MHz

LIMIT : FCC15.207 QP
FCC15.207 AV

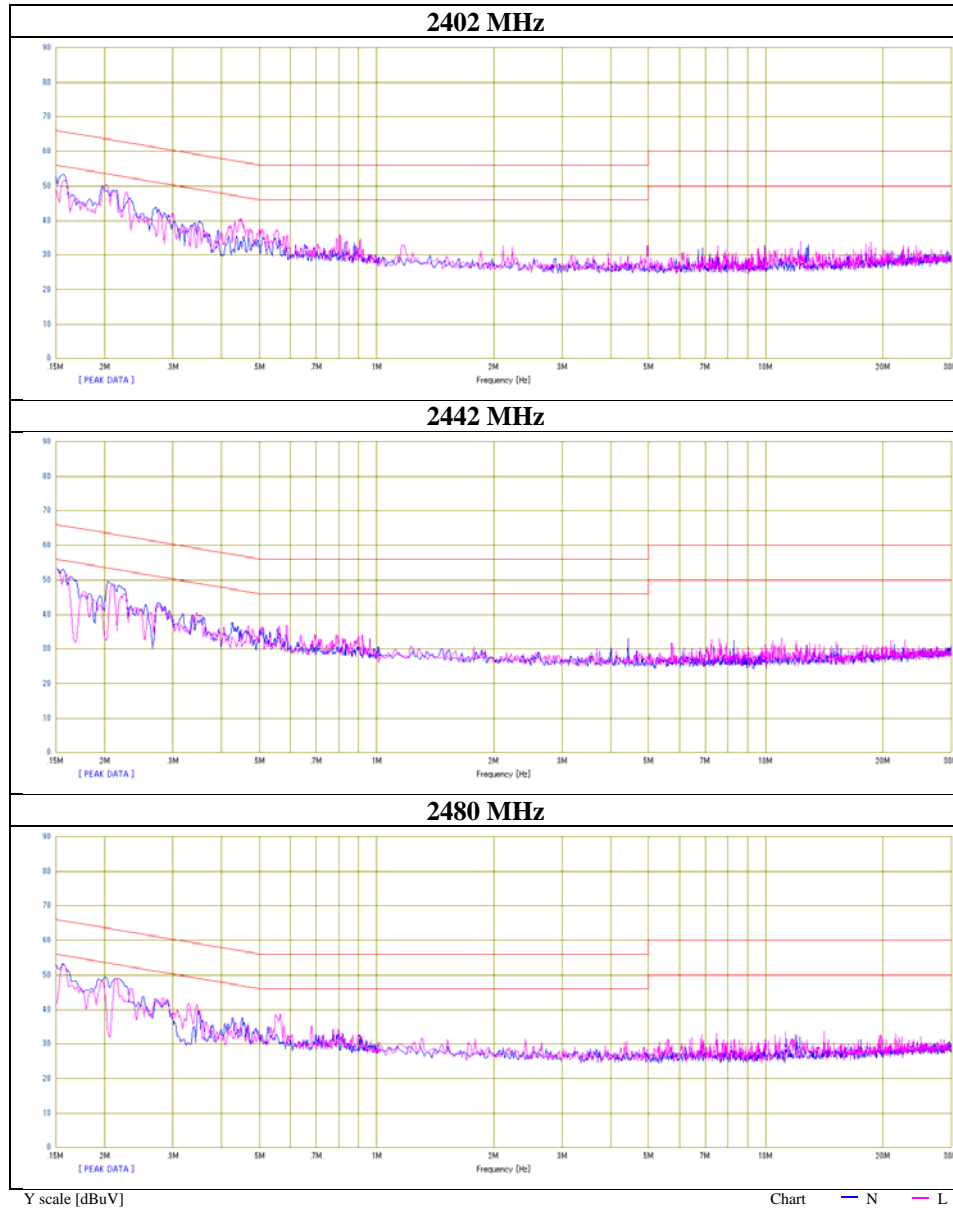


Frequency [MHz]	Reading		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15152	25.3	1.2	13.3	38.6	14.5	65.9	55.9	27.3	41.4	N	
0.20698	22.3	0.4	13.4	35.7	13.8	63.3	53.3	27.6	39.5	N	
0.26858	16.5	-1.7	13.4	29.9	11.7	61.2	51.2	31.3	39.5	N	
0.32909	11.2	-2.4	13.4	24.6	11.0	59.5	49.5	34.9	38.5	N	
0.56068	6.3	-2.4	13.4	19.7	11.0	56.0	46.0	36.3	35.0	N	
8.31030	0.6	-4.7	14.3	14.9	9.6	60.0	50.0	45.1	40.4	N	
0.15112	25.1	1.1	13.3	38.4	14.4	65.9	55.9	27.5	41.5	L	
0.20339	22.2	0.5	13.4	35.6	13.9	63.5	53.5	27.9	39.6	L	
0.26382	16.2	-1.7	13.4	29.6	11.7	61.3	51.3	31.7	39.6	L	
0.32125	10.2	-2.5	13.4	23.6	10.9	59.7	49.7	36.1	38.8	L	
0.56157	8.8	-2.1	13.4	22.2	11.3	56.0	46.0	33.8	34.7	L	
8.28136	2.0	-4.5	14.3	16.3	9.8	60.0	50.0	43.7	40.2	L	

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

Conducted Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	10814099H
Date	April 1, 2015
Temperature / Humidity	23 deg. C / 62 % RH
Engineer	Takumi Shimada
Mode	Tx BT LE



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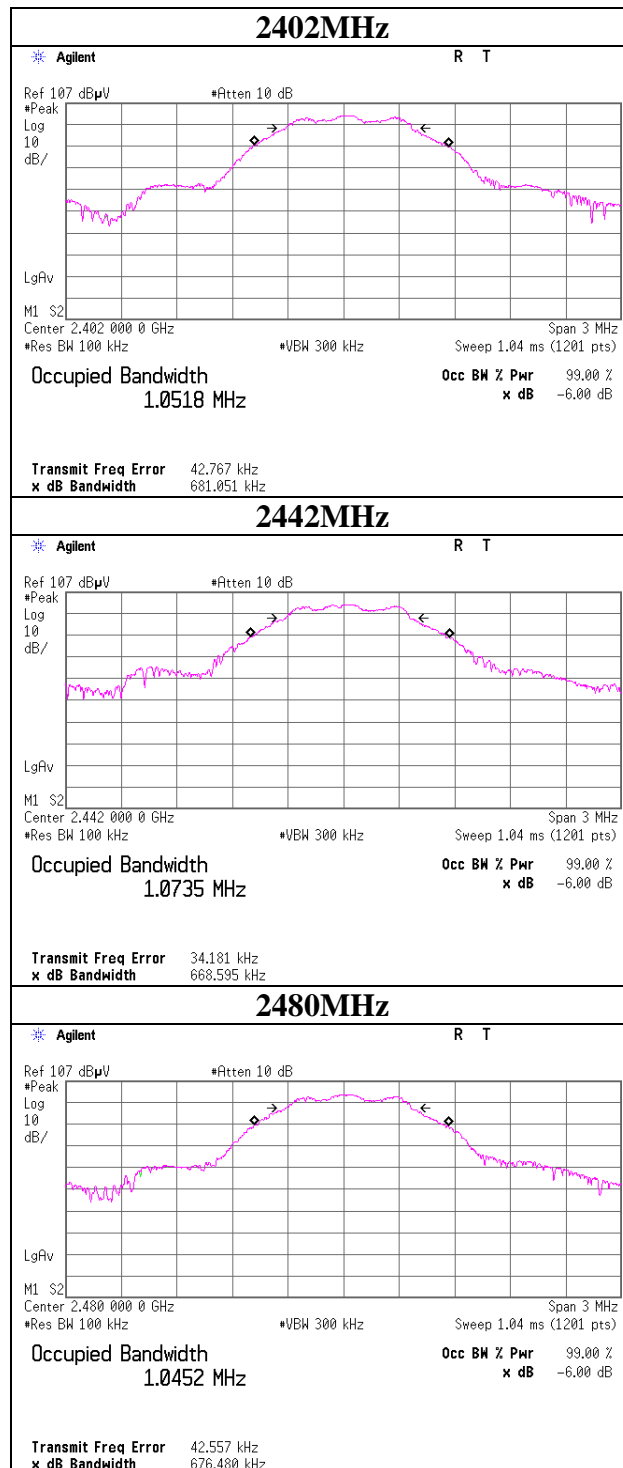
Facsimile : +81 596 24 8124

6dB Bandwidth

Test place Ise EMC Lab. No.7 Shielded Room
Report No. 10814099H
Date June 26, 2015
Temperature / Humidity 23 deg. C / 57 % RH
Engineer Kazuya Yoshioka
Mode Tx BT LE

Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2402	0.681	> 500
2442	0.669	> 500
2480	0.676	> 500

6dB Bandwidth



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Maximum Peak Output Power

Test place Ise EMC Lab. No.7 Shielded Room
Report No. 10814099H
Date June 26, 2015
Temperature / Humidity 23 deg. C / 57 % RH
Engineer Kazuya Yoshioka
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-4.32	0.87	0.00	-3.45	0.45	30.00	1000	33.45
2442	-4.02	0.87	0.00	-3.15	0.48	30.00	1000	33.15
2480	-4.58	0.88	0.00	-3.70	0.43	30.00	1000	33.70

Sample Calculation:

Result = Reading + Cable Loss + 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)**

Test place	Ise EMC Lab. No.7 Shielded Room
Report No.	10814099H
Date	June 26, 2015
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Kazuya Yoshioka
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Frame power)		Duty factor [dB]	Result (Burst power)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-6.09	0.87	0.00	-5.22	0.30	1.03	-4.19	0.38
2442	-5.65	0.87	0.00	-4.78	0.33	1.03	-3.75	0.42
2480	-6.28	0.88	0.00	-5.40	0.29	1.03	-4.37	0.37

Sample Calculation:

Result (Frame power) = Reading + Cable Loss + Attenuator

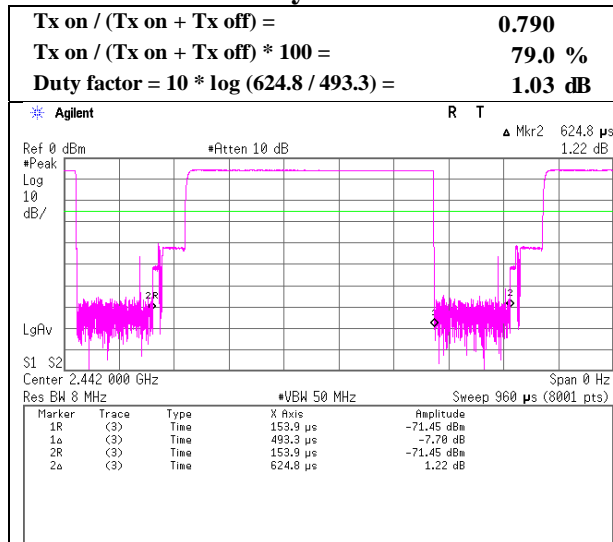
Result (Burst power) = Frame power + Duty factor

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

Burst rate confirmation and Dwell time factor

Test place	Ise EMC Lab. No.7 Shielded Room
Report No.	10814099H
Date	June 26, 2015
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Kazuya Yoshioka
Mode	Tx BT LE

Duty factor

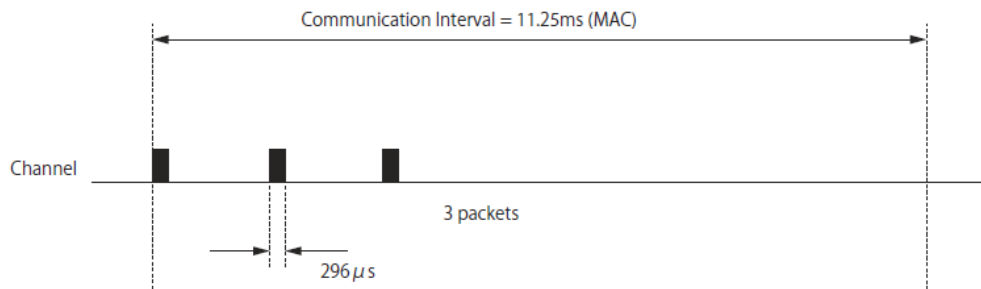


Dwell time factor

Max on time : $0.296 * 3 = 0.888\text{ms}$
 Communication interval : 11.25 ms.
 Worst Duty cycle = $0.888/11.25 = 7.9\%$

Dwell time factor = $20 * \log(7.9\%) = -22.0\text{dB}$

Specification of Worst Tx Duty cycle



Radiated Spurious Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber	
Report No.	10814099H	
Date	June 27, 2015	June 28, 2015
Temperature / Humidity	23 deg. C / 53 % RH	23 deg. C / 62 % RH
Engineer	Kazuya Yoshioka (Above 1GHz)	Takumi Shimada (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	48.467	QP	22.2	11.2	7.3	32.2	-	8.5	40.0	31.5	
Hori	76.334	QP	22.6	6.5	7.7	32.0	-	4.8	40.0	35.2	
Hori	132.517	QP	22.2	13.8	8.4	32.2	-	12.2	43.5	31.3	
Hori	400.000	QP	21.8	17.6	10.6	32.0	-	18.0	46.0	28.0	
Hori	500.000	QP	21.8	18.2	11.3	32.1	-	19.2	46.0	26.8	
Hori	600.000	QP	22.1	19.5	11.7	32.1	-	21.2	46.0	24.8	
Hori	2390.000	PK	51.1	26.9	3.4	32.0	-	49.4	73.9	24.5	
Hori	4804.000	PK	57.8	31.8	5.5	31.3	-	63.8	73.9	10.1	
Hori	7206.000	PK	42.2	36.0	6.8	32.0	-	53.0	73.9	20.9	
Hori	9608.000	PK	42.6	38.2	7.3	32.4	-	55.7	73.9	18.2	
Hori	2390.000	AV	37.3	26.9	3.4	32.0	1.0	36.6	53.9	17.3	*1)
Hori	7206.000	AV	34.3	36.0	6.8	32.0	-	45.1	53.9	8.8	Floor noise
Hori	9608.000	AV	34.4	38.2	7.3	32.4	-	47.5	53.9	6.4	Floor noise
Vert	48.467	QP	30.3	11.2	7.3	32.2	-	16.6	40.0	23.4	
Vert	76.334	QP	31.1	6.5	7.7	32.0	-	13.3	40.0	26.7	
Vert	132.517	QP	26.6	13.8	8.4	32.2	-	16.6	43.5	26.9	
Vert	400.000	QP	21.9	17.6	10.6	32.0	-	18.1	46.0	27.9	
Vert	500.000	QP	21.9	18.2	11.3	32.1	-	19.3	46.0	26.7	
Vert	600.000	QP	22.1	19.5	11.7	32.1	-	21.2	46.0	24.8	
Vert	2390.000	PK	48.6	26.9	3.4	32.0	-	46.9	73.9	27.0	
Vert	4804.000	PK	57.5	31.8	5.5	31.3	-	63.5	73.9	10.4	
Vert	7206.000	PK	42.1	36.0	6.8	32.0	-	52.9	73.9	21.0	
Vert	9608.000	PK	42.3	38.2	7.3	32.4	-	55.4	73.9	18.5	
Vert	2390.000	AV	36.1	26.9	3.4	32.0	1.0	35.4	53.9	18.5	*1)
Vert	7206.000	AV	34.3	36.0	6.8	32.0	-	45.1	53.9	8.8	Floor noise
Vert	9608.000	AV	34.4	38.2	7.3	32.4	-	47.5	53.9	6.4	Floor noise

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10 GHz)) - Gain(Amplifier)

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

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

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

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	97.1	26.9	3.4	32.0	95.4	-	-	Carrier
Hori	2400.000	PK	56.0	26.9	3.4	32.0	54.3	75.4	21.1	
Vert	2402.000	PK	96.5	26.9	3.4	32.0	94.8	-	-	Carrier
Vert	2400.000	PK	51.9	26.9	3.4	32.0	50.2	74.8	24.6	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4804.000	AV	46.5	31.8	5.5	31.3	1.0	-22.0	31.5	53.9	22.4	Y-axis
Vert	4804.000	AV	46.7	31.8	5.5	31.3	1.0	-22.0	31.7	53.9	22.2	X-axis

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz))

- Gain(Amplifier) + Duty Factor + Dwell time factor (Refer to dwell time data sheet)

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Radiated Spurious Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber	
Report No.	10814099H	
Date	June 27, 2015	June 28, 2015
Temperature / Humidity	23 deg. C / 53 % RH	23 deg. C / 62 % RH
Engineer	Kazuya Yoshioka (Above 1GHz)	Takumi Shimada (Below 1GHz)
Mode	Tx BT LE 2442 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	48.634	QP	22.2	11.2	7.3	32.2	-	8.5	40.0	31.5	
Hori	76.240	QP	22.5	6.5	7.7	32.0	-	4.7	40.0	35.3	
Hori	132.532	QP	22.3	13.8	8.4	32.2	-	12.3	43.5	31.2	
Hori	400.000	QP	21.8	17.6	10.6	32.0	-	18.0	46.0	28.0	
Hori	500.000	QP	21.8	18.2	11.3	32.1	-	19.2	46.0	26.8	
Hori	600.000	QP	22.1	19.5	11.7	32.1	-	21.2	46.0	24.8	
Hori	4884.000	PK	55.8	32.0	5.5	31.3	-	62.0	73.9	11.9	
Hori	7326.000	PK	41.6	36.0	6.8	32.0	-	52.4	73.9	21.5	
Hori	9768.000	PK	42.3	38.2	7.3	32.5	-	55.3	73.9	18.6	
Hori	7326.000	AV	34.8	36.0	6.8	32.0	-	45.6	53.9	8.3	Floor noise
Hori	9768.000	AV	34.2	38.2	7.3	32.5	-	47.2	53.9	6.7	Floor noise
Vert	48.634	QP	30.1	11.2	7.3	32.2	-	16.4	40.0	23.6	
Vert	76.240	QP	31.0	6.5	7.7	32.0	-	13.2	40.0	26.8	
Vert	132.532	QP	27.1	13.8	8.4	32.2	-	17.1	43.5	26.4	
Vert	400.000	QP	21.9	17.6	10.6	32.0	-	18.1	46.0	27.9	
Vert	500.000	QP	21.9	18.2	11.3	32.1	-	19.3	46.0	26.7	
Vert	600.000	QP	22.2	19.5	11.7	32.1	-	21.3	46.0	24.7	
Vert	4884.000	PK	56.2	32.0	5.5	31.3	-	62.4	73.9	11.5	
Vert	7326.000	PK	41.8	36.0	6.8	32.0	-	52.6	73.9	21.3	
Vert	9768.000	PK	42.5	38.2	7.3	32.5	-	55.5	73.9	18.4	
Vert	7326.000	AV	34.8	36.0	6.8	32.0	-	45.6	53.9	8.3	Floor noise
Vert	9768.000	AV	34.2	38.2	7.3	32.5	-	47.2	53.9	6.7	Floor noise

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10 GHz)) - Gain(Amplifier)

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

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

Dwell time factor relaxation

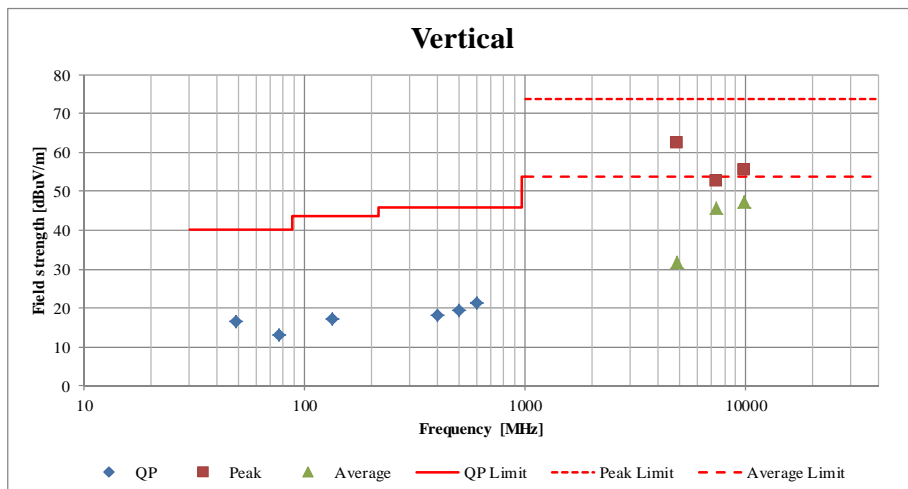
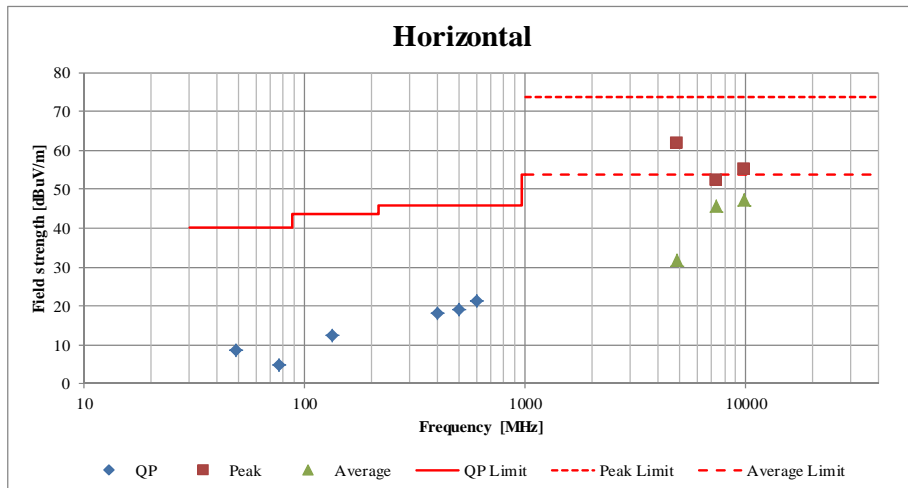
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4884.000	AV	46.4	32.0	5.5	31.3	1.0	-22.0	31.6	53.9	22.3	Y-axis
Vert	4884.000	AV	46.5	32.0	5.5	31.3	1.0	-22.0	31.7	53.9	22.2	X-axis

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz))

- Gain(Amplifier) + Duty Factor + Dwell time factor (Refer to dwell time data sheet)

Radiated Spurious Emission
(Plot data, Worst case)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber	
Report No.	10814099H	
Date	June 27, 2015	June 28, 2015
Temperature / Humidity	23 deg. C / 53 % RH	23 deg. C / 62 % RH
Engineer	Kazuya Yoshioka (Above 1GHz)	Takumi Shimada (Below 1GHz)
Mode	Tx BT LE 2442 MHz	



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

Radiated Spurious Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber	
Report No.	10814099H	
Date	June 27, 2015	June 28, 2015
Temperature / Humidity	23 deg. C / 53 % RH	23 deg. C / 62 % RH
Engineer	Kazuya Yoshioka (Above 1GHz)	Takumi Shimada (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	48.641	QP	22.2	11.2	7.3	32.2	-	8.5	40.0	31.5	
Hori	76.170	QP	22.3	6.5	7.7	32.0	-	4.5	40.0	35.5	
Hori	132.526	QP	22.2	13.8	8.4	32.2	-	12.2	43.5	31.3	
Hori	400.000	QP	21.9	17.6	10.6	32.0	-	18.1	46.0	27.9	
Hori	500.000	QP	21.8	18.2	11.3	32.1	-	19.2	46.0	26.8	
Hori	600.000	QP	22.1	19.5	11.7	32.1	-	21.2	46.0	24.8	
Hori	2483.500	PK	49.1	26.9	3.4	32.0	-	47.4	73.9	26.5	
Hori	4960.000	PK	54.5	32.1	5.4	31.2	-	60.8	73.9	13.1	
Hori	7440.000	PK	41.6	36.0	6.8	32.1	-	52.3	73.9	21.6	
Hori	9920.000	PK	41.9	38.2	7.4	32.5	-	55.0	73.9	18.9	
Hori	2483.500	AV	36.7	26.9	3.4	32.0	1.0	36.0	53.9	17.9	*1)
Hori	7440.000	AV	34.2	36.0	6.8	32.1	-	44.9	53.9	9.0	Floor noise
Hori	9920.000	AV	33.7	38.2	7.4	32.5	-	46.8	53.9	7.1	Floor noise
Vert	48.641	QP	30.1	11.2	7.3	32.2	-	16.4	40.0	23.6	
Vert	76.170	QP	31.3	6.5	7.7	32.0	-	13.5	40.0	26.5	
Vert	132.526	QP	27.3	13.8	8.4	32.2	-	17.3	43.5	26.2	
Vert	400.000	QP	21.9	17.6	10.6	32.0	-	18.1	46.0	27.9	
Vert	500.000	QP	21.9	18.2	11.3	32.1	-	19.3	46.0	26.7	
Vert	600.000	QP	22.2	19.5	11.7	32.1	-	21.3	46.0	24.7	
Vert	2483.500	PK	51.0	26.9	3.4	32.0	-	49.3	73.9	24.6	
Vert	4960.000	PK	55.1	32.1	5.4	31.2	-	61.4	73.9	12.5	
Vert	7440.000	PK	41.8	36.0	6.8	32.1	-	52.5	73.9	21.4	
Vert	9920.000	PK	42.1	38.2	7.4	32.5	-	55.2	73.9	18.7	
Vert	2483.500	AV	37.1	26.9	3.4	32.0	1.0	36.4	53.9	17.5	*1)
Vert	7440.000	AV	34.2	36.0	6.8	32.1	-	44.9	53.9	9.0	Floor noise
Vert	9920.000	AV	33.7	38.2	7.4	32.5	-	46.8	53.9	7.1	Floor noise

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10 GHz)) - Gain(Amplifier)

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

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

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

Dwell time factor relaxation

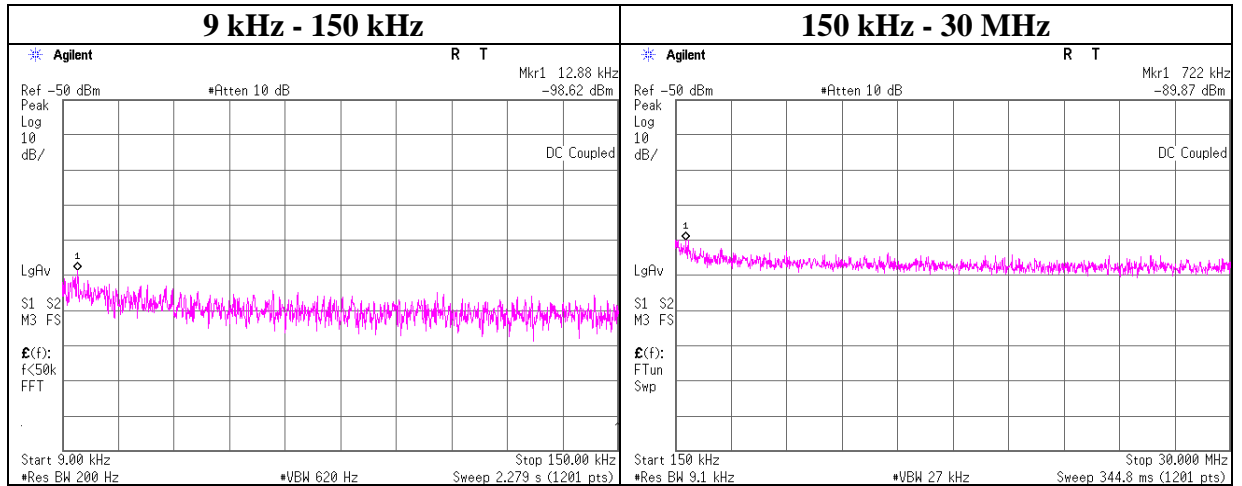
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4960.000	AV	50.5	32.1	5.4	31.2	1.0	-22.0	35.8	53.9	18.1	Y-axis
Vert	4960.000	AV	50.6	32.1	5.4	31.2	1.0	-22.0	35.9	53.9	18.0	X-axis

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz))

- Gain(Amplifier) + Duty Factor + Dwell time factor (Refer to dwell time data sheet)

Conducted Spurious Emission

Test place	Ise EMC Lab. No.7 Shielded Room
Report No.	10814099H
Date	June 26, 2015
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Kazuya Yoshioka
Mode	Tx BT LE 2402 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	N (Number of Output)	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	-98.6	0.01	0.0	2.0	1	-96.6	300	6.0	-35.4	45.4	80.8	
722.00	-89.9	0.01	0.0	2.0	1	-87.9	30	6.0	-6.6	30.4	37.0	

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

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

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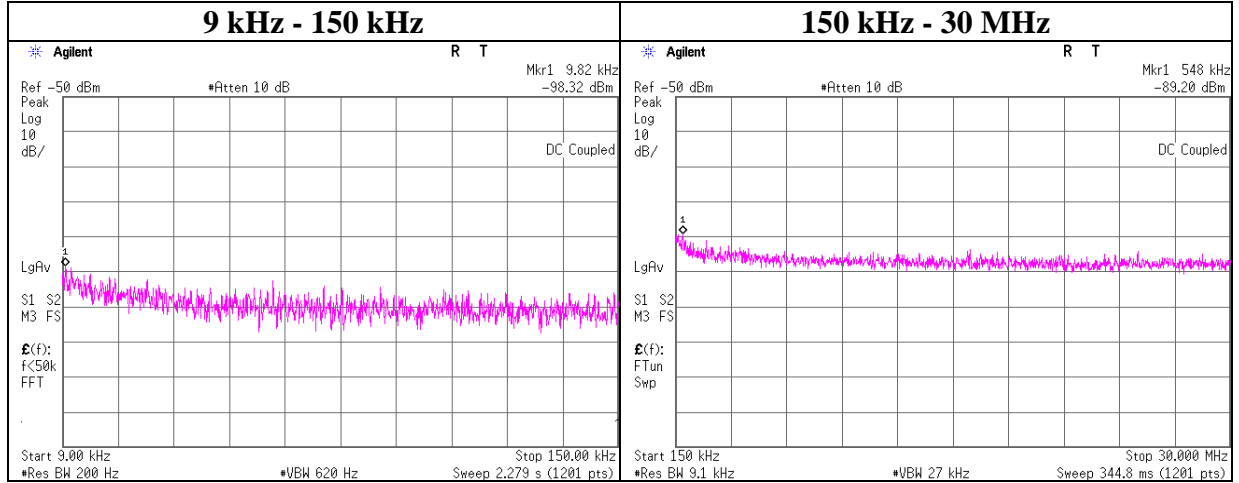
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Conducted Spurious Emission

Test place	Ise EMC Lab. No.7 Shielded Room
Report No.	10814099H
Date	June 26, 2015
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Kazuya Yoshioka
Mode	Tx BT LE 2442 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.82	-98.3	0.01	0.0	2.0	1	-96.3	300	6.0	-35.1	47.7	82.8	
548.00	-89.2	0.01	0.0	2.0	1	-87.2	30	6.0	-5.9	32.8	38.7	

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

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

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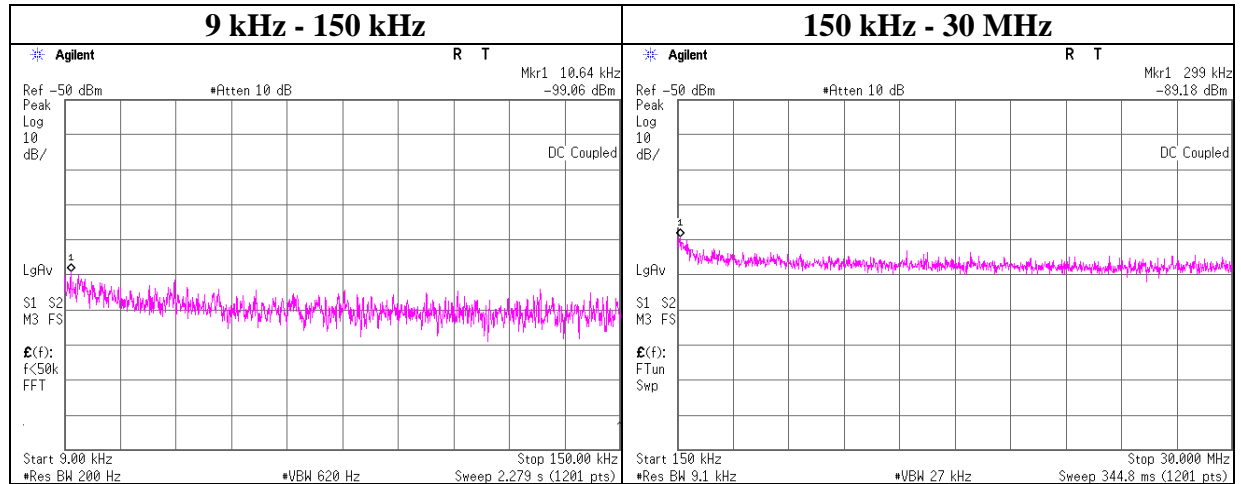
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Conducted Spurious Emission

Test place	Ise EMC Lab. No.7 Shielded Room
Report No.	10814099H
Date	June 26, 2015
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Kazuya Yoshioka
Mode	Tx BT LE 2480 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	N (Number of Output)	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]		[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
10.64	-99.1	0.01	0.0	2.0	1	-97.1	300	6.0	-35.8	47.0	82.8	
299.00	-89.2	0.01	0.0	2.0	1	-87.2	300	6.0	-25.9	18.0	43.9	

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

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

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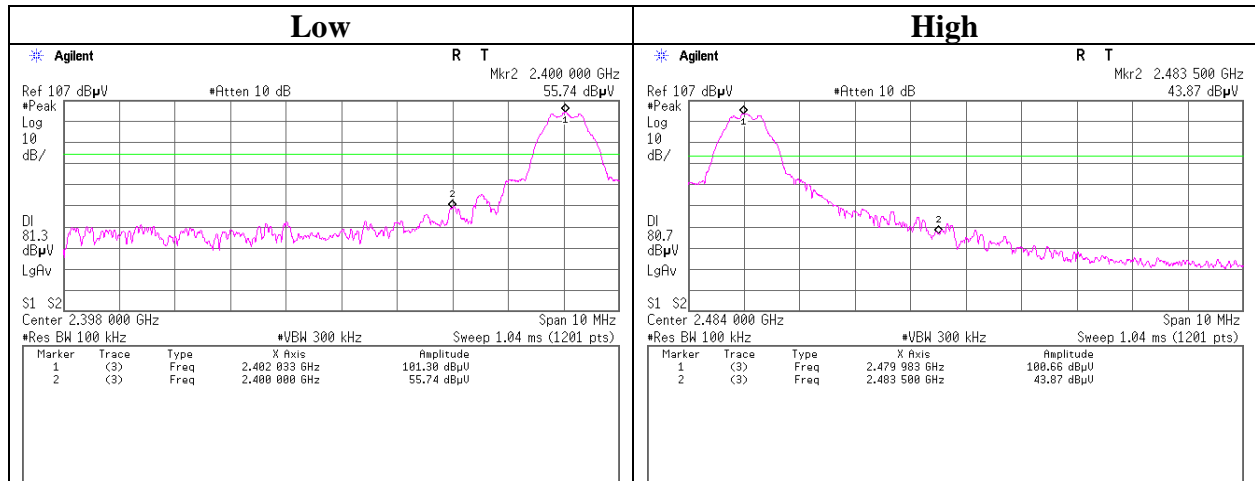
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Band Edge confirmation

Test place	Ise EMC Lab. No.7 Shielded Room
Report No.	10814099H
Date	June 26, 2015
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Kazuya Yoshioka
Mode	Tx BT LE



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Power Density

Test place Ise EMC Lab. No.7 Shielded Room
Report No. 10814099H
Date June 26, 2015
Temperature / Humidity 23 deg. C / 57 % RH
Engineer Kazuya Yoshioka
Mode Tx BT LE

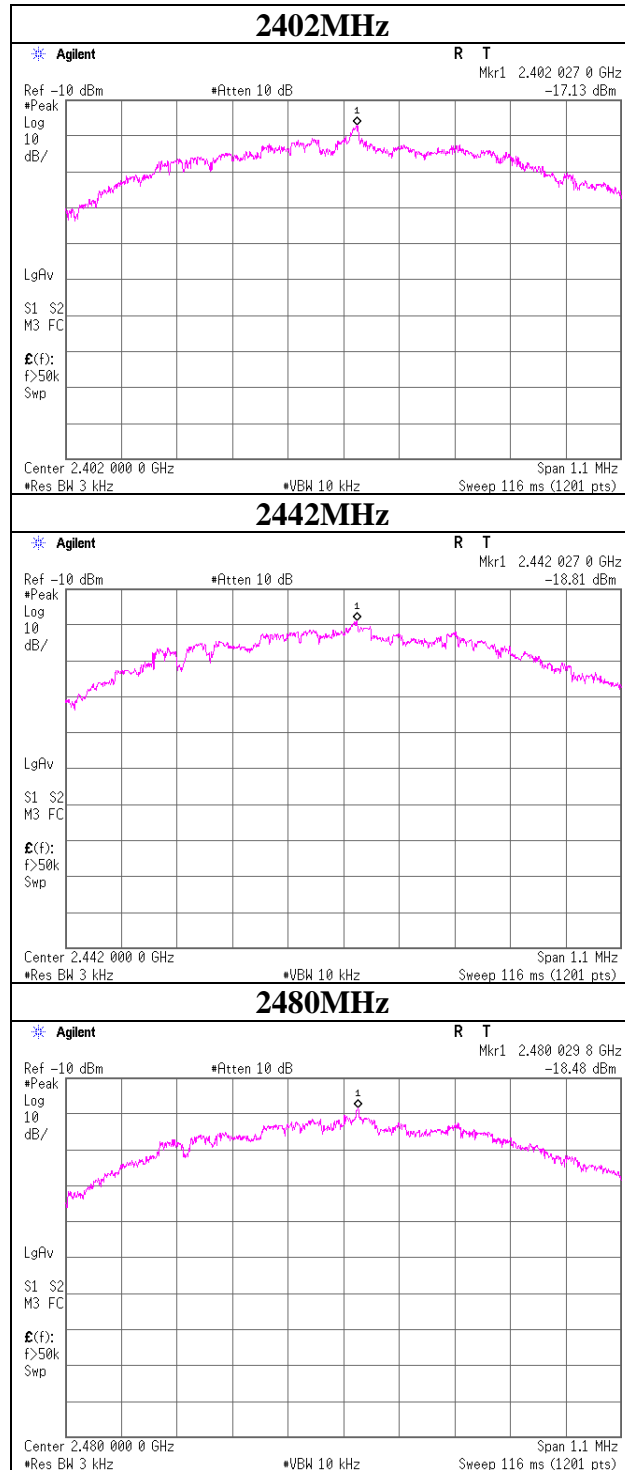
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-17.13	0.87	0.00	-16.26	8.00	24.26
2442.00	-18.81	0.87	0.00	-17.94	8.00	25.94
2480.00	-18.48	0.88	0.00	-17.60	8.00	25.60

Sample Calculation:

Result = Reading + Cable Loss + Attenuator

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

Power Density



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Ise EMC Lab.

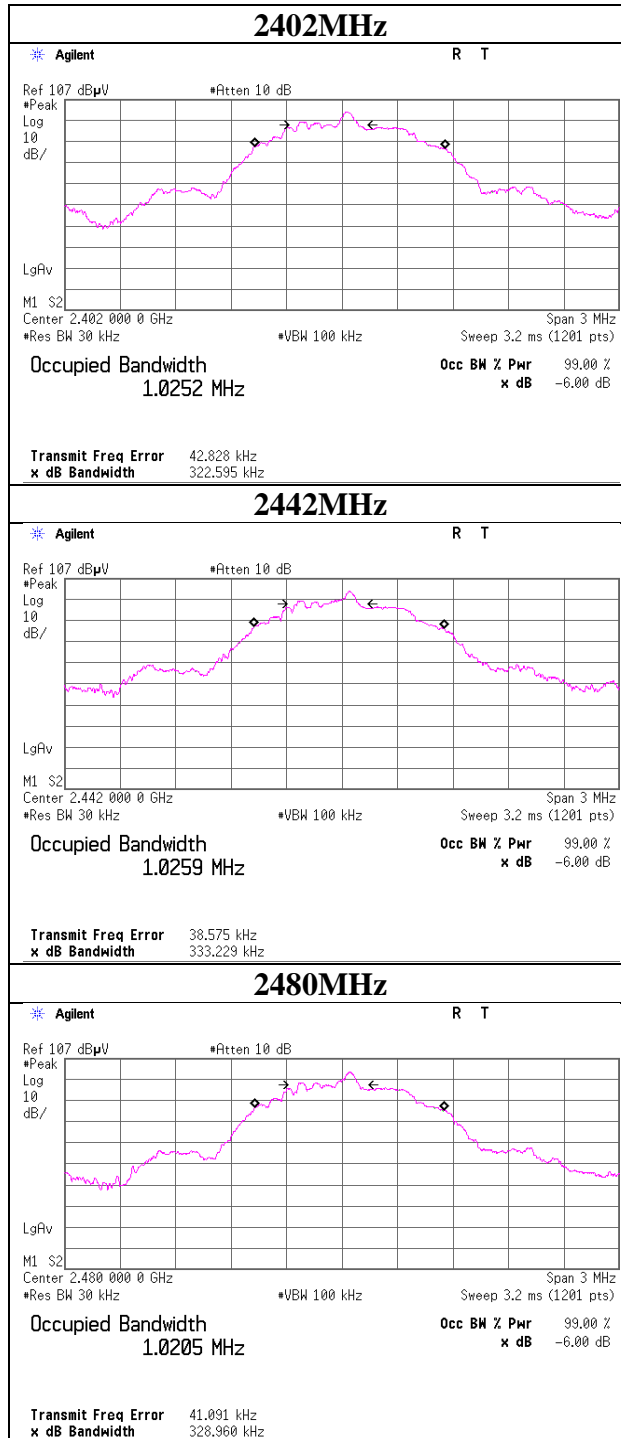
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99%Occupied Bandwidth

Test place	Ise EMC Lab. No.7 Shielded Room
Report No.	10814099H
Date	June 26, 2015
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Kazuya Yoshioka
Mode	Tx BT LE



UL Japan, Inc.

Ise EMC Lab.

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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MSA-13	Spectrum Analyzer	Agilent	E4440A	MY46185823	AT	2015/06/02 * 12
MCC-171	Microwave Cable	Junkosha	MWX221	1409S494	AT	2015/03/04 * 12
MPM-08	Power Meter	Anritsu	ML2495A	6K00003338	AT	2014/10/16 * 12
MPSE-11	Power sensor	Anritsu	MA2411B	011737	AT	2014/10/15 * 12
MOS-34	Thermo-Hygrometer	Custom	CTH-201	3401	AT	2015/01/13 * 12
MOTS-MATM	Antenna Terminal Measurement Software	UL Japan	-	-	AT	-
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE/CE	2015/02/19 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE/CE	2015/01/13 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE/CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE/CE	2015/05/18 * 12
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2015/05/18 * 12
MCC-167	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	RE	2015/05/21 * 12
MPA-11	MicroWave System Amplifier	Agilent	83017A	MY39500779	RE	2015/03/19 * 12
MHA-16	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	RE	2015/05/19 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2014/09/22 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE/CE	2014/08/19 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2014/10/18 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2014/10/18 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2014/07/14 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2015/04/08 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2015/03/10 * 12
MLS-24	LISN(AMN)	Schwarzbeck	NSLK8127	8127-730	CE(EUT)	2014/07/10 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ suciform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	CE	2014/07/14 * 12
MAT-66	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2015/01/29 * 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: CE: Conducted Emission test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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