



Test report No. : 10988152S-A
Page : 1 of 29
Issued date : October 20, 2015
Revised date : October 28, 2015
FCC ID : GT3FC021

RADIO TEST REPORT

Test Report No. : 10988152S-A

Applicant : SMK Corporation
Type of Equipment : neyya
Model No. : Ring
FCC ID : GT3FC021
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. 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:

October 5 to 7, 2015

Representative test engineer:

H. Morikawa

Hiroyuki Morikawa
Engineer
Consumer Technology Division

Approved by:

T. Imamura

Toyokazu Imamura
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".

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 10988152S-A

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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.....	7
SECTION 5: Radiated Spurious Emission	8
SECTION 6: Antenna Terminal Conducted Tests.....	9
APPENDIX 1: Test data	10
6dB Bandwidth	10
Maximum Peak Output Power	12
Average Output Power	13
Burst rate confirmation	14
Radiated Spurious Emission	15
Conducted Spurious Emission	21
Power Density	24
99%Occupied Bandwidth	26
APPENDIX 2: Test instruments	27
APPENDIX 3: Photographs of test setup	28
Radiated Spurious Emission	28
Worst Case Position	29

SECTION 1: Customer information

Company Name	:	SMK Corporation
Address	:	5-5, Togoshi 6-chome, Shinagawa-ku, Tokyo 142-8511, Japan
Telephone Number	:	+81-3-3785-1110
Facsimile Number	:	+81-3-3785-2804
Contact Person	:	Hiroshi Fujikawa

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

2.1 Identification of E.U.T.

Type of Equipment	:	neyya
Model No.	:	Ring
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 4.2 V
Receipt Date of Sample	:	October 5, 2015
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: Ring (referred to as the EUT in this report) is neyya.

General Specification

Clock frequency(ies) in the system	:	16 MHz
------------------------------------	---	--------

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Power Supply (radio part input)	:	DC 3.1 V
Antenna type	:	Monopole (Chip)
Antenna Gain	:	-11.14 dBi

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2015, final revised on September 8, 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 EUT has been tested for compliance with FCC Part 15 Subpart B. Refer to the test report 10988152S-C.

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	-	N/A *1)	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v03r03 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 v03r03 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 v03r03 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 v03r03 IC: RSS-Gen 6.13	FCC: Section15.247(d) ----- IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	1.2 dB 4960.00 MHz, AV, 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 DTS Meas Guidance v03r03 12.2.7.

* In case any questions arise about test procedure, ANSI C 63.10:2013 is also referred.
 However, there is one deviation from ANSI C 63.10:2013. (ANSI C63.10:2013 is Non-accreditation)
 Measurement height is not 1.5 m, but 0.8 m.

FCC Part 15.31 (e)

The EUT is a battery-operated device and test was performed with the full-charged battery. Therefore, the EUT complies with the requirement.

FCC Part 15.203

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.

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.

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3.4 Uncertainty

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

Item	Frequency range	Uncertainty (+/-)		
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	3.6 dB	3.4 dB	3.4 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.7 dB	3.5 dB	3.5 dB
	30 MHz-300 MHz	4.9 dB	4.9 dB	4.7 dB
	300 MHz-1 GHz	5.0 dB	5.0 dB	4.8 dB
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB
Radiated emission (Measurement distance: 1 m)	13 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB
	18 GHz-40 GHz	4.5 dB	4.3 dB	4.3 dB

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.76 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.79 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.74 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.08 dB
Spurious emission (Conducted) below 1GHz	1.5 dB

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. Shonan EMC Lab.

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JAB Accreditation No. RTL02610

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 shielded room	-	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	-	2.55 x 4.1 x 2.5	-	-

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

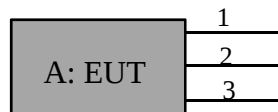
4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth Low Energy	PRBS9
* The worst condition was determined based on the test result of Maximum Peak Output Power.	
* Power of the EUT was set by the software as follows; Power settings: Fixed Software: nRFgo Studio ver. 1.21.0.2	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Spurious Emission 6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	Bluetooth Low Energy	2402 MHz 2440 MHz 2480 MHz

4.2 Configuration and peripherals



Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	neyya	Ring	2 *1) L1 *2)	SMK Corporation	EUT

*1) Used for Antenna Terminal conducted test

*2) Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Tx	0.05	Unshielded	-	*3)
2	Rx	0.05	Unshielded	-	*3)
3	GND	0.05	Unshielded	-	*3)

*3) Signal cable for test operation

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SECTION 5: 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 polystyrene 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.

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	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 (Linear voltage) Trace: 100 traces Duty factor was added to the results.
Test Distance	3m	3 m (below 13 GHz), 1 m *1) (above 13 GHz)	3 m (below 13 GHz), 1 m *1) (above 13 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.

Combinations of the worst case

Antenna polarization	Frequency			
	Below 1GHz	1 GHz - 2.8 GHz	2.8 GHz - 13 GHz	13 GHz - 25 GHz
Horizontal	Z	X	Y	X
Vertical	Z	Y	Y	X

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

Measurement range : 30 M - 25 GHz
Test data : APPENDIX
Test result : Pass

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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	Sample	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	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3) *4)
Conducted Spurious Emission *5)	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 v03r03".

*4) The test was not performed at RBW:3 kHz however the measurement is to be performed with RBW:3kHz in the regulation, because, the measurement value with RBW:3 kHz is less than the value of RBW:30 kHz and the test data met the limit with RBW:30 kHz.

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

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.

(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz)

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

Test data : APPENDIX

Test result : Pass

APPENDIX 1: Test data

6dB Bandwidth

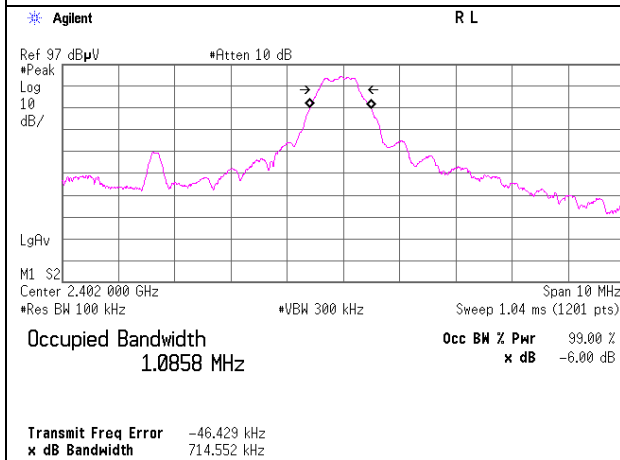
Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	10988152S-A
Date	October 7, 2015
Temperature / Humidity	25 deg. C / 43 % RH
Engineer	Tomohiro Hara
Mode	Tx BT LE

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
BTLE	2402	0.715	>500
	2440	0.720	>500
	2480	0.730	>500

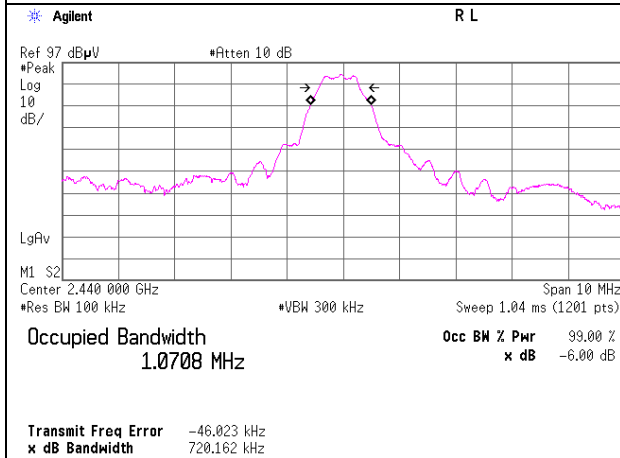
6dB Bandwidth

BTLE

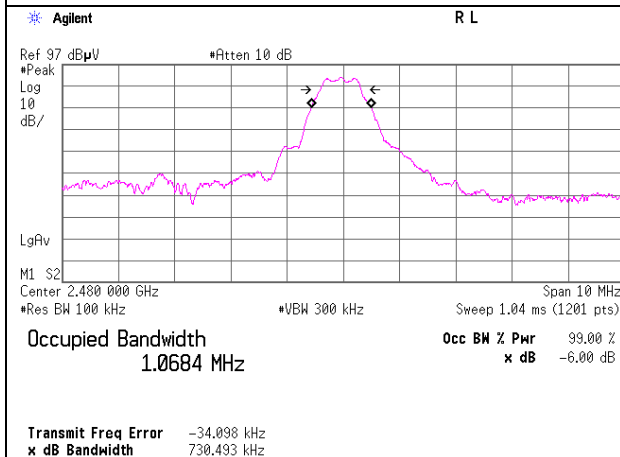
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 10988152S-A
Date October 7, 2015
Temperature / Humidity 25 deg. C / 43 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

BTLE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-14.99	0.62	9.63	-4.74	0.34	30.00	1000	34.74
2440	-14.97	0.63	9.63	-4.71	0.34	30.00	1000	34.71
2480	-15.13	0.64	9.63	-4.86	0.33	30.00	1000	34.86

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)

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	10988152S-A
Date	October 7, 2015
Temperature / Humidity	25 deg. C / 43 % RH
Engineer	Tomohiro Hara
Mode	Tx BT LE

BTLE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Frame power)		Duty factor [dB]	Result (Burst power)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-17.50	0.62	9.63	-7.25	0.19	1.19	-6.06	0.25
2440	-17.42	0.63	9.63	-7.16	0.19	1.19	-5.97	0.25
2480	-17.71	0.64	9.63	-7.44	0.18	1.19	-6.25	0.24

Sample Calculation:

Result (Frame power) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuate

Result (Burst power) = Frame power + Duty factor

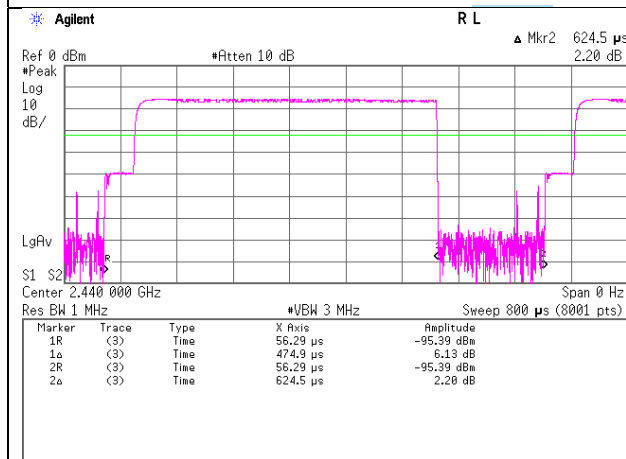
*The equipment and cables were not used for factor 0 dB of the data sheets.

Burst rate confirmation

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 10988152S-A
Date October 7, 2015
Temperature / Humidity 25 deg. C / 43 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

BTLE

$Tx\ on / (Tx\ on + Tx\ off) = 0.760$
 $Tx\ on / (Tx\ on + Tx\ off) * 100 = 76.0\ \%$
 $Duty\ factor = 10 * \log (0.0006245 / 0.0004749) = 1.19\ dB$
 $Duty\ factor = 20 * \log (0.0006245 / 0.0004749) = 2.38\ dB$



Radiated Spurious Emission

Test place : Shonan EMC Lab. No.2, 3 Semi Anechoic Chamber
Report No. : 10988152S-A
Date : October 5, 2015 October 7, 2015
Temperature / Humidity : 26 deg. C / 46 % RH 26 deg. C / 46 % RH
Engineer : Hiroyuki Morikawa Wataru Kojima
 (1-25 GHz) (30-1000 MHz)
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.	167.431	QP	22.4	15.5	8.7	31.8	0.0	14.8	43.5	28.7	200	349	
Hori.	443.974	QP	21.8	16.8	7.5	31.6	0.0	14.5	46.0	31.5	150	244	
Hori.	2390.000	PK	45.6	27.8	13.7	41.0	3.5	49.6	73.9	24.3	100	325	
Hori.	4804.000	PK	52.4	31.4	5.7	39.6	3.5	53.4	73.9	20.5	111	341	
Hori.	7206.000	PK	45.0	36.9	7.1	40.1	3.5	52.4	73.9	21.5	100	0	
Hori.	9608.000	PK	44.0	38.5	8.2	39.6	3.5	54.6	73.9	19.3	100	0	
Vert.	213.336	QP	22.1	16.5	9.0	31.7	0.0	15.9	43.5	27.6	100	153	
Vert.	282.510	QP	21.9	18.6	9.6	31.7	0.0	18.4	46.0	27.6	100	241	
Vert.	623.806	QP	21.9	19.3	8.4	31.6	0.0	18.0	46.0	28.0	100	359	
Vert.	664.455	QP	22.0	19.9	8.6	31.5	0.0	19.0	46.0	27.0	100	358	
Vert.	2390.000	PK	46.5	27.8	13.7	41.0	3.5	50.5	73.9	23.4	184	34	
Vert.	4804.000	PK	51.8	31.4	5.7	39.6	3.5	52.8	73.9	21.1	132	0	
Vert.	7206.000	PK	45.1	36.9	7.1	40.1	3.5	52.5	73.9	21.4	100	0	
Vert.	9608.000	PK	44.7	38.5	8.2	39.6	3.5	55.3	73.9	18.6	100	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(4.48 m / 3.0 m) = 3.5 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.5 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	36.8	27.8	13.7	41.0	2.4	3.5	43.2	53.9	10.7	*1)
Hori.	4804.000	AV	46.2	31.4	5.7	39.6	2.4	3.5	49.6	53.9	4.3	
Hori.	7206.000	AV	36.4	36.9	7.1	40.1	2.4	3.5	46.2	53.9	7.7	
Hori.	9608.000	AV	35.5	38.5	8.2	39.6	2.4	3.5	48.5	53.9	5.4	
Vert.	2390.000	AV	36.8	27.8	13.7	41.0	2.4	3.5	43.2	53.9	10.7	*1)
Vert.	4804.000	AV	44.7	31.4	5.7	39.6	2.4	3.5	48.1	53.9	5.8	
Vert.	7206.000	AV	36.4	36.9	7.1	40.1	2.4	3.5	46.2	53.9	7.7	
Vert.	9608.000	AV	35.4	38.5	8.2	39.6	2.4	3.5	48.4	53.9	5.5	

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

Distance factor : 1 GHz - 13 GHz : 20log(4.48 m / 3.0 m) = 3.5 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.5 dB

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

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

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	62.9	27.8	13.7	41.0	3.5	66.9	-	-	Carrier
Hori.	2400.000	PK	36.4	27.8	13.7	41.0	3.5	40.4	46.9	6.5	
Vert.	2402.000	PK	62.8	27.8	13.7	41.0	3.5	66.8	-	-	Carrier
Vert.	2400.000	PK	37.0	27.8	13.7	41.0	3.5	41.0	46.7	5.7	

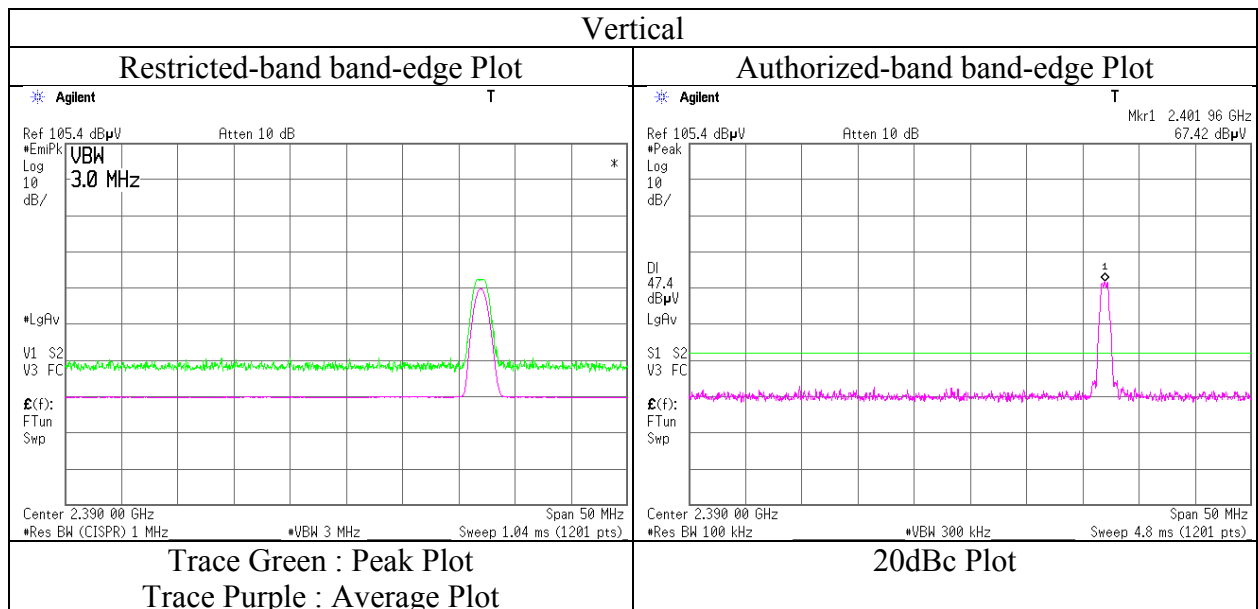
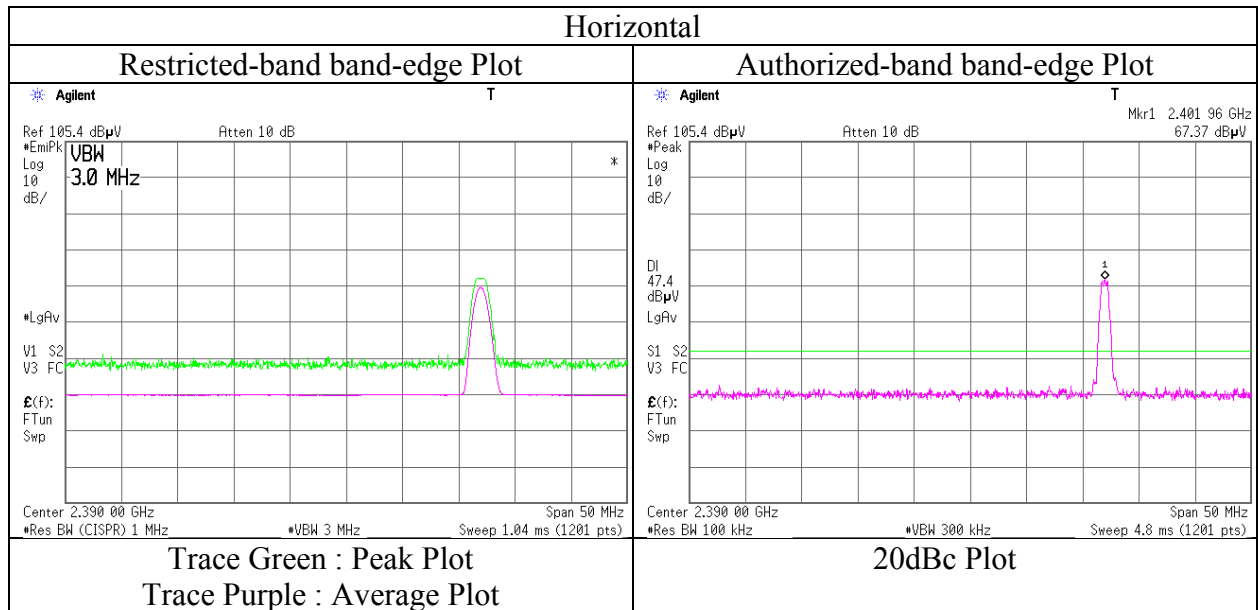
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(4.48 m / 3.0 m) = 3.5 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No. 3 Semi Anechoic Chamber
Report No.	10988152S-A
Date	October 5, 2015
Temperature / Humidity	26 deg. C / 46 % RH
Engineer	Hiroyuki Morikawa
Mode	Tx BT LE 2440 MHz



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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.2, 3 Semi Anechoic Chamber
Report No. : 10988152S-A
Date : October 5, 2015 October 7, 2015
Temperature / Humidity : 26 deg. C / 46 % RH 26 deg. C / 46 % RH
Engineer : Hiroyuki Morikawa Wataru Kojima
(1-25 GHz) (30-1000 MHz)
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.	77.925	QP	28.5	6.3	8.0	31.9	0.0	10.9	40.0	29.1	150	41	
Hori.	167.417	QP	22.4	15.5	8.7	31.8	0.0	14.8	43.5	28.7	150	110	
Hori.	444.354	QP	21.8	16.8	7.5	31.6	0.0	14.5	46.0	31.5	150	264	
Hori.	4880.000	PK	54.5	31.7	5.8	39.5	3.5	56.0	73.9	17.9	112	349	
Hori.	7320.000	PK	45.3	36.9	7.2	40.2	3.5	52.7	73.9	21.2	100	0	
Hori.	9760.000	PK	44.9	38.5	8.2	39.5	3.5	55.6	73.9	18.3	100	0	
Vert.	65.102	QP	30.1	7.0	7.0	31.9	0.0	12.2	40.0	27.8	100	305	
Vert.	96.182	QP	28.3	9.4	8.0	31.9	0.0	13.8	43.5	29.7	100	1	
Vert.	213.336	QP	22.0	16.5	9.0	31.7	0.0	15.8	43.5	27.7	100	119	
Vert.	282.164	QP	22.0	18.6	9.6	31.7	0.0	18.5	46.0	27.5	100	58	
Vert.	623.673	QP	21.9	19.3	8.4	31.6	0.0	18.0	46.0	28.0	100	3	
Vert.	664.635	QP	22.0	19.9	8.6	31.5	0.0	19.0	46.0	27.0	100	11	
Vert.	4880.000	PK	50.4	31.7	5.8	39.5	3.5	51.9	73.9	22.0	100	348	
Vert.	7320.000	PK	45.7	36.9	7.2	40.2	3.5	53.1	73.9	20.8	100	0	
Vert.	9760.000	PK	44.5	38.5	8.2	39.5	3.5	55.2	73.9	18.7	100	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(4.48 \text{ m} / 3.0 \text{ m}) = 3.5 \text{ dB}$

13 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	48.1	31.7	5.8	39.5	2.4	3.5	52.0	53.9	1.9	
Hori.	7320.000	AV	37.1	36.9	7.2	40.2	2.4	3.5	46.9	53.9	7.0	
Hori.	9760.000	AV	35.8	38.5	8.2	39.5	2.4	3.5	48.9	53.9	5.0	
Vert.	4880.000	AV	43.4	31.7	5.8	39.5	2.4	3.5	47.3	53.9	6.6	
Vert.	7320.000	AV	36.8	36.9	7.2	40.2	2.4	3.5	46.6	53.9	7.3	
Vert.	9760.000	AV	35.9	38.5	8.2	39.5	2.4	3.5	49.0	53.9	4.9	

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

Distance factor : 1 GHz - 13 GHz : $20\log(4.48 \text{ m} / 3.0 \text{ m}) = 3.5 \text{ dB}$

13 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

Test place : Shonan EMC Lab. No.2, 3 Semi Anechoic Chamber
Report No. : 10988152S-A
Date : October 5, 2015 October 7, 2015
Temperature / Humidity : 26 deg. C / 46 % RH 26 deg. C / 46 % RH
Engineer : Hiroyuki Morikawa Wataru Kojima
(1-25 GHz) (30-1000 MHz)
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.	167.437	QP	22.4	15.5	8.7	31.8	0.0	14.8	43.5	28.7	300	352	
Hori.	444.228	QP	21.8	16.8	7.5	31.6	0.0	14.5	46.0	31.5	150	355	
Hori.	2483.500	PK	46.1	27.9	13.8	41.0	3.5	50.3	73.9	23.6	100	0	
Hori.	4960.000	PK	56.9	32.0	5.8	39.4	3.5	58.8	73.9	15.1	108	326	
Hori.	7440.000	PK	45.4	37.0	7.2	40.4	3.5	52.7	73.9	21.2	100	0	
Hori.	9920.000	PK	45.0	38.4	8.2	39.4	3.5	55.7	73.9	18.2	100	0	
Vert.	213.355	QP	22.4	16.5	9.0	31.7	0.0	16.2	43.5	27.3	100	351	
Vert.	282.191	QP	22.1	18.6	9.6	31.7	0.0	18.6	46.0	27.4	100	116	
Vert.	623.096	QP	22.2	19.3	8.4	31.6	0.0	18.3	46.0	27.7	100	74	
Vert.	664.311	QP	22.0	19.9	8.6	31.5	0.0	19.0	46.0	27.0	100	238	
Vert.	2483.500	PK	45.0	27.9	13.8	41.0	3.5	49.2	73.9	24.7	128	0	
Vert.	4960.000	PK	55.3	32.0	5.8	39.4	3.5	57.2	73.9	16.7	130	0	
Vert.	7440.000	PK	46.3	37.0	7.2	40.4	3.5	53.6	73.9	20.3	100	0	
Vert.	9920.000	PK	44.4	38.4	8.2	39.4	3.5	55.1	73.9	18.8	100	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(4.48 \text{ m} / 3.0 \text{ m}) = 3.5 \text{ dB}$

13 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.	2483.500	AV	36.8	27.9	13.8	41.0	2.4	3.5	43.4	53.9	10.5	*1)
Hori.	4960.000	AV	48.4	32.0	5.8	39.4	2.4	3.5	52.7	53.9	1.2	
Hori.	7440.000	AV	37.1	37.0	7.2	40.4	2.4	3.5	46.8	53.9	7.1	
Hori.	9920.000	AV	36.2	38.4	8.2	39.4	2.4	3.5	49.3	53.9	4.6	
Vert.	2483.500	AV	36.6	27.9	13.8	41.0	2.4	3.5	43.2	53.9	10.7	*1)
Vert.	4960.000	AV	45.2	32.0	5.8	39.4	2.4	3.5	49.5	53.9	4.4	
Vert.	7440.000	AV	37.0	37.0	7.2	40.4	2.4	3.5	46.7	53.9	7.2	
Vert.	9920.000	AV	36.0	38.4	8.2	39.4	2.4	3.5	49.1	53.9	4.8	

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

Distance factor : 1 GHz - 13 GHz : $20\log(4.48 \text{ m} / 3.0 \text{ m}) = 3.5 \text{ dB}$

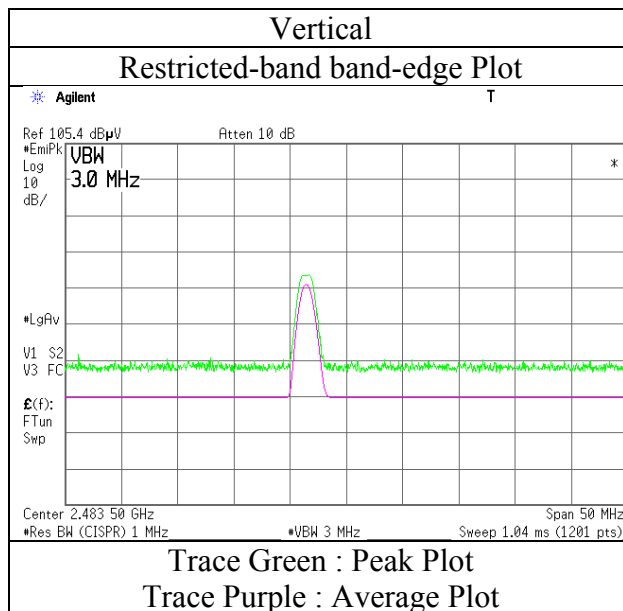
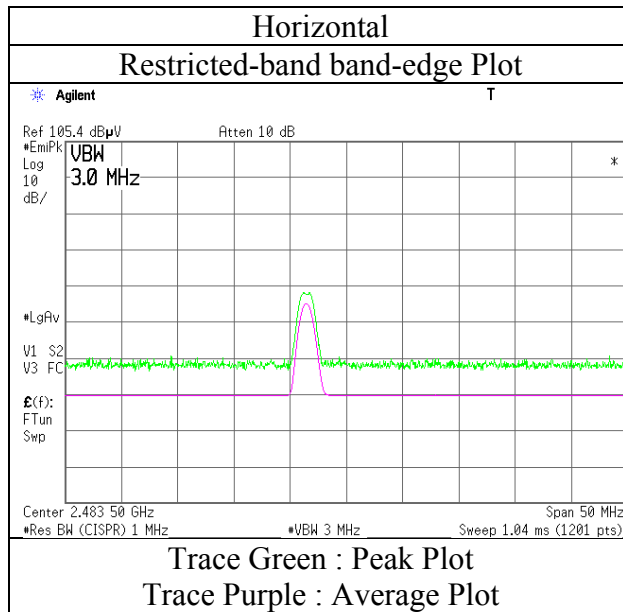
13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

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

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

Radiated Spurious Emission (Reference Plot for band-edge)

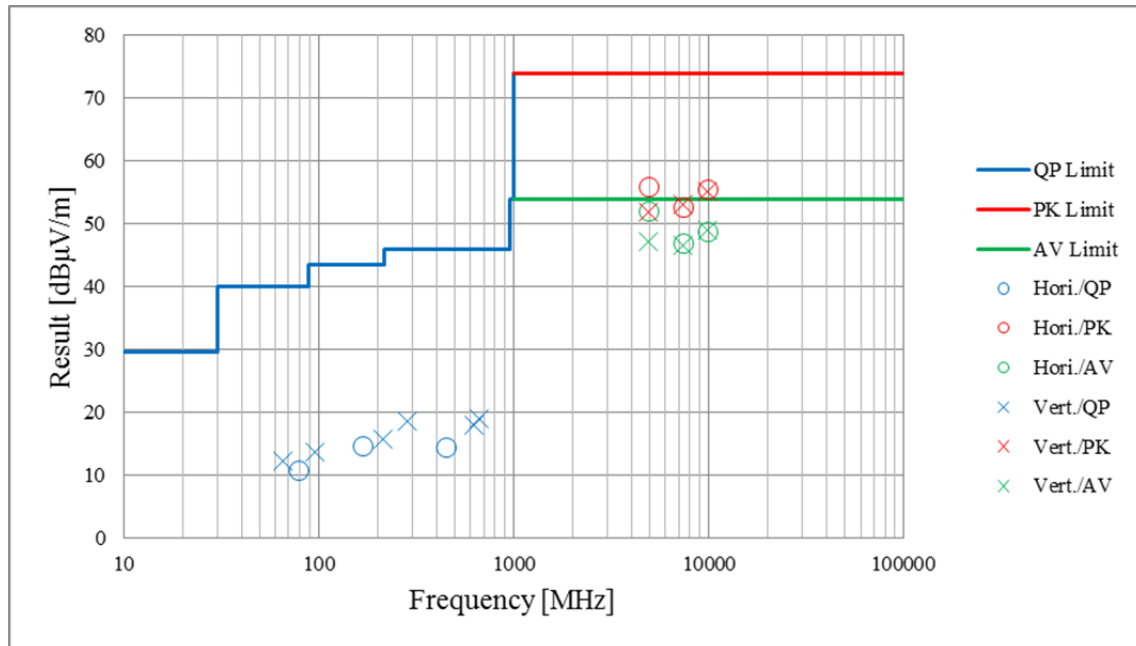
Test place	Shonan EMC Lab. No. 3 Semi Anechoic Chamber
Report No.	10988152S-A
Date	October 5, 2015
Temperature / Humidity	26 deg. C / 46 % RH
Engineer	Hiroyuki Morikawa
Mode	Tx BT LE 2480 MHz



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

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

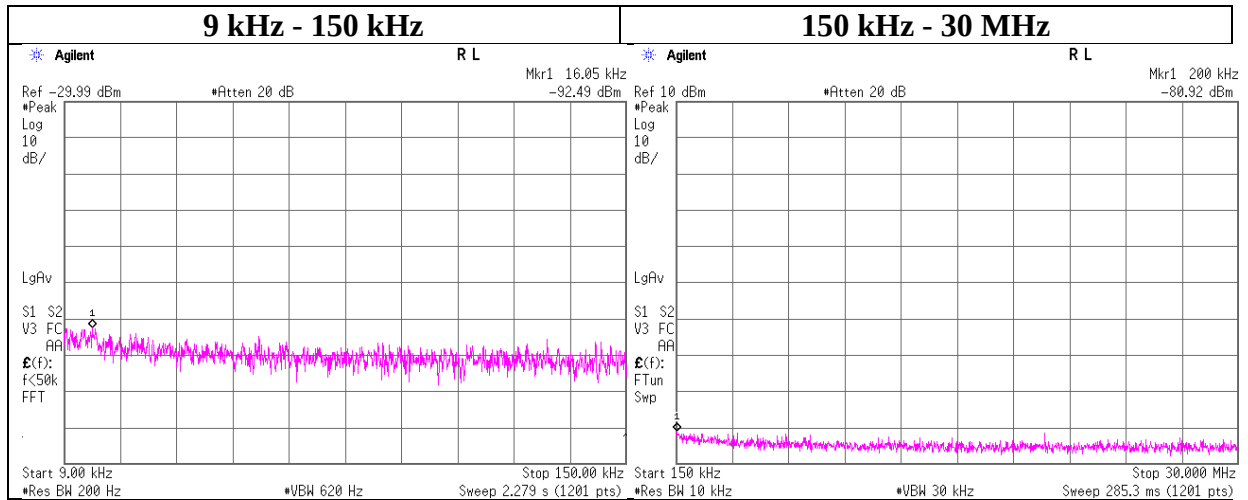
Test place	Shonan EMC Lab. No.2, 3 Semi Anechoic Chamber		
Report No.	10988152S-A		
Date	October 5, 2015	October 7, 2015	
Temperature / Humidity	26 deg. C / 46 % RH	26 deg. C / 46 % RH	
Engineer	Hiroyuki Morikawa (1-25 GHz)	Wataru Kojima (30-1000 MHz)	
Mode	Tx BT LE 2480 MHz		



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

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	10988152S-A
Date	October 7, 2015
Temperature / Humidity	25 deg. C / 43 % RH
Engineer	Tomohiro Hara
Mode	Tx BT LE 2402 MHz



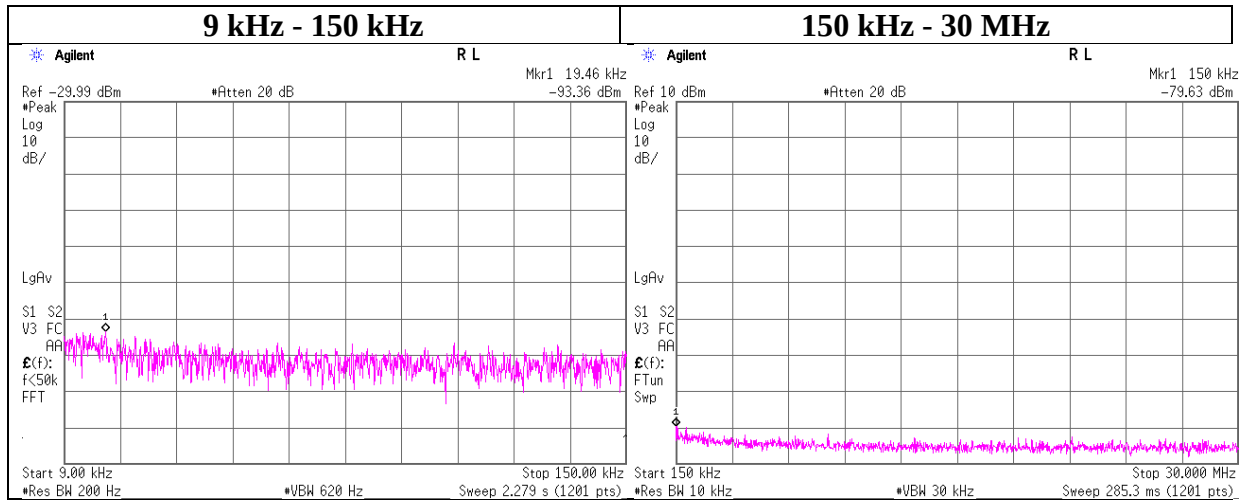
Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	N (Number of Output)	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]		[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
16.05	-92.5	0.01	9.5	15.2	1	-67.7	300	6.0	-6.5	43.4	49.9	
200.00	-80.9	0.01	9.5	15.2	1	-56.1	300	6.0	5.1	21.5	16.4	

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

EIRP = Reading + Cable Loss + Attenuator Loss + Antenna Gain + 10 * log (N)

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 10988152S-A
Date : October 7, 2015
Temperature / Humidity : 25 deg. C / 43 % RH
Engineer : Tomohiro Hara
Mode : Tx BT LE 2440 MHz



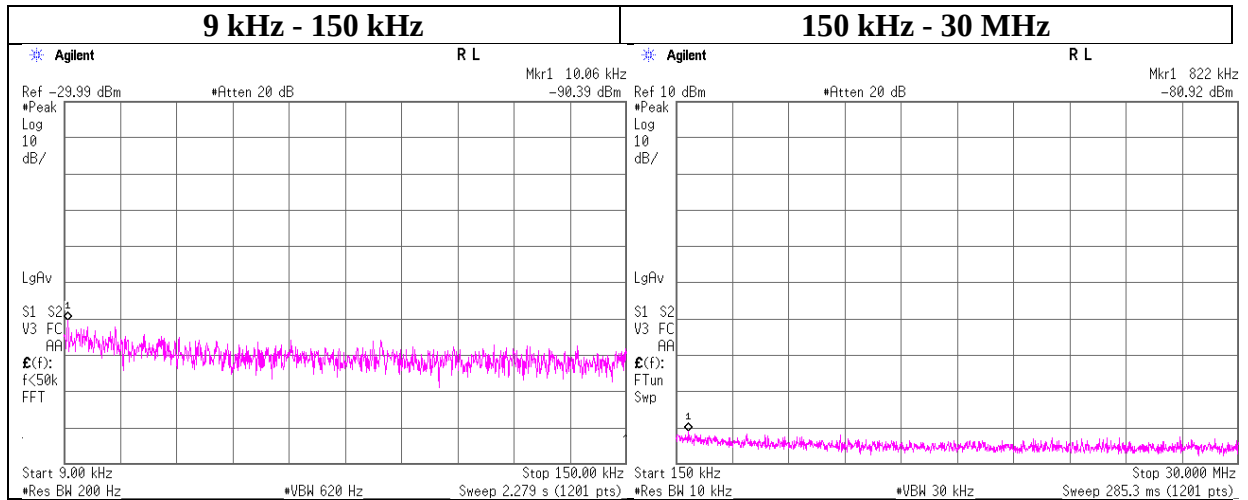
Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	N (Number of Output)	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]		[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
19.46	-93.4	0.01	9.5	15.2	1	-68.6	300	6.0	-7.3	41.8	49.1	
150.00	-79.6	0.01	9.5	15.2	1	-54.9	300	6.0	6.4	24.0	17.6	

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

EIRP = Reading + Cable Loss + Attenuator Loss + Antenna Gain + 10 * log (N)

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 10988152S-A
Date : October 7, 2015
Temperature / Humidity : 25 deg. C / 43 % RH
Engineer : Tomohiro Hara
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]	
10.06	-90.4	0.01	9.5	15.2	1	-65.6	300	6.0	-4.4	47.5	51.9	
822.00	-80.9	0.01	9.5	15.2	1	-56.1	30	6.0	25.1	29.3	4.2	

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

EIRP = Reading + Cable Loss + Attenuator Loss + Antenna Gain + 10 * log (N)

Power Density

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 10988152S-A
Date October 7, 2015
Temperature / Humidity 25 deg. C / 43 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

BTLE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-29.88	0.62	9.63	-19.63	8.00	27.63
2440.00	-29.28	0.63	9.63	-19.02	8.00	27.02
2480.00	-29.11	0.64	9.63	-18.84	8.00	26.84

Sample Calculation:

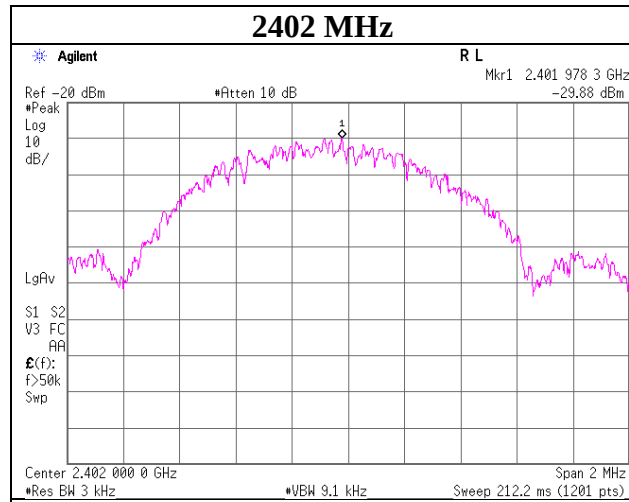
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

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

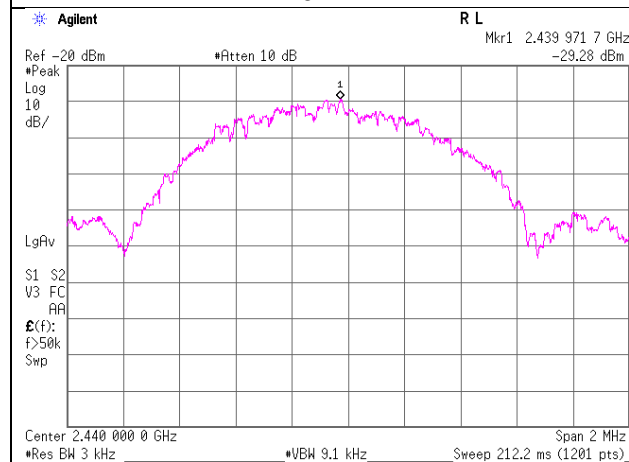
Power Density

BTLE

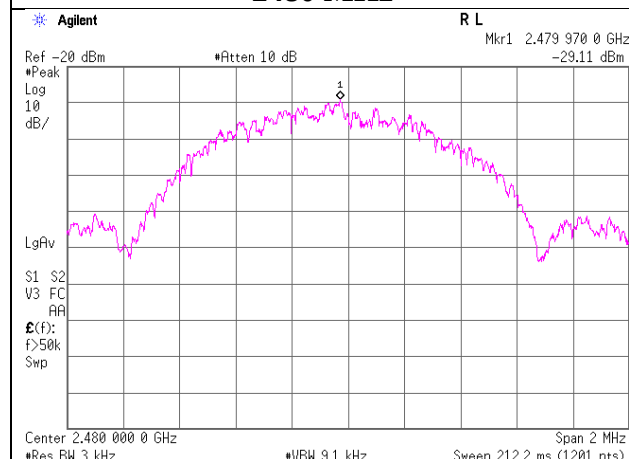
2402 MHz



2440 MHz



2480 MHz



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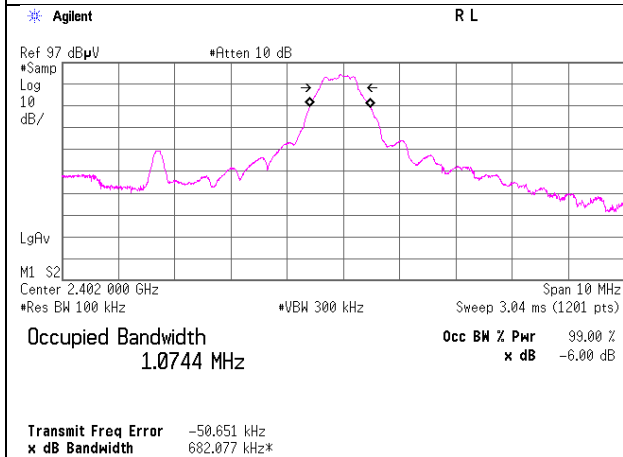
Facsimile : +81 463 50 6401

99%Occupied Bandwidth

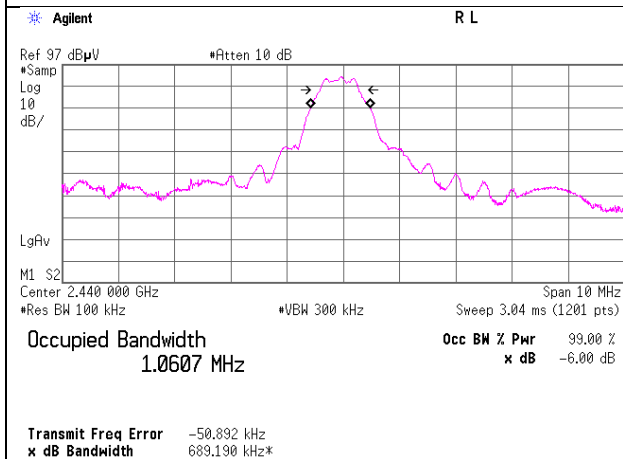
Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 10988152S-A
Date October 7, 2015
Temperature / Humidity 25 deg. C / 43 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

BTLE

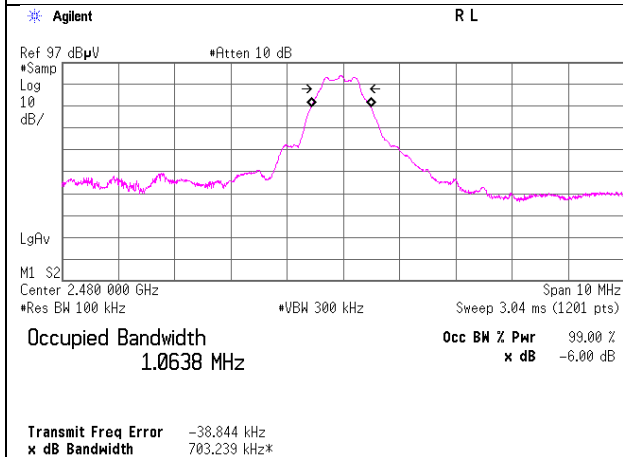
2402 MHz



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)
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	1440491	RE	2015/05/27 * 12
SCC-G04	Coaxial Cable	Junkosha	J12J102207-00	JUN-12-14-018	RE	2015/06/08 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2015/05/19 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2015/08/11 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2014/10/30 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2015/03/23 * 12
SJM-15	Measure	ASKUL	-	-	RE	-
SAEC-03(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	RE	2015/08/28 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE ,RFI,MF)	-	RE	-
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2014/11/21 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2014/11/21 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2015/03/17 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2015/03/23 * 12
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	RE	2015/03/11 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2014/12/24 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	AT	2015/03/23 * 12
SAT10-09	Attenuator	Weinschel Corp.	54A-10	W5692	AT	2014/11/21 * 12
SCC-G31	Coaxial Cable	Junkosha	MWX241-01000K MSKMS	OCT-08-13-046	AT	2015/04/09 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2015/04/07 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2015/04/07 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2015/02/18 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2015/02/18 * 12
KAT3-11	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2015/08/31 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2014/11/22 * 12
SCC-B1/B3/B5/ B7/B8/B13/SRS E-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/ Suhner/Suhner/Suhner/TO YO	8D2W/12DSFA/14 1PE/141PE/141PE/ 141PE/NS4906	-/0901-270(RF Selector)	RE	2015/04/17 * 12
SCC-B2/B4/B6/ B7/B8/B13/SRS E-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/ Suhner/Suhner/Suhner/TO YO	8D2W/12DSFA/14 1PE/141PE/141PE/ 141PE/NS4906	-/0901-270(RF Selector)	RE	2015/04/17 * 12
SLA-02	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0893	RE	2014/11/22 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2014/10/30 * 12
STR-02	Test Receiver	Rohde & Schwarz	ESCI	100575	RE	2015/09/11 * 12
SJM-14	Measure	ASKUL	-	-	RE	-
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2015/07/15 * 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.

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