



RADIO TEST REPORT

Test Report No. : 11019835S-B-R1

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : Bluetooth Watch
Model No. : SHB-100
FCC ID : BBQS04W
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)
7. This report is a revised version of 11019835S-B. 11019835S-B is replaced with this report.

Date of test:

December 8 to 15, 2015

Representative test engineer:

Hiroyuki Morikawa
Engineer
Consumer Technology Division

Approved by:

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.: 11019835S-B

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SECTION 1: Customer information

Company Name	:	CASIO COMPUTER CO., LTD.
Address	:	2-1, Sakaecho 3 chome, Hamura-shi, Tokyo 205-8555 Japan
Telephone Number	:	+81-42-579-7282
Facsimile Number	:	+81-42-579-7702
Contact Person	:	Hiroaki Suzuki

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

2.1 Identification of E.U.T.

Type of Equipment	:	Bluetooth Watch
Model No.	:	SHB-100
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 2.5 V
Receipt Date of Sample	:	November 26, 2015
Country of Mass-production	:	China, Thailand, 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: SHB-100 (referred to as the EUT in this report) is a Bluetooth Watch.

Series models: SHB-200

Models SHB-200 is identical to SHB-100 except for model designation, design of watch face (display), and design of enclosure. These differences have no influence to mechanical, electrical and radio condition of Bluetooth Watches.

General Specification

Clock frequency(ies) in the system	:	26 MHz, 32.768 kHz
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Radio Specification

Equipment type	:	Transceiver
Frequency of operation	:	2402 MHz - 2480 MHz
Bandwidth & channel spacing	:	2 MHz
Type of modulation	:	GFSK
Antenna type	:	Pattern (Mono Pole)
Antenna gain	:	-5.0 dBi

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2015, final revised on November 23, 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

* 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.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	-	-	N/A *1)
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v03r04 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 v03r04 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 v03r04 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 v03r04 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	3.3 dB 9760.00 MHz, AV, Vert. Tx BT LE 2440 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

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

*1) The test is not applicable since the EUT has no AC mains.

*2) Radiated test was selected over 30 MHz based on section 15.247(d).

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred. (ANSI C63.10:2013 is Non-accreditation)

FCC Part 15.31 (e)

The EUT provides stable voltage (DC 1.35 V) constantly to RF IC regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203

The antenna is not removable from 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 $k = 2$.
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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
Spurious emission (Conducted) 1 GHz-3 GHz	1.7 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.4 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.5 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.5 dB
Bandwidth Measurement	0.66 %
Duty cycle and Time Measurement	0.012 %

Radiated emission test

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

3.5 Test Location

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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	10m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5m
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

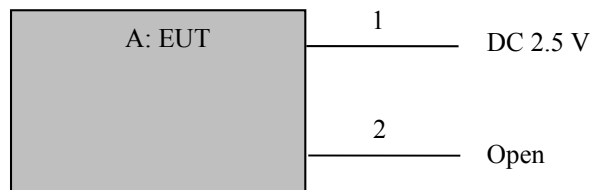
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Remarks*	Tested frequency
Bluetooth Low Energy	PN9	2402 MHz, 2440 MHz, 2480 MHz
* The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel) Power settings: 0 dBm Test software: Ver. 96		

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

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Bluetooth Watch	SHB-100	93 *1)	Casio Computer Co., Ltd.	EUT
A'	Bluetooth Watch	EQB-600	6 *2)	Casio Computer Co., Ltd.	EUT

*1) Used for Radiated Emission test

*2) For Antenna terminal conducted test, the result of EQB-600 is used since there is no difference in the radio block of EQB-600 and SHB-100.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	0.05 + 2	Unshielded	Unshielded	*3)
2	Signal Cable	0.05	Unshielded	Unshielded	*4)

*3) Cable for test operation

*4) Cable for system reset during the development, not used for the product

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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 v03r04".

[For below 1GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1GHz]

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 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.

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: 12.2.5.2 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	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: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

*2) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r04"

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.

Antenna polarization	Carrier (Band edge)	Spurious (Below 1 GHz)	Spurious (1 G -13 GHz)	Spurious (13 G -18 GHz)	Spurious (18 G -26.5 GHz)
Horizontal	X	X	X	X	X
Vertical	Y	X	Z	X	X

Measurement range : 30 M - 26.5 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)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v03r04". *4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 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

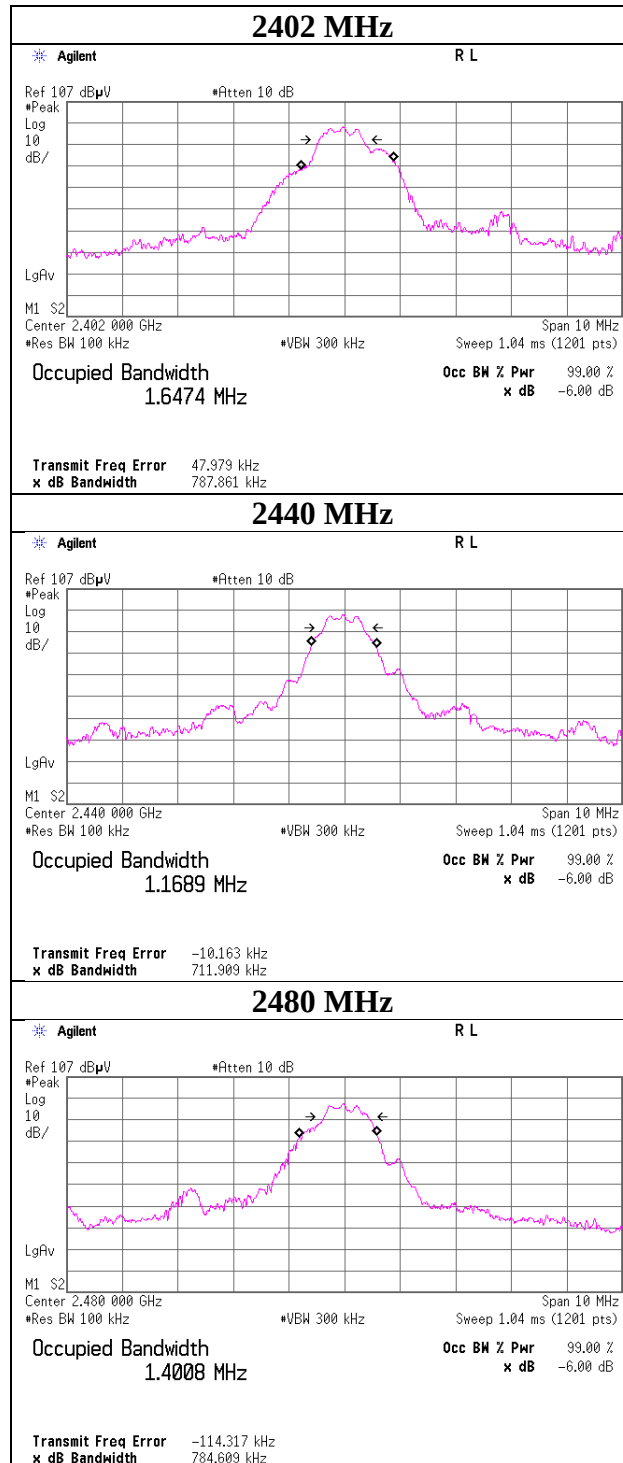
APPENDIX 1: Test data

6dB Bandwidth

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11019835S-B-R1
Date December 15, 2015
Temperature / Humidity 25 deg. C / 40 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
Tx BT LE	2402	0.788	> 500
	2440	0.712	> 500
	2480	0.785	> 500

6dB Bandwidth



Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11019835S-B-R1
Date December 15, 2015
Temperature / Humidity 25 deg. C / 40 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-11.74	1.34	9.67	-0.73	0.85	30.00	1000	30.73
2440	-11.93	1.35	9.67	-0.91	0.81	30.00	1000	30.91
2480	-12.43	1.36	9.67	-1.40	0.72	30.00	1000	31.40

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)

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11019835S-B-R1
Date	December 15, 2015
Temperature / Humidity	25 deg. C / 40 % RH
Engineer	Tomohiro Hara
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	-13.13	1.34	9.67	-2.12	0.61	0.83	-1.29	0.74
2440	-13.33	1.35	9.67	-2.31	0.59	0.83	-1.48	0.71
2480	-13.93	1.36	9.67	-2.90	0.51	0.83	-2.07	0.62

Sample Calculation:

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

Result (Burst power) = Frame power + Duty factor

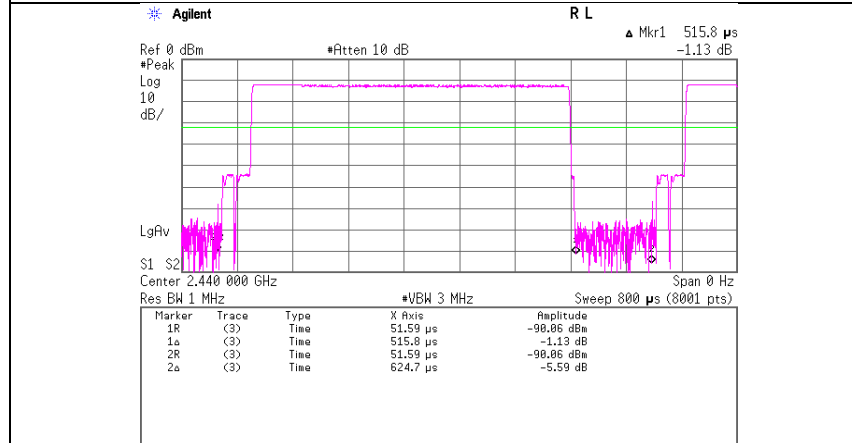
*The equipment and cables were not used for factor 0 dB of the data sheets.

Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11019835S-B-R1
Date	December 15, 2015
Temperature / Humidity	25 deg. C / 40 % RH
Engineer	Tomohiro Hara
Mode	Tx BT LE

Tx on / (Tx on + Tx off) =	0.826
Tx on / (Tx on + Tx off) * 100 =	82.6 %
Duty factor = 10 * log (0.0006247 / 0.0005158) =	0.83 dB
Duty factor = 20 * log (0.0006247 / 0.0005158) =	1.66 dB *

*For radiated emission



Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11019835S-B-R1
Date : December 8, 2015
Temperature / Humidity : 26 deg. C / 21 % RH
Engineer : Hiroyuki Morikawa

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.	48.111	QP	21.5	10.9	7.0	32.1	0.0	7.3	40.0	32.7	202	4	
Hori.	56.361	QP	22.0	8.4	7.0	32.1	0.0	5.3	40.0	34.7	152	279	
Hori.	102.823	QP	21.5	10.1	7.5	32.1	0.0	7.0	43.5	36.5	151	319	
Hori.	156.721	QP	21.2	14.9	7.8	32.1	0.0	11.8	43.5	31.7	287	358	
Hori.	557.567	QP	21.0	18.3	9.8	31.9	0.0	17.2	46.0	28.8	148	21	
Hori.	615.706	QP	21.0	19.2	10.0	31.9	0.0	18.3	46.0	27.7	102	24	
Hori.	2390.000	PK	46.4	27.8	13.7	41.0	3.5	50.4	73.9	23.5	179	144	
Hori.	4804.000	PK	45.4	31.4	5.8	39.6	3.5	46.5	73.9	27.4	100	142	
Hori.	7206.000	PK	45.1	36.9	7.2	40.1	3.5	52.6	73.9	21.3	100	0	
Hori.	9608.000	PK	44.4	38.5	8.2	39.6	3.5	55.0	73.9	18.9	100	0	
Vert.	48.111	QP	21.5	10.9	7.0	32.1	0.0	7.3	40.0	32.7	100	229	
Vert.	56.361	QP	21.9	8.4	7.0	32.1	0.0	5.2	40.0	34.8	100	139	
Vert.	102.823	QP	21.5	10.1	7.5	32.1	0.0	7.0	43.5	36.5	100	221	
Vert.	156.721	QP	21.3	14.9	7.8	32.1	0.0	11.9	43.5	31.6	100	143	
Vert.	557.567	QP	21.1	18.3	9.8	31.9	0.0	17.3	46.0	28.7	100	358	
Vert.	615.706	QP	21.0	19.2	10.0	31.9	0.0	18.3	46.0	27.7	100	223	
Vert.	2390.000	PK	47.3	27.8	13.7	41.0	3.5	51.3	73.9	22.6	136	170	
Vert.	4804.000	PK	44.9	31.4	5.8	39.6	3.5	46.0	73.9	27.9	133	43	
Vert.	7206.000	PK	44.8	36.9	7.2	40.1	3.5	52.3	73.9	21.6	100	0	
Vert.	9608.000	PK	46.2	38.5	8.2	39.6	3.5	56.8	73.9	17.1	396	325	

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

Distance factor : 1 GHz - 13 GHz : 20log (4.47 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	37.0	27.8	13.7	41.0	1.6	3.5	42.6	53.9	11.3	*1)
Hori.	4804.000	AV	35.5	31.4	5.8	39.6	1.6	3.5	38.2	53.9	15.7	
Hori.	7206.000	AV	36.0	36.9	7.2	40.1	1.6	3.5	45.1	53.9	8.8	
Hori.	9608.000	AV	36.3	38.5	8.2	39.6	1.6	3.5	48.5	53.9	5.4	
Vert.	2390.000	AV	36.9	27.8	13.7	41.0	1.6	3.5	42.5	53.9	11.4	*1)
Vert.	4804.000	AV	37.3	31.4	5.8	39.6	1.6	3.5	40.0	53.9	13.9	
Vert.	7206.000	AV	36.1	36.9	7.2	40.1	1.6	3.5	45.2	53.9	8.7	
Vert.	9608.000	AV	36.7	38.5	8.2	39.6	1.6	3.5	48.9	53.9	5.0	

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 (4.47 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	74.4	27.8	13.7	41.0	3.5	78.4	-	-	Carrier
Hori.	2400.000	PK	39.6	27.8	13.7	41.0	3.5	43.6	58.4	14.8	
Vert.	2402.000	PK	74.1	27.8	13.7	41.0	3.5	78.1	-	-	Carrier
Vert.	2400.000	PK	40.8	27.8	13.7	41.0	3.5	44.8	58.1	13.3	

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

Distance factor : 1 GHz - 13 GHz : 20log (4.47 m / 3.0 m) = 3.5 dB

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

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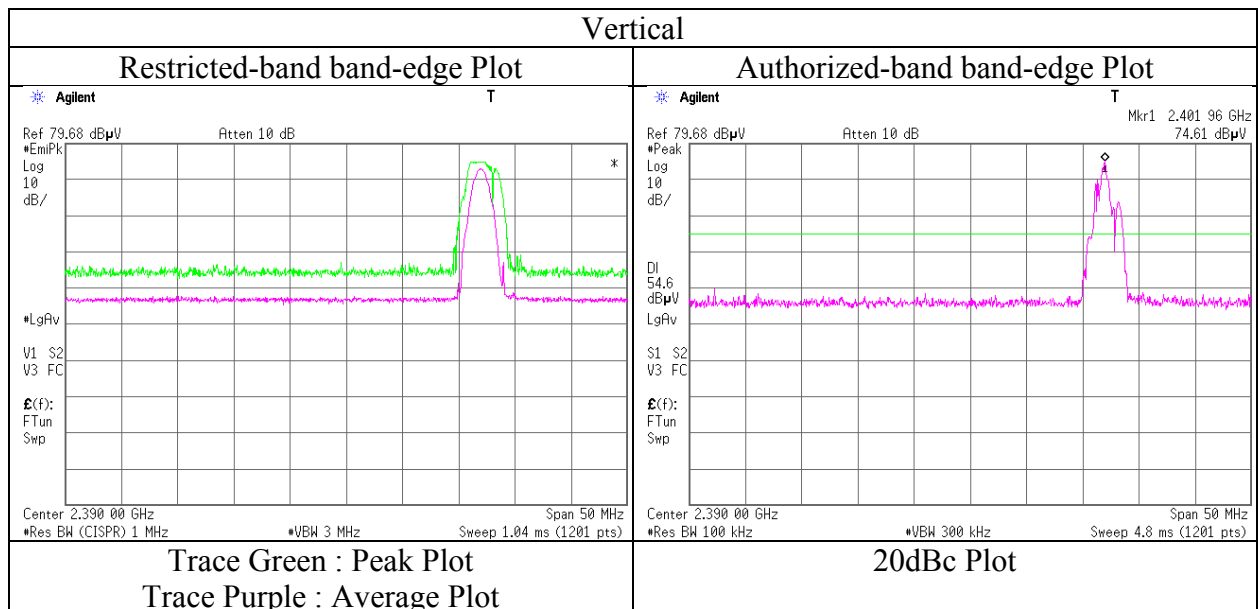
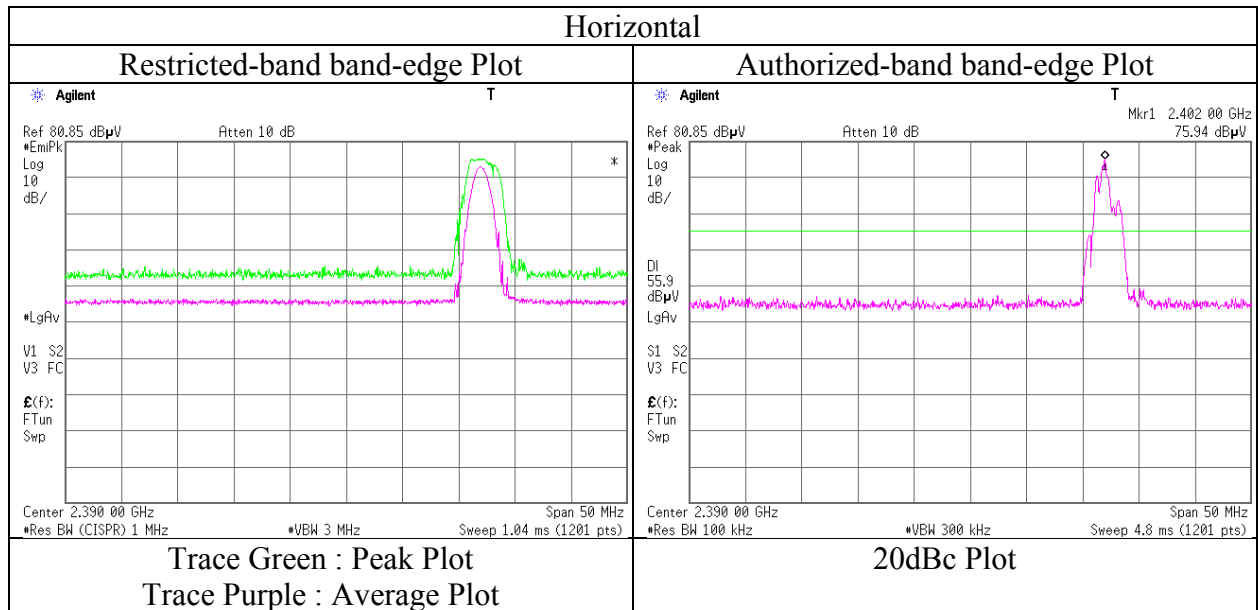
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Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11019835S-B-R1
Date	December 8, 2015
Temperature / Humidity	26 deg. C / 21 % RH
Engineer	Hiroyuki Morikawa
Mode	Tx BT LE 2402 MHz



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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11019835S-B-R1
Date : December 8, 2015
Temperature / Humidity : 26 deg. C / 21 % RH
Engineer : Hiroyuki Morikawa

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.	48.111	QP	21.5	10.9	7.0	32.1	0.0	7.3	40.0	32.7	201	4	
Hori.	56.361	QP	21.9	8.4	7.0	32.1	0.0	5.2	40.0	34.8	153	280	
Hori.	102.823	QP	21.4	10.1	7.5	32.1	0.0	6.9	43.5	36.6	151	320	
Hori.	156.721	QP	21.2	14.9	7.8	32.1	0.0	11.8	43.5	31.7	288	357	
Hori.	4880.000	PK	46.0	31.7	5.9	39.5	3.5	47.6	73.9	26.3	100	139	
Hori.	7320.000	PK	46.1	36.9	7.3	40.2	3.5	53.6	73.9	20.3	100	0	
Hori.	9760.000	PK	46.4	38.5	8.3	39.5	3.5	57.2	73.9	16.7	100	305	
Vert.	48.111	QP	21.5	10.9	7.0	32.1	0.0	7.3	40.0	32.7	100	230	
Vert.	56.361	QP	22.0	8.4	7.0	32.1	0.0	5.3	40.0	34.7	100	140	
Vert.	102.823	QP	21.6	10.1	7.5	32.1	0.0	7.1	43.5	36.4	100	357	
Vert.	156.721	QP	21.3	14.9	7.8	32.1	0.0	11.9	43.5	31.6	100	224	
Vert.	4880.000	PK	44.1	31.7	5.9	39.5	3.5	45.7	73.9	28.2	100	143	
Vert.	7320.000	PK	46.0	36.9	7.3	40.2	3.5	53.5	73.9	20.4	100	0	
Vert.	9760.000	PK	47.8	38.5	8.3	39.5	3.5	58.6	73.9	15.3	396	311	

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

Distance factor : 1 GHz - 13 GHz : 20log(4.47 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.	4880.000	AV	36.4	31.7	5.9	39.5	1.6	3.5	39.6	53.9	14.3	
Hori.	7320.000	AV	36.6	36.9	7.3	40.2	1.6	3.5	45.7	53.9	8.2	
Hori.	9760.000	AV	36.7	38.5	8.3	39.5	1.6	3.5	49.1	53.9	4.8	
Vert.	4880.000	AV	35.5	31.7	5.9	39.5	1.6	3.5	38.7	53.9	15.2	
Vert.	7320.000	AV	36.8	36.9	7.3	40.2	1.6	3.5	45.9	53.9	8.0	
Vert.	9760.000	AV	38.2	38.5	8.3	39.5	1.6	3.5	50.6	53.9	3.3	

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(4.47 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)

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11019835S-B-R1
Date : December 8, 2015
Temperature / Humidity : 26 deg. C / 21 % RH
Engineer : Hiroyuki Morikawa

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.	48.111	QP	21.5	10.9	7.0	32.1	0.0	7.3	40.0	32.7	202	5	
Hori.	56.361	QP	21.9	8.4	7.0	32.1	0.0	5.2	40.0	34.8	155	280	
Hori.	102.823	QP	21.4	10.1	7.5	32.1	0.0	6.9	43.5	36.6	152	318	
Hori.	156.721	QP	21.2	14.9	7.8	32.1	0.0	11.8	43.5	31.7	286	355	
Hori.	2483.500	PK	45.8	27.9	13.8	41.0	3.5	50.0	73.9	23.9	239	124	
Hori.	4960.000	PK	46.1	32.0	6.0	39.4	3.5	48.2	73.9	25.7	100	138	
Hori.	7440.000	PK	46.2	37.0	7.5	40.4	3.5	53.8	73.9	20.1	100	0	
Hori.	9920.000	PK	45.4	38.4	8.4	39.4	3.5	56.3	73.9	17.6	100	311	
Vert.	48.111	QP	21.5	10.9	7.0	32.1	0.0	7.3	40.0	32.7	100	228	
Vert.	56.361	QP	21.9	8.4	7.0	32.1	0.0	5.2	40.0	34.8	100	140	
Vert.	102.823	QP	21.6	10.1	7.5	32.1	0.0	7.1	43.5	36.4	100	222	
Vert.	156.721	QP	21.3	14.9	7.8	32.1	0.0	11.9	43.5	31.6	100	143	
Vert.	2483.500	PK	45.9	27.9	13.8	41.0	3.5	50.1	73.9	23.8	108	193	
Vert.	4960.000	PK	45.5	32.0	6.0	39.4	3.5	47.6	73.9	26.3	400	102	
Vert.	7440.000	PK	45.8	37.0	7.5	40.4	3.5	53.4	73.9	20.5	100	0	
Vert.	9920.000	PK	45.4	38.4	8.4	39.4	3.5	56.3	73.9	17.6	100	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(4.47 \text{ m} / 3.0 \text{ m}) = 3.5 \text{ dB}$

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	36.6	27.9	13.8	41.0	1.6	3.5	42.4	53.9	11.5	*1)
Hori.	4960.000	AV	36.7	32.0	6.0	39.4	1.6	3.5	40.4	53.9	13.5	
Hori.	7440.000	AV	37.3	37.0	7.5	40.4	1.6	3.5	46.5	53.9	7.4	
Hori.	9920.000	AV	36.7	38.4	8.4	39.4	1.6	3.5	49.2	53.9	4.7	
Vert.	2483.500	AV	36.4	27.9	13.8	41.0	1.6	3.5	42.2	53.9	11.7	*1)
Vert.	4960.000	AV	35.9	32.0	6.0	39.4	1.6	3.5	39.6	53.9	14.3	
Vert.	7440.000	AV	37.0	37.0	7.5	40.4	1.6	3.5	46.2	53.9	7.7	
Vert.	9920.000	AV	36.4	38.4	8.4	39.4	1.6	3.5	48.9	53.9	5.0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(4.47 \text{ m} / 3.0 \text{ m}) = 3.5 \text{ dB}$

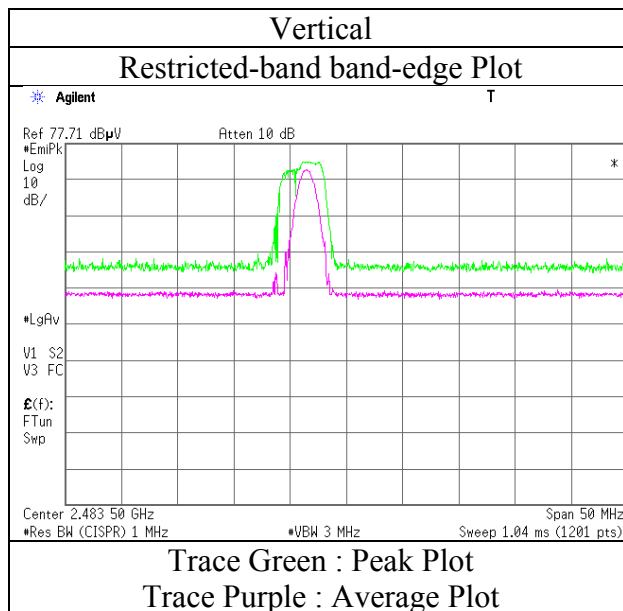
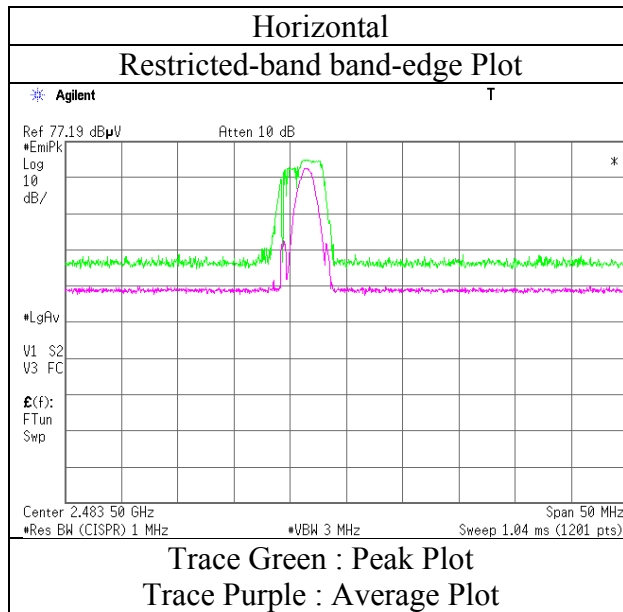
13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

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)

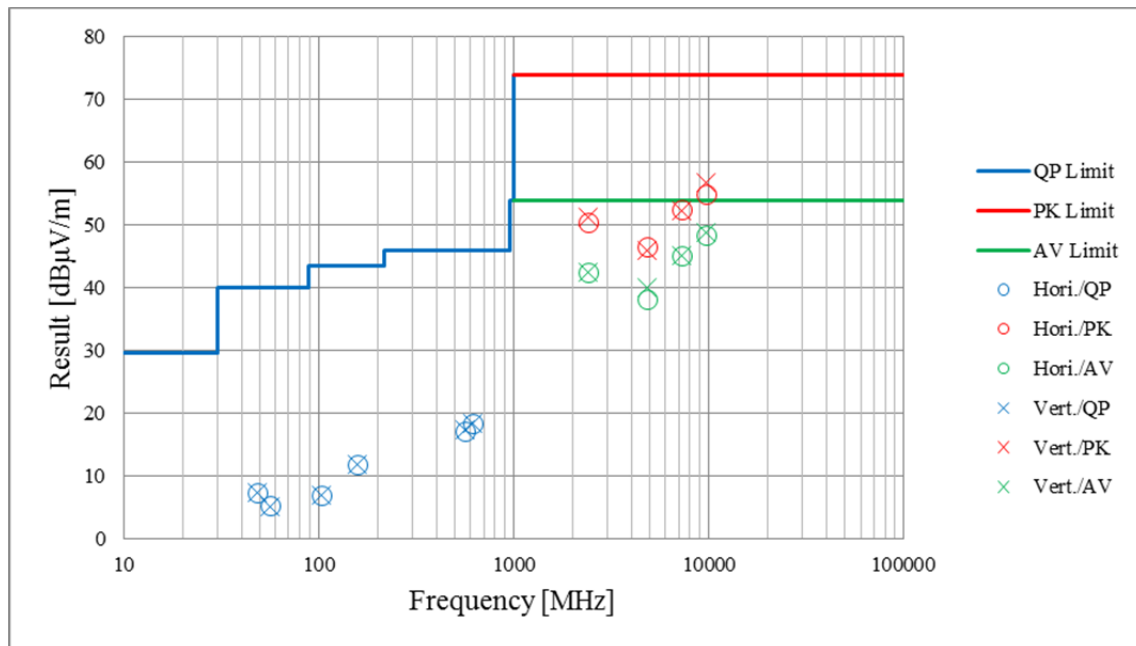
Test place Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. 11019835S-B-R1
Date December 8, 2015
Temperature / Humidity 26 deg. C / 21 % RH
Engineer Hiroyuki Morikawa
Mode Tx BT LE 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

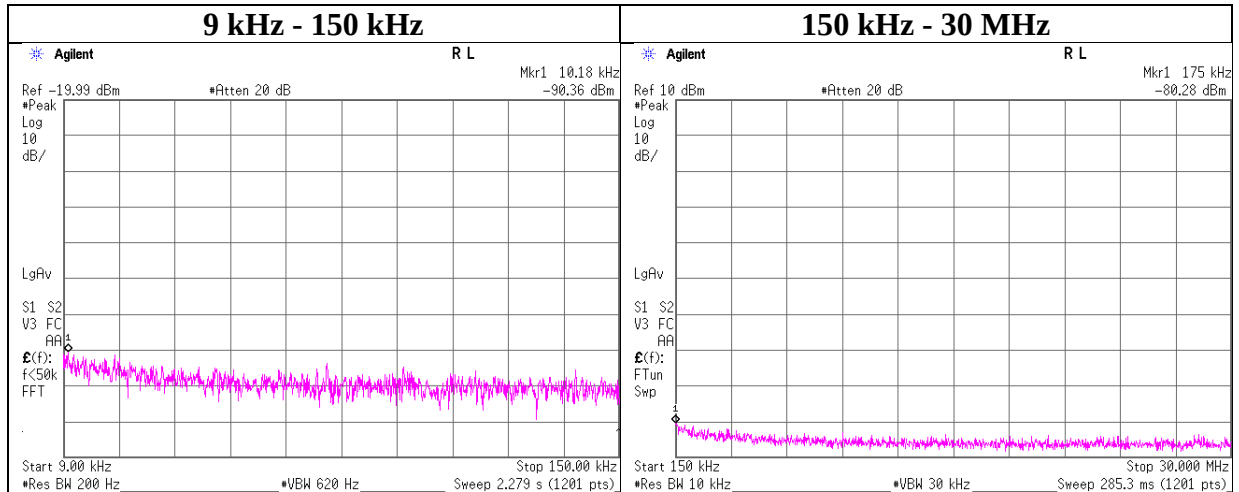
Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11019835S-B-R1
Date : December 8, 2015
Temperature / Humidity : 26 deg. C / 21 % RH
Engineer : Hiroyuki Morikawa
Mode : Tx BT LE 2402 MHz



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

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11019835S-B-R1
Date : December 15, 2015
Temperature / Humidity : 25 deg. C / 40 % RH
Engineer : Tomohiro Hara
Mode : Tx BT LE 2402 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	N	EIRP	Distance	Ground bounce	E	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi] *1)	(Number of Output	[dBm]	[m]	[dB]	(field strength) [dBuV/m]	[dBuV/m]	[dB]	
10.18	-90.4	0.01	9.5	2.0	1	-78.8	300	6.0	-17.6	47.4	65.0	
175.00	-80.3	0.01	9.5	2.0	1	-68.7	300	6.0	-7.5	22.7	30.2	

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

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

*1) Antenna Gain was based on KDB 558074 section 12.2.6.

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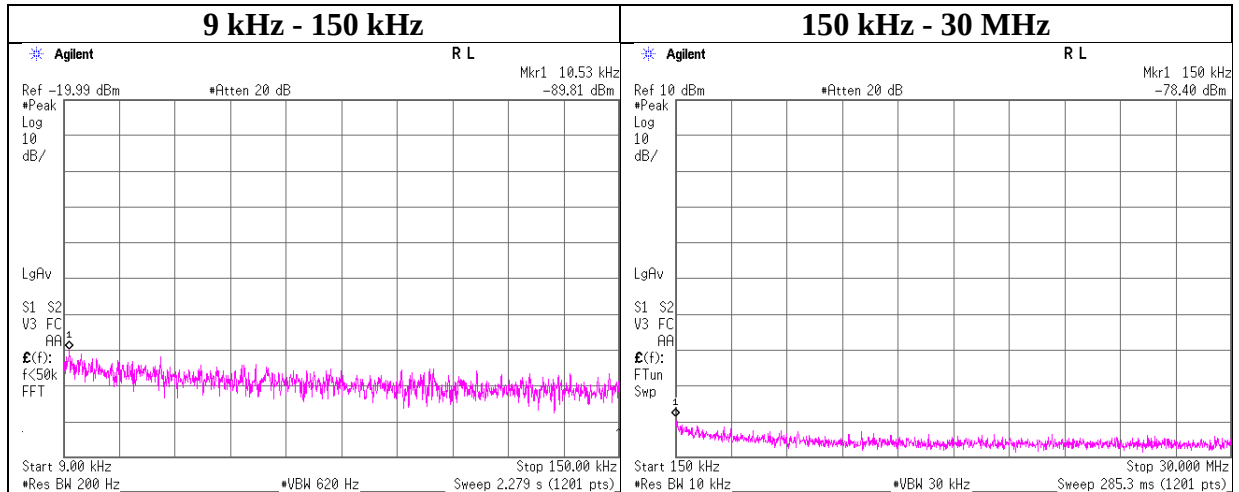
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11019835S-B-R1
Date : December 15, 2015
Temperature / Humidity : 25 deg. C / 40 % RH
Engineer : Tomohiro Hara
Mode : Tx BT LE 2440 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	N	EIRP	Distance	Ground bounce	E	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi] *1)	(Number of Output	[dBm]	[m]	[dB]	(field strength) [dBuV/m]	[dBuV/m]	[dB]	
10.53	-89.8	0.01	9.5	2.0	1	-78.3	300	6.0	-17.0	47.1	64.1	
150.00	-78.4	0.01	9.5	2.0	1	-66.9	300	6.0	-5.6	24.0	29.6	

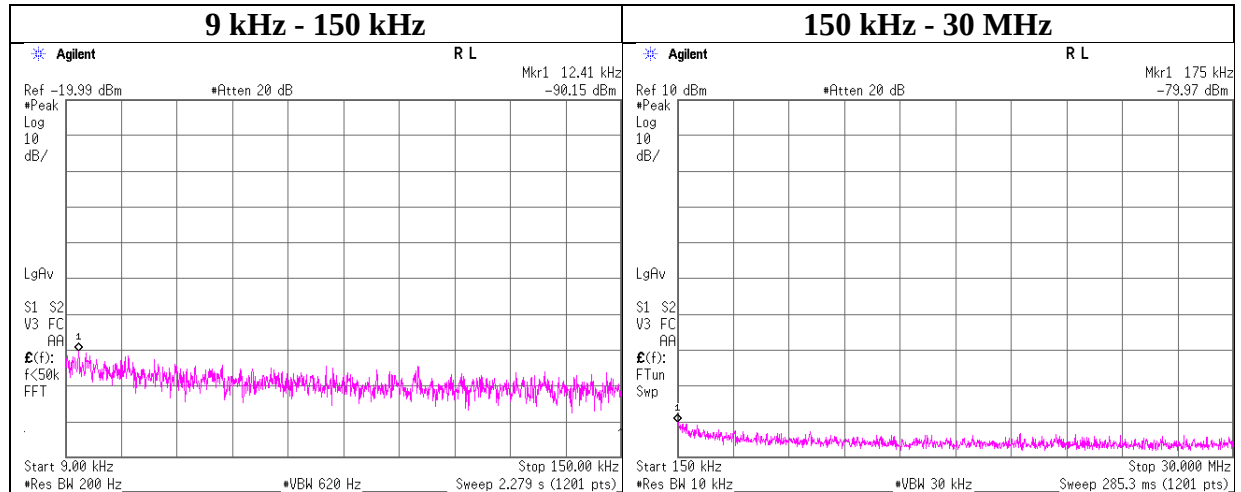
$$E = \text{EIRP} - 20 \log(D) + \text{Ground bounce} + 104.8 \text{ [dBuV/m]}$$

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

*1) Antenna Gain was based on KDB 558074 section 12.2.6.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11019835S-B-R1
Date : December 15, 2015
Temperature / Humidity : 25 deg. C / 40 % RH
Engineer : Tomohiro Hara
Mode : Tx BT LE 2480 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain	N	EIRP	Distance	Ground bounce	E	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi] *1)	(Number of Output	[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
12.41	-90.2	0.01	9.5	2.0	1	-78.6	300	6.0	-17.3	45.7	63.0	
175.00	-79.2	0.01	9.5	2.0	1	-67.6	300	6.0	-6.4	22.7	29.1	

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

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

*1) Antenna Gain was based on KDB 558074 section 12.2.6.

Power Density

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11019835S-B-R1
Date December 15, 2015
Temperature / Humidity 25 deg. C / 40 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

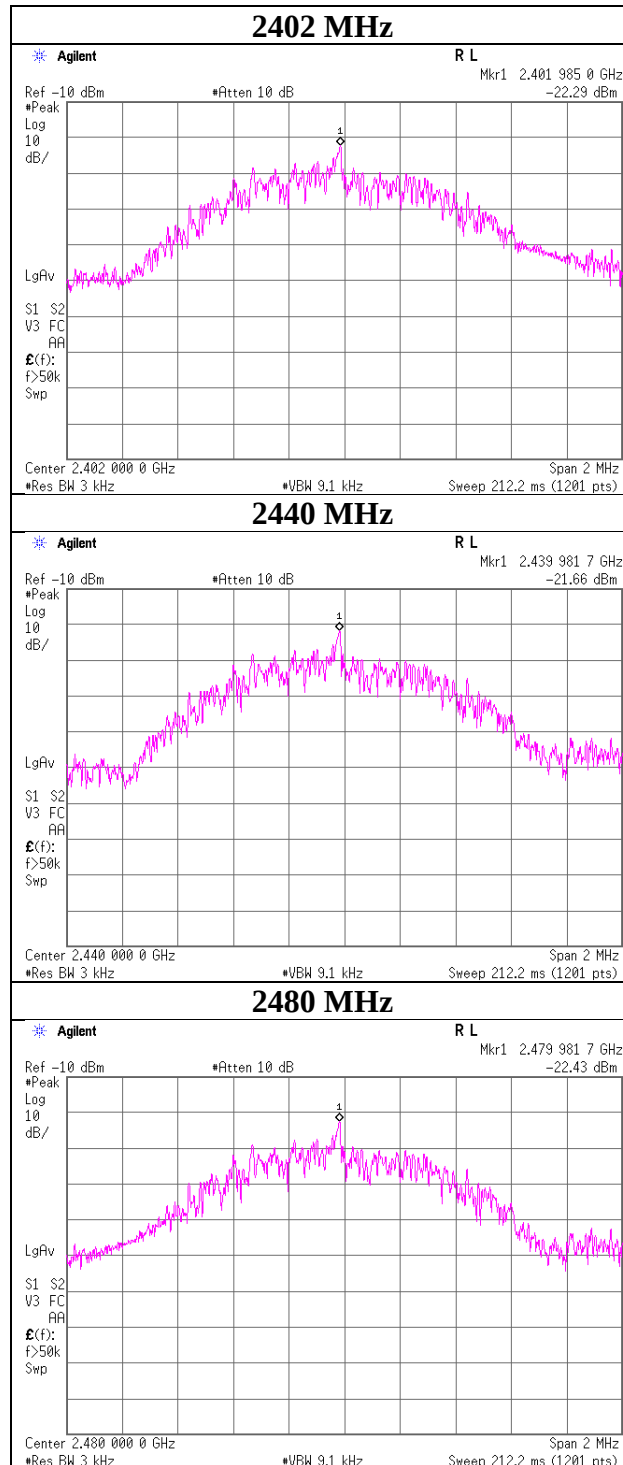
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-22.29	1.34	9.67	-11.28	8.00	19.28
2440.00	-21.66	1.35	9.67	-10.64	8.00	18.64
2480.00	-22.43	1.36	9.67	-11.40	8.00	19.40

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



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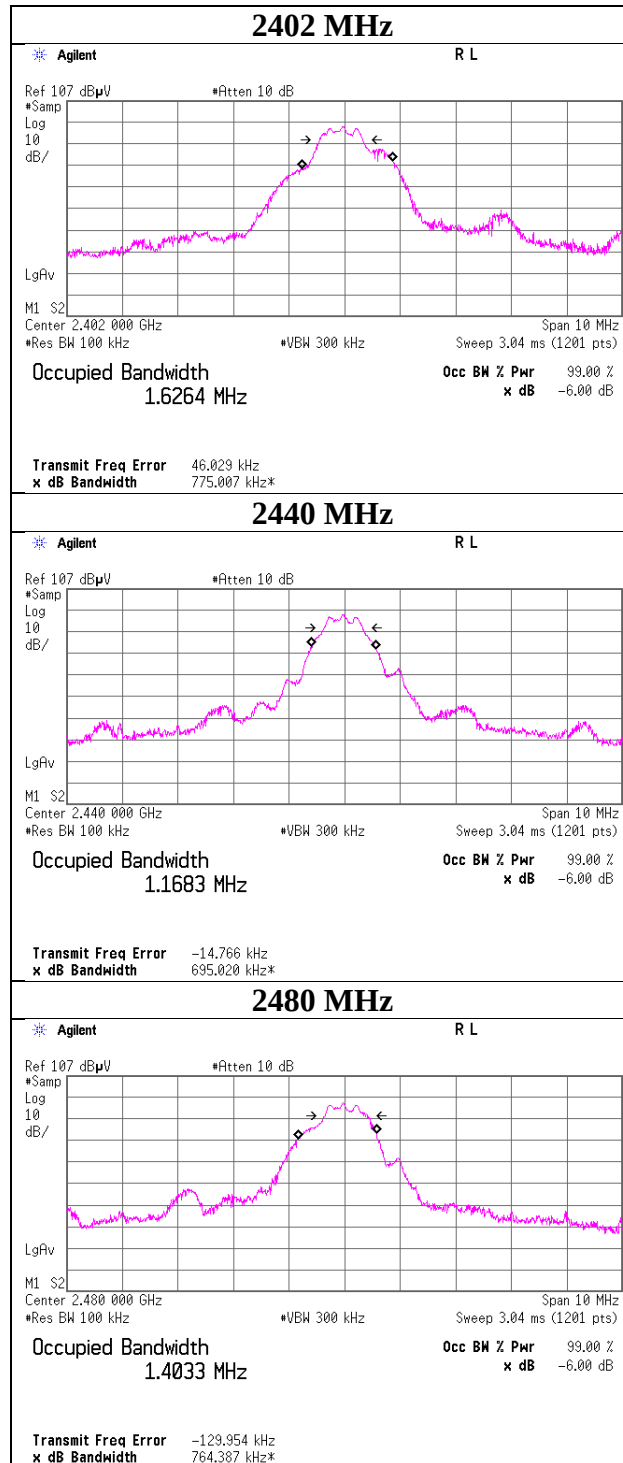
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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99% Occupied Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11019835S-B-R1
Date	December 15, 2015
Temperature / Humidity	25 deg. C / 40 % RH
Engineer	Tomohiro Hara
Mode	Tx BT LE



APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2015/07/16 * 12
SEAC-03(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-03(SVS WR)	3	RE	2015/08/28 * 12
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	2015/10/22 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2015/03/23 * 12
SJM-15	Measure	ASKUL	-	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFL,MF)	-	RE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2015/11/18 * 12
SAT10-05	Attenuator(above1GHz)	Agilent	8493C-010	74864	RE	2015/11/04 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2015/11/16 * 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
SCC-G33	Coaxial Cable	Junkosha	MWX241-0100 OKMSKMS	-	RE	2015/04/09 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2015/10/11 * 12
SLA-03	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0901	RE	2015/10/11 * 12
SAT6-08	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	RE	2015/08/31 * 12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/T OYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(R F Selector)	RE	2015/04/17 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2015/02/18 * 12
STR-06	Test Receiver	Rohde & Schwarz	ESCI	101259	RE	2015/03/24 * 12
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY48250152	AT	2015/09/16 * 12
SAT10-09	Attenuator	Weinschel Corp.	54A-10	W5692	AT	2015/11/04 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2015/03/11 * 12
SPM-01	Power Meter	Agilent	E4419B	MY45104212	AT	2015/01/14 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2015/04/07 * 12
KTS-07	Digital Tester	SANWA	PC500	7019232	AT	2015/11/18 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2015/12/07 * 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.

Shonan EMC Lab.

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