



RADIO TEST REPORT

Test Report No. : 11931208S-A-R1

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : Watch
Model No. : GMW-B5000
FCC ID : BBQS0DW
Test regulation : FCC Part 15 Subpart C: 2018
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 11931208S-A. 11931208S-A is replaced with this report.

Date of test: September 15 to November 1, 2017

Representative test engineer:

Makoto Hosaka

Engineer

Consumer Technology Division

Approved by:

Akio Hayashi

Leader

Consumer Technology Division



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Testing
RTL02610

- ☐ 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

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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	:	Watch
Model No.	:	GMW-B5000
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	Typical: DC 2.5 V, Min.: DC 1.9 V, Max.: DC 2.7 V CW3459 (Module): Typical: DC 2.5 V/DC 3.0 V*, Min.: DC 1.9 V, Max.: DC 3.3 V
Receipt Date of Sample	:	September 14, 2017
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.

* Specification of BLE module CW3459 installed in GMW-B5000.
For the GMW-B5000, use only DC 2.5 V battery and don't use DC 3.0 V battery.

2.2 Product Description

Model: GMW-B5000 (referred to as the EUT in this report) is a Watch.

* GMW-B5000 has alternative name as R009.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Power Supply (radio part input)	:	DC 1.35 V
Antenna type	:	Chip (Mono Pole)
Antenna Gain	:	2.5 dBi
Clock frequency (Maximum)	:	26 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on February 2, 2018 and effective March 5, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz,
2400-2483.5 MHz, and 5725-5850 MHz

* The revisions made after testing date do 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	-	-	*1)
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	5.2 dB 2400.000 MHz, AV, Vertical Tx 2402 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) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7.

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

FCC Part 15.31 (e)

The EUT provides stable voltage (DC 1.35 V) constantly to the wireless transmitter regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the 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.

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3.3 Addition to standard

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

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

3.4 Uncertainty

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	No. 4 SAC / SR	No. 5,6,8 SR
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.1 dB	3.1 dB	3.1 dB	-	-
	30 MHz-200 MHz	4.6 dB	4.4 dB	4.6 dB	-	-
	200 MHz-1 GHz	5.8 dB	5.7 dB	5.8 dB	-	-
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
Radiated emission (Measurement distance: 1 m)	13 GHz-18 GHz	4.6 dB	4.6 dB	4.6 dB	-	-
	18 GHz-40 GHz	4.9 dB	4.9 dB	4.9 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	0.72 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.85 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.74 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	0.91 dB
Spurious emission (Conducted) below 1GHz	1.6 dB
Spurious emission, Power Density (Conducted) 1 GHz-3 GHz	1.3 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.2 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.3 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %

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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Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401
JAB Accreditation No. RTL02610, FCC Test Firm Registration Number: 839876

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

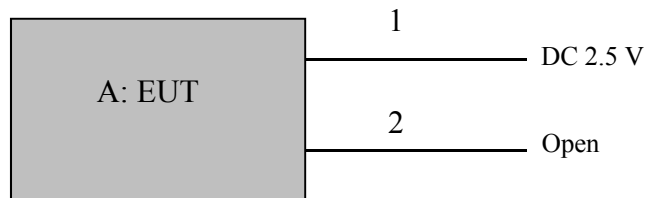
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Bluetooth Low Energy (BT LE)	2402 MHz, 2440 MHz, 2480 MHz	PN9
*Power of the EUT was set by the software as follows; - Power Setting: Fixed - Software: BLE RF Test Version 9.9 *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

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Watch	GMW-B5000	61 *1) 20 *2)	Casio Computer Co., Ltd.	EUT

*1) Used for AT test

*2) Used for RE test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	0.1 + 1.5	Unshielded	Unshielded	*3)
2	Signal Cable	0.1	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 "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]

EUT was placed on a platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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

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

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

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

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

Test Antennas are used as below;

Frequency	30 MHz to 200 MHz	200 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 *1)	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.	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	3.96 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)		3.96 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)

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

*2) Distance Factor: $20 \times \log (3.96 \text{ m} / 3.0 \text{ m}) = 2.42 \text{ dB}$

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

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- 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	Spurious (Below 1 GHz)	Spurious (1 GHz -13 GHz)	Spurious (13 GHz -26.5 GHz)
Horizontal	X	X	X	X
Vertical	Y	X	Y	X

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

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

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	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) Max hold was applied as Worst-case measurement.

*2) Reference data

*3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04".

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

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

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

Test data : APPENDIX
Test result : Pass

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APPENDIX 1: Test data

6dB Bandwidth

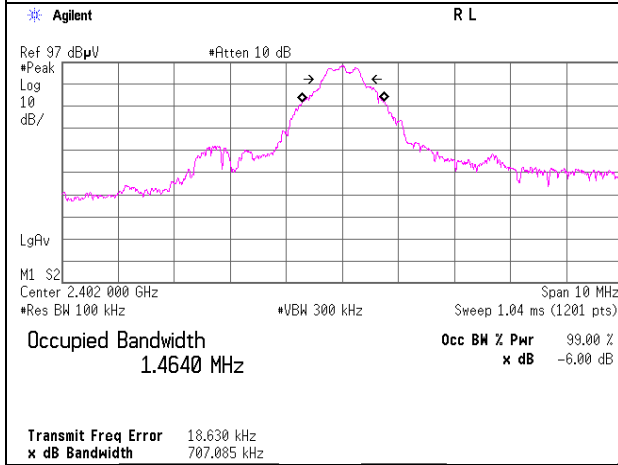
Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11931208S-A-R1
Date	September 15, 2017
Temperature / Humidity	24 deg. C / 49 % RH
Engineer	Makoto Hosaka
Mode	Tx BT LE

Mode	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [kHz]
BTLE	2402	0.707	> 500
	2440	0.693	> 500
	2480	0.691	> 500

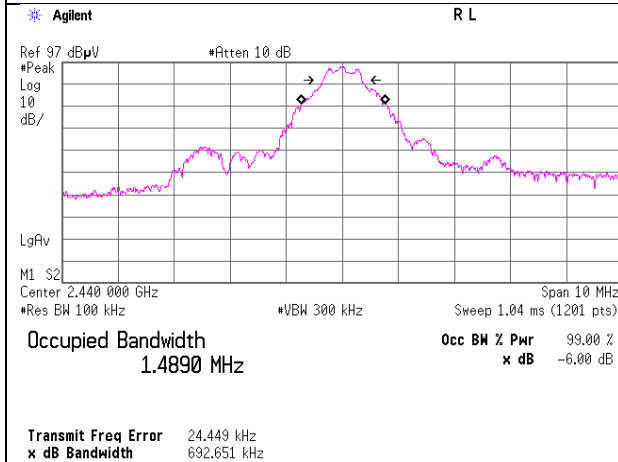
6dB Bandwidth

BTLE

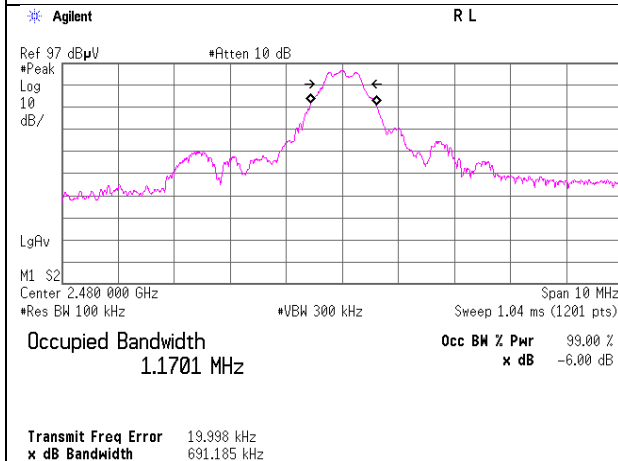
2402 MHz



2440 MHz



2480 MHz

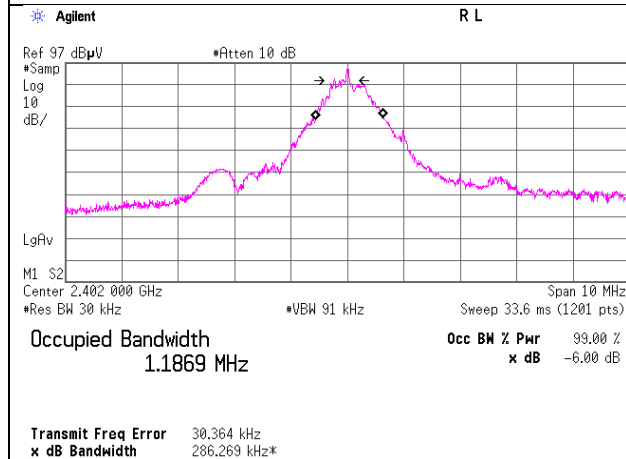


99% Occupied Bandwidth

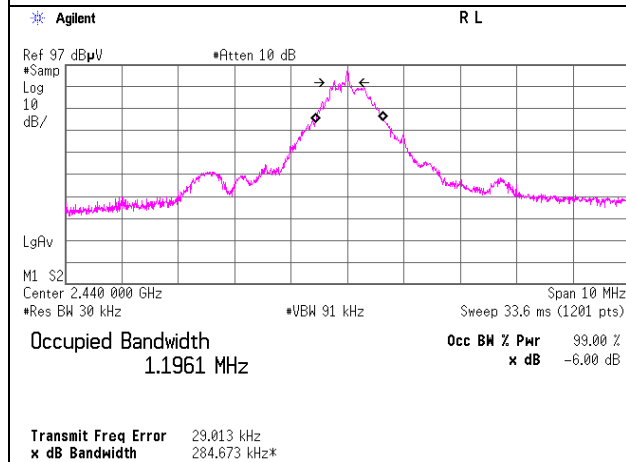
Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11931208S-A-R1
Date : September 15, 2017
Temperature / Humidity : 24 deg. C / 49 % RH
Engineer : Makoto Hosaka
Mode : Tx BT LE

BTLE

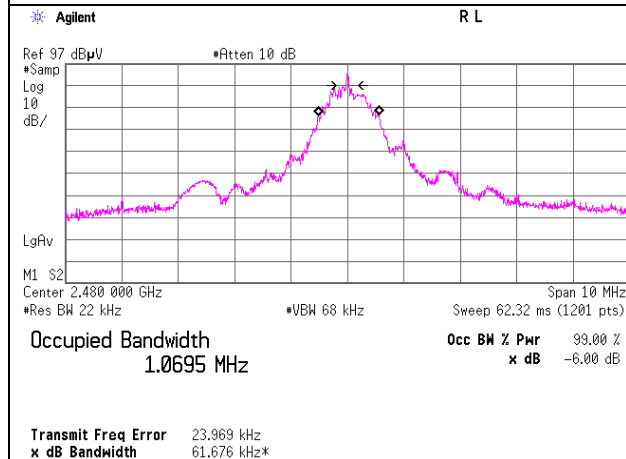
2402 MHz



2440 MHz



2480 MHz



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Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11931208S-A-R1
Date September 15, 2017
Temperature / Humidity 24 deg. C / 49 % RH
Engineer Makoto Hosaka
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-11.55	1.82	9.80	0.07	1.02	30.00	1000	29.93
2440	-11.88	1.83	9.80	-0.25	0.94	30.00	1000	30.25
2480	-12.77	1.84	9.80	-1.13	0.77	30.00	1000	31.13

Sample Calculation:

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

Average Output Power
(Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11931208S-A-R1
Date	September 15, 2017
Temperature / Humidity	24 deg. C / 49 % RH
Engineer	Makoto Hosaka
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-13.48	1.82	9.80	-1.86	0.65	0.89	-0.97	0.80
2440	-13.78	1.83	9.80	-2.15	0.61	0.89	-1.26	0.75
2480	-14.79	1.84	9.80	-3.15	0.48	0.89	-2.26	0.59

Sample Calculation:

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

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

Radiated Spurious Emission

Test place	Shonan EMC Lab. No.1 & 3 Semi Anechoic Chamber		
Report No.	11931208S-A-R1		
Date	October 21, 2017	November 1, 2017	November 1, 2017
Temperature / Humidity	21 deg. C / 56 % RH	22 deg. C / 40 % RH	22 deg. C / 40 % RH
Engineer	Hikaru Shirasawa (1 GHz -13 GHz)	Kazutaka Takeyama (13 GHz- 26.5 GHz)	Kazutaka Takeyama (30 MHz- 1 GHz)
Mode	Tx BT LE 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	164.899	QP	21.54	15.61	8.03	32.02	0.00	13.16	43.50	30.3	162	101	
Hori.	197.895	QP	21.75	16.24	7.99	32.00	0.00	13.98	43.50	29.5	167	106	
Hori.	834.679	QP	21.31	21.05	10.83	31.30	0.00	21.89	46.00	24.1	100	3	
Hori.	909.241	QP	21.28	21.98	11.08	30.84	0.00	23.50	46.00	22.5	158	320	
Hori.	2390.000	PK	48.06	27.14	14.27	40.85	2.42	51.04	73.90	22.8	197	336	
Hori.	2399.409	PK	61.84	27.17	14.27	40.84	2.42	64.86	73.90	9.0	197	336	
Hori.	2400.000	PK	60.27	27.17	14.27	40.84	2.42	63.29	73.90	10.6	197	336	
Hori.	4804.000	PK	46.49	31.13	6.72	41.86	2.42	44.90	73.90	29.0	146	324	
Hori.	7206.000	PK	47.52	36.35	8.21	41.18	2.42	53.32	73.90	20.5	150	359	
Hori.	14412.000	PK	51.16	41.65	9.25	42.94	-9.54	49.58	73.90	24.3	144	196	
Vert.	31.514	QP	22.62	16.96	6.66	32.13	0.00	14.11	40.00	25.8	146	234	
Vert.	396.013	QP	21.59	15.53	9.19	31.87	0.00	14.44	46.00	31.5	100	20	
Vert.	542.559	QP	21.92	18.20	9.80	31.88	0.00	18.04	46.00	27.9	100	59	
Vert.	954.414	QP	21.03	22.10	11.21	30.44	0.00	23.90	46.00	22.1	100	359	
Vert.	2390.000	PK	45.53	27.14	14.27	40.85	2.42	48.51	73.90	25.3	201	307	
Vert.	2399.409	PK	61.14	27.17	14.27	40.84	2.42	64.16	73.90	9.7	201	307	
Vert.	2400.000	PK	60.53	27.17	14.27	40.84	2.42	63.55	73.90	10.3	201	307	
Vert.	4804.000	PK	49.29	31.13	6.72	41.86	2.42	47.70	73.90	26.2	157	349	
Vert.	7206.000	PK	47.17	36.35	8.21	41.18	2.42	52.97	73.90	20.9	150	359	
Vert.	14412.000	PK	52.18	41.65	9.25	42.94	-9.54	50.60	73.90	23.3	158	54	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.96\text{ m} / 3.0\text{ m}) = 2.42\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	36.46	27.14	14.27	40.85	1.78	2.42	41.22	53.90	12.7	*1)
Hori.	2399.409	AV	39.42	27.17	14.27	40.84	1.78	2.42	44.22	53.90	9.7	
Hori.	2400.000	AV	42.93	27.17	14.27	40.84	1.78	2.42	47.73	53.90	6.2	
Hori.	4804.000	AV	39.83	31.13	6.72	41.86	1.78	2.42	40.02	53.90	13.9	
Hori.	7206.000	AV	37.51	36.35	8.21	41.18	1.78	2.42	45.09	53.90	8.8	
Hori.	14412.000	AV	39.79	41.65	9.25	42.94	1.78	-9.54	39.99	53.90	13.9	
Vert.	2390.000	AV	36.92	27.14	14.27	40.85	1.78	2.42	41.68	53.90	12.2	*1)
Vert.	2399.409	AV	41.21	27.17	14.27	40.84	1.78	2.42	46.01	53.90	7.9	
Vert.	2400.000	AV	43.94	27.17	14.27	40.84	1.78	2.42	48.74	53.90	5.2	
Vert.	4804.000	AV	40.92	31.13	6.72	41.86	1.78	2.42	41.11	53.90	12.8	
Vert.	7206.000	AV	37.34	36.35	8.21	41.18	1.78	2.42	44.92	53.90	9.0	
Vert.	14412.000	AV	40.27	41.65	9.25	42.94	1.78	-9.54	40.47	53.90	13.4	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.96\text{ m} / 3.0\text{ m}) = 2.42\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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

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

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	82.50	27.18	14.28	40.84	2.42	85.54	-	-	
Hori.	9608.000	PK	50.50	38.11	9.37	40.59	2.42	59.81	65.54	5.7	
Vert.	2402.000	PK	82.31	27.18	14.28	40.84	2.42	85.35	-	-	
Vert.	9608.000	PK	48.94	38.11	9.37	40.59	2.42	58.25	65.35	7.1	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.96\text{ m} / 3.0\text{ m}) = 2.42\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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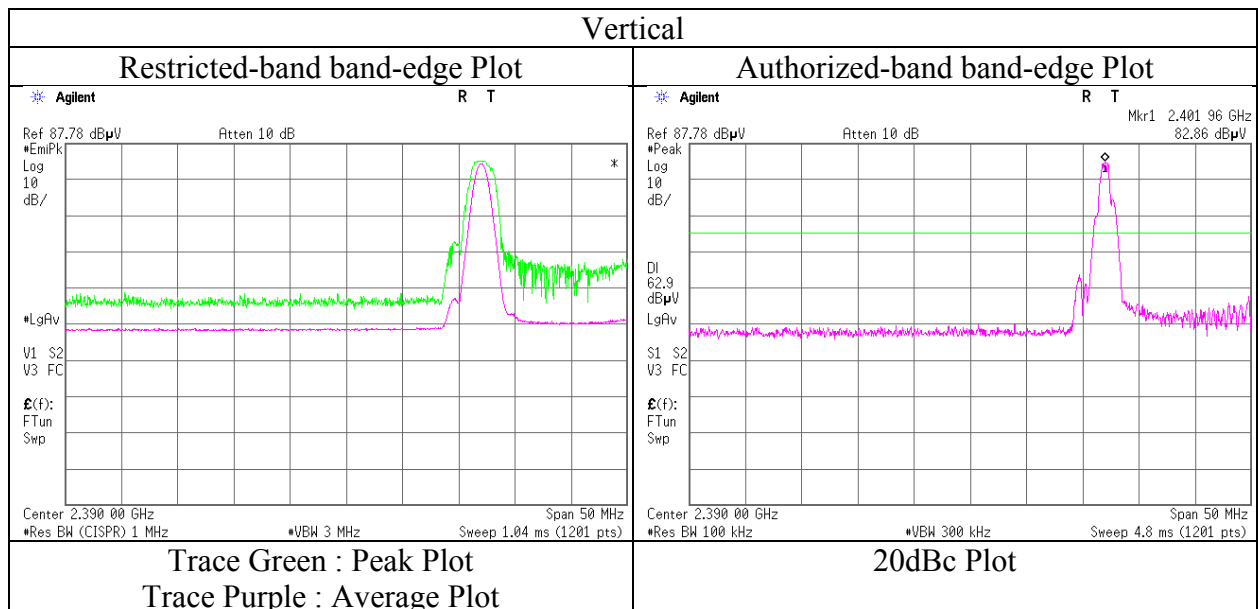
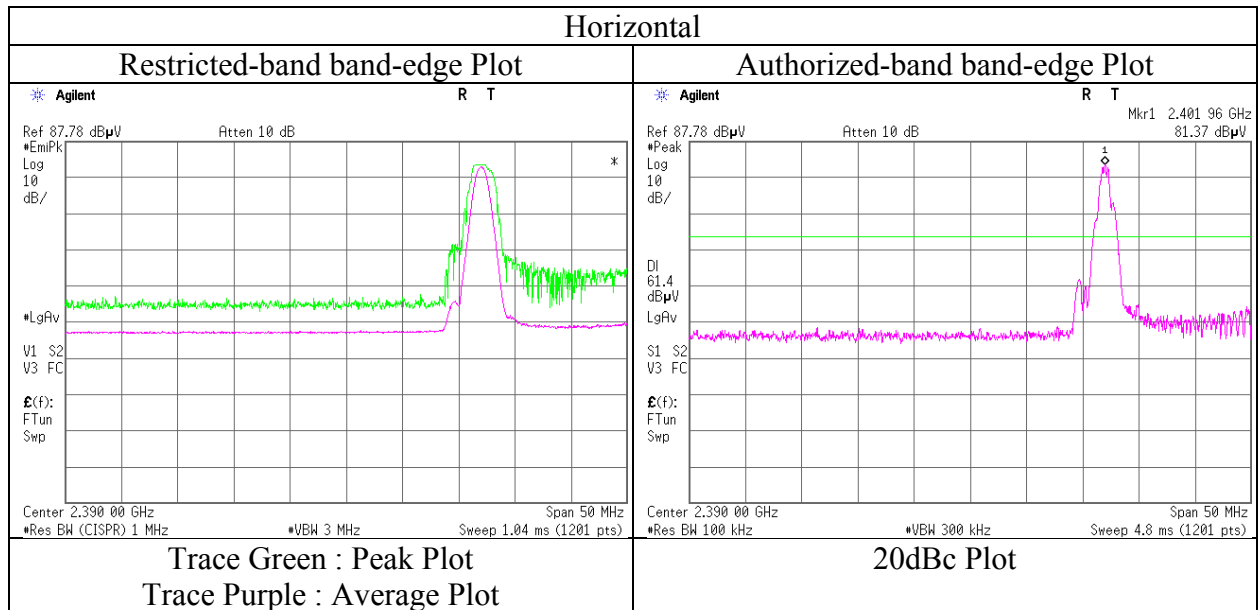
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11931208S-A-R1
Date	October 21, 2017
Temperature / Humidity	21 deg. C / 56 % RH
Engineer	Hikaru Shirasawa (1 GHz -13 GHz)
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.1 & 3 Semi Anechoic Chamber
Report No. : 11931208S-A-R1
Date : October 21, 2017 November 1, 2017 November 1, 2017
Temperature / Humidity : 21 deg. C / 56 % RH 22 deg. C / 40 % RH 22 deg. C / 40 % RH
Engineer : Hikaru Shirasawa Kazutaka Takeyama Kazutaka Takeyama
(1 GHz -13 GHz) (13 GHz- 26.5 GHz) (30 MHz- 1 GHz)
Mode : Tx BT LE 2440 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	195.066	QP	22.17	16.24	7.98	32.00	0.00	14.39	43.50	29.1	153	291	
Hori.	723.376	QP	20.76	19.81	10.46	31.70	0.00	19.33	46.00	26.6	100	276	
Hori.	877.140	QP	20.69	21.63	10.97	31.07	0.00	22.22	46.00	23.7	100	71	
Hori.	959.413	QP	20.05	22.12	11.23	30.40	0.00	23.00	46.00	23.0	100	58	
Hori.	4880.000	PK	48.49	31.30	6.74	41.76	2.42	47.19	73.90	26.7	142	346	
Hori.	7320.000	PK	48.06	36.51	8.24	41.27	2.42	53.96	73.90	19.9	150	359	
Hori.	14640.000	PK	51.02	41.96	9.21	42.74	-9.54	49.91	73.90	23.9	144	201	
Vert.	31.370	QP	22.47	17.00	6.66	32.13	0.00	14.00	40.00	26.0	100	73	
Vert.	180.237	QP	22.08	16.28	7.97	32.01	0.00	14.32	43.50	29.1	100	297	
Vert.	603.034	QP	20.58	18.97	10.03	31.82	0.00	17.76	46.00	28.2	100	162	
Vert.	767.228	QP	20.81	20.25	10.61	31.60	0.00	20.07	46.00	25.9	100	244	
Vert.	4880.000	PK	48.85	31.30	6.74	41.76	2.42	47.55	73.90	26.3	149	359	
Vert.	7320.000	PK	47.06	36.51	8.24	41.27	2.42	52.96	73.90	20.9	150	0	
Vert.	14640.000	PK	51.29	41.96	9.21	42.74	-9.54	50.18	73.90	23.7	154	59	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.96 m / 3.0 m) = 2.42 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 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	38.65	31.30	6.74	41.76	1.78	2.42	39.13	53.90	14.8	
Hori.	7320.000	AV	37.78	36.51	8.24	41.27	1.78	2.42	45.46	53.90	8.4	
Hori.	14640.000	AV	39.42	41.96	9.21	42.74	1.78	-9.54	40.09	53.90	13.8	
Vert.	4880.000	AV	39.66	31.30	6.74	41.76	1.78	2.42	40.14	53.90	13.8	
Vert.	7320.000	AV	37.87	36.51	8.24	41.27	1.78	2.42	45.55	53.90	8.4	
Vert.	14640.000	AV	39.94	41.96	9.21	42.74	1.78	-9.54	40.61	53.90	13.3	

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 (3.96 m / 3.0 m) = 2.42 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

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.	2440.000	PK	83.34	27.30	14.31	40.83	2.42	86.54	-	-	
Hori.	9760.000	PK	46.55	38.36	9.41	40.62	2.42	56.12	66.54	10.4	
Vert.	2440.000	PK	81.93	27.30	14.31	40.83	2.42	85.13	-	-	
Vert.	9760.000	PK	47.29	38.36	9.41	40.62	2.42	56.86	65.13	8.3	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.96 m / 3.0 m) = 2.42 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission

Test place	Shonan EMC Lab. No.1 & 3 Semi Anechoic Chamber		
Report No.	11931208S-A-R1		
Date	October 21, 2017	November 1, 2017	November 1, 2017
Temperature / Humidity	21 deg. C / 56 % RH	22 deg. C / 40 % RH	22 deg. C / 40 % RH
Engineer	Hikaru Shirasawa (1 GHz -13 GHz)	Kazutaka Takeyama (13 GHz- 26.5 GHz)	Kazutaka Takeyama (30 MHz- 1 GHz)
Mode	Tx BT LE 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	31.569	QP	22.55	16.94	6.66	32.13	0.00	14.02	40.00	25.9	100	283	
Hori.	194.169	QP	22.12	16.24	7.97	32.00	0.00	14.33	43.50	29.1	191	265	
Hori.	592.759	QP	21.25	18.86	9.99	31.83	0.00	18.27	46.00	27.7	100	155	
Hori.	957.191	QP	20.93	22.11	11.22	30.42	0.00	23.84	46.00	22.1	100	120	
Hori.	2483.500	PK	52.82	27.45	14.37	40.81	2.42	56.25	73.90	17.6	163	215	
Hori.	4960.000	PK	47.91	31.48	6.76	41.65	2.42	46.92	73.90	26.9	148	359	
Hori.	7440.000	PK	46.63	36.68	8.29	41.36	2.42	52.66	73.90	21.2	150	359	
Hori.	14879.920	PK	51.12	42.29	9.05	42.57	-9.54	50.35	73.90	23.5	171	8	
Vert.	127.936	QP	22.28	13.42	7.51	32.05	0.00	11.16	43.50	32.3	100	226	
Vert.	180.570	QP	22.09	16.28	7.98	32.01	0.00	14.34	43.50	29.1	100	79	
Vert.	533.896	QP	21.94	18.08	9.77	31.87	0.00	17.92	46.00	28.0	100	86	
Vert.	891.461	QP	21.12	21.83	11.02	30.98	0.00	22.99	46.00	23.0	127	153	
Vert.	2483.500	PK	51.74	27.45	14.37	40.81	2.42	55.17	73.90	18.7	185	308	
Vert.	4960.000	PK	48.86	31.48	6.76	41.65	2.42	47.87	73.90	26.0	149	7	
Vert.	7440.000	PK	47.13	36.68	8.29	41.36	2.42	53.16	73.90	20.7	150	359	
Vert.	14880.000	PK	50.89	42.29	9.05	42.57	-9.54	50.12	73.90	23.7	155	62	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.96 m / 3.0 m) = 2.42 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 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	37.88	27.45	14.37	40.81	1.78	2.42	43.09	53.90	10.8	*1)
Hori.	4960.000	AV	39.98	31.48	6.76	41.65	1.78	2.42	40.77	53.90	13.1	
Hori.	7440.000	AV	37.62	36.68	8.29	41.36	1.78	2.42	45.43	53.90	8.5	
Hori.	14879.920	AV	40.09	42.29	9.05	42.57	1.78	-9.54	41.10	53.90	12.8	
Vert.	2483.500	AV	37.33	27.45	14.37	40.81	1.78	2.42	42.54	53.90	11.4	*1)
Vert.	4960.000	AV	40.11	31.48	6.76	41.65	1.78	2.42	40.90	53.90	13.0	
Vert.	7440.000	AV	37.65	36.68	8.29	41.36	1.78	2.42	45.46	53.90	8.4	
Vert.	14880.000	AV	39.84	42.29	9.05	42.57	1.78	-9.54	40.85	53.90	13.1	

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 (3.96 m / 3.0 m) = 2.42 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 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.	2480.000	PK	82.70	27.43	14.37	40.81	2.42	86.11	-	-	
Hori.	9920.000	PK	46.77	38.63	9.45	40.66	2.42	56.61	66.11	9.5	
Vert.	2480.000	PK	80.72	27.43	14.37	40.81	2.42	84.13	-	-	
Vert.	9920.000	PK	46.88	38.63	9.45	40.66	2.42	56.72	64.13	7.4	

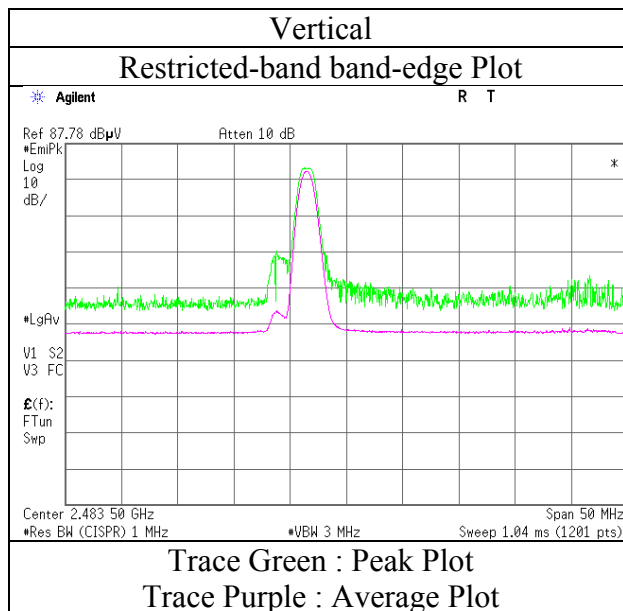
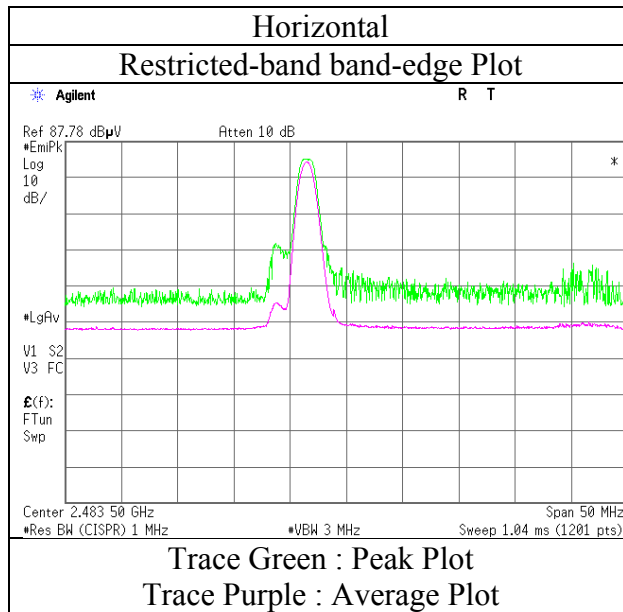
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.96 m / 3.0 m) = 2.42 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission (Reference Plot for band-edge)

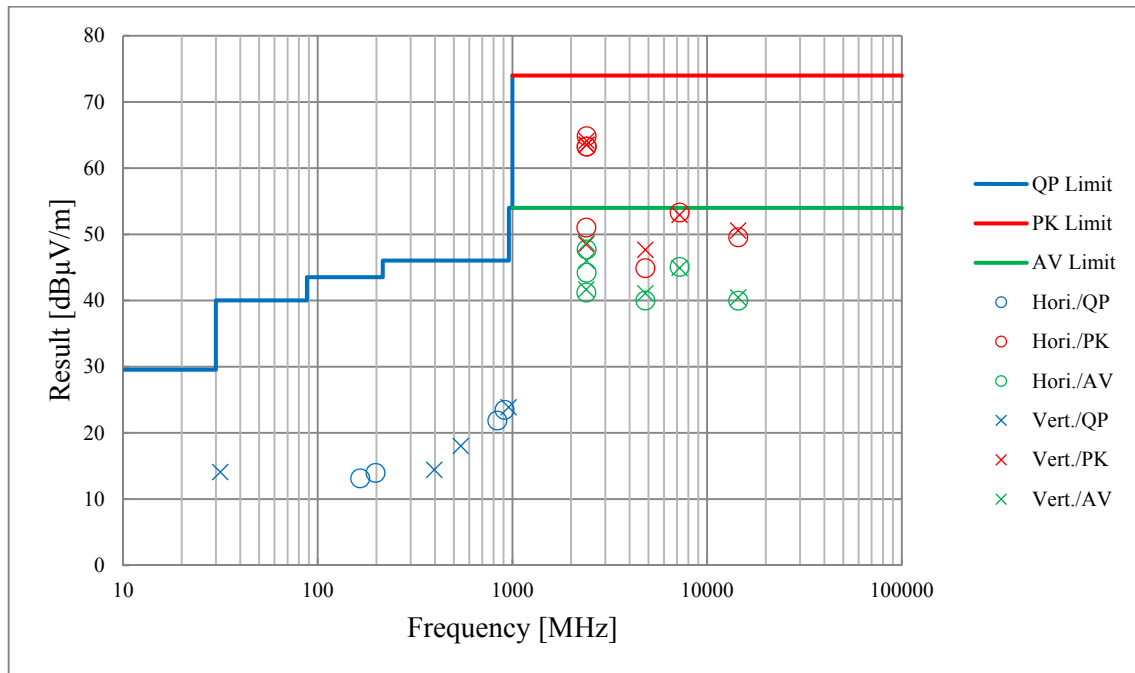
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11931208S-A-R1
Date	October 21, 2017
Temperature / Humidity	21 deg. C / 56 % RH
Engineer	Hikaru Shirasawa (1 GHz -13 GHz)
Mode	Tx BT LE 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

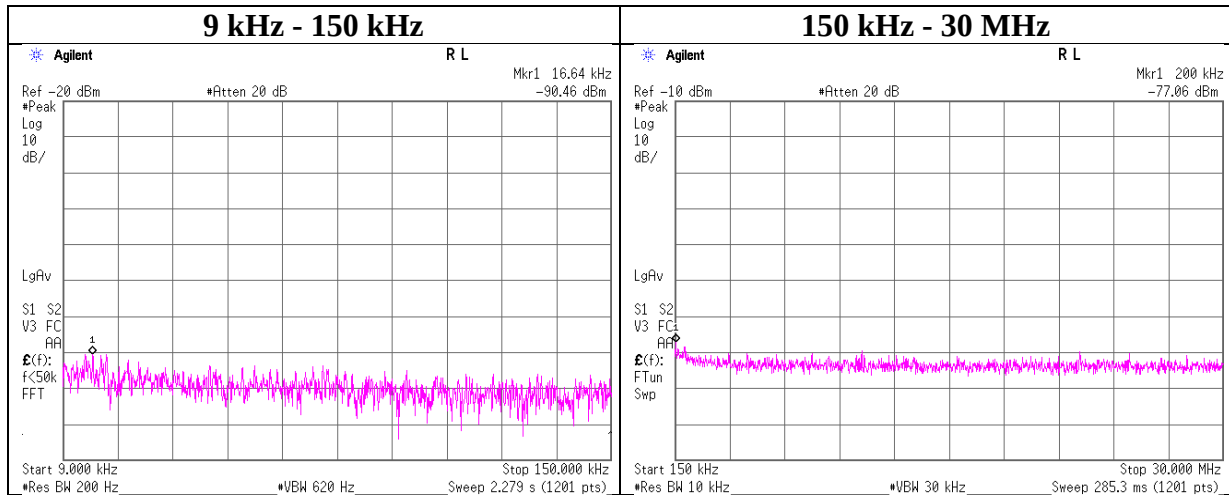
Test place	Shonan EMC Lab. No.1 & 3 Semi Anechoic Chamber		
Report No.	11931208S-A-R1		
Date	October 21, 2017	November 1, 2017	November 1, 2017
Temperature / Humidity	21 deg. C / 56 % RH	22 deg. C / 40 % RH	22 deg. C / 40 % RH
Engineer	Hikaru Shirasawa (1 GHz -13 GHz)	Kazutaka Takeyama (13 GHz- 26.5 GHz)	Kazutaka Takeyama (30 MHz- 1 GHz)
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. : 11931208S-A-R1
Date : September 15, 2017
Temperature / Humidity : 24 deg. C / 49 % RH
Engineer : Makoto Hosaka
Mode : Tx BT LE 2402 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
16.64	-90.46	0.50	9.8	2.5	1	-77.6	300	6.0	-16.4	43.1	59.5	
200.00	-77.06	0.50	9.8	2.5	1	-64.2	300	6.0	-3.0	21.5	24.5	

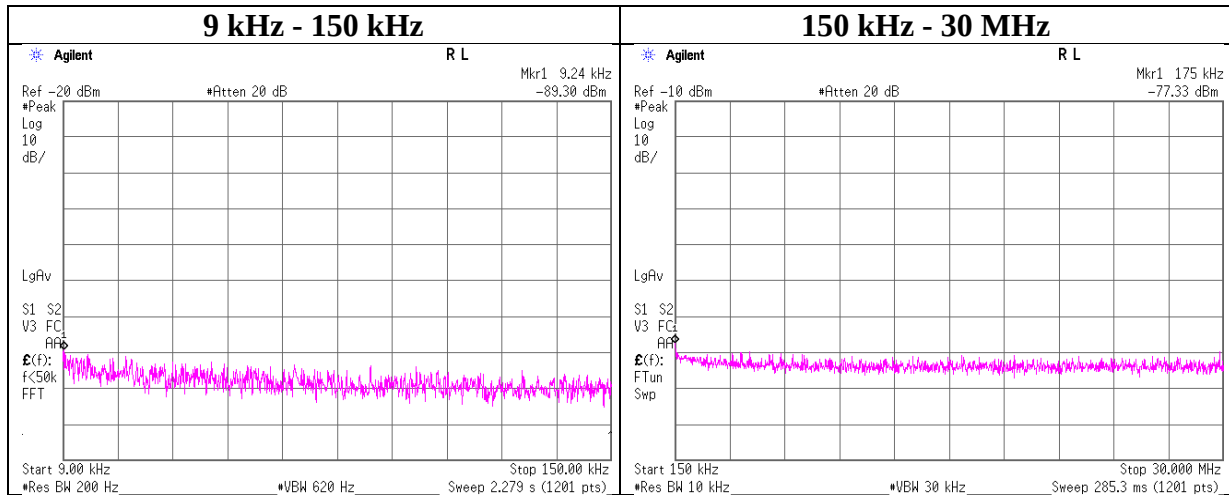
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11931208S-A-R1
Date : September 15, 2017
Temperature / Humidity : 24 deg. C / 49 % RH
Engineer : Makoto Hosaka
Mode : Tx BT LE 2440 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
9.24	-89.30	0.50	9.80	2.5	1	-76.5	300	6.0	-15.2	48.2	63.4	
175.00	-77.33	0.50	9.80	2.5	1	-64.5	300	6.0	-3.3	22.7	26.0	

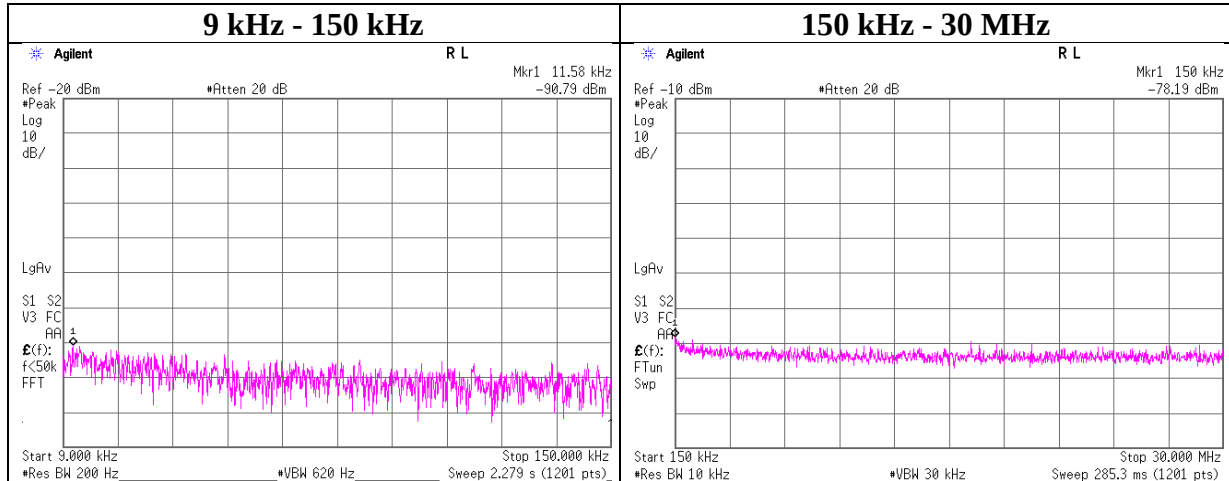
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11931208S-A-R1
Date : September 15, 2017
Temperature / Humidity : 24 deg. C / 49 % RH
Engineer : Makoto Hosaka
Mode : Tx BT LE 2480 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
11.58	-90.79	0.50	9.80	2.5	1	-78.0	300	6.0	-16.7	46.3	63.0	
150.00	-78.19	0.50	9.80	2.5	1	-65.4	300	6.0	-4.1	24.0	28.1	

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

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

N: Number of output

Power Density

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11931208S-A-R1
Date	September 15, 2017
Temperature / Humidity	24 deg. C / 49 % RH
Engineer	Makoto Hosaka
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-22.69	1.82	9.80	-11.07	8.00	19.07
2440.00	-22.74	1.83	9.80	-11.11	8.00	19.11
2480.00	-23.93	1.84	9.80	-12.29	8.00	20.29

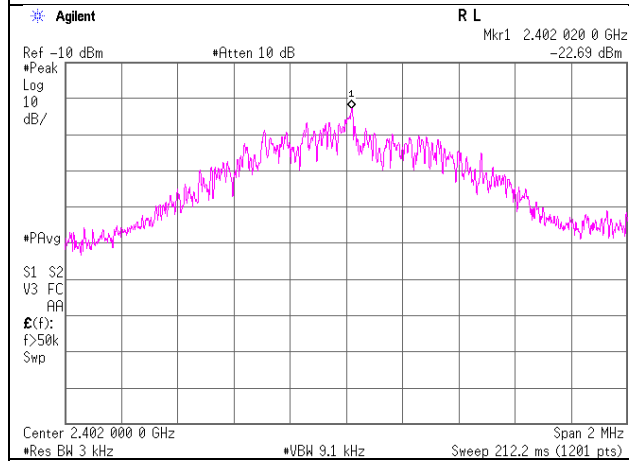
Sample Calculation:

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

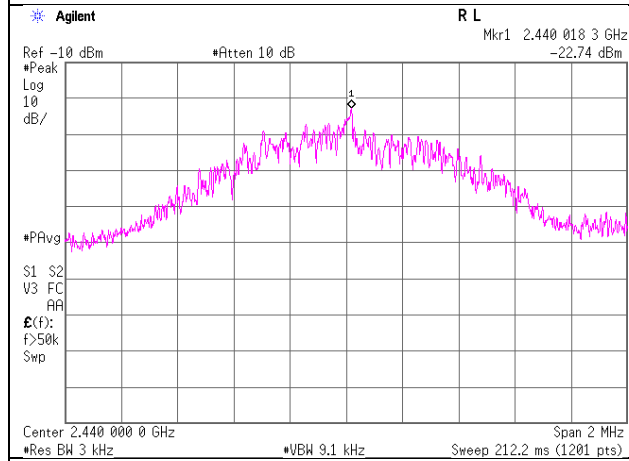
Power Density

BTLE

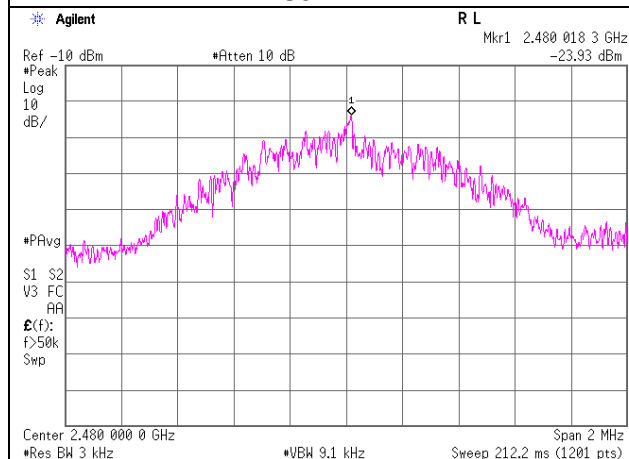
2402 MHz



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)
SCC-G14	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	AT	2017/03/23 * 12
SAT10-14	Attenuator	Weinschel Corp.	54A-10	81595	AT	2017/04/20 * 12
SRENT-08	Spectrum Analyzer	Agilent	E4448A	MY50180019	AT	2016/10/24 * 12 *1)
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2017/05/01 * 12
SPSS-04	Power sensor	Agilent	N1923A	MY5326009	AT	2017/05/01 * 12
KTS-07	Digital Tester	SANWA	PC500	7019232	AT	2016/10/17 * 12 *1)
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 12
SAF-04	Pre Amplifier	TOYO Corporation	TPA0118-36	1440489	RE	2017/03/17 * 12
SCC-G05	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-03 7	RE	2017/01/08 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2017/05/08 * 12
SHA-01	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	RE	2017/08/14 * 12
SOS-01	Humidity Indicator	A&D	AD-5681	4062555	RE	2016/10/12 * 12 *1)
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2017/10/10 * 12
KJM-09	Measure	KOMELON	KMC-36	-	RE	-
SAEC-01(SVSWR)	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	RE	2017/07/20 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFI,MF)	-	RE	-
STS-01	Digital Hitester	Hioki	3805-50	080997812	RE	2017/10/16 * 12
SAT10-05	Attenuator(above1G Hz)	Agilent	8493C-010	74864	RE	2016/11/07 * 12
SFL-18	Highpass Filter	MICRO-TRONICS	HPM50111	119	RE	2017/04/20 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000NF SNMS/B	1612S005	RE	2017/01/08 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2017/06/11 * 12
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	2046104	RE	2017/09/22 * 12
SCC-G07	Coaxial Cable	Junkosha	J12J103316-00-R	OCT-12-17-05 4	RE	2017/10/23 * 12
SCC-G43	Coaxial Cable	HUBER+SUHNER	SUCOFLEX_104_E	SN MY 13406/4E	RE	2017/07/10 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2017/08/23 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	RE	2016/12/13 * 12
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	RE	2016/11/08 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2017/10/16 * 12
SCC-G20	Coaxial Cable	Junkosha	J12J102518-00	APR-15-15-00 3	RE	2017/04/20 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000KM SKMS	-	RE	2017/04/20 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2017/03/15 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2017/09/22 * 12

*1) This test equipment was used for the tests before the expiration date of the calibration.

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

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