



RADIO TEST REPORT

Test Report No. : 11853102S-A

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : Watch
Model No. : GBA-800
FCC ID : BBQS0CW
Test regulation : FCC Part 15 Subpart C: 2017
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: July 21 to 24, 2017

Representative test engineer:

M. Hosaka

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Approved by:

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- 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. : GBA-800
Serial No. : Refer to Section 4, Clause 4.2
Rating : Typical: Nom : DC 3.0 V, Min.: DC 1.9 V, Max.: DC 3.3 V
CW5554 (Module): Min.: DC 1.9 V, Max.: DC 3.3 V
Receipt Date of Sample : July 18, 2017
Country of Mass-production : China, Thailand, Japan
Condition of EUT : Engineering prototype
(Not for Sale: This sample is equivalent to mass-production items)
Modification of EUT : No Modification by the test lab

2.2 Product Description

Model: GBA-800 (referred to as the EUT in this report) is a Watch.

* GBA-800 has alternative name as R008

General Specification

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

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Antenna type : SMD
Antenna Gain : 2.5 dBi
Clock frequency (Maximum) : -10 deg. C - +60 deg. C

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test specification : FCC Part 15 Subpart C
FCC Part 15 final revised on September 20, 2017 and effective October 20, 2017

Title : FCC 47CFR Part15 Radio Frequency Device
Subpart B Unintentional Radiators

* The revision on September 20, 2017, 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	FCC: Section 15.207	N/A	N/A	*1)
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8			
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(a)(2)	See data.	Complied	Conducted
	IC: -	IC: RSS-247 5.2(a)			
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(b)(3)		Complied	Conducted
	IC: RSS-Gen 6.12	IC: RSS-247 5.4(d)			
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(e)		Complied	Conducted
	IC: -	IC: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(d)	2.8 dB 9608.000 MHz, AV, Vert. Tx BT LE 2402 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
	IC: RSS-Gen 6.13	IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

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

EMI

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

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
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.5 dB	2.6 dB	2.5 dB	2.5 dB
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	-	-
Radiated emission (Measurement distance: 1 m)	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
	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 (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 %

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	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

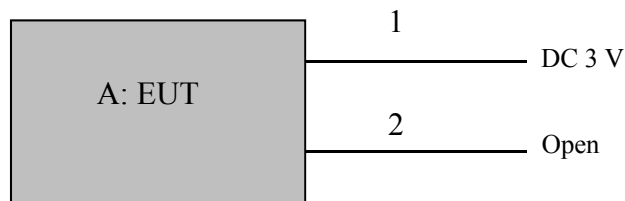
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Bluetooth Low Energy	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.		

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	GBA-800	82 *1) 64 *2)	Casio Computer Co., Ltd.	EUT

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	0.15 + 2.5	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

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 Styrofoam and covered with polyvinyl chloride. 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: 300kHz
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: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

Combinations of the worst case

Antenna polarization \ Frequency	Carrier *4)	Spurious			
		Below 1 GHz	1 GHz – 13 GHz	13 GHz – 18 GHz	18 GHz - 26.5 GHz
Horizontal	X	X	Y	X	X
Vertical	Y	X	X	X	X

*4) with spurious emissions near carrier frequency.

Measurement range : 30 MHz - 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 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

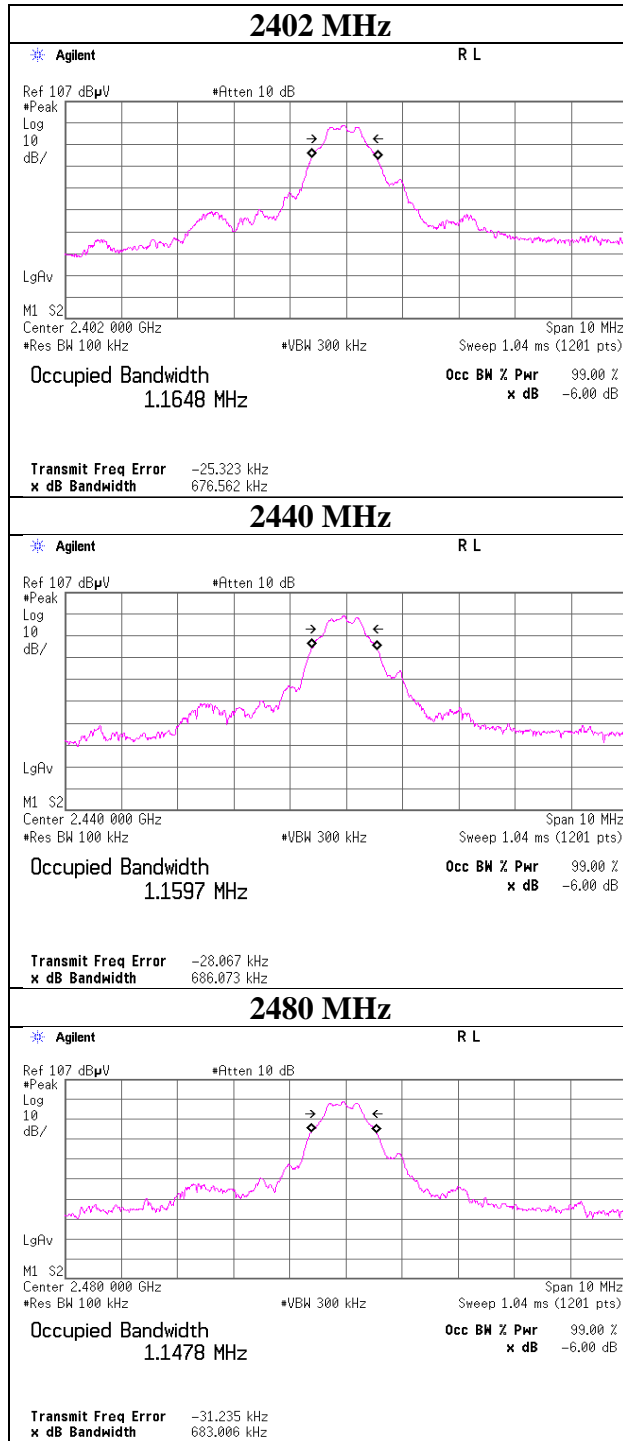
APPENDIX 1: Test data

6dB Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11853102S-A
Date	July 24, 2017
Temperature / Humidity	24 deg. C / 59 % RH
Engineer	Makoto Hosaka
Mode	Tx BT LE

Mode	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [kHz]
BTLE	2402	0.677	> 500
	2440	0.686	> 500
	2480	0.683	> 500

6dB Bandwidth
BTLE



Maximum Peak Output Power

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11853102S-A
Date : July 24, 2017
Temperature / Humidity : 24 deg. C / 59 % 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	-10.85	1.82	9.96	0.93	1.24	30.00	1000	29.07
2440	-10.75	1.83	9.97	1.05	1.27	30.00	1000	28.95
2480	-10.89	1.84	9.97	0.92	1.24	30.00	1000	29.08

Sample Calculation:

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

Average Output Power
(Reference data for SAR testing)

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11853102S-A
Date July 24, 2017
Temperature / Humidity 24 deg. C / 59 % 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	-12.76	1.82	9.96	-0.98	0.80	0.90	-0.08	0.98
2440	-12.64	1.83	9.97	-0.84	0.82	0.90	0.06	1.01
2480	-12.81	1.84	9.97	-1.00	0.79	0.90	-0.10	0.98

Sample Calculation:

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

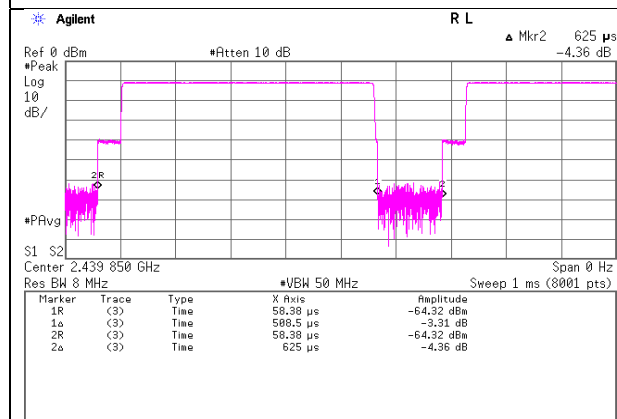
Result (Burst power average) = Time average + Duty factor

Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11853102S-A
Date	July 24, 2017
Temperature / Humidity	24 deg. C / 59 % RH
Engineer	Makoto Hosaka
Mode	Tx BT LE

BT LE

Tx on / (Tx on + Tx off) =	0.814
Tx on / (Tx on + Tx off) * 100 =	81.4 %
Duty factor = 10 * log (0.625 / 0.5085) =	0.90 dB
Duty factor = 20 * log (0.625 / 0.5085) =	1.79 dB



* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

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Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 & 2 Semi Anechoic Chamber
Report No. : 11853102S-A
Date : July 21, 2017 July 22, 2017
Temperature / Humidity : 20 deg. C / 64 % RH 22 deg. C / 55 % RH
Engineer : Hiroyuki Morikawa Hiroyuki Morikawa
(1 GHz -26.5 GHz) (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.	147.755	QP	22.38	14.73	8.61	31.80	0.00	13.92	43.50	29.5	218	208	
Hori.	194.966	QP	21.89	16.28	8.86	31.77	0.00	15.26	43.50	28.2	144	359	
Hori.	408.844	QP	21.67	15.99	7.38	31.62	0.00	13.42	46.00	32.5	148	180	
Hori.	855.802	QP	20.83	21.67	9.63	31.07	0.00	21.06	46.00	24.9	152	329	
Hori.	2390.000	PK	43.49	27.41	13.48	36.83	2.42	49.97	73.90	23.9	188	203	*1)
Hori.	4804.000	PK	46.05	31.13	5.72	36.99	2.42	48.33	73.90	25.5	175	357	
Hori.	7206.000	PK	44.74	36.44	7.03	37.81	2.42	52.82	73.90	21.0	100	0	floor noise
Hori.	9608.000	PK	48.36	38.63	7.86	38.48	2.42	58.79	73.90	15.1	158	231	
Vert.	32.034	QP	22.51	16.89	6.86	31.90	0.00	14.36	40.00	25.6	100	269	
Vert.	524.013	QP	21.76	18.09	8.03	31.61	0.00	16.27	46.00	29.7	100	358	
Vert.	818.305	QP	21.18	21.13	9.45	31.22	0.00	20.54	46.00	25.4	100	231	
Vert.	955.049	QP	20.63	22.52	10.10	30.43	0.00	22.82	46.00	23.1	100	353	
Vert.	2390.000	PK	43.91	27.41	13.48	36.83	2.42	50.39	73.90	23.5	113	187	*1)
Vert.	4804.000	PK	44.63	31.13	5.72	36.99	2.42	46.91	73.90	26.9	110	25	
Vert.	7206.000	PK	45.33	36.44	7.03	37.81	2.42	53.41	73.90	20.4	150	0	floor noise
Vert.	9608.000	PK	47.08	38.63	7.86	38.48	2.42	57.51	73.90	16.3	135	152	

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.	2390.000	AV	34.52	27.41	13.48	36.83	1.79	2.42	42.79	53.90	11.1	*1)
Hori.	4804.000	AV	36.78	31.13	5.72	36.99	1.79	2.42	40.85	53.90	13.1	
Hori.	7206.000	AV	35.78	36.44	7.03	37.81	1.79	2.42	45.65	53.90	8.3	floor noise
Hori.	9608.000	AV	38.61	38.63	7.86	38.48	1.79	2.42	50.83	53.90	3.1	
Vert.	2390.000	AV	34.53	27.41	13.48	36.83	1.79	2.42	42.80	53.90	11.1	*1)
Vert.	4804.000	AV	36.63	31.13	5.72	36.99	1.79	2.42	40.70	53.90	13.2	
Vert.	7206.000	AV	36.62	36.44	7.03	37.81	1.79	2.42	46.49	53.90	7.4	floor noise
Vert.	9608.000	AV	38.88	38.63	7.86	38.48	1.79	2.42	51.10	53.90	2.8	

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

Distance factor : 1 GHz - 13 GHz : 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.	2402.000	PK	76.88	27.46	13.49	36.83	2.42	83.42	-	-	carrier
Hori.	2400.000	PK	38.79	27.45	13.49	36.83	2.42	45.32	63.42	18.1	
Vert.	2402.000	PK	78.29	27.46	13.49	36.83	2.42	84.83	-	-	carrier
Vert.	2400.000	PK	39.98	27.45	13.49	36.83	2.42	46.51	64.83	18.3	

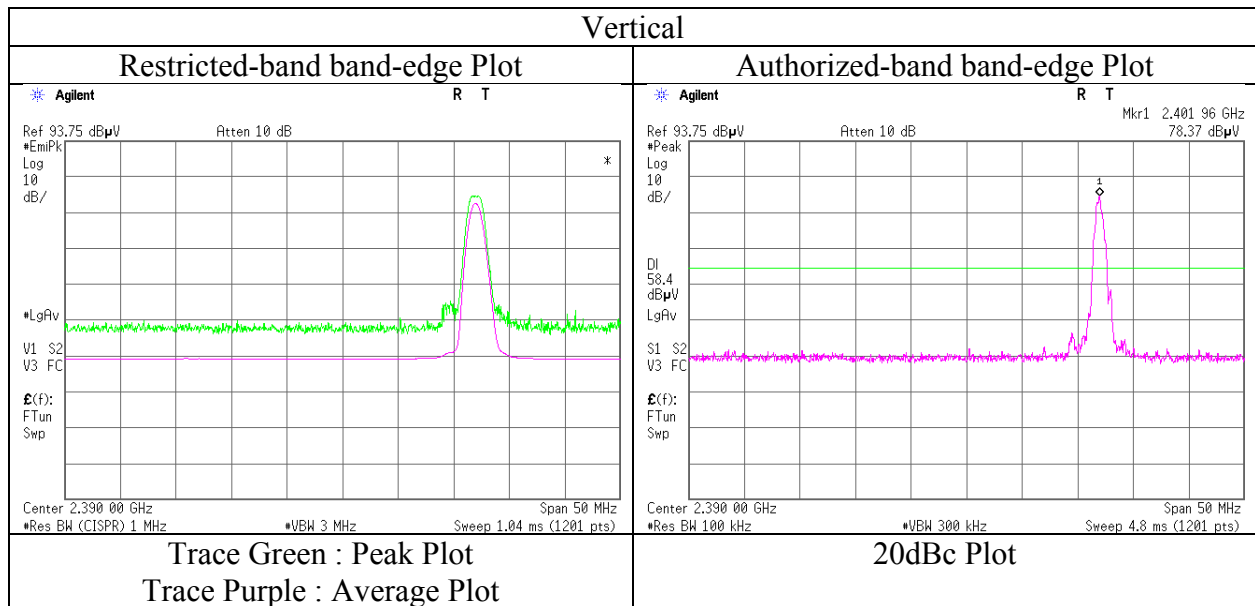
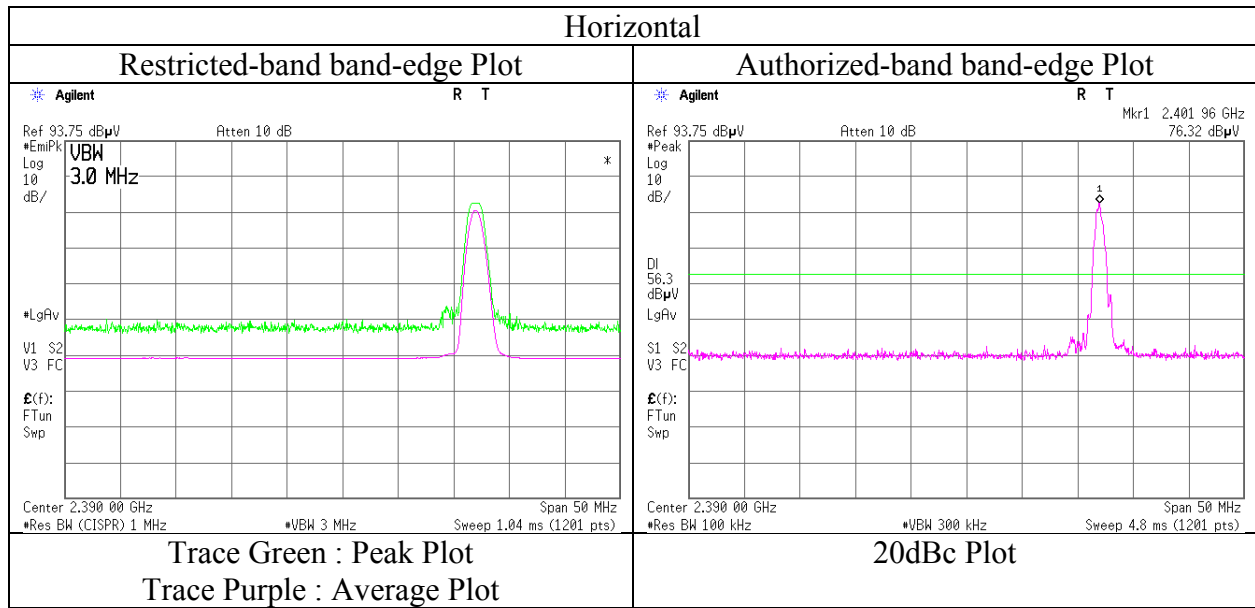
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

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
(Reference Plot for band-edge)

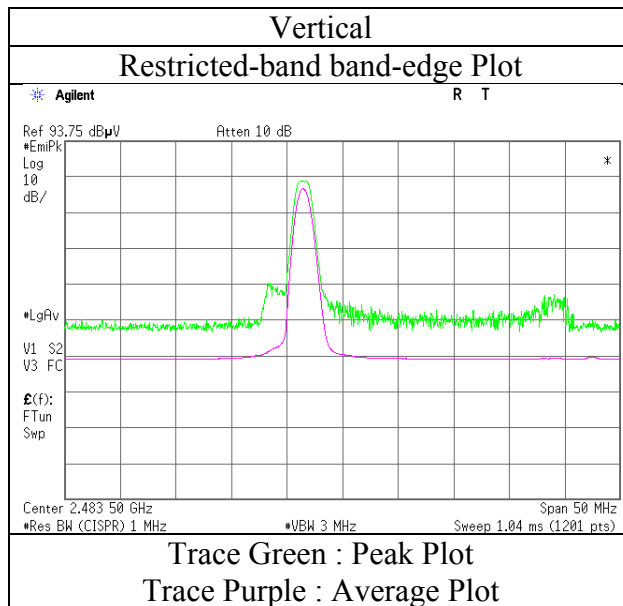
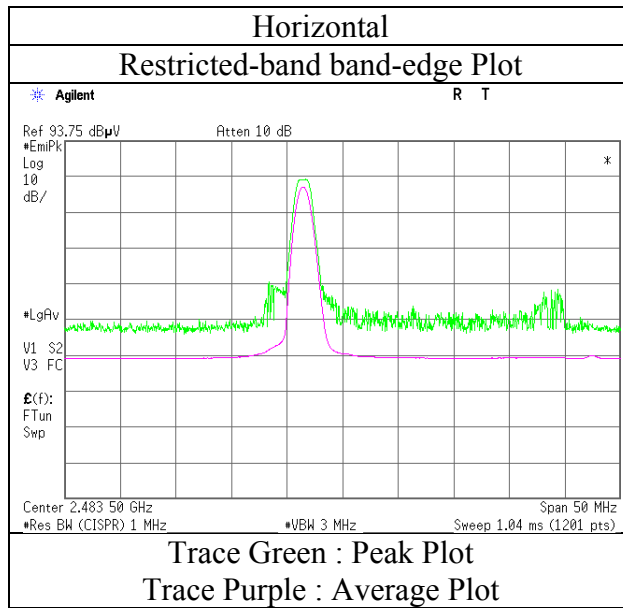
Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11853102S-A
Date	July 21, 2017
Temperature / Humidity	20 deg. C / 64 % RH
Engineer	Hiroyuki Morikawa (1 GHz -26.5 GHz)
Mode	Tx BT LE 2402 MHz



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

Radiated Spurious Emission
(Reference Plot for band-edge)

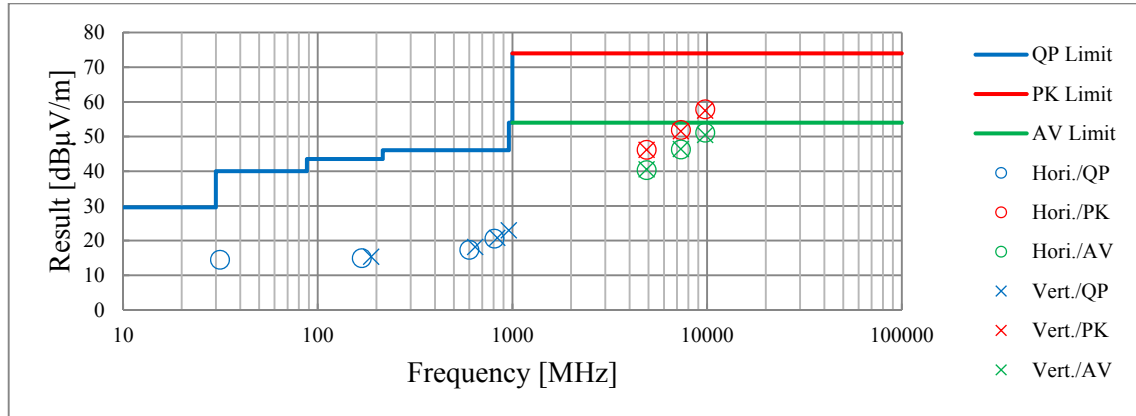
Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11853102S-A
Date	July 21, 2017
Temperature / Humidity	20 deg. C / 64 % RH
Engineer	Hiroyuki Morikawa (1 GHz -26.5 GHz)
Mode	Tx BT LE 2480 MHz



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

Radiated Spurious Emission (Plot data, Worst case)

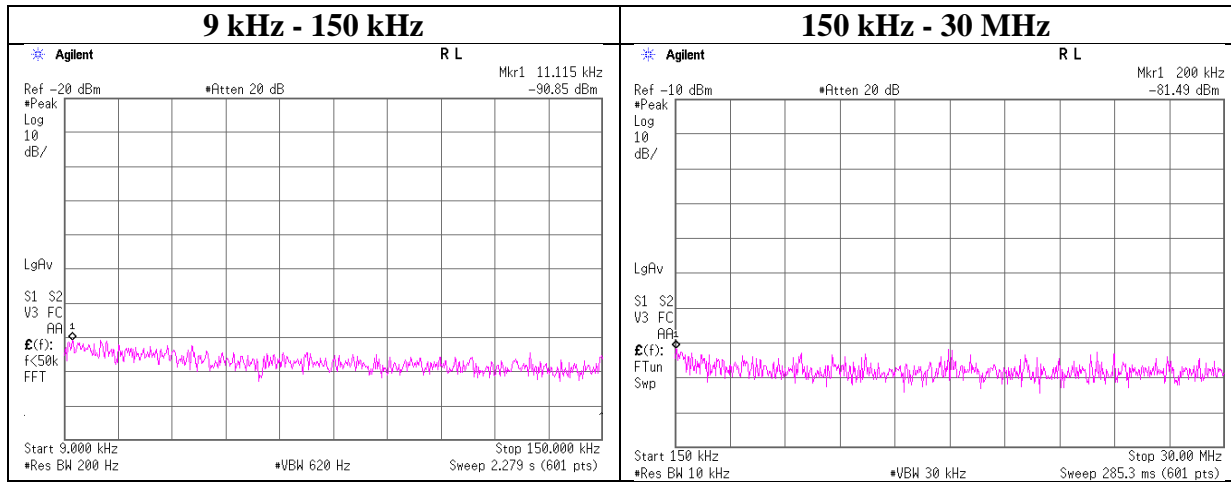
Test place	Shonan EMC Lab. No.3 & 2 Semi Anechoic Chamber	
Report No.	11853102S-A	
Date	July 21, 2017	July 22, 2017
Temperature / Humidity	20 deg. C / 64 % RH	22 deg. C / 55 % RH
Engineer	Hiroyuki Morikawa	Hiroyuki Morikawa
	(1 GHz -26.5 GHz)	(30 MHz- 1 GHz)
Mode	Tx BT LE 2440 MHz	



*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.	11853102S-A
Date	July 24, 2017
Temperature / Humidity	24 deg. C / 59 % 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
11.12	-90.85	0.51	9.8	2.5	1	-78.0	300	6.0	-16.8	46.6	63.4	
200.00	-81.49	0.52	9.8	2.5	1	-68.7	300	6.0	-7.4	21.5	28.9	

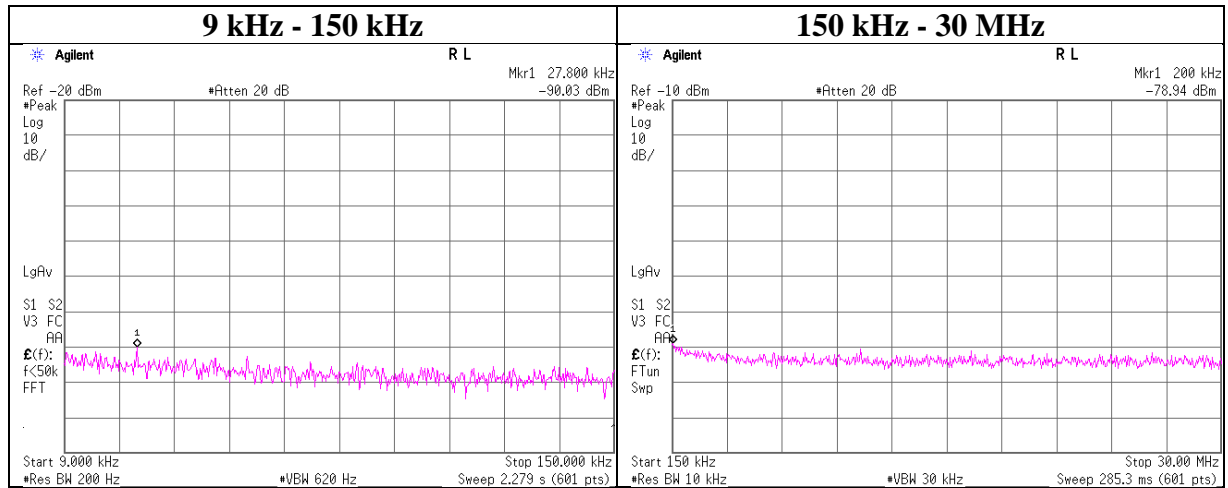
$$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$$

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

N: Number of output

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11853102S-A
Date : July 24, 2017
Temperature / Humidity : 24 deg. C / 59 % 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
27.80	-90.03	0.52	9.82	2.5	1	-77.2	300	6.0	-15.9	38.7	54.6	
200.00	-78.94	0.52	9.82	2.5	1	-66.1	300	6.0	-4.8	21.5	26.3	

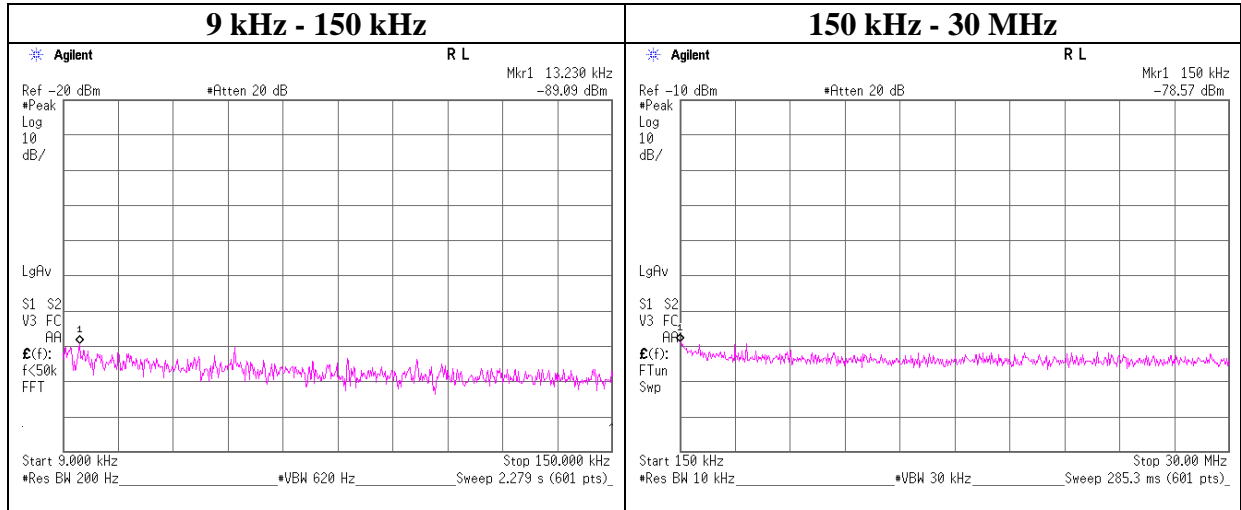
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11853102S-A
Date	July 24, 2017
Temperature / Humidity	24 deg. C / 59 % 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
13.23	-89.09	0.51	9.82	2.5	1	-76.3	300	6.0	-15.0	45.1	60.1	
150.00	-78.57	0.52	9.82	2.5	1	-65.7	300	6.0	-4.5	24.0	28.5	

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

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

N: Number of output

Power Density

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11853102S-A
Date July 24, 2017
Temperature / Humidity 24 deg. C / 59 % RH
Engineer Makoto Hosaka
Mode Tx BT LE

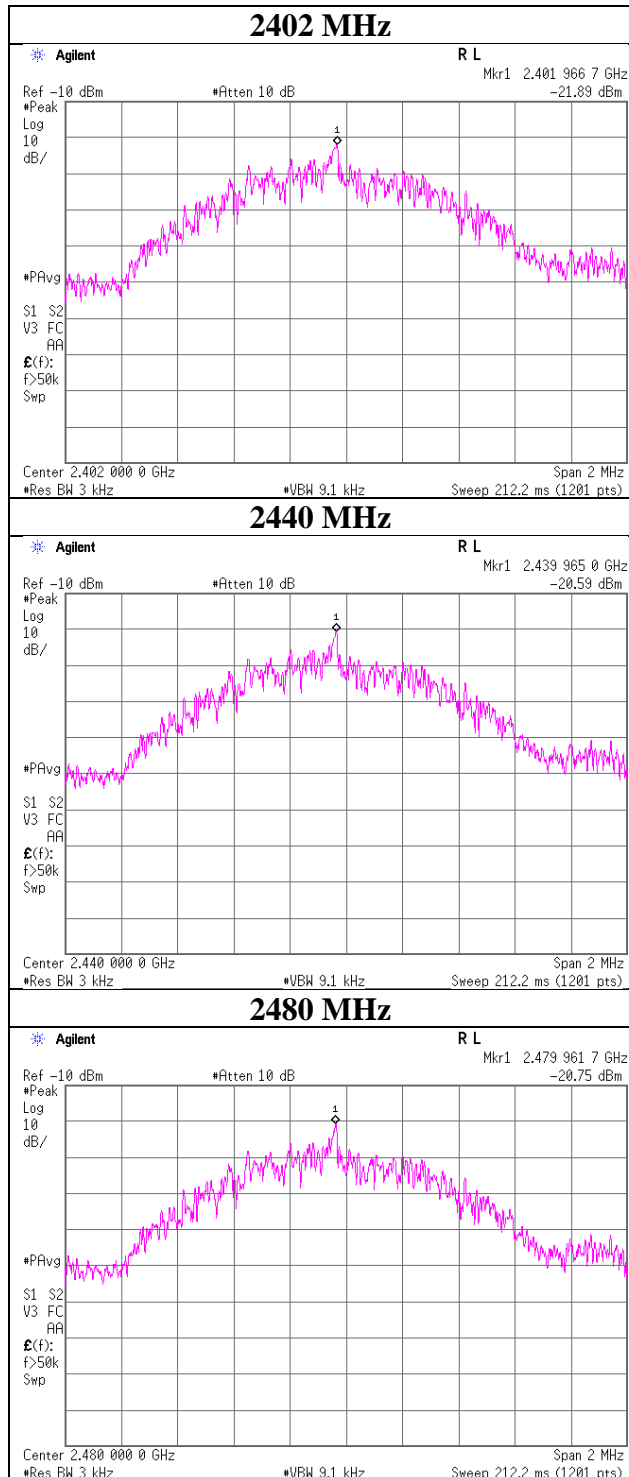
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-21.89	1.82	9.96	-10.11	8.00	18.11
2440.00	-20.59	1.83	9.97	-8.79	8.00	16.79
2480.00	-20.75	1.84	9.97	-8.94	8.00	16.94

Sample Calculation:

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

Power Density

BTLE



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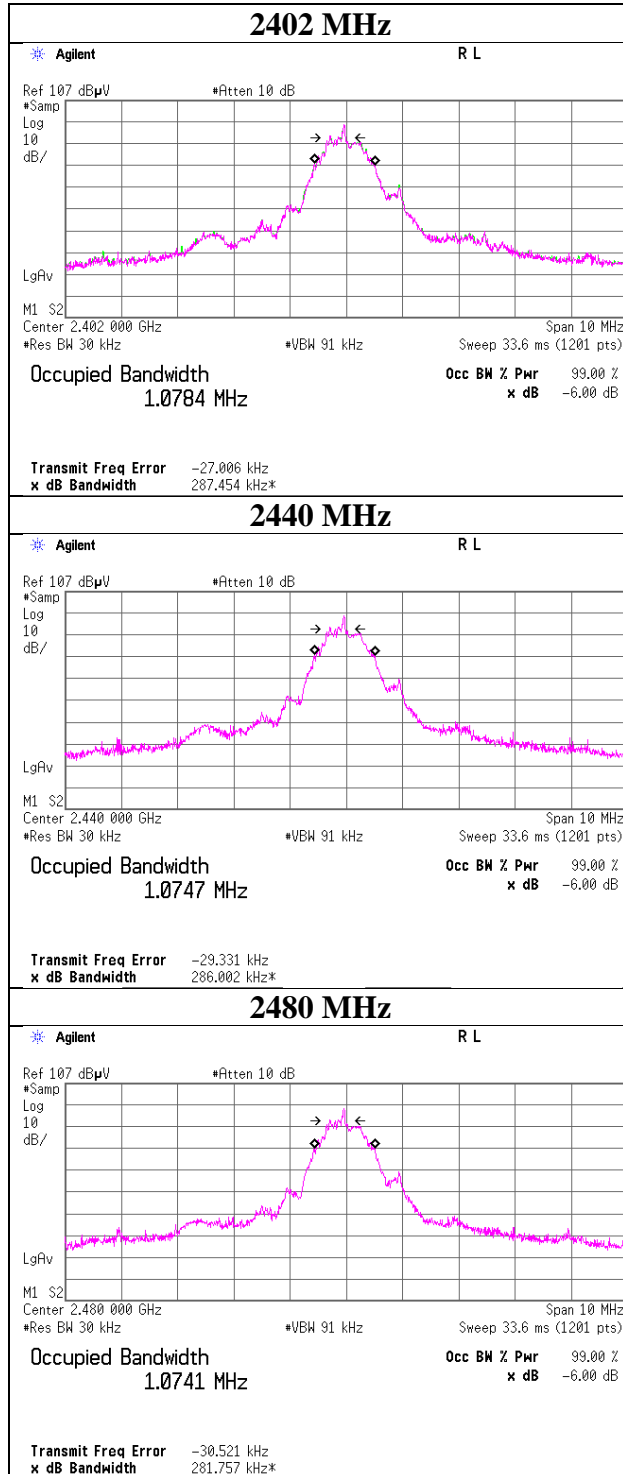
Telephone : +81 463 50 6400

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99% Occupied Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11853102S-A
Date	July 24, 2017
Temperature / Humidity	24 deg. C / 59 % RH
Engineer	Makoto Hosaka
Mode	Tx BT LE

BTLE



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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2017/03/07 * 12
SAEC-03(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	RE	2016/07/25 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2017/06/11 * 12
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2017/02/17 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2016/09/27 * 12
SCC-G07	Coaxial Cable	Junkosha	J12J103316-00	MAY-25-17-00 8	RE	2017/06/13 * 12
SCC-G19	Coaxial Cable	Suhner	SUCOFLEX 102A	1188/2A	RE	2017/03/23 * 12
SCC-G43	Coaxial Cable	HUBER+SUHNE R	SUCOFLEX_104_E	SN MY 13406/4E	RE	2017/07/10 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000KM SKMS	-	RE	2017/04/20 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2016/08/22 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2017/03/15 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2016/10/12 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFI,MF)	-	RE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2016/10/17 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2016/11/29 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2016/11/07 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2017/02/09 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2017/02/09 * 12
KAT3-10	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2016/07/26 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2016/11/23 * 12
SCC-B1/B3/B5 /B7/B8/B13/S RSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/S uhne r/Suhner/Suhner/Su hner/TOYO	8D2W/12DSFA/14 1PE/141PE/141PE /141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SCC-B2/B4/B6 /B7/B8/B13/S RSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/S uhne r/Suhner/Suhner/Su hner/TOYO	8D2W/12DSFA/14 1PE/141PE/141PE /141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SLA-06	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	195	RE	2017/01/05 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2016/10/12 * 12
STR-07	Test Receiver	Rohde & Schwarz	ESU26	100484	RE	2016/09/28 * 12
SJM-09	Measure	PROMART	SEN1935	-	RE	-
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2017/06/08 * 12
STS-02	Digital Hitester	Hioki	3805-50	080997819	RE	2017/03/08 * 12
SDPS-05	Power Supply(DC)	TEXIO	PW18-2AP	19050351	AT	Pre Check
SRENT-08	Spectrum Analyzer	Agilent	E4448A	MY50180019	AT	2016/10/24 * 12
SAT10-13	Attenuator	Weinschel Corp.	54A-10	81626	AT	2017/03/23 * 12
SCC-G14	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	AT	2017/03/23 * 12
SPSS-05	Power sensor	Agilent	N1923A	MY5349008	AT	2017/05/01 * 12
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2017/05/01 * 12
KTS-07	Digital Tester	SANWA	PC500	7019232	AT	2016/10/17 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 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

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