



# RADIO TEST REPORT

Test Report No. : 12385104S-A-R2

**Applicant** : CASIO COMPUTER CO., LTD  
**Type of Equipment** : Watch  
**Model No.** : GWR-B1000  
**FCC ID** : BBQS0GW  
**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 limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. This test report covers EMC technical requirements.  
It does not cover administrative issues such as Manual or non-EMC test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. This report is a revised version of 12385104S-A-R1. 12385104S-A-R1 is replaced with this report.

**Date of test:** July 13 to 15, 2018

**Representative test engineer:** *Y. Ishikawa*  
Yosuke Ishikawa  
Engineer  
Consumer Technology Division

**Approved by:** *A. Hayashi*  
Akio Hayashi  
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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## **SECTION 1: Customer information**

Company Name : CASIO COMPUTER CO., LTD  
Address : 2-1, Sakaecho 3 chome, Hamura-shi, Tokyo 205-8555 Japan  
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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. : GWR-B1000  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : Typical: Normal : DC 2.5 V, Min.: DC 1.9 V, Max.: DC 2.7 V  
CW5588 (Module): Normal: DC 3.0 V, Min.: DC 1.9 V, Max.: DC 3.3 V  
Receipt Date of Sample : July 13, 2018  
Country of Mass-production : China, Thailand, Japan  
Condition of EUT : Engineering prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Modification of EUT : No Modification by the test lab.

### **2.2 Product Description**

Model: GWR-B1000 (referred to as the EUT in this report) is a Watch.  
\* GWR-B1000 has alternative name as R017.

### **Radio Specification**

Equipment Type : Transceiver  
Frequency of Operation : 2402 MHz - 2480 MHz  
Type of Modulation : GFSK  
Channel spacing : 2 MHz  
Antenna Type : Pattern  
Antenna Gain : -2.0 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 March 12, 2018 and effective April 11, 2018

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

### **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	*1)
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8			
6 dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05	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 15.247 Meas Guidance v05	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 15.247 Meas Guidance v05	FCC: Section 15.247(e)	N/A	Conducted	
	IC: -	IC: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section15.247(d)	3.1 dB 9608.00 MHz, AV, Horizontal Tx 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 15.247 Meas Guidance v05.8.5 and 8.6.

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

\* 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 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 6.7	IC: -	N/A	Complied	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
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.5 dB	2.5 dB	2.5 dB	2.6 dB	2.6 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.2 dB	3.2 dB	3.3 dB	-	-
	30 MHz-200 MHz	4.9 dB	4.8 dB	4.9 dB	-	-
	200 MHz-1 GHz	6.1 dB	6.1 dB	6.1 dB	-	-
	1 GHz-6 GHz	4.7 dB	4.7 dB	4.7 dB	-	-
	6 GHz-18 GHz	5.3 dB	5.3 dB	5.3 dB	-	-
	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.6 dB	5.6 dB	5.6 dB	-	-
	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 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	0.48 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.66 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.47 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	0.64 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.90 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.04 dB
Spurious emission (Conducted) below 1GHz	1.8 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.7 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.5 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.5 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.7 dB
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %

### 3.5 Test Location

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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

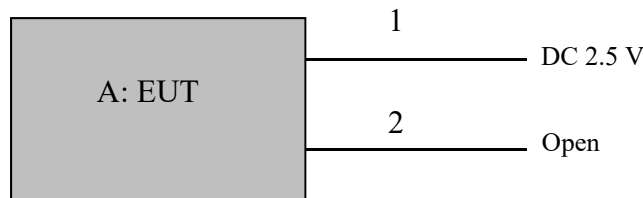
Refer to APPENDIX.

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

### **4.1 Operating Mode(s)**

Mode	Frequency	Remarks*
Bluetooth Low Energy	2402 MHz, 2440 MHz, 2480 MHz	PRBS9
*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	GWR-B1000	70 *1) 71 *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	0.1 + 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



## **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 v05".

[For below 1 GHz]

EUT was placed on a platform of nominal size, 1.0 m by 1.5 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 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

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

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

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

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

### **Test Antennas are used as below;**

Frequency	30 MHz to 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: 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. *2)	RBW: 100 kHz VBW: 300 kHz

\*1) Average Power Measurement was performed based on ANSI C63.10-2013.

\*2) Duty factor: Refer to "Duty factor Calculation chart".

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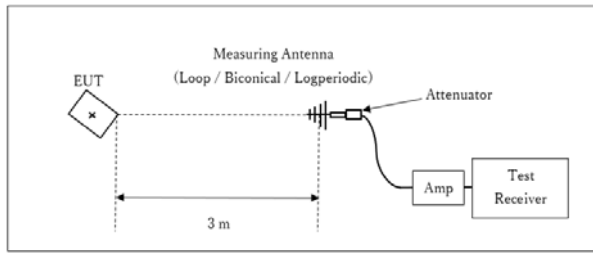
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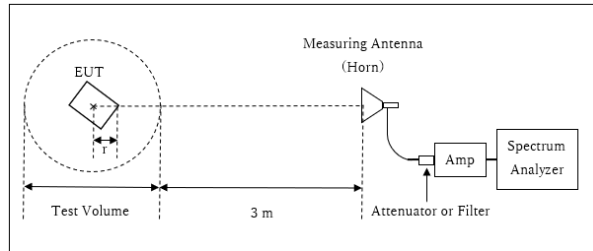
Below 1 GHz



\* : Center of turn table

Test Distance: 3 m

1 GHz - 13 GHz



r : Radius of an outer periphery of EUT  
\* : Center of turn table

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

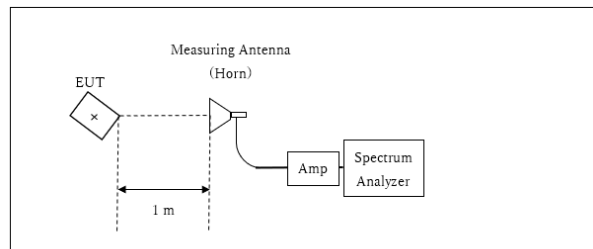
\* Test Distance:  $(3 + \text{Test Volume} / 2) - r = 3.96 \text{ m}$

Test Volume: 2 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.04 \text{ m}$

13 GHz - 26.5 GHz



\* : Center of turn table

Distance Factor:  $20 \times \log(1.0 \text{ m}^*/3.0 \text{ m}) = -9.54 \text{ dB}$

\*Test Distance: 1 m

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	Z	X	Z	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

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## **SECTION 6: Antenna Terminal Conducted Tests**

### **Test Procedure**

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

<b>Test</b>	<b>Span</b>	<b>RBW</b>	<b>VBW</b>	<b>Sweep time</b>	<b>Detector</b>	<b>Trace</b>	<b>Instrument used</b>
6 dB 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	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013". *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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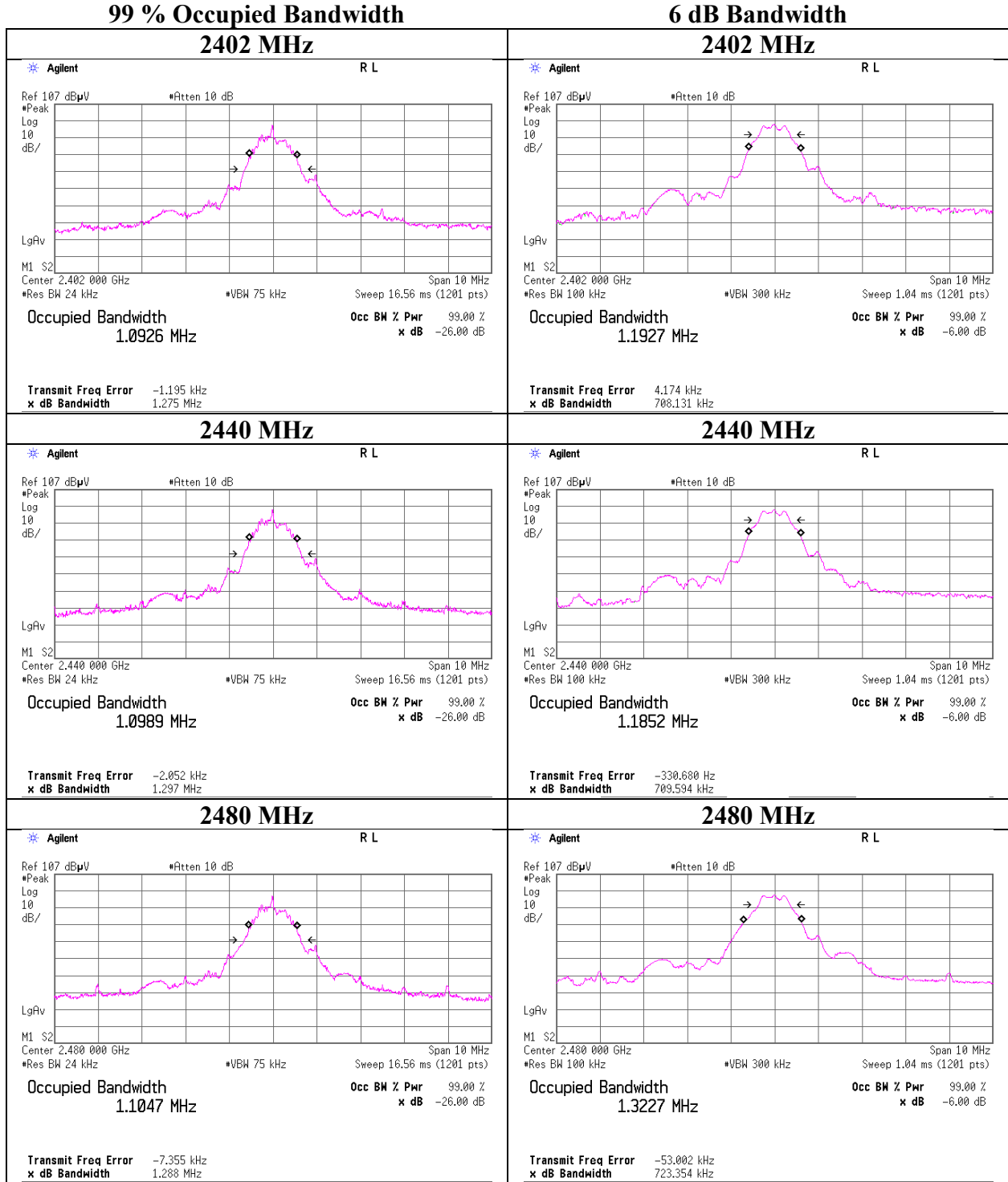
## APPENDIX 1: Test data

### 6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12385104S-A-R2  
Test place Shonan EMC Lab. No.1 Measurement Room  
Date July 13, 2018  
Temperature / Humidity 25 deg. C / 52 % RH  
Engineer Kenichi Adachi  
Mode Tx BT LE

Mode	Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
BT LE	2402	1092.6	0.708	> 0.5000
	2440	1098.9	0.710	> 0.5000
	2480	1104.7	0.723	> 0.5000

**6 dB Bandwidth and 99 % Occupied Bandwidth**



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## Maximum Peak Output Power

Report No. 12385104S-A-R2  
Test place Shonan EMC Lab. No.1 Measurement Room  
Date July 13, 2018  
Temperature / Humidity 25 deg. C / 52 % RH  
Engineer Kenichi Adachi  
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-12.42	1.78	9.68	-0.96	0.80	30.00	1000	30.96	-2.00	-2.96	0.51	36.02	4000	38.98
2440	-11.52	1.79	9.67	-0.06	0.99	30.00	1000	30.06	-2.00	-2.06	0.62	36.02	4000	38.08
2480	-12.11	1.80	9.67	-0.64	0.86	30.00	1000	30.64	-2.00	-2.64	0.54	36.02	4000	38.66

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

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

## Average Output Power (Reference data for RF Exposure / SAR testing)

Report No. 12385104S-A-R2  
Test place Shonan EMC Lab. No.1 Measurement Room  
Date July 13, 2018  
Temperature / Humidity 25 deg. C / 52 % RH  
Engineer Kenichi Adachi  
Mode Tx BT LE

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	-14.15	1.78	9.68	-2.69
2440	-13.22	1.79	9.67	-1.76	0.67	0.86	-0.90	0.81
2480	-13.87	1.80	9.67	-2.40	0.58	0.86	-1.54	0.70

Sample Calculation:

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

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

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

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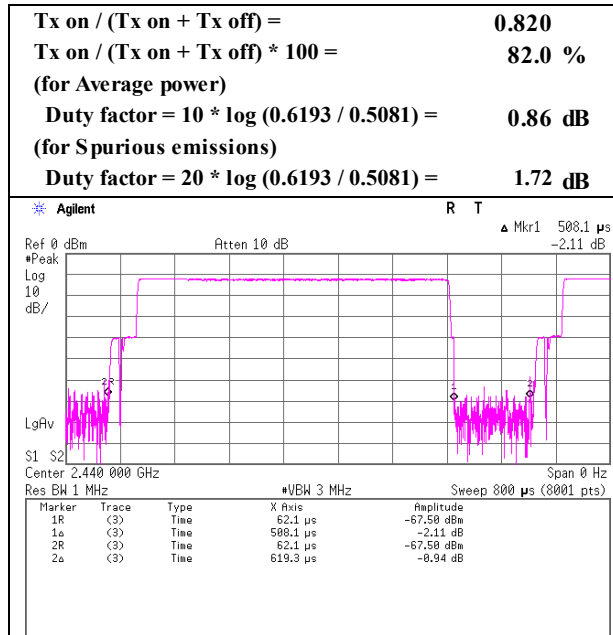
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### Duty factor Calculation chart

Report No. 12385104S-A-R2  
 Test place Shonan EMC Lab. No.1 Measurement Room  
 Date July 13, 2018  
 Temperature / Humidity 25 deg. C / 52 % RH  
 Engineer Kenichi Adachi  
 Mode Tx BT LE

#### BT LE



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

## Radiated Spurious Emission

Report No.	12385104S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	July 14, 2018	July 15, 2018
Temperature / Humidity	21 deg. C / 53 % RH	25 deg. C / 56 % RH
Engineer	Yosuke Ishikawa (1 GHz - 13 GHz)	Kazuya Noda (13 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.	102.021	QP	24.03	10.53	7.34	32.16	0.00	9.74	43.50	33.7	275	238	
Hori.	167.724	QP	22.18	15.45	7.88	32.10	0.00	13.41	43.50	30.0	152	356	
Hori.	448.473	QP	21.92	16.74	9.44	31.97	0.00	16.13	46.00	29.8	150	160	
Hori.	569.449	QP	21.62	18.31	9.89	31.98	0.00	17.84	46.00	28.1	140	358	
Hori.	2390.000	PK	48.49	27.26	14.09	44.13	2.42	48.13	73.90	25.7	282	36	
Hori.	4804.000	PK	48.61	31.40	6.42	44.45	2.42	44.40	73.90	29.5	100	0	
Hori.	7206.000	PK	48.36	36.56	8.24	43.99	2.42	51.59	73.90	22.3	100	0	
Hori.	9608.000	PK	50.82	38.61	9.14	43.83	2.42	57.16	73.90	16.7	100	205	
Vert.	36.405	QP	23.01	16.23	6.58	32.20	0.00	13.62	40.00	26.3	100	355	
Vert.	43.657	QP	22.84	13.52	6.71	32.19	0.00	10.88	40.00	29.1	100	3	
Vert.	476.527	QP	21.84	17.18	9.54	31.97	0.00	16.59	46.00	29.4	100	21	
Vert.	939.781	QP	21.16	22.18	11.21	30.74	0.00	23.81	46.00	22.1	100	357	
Vert.	2390.000	PK	49.31	27.26	14.09	44.13	2.42	48.95	73.90	24.9	281	207	
Vert.	4804.000	PK	48.43	31.40	6.42	44.45	2.42	44.22	73.90	29.6	100	0	
Vert.	7206.000	PK	47.77	36.56	8.24	43.99	2.42	51.00	73.90	22.9	100	0	
Vert.	9608.000	PK	50.66	38.61	9.14	43.83	2.42	57.00	73.90	16.9	100	122	

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	40.02	27.26	14.09	44.13	1.72	2.42	41.38	53.90	12.5	*1)
Hori.	4804.000	AV	40.52	31.40	6.42	44.45	1.72	2.42	38.03	53.90	15.9	
Hori.	7206.000	AV	39.79	36.56	8.24	43.99	1.72	2.42	44.74	53.90	9.2	
Hori.	9608.000	AV	42.75	38.61	9.14	43.83	1.72	2.42	50.81	53.90	3.1	
Vert.	2390.000	AV	38.36	27.26	14.09	44.13	1.72	2.42	39.72	53.90	14.2	*1)
Vert.	4804.000	AV	40.48	31.40	6.42	44.45	1.72	2.42	37.99	53.90	15.9	
Vert.	7206.000	AV	39.95	36.56	8.24	43.99	1.72	2.42	44.90	53.90	9.0	
Vert.	9608.000	AV	41.64	38.61	9.14	43.83	1.72	2.42	49.70	53.90	4.2	

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	77.62	27.29	14.10	44.14	2.42	77.29	-	-	Carrier
Hori.	2400.000	PK	40.78	27.29	14.10	44.14	2.42	40.45	57.29	16.8	
Vert.	2402.000	PK	74.23	27.29	14.10	44.14	2.42	73.90	-	-	Carrier
Vert.	2400.000	PK	39.87	27.29	14.10	44.14	2.42	39.54	53.90	14.4	

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

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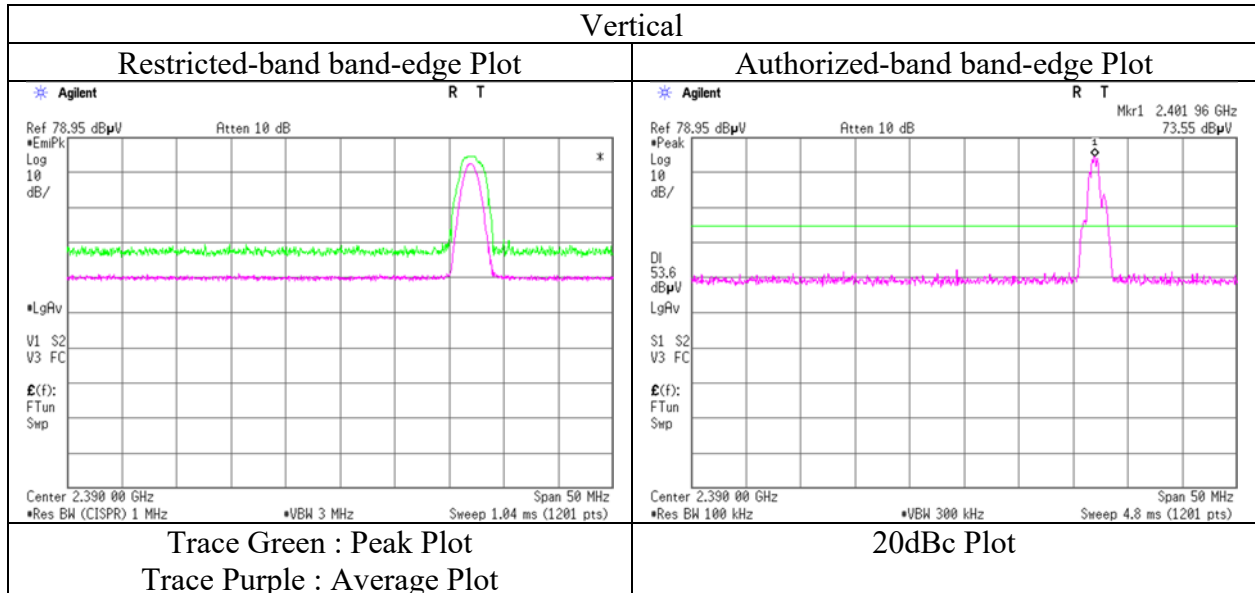
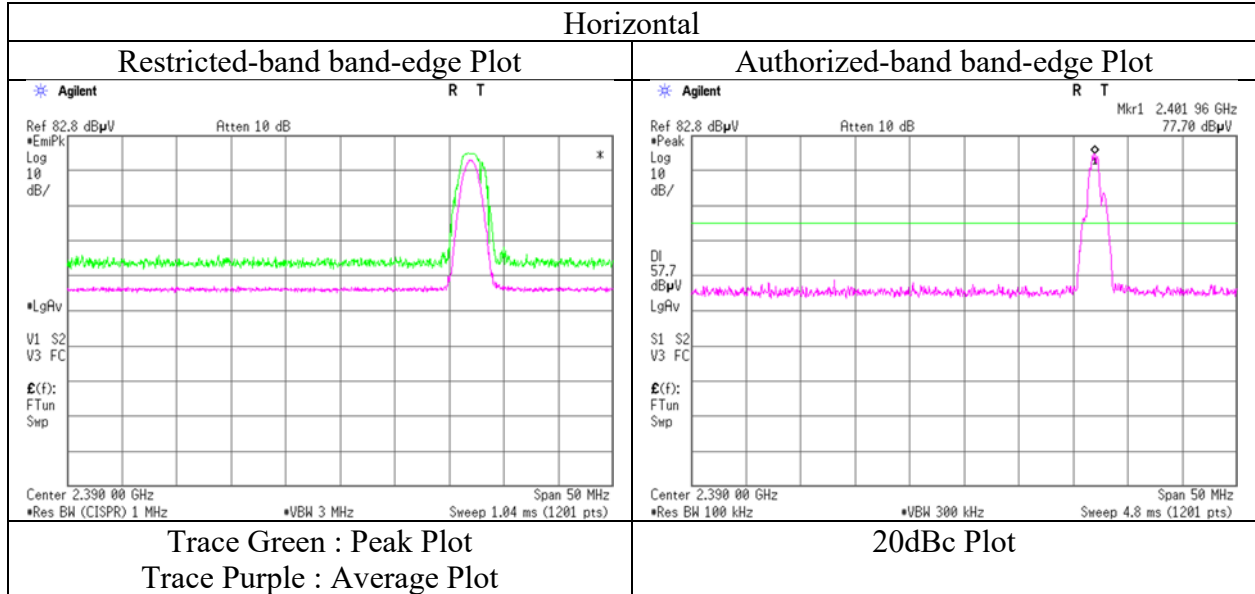
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**Radiated Spurious Emission  
(Reference Plot for band-edge)**

Report No. 12385104S-A-R2  
Test place Shonan EMC Lab.  
Semi Anechoic Chamber No.3  
Date July 14, 2018  
Temperature / Humidity 21 deg. C / 53 % RH  
Engineer Yosuke Ishikawa  
(1 GHz - 13 GHz)  
Mode Tx BT LE 2402 MHz



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

## Radiated Spurious Emission

Report No.	12385104S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	July 14, 2018	July 15, 2018
Temperature / Humidity	21 deg. C / 53 % RH	25 deg. C / 56 % RH
Engineer	Yosuke Ishikawa (1 GHz - 13 GHz)	Kazuya Noda (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.	102.419	QP	23.89	10.63	7.33	32.16	0.00	9.69	43.50	33.8	275	230	
Hori.	168.457	QP	22.11	15.43	7.88	32.10	0.00	13.32	43.50	30.1	149	359	
Hori.	523.060	QP	22.26	17.68	9.71	31.98	0.00	17.67	46.00	28.3	100	12	
Hori.	849.931	QP	21.42	21.60	10.94	31.39	0.00	22.57	46.00	23.4	150	3	
Hori.	4880.000	PK	48.85	31.61	6.45	44.48	2.42	44.85	73.90	29.0	100	0	
Hori.	7320.000	PK	48.13	36.76	8.32	44.03	2.42	51.60	73.90	22.3	100	0	
Hori.	9760.000	PK	48.19	38.79	9.17	43.85	2.42	54.72	73.90	19.1	100	272	
Vert.	36.220	QP	23.04	16.30	6.57	32.20	0.00	13.71	40.00	26.2	100	4	
Vert.	43.934	QP	22.74	13.43	6.72	32.19	0.00	10.70	40.00	29.3	100	2	
Vert.	618.034	QP	20.79	19.76	10.07	31.96	0.00	18.66	46.00	27.3	100	358	
Vert.	922.721	QP	21.34	22.02	11.15	30.89	0.00	23.62	46.00	22.3	100	359	
Vert.	4880.000	PK	48.51	31.61	6.45	44.48	2.42	44.51	73.90	29.3	100	0	
Vert.	7320.000	PK	47.64	36.76	8.32	44.03	2.42	51.11	73.90	22.7	100	0	
Vert.	9760.000	PK	49.51	38.79	9.17	43.85	2.42	56.04	73.90	17.8	105	112	

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.	4880.000	AV	40.34	31.61	6.45	44.48	1.72	2.42	38.06	53.90	15.8	
Hori.	7320.000	AV	38.97	36.76	8.32	44.03	1.72	2.42	44.16	53.90	9.7	
Hori.	9760.000	AV	40.31	38.79	9.17	43.85	1.72	2.42	48.56	53.90	5.3	
Vert.	4880.000	AV	40.35	31.61	6.45	44.48	1.72	2.42	38.07	53.90	15.8	
Vert.	7320.000	AV	39.24	36.76	8.32	44.03	1.72	2.42	44.43	53.90	9.5	
Vert.	9760.000	AV	41.79	38.79	9.17	43.85	1.72	2.42	50.04	53.90	3.9	

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

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

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)

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## Radiated Spurious Emission

Report No.	12385104S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	July 14, 2018	July 15, 2018
Temperature / Humidity	21 deg. C / 53 % RH	25 deg. C / 56 % RH
Engineer	Yosuke Ishikawa (1 GHz - 13 GHz)	Kazuya Noda (13 GHz - 26.5 GHz) (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.	102.533	QP	23.94	10.65	7.32	32.16	0.00	9.75	43.50	33.7	281	202	
Hori.	133.303	QP	22.44	14.13	7.46	32.13	0.00	11.90	43.50	31.6	152	357	
Hori.	566.373	QP	21.53	18.23	9.88	31.99	0.00	17.65	46.00	28.3	150	359	
Hori.	825.495	QP	21.37	21.10	10.85	31.49	0.00	21.83	46.00	24.1	145	3	
Hori.	2483.500	PK	48.80	27.55	14.18	44.16	2.42	48.79	73.90	25.1	118	285	
Hori.	4960.000	PK	48.06	31.83	6.48	44.51	2.42	44.28	73.90	29.6	100	0	
Hori.	7440.000	PK	47.62	36.97	8.41	44.08	2.42	51.34	73.90	22.5	100	123	
Hori.	9920.000	PK	47.64	38.98	9.22	43.87	2.42	54.39	73.90	19.5	100	209	
Vert.	36.514	QP	23.04	16.19	6.58	32.20	0.00	13.61	40.00	26.3	100	11	
Vert.	41.312	QP	22.73	14.36	6.67	32.19	0.00	11.57	40.00	28.4	100	359	
Vert.	844.202	QP	21.31	21.46	10.92	31.41	0.00	22.28	46.00	23.7	100	357	
Vert.	948.129	QP	21.14	22.13	11.23	30.66	0.00	23.84	46.00	22.1	100	358	
Vert.	2483.500	PK	48.69	27.55	14.18	44.16	2.42	48.68	73.90	25.2	100	272	
Vert.	4960.000	PK	48.18	31.83	6.48	44.51	2.42	44.40	73.90	29.5	100	0	
Vert.	7440.000	PK	48.37	36.97	8.41	44.08	2.42	52.09	73.90	21.8	100	0	
Vert.	9920.000	PK	48.88	38.98	9.22	43.87	2.42	55.63	73.90	18.2	100	112	

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	40.49	27.55	14.18	44.16	1.72	2.42	42.20	53.90	11.7	*1)
Hori.	4960.000	AV	40.64	31.83	6.48	44.51	1.72	2.42	38.58	53.90	15.3	
Hori.	7440.000	AV	39.90	36.97	8.41	44.08	1.72	2.42	45.34	53.90	8.6	
Hori.	9920.000	AV	39.94	38.98	9.22	43.87	1.72	2.42	48.41	53.90	5.5	
Vert.	2483.500	AV	38.05	27.55	14.18	44.16	1.72	2.42	39.76	53.90	14.1	*1)
Vert.	4960.000	AV	40.75	31.83	6.48	44.51	1.72	2.42	38.69	53.90	15.2	
Vert.	7440.000	AV	40.14	36.97	8.41	44.08	1.72	2.42	45.58	53.90	8.3	
Vert.	9920.000	AV	41.26	38.98	9.22	43.87	1.72	2.42	49.73	53.90	4.2	

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)

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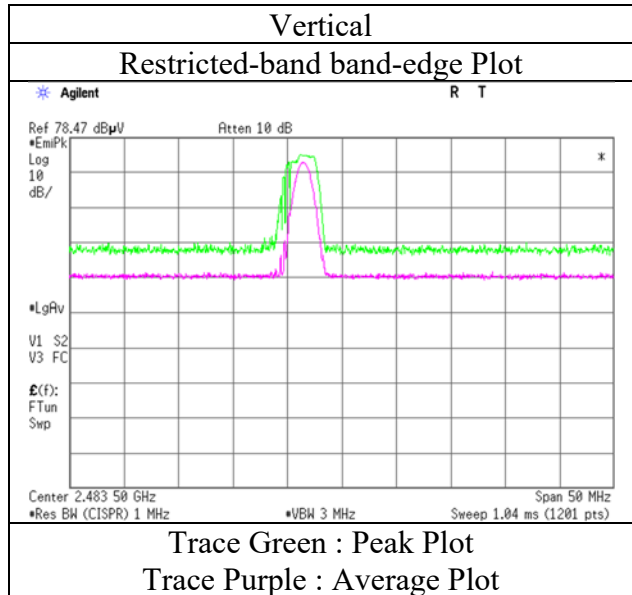
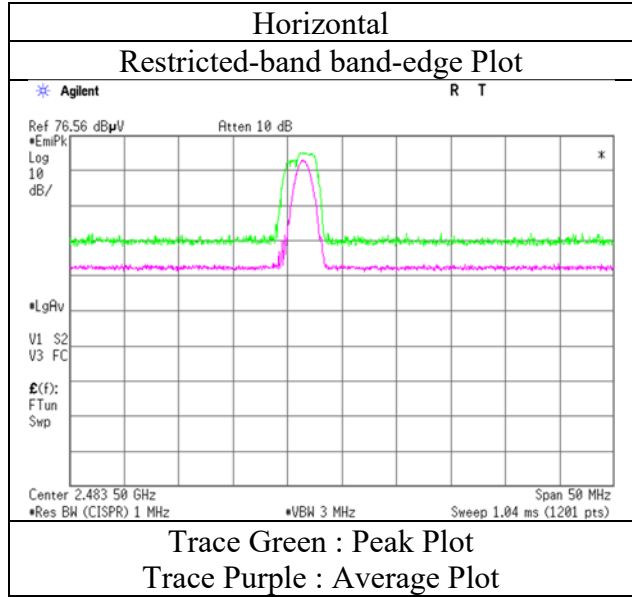
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**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

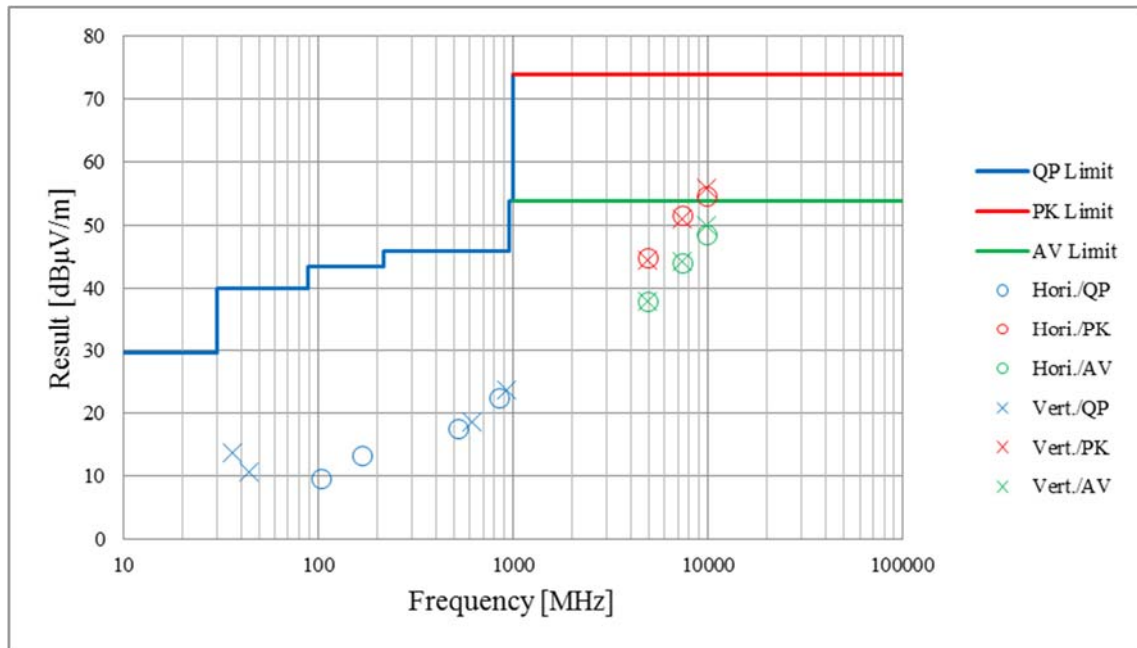
Report No. 12385104S-A-R2  
Test place Shonan EMC Lab.  
Semi Anechoic Chamber No.3  
Date July 14, 2018  
Temperature / Humidity 21 deg. C / 53 % RH  
Engineer Yosuke Ishikawa  
(1 GHz - 13 GHz)  
Mode Tx BT LE 2480 MHz



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

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

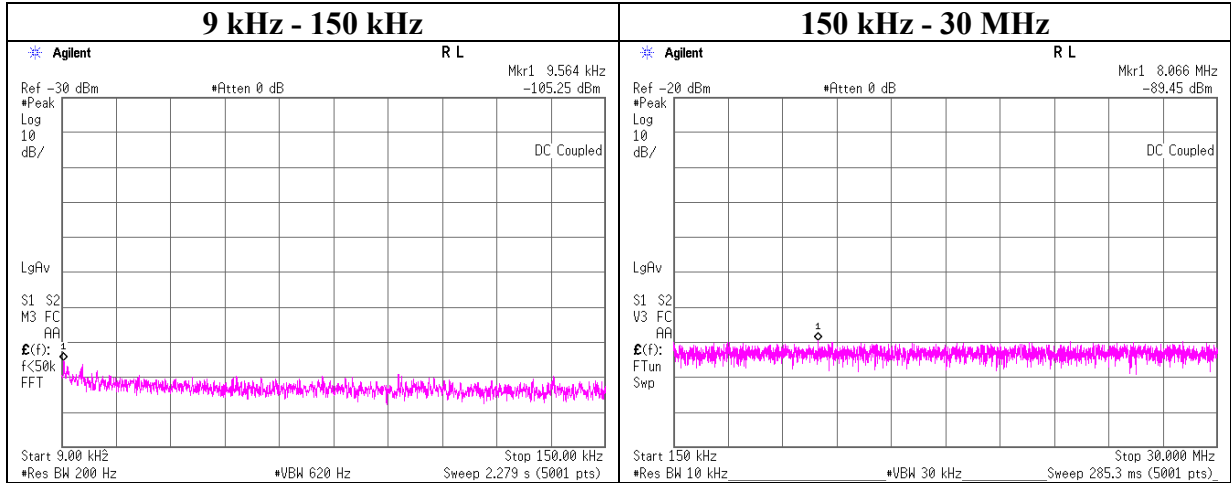
Report No.	12385104S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	July 14, 2018	July 15, 2018
Temperature / Humidity	21 deg. C / 53 % RH	25 deg. C / 56 % RH
Engineer	Yosuke Ishikawa (1 GHz - 13 GHz)	Kazuya Noda (13 GHz - 26.5 GHz) (30 MHz - 1 GHz)
Mode	Tx BT LE 2440 MHz	



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

## Conducted Spurious Emission

Report No. 12385104S-A-R2  
Test place Shonan EMC Lab. No.1 Measurement Room  
Date July 13, 2018  
Temperature / Humidity 25 deg. C / 52 % RH  
Engineer Kenichi Adachi  
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
9.56	-105.25	0.51	9.54	2.0	1	-93.20	300	6.0	-31.94	47.90	79.84	
8066.00	-89.45	0.55	9.54	2.0	1	-77.36	30	6.0	3.90	29.54	25.65	

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

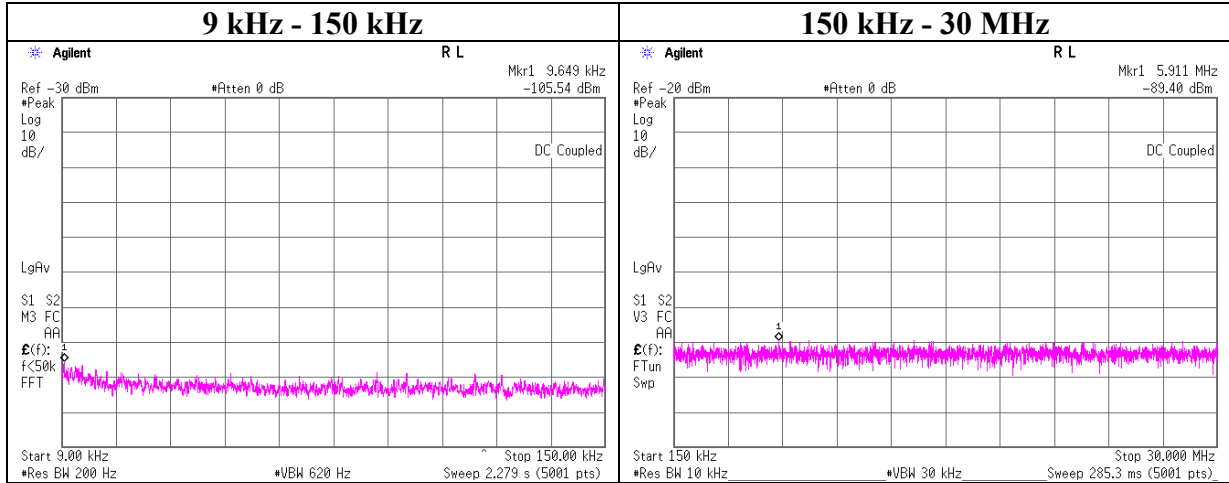
$$\text{EIRP[dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$$

N: Number of output

\*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

## Conducted Spurious Emission

Report No. 12385104S-A-R2  
 Test place Shonan EMC Lab. No.1 Measurement Room  
 Date July 13, 2018  
 Temperature / Humidity 25 deg. C / 52 % RH  
 Engineer Kenichi Adachi  
 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
9.65	-105.54	0.51	9.54	2.0	1	-93.5	300	6.0	-32.23	47.90	80.13	
5911.00	-89.40	0.54	9.54	2.0	1	-77.3	30	6.0	3.94	29.54	25.61	

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

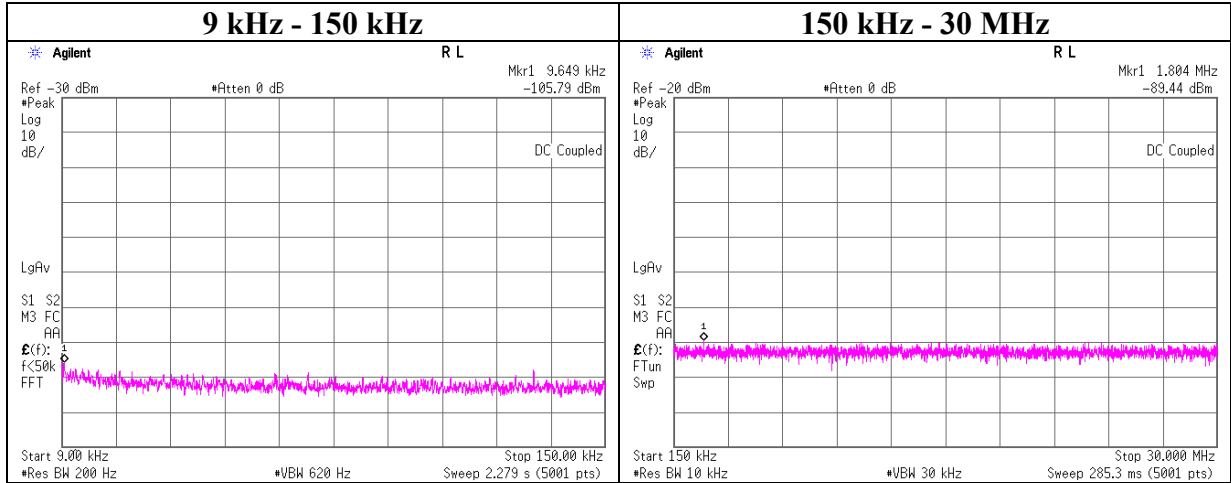
$$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$$

N: Number of output

\*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

## Conducted Spurious Emission

Report No. 12385104S-A-R2  
Test place Shonan EMC Lab. No.1 Measurement Room  
Date July 13, 2018  
Temperature / Humidity 25 deg. C / 52 % RH  
Engineer Kenichi Adachi  
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
9.65	-105.79	0.51	9.54	2.0	1	-93.7	300	6.0	-32.48	47.90	80.38	
1804.00	-89.44	0.52	9.54	2.0	1	-77.4	30	6.0	3.88	29.54	25.67	

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

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

N: Number of output

\*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

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## Power Density

Report No.	12385104S-A-R2
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	July 13, 2018
Temperature / Humidity	25 deg. C / 52 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE

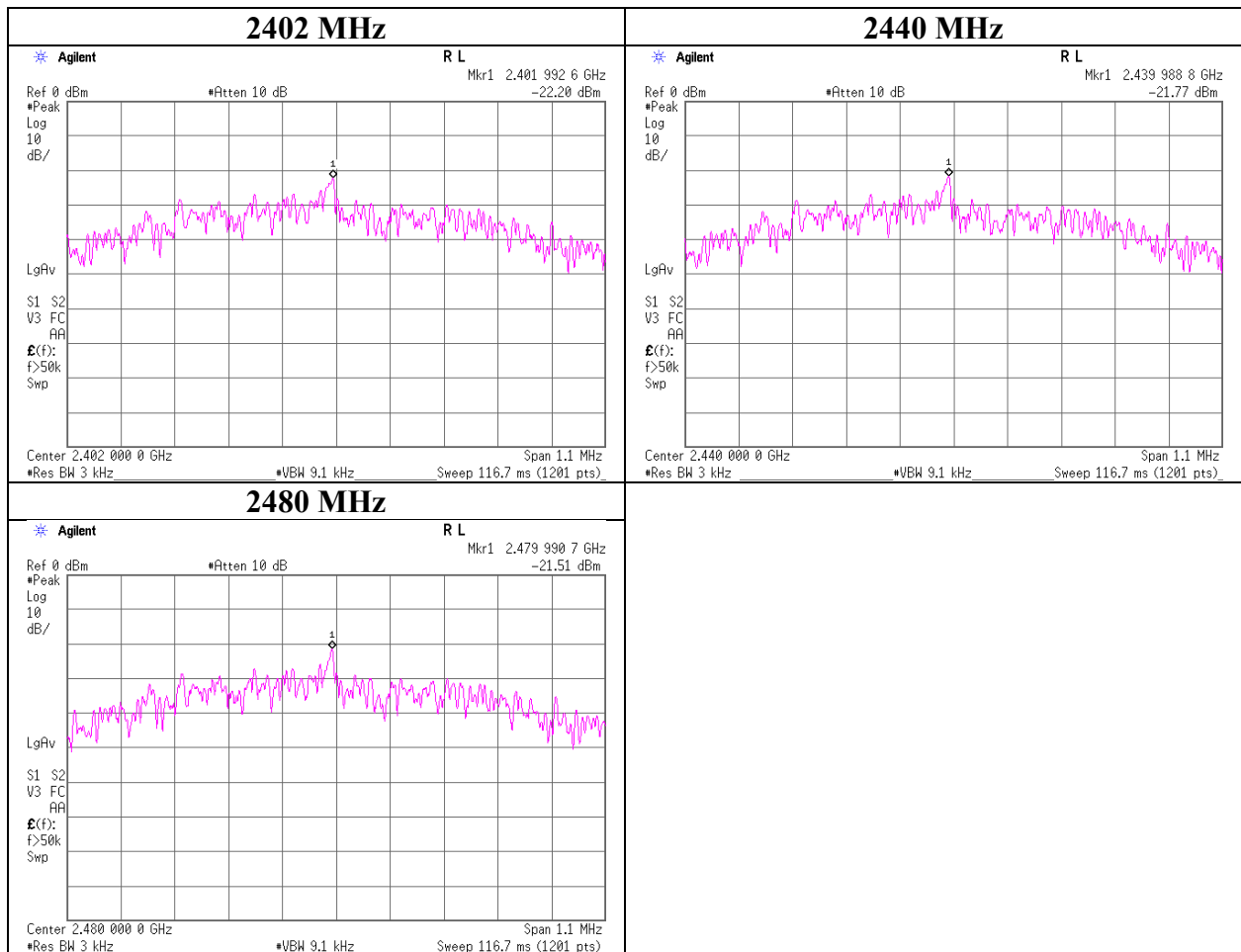
BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402	-22.20	1.78	9.68	-10.74	8.00	18.74
2440	-21.77	1.79	9.67	-10.31	8.00	18.31
2480	-21.51	1.80	9.67	-10.04	8.00	18.04

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.



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## APPENDIX 2: Test instruments

### Test Instruments

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	2046104	RE	2017/09/22 * 12
SCC-G06	Coaxial Cable	Junkosha	J12J102207-00	MAY-23-16-091	RE	2018/06/01 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2018/05/11 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2017/08/23 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2017/10/30 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2018/03/05 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
SAEC-03(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-03(SVSW R)	3	RE	2017/07/17 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE, CE,RFL,MF)	-	RE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2017/10/16 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000 NFSNMS/B	1612S005	RE	2018/01/29 * 12
SAT10-05	Attenuator(above1 GHz)	Agilent	8493C-010	74864	RE	2017/11/22 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2017/11/16 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM9861	RE	2017/07/11 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2018/03/27 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000 KMSKMS	-	RE	2018/04/20 * 12
SCC-G45	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102 E	800137/2EA	RE	2018/03/28 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2018/06/02 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2018/06/17 * 12
SLA-07	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	RE	2018/06/17 * 12
SAT6-13	Attenuator	JFW	50HF-006N	-	RE	2018/02/09 * 12
SCC-C1/C2/C3/ C4/C5/C10/SRS E-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhn er/Suhner/Suhner/Suhn er/TOYO	8D2W/12DSFA/ 141PE/141PE/14 1PE/141PE/NS4 906	-/0901-271(RF Selector)	RE	2018/04/09 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2018/02/16 * 12
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	RE	2017/11/24 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2018/05/10 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2018/05/10 * 12
SRENT-09	Spectrum Analyzer	Agilent	E4440A	MY46186392	AT	2017/11/08 * 12
SAT10-09	Attenuator	Weinschel Corp.	54A-10	W5692	AT	2017/11/22 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2018/03/19 * 12
SOS-13	Humidity Indicator	Custom	CTH-202	Q.C.17	AT	2017/12/21 * 12
KTS-08	Digital Tester	SANWA	PC500	7019224	AT	2018/03/05 * 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