



RADIO TEST REPORT

Test Report No. : 12562008S-A-R1

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : Watch
Model No. : OCW-S5000
FCC ID : BBQS0HW
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied (Refer to Section 3.2)

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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.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by any agency of the Federal Government.
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. 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. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 12562008S-A. 12562008S-A is replaced with this report.

Date of test: January 19 to February 5, 2019

Representative test engineer: K. Takeyama
Kazutaka Takeyama
Engineer
Consumer Technology Division

Approved by: A. Hayashi
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Leader
Consumer Technology Division



CERTIFICATE 1266.03

- ☐ 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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Shonan EMC Lab.

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REVISION HISTORY

Original Test Report No.: 12562008S-A

[illegible]

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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

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

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

2.1 Identification of E.U.T.

Type of Equipment	:	Watch
Model No.	:	OCW-S5000
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	OCW-S5000 (Watch): Typical DC 2.5 V CW5603 (Module): Normal: DC 3.0 V, Min.: DC 1.9 V, Max.: DC 3.3 V
Receipt Date of Sample (Information from test lab.)	:	January 18, 2019
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: OCW-S5000 (referred to as the EUT in this report) is a Watch.

* OCW-S5000 has alternative name as R019.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Channel spacing	:	2 MHz
Antenna type	:	Chip (Monopole)
Antenna Gain	:	2.5 dBi
Operating Temperature	:	-10 deg.C to +60 deg.C
Clock frequency (Maximum)	:	16 MHz

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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 IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	-	N/A	*1)
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05 *3) IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	See data.	Complied a)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05*3) IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)		Complied b)	Conducted
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05 *3) IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)		Complied c)	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05 *3) IC: RSS-Gen 6.13	FCC: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	5.4 dB 7440.00 MHz, AV, Vertical Tx 2480 MHz	Complied d), e)	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 15.247 Meas Guidance v05 8.5 and 8.6.

*3) Measurement was performed before issue of KDB 558074 v05r01.

a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)

b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)

c) Refer to APPENDIX 1 (data of Power Density)

d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)

e) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

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	N/A a)	Conducted

*a) Refer to Appendix 1 (data of Antenna port conducted test)

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

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

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

Item	Frequency range	Uncertainty (+/-)		
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.1 dB
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.7 dB
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.1 dB
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB
	6 GHz-18 GHz	5.4 dB	5.4 dB	5.4 dB
	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 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	0.81 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.53 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.95 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.21 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	2.3 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.4 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	0.61 %
Duty cycle and Time Measurement	0.012 %

3.5 Test Location

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A2LA Certificate Number: 1266.03
FCC Test Firm Registration Number: 626366

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

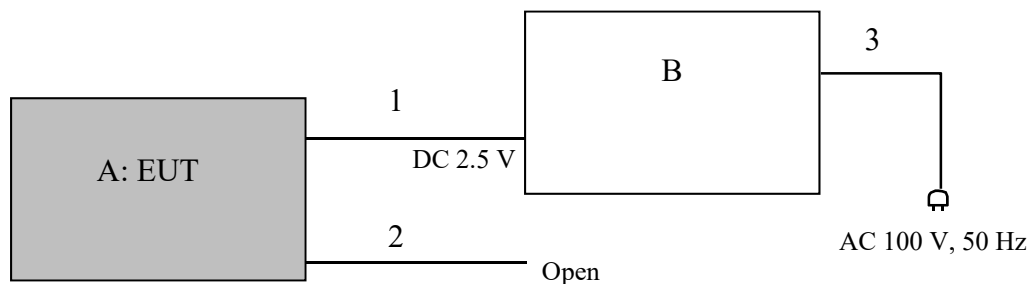
Refer to APPENDIX.

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	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 and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Watch	OCW-S5000	No.19 *1) No.20 *2)	Casio Computer Co., Ltd.	EUT
B	Power Supply	PAN35-10A	NA000955	KIKUSUI	-

*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 + 2.0	Unshielded	Unshielded	*3)
2	Signal Cable	0.1	Unshielded	Unshielded	*4)
3	AC Cable	1.8	Unshielded	Unshielded	-

*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 "8.5 and 8.6 of KDB 558074 D01 15.247 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 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.

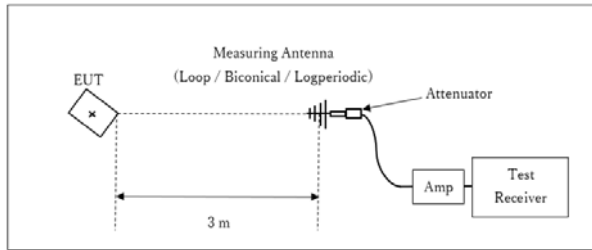
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

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	11.12.2.5.2 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz

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

Figure 1: Test Setup

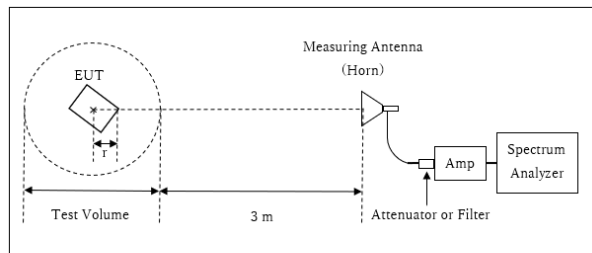
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 13 GHz



r : Radius of an outer periphery of EUT
x : Center of turn table

Distance Factor: $20 \times \log (3.95 \text{ m} / 3.0 \text{ m}) = 2.39 \text{ dB}$

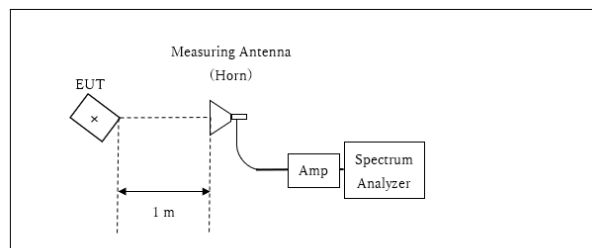
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.95 \text{ m}$

Test Volume : 2.0 m

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

r = 0.05 m

13 GHz - 26.5 GHz



x : 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	Y	X	Y	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

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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	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 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3) *4)
Conducted Spurious Emission *5)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.
 *2) Reference data
 *3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
 *4) The test was not performed at RBW:3 kHz however the measurement is to be performed with RBW:3kHz in the regulation, because, the measurement value with RBW:3 kHz is less than the value of RBW:30 kHz and the test data met the limit with RBW:30 kHz.
 *5) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
 Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart.
 (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz).

The test results and limit are rounded off to two decimals place, so some differences might be observed.
 The equipment and cables were not used for factor 0 dB of the data sheets.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

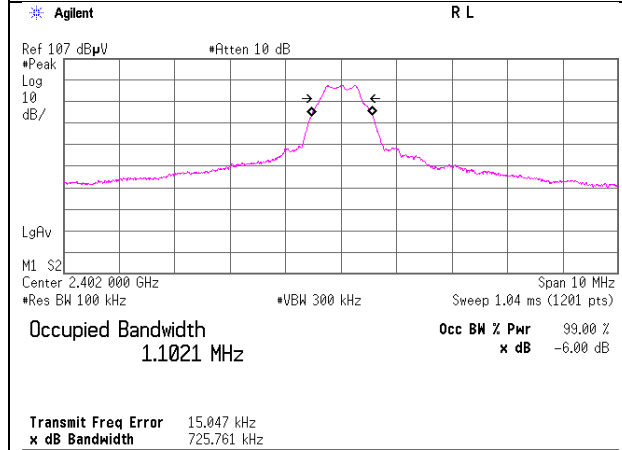
Report No. 12562008S-A-R1
Test place Shonan EMC Lab. No.2 Shielded Room
Date January 19, 2019
Temperature / Humidity 22 deg. C / 32 % RH
Engineer Kazutaka Takeyama
Mode Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BT LE	2402	1069.8	0.726	> 0.5000
	2440	1081.9	0.744	> 0.5000
	2480	1076.6	0.739	> 0.5000

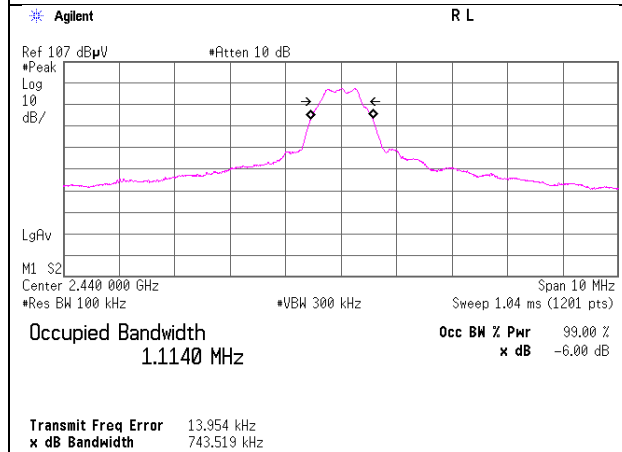
6dB Bandwidth

BTLE

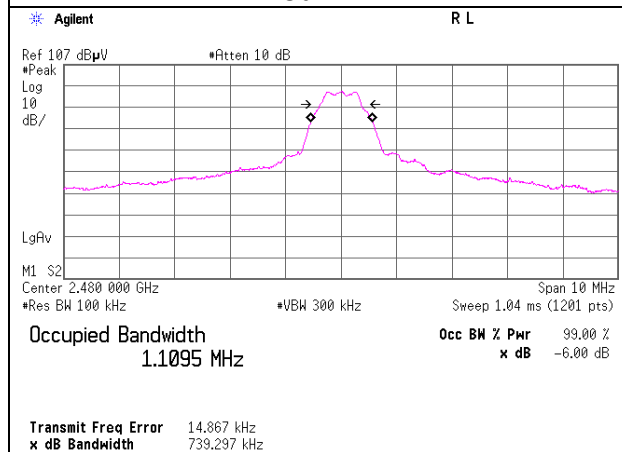
2402 MHz



2440 MHz



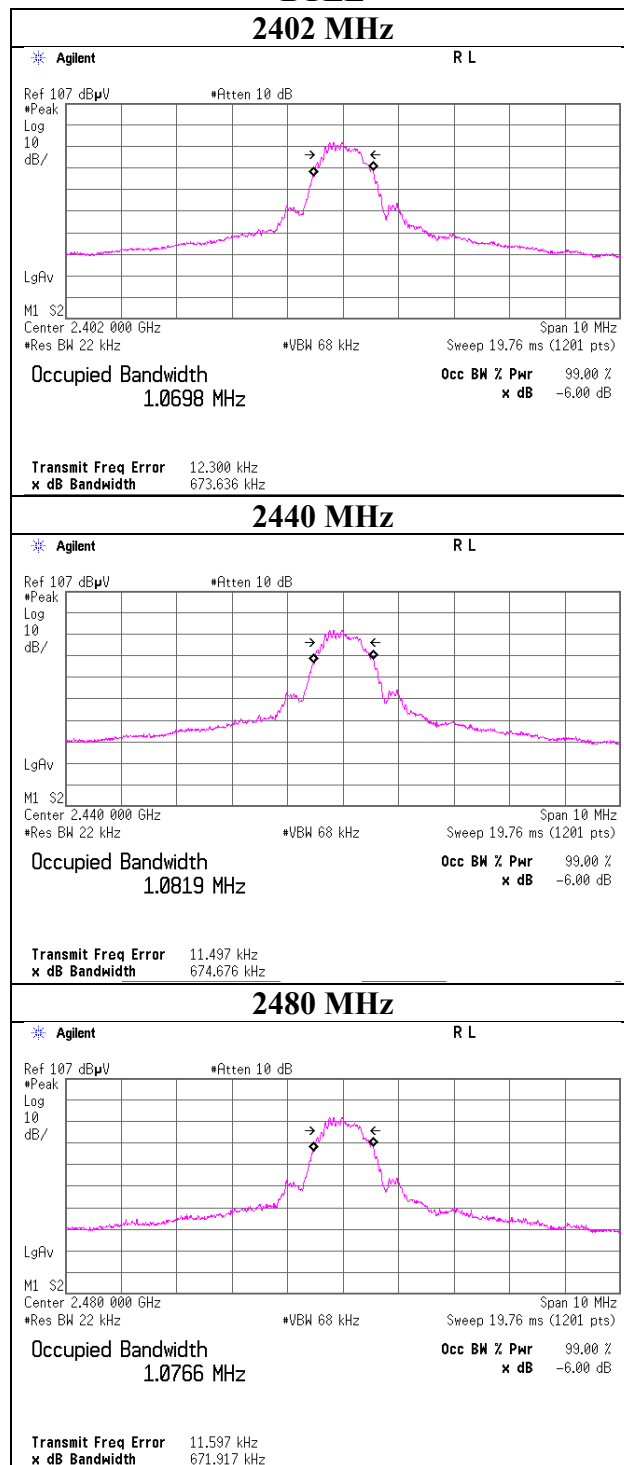
2480 MHz



99%Occupied Bandwidth

Test place Shonan EMC Lab. No.2 Shielded Room
Report No. 12562008S-A-R1
Date January 19, 2019
Temperature / Humidity 22 deg. C / 32 % RH
Engineer Kazutaka Takeyama
Mode Tx BT LE

BTLE



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Maximum Peak Output Power

Report No. 12562008S-A-R1
Test place Shonan EMC Lab. No.2 Shielded Room
Date January 19, 2019
Temperature / Humidity 22 deg. C / 32 % RH
Engineer Kazutaka Takeyama
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	-11.54	1.27	9.82	-0.450	0.90	30.00	1000	30.45	2.50	2.05	1.60	36.02	4000	33.97
2440	-11.67	1.28	9.82	-0.570	0.88	30.00	1000	30.57	2.50	1.93	1.56	36.02	4000	34.09
2480	-11.78	1.29	9.82	-0.670	0.86	30.00	1000	30.67	2.50	1.83	1.52	36.02	4000	34.19

Sample Calculation:

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

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

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

Report No. 12562008S-A-R1
Test place Shonan EMC Lab. No.2 Shielded Room
Date January 19, 2019
Temperature / Humidity 22 deg. C / 32 % RH
Engineer Kazutaka Takeyama
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	-14.08	1.27	9.82	-2.99	0.50	2.01	-0.98	0.80
2440	-14.22	1.28	9.82	-3.12	0.49	2.01	-1.11	0.77
2480	-14.33	1.29	9.82	-3.22	0.48	2.01	-1.21	0.76

Sample Calculation:

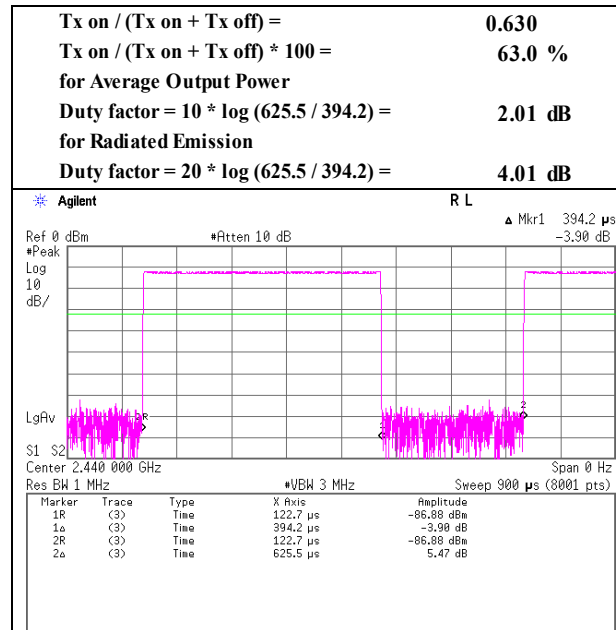
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

Burst rate confirmation

Report No.	12562008S-A-R1
Test place	Shonan EMC Lab. No.2 Shielded Room
Date	January 19, 2019
Temperature / Humidity	22 deg. C / 32 % RH
Engineer	Kazutaka Takeyama
Mode	Tx BT LE 2440 MHz

BTLE



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

Radiated Spurious Emission

Report No. 12562008S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date February 5, 2019 February 4, 2019
Temperature / Humidity 23 deg. C / 38 % RH 20 deg. C / 35 % RH
Engineer Makoto Hosaka Makoto Hosaka
(1 GHz – 26.5 GHz) (30 MHz – 1000 MHz)
Mode Tx BT LE 2402 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.00	17.92	6.49	32.20	0.00	14.21	40.00	25.7	245	2	
Hori.	64.000	QP	21.80	7.46	6.48	32.18	0.00	3.56	40.00	36.4	100	92	
Hori.	240.000	QP	22.00	11.65	8.31	32.03	0.00	9.93	46.00	36.0	100	150	
Hori.	368.000	QP	20.80	15.14	9.11	31.96	0.00	13.09	46.00	32.9	100	357	
Hori.	2390.000	PK	46.30	27.86	14.73	39.46	2.39	51.82	73.90	22.0	156	206	
Hori.	4804.000	PK	45.17	31.43	7.28	39.50	2.39	46.77	73.90	27.1	150	0	
Hori.	7206.000	PK	41.93	36.79	9.14	39.29	2.39	50.96	73.90	22.9	150	0	
Vert.	80.000	QP	23.19	6.44	7.56	32.17	0.00	5.02	40.00	34.9	100	131	
Vert.	96.000	QP	21.40	9.46	7.44	32.16	0.00	6.14	43.50	37.3	100	125	
Vert.	112.000	QP	21.40	12.17	7.24	32.15	0.00	8.66	43.50	34.8	100	0	
Vert.	256.000	QP	21.00	12.00	8.42	32.01	0.00	9.41	46.00	36.5	100	35	
Vert.	304.000	QP	21.00	13.76	8.74	32.01	0.00	11.49	46.00	34.5	100	303	
Vert.	320.000	QP	21.10	14.27	8.84	31.99	0.00	12.22	46.00	33.7	100	48	
Vert.	352.000	QP	21.00	15.14	9.04	31.95	0.00	13.23	46.00	32.7	100	4	
Vert.	2390.000	PK	44.36	27.86	14.73	39.46	2.39	49.88	73.90	24.0	182	174	
Vert.	4804.000	PK	45.02	31.43	7.28	39.50	2.39	46.62	73.90	27.2	150	0	
Vert.	7206.000	PK	43.33	36.79	9.14	39.29	2.39	52.36	73.90	21.5	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.95 m / 3.0 m) = 2.39 dB

13 GHz - 26.5 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	36.23	27.86	14.73	39.46	4.01	2.39	45.76	53.90	8.1	*1)
Hori.	4804.000	AV	35.72	31.43	7.28	39.50	4.01	2.39	41.33	53.90	12.5	
Hori.	7206.000	AV	34.13	36.79	9.14	39.29	4.01	2.39	47.17	53.90	6.7	
Vert.	2390.000	AV	35.83	27.86	14.73	39.46	4.01	2.39	45.36	53.90	8.5	*1)
Vert.	4804.000	AV	34.46	31.43	7.28	39.50	4.01	2.39	40.07	53.90	13.8	
Vert.	7206.000	AV	33.92	36.79	9.14	39.29	4.01	2.39	46.96	53.90	6.9	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.95 m / 3.0 m) = 2.39 dB

13 GHz - 26.5 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	70.03	27.86	14.74	39.46	2.39	75.56	-	-	Carrier
Hori.	2400.000	PK	38.11	27.86	14.74	39.46	2.39	43.64	55.56	11.9	
Vert.	2402.000	PK	70.00	27.86	14.74	39.46	2.39	75.53	-	-	Carrier
Vert.	2400.000	PK	37.62	27.86	14.74	39.46	2.39	43.15	55.53	12.3	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.95 m / 3.0 m) = 2.39 dB

13 GHz - 26.5 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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Shonan EMC Lab.

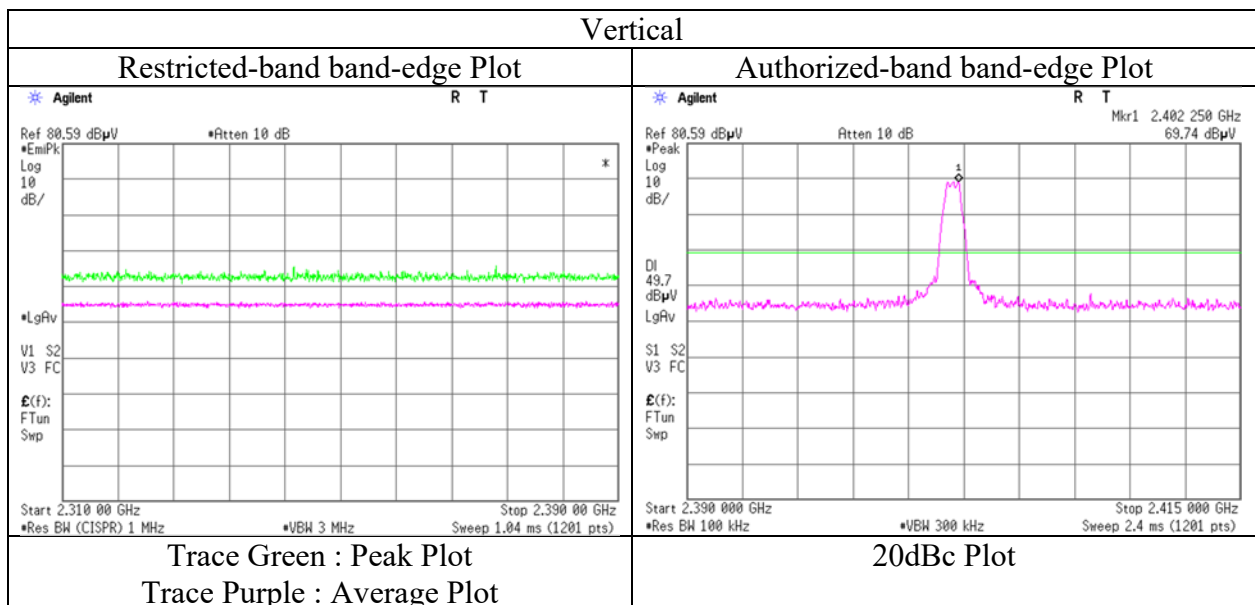
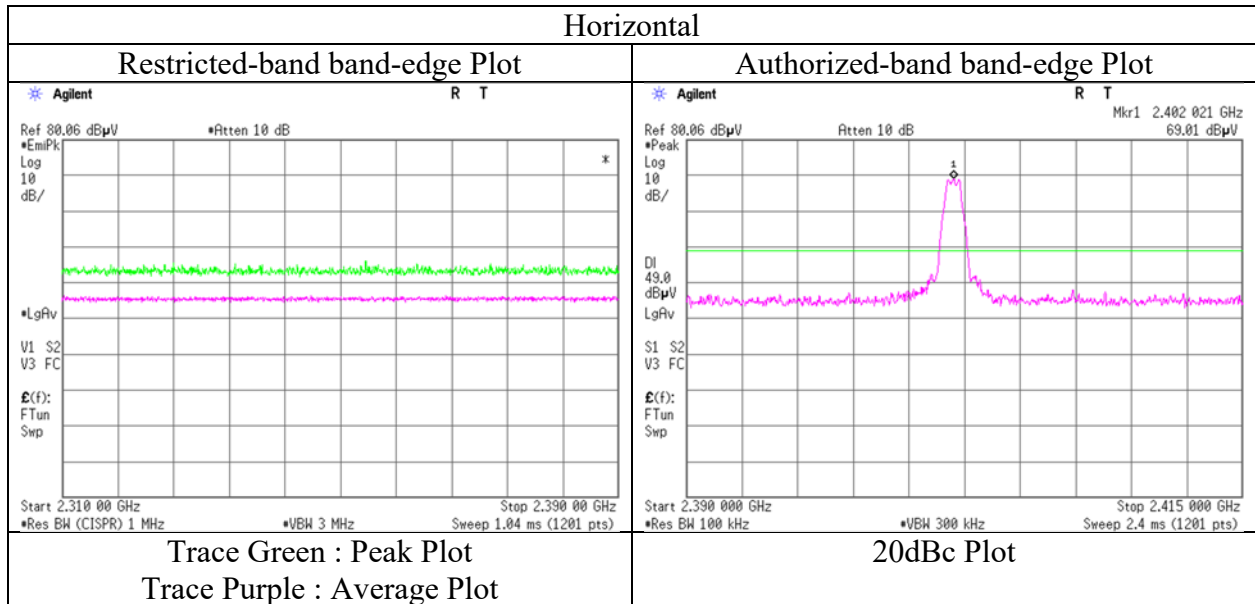
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12562008S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	February 4, 2019
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Makoto Hosaka
	(1 GHz – 26.5 GHz)
Mode	Tx BT LE 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

Radiated Spurious Emission

Report No. 12562008S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date February 5, 2019 February 4, 2019
Temperature / Humidity 23 deg. C / 38 % RH 20 deg. C / 35 % RH
Engineer Makoto Hosaka Makoto Hosaka
(1 GHz – 26.5 GHz) (30 MHz – 1000 MHz)
Mode Tx BT LE 2440 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.00	17.92	6.49	32.20	0.00	14.21	40.00	25.7	132	355	
Hori.	80.000	QP	22.20	6.44	7.56	32.17	0.00	4.03	40.00	35.9	303	28	
Hori.	304.000	QP	21.00	13.76	8.74	32.01	0.00	11.49	46.00	34.5	100	316	
Hori.	416.000	QP	20.70	16.13	9.31	31.98	0.00	14.16	46.00	31.8	112	1	
Hori.	4880.000	PK	44.97	31.37	7.34	39.50	2.39	46.57	73.90	27.3	150	0	
Hori.	7320.000	PK	43.33	37.00	9.14	39.35	2.39	52.51	73.90	21.3	150	0	
Vert.	48.000	QP	21.30	11.93	6.77	32.19	0.00	7.81	40.00	32.1	100	3	
Vert.	112.000	QP	21.40	12.17	7.24	32.15	0.00	8.66	43.50	34.8	100	144	
Vert.	160.000	QP	21.80	15.05	7.87	32.11	0.00	12.61	43.50	30.8	100	311	
Vert.	208.000	QP	20.90	11.28	8.09	32.06	0.00	8.21	43.50	35.2	100	268	
Vert.	352.000	QP	21.00	15.14	9.04	31.95	0.00	13.23	46.00	32.7	100	146	
Vert.	368.000	QP	20.80	15.14	9.11	31.96	0.00	13.09	46.00	32.9	100	358	
Vert.	400.000	QP	20.90	15.86	9.25	31.98	0.00	14.03	46.00	31.9	100	13	
Vert.	4880.000	PK	45.03	31.37	7.34	39.50	2.39	46.63	73.90	27.2	150	0	
Vert.	7320.000	PK	43.23	37.00	9.14	39.35	2.39	52.41	73.90	21.4	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

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	36.02	31.37	7.34	39.50	4.01	2.39	41.63	53.90	12.2	
Hori.	7320.000	AV	34.32	37.00	9.14	39.35	4.01	2.39	47.51	53.90	6.3	
Vert.	4880.000	AV	35.78	31.37	7.34	39.50	4.01	2.39	41.39	53.90	12.5	
Vert.	7320.000	AV	34.32	37.00	9.14	39.35	4.01	2.39	47.51	53.90	6.3	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

13 GHz - 26.5GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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

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Radiated Spurious Emission

Report No. 12562008S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date February 5, 2019 February 4, 2019
Temperature / Humidity 23 deg. C / 38 % RH 20 deg. C / 35 % RH
Engineer Makoto Hosaka Makoto Hosaka
(1 GHz – 26.5 GHz) (30 MHz – 1000 MHz)
Mode Tx BT LE 2480 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	64.000	QP	21.80	7.46	6.48	32.18	0.00	3.56	40.00	36.4	132	183	
Hori.	96.000	QP	21.30	9.46	7.44	32.16	0.00	6.04	43.50	37.4	287	247	
Hori.	144.000	QP	21.00	14.57	7.68	32.12	0.00	11.13	43.50	32.3	150	358	
Hori.	368.000	QP	20.80	15.14	9.11	31.96	0.00	13.09	46.00	32.9	100	0	
Hori.	416.000	QP	20.80	16.13	9.31	31.98	0.00	14.26	46.00	31.7	100	0	
Hori.	2483.500	PK	46.36	27.65	14.82	39.46	2.39	51.76	73.90	22.1	138	216	
Hori.	4960.000	PK	44.27	31.54	7.39	39.50	2.39	46.09	73.90	27.8	150	0	
Hori.	7440.000	PK	43.82	37.10	9.15	39.42	2.39	53.04	73.90	20.8	150	0	
Vert.	32.000	QP	22.00	17.92	6.49	32.20	0.00	14.21	40.00	25.7	100	358	
Vert.	48.000	QP	21.30	11.93	6.77	32.19	0.00	7.81	40.00	32.1	100	88	
Vert.	128.000	QP	21.70	13.79	7.36	32.14	0.00	10.71	43.50	32.7	100	127	
Vert.	160.000	QP	21.80	15.05	7.87	32.11	0.00	12.61	43.50	30.8	100	355	
Vert.	304.000	QP	21.00	13.76	8.74	32.01	0.00	11.49	46.00	34.5	100	0	
Vert.	352.000	QP	20.00	15.14	9.04	31.95	0.00	12.23	46.00	33.7	100	0	
Vert.	2483.500	PK	49.88	27.65	14.82	39.46	2.39	55.28	73.90	18.6	219	359	
Vert.	4960.000	PK	45.53	31.54	7.39	39.50	2.39	47.35	73.90	26.5	150	0	
Vert.	7440.000	PK	44.35	37.10	9.15	39.42	2.39	53.57	73.90	20.3	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

13 GHz - 26.5 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.	2483.500	AV	36.14	27.65	14.82	39.46	4.01	2.39	45.55	53.90	8.3	*1)
Hori.	4960.000	AV	36.00	31.54	7.39	39.50	4.01	2.39	41.83	53.90	12.0	
Hori.	7440.000	AV	35.17	37.10	9.15	39.42	4.01	2.39	48.40	53.90	5.5	
Vert.	2483.500	AV	36.24	27.65	14.82	39.46	4.01	2.39	45.65	53.90	8.2	*1)
Vert.	4960.000	AV	35.91	31.54	7.39	39.50	4.01	2.39	41.74	53.90	12.1	
Vert.	7440.000	AV	35.21	37.10	9.15	39.42	4.01	2.39	48.44	53.90	5.4	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

13 GHz - 26.5 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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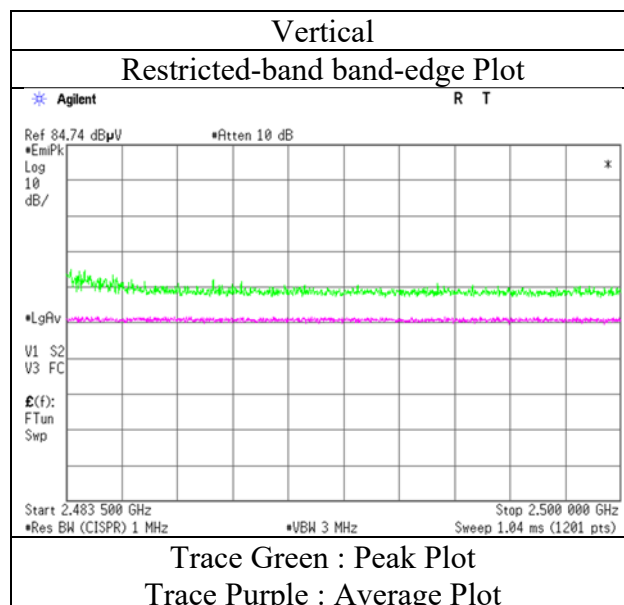
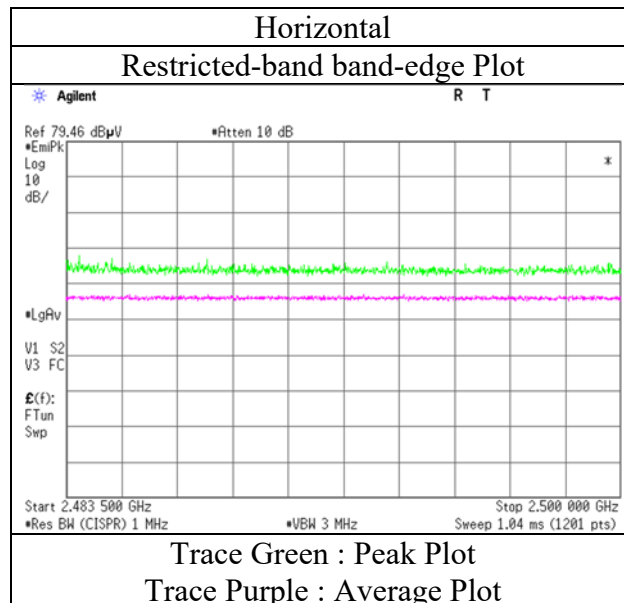
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12562008S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	February 4, 2019
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Makoto Hosaka
	(1 GHz – 26.5 GHz)
Mode	Tx BT LE 2480 MHz

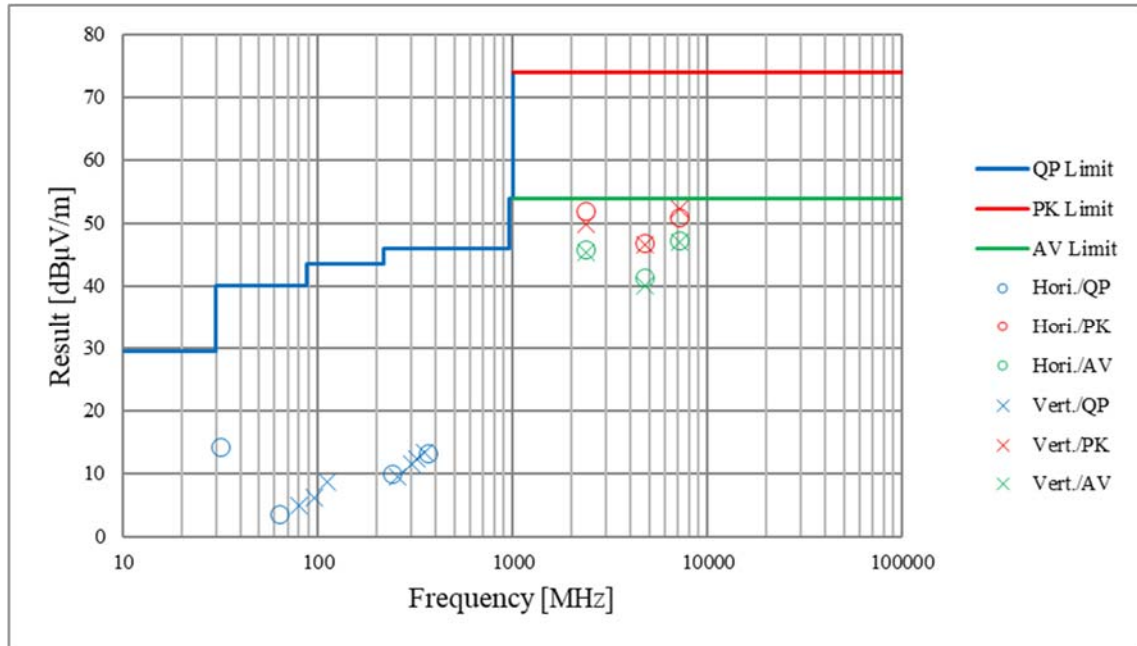


* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

Radiated Spurious Emission
(Plot data, Worst case)

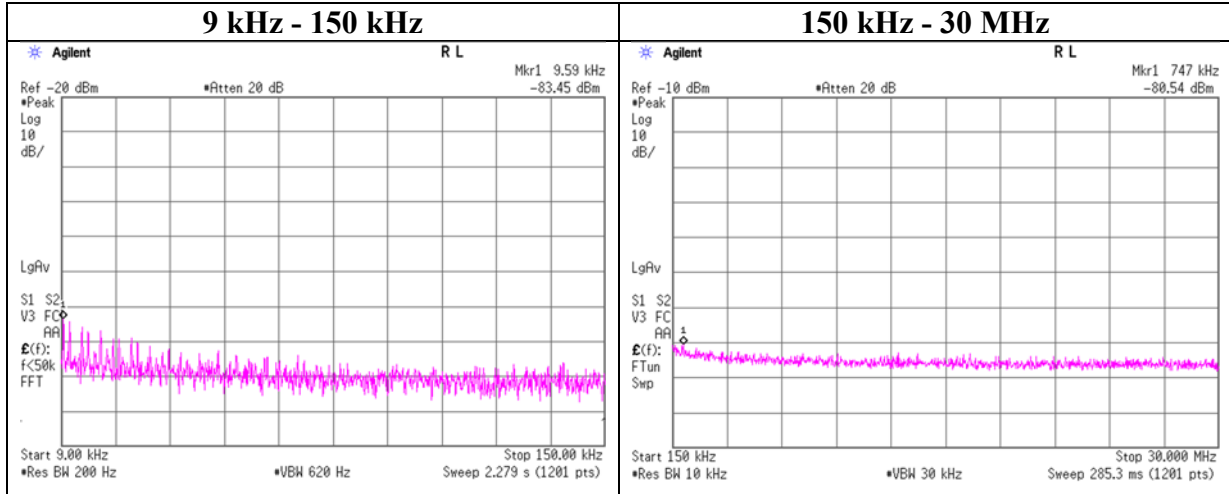
Report No.	12562008S-A-R1	No.3
Test place	Shonan EMC Lab.	No.3
Semi Anechoic Chamber	No.3	No.3
Date	February 5, 2019	February 4, 2019
Temperature / Humidity	23 deg. C / 38 % RH	20 deg. C / 35 % RH
Engineer	Makoto Hosaka (1 GHz – 26.5 GHz)	Makoto Hosaka (30 MHz – 1000 MHz)
Mode	Tx BT LE 2402 MHz	



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

Conducted Spurious Emission

Report No.	12562008S-A-R1
Test place	Shonan EMC Lab. No.2 Shielded Room
Date	January 19, 2019
Temperature / Humidity	22 deg. C / 32 % RH
Engineer	Kazutaka Takeyama
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
9.59	-83.5	0.01	9.7	2.5	1	-71.2	300	6.0	-10.0	47.9	57.9	
747.00	-80.5	0.02	9.7	2.5	1	-68.3	30	6.0	13.0	30.1	17.1	

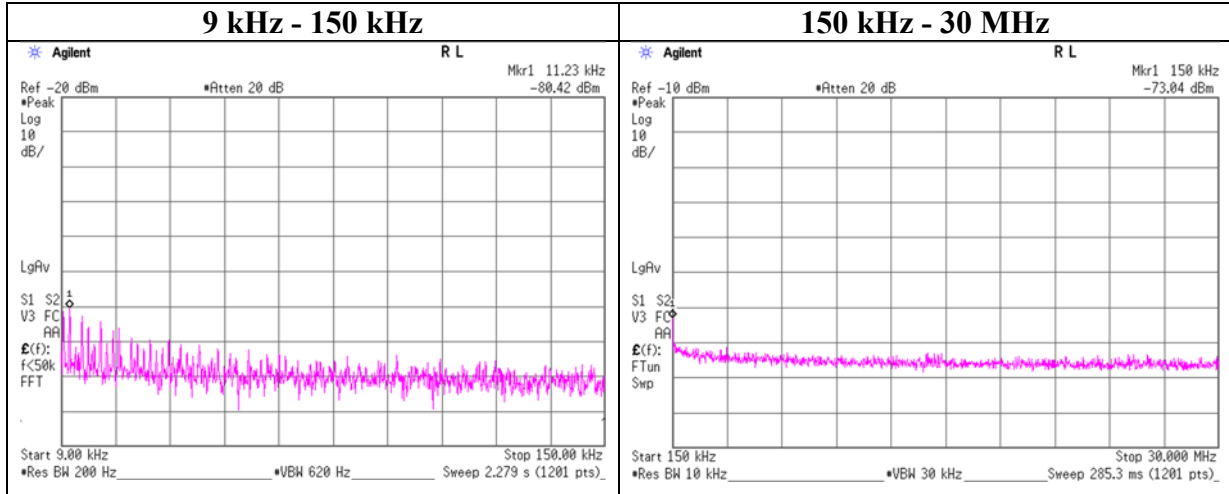
$E [dBuV/m] = EIRP [dBm] - 20 \log (Distance [m]) + Ground\ bounce [dB] + 104.8 [dBuV/m]$

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

N: Number of output

Conducted Spurious Emission

Report No.	12562008S-A-R1
Test place	Shonan EMC Lab. No.2 Shielded Room
Date	January 19, 2019
Temperature / Humidity	22 deg. C / 32 % RH
Engineer	Kazutaka Takeyama
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
11.23	-80.4	0.01	9.7	2.5	1	-68.2	300	6.0	-6.9	46.5	53.4	
150.00	-73.0	0.01	9.7	2.5	1	-60.8	300	6.0	0.5	24.0	23.5	

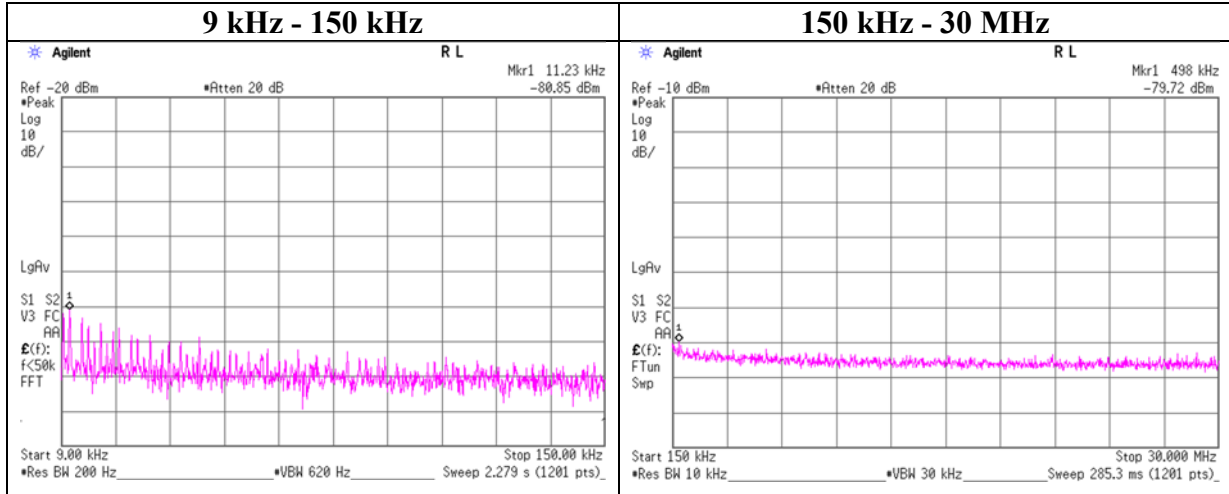
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log(\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Report No.	12562008S-A-R1
Test place	Shonan EMC Lab. No.2 Shielded Room
Date	January 19, 2019
Temperature / Humidity	22 deg. C / 32 % RH
Engineer	Kazutaka Takeyama
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
11.23	-80.9	0.01	9.7	2.5	1	-68.6	300	6.0	-7.4	46.5	53.9	
498.00	-79.7	0.01	9.7	2.5	1	-67.5	30	6.0	13.8	33.6	19.8	

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

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

N: Number of output

Power Density

Report No. 12562008S-A-R1
Test place Shonan EMC Lab. No.2 Shielded Room
Date January 19, 2019
Temperature / Humidity 22 deg. C / 32 % RH
Engineer Kazutaka Takeyama
Mode Tx BT LE

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-26.84	1.27	9.82	-15.75	8.00	23.75
2440	-26.84	1.28	9.82	-15.74	8.00	23.74
2480	-26.98	1.29	9.82	-15.87	8.00	23.87

Sample Calculation:

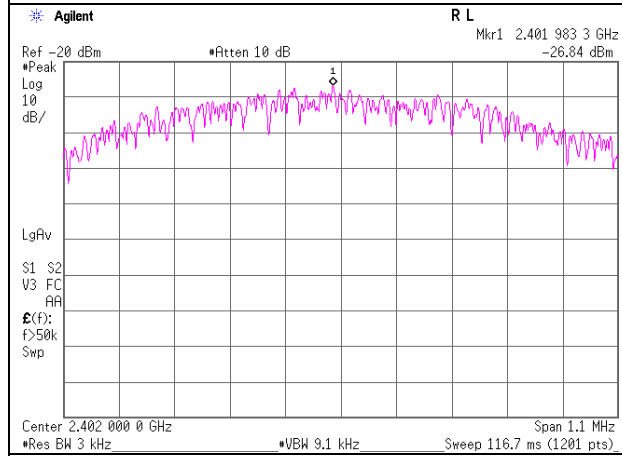
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

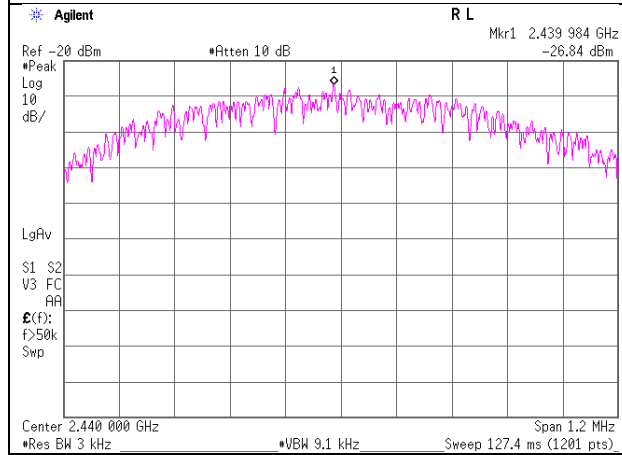
Power Density

BT LE

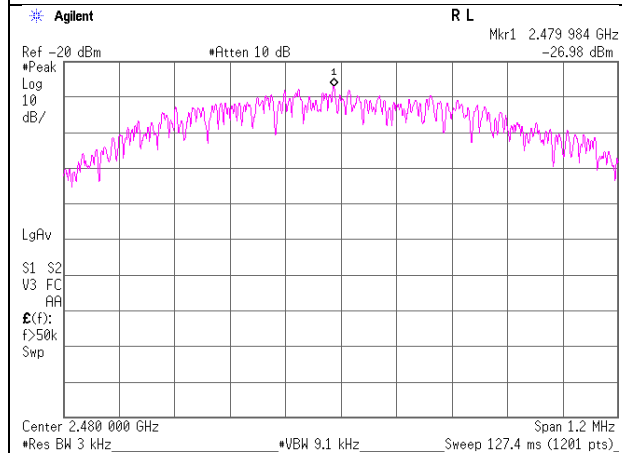
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test Instruments

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SAT10-14	AT	154591	Attenuator	Weinschel Corp.	54A-10	81595	2018/4/20	2019/4/30	12
SCC-G12	AT	145040	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	2018/3/19	2019/3/31	12
SJM-09	AT	145336	Measure	PROMART	SEN1935	-	-	-	-
SOS-04	AT	146292	Humidity Indicator	A&D	AD-5681	4061512	2018/12/5	2019/12/31	12
SPM-07	AT	146247	Power Meter	AGILENT	8990B	MY5100272	2018/7/13	2019/7/31	12
SPSS-04	AT	146310	Power sensor	AGILENT	N1923A	MY5326009	2018/7/13	2019/7/31	12
SSA-02	AT	145800	Spectrum Analyzer	AGILENT	E4448A	MY48250106	2018/3/5	2019/3/31	12
STS-02	AT	145793	Digital Hitester	HIOKI	3805-50	80997819	2018/3/8	2019/3/31	12
COTS-SEMI-5	RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,M E,PE)	-	-	-	-
KJM-02	RE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
KSA-08	RE	145089	Spectrum Analyzer	AGILENT	E4446A	MY46180525	2018/10/7	2019/10/31	12
SAEC-03(NSA)	RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2018/6/2	2019/6/30	12
SAEC-03(SVSWR)	RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2018/7/17	2019/7/31	12
SAF-03	RE	145126	Pre Amplifier	SONOMA	310N	290213	2018/2/16	2019/2/28	12
SAF-04	RE	145127	Pre Amplifier	Toyo Corporation	TPA0118-36	2072554	2018/6/26	2019/6/30	12
SAF-08	RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2018/3/27	2019/3/31	12
SAT10-06	RE	145137	Attenuator	AGILENT	8493C-010	74865	2018/11/25	2019/11/30	12
SAT6-13	RE	167094	Attenuator	JFW	50HF-006N	-	2018/2/9	2019/2/28	12
SBA-03	RE	145023	Biconical Antenna	Schwarzbeck	BBA9106	91032666	2018/6/17	2019/6/30	12
SCC-C1/C2/C3/C4/C5/C10/S RSE-03	RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141P E/141PE/141P	-/0901-271(RF Selector)	2018/4/9	2019/4/30	12
SCC-G05	RE	145039	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-037	2019/1/25	2020/1/31	12
SCC-G22	RE	145180	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	2018/5/11	2019/5/31	12
SCC-G33	RE	145184	Coaxial Cable	Junkosha	MWX241-01000KMSK MS	-	2018/4/20	2019/4/30	12
SCC-G40	RE	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNM S/B	1612S005	2019/1/25	2020/1/31	12
SCC-G45	RE	168301	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102 E	800137/2EA	2018/3/28	2019/3/31	12
SFL-02	RE	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2018/11/16	2019/11/30	12
SHA-03	RE	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2018/7/23	2019/7/31	12
SHA-04	RE	145512	Horn Antenna	ETS LINDGREN	Sep-60	LM3640	2018/7/23	2019/7/31	12
SLA-07	RE	145529	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	2018/6/17	2019/6/30	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2018/10/25	2019/10/31	12
STR-08	RE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2018/11/28	2019/11/30	12
STS-03	RE	146210	Digital Hitester	HIOKI	3805-50	80997823	2018/10/16	2019/10/31	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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