



RADIO TEST REPORT

Test Report No. : 12945986S-A-R1

Applicant : CASIO COMPUTER CO., LTD.

Type of Equipment : Watch

Model No. : GBD-H1000

FCC ID : BBQS0LW

Test regulation : FCC Part 15 Subpart C: 2019

Test Result : Complied (Refer to SECTION 3.2)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
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 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 12945986S-A. 12945986S-A is replaced with this report.

Date of test: August 26 to November 18, 2019

Representative test engineer:

T. Yamada

Toshinori Yamada
Engineer
Consumer Technology Division

Approved by:

A. Hayashi

Akio Hayashi
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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REVISION HISTORY

Original Test Report No.: 12945986S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12945986S-A	October 30, 2019	-	-
1	12945986S-A-R1	November 27, 2019	1	Update of Date of test: “August 26 to September 6, 2019” to “August 26 to November 18, 2019”
			5	Correction of Rating: “Typical: DC 3.7 V, Min.: DC 3.5 V, Max.: DC 4.2 V CW3475 (Module) : Typical: DC 3.7 V, Min.: DC 3.5 V, Max.: DC 4.2 V” to “Typical (Battery): DC 3.7 V, Min.: DC 3.5 V, Max.: DC 4.2 V Typical (Charging Terminal): DC 5.0 V, Min.: DC 4.75 V, Max.: DC 5.25 V CW3475 (Module): Typical: DC 3.7 V, Min.: DC 3.5 V, Max.: DC 4.2 V CW3475 (Charging Terminal): DC 5.0 V, Min.: DC 4.75 V, Max.: DC 5.25 V”
				Addition to Receipt Date of Sample: “(No moving, modification or maintenance has been performed during the test.)”
			6	Update of Item Conducted Emission: Worst margin: “-” to “20.1 dB 0.41300 MHz, QP, N Mode: Tx 2440 MHz” Result: “N/A” to “Complied a)” Remarks: “*1)” to “-” Deletion: “1) The test is not applicable since the EUT has no AC mains.”
			9	Addition in 4.1: “The EUT has Charging Terminal and can transmit the radio signal during charging. In the pretest, the data of “with charging (via Charging Terminal)” and “without charging (Battery)” was compared. This report contains the data which has the worse-case.” Update of 4.2: “*1) Supplied voltage: DC 3.9 V has been specified by the customer.” to “*1) For other than Conducted emission, supplied voltage: DC 3.9 V has been specified by the customer. For Conducted emission, DC 5 V has been supplied via Charging Terminal.” “*3) Used for Radiated Emission test” to “*3) Used for Conducted Emission and Radiated Emission test” Addition: “*2) For other than Conducted emission: AC 100 V, 50 Hz, For Conducted emission: AC 120 V, 60 Hz” “Used for Other than Conducted emission” in Remarks of No.1 Update in the figure: Addition of “DC 5V or” Addition of “or 4” Addition of “or AC 120 V, 60 Hz”
			10	Addition of SECTION 5: Conducted Emission
			15-17	Addition of data of Conducted Emission
			34-35	Addition of test equipment used for Conducted Emission
			36	Addition of photographs of Conducted Emission

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Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	MCS	Modulation and Coding Scheme
AC	Alternating Current	MRA	Mutual Recognition Arrangement
AFH	Adaptive Frequency Hopping	N/A	Not Applicable
AM	Amplitude Modulation	NIST	National Institute of Standards and Technology
Amp, AMP	Amplifier	NS	No signal detect.
ANSI	American National Standards Institute	NSA	Normalized Site Attenuation
Ant, ANT	Antenna	NVLAP	National Voluntary Laboratory Accreditation Program
AP	Access Point	OBW	Occupied Band Width
ASK	Amplitude Shift Keying	OFDM	Orthogonal Frequency Division Multiplexing
Atten., ATT	Attenuator	P/M	Power meter
AV	Average	PCB	Printed Circuit Board
BPSK	Binary Phase-Shift Keying	PER	Packet Error Rate
BR	Bluetooth Basic Rate	PHY	Physical Layer
BT	Bluetooth	PK	Peak
BT LE	Bluetooth Low Energy	PN	Pseudo random Noise
BW	BandWidth	PRBS	Pseudo-Random Bit Sequence
Cal Int	Calibration Interval	PSD	Power Spectral Density
CCK	Complementary Code Keying	QAM	Quadrature Amplitude Modulation
Ch., CH	Channel	QP	Quasi-Peak
CISPR	Comite International Special des Perturbations Radioelectriques	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	RBW	Resolution Band Width
DBPSK	Differential BPSK	RDS	Radio Data System
DC	Direct Current	RE	Radio Equipment
D-factor	Distance factor	RF	Radio Frequency
DFS	Dynamic Frequency Selection	RMS	Root Mean Square
DQPSK	Differential QPSK	RSS	Radio Standards Specifications
DSSS	Direct Sequence Spread Spectrum	Rx	Receiving
EDR	Enhanced Data Rate	SA, S/A	Spectrum Analyzer
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	SG	Signal Generator
EMC	ElectroMagnetic Compatibility	SVSWR	Site-Voltage Standing Wave Ratio
EMI	ElectroMagnetic Interference	TR	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
EU	European Union	Vert.	Vertical
EUT	Equipment Under Test	WLAN	Wireless LAN
Fac.	Factor		
FCC	Federal Communications Commission		
FHSS	Frequency Hopping Spread Spectrum		
FM	Frequency Modulation		
Freq.	Frequency		
FSK	Frequency Shift Keying		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		
ILAC	International Laboratory Accreditation Conference		
ISED	Innovation, Science and Economic Development Canada		
ISO	International Organization for Standardization		
JAB	Japan Accreditation Board		
LAN	Local Area Network		
LIMS	Laboratory Information Management System		

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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
 - Operating/Test Mode(s) (Mode(s)) on all the 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.	:	GBD-H1000
Serial No.	:	Refer to SECTION 4.2
Rating	:	Typical (Battery): DC 3.7 V, Min.: DC 3.5 V, Max.: DC 4.2 V Typical (Charging Terminal): DC 5.0 V, Min.: DC 4.75 V, Max.: DC 5.25 V CW3475 (Module): Typical: DC 3.7 V, Min.: DC 3.5 V, Max.: DC 4.2 V CW3475 (Charging Terminal): DC 5.0 V, Min.: DC 4.75 V, Max.: DC 5.25 V
Receipt Date of Sample (Information from test lab.)	:	August 9, 2019 (No moving, modification or maintenance has been performed during the test.)
Country of Mass-production	:	China, Thailand, Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab.

2.2 Product Description

Model: GBD-H1000 (referred to as the EUT in this report) is a Watch.

* GBD-H1000 has alternative name as R027.

Radio Specification

Equipment Type	:	Transceiver
Frequency of Operation	:	2402 MHz – 2480 MHz
Type of Modulation	:	GFSK
Channel spacing	:	2 MHz
Antenna Type	:	Chip (Mono Pole)
Antenna Gain	:	2.5 dBi
Clock frequency (Maximum)	:	32 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 July 19, 2019 and effective August 19, 2019 except 15.258

Title : FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	20.1 dB 0.41300 MHz, QP, N Mode: Tx 2440 MHz	Complied a)	-
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(2) ISED: RSS-247 5.2(a)	See data.	Complied b)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section 15.247(b)(3) ISED: RSS-247 5.4(d)		Complied c)	Conducted
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(e) ISED: RSS-247 5.2(b)		Complied d)	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13	FCC: Section 15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	2.5 dB 9608.00 MHz, AV, Horizontal Mode: Tx 2402 MHz	Complied# e), f)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)

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

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

- a) Refer to APPENDIX 1 (data of Conducted Emission)
b) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
c) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
d) Refer to APPENDIX 1 (data of Power Density)
e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
f) 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.

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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 requirement.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	RSS-Gen 6.7	IC: -	N/A	- a)	Conducted
b) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)					

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 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 $k=2$.

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Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 dB	2.9 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	-
Radiated emission (Measurement distance: 1 m)	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-
	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 %

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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

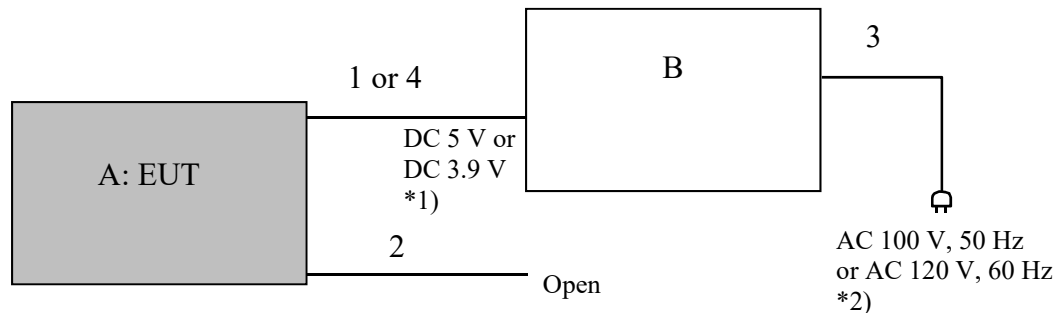
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Transmitting, 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 The EUT has Charging Terminal and can transmit the radio signal during charging. In the pretest, the data of “with charging (via Charging Terminal)” and “without charging (Battery)” was compared. This report contains the data which has the worse-case. *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	GBD-H1000	No.08 *3) No.11 *4)	Casio Computer Co., Ltd.	EUT
B	Power Supply(DC)	PAN35-10A	PAN35-10A	KIKUSUI	-

*1) For other than Conducted emission, supplied voltage: DC 3.9 V has been specified by the customer. For Conducted emission, DC 5 V has been supplied via Charging Terminal.

*2) For other than Conducted emission: AC 100 V, 50 Hz, For Conducted emission: AC 120 V, 60 Hz

*3) Used for Antenna Terminal conducted test

*4) Used for Conducted Emission and Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	0.1 + 2.0	Unshielded	Unshielded	Used for Other than Conducted emission *5)
2	Signal Cable	0.1	Unshielded	Unshielded	*6)
3	AC Cable	1.8	Unshielded	Unshielded	-
4	DC Cable	0.65 + 1.5	Unshielded	Unshielded	Used for Conducted emission *5)

*5) Cable for test operation

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

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a shielded room.

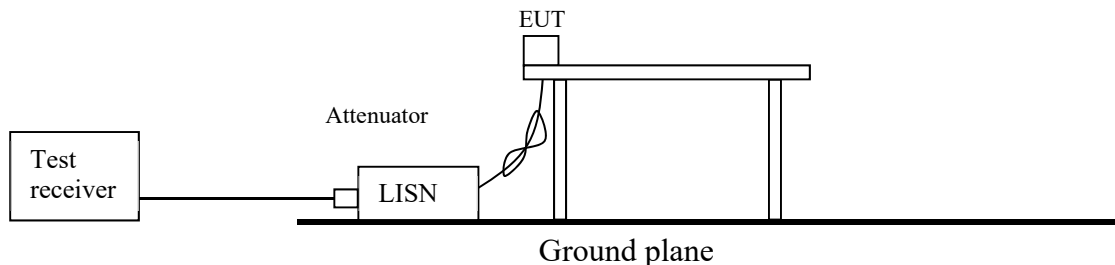
The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

Detector	: QP and CISPR AV
Measurement range	: 0.15 MHz - 30 MHz
Test data	: APPENDIX
Test result	: Pass

Figure 1: Test Setup



SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 1 GHz]

EUT was placed on a platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity.

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

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

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	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	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(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 30 MHz	30 MHz to 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	QP	PK	AV *1)	PK
IF Bandwidth	BW 200 Hz (9 kHz-150 kHz) 10 kHz (150 kHz-30 MHz)	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.

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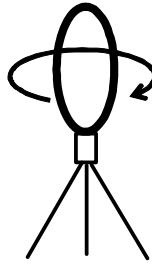
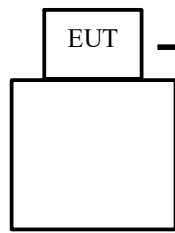
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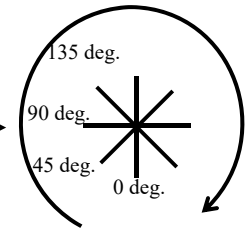
Figure 1: Direction of the Loop Antenna

Side View (Vertical)



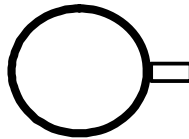
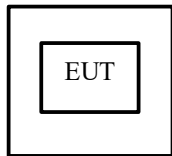
Front side: 0 deg.
Forward direction: clockwise

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

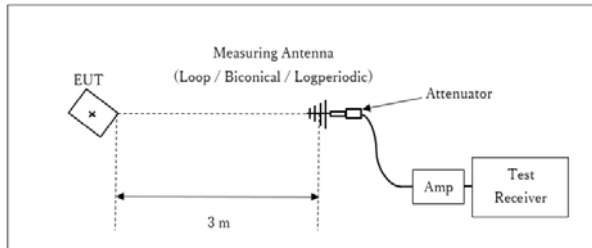
Top View (Horizontal)



Antenna was not rotated.

Figure 2: Test Setup

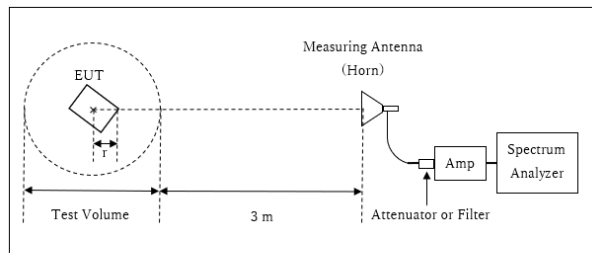
Below 1 GHz



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

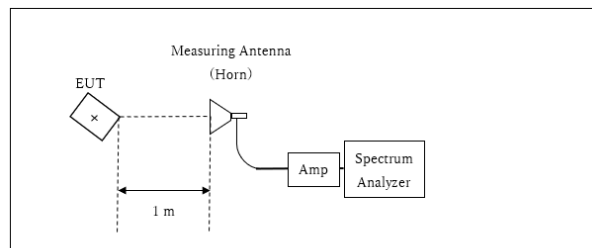
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.96 \text{ m}$

Test Volume : 2.0 m

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

$r = 0.04 \text{ m}$

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 30 MHz)	Spurious (30 MHz to 1 GHz)	Spurious (1 GHz -13 GHz)	Spurious (13 GHz -26.5 GHz)
Horizontal	X	X	Z	X	X
Vertical	Y	X	Z	Z	X

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

Measurement range : 9 kHz - 26.5 GHz

Test data : APPENDIX

Test result : Pass

UL Japan, Inc.

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SECTION 7: 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)
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 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 and the noise was detected as shown in the chart, and therefore, Radiated Emission below 30MHz was performed.							

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

Conducted Emission

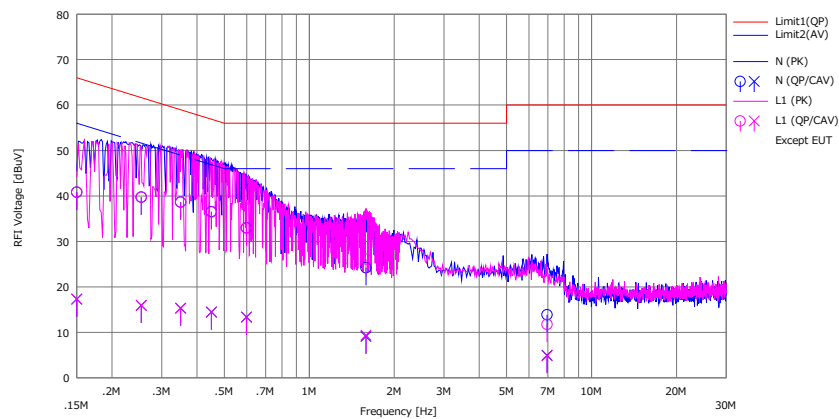
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2019/11/18

Mode : Tx, BT LE, 2402 MHz
Power : (AC 120 V / 60 Hz)DC 5.0 V
Temp./Humi. : 25 deg.C / 40 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Takahiro Kawakami



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		[dBP]	[dBAV]		[dBP]	[dBAV]	[dBP]	[dBAV]	[dBP]	[dBAV]		
1	0.15000	28.40	4.90	12.43	40.83	17.33	66.00	56.00	25.1	38.6	N	
2	0.25400	27.30	3.50	12.43	39.73	15.93	61.63	51.63	21.9	35.7	N	
3	0.35000	26.20	2.90	12.44	38.64	15.34	58.96	48.96	20.3	33.6	N	
4	0.45000	24.10	2.00	12.46	36.56	14.46	56.88	46.88	20.3	32.4	N	
5	0.59900	20.50	0.90	12.47	32.97	13.37	56.00	46.00	23.0	32.6	N	
6	1.58800	11.70	-3.40	12.51	24.21	9.11	56.00	46.00	31.7	36.8	N	
7	6.95546	1.10	-7.80	12.78	13.88	4.98	60.00	50.00	46.1	45.0	N	
8	0.15000	28.40	4.90	12.43	40.83	17.33	66.00	56.00	25.1	38.6	L1	
9	0.25400	27.30	3.50	12.44	39.74	15.94	61.63	51.63	21.8	35.6	L1	
10	0.35000	26.20	2.90	12.44	38.64	15.34	58.96	48.96	20.3	33.6	L1	
11	0.45000	24.00	2.00	12.46	36.46	14.46	56.88	46.88	20.4	32.4	L1	
12	0.59900	20.50	0.90	12.46	32.96	13.36	56.00	46.00	23.0	32.6	L1	
13	1.58800	13.60	-3.10	12.52	26.12	9.42	56.00	46.00	29.8	36.5	L1	
14	6.95500	-1.00	-7.90	12.76	11.76	4.86	60.00	50.00	48.2	45.1	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN) = SLS-05

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Conducted Emission

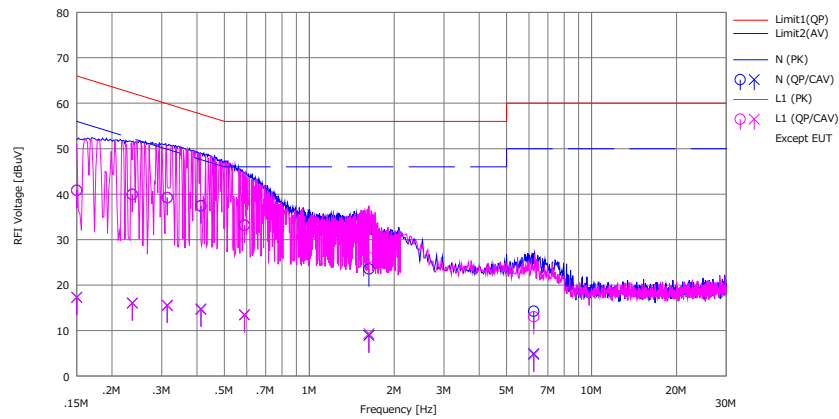
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2019/11/18

Mode : Tx, BT LE, 2440 MHz
Power : (AC 120 V / 60 Hz)DC 5.0 V
Temp./Humi. : 25 deg.C / 40 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Takahiro Kawakami



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		[QP] [dBuV]	[CAV] [dBuV]		[QP] [dBuV]	[CAV] [dBuV]	[QP] [dBuV]	[AV] [dBuV]	[QP] [dB]	[AV] [dB]		
1	0.15000	28.40	4.90	12.43	40.83	17.33	66.00	56.00	25.1	38.6	N	
2	0.23600	27.50	3.60	12.44	39.94	16.04	62.24	52.24	22.3	36.2	N	
3	0.31400	26.80	3.10	12.44	39.24	15.54	59.86	49.86	20.6	34.3	N	
4	0.41300	25.00	2.30	12.45	37.45	14.75	57.59	47.59	20.1	32.8	N	
5	0.58900	20.70	1.00	12.47	33.17	13.47	56.00	46.00	22.8	32.5	N	
6	1.62700	11.00	-3.60	12.53	23.53	8.93	56.00	46.00	32.4	37.0	N	
7	6.24400	1.50	-7.80	12.75	14.25	4.95	60.00	50.00	45.7	45.0	N	
8	0.15000	28.40	4.90	12.43	40.83	17.33	66.00	56.00	25.1	38.6	L1	
9	0.23600	27.50	3.60	12.44	39.94	16.04	62.24	52.24	22.3	36.2	L1	
10	0.31400	26.80	3.10	12.43	39.23	15.53	59.86	49.86	20.6	34.3	L1	
11	0.41300	24.90	2.20	12.44	37.34	14.64	57.59	47.59	20.2	32.9	L1	
12	0.58900	20.70	1.00	12.46	33.16	13.46	56.00	46.00	22.8	32.5	L1	
13	1.62700	13.50	-3.20	12.53	26.03	9.33	56.00	46.00	29.9	36.6	L1	
14	6.24400	0.30	-8.00	12.73	13.03	4.73	60.00	50.00	46.9	45.2	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN) = SLS-05

Conducted Emission

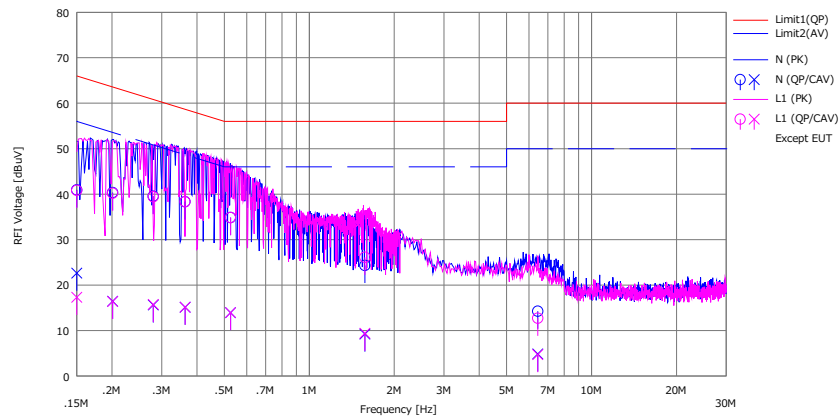
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2019/11/18

Mode : Tx, BT LE, 2480 MHz
Power : (AC 120 V / 60 Hz)DC 5.0 V
Temp./Humi. : 25 deg.C / 40 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Takahiro Kawakami



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		[QP] [dBuV]	[CAV] [dBuV]		[QP] [dBuV]	[CAV] [dBuV]	[QP] [dBuV]	[AV] [dBuV]	[QP] [dB]	[AV] [dB]		
1	0.15000	28.50	10.20	12.43	40.93	22.63	66.00	56.00	25.0	33.3	N	
2	0.20100	27.90	4.00	12.44	40.34	16.44	63.57	53.57	23.2	37.1	N	
3	0.28000	27.10	3.20	12.44	39.54	15.64	60.82	50.82	21.2	35.1	N	
4	0.36300	25.90	2.70	12.44	38.34	15.14	58.66	48.66	20.3	33.5	N	
5	0.52600	22.40	1.50	12.46	34.86	13.96	56.00	46.00	21.1	32.0	N	
6	1.57400	11.80	-3.30	12.51	24.31	9.21	56.00	46.00	31.6	36.7	N	
7	6.44800	1.50	-7.90	12.75	14.25	4.85	60.00	50.00	45.7	45.1	N	
8	0.15000	28.40	4.90	12.43	40.83	17.33	66.00	56.00	25.1	38.6	L1	
9	0.20100	27.80	4.00	12.42	40.22	16.42	63.57	53.57	23.3	37.1	L1	
10	0.28000	27.00	3.30	12.43	39.43	15.73	60.82	50.82	21.3	35.0	L1	
11	0.36300	25.90	2.70	12.44	38.34	15.14	58.66	48.66	20.3	33.5	L1	
12	0.52600	22.40	1.50	12.46	34.86	13.96	56.00	46.00	21.1	32.0	L1	
13	1.57400	13.60	-3.10	12.52	26.12	9.42	56.00	46.00	29.8	36.5	L1	
14	6.44800	0.00	-8.00	12.73	12.73	4.73	60.00	50.00	47.2	45.2	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN) = SLS-05

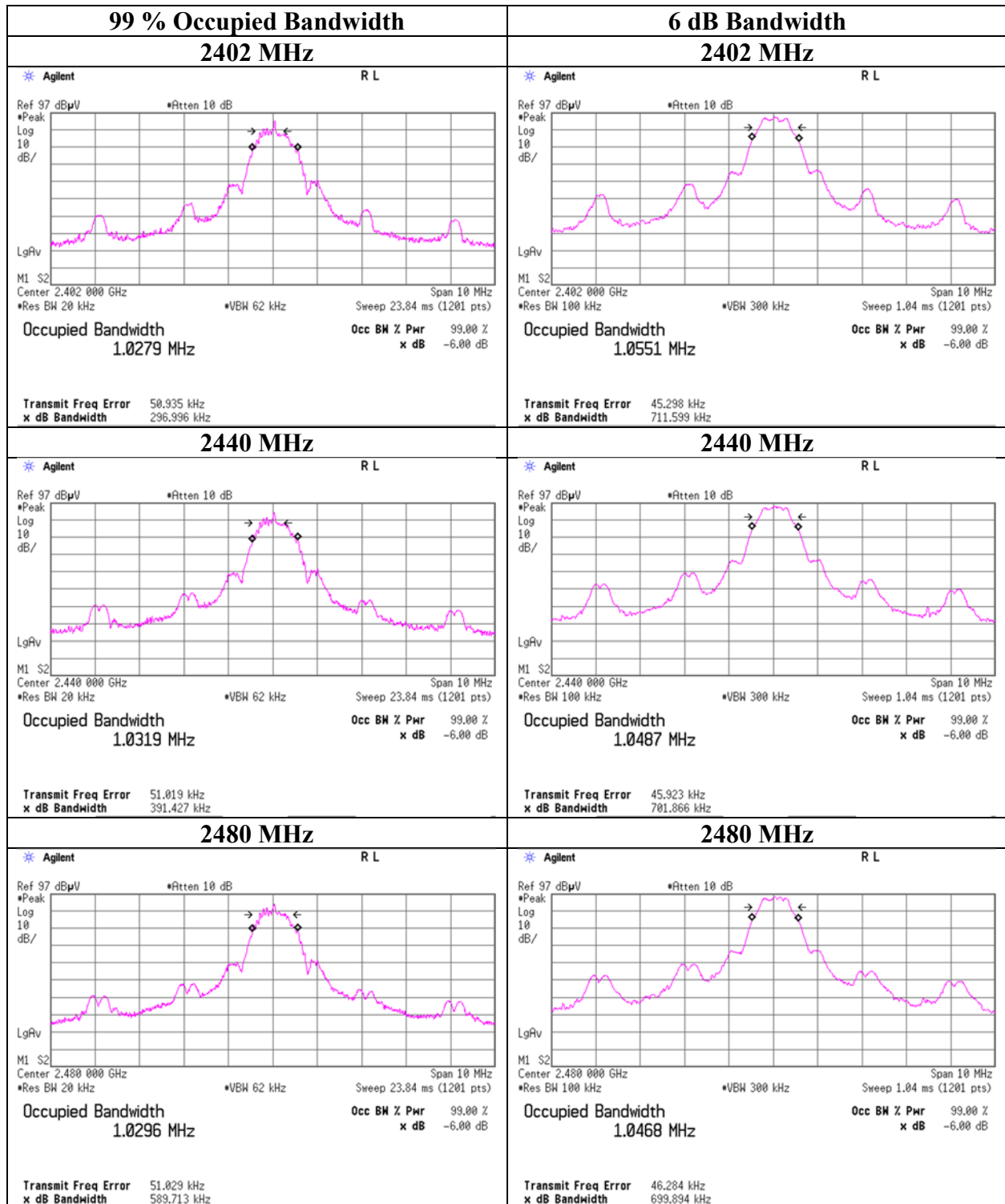
6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12945986S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 26, 2019
Temperature / Humidity 24 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BT LE	2402	1027.9	0.712	> 0.5000
	2440	1031.9	0.702	> 0.5000
	2480	1029.6	0.700	> 0.5000

6 dB Bandwidth and 99 % Occupied Bandwidth

BT LE



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Maximum Peak Output Power

Report No. 12945986S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 26, 2019
Temperature / Humidity 24 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE

BT LE				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-12.15	1.23	9.89	-1.03	0.79	30.00	1000	31.03	2.50	1.47	1.40	36.02	4000	34.55
2440	-11.87	1.24	9.89	-0.74	0.84	30.00	1000	30.74	2.50	1.76	1.50	36.02	4000	34.26
2480	-11.70	1.25	9.89	-0.56	0.88	30.00	1000	30.56	2.50	1.94	1.56	36.02	4000	34.08

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.

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Average Output Power
(Reference data for RF Exposure)

Report No. 12945986S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 26, 2019
Temperature / Humidity 24 deg. C / 46 % RH
Engineer Toshinori Yamada
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	-14.49	1.23	9.89	-3.37	0.46	1.49	-1.88	0.65
2440	-14.13	1.24	9.89	-3.00	0.50	1.49	-1.51	0.71
2480	-13.93	1.25	9.89	-2.79	0.53	1.49	-1.30	0.74

Sample Calculation:

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

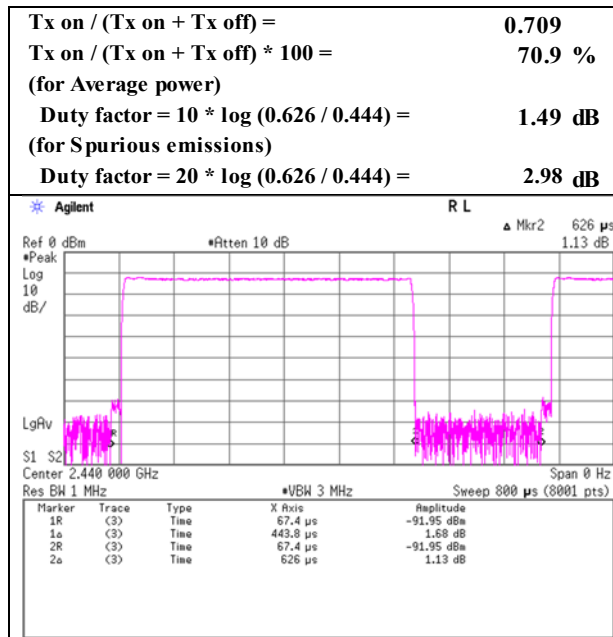
Result (Burst power average) = Time average + Duty factor

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

Burst rate confirmation

Report No.	12945986S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 26, 2019
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Toshinori Yamada
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.	12945986S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	September 6, 2019	September 1, 2019
Temperature / Humidity	24 deg. C / 45 % RH	26 deg. C / 67 % RH
Engineer	Toshinori Yamada	Toshinori Yamada
	(9 kHz - 1000 MHz)	(1 GHz - 26.5 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.	42.929	QP	22.70	13.59	7.34	31.84	0.00	11.79	40.00	28.2	169	110	
Hori.	815.488	QP	21.30	20.89	9.51	31.72	0.00	19.98	46.00	26.0	100	72	
Hori.	905.194	QP	21.20	22.09	9.87	31.31	0.00	21.85	46.00	24.1	127	109	
Hori.	908.901	QP	20.90	22.10	9.88	31.27	0.00	21.61	46.00	24.3	159	46	
Hori.	2390.000	PK	45.29	28.51	13.78	38.68	2.42	51.32	73.90	22.5	144	11	
Hori.	4804.000	PK	47.04	31.71	6.40	38.55	2.42	49.02	73.90	24.8	111	275	
Hori.	7206.000	PK	45.47	37.30	7.92	39.15	2.42	53.96	73.90	19.9	150	0	
Hori.	9608.000	PK	46.60	38.78	9.24	39.74	2.42	57.30	73.90	16.6	150	0	
Vert.	38.808	QP	21.80	15.19	7.23	31.84	0.00	12.38	40.00	27.6	100	310	
Vert.	876.140	QP	21.20	22.05	9.76	31.46	0.00	21.55	46.00	24.4	100	170	
Vert.	934.499	QP	20.50	21.98	9.98	31.05	0.00	21.41	46.00	24.5	100	66	
Vert.	2390.000	PK	45.24	28.51	13.78	38.68	2.42	51.27	73.90	22.6	191	352	
Vert.	4804.000	PK	47.21	31.71	6.40	38.55	2.42	49.19	73.90	24.7	203	270	
Vert.	7206.000	PK	45.42	37.30	7.92	39.15	2.42	53.91	73.90	19.9	150	0	
Vert.	9608.000	PK	46.39	38.78	9.24	39.74	2.42	57.09	73.90	16.8	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(3.96 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	35.80	28.51	13.78	38.68	2.98	2.42	44.81	53.90	9.0	*1)
Hori.	4804.000	AV	38.68	31.71	6.40	38.55	2.98	2.42	43.64	53.90	10.2	
Hori.	7206.000	AV	36.23	37.30	7.92	39.15	2.98	2.42	47.70	53.90	6.2	
Hori.	9608.000	AV	37.65	38.78	9.24	39.74	2.98	2.42	51.33	53.90	2.5	
Vert.	2390.000	AV	35.46	28.51	13.78	38.68	2.98	2.42	44.47	53.90	9.4	*1)
Vert.	4804.000	AV	38.87	31.71	6.40	38.55	2.98	2.42	43.83	53.90	10.0	
Vert.	7206.000	AV	36.20	37.30	7.92	39.15	2.98	2.42	47.67	53.90	6.2	
Vert.	9608.000	AV	37.39	38.78	9.24	39.74	2.98	2.42	51.07	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	80.86	28.48	13.79	38.67	2.42	86.88	-	-	
Hori.	2400.000	PK	41.55	28.48	13.79	38.67	2.42	47.57	66.88	19.3	
Vert.	2402.000	PK	79.31	28.48	13.79	38.67	2.42	85.33	-	-	
Vert.	2400.000	PK	40.27	28.48	13.79	38.67	2.42	46.29	65.33	19.0	

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

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

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

* No noise was detected at 9 kHz to 30 MHz.

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Shonan EMC Lab.

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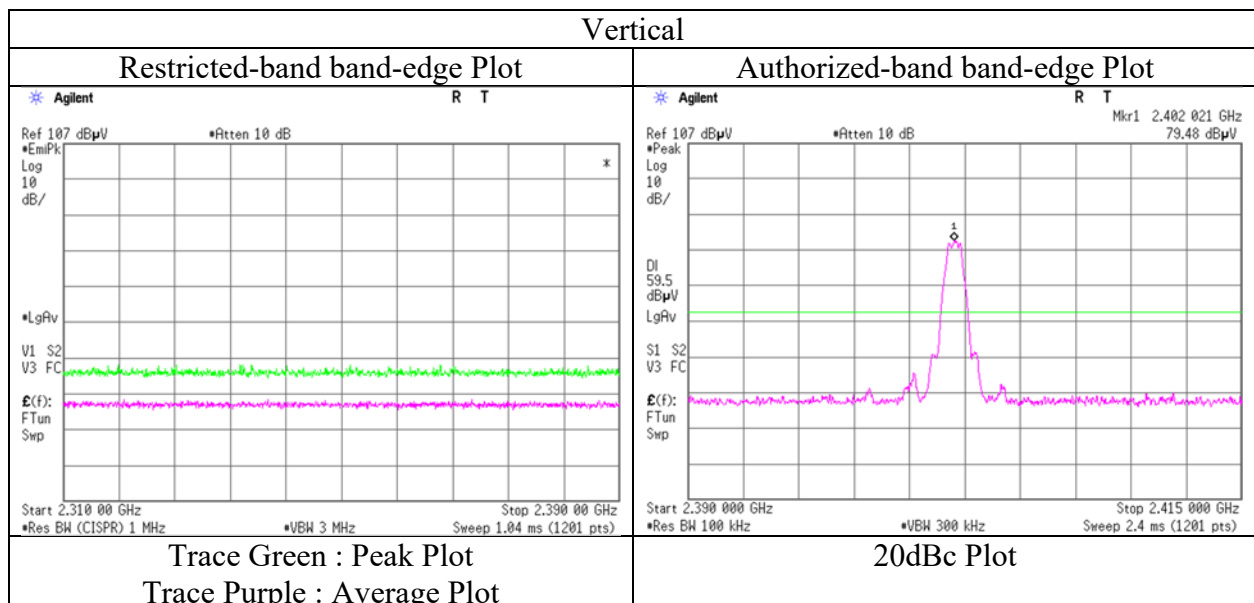
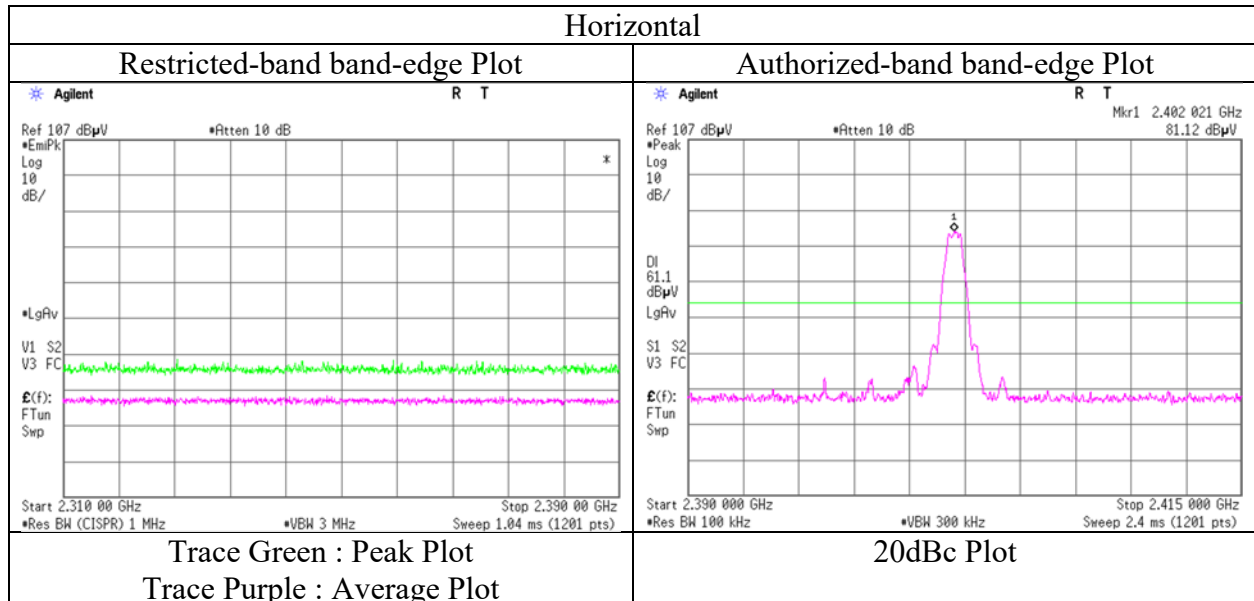
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Radiated Spurious Emission

(Reference Plot for band-edge)

Report No.	12945986S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.2
Date	September 1, 2019
Temperature / Humidity	26 deg. C / 67 % RH
Engineer	Toshinori Yamada
	(1 GHz – 2.8 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.

UL Japan, Inc.

Shonan EMC Lab.

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Radiated Spurious Emission

Report No.	12945986S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	September 6, 2019	September 1, 2019
Temperature / Humidity	24 deg. C / 45 % RH	26 deg. C / 67 % RH
Engineer	Toshinori Yamada	Toshinori Yamada
	(9 kHz - 1000 MHz)	(1 GHz - 26.5 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.	178.166	QP	21.50	16.20	9.12	31.79	0.00	15.03	43.50	28.4	158	280	
Hori.	866.307	QP	21.00	21.89	9.73	31.50	0.00	21.12	46.00	24.8	100	199	
Hori.	881.233	QP	21.20	22.10	9.78	31.44	0.00	21.64	46.00	24.3	100	230	
Hori.	4880.000	PK	47.17	31.74	6.45	38.55	2.42	49.23	73.90	24.6	272	54	
Hori.	7320.000	PK	44.71	37.42	8.03	39.33	2.42	53.25	73.90	20.6	150	0	
Hori.	9760.000	PK	45.72	39.36	9.25	39.63	2.42	57.12	73.90	16.7	150	0	
Vert.	167.275	QP	21.30	15.73	9.10	31.79	0.00	14.34	43.50	29.1	100	211	
Vert.	892.600	QP	20.90	22.10	9.82	31.38	0.00	21.44	46.00	24.5	100	215	
Vert.	902.002	QP	21.10	22.10	9.86	31.33	0.00	21.73	46.00	24.2	100	2	
Vert.	961.810	QP	20.40	22.10	10.10	30.84	0.00	21.76	53.90	32.1	100	343	
Vert.	4880.000	PK	47.63	31.74	6.45	38.55	2.42	49.69	73.90	24.2	202	218	
Vert.	7320.000	PK	44.44	37.42	8.03	39.33	2.42	52.98	73.90	20.9	150	0	
Vert.	9760.000	PK	46.01	39.36	9.25	39.63	2.42	57.41	73.90	16.4	150	0	

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

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

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	38.57	31.74	6.45	38.55	2.98	2.42	43.61	53.90	10.2	
Hori.	7320.000	AV	35.48	37.42	8.03	39.33	2.98	2.42	47.00	53.90	6.9	
Hori.	9760.000	AV	36.23	39.36	9.25	39.63	2.98	2.42	50.61	53.90	3.2	
Vert.	4880.000	AV	38.33	31.74	6.45	38.55	2.98	2.42	43.37	53.90	10.5	
Vert.	7320.000	AV	35.53	37.42	8.03	39.33	2.98	2.42	47.05	53.90	6.8	
Vert.	9760.000	AV	35.83	39.36	9.25	39.63	2.98	2.42	50.21	53.90	3.6	

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.

* No noise was detected at 9 kHz to 30 MHz.

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Radiated Spurious Emission

Report No.	12945986S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	September 6, 2019	September 1, 2019
Temperature / Humidity	24 deg. C / 45 % RH	26 deg. C / 67 % RH
Engineer	Toshinori Yamada	Toshinori Yamada
	(9 kHz - 1000 MHz)	(1 GHz - 26.5 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.	921.312	QP	20.40	22.03	9.93	31.17	0.00	21.19	46.00	24.8	100	344	
Hori.	2483.500	PK	44.94	28.35	13.87	38.62	2.42	50.96	73.90	22.9	110	2	
Hori.	4960.000	PK	47.15	31.99	6.50	38.55	2.42	49.51	73.90	24.3	289	49	
Hori.	7440.000	PK	45.17	37.58	8.12	39.51	2.42	53.78	73.90	20.1	150	0	
Hori.	9920.000	PK	44.66	39.47	9.27	39.51	2.42	56.31	73.90	17.5	150	0	
Vert.	181.788	QP	21.40	16.34	9.13	31.79	0.00	15.08	43.50	28.4	100	259	
Vert.	824.825	QP	21.10	20.98	9.55	31.69	0.00	19.94	46.00	26.0	100	355	
Vert.	861.402	QP	21.10	21.80	9.71	31.53	0.00	21.08	46.00	24.9	100	89	
Vert.	890.003	QP	20.70	22.13	9.81	31.40	0.00	21.24	46.00	24.7	100	114	
Vert.	936.910	QP	20.60	21.96	9.99	31.03	0.00	21.52	46.00	24.4	100	259	
Vert.	2483.500	PK	45.18	28.35	13.87	38.62	2.42	51.20	73.90	22.7	186	345	
Vert.	4960.000	PK	46.76	31.99	6.50	38.55	2.42	49.12	73.90	24.7	162	218	
Vert.	7440.000	PK	44.58	37.58	8.12	39.51	2.42	53.19	73.90	20.7	150	0	
Vert.	9920.000	PK	44.95	39.47	9.27	39.51	2.42	56.60	73.90	17.3	150	0	

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

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

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.	2483.500	AV	35.67	28.35	13.87	38.62	2.98	2.42	44.67	53.90	9.2	*1)
Hori.	4960.000	AV	38.71	31.99	6.50	38.55	2.98	2.42	44.05	53.90	9.8	
Hori.	7440.000	AV	35.47	37.58	8.12	39.51	2.98	2.42	47.06	53.90	6.8	
Hori.	9920.000	AV	35.26	39.47	9.27	39.51	2.98	2.42	49.89	53.90	4.0	
Vert.	2483.500	AV	35.15	28.35	13.87	38.62	2.98	2.42	44.15	53.90	9.7	*1)
Vert.	4960.000	AV	38.26	31.99	6.50	38.55	2.98	2.42	43.60	53.90	10.3	
Vert.	7440.000	AV	35.28	37.58	8.12	39.51	2.98	2.42	46.87	53.90	7.0	
Vert.	9920.000	AV	35.10	39.47	9.27	39.51	2.98	2.42	49.73	53.90	4.1	

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

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

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)

* No noise was detected at 9 kHz to 30 MHz.

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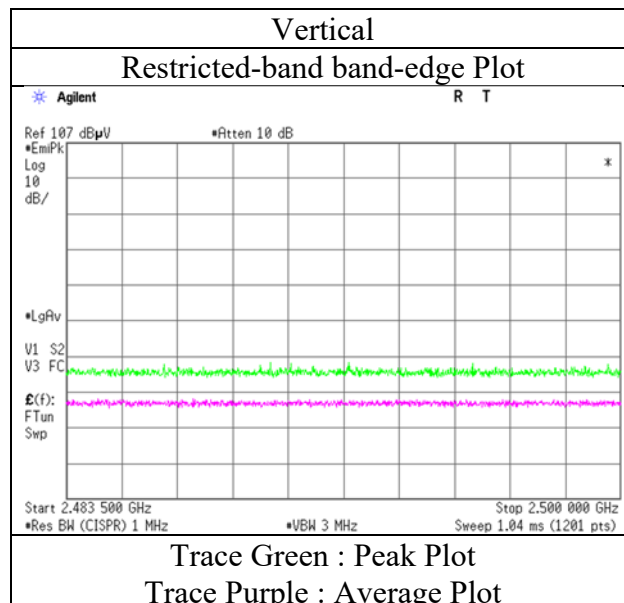
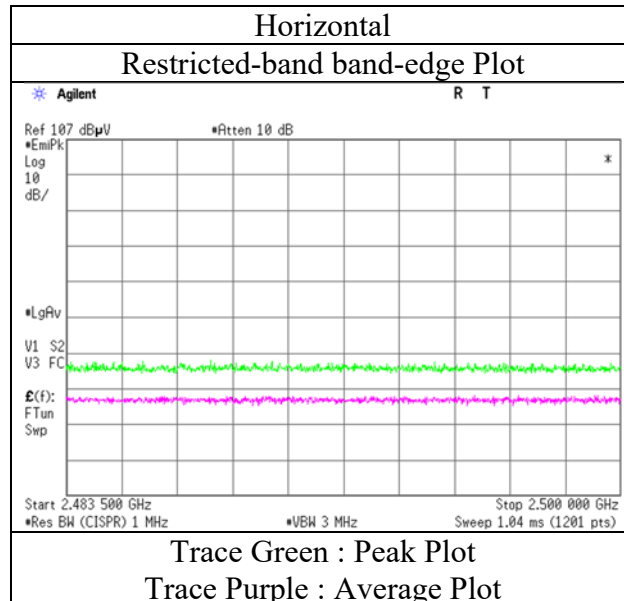
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12945986S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.2
Date	September 1, 2019
Temperature / Humidity	26 deg. C / 67 % RH
Engineer	Toshinori Yamada
	(1 GHz – 2.8 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.

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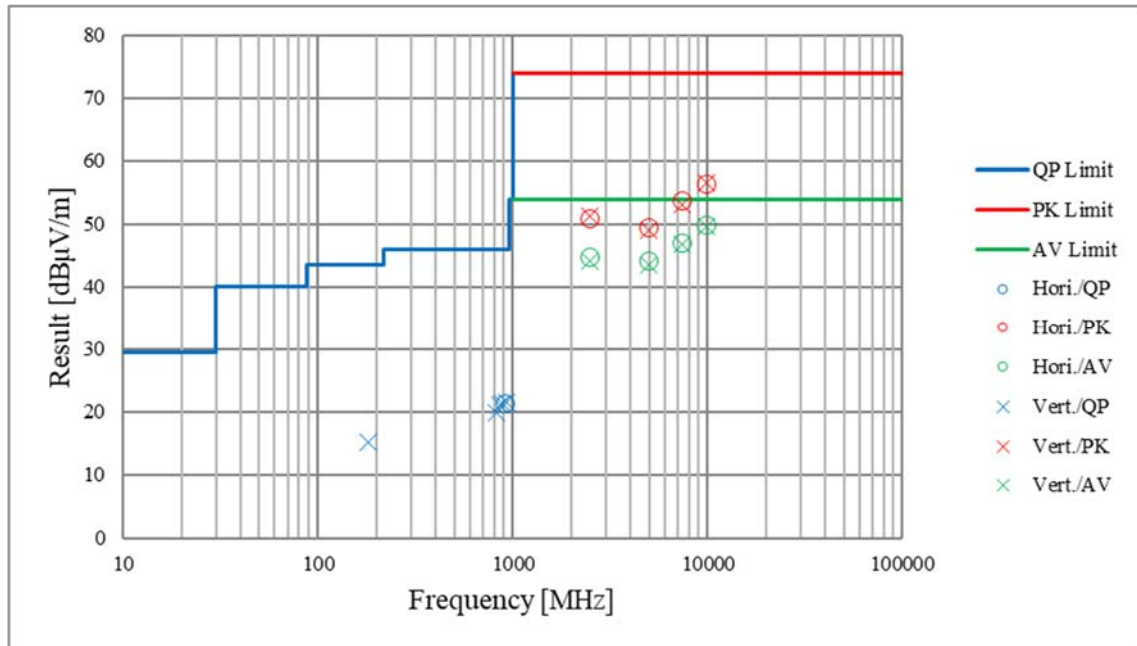
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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

Report No.	12945986S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	September 6, 2019	September 1, 2019
Temperature / Humidity	24 deg. C / 45 % RH	26 deg. C / 67 % RH
Engineer	Toshinori Yamada	Toshinori Yamada
	(9 kHz - 1000 MHz)	(1 GHz - 26.5 GHz)
Mode	Tx BT LE 2480 MHz	

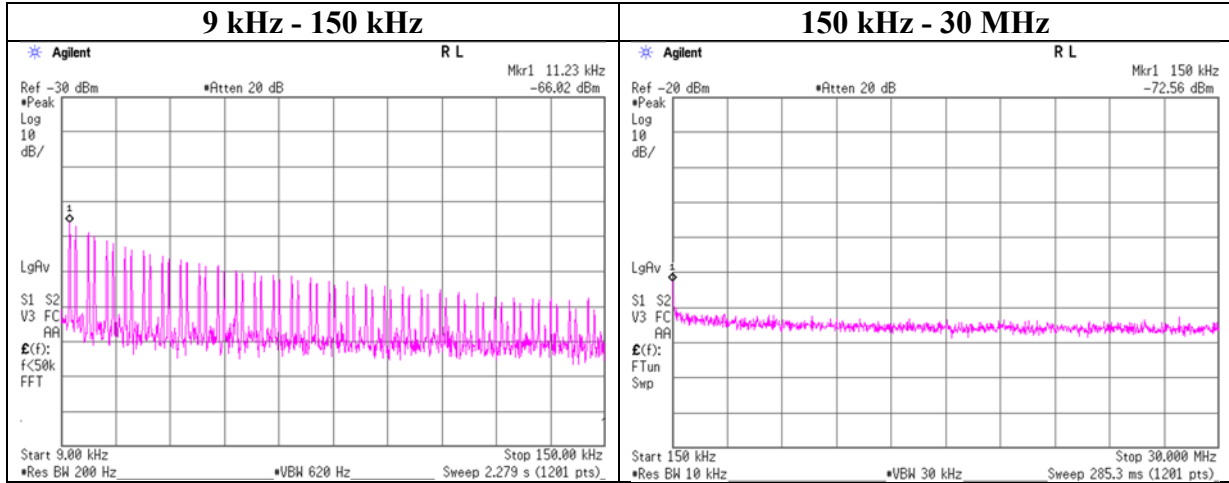


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

* No noise was detected at 9 kHz to 30 MHz.

Conducted Spurious Emission

Report No. 12945986S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 26, 2019
Temperature / Humidity 24 deg. C / 46 % RH
Engineer Toshinori Yamada
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
11.23	-66.0	0.02	9.8	2.5	1	-53.7	300	6.0	7.6	46.5	38.9	
150.00	-72.6	0.02	9.8	2.5	1	-60.2	300	6.0	1.0	24.0	23.0	

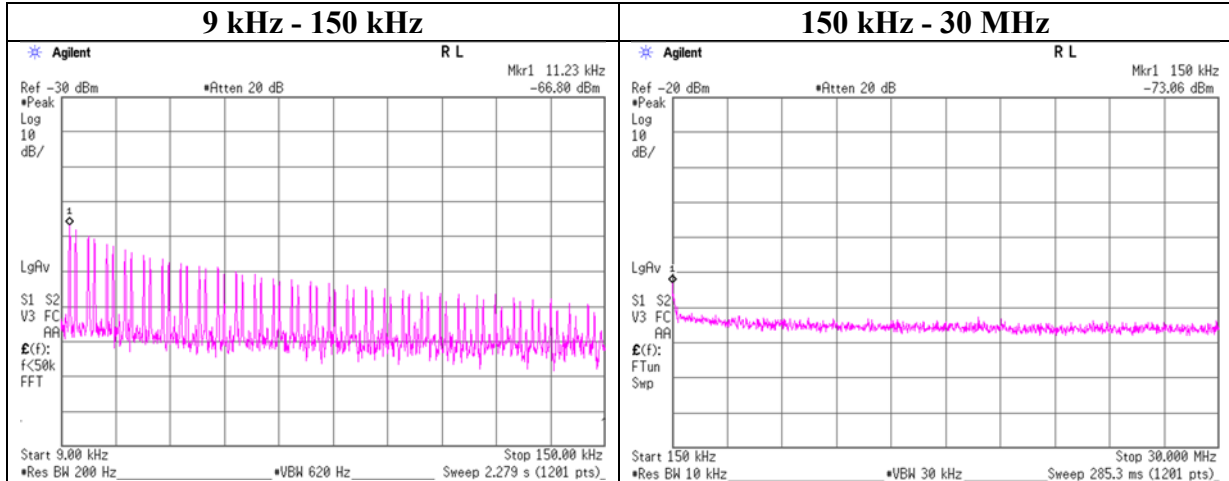
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Report No. 12945986S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 26, 2019
Temperature / Humidity 24 deg. C / 46 % RH
Engineer Toshinori Yamada
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	-66.8	0.02	9.8	2.5	1	-54.5	300	6.0	6.8	46.5	39.7	
150.00	-73.1	0.02	9.8	2.5	1	-60.7	300	6.0	0.5	24.0	23.5	

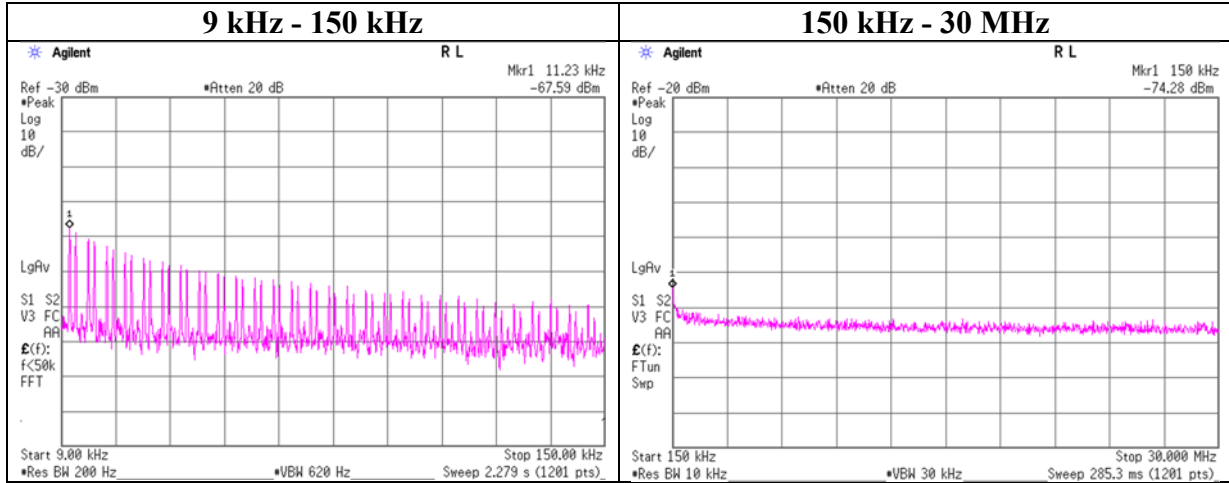
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Report No.	12945986S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 26, 2019
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Toshinori Yamada
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	-67.6	0.02	9.8	2.5	1	-55.3	300	6.0	6.0	46.5	40.5	
150.00	-74.3	0.02	9.8	2.5	1	-62.0	300	6.0	-0.7	24.0	24.7	

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

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

N: Number of output

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Power Density

Report No. 12945986S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 26, 2019
Temperature / Humidity 24 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE

BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402	-26.79	1.23	9.89	-15.67	8.00	23.67
2440	-25.80	1.24	9.89	-14.67	8.00	22.67
2480	-26.26	1.25	9.89	-15.12	8.00	23.12

Sample Calculation:

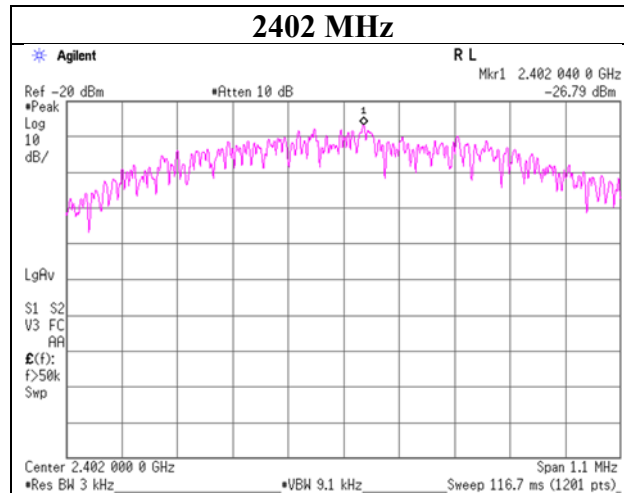
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

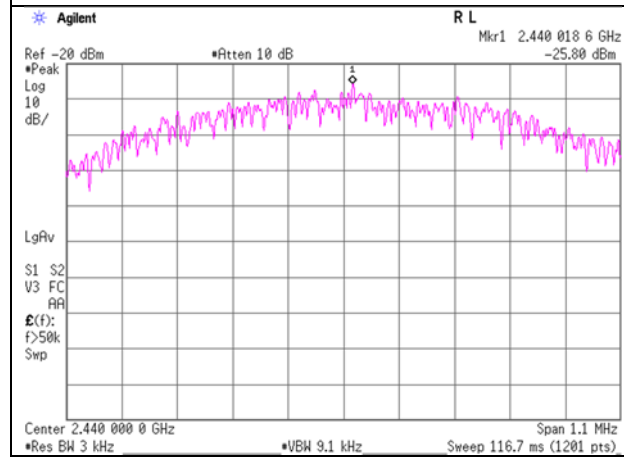
Power Density

BT LE

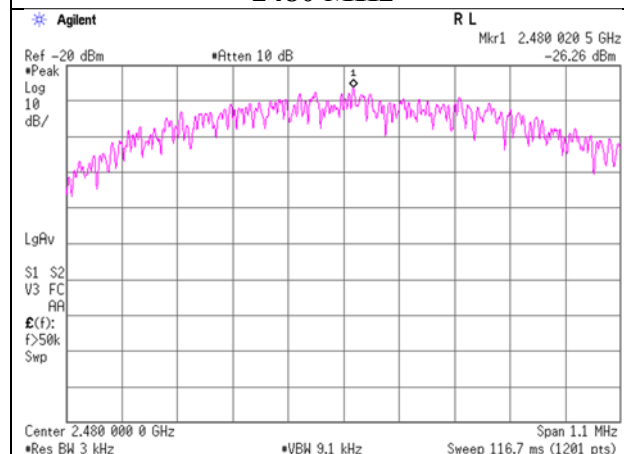
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test Instruments (1/2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SSA-02	AT	145800	Spectrum Analyzer	AGILENT	E4448A	MY48250106	2019/4/4	2020/4/30	12
KTS-07	AT	145111	Digital Tester	SANWA	PC500	7019232	2018/10/17	2019/10/31	12
SAT10-16	AT	160494	Attenuator	Weinschel Corp.	54A-10	83406	2018/12/6	2019/12/30	12
SCC-G31	AT	145042	Coaxial Cable	Junkosha	MWX241-01000KMSK MS	OCT-08-13-046	2019/4/16	2020/4/30	12
SOS-09	AT	146318	Humidity Indicator	A&D	AD-5681	4061484	2018/12/5	2019/12/31	12
SPM-07	AT	146247	Power Meter	AGILENT	8990B	MY5100272	2019/7/16	2020/7/31	12
SPSS-04	AT	146310	Power sensor	AGILENT	N1923A	MY5326009	2019/7/16	2020/7/31	12
SCC-A2/A4/A6/A7/A8/A13/SRSE-01	RE	144968	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-269(RF Selector)	2019/4/19	2020/4/30	12
KAT6-04	RE	144899	Attenuator	Inmet	18N-6dB	-	2018/12/25	2019/12/31	12
SLP-02	RE	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2018/10/10	2019/10/31	12
SOS-01	RE	146316	Humidity Indicator	A&D	AD-5681	4062555	2018/10/25	2019/10/31	12
STS-01	RE	145792	Digital Hitester	HIOKI	3805-50	80997812	2018/10/16	2019/10/31	12
SAF-01	RE	145003	Pre Amplifier	SONOMA	310N	290211	2019/2/5	2020/2/29	12
SAT6-12	RE	145158	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	2019/8/6	2020/8/31	12
SAT3-10	CE	144960	Attenuator	JFW	50HF-003N	-	2019/8/6	2020/8/31	12
SCC-C9/C10/SRSE-03	CE	145036	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-271(RF Selector)	2019/4/19	2020/4/30	12
SLS-05	CE	145542	LISN	Rohde & Schwarz	ENV216	100516	2019/2/19	2020/2/29	12
SOS-06	CE	146294	Humidity Indicator	A&D	AD-5681	4062118	2018/12/5	2019/12/31	12
COTS-SEMI-5	CE,RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-	-
KJM-02	CE,RE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
STR-01	CE,RE	145790	Test Receiver	Rohde & Schwarz	ESU40	100093	2019/4/14	2020/4/30	12
STS-03	CE,RE	146210	Digital Hitester	HIOKI	3805-50	80997823	2019/10/1	2020/10/31	12
SAEC-03(NSA)	RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2019/4/8	2020/4/30	12
SAEC-03(SVSWR)	RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2019/5/3	2020/5/31	12
SAF-03	RE	145126	Pre Amplifier	SONOMA	310N	290213	2019/2/5	2020/2/29	12
SAF-06	RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2019/2/8	2020/2/29	12

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Test Instruments (2/2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SAF-08	RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2019/3/5	2020/3/31	12
SAT10-06	RE	145137	Attenuator	AGILENT	8493C-010	74865	2019/11/6	2020/11/30	12
SAT6-13	RE	167094	Attenuator	JFW	50HF-006N	-	2019/2/5	2020/2/29	12
SBA-03	RE	145023	Biconical Antenna	Schwarzbeck	BBA9106	91032666	2019/5/7	2020/5/31	12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141P	-/0901-271(RF Selector)	2019/4/19	2020/4/30	12
SCC-G15	RE	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2019/3/27	2020/3/31	12
SCC-G43	RE	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104 E	SN MY 13406/4E	2019/7/3	2020/7/31	12
SCC-G57	RE	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2019/5/16	2020/5/31	12
SCC-G58	RE	183047	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800287/4A	2019/7/23	2020/7/31	12
SFL-18	RE	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2019/4/16	2020/4/30	12
SHA-03	RE	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2019/6/26	2020/6/30	12
SHA-04	RE	145512	Horn Antenna	ETS LINDGREN	3160-09	94868	2019/6/26	2020/6/30	12
SLA-07	RE	145529	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	2019/5/7	2020/5/31	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2019/10/8	2020/10/31	12
SSA-03	RE	145801	Spectrum Analyzer	AGILENT	E4448A	MY48250152	2019/8/8	2020/8/31	12

*Hyphens for Last Calibration Date, Calibration Due Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

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: CE: Conducted Emission
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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