



RADIO TEST REPORT

Test Report No. : 13384109S-A-R2

Applicant : ALPS ALPINE CO., LTD.
Type of EUT : WEARABLE EYEWEAR
Model Number of EUT : JINS MEME CORE
FCC ID : CWTCVASW0A
Test regulation : FCC Part 15 Subpart C: 2020
Test Result : Complied (Refer to SECTION 3.2)

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6. This test report covers Radio technical requirements.
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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 13384109S-A-R1. 13384109S-A-R1 is replaced with this report.

Date of test: July 31 to August 21, 2020

Representative test engineer: 
Kenichi Adachi
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Approved by: 
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Engineer
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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.: 13384109S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13384109S-A	September 16, 2020	-	-
1	13384109S-A-R1	September 18, 2020	P.1 and P.5	Modification of "Type of EUT" from JINS MEME CORE to WEARABLE EYEWEAR
			P.1 and P.5	Modification of "Model Number of EUT" from CVASW0A001B to JINS MEME CORE
			P.1	Deletion of "*Bluetooth Low Energy part"
			P.5	Addition of Rating: DC 5 V (USB)
2	13384109S-A-R2	September 24, 2020	P.10	Added configuration and peripherals for Antenna terminal conducted tests.

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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	:	ALPS ALPINE CO., LTD.
Address	:	6-3-36, Nakazato, Furukawa, Osaki-city, Miyagi-pref., JAPAN 989-6181
Telephone Number	:	+81-229-23-5111
Facsimile Number	:	+81-229-23-5129
Contact Person	:	Yuji Ouchi

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, 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 (EUT) other than the Receipt Date
 - SECTION 4: Operation of EUT 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 (EUT)

2.1 Identification of EUT

Type	:	WEARABLE EYEWEAR
Model Number	:	JINS MEME CORE
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 3.7 V (battery) DC 5 V (USB)
Receipt Date	:	July 6, 2020
Country of Mass-production	:	Japan
Condition	:	Production model
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: JINS MEME CORE (referred to as the EUT in this report) is a WEARABLE EYEWEAR.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Antenna type	:	Monopole Antenna
Antenna Gain	:	0.3 dBi max
Clock frequency (Maximum)	:	32 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on June 26, 2020 and effective July 27, 2020

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	AV 25.5 dB, 0.79302 MHz, L1 Mode: Tx, BT LE, 2480 MHz	Complied a)	-
6 dB 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	6.8 dB 9760.000 MHz, AV, Vert. Mode: Tx BT LE 2440 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.

FCC Part 15.31 (e)

The EUT is a battery-operated device and test was performed with the full-charged battery. Therefore, this 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 of Section 15.203.

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % Occupied Bandwidth	ISED: RSS-Gen 6.7	ISED: -	N/A	- b)	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. 4,5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.6 dB	2.5 dB	2.6 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.0 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.0 dB	-
	1 GHz-6 GHz	4.9 dB	4.9 dB	4.9 dB	-
	6 GHz-18 GHz	5.5 dB	5.5 dB	5.5 dB	-
Radiated emission (Measurement distance: 1 m)	18 GHz-40 GHz	5.4 dB	5.4 dB	5.4 dB	-
	1 GHz-18 GHz	5.8 dB	5.8 dB	5.8 dB	-
	18 GHz-40 GHz	5.7 dB	5.7 dB	5.7 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	0.98 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.75 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.12 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.06 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.24 dB
Spurious emission (Conducted) below 1GHz	0.9 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.9 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.9 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.0 dB
Bandwidth Measurement	0.07 %
Duty cycle and Time Measurement	0.262 %
Temperature	0.95 deg.C.
Voltage	0.83 %

3.5 Test Location

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A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973

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 EUT during testing

4.1 Operating Mode(s)

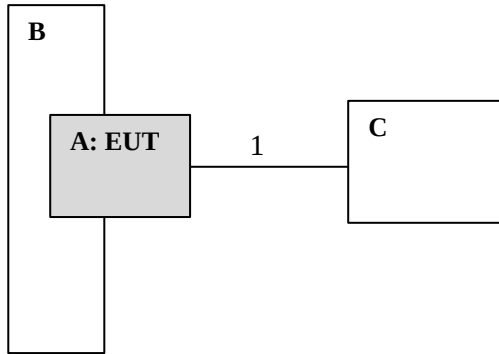
Mode	Remarks*
Bluetooth Low Energy mode (BT LE)	Maximum packet size (255 bytes), PRBS9
*The worst condition was determined based on the test result of Maximum Peak Output Power.	
*Power of the EUT was set by the software as follows; Power settings: 0 dBm Software: nRF Connect, Version 3.4.1 (Date: 2020.7.31., Storage location: Driven by connected PC) *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.	

*The details of Operating mode(s)

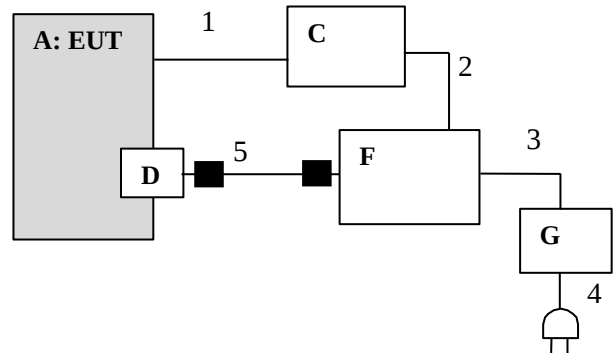
Test Item	Operating Mode	Tested frequency
Conducted Emission	Transmitting (Tx), BT LE	2402 MHz 2440 MHz 2480 MHz
Spurious Emission	Transmitting (Tx), BT LE	2402 MHz 2440 MHz 2480 MHz
6 dB Bandwidth, Maximum Peak Output Power, Power Density, 99 % Occupied Bandwidth	Transmitting (Tx), BT LE	2402 MHz 2440 MHz 2480 MHz

4.2 Configuration and peripherals

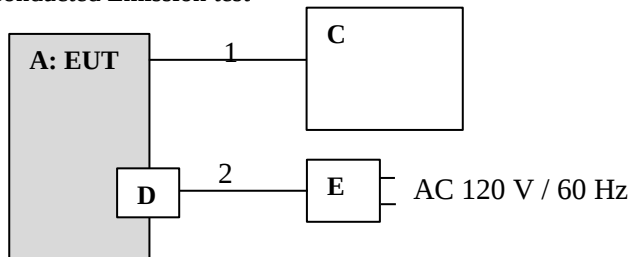
for Radiated Emission test



for Antenna terminal conducted tests



for Conducted Emission test



AC 120 V / 60 Hz

■ : Standard Ferrite Core

* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

*As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 120 V of the worst voltage as representative.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	WEARABLE EYEWEAR	JINS MEME CORE	JMC03 *1) JMC04 *2)	ALPS ALPINE CO., LTD.	EUT
B	Glasses	CNPME	001	JINS	*3)
C	Jig	USB-UART PWB	001	ALPS ALPINE CO., LTD.	-
D	Cradle	CCDME	001	ALPS ALPINE CO., LTD.	-
E	AC Adapter	A1385	E1862497H11 ITE	Apple	-
F	Personal Computer	20LW-0030JP	PF-1PLZHX	Lenovo	*1)
G	AC Adapter	SA10E75844	8SSA10E75844C1 SG94BGN8V	Lenovo	*1)

*1) Used for Antenna Terminal conducted test

*2) Used for Conducted Emission test and Radiated Emission test

*3) Used for Radiated Emission test only.

List of cables used

No.	Cable name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.37	Unshielded	Unshielded	-
2	USB Cable	0.9	Shielded	Shielded	-
3	DC Cable	1.8	Unshielded	Unshielded	*1)
4	AC Cable	0.9	Unshielded	Unshielded	*1)
5	USB Cable	0.9	Shielded	Shielded	*1)

*1) Used for Antenna Terminal conducted test

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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.

1) For the tests on EUT with other peripherals (as a whole system)

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. All unused 50ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT via AC adapter in a Semi Anechoic Chamber / Shielded Room.

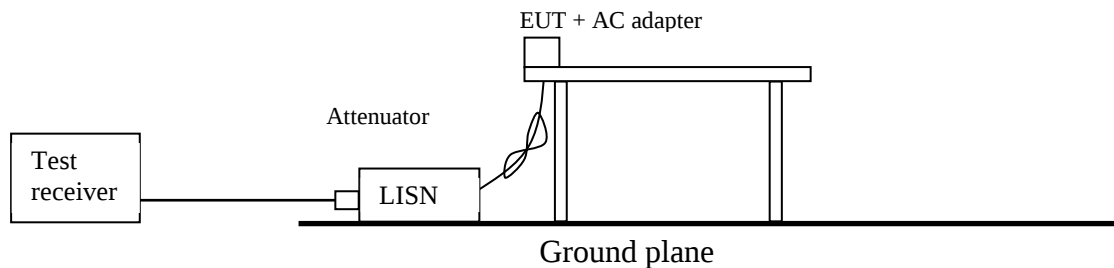
The EUT via AC adapter was connected to a LISN (AMN).

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 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 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	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.

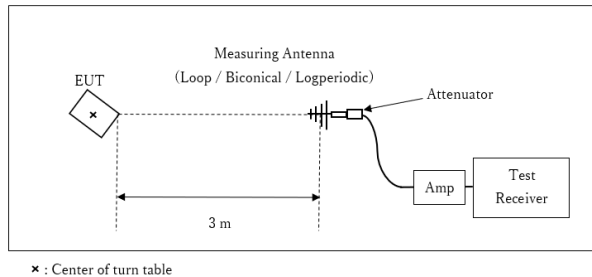
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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: Voltage 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.

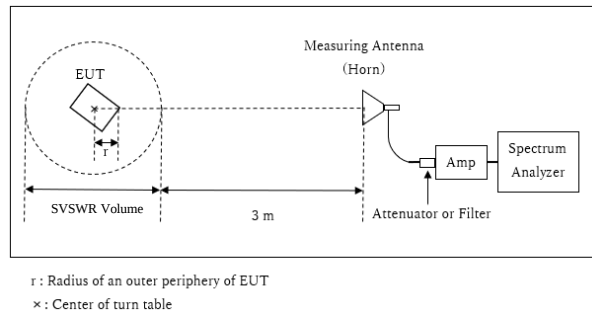
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

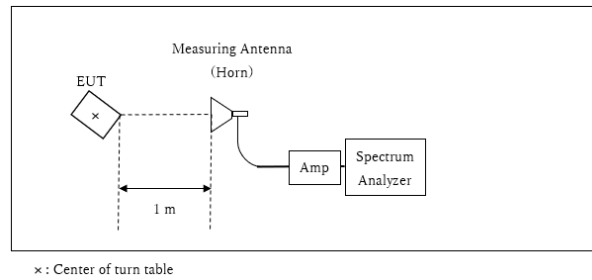
1 GHz - 10 GHz



Distance Factor: $20 \times \log (3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.9875 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.0125 \text{ m}$

10 GHz – 26.5 GHz



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

Combinations of the worst case (BT LE)

Frequency	Below 1 GHz	1 GHz - 2.8 GHz	2.8 GHz - 10 GHz	10 GHz – 18 GHz	Above 18 GHz
Antenna polarization					
Horizontal	X	X	Z	X	X
Vertical	X	Z	X	X	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 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
6 dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/Average *2)	-	Power Meter (Sensor: 160 MHz BW)
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *5) *6)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.
 *2) Reference data
 *3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
 *5) In the frequency range below 30 MHz, RBW was narrowed to separate the noise contents.
 Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
 *6) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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.6 Shielded Room
Date : 2020/08/21

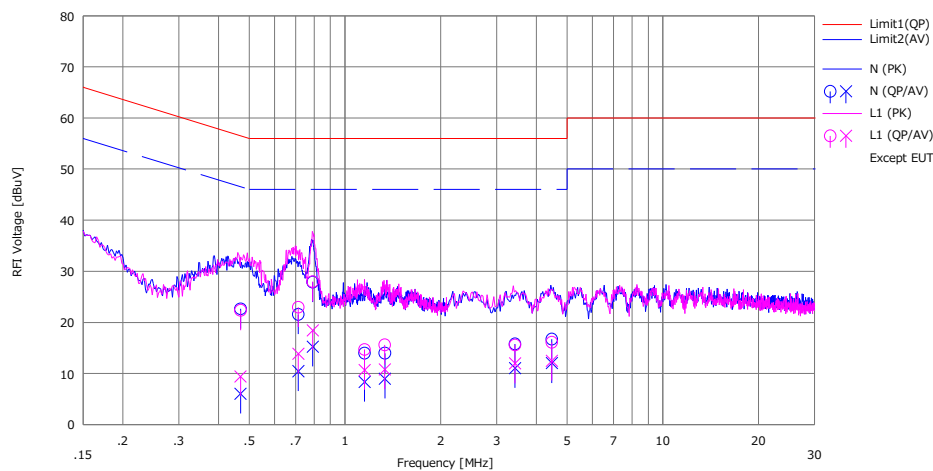
Mode : Tx, BT LE, 2402 MHz

Power : DC 5 V (from USB)
Temp./Humi. : 26 deg.C / 43 %RH

Remarks : AC Adapter : AC 120 V / 60 Hz

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Hiromasa Sato



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		[dBUV]	[dBUV]		[dBUV]	[dBUV]	[dBUV]	[dBUV]	[dB]	[dB]		
1	0.46966	10.20	-6.40	12.44	22.64	6.04	56.52	46.52	33.8	40.4	N	-
2	0.71302	9.10	-2.00	12.46	21.56	10.46	56.00	46.00	34.4	35.5	N	
3	0.79160	15.40	2.80	12.47	27.87	15.27	56.00	46.00	28.1	30.7	N	
4	1.15334	1.50	-4.10	12.47	13.97	8.37	56.00	46.00	42.0	37.6	N	
5	1.33608	1.50	-3.50	12.48	13.98	8.98	56.00	46.00	42.0	37.0	N	
6	3.42900	3.20	-1.50	12.57	15.77	11.07	56.00	46.00	40.2	34.9	N	
7	4.47320	4.10	-0.60	12.62	16.72	12.02	56.00	46.00	39.2	33.9	N	
8	0.46960	9.90	-3.00	12.46	22.36	9.46	56.52	46.52	34.1	37.0	L1	
9	0.71307	10.50	1.40	12.47	22.97	13.87	56.00	46.00	33.0	32.1	L1	
10	0.79140	15.50	6.00	12.46	27.96	18.46	56.00	46.00	28.0	27.5	L1	
11	1.15360	2.20	-1.80	12.49	14.69	10.69	56.00	46.00	41.3	35.3	L1	
12	1.33428	3.10	-1.70	12.50	15.60	10.80	56.00	46.00	40.4	35.2	L1	
13	3.42800	3.00	-0.60	12.57	15.57	11.97	56.00	46.00	40.4	34.0	L1	
14	4.47318	3.50	-0.10	12.60	16.10	12.50	56.00	46.00	39.9	33.5	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN):SLS-02

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.6 Shielded Room
Date : 2020/08/21

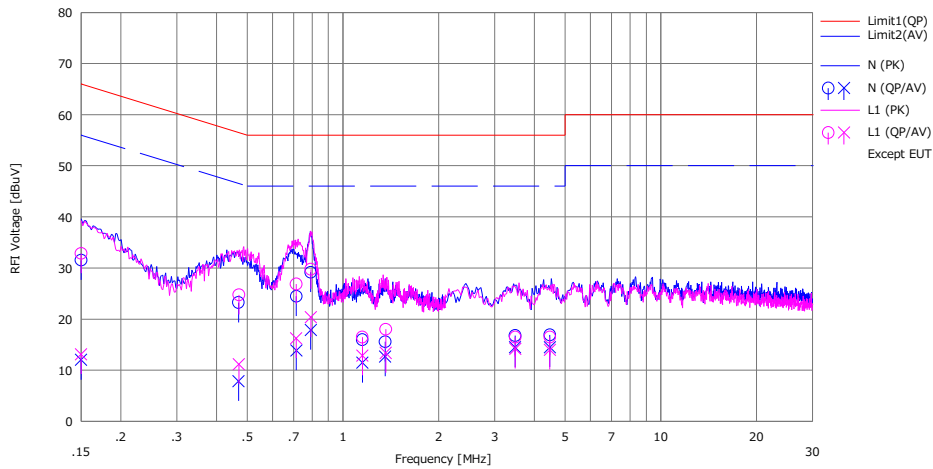
Mode : Tx, BT LE, 2440 MHz

Power : DC 5 V (from USB)
Temp./Humi. : 26 deg.C / 43 %RH

Remarks : AC Adapter : AC 120 V / 60 Hz

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Hiromasa Sato



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		[QP] [dBuV]	[AV] [dBuV]		[QP] [dBuV]	[AV] [dBuV]	[QP] [dBuV]	[AV] [dBuV]	[QP] [dB]	[AV] [dB]		
1	0.15000	19.10	-0.40	12.42	31.52	12.02	66.00	56.00	34.4	43.9	N	-
2	0.46924	10.80	-4.60	12.44	23.24	7.84	56.53	46.53	33.2	38.6	N	
3	0.71303	12.00	1.40	12.46	24.46	13.86	56.00	46.00	31.5	32.1	N	
4	0.79202	16.70	5.40	12.47	29.17	17.87	56.00	46.00	26.8	28.1	N	
5	1.15103	3.50	-1.00	12.47	15.97	11.47	56.00	46.00	40.0	34.5	N	
6	1.35821	3.10	0.20	12.48	15.58	12.68	56.00	46.00	40.4	33.3	N	
7	3.48200	4.20	1.90	12.58	16.78	14.48	56.00	46.00	39.2	31.5	N	
8	4.47342	4.30	1.90	12.62	16.92	14.52	56.00	46.00	39.0	31.4	N	
9	0.15000	20.40	0.70	12.44	32.84	13.14	66.00	56.00	33.1	42.8	L1	
10	0.47050	12.30	-1.30	12.46	24.76	11.16	56.51	46.51	31.7	35.3	L1	
11	0.71280	14.40	3.80	12.47	26.87	16.27	56.00	46.00	29.1	29.7	L1	
12	0.79260	17.30	7.90	12.46	29.76	20.36	56.00	46.00	26.2	25.6	L1	
13	1.15102	4.00	0.40	12.49	16.49	12.89	56.00	46.00	39.5	33.1	L1	
14	1.36370	5.50	0.90	12.50	18.00	13.40	56.00	46.00	38.0	32.6	L1	
15	3.48700	3.90	1.60	12.57	16.47	14.17	56.00	46.00	39.5	31.8	L1	
16	4.47312	3.90	1.40	12.60	16.50	14.00	56.00	46.00	39.5	32.0	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN):SLS-02

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.6 Shielded Room
Date : 2020/08/21

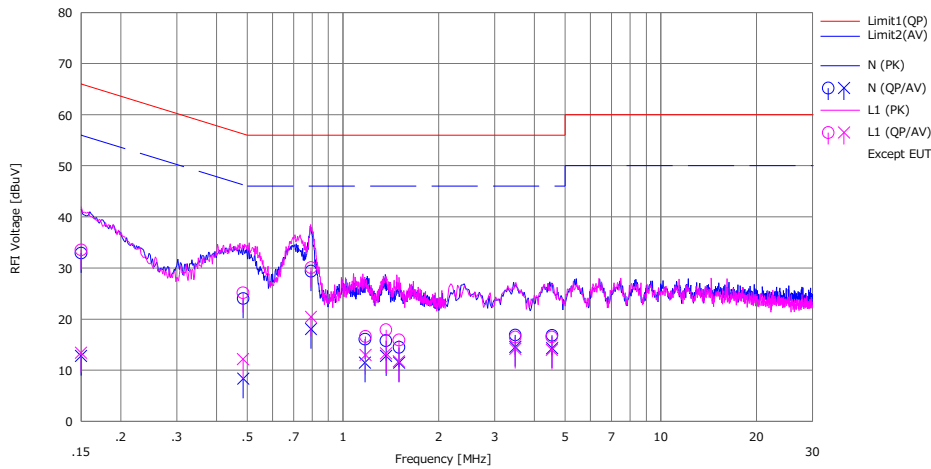
Mode : Tx, BT LE, 2480 MHz

Power : DC 5 V (from USB)
Temp./Humi. : 26 deg.C / 43 %RH

Remarks : AC Adapter : AC 120 V / 60 Hz

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Hiromasa Sato



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		[dBUV]	[dBUV]		[dBUV]	[dBUV]	[dBUV]	[dBUV]	[dB]	[dB]		
1	0.15000	20.50	0.40	12.42	32.92	12.82	66.00	56.00	33.0	43.1	N	-
2	0.48531	11.60	-4.10	12.44	24.04	8.34	56.25	46.25	32.2	37.9	N	
3	0.79344	16.90	5.60	12.47	29.37	18.07	56.00	46.00	26.6	27.9	N	
4	1.17323	3.60	-1.00	12.48	16.08	11.48	56.00	46.00	39.9	34.5	N	
5	1.36690	3.30	0.30	12.48	15.78	12.78	56.00	46.00	40.2	33.2	N	
6	1.50120	2.00	-1.00	12.49	14.49	11.49	56.00	46.00	41.5	34.5	N	
7	3.48402	4.30	2.00	12.58	16.88	14.58	56.00	46.00	39.1	31.4	N	
8	4.54802	4.20	1.70	12.63	16.83	14.33	56.00	46.00	39.1	31.6	N	
9	0.15000	21.10	1.00	12.44	33.54	13.44	66.00	56.00	32.4	42.5	L1	
10	0.48502	12.70	-0.30	12.46	25.16	12.16	56.25	46.25	31.0	34.0	L1	
11	0.79302	17.60	8.00	12.46	30.06	20.46	56.00	46.00	25.9	25.5	L1	
12	1.17723	4.10	0.50	12.50	16.60	13.00	56.00	46.00	39.4	33.0	L1	
13	1.36660	5.40	0.80	12.50	17.90	13.30	56.00	46.00	38.1	32.7	L1	
14	1.50102	3.40	-0.80	12.51	15.91	11.71	56.00	46.00	40.0	34.2	L1	
15	3.48401	3.90	1.60	12.57	16.47	14.17	56.00	46.00	39.5	31.8	L1	
16	4.54002	3.90	1.40	12.62	16.52	14.02	56.00	46.00	39.4	31.9	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN):SLS-02

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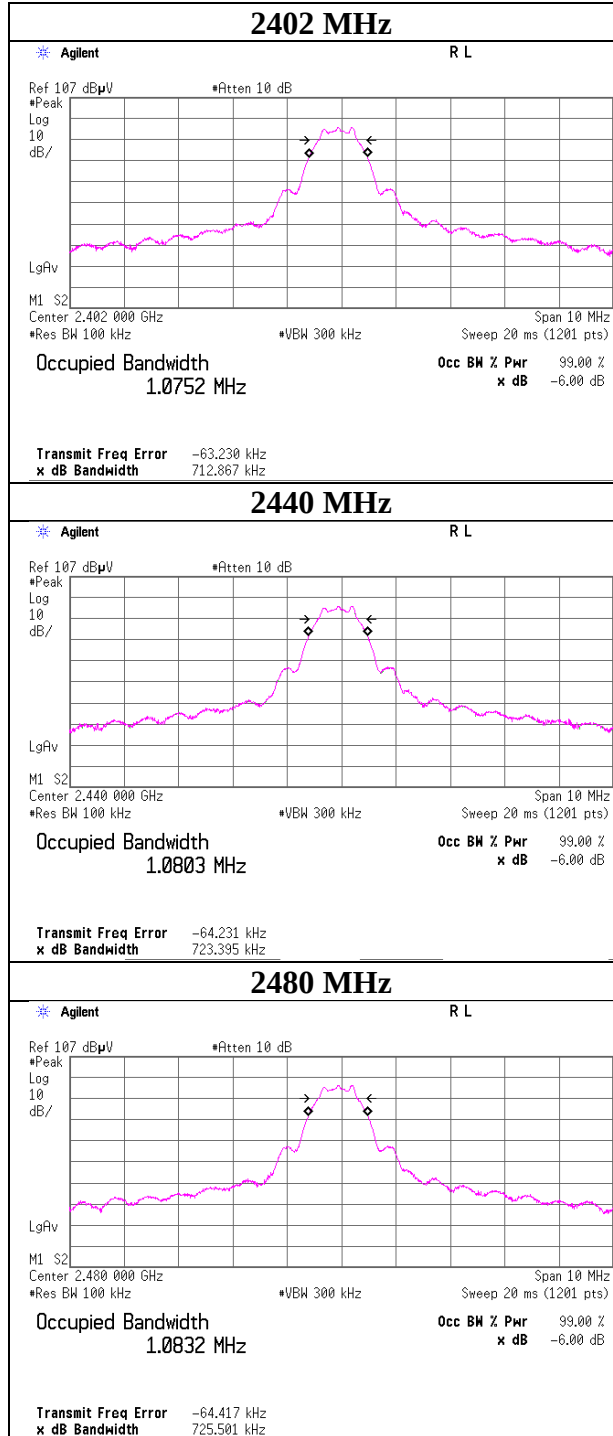
6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 13384109S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 31, 2020
Temperature / Humidity 22 deg. C / 61 % RH
Engineer Kenichi Adachi
Mode Tx BT LE

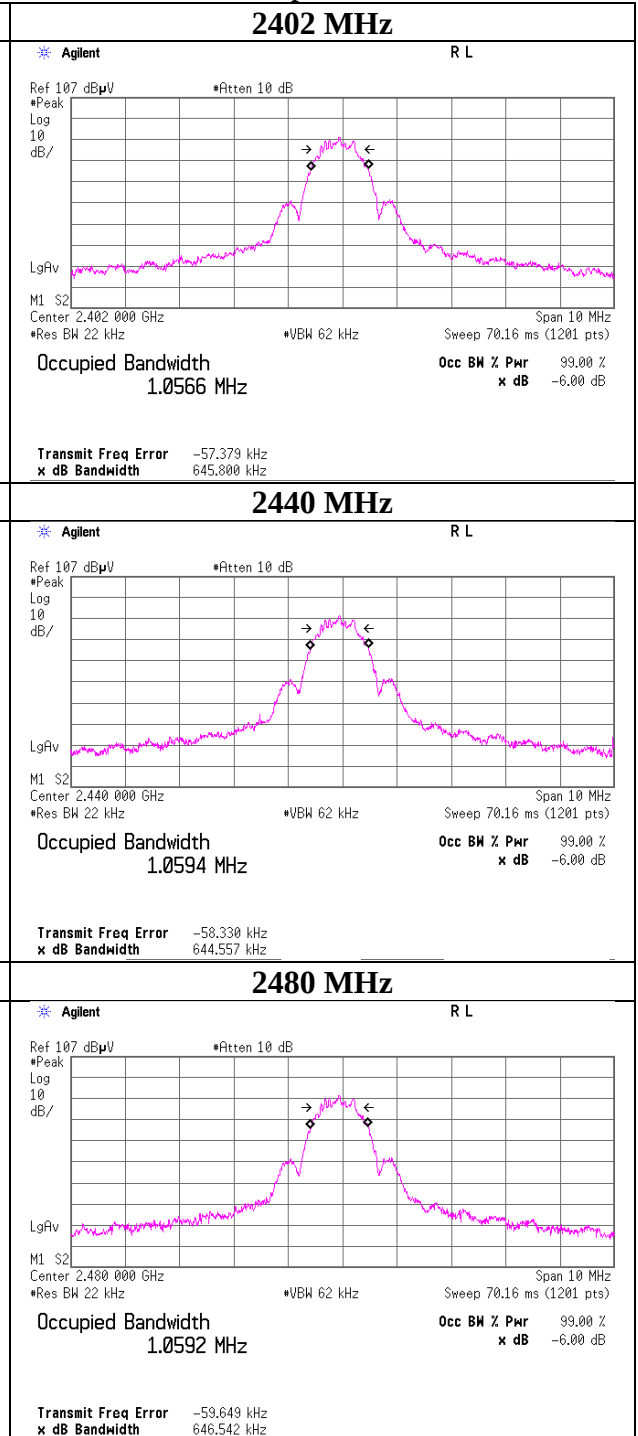
Mode	Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
BT LE	2402	1056.6	0.713	> 0.5000
	2440	1059.4	0.723	> 0.5000
	2480	1059.2	0.726	> 0.5000

6 dB Bandwidth and 99 % Occupied Bandwidth

6 dB Bandwidth



99 % Occupied Bandwidth



Maximum Peak Output Power

Report No. 13384109S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 31, 2020
Temperature / Humidity 22 deg. C / 61 % RH
Engineer Kenichi Adachi
Mode Tx BT LE

Freq.	Reading	Cable Loss	Atten. Loss	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
				[dBm]	[mW]	[dBm]	[mW]	[dB]		[dBi]	[dBm]	[mW]	[dBm]	
[MHz]	[dBm]	[dB]	[dB]											
2402	-13.96	1.66	9.87	-2.43	0.57	30.00	1000	32.43	0.30	-2.13	0.61	36.02	4000	38.15
2440	-13.89	1.66	9.87	-2.36	0.58	30.00	1000	32.36	0.30	-2.06	0.62	36.02	4000	38.08
2480	-13.69	1.67	9.87	-2.15	0.61	30.00	1000	32.15	0.30	-1.85	0.65	36.02	4000	37.87

Sample Calculation:

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

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

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

Average Output Power
(Reference data for RF Exposure)

Report No. 13384109S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 31, 2020
Temperature / Humidity 22 deg. C / 61 % RH
Engineer Kenichi Adachi
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-14.82	1.66	9.87	-3.29	0.47	0.67	-2.62	0.55
2440	-14.74	1.66	9.87	-3.21	0.48	0.67	-2.54	0.56
2480	-14.53	1.67	9.87	-2.99	0.50	0.67	-2.32	0.59

Sample Calculation:

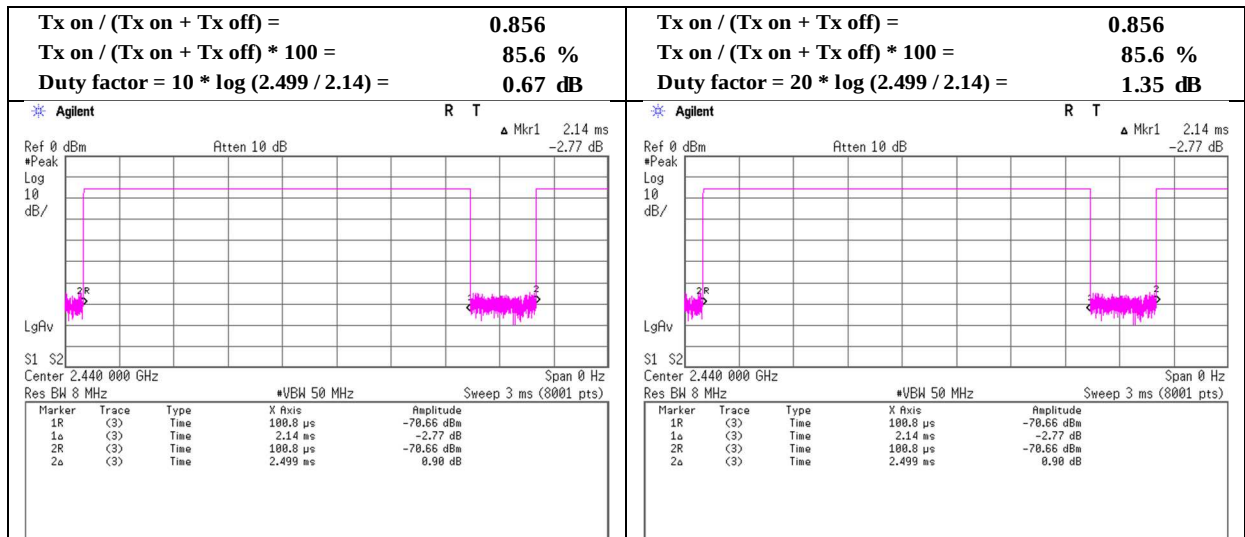
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

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

Duty Factor Calculation chart

Report No.	13384109S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	July 31, 2020
Temperature / Humidity	22 deg. C / 61 % RH
Engineer	Kenichi Adachi
Mode	Tx 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.	13384109S-A-R2		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.1
Date	August 11, 2020	August 2, 2020	July 31, 2020
Temperature / Humidity	25 deg. C / 65 % RH	23 deg. C / 68 % RH	21 deg. C / 66 % RH
Engineer	Toshinori Yamada	Kenichi Adachi	Yasumasa Owaki
	(below 1 GHz)	(1 GHz - 10 GHz)	(10 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.	30.723	QP	22.10	18.49	6.83	31.90	0.00	15.52	40.0	24.4	311	138	
Hori.	39.285	QP	21.50	15.19	7.04	31.90	0.00	11.83	40.0	28.1	187	210	
Hori.	41.071	QP	21.80	14.51	7.08	31.89	0.00	11.50	40.0	28.5	302	322	
Hori.	874.611	QP	20.50	22.08	9.35	30.97	0.00	20.96	46.0	25.0	143	294	
Hori.	2337.959	PK	45.42	28.01	14.43	39.53	2.48	50.81	73.9	23.0	163	203	
Hori.	2390.000	PK	45.40	27.93	14.49	39.55	2.48	50.75	73.9	23.1	163	203	
Hori.	4804.000	PK	50.13	31.47	7.03	39.73	2.48	51.38	73.9	22.5	164	149	
Hori.	7206.000	PK	45.76	36.90	8.67	39.51	2.48	54.30	73.9	19.6	165	300	
Hori.	9608.000	PK	44.88	38.23	10.20	39.66	2.48	56.13	73.9	17.7	150	0	Floor
Hori.	12010.000	PK	47.81	38.87	11.05	39.05	-9.54	49.14	73.9	24.7	213	88	
Hori.	2337.959	AV	35.38	28.01	14.43	39.53	2.48	40.77	53.9	13.1	163	203	
Hori.	9608.000	AV	35.69	38.23	10.20	39.66	2.48	46.94	53.9	6.9	150	0	Floor
Vert.	167.586	QP	21.10	15.50	8.75	31.79	0.00	13.56	43.5	29.9	100	92	
Vert.	178.643	QP	21.40	15.91	8.73	31.78	0.00	14.26	43.5	29.2	100	42	
Vert.	781.301	QP	20.90	20.54	8.95	31.40	0.00	18.99	46.0	27.0	100	121	
Vert.	2337.959	PK	45.45	28.01	14.43	39.53	2.48	50.84	73.9	23.0	230	160	
Vert.	2390.000	PK	45.43	27.93	14.49	39.55	2.48	50.78	73.9	23.1	230	160	
Vert.	4804.000	PK	50.19	31.47	7.03	39.73	2.48	51.44	73.9	22.4	156	211	
Vert.	7206.000	PK	45.88	36.90	8.67	39.51	2.48	54.42	73.9	19.4	193	236	
Vert.	9608.000	PK	44.84	38.23	10.20	39.66	2.48	56.09	73.9	17.8	150	0	Floor
Vert.	12010.000	PK	46.78	38.87	11.05	39.05	-9.54	48.11	73.9	25.7	148	211	
Vert.	2337.959	AV	35.40	28.01	14.43	39.53	2.48	40.79	53.9	13.1	230	160	
Vert.	9608.000	AV	35.62	38.23	10.20	39.66	2.48	46.87	53.9	7.0	150	0	Floor

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

10 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.	2390.000	AV	35.78	27.93	14.49	39.55	1.35	2.48	42.48	53.9	11.4	*1)
Hori.	4804.000	AV	43.33	31.47	7.03	39.73	1.35	2.48	45.93	53.9	7.9	
Hori.	7206.000	AV	36.09	36.90	8.67	39.51	1.35	2.48	45.98	53.9	7.9	
Hori.	12010.000	AV	37.38	38.87	11.05	39.05	1.35	-9.54	40.06	53.9	13.8	
Vert.	2390.000	AV	35.80	27.93	14.49	39.55	1.35	2.48	42.50	53.9	11.4	*1)
Vert.	4804.000	AV	43.04	31.47	7.03	39.73	1.35	2.48	45.64	53.9	8.2	
Vert.	7206.000	AV	36.14	36.90	8.67	39.51	1.35	2.48	46.03	53.9	7.8	
Vert.	12010.000	AV	38.45	38.87	11.05	39.05	1.35	-9.54	41.13	53.9	12.7	

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

10 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)

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	75.05	27.92	14.50	39.56	2.48	80.39	-	-	Carrier
Hori.	2400.000	PK	37.29	27.92	14.50	39.56	2.48	42.63	60.39	17.7	
Vert.	2402.000	PK	75.59	27.92	14.50	39.56	2.48	80.93	-	-	Carrier
Vert.	2400.000	PK	37.77	27.92	14.50	39.56	2.48	43.11	60.93	17.8	

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

UL Japan, Inc.

Shonan EMC Lab.

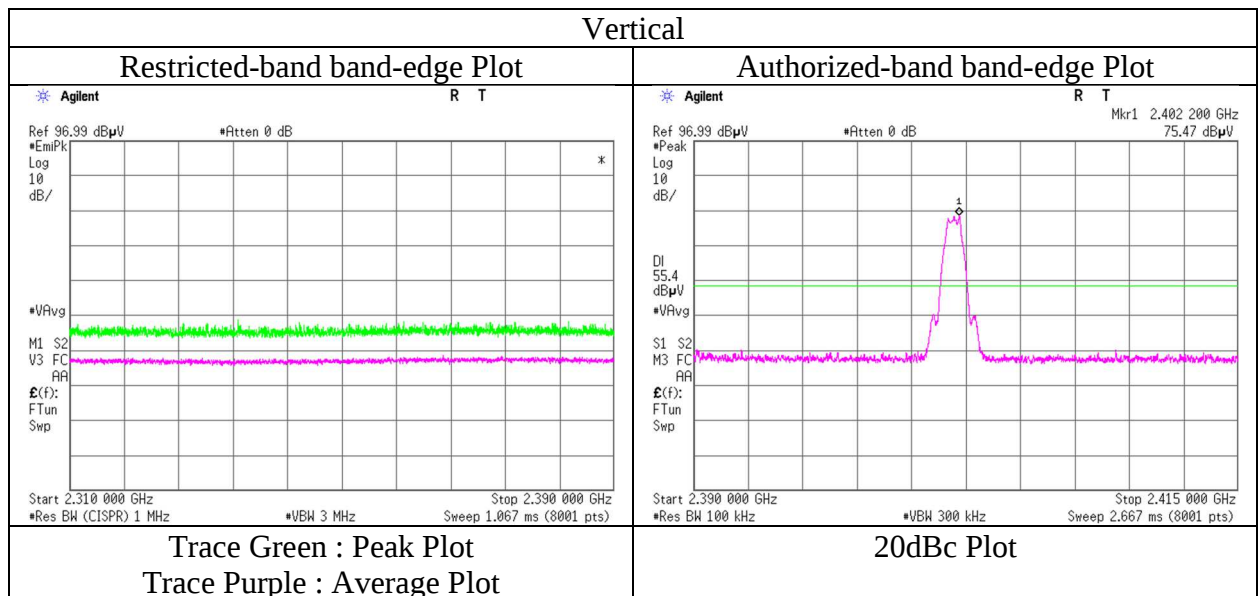
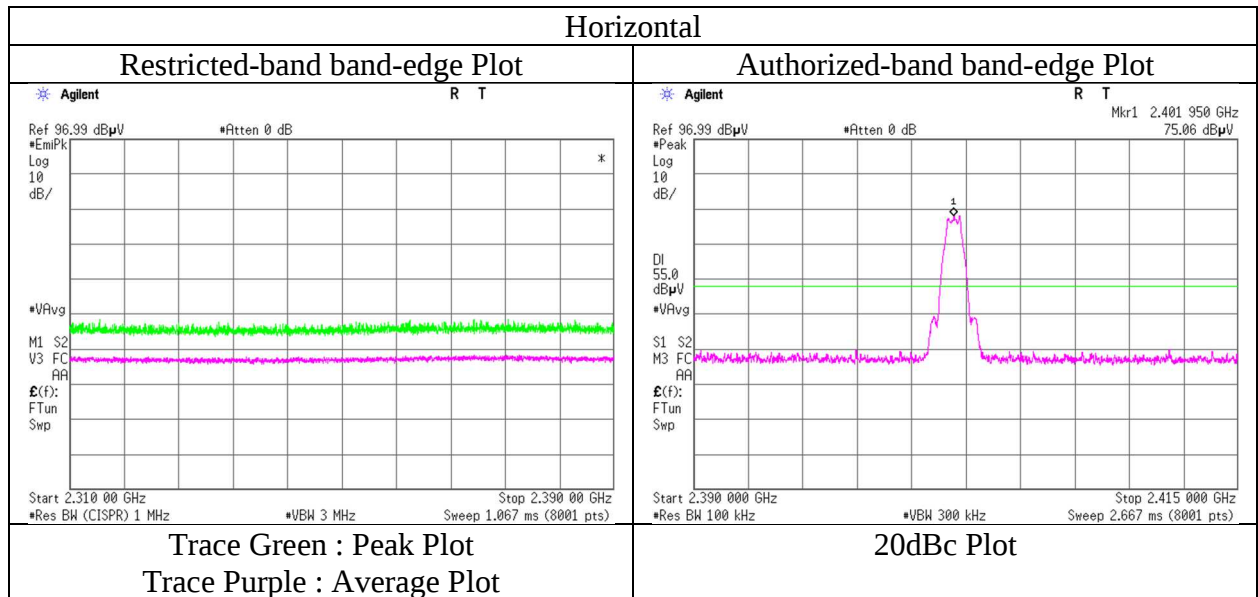
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13384109S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.1
Date	August 2, 2020
Temperature / Humidity	23 deg. C / 68 % RH
Engineer	Kenichi Adachi (1 GHz - 10 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.

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

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Facsimile : +81 463 50 6401

Radiated Spurious Emission

Report No.	13384109S-A-R2		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.1
Date	August 11, 2020	August 2, 2020	July 31, 2020
Temperature / Humidity	25 deg. C / 65 % RH	23 deg. C / 68 % RH	21 deg. C / 66 % RH
Engineer	Toshinori Yamada (below 1 GHz)	Kenichi Adachi (1 GHz - 10 GHz)	Yasumasa Owaki (10 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.	187.140	QP	21.20	16.24	8.75	31.77	0.00	14.42	43.5	29.0	100	348	
Hori.	852.730	QP	20.50	21.62	9.25	31.07	0.00	20.30	46.0	25.7	100	145	
Hori.	4880.000	PK	50.22	31.51	7.07	39.72	2.48	51.56	73.9	22.3	164	92	
Hori.	7320.000	PK	43.35	36.94	8.73	39.56	2.48	51.94	73.9	21.9	159	298	
Hori.	9760.000	PK	44.59	38.62	10.22	39.47	2.48	56.44	73.9	17.4	150	0	Floor
Hori.	12200.000	PK	44.57	38.75	11.17	38.75	-9.54	46.20	73.9	27.7	204	89	
Hori.	9760.000	AV	35.12	38.62	10.22	39.47	2.48	46.97	53.9	6.9	150	0	Floor
Vert.	31.233	QP	21.80	18.26	6.84	31.90	0.00	15.00	40.0	25.0	100	357	
Vert.	161.431	QP	21.50	15.24	8.72	31.79	0.00	13.67	43.5	29.8	100	355	
Vert.	166.490	QP	21.40	15.45	8.75	31.79	0.00	13.81	43.5	29.6	100	12	
Vert.	194.957	QP	21.30	16.50	8.78	31.76	0.00	14.82	43.5	28.6	100	277	
Vert.	880.331	QP	20.50	22.12	9.38	30.95	0.00	21.05	46.0	24.9	100	234	
Vert.	4880.000	PK	50.26	31.51	7.07	39.72	2.48	51.60	73.9	22.3	154	203	
Vert.	7320.000	PK	43.56	36.94	8.73	39.56	2.48	52.15	73.9	21.7	197	234	
Vert.	9760.000	PK	44.62	38.62	10.22	39.47	2.48	56.47	73.9	17.4	150	0	Floor
Vert.	12200.000	PK	45.04	38.75	11.17	38.75	-9.54	46.67	73.9	27.2	142	204	
Vert.	9760.000	AV	35.16	38.62	10.22	39.47	2.48	47.01	53.9	6.8	150	0	Floor

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

10 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.	4880.000	AV	43.42	31.51	7.07	39.72	1.35	2.48	46.11	53.9	7.7	-
Hori.	7320.000	AV	34.47	36.94	8.73	39.56	1.35	2.48	44.41	53.9	9.4	
Hori.	12200.000	AV	35.35	38.75	11.17	38.75	1.35	-9.54	38.33	53.9	15.5	
Vert.	4880.000	AV	43.16	31.51	7.07	39.72	1.35	2.48	45.85	53.9	8.0	
Vert.	7320.000	AV	34.58	36.94	8.73	39.56	1.35	2.48	44.52	53.9	9.3	
Vert.	12200.000	AV	35.68	38.75	11.17	38.75	1.35	-9.54	38.66	53.9	15.2	

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

10 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)

Radiated Spurious Emission

Report No.	13384109S-A-R2		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.1
Date	August 11, 2020	August 2, 2020	July 31, 2020
Temperature / Humidity	25 deg. C / 65 % RH	23 deg. C / 68 % RH	21 deg. C / 66 % RH
Engineer	Toshinori Yamada (below 1 GHz)	Kenichi Adachi (1 GHz - 10 GHz)	Yasumasa Owaki (10 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.	199.320	QP	21.20	16.58	8.81	31.76	0.00	14.83	43.5	28.6	100	23	
Hori.	917.196	QP	20.20	22.03	9.54	30.74	0.00	21.03	46.0	24.9	100	72	
Hori.	2483.500	PK	45.33	27.84	14.59	39.58	2.48	50.66	73.9	23.2	166	206	
Hori.	2523.491	PK	45.45	27.83	14.62	39.59	2.48	50.79	73.9	23.1	166	206	
Hori.	4960.000	PK	50.28	31.69	7.14	39.71	2.48	51.88	73.9	22.0	166	152	
Hori.	7440.000	PK	43.54	37.02	8.80	39.62	2.48	52.22	73.9	21.6	162	302	
Hori.	9920.000	PK	44.45	38.66	10.23	39.28	2.48	56.54	73.9	17.3	150	0	Floor
Hori.	12400.000	PK	43.98	38.37	11.33	38.44	-9.54	45.70	73.9	28.2	209	91	
Hori.	2523.491	AV	35.78	27.83	14.62	39.59	2.48	41.12	53.9	12.7	166	206	
Hori.	9920.000	AV	34.26	38.66	10.23	39.28	2.48	46.35	53.9	7.5	150	0	Floor
Vert.	31.508	QP	22.10	18.15	6.85	31.90	0.00	15.20	40.0	24.8	100	160	
Vert.	149.446	QP	21.40	14.84	8.59	31.80	0.00	13.03	43.5	30.4	100	18	
Vert.	171.144	QP	21.50	15.67	8.75	31.78	0.00	14.14	43.5	29.3	100	108	
Vert.	895.704	QP	20.20	22.08	9.45	30.89	0.00	20.84	46.0	25.1	100	342	
Vert.	933.899	QP	20.00	21.90	9.61	30.62	0.00	20.89	46.0	25.1	100	234	
Vert.	2483.500	PK	45.48	27.84	14.59	39.58	2.48	50.81	73.9	23.0	245	174	
Vert.	2523.491	PK	45.71	27.83	14.62	39.59	2.48	51.05	73.9	22.8	245	174	
Vert.	4960.000	PK	50.36	31.69	7.14	39.71	2.48	51.96	73.9	21.9	157	209	
Vert.	7440.000	PK	43.72	37.02	8.80	39.62	2.48	52.40	73.9	21.5	196	232	
Vert.	9920.000	PK	44.52	38.66	10.23	39.28	2.48	56.61	73.9	17.2	150	0	Floor
Vert.	12400.000	PK	44.37	38.37	11.33	38.44	-9.54	46.09	73.9	27.8	147	205	
Vert.	2523.491	AV	35.91	27.83	14.62	39.59	2.48	41.25	53.9	12.6	245	174	
Vert.	9920.000	AV	34.32	38.66	10.23	39.28	2.48	46.41	53.9	7.4	150	0	Floor

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

10 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	35.26	27.84	14.59	39.58	1.35	2.48	41.94	53.9	11.9	*1)
Hori.	4960.000	AV	43.22	31.69	7.14	39.71	1.35	2.48	46.17	53.9	7.7	
Hori.	7440.000	AV	34.78	37.02	8.80	39.62	1.35	2.48	44.81	53.9	9.0	
Hori.	12400.000	AV	34.89	38.37	11.33	38.44	1.35	-9.54	37.96	53.9	15.9	
Vert.	2483.500	AV	35.29	27.84	14.59	39.58	1.35	2.48	41.97	53.9	11.9	*1)
Vert.	4960.000	AV	43.48	31.69	7.14	39.71	1.35	2.48	46.43	53.9	7.4	
Vert.	7440.000	AV	34.87	37.02	8.80	39.62	1.35	2.48	44.90	53.9	9.0	
Vert.	12400.000	AV	35.39	38.37	11.33	38.44	1.35	-9.54	38.46	53.9	15.4	

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.9875 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

10 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)

UL Japan, Inc.

Shonan EMC Lab.

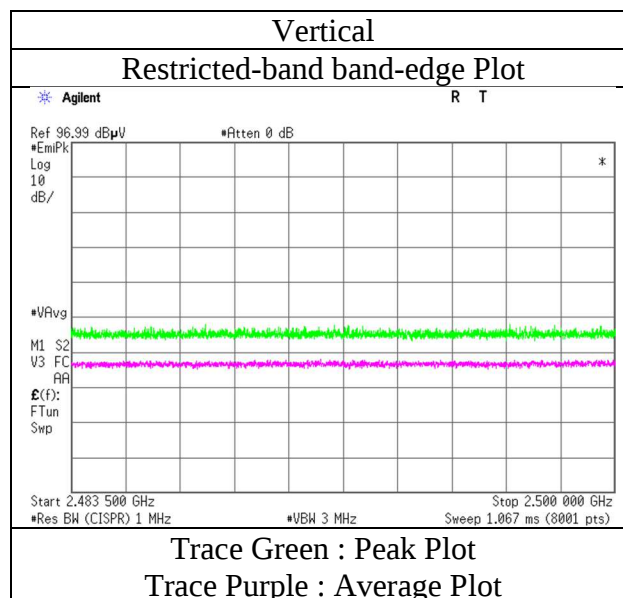
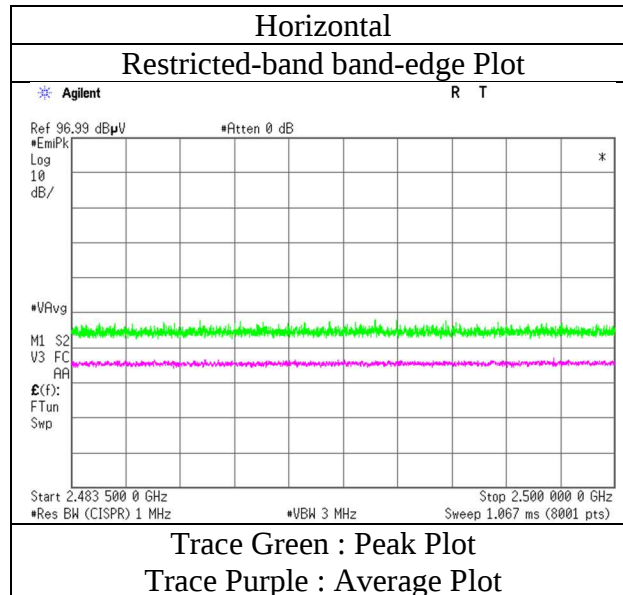
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13384109S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.1
Date	August 2, 2020
Temperature / Humidity	23 deg. C / 68 % RH
Engineer	Kenichi Adachi
	(1 GHz - 10 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.

UL Japan, Inc.

Shonan EMC Lab.

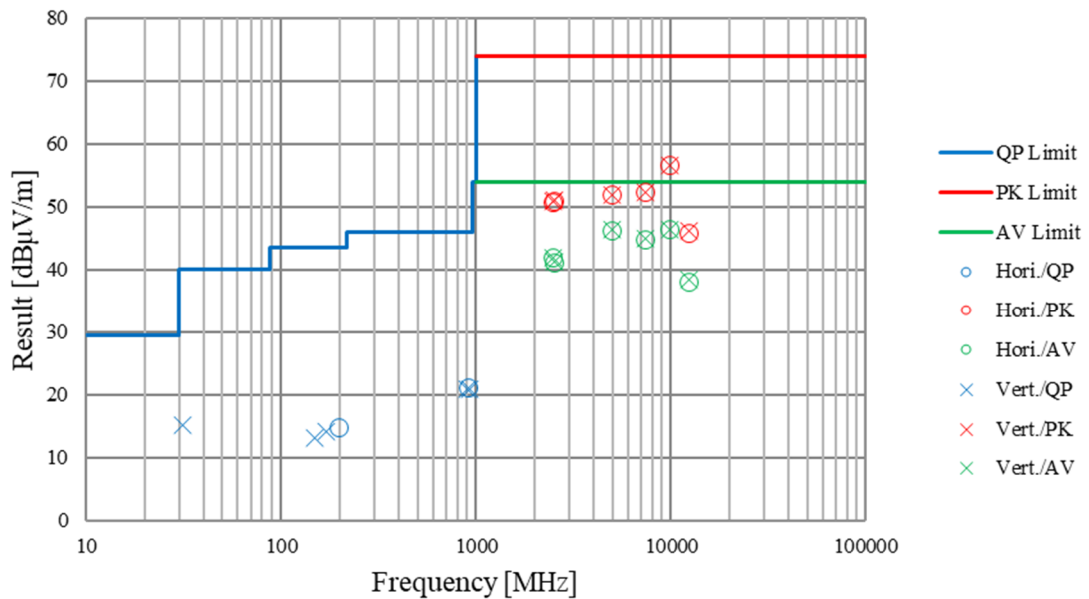
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Plot data, Worst case)

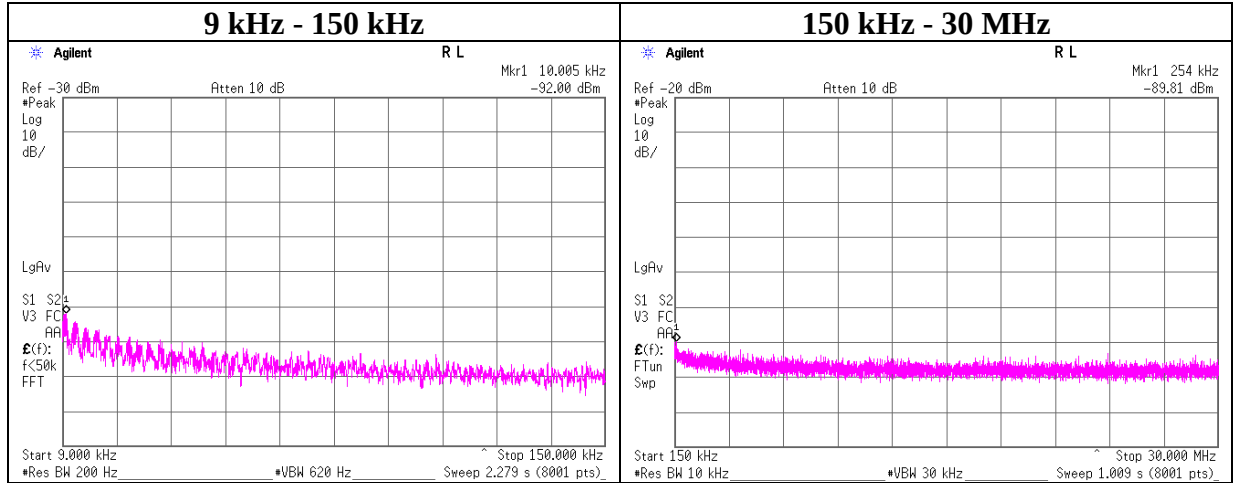
Report No.	13384109S-A-R2		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.1
Date	August 11, 2020	August 2, 2020	July 31, 2020
Temperature / Humidity	25 deg. C / 65 % RH	23 deg. C / 68 % RH	21 deg. C / 66 % RH
Engineer	Toshinori Yamada (below 1 GHz)	Kenichi Adachi (1 GHz - 10 GHz)	Yasumasa Owaki (10 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.

Conducted Spurious Emission

Report No. 13384109S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 31, 2020
Temperature / Humidity 22 deg. C / 61 % RH
Engineer Kenichi Adachi
Mode Tx BT LE, 2402 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.01	-92.0	1.00	9.8	2.0	1	-79.2	300	6.0	-17.9	47.5	65.4	-
254.00	-89.8	1.01	9.8	2.0	1	-77.0	300	6.0	-15.7	19.5	35.2	-

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

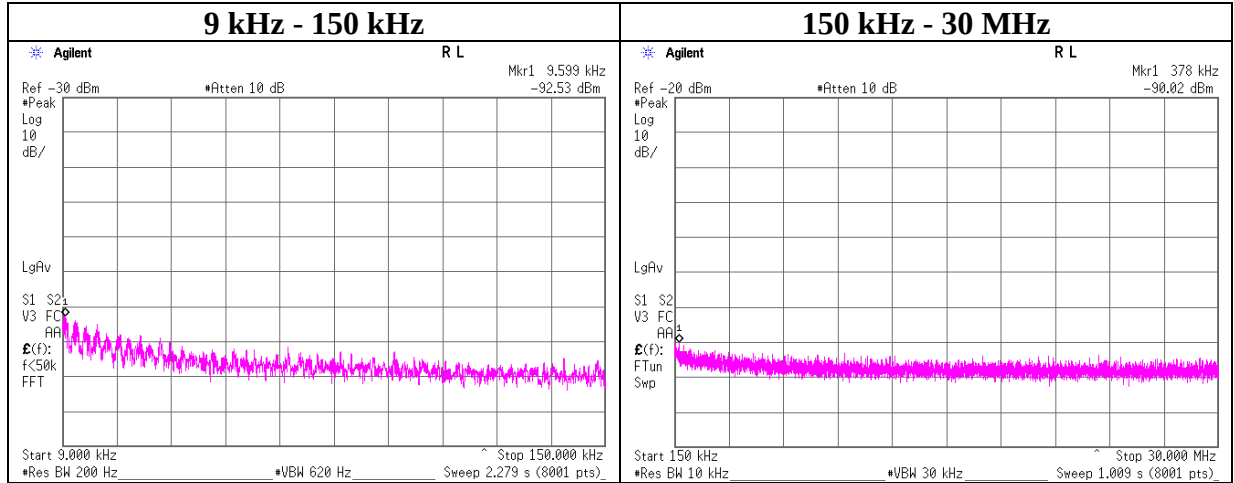
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Report No. 13384109S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 31, 2020
Temperature / Humidity 22 deg. C / 61 % RH
Engineer Kenichi Adachi
Mode Tx BT LE, 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.60	-92.5	1.00	9.8	2.0	1	-79.7	300	6.0	-18.5	47.9	66.4	-
378.00	-90.0	1.01	9.8	2.0	1	-77.2	300	6.0	-15.9	16.0	31.9	-

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

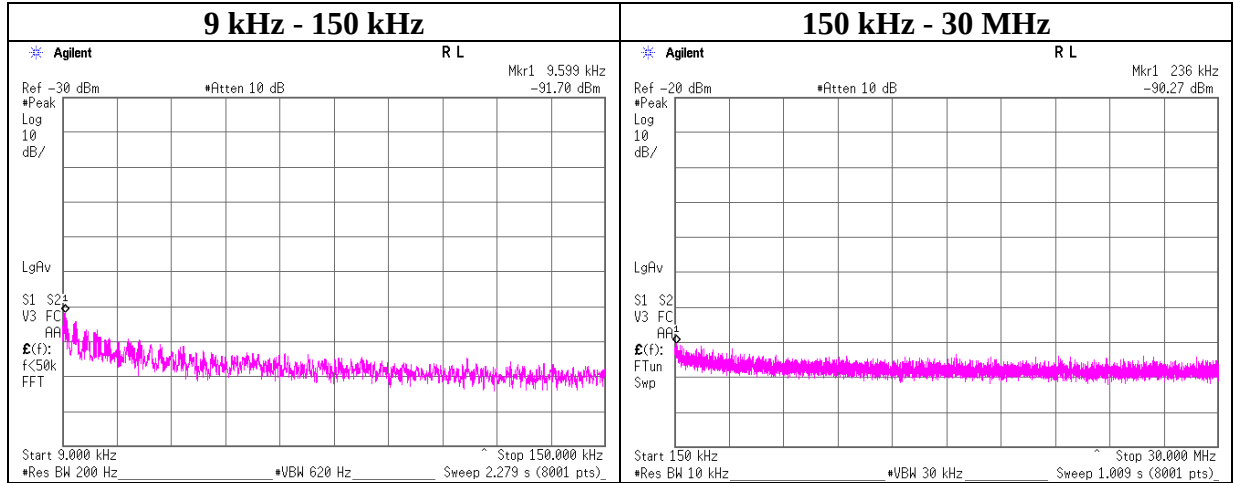
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Report No. 13384109S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 31, 2020
Temperature / Humidity 22 deg. C / 61 % RH
Engineer Kenichi Adachi
Mode Tx BT LE, 2480 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.60	-91.7	1.00	9.8	2.0	1	-78.9	300	6.0	-17.6	47.9	65.5	-
236.00	-90.3	1.01	9.8	2.0	1	-77.5	300	6.0	-16.2	20.1	36.3	-

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

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

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Power Density

Report No. 13384109S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 31, 2020
Temperature / Humidity 22 deg. C / 61 % RH
Engineer Kenichi Adachi
Mode Tx BT LE

BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402	-30.50	1.66	9.87	-18.97	8.00	26.97
2440	-30.50	1.66	9.87	-18.97	8.00	26.97
2480	-30.51	1.67	9.87	-18.97	8.00	26.97

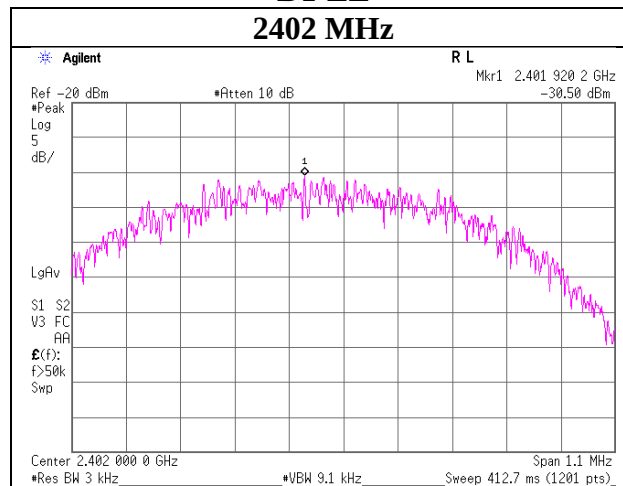
Sample Calculation:

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

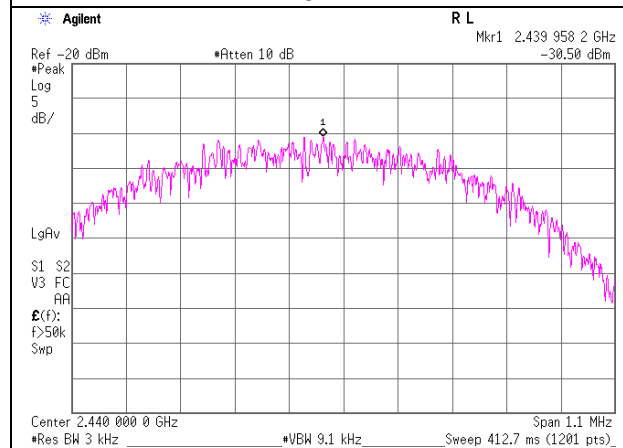
*The equipment and cables were not used for factor 0 dB of the data sheets.

Power Density

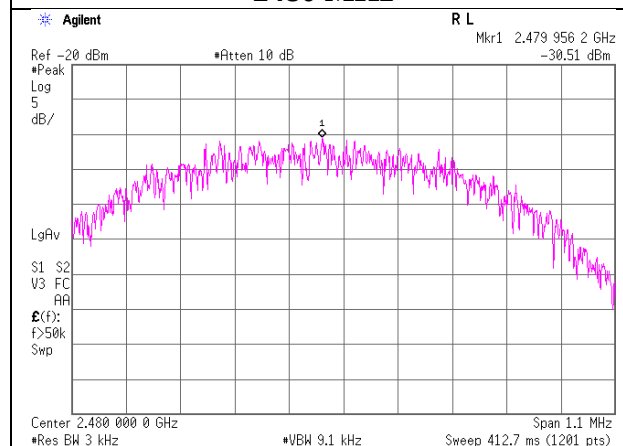
BT LE 2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2019/10/01	12
AT	SAT10-13	151610	Attenuator	Weinschel Corp.	54A-10	81626	2020/03/02	12
AT	SCC-G63	196946	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	803411/2	2020/03/10	12
AT	SOS-19	175823	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2019/12/19	12
AT	SPM-07	146247	Power Meter	Keysight Technologies Inc	8990B	MY5100272	2020/05/27	12
AT	SPSS-04	146310	Power sensor	Keysight Technologies Inc	N1923A	MY5326009	2020/05/27	12
AT	SSA-03	145801	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250152	2019/08/08	12
CE	KTS-06	145110	Digital Tester	SANWA	PC500	7019240	2020/04/09	12
CE	SAT3-10	144960	Attenuator	JFW	50HF-003N	-	2020/08/18	12
CE	SCC-C9	145035	Coaxial Cable	Suhner	RG223U	-	2020/04/12	12
CE	SJM-18	147480	Measure	ASKUL	-	-	-	-
CE	SLS-02	145539	LISN	Rohde & Schwarz	ENV216	100512	2020/02/18	12
CE	SOS-18	175822	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2019/12/19	12
CE	STR-02	145791	Test Receiver	Rohde & Schwarz	ESCI	100575	2019/09/25	12
CE,RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
RE	KJM-09	145929	Measure	KOMELON	KMC-36	-	-	-
RE	KJM-10	146454	Measure	KOMELON	KMC-36	-	-	-
RE	SAEC-01(SVSWR)	145561	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	2020/05/04	12
RE	SAEC-02(NSA)	145563	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	2020/03/20	12
RE	SAF-02	145004	Pre Amplifier	SONOMA	310N	290212	2020/02/19	12
RE	SAF-04	145127	Pre Amplifier	Toyo Corporation	TPA0118-36	2072554	2020/06/02	12
RE	SAJ-02	146104	Antenna Tilt Jig	Intelligent System Engineering Co., Ltd	Antenna Tilt Jig	T-S002	-	-
RE	SAT10-05	145136	Attenuator(above1GHz)	Keysight Technologies Inc	8493C-010	74864	2019/11/06	12
RE	SAT3-11	150921	Attenuator	JFW	50HF-003N	-	2020/01/30	12
RE	SAT6-14	167095	Attenuator	JFW	50HF-006N	-	2020/02/21	12
RE	SBA-02	145022	Biconical Antenna	Schwarzbeck Mess - Elektronik	BBA9106	91032665	2020/04/04	12

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	SCC-B1/B3/B5/B7/B8/B13/SRSE-02	144975	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	2020/04/17	12
RE	SCC-B2/B4/B6/B7/B8/B13/SRSE-02	144976	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	2020/04/17	12
RE	SCC-G05	145039	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-037	2020/01/31	12
RE	SCC-G41	151617	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S006	2020/01/08	12
RE	SCC-G62	196985	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	803650/2	2020/03/10	12
RE	SFL-18	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2020/04/03	12
RE	SHA-01	145383	Horn Antenna	Schwarzbeck Mess - Elektronik	BBHA9120D	9120D-725	2020/05/27	12
RE	SLA-06	145528	Logperiodic Antenna	Schwarzbeck Mess - Elektronik	VUSLP9111B	195	2020/04/04	12
RE	SOS-20	191837	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2019/12/12	12
RE	SOS-21	191838	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2019/12/12	12
RE	SSA-02	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2020/04/16	12
RE	STR-01	145790	Test Receiver	Rohde & Schwarz	ESU40	100093	2020/04/24	12
RE	STS-01	145792	Digital Hitester	Hioki	3805-50	80997812	2019/10/01	12
RE	STS-02	145793	Digital Hitester	Hioki	3805-50	80997819	2020/04/09	12

*Hyphens for Last Calibration 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.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

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