



RADIO TEST REPORT

Test Report No. : 13704855S-E

Applicant : CITIZEN WATCH CO., LTD.
Type of EUT : Hybrid smart watch module
Model Number of EUT : W3MV
FCC ID : YUQ-W3MV
Test regulation : FCC Part 15 Subpart C: 2021
Test Result : Complied (Refer to SECTION 3)

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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.

Date of test: March 19 to 23, 2021

Representative test engineer: 
Hiromasa Sato
Engineer

Approved by: 
Kazutaka Takeyama
Leader



CERTIFICATE 1266.03

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 There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13704855S-E

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13704855S-E	May 28, 2021	-	-

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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 : CITIZEN WATCH CO., LTD.
Address : 6-1-12, Tanashi-cho, Nishi-Tokyo-shi, Tokyo 188-8511, Japan
Telephone Number : +81-42-467-6218
Facsimile Number : +81-42-467-1549
Contact Person : Yasuhiro Sakuma

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 : Hybrid smart watch module
Model Number : W3MV
Serial Number : Refer to SECTION 4.2
Rating : DC 3.0 V
Receipt Date : March 4, 2021
Country of Mass-production : China
Condition : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification : No Modification by the test lab.

2.2 Product Description

Model: W3MV (referred to as the EUT in this report) is a Hybrid smart watch module.

Radio Specification

Bluetooth Low Energy

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Antenna type : Inverted-F Trace antenna
Antenna Gain : -15.65 dBi
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 May 3, 2021 and effective July 2, 2021
* The revision does not affect the test result conducted before its effective date.

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	FCC: Section 15.207	28.3 dB	Complied a)	
	ISED: RSS-Gen 8.8	ISED: RSS-Gen 8.8	0.39961 MHz, L1, QP Tx, BT LE, 2402 MHz 0.40002 MHz, L1, QP Tx, BT LE, 2440 MHz 0.40001 MHz, L1, QP Tx, BT LE, 2480 MHz		
6 dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(a)(2)	See data.	Complied b)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(b)(3)		Complied c)	Conducted
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(e)		Complied d)	Conducted
	ISED: -	ISED: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(d)	3.3 dB 7206.000 MHz, AV, Hori. Tx BT LE 2402 MHz	Complied# e), f)	Conducted (below 30 MHz)/ Radiated
	ISED: RSS-Gen 6.13	ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

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

- 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)

This EUT provides the stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 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	a)	Conducted
a) 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	2.6 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	2.7 dB	2.7 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	4.8 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	5.3 dB	5.3 dB	5.3 dB	-
	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB	-
	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 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	1.4 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.6 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.2 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.91 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.2 dB
Spurious emission (Conducted) below 1GHz	0.87 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.96 dB
Spurious emission (Conducted) 3 GHz-18 GHz	3.0 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.2 dB
Bandwidth Measurement	0.012 %
Duty cycle and Time Measurement	0.27 %
Temperature_SCH-01	0.87 deg.C.
Humidity_SCH-01	4.3 %
Temperature_SCH-02	2.0 deg.C.
Humidity_SCH-02	6.6 %
Voltage	0.86 %

3.5 Test Location

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A2LA Certificate Number: 1266.03
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground p lane (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 (BT) Low Energy (LE)	Uncoded 1 M-PHY, Maximum Packet Size, PRBS9
<p>*Power of the EUT was set by the software as follows; Power settings: 0 dBm Software: Windows PowerShell Ver.10.0.18362.1 (Date: 2019.3.19, Storage location: Driven by connected PC)</p> <p>*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.</p>	

*The details of Operating mode(s)

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

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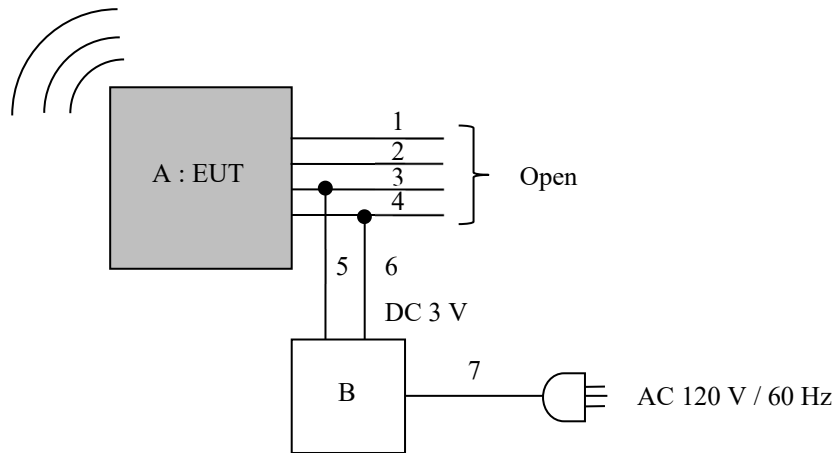
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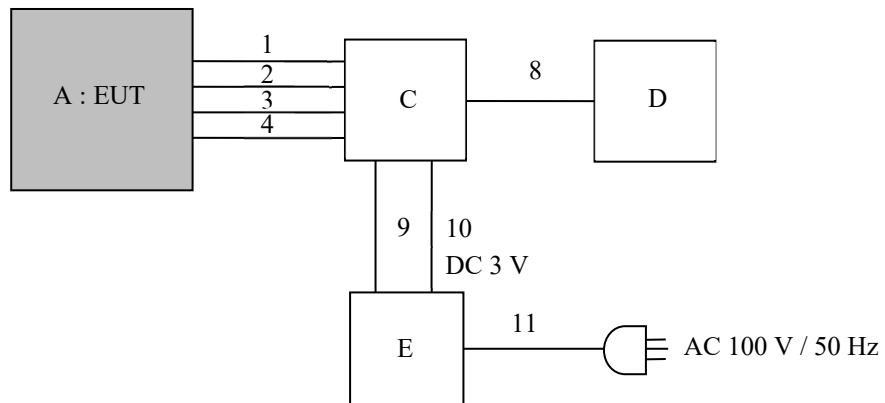
Facsimile : +81 463 50 6401

4.2 Configuration and peripherals

Conducted Emission test and Radiated Emission test



Antenna Terminal conducted test



* 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	Remark
A	Hybrid smart watch module	W3MV	MV105 *1) MV109 *2)	CITIZEN WATCH CO., LTD.	EUT
B	DC Power Supply	PAN35-10A	DE001677	KIKUSUI	-
C	Jig 1	-	-	CITIZEN WATCH CO., LTD.	-
D	Jig 2	-	-	CITIZEN WATCH CO., LTD.	-
E	DC Power Supply	PW8-5ADPS	14086035	TEXIO	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Signal	0.1	Unshielded	Unshielded	-
2	Signal	0.1	Unshielded	Unshielded	-
3	DC (+)	0.1	Unshielded	Unshielded	-
4	DC (-)	0.1	Unshielded	Unshielded	-
5	DC (+)	0.3 + 1.5	Unshielded	Unshielded	-
6	DC (-)	0.3 + 1.5	Unshielded	Unshielded	-
7	AC	2.0	Unshielded	Unshielded	-
8	Signal	0.1	Unshielded	Unshielded	-
9	DC (+)	1.5	Unshielded	Unshielded	-
10	DC (-)	1.5	Unshielded	Unshielded	-
11	AC	2.0	Unshielded	Unshielded	-

*1) Used for Antenna Terminal conducted test

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

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SECTION 5: Conducted Emission

Test Procedure and conditions

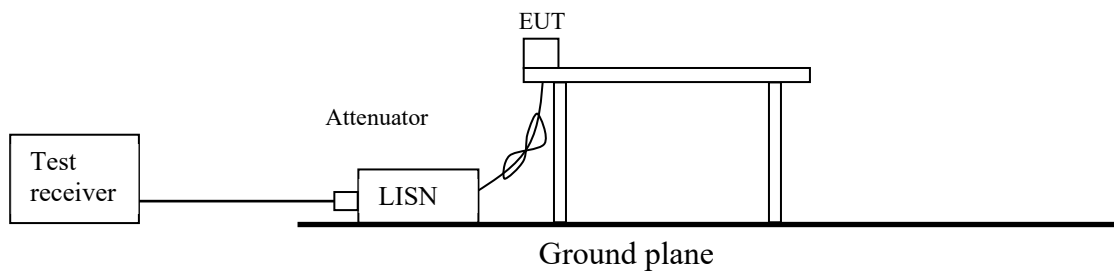
EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm 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.

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 urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 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	9 kHz to 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	9 kHz to 90 kHz & 110 kHz to 150 kHz	90 kHz to 110 kHz	150 kHz to 490 kHz	490 kHz to 30 MHz
Instrument used	Spectrum Analyzer	Test Receiver	Spectrum Analyzer	Test Receiver
Detector	PK/AV	QP	PK/AV	QP
IF Bandwidth	RBW: 200 Hz VBW: 1 kHz	BW 200 Hz	RBW: 10 kHz VBW: 30 kHz	BW 9 kHz

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

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

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Figure 1: Direction of the Loop Antenna

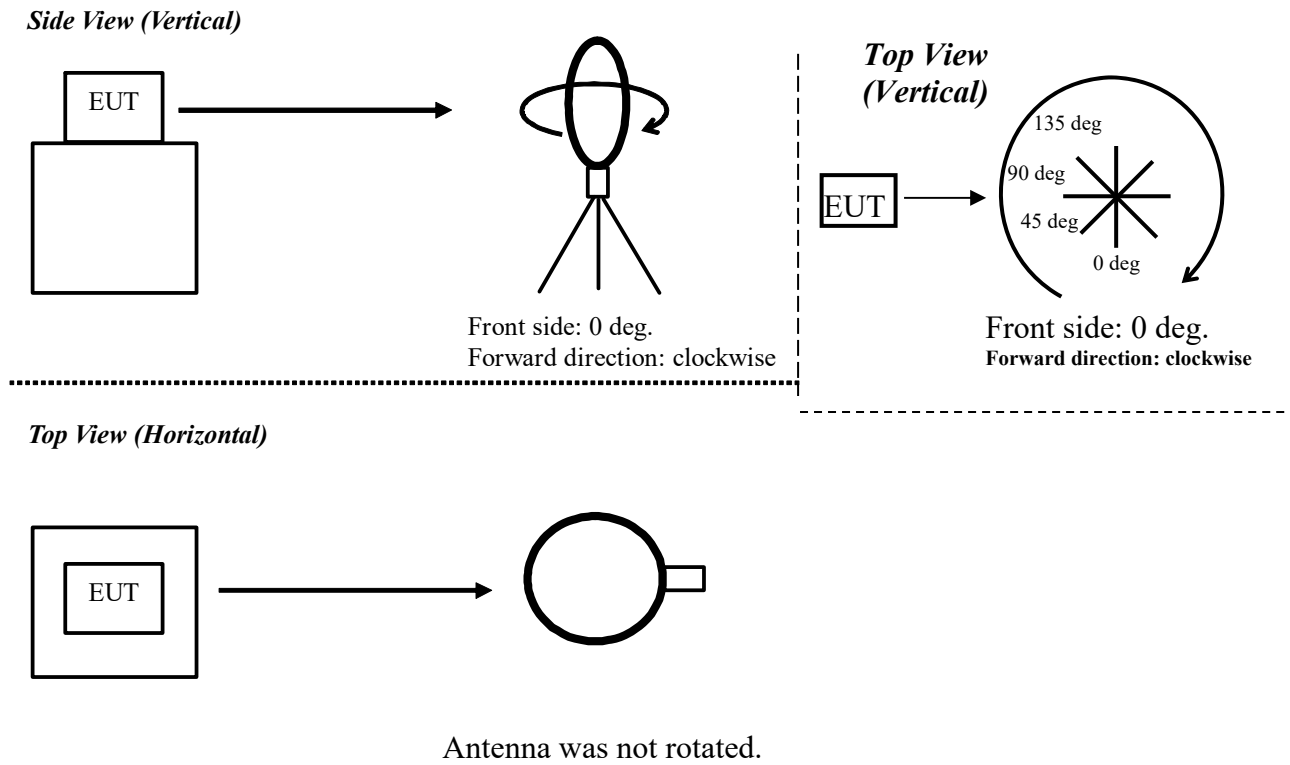
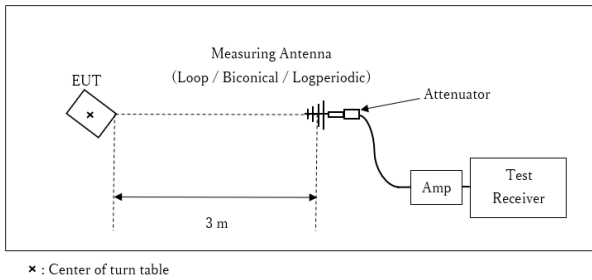


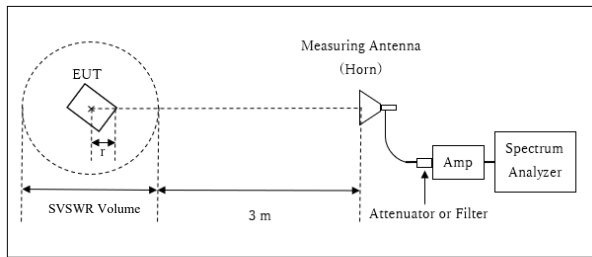
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 10 GHz

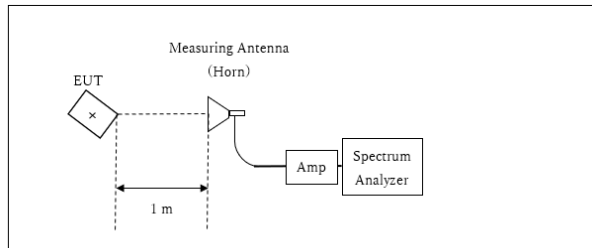


Distance Factor: $20 \times \log(3.985 \text{ m} / 3.0 \text{ m}) = 2.47 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.985 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.015 \text{ m}$

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

10 GHz – 26.5 GHz



Distance Factor: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$
*Test Distance: 1 m

x : Center of turn table

- 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 (Band edge)	Spurious				
		Below 1 GHz	Above 1 GHz			
			1 GHz - 2.8 GHz	2.8 GHz - 10 GHz	10 GHz - 18 GHz	18 GHz - 26.5 GHz
Horizontal	Z	X	Z	Z	X	X
Vertical	Z	X	Z	Z	X	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

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 *4) *5)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.

*2) Reference data

*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".

*4) 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.

*5) 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

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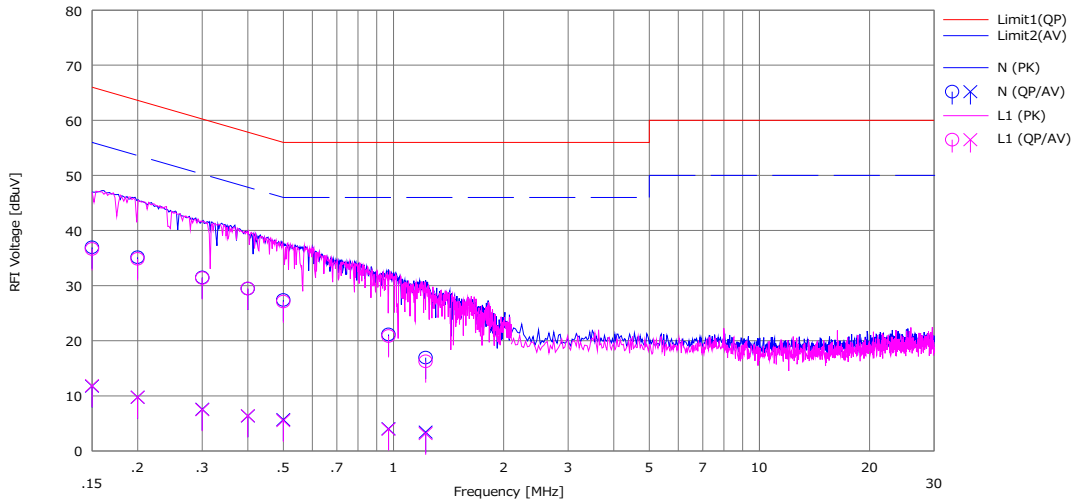
Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

APPENDIX 1: Test data

Conducted Emission

Report No. 13704855S-E
Test place Shonan EMC Lab. No.6 Shielded Room
Date March 23, 2021
Temperature / Humidity 22 deg. C / 35 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 2402 MHz
Remarks Supply Voltage DC 3 V (AC 120 V, 60 Hz)



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
		[dBuV]	[dBuV]		[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]		
1	0.15000	24.50	-0.70	12.45	36.95	11.75	66.00	56.00	29.0	44.2	N	
2	0.19992	22.70	-2.70	12.44	35.14	9.74	63.61	53.61	28.4	43.8	N	
3	0.30032	19.00	-4.90	12.47	31.47	7.57	60.23	50.23	28.7	42.6	N	
4	0.40004	17.00	-6.10	12.45	29.45	6.35	57.85	47.85	28.4	41.5	N	
5	0.50019	14.90	-6.80	12.48	27.38	5.68	56.00	46.00	28.6	40.3	N	
6	0.96899	8.60	-8.50	12.53	21.13	4.03	56.00	46.00	34.8	41.9	N	
7	1.22447	4.40	-9.10	12.54	16.94	3.44	56.00	46.00	39.0	42.5	N	
8	0.15000	24.20	-0.60	12.44	36.64	11.84	66.00	56.00	29.3	44.1	L1	
9	0.19991	22.40	-2.70	12.45	34.85	9.75	63.61	53.61	28.7	43.8	L1	
10	0.30031	18.90	-5.00	12.47	31.37	7.47	60.23	50.23	28.8	42.7	L1	
11	0.39961	17.00	-6.10	12.48	29.48	6.38	57.86	47.86	28.3	41.4	L1	
12	0.50021	14.60	-7.00	12.50	27.10	5.50	56.00	46.00	28.9	40.5	L1	
13	0.96899	8.30	-8.60	12.55	20.85	3.95	56.00	46.00	35.1	42.0	L1	
14	1.22444	3.70	-9.40	12.56	16.26	3.16	56.00	46.00	39.7	42.8	L1	

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

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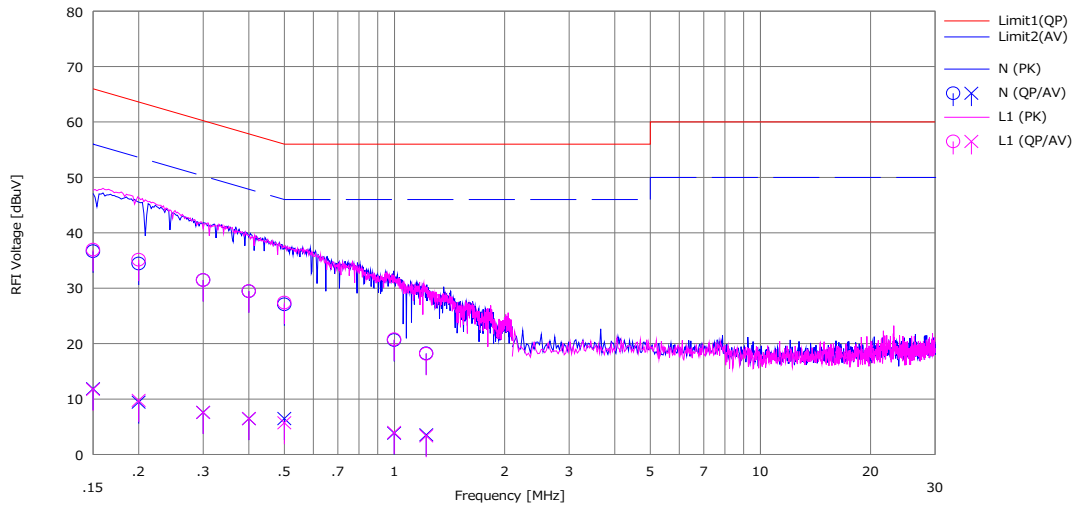
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Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Conducted Emission

Report No. 13704855S-E
Test place Shonan EMC Lab. No.6 Shielded Room
Date March 23, 2021
Temperature / Humidity 22 deg. C / 35 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 2440 MHz
Remarks Supply Voltage DC 3 V (AC 120 V, 60 Hz)



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	24.20	-0.60	12.45	36.65	11.85	66.00	56.00	29.3	44.1	N	
2	0.19996	22.00	-3.00	12.44	34.44	9.44	63.61	53.61	29.1	44.1	N	
3	0.30002	19.00	-4.90	12.47	31.47	7.57	60.24	50.24	28.7	42.6	N	
4	0.40005	17.00	-6.00	12.45	29.45	6.45	57.85	47.85	28.4	41.4	N	
5	0.50019	14.60	-6.00	12.48	27.08	6.48	56.00	46.00	28.9	39.5	N	
6	0.99788	8.10	-8.70	12.53	20.63	3.83	56.00	46.00	35.3	42.1	N	
7	1.22152	5.70	-9.00	12.54	18.24	3.54	56.00	46.00	37.7	42.4	N	
8	0.15005	24.50	-0.70	12.44	36.94	11.74	66.00	56.00	29.0	44.2	L1	
9	0.19995	22.70	-2.70	12.45	35.15	9.75	63.61	53.61	28.4	43.8	L1	
10	0.30003	19.00	-4.90	12.47	31.47	7.57	60.24	50.24	28.7	42.6	L1	
11	0.40002	17.00	-6.00	12.48	29.48	6.48	57.85	47.85	28.3	41.3	L1	
12	0.50021	14.90	-6.80	12.50	27.40	5.70	56.00	46.00	28.6	40.3	L1	
13	0.99781	8.20	-8.60	12.56	20.76	3.96	56.00	46.00	35.2	42.0	L1	
14	1.22151	5.60	-9.20	12.56	18.16	3.36	56.00	46.00	37.8	42.6	L1	

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

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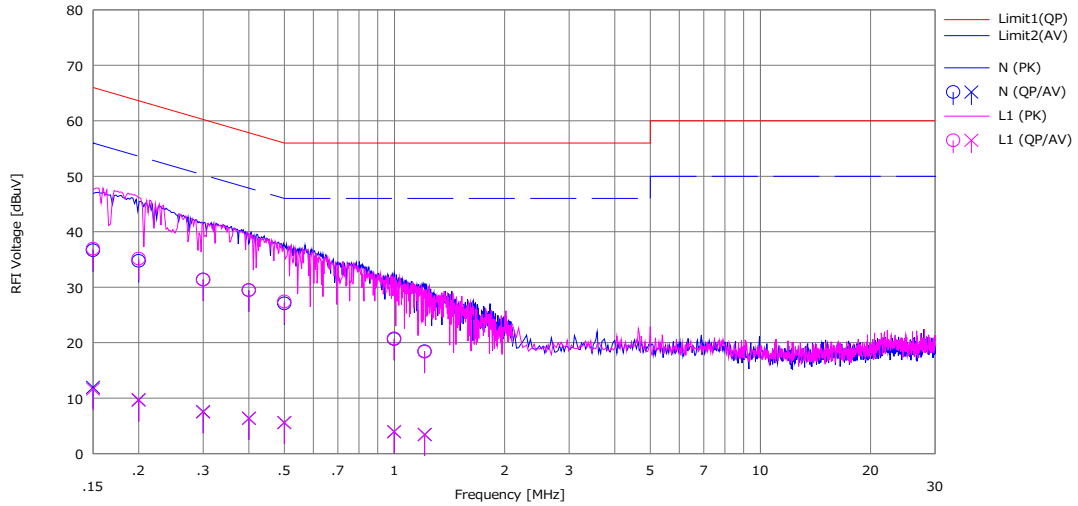
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

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Conducted Emission

Report No. 13704855S-E
Test place Shonan EMC Lab. No.6 Shielded Room
Date March 23, 2021
Temperature / Humidity 22 deg. C / 35 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 2480 MHz
Remarks Supply Voltage DC 3 V (AC 120 V, 60 Hz)



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
		[dBuV]	[dBuV]		[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	24.20	-0.50	12.45	36.65	11.95	66.00	56.00	29.3	44.0	N	
2	0.20006	22.30	-2.80	12.44	34.74	9.64	63.61	53.61	28.8	43.9	N	
3	0.30004	18.90	-4.90	12.47	31.37	7.57	60.24	50.24	28.8	42.6	N	
4	0.40006	17.00	-6.10	12.45	29.45	6.35	57.85	47.85	28.4	41.5	N	
5	0.50008	14.60	-6.90	12.48	27.08	5.58	56.00	46.00	28.9	40.4	N	
6	0.99823	8.10	-8.60	12.53	20.63	3.93	56.00	46.00	35.3	42.0	N	
7	1.20895	5.90	-9.10	12.54	18.44	3.44	56.00	46.00	37.5	42.5	N	
8	0.15000	24.50	-0.80	12.44	36.94	11.64	66.00	56.00	29.0	44.3	L1	
9	0.20005	22.70	-2.70	12.45	35.15	9.75	63.61	53.61	28.4	43.8	L1	
10	0.30002	18.90	-5.00	12.47	31.37	7.47	60.24	50.24	28.8	42.7	L1	
11	0.40001	17.00	-6.10	12.48	29.48	6.38	57.85	47.85	28.3	41.4	L1	
12	0.50002	14.90	-6.90	12.50	27.40	5.60	56.00	46.00	28.6	40.4	L1	
13	0.99825	8.20	-8.60	12.56	20.76	3.96	56.00	46.00	35.2	42.0	L1	
14	1.20890	5.80	-9.10	12.56	18.36	3.46	56.00	46.00	37.6	42.5	L1	

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

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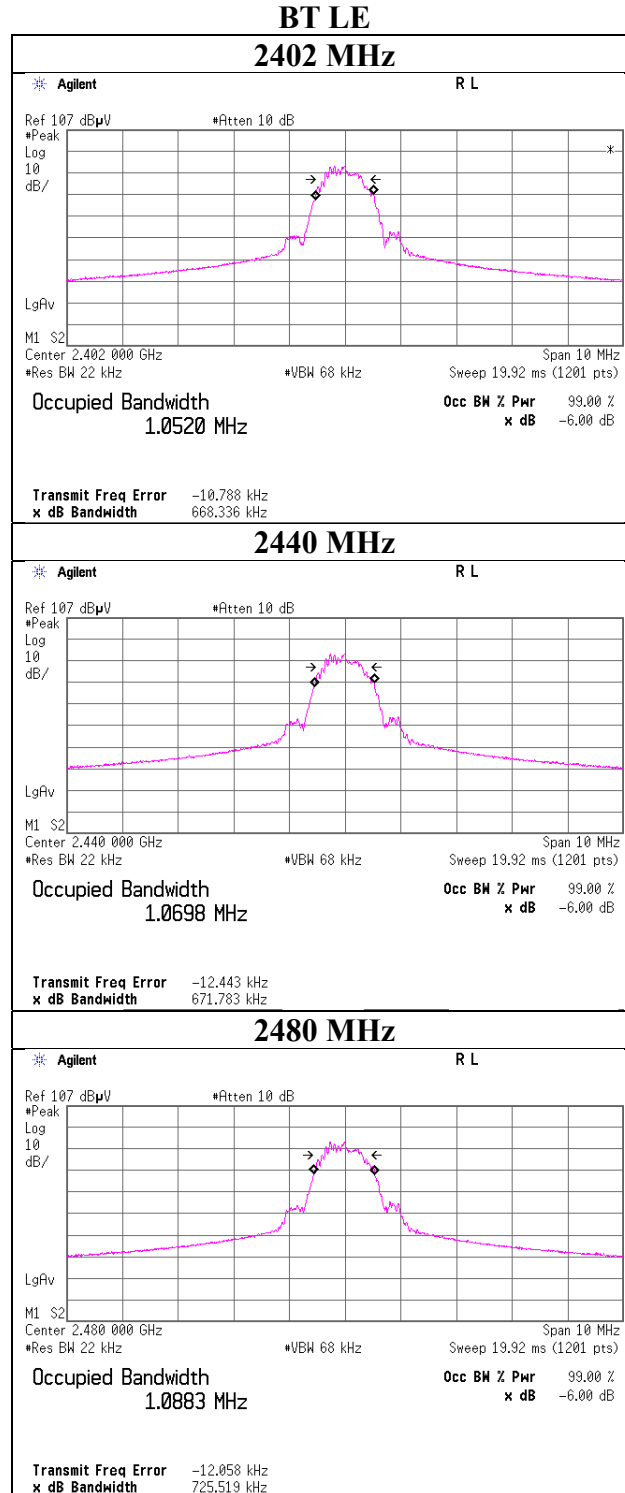
Facsimile : +81 463 50 6401

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 13704855S-E
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 19, 2021
Temperature / Humidity 20 deg. C / 49 % RH
Engineer Shiro Kobayashi
Mode Tx BT LE

Mode	Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
BT LE	2402	1052.0	0.721	> 0.5000
	2440	1069.8	0.733	> 0.5000
	2480	1088.3	0.741	> 0.5000

99 % Occupied Bandwidth



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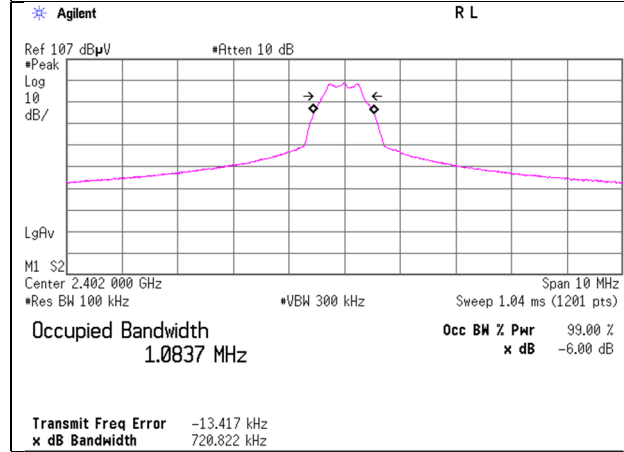
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Facsimile : +81 463 50 6401

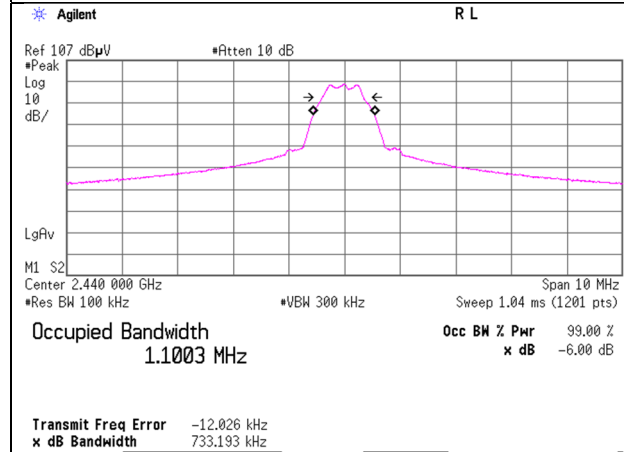
6 dB Bandwidth

BT LE

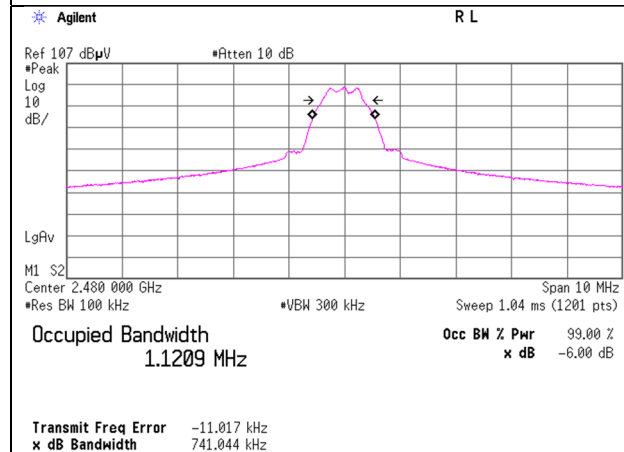
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No. 13704855S-E
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 19, 2021
Temperature / Humidity 23 deg. C / 49 % RH
Engineer Shiro Kobayashi
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-10.65	1.40	9.64	0.39	1.09	30.00	1000	29.61	-15.65	-15.26	0.03	36.02	4000	51.28
2440	-10.39	1.41	9.64	0.66	1.16	30.00	1000	29.34	-15.65	-14.99	0.03	36.02	4000	51.01
2480	-10.80	1.42	9.64	0.26	1.06	30.00	1000	29.74	-15.65	-15.39	0.03	36.02	4000	51.41

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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Shonan EMC Lab.

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Average Output Power
(Reference data for RF Exposure)

Report No. 13704855S-E
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 19, 2021
Temperature / Humidity 23 deg. C / 49 % RH
Engineer Shiro Kobayashi
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	-13.11	1.40	9.64	-2.07	0.62	1.95	-0.12	0.97
2440	-13.19	1.41	9.64	-2.14	0.61	1.95	-0.19	0.96
2480	-13.36	1.42	9.64	-2.30	0.59	1.95	-0.35	0.92

Sample Calculation:

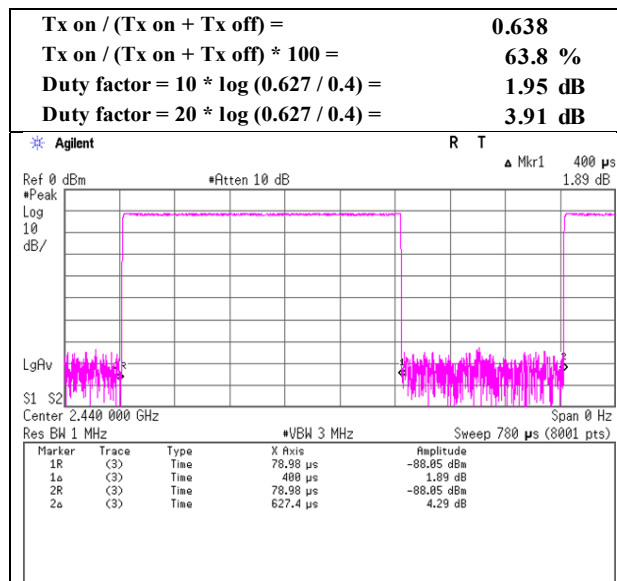
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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. 13704855S-E
 Test place Shonan EMC Lab. No.5 Shielded Room
 Date March 19, 2021
 Temperature / Humidity 23 deg. C / 49 % RH
 Engineer Shiro Kobayashi
 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.	13704855S-E	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 21, 2021	March 23, 2021
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 30 % RH
Engineer	Toshinori Yamada	Yosuke Murakami
	(9 kHz - 30 MHz)	(30 MHz - 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.	30.552	QP	22.20	18.58	6.82	31.92	0.00	15.68	40.0	24.3	300	359	-
Hori.	199.575	QP	22.00	16.59	8.83	31.78	0.00	15.64	43.5	27.8	150	0	-
Hori.	890.401	QP	20.90	22.09	9.43	30.91	0.00	21.51	46.0	24.4	150	359	-
Hori.	2390.000	PK	47.04	28.41	14.41	41.62	2.47	50.71	73.9	23.1	184	0	-
Hori.	4804.000	PK	55.72	31.60	7.06	42.89	2.47	53.96	73.9	19.9	167	5	-
Hori.	7206.000	PK	52.23	37.60	8.57	43.39	2.47	57.48	73.9	16.4	129	338	-
Hori.	9608.000	PK	49.13	38.92	9.71	43.18	2.47	57.05	73.9	16.8	150	0	-
Hori.	9608.000	AV	39.87	38.92	9.71	43.18	2.47	47.79	53.9	6.1	150	0	Floor noise
Vert.	31.594	QP	22.70	18.12	6.85	31.92	0.00	15.75	40.0	24.2	100	0	-
Vert.	185.655	QP	22.00	16.21	8.76	31.79	0.00	15.18	43.5	28.3	100	359	-
Vert.	823.201	QP	21.50	20.86	9.13	31.22	0.00	20.27	46.0	25.7	100	0	-
Vert.	958.501	QP	20.80	22.08	9.72	30.42	0.00	22.18	46.0	23.8	100	359	-
Vert.	2390.000	PK	46.88	28.41	14.41	41.62	2.47	50.55	73.9	23.3	186	244	-
Vert.	4804.000	PK	53.51	31.60	7.06	42.89	2.47	51.75	73.9	22.1	186	267	-
Vert.	7206.000	PK	50.68	37.60	8.57	43.39	2.47	55.93	73.9	17.9	172	220	-
Vert.	9608.000	PK	50.29	38.92	9.71	43.18	2.47	58.21	73.9	15.6	150	0	-
Vert.	9608.000	AV	38.47	38.92	9.71	43.18	2.47	46.39	53.9	7.5	150	0	Floor noise

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

Distance factor : 1 GHz - 10 GHz : 20log(3.985 m / 3.0 m) = 2.47 dB

10 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	36.07	28.41	14.41	41.62	3.91	2.47	43.65	53.9	10.2	*1)
Hori.	4804.000	AV	47.32	31.60	7.06	42.89	3.91	2.47	49.47	53.9	4.4	-
Hori.	7206.000	AV	41.40	37.60	8.57	43.39	3.91	2.47	50.56	53.9	3.3	-
Vert.	2390.000	AV	36.41	28.41	14.41	41.62	3.91	2.47	43.99	53.9	9.9	*1)
Vert.	4804.000	AV	45.71	31.60	7.06	42.89	3.91	2.47	47.86	53.9	6.0	-
Vert.	7206.000	AV	40.72	37.60	8.57	43.39	3.91	2.47	49.88	53.9	4.0	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.985 m / 3.0 m) = 2.47 dB

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

Duty factor refer to "Burst rate confirmation" 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	75.16	28.38	14.43	41.63	2.47	78.81	-	-	Carrier
Hori.	2400.000	PK	40.83	28.38	14.42	41.63	2.47	44.47	58.8	14.3	-
Vert.	2402.000	PK	72.63	28.38	14.43	41.63	2.47	76.28	-	-	Carrier
Vert.	2400.000	PK	40.84	28.38	14.42	41.63	2.47	44.48	56.2	11.7	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.985 m / 3.0 m) = 2.47 dB

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

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Shonan EMC Lab.

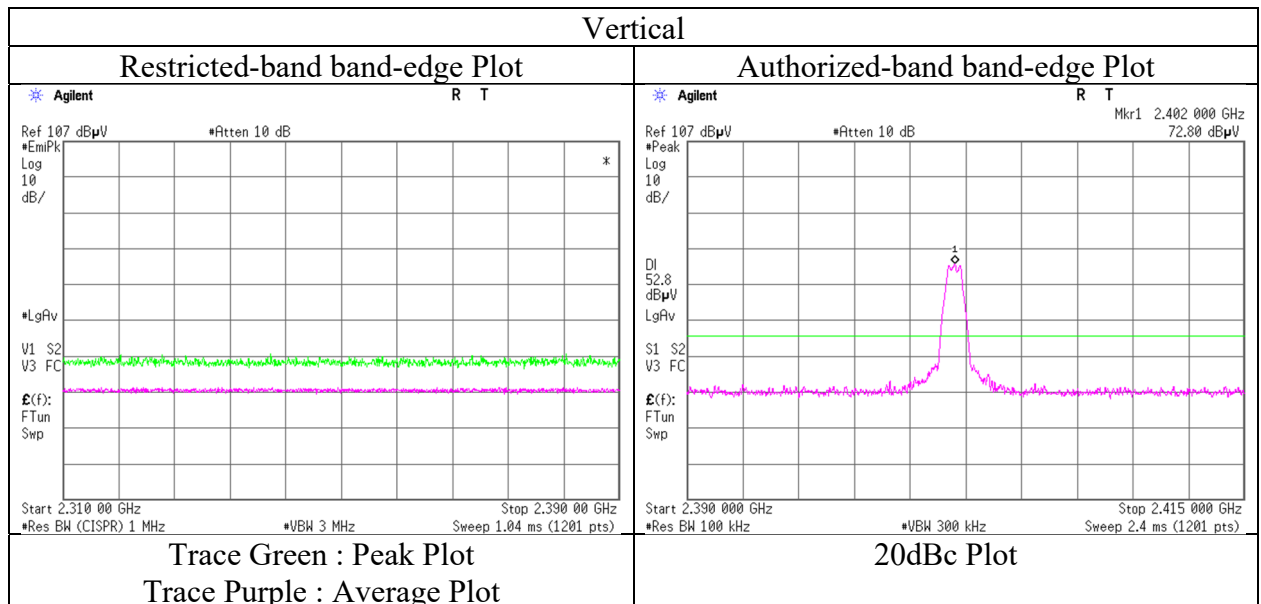
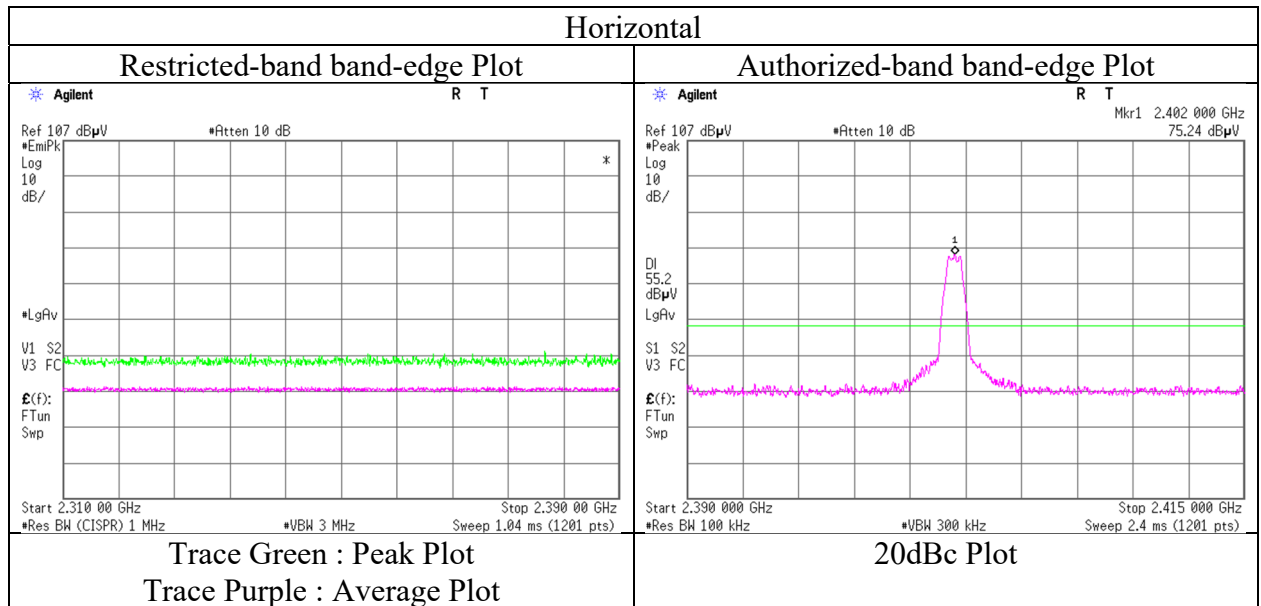
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13704855S-E
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	March 21, 2021
Temperature / Humidity	23 deg. C / 53 % RH
Engineer	Toshinori Yamada
Mode	Tx BT LE 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	13704855S-E	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 21, 2021	March 23, 2021
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 30 % RH
Engineer	Toshinori Yamada	Yosuke Murakami
	(9 kHz - 30 MHz)	(30 MHz - 1 GHz)
	(1 GHz - 10 GHz)	(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.	31.360	QP	22.60	18.21	6.84	31.92	0.00	15.73	40.0	24.2	300	0	-
Hori.	195.346	QP	21.90	16.50	8.80	31.78	0.00	15.42	43.5	28.0	150	359	-
Hori.	889.608	QP	21.00	22.09	9.42	30.92	0.00	21.59	46.0	24.4	150	0	-
Hori.	4880.000	PK	53.25	31.63	7.11	42.89	2.47	51.57	73.9	22.3	148	8	-
Hori.	7320.000	PK	50.62	37.71	8.65	43.52	2.47	55.93	73.9	17.9	117	347	-
Hori.	9760.000	PK	47.96	39.19	9.79	42.98	2.47	56.43	73.9	17.4	150	0	-
Hori.	9760.000	AV	37.44	39.19	9.79	42.98	2.47	45.91	53.9	7.9	150	0	Floor noise
Vert.	32.210	QP	22.50	17.87	6.87	31.92	0.00	15.32	40.0	24.6	100	359	-
Vert.	181.364	QP	21.80	16.10	8.74	31.79	0.00	14.85	43.5	28.6	100	0	-
Vert.	596.699	QP	21.60	19.14	8.09	31.60	0.00	17.23	46.0	28.7	100	359	-
Vert.	938.404	QP	20.80	21.87	9.63	30.57	0.00	21.73	46.0	24.2	100	0	-
Vert.	4880.000	PK	52.74	31.63	7.11	42.89	2.47	51.06	73.9	22.8	227	265	-
Vert.	7320.000	PK	48.80	37.71	8.65	43.52	2.47	54.11	73.9	19.7	100	0	-
Vert.	9760.000	PK	48.23	39.19	9.79	42.98	2.47	56.70	73.9	17.2	150	0	-
Vert.	9760.000	AV	38.08	39.19	9.79	42.98	2.47	46.55	53.9	7.3	150	0	Floor noise

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

Distance factor : 1 GHz - 10 GHz : 20log(3.985 m / 3.0 m) = 2.47 dB

10 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.	4880.000	AV	45.00	31.63	7.11	42.89	3.91	2.47	47.23	53.9	6.6	-
Hori.	7320.000	AV	39.69	37.71	8.65	43.52	3.91	2.47	48.91	53.9	4.9	-
Vert.	4880.000	AV	43.76	31.63	7.11	42.89	3.91	2.47	45.99	53.9	7.9	-
Vert.	7320.000	AV	39.03	37.71	8.65	43.52	3.91	2.47	48.25	53.9	5.6	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.985 m / 3.0 m) = 2.47 dB

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

Duty factor refer to "Burst rate confirmation" sheet.

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Radiated Spurious Emission

Report No.	13704855S-E	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 21, 2021	March 23, 2021
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 30 % RH
Engineer	Toshinori Yamada	Yosuke Murakami
	(9 kHz - 30 MHz)	(30 MHz - 1 GHz)
	(1 GHz - 10 GHz)	(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.	31.424	QP	22.70	18.18	6.84	31.92	0.00	15.80	40.0	24.2	150	359	-
Hori.	192.095	QP	22.00	16.34	8.78	31.79	0.00	15.33	43.5	28.1	150	0	-
Hori.	880.809	QP	21.20	22.11	9.39	30.96	0.00	21.74	46.0	24.2	100	359	-
Hori.	2483.500	PK	54.53	28.28	14.51	41.65	2.47	58.14	73.9	15.7	194	0	-
Hori.	4960.000	PK	53.82	31.79	7.18	42.89	2.47	52.37	73.9	21.5	177	7	-
Hori.	7440.000	PK	49.14	37.88	8.72	43.65	2.47	54.56	73.9	19.3	227	0	-
Hori.	9920.000	PK	48.29	39.05	9.87	42.77	2.47	56.91	73.9	16.9	150	0	-
Hori.	9920.000	AV	38.32	39.05	9.87	42.77	2.47	46.94	53.9	6.9	150	0	Floor noise
Vert.	30.446	QP	22.10	18.64	6.82	31.92	0.00	15.64	40.0	24.3	100	0	-
Vert.	196.004	QP	22.00	16.49	8.80	31.78	0.00	15.51	43.5	27.9	100	359	-
Vert.	827.900	QP	22.60	20.91	9.15	31.21	0.00	21.45	46.0	24.5	100	0	-
Vert.	921.700	QP	20.80	22.00	9.56	30.70	0.00	21.66	46.0	24.3	100	359	-
Vert.	2483.500	PK	50.71	28.28	14.51	41.65	2.47	54.32	73.9	19.5	210	241	-
Vert.	4960.000	PK	53.32	31.79	7.18	42.89	2.47	51.87	73.9	22.0	187	215	-
Vert.	7440.000	PK	48.86	37.88	8.72	43.65	2.47	54.28	73.9	19.6	143	261	-
Vert.	9920.000	PK	47.81	39.05	9.87	42.77	2.47	56.43	73.9	17.4	150	0	-
Vert.	9920.000	AV	37.91	39.05	9.87	42.77	2.47	46.53	53.9	7.3	150	0	Floor noise

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.985\text{ m} / 3.0\text{ m}) = 2.47\text{ dB}$

10 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	37.27	28.28	14.51	41.65	3.91	2.47	44.79	53.9	9.1	*1)
Hori.	4960.000	AV	45.71	31.79	7.18	42.89	3.91	2.47	48.17	53.9	5.7	-
Hori.	7440.000	AV	40.33	37.88	8.72	43.65	3.91	2.47	49.66	53.9	4.2	-
Vert.	2483.500	AV	38.43	28.28	14.51	41.65	3.91	2.47	45.95	53.9	7.9	*1)
Vert.	4960.000	AV	45.65	31.79	7.18	42.89	3.91	2.47	48.11	53.9	5.7	-
Vert.	7440.000	AV	39.45	37.88	8.72	43.65	3.91	2.47	48.78	53.9	5.1	-

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.985\text{ m} / 3.0\text{ m}) = 2.47\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Burst rate confirmation" sheet.

*1) Not out of band emission (Leakage Power)

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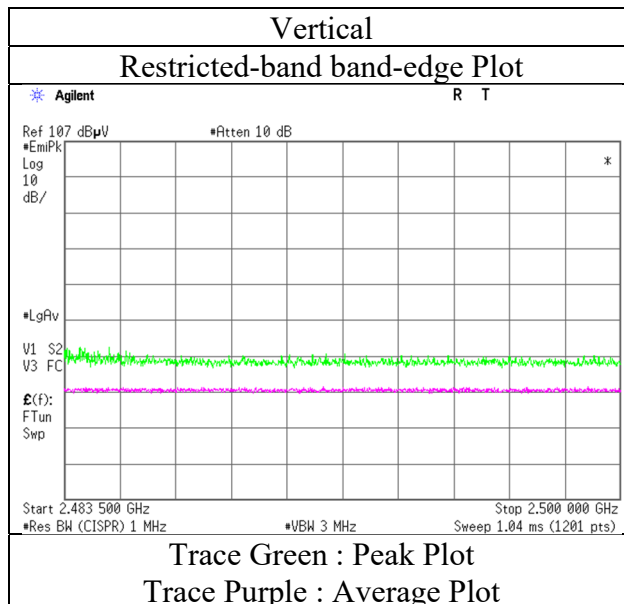
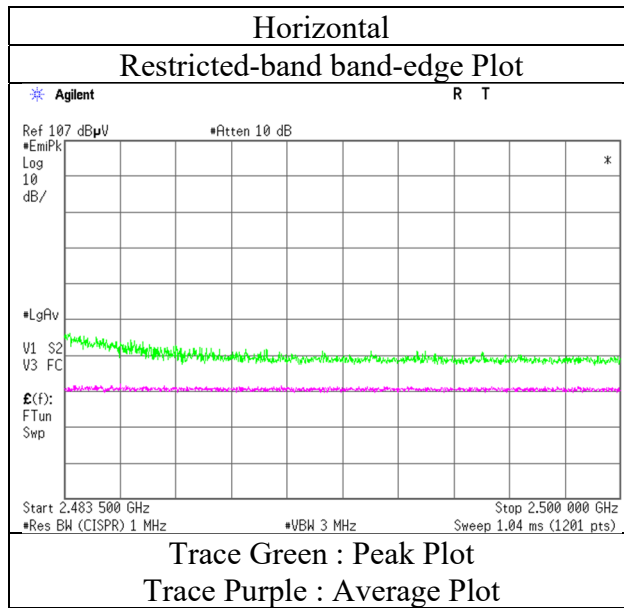
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Radiated Spurious Emission
(Reference Plot for band-edge)

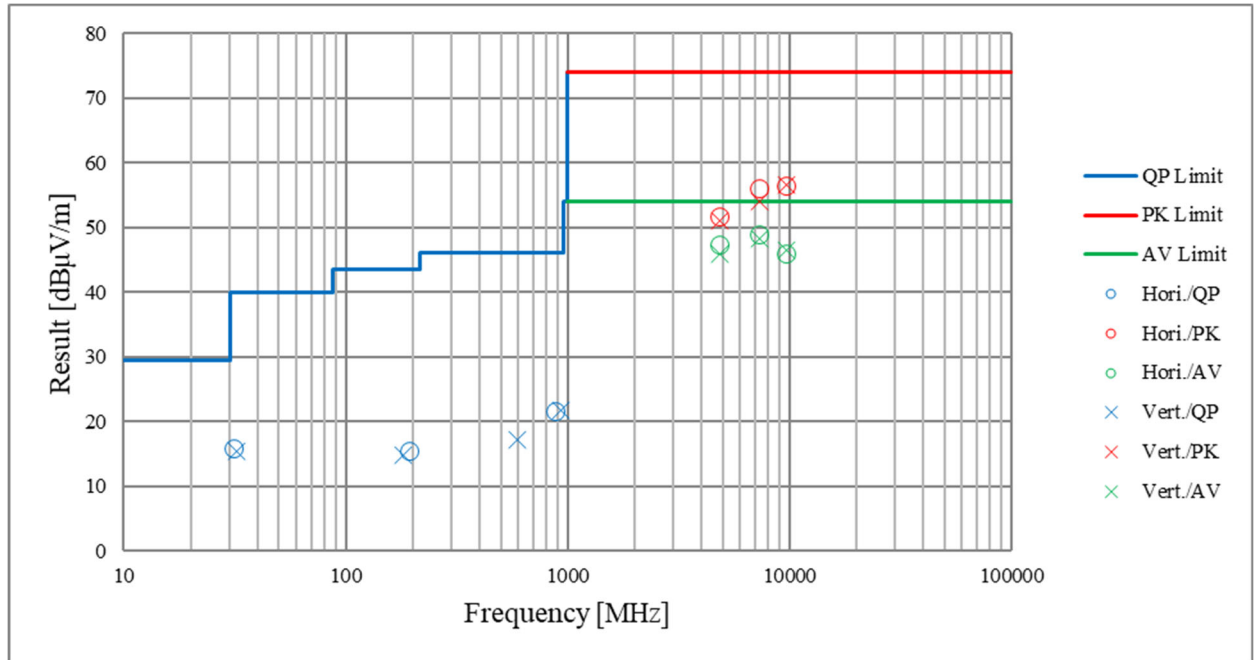
Report No. 13704855S-E
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date March 21, 2021
Temperature / Humidity 23 deg. C / 53 % RH
Engineer Toshinori Yamada
Mode Tx BT LE 2480 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	13704855S-E	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 21, 2021	March 23, 2021
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 30 % RH
Engineer	Toshinori Yamada (9 kHz - 30 MHz) (1 GHz - 10 GHz)	Yosuke Murakami (30 MHz - 1 GHz) (10 GHz - 26.5 GHz)
Mode	Tx BT LE 2440 MHz	

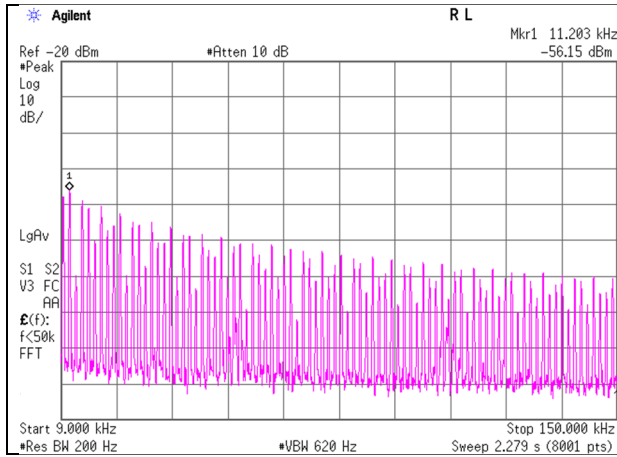


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

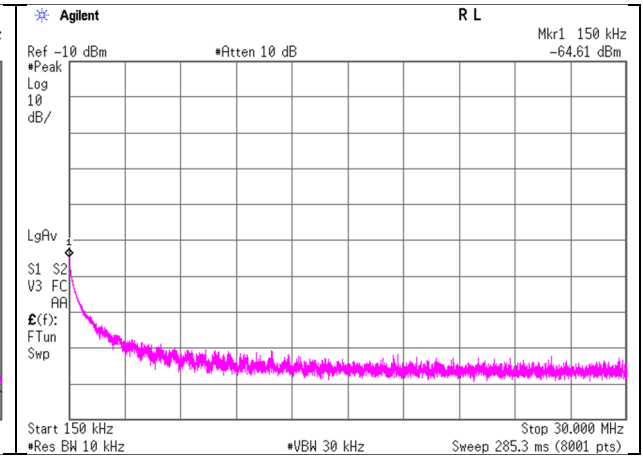
Conducted Spurious Emission

Report No. 13704855S-E
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 19, 2021
Temperature / Humidity 20 deg. C / 49 % RH
Engineer Shiro Kobayashi
Mode Tx BT LE 2402 MHz

9 kHz – 150 k Hz



150 kHz – 30 M Hz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator [dB]	Antenna Gain* [dBi]	N (Number of output)	EIRP [dBm]	D Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.203	-56.15	0.35	9.55	2.00	1	-44.25	300	6.00	17.01	46.62	29.61	-
150.000	-64.61	0.35	9.55	2.00	1	-52.71	300	6.00	8.55	24.08	15.53	-

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

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

N: Number of output

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

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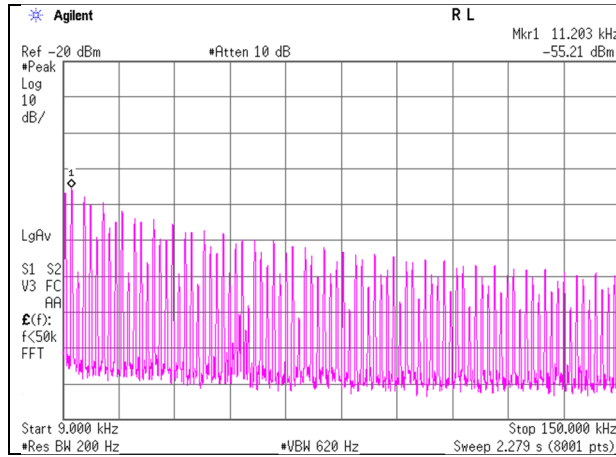
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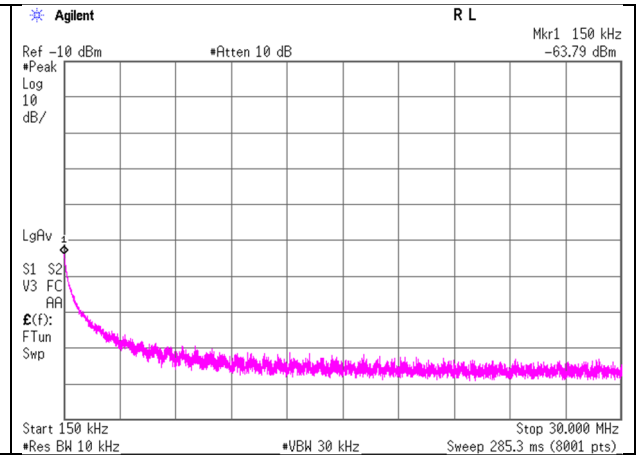
Conducted Spurious Emission

Report No. 13704855S-E
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 19, 2021
Temperature / Humidity 20 deg. C / 49 % RH
Engineer Shiro Kobayashi
Mode Tx BT LE 2440 MHz

9 kHz – 150 kHz



150 kHz – 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator [dB]	Antenna Gain* [dBi]	N (Number of output)	EIRP [dBm]	D Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.203	-55.21	0.35	9.55	2.00	1	-43.31	300	6.00	17.95	46.62	28.67	-
150.000	-63.79	0.35	9.55	2.00	1	-51.89	300	6.00	9.37	24.08	14.71	-

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

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

N: Number of output

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

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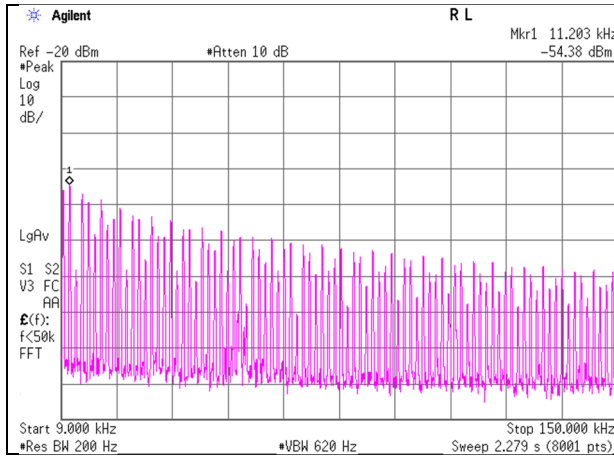
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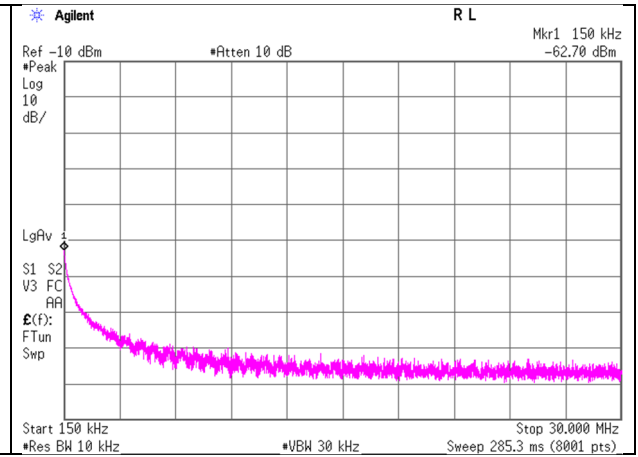
Conducted Spurious Emission

Report No. 13704855S-E
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 19, 2021
Temperature / Humidity 20 deg. C / 49 % RH
Engineer Shiro Kobayashi
Mode Tx BT LE 2480 MHz

9 kHz – 150 kHz



150 kHz – 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator [dB]	Antenna Gain* [dBi]	N (Number of output)	EIRP [dBm]	D Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.203	-54.38	0.35	9.55	2.00	1	-42.48	300	6.00	18.78	46.62	27.84	-
150.000	-62.70	0.35	9.55	2.00	1	-50.80	300	6.00	10.46	24.08	13.62	-

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

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

N: Number of output

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

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Power Density

Report No. 13704855S-E
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 19, 2021
Temperature / Humidity 20 deg. C / 49 % RH
Engineer Shiro Kobayashi
Mode Tx BT LE

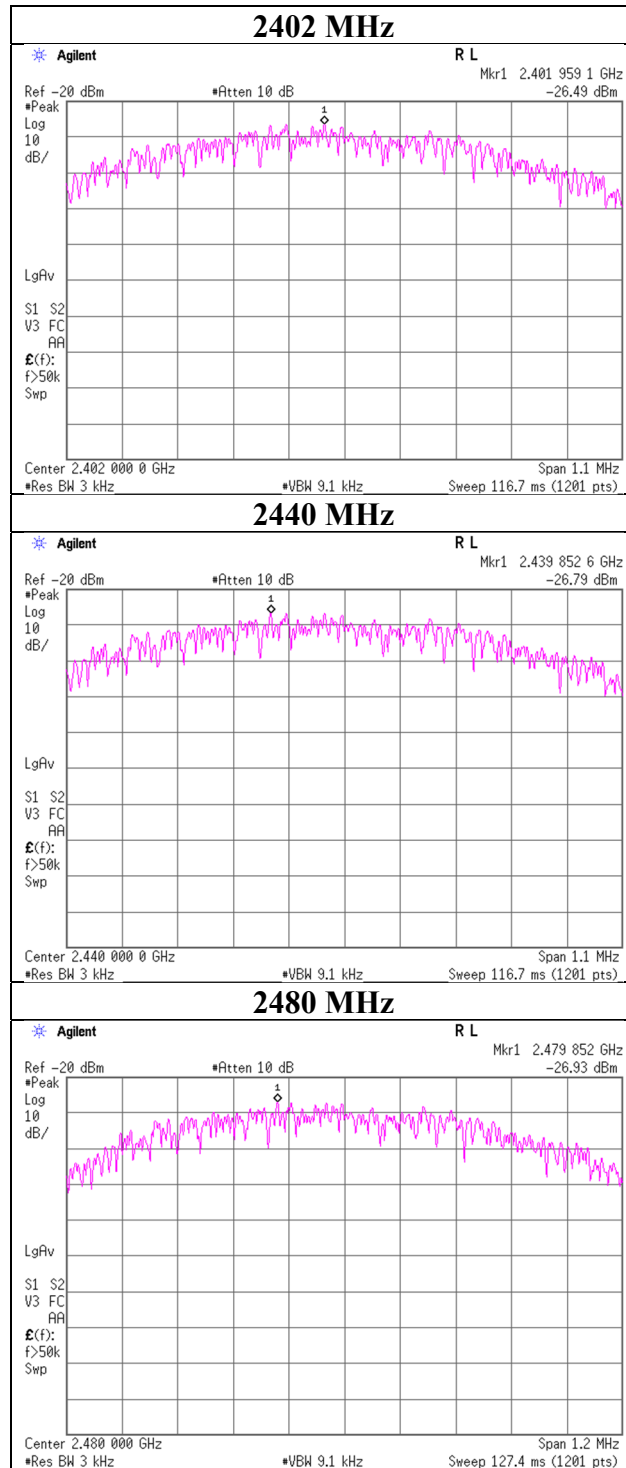
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm/3 kHz]	[dB]	[dB]	[dBm/3 kHz]	[dBm/3 kHz]	[dB]
2402	-26.49	1.40	9.64	-15.45	8.00	23.45
2440	-26.79	1.41	9.64	-15.74	8.00	23.74
2480	-26.93	1.42	9.64	-15.87	8.00	23.87

Sample Calculation:

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

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

Power Density



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APPENDIX 2: Test instruments

Test equipment (1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	SAT10-09	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2020/10/05	12
AT	SCC-G67	196949	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803480/2	2021/03/01	12
AT	SOS-27	191845	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2020/09/29	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-02	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2020/04/16	12
AT	STS-05	146212	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997828	2020/10/19	12
CE	KTS-06	145110	Digital Tester	SANWA	PC500	7019240	2020/04/09	12
CE	SAT3-13	150923	Attenuator	JFW	50HF-003N	-	2021/01/26	12
CE	SCC-05	145033	Coaxial Cable	Fujikura	5D2W	-	2020/04/17	12
CE	SJM-18	147480	Measure	ASKUL	-	-	-	-
CE	SLS-02	145539	LISN	Rohde & Schwarz	ENV216	100512	2021/02/24	12
CE	SOS-05	146293	Humidity Indicator	A&D Company	AD-5681	4062518	2020/09/30	12
CE	STR-06	146208	Test Receiver	Rohde & Schwarz	ESCI	101259	2020/04/01	12
RE, CE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	KSA-08	145089	Spectrum Analyzer	Keysight Technologies Inc	E4446A	MY46180525	2020/11/24	12
RE	SAEC-03(NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2020/04/12	12
RE	SAEC-03(SVSWR)	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2020/05/11	12
RE	SAF-03	145126	Pre Amplifier	SONOMA	310N	290213	2021/02/10	12
RE	SAF-06	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2021/02/08	12
RE	SAF-08	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2021/03/01	12
RE	SAT10-05	145136	Attenuator	Keysight Technologies Inc	8493C-010	74864	2020/10/05	12
RE	SAT6-13	167094	Attenuator	JFW	50HF-006N	-	2021/02/10	12
RE	SAT6-15	167096	Attenuator	JFW	50HF-006N	-	2021/02/10	12
RE	SBA-03	145023	Biconical Antenna	Schwarzbeck Mess - Elektronik	BBA9106	91032666	2020/05/17	12
RE	SCC-C1/C2/C3/C4/C5/C10/SRSE-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2020/04/12	12
RE	SCC-G15	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2021/03/01	12
RE	SCC-G40	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	2021/01/19	12
RE	SCC-G43	156380	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	SN MY 13406/4E	2020/06/04	12
RE	SCC-G57	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2020/05/12	12
RE	SCC-G58	183047	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800287/4A	2020/06/04	12

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Test equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	SCC-G70	200010	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575618/4	2020/07/07	12
RE	SCC-M1	194601	Coaxial Cable	Fjikura	5D-2W	-	2020/12/10	12
RE	SFL-02	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2020/10/05	12
RE	SHA-03	145501	Horn Antenna	Schwarzbeck Mess - Elektronik	BBHA9120D	9120D-739	2020/06/15	12
RE	SHA-04	145512	Horn Antenna	ETS-Lindgren	3160-09	00094868	2020/06/15	12
RE	SHA-10	194685	Horn Antenna	Schwarzbeck Mess - Elektronik	BBHA 9120 C	711	2021/03/03	12
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck Mess - Elektronik	VUSLP9111B	196	2020/05/17	12
RE	SLP-02	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2020/04/15	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2020/09/28	12
RE	STR-08	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2020/12/02	12
RE	STS-03	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2020/10/19	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

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