



RADIO TEST REPORT

Test Report No. : 13692047S-A-R2

Applicant : CASIO COMPUTER CO., LTD.
Type of EUT : Motion Sensor
Model Number of EUT : CMT-S20R-AS
FCC ID : BBQCMTS20RAS
Test regulation : FCC Part 15 Subpart C: 2021
Test Result : Complied (Refer to SECTION 3)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13692047S-A-R1. 13692047S-A-R1 is replaced with this report.

Date of test: February 10 to May 24, 2021

Representative test engineer: 
Yasumasa Owaki
Engineer

Approved by: 
Akio Hayashi
Manager



CERTIFICATE 1266.03

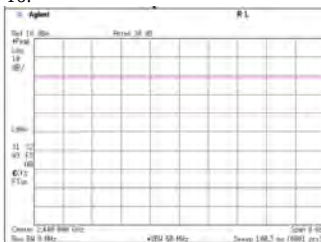
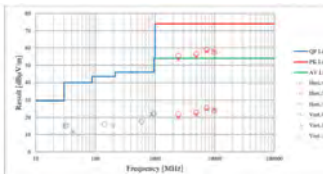
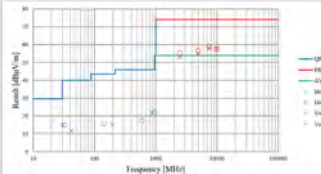
- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
- ☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13692047S-A

Revision	Test report No.	Date	Page revised	Contents																																																																								
- (Original)	13692047S-A	June 24, 2021	-	-																																																																								
1	13692047S-A-R1	September 22, 2021	P.1, P.5, P.10	Correction of "Type of EUT" From: RUNNING Sensor To: Motion Sensor																																																																								
			P.5	Addition of "Clock frequency (Maximum): 32 MHz"																																																																								
			P.9	Deletion the following - "Power settings of -40 dBm" - "*2) Other than Maximum Peak Output Power test, power setting is 8 dBm."																																																																								
			P.18	Deletion the following - "power setting: 8 dBm" - data <table><tr><th colspan="4">power setting: -40 dBm</th><th colspan="4">Conducted Power</th><th colspan="4">e.i.r.p. for RSS-347</th></tr><tr><th>Freq.</th><th>Reading</th><th>Cable Loss</th><th>Atten. Loss</th><th>Result</th><th>Limit</th><th>Margin</th><th>Antenna Gain</th><th>Result</th><th>Limit</th><th>Margin</th><th></th></tr><tr><th>[MHz]</th><th>[dBm]</th><th>[dB]</th><th>[dB]</th><th>[dBm]</th><th>[mW]</th><th>[dBm]</th><th>[mW]</th><th>[dB]</th><th>[dBm]</th><th>[mW]</th><th>[dBm]</th></tr><tr><td>2402</td><td>-39.20</td><td>2.20</td><td>0.00</td><td>-37.00</td><td>0.00</td><td>30.00</td><td>1000</td><td>67.00</td><td>0.79</td><td>-36.21</td><td>0.00</td></tr><tr><td>2440</td><td>-39.44</td><td>2.27</td><td>0.00</td><td>-37.17</td><td>0.00</td><td>30.00</td><td>1000</td><td>67.17</td><td>0.79</td><td>-36.38</td><td>0.00</td></tr><tr><td>2480</td><td>-39.83</td><td>2.21</td><td>0.00</td><td>-37.62</td><td>0.00</td><td>30.00</td><td>1000</td><td>67.62</td><td>0.79</td><td>-36.83</td><td>0.00</td></tr></table>	power setting: -40 dBm				Conducted Power				e.i.r.p. for RSS-347				Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin	Antenna Gain	Result	Limit	Margin		[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBm]	[mW]	[dBm]	2402	-39.20	2.20	0.00	-37.00	0.00	30.00	1000	67.00	0.79	-36.21	0.00	2440	-39.44	2.27	0.00	-37.17	0.00	30.00	1000	67.17	0.79	-36.38	0.00	2480	-39.83	2.21	0.00	-37.62	0.00	30.00	1000	67.62	0.79	-36.83	0.00
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			P.19	Deletion the following - "power setting: 8 dBm" - data power setting: -40 dBm <table><tr><th>Freq.</th><th>Reading</th><th>Cable Loss</th><th>Atten. Loss</th><th colspan="2">Result (Time average)</th><th>DCCF</th><th colspan="2">Result (Burst power average)</th></tr><tr><th>[MHz]</th><th>[dBm]</th><th>[dB]</th><th>[dB]</th><th>[dBm]</th><th>[mW]</th><th>[dB]</th><th>[dBm]</th><th>[mW]</th></tr><tr><td>2412</td><td>-39.53</td><td>2.20</td><td>0.00</td><td>-37.33</td><td>0.00</td><td>-16.77</td><td>-54.10</td><td>0.00</td></tr><tr><td>2437</td><td>-39.73</td><td>2.27</td><td>0.00</td><td>-37.46</td><td>0.00</td><td>-16.77</td><td>-54.23</td><td>0.00</td></tr><tr><td>2462</td><td>-40.12</td><td>2.21</td><td>0.00</td><td>-37.91</td><td>0.00</td><td>-16.77</td><td>-54.68</td><td>0.00</td></tr></table>	Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		DCCF	Result (Burst power average)		[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]	2412	-39.53	2.20	0.00	-37.33	0.00	-16.77	-54.10	0.00	2437	-39.73	2.27	0.00	-37.46	0.00	-16.77	-54.23	0.00	2462	-40.12	2.21	0.00	-37.91	0.00	-16.77	-54.68	0.00																											
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2	13692047S-A-R2	October 1, 2021	P.5	Addition of Receipt Date of EUT. "March 31, 2021 (DCCF sample)"																																																																								
			P.20	Correction of "Burst rate confirmation chart" From:  To: 																																																																								
			P.27	Correction of "plot data chart" From:  To: 																																																																								

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer information

Company Name : CASIO COMPUTER CO., LTD.
 Address : 2-1, Sakaecho 3-chome, Hamura-shi Tokyo 205-8555, Japan
 Telephone Number : +81-42-579-7375
 Contact Person : Daisuke Uematsu

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 : Motion Sensor
 Model Number : CMT-S20R-AS
 Serial Number : Refer to SECTION 4.2
 Rating : DC 3.8 V (Battery)
 DC 5 V (USB)
 Receipt Date : August 17, 2020
 March 31, 2021 (DCCF sample)
 Country of Mass-production : Philippines
 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: CMT-S20R-AS (referred to as the EUT in this report) is a Motion Sensor.

Radio Specification

Bluetooth Low Energy

Equipment Type : Transceiver
 Frequency of Operation : 2402 MHz - 2480MHz
 Type of Modulation : GFSK
 Antenna Type : Multiband Antenna
 Antenna Gain : 0.79 dBi
 Operating Temperature : -10 deg. C - +40 deg. C
 Clock frequency (Maximum) : 32 MHz

Supported GNSS and GNSS signals

GNSS	RNSS Frequency Band / Frequency [MHz]		
	1559 to 1610	1215 to 1300	1164 to 1215
BDS	☐ B1I 1561.098	-	-
Galileo	☐ E1 1575.42	☐ E6 1278.75	☐ E5a 1176.45
			☐ E5b 1207.14
GLONASS	☒ G1 1598.0625 - 1605.375	☐ G2 1242.9375 - 1248.625	-
GPS	☒ L1 1575.42	☐ L2 1227.6	☐ L5 1176.45
SBAS	☐ L1 1575.42	-	☐ L5 1176.45

- ☒ Supported GNSS signal
☐ Not supported GNSS signal

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021

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

* The revision does not affect the test result conducted before its effective date.

* 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	-	N/A	*1)
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(2) ISED: RSS-247 5.2(a)	See data.	Complied a)	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 b)	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 c)	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	11.4 dB 7206.00 MHz, PK, Hori. Mode: Tx BT LE 2402 MHz, power setting: 8 dBm	Complied d), e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

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

*1) The test is not applicable since the EUT does not output BT LE during charging.

*2) 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 6 dB Bandwidth and 99 % Occupied Bandwidth)

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

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

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

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

Symbols:

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

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

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

FCC Part 15.31 (e)

This EUT provides the stable voltage constantly to the wireless transmitter regardless of input voltage.

Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

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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.

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
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.6 dB	2.56dB
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
	18 GHz-40 GHz	5.3 dB	5.3 dB	5.3 dB
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB
	18 GHz-40 GHz	5.6 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	0.95 deg.C.
Humidity_SCH-01	0.83 %
Temperature_SCH-02	2.0 deg.C.
Humidity_SCH-02	6.6 %
Voltage	0.86 %

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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 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.

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SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

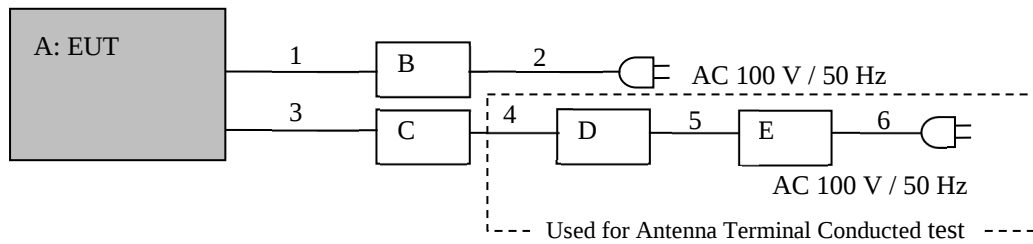
Mode	Remarks*
Bluetooth Low Energy (BT LE)	Maximum Packet Size, PRBS9
*Transmitting duty was 100 % on all tests.	
*Power of the EUT was set by the software as follows; Power settings: 8 dBm *1) Software: TeraTerm Ver. 4.87 (Date: 2021.2.10, Storage location: Driven by connected PC) *1) This power setting is test mode. *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)

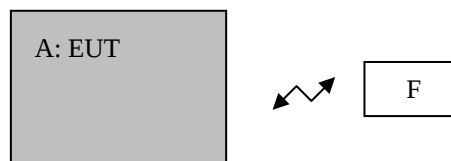
Test Item	Operating Mode	Tested frequency
6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth Spurious Emission (Radiated/Conducted)	BT LE	2402 MHz 2440 MHz 2480 MHz

4.2 Configuration and peripherals

[Antenna Terminal Conducted test and Radiated Emission test]



[Checking for DCCF]



* 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	Motion Sensor	CMT-S20R-AS	CS1-033 *1) CS1-030 *2) No.1 *3)	CASIO COMPUTER CO., LTD.	EUT
B	Power Supply (DC)	PAN60-10A	NL002383	KIKUSUI	*1), *2)
C	jig	-	-	CASIO COMPUTER CO., LTD.	*1), *2)
D	PC	8570p	5CB3310KHW	HP	*1)
E	AC Adapter	PPP009L-E	3453442403	HP	*1)
F	Smart phone	ZenFone 3 X00DDA	H3AXHM0291284 85	ASUS	*3)

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

*3) Used for checking for DCCF

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC	1.5	Unshielded	Unshielded	*1), *2)
2	AC	1.8	Unshielded	Unshielded	*1), *2)
3	Signal	0.15	Unshielded	Unshielded	*1), *2)
4	RS232C	1.1	Shielded	Shielded	*1)
5	DC	0.8	Unshielded	Unshielded	*1)
6	AC	1.8	Unshielded	Unshielded	*1)

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

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SECTION 5: Radiated Spurious Emission

Test Procedure

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

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.0 m by 2.0 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	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

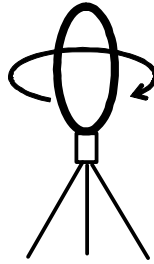
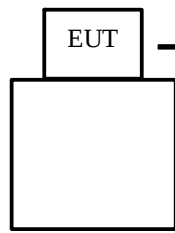
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 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	-	RBW: 100 kHz VBW: 300 kHz

*1) Measurement with Average detector was not performed. The limit for Average detector is applied to the measurement value with Peak detector used Duty cycle correction factor (DCCF).

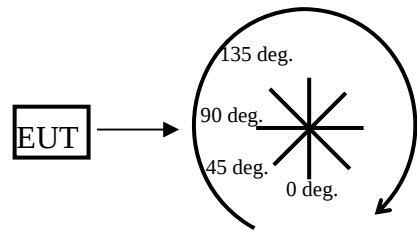
Figure 1. Direction of the Loop Antenna

Side View (Vertical)



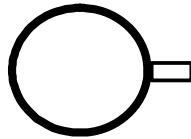
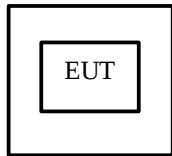
Front side: 0 deg.
Forward direction: clockwise

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

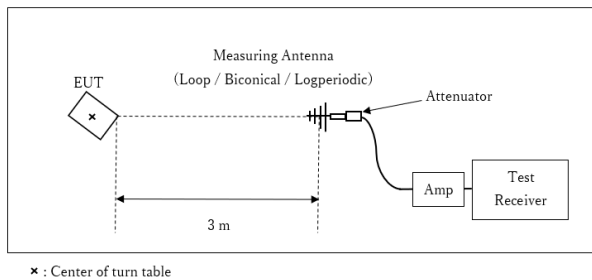
Top View (Horizontal)



Antenna was not rotated.

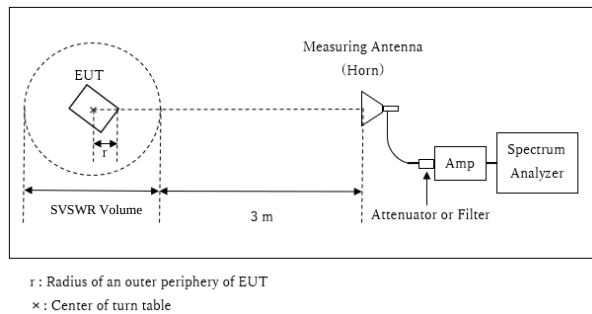
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

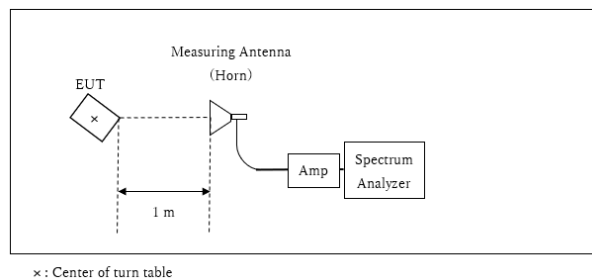
1 GHz - 10 GHz



Distance Factor: $20 \times \log (3.97 \text{ m} / 3.0 \text{ m}) = 2.44 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.97 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.03 m

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

The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Antenna polarization	Carrier	Spurious (Below 30 MHz)	Spurious (30 MHz - 1 GHz)	Spurious (1 GHz - 2.8 GHz)	Spurious (2.8 GHz - 10 GHz)	Spurious (10 GHz - 18 GHz)	Spurious (18 GHz - 26.5 GHz)
Horizontal	Z	X	Z	Z	Y	X	X
Vertical	Y	X	Z	Y	Y	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

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SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 160 MHz BW) Spectrum Analyzer
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) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately and the noise was detected as shown in the chart, and therefore, Radiated Emission below 30MHz was performed.

*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

APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

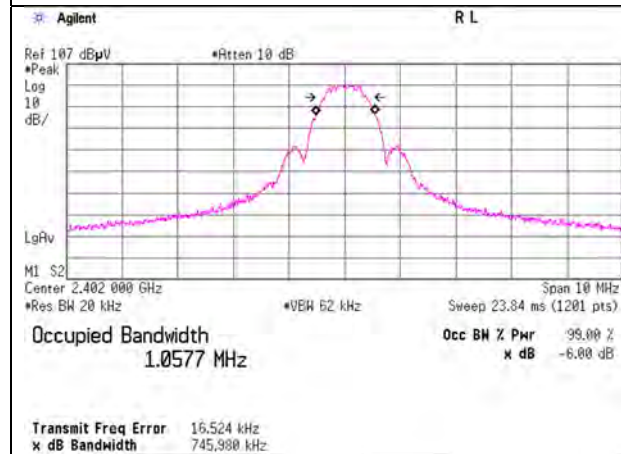
Report No. 13692047S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 29, 2021
Temperature / Humidity 23 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE, power setting: 8 dBm

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BT LE	2402	1057.7	0.732	> 0.5000
	2440	1060.0	0.727	> 0.5000
	2480	1063.0	0.741	> 0.5000

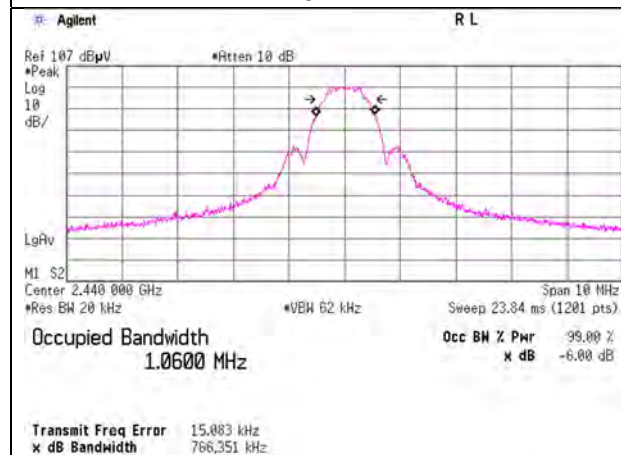
99% Occupied Bandwidth

BT LE

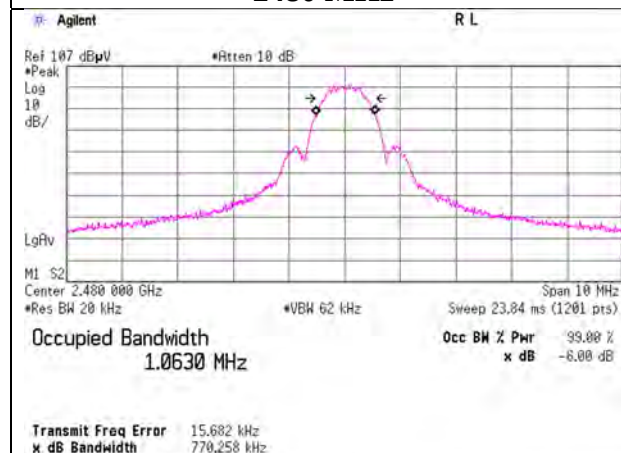
2402 MHz



2440 MHz



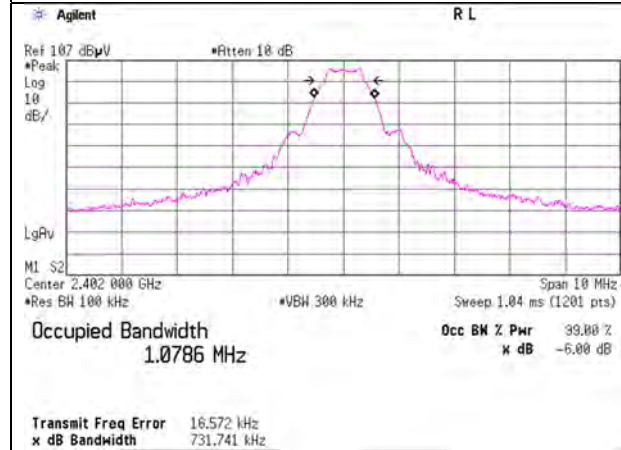
2480 MHz



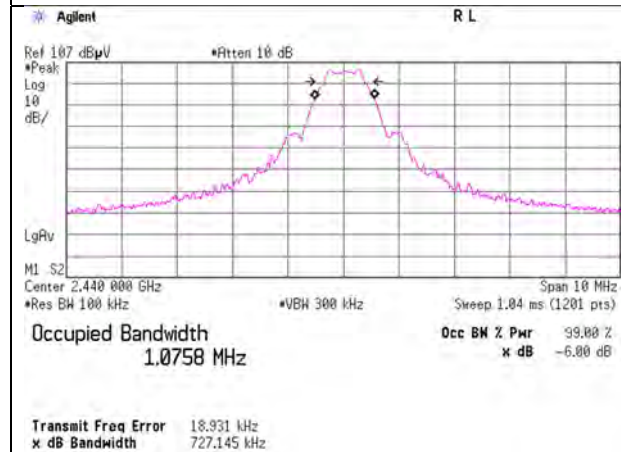
6dB Bandwidth

BT LE

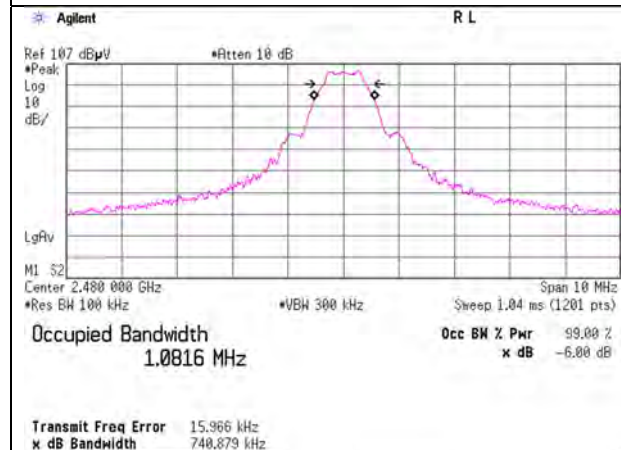
2402 MHz



2440 MHz



2480 MHz



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Maximum Peak Output Power

Report No. 13692047S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 29, 2021
Temperature / Humidity 23 deg. C / 46 % RH
Engineer Toshinori Yamada
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	Antenna Gain	Result		Limit		Margin
				[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-3.62	2.20	10.05	8.63	7.29	30.00	1000	21.37	0.79	9.42	8.75	36.02	4000	26.60
2440	-3.32	2.27	10.05	9.00	7.94	30.00	1000	21.00	0.79	9.79	9.53	36.02	4000	26.23
2480	-3.17	2.21	10.05	9.09	8.11	30.00	1000	20.91	0.79	9.88	9.73	36.02	4000	26.14

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. 13692047S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 29, 2021
Temperature / Humidity 23 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		DCCF [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-3.74	2.20	10.05	8.51	7.10	-16.77	-8.26	0.15
2440	-3.43	2.27	10.05	8.89	7.74	-16.77	-7.88	0.16
2480	-3.29	2.21	10.05	8.97	7.89	-16.77	-7.80	0.17

Sample Calculation:

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

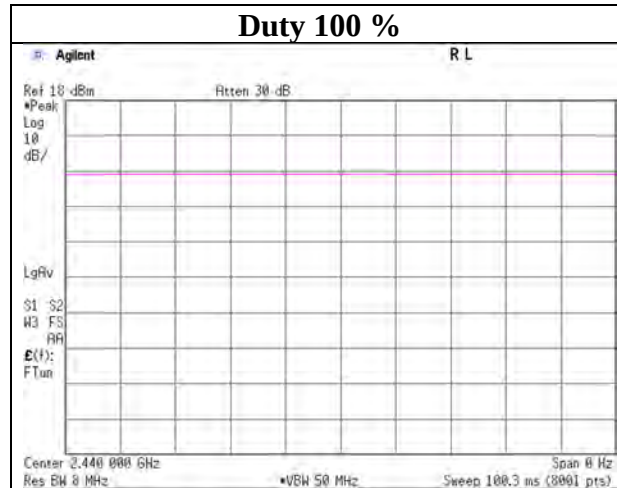
Result (Burst power average) = Time average + DCCF

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

*DCCF refer to "Duty cycle correction factor" sheet.

Burst rate confirmation

Report No. 13692047S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 29, 2021
Temperature / Humidity 23 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE, power setting: 8 dBm



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

Duty cycle correction factor (DCCF)

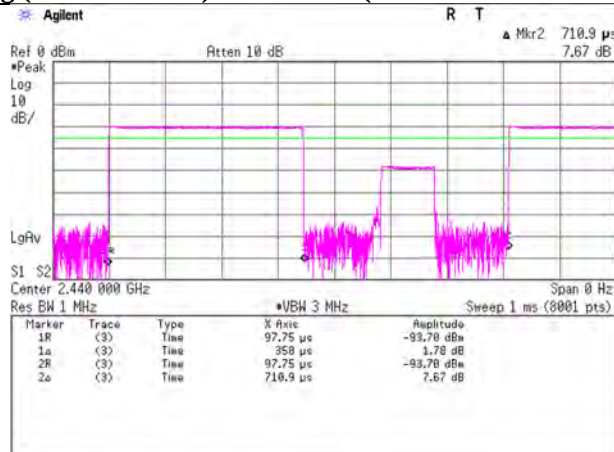
Report No.	13692047S-A-R2
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	April 20, 2021
Temperature / Humidity	25 deg. C / 31 % RH
Engineer	Yusuke Tanikawara
Mode	Tx BT LE, power setting: 8 dBm

Worst 100ms

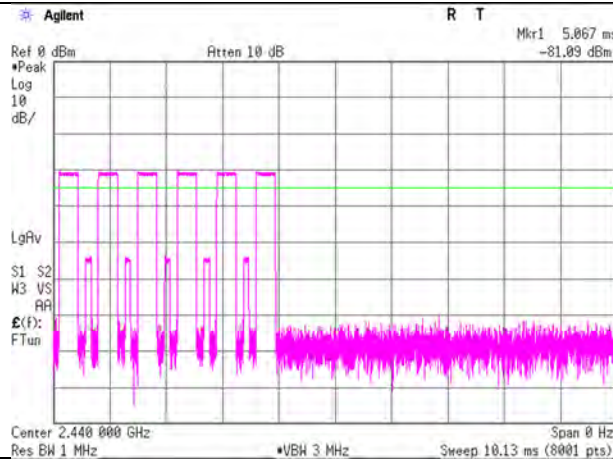
Duty cycle correction factor (DCCF) =

$10 * \log (0.350 \times 6 / 100) = -16.77 \text{ dB}$ (For Antenna Terminal conducted test)

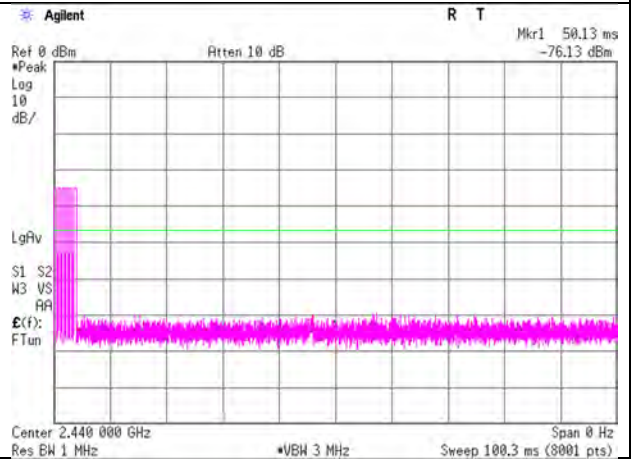
$20 * \log (0.350 \times 6 / 100) = -33.55 \text{ dB}$ (For Radiated Emission test)



Measurement time : 1 msec



Measurement time : 10.13 msec



Measurement time : 100.3 msec

*Worst TX Duty cycle BT LE is transmitting data which maximum on time is 6 times at 0.350 ms and minimum interval is more than 100 ms.

(Refer to BLE Worst TX Duty sheet).

The actual measurement value was applied as Averaging factor (Duty Factor).

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Radiated Spurious Emission

Report No. 13692047S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber 2
Date April 29, 2021 February 10, 2021
Temperature / Humidity 21 deg.C, 61 %RH 23 deg.C, 21 %RH
Engineer Yasumasa Owaki Makoto Hosaka
(30 MHz -1 GHz, 2.8 GHz -26.5 GHz) (1 GHz -2.8 GHz)
Mode Tx BT LE 2402 MHz, power setting: 8 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.285	QP	22.20	17.84	6.88	31.92	0.00	15.00	40.0	25.0	150	177	-
Hori.	142.735	QP	24.80	14.46	8.47	31.83	0.00	15.90	43.5	27.6	228	60	-
Hori.	597.350	QP	21.60	19.31	8.23	31.60	0.00	17.54	46.0	28.4	100	213	-
Hori.	946.650	QP	20.50	22.08	9.93	30.51	0.00	22.00	46.0	24.0	150	111	-
Hori.	2390.000	PK	48.24	28.41	14.41	41.66	2.44	51.84	73.9	22.0	138	258	-
Hori.	4804.000	PK	53.70	31.62	6.66	38.54	2.44	55.88	73.9	18.0	320	149	-
Hori.	7206.000	PK	53.54	37.62	8.03	39.13	2.44	62.50	73.9	11.4	222	142	-
Hori.	9608.000	PK	46.98	38.74	9.27	39.70	2.44	57.73	73.9	16.1	150	0	-
Vert.	30.505	QP	21.90	18.53	6.83	31.92	0.00	15.34	40.0	24.6	100	218	-
Vert.	41.975	QP	22.30	14.12	7.11	31.91	0.00	11.62	40.0	28.3	100	355	-
Vert.	197.000	QP	21.50	16.55	8.84	31.78	0.00	15.11	43.5	28.3	100	106	-
Vert.	877.250	QP	20.90	22.08	9.60	30.98	0.00	21.60	46.0	24.4	100	251	-
Vert.	2390.000	PK	47.92	28.41	14.41	41.66	2.44	51.52	73.9	22.3	162	325	-
Vert.	4804.000	PK	54.21	31.62	6.66	38.54	2.44	56.39	73.9	17.5	304	219	-
Vert.	7206.000	PK	51.79	37.62	8.03	39.13	2.44	60.75	73.9	13.1	102	82	-
Vert.	9608.000	PK	47.98	38.74	9.27	39.70	2.44	58.73	73.9	15.1	150	0	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.97 m / 3.0 m) = 2.44 dB

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

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	PK	48.24	28.41	14.41	41.66	-33.55	2.44	18.29	53.9	35.6	*1)
Hori.	4804.000	PK	53.70	31.62	6.66	38.54	-33.55	2.44	22.33	53.9	31.5	-
Hori.	7206.000	PK	53.54	37.62	8.03	39.13	-33.55	2.44	28.95	53.9	24.9	-
Hori.	9608.000	PK	46.98	38.74	9.27	39.70	-33.55	2.44	24.18	53.9	29.7	-
Vert.	2390.000	PK	47.92	28.41	14.41	41.66	-33.55	2.44	17.97	53.9	35.9	*1)
Vert.	4804.000	PK	54.21	31.62	6.66	38.54	-33.55	2.44	22.84	53.9	31.0	-
Vert.	7206.000	PK	51.79	37.62	8.03	39.13	-33.55	2.44	27.20	53.9	26.7	-
Vert.	9608.000	PK	47.98	38.74	9.27	39.70	-33.55	2.44	25.18	53.9	28.7	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.97 m / 3.0 m) = 2.44 dB

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

Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" 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	94.30	28.38	14.43	41.67	2.44	97.88	-	-	Carrier
Hori.	2400.000	PK	46.48	28.38	14.42	41.67	2.44	50.05	77.8	27.7	-
Vert.	2402.000	PK	90.50	28.38	14.43	41.67	2.44	94.08	-	-	Carrier
Vert.	2400.000	PK	43.86	28.38	14.42	41.67	2.44	47.43	74.0	26.5	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.97 m / 3.0 m) = 2.44 dB

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

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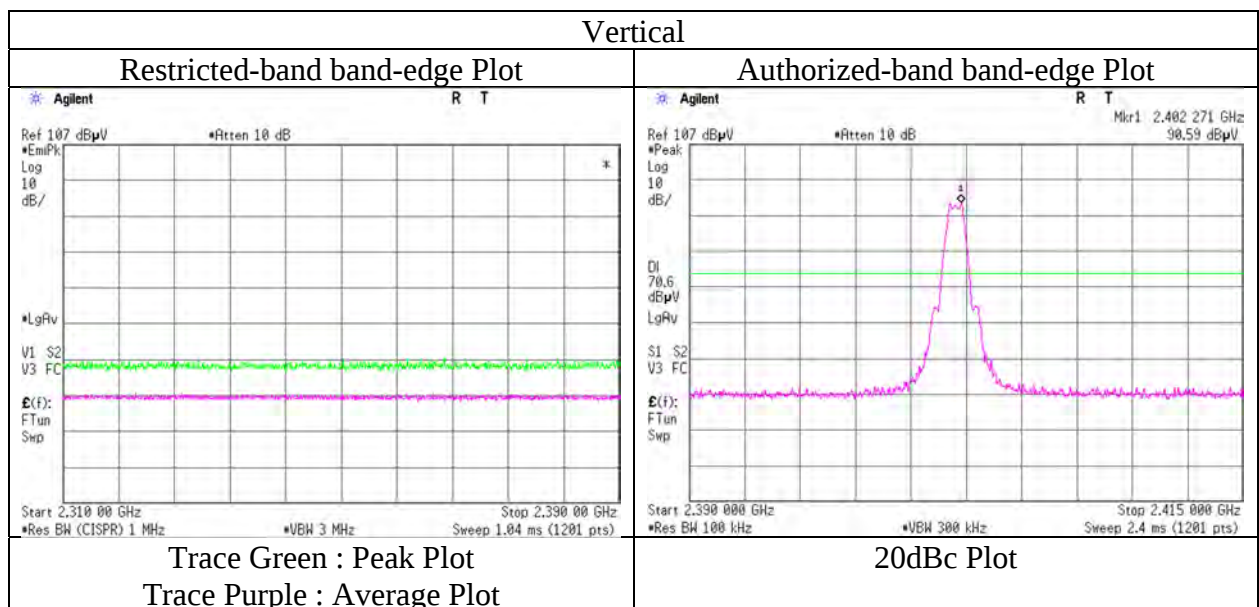
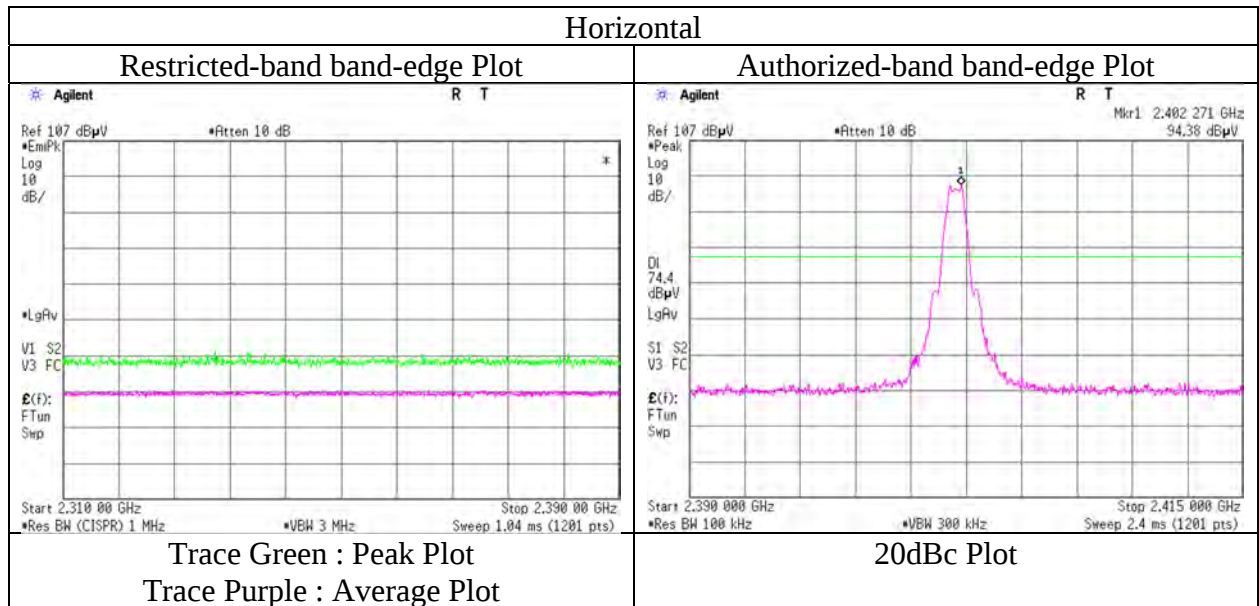
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13692047S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	February 10, 2021
Temperature / Humidity	23 deg.C, 21 %RH
Engineer	Makoto Hosaka
Mode	Tx BT LE 2402 MHz, power setting: 8 dBm



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

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Radiated Spurious Emission

Report No. 13692047S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber 2 3
Date April 29, 2021 February 10, 2021
Temperature / Humidity 21 deg.C, 61 %RH 23 deg.C, 21 %RH
Engineer Yasumasa Owaki Makoto Hosaka
(30 MHz -1 GHz, 2.8 GHz -26.5 GHz) (1 GHz -2.8 GHz)
Mode Tx BT LE 2440 MHz, power setting: 8 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.285	QP	22.20	17.84	6.88	31.92	0.00	15.00	40.0	25.0	150	171	-
Hori.	142.735	QP	24.90	14.46	8.47	31.83	0.00	16.00	43.5	27.5	237	61	-
Hori.	597.350	QP	21.80	19.31	8.23	31.60	0.00	17.74	46.0	28.2	100	210	-
Hori.	946.650	QP	20.50	22.08	9.93	30.51	0.00	22.00	46.0	24.0	150	108	-
Hori.	4880.000	PK	54.06	31.58	6.70	38.54	2.44	56.24	73.9	17.6	299	147	-
Hori.	7320.000	PK	51.39	37.73	8.10	39.28	2.44	60.38	73.9	13.5	257	145	-
Hori.	9760.000	PK	46.12	39.12	9.33	39.61	2.44	57.40	73.9	16.5	150	0	-
Vert.	30.505	QP	21.80	18.53	6.83	31.92	0.00	15.24	40.0	24.7	100	220	-
Vert.	41.975	QP	22.20	14.12	7.11	31.91	0.00	11.52	40.0	28.4	100	347	-
Vert.	197.000	QP	21.60	16.55	8.84	31.78	0.00	15.21	43.5	28.2	100	102	-
Vert.	877.250	QP	21.00	22.08	9.60	30.98	0.00	21.70	46.0	24.3	100	255	-
Vert.	4880.000	PK	53.78	31.58	6.70	38.54	2.44	55.96	73.9	17.9	349	215	-
Vert.	7320.000	PK	51.92	37.73	8.10	39.28	2.44	60.91	73.9	12.9	101	178	-
Vert.	9760.000	PK	46.27	39.12	9.33	39.61	2.44	57.55	73.9	16.3	150	0	-

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

Distance factor : 1 GHz - 10 GHz : 20log (3.97 m / 3.0 m) = 2.44 dB

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

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	PK	54.06	31.58	6.70	38.54	-33.55	2.44	22.69	53.9	31.2	-
Hori.	7320.000	PK	51.39	37.73	8.10	39.28	-33.55	2.44	26.83	53.9	27.0	-
Hori.	9760.000	PK	46.12	39.12	9.33	39.61	-33.55	2.44	23.85	53.9	30.0	-
Vert.	4880.000	PK	53.78	31.58	6.70	38.54	-33.55	2.44	22.41	53.9	31.4	-
Vert.	7320.000	PK	51.92	37.73	8.10	39.28	-33.55	2.44	27.36	53.9	26.5	-
Vert.	9760.000	PK	46.27	39.12	9.33	39.61	-33.55	2.44	24.00	53.9	29.9	-

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

Distance factor : 1 GHz - 10 GHz : 20log (3.97 m / 3.0 m) = 2.44 dB

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

Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.

Radiated Spurious Emission

Report No.	13692047S-A-R2		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	2	2	3
Date	May 24, 2021	April 29, 2021	February 10, 2021
Temperature / Humidity	24 deg.C, 53 %RH	21 deg.C, 61 %RH	23 deg.C, 21 %RH
Engineer	Yosuke Murakami (Below 30 MHz)	Yasumasa Owaki (30 MHz -1 GHz, 2.8 GHz -26.5 GHz)	Makoto Hosaka (1 GHz -2.8 GHz)
Mode	Tx BT LE 2480 MHz, power setting: 8 dBm		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.285	QP	22.20	17.84	6.88	31.92	0.00	15.00	40.0	25.0	150	167	-
Hori.	142.735	QP	24.80	14.46	8.47	31.83	0.00	15.90	43.5	27.6	216	37	-
Hori.	597.350	QP	21.60	19.31	8.23	31.60	0.00	17.54	46.0	28.4	100	212	-
Hori.	946.650	QP	20.60	22.08	9.93	30.51	0.00	22.10	46.0	23.9	150	103	-
Hori.	2483.500	PK	51.85	28.28	14.51	41.69	2.44	55.39	73.9	18.5	111	276	-
Hori.	4960.000	PK	54.04	31.74	6.76	38.54	2.44	56.44	73.9	17.4	331	219	-
Hori.	7440.000	PK	50.02	37.84	8.16	39.43	2.44	59.03	73.9	14.8	110	47	-
Hori.	9920.000	PK	45.78	39.25	9.40	39.52	2.44	57.35	73.9	16.5	150	0	-
Vert.	30.505	QP	21.80	18.53	6.83	31.92	0.00	15.24	40.0	24.7	100	226	-
Vert.	41.975	QP	22.30	14.12	7.11	31.91	0.00	11.62	40.0	28.3	100	355	-
Vert.	197.000	QP	21.50	16.55	8.84	31.78	0.00	15.11	43.5	28.3	100	101	-
Vert.	877.250	QP	21.00	22.08	9.60	30.98	0.00	21.70	46.0	24.3	100	259	-
Vert.	2483.500	PK	49.73	28.28	14.51	41.69	2.44	53.27	73.9	20.6	115	4	-
Vert.	4960.000	PK	52.55	31.74	6.76	38.54	2.44	54.95	73.9	18.9	341	225	-
Vert.	7440.000	PK	49.09	37.84	8.16	39.43	2.44	58.10	73.9	15.8	122	148	-
Vert.	9920.000	PK	46.29	39.25	9.40	39.52	2.44	57.86	73.9	16.0	150	0	-

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.97\text{ m} / 3.0\text{ m}) = 2.44\text{ dB}$

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

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	PK	51.85	28.28	14.51	41.69	-33.55	2.44	21.84	53.9	32.0	*1)
Hori.	4960.000	PK	54.04	31.74	6.76	38.54	-33.55	2.44	22.89	53.9	31.0	-
Hori.	7440.000	PK	50.02	37.84	8.16	39.43	-33.55	2.44	25.48	53.9	28.4	-
Hori.	9920.000	PK	45.78	39.25	9.40	39.52	-33.55	2.44	23.80	53.9	30.1	-
Vert.	2483.500	PK	49.73	28.28	14.51	41.69	-33.55	2.44	19.72	53.9	34.1	*1)
Vert.	4960.000	PK	52.55	31.74	6.76	38.54	-33.55	2.44	21.40	53.9	32.5	-
Vert.	7440.000	PK	49.09	37.84	8.16	39.43	-33.55	2.44	24.55	53.9	29.3	-
Vert.	9920.000	PK	46.29	39.25	9.40	39.52	-33.55	2.44	24.31	53.9	29.5	-

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.97\text{ m} / 3.0\text{ m}) = 2.44\text{ dB}$

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

Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.

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

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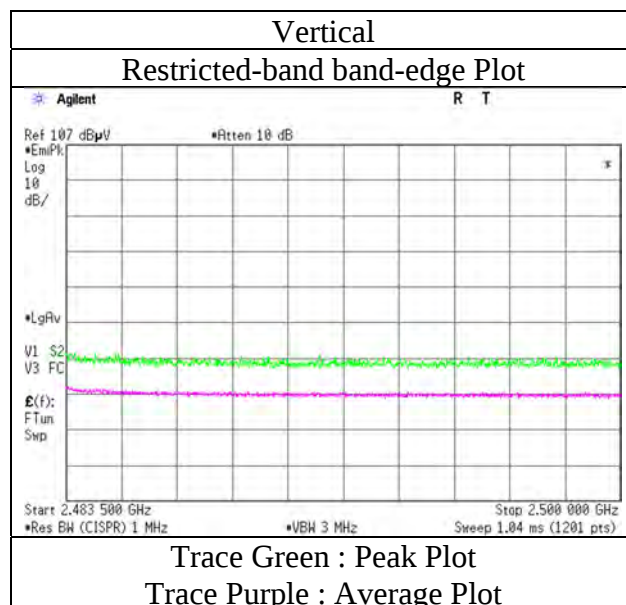
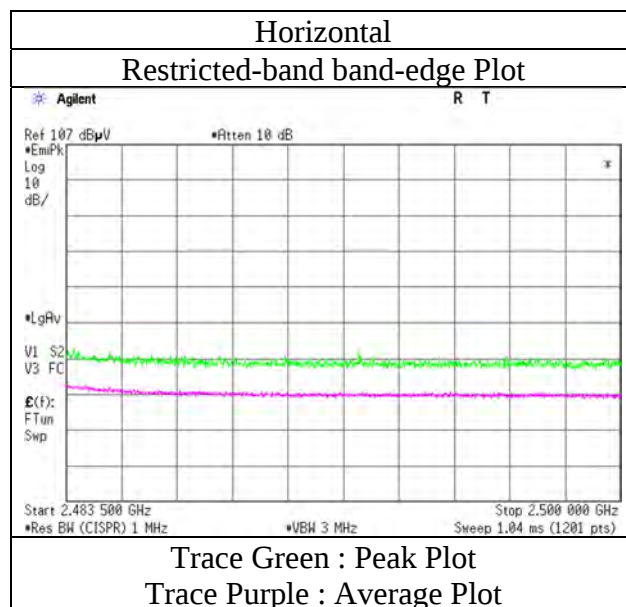
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

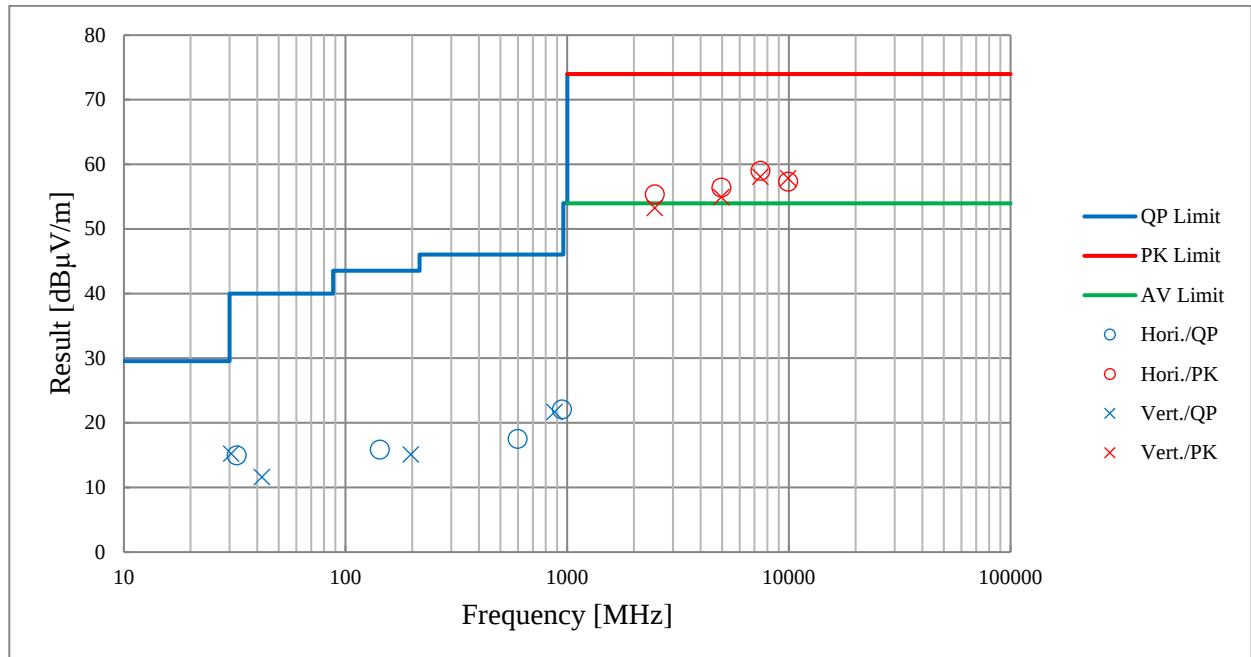
Report No.	13692047S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	February 10, 2021
Temperature / Humidity	23 deg.C, 21 %RH
Engineer	Makoto Hosaka
Mode	Tx BT LE 2480 MHz, power setting: 8 dBm



* 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)

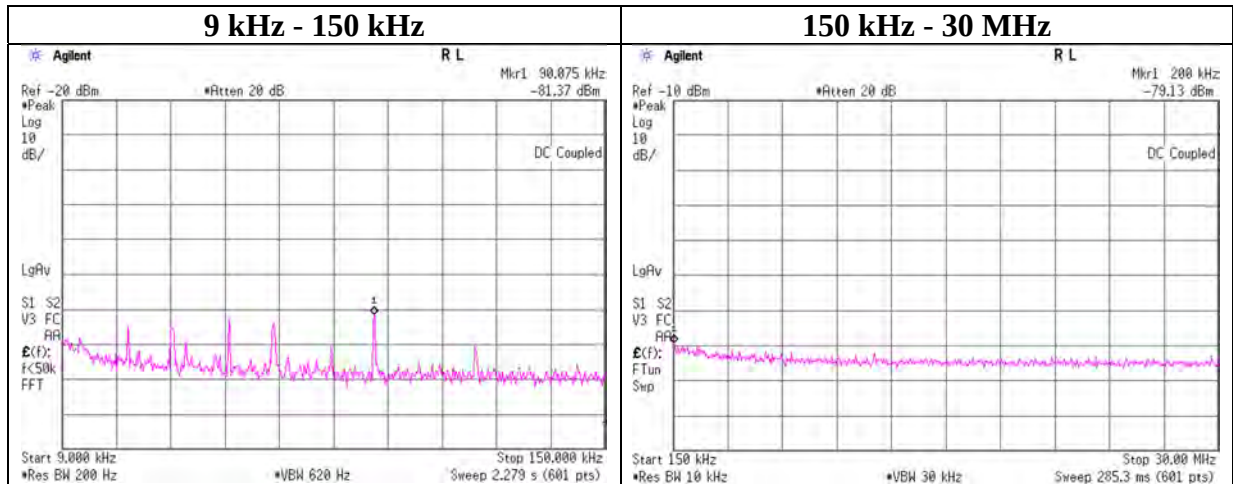
Report No.	13692047S-A-R2		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	2	2	3
Date	May 24, 2021	April 29, 2021	February 10, 2021
Temperature / Humidity	24 deg.C, 53 %RH	21 deg.C, 61 %RH	23 deg.C, 21 %RH
Engineer	Yosuke Murakami (Below 30 MHz)	Yasumasa Owaki (30 MHz -1 GHz, 2.8 GHz -26.5 GHz)	Makoto Hosaka (1 GHz -2.8 GHz)
Mode	Tx BT LE 2480 MHz, power setting: 8 dBm		



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

Conducted Spurious Emission

Report No.	13692047S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 29, 2021
Temperature / Humidity	23 deg. C / 46 % RH
Engineer	Toshinori Yamada
Mode	Tx BT LE 2402 MHz, power setting: 8 dBm



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
90.08	-81.4	0.03	10.0	2.0	1	-69.4	300	6.0	-8.1	28.5	36.6	-
200.00	-79.1	0.02	10.0	2.0	1	-67.1	300	6.0	-5.9	21.5	27.4	-

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

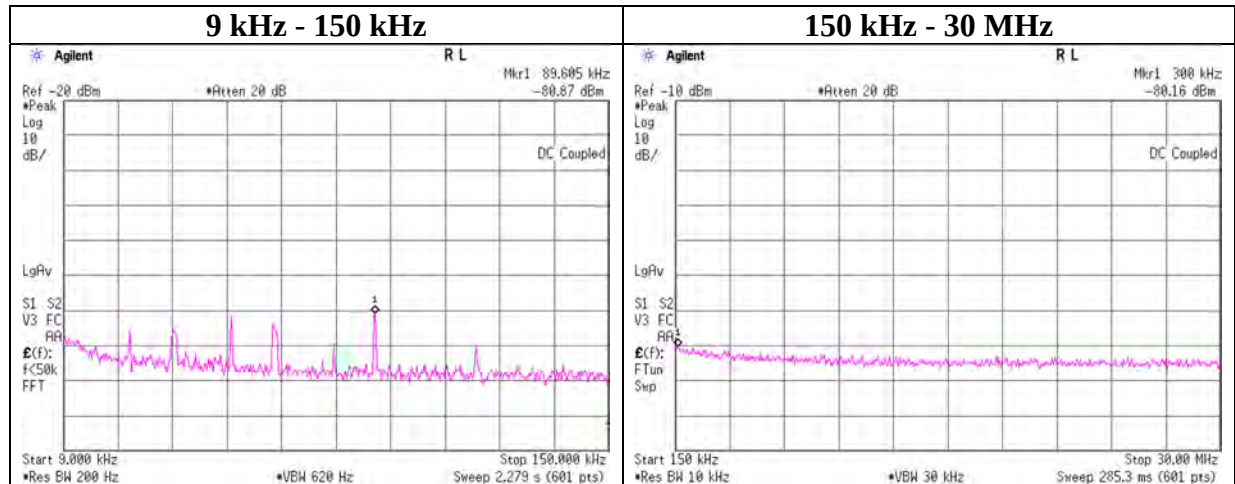
N: Number of output

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

*We confirmed this band (9 kHz to 30 MHz) by radiated but we cannot detect these spurious emissions.

Conducted Spurious Emission

Report No. 13692047S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 29, 2021
Temperature / Humidity 23 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE 2440 MHz, power setting: 8 dBm



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
89.61	-80.9	0.02	10.0	2.0	1	-68.9	300	6.0	-7.6	28.5	36.1	-
300.00	-80.2	0.03	10.0	2.0	1	-68.2	300	6.0	-6.9	18.0	24.9	-

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

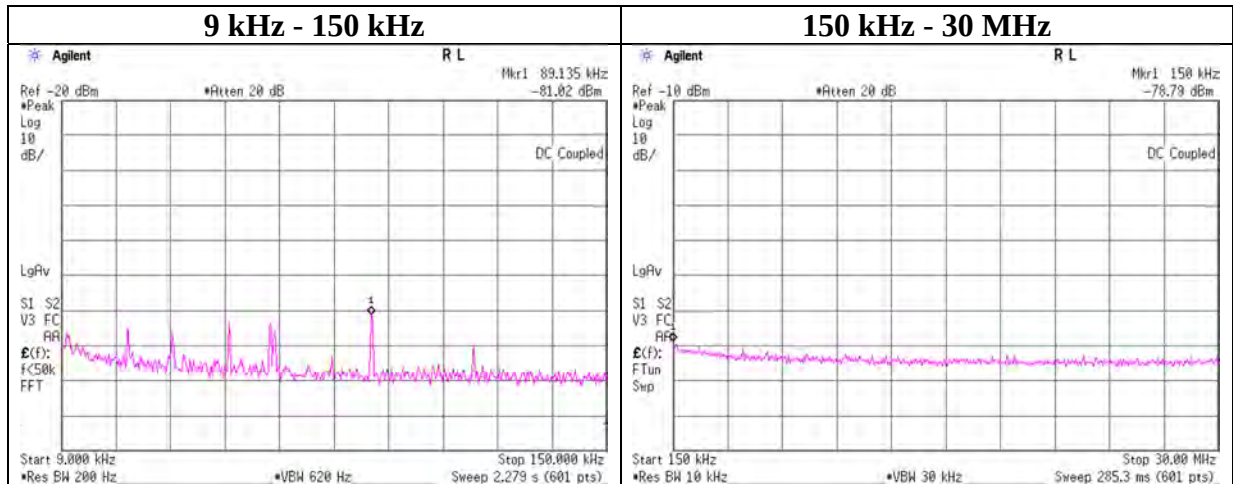
N: Number of output

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

*We confirmed this band (9 kHz to 30 MHz) by radiated but we cannot detect these spurious emissions.

Conducted Spurious Emission

Report No.	13692047S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 29, 2021
Temperature / Humidity	23 deg. C / 46 % RH
Engineer	Toshinori Yamada
Mode	Tx BT LE 2480 MHz, power setting: 8 dBm



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
89.14	-81.0	0.02	10.0	2.0	1	-69.0	300	6.0	-7.8	28.6	36.4	-
150.00	-78.8	0.02	10.0	2.0	1	-66.8	300	6.0	-5.5	24.0	29.5	-

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.

*We confirmed this band (9 kHz to 30 MHz) by radiated but we cannot detect these spurious emissions.

Power Density

Report No. 13692047S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date March 29, 2021
Temperature / Humidity 23 deg. C / 46 % RH
Engineer Toshinori Yamada
Mode Tx BT LE, power setting: 8 dBm

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	dBm / 3 kHz	[dB]	[dB]	[dBm / 3 kHz]	[dBm / 3 kHz]	[dB]
2402	-16.49	2.20	10.05	-4.24	8.00	12.24
2440	-16.22	2.27	10.05	-3.90	8.00	11.90
2480	-16.07	2.21	10.05	-3.81	8.00	11.81

Sample Calculation:

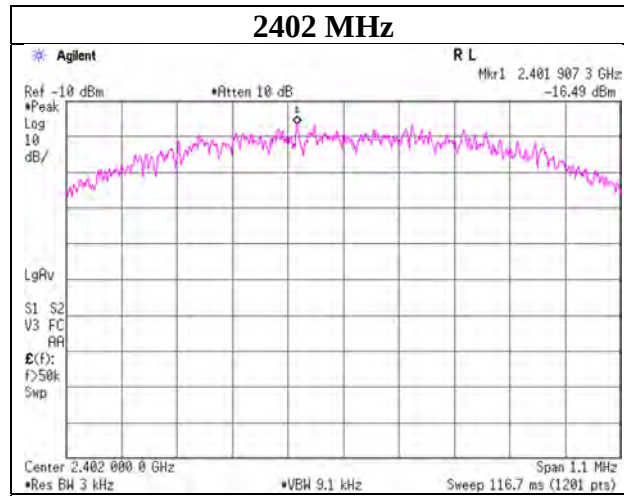
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

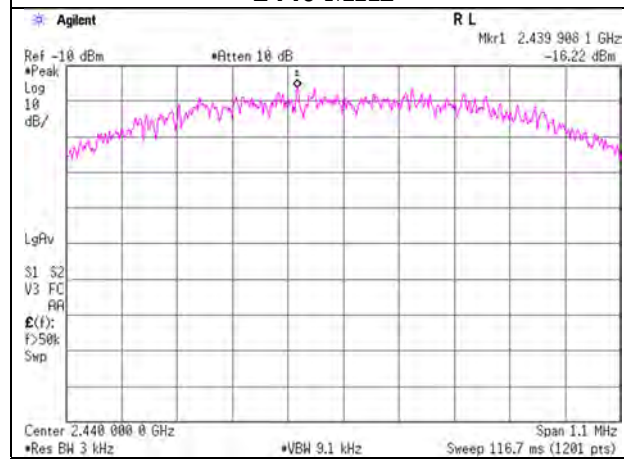
Power Density

BT LE

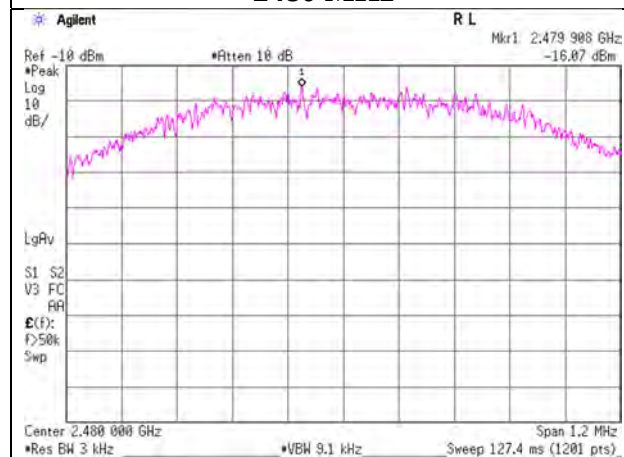
2402 MHz



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	SAT10-22	204926	Attenuator	Weinschel Corp.	54A-10	-	2021/02/09	12
AT	SCC-G12	145040	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	2021/03/04	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	SRENT-15	160899	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46185516	2021/01/26	12
AT	STS-05	146212	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997828	2020/10/19	12
RE	SAT6-15	167096	Attenuator	JFW	50HF-006N	-	2021/02/10	12
RE	SCC-M1	194601	Coaxial Cable	Fjikura	5D-2W	-	2020/12/10	12
RE	SJM-09	145336	Measure	PROMART	SEN1935	-	-	-
RE	SLP-02	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2021/04/06	12
RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
RE	SAEC-02(NSA)	145563	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	2021/03/16	12
RE	SAF-02	145004	Pre Amplifier	SONOMA	310N	290212	2021/02/10	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/NS4906	-/0901-270(RF Selector)	2021/04/12	12
RE	SOS-21	191838	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2020/09/28	12
RE	STR-07	146209	Test Receiver	Rohde & Schwarz	ESU26	100484	2020/09/07	12
RE	STS-02	145793	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997819	2021/04/28	12
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	KJM-10	146454	Measure	KOMELON	KMC-36	-	-	-
RE	SAEC-02(SVSWR)	145598	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	2021/05/20	12
RE	SAEC-03(SVSWR)	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2020/05/11	12

UL Japan, Inc.

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Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	SAF-05	145128	Pre Amplifier	Toyo Corporation	TPA0118-36	1440490	2021/05/17	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	SAT3-11	150921	Attenuator	JFW	50HF-003N	-	2021/01/26	12
RE	SAT6-14	167095	Attenuator	JFW	50HF-006N	-	2021/02/10	12
RE	SBA-02	145022	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032665	2021/04/10	12
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/NS4906	-/0901-270(RF Selector)	2021/04/12	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	2021/05/17	12
RE	SCC-G50	178573	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	MY13407/4E	2021/03/01	12
RE	SCC-G51	178572	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800288 /4A	2021/03/01	12
RE	SCC-G57	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2021/05/18	12
RE	SCC-G58	183047	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800287/4A	2021/05/17	12
RE	SCC-G69	200009	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575617/4	2020/07/07	12
RE	SFL-18	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2021/04/08	12
RE	SHA-02	145384	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-726	2020/06/15	12
RE	SHA-03	145501	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-739	2020/06/15	12
RE	SHA-04	145512	Horn Antenna	ETS-Lindgren	3160-09	00094868	2020/06/15	12
RE	SHA-09	194684	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	695	2021/03/03	12
RE	SLA-06	145528	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	195	2021/04/10	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2020/09/28	12
RE	SSA-02	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2021/04/13	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: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

UL Japan, Inc.

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