



RADIO TEST REPORT

Test Report No. : 14178608S-A

Applicant : TOPCON CORPORATION
Type of EUT : Bluetooth Module
Model Number of EUT : CYBT-333047-02
FCC ID : H5P-333047
Test regulation : FCC Part 15 Subpart C: 2021
*Bluetooth Low Energy parts
Test item : Duty cycle, Spurious Emission (Radiated)
Test result : Complied (Refer to SECTION 3)

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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: February 2 to 25, 2022

Representative test engineer: Y. Tanikawara
Yusuke Tanikawara
Engineer

Approved by: K. Noda
Kazuya Noda
Leader



CERTIFICATE 1266.03

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

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Shonan EMC Lab.

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REVISION HISTORY

Original Test Report No.: 14178608S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	14178608S-A	March 22, 2022	-	-

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Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	LIMS	Laboratory Information Management System
AC	Alternating Current	MCS	Modulation and Coding Scheme
AFH	Adaptive Frequency Hopping	MRA	Mutual Recognition Arrangement
AM	Amplitude Modulation	N/A	Not Applicable
Amp, AMP	Amplifier	NIST	National Institute of Standards and Technology
ANSI	American National Standards Institute	NS	No signal detect.
Ant, ANT	Antenna	NSA	Normalized Site Attenuation
AP	Access Point	OBW	Occupied BandWidth
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	Quadrature Phase Shift Keying
CW	Continuous Wave	RBW	Resolution BandWidth
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	RNSS	Radio Navigation Satellite Service
DSSS	Direct Sequence Spread Spectrum	RSS	Radio Standards Specifications
DUT	Device Under Test	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, T/R	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
ETSI	European Telecommunications Standards Institute	Vert.	Vertical
EU	European Union	WLAN	Wireless LAN
EUT	Equipment Under Test		
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		

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SECTION 1: Customer information

Company Name : TOPCON CORPORATION
Address : 75-1, Hasunuma-cho, Itabashi-ku, Tokyo, 174-8580 Japan
Telephone Number : +81-03-3558-2577
Contact Person : Eiji Takeuchi

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 : Bluetooth Module
Model Number : CYBT-333047-02
Serial Number : Refer to SECTION 4.2
Receipt Date : January 17, 2022
Condition : Production model
Modification : No Modification by the test lab.

2.2 Product Description

Model: CYBT-333047-02 (referred to as the EUT in this report) is a Bluetooth Module.

General Specification

Rating	DC 2.3 V to 3.6 V
--------	-------------------

Radio Specification

Bluetooth Low Energy

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK, $\pi/4$ -DQPSK, 8DPSK
Operating Temperature	-40 deg. C to +85 deg. C
Clock frequency	24 MHz

Antenna Type	Antenna Gain	Remarks
1/2 λ sleeve antenna	2.14 dBi	original
PCB Antenna (TOP)	2.0 dBi	tested antenna *1)
PCB Antenna (BOTTOM)	1.1 dBi	*1)

*This is a test report for adding a PCB Antenna.

*1) Since it is the same type of antenna, we tested it with the Antenna higher Antenna Gain.

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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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13	FCC: Section15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	10.7 dB 143.912 MHz, QP, Hori Mode: Tx BT LE 2440 MHz	Complied a)	Radiated (above 30 MHz) *1)
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422. *1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.					
a) Refer to APPENDIX 1 (data of Radiated Spurious Emission)					
Symbols: Complied The data of this test item has enough margin, more than the measurement uncertainty. Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.					

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

FCC Part 15.31 (e)

The RF Module has its own regulator. The RF Module is constantly provided voltage through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The EUT has a unique coupling/antenna connector (U.FL). Therefore, the equipment complies with the antenna requirement.

3.3 Addition to standard

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 $k = 2$.
Shonan EMC Lab.

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	2.9 dB	2.9 dB	3.0 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.2 dB	3.1 dB	3.1 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.1 dB	6.1 dB	-
	1 GHz-6 GHz	4.7 dB	4.7 dB	4.7 dB	-
	6 GHz-18 GHz	5.2 dB	5.3 dB	5.3 dB	-
	18 GHz-40 GHz	5.4 dB	5.5 dB	5.5 dB	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.6 dB	5.6 dB	5.6 dB	-
	18 GHz-40 GHz	5.8 dB	5.8 dB	5.8 dB	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Duty cycle and Time Measurement	0.27 %

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)

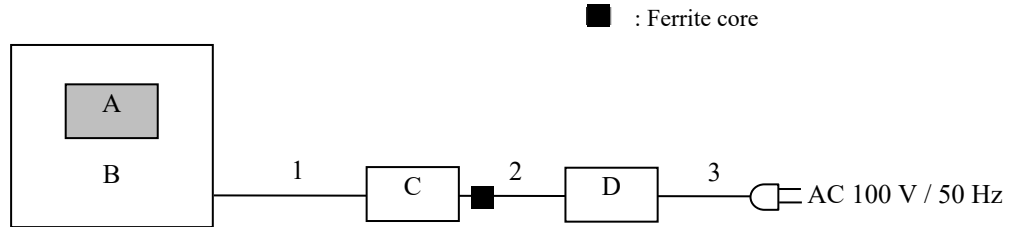
Mode	Remarks*
Bluetooth Low Energy (BT LE) 1M-PHY Uncoded PHY (1M-PHY)	Maximum Packet Size, PRBS9
*Power of the EUT was set by the software as follows; Power settings: Fixed Software: Cybluetool Version 0.1.97.1 (Date: 2022.1.28, Storage location: Driven by connected PC)	
*This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Radiated Spurious Emission	BLE, 1M-PHY	2402 MHz 2440 MHz 2480 MHz

4.2 Configuration and peripherals

<Antenna Terminal Conducted test>



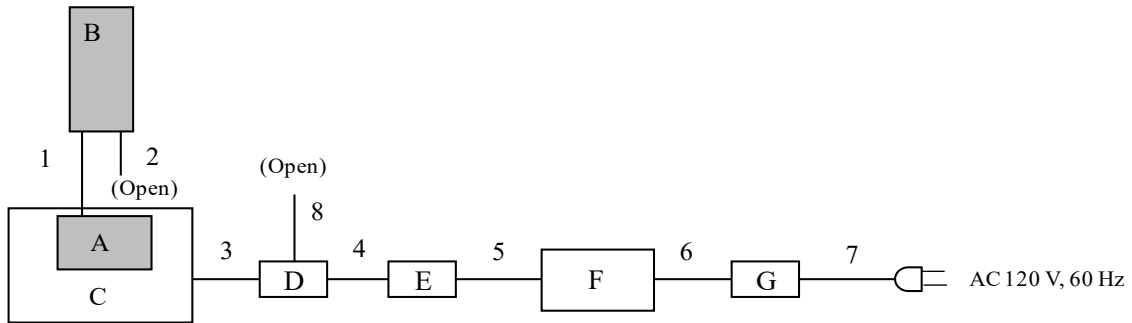
Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Bluetooth Module	CYBT-333047-02	3330470202184510005	Cypress Semiconductor	EUT
B	Evaluation Board of Bluetooth	CYBT-333047-EVAL 01	1902-1-008 3	Cypress Semiconductor	-
C	Laptop Computer	7666-77J	LV-B8PZ8 08/05	Lenovo	-
D	AC Adapter	92P1213	11S92P1213Z1Z DDZ92C2WU	Lenovo	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB	0.3	Shielded	Shielded	-
2	DC	1.8	Unshielded	Unshielded	-
3	AC	0.9	Unshielded	Unshielded	-

<Radiated Emission 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	Remarks
A	Bluetooth Module	CYBT-333047-02	3330470206211610CZK	Cypress Semiconductor	EUT
B	PCB Antenna	2130520510	001	SANSEI ELECTRIC CO., LTD	EUT
C	Jig board	BT_CY333047	1042071-01	TOPCON	-
D	Jig board	XML-2	-	-	-
E	Jig board	LC234X	-	-	-
F	Laptop Computer	ThinkPad E14 Gen2	PF397TS8	LENOVO	-
G	AC Adapter	ADLX65YCC2D	8SSA10R16922C2TJ19M0AZJ	LENOVO	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna	0.14	Shielded	Shielded	-
2	Antenna	0.12	Shielded	Shielded	-
3	Signal	0.2	Unshielded	Unshielded	-
4	Signal	0.05	Unshielded	Unshielded	-
5	USB	1.0	Shielded	Shielded	-
6	DC	1.8	Unshielded	Unshielded	-
7	AC	0.9	Unshielded	Unshielded	-
8	DC	0.35	Unshielded	Unshielded	-

SECTION 5: Duty cycle

Test Procedure

Duty Cycle was measured with a Spectrum Analyzer.

Test data : APPENDIX

SECTION 6: Radiated Spurious Emission

Test Procedure

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

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 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	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

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

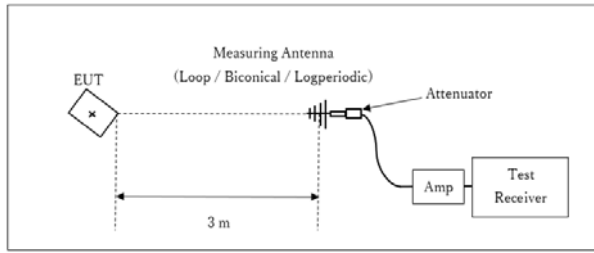
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	-	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 2: Test Setup

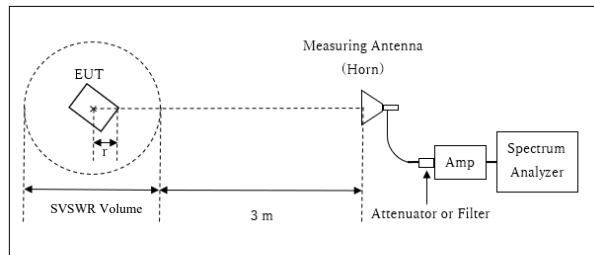
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

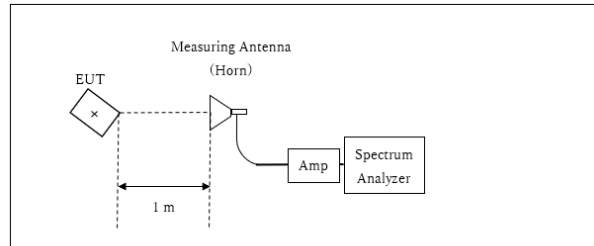


r : Radius of an outer periphery of EUT
x : Center of turn table

Distance Factor: $20 \times \log(3.9 \text{ m} / 3.0 \text{ m}) = 2.28 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.9 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.1 m

10 GHz – 26.5 GHz



x : Center of turn table

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

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

Module

Antenna polarization	Carrier	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	Y	Y	Y	Z	X	X
Vertical	Y	Y	Y	Z	X	X

Antenna

Antenna polarization	Carrier	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	X	Y	X	X	X	X
Vertical	Y	Y	Y	Y	X	X

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

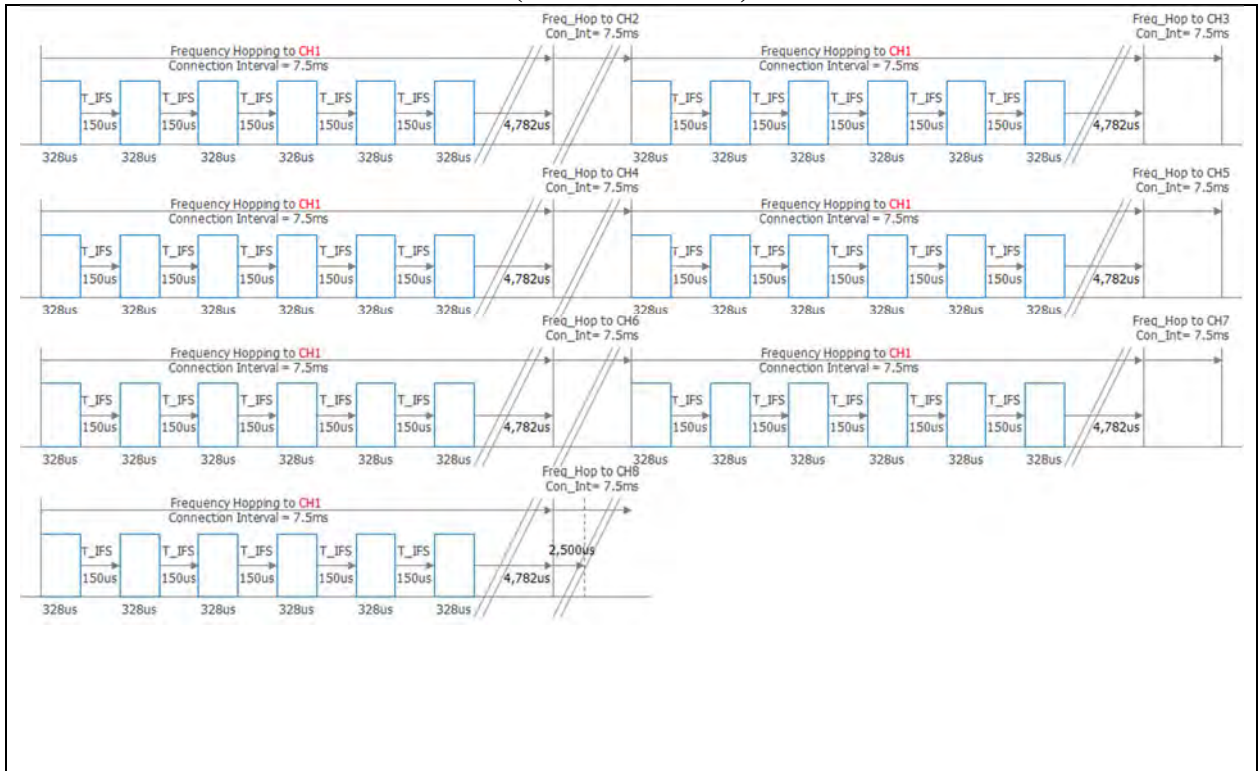
Measurement range : 30 MHz - 26.5 GHz
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Duty cycle correction factor
(Declared value of applicant)

The information provided from the applicant.

(Reference chart)



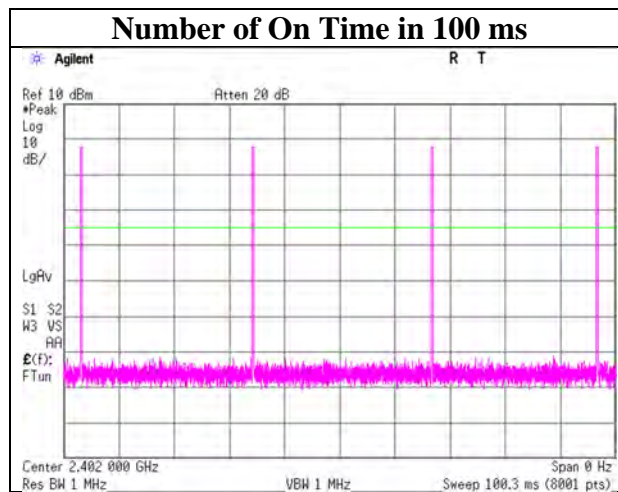
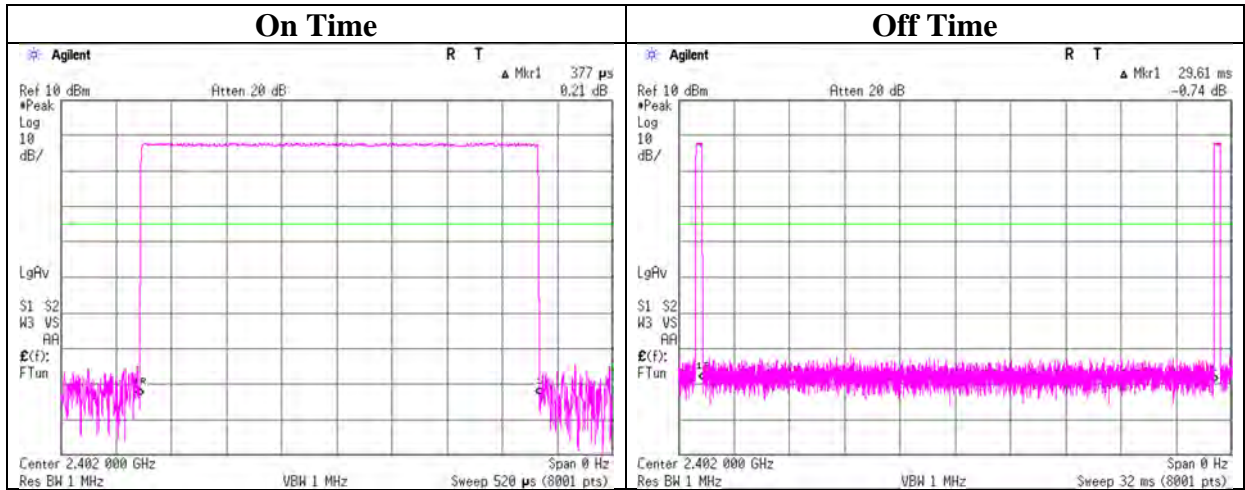
(for Duty cycle correction factor for Radiated Spurious Emission)
Worst 100 ms case

$$DCCF = 20 \log(0.328 \times 42 / 100) = -17.21 \text{ dB} *$$

*On time: 328 us (0.328 ms)
 *Maximum opportunity for 1 channel in 100 ms: 7 cycle / 100 ms
 *Maximum on time for 1 channel in 100 ms: 7 cycle x 6 times = 42 times / 100 ms

Duty cycle correction factor
(Actual measured value)

Report No. 14178608S-A
 Test place Shonan EMC Lab. No.5 Shielded Room
 Date February 25, 2022
 Temperature / Humidity 21 deg. C / 43 % RH
 Engineer Shiro Kobayashi
 Mode Tx



$DCCF = 20 \log(0.377 \times 4 / 100) = -36.43 \text{ dB} *$

*On time: 377 us
 *Off time: 29.61 ms
 *Maximum opportunity for 1 channel in 100 ms: 4 times / 100 ms
 *Maximum on time for 1 channel in 100 ms: 4 times = 0.377 ms x 4 times / 100 ms

* The above chart was the maximum Duty cycle that can be achieved using the sample provided by the applicant (Advertising mode).

*Since there are no design changes regarding Duty Cycle, the DCCF of the applicant's declared value, which is theoretically the maximum, was applied to Radiated Spurious Emission.

Radiated Spurious Emission

Report No.	14178608S-A		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	2	2	2
Date	February 4, 2022	February 2, 2022	February 3, 2022
Temperature / Humidity	24 deg.C, 30 %RH	22 deg.C, 30 %RH	23 deg.C, 31 %RH
Engineer	Yusuke Tanikawara (30 MHz -1 GHz)	Yusuke Tanikawara (1 GHz -2.8 GHz)	Yusuke Tanikawara (2.8 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.	143.864	QP	41.40	14.52	8.53	31.83	0.00	32.62	43.5	10.8	227	4	-
Hori.	335.668	QP	32.70	14.96	6.73	31.65	0.00	22.74	46.0	23.2	100	328	-
Hori.	395.557	QP	34.60	15.83	7.10	31.64	0.00	25.89	46.0	20.1	100	2	-
Hori.	539.497	QP	33.20	17.86	7.96	31.64	0.00	27.38	46.0	18.6	100	287	-
Hori.	551.389	QP	32.30	18.05	8.03	31.65	0.00	26.73	46.0	19.2	100	288	-
Hori.	1441.200	PK	51.87	25.66	13.18	38.92	2.28	54.07	73.9	19.8	145	249	-
Hori.	2390.000	PK	44.94	28.58	14.16	38.72	2.28	51.24	73.9	22.6	148	59	-
Hori.	4804.000	PK	52.56	31.75	6.71	38.55	2.28	54.75	73.9	19.1	126	77	-
Hori.	7206.000	PK	45.76	37.60	8.25	39.16	2.28	54.73	73.9	19.1	162	318	-
Vert.	51.014	QP	39.60	10.80	7.28	31.90	0.00	25.78	40.0	14.2	100	53	-
Vert.	143.905	QP	33.00	14.53	8.53	31.83	0.00	24.23	43.5	19.2	100	263	-
Vert.	239.799	QP	42.00	11.69	6.04	31.72	0.00	28.01	46.0	17.9	100	332	-
Vert.	299.687	QP	32.20	13.73	6.47	31.69	0.00	20.71	46.0	25.2	164	188	-
Vert.	323.626	QP	35.80	14.54	6.65	31.66	0.00	25.33	46.0	20.6	130	207	-
Vert.	1441.200	PK	50.01	25.66	13.18	38.92	2.28	52.21	73.9	21.6	365	17	-
Vert.	2390.000	PK	44.59	28.58	14.16	38.72	2.28	50.89	73.9	23.0	144	233	-
Vert.	4804.000	PK	52.43	31.75	6.71	38.55	2.28	54.62	73.9	19.2	146	357	-
Vert.	7206.000	PK	45.54	37.60	8.25	39.16	2.28	54.51	73.9	19.3	145	98	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.90 m / 3.0 m) = 2.28 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.	1441.200	PK	51.87	25.66	13.18	38.92	-17.21	2.28	36.86	53.9	17.0	*2)
Hori.	2390.000	PK	44.94	28.58	14.16	38.72	-17.21	2.28	34.03	53.9	19.8	*1)
Hori.	4804.000	PK	52.56	31.75	6.71	38.55	-17.21	2.28	37.54	53.9	16.3	-
Hori.	7206.000	PK	45.76	37.60	8.25	39.16	-17.21	2.28	37.52	53.9	16.3	-
Vert.	1441.200	PK	50.01	25.66	13.18	38.92	-17.21	2.28	35.00	53.9	18.9	*2)
Vert.	2390.000	PK	44.59	28.58	14.16	38.72	-17.21	2.28	33.68	53.9	20.2	*1)
Vert.	4804.000	PK	52.43	31.75	6.71	38.55	-17.21	2.28	37.41	53.9	16.4	-
Vert.	7206.000	PK	45.54	37.60	8.25	39.16	-17.21	2.28	37.30	53.9	16.6	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.90 m / 3.0 m) = 2.28 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)

*2) These point are the same duty cycle as carrier.

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	99.49	28.56	14.18	38.72	2.28	105.79	-	-	Carrier
Hori.	2400.000	PK	42.58	28.56	14.17	38.72	2.28	48.87	85.7	36.8	-
Vert.	2402.000	PK	99.22	28.56	14.18	38.72	2.28	105.52	-	-	Carrier
Vert.	2400.000	PK	42.44	28.56	14.17	38.72	2.28	48.73	85.5	36.7	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.90 m / 3.0 m) = 2.28 dB

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

UL Japan, Inc.

Shonan EMC Lab.

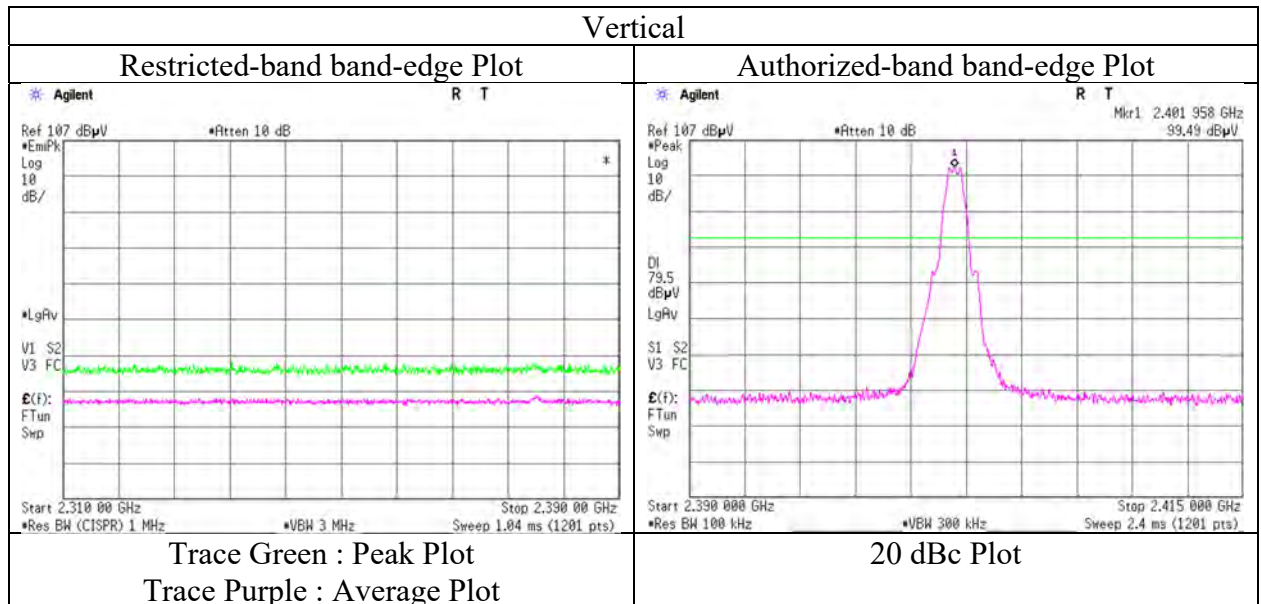
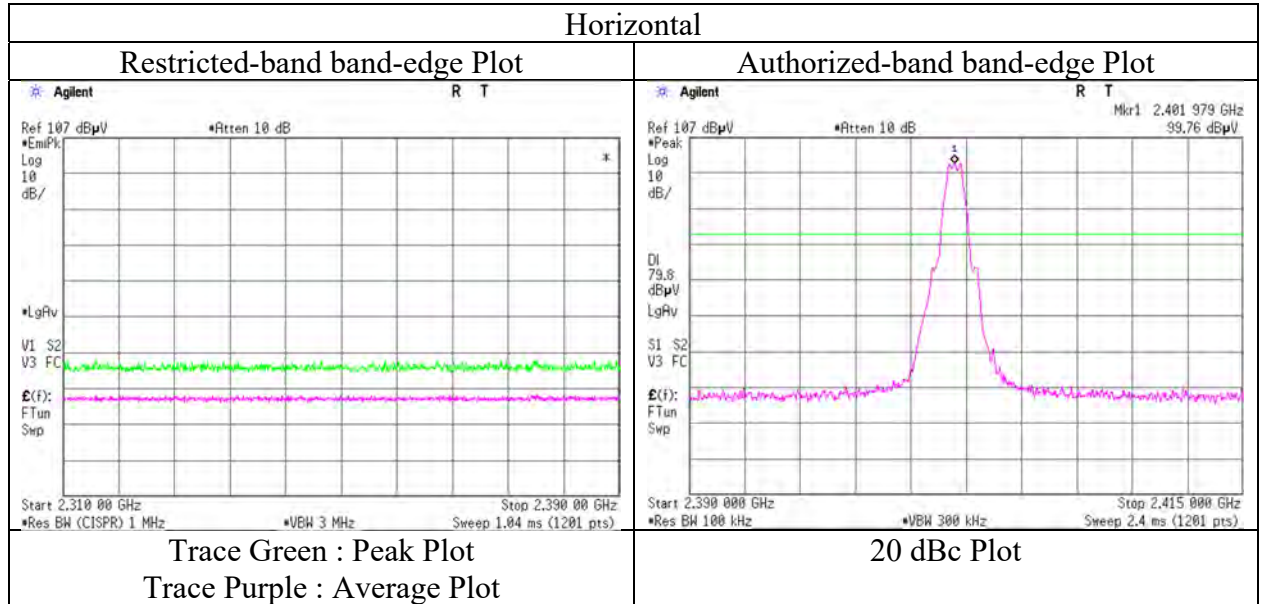
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	14178608S-A
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	2
Date	February 2, 2022
Temperature / Humidity	22 deg.C, 30 %RH
Engineer	Yusuke Tanikawara (1 GHz -2.8 GHz)
Mode	Tx BT LE 24022 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.	14178608S-A		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	2	2	2
Date	February 4, 2022	February 2, 2022	February 3, 2022
Temperature / Humidity	24 deg.C, 30 %RH	22 deg.C, 30 %RH	23 deg.C, 31 %RH
Engineer	Yusuke Tanikawara	Yusuke Tanikawara	Yusuke Tanikawara
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 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.	143.912	QP	41.50	14.53	8.53	31.83	0.00	32.73	43.5	10.7	228	5	-
Hori.	323.734	QP	36.00	14.54	6.65	31.66	0.00	25.53	46.0	20.4	100	337	-
Hori.	395.541	QP	34.70	15.83	7.10	31.64	0.00	25.99	46.0	20.0	100	3	-
Hori.	539.405	QP	33.30	17.86	7.96	31.64	0.00	27.48	46.0	18.5	100	283	-
Hori.	551.435	QP	32.20	18.05	8.03	31.65	0.00	26.63	46.0	19.3	100	289	-
Hori.	1464.000	PK	54.30	25.58	13.21	38.92	2.28	56.45	73.9	17.4	148	250	-
Hori.	4880.000	PK	50.88	31.78	6.75	38.58	2.28	53.11	73.9	20.7	147	295	-
Hori.	7320.000	PK	46.12	37.75	8.34	39.22	2.28	55.27	73.9	18.6	122	136	-
Vert.	51.029	QP	39.60	10.79	7.28	31.90	0.00	25.77	40.0	14.2	100	45	-
Vert.	143.903	QP	32.80	14.53	8.53	31.83	0.00	24.03	43.5	19.4	100	268	-
Vert.	227.836	QP	38.40	11.42	5.94	31.74	0.00	24.02	46.0	21.9	100	343	-
Vert.	239.852	QP	42.00	11.69	6.04	31.72	0.00	28.01	46.0	17.9	100	285	-
Vert.	299.677	QP	32.30	13.73	6.47	31.69	0.00	20.81	46.0	25.1	138	211	-
Vert.	1464.000	PK	49.85	25.58	13.21	38.92	2.28	52.00	73.9	21.9	100	60	-
Vert.	4880.000	PK	50.39	31.78	6.75	38.58	2.28	52.62	73.9	21.2	107	158	-
Vert.	7320.000	PK	45.54	37.75	8.34	39.22	2.28	54.69	73.9	19.2	151	59	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.90 m / 3.0 m) = 2.28 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.	1464.000	PK	54.30	25.58	13.21	38.92	-17.21	2.28	39.24	53.9	14.6	*1)
Hori.	4880.000	PK	50.88	31.78	6.75	38.58	-17.21	2.28	35.90	53.9	18.0	-
Hori.	7320.000	PK	46.12	37.75	8.34	39.22	-17.21	2.28	38.06	53.9	15.8	-
Vert.	1464.000	PK	49.85	25.58	13.21	38.92	-17.21	2.28	34.79	53.9	19.1	*1)
Vert.	4880.000	PK	50.39	31.78	6.75	38.58	-17.21	2.28	35.41	53.9	18.4	-
Vert.	7320.000	PK	45.54	37.75	8.34	39.22	-17.21	2.28	37.48	53.9	16.4	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.90 m / 3.0 m) = 2.28 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) These point are the same duty cycle as carrier.

Radiated Spurious Emission

Report No.	14178608S-A		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	2	2	2
Date	February 4, 2022	February 2, 2022	February 3, 2022
Temperature / Humidity	24 deg.C, 30 %RH	22 deg.C, 30 %RH	23 deg.C, 31 %RH
Engineer	Yusuke Tanikawara (30 MHz -1 GHz)	Yusuke Tanikawara (1 GHz -2.8 GHz)	Yusuke Tanikawara (2.8 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.	143.918	QP	41.30	14.53	8.53	31.83	0.00	32.53	43.5	10.9	221	2	-
Hori.	323.742	QP	35.80	14.54	6.65	31.66	0.00	25.33	46.0	20.6	100	340	-
Hori.	335.731	QP	32.70	14.96	6.73	31.65	0.00	22.74	46.0	23.2	100	332	-
Hori.	371.689	QP	32.30	15.32	6.96	31.63	0.00	22.95	46.0	23.0	100	344	-
Hori.	395.611	QP	34.50	15.83	7.10	31.64	0.00	25.79	46.0	20.2	100	3	-
Hori.	539.472	QP	33.30	17.86	7.96	31.64	0.00	27.48	46.0	18.5	100	288	-
Hori.	1488.000	PK	57.63	25.53	13.24	38.91	2.28	59.77	73.9	14.1	138	248	-
Hori.	2483.500	PK	47.45	28.47	14.26	38.67	2.28	53.79	73.9	20.1	165	63	-
Hori.	4960.000	PK	52.18	32.03	6.81	38.62	2.28	54.68	73.9	19.2	119	287	-
Hori.	7440.000	PK	48.00	37.82	8.42	39.28	2.28	57.24	73.9	16.6	160	221	-
Vert.	51.047	QP	39.70	10.78	7.28	31.90	0.00	25.86	40.0	14.1	100	76	-
Vert.	143.906	QP	33.00	14.53	8.53	31.83	0.00	24.23	43.5	19.2	100	269	-
Vert.	239.814	QP	41.90	11.69	6.04	31.72	0.00	27.91	46.0	18.0	100	299	-
Vert.	251.832	QP	39.50	11.96	6.13	31.71	0.00	25.88	46.0	20.1	100	268	-
Vert.	323.623	QP	35.80	14.53	6.65	31.66	0.00	25.32	46.0	20.6	130	207	-
Vert.	1488.000	PK	53.37	25.53	13.24	38.91	2.28	55.51	73.9	18.3	344	24	-
Vert.	2483.500	PK	46.76	28.47	14.26	38.67	2.28	53.10	73.9	20.8	142	298	-
Vert.	4960.000	PK	51.81	32.03	6.81	38.62	2.28	54.31	73.9	19.5	149	163	-
Vert.	7440.000	PK	46.25	37.82	8.42	39.28	2.28	55.49	73.9	18.4	145	210	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.90 m / 3.0 m) = 2.28 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.	1488.000	PK	57.63	25.53	13.24	38.91	-17.21	2.28	42.56	53.9	11.3	*2)
Hori.	2483.500	PK	47.45	28.47	14.26	38.67	-17.21	2.28	36.58	53.9	17.3	*1)
Hori.	4960.000	PK	52.18	32.03	6.81	38.62	-17.21	2.28	37.47	53.9	16.4	-
Hori.	7440.000	PK	48.00	37.82	8.42	39.28	-17.21	2.28	40.03	53.9	13.8	-
Vert.	1488.000	PK	53.37	25.53	13.24	38.91	-17.21	2.28	38.30	53.9	15.6	*2)
Vert.	2483.500	PK	46.76	28.47	14.26	38.67	-17.21	2.28	35.89	53.9	18.0	*1)
Vert.	4960.000	PK	51.81	32.03	6.81	38.62	-17.21	2.28	37.10	53.9	16.8	-
Vert.	7440.000	PK	46.25	37.82	8.42	39.28	-17.21	2.28	38.28	53.9	15.6	-

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

Distance factor : 1 GHz - 10 GHz : 20log(3.90 m / 3.0 m) = 2.28 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)

*2) These point are the same duty cycle as carrier.

UL Japan, Inc.

Shonan EMC Lab.

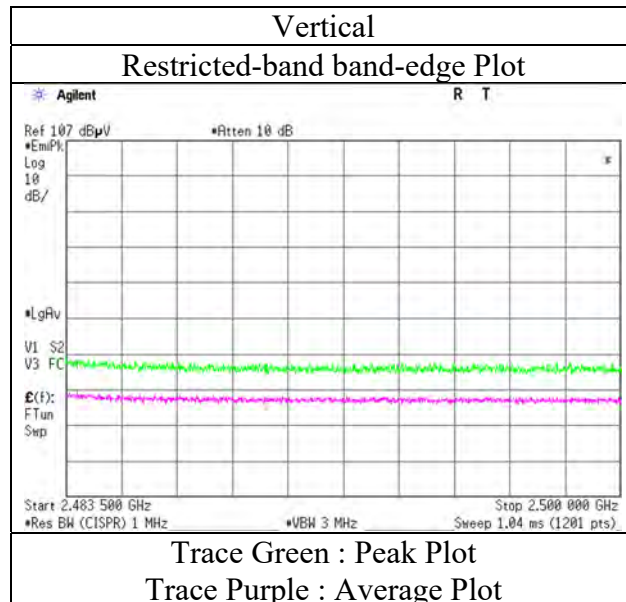
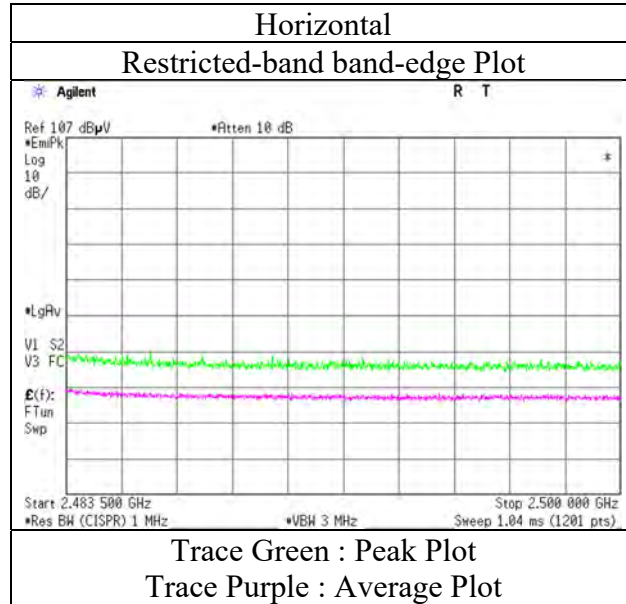
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission
(Reference Plot for band-edge)

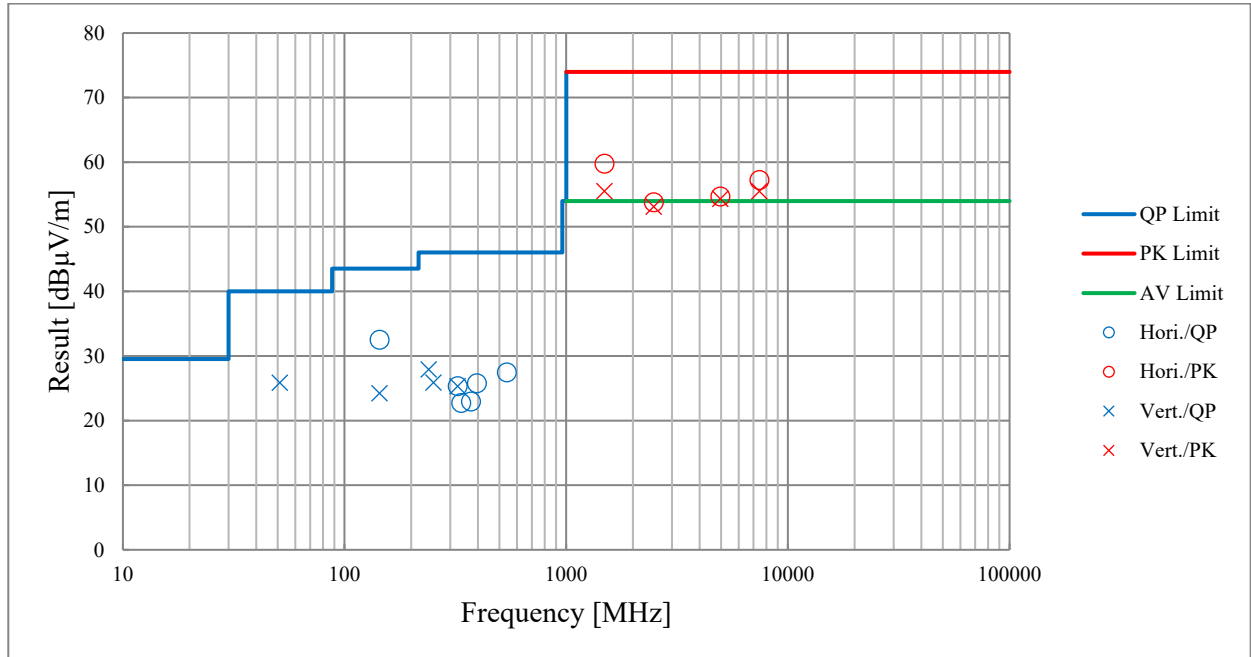
Report No. 14178608S-A
Test place Shonan EMC Lab.
Semi Anechoic Chamber 2
Date February 2, 2022
Temperature / Humidity 22 deg.C, 30 %RH
Engineer Yusuke Tanikawara
(1 GHz -2.8 GHz)
Mode Tx BT LE 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case mode for Maximum Peak Output Power)

Report No.	14178608S-A		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	2	2	2
Date	February 4, 2022	February 2, 2022	February 3, 2022
Temperature / Humidity	24 deg.C, 30 %RH	22 deg.C, 30 %RH	23 deg.C, 31 %RH
Engineer	Yusuke Tanikawara (30 MHz -1 GHz)	Yusuke Tanikawara (1 GHz -2.8 GHz)	Yusuke Tanikawara (2.8 GHz -26.5 GHz)
Mode	Tx BT LE 2480 MHz		



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

APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2021/09/14	12
AT	SAT10-22	204926	Attenuator	Weinschel Corp.	54A-10	-	2022/02/21	12
AT	SCC-G11	145174	Coaxial Cable	Suhner	SUCOFLEX 102	31595/2	2021/03/01	12
AT	SCC-H26	202920	Microwave cable	RS Pro	R-132G7210 100CO	-	2021/11/10	12
AT	SOS-27	191845	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
AT,RE	KSA-08	145089	Spectrum Analyzer	Keysight Technologies Inc	E4446A	MY46180525	2021/10/13	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	SAEC-02(SVSWR)	145598	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	2021/05/20	12
RE	SAF-02	145004	Pre Amplifier	SONOMA	310N	290212	2022/02/24	12
RE	SAF-05	145128	Pre Amplifier	Toyo Corporation	TPA0118-36	1440490	2021/05/17	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	2021/10/07	12
RE	SAT3-16	175905	Attenuator	JFW	50HF-003N	-	2021/12/10	12
RE	SAT6-14	167095	Attenuator	JFW	50HF-006N	-	2022/02/21	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/SR SE-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-B2/B4/B6/B7/B8/B13/SR SE-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	SCC-G15	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2021/03/01	12
RE	SCC-G41	151617	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S006	2022/01/06	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-G69	200009	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575617/4	2021/07/06	12
RE	SFL-02	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2021/10/07	12
RE	SHA-02	145384	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-726	2021/06/14	12
RE	SHA-04	145512	Horn Antenna	ETS-Lindgren	3160-09	00094868	2021/06/14	12
RE	SHA-09	194684	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	695	2021/03/03	12
RE	SJM-20	207277	Measuring	ASKUL	-	-	-	-
RE	SLA-06	145528	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	195	2021/04/10	12
RE	SOS-21	191838	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
RE	STR-07	146209	Test Receiver	Rohde & Schwarz	ESU26	100484	2021/09/17	12
RE	STS-02	145793	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997819	2021/04/28	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.

Shonan EMC Lab.

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