



RADIO TEST REPORT

Test Report No. : 12407798S-A-R2

Applicant : CITIZEN WATCH CO., LTD.
Type of Equipment : Module for Wrist WATCH
Model No. : W510MV
FCC ID : YUQ-W510MV
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied

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3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. This report is a revised version of 12407798S-A-R1. 12407798S-A-R1 is replaced with this report.

Date of test: November 5 to 16, 2018

Representative test engineer:

M. Hosaka

Makoto Hosaka
Engineer
Consumer Technology Division

Approved by:

A. Hayashi

Akio Hayashi
Leader
Consumer Technology Division



- ☐ 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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13-EM-F0429

CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Conducted Emission.....	10
SECTION 6: Radiated Spurious Emission	11
SECTION 7: Antenna Terminal Conducted Tests.....	13
APPENDIX 1: Test data	14
Conducted Emission	14
6 dB Bandwidth and 99 % Occupied Bandwidth.....	18
Maximum Peak Output Power	21
Average Output Power	22
Radiated Spurious Emission	24
Conducted Spurious Emission	35
Power Density	41
APPENDIX 2: Test instruments	43
APPENDIX 3: Photographs of test setup	45
Conducted Emission	45
Radiated Spurious Emission	46
Worst Case Position	47

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	:	+81-42-468-4769
Facsimile Number	:	+81-42-468-4730
Contact Person	:	Masayuki Araki

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Module for Wrist WATCH
Model No.	:	W510MV
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 2.8 V
Receipt Date of Sample	:	November 2, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: W510MV (referred to as the EUT in this report) is a Module for Wrist WATCH.

Radio Specification

Equipment Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Type of Modulation	:	GFSK
Antenna Type	:	Monopole Antenna
Antenna Gain	:	-12.56 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 March 12, 2018 and effective April 11, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928MHz,
2400-2483.5MHz, and 5725-5850MHz

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	4.6 dB 24.00010 MHz, N, AV Tx BLE 2M PHY 2480 MHz	Complied	-
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8			
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section 15.247(a)(2)	See data.	Complied	Conducted
	IC: -	IC: RSS-247 5.2(a)			
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section 15.247(b)(3)		Complied	Conducted
	IC: RSS-Gen 6.12	IC: RSS-247 5.4(d)			
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section 15.247(e)		Complied	Conducted
	IC: -	IC: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05	FCC: Section15.247(d)	3.7 dB 7206.00 MHz, AV, Vert. Tx BLE 2M PHY 2402 MHz	Complied#	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)
	IC: RSS-Gen 6.13	IC: 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.

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05 8.5 and 8.6.

Symbols:

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

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

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

FCC Part 15.31 (e)

The EUT provides stable voltage constantly to RF IC 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 module and Antenna are mechanically fixed by being installed in the end product. 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	RSS-Gen 6.7	IC: -	N/A	Complied	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

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Item	Frequency range	Uncertainty (+/-)				
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR	No. 5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 dB	2.9 dB	2.9 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.1 dB	-	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.7 dB	-	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.1 dB	-	-
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB	-	-
	6 GHz-18 GHz	5.4 dB	5.4 dB	5.4 dB	-	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB	-	-
	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 dB	-	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.48 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.66 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.47 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	0.64 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.90 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.04 dB
Spurious emission (Conducted) below 1GHz	1.8 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.7 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.5 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.5 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.7 dB
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %

3.5 Test Location

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JAB Accreditation No. RTL02610
FCC Test Firm Registration Number: 839876

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 shielded room	-	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	-	2.55 x 4.1 x 2.5	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth Low Energy (BT LE)	PRBS9
*Power of the EUT was set by the software as follows; Power settings: Fixed Software: 1M PHY: nRF52810 v2.6.6 2M PHY: Serial Debug2 R2.03.3 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Conducted Emission	BT LE Tx	2402 MHz
	1M PHY	2440 MHz
	2M PHY	2480 MHz
Spurious Emission	BT LE Tx	2402 MHz
	1M PHY	2440 MHz
	2M PHY	2480 MHz
6dB Bandwidth	BT LE Tx	2402 MHz
Maximum Peak Output Power	1M PHY	2440 MHz
Power Density	2M PHY	2480 MHz
99% Occupied Bandwidth		

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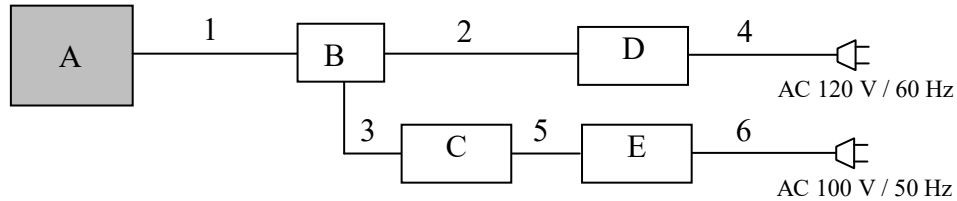
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4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Module for Wrist WATCH	W510MV	FCC001 1*) FCC002 2*)	Citizen Watch	EUT
B	Jig Board	-	-	Citizen Watch	-
C	Note personal computer	Satellite Pro A50-A Series	ZE127518H	TOSHIBA	-
D	DC power supply	PAN35-10A	DE001677	KIKUSUI	-
E	AC Adaptor	PA3917U-1ACA	201140918507284	TOSHIBA	-

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.1 + 0.7	Unshielded	Unshielded	-
2	DC	1.5	Unshielded	Unshielded	-
3	USB Cable	1.0	Shielded	Shielded	*3)
4	AC	2.0	Unshielded	Unshielded	-
5	DC	1.7	Unshielded	Unshielded	-
6	AC	0.8	Unshielded	Unshielded	-

*3) Used for data communication between Jig Board and Note personal computer.

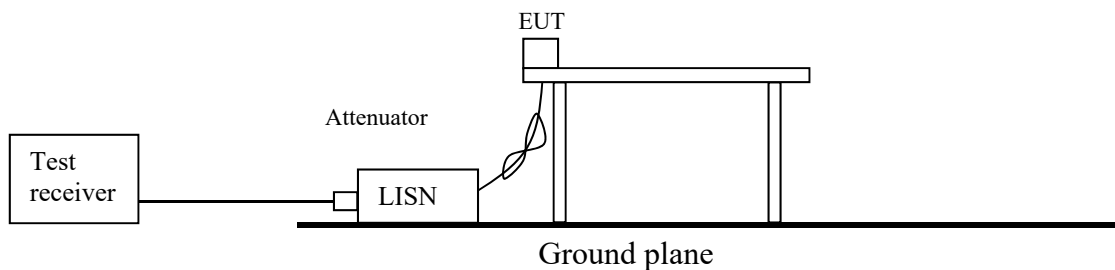
SECTION 5: Conducted Emission

Test Procedure and conditions

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

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

Conducted emission



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

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT 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

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 v05".

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 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 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

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(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	11.12.2.5.2 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz

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

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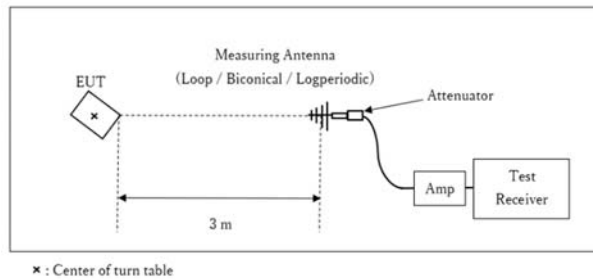
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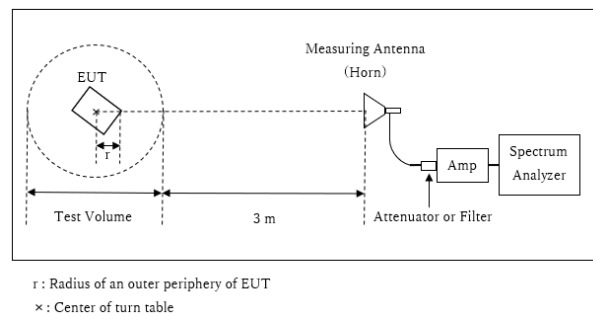
Radiated emission

Below 1 GHz



Test Distance: 3 m

1 GHz - 13 GHz



Distance Factor: $20 \times \log (3.99 \text{ m}^* / 3.0 \text{ m}) = 2.48 \text{ dB}$

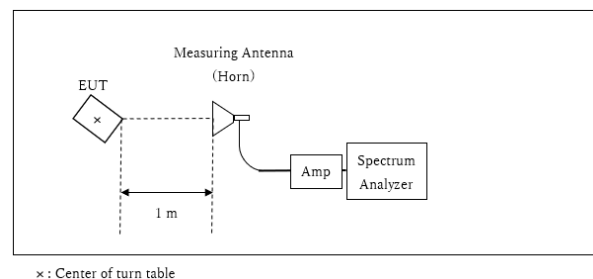
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.99 \text{ m}$

Test Volume: 2 m

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

$r = 0.01 \text{ m}$

13 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.

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

Measurement range : 30 MHz - 26.5 GHz

Test data : APPENDIX

Test result : Pass

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SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	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, however the noise was not detected as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)							

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

Test data	: APPENDIX
Test result	: Pass

APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

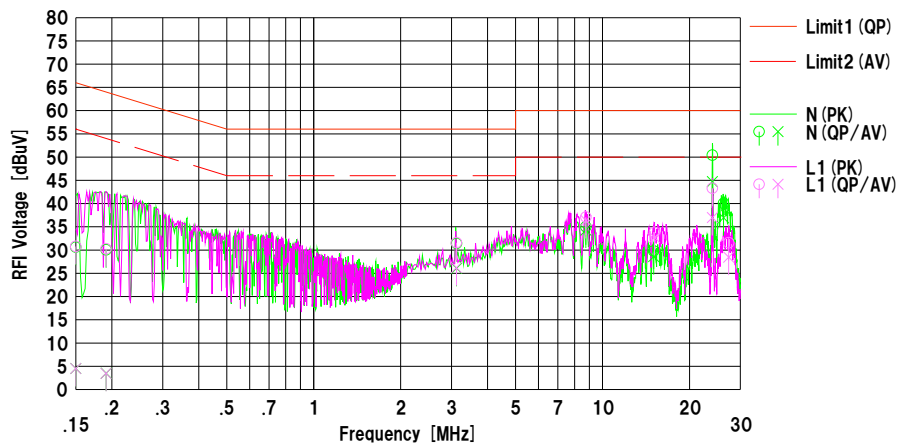
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Date : 2018/11/16

Mode : Tx BLE 1M_2480 MHz
Power : AC 120V / 60 Hz
Temp./Humi. : 25 deg.C. / 44 %RH

Remarks : -

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Makoto Hosaka



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	18.28	-7.82	12.33	30.61	4.51	66.00	56.00	35.3	51.4	N	
2	0.19105	17.73	-8.82	12.33	30.06	3.51	63.99	53.99	33.9	50.4	N	
3	3.12313	19.04	13.70	12.37	31.41	26.07	56.00	46.00	24.5	19.9	N	
4	8.76012	22.44	21.76	12.54	34.98	34.30	60.00	50.00	25.0	15.7	N	
5	15.03956	17.15	15.94	12.65	29.80	28.59	60.00	50.00	30.2	21.4	N	
6	24.00260	37.52	31.85	12.88	50.40	44.73	60.00	50.00	9.6	5.2	N	
7	26.23873	27.12	24.03	12.91	40.03	36.94	60.00	50.00	19.9	13.0	N	
8	0.15000	18.45	-7.82	12.33	30.78	4.51	66.00	56.00	35.2	51.4	L1	
9	0.19095	17.93	-8.86	12.33	30.26	3.47	64.00	54.00	33.7	50.5	L1	
10	3.12174	19.21	13.85	12.37	31.58	26.22	56.00	46.00	24.4	19.7	L1	
11	8.76005	24.55	23.83	12.54	37.09	36.37	60.00	50.00	22.9	13.6	L1	
12	15.13082	21.18	20.06	12.65	33.83	32.71	60.00	50.00	26.1	17.2	L1	
13	24.00122	30.41	24.12	12.88	43.29	37.00	60.00	50.00	16.7	13.0	L1	
14	27.33858	18.65	15.56	12.91	31.56	28.47	60.00	50.00	28.4	21.5	L1	

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

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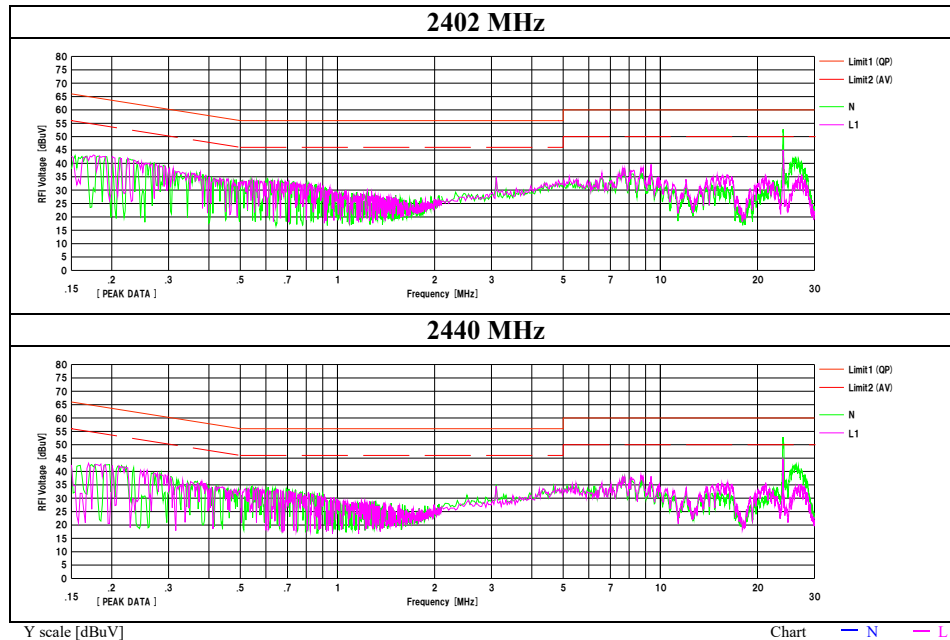
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Conducted Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.1 Semi Anechoic Chamber
Date November 16, 2018
Temperature / Humidity 25 deg. C / 44 % RH
Engineer Makoto Hosaka
Mode Tx BT LE 1M PHY



Conducted Emission

DATA OF CONDUCTED EMISSION TEST

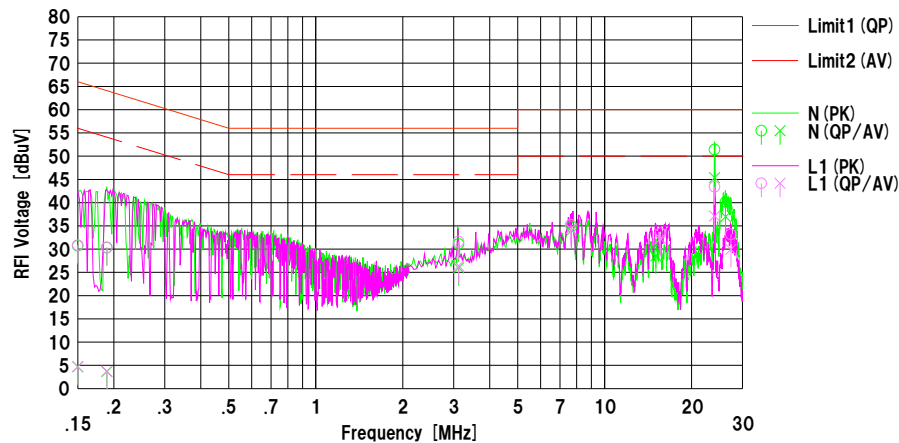
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2018/11/16

Mode : Tx_BLE_2M_2480 MHz
Power : AC 120V / 60 Hz
Temp./Humi. : 25 deg.C. / 44 %RH

Remarks : -

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Makoto Hosaka

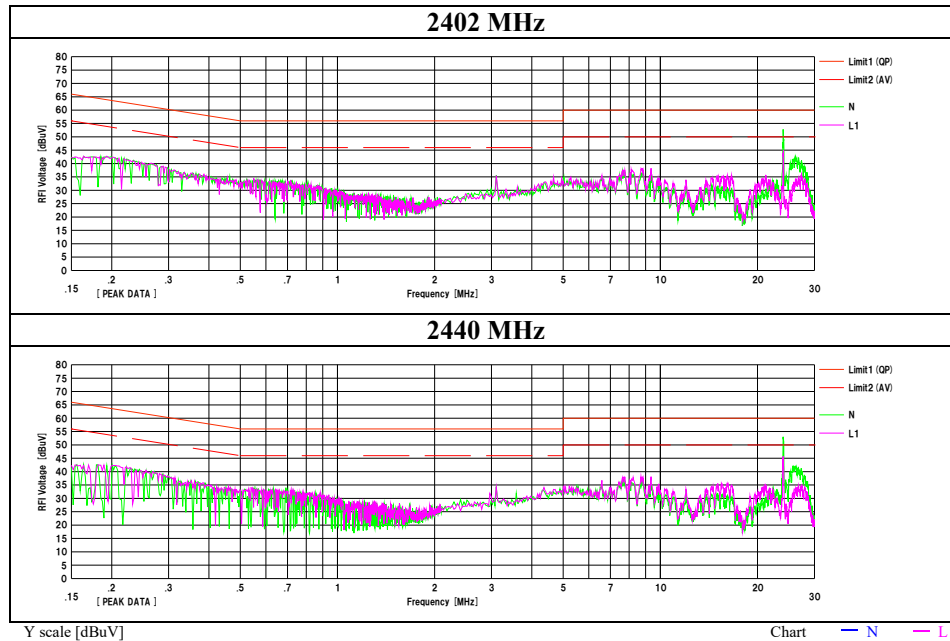


No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	18.38	-7.64	12.33	30.71	4.69	66.00	56.00	35.2	51.3	N	
2	0.18900	17.97	-8.66	12.33	30.30	3.67	64.08	54.08	33.7	50.4	N	
3	3.12409	18.75	13.61	12.37	31.12	25.98	56.00	46.00	24.8	20.0	N	
4	7.68000	22.37	21.52	12.50	34.87	34.02	60.00	50.00	25.1	15.9	N	
5	15.03967	17.11	15.89	12.65	29.76	28.54	60.00	50.00	30.2	21.4	N	
6	24.00010	38.53	32.49	12.88	51.41	45.37	60.00	50.00	8.5	4.6	N	
7	26.19938	27.22	24.07	12.91	40.13	36.98	60.00	50.00	19.8	13.0	N	
8	0.15000	18.52	-7.65	12.33	30.85	4.68	66.00	56.00	35.1	51.3	L1	
9	0.18923	18.04	-8.59	12.33	30.37	3.74	64.07	54.07	33.7	50.3	L1	
10	3.12349	19.25	14.05	12.37	31.62	26.42	56.00	46.00	24.3	19.5	L1	
11	7.63992	22.75	21.85	12.50	35.25	34.35	60.00	50.00	24.7	15.6	L1	
12	15.59963	20.72	19.61	12.67	33.39	32.28	60.00	50.00	26.6	17.7	L1	
13	24.00150	30.53	24.24	12.88	43.41	37.12	60.00	50.00	16.5	12.8	L1	
14	27.35896	20.27	17.04	12.91	33.18	29.95	60.00	50.00	26.8	20.0	L1	

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

Conducted Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.1 Semi Anechoic Chamber
Date November 16, 2018
Temperature / Humidity 25 deg. C / 44 % RH
Engineer Makoto Hosaka
Mode Tx BT LE 2MHz

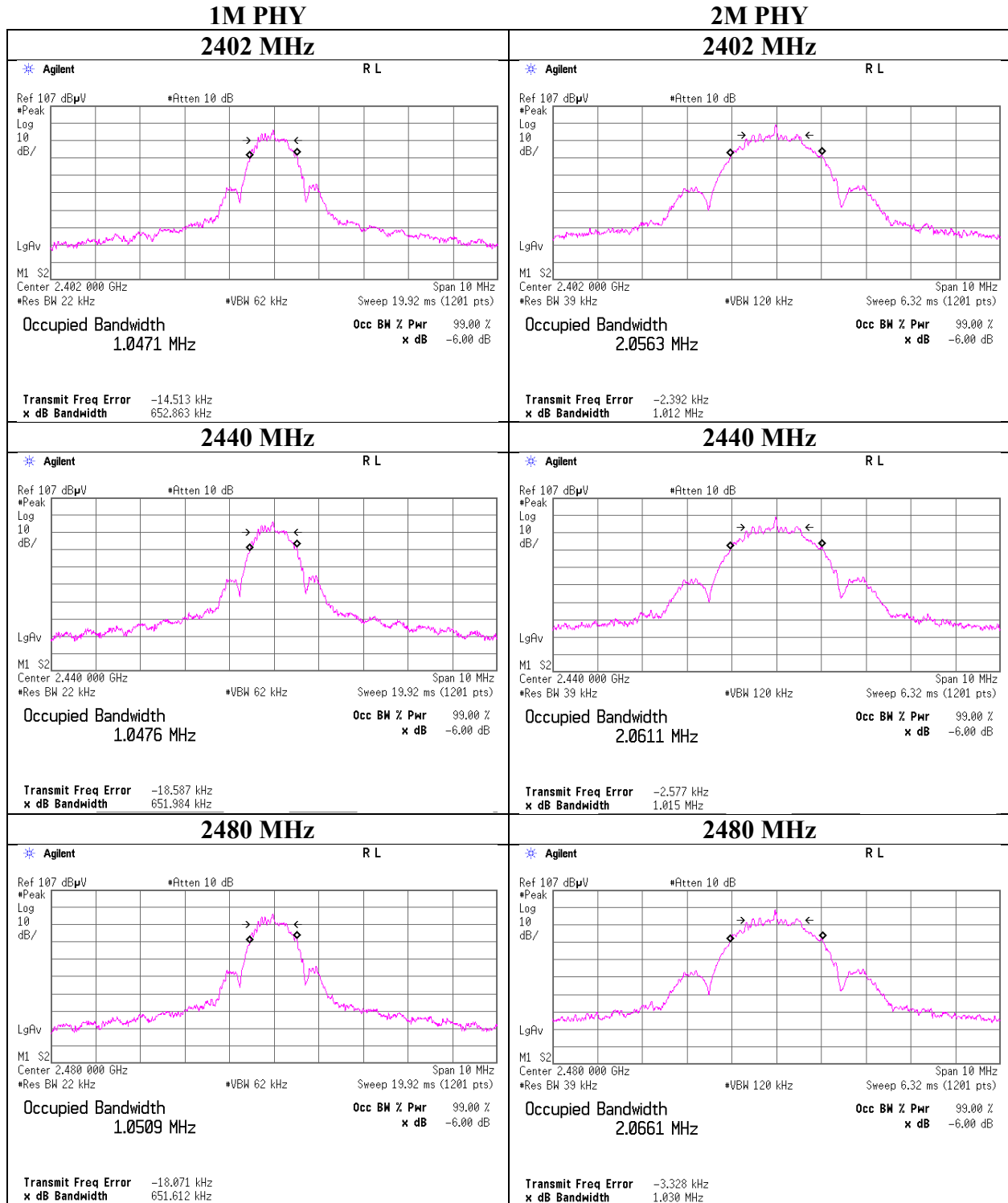


6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
1M PHY	2402	1047.1	0.727	> 0.5000
	2440	1047.6	0.718	> 0.5000
	2480	1050.9	0.719	> 0.5000
2M PHY	2402	2056.3	1.161	> 0.5000
	2440	2061.1	1.166	> 0.5000
	2480	2066.1	1.183	> 0.5000

99%Occupied Bandwidth



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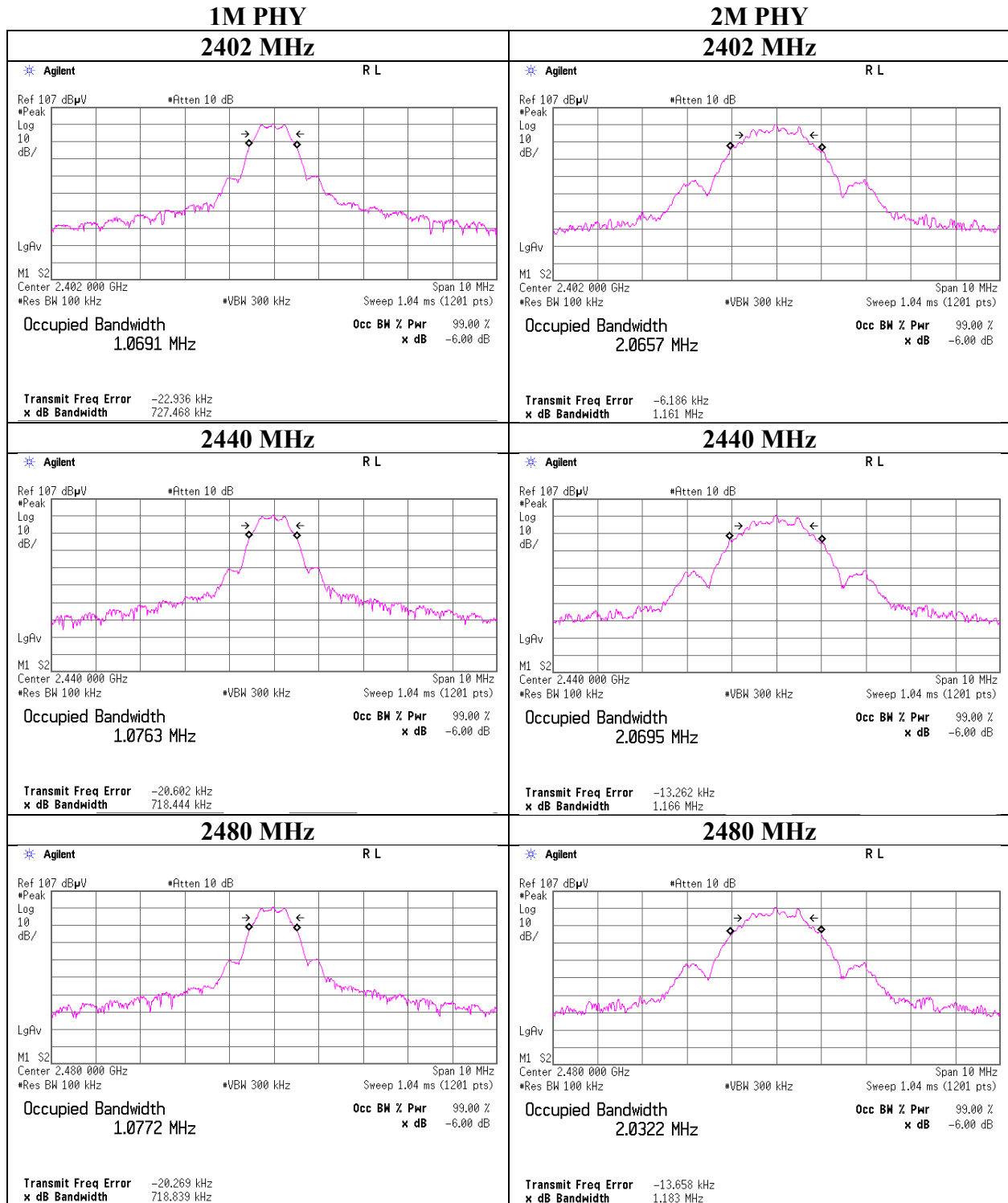
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6dB Bandwidth



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Maximum Peak Output Power

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE

1M PHY				Conducted Power					e.i.r.p. for RSS-247					
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-9.52	1.22	9.68	1.38	1.37	30.00	1000	28.62	-12.56	-11.18	0.08	36.02	4000	47.20
2440	-9.41	1.22	9.67	1.48	1.41	30.00	1000	28.52	-12.56	-11.08	0.08	36.02	4000	47.10
2480	-9.40	1.23	9.67	1.50	1.41	30.00	1000	28.50	-12.56	-11.06	0.08	36.02	4000	47.08

2M PHY				Conducted Power					e.i.r.p. for RSS-247					
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-9.46	1.22	9.68	1.44	1.39	30.00	1000	28.56	-12.56	-11.12	0.08	36.02	4000	47.14
2440	-9.45	1.22	9.67	1.44	1.39	30.00	1000	28.56	-12.56	-11.12	0.08	36.02	4000	47.14
2480	-9.39	1.23	9.67	1.51	1.42	30.00	1000	28.49	-12.56	-11.05	0.08	36.02	4000	47.07

Sample Calculation:

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

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

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Average Output Power
(Reference data for RF Exposure / SAR testing)

Report No.	12407798S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 9, 2018
Temperature / Humidity	26 deg. C / 42 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE

1M PHY

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	-11.84	1.22	9.68	-0.94	0.81	1.96	1.02	1.26
2440	-11.77	1.22	9.67	-0.88	0.82	1.96	1.08	1.28
2480	-11.73	1.23	9.67	-0.83	0.83	1.96	1.13	1.30

2M PHY

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	-12.18	1.22	9.68	-1.28	0.74	2.37	1.09	1.28
2440	-12.15	1.22	9.67	-1.26	0.75	2.37	1.11	1.29
2480	-12.12	1.23	9.67	-1.22	0.76	2.37	1.15	1.30

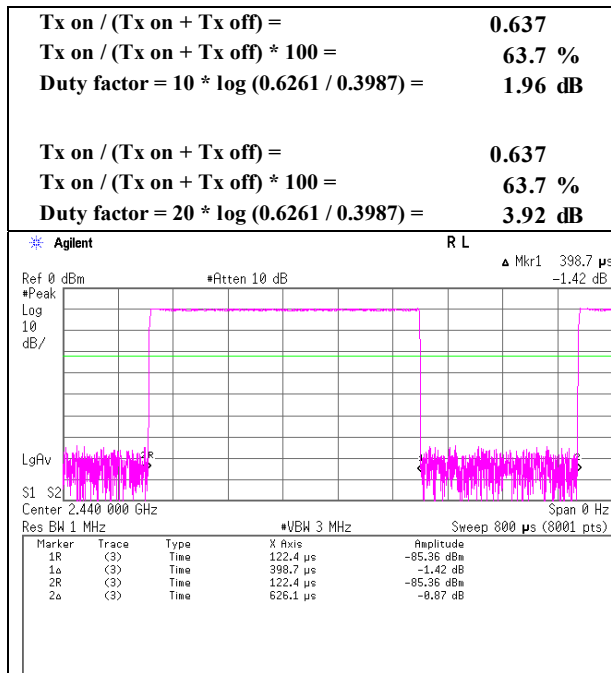
Sample Calculation:

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

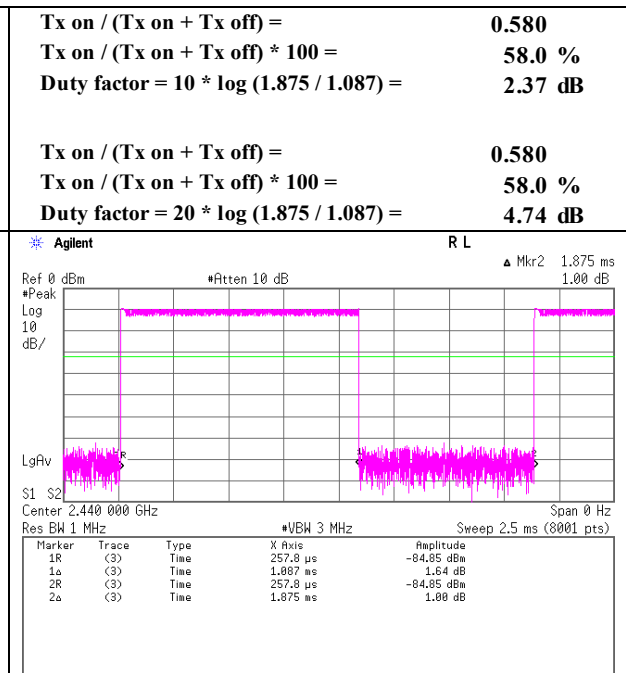
Burst rate confirmation

Report No.	12407798S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 9, 2018
Temperature / Humidity	26 deg. C / 42 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE

BLE 1M PHY



BLE 2M PHY



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

Radiated Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date November 6, 2018 November 5, 2018 November 6, 2018
Temperature / Humidity 23 deg. C / 61 % RH 24 deg. C / 54 % RH 23 deg. C / 61 % RH
Engineer Yosuke Ishikawa Makoto Hosaka Yosuke Ishikawa
(30 MHz - 1 GHz) (1 GHz - 13 GHz) (13 GHz - 26.5 GHz)
Mode Tx BT LE 1M PHY 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.	159.925	QP	22.08	15.05	7.87	32.11	0.00	12.89	43.50	30.6	100	2	
Hori.	240.000	QP	28.02	11.65	8.31	32.03	0.00	15.95	46.00	30.0	210	18	
Hori.	299.500	QP	22.08	13.70	8.71	32.01	0.00	12.48	46.00	33.5	100	1	
Hori.	431.012	QP	21.82	16.35	9.37	31.97	0.00	15.57	46.00	30.4	100	358	
Hori.	850.089	QP	21.45	21.60	10.94	31.39	0.00	22.60	46.00	23.4	100	1	
Hori.	2390.000	PK	43.81	27.86	14.13	36.58	2.48	51.70	73.90	22.2	168	85	
Hori.	4804.000	PK	47.98	31.43	6.51	36.88	2.48	51.52	73.90	22.3	168	144	
Hori.	7206.000	PK	43.26	36.79	8.23	37.26	2.48	53.50	73.90	20.4	150	0	
Vert.	151.223	QP	22.18	14.83	7.80	32.12	0.00	12.69	43.50	30.8	100	1	
Vert.	240.004	QP	27.78	11.65	8.31	32.03	0.00	15.71	46.00	30.2	141	348	
Vert.	350.496	QP	21.82	15.12	9.03	31.95	0.00	14.02	46.00	31.9	100	1	
Vert.	582.032	QP	21.51	18.69	9.94	31.97	0.00	18.17	46.00	27.8	100	1	
Vert.	2390.000	PK	44.04	27.86	14.13	36.58	2.48	51.93	73.90	21.9	223	0	
Vert.	4804.000	PK	47.40	31.43	6.51	36.88	2.48	50.94	73.90	22.9	150	138	
Vert.	7206.000	PK	43.52	36.79	8.23	37.26	2.48	53.76	73.90	20.1	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.99 m / 3.0 m) = 2.48 dB

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	33.45	27.86	14.13	36.58	3.92	2.48	45.26	53.90	8.6	*1)
Hori.	4804.000	AV	35.93	31.43	6.51	36.88	3.92	2.48	43.39	53.90	10.5	
Hori.	7206.000	AV	35.62	36.79	8.23	37.26	3.92	2.48	49.78	53.90	4.1	
Vert.	2390.000	AV	32.65	27.86	14.13	36.58	3.92	2.48	44.46	53.90	9.4	*1)
Vert.	4804.000	AV	34.45	31.43	6.51	36.88	3.92	2.48	41.91	53.90	12.0	
Vert.	7206.000	AV	34.47	36.79	8.23	37.26	3.92	2.48	48.63	53.90	5.3	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.99 m / 3.0 m) = 2.48 dB

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

Duty factor refer to "Duty factor Calculation chart" sheet.

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

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	71.52	27.86	14.14	36.57	2.48	79.43	-	-	Carrier
Hori.	2400.000	PK	36.14	27.86	14.14	36.58	2.48	44.04	59.43	15.4	
Hori.	9608.000	PK	36.88	38.51	9.21	38.47	2.48	48.61	59.43	10.8	
Vert.	2402.000	PK	71.57	27.86	14.14	36.57	2.48	79.48	-	-	Carrier
Vert.	2400.000	PK	39.16	27.86	14.14	36.58	2.48	47.06	59.48	12.4	
Vert.	9608.000	PK	37.45	38.51	9.21	38.47	2.48	49.18	59.48	10.3	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.99 m / 3.0 m) = 2.48 dB

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

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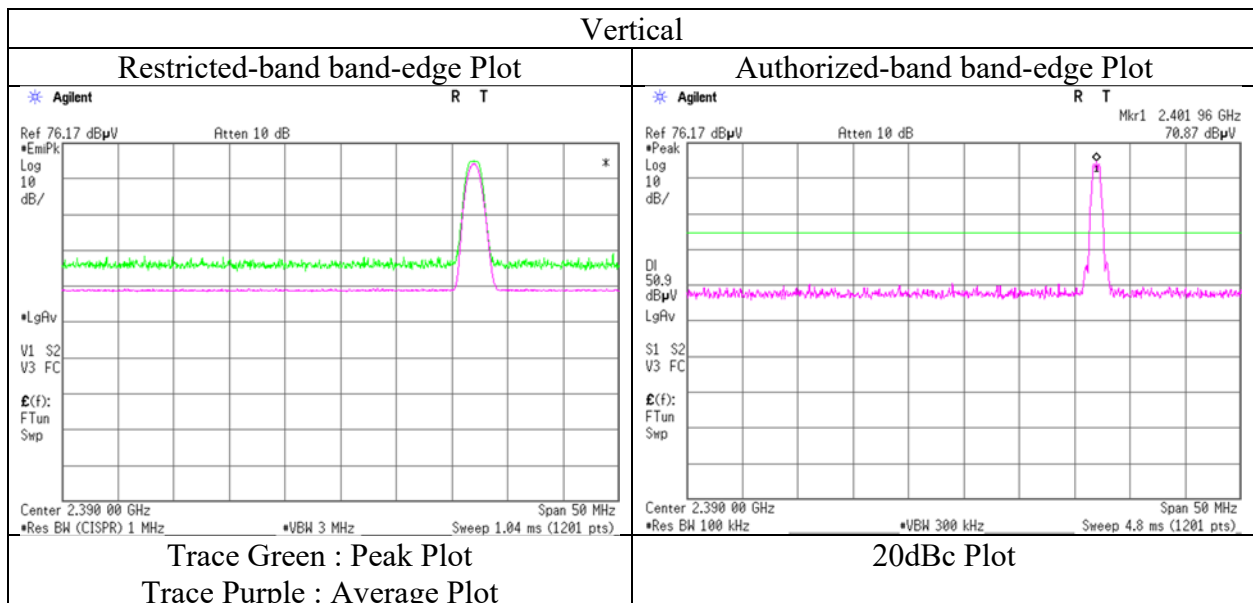
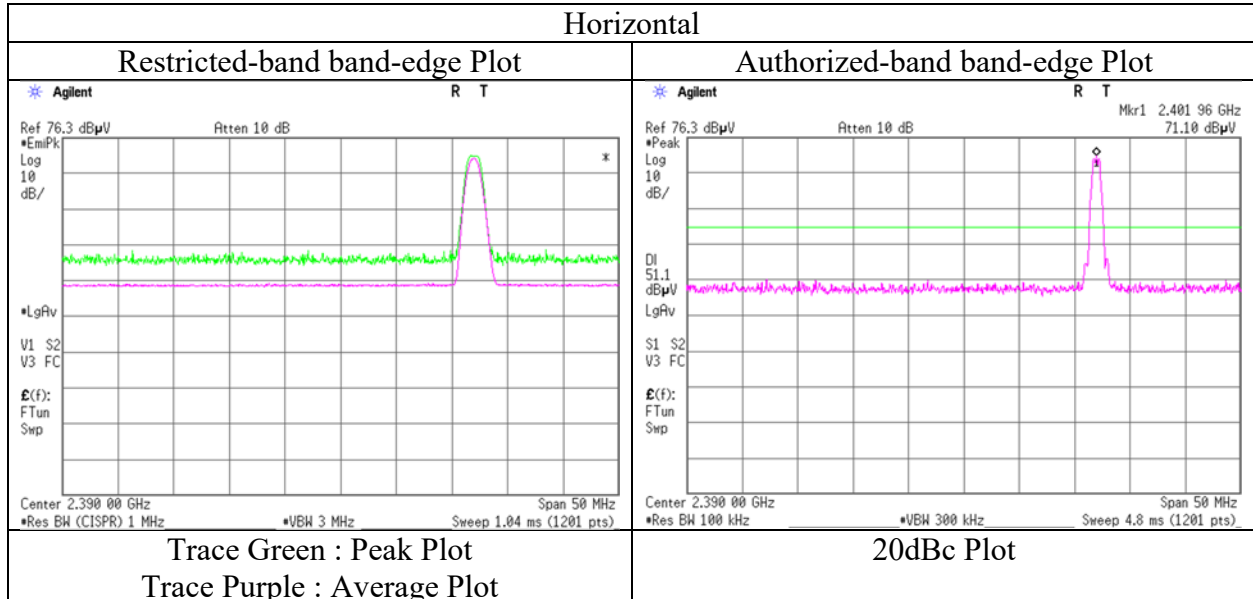
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12407798S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No. 3
Date	November 5, 2018
Temperature / Humidity	24 deg. C / 54 % RH
Engineer	Makoto Hosaka
	(1 GHz - 13 GHz)
Mode	Tx BT LE 1M PHY 2402 MHz



- * Final result of restricted band edge was shown in tabular data.
- * The spurious emission on the band between 2310 MHz to 2365 MHz were not observed.

Radiated Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date November 6, 2018 November 5, 2018 November 6, 2018
Temperature / Humidity 23 deg. C / 61 % RH 24 deg. C / 54 % RH 23 deg. C / 61 % RH
Engineer Yosuke Ishikawa Makoto Hosaka Yosuke Ishikawa
(30 MHz - 1 GHz) (1 GHz - 13 GHz) (13 GHz - 26.5 GHz)
Mode Tx BT LE 1M PHY 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.	160.009	QP	22.48	15.05	7.87	32.11	0.00	13.29	43.50	30.2	100	1	
Hori.	240.000	QP	27.31	11.65	8.31	32.03	0.00	15.24	46.00	30.7	219	31	
Hori.	300.794	QP	21.86	13.72	8.72	32.01	0.00	12.29	46.00	33.7	100	1	
Hori.	431.711	QP	21.73	16.36	9.38	31.97	0.00	15.50	46.00	30.5	100	2	
Hori.	850.697	QP	21.18	21.62	10.94	31.38	0.00	22.36	46.00	23.6	100	1	
Hori.	4880.000	PK	44.88	31.37	6.56	36.90	2.48	48.39	73.90	25.5	144	124	
Hori.	7320.000	PK	42.68	37.00	8.31	37.44	2.48	53.03	73.90	20.8	150	0	
Vert.	151.274	QP	21.11	14.83	7.81	32.12	0.00	11.63	43.50	31.8	100	2	
Vert.	240.000	QP	27.97	11.65	8.31	32.03	0.00	15.90	46.00	30.1	140	350	
Vert.	349.500	QP	21.81	15.10	9.03	31.95	0.00	13.99	46.00	32.0	100	1	
Vert.	582.018	QP	21.39	18.69	9.94	31.97	0.00	18.05	46.00	27.9	100	2	
Vert.	4880.000	PK	44.77	31.37	6.56	36.90	2.48	48.28	73.90	25.6	254	337	
Vert.	7320.000	PK	42.39	37.00	8.31	37.44	2.48	52.74	73.90	21.1	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.99 m / 3.0 m) = 2.48 dB

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	34.30	31.37	6.56	36.90	3.92	2.48	41.73	53.90	12.2	
Hori.	7320.000	AV	34.37	37.00	8.31	37.44	3.92	2.48	48.64	53.90	5.3	
Vert.	4880.000	AV	36.56	31.37	6.56	36.90	3.92	2.48	43.99	53.90	9.9	
Vert.	7320.000	AV	34.88	37.00	8.31	37.44	3.92	2.48	49.15	53.90	4.7	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.99 m / 3.0 m) = 2.48 dB

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

Duty factor refer to "Duty factor Calculation chart" sheet.

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

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2440.000	PK	72.52	27.81	14.17	36.55	2.48	80.43	-	-	Carrier
Hori.	9760.000	PK	34.90	38.92	9.21	38.65	2.48	46.86	60.43	13.6	
Vert.	2440.000	PK	72.37	27.81	14.17	36.55	2.48	80.28	-	-	Carrier
Vert.	9760.000	PK	34.50	38.92	9.21	38.65	2.48	46.46	60.28	13.8	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.99 m / 3.0 m) = 2.48 dB

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

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Radiated Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date November 6, 2018 November 5, 2018 November 6, 2018
Temperature / Humidity 23 deg. C / 61 % RH 24 deg. C / 54 % RH 23 deg. C / 61 % RH
Engineer Yosuke Ishikawa Makoto Hosaka Yosuke Ishikawa
(30 MHz - 1 GHz) (1 GHz - 13 GHz) (13 GHz - 26.5 GHz)
Mode Tx BT LE 1M PHY 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.	160.001	QP	22.27	15.05	7.87	32.11	0.00	13.08	43.50	30.4	100	1	
Hori.	240.000	QP	27.35	11.65	8.31	32.03	0.00	15.28	46.00	30.7	210	26	
Hori.	299.709	QP	22.01	13.70	8.71	32.01	0.00	12.41	46.00	33.5	100	358	
Hori.	431.499	QP	21.91	16.36	9.38	31.97	0.00	15.68	46.00	30.3	100	2	
Hori.	849.992	QP	21.39	21.60	10.94	31.39	0.00	22.54	46.00	23.4	100	1	
Hori.	2483.500	PK	44.35	27.65	14.22	36.52	2.48	52.18	73.90	21.7	345	188	
Hori.	4960.000	PK	45.68	31.54	6.61	36.93	2.48	49.38	73.90	24.5	178	158	
Hori.	7440.000	PK	43.47	37.10	8.38	37.63	2.48	53.80	73.90	20.1	150	0	
Vert.	150.993	QP	22.36	14.82	7.80	32.12	0.00	12.86	43.50	30.6	100	1	
Vert.	240.000	QP	27.83	11.65	8.31	32.03	0.00	15.76	46.00	30.2	136	350	
Vert.	350.600	QP	21.96	15.12	9.03	31.95	0.00	14.16	46.00	31.8	100	358	
Vert.	582.034	QP	21.45	18.69	9.94	31.97	0.00	18.11	46.00	27.8	100	1	
Vert.	2483.500	PK	44.41	27.65	14.22	36.52	2.48	52.24	73.90	21.6	168	297	
Vert.	4960.000	PK	46.04	31.54	6.61	36.93	2.48	49.74	73.90	24.1	127	359	
Vert.	7440.000	PK	43.35	37.10	8.38	37.63	2.48	53.68	73.90	20.2	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	34.70	27.65	14.22	36.52	3.92	2.48	46.45	53.90	7.4	*1)
Hori.	4960.000	AV	34.88	31.54	6.61	36.93	3.92	2.48	42.50	53.90	11.4	
Hori.	7440.000	AV	33.95	37.10	8.38	37.63	3.92	2.48	48.20	53.90	5.7	
Vert.	2483.500	AV	35.03	27.65	14.22	36.52	3.92	2.48	46.78	53.90	7.1	*1)
Vert.	4960.000	AV	36.67	31.54	6.61	36.93	3.92	2.48	44.29	53.90	9.6	
Vert.	7440.000	AV	33.72	37.10	8.38	37.63	3.92	2.48	47.97	53.90	5.9	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Duty factor refer to "Duty factor Calculation chart" sheet.

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

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.	2480.000	PK	71.31	27.67	14.22	36.52	2.48	79.16	-	-	Carrier
Hori.	9920.000	PK	33.96	38.97	9.22	38.84	2.48	45.79	59.16	13.4	
Vert.	2480.000	PK	71.91	27.67	14.22	36.52	2.48	79.76	-	-	Carrier
Vert.	9920.000	PK	34.45	38.97	9.22	38.84	2.48	46.28	59.76	13.5	

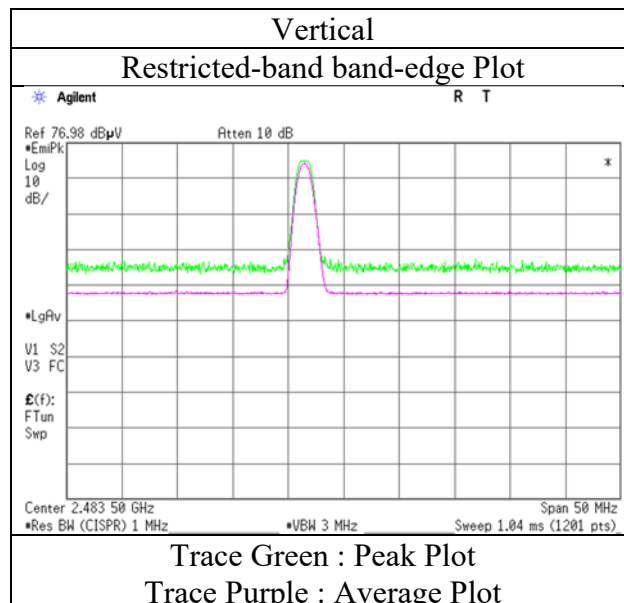
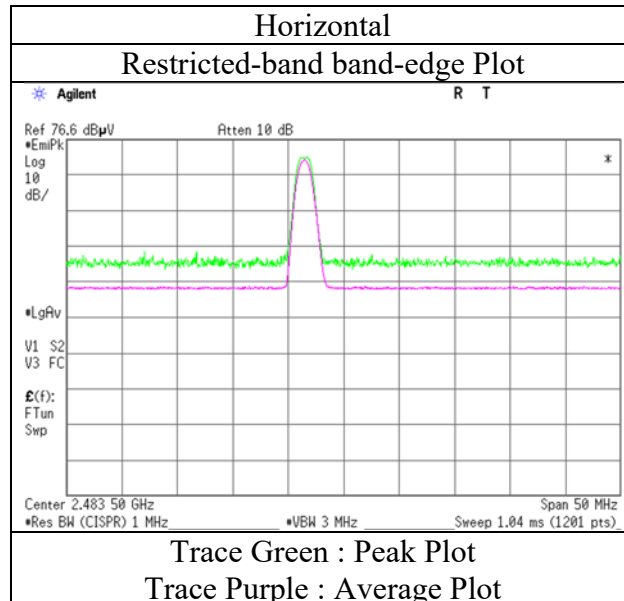
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12407798S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	November 5, 2018
Temperature / Humidity	24 deg. C / 54 % RH
Engineer	Makoto Hosaka (1 GHz - 13 GHz)
Mode	Tx BT LE 1M PHY 2480 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 3
Date November 6, 2018 November 6, 2018
Temperature / Humidity 23 deg. C / 61 % RH 24 deg. C / 61 % RH
Engineer Yosuke Ishikawa Makoto Hosaka
(30 MHz - 1 GHz) (1 GHz - 26.5 GHz)
Mode Tx BT LE 2M PHY 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.	160.005	QP	22.33	15.05	7.87	32.11	0.00	13.14	43.50	30.3	100	2	
Hori.	240.000	QP	27.96	11.65	8.31	32.03	0.00	15.89	46.00	30.1	210	25	
Hori.	299.700	QP	22.01	13.70	8.71	32.01	0.00	12.41	46.00	33.5	100	2	
Hori.	431.005	QP	21.88	16.35	9.37	31.97	0.00	15.63	46.00	30.3	100	1	
Hori.	850.098	QP	21.37	21.60	10.94	31.39	0.00	22.52	46.00	23.4	100	1	
Hori.	2390.000	PK	43.81	27.86	14.13	36.58	2.48	51.70	73.90	22.2	157	33	
Hori.	4804.000	PK	45.52	31.43	6.51	36.88	2.48	49.06	73.90	24.8	222	166	
Hori.	7206.000	PK	44.58	36.79	8.23	37.26	2.48	54.82	73.90	19.0	150	0	
Vert.	151.213	QP	22.15	14.83	7.80	32.12	0.00	12.66	43.50	30.8	100	3	
Vert.	240.000	QP	28.32	11.65	8.31	32.03	0.00	16.25	46.00	29.7	141	353	
Vert.	350.122	QP	21.77	15.11	9.03	31.95	0.00	13.96	46.00	32.0	100	358	
Vert.	582.020	QP	21.49	18.69	9.94	31.97	0.00	18.15	46.00	27.8	100	1	
Vert.	2390.000	PK	46.04	27.86	14.13	36.58	2.48	53.93	73.90	19.9	210	273	
Vert.	4804.000	PK	45.44	31.43	6.51	36.88	2.48	48.98	73.90	24.9	384	36	
Vert.	7206.000	PK	44.69	36.79	8.23	37.26	2.48	54.93	73.90	18.9	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	34.82	27.86	14.13	36.58	4.74	2.48	47.45	53.90	6.4	*1)
Hori.	4804.000	AV	35.82	31.43	6.51	36.88	4.74	2.48	44.10	53.90	9.8	
Hori.	7206.000	AV	35.18	36.79	8.23	37.26	4.74	2.48	50.16	53.90	3.7	
Vert.	2390.000	AV	34.92	27.86	14.13	36.58	4.74	2.48	47.55	53.90	6.4	*1)
Vert.	4804.000	AV	35.34	31.43	6.51	36.88	4.74	2.48	43.62	53.90	10.3	
Vert.	7206.000	AV	35.26	36.79	8.23	37.26	4.74	2.48	50.24	53.90	3.7	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Duty factor refer to "Duty factor Calculation chart" sheet.

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

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	73.21	27.86	14.14	36.57	2.48	81.12	-	-	Carrier
Hori.	2400.000	PK	42.81	27.86	14.14	36.58	2.48	50.71	61.12	10.4	
Hori.	9608.000	PK	35.07	38.51	9.21	38.47	2.48	46.80	61.12	14.3	
Vert.	2402.000	PK	70.92	27.86	14.14	36.57	2.48	78.83	-	-	Carrier
Vert.	2400.000	PK	40.02	27.86	14.14	36.58	2.48	47.92	58.83	10.9	
Vert.	9608.000	PK	36.65	38.51	9.21	38.47	2.48	48.38	58.83	10.5	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

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Shonan EMC Lab.

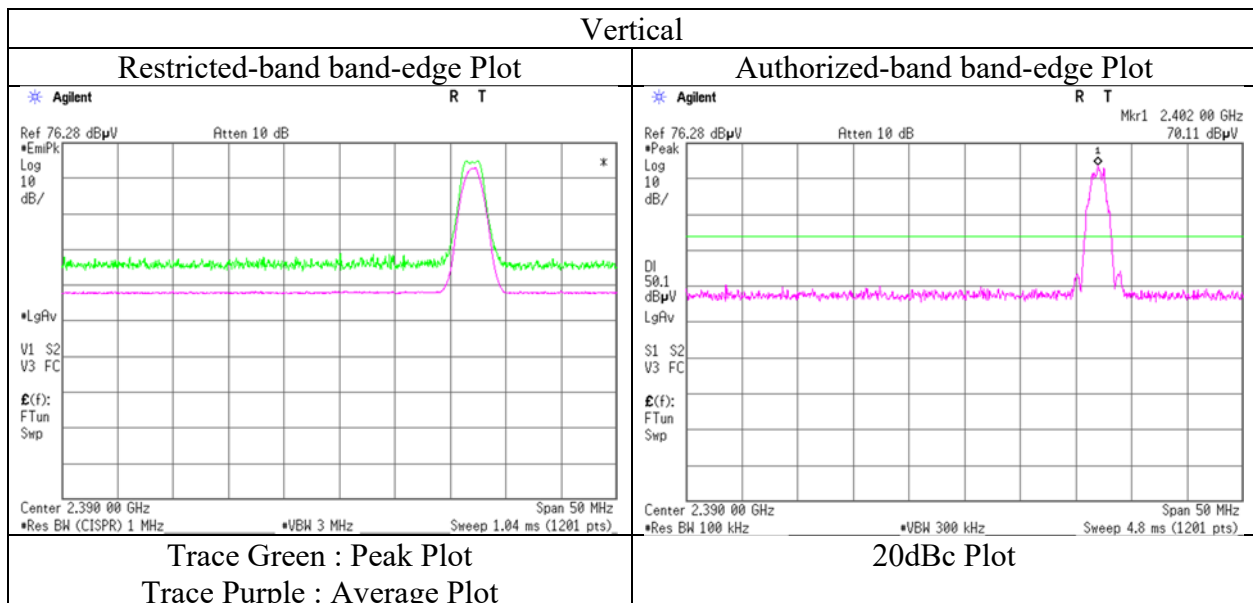
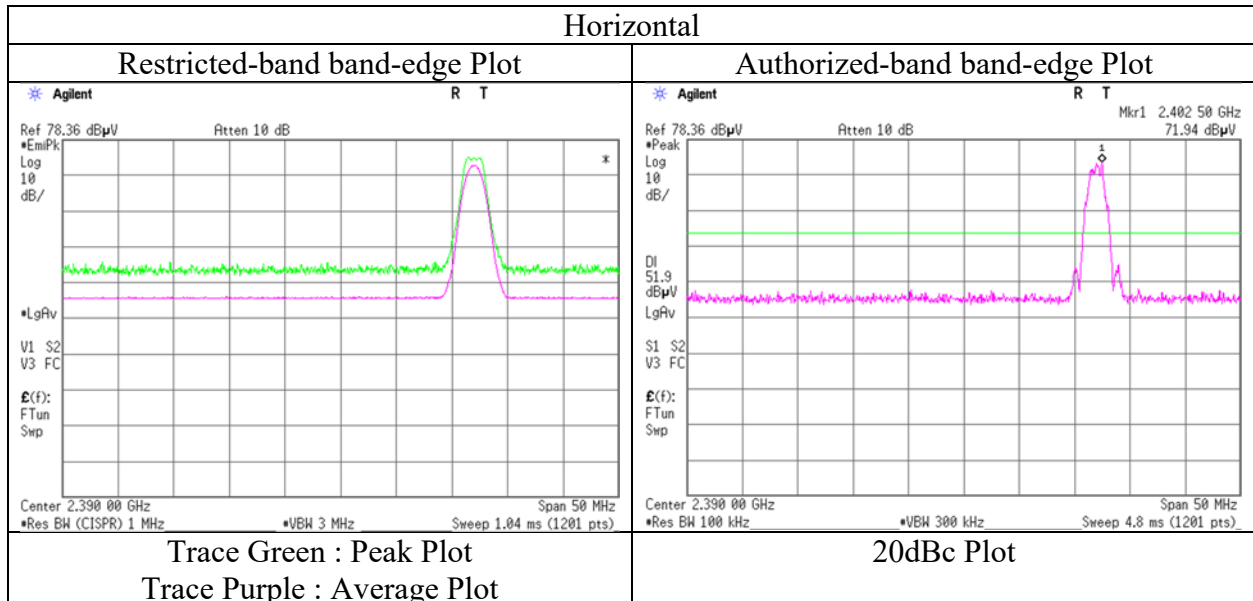
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12407798S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No. 3
Date	November 6, 2018
Temperature / Humidity	24 deg. C / 61 % RH
Engineer	Makoto Hosaka
	(1 GHz –13 GHz)
Mode	Tx BT LE 2M PHY 2402 MHz



- * Final result of restricted band edge was shown in tabular data.
- * The spurious emission on the band between 2310 MHz to 2365 MHz were not observed.

Radiated Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 3
Date November 6, 2018 November 6, 2018
Temperature / Humidity 23 deg. C / 61 % RH 24 deg. C / 61 % RH
Engineer Yosuke Ishikawa Makoto Hosaka
(30 MHz - 1 GHz) (1 GHz - 26.5 GHz)
Mode Tx BT LE 2M PHY 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.	160.003	QP	22.32	15.05	7.87	32.11	0.00	13.13	43.50	30.3	100	2	
Hori.	240.000	QP	28.70	11.65	8.31	32.03	0.00	16.63	46.00	29.3	221	352	
Hori.	300.102	QP	22.11	13.71	8.71	32.01	0.00	12.52	46.00	33.4	100	2	
Hori.	431.011	QP	21.91	16.35	9.37	31.97	0.00	15.66	46.00	30.3	100	0	
Hori.	850.090	QP	21.31	21.60	10.94	31.39	0.00	22.46	46.00	23.5	100	2	
Hori.	4880.000	PK	45.69	31.37	6.56	36.90	2.48	49.20	73.90	24.7	115	159	
Hori.	7320.000	PK	44.90	37.00	8.31	37.44	2.48	55.25	73.90	18.7	150	0	
Vert.	151.228	QP	22.52	14.83	7.80	32.12	0.00	13.03	43.50	30.4	100	2	
Vert.	240.000	QP	28.27	11.65	8.31	32.03	0.00	16.20	46.00	29.8	134	352	
Vert.	350.011	QP	21.88	15.11	9.03	31.95	0.00	14.07	46.00	31.9	100	1	
Vert.	582.024	QP	21.71	18.69	9.94	31.97	0.00	18.37	46.00	27.6	100	1	
Vert.	4880.000	PK	44.91	31.37	6.56	36.90	2.48	48.42	73.90	25.5	102	29	
Vert.	7320.000	PK	44.79	37.00	8.31	37.44	2.48	55.14	73.90	18.8	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99\text{ m} / 3.0\text{ m}) = 2.48\text{ dB}$

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	34.89	31.37	6.56	36.90	4.74	2.48	43.14	53.90	10.8	
Hori.	7320.000	AV	34.52	37.00	8.31	37.44	4.74	2.48	49.61	53.90	4.3	
Vert.	4880.000	AV	35.10	31.37	6.56	36.90	4.74	2.48	43.35	53.90	10.6	
Vert.	7320.000	AV	34.45	37.00	8.31	37.44	4.74	2.48	49.54	53.90	4.4	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99\text{ m} / 3.0\text{ m}) = 2.48\text{ dB}$

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

Duty factor refer to "Duty factor Calculation chart" sheet.

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

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.	2440.000	PK	74.88	27.81	14.17	36.55	2.48	82.79	-	-	Carrier
Hori.	9760.000	PK	34.49	38.92	9.21	38.65	2.48	46.45	60.31	16.3	
Vert.	2440.000	PK	69.52	27.81	14.17	36.55	2.48	77.43	-	-	Carrier
Vert.	9760.000	PK	34.92	38.92	9.21	38.65	2.48	46.88	54.95	10.6	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99\text{ m} / 3.0\text{ m}) = 2.48\text{ dB}$

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

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Radiated Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 3
Date November 6, 2018 November 6, 2018
Temperature / Humidity 23 deg. C / 61 % RH 24 deg. C / 61 % RH
Engineer Yosuke Ishikawa Makoto Hosaka
(30 MHz - 1 GHz) (1 GHz - 26.5 GHz)
Mode Tx BT LE 2M PHY 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.	160.010	QP	22.21	15.05	7.87	32.11	0.00	13.02	43.50	30.4	100	2	
Hori.	240.000	QP	28.11	11.65	8.31	32.03	0.00	16.04	46.00	29.9	211	26	
Hori.	299.981	QP	22.01	13.71	8.71	32.01	0.00	12.42	46.00	33.5	100	1	
Hori.	431.021	QP	21.83	16.35	9.37	31.97	0.00	15.58	46.00	30.4	100	1	
Hori.	850.088	QP	21.27	21.60	10.94	31.39	0.00	22.42	46.00	23.5	100	2	
Hori.	2483.500	PK	45.50	27.65	14.22	36.52	2.48	53.33	73.90	20.6	152	335	
Hori.	4960.000	PK	44.59	31.54	6.61	36.93	2.48	48.29	73.90	25.6	223	164	
Hori.	7440.000	PK	42.45	37.10	8.38	37.63	2.48	52.78	73.90	21.1	150	0	
Vert.	151.219	QP	22.31	14.83	7.80	32.12	0.00	12.82	43.50	30.6	100	2	
Vert.	240.001	QP	28.53	11.65	8.31	32.03	0.00	16.46	46.00	29.5	137	334	
Vert.	350.114	QP	21.83	15.11	9.03	31.95	0.00	14.02	46.00	31.9	100	359	
Vert.	582.020	QP	21.72	18.69	9.94	31.97	0.00	18.38	46.00	27.6	100	1	
Vert.	2483.500	PK	44.65	27.65	14.22	36.52	2.48	52.48	73.90	21.4	295	103	
Vert.	4960.000	PK	45.27	31.54	6.61	36.93	2.48	48.97	73.90	24.9	240	1	
Vert.	7440.000	PK	44.02	37.10	8.38	37.63	2.48	54.35	73.90	19.6	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	34.02	27.65	14.22	36.52	4.74	2.48	46.59	53.90	7.3	*1)
Hori.	4960.000	AV	34.83	31.54	6.61	36.93	4.74	2.48	43.27	53.90	10.6	
Hori.	7440.000	AV	33.83	37.10	8.38	37.63	4.74	2.48	48.90	53.90	5.0	
Vert.	2483.500	AV	34.02	27.65	14.22	36.52	4.74	2.48	46.59	53.90	7.3	*1)
Vert.	4960.000	AV	35.24	31.54	6.61	36.93	4.74	2.48	43.68	53.90	10.2	
Vert.	7440.000	AV	33.05	37.10	8.38	37.63	4.74	2.48	48.12	53.90	5.8	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Duty factor refer to "Duty factor Calculation chart" sheet.

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

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.	2480.000	PK	75.08	27.67	14.22	36.52	2.48	82.93	-	-	Carrier
Hori.	9920.000	PK	34.49	38.97	9.22	38.84	2.48	46.32	62.93	16.6	
Vert.	2480.000	PK	71.32	27.67	14.22	36.52	2.48	79.17	-	-	Carrier
Vert.	9920.000	PK	35.23	38.97	9.22	38.84	2.48	47.06	59.17	12.1	

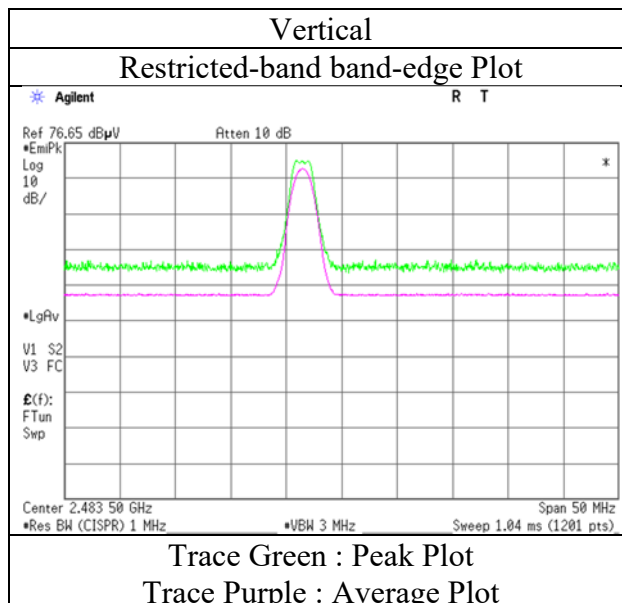
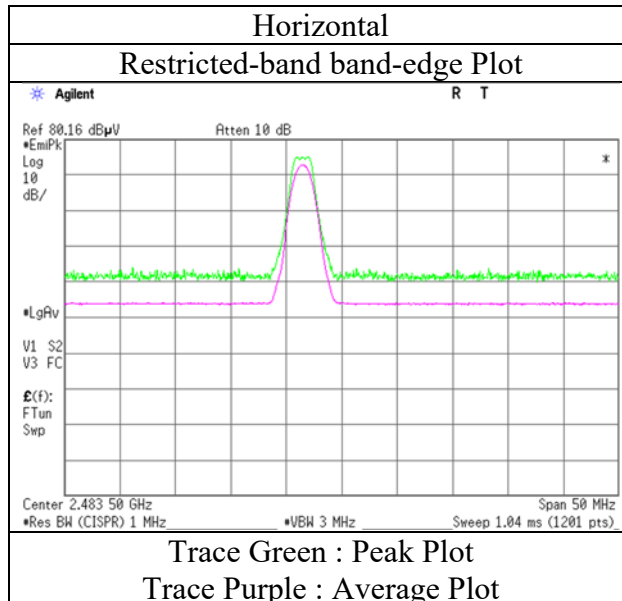
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.99 \text{ m} / 3.0 \text{ m}) = 2.48 \text{ dB}$

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

Radiated Spurious Emission (Reference Plot for band-edge)

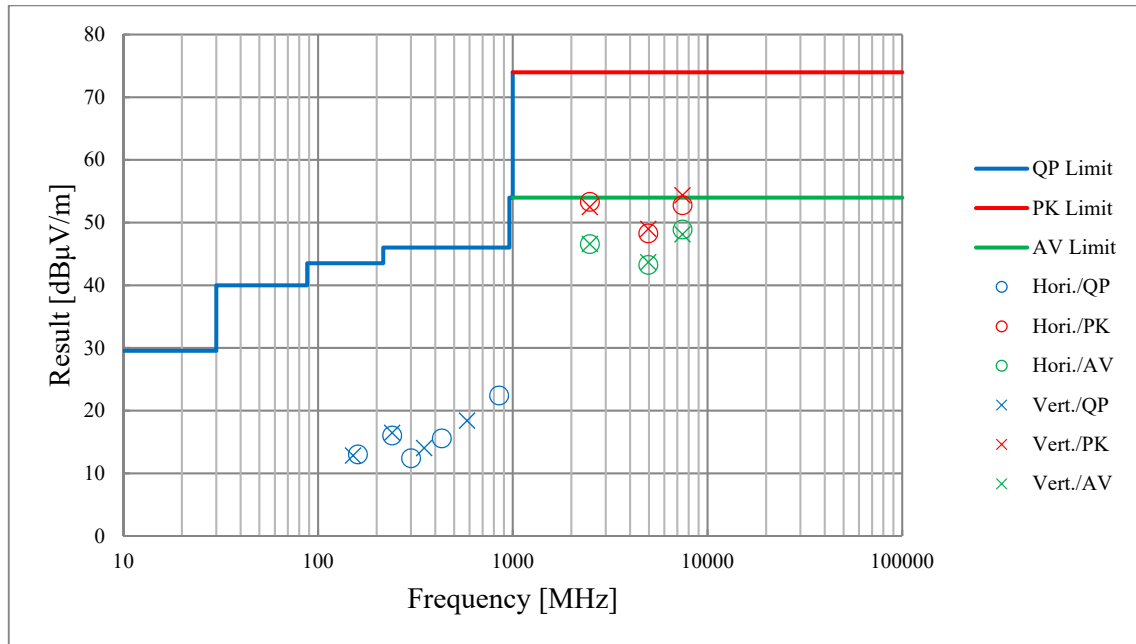
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Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No. 3
Date	November 6, 2018
Temperature / Humidity	24 deg. C / 61 % RH
Engineer	Makoto Hosaka (1 GHz –13 GHz)
Mode	Tx BT LE 2M PHY 2480 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case)

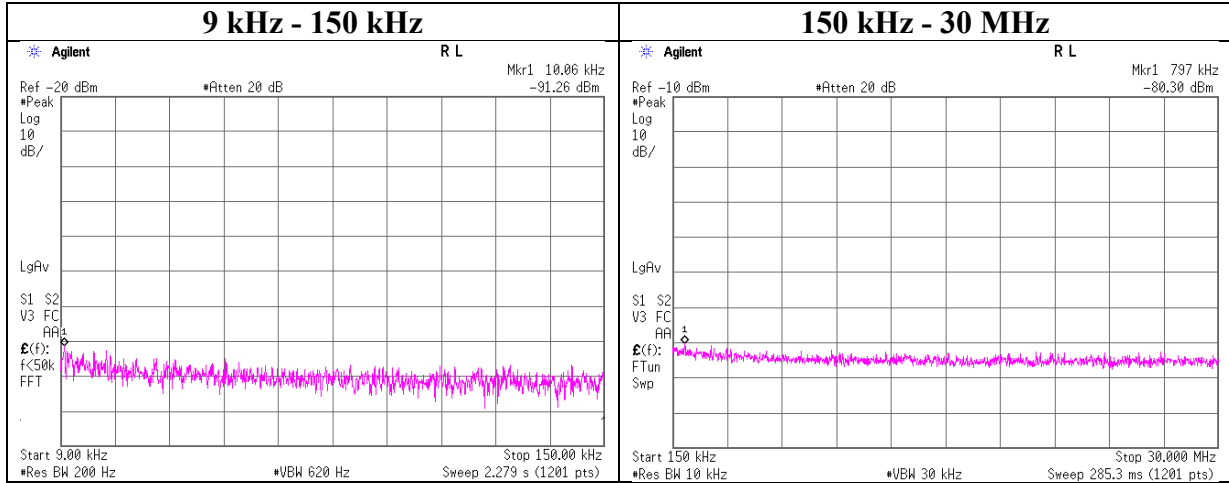
Report No.	12407798S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No. 3	
Date	November 6, 2018	November 6, 2018
Temperature / Humidity	23 deg. C / 61 % RH	24 deg. C / 61 % RH
Engineer	Yosuke Ishikawa	Makoto Hosaka
	(30 MHz - 1 GHz)	(1 GHz - 26.5 GHz)
Mode	Tx BT LE 2M PHY 2480 MHz	



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

Conducted Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE 1M PHY 2402 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.06	-91.3	0.01	9.5	2.0	1	-79.7	300	6.0	-18.5	47.5	66.0	
797.00	-80.3	0.02	9.5	2.0	1	-68.7	30	6.0	12.5	29.5	17.0	

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

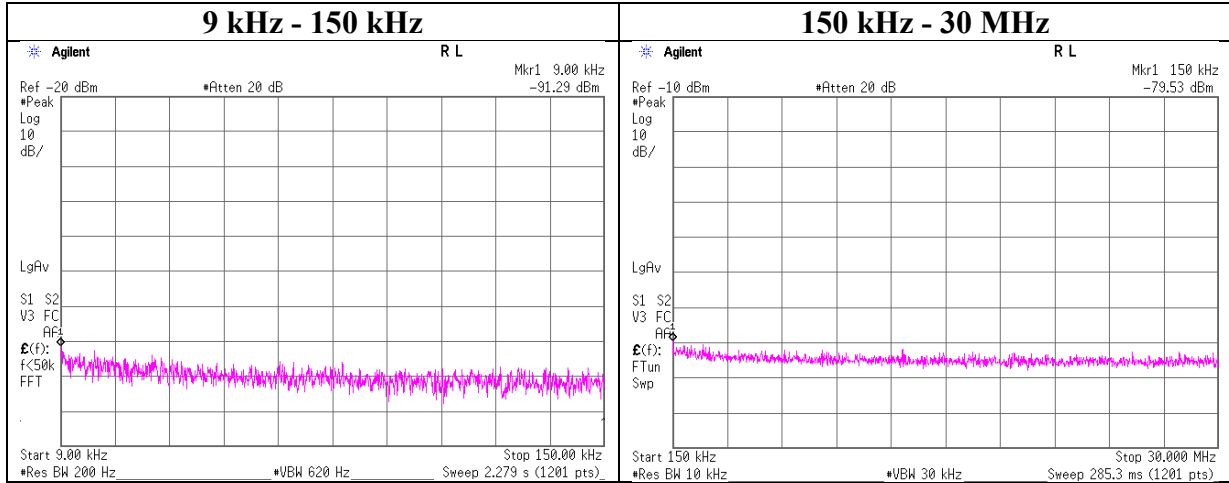
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE 1M PHY 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.00	-91.3	0.01	9.5	2.0	1	-79.7	300	6.0	-18.5	48.5	67.0	
150.00	-79.5	0.01	9.5	2.0	1	-68.0	300	6.0	-6.7	24.0	30.7	

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

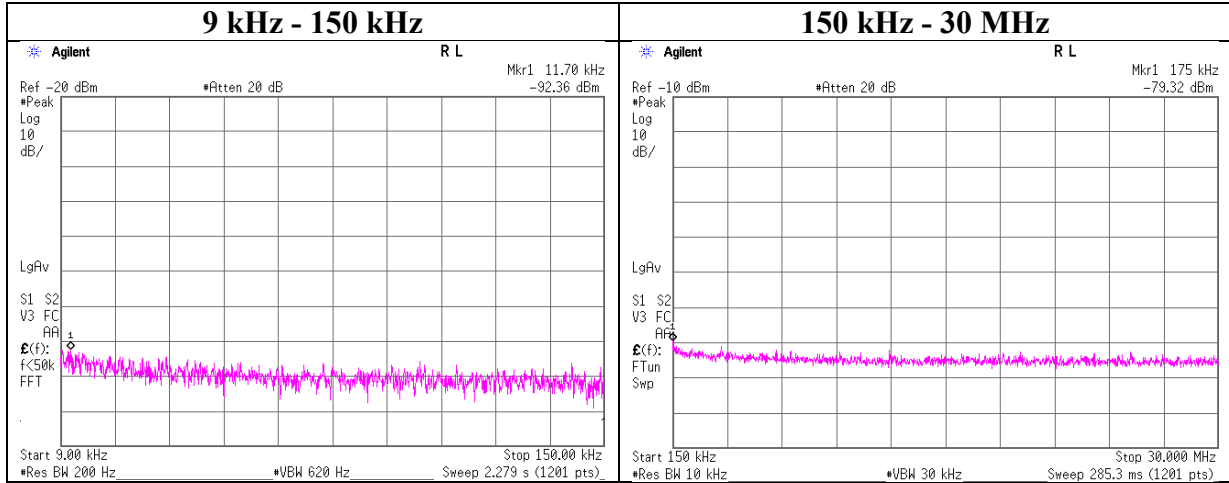
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE 1M PHY 2480 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.70	-92.4	0.01	9.5	2.0	1	-80.8	300	6.0	-19.6	46.2	65.8	
175.00	-79.3	0.01	9.5	2.0	1	-67.8	300	6.0	-6.5	22.7	29.2	

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

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

N: Number of output

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

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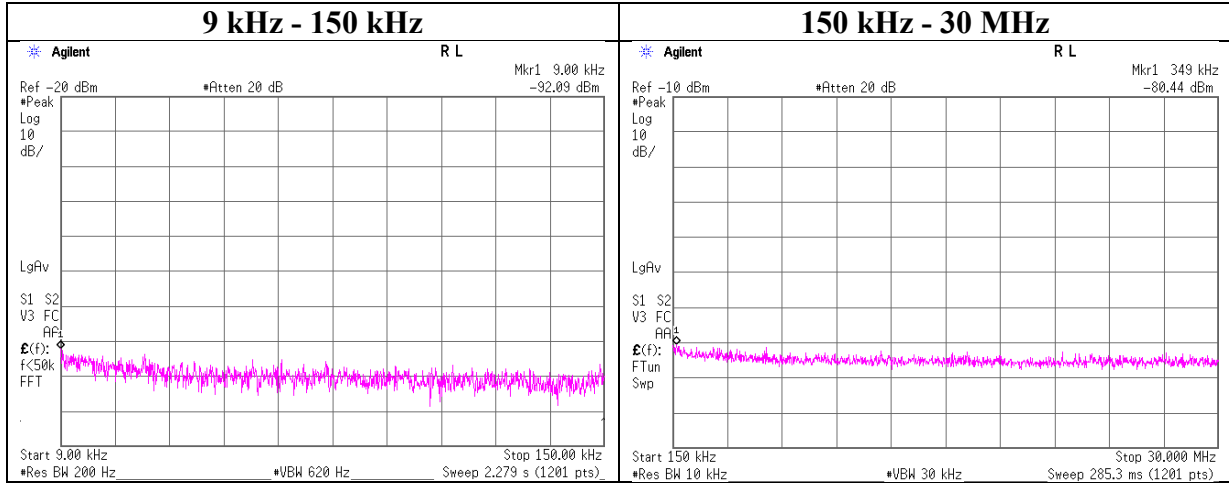
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Conducted Spurious Emission

Report No.	12407798S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 9, 2018
Temperature / Humidity	26 deg. C / 42 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE 2M PHY 2402 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.00	-92.1	0.01	9.5	2.0	1	-80.5	300	6.0	-19.3	48.5	67.8	
349.00	-80.4	0.01	9.5	2.0	1	-68.9	300	6.0	-7.6	16.7	24.3	

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

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

N: Number of output

*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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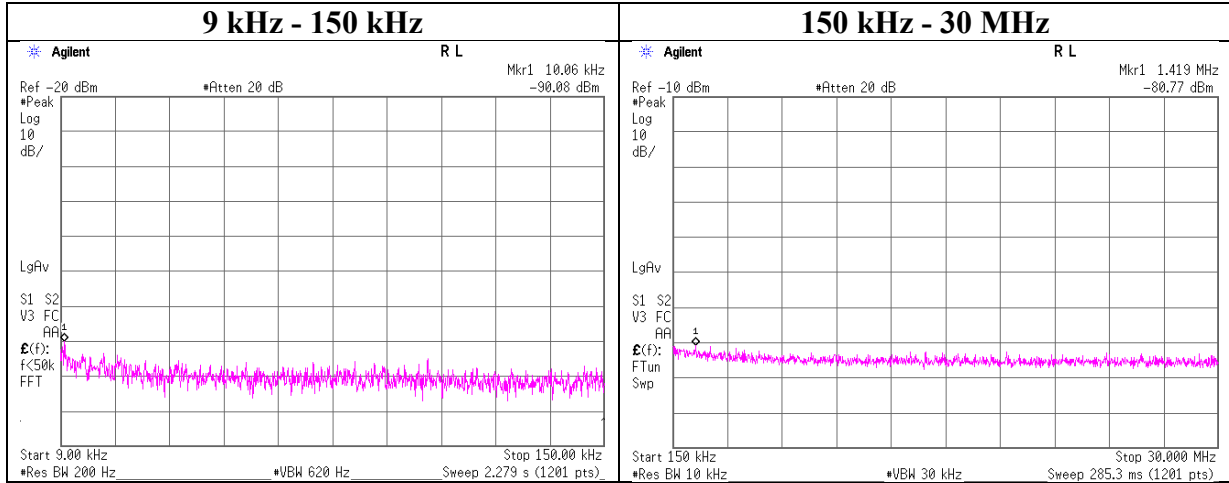
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Conducted Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE 2M PHY 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.06	-90.1	0.01	9.5	2.0	1	-78.5	300	6.0	-17.3	47.5	64.8	
1419.00	-80.8	0.02	9.5	2.0	1	-69.2	30	6.0	12.0	24.5	12.5	

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

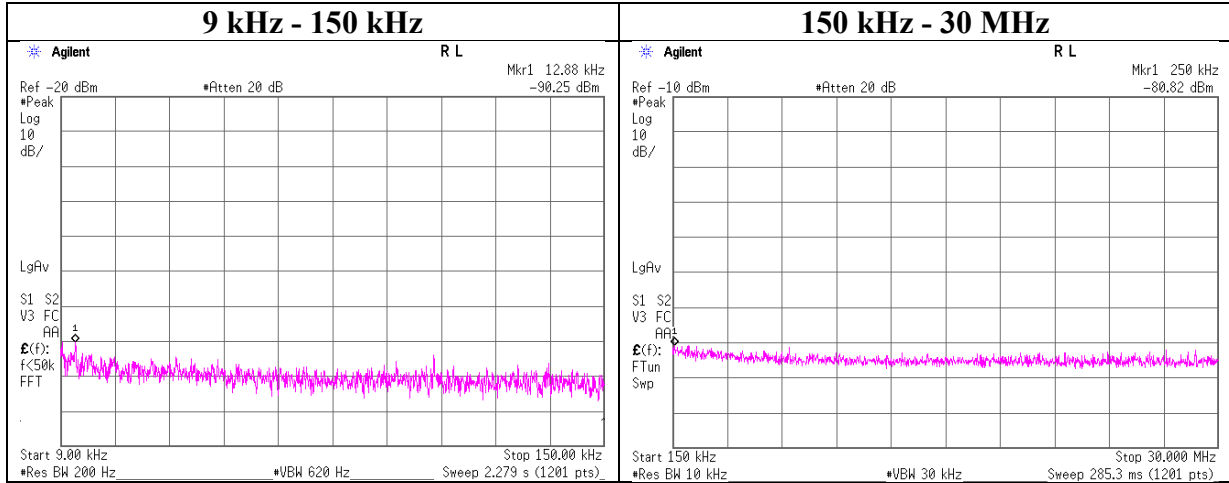
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Report No. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE 2M PHY 2480 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12.88	-90.3	0.01	9.5	2.0	1	-78.7	300	6.0	-17.4	45.4	62.8	
250.00	-80.8	0.01	9.5	2.0	1	-69.3	300	6.0	-8.0	19.6	27.6	

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

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

N: Number of output

*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. 12407798S-A-R2
Test place Shonan EMC Lab. No.5 Shielded Room
Date November 9, 2018
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE

1M PHY

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-24.97	1.22	9.68	-14.07	8.00	22.07
2440.00	-24.91	1.22	9.67	-14.02	8.00	22.02
2480.00	-24.73	1.23	9.67	-13.83	8.00	21.83

2M PHY

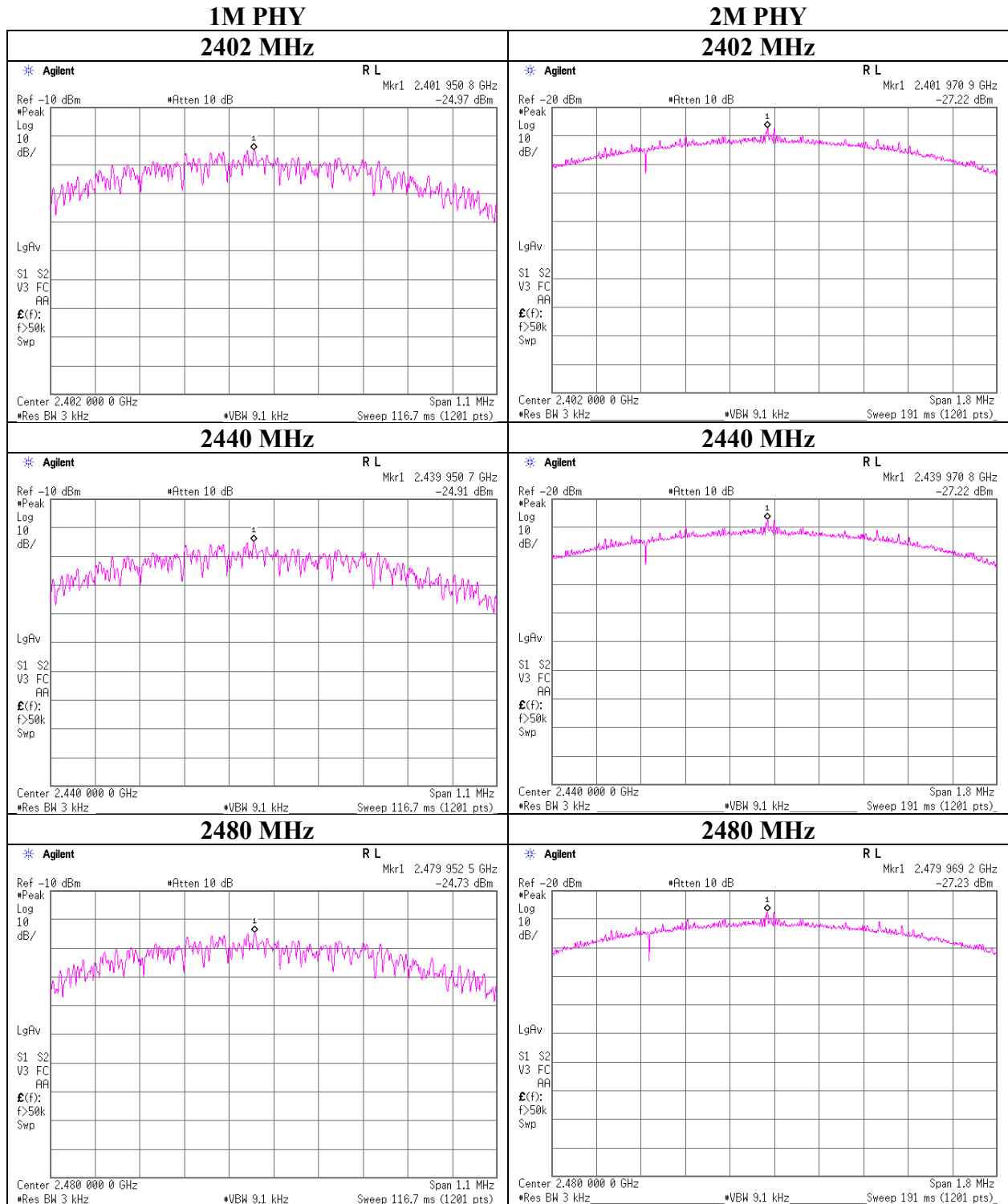
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-27.22	1.22	9.68	-16.32	8.00	24.32
2440.00	-27.22	1.22	9.67	-16.33	8.00	24.33
2480.00	-27.23	1.23	9.67	-16.33	8.00	24.33

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 Instruments

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
KTS-07	AT	145111	Digital Tester	SANWA	PC500	7019232	2018/10/17	2019/10/31	12
SAT10-09	AT	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2017/11/22	2018/11/30	12
KSA-08	AT	145089	Spectrum Analyzer	AGILENT	E4446A	MY46180525	2018/10/7	2019/10/31	12
KTS-07	AT	145111	Digital Tester	SANWA	PC500	7019232	2018/10/17	2019/10/31	12
SAT10-09	AT	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2017/11/22	2018/11/30	12
SCC-G12	AT	145040	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	2018/3/19	2019/3/31	12
SOS-09	AT	146318	Humidity Indicator	A&D	AD-5681	4061484	2017/12/21	2018/12/31	12
SPM-07	AT	146247	Power Meter	AGILENT	8990B	MY5100272	2018/7/13	2019/7/31	12
SPSS-04	AT	146310	Power sensor	AGILENT	N1923A	MY5326009	2018/7/13	2019/7/31	12
SAT3-10	CE	144960	Attenuator	JFW	50HF-003N	-	2018/8/23	2019/8/31	12
SCC-C9	CE	145035	Coaxial Cable	Suhner	RG223U	-	2018/4/9	2019/4/30	12
SCC-C9/C10/SRSE-03	CE	145036	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-271(RF Selector)	2018/4/9	2019/4/30	12
SLS-02	CE	145539	LISN	Rohde & Schwarz	ENV216	100512	2018/2/26	2019/2/28	12
SLS-05	CE	145542	LISN	Rohde & Schwarz	ENV216	100516	2018/2/26	2019/2/28	12
SOS-06	CE	146294	Humidity Indicator	A&D	AD-5681	4062118	2017/12/21	2018/12/31	12
STM-05	CE	145762	Terminator	TME	CT-01 BP	-	2017/12/14	2018/12/31	12
COTS-SEM I-1	CE,RE	144865	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,M F)	-	-	-	-
KJM-02	CE,RE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
STR-02	CE,RE	145791	Test Receiver	Rohde & Schwarz	ESCI	100575	2018/10/19	2019/10/31	12
STS-03	CE,RE	146210	Digital Hister	HIOKI	3805-50	80997823	2018/10/16	2019/10/31	12
SAEC-03(NSA)	RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2018/6/2	2019/6/30	12
SAEC-03(SVSWR)	RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2018/7/17	2019/7/31	12
SAF-03	RE	145126	Pre Amplifier	SONOMA	310N	290213	2018/2/16	2019/2/28	12
SAF-05	RE	145128	Pre Amplifier	Toyo Corporation	TPA0118-36	1440490	2018/2/15	2019/2/28	12
SAF-06	RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2018/9/14	2019/9/30	12
SAF-09	RE	145008	Pre Amplifier	Toyo Corporation	HAP18-26W	18	2018/9/21	2019/9/30	12
SAT10-05	RE	145136	Attenuator(above 1GHz)	AGILENT	8493C-010	74864	2017/11/22	2018/11/30	12
SAT6-13	RE	167094	Attenuator	JFW	50HF-006N		2018/2/9	2019/2/28	12
SBA-03	RE	145023	Biconical Antenna	Schwarzbeck	BBA9106	91032666	2018/6/17	2019/6/30	12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141P	-/0901-271(RF Selector)	2018/4/9	2019/4/30	12

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Test Instruments

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SCC-G06	RE	145173	Coaxial Cable	Junkosha	J12J102207-00	MAY-23-16-091	2018/6/1	2019/6/30	12
SCC-G23	RE	145168	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	2018/5/11	2019/5/31	12
SCC-G33	RE	145184	Coaxial Cable	Junkosha	MWX241-01000KMSKMS	-	2018/4/20	2019/4/30	12
SCC-G41	RE	151617	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S006	2018/1/29	2019/1/31	12
SCC-G45	RE	168301	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102 E	800137/2EA	2018/3/28	2019/3/31	12
SFL-18	RE	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2018/4/20	2019/4/30	12
SHA-03	RE	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2018/7/23	2019/7/31	12
SHA-05	RE	145513	Horn Antenna	ETS LINDGREN	Sep-60	LM4210	2018/7/23	2019/7/31	12
SLA-07	RE	145529	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	2018/6/17	2019/6/30	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2018/10/25	2019/10/31	12
SSA-02	RE	145800	Spectrum Analyzer	AGILENT	E4448A	MY48250106	2018/3/5	2019/3/31	12

The expiration date of the calibration is the end of the expired month.

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

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

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

UL Japan, Inc.

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