



RADIO TEST REPORT

Test Report No. : 12920932S-A-R1

Applicant : Sony Corporation
Type of Equipment : Wireless Noise Canceling Stereo Headset
Model No. : WH-H910N
FCC ID : AK8WHH910N
Test regulation : FCC Part 15 Subpart C: 2019
* Bluetooth Low Energy part
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 12920932S-A. 12920932S-A is replaced with this report.

Date of test: June 18 to 28, 2019

Representative test engineer:

Hiromasa Sato
Engineer
Consumer Technology Division

Approved by:

Toyokazu Imamura
Leader
Consumer Technology Division



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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SECTION 1: Customer information

Company Name	:	Sony Corporation
Address	:	1-7-1 Konan Minato-ku Tokyo, 108-0075 Japan
Telephone Number	:	+604-3835075
Contact Person	:	Maizatul Akmal, Mat Zan

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., 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 (E.U.T.)
- SECTION 4: Operation of E.U.T. 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 (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Wireless Noise Canceling Stereo Headset
Model No.	:	WH-H910N
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 3.7 V: Built-in lithium-ion rechargeable battery DC 5 V: When charged using USB
Receipt Date of Sample (Information from test lab.)	:	June 3, 2019
Country of Mass-production	:	Malaysia
Condition of EUT	:	Engineering 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: WH-H910N (referred to as the EUT in this report) is a Wireless Noise Canceling Stereo Headset.

Radio Specification

Radio Type	: Transceiver
Frequency of Operation	: 2402 MHz - 2480 MHz
Modulation	: GFSK, $\pi/4$ -DQPSK, 8DPSK
Power Supply (radio part input)	: DC 1.45 V
Antenna type	: Chip Antenna
Antenna Gain	: 1.6 dBi
Clock frequency	: X201: 26 MHz (crystal)

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on June 4, 2019 and effective July 5, 2019 except 15.258

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

* The revision on June 4, 2019, does not affect the test specification applied to the EUT.

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods	FCC: Section 15.207	N/A	N/A*1)	-
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8			
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(a)(2)	See data.	Complied a)	Conducted
	IC: -	IC: RSS-247 5.2(a)			
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(b)(3)		Complied b)	Conducted
	IC: RSS-Gen 6.12	IC: RSS-247 5.4(d)			
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(e)		Complied c)	Conducted
	IC: -	IC: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(d)	1.7 dB 9920.000 MHz, AV Horizontal & Vertical Mode: Tx BT LE 2 M PHY 2480 MHz	Complied# d),e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
	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) The EUT operates with a battery. AC Line can be connected to the EUT via other device's USB port; however, the EUT stops transmission during recharging. Therefore, the test is not applicable to the EUT.

*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)

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

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

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

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

Symbols:

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

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

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

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FCC Part 15.31 (e)

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

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	RSS-Gen 6.7	IC: -	N/A	- a)	Conducted
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422. a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)					

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

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

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Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 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)	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-
	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	0.81 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.53 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.95 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.21 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	2.3 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.4 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	0.61 %
Duty cycle and Time Measurement	0.012 %

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3.5 Test Location

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

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	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

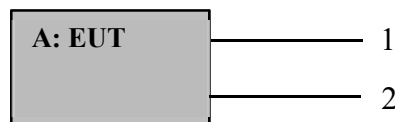
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Bluetooth Low Energy 1 Mbps Physical Layer (BT LE 1 M PHY)	2402 MHz, 2440 MHz, 2480 MHz	PRBS9
Bluetooth Low Energy 2 Mbps Physical Layer (BT LE 2 M PHY)		
*Power of the EUT was set by the software as follows; Power settings: Fixed Software: WCN Combo Tool Ver 2.1749.00 *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.		

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

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless Noise Cancelling Stereo Headset	WH-H910N	1000079 *1) 1000073 *2)	Sony Corporation.	EUT

*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	USB Cable	1.0	Shielded	Shielded	-
2	Audio Cable	1.0	Shielded	Shielded	-

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SECTION 5: Radiated Spurious Emission

Test Procedure

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

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 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 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.

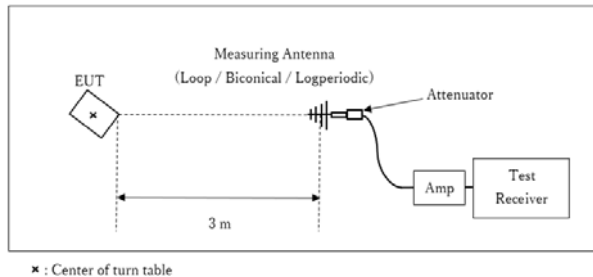
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

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.

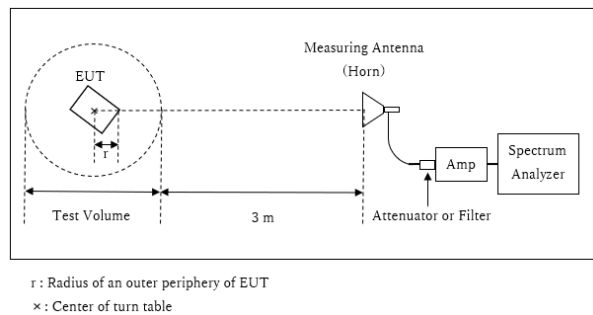
Figure 1: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 13 GHz



Distance Factor: $20 \times \log (3.91 \text{ m} / 3.0 \text{ m}) = 2.30 \text{ dB}$

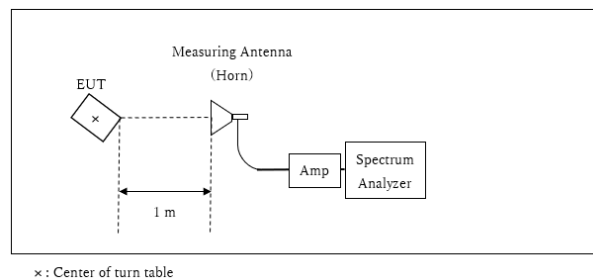
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.91 \text{ m}$

Test Volume : 2.0 m

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

$r = 0.09 \text{ m}$

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.

Antenna polarization	Frequency				
	Below 1 GHz	1 GHz - 2.8 GHz	2.8 GHz - 13 GHz	13 GHz - 18 GHz	18 GHz - 26.5 GHz
Horizontal	Z	Z	X	X	X
Vertical	Z	X	Z	X	Z

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 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 160 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	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.
 The equipment and cables were not used for factor 0 dB of the data sheets.

Test data : APPENDIX
Test result : Pass

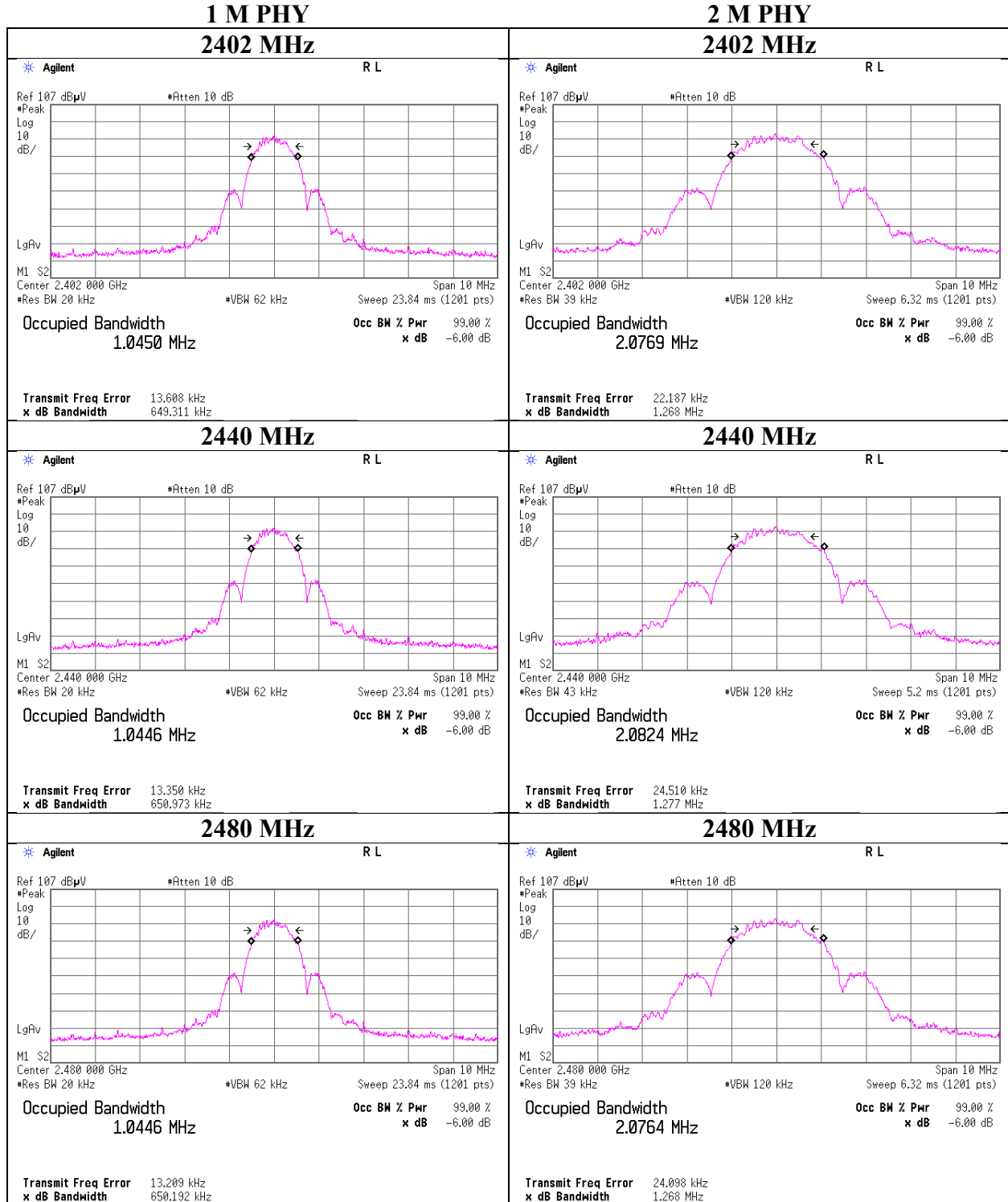
APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12920932S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date June 19, 2019
Temperature / Humidity 26 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
1 M PHY	2402	1045.0	0.720	> 0.5000
	2440	1044.6	0.717	> 0.5000
	2480	1044.6	0.718	> 0.5000
2 M PHY	2402	2076.9	1.278	> 0.5000
	2440	2082.4	1.284	> 0.5000
	2480	2076.4	1.278	> 0.5000

99%Occupied Bandwidth



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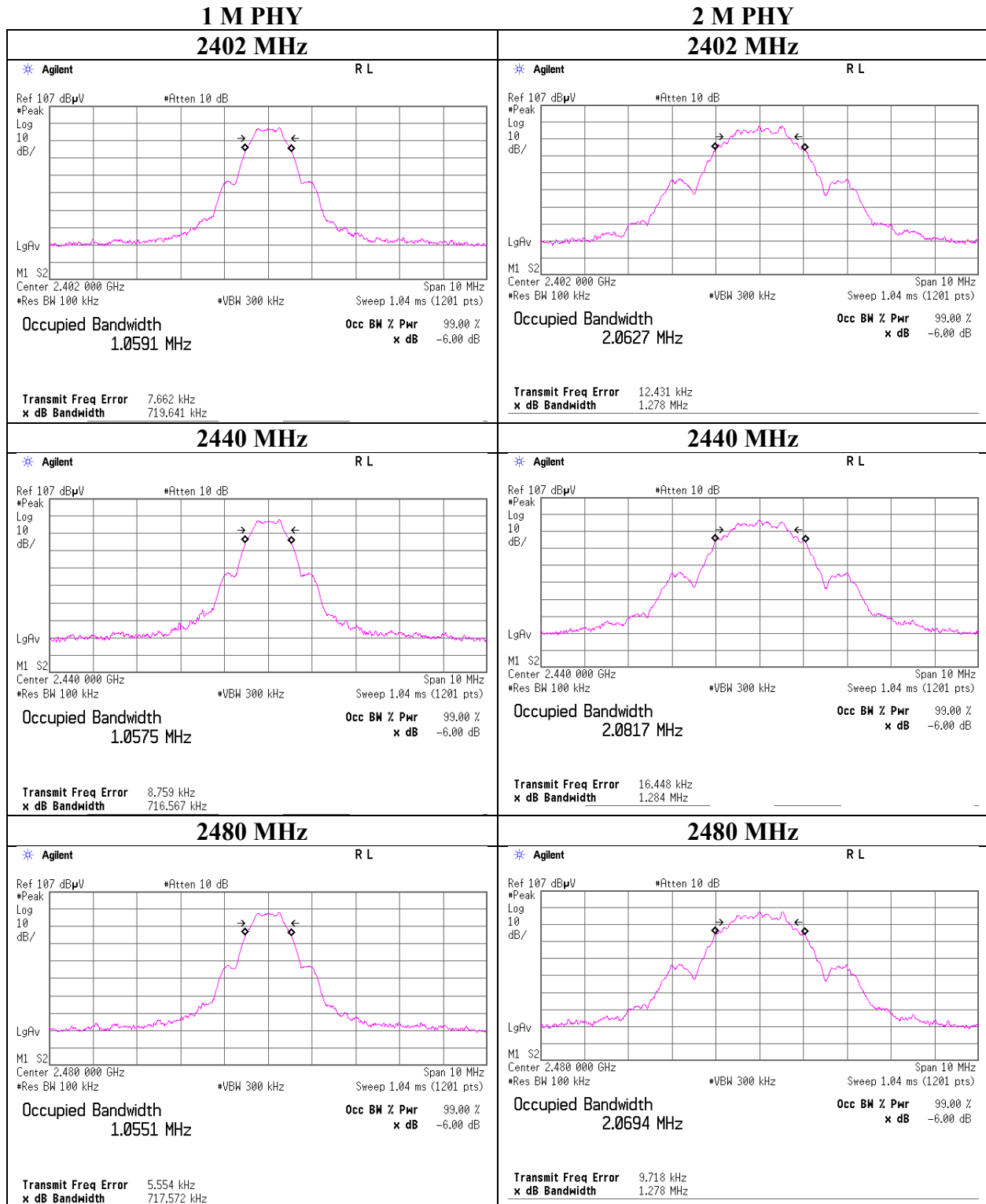
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6dB Bandwidth



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Maximum Peak Output Power

Report No. 12920932S-A-R1
Test place Shonan EMC Lab. No.3 Shielded Room
Date June 28, 2019
Temperature / Humidity 26 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx BT LE

1 M 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	-11.63	1.62	9.89	-0.12	0.97	30.00	1000	30.12	1.60	1.48	1.41	36.02	4000	34.54
2440	-11.35	1.64	9.89	0.18	1.04	30.00	1000	29.82	1.60	1.78	1.51	36.02	4000	34.24
2480	-11.20	1.65	9.89	0.34	1.08	30.00	1000	29.66	1.60	1.94	1.56	36.02	4000	34.08

Sample Calculation:

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

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

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

2 M 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	-11.63	1.62	9.89	-0.12	0.97	30.00	1000	30.12	1.60	1.48	1.41	36.02	4000	34.54
2440	-11.31	1.64	9.89	0.22	1.05	30.00	1000	29.78	1.60	1.82	1.52	36.02	4000	34.20
2480	-11.15	1.65	9.89	0.39	1.09	30.00	1000	29.61	1.60	1.99	1.58	36.02	4000	34.03

Sample Calculation:

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

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

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

Average Output Power (Reference data for RF Exposure)

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab. No.3 Shielded Room
Date	June 28, 2019
Temperature / Humidity	26 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx BT LE

1 M 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	-13.01	1.62	9.89	-1.50	0.71	0.66	-0.84	0.82
2440	-12.68	1.64	9.89	-1.15	0.77	0.66	-0.49	0.89
2480	-12.49	1.65	9.89	-0.95	0.80	0.66	-0.29	0.94

2 M 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	-14.91	1.62	9.89	-3.40	0.46	2.34	-1.06	0.78
2440	-14.51	1.64	9.89	-2.98	0.50	2.34	-0.64	0.86
2480	-14.28	1.65	9.89	-2.74	0.53	2.34	-0.40	0.91

Sample Calculation:

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

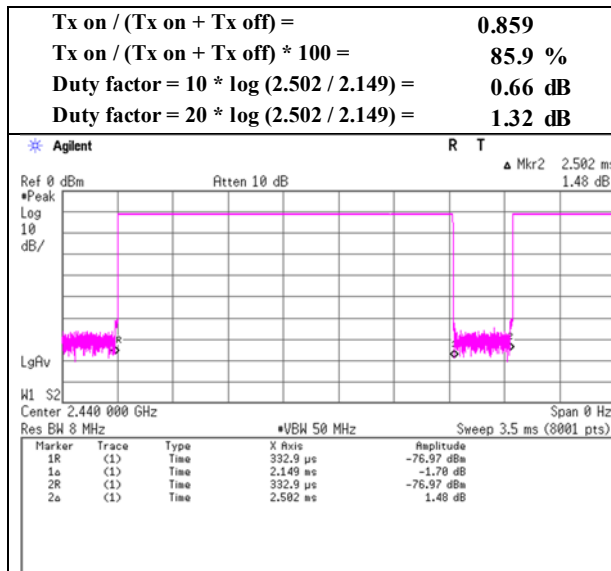
Result (Burst power average) = Time average + Duty factor

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

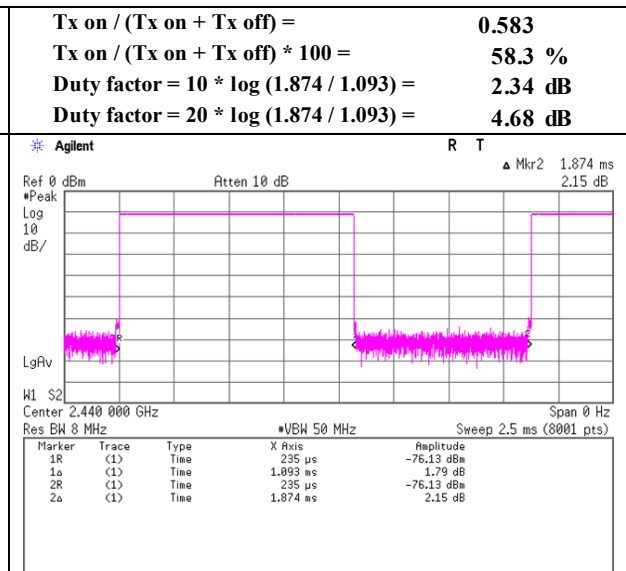
Burst rate confirmation

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	June 28, 2019
Temperature / Humidity	26 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx BT LE

1 M PHY



2 M 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.	12920932S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	June 18, 2019	June 19, 2019	June 19, 2019
Temperature / Humidity	24 deg. C / 40 % RH	21 deg. C / 56 % RH	23 deg. C / 52 % RH
Engineer	Yosuke Ishikawa	Takahiro Kawakami	Yosuke Ishikawa
	(30 MHz -1000 MHz)	(1 GHz -13 GHz)	(13 GHz -26.5 GHz)
Mode	Tx BT LE 1 M 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.	52.000	QP	22.20	10.37	6.79	32.19	0.00	7.17	40.00	32.8	100	0	
Hori.	78.000	QP	22.20	6.16	7.45	32.17	0.00	3.64	40.00	36.3	100	0	
Hori.	98.304	QP	22.20	9.75	7.42	32.15	0.00	7.22	43.50	36.2	100	0	
Hori.	196.608	QP	21.80	16.37	7.90	32.07	0.00	14.00	43.50	29.5	100	0	
Hori.	2390.000	PK	47.23	27.86	14.15	41.59	2.30	49.95	73.90	23.9	255	359	
Hori.	4804.000	PK	49.86	31.43	6.45	42.88	2.30	47.16	73.90	26.7	224	171	
Hori.	7206.000	PK	48.31	36.79	8.13	42.92	2.30	52.61	73.90	21.2	100	0	
Hori.	9608.000	PK	48.76	38.51	9.30	43.17	2.30	55.70	73.90	18.2	100	0	
Vert.	312.000	QP	21.60	13.70	8.85	32.00	0.00	12.15	46.00	33.8	100	0	
Vert.	624.000	QP	21.70	19.24	10.08	31.94	0.00	19.08	46.00	26.9	100	0	
Vert.	936.000	QP	21.00	21.60	11.13	30.77	0.00	22.96	46.00	23.0	100	0	
Vert.	2390.000	PK	46.74	27.86	14.15	41.59	2.30	49.46	73.90	24.4	135	123	
Vert.	4804.000	PK	49.65	31.43	6.45	42.88	2.30	46.95	73.90	26.9	125	359	
Vert.	7206.000	PK	49.09	36.79	8.13	42.92	2.30	53.39	73.90	20.5	100	0	
Vert.	9608.000	PK	48.49	38.51	9.30	43.17	2.30	55.43	73.90	18.4	100	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.91 m / 3.0 m) = 2.30 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	39.06	27.86	14.15	41.59	1.32	2.30	43.10	53.90	10.8	*1)
Hori.	4804.000	AV	41.76	31.43	6.45	42.88	1.32	2.30	40.38	53.90	13.5	
Hori.	7206.000	AV	40.22	36.79	8.13	42.92	1.32	2.30	45.84	53.90	8.0	
Hori.	9608.000	AV	40.31	38.51	9.30	43.17	1.32	2.30	48.57	53.90	5.3	
Vert.	2390.000	AV	37.01	27.86	14.15	41.59	1.32	2.30	41.05	53.90	12.8	*1)
Vert.	4804.000	AV	41.75	31.43	6.45	42.88	1.32	2.30	40.37	53.90	13.5	
Vert.	7206.000	AV	40.22	36.79	8.13	42.92	1.32	2.30	45.84	53.90	8.0	
Vert.	9608.000	AV	40.31	38.51	9.30	43.17	1.32	2.30	48.57	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(3.91 m / 3.0 m) = 2.30 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	93.83	27.86	14.16	41.60	2.30	96.55	-	-	Carrier
Hori.	2400.000	PK	38.19	27.86	14.16	41.60	2.30	40.91	76.55	35.6	
Vert.	2402.000	PK	93.25	27.86	14.16	41.60	2.30	95.97	-	-	Carrier
Vert.	2400.000	PK	37.78	27.86	14.16	41.60	2.30	40.50	75.97	35.4	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.91 m / 3.0 m) = 2.30 dB

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

UL Japan, Inc.

Shonan EMC Lab.

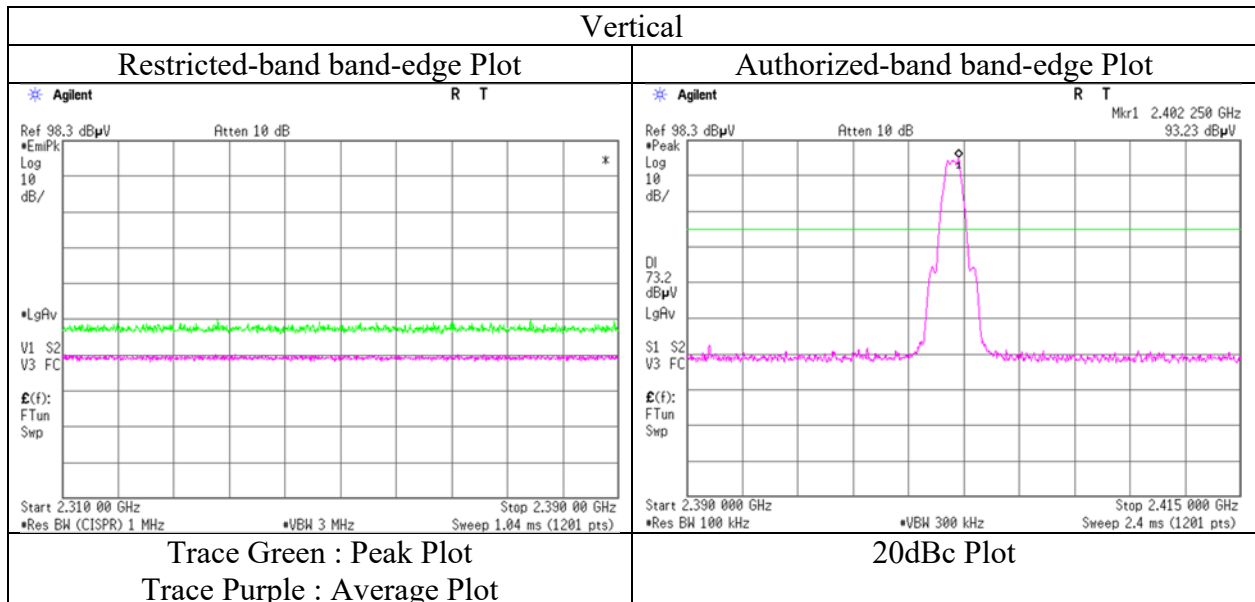
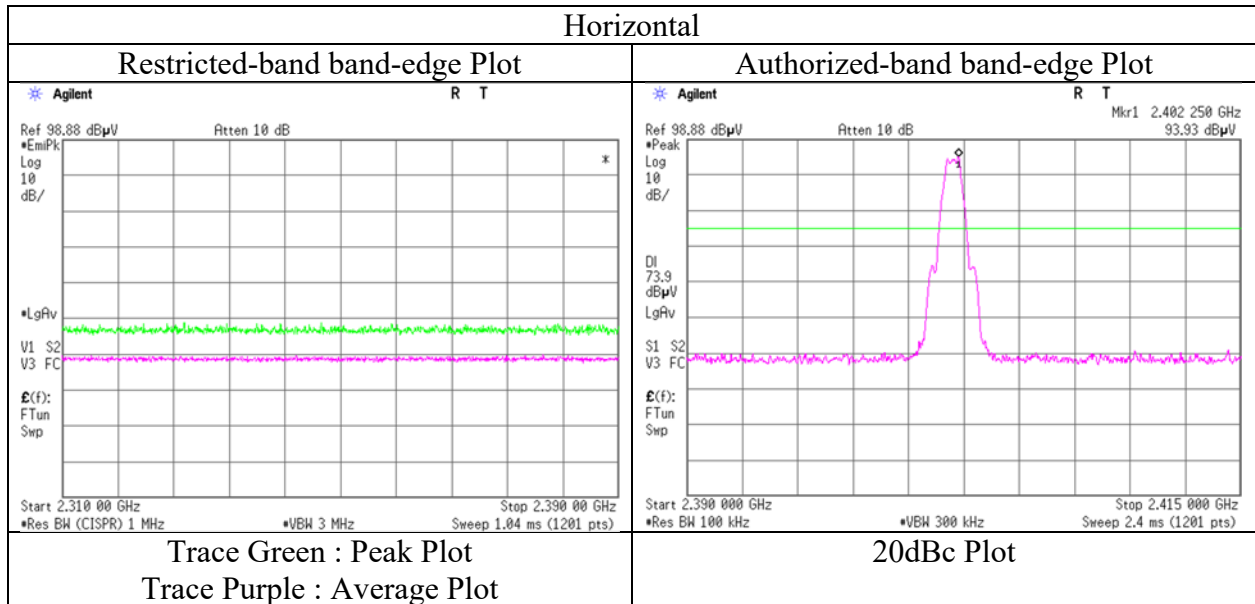
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	June 19, 2019
Temperature / Humidity	21 deg. C / 56 % RH
Engineer	Takahiro Kawakami
	(1 GHz -13 GHz)
Mode	Tx BT LE 1 M PHY 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

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Radiated Spurious Emission

Report No.	12920932S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	June 18, 2019	June 19, 2019	June 19, 2019
Temperature / Humidity	24 deg. C / 40 % RH	21 deg. C / 56 % RH	23 deg. C / 52 % RH
Engineer	Yosuke Ishikawa	Takahiro Kawakami	Yosuke Ishikawa
	(30 MHz -1000 MHz)	(1 GHz -13 GHz)	(13 GHz -26.5 GHz)
Mode	Tx BT LE 1 M 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.	52.000	QP	22.20	10.37	6.79	32.19	0.00	7.17	40.00	32.8	100	0	
Hori.	78.000	QP	21.90	6.16	7.45	32.17	0.00	3.34	40.00	36.6	100	0	
Hori.	98.304	QP	22.50	9.75	7.42	32.15	0.00	7.52	43.50	35.9	100	0	
Hori.	196.608	QP	22.20	16.37	7.90	32.07	0.00	14.40	43.50	29.1	100	0	
Hori.	4880.000	PK	49.20	31.37	6.48	42.89	2.30	46.46	73.90	27.4	207	165	
Hori.	7320.000	PK	48.73	37.00	8.12	43.15	2.30	53.00	73.90	20.9	100	0	
Hori.	9760.000	PK	47.86	38.92	9.29	43.01	2.30	55.36	73.90	18.5	100	0	
Vert.	312.000	QP	21.70	13.70	8.85	32.00	0.00	12.25	46.00	33.7	100	0	
Vert.	624.000	QP	21.70	19.24	10.08	31.94	0.00	19.08	46.00	26.9	100	0	
Vert.	936.000	QP	21.00	21.60	11.13	30.77	0.00	22.96	46.00	23.0	100	0	
Vert.	4880.000	PK	49.89	31.37	6.48	42.89	2.30	47.15	73.90	26.7	131	359	
Vert.	7320.000	PK	48.51	37.00	8.12	43.15	2.30	52.78	73.90	21.1	100	0	
Vert.	9760.000	PK	48.85	38.92	9.29	43.01	2.30	56.35	73.90	17.5	100	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.91 m / 3.0 m) = 2.30 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	41.82	31.37	6.48	42.89	1.32	2.30	40.40	53.90	13.5	
Hori.	7320.000	AV	39.90	37.00	8.12	43.15	1.32	2.30	45.49	53.90	8.4	
Hori.	9760.000	AV	40.13	38.92	9.29	43.01	1.32	2.30	48.95	53.90	4.9	
Vert.	4880.000	AV	41.44	31.37	6.48	42.89	1.32	2.30	40.02	53.90	13.8	
Vert.	7320.000	AV	40.35	37.00	8.12	43.15	1.32	2.30	45.94	53.90	7.9	
Vert.	9760.000	AV	39.79	38.92	9.29	43.01	1.32	2.30	48.61	53.90	5.2	

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(3.91 m / 3.0 m) = 2.30 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)

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Radiated Spurious Emission

Report No.	12920932S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	June 18, 2019	June 19, 2019	June 19, 2019
Temperature / Humidity	24 deg. C / 40 % RH	21 deg. C / 56 % RH	23 deg. C / 52 % RH
Engineer	Yosuke Ishikawa	Takahiro Kawakami	Yosuke Ishikawa
	(30 MHz -1000 MHz)	(1 GHz -13 GHz)	(13 GHz -26.5 GHz)
Mode	Tx BT LE 1 M 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.	52.000	QP	22.20	10.37	6.79	32.19	0.00	7.17	40.00	32.8	100	0	
Hori.	78.000	QP	22.30	6.16	7.45	32.17	0.00	3.74	40.00	36.2	100	0	
Hori.	98.304	QP	22.20	9.75	7.42	32.15	0.00	7.22	43.50	36.2	100	0	
Hori.	196.608	QP	21.90	16.37	7.90	32.07	0.00	14.10	43.50	29.4	100	0	
Hori.	2483.500	PK	47.77	27.65	14.22	41.62	2.30	50.32	73.90	23.5	157	187	
Hori.	4960.000	PK	50.17	31.54	6.51	42.91	2.30	47.61	73.90	26.2	220	158	
Hori.	7440.000	PK	49.77	37.10	8.12	43.38	2.30	53.91	73.90	19.9	100	0	
Hori.	9920.000	PK	47.63	38.97	9.28	42.84	2.30	55.34	73.90	18.5	100	0	
Vert.	312.000	QP	21.70	13.70	8.85	32.00	0.00	12.25	46.00	33.7	100	0	
Vert.	624.000	QP	21.80	19.24	10.08	31.94	0.00	19.18	46.00	26.8	100	0	
Vert.	936.000	QP	21.10	21.60	11.13	30.77	0.00	23.06	46.00	22.9	100	0	
Vert.	2483.500	PK	47.94	27.65	14.22	41.62	2.30	50.49	73.90	23.4	145	107	
Vert.	4960.000	PK	50.06	31.54	6.51	42.91	2.30	47.50	73.90	26.4	135	359	
Vert.	7440.000	PK	49.40	37.10	8.12	43.38	2.30	53.54	73.90	20.3	100	0	
Vert.	9920.000	PK	47.35	38.97	9.28	42.84	2.30	55.06	73.90	18.8	100	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.91\text{ m} / 3.0\text{ m}) = 2.30\text{ dB}$

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	39.56	27.65	14.22	41.62	1.32	2.30	43.43	53.90	10.4	*1)
Hori.	4960.000	AV	41.89	31.54	6.51	42.91	1.32	2.30	40.65	53.90	13.2	
Hori.	7440.000	AV	40.75	37.10	8.12	43.38	1.32	2.30	46.21	53.90	7.6	
Hori.	9920.000	AV	39.77	38.97	9.28	42.84	1.32	2.30	48.80	53.90	5.1	
Vert.	2483.500	AV	37.95	27.65	14.22	41.62	1.32	2.30	41.82	53.90	12.0	*1)
Vert.	4960.000	AV	42.04	31.54	6.51	42.91	1.32	2.30	40.80	53.90	13.1	
Vert.	7440.000	AV	40.72	37.10	8.12	43.38	1.32	2.30	46.18	53.90	7.7	
Vert.	9920.000	AV	39.83	38.97	9.28	42.84	1.32	2.30	48.86	53.90	5.0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.91\text{ m} / 3.0\text{ m}) = 2.30\text{ dB}$

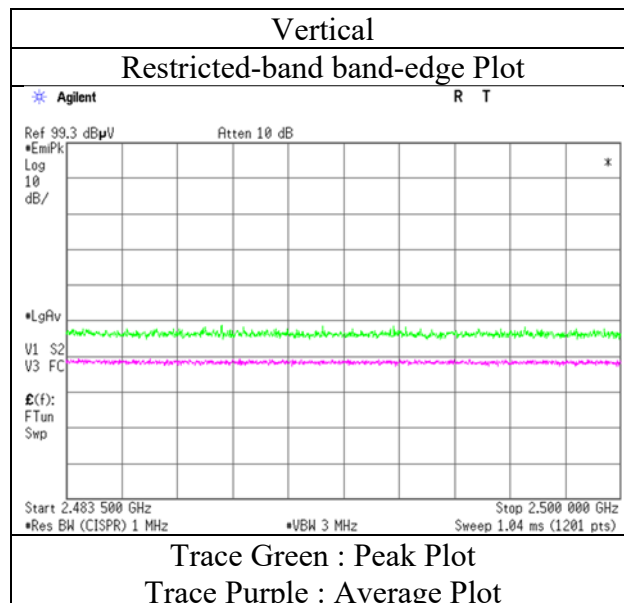
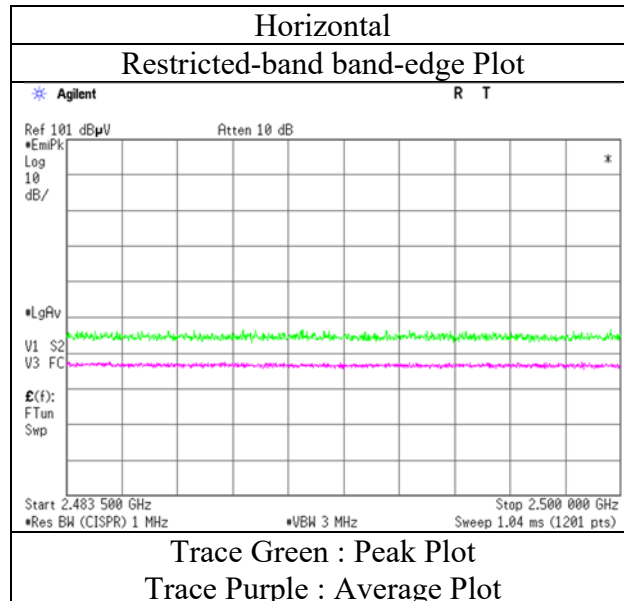
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	June 19, 2019
Temperature / Humidity	21 deg. C / 56 % RH
Engineer	Takahiro Kawakami (1 GHz -13 GHz)
Mode	Tx BT LE 1 M PHY 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

Report No.	12920932S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	June 18, 2019	June 19, 2019	June 19, 2019
Temperature / Humidity	24 deg. C / 40 % RH	21 deg. C / 56 % RH	23 deg. C / 52 % RH
Engineer	Yosuke Ishikawa	Takahiro Kawakami	Yosuke Ishikawa
	(30 MHz -1000 MHz)	(1 GHz -13 GHz)	(13 GHz -26.5 GHz)
Mode	Tx BT LE 2 M 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.	52.000	QP	22.20	10.37	6.79	32.19	0.00	7.17	40.00	32.8	100	0	
Hori.	78.000	QP	22.30	6.16	7.45	32.17	0.00	3.74	40.00	36.2	100	0	
Hori.	98.304	QP	22.20	9.75	7.42	32.15	0.00	7.22	43.50	36.2	100	0	
Hori.	196.608	QP	21.90	16.37	7.90	32.07	0.00	14.10	43.50	29.4	100	0	
Hori.	2390.000	PK	47.37	27.86	14.15	41.59	2.30	50.09	73.90	23.8	109	352	
Hori.	4804.000	PK	49.45	31.43	6.45	42.88	2.30	46.75	73.90	27.1	218	162	
Hori.	7206.000	PK	48.13	36.79	8.13	42.92	2.30	52.43	73.90	21.4	100	0	
Hori.	9608.000	PK	49.04	38.51	9.30	43.17	2.30	55.98	73.90	17.9	100	0	
Vert.	312.000	QP	21.70	13.70	8.85	32.00	0.00	12.25	46.00	33.7	100	0	
Vert.	624.000	QP	21.80	19.24	10.08	31.94	0.00	19.18	46.00	26.8	100	0	
Vert.	936.000	QP	21.10	21.60	11.13	30.77	0.00	23.06	46.00	22.9	100	0	
Vert.	2390.000	PK	48.27	27.86	14.15	41.59	2.30	50.99	73.90	22.9	100	32	
Vert.	4804.000	PK	49.41	31.43	6.45	42.88	2.30	46.71	73.90	27.1	100	154	
Vert.	7206.000	PK	49.07	36.79	8.13	42.92	2.30	53.37	73.90	20.5	100	0	
Vert.	9608.000	PK	48.74	38.51	9.30	43.17	2.30	55.68	73.90	18.2	100	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.91 m / 3.0 m) = 2.30 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	38.21	27.86	14.15	41.59	4.68	2.30	45.61	53.90	8.2	*1)
Hori.	4804.000	AV	40.39	31.43	6.45	42.88	4.68	2.30	42.37	53.90	11.5	
Hori.	7206.000	AV	39.35	36.79	8.13	42.92	4.68	2.30	48.33	53.90	5.5	
Hori.	9608.000	AV	39.51	38.51	9.30	43.17	4.68	2.30	51.13	53.90	2.7	
Vert.	2390.000	AV	38.13	27.86	14.15	41.59	4.68	2.30	45.53	53.90	8.3	*1)
Vert.	4804.000	AV	40.15	31.43	6.45	42.88	4.68	2.30	42.13	53.90	11.7	
Vert.	7206.000	AV	39.17	36.79	8.13	42.92	4.68	2.30	48.15	53.90	5.7	
Vert.	9608.000	AV	39.57	38.51	9.30	43.17	4.68	2.30	51.19	53.90	2.7	

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(3.91 m / 3.0 m) = 2.30 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	93.45	27.86	14.16	41.60	2.30	96.17	-	-	Carrier
Hori.	2400.000	PK	61.94	27.86	14.16	41.60	2.30	64.66	76.17	11.5	
Vert.	2402.000	PK	91.57	27.86	14.16	41.60	2.30	94.29	-	-	Carrier
Vert.	2400.000	PK	60.51	27.86	14.16	41.60	2.30	63.23	74.29	11.0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.91 m / 3.0 m) = 2.30 dB

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

UL Japan, Inc.

Shonan EMC Lab.

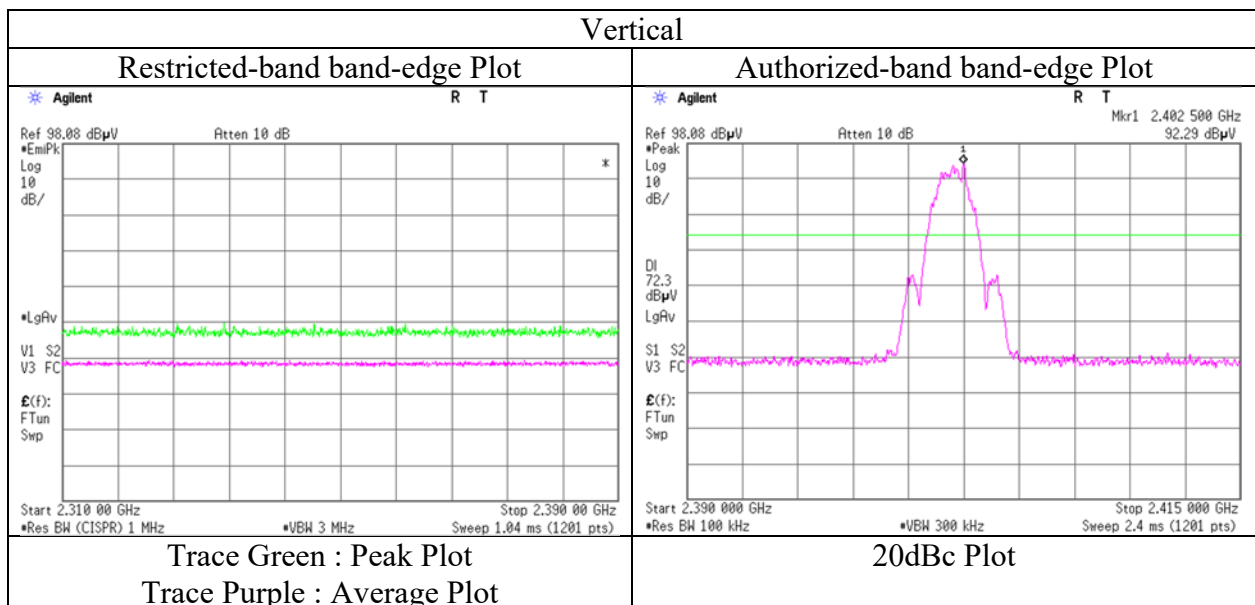
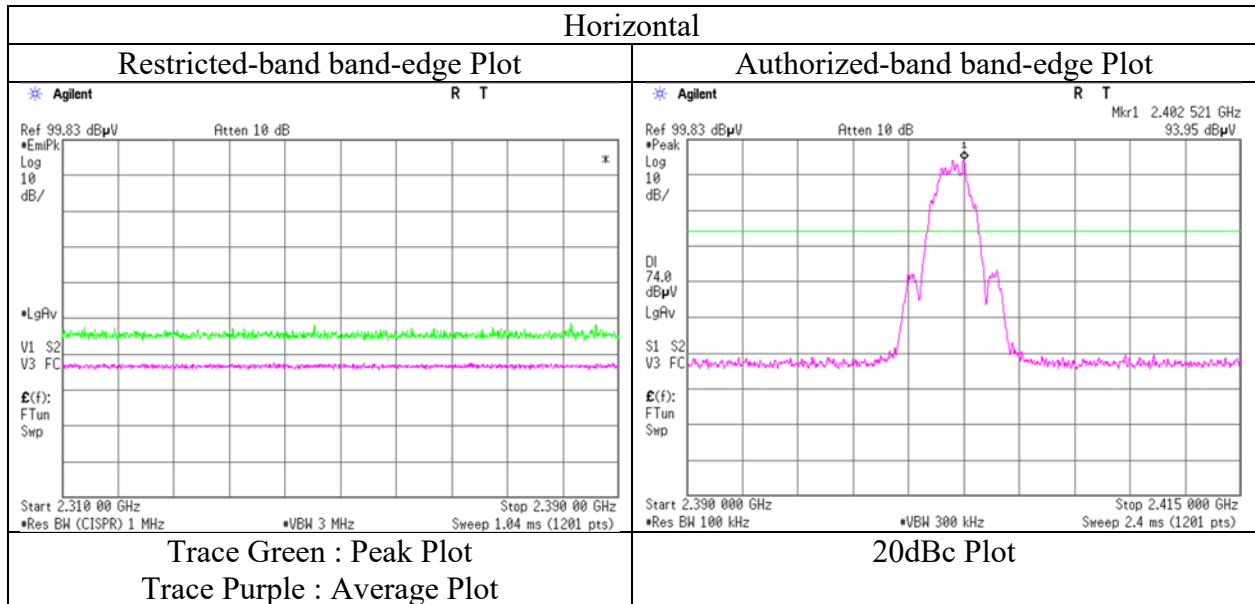
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	June 19, 2019
Temperature / Humidity	21 deg. C / 56 % RH
Engineer	Takahiro Kawakami
	(1 GHz -13 GHz)
Mode	Tx BT LE 2 M PHY 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

UL Japan, Inc.

Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission

Report No. 12920932S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date June 18, 2019 No.3
Temperature / Humidity 24 deg. C / 40 % RH 23 deg. C / 52 % RH
Engineer Yosuke Ishikawa Yosuke Ishikawa
(30 MHz -1000 MHz) (1 GHz -26.5 GHz)
Mode Tx BT LE 2 M 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.	52.000	QP	22.20	10.37	6.79	32.19	0.00	7.17	40.00	32.8	100	0	
Hori.	78.000	QP	22.30	6.16	7.45	32.17	0.00	3.74	40.00	36.2	100	0	
Hori.	98.304	QP	22.50	9.75	7.42	32.15	0.00	7.52	43.50	35.9	100	0	
Hori.	196.608	QP	21.90	16.37	7.90	32.07	0.00	14.10	43.50	29.4	100	0	
Hori.	4880.000	PK	49.95	31.37	6.48	42.89	2.30	47.21	73.90	26.6	208	172	
Hori.	7320.000	PK	49.65	37.00	8.12	43.15	2.30	53.92	73.90	19.9	100	0	
Hori.	9760.000	PK	48.57	38.92	9.29	43.01	2.30	56.07	73.90	17.8	100	0	
Vert.	312.000	QP	21.70	13.70	8.85	32.00	0.00	12.25	46.00	33.7	100	0	
Vert.	624.000	QP	21.80	19.24	10.08	31.94	0.00	19.18	46.00	26.8	100	0	
Vert.	936.000	QP	21.10	21.60	11.13	30.77	0.00	23.06	46.00	22.9	100	0	
Vert.	4880.000	PK	50.17	31.37	6.48	42.89	2.30	47.43	73.90	26.4	110	0	
Vert.	7320.000	PK	48.27	37.00	8.12	43.15	2.30	52.54	73.90	21.3	100	0	
Vert.	9760.000	PK	48.30	38.92	9.29	43.01	2.30	55.80	73.90	18.1	100	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.91\text{ m} / 3.0\text{ m}) = 2.30\text{ dB}$

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	40.03	31.37	6.48	42.89	4.68	2.30	41.97	53.90	11.9	
Hori.	7320.000	AV	39.17	37.00	8.12	43.15	4.68	2.30	48.12	53.90	5.7	
Hori.	9760.000	AV	39.26	38.92	9.29	43.01	4.68	2.30	51.44	53.90	2.4	
Vert.	4880.000	AV	40.05	31.37	6.48	42.89	4.68	2.30	41.99	53.90	11.9	
Vert.	7320.000	AV	39.29	37.00	8.12	43.15	4.68	2.30	48.24	53.90	5.6	
Vert.	9760.000	AV	38.98	38.92	9.29	43.01	4.68	2.30	51.16	53.90	2.7	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.91\text{ m} / 3.0\text{ m}) = 2.30\text{ dB}$

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)

Radiated Spurious Emission

Report No. 12920932S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date June 18, 2019 No.3
Temperature / Humidity 24 deg. C / 40 % RH 23 deg. C / 52 % RH
Engineer Yosuke Ishikawa Yosuke Ishikawa
(30 MHz -1000 MHz) (1 GHz -26.5 GHz)
Mode Tx BT LE 2 M 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.	52.000	QP	21.90	10.37	6.79	32.19	0.00	6.87	40.00	33.1	100	0	
Hori.	78.000	QP	22.00	6.16	7.45	32.17	0.00	3.44	40.00	36.5	100	0	
Hori.	98.304	QP	22.50	9.75	7.42	32.15	0.00	7.52	43.50	35.9	100	0	
Hori.	196.608	QP	21.90	16.37	7.90	32.07	0.00	14.10	43.50	29.4	100	0	
Hori.	2483.500	PK	48.06	27.65	14.22	41.62	2.30	50.61	73.90	23.2	235	359	
Hori.	4960.000	PK	49.25	31.54	6.51	42.91	2.30	46.69	73.90	27.2	265	171	
Hori.	7440.000	PK	48.63	37.10	8.12	43.38	2.30	52.77	73.90	21.1	100	0	
Hori.	9920.000	PK	47.65	38.97	9.28	42.84	2.30	55.36	73.90	18.5	100	0	
Vert.	312.000	QP	21.70	13.70	8.85	32.00	0.00	12.25	46.00	33.7	100	0	
Vert.	624.000	QP	21.80	19.24	10.08	31.94	0.00	19.18	46.00	26.8	100	0	
Vert.	936.000	QP	21.10	21.60	11.13	30.77	0.00	23.06	46.00	22.9	100	0	
Vert.	2483.500	PK	47.91	27.65	14.22	41.62	2.30	50.46	73.90	23.4	126	188	
Vert.	4960.000	PK	49.92	31.54	6.51	42.91	2.30	47.36	73.90	26.5	135	355	
Vert.	7440.000	PK	49.22	37.10	8.12	43.38	2.30	53.36	73.90	20.5	100	0	
Vert.	9920.000	PK	47.99	38.97	9.28	42.84	2.30	55.70	73.90	18.2	100	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.91\text{ m} / 3.0\text{ m}) = 2.30\text{ dB}$

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	39.96	27.65	14.22	41.62	4.68	2.30	47.19	53.90	6.7	*1)
Hori.	4960.000	AV	41.37	31.54	6.51	42.91	4.68	2.30	43.49	53.90	10.4	
Hori.	7440.000	AV	40.69	37.10	8.12	43.38	4.68	2.30	49.51	53.90	4.3	
Hori.	9920.000	AV	39.75	38.97	9.28	42.84	4.68	2.30	52.14	53.90	1.7	
Vert.	2483.500	AV	37.46	27.65	14.22	41.62	4.68	2.30	44.69	53.90	9.2	*1)
Vert.	4960.000	AV	41.47	31.54	6.51	42.91	4.68	2.30	43.59	53.90	10.3	
Vert.	7440.000	AV	40.68	37.10	8.12	43.38	4.68	2.30	49.50	53.90	4.4	
Vert.	9920.000	AV	39.77	38.97	9.28	42.84	4.68	2.30	52.16	53.90	1.7	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.91\text{ m} / 3.0\text{ m}) = 2.30\text{ dB}$

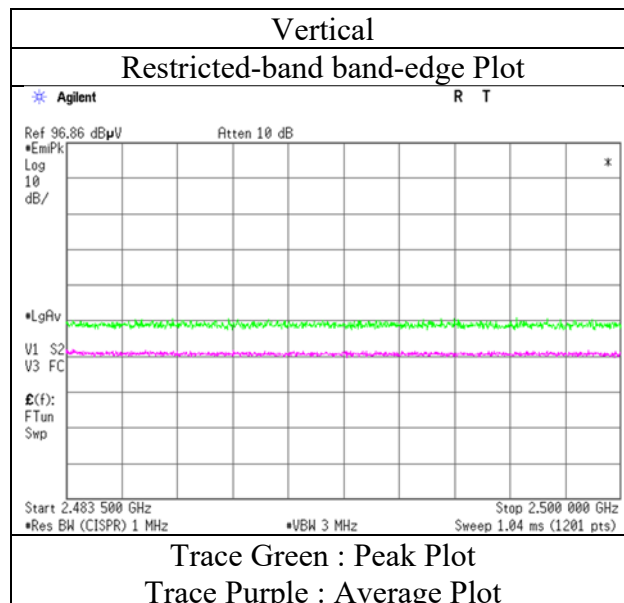
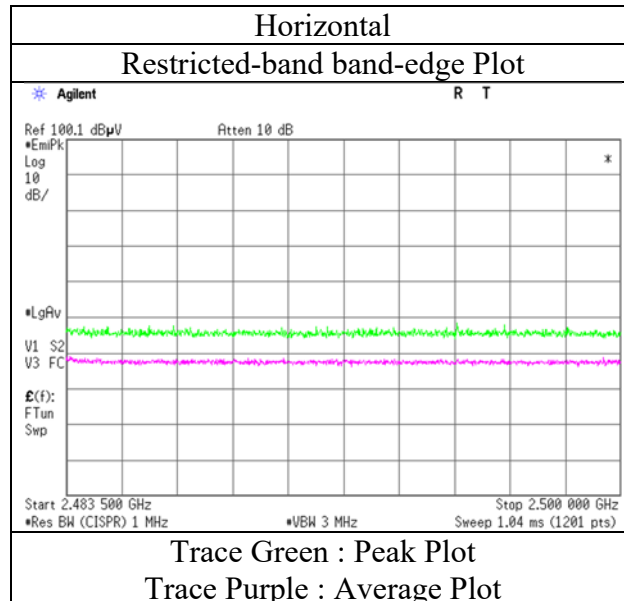
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	June 19, 2019
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Yosuke Ishikawa
	(1 GHz -26.5 GHz)
Mode	Tx BT LE 2 M PHY 2480 MHz

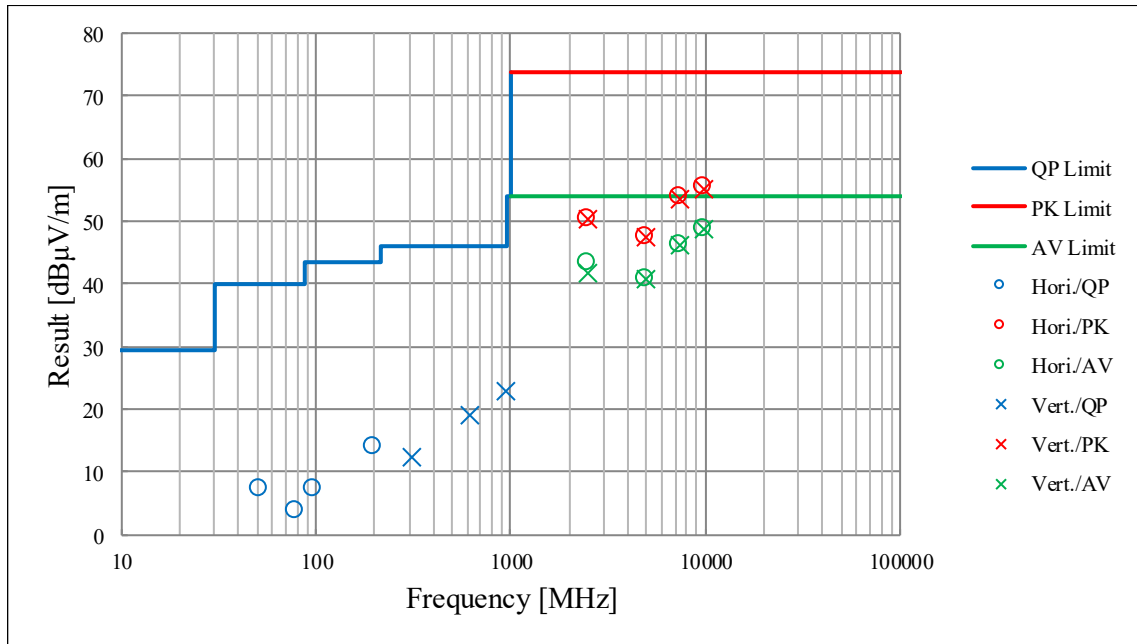


* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

Radiated Spurious Emission
(Plot data, Worst case)

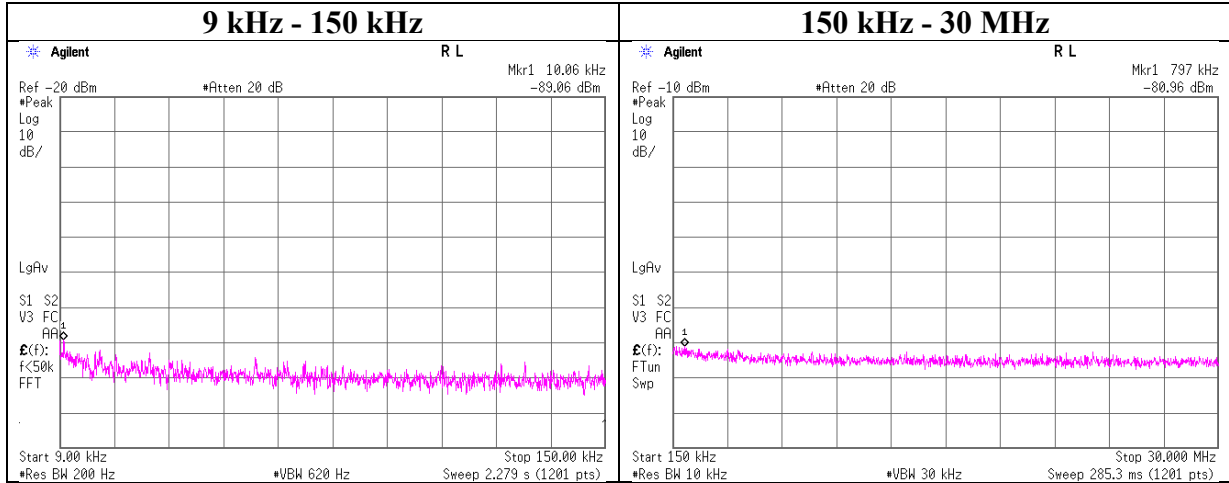
Report No.	12920932S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	June 18, 2019	June 19, 2019	June 19, 2019
Temperature / Humidity	24 deg. C / 40 % RH	21 deg. C / 56 % RH	23 deg. C / 52 % RH
Engineer	Yosuke Ishikawa	Takahiro Kawakami	Yosuke Ishikawa
	(30 MHz -1000 MHz)	(1 GHz -13 GHz)	(13 GHz -26.5 GHz)
Mode	Tx BT LE 1 M PHY 2480 MHz		



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

Conducted Spurious Emission

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	June 28, 2019
Temperature / Humidity	26 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx BT LE 1 M 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
10.0600	-89.06	0.02	9.8	2.0	1	-77.2	300	6.0	-16.0	47.5	63.5	
797.0000	-80.96	0.02	9.8	2.0	1	-69.1	30	6.0	12.1	29.5	17.4	

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

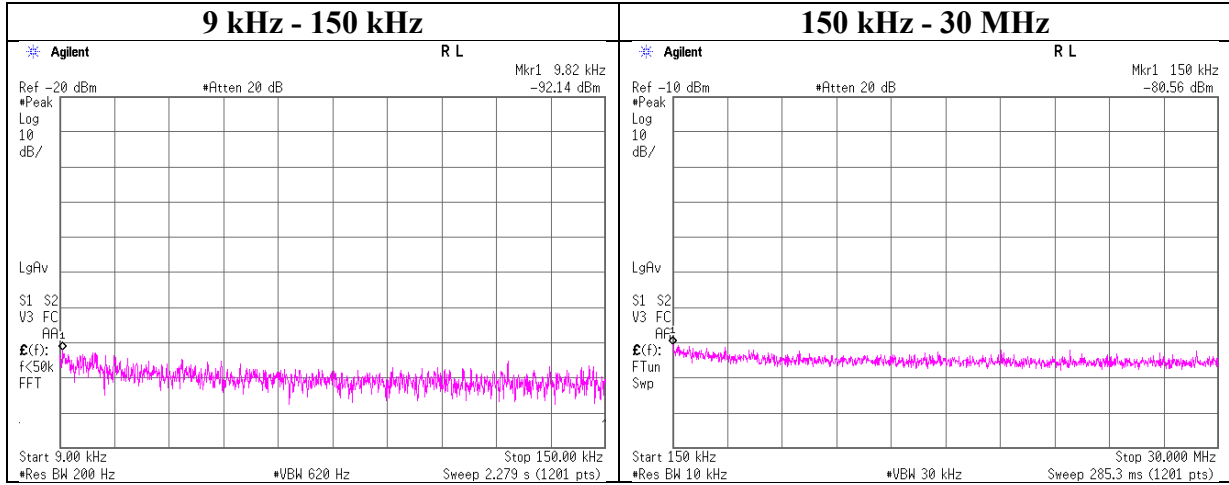
$EIRP[dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Report No. 12920932S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date June 28, 2019
Temperature / Humidity 26 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 1 M 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
9.8200	-92.14	0.02	9.8	2.0	1	-80.3	300	6.0	-19.1	47.7	66.8	
150.0000	-80.56	0.02	9.8	2.0	1	-68.7	300	6.0	-7.5	24.0	31.5	

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

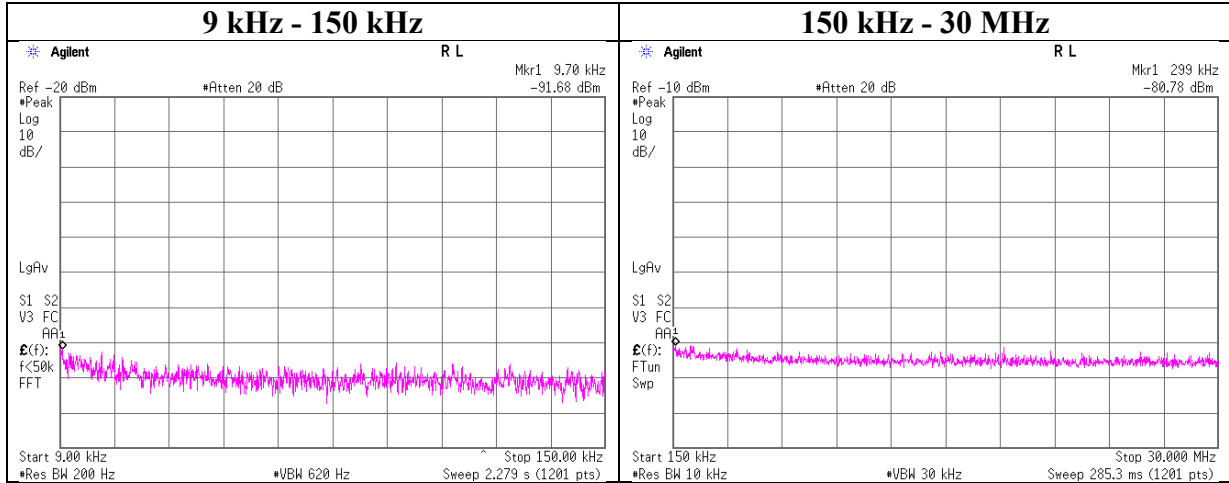
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	June 28, 2019
Temperature / Humidity	26 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx BT LE 1 M 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
9.7000	-91.68	0.02	9.8	2.0	1	-79.9	300	6.0	-18.6	47.8	66.4	
299.0000	-80.78	0.02	9.8	2.0	1	-69.0	300	6.0	-7.7	18.0	25.7	

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

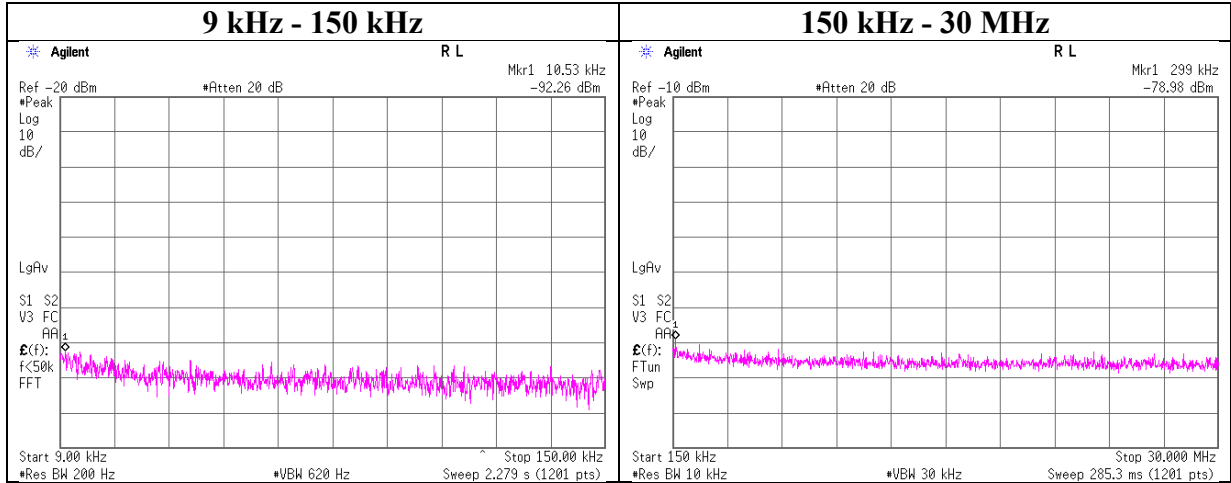
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	June 28, 2019
Temperature / Humidity	26 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx BT LE 2 M 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
10.5300	-92.26	0.02	9.8	2.0	1	-80.4	300	6.0	-19.2	47.1	66.3	
299.0000	-78.98	0.02	9.8	2.0	1	-67.2	300	6.0	-5.9	18.0	23.9	

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

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

N: Number of output

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

UL Japan, Inc.

Shonan EMC Lab.

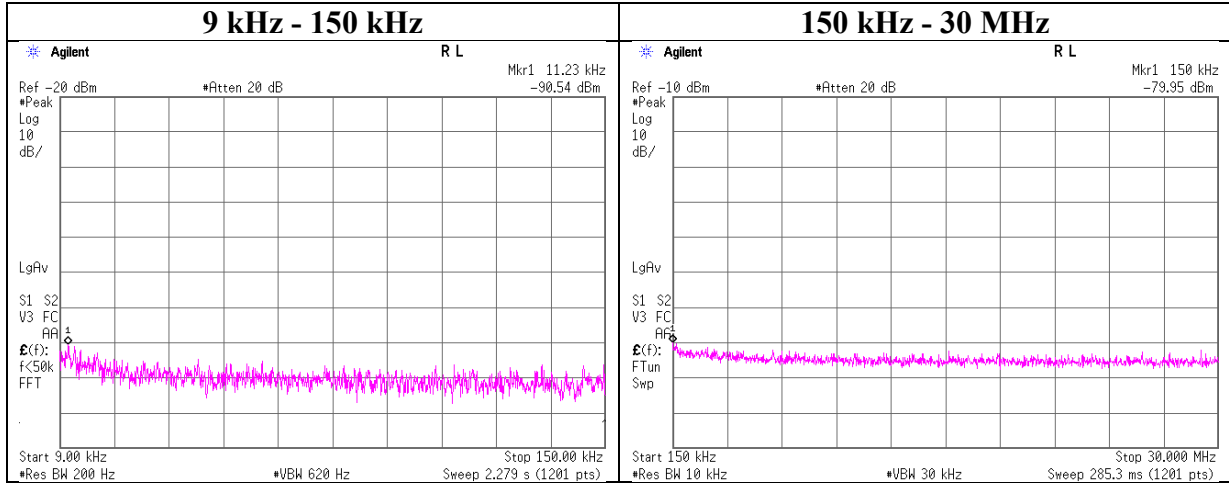
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Conducted Spurious Emission

Report No. 12920932S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date June 28, 2019
Temperature / Humidity 26 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx BT LE 2 M 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
11.2300	-90.54	0.02	9.8	2.0	1	-78.7	300	6.0	-17.5	46.5	64.0	
150.0000	-79.95	0.02	9.8	2.0	1	-68.1	300	6.0	-6.9	24.0	30.9	

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

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

N: Number of output

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

UL Japan, Inc.

Shonan EMC Lab.

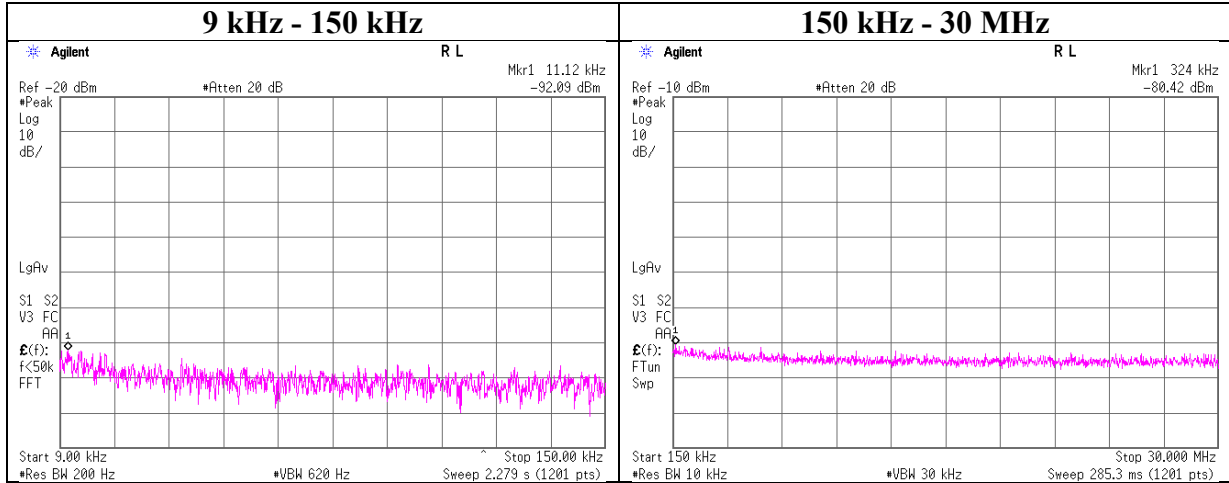
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

Conducted Spurious Emission

Report No.	12920932S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	June 28, 2019
Temperature / Humidity	26 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx BT LE 2 M 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
11.1200	-92.09	0.02	9.8	2.0	1	-80.3	300	6.0	-19.0	46.6	65.6	
324.0000	-80.42	0.02	9.8	2.0	1	-68.6	300	6.0	-7.3	17.3	24.6	

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

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

N: Number of output

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

Power Density

Report No. 12920932S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date June 28, 2019
Temperature / Humidity 26 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx BT LE

1 M PHY

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-27.61	1.62	9.89	-16.10	8.00	24.10
2440	-27.18	1.64	9.89	-15.65	8.00	23.65
2480	-26.93	1.65	9.89	-15.39	8.00	23.39

2 M PHY

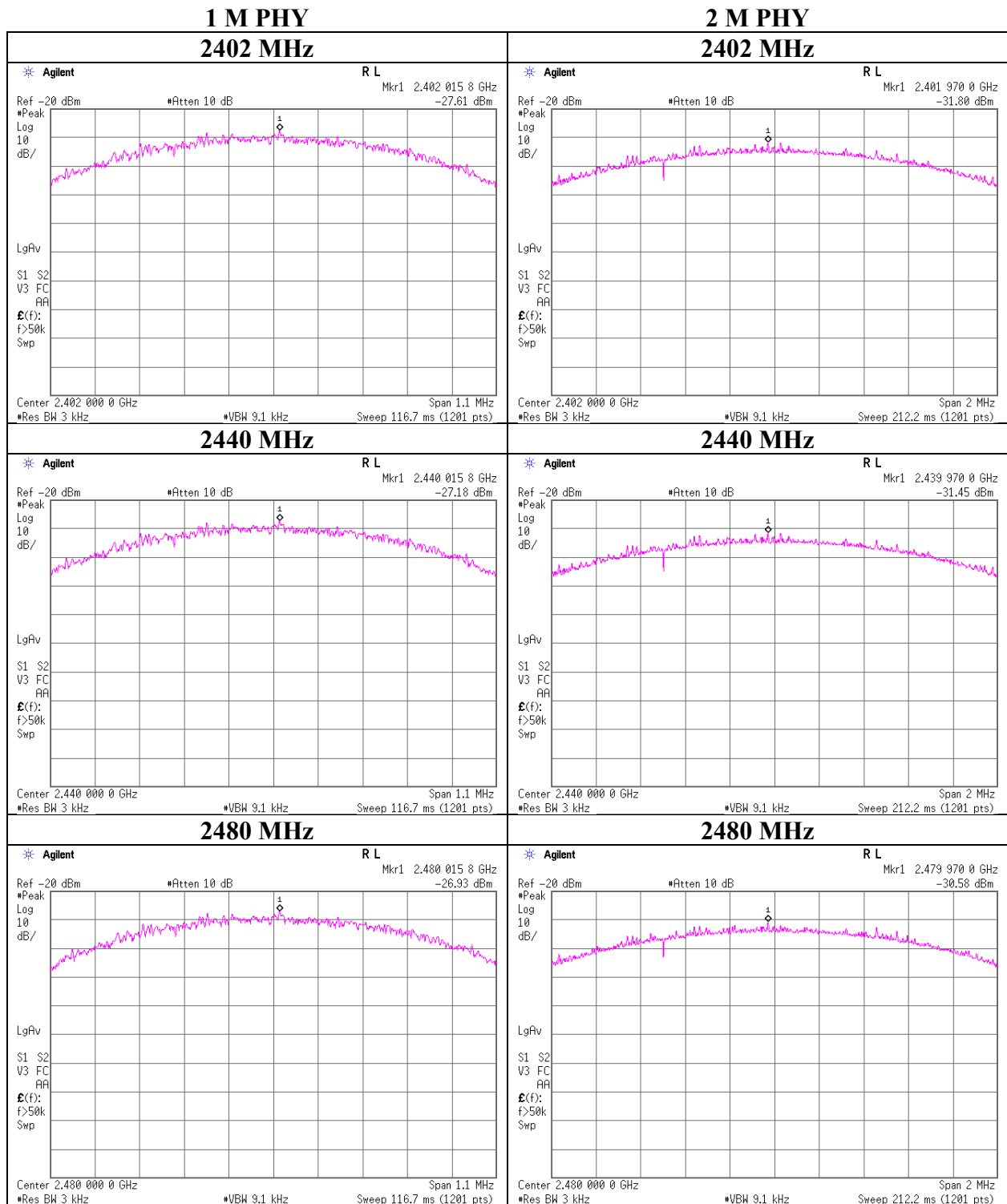
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-31.80	1.62	9.89	-20.29	8.00	28.29
2440	-31.45	1.64	9.89	-19.92	8.00	27.92
2480	-30.58	1.65	9.89	-19.04	8.00	27.04

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 (1 / 2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SAT10-16	AT	160494	Attenuator	Weinschel Corp.	54A-10	83406	2018/12/6	2019/12/30	12
SCC-G32	AT	145183	Coaxial Cable	Junkosha	MWX241-02000KMSK MS	OCT-09-13-005	2018/11/25	2019/11/30	12
SOS-09	AT	146318	Humidity Indicator	A&D	AD-5681	4061484	2018/12/5	2019/12/31	12
SPM-13	AT	169910	Power Meter	EMC Instruments Corporation	8990B	MY51000448	2019/3/6	2020/3/31	12
SPSS-06	AT	169911	Power sensor	EMC Instruments Corporation	N1923A	MY57270004	2019/3/6	2020/3/31	12
KSA-08	AT,RE	145089	Spectrum Analyzer	AGILENT	E4446A	MY46180525	2018/10/7	2019/10/31	12

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Test Instruments (2 / 2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
COTS-SEMI-5	RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-	-
KJM-02	RE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
SAEC-03(NSA)	RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2019/4/8	2020/4/30	12
SAEC-03(SVSWR)	RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2019/5/3	2020/5/31	12
SAF-03	RE	145126	Pre Amplifier	SONOMA	310N	290213	2019/2/5	2020/2/29	12
SAF-06	RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2019/2/8	2020/2/29	12
SAF-08	RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2019/3/5	2020/3/31	12
SAT10-05	RE	145136	Attenuator(above 1GHz)	AGILENT	8493C-010	74864	2018/11/25	2019/11/30	12
SAT6-13	RE	167094	Attenuator	JFW	50HF-006N	-	2019/2/5	2020/2/29	12
SBA-03	RE	145023	Biconical Antenna	Schwarzbeck	BBA9106	91032666	2019/5/7	2020/5/31	12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-271(RF Selector)	2019/4/19	2020/4/30	12
SCC-G40	RE	166491	Coaxial Cable	Junkosha	MWX221-01000NFSN MS/B	1612S005	2019/1/25	2020/1/31	12
SCC-G43	RE	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104 E	SN MY 13406/4E	2018/7/10	2019/7/31	12
SCC-G44	RE	168300	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800070/4A	2019/3/26	2020/3/31	12
SCC-G45	RE	168301	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102 E	800137/2E A	2019/3/26	2020/3/31	12
SCC-G57	RE	179540	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	802815/2	2019/5/16	2020/5/31	12
SFL-02	RE	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2018/11/16	2019/11/30	12
SHA-03	RE	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2018/7/23	2019/7/31	12
SHA-04	RE	145512	Horn Antenna	ETS LINDGREN	9-60	LM3640	2018/7/23	2019/7/31	12
SLA-07	RE	145529	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	2019/5/7	2020/5/31	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2018/10/25	2019/10/31	12
STR-08	RE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2018/11/28	2019/11/30	12
STS-03	RE	146210	Digital Hitester	HIOKI	3805-50	80997823	2018/10/16	2019/10/31	12

*Hyphens for Last Calibration Date, Calibration Due 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.

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: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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