



RADIO TEST REPORT

Test Report No. : 11989460S-A-R1

Applicant : TAIYO YUDEN CO., LTD.
Type of Equipment : Bluetooth Smart/ ANT Module
Model No. : EYSLCN
FCC ID : RYYEYSLCN
Test regulation : FCC Part 15 Subpart C: 2017
Test Result : Complied


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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 above regulation.
4. The test results in this report are traceable to the national or international standards.
5. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
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. This report is a revised version of 11989460S-A. 11989460S-A is replaced with this report.

Date of test: October 16 to 19, 2017

Representative test engineer:


Kazutaka Takeyama
Engineer
Consumer Technology Division

Approved by:


Toyokazu Imamura
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".



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

13-EM-F0429

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SECTION 1: Customer information

Company Name : TAIYO YUDEN CO., LTD.
Address : 8-1, Sakae-cho, Takasaki-shi, Gunma, 370-8522 Japan
Telephone Number : +81-27-324-2300
Facsimile Number : +81-27-324-2301
Contact Person : Hideki Kato

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

2.1 Identification of E.U.T.

Type of Equipment : Bluetooth Smart/ ANT Module
Model No. : EYSLCN
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3 V
Receipt Date of Sample : October 11, 2017
Country of Mass-production : Japan
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: EYSLCN (referred to as the EUT in this report) is a Bluetooth Smart/ ANT Module.

General Specification

Clock frequency(ies) in the system : 32.768 kHz, 32 MHz

Radio Specification

< Bluetooth (BT) Low Energy (LE) (1 Mbps, 2 Mbps) >

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Power Supply (radio part input) : DC 1.3 V
Antenna type : Monopole
Antenna Gain : +0.9 dBi
Operating Temperature : -40 deg. C to +105 deg. C

< ANT (1 Mbps) >

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Power Supply (radio part input) : DC 1.3 V
Antenna type : Monopole
Antenna Gain : +0.9 dBi
Operating Temperature : -40 deg. C to +105 deg. C

< Nordic Original (2 Mbps) >

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Power Supply (radio part input) : DC 1.3 V
Antenna type : Monopole
Antenna Gain : +0.9 dBi
Operating Temperature : -40 deg. C to +105 deg. C

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Shonan EMC Lab.

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Facsimile : +81 463 50 6401

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on November 2, 2017

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 November 2, 2017, does not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	15.6 dB, 7.02632 MHz, N AV, Tx 2441 MHz Nordic Original	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	2.1 dB 7206.00 MHz, AV, Vertical Tx 2402 MHz BT LE 2 Mbps	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.					
*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7.					

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

FCC Part 15.31 (e) / 212

The RF Module has its own regulator. The RF Module is constantly provided voltage (DC 1.3 V) through the regulator 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 it is soldered on the circuit board. Therefore the equipment complies with the requirement.

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	N/A	-	Conducted

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

3.4 Uncertainty

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

Item	Frequency range	Uncertainty (+/-)				
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR	No. 5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.5 dB	2.6 dB	2.5 dB	2.5 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.1 dB	3.1 dB	3.1 dB	-	-
	30 MHz-200 MHz	4.6 dB	4.4 dB	4.6 dB	-	-
	200 MHz-1 GHz	5.8 dB	5.7 dB	5.8 dB	-	-
Radiated emission (Measurement distance: 1 m)	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
	13 GHz-18 GHz	4.6 dB	4.6 dB	4.6 dB	-	-
	18 GHz-40 GHz	4.9 dB	4.9 dB	4.9 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	0.72 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.85 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.74 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	0.91 dB
Spurious emission (Conducted) below 1GHz	1.6 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.3 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.2 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.3 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %

Conducted Emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test Location

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
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

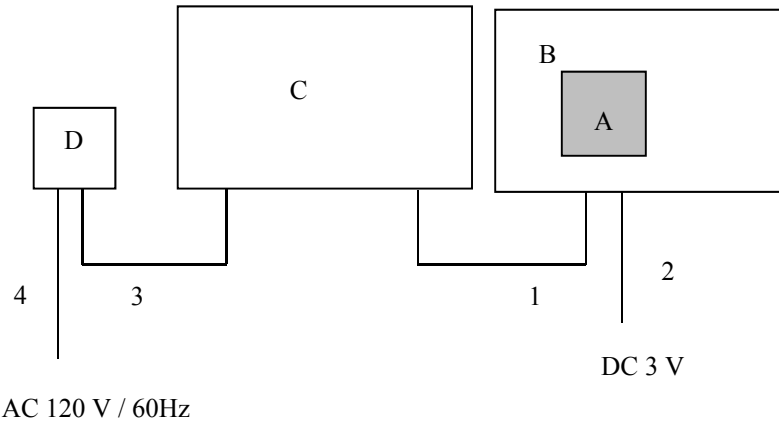
4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth(BT) Low Energy (LE) 1 Mbps	Maximum Packet Size, PRBS9
Bluetooth(BT) Low Energy (LE) 2 Mbps	Maximum Packet Size, PRBS9
ANT	1 Mbps
Nordic Original	2 Mbps
<p>*Power of the EUT was set by the software as follows; Power settings: +4 dBm, -40 dBm Software: Radio_test_tool_BLE2M *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.</p>	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Conducted Emission, Spurious Emission (Radiated) Spurious Emission (Conducted) 6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	Tx BT LE 1 Mbps	2402 MHz
	Tx BT LE 2 Mbps	2440 MHz
		2480 MHz
	Tx ANT	2402 MHz
	Tx Nordic Original	2441 MHz
Spurious Emission (Radiated, Band-edge)		2480 MHz
	Tx BT LE 1 Mbps	2402 MHz
	Tx BT LE 2 Mbps	2480 MHz
	Tx ANT	
	Tx Nordic Original	

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	Bluetooth Smart/ ANT Module	EYSLCN	1 *2) 2 *1)	TAIYO YUDEN	EUT
B	Evaluation Board	TE8648-2	-	TAIYO YUDEN	*3)
C	Laptop PC	CF-T2	4CKSA46826	Panasonic	-
D	AC Adaptor	CF-AA1625A	1625AM406221913F	FUJITSU	-

*1) Used for Antenna Terminal conducted test

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

*3) The use of a board does not affect the test result.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	2.0	Shielded	Shielded	-
2	DC Cable	0.5 + 1.5	Unshielded	Unshielded	-
3	DC Cable	1.2	Unshielded	Unshielded	-
4	AC Cable	0.8	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane.

The 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.

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 "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

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	Average Power Method: <u>12.2.5.2</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	3.99 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)		3.99 m *2) (1 GHz – 13 GHz), 1 m *3) (10 GHz – 26.5 GHz)

*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

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

*3) Distance Factor: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

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

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	Sample	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/Average *2)	-	Power Meter (Sensor: 50 MHz BW) Spectrum Analyzer *5)
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 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04".

*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 low enough as shown in the chart.

(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz).

*5) The setting of spectrum Analyzer used for KDB 558074 D01 DTS Meas Guidance v04 Section 9.1.1 and Section 9.2.2.4 Method AVGSA-2.

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

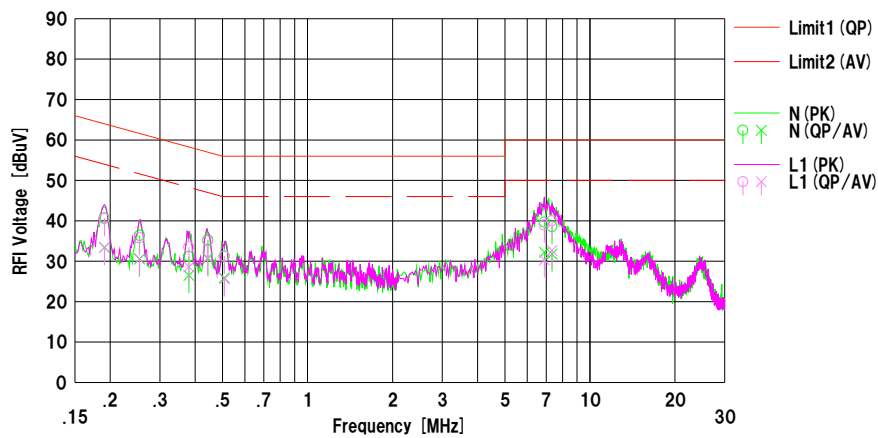
UL Japan, Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2017/10/18

Mode : Tx BLE (1Mbps) 2402 MHz
Power : DC 3 V (AC 120 V/60 Hz)
Temp./Humi. : 23 deg.C / 43 %RH

Remarks : -

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

Engineer : Kazutaka Takeyama

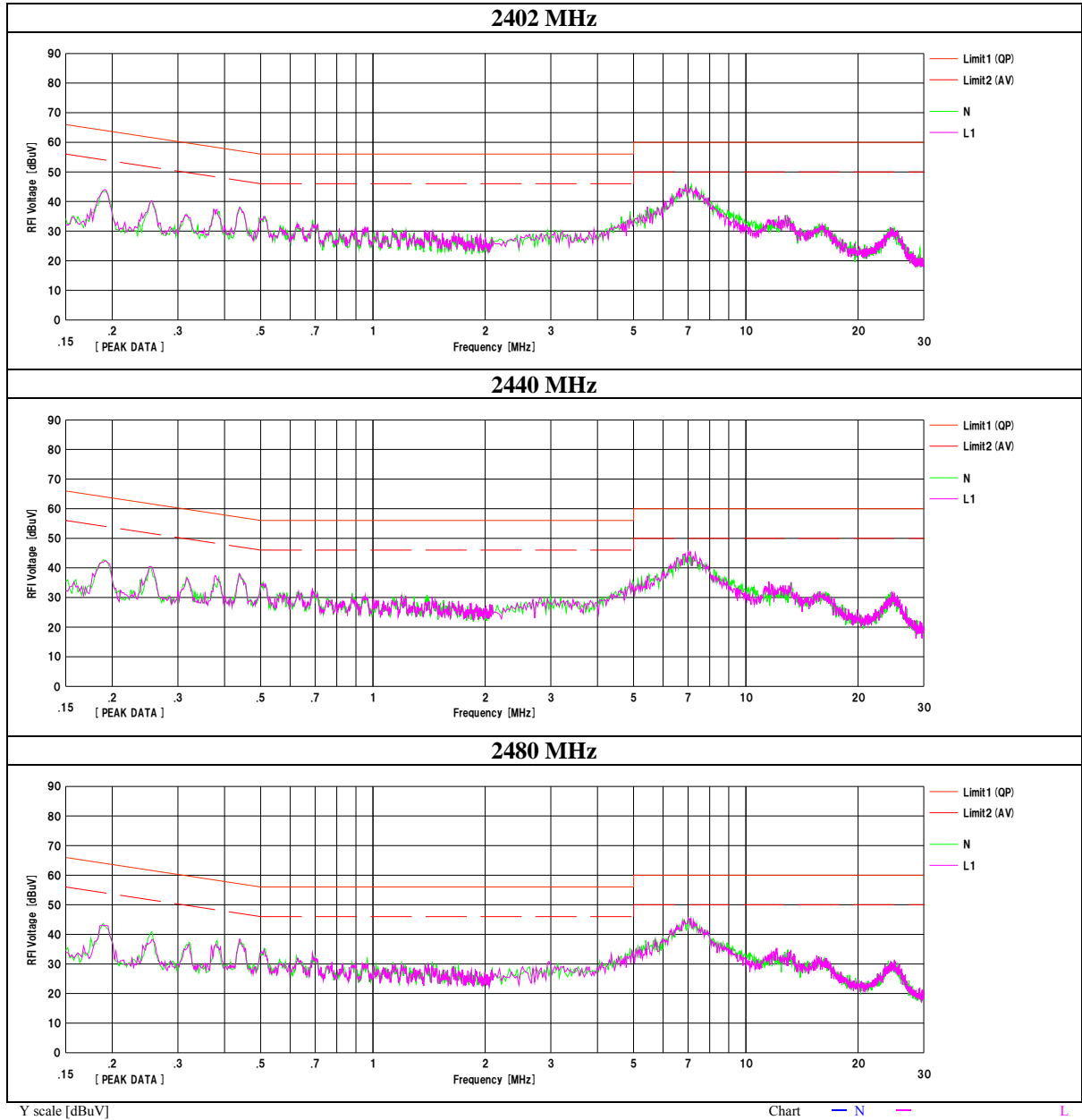


No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]		
1	0.19097	28.20	21.00	12.46	40.66	33.46	63.99	53.99	23.3	20.5	N	
2	0.25412	23.90	18.10	12.49	36.39	30.59	61.62	51.62	25.2	21.0	N	
3	0.38000	18.70	14.00	12.50	31.20	26.50	58.28	48.28	27.0	21.7	N	
4	0.44348	22.80	18.10	12.50	35.30	30.60	57.00	47.00	21.7	16.4	N	
5	0.50716	18.70	13.40	12.52	31.22	25.92	56.00	46.00	24.7	20.0	N	
6	6.90042	26.70	19.30	12.94	39.64	32.24	60.00	50.00	20.3	17.7	N	
7	7.34184	25.60	18.80	12.96	38.56	31.76	60.00	50.00	21.4	18.2	N	
8	0.19070	28.10	20.90	12.46	40.56	33.36	64.01	54.01	23.4	20.6	L1	
9	0.25370	23.30	18.00	12.49	35.79	30.49	61.64	51.64	25.8	21.1	L1	
10	0.37996	21.00	16.10	12.50	33.50	28.60	58.28	48.28	24.7	19.6	L1	
11	0.44306	22.50	18.40	12.50	35.00	30.90	57.00	47.00	22.0	16.1	L1	
12	0.50782	18.70	13.10	12.52	31.22	25.62	56.00	46.00	24.7	20.3	L1	
13	6.89653	26.00	17.40	12.94	38.94	30.34	60.00	50.00	21.0	19.6	L1	
14	7.34108	27.00	19.70	12.96	39.96	32.66	60.00	50.00	20.0	17.3	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN (AMN) + Cable + ATT) [dB]
LISN (AMN) = SLS-03

Conducted Emission

Test place	Shonan EMC Lab. No.2 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kazutaka Takeyama
Mode	Tx BT LE 1 Mbps



Conducted Emission

DATA OF CONDUCTED EMISSION TEST

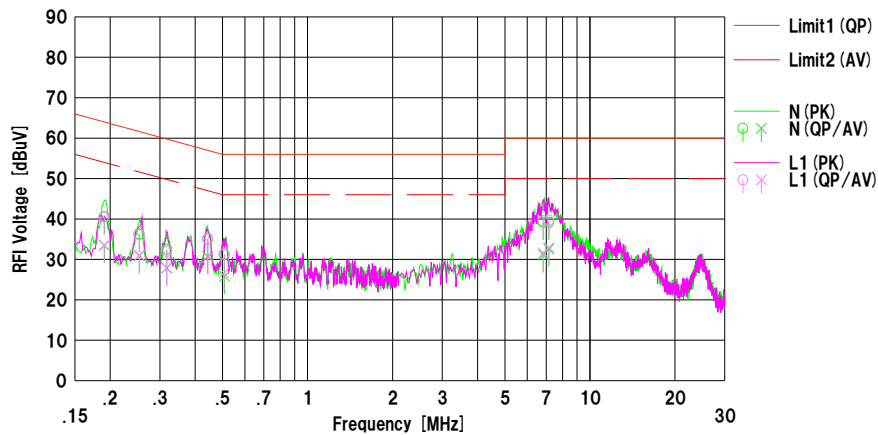
UL Japan, Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2017/10/18

Mode : Tx BLE(2Mbps) 2440 MHz
Power : DC 3 V (AC 120 V/60 Hz)
Temp./Humi. : 23 deg.C / 43 %RH

Remarks : -

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

Engineer : Kazutaka Takeyama

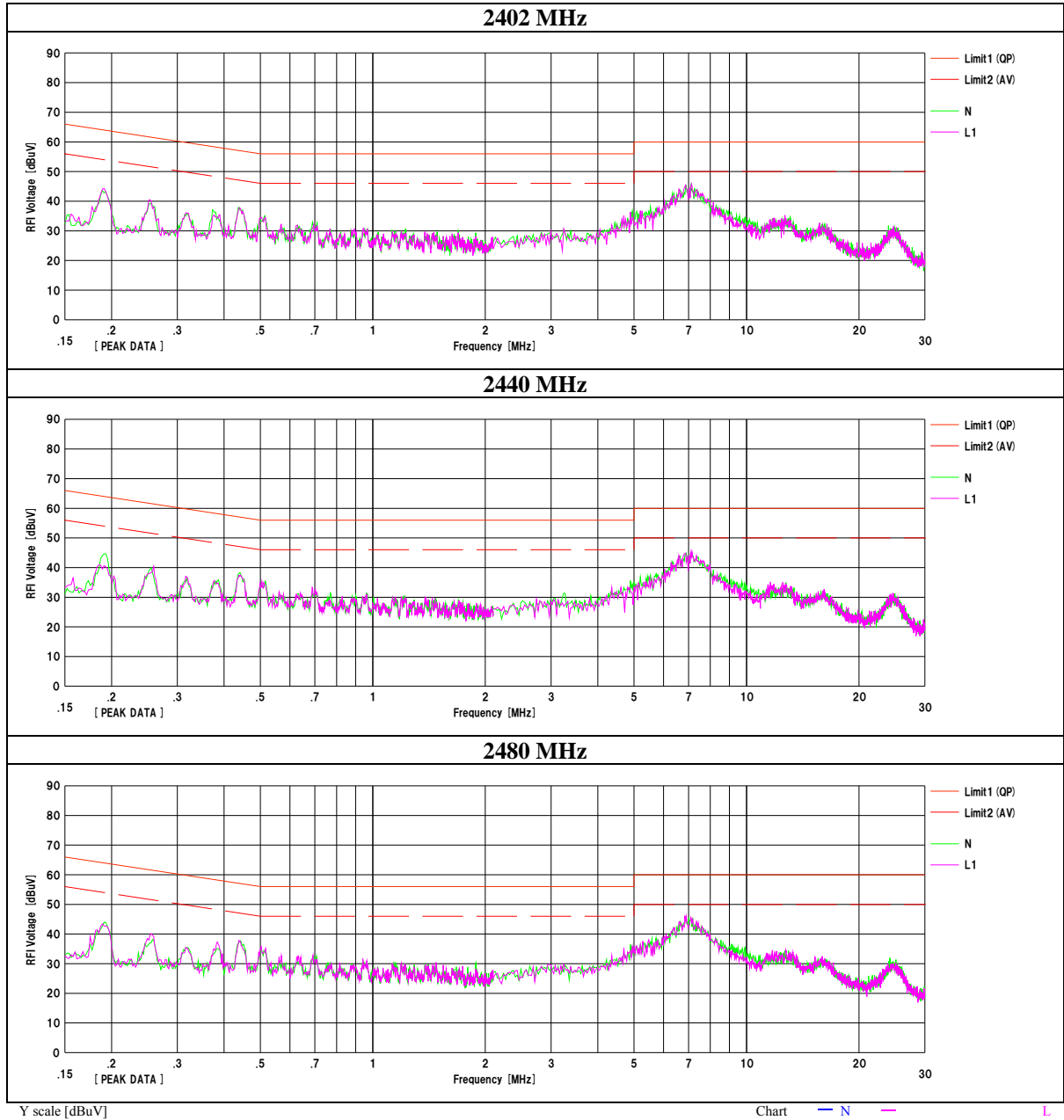


No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.19113	28.10	21.00	12.46	40.56	33.46	63.99	53.99	23.4	20.5	N	
2	0.25358	23.80	18.40	12.49	36.29	30.89	61.64	51.64	25.3	20.7	N	
3	0.31758	20.00	15.40	12.48	32.48	27.88	59.77	49.77	27.2	21.8	N	
4	0.44304	22.60	18.30	12.50	35.10	30.80	57.00	47.00	21.9	16.2	N	
5	0.50744	18.60	13.30	12.52	31.12	25.82	56.00	46.00	24.8	20.1	N	
6	6.83694	26.20	18.20	12.94	39.14	31.14	60.00	50.00	20.8	18.8	N	
7	7.15084	26.20	19.60	12.95	39.15	32.55	60.00	50.00	20.8	17.4	N	
8	0.19028	28.00	21.00	12.46	40.46	33.46	64.02	54.02	23.5	20.5	L1	
9	0.25368	23.60	18.50	12.49	36.09	30.99	61.64	51.64	25.5	20.6	L1	
10	0.31674	19.50	15.40	12.48	31.98	27.88	59.79	49.79	27.8	21.9	L1	
11	0.44382	22.50	18.00	12.50	35.00	30.50	56.99	46.99	21.9	16.4	L1	
12	0.50622	18.80	14.10	12.52	31.32	26.62	56.00	46.00	24.6	19.3	L1	
13	6.83752	26.60	18.70	12.94	39.54	31.64	60.00	50.00	20.4	18.3	L1	
14	7.15197	26.70	20.00	12.95	39.65	32.95	60.00	50.00	20.3	17.0	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN (AMN) + Cable + ATT) [dB]
LISN (AMN) = SLS-03

Conducted Emission

Test place	Shonan EMC Lab. No.2 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kazutaka Takeyama
Mode	Tx BT LE 2 Mbps



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

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

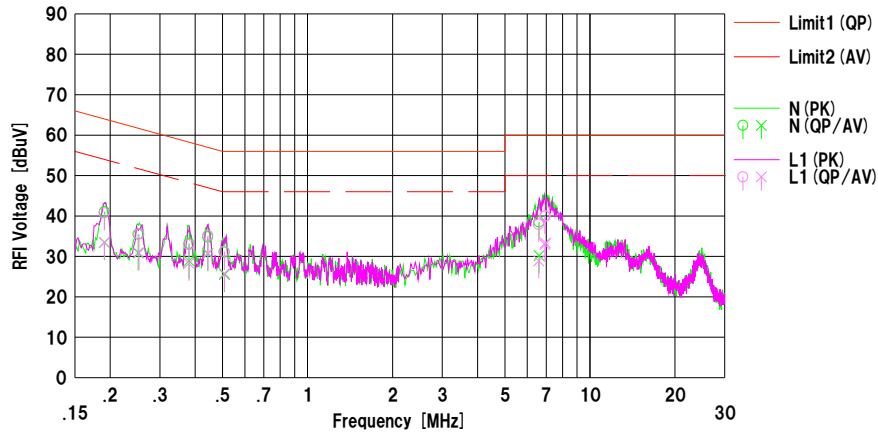
UL Japan, Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2017/10/18

Mode : Tx ANT 2402 MHz
Power : DC 3 V (AC 120 V/60 Hz)
Temp./Humi. : 23 deg.C / 43 %RH

Remarks : -

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

Engineer : Kazutaka Takeyama

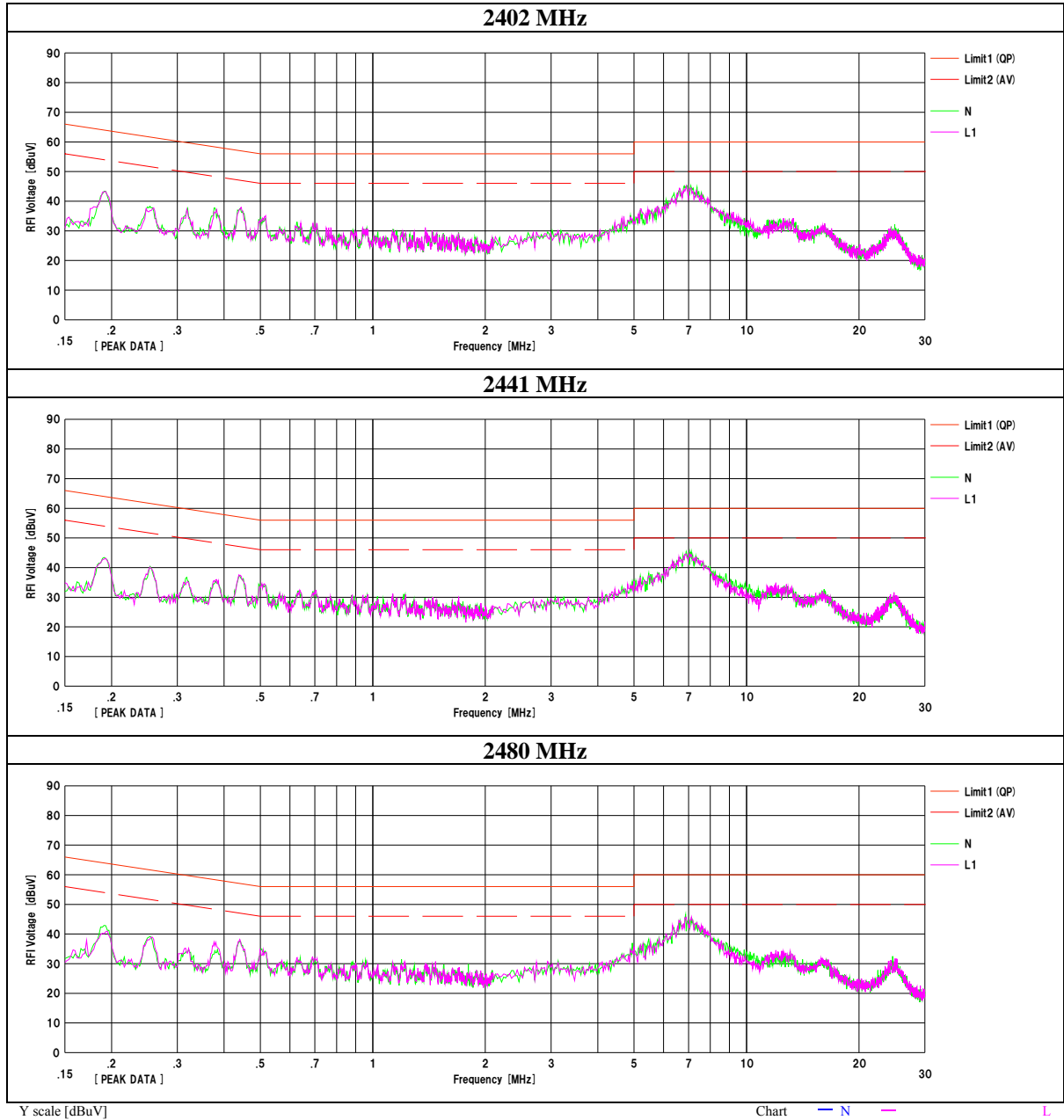


No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]	<QP> [dB]	<AV> [dB]		
1	0.19089	28.60	21.00	12.46	41.06	33.46	64.00	54.00	22.9	20.5	N	
2	0.25116	23.00	18.40	12.49	35.49	30.89	61.72	51.72	26.2	20.8	N	
3	0.38042	20.70	16.40	12.50	33.20	28.90	58.27	48.27	25.0	19.3	N	
4	0.44338	22.30	18.20	12.50	34.80	30.70	57.00	47.00	22.2	16.3	N	
5	0.50764	18.50	13.00	12.52	31.02	25.52	56.00	46.00	24.9	20.4	N	
6	6.60815	25.60	17.30	12.92	38.52	30.22	60.00	50.00	21.4	19.7	N	
7	0.19052	28.30	21.00	12.46	40.76	33.46	64.01	54.01	23.2	20.5	L1	
8	0.25290	23.00	18.40	12.49	35.49	30.89	61.66	51.66	26.1	20.7	L1	
9	0.38012	20.40	15.80	12.50	32.90	28.30	58.28	48.28	25.3	19.9	L1	
10	0.44346	22.70	18.30	12.50	35.20	30.80	57.00	47.00	21.8	16.2	L1	
11	0.50760	18.70	13.30	12.52	31.22	25.82	56.00	46.00	24.7	20.1	L1	
12	6.59180	25.00	16.00	12.92	37.92	28.92	60.00	50.00	22.0	21.0	L1	
13	6.92688	27.00	20.00	12.94	39.94	32.94	60.00	50.00	20.0	17.0	L1	
14	6.96268	27.00	20.40	12.94	39.94	33.34	60.00	50.00	20.0	16.6	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN (AMN) + Cable + ATT) [dB]
LISN (AMN) = SLS-03

Conducted Emission

Test place	Shonan EMC Lab. No.2 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kazutaka Takeyama
Mode	Tx ANT



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

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

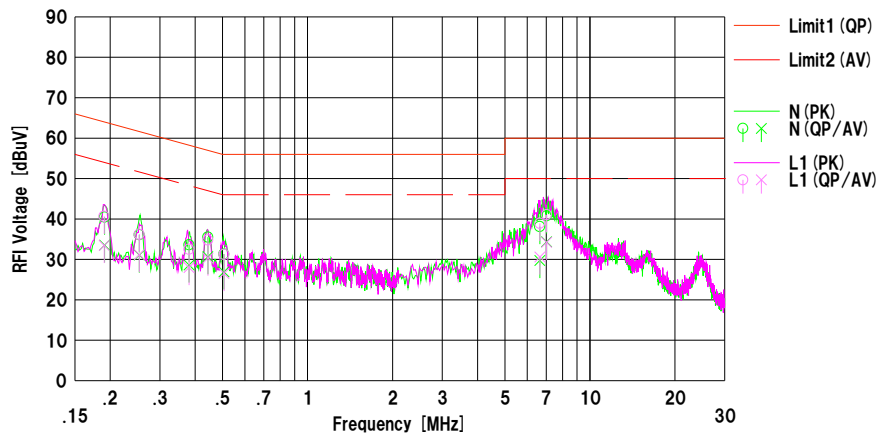
UL Japan, Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2017/10/18

Mode : Tx Nordic Original 2441 MHz
Power : DC 3 V (AC 120 V/60 Hz)
Temp./Humi. : 23 deg.C / 43 %RH

Remarks : -

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

Engineer : Kazutaka Takeyama

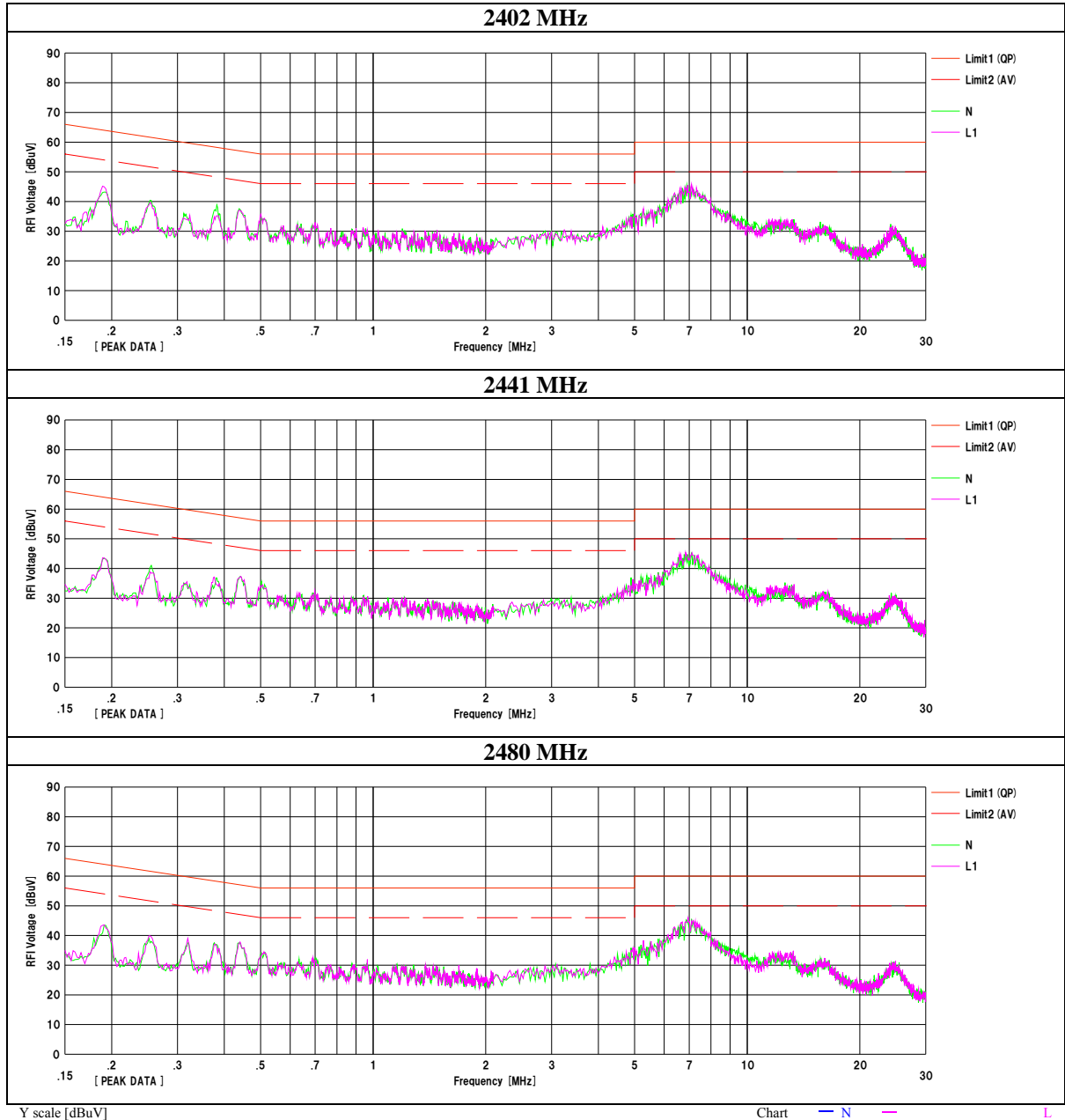


No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]	<QP> [dB]	<AV> [dB]		
1	0.19111	28.00	21.10	12.46	40.46	33.56	63.99	53.99	23.5	20.4	N	
2	0.25370	23.60	18.60	12.49	36.09	31.09	61.64	51.64	25.5	20.5	N	
3	0.38052	21.10	16.10	12.50	33.60	28.60	58.27	48.27	24.6	19.6	N	
4	0.44358	23.00	18.20	12.50	35.50	30.70	56.99	46.99	21.4	16.2	N	
5	0.50584	18.80	14.40	12.52	31.32	26.92	56.00	46.00	24.6	19.0	N	
6	6.64709	25.20	16.80	12.92	38.12	29.72	60.00	50.00	21.8	20.2	N	
7	7.02632	27.80	21.40	12.95	40.75	34.35	60.00	50.00	19.2	15.6	N	
8	0.19038	28.20	21.00	12.46	40.66	33.46	64.02	54.02	23.3	20.5	L1	
9	0.25366	23.70	18.70	12.49	36.19	31.19	61.64	51.64	25.4	20.4	L1	
10	0.38030	20.00	15.50	12.50	32.50	28.00	58.27	48.27	25.7	20.2	L1	
11	0.44378	22.30	17.80	12.50	34.80	30.30	56.99	46.99	22.1	16.6	L1	
12	0.50624	18.70	14.00	12.52	31.22	26.52	56.00	46.00	24.7	19.4	L1	
13	6.64871	26.00	17.70	12.92	38.92	30.62	60.00	50.00	21.0	19.3	L1	
14	7.02765	28.10	21.30	12.95	41.05	34.25	60.00	50.00	18.9	15.7	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN (AMN) + Cable + ATT) [dB]
LISN (AMN) = SLS-03

Conducted Emission

Test place	Shonan EMC Lab. No.2 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kazutaka Takeyama
Mode	Tx Nordic Original

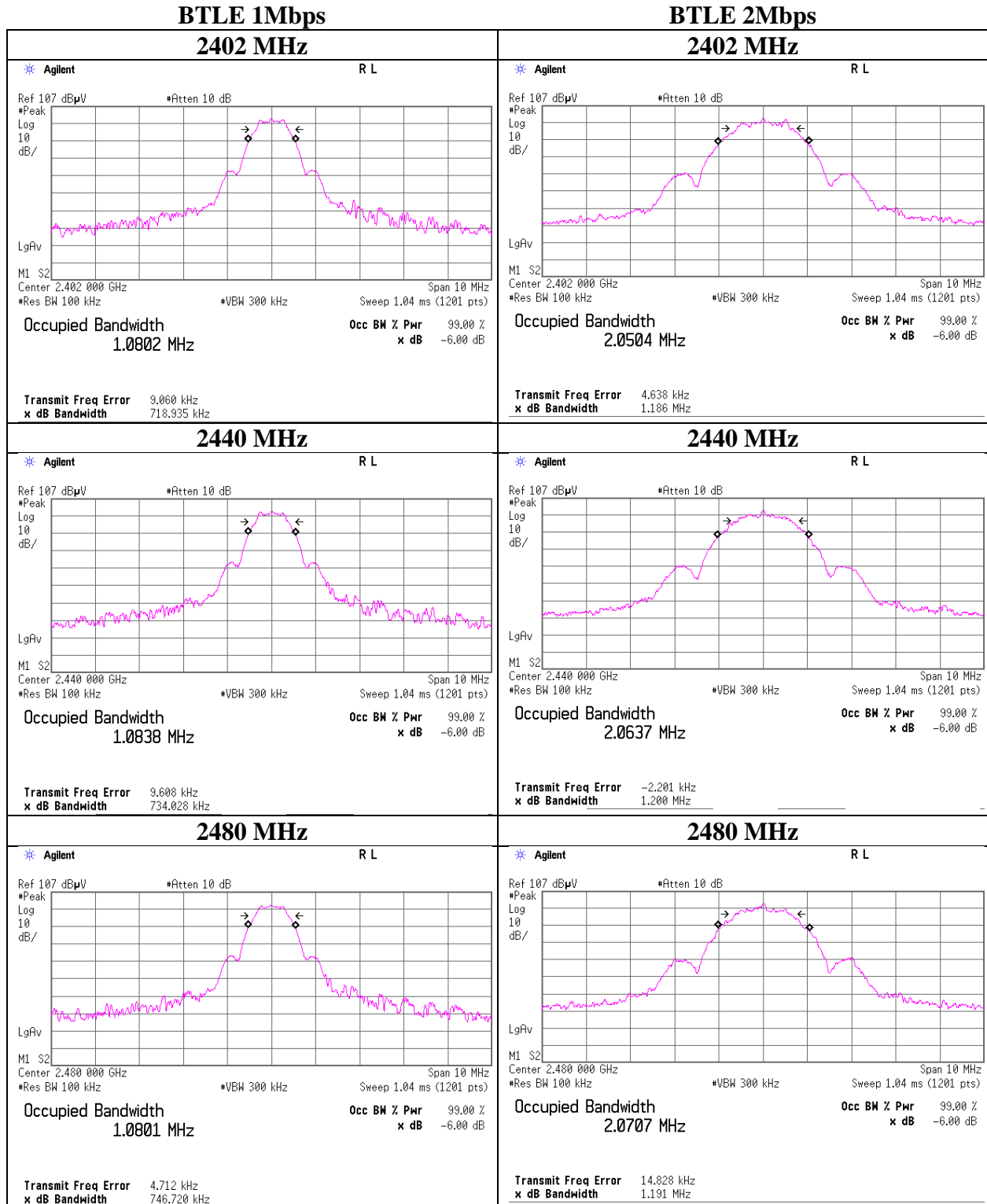


6dB Bandwidth

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
BTLE (1Mbps)	2402	0.719	> 500
	2440	0.734	> 500
	2480	0.747	> 500
BTLE (2Mbps)	2402	1.186	> 500
	2440	1.200	> 500
	2480	1.191	> 500
ANT (1Mbps)	2402	0.504	> 500
	2441	0.512	> 500
	2480	0.512	> 500
Nordic (2Mbps)	2402	0.860	> 500
	2441	0.889	> 500
	2480	0.790	> 500

6dB Bandwidth



UL Japan, Inc.

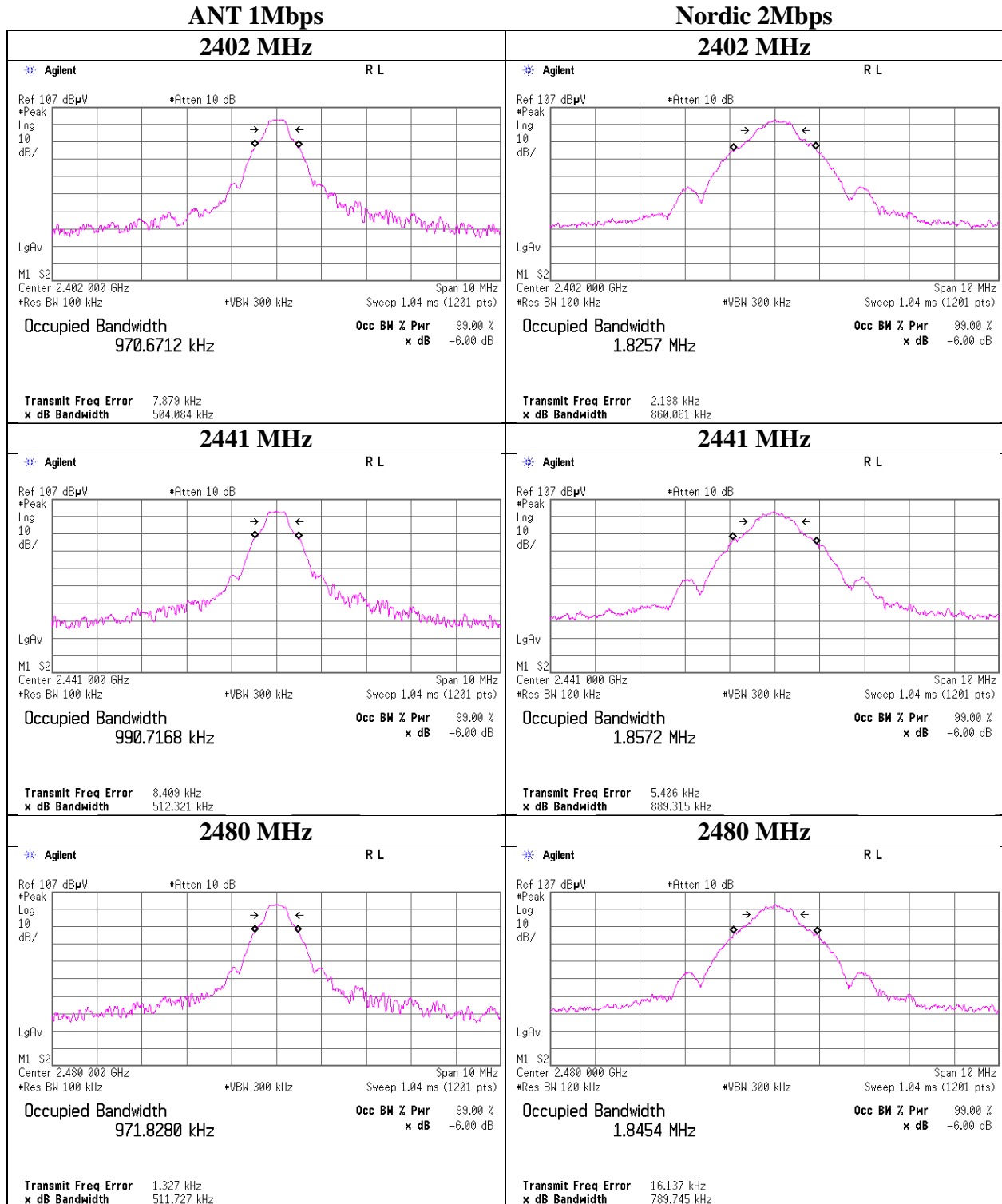
Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

6dB Bandwidth



Maximum Peak Output Power

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx(+4dBm setting)

BTLE 1Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-7.03	1.58	9.80	4.35	2.72	30.00	1000	25.65
2440	-7.05	1.59	9.80	4.34	2.72	30.00	1000	25.66
2480	-7.14	1.60	9.80	4.26	2.67	30.00	1000	25.74

BTLE 2Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-7.00	1.58	9.80	4.38	2.74	30.00	1000	25.62
2440	-6.99	1.59	9.80	4.40	2.75	30.00	1000	25.60
2480	-7.05	1.60	9.80	4.35	2.72	30.00	1000	25.65

ANT 1Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-6.95	1.58	9.80	4.43	2.77	30.00	1000	25.57
2441	-6.98	1.59	9.80	4.41	2.76	30.00	1000	25.59
2480	-7.05	1.60	9.80	4.35	2.72	30.00	1000	25.65

Nordic 2Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-6.95	1.58	9.80	4.43	2.77	30.00	1000	25.57
2441	-6.99	1.59	9.80	4.40	2.75	30.00	1000	25.60
2480	-7.06	1.60	9.80	4.34	2.72	30.00	1000	25.66

Sample Calculation:

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

*The equipment and cables were not used for factor 0.0 dB of the data sheets.

Maximum Peak Output Power

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 19, 2017
Temperature / Humidity : 26 deg. C / 42 % RH
Engineer : Hiroyuki Morikawa
Mode : Tx(-40dBm setting)

BTLE 1Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-41.45	1.58	0.00	-39.87	0.000103	30.00	1000	69.87
2440	-41.53	1.59	0.00	-39.94	0.000101	30.00	1000	69.94
2480	-41.76	1.60	0.00	-40.16	0.000096	30.00	1000	70.16

BTLE 2Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-41.46	1.58	0.00	-39.88	0.000103	30.00	1000	69.88
2440	-41.52	1.59	0.00	-39.93	0.000102	30.00	1000	69.93
2480	-41.74	1.60	0.00	-40.14	0.000097	30.00	1000	70.14

ANT 1Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-41.46	1.58	0.00	-39.88	0.000103	30.00	1000	69.88
2441	-41.53	1.59	0.00	-39.94	0.000101	30.00	1000	69.94
2480	-41.76	1.60	0.00	-40.16	0.000096	30.00	1000	70.16

Unique 2Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-41.46	1.58	0.00	-39.88	0.000103	30.00	1000	69.88
2441	-41.53	1.59	0.00	-39.94	0.000101	30.00	1000	69.94
2480	-41.75	1.60	0.00	-40.15	0.000097	30.00	1000	70.15

Sample Calculation:

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

*The equipment and cables were not used for factor 0.0 dB of the data sheets.

Average Output Power(Reference data)

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx(+4dBm setting)

BTLE 1Mbps

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	-7.45	1.58	9.80	3.93	2.47	0.23	4.16	2.61
2440	-7.46	1.59	9.80	3.93	2.47	0.23	4.16	2.61
2480	-7.55	1.60	9.80	3.85	2.43	0.23	4.08	2.56

BTLE 2Mbps

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	-7.71	1.58	9.80	3.67	2.33	0.44	4.11	2.58
2440	-7.72	1.59	9.80	3.67	2.33	0.44	4.11	2.58
2480	-7.79	1.60	9.80	3.61	2.30	0.44	4.05	2.54

ANT 1Mbps

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	-7.44	1.58	9.80	3.94	2.48	0.23	4.17	2.61
2441	-7.45	1.59	9.80	3.94	2.48	0.23	4.17	2.61
2480	-7.54	1.60	9.80	3.86	2.43	0.23	4.09	2.56

Nordic 2Mbps

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	-7.70	1.58	9.80	3.68	2.33	0.45	4.13	2.59
2441	-7.71	1.59	9.80	3.68	2.33	0.45	4.13	2.59
2480	-7.79	1.60	9.80	3.61	2.30	0.45	4.06	2.55

Sample Calculation:

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

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

Average Output Power(Reference data)

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11989460S-A-R1
Date October 19, 2017
Temperature / Humidity 26 deg. C / 42 % RH
Engineer Hiroyuki Morikawa
Mode Tx(-40dBm setting)

BTLE 1Mbps

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	-41.99	1.58	0.00	-40.41	0.000091	0.23	-40.18	0.000096
2440	-42.02	1.59	0.00	-40.43	0.000091	0.23	-40.20	0.000095
2480	-42.25	1.60	0.00	-40.65	0.000086	0.23	-40.42	0.000091

BTLE 2Mbps

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	-42.18	1.58	0.00	-40.60	0.000087	0.44	-40.16	0.000096
2440	-42.31	1.59	0.00	-40.72	0.000085	0.44	-40.28	0.000094
2480	-42.53	1.60	0.00	-40.93	0.000081	0.44	-40.49	0.000089

ANT 1Mbps

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	-41.99	1.58	0.00	-40.41	0.000091	0.23	-40.18	0.000096
2441	-42.00	1.59	0.00	-40.41	0.000091	0.23	-40.18	0.000096
2480	-42.34	1.60	0.00	-40.74	0.000084	0.23	-40.51	0.000089

Nordic 2Mbps

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	-42.14	1.58	0.00	-40.56	0.000088	0.45	-40.11	0.000097
2441	-42.23	1.59	0.00	-40.64	0.000086	0.45	-40.19	0.000096
2480	-42.52	1.60	0.00	-40.92	0.000081	0.45	-40.47	0.000090

Sample Calculation:

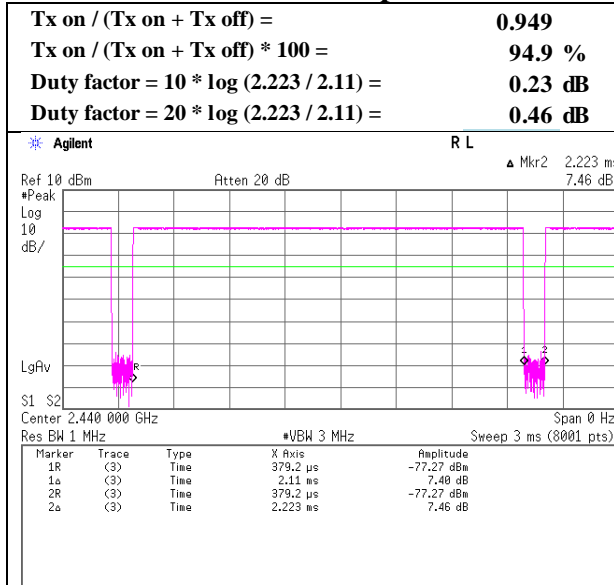
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

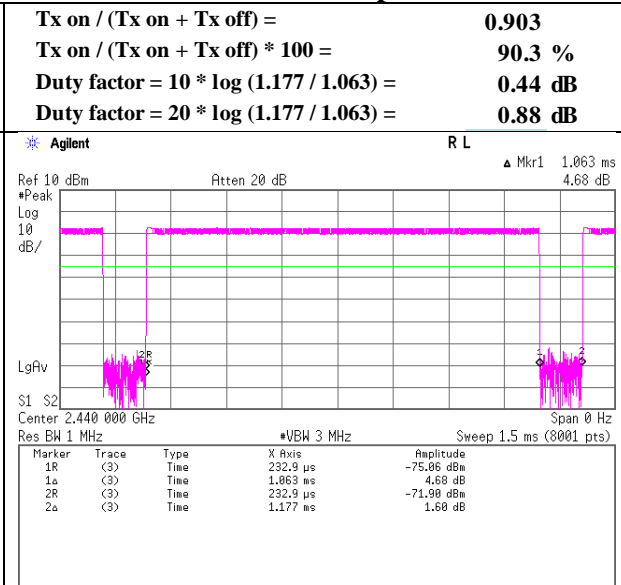
Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	25 deg. C / 47 % RH
Engineer	Yosuke Ishikawa
Mode	Tx

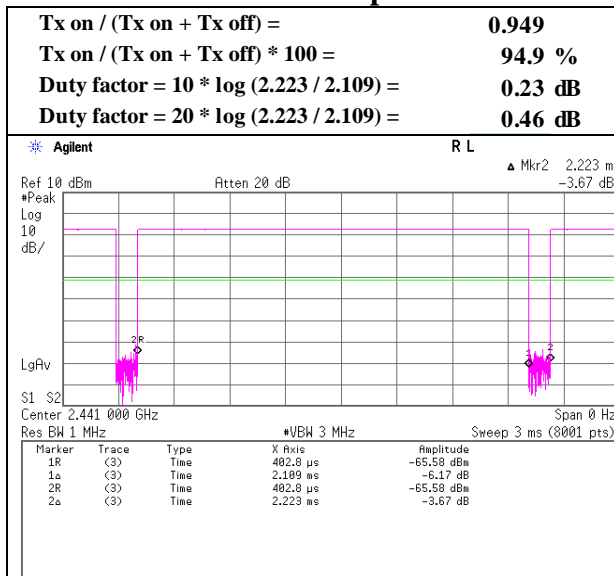
BTLE 1Mbps



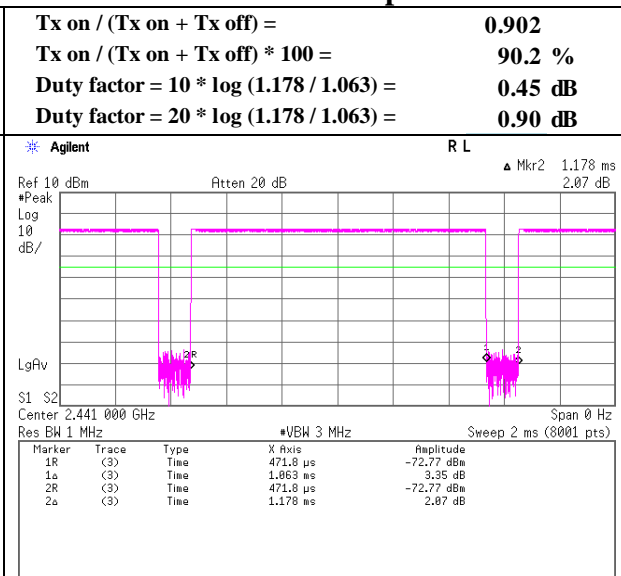
BTLE 2Mbps



ANT 1Mbps



Nordic 2 Mbps



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.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx BT LE 1Mbps 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.	168.000	QP	21.52	15.64	8.74	31.79	0.00	14.11	43.50	29.3	204	323	
Hori.	480.002	QP	21.40	17.38	7.62	31.60	0.00	14.80	46.00	31.2	210	36	
Hori.	576.003	QP	20.76	18.78	8.11	31.60	0.00	16.05	46.00	29.9	177	59	
Hori.	2390.000	PK	44.33	27.16	14.27	36.83	2.48	51.41	73.90	22.4	212	215	
Hori.	4804.000	PK	47.09	31.14	6.79	36.99	2.48	50.51	73.90	23.3	139	130	
Hori.	7206.000	PK	47.93	36.48	8.41	37.81	2.48	57.49	73.90	16.4	134	2	
Hori.	9608.000	PK	45.90	38.20	9.48	38.48	2.48	57.58	73.90	16.3	150	0	
Vert.	32.000	QP	22.17	16.90	6.97	31.90	0.00	14.14	40.00	25.8	100	3	
Vert.	112.000	QP	22.18	11.82	8.12	31.84	0.00	10.28	43.50	33.2	100	82	
Vert.	160.000	QP	22.38	15.30	8.65	31.79	0.00	14.54	43.50	28.9	100	358	
Vert.	168.000	QP	23.28	15.64	8.74	31.79	0.00	15.87	43.50	27.6	100	218	
Vert.	232.001	QP	22.74	11.60	5.93	31.72	0.00	8.55	46.00	37.4	100	83	
Vert.	432.068	QP	25.49	16.45	7.36	31.62	0.00	17.68	46.00	28.3	101	276	
Vert.	2390.000	PK	43.82	27.16	14.27	36.83	2.48	50.90	73.90	23.0	210	234	
Vert.	4804.000	PK	46.42	31.14	6.79	36.99	2.48	49.84	73.90	24.0	116	14	
Vert.	7206.000	PK	49.95	36.48	8.41	37.81	2.48	59.51	73.90	14.3	142	31	
Vert.	9608.000	PK	45.92	38.20	9.48	38.48	2.48	57.60	73.90	16.3	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	34.60	27.16	14.27	36.83	0.46	2.48	42.14	53.90	11.8	*1)
Hori.	4804.000	AV	40.39	31.14	6.79	36.99	0.46	2.48	44.27	53.90	9.6	
Hori.	7206.000	AV	40.56	36.48	8.41	37.81	0.46	2.48	50.58	53.90	3.3	
Hori.	9608.000	AV	36.16	38.20	9.48	38.48	0.46	2.48	48.30	53.90	5.6	
Vert.	2390.000	AV	34.69	27.16	14.27	36.83	0.46	2.48	42.23	53.90	11.7	*1)
Vert.	4804.000	AV	38.22	31.14	6.79	36.99	0.46	2.48	42.10	53.90	11.8	
Vert.	7206.000	AV	41.73	36.48	8.41	37.81	0.46	2.48	51.75	53.90	2.2	
Vert.	9608.000	AV	37.07	38.20	9.48	38.48	0.46	2.48	49.21	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.	2402.000	PK	90.39	27.20	14.28	36.83	2.48	97.52	-	-	
Hori.	2400.000	PK	38.26	27.20	14.27	36.83	2.48	45.38	77.52	32.1	
Vert.	2402.000	PK	86.15	27.20	14.28	36.83	2.48	93.28	-	-	
Vert.	2400.000	PK	36.10	27.20	14.27	36.83	2.48	43.22	73.28	30.1	

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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Shonan EMC Lab.

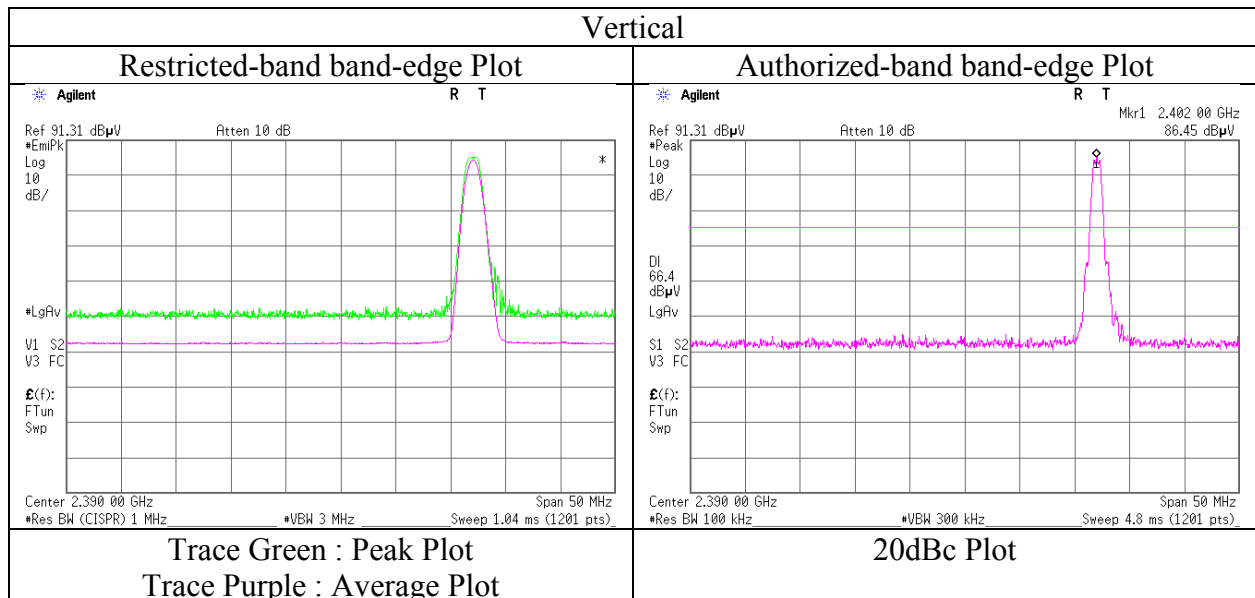
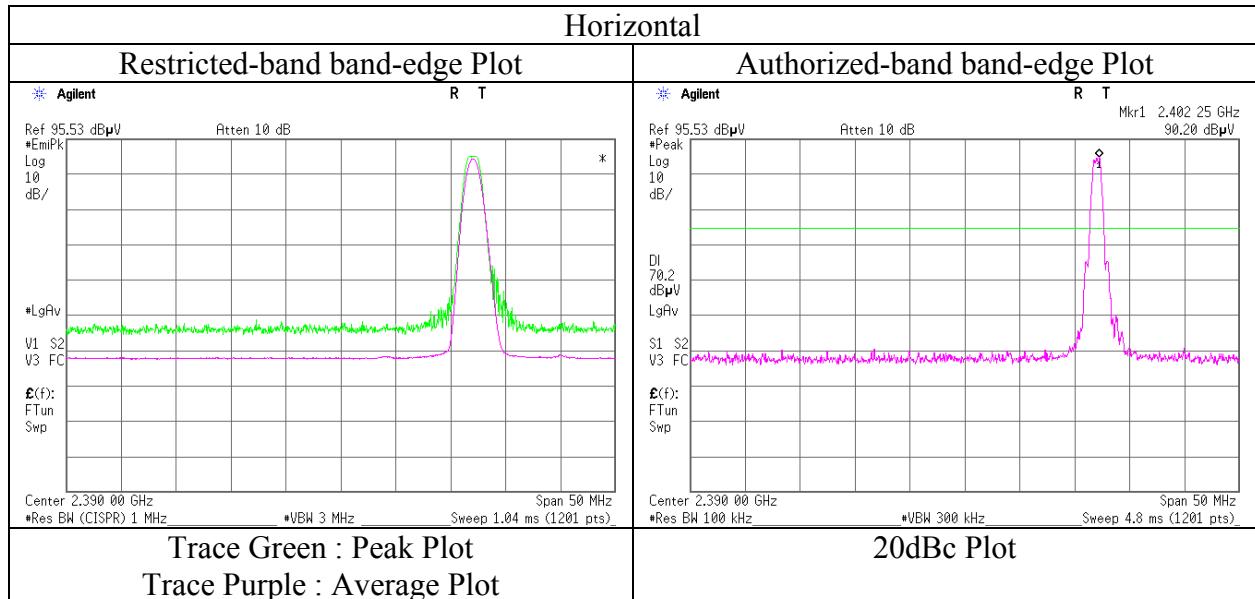
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 11989460S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 2
Date October 16, 2017
Temperature / Humidity 20 deg. C / 64 % RH
Engineer Shiro Kobayashi
(1 GHz – 13 GHz)
Mode Tx BT LE 1Mbps 2402 MHz



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

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx BT LE 1Mbps 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.	168.000	QP	21.52	15.64	8.74	31.79	0.00	14.11	43.50	29.3	209	139	
Hori.	480.002	QP	21.63	17.38	7.62	31.60	0.00	15.03	46.00	30.9	197	39	
Hori.	576.003	QP	20.78	18.78	8.11	31.60	0.00	16.07	46.00	29.9	246	357	
Hori.	4880.000	PK	48.08	31.31	6.87	37.03	2.48	51.71	73.90	22.2	120	344	
Hori.	7320.000	PK	47.29	36.64	8.57	37.88	2.48	57.10	73.90	16.8	102	49	
Hori.	9760.000	PK	46.09	38.50	9.60	38.67	2.48	58.00	73.90	15.9	150	0	
Vert.	32.000	QP	22.16	16.90	6.97	31.90	0.00	14.13	40.00	25.8	100	82	
Vert.	112.000	QP	22.28	11.82	8.12	31.84	0.00	10.38	43.50	33.1	100	299	
Vert.	160.000	QP	21.76	15.30	8.65	31.79	0.00	13.92	43.50	29.5	100	336	
Vert.	168.000	QP	22.77	15.64	8.74	31.79	0.00	15.36	43.50	28.1	100	243	
Vert.	232.001	QP	22.23	11.60	5.93	31.72	0.00	8.04	46.00	37.9	100	89	
Vert.	432.069	QP	22.59	16.45	7.36	31.62	0.00	14.78	46.00	31.2	100	271	
Vert.	4880.000	PK	46.89	31.31	6.87	37.03	2.48	50.52	73.90	23.4	126	4	
Vert.	7320.000	PK	47.65	36.64	8.57	37.88	2.48	57.46	73.90	16.4	132	128	
Vert.	9760.000	PK	46.19	38.50	9.60	38.67	2.48	58.10	73.90	15.8	150	0	

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

Distance factor : 1 GHz - 13 GHz : 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	40.28	31.31	6.87	37.03	0.46	2.48	44.37	53.90	9.5	
Hori.	7320.000	AV	39.70	36.64	8.57	37.88	0.46	2.48	49.97	53.90	3.9	
Hori.	9760.000	AV	36.23	38.50	9.60	38.67	0.46	2.48	48.60	53.90	5.3	
Vert.	4880.000	AV	39.42	31.31	6.87	37.03	0.46	2.48	43.51	53.90	10.4	
Vert.	7320.000	AV	40.34	36.64	8.57	37.88	0.46	2.48	50.61	53.90	3.3	
Vert.	9760.000	AV	36.22	38.50	9.60	38.67	0.46	2.48	48.59	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.

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx BT LE 1Mbps 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.	159.539	QP	21.40	15.28	8.64	31.79	0.00	13.53	43.50	29.9	200	3	
Hori.	184.203	QP	21.50	16.18	8.90	31.78	0.00	14.80	43.50	28.7	200	3	
Hori.	957.646	QP	20.80	22.53	9.92	30.41	0.00	22.84	46.00	23.1	100	107	
Hori.	2483.500	PK	49.63	27.48	14.37	36.79	2.48	57.17	73.90	16.7	190	214	
Hori.	4960.000	PK	49.28	31.48	6.94	37.07	2.48	53.11	73.90	20.8	187	202	
Hori.	7440.000	PK	45.82	36.81	8.75	37.95	2.48	55.91	73.90	18.0	147	202	
Hori.	9920.000	PK	46.02	38.82	9.72	38.87	2.48	58.17	73.90	15.7	150	0	
Vert.	31.531	QP	22.14	17.00	6.96	31.90	0.00	14.20	40.00	25.8	100	331	
Vert.	240.000	QP	24.70	11.66	5.99	31.71	0.00	10.64	46.00	35.3	100	292	
Vert.	835.206	QP	20.80	21.37	9.34	31.16	0.00	20.35	46.00	25.6	100	354	
Vert.	947.194	QP	20.90	22.49	9.88	30.49	0.00	22.78	46.00	23.2	100	161	
Vert.	2483.500	PK	47.56	27.48	14.37	36.79	2.48	55.10	73.90	18.8	192	240	
Vert.	4960.000	PK	47.75	31.48	6.94	37.07	2.48	51.58	73.90	22.3	102	343	
Vert.	7440.000	PK	47.14	36.81	8.75	37.95	2.48	57.23	73.90	16.7	132	144	
Vert.	9920.000	PK	45.28	38.82	9.72	38.87	2.48	57.43	73.90	16.5	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	34.98	27.48	14.37	36.79	0.46	2.48	42.98	53.90	10.9	*1)
Hori.	4960.000	AV	42.91	31.48	6.94	37.07	0.46	2.48	47.20	53.90	6.7	
Hori.	7440.000	AV	36.53	36.81	8.75	37.95	0.46	2.48	47.08	53.90	6.8	
Hori.	9920.000	AV	36.01	38.82	9.72	38.87	0.46	2.48	48.62	53.90	5.3	
Vert.	2483.500	AV	34.55	27.48	14.37	36.79	0.46	2.48	42.55	53.90	11.4	*1)
Vert.	4960.000	AV	40.85	31.48	6.94	37.07	0.46	2.48	45.14	53.90	8.8	
Vert.	7440.000	AV	38.20	36.81	8.75	37.95	0.46	2.48	48.75	53.90	5.2	
Vert.	9920.000	AV	36.13	38.82	9.72	38.87	0.46	2.48	48.74	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 : $20\log(3.99\text{ m} / 3.0\text{ m}) = 2.48\text{ dB}$

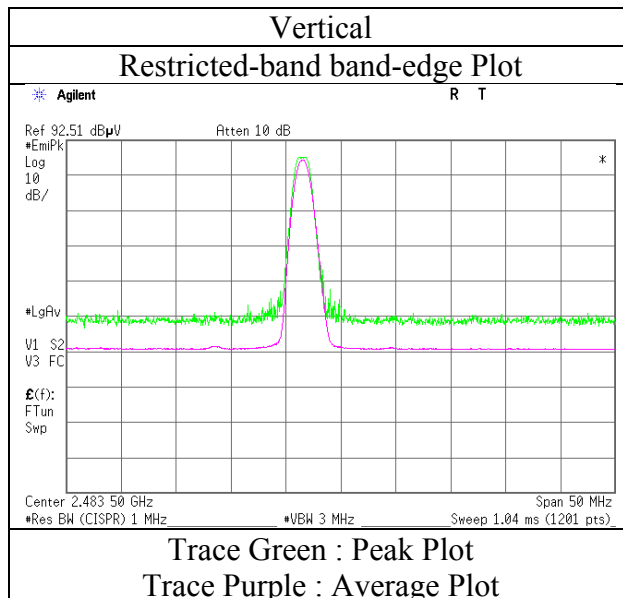
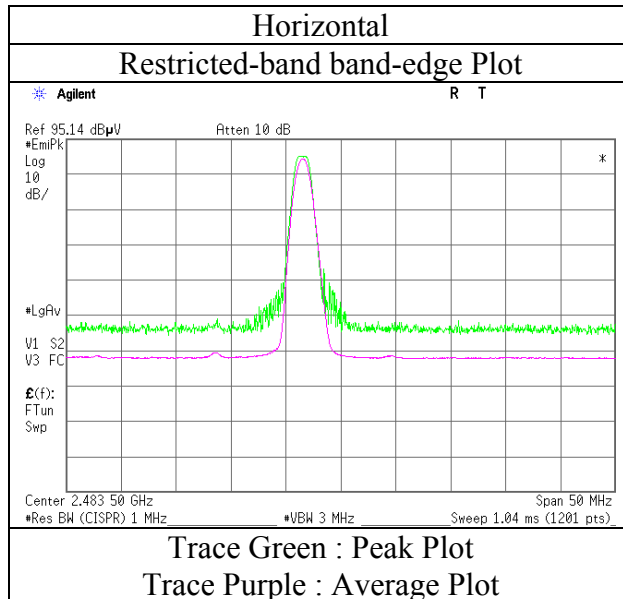
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

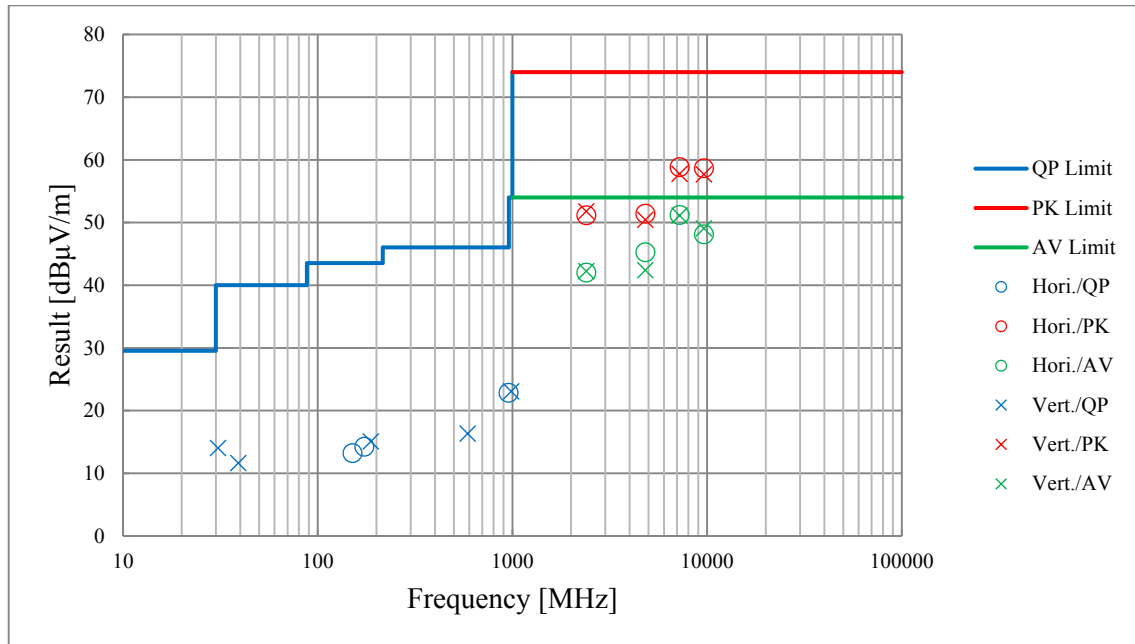
Report No. 11989460S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 2
Date October 16, 2017
Temperature / Humidity 20 deg. C / 64 % RH
Engineer Shiro Kobayashi
(1 GHz – 13 GHz)
Mode Tx BT LE 1Mbps 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx BT LE 1Mbps 2402 MHz		



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

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx BT LE 2Mbps 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.	82.532	QP	21.80	6.74	7.74	31.86	0.00	4.42	40.00	35.5	300	1	
Hori.	664.067	QP	20.90	19.60	8.55	31.58	0.00	17.47	46.00	28.5	100	3	
Hori.	936.957	QP	20.80	22.45	9.83	30.56	0.00	22.52	46.00	23.4	100	266	
Hori.	2390.000	PK	44.31	27.16	14.27	36.83	2.48	51.39	73.90	22.5	214	215	
Hori.	4804.000	PK	46.68	31.14	6.79	36.99	2.48	50.10	73.90	23.8	107	128	
Hori.	7206.000	PK	48.03	36.48	8.41	37.81	2.48	57.59	73.90	16.3	109	42	
Hori.	9608.000	PK	45.90	38.20	9.48	38.48	2.48	57.58	73.90	16.3	150	0	
Vert.	113.936	PK	22.10	12.09	8.14	31.84	0.00	10.49	43.50	33.0	100	15	
Vert.	153.922	QP	21.80	15.02	8.59	31.80	0.00	13.61	43.50	29.8	100	320	
Vert.	240.000	QP	23.90	11.66	5.99	31.71	0.00	9.84	46.00	36.1	100	160	
Vert.	878.450	QP	21.00	22.00	9.56	30.95	0.00	21.61	46.00	24.3	100	6	
Vert.	2390.000	PK	42.91	27.16	14.27	36.83	2.48	49.99	73.90	23.9	207	220	
Vert.	4804.000	PK	45.88	31.14	6.79	36.99	2.48	49.30	73.90	24.6	165	16	
Vert.	7206.000	PK	48.81	36.48	8.41	37.81	2.48	58.37	73.90	15.5	138	31	
Vert.	9608.000	PK	46.50	38.20	9.48	38.48	2.48	58.18	73.90	15.7	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	34.77	27.16	14.27	36.83	0.88	2.48	42.73	53.90	11.2	*1)
Hori.	4804.000	AV	38.47	31.14	6.79	36.99	0.88	2.48	42.77	53.90	11.1	
Hori.	7206.000	AV	39.44	36.48	8.41	37.81	0.88	2.48	49.88	53.90	4.0	
Hori.	9608.000	AV	36.24	38.20	9.48	38.48	0.88	2.48	48.80	53.90	5.1	
Vert.	2390.000	AV	33.79	27.16	14.27	36.83	0.88	2.48	41.75	53.90	12.2	*1)
Vert.	4804.000	AV	37.22	31.14	6.79	36.99	0.88	2.48	41.52	53.90	12.4	
Vert.	7206.000	AV	41.38	36.48	8.41	37.81	0.88	2.48	51.82	53.90	2.1	
Vert.	9608.000	AV	36.33	38.20	9.48	38.48	0.88	2.48	48.89	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 : 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	88.92	27.20	14.28	36.83	2.48	96.05	-	-	
Hori.	2400.000	PK	56.82	27.20	14.27	36.83	2.48	63.94	76.05	12.1	
Vert.	2402.000	PK	82.42	27.20	14.28	36.83	2.48	89.55	-	-	
Vert.	2400.000	PK	48.75	27.20	14.27	36.83	2.48	55.87	69.55	13.7	

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

UL Japan, Inc.

Shonan EMC Lab.

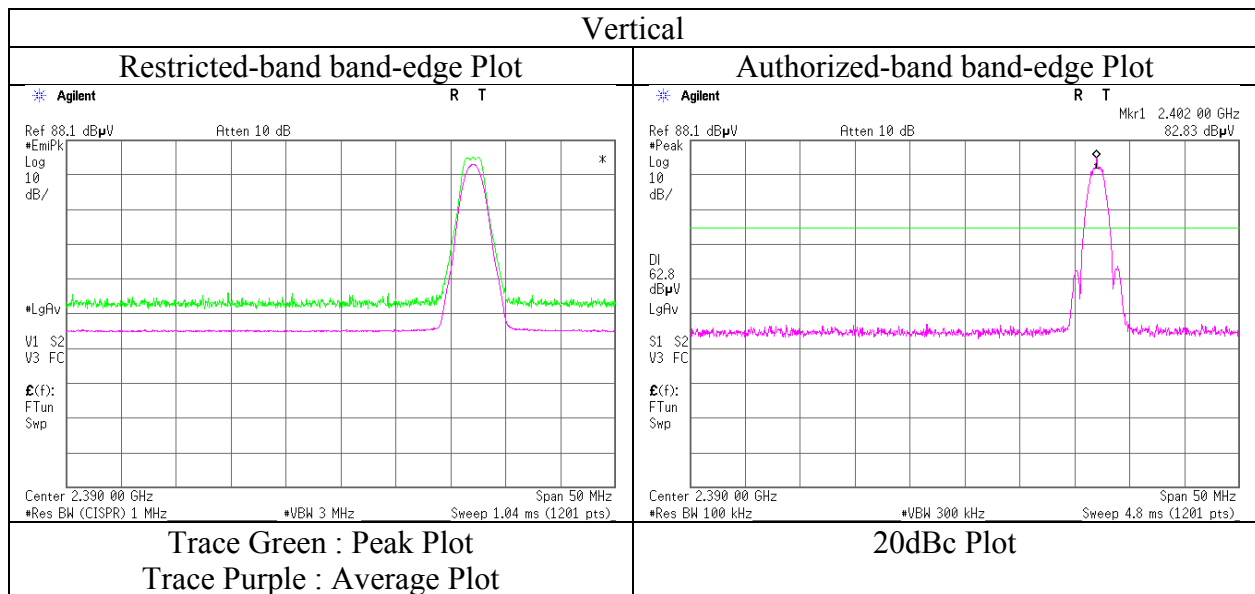
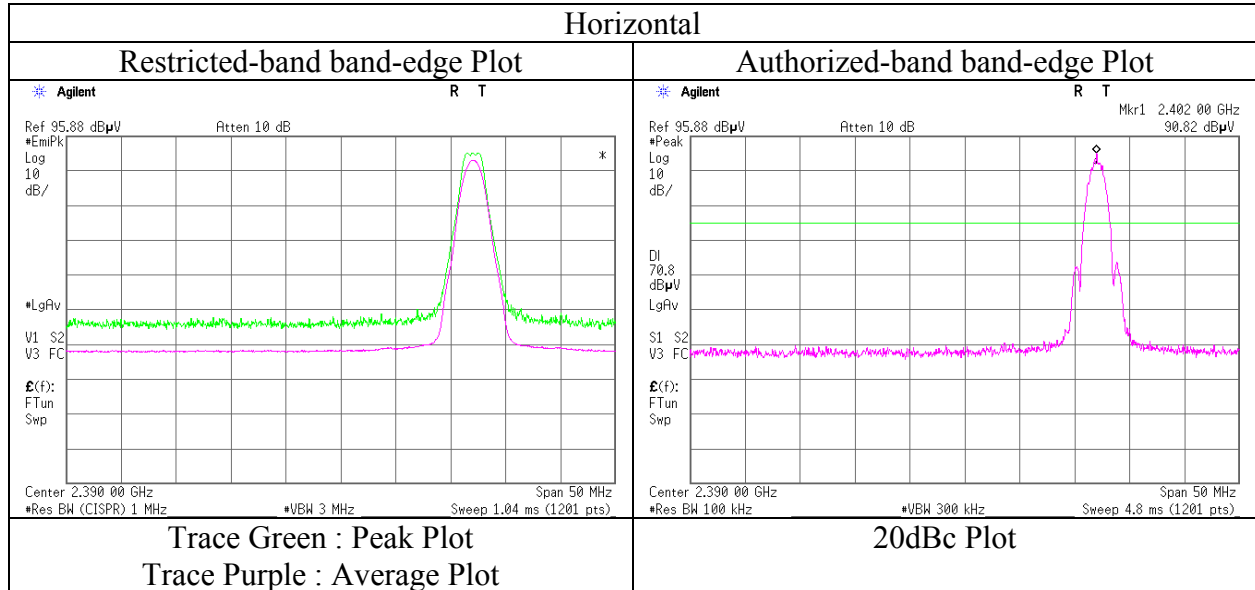
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

**Radiated Spurious Emission
 (Reference Plot for band-edge)**

Report No. 11989460S-A-R1
 Test place Shonan EMC Lab.
 Semi Anechoic Chamber No. 2
 Date October 16, 2017
 Temperature / Humidity 20 deg. C / 64 % RH
 Engineer Shiro Kobayashi
 (1 GHz – 13 GHz)
 Mode Tx BT LE 2Mbps 2402 MHz



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

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx BT LE 2Mbps 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.	123.696	QP	21.60	13.21	8.25	31.83	0.00	11.23	43.50	32.2	200	357	
Hori.	154.214	QP	21.80	15.03	8.59	31.80	0.00	13.62	43.50	29.8	150	38	
Hori.	166.867	QP	21.70	15.59	8.73	31.79	0.00	14.23	43.50	29.2	300	98	
Hori.	267.200	QP	21.00	12.30	6.20	31.69	0.00	7.81	46.00	38.1	150	292	
Hori.	982.354	QP	20.50	22.63	10.03	30.25	0.00	22.91	53.90	30.9	100	4	
Hori.	4880.000	PK	46.09	31.31	6.87	37.03	2.48	49.72	73.90	24.2	156	201	
Hori.	7320.000	PK	45.26	36.64	8.57	37.88	2.48	55.07	73.90	18.8	107	209	
Hori.	9760.000	PK	46.44	38.50	9.60	38.67	2.48	58.35	73.90	15.6	150	0	
Vert.	158.860	QP	21.83	15.25	8.64	31.79	0.00	13.93	43.50	29.5	100	100	
Vert.	246.404	QP	21.70	11.70	6.04	31.70	0.00	7.74	46.00	38.2	100	108	
Vert.	916.780	QP	21.00	22.38	9.74	30.71	0.00	22.41	46.00	23.5	100	141	
Vert.	4880.000	PK	46.60	31.31	6.87	37.03	2.48	50.23	73.90	23.7	139	8	
Vert.	7320.000	PK	47.57	36.64	8.57	37.88	2.48	57.38	73.90	16.5	156	216	
Vert.	9760.000	PK	46.03	38.50	9.60	38.67	2.48	57.94	73.90	16.0	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	37.30	31.31	6.87	37.03	0.88	2.48	41.81	53.90	12.1	
Hori.	7320.000	AV	37.18	36.64	8.57	37.88	0.88	2.48	47.87	53.90	6.0	
Hori.	9760.000	AV	36.28	38.50	9.60	38.67	0.88	2.48	49.07	53.90	4.8	
Vert.	4880.000	AV	37.95	31.31	6.87	37.03	0.88	2.48	42.46	53.90	11.4	
Vert.	7320.000	AV	39.74	36.64	8.57	37.88	0.88	2.48	50.43	53.90	3.5	
Vert.	9760.000	AV	36.22	38.50	9.60	38.67	0.88	2.48	49.01	53.90	4.9	

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

Distance factor : 1 GHz - 13 GHz : 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.

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx BT LE 2Mbps 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.	32.210	QP	22.20	16.85	6.97	31.90	0.00	14.12	40.00	25.8	300	254	
Hori.	193.030	QP	21.30	16.26	8.98	31.77	0.00	14.77	43.50	28.7	200	311	
Hori.	522.406	QP	21.80	18.07	7.84	31.61	0.00	16.10	46.00	29.9	150	246	
Hori.	785.644	QP	21.00	20.72	9.12	31.33	0.00	19.51	46.00	26.4	100	295	
Hori.	2483.500	PK	50.47	27.48	14.37	36.79	2.48	58.01	73.90	15.9	190	212	
Hori.	4960.000	PK	48.09	31.48	6.94	37.07	2.48	51.92	73.90	22.0	207	200	
Hori.	7440.000	PK	45.33	36.81	8.75	37.95	2.48	55.42	73.90	18.5	195	199	
Hori.	9920.000	PK	45.32	38.82	9.72	38.87	2.48	57.47	73.90	16.4	150	0	
Vert.	34.929	QP	22.20	16.28	7.02	31.90	0.00	13.60	40.00	26.4	100	118	
Vert.	159.379	QP	22.80	15.27	8.64	31.79	0.00	14.92	43.50	28.5	100	24	
Vert.	544.841	QP	21.60	18.37	7.95	31.63	0.00	16.29	46.00	29.7	100	0	
Vert.	888.304	QP	21.00	22.14	9.60	30.90	0.00	21.84	46.00	24.1	100	187	
Vert.	2483.500	PK	46.51	27.48	14.37	36.79	2.48	54.05	73.90	19.9	244	289	
Vert.	4960.000	PK	46.72	31.48	6.94	37.07	2.48	50.55	73.90	23.4	102	21	
Vert.	7440.000	PK	46.07	36.81	8.75	37.95	2.48	56.16	73.90	17.7	124	204	
Vert.	9920.000	PK	45.66	38.82	9.72	38.87	2.48	57.81	73.90	16.1	150	0	

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

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

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	38.33	27.48	14.37	36.79	0.88	2.48	46.75	53.90	7.1	*1)
Hori.	4960.000	AV	40.29	31.48	6.94	37.07	0.88	2.48	45.00	53.90	8.9	
Hori.	7440.000	AV	35.71	36.81	8.75	37.95	0.88	2.48	46.68	53.90	7.2	
Hori.	9920.000	AV	36.16	38.82	9.72	38.87	0.88	2.48	49.19	53.90	4.7	
Vert.	2483.500	AV	35.78	27.48	14.37	36.79	0.88	2.48	44.20	53.90	9.7	*1)
Vert.	4960.000	AV	38.38	31.48	6.94	37.07	0.88	2.48	43.09	53.90	10.8	
Vert.	7440.000	AV	37.19	36.81	8.75	37.95	0.88	2.48	48.16	53.90	5.7	
Vert.	9920.000	AV	36.10	38.82	9.72	38.87	0.88	2.48	49.13	53.90	4.8	

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

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

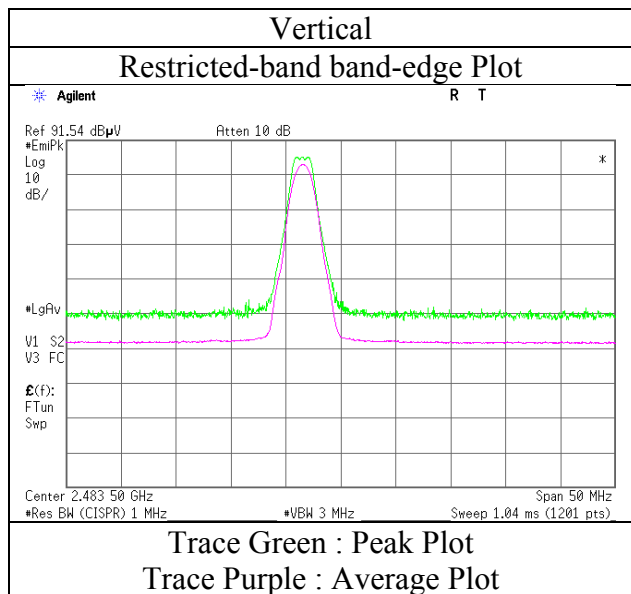
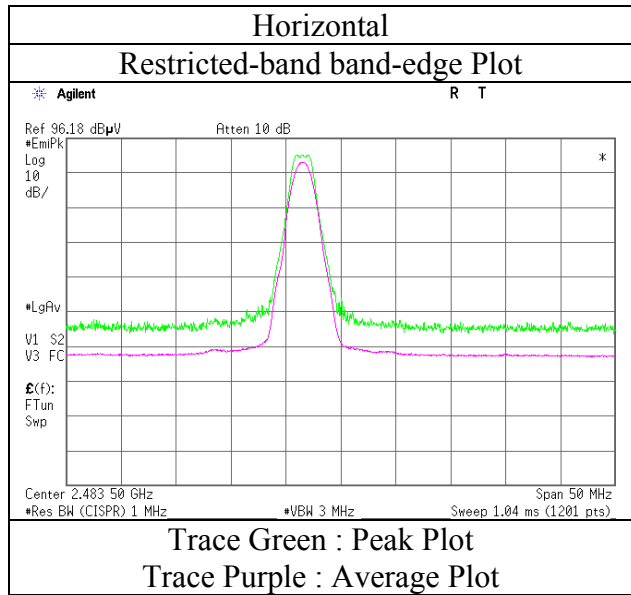
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

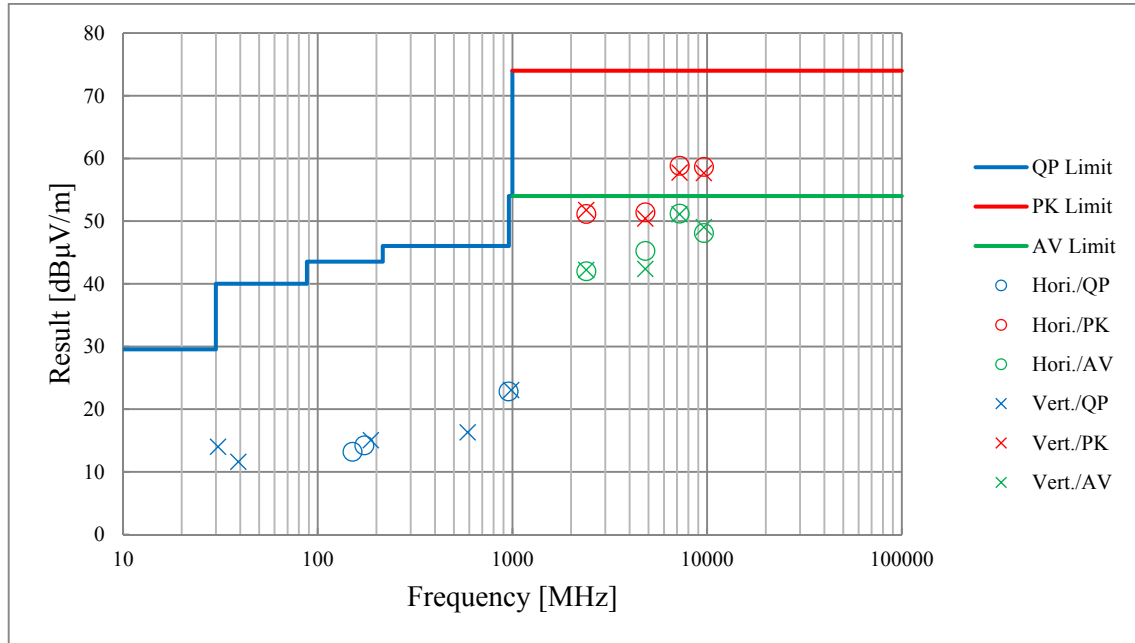
Report No. 11989460S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 2
Date October 16, 2017
Temperature / Humidity 20 deg. C / 64 % RH
Engineer Shiro Kobayashi
(1 GHz – 13 GHz)
Mode Tx BT LE 2Mbps 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi (13 GHz – 26.5 GHz)	Shiro Kobayashi (1 GHz – 13 GHz)	Kazutaka Takeyama (30 MHz – 1 GHz)
Mode	Tx BT LE 2Mbps 2480 MHz		



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

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Kazutaka Takeyama	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx ANT 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.	150.589	QP	21.60	14.86	8.56	31.80	0.00	13.22	43.50	30.2	150	262	
Hori.	173.167	QP	21.40	15.85	8.79	31.78	0.00	14.26	43.50	29.2	150	7	
Hori.	952.521	QP	20.90	22.51	9.90	30.45	0.00	22.86	46.00	23.1	100	253	
Hori.	2390.000	PK	44.10	27.16	14.27	36.83	2.48	51.18	73.90	22.7	218	215	
Hori.	4804.000	PK	48.00	31.14	6.79	36.99	2.48	51.42	73.90	22.4	150	145	
Hori.	7206.000	PK	49.30	36.48	8.41	37.81	2.48	58.86	73.90	15.0	100	53	
Hori.	9608.000	PK	47.00	38.20	9.48	38.48	2.48	58.68	73.90	15.2	100	0	
Vert.	30.682	QP	21.80	17.18	6.94	31.90	0.00	14.02	40.00	25.9	100	358	
Vert.	39.066	QP	21.70	14.74	7.09	31.90	0.00	11.63	40.00	28.3	100	331	
Vert.	187.278	QP	21.70	16.21	8.93	31.77	0.00	15.07	43.50	28.4	100	171	
Vert.	588.000	QP	20.80	18.94	8.17	31.59	0.00	16.32	46.00	29.6	100	196	
Vert.	984.858	QP	20.60	22.64	10.04	30.23	0.00	23.05	53.90	30.8	100	138	
Vert.	2390.000	PK	44.70	27.16	14.27	36.83	2.48	51.78	73.90	22.1	195	211	
Vert.	4804.000	PK	47.00	31.14	6.79	36.99	2.48	50.42	73.90	23.4	100	347	
Vert.	7206.000	PK	48.20	36.48	8.41	37.81	2.48	57.76	73.90	16.1	151	150	
Vert.	9608.000	PK	46.00	38.20	9.48	38.48	2.48	57.68	73.90	16.2	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(3.99 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	34.50	27.16	14.27	36.83	0.46	2.48	42.04	53.90	11.9	*1)
Hori.	4804.000	AV	41.40	31.14	6.79	36.99	0.46	2.48	45.28	53.90	8.6	
Hori.	7206.000	AV	41.20	36.48	8.41	37.81	0.46	2.48	51.22	53.90	2.7	
Hori.	9608.000	AV	36.00	38.20	9.48	38.48	0.46	2.48	48.14	53.90	5.8	
Vert.	2390.000	AV	34.70	27.16	14.27	36.83	0.46	2.48	42.24	53.90	11.7	*1)
Vert.	4804.000	AV	38.50	31.14	6.79	36.99	0.46	2.48	42.38	53.90	11.5	
Vert.	7206.000	AV	41.10	36.48	8.41	37.81	0.46	2.48	51.12	53.90	2.8	
Vert.	9608.000	AV	36.90	38.20	9.48	38.48	0.46	2.48	49.04	53.90	4.9	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 13 GHz : 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	88.60	27.20	14.28	36.83	2.48	95.73	-	-	
Hori.	2400.000	PK	34.00	27.20	14.27	36.83	2.48	41.12	75.73	34.6	
Vert.	2402.000	PK	85.60	27.20	14.28	36.83	2.48	92.73	-	-	
Vert.	2400.000	PK	33.50	27.20	14.27	36.83	2.48	40.62	72.73	32.1	

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

UL Japan, Inc.

Shonan EMC Lab.

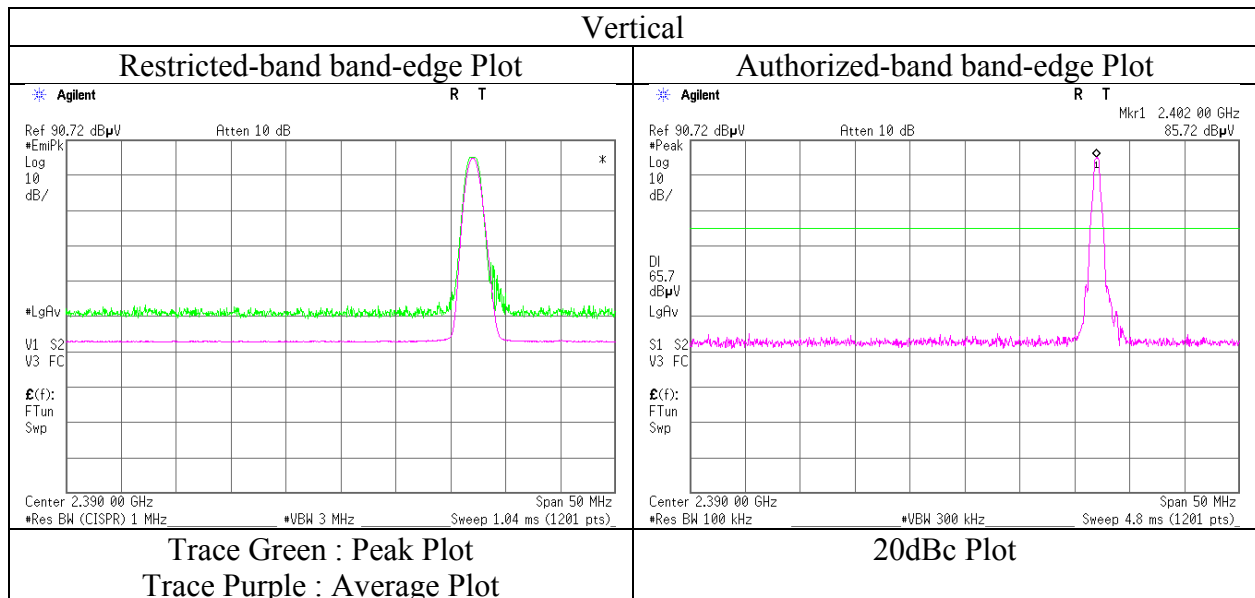
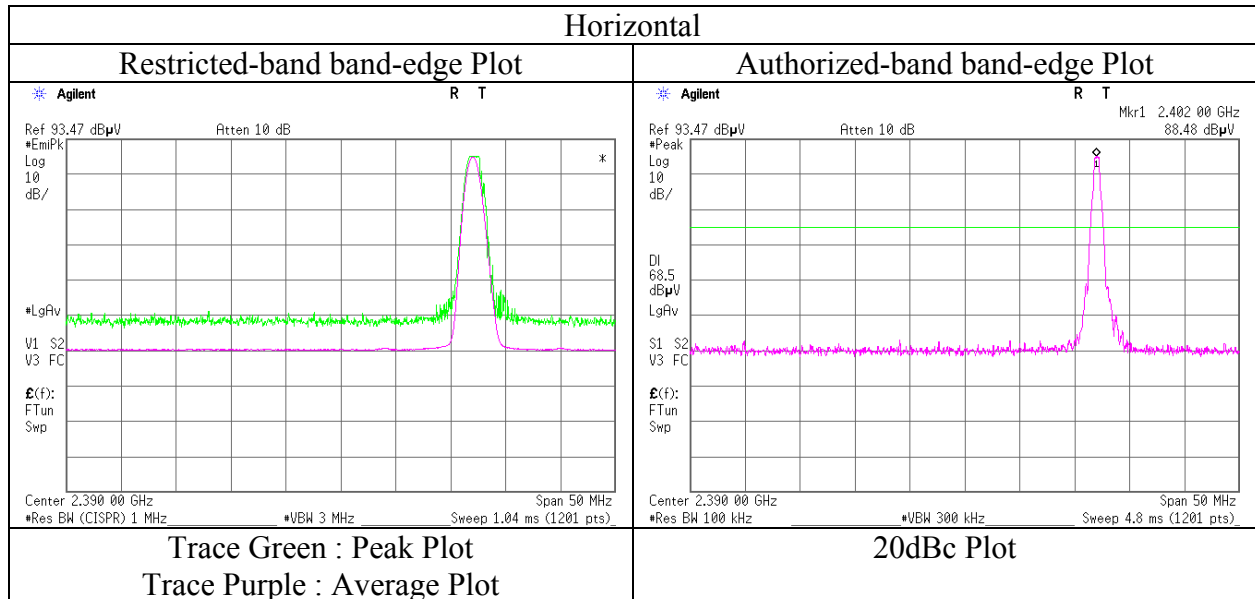
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 11989460S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 2
Date October 16, 2017
Temperature / Humidity 20 deg. C / 64 % RH
Engineer Kazutaka Takeyama
(1 GHz – 13 GHz)
Mode Tx ANT 2402 MHz



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

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Kazutaka Takeyama	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx ANT 2441 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.	34.932	QP	22.10	16.27	7.02	31.90	0.00	13.49	40.00	26.5	300	357	
Hori.	344.747	QP	21.60	14.48	6.77	31.62	0.00	11.23	46.00	34.7	100	282	
Hori.	420.611	QP	21.50	16.22	7.28	31.62	0.00	13.38	46.00	32.6	100	4	
Hori.	464.053	QP	21.30	17.07	7.55	31.60	0.00	14.32	46.00	31.6	100	4	
Hori.	948.545	QP	21.00	22.50	9.88	30.48	0.00	22.90	46.00	23.1	150	143	
Hori.	4882.000	PK	47.40	31.31	6.87	37.03	2.48	51.03	73.90	22.8	150	214	
Hori.	7323.000	PK	48.00	36.65	8.57	37.88	2.48	57.82	73.90	16.0	100	60	
Hori.	9764.000	PK	45.90	38.51	9.60	38.67	2.48	57.82	73.90	16.0	100	0	
Vert.	34.643	QP	22.00	16.34	7.01	31.90	0.00	13.45	40.00	26.5	100	139	
Vert.	183.510	QP	21.40	16.17	8.89	31.78	0.00	14.68	43.50	28.8	100	102	
Vert.	956.477	QP	20.80	22.53	9.92	30.42	0.00	22.83	46.00	23.1	100	77	
Vert.	4882.000	PK	45.90	31.31	6.87	37.03	2.48	49.53	73.90	24.3	104	347	
Vert.	7323.000	PK	47.60	36.65	8.57	37.88	2.48	57.42	73.90	16.4	150	164	
Vert.	9764.000	PK	46.00	38.51	9.60	38.67	2.48	57.92	73.90	15.9	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(3.99 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.	4882.000	AV	39.50	31.31	6.87	37.03	0.46	2.48	43.59	53.90	10.3	
Hori.	7323.000	AV	40.70	36.65	8.57	37.88	0.46	2.48	50.98	53.90	2.9	
Hori.	9764.000	AV	37.10	38.51	9.60	38.67	0.46	2.48	49.48	53.90	4.4	
Vert.	4882.000	AV	39.20	31.31	6.87	37.03	0.46	2.48	43.29	53.90	10.6	
Vert.	7323.000	AV	40.40	36.65	8.57	37.88	0.46	2.48	50.68	53.90	3.2	
Vert.	9764.000	AV	36.70	38.51	9.60	38.67	0.46	2.48	49.08	53.90	4.8	

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

Distance factor : 1 GHz - 13 GHz : 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.

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Kazutaka Takeyama	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Tx ANT 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.	167.867	QP	21.60	15.63	8.74	31.79	0.00	14.18	43.50	29.3	200	110	
Hori.	332.644	QP	21.20	14.18	6.69	31.63	0.00	10.44	46.00	35.5	150	122	
Hori.	642.425	QP	20.80	19.43	8.44	31.60	0.00	17.07	46.00	28.9	100	329	
Hori.	948.773	QP	20.80	22.50	9.88	30.47	0.00	22.71	46.00	23.2	100	138	
Hori.	2483.500	PK	50.90	27.48	14.37	36.79	2.48	58.44	73.90	15.4	150	218	
Hori.	4960.000	PK	48.60	31.48	6.94	37.07	2.48	52.43	73.90	21.4	152	215	
Hori.	7440.000	PK	46.70	36.81	8.75	37.95	2.48	56.79	73.90	17.1	150	355	
Hori.	9920.000	PK	46.00	38.82	9.72	38.87	2.48	58.15	73.90	15.7	100	0	
Vert.	51.590	QP	22.20	10.27	7.31	31.89	0.00	7.89	40.00	32.1	100	110	
Vert.	160.223	QP	21.40	15.31	8.65	31.79	0.00	13.57	43.50	29.9	100	0	
Vert.	179.604	QP	21.20	16.12	8.85	31.78	0.00	14.39	43.50	29.1	100	313	
Vert.	825.577	QP	21.10	21.23	9.30	31.19	0.00	20.44	46.00	25.5	100	359	
Vert.	2483.500	PK	49.50	27.48	14.37	36.79	2.48	57.04	73.90	16.8	190	251	
Vert.	4960.000	PK	48.20	31.48	6.94	37.07	2.48	52.03	73.90	21.8	105	347	
Vert.	7440.000	PK	47.60	36.81	8.75	37.95	2.48	57.69	73.90	16.2	148	146	
Vert.	9920.000	PK	45.50	38.82	9.72	38.87	2.48	57.65	73.90	16.2	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(3.99 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.	2483.500	AV	35.80	27.48	14.37	36.79	0.46	2.48	43.80	53.90	10.1	*1)
Hori.	4960.000	AV	42.60	31.48	6.94	37.07	0.46	2.48	46.89	53.90	7.0	
Hori.	7440.000	AV	36.60	36.81	8.75	37.95	0.46	2.48	47.15	53.90	6.8	
Hori.	9920.000	AV	36.00	38.82	9.72	38.87	0.46	2.48	48.61	53.90	5.3	
Vert.	2483.500	AV	35.20	27.48	14.37	36.79	0.46	2.48	43.20	53.90	10.7	*1)
Vert.	4960.000	AV	41.20	31.48	6.94	37.07	0.46	2.48	45.49	53.90	8.4	
Vert.	7440.000	AV	38.40	36.81	8.75	37.95	0.46	2.48	48.95	53.90	4.9	
Vert.	9920.000	AV	36.00	38.82	9.72	38.87	0.46	2.48	48.61	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

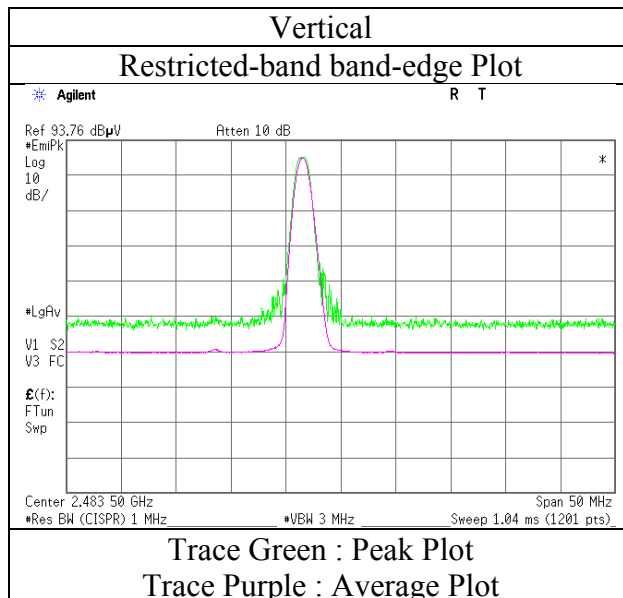
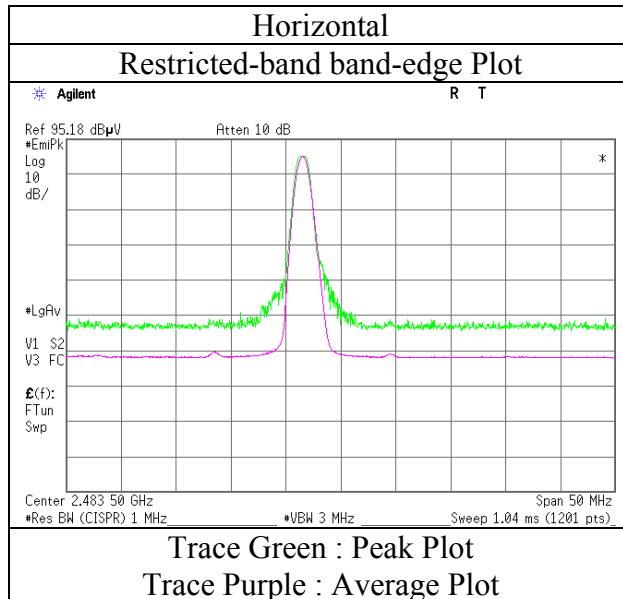
13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

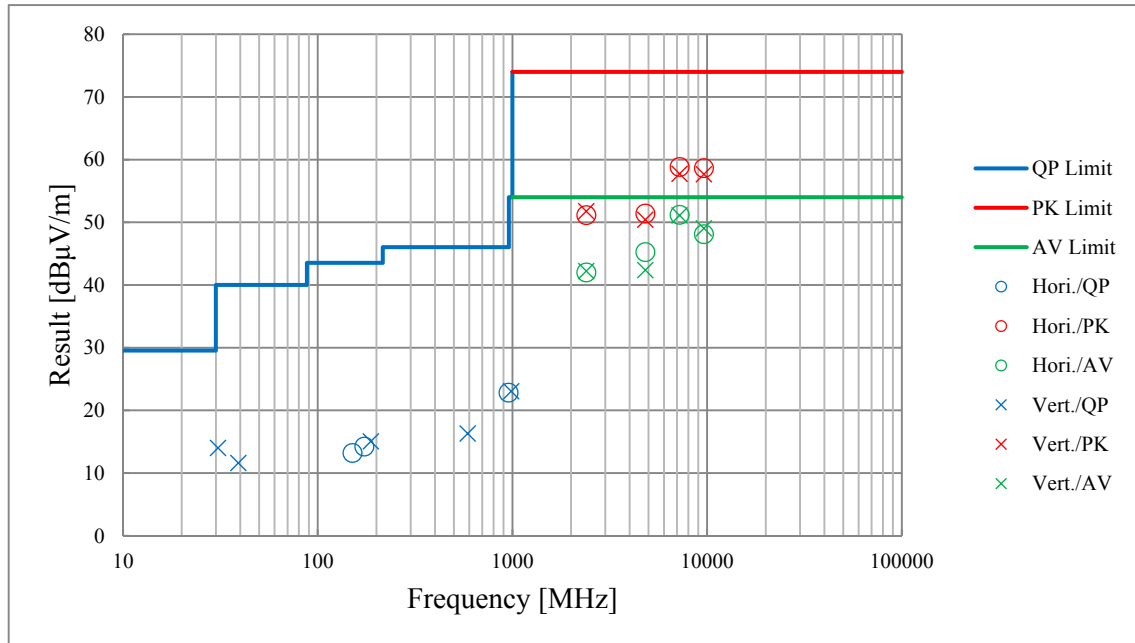
Report No. 11989460S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 2
Date October 16, 2017
Temperature / Humidity 20 deg. C / 64 % RH
Engineer Kazutaka Takeyama
(1 GHz – 13 GHz)
Mode Tx ANT 2480MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi (13 GHz – 26.5 GHz)	Kazutaka Takeyama (1 GHz – 13 GHz)	Kazutaka Takeyama (30 MHz – 1 GHz)
Mode	Tx ANT 2402 MHz		



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

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Kazutaka Takeyama	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Nordic Original 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.	191.007	QP	21.60	16.24	8.96	31.77	0.00	15.03	43.50	28.4	150	230	
Hori.	715.174	QP	20.80	20.03	8.79	31.49	0.00	18.13	46.00	27.8	150	126	
Hori.	899.227	QP	20.90	22.30	9.66	30.85	0.00	22.01	46.00	23.9	100	351	
Hori.	997.839	QP	20.40	22.69	10.10	30.15	0.00	23.04	53.90	30.8	100	201	
Hori.	2390.000	PK	44.00	27.16	14.27	36.83	2.48	51.08	73.90	22.8	212	214	
Hori.	4804.000	PK	48.10	31.14	6.79	36.99	2.48	51.52	73.90	22.3	219	202	
Hori.	7206.000	PK	49.00	36.48	8.41	37.81	2.48	58.56	73.90	15.3	146	50	
Hori.	9608.000	PK	45.90	38.20	9.48	38.48	2.48	57.58	73.90	16.3	100	0	
Vert.	34.930	QP	22.20	16.27	7.02	31.90	0.00	13.59	40.00	26.4	100	294	
Vert.	101.400	QP	21.80	10.32	8.00	31.85	0.00	8.27	43.50	35.2	100	357	
Vert.	678.412	QP	20.80	19.71	8.62	31.55	0.00	17.58	46.00	28.4	100	245	
Vert.	944.836	QP	21.10	22.48	9.87	30.50	0.00	22.95	46.00	23.0	100	254	
Vert.	2390.000	PK	46.60	27.16	14.27	36.83	2.48	53.68	73.90	20.2	222	225	
Vert.	4804.000	PK	46.30	31.14	6.79	36.99	2.48	49.72	73.90	24.1	117	10	
Vert.	7206.000	PK	49.50	36.48	8.41	37.81	2.48	59.06	73.90	14.8	120	30	
Vert.	9608.000	PK	46.20	38.20	9.48	38.48	2.48	57.88	73.90	16.0	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(3.99 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	35.40	27.16	14.27	36.83	0.90	2.48	43.38	53.90	10.5	*1)
Hori.	4804.000	AV	40.60	31.14	6.79	36.99	0.90	2.48	44.92	53.90	9.0	
Hori.	7206.000	AV	39.50	36.48	8.41	37.81	0.90	2.48	49.96	53.90	3.9	
Hori.	9608.000	AV	36.20	38.20	9.48	38.48	0.90	2.48	48.78	53.90	5.1	
Vert.	2390.000	AV	36.00	27.16	14.27	36.83	0.90	2.48	43.98	53.90	9.9	*1)
Vert.	4804.000	AV	38.60	31.14	6.79	36.99	0.90	2.48	42.92	53.90	11.0	
Vert.	7206.000	AV	41.00	36.48	8.41	37.81	0.90	2.48	51.46	53.90	2.4	
Vert.	9608.000	AV	36.30	38.20	9.48	38.48	0.90	2.48	48.88	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 : 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	88.10	27.20	14.28	36.83	2.48	95.23	-	-	
Hori.	2400.000	PK	50.50	27.20	14.27	36.83	2.48	57.62	75.23	17.6	
Vert.	2402.000	PK	82.00	27.20	14.28	36.83	2.48	89.13	-	-	
Vert.	2400.000	PK	44.00	27.20	14.27	36.83	2.48	51.12	69.13	18.0	

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

UL Japan, Inc.

Shonan EMC Lab.

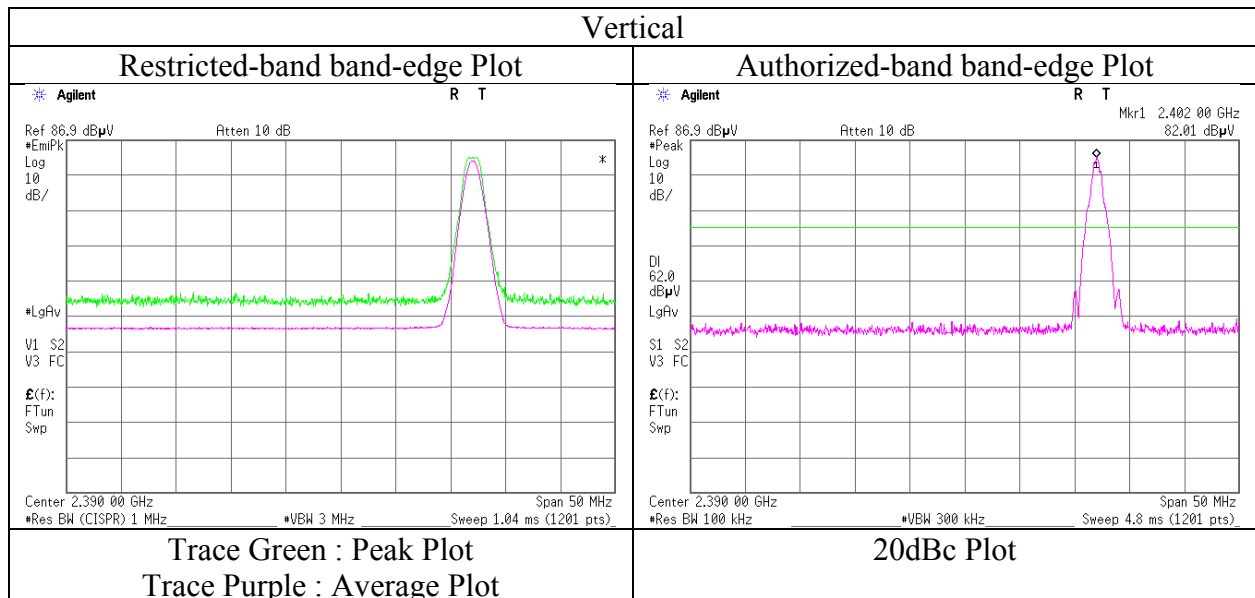
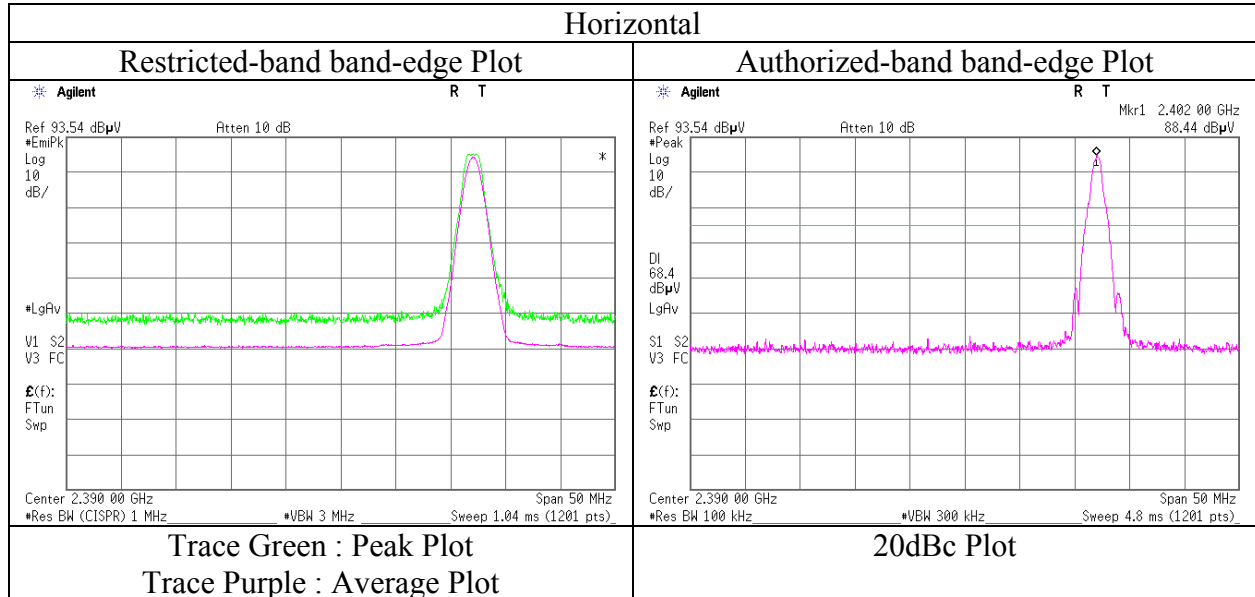
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 11989460S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No. 2
Date October 16, 2017
Temperature / Humidity 20 deg. C / 64 % RH
Engineer Kazutaka Takeyama
(1 GHz – 13 GHz)
Mode Nordic Original 2402 MHz



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

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Kazutaka Takeyama	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Nordic Original 2441 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.	33.739	QP	21.70	16.53	7.00	31.90	0.00	13.33	40.00	26.6	150	316	
Hori.	170.605	QP	21.50	15.75	8.76	31.79	0.00	14.22	43.50	29.2	150	356	
Hori.	524.057	QP	21.70	18.09	7.85	31.61	0.00	16.03	46.00	29.9	150	114	
Hori.	878.434	QP	21.10	22.00	9.56	30.95	0.00	21.71	46.00	24.2	100	66	
Hori.	997.571	QP	20.50	22.69	10.10	30.15	0.00	23.14	53.90	30.7	150	96	
Hori.	4882.000	PK	45.00	31.31	6.87	37.03	2.48	48.63	73.90	25.2	112	211	
Hori.	7323.000	PK	46.70	36.65	8.57	37.88	2.48	56.52	73.90	17.3	145	68	
Hori.	9764.000	PK	46.40	38.51	9.60	38.67	2.48	58.32	73.90	15.5	100	0	
Vert.	116.669	QP	22.20	12.48	8.17	31.83	0.00	11.02	43.50	32.4	100	76	
Vert.	126.395	QP	21.80	13.40	8.28	31.82	0.00	11.66	43.50	31.8	100	161	
Vert.	543.199	QP	21.60	18.34	7.94	31.63	0.00	16.25	46.00	29.7	100	222	
Vert.	830.401	QP	21.00	21.30	9.32	31.17	0.00	20.45	46.00	25.5	100	215	
Vert.	4882.000	PK	45.50	31.31	6.87	37.03	2.48	49.13	73.90	24.7	135	352	
Vert.	7323.000	PK	48.20	36.65	8.57	37.88	2.48	58.02	73.90	15.8	216	140	
Vert.	9764.000	PK	46.00	38.51	9.60	38.67	2.48	57.92	73.90	15.9	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 (3.99 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.	4882.000	AV	36.60	31.31	6.87	37.03	0.90	2.48	41.13	53.90	12.8	
Hori.	7323.000	AV	37.30	36.65	8.57	37.88	0.90	2.48	48.02	53.90	5.9	
Hori.	9764.000	AV	35.80	38.51	9.60	38.67	0.90	2.48	48.62	53.90	5.3	
Vert.	4882.000	AV	37.10	31.31	6.87	37.03	0.90	2.48	41.63	53.90	12.3	
Vert.	7323.000	AV	39.50	36.65	8.57	37.88	0.90	2.48	50.22	53.90	3.7	
Vert.	9764.000	AV	35.80	38.51	9.60	38.67	0.90	2.48	48.62	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.

Radiated Spurious Emission

Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi	Kazutaka Takeyama	Kazutaka Takeyama
	(13 GHz – 26.5 GHz)	(1 GHz – 13 GHz)	(30 MHz – 1 GHz)
Mode	Nordic Original 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.	32.549	QP	22.00	16.78	6.98	31.90	0.00	13.86	40.00	26.1	200	211	
Hori.	168.051	QP	21.40	15.64	8.74	31.79	0.00	13.99	43.50	29.5	200	7	
Hori.	591.225	QP	20.70	18.98	8.19	31.58	0.00	16.29	46.00	29.7	100	353	
Hori.	799.203	QP	21.00	20.85	9.18	31.28	0.00	19.75	46.00	26.2	150	329	
Hori.	2483.500	PK	52.00	27.48	14.37	36.79	2.48	59.54	73.90	14.3	188	223	
Hori.	4960.000	PK	48.60	31.48	6.94	37.07	2.48	52.43	73.90	21.4	202	213	
Hori.	7440.000	PK	45.10	36.81	8.75	37.95	2.48	55.19	73.90	18.7	150	52	
Hori.	9920.000	PK	45.40	38.82	9.72	38.87	2.48	57.55	73.90	16.3	100	0	
Vert.	32.042	QP	22.22	16.89	6.97	31.90	0.00	14.18	40.00	25.8	100	320	
Vert.	161.235	QP	21.90	15.35	8.66	31.79	0.00	14.12	43.50	29.3	100	308	
Vert.	883.824	QP	21.10	22.08	9.58	30.93	0.00	21.83	46.00	24.1	100	343	
Vert.	982.369	QP	20.70	22.63	10.03	30.25	0.00	23.11	53.90	30.7	100	33	
Vert.	2483.500	PK	51.40	27.48	14.37	36.79	2.48	58.94	73.90	14.9	184	248	
Vert.	4960.000	PK	46.40	31.48	6.94	37.07	2.48	50.23	73.90	23.6	123	345	
Vert.	7440.000	PK	45.30	36.81	8.75	37.95	2.48	55.39	73.90	18.5	150	190	
Vert.	9920.000	PK	45.40	38.82	9.72	38.87	2.48	57.55	73.90	16.3	100	0	

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

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

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	37.56	27.48	14.37	36.79	0.90	2.48	46.00	53.90	7.9	*1)
Hori.	4960.000	AV	41.70	31.48	6.94	37.07	0.90	2.48	46.43	53.90	7.5	
Hori.	7440.000	AV	35.50	36.81	8.75	37.95	0.90	2.48	46.49	53.90	7.4	
Hori.	9920.000	AV	36.20	38.82	9.72	38.87	0.90	2.48	49.25	53.90	4.7	
Vert.	2483.500	AV	35.70	27.48	14.37	36.79	0.90	2.48	44.14	53.90	9.8	*1)
Vert.	4960.000	AV	40.10	31.48	6.94	37.07	0.90	2.48	44.83	53.90	9.1	
Vert.	7440.000	AV	37.10	36.81	8.75	37.95	0.90	2.48	48.09	53.90	5.8	
Vert.	9920.000	AV	35.70	38.82	9.72	38.87	0.90	2.48	48.75	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 : $20\log(3.99\text{ m} / 3.0\text{ m}) = 2.48\text{ dB}$

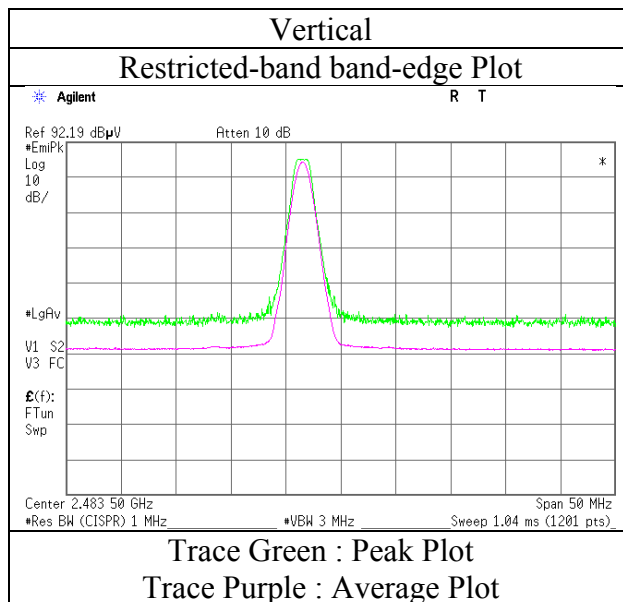
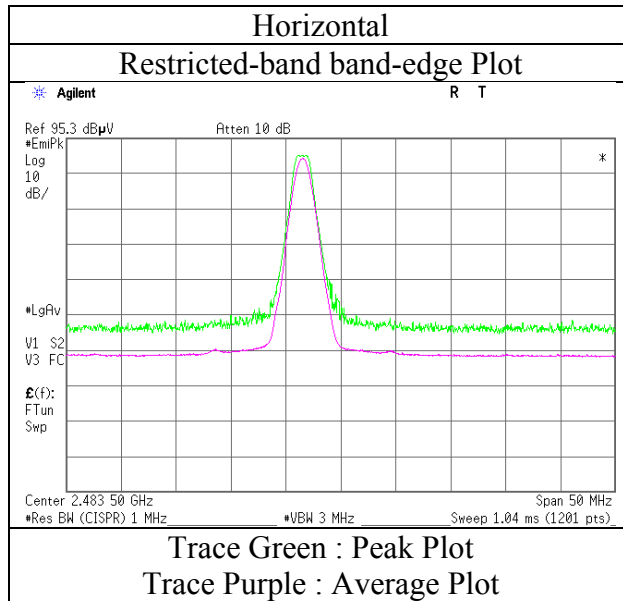
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

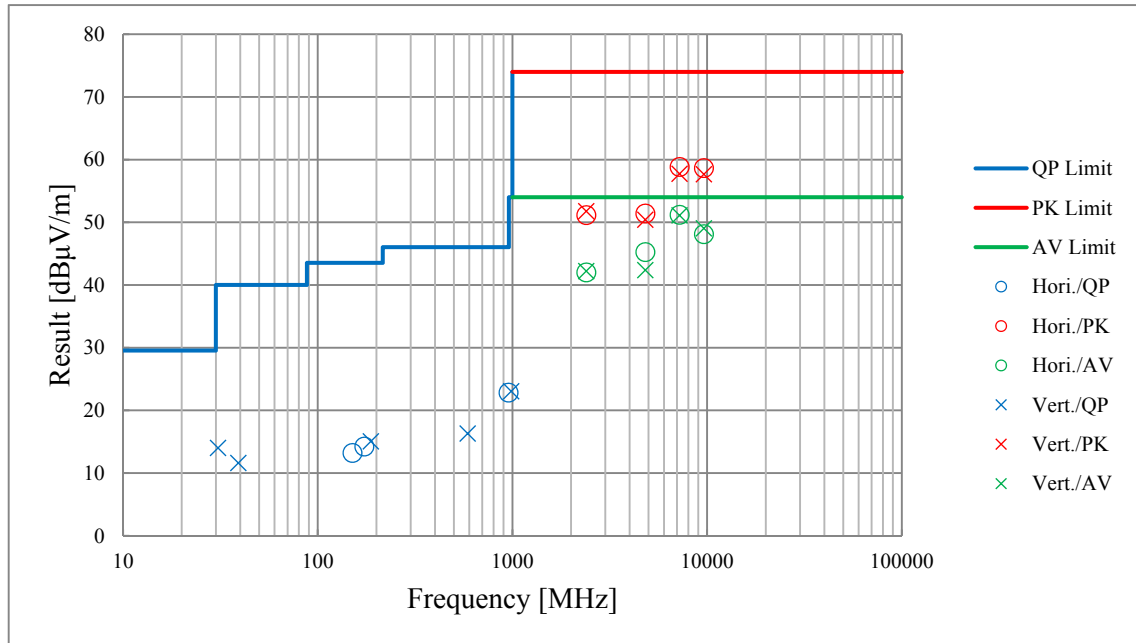
Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi (13 GHz – 26.5 GHz)	Kazutaka Takeyama (1 GHz – 13 GHz)	Kazutaka Takeyama (30 MHz – 1 GHz)
Mode	Nordic Original 2480 MHz		



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

Radiated Spurious Emission
(Plot data, Worst case)

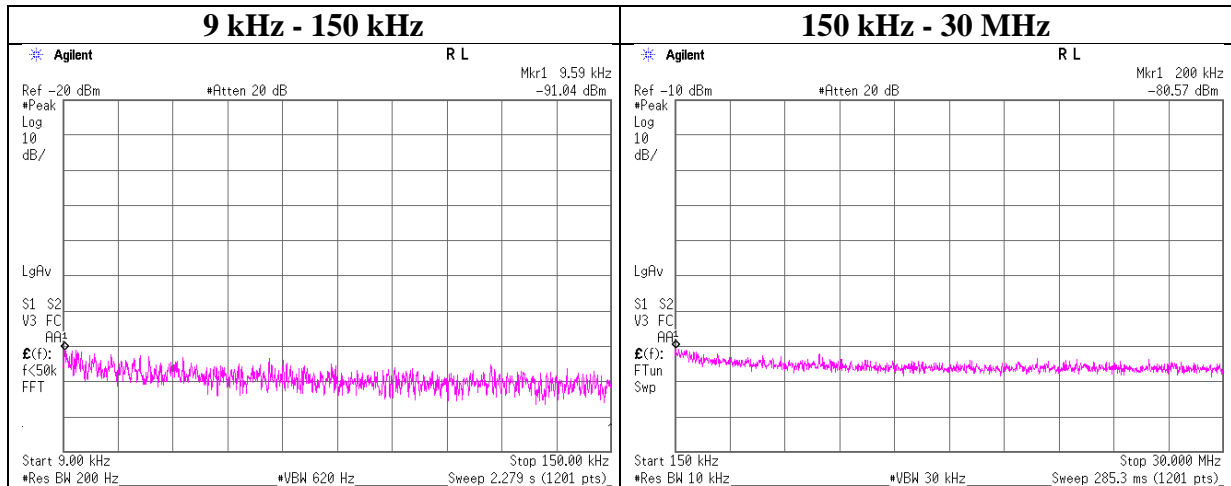
Report No.	11989460S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 2
Date	October 17, 2017	October 16, 2017	October 17, 2017
Temperature / Humidity	20 deg. C / 62 % RH	20 deg. C / 64 % RH	20 deg. C / 62 % RH
Engineer	Shiro Kobayashi (13 GHz – 26.5 GHz)	Kazutaka Takeyama (1 GHz – 13 GHz)	Kazutaka Takeyama (30 MHz – 1 GHz)
Mode	Nordic Original 2441 MHz		



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

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx BT LE (1Mbps) 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
9.59	-91.0	0.01	9.74	2.0	1	-79.3	300	6.0	-18.0	47.9	65.9	
200.00	-80.6	0.01	9.74	2.0	1	-68.8	300	6.0	-7.6	21.5	29.1	

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

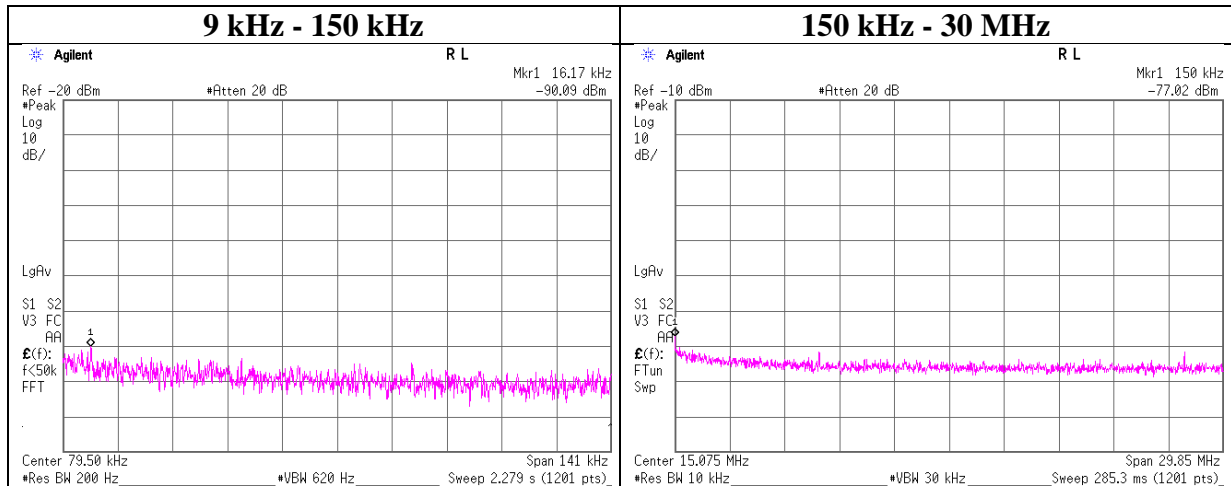
$\text{EIRP[dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

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

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	25 deg. C / 47 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE (1Mbps) 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
16.17	-90.1	0.01	9.74	2.0	1	-78.3	300	6.0	-17.1	43.4	60.5	
150.00	-77.0	0.01	9.74	2.0	1	-65.3	300	6.0	-4.0	24.0	28.0	

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

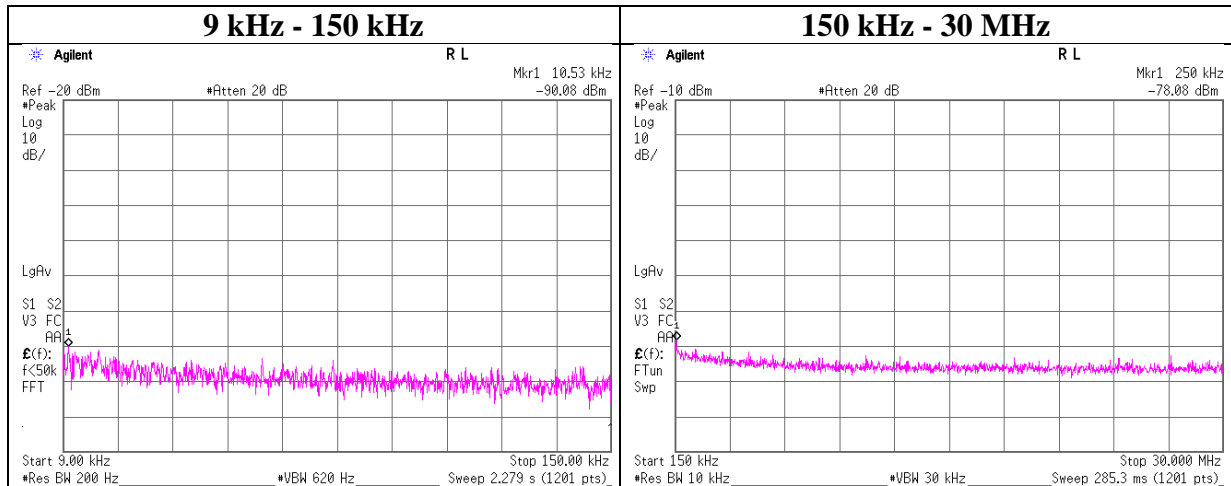
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

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

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	25 deg. C / 47 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE (1Mbps) 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
10.53	-90.1	0.01	9.74	2.0	1	-78.3	300	6.0	-17.1	47.1	64.2	
250.00	-78.1	0.02	9.74	2.0	1	-66.3	300	6.0	-5.1	19.6	24.7	

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

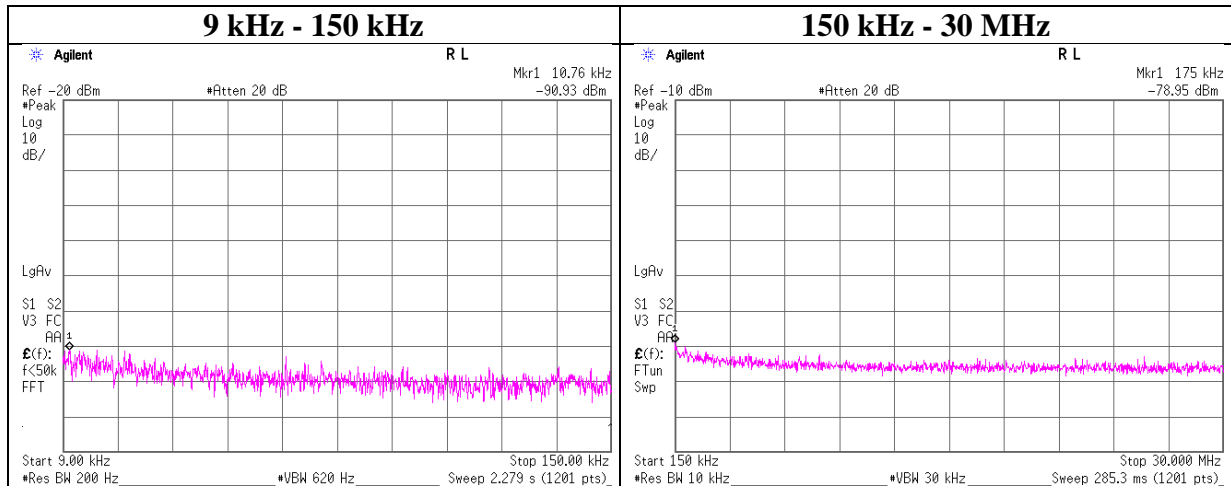
$$\text{EIRP[dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$$

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

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx BT LE (2Mbps) 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
10.76	-90.9	0.01	9.74	2.0	1	-79.2	300	6.0	-17.9	46.9	64.8	
175.00	-79.0	0.01	9.74	2.0	1	-67.2	300	6.0	-5.9	22.7	28.6	

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

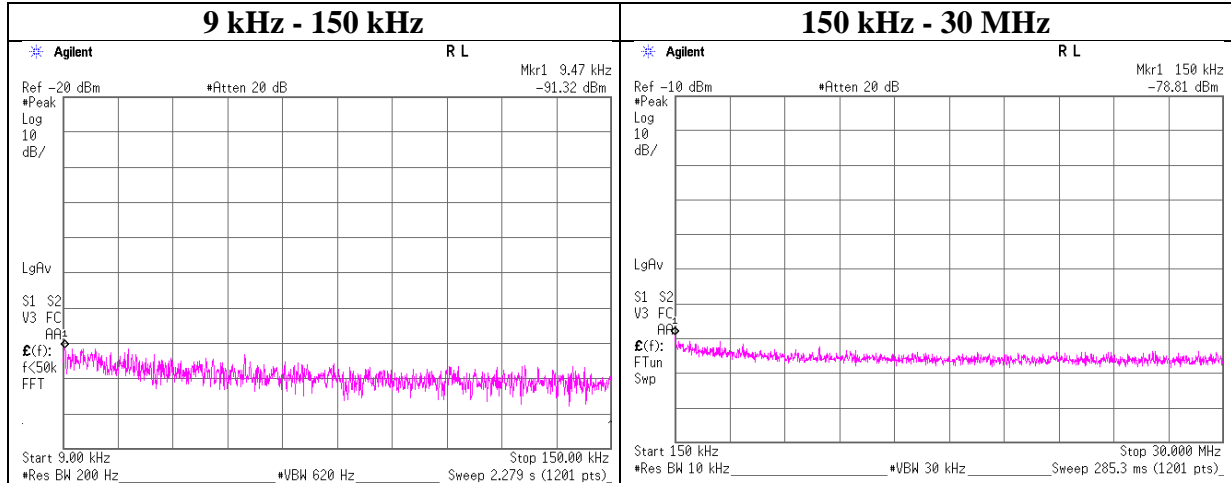
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

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.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx BT LE (2Mbps) 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
9.47	-91.3	0.01	9.74	2.0	1	-79.6	300	6.0	-18.3	48.0	66.3	
150.00	-78.8	0.01	9.74	2.0	1	-67.1	300	6.0	-5.8	24.0	29.8	

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

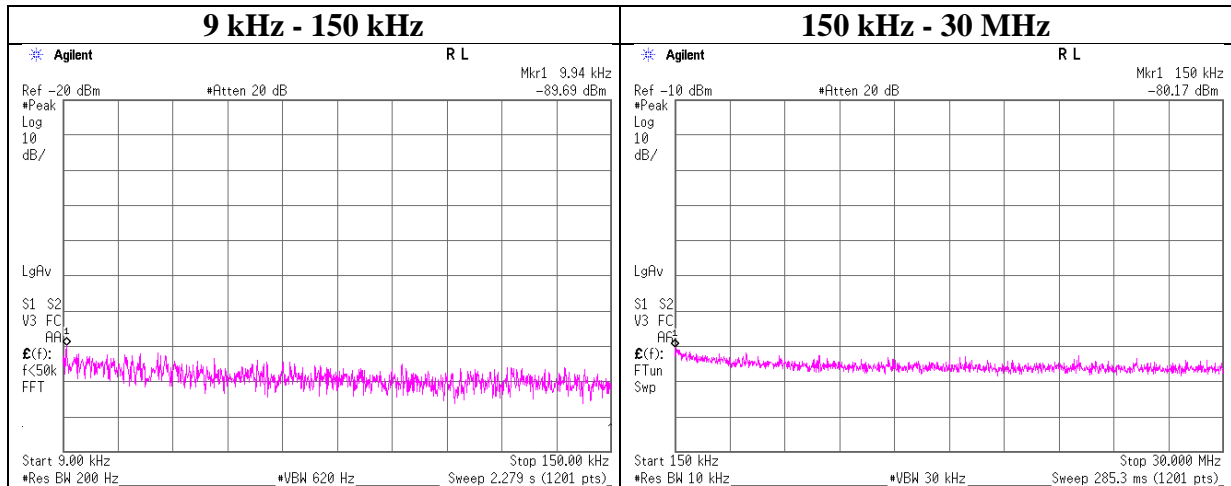
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

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

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx BT LE (2Mbps) 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
9.94	-89.7	0.01	9.74	2.0	1	-77.9	300	6.0	-16.7	47.6	64.3	
150.00	-80.2	0.01	9.74	2.0	1	-68.4	300	6.0	-7.2	24.0	31.2	

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

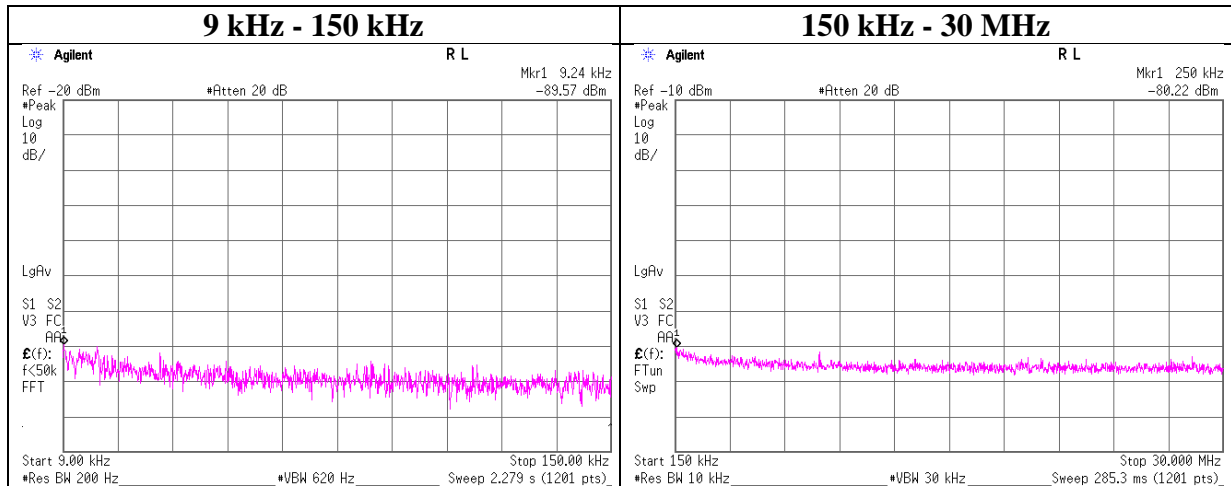
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

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

Test place : Shonan EMC Lab. No.5 Shielded Room
 Report No. : 11989460S-A-R1
 Date : October 18, 2017
 Temperature / Humidity : 25 deg. C / 47 % RH
 Engineer : Yosuke Ishikawa
 Mode : Tx ANT (1Mbps) 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
9.24	-89.6	0.01	9.74	2.0	1	-77.8	300	6.0	-16.6	48.2	64.8	
250.00	-80.2	0.02	9.74	2.0	1	-68.5	300	6.0	-7.2	19.6	26.8	

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

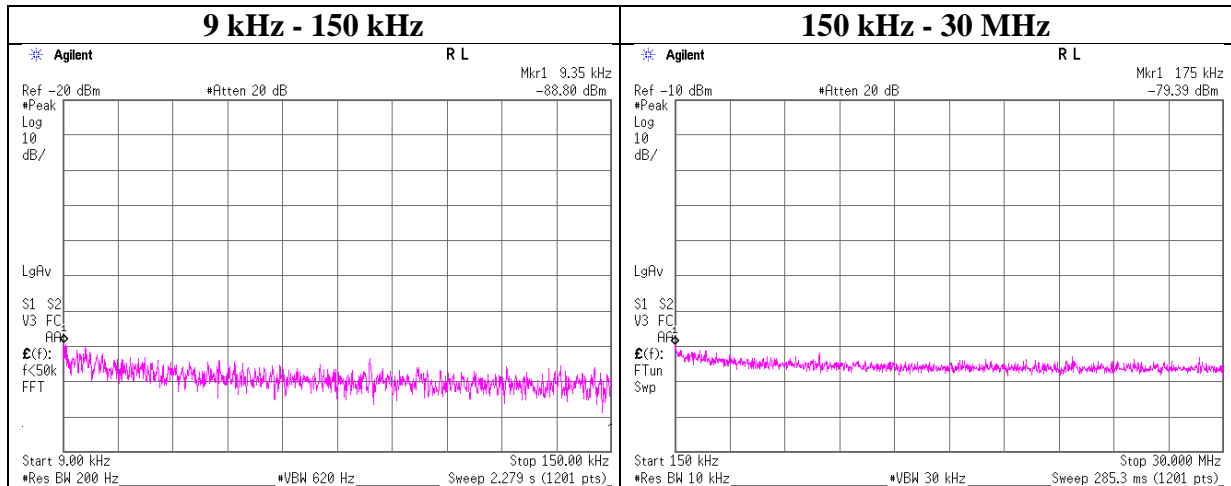
$$\text{EIRP[dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$$

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

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx ANT (1Mbps) 2441 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
9.35	-88.8	0.01	9.74	2.0	1	-77.1	300	6.0	-15.8	48.1	63.9	
175.00	-79.4	0.01	9.74	2.0	1	-67.6	300	6.0	-6.4	22.7	29.1	

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

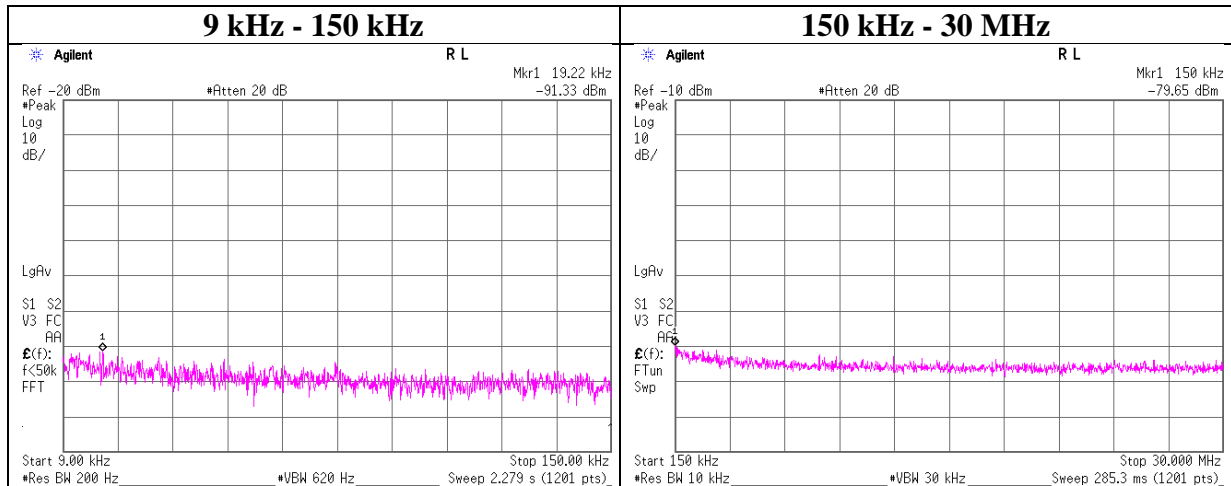
$$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$$

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

Test place : Shonan EMC Lab. No.5 Shielded Room
 Report No. : 11989460S-A-R1
 Date : October 18, 2017
 Temperature / Humidity : 25 deg. C / 47 % RH
 Engineer : Yosuke Ishikawa
 Mode : Tx ANT (1Mbps) 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
19.22	-91.3	0.01	9.74	2.0	1	-79.6	300	6.0	-18.3	41.9	60.2	
150.00	-79.7	0.01	9.74	2.0	1	-67.9	300	6.0	-6.6	24.0	30.6	

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

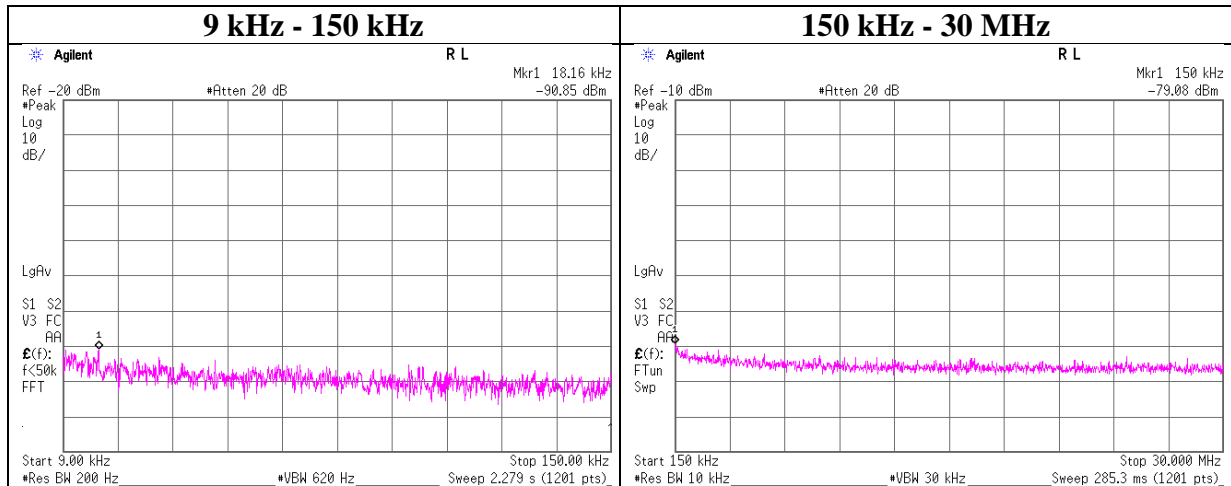
$\text{EIRP[dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

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.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11989460S-A-R1
Date : October 18, 2017
Temperature / Humidity : 25 deg. C / 47 % RH
Engineer : Yosuke Ishikawa
Mode : Tx Nordic (2Mbps) 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
18.16	-90.9	0.01	9.74	2.0	1	-79.1	300	6.0	-17.8	42.4	60.2	
150.00	-79.1	0.01	9.74	2.0	1	-67.3	300	6.0	-6.1	24.0	30.1	

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

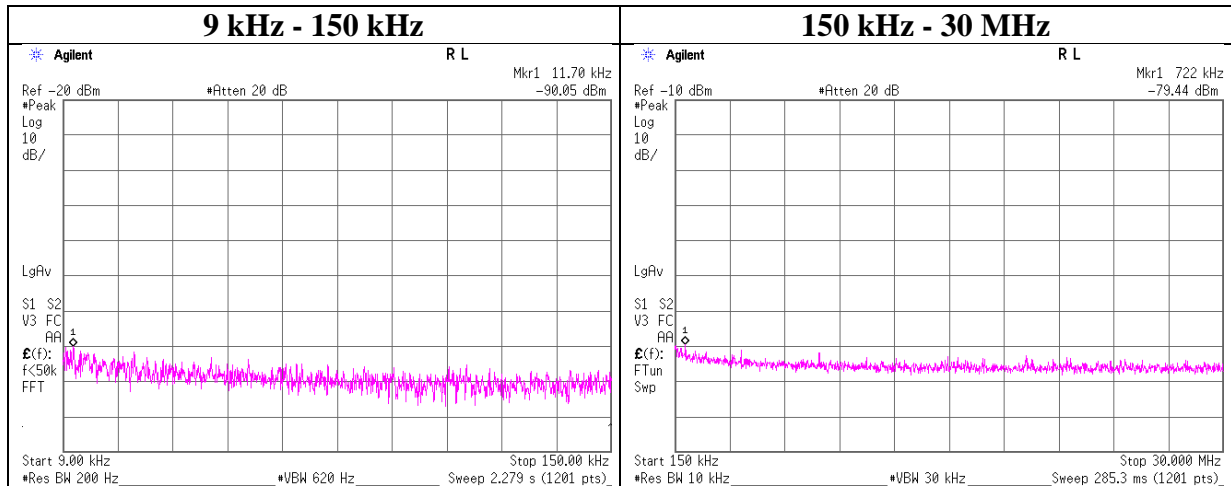
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

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

Test place : Shonan EMC Lab. No.5 Shielded Room
 Report No. : 11989460S-A-R1
 Date : October 18, 2017
 Temperature / Humidity : 25 deg. C / 47 % RH
 Engineer : Yosuke Ishikawa
 Mode : Tx Nordic (2Mbps) 2441 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	-90.1	0.01	9.7	2.0	1	-78.3	300	6.0	-17.0	46.2	63.2	
722.00	-79.4	0.02	9.7	2.0	1	-67.7	30	6.0	13.6	30.4	16.8	

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

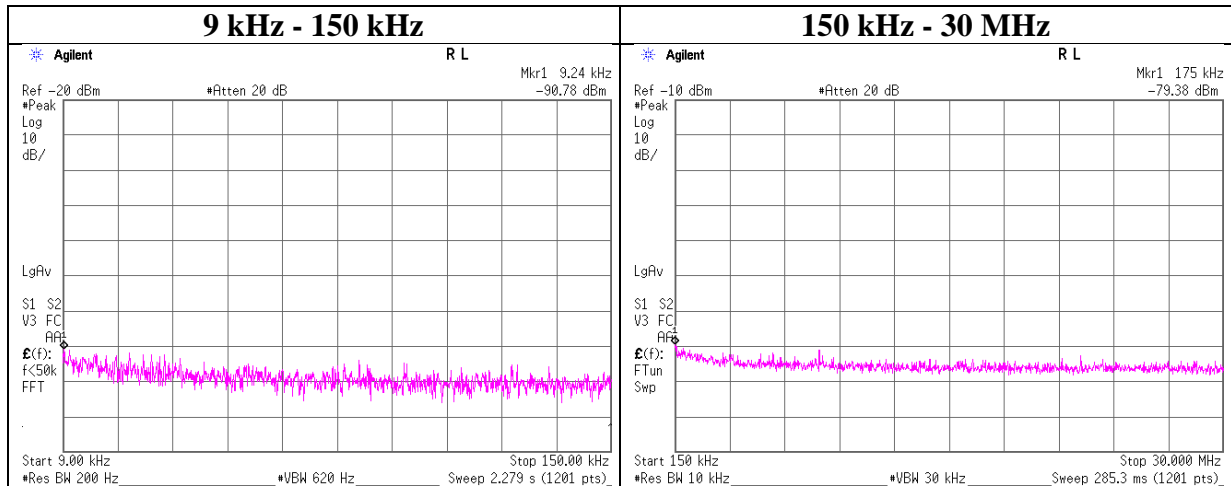
$\text{EIRP[dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

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

Test place : Shonan EMC Lab. No.5 Shielded Room
 Report No. : 11989460S-A-R1
 Date : October 18, 2017
 Temperature / Humidity : 25 deg. C / 47 % RH
 Engineer : Yosuke Ishikawa
 Mode : Tx Nordic (2Mbps) 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
9.24	-90.8	0.01	9.74	2.0	1	-79.0	300	6.0	-17.8	48.2	66.0	
175.00	-79.4	0.01	9.74	2.0	1	-67.6	300	6.0	-6.4	22.7	29.1	

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

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

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.

Power Density

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11989460S-A-R1
Date October 18, 2017
Temperature / Humidity 25 deg. C / 47 % RH
Engineer Yosuke Ishikawa
Mode Tx

BTLE 1Mbps

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-19.67	1.58	9.80	-8.29	8.00	16.29
2440	-19.78	1.59	9.80	-8.39	8.00	16.39
2480	-20.49	1.60	9.80	-9.09	8.00	17.09

BTLE 2Mbps

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-23.27	1.58	9.80	-11.89	8.00	19.89
2440	-23.18	1.59	9.80	-11.79	8.00	19.79
2480	-22.13	1.60	9.80	-10.73	8.00	18.73

ANT 1Mbps

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-18.40	1.58	9.80	-7.02	8.00	15.02
2441	-17.51	1.59	9.80	-6.12	8.00	14.12
2480	-16.93	1.60	9.80	-5.53	8.00	13.53

Nordic 2Mbps

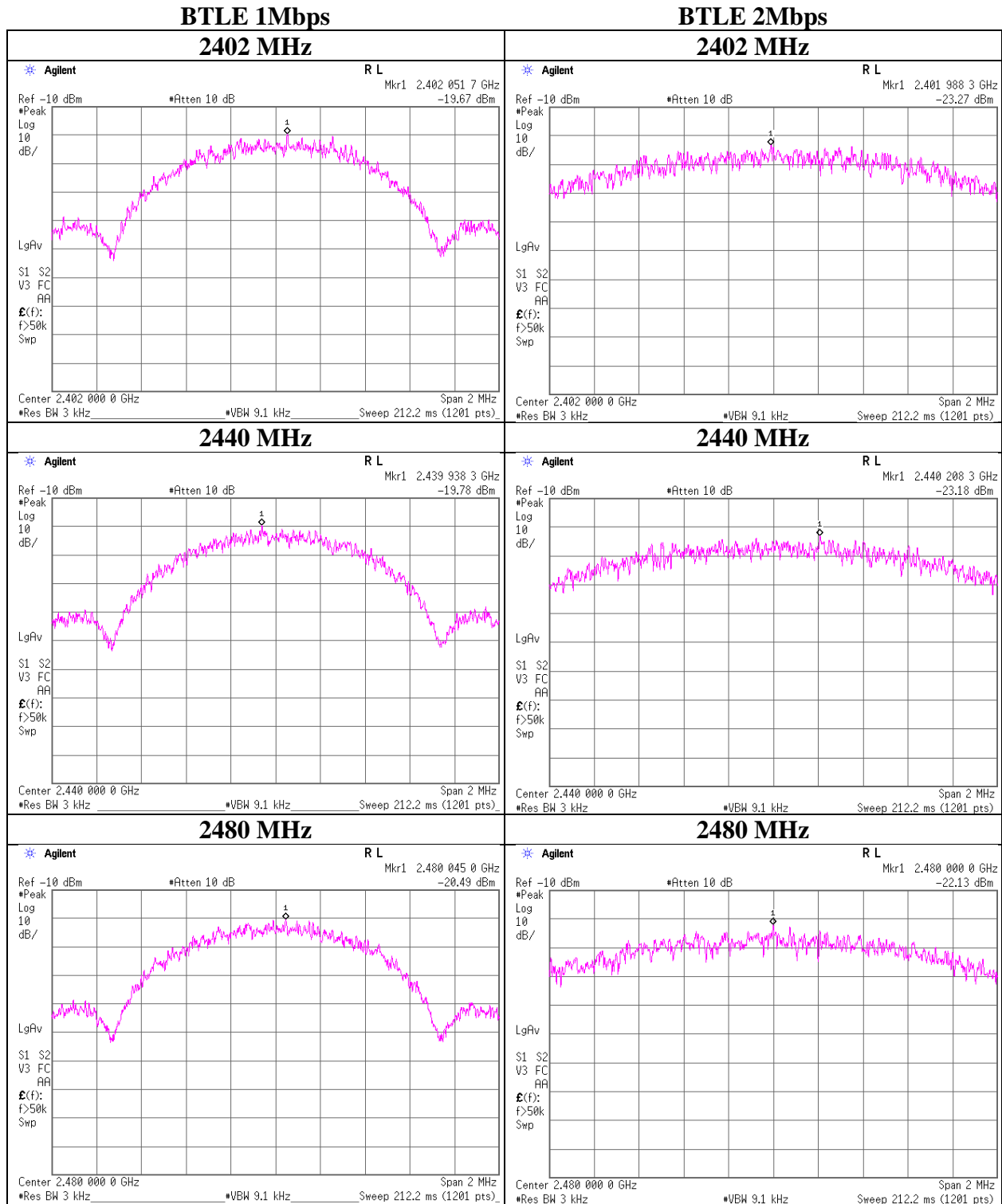
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-21.50	1.58	9.80	-10.12	8.00	18.12
2441	-18.88	1.59	9.80	-7.49	8.00	15.49
2480	-20.60	1.60	9.80	-9.20	8.00	17.20

Sample Calculation:

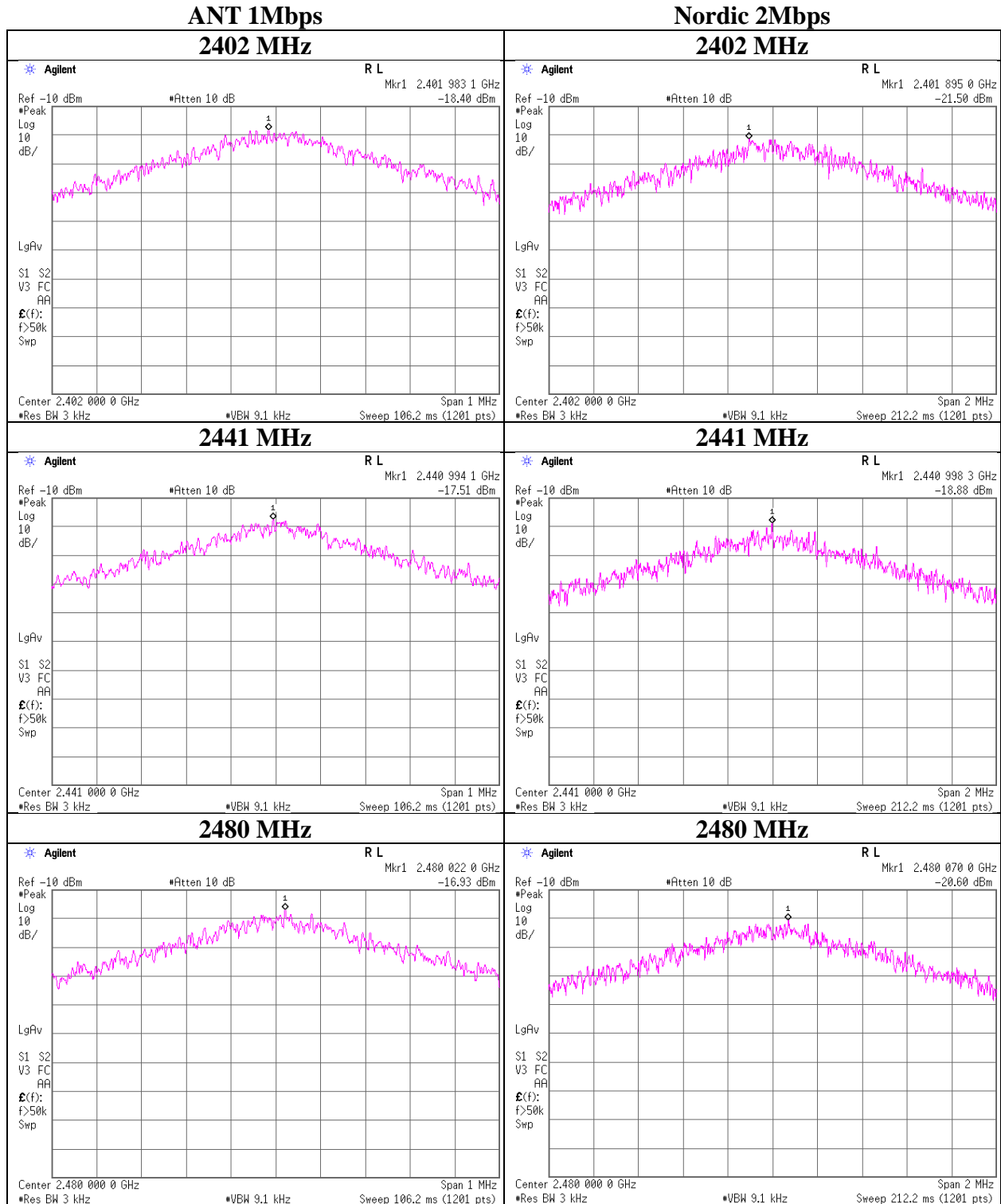
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

Power Density

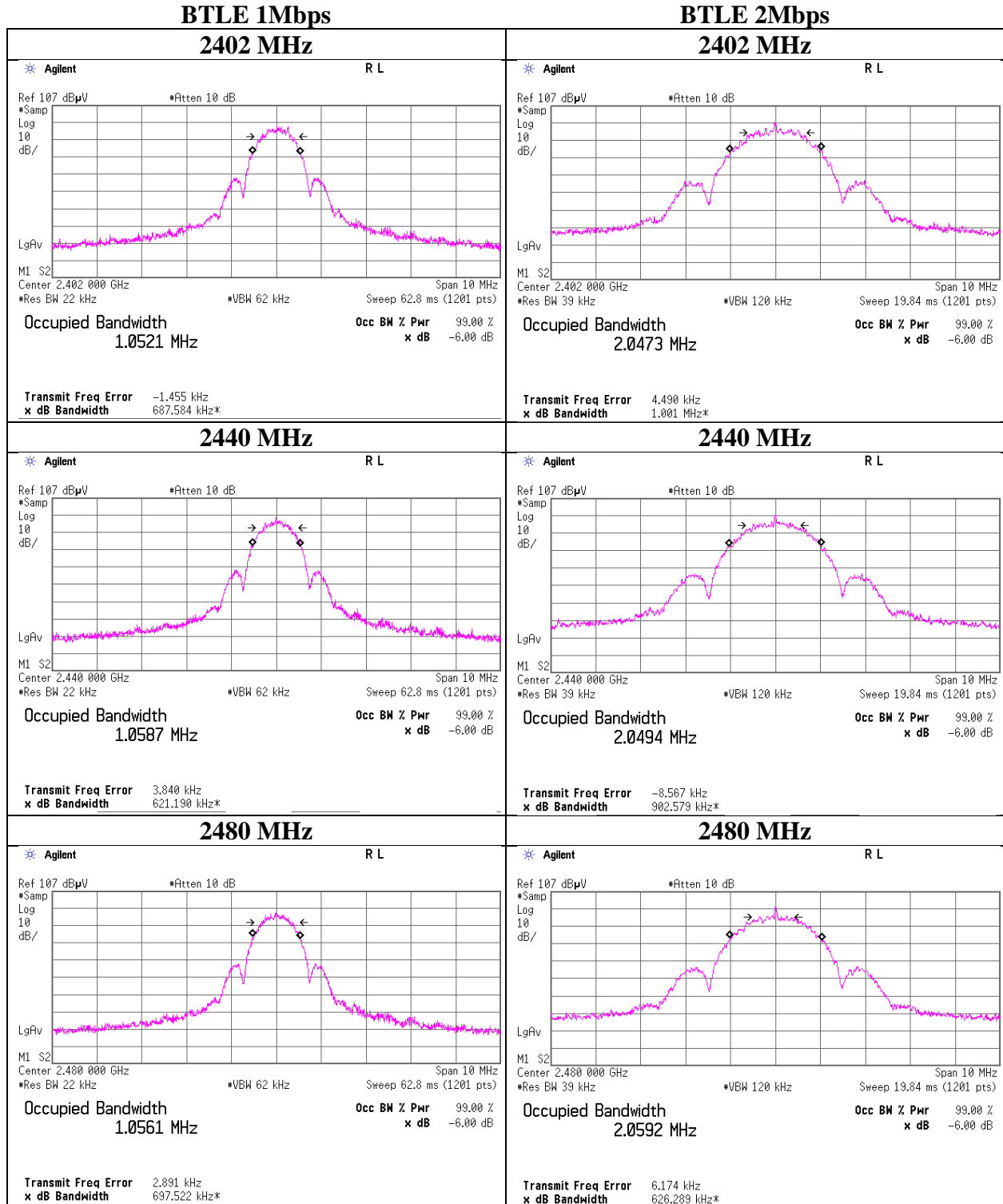


Power Density



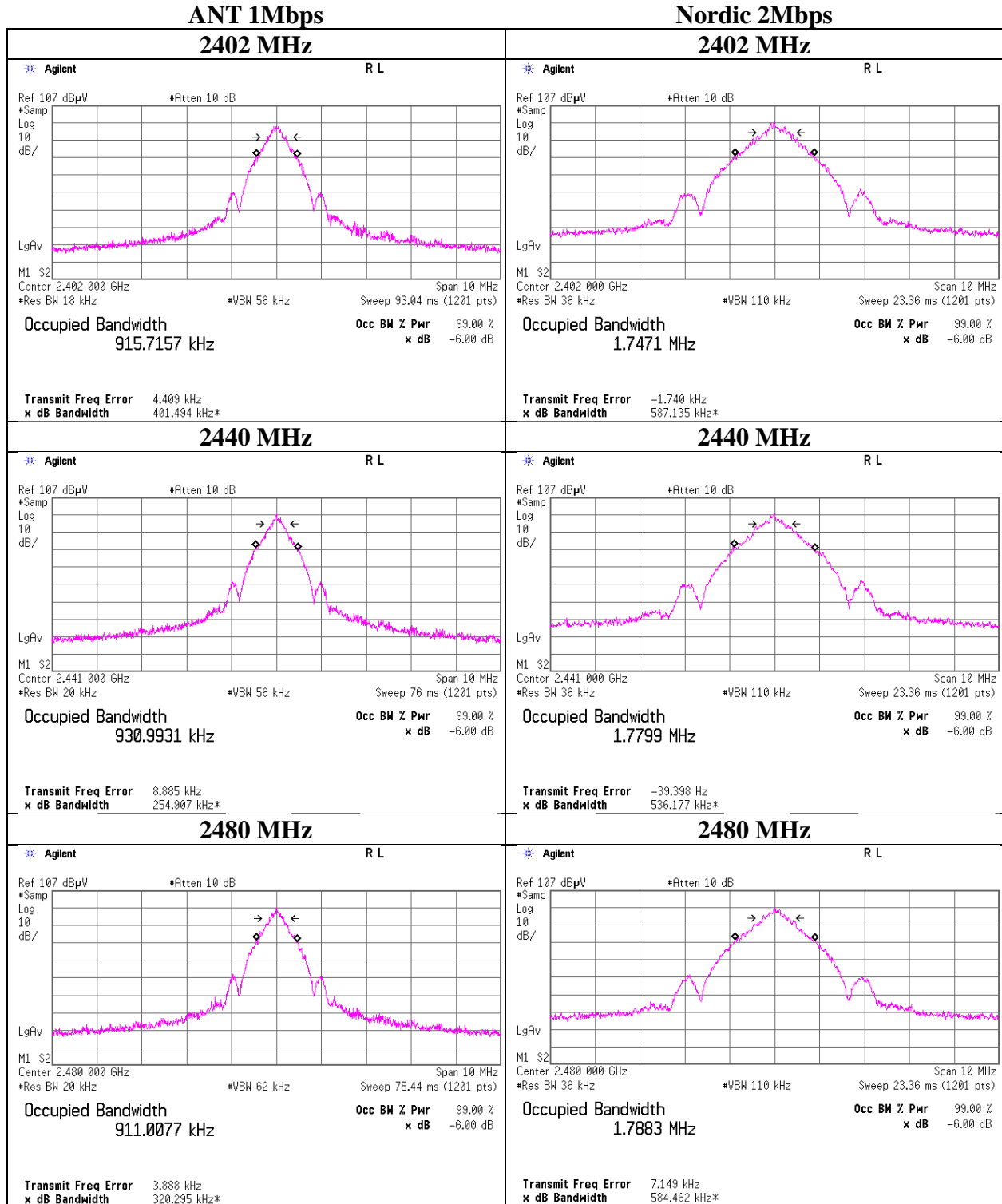
99% Occupied Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	25 deg. C / 47 % RH
Engineer	Yosuke Ishikawa
Mode	Tx



99% Occupied Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11989460S-A-R1
Date	October 18, 2017
Temperature / Humidity	25 deg. C / 47 % RH
Engineer	Yosuke Ishikawa
Mode	Tx



APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SPM-07	Power Meter	Agilent	8990B	MY510027 2	AT	2017/05/01 * 12
SPSS-05	Power sensor	Agilent	N1923A	MY534900 8	AT	2017/05/01 * 12
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY482501 52	AT	2017/08/20 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2017/03/23 * 12
SAT10-14	Attenuator	Weinschel Corp.	54A-10	81595	AT	2017/04/20 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 12
KTS-07	Digital Tester	SANWA	PC500	7019232	AT	2017/10/11 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2016/10/12 * 12
SRENT-10	Spectrum Analyzer	Agilent	E4440A	US4142151 1	RE	2016/12/05 * 12
SJM-09	Measure	PROMART	SEN1935	-	RE, CE	-
SAEC-02(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-02(SV SWR)	2	RE	2017/07/18 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,M F)	-	RE, CE	-
STS-02	Digital Hitester	Hioki	3805-50	080997819	RE, CE	2017/03/08 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2017/09/22 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2017/03/15 * 12
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	RE	2017/03/23 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01 000KMSKM S	-	RE	2017/04/20 * 12
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2017/02/17 * 12
SCC-G05	Coaxial Cable	Junkosha	J12J102207-0 0	APR-30-15- 037	RE	2017/01/08 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2017/05/08 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01 000NFSNMS/ B	1612S005	RE	2017/01/08 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2017/08/14 * 12
SAT10-05	Attenuator(above1GH z)	Agilent	8493C-010	74864	RE	2016/11/07 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2016/11/29 * 12

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

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2017/06/08 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2017/02/09 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2017/02/09 * 12
SAT3-11	Attenuator	JFW	50HF-003N	-	RE	2017/02/23 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2016/11/23 * 12
SCC-B1/B3/B5/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SCC-B2/B4/B6/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SLA-06	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	195	RE	2017/01/05 * 12
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	RE	2016/11/08 * 12
SCC-B12/B13/SRSE-02	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-270(RF Selector)	CE	2017/04/07 * 12
SLS-03	LISN	Rohde & Schwarz	ENV216	100513	CE	2017/02/27 * 12
SLS-04	LISN	Rohde & Schwarz	ENV216	100514	CE	2017/02/27 * 12
KAT3-12	Attenuator	JFW IND. INC.	50HF-003N	-	CE	2017/07/24 * 12
SOS-04	Humidity Indicator	A&D	AD-5681	4061512	CE	2016/12/13 * 12
STM-03	Terminator	TME	CT-01 BP	-	CE	2016/12/15 * 12
STR-01	Test Receiver	Rohde & Schwarz	ESU40	100093	CE	2017/04/12 * 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

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