



RADIO TEST REPORT

Test Report No. : 11794094S-R2

Applicant : Novars Inc.
Type of Equipment : BLE Module
Model No. : NV82201
FCC ID : 2AMM9NV82201
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 11794094S-R1.

Date of test: July 1 to 6, 2017

Representative test engineer:

Hikaru Shirasawa

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".

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Shonan EMC Lab.

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 11794094S

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CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Conducted Emission.....	9
SECTION 6: Radiated Spurious Emission	10
SECTION 7: Antenna Terminal Conducted Tests.....	12
APPENDIX 1: Test data	13
Conducted Emission	13
6 dB Bandwidth	19
Maximum Peak Output Power	21
Average Output Power	22
Duty factor Calculation chart	23
Averaging factor (Duty Factor).....	24
Radiated Spurious Emission	25
Conducted Spurious Emission	36
Power Density	42
99 % Occupied Bandwidth.....	44
APPENDIX 2: Test instruments	45
APPENDIX 3: Photographs of test setup	47
Conducted Emission	47
Radiated Spurious Emission	48
Pre-check of Worst Case Position.....	49

SECTION 1: Customer information

Company Name	:	Novars Inc.
Address	:	Otemachi modern build.3F, 1-21, Kandanishikicho, Chiyoda-ku, Tokyo, 101-0054 Japan
Telephone Number	:	+81-3-4405-8866
Facsimile Number	:	+81-3-5210-3240
Contact Person	:	Kazuhiro Koyama

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

2.1 Identification of E.U.T.

Type of Equipment	:	BLE Module
Model No.	:	NV82201
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3 V typical (DC 2.7 V-3.3 V)
Receipt Date of Sample	:	June 30, 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: NV82201 (referred to as the EUT in this report) is a BLE Module.

Radio Specification

Bluetooth Low Energy

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Power Supply (radio part input)	:	DC 1.7 V
Antenna type	:	Monopole (V) $1/4\lambda$
Antenna Gain	:	1.9 dBi
Clock frequency (Maximum)	:	32 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on June 14, 2017 and effective July 14, 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 June 14, 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	QP 19.9 dB 0.41509 MHz, N/L1, Tx BLE 2402 MHz Power : 4 dBm 0.41516 MHz, N, Tx BLE 2440 MHz, Power : 4 dBm 0.41514 MHz, N, Tx BLE 2402 MHz, Power : -20 dBm 0.41508 MHz, N/L1, Tx BLE 2440 MHz, Power : -20 dBm	Complied	-
6 dB 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	1.7 dB 2487.381 MHz, PK, Vert. 2520.130 MHz, PK, Vert. Tx BT LE 2480 MHz, power setting -20 dBm	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

This EUT provides stable voltage (internal voltage DC 1.7 V) constantly to RF Module 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 printed 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

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	-	-
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
Radiated emission (Measurement distance: 1 m)	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

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 JAB Accreditation No. RTL02610

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

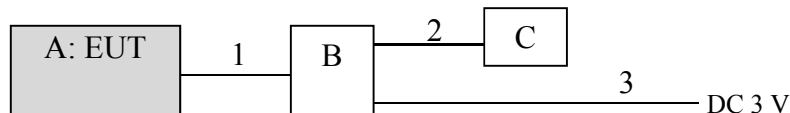
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Transmitting (Tx), Bluetooth Low Energy (BTLE)	2402 MHz 2440 MHz 2480 MHz	PRBS9, 37 bytes (worst)
*Power of the EUT was set by the software as follows; Power settings: 4 dBm -20 dBm Software: nRFgo Studio version 1.21.2 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals



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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	BLE Module	NV82201	1 *1) 2 *2)	Novars	EUT
B	Jig	-	-	Novars	-
C	RS-232C Connector	-	-	Novars	-

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

*2) Used for Antenna Terminal conducted test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal	0.01	Unshielded	Unshielded	-
2	RS-232C	0.1	Unshielded	Unshielded	-
3	DC	0.05+2.0	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. 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 80 cm 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.

Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN / (AMN) to the input power source.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT via DC power supply in a Shielded room.

The EUT via DC power supply 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 platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	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: 300 kHz
Test Distance	3 m	3.95 m *2) (1 GHz – 13 GHz, power 4 dBm), 1 m *3) (1 GHz – 13 GHz, power -20 dBm), 1 m *4) (13 GHz – 26.5 GHz)		3.95 m *2) (1 GHz – 13 GHz, power 4 dBm), 1 m *3) (1 GHz – 13 GHz, power -20 dBm), 1 m *4) (13 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: $20 \times \log(3.95 \text{ m} / 3.0 \text{ m}) = 2.39 \text{ dB}$

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

(It was measured at 1 m distance, because the carrier level was too low at 3 m distance from the EUT and it was impossible to measure 20 dBc.)

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

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

Antenna polarization	Carrier	Spurious (Below 1 GHz)	Spurious (1 GHz -13 GHz)	Spurious (13 GHz -18 GHz)	Spurious (18 GHz -26.5 GHz)
Horizontal	Y	Y	X	X	X
Vertical	Y	Y	Z	X	X

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

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

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
6 dB 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)
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 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 not detected as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)							

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

Test data : APPENDIX
 Test result : Pass

APPENDIX 1: Test data

Conducted Emission DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/02

Mode : Tx_BLE_2402 MHz, Power : 4dBm

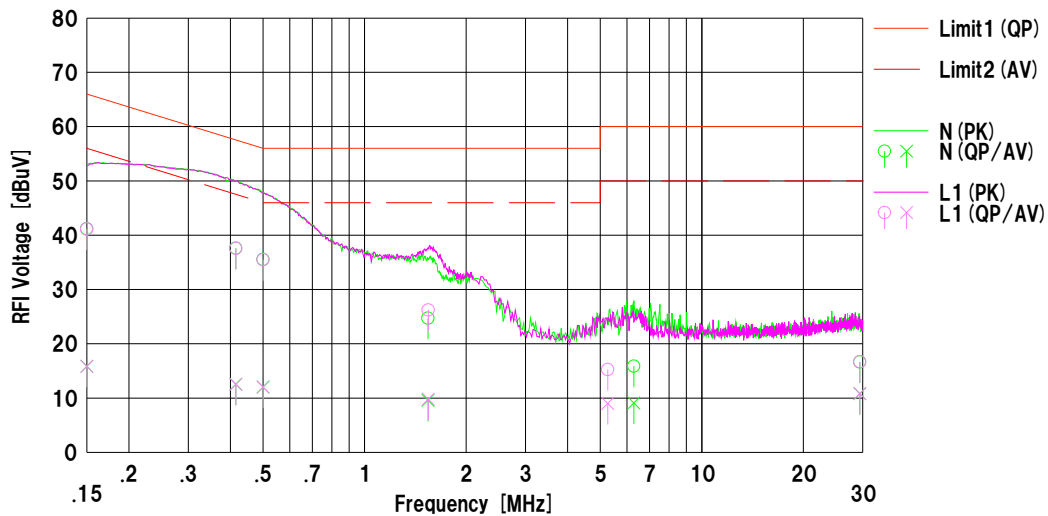
Power : DC 3 V

Temp./Humi. : 26 deg.C / 59 %RH

Remarks :

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.79	3.45	12.41	41.20	15.86	66.00	56.00	24.8	40.1	N	
2	0.41509	25.19	0.15	12.42	37.61	12.57	57.55	47.55	19.9	34.9	N	
3	0.50000	23.09	-0.40	12.44	35.53	12.04	56.00	46.00	20.4	33.9	N	
4	1.54152	12.19	-2.94	12.52	24.71	9.58	56.00	46.00	31.2	36.4	N	
5	6.28745	3.12	-3.64	12.75	15.87	9.11	60.00	50.00	44.1	40.8	N	
6	29.41811	2.98	-2.86	13.65	16.63	10.79	60.00	50.00	43.3	39.2	N	
7	0.15000	28.72	3.42	12.41	41.13	15.83	66.00	56.00	24.8	40.1	L1	
8	0.41509	25.14	0.10	12.42	37.56	12.52	57.55	47.55	19.9	35.0	L1	
9	0.50000	23.04	-0.41	12.44	35.48	12.03	56.00	46.00	20.5	33.9	L1	
10	1.54547	13.71	-2.72	12.52	26.23	9.80	56.00	46.00	29.7	36.2	L1	
11	5.26098	2.56	-3.72	12.70	15.26	8.98	60.00	50.00	44.7	41.0	L1	
12	29.41811	3.03	-2.79	13.65	16.68	10.86	60.00	50.00	43.3	39.1	L1	

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

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Conducted Emission DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/02

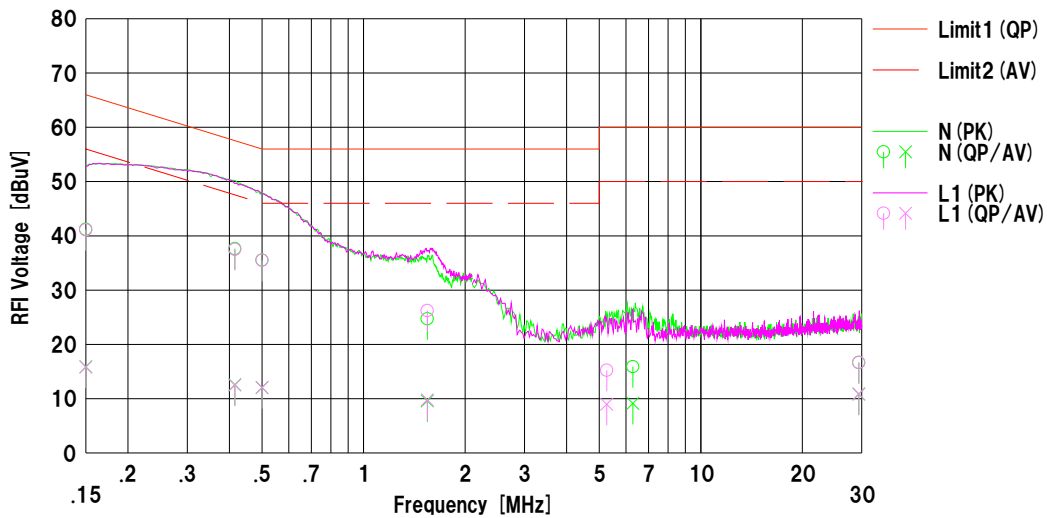
Mode : Tx_BLE_2440 MHz, Power : 4dBm

Power : DC 3 V
Temp./Humi. : 26 deg.C / 59 %RH

Remarks :

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.80	3.46	12.41	41.21	15.87	66.00	56.00	24.7	40.1	N	
2	0.41516	25.21	0.16	12.42	37.63	12.58	57.54	47.54	19.9	34.9	N	
3	0.50000	23.10	-0.39	12.44	35.54	12.05	56.00	46.00	20.4	33.9	N	
4	1.54557	12.20	-2.94	12.52	24.72	9.58	56.00	46.00	31.2	36.4	N	
5	6.28754	3.14	-3.62	12.75	15.89	9.13	60.00	50.00	44.1	40.8	N	
6	29.41902	2.99	-2.81	13.65	16.64	10.84	60.00	50.00	43.3	39.1	N	
7	0.15000	28.70	3.40	12.41	41.11	15.81	66.00	56.00	24.8	40.1	L1	
8	0.41516	25.09	0.09	12.42	37.51	12.51	57.54	47.54	20.0	35.0	L1	
9	0.50000	23.06	-0.40	12.44	35.50	12.04	56.00	46.00	20.5	33.9	L1	
10	1.54548	13.70	-2.73	12.52	26.22	9.79	56.00	46.00	29.7	36.2	L1	
11	5.26113	2.54	-3.74	12.70	15.24	8.96	60.00	50.00	44.7	41.0	L1	
12	29.41902	3.01	-2.75	13.65	16.66	10.90	60.00	50.00	43.3	39.1	L1	

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

Conducted Emission DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/03

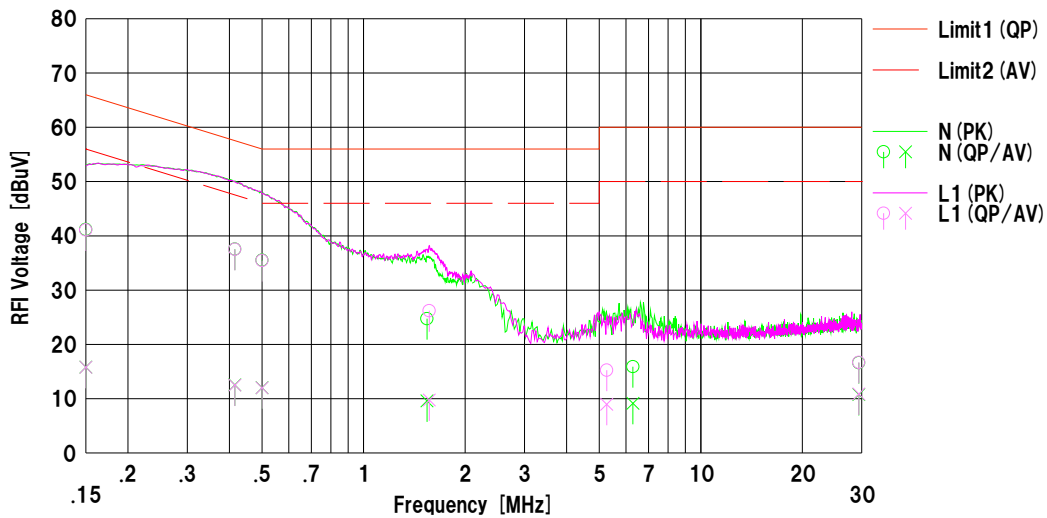
Mode : Tx BLE 2480 MHz. Power : 4dBm

Power : DC 3 V
Temp./Humi. : 26 deg.C / 59 %RH

Remarks :

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.77	3.41	12.41	41.18	15.82	66.00	56.00	24.8	40.1	N	
2	0.41512	25.13	0.13	12.42	37.55	12.55	57.55	47.55	20.0	35.0	N	
3	0.50000	23.07	-0.42	12.44	35.51	12.02	56.00	46.00	20.4	33.9	N	
4	1.54158	12.22	-2.91	12.52	24.74	9.61	56.00	46.00	31.2	36.3	N	
5	6.28926	3.14	-3.61	12.75	15.89	9.14	60.00	50.00	44.1	40.8	N	
6	29.41915	2.97	-2.88	13.65	16.62	10.77	60.00	50.00	43.3	39.2	N	
7	0.15000	28.68	3.39	12.41	41.09	15.80	66.00	56.00	24.9	40.2	L1	
8	0.41512	25.11	0.08	12.42	37.53	12.50	57.55	47.55	20.0	35.0	L1	
9	0.50000	23.02	-0.43	12.44	35.46	12.01	56.00	46.00	20.5	33.9	L1	
10	1.56581	13.68	-2.75	12.52	26.20	9.77	56.00	46.00	29.8	36.2	L1	
11	5.26122	2.55	-3.74	12.70	15.25	8.96	60.00	50.00	44.7	41.0	L1	
12	29.41915	3.04	-2.78	13.65	16.69	10.87	60.00	50.00	43.3	39.1	L1	

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

Conducted Emission DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/03

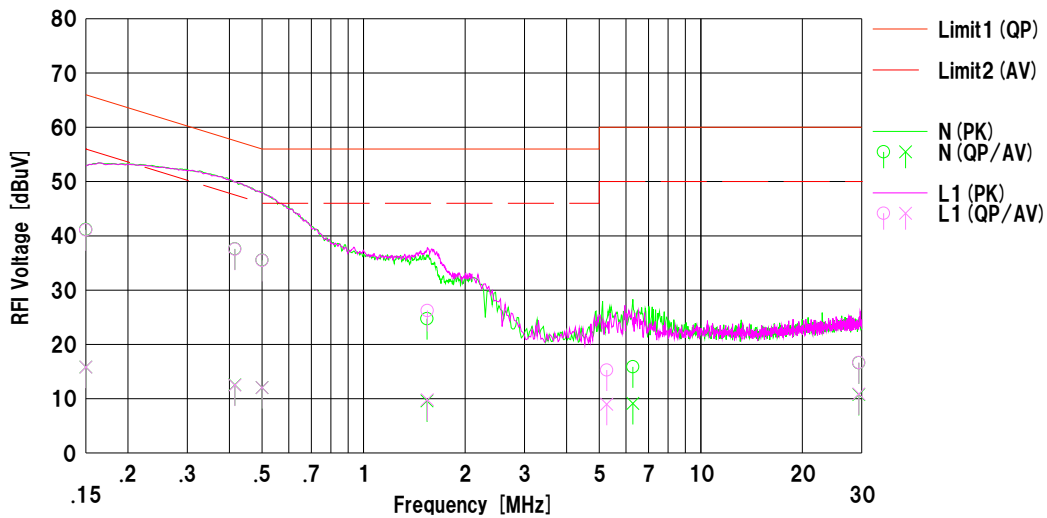
Mode : Tx BLE 2402 MHz. Power : -20dBm

Power : DC 3 V
Temp./Humi. : 26 deg.C / 59 %RH

Remarks :

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.77	3.43	12.41	41.18	15.84	66.00	56.00	24.8	40.1	N	
2	0.41514	25.18	0.14	12.42	37.60	12.56	57.54	47.54	19.9	34.9	N	
3	0.50000	23.10	-0.39	12.44	35.54	12.05	56.00	46.00	20.4	33.9	N	
4	1.54165	12.21	-2.92	12.52	24.73	9.60	56.00	46.00	31.2	36.4	N	
5	6.28741	3.13	-3.62	12.75	15.88	9.13	60.00	50.00	44.1	40.8	N	
6	29.41697	2.96	-2.89	13.65	16.61	10.76	60.00	50.00	43.3	39.2	N	
7	0.15000	28.70	3.40	12.41	41.11	15.81	66.00	56.00	24.8	40.1	L1	
8	0.41514	25.12	0.09	12.42	37.54	12.51	57.54	47.54	20.0	35.0	L1	
9	0.50000	23.06	-0.39	12.44	35.50	12.05	56.00	46.00	20.5	33.9	L1	
10	1.54549	13.73	-2.71	12.52	26.25	9.81	56.00	46.00	29.7	36.1	L1	
11	5.26141	2.57	-3.71	12.70	15.27	8.99	60.00	50.00	44.7	41.0	L1	
12	29.41697	3.00	-2.77	13.65	16.65	10.88	60.00	50.00	43.3	39.1	L1	

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

Conducted Emission DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/03

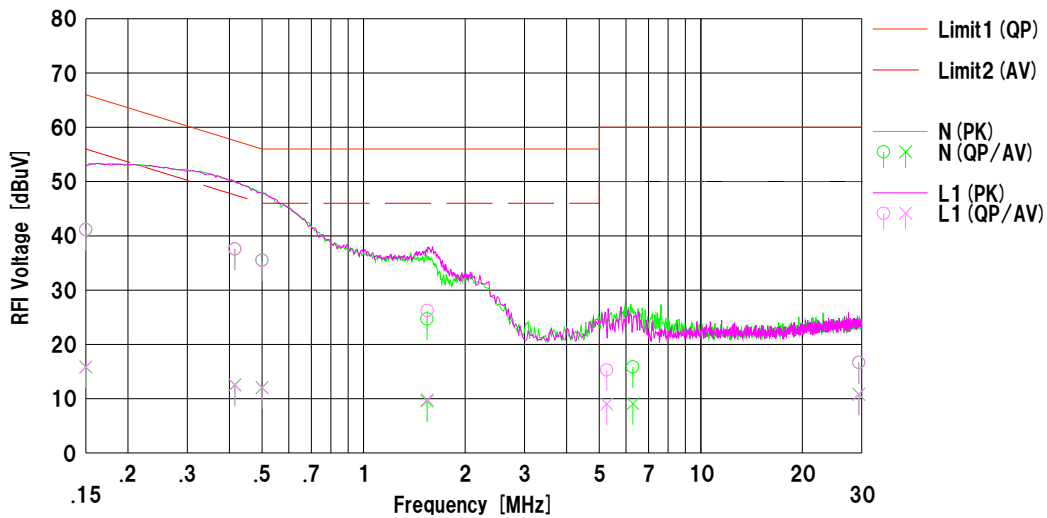
Mode : Tx BLE 2440 MHz. Power : -20dBm

Power : DC 3 V
Temp./Humi. : 26 deg.C / 59 %RH

Remarks :

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.76	3.42	12.41	41.17	15.83	66.00	56.00	24.8	40.1	N	
2	0.41508	25.17	0.15	12.42	37.59	12.57	57.55	47.55	19.9	34.9	N	
3	0.50000	23.10	-0.39	12.44	35.54	12.05	56.00	46.00	20.4	33.9	N	
4	1.54146	12.18	-2.96	12.52	24.70	9.56	56.00	46.00	31.3	36.4	N	
5	6.28722	3.11	-3.66	12.75	15.86	9.09	60.00	50.00	44.1	40.9	N	
6	29.41881	3.00	-2.83	13.65	16.65	10.82	60.00	50.00	43.3	39.1	N	
7	0.15000	28.74	3.43	12.41	41.15	15.84	66.00	56.00	24.8	40.1	L1	
8	0.41508	25.16	0.11	12.42	37.58	12.53	57.55	47.55	19.9	35.0	L1	
9	0.50000	23.02	-0.42	12.44	35.46	12.02	56.00	46.00	20.5	33.9	L1	
10	1.54546	13.73	-2.70	12.52	26.25	9.82	56.00	46.00	29.7	36.1	L1	
11	5.26109	2.58	-3.70	12.70	15.28	9.00	60.00	50.00	44.7	41.0	L1	
12	29.41881	3.02	-2.80	13.65	16.67	10.85	60.00	50.00	43.3	39.1	L1	

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

Conducted Emission DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/03

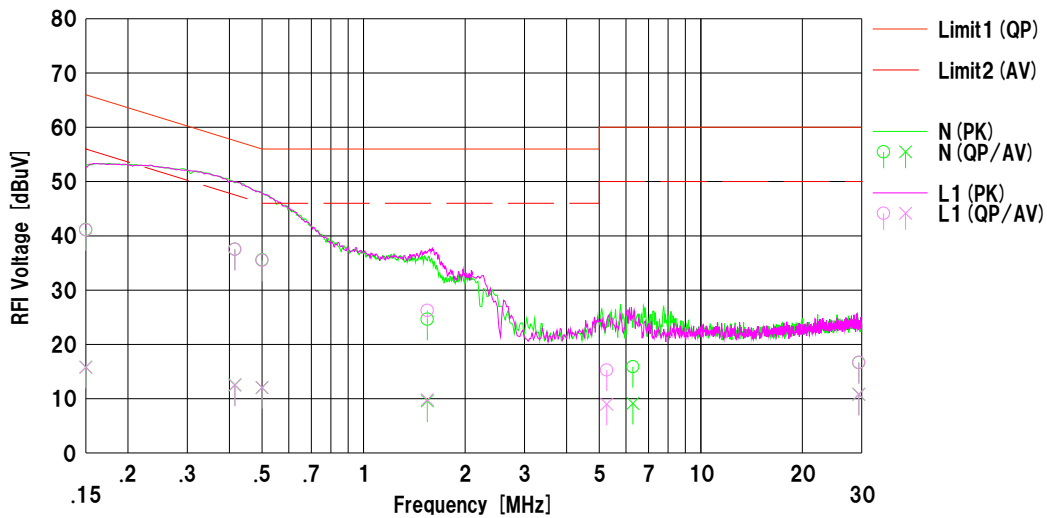
Mode : Tx BLE 2480 MHz. Power : -20dBm

Power : DC 3 V
Temp./Humi. : 26 deg.C / 59 %RH

Remarks :

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.76	3.41	12.41	41.17	15.82	66.00	56.00	24.8	40.1	N	
2	0.41511	25.11	0.12	12.42	37.53	12.54	57.55	47.55	20.0	35.0	N	
3	0.50000	23.12	-0.39	12.44	35.56	12.05	56.00	46.00	20.4	33.9	N	
4	1.54519	12.12	-2.91	12.52	24.64	9.61	56.00	46.00	31.3	36.3	N	
5	6.28713	3.15	-3.62	12.75	15.90	9.13	60.00	50.00	44.1	40.8	N	
6	29.41833	3.00	-2.84	13.65	16.65	10.81	60.00	50.00	43.3	39.1	N	
7	0.15000	28.68	3.39	12.41	41.09	15.80	66.00	56.00	24.9	40.2	L1	
8	0.41511	25.11	0.08	12.42	37.53	12.50	57.55	47.55	20.0	35.0	L1	
9	0.50000	23.06	-0.39	12.44	35.50	12.05	56.00	46.00	20.5	33.9	L1	
10	1.54542	13.74	-2.70	12.52	26.26	9.82	56.00	46.00	29.7	36.1	L1	
11	5.26112	2.58	-3.71	12.70	15.28	8.99	60.00	50.00	44.7	41.0	L1	
12	29.41833	3.01	-2.81	13.65	16.66	10.84	60.00	50.00	43.3	39.1	L1	

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

6 dB Bandwidth

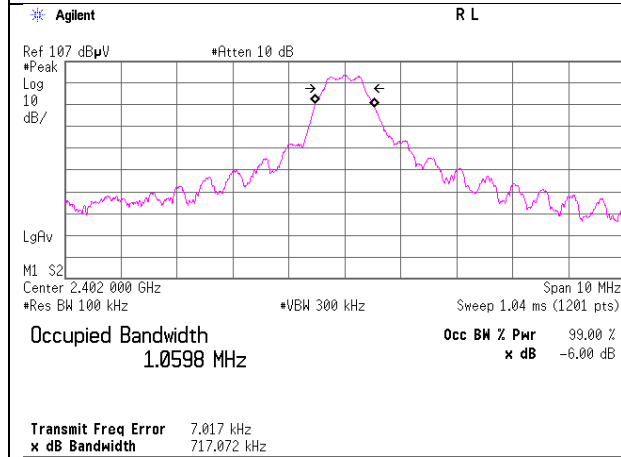
Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11794094S-R2
Date July 5, 2017
Temperature / Humidity 24 deg. C / 53 % RH
Engineer Hikaru Shirasawa
Mode Tx BT LE, power setting +4 dBm

Mode	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [kHz]
BT LE	2402	0.717	> 500
	2440	0.741	> 500
	2480	0.700	> 500

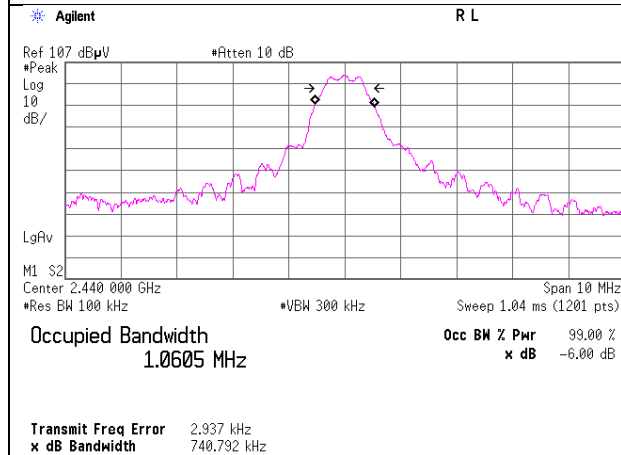
6 dB Bandwidth

BT LE

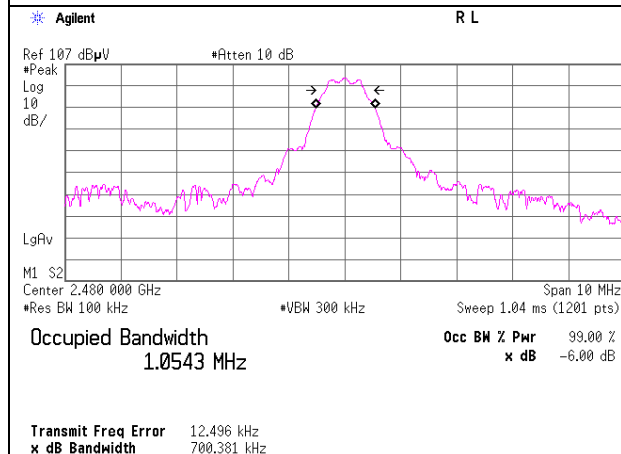
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place	Shonan EMC Lab. No.1 Measurement Room / No.5 Shielded Room	
Report No.	11794094S-R2	
Date	July 5, 2017	July 6, 2017
Temperature / Humidity	24 deg. C / 53 % RH	26 deg. C / 49 % RH
Engineer	Hikaru Shirasawa	Hikaru Shirasawa
Mode	Tx BT LE	

Power setting +4 dBm

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-6.48	1.10	9.80	4.42	2.77	30.00	1000	25.58
2440	-6.39	1.10	9.80	4.51	2.82	30.00	1000	25.49
2480	-6.51	1.11	9.80	4.40	2.75	30.00	1000	25.60

Power setting -20 dBm

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-17.43	1.10	0.00	-16.33	0.02	30.00	1000	46.33
2440	-17.60	1.10	0.00	-16.50	0.02	30.00	1000	46.50
2480	-17.71	1.11	0.00	-16.60	0.02	30.00	1000	46.60

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.

Average Output Power (Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.1 Measurement Room / No.5 Shielded Room	
Report No.	11794094S-R2	
Date	July 5, 2017	July 6, 2017
Temperature / Humidity	24 deg. C / 53 % RH	26 deg. C / 49 % RH
Engineer	Hikaru Shirasawa	
Mode	Tx BT LE	

Power setting +4 dBm

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	-8.25	1.10	9.80	2.65	1.84	1.09	3.74	2.37
2440	-8.16	1.10	9.80	2.74	1.88	1.09	3.83	2.42
2480	-8.29	1.11	9.80	2.62	1.83	1.09	3.71	2.35

Power setting -20 dBm

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	-22.44	1.10	0.00	-21.34	0.01	1.09	-20.25	0.01
2440	-22.61	1.10	0.00	-21.51	0.01	1.09	-20.42	0.01
2480	-22.50	1.11	0.00	-21.39	0.01	1.09	-20.30	0.01

Sample Calculation:

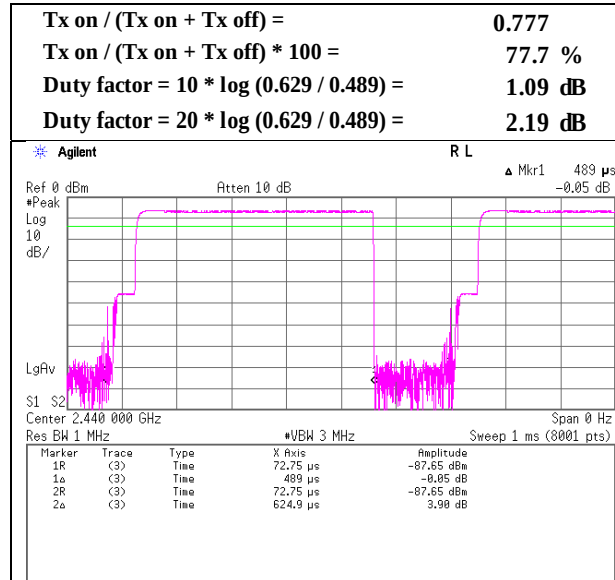
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

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

Duty factor Calculation chart

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11794094S-R2
Date July 5, 2017
Temperature / Humidity 24 deg. C / 53 % RH
Engineer Hikaru Shirasawa
Mode Tx BT LE, power setting +4 dBm



* 1.09 dB is for Average Output Power
* 2.19 dB is for Radiated Spurious Emission

Averaging factor (Duty Factor)

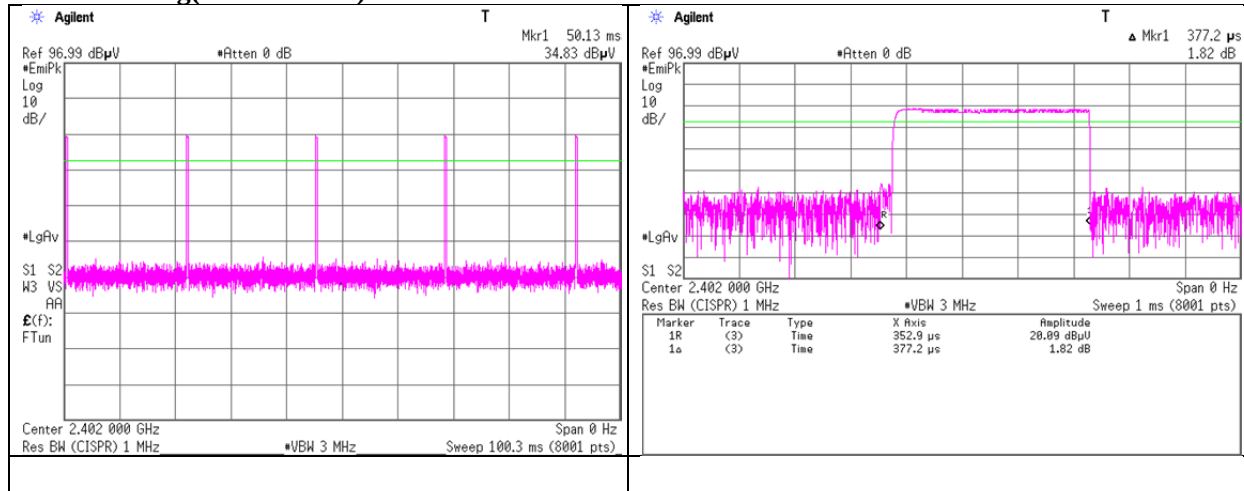
Test place Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. 11794094S-R2
Date July 1, 2017
Temperature / Humidity 23 deg. C / 65 % RH
Engineer Hikaru Shirasawa
Mode Tx BT LE, power setting +4 dBm

Worst 100ms

Averaging factor (Duty Factor) =
 $20\log(5 \times 0.3772/100) = -34.49 \text{ dB}$

1cycle time

0.3772 ms



*Worst TX Duty cycle BLE is Advertising mode which max on time is 0.3772 ms and Min interval is 20 ms (Refer to BLE Worst TX Duty sheet).

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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11794094S-R2
Date : July 1, 2017 July 2, 2017
Temperature / Humidity : 23 deg. C / 65 % RH 25 deg. C / 66 % RH
Engineer : Hikaru Shirasawa Kenichi Adachi
(1 GHz -13 GHz) (other range)
Mode : Tx BT LE 2402 MHz, power setting +4 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.28	16.81	6.67	32.13	0.00	13.63	40.00	26.4	100	0	
Hori.	192.000	QP	21.57	16.25	7.97	32.00	0.00	13.79	43.50	29.7	100	0	
Hori.	320.000	QP	21.67	13.84	8.82	31.89	0.00	12.44	46.00	33.6	100	0	
Hori.	640.000	QP	21.48	19.20	10.16	31.85	0.00	18.99	46.00	27.0	100	0	
Hori.	928.000	QP	21.22	22.03	11.14	30.67	0.00	23.72	46.00	22.3	100	0	
Hori.	2390.000	PK	43.09	27.41	14.27	36.83	2.39	50.33	73.90	23.6	110	162	
Hori.	4804.000	PK	51.19	31.13	6.79	36.99	2.39	54.51	73.90	19.4	152	138	
Hori.	7206.000	PK	43.66	36.44	8.41	37.81	2.39	53.09	73.90	20.8	150	359	
Hori.	9608.000	PK	45.02	38.63	9.48	38.48	2.39	57.04	73.90	16.9	150	0	
Hori.	12010.000	PK	46.76	39.28	10.57	39.18	2.39	59.82	73.90	14.1	150	359	
Hori.	2390.000	AV	34.24	27.41	14.27	36.83	2.39	41.48	53.90	12.4	110	162	
Vert.	32.000	QP	22.29	16.81	6.67	32.13	0.00	13.64	40.00	26.4	100	0	
Vert.	192.000	QP	21.54	16.25	7.97	32.00	0.00	13.76	43.50	29.7	100	0	
Vert.	320.000	QP	21.66	13.84	8.82	31.89	0.00	12.43	46.00	33.6	100	0	
Vert.	640.000	QP	21.46	19.20	10.16	31.85	0.00	18.97	46.00	27.0	100	0	
Vert.	928.000	QP	21.24	22.03	11.14	30.67	0.00	23.74	46.00	22.3	100	0	
Vert.	2390.000	PK	43.42	27.41	14.27	36.83	2.39	50.66	73.90	23.2	214	318	
Vert.	4804.000	PK	52.10	31.13	6.79	36.99	2.39	55.42	73.90	18.5	130	20	
Vert.	7206.000	PK	44.04	36.44	8.41	37.81	2.39	53.47	73.90	20.4	150	359	
Vert.	9608.000	PK	45.59	38.63	9.48	38.48	2.39	57.61	73.90	16.3	150	0	
Vert.	12010.000	PK	44.84	39.28	10.57	39.18	2.39	57.90	73.90	16.0	150	359	
Vert.	2390.000	AV	34.40	27.41	14.27	36.83	2.39	41.64	53.90	12.3	214	318	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

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]	Averaging factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4804.000	AV	41.68	31.13	6.79	36.99	2.19	-34.49	2.39	12.70	53.90	41.2	
Hori.	7206.000	AV	34.29	36.44	8.41	37.81	2.19	-34.49	2.39	11.42	53.90	42.5	
Hori.	9608.000	AV	35.93	38.63	9.48	38.48	2.19	-34.49	2.39	15.65	53.90	38.3	
Hori.	12010.000	AV	37.23	39.28	10.57	39.18	2.19	-34.49	2.39	17.99	53.90	35.9	
Vert.	4804.000	AV	43.05	31.13	6.79	36.99	2.19	-34.49	2.39	14.07	53.90	39.8	
Vert.	7206.000	AV	34.20	36.44	8.41	37.81	2.19	-34.49	2.39	11.33	53.90	42.6	
Vert.	9608.000	AV	35.86	38.63	9.48	38.48	2.19	-34.49	2.39	15.58	53.90	38.3	
Vert.	12010.000	AV	35.92	39.28	10.57	39.18	2.19	-34.49	2.39	16.68	53.90	37.2	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

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. Averaging factor refer to "Averaging factor (Duty Factor)" sheet.

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	76.30	27.46	14.28	36.83	2.39	83.60	-	-	Carrier
Hori.	2400.000	PK	34.11	27.45	14.27	36.83	2.39	41.39	63.60	22.2	
Vert.	2402.000	PK	75.38	27.46	14.28	36.83	2.39	82.68	-	-	Carrier
Vert.	2400.000	PK	34.54	27.45	14.27	36.83	2.39	41.82	62.68	20.9	

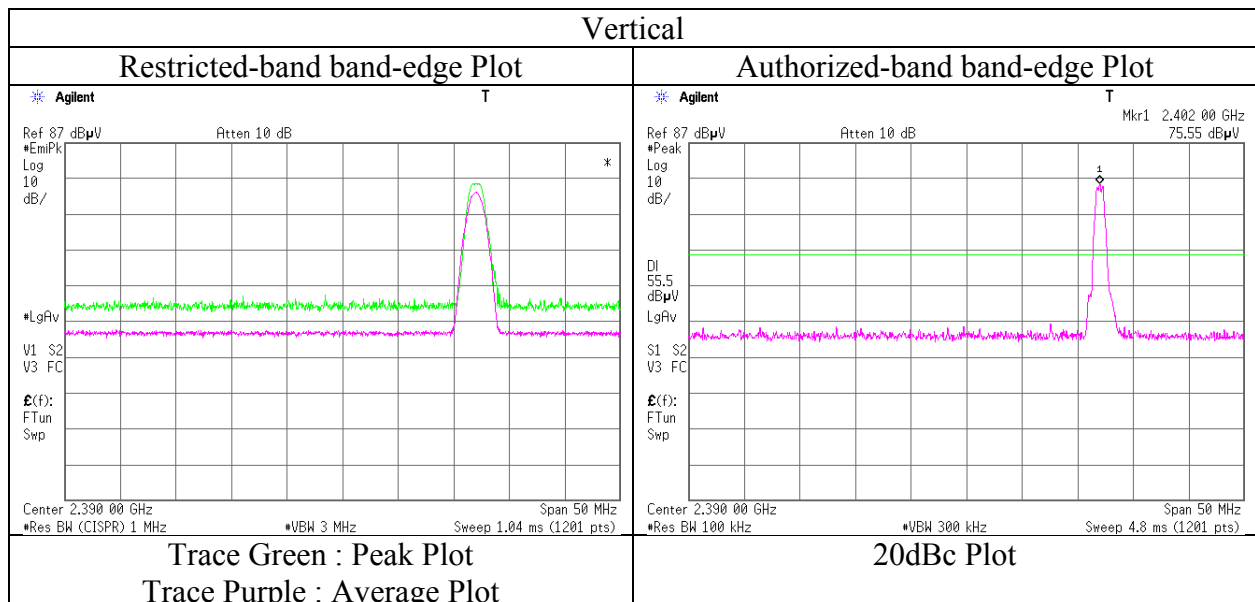
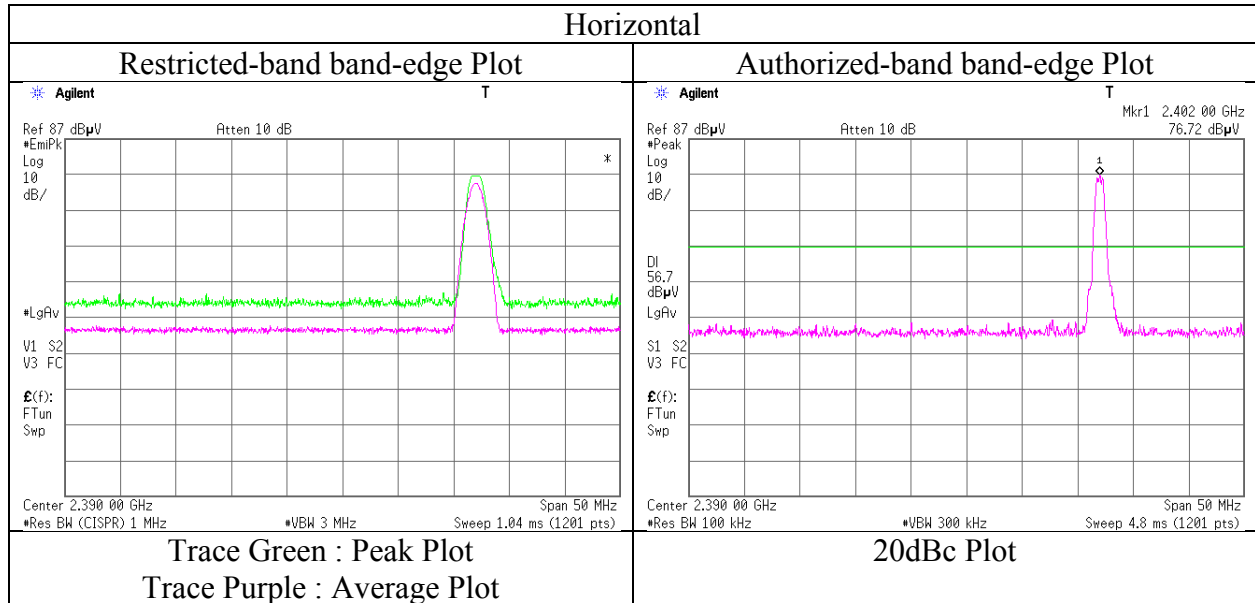
Result = Reading + Ant. Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

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

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11794094S-R2
Date	July 1, 2017
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Hikaru Shirasawa (1 GHz -13 GHz)
Mode	Tx BT LE 2402 MHz, power setting +4 dBm



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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11794094S-R2
Date : July 1, 2017 July 2, 2017
Temperature / Humidity : 23 deg. C / 65 % RH 25 deg. C / 66 % RH
Engineer : Hikaru Shirasawa Kenichi Adachi
(1 GHz -13 GHz) (other range)
Mode : Tx BT LE 2440 MHz, power setting +4 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.25	16.81	6.67	32.13	0.00	13.60	40.00	26.4	100	0	
Hori.	192.000	QP	21.53	16.25	7.97	32.00	0.00	13.75	43.50	29.8	100	0	
Hori.	320.000	QP	21.65	13.84	8.82	31.89	0.00	12.42	46.00	33.6	100	0	
Hori.	640.000	QP	21.44	19.20	10.16	31.85	0.00	18.95	46.00	27.1	100	0	
Hori.	928.000	QP	21.23	22.03	11.14	30.67	0.00	23.73	46.00	22.3	100	0	
Hori.	4880.000	PK	52.78	31.29	6.87	37.03	2.39	56.30	73.90	17.6	157	152	
Hori.	7320.000	PK	42.93	36.77	8.57	37.88	2.39	52.78	73.90	21.1	150	359	
Hori.	9760.000	PK	44.36	38.75	9.60	38.67	2.39	56.43	73.90	17.5	150	0	
Hori.	12200.000	PK	44.97	39.30	10.83	39.14	2.39	58.35	73.90	15.6	150	359	
Vert.	32.000	QP	22.27	16.81	6.67	32.13	0.00	13.62	40.00	26.4	100	0	
Vert.	192.000	QP	21.56	16.25	7.97	32.00	0.00	13.78	43.50	29.7	100	0	
Vert.	320.000	QP	21.62	13.84	8.82	31.89	0.00	12.39	46.00	33.6	100	0	
Vert.	640.000	QP	21.42	19.20	10.16	31.85	0.00	18.93	46.00	27.1	100	0	
Vert.	928.000	QP	21.21	22.03	11.14	30.67	0.00	23.71	46.00	22.3	100	0	
Vert.	4880.000	PK	51.66	31.29	6.87	37.03	2.39	55.18	73.90	18.7	180	217	
Vert.	7320.000	PK	43.26	36.77	8.57	37.88	2.39	53.11	73.90	20.8	150	359	
Vert.	9760.000	PK	44.76	38.75	9.60	38.67	2.39	56.83	73.90	17.1	150	0	
Vert.	12200.000	PK	46.08	39.30	10.83	39.14	2.39	59.46	73.90	14.4	150	359	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

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]	Averageing factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	47.58	31.29	6.87	37.03	2.19	-34.49	2.39	18.80	53.90	35.1	
Hori.	7320.000	AV	33.44	36.77	8.57	37.88	2.19	-34.49	2.39	10.99	53.90	42.9	
Hori.	9760.000	AV	34.93	38.75	9.60	38.67	2.19	-34.49	2.39	14.70	53.90	39.2	
Hori.	12200.000	AV	35.67	39.30	10.83	39.14	2.19	-34.49	2.39	16.75	53.90	37.2	
Vert.	4880.000	AV	46.55	31.29	6.87	37.03	2.19	-34.49	2.39	17.77	53.90	36.1	
Vert.	7320.000	AV	33.39	36.77	8.57	37.88	2.19	-34.49	2.39	10.94	53.90	43.0	
Vert.	9760.000	AV	35.14	38.75	9.60	38.67	2.19	-34.49	2.39	14.91	53.90	39.0	
Vert.	12200.000	AV	35.94	39.30	10.83	39.14	2.19	-34.49	2.39	17.02	53.90	36.9	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$

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. Averageing factor refer to "Averageing factor (Duty Factor)" sheet.

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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11794094S-R2
Date : July 1, 2017 July 2, 2017
Temperature / Humidity : 23 deg. C / 65 % RH 25 deg. C / 66 % RH
Engineer : Hikaru Shirasawa Kenichi Adachi
(1 GHz -13 GHz) (other range)
Mode : Tx BT LE 2480 MHz, power setting +4 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.31	16.81	6.67	32.13	0.00	13.66	40.00	26.3	100	0	
Hori.	192.000	QP	21.51	16.25	7.97	32.00	0.00	13.73	43.50	29.8	100	0	
Hori.	320.000	QP	21.65	13.84	8.82	31.89	0.00	12.42	46.00	33.6	100	0	
Hori.	640.000	QP	21.44	19.20	10.16	31.85	0.00	18.95	46.00	27.1	100	0	
Hori.	928.000	QP	21.26	22.03	11.14	30.67	0.00	23.76	46.00	22.2	100	0	
Hori.	2483.500	PK	43.97	27.79	14.37	36.79	2.39	51.73	73.90	22.2	191	241	
Hori.	2485.651	PK	46.70	27.80	14.37	36.79	2.39	54.47	73.90	19.4	151	119	
Hori.	4960.000	PK	56.99	31.45	6.94	37.07	2.39	60.70	73.90	13.2	168	148	
Hori.	7440.000	PK	42.82	37.11	8.75	37.95	2.39	53.12	73.90	20.8	150	359	
Hori.	9920.000	PK	43.93	38.87	9.72	38.87	2.39	56.04	73.90	17.9	150	0	
Hori.	12400.000	PK	45.23	39.32	11.11	39.10	2.39	58.95	73.90	15.0	150	359	
Hori.	2483.500	AV	34.28	27.79	14.37	36.79	2.39	42.04	53.90	11.9	191	241	
Hori.	2485.651	AV	34.74	27.80	14.37	36.79	2.39	42.51	53.90	11.4	151	119	
Vert.	32.000	QP	22.27	16.81	6.67	32.13	0.00	13.62	40.00	26.4	100	0	
Vert.	192.000	QP	21.53	16.25	7.97	32.00	0.00	13.75	43.50	29.8	100	0	
Vert.	320.000	QP	21.57	13.84	8.82	31.89	0.00	12.34	46.00	33.7	100	0	
Vert.	640.000	QP	21.42	19.20	10.16	31.85	0.00	18.93	46.00	27.1	100	0	
Vert.	928.000	QP	21.25	22.03	11.14	30.67	0.00	23.75	46.00	22.3	100	0	
Vert.	2483.500	PK	43.53	27.79	14.37	36.79	2.39	51.29	73.90	22.6	150	283	
Vert.	2485.651	PK	46.45	27.80	14.37	36.79	2.39	54.22	73.90	19.7	200	288	
Vert.	4960.000	PK	57.63	31.45	6.94	37.07	2.39	61.34	73.90	12.6	137	44	
Vert.	7440.000	PK	42.80	37.11	8.75	37.95	2.39	53.10	73.90	20.8	150	0	
Vert.	9920.000	PK	43.39	38.87	9.72	38.87	2.39	55.50	73.90	18.4	150	359	
Vert.	12400.000	PK	44.39	39.32	11.11	39.10	2.39	58.11	73.90	15.8	150	0	
Vert.	2483.500	AV	34.37	27.79	14.37	36.79	2.39	42.13	53.90	11.8	150	283	
Vert.	2485.651	AV	34.35	27.80	14.37	36.79	2.39	42.12	53.90	11.8	200	288	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.95 m / 3.0 m) = 2.39 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]	Averaging factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4960.000	AV	51.94	31.45	6.94	37.07	2.19	-34.49	2.39	23.35	53.90	30.6	
Hori.	7440.000	AV	32.85	37.11	8.75	37.95	2.19	-34.49	2.39	10.85	53.90	43.1	
Hori.	9920.000	AV	34.46	38.87	9.72	38.87	2.19	-34.49	2.39	14.27	53.90	39.6	
Hori.	12400.000	AV	35.17	39.32	11.11	39.10	2.19	-34.49	2.39	16.59	53.90	37.3	
Vert.	4960.000	AV	53.32	31.45	6.94	37.07	2.19	-34.49	2.39	24.73	53.90	29.2	
Vert.	7440.000	AV	33.29	37.11	8.75	37.95	2.19	-34.49	2.39	11.29	53.90	42.6	
Vert.	9920.000	AV	33.39	38.87	9.72	38.87	2.19	-34.49	2.39	13.20	53.90	40.7	
Vert.	12400.000	AV	34.92	39.32	11.11	39.10	2.19	-34.49	2.39	16.34	53.90	37.6	

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

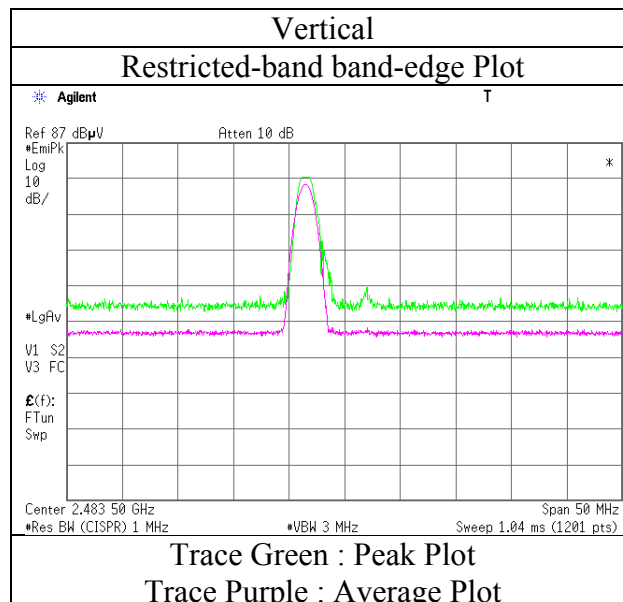
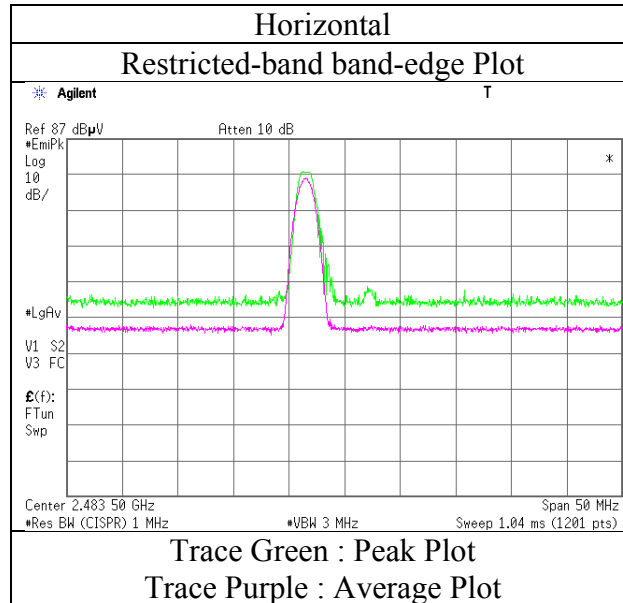
Distance factor : 1 GHz - 13 GHz : 20log(3.95 m / 3.0 m) = 2.39 dB

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

Duty factor refer to "Duty factor Calculation chart" sheet. Averaging factor refer to "Averaging factor (Duty Factor)" sheet.

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber	
Report No.	11794094S-R2	
Date	July 1, 2017	July 2, 2017
Temperature / Humidity	23 deg. C / 65 % RH	25 deg. C / 66 % RH
Engineer	Hikaru Shirasawa	Kenichi Adachi
	(1 GHz -13 GHz)	(other range)
Mode	Tx BT LE 2480 MHz, power setting +4 dBm	



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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11794094S-R2
Date : July 2, 2017
Temperature / Humidity : 25 deg. C / 66 % RH
Engineer : Kenichi Adachi

Mode : Tx BT LE 2402 MHz, power setting -20 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.30	16.81	6.67	32.13	0.00	13.65	40.00	26.4	100	0	
Hori.	192.000	QP	21.53	16.25	7.97	32.00	0.00	13.75	43.50	29.8	100	0	
Hori.	320.000	QP	21.64	13.84	8.82	31.89	0.00	12.41	46.00	33.6	100	0	
Hori.	640.000	QP	21.45	19.20	10.16	31.85	0.00	18.96	46.00	27.0	100	0	
Hori.	928.000	QP	21.23	22.03	11.14	30.67	0.00	23.73	46.00	22.3	100	0	
Hori.	2344.179	PK	51.92	27.22	4.23	36.85	-9.54	36.98	73.90	36.9	146	234	
Hori.	2390.000	PK	47.69	27.41	4.27	36.83	-9.54	33.00	73.90	40.9	146	234	
Hori.	4804.000	PK	46.96	31.13	6.79	36.99	-9.54	38.35	73.90	35.6	156	159	
Hori.	7206.000	PK	43.40	36.44	8.41	37.81	-9.54	40.90	73.90	33.0	150	0	
Hori.	9608.000	PK	45.58	38.63	9.48	38.48	-9.54	45.67	73.90	28.2	150	0	
Hori.	12010.000	PK	46.13	39.28	10.57	39.18	-9.54	47.26	73.90	26.6	150	0	
Hori.	2344.179	AV	34.29	27.22	4.23	36.85	-9.54	19.35	53.90	34.6	146	234	
Hori.	2390.000	AV	32.98	27.41	4.27	36.83	-9.54	18.29	53.90	35.6	146	234	
Vert.	32.000	QP	22.32	16.81	6.67	32.13	0.00	13.67	40.00	26.3	100	0	
Vert.	192.000	QP	21.55	16.25	7.97	32.00	0.00	13.77	43.50	29.7	100	0	
Vert.	320.000	QP	21.61	13.84	8.82	31.89	0.00	12.38	46.00	33.6	100	0	
Vert.	640.000	QP	21.43	19.20	10.16	31.85	0.00	18.94	46.00	27.1	100	0	
Vert.	928.000	QP	21.21	22.03	11.14	30.67	0.00	23.71	46.00	22.3	100	0	
Vert.	2344.179	PK	50.99	27.22	4.23	36.85	-9.54	36.05	73.90	37.9	100	74	
Vert.	2390.000	PK	44.73	27.41	4.27	36.83	-9.54	30.04	73.90	43.9	100	74	
Vert.	4804.000	PK	46.61	31.13	6.79	36.99	-9.54	38.00	73.90	35.9	147	71	
Vert.	7206.000	PK	43.49	36.44	8.41	37.81	-9.54	40.99	73.90	32.9	150	0	
Vert.	9608.000	PK	45.52	38.63	9.48	38.48	-9.54	45.61	73.90	28.3	150	0	
Vert.	12010.000	PK	46.04	39.28	10.57	39.18	-9.54	47.17	73.90	26.7	150	0	
Vert.	2344.179	AV	34.22	27.22	4.23	36.85	-9.54	19.28	53.90	34.6	100	74	
Vert.	2390.000	AV	33.67	27.41	4.27	36.83	-9.54	18.98	53.90	34.9	100	74	

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

Distance factor : 1 GHz - 13 GHz : 20log(1.0 m / 3.0 m) = -9.54 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]	Averageing factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4804.000	AV	38.42	31.13	6.79	36.99	2.19	-34.49	-9.54	-2.49	53.90	56.4	
Hori.	7206.000	AV	33.94	36.44	8.41	37.81	2.19	-34.49	-9.54	-0.86	53.90	54.8	
Hori.	9608.000	AV	36.22	38.63	9.48	38.48	2.19	-34.49	-9.54	4.01	53.90	49.9	
Hori.	12010.000	AV	37.45	39.28	10.57	39.18	2.19	-34.49	-9.54	6.28	53.90	47.6	
Vert.	4804.000	AV	37.90	31.13	6.79	36.99	2.19	-34.49	-9.54	-3.01	53.90	56.9	
Vert.	7206.000	AV	33.97	36.44	8.41	37.81	2.19	-34.49	-9.54	-0.83	53.90	54.7	
Vert.	9608.000	AV	36.14	38.63	9.48	38.48	2.19	-34.49	-9.54	3.93	53.90	50.0	
Vert.	12010.000	AV	37.37	39.28	10.57	39.18	2.19	-34.49	-9.54	6.20	53.90	47.7	

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

Distance factor : 1 GHz - 13 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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

Duty factor refer to "Duty factor Calculation chart" sheet. Averageing factor refer to "Averageing factor (Duty Factor)" sheet.

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	74.69	27.46	4.28	36.83	-9.54	60.06	-	-	Carrier
Hori.	2400.000	PK	39.59	27.45	4.27	36.83	-9.54	24.94	40.06	15.1	
Vert.	2402.000	PK	73.38	27.46	4.28	36.83	-9.54	58.75	-	-	Carrier
Vert.	2400.000	PK	50.10	27.45	4.27	36.83	-9.54	35.45	38.75	3.3	

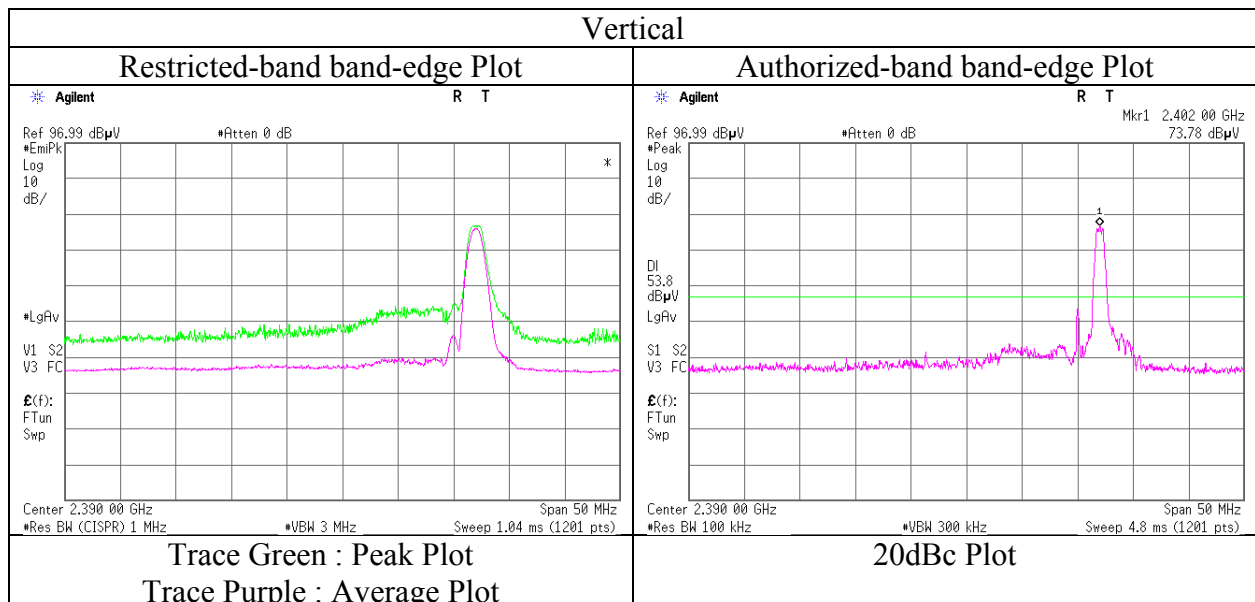
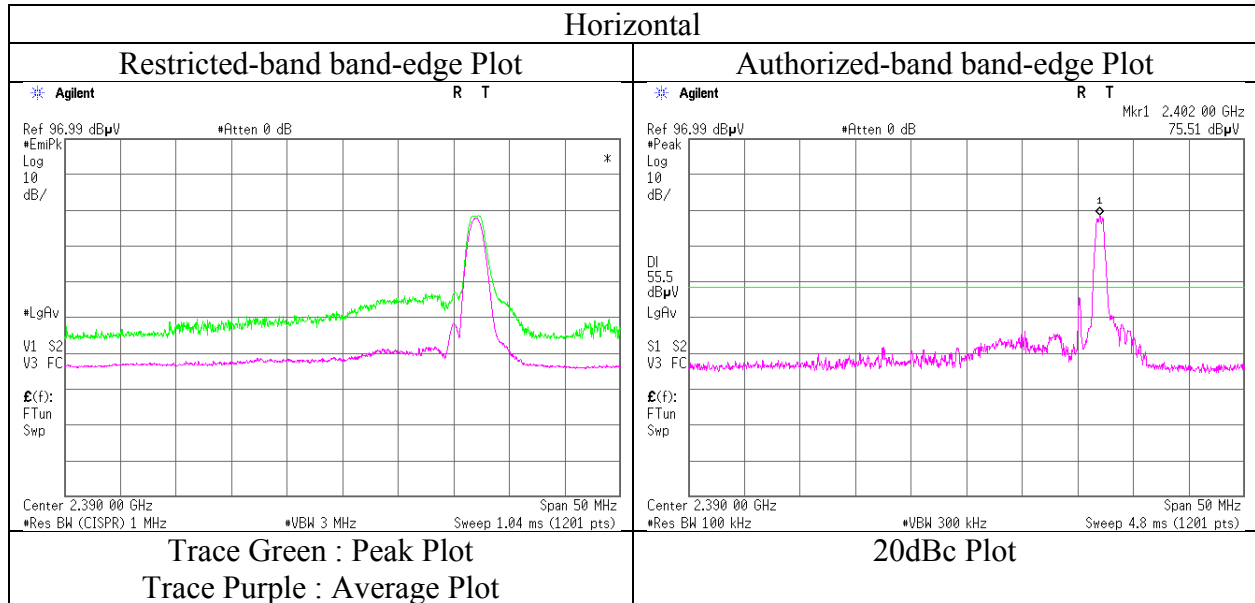
Result = Reading + Ant. Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11794094S-R2
Date	July 2, 2017
Temperature / Humidity	25 deg. C / 66 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE 2402 MHz, power setting -20 dBm



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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11794094S-R2
Date : July 2, 2017
Temperature / Humidity : 25 deg. C / 66 % RH
Engineer : Kenichi Adachi

Mode : Tx BT LE 2440 MHz, power setting -20 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.26	16.81	6.67	32.13	0.00	13.61	40.00	26.4	100	0	
Hori.	192.000	QP	21.53	16.25	7.97	32.00	0.00	13.75	43.50	29.8	100	0	
Hori.	320.000	QP	21.64	13.84	8.82	31.89	0.00	12.41	46.00	33.6	100	0	
Hori.	640.000	QP	21.44	19.20	10.16	31.85	0.00	18.95	46.00	27.1	100	0	
Hori.	928.000	QP	21.21	22.03	11.14	30.67	0.00	23.71	46.00	22.3	100	0	
Hori.	2344.858	PK	52.58	27.22	4.23	36.85	-9.54	37.64	73.90	36.3	148	233	
Hori.	4880.000	PK	46.84	31.29	6.87	37.03	-9.54	38.43	73.90	35.5	157	161	
Hori.	7320.000	PK	42.18	36.77	8.57	37.88	-9.54	40.10	73.90	33.8	150	0	
Hori.	9760.000	PK	45.55	38.75	9.60	38.67	-9.54	45.69	73.90	28.2	150	0	
Hori.	12200.000	PK	45.52	39.30	10.83	39.14	-9.54	46.97	73.90	26.9	150	0	
Hori.	2344.858	AV	34.94	27.22	4.23	36.85	-9.54	20.00	53.90	33.9	148	233	
Vert.	32.000	QP	22.27	16.81	6.67	32.13	0.00	13.62	40.00	26.4	100	0	
Vert.	192.000	QP	21.56	16.25	7.97	32.00	0.00	13.78	43.50	29.7	100	0	
Vert.	320.000	QP	21.62	13.84	8.82	31.89	0.00	12.39	46.00	33.6	100	0	
Vert.	640.000	QP	21.45	19.20	10.16	31.85	0.00	18.96	46.00	27.0	100	0	
Vert.	928.000	QP	21.24	22.03	11.14	30.67	0.00	23.74	46.00	22.3	100	0	
Vert.	2344.858	PK	51.87	27.22	4.23	36.85	-9.54	36.93	73.90	37.0	100	73	
Vert.	4880.000	PK	45.78	31.29	6.87	37.03	-9.54	37.37	73.90	36.5	156	174	
Vert.	7320.000	PK	42.25	36.77	8.57	37.88	-9.54	40.17	73.90	33.7	150	0	
Vert.	9760.000	PK	45.44	38.75	9.60	38.67	-9.54	45.58	73.90	28.3	150	0	
Vert.	12200.000	PK	45.48	39.30	10.83	39.14	-9.54	46.93	73.90	27.0	150	0	
Vert.	2344.858	AV	34.88	27.22	4.23	36.85	-9.54	19.94	53.90	34.0	100	73	

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

Distance factor : 1 GHz - 13 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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]	Averaging factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	38.54	31.29	6.87	37.03	2.19	-34.49	-9.54	-2.17	53.90	56.1	
Hori.	7320.000	AV	34.66	36.77	8.57	37.88	2.19	-34.49	-9.54	0.28	53.90	53.6	
Hori.	9760.000	AV	35.73	38.75	9.60	38.67	2.19	-34.49	-9.54	3.57	53.90	50.3	
Hori.	12200.000	AV	36.62	39.30	10.83	39.14	2.19	-34.49	-9.54	5.77	53.90	48.1	
Vert.	4880.000	AV	36.52	31.29	6.87	37.03	2.19	-34.49	-9.54	-4.19	53.90	58.1	
Vert.	7320.000	AV	34.75	36.77	8.57	37.88	2.19	-34.49	-9.54	0.37	53.90	53.5	
Vert.	9760.000	AV	35.64	38.75	9.60	38.67	2.19	-34.49	-9.54	3.48	53.90	50.4	
Vert.	12200.000	AV	36.54	39.30	10.83	39.14	2.19	-34.49	-9.54	5.69	53.90	48.2	

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

Distance factor : 1 GHz - 13 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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. Averaging factor refer to "Averaging factor (Duty Factor)" sheet.

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11794094S-R2
Date : July 2, 2017
Temperature / Humidity : 25 deg. C / 66 % RH
Engineer : Kenichi Adachi

Mode : Tx BT LE 2480 MHz, power setting -20 dBm

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.000	QP	22.29	16.81	6.67	32.13	0.00	13.64	40.00	26.4	100	0	
Hori.	192.000	QP	21.54	16.25	7.97	32.00	0.00	13.76	43.50	29.7	100	0	
Hori.	320.000	QP	21.64	13.84	8.82	31.89	0.00	12.41	46.00	33.6	100	0	
Hori.	640.000	QP	21.45	19.20	10.16	31.85	0.00	18.96	46.00	27.0	100	0	
Hori.	928.000	QP	21.25	22.03	11.14	30.67	0.00	23.75	46.00	22.3	100	0	
Hori.	2483.500	PK	53.73	27.79	4.36	36.79	-9.54	39.55	73.90	34.4	148	233	
Hori.	2487.381	PK	56.08	27.81	4.36	36.79	-9.54	41.92	73.90	32.0	148	233	
Hori.	2520.130	PK	56.07	27.88	4.38	36.78	-9.54	42.01	73.90	31.9	148	233	
Hori.	2588.422	PK	54.84	27.96	4.45	36.77	-9.54	40.94	73.90	33.0	148	233	
Hori.	4960.000	PK	46.29	31.45	6.94	37.07	-9.54	38.07	73.90	35.8	155	163	
Hori.	7440.000	PK	42.64	37.11	8.75	37.95	-9.54	41.01	73.90	32.9	150	0	
Hori.	9920.000	PK	44.76	38.87	9.72	38.87	-9.54	44.94	73.90	29.0	150	0	
Hori.	12400.000	PK	44.82	39.32	11.11	39.10	-9.54	46.61	73.90	27.3	150	0	
Hori.	2483.500	AV	33.96	27.79	4.36	36.79	-9.54	19.78	53.90	34.1	148	233	
Hori.	2487.381	AV	36.76	27.81	4.36	36.79	-9.54	22.60	53.90	31.3	148	233	
Hori.	2520.130	AV	36.48	27.88	4.38	36.78	-9.54	22.42	53.90	31.5	148	233	
Hori.	2588.422	AV	34.68	27.96	4.45	36.77	-9.54	20.78	53.90	33.1	148	233	
Vert.	32.000	QP	22.30	16.81	6.67	32.13	0.00	13.65	40.00	26.4	100	0	
Vert.	192.000	QP	21.56	16.25	7.97	32.00	0.00	13.78	43.50	29.7	100	0	
Vert.	320.000	QP	21.61	13.84	8.82	31.89	0.00	12.38	46.00	33.6	100	0	
Vert.	640.000	QP	21.43	19.20	10.16	31.85	0.00	18.94	46.00	27.1	100	0	
Vert.	928.000	QP	21.24	22.03	11.14	30.67	0.00	23.74	46.00	22.3	100	0	
Vert.	2483.500	PK	51.59	27.79	4.36	36.79	-9.54	37.41	73.90	36.5	100	71	
Vert.	2487.381	PK	55.09	27.81	4.36	36.79	-9.54	40.93	73.90	33.0	100	71	
Vert.	2520.130	PK	55.02	27.88	4.38	36.78	-9.54	40.96	73.90	32.9	100	71	
Vert.	2588.422	PK	53.48	27.96	4.45	36.77	-9.54	39.58	73.90	34.3	100	71	
Vert.	4960.000	PK	46.16	31.45	6.94	37.07	-9.54	37.94	73.90	36.0	157	72	
Vert.	7440.000	PK	42.58	37.11	8.75	37.95	-9.54	40.95	73.90	33.0	150	0	
Vert.	9920.000	PK	44.62	38.87	9.72	38.87	-9.54	44.80	73.90	29.1	150	0	
Vert.	12400.000	PK	44.74	39.32	11.11	39.10	-9.54	46.53	73.90	27.4	150	0	
Vert.	2483.500	AV	34.43	27.79	4.36	36.79	-9.54	20.25	53.90	33.7	100	71	
Vert.	2487.381	AV	35.74	27.81	4.36	36.79	-9.54	21.58	53.90	32.3	100	71	
Vert.	2520.130	AV	35.73	27.88	4.38	36.78	-9.54	21.67	53.90	32.2	100	71	
Vert.	2588.422	AV	34.91	27.96	4.45	36.77	-9.54	21.01	53.90	32.9	100	71	

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

Distance factor : 1 GHz - 13 GHz : 20log (1.0 m / 3.0 m) = -9.54 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]	Averaging factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4960.000	AV	38.11	31.45	6.94	37.07	2.19	-34.49	-9.54	-2.41	53.90	56.3	
Hori.	7440.000	AV	32.94	37.11	8.75	37.95	2.19	-34.49	-9.54	-0.99	53.90	54.9	
Hori.	9920.000	AV	34.33	38.87	9.72	38.87	2.19	-34.49	-9.54	2.21	53.90	51.7	
Hori.	12400.000	AV	34.75	39.32	11.11	39.10	2.19	-34.49	-9.54	4.24	53.90	49.7	
Vert.	4960.000	AV	37.72	31.45	6.94	37.07	2.19	-34.49	-9.54	-2.80	53.90	56.7	
Vert.	7440.000	AV	32.89	37.11	8.75	37.95	2.19	-34.49	-9.54	-1.04	53.90	54.9	
Vert.	9920.000	AV	34.23	38.87	9.72	38.87	2.19	-34.49	-9.54	2.11	53.90	51.8	
Vert.	12400.000	AV	34.68	39.32	11.11	39.10	2.19	-34.49	-9.54	4.17	53.90	49.7	

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

Distance factor : 1 GHz - 13 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

Duty factor refer to "Duty factor Calculation chart" sheet. Averaging factor refer to "Averaging factor (Duty Factor)" sheet.

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2480.000	PK	76.72	27.78	4.36	36.79	-9.54	62.53	-	-	Carrier
Hori.	2487.381	PK	54.26	27.81	4.36	36.79	-9.54	40.10	42.53	2.4	
Hori.	2520.130	PK	51.17	27.88	4.38	36.78	-9.54	37.11	42.53	5.4	
Vert.	2480.000	PK	74.65	27.78	4.36	36.79	-9.54	60.46	-	-	Carrier
Vert.	2487.381	PK	52.90	27.81	4.36	36.79	-9.54	38.74	40.46	1.7	
Vert.	2520.130	PK	52.78	27.88	4.38	36.78	-9.54	38.72	40.46	1.7	

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

Distance factor : 1 GHz - 13 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

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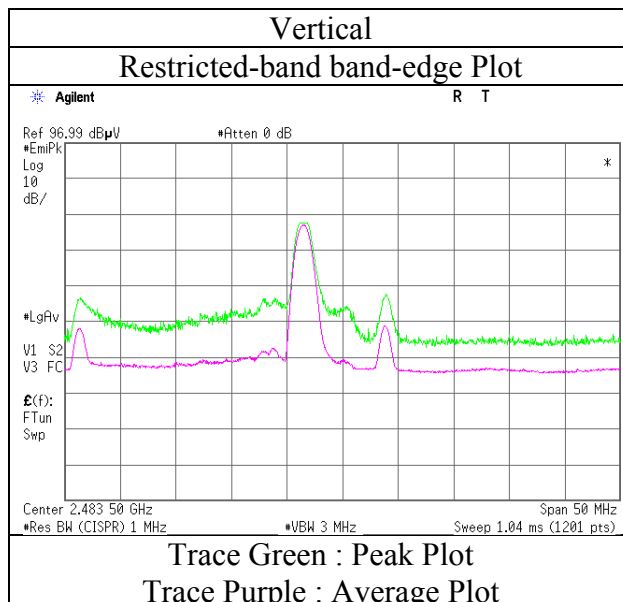
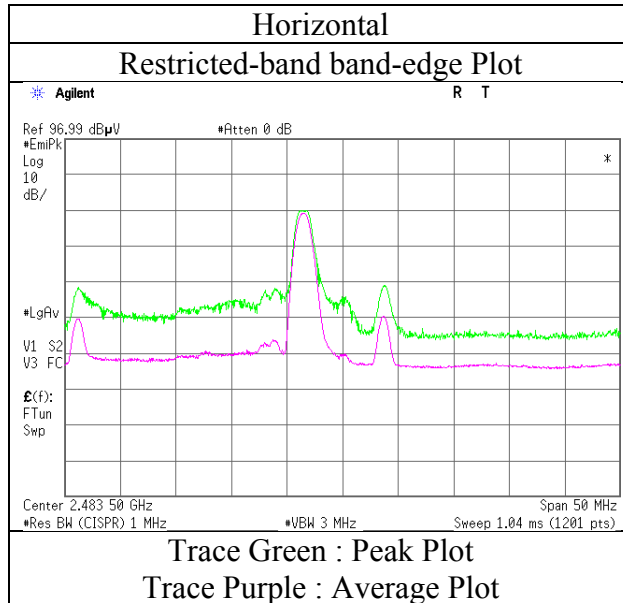
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

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Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11794094S-R2
Date	July 2, 2017
Temperature / Humidity	25 deg. C / 66 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE 2480 MHz, power setting -20 dBm

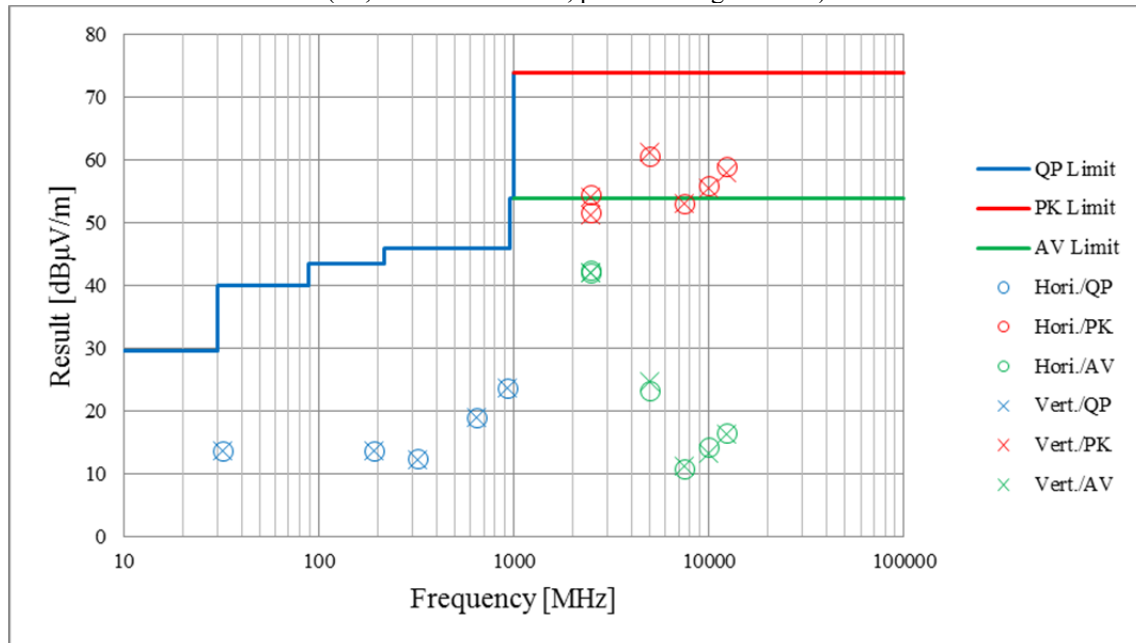


* Final result of restricted band edge was shown in tabular data.

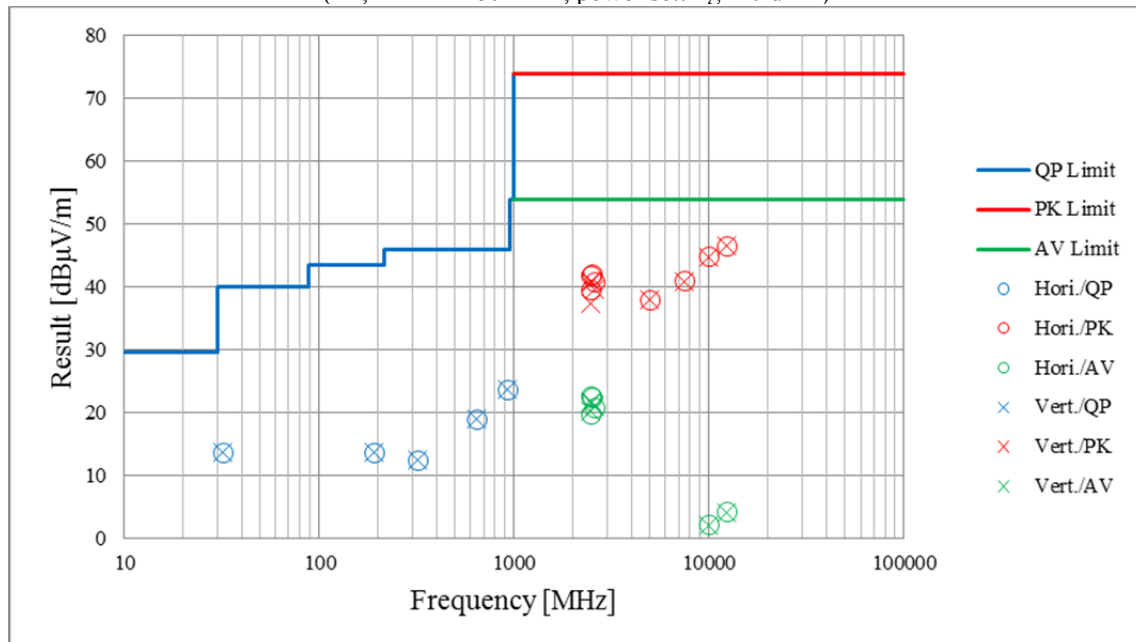
Radiated Spurious Emission (Plot data, Worst case)

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber	
Report No.	11794094S-R2	
Date	July 1, 2017	July 2, 2017
Temperature / Humidity	23 deg. C / 65 % RH	25 deg. C / 66 % RH
Engineer	Hikaru Shirasawa	Kenichi Adachi
	(1 GHz -13 GHz)	(other range)
Mode	Tx BT LE 2480 MHz, power setting +4 dBm	

(Tx, BTLE 2480 MHz, power setting +4 dBm)



(Tx, BTLE 2480 MHz, power setting -20 dBm)



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

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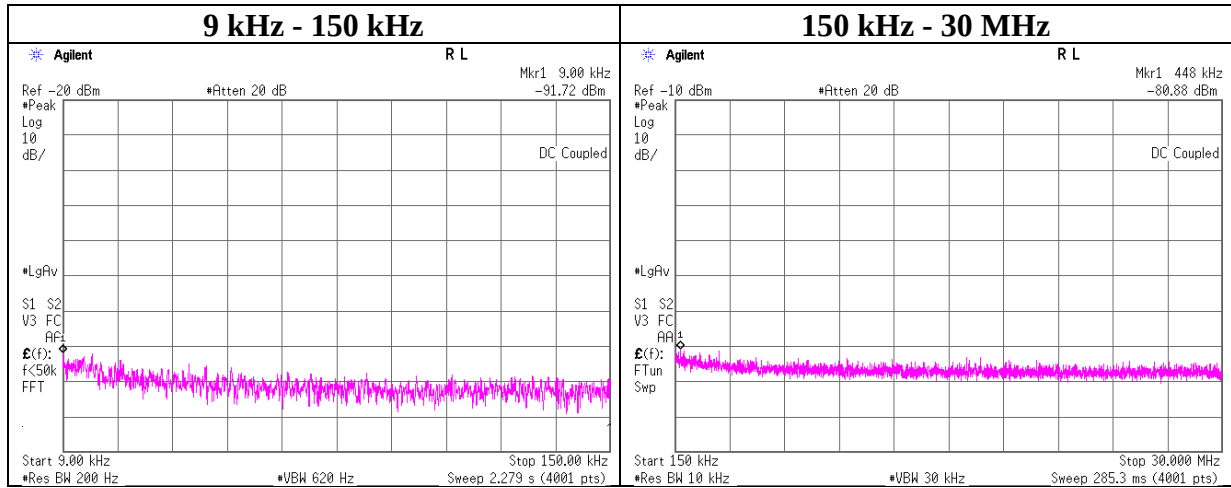
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Conducted Spurious Emission

Test place : Shonan EMC Lab. No.1 Measurement Room
Report No. : 11794094S-R2
Date : July 5, 2017
Temperature / Humidity : 23 deg. C / 68 % RH
Engineer : Hikaru Shirasawa
Mode : Tx BT LE 2402 MHz, power setting +4 dBm



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9	-91.7	0.01	9.7	2.0	1	-80.0	300	6.0	-18.7	48.5	67.2	
448	-80.9	0.01	9.7	2.0	1	-69.1	300	6.0	-7.9	14.5	22.4	

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

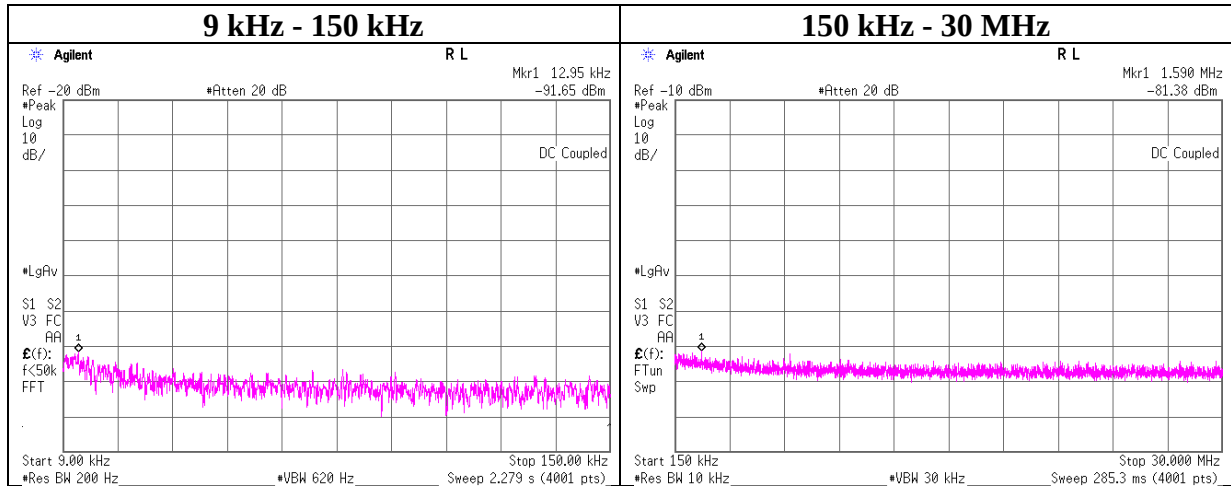
$EIRP[dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output (= 1 (*The antenna port of this EUT is one port))

*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.1 Measurement Room
Report No. : 11794094S-R2
Date : July 5, 2017
Temperature / Humidity : 23 deg. C / 68 % RH
Engineer : Hikaru Shirasawa
Mode : Tx BT LE 2440 MHz, power setting +4 dBm



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12.95	-91.7	0.01	9.7	2.0	1	-79.9	300	6.0	-18.7	45.3	64.0	
1590.00	-81.4	0.01	9.7	2.0	1	-69.6	30	6.0	11.6	23.5	11.9	

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

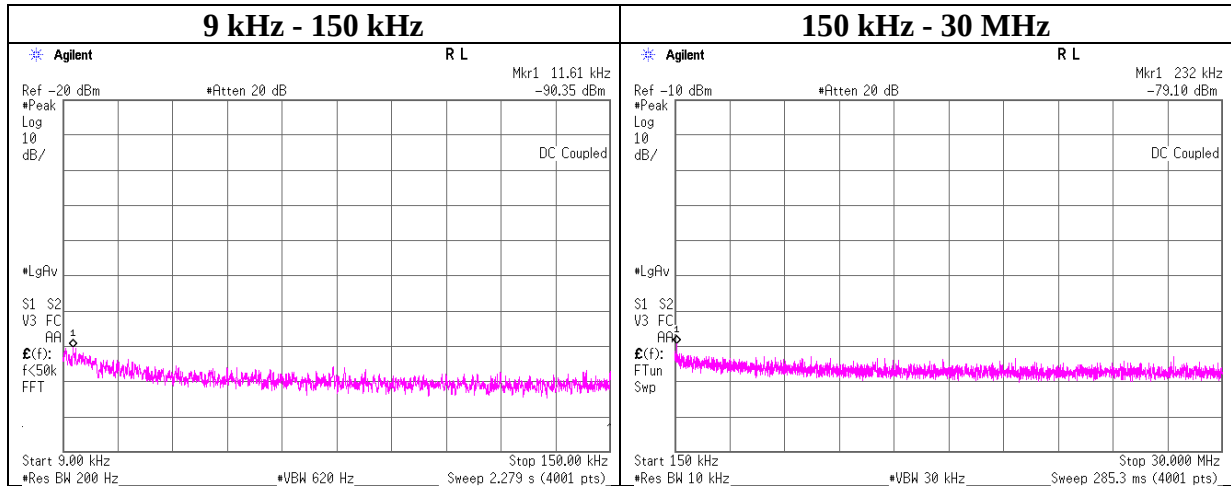
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output (= 1 (*The antenna port of this EUT is one port))

*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.1 Measurement Room
Report No. : 11794094S-R2
Date : July 5, 2017
Temperature / Humidity : 23 deg. C / 68 % RH
Engineer : Hikaru Shirasawa
Mode : Tx BT LE 2480 MHz, power setting +4 dBm



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.61	-90.4	0.01	9.7	2.0	1	-78.6	300	6.0	-17.4	46.3	63.7	
232.00	-79.1	0.01	9.7	2.0	1	-67.4	300	6.0	-6.1	20.2	26.3	

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

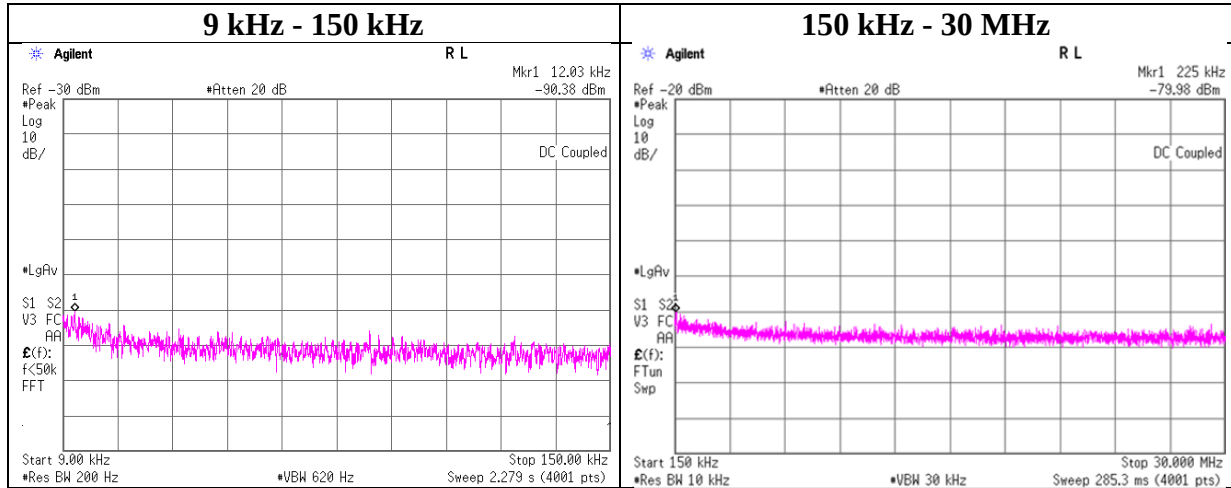
$EIRP[dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output (= 1 (*The antenna port of this EUT is one port))

*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.1 Measurement Room
Report No. : 11794094S-R2
Date : July 5, 2017
Temperature / Humidity : 23 deg. C / 68 % RH
Engineer : Hikaru Shirasawa
Mode : Tx BT LE 2402 MHz, power setting -20 dBm



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12	-90.4	0.01	0.0	2.0	1	-88.4	300	6.0	-27.1	45.9	73.0	
225	-80.0	0.01	0.0	2.0	1	-78.0	300	6.0	-16.7	20.5	37.2	

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

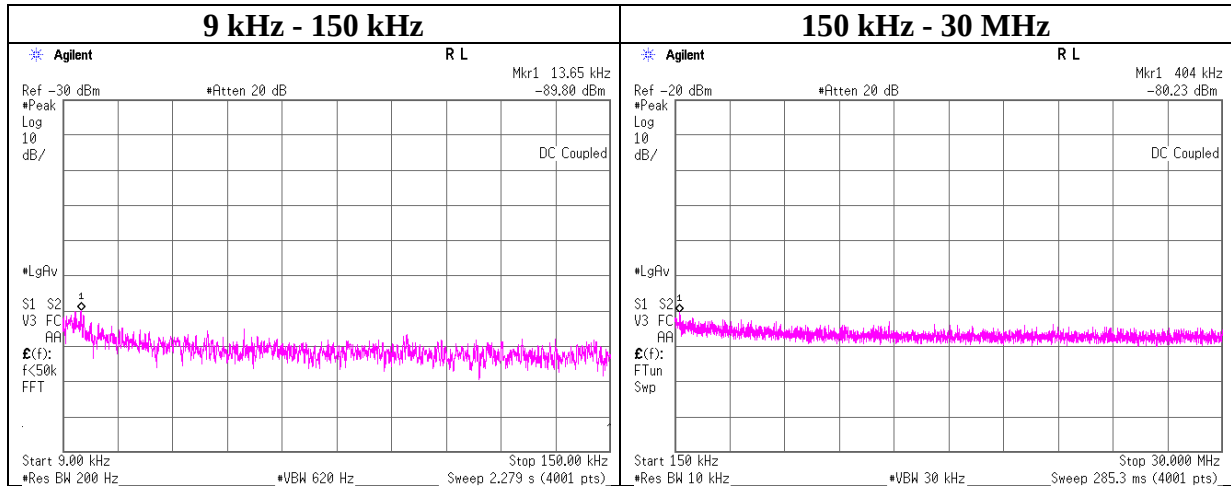
$EIRP[dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output (= 1 (*The antenna port of this EUT is one port))

*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.1 Measurement Room
Report No. : 11794094S-R2
Date : July 5, 2017
Temperature / Humidity : 23 deg. C / 68 % RH
Engineer : Hikaru Shirasawa
Mode : Tx BT LE 2440 MHz, power setting -20 dBm



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
13.65	-89.8	0.01	0.0	2.0	1	-87.8	300	6.0	-26.5	44.9	71.4	
404.00	-80.2	0.01	0.0	2.0	1	-78.2	300	6.0	-17.0	15.4	32.4	

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

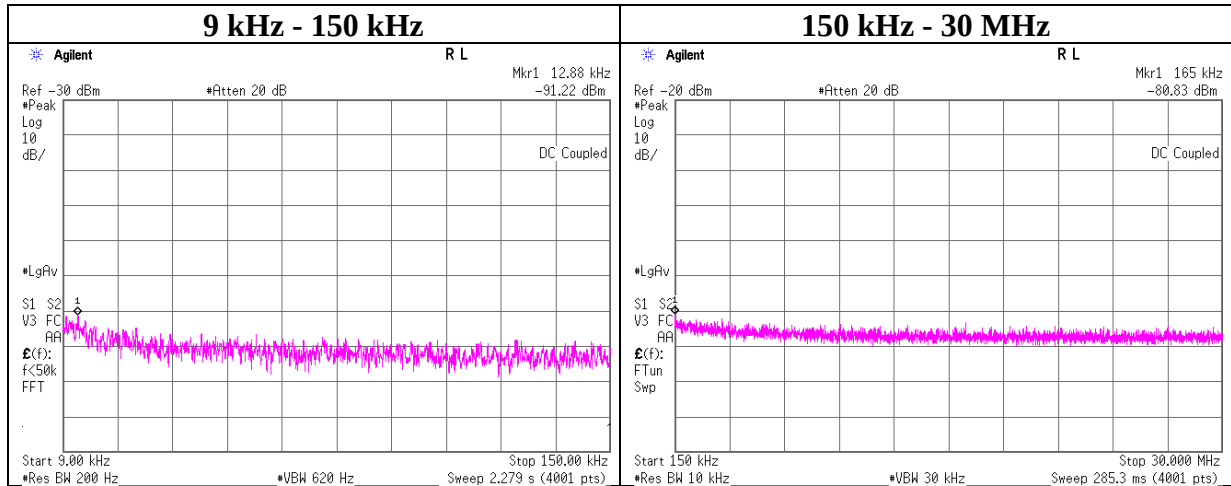
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output (= 1 (*The antenna port of this EUT is one port))

*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.1 Measurement Room
Report No. : 11794094S-R2
Date : July 5, 2017
Temperature / Humidity : 23 deg. C / 68 % RH
Engineer : Hikaru Shirasawa
Mode : Tx BT LE 2480 MHz, power setting -20 dBm



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12.88	-91.2	0.01	0.0	2.0	1	-89.2	300	6.0	-28.0	45.4	73.4	
165.00	-80.8	0.01	0.0	2.0	1	-78.8	300	6.0	-17.6	23.2	40.8	

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

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

N: Number of output (= 1 (*The antenna port of this EUT is one port))

*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.1 Measurement Room
Report No. 11794094S-R2
Date July 5, 2017
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Hikaru Shirasawa
Mode Tx BT LE

Power setting +4 dBm

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402.00	-18.77	1.10	9.80	-7.87	8.00	15.87
2440.00	-18.97	1.10	9.80	-8.07	8.00	16.07
2480.00	-18.23	1.11	9.80	-7.32	8.00	15.32

Power setting -20 dBm

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402.00	-31.28	1.10	0.00	-30.18	8.00	38.18
2440.00	-31.25	1.10	0.00	-30.15	8.00	38.15
2480.00	-30.69	1.11	0.00	-29.58	8.00	37.58

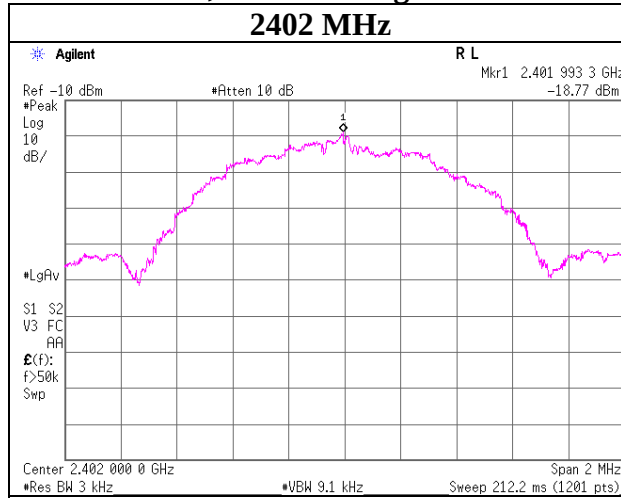
Sample Calculation:

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

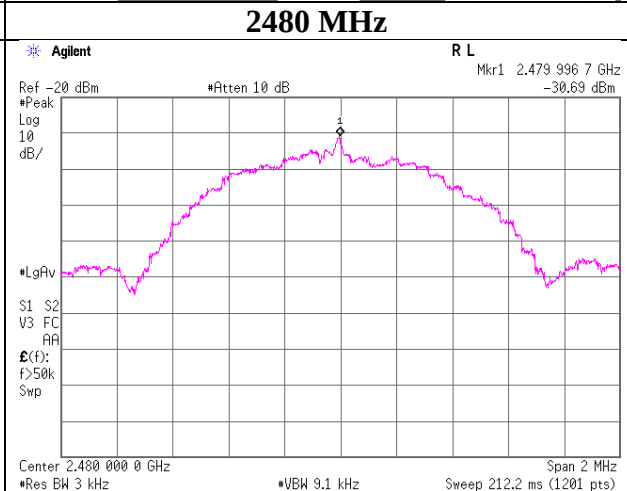
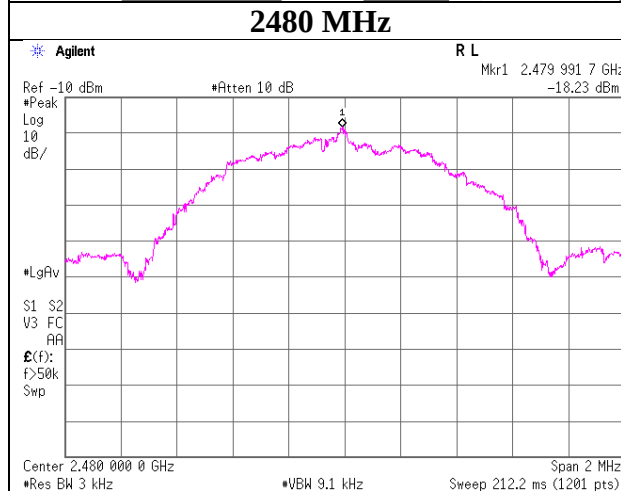
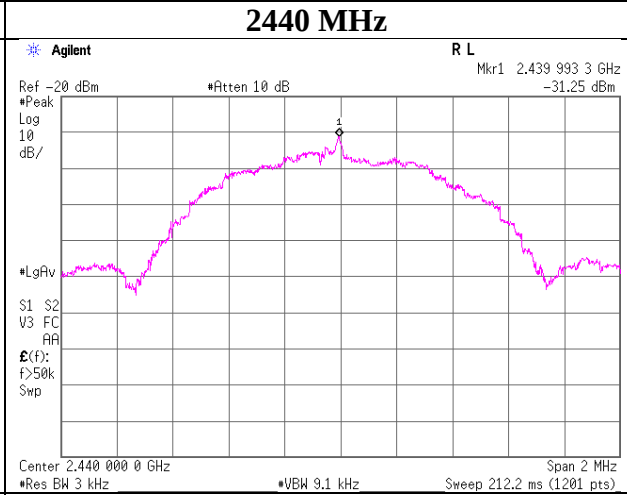
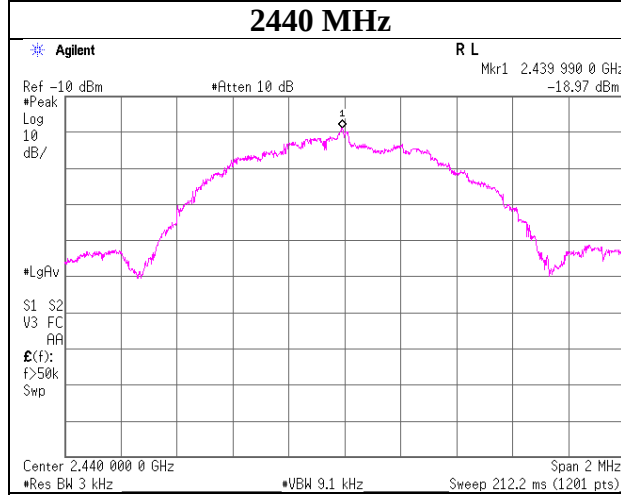
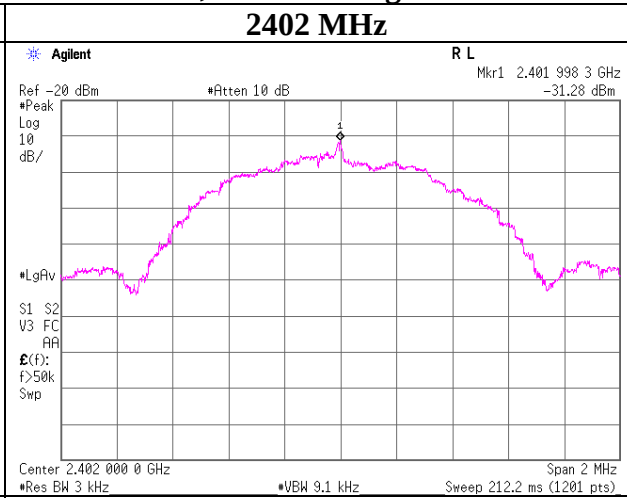
*The equipment and cables were not used for factor 0 dB of the data sheets.

Power Density

BT LE, Power setting +4 dBm



BT LE, Power setting -20 dBm



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Shonan EMC Lab.

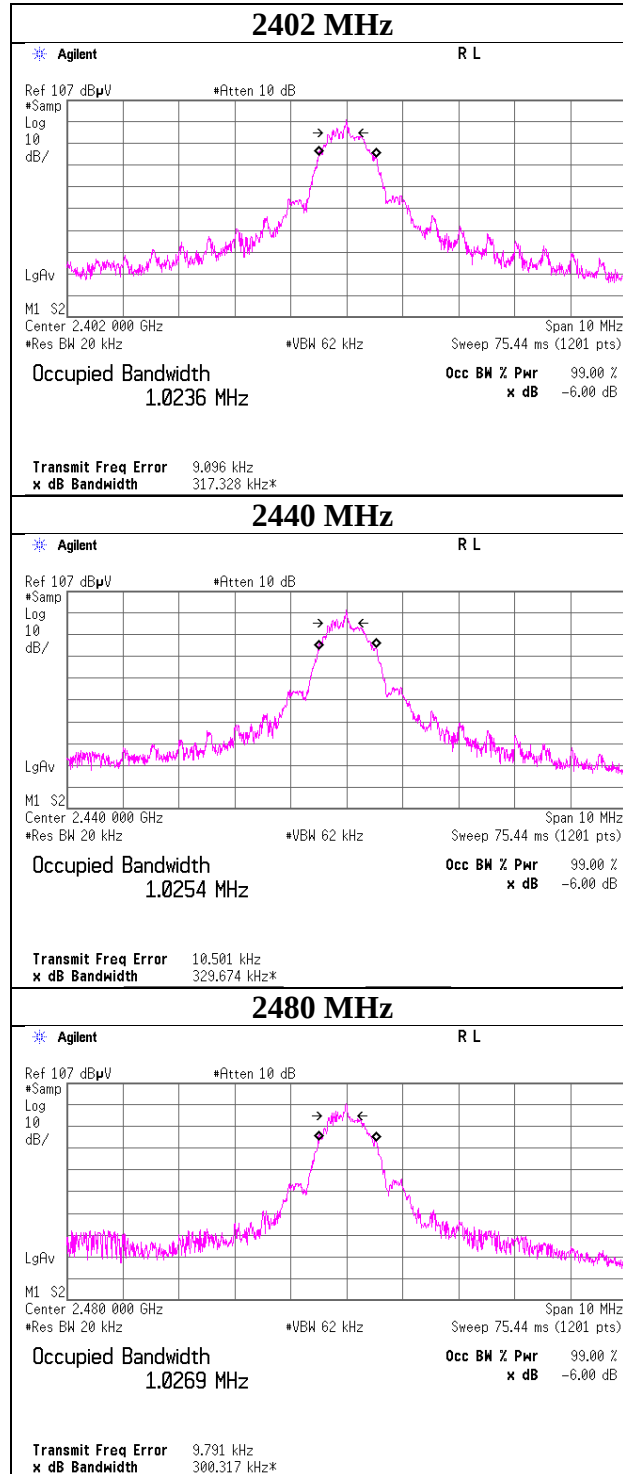
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

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99 % Occupied Bandwidth

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11794094S-R2
Date July 5, 2017
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Hikaru Shirasawa
Mode Tx BT LE, power setting +4 dBm



APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2017/02/17 * 12
SCC-G05	Coaxial Cable	Junkosha	J12J102207-00	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	MWX221-0100 0NFSNMS/B	1612S005	RE	2017/01/08 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2016/08/22 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2016/10/12 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2017/03/07 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE, CE	-
SAEC-03(SV SWR)	Semi-Anechoic Chamber	TDK	SAEC-03(SVS WR)	3	RE	2016/07/25 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE, CE,RFI,MF)	-	RE, CE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE, CE	2016/10/17 * 12
SAT10-05	Attenuator(above1G Hz)	Agilent	8493C-010	74864	RE	2016/11/07 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2016/11/29 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2017/03/15 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2016/09/27 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-0100 0KMSKMS	-	RE	2017/04/20 * 12
SCC-G20	Coaxial Cable	Junkosha	J12J102518-00	APR-15-15-003	RE	2017/04/20 * 12
SAEC-03(NS A)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2017/06/11 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2016/10/18 * 12
SLA-07	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	RE	2017/01/26 * 12
SAT6-08	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	RE	2016/08/04 * 12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(R F Selector)	RE	2017/04/07 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2017/02/09 * 12

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

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

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

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

UL Japan, Inc.

Shonan EMC Lab.

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Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	RE, CE	2016/11/08 * 12
SCC-C9/C10/ SRSE-03	Coaxial Cable&RF Selector	Suhner/Suhner/TOY O	RG223U/141PE /NS4906	-/0901-271(R F Selector)	CE	2017/04/07 * 12
SLS-05	LISN	Rohde & Schwarz	ENV216	100516	CE	2017/02/27 * 12
SAT3-07	Attenuator	JFW	50HF-003N	-	CE	2016/09/23 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	CE	2016/12/13 * 12
SRENT-05	Spectrum Analyzer	KEYSIGHT	E4440A	MY46187752	AT	2016/11/04 * 12
KPM-08	Power meter	Anritsu	ML2495A	6K00003356	AT	2016/09/05 * 12
KPSS-04	Power sensor	Anritsu	MA2411B	012088	AT	2016/09/05 * 12
SCC-G12	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	AT	2017/03/23 * 12
SAT10-14	Attenuator	Weinschel Corp.	54A-10	81595	AT	2017/04/20 * 12
SOS-13	Humidity Indicator	Custom	CTH-202	Q.C.17	AT	2016/12/13 * 12
STS-05	Digital Hitester	Hioki	3805-50	080997828	AT	2016/10/17 * 12
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2017/05/01 * 12
SPSS-05	Power sensor	Agilent	N1923A	MY5349008	AT	2017/05/01 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 12
KTS-07	Digital Tester	SANWA	PC500	7019232	AT	2016/10/17 * 12

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

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Test Item: CE: Conducted Emission test
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