




RADIO TEST REPORT


Test Report No. : 11733126S-A-R2

Applicant : SMK Corporation
Type of Equipment : Bluetooth Low Energy Module
Model No. : FC9303M
FCC ID : GT3FC024
Test regulation : FCC Part 15 Subpart C: 2017
Test Result : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
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 11733126S-A-R1. 11733126S-A-R1 is replaced with this report.

Date of test: June 4 to 6, 2017

Representative test engineer: 
Kenichi Adachi
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

REVISION HISTORY

Original Test Report No.: 11733126S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	11733126S-A	June 22, 2017	-	-
1	11733126S-A-R1	June 26, 2017	1,4,8	Update of Type of Equipment
2	11733126S-A-R2	June 29, 2017	6 25-27	Correction of 3.4 Addition comment

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	16
Maximum Peak Output Power	17
Average Output Power	17
Duty Factor Calculation chart	18
Radiated Spurious Emission	19
Conducted Spurious Emission	25
Power Density	28
99 % Occupied Bandwidth.....	29
APPENDIX 2: Test instruments	30
APPENDIX 3: Photographs of test setup	32
Conducted Emission	32
Radiated Spurious Emission	33
Pre-check of Worst Case Position.....	34

SECTION 1: Customer information

Company Name : SMK Corporation
Address : 5-5, Togoshi 6-chome, Sinagawa-ku, 142-8511 Tokyo
Telephone Number : +81-3-3785-1110
Facsimile Number : +81-3-3785-2804
Contact Person : Hiroshi Fujikawa

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

2.1 Identification of E.U.T.

Type of Equipment : Bluetooth Low Energy Module
Model No. : FC9303M
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 1.8 V to 3.6 V (Typical DC 3.0 V)
Receipt Date of Sample : June 4, 2017
Country of Mass-production : China
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: FC9303M (referred to as the EUT in this report) is a Bluetooth Low Energy Module.

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Power Supply (radio part input) : DC 1.6 V
Antenna type : Monopole antenna (Inverted-F antenna)
Antenna Gain : +0.59 dBi max
Clock frequency : 16 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 902-928 MHz,
2400-2483.5 MHz, and 5725-5850 MHz

* 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	30.1 dB 0.39791 MHz, N, QP Tx 2440 MHz	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: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	2.2 dB 7320 MHz, AV, Vertical Tx 2440 MHz, 7440 MHz, AV, Vertical Tx 2480 MHz	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 IC is constantly provided voltage (DC1.6 V) through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC 15.203/212

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.

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

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	-	-
	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

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

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

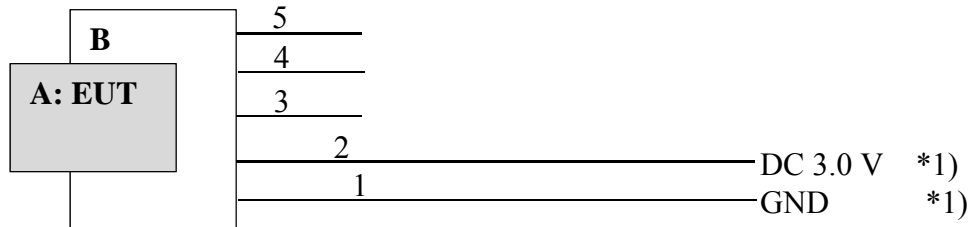
Refer to APPENDIX.

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	Packet length 37 bytes, PRBS9
*Transmitting duty was refer to APPENDIX. *Power of the EUT was set by the software as follows; Power settings: Fixed Software: nRFgo Studio.exe version 1.21.2.10 *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



*1) DC power supply (Model No.: PAN55-20A) was used for DC 3.0 V / GND input.

*2) 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	Bluetooth Low Energy Module	FC9303M	20170530001, *1) 20170530002 *2)	SMK	EUT
B	Jig	-	-	SMK	-

*1) Used for Antenna Terminal conducted test

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

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC (-)	3.2 1.0 *3)	Unshielded	Unshielded	-
2	DC (+)	3.2 1.0 *3)	Unshielded	Unshielded	-
3	Signal (red line)	0.1	Unshielded	Unshielded	-
4	Signal (white line)	0.1	Unshielded	Unshielded	-
5	Signal (black line)	0.1	Unshielded	Unshielded	-

*3) Used for Conducted Emission test

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 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.

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 "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 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	3.98 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)		3.98 m *2) (1 GHz – 13 GHz), 1 m *3) (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: $20 \times \log(3.98 \text{ m} / 3.0 \text{ m}) = 2.45 \text{ dB}$

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

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

- 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	X	Z	Z	X	X
Vertical	Z	Z	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	2 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 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).

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

Test data : APPENDIX

Test result : Pass

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

APPENDIX 1: Test data

Conducted Emission

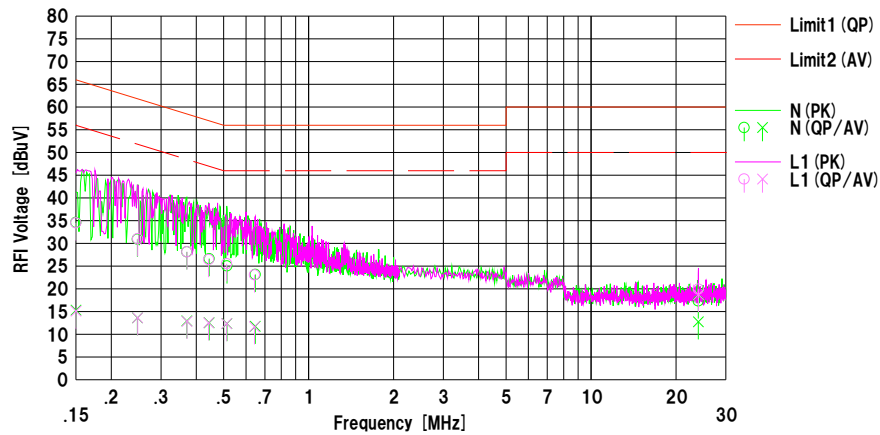
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2017/06/06

Mode : Bluetooth Low Energy Tx 2402 MHz
Power : DC 3.0 V
Temp./Humi. : 23 deg.C / 48 %RH

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

Engineer : Kazutaka Takeyama



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	22.20	2.90	12.40	34.60	13.30	66.00	56.00	31.4	40.7	N	
2	0.24780	18.50	1.20	12.41	30.91	13.61	61.83	51.83	30.9	38.2	N	
3	0.37052	15.70	0.50	12.44	28.14	12.94	58.49	48.49	30.3	35.5	N	
4	0.44450	14.20	0.10	12.43	26.63	12.53	56.98	46.98	30.3	34.4	N	
5	0.51367	12.60	-0.10	12.43	25.03	12.33	56.00	46.00	30.9	33.6	N	
6	0.64724	10.70	-0.70	12.45	23.15	11.75	56.00	46.00	32.8	34.2	N	
7	23.98681	3.80	-0.80	13.53	17.33	12.73	60.00	50.00	42.6	37.2	N	
8	0.15000	22.10	2.70	12.40	34.50	15.10	66.00	56.00	31.5	40.9	L1	
9	0.24802	18.60	1.20	12.41	31.01	13.61	61.82	51.82	30.8	38.2	L1	
10	0.37081	15.70	0.40	12.44	28.14	12.84	58.48	48.48	30.3	35.6	L1	
11	0.44256	14.00	0.10	12.43	26.43	12.53	57.01	47.01	30.5	34.4	L1	
12	0.51277	13.10	-0.10	12.43	25.53	12.33	56.00	46.00	30.4	33.6	L1	
13	0.64354	10.60	-0.80	12.45	23.05	11.65	56.00	46.00	32.9	34.3	L1	
14	24.00163	6.40	5.20	13.53	19.93	18.73	60.00	50.00	40.0	31.2	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN:SLS-01

Conducted Emission

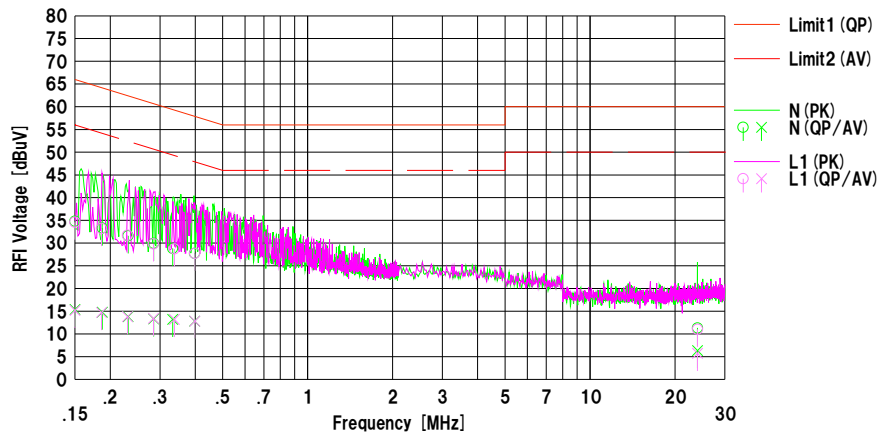
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2017/06/06

Mode : Bluetooth Low Energy Tx 2440 MHz
Power : DC 3.0 V
Temp./Humi. : 23 deg.C / 48 %RH

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
		<OP> [dBuV]	<AV> [dBuV]		[dB]	<OP> [dBuV]	<AV> [dBuV]	<OP> [dBuV]	<AV> [dBuV]	<OP> [dB]		
1	0.15000	22.40	3.00	12.40	34.80	15.40	66.00	56.00	31.2	40.6	N	
2	0.18740	20.90	2.40	12.41	33.31	14.81	64.15	54.15	30.8	39.3	N	
3	0.23142	19.20	1.40	12.41	31.61	13.81	62.40	52.40	30.7	38.5	N	
4	0.28515	17.50	0.90	12.43	29.93	13.33	60.66	50.66	30.7	37.3	N	
5	0.33277	16.40	0.80	12.43	28.83	13.23	59.38	49.38	30.5	36.1	N	
6	0.39791	15.30	0.40	12.44	27.74	12.84	57.90	47.90	30.1	35.0	N	
7	24.03141	-2.20	-7.20	13.53	11.33	6.33	60.00	50.00	48.6	43.6	N	
8	0.15000	22.20	2.80	12.40	34.90	15.20	66.00	56.00	31.4	40.8	L1	
9	0.18640	20.80	2.30	12.41	33.21	14.71	64.20	54.20	30.9	39.4	L1	
10	0.23032	19.30	1.40	12.41	31.71	13.81	62.44	52.44	30.7	38.6	L1	
11	0.28466	17.40	1.00	12.43	29.83	13.43	60.68	50.68	30.8	37.2	L1	
12	0.33768	16.30	0.80	12.43	28.73	13.23	59.26	49.26	30.5	36.0	L1	
13	0.39865	15.30	0.40	12.44	27.74	12.84	57.88	47.88	30.1	35.0	L1	
14	24.02520	-2.50	-7.80	13.53	11.03	5.72	60.00	50.00	48.9	44.2	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN:SLS-01

Conducted Emission

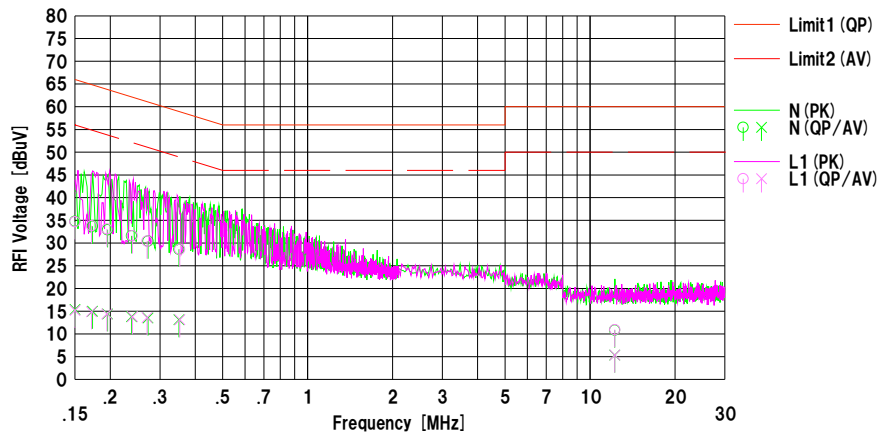
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2017/06/06

Mode : Bluetooth Low Energ Tx 2480 MHz
Power : DC 3.0 V
Temp./Humi. : 23 deg.C / 48 %RH

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	0.15000	22.40	3.00	12.40	34.80	15.40	66.00	56.00	31.2	40.6	N	
2	0.17307	21.30	2.60	12.41	33.71	15.01	64.81	54.81	31.1	39.8	N	
3	0.19566	20.50	2.00	12.42	32.92	14.42	63.79	53.79	30.8	39.3	N	
4	0.23797	19.20	1.40	12.41	31.61	13.81	62.17	52.17	30.5	38.3	N	
5	0.27210	18.00	1.10	12.42	30.42	13.52	61.05	51.05	30.6	37.5	N	
6	0.35028	16.20	0.70	12.43	28.63	13.13	58.96	48.96	30.3	35.8	N	
7	12.22818	-2.30	-7.80	13.14	10.84	5.34	60.00	50.00	49.1	44.6	N	
8	0.15000	22.30	2.80	12.40	34.70	15.20	66.00	56.00	31.3	40.8	L1	
9	0.17182	21.40	2.50	12.41	33.81	14.91	64.87	54.87	31.0	39.9	L1	
10	0.19466	20.70	2.00	12.42	33.12	14.42	63.84	53.84	30.7	39.4	L1	
11	0.23962	19.20	1.40	12.41	31.61	13.81	62.11	52.11	30.5	38.3	L1	
12	0.27031	18.00	1.20	12.42	30.42	13.62	61.11	51.11	30.6	37.4	L1	
13	0.35269	16.20	0.70	12.43	28.63	13.13	58.90	48.90	30.2	35.7	L1	
14	12.23608	-2.20	-7.80	13.14	10.94	5.34	60.00	50.00	49.0	44.6	L1	

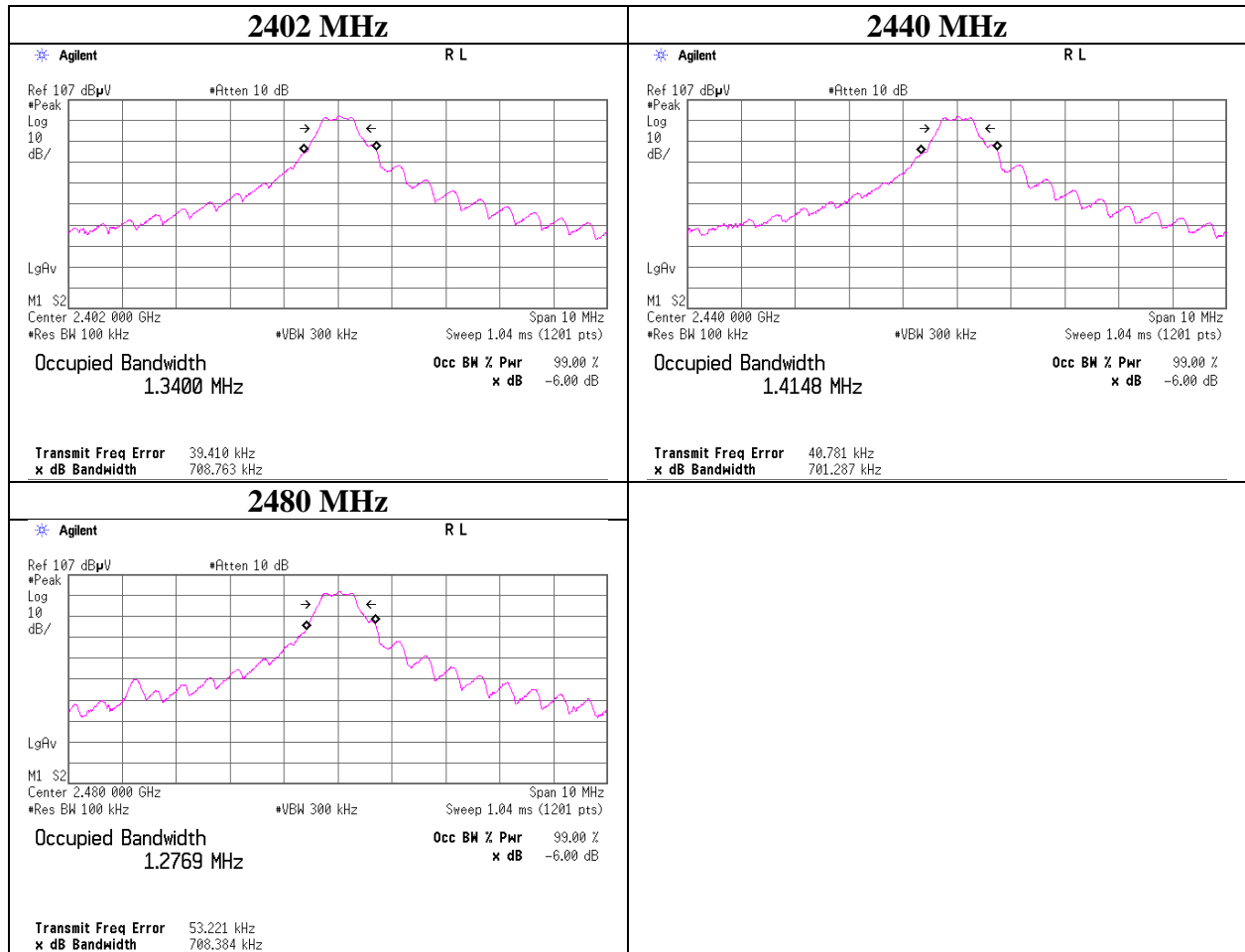
Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN:SLS-01

6 dB Bandwidth

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11733126S-A-R2
Date	June 4, 2017
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE

Mode	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [kHz]
BTLE	2402	0.709	> 500
	2440	0.701	> 500
	2480	0.708	> 500

BTLE



Maximum Peak Output Power

Test place : Shonan EMC Lab. No.1 Measurement Room
Report No. : 11733126S-A-R2
Date : June 4, 2017
Temperature / Humidity : 26 deg. C / 45 % RH
Engineer : Kenichi Adachi
Mode : Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-8.16	1.52	9.85	3.21	2.09	30.00	1000.0	26.79
2440	-8.20	1.52	9.84	3.16	2.07	30.00	1000.0	26.84
2480	-8.32	1.53	9.84	3.05	2.02	30.00	1000.0	26.95

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 / SAR testing)

Test place : Shonan EMC Lab. No.1 Measurement Room
Report No. : 11733126S-A-R2
Date : June 4, 2017
Temperature / Humidity : 26 deg. C / 45 % RH
Engineer : Kenichi Adachi
Mode : Tx BT LE

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	-9.73	1.52	9.85	1.64	1.46	1.06	2.70	1.86
2440	-9.75	1.52	9.84	1.61	1.45	1.06	2.67	1.85
2480	-9.87	1.53	9.84	1.50	1.41	1.06	2.56	1.80

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.

UL Japan, Inc.

Shonan EMC Lab.

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

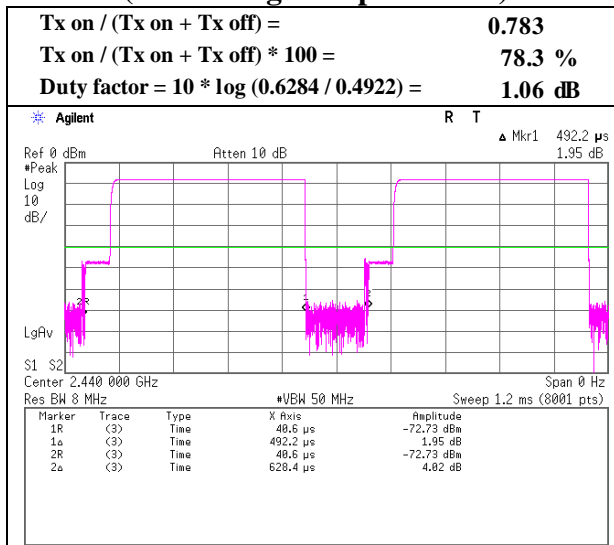
Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

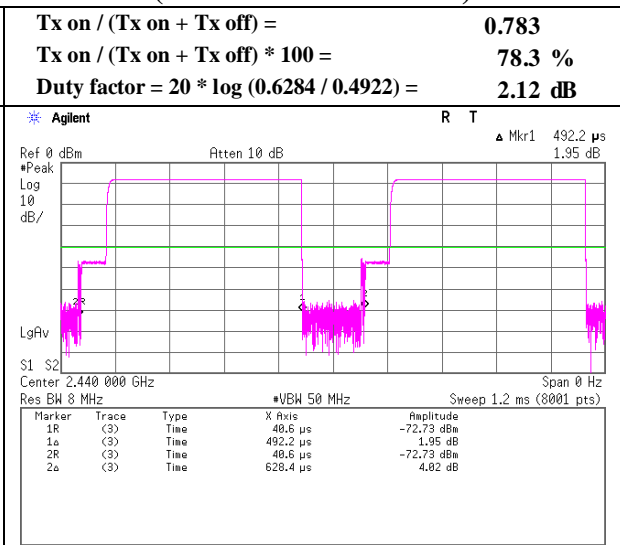
Duty Factor Calculation chart

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11733126S-A-R2
Date	June 4, 2017
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE

BTLE (for Average Output Power)



BTLE (for Radiated emission)



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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 11733126S-A-R2
Date : June 6, 2017 June 5, 2017
Temperature / Humidity : 23 deg. C / 48 % RH 23 deg. C / 38 % RH
Engineer : Kazutaka Takeyama Yosuke Ishikawa
(30 MHz - 1 GHz) (1 GHz - 13 GHz)
(13 GHz - 26.5 GHz)
Mode : Tx BT LE 2402 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	180.643	QP	21.38	16.33	8.97	31.77	0.00	14.91	43.50	28.5	100	168	
Hori.	959.177	QP	20.39	22.37	10.19	30.85	0.00	22.10	46.00	23.9	100	57	
Hori.	2323.430	PK	51.64	26.99	13.99	40.88	2.45	54.19	73.90	19.7	156	18	
Hori.	2390.000	PK	50.06	27.21	14.05	40.85	2.45	52.92	73.90	20.9	150	155	
Hori.	4804.000	PK	53.05	31.13	6.38	41.86	2.45	51.15	73.90	22.7	118	207	
Hori.	7206.400	PK	50.79	36.24	8.00	41.18	2.45	56.30	73.90	17.6	100	231	
Hori.	9608.000	PK	45.35	38.13	9.29	40.59	2.45	54.63	73.90	19.2	100	0	
Hori.	12010.000	PK	44.67	39.15	10.32	40.20	2.45	56.39	73.90	17.5	100	0	
Hori.	2323.430	AV	38.67	26.99	13.99	40.88	2.45	41.22	53.90	12.6	156	18	
Vert.	196.379	QP	22.69	16.41	9.04	31.77	0.00	16.37	43.50	27.1	100	147	
Vert.	239.998	QP	29.31	11.59	6.23	31.74	0.00	15.39	46.00	30.6	100	144	
Vert.	271.999	QP	31.02	12.48	6.52	31.74	0.00	18.28	46.00	27.7	144	112	
Vert.	855.228	QP	21.22	21.48	9.78	31.57	0.00	20.91	46.00	25.0	100	0	
Vert.	2323.715	PK	54.51	26.99	13.99	40.88	2.45	57.06	73.90	16.8	1161	134	
Vert.	2390.000	PK	51.41	27.21	14.05	40.85	2.45	54.27	73.90	19.6	144	141	
Vert.	4803.504	PK	56.50	31.13	6.38	41.87	2.45	54.59	73.90	19.3	100	193	
Vert.	7206.000	PK	51.46	36.24	8.00	41.18	2.45	56.97	73.90	16.9	100	8	
Vert.	9608.000	PK	45.87	38.13	9.29	40.59	2.45	55.15	73.90	18.7	100	0	
Vert.	12010.000	PK	44.79	39.15	10.32	40.20	2.45	56.51	73.90	17.3	100	0	
Vert.	2323.715	AV	41.04	26.99	13.99	40.88	2.45	43.59	53.90	10.3	1161	134	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.45 dB

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	38.70	27.21	14.05	40.85	2.12	2.45	43.68	53.90	10.2	*1)
Hori.	4804.000	AV	42.59	31.13	6.38	41.86	2.12	2.45	42.81	53.90	11.1	
Hori.	7206.400	AV	42.06	36.24	8.00	41.18	2.12	2.45	49.69	53.90	4.2	
Hori.	9608.000	AV	32.29	38.13	9.29	40.59	2.12	2.45	43.69	53.90	10.2	
Hori.	12010.000	AV	33.45	39.15	10.32	40.20	2.12	2.45	47.29	53.90	6.6	
Vert.	2390.000	AV	38.91	27.21	14.05	40.85	2.12	2.45	43.89	53.90	10.0	*1)
Vert.	4803.504	AV	44.91	31.13	6.38	41.87	2.12	2.45	45.12	53.90	8.8	
Vert.	7206.000	AV	41.44	36.24	8.00	41.18	2.12	2.45	49.07	53.90	4.8	
Vert.	9608.000	AV	34.89	38.13	9.29	40.59	2.12	2.45	46.29	53.90	7.6	
Vert.	12010.000	AV	34.46	39.15	10.32	40.20	2.12	2.45	48.30	53.90	5.6	

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(3.98 m / 3.0 m) = 2.45 dB

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

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

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

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	93.40	27.25	14.06	40.84	2.45	96.32	-	-	Carrier
Hori.	2400.000	PK	55.52	27.25	14.06	40.84	2.45	58.44	76.32	17.9	
Vert.	2402.000	PK	96.36	27.25	14.06	40.84	2.45	99.28	-	-	Carrier
Vert.	2400.000	PK	55.75	27.25	14.06	40.84	2.45	58.67	79.28	20.6	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.45 dB

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

UL Japan, Inc.

Shonan EMC Lab.

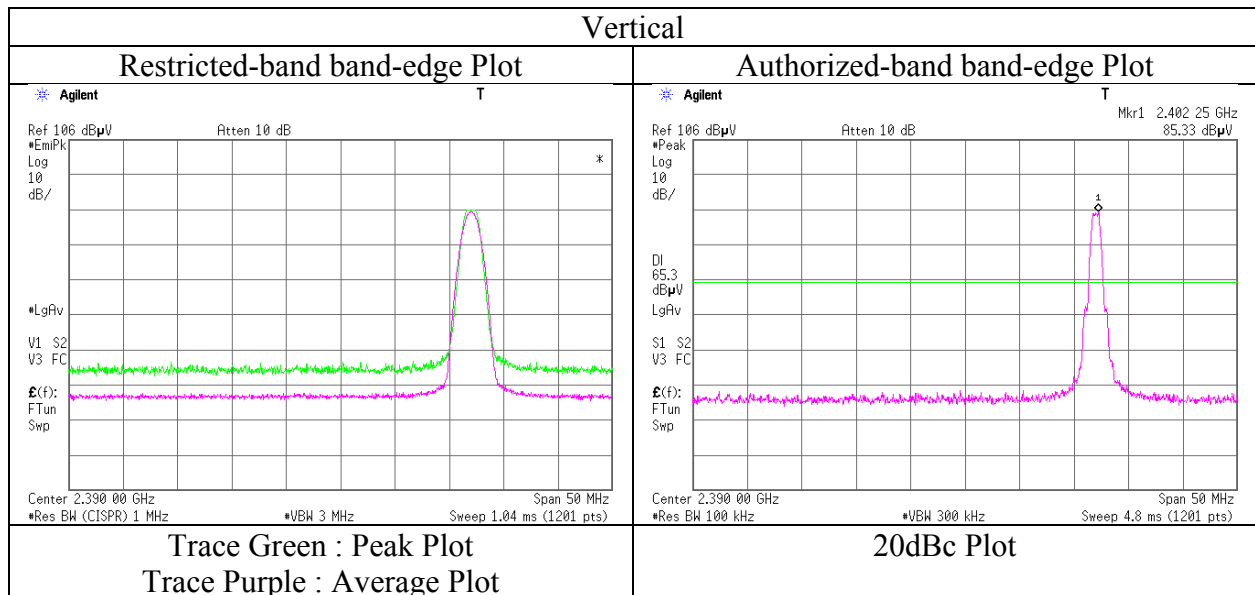
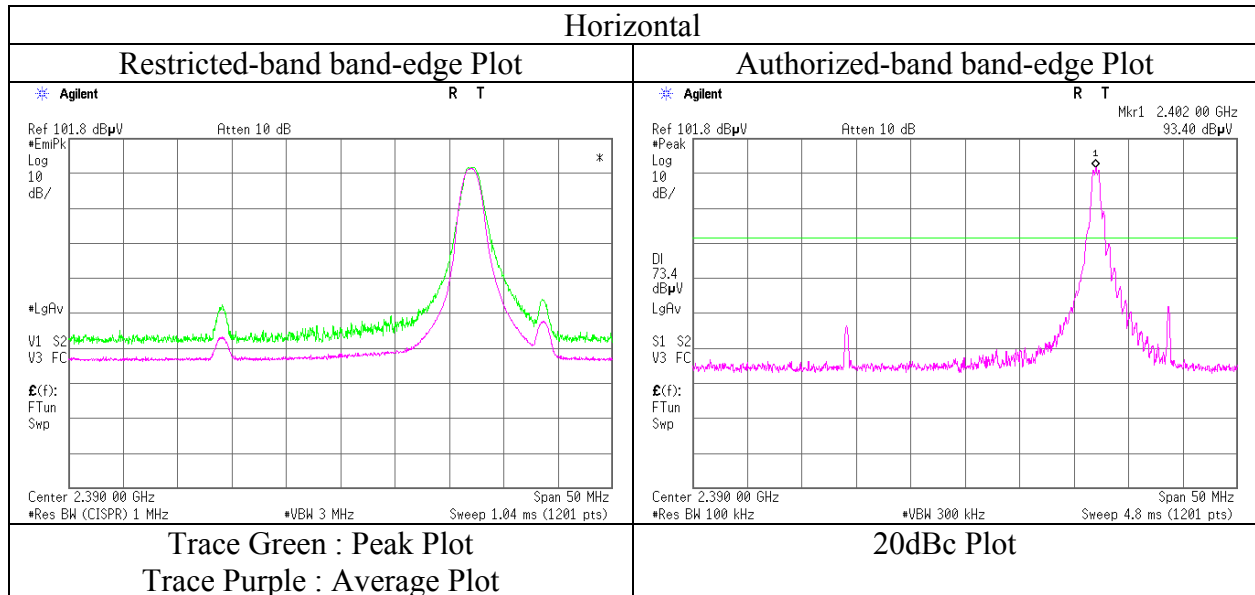
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11733126S-A-R2
Date	June 5, 2017
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Yosuke Ishikawa (1 GHz -13MHz)
Mode	Tx BT LE 2402 MHz



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

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 11733126S-A-R2
Date : June 6, 2017 June 5, 2017
Temperature / Humidity : 23 deg. C / 48 % RH 23 deg. C / 38 % RH
Engineer : Kazutaka Takeyama Yosuke Ishikawa
(30 MHz - 1 GHz) (1 GHz - 13 GHz)
(13 GHz -26.5 GHz)
Mode : Tx BT LE 2440 MHz

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	178.228	QP	21.32	16.24	9.00	31.77	0.00	14.79	43.50	28.7	100	191	
Hori.	958.333	QP	20.48	22.37	10.18	30.86	0.00	22.17	46.00	23.8	100	263	
Hori.	2569.611	PK	55.83	27.71	14.21	40.89	2.45	59.31	73.90	14.5	119	75	
Hori.	4880.000	PK	49.47	31.29	6.45	41.76	2.45	47.90	73.90	26.0	114	224	
Hori.	7320.000	PK	50.37	36.40	8.13	41.27	2.45	56.08	73.90	17.8	100	132	
Hori.	9760.000	PK	45.14	38.35	9.36	40.62	2.45	54.68	73.90	19.2	100	0	
Hori.	12200.000	PK	44.21	39.12	10.51	40.17	2.45	56.12	73.90	17.7	100	0	
Hori.	2569.611	AV	40.33	27.71	14.21	40.89	2.45	43.81	53.90	10.0	119	75	
Vert.	196.223	QP	21.98	16.41	9.18	31.77	0.00	15.80	43.50	27.7	100	15	
Vert.	240.004	QP	29.26	11.59	6.23	31.74	0.00	15.34	46.00	30.6	100	143	
Vert.	272.001	QP	31.06	12.48	6.52	31.74	0.00	18.32	46.00	27.6	147	107	
Vert.	855.174	QP	21.19	21.48	9.77	31.57	0.00	20.87	46.00	25.1	100	62	
Vert.	2570.026	PK	57.03	27.71	14.21	40.89	2.45	60.51	73.90	13.3	102	163	
Vert.	4880.000	PK	47.16	31.29	6.45	41.76	2.45	45.59	73.90	28.3	153	76	
Vert.	7320.000	PK	51.66	36.40	8.13	41.27	2.45	57.37	73.90	16.5	112	76	
Vert.	9760.000	PK	45.09	38.35	9.36	40.62	2.45	54.63	73.90	19.2	100	0	
Vert.	12200.000	PK	45.21	39.12	10.51	40.17	2.45	57.12	73.90	16.7	100	0	
Vert.	2570.026	AV	40.32	27.71	14.21	40.89	2.45	43.80	53.90	10.1	102	163	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.98\text{ m} / 3.0\text{ m}) = 2.45\text{ dB}$

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	40.30	31.29	6.45	41.76	2.12	2.45	40.85	53.90	13.0	
Hori.	7320.000	AV	40.72	36.40	8.13	41.27	2.12	2.45	48.55	53.90	5.4	
Hori.	9760.000	AV	34.10	38.35	9.36	40.62	2.12	2.45	45.76	53.90	8.1	
Hori.	12200.000	AV	34.32	39.12	10.51	40.17	2.12	2.45	48.35	53.90	5.5	
Vert.	4880.000	AV	39.87	31.29	6.45	41.76	2.12	2.45	40.42	53.90	13.5	
Vert.	7320.000	AV	43.87	36.40	8.13	41.27	2.12	2.45	51.70	53.90	2.2	
Vert.	9760.000	AV	35.93	38.35	9.36	40.62	2.12	2.45	47.59	53.90	6.3	
Vert.	12200.000	AV	35.86	39.12	10.51	40.17	2.12	2.45	49.89	53.90	4.0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.98\text{ m} / 3.0\text{ m}) = 2.45\text{ dB}$

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)

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

Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber		
Report No.	11733126S-A-R2		
Date	June 6, 2017	June 5, 2017	
Temperature / Humidity	23 deg. C / 48 % RH	23 deg. C / 38 % RH	
Engineer	Kazutaka Takeyama (30 MHz - 1 GHz) (13 GHz -26.5 GHz)	Yosuke Ishikawa (1 GHz - 13 GHz)	
Mode	Tx BT LE 2480 MHz		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	190.363	QP	21.22	16.38	9.00	31.77	0.00	14.83	43.50	28.6	100	187	
Hori.	896.107	QP	20.81	21.99	9.98	31.36	0.00	21.42	46.00	24.5	100	256	
Hori.	2483.500	PK	57.39	27.52	14.14	40.81	2.45	60.69	73.90	13.2	159	49	
Hori.	2570.041	PK	53.49	27.71	14.21	40.89	2.45	56.97	73.90	16.9	125	203	
Hori.	4960.000	PK	50.82	31.45	6.50	41.65	2.45	49.57	73.90	24.3	131	16	
Hori.	7440.000	PK	48.48	36.57	8.26	41.36	2.45	54.40	73.90	19.5	145	298	
Hori.	9920.000	PK	45.28	38.58	9.43	40.66	2.45	55.08	73.90	18.8	100	0	
Hori.	12400.000	PK	44.60	39.09	10.71	40.14	2.45	56.71	73.90	17.1	100	0	
Hori.	2570.041	AV	40.13	27.71	14.21	40.89	2.45	43.61	53.90	10.2	125	203	
Vert.	197.233	QP	21.28	16.42	9.05	31.77	0.00	14.98	43.50	28.5	100	354	
Vert.	239.989	QP	28.51	11.59	6.23	31.74	0.00	14.59	46.00	31.4	100	147	
Vert.	272.003	QP	30.94	12.48	6.52	31.74	0.00	18.20	46.00	27.8	106	113	
Vert.	857.098	QP	21.26	21.50	9.78	31.56	0.00	20.98	46.00	25.0	100	135	
Vert.	2483.500	PK	57.56	27.52	14.14	40.81	2.45	60.86	73.90	13.0	105	124	
Vert.	2570.041	PK	58.28	27.71	14.21	40.89	2.45	61.76	73.90	12.1	151	123	
Vert.	4960.000	PK	50.48	31.45	6.50	41.65	2.45	49.23	73.90	24.6	100	354	
Vert.	7440.000	PK	50.70	36.57	8.26	41.36	2.45	56.62	73.90	17.2	100	9	
Vert.	9920.000	PK	45.99	38.58	9.43	40.66	2.45	55.79	73.90	18.1	100	342	
Vert.	12400.000	PK	46.89	39.09	10.71	40.14	2.45	59.00	73.90	14.9	100	0	
Vert.	2570.041	AV	43.77	27.71	14.21	40.89	2.45	47.25	53.90	6.6	151	123	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.45 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	41.26	27.52	14.14	40.81	2.12	2.45	46.68	53.90	7.2	*1)
Hori.	4960.000	AV	41.83	31.45	6.50	41.65	2.12	2.45	42.70	53.90	11.2	
Hori.	7440.000	AV	41.58	36.57	8.26	41.36	2.12	2.45	49.62	53.90	4.3	
Hori.	9920.000	AV	35.71	38.58	9.43	40.66	2.12	2.45	47.63	53.90	6.3	
Hori.	12400.000	AV	35.03	39.09	10.71	40.14	2.12	2.45	49.26	53.90	4.6	
Vert.	2483.500	AV	44.33	27.52	14.14	40.81	2.12	2.45	49.75	53.90	4.2	*1)
Vert.	4960.000	AV	42.09	31.45	6.50	41.65	2.12	2.45	42.96	53.90	10.9	
Vert.	7440.000	AV	43.61	36.57	8.26	41.36	2.12	2.45	51.65	53.90	2.2	
Vert.	9920.000	AV	37.53	38.58	9.43	40.66	2.12	2.45	49.45	53.90	4.4	
Vert.	12400.000	AV	35.24	39.09	10.71	40.14	2.12	2.45	49.47	53.90	4.4	

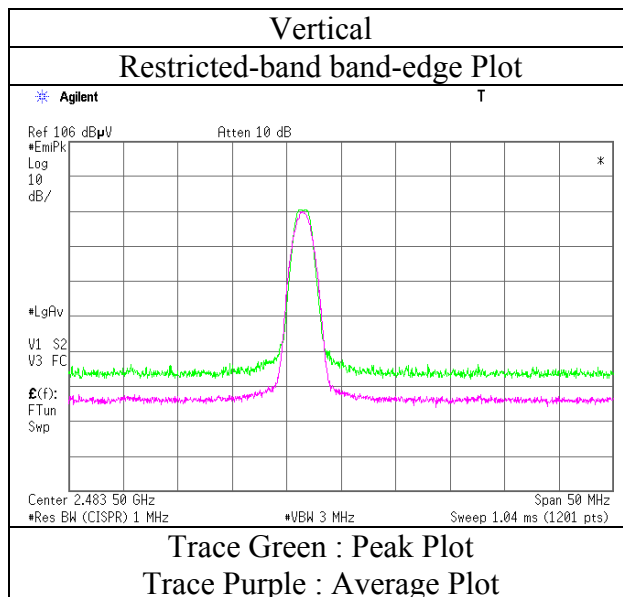
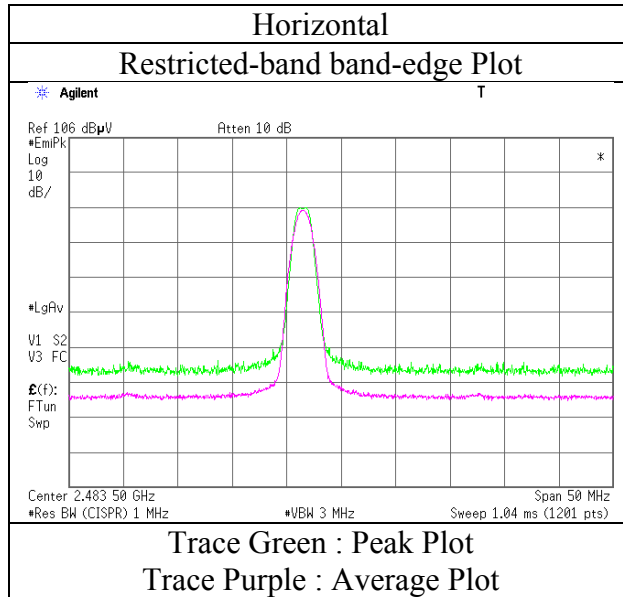
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.45 dB
13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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)

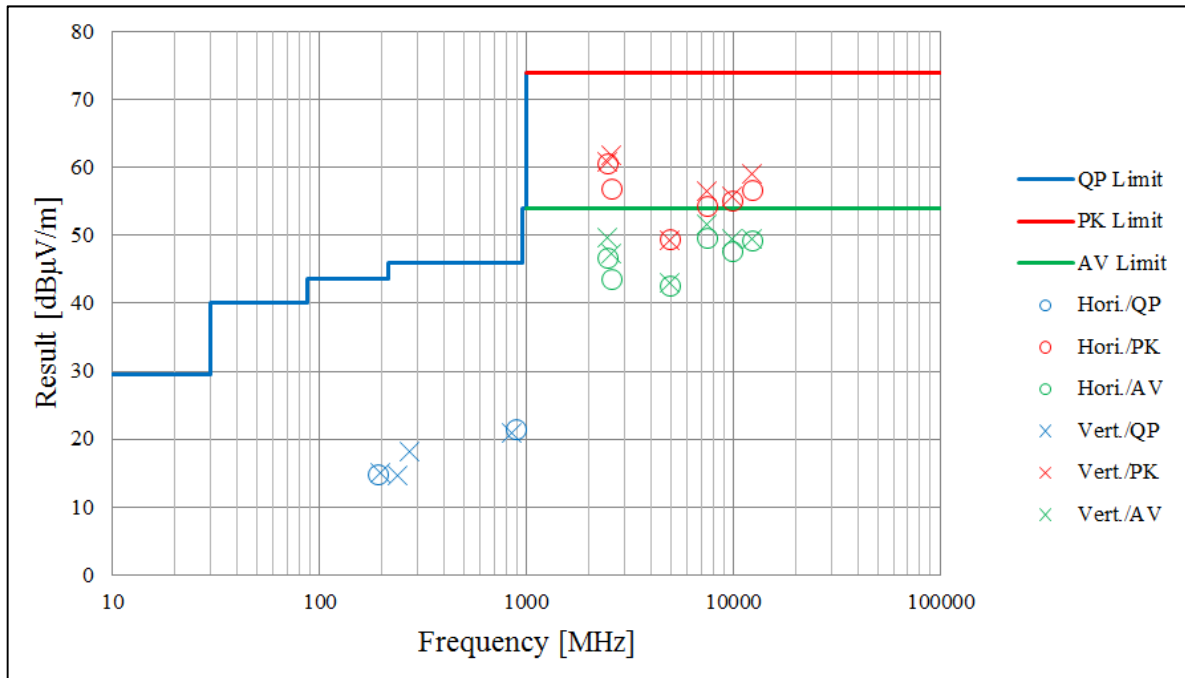
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11733126S-A-R2
Date	June 5, 2017
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Yosuke Ishikawa
	(1 GHz -13 GHz)
Mode	Tx BT LE 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

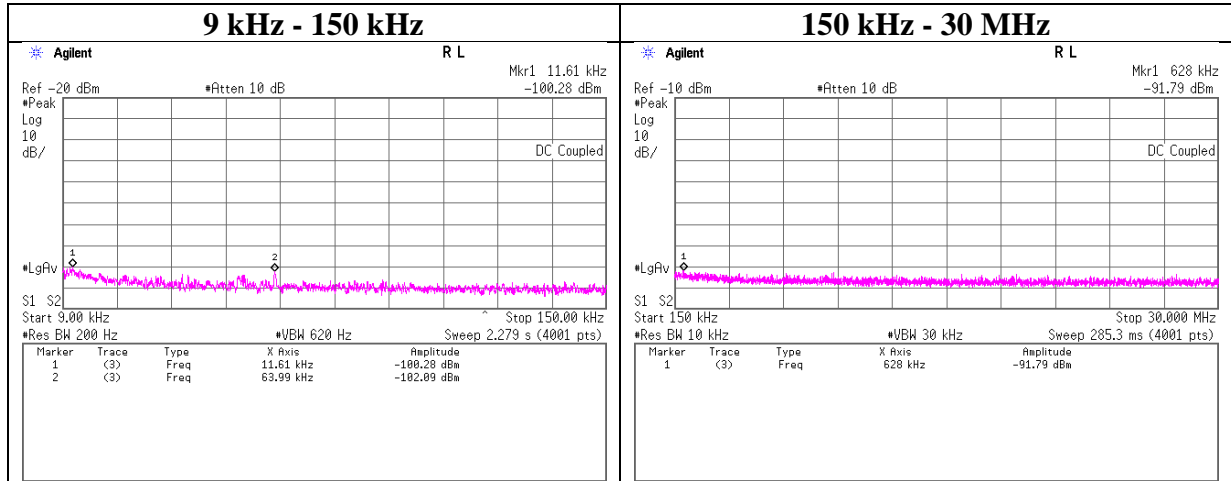
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber	
Report No.	11733126S-A-R2	
Date	June 6, 2017	June 5, 2017
Temperature / Humidity	23 deg. C / 48 % RH	23 deg. C / 38 % RH
Engineer	Kazutaka Takeyama (30 MHz - 1 GHz)	Yosuke Ishikawa (1 GHz - 13 GHz)
	(13 GHz -26.5 GHz)	
Mode	Tx BT LE 2480 MHz	



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

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11733126S-A-R2
Date	June 4, 2017
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE, 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
11.61	-100.28	0.81	9.84	2.00	1.00	-87.64	300	6.0	-26.4	46.3	72.7	
63.99	-102.09	0.81	9.84	2.00	1.00	-89.45	300	6.0	-28.2	31.4	59.6	
628.00	-91.79	0.81	9.84	2.00	1.00	-79.14	300	6.0	-17.9	31.6	49.5	

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

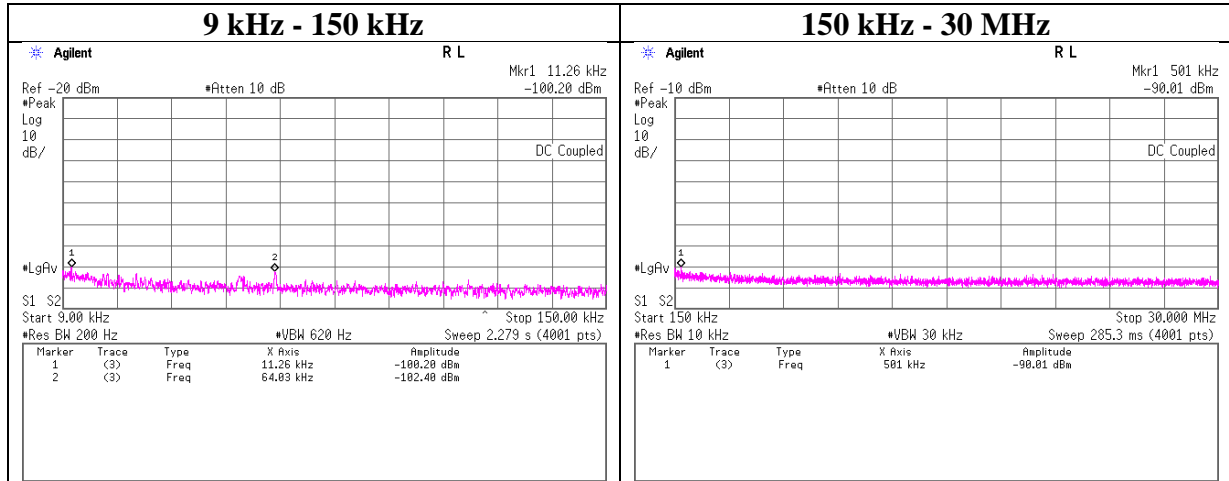
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output (= 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.	11733126S-A-R2
Date	June 4, 2017
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE, 2440 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain*	N (Number of Output)	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]		[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
11.26	-100.20	0.81	9.84	2.00	1.00	-87.56	300	6.0	-26.3	46.5	72.8	
64.03	-102.40	0.81	9.84	2.00	1.00	-89.76	300	6.0	-28.5	31.4	59.9	
501.00	-90.01	0.81	9.84	2.00	1.00	-77.36	300	6.0	-16.1	33.6	49.7	

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

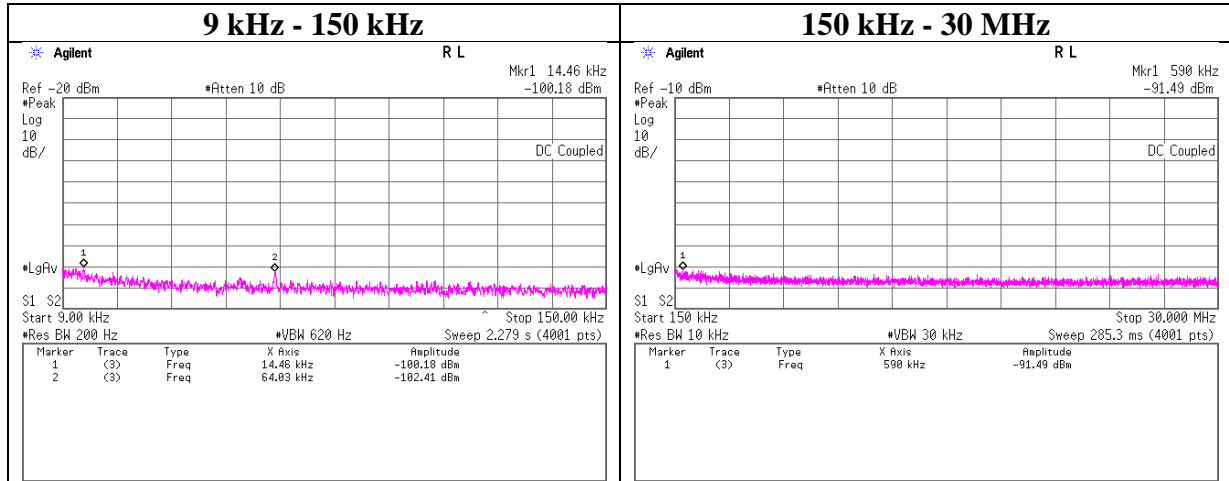
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output (= 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.	11733126S-A-R2
Date	June 4, 2017
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE, 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
14.46	-100.18	0.81	9.84	2.00	1.00	-87.54	300	6.0	-26.3	44.4	70.7	
64.03	-102.41	0.81	9.84	2.00	1.00	-89.77	300	6.0	-28.5	31.4	59.9	
590.00	-91.49	0.81	9.84	2.00	1.00	-78.84	300	6.0	-17.6	32.1	49.7	

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

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

N: Number of output (= 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

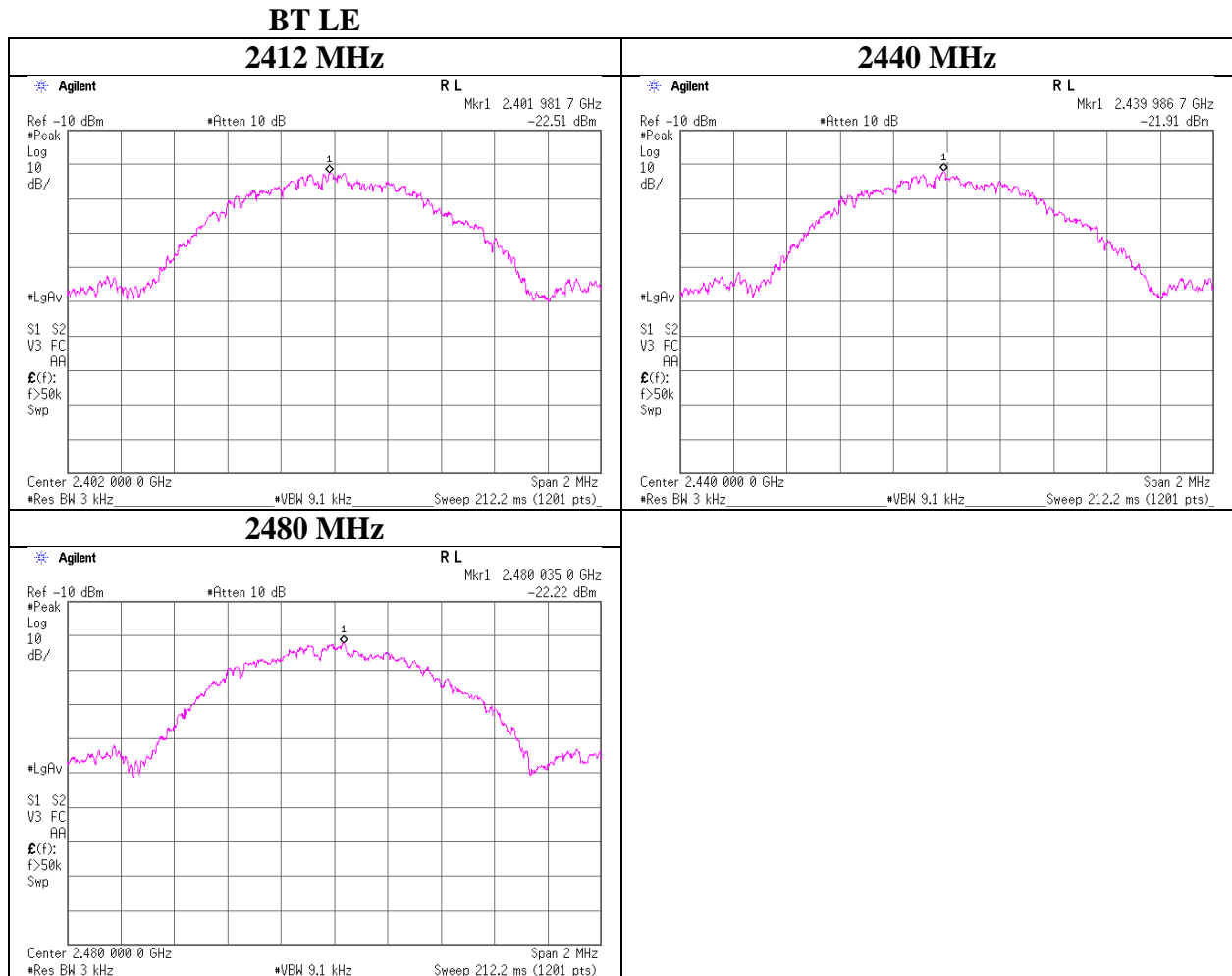
Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11733126S-A-R2
Date	June 4, 2017
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-22.51	1.52	9.85	-11.14	8.00	19.14
2440.00	-21.91	1.52	9.84	-10.55	8.00	18.55
2480.00	-22.22	1.53	9.84	-10.85	8.00	18.85

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.



UL Japan, Inc.

Shonan EMC Lab.

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

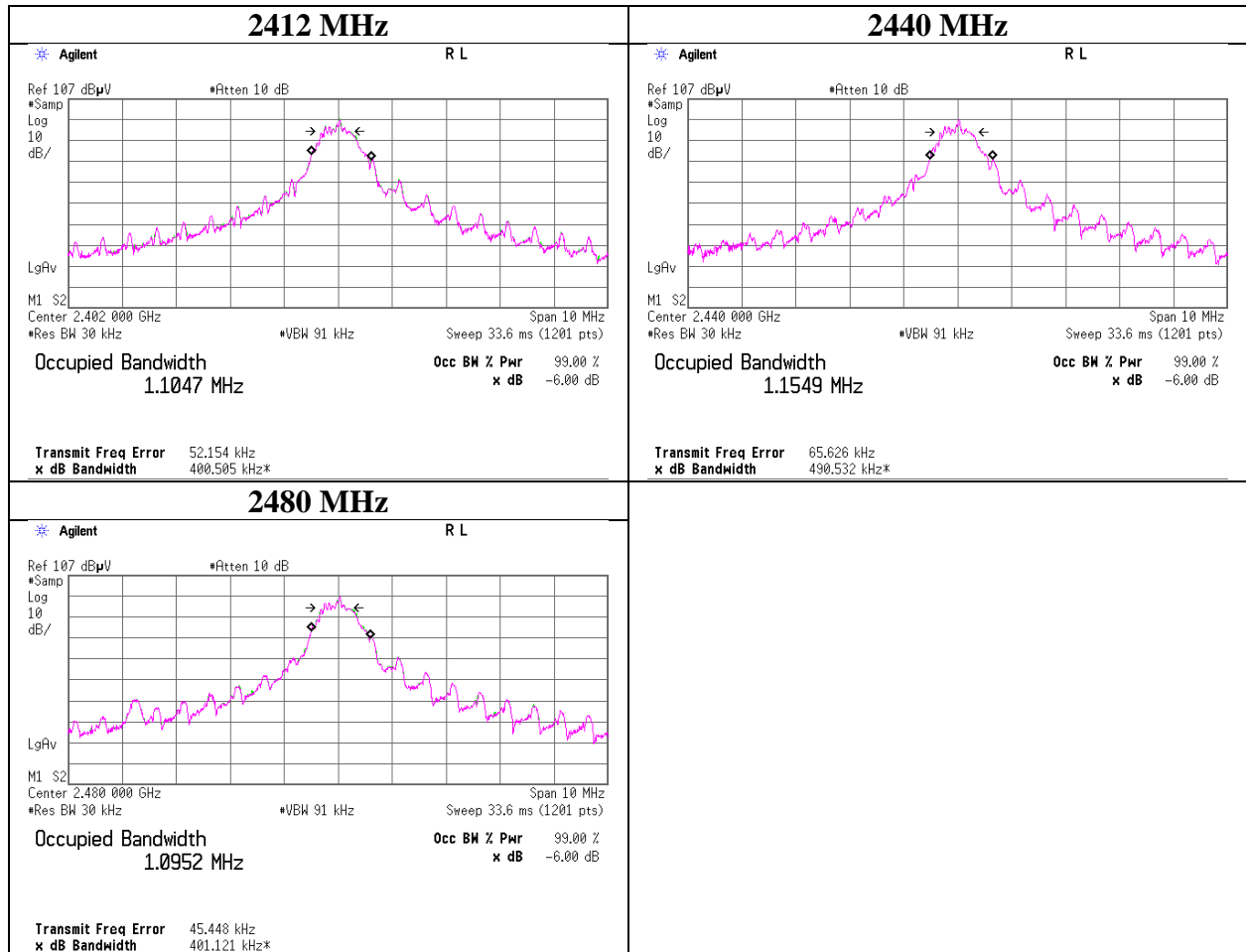
Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

99 % Occupied Bandwidth

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11733126S-A-R2
Date	June 4, 2017
Temperature / Humidity	26 deg. C / 45 % RH
Engineer	Kenichi Adachi
Mode	Tx BT LE

BTLE



APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAEC-01(SV SWR)	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	RE	2016/07/24 * 12
SAF-04	Pre Amplifier	TOYO Corporation	TPA0118-36	1440489	RE	2017/03/17 * 12
SCC-G06	Coaxial Cable	Junkosha	J12J102207-00	MAY-23-16-09 1	RE	2016/06/14 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2017/05/08 * 12
SHA-01	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	RE	2016/08/09 * 12
SOS-01	Humidity Indicator	A&D	AD-5681	4062555	RE	2016/10/12 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2016/10/11 * 12
KJM-09	Measure	KOMELON	KMC-36	-	RE,CE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFL, MF)	-	RE,CE	-
STS-01	Digital Hitester	Hioki	3805-50	080997812	RE,CE	2016/10/17 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2016/11/29 * 12
SAT10-05	Attenuator(above 1G Hz)	Agilent	8493C-010	74864	RE	2016/11/07 * 12
SCC-G41	Coaxial Cable	Junkosha	MWX221-01000N F SNMS/B	1612S006	RE	2017/01/08 * 12
STR-01	Test Receiver	Rohde & Schwarz	ESU40	100093	RE,CE	2017/04/12 * 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	MWX241-01000K M SKMS	-	RE	2017/04/20 * 12
SCC-G19	Coaxial Cable	Suhner	SUCOFLEX 102A	1188/2A	RE	2017/03/23 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000N F SNMS/B	1612S005	RE	2017/01/08 * 12
SCC-G05	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-03 7	RE	2017/01/08 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2017/05/08 * 12
SFL-18	Highpass Filter	MICRO-TRONICS	HPM50111	119	RE	2017/04/20 * 12
SAEC-01(NS A)	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	RE	2016/07/14 * 12
SAF-01	Pre Amplifier	SONOMA	310N	290211	RE	2017/02/09 * 12
KAT6-04	Attenuator	INMET	18N-6dB	-	RE	2016/12/15 * 12
SAT3-09	Attenuator	JFW	50HF-003N	-	RE	2016/08/04 * 12
SBA-01	Biconical Antenna	Schwarzbeck	BBA9106	91032664	RE	2016/10/15 * 12
SCC-A1/A3/A5 /A7/A8/A13/ S RSE-01	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	RE	2017/04/07 * 12
SCC-A2/A4/A6 /A7/A8/A13/ S RSE-01	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	RE	2017/04/07 * 12
SLA-05	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	193	RE	2017/01/05 * 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

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2017/04/25 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2017/04/25 * 12
SRENT-05	Spectrum Analyzer	KEYSIGHT	E4440A	MY46187752	AT	2016/11/04 * 12
SAT10-12	Attenuator	Weinschel Corp.	54A-10	81601	AT	2017/03/23 * 12
SCC-G12	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	AT	2017/03/23 * 12
SOS-13	Humidity Indicator	Custom	CTH-202	Q.C.17	AT	2016/12/13 * 12
KTS-08	Digital Tester	SANWA	PC500	7019224	AT	2017/03/08 * 12
SLS-01	LISN	Rohde & Schwarz	ENV216	100511	CE	2017/02/10 * 12
SAT3-10	Attenuator	JFW	50HF-003N	-	CE	2016/08/04 * 12
SOS-15	Humidity Indicator	A&D	AD-5681	7478311	CE	2017/02/21 * 12
SBM-02	Barometer	Sunoh	SBR121	001004	CE	2014/10/16 * 36
SCC-A12/A 13/ SRSE-01	Coaxial Cable&RF Selector	Suhner/Suhner/TO YO	RG223U/141PE/N S4906	-/0901-269(RF Selector)	CE	2017/04/07 * 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.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401