



RADIO TEST REPORT

Test Report No. : 12519064S-R2

Applicant : FDK CORPORATION
Type of Equipment : SENSOR LOGGER
Model No. : AZ003
FCC ID : 2AQ85AZ003
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied

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7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. This report is a revised version of 12519064S-R1. 12519064S-R1 is replaced with this report.

Date of test: March 9 to 13, 2018

Representative test engineer:

Shiro Kobayashi
Engineer
Consumer Technology Division

Approved by:

Akio Hayashi
Leader
Consumer Technology Division



- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12519064S

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SECTION 1: Customer information

Company Name	:	FDK CORPORATION
Address	:	2281 Washizu Kosai-shi Shizuoka, Japan 431-0495
Telephone Number	:	+81-53-575-2537
Facsimile Number	:	+81-53-575-1496
Contact Person	:	Yoshiro Saito

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

2.1 Identification of E.U.T.

Type of Equipment	:	SENSOR LOGGER
Model No.	:	AZ003
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3 V
Receipt Date of Sample	:	March 9, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: AZ003 (referred to as the EUT in this report) is a SENSOR LOGGER.

Radio Specification

Bluetooth Low Energy

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Antenna type	:	1/4-Wave Monopole
Antenna Gain	:	0.6 dBi
Clock frequency (Maximum)	:	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 March 12, 2018 and effective April 11, 2018

* The revision on March 12, 2018, does not affect the test specification applied to the EUT.

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	N/A	N/A	*1)
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	6.3 dB 4804.000 MHz, AV, Vert. Tx BT LE 2402 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*1) The test is not applicable since the EUT does not have AC power ports.

*2) 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)

The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage.

Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

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

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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

EMI

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

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Item	Frequency range	Uncertainty (+/-)				
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR	No. 5,6,8 SR
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.2 dB	3.2 dB	3.3 dB	-	-
	30 MHz-200 MHz	4.3 dB	4.3 dB	4.3 dB	-	-
	200 MHz-1 GHz	5.9 dB	5.9 dB	5.9 dB	-	-
	1 GHz-6 GHz	4.7 dB	4.7 dB	4.7 dB	-	-
	6 GHz-18 GHz	5.3 dB	5.3 dB	5.3 dB	-	-
Radiated emission (Measurement distance: 1 m)	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-	-
	1 GHz-18 GHz	5.6 dB	5.6 dB	5.6 dB	-	-
Radiated emission (Measurement distance: 1 m)	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 dB	-	-
	1 GHz-18 GHz	5.9 dB	5.9 dB	5.9 dB	-	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

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

Radiated emission test

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

3.5 Test Location

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

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

3.6 Test data, Test instruments, and Test set up

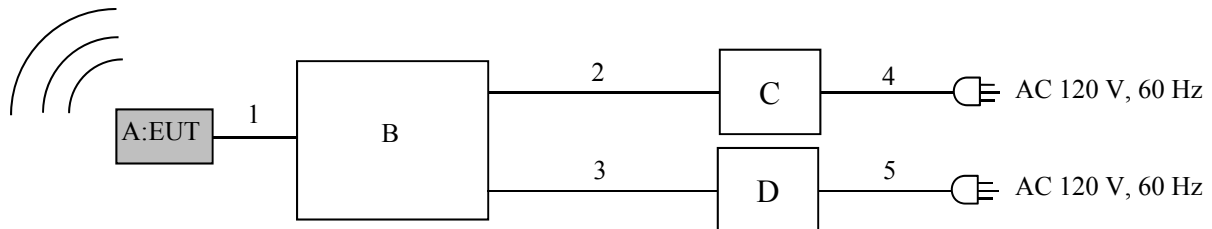
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Tested frequency	Remarks*
Bluetooth Low Energy	2402 MHz 2440 MHz 2480 MHz	-
*Power of the EUT was set by the software as follows; Power settings: Fixed Software: nRFgo Studio version 1.17.1.3252 *This setting of software is the worst case that can be set in test mode. 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 and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	SENSOR LOGGER	AZ003	1 *1) 2 *2)	FDK	EUT
B	Jig Board	-	-	-	-
C	Power Supply(DC)	PAN35-10A	NA000955	Kikusui	-
D	Power Supply(DC)	PAN35-10A	DE001677	Kikusui	-

*1) Used for Radiated Emission test

*2) Used for Antenna Terminal conducted test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.14	Unshielded	Unshielded	-
2	DC	1.50	Unshielded	Unshielded	DC 3.0 V (RF Part)
3	DC	1.50	Unshielded	Unshielded	DC 5.0 V (I/O Part)
4	AC	1.80	Unshielded	Unshielded	-
5	AC	2.00	Unshielded	Unshielded	-

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SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

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

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

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

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

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

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

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

Test Antennas are used as below;

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1) *4)	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	3.98 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: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

*4) As for Carrier related spurious emissions, "Averaging factor" based on FCC section 15.35(c) were used.

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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.

Combinations of the worst case

Antenna polarization \ Frequency	Spurious				
	Below 1 GHz	1 GHz – 2.8 GHz	2.8 GHz – 13 GHz	13 GHz-18 GHz	18 GHz-26.5 GHz
Horizontal	X	X	Z	X	X
Vertical	X	Y	Y	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 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 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 11.10.2 Method PKPSD (peak PSD) of “ANSI C63.10-2013”. *4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)							

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

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

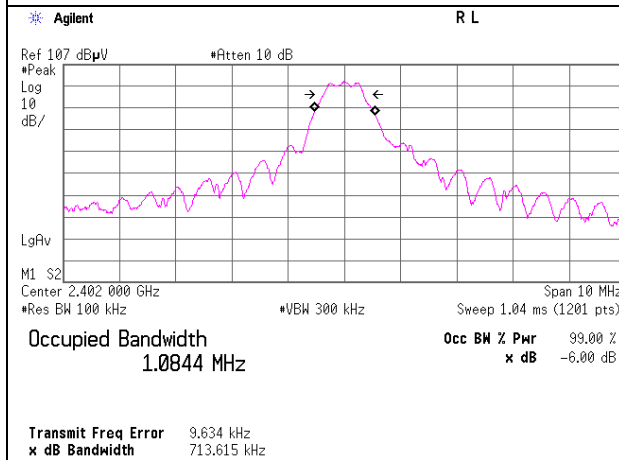
Test place Shonan EMC Lab. No.1 Measurement
Report No. 12519064S-R2
Date March 13, 2018
Temperature / Humidity 24 deg. C / 31 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BT LE	2402	1024.0	0.714	> 0.5000
	2440	1019.8	0.708	> 0.5000
	2480	1022.9	0.699	> 0.5000

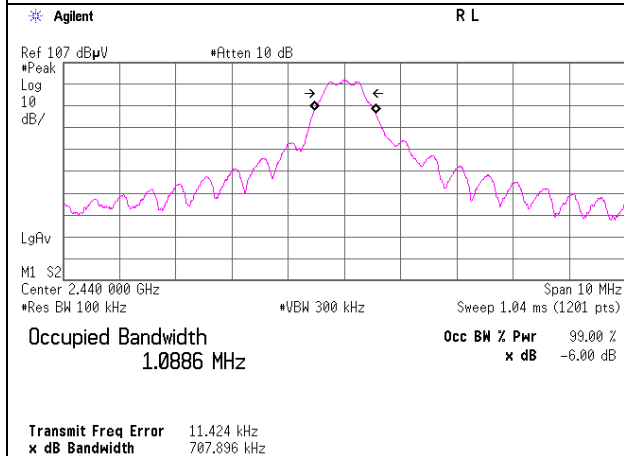
6dB Bandwidth

BT LE

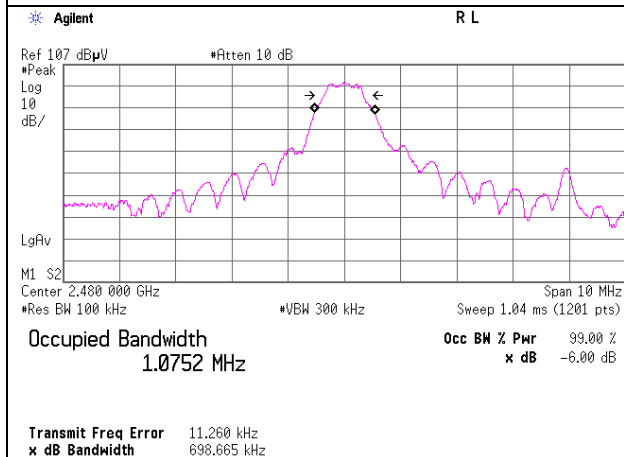
2402 MHz



2440 MHz



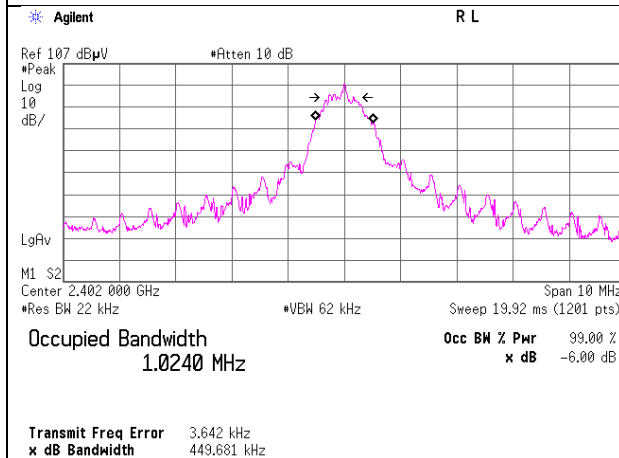
2480 MHz



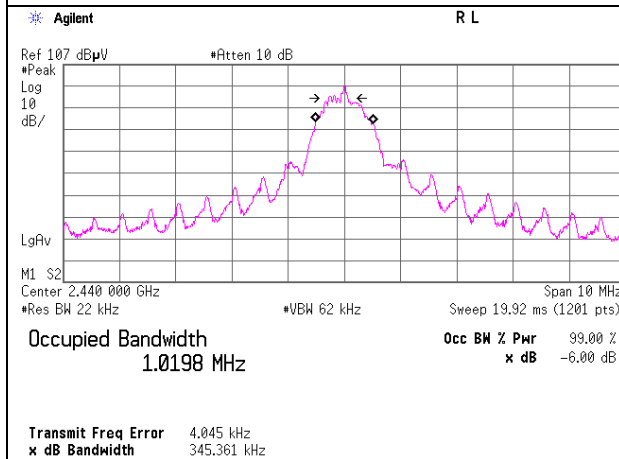
99% Occupied Bandwidth

BT LE

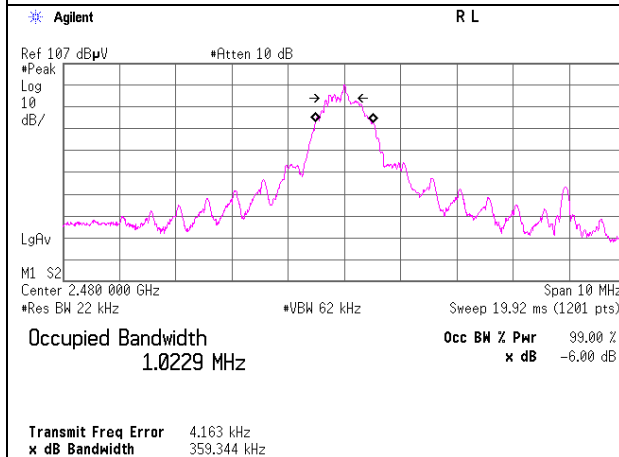
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 12519064S-R2
Date March 13, 2018
Temperature / Humidity 24 deg. C / 31 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-8.07	2.02	9.68	3.63	2.31	30.00	1000	26.37
2440	-8.15	2.03	9.67	3.55	2.26	30.00	1000	26.45
2480	-8.33	2.04	9.67	3.38	2.18	30.00	1000	26.62

Sample Calculation:

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

Average Output Power
(Reference data for SAR testing)

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 12519064S-R2
Date March 13, 2018
Temperature / Humidity 25 deg. C / 34 % RH
Engineer Yosuke Ishikawa
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	-9.97	2.02	9.68	1.73	1.49	1.19	2.92	1.96
2440	-10.10	2.03	9.67	1.60	1.45	1.19	2.79	1.90
2480	-10.25	2.04	9.67	1.46	1.40	1.19	2.65	1.84

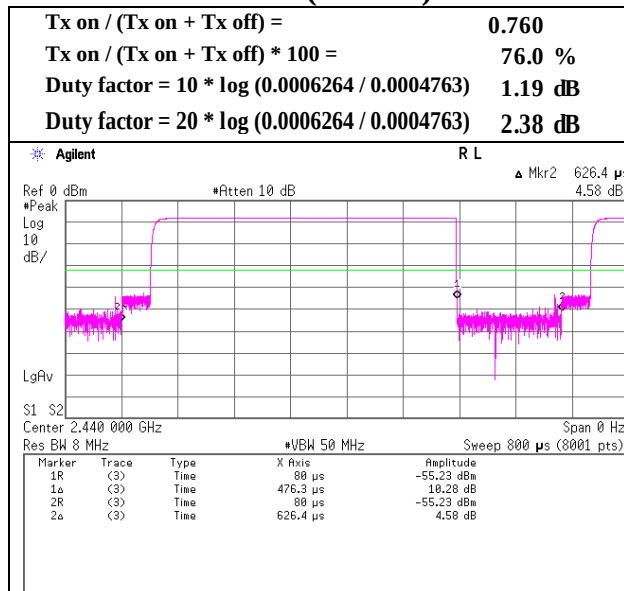
Sample Calculation:

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

Burst rate confirmation

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 12519064S-R2
Date March 13, 2018
Temperature / Humidity 24 deg. C / 31 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE

BT LE (Carrier)



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

Radiated Spurious Emission

Report No.	12519064S-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	3	3
Date	March 12, 2018	March 9, 2018
Temperature / Humidity	23 deg. C / 30 % RH	22 deg. C / 44 % RH
Engineer	Tatsuya Arai	Shiro Kobayashi
	(30 MHz – 1000 MHz, 13 GHz – 26.5 GHz)	(1 GHz – 13 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.	191.989	QP	34.71	16.16	7.97	32.08	0.00	26.76	43.50	16.7	166	126	
Hori.	320.001	QP	38.37	13.74	8.82	31.99	0.00	28.94	46.00	17.0	100	131	
Hori.	336.000	QP	38.31	14.07	8.91	31.97	0.00	29.32	46.00	16.6	100	141	
Hori.	352.000	QP	39.68	14.40	9.00	31.95	0.00	31.13	46.00	14.8	100	126	
Hori.	368.002	QP	41.79	14.73	9.07	31.96	0.00	33.63	46.00	12.3	100	127	
Hori.	2313.151	PK	58.41	27.02	14.12	44.12	2.45	57.88	73.90	16.0	149	1	
Hori.	2369.339	PK	59.66	27.19	14.17	44.13	2.45	59.34	73.90	14.5	149	1	
Hori.	2390.000	PK	55.21	27.26	14.19	44.13	2.45	54.98	73.90	18.9	149	1	
Hori.	4804.000	PK	57.86	31.40	6.68	44.45	2.45	53.94	73.90	19.9	150	14	
Hori.	7206.000	PK	47.68	36.56	8.24	43.99	2.45	50.94	73.90	22.9	150	0	
Vert.	112.003	QP	27.57	11.80	7.40	32.15	0.00	14.62	43.50	28.8	100	195	
Vert.	352.002	QP	41.47	14.40	9.00	31.95	0.00	32.92	46.00	13.0	120	185	
Vert.	368.001	QP	40.96	14.73	9.07	31.96	0.00	32.80	46.00	13.2	116	189	
Vert.	416.001	QP	36.27	15.73	9.28	31.98	0.00	29.30	46.00	16.7	100	162	
Vert.	431.999	QP	37.16	16.06	9.35	31.97	0.00	30.60	46.00	15.4	100	151	
Vert.	2313.374	PK	55.73	27.02	14.12	44.12	2.45	55.20	73.90	18.7	119	3	
Vert.	2369.646	PK	58.02	27.19	14.17	44.13	2.45	57.70	73.90	16.2	119	3	
Vert.	2390.000	PK	54.52	27.26	14.19	44.13	2.45	54.29	73.90	19.6	119	3	
Vert.	4804.000	PK	59.43	31.40	6.68	44.45	2.45	55.51	73.90	18.3	101	304	
Vert.	7206.000	PK	47.76	36.56	8.24	43.99	2.45	51.02	73.90	22.8	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.98 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	39.86	27.26	14.19	44.13	2.38	2.45	42.01	53.90	11.9 *1)	
Hori.	4804.000	AV	47.54	31.40	6.68	44.45	2.38	2.45	46.00	53.90	7.9	
Hori.	7206.000	AV	38.56	36.56	8.24	43.99	2.38	2.45	44.20	53.90	9.7	
Vert.	2390.000	AV	39.17	27.26	14.19	44.13	2.38	2.45	41.32	53.90	12.6 *1)	
Vert.	4804.000	AV	49.11	31.40	6.68	44.45	2.38	2.45	47.57	53.90	6.3	
Vert.	7206.000	AV	38.47	36.56	8.24	43.99	2.38	2.45	44.11	53.90	9.8	

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

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

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

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

Peak measurement value with Averaging factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2313.151	PK	58.41	27.02	14.12	44.12	-73.55	2.45	-15.67	53.90	69.6	
Hori.	2369.339	PK	59.66	27.19	14.17	44.13	-73.55	2.45	-14.21	53.90	68.1	
Vert.	2313.374	PK	55.73	27.02	14.12	44.12	-73.55	2.45	-18.35	53.90	72.3	
Vert.	2369.646	PK	58.02	27.19	14.17	44.13	-73.55	2.45	-15.85	53.90	69.8	

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

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

Averaging factor refer to APPENDIX 4.

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	98.69	27.29	14.20	44.14	2.45	98.49	-	-	Carrier
Hori.	2400.000	PK	60.15	27.29	14.19	44.14	2.45	59.94	78.49	18.6	
Hori.	9608.000	PK	38.58	38.61	9.27	43.83	2.45	45.08	78.49	33.4	
Vert.	2402.000	PK	97.97	27.29	14.20	44.14	2.45	97.77	-	-	Carrier
Vert.	2400.000	PK	59.66	27.29	14.19	44.14	2.45	59.45	77.77	18.3	
Vert.	9608.000	PK	40.04	38.61	9.27	43.83	2.45	46.54	77.77	31.2	

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

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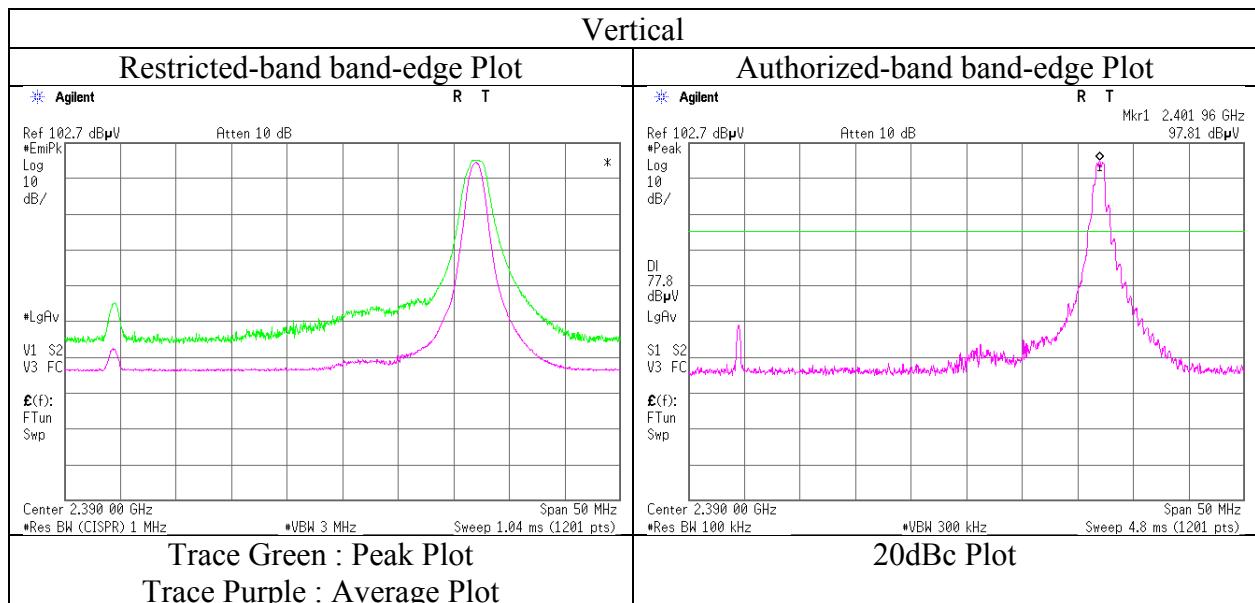
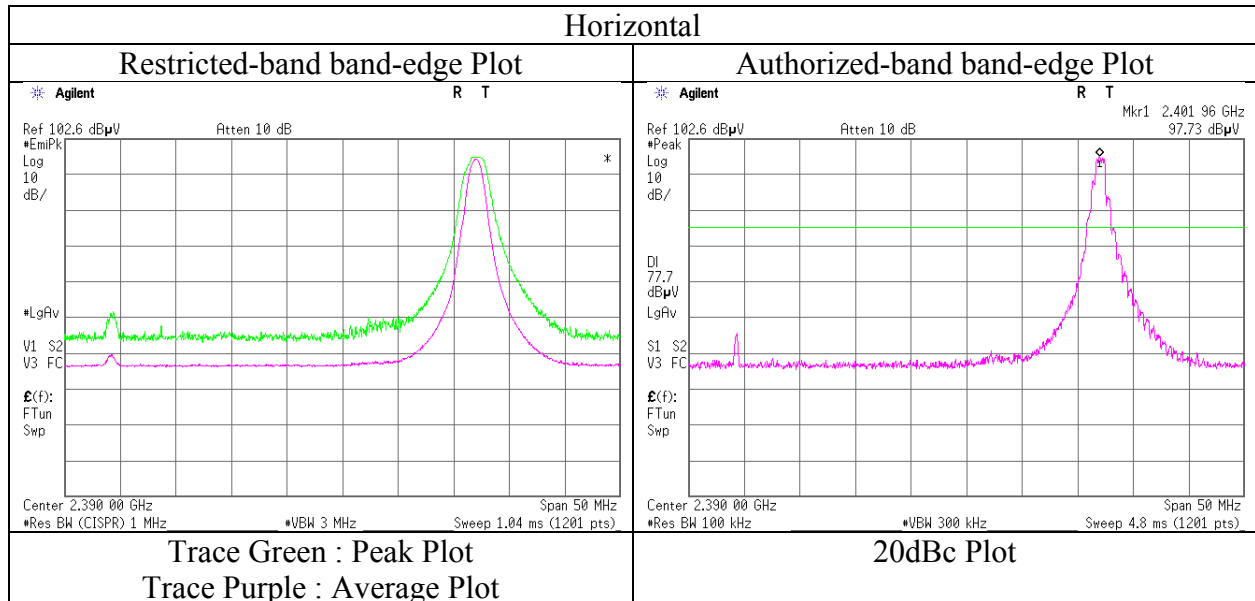
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12519064S-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	March 9, 2018
Temperature / Humidity	22 deg. C / 44 % RH
Engineer	Shiro Kobayashi (1 GHz – 13 GHz)
Mode	Tx BT LE 2402 MHz



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

Radiated Spurious Emission

Report No. 12519064S-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber 3
Date March 12, 2018 March 9, 2018
Temperature / Humidity 23 deg. C / 30 % RH 22 deg. C / 44 % RH
Engineer Tatsuya Arai Shiro Kobayashi
(30 MHz – 1000 MHz, (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.	192.000	QP	34.74	16.16	7.97	32.08	0.00	26.79	43.50	16.7	163	125	
Hori.	320.000	QP	38.26	13.74	8.82	31.99	0.00	28.83	46.00	17.1	100	131	
Hori.	335.998	QP	38.12	14.07	8.91	31.97	0.00	29.13	46.00	16.8	100	139	
Hori.	352.000	QP	39.85	14.40	9.00	31.95	0.00	31.30	46.00	14.7	100	126	
Hori.	368.001	QP	41.91	14.73	9.07	31.96	0.00	33.75	46.00	12.2	100	125	
Hori.	2491.207	PK	60.85	27.57	14.29	44.16	2.45	61.00	73.90	12.9	137	12	
Hori.	2560.843	PK	56.64	27.74	14.35	44.15	2.45	57.03	73.90	16.8	137	12	
Hori.	4880.000	PK	57.32	31.61	6.70	44.48	2.45	53.60	73.90	20.3	169	7	
Hori.	7320.000	PK	48.46	36.76	8.26	44.03	2.45	51.90	73.90	22.0	146	0	
Vert.	112.000	QP	27.29	11.80	7.40	32.15	0.00	14.34	43.50	29.1	100	189	
Vert.	352.000	QP	39.84	14.40	9.00	31.95	0.00	31.29	46.00	14.7	118	194	
Vert.	368.001	QP	40.98	14.73	9.07	31.96	0.00	32.82	46.00	13.1	116	196	
Vert.	416.002	QP	36.14	15.73	9.28	31.98	0.00	29.17	46.00	16.8	100	155	
Vert.	432.000	QP	37.08	16.06	9.35	31.97	0.00	30.52	46.00	15.4	100	158	
Vert.	2491.234	PK	60.36	27.57	14.29	44.16	2.45	60.51	73.90	13.3	120	0	
Vert.	2560.949	PK	56.10	27.74	14.35	44.15	2.45	56.49	73.90	17.4	120	0	
Vert.	4880.000	PK	57.99	31.61	6.70	44.48	2.45	54.27	73.90	19.6	111	302	
Vert.	7320.000	PK	48.34	36.76	8.26	44.03	2.45	51.78	73.90	22.1	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.98 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.	4880.000	AV	43.65	31.61	6.70	44.48	2.38	2.45	42.31	53.90	11.6	
Hori.	7320.000	AV	39.07	36.76	8.26	44.03	2.38	2.45	44.89	53.90	9.0	
Vert.	4880.000	AV	43.35	31.61	6.70	44.48	2.38	2.45	42.01	53.90	11.9	
Vert.	7320.000	AV	38.98	36.76	8.26	44.03	2.38	2.45	44.80	53.90	9.1	

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

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

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

Peak measurement value with Averaging factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2491.207	PK	60.85	27.57	14.29	44.16	-73.55	2.45	-12.55	53.90	66.5	
Hori.	2560.843	PK	56.64	27.74	14.35	44.15	-73.55	2.45	-16.52	53.90	70.4	
Vert.	2491.234	PK	60.36	27.57	14.29	44.16	-73.55	2.45	-13.04	53.90	66.9	
Vert.	2560.949	PK	56.10	27.74	14.35	44.15	-73.55	2.45	-17.06	53.90	71.0	

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

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

Averaging factor refer to APPENDIX 4.

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2440.000	PK	99.56	27.41	14.25	44.15	2.45	99.52	-	-	Carrier
Hori.	9760.000	PK	39.31	38.79	9.32	43.85	2.45	46.02	79.52	33.5	
Vert.	2440.000	PK	99.34	27.41	14.25	44.15	2.45	99.30	-	-	Carrier
Vert.	9760.000	PK	38.96	38.79	9.32	43.85	2.45	45.67	79.30	33.6	

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

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Radiated Spurious Emission

Report No. 12519064S-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber 3
Date March 12, 2018 March 9, 2018
Temperature / Humidity 23 deg. C / 30 % RH 22 deg. C / 44 % RH
Engineer Tatsuya Arai Shiro Kobayashi
(30 MHz – 1000 MHz, (1 GHz – 13 GHz)
13 GHz – 26.5 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.	192.001	QP	34.74	16.16	7.97	32.08	0.00	26.79	43.50	16.7	166	121	
Hori.	320.001	QP	38.07	13.74	8.82	31.99	0.00	28.64	46.00	17.3	100	134	
Hori.	336.001	QP	37.92	14.07	8.91	31.97	0.00	28.93	46.00	17.0	100	139	
Hori.	352.001	QP	39.67	14.40	9.00	31.95	0.00	31.12	46.00	14.8	100	126	
Hori.	368.001	QP	41.91	14.73	9.07	31.96	0.00	33.75	46.00	12.2	100	128	
Hori.	2483.500	PK	63.83	27.55	14.29	44.16	2.45	63.96	73.90	9.9	129	324	
Hori.	2491.070	PK	61.83	27.57	14.29	44.16	2.45	61.98	73.90	11.9	129	324	
Hori.	2560.933	PK	56.64	27.74	14.35	44.15	2.45	57.03	73.90	16.8	129	324	
Hori.	4960.000	PK	54.48	31.83	6.72	44.51	2.45	50.97	73.90	22.9	140	25	
Hori.	7440.000	PK	50.14	36.97	8.27	44.08	2.45	53.75	73.90	20.1	173	6	
Vert.	112.002	QP	27.31	11.80	7.40	32.15	0.00	14.36	43.50	29.1	100	194	
Vert.	352.001	QP	39.93	14.40	9.00	31.95	0.00	31.38	46.00	14.6	118	187	
Vert.	368.000	QP	40.87	14.73	9.07	31.96	0.00	32.71	46.00	13.2	116	189	
Vert.	416.001	QP	36.26	15.73	9.28	31.98	0.00	29.29	46.00	16.7	100	154	
Vert.	432.001	QP	37.21	16.06	9.35	31.97	0.00	30.65	46.00	15.3	100	151	
Vert.	2483.500	PK	60.11	27.55	14.29	44.16	2.45	60.24	73.90	13.6	118	1	
Vert.	2491.146	PK	61.22	27.57	14.29	44.16	2.45	61.37	73.90	12.5	118	1	
Vert.	2560.804	PK	55.76	27.74	14.35	44.15	2.45	56.15	73.90	17.7	118	1	
Vert.	4960.000	PK	55.62	31.83	6.72	44.51	2.45	52.11	73.90	21.7	119	280	
Vert.	7440.000	PK	49.90	36.97	8.27	44.08	2.45	53.51	73.90	20.3	122	159	

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.	2483.500	AV	43.47	27.55	14.29	44.16	2.38	2.45	45.98	53.90	7.9	*1)
Hori.	4960.000	AV	45.85	31.83	6.72	44.51	2.38	2.45	44.72	53.90	9.2	
Hori.	7440.000	AV	41.06	36.97	8.27	44.08	2.38	2.45	47.05	53.90	6.9	
Vert.	2483.500	AV	42.56	27.55	14.29	44.16	2.38	2.45	45.07	53.90	8.8	*1)
Vert.	4960.000	AV	48.03	31.83	6.72	44.51	2.38	2.45	46.90	53.90	7.0	
Vert.	7440.000	AV	40.74	36.97	8.27	44.08	2.38	2.45	46.73	53.90	7.2	

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

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

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

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

Peak measurement value with Averaging factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2491.070	PK	61.83	27.57	14.29	44.16	-73.55	2.45	-11.57	53.90	65.5	
Hori.	2560.933	PK	56.64	27.74	14.35	44.15	-73.55	2.45	-16.52	53.90	70.4	
Vert.	2491.146	PK	61.22	27.57	14.29	44.16	-73.55	2.45	-12.18	53.90	66.1	
Vert.	2560.804	PK	55.76	27.74	14.35	44.15	-73.55	2.45	-17.40	53.90	71.3	

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

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

Averaging factor refer to APPENDIX 4.

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	100.30	27.54	14.28	44.16	2.45	100.41	-	-	Carrier
Hori.	9920.000	PK	38.86	38.98	9.38	43.87	2.45	45.80	80.41	34.6	
Vert.	2480.000	PK	99.24	27.54	14.28	44.16	2.45	99.35	-	-	Carrier
Vert.	9920.000	PK	39.05	38.98	9.38	43.87	2.45	45.99	79.35	33.4	

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

UL Japan, Inc.

Shonan EMC Lab.

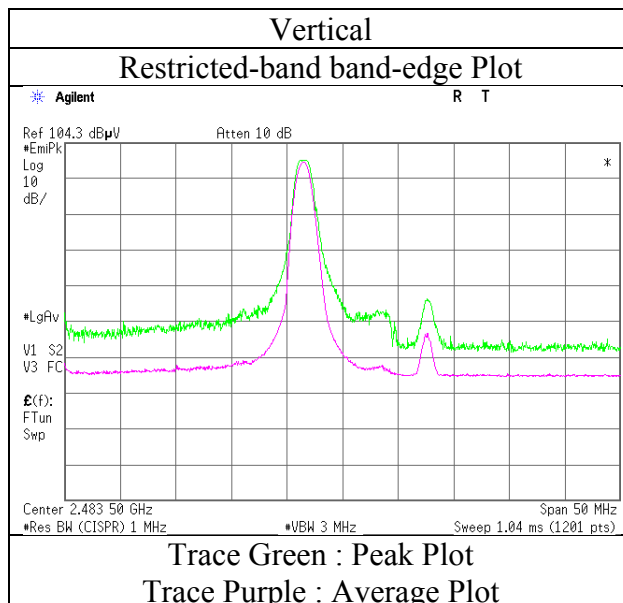
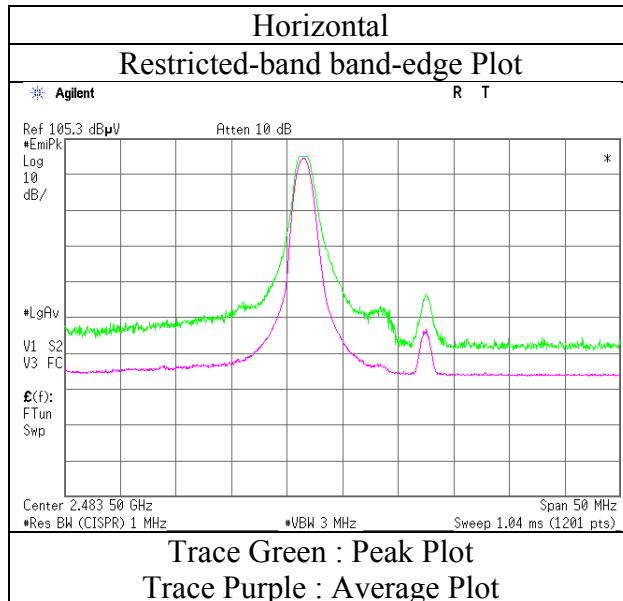
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

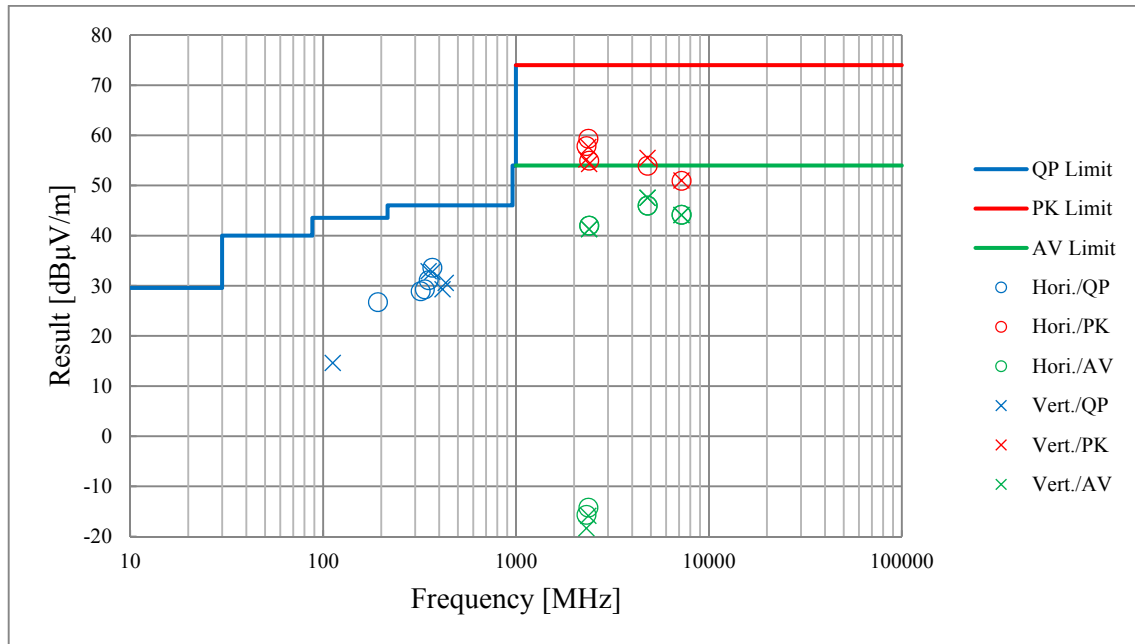
Report No.	12519064S-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	March 9, 2018
Temperature / Humidity	22 deg. C / 44 % RH
Engineer	Shiro Kobayashi
	(1 GHz – 13 GHz)
Mode	Tx BT LE 2480 MHz



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

Radiated Spurious Emission (Plot data, Worst case)

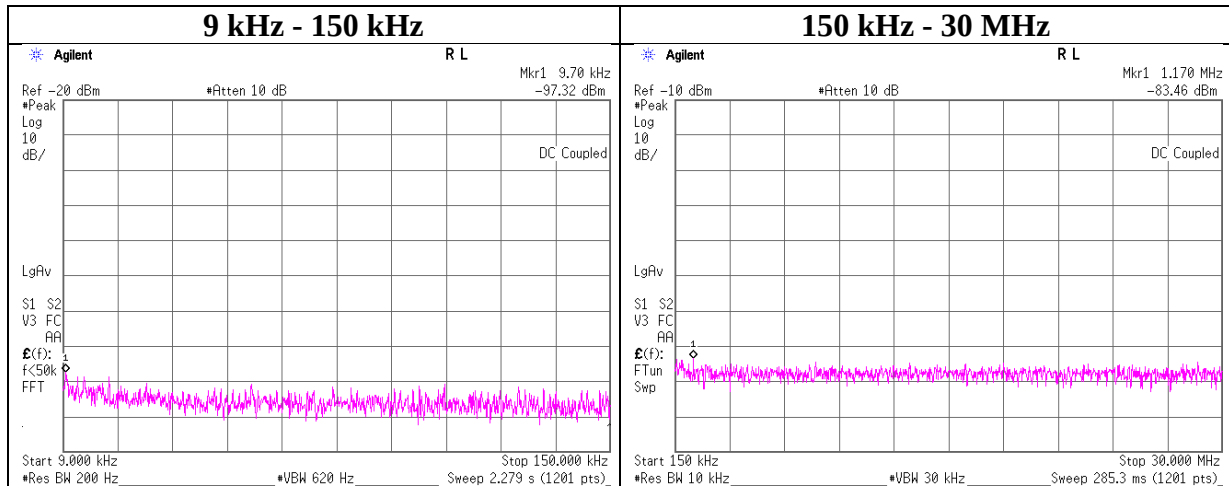
Report No.	12519064S-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	3	
Date	March 12, 2018	March 9, 2018
Temperature / Humidity	23 deg. C / 30 % RH	22 deg. C / 44 % RH
Engineer	Tatsuya Arai	Shiro Kobayashi
	(30 MHz – 1000 MHz,	(1 GHz – 13 GHz)
	13 GHz – 26.5 GHz)	
Mode	Tx BT LE 2402 MHz	



*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.	12519064S-R2
Date	March 13, 2018
Temperature / Humidity	24 deg. C / 31 % RH
Engineer	Yosuke Ishikawa
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
9.70	-97.3	0.01	10.0	2.0	1	-85.3	300	6.0	-24.1	47.8	71.9	
1170.00	-83.5	0.03	9.5	2.0	1	-71.9	30	6.0	9.4	26.2	16.8	

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

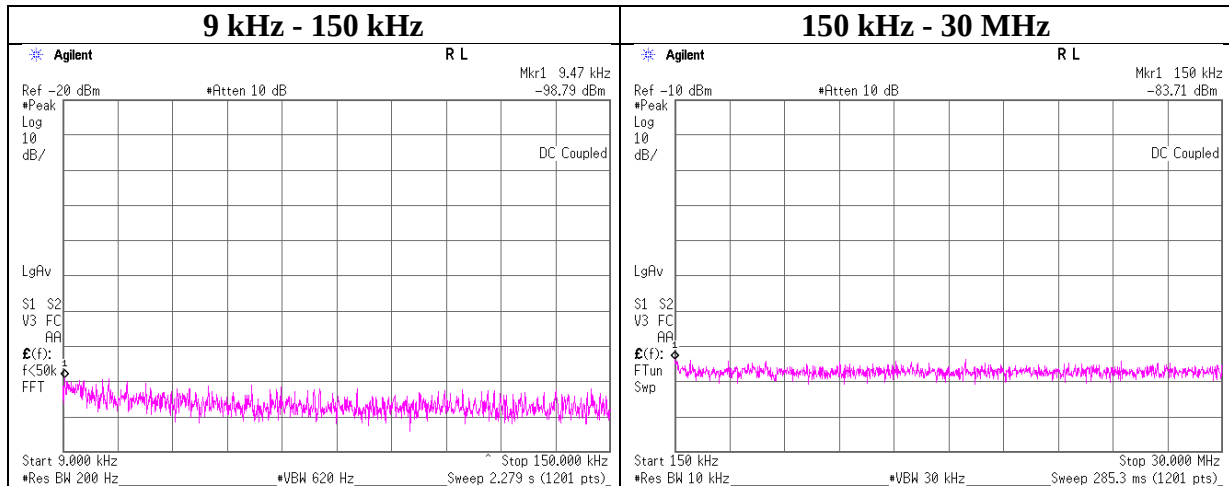
$EIRP[dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 12519064S-R2
Date : March 13, 2018
Temperature / Humidity : 24 deg. C / 31 % RH
Engineer : Yosuke Ishikawa
Mode : Tx BT LE 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.47	-98.8	0.01	9.8	2.0	1	-87.0	300	6.0	-25.7	48.0	73.7	
150.00	-83.7	0.02	9.8	2.0	1	-71.9	300	6.0	-10.6	24.0	34.6	

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

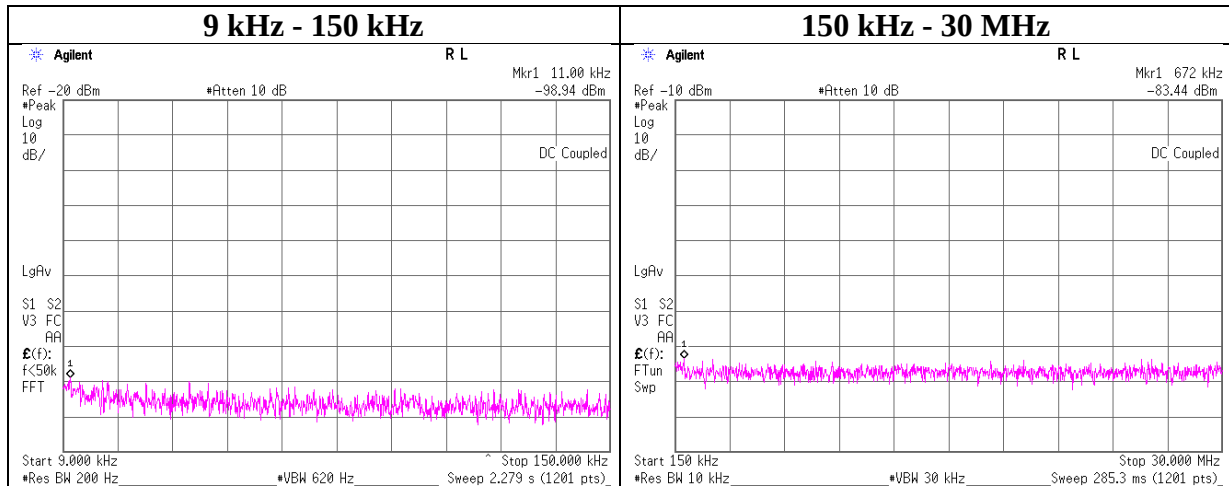
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 12519064S-R2
Date : March 13, 2018
Temperature / Humidity : 24 deg. C / 31 % RH
Engineer : Yosuke Ishikawa
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
11.00	-98.9	0.01	9.5	2.0	1	-87.4	300	6.0	-26.1	46.7	72.8	
672.00	-83.4	0.02	9.5	2.0	1	-71.9	30	6.0	9.4	31.0	21.6	

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

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

N: Number of output

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

Power Density

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 12519064S-R2
Date March 13, 2018
Temperature / Humidity 24 deg. C / 31 % RH
Engineer Yosuke Ishikawa
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-21.65	2.02	9.68	-9.95	8.00	17.95
2440.00	-21.91	2.03	9.67	-10.21	8.00	18.21
2480.00	-21.57	2.04	9.67	-9.86	8.00	17.86

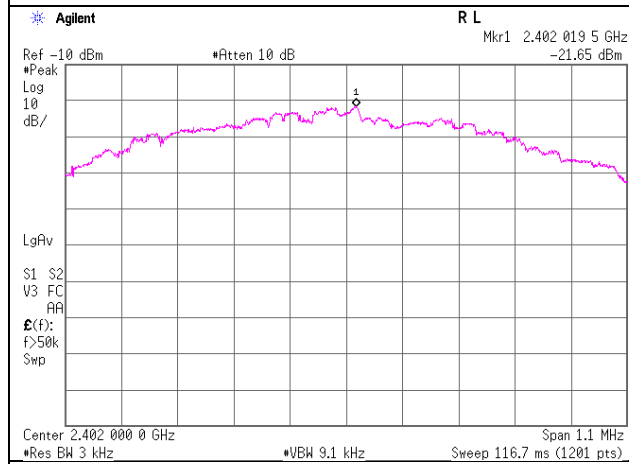
Sample Calculation:

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

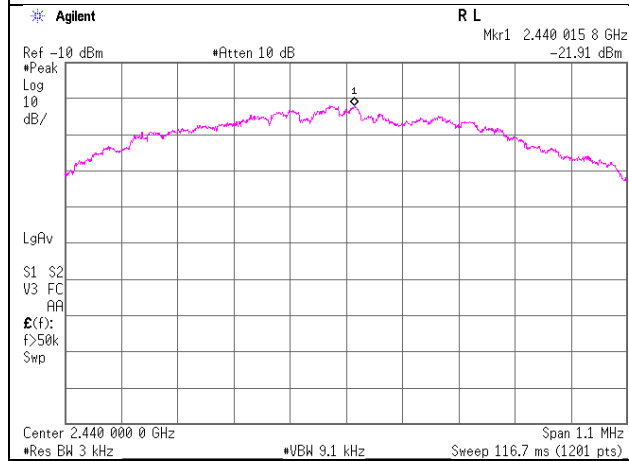
Power Density

BT LE

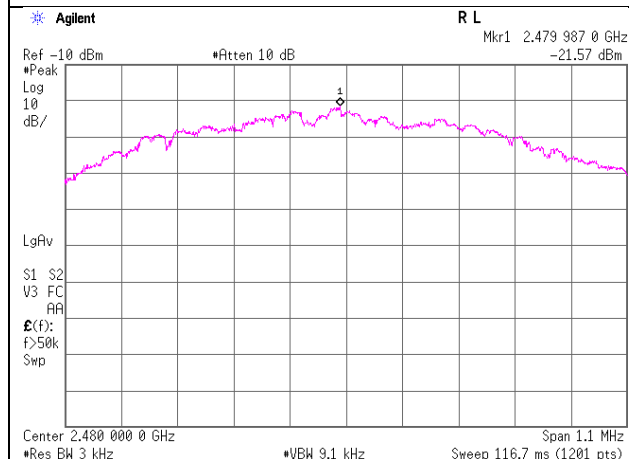
2402 MHz



2440 MHz



2480 MHz



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APPENDIX 2: Test instruments

Test Instruments

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	2046104	RE	2017/09/22 * 12
SCC-G06	Coaxial Cable	Junkosha	J12J102207-00	MAY-23-16-091	RE	2017/06/13 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2017/05/08 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000N FSNMS/B	1612S005	RE	2018/01/29 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2017/08/23 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2017/10/30 * 12
SRENT-15	Spectrum Analyzer	Agilent	E4440A	MY46185516	RE	2017/12/26 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
SAEC-03(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-03(SVSW R)	3	RE	2017/07/17 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,C E,RFL,MF)	-	RE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2017/10/16 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2017/11/22 * 12
SFL-18	Highpass Filter	MICRO-TRONICS	HPM50111	119	RE	2017/04/20 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2017/06/11 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2017/10/02 * 12
SLA-07	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	RE	2018/01/30 * 12
SAT6-08	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	RE	2017/08/24 * 12
SCC-C1/C2/C3/ C4/C5/C10/SRS E-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhn er/Suhner/Suhner/Suhn er/TOYO	8D2W/12DSFA/1 41PE/141PE/141P E/141PE/NS4906	-/0901-271(RF Selector)	RE	2017/04/07 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2018/02/16 * 12
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	RE	2017/11/24 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2017/11/16 * 12
SCC-G41	Coaxial Cable	Junkosha	MWX221-01000N FSNMS/B	1612S006	RE	2018/01/29 * 12
SCC-G19	Coaxial Cable	Suhner	SUCOFLEX 102A	1188/2A	RE	2017/03/23 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000K MSKMS	-	RE	2017/04/20 * 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	2017/09/22 * 12
SOS-13	Humidity Indicator	Custom	CTH-202	Q.C.17	AT	2017/12/21 * 12
SRENT-09	Spectrum Analyzer	Agilent	E4440A	MY46186392	AT	2017/11/08 * 12
SPSS-04	Power sensor	Agilent	N1923A	MY5326009	AT	2017/05/01 * 12
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2017/05/01 * 12
SCC-G14	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	AT	2017/03/23 * 12
SAT10-09	Attenuator	Weinschel Corp.	54A-10	W5692	AT	2017/11/22 * 12
KTS-08	Digital Tester	SANWA	PC500	7019224	AT	2018/03/05 * 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: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

UL Japan, Inc.

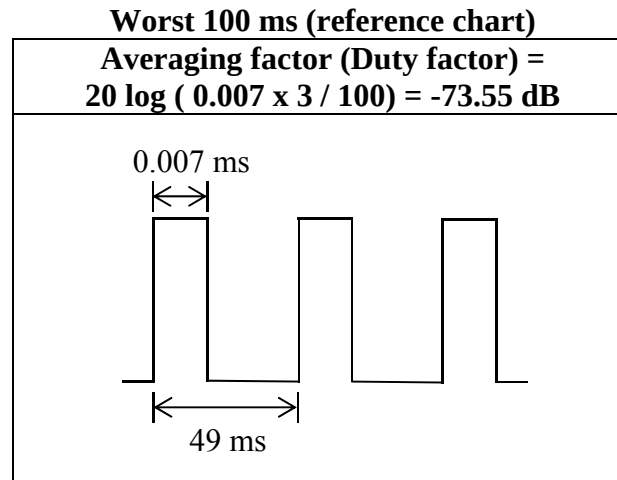
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APPENDIX 4: Averaging factor (Duty factor)



- * Worst Transmit Duty cycle BLE is Data communication mode which max on time is 0.007 ms and Minimum interval is 49 ms (Refer to worst duty sheet for carrier-related signal).
The ON time (0.007 ms) appears 3 times (100 / 49) in 100 ms.
The actual measurement value was applied as Averaging factor (Duty factor).
(This specification is declared by customer)

End of Report