



RADIO TEST REPORT

Test Report No. : 11920651S-D-R3

Applicant : Ueda Japan Radio Co., Ltd.
Type of Equipment : Wireless Foot Switch
Model No. : DTF-253
FCC ID : 2ADKK-DTF253
Test regulation : FCC Part 15 Subpart C: 2018
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 11920651S-D-R2. 11920651S-D-R2 is replaced with this report.

Date of test: December 8 to 24, 2017

Representative test engineer:

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Leader
Consumer Technology Division



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13-EM-F0429

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SECTION 1: Customer information

Company Name : Ueda Japan Radio Co., Ltd.
Address : 2-10-19, Fumiiri, Ueda City, Nagano Prefecture 386-8608, Japan
Telephone Number : +81-268-26-2112
Facsimile Number : +81-268-26-2070
Contact Person : Mitsugu Suzuki

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

2.1 Identification of E.U.T.

Type of Equipment : Wireless Foot Switch
Model No. : DTF-253
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3 V
Receipt Date of Sample : December 5, 2017
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: DTF-253 (referred to as the EUT in this report) is a Wireless Foot Switch.

General Specification

Clock frequency(ies) in the system : 32 MHz (Oscillator)

Radio Specification

SRD

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK
Power Supply (radio part input) : DC 3.0 V
Antenna type : Inverted F type pattern antenna
Antenna Gain : 2.4 dBi
Operating Temperature : 5 deg. C to +40 deg. C

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on February 2, 2018 and effective March 5, 2018

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 February 2, 2018, does not affect the test specification applied to the EUT.

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ----- IC: RSS-Gen 8.8	FCC: Section 15.207 ----- IC: RSS-Gen 8.8		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	5.3 dB 9920.000 MHz, AV, Hori. Tx 2480 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 is supplied from own battery.

*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 test was performed with the New Battery (DC 3.0 V) during the tests. 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 RF part. 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
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.5 dB	2.5 dB	2.5 dB	2.6 dB	2.6 dB
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	-	-
	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 dB	-	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.48 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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Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401
JAB Accreditation No. RTL02610
FCC Test Firm Registration Number: 839876

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

3.6 Test data, Test instruments, and Test set up

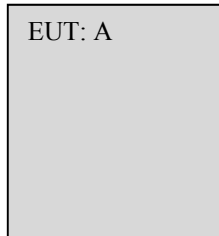
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Short Range Device	2402 MHz 2440 MHz 2480 MHz	PRBS9
<p>*Power of the EUT was set by the software as follows; - Power Setting: Fixed - Software: nRFgo Studio version 1.21.2.10</p> <p>*This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.</p>		

4.2 Configuration and peripherals



*Setup was 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	Remark
A	Wireless Foot Switch	DTF-253	9990016	Ueda Japan Radio Co., Ltd.	EUT

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SECTION 6: Radiated Spurious Emission

Test Procedure

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

[For below 1 GHz]

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

[For above 1 GHz]

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

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

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

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	3.88 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)		3.88 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: $20 \times \log(3.88 \text{ m}/3.0 \text{ m}) = 2.24 \text{ dB}$

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

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The test was made on EUT at the normal use position.

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

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

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	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 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 = 9.1 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

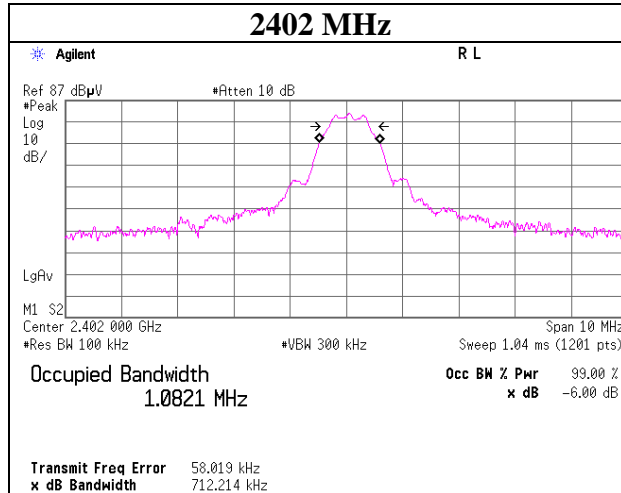
Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11920651S-D-R3
Date December 8, 2017
Temperature / Humidity 27 deg. C / 25 % RH
Engineer Ishikawa Yosuke
Mode Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
Short	2402	1054.3	0.712	> 0.5000
Range	2440	1053.9	0.733	> 0.5000
Device	2480	1055.1	0.735	> 0.5000

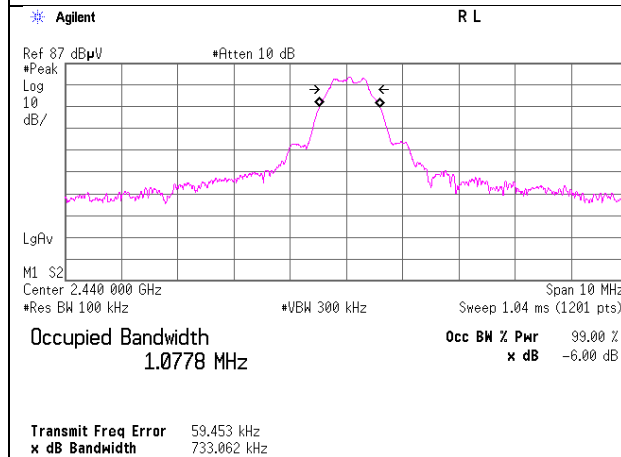
6dB Bandwidth

SRD

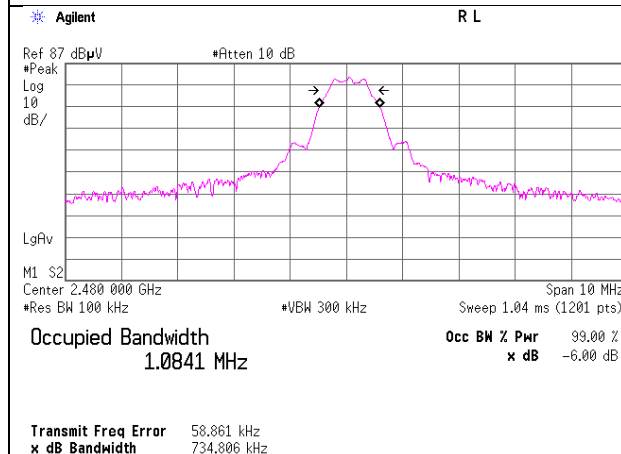
2402 MHz



2440 MHz



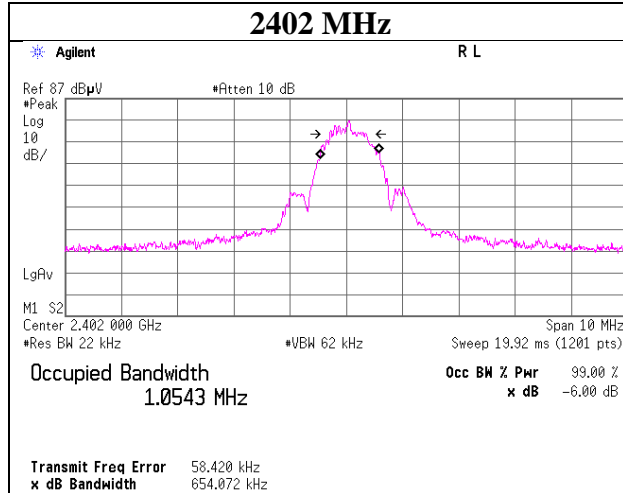
2480 MHz



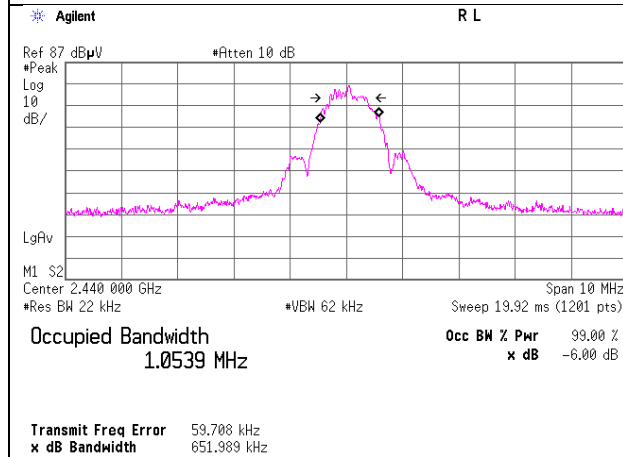
99%Occupied Bandwidth

SRD

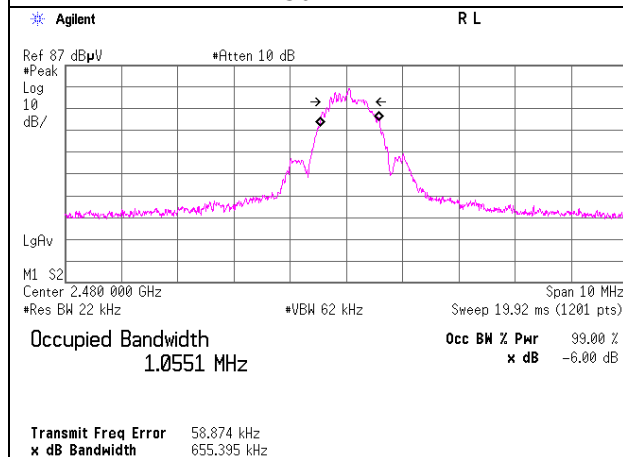
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11920651S-D-R3
Date : December 8, 2017
Temperature / Humidity : 27 deg. C / 25 % RH
Engineer : Ishikawa Yosuke
Mode : Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-15.56	2.02	0.00	-13.54	0.04	30.00	1000	43.54
2440	-15.66	2.03	0.00	-13.63	0.04	30.00	1000	43.63
2480	-15.90	2.04	0.00	-13.86	0.04	30.00	1000	43.86

Sample Calculation:

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

Average Output Power
(Reference data for RF Exposure)

Test place : Shonan EMC Lab. No.5 Shielded Room
 Report No. : 11920651S-D-R3
 Date : December 8, 2017
 Temperature / Humidity : 27 deg. C / 25 % RH
 Engineer : Ishikawa Yosuke
 Mode : Tx

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	-19.07	2.02	0.00	-17.05	0.02	1.98	-15.07	0.03
2440	-19.19	2.03	0.00	-17.16	0.02	1.98	-15.18	0.03
2480	-19.51	2.04	0.00	-17.47	0.02	1.98	-15.49	0.03

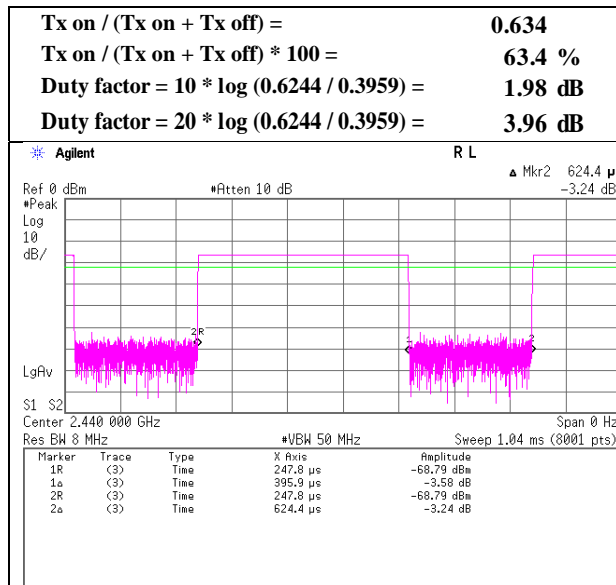
Sample Calculation:

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

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

Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11920651S-D-R3
Date	December 8, 2017
Temperature / Humidity	27 deg. C / 25 % RH
Engineer	Ishikawa Yosuke
Mode	Tx



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

Radiated Spurious Emission

Report No. 11920651S-D-R3
Test place Shonan EMC Lab.
Semi Anechoic Chamber 3AC
Date December 23, 2017 December 24, 2017
Temperature / Humidity 22 deg.C / 24 %RH 21 deg.C / 31 %RH
Engineer Kazuya Noda Kazutaka Takeyama
(30 MHz - 1 GHz) (1 GHz - 18 GHz)
(18 GHz - 26.5 GHz)
Mode Tx 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.	188.250	QP	22.31	16.13	7.96	32.00	0.00	14.40	43.50	29.1	100		1
Hori.	267.488	QP	21.77	12.28	8.54	31.92	0.00	10.67	46.00	35.3	100		2
Hori.	288.718	QP	21.86	13.00	8.66	31.92	0.00	11.60	46.00	34.4	100		1
Hori.	598.917	QP	21.42	18.94	10.02	31.82	0.00	18.56	46.00	27.4	100		3
Hori.	910.665	QP	21.64	21.98	11.08	30.83	0.00	23.87	46.00	22.1	100		1
Hori.	2390.000	PK	48.57	27.26	13.56	44.13	2.24	47.50	73.90	26.4	283		169
Hori.	4804.000	PK	49.31	31.40	5.61	44.45	2.24	44.11	73.90	29.7	198		237
Hori.	7206.000	PK	46.98	36.56	6.86	43.99	2.24	48.65	73.90	25.2	150		0
Hori.	9608.000	PK	48.61	38.61	7.84	43.83	2.24	53.47	73.90	20.4	150		0
Vert.	161.568	QP	22.32	15.27	8.01	32.02	0.00	13.58	43.50	29.9	100		1
Vert.	367.200	QP	21.87	14.89	9.07	31.85	0.00	13.98	46.00	32.0	100		3
Vert.	381.701	QP	22.01	15.21	9.13	31.86	0.00	14.49	46.00	31.5	100		2
Vert.	648.101	QP	21.35	19.25	10.19	31.85	0.00	18.94	46.00	27.0	100		2
Vert.	780.700	QP	21.73	20.38	10.65	31.54	0.00	21.22	46.00	24.7	100		1
Vert.	2390.000	PK	49.83	27.26	13.56	44.13	2.24	48.76	73.90	25.1	279		229
Vert.	4804.000	PK	51.50	31.40	5.61	44.45	2.24	46.30	73.90	27.6	249		181
Vert.	7206.000	PK	46.41	36.56	6.86	43.99	2.24	48.08	73.90	25.8	150		0
Vert.	9608.000	PK	49.02	38.61	7.84	43.83	2.24	53.88	73.90	20.0	150		0

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 13 GHz : 20log(3.88 m / 3.0 m) = 2.24 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	39.45	27.26	13.56	44.13	3.96	2.24	42.34	53.90	11.6	*1)
Hori.	4804.000	AV	40.77	31.40	5.61	44.45	3.96	2.24	39.53	53.90	14.4	
Hori.	7206.000	AV	37.63	36.56	6.86	43.99	3.96	2.24	43.26	53.90	10.6	
Hori.	9608.000	AV	39.03	38.61	7.84	43.83	3.96	2.24	47.85	53.90	6.0	
Vert.	2390.000	AV	39.44	27.26	13.56	44.13	3.96	2.24	42.33	53.90	11.6	*1)
Vert.	4804.000	AV	43.22	31.40	5.61	44.45	3.96	2.24	41.98	53.90	11.9	
Vert.	7206.000	AV	37.94	36.56	6.86	43.99	3.96	2.24	43.57	53.90	10.3	
Vert.	9608.000	AV	39.39	38.61	7.84	43.83	3.96	2.24	48.21	53.90	5.7	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 13 GHz : 20log(3.88 m / 3.0 m) = 2.24 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	72.65	27.29	13.57	44.14	2.24	71.61	-	-	Carrier
Hori.	2400.000	PK	38.86	27.29	13.57	44.14	2.24	37.82	51.61	13.8	
Vert.	2402.000	PK	79.67	27.29	13.57	44.14	2.24	78.63	-	-	Carrier
Vert.	2400.000	PK	39.96	27.29	13.57	44.14	2.24	38.92	58.63	19.7	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 13 GHz : 20log(3.88 m / 3.0 m) = 2.24 dB
13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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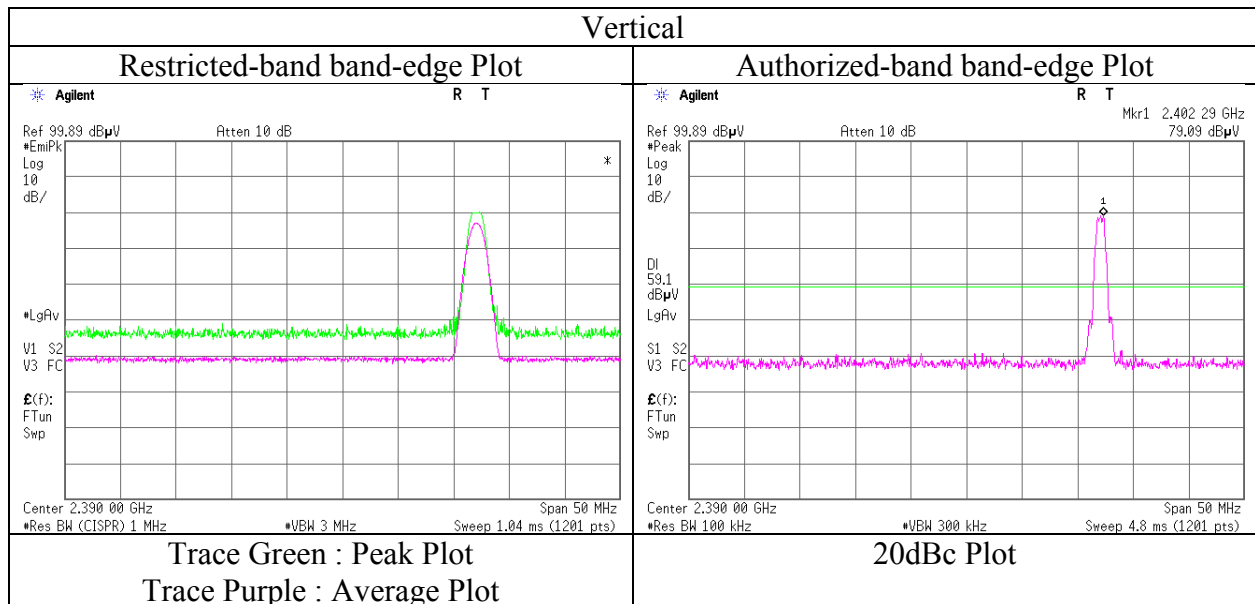
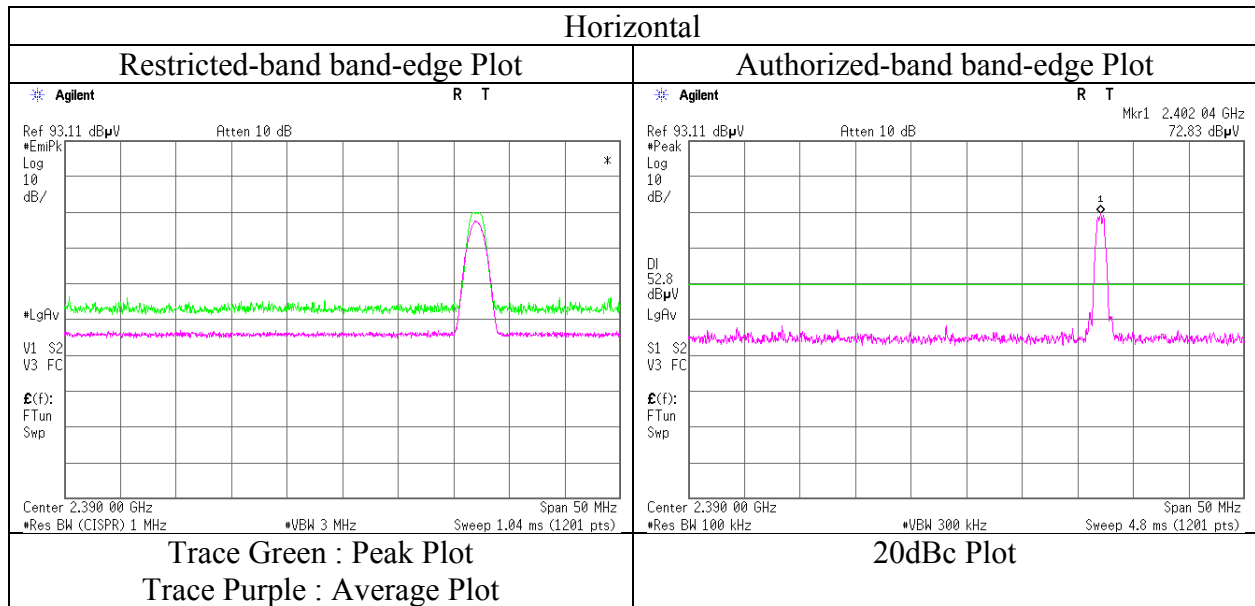
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 11920651S-D-R3
Test place Shonan EMC Lab.
Semi Anechoic Chamber 3AC
Date December 24, 2017
Temperature / Humidity 21 deg.C / 31 %RH
Engineer Kazutaka Takeyama
Mode Tx 2402 MHz



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

Radiated Spurious Emission

Report No.	11920651S-D-R3	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	3AC	3AC
Date	December 23, 2017	December 24, 2017
Temperature / Humidity	22 deg.C / 24 %RH	21 deg.C / 31 %RH
Engineer	Kazuya Noda (30 MHz - 1 GHz)	Kazutaka Takeyama (1 GHz - 18 GHz)
Mode	(18 GHz - 26.5 GHz) Tx 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.	166.575	QP	21.98	15.48	8.03	32.02	0.00	13.47	43.50	30.0	100	1	
Hori.	450.600	QP	21.89	16.64	9.44	31.85	0.00	16.12	46.00	29.8	100	3	
Hori.	546.188	QP	22.01	18.25	9.82	31.89	0.00	18.19	46.00	27.8	100	3	
Hori.	757.904	QP	21.42	20.15	10.58	31.64	0.00	20.51	46.00	25.4	100	2	
Hori.	866.587	QP	21.58	21.49	10.94	31.13	0.00	22.88	46.00	23.1	100	1	
Hori.	4880.000	PK	51.84	31.61	5.59	44.48	2.24	46.80	73.90	27.1	260	169	
Hori.	7320.000	PK	48.05	36.76	6.89	44.03	2.24	49.91	73.90	23.9	150	0	
Hori.	9760.000	PK	47.74	38.79	7.94	43.85	2.24	52.86	73.90	21.0	150	0	
Vert.	189.689	QP	22.15	16.14	7.96	32.00	0.00	14.25	43.50	29.2	100	2	
Vert.	245.101	QP	21.88	11.65	8.41	31.93	0.00	10.01	46.00	35.9	100	3	
Vert.	433.295	QP	21.94	16.29	9.36	31.86	0.00	15.73	46.00	30.2	100	1	
Vert.	465.696	QP	21.76	16.95	9.50	31.85	0.00	16.36	46.00	29.6	100	1	
Vert.	935.805	QP	21.56	22.05	11.16	30.60	0.00	24.17	46.00	21.8	100	2	
Vert.	4880.000	PK	51.04	31.61	5.59	44.48	2.24	46.00	73.90	27.9	209	335	
Vert.	7320.000	PK	46.44	36.76	6.89	44.03	2.24	48.30	73.90	25.6	150	0	
Vert.	9760.000	PK	47.01	38.79	7.94	43.85	2.24	52.13	73.90	21.7	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.88 m / 3.0 m) = 2.24 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	43.32	31.61	5.59	44.48	3.96	2.24	42.24	53.90	11.7	
Hori.	7320.000	AV	38.24	36.76	6.89	44.03	3.96	2.24	44.06	53.90	9.8	
Hori.	9760.000	AV	38.60	38.79	7.94	43.85	3.96	2.24	47.68	53.90	6.2	
Vert.	4880.000	AV	42.68	31.61	5.59	44.48	3.96	2.24	41.60	53.90	12.3	
Vert.	7320.000	AV	38.21	36.76	6.89	44.03	3.96	2.24	44.03	53.90	9.9	
Vert.	9760.000	AV	38.51	38.79	7.94	43.85	3.96	2.24	47.59	53.90	6.3	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.88 m / 3.0 m) = 2.24 dB

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

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

Radiated Spurious Emission

Report No.	11920651S-D-R3	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	3AC	3AC
Date	December 23, 2017	December 24, 2017
Temperature / Humidity	22 deg.C / 24 %RH	21 deg.C / 31 %RH
Engineer	Kazuya Noda (30 MHz - 1 GHz)	Kazutaka Takeyama (1 GHz - 18 GHz)
Mode	(18 GHz - 26.5 GHz) Tx 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.	161.768	QP	22.24	15.28	8.02	32.02	0.00	13.52	43.50	29.9	100	1	
Hori.	346.312	QP	21.77	14.42	8.96	31.85	0.00	13.30	46.00	32.7	100	2	
Hori.	423.497	QP	22.06	16.09	9.31	31.86	0.00	15.60	46.00	30.4	100	2	
Hori.	607.993	QP	21.22	19.00	10.05	31.82	0.00	18.45	46.00	27.5	100	1	
Hori.	842.283	QP	21.69	21.15	10.85	31.26	0.00	22.43	46.00	23.5	100	1	
Hori.	2483.500	PK	48.79	27.55	13.65	44.16	2.24	48.07	73.90	25.8	184	191	
Hori.	4960.000	PK	50.83	31.83	5.59	44.51	2.24	45.98	73.90	27.9	187	187	
Hori.	7440.000	PK	48.31	36.97	6.92	44.08	2.24	50.36	73.90	23.5	150	0	
Hori.	9920.000	PK	48.39	38.98	8.04	43.87	2.24	53.78	73.90	20.1	150	0	
Vert.	170.462	QP	21.76	15.65	8.01	32.02	0.00	13.40	43.50	30.1	100	2	
Vert.	242.493	QP	21.97	11.64	8.40	31.93	0.00	10.08	46.00	35.9	100	1	
Vert.	343.200	QP	21.93	14.35	8.94	31.85	0.00	13.37	46.00	32.6	100	3	
Vert.	604.605	QP	21.34	18.98	10.04	31.82	0.00	18.54	46.00	27.4	100	1	
Vert.	913.728	QP	21.77	21.99	11.09	30.80	0.00	24.05	46.00	21.9	100	2	
Vert.	2483.500	PK	49.34	27.55	13.65	44.16	2.24	48.62	73.90	25.2	254	234	
Vert.	4960.000	PK	51.51	31.83	5.59	44.51	2.24	46.66	73.90	27.2	166	328	
Vert.	7440.000	PK	48.07	36.97	6.92	44.08	2.24	50.12	73.90	23.7	150	0	
Vert.	9920.000	PK	47.99	38.98	8.04	43.87	2.24	53.38	73.90	20.5	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.88 m / 3.0 m) = 2.24 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	38.97	27.55	13.65	44.16	3.96	2.24	42.21	53.90	11.7	*1)
Hori.	4960.000	AV	42.84	31.83	5.59	44.51	3.96	2.24	41.95	53.90	11.9	
Hori.	7440.000	AV	38.98	36.97	6.92	44.08	3.96	2.24	44.99	53.90	8.9	
Hori.	9920.000	AV	39.29	38.98	8.04	43.87	3.96	2.24	48.64	53.90	5.3	
Vert.	2483.500	AV	39.38	27.55	13.65	44.16	3.96	2.24	42.62	53.90	11.3	*1)
Vert.	4960.000	AV	42.75	31.83	5.59	44.51	3.96	2.24	41.86	53.90	12.0	
Vert.	7440.000	AV	38.97	36.97	6.92	44.08	3.96	2.24	44.98	53.90	8.9	
Vert.	9920.000	AV	38.94	38.98	8.04	43.87	3.96	2.24	48.29	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(3.88 m / 3.0 m) = 2.24 dB

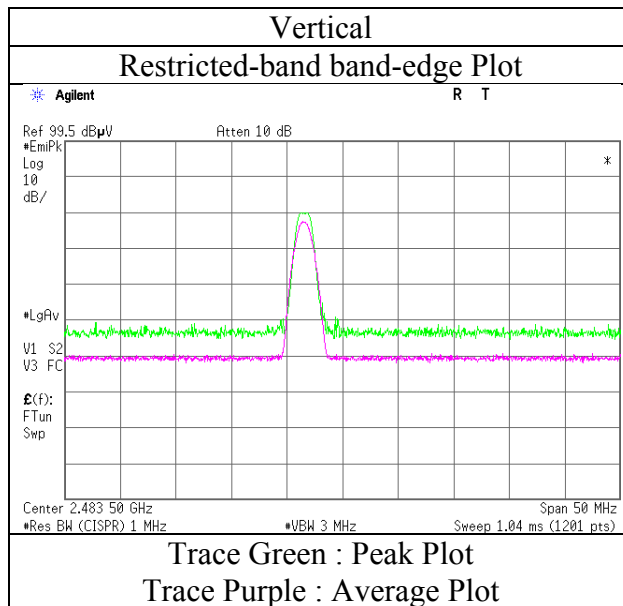
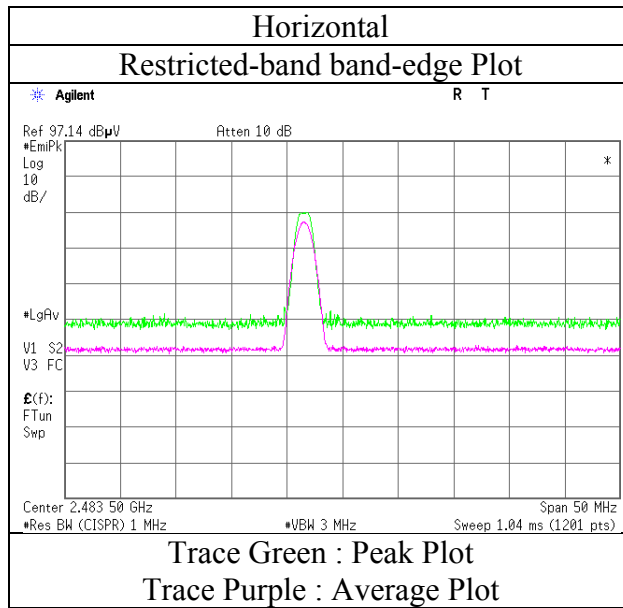
13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

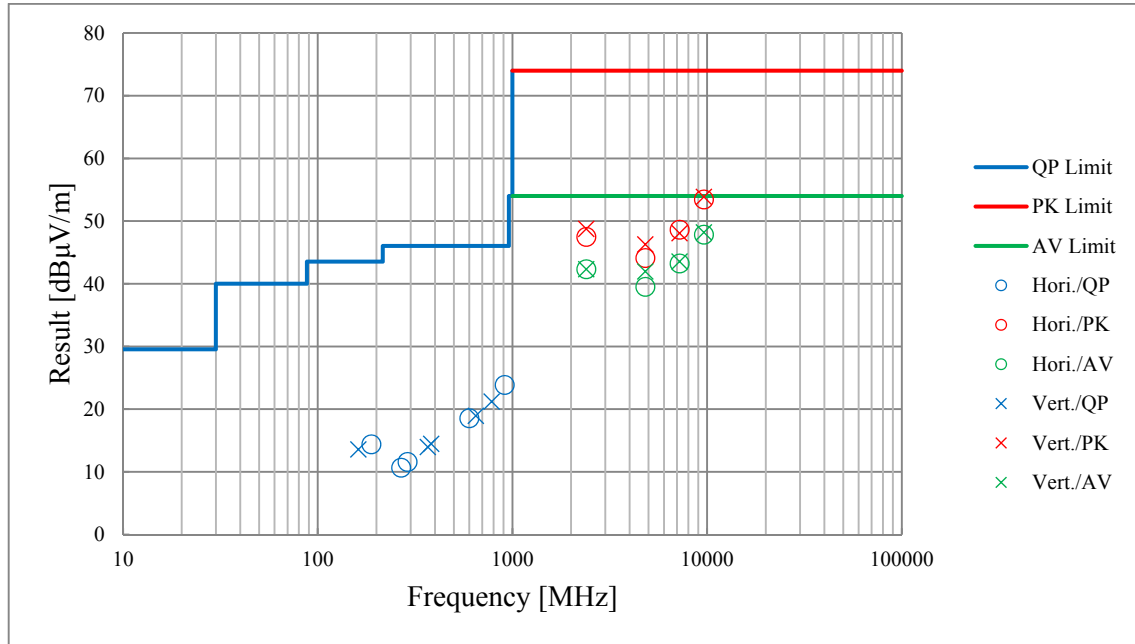
Report No. 11920651S-D-R3
Test place Shonan EMC Lab.
Semi Anechoic Chamber 3AC
Date December 24, 2017
Temperature / Humidity 21 deg.C / 31 %RH
Engineer Kazutaka Takeyama
Mode Tx 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

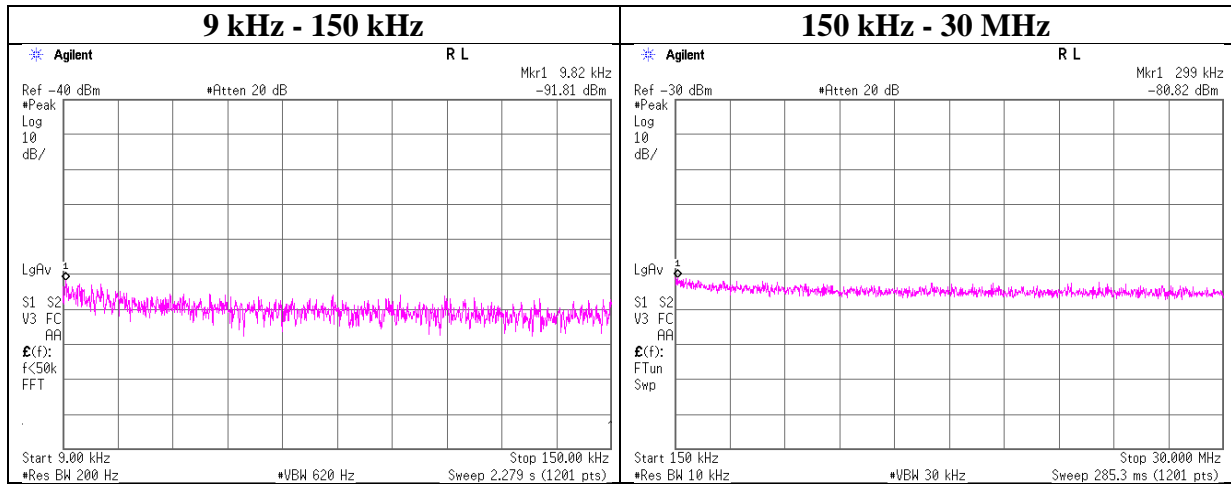
Report No.	11920651S-D-R3	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	3AC	3AC
Date	December 23, 2017	December 24, 2017
Temperature / Humidity	22 deg.C / 24 %RH	21 deg.C / 31 %RH
Engineer	Kazuya Noda (30 MHz - 1 GHz)	Kazutaka Takeyama (1 GHz - 18 GHz)
	(18 GHz - 26.5 GHz)	
Mode	Tx 2402 MHz	



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

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
 Report No. : 11920651S-D-R3
 Date : December 8, 2017
 Temperature / Humidity : 27 deg. C / 25 % RH
 Engineer : Ishikawa Yosuke
 Mode : Tx 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
9.82	-91.8	0.01	9.5	2.4	1	-79.9	300	6.0	-18.6	47.7	66.3	
299.00	-80.8	0.02	9.5	2.4	1	-68.9	300	6.0	-7.6	18.0	25.6	

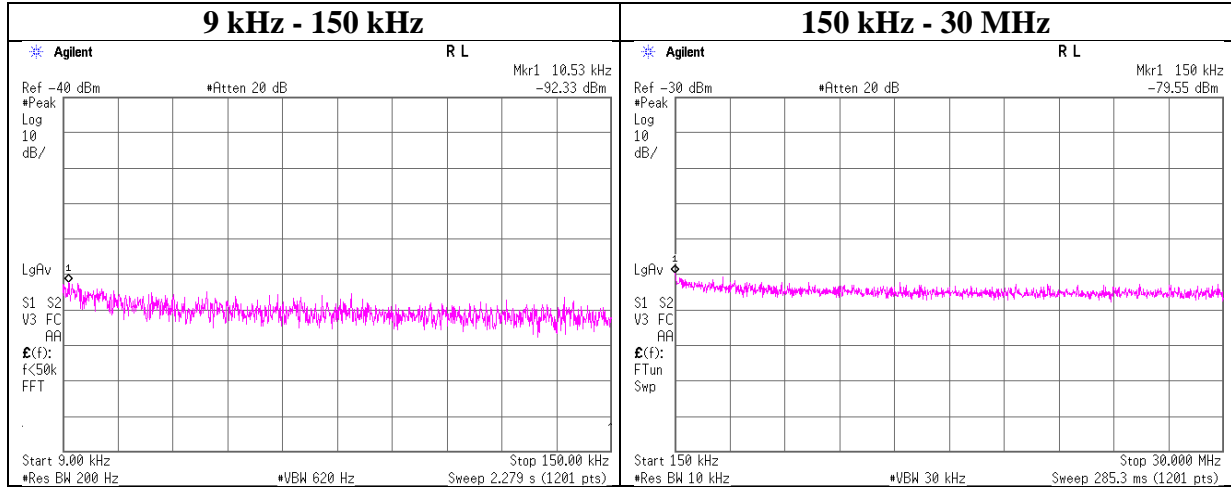
$$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log(\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$$

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

N: Number of output

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11920651S-D-R3
Date	December 8, 2017
Temperature / Humidity	27 deg. C / 25 % RH
Engineer	Ishikawa Yosuke
Mode	Tx 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
10.53	-92.3	0.01	9.5	2.4	1	-80.4	300	6.0	-19.1	47.1	66.2	
150.00	-79.6	0.02	9.5	2.4	1	-67.6	300	6.0	-6.3	24.0	30.3	

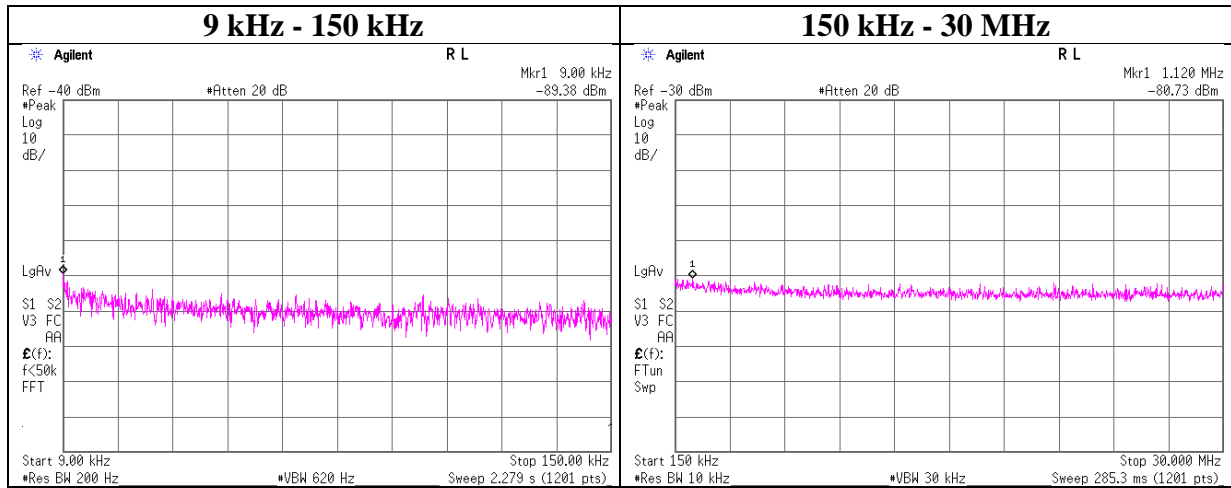
$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

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

N: Number of output

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11920651S-D-R3
Date	December 8, 2017
Temperature / Humidity	27 deg. C / 25 % RH
Engineer	Ishikawa Yosuke
Mode	Tx 2480 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.00	-89.4	0.01	9.5	2.4	1	-77.4	300	6.0	-16.2	48.5	64.7	
1120.00	-80.7	0.03	9.5	2.4	1	-68.8	30	6.0	12.5	26.6	14.1	

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

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

N: Number of output

Power Density

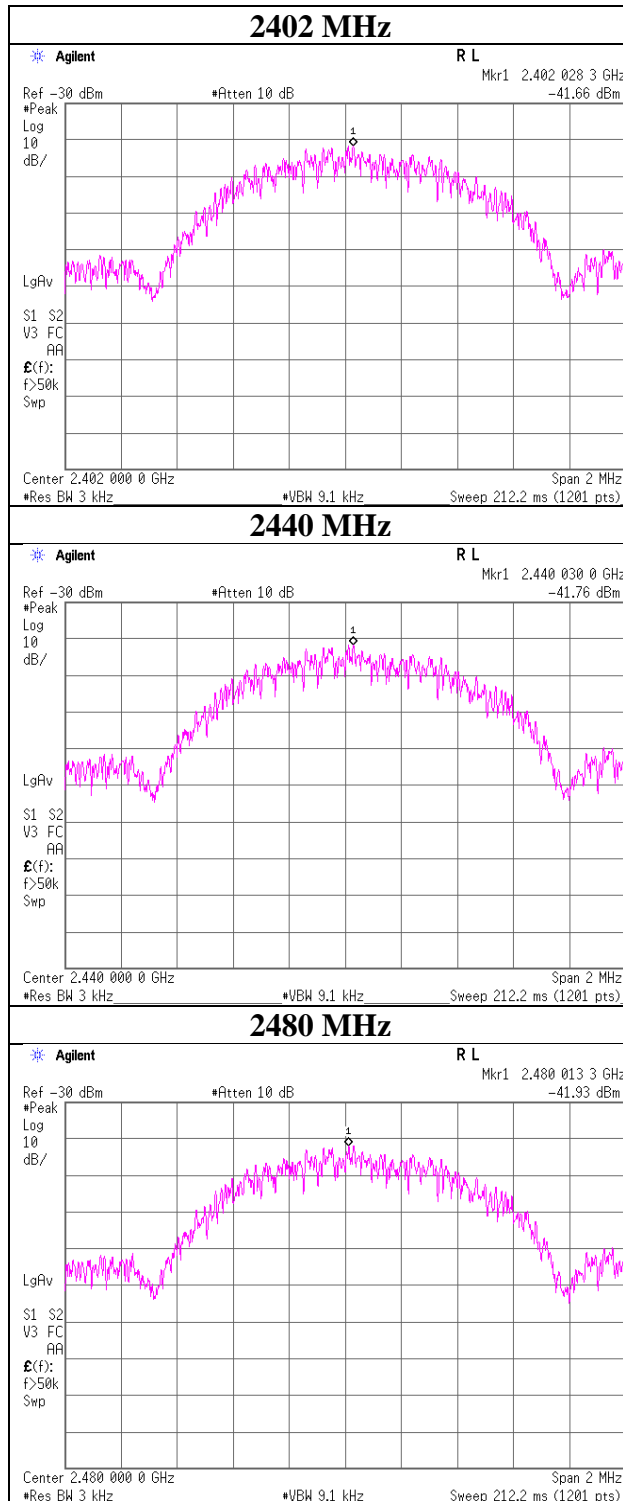
Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11920651S-D-R3
Date December 8, 2017
Temperature / Humidity 27 deg. C / 25 % RH
Engineer Ishikawa Yosuke
Mode Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-41.66	2.02	9.68	-29.96	8.00	37.96
2440.00	-41.76	2.03	9.67	-30.06	8.00	38.06
2480.00	-41.93	2.04	9.67	-30.22	8.00	38.22

Sample Calculation:

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

Power Density



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APPENDIX 2: Test instruments

Test Instruments

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2017/05/01 * 12
SPSS-04	Power sensor	Agilent	N1923A	MY5326009	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
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	AT	2017/10/10 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 12
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	RE	2017/03/23 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000 KM SKMS	-	RE	2017/04/20 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM9861	RE	2017/07/11 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2017/03/17 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2017/06/11 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2017/10/30 * 12
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	RE	2017/11/24 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,C E, RFI, MF)	-	RE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2017/10/16 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2017/10/02 * 12
SLA-07	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	RE	2017/01/26 * 12
SAT6-08	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	RE	2017/08/24 * 12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/14 1PE/141PE/141PE /141PE/NS4906	-/0901-271(RF Selector)	RE	2017/04/07 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2017/02/09 * 12
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	2046104	RE	2017/09/22 * 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	MWX221-01000 NF SNMS/B	1612S005	RE	2017/01/08 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2017/08/23 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2017/10/10 * 12
SAEC-03(SVSWR)	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	RE	2017/07/17 * 12
SAT10-05	Attenuator(above1G Hz)	Agilent	8493C-010	74864	RE	2017/11/22 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2017/11/16 * 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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