



RADIO TEST REPORT

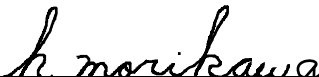
Test Report No. : 11984008S-R2

Applicant : Circuit Design, Inc.
Type of Equipment : Wireless remote control transmitter
Model No. : KST2.4W
FCC ID : V9X-KST24W
Test regulation : FCC Part 15 Subpart C: 2017
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11984008S-R1. 11984008S-R1 is replaced with this report.

Date of test: October 31 and November 1, 2017

Representative test engineer:


Hiroyuki Morikawa
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.: 11984008S

[illegible]

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SECTION 1: Customer information

Company Name	:	Circuit Design, Inc.
Address	:	7557-1, Hotaka, Azumino, Nagano 399-8303 Japan
Telephone Number	:	+81-263-82-1011
Facsimile Number	:	+81-263-82-1012
Contact Person	:	Maiko Yasunaga

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

2.1 Identification of E.U.T.

Type of Equipment	:	Wireless remote control transmitter
Model No.	:	KST2.4W
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3 V (battery)
Receipt Date of Sample	:	October 30, 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: KST2.4W (referred to as the EUT in this report) is a Wireless remote control transmitter.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2403 MHz - 2479 MHz
Modulation	:	GFSK (FHSS)
Power Supply (radio part input)	:	DC 2.2 V
Antenna type	:	pattern antenna
Antenna Gain	:	2.49 dBi
Clock frequency (Maximum)	:	16 MHz
Operating Temperature	:	-20 to +60 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 November 2, 2017

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

* The revision on November 2, 2017, does not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	N/A	N/A	N/A*1)
Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (b)	See data.	Complied	Conducted
20 dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (a)		Complied	Conducted
Number of Hopping Frequency	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		Complied	Conducted
Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		Complied	Conducted
Maximum Peak Output Power	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.12	FCC: Section15.247(b)(1) IC: RSS-247 5.4 (b)		Complied	Conducted
Spurious Emission & Band Edge Compliance	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.13	FCC: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	5.8 dB 12015.000 MHz, AV, Vert. (Tx, 2403 MHz)	Complied	Conducted/ 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 ports.

*2) Radiated test was selected over 30 MHz based on FCC section 15.247(d).

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

FCC Part 15.31 (e)

The RF Module has its own regulator.

This EUT provides stable voltage (DC 2.2 V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement. (Used new battery whole these testing.)

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
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.5 dB	2.6 dB	2.5 dB	2.5 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.1 dB	3.1 dB	3.1 dB	-	-
	30 MHz-200 MHz	4.6 dB	4.4 dB	4.6 dB	-	-
	200 MHz-1 GHz	5.8 dB	5.7 dB	5.8 dB	-	-
Radiated emission (Measurement distance: 1 m)	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
	13 GHz-18 GHz	4.6 dB	4.6 dB	4.6 dB	-	-
	18 GHz-40 GHz	4.9 dB	4.9 dB	4.9 dB	-	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.72 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.85 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.74 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	0.91 dB
Spurious emission (Conducted) below 1GHz	1.6 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.3 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.2 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.3 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %

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

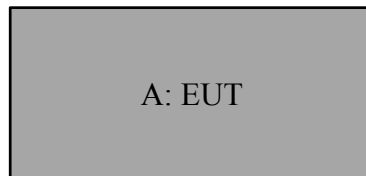
4.1 Operating Mode(s)

Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, Spurious Emission (Conducted/Radiated)	Tx (Hopping Off)	2403 MHz 2439 MHz 2479 MHz
Carrier Frequency Separation	Tx (Hopping On)	2403 MHz 2439 MHz 2479 MHz
20dB Bandwidth	Tx (Hopping Off)	2403 MHz 2439 MHz 2479 MHz
Number of Hopping Frequency	Tx (Hopping On)	-
Dwell time	Tx (Hopping On)	-
Maximum Peak Output Power	Tx (Hopping Off)	2403 MHz 2439 MHz 2479 MHz
Band Edge Compliance (Conducted)	Tx, -Hopping On -Hopping Off	2403 MHz 2479 MHz
99% Occupied Bandwidth	Tx, -Hopping On -Hopping Off	2403 MHz 2439 MHz 2479 MHz
*EUT has the power settings by the software as follows; Power settings: Fixed Software: T082C01_V1R380.hex *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless remote control transmitter	KST2.4W	10200113, *1) 10200111 *2)	Circuit Design, Inc.	EUT

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

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SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

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

[For above 1 GHz]

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

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

The height of the measuring antenna varied between 1 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	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	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	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz *1)	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	3 m*2) (1 GHz – 13 GHz), 1 m*3) (13 GHz – 40 GHz)		3 m*2) (1 GHz – 13 GHz), 1 m*3) (13 GHz – 40 GHz),

*1) Although DA 00-705 accepts VBW = 10 Hz for AV measurements, it was confirmed that superfluous smoothing was not performed.

*2) Distance Factor: $20 \times \log(3.94 \text{ m}/3.0 \text{ m}) = 2.37 \text{ dB}$

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

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

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

Measurement range : 30 MHz - 25 GHz

Test data : APPENDIX

Test result : Pass

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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
20 dB Bandwidth	5 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold *1)	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Carrier Frequency Separation	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	30 MHz	300 kHz	1 MHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	100 kHz, 1 MHz	300 kHz, 3 MHz	As necessary capture the entire dwell time per hopping channel	Peak	Clear Write	Spectrum Analyzer
Conducted Spurious Emission *3)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*1) The measurement was performed with Max Hold since the duty cycle was not 100 %.

*2) Reference data

*3) In the frequency range below 30 MHz, 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.

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

20 dB Bandwidth and Carrier Frequency Separation

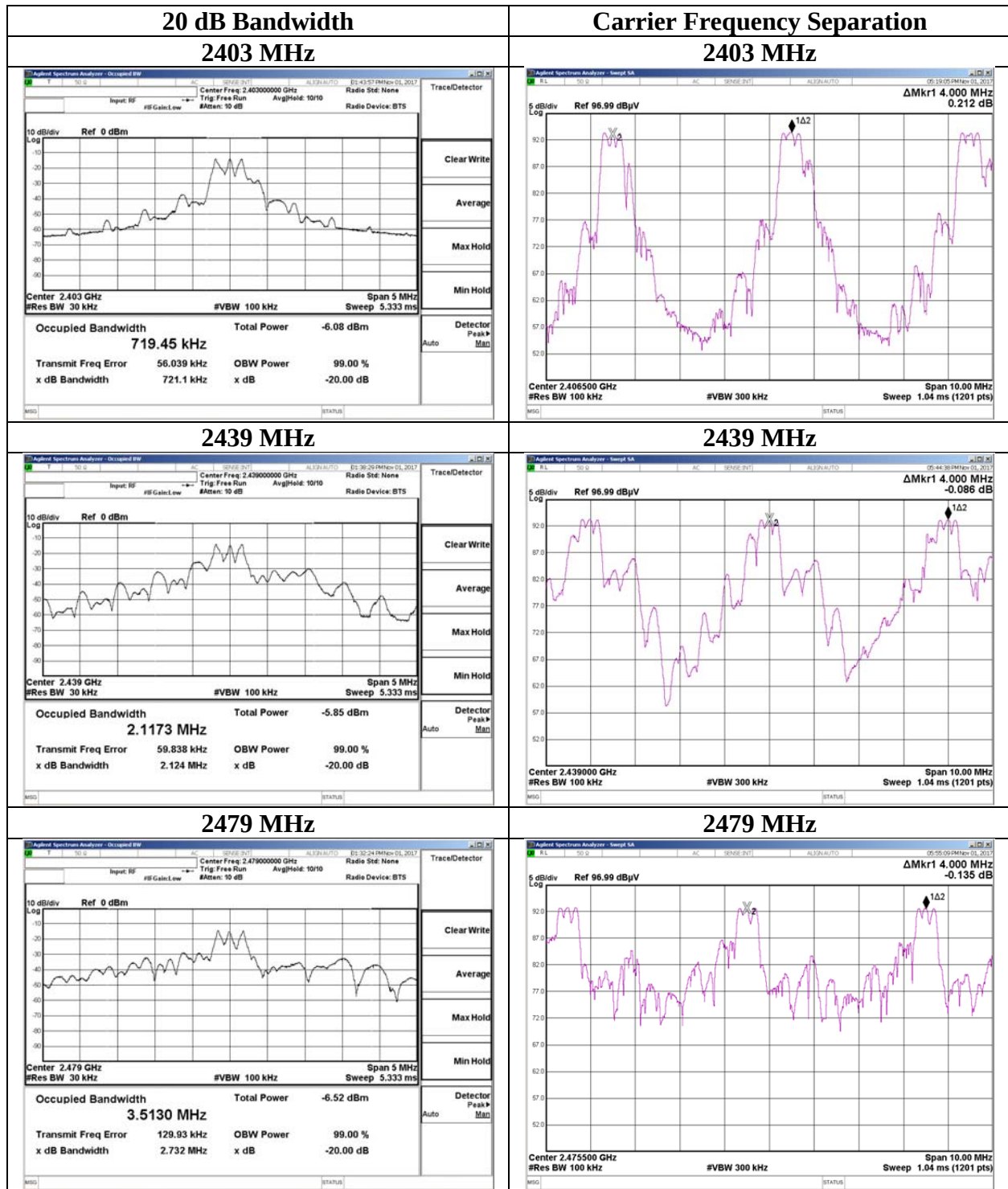
Test place Shonan EMC Lab. No.6 Shielded Room
Report No. 11984008S-R2
Date November 1, 2017
Temperature / Humidity 23 deg. C / 37 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping On, Tx, Hopping Off

Freq. [MHz]	20 dB Bandwidth [MHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
2403.0	0.721	4.000	≥ 0.481
2439.0	2.124	4.000	≥ 1.416
2479.0	2.732	4.000	≥ 1.821

Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).

No limit applies to 20dB Bandwidth.

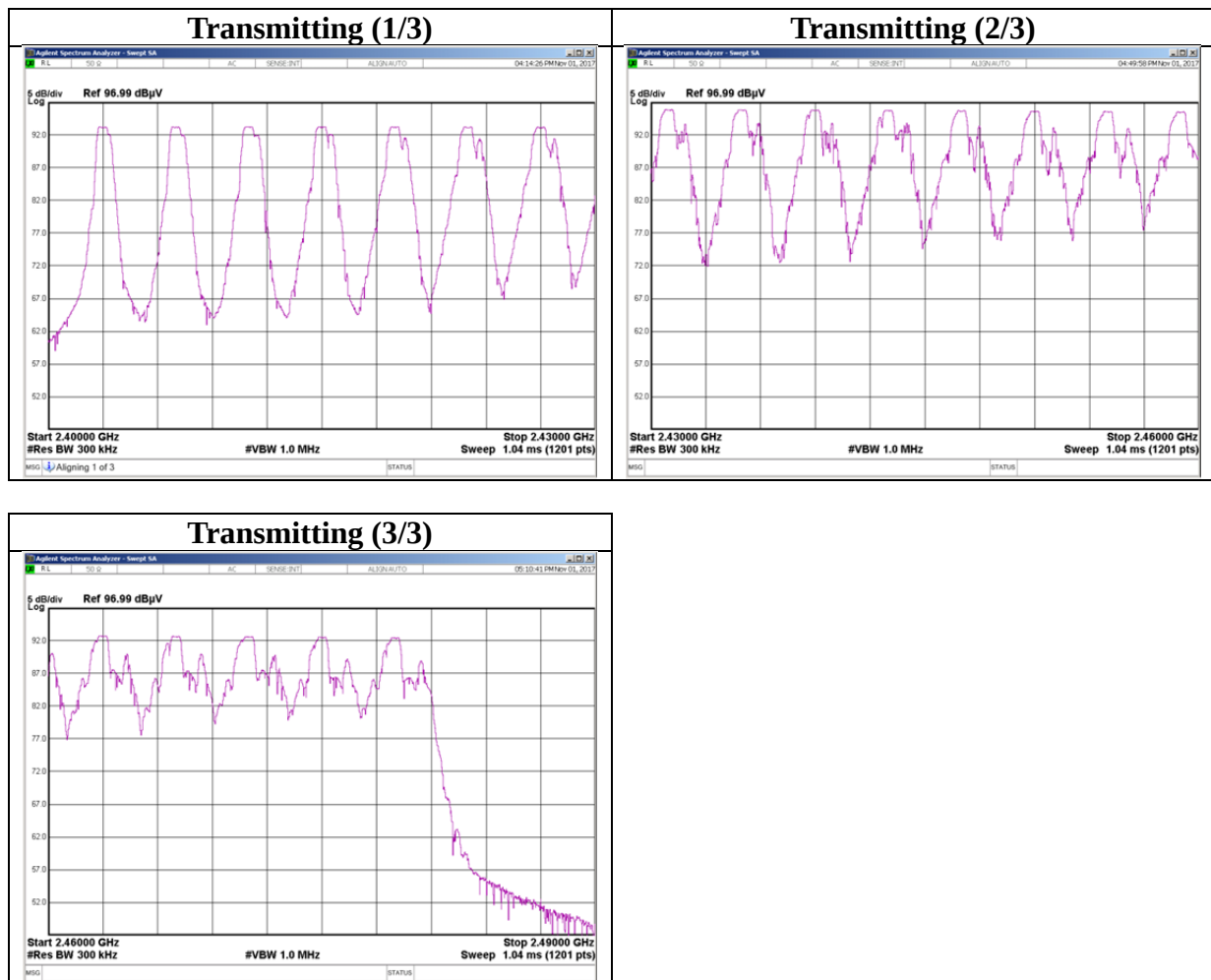
20 dB Bandwidth and Carrier Frequency Separation



Number of Hopping Frequency

Test place : Shonan EMC Lab. No.6 Shielded Room
Report No. : 11984008S-R2
Date : November 1, 2017
Temperature / Humidity : 23 deg. C / 37 % RH
Engineer : Kenichi Adachi
Mode : Tx, Hopping On,

Number of channel [channels]	Limit [channels]
20	≥ 15



Dwell time

Test place	Shonan EMC Lab. No.6 Shielded Room
Report No.	11984008S-R2
Date	November 1, 2017
Temperature / Humidity	23 deg. C / 37 % RH
Engineer	Kenichi Adachi
Mode	Tx, Hopping On,

Number of transmission in a 8 s (= 20 Hopping x 0.4)	Length of transmission [ms]	Result [ms]	Limit [ms]
24.6 times / 5 s x 8.0 s = 40 times	0.729	29	400

Sample Calculation

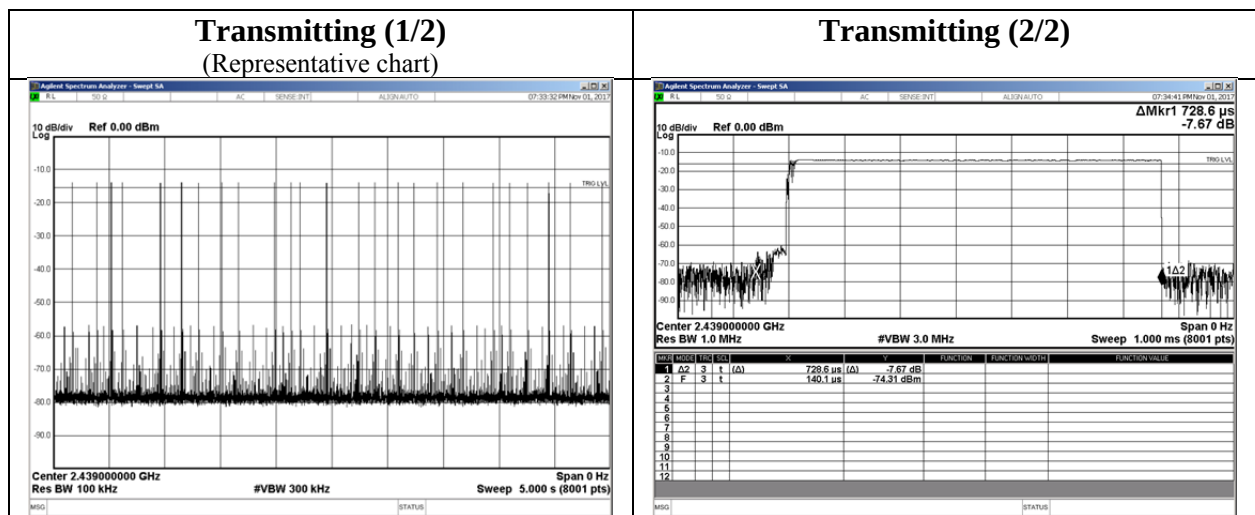
Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

Sampling [times]					Average [times]
1	2	3	4	5	
25	24	25	25	24	24.6

Sample Calculation

Average = Summation (Sampling 1 to 5) / 5



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Maximum Peak Output Power

Test place Shonan EMC Lab. No.6 Shielded Room
Report No. 11984008S-R2
Date November 1, 2017
Temperature / Humidity 23 deg. C / 37 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping Off,

Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2403.0	-13.20	1.73	9.64	-1.83	0.66	20.96	125	22.79
2439.0	-13.32	1.74	9.64	-1.94	0.64	20.96	125	22.90
2479.0	-13.87	1.75	9.65	-2.47	0.57	20.96	125	23.43

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 Exposur)

Test place	Shonan EMC Lab. No.6 Shielded Room
Report No.	11984008S-R2
Date	November 1, 2017
Temperature / Humidity	23 deg. C / 37 % RH
Engineer	Kenichi Adachi
Mode	Tx, Hopping Off,

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2403.0	-24.54	1.73	9.64	-13.17	0.05	11.31	-1.86	0.65
2439.0	-24.66	1.74	9.64	-13.28	0.05	11.31	-1.97	0.64
2479.0	-25.10	1.75	9.65	-13.70	0.04	11.31	-2.39	0.58

Sample Calculation:

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

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

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

Radiated Spurious Emission

Report No. 11984008S-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date October 31, 2017
Temperature / Humidity 24 deg. C / 42 % RH
Engineer Hiroyuki Morikawa
(30 MHz -25 GHz)
Mode Tx, Hopping Off 2403 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.	100.000	QP	22.20	10.12	7.98	31.85	0.00	8.45	43.50	35.0	100	0	
Hori.	200.000	QP	21.60	16.33	9.05	31.77	0.00	15.21	43.50	28.2	100	0	
Hori.	300.000	QP	21.70	13.39	6.45	31.68	0.00	9.86	46.00	36.1	100	0	
Hori.	400.000	QP	21.20	15.82	7.14	31.63	0.00	12.53	46.00	33.4	100	0	
Hori.	500.000	QP	21.20	17.77	7.72	31.59	0.00	15.10	46.00	30.9	100	0	
Hori.	600.000	QP	21.40	19.10	8.23	31.57	0.00	17.16	46.00	28.8	100	0	
Hori.	2390.000	PK	51.75	27.16	14.16	36.83	2.37	58.61	73.90	15.2	109	45	
Hori.	4806.000	PK	47.36	31.15	6.60	36.99	2.37	50.49	73.90	23.4	215	358	
Hori.	7209.000	PK	43.79	36.49	8.15	37.81	2.37	52.99	73.90	20.9	150	0	
Hori.	9612.000	PK	45.55	38.21	9.14	38.48	2.37	56.79	73.90	17.1	150	0	
Hori.	12015.000	PK	47.03	39.06	10.46	39.18	2.37	59.74	73.90	14.1	150	0	
Hori.	2390.000	AV	31.44	27.16	14.16	36.83	2.37	38.30	53.90	15.6	109	45	
Hori.	4806.000	AV	32.96	31.15	6.60	36.99	2.37	36.09	53.90	17.8	215	358	
Hori.	7209.000	AV	32.66	36.49	8.15	37.81	2.37	41.86	53.90	12.0	150	0	
Hori.	9612.000	AV	33.68	38.21	9.14	38.48	2.37	44.92	53.90	8.9	150	0	
Hori.	12015.000	AV	35.26	39.06	10.46	39.18	2.37	47.97	53.90	5.9	150	0	
Vert.	100.000	QP	22.20	10.12	7.98	31.85	0.00	8.45	43.50	35.0	100	0	
Vert.	200.000	QP	21.60	16.33	9.05	31.77	0.00	15.21	43.50	28.2	100	0	
Vert.	300.000	QP	21.70	13.39	6.45	31.68	0.00	9.86	46.00	36.1	100	0	
Vert.	400.000	QP	21.20	15.82	7.14	31.63	0.00	12.53	46.00	33.4	100	0	
Vert.	500.000	QP	21.20	17.77	7.72	31.59	0.00	15.10	46.00	30.9	100	0	
Vert.	600.000	QP	21.40	19.10	8.23	31.57	0.00	17.16	46.00	28.8	100	0	
Vert.	2390.000	PK	45.25	27.16	14.16	36.83	2.37	52.11	73.90	21.7	400	126	
Vert.	4806.000	PK	49.39	31.15	6.60	36.99	2.37	52.52	73.90	21.3	100	22	
Vert.	7209.000	PK	44.38	36.49	8.15	37.81	2.37	53.58	73.90	20.3	150	0	
Vert.	9612.000	PK	45.67	38.21	9.14	38.48	2.37	56.91	73.90	16.9	150	0	
Vert.	12015.000	PK	47.90	39.06	10.46	39.18	2.37	60.61	73.90	13.2	150	0	
Vert.	2390.000	AV	31.44	27.16	14.16	36.83	2.37	38.30	53.90	15.6	400	126	
Vert.	4806.000	AV	33.35	31.15	6.60	36.99	2.37	36.48	53.90	17.4	100	22	
Vert.	7209.000	AV	32.63	36.49	8.15	37.81	2.37	41.83	53.90	12.0	150	0	
Vert.	9612.000	AV	33.74	38.21	9.14	38.48	2.37	44.98	53.90	8.9	150	0	
Vert.	12015.000	AV	35.31	39.06	10.46	39.18	2.37	48.02	53.90	5.8	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.94\text{ m} / 3.0\text{ m}) = 2.37\text{ dB}$

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

* These results have sufficient margin without taking account Dwell time factor.

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.	2403.000	PK	88.82	27.21	14.17	36.82	2.37	95.75	-	-	Carrier
Hori.	2400.000	PK	46.59	27.20	14.16	36.83	2.37	53.49	75.75	22.3	
Vert.	2403.000	PK	81.17	27.21	14.17	36.82	2.37	88.10	-	-	Carrier
Vert.	2400.000	PK	39.42	27.20	14.16	36.83	2.37	46.32	68.10	21.8	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.94\text{ m} / 3.0\text{ m}) = 2.37\text{ dB}$

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

UL Japan, Inc.

Shonan EMC Lab.

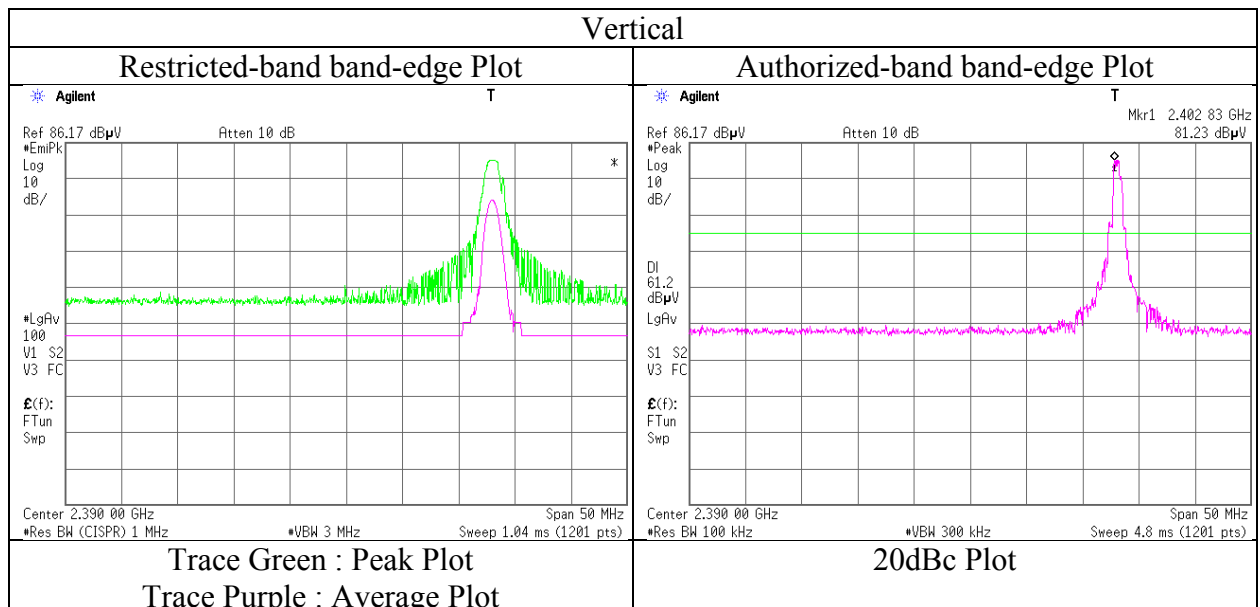
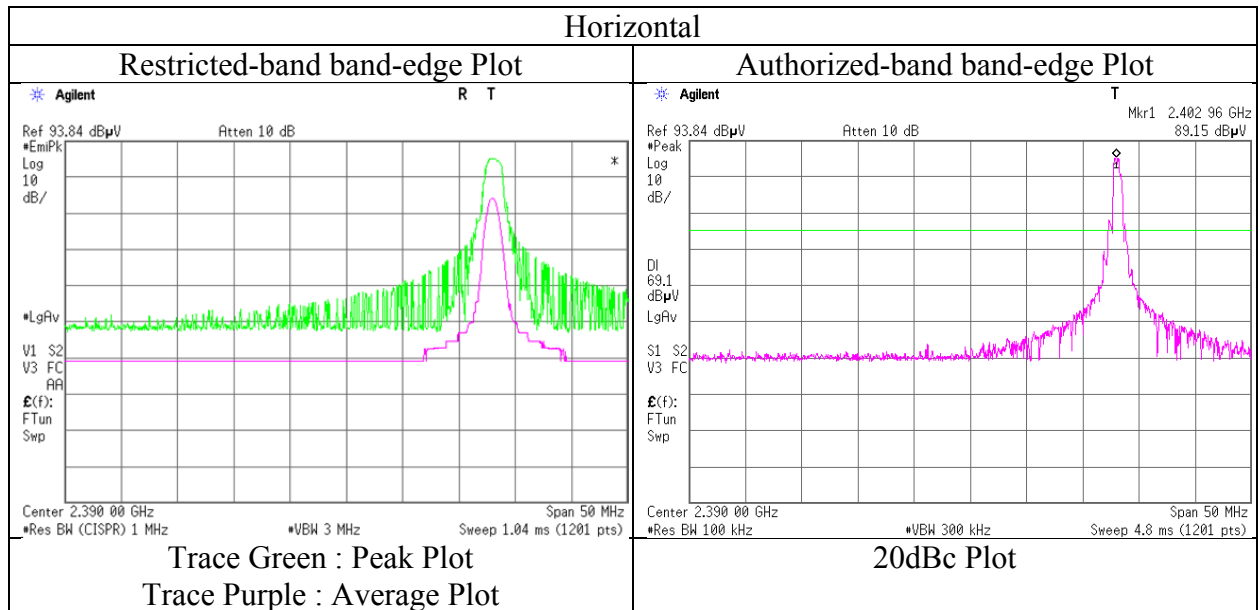
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	11984008S-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.2
Date	October 31, 2017
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	Hiroyuki Morikawa (1 GHz -13 GHz)
Mode	Tx, Hopping Off 2403 MHz



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

Radiated Spurious Emission

Report No. 11984008S-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date October 31, 2017
Temperature / Humidity 24 deg. C / 42 % RH
Engineer Hiroyuki Morikawa
(30 MHz -25 GHz)
Mode Tx, Hopping Off 2439 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.	100.000	QP	22.20	10.12	7.98	31.85	0.00	8.45	43.50	35.0	100	0	
Hori.	200.000	QP	21.60	16.33	9.05	31.77	0.00	15.21	43.50	28.2	100	0	
Hori.	300.000	QP	21.70	13.39	6.45	31.68	0.00	9.86	46.00	36.1	100	0	
Hori.	400.000	QP	21.20	15.82	7.14	31.63	0.00	12.53	46.00	33.4	100	0	
Hori.	500.000	QP	21.20	17.77	7.72	31.59	0.00	15.10	46.00	30.9	100	0	
Hori.	600.000	QP	21.40	19.10	8.23	31.57	0.00	17.16	46.00	28.8	100	0	
Hori.	4878.000	PK	49.15	31.30	6.65	37.03	2.37	52.44	73.90	21.4	154	357	
Hori.	7317.000	PK	42.71	36.64	8.18	37.88	2.37	52.02	73.90	21.8	150	0	
Hori.	9756.000	PK	43.87	38.50	9.18	38.66	2.37	55.26	73.90	18.6	150	0	
Hori.	12195.000	PK	45.46	39.08	10.47	39.14	2.37	58.24	73.90	15.6	150	0	
Hori.	4878.000	AV	33.39	31.30	6.65	37.03	2.37	36.68	53.90	17.2	154	357	
Hori.	7317.000	AV	31.45	36.64	8.18	37.88	2.37	40.76	53.90	13.1	150	0	
Hori.	9756.000	AV	32.26	38.50	9.18	38.66	2.37	43.65	53.90	10.2	150	0	
Hori.	12195.000	AV	32.81	39.08	10.47	39.14	2.37	45.59	53.90	8.3	150	0	
Vert.	100.000	QP	22.20	10.12	7.98	31.85	0.00	8.45	43.50	35.0	100	0	
Vert.	200.000	QP	21.60	16.33	9.05	31.77	0.00	15.21	43.50	28.2	100	0	
Vert.	300.000	QP	21.70	13.39	6.45	31.68	0.00	9.86	46.00	36.1	100	0	
Vert.	400.000	QP	21.30	15.82	7.14	31.63	0.00	12.63	46.00	33.3	100	0	
Vert.	500.000	QP	21.20	17.77	7.72	31.59	0.00	15.10	46.00	30.9	100	0	
Vert.	600.000	QP	21.40	19.10	8.23	31.57	0.00	17.16	46.00	28.8	100	0	
Vert.	4878.000	PK	49.70	31.30	6.65	37.03	2.37	52.99	73.90	20.9	102	7	
Vert.	7317.000	PK	43.33	36.64	8.18	37.88	2.37	52.64	73.90	21.2	150	0	
Vert.	9756.000	PK	45.64	38.50	9.18	38.66	2.37	57.03	73.90	16.8	150	0	
Vert.	12195.000	PK	45.15	39.08	10.47	39.14	2.37	57.93	73.90	15.9	150	0	
Vert.	4878.000	AV	33.73	31.30	6.65	37.03	2.37	37.02	53.90	16.8	102	7	
Vert.	7317.000	AV	31.79	36.64	8.18	37.88	2.37	41.10	53.90	12.8	150	0	
Vert.	9756.000	AV	32.73	38.50	9.18	38.66	2.37	44.12	53.90	9.7	150	0	
Vert.	12195.000	AV	33.06	39.08	10.47	39.14	2.37	45.84	53.90	8.0	150	0	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.94\text{ m} / 3.0\text{ m}) = 2.37\text{ dB}$

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

* These results have sufficient margin without taking account Dwell time factor.

UL Japan, Inc.

Shonan EMC Lab.

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Facsimile : +81 463 50 6401

Radiated Spurious Emission

Report No. 11984008S-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date October 31, 2017
Temperature / Humidity 24 deg. C / 42 % RH
Engineer Hiroyuki Morikawa
(30 MHz -25 GHz)
Mode Tx, Hopping Off 2479 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.	100.000	QP	22.10	10.12	7.98	31.85	0.00	8.35	43.50	35.1	100	0	
Hori.	200.000	QP	21.60	16.33	9.05	31.77	0.00	15.21	43.50	28.2	100	0	
Hori.	300.000	QP	21.70	13.39	6.45	31.68	0.00	9.86	46.00	36.1	100	0	
Hori.	400.000	QP	21.20	15.82	7.14	31.63	0.00	12.53	46.00	33.4	100	0	
Hori.	500.000	QP	21.20	17.77	7.72	31.59	0.00	15.10	46.00	30.9	100	0	
Hori.	600.000	QP	21.40	19.10	8.23	31.57	0.00	17.16	46.00	28.8	100	0	
Hori.	2483.500	PK	59.41	27.48	14.27	36.79	2.37	66.74	73.90	7.1	117	47	
Hori.	4958.000	PK	50.53	31.48	6.67	37.07	2.37	53.98	73.90	19.9	177	1	
Hori.	7437.000	PK	43.36	36.80	8.20	37.95	2.37	52.78	73.90	21.1	150	0	
Hori.	9956.000	PK	43.82	38.89	9.21	38.91	2.37	55.38	73.90	18.5	150	0	
Hori.	12395.000	PK	47.80	39.10	10.45	39.10	2.37	60.62	73.90	13.2	150	0	
Hori.	2483.500	AV	31.51	27.48	14.27	36.79	2.37	38.84	53.90	15.0	117	47	
Hori.	4958.000	AV	34.10	31.48	6.67	37.07	2.37	37.55	53.90	16.3	177	1	
Hori.	7437.000	AV	31.48	36.80	8.20	37.95	2.37	40.90	53.90	13.0	150	0	
Hori.	9956.000	AV	32.50	38.89	9.21	38.91	2.37	44.06	53.90	9.8	150	0	
Hori.	12395.000	AV	32.47	39.10	10.45	39.10	2.37	45.29	53.90	8.6	150	0	
Vert.	100.000	QP	22.20	10.12	7.98	31.85	0.00	8.45	43.50	35.0	100	0	
Vert.	200.000	QP	21.70	16.33	9.05	31.77	0.00	15.31	43.50	28.1	100	0	
Vert.	300.000	QP	21.70	13.39	6.45	31.68	0.00	9.86	46.00	36.1	100	0	
Vert.	400.000	QP	21.20	15.82	7.14	31.63	0.00	12.53	46.00	33.4	100	0	
Vert.	500.000	QP	21.20	17.77	7.72	31.59	0.00	15.10	46.00	30.9	100	0	
Vert.	600.000	QP	21.40	19.10	8.23	31.57	0.00	17.16	46.00	28.8	100	0	
Vert.	2483.500	PK	55.37	27.48	14.27	36.79	2.37	62.70	73.90	11.2	395	3	
Vert.	4958.000	PK	50.33	31.48	6.67	37.07	2.37	53.78	73.90	20.1	100	2	
Vert.	7437.000	PK	43.61	36.80	8.20	37.95	2.37	53.03	73.90	20.8	150	0	
Vert.	9956.000	PK	44.50	38.89	9.21	38.91	2.37	56.06	73.90	17.8	150	0	
Vert.	12395.000	PK	44.68	39.10	10.45	39.10	2.37	57.50	73.90	16.4	150	0	
Vert.	2483.500	AV	31.48	27.48	14.27	36.79	2.37	38.81	53.90	15.0	395	3	
Vert.	4958.000	AV	34.36	31.48	6.67	37.07	2.37	37.81	53.90	16.0	100	2	
Vert.	7437.000	AV	31.63	36.80	8.20	37.95	2.37	41.05	53.90	12.8	150	0	
Vert.	9956.000	AV	32.66	38.89	9.21	38.91	2.37	44.22	53.90	9.6	150	0	
Vert.	12395.000	AV	32.56	39.10	10.45	39.10	2.37	45.38	53.90	8.5	150	0	

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

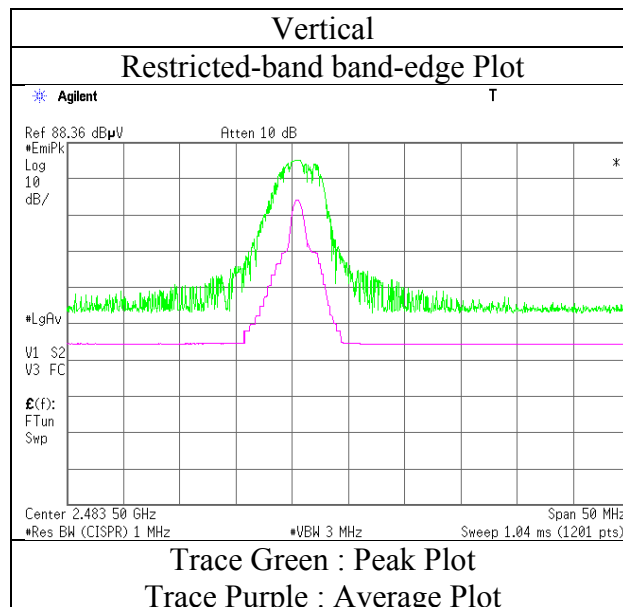
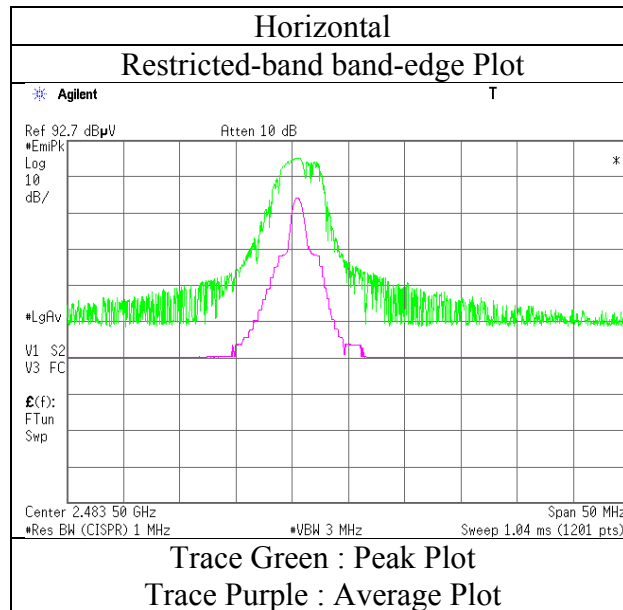
Distance factor : 1 GHz - 13 GHz : $20\log(3.94\text{ m} / 3.0\text{ m}) = 2.37\text{ dB}$

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

* These results have sufficient margin without taking account Dwell time factor.

Radiated Spurious Emission (Reference Plot for band-edge)

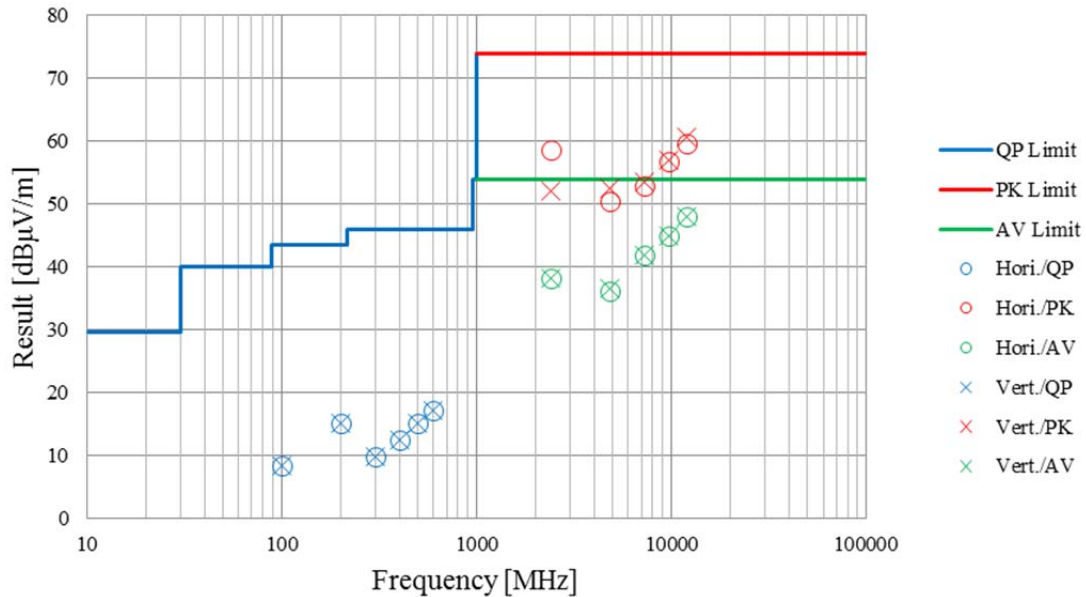
Report No.	11984008S-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.2
Date	October 31, 2017
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	Hiroyuki Morikawa (1 GHz -13 GHz)
Mode	Tx, Hopping Off 2479 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Report No. 11984008S-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date October 31, 2017
Temperature / Humidity 24 deg. C / 42 % RH
Engineer Hiroyuki Morikawa
(30 MHz -25 GHz)
Mode Tx, Hopping Off 2403 MHz

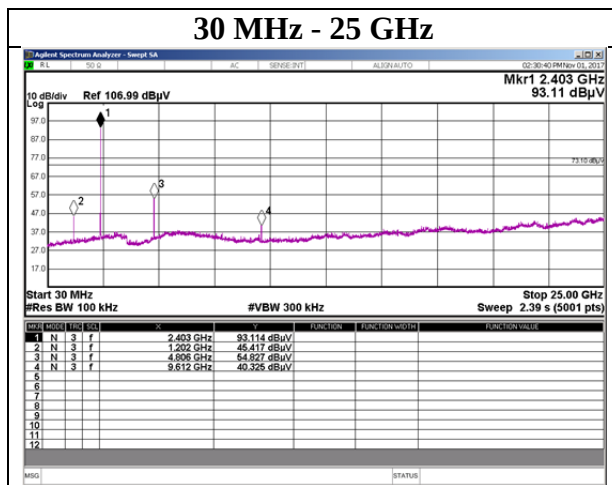
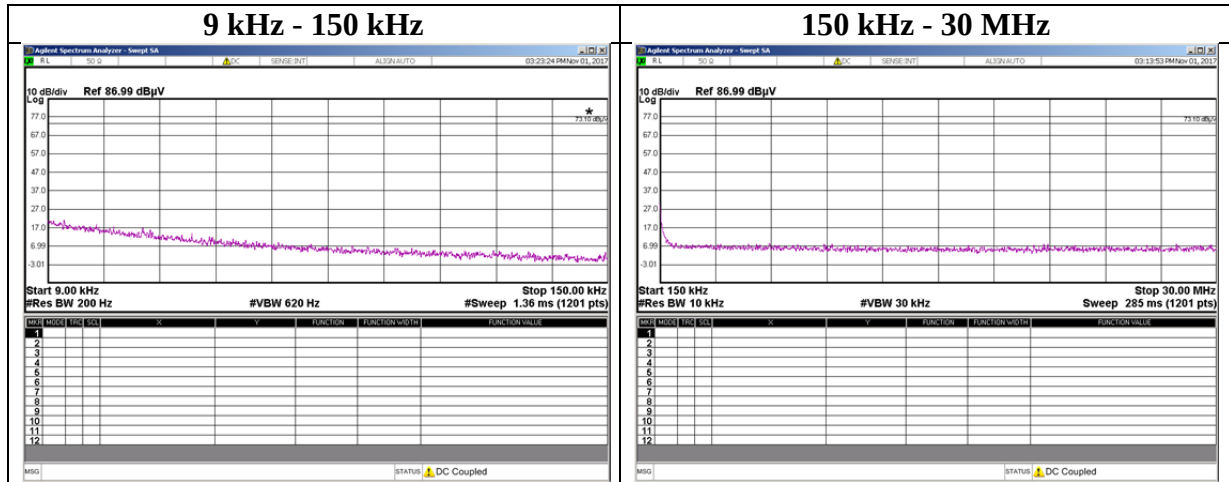


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.6 Shielded Room
Report No. : 11984008S-R2
Date : November 1, 2017
Temperature / Humidity : 23 deg. C / 37 % RH
Engineer : Kenichi Adachi
Mode : Tx, Hopping Off,

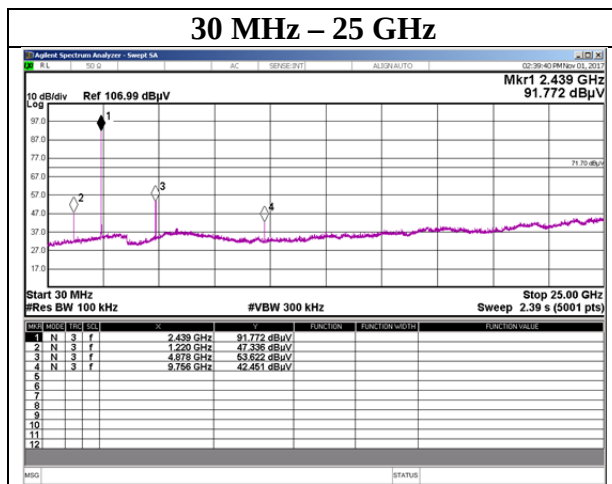
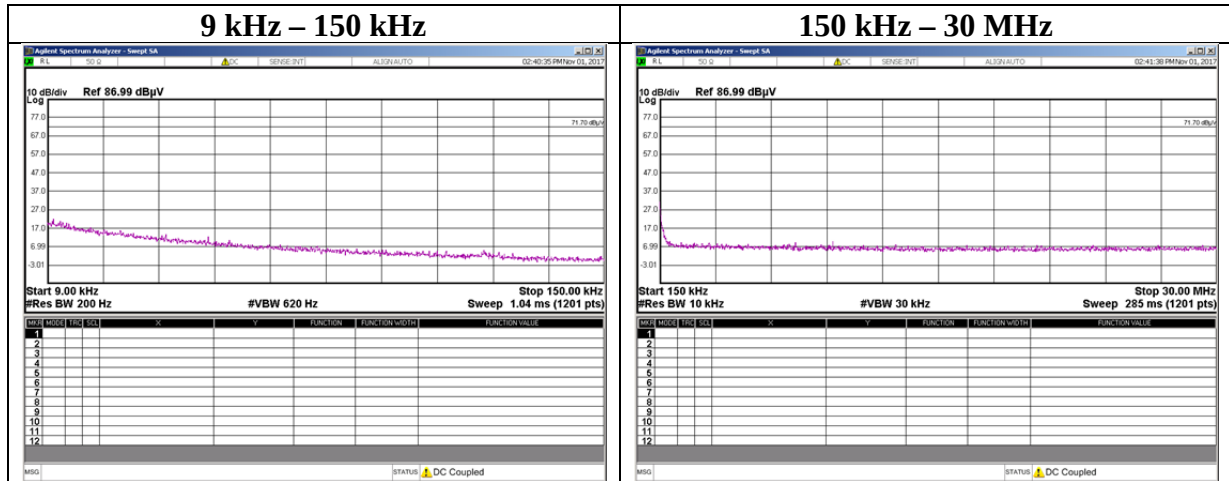
2403 MHz



Conducted Spurious Emission

Test place : Shonan EMC Lab. No.6 Shielded Room
Report No. : 11984008S-R2
Date : November 1, 2017
Temperature / Humidity : 23 deg. C / 37 % RH
Engineer : Kenichi Adachi
Mode : Tx, Hopping Off,

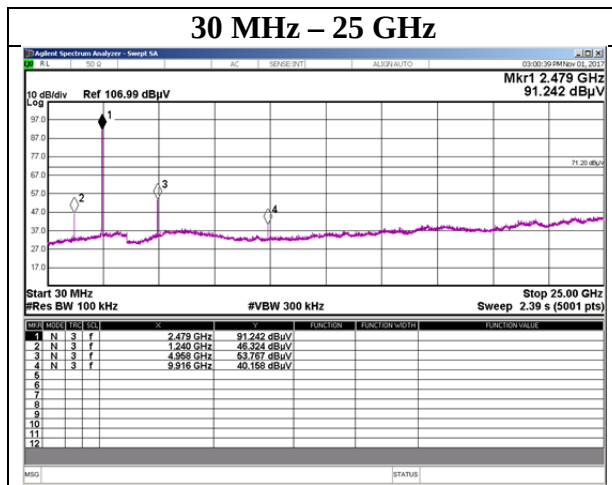
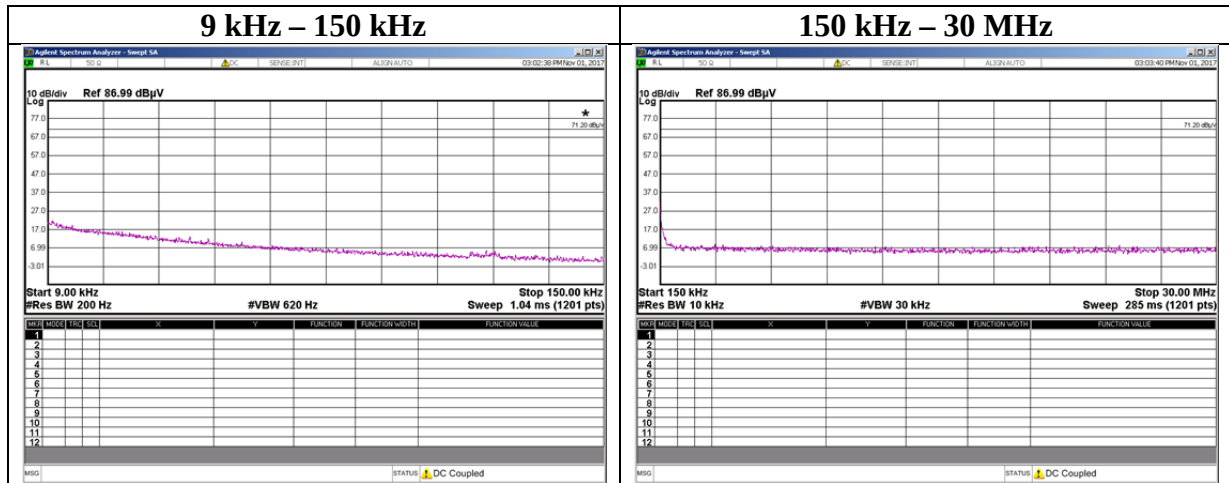
2439 MHz



Conducted Spurious Emission

Test place	Shonan EMC Lab. No.6 Shielded Room
Report No.	11984008S-R2
Date	November 1, 2017
Temperature / Humidity	23 deg. C / 37 % RH
Engineer	Kenichi Adachi
Mode	Tx, Hopping Off,

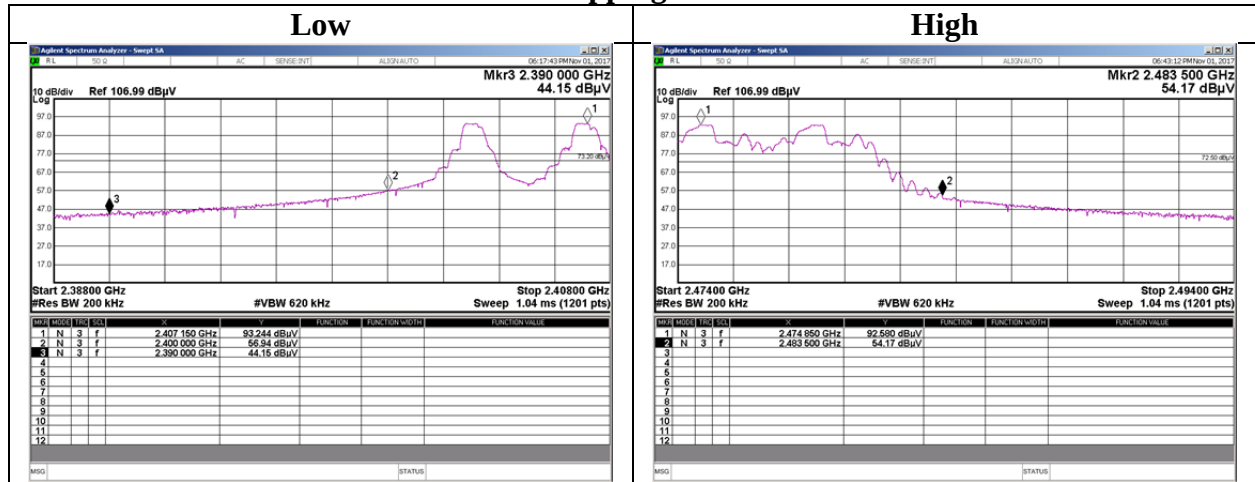
2479 MHz



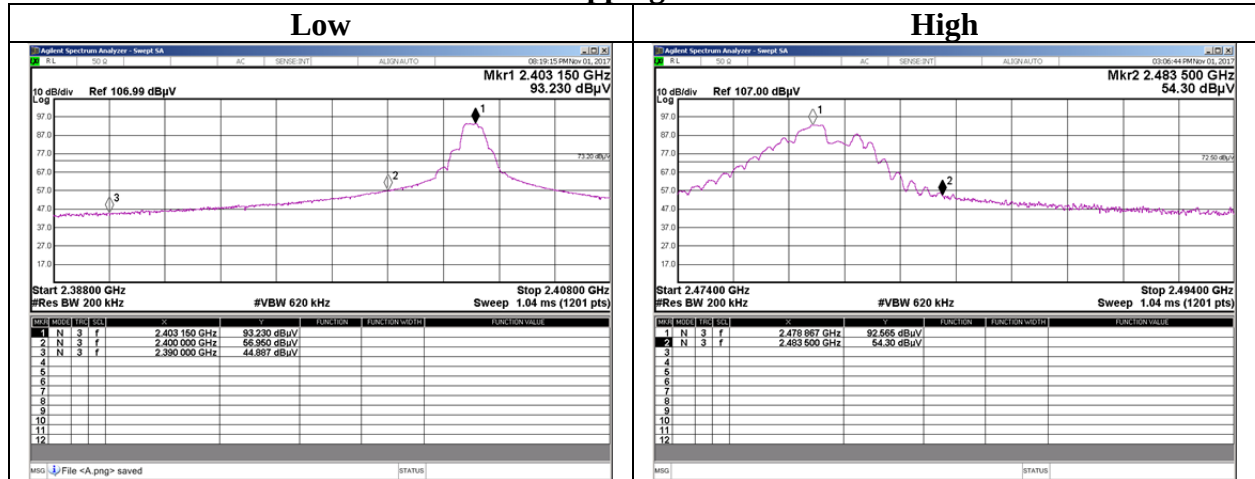
Conducted Emission Band Edge compliance

Test place : Shonan EMC Lab. No.6 Shielded Room
Report No. : 11984008S-R2
Date : November 1, 2017
Temperature / Humidity : 23 deg. C / 37 % RH
Engineer : Kenichi Adachi
Mode : Tx, Hopping On, Tx, Hopping Off

Hopping On



Hopping Off

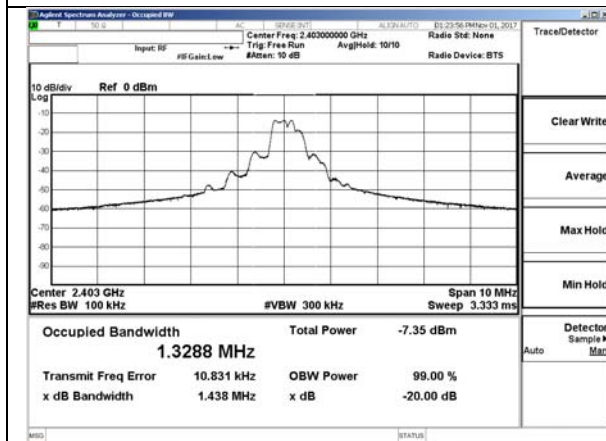


99% Occupied Bandwidth

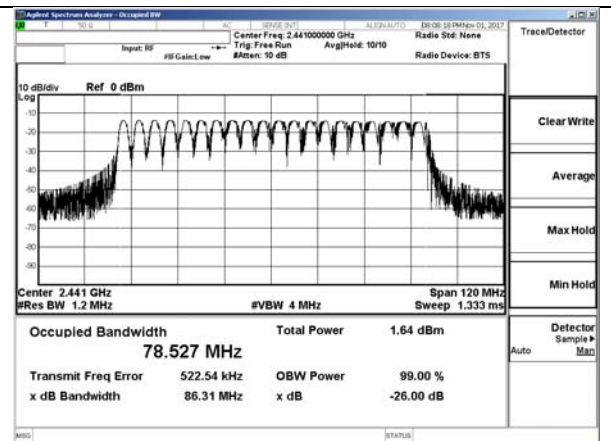
Test place	Shonan EMC Lab. No.6 Shielded Room
Report No.	11984008S-R2
Date	November 1, 2017
Temperature / Humidity	23 deg. C / 37 % RH
Engineer	Kenichi Adachi
Mode	Tx, Hopping On, Tx, Hopping Off

Hopping Off

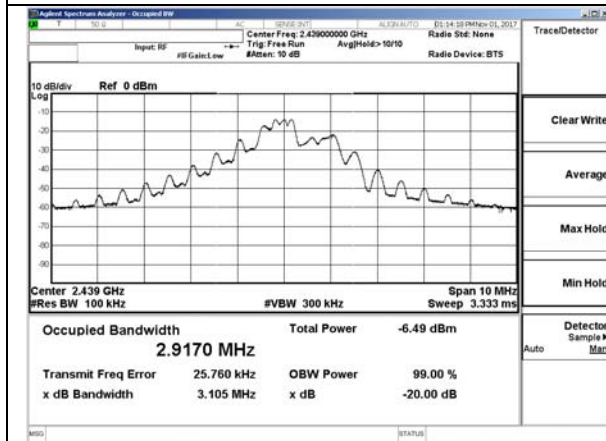
2403 MHz



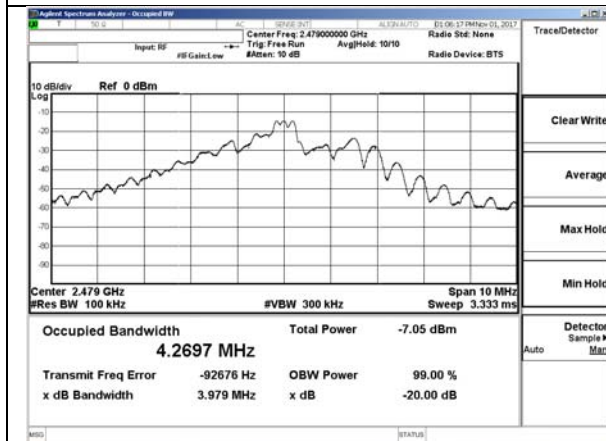
Hopping On



2439 MHz



2479 MHz



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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2017/02/17 * 12
SCC-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
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2017/08/14 * 12
SOS-04	Humidity Indicator	A&D	AD-5681	4061512	RE	2016/12/13 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2017/03/07 * 12
SJM-09	Measure	PROMART	SEN1935	-	RE	-
SAEC-02(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	RE	2017/07/18 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFI,MF)	-	RE	-
STS-02	Digital Hitester	Hioki	3805-50	080997819	RE	2017/03/08 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000NF SNMS/B	1612S005	RE	2017/01/08 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2016/11/07 * 12
SFL-18	Highpass Filter	MICRO-TRONICS	HPM50111	119	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
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	RE	2017/03/23 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000K MSKMS	-	RE	2017/04/20 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2017/02/09 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2017/02/09 * 12
SAT3-11	Attenuator	JFW	50HF-003N	-	RE	2017/02/23 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2016/11/23 * 12
SCC-B1/B3/B5/B7/B8/B13/SRS E-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SCC-B2/B4/B6/B7/B8/B13/SRS E-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SLA-06	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	195	RE	2017/01/05 * 12
STR-07	Test Receiver	Rohde & Schwarz	ESU26	100484	RE	2017/09/26 * 12
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2017/06/08 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2017/04/25 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2017/04/25 * 12
SSA-01	Spectrum Analyzer	Agilent	N9010A-526	MY48031482	AT	2017/04/14 * 12
SAT10-09	Attenuator	Weinschel Corp.	54A-10	W5692	AT	2016/11/07 * 12
SCC-G32	Coaxial Cable	Junkosha	MWX241-02000KMSKMS	OCT-09-13-005	AT	2016/11/07 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 12

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

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

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

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

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