



RADIO TEST REPORT

Test Report No. : 11491472S-A-R2

Applicant : Yokogawa Electric Corporation
Type of Equipment : RF Board Assy
Model No. : F9924BF
FCC ID : SGJ-WFC014
Test regulation : FCC Part 15 Subpart C: 2016
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 11491472S-A-R1. 11491472S-A-R1 is replaced with this report.

Date of test: November 8, 2016
January 19 to February 17, 2017

Representative test engineer:

Yosuke Ishikawa
Engineer
Consumer Technology Division

Approved by:

Toyokazu Imamura
Leader
Consumer Technology Division



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

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 11491472S-A

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SECTION 1: Customer information

Company Name	:	Yokogawa Electric Corporation
Address	:	2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750 Japan
Telephone Number	:	+81-422-52-5558
Facsimile Number	:	+81-422-52-5904
Contact Person	:	Jun Miyake

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

2.1 Identification of E.U.T.

Type of Equipment	:	RF Board Assy
Model No.	:	F9924BF
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.05 V
Receipt Date of Sample	:	October 31, 2016
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: F9924BF (referred to as the EUT in this report) is a RF Board Assy.

Radio Specification

Radio Type	:	Transmitter
Frequency of Operation	:	2405 MHz - 2475 MHz
Modulation	:	O-QPSK
Power Supply (radio part input)	:	DC 2.7 V
Antenna type	:	Sleeve / Collinear
Antenna Gain	:	2.14 dBi (Sleeve), 6 dBi (Collinear)
Clock frequency (Maximum)	:	16 MHz, 32 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on November 14, 2016 and effective December 14, 2016

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 November 14, 2016, 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	17.6 dB 17.44455 MHz, N, AV, Tx 2475 MHz, Sleeve Antenna	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(1)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(4)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(2)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	5.1 dB 2388.467 MHz, PK, Horizontal, Tx 2405 MHz Collinear Antenna	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)

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

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v03r05 12.2.7.

* 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. The RF Module is constantly provided voltage (DC 2.7 V) through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The EUT has an external antenna connector, but it is installed by the professionals. Therefore, the equipment complies with the antenna requirement.

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	N/A	-	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

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	-	-
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
Radiated emission (Measurement distance: 1 m)	13 GHz-18 GHz	4.6 dB	4.6 dB	4.6 dB	-	-
	18 GHz-40 GHz	4.9 dB	4.9 dB	4.9 dB	-	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

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

Conducted Emission test

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

Radiated emission test

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

3.5 Test Location

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JAB Accreditation No. RTL02610

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

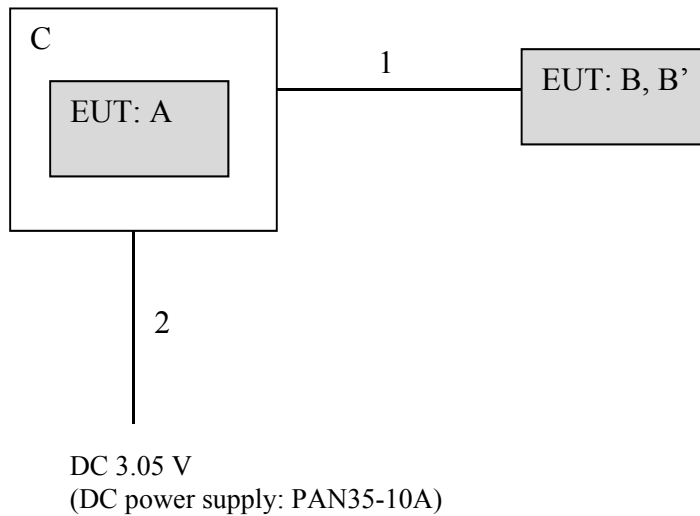
4.1 Operating Mode(s)

Mode	Remarks*
ISA100.11a	PN9
*Power of the EUT was set by the software as follows; Power settings: 08 Software: IrDAApp Version 2.0.6.0 *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.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested Antenna	Tested frequency
Conducted Emission	ISA100.11a	2.14 dBi Sleeve Antenna and 6.00 dBi Collinear Antenna	2405 MHz 2440 MHz 2475 MHz
Spurious Emission	ISA100.11a	2.14 dBi Sleeve Antenna and 6.00 dBi Collinear Antenna	2405 MHz 2440 MHz 2475 MHz
6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	ISA100.11a	-	2405 MHz 2440 MHz 2475 MHz

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	Module	F9924BF	000064FFFEA0904B	Yokogawa Electric	EUT
B	Antenna *1)	ASSL-NP-00400	-	Yokogawa Electric	EUT
B'	Antenna *2)	ASCL-NP-00200	-	Yokogawa Electric	EUT
C	Jig	-	-	Yokogawa Electric	-

*1) 2.14 dBi Sleeve Antenna

*2) 6.00 dBi Collinear Antenna

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna	0.1	Shielded	Shielded	-
2	DC	1.7	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity.

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

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

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a shielded room. The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

Detector	: QP and CISPR AV
Measurement range	: 0.15 MHz – 30 MHz
Test data	: APPENDIX
Test result	: Pass

SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "558074 D01 DTS Meas Guidance v03r05".

[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 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

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

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

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

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

Test Antennas are used as below;

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *3)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces If duty cycle was less than 98%, a duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	3.45 m *1) (1 GHz – 13 GHz), 1 m *2) (13 GHz – 26.5 GHz)		

*1) Distance Factor: $20 \times \log(3.45 \text{ m} / 3.0 \text{ m}) = 1.22 \text{ dB}$ (Horizontal), $20 \times \log(3.85 \text{ m} / 3.0 \text{ m}) = 2.17 \text{ dB}$ (Horizontal)

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

*3) Average Power Measurement was performed based on 6. 0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r05"

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

Antenna 2

	Measurement antenna polarization	Carrier	Spurious (Below 1 GHz)	Spurious (1 GHz - 2.8 GHz)	Spurious (2.8 GHz - 13 GHz)	Spurious (13 GHz - 18 GHz)	Spurious (13 GHz - 26.5 GHz)
Module	Horizontal	Z	Z	Z	Z	X	X
	Vertical	Z	Z	Z	Z	X	X
Antenna	Horizontal	X	X	X	X	X	X
	Vertical	Z	Z	Z	X	X	X

Antenna 3

	Measurement antenna polarization	Carrier	Spurious (Below 1 GHz)	Spurious (1 GHz - 2.8 GHz)	Spurious (2.8 GHz - 13 GHz)	Spurious (13 GHz - 18 GHz)	Spurious (13 GHz - 26.5 GHz)
Module	Horizontal	Z	Z	Z	Z	X	X
	Vertical	Z	Z	Z	Z	X	X
Antenna	Horizontal	X	X	X	X	X	X
	Vertical	Z	Z	Z	Z	X	X

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

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

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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 v03r05".
 *4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
 Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
 (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)

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

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

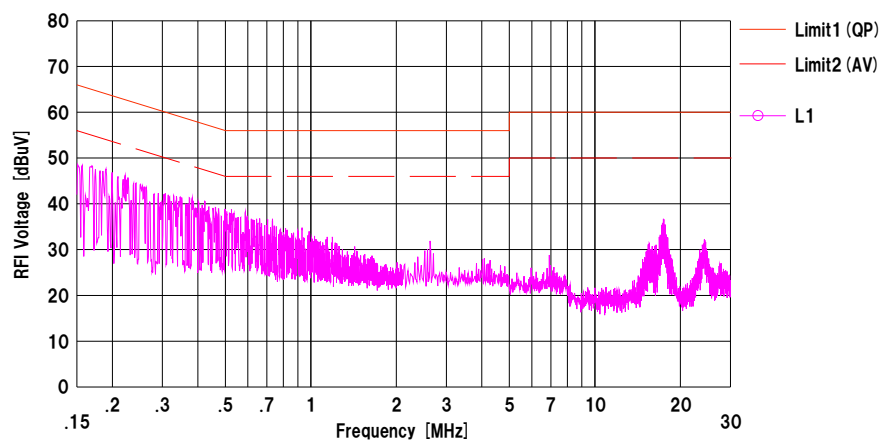
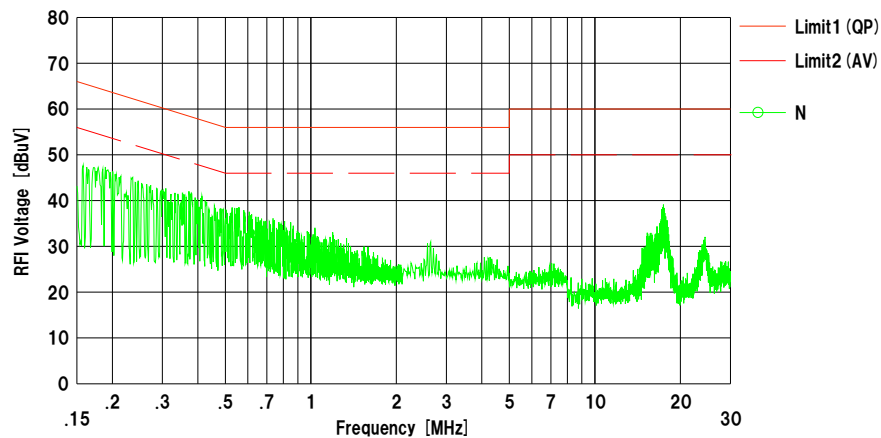
UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2017/01/24

Mode : Tx. 2405 MHz
Power : AC 120 V / 60 Hz
Temp./Humi. : 20 deg.C / 30 %RH

Remarks : Sleeve Antenna

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

Engineer : Yasumasa Owaki



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

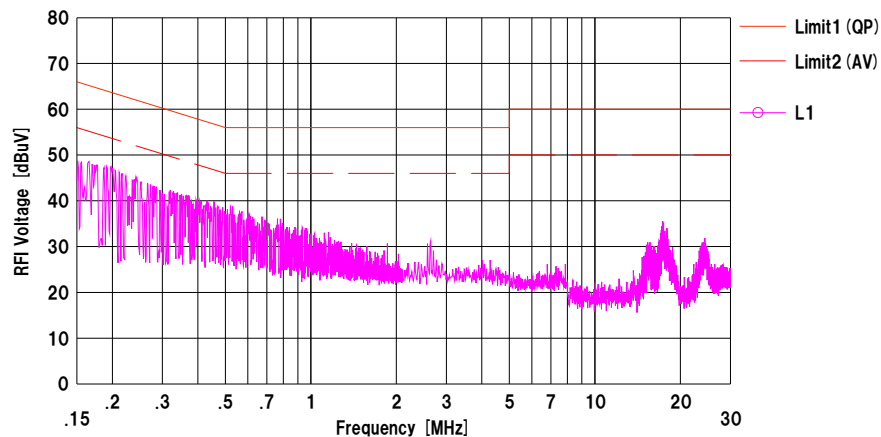
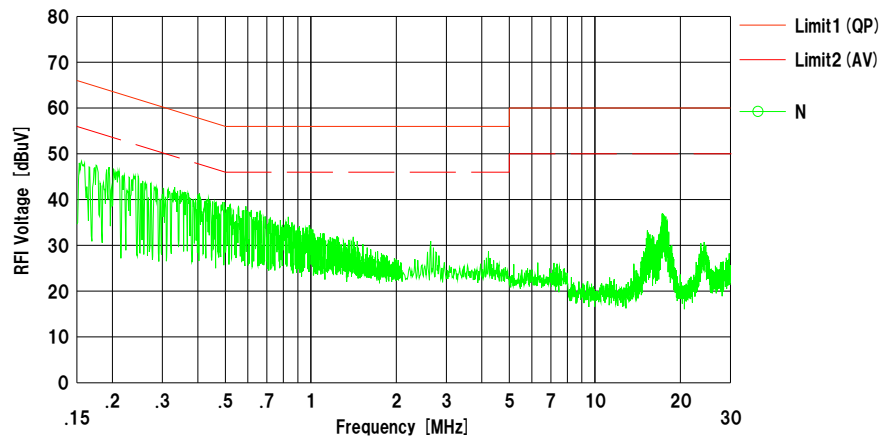
UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2017/01/24

Mode : Tx, 2440 MHz
Power : AC 120 V / 60 Hz
Temp./Humi. : 20 deg.C / 30 %RH

Remarks : Sleeve Antenna

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

Engineer : Yasumasa Owaki



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

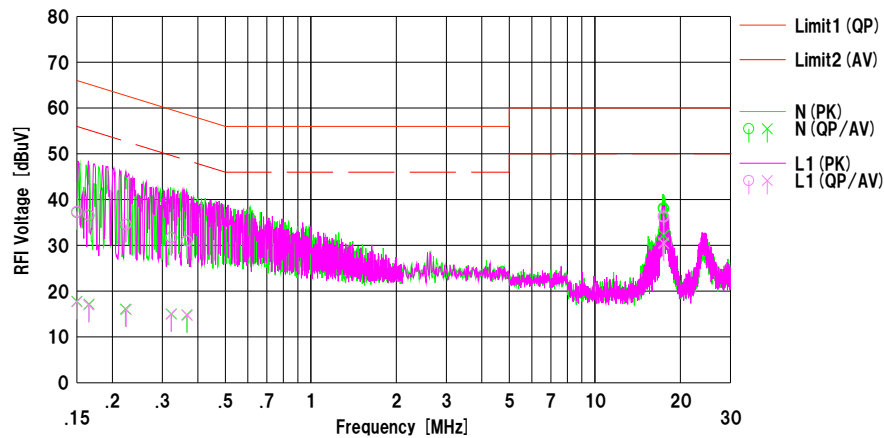
UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2017/01/24

Mode : Tx. 2475 MHz
Power : AC 120 V / 60 Hz
Temp./Humi. : 20 deg.C / 30 %RH

Remarks : Sleeve Antenna

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

Engineer : Yasumasa Owaki



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	24.60	5.20	12.58	37.18	17.78	66.00	56.00	28.8	38.2	N	
2	0.16566	23.90	4.60	12.58	36.48	17.18	65.18	55.18	28.7	38.0	N	
3	0.22245	21.90	3.50	12.59	34.49	16.09	62.73	52.73	28.2	36.6	N	
4	0.32314	19.10	2.40	12.61	31.71	15.01	59.63	49.63	27.9	34.6	N	
5	0.36588	18.40	2.20	12.62	31.02	14.82	58.59	48.59	27.5	33.7	N	
6	17.44455	24.60	18.80	13.56	38.16	32.36	60.00	50.00	21.8	17.6	N	
7	17.50932	24.40	18.60	13.56	37.96	32.16	60.00	50.00	22.0	17.8	N	
8	0.15000	24.80	5.10	12.58	37.38	17.68	66.00	56.00	28.6	38.3	L1	
9	0.16511	24.10	4.40	12.58	36.68	16.98	65.20	55.20	28.5	38.2	L1	
10	0.22395	22.00	3.40	12.59	34.59	15.99	62.67	52.67	28.0	36.6	L1	
11	0.32178	19.00	2.40	12.61	31.61	15.01	59.66	49.66	28.0	34.6	L1	
12	0.36711	18.30	2.10	12.62	30.92	14.72	58.57	48.57	27.6	33.8	L1	
13	17.43911	22.80	17.00	13.56	36.36	30.56	60.00	50.00	23.6	19.4	L1	
14	17.50303	22.60	16.80	13.56	36.16	30.36	60.00	50.00	23.8	19.6	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

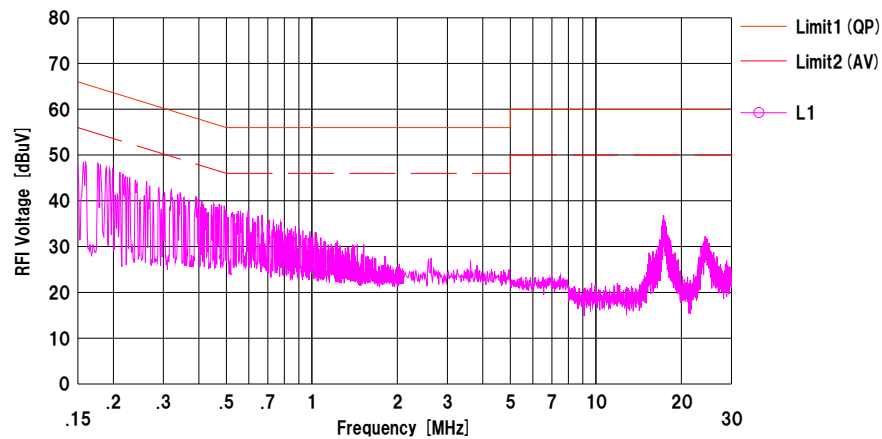
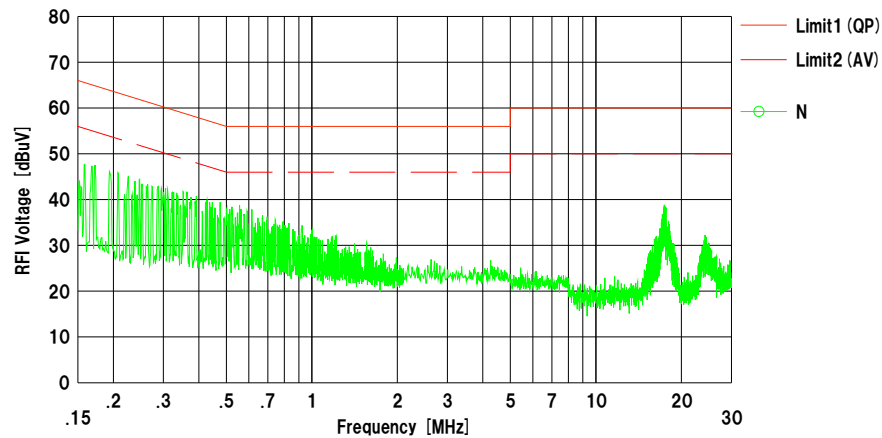
UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2017/01/24

Mode : Tx. 2405 MHz
Power : AC 120 V / 60 Hz
Temp./Humi. : 20 deg.C / 30 %RH

Remarks : Collinear Antenna

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

Engineer : Yasumasa Owaki



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

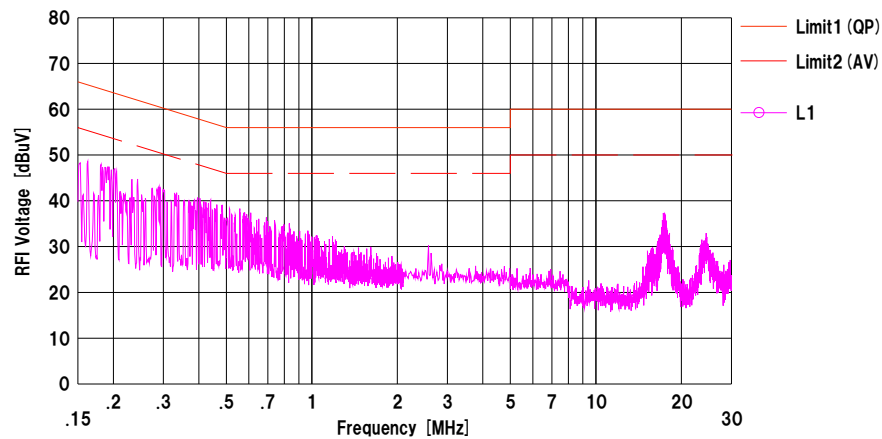
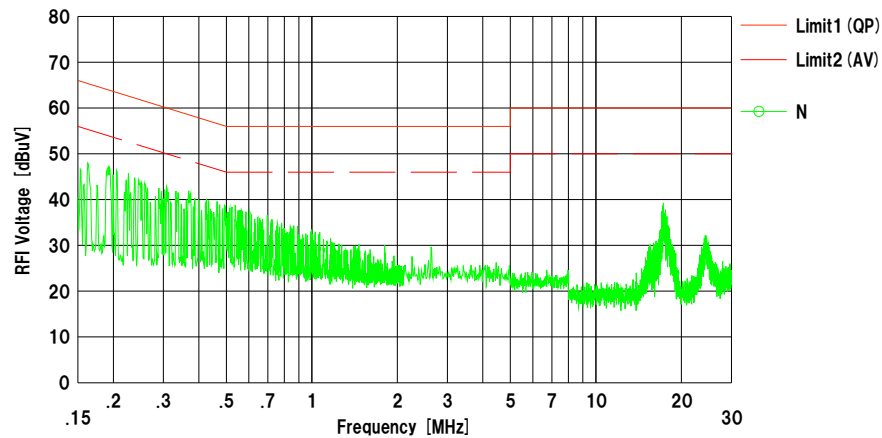
UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2017/01/24

Mode : Tx, 2440 MHz
Power : AC 120 V / 60 Hz
Temp./Humi. : 20 deg.C / 30 %RH

Remarks : Collinear Antenna

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

Engineer : Yasumasa Owaki



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

UL Japan, Inc.

Shonan EMC Lab.

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

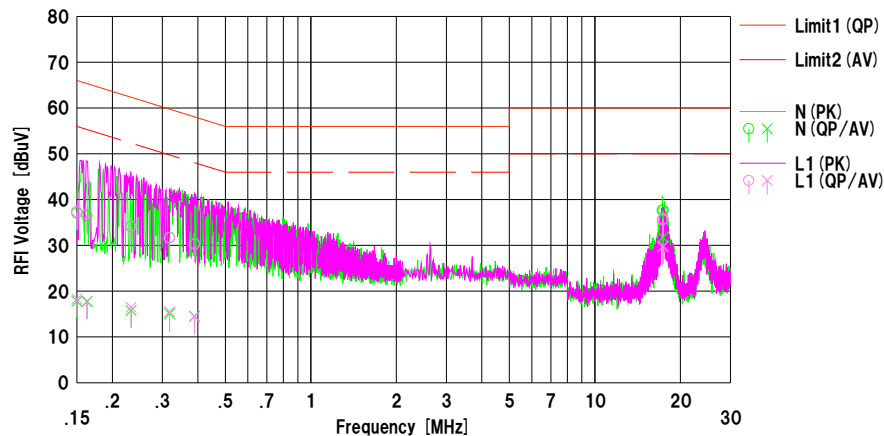
UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2017/01/24

Mode : Tx. 2475 MHz
Power : AC 120 V / 60 Hz
Temp./Humi. : 20 deg.C / 30 %RH

Remarks : Collinear Antenna

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

Engineer : Yasumasa Owaki



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	24.50	5.20	12.58	37.08	17.78	66.00	56.00	28.9	38.2	N	
2	0.16294	23.90	5.20	12.58	36.48	17.78	65.31	55.31	28.8	37.5	N	
3	0.23303	21.50	3.20	12.58	34.08	15.78	62.34	52.34	28.2	36.5	N	
4	0.31812	19.10	2.50	12.61	31.71	15.11	59.76	49.76	28.0	34.6	N	
5	0.38946	17.90	1.90	12.62	30.52	14.52	58.08	48.08	27.5	33.5	N	
6	17.30949	24.10	18.20	13.56	37.66	31.76	60.00	50.00	22.3	18.2	N	
7	17.43554	24.10	18.20	13.56	37.66	31.76	60.00	50.00	22.3	18.2	N	
8	0.15000	24.80	5.70	12.58	37.38	18.28	66.00	56.00	28.6	37.7	L1	
9	0.16251	24.20	5.10	12.58	36.78	17.68	65.33	55.33	28.5	37.6	L1	
10	0.23262	21.60	3.90	12.58	34.18	16.48	62.36	52.36	28.1	35.8	L1	
11	0.31807	19.00	2.90	12.61	31.61	15.51	59.76	49.76	28.1	34.2	L1	
12	0.38950	17.60	1.80	12.62	30.22	14.42	58.07	48.07	27.8	33.6	L1	
13	17.29813	22.00	16.10	13.56	35.56	29.66	60.00	50.00	24.4	20.3	L1	
14	17.42629	22.20	16.30	13.56	35.76	29.86	60.00	50.00	24.2	20.1	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

6dB Bandwidth

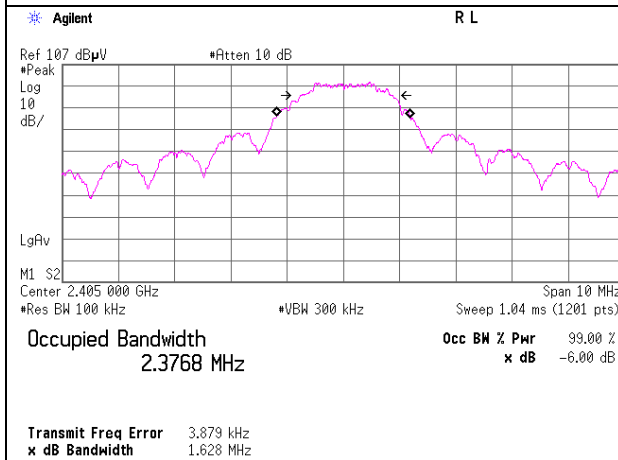
Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11491472S-A-R2
Date February 17, 2017
Temperature / Humidity 26 deg. C / 36 % RH
Engineer Yosuke Ishikawa
Mode Tx ISA100.11a

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
ISA 100.11a	2405	1.628	> 500
	2440	1.545	> 500
	2475	1.609	> 500

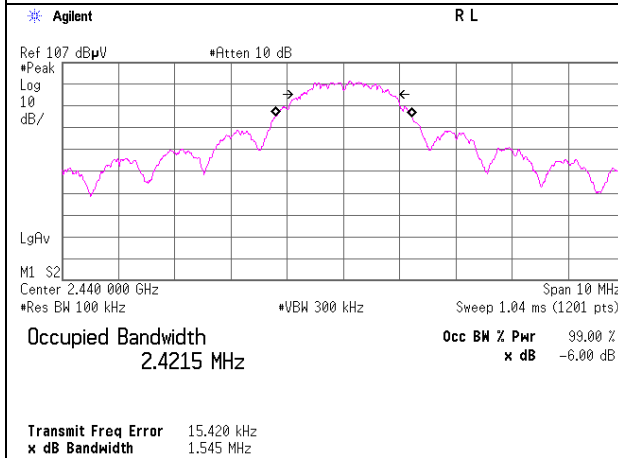
6dB Bandwidth

Tx ISA100.11a

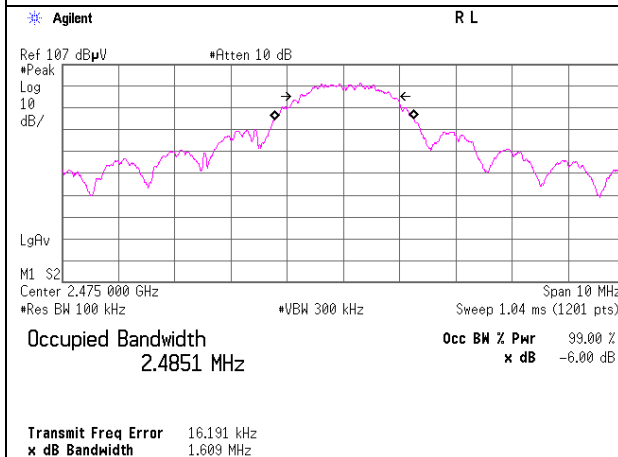
2405 MHz



2440 MHz



2475 MHz



Maximum Peak Output Power

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11491472S-A-R2
Date February 17, 2017
Temperature / Humidity 26 deg. C / 36 % RH
Engineer Yosuke Ishikawa
Mode Tx ISA100.11a

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2405	-4.48	2.15	9.64	7.31	5.38	30.00	1000	22.69
2440	-4.68	2.16	9.64	7.12	5.15	30.00	1000	22.88
2475	-4.84	2.17	9.65	6.98	4.99	30.00	1000	23.02

Sample Calculation:

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

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

Average Output Power
(Reference data for RF Exposure)

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11491472S-A-R2
Date February 17, 2017
Temperature / Humidity 26 deg. C / 36 % RH
Engineer Yosuke Ishikawa
Mode Tx ISA100.11a

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2405	-13.09	2.15	9.64	-1.30	0.74	8.43	7.13	5.16
2440	-13.19	2.16	9.64	-1.39	0.73	8.43	7.04	5.06
2475	-13.28	2.17	9.65	-1.46	0.71	8.43	6.97	4.98

Sample Calculation:

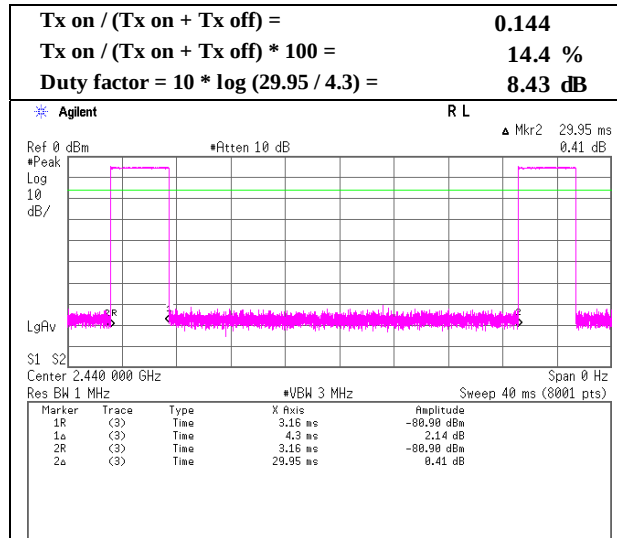
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

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

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

Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	11491472S-A-R2
Date	February 17, 2017
Temperature / Humidity	26 deg. C / 36 % RH
Engineer	Yosuke Ishikawa
Mode	Tx ISA100.11a



Radiated Spurious Emission

Report No. 11491472S-A-R2
Test Place(AC No) 2 1
Date January 31, 2017 November 8, 2016
Temperature / Humidity 22 deg. C / 31 % RH 23 deg. C / 45 % RH
Engineer Yosuke Ishikawa Takahiro Suzuki
(1 GHz -26.5 GHz) (30 MHz -1000MHz)
Mode Tx 2405 MHz (Sleeve Antenna)

(* 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.	568.821	QP	21.72	18.61	8.16	32.00	0.00	16.49	46.00	29.5	136	120	
Hori.	749.140	QP	21.63	20.24	9.06	31.91	0.00	19.02	46.00	26.9	100	82	
Hori.	818.186	QP	21.65	20.96	9.40	31.77	0.00	20.24	46.00	25.7	100	262	
Hori.	922.389	QP	21.18	21.95	9.89	31.18	0.00	21.84	46.00	24.1	141	9	
Hori.	2388.675	PK	60.80	27.16	14.19	37.06	2.04	67.13	73.90	6.8	120	155	
Hori.	2390.000	PK	53.03	27.17	14.19	37.06	2.04	59.37	73.90	14.5	120	155	
Hori.	4810.000	PK	47.79	31.14	5.93	37.12	2.04	49.78	73.90	24.1	110	350	
Hori.	7215.000	PK	48.00	36.26	7.15	37.85	2.04	55.60	73.90	18.3	114	41	
Hori.	9620.000	PK	44.89	38.15	8.04	39.13	2.04	53.99	73.90	19.9	118	301	
Hori.	2388.675	AV	34.43	27.16	14.19	37.06	2.04	40.76	53.90	13.1	120	155	
Hori.	2390.000	AV	33.72	27.17	14.19	37.06	2.04	40.06	53.90	13.8	120	155	
Hori.	4810.000	AV	41.23	31.14	5.93	37.12	2.04	43.22	53.90	10.6	110	350	
Hori.	7215.000	AV	40.24	36.26	7.15	37.85	2.04	47.84	53.90	6.0	114	41	
Hori.	9620.000	AV	37.78	38.15	8.04	39.13	2.04	46.88	53.90	7.0	118	301	
Vert.	171.952	QP	21.63	15.92	8.92	31.77	0.00	14.70	43.50	28.8	100	11	
Vert.	624.019	QP	30.14	19.24	8.43	32.01	0.00	25.80	46.00	20.2	100	97	
Vert.	655.982	QP	28.27	19.45	8.62	32.04	0.00	24.30	46.00	21.7	100	352	
Vert.	706.369	QP	21.94	19.80	8.89	32.01	0.00	18.62	46.00	27.3	100	355	
Vert.	737.635	QP	21.85	20.12	9.01	31.94	0.00	19.04	46.00	26.9	100	356	
Vert.	2388.640	PK	60.58	27.16	14.19	37.06	2.19	67.06	73.90	6.8	160	294	
Vert.	2390.000	PK	55.62	27.17	14.19	37.06	2.19	62.11	73.90	11.8	160	294	
Vert.	4810.000	PK	46.41	31.14	5.93	37.12	2.19	48.55	73.90	25.4	124	3	
Vert.	7215.000	PK	45.83	36.26	7.15	37.85	2.19	53.58	73.90	20.3	173	351	
Vert.	9620.000	PK	45.61	38.15	8.04	39.13	2.19	54.86	73.90	19.0	136	10	
Vert.	2388.640	AV	34.23	27.16	14.19	37.06	2.19	40.71	53.90	13.2	160	294	
Vert.	2390.000	AV	34.36	27.17	14.19	37.06	2.19	40.85	53.90	13.1	160	294	
Vert.	4810.000	AV	37.02	31.14	5.93	37.12	2.19	39.16	53.90	14.7	124	3	
Vert.	7215.000	AV	37.64	36.26	7.15	37.85	2.19	45.39	53.90	8.5	173	351	
Vert.	9620.000	AV	35.52	38.15	8.04	39.13	2.19	44.77	53.90	9.1	136	10	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.79\text{ m} / 3.0\text{ m}) = 2.04\text{ dB}$

1 GHz - 13 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

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

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.	2405.000	PK	95.84	27.22	14.20	37.05	2.04	102.25	-	-	Carrier
Hori.	2400.000	PK	55.89	27.20	14.19	37.05	2.04	62.27	82.25	20.0	
Vert.	2405.000	PK	95.11	27.22	14.20	37.05	2.19	101.67	-	-	Carrier
Vert.	2400.000	PK	54.58	27.20	14.19	37.05	2.19	61.11	81.67	20.6	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.79\text{ m} / 3.0\text{ m}) = 2.04\text{ dB}$

1 GHz - 13 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

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

UL Japan, Inc.

Shonan EMC Lab.

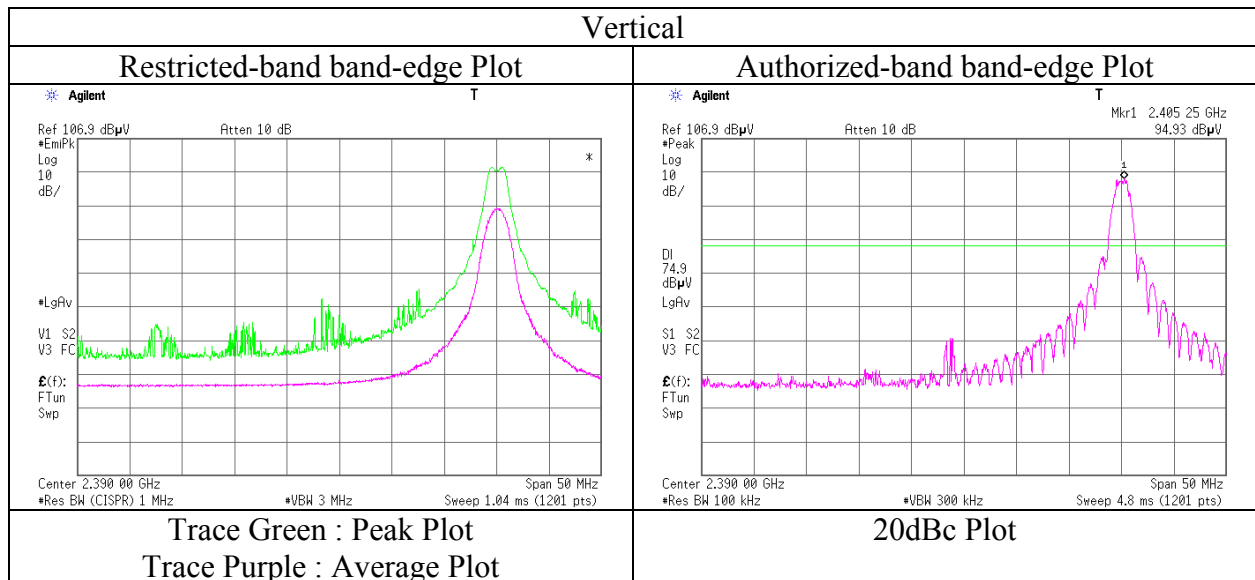
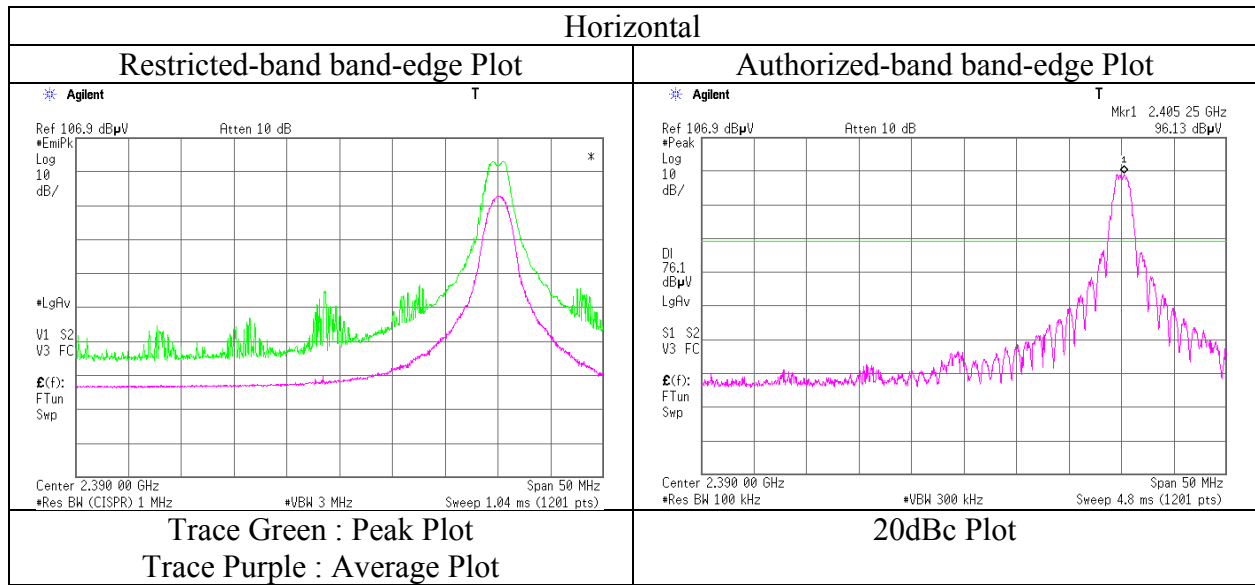
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11491472S-A-R2
Date	January 31, 2017
Temperature / Humidity	22 deg. C / 31 % RH
Engineer	Yosuke Ishikawa (1 GHz -2.8 GHz)
Mode	Tx 2405 MHz (Sleeve Antenna)



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

Radiated Spurious Emission

Report No. 11491472S-A-R2
Test Place(AC No) 2 1
Date January 31, 2017 November 8, 2016
Temperature / Humidity 22 deg. C / 31 % RH 23 deg. C / 45 % RH
Engineer Yosuke Ishikawa Takahiro Suzuki
(1 GHz -26.5 GHz) (30 MHz -1000MHz)
Mode Tx 2440 MHz (Sleeve Antenna)

(* 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.	568.263	QP	21.68	18.60	8.16	32.00	0.00	16.44	46.00	29.5	129	4	
Hori.	749.682	QP	21.66	20.25	9.06	31.91	0.00	19.06	46.00	26.9	118	1	
Hori.	818.717	QP	21.58	20.96	9.40	31.76	0.00	20.18	46.00	25.8	100	219	
Hori.	922.271	QP	21.20	21.95	9.88	31.18	0.00	21.85	46.00	24.1	100	242	
Hori.	4880.000	PK	48.48	31.29	6.72	37.15	2.04	51.38	73.90	22.5	132	1	
Hori.	7320.000	PK	47.57	36.63	8.20	37.91	2.04	56.53	73.90	17.4	167	46	
Hori.	9760.000	PK	45.80	38.52	9.09	39.19	2.04	56.26	73.90	17.6	139	289	
Hori.	4880.000	AV	39.51	31.29	6.72	37.15	2.04	42.41	53.90	11.5	132	1	
Hori.	7320.000	AV	37.86	36.63	8.20	37.91	2.04	46.82	53.90	7.1	167	46	
Hori.	9760.000	AV	36.31	38.52	9.09	39.19	2.04	46.77	53.90	7.1	139	289	
Vert.	171.711	QP	21.68	15.91	8.92	31.77	0.00	14.74	43.50	28.7	100	235	
Vert.	624.011	QP	30.08	19.24	8.43	32.01	0.00	25.74	46.00	20.2	100	157	
Vert.	656.331	QP	28.19	19.45	8.62	32.04	0.00	24.22	46.00	21.7	100	243	
Vert.	706.739	QP	21.99	19.80	8.89	32.01	0.00	18.67	46.00	27.3	100	354	
Vert.	737.279	QP	21.78	20.12	9.01	31.94	0.00	18.97	46.00	27.0	100	354	
Vert.	4880.000	PK	44.35	31.29	6.72	37.15	2.19	47.40	73.90	26.5	148	330	
Vert.	7320.000	PK	44.67	36.63	8.20	37.91	2.19	53.78	73.90	20.1	150	0	
Vert.	9760.000	PK	45.52	38.52	9.09	39.19	2.19	56.13	73.90	17.8	162	31	
Vert.	4880.000	AV	34.68	31.29	6.72	37.15	2.19	37.73	53.90	16.2	148	330	
Vert.	7320.000	AV	35.25	36.63	8.20	37.91	2.19	44.36	53.90	9.5	150	0	
Vert.	9760.000	AV	36.55	38.52	9.09	39.19	2.19	47.16	53.90	6.7	162	31	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.79 \text{ m} / 3.0 \text{ m}) = 2.04 \text{ dB}$

1 GHz - 13 GHz : $20\log(3.86 \text{ m} / 3.0 \text{ m}) = 2.19 \text{ dB}$

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

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Facsimile : +81 463 50 6401

Radiated Spurious Emission

Report No. 11491472S-A-R2
Test Place(AC No) 2 1
Date January 31, 2017 November 8, 2016
Temperature / Humidity 22 deg. C / 31 % RH 23 deg. C / 45 % RH
Engineer Yosuke Ishikawa Takahiro Suzuki
(1 GHz -26.5 GHz) (30 MHz -1000MHz)
Mode Tx 2475 MHz (Sleeve Antenna)

(* 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.	568.539	QP	21.55	18.61	8.16	32.00	0.00	16.32	46.00	29.6	120	77	
Hori.	749.747	QP	21.68	20.25	9.06	31.91	0.00	19.08	46.00	26.9	116	60	
Hori.	819.246	QP	21.60	20.97	9.41	31.76	0.00	20.22	46.00	25.7	109	67	
Hori.	922.222	QP	21.27	21.95	9.88	31.18	0.00	21.92	46.00	24.0	108	1	
Hori.	2483.500	PK	59.71	27.49	14.27	37.01	2.04	66.50	73.90	7.4	179	130	
Hori.	4950.000	PK	49.33	31.44	6.78	37.19	2.04	52.40	73.90	21.5	155	346	
Hori.	7425.000	PK	43.12	36.82	8.33	37.98	2.04	52.33	73.90	21.6	151	269	
Hori.	9900.000	PK	45.53	38.73	9.19	39.26	2.04	56.23	73.90	17.7	174	334	
Hori.	2483.500	AV	37.83	27.49	14.27	37.01	2.04	44.62	53.90	9.3	179	130	
Hori.	4950.000	AV	37.73	31.44	6.78	37.19	2.04	40.80	53.90	13.1	155	346	
Hori.	7425.000	AV	35.20	36.82	8.33	37.98	2.04	44.41	53.90	9.5	151	269	
Hori.	9900.000	AV	36.39	38.73	9.19	39.26	2.04	47.09	53.90	6.8	174	334	
Vert.	171.514	QP	21.66	15.90	8.91	31.77	0.00	14.70	43.50	28.8	100	224	
Vert.	624.831	QP	30.03	19.25	8.43	32.01	0.00	25.70	46.00	20.3	100	359	
Vert.	652.324	QP	28.25	19.42	8.60	32.04	0.00	24.23	46.00	21.7	100	13	
Vert.	706.493	QP	21.89	19.80	8.89	32.01	0.00	18.57	46.00	27.4	100	81	
Vert.	737.253	QP	21.68	20.12	9.01	31.94	0.00	18.87	46.00	27.1	100	352	
Vert.	2483.500	PK	61.33	27.49	14.27	37.01	2.19	68.27	73.90	5.6	185	186	
Vert.	4950.000	PK	44.21	31.44	6.78	37.19	2.19	47.43	73.90	26.5	154	204	
Vert.	7425.000	PK	44.23	36.82	8.33	37.98	2.19	53.59	73.90	20.3	150	0	
Vert.	9900.000	PK	45.22	38.73	9.19	39.26	2.19	56.07	73.90	17.8	183	8	
Vert.	2483.500	AV	37.26	27.49	14.27	37.01	2.19	44.20	53.90	9.7	185	186	
Vert.	4950.000	AV	34.52	31.44	6.78	37.19	2.19	37.74	53.90	16.2	154	204	
Vert.	7425.000	AV	35.01	36.82	8.33	37.98	2.19	44.37	53.90	9.5	150	0	
Vert.	9900.000	AV	37.20	38.73	9.19	39.26	2.19	48.05	53.90	5.8	183	8	

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

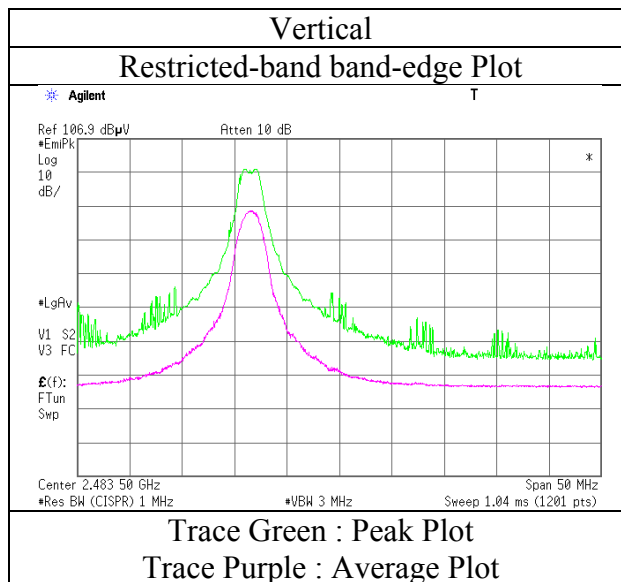
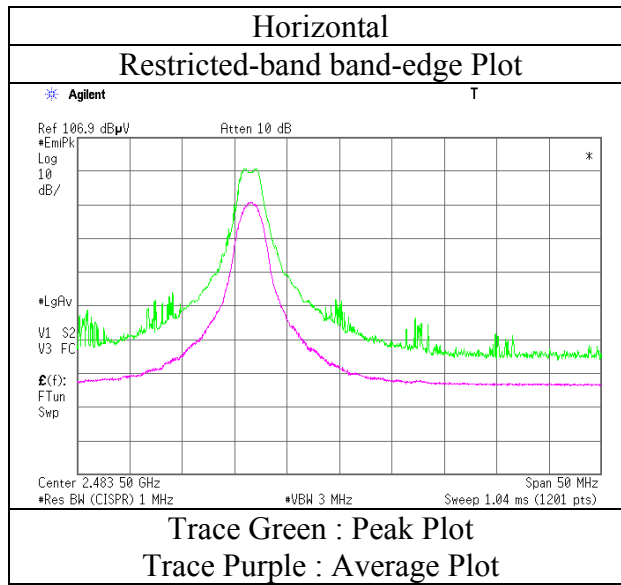
Distance factor : 1 GHz - 13 GHz : $20\log(3.79\text{ m} / 3.0\text{ m}) = 2.04\text{ dB}$

1 GHz - 13 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

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

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11491472S-A-R2
Date	January 31, 2017
Temperature / Humidity	22 deg. C / 31 % RH
Engineer	Yosuke Ishikawa
	(1 GHz -2.8 GHz)
Mode	Tx 2475 MHz (Sleeve Antenna)



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

Radiated Spurious Emission

Report No. 11491472S-A-R2
Test Place(AC No) 1 2
Date January 19, 2017 January 24, 2017
Temperature / Humidity 25 deg. C / 22 % RH 20 deg. C / 30 % RH
Engineer Yosuke Ishikawa Yasumasa Owaki
(1 GHz -26.5 GHz) (30 MHz -1000MHz)
Mode Tx 2405 MHz (Collinear Antenna)

(* 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.	185.665	QP	22.20	16.19	8.53	31.77	0.00	15.15	43.50	28.3	150	356	
Hori.	192.438	QP	22.20	16.26	8.59	31.77	0.00	15.28	43.50	28.2	300	296	
Hori.	876.941	QP	21.50	21.98	9.55	30.96	0.00	22.07	46.00	23.9	100	168	
Hori.	922.819	QP	21.30	22.40	9.76	30.70	0.00	22.76	46.00	23.2	100	302	
Hori.	2388.467	PK	67.31	27.21	13.72	40.70	1.22	68.76	73.90	5.1	217	270	
Hori.	2390.000	PK	61.79	27.21	13.72	40.70	1.22	63.24	73.90	10.7	217	270	
Hori.	4810.000	PK	52.57	31.14	5.93	41.53	1.22	49.33	73.90	24.6	104	3	
Hori.	7215.000	PK	49.35	36.26	7.15	41.13	1.22	52.85	73.90	21.1	119	51	
Hori.	9620.000	PK	45.61	38.15	8.04	40.49	1.22	52.53	73.90	21.4	100	354	
Hori.	2388.467	AV	36.97	27.21	13.72	40.70	1.22	38.42	53.90	15.5	217	270	
Hori.	2390.000	AV	40.06	27.21	13.72	40.70	1.22	41.51	53.90	12.4	217	270	
Hori.	4810.000	AV	39.52	31.14	5.93	41.53	1.22	36.28	53.90	17.6	104	3	
Hori.	7215.000	AV	35.22	36.26	7.15	41.13	1.22	38.72	53.90	15.2	119	51	
Hori.	9620.000	AV	31.00	38.15	8.04	40.49	1.22	37.92	53.90	16.0	100	354	
Vert.	32.052	QP	22.80	16.88	6.82	31.91	0.00	14.59	40.00	25.4	100	277	
Vert.	34.107	QP	22.70	16.45	6.85	31.91	0.00	14.09	40.00	25.9	100	348	
Vert.	199.340	QP	22.00	16.32	8.65	31.76	0.00	15.21	43.50	28.2	100	5	
Vert.	679.997	QP	21.90	19.72	8.60	31.57	0.00	18.65	46.00	27.3	100	61	
Vert.	759.674	QP	22.00	20.46	8.99	31.42	0.00	20.03	46.00	25.9	100	347	
Vert.	2388.595	PK	66.11	27.21	13.72	40.70	2.17	68.51	73.90	5.4	113	351	
Vert.	2390.000	PK	60.29	27.21	13.72	40.70	2.17	62.69	73.90	11.2	113	351	
Vert.	4810.000	PK	48.44	31.14	5.93	41.53	2.17	46.15	73.90	27.8	132	329	
Vert.	7215.000	PK	47.79	36.26	7.15	41.13	2.17	52.24	73.90	21.7	132	330	
Vert.	9620.000	PK	46.20	38.15	8.04	40.49	2.17	54.07	73.90	19.8	309	11	
Vert.	2388.595	AV	41.19	27.21	13.72	40.70	2.17	43.59	53.90	10.3	113	351	
Vert.	2390.000	AV	38.77	27.21	13.72	40.70	2.17	41.17	53.90	12.7	113	351	
Vert.	4810.000	AV	38.43	31.14	5.93	41.53	2.17	36.14	53.90	17.8	132	329	
Vert.	7215.000	AV	38.05	36.26	7.15	41.13	2.17	42.50	53.90	11.4	132	330	
Vert.	9620.000	AV	36.22	38.15	8.04	40.49	2.17	44.09	53.90	9.8	309	11	

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

Distance factor :
1 GHz - 13 GHz : $20\log(3.45 \text{ m} / 3.0 \text{ m}) = 1.22 \text{ dB (Hori.)}$
1 GHz - 13 GHz : $20\log(3.85 \text{ m} / 3.0 \text{ m}) = 2.17 \text{ dB (Vert.)}$
13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

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.	2405.000	PK	101.77	27.26	13.73	40.70	1.22	103.28	-	-	Carrier
Hori.	2399.933	PK	62.22	27.25	13.73	40.70	1.22	63.72	83.28	19.6	
Hori.	2400.000	PK	61.05	27.25	13.73	40.70	1.22	62.55	83.28	20.7	
Vert.	2405.000	PK	100.78	27.26	13.73	40.70	2.17	103.24	-	-	Carrier
Vert.	2399.942	PK	61.05	27.25	13.73	40.70	2.17	63.50	83.24	19.7	
Vert.	2400.000	PK	59.90	27.25	13.73	40.70	2.17	62.35	83.24	20.9	

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

Distance factor :
1 GHz - 13 GHz : $20\log(3.45 \text{ m} / 3.0 \text{ m}) = 1.22 \text{ dB (Hori.)}$
1 GHz - 13 GHz : $20\log(3.85 \text{ m} / 3.0 \text{ m}) = 2.17 \text{ dB (Vert.)}$
13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

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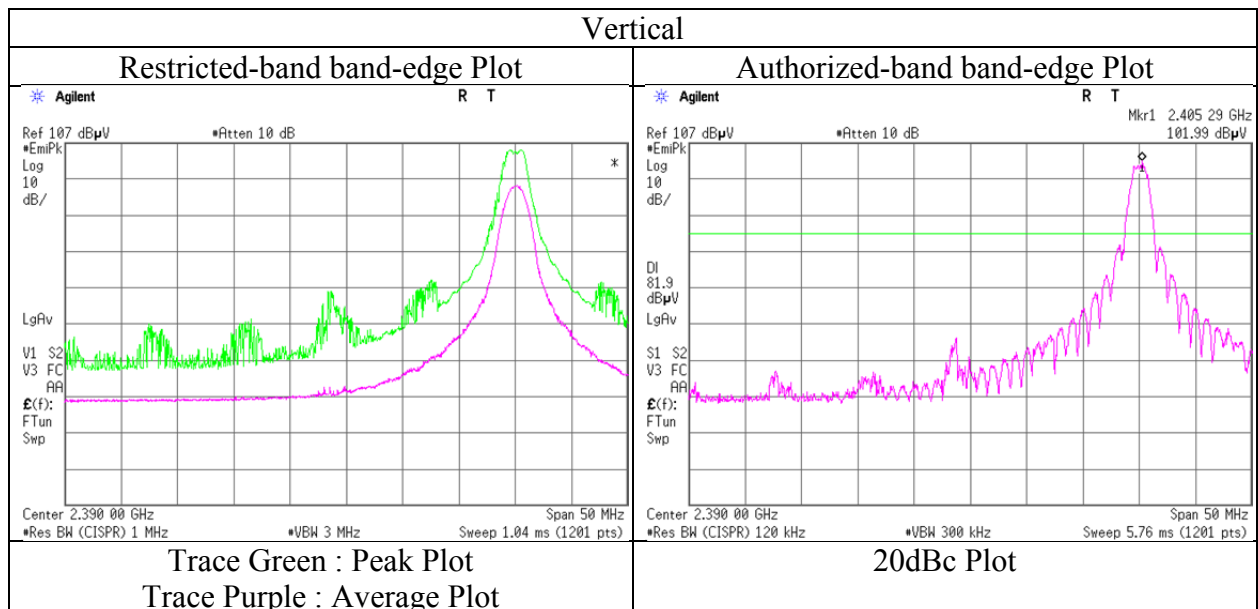
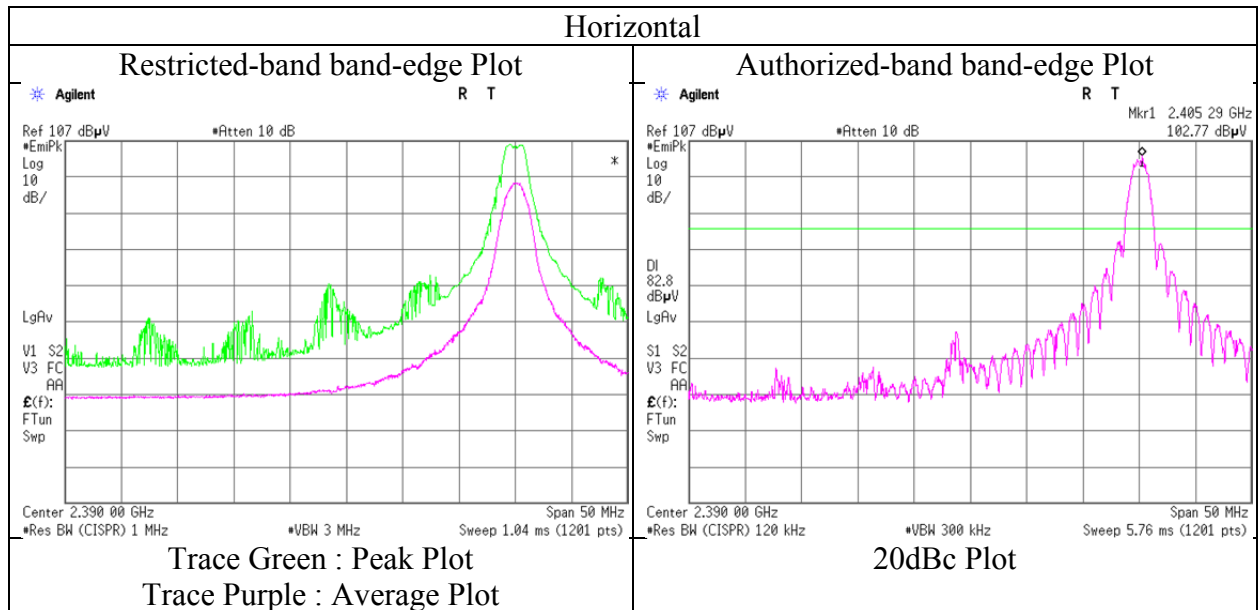
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11491472S-A-R2
Date	January 19, 2017
Temperature / Humidity	25 deg. C / 22 % RH
Engineer	Yosuke Ishikawa
	(1 GHz -26.5 GHz)
Mode	Tx 2405 MHz (Collinear Antenna)



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

Radiated Spurious Emission

Report No. 11491472S-A-R2
Test Place(AC No) 1 2
Date January 19, 2017 January 24, 2017
Temperature / Humidity 25 deg. C / 22 % RH 20 deg. C / 30 % RH
Engineer Yosuke Ishikawa Yasumasa Owaki
(1 GHz -26.5 GHz) (30 MHz -1000MHz)
Mode Tx 2440 MHz (Collinear Antenna)

(* 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.	33.322	QP	23.10	16.62	6.84	31.91	0.00	14.65	40.00	25.3	150	5	
Hori.	183.982	QP	22.40	16.18	8.51	31.78	0.00	15.31	43.50	28.1	300	283	
Hori.	193.447	QP	22.50	16.27	8.60	31.77	0.00	15.60	43.50	27.9	200	185	
Hori.	199.304	QP	22.10	16.32	8.65	31.76	0.00	15.31	43.50	28.1	300	126	
Hori.	845.417	QP	21.80	21.52	9.39	31.10	0.00	21.61	46.00	24.3	100	3	
Hori.	887.534	QP	21.60	22.13	9.60	30.91	0.00	22.42	46.00	23.5	100	233	
Hori.	909.451	QP	21.50	22.35	9.71	30.79	0.00	22.77	46.00	23.2	150	12	
Hori.	4880.000	PK	54.01	31.29	5.96	41.39	1.22	51.09	73.90	22.8	107	5	
Hori.	7320.000	PK	49.67	36.40	7.17	41.24	1.22	53.22	73.90	20.7	123	45	
Hori.	9760.000	PK	45.71	38.35	8.10	40.41	1.22	52.97	73.90	20.9	100	33	
Hori.	4880.000	AV	41.39	31.29	5.96	41.39	1.22	38.47	53.90	15.4	107	5	
Hori.	7320.000	AV	35.48	36.40	7.17	41.24	1.22	39.03	53.90	14.9	123	45	
Hori.	9760.000	AV	31.05	38.35	8.10	40.41	1.22	38.31	53.90	15.6	100	33	
Vert.	32.447	QP	23.00	16.80	6.83	31.91	0.00	14.72	40.00	25.2	100	186	
Vert.	180.143	QP	22.50	16.14	8.48	31.78	0.00	15.34	43.50	28.1	100	298	
Vert.	4880.000	PK	50.12	31.29	5.96	41.39	2.17	48.15	73.90	25.8	111	325	
Vert.	7320.000	PK	49.22	36.40	7.17	41.24	2.17	53.72	73.90	20.2	115	332	
Vert.	9760.000	PK	47.39	38.35	8.10	40.41	2.17	55.60	73.90	18.3	277	17	
Vert.	4880.000	AV	38.95	31.29	5.96	41.39	2.17	36.98	53.90	16.9	111	325	
Vert.	7320.000	AV	37.38	36.40	7.17	41.24	2.17	41.88	53.90	12.0	115	332	
Vert.	9760.000	AV	36.92	38.35	8.10	40.41	2.17	45.13	53.90	8.8	277	17	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.45 m / 3.0 m) = 1.22 dB (Hori.)
1 GHz - 13 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB (Vert.)
13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

UL Japan, Inc.

Shonan EMC Lab.

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Radiated Spurious Emission

Report No. 11491472S-A-R2
Test Place(AC No) 1 2
Date January 19, 2017 January 24, 2017
Temperature / Humidity 25 deg. C / 22 % RH 20 deg. C / 30 % RH
Engineer Yosuke Ishikawa Yasumasa Owaki
(1 GHz -26.5 GHz) (30 MHz -1000MHz)
Mode Tx 2475 MHz (Collinear Antenna)

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	32.882	QP	23.20	16.71	6.83	31.91	0.00	14.83	40.00	25.1	150	167	
Hori.	170.302	QP	22.40	15.73	8.40	31.79	0.00	14.74	43.50	28.7	200	1	
Hori.	190.013	QP	22.20	16.24	8.57	31.77	0.00	15.24	43.50	28.2	200	170	
Hori.	198.016	QP	22.50	16.31	8.63	31.76	0.00	15.68	43.50	27.8	300	109	
Hori.	873.672	QP	21.70	21.93	9.53	30.97	0.00	22.19	46.00	23.8	150	314	
Hori.	924.593	QP	21.10	22.41	9.77	30.69	0.00	22.59	46.00	23.4	150	30	
Hori.	2483.500	PK	66.55	27.52	13.81	40.69	1.22	68.41	73.90	5.5	175	81	
Hori.	4950.000	PK	56.15	31.43	5.98	41.25	1.22	53.53	73.90	20.4	102	4	
Hori.	7425.000	PK	50.28	36.55	7.19	41.35	1.22	53.89	73.90	20.0	133	46	
Hori.	9900.000	PK	46.19	38.55	8.17	40.33	1.22	53.80	73.90	20.1	100	62	
Hori.	2483.500	AV	45.90	27.52	13.81	40.69	1.22	47.76	53.90	6.1	175	81	
Hori.	4950.000	AV	44.23	31.43	5.98	41.25	1.22	41.61	53.90	12.3	102	4	
Hori.	7425.000	AV	36.57	36.55	7.19	41.35	1.22	40.18	53.90	13.7	133	46	
Hori.	9900.000	AV	32.15	38.55	8.17	40.33	1.22	39.76	53.90	14.1	100	62	
Vert.	33.653	QP	23.10	16.55	6.85	31.91	0.00	14.59	40.00	25.4	100	113	
Vert.	179.623	QP	22.60	16.12	8.48	31.78	0.00	15.42	43.50	28.0	100	7	
Vert.	934.401	QP	21.20	22.44	9.81	30.62	0.00	22.83	46.00	23.1	100	356	
Vert.	2483.500	PK	65.76	27.52	13.81	40.69	2.17	68.57	73.90	5.3	142	335	
Vert.	4950.000	PK	49.30	31.43	5.98	41.25	2.17	47.63	73.90	26.3	113	329	
Vert.	7425.000	PK	48.21	36.55	7.19	41.35	2.17	52.77	73.90	21.1	136	327	
Vert.	9900.000	PK	49.30	38.55	8.17	40.33	2.17	57.86	73.90	16.0	285	12	
Vert.	2483.500	AV	45.88	27.52	13.81	40.69	2.17	48.69	53.90	5.2	142	335	
Vert.	4950.000	AV	38.29	31.43	5.98	41.25	2.17	36.62	53.90	17.3	113	329	
Vert.	7425.000	AV	38.45	36.55	7.19	41.35	2.17	43.01	53.90	10.9	136	327	
Vert.	9900.000	AV	37.98	38.55	8.17	40.33	2.17	46.54	53.90	7.4	285	12	

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

Distance factor :
1 GHz - 13 GHz : $20\log(3.45 \text{ m} / 3.0 \text{ m}) = 1.22 \text{ dB (Hori.)}$
1 GHz - 13 GHz : $20\log(3.85 \text{ m} / 3.0 \text{ m}) = 2.17 \text{ dB (Vert.)}$
13 GHz - 40 GHz : $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

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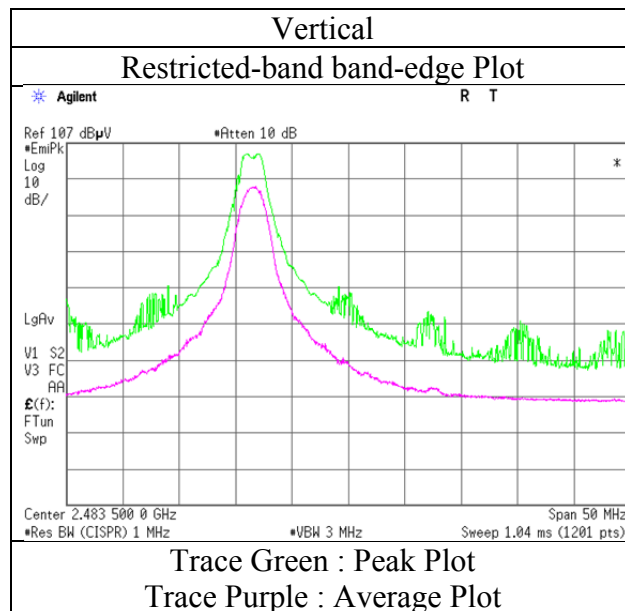
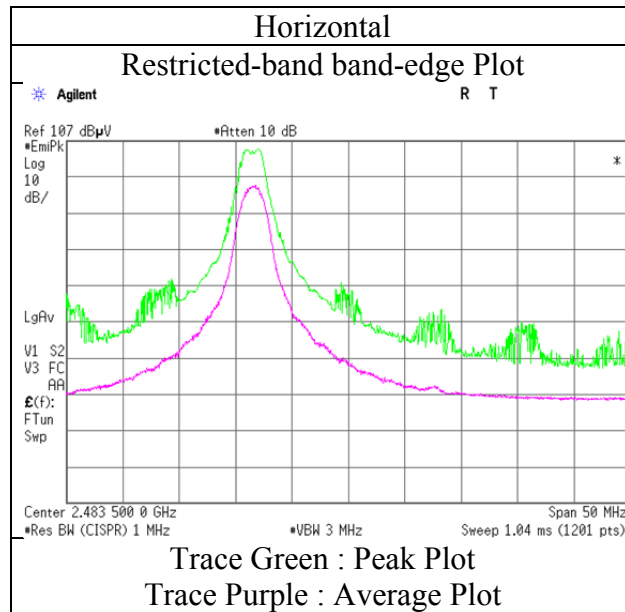
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

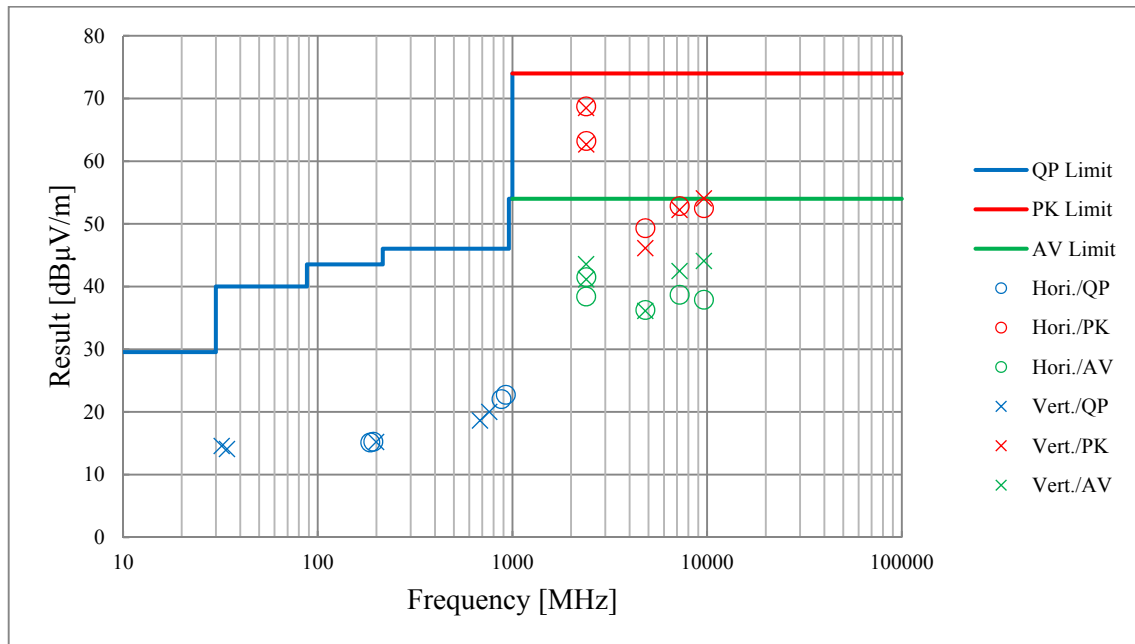
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11491472S-A-R2
Date	January 19, 2017
Temperature / Humidity	25 deg. C / 22 % RH
Engineer	Yosuke Ishikawa
	(1 GHz -26.5 GHz)
Mode	Tx 2475 MHz (Collinear Antenna)



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

Radiated Spurious Emission
(Plot data, Worst case)

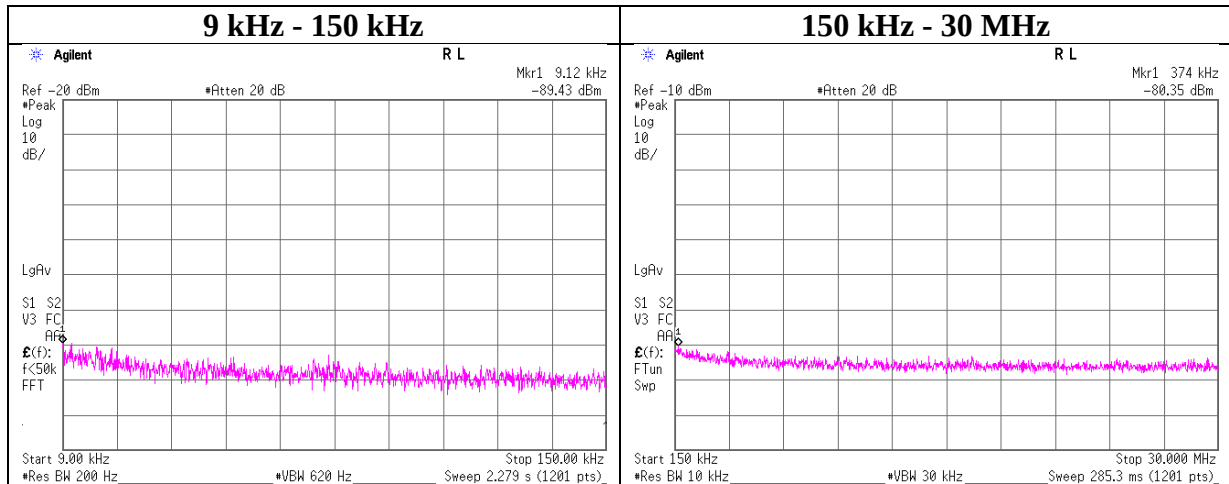
Report No.	11491472S-A-R2	
Test Place(AC No)	1	2
Date	January 19, 2017	January 24, 2017
Temperature / Humidity	25 deg. C / 22 % RH	20 deg. C / 30 % RH
Engineer	Yosuke Ishikawa	Yasumasa Owaki
	(1 GHz -26.5 GHz)	(30 MHz -1000MHz)
Mode	Tx 2405 MHz (Collinear Antenna)	



*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. : 11491472S-A-R2
Date : February 17, 2017
Temperature / Humidity : 26 deg. C / 36 % RH
Engineer : Yosuke Ishikawa
Mode : Tx ISA100.11a 2405 MHz



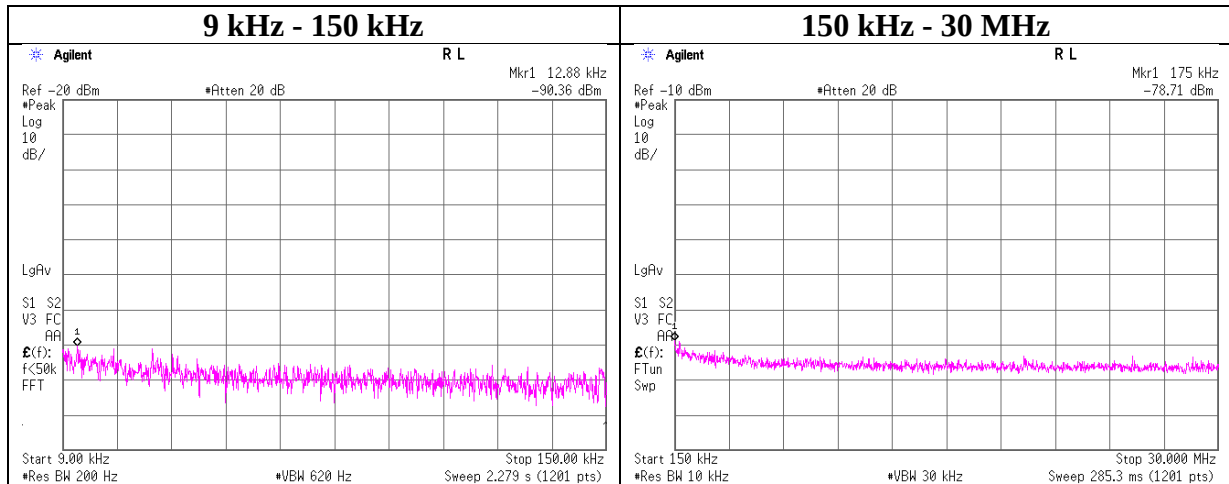
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0.01	-89.4	0.02	9.5	6.0	1	-73.9	300	6.0	-12.6	108.5	121.1	
0.15	-80.4	0.02	9.5	6.0	1	-64.8	300	6.0	-3.5	84.0	87.5	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11491472S-A-R2
Date : February 17, 2017
Temperature / Humidity : 26 deg. C / 36 % RH
Engineer : Yosuke Ishikawa
Mode : Tx ISA100.11a 2440 MHz



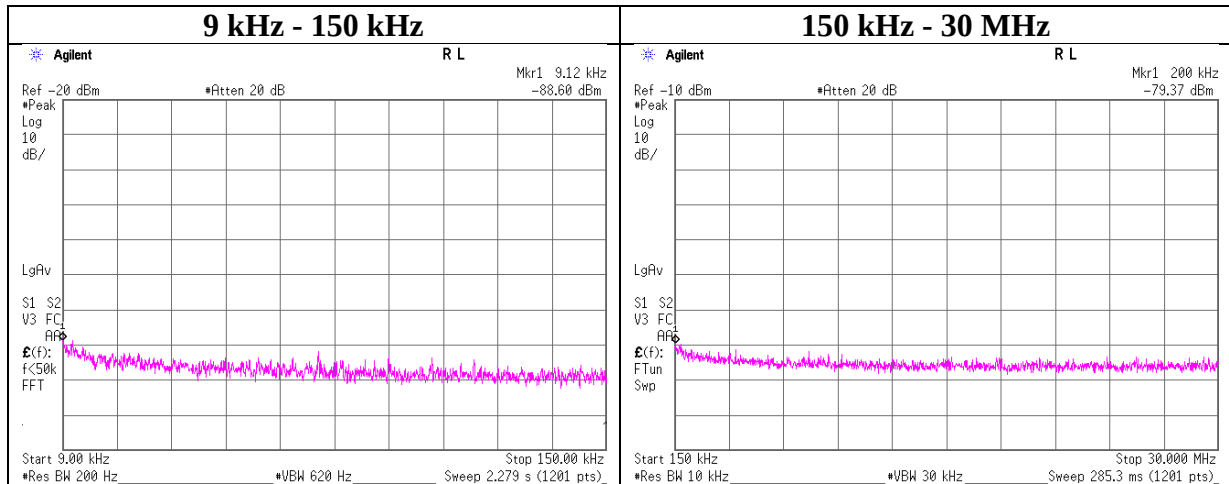
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0.01	-90.4	0.02	9.5	6.0	1	-74.8	300	6.0	-13.5	108.5	122.0	
0.15	-78.7	0.02	9.5	6.0	1	-63.2	300	6.0	-1.9	84.0	85.9	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 11491472S-A-R2
Date : February 17, 2017
Temperature / Humidity : 26 deg. C / 36 % RH
Engineer : Yosuke Ishikawa
Mode : Tx ISA100.11a 2475 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
0.01	-88.6	0.02	9.5	6.0	1	-73.0	300	6.0	-11.8	108.5	120.3	
0.15	-79.4	0.02	9.5	6.0	1	-63.8	300	6.0	-2.6	84.0	86.6	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

Power Density

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11491472S-A-R2
Date February 17, 2017
Temperature / Humidity 26 deg. C / 36 % RH
Engineer Yosuke Ishikawa
Mode Tx ISA100.11a

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2405.46	-17.26	2.15	9.64	-5.47	8.00	13.47
2440.46	-17.33	2.16	9.64	-5.53	8.00	13.53
2475.46	-16.97	2.17	9.65	-5.15	8.00	13.15

Sample Calculation:

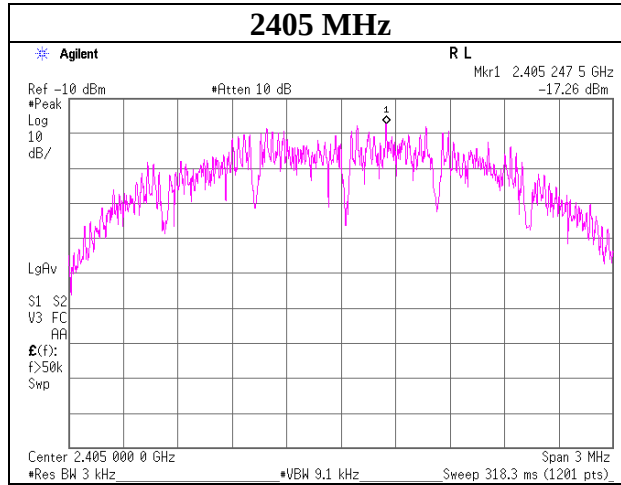
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

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

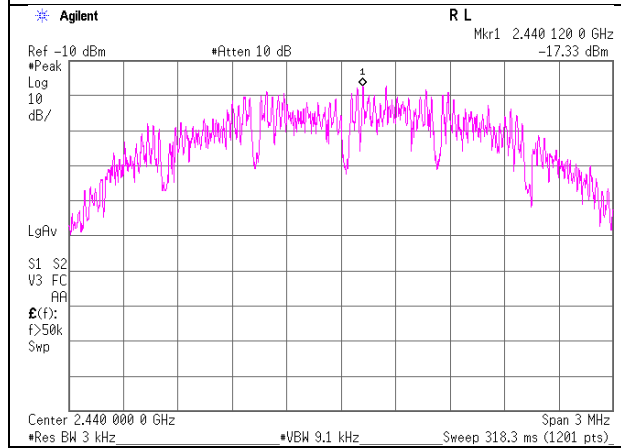
Power Density

ISA100.11a

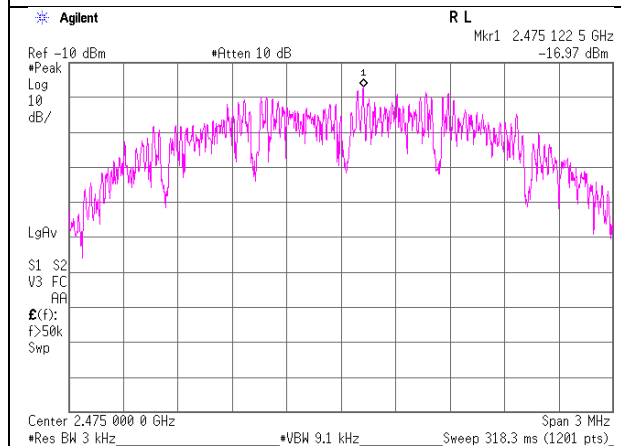
2405 MHz



2440 MHz



2475 MHz

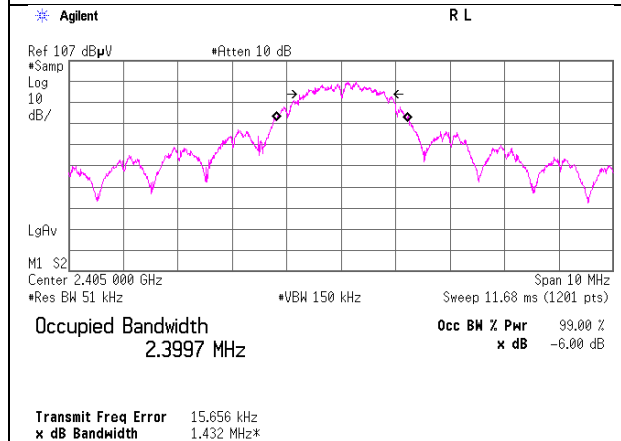


99% Occupied Bandwidth

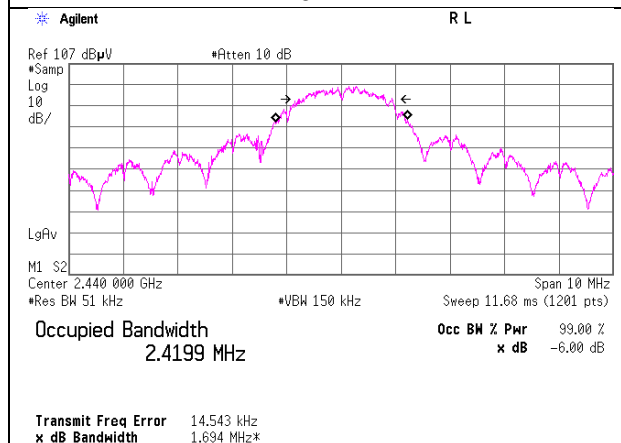
Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 11491472S-A-R2
Date February 17, 2017
Temperature / Humidity 26 deg. C / 36 % RH
Engineer Yosuke Ishikawa
Mode Tx ISA100.11a

ISA100.11a

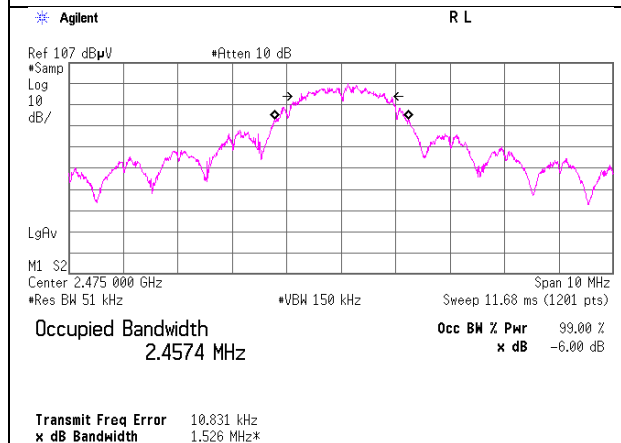
2405 MHz



2440 MHz



2475 MHz



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APPENDIX 2: Test instruments

Test equipment (1/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY48250152	AT, RE	2016/09/26 * 12
SCC-G14	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	AT	2016/03/23 * 12
SAT10-09	Attenuator	Weinschel Corp.	54A-10	W5692	AT	2016/11/07 * 12
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2016/04/04 * 12
SPSS-04	Power sensor	Agilent	N1923A	MY5326009	AT	2016/04/04 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 12
KTS-07	Digital Tester	SANWA	PC500	7019232	AT	2016/10/17 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2016/03/23 * 12
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2016/02/10 * 12
SCC-G01	Coaxial Cable	Suhner	SUCOFLEX 104A	46497/4A	RE	2016/04/22 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2016/05/11 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2016/08/09 * 12
SAEC-02(SVSW R)	Semi-Anechoic Chamber	TDK	SAEC-02(SVS WR)	2	RE	2016/07/22 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE ,CE,RFI,MF)	-	RE	
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2016/03/15 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2016/03/23 * 12
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	RE	2016/03/08 * 12
SAF-04	Pre Amplifier	TOYO Corporation	TPA0118-36	1440489	RE	2016/03/22 * 12
SCC-G06	Coaxial Cable	Junkosha	J12J102207-00	MAY-23-16- 091	RE	2016/06/14 * 12
SCC-G21	Coaxial Cable	Suhner	SUCOFLEX 104	296169/4	RE	2016/05/11 * 12
SHA-01	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	RE	2016/08/09 * 12
SOS-01	Humidity Indicator	A&D	AD-5681	4062555	RE	2016/10/12 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2016/10/11 * 12
KJM-09	Measure	KOMELON	KMC-36	-	RE	-
SAEC-01(SVSW R)	Semi-Anechoic Chamber	TDK	SAEC-01(SVS WR)	1	RE	2016/07/24 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE ,CE,RFI,MF)	-	RE,CE	-
STS-01	Digital Hitester	Hioki	3805-50	080997812	RE	2016/10/17 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2016/11/07 * 12
SFL-18	Highpass Filter	MICRO-TRONICS	HPM50111	119	RE	2016/04/18 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2016/03/24 * 12
SCC-G19	Coaxial Cable	Suhner	SUCOFLEX 102A	1188/2A	RE	2016/03/08 * 12
SCC-G32	Coaxial Cable	Junkosha	MWX241-0200 0KMSKMS	OCT-09-13-0 05	RE	2016/11/07 * 12

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

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

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

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

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Test equipment (2/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2016/09/27 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2016/02/19 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2016/02/25 * 12
KAT3-10	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2016/07/26 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2016/11/23 * 12
SCC-B2/B4/B6/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/T OYO	8D2W/12DSFA/141PE/141PE/141PE/NS4906	-/0901-270(R F Selector)	RE	2016/04/22 * 12
SLA-06	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	195	RE	2017/01/05 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2016/10/12 * 12
STR-07	Test Receiver	Rohde & Schwarz	ESU26	100484	RE,CE	2016/09/28 * 12
SJM-09	Measure	PROMART	SEN1935	-	RE,CE	-
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2016/07/13 * 12
STS-02	Digital Hitester	Hioki	3805-50	080997819	RE,CE	2016/03/22 * 12
SCC-B12/B13/SRSE-02	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-270(R F Selector)	CE	2016/04/22 * 12
SLS-03	LISN	Rohde & Schwarz	ENV216	100513	CE	2016/02/08 * 12
SAT3-06	Attenuator	JFW	50HF-003N	-	CE	2016/02/25 * 12
SOS-04	Humidity Indicator	A&D	AD-5681	4061512	CE	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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