RADIO TEST REPORT

Test Report No. : 11211969H

Applicant	:	**URYU SEISAKU, LTD.**
Type of Equipment	:	**Equipment built-in 2.4GHz band transceiver module**
Model No.	:	**HTW-2401T**
FCC ID	:	**ZVI-UDBP-RF8**
Test regulation	:	**FCC Part 15 Subpart C: 2015**
Test Result	:	**Complied**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
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)

Date of test: May 10 and 11, 2016

Representative test engineer:
Keisuke Kawamura
Engineer
Consumer Technology Division

Approved by:
Tsubasa Takayama
Engineer
Consumer Technology Division

NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

REVISION HISTORY

Original Test Report No.: 11211969H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	11211969H	May 19, 2016	-	-

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	URYU SEISAKU, LTD.
Address	:	2-9-26, Higashinari-ku,Osaka 537-0003 Japan
Telephone Number	:	+81-6-6973-9444
Facsimile Number	:	+81-6-6973-5759
Contact Person	:	Hidekazu Kimura

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

2.1 Identification of E.U.T.

Type of Equipment	:	Equipment built-in 2.4GHz band transceiver module
Model No.	:	HTW-2401T
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 5.0V
Receipt Date of Sample	:	April 18, 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: HTW-2401T (referred to as the EUT in this report) is a Equipment built-in 2.4GHz band transceiver module.

General Specification

Clock frequency(ies) in the system	:	Crystal: 16 MHz

Radio Specification

Equipment Type	:	Transceiver
Frequency of Operation	:	2403MHz - 2478MHz
Channel Spacing	:	1MHz
Modulation	:	GFSK
Antenna Type	:	1/4λ Dipole chip antenna
Antenna Gain	:	-2.13dBi
Method of Frequency Generation	:	Synthesizer

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C: 2015, final revised on November 23, 2015 *Some parts are effective on and after December 17, 2015 or December 23, 2015. The revision does not affect the test specification applied to the EUT.
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods **IC:** RSS-Gen 8.8	**FCC:** Section 15.207 **IC:** RSS-Gen 8.8	**QP** 31.0 dB, 0.15000 MHz, L **AV** 37.1 dB, 0.79670 MHz, L	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:** Section15.247(d) **IC:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	3.6 dB 7323.000 MHz, AV, Vert.	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 15.31 (e)

This EUT provides stable voltage (DC 2.0 V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The antenna is not removable from the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203

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 $k = 2$.

Ise EMC Lab.

Antenna terminal test Uncertainty (+/-)							
Power meter		Conducted emission and Power density			Conducted emission		Channel power
Below 1 GHz	Above 1 GHz	Below 1 GHz	1 GHz -3 GHz	3 GHz -18 GHz	18 GHz -26.5 GHz	26.5 GHz -40 GHz	
0.9 dB	1.0 dB	1.4 dB	1.7 dB	2.8 dB	2.8 dB	2.9 dB	2.6 dB

Frequency range	Conducted emission using AMN(LISN) (±dB)
0.009 – 0.15MHz	3.5 dB
0.15 – 30MHz	2.9 dB

Test distance	Radiated emission (±dB) 9 kHz - 30 MHz
3m	3.8 dB
10m	3.7 dB

Polarity	Radiated emission (Below 1GHz)			
	(3 m*)(±dB)		(10 m*)(±dB)	
	30 – 200 MHz	200 – 1000MHz	30 – 200 MHz	200 – 1000MHz
Horizontal	4.9 dB	5.2 dB	4.9 dB	5.0 dB
Vertical	4.6 dB	5.9 dB	5.0 dB	5.0 dB

Radiated emission				
(3 m*)(±dB)		(1 m*)(±dB)	(0.5 m*)(±dB)	(10 m*)(±dB)
1 – 6GHz	6 – 18GHz	10 – 26.5 GHz	26.5 – 40GHz	1 -18 GHz
5.1 dB	5.3 dB	5.1 dB	5.1 dB	5.3 dB

*Measurement distance

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

Radiated emission test
The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test Location

UL Japan, Inc. Ise EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	N/A	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

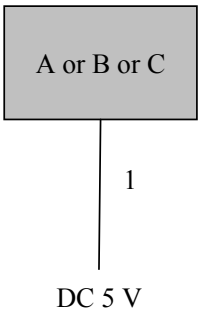
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, Spurious Emission (Conducted/Radiated) 6 dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	Transmitting (Tx) ,PN9	2403MHz 2441MHz 2478MHz
The system was configured in typical fashion (as a customer would normally use it) for testing. *EUT has the power settings by the software as follows; Power settings: 0dBm Software: HTW2401T RF-TEST V1.00 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting.		

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

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Equipment built-in 2.4GHz band transceiver module	HTW-2401T	810190001F	URYU SEISAKU, LTD.	EUT
B	Equipment built-in 2.4GHz band transceiver module	HTW-2401T	8101900020	URYU SEISAKU, LTD.	EUT
C	Equipment built-in 2.4GHz band transceiver module	HTW-2401T	8101900024	URYU SEISAKU, LTD.	EUT

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Power Cable	3.0	Unshielded	Unshielded	-

※EUT worked with each one channel.
S/N: 810190001F: L ch
S/N: 8101900020: M ch
S/N: 8101900024: H ch
It's equipment other than the transmission channel.

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The 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.

For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.
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 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: 12.2.5.2 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces Duty factor was added to the results *4)	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	3.75 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)		3.75 m *2) (1 GHz – 10 GHz), 1 m *3) (10 GHz – 26.5 GHz)

*1) Average Power Measurement was performed based on 6. 0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r05"
*2) Distance Factor: 20 x log (3.75 m / 3.0 m) = 1.94 dB
*3) Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 dB
*****4) Some spurious evaluations were performed by Peak with Duty factor, since the spurious emission occurred in synchronization with carrier. In this case carrier frequency kept the worst duty cycle; refer page 20 and 21.

- 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 M - 26.5 GHz
Test data : APPENDIX
Test result : Pass

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	20 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	10 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	9.1 kHz	27 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.

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

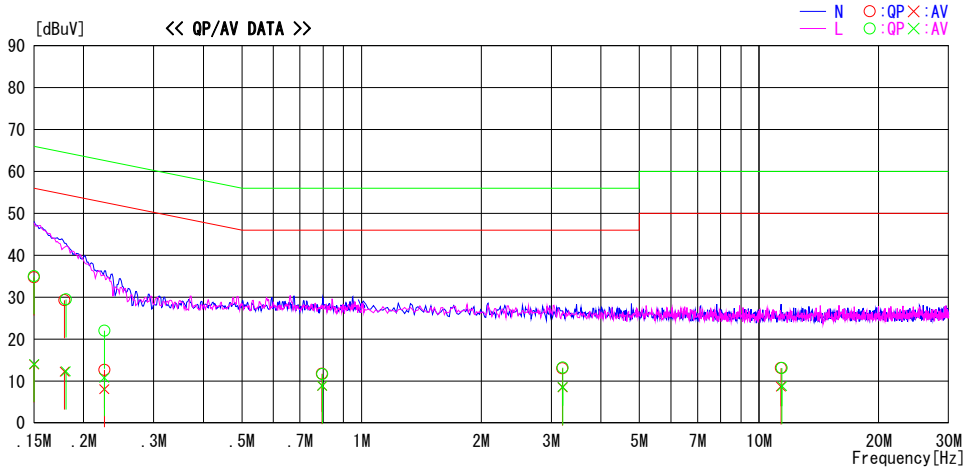
UL Japan, Inc. Ise EMC Lab. No.2 Semi Anechoic Chamber
Date : 2016/05/10

Report No. : 11211969H

Temp./Humi. : 24deg. C / 45% RH
Engineer : Shinichi Miyazono

Mode / Remarks : Tx_2441MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



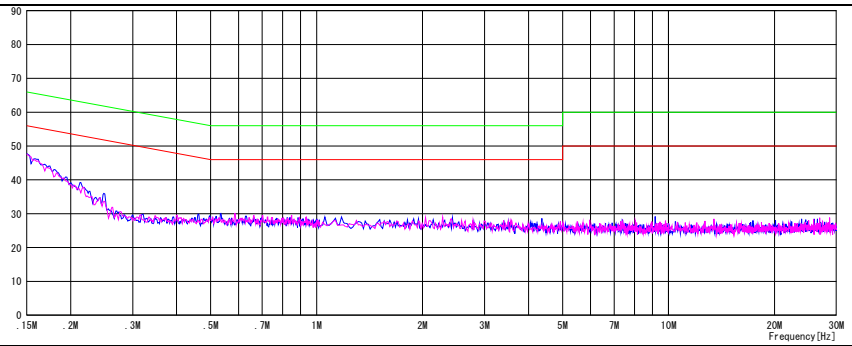
Frequency	Reading Level		Corr.	Results		Limit		Margin		Phase	Comment
	QP	AV	Factor	QP	AV	QP	AV	QP	AV		
[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
0.15000	21.5	0.8	13.2	34.7	14.0	66.0	56.0	31.3	42.0	N	
0.15000	21.8	0.9	13.2	35.0	14.1	66.0	56.0	31.0	41.9	L	
0.17900	16.1	-1.0	13.2	29.3	12.3	64.5	54.5	35.2	42.3	N	
0.18045	16.3	-0.9	13.2	29.5	12.3	64.5	54.5	35.0	42.2	L	
0.22540	-0.5	-5.1	13.2	12.7	8.1	62.6	52.6	49.9	44.5	N	
0.22540	8.8	-2.4	13.2	22.0	10.8	62.6	52.6	40.6	41.8	L	
0.79525	-1.6	-4.5	13.3	11.7	8.8	56.0	46.0	44.3	37.2	N	
0.79670	-1.7	-4.4	13.3	11.6	8.9	56.0	46.0	44.4	37.1	L	
3.20215	-0.6	-5.1	13.6	13.0	8.5	56.0	46.0	43.0	37.5	N	
3.20510	-0.4	-5.0	13.6	13.2	8.6	56.0	46.0	42.8	37.4	L	
11.35350	-1.2	-5.6	14.3	13.1	8.7	60.0	50.0	46.9	41.3	N	
11.42000	-1.2	-5.5	14.3	13.1	8.8	60.0	50.0	46.9	41.2	L	

CHART : WITH FACTOR, Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + ATTEN + CABLE)
Except for the above table : adequate margin data below the limits.

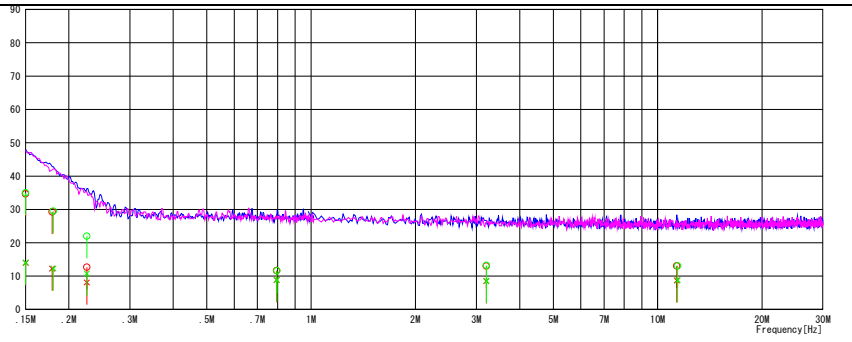
Conducted Emission

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11211969H
Date	May 10, 2016
Temperature / Humidity	24 deg. C / 45 % RH
Engineer	Shinichi Miyazono
Mode	Tx

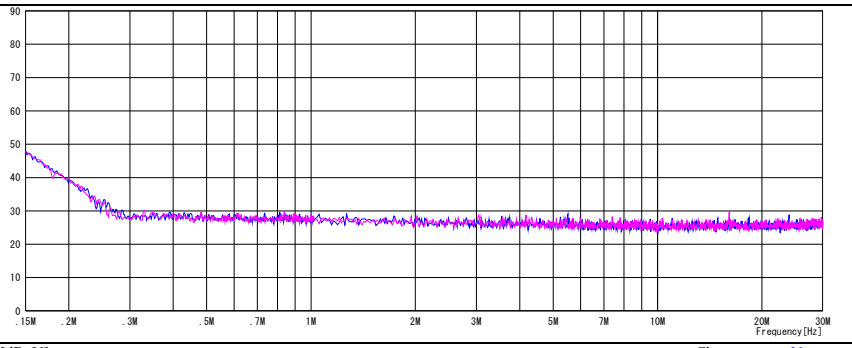
2403 MHz



2441 MHz



2478 MHz



Y scale [dBuV] Chart — N — L

UL Japan, Inc.
Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

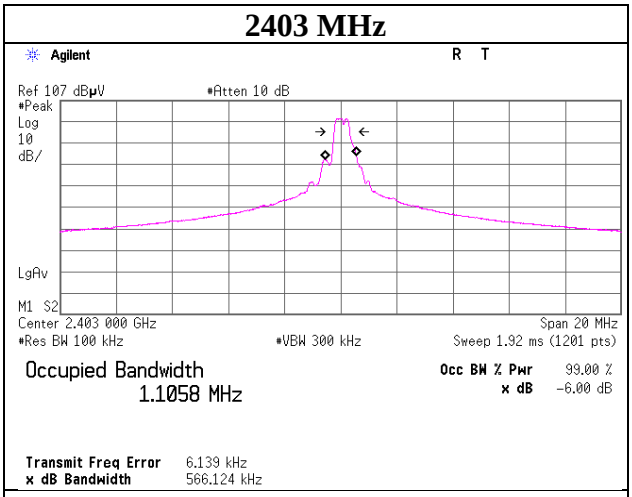
6dB Bandwidth

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx

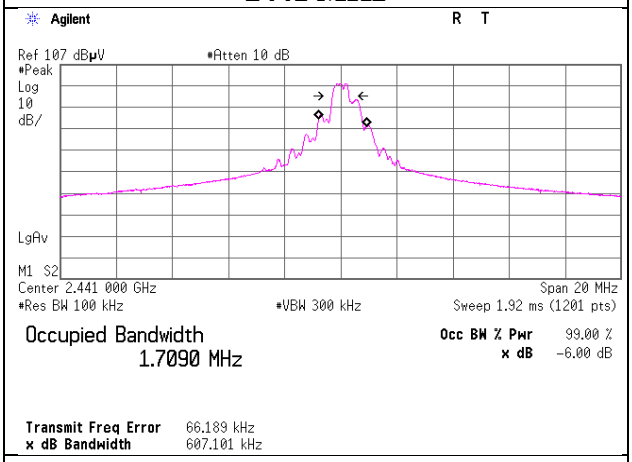
Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2403	0.566	> 500
2441	0.607	> 500
2478	0.722	> 500

6dB Bandwidth

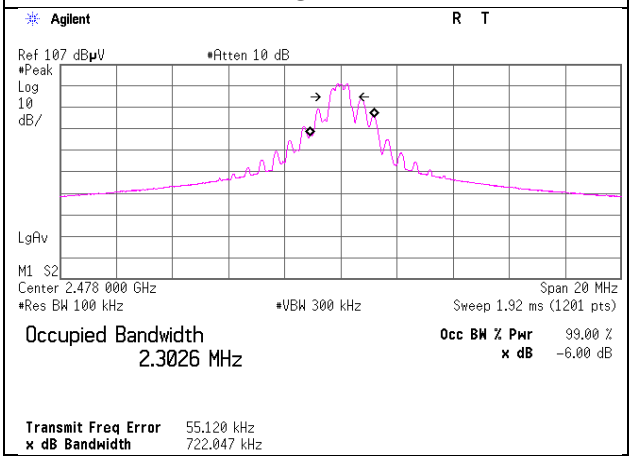
2403 MHz



2441 MHz



2478 MHz



Maximum Peak Output Power

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx

Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2403	-8.59	0.97	10.09	2.47	1.77	30.00	1000	27.53
2441	-8.81	0.99	10.09	2.27	1.69	30.00	1000	27.73
2478	-9.02	1.00	10.09	2.07	1.61	30.00	1000	27.93

Sample Calculation:
Result = Reading + Cable Loss + Attenuator Loss

Average Output Power
(Reference data for RF Exposure

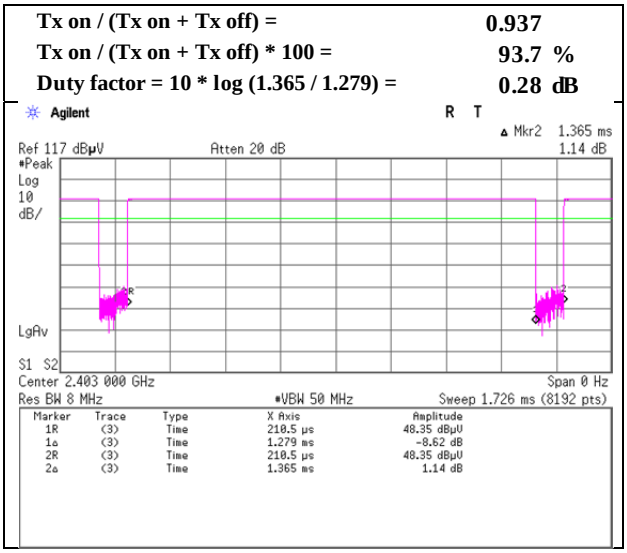
Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2403	-9.04	0.97	10.09	2.02	1.59	0.28	2.30	1.70
2441	-9.28	0.99	10.09	1.80	1.51	0.28	2.08	1.61
2478	-9.50	1.00	10.09	1.59	1.44	0.28	1.87	1.54

Sample Calculation:
Result (Time average) = Reading + Cable Loss + Attenuator
Result (Burst power average) = Time average + Duty factor

Burst rate confirmation

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11211969H
Date	May 10, 2016
Temperature / Humidity	22 deg. C / 50 % RH
Engineer	Masafumi Niwa
Mode	Tx



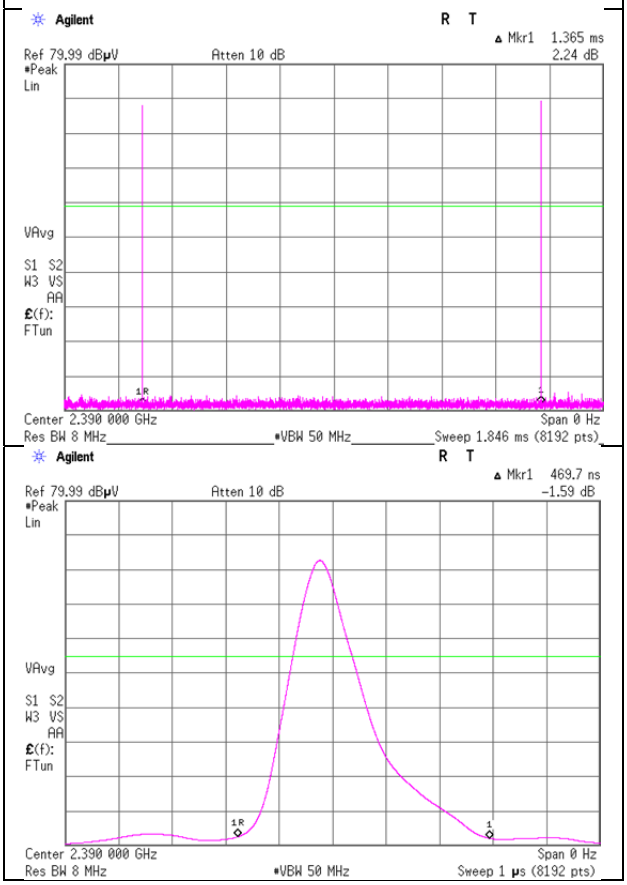
*This is a waveform of transmission carrier.

Burst rate confirmation
(Reference data for Peak with Duty factor)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11211969H
Date	May 10, 2016
Temperature / Humidity	22 deg. C / 50 % RH
Engineer	Masafumi Niwa
Mode	Tx

Tx

Tx on / (Tx on + Tx off) = 0.0003
Tx on / (Tx on + Tx off) * 100 = 0.03 %
Duty factor = 10 * log (1.365 / 0.0004697) = 34.63 dB



*This is a waveform of transmission carrier.

Radiated Spurious Emission

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber	
Report No.	11211969H	
Date	May 10, 2016	May 10, 2016
Temperature / Humidity	23 deg. C / 60 % RH	24 deg. C / 45 % RH
Engineer	Masafumi Niwa (1-26.5GHz)	Shinichi Miyazono (Below 1GHz)
Mode	Tx 2403 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	35.667	QP	22.9	15.5	6.8	28.5	-	16.7	40.0	23.3	
Hori	193.415	QP	21.9	16.6	8.1	27.7	-	18.9	43.5	24.6	
Hori	208.000	QP	21.9	11.7	8.2	27.6	-	14.2	43.5	29.3	
Hori	216.000	QP	21.6	11.8	8.2	27.6	-	14.0	43.5	29.5	
Hori	240.000	QP	21.4	12.4	8.4	27.5	-	14.7	46.0	31.3	
Hori	557.334	QP	22.2	18.3	9.9	28.5	-	21.9	46.0	24.1	
Hori	2390.000	PK	63.1	27.6	5.0	34.8	-	60.9	73.9	13.0	
Hori	4806.000	PK	42.9	31.5	7.2	34.1	-	47.5	73.9	26.4	
Hori	7209.000	PK	45.0	36.1	8.5	34.1	-	55.5	73.9	18.4	
Hori	9612.000	PK	44.0	38.5	9.2	34.8	-	56.9	73.9	17.0	
Hori	4806.000	AV	34.4	31.5	7.2	34.1	0.3	39.3	53.9	14.6	
Hori	7209.000	AV	37.6	36.1	8.5	34.1	0.3	48.4	53.9	5.5	
Hori	9612.000	AV	35.9	38.5	9.2	34.8	0.3	49.1	53.9	4.8	
Vert	35.383	QP	23.7	15.6	6.8	28.5	-	17.6	40.0	22.4	
Vert	193.768	QP	21.7	16.6	8.1	27.7	-	18.7	43.5	24.8	
Vert	205.333	QP	21.8	11.6	8.2	27.7	-	13.9	43.5	29.6	
Vert	220.000	QP	21.6	11.9	8.2	27.6	-	14.1	46.0	31.9	
Vert	238.667	QP	21.4	12.3	8.4	27.5	-	14.6	46.0	31.4	
Vert	562.668	QP	22.2	18.4	9.9	28.5	-	22.0	46.0	24.0	
Vert	2390.000	PK	63.5	27.6	5.0	34.8	-	61.3	73.9	12.6	
Vert	4806.000	PK	44.5	31.5	7.2	34.1	-	49.1	73.9	24.8	
Vert	7209.000	PK	46.2	36.1	8.5	34.1	-	56.7	73.9	17.2	
Vert	9612.000	PK	45.1	38.5	9.2	34.8	-	58.0	73.9	15.9	
Vert	4806.000	AV	37.4	31.5	7.2	34.1	0.3	42.3	53.9	11.6	
Vert	7209.000	AV	39.1	36.1	8.5	34.1	0.3	49.9	53.9	4.0	
Vert	9612.000	AV	36.8	38.5	9.2	34.8	0.3	50.0	53.9	3.9	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty Factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

PK with Duty factor

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m] Hor	Result [dBuV/m] Ver	Limit [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark
2390.000	PK	63.1	63.5	27.6	5.0	34.8	-34.7	26.3	26.7	53.9	27.7	27.3	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier) + Duty factor (Refer to Burst rate confirmation sheet)

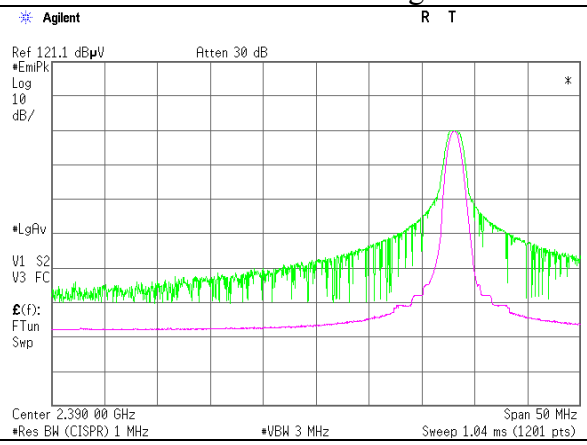
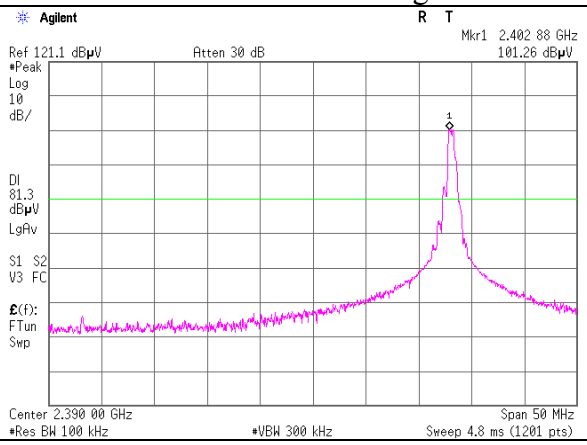
20dBc Data Sheet

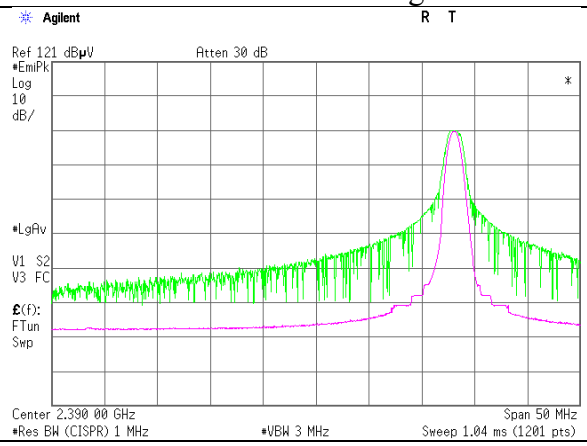
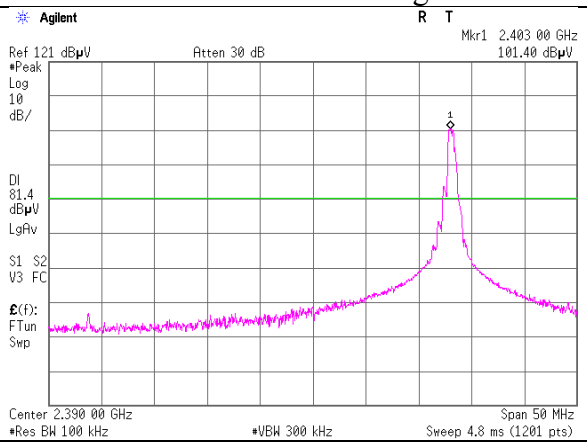
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2403.000	PK	101.3	27.6	5.0	34.8	99.1	-	-	Carrier
Hori	2400.000	PK	59.6	27.6	5.0	34.8	57.4	79.1	21.7	
Vert	2403.000	PK	101.4	27.6	5.0	34.8	99.2	-	-	Carrier
Vert	2400.000	PK	59.7	27.6	5.0	34.8	57.5	79.2	21.7	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11211969H
Date	May 10, 2016
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Masafumi Niwa
	(1-10GHz)
Mode	Tx 2403 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber	
Report No.	11211969H	
Date	May 10, 2016	May 10, 2016
Temperature / Humidity	23 deg. C / 60 % RH	24 deg. C / 45 % RH
Engineer	Masafumi Niwa (1-26.5GHz)	Shinichi Miyazono (Below 1GHz)
Mode	Tx 2441 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	49.550	QP	24.6	10.5	7.0	28.5	-	13.6	40.0	26.4	
Hori	183.001	QP	21.9	16.3	8.0	27.8	-	18.4	43.5	25.1	
Hori	188.951	QP	21.8	16.4	8.1	27.7	-	18.6	43.5	24.9	
Hori	204.000	QP	21.8	11.6	8.1	27.7	-	13.8	43.5	29.7	
Hori	248.000	QP	21.4	12.5	8.4	27.4	-	14.9	46.0	31.1	
Hori	278.667	QP	21.2	13.1	8.6	27.4	-	15.5	46.0	30.5	
Hori	4882.000	PK	44.3	31.7	7.2	34.1	-	49.1	73.9	24.8	
Hori	7323.000	PK	44.1	36.3	8.6	34.1	-	54.9	73.9	19.0	
Hori	9764.000	PK	42.0	38.5	9.2	34.8	-	54.9	73.9	19.0	Noise Floor
Hori	4882.000	AV	36.2	31.7	7.2	34.1	0.3	41.3	53.9	12.6	
Hori	7323.000	AV	36.5	36.3	8.6	34.1	0.3	47.6	53.9	6.3	
Hori	9764.000	AV	34.7	38.5	9.2	34.8	-	47.6	53.9	6.3	Noise Floor
Vert	49.267	QP	22.8	10.6	7.0	28.5	-	11.9	40.0	28.1	
Vert	183.001	QP	22.0	16.3	8.0	27.8	-	18.5	43.5	25.0	
Vert	189.518	QP	21.7	16.5	8.1	27.7	-	18.6	43.5	24.9	
Vert	202.667	QP	21.7	11.5	8.1	27.7	-	13.6	43.5	29.9	
Vert	249.333	QP	21.4	12.6	8.4	27.4	-	15.0	46.0	31.0	
Vert	280.000	QP	21.2	13.1	8.6	27.4	-	15.5	46.0	30.5	
Vert	4882.000	PK	46.3	31.7	7.2	34.1	-	51.1	73.9	22.8	
Vert	7323.000	PK	45.8	36.3	8.6	34.1	-	56.6	73.9	17.3	
Vert	9764.000	PK	42.5	38.5	9.2	34.8	-	55.4	73.9	18.5	Noise Floor
Vert	4882.000	AV	39.5	31.7	7.2	34.1	0.3	44.6	53.9	9.3	
Vert	7323.000	AV	39.2	36.3	8.6	34.1	0.3	50.3	53.9	3.6	
Vert	9764.000	AV	34.4	38.5	9.2	34.8	-	47.3	53.9	6.6	Noise Floor

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty Factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber	
Report No.	11211969H	
Date	May 10, 2016	May 10, 2016
Temperature / Humidity	23 deg. C / 60 % RH	24 deg. C / 45 % RH
Engineer	Masafumi Niwa (1-26.5GHz)	Shinichi Miyazono (Below 1GHz)
Mode	Tx 2478 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	33.117	QP	22.9	16.2	6.8	28.5	-	17.4	40.0	22.6	
Hori	48.983	QP	23.1	10.7	7.0	28.5	-	12.3	40.0	27.7	
Hori	98.000	QP	22.5	9.3	7.4	28.2	-	11.0	43.5	32.5	
Hori	314.667	QP	21.4	13.8	8.9	27.5	-	16.6	46.0	29.4	
Hori	628.000	QP	21.9	19.1	10.2	28.3	-	22.9	46.0	23.1	
Hori	921.329	QP	21.1	22.0	11.2	27.2	-	27.1	46.0	18.9	
Hori	2483.500	PK	68.5	27.7	5.1	34.7	-	66.6	73.9	7.3	
Hori	4956.000	PK	43.8	32.0	7.2	34.2	-	48.8	73.9	25.1	
Hori	7434.000	PK	43.2	36.4	8.5	34.1	-	54.0	73.9	19.9	
Hori	9912.000	PK	43.1	38.6	9.2	34.9	-	56.0	73.9	17.9	
Hori	4956.000	AV	36.4	32.0	7.2	34.2	0.3	41.7	53.9	12.2	
Hori	7434.000	AV	34.7	36.4	8.5	34.1	0.3	45.8	53.9	8.1	
Hori	9912.000	AV	35.2	38.6	9.2	34.9	0.3	48.4	53.9	5.5	
Vert	32.833	QP	23.6	16.2	6.8	28.5	-	18.1	40.0	21.9	
Vert	48.983	QP	22.8	10.7	7.0	28.5	-	12.0	40.0	28.0	
Vert	96.867	QP	22.7	9.1	7.4	28.2	-	11.0	43.5	32.5	
Vert	313.334	QP	21.4	13.8	8.9	27.5	-	16.6	46.0	29.4	
Vert	626.667	QP	21.9	19.1	10.1	28.3	-	22.8	46.0	23.2	
Vert	918.662	QP	21.2	21.9	11.2	27.3	-	27.0	46.0	19.0	
Vert	2483.500	PK	66.8	27.7	5.1	34.7	-	64.9	73.9	9.0	
Vert	4956.000	PK	46.4	32.0	7.2	34.2	-	51.4	73.9	22.5	
Vert	7434.000	PK	44.8	36.4	8.5	34.1	-	55.6	73.9	18.3	
Vert	9912.000	PK	44.0	38.6	9.2	34.9	-	56.9	73.9	17.0	
Vert	4956.000	AV	41.1	32.0	7.2	34.2	0.3	46.4	53.9	7.5	
Vert	7434.000	AV	36.4	36.4	8.5	34.1	0.3	47.5	53.9	6.4	
Vert	9912.000	AV	35.7	38.6	9.2	34.9	0.3	48.9	53.9	5.0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty Factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

PK with Duty factor

Frequency	Detector	Reading [dBuV]		Ant Factor	Loss	Gain	Duty Factor	Result [dBuV/m]		Limit	Margin [dB]		Remark
[MHz]		Hor	Ver	[dB/m]	[dB]	[dB]	[dB]	Hor	Ver	[dBuV/m	Hor	Ver	
2483.500	PK	68.5	66.8	27.7	5.1	34.7	-34.7	32.0	30.3	53.9	22.0	23.7	

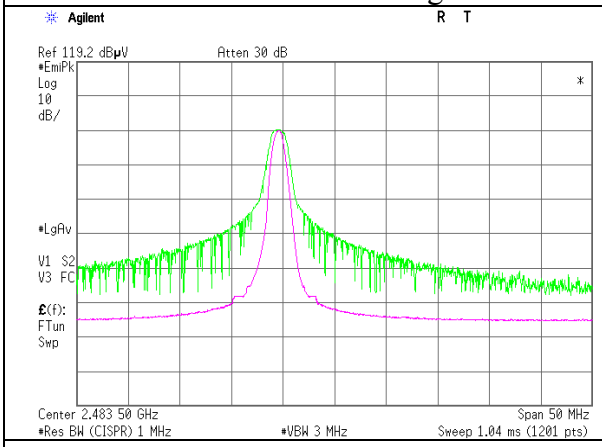
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier) + Duty factor (Refer to Burst rate confirmation sheet)

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11211969H
Date	May 10, 2016
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Masafumi Niwa
	(1-10GHz)
Mode	Tx 2478 MHz

Horizontal

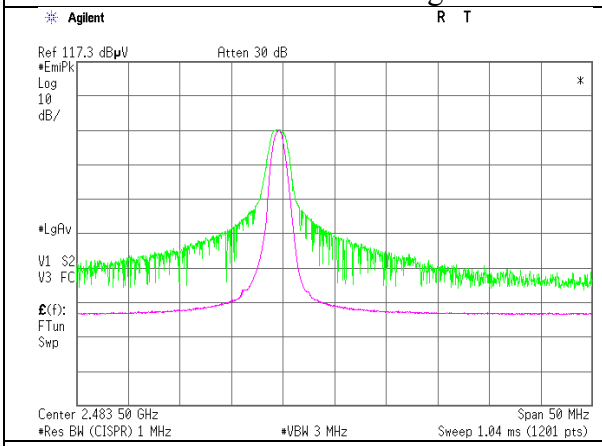
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

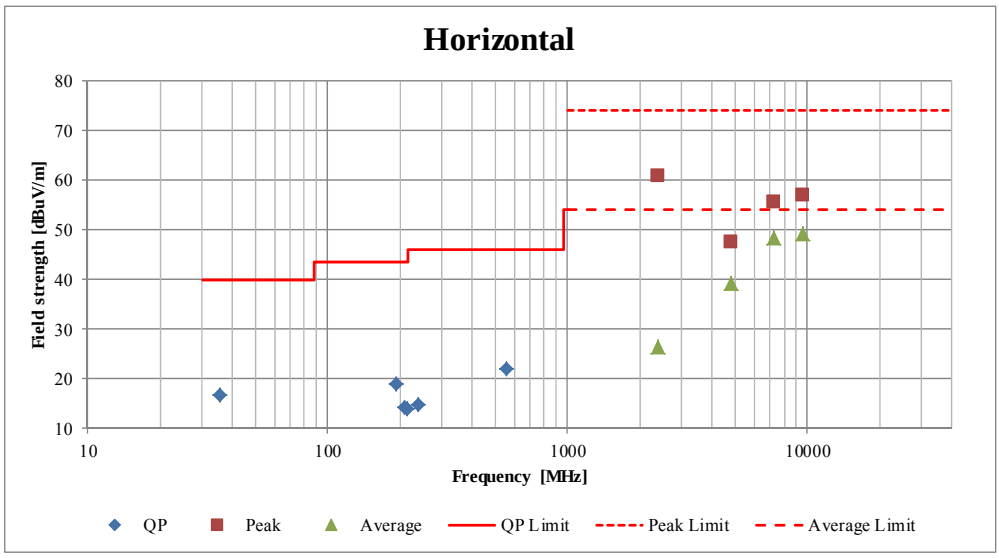


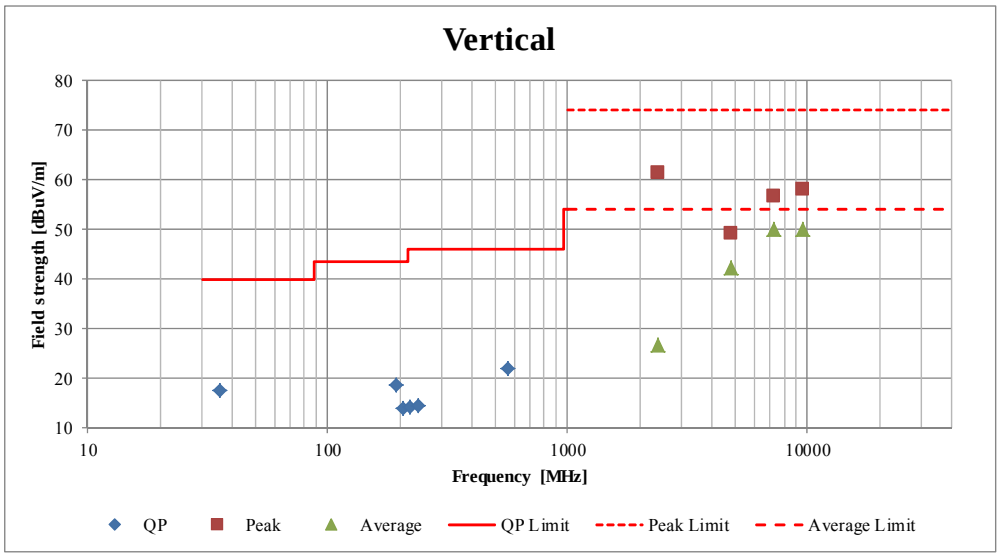
Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission
(Plot data, Worst case)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber	
Report No.	11211969H	
Date	May 10, 2016	May 10, 2016
Temperature / Humidity	23 deg. C / 60 % RH	24 deg. C / 45 % RH
Engineer	Masafumi Niwa (1-26.5GHz)	Shinichi Miyazono (Below 1GHz)
Mode	Tx 2403 MHz	





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

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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
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Power Density

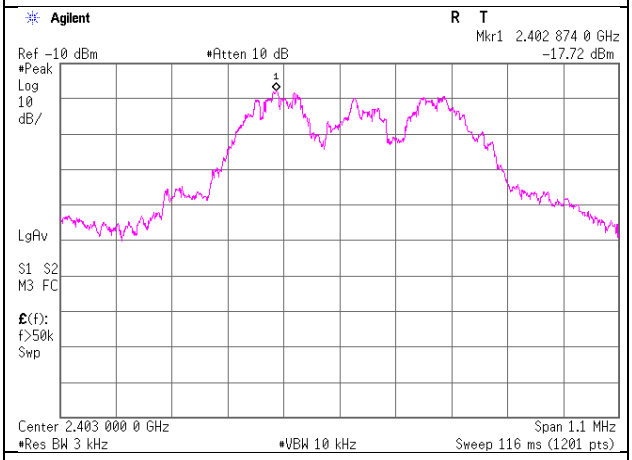
Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2403.00	-17.72	0.97	10.09	-6.66	8.00	14.66
2441.00	-18.24	0.99	10.09	-7.16	8.00	15.16
2478.00	-18.63	1.00	10.09	-7.54	8.00	15.54

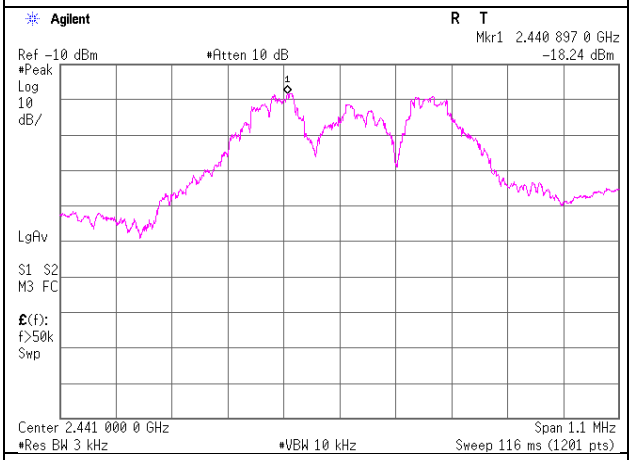
Sample Calculation:
Result = Reading + Cable Loss + Attenuator

Power Density

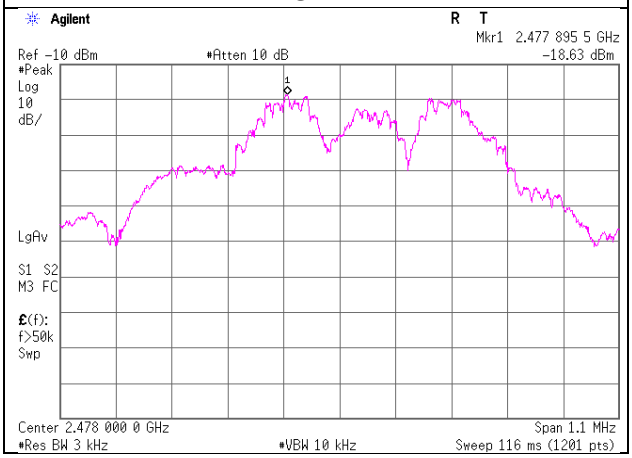
2403 MHz



2441 MHz



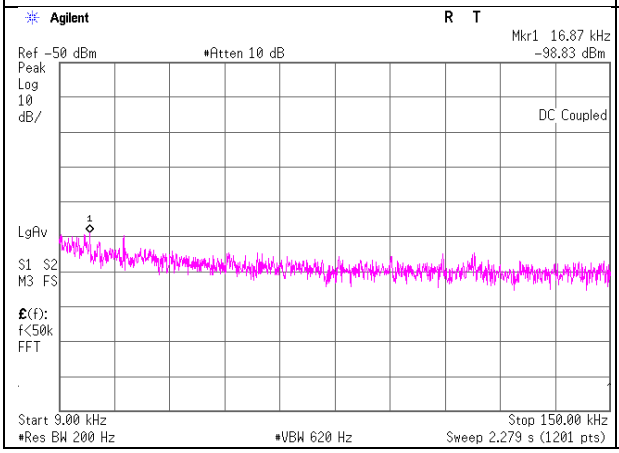
2478 MHz



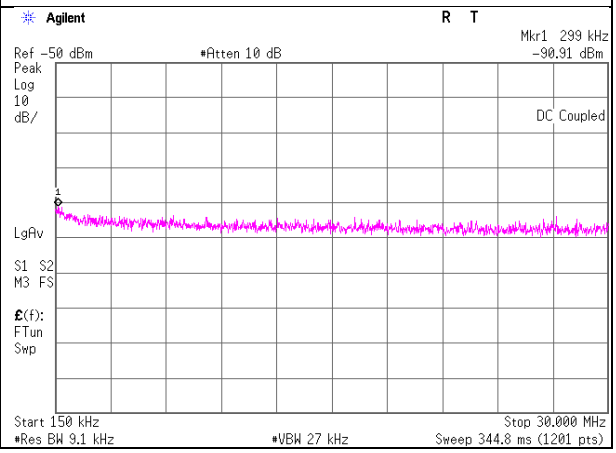
Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx 2403 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenator 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
16.87	-98.8	0.01	9.8	-3.0	1	-92.0	300	6.0	-30.7	43.0	73.7	
299.00	-90.9	0.01	9.9	-3.0	1	-84.0	300	6.0	-22.8	18.0	40.8	

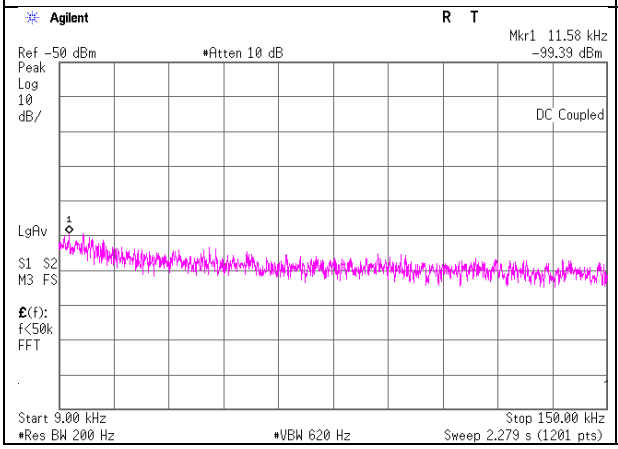
E = EIRP - 20 log (D) + Ground bounce + 104.8 [dBuV/m]

EIRP = Reading + Cable Loss + Attenator Loss + Antenna Gain + 10 * log (N)

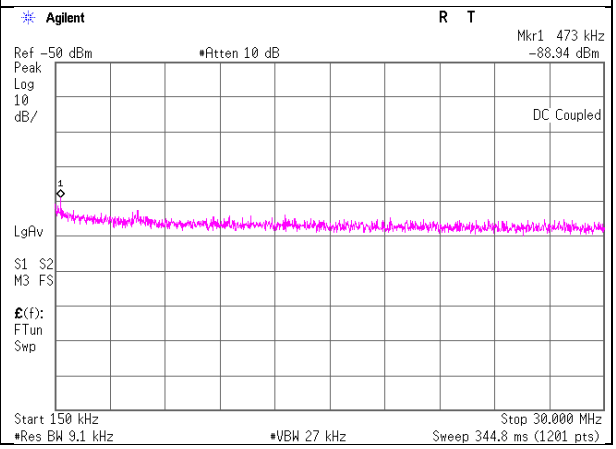
Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx 2441 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenator Loss [dB]	Antenna Gain [dBi]	N (Number of Output	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.58	-99.4	0.01	9.8	-3.0	1	-92.6	300	6.0	-31.3	46.3	77.6	
473.00	-88.9	0.01	9.9	-3.0	1	-82.1	300	6.0	-20.8	14.1	34.9	

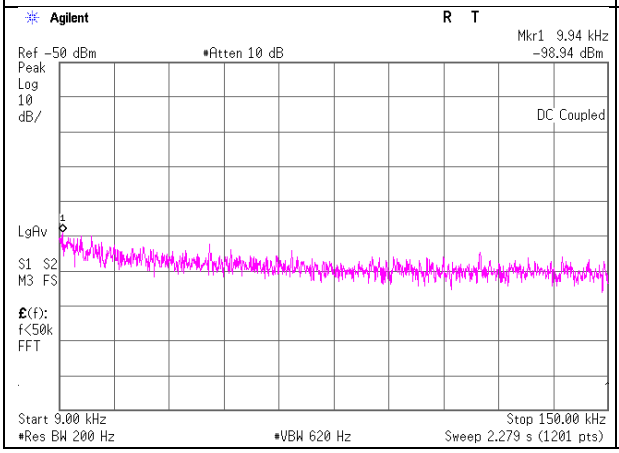
E = EIRP - 20 log (D) + Ground bounce + 104.8 [dBuV/m]

EIRP = Reading + Cable Loss + Attenator Loss + Antenna Gain + 10 * log (N)

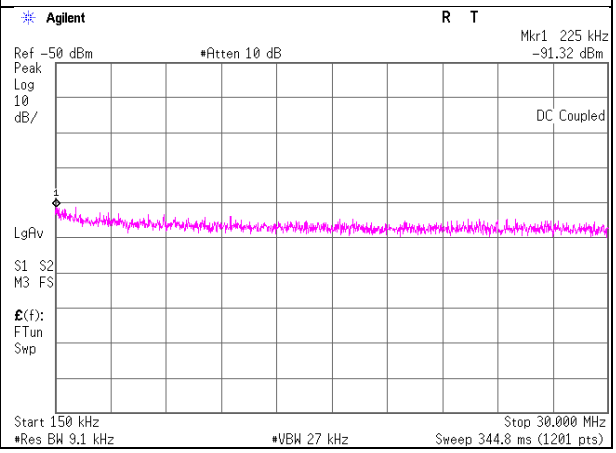
Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx 2478 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenator Loss [dB]	Antenna Gain [dBi]	N (Number of Output	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.94	-98.9	0.01	9.8	-3.0	1	-92.1	300	6.0	-30.9	47.6	78.5	
225.00	-91.3	0.01	9.9	-3.0	1	-84.5	300	6.0	-23.2	20.5	43.7	

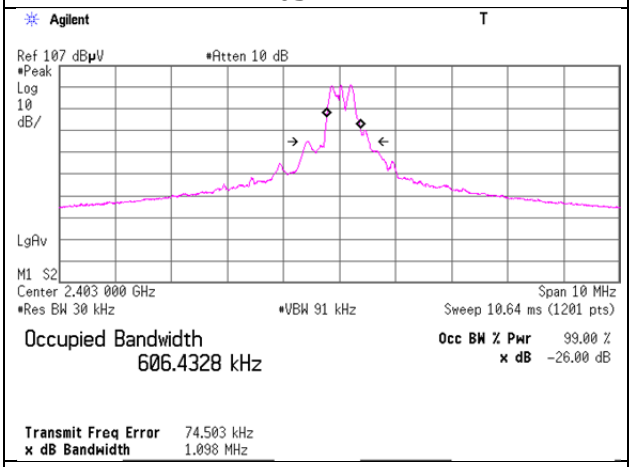
E = EIRP - 20 log (D) + Ground bounce + 104.8 [dBuV/m]

EIRP = Reading + Cable Loss + Attenator Loss + Antenna Gain + 10 * log (N)

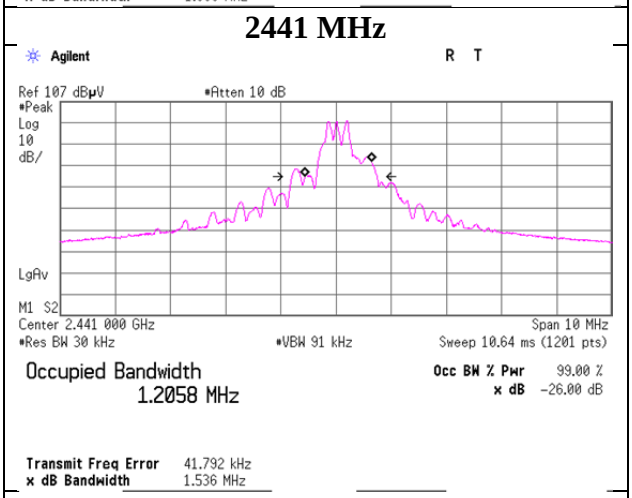
99% Occupied Bandwidth

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11211969H
Date	May 11, 2016
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Keisuke Kawamura
Mode	Tx

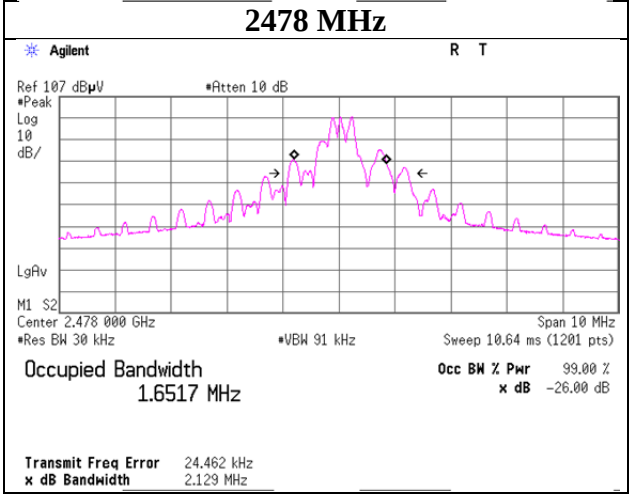
2403 MHz



2441 MHz



2478 MHz



APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE/CE	2015/07/01 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE/CE	2016/01/21 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE/CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-14	Spectrum Analyzer	Agilent	E4440A	MY48250080	RE/CE	2015/10/07 * 12
MHA-06	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	RE	2016/02/29 * 12
MCC-168	Microwave Cable	Junkosha	MWX221	1408S016(1m) / 1409S492(5m)	RE	2015/09/24 * 12
MPA-10	Pre Amplifier	Agilent	8449B	3008A02142	RE	2016/01/19 * 12
MHA-02	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	RE	2016/02/29 * 12
MMM-01	Digital Tester	Fluke	FLUKE 26-3	78030611	CE/RE	2015/08/19 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2015/09/16 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2015/10/11 * 12
MLA-21	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	RE	2016/01/30 * 12
MPA-09	Pre Amplifier	Agilent	8447D	2944A10845	RE	2015/09/04 * 12
MLS-23	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	CE(EUT)	2015/07/10 * 12
MCC-13	Coaxial Cable	Fujikura	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	CE	2016/02/08 * 12
MAT-65	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2016/01/14 * 12
MMM-07	DIGITAL HiTESTER	Hioki	3805	051201150	AT	2016/01/18 * 12
MOS-19	Thermo-Hygrometer	Custom	CTH-201	0001	AT	2015/12/08 * 12
MPM-13	Power Meter	Anritsu	ML2495A	0824014	AT	2015/11/11 * 12
MPSE-18	Power sensor	Anritsu	MA2411B	0738174	AT	2015/11/11 * 12
MSA-16	Spectrum Analyzer	Agilent	E4440A	MY46186390	AT	2016/02/08 * 12
MAT-23	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2016/03/18 * 12
MCC-163	Microwave Cable	Murata	MXGS83RK3000	-	AT	2015/11/10 * 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