



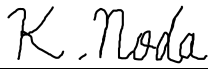
RADIO TEST REPORT


Test Report No. : 12732618S-D-R2

Applicant : TOHNICHI MFG. CO., LTD.
Type of Equipment : RF TRANSCEIVER
Model No. : T-FHW
FCC ID : UY6-TFHW
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied (Refer to SECTION 3.2)

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 limits of the above regulation.
4. The test results in this test 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 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)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 12732618S-D-R1. 12732618S-D-R1 is replaced with this report.

Date of test: April 5 to May 25, 2019

Representative test engineer: 
Kazuya Noda
Engineer
Consumer Technology Division

Approved by: 
Toyokazu Imamura
Leader
Consumer Technology Division



CERTIFICATE 1266.03

- ☐ 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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Shonan EMC Lab.

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REVISION HISTORY

Original Test Report No.: 12732618S-D

[illegible]

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SECTION 1: Customer information

Company Name	:	TOHNICHI MFG. CO., LTD.
Address	:	2-12, OMORI-KITA 2-CHOME OTA-KU, TOKYO, 143-0016, JAPAN
Telephone Number	:	+81-3-3762-7859
Facsimile Number	:	+81-3-3762-7166
Contact Person	:	Yuya Iwashita

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

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

2.1 Identification of E.U.T.

Type of Equipment	:	RF TRANSCEIVER
Model No.	:	T-FHW
Serial No.	:	Refer to SECTION 4, SECTION 4.2
Rating	:	DC 1.5 V
Receipt Date of Sample (Information from test lab.)	:	April 4 and April 22, 2019
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: T-FHW (referred to as the EUT in this report) is a RF TRANSCEIVER.

Radio Specification

Equipment Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2479 MHz
Type of Modulation	:	FHSS (GFSK)
Antenna Type	:	Chip antenna
Antenna Gain	:	-8.5 dBi
Operating Temperature	:	0 deg. C - +45 deg. C
Clock frequency (Maximum)	:	16 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.249 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted emission	FCC: ANSI C63.10:2013 IC: RSS-Gen 8.8	FCC 15.207(a) IC: RSS-Gen 8.8	-	N/A	*1)
Electric field strength of fundamental emission	FCC: ANSI C63.10:2013 IC: RSS-Gen 6.6, 6.12	FCC 15.249(a)(e) IC: RSS-210 B.10	4.1 dB (2402.000 MHz, Horizontal, AV, Tx 2402 MHz)	Complied# a)	-
Electric field strength of spurious emission	FCC: ANSI C63.10:2013 IC: RSS-Gen 6.5,6.6, 6.13	FCC 15.205(a)(b) FCC 15.209(a) FCC 15.249(a)(d)(e) IC: RSS-210 B.10	1.4 dB (7206.00 MHz, Vertical, AV, Tx 2402 MHz)	Complied# a)	-
20 dB bandwidth	FCC: ANSI C63.10:2013 IC: -	FCC 15.215 IC: -	-	Complied b)	-
Frequency tolerance	FCC: ANSI C63.10:2013 IC: RSS-Gen 6.11, 8.11	FCC 15.249(b) IC: -	-	-	*2)
Note: UL Japan's Work Procedures No. 13-EM-W0420 and 13-EM-W0422					
*1) The test is not applicable since the EUT has no AC mains.					
*2) The test is not required since this EUT does not operate with 24.05 GHz to 24.25 GHz.					
a) Refer to APPENDIX 1 (data of Radiated Emission)					
b) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99% Occupied Bandwidth)					
Symbols:					
Complied The data of this test item has enough margin, more than the measurement uncertainty.					
Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.					

FCC Part 15.31 (e)

The EUT is a battery-operated device and test was performed with the new battery. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The antenna is not removable from the EUT. Therefore the equipment complies with the requirement.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	RSS-Gen 6.7	IC: -	N/A	- a)	Conducted
a) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99% Occupied Bandwidth)					

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

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3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

Shonan EMC Lab.

Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 dB	2.9 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.1 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.7 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.1 dB	-
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB	-
	6 GHz-18 GHz	5.4 dB	5.4 dB	5.4 dB	-
Radiated emission (Measurement distance: 1 m)	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-
	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB	-
	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 dB	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.81 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.53 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.95 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.21 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.90 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.04 dB
Spurious emission (Conducted) below 1GHz	1.8 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.7 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.3 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.4 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	0.61 %
Duty cycle and Time Measurement	0.012 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
 1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
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 A2LA Certificate Number: 1266.03
 FCC Test Firm Registration Number: 626366

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

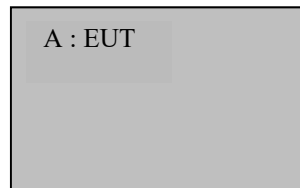
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Test Item	Mode	Tested frequency
Electric Field Strength of Fundamental Emission Electric Field Strength of Spurious Emission Bandwidth Duty cycle	Transmitting (Tx)	2402 MHz, 2440 MHz, 2479 MHz
<p>The system was configured in typical fashion (as a customer would normally use it) for testing.</p> <p>*EUT has the power settings by the software as follows;</p> <p>- Power Setting: Fixed</p> <p>- Software: R023M01 ver. R023M01_38_08</p> <p>*This setting of software is the worst case.</p> <p>Any conditions under the normal use do not exceed the condition of setting.</p>		

4.2 Configuration and peripherals



* Test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remark
A	RF TRANSCEIVER	T-FHW	1 *1) 2 *2)	TOHNICHI	EUT

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

SECTION 5: Radiated Emission

Test Procedure

[For below 1 GHz]

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

[For above 1 GHz]

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

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788. These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane. However test results were confirmed to pass against standard limit.

Frequency: From 9 kHz to 30 MHz at distance 3 m (Refer to Figure 2)

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg. and 135 deg.) and horizontal polarization. Drawing of the antenna direction is shown in Figure 1.

Frequency: From 30 MHz to 26.5 GHz at distance 3 m (Refer to Figure 2).

The measuring antenna height was 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 intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

Measurements were performed with QP, PK, and AV detector.

Test Antennas are used as below;

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

	9 kHz to 90 kHz & 110 kHz to 150 kHz	90 kHz to 110 kHz	150 kHz to 490 kHz	490 kHz to 30 MHz	30 MHz to 1 GHz
Detector Type	PK/AV	QP	PK/AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	10 kHz	9 kHz	120 kHz
Distance factor *1)	-80 dB	-80 dB	-80 dB	-40 dB	-

*1) FCC 15.31 (f)(2) (9kHz-30MHz)

Distance Factor: $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

Distance Factor: $40 \times \log(3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

	above 1 GHz	
Detector Type	PK	AV *2)
IF Bandwidth	RBW: 1 MHz VBW: 3 MHz	Reduced VBW Method 11.12.2.5.3 RBW: 1 MHz VBW: $\geq 1/T$ Detector: Peak Trace: max hold

*2) Average Power Measurement was performed based on ANSI C63.10-2013.

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Figure 1. Direction of the Loop Antenna

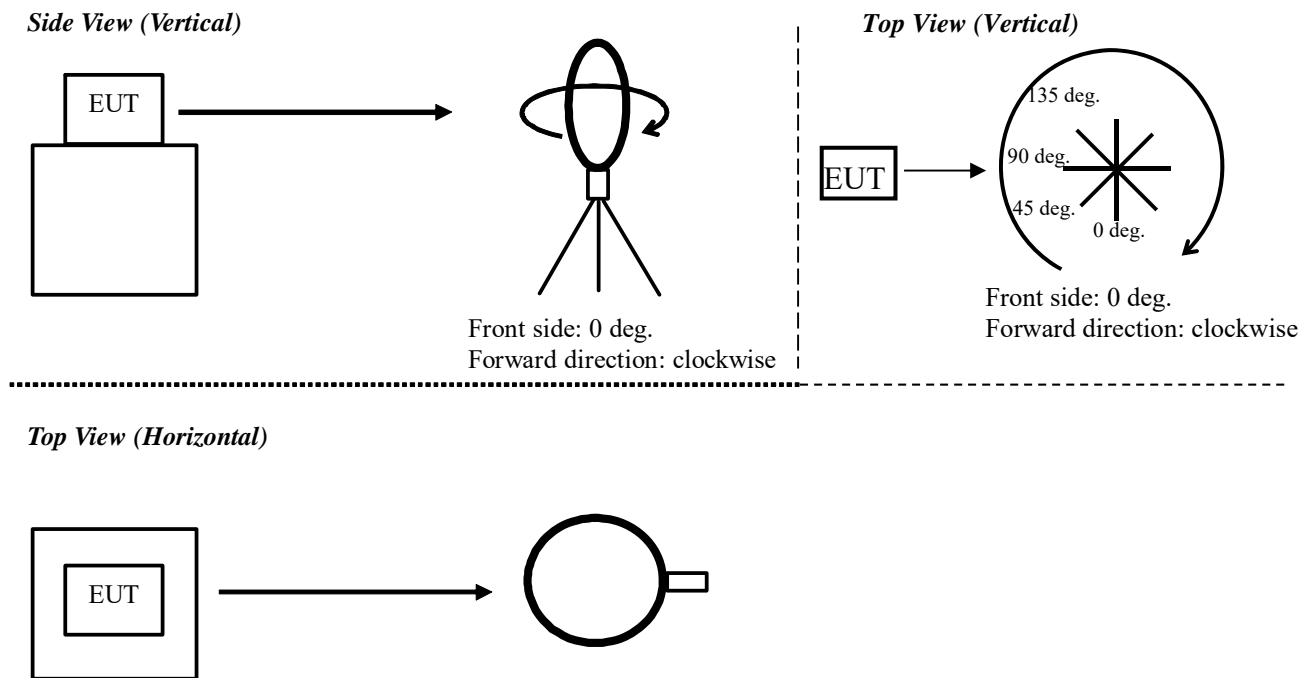
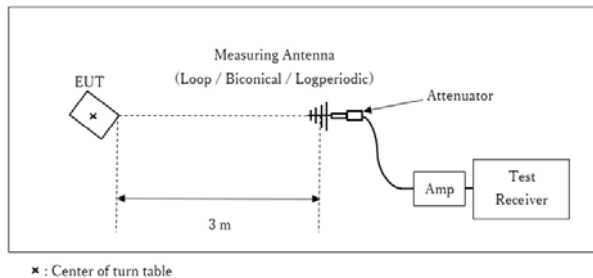


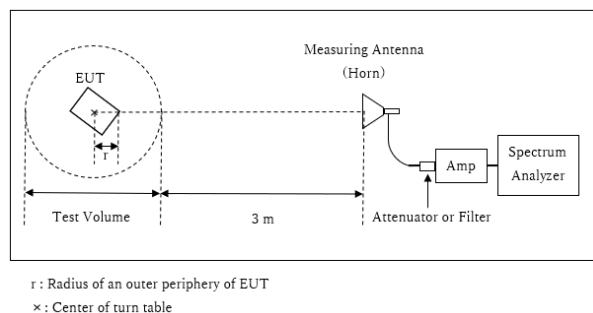
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 13 GHz



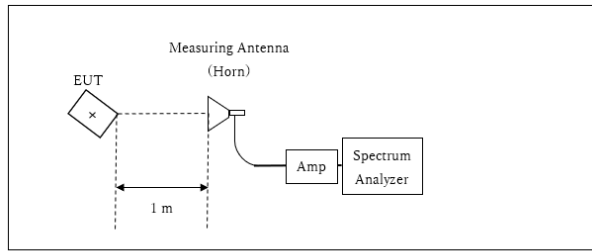
Distance Factor: $20 \times \log (3.96 \text{ m} / 3.0 \text{ m}) = 2.42 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.96 \text{ m}$

Test Volume : 2.0 m

(Test Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.04 \text{ m}$

13 GHz - 26.5 GHz



× : Center of turn table

Distance Factor: $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$
*Test Distance: 1 m

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 polarization	Carrier	Spurious (Below 1 GHz)	Spurious (1 GHz -13 GHz)	Spurious (13 GHz -26.5 GHz)
Horizontal	Z	X	Z	X
Vertical	X	X	X	X

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

Measurement range : 9 kHz - 26.5 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: Bandwidth and Duty Cycle

Test Procedure

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
Duty Cycle	zero span	1 MHz	3 MHz	3 msec	Peak	Single	Spectrum Analyzer
20 dB Bandwidth	2 to 5 time of OBW.	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold *1)	Spectrum Analyzer

*1) Peak hold was applied as Worst-case measurement.

Test data : APPENDIX 1
Test result : Pass

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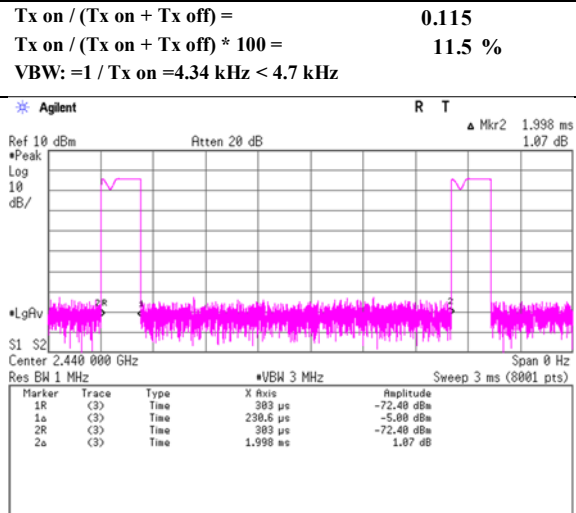
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APPENDIX 1: Test data

Duty Cycle

Shield Room 5
Date April 5, 2019
Temperature / Humidity 24 deg. C / 35 % RH
Engineer Kazuya Noda



Radiated Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	3	3	1
Date	April 24, 2019	May 25, 2019	May 25, 2019
Temperature / Humidity	24 deg. C / 45 % RH	25 deg. C / 51 % RH	22 deg. C / 47 % RH
Engineer	Kazuya Noda (9 kHz -30 MHz)	Kazuya Noda (30 MHz -1 GHz)	Hiromasa Sato (1 GHz -26.5 GHz)
Mode	Tx 2402 MHz		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	33.637	QP	21.65	17.28	6.54	32.19	0.00	13.28	40.00	26.7	100	359	
Hori.	283.821	QP	21.53	13.40	8.66	32.02	0.00	11.57	46.00	34.4	100	359	
Hori.	472.995	QP	21.36	17.09	9.54	31.96	0.00	16.03	46.00	29.9	100	1	
Hori.	785.099	QP	21.30	20.68	10.66	31.67	0.00	20.97	46.00	25.0	100	0	
Hori.	2390.000	PK	50.97	27.89	14.62	39.46	2.42	56.44	73.90	17.4	160	117	
Hori.	2400.000	PK	63.42	27.89	14.63	39.46	2.42	68.90	73.90	5.0	160	117	
Hori.	2402.000	PK	84.47	27.88	14.63	39.46	2.42	89.94	113.90	24.0	160	117	Carrier
Hori.	4804.000	PK	46.79	31.35	7.05	39.50	2.42	48.11	73.90	25.7	154	279	
Hori.	7206.000	PK	53.17	36.78	8.73	39.29	2.42	61.81	73.90	12.0	101	319	
Hori.	9608.000	PK	45.86	38.10	10.28	39.52	2.42	57.14	73.90	16.7	153	309	
Hori.	2390.000	AV	35.30	27.89	14.62	39.46	2.42	40.77	53.90	13.1	160	117	VBW: 4.7 kHz
Hori.	2400.000	AV	40.08	27.89	14.63	39.46	2.42	45.56	53.90	8.3	160	117	VBW: 4.7 kHz
Hori.	2402.000	AV	84.31	27.88	14.63	39.46	2.42	89.78	93.90	4.1	160	117	Carrier , VBW: 4.7 kHz
Hori.	4804.000	AV	37.58	31.35	7.05	39.50	2.42	38.90	53.90	15.0	154	279	VBW: 4.7 kHz
Hori.	7206.000	AV	41.62	36.78	8.73	39.29	2.42	50.26	53.90	3.6	101	319	VBW: 4.7 kHz
Hori.	9608.000	AV	35.33	38.10	10.28	39.52	2.42	46.61	53.90	7.2	153	309	VBW: 4.7 kHz
Vert.	30.126	QP	22.32	18.65	6.47	32.19	0.00	15.25	40.00	24.7	100	0	
Vert.	255.681	QP	21.29	11.99	8.46	32.01	0.00	9.73	46.00	36.2	100	359	
Vert.	750.580	QP	21.31	20.29	10.54	31.78	0.00	20.36	46.00	25.6	100	0	
Vert.	966.265	QP	20.65	22.22	11.22	30.51	0.00	23.58	53.90	30.3	100	1	
Vert.	2390.000	PK	50.07	27.89	14.62	39.46	2.42	55.54	73.90	18.3	225	85	
Vert.	2400.000	PK	63.84	27.89	14.63	39.46	2.42	69.32	73.90	4.5	225	85	
Vert.	2402.000	PK	84.33	27.88	14.63	39.46	2.42	89.80	113.90	24.1	225	85	Carrier
Vert.	4804.000	PK	46.23	31.35	7.05	39.50	2.42	47.55	73.90	26.3	121	145	
Vert.	7206.000	PK	52.31	36.78	8.73	39.29	2.42	60.95	73.90	12.9	177	72	
Vert.	9608.000	PK	45.34	38.10	10.28	39.52	2.42	56.62	73.90	17.2	157	164	
Vert.	2390.000	AV	35.85	27.89	14.62	39.46	2.42	41.32	53.90	12.5	225	85	VBW: 4.7 kHz
Vert.	2400.000	AV	40.23	27.89	14.63	39.46	2.42	45.71	53.90	8.1	225	85	VBW: 4.7 kHz
Vert.	2402.000	AV	83.99	27.88	14.63	39.46	2.42	89.46	93.90	4.4	225	85	Carrier , VBW: 4.7 kHz
Vert.	4804.000	AV	36.15	31.35	7.05	39.50	2.42	37.47	53.90	16.4	121	145	VBW: 4.7 kHz
Vert.	7206.000	AV	43.82	36.78	8.73	39.29	2.42	52.46	53.90	1.4	177	72	VBW: 4.7 kHz
Vert.	9608.000	AV	35.57	38.10	10.28	39.52	2.42	46.85	53.90	7.0	157	164	VBW: 4.7 kHz

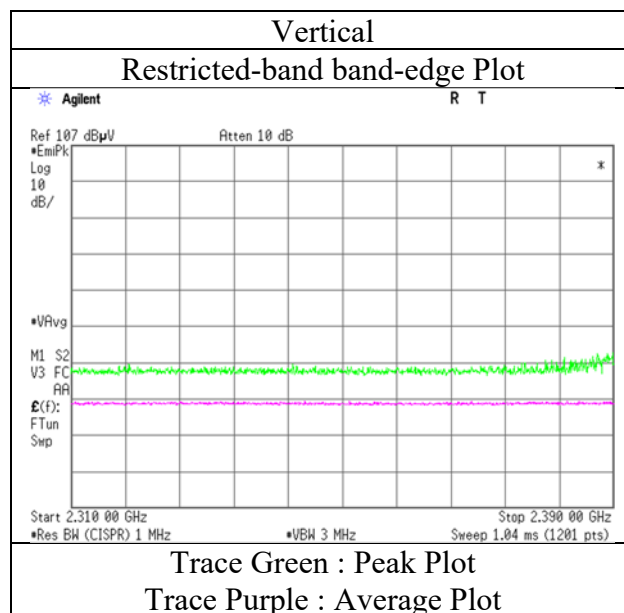
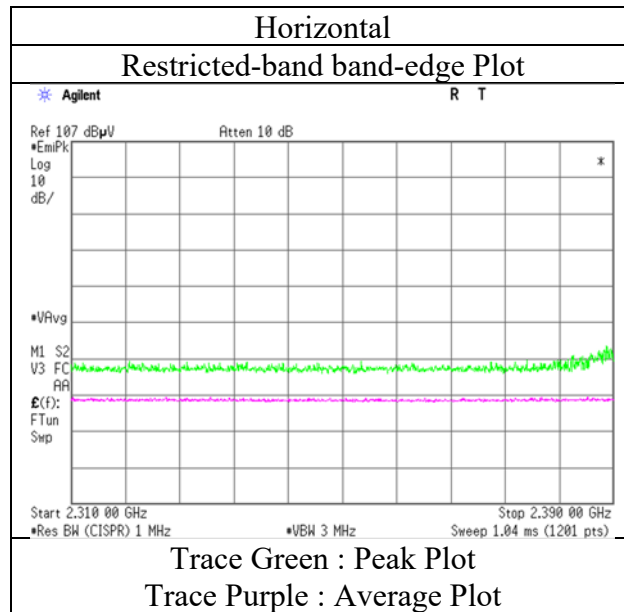
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.96\text{ m} / 3.0\text{ m}) = 2.42\text{ dB}$

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.
Semi Anechoic Chamber	1
Date	May 25, 2019
Temperature / Humidity	22 deg. C / 47 % RH
Engineer	Hiromasa Sato
	(1 GHz -26.5 GHz)
Mode	Tx 2402 MHz



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

Radiated Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	3	3	1
Date	April 24, 2019	May 25, 2019	May 25, 2019
Temperature / Humidity	24 deg. C / 45 % RH	25 deg. C / 51 % RH	22 deg. C / 47 % RH
Engineer	Kazuya Noda	Kazuya Noda	Hiromasa Sato
	(9 kHz -30 MHz)	(30 MHz -1 GHz)	(1 GHz -26.5 GHz)
Mode	Tx 2440 MHz		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	37.006	QP	22.35	16.00	6.60	32.19	0.00	12.76	40.00	27.2	100	359	
Hori.	234.868	QP	21.36	11.58	8.31	32.03	0.00	9.22	46.00	36.7	100	0	
Hori.	714.521	QP	21.63	20.08	10.42	31.84	0.00	20.29	46.00	25.7	100	1	
Hori.	864.140	QP	21.31	21.91	10.91	31.29	0.00	22.84	46.00	23.1	100	359	
Hori.	2440.000	PK	84.71	27.78	14.66	39.46	2.42	90.11	113.90	23.8	120	111	Carrier
Hori.	4880.000	PK	45.73	31.20	7.11	39.50	2.42	46.96	73.90	26.9	179	221	
Hori.	7320.000	PK	50.71	36.71	8.83	39.35	2.42	59.32	73.90	14.5	130	252	
Hori.	9760.000	PK	46.45	38.60	10.24	39.41	2.42	58.30	73.90	15.6	120	64	
Hori.	2440.000	AV	84.31	27.78	14.66	39.46	2.42	89.71	93.90	4.2	120	111	Carrier, VBW: 4.7 KHz
Hori.	4880.000	AV	35.53	31.20	7.11	39.50	2.42	36.76	53.90	17.1	179	221	VBW: 4.7 KHz
Hori.	7320.000	AV	40.38	36.71	8.83	39.35	2.42	48.99	53.90	4.9	130	252	VBW: 4.7 KHz
Hori.	9760.000	AV	34.77	38.60	10.24	39.41	2.42	46.62	53.90	7.2	120	64	VBW: 4.7 KHz
Vert.	30.159	QP	22.39	18.64	6.47	32.19	0.00	15.31	40.00	24.6	100	359	
Vert.	278.499	QP	21.47	13.22	8.63	32.02	0.00	11.30	46.00	34.7	100	0	
Vert.	773.184	QP	21.37	20.53	10.62	31.71	0.00	20.81	46.00	25.1	100	1	
Vert.	965.605	QP	20.60	22.21	11.22	30.52	0.00	23.51	53.90	30.3	100	0	
Vert.	2440.000	PK	82.95	27.78	14.66	39.46	2.42	88.35	113.90	25.6	292	68	Carrier
Vert.	4880.000	PK	46.48	31.20	7.11	39.50	2.42	47.71	73.90	26.1	112	337	
Vert.	7320.000	PK	48.03	36.71	8.83	39.35	2.42	56.64	73.90	17.2	171	56	
Vert.	9760.000	PK	45.57	38.60	10.24	39.41	2.42	57.42	73.90	16.4	166	239	
Vert.	2440.000	AV	81.71	27.78	14.66	39.46	2.42	87.11	93.90	6.8	292	68	Carrier, VBW: 4.7 KHz
Vert.	4880.000	AV	36.50	31.20	7.11	39.50	2.42	37.73	53.90	16.1	112	337	VBW: 4.7 KHz
Vert.	7320.000	AV	41.25	36.71	8.83	39.35	2.42	49.86	53.90	4.0	171	56	VBW: 4.7 KHz
Vert.	9760.000	AV	35.28	38.60	10.24	39.41	2.42	47.13	53.90	6.7	166	239	VBW: 4.7 KHz

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.96\text{ m} / 3.0\text{ m}) = 2.42\text{ dB}$

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

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Radiated Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	3	3	1
Date	April 24, 2019	May 25, 2019	May 25, 2019
Temperature / Humidity	24 deg. C / 45 % RH	25 deg. C / 51 % RH	22 deg. C / 47 % RH
Engineer	Kazuya Noda (9 kHz -30 MHz)	Kazuya Noda (30 MHz -1 GHz)	Hiromasa Sato (1 GHz -26.5 GHz)
Mode	Tx 2479 MHz		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	30.682	QP	22.45	18.44	6.49	32.19	0.00	15.19	40.00	24.8	100	0	
Hori.	227.267	QP	21.16	11.33	8.26	32.04	0.00	8.71	46.00	37.2	100	359	
Hori.	876.146	QP	20.97	22.15	10.95	31.22	0.00	22.85	46.00	23.1	100	1	
Hori.	939.932	QP	20.68	22.18	11.14	30.73	0.00	23.27	46.00	22.7	100	0	
Hori.	2479.000	PK	84.87	27.66	14.70	39.46	2.42	90.19	113.90	23.7	128	121	Carrier
Hori.	2483.500	PK	57.19	27.64	14.71	39.46	2.42	62.50	73.90	11.4	128	121	
Hori.	4958.000	PK	45.84	31.39	7.16	39.50	2.42	47.31	73.90	26.5	191	305	
Hori.	7437.000	PK	52.53	36.83	8.91	39.42	2.42	61.27	73.90	12.6	125	353	
Hori.	9916.000	PK	45.69	38.76	10.20	39.30	2.42	57.77	73.90	16.1	134	62	
Hori.	2479.000	AV	83.59	27.66	14.70	39.46	2.42	88.91	93.90	5.0	128	121	Carrier , VBW: 4.7 kHz
Hori.	2483.500	AV	36.26	27.64	14.71	39.46	2.42	41.57	53.90	12.3	128	121	VBW: 4.7 kHz
Hori.	4958.000	AV	35.45	31.39	7.16	39.50	2.42	36.92	53.90	16.9	191	305	VBW: 4.7 kHz
Hori.	7437.000	AV	40.88	36.83	8.91	39.42	2.42	49.62	53.90	4.2	125	353	VBW: 4.7 kHz
Hori.	9916.000	AV	35.63	38.76	10.20	39.30	2.42	47.71	53.90	6.1	134	62	VBW: 4.7 kHz
Vert.	36.682	QP	22.33	16.12	6.60	32.19	0.00	12.86	40.00	27.1	100	359	
Vert.	296.267	QP	21.42	13.64	8.75	32.02	0.00	11.79	46.00	34.2	100	0	
Vert.	722.332	QP	21.66	20.18	10.45	31.82	0.00	20.47	46.00	25.5	100	0	
Vert.	967.146	QP	20.62	22.23	11.22	30.50	0.00	23.57	53.90	30.3	100	359	
Vert.	2479.000	PK	83.61	27.66	14.70	39.46	2.42	88.93	113.90	25.0	228	68	Carrier
Vert.	2483.500	PK	55.85	27.64	14.71	39.46	2.42	61.16	73.90	12.7	228	68	
Vert.	4958.000	PK	46.40	31.39	7.16	39.50	2.42	47.87	73.90	26.0	177	319	
Vert.	7437.000	PK	50.61	36.83	8.91	39.42	2.42	59.35	73.90	14.5	157	94	
Vert.	9916.000	PK	44.95	38.76	10.20	39.30	2.42	57.03	73.90	16.8	114	233	
Vert.	2479.000	AV	83.26	27.66	14.70	39.46	2.42	88.58	93.90	5.3	228	68	Carrier , VBW: 4.7 kHz
Vert.	2483.500	AV	35.82	27.64	14.71	39.46	2.42	41.13	53.90	12.7	228	68	VBW: 4.7 kHz
Vert.	4958.000	AV	36.78	31.39	7.16	39.50	2.42	38.25	53.90	15.6	177	319	VBW: 4.7 kHz
Vert.	7437.000	AV	40.73	36.83	8.91	39.42	2.42	49.47	53.90	4.4	157	94	VBW: 4.7 kHz
Vert.	9916.000	AV	35.57	38.76	10.20	39.30	2.42	47.65	53.90	6.2	114	233	VBW: 4.7 kHz

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

Distance factor : 1 GHz - 13 GHz : 20log(3.96 m / 3.0 m) = 2.42 dB

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

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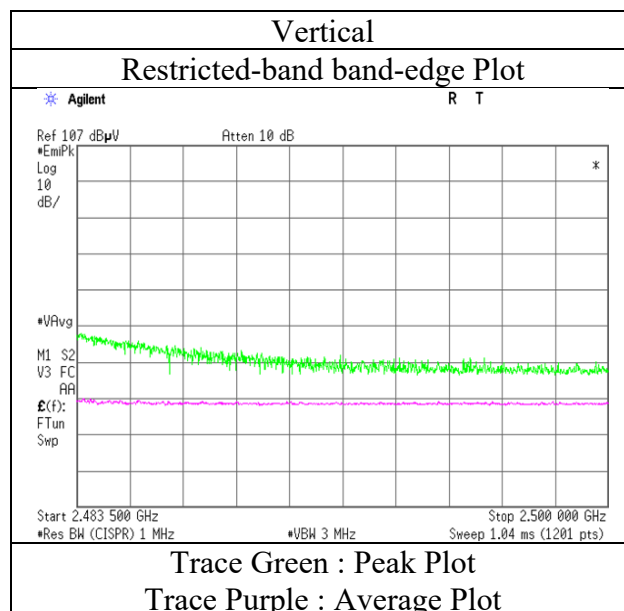
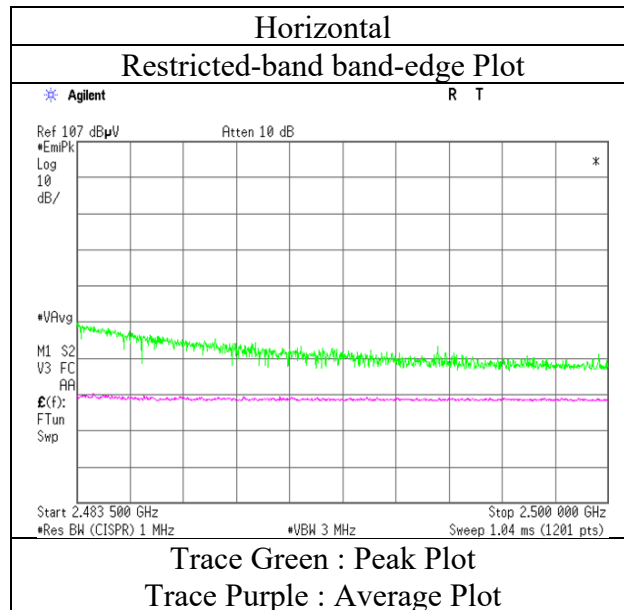
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Radiated Spurious Emission
(Reference Plot for band-edge)

Test place Shonan EMC Lab.
Semi Anechoic Chamber 1
Date May 25, 2019
Temperature / Humidity 22 deg. C / 47 % RH
Engineer Hiromasa Sato
(1 GHz -26.5 GHz)
Mode Tx 2479 MHz

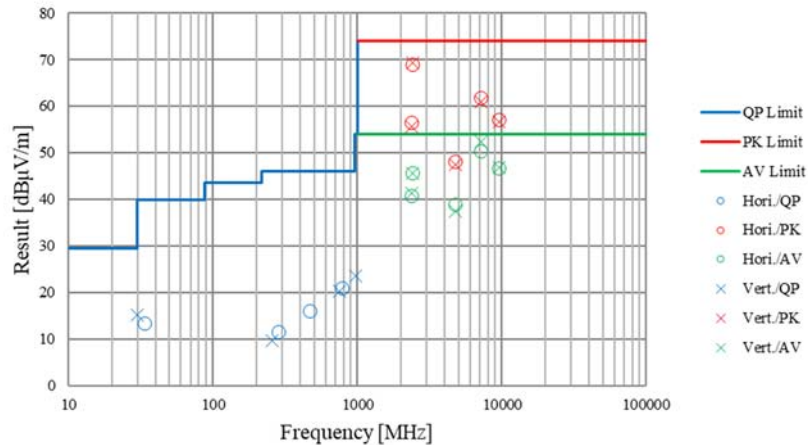


* Final result of restricted band edge was shown in tabular data.

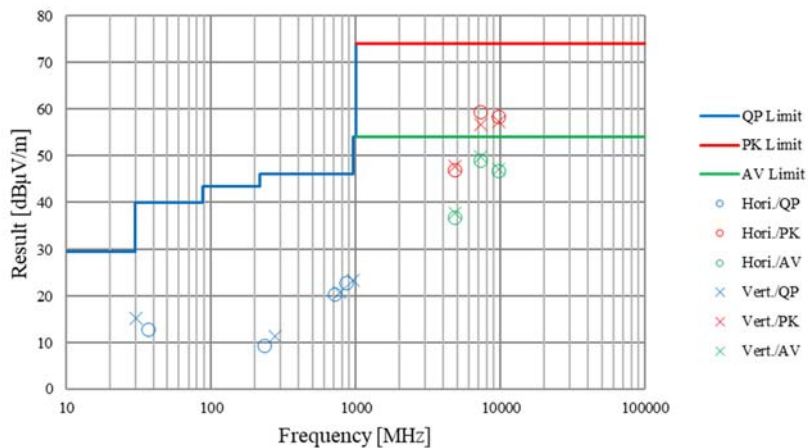
Radiated Emission (Plot data)

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	3	3	1
Date	April 24, 2019	May 25, 2019	May 25, 2019
Temperature / Humidity	24 deg. C / 45 % RH	25 deg. C / 51 % RH	22 deg. C / 47 % RH
Engineer	Kazuya Noda (9 kHz -30 MHz)	Kazuya Noda (30 MHz -1 GHz)	Hiromasa Sato (1 GHz -26.5 GHz)

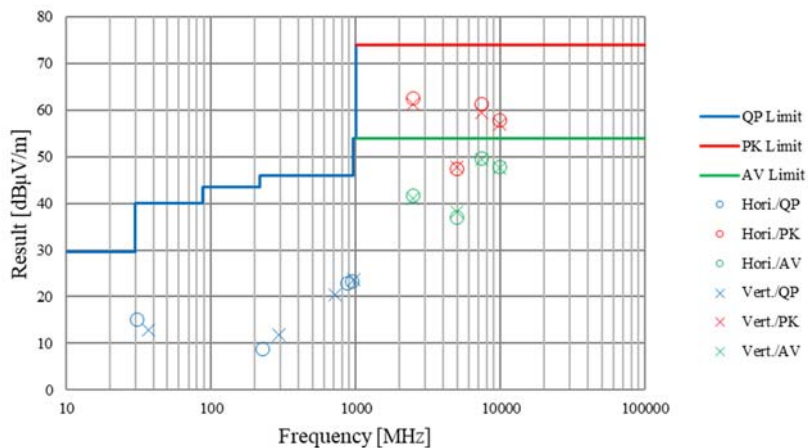
Tx 2402 MHz



Tx 2440 MHz



Tx 2479 MHz



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

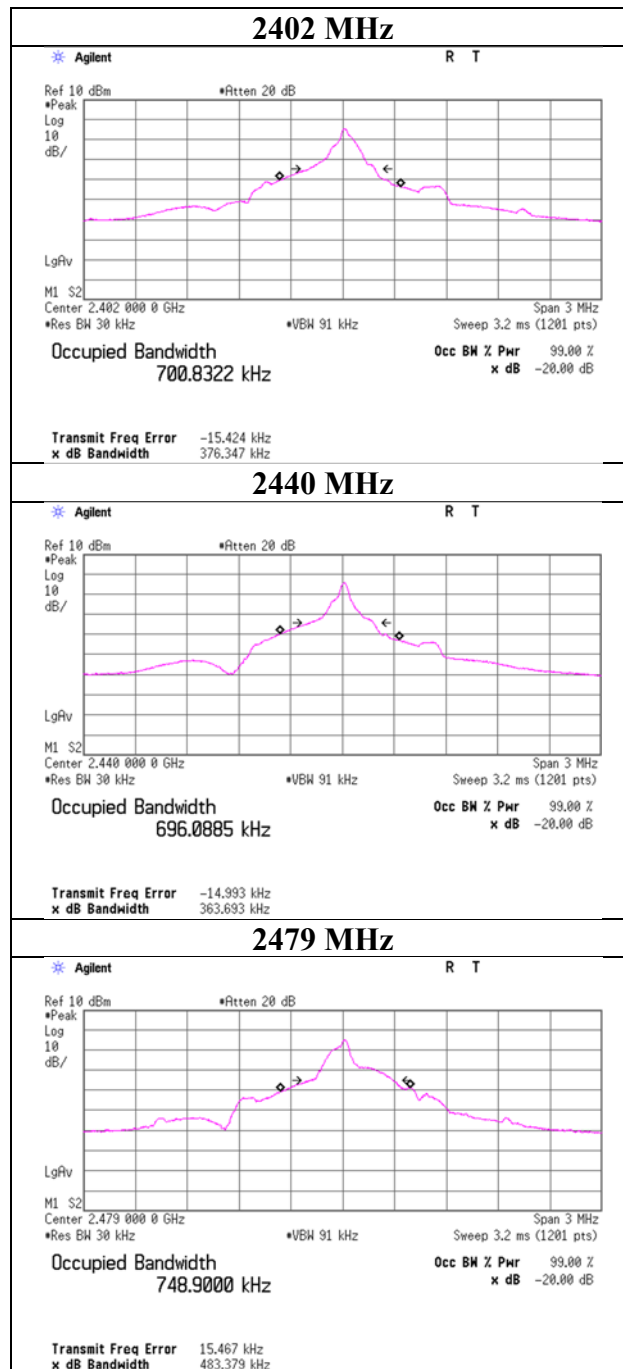
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20dB Bandwidth, 99%Occupied Bandwidth

Shield Room	5
Date	April 5, 2019
Temperature / Humidity	24 deg. C / 35 % RH
Engineer	Kazuya Noda

Freq.	20dB Bandwidth	99% Occupied Bandwidth
[MHz]	[MHz]	[kHz]
2402.0	0.376	700.832
2440.0	0.364	696.089
2479.0	0.483	748.900



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APPENDIX 2: Test instruments

Test Instruments (1 / 2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SAT10-14	AT	154591	Attenuator	Weinschel Corp.	54A-10	81595	2019/4/16	2020/4/30	12
SCC-G32	AT	145183	Coaxial Cable	Junkosha	MWX241-02000KMSK MS	OCT-09-13-005	2018/11/25	2019/11/30	12
SCC-H15	AT	144996	Microwave cable	RS Pro	R-132G7210 100CO	-	2019/4/16	2020/4/30	12
SOS-09	AT	146318	Humidity Indicator	A&D	AD-5681	4061484	2018/12/5	2019/12/31	12
SSA-03	AT	145801	Spectrum Analyzer	AGILENT	E4448A	MY48250152	2018/8/30	2019/8/31	12
COTS-SEMI-5	RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-	-
KJM-02	RE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
KJM-09	RE	145929	Measure	KOMELON	KMC-36	-	-	-	-
KSA-08	RE	145089	Spectrum Analyzer	AGILENT	E4446A	MY46180525	2018/10/7	2019/10/31	12
SAEC-01(SVSWR)	RE	145561	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	2019/5/6	2020/5/30	12
SAEC-03(NSA)	RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2019/4/8	2020/4/30	12
SAF-03	RE	145126	Pre Amplifier	SONOMA	310N	290213	2019/2/5	2020/2/29	12
SAF-04	RE	145127	Pre Amplifier	Toyo Corporation	TPA0118-36	2072554	2018/6/26	2019/6/30	12
SAF-08	RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2019/3/5	2020/3/31	12
SAT10-05	RE	145136	Attenuator(above1GHz)	AGILENT	8493C-010	74864	2018/11/25	2019/11/30	12
SAT6-12	RE	145158	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	2018/8/23	2019/8/31	12
SAT6-13	RE	167094	Attenuator	JFW	50HF-006N	-	2019/2/5	2020/2/29	12
SBA-03	RE	145023	Biconical Antenna	Schwarzbeck	BBA9106	91032666	2019/5/7	2020/5/31	12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-271(RF Selector)	2019/4/19	2020/4/30	12
SCC-G05	RE	145039	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-037	2019/1/25	2020/1/31	12
SCC-G41	RE	151617	Coaxial Cable	Junkosha	MWX221-01000NFSN MS/B	1612S006	2019/1/25	2020/1/31	12
SCC-G45	RE	168301	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102 E	800137/2E A	2019/3/26	2020/3/31	12
SCC-G56	RE	179539	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	803289/4	2019/5/16	2020/5/31	12
SFL-18	RE	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2019/4/16	2020/4/30	12
SHA-01	RE	145383	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	2018/7/23	2019/7/31	12
SHA-04	RE	145512	Horn Antenna	ETS LINDGREN	Sep-60	LM3640	2018/7/23	2019/7/31	12

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Test Instruments (2 / 2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SLA-07	RE	145529	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	2019/5/7	2020/5/31	12
SLP-02	RE	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2018/10/10	2019/10/31	12
SOS-01	RE	146316	Humidity Indicator	A&D	AD-5681	4062555	2018/10/25	2019/10/31	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2018/10/25	2019/10/31	12
STR-08	RE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2018/11/28	2019/11/30	12
STS-01	RE	145792	Digital Hitester	HIOKI	3805-50	80997812	2018/10/16	2019/10/31	12
STS-03	RE	146210	Digital Hitester	HIOKI	3805-50	80997823	2018/10/16	2019/10/31	12

*Hyphens for Last Calibration Date, Calibration Due Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

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

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

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

Test item: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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