



RADIO TEST REPORT

Test Report No. : 12992253S-A-R2

Applicant : TOHNICHI MFG. CO., LTD.
Type of Equipment : RF TRANSCEIVER
Model No. : T-FHM
FCC ID : UY6-TFHM
Test regulation : FCC Part 15 Subpart C: 2019
Test Result : Complied (Refer to SECTION 3.2)

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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 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 the A2LA accreditation body.
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 12992253S-A-R1. 12992253S-A-R1 is replaced with this report.

Date of test: August 30, 2019

Representative test engineer:

H. Sato

Hiromasa Sato
Engineer
Consumer Technology Division

Approved by:

T. Imamura

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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REVISION HISTORY

Original Test Report No.: 12992253S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12992253S-A	September 19, 2019	-	-
1	12992253S-A-R1	September 26, 2019	5	Correction of antenna gain: “-8.5 dBi” to “-5 dBi”
			14,16,17	Changes of significant digits
2	12992253S-A-R2	September 27, 2019	14,16,17	Deletion: “* These results have sufficient margin without taking account Dwell time factor.”

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	NS	No signal detect.
AC	Alternating Current	NSA	Normalized Site Attenuation
AFH	Adaptive Frequency Hopping	NVLAP	National Voluntary Laboratory Accreditation Program
AM	Amplitude Modulation	OBW	Occupied Band Width
Amp, AMP	Amplifier	OFDM	Orthogonal Frequency Division Multiplexing
ANSI	American National Standards Institute	P/M	Power meter
Ant, ANT	Antenna	PCB	Printed Circuit Board
AP	Access Point	PER	Packet Error Rate
Atten., ATT	Attenuator	PHY	Physical Layer
AV	Average	PK	Peak
BPSK	Binary Phase-Shift Keying	PN	Pseudo random Noise
BR	Bluetooth Basic Rate	PRBS	Pseudo-Random Bit Sequence
BT	Bluetooth	PSD	Power Spectral Density
BT LE	Bluetooth Low Energy	QAM	Quadrature Amplitude Modulation
BW	BandWidth	QP	Quasi-Peak
Cal Int	Calibration Interval	QPSK	Quadri-Phase Shift Keying
CCK	Complementary Code Keying	RBW	Resolution Band Width
Ch., CH	Channel	RDS	Radio Data System
CISPR	Comite International Special des Perturbations Radioelectriques	RE	Radio Equipment
CW	Continuous Wave	RF	Radio Frequency
DBPSK	Differential BPSK	RMS	Root Mean Square
DC	Direct Current	RSS	Radio Standards Specifications
DFS	Dynamic Frequency Selection	Rx	Receiving
DQPSK	Differential QPSK	SA, S/A	Spectrum Analyzer
DSSS	Direct Sequence Spread Spectrum	SG	Signal Generator
EDR	Enhanced Data Rate	SVSWR	Site-Voltage Standing Wave Ratio
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	TR	Test Receiver
EMC	ElectroMagnetic Compatibility	Tx	Transmitting
EMI	ElectroMagnetic Interference	VBW	Video BandWidth
EN	European Norm	Vert.	Vertical
ERP, e.r.p.	Effective Radiated Power	WLAN	Wireless LAN
EU	European Union		
EUT	Equipment Under Test		
Fac.	Factor		
FCC	Federal Communications Commission		
FHSS	Frequency Hopping Spread Spectrum		
FM	Frequency Modulation		
Freq.	Frequency		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		
ILAC	International Laboratory Accreditation Conference		
ISED	Innovation, Science and Economic Development Canada		
ISO	International Organization for Standardization		
JAB	Japan Accreditation Board		
LAN	Local Area Network		
LIMS	Laboratory Information Management System		
MCS	Modulation and Coding Scheme		
MRA	Mutual Recognition Arrangement		
NIST	National Institute of Standards and Technology		

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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
 - Operating/Test Mode(s) (Mode(s)) on all the 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-FHM
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 1.5 V
Receipt Date of Sample (Information from test lab.)	:	August 23, 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-FHM (referred to as the EUT in this report) is an 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	:	-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 July 19, 2019 and effective August 19, 2019 except 15.258

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 ISED: RSS-Gen 8.8	FCC 15.207(a) RSS-Gen 8.8	-	N/A	*1)
Electric field strength of fundamental emission	FCC: ANSI C63.10:2013 ISED: RSS-Gen 6.6, 6.12	FCC 15.249(a)(e) RSS-210 B.10	1.4 dB (2402.000 MHz, Horizontal, AV, Mode: Tx 2402 MHz)	Complied# a)	-
Electric field strength of spurious emission	FCC: ANSI C63.10:2013 ISED: RSS-Gen 6.5,6.6, 6.13	FCC 15.205(a)(b) FCC 15.209(a) FCC 15.249(a)(d)(e) RSS-210 B.10	2.2 dB (2400.00 MHz, Horizontal, PK, Mode: Tx 2402 MHz)	Complied# a)	-
20 dB bandwidth	FCC: ANSI C63.10:2013 ISED: -	FCC 15.215	-	Complied b)	-
Frequency tolerance	FCC: ANSI C63.10:2013 ISED: RSS-Gen 6.11, 8.11	FCC 15.249(b)	-	-	*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	-	N/A	- b)	-
b) 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 $k=2$.

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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	-
	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-
Radiated emission (Measurement distance: 1 m)	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

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A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	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.

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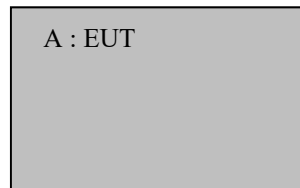
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SECTION 4: Operation of E.U.T. during testing

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
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 Setting: Fixed - Software: R023M01 ver. R023M01_38_08 *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



* Test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remark
A	RF TRANSCEIVER	T-FHM	6	TOHNICHI	EUT

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

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

[For above 1 GHz]

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

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 <u>11.12.2.5.3</u> 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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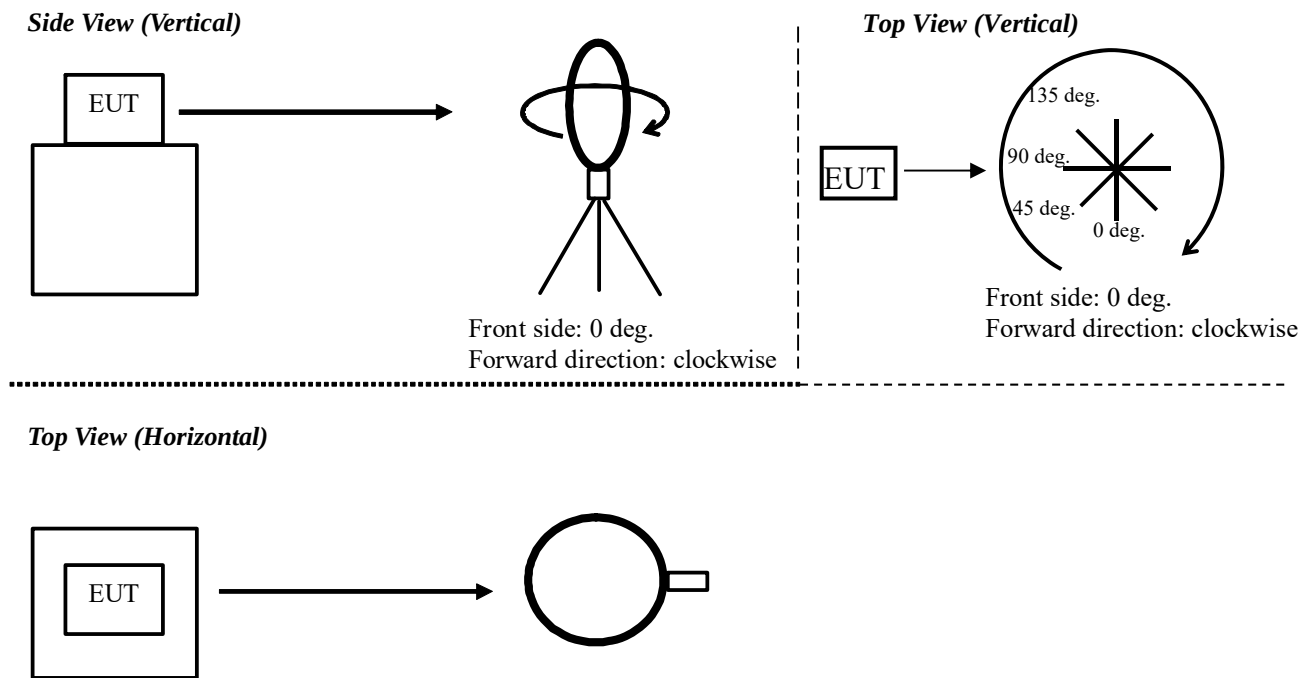
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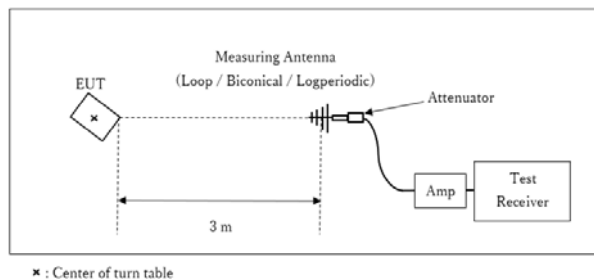
Figure 1. Direction of the Loop Antenna



Antenna was not rotated.

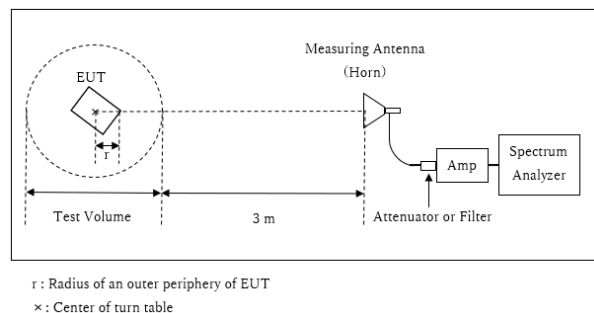
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 13 GHz



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

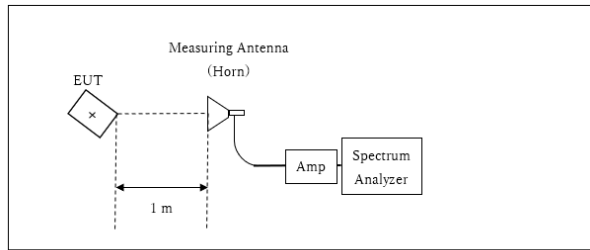
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.96 \text{ m}$

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



x : 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	Y	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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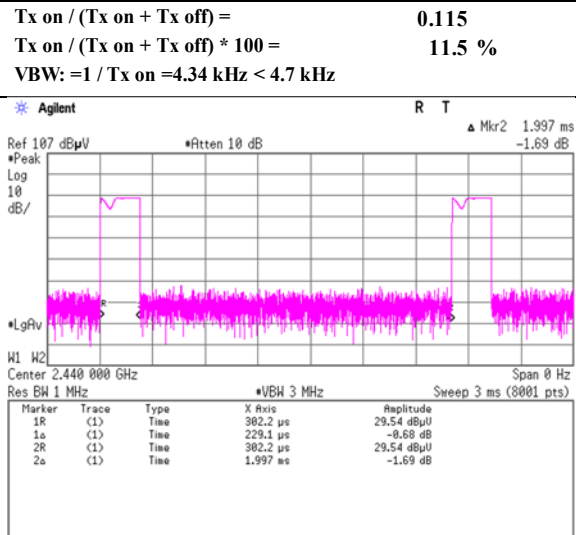
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APPENDIX 1: Test data

Duty Cycle

Semi Anechoic Chamber No.2
Date August 30, 2019
Temperature / Humidity 24 deg. C / 67 % RH
Engineer Toshinori Yamada



Radiated Spurious Emission

Report No. 12992253S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2 No.2
Date August 30, 2019 August 30, 2019
Temperature / Humidity 22 deg. C / 68 % RH 24 deg. C / 67 % RH
Engineer Hiromasa Sato Toshinori Yamada
(9 kHz -1000 MHz) (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.	38.571	QP	22.90	15.42	7.11	31.93	0.00	13.50	40.0	26.5	100	355	
Hori.	197.822	QP	22.33	16.61	9.18	31.80	0.00	16.32	43.5	27.1	100	21	
Hori.	505.174	QP	22.01	17.73	8.09	31.62	0.00	16.21	46.0	29.7	100	106	
Hori.	874.609	QP	21.89	22.03	9.73	31.03	0.00	22.62	46.0	23.3	100	204	
Hori.	2390.000	PK	52.15	28.51	14.11	38.68	2.42	58.51	73.9	15.3	116	125	
Hori.	2400.000	PK	65.31	28.48	14.12	38.67	2.42	71.66	73.9	2.2	116	125	
Hori.	2402.000	PK	86.47	28.48	14.12	38.67	2.42	92.82	113.9	21.1	116	125	Carrier
Hori.	4804.000	PK	44.22	31.71	6.45	38.55	2.42	46.25	73.9	27.6	100	343	
Hori.	7206.000	PK	47.36	37.30	8.19	39.15	2.42	56.12	73.9	17.7	124	330	
Hori.	9608.000	PK	46.62	38.78	9.39	39.74	2.42	57.47	73.9	16.4	150	0	
Hori.	19216.000	PK	51.21	40.44	13.64	47.69	-9.54	48.06	73.9	25.8	172	144	
Hori.	21618.000	PK	45.15	40.41	14.58	47.43	-9.54	43.17	73.9	30.7	156	192	
Hori.	2390.000	AV	34.82	28.51	14.11	38.68	2.42	41.18	53.9	12.7	116	125	VBW: 4.7 kHz
Hori.	2400.000	AV	40.24	28.48	14.12	38.67	2.42	46.59	53.9	7.3	116	125	VBW: 4.7 kHz
Hori.	2402.000	AV	86.18	28.48	14.12	38.67	2.42	92.53	93.9	1.4	116	125	Carrier VBW: 4.7 kHz
Hori.	4804.000	AV	36.23	31.71	6.45	38.55	2.42	38.26	53.9	15.6	100	343	VBW: 4.7 kHz
Hori.	7206.000	AV	41.23	37.30	8.19	39.15	2.42	49.99	53.9	3.9	124	330	VBW: 4.7 kHz
Hori.	9608.000	AV	36.62	38.78	9.39	39.74	2.42	47.47	53.9	6.4	150	0	VBW: 4.7 kHz
Hori.	19216.000	AV	45.43	40.44	13.64	47.69	-9.54	42.28	53.9	11.6	172	144	VBW: 4.7 kHz
Hori.	21618.000	AV	36.96	40.41	14.58	47.43	-9.54	34.98	53.9	18.9	156	192	VBW: 4.7 kHz
Vert.	30.241	QP	22.84	18.62	6.96	31.93	0.00	16.49	40.0	23.5	100	58	
Vert.	167.513	QP	22.39	15.44	8.83	31.83	0.00	14.83	43.5	28.6	100	25	
Vert.	721.221	QP	21.81	20.09	9.05	31.52	0.00	19.43	46.0	26.5	100	82	
Vert.	948.442	QP	21.36	21.96	10.05	30.53	0.00	22.84	46.0	23.1	100	151	
Vert.	2390.000	PK	51.69	28.51	14.11	38.68	2.42	58.05	73.9	15.8	275	73	
Vert.	2400.000	PK	64.45	28.48	14.12	38.67	2.42	70.80	73.9	3.1	275	73	
Vert.	2402.000	PK	85.73	28.48	14.12	38.67	2.42	92.08	113.9	21.8	275	73	Carrier
Vert.	4804.000	PK	44.36	31.71	6.45	38.55	2.42	46.39	73.9	27.5	169	265	
Vert.	7206.000	PK	46.24	37.30	8.19	39.15	2.42	55.00	73.9	18.9	281	278	
Vert.	9608.000	PK	46.47	38.78	9.39	39.74	2.42	57.32	73.9	16.5	150	0	
Vert.	19216.000	PK	50.85	40.44	13.64	47.69	-9.54	47.70	73.9	26.2	109	174	
Vert.	21618.000	PK	48.93	40.41	14.58	47.43	-9.54	46.95	73.9	26.9	139	177	
Vert.	2390.000	AV	35.23	28.51	14.11	38.68	2.42	41.59	53.9	12.3	275	73	VBW: 4.7 kHz
Vert.	2400.000	AV	39.60	28.48	14.12	38.67	2.42	45.95	53.9	7.9	275	73	VBW: 4.7 kHz
Vert.	2402.000	AV	85.43	28.48	14.12	38.67	2.42	91.78	93.9	2.1	275	73	Carrier VBW: 4.7 kHz
Vert.	4804.000	AV	36.27	31.71	6.45	38.55	2.42	38.30	53.9	15.6	169	265	VBW: 4.7 kHz
Vert.	7206.000	AV	40.32	37.30	8.19	39.15	2.42	49.08	53.9	4.8	281	278	VBW: 4.7 kHz
Vert.	9608.000	AV	36.70	38.78	9.39	39.74	2.42	47.55	53.9	6.3	150	0	VBW: 4.7 kHz
Vert.	19216.000	AV	44.74	40.44	13.64	47.69	-9.54	41.59	53.9	12.3	109	174	VBW: 4.7 kHz
Vert.	21618.000	AV	41.62	40.41	14.58	47.43	-9.54	39.64	53.9	14.2	139	177	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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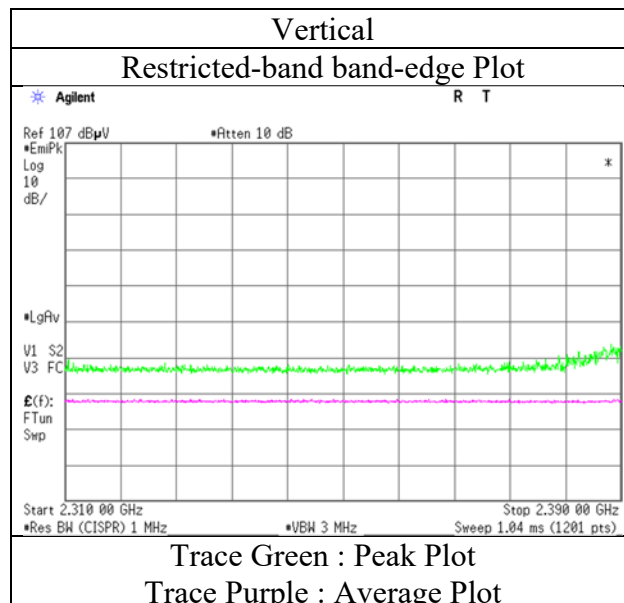
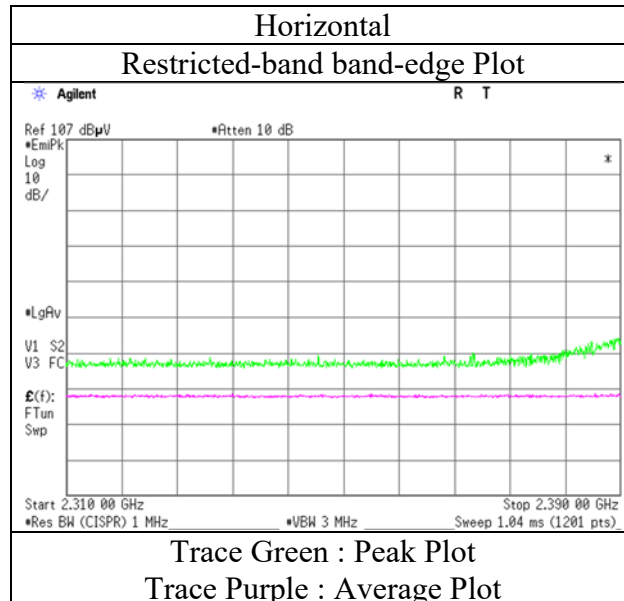
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12992253S-A-R2	No.2
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.2	
Date	August 30, 2019	August 30, 2019
Temperature / Humidity	22 deg. C / 68 % RH	24 deg. C / 67 % RH
Engineer	Hiromasa Sato	Toshinori Yamada
	(9 kHz -1000 MHz)	(1 GHz -26.5 GHz)
Mode	Tx 2402 MHz	



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

Radiated Spurious Emission

Report No. 12992253S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2 No.2
Date August 30, 2019 August 30, 2019
Temperature / Humidity 22 deg. C / 68 % RH 24 deg. C / 67 % RH
Engineer Hiromasa Sato Toshinori Yamada
(9 kHz -1000 MHz) (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.	38.876	QP	22.82	15.33	7.12	31.93	0.00	13.34	40.0	26.6	100	343	
Hori.	184.753	QP	22.25	16.20	9.03	31.81	0.00	15.67	43.5	27.8	100	359	
Hori.	565.565	QP	22.22	18.21	8.38	31.64	0.00	17.17	46.0	28.8	100	0	
Hori.	864.002	QP	21.90	21.79	9.68	31.08	0.00	22.29	46.0	23.7	101	42	
Hori.	2440.000	PK	85.91	28.42	14.16	38.65	2.42	92.26	113.9	21.6	153	116	Carrier
Hori.	4880.000	PK	44.38	31.74	6.48	38.55	2.42	46.47	73.9	27.4	118	24	
Hori.	7320.000	PK	45.35	37.42	8.23	39.33	2.42	54.09	73.9	19.8	132	325	
Hori.	9760.000	PK	45.23	39.36	9.35	39.63	2.42	56.73	73.9	17.1	150	0	
Hori.	19520.000	PK	53.04	40.45	13.73	47.51	-9.54	50.17	73.9	23.7	174	188	
Hori.	21960.000	PK	44.54	40.51	14.79	47.80	-9.54	42.50	73.9	31.4	164	198	
Hori.	2440.000	AV	85.58	28.42	14.16	38.65	2.42	91.93	93.9	2.0	153	116	Carrier VBW: 4.7 kHz
Hori.	4880.000	AV	35.75	31.74	6.48	38.55	2.42	37.84	53.9	16.0	118	24	VBW: 4.7 kHz
Hori.	7320.000	AV	39.13	37.42	8.23	39.33	2.42	47.87	53.9	6.0	132	325	VBW: 4.7 kHz
Hori.	9760.000	AV	35.30	39.36	9.35	39.63	2.42	46.80	53.9	7.1	150	0	VBW: 4.7 kHz
Hori.	19520.000	AV	45.25	40.45	13.73	47.51	-9.54	42.38	53.9	11.5	174	188	VBW: 4.7 kHz
Hori.	21960.000	AV	36.01	40.51	14.79	47.80	-9.54	33.97	53.9	19.9	164	198	VBW: 4.7 kHz
Vert.	32.448	QP	22.38	17.73	7.00	31.93	0.00	15.18	40.0	24.8	100	211	
Vert.	167.609	QP	22.41	15.45	8.83	31.83	0.00	14.86	43.5	28.6	100	74	
Vert.	767.283	QP	21.81	20.35	9.26	31.44	0.00	19.98	46.0	26.0	100	355	
Vert.	945.022	QP	21.63	21.93	10.04	30.56	0.00	23.04	46.0	22.9	100	252	
Vert.	2440.000	PK	84.55	28.42	14.16	38.65	2.42	90.90	113.9	23.0	336	70	Carrier
Vert.	4880.000	PK	44.90	31.74	6.48	38.55	2.42	46.99	73.9	26.9	155	201	
Vert.	7320.000	PK	45.86	37.42	8.23	39.33	2.42	54.60	73.9	19.3	251	282	
Vert.	9760.000	PK	44.89	39.36	9.35	39.63	2.42	56.39	73.9	17.5	150	0	
Vert.	19520.000	PK	53.63	40.45	13.73	47.51	-9.54	50.76	73.9	23.1	162	177	
Vert.	21960.000	PK	46.40	40.51	14.79	47.80	-9.54	44.36	73.9	29.5	160	233	
Vert.	2440.000	AV	84.18	28.42	14.16	38.65	2.42	90.53	93.9	3.4	336	70	Carrier VBW: 4.7 kHz
Vert.	4880.000	AV	35.54	31.74	6.48	38.55	2.42	37.63	53.9	16.2	155	201	VBW: 4.7 kHz
Vert.	7320.000	AV	37.72	37.42	8.23	39.33	2.42	46.46	53.9	7.4	251	282	VBW: 4.7 kHz
Vert.	9760.000	AV	35.01	39.36	9.35	39.63	2.42	46.51	53.9	7.3	150	0	VBW: 4.7 kHz
Vert.	19520.000	AV	45.29	40.45	13.73	47.51	-9.54	42.42	53.9	11.4	162	177	VBW: 4.7 kHz
Vert.	21960.000	AV	37.43	40.51	14.79	47.80	-9.54	35.39	53.9	18.5	160	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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Shonan EMC Lab.

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Radiated Spurious Emission

Report No. 12992253S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date August 30, 2019 August 30, 2019
Temperature / Humidity 22 deg. C / 68 % RH 24 deg. C / 67 % RH
Engineer Hiromasa Sato Toshinori Yamada
(9 kHz -1000 MHz) (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.	38.728	QP	22.84	15.37	7.11	31.93	0.00	13.39	40.0	26.6	100	195	
Hori.	196.330	QP	22.32	16.46	9.16	31.80	0.00	16.14	43.5	27.3	100	116	
Hori.	539.305	QP	21.94	17.69	8.26	31.65	0.00	16.24	46.0	29.7	100	83	
Hori.	861.123	QP	21.82	21.73	9.67	31.10	0.00	22.12	46.0	23.8	100	258	
Hori.	2479.000	PK	84.17	28.36	14.19	38.62	2.42	90.52	113.9	23.4	174	117	Carrier
Hori.	2483.500	PK	55.87	28.35	14.19	38.62	2.42	62.21	73.9	11.6	174	117	
Hori.	4958.000	PK	44.42	31.98	6.51	38.55	2.42	46.78	73.9	27.1	162	231	
Hori.	7437.000	PK	46.33	37.58	8.26	39.50	2.42	55.09	73.9	18.8	115	327	
Hori.	9916.000	PK	44.17	39.47	9.31	39.51	2.42	55.86	73.9	18.0	150	0	
Hori.	19832.000	PK	47.75	40.41	13.77	47.54	-9.54	44.85	73.9	29.0	173	178	
Hori.	22311.000	PK	42.46	40.56	14.83	48.07	-9.54	40.24	73.9	33.6	138	226	
Hori.	2479.000	AV	83.95	28.36	14.19	38.62	2.42	90.30	93.9	3.6	174	117	Carrier VBW: 4.7 kHz
Hori.	2483.500	AV	35.74	28.35	14.19	38.62	2.42	42.08	53.9	11.8	174	117	VBW: 4.7 kHz
Hori.	4958.000	AV	35.38	31.98	6.51	38.55	2.42	37.74	53.9	16.1	162	231	VBW: 4.7 kHz
Hori.	7437.000	AV	38.16	37.58	8.26	39.50	2.42	46.92	53.9	6.9	115	327	VBW: 4.7 kHz
Hori.	9916.000	AV	34.04	39.47	9.31	39.51	2.42	45.73	53.9	8.1	150	0	VBW: 4.7 kHz
Hori.	19832.000	AV	41.12	40.41	13.77	47.54	-9.54	38.22	53.9	15.6	173	178	VBW: 4.7 kHz
Hori.	22311.000	AV	32.99	40.56	14.83	48.07	-9.54	30.77	53.9	23.1	138	226	VBW: 4.7 kHz
Vert.	30.943	QP	22.19	18.40	6.98	31.93	0.00	15.64	40.0	24.3	100	292	
Vert.	144.297	QP	22.47	14.58	8.56	31.84	0.00	13.77	43.5	29.7	100	156	
Vert.	704.479	QP	21.98	19.90	8.97	31.54	0.00	19.31	46.0	26.6	100	88	
Vert.	945.760	QP	21.62	21.94	10.04	30.55	0.00	23.05	46.0	22.9	100	228	
Vert.	2479.000	PK	83.25	28.36	14.19	38.62	2.42	89.60	113.9	24.3	301	74	Carrier
Vert.	2483.500	PK	55.11	28.35	14.19	38.62	2.42	61.45	73.9	12.4	301	74	
Vert.	4958.000	PK	45.04	31.98	6.51	38.55	2.42	47.40	73.9	26.5	171	24	
Vert.	7437.000	PK	45.03	37.58	8.26	39.50	2.42	53.79	73.9	20.1	251	274	
Vert.	9916.000	PK	44.50	39.47	9.31	39.51	2.42	56.19	73.9	17.7	150	0	
Vert.	19832.000	PK	49.20	40.41	13.77	47.54	-9.54	46.30	73.9	27.6	162	177	
Vert.	22311.000	PK	42.67	40.56	14.83	48.07	-9.54	40.45	73.9	33.4	174	224	
Vert.	2479.000	AV	83.08	28.36	14.19	38.62	2.42	89.43	93.9	4.5	301	74	Carrier VBW: 4.7 kHz
Vert.	2483.500	AV	35.80	28.35	14.19	38.62	2.42	42.14	53.9	11.7	301	74	VBW: 4.7 kHz
Vert.	4958.000	AV	34.92	31.98	6.51	38.55	2.42	37.28	53.9	16.6	171	24	VBW: 4.7 kHz
Vert.	7437.000	AV	37.38	37.58	8.26	39.50	2.42	46.14	53.9	7.7	251	274	VBW: 4.7 kHz
Vert.	9916.000	AV	34.23	39.47	9.31	39.51	2.42	45.92	53.9	7.9	150	0	VBW: 4.7 kHz
Vert.	19832.000	AV	40.41	40.41	13.77	47.54	-9.54	37.51	53.9	16.3	162	177	VBW: 4.7 kHz
Vert.	22311.000	AV	32.87	40.56	14.83	48.07	-9.54	30.65	53.9	23.2	174	224	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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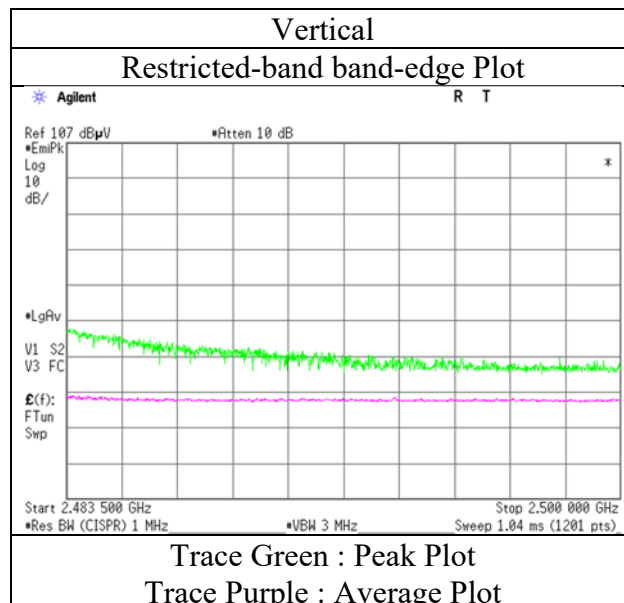
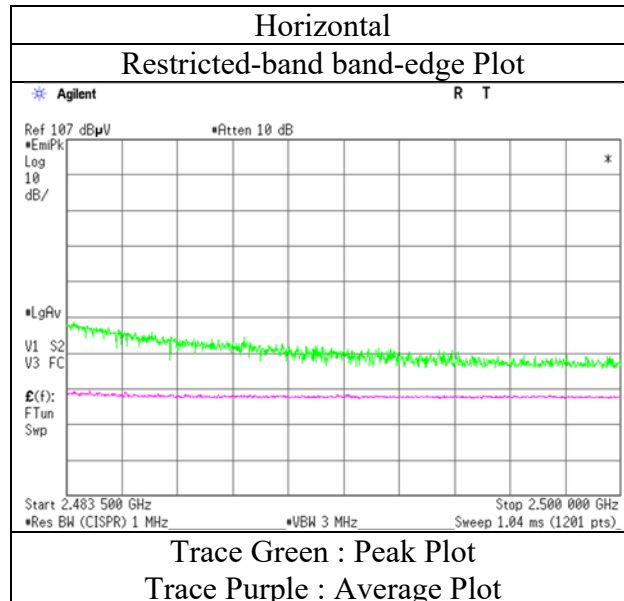
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12992253S-A-R2	No.2
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.2	
Date	August 30, 2019	August 30, 2019
Temperature / Humidity	22 deg. C / 68 % RH	24 deg. C / 67 % RH
Engineer	Hiromasa Sato	Toshinori Yamada
	(9 kHz -1000 MHz)	(1 GHz -26.5 GHz)
Mode	Tx 2479 MHz	



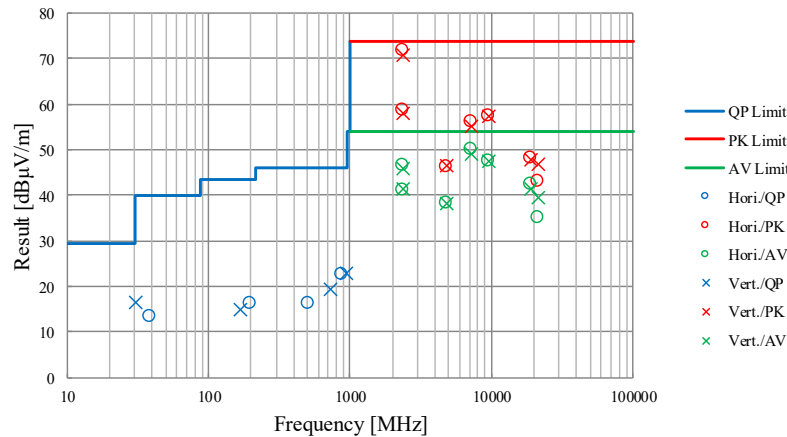
* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

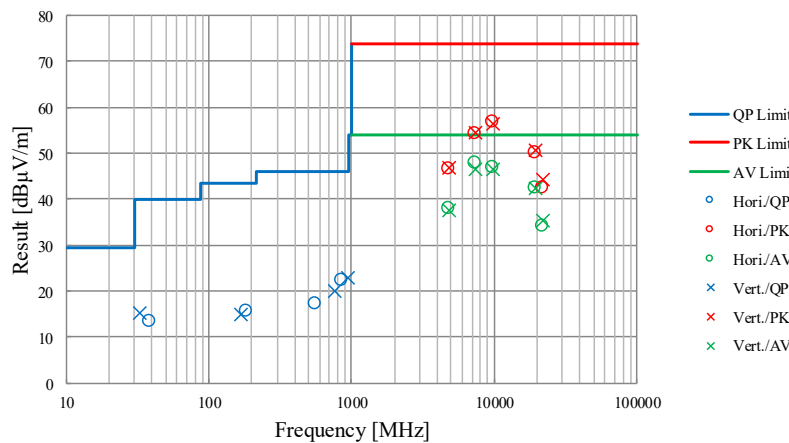
Radiated Spurious Emission **(Plot data)**

Report No.	12992253S-A-R2	No.2
Test place	Shonan EMC Lab.	No.2
Semi Anechoic Chamber		
Date	August 30, 2019	August 30, 2019
Temperature / Humidity	22 deg. C / 68 % RH	24 deg. C / 67 % RH
Engineer	Hiromasa Sato	Toshinori Yamada
	(9 kHz -1000 MHz)	(1 GHz -26.5 GHz)

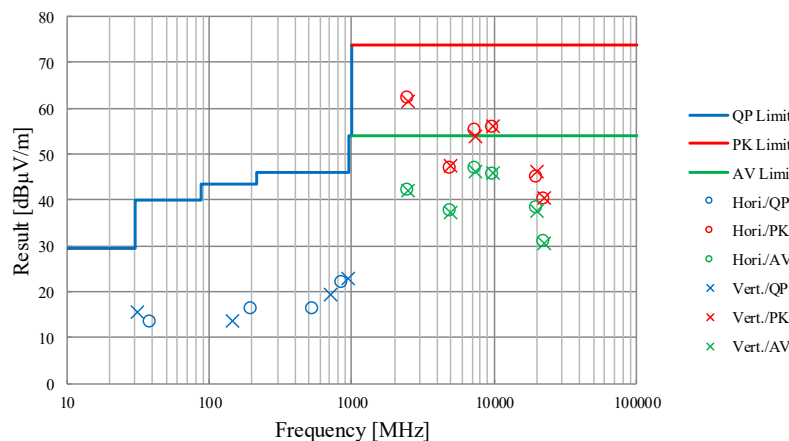
Tx 2402 MHz



Tx 2440 MHz



Tx 2479 MHz



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

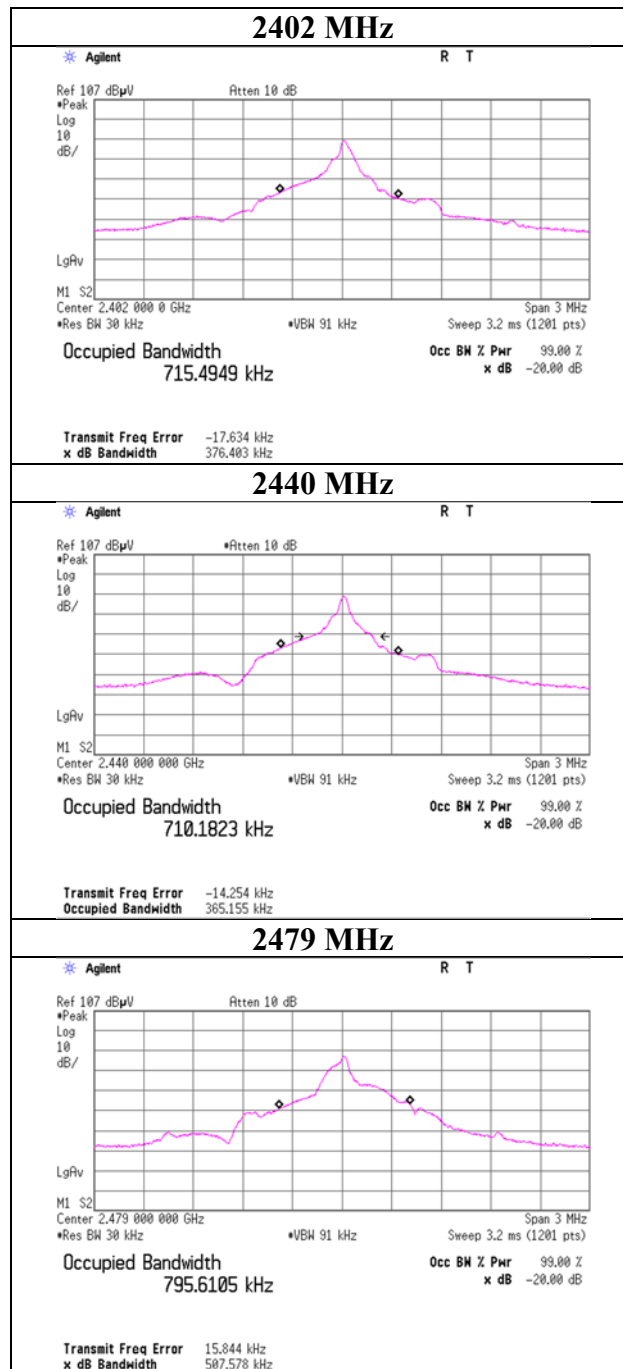
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20dB Bandwidth, 99%Occupied Bandwidth

Semi Anechoic Chamber	No.2
Date	August 30, 2019
Temperature / Humidity	24 deg. C / 67 % RH
Engineer	Toshinori Yamada

Freq.	20dB Bandwidth	99% Occupied Bandwidth
[MHz]	[MHz]	[kHz]
2402.0	0.376	715.495
2440.0	0.365	710.182
2479.0	0.508	795.611



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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)
COTS-SEM I-5	RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-	-
SAEC-02(NSA)	RE	145563	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	2019/4/4	2020/4/30	12
SAEC-02(SVSWR)	RE	145598	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	2019/5/9	2020/5/31	12
SAF-02	RE	145004	Pre Amplifier	SONOMA	310N	290212	2019/2/5	2020/2/29	12
SAF-05	RE	145128	Pre Amplifier	Toyo Corporation	TPA0118-36	1440490	2019/7/12	2020/7/31	12
SAF-08	RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2019/3/5	2020/3/31	12
SAT10-05	RE	145136	Attenuator(above 1GHz)	AGILENT	8493C-010	74864	2018/11/25	2019/11/30	12
SAT3-11	RE	150921	Attenuator	JFW	50HF-003N	-	2019/1/25	2020/1/31	12
SAT6-02	RE	145045	Attenuator	JFW	50HF-006N	-	2019/2/5	2020/2/29	12
SAT6-12	RE	145158	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	2019/8/6	2020/8/31	12
SBA-02	RE	145022	Biconical Antenna	Schwarzbeck	BBA9106	91032665	2019/4/1	2020/4/30	12
SCC-B1/B3/B5/B7/B8/B13/SRSE-02	RE	144975	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141P	-/0901-270(RF Selector)	2019/4/19	2020/4/30	12
SCC-B2/B4/B6/B7/B8/B13/SRSE-02	RE	144976	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141P	-/0901-270(RF Selector)	2019/4/19	2020/4/30	12

Test Instruments (2 / 2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SCC-G15	RE	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2019/3/27	2020/3/31	12
SCC-G41	RE	151617	Coaxial Cable	Junkosha	MWX221-01 000NFSNMS/B	1612S006	2019/1/25	2020/1/31	12
SCC-G50	RE	178573	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104 E	MY13407/4 E	2019/3/26	2020/3/31	12
SCC-G51	RE	178572	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800288 /4A	2019/3/26	2020/3/31	12
SCC-G57	RE	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2019/5/16	2020/5/31	12
SFL-02	RE	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2018/11/16	2019/11/30	12
SHA-02	RE	145384	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	2019/6/26	2020/6/30	12
SHA-04	RE	145512	Horn Antenna	ETS LINDGREN	9-60	LM3640	2019/6/26	2020/6/30	12
SJM-09	RE	145336	Measure	PROMART	SEN1935	-	-	-	-
SLA-06	RE	145528	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	195	2019/4/1	2020/4/30	12
SLP-02	RE	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2018/10/10	2019/10/31	12
SOS-03	RE	146317	Humidity Indicator	A&D	AD-5681	4063325	2018/10/25	2019/10/31	12
SSA-02	RE	145800	Spectrum Analyzer	AGILENT	E4448A	MY482501 06	2019/4/4	2020/4/30	12
STR-02	RE	145791	Test Receiver	Rohde & Schwarz	ESCI	100575	2018/10/19	2019/10/31	12
STS-02	RE	145793	Digital Hitester	HIOKI	3805-50	80997819	2019/4/2	2020/4/30	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

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