



RADIO TEST REPORT

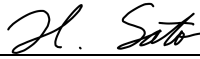
Test Report No. : 13417530S

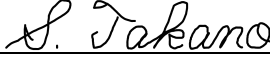
Applicant : Panasonic Corporation
Type of EUT : Seat Back ECU
Model Number of EUT : AT2002
FCC ID : ACJ932AT2002
Test regulation : FCC Part 15 Subpart C: 2020
For Permissive Change
(Maximum Peak Output Power test,
Spurious Emission test only)

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 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.

Date of test: July 4, 2020

Representative test engineer: 
Hiromasa Sato
Engineer
Consumer Technology Division

Approved by: 
Shinichi Takano
Engineer
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".

UL Japan, Inc.
Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN
Telephone : +81 463 50 6400
Facsimile : +81 463 50 6401

REVISION HISTORY

Original Test Report No.: 13417530S

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13417530S	July 17, 2020	-	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	MCS	Modulation and Coding Scheme
AC	Alternating Current	MRA	Mutual Recognition Arrangement
AFH	Adaptive Frequency Hopping	N/A	Not Applicable
AM	Amplitude Modulation	NIST	National Institute of Standards and Technology
Amp, AMP	Amplifier	NS	No signal detect.
ANSI	American National Standards Institute	NSA	Normalized Site Attenuation
Ant, ANT	Antenna	NVLAP	National Voluntary Laboratory Accreditation Program
AP	Access Point	OBW	Occupied Band Width
ASK	Amplitude Shift Keying	OFDM	Orthogonal Frequency Division Multiplexing
Atten., ATT	Attenuator	P/M	Power meter
AV	Average	PCB	Printed Circuit Board
BPSK	Binary Phase-Shift Keying	PER	Packet Error Rate
BR	Bluetooth Basic Rate	PHY	Physical Layer
BT	Bluetooth	PK	Peak
BT LE	Bluetooth Low Energy	PN	Pseudo random Noise
BW	BandWidth	PRBS	Pseudo-Random Bit Sequence
Cal Int	Calibration Interval	PSD	Power Spectral Density
CCK	Complementary Code Keying	QAM	Quadrature Amplitude Modulation
Ch., CH	Channel	QP	Quasi-Peak
CISPR	Comite International Special des Perturbations Radioelectriques	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	RBW	Resolution Band Width
DBPSK	Differential BPSK	RDS	Radio Data System
DC	Direct Current	RE	Radio Equipment
D-factor	Distance factor	RF	Radio Frequency
DFS	Dynamic Frequency Selection	RMS	Root Mean Square
DQPSK	Differential QPSK	RSS	Radio Standards Specifications
DSSS	Direct Sequence Spread Spectrum	Rx	Receiving
EDR	Enhanced Data Rate	SA, S/A	Spectrum Analyzer
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	SG	Signal Generator
EMC	ElectroMagnetic Compatibility	SVSWR	Site-Voltage Standing Wave Ratio
EMI	ElectroMagnetic Interference	TR	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
EU	European Union	Vert.	Vertical
EUT	Equipment Under Test	WLAN	Wireless LAN
Fac.	Factor		
FCC	Federal Communications Commission		
FHSS	Frequency Hopping Spread Spectrum		
FM	Frequency Modulation		
Freq.	Frequency		
FSK	Frequency Shift Keying		
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		

UL Japan, Inc.

Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

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SECTION 1: Customer information

Company Name	:	Panasonic Corporation
Address	:	4261, Ikonobe-cho, Tsuzuki-ku, Yokohama-shi, Kanagawa-ken, 224-8520, Japan
Telephone Number	:	+81-50-3380-5341
Facsimile Number	:	+81-45-931-0806
Contact Person	:	Yuki Tojo

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, 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 (EUT) other than the Receipt Date
- SECTION 4: Operation of EUT 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 (EUT)

2.1 Identification of EUT

Type	:	Seat Back ECU
Model Number	:	AT2002
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 13.2 V
Receipt Date	:	June 24 and 30, 2020
Country of Mass-production	:	Japan
Condition	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: AT2002 (referred to as the EUT in this report) is a Seat Back ECU.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2412 MHz - 2462 MHz
Modulation	:	DSSS, OFDM
Antenna type	:	Dipole
Antenna Gain	:	0.85 dBi
Clock frequency (Maximum)	:	48 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 26, 2020 and effective July 27, 2020 except 15.258

Title : FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

* The revision does not affect the test result conducted before its effective date.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section 15.247(b)(3) ISED: RSS-247 5.4(d)	-	Complied a)	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13	FCC: Section 15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	6.3 dB 9648.00 MHz, AV, Vertical Tx 11n-20, 2412 MHz	Complied b), c)	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 15.247 Meas Guidance v05r02 8.5 and 8.6. a) Refer to APPENDIX 1 (data of Maximum Peak Output Power) b) Refer to APPENDIX 1 (data of Conducted Spurious Emission) c) Refer to APPENDIX 1 (data of Radiated Spurious Emission) 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.					

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

FCC Part 15.31 (e)

The equipment provides the wireless transmitter with stable power supply.
Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement.

3.3 Addition to standard

No addition, exclusion nor deviation has been made from the standard.

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. 4,5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.6 dB	2.5 dB	2.6 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.0 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.0 dB	-
	1 GHz-6 GHz	4.9 dB	4.9 dB	4.9 dB	-
	6 GHz-18 GHz	5.5 dB	5.5 dB	5.5 dB	-
	18 GHz-40 GHz	5.4 dB	5.4 dB	5.4 dB	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.8 dB	5.8 dB	5.8 dB	-
	18 GHz-40 GHz	5.7 dB	5.7 dB	5.7 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	0.98 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.75 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.12 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.06 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.24 dB
Spurious emission (Conducted) below 1GHz	0.9 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.9 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.9 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.0 dB
Bandwidth Measurement	0.07 %
Duty cycle and Time Measurement	0.262 %
Temperature	0.95 deg.C.
Voltage	0.83 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401
JAB Accreditation No. RTL02610

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Remarks*
IEEE 802.11n 20 MHz BW (11n-20)	MCS 7, PN9
* The worst condition was determined based on the result of the original test report.	
*Power of the EUT was set by the software as follows; Power settings: 10 dBm Software: WIFI Diag ver.9.94 (Date: 2020.03.12, Storage location: EUT memory)	
* This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Spurious Emission (below 1 GHz)	11n-20 Tx	2412 MHz
Maximum Peak Output Power	11n-20 Tx	2412 MHz
Spurious Emission (above 1 GHz)		2462 MHz

4.2 Configuration and peripherals

The pages have been submitted for separate exhibit (refer to APPENDIX 4).

SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

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

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

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.

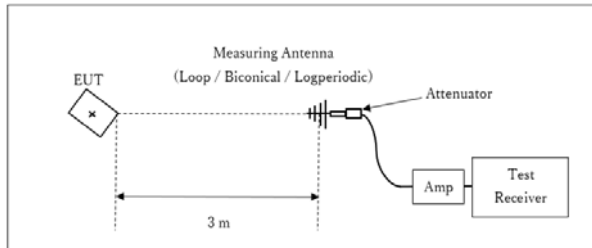
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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	11.12.2.5.2 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz

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

Figure 1: Test Setup

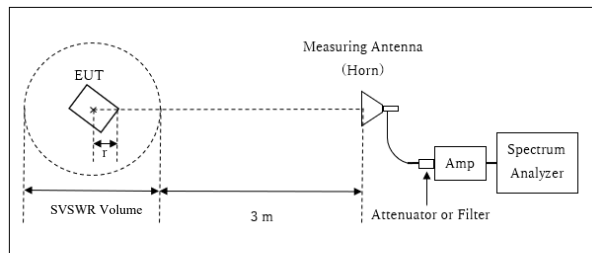
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 13 GHz

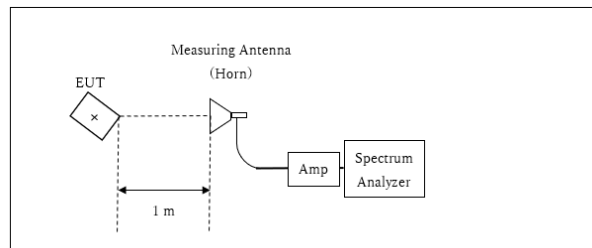


r : Radius of an outer periphery of EUT
x : Center of turn table

Distance Factor: $20 \times \log (3.88 \text{ m} / 3.0 \text{ m}) = 2.24 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.88 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.12 \text{ m}$

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 test was made on EUT at the normal use position.

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

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

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *1)	-	Power Meter (Sensor: 160 MHz BW)
Conducted Spurious Emission *2)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				
*1) Reference data *2) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)							

The test results and limit are rounded off to two decimals place, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Maximum Peak Output Power

Report No. 13417530S
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 4, 2020
Temperature / Humidity 25 deg. C / 57 % RH
Engineer Hiromasa Sato
Mode Tx 11n-20

Freq.	Reading	Cable Loss	Atten. Loss	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
				[dBm]	[mW]	[dBm]	[mW]			[dB]	[dBm]	[mW]	[dBm]	
2412	9.78	1.28	9.88	20.94	124.17	30.00	1000	9.06	0.85	21.79	151.01	36.02	4000	14.23
2462	9.09	1.28	9.89	20.26	106.17	30.00	1000	9.74	0.85	21.11	129.12	36.02	4000	14.91

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

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

Average Output Power (Reference data for RF Exposure)

Report No. 13417530S
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 4, 2020
Temperature / Humidity 25 deg. C / 57 % RH
Engineer Hiromasa Sato
Mode Tx 11n-20

11n-20 MCS 7

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	-1.19	1.28	9.88	9.97	9.93	0.21	10.18	10.42
2462	-1.31	1.28	9.89	9.86	9.68	0.21	10.07	10.16

Sample Calculation:

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

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

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

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Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission

Report No. 13417530S
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date July 4, 2020
Temperature / Humidity 26 deg. C / 60 % RH
Engineer Hiromasa Sato
(30 MHz – 26.5 GHz)
Mode Tx 11n-20 2412 MHz [1 / 2]

(* 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.	74.247	QP	39.34	6.36	7.12	32.15	0.00	20.67	40.00	19.3	260	191	
Hori.	148.494	QP	32.91	14.75	7.73	32.08	0.00	23.31	43.50	20.1	125	267	
Hori.	308.272	QP	42.89	13.70	8.57	31.96	0.00	33.20	46.00	12.8	100	86	
Hori.	444.077	QP	43.33	16.33	9.20	31.95	0.00	36.91	46.00	9.0	100	187	
Hori.	491.512	QP	43.75	17.61	9.38	31.92	0.00	38.82	46.00	7.1	100	17	
Hori.	629.109	QP	35.39	19.43	9.90	31.94	0.00	32.78	46.00	13.2	100	344	
Hori.	666.115	QP	40.36	19.41	10.03	31.93	0.00	37.87	46.00	8.1	100	24	
Hori.	741.755	QP	36.50	20.11	10.31	31.76	0.00	35.16	46.00	10.8	144	42	
Hori.	816.719	QP	32.55	20.85	10.55	31.55	0.00	32.40	46.00	13.6	144	166	
Hori.	889.046	QP	33.37	22.02	10.79	31.11	0.00	35.07	46.00	10.9	191	116	
Hori.	2390.000	PK	47.68	28.41	14.23	41.66	2.24	50.90	73.90	23.0	338	353	
Hori.	4824.000	PK	48.13	31.61	6.69	42.93	2.24	45.74	73.90	28.1	370	357	
Hori.	7236.000	PK	48.09	37.62	8.17	43.41	2.24	52.71	73.90	21.1	150	0	
Hori.	9648.000	PK	48.69	39.01	9.36	43.10	2.24	56.20	73.90	17.7	150	0	
Hori.	19296.000	PK	43.24	40.33	13.77	48.20	-9.54	39.60	73.90	34.3	159	321	
Vert.	666.116	QP	36.70	19.41	10.03	31.93	0.00	34.21	46.00	11.7	100	157	
Vert.	693.615	QP	35.87	19.72	10.14	31.90	0.00	33.83	46.00	12.1	100	148	
Vert.	741.755	QP	38.25	20.11	10.31	31.76	0.00	36.91	46.00	9.0	121	29	
Vert.	755.995	QP	34.32	20.25	10.37	31.72	0.00	33.22	46.00	12.7	100	193	
Vert.	816.717	QP	33.86	20.85	10.55	31.55	0.00	33.71	46.00	12.2	100	327	
Vert.	890.106	QP	31.29	22.03	10.79	31.10	0.00	33.01	46.00	12.9	145	196	
Vert.	924.818	QP	30.42	22.11	10.90	30.85	0.00	32.58	46.00	13.4	100	332	
Vert.	2390.000	PK	47.47	28.41	14.23	41.66	2.24	50.69	73.90	23.2	273	14	
Vert.	3774.762	PK	52.09	29.93	6.20	42.27	2.24	48.19	73.90	25.7	165	128	
Vert.	4454.998	PK	54.07	30.80	6.44	42.83	2.24	50.72	73.90	23.1	220	195	
Vert.	4824.000	PK	48.39	31.61	6.69	42.93	2.24	46.00	73.90	27.9	398	131	
Vert.	7236.000	PK	47.99	37.62	8.17	43.41	2.24	52.61	73.90	21.2	150	0	
Vert.	9648.000	PK	48.81	39.01	9.36	43.10	2.24	56.32	73.90	17.5	150	0	
Vert.	19296.000	PK	45.16	40.33	13.77	48.20	-9.54	41.52	73.90	32.3	166	318	
Vert.	3774.762	AV	46.36	29.93	6.20	42.27	2.24	42.46	53.90	11.4	165	128	
Vert.	4454.998	AV	49.43	30.80	6.44	42.83	2.24	46.08	53.90	7.8	220	195	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.88\text{ m} / 3.0\text{ m}) = 2.24\text{ dB}$

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

UL Japan, Inc.

Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission

Report No. 13417530S
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date July 4, 2020
Temperature / Humidity 26 deg. C / 60 % RH
Engineer Hiromasa Sato
(30 MHz – 26.5 GHz)
Mode Tx 11n-20 2412 MHz [2 / 2]

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	38.89	28.41	14.23	41.66	0.41	2.24	42.52	53.9	11.3	*1)
Hori.	4824.000	AV	40.03	31.61	6.69	42.93	0.41	2.24	38.05	53.9	15.8	
Hori.	7236.000	AV	38.96	37.62	8.17	43.41	0.41	2.24	43.99	53.9	9.9	
Hori.	9648.000	AV	39.46	39.01	9.36	43.10	0.41	2.24	47.38	53.9	6.5	
Hori.	19296.000	AV	34.23	40.33	13.77	48.20	0.41	-9.54	31.00	53.9	22.9	
Vert.	2390.000	AV	38.31	28.41	14.23	41.66	0.41	2.24	41.94	53.9	11.9	*1)
Vert.	4824.000	AV	38.69	31.61	6.69	42.93	0.41	2.24	36.71	53.9	17.1	
Vert.	7236.000	AV	39.02	37.62	8.17	43.41	0.41	2.24	44.05	53.9	9.8	
Vert.	9648.000	AV	39.66	39.01	9.36	43.10	0.41	2.24	47.58	53.9	6.3	
Vert.	19296.000	AV	42.56	40.33	13.77	48.20	0.41	-9.54	39.33	53.9	14.5	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.88\text{ m} / 3.0\text{ m}) = 2.24\text{ dB}$

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

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	85.57	28.37	14.24	41.67	2.24	88.75	-	-	Carrier
Hori.	2400.000	PK	51.21	28.38	14.23	41.67	2.24	54.39	68.75	14.3	
Vert.	2412.000	PK	83.63	28.37	14.24	41.67	2.24	86.81	-	-	Carrier
Vert.	2400.000	PK	49.43	28.38	14.23	41.67	2.24	52.61	66.81	14.2	

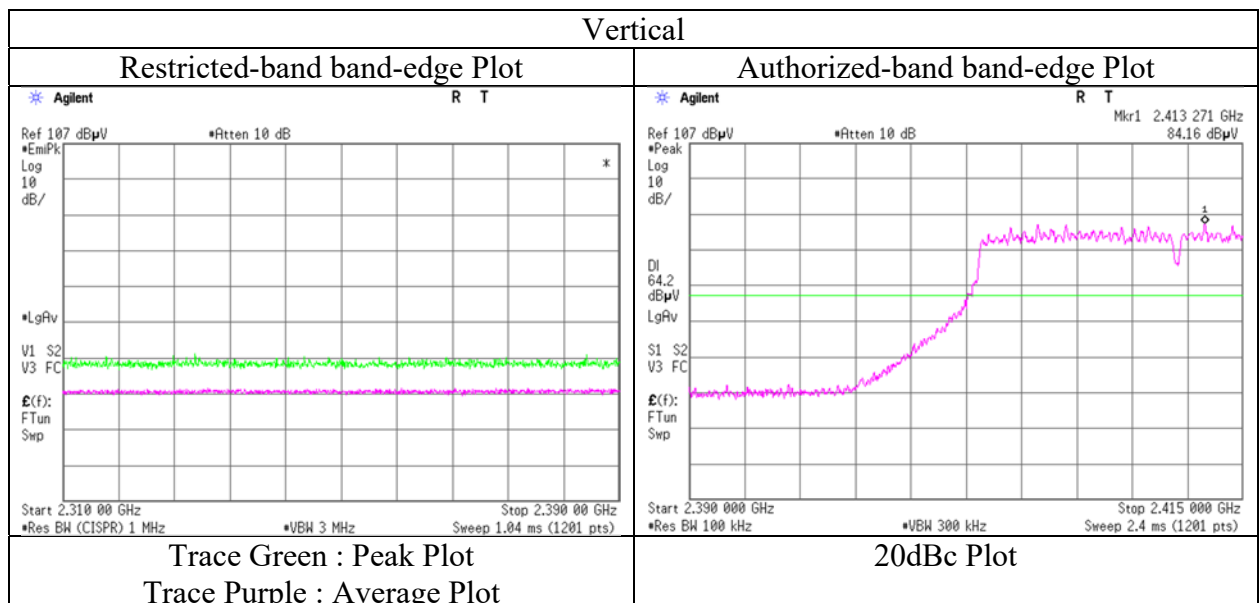
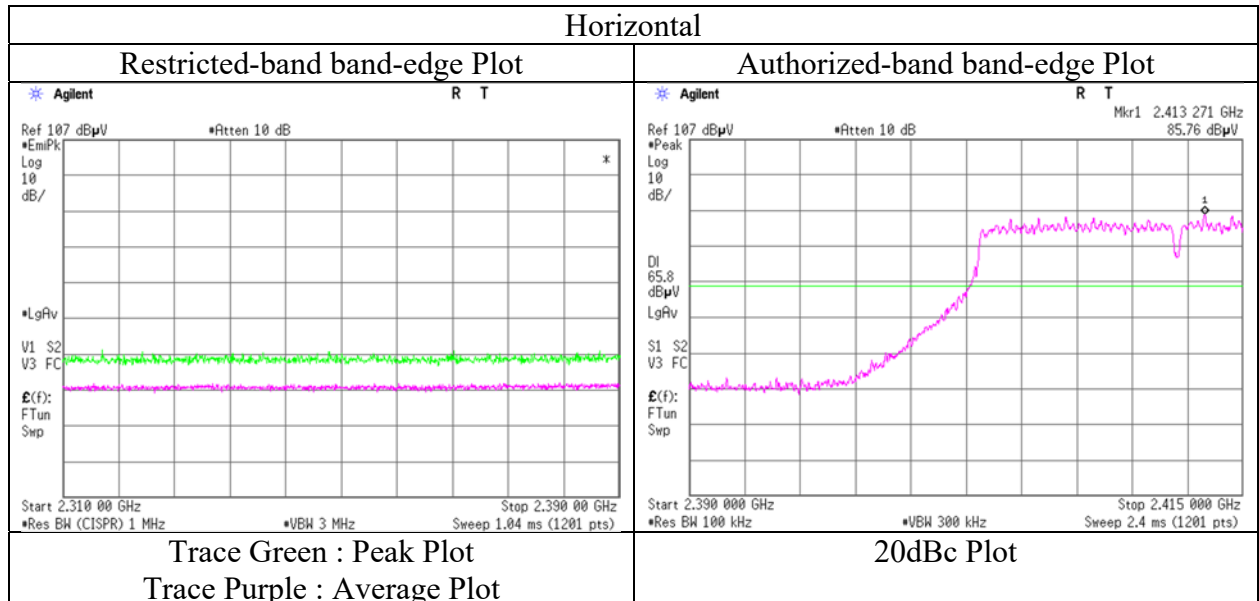
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.88\text{ m} / 3.0\text{ m}) = 2.24\text{ dB}$

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)

Report No.	13417530S
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 4, 2020
Temperature / Humidity	26 deg. C / 60 % RH
Engineer	Hiromasa Sato
	(30 MHz – 26.5 GHz)
Mode	Tx 11n-20 2412 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.

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Radiated Spurious Emission

Report No. 13417530S
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date July 4, 2020
Temperature / Humidity 26 deg. C / 60 % RH
Engineer Hiromasa Sato
(30 MHz – 26.5 GHz)
Mode Tx 11n-20 2462 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.	2483.500	PK	48.90	28.28	14.32	41.69	2.24	52.05	73.90	21.8	317	336	
Hori.	4924.000	PK	48.06	31.68	6.76	42.94	2.24	45.80	73.90	28.1	366	359	
Hori.	7386.000	PK	47.23	37.81	8.24	43.55	2.24	51.97	73.90	21.9	150	0	
Hori.	9848.000	PK	47.02	39.16	9.44	42.87	2.24	54.99	73.90	18.9	150	0	
Vert.	2483.500	PK	48.16	28.28	14.32	41.69	2.24	51.31	73.90	22.5	240	13	
Vert.	3774.715	PK	51.87	29.93	6.20	42.27	2.24	47.97	73.90	25.9	157	103	
Vert.	4455.004	PK	54.21	30.80	6.44	42.83	2.24	50.86	73.90	23.0	236	205	
Vert.	4924.000	PK	47.63	31.68	6.76	42.94	2.24	45.37	73.90	28.5	379	127	
Vert.	7386.000	PK	48.14	37.81	8.24	43.55	2.24	52.88	73.90	21.0	150	0	
Vert.	9848.000	PK	48.73	39.16	9.44	42.87	2.24	56.70	73.90	17.2	150	0	
Vert.	3774.715	AV	46.33	29.93	6.20	42.27	2.24	42.43	53.90	11.4	157	103	
Vert.	4455.004	AV	49.40	30.80	6.44	42.83	2.24	46.05	53.90	7.8	236	205	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.88\text{ m} / 3.0\text{ m}) = 2.24\text{ dB}$

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	39.12	28.28	14.32	41.69	0.41	2.24	42.68	53.9	11.2	*1)
Hori.	4924.000	AV	40.12	31.68	6.76	42.94	0.41	2.24	38.27	53.9	15.6	
Hori.	7386.000	AV	38.54	37.81	8.24	43.55	0.41	2.24	43.69	53.9	10.2	
Hori.	9848.000	AV	38.72	39.16	9.44	42.87	0.41	2.24	47.10	53.9	6.8	
Vert.	2483.500	AV	38.97	28.28	14.32	41.69	0.41	2.24	42.53	53.9	11.3	*1)
Vert.	4924.000	AV	38.66	31.68	6.76	42.94	0.41	2.24	36.81	53.9	17.0	
Vert.	7386.000	AV	38.72	37.81	8.24	43.55	0.41	2.24	43.87	53.9	10.0	
Vert.	9848.000	AV	38.26	39.16	9.44	42.87	0.41	2.24	46.64	53.9	7.2	

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

Distance factor : 1 GHz - 13 GHz : $20\log(3.88\text{ m} / 3.0\text{ m}) = 2.24\text{ dB}$

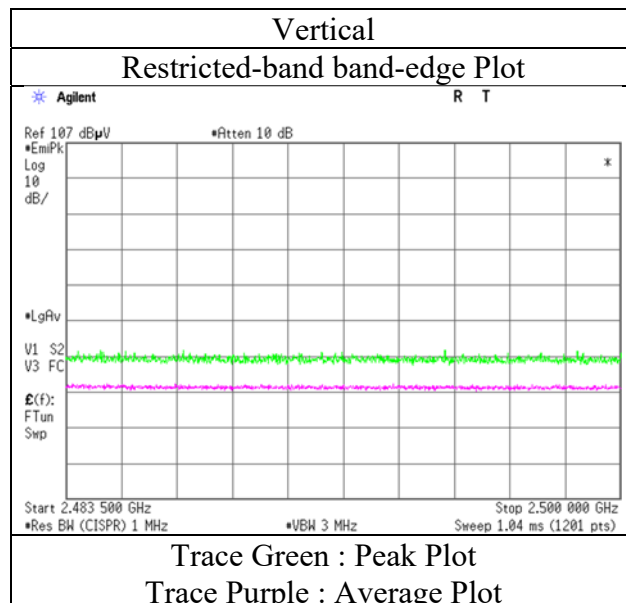
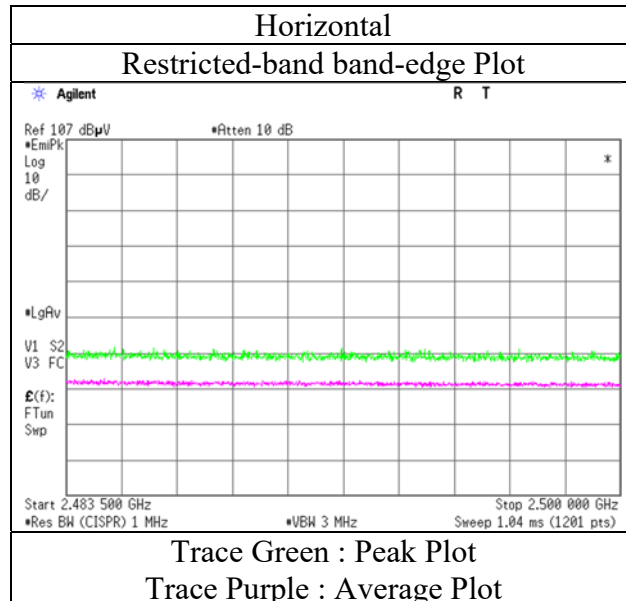
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13417530S
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 4, 2020
Temperature / Humidity	26 deg. C / 60 % RH
Engineer	Hiromasa Sato
	(30 MHz – 26.5 GHz)
Mode	Tx 11n-20 2462 MHz

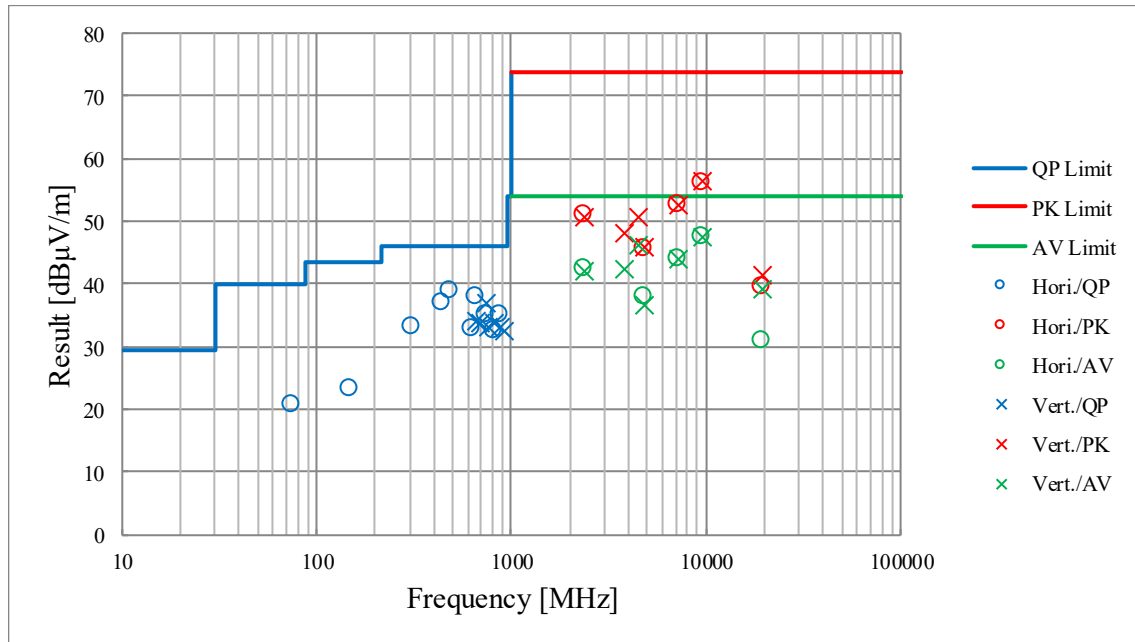


* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

Radiated Spurious Emission
(Plot data, Worst case)

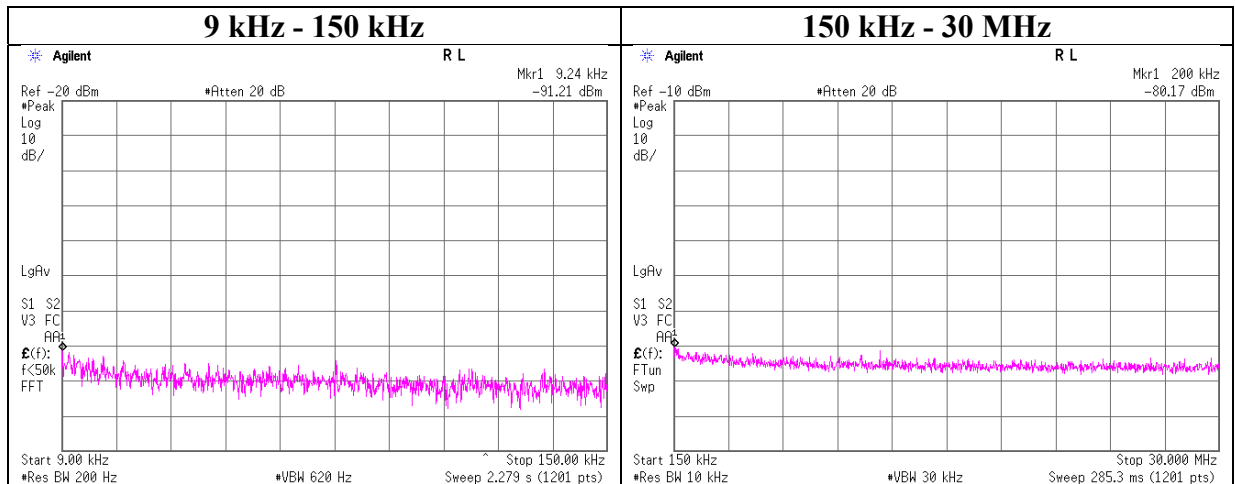
Report No. 13417530S
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date July 4, 2020
Temperature / Humidity 26 deg. C / 60 % RH
Engineer Hiromasa Sato
(30 MHz – 26.5 GHz)
Mode Tx 11n-20 2412 MHz



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

Conducted Spurious Emission

Report No. 13417530S
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 4, 2020
Temperature / Humidity 25 deg. C / 57 % RH
Engineer Hiromasa Sato
Mode Tx 11n-20 2412 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.24	-91.21	0.01	10.1	2.0	1	-79.1	300	6.0	-17.8	48.2	66.0	-
200.00	-80.17	0.01	10.1	2.0	1	-68.0	300	6.0	-6.8	21.5	28.3	-

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

$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

APPENDIX 2: Test instruments

Test equipment(1 / 2)

Test Name	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Interval (Month)
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2019/10/01	12
AT	SAT10-12	151609	Attenuator	Weinschel Corp.	54A-10	81601	2020/03/02	12
AT	SCC-G61	196937	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	803605/2	2020/03/10	12
AT	SOS-19	175823	Humidity Indicator	CUSTOM	CTH-201	-	2019/12/19	12
AT	SPM-13	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2020/01/28	12
AT	SPSS-06	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2020/01/28	12
RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,M E,PE)	-	-	-
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	SAEC-03(NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2020/04/12	12
RE	SAEC-03(SVSWR)	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2020/05/11	12
RE	SAF-03	145126	Pre Amplifier	SONOMA	310N	290213	2020/02/19	12
RE	SAF-04	145127	Pre Amplifier	Toyo Corporation	TPA0118-36	2072554	2020/06/02	12
RE	SAF-08	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2020/03/03	12
RE	SAT10-06	145137	Attenuator	Keysight Technologies Inc	8493C-010	74865	2019/11/06	12
RE	SAT6-13	167094	Attenuator	JFW	50HF-006N	-	2020/02/21	12
RE	SBA-03	145023	Biconical Antenna	Schwarzbeck Mess - Elektronik	BBA9106	91032666	2020/05/17	12

Test equipment(2 / 2)

Test Name	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Interval (Month)
RE	SCC-C1/C2/C3/C4/C5/C10/SRSE-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2020/04/12	12
RE	SCC-G19	145178	Coaxial Cable	Suhner	SUCOFLEX 102A	1188/2A	2020/03/04	12
RE	SCC-G40	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	2020/01/08	12
RE	SCC-G43	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104 E	SN MY 13406/4E	2020/06/04	12
RE	SCC-G44	168300	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800375/4A	2019/11/11	12
RE	SCC-G45	168301	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102 E	800137/2EA	2020/03/04	12
RE	SFL-02	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2019/11/06	12
RE	SHA-03	145501	Horn Antenna	Schwarzbeck Mess - Elektronik	BBHA9120D	9120D-739	2020/06/15	12
RE	SHA-04	145512	Horn Antenna	ETS LINDGREN	3160-09	00094868	2020/06/15	12
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck Mess - Elektronik	VUSLP9111B	196	2020/05/17	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM	CTH-201	-	2019/12/12	12
RE	SSA-03	145801	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250152	2019/08/08	12
RE	STR-08	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2019/11/22	12

*Hyphens for Last Calibration 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.

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

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

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