



RADIO TEST REPORT

Test Report No. : 13130343H-A-R1

Applicant : A&D Company, Ltd.
Type of EUT : Wireless Module
Model Number of EUT : AD1321A
FCC ID : KSNAD1321A
Test regulation : FCC Part 15 Subpart C: 2020
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
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7. The all test items in this test report are conducted by UL Japan, Inc. Ise 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 13130343H-A. 13130343H-A is replaced with this report.

Date of test: April 15 to August 9, 2020

Representative test engineer:


Takafumi Noguchi
Engineer
Consumer Technology Division

Approved by:


Satofumi Matsuyama
Engineer
Consumer Technology Division



CERTIFICATE 5107.02

- ☐ 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.: 13130343H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13130343H-A	August 26, 2020	-	-
1	13130343H-A-R1	September 10, 2020	P.1	Signed the signature the Engineer and Approver.
1	13130343H-A-R1	September 10, 2020	P.6	Correction of sentence about FCC 15.31 (e)
1	13130343H-A-R1	September 10, 2020	P.9	Correction of power setting and addition of remarks (*1) and (*2).
1	13130343H-A-R1	September 10, 2020	P.10,11	Correction of Item A Model Number from AD-1321A to AD1321A
1	13130343H-A-R1	September 10, 2020	P.11	Correction of Cable list.
1	13130343H-A-R1	September 10, 2020	P.13	Deletion of Blank cell
1	13130343H-A-R1	September 10, 2020	P.14	Addition of Sentence about EUT setup
1	13130343H-A-R1	September 10, 2020	P.24	Deletion of Data at Frequency 2400 MHz

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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		

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SECTION 1: Customer information

Company Name	:	A&D Company, Ltd.
Address	:	1-243 Asahi, Kitamoto-city, Saitama, 364-8585 Japan
Telephone Number	:	+81-48-593-1342
Facsimile Number	:	+81-48-593-1117
Contact Person	:	Onodera Fukushi

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	:	Wireless Module
Model Number	:	AD1321A
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 3.2 ±0.2 V
Receipt Date	:	April 9, 2020
Country of Mass-production	:	Japan
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: AD1321A (referred to as the EUT in this report) is a Wireless Module.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2405 MHz - 2480 MHz
Modulation	:	Offset QPSK
Type of Antenna	:	Inverted F Antenna
Antenna Gain	:	0.9 dBi
Antenna connector type	:	U.FL
Clock Frequency (Maximum)	:	32 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

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

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	15.99 dB 0.150000 MHz, QP, N	Complied a)	-
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(2) ISED: RSS-247 5.2(a)	See data.	Complied b)	Conducted
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 c)	Conducted
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(e) ISED: RSS-247 5.2(b)		Complied d)	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	0.3 dB 4810.000 MHz AV, Vertical	Complied# e), f)	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 Conducted Emission)
b) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
c) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
d) Refer to APPENDIX 1 (data of Power Density)
e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
f) 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 15.31 (e)

The EUT has the power supply regulator. However one of the input voltages to RF part doesn't go through the regulator. The stable voltage will be supplied by the end product, which will be required to have a power supply regulator. Therefore, the EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The EUT has a unique coupling/antenna connector (UFL Connector). Therefore, the equipment complies with the requirement of 15.203.

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	RSS-Gen 6.7	ISED: -	N/A	- a) b)	Conducted
a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)					

Other than above, 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 $k=2$.
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Antenna Terminal test

Test Item	Uncertainty (+/-)
20 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %
Maximum Peak Output Power / Average Output Power	1.4 dB
Carrier Frequency Separation	0.42 %
Dwell time / Burst rate	0.10 %
Conducted Spurious Emission	2.6 dB

Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.4 dB
	0.15 MHz to 30 MHz	2.9 dB

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		5.0 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		4.8 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.0 dB
		5.0 dB
3 m	1 GHz to 6 GHz	4.9 dB
	6 GHz to 18 GHz	5.2 dB
1 m	10 GHz to 26.5 GHz	5.5 dB
	26.5 GHz to 40 GHz	5.5 dB
10 m	1 GHz to 18 GHz	5.2 dB

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3.5 Test Location

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*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

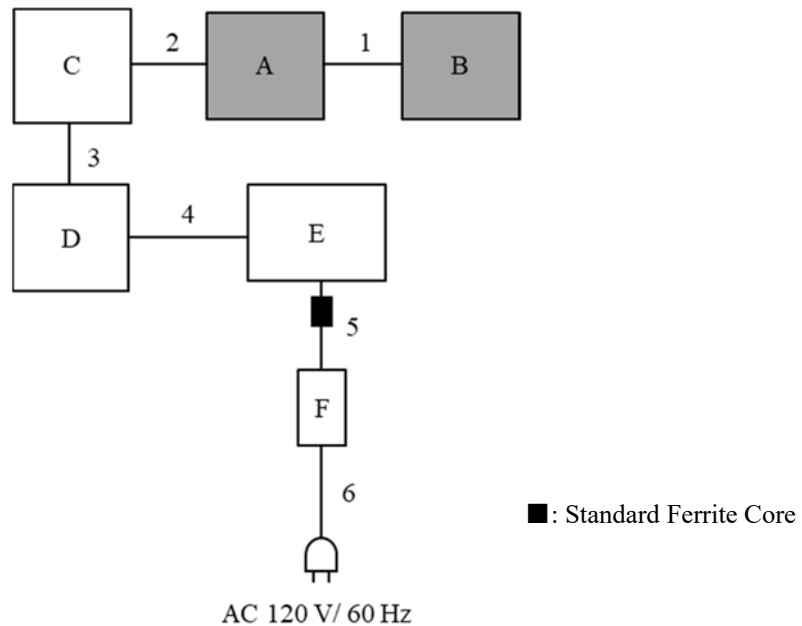
SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Tested Frequency
Transmitting mode (Tx mode)	2405 MHz 2440 MHz 2480 MHz
*Power of the EUT was set by the software as follows; Power settings: <u>Conducted Emission and Maximum Peak Output Power, Average Output Power, Radiated Spurious Emission, Power Density</u> [2405 MHz] Setting Att 1: 16 (*1) [2440 MHz] Setting Att 1: 0 (*1) [2480 MHz] Setting Att 1: 20 (*1) <u>6 dB Bandwidth and 99 % Occupied Bandwidth, Conducted Spurious Emission, Burst rate confirmation</u> [2405 MHz] Setting Att 0: 0 (*2) [2440 MHz] Setting Att 0: 0 (*2) [2480 MHz] Setting Att 0: 0 (*2) Software: Hardware AT_Command Ver,3 (Date: April 15, 2020, Storage location: EUT memory) (*1) Final Power setting value (*2) The measurement data on April 15th is higher power setting value than the final setting value. There is no difference the result in the pre-check with the final power setting value. Therefore, the test data on April 15th was used. *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.	

4.2 Configuration and peripherals

Conducted and Radiated Emission tests



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless Module	AD1321A	00-09-1F-40-4E-02	A&D Company, Ltd.	EUT
B	Antenna	ANT-PC6859/7651	1	A&D Company, Ltd.	EUT
C	Jig board	PZ7651	2	A&D Company, Ltd.	-
D	Jig board	Jig-Cable	1	A&D Company, Ltd.	-
E	Laptop PC	CF-MX4	5FKSA17992	Panasonic	-
F	AC Adaptor	CF-AA62J2C	62J2CM2152251438SB	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna Cable	0.1	Shielded	Shielded	-
2	Signal and Power supply Cable	0.1	Unshielded	Unshielded	-
3	Signal and Power supply Cable	1.9	Unshielded	Unshielded	-
4	USB Cable	3.0	Shielded	Shielded	-
5	DC Cable	1.6	Unshielded	Unshielded	-
6	AC Cable	1.0	Unshielded	Unshielded	-

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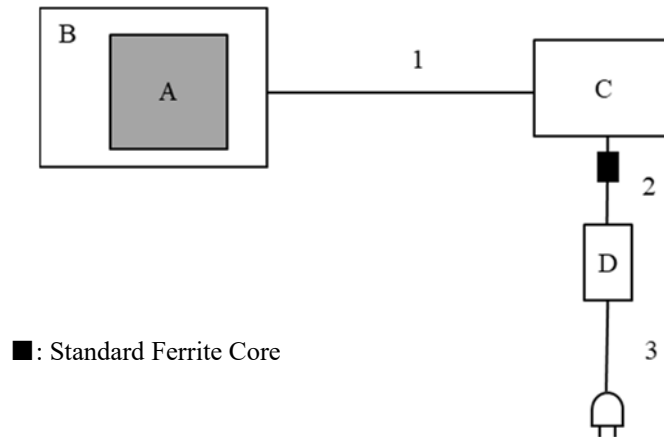
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Antenna Terminal Conducted tests



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless Module	AD1321A	00-09-1F-40-4E-0B	A&D Company, Ltd.	EUT
B	Jig	Platform	1	A&D Company, Ltd.	-
C	Laptop PC	CF-MX4	5FKSA17992	Panasonic	-
D	AC Adapter	CF-AA62J2C	62J2CM2152251438SB	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	3.0	Shielded	Shielded	-
2	DC Cable	1.6	Unshielded	Unshielded	-
3	AC Cable	1.0	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

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

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

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

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

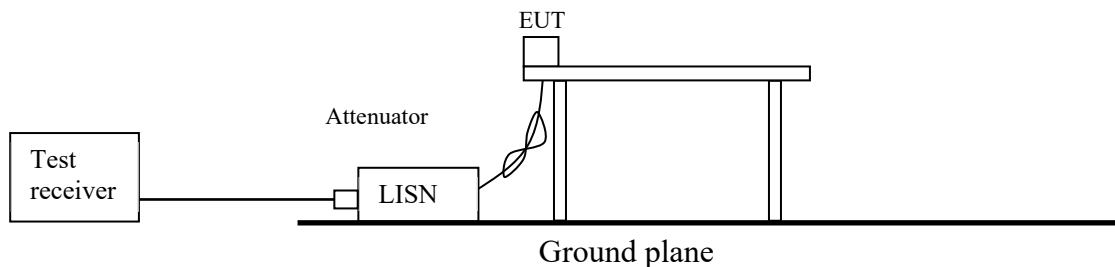
The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

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

Figure 1: Test Setup



SECTION 6: 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	11.12.2.5.1 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces 11.12.2.5.2 The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results.	RBW: 100 kHz VBW: 300 kHz

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

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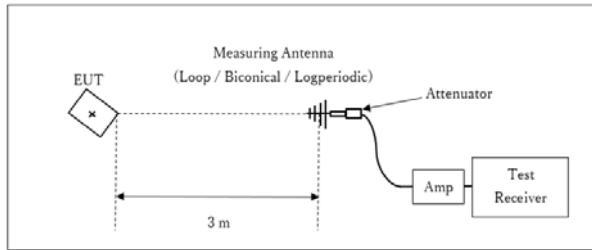
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Figure 2: Test Setup

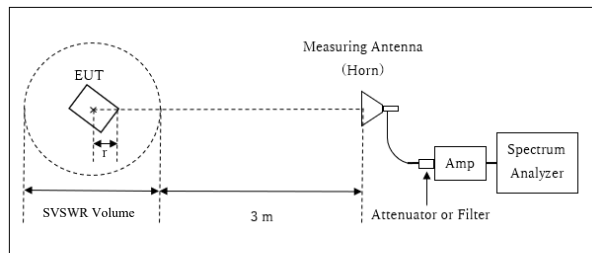
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log (3.95 \text{ m} / 3.0 \text{ m}) = 2.39 \text{ dB}$

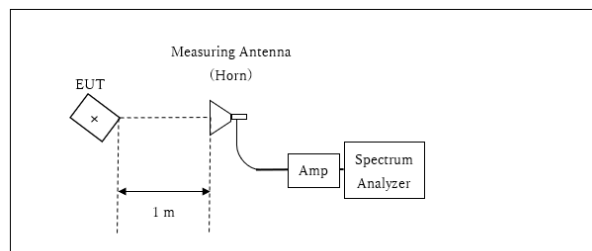
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.95 \text{ m}$

SVSWR Volume : 2.0 m

(SVSWR Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.05 \text{ m}$

10 GHz - 26.5 GHz



x : Center of turn table

Distance Factor: $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

*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.

During the test, antenna and module were set to be separated considering the worst condition, not in the final installed condition.

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

Measurement range : 30 MHz - 26.5 GHz

Test data : APPENDIX

Test result : Pass

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SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	2.5 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1 kHz	27 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013". *4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 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.

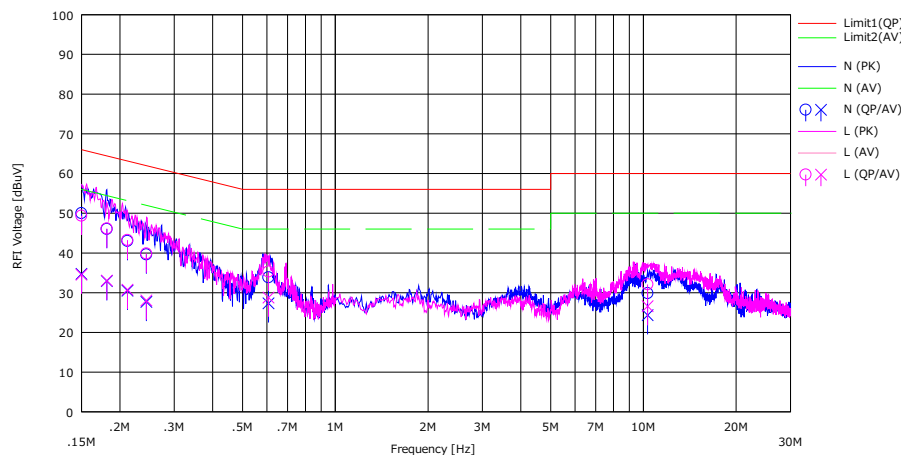
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Report No. 13130343H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date August 8, 2020
Temperature / Humidity 25 deg. C / 66 % RH
Engineer Takafumi Noguchi
Mode Tx 2440 MHz

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq. [MHz]	Reading		USN	LOSS	Results		Limit		Margin		Phase	Comment
		(QP) [dBuV]	(AV) [dBuV]			(QP) [dBuV]	(AV) [dBuV]	(QP) [dBuV]	(AV) [dBuV]	(QP) [dB]	(AV) [dB]		
1	0.15000	36.80	21.50	0.07	13.14	50.01	34.71	66.00	56.00	15.99	21.29	N	
2	0.18140	32.80	19.70	0.06	13.15	46.01	32.91	64.40	54.40	18.39	21.49	N	
3	0.21160	29.80	17.30	0.06	13.15	43.01	30.51	63.10	53.10	20.09	22.59	N	
4	0.24370	26.40	14.50	0.06	13.15	39.61	27.71	62.00	52.00	22.39	24.29	N	
5	0.60725	20.60	14.10	0.06	13.19	33.85	27.35	56.00	46.00	22.15	18.65	N	
6	10.32100	16.00	10.50	0.25	13.60	29.85	24.35	60.00	50.00	30.15	25.65	N	
7	0.15000	36.10	21.30	0.10	13.14	49.34	34.54	66.00	56.00	16.66	21.46	L	
8	0.18140	32.90	19.80	0.10	13.15	46.15	33.05	64.40	54.40	18.25	21.35	L	
9	0.21160	30.00	17.50	0.10	13.15	43.25	30.75	63.10	53.10	19.85	22.35	L	
10	0.24370	26.60	14.80	0.10	13.15	39.85	28.05	62.00	52.00	22.15	23.95	L	
11	0.60725	22.00	15.50	0.10	13.19	35.29	28.79	56.00	46.00	20.71	17.21	L	
12	10.32100	18.20	12.70	0.29	13.60	32.09	26.59	60.00	50.00	27.91	23.41	L	

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

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Ise EMC Lab.

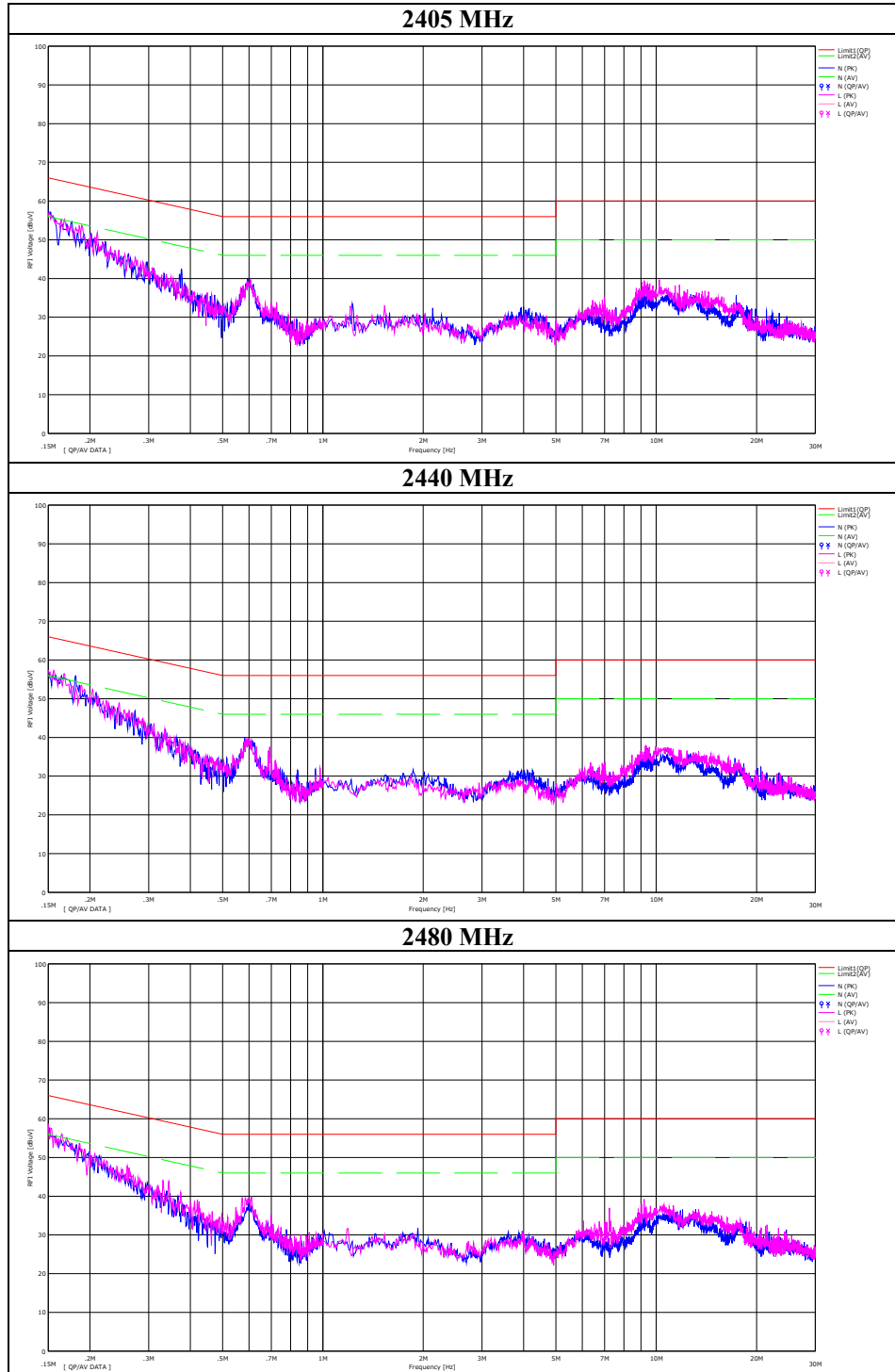
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Conducted Emission

Report No. 13130343H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date August 8, 2020
Temperature / Humidity 25 deg. C / 66 % RH
Engineer Takafumi Noguchi
Mode Tx



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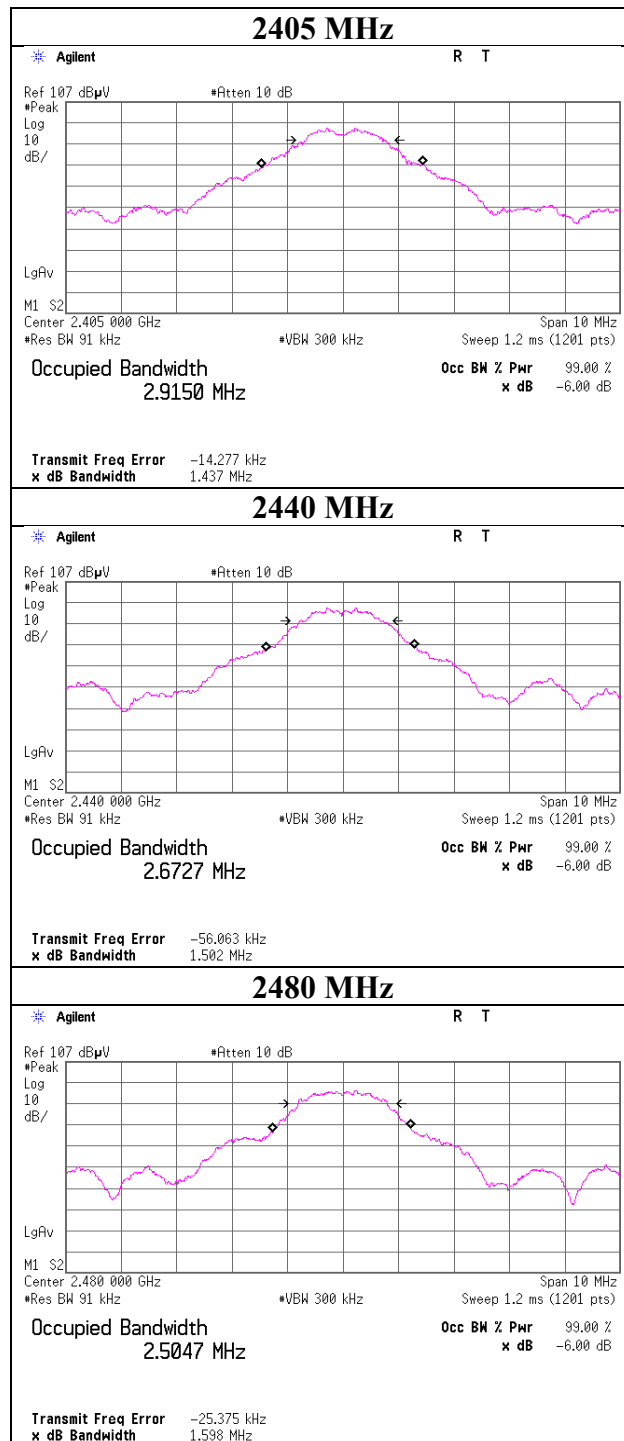
Facsimile : +81 596 24 8124

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 13130343H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 15, 2020
Temperature / Humidity 23 deg. C / 35 % RH
Engineer Akihiko Maeda
Mode Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
Zigbee	2405	2915.0	1.453	> 0.5000
	2440	2672.7	1.480	> 0.5000
	2480	2504.7	1.576	> 0.5000

99%Occupied Bandwidth



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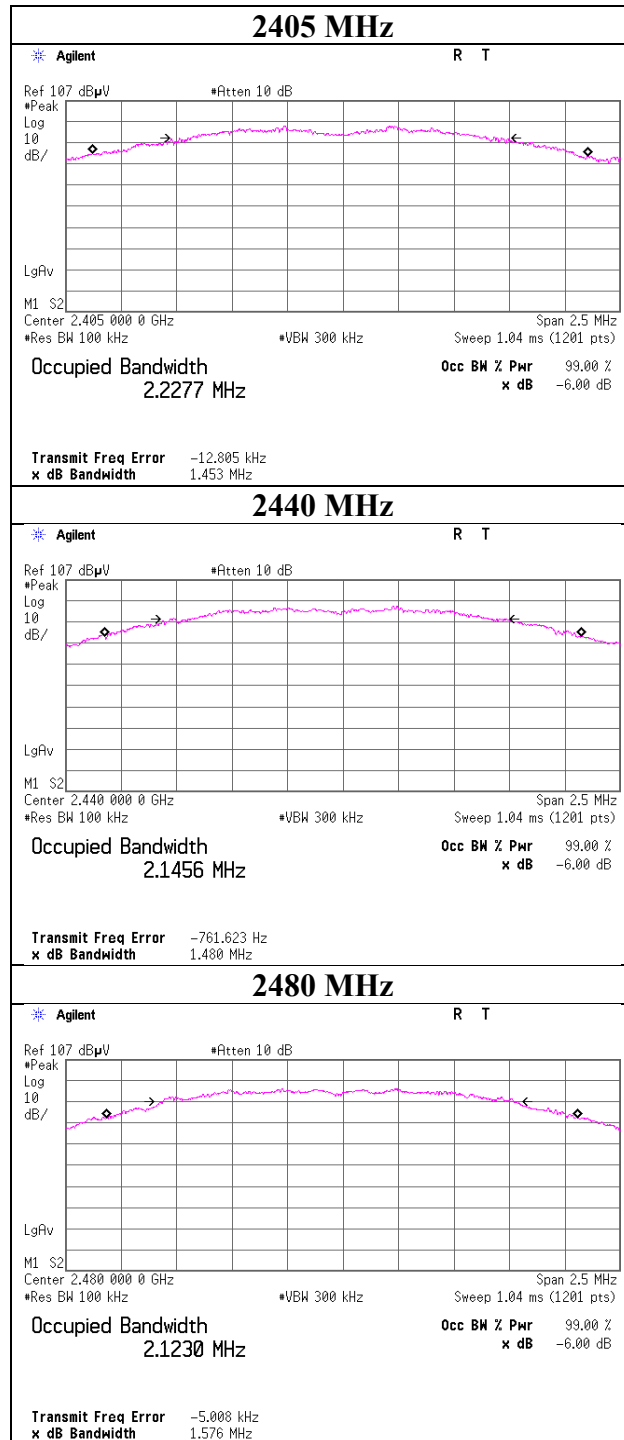
Ise EMC Lab.

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6dB Bandwidth



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Maximum Peak Output Power

Report No. 13130343H
Test place Ise EMC Lab. No.6 Measurement Room
Date August 9, 2020
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Takafumi Noguchi
Mode Tx

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]			[dBm]	[mW]	[dBm]	[mW]	
2405	-5.59	1.33	9.50	5.24	3.34	30.00	1000	24.76	0.90	6.14	4.11	36.02	4000	29.88
2440	-3.66	1.34	9.50	7.18	5.22	30.00	1000	22.82	0.90	8.08	6.43	36.02	4000	27.94
2480	-8.84	1.35	9.50	2.01	1.59	30.00	1000	27.99	0.90	2.91	1.95	36.02	4000	33.11

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.

UL Japan, Inc.

Ise EMC Lab.

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Average Output Power
(Reference data for RF Exposure / SAR testing)

Report No. 13130343H
Test place Ise EMC Lab. No.6 Measurement Room
Date August 9, 2020
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Takafumi Noguchi
Mode Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2405	-6.30	1.33	9.50	4.53	2.84	0.00	4.53	2.84
2440	-4.22	1.34	9.50	6.62	4.59	0.00	6.62	4.59
2480	-9.74	1.35	9.50	1.11	1.29	0.00	1.11	1.29

Sample Calculation:

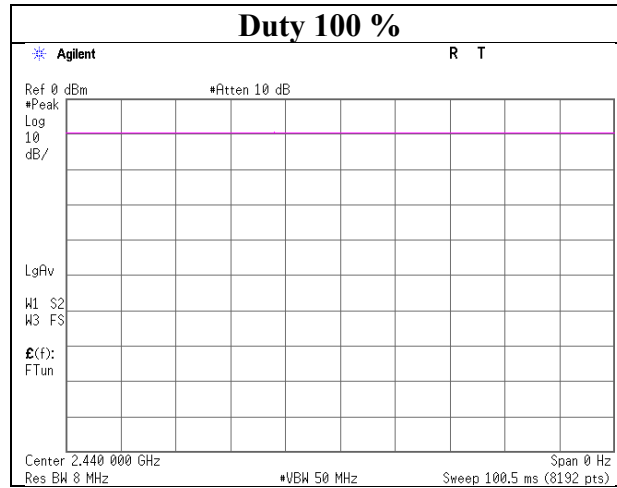
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

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

Burst rate confirmation

Report No. 13130343H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 15, 2020
Temperature / Humidity 23 deg. C / 35 % RH
Engineer Akihiko Maeda
Mode Tx



* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Radiated Spurious Emission

Report No.	13130343H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.1	No.3
Date	August 2, 2020	August 7, 2020	August 8, 2020
Temperature / Humidity	22 deg. C / 61 % RH	22 deg. C / 67 % RH	25 deg. C / 66 % RH
Engineer	Ken Fujita	Takafumi Noguchi	Takafumi Noguchi
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx 2405 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	66.302	QP	31.5	8.9	7.7	32.2	-	16.0	40.0	24.0	
Hori.	134.500	QP	29.2	11.5	8.6	32.1	-	17.1	43.5	26.4	
Hori.	192.000	QP	35.4	14.0	9.1	32.0	-	26.5	43.5	17.0	
Hori.	288.000	QP	42.5	13.5	10.0	32.0	-	33.9	46.0	12.1	
Hori.	352.000	QP	39.4	15.1	10.4	32.0	-	33.0	46.0	13.0	
Hori.	416.000	QP	39.4	16.1	10.9	32.0	-	34.4	46.0	11.6	
Hori.	432.000	QP	35.2	16.2	11.0	32.0	-	30.4	46.0	15.6	
Hori.	480.000	QP	34.8	17.3	11.3	32.0	-	31.4	46.0	14.6	
Hori.	2390.000	PK	58.3	27.7	5.5	32.7	-	58.8	73.9	15.1	
Hori.	4810.000	PK	49.0	31.6	6.8	31.7	-	55.7	73.9	18.2	
Hori.	7215.000	PK	40.6	36.0	8.1	32.6	-	52.0	73.9	21.9	Floor noise
Hori.	9620.000	PK	41.1	38.6	8.9	33.3	-	55.3	73.9	18.6	Floor noise
Hori.	2390.000	AV	43.1	27.7	5.5	32.7	-	43.6	53.9	10.4	
Hori.	4810.000	AV	45.3	31.6	6.8	31.7	-	52.1	53.9	1.8	
Hori.	7215.000	AV	32.5	36.0	8.1	32.6	-	43.9	53.9	10.0	Floor noise
Hori.	9620.000	AV	32.4	38.6	8.9	33.3	-	46.6	53.9	7.3	Floor noise
Vert.	66.302	QP	42.3	8.9	7.7	32.2	-	26.8	40.0	13.2	
Vert.	134.500	QP	37.3	11.5	8.6	32.1	-	25.2	43.5	18.3	
Vert.	192.000	QP	32.3	14.0	9.1	32.0	-	23.4	43.5	20.1	
Vert.	288.000	QP	37.7	13.5	10.0	32.0	-	29.1	46.0	16.9	
Vert.	352.000	QP	34.0	15.1	10.4	32.0	-	27.6	46.0	18.4	
Vert.	416.000	QP	31.8	16.1	10.9	32.0	-	26.8	46.0	19.2	
Vert.	432.000	QP	35.1	16.2	11.0	32.0	-	30.3	46.0	15.7	
Vert.	480.000	QP	37.2	17.3	11.3	32.0	-	33.8	46.0	12.2	
Vert.	2390.000	PK	57.7	27.7	5.5	32.7	-	58.1	73.9	15.8	
Vert.	4810.000	PK	50.3	31.6	6.8	31.7	-	57.0	73.9	16.9	
Vert.	7215.000	PK	40.6	36.0	8.1	32.6	-	52.0	73.9	21.9	Floor noise
Vert.	9620.000	PK	40.3	38.6	8.9	33.3	-	54.5	73.9	19.4	Floor noise
Vert.	2390.000	AV	42.1	27.7	5.5	32.7	-	42.5	53.9	11.4	
Vert.	4810.000	AV	46.8	31.6	6.8	31.7	-	53.6	53.9	0.3	
Vert.	7215.000	AV	32.7	36.0	8.1	32.6	-	44.1	53.9	9.8	Floor noise
Vert.	9620.000	AV	32.1	38.6	8.9	33.3	-	46.3	53.9	7.6	Floor noise

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.95 m / 3.0 m) = 2.39 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2405.000	PK	89.6	27.7	5.5	32.7	90.0	-	-	Carrier
Hori.	2400.000	PK	55.8	27.7	5.5	32.7	56.3	70.0	13.8	
Vert.	2405.000	PK	92.8	27.7	5.5	32.7	93.2	-	-	Carrier
Vert.	2400.000	PK	53.1	27.7	5.5	32.7	53.6	73.2	19.6	

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

UL Japan, Inc.

Ise EMC Lab.

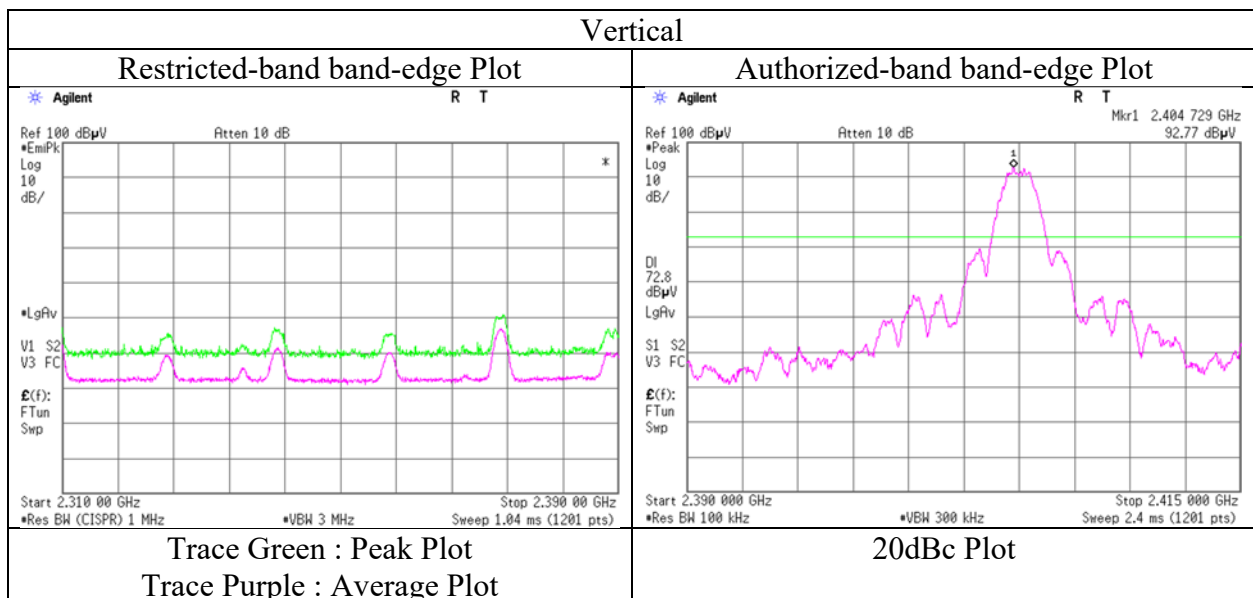
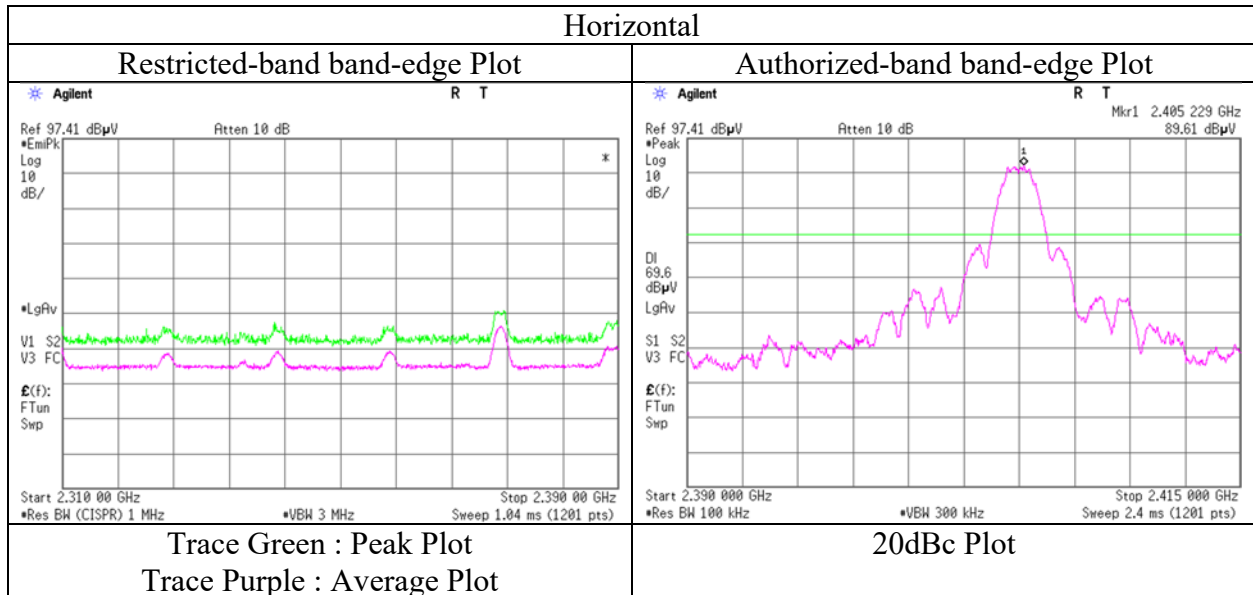
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13130343H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 2, 2020
Temperature / Humidity	22 deg. C / 61 % RH
Engineer	Ken Fujita
	(1 GHz - 10 GHz)
Mode	Tx 2405 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.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

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Radiated Spurious Emission

Report No.	13130343H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.1	No.3
Date	August 2, 2020	August 7, 2020	August 8, 2020
Temperature / Humidity	22 deg. C / 61 % RH	22 deg. C / 67 % RH	25 deg. C / 66 % RH
Engineer	Ken Fujita (1 GHz - 10 GHz)	Takafumi Noguchi (10 GHz - 26.5 GHz)	Takafumi Noguchi (Below 1 GHz)
Mode	Tx 2440 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	66.302	QP	31.8	8.9	7.7	32.2	-	16.3	40.0	23.7	
Hori.	134.500	QP	29.2	11.5	8.6	32.1	-	17.1	43.5	26.4	
Hori.	192.000	QP	35.3	14.0	9.1	32.0	-	26.4	43.5	17.1	
Hori.	288.000	QP	42.4	13.5	10.0	32.0	-	33.8	46.0	12.2	
Hori.	352.000	QP	39.6	15.1	10.4	32.0	-	33.2	46.0	12.8	
Hori.	416.000	QP	39.1	16.1	10.9	32.0	-	34.1	46.0	11.9	
Hori.	432.000	QP	35.0	16.2	11.0	32.0	-	30.2	46.0	15.8	
Hori.	480.000	QP	34.7	17.3	11.3	32.0	-	31.3	46.0	14.7	
Hori.	4880.000	PK	49.7	31.5	6.9	31.6	-	56.5	73.9	17.4	
Hori.	7320.000	PK	43.2	36.2	8.1	32.6	-	54.9	73.9	19.0	Floor noise
Hori.	9760.000	PK	42.2	38.8	9.0	33.4	-	56.6	73.9	17.3	Floor noise
Hori.	4880.000	AV	46.0	31.5	6.9	31.6	-	52.7	53.9	1.2	
Hori.	7320.000	AV	32.3	36.2	8.1	32.6	-	43.9	53.9	10.0	Floor noise
Hori.	9760.000	AV	32.4	38.8	9.0	33.4	-	46.7	53.9	7.2	Floor noise
Vert.	66.302	QP	42.3	8.9	7.7	32.2	-	26.8	40.0	13.2	
Vert.	134.500	QP	35.8	11.5	8.6	32.1	-	23.7	43.5	19.8	
Vert.	192.000	QP	32.3	14.0	9.1	32.0	-	23.4	43.5	20.1	
Vert.	288.000	QP	37.7	13.5	10.0	32.0	-	29.1	46.0	16.9	
Vert.	352.000	QP	34.1	15.1	10.4	32.0	-	27.7	46.0	18.3	
Vert.	416.000	QP	31.4	16.1	10.9	32.0	-	26.4	46.0	19.6	
Vert.	432.000	QP	35.1	16.2	11.0	32.0	-	30.3	46.0	15.7	
Vert.	480.000	QP	37.1	17.3	11.3	32.0	-	33.7	46.0	12.3	
Vert.	4880.000	PK	48.5	31.5	6.9	31.6	-	55.2	73.9	18.7	
Vert.	7320.000	PK	42.3	36.2	8.1	32.6	-	54.0	73.9	19.9	Floor noise
Vert.	9760.000	PK	42.3	38.8	9.0	33.4	-	56.7	73.9	17.2	Floor noise
Vert.	4880.000	AV	42.7	31.5	6.9	31.6	-	49.4	53.9	4.5	
Vert.	7320.000	AV	32.2	36.2	8.1	32.6	-	43.9	53.9	10.0	Floor noise
Vert.	9760.000	AV	32.1	38.8	9.0	33.4	-	46.5	53.9	7.4	Floor noise

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.95 m / 3.0 m) = 2.39 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	13130343H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.1	No.3
Date	August 2, 2020	August 7, 2020	August 8, 2020
Temperature / Humidity	22 deg. C / 61 % RH	22 deg. C / 67 % RH	25 deg. C / 66 % RH
Engineer	Ken Fujita	Takafumi Noguchi	Takafumi Noguchi
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx 2480 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	66.302	QP	31.8	8.9	7.7	32.2	-	16.3	40.0	23.7	
Hori.	134.500	QP	29.3	11.5	8.6	32.1	-	17.2	43.5	26.3	
Hori.	192.000	QP	35.3	14.0	9.1	32.0	-	26.4	43.5	17.1	
Hori.	288.000	QP	42.5	13.5	10.0	32.0	-	33.9	46.0	12.1	
Hori.	352.000	QP	39.6	15.1	10.4	32.0	-	33.2	46.0	12.8	
Hori.	416.000	QP	38.8	16.1	10.9	32.0	-	33.8	46.0	12.2	
Hori.	432.000	QP	35.2	16.2	11.0	32.0	-	30.4	46.0	15.6	
Hori.	480.000	QP	35.1	17.3	11.3	32.0	-	31.7	46.0	14.3	
Hori.	2483.500	PK	57.1	27.5	5.6	32.7	-	57.4	73.9	16.5	
Hori.	4960.000	PK	47.2	31.6	6.9	31.6	-	54.1	73.9	19.8	
Hori.	7440.000	PK	42.0	36.3	8.2	32.7	-	53.8	73.9	20.1	Floor noise
Hori.	9920.000	PK	42.0	38.9	9.0	33.5	-	56.5	73.9	17.4	Floor noise
Hori.	2483.500	AV	52.3	27.5	5.6	32.7	-	52.6	53.9	1.3	
Hori.	4960.000	AV	44.2	31.6	6.9	31.6	-	51.0	53.9	2.9	
Hori.	7440.000	AV	32.2	36.3	8.2	32.7	-	44.0	53.9	9.9	Floor noise
Hori.	9920.000	AV	32.8	38.9	9.0	33.5	-	47.2	53.9	6.7	Floor noise
Vert.	66.302	QP	42.3	8.9	7.7	32.2	-	26.8	40.0	13.2	
Vert.	134.500	QP	35.7	11.5	8.6	32.1	-	23.6	43.5	19.9	
Vert.	192.000	QP	32.3	14.0	9.1	32.0	-	23.4	43.5	20.1	
Vert.	288.000	QP	37.8	13.5	10.0	32.0	-	29.2	46.0	16.8	
Vert.	352.000	QP	34.1	15.1	10.4	32.0	-	27.7	46.0	18.3	
Vert.	416.000	QP	31.2	16.1	10.9	32.0	-	26.2	46.0	19.8	
Vert.	432.000	QP	35.1	16.2	11.0	32.0	-	30.3	46.0	15.7	
Vert.	480.000	QP	37.2	17.3	11.3	32.0	-	33.8	46.0	12.2	
Vert.	2483.500	PK	57.8	27.5	5.6	32.7	-	58.1	73.9	15.8	
Vert.	4960.000	PK	48.6	31.6	6.9	31.6	-	55.4	73.9	18.5	
Vert.	7440.000	PK	42.3	36.3	8.2	32.7	-	54.1	73.9	19.8	Floor noise
Vert.	9920.000	PK	41.6	38.9	9.0	33.5	-	56.1	73.9	17.8	Floor noise
Vert.	2483.500	AV	52.6	27.5	5.6	32.7	-	52.9	53.9	1.0	
Vert.	4960.000	AV	45.3	31.6	6.9	31.6	-	52.1	53.9	1.8	
Vert.	7440.000	AV	32.3	36.3	8.2	32.7	-	44.1	53.9	9.8	Floor noise
Vert.	9920.000	AV	32.2	38.9	9.0	33.5	-	46.7	53.9	7.2	Floor noise

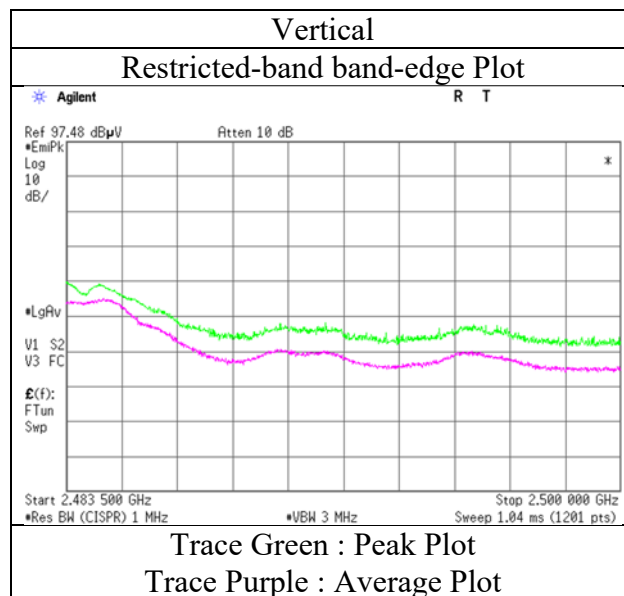
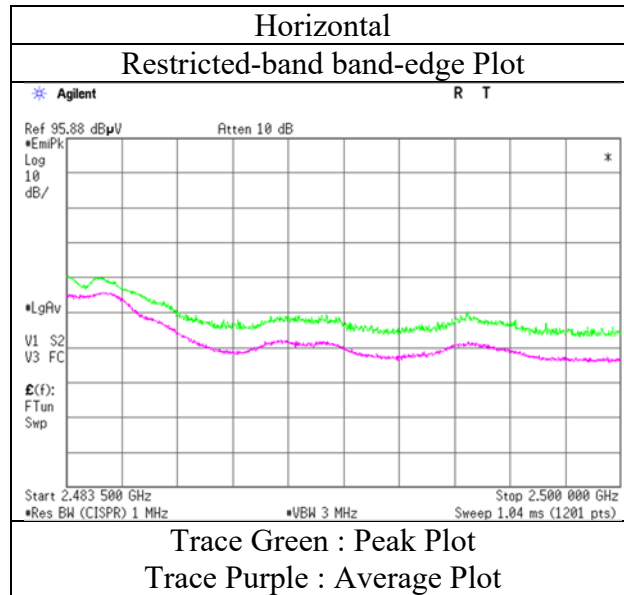
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13130343H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 2, 2020
Temperature / Humidity	22 deg. C / 61 % RH
Engineer	Ken Fujita
	(1 GHz - 10 GHz)
Mode	Tx 2480 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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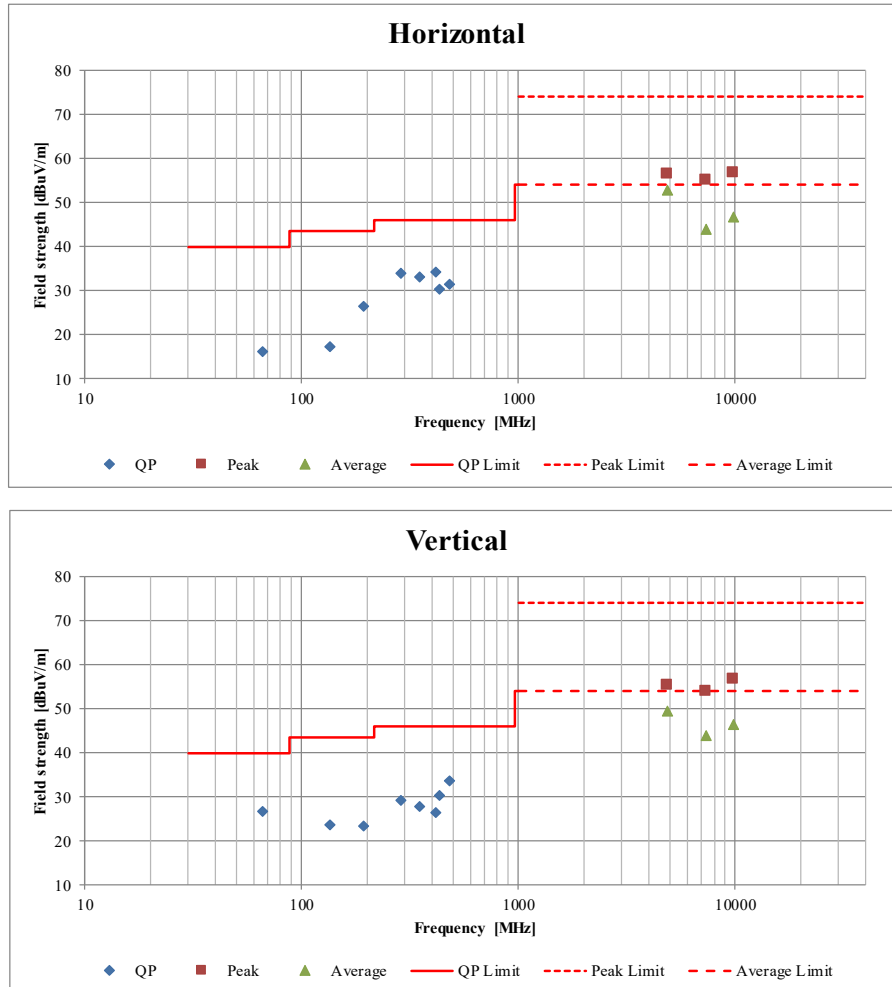
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Radiated Spurious Emission
(Plot data, Worst case)

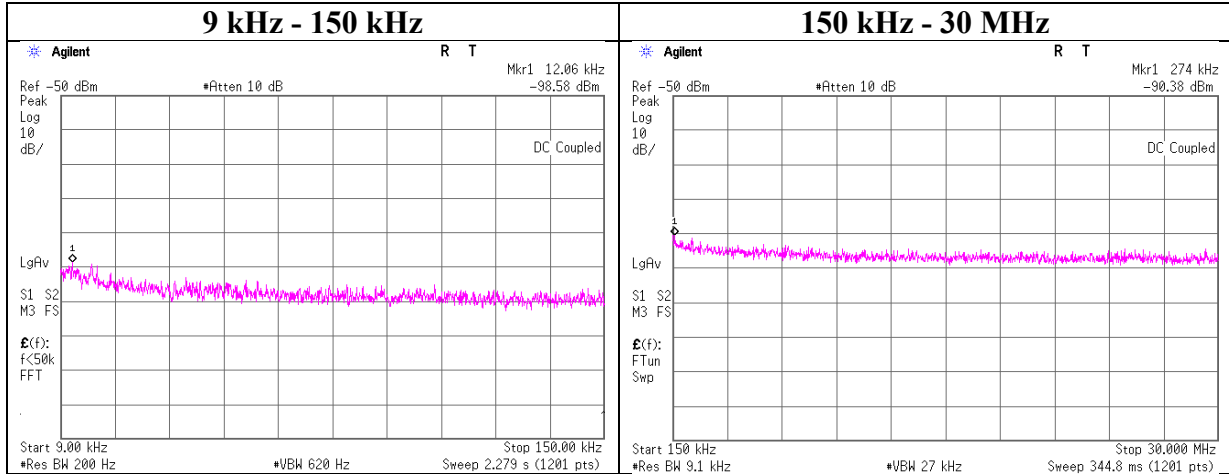
Report No.	13130343H	No.1	No.3
Test place	Ise EMC Lab.	August 7, 2020	August 8, 2020
Semi Anechoic Chamber	No.3	22 deg. C / 67 % RH	25 deg. C / 66 % RH
Date	August 2, 2020	Takafumi Noguchi	Takafumi Noguchi
Temperature / Humidity	22 deg. C / 61 % RH	(10 GHz – 26.5 GHz)	(Below 1 GHz)
Engineer	Ken Fujita		
Mode	(1 GHz - 10 GHz) Tx 2440 MHz		



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

Conducted Spurious Emission

Report No. 13130343H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 15, 2020
Temperature / Humidity 23 deg. C / 35 % RH
Engineer Akihiko Maeda
Mode Tx 2405 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12.06	-98.58	1.33	19.97	2.0	1	-75.3	300	6.0	-14.0	45.9	59.9	
274.00	-90.38	1.33	19.97	2.0	1	-67.1	300	6.0	-5.8	18.8	24.6	

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

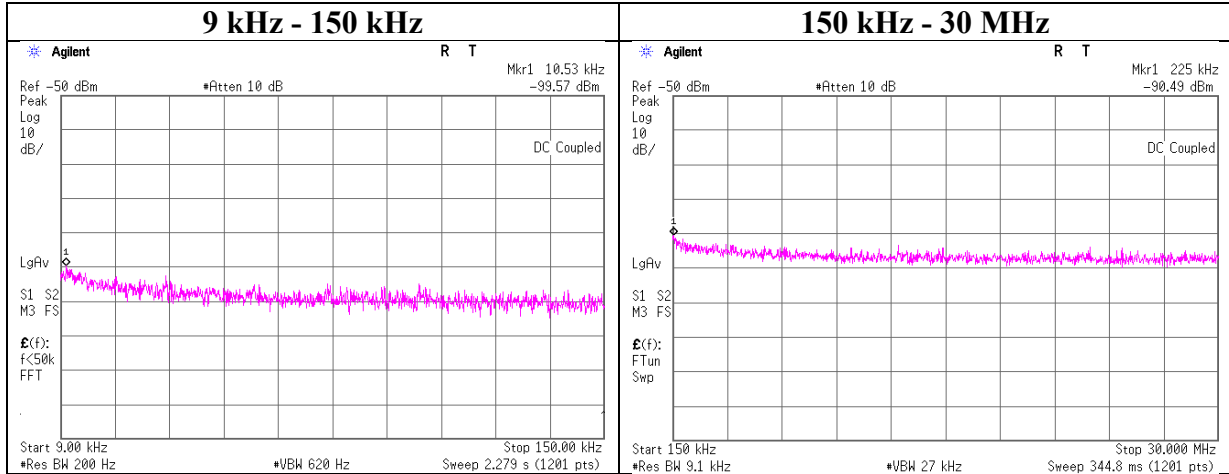
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

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.

Conducted Spurious Emission

Report No. 13130343H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 15, 2020
Temperature / Humidity 23 deg. C / 35 % RH
Engineer Akihiko Maeda
Mode Tx 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.53	-99.57	1.34	19.97	2.0	1	-76.3	300	6.0	-15.0	47.1	62.1	
225.00	-90.49	1.34	19.97	2.0	1	-67.2	300	6.0	-5.9	20.5	26.4	

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

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

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.

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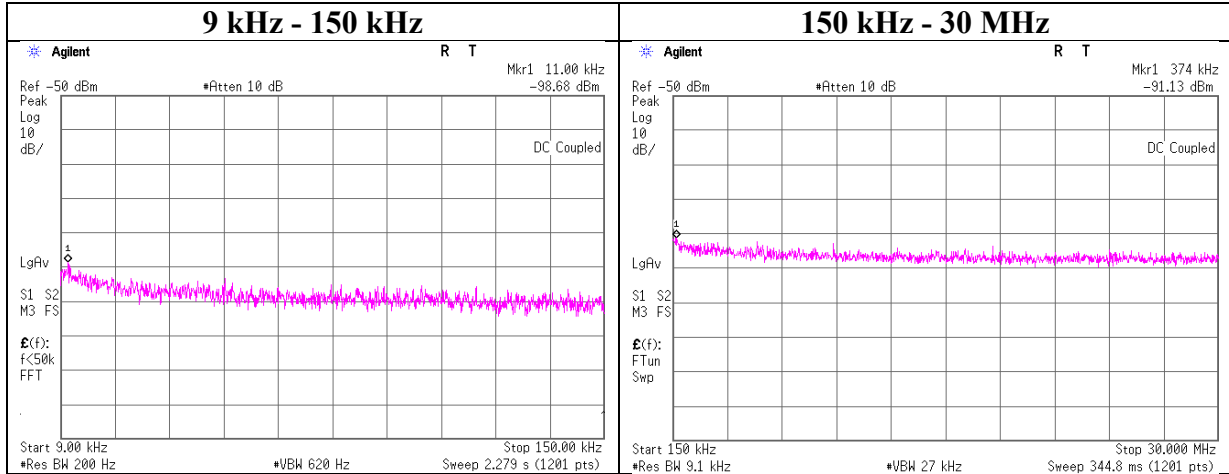
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Conducted Spurious Emission

Report No.	13130343H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 15, 2020
Temperature / Humidity	23 deg. C / 35 % RH
Engineer	Akihiko Maeda
Mode	Tx 2480 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
11.00	-98.68	1.35	19.97	2.0	1	-75.4	300	6.0	-14.1	46.7	60.8	
374.00	-91.13	1.35	19.97	2.0	1	-67.8	300	6.0	-6.6	16.1	22.7	

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

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

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.

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Power Density

Report No. 13130343H
Test place Ise EMC Lab. No.6 Measurement Room
Date August 9, 2020
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Takafumi Noguchi
Mode Tx

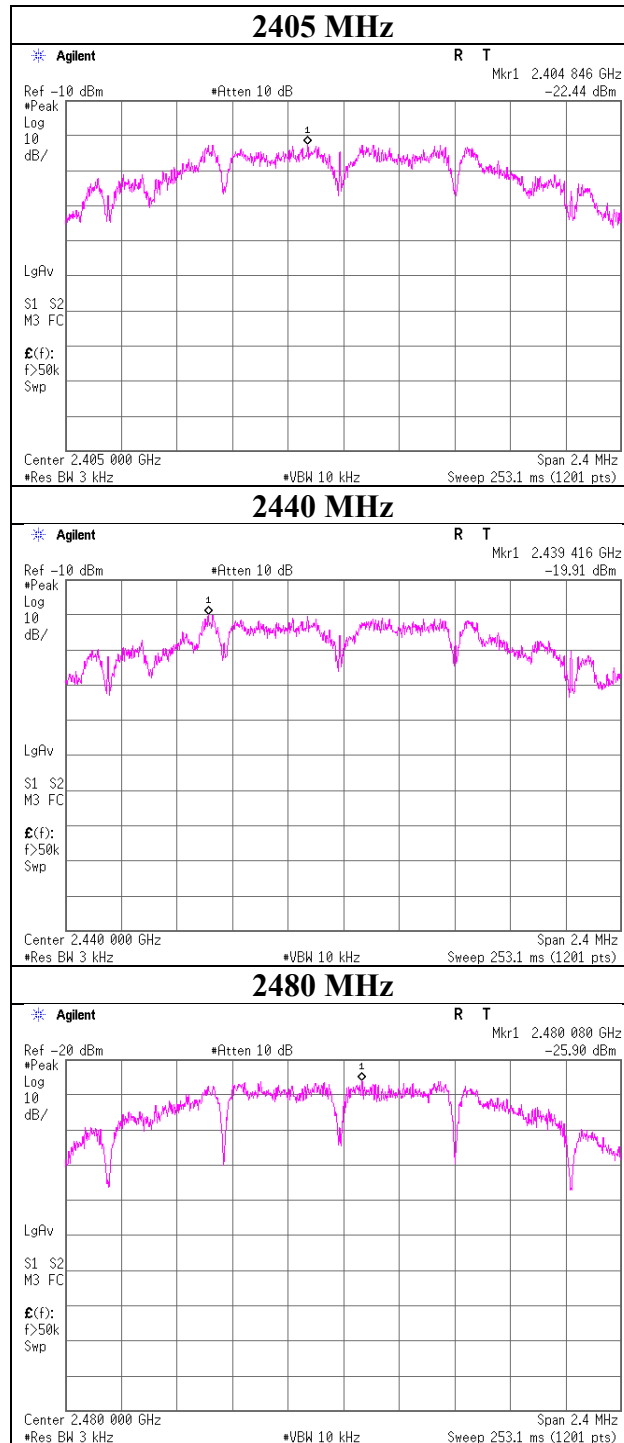
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2405	-22.44	1.33	9.50	-11.61	8.00	19.61
2440	-19.91	1.34	9.50	-9.07	8.00	17.07
2480	-25.90	1.35	9.50	-15.05	8.00	23.05

Sample Calculation:

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

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

Power Density



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APPENDIX 2: Test instruments

Test equipment-1/2

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	MLS-23	141357	LISN(AMN)	Schwarzbeck Mess - Elektronik	NSLK8127	8127-729	07/22/2020	12
CE	MAT-67	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/02/2019	12
CE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/sucoform141-PE/421-010/RFM-E321(SW)	-/00640	07/06/2020	12
RE/CE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2020	24
RE/CE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/07/2020	12
RE/CE	MMM-08	141532	DIGITAL HiTESTER	Hioki	3805	51201197	01/06/2020	12
RE/CE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
RE/CE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MOS-27	141566	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	A08Q26	01/07/2020	12
RE	MMM-03	141530	Digital Tester	Fluke Corporation	FLUKE 26-3	78030621	08/18/2020	12
RE	MJM-25	142226	Measure	KOMELON	KMC-36	-	-	-
RE	MAEC-01-SVSWR	141994	AC1_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 10m	DA-06881	04/16/2019	24
RE	MHA-05	141511	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	253	09/03/2019	12
RE	MCC-217	141393	Microwave Cable	Junkosha	MWX221	1604S254(1 m) / 1608S088(5 m)	08/06/2019	12
RE	MPA-01	141576	Pre Amplifier	Keysight Technologies Inc	8449B	3008A01671	02/20/2020	12
RE	MHF-06	141404	High Pass Filter 3.5-24GHz	TOKIMEC	TF323DCA	601	05/25/2020	12
RE	MHA-16	141513	Horn Antenna 15-40GHz	Schwarzbeck Mess - Elektronik	BBHA9170	BBHA9170306	05/21/2020	12
RE	MSA-14	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	10/06/2019	12
RE	MAT-95	142314	Attenuator	Pasternack	PE7390-6	D/C 1504	06/17/2020	12
RE	YBA-03	197990	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHBB 9124 + BBA 9106	01365	05/17/2020	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	07/06/2020	12
RE	LA-17	160924	Logperiodic Antenna	Schwarzbeck Mess - Elektronik	VUSLP9111B	225	11/29/2019	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/10/2020	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/02/2019	12
RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2020	24
RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/07/2020	12
RE	MMM-08	141532	DIGITAL HiTESTER	Hioki	3805	51201197	01/06/2020	12
RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
RE	MAEC-03-SVSWR	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/08/2019	24
RE	MHA-20	141507	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	258	09/26/2019	12
RE	MPA-11	141580	MicroWave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	03/24/2020	12
RE	MCC-231	177964	Microwave Cable	Junkosha INC.	MMX221	1901S329(1m)/1902S579(5m)	03/02/2020	12
RE	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/04/2020	12
RE	MHF-25	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/11/2019	12

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Test equipment-2/2

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	MSA-16	141903	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186390	02/06/2020	12
AT	MPM-12	141809	Power Meter	ANRITSU	ML2495A	825002	05/07/2020	12
AT	MPSE-17	141830	Power sensor	ANRITSU	MA2411B	738285	05/07/2020	12
AT	MAT-21	141174	Attenuator(20dB) (above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	01/07/2020	12
AT	MCC-66	141328	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	04/02/2020	12
AT	MMM-12	141547	DIGITAL HiTESTER	Hioki	3805	60500120	02/03/2020	12
AT	MOS-14	141561	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1401	01/07/2020	12
AT	MTW-08	141954	Torque wrench	Huber+Suhner	74 Z-0-0-21	72555	03/12/2018	36
AT	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	08/07/2019	12
AT	MAT-90	141223	Attenuator	Weinschel Associates	WA56-10	56100306	05/25/2020	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: CE: Conducted Emission test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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