RADIO TEST REPORT

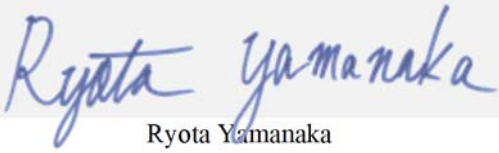
Test Report No.: 14483763H-A-R1

Customer	**DENSO TEN Limited**
Description of EUT	**Car Audio**
Model Number of EUT	**TN0040A**
FCC ID	**BABTN0040A**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**July 4, 2023**
Remarks	***WLAN part**

Representative Test Engineer

Keiya Ido
Engineer

Approved By



Ryota Yamanaka
Engineer

CERTIFICATE 5107.02

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REVISION HISTORY

Original Test Report No.: 14483763H-A

This report is a revised version of 14483763H-A. 14483763H-A is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14483763H-A	November 8, 2022	-
1	14483763H-A-R1	July 4, 2023	SECTION 2.2: Radio Specification from 4.17 dBi to 3.79 dBi (U-NII-1) 3.34 dBi (U-NII-3)
1	14483763H-A-R1	July 4, 2023	SECTION 2.2 Deletion of sentence about simultaneous transmission.
1	14483763H-A-R1	July 4, 2023	SECTION 4.2 Correction of Configuration for Radiated emission test -Correction of DC power from DC 13.2 V to DC 12 V -Deletion of item P to R and Cable 16 to 19
1	14483763H-A-R1	July 4, 2023	SECTION 4.2 Addition of Configuration for Antenna Terminal Conducted test

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS **PAGE**

SECTION 1: Customer Information **5**
SECTION 2: Equipment Under Test (EUT) **5**
SECTION 3: Test Specification, Procedures & Results **7**
SECTION 4: Operation of EUT during testing **10**
SECTION 5: Radiated Spurious Emission **14**
SECTION 6: Antenna Terminal Conducted Tests **16**
APPENDIX 1: Test Data **17**
99 % Occupied Bandwidth and 6 dB Bandwidth 17
Maximum Peak Output Power 21
Average Output Power 24
Radiated Spurious Emission 27
Conducted Spurious Emission 38
Power Density 39
APPENDIX 2: Test Instruments **42**
APPENDIX 3: Photographs of Test Setup **44**
Radiated Spurious Emission 44
Antenna Terminal Conducted Tests 45

SECTION 1: Customer Information

Company Name	DENSO TEN Limited
Address	2-28, Gosho-dori 1-chome, Hyogo-ku, Kobe, 652-8510 Japan
Telephone Number	+81-78-682-2159
Contact Person	Kaoru Abe

The information provided from the customer is as follows;
- Customer, Description 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 and Test 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

Description	Car Audio
Model Number	TN0040A
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	September 20, 2022
Test Date	September 22 to October 11, 2022

2.2 Product Description

General Specification

Rating	DC 12 V
Operating temperature	-30 deg. C to 65 deg. C

Radio Specification

WLAN (IEEE802.11b/11g/11n-20)

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS/CCK(11b), OFDM(11g, 11n)
Antenna Gain	0.63 dBi

WLAN (IEEE802.11a/11n-20/11ac-20/11n-40/11ac-40/11ac-80)

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band:	5180 MHz to 5240 MHz 5745 MHz to 5805 MHz
	40 MHz Band:	5190 MHz to 5230 MHz 5755 MHz to 5795 MHz
	80 MHz Band:	5210 MHz 5775 MHz
Type of Modulation	OFDM(11a,11n,11ac)	
Antenna Gain	3.79 dBi (U-NII-1) 3.34 dBi (U-NII-3)	

Bluetooth (BR / EDR)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS (GFSK, π/4 DQPSK, 8 DPSK)
Antenna Gain	-0.99 dBi

AM/FM (incl. RDS) / DAB

Equipment Type	Receiver
Frequency of Operation	AM: MW:522 kHz to 1710 kHz FM: 87.5 MHz to 108.0 MHz DAB (Band III): 174.928 MHz to 239.200 MHz
Type of Modulation	AM FM DAB: OFDM
Antenna Connector Type	GT21
Impedance	AM, FM: 75 ohm DAB: 50 ohm

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
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	ANSI C63.10-2013 6. Standard test methods	Section 15.207	-	N/A	*1)
6dB Bandwidth	KDB 558074 D01 15.247 Meas Guidance v05r02	Section 15.247(a)(2)	See data.	Complied a)	Conducted
Maximum Peak Output Power	KDB 558074 D01 15.247 Meas Guidance v05r02	Section 15.247(b)(3)		Complied b)	Conducted
Power Density	KDB 558074 D01 15.247 Meas Guidance v05r02	Section 15.247(e)		Complied c)	Conducted
Spurious Emission Restricted Band Edges	KDB 558074 D01 15.247 Meas Guidance v05r02	Section15.247(d)	1.7 dB 2483.5 MHz, AV, Vert.	Complied d), e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.
* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.
*2) 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 99 % Occupied Bandwidth and 6 dB Bandwidth)
b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
c) Refer to APPENDIX 1 (data of Power Density)
d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
e) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

FCC Part 15.31 (e)

This EUT provides the stable voltage constantly to RF Module regardless of input voltage.
Therefore, this 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 of Section 15.203.

3.3 Addition to Standard

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

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Radiated emission

Measurement distance	Frequency range		Uncertainty (+/-)
3 m	9 kHz to 30 MHz		3.2 dB
10 m			3.0 dB
3 m	30 MHz to 200 MHz	Horizontal	4.8 dB
		Vertical	5.0 dB
	200 MHz to 1000 MHz	Horizontal	5.1 dB
		Vertical	6.2 dB
10 m	30 MHz to 200 MHz	Horizontal	4.8 dB
		Vertical	4.8 dB
	200 MHz to 1000 MHz	Horizontal	5.0 dB
		Vertical	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		5.4 dB
	26.5 GHz to 40 GHz		5.4 dB
10 m	1 GHz to 18 GHz		5.4 dB

Antenna Terminal test

Test Item	Uncertainty (+/-)
20 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %
Maximum Peak Output Power / Average Output Power	1.5 dB
Carrier Frequency Separation	0.42 %
Dwell time / Burst rate	0.10 %
Conducted Spurious Emission	2.7 dB

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919
ISED Lab Company Number: 2973C / CAB identifier: JP0002
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan
Telephone: +81-596-24-8999

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.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

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)

[WLAN]
Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009

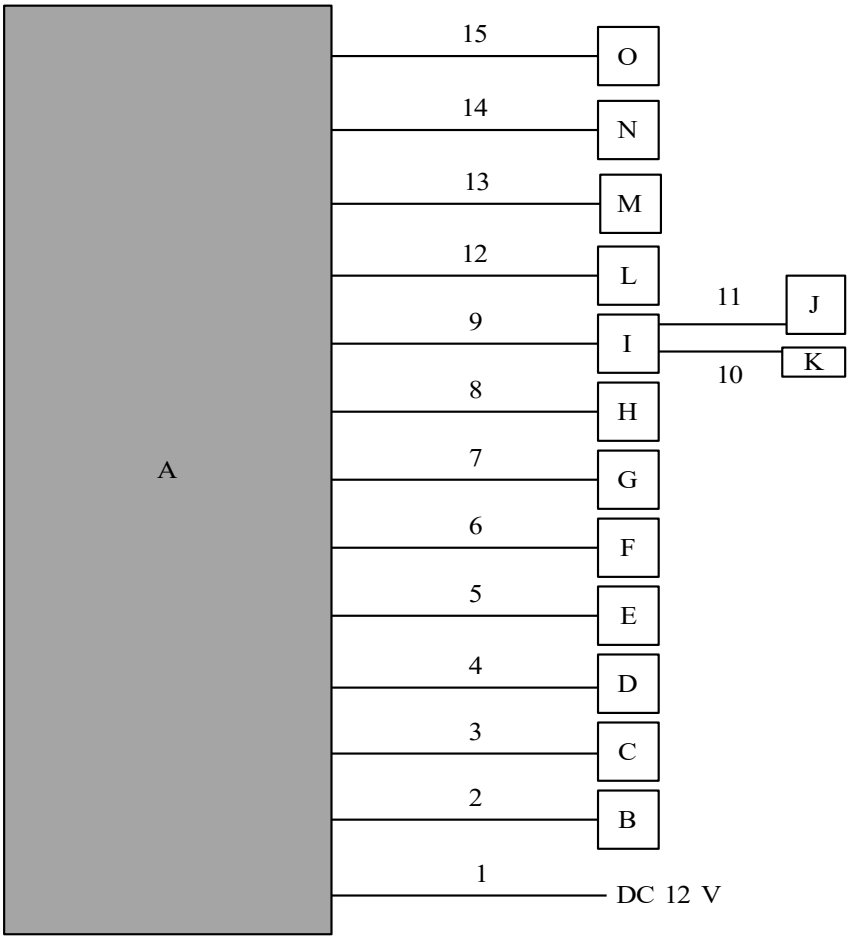
Mode	Remarks*
IEEE 802.11b (11b)	11 Mbps, PN9
IEEE 802.11g (11g)	6 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 0 (Short GI), PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
* Power of the EUT was set by the software as follows; Power Setting: 11b: +13 dBm 11g: +11 dBm 11n-20: +10 dBm Software: 1A.00.12.78.00 (Date: September 5, 2022, 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
Radiated Spurious Emission (Below 1 GHz) Conducted Spurious Emission	Tx 11n-20 *1)	2462 MHz
6dB Bandwidth, Maximum Peak Output Power, Power Density, 99% Occupied Bandwidth	Tx 11b Tx 11g Tx 11n-20	2412 MHz 2437 MHz 2462 MHz
Radiated Spurious Emission (Above 1 GHz)	Tx 11b Tx 11n-20 *2)	2412 MHz 2437 MHz 2462 MHz
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test. *2) Since 11g and 11n-20 have the same modulation method, tests were conducted for 11n-20.		

4.2 Configuration and Peripherals

For Radiated emission tests



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

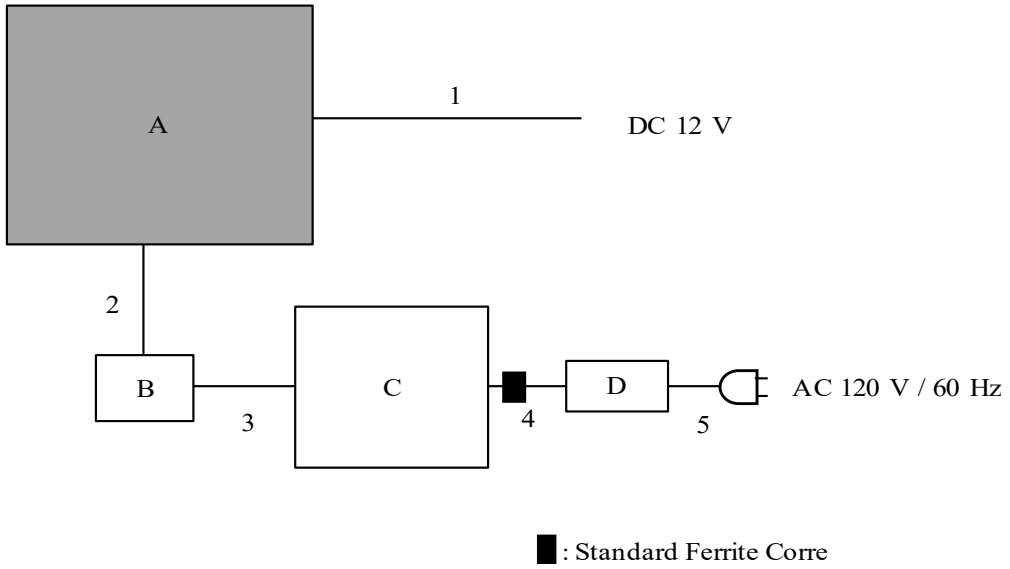
Description of EUT and Support Equipment

No.	Item	Model Number	Serial Number	Manufacturer	Remarks
A	Car Audio	TN0040A	NAVI-0029	DENSO TEN Limited	EUT
B	Microphone	8983963631	1Y141500310277	Transtron	-
C	Analog Camera	8983980531	0289018	Faurecia Clarion Electronics	-
D	Digital Camera	5JX4707170	0112	AISIN	-
E	Steering Switch	876521340	-	TOYODENSO	-
F	Meter	8976834551	A220405111418	YAZAKI	-
G	Radio and DAB Antenna	8983960350	-	HARADA INDUSTRY	-
H	GPS Antenna	8983963531	-	JVCKENWOOD	-
I	Rear USB CN	-	No.1	-	-
J	Smartphone	Pixel 4a(5G)	87667	-	-
K	USB Memory	RUF3-K8GA-BK/N	P90611	BUFFALO	-
L	Speaker	-	-	-	-
M	Speaker	-	-	-	-
N	Speaker	-	-	-	-
O	Speaker	-	-	-	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	5.0	Unshielded	Unshielded	-
2	MIC Cable	3.0	Unshielded	Unshielded	-
3	Signal Cable	3.0	Unshielded	Unshielded	-
4	Signal Cable	9.6	Unshielded	Unshielded	-
5	Signal Cable	3.0	Unshielded	Unshielded	-
6	Signal Cable	3.0	Unshielded	Unshielded	-
7	Antenna Cable	2.7	Shielded	Shielded	-
8	GNSS Antenna Cable	3.0	Shielded	Shielded	-
9	Signal Cable	3.0	Unshielded	Unshielded	-
10	USB Cable	3.0	Shielded	Shielded	-
11	USB Cable	1.6	Shielded	Shielded	-
12	Speaker Cable	3.0	Unshielded	Unshielded	-
13	Speaker Cable	3.0	Unshielded	Unshielded	-
14	Speaker Cable	3.0	Unshielded	Unshielded	-
15	Speaker Cable	3.0	Unshielded	Unshielded	-

For Antenna Terminal Conducted tests



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

No.	Item	Model Number	Serial Number	Manufacturer	Remarks
A	Car Audio	TN0040A	NAVI-0024	DENSO TEN Limited	EUT
B	RG14 Debug Board	-	-	-	-
C	Laptop PC	X1 Carbon	R90OH8TU 15/9	Lenovo	-
D	AC Adaptor	ADLX45NCC2A	8SSA10E75794C1SG59R0GHF	Lenovo	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	5.0	Unshielded	Unshielded	-
2	Flexible Flat Cable	0.1	Unshielded	Unshielded	-
3	USB Cable	1.5	Shielded	Shielded	-
4	DC Cable	1.7	Unshielded	Unshielded	-
5	AC Cable	1.0	Unshielded	Unshielded	-

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, 1.0 m by 1.5 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.

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.

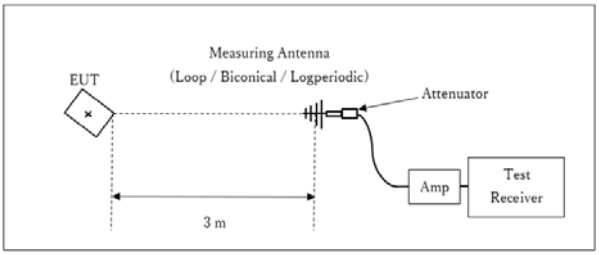
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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.

Figure 1: Test Setup

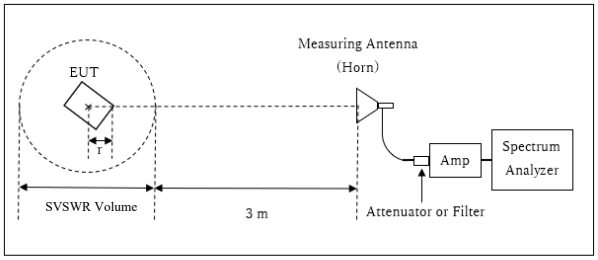
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz

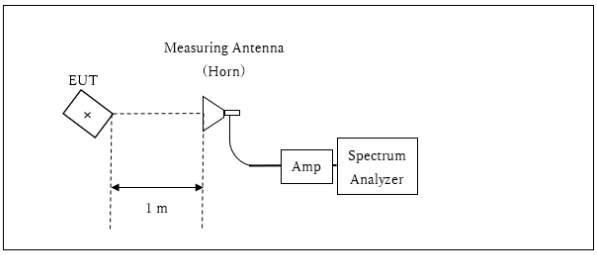


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.6 m / 3.0 m) = 1.59 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.6 m

SVSWR Volume : 1.5 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.15 m

10 GHz to 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 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 to 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
6dB Bandwidth	20 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4) *5)	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)
*5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 – 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

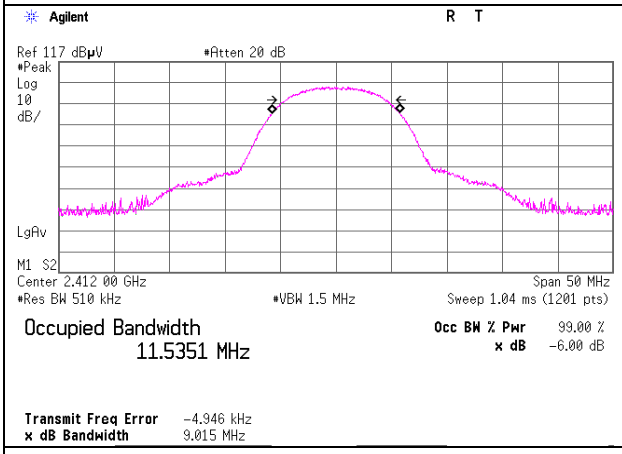
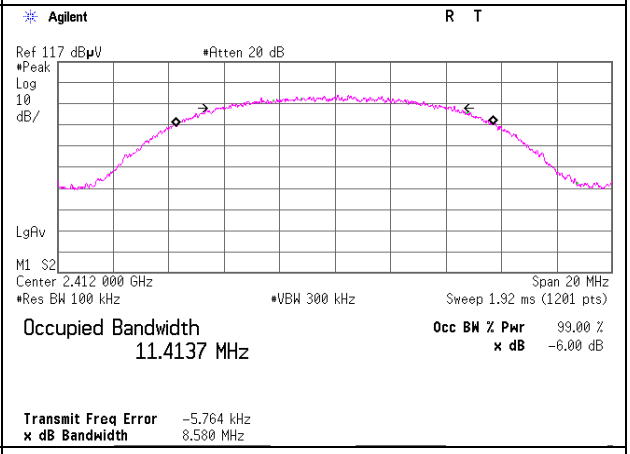
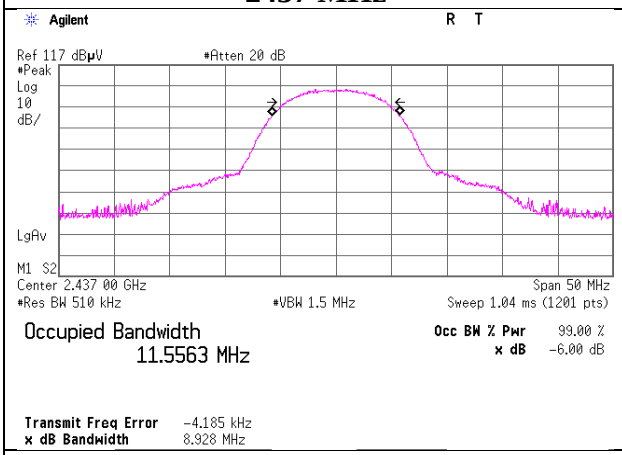
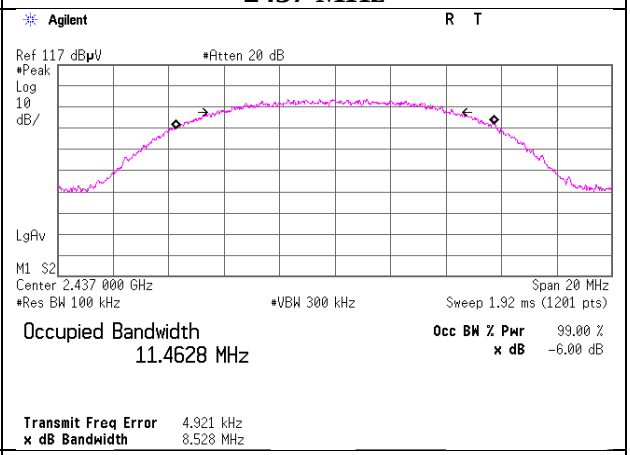
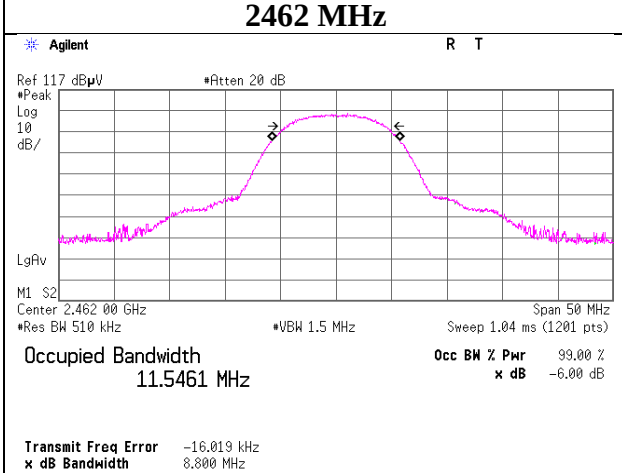
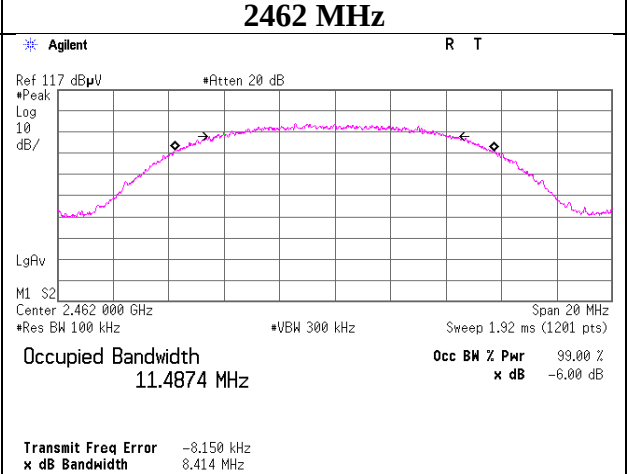
99 % Occupied Bandwidth and 6 dB Bandwidth

Test place	Ise EMC Lab. No.4 Measurement Room
Date	October 11, 2022
Temperature / Humidity	23 deg. C / 55 % RH
Engineer	Takumi Nishida
Mode	Tx

Mode	Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
11b	2412	11535.1	8.580	> 0.5000
	2437	11556.3	8.528	> 0.5000
	2462	11546.1	8.414	> 0.5000
11g	2412	17685.6	16.356	> 0.5000
	2437	17715.1	16.350	> 0.5000
	2462	17724.2	16.353	> 0.5000
11n-20	2412	18458.2	17.594	> 0.5000
	2437	18522.4	17.615	> 0.5000
	2462	18443.1	17.617	> 0.5000

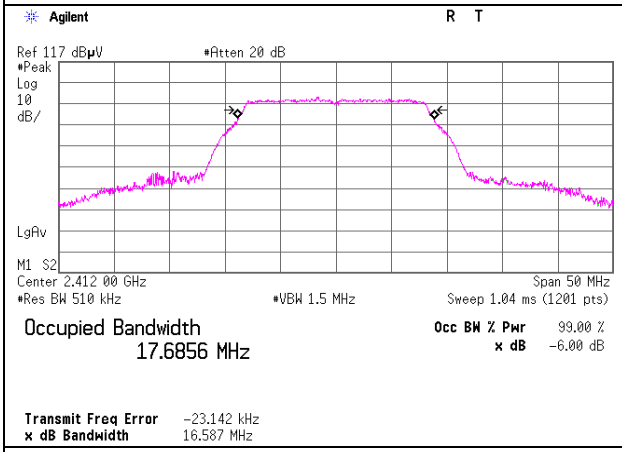
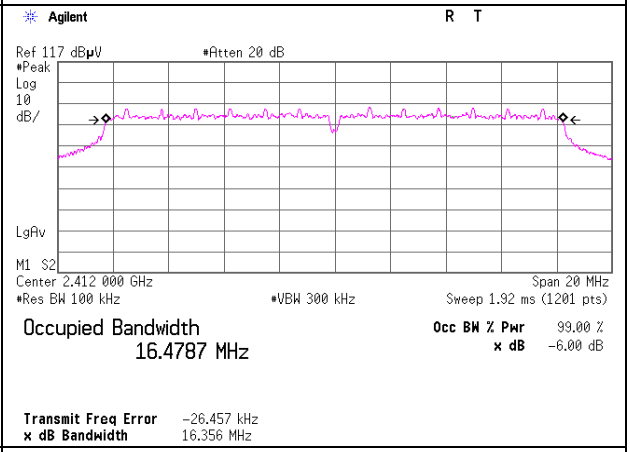
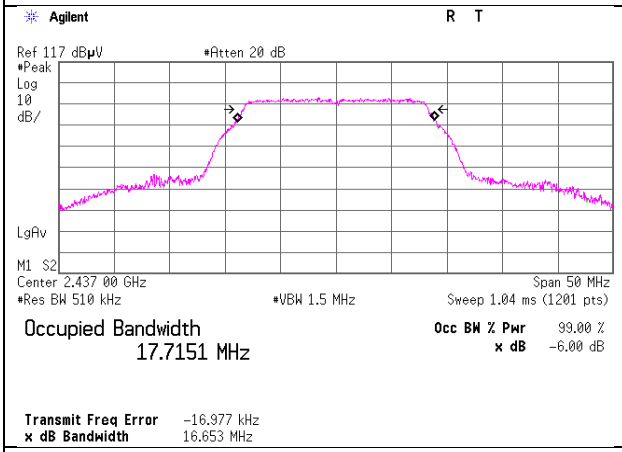
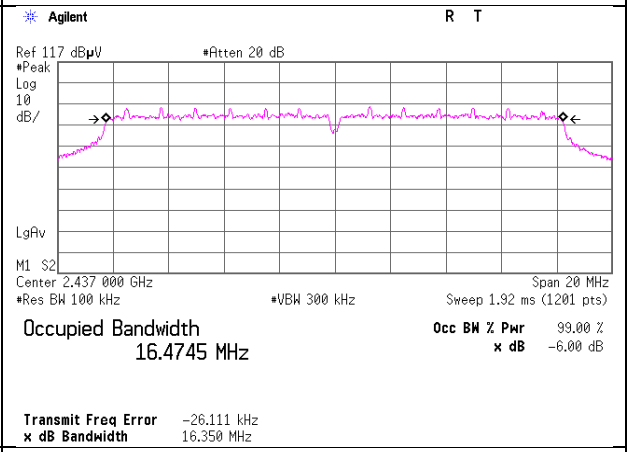
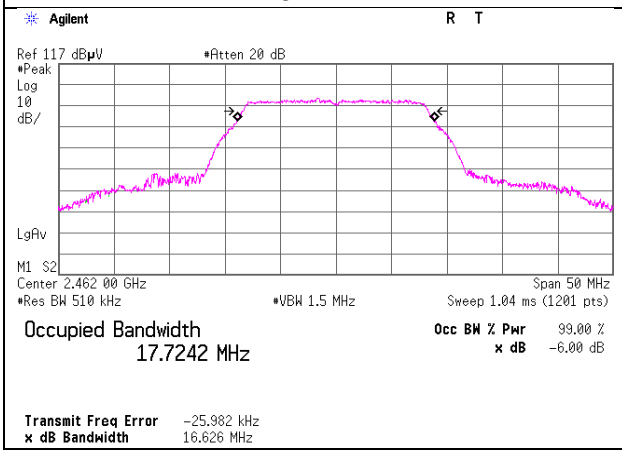
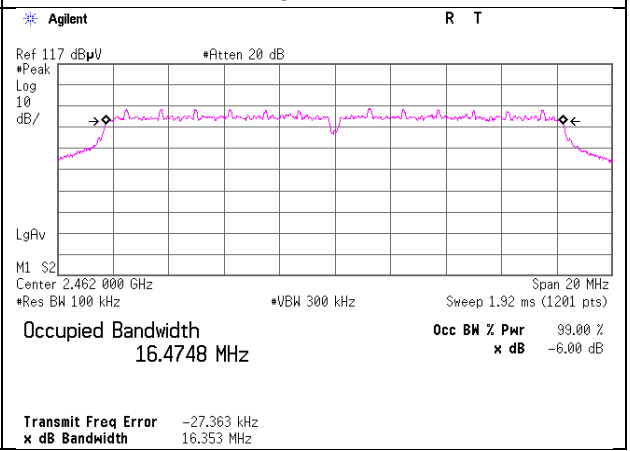
99 % Occupied Bandwidth and 6 dB Bandwidth

11b

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

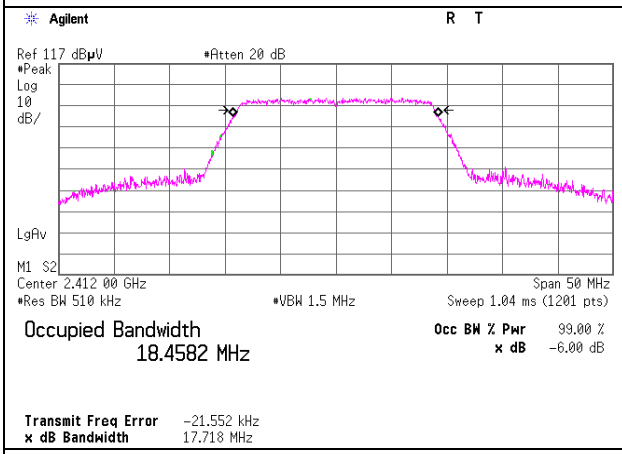
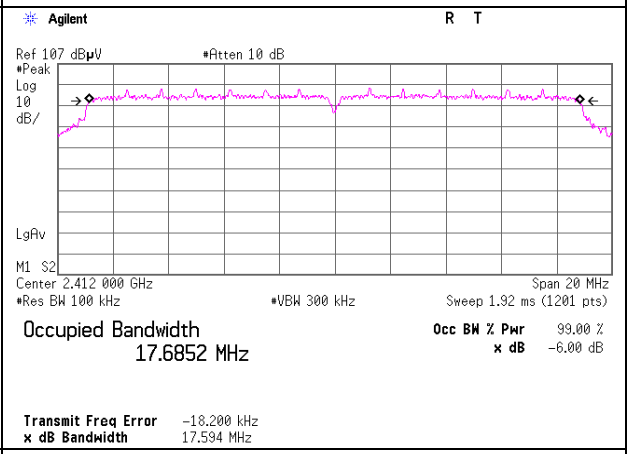
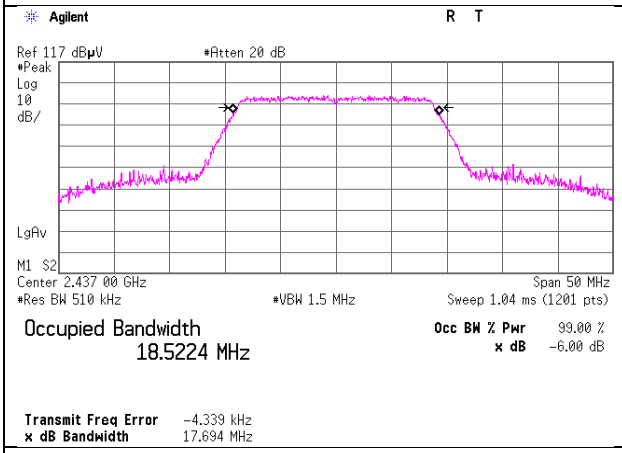
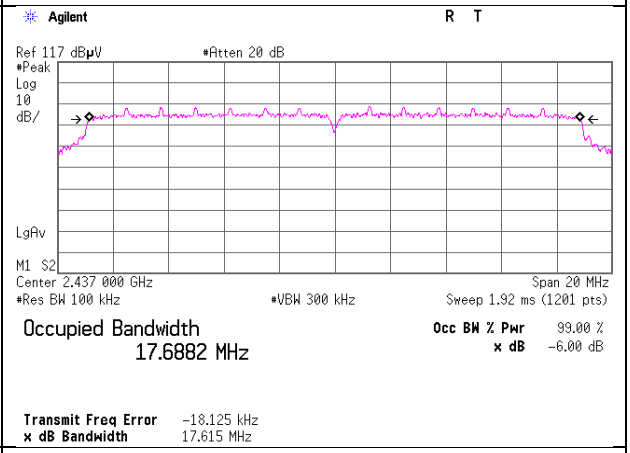
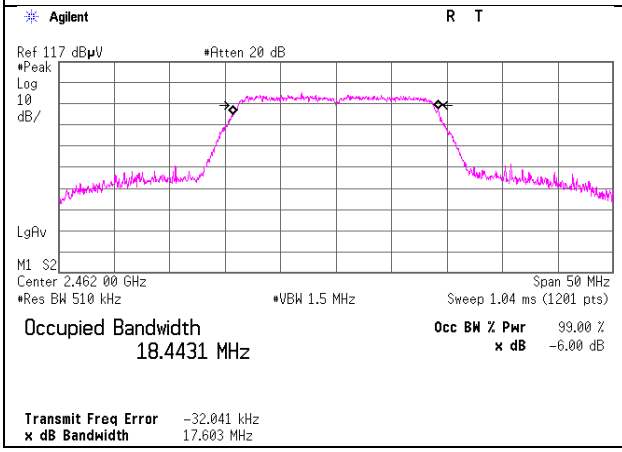
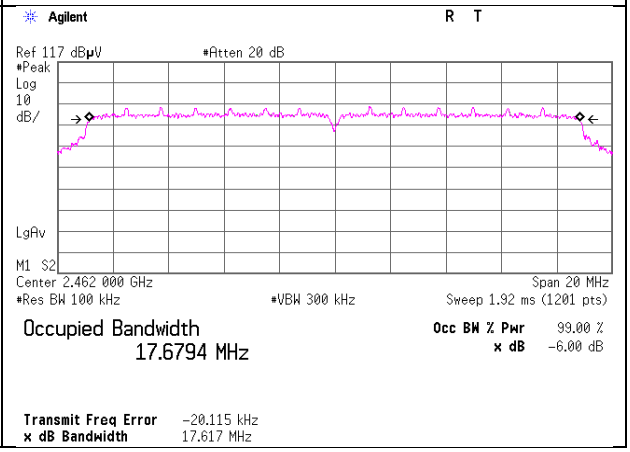
99 % Occupied Bandwidth and 6 dB Bandwidth

11g

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	2412 MHz
	
2437 MHz	2437 MHz
	
2462 MHz	2462 MHz
	

99 % Occupied Bandwidth and 6 dB Bandwidth

11n-20

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

Maximum Peak Output Power

Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 22, 2022
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Tetsuro Yoshida
Mode	Tx 11b

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	5.59	0.54	10.08	16.21	41.76	30.00	1000	13.79	0.63	16.84	48.28	36.02	4000	19.18
2437	5.74	0.50	10.08	16.32	42.88	30.00	1000	13.68	0.63	16.95	49.58	36.02	4000	19.07
2462	5.89	0.46	10.08	16.43	43.92	30.00	1000	13.57	0.63	17.06	50.78	36.02	4000	18.96

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.

2437MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	5.18	
2	5.53	
5.5	5.55	
11	5.74	*

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 22, 2022
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Tetsuro Yoshida
Mode	Tx 11g

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	10.55	0.54	10.08	21.17	130.92	30.00	1000	8.83	0.63	21.80	151.36	36.02	4000	14.22
2437	10.78	0.50	10.08	21.36	136.77	30.00	1000	8.64	0.63	21.99	158.12	36.02	4000	14.03
2462	11.00	0.46	10.08	21.54	142.56	30.00	1000	8.46	0.63	22.17	164.82	36.02	4000	13.85

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.

2437 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	10.78	*
9	10.44	
12	10.27	
18	10.19	
24	9.44	
36	9.62	
48	10.56	
54	9.04	

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 22, 2022
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Tetsuro Yoshida
Mode	Tx 11n-20

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	10.74	0.54	10.08	21.36	136.77	30.00	1000	8.64	0.63	21.99	158.12	36.02	4000	14.03
2437	11.14	0.50	10.08	21.72	148.59	30.00	1000	8.28	0.63	22.35	171.79	36.02	4000	13.67
2462	11.32	0.46	10.08	21.86	153.46	30.00	1000	8.14	0.63	22.49	177.42	36.02	4000	13.53

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.

2437 MHz

Rate	Reading		Remark
	SGI	LGI	
[MCS]	[dBm]	[dBm]	
0	11.14	11.00	*
1	11.01		
2	10.66		
3	10.56		
4	10.51		
5	10.87		
6	10.62		
7	9.48		

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Average Output Power
(Reference data for RF Exposure)

Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 22, 2022
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Tetsuro Yoshida
Mode	Tx

11b **1 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	1.67	0.54	10.08	12.29	16.94	0.04	12.33	17.10
2437	1.95	0.50	10.08	12.53	17.91	0.04	12.57	18.07
2462	2.02	0.46	10.08	12.56	18.03	0.04	12.60	18.20

11g **6 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-0.28	0.54	10.08	10.34	10.81	0.29	10.63	11.56
2437	-0.02	0.50	10.08	10.56	11.38	0.29	10.85	12.16
2462	0.14	0.46	10.08	10.68	11.69	0.29	10.97	12.50

11n-20 **MCS 0**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-0.20	0.54	10.08	10.42	11.02	0.34	10.76	11.91
2437	-0.08	0.50	10.08	10.50	11.22	0.34	10.84	12.13
2462	0.12	0.46	10.08	10.66	11.64	0.34	11.00	12.59

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.

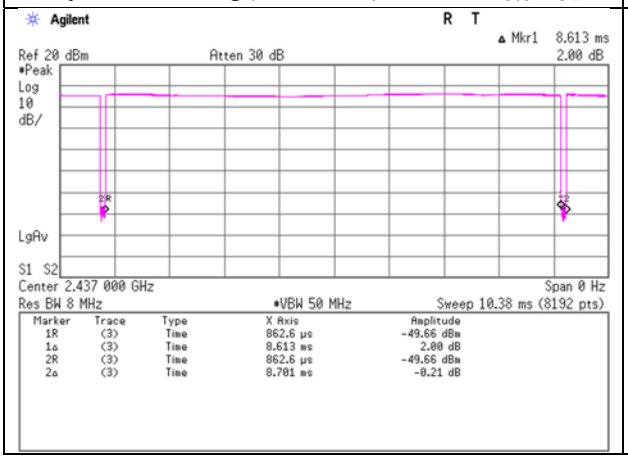
The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.

Burst rate confirmation

Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 22, 2022
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Tetsuro Yoshida
Mode	Tx

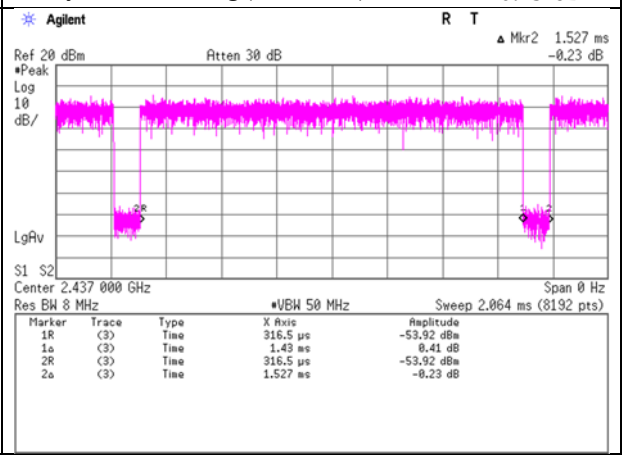
11b 1 Mbps

Tx on / (Tx on + Tx off) =	**0.990**
Tx on / (Tx on + Tx off) * 100 =	**99.0 %**
Duty factor = 10 * log (8.701 / 8.613) =	**0.04 dB**



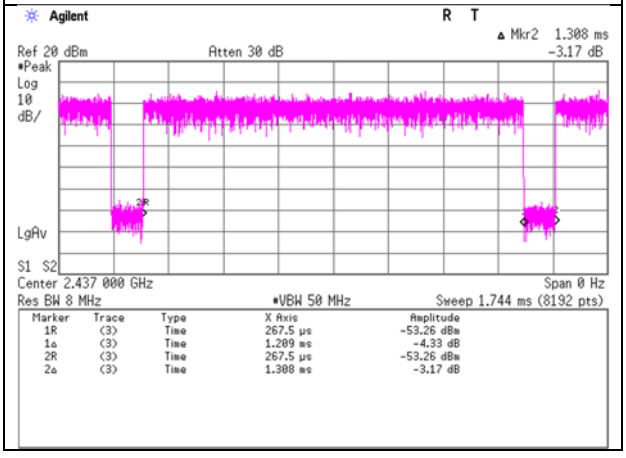
11g 6 Mbps

Tx on / (Tx on + Tx off) =	**0.936**
Tx on / (Tx on + Tx off) * 100 =	**93.6 %**
Duty factor = 10 * log (1.527 / 1.43) =	**0.29 dB**



11n-20 MCS 0 SGI

Tx on / (Tx on + Tx off) =	**0.924**
Tx on / (Tx on + Tx off) * 100 =	**92.4 %**
Duty factor = 10 * log (1.308 / 1.209) =	**0.34 dB**



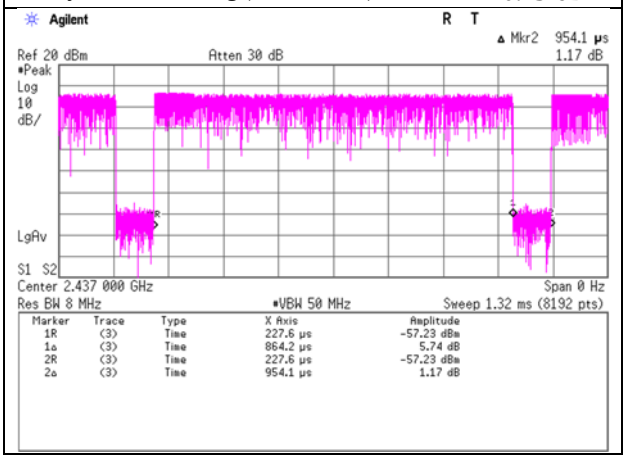
* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Burst rate confirmation

Test place	Ise EMC Lab. No.8 Measurement Room	
Date	September 22, 2022	September 22, 2022
Temperature / Humidity	24 deg. C / 50 % RH	24 deg. C / 50 % RH
Engineer	Tetsuro Yoshida	Tetsuro Yoshida
Mode	Tx	

11b 11 Mbps

Tx on / (Tx on + Tx off) = **0.906**
Tx on / (Tx on + Tx off) * 100 = **90.6 %**
Duty factor = 10 * log (954.1 / 864.2) = **0.43 dB**



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

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	September 30, 2022	October 5, 2022
Temperature / Humidity	22 deg. C / 64 % RH	24 deg. C / 50 % RH
Engineer	Nachi Konegawa	Hiroyuki Furutaka
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx 11b 2412 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	2390.0	51.9	39.4	27.6	4.8	34.9	0.4	49.4	37.4	73.9	53.9	24.5	16.5	*1)
Hori.	4824.0	43.0	34.4	31.5	7.1	34.1	-	47.5	38.9	73.9	53.9	26.4	15.0	Floor noise
Hori.	7236.0	43.3	35.3	35.9	8.3	34.1	-	53.4	45.4	73.9	53.9	20.5	8.6	Floor noise
Hori.	9648.0	46.3	34.4	38.8	9.2	34.7	-	59.6	47.7	73.9	53.9	14.3	6.2	Floor noise
Vert.	2390.0	54.6	41.8	27.6	4.8	34.9	0.4	52.1	39.8	73.9	53.9	21.8	14.1	*1)
Vert.	4824.0	43.0	34.4	31.5	7.1	34.1	-	47.5	38.9	73.9	53.9	26.4	15.0	Floor noise
Vert.	7236.0	43.3	35.3	35.9	8.3	34.1	-	53.4	45.4	73.9	53.9	20.5	8.6	Floor noise
Vert.	9648.0	46.3	34.4	38.8	9.2	34.7	-	59.6	47.7	73.9	53.9	14.3	6.2	Floor noise

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

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

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

*QP detector was used up to 1GHz.

*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.0	98.0	27.5	4.8	34.9	95.5	-	-	Carrier
Hori.	2400.0	50.3	27.6	4.8	34.9	47.8	75.5	27.7	
Vert.	2412.0	100.8	27.5	4.8	34.9	98.2	-	-	Carrier
Vert.	2400.0	53.3	27.6	4.8	34.9	50.8	78.2	27.4	

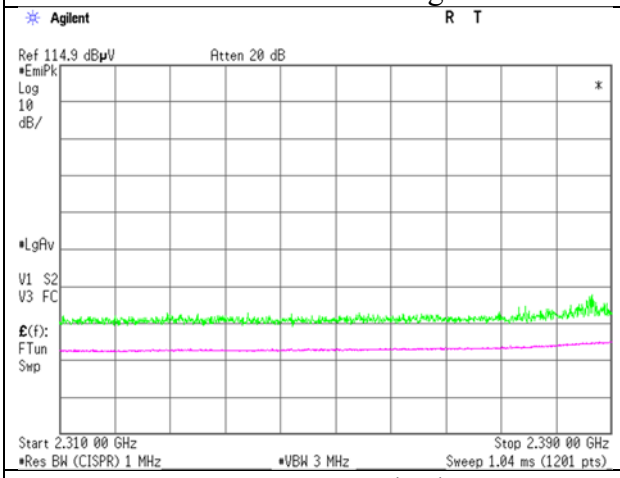
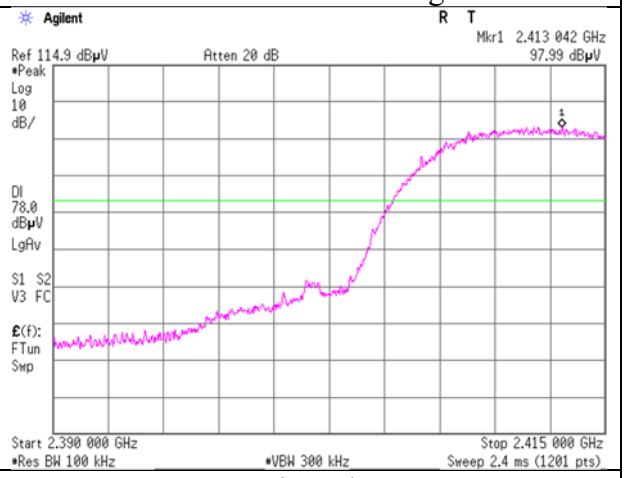
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

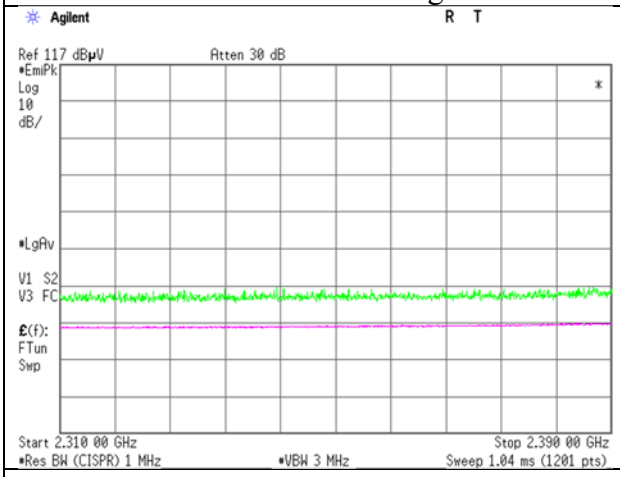
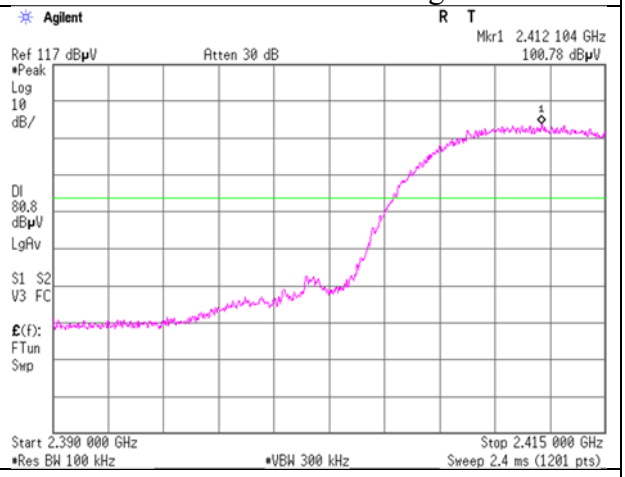
Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB

10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	September 30, 2022
Temperature / Humidity	22 deg. C / 64 % RH
Engineer	Nachi Konegawa
	(1 GHz - 10 GHz)
Mode	Tx 11b 2412 MHz

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

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

* 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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	September 30, 2022	October 5, 2022
Temperature / Humidity	22 deg. C / 64 % RH	24 deg. C / 50 % RH
Engineer	Nachi Konegawa	Hiroyuki Furutaka
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx 11b 2437 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	4874.0	44.4	34.6	31.5	7.1	34.1	-	48.9	39.1	73.9	53.9	25.0	14.8	Floor noise
Hori.	7311.0	43.5	34.9	36.0	8.3	34.1	-	53.7	45.1	73.9	53.9	20.2	8.8	Floor noise
Hori.	9748.0	45.6	34.3	39.0	9.2	34.7	-	59.1	47.8	73.9	53.9	14.8	6.1	Floor noise
Vert.	4874.0	44.4	34.6	31.5	7.1	34.1	-	48.9	39.1	73.9	53.9	25.0	14.8	Floor noise
Vert.	7311.0	43.5	34.9	36.0	8.3	34.1	-	53.7	45.1	73.9	53.9	20.2	8.8	Floor noise
Vert.	9748.0	45.6	34.3	39.0	9.2	34.7	-	59.1	47.8	73.9	53.9	14.8	6.1	Floor noise

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

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

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

*QP detector was used up to 1GHz.

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	September 30, 2022	October 5, 2022
Temperature / Humidity	22 deg. C / 64 % RH	24 deg. C / 50 % RH
Engineer	Nachi Konegawa	Hiroyuki Furutaka
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx 11b 2462 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	2483.5	50.4	38.6	27.5	3.3	34.9	0.4	46.3	35.0	73.9	53.9	27.6	19.0	*1)
Hori.	4924.0	42.8	34.4	31.5	7.1	34.1	-	47.2	38.9	73.9	53.9	26.7	15.1	Floor noise
Hori.	7386.0	43.5	34.6	36.1	8.3	34.1	-	53.7	44.9	73.9	53.9	20.2	9.0	Floor noise
Hori.	9848.0	45.5	34.2	39.1	9.2	34.7	-	59.1	47.8	73.9	53.9	14.8	6.1	Floor noise
Vert.	2483.5	56.8	43.4	27.5	3.3	34.9	0.4	52.6	39.7	73.9	53.9	21.3	14.2	*1)
Vert.	4924.0	42.8	34.4	31.5	7.1	34.1	-	47.2	38.9	73.9	53.9	26.7	15.1	Floor noise
Vert.	7386.0	43.5	34.6	36.1	8.3	34.1	-	53.7	44.9	73.9	53.9	20.2	9.0	Floor noise
Vert.	9848.0	45.5	34.2	39.1	9.2	34.7	-	59.1	47.8	73.9	53.9	14.8	6.1	Floor noise

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

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

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

*QP detector was used up to 1GHz.

*1) Not Out of Band emission(Leakage Power)

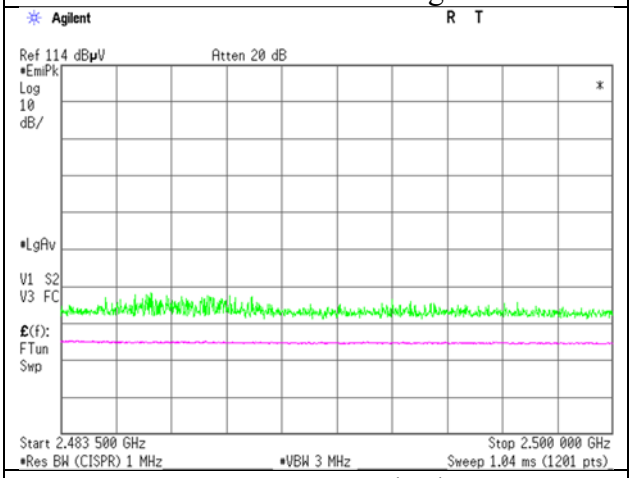
Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	September 30, 2022
Temperature / Humidity	22 deg. C / 64 % RH
Engineer	Nachi Konegawa
	(1 GHz - 10 GHz)
Mode	Tx 11b 2462 MHz

Horizontal

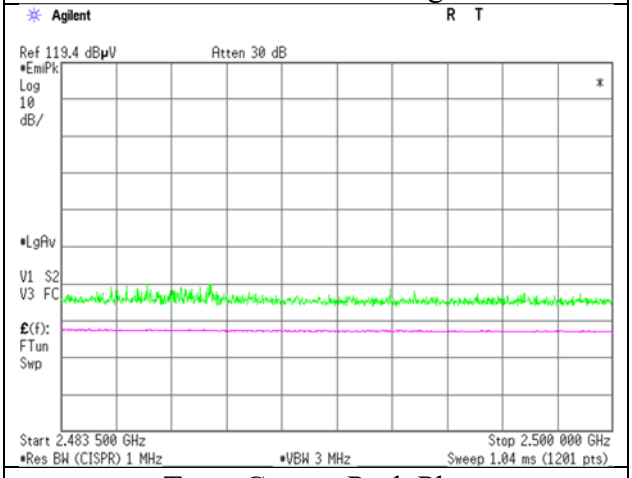
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

* 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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	September 30, 2022	October 5, 2022
Temperature / Humidity	22 deg. C / 64 % RH	24 deg. C / 50 % RH
Engineer	Nachi Konegawa	Hiroyuki Furutaka
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx 11n-20 2412 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	2390.0	60.4	44.9	27.6	3.2	34.9	0.3	56.3	41.2	73.9	53.9	17.6	12.7	*1)
Hori.	4824.0	43.0	34.4	31.5	7.1	34.1	-	47.5	38.9	73.9	53.9	26.4	15.0	Floor noise
Hori.	7236.0	43.3	35.3	35.9	8.3	34.1	-	53.4	45.4	73.9	53.9	20.5	8.6	Floor noise
Hori.	9648.0	46.3	34.4	38.8	9.2	34.7	-	59.6	47.7	73.9	53.9	14.3	6.2	Floor noise
Vert.	2390.0	63.6	45.9	27.6	3.2	34.9	0.3	59.6	42.1	73.9	53.9	14.4	11.8	*1)
Vert.	4824.0	43.0	34.4	31.5	7.1	34.1	-	47.5	38.9	73.9	53.9	26.4	15.0	Floor noise
Vert.	7236.0	43.3	35.3	35.9	8.3	34.1	-	53.4	45.4	73.9	53.9	20.5	8.6	Floor noise
Vert.	9648.0	46.3	34.4	38.8	9.2	34.7	-	59.6	47.7	73.9	53.9	14.3	6.2	Floor noise

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

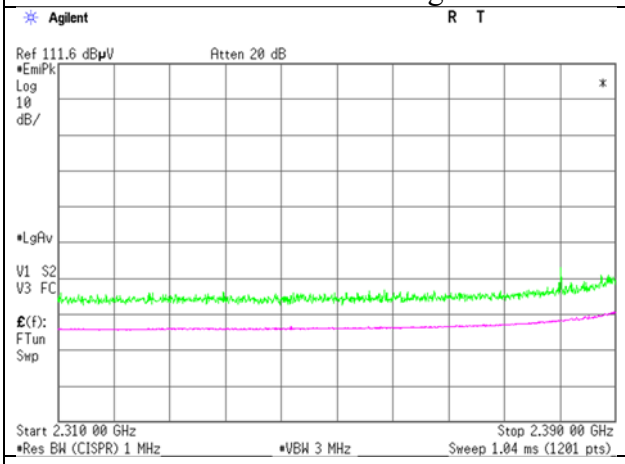
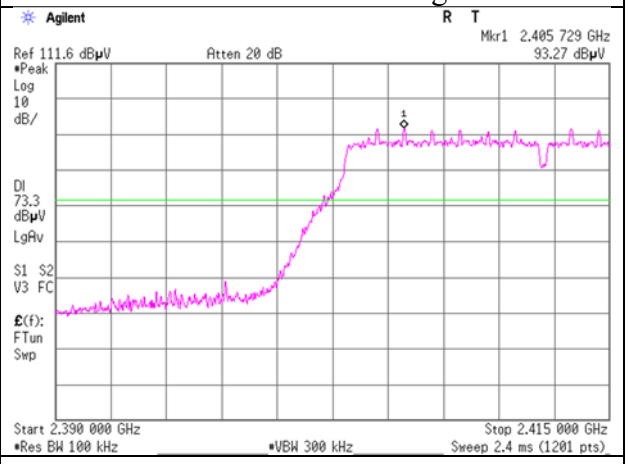
Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.0	93.3	27.5	3.2	34.9	89.2	-	-	Carrier
Hori.	2400.0	51.8	27.6	3.2	34.9	47.7	69.2	21.5	
Vert.	2412.0	95.5	27.5	3.2	34.9	91.3	-	-	Carrier
Vert.	2400.0	54.4	27.6	3.2	34.9	50.3	71.3	21.0	

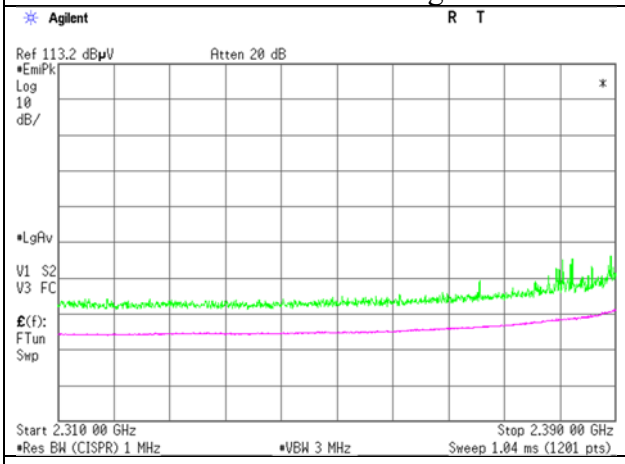
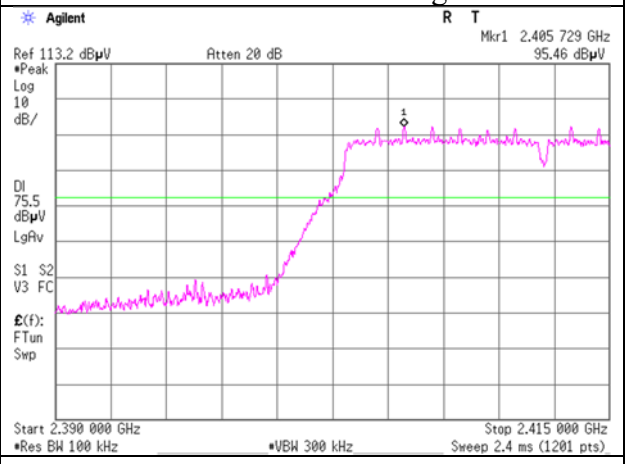
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	September 30, 2022
Temperature / Humidity	22 deg. C / 64 % RH
Engineer	Nachi Konegawa
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 MHz

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

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

* 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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	September 30, 2022	October 5, 2022
Temperature / Humidity	22 deg. C / 64 % RH	24 deg. C / 50 % RH
Engineer	Nachi Konegawa	Hiroyuki Furutaka
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx 11n-20 2437 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	4874.0	44.4	34.6	31.5	7.1	34.1	-	48.9	39.1	73.9	53.9	25.0	14.8	Floor noise
Hori.	7311.0	43.5	34.9	36.0	8.3	34.1	-	53.7	45.1	73.9	53.9	20.2	8.8	Floor noise
Hori.	9748.0	45.6	34.3	39.0	9.2	34.7	-	59.1	47.8	73.9	53.9	14.8	6.1	Floor noise
Vert.	4874.0	44.4	34.6	31.5	7.1	34.1	-	48.9	39.1	73.9	53.9	25.0	14.8	Floor noise
Vert.	7311.0	43.5	34.9	36.0	8.3	34.1	-	53.7	45.1	73.9	53.9	20.2	8.8	Floor noise
Vert.	9748.0	45.6	34.3	39.0	9.2	34.7	-	59.1	47.8	73.9	53.9	14.8	6.1	Floor noise

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

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

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

*QP detector was used up to 1GHz.

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB

10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	September 30, 2022	October 5, 2022	October 6, 2022
Temperature / Humidity	22 deg. C / 64 % RH	24 deg. C / 50 % RH	22 deg. C / 42 % RH
Engineer	Nachi Konegawa	Hiroyuki Furutaka	Keiya Ido
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx 11n-20 2462 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	99.8	34.7	-	10.3	7.4	28.4	-	23.9	-	43.5	-	19.6	-	
Hori.	200.0	47.5	-	11.9	8.1	28.0	-	39.5	-	43.5	-	4.0	-	
Hori.	234.5	37.1	-	12.2	8.3	27.8	-	29.7	-	46.0	-	16.3	-	
Hori.	244.0	36.3	-	12.1	8.4	27.8	-	29.0	-	46.0	-	17.0	-	
Hori.	800.0	32.2	-	20.9	10.9	29.1	-	34.9	-	46.0	-	11.1	-	
Hori.	926.2	33.4	-	22.2	11.3	28.8	-	38.1	-	46.0	-	7.9	-	
Hori.	2483.5	63.2	46.2	27.5	4.9	34.9	0.3	60.7	44.0	73.9	53.9	13.2	9.9	*1)
Hori.	4924.0	42.8	34.4	31.5	6.3	34.1	-	46.5	38.1	73.9	53.9	27.4	15.8	Floor noise
Hori.	7386.0	43.5	34.6	36.1	7.5	34.1	-	53.0	44.1	73.9	53.9	20.9	9.8	Floor noise
Hori.	9848.0	45.5	34.2	39.1	8.4	34.7	-	58.2	46.9	73.9	53.9	15.7	7.0	Floor noise
Vert.	99.8	31.9	-	10.3	7.4	28.4	-	21.1	-	43.5	-	22.4	-	
Vert.	200.0	40.0	-	11.9	8.1	28.0	-	32.0	-	43.5	-	11.5	-	
Vert.	234.5	34.8	-	12.2	8.3	27.8	-	27.4	-	46.0	-	18.6	-	
Vert.	244.0	32.4	-	12.1	8.4	27.8	-	25.1	-	46.0	-	20.9	-	
Vert.	800.0	34.8	-	20.9	10.9	29.1	-	37.5	-	46.0	-	8.5	-	
Vert.	926.2	31.6	-	22.2	11.3	28.8	-	36.3	-	46.0	-	9.7	-	
Vert.	2483.5	69.1	54.4	27.5	4.9	34.9	0.3	66.6	52.2	73.9	53.9	7.3	1.7	*1)
Vert.	4924.0	42.8	34.4	31.5	6.3	34.1	-	46.5	38.1	73.9	53.9	27.4	15.8	Floor noise
Vert.	7386.0	43.5	34.6	36.1	7.5	34.1	-	53.0	44.1	73.9	53.9	20.9	9.8	Floor noise
Vert.	9848.0	45.5	34.2	39.1	8.4	34.7	-	58.2	46.9	73.9	53.9	15.7	7.0	Floor noise

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

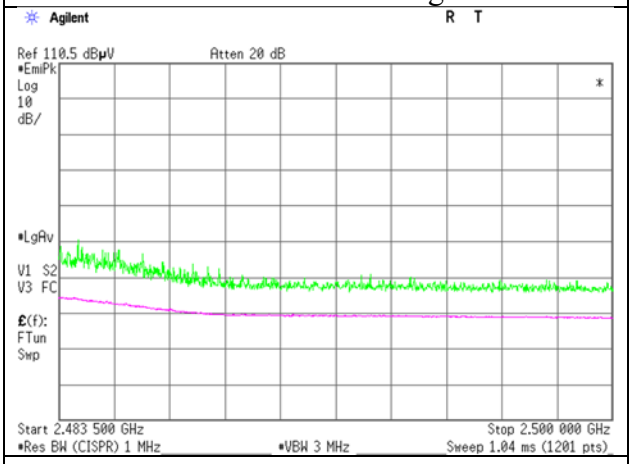
Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	September 30, 2022
Temperature / Humidity	22 deg. C / 64 % RH
Engineer	Nachi Konegawa
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2462 MHz

Horizontal

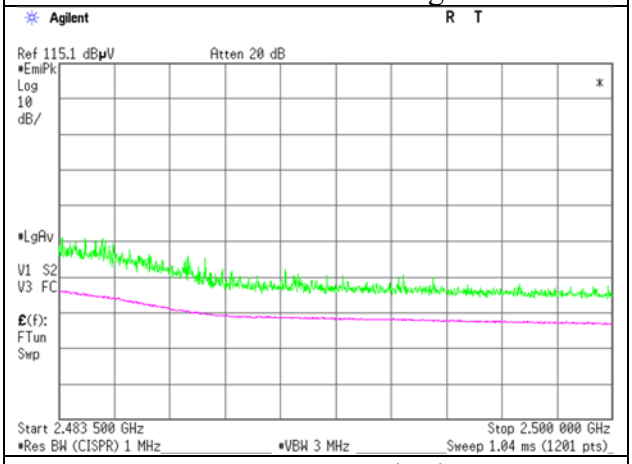
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

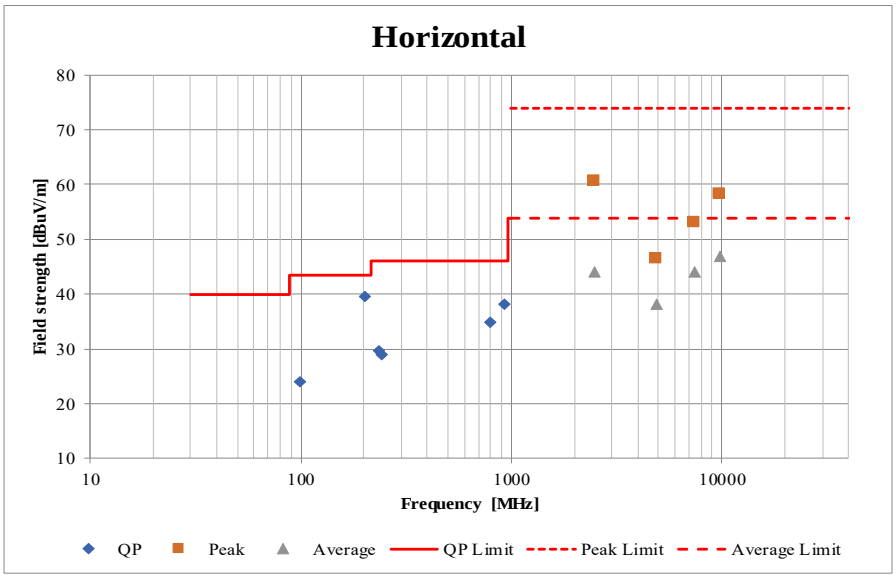


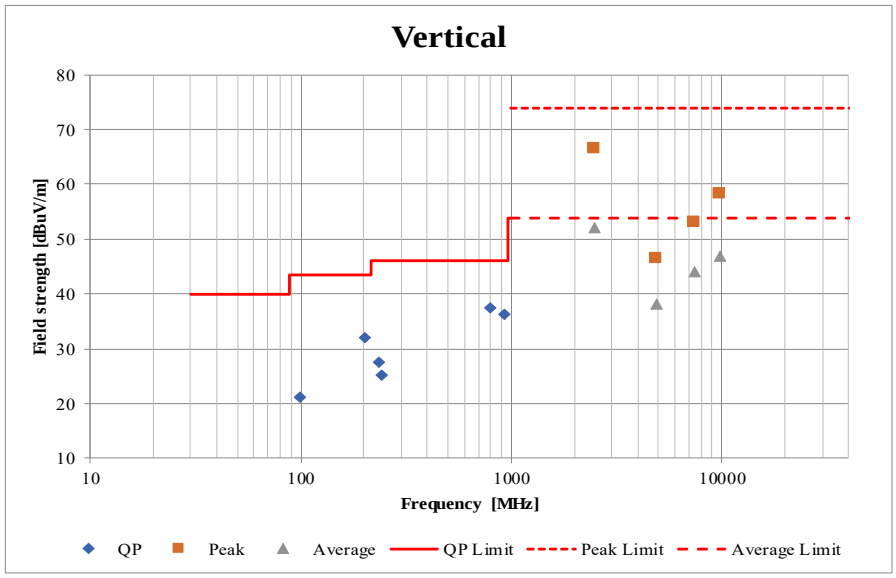
Trace Green : Peak Plot
Trace Purple : Average Plot

* 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 mode for Maximum Peak Output Power)

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	September 30, 2022	October 5, 2022	October 6, 2022
Temperature / Humidity	22 deg. C / 64 % RH	24 deg. C / 50 % RH	22 deg. C / 42 % RH
Engineer	Nachi Konegawa	Hiroyuki Furutaka	Keiya Ido
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)	(Below 1 GHz)
Mode	Tx 11n-20 2462 MHz		



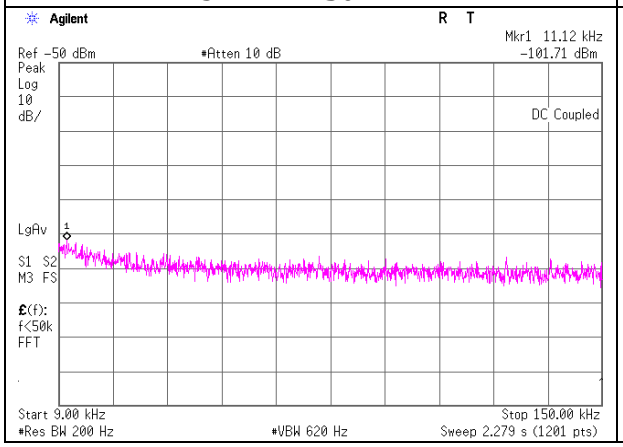


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

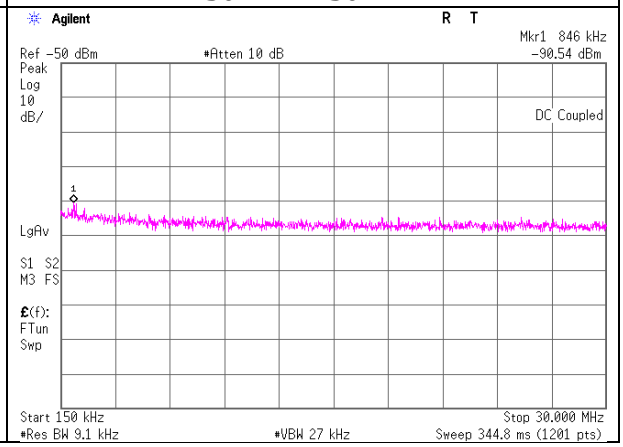
Conducted Spurious Emission

Test place	Ise EMC Lab. No.4 Measurement Room
Date	October 11, 2022
Temperature / Humidity	23 deg. C / 55 % RH
Engineer	Takumi Nishida
Mode	Tx 11n-20 2462 MHz

9 kHz - 150 kHz



150 kHz - 30 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
11.12	-101.7	0.02	9.8	2.0	1	-89.9	300	6.0	-28.6	46.6	75.2	
846.00	-90.5	0.27	9.9	2.0	1	-78.4	30	6.0	2.9	29.0	26.1	

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.

Power Density

Test place	Ise EMC Lab. No.4 Measurement Room
Date	October 11, 2022
Temperature / Humidity	23 deg. C / 55 % RH
Engineer	Takumi Nishida
Mode	Tx

11b

Freq. [MHz]	Reading [dBm / 3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2412	-20.92	1.40	10.08	-9.44	8.00	17.44
2437	-20.91	1.36	10.08	-9.47	8.00	17.47
2462	-20.81	1.32	10.08	-9.41	8.00	17.41

11g

Freq. [MHz]	Reading [dBm / 3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2412	-24.79	1.40	10.08	-13.31	8.00	21.31
2437	-24.58	1.36	10.08	-13.14	8.00	21.14
2462	-24.36	1.32	10.08	-12.96	8.00	20.96

11n-20

Freq. [MHz]	Reading [dBm / 3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2412	-27.05	1.40	10.08	-15.57	8.00	23.57
2437	-26.45	1.36	10.08	-15.01	8.00	23.01
2462	-26.08	1.32	10.08	-14.68	8.00	22.68

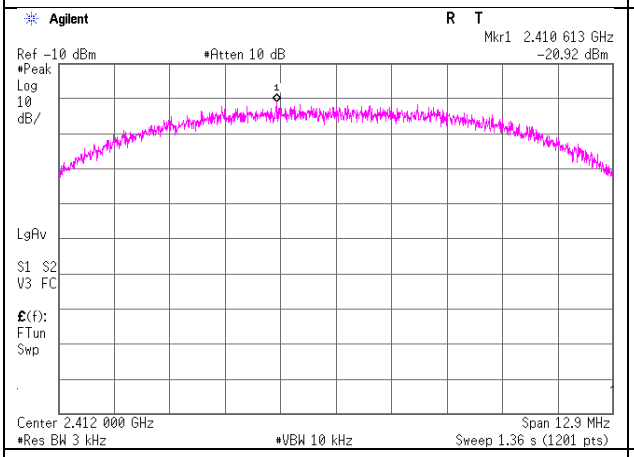
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

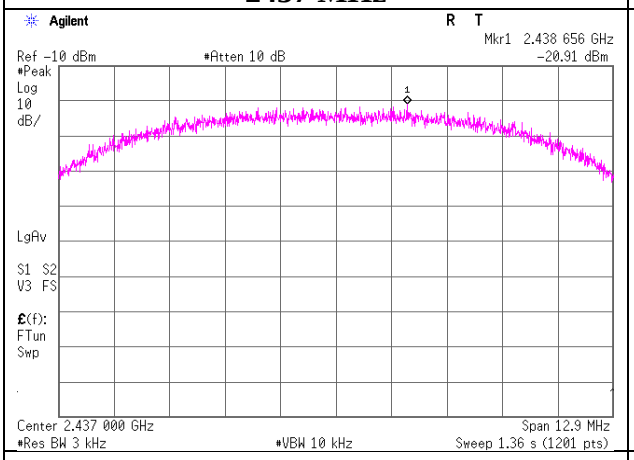
Power Density

11b

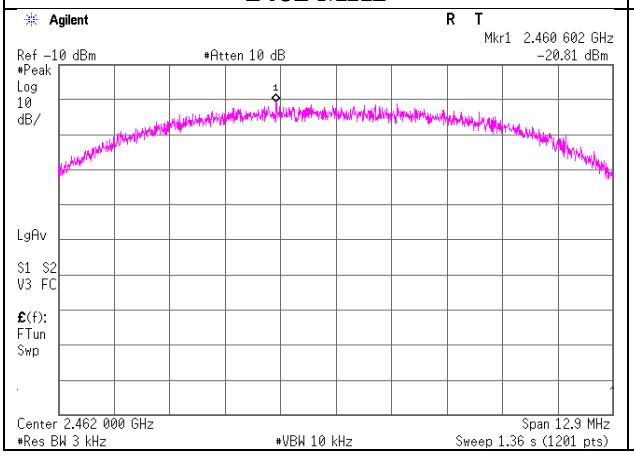
2412 MHz



2437 MHz

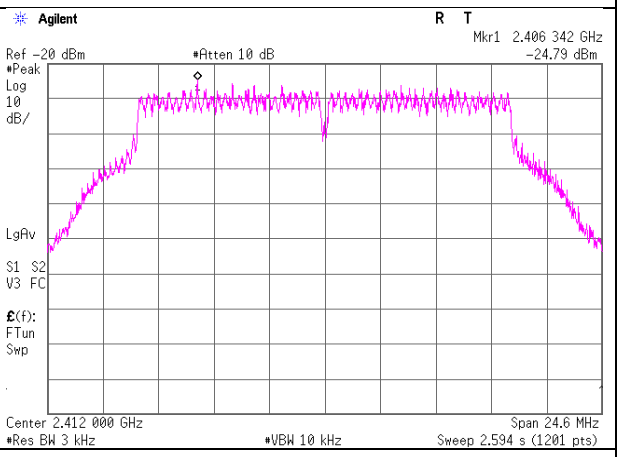


2462 MHz

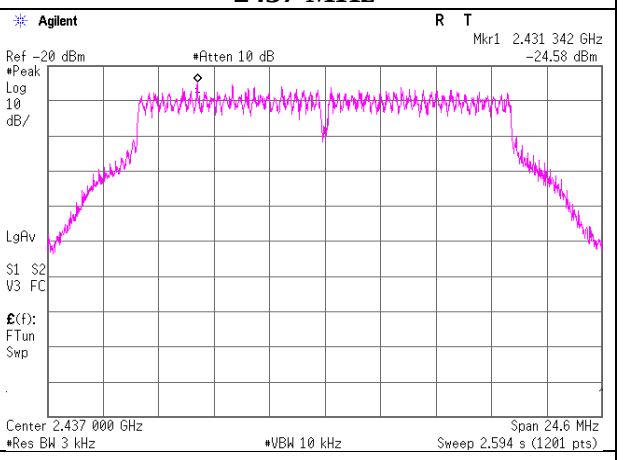


11g

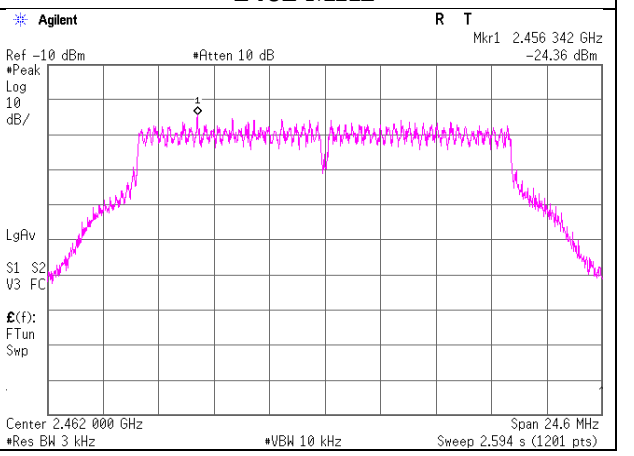
2412 MHz



2437 MHz



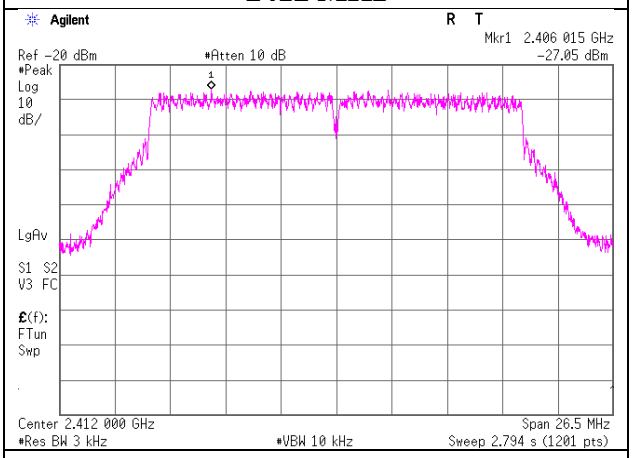
2462 MHz



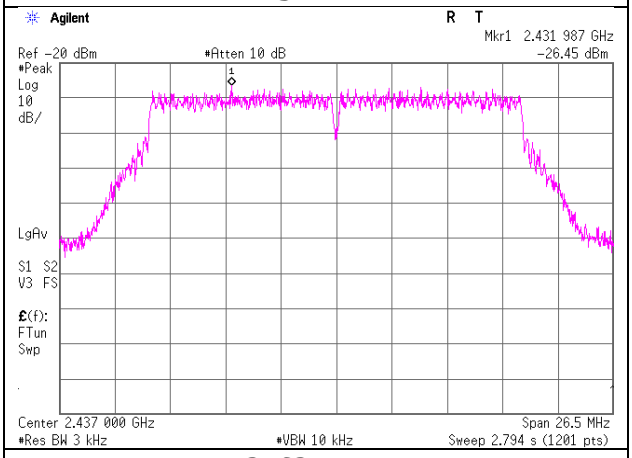
Power Density

11n-20

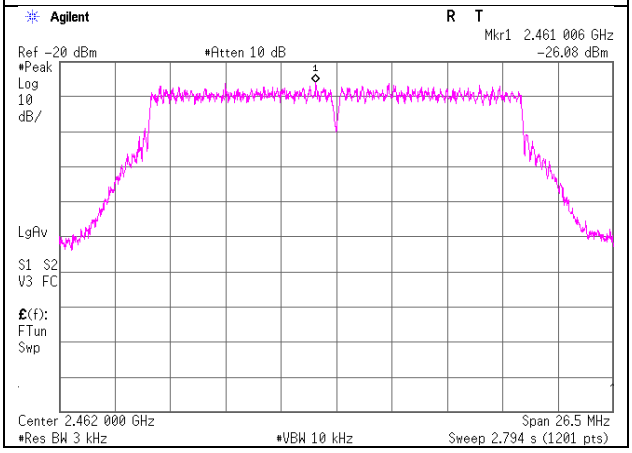
2412 MHz



2437 MHz



2462 MHz



APPENDIX 2: Test Instruments

Test Equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-02	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/30/2022	24
RE	MAEC-02-SVSWR	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/09/2021	24
RE	MAT-112	220646	Attenuator	Huber+Suhner	6806_N-50-1	-	06/07/2022	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	VHA 91031302	08/26/2022	12
RE	MCC-12	141317	Coaxial Cable	UL Japan	-	-	09/27/2022	12
RE	MCC-218	141394	Microwave Cable	Junkosha	MWX221	1607S141(1 m) / 1608S264(5 m)	09/12/2022	12
RE	MHA-06	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/21/2021	12
RE	MHA-17	141506	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170307	07/22/2022	12
RE	MHF-26	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	09/08/2022	12
RE	MJM-27	142228	Measure	KOMELON	KMC-36	-	-	-
RE	MLA-21	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/30/2022	12
RE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/12/2022	12
RE	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/19/2021	12
RE	MPA-10	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	02/22/2022	12
RE	MPA-24	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/25/2022	12
RE	MSA-04	141885	Spectrum Analyzer	Keysight Technologies Inc	E4448A	US44300523	11/10/2021	12
RE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	07/29/2022	12
AT	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2022	24
AT	MAT-10	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/09/2021	12
AT	MAT-20	141173	Attenuator(10dB) (above1GHz)	HIROSEELECTRIC CO.,LTD.	AT-110	-	12/08/2021	12
AT	MCC-144	141414	Microwave Cable	Junkosha	MWX221	1207S407	08/01/2022	12
AT	MCC-245	197220	Microwave cable	Huber+Suhner	SF126E/11PC35/ 11PC35/2000MM	537003/126E	03/17/2022	12
AT	MCC-38	141395	Coaxial Cable	UL Japan	-	-	11/19/2021	12
AT	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/16/2022	12
AT	MMM-17	141557	DIGIITAL HiTESTER	HIOKI E.E. CORPORATION	3805	70900530	01/16/2022	12
AT	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/10/2022	12
AT	MOS-28	141567	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0008	01/10/2022	12
AT	MPM-16	141812	Power Meter	Keysight Technologies Inc	8990B	MY51000271	08/05/2022	12
AT	MPSE-22	141842	Power sensor	Keysight Technologies Inc	N1923A	MY54070003	08/05/2022	12
AT	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/31/2022	12
AT	MSA-14	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	01/10/2022	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**
AT: Antenna Terminal Conducted