RADIO TEST REPORT

Test Report No. : 12344074H-A-R1

Applicant	:	**DENSO CORPORATION**
Type of Equipment	:	**Cockpit Control Unit (CCU)**
Model No.	:	**DNNS091**
FCC ID	:	**HYQDNNS091**
Test regulation	:	**FCC Part 15 Subpart C: 2018 (WLAN Part)**
Test Result	:	**Complied**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. This report is a revised version of 12344074H-A. 12344074H-A is replaced with this report.

Date of test: May 24 to June 17, 2018

Representative test engineer:

Takafumi Noguchi
Engineer
Consumer Technology Division

Approved by:

Satofumi Matsuyama
Engineer
Consumer Technology Division

NVLAP LAB CODE: 200572-0

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REVISION HISTORY

Original Test Report No.: 12344074H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12344074H-A	July 19, 2018	-	-
1	12344074H-A-R1	July 25, 2018	P.6	Correction of Worst margin (Radiated Spurious Emission): from 1.8 to 1.7.
1	12344074H-A-R1	July 25, 2018	P.14	Deletion of remarks *4) and renumbering remarks number from *5) to *4)
1	12344074H-A-R1	July 25, 2018	P.22	Correction of Duty factor 11b: from 0.12 to 0.13 11g: from 0.76 to 0.79 11n-20: from 0.74 to 0.76
1	12344074H-A-R1	July 25, 2018	P.34, 36	Correction of Duty factor from 0.7 to 0.8

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SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1 Showa-cho, Kariya-shi, Aichi ken, 448-8661 Japan
Telephone Number	:	+81-566-20-3304
Facsimile Number	:	+81-566-25-4920
Contact Person	:	Naoto Makino

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

2.1 Identification of E.U.T.

Type of Equipment	:	Cockpit Control Unit (CCU)
Model No.	:	DNNS091
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 13.2 V
Receipt Date of Sample	:	May 24, 2018
Country of Mass-production	:	the United States of America
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: DNNS091 (referred to as the EUT in this report) are Cockpit Control Units (CCU).

Radio Specification

Feature of EUT:
Clock frequency(ies) in the system : 2.0 GHz (max.)
Operating Temperature : -30 deg. C to 65 deg. C

[AM/FM/HD/XM Radio]

	AM	FM	HD	XM
Equipment type	Receiver			
Frequency of operation	531 kHz to 1602 kHz	87.5 MHz to 108.0 MHz	AM: 531 kHz to 1602 kHz FM: 87.5 MHz to 108.0 MHz	2333.465 MHz to 2344.045 MHz
Channel spacing	9 kHz	50 kHz	AM: 9 kHz FM: 50 kHz	-
Antenna connector type	Receptacle Connector			High Frequency Connector

[WLAN (IEEE802.11b/g/n-20) / Bluetooth (Ver4.2 BDR/EDR)]

	IEEE802.11b	IEEE802.11g/n (20 M band)	Bluetooth
Equipment type	Transceiver		
Frequency of operation	2412 MHz to 2462 MHz	2412 MHz to 2462 MHz	2402 MHz to 2480 MHz
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)	FHSS (GFSK, π/4-DQPSK, 8-DPSK)
Channel spacing	5MHz		1 MHz
Antenna type	ASSEMBLY Bluetooth/WiFi Antenna		
Antenna Connector type	MHF PLUG		
Antenna Gain	-4.15 dBi		1.35 dBi

Variant models
The EUT has two type: High model and Mid model.
Differences between High model and Mid model are Navigation and OTA.

Test was only performed to High model according to the customer's request.

* This test report applied to WLAN (IEEE802.11b/g/n-20).

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207	N/A	N/A	- *1)
	IC: RSS-Gen 8.8	**IC:** RSS-Gen 8.8			
6dB Bandwidth	**FCC:** KDB 558074 D01 DTS Meas Guidance v04	**FCC:** Section 15.247(a)(2)	See data.	Complied	Conducted
	IC: -	**IC:** RSS-247 5.2(a)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 DTS Meas Guidance v04	**FCC:** Section 15.247(b)(3)		Complied	Conducted
	IC: RSS-Gen 6.12	**IC:** RSS-247 5.4(d)			
Power Density	**FCC:** KDB 558074 D01 DTS Meas Guidance v04	**FCC:** Section 15.247(e)		Complied	Conducted
	IC: -	**IC:** RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 DTS Meas Guidance v04	**FCC:** Section15.247(d)	1.7 dB 2483.500 MHz, AV, Hori.	Complied#	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
	IC: RSS-Gen 6.13	**IC:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*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 DTS Meas Guidance v04 12.2.7.

Symbols:

Complied	The data of this test item has enough margin, more than the measurement uncertainty.
Complied#	The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

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

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage.
Instead of a new battery, DC power supply was used for the test.
That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the vehicle. 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	**IC:** RSS-Gen 6.6	**IC:** -	N/A	Complied	Conducted

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.

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

3.4 Uncertainty

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

Antenna Terminal test

Test Item		Uncertainty (+/-)
RF output power		1.3 dB
Antenna terminal conducted emission / Power dencity / Burst power		
Below 3GHz		2.0 dB
Adjacent channnel power / Channnel power		
	Below 3GHz	1.9 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)	4.8 dB
		(Vertical)	5.0 dB
	200 MHz to 1000 MHz	(Horizontal)	5.2 dB
		(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz	(Horizontal)	4.8 dB
		(Vertical)	4.9 dB
	200 MHz to 1000 MHz	(Horizontal)	5.0 dB
		(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz		5.0 dB
	6 GHz to 18 GHz		5.3 dB
1 m	10 GHz to 26.5 GHz		5.8 dB
	26.5 GHz to 40 GHz		5.8 dB
10 m	1 GHz to 18 GHz		5.2 dB

3.5 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	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	2973C-1	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	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	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	2973C-4	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.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	N/A	-	-
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 m x 2.0m 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 E.U.T. during testing

4.1 Operating Mode(s)

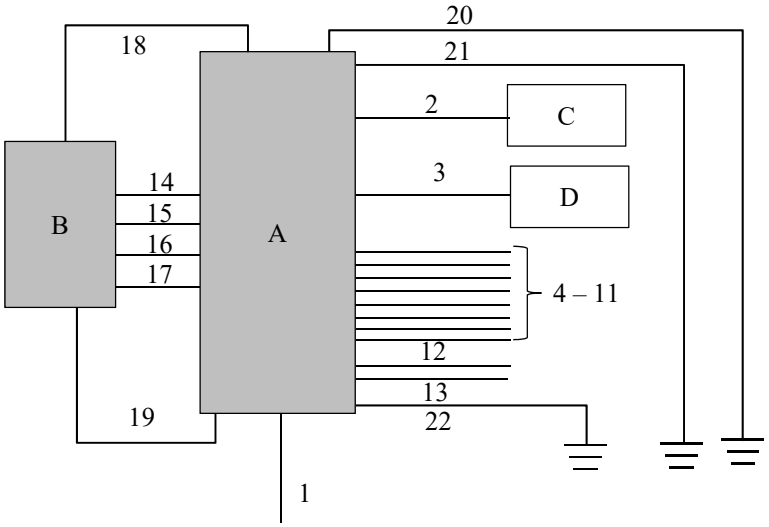
Test operating mode was determined as follows according to "Section 1 of 6 802.11 b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11b (11b)	1 Mbps, PN9
IEEE 802.11g (11g)	6 Mbps, PN9
IEEE 802.11n SISO 20 MHz BW (11n-20)	MCS 0, PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Low Channel)	
*Power of the EUT was set by the software as follows; Power settings: 11b/g/n 11 dBm Software: MSoC Ver: F11GHMO11-O14 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Spurious Emission (Radiated)	11b Tx 11g Tx	2412 MHz 2437 MHz 2462 MHz
	11n-20 Tx	2412 MHz 2462 MHz
Spurious Emission (Conducted)	11n-20 Tx	2462 MHz
6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	11b Tx 11g Tx 11n-20 Tx	2412 MHz 2437 MHz 2462 MHz

4.2 Configuration and peripherals



* 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	Cockpit Control Unit (CCU)	DNNS091	468726300000833	DENSO CORPORATION	EUT
B	CID	86213AN65A	ASSY-K3-HiMid-089	DENSO CORPORATION	EUT
C	Speaker	-	-	-	-
D	Speaker	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.5	Unshielded	Unshielded	-
2	Speaker Cable	1.0	Unshielded	Unshielded	-
3	Speaker Cable	1.0	Unshielded	Unshielded	-
4	Signal Cable	1.8	Unshielded	Unshielded	-
5	Mater Cable	1.7	Shielded	Shielded	-
6	USB Cable	2.0	Shielded	Shielded	-
7	USB Cable	2.0	Shielded	Shielded	-
8	USB Cable	2.0	Shielded	Shielded	-
9	XM Cable	1.0	Shielded	Shielded	-
10	Signal Cable	2.0	Unshielded	Unshielded	-
11	GPS Cable	1.0	Shielded	Shielded	
12	AM/FM Cable (Main)	1.0	Shielded	Shielded	-
13	AM/FM Cable (Sub)	1.0	Shielded	Shielded	-
14	DC Cable	0.2	Unshielded	Unshielded	-
15	Signal Cable	0.2	Shielded	Shielded	-
16	BT Cable	0.2	Shielded	Shielded	-
17	WiFi Cable	0.2	Shielded	Shielded	-
18	FG Cable	0.1	Unshielded	Unshielded	-
19	FG Cable	0.1	Unshielded	Unshielded	-
20	FG Cable	3.0	Unshielded	Unshielded	-
21	FG Cable	3.0	Unshielded	Unshielded	-
22	FG Cable	3.0	Unshielded	Unshielded	-

SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 1.5 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 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
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(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

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	Average Power Method: RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces If duty cycle was less than 98%, a duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	4.0 m *2) (1 GHz - 10 GHz), 1 m *3) (10 GHz - 26.5 GHz)		4.0 m *2) (1 GHz - 10 GHz), 1 m *3) (10 GHz - 26.5 GHz)

*1) Average Power Measurement was performed based on 6. 0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

*2) Distance Factor: 20 x log (4.0 m / 3.0 m) = 2.5 dB
*3) Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 dB

- The carrier level and noise levels were confirmed at each position of 0 degree and 30 degree as tilt angle of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

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

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
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)	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 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04".
*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 low enough 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.

Test data : APPENDIX
Test result : Pass

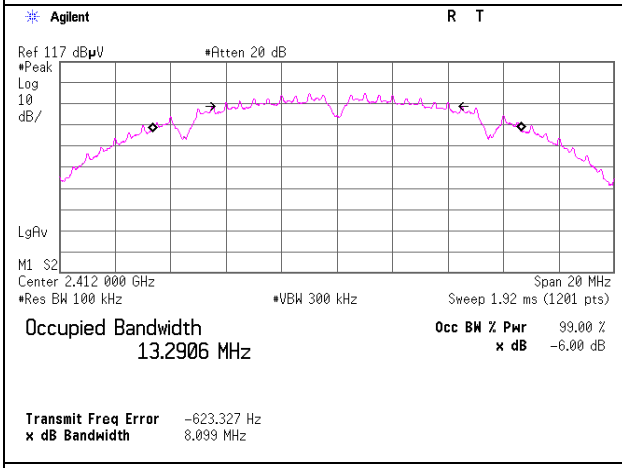
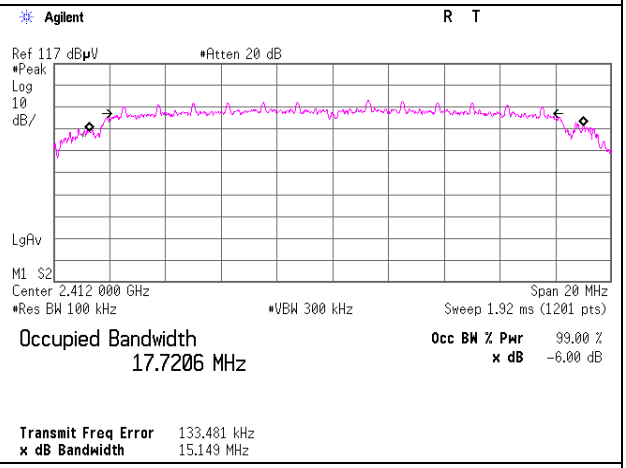
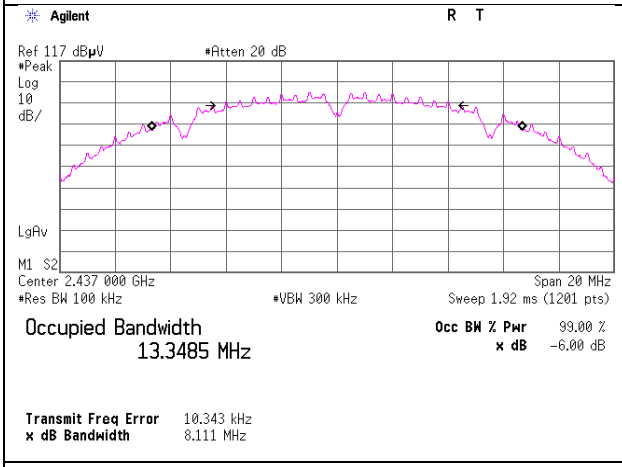
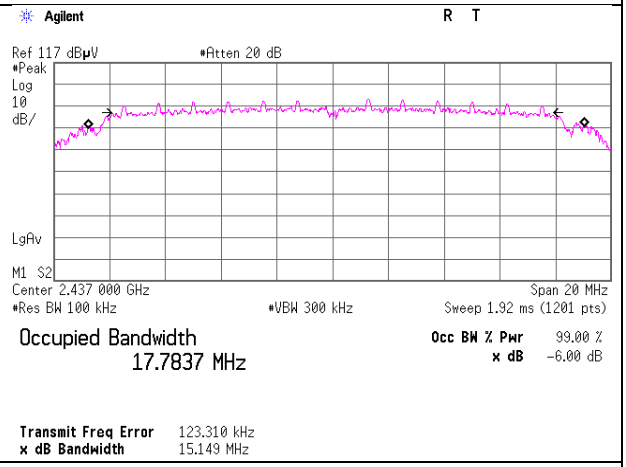
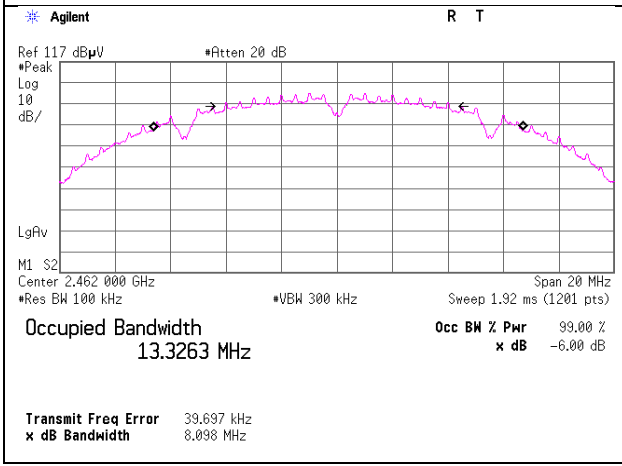
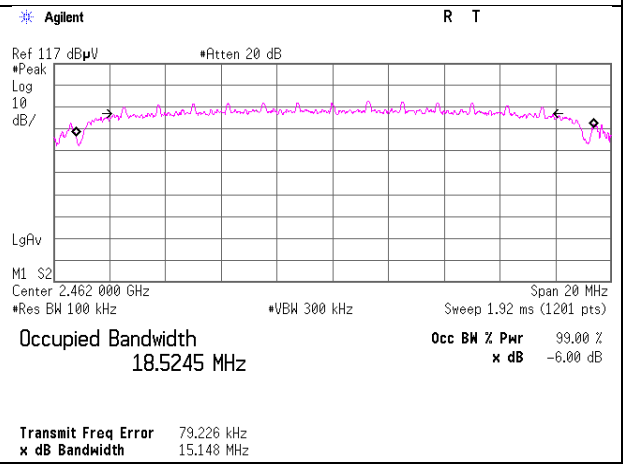
APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	12344074H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	June 17, 2018
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Takafumi Noguchi
Mode	Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	13344.5	8.099	> 0.5000
	2437	13378.5	8.111	> 0.5000
	2462	13371.2	8.098	> 0.5000
11g	2412	18953.4	15.149	> 0.5000
	2437	18718.1	15.149	> 0.5000
	2462	18613.8	15.148	> 0.5000
11n-20	2412	19648.1	15.152	> 0.5000
	2437	19791.4	15.152	> 0.5000
	2462	19694.1	15.152	> 0.5000

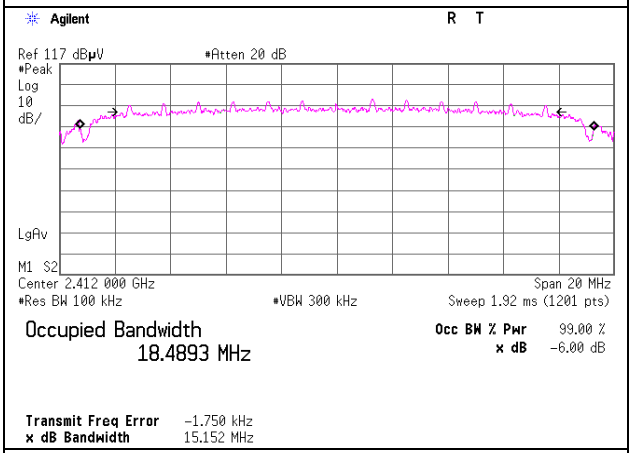
6dB Bandwidth

11b	11g
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

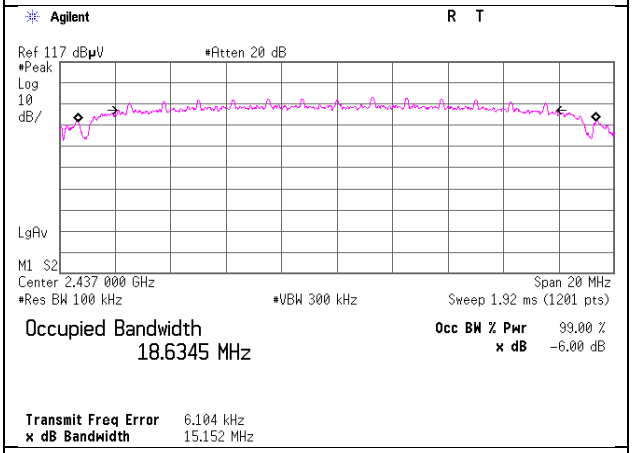
6dB Bandwidth

11n-20

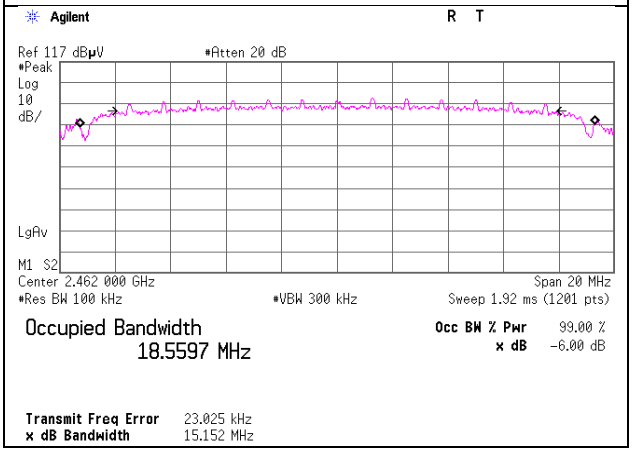
2412 MHz



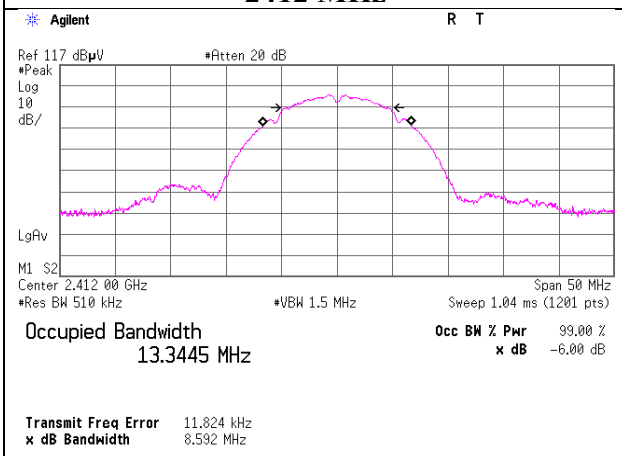
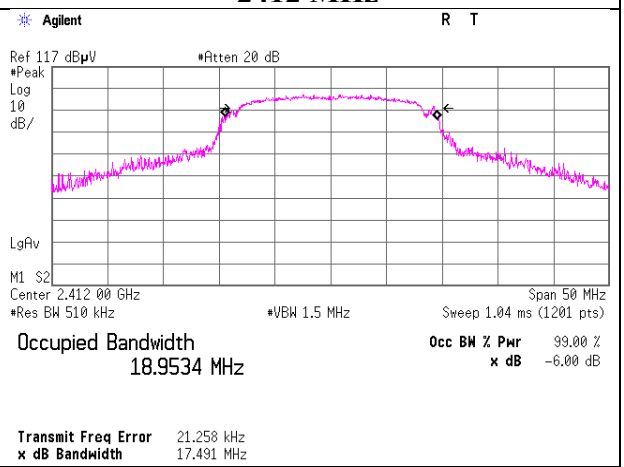
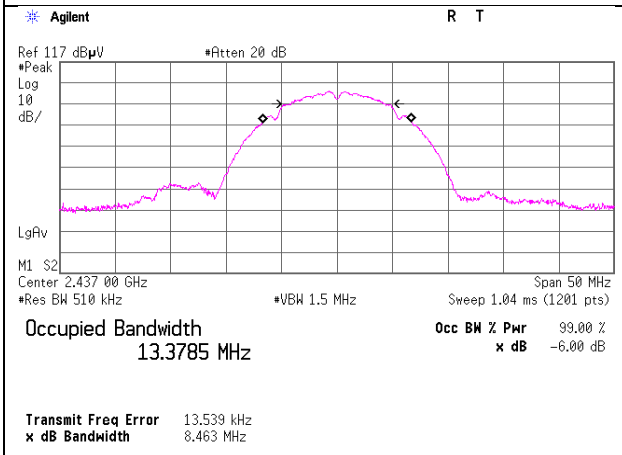
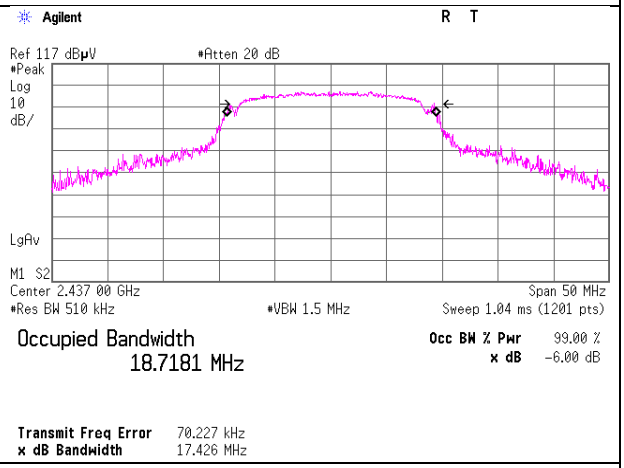
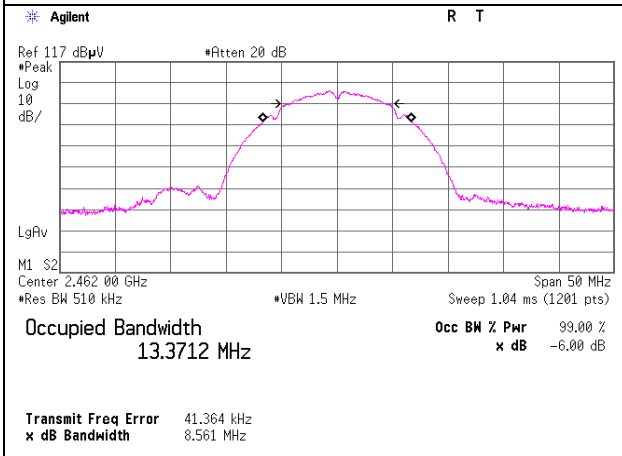
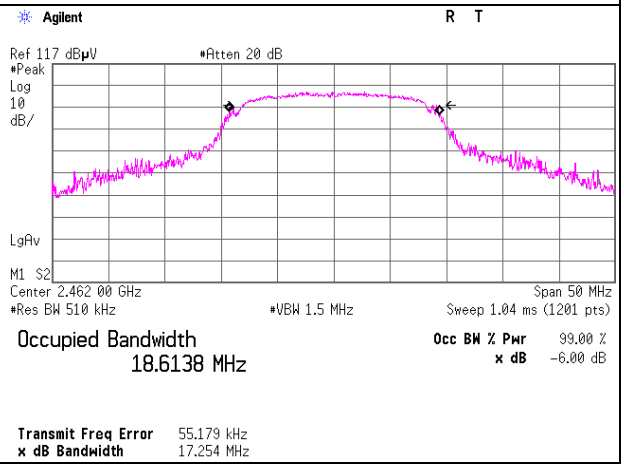
2437 MHz



2462 MHz



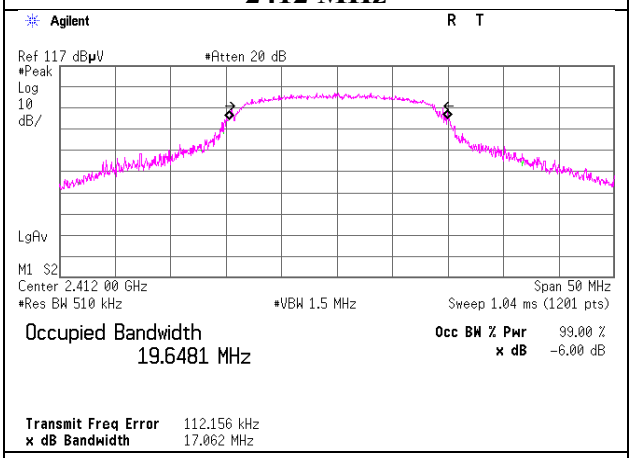
99%Occupied Bandwidth

11b	11g
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

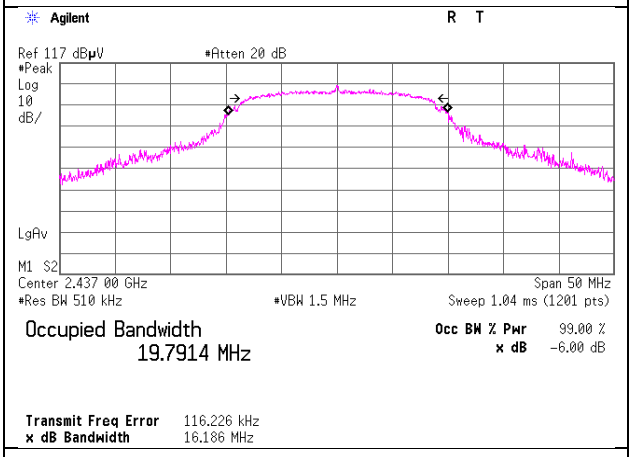
99% Occupied Bandwidth

11n-20

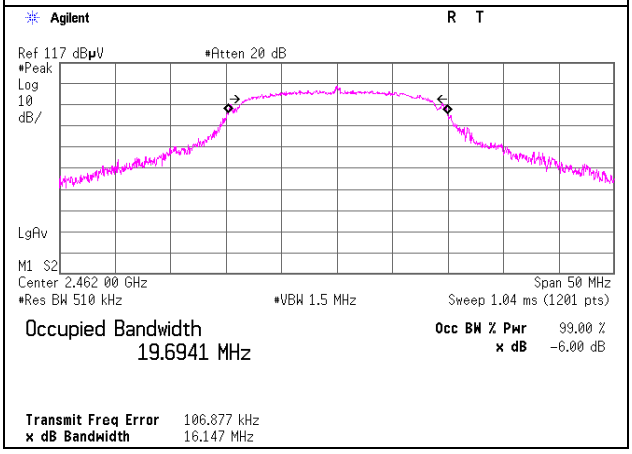
2412 MHz



2437 MHz



2462 MHz



Maximum Peak Output Power

Report No.	12344074H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	June 17, 2018
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Takafumi Noguchi
Mode	Tx 11b/11g/11n-20

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	5.45	1.63	9.96	17.04	50.55	30.00	1000	12.96	-4.15	12.89	19.44	36.02	4000	23.13
2437	5.72	1.40	9.96	17.08	51.06	30.00	1000	12.92	-4.15	12.93	19.64	36.02	4000	23.09
2462	5.77	1.50	9.96	17.23	52.86	30.00	1000	12.77	-4.15	13.08	20.33	36.02	4000	22.94

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.

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	9.89	1.63	9.96	21.48	140.50	30.00	1000	8.52	-4.15	17.33	54.04	36.02	4000	18.69
2437	10.06	1.40	9.96	21.42	138.70	30.00	1000	8.58	-4.15	17.27	53.34	36.02	4000	18.75
2462	10.17	1.50	9.96	21.63	145.59	30.00	1000	8.37	-4.15	17.48	55.99	36.02	4000	18.54

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.

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	9.85	1.63	9.96	21.44	139.22	30.00	1000	8.56	-4.15	17.29	53.54	36.02	4000	18.73
2437	10.05	1.40	9.96	21.41	138.38	30.00	1000	8.59	-4.15	17.26	53.22	36.02	4000	18.76
2462	10.16	1.50	9.96	21.62	145.26	30.00	1000	8.38	-4.15	17.47	55.87	36.02	4000	18.55

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.

Maximum Peak Output Power

Worst Rate Check

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.4
Date	May 24, 2018	June 12, 2018
Temperature / Humidity	24 deg. C / 68 % RH	23 deg. C / 71 % RH
Engineer	Takumi Shimada	Tomoki Matsui
Mode	Tx 11b/11g/11n-20	

11b 2412MHz

Rate [Mbps]	Reading [dBm]	Remark
1	4.77	*
2	4.58	
5.5	4.67	
11	4.59	

11g 2412 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	10.02	*
9	10.01	
12	9.94	
18	9.70	
24	9.40	
36	9.34	
48	9.11	
54	9.24	

11n-20 2412 MHz

MCS Number	Reading [dBm]	Remark
0	9.93	*
1	9.68	
2	9.67	
3	9.28	
4	9.10	
5	8.44	
6	8.42	
7	8.21	

*: Worst Rate

All comparison were carried out on same frequency and measurement factors.

Average Output Power
(Reference data for RF Exposure)

Report No.	12344074H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	June 17, 2018
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Takafumi Noguchi
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	2.74	1.63	9.96	14.33	27.08	0.13	14.46	27.91
2437	3.01	1.40	9.96	14.37	27.36	0.13	14.50	28.19
2462	3.05	1.50	9.96	14.51	28.26	0.13	14.64	29.12

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	2.19	1.63	9.96	13.78	23.86	0.79	14.57	28.62
2437	2.41	1.40	9.96	13.77	23.83	0.79	14.56	28.58
2462	2.18	1.50	9.96	13.64	23.13	0.79	14.43	27.74

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	2.16	1.63	9.96	13.75	23.70	0.76	14.51	28.23
2437	2.35	1.40	9.96	13.71	23.50	0.76	14.47	27.99
2462	2.14	1.50	9.96	13.60	22.92	0.76	14.36	27.30

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.

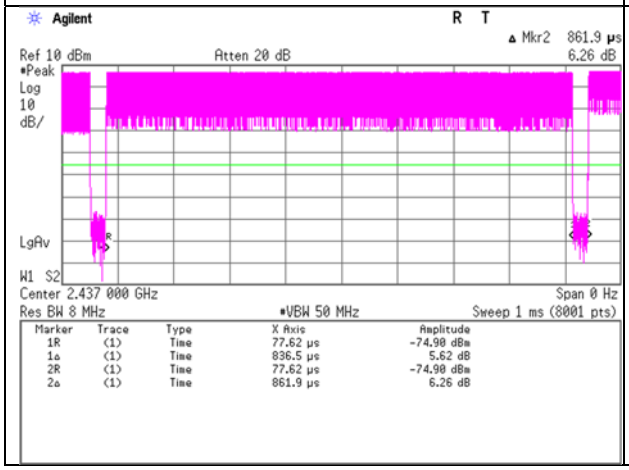
The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.

Burst rate confirmation

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui
Mode	Tx 11b/11g/11n-20

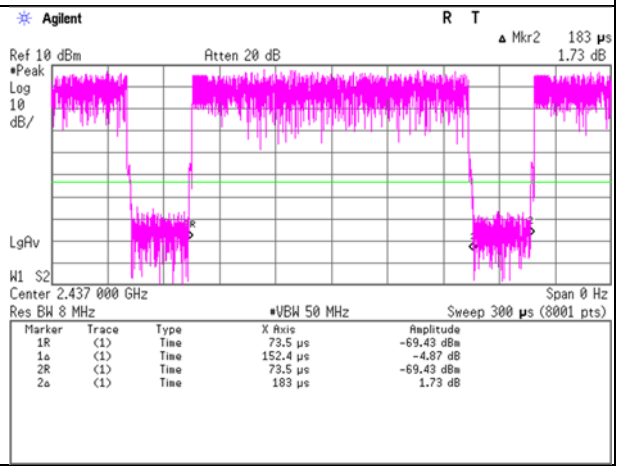
11b 1 Mbps

Tx on / (Tx on + Tx off) = 0.971
Tx on / (Tx on + Tx off) * 100 = 97.1 %
Duty factor = 10 * log (861.9 / 836.5) = 0.13 dB



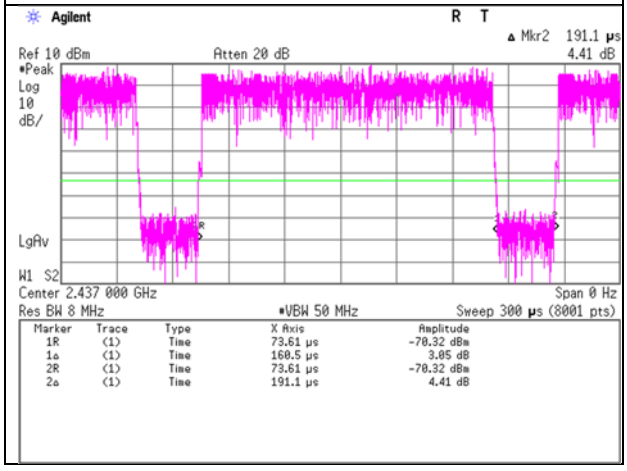
11g 6 Mbps

Tx on / (Tx on + Tx off) = 0.833
Tx on / (Tx on + Tx off) * 100 = 83.3 %
Duty factor = 10 * log (183 / 152.4) = 0.79 dB



11n-20 MCS 0

Tx on / (Tx on + Tx off) = 0.840
Tx on / (Tx on + Tx off) * 100 = 84.0 %
Duty factor = 10 * log (191.1 / 160.5) = 0.76 dB



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

Radiated Spurious Emission

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 12, 2018	June 12, 2018 (Night)
Temperature / Humidity	23 deg. C / 71 % RH	21 deg. C / 57 % RH
Engineer	Tomoki Matsui	Takumi Shimada
	(1 GHz - 10 GHz)	(Above 10 GHz)
Mode	Tx 11b 2412 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	2390.000	PK	43.0	27.4	5.9	32.1	-	44.2	73.9	29.7	
Hori	4824.000	PK	45.8	31.7	8.1	31.3	-	54.3	73.9	19.6	
Hori	7236.000	PK	42.7	36.5	9.5	32.4	-	56.3	73.9	17.6	
Hori	2390.000	AV	33.3	27.4	5.9	32.1	0.1	34.6	53.9	19.3	*1)
Hori	4824.000	AV	40.4	31.7	8.1	31.3	0.1	49.0	53.9	4.9	
Hori	7236.000	AV	33.2	36.5	9.5	32.4	0.1	46.9	53.9	7.0	
Vert	2390.000	PK	42.4	27.4	5.9	32.1	-	43.6	73.9	30.3	
Vert	4824.000	PK	46.6	31.7	8.1	31.3	-	55.1	73.9	18.8	
Vert	7236.000	PK	42.6	36.5	9.5	32.4	-	56.2	73.9	17.7	
Vert	2390.000	AV	34.4	27.4	5.9	32.1	0.1	35.7	53.9	18.2	*1)
Vert	4824.000	AV	41.5	31.7	8.1	31.3	0.1	50.1	53.9	3.8	
Vert	7236.000	AV	35.2	36.5	9.5	32.4	0.1	48.9	53.9	5.0	

Result = 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).

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

20dBc Data Sheet

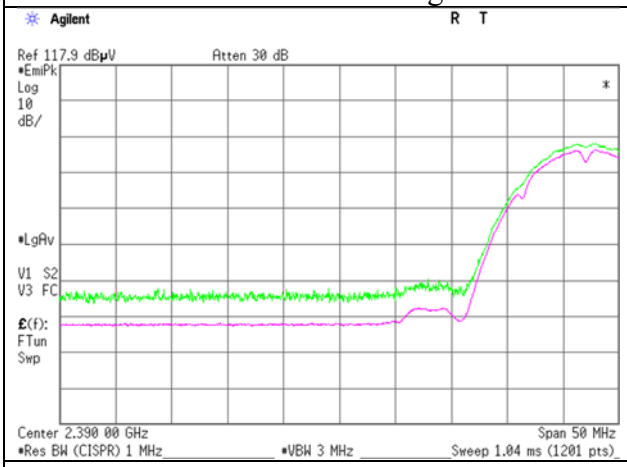
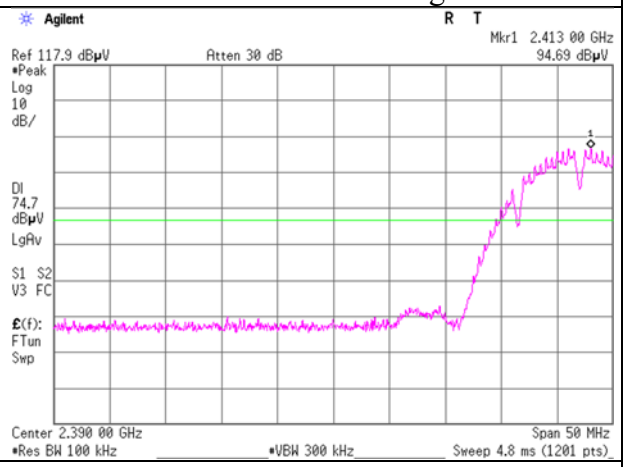
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	94.7	27.4	5.9	32.1	95.9	-	-	Carrier
Hori	2400.000	PK	47.0	27.4	5.9	32.1	48.2	75.9	27.7	
Hori	9648.000	PK	37.7	38.0	10.2	32.6	53.3	75.9	22.6	
Vert	2412.000	PK	91.9	27.4	5.9	32.1	93.1	-	-	Carrier
Vert	2400.000	PK	44.3	27.4	5.9	32.1	45.5	73.1	27.6	
Vert	9648.000	PK	38.0	38.0	10.2	32.6	53.6	73.1	19.5	

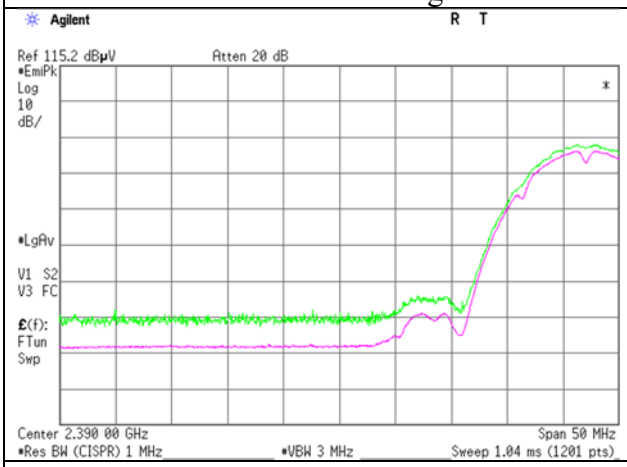
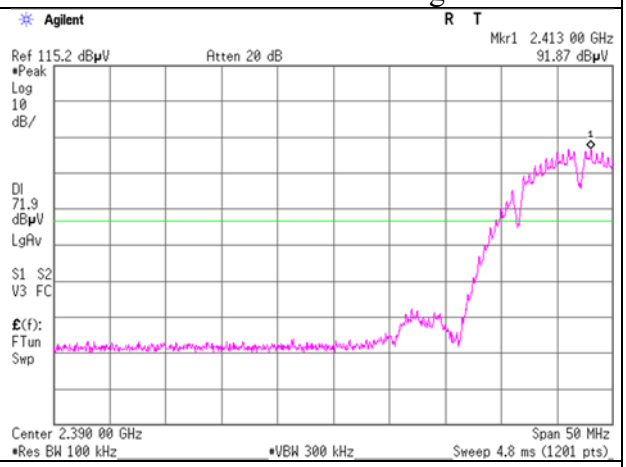
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui
	(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

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

Radiated Spurious Emission

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 12, 2018	June 12, 2018 (Night)
Temperature / Humidity	23 deg. C / 71 % RH	21 deg. C / 57 % RH
Engineer	Tomoki Matsui	Takumi Shimada
	(1 GHz - 10 GHz)	(Above 10 GHz)
Mode	Tx 11b 2437 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	4874.000	PK	45.9	31.9	8.2	31.3	-	54.7	73.9	19.2	
Hori	7311.000	PK	43.3	36.6	9.5	32.4	-	57.0	73.9	16.9	
Hori	4874.000	AV	40.8	31.9	8.2	31.3	0.1	49.7	53.9	4.2	
Hori	7311.000	AV	35.6	36.6	9.5	32.4	0.1	49.4	53.9	4.5	
Vert	4874.000	PK	45.7	31.9	8.2	31.3	-	54.5	73.9	19.4	
Vert	7311.000	PK	44.2	36.6	9.5	32.4	-	57.9	73.9	16.0	
Vert	4874.000	AV	39.7	31.9	8.2	31.3	0.1	48.6	53.9	5.3	
Vert	7311.000	AV	36.2	36.6	9.5	32.4	0.1	50.0	53.9	3.9	

Result = 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).

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 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	2437.000	PK	94.9	27.4	5.9	32.1	96.1	-	-	Carrier
Hori	9748.000	PK	37.2	38.0	10.2	32.7	52.7	76.1	23.4	
Vert	2437.000	PK	92.7	27.4	5.9	32.1	93.9	-	-	Carrier
Vert	9748.000	PK	38.2	38.0	10.2	32.7	53.7	73.9	20.2	

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

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

Radiated Spurious Emission

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 12, 2018	June 12, 2018 (Night)
Temperature / Humidity	23 deg. C / 71 % RH	21 deg. C / 57 % RH
Engineer	Tomoki Matsui	Takumi Shimada
	(1 GHz - 10 GHz)	(Above 10 GHz)
Mode	Tx 11b 2462 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	2483.500	PK	46.5	27.5	5.9	32.0	-	47.9	73.9	26.0	
Hori	4924.000	PK	46.4	32.1	8.2	31.2	-	55.5	73.9	18.4	
Hori	7386.000	PK	43.5	36.7	9.5	32.5	-	57.2	73.9	16.7	
Hori	2483.500	AV	35.8	27.5	5.9	32.0	0.1	37.3	53.9	16.6	*1)
Hori	4924.000	AV	41.4	32.1	8.2	31.2	0.1	50.6	53.9	3.3	
Hori	7386.000	AV	33.9	36.7	9.5	32.5	0.1	47.7	53.9	6.2	
Vert	2483.500	PK	44.4	27.5	5.9	32.0	-	45.8	73.9	28.1	
Vert	4924.000	PK	46.6	32.1	8.2	31.2	-	55.7	73.9	18.2	
Vert	7386.000	PK	43.6	36.7	9.5	32.5	-	57.3	73.9	16.6	
Vert	2483.500	AV	34.1	27.5	5.9	32.0	0.1	35.6	53.9	18.3	*1)
Vert	4924.000	AV	42.4	32.1	8.2	31.2	0.1	51.6	53.9	2.3	
Vert	7386.000	AV	34.4	36.7	9.5	32.5	0.1	48.2	53.9	5.7	

Result = 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).

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

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	2462.000	PK	95.3	27.5	5.9	32.1	96.6	-	-	Carrier
Hori	9848.000	PK	38.3	38.1	10.2	32.7	53.9	76.6	22.7	
Vert	2462.000	PK	92.5	27.5	5.9	32.1	93.8	-	-	Carrier
Vert	9848.000	PK	39.1	38.1	10.2	32.7	54.7	73.8	19.1	

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

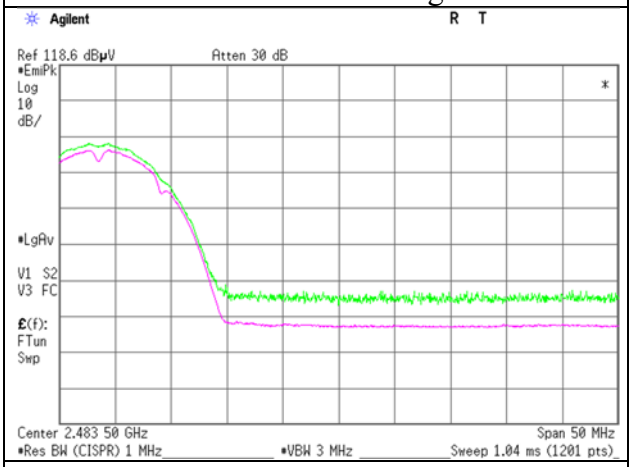
Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui
	(1 GHz - 10 GHz)
Mode	Tx 11b 2462 MHz

Horizontal

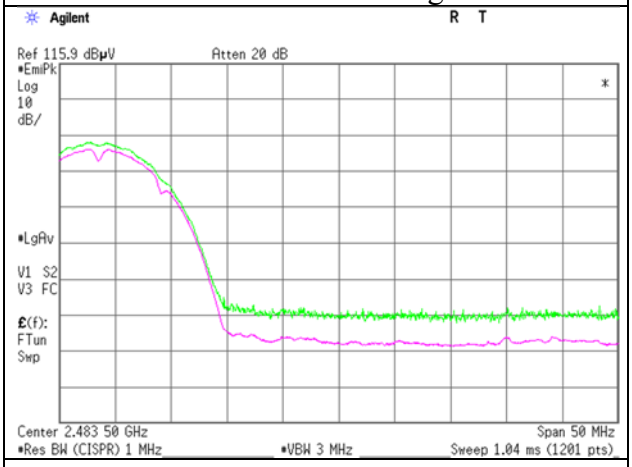
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 12, 2018	June 12, 2018 (Night)
Temperature / Humidity	23 deg. C / 71 % RH	21 deg. C / 57 % RH
Engineer	Tomoki Matsui	Takumi Shimada
	(1 GHz - 10 GHz)	(Above 10 GHz)
Mode	Tx 11g 2412 MHz	

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
2390.000	PK	59.1	27.4	5.9	32.1	-	60.3	73.9	13.6	
4824.000	PK	44.5	31.7	8.1	31.3	-	53.0	73.9	20.9	
7236.000	PK	43.3	36.5	9.5	32.4	-	56.9	73.9	17.0	Floor noise
9648.000	PK	43.8	38.0	10.2	32.6	-	59.4	73.9	14.5	Floor noise
2390.000	AV	39.6	27.4	5.9	32.1	0.8	41.6	53.9	12.3	*1)
4824.000	AV	33.2	31.7	8.1	31.3	0.8	42.5	53.9	11.4	
7236.000	AV	32.7	36.5	9.5	32.4	-	46.3	53.9	7.6	Floor noise
9648.000	AV	32.1	38.0	10.2	32.6	-	47.7	53.9	6.2	Floor noise
2390.000	PK	58.2	27.4	5.9	32.1	-	59.4	73.9	14.5	
4824.000	PK	45.3	31.7	8.1	31.3	-	53.8	73.9	20.1	
7236.000	PK	42.5	36.5	9.5	32.4	-	56.1	73.9	17.8	Floor noise
9648.000	PK	43.5	38.0	10.2	32.6	-	59.1	73.9	14.8	Floor noise
2390.000	AV	39.1	27.4	5.9	32.1	0.8	41.1	53.9	12.8	*1)
4824.000	AV	30.3	31.7	8.1	31.3	0.8	39.6	53.9	14.3	
7236.000	AV	32.3	36.5	9.5	32.4	-	45.9	53.9	8.0	Floor noise
9648.000	AV	32.1	38.0	10.2	32.6	-	47.7	53.9	6.2	Floor noise

Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
equency noises omitted in this report were not seen or had enough margin (more than 20 dB).

factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
ut of Band emission(Leakage Power)

20dBc Data Sheet

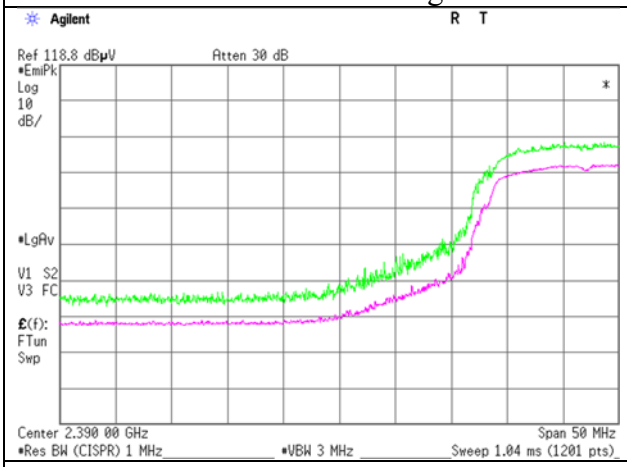
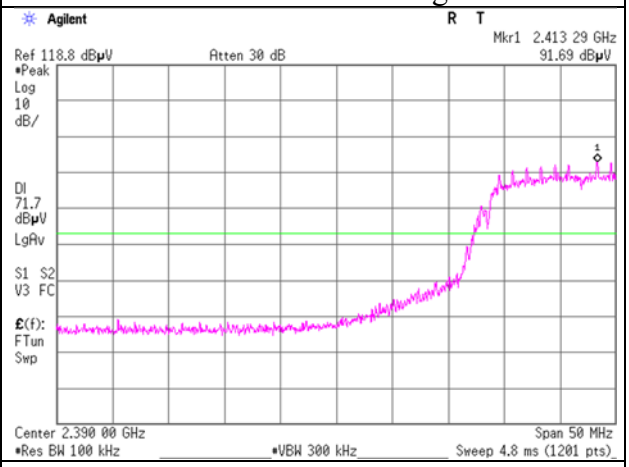
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	91.7	27.4	5.9	32.1	92.9	-	-	Carrier
Hori	2400.000	PK	58.1	27.4	5.9	32.1	59.3	72.9	13.6	
Vert	2412.000	PK	89.8	27.4	5.9	32.1	91.0	-	-	Carrier
Vert	2400.000	PK	55.4	27.4	5.9	32.1	56.6	71.0	14.4	

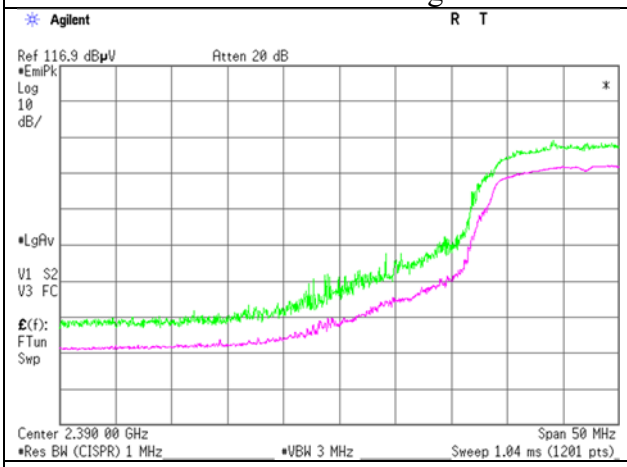
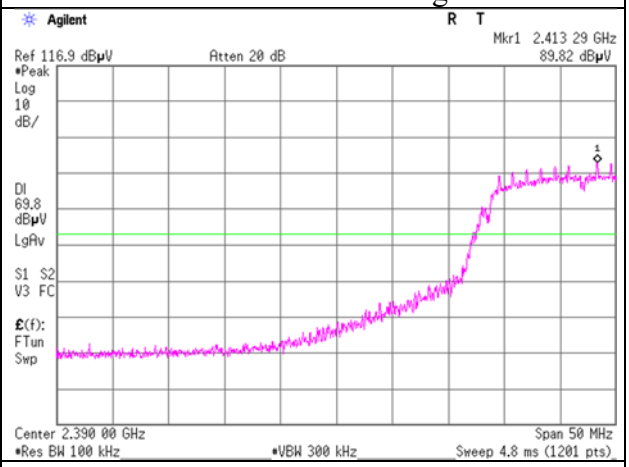
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui (1 GHz - 10 GHz)
Mode	Tx 11g 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

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

Radiated Spurious Emission

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 12, 2018	June 12, 2018 (Night)
Temperature / Humidity	23 deg. C / 71 % RH	21 deg. C / 57 % RH
Engineer	Tomoki Matsui	Takumi Shimada
	(1 GHz - 10 GHz)	(Above 10 GHz)
Mode	Tx 11g 2437 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	4874.000	PK	45.1	31.9	8.2	31.3	-	53.9	73.9	20.0	
Hori	7311.000	PK	41.4	36.6	9.5	32.4	-	55.1	73.9	18.8	Floor noise
Hori	4874.000	AV	35.7	31.9	8.2	31.3	0.8	45.3	53.9	8.6	
Hori	7311.000	AV	33.9	36.6	9.5	32.4	-	47.6	53.9	6.3	Floor noise
Vert	4874.000	PK	43.4	31.9	8.2	31.3	-	52.2	73.9	21.7	
Vert	7311.000	PK	41.5	36.6	9.5	32.4	-	55.2	73.9	18.7	Floor noise
Vert	4874.000	AV	34.6	31.9	8.2	31.3	0.8	44.2	53.9	9.7	
Vert	7311.000	AV	33.9	36.6	9.5	32.4	-	47.6	53.9	6.3	Floor noise

Result = 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).

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 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	2437.000	PK	93.1	27.4	5.9	32.1	94.3	-	-	Carrier
Hori	9748.000	PK	37.9	38.0	10.2	32.7	53.4	74.3	20.9	
Vert	2437.000	PK	90.2	27.4	5.9	32.1	91.4	-	-	Carrier
Vert	9748.000	PK	38.0	38.0	10.2	32.7	53.5	71.4	17.9	

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

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

Radiated Spurious Emission

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 12, 2018	June 12, 2018 (Night)
Temperature / Humidity	23 deg. C / 71 % RH	21 deg. C / 57 % RH
Engineer	Tomoki Matsui	Takumi Shimada
	(1 GHz - 10 GHz)	(Above 10 GHz , Below 1 GHz)
Mode	Tx 11g 2462 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	168.000	QP	39.5	15.9	8.9	32.0	-	32.3	43.5	11.2	
Hori	208.000	QP	42.2	11.5	9.2	32.0	-	30.9	43.5	12.6	
Hori	216.000	QP	42.4	11.6	9.3	32.0	-	31.3	43.5	12.2	
Hori	224.000	QP	43.3	11.6	9.3	32.0	-	32.2	46.0	13.8	
Hori	240.000	QP	40.0	11.7	9.5	32.0	-	29.2	46.0	16.8	
Hori	256.000	QP	40.5	12.0	9.6	32.0	-	30.1	46.0	15.9	
Hori	2483.500	PK	70.1	27.5	5.9	32.0	-	71.5	73.9	2.4	
Hori	4924.000	PK	45.1	32.1	8.2	31.2	-	54.2	73.9	19.7	
Hori	7386.000	PK	44.1	36.7	9.5	32.5	-	57.8	73.9	16.1	
Hori	2483.500	AV	45.5	27.5	5.9	32.0	0.8	47.7	53.9	6.2	*1)
Hori	4924.000	AV	32.9	32.1	8.2	31.2	0.8	42.8	53.9	11.1	
Hori	7386.000	AV	33.1	36.7	9.5	32.5	0.8	47.6	53.9	6.3	
Vert	168.000	QP	36.5	15.9	8.9	32.0	-	29.3	43.5	14.2	
Vert	208.000	QP	40.0	11.5	9.2	32.0	-	28.7	43.5	14.8	
Vert	216.000	QP	41.9	11.6	9.3	32.0	-	30.8	43.5	12.7	
Vert	224.000	QP	40.6	11.6	9.3	32.0	-	29.5	46.0	16.5	
Vert	240.000	QP	41.0	11.7	9.5	32.0	-	30.2	46.0	15.8	
Vert	256.000	QP	41.5	12.0	9.6	32.0	-	31.1	46.0	14.9	
Vert	2483.500	PK	68.4	27.5	5.9	32.0	-	69.8	73.9	4.1	
Vert	4924.000	PK	46.7	32.1	8.2	31.2	-	55.8	73.9	18.1	
Vert	7386.000	PK	42.0	36.7	9.5	32.5	-	55.7	73.9	18.2	
Vert	2483.500	AV	43.1	27.5	5.9	32.0	0.8	45.3	53.9	8.6	*1)
Vert	4924.000	AV	34.1	32.1	8.2	31.2	0.8	44.0	53.9	9.9	
Vert	7386.000	AV	32.3	36.7	9.5	32.5	0.8	46.8	53.9	7.1	

Result = 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).

Distance factor: 1 GHz - 10 GHz 20log (4.5 m / 3.0 m) = 3.53 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

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	2462.000	PK	93.5	27.5	5.9	32.1	94.8	-	-	Carrier
Hori	9848.000	PK	39.0	38.1	10.2	32.7	54.6	74.8	20.2	
Vert	2462.000	PK	90.9	27.5	5.9	32.1	92.2	-	-	Carrier
Vert	9848.000	PK	42.1	38.1	10.2	32.7	57.7	72.2	14.5	

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

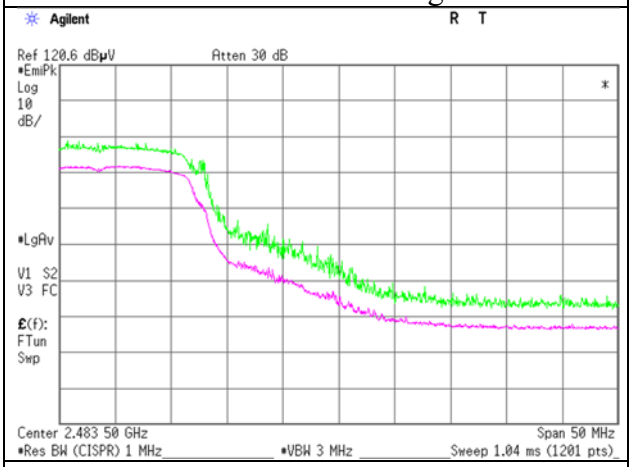
Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui
	(1 GHz - 10 GHz)
Mode	Tx 11g 2462 MHz

Horizontal

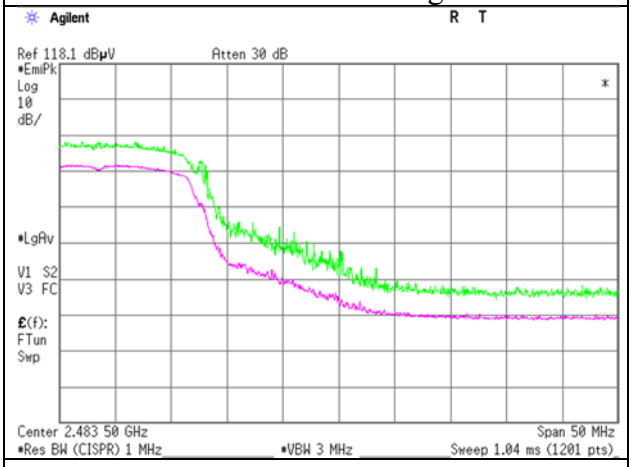
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 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	2390.000	PK	58.2	27.4	5.9	32.1	-	59.4	73.9	14.5	
Hori	2390.000	AV	41.2	27.4	5.9	32.1	0.8	43.2	53.9	10.7	*1)
Vert	2390.000	PK	56.8	27.4	5.9	32.1	-	58.0	73.9	15.9	
Vert	2390.000	AV	44.6	27.4	5.9	32.1	0.8	46.6	53.9	7.3	*1)

Result = 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).

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

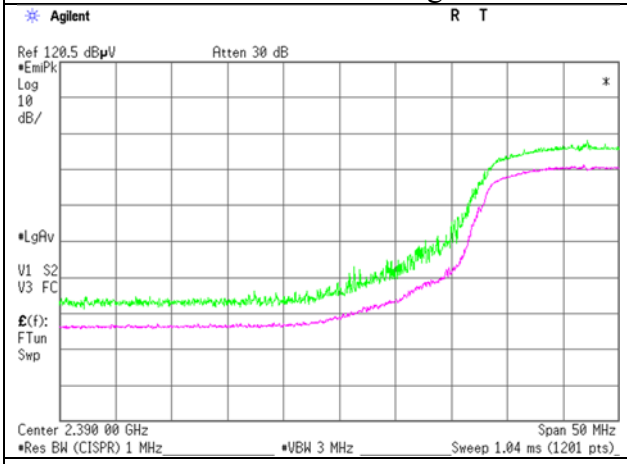
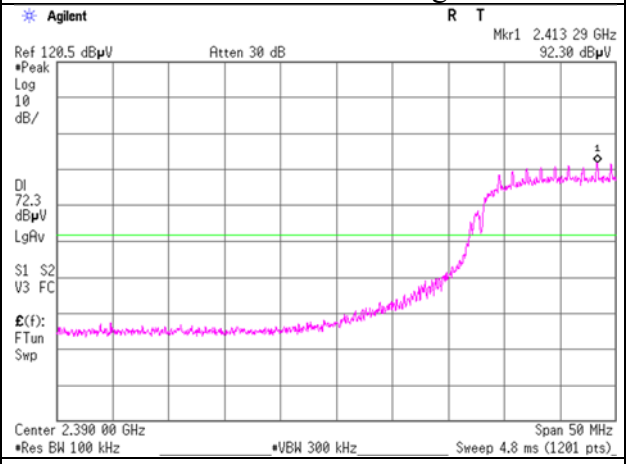
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	92.3	27.4	5.9	32.1	93.5	-	-	Carrier
Hori	2400.000	PK	61.6	27.4	5.9	32.1	62.8	73.5	10.7	
Vert	2412.000	PK	89.7	27.4	5.9	32.1	90.9	-	-	Carrier
Vert	2400.000	PK	59.1	27.4	5.9	32.1	60.3	70.9	10.6	

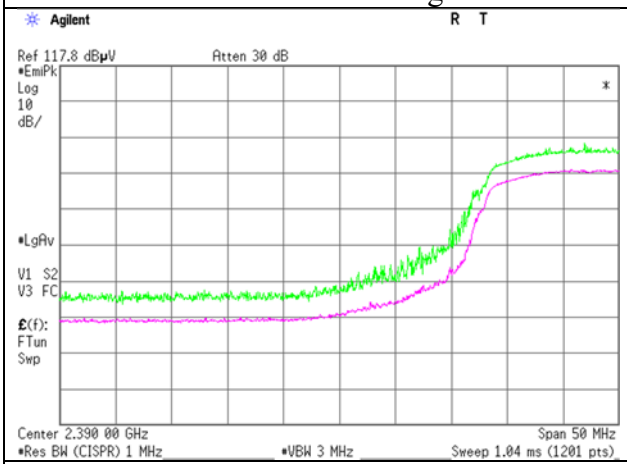
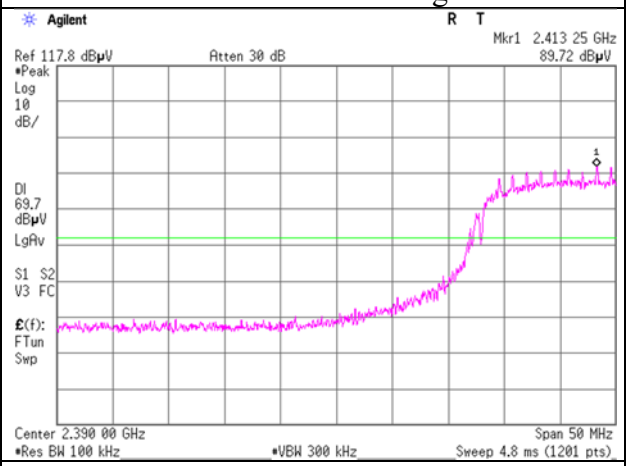
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui (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

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

Radiated Spurious Emission

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2462 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	2483.500	PK	55.1	27.5	5.9	32.0	-	56.5	73.9	17.4	
Hori	2483.500	AV	50.0	27.5	5.9	32.0	0.8	52.2	53.9	1.7	*1),*2)
Vert	2483.500	PK	62.7	27.5	5.9	32.0	-	64.1	73.9	9.8	
Vert	2483.500	AV	45.2	27.5	5.9	32.0	0.8	47.4	53.9	6.5	*1),*2)

Result = 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).

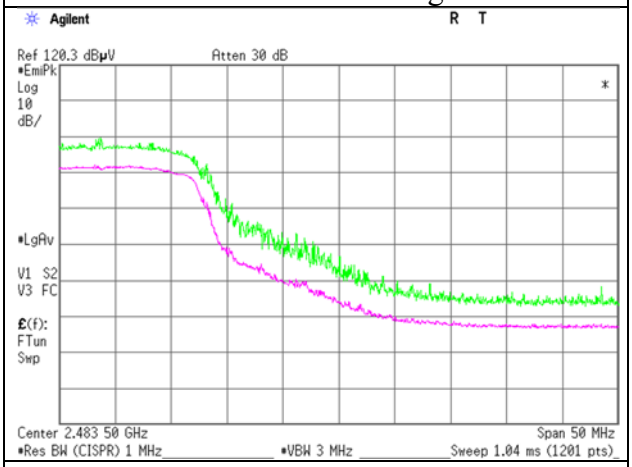
Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
*1) Not Out of Band emission(Leakage Power)
*2) Integration method

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 12, 2018
Temperature / Humidity	23 deg. C / 71 % RH
Engineer	Tomoki Matsui
	(1 GHz - 10 GHz)
Mode	Tx 11n-20 2462 MHz

Horizontal

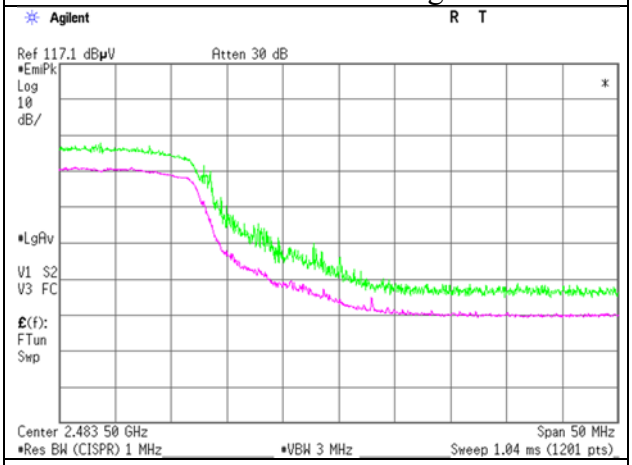
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

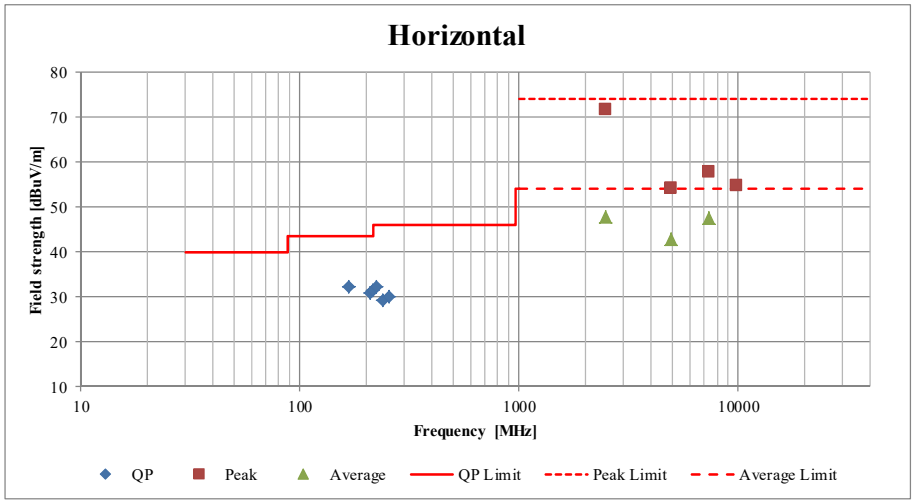


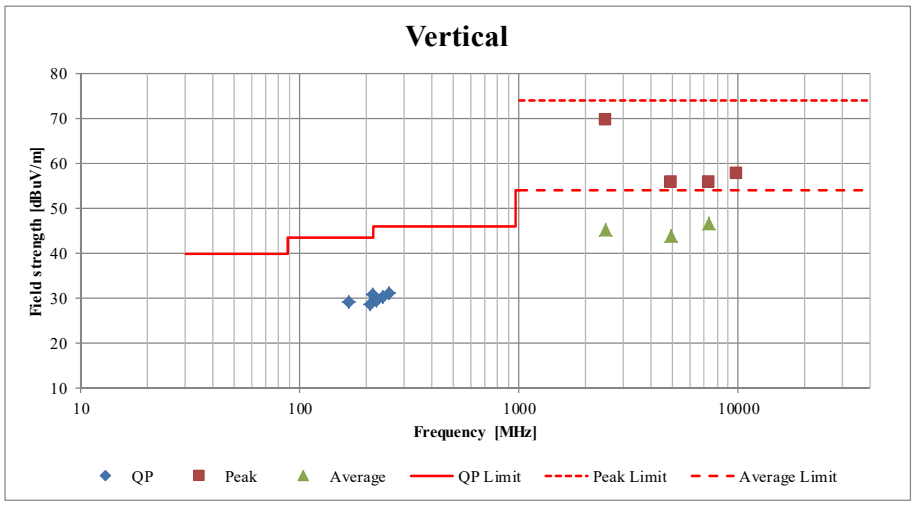
Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	12344074H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 12, 2018	June 12, 2018 (Night)
Temperature / Humidity	23 deg. C / 71 % RH	21 deg. C / 57 % RH
Engineer	Tomoki Matsui	Takumi Shimada
	(1 GHz - 10 GHz)	(Above 10 GHz , Below 1 GHz)
Mode	Tx 11g 2462 MHz	



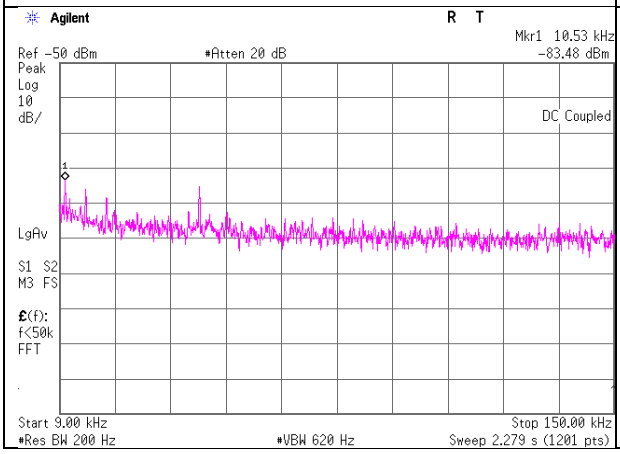


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

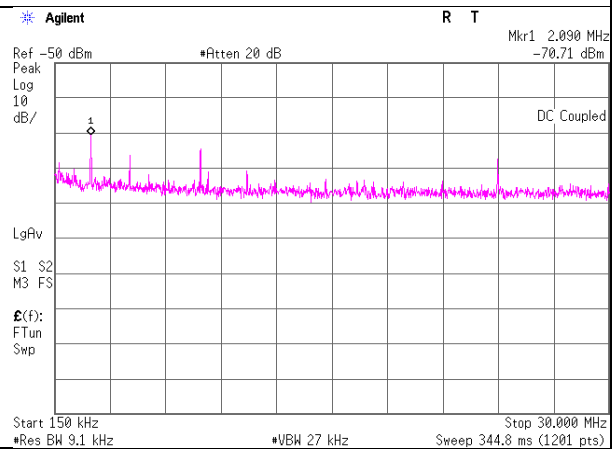
Conducted Spurious Emission

Report No.	12344074H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	June 17, 2018
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Takafumi Noguchi
Mode	Tx 11g 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
10.53	-83.5	1.53	9.8	2.0	1	-70.1	300	6.0	-8.9	47.1	56.0	
2090.00	-70.7	1.53	9.8	2.0	1	-57.3	30	6.0	23.9	29.5	5.6	

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 KDB 558074 since antenna gain was less than 2.0 dBi.

Power Density

Report No.	12344074H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	June 17, 2018
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Takafumi Noguchi
Mode	Tx

11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-11.20	1.63	9.96	0.39	8.00	7.61
2437.00	-11.46	1.40	9.96	-0.10	8.00	8.10
2462.00	-11.63	1.50	9.96	-0.17	8.00	8.17

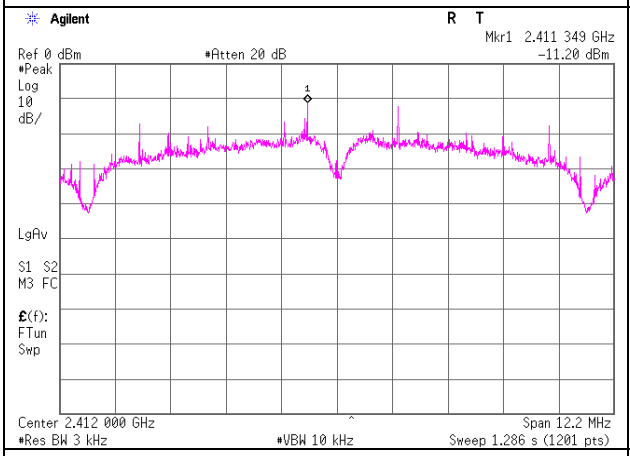
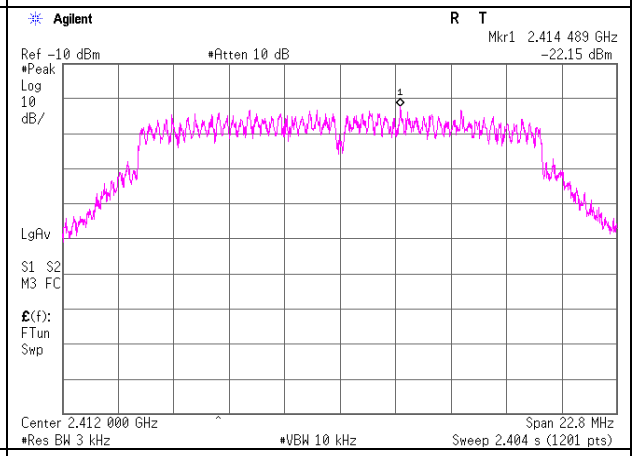
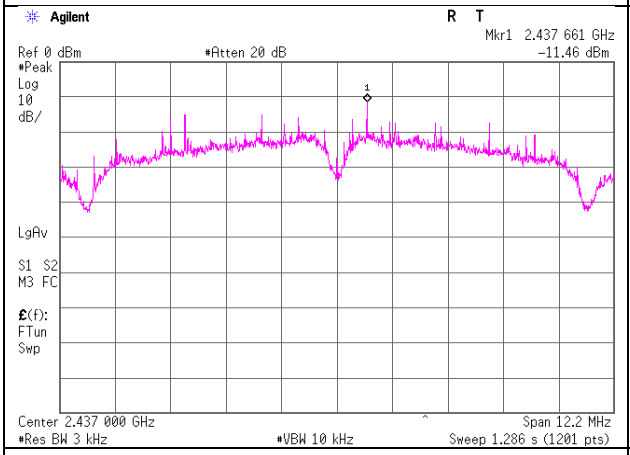
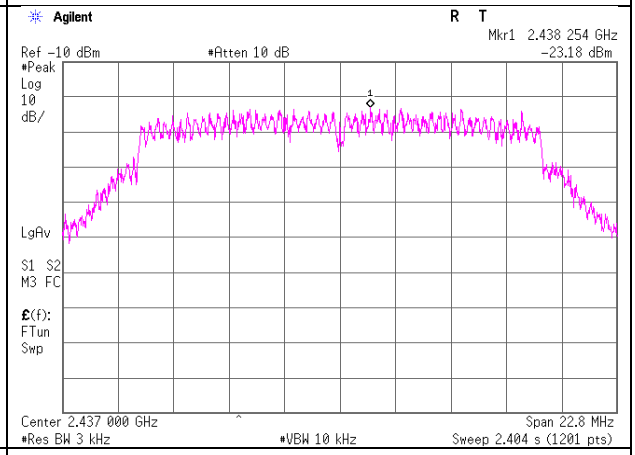
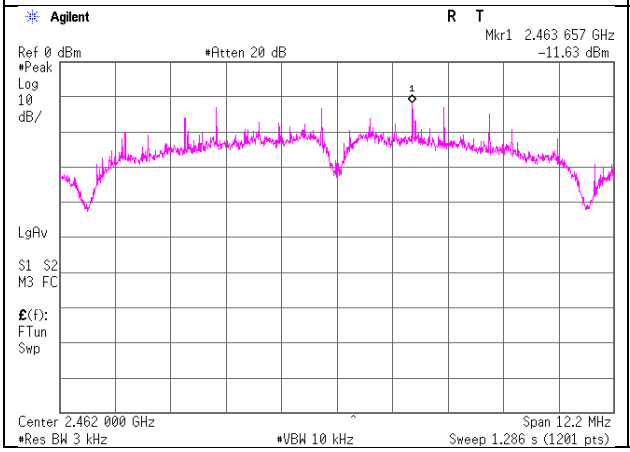
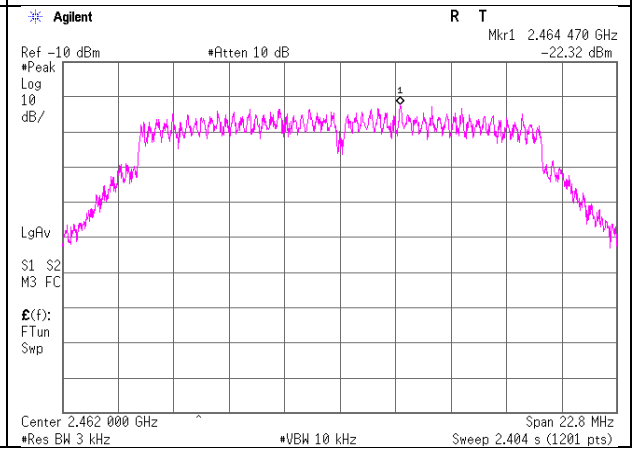
11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-22.15	1.63	9.96	-10.56	8.00	18.56
2437.00	-23.18	1.40	9.96	-11.82	8.00	19.82
2462.00	-22.32	1.50	9.96	-10.86	8.00	18.86

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	11g
2412 MHz	2412 MHz
	
2437 MHz	2437 MHz
	
2462 MHz	2462 MHz
	

Power Density

Report No.	12344074H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	June 17, 2018
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Takafumi Noguchi
Mode	Tx

11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-21.12	1.63	9.96	-9.53	8.00	17.53
2437.00	-22.10	1.40	9.96	-10.74	8.00	18.74
2462.00	-22.03	1.50	9.96	-10.57	8.00	18.57

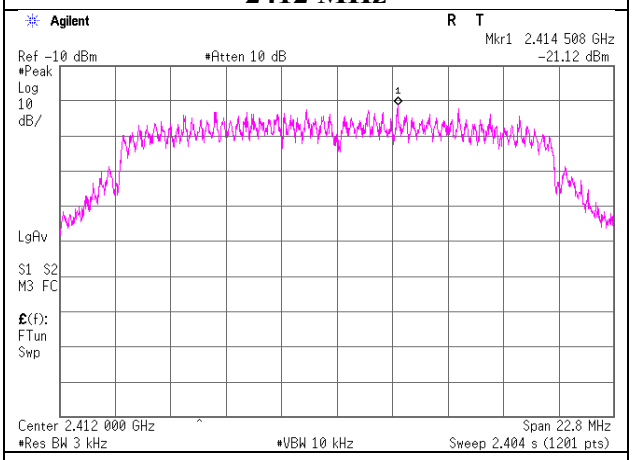
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

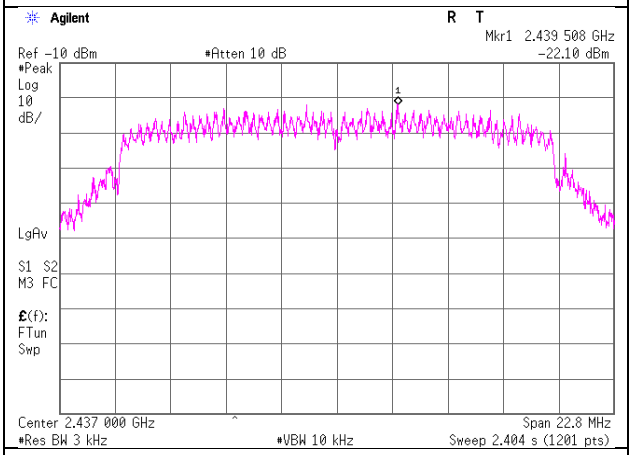
Power Density

11n-20

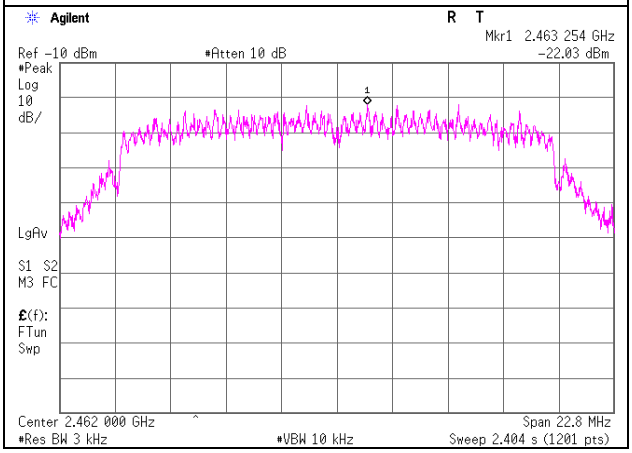
2412 MHz



2437 MHz



2462 MHz



APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	9/11/2017	9/30/2018	12
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	1/9/2018	1/31/2019	12
RE	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	6/14/2018	6/30/2019	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/6/2017	10/31/2018	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	2/25/2018	2/27/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	1/24/2018	1/31/2019	12
RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	10/30/2017	10/31/2018	12
RE	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/14/2017	11/30/2018	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	1/30/2018	1/31/2019	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	11/23/2017	11/30/2018	12
RE	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	12/10/2017	12/31/2018	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/12/2017	10/31/2018	12
RE	141397	Coaxial Cable	UL Japan	-	-	6/13/2018	6/30/2019	12
RE	141506	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	6/29/2017	6/30/2018	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	11/5/1900	260833	2/27/2018	2/28/2019	12
AT	141835	Power sensor	AGILENT	N1923A	MY54070004	4/19/2018	4/30/2019	12
AT	141812	Power Meter	AGILENT	8990B	MY51000271	4/19/2018	4/30/2019	12
AT	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	9/20/2017	9/30/2018	12
AT	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/14/2017	11/30/2018	12
AT	141226	Microwave Cable	Junkosha	MMX221-00500D MSDMS	1502S304	3/12/2018	3/31/2019	12
AT	141535	Thermo-Hygrometer	CUSTOM	CTH-201	0001	12/21/2017	12/31/2018	12

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

The expiration date of the calibration is the end of the expired month.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

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

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