



RADIO TEST REPORT

Test Report No. : 12353467H-A-R1

Applicant : CAR MATE MFG. CO., LTD.
Type of Equipment : Communication module
Model No. : TYPE1FJ
FCC ID : 2AP43-CMDC5000
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied

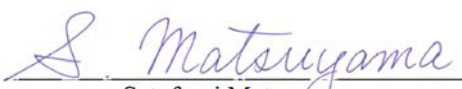
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3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative 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.
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8. This report is a revised version of 12353467H-A. 12353467H-A is replaced with this report.

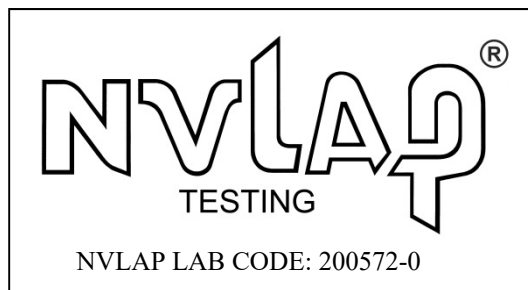
Date of test: June 14 to 24, 2018

Representative test engineer:


Takumi Shimada
Engineer
Consumer Technology Division

Approved by:


Satofumi Matsuyama
Engineer
Consumer Technology Division



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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12353467H-A

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SECTION 1: Customer information

Company Name	:	CAR MATE MFG. CO., LTD.
Address	:	5-33-11, Nagasaki, Toshima-ku, Tokyo 171-0051 Japan
Telephone Number	:	+81-3-5926-1004
Facsimile Number	:	+81-3-5926-1250
Contact Person	:	Tomoaki Sasaki

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

2.1 Identification of E.U.T.

Type of Equipment	:	Communication module
Model No.	:	TYPE1FJ
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.3 V
Receipt Date of Sample	:	June 12, 2018
Country of Mass-production	:	China
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: TYPE1FJ (referred to as the EUT in this report) is a Communication module.

General Specification

Clock frequency (crystal)	:	37.4 MHz for communication module
Operating temperature	:	-30 deg. C to +70 deg. C

Radio Specification

WLAN (IEEE802.11b/g/n)

Equipment Type	:	Transceiver
Frequency of Operation	:	2412 MHz - 2462 MHz
Type of Modulation	:	DSSS, OFDM
Bandwidth & Channel spacing	:	20 MHz & 5 MHz
Method of frequency generation	:	Synthesizer
Antenna Type	:	Monopole Pattern Antenna
Antenna Gain	:	0.8 dBi

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

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	QP 29.6 dB, (0.15000 MHz, L) AV 33.4 dB, (0.44622 MHz, N) (0.43870 MHz, L)	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(a)(2)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(b)(3)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(e)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04	FCC: Section 15.247(d)	0.5 dB (3618.00 MHz, AV, Vert.) (3618.00 MHz, AV, Hori.)	Complied#	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 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 RF Module has its own regulator.

The RF Module is constantly provided voltage through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The antenna is not removable from the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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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 density /	2.7 dB
Adjacent channel power / Channel power	
Below 3GHz	1.9 dB
3 GHz ot 6 GHz	2.1 dB

Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.8 dB
	0.15 MHz to 30 MHz	3.4 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 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

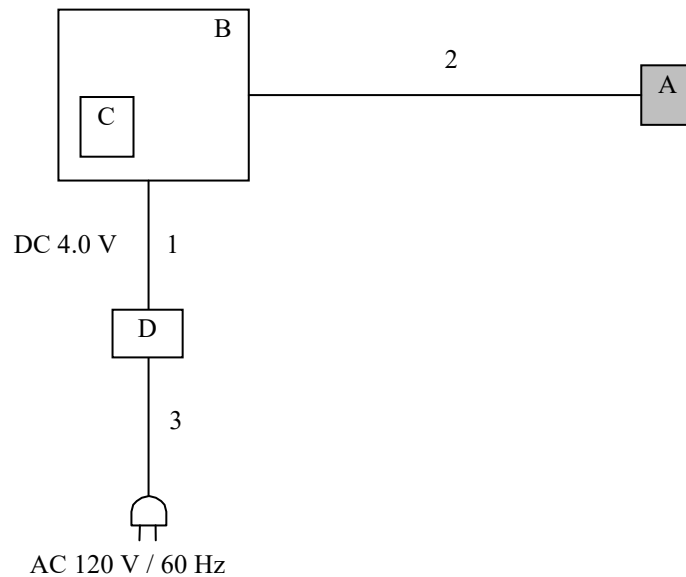
Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11b (11b)	11 Mbps, PN9
IEEE 802.11g (11g)	24 Mbps, PN9
IEEE 802.11n MIMO 20 MHz BW (11n-20)	MCS 3, 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 settings: 8.5 dBm Software: C71J1 wireless test firmware Ver. 1.0 *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
Conducted Emission	11g Tx *1)	2412 MHz
Spurious Emission (Radiated)	11b Tx	2412 MHz
	11g Tx	2437 MHz
		2462 MHz
	11n-20 Tx	2412 MHz
		2462 MHz
Spurious Emission (Conducted)	11g Tx *1)	2412 MHz
6dB Bandwidth	11b Tx	2412 MHz
Maximum Peak Output Power	11g Tx	2437 MHz
Power Density	11n-20 Tx	2462 MHz
99% Occupied Bandwidth		
*1) The test was performed on the mode as a representative, because it had the highest power at antenna terminal test.		

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	Communication Module	TYPE1FJ	CM001	CAR MATE MFG. CO., LTD.	EUT
B	Jig	-	-	CAR MATE MFG. CO., LTD.	-
C	SD Card	RP-SD016B	BQ4FG028106	Panasonic	-
D	Regulated DC Power Supply	PMC35-2A	13090501	KIKUSUI	*1)

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.5	Unshielded	Unshielded	-
2	Flat Cable	0.2	Unshielded	Unshielded	-
3	AC Cable	1.0	Unshielded	Unshielded	*1)

*1) Used for Conducted Emission test

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SECTION 5: Conducted Emission

Test Procedure and conditions

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

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

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

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

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

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

SECTION 6: 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, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 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	4m *2) (1 GHz - 10 GHz), 1 m *3) (10 GHz - 26.5 GHz)		4 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: $20 \times \log(4.0 \text{ m} / 3.0 \text{ m}) = 2.5 \text{ dB}$

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

- The noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	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

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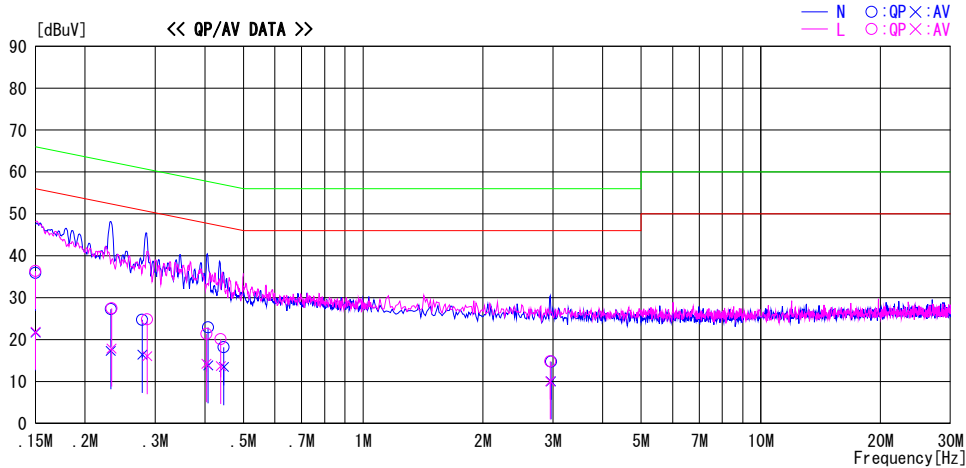
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APPENDIX 1: Test data

Conducted Emission

Report No. 12353467H
Test place Ise EMC Lab. No.2 Semi Anechoic Chamber
Date June 24, 2018
Temperature / Humidity 22 deg. C / 56 % RH
Engineer Shuichi Ohyama
Mode Tx 11g 2412 MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15000	22.7	8.5	13.2	35.9	21.7	66.0	56.0	30.1	34.3	N	
0.23203	14.1	4.1	13.2	27.3	17.3	62.4	52.4	35.1	35.1	N	
0.27825	11.5	3.2	13.2	24.7	16.4	60.9	50.9	36.2	34.5	N	
0.40785	9.7	0.7	13.2	22.9	13.9	57.7	47.7	34.8	33.8	N	
0.44622	5.0	0.3	13.2	18.2	13.5	56.9	46.9	38.7	33.4	N	
2.96753	1.1	-3.5	13.6	14.7	10.1	56.0	46.0	41.3	35.9	N	
0.15000	23.2	8.7	13.2	36.4	21.9	66.0	56.0	29.6	34.1	L	
0.23305	14.3	4.7	13.2	27.5	17.9	62.3	52.3	34.8	34.4	L	
0.28650	11.6	2.9	13.2	24.8	16.1	60.6	50.6	35.8	34.5	L	
0.40374	8.2	1.0	13.2	21.4	14.2	57.8	47.8	36.4	33.6	L	
0.43870	6.9	0.5	13.2	20.1	13.7	57.1	47.1	37.0	33.4	L	
2.95469	1.2	-3.5	13.6	14.8	10.1	56.0	46.0	41.2	35.9	L	

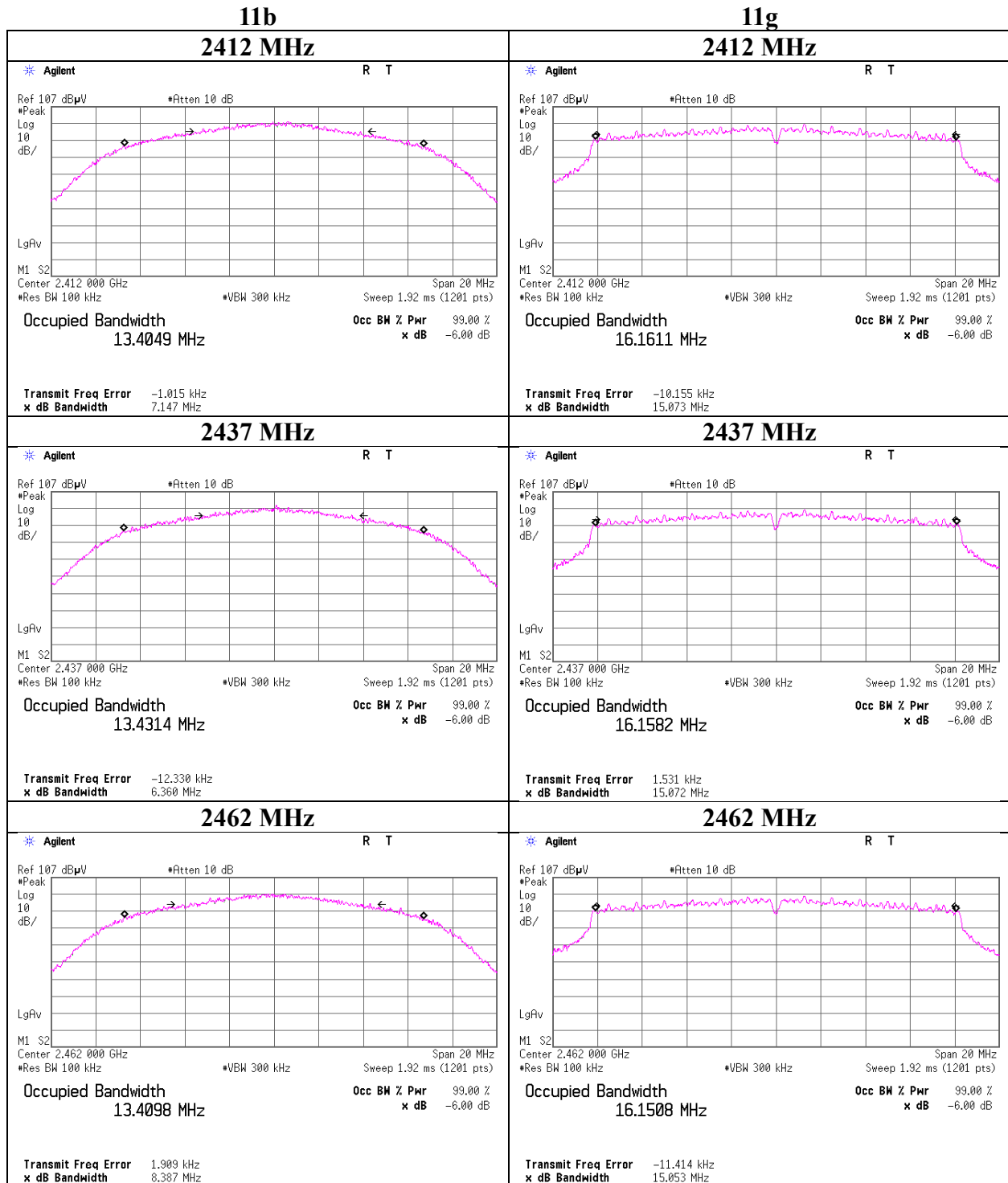
CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + CABLE + ATT)
Except for the above table: adequate margin data below the limits.

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	13429.1	7.147	> 0.5000
	2437	13471.1	6.360	> 0.5000
	2462	13481.6	8.387	> 0.5000
11g	2412	16371.5	15.073	> 0.5000
	2437	16396.6	15.072	> 0.5000
	2462	16405.1	15.053	> 0.5000
11n-20	2412	17323.0	15.071	> 0.5000
	2437	17350.6	15.065	> 0.5000
	2462	17283.1	15.044	> 0.5000

6dB Bandwidth



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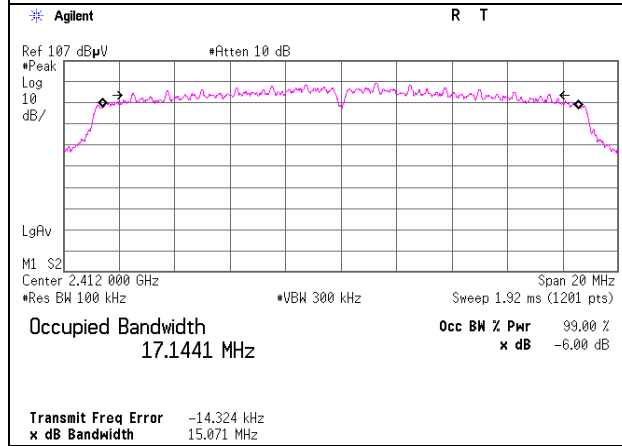
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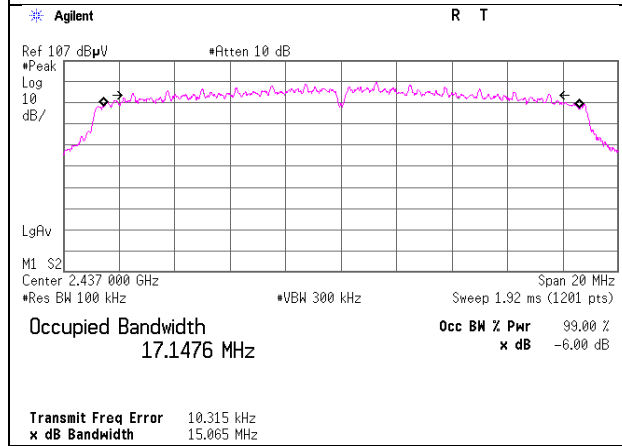
6dB Bandwidth

11n-20 Antenna

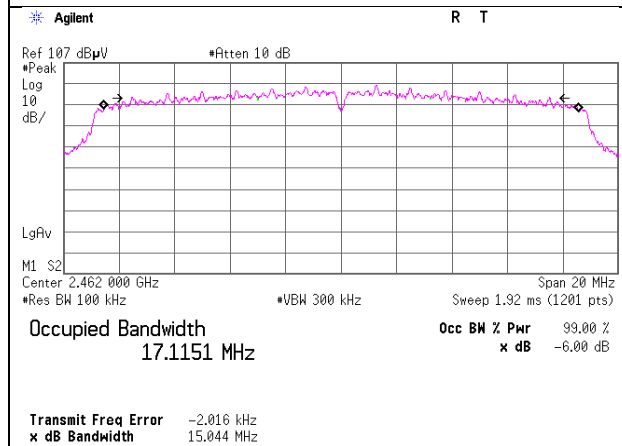
2412 MHz



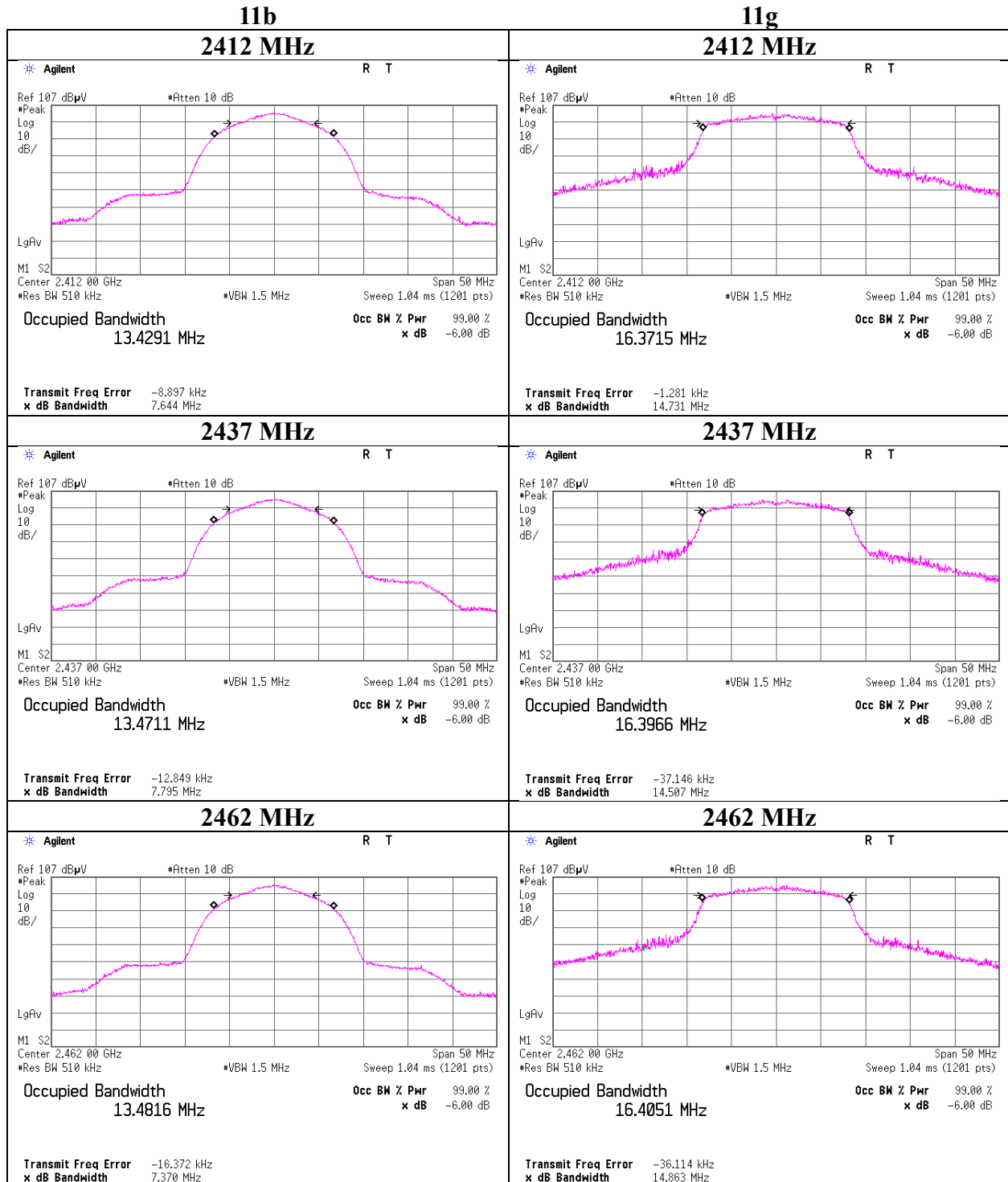
2437 MHz



2462 MHz



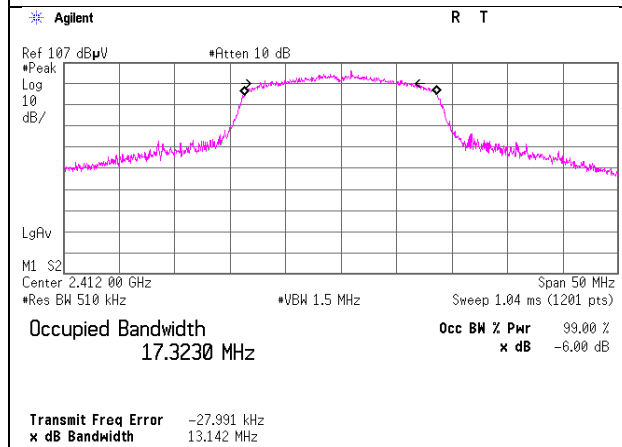
99%Occupied Bandwidth



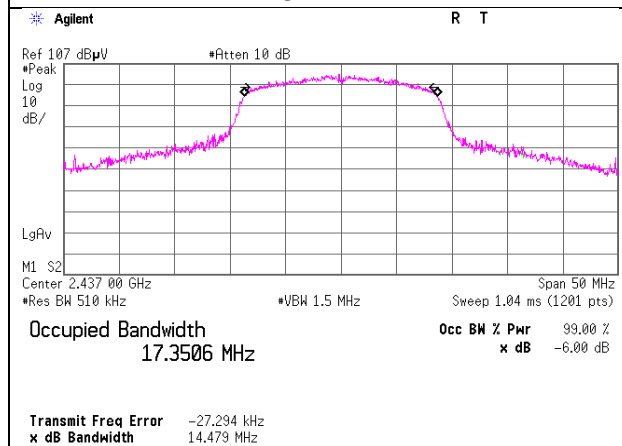
99% Occupied Bandwidth

11n-20 Antenna

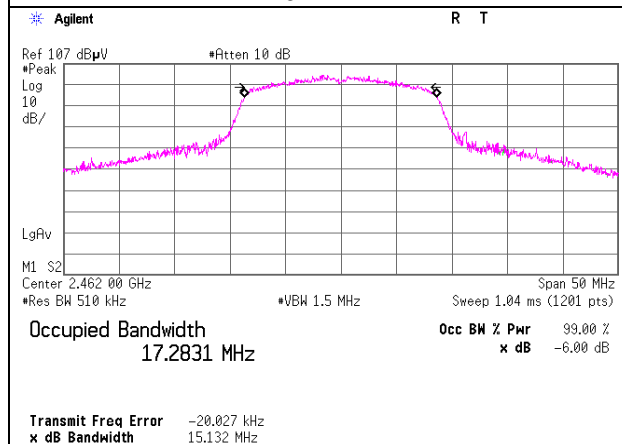
2412 MHz



2437 MHz



2462 MHz



Maximum Peak Output Power

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx 11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2412	0.85	0.85	9.71	11.41	13.84	30.00	1000	18.59	0.8	12.21	16.63	36.02	4000	23.81
2437	0.53	0.85	9.71	11.09	12.85	30.00	1000	18.91	0.8	11.89	15.45	36.02	4000	24.13
2462	0.63	0.85	9.71	11.19	13.15	30.00	1000	18.81	0.8	11.99	15.81	36.02	4000	24.03

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	0.25	
2	0.32	
5.5	0.35	
11	0.53	*

*: Worst Rate

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

Maximum Peak Output Power

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx 11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2412	7.73	0.85	9.71	18.29	67.45	30.00	1000	11.71	0.8	19.09	81.10	36.02	4000	16.93
2437	7.56	0.85	9.71	18.12	64.86	30.00	1000	11.88	0.8	18.92	77.98	36.02	4000	17.10
2462	7.38	0.85	9.71	17.94	62.23	30.00	1000	12.06	0.8	18.74	74.82	36.02	4000	17.28

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
[Mbps]	[dBm]	
6	7.27	
9	7.26	
12	7.45	
18	7.52	
24	7.56	*
36	7.38	
48	7.31	
54	7.32	

*: Worst Rate

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

Maximum Peak Output Power

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx 11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2412	7.62	0.85	9.71	18.18	65.77	30.00	1000	11.82	0.8	18.98	79.07	36.02	4000	17.04
2437	7.53	0.85	9.71	18.09	64.42	30.00	1000	11.91	0.8	18.89	77.45	36.02	4000	17.13
2462	7.23	0.85	9.71	17.79	60.12	30.00	1000	12.21	0.8	18.59	72.28	36.02	4000	17.43

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

MCS Number	Reading [dBm]	Remark
0	7.28	
1	7.31	
2	7.39	
3	7.53	*
4	7.22	
5	7.36	
6	7.23	
7	7.12	

*: Worst Rate

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

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Average Output Power
(Reference data for RF Exposure)

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx

11b 1 Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	-2.71	0.85	9.71	7.85	6.10	0.04	7.89	6.15
2437	-2.72	0.85	9.71	7.84	6.08	0.04	7.88	6.14
2462	-2.98	0.85	9.71	7.58	5.73	0.04	7.62	5.78

11g 6 Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	-2.31	0.85	9.71	8.25	6.68	0.24	8.49	7.06
2437	-2.32	0.85	9.71	8.24	6.67	0.24	8.48	7.05
2462	-2.81	0.85	9.71	7.75	5.96	0.24	7.99	6.30

11n-20 MCS 0

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	-2.61	0.85	9.71	7.95	6.24	0.31	8.26	6.70
2437	-2.73	0.85	9.71	7.83	6.07	0.31	8.14	6.52
2462	-3.09	0.85	9.71	7.47	5.58	0.31	7.78	6.00

Sample Calculation:

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

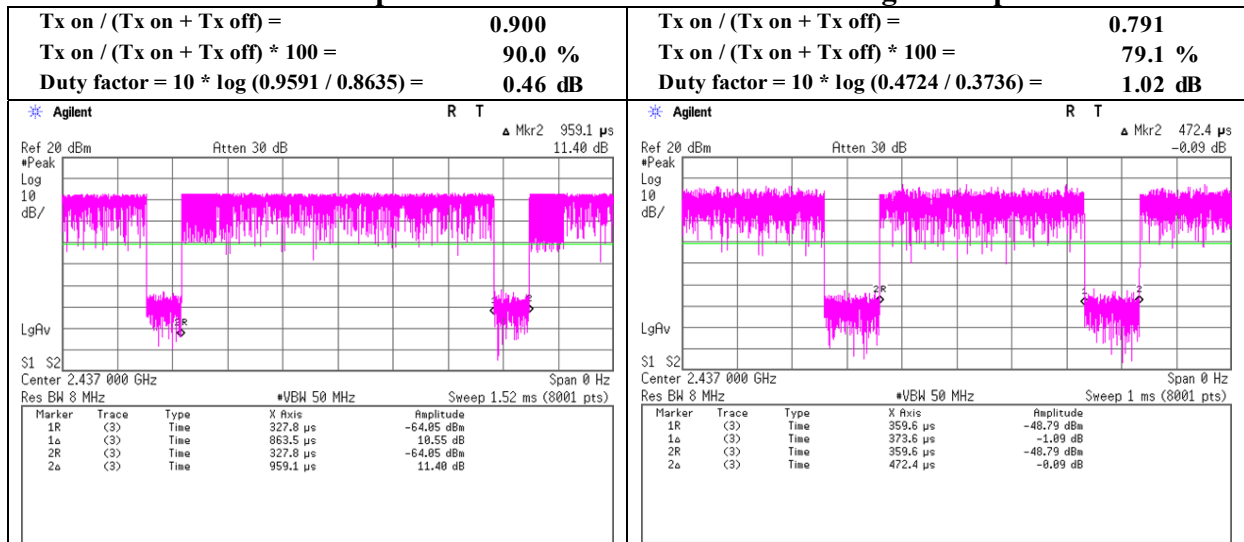
Result (Burst power average) = Time average + Duty factor

The 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.

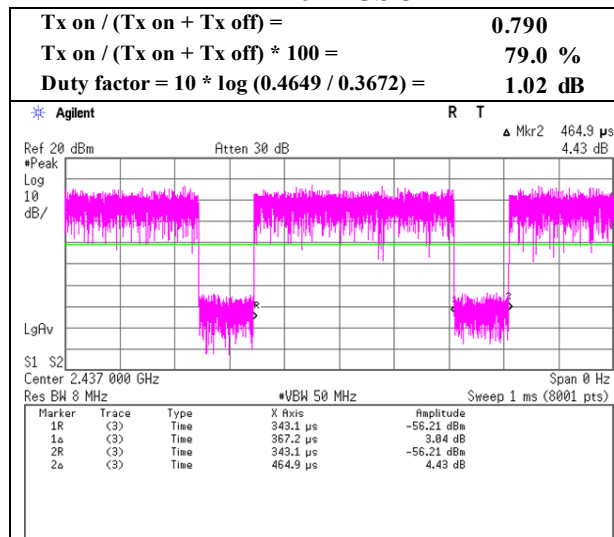
Burst rate confirmation

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx

11b 11 Mbps



11n-20 MCS 3

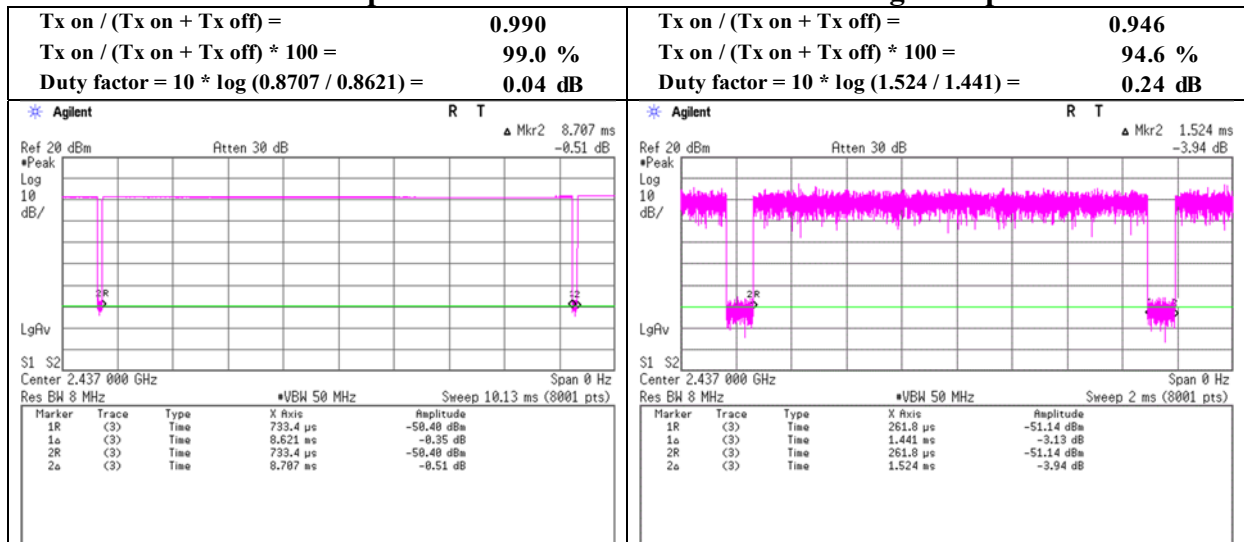


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

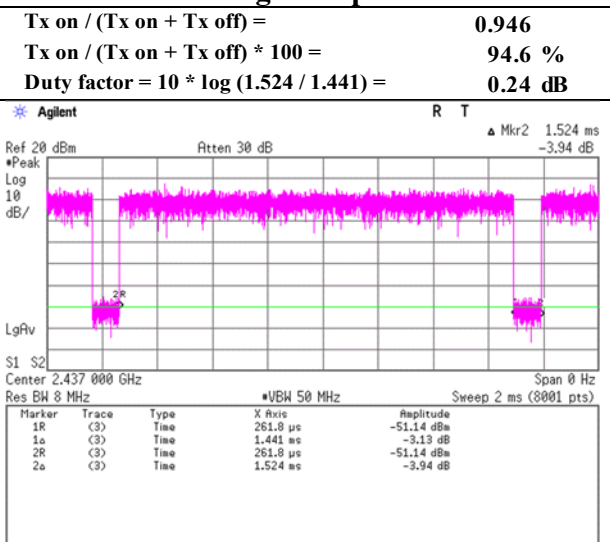
Burst rate confirmation

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx

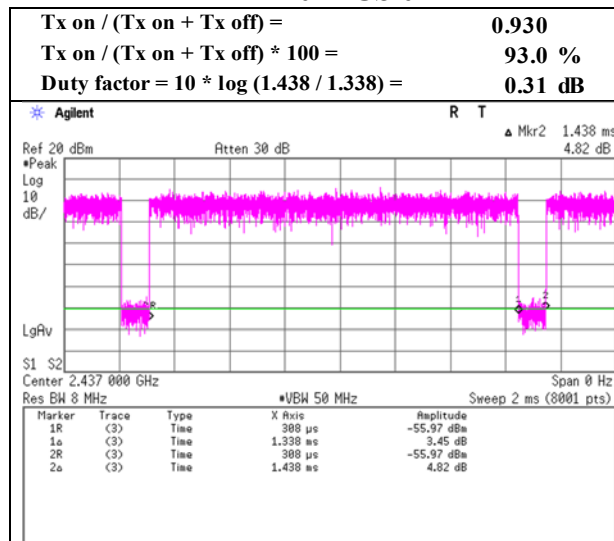
11b 1 Mbps



11g 6 Mbps



11n-20 MCS 0



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

Radiated Spurious Emission

Report No.	12353467H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 15, 2018	June 16, 2018
Temperature / Humidity	22 deg. C / 73 % RH	20 deg. C / 65 % RH
Engineer	Akihiko Maeda	Akihiko Maeda
	(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	42.1	27.4	5.9	32.1	-	43.3	73.9	30.6	
Hori	3618.000	PK	51.2	28.6	8.0	31.7	-	56.1	73.9	17.8	
Hori	4824.000	PK	40.3	31.7	8.1	31.3	-	48.8	73.9	25.1	Floor noise
Hori	7236.000	PK	42.3	36.5	9.4	32.4	-	55.8	73.9	18.1	Floor noise
Hori	2390.000	AV	33.7	27.4	5.9	32.1	0.5	35.4	53.9	18.5	*1)
Hori	3618.000	AV	48.4	28.6	8.0	31.7	-	53.3	53.9	0.6	
Hori	4824.000	AV	30.6	31.7	8.1	31.3	-	39.1	53.9	14.8	Floor noise
Hori	7236.000	AV	34.3	36.5	9.4	32.4	-	47.8	53.9	6.1	Floor noise
Vert	2390.000	PK	42.5	27.4	5.9	32.1	-	43.7	73.9	30.2	
Vert	3618.000	PK	51.4	28.6	8.0	31.7	-	56.3	73.9	17.6	
Vert	4824.000	PK	40.2	31.7	8.1	31.3	-	48.7	73.9	25.2	Floor noise
Vert	7236.000	PK	43.3	36.5	9.4	32.4	-	56.8	73.9	17.1	Floor noise
Vert	2390.000	AV	32.0	27.4	5.9	32.1	0.5	33.7	53.9	20.2	*1)
Vert	3618.000	AV	48.5	28.6	8.0	31.7	-	53.4	53.9	0.5	
Vert	4824.000	AV	30.7	31.7	8.1	31.3	-	39.2	53.9	14.7	Floor noise
Vert	7236.000	AV	32.3	36.5	9.4	32.4	-	45.8	53.9	8.1	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

*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	92.2	27.4	5.9	32.1	93.4	-	-	Carrier
Hori	2400.000	PK	42.3	27.4	5.9	32.1	43.5	73.4	29.9	
Hori	9648.000	PK	44.8	38.0	10.3	32.6	60.5	73.4	12.9	
Vert	2412.000	PK	94.3	27.4	5.9	32.1	95.5	-	-	Carrier
Vert	2400.000	PK	45.0	27.4	5.9	32.1	46.2	75.5	29.3	
Vert	9648.000	PK	43.9	38.0	10.3	32.6	59.6	75.5	15.9	

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

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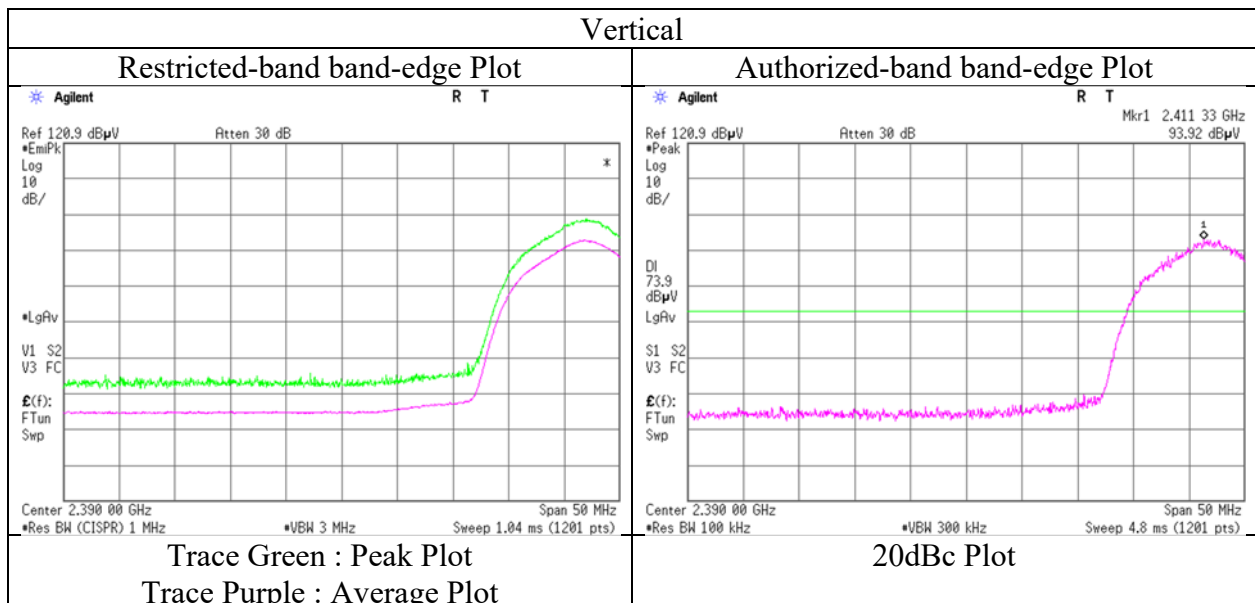
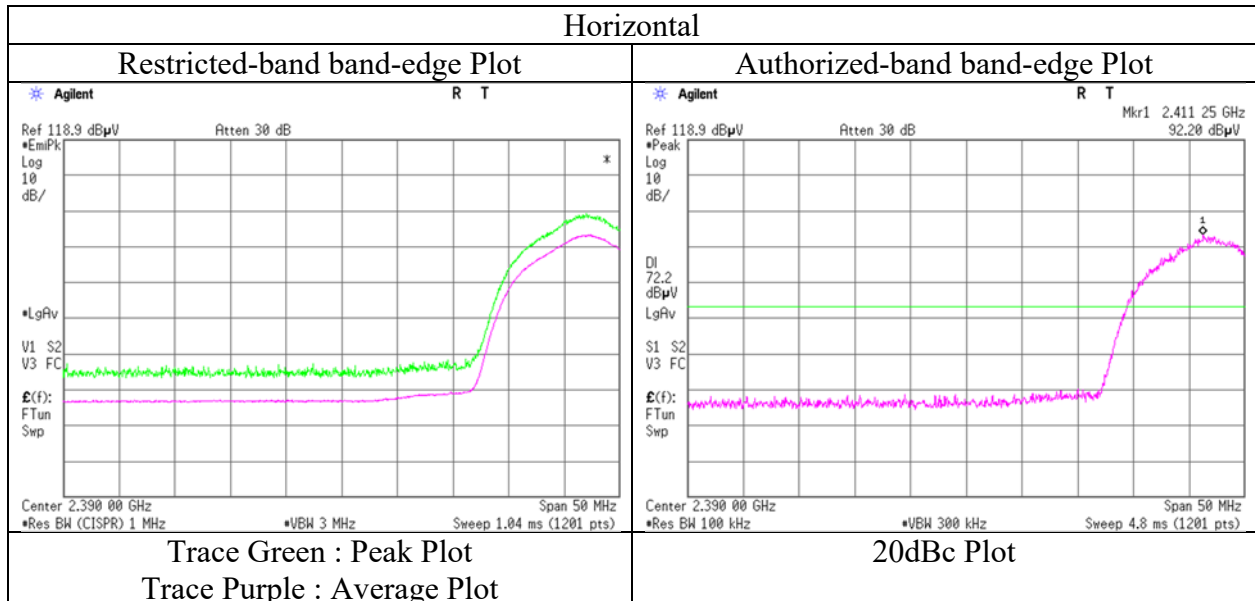
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12353467H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 15, 2018
Temperature / Humidity	22 deg. C / 73 % RH
Engineer	Akihiko Maeda (Above 1 GHz)
Mode	Tx 11b 2412 MHz



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

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Radiated Spurious Emission

Report No.	12353467H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 15, 2018	June 16, 2018
Temperature / Humidity	22 deg. C / 73 % RH	20 deg. C / 65 % RH
Engineer	Akihiko Maeda (1 GHz - 10 GHz)	Akihiko Maeda (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	3655.484	PK	49.9	28.6	8.0	31.6	-	54.9	73.9	19.0	
Hori	4874.000	PK	40.8	31.9	8.1	31.3	-	49.5	73.9	24.4	Floor noise
Hori	7311.000	PK	41.8	36.6	9.4	32.4	-	55.4	73.9	18.5	Floor noise
Hori	3655.484	AV	47.3	28.6	8.0	31.6	-	52.3	53.9	1.6	
Hori	4874.000	AV	32.8	31.9	8.1	31.3	-	41.5	53.9	12.4	Floor noise
Hori	7311.000	AV	34.0	36.6	9.4	32.4	-	47.6	53.9	6.3	Floor noise
Vert	3655.484	PK	50.1	28.6	8.0	31.6	-	55.1	73.9	18.8	
Vert	4874.000	PK	41.1	31.9	8.1	31.3	-	49.8	73.9	24.1	Floor noise
Vert	7311.000	PK	42.3	36.6	9.4	32.4	-	55.9	73.9	18.0	Floor noise
Vert	3655.484	AV	47.4	28.6	8.0	31.6	-	52.4	53.9	1.5	
Vert	4874.000	AV	32.4	31.9	8.1	31.3	-	41.1	53.9	12.8	Floor noise
Vert	7311.000	AV	34.2	36.6	9.4	32.4	-	47.8	53.9	6.1	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (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	93.7	27.4	5.9	32.1	94.9	-	-	Carrier
Hori	9748.000	PK	47.5	38.0	10.2	32.7	63.0	74.9	11.9	
Vert	2437.000	PK	94.7	27.4	5.9	32.1	95.9	-	-	Carrier
Vert	9748.000	PK	43.6	38.0	10.2	32.7	59.1	75.9	16.8	

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

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Radiated Spurious Emission

Report No.	12353467H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	June 15, 2018	June 16, 2018
Temperature / Humidity	22 deg. C / 73 % RH	20 deg. C / 65 % RH
Engineer	Akihiko Maeda	Akihiko Maeda
	(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	42.5	27.5	5.9	32.0	-	43.9	73.9	30.0	
Hori	3693.000	PK	48.0	28.7	7.9	31.6	-	53.0	73.9	20.9	
Hori	4924.000	PK	40.5	32.1	8.1	31.2	-	49.5	73.9	24.4	Floor noise
Hori	7386.000	PK	41.5	36.7	9.3	32.5	-	55.0	73.9	18.9	Floor noise
Hori	2483.500	AV	34.2	27.5	5.9	32.0	0.5	36.1	53.9	17.8	*1)
Hori	3693.000	AV	44.5	28.7	7.9	31.6	-	49.5	53.9	4.4	
Hori	4924.000	AV	32.6	32.1	8.1	31.2	-	41.6	53.9	12.3	Floor noise
Hori	7386.000	AV	33.6	36.7	9.3	32.5	-	47.1	53.9	6.8	Floor noise
Vert	2483.500	PK	43.0	27.5	5.9	32.0	-	44.4	73.9	29.5	
Vert	3693.000	PK	49.9	28.7	7.9	31.6	-	54.9	73.9	19.0	
Vert	4924.000	PK	41.5	32.1	8.1	31.2	-	50.5	73.9	23.4	Floor noise
Vert	7386.000	PK	41.9	36.7	9.3	32.5	-	55.4	73.9	18.5	Floor noise
Vert	2483.500	AV	34.3	27.5	5.9	32.0	0.5	36.2	53.9	17.7	*1)
Vert	3693.000	AV	46.7	28.7	7.9	31.6	-	51.7	53.9	2.2	
Vert	4924.000	AV	32.4	32.1	8.1	31.2	-	41.4	53.9	12.5	Floor noise
Vert	7386.000	AV	33.4	36.7	9.3	32.5	-	46.9	53.9	7.0	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

*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	43.1	38.1	10.3	32.7	58.8	74.8	16.0	
Vert	2462.000	PK	95.0	27.5	5.9	32.1	96.3	-	-	Carrier
Vert	9848.000	PK	42.7	38.1	10.3	32.7	58.4	76.3	17.9	

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

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Ise EMC Lab.

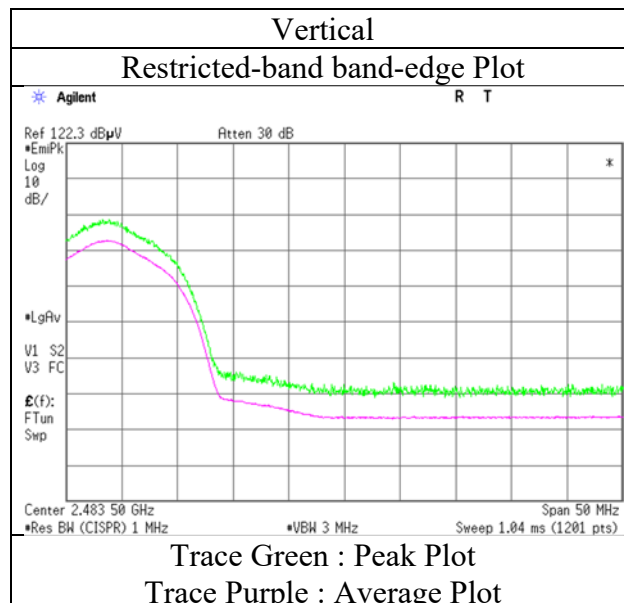
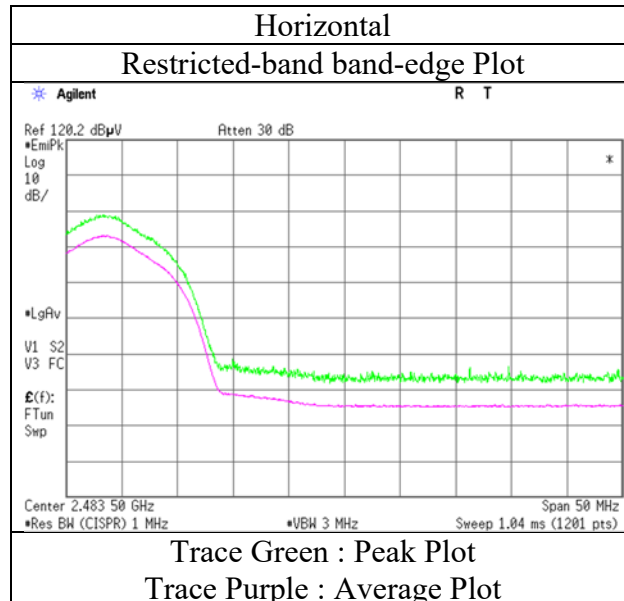
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12353467H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 15, 2018
Temperature / Humidity	22 deg. C / 73 % RH
Engineer	Akihiko Maeda (Above 1 GHz)
Mode	Tx 11b 2462 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No. 12353467H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 16, 2018 No.2
Temperature / Humidity 20 deg. C / 65 % RH June 24, 2018
Engineer Akihiko Maeda Shuichi Ohyama
(Above 1 GHz) (Below 1 GHz)
Mode Tx 11g 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	121.517	QP	33.7	12.9	7.6	30.1	-	24.1	43.5	19.4	
Hori	175.497	QP	37.5	16.0	8.0	29.8	-	31.7	43.5	11.8	
Hori	215.998	QP	47.7	11.5	8.3	29.5	-	38.0	43.5	5.5	
Hori	310.494	QP	47.0	13.7	9.0	29.3	-	40.4	46.0	5.6	
Hori	337.495	QP	46.6	14.3	9.2	29.4	-	40.7	46.0	5.3	
Hori	566.991	QP	38.5	18.7	10.1	29.8	-	37.5	46.0	8.5	
Hori	2390.000	PK	56.5	27.4	5.7	32.7	-	56.9	73.9	17.0	
Hori	3618.000	PK	51.6	28.6	8.0	32.2	-	56.0	73.9	17.9	
Hori	4824.000	PK	40.7	31.7	8.1	31.8	-	48.7	73.9	25.2	Floor noise
Hori	7236.000	PK	41.9	36.5	9.3	32.6	-	55.1	73.9	18.8	Floor noise
Hori	2390.000	AV	44.4	27.4	5.7	32.7	1.0	45.8	53.9	8.1	*1)
Hori	3618.000	AV	49.0	28.6	8.0	32.2	-	53.4	53.9	0.5	
Hori	4824.000	AV	32.2	31.7	8.1	31.8	-	40.2	53.9	13.7	Floor noise
Hori	7236.000	AV	34.1	36.5	9.3	32.6	-	47.3	53.9	6.6	Floor noise
Vert	121.517	QP	39.8	12.9	7.6	30.1	-	30.2	43.5	13.3	
Vert	175.497	QP	35.2	16.0	8.0	29.8	-	29.4	43.5	14.1	
Vert	215.998	QP	43.1	11.5	8.3	29.5	-	33.4	43.5	10.1	
Vert	310.494	QP	36.9	13.7	9.0	29.3	-	30.3	46.0	15.7	
Vert	337.495	QP	40.4	14.3	9.2	29.4	-	34.5	46.0	11.5	
Vert	566.991	QP	31.1	18.7	10.1	29.8	-	30.1	46.0	15.9	
Vert	2390.000	PK	57.1	27.4	5.7	32.7	-	57.5	73.9	16.4	
Vert	3618.000	PK	50.7	28.6	8.0	32.2	-	55.1	73.9	18.8	
Vert	4824.000	PK	39.7	31.7	8.1	31.8	-	47.7	73.9	26.2	Floor noise
Vert	7236.000	PK	42.2	36.5	9.3	32.6	-	55.4	73.9	18.5	Floor noise
Vert	2390.000	AV	44.1	27.4	5.7	32.7	1.0	45.5	53.9	8.4	*1)
Vert	3618.000	AV	48.4	28.6	8.0	32.2	-	52.8	53.9	1.1	
Vert	4824.000	AV	32.4	31.7	8.1	31.8	-	40.4	53.9	13.5	Floor noise
Vert	7236.000	AV	33.8	36.5	9.3	32.6	-	47.0	53.9	6.9	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

*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	90.0	27.4	5.7	32.7	90.4	-	-	Carrier
Hori	2400.000	PK	53.4	27.4	5.7	32.7	53.8	70.4	16.6	
Hori	9648.000	PK	41.6	38.0	9.7	33.3	56.0	70.4	14.4	
Vert	2412.000	PK	89.7	27.4	5.7	32.7	90.1	-	-	Carrier
Vert	2400.000	PK	54.7	27.4	5.7	32.7	55.1	70.1	15.0	
Vert	9648.000	PK	43.0	38.0	9.7	33.3	57.4	70.1	12.7	

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

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Ise EMC Lab.

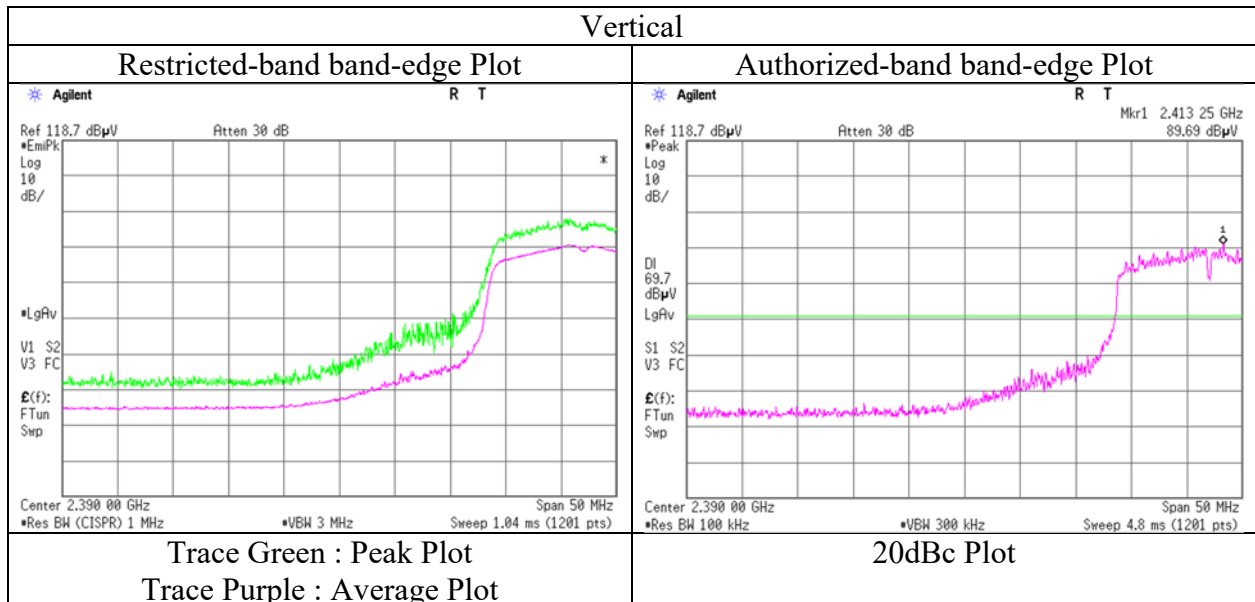
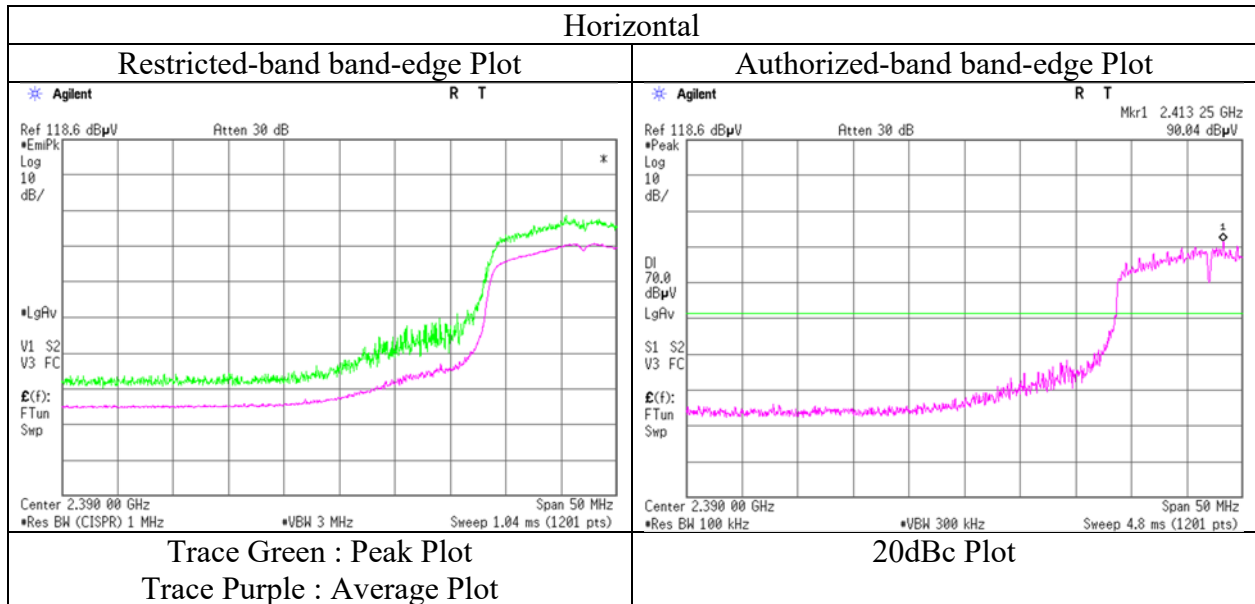
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12353467H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 16, 2018
Temperature / Humidity	20 deg. C / 65 % RH
Engineer	Akihiko Maeda (Above 1 GHz)
Mode	Tx 11g 2412 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No. 12353467H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 16, 2018
Temperature / Humidity 20 deg. C / 65 % RH
Engineer Akihiko Maeda
(Above 1 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	3655.484	PK	50.0	28.6	8.0	32.2	-	54.4	73.9	19.5	
Hori	4874.000	PK	40.3	31.9	8.1	31.7	-	48.6	73.9	25.3	Floor noise
Hori	7311.000	PK	41.9	36.6	9.4	32.7	-	55.2	73.9	18.7	Floor noise
Hori	3655.484	AV	47.2	28.6	8.0	32.2	-	51.6	53.9	2.3	
Hori	4874.000	AV	32.2	31.9	8.1	31.7	-	40.5	53.9	13.4	Floor noise
Hori	7311.000	AV	33.7	36.6	9.4	32.7	-	47.0	53.9	6.9	Floor noise
Vert	3655.484	PK	50.3	28.6	8.0	32.2	-	54.7	73.9	19.2	
Vert	4874.000	PK	41.1	31.9	8.1	31.7	-	49.4	73.9	24.5	Floor noise
Vert	7311.000	PK	41.7	36.6	9.4	32.7	-	55.0	73.9	18.9	Floor noise
Vert	3655.484	AV	47.8	28.6	8.0	32.2	-	52.2	53.9	1.7	
Vert	4874.000	AV	32.9	31.9	8.1	31.7	-	41.2	53.9	12.7	Floor noise
Vert	7311.000	AV	33.6	36.6	9.4	32.7	-	46.9	53.9	7.0	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (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	91.0	27.4	5.7	32.7	91.4	-	-	Carrier
Hori	9748.000	PK	43.5	38.0	9.7	33.4	57.8	71.4	13.6	
Vert	2437.000	PK	92.3	27.4	5.7	32.7	92.7	-	-	Carrier
Vert	9748.000	PK	43.1	38.0	9.7	33.4	57.4	72.7	15.3	

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

Radiated Spurious Emission

Report No. 12353467H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 16, 2018
Temperature / Humidity 20 deg. C / 65 % RH
Engineer Akihiko Maeda
(Above 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	2483.500	PK	59.7	27.5	5.8	32.7	-	60.3	73.9	13.6	
Hori	3693.000	PK	48.0	28.7	8.0	32.2	-	52.5	73.9	21.4	
Hori	4924.000	PK	40.0	32.1	8.1	31.7	-	48.5	73.9	25.4	Floor noise
Hori	7386.000	PK	42.7	36.7	9.4	32.7	-	56.1	73.9	17.8	Floor noise
Hori	2483.500	AV	46.4	27.5	5.8	32.7	1.0	48.0	53.9	5.9	*1)
Hori	3693.000	AV	44.3	28.7	8.0	32.2	-	48.8	53.9	5.1	
Hori	4924.000	AV	31.7	32.1	8.1	31.7	-	40.2	53.9	13.7	Floor noise
Hori	7386.000	AV	34.1	36.7	9.4	32.7	-	47.5	53.9	6.4	Floor noise
Vert	2483.500	PK	60.8	27.5	5.8	32.7	-	61.4	73.9	12.5	
Vert	3693.000	PK	49.0	28.7	8.0	32.2	-	53.5	73.9	20.4	
Vert	4924.000	PK	40.4	32.1	8.1	31.7	-	48.9	73.9	25.0	Floor noise
Vert	7386.000	PK	41.3	36.7	9.4	32.7	-	54.7	73.9	19.2	Floor noise
Vert	2483.500	AV	47.7	27.5	5.8	32.7	1.0	49.3	53.9	4.6	*1)
Vert	3693.000	AV	45.9	28.7	8.0	32.2	-	50.4	53.9	3.5	
Vert	4924.000	AV	31.8	32.1	8.1	31.7	-	40.3	53.9	13.6	Floor noise
Vert	7386.000	AV	34.0	36.7	9.4	32.7	-	47.4	53.9	6.5	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 $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*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	91.8	27.5	5.7	32.7	92.3	-	-	Carrier
Hori	9748.000	PK	42.7	38.1	9.7	33.4	57.1	72.3	15.2	
Vert	2462.000	PK	92.8	27.5	5.7	32.7	93.3	-	-	Carrier
Vert	9748.000	PK	42.3	38.1	9.7	33.4	56.7	73.3	16.6	

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

UL Japan, Inc.

Ise EMC Lab.

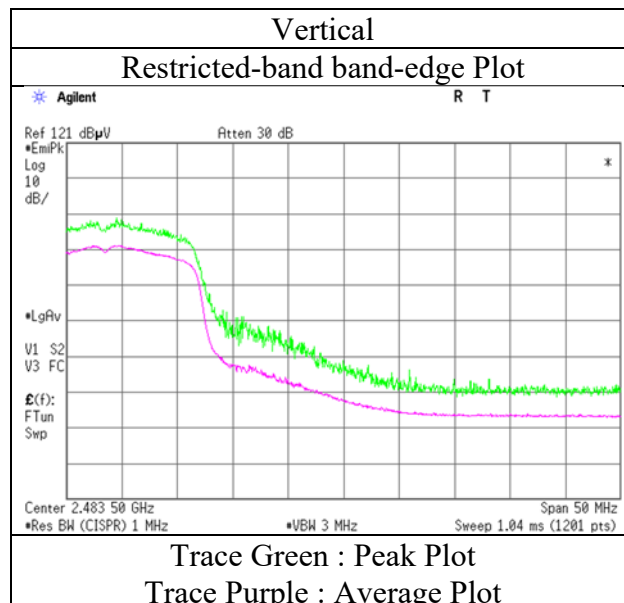
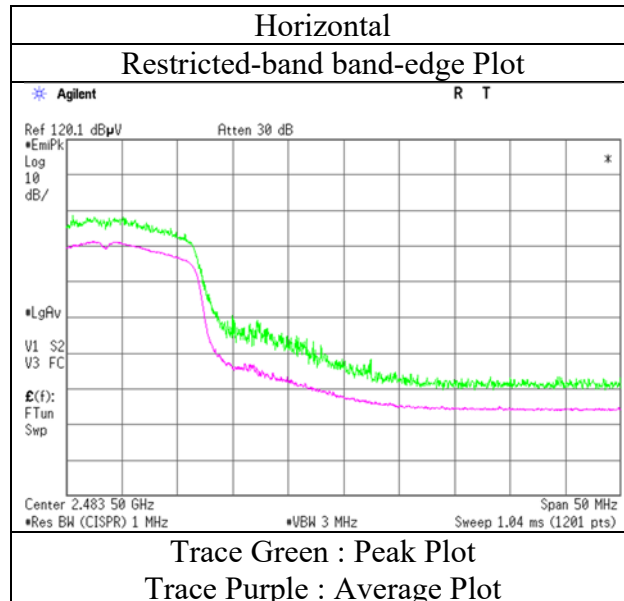
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12353467H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 16, 2018
Temperature / Humidity	20 deg. C / 65 % RH
Engineer	Akihiko Maeda (Above 1 GHz)
Mode	Tx 11g 2462 MHz



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

Radiated Spurious Emission

Report No. 12353467H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 16, 2018
Temperature / Humidity 20 deg. C / 65 % RH
Engineer Akihiko Maeda
(Above 1 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	55.1	27.4	5.7	32.7	-	55.5	73.9	18.4	
Hori	2390.000	AV	40.8	27.4	5.7	32.7	1.0	42.2	53.9	11.7	*1)
Vert	2390.000	PK	57.4	27.4	5.7	32.7	-	57.8	73.9	16.1	
Vert	2390.000	AV	43.2	27.4	5.7	32.7	1.0	44.6	53.9	9.3	*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	89.0	27.4	5.7	32.7	89.4	-	-	Carrier
Hori	2400.000	PK	55.1	27.4	5.7	32.7	55.5	69.4	13.9	
Vert	2412.000	PK	91.4	27.4	5.7	32.7	91.8	-	-	Carrier
Vert	2400.000	PK	56.0	27.4	5.7	32.7	56.4	71.8	15.4	

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

UL Japan, Inc.

Ise EMC Lab.

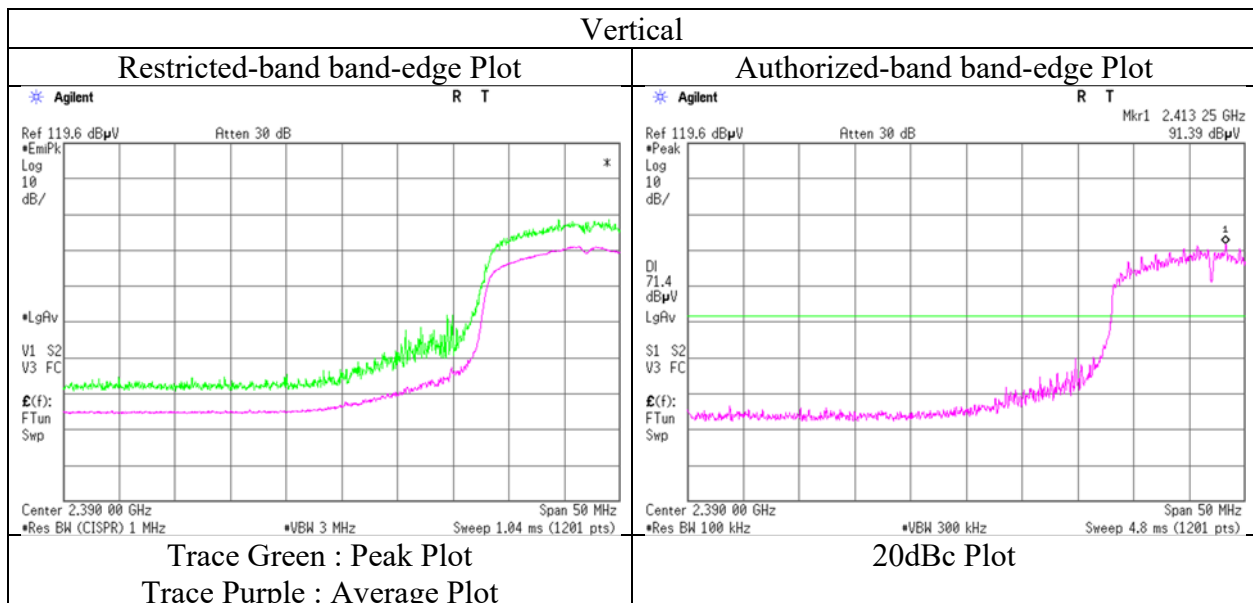
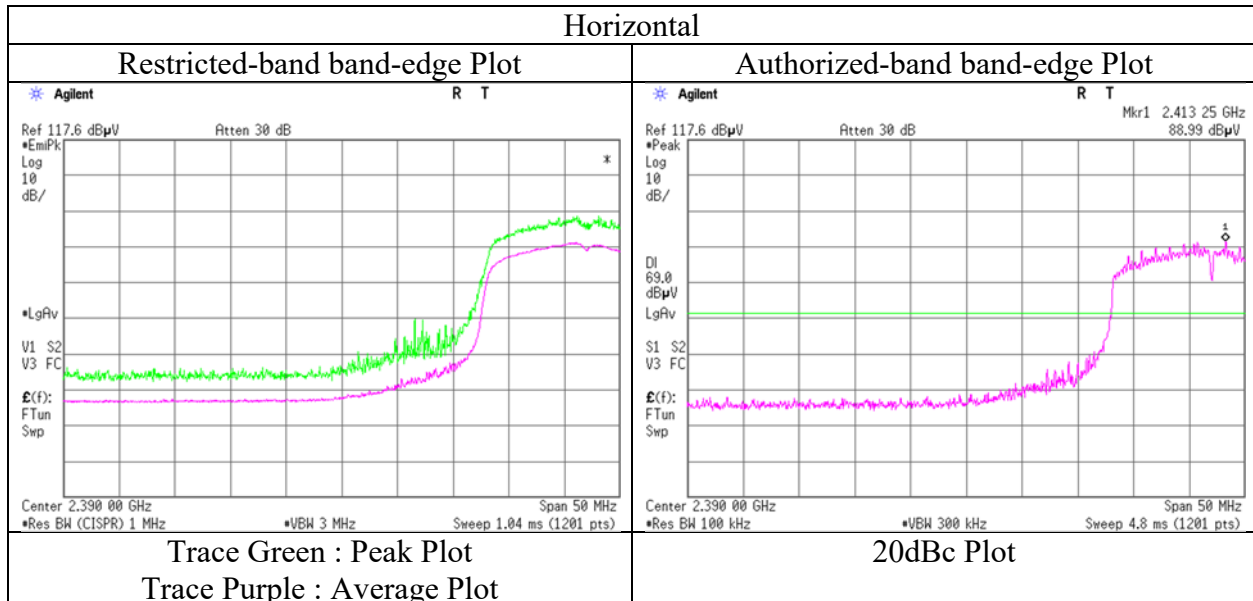
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12353467H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 16, 2018
Temperature / Humidity	20 deg. C / 65 % RH
Engineer	Akihiko Maeda (Above 1 GHz)
Mode	Tx 11n-20 2412 MHz



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

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Telephone : +81 596 24 8999

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Radiated Spurious Emission

Report No. 12353467H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 16, 2018
Temperature / Humidity 20 deg. C / 65 % RH
Engineer Akihiko Maeda
(Above 1 GHz)
Mode Tx 11n-20 2462 MHz

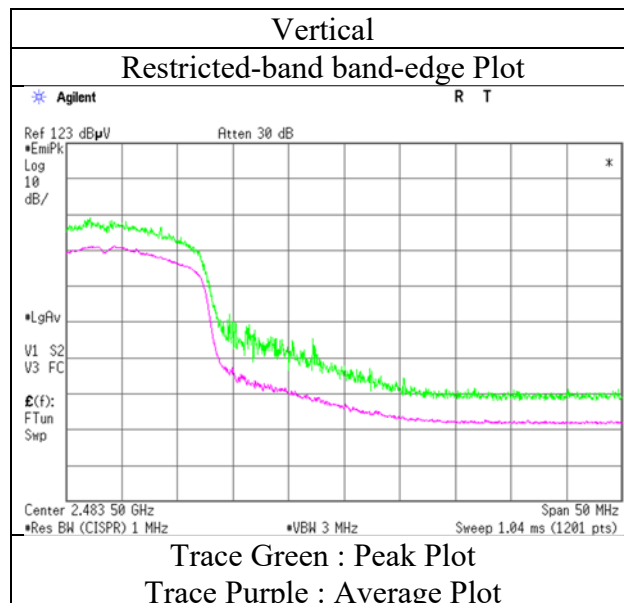
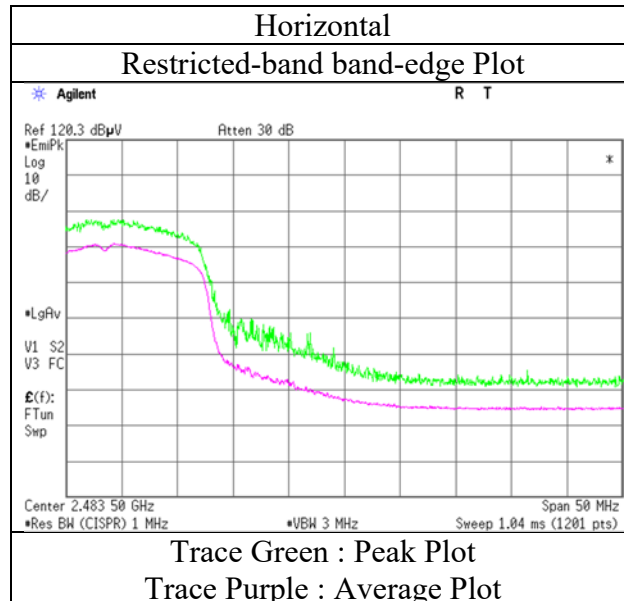
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2483.500	PK	59.2	27.5	5.8	32.7	-	59.8	73.9	14.1	
Hori	2483.500	AV	45.3	27.5	5.8	32.7	1.0	46.9	53.9	7.0	*1)
Vert	2483.500	PK	62.1	27.5	5.8	32.7	-	62.7	73.9	11.2	
Vert	2483.500	AV	48.1	27.5	5.8	32.7	1.0	49.7	53.9	4.2	*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).

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12353467H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 16, 2018
Temperature / Humidity	20 deg. C / 65 % RH
Engineer	Akihiko Maeda (Above 1 GHz)
Mode	Tx 11n-20 2462 MHz



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

UL Japan, Inc.

Ise EMC Lab.

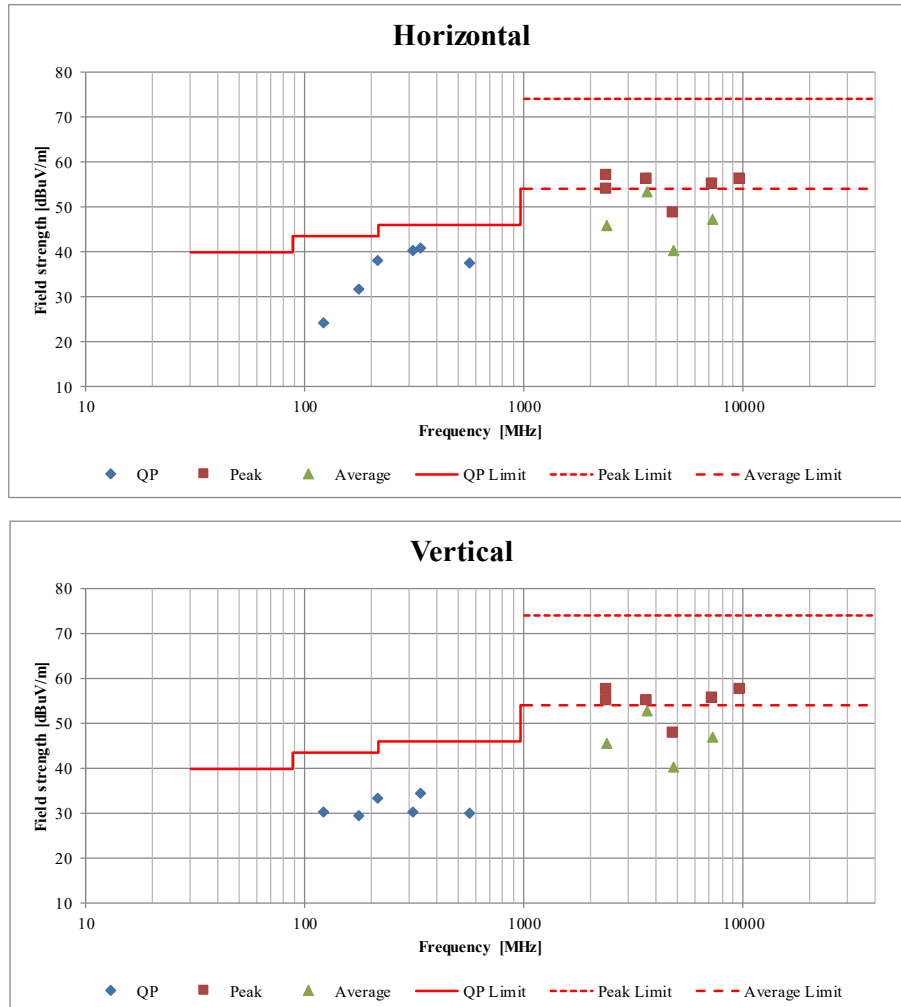
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Radiated Spurious Emission (Plot data, Worst case)

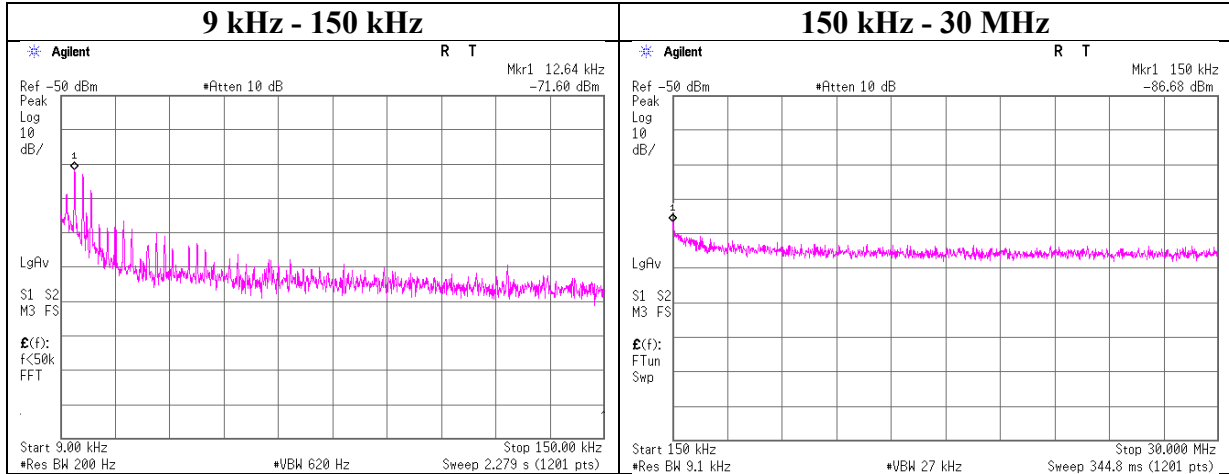
Report No.	12353467H	No.2
Test place	Ise EMC Lab.	June 24, 2018
Semi Anechoic Chamber	No.4	June 16, 2018
Date	June 16, 2018	22 deg. C / 56 % RH
Temperature / Humidity	20 deg. C / 65 % RH	22 deg. C / 56 % RH
Engineer	Akihiko Maeda (Above 1 GHz)	Shuichi Ohyama (Below 1 GHz)
Mode	Tx 11g 2412 MHz	



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

Conducted Spurious Emission

Report No.	12353467H
Test place	Ise EMC Lab. No.4 Measurement Room
Date	June 14, 2018
Temperature / Humidity	23 deg. C / 58 % RH
Engineer	Takumi Shimada
Mode	Tx 11g 2412 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12.64	-71.6	0.85	9.8	2.0	1	-58.9	300	6.0	2.3	45.5	43.2	
150.00	-86.7	0.85	9.8	2.0	1	-74.0	300	6.0	-12.7	24.0	36.7	

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

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

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

UL Japan, Inc.

Ise EMC Lab.

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

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Power Density

Report No. 12353467H
Test place Ise EMC Lab. No.4 Measurement Room
Date June 14, 2018
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Takumi Shimada
Mode Tx

11b

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412.00	-24.10	0.85	9.71	-13.54	8.00	21.54
2437.00	-23.87	0.85	9.71	-13.31	8.00	21.31
2462.00	-24.07	0.85	9.71	-13.51	8.00	21.51

11g

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412.00	-24.96	0.85	9.71	-14.40	8.00	22.40
2437.00	-25.47	0.85	9.71	-14.91	8.00	22.91
2462.00	-25.37	0.85	9.71	-14.81	8.00	22.81

11n-20

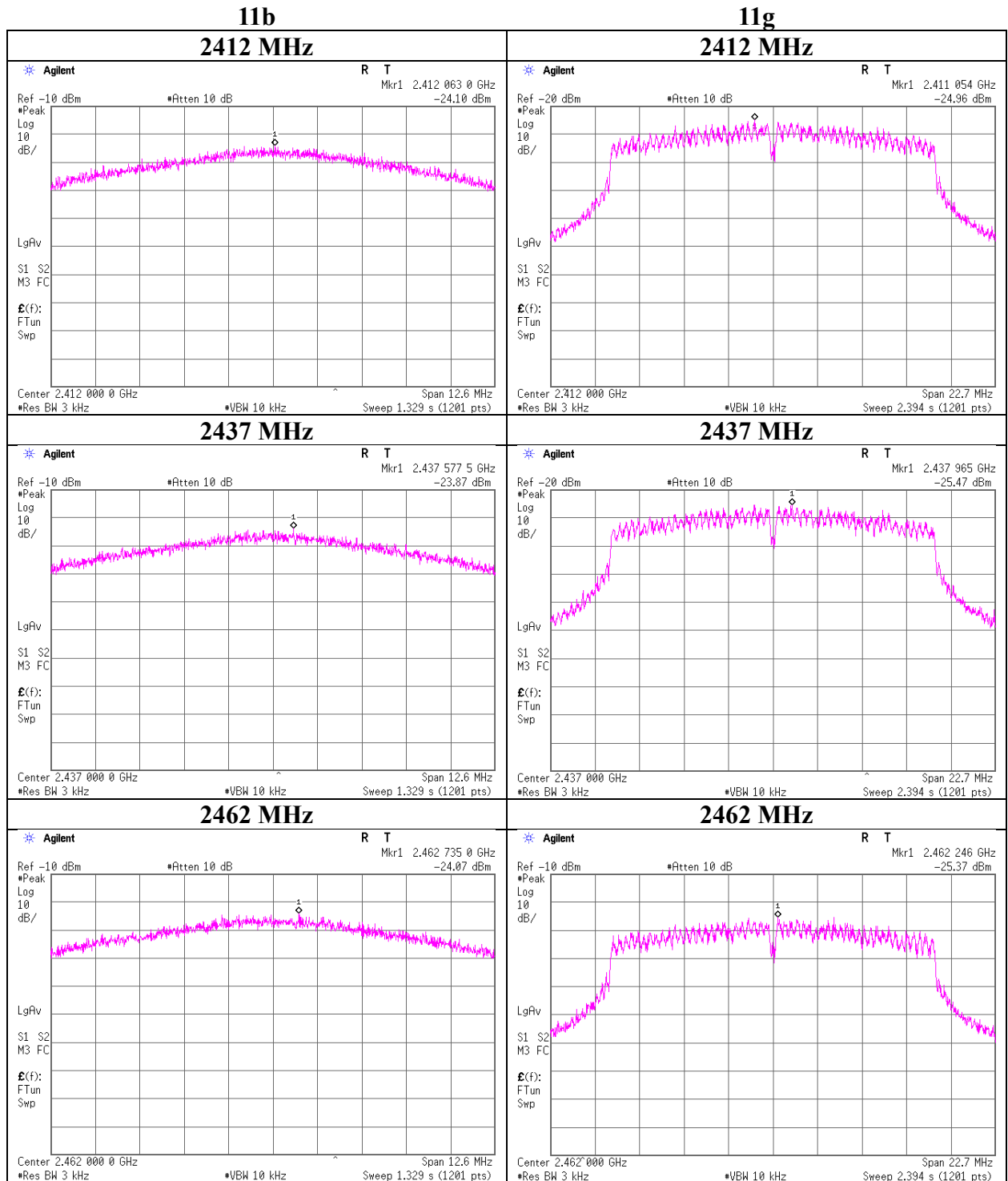
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412.00	-25.02	0.85	9.71	-14.46	8.00	22.46
2437.00	-25.43	0.85	9.71	-14.87	8.00	22.87
2462.00	-25.09	0.85	9.71	-14.53	8.00	22.53

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



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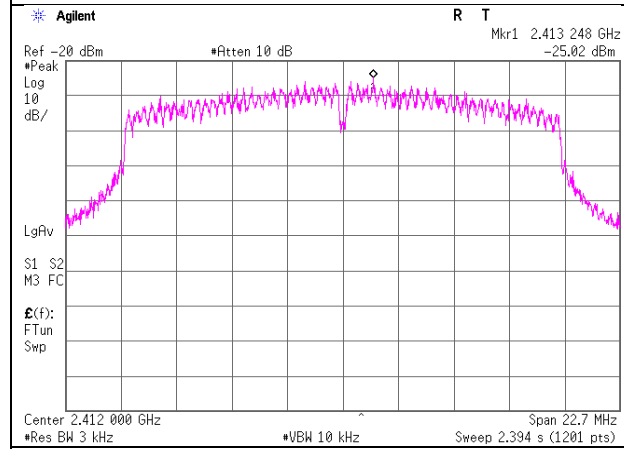
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

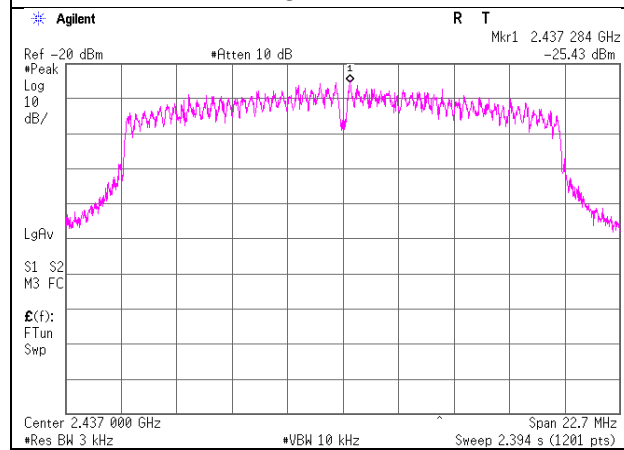
Power Density

11n-20 Antenna

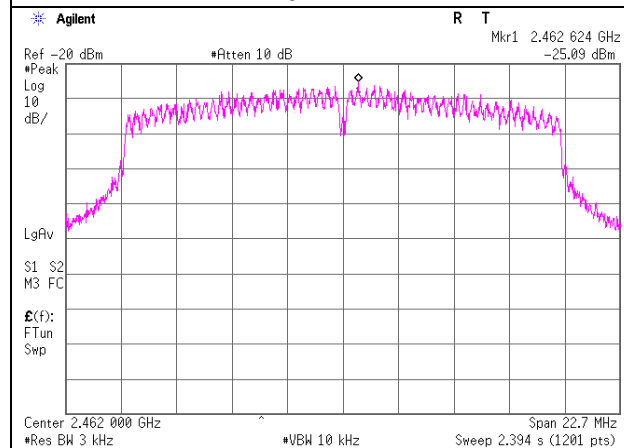
2412 MHz



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	09/11/2017	09/30/2018	12
RE	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	06/14/2018	06/30/2019	12
RE	141508	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	09/14/2017	09/30/2018	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/06/2017	10/31/2018	12
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	01/24/2018	01/31/2019	12
AT,RE	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/14/2017	11/30/2018	12
RE	142011	AC4 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	10/30/2017	10/31/2018	12
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	01/09/2018	01/31/2019	12
AT	141564	Thermo-Hygrometer	CUSTOM	CTH-201	0004	12/21/2017	12/31/2018	12
AT	141312	Attenuator	Weinschel Associates	WA56-10	56100304	05/29/2018	05/31/2019	12
AT	141832	Power sensor	ANRITSU	MA2411B	738174	11/16/2017	11/30/2018	12
AT	141810	Power Meter	ANRITSU	ML2495A	824014	11/16/2017	11/30/2018	12
RE	141506	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	06/29/2017	06/30/2018	12
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/22/2017	09/30/2018	12
RE	141417	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	05/07/2018	05/31/2019	12
RE	141580	MicroWave System Amplifier	AGILENT	83017A	MY39500779	03/13/2018	03/31/2019	12
RE	141900	Spectrum Analyzer	AGILENT	E4440A	MY46185823	11/16/2017	11/30/2018	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/09/2018	01/31/2019	12
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/24/2018	01/31/2019	12
RE	142008	AC3 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	10/31/2017	10/31/2018	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/14/2017	11/30/2018	12
RE	141427	Biconical Antenna	Schwarzbeck	VHA9103B	8031	09/13/2017	09/30/2018	12
RE	141317	Coaxial Cable	Fujikura/Agilent	-	-	02/23/2018	02/28/2019	12
RE,CE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/07/2017	08/31/2018	12
CE	141222	Coaxial Cable	FUJIKURA	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	02/23/2018	02/28/2019	12
RE	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	05/31/2018	05/31/2019	12
RE,CE	141884	Spectrum Analyzer	AGILENT	E4448A	MY44020357	11/07/2017	11/30/2018	12
RE	141578	Pre Amplifier	AGILENT	8447D	2944A10845	09/27/2017	09/30/2018	12
RE,CE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/21/2017	12/31/2018	12
CE	141246	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	12/19/2017	12/31/2018	12
CE	141357	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	07/24/2017	07/31/2018	12
RE,CE	142004	AC2 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	08/31/2017	08/31/2018	12
RE,CE	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/21/2017	08/31/2018	12
RE,CE	142182	Measure	KOMELON	KMC-36	-	-	-	-

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*Hyphens for Last Calibration Date, Calibration Due Date and Cal Int 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: CE: Conducted Emission test
 RE: Radiated Emission test
 AT: Antenna Terminal Conducted test