



RADIO TEST REPORT

Test Report No. : 11598956H-A-R1

Applicant : Leica Camera AG
Type of Equipment : Communication module
Model No. : 5370M
FCC ID : N5A5370
Test regulation : FCC Part 15 Subpart C: 2016
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.
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6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11598956H-A. 11598956H-A is replaced with this report.

Date of test: February 21 to 24, 2017

Representative test engineer:

Hiroyuki Furutaka
Engineer
Consumer Technology Division

Approved by:

Tsubasa Takayama
Engineer
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 11598956H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	11598956H-A	March 13, 2017	-	-
1	11598956H-A-R1	March 21, 2017	P.6	Correction of Uncertainty in Clause 3.4.

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SECTION 1: Customer information

Company Name : Leica Camera AG
Address : Am Leitz-Park 5, 35578 Wetzlar, Germany
Telephone Number : +49 6442-2080-282
Facsimile Number : +49 6442-2080-170
Contact Person : Dennis Steuer

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

2.1 Identification of E.U.T.

Type of Equipment : Communication module
Model No. : 5370M
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3.3 V
Receipt Date of Sample : January, 5, 2017
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: 5370M (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

< Communication module >

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

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
Power Supply (inner)	DC 1.2 V / DC 3.3 V
Antenna Type	Monopole Pattern Antenna
Antenna Gain	0.8 dBi

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on November 14, 2016 and effective December 14, 2016

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 ----- IC: RSS-Gen 8.8	FCC: Section 15.207 ----- IC: RSS-Gen 8.8	QP 22.8 dB, 27.00000 MHz, L AV 12.5 dB, 27.00000 MHz, L	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 ----- IC: -	FCC: Section 15.247(a)(2) ----- IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 ----- IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) ----- IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 ----- IC: -	FCC: Section 15.247(e) ----- IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 ----- IC: RSS-Gen 6.13	FCC: Section15.247(d) ----- IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	1.6 dB 3618.000 MHz, Horizontal AV	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 v03r05 12.2.7.					

* 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 (DC 1.2 / 3.3 V) through the regulator regardless of input voltage.
Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 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	-	Conducted

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

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k = 2$.
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Antenna terminal test Uncertainty (+/-)							
Power meter		Conducted emission and Power density			Conducted emission		Channel power
Below 1 GHz	Above 1 GHz	Below 1 GHz	1 GHz - 3 GHz	3 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz	
0.9 dB	1.0 dB	1.4 dB	1.5 dB	2.8 dB	2.8 dB	2.9 dB	2.6 dB

Frequency range	Conducted emission using AMN(LISN) (+/-)
0.009 MHz - 0.15 MHz	3.5 dB
0.15 MHz - 30 MHz	3.0 dB

Test distance	Radiated emission (+/-) 9 kHz - 30 MHz
3 m	3.8 dB
10 m	3.7 dB

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*) (+/-)		(10 m*) (+/-)	
	30 MHz - 200 MHz	200 MHz - 1000 MHz	30 MHz - 200 MHz	200 MHz - 1000 MHz
Horizontal	5.0 dB	5.3 dB	5.0 dB	5.0 dB
Vertical	4.7 dB	5.9 dB	5.0 dB	5.1 dB

Radiated emission (Above 1 GHz)				
(3 m*) (+/-)		(1 m*) (+/-)		(10 m*) (+/-)
1 GHz - 6 GHz	6 GHz - 18 GHz	10 GHz - 26.5 GHz	26.5 GHz - 40 GHz	1 GHz - 18 GHz
5.2 dB	5.4 dB	5.5 dB	5.5 dB	5.4 dB

*Measurement distance

Conducted Emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

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3.5 Test Location

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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 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 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 setting value might be different from product specification value); Power settings: 11b/g/n-20: 9 dBm Software: C611A 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.	

*Details of Operating mode for WLAN

Test Item	Operating Mode	Tested frequency
Conducted Emission	11n-20 Tx *1)	2412MHz
Spurious Emission (Conducted)	11n-20 Tx *1)	2412MHz
6dB Bandwidth, 99% Occupied Bandwidth	11b Tx 11g Tx 11n-20 Tx	2412MHz 2437MHz 2462MHz
Maximum Peak Output Power, Power Density	11b Tx 11g Tx 11n-20 Tx	2412MHz 2437MHz 2462MHz
Spurious Emission (Radiated)	11b Tx 11n-20 Tx *2)	2412MHz 2437MHz 2462MHz
*1) The test was performed on the mode as a representative, because it had the highest power at antenna terminal test. *2) The test was performed on 11n-20 Tx mode according to “Section 1 of 6 802.11 a/b/g/n testing- Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009, as the 11n-20 Tx mode had higher power than 11g mode at antenna terminal test.		

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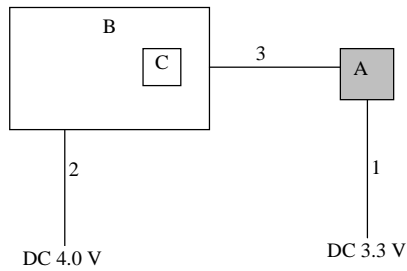
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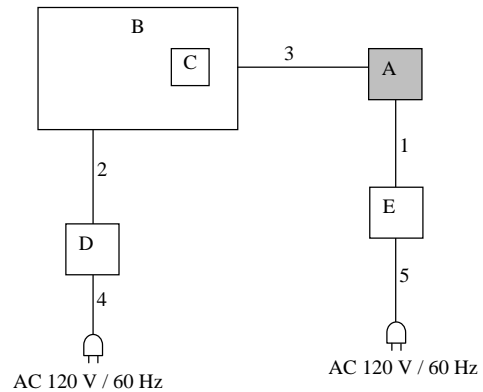
Facsimile : +81 596 24 8124

4.2 Configuration and peripherals

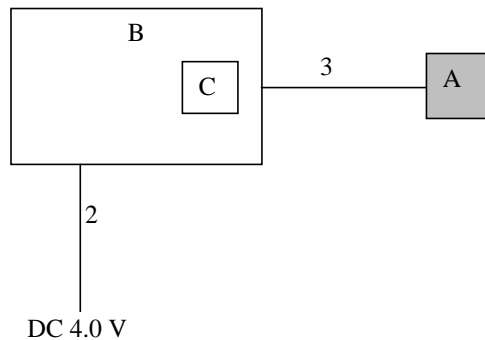
[Antenna Terminal Conducted Tests]



[Conducted Emission Test]



[Radiated Spurious Emission test]



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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Communication module	5370M	LCM001	Leica Camera AG	EUT
B	Jig board	-	-	Leica Camera AG	-
C	Micro SD Card	SD-C01G	-	Toshiba	-
D	DC Power Supply	PW16-5ADP	17116347	TEXIO	-
E	DC Power Supply	PMC35-2H	13090501	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	0.4	Unshielded	Unshielded	-
2	DC Cable	0.4 for CE, AT* 3.0 for RE*	Unshielded	Unshielded	-
3	Signal Cable	0.1 for CE, AT* 0.2 for RE*	Unshielded	Unshielded	-
4	AC Cable	1.5	Unshielded	Unshielded	-
5	AC Cable	1.5	Unshielded	Unshielded	*1)

*CE: Conducted Emission test, AT: Antenna Terminal Conducted Tests, RE: Radiated Spurious Emission test

*1) Conducted Emission test was performed on this AC Cable.

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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.

For the tests on EUT with other peripherals (as a whole system)

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 "558074 D01 DTS Meas Guidance v03r05".

[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	4.5 m *2) (1 GHz – 10 GHz), 1.0 m *3) (10 GHz – 26.5 GHz)		4.5 m *2) (1 GHz – 10 GHz), 1.0 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 v03r05".

*2) Distance Factor: $20 \times \log(4.5 \text{ m} / 3.0 \text{ m}) = 3.53 \text{ dB}$

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

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

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 v03r05".

*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

Conducted Emission

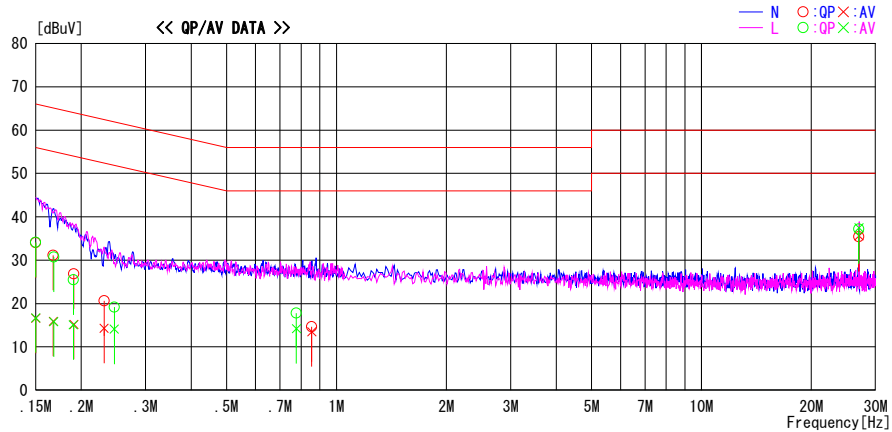
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.1 Semi Anechoic Chamber
Date : 2017/02/24

Report No. : 11598956H
Temp./Humi. : 26deg.C / 49% RH
Engineer : Hiroyuki Furutaka

Mode / Remarks : Tx 11n-20 2412MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15000	20.8	3.4	13.2	34.0	16.6	66.0	56.0	32.0	39.4	N	
0.15000	20.9	3.5	13.2	34.1	16.7	66.0	56.0	31.9	39.3	L	
0.16750	17.9	2.7	13.2	31.1	15.9	65.1	55.1	34.0	39.2	N	
0.16808	17.5	2.6	13.2	30.7	15.8	65.1	55.1	34.4	39.3	L	
0.19025	12.3	1.9	13.2	25.5	15.1	64.0	54.0	38.5	38.9	L	
0.19083	13.6	2.0	13.2	26.8	15.2	64.0	54.0	37.2	38.8	N	
0.23100	7.4	1.1	13.2	20.6	14.3	62.4	52.4	41.8	38.1	N	
0.24625	5.9	0.8	13.3	19.2	14.1	61.9	51.9	42.7	37.8	L	
0.77700	4.5	0.9	13.3	17.8	14.2	56.0	46.0	38.2	31.8	L	
0.85566	1.3	0.2	13.3	14.6	13.5	56.0	46.0	41.4	32.5	N	
27.00000	20.6	20.8	14.8	35.4	35.6	60.0	50.0	24.6	14.4	N	
27.00000	22.4	22.7	14.8	37.2	37.5	60.0	50.0	22.8	12.5	L	

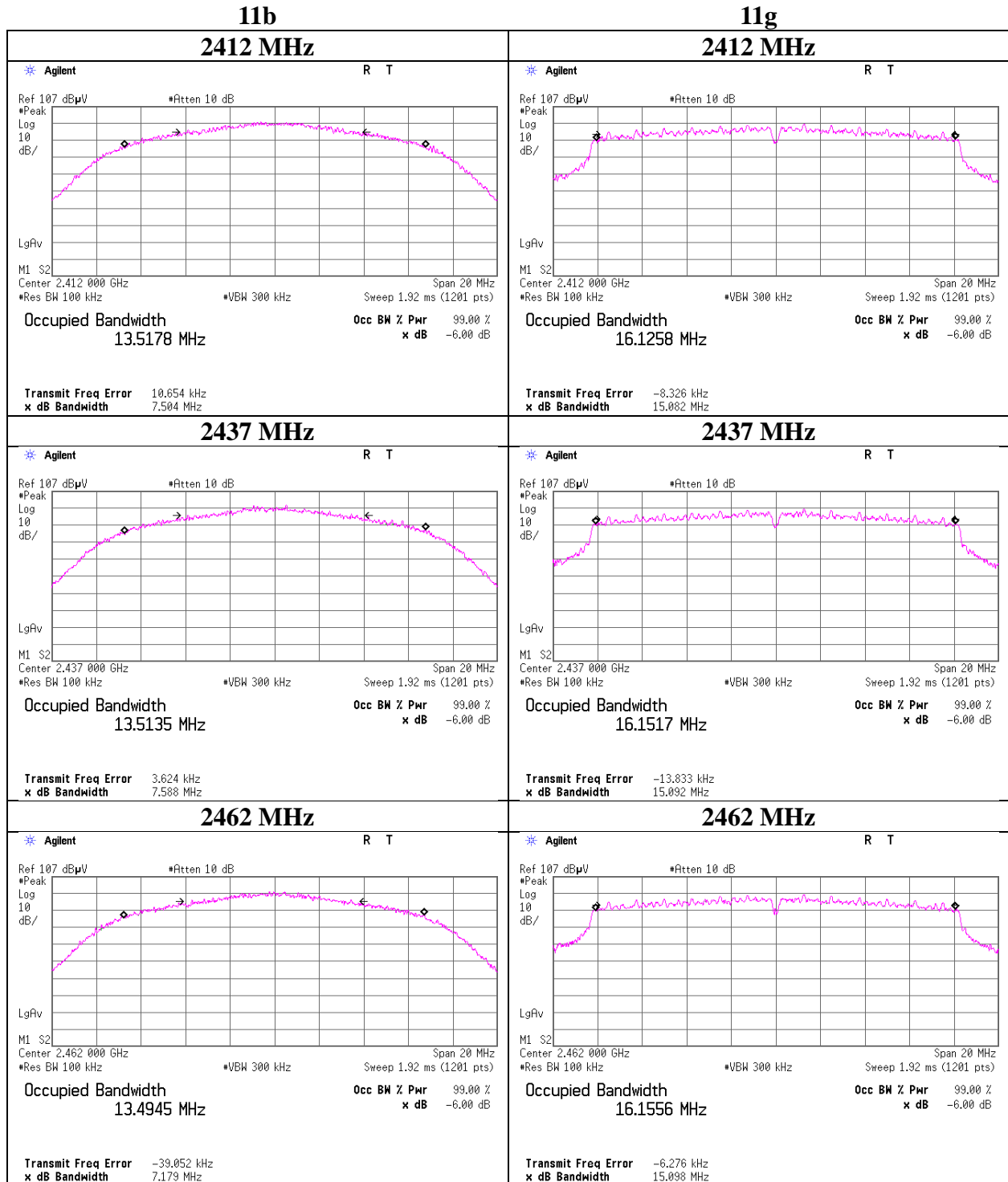
CHART: WITH FACTOR, Peak hold data. CALCULATION: RESULT[dBuV]=READING[dBuV]+C.F[dB] (LISN LOSS+CABLE LOSS)
Except for the above table : adequate margin data below the limits.

6dB Bandwidth

Test place Ise EMC Lab. No.7 Measurement Room
Report No. 11598956H
Date February 21, 2017
Temperature / Humidity 25 deg. C / 33 % RH
Engineer Satofumi Matsuyama
Mode Tx

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
11b	2412	7.504	> 500
	2437	7.588	> 500
	2462	7.179	> 500
11g	2412	15.082	> 500
	2437	15.092	> 500
	2462	15.098	> 500
11n-20	2412	15.076	> 500
	2437	15.106	> 500
	2462	14.829	> 500

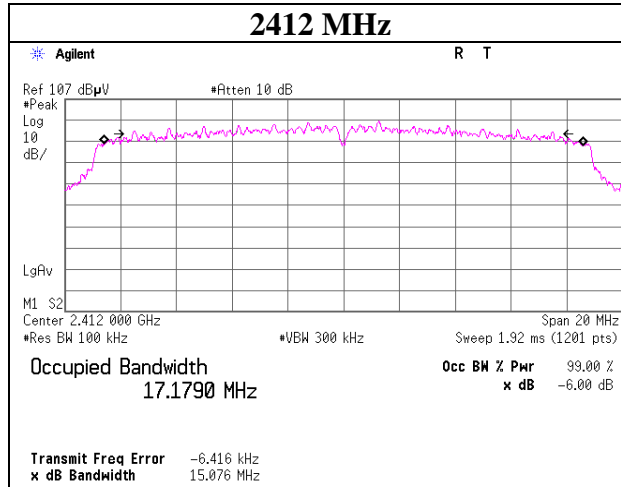
6dB Bandwidth



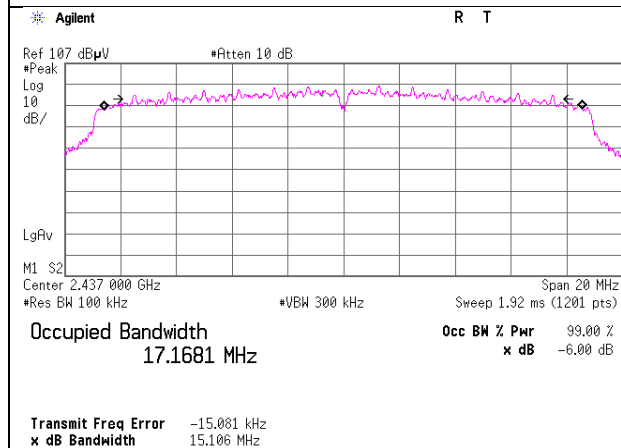
6dB Bandwidth

11n-20

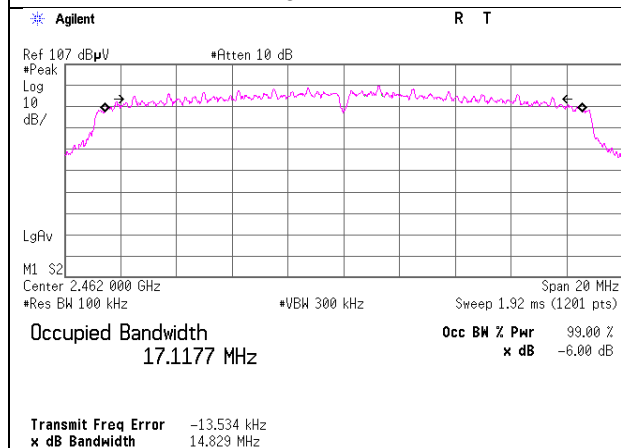
2412 MHz



2437 MHz



2462 MHz



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Maximum Peak Output Power

Test place	Ise EMC Lab. No.7 Measurement Room
Report No.	11598956H
Date	February 21, 2017
Temperature / Humidity	25 deg. C / 33 % RH
Engineer	Satofumi Matsuyama
Mode	Tx 11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2412	1.94	0.85	10.09	12.88	19.41	30.00	1000	17.12
2437	1.92	0.85	10.09	12.86	19.32	30.00	1000	17.14
2462	1.75	0.85	10.09	12.69	18.58	30.00	1000	17.31

Sample Calculation:

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

2437 MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	1.47	
2	1.64	
5.5	1.54	
11	1.92	*

*: Worst Rate

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

Maximum Peak Output Power

Test place	Ise EMC Lab. No.7 Measurement Room
Report No.	11598956H
Date	February 21, 2017
Temperature / Humidity	25 deg. C / 33 % RH
Engineer	Satofumi Matsuyama
Mode	Tx 11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2412	8.19	0.85	10.09	19.13	81.85	30.00	1000	10.87
2437	8.07	0.85	10.09	19.01	79.62	30.00	1000	10.99
2462	8.15	0.85	10.09	19.09	81.10	30.00	1000	10.91

Sample Calculation:

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

2437 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	7.75	
9	7.78	
12	7.91	
18	7.96	
24	8.07	*
36	7.98	
48	8.01	
54	8.01	

*: Worst Rate

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

Maximum Peak Output Power

Test place : Ise EMC Lab. No.7 Measurement Room
Report No. : 11598956H
Date : February 21, 2017
Temperature / Humidity : 25 deg. C / 33 % RH
Engineer : Satofumi Matsuyama
Mode : Tx 11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2412	8.39	0.85	10.09	19.33	85.70	30.00	1000	10.67
2437	8.17	0.85	10.09	19.11	81.47	30.00	1000	10.89
2462	8.04	0.85	10.09	18.98	79.07	30.00	1000	11.02

Sample Calculation:

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

2437 MHz

MCS Number	Reading [dBm]	Remark
0	8.01	
1	8.11	
2	8.04	
3	8.17	*
4	7.96	
5	8.09	
6	7.90	
7	8.14	

*: Worst Rate

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

Average Output Power
(Reference data for RF Exposure)

Test place : Ise EMC Lab. No.7 Measurement Room
Report No. : 11598956H
Date : February 21, 2017
Temperature / Humidity : 25 deg. C / 33 % RH
Engineer : Satofumi Matsuyama
Mode : Tx

11b 1Mbps

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	-1.47	0.85	10.09	9.47	8.85	0.05	9.52	8.95
2437	-1.61	0.85	10.09	9.33	8.57	0.05	9.38	8.67
2462	-1.67	0.85	10.09	9.27	8.45	0.05	9.32	8.55

11g 6Mbps

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	-1.17	0.85	10.09	9.77	9.48	0.29	10.06	10.14
2437	-1.23	0.85	10.09	9.71	9.35	0.29	10.00	10.00
2462	-1.36	0.85	10.09	9.58	9.08	0.29	9.87	9.71

11n-20 MCS0

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	-1.49	0.85	10.09	9.45	8.81	0.31	9.76	9.46
2437	-1.52	0.85	10.09	9.42	8.75	0.31	9.73	9.40
2462	-1.67	0.85	10.09	9.27	8.45	0.31	9.58	9.08

Sample Calculation:

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

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

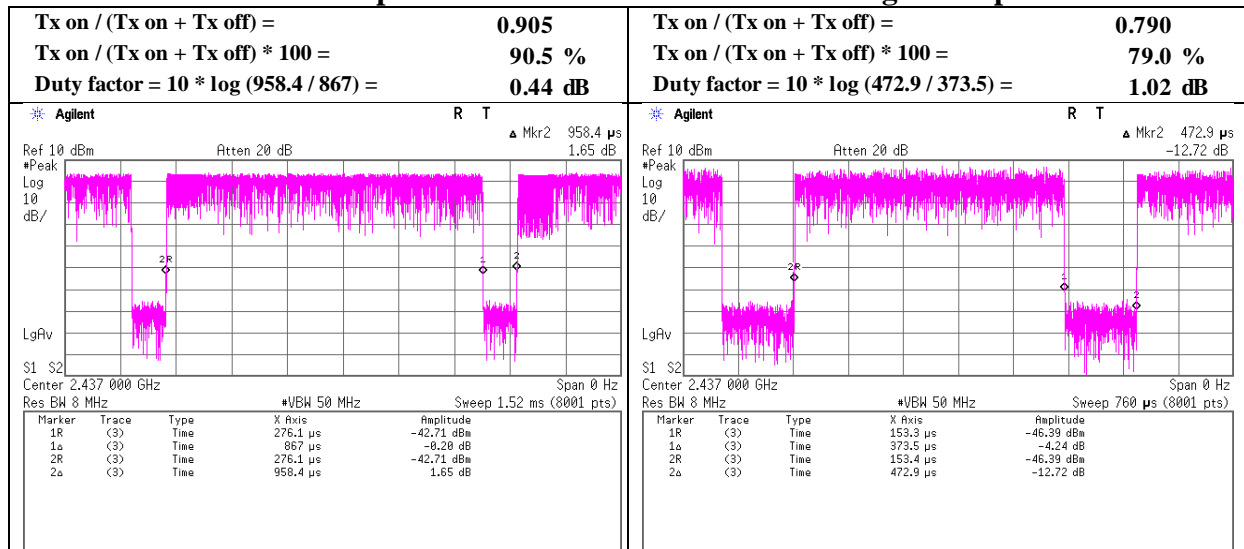
The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01 v02r02.

Burst rate confirmation

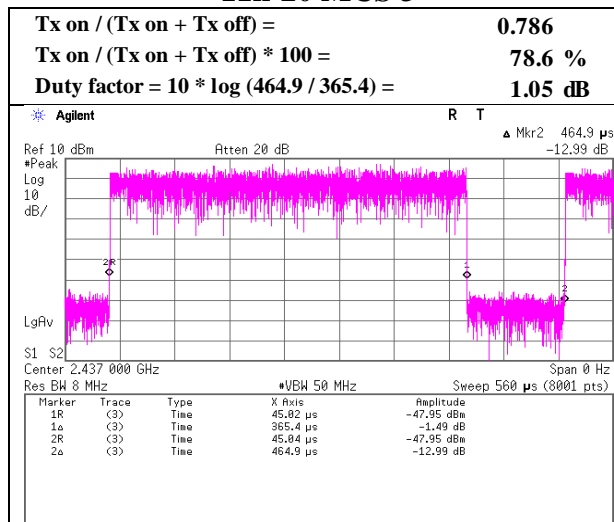
Test place : Ise EMC Lab. No.7 Measurement Room
 Report No. : 11598956H
 Date : February 21, 2017
 Temperature / Humidity : 25 deg. C / 33 % RH
 Engineer : Satofumi Matsuyama
 Mode : Tx

11b 11 Mbps

11g 24 Mbps



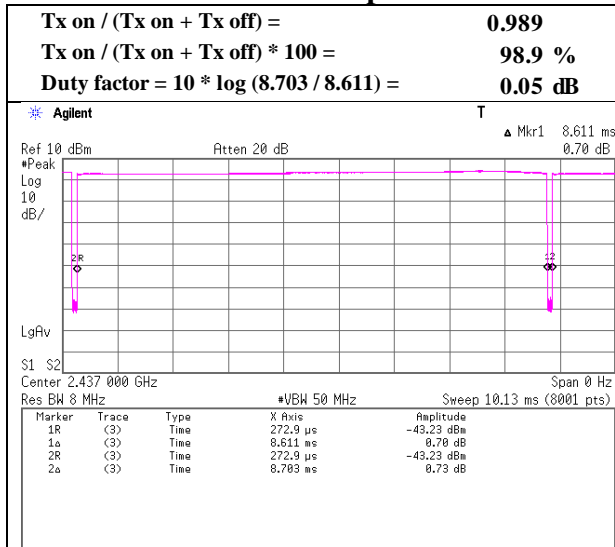
11n-20 MCS 3



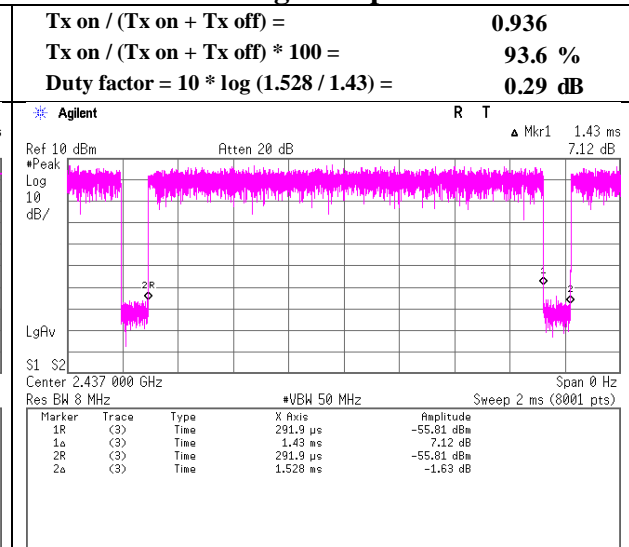
Burst rate confirmation
(Reference data for RF Exposure)

Test place : Ise EMC Lab. No.7 Measurement Room
Report No. : 11598956H
Date : February 21, 2017
Temperature / Humidity : 25 deg. C / 33 % RH
Engineer : Satofumi Matsuyama
Mode : Tx

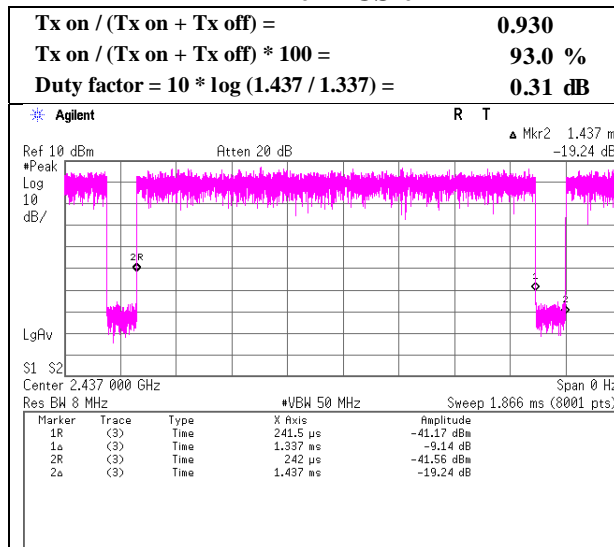
11b 1 Mbps



11g 6 Mbps

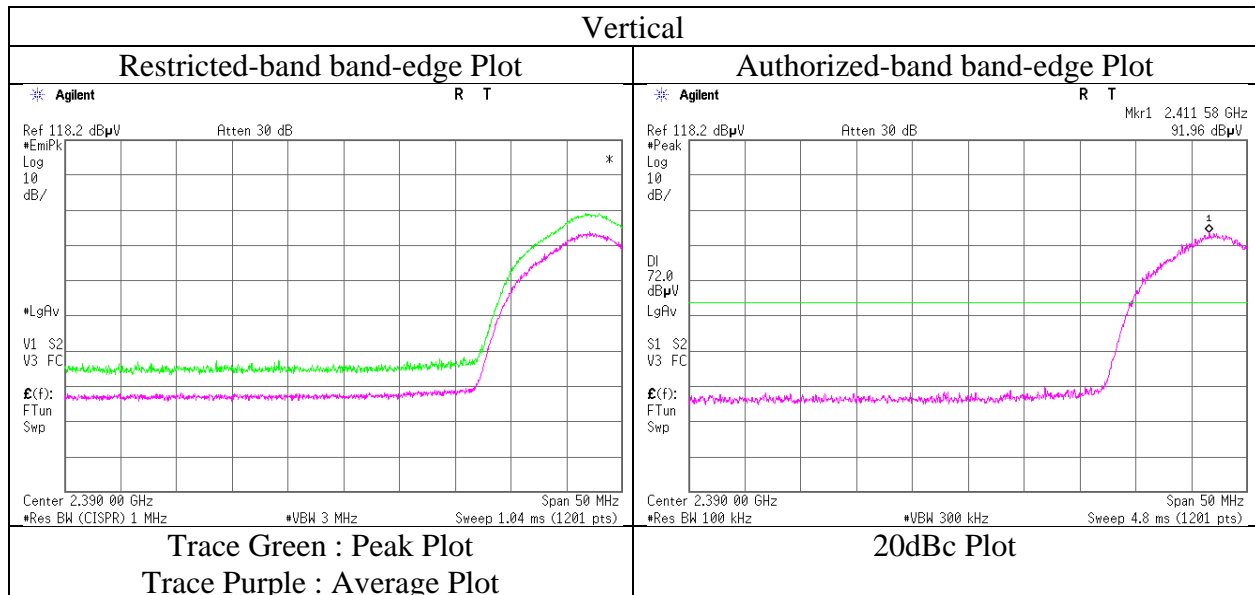
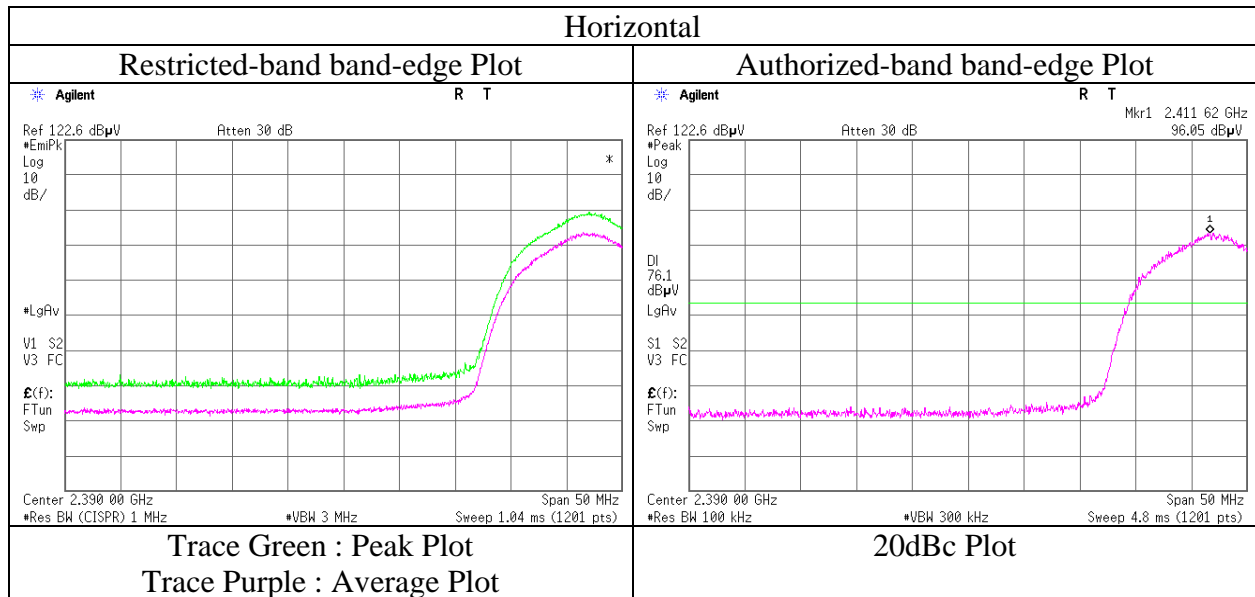


11n-20 MCS 0



Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11598956H
Date	February 22, 2017
Temperature / Humidity	23 deg. C / 35 % RH
Engineer	Shinichi Miyazono (1GHz - 10GHz)
Mode	Tx 11b 2412 MHz



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

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Ise EMC Lab.

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Facsimile : +81 596 24 8124

Radiated Spurious Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11598956H
Date	February 22, 2017 February 23, 2017
Temperature / Humidity	23 deg. C / 35 % RH 20 deg. C / 45 % RH
Engineer	Shinichi Miyazono Hiroyuki Furutaka (1GHz - 10GHz) (10GHz - 26.5GHz)
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	3655.500	PK	49.5	28.7	9.1	32.1	-	55.2	73.9	18.7	
Hori	4874.000	PK	40.4	31.2	9.1	31.7	-	49.0	73.9	24.9	Floor noise
Hori	7311.000	PK	41.8	35.6	10.4	32.6	-	55.2	73.9	18.7	Floor noise
Hori	3655.500	AV	44.8	28.7	9.1	32.1	-	50.5	53.9	3.4	
Hori	4874.000	AV	32.3	31.2	9.1	31.7	-	40.9	53.9	13.0	Floor noise
Hori	7311.000	AV	33.5	35.6	10.4	32.6	-	46.9	53.9	7.0	Floor noise
Vert	3655.500	PK	47.2	28.7	9.1	32.1	-	52.9	73.9	21.0	
Vert	4874.000	PK	41.0	31.2	9.1	31.7	-	49.6	73.9	24.3	Floor noise
Vert	7311.000	PK	42.1	35.6	10.4	32.6	-	55.5	73.9	18.4	Floor noise
Vert	3655.500	AV	43.0	28.7	9.1	32.1	-	48.7	53.9	5.2	
Vert	4874.000	AV	32.4	31.2	9.1	31.7	-	41.0	53.9	12.9	Floor noise
Vert	7311.000	AV	33.4	35.6	10.4	32.6	-	46.8	53.9	7.1	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 (4.5 m / 3.0 m) = 3.53 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

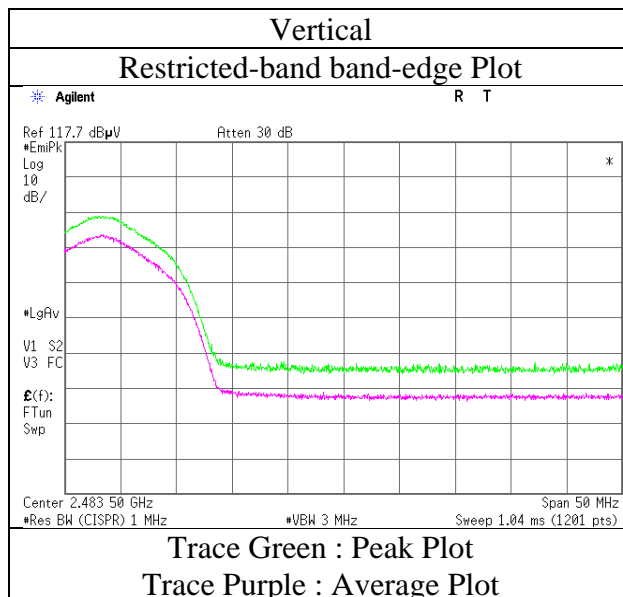
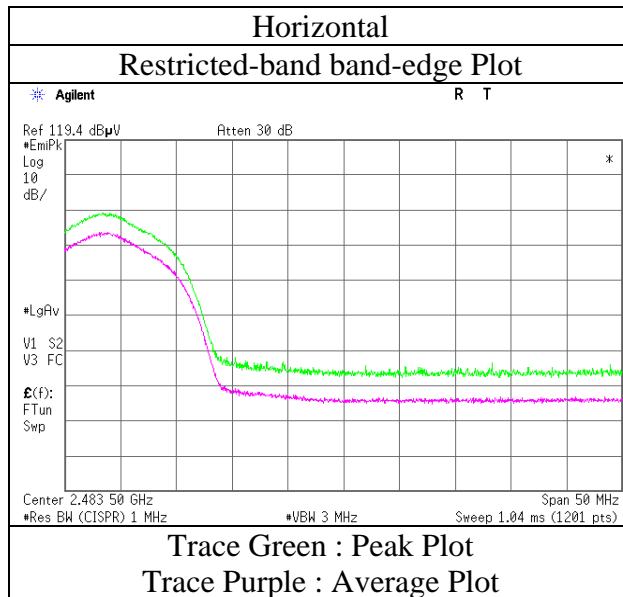
20dBc Data Sheet

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	96.6	26.8	6.9	32.7	97.6	-	-	Carrier
Hori	9748.000	PK	45.5	37.2	10.4	33.2	59.9	77.6	17.7	
Vert	2437.000	PK	92.1	26.8	6.9	32.7	93.1	-	-	Carrier
Vert	9748.000	PK	44.9	37.2	10.4	33.2	59.3	73.1	13.8	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

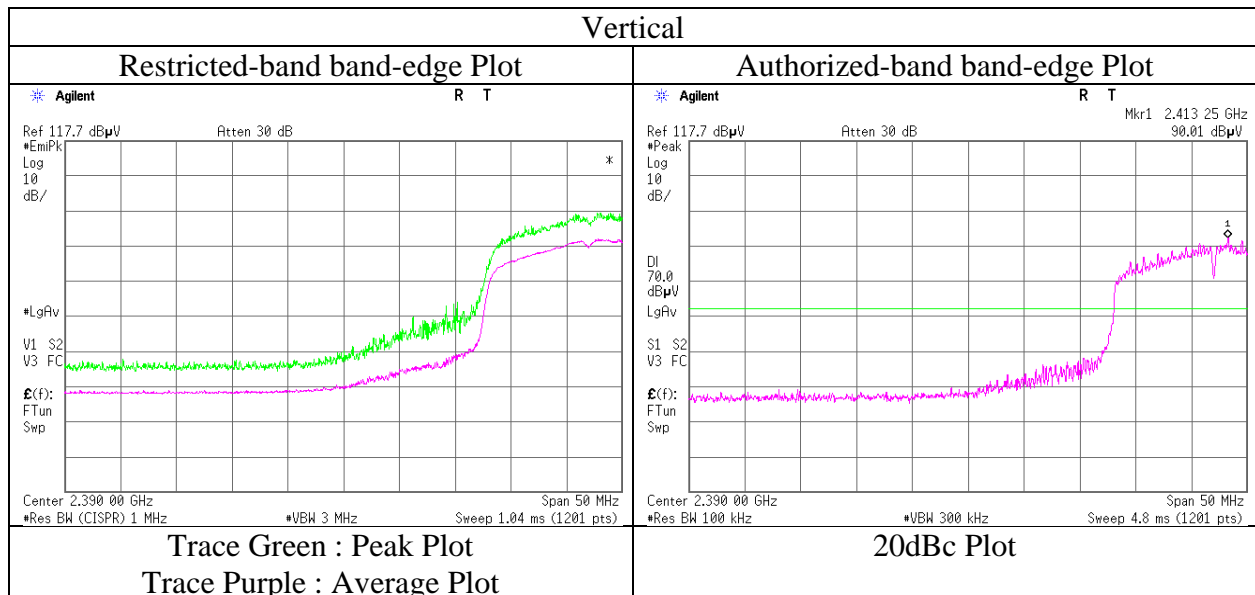
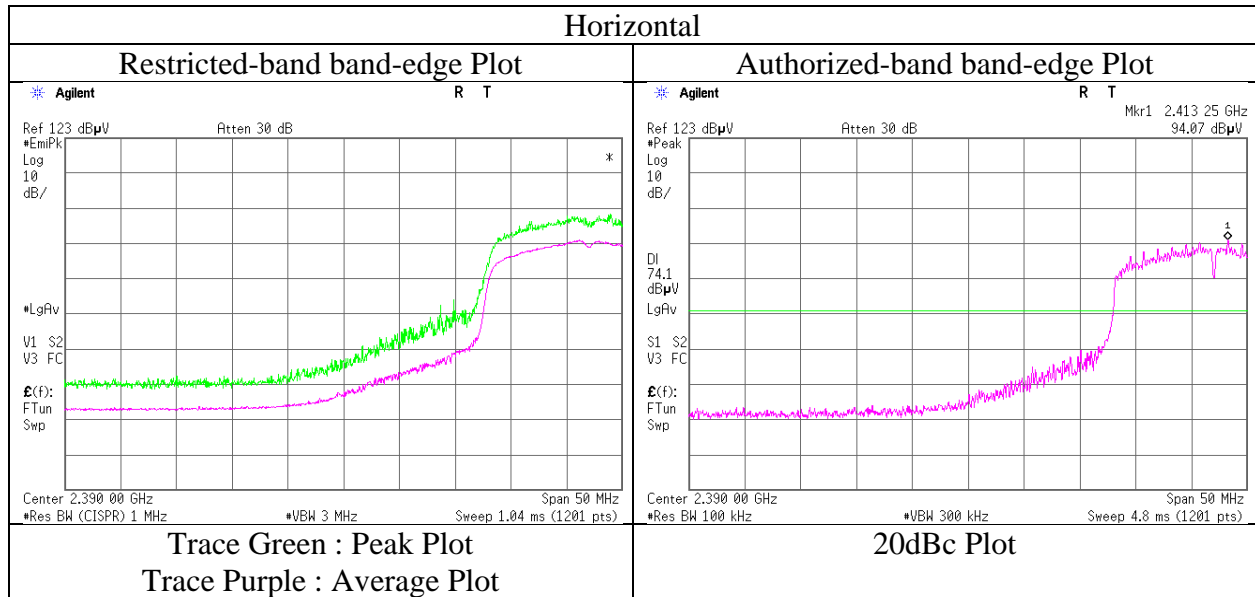
Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11598956H
Date	February 22, 2017
Temperature / Humidity	23 deg. C / 35 % RH
Engineer	Shinichi Miyazono (1GHz - 10GHz)
Mode	Tx 11b 2462 MHz



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

Radiated Spurious Emission
(Reference Plot for band-edge)

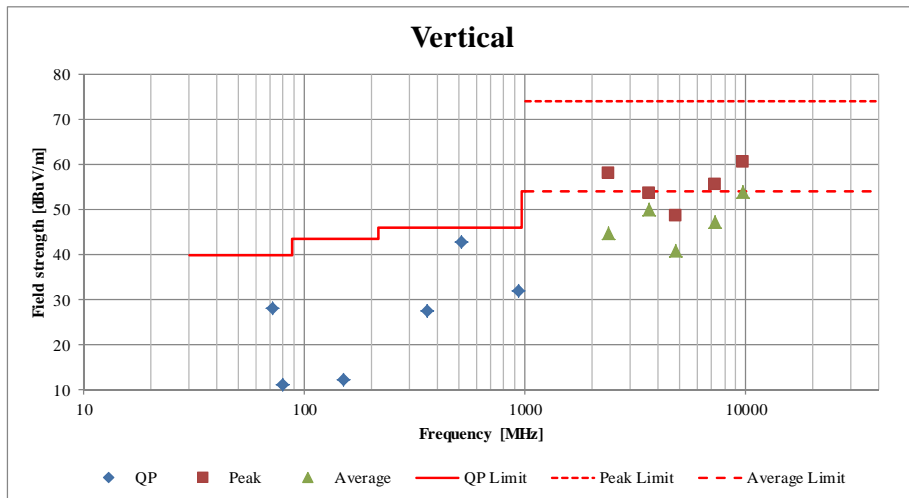
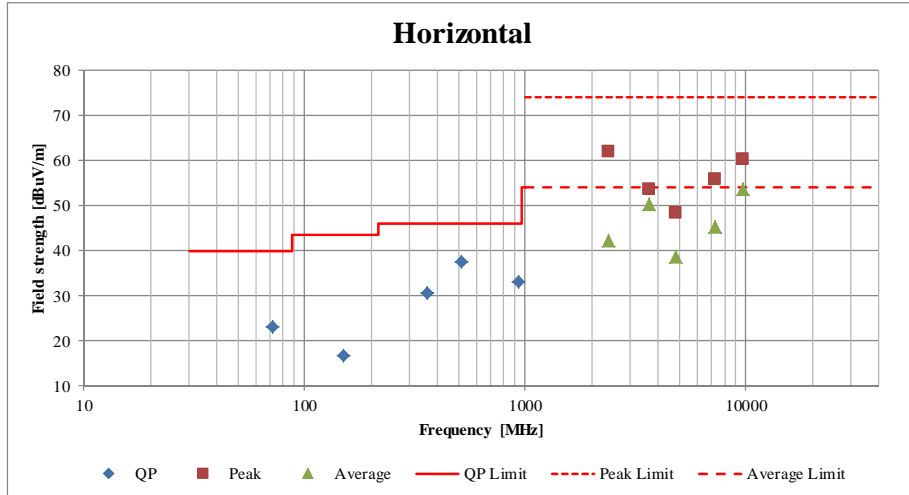
Test place : Ise EMC Lab.
Report No. : 11598956H
Semi Anechoic Chamber : No.3
Date : February 22, 2017
Temperature / Humidity : 23 deg. C / 35 % RH
Engineer : Shinichi Miyazono
(1GHz - 10GHz)
Mode : Tx 11n-20 2412 MHz



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

Radiated Spurious Emission (Plot data, Worst case)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber	
Report No.	11598956H	
Date	February 22, 2017	February 23, 2017
Temperature / Humidity	23 deg. C / 35 % RH	20 deg. C / 45 % RH
Engineer	Shinichi Miyazono (1GHz - 10GHz)	Hiroyuki Furutaka (Below 1GHz) (10GHz - 26.5GHz)
Mode	Tx 11n-20 2412 MHz	



Radiated Spurious Emission

Test place : Ise EMC Lab. No.2 and No.1 Semi Anechoic Chamber
Report No. : 11598956H
Date : February 22, 2017 February 23, 2017
Temperature / Humidity : 23 deg. C / 35 % RH 20 deg. C / 45 % RH
Engineer : Shinichi Miyazono Hiroyuki Furutaka
 (1GHz - 10GHz) (10GHz - 26.5GHz)
Mode : Tx 11n-20 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	3655.500	PK	48.2	28.7	9.1	32.1	-	53.9	73.9	20.0	
Hori	4874.000	PK	40.9	31.2	9.1	31.7	-	49.5	73.9	24.4	Floor noise
Hori	7311.000	PK	41.2	35.6	10.4	32.6	-	54.6	73.9	19.3	Floor noise
Hori	3655.500	AV	44.8	28.7	9.1	32.1	-	50.5	53.9	3.4	
Hori	4874.000	AV	32.2	31.2	9.1	31.7	-	40.8	53.9	13.1	Floor noise
Hori	7311.000	AV	33.7	35.6	10.4	32.6	-	47.1	53.9	6.8	Floor noise
Vert	3655.500	PK	47.1	28.7	9.1	32.1	-	52.8	73.9	21.1	
Vert	4874.000	PK	40.1	31.2	9.1	31.7	-	48.7	73.9	25.2	Floor noise
Vert	7311.000	PK	41.7	35.6	10.4	32.6	-	55.1	73.9	18.8	Floor noise
Vert	3655.500	AV	42.5	28.7	9.1	32.1	-	48.2	53.9	5.7	
Vert	4874.000	AV	32.3	31.2	9.1	31.7	-	40.9	53.9	13.0	Floor noise
Vert	7311.000	AV	33.5	35.6	10.4	32.6	-	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 (4.5 m / 3.0 m) = 3.53 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	93.8	26.7	6.9	32.7	94.7	-	-	Carrier
Hori	9748.000	PK	45.2	37.2	11.0	33.2	60.2	74.7	14.5	
Vert	2437.000	PK	90.2	26.7	6.9	32.7	91.1	-	-	Carrier
Vert	9748.000	PK	45.6	37.2	11.0	33.2	60.6	71.1	10.5	

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

Radiated Spurious Emission

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No. : 11598956H
Date : February 22, 2017 February 23, 2017
Temperature / Humidity : 23 deg. C / 35 % RH 20 deg. C / 45 % RH
Engineer : Shinichi Miyazono Hiroyuki Furutaka
 (1GHz - 10GHz) (10GHz - 26.5GHz)
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	60.1	26.8	7.0	32.7	-	61.2	73.9	12.7	
Hori	3693.000	PK	48.7	28.7	7.7	32.1	-	53.0	73.9	20.9	
Hori	4924.000	PK	40.0	31.4	9.1	31.7	-	48.8	73.9	25.1	Floor noise
Hori	7386.000	PK	42.2	35.5	10.3	32.7	-	55.3	73.9	18.6	Floor noise
Hori	2483.500	AV	38.7	26.8	7.0	32.7	1.1	40.9	53.9	13.0	*1)
Hori	3693.000	AV	44.9	28.7	7.7	32.1	-	49.2	53.9	4.7	
Hori	4924.000	AV	30.5	31.4	9.1	31.7	-	39.3	53.9	14.6	Floor noise
Hori	7386.000	AV	31.7	35.5	10.3	32.7	-	44.8	53.9	9.1	Floor noise
Vert	2483.500	PK	57.3	26.8	7.0	32.7	-	58.4	73.9	15.5	
Vert	3693.000	PK	45.7	28.7	7.7	32.1	-	50.0	73.9	23.9	
Vert	4924.000	PK	40.5	31.4	9.1	31.7	-	49.3	73.9	24.6	Floor noise
Vert	7386.000	PK	41.2	35.5	10.3	32.7	-	54.3	73.9	19.6	Floor noise
Vert	2483.500	AV	37.1	26.8	7.0	32.7	1.1	39.3	53.9	14.6	*1)
Vert	3693.000	AV	40.2	28.7	7.7	32.1	-	44.5	53.9	9.4	
Vert	4924.000	AV	30.9	31.4	9.1	31.7	-	39.7	53.9	14.2	Floor noise
Vert	7386.000	AV	31.9	35.5	10.3	32.7	-	45.0	53.9	8.9	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 (4.5 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)

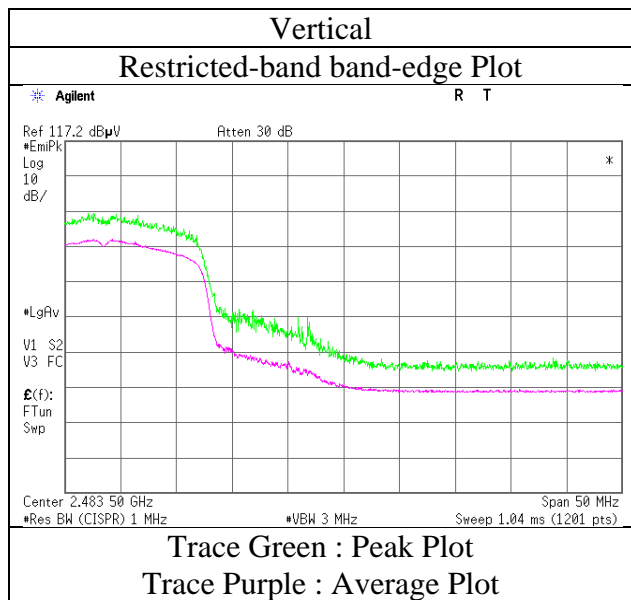
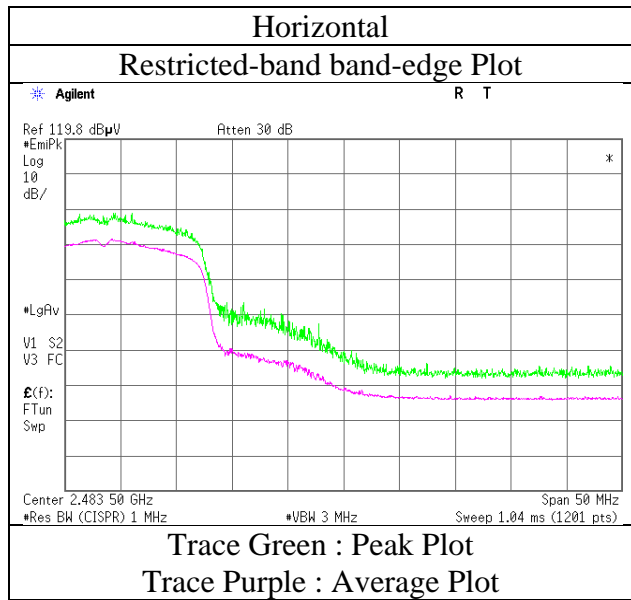
20dBc Data Sheet

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	91.4	26.8	7.0	32.7	92.5	-	-	Carrier
Hori	9848.000	PK	46.5	37.2	11.1	33.3	61.5	72.5	11.0	
Vert	2462.000	PK	89.3	26.8	7.0	32.7	90.4	-	-	Carrier
Vert	9848.000	PK	44.5	37.2	11.1	33.3	59.5	70.4	10.9	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

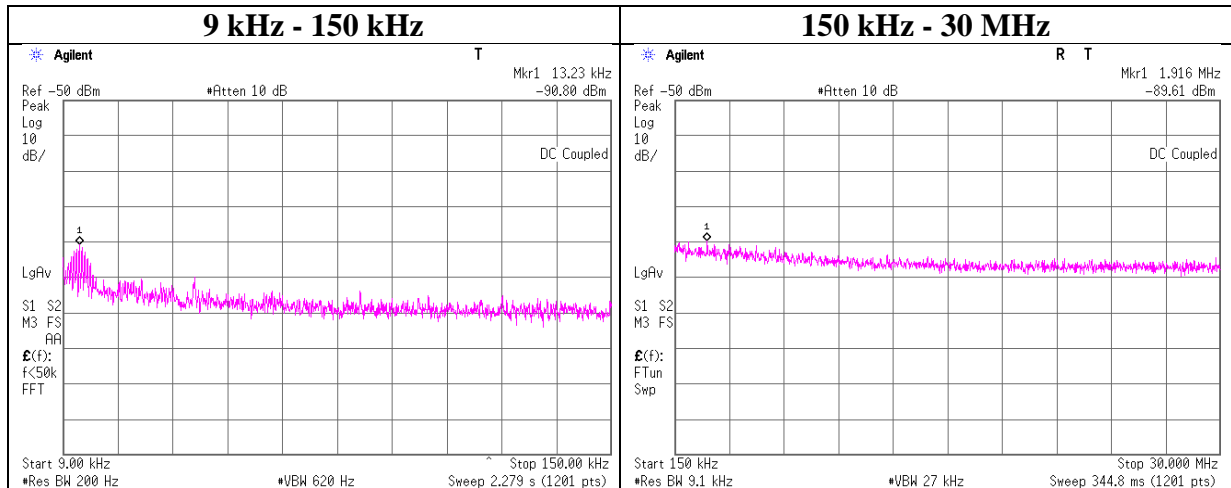
Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11598956H
Date : February 22, 2017
Temperature / Humidity : 23 deg. C / 35 % RH
Engineer : Shinichi Miyazono
Mode : Tx 11n-20 2462 MHz



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

Conducted Spurious Emission

Test place	Ise EMC Lab. No.7 Measurement Room
Report No.	11598956H
Date	February 21, 2017
Temperature / Humidity	25 deg. C / 33 % RH
Engineer	Satofumi Matsuyama
Mode	Tx 11n-20 2412 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
13.23	-90.8	0.03	9.9	2.0	1	-78.8	300	6.0	-17.6	45.1	62.7	
1916.00	-89.6	0.23	10.0	2.0	1	-77.4	30	6.0	3.8	29.5	25.7	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

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

Power Density

Test place Ise EMC Lab. No.7 Measurement Room
Report No. 11598956H
Date February 21, 2017
Temperature / Humidity 25 deg. C / 33 % RH
Engineer Satofumi Matsuyama
Mode Tx

11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-23.81	0.85	10.09	-12.87	8.00	20.87
2437.00	-23.74	0.85	10.09	-12.80	8.00	20.80
2462.00	-23.86	0.85	10.09	-12.92	8.00	20.92

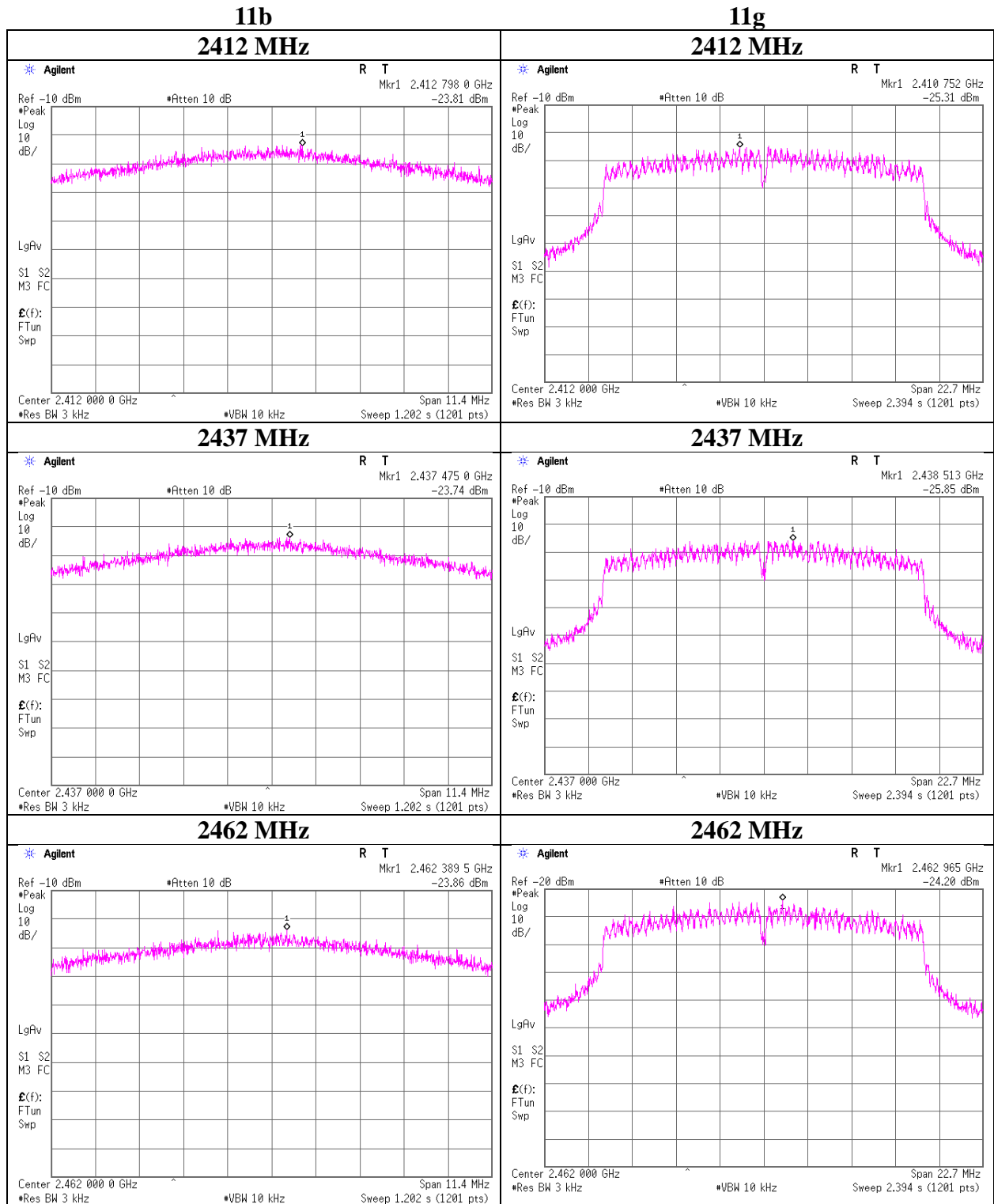
11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-25.31	0.85	10.09	-14.37	8.00	22.37
2437.00	-25.85	0.85	10.09	-14.91	8.00	22.91
2462.00	-24.20	0.85	10.09	-13.26	8.00	21.26

Sample Calculation:

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

Power Density



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Power Density

Test place Ise EMC Lab. No.7 Measurement Room
Report No. 11598956H
Date February 21, 2017
Temperature / Humidity 25 deg. C / 33 % RH
Engineer Satofumi Matsuyama
Mode Tx

11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-25.69	0.85	10.09	-14.75	8.00	22.75
2437.00	-25.88	0.85	10.09	-14.94	8.00	22.94
2462.00	-25.50	0.85	10.09	-14.56	8.00	22.56

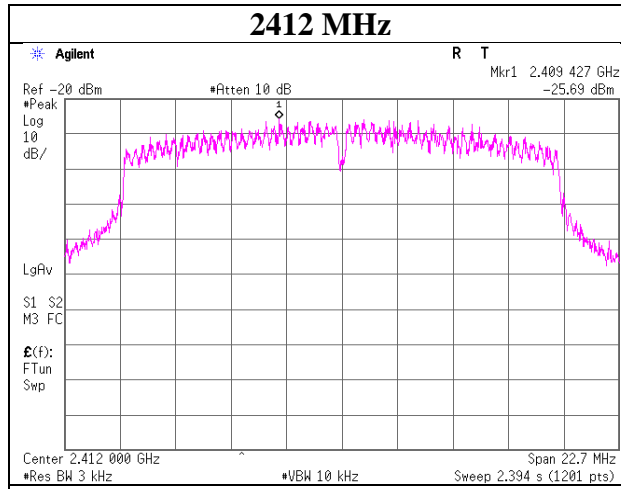
Sample Calculation:

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

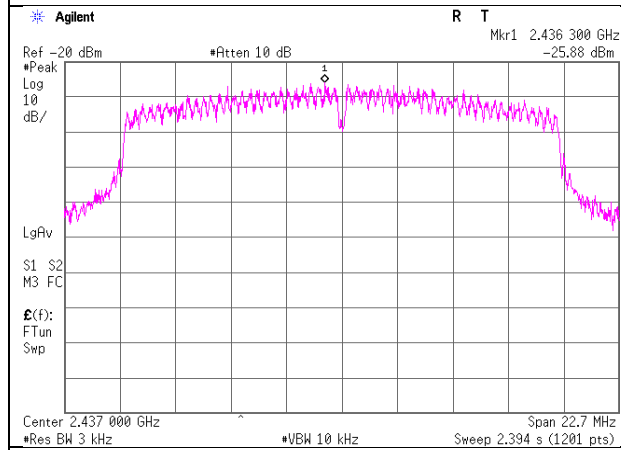
Power Density

11n-20

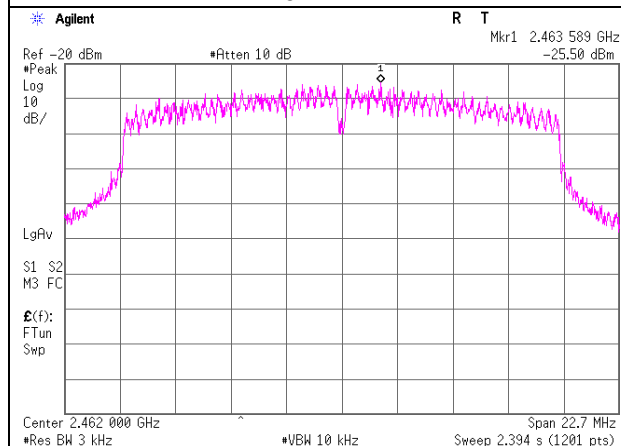
2412 MHz



2437 MHz



2462 MHz



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Ise EMC Lab.

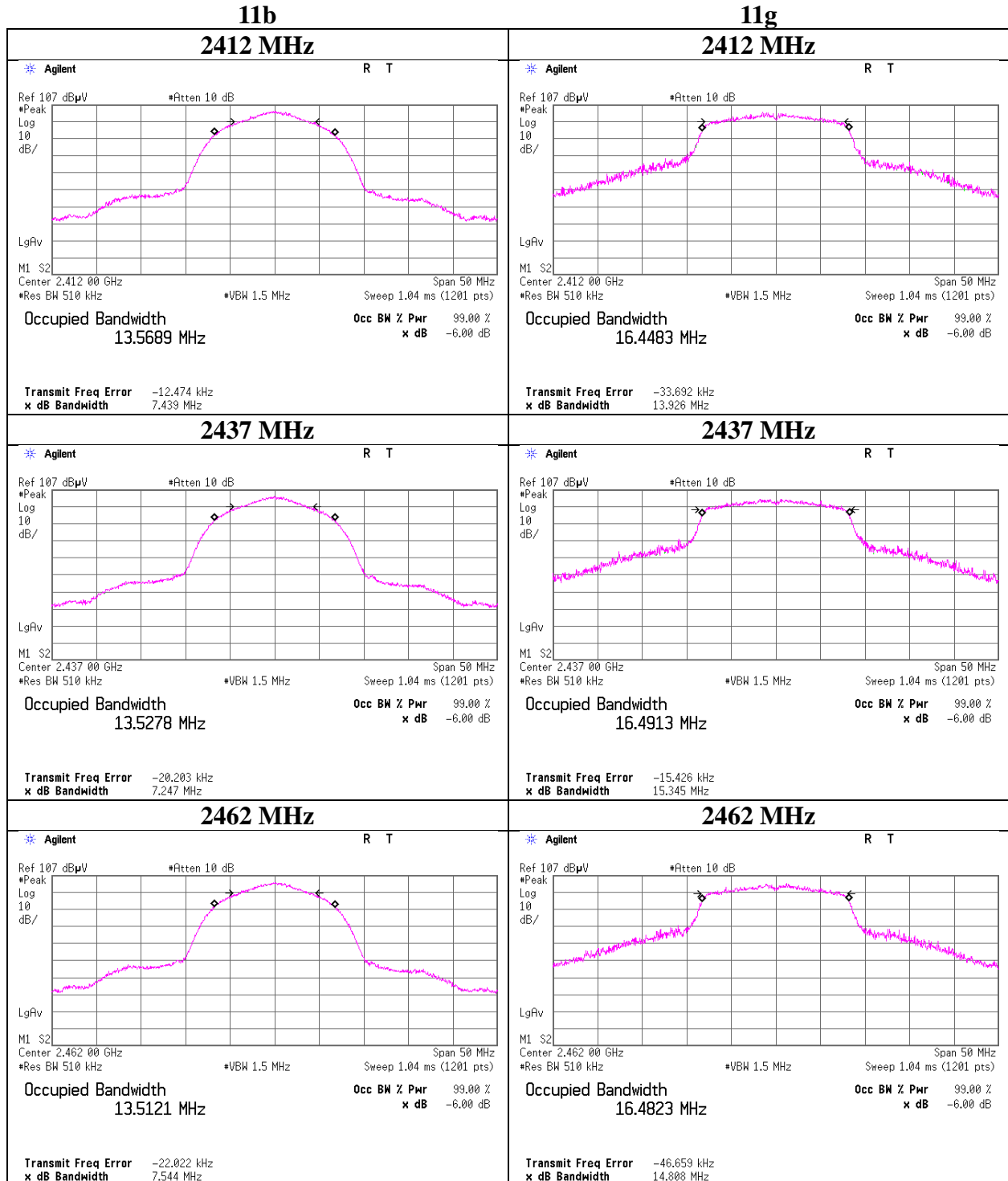
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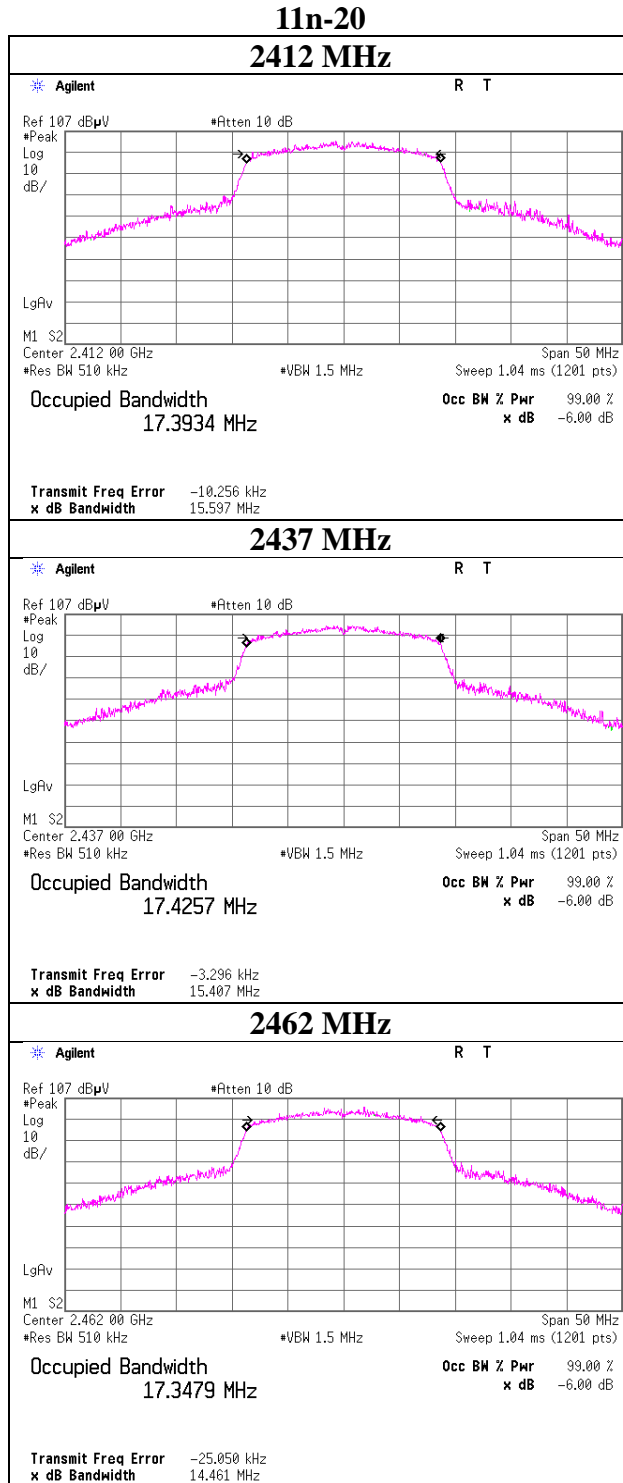
99%Occupied Bandwidth

Test place	Ise EMC Lab. No.7 Measurement Room
Report No.	11598956H
Date	February 21, 2017
Temperature / Humidity	25 deg. C / 33 % RH
Engineer	Satofumi Matsuyama
Mode	Tx



99% Occupied Bandwidth

Test place	Ise EMC Lab. No.7 Measurement Room
Report No.	11598956H
Date	February 21, 2017
Temperature / Humidity	25 deg. C / 33 % RH
Engineer	Satofumi Matsuyama
Mode	Tx



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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MLS-23	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	CE(EUT)	2016/07/07 * 12
MLS-24	LISN(AMN)	Schwarzbeck	NSLK8127	8127-730	CE(AE)	2016/07/11 * 12
MTA-52	Terminator	TME	CT-01BP	-	CE	2016/12/01 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ sucoform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	CE	2016/07/26 * 12
MAT-66	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2016/12/24 * 12
MTA-28	Terminator	TME	CT-01	-	CE	2016/11/16 * 12
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE/CE	2016/10/20 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE/CE	2017/01/20 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE/CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE/CE	2016/08/17 * 12
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2016/05/29 * 12
MCC-167	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	RE	2016/05/20 * 12
MPA-11	MicroWave System Amplifier	Agilent	83017A	MY39500779	RE	2016/03/24 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2016/09/21 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE	2017/01/19 * 12
MHA-16	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	RE	2016/05/29 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE/CE	2016/09/15 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2016/10/15 * 12
MLA-22	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	RE	2017/01/26 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2016/07/26 * 12
MAT-98	Attenuator	KEYSIGHT	8491A	MY52462349	RE	2016/12/05 * 12
MPA-15	Pre Amplifier	SONOMA INSTRUMENT	315	260698	RE	2016/06/20 * 12
MRENT-130	Spectrum Analyzer	Agilent	E4440A	MY46187750	AT	2016/06/03 * 12
MAT-23	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2016/03/18 * 12
MPM-09	Power Meter	Anritsu	ML2495A	6K00003348	AT	2016/10/17 * 12
MPSE-12	Power sensor	Anritsu	MA2411B	011598	AT	2016/10/17 * 12
MOS-34	Thermo-Hygrometer	Custom	CTH-201	3401	AT	2017/01/20 * 12
MMM-16	DIGITAL HiTESTER	Hioki	3805	070900532	AT	2017/01/19 * 12
MOTS-MATM	Antenna Terminal Measurement Software	UL Japan	-	-	AT	-

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**

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