



# RADIO TEST REPORT

**Test Report No. : 11160421H-A-R1**

**Applicant** : **Yamaha Corporation**  
**Type of Equipment** : **Network Module**  
**Model No.** : **NW-01**  
**FCC ID** : **A6RNW01A**  
**Test regulation** : **FCC Part 15 Subpart C: 2015**  
**\*WLAN part (Radiated Spurious Emission test only)**  
**(Permissive Change Class II Application)**  
**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 11160421H-A. 11160421H-A is replaced with this report.

**Date of test:** January 13, 2015,  
March 11 to 14, 2016

**Representative test engineer:**

*S. Matsuyama*

Satofumi Matsuyama  
Engineer  
Consumer Technology Division

**Approved by:**

*Takayuki S.*

Takayuki Shimada  
Engineer  
Consumer Technology Division



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## **SECTION 1: Customer information**

Company Name : Yamaha Corporation  
Address : 10-1 Nakazawa-Cho, Naka-ku, Hamamatsu, Shizuoka, 430-8650, Japan  
Telephone Number : +81-53-460-2407  
Facsimile Number : +81-53-460-2878  
Contact Person : Hideyuki Suzuki

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

### **2.1 Identification of E.U.T.**

Type of Equipment : Network Module  
Model No. : NW-01  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 5.0 V  
Receipt Date of Sample : January 10, 2015(Sample used on January 13, 2015)  
March 7, 2016 (Sample used on March 11 to 14, 2016)  
Country of Mass-production : Malaysia  
Condition of EUT : Engineering 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: NW-01 (referred to as the EUT in this report) is a Network Module.

### General Specification

Clock frequency(ies) in the system : 32.768 kHz, 2.25 MHz, 6 MHz, 22.5792 MHz, 24.576 MHz, 25 MHz, 26 MHz, 50 MHz, 400 MHz

Operating temperature : 0deg. C to + 67deg. C

### Radio Specification

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

Equipment Type	Transceiver
Frequency of Operation	2412-2462MHz
Type of Modulation	DSSS, OFDM
Bandwidth & Channel spacing	20MHz & 5MHz
Method of frequency generation	Synthesizer
Power Supply (inner)	DC 3.3V
Antenna Type	Dipole Antenna
Antenna Gain	4.8 dBi including connector and cable

#### **Bluetooth (Ver. 2.1 with EDR function)**

Equipment Type	Transceiver
Frequency of Operation	2402-2480MHz
Type of Modulation	FHSS (GFSK, $\pi/4$ DQPSK, 8DPSK)
Bandwidth & Channel spacing	1MHz & 1MHz
Method of frequency generation	Synthesizer
Power Supply (inner)	DC 3.3V
Antenna Type	Dipole Antenna
Antenna Gain	4.8 dBi including connector and cable

\*This test report applies for WLAN.

<Contents of the change from original model>

Original test report number of this report is 10646854H-A-R2.

The EUT is changed the specification from original model as below.

\* The form change of the antenna design.

## **SECTION 3: Test specification, procedures & results**

### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C: 2015, final revised on November 23, 2015  
\*Some parts are effective on and after December 17, 2015 or December 23, 2015. The revision does not affect the test specification applied to the EUT.

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
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	5.3 dB 2483.500 MHz, AV, Vertical.	Complied	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.

\*\* The test procedure and specification for burst rate confirmation have not changed and the data was used from the original report.

#### **FCC Part 15.31 (e)**

This EUT provides stable voltage (DC 3.3V) constantly to RF Module regardless of input voltage.  
Therefore, this EUT complies with the requirement.

#### **FCC Part 15.203 Antenna requirement**

The EUT has a unique antenna connector (U.FL on the Module). Therefore the equipment complies with the requirement of Section 15.203/212.

### **3.3 Addition to standard**

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  $k = 2$ .  
Ise EMC Lab.

Polarity	Radiated emission (Below 1GHz)			
	(3 m*)(+dB)		(10 m*)(+dB)	
	30 – 300 MHz	300 – 1000MHz	30 – 300 MHz	300 – 1000MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	4.5 dB	5.9 dB	4.8 dB	5.1 dB

Radiated emission				
(3 m*)(+dB)		(1 m*)(+dB)	(0.5 m*)(+dB)	(10 m*)(+dB)
1 – 6GHz	6 – 18GHz	10 – 26.5 GHz	26.5 – 40GHz	1 -18 GHz
5.1 dB	5.3 dB	5.1 dB	5.1 dB	5.3 dB

\*Measurement distance

#### Radiated emission test

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

### 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)**

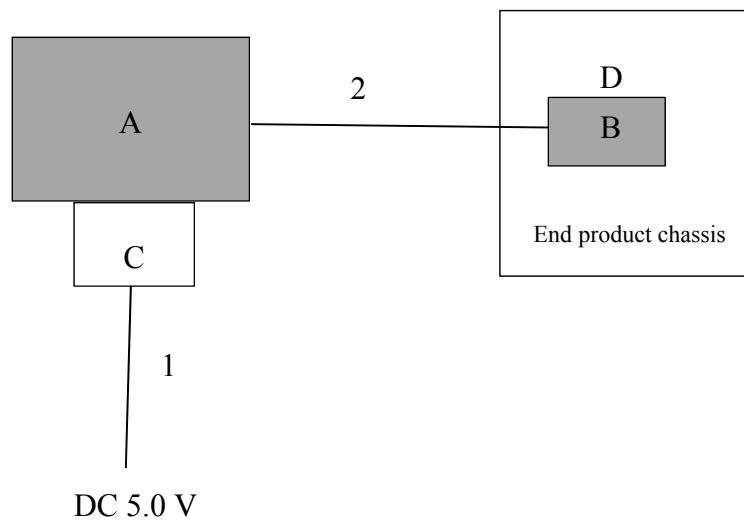
\*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Radiated Spurious Emission (Below 1GHz) *1)	11n-20 Tx	2437MHz
Radiated Spurious Emission (Above 1GHz)	11b Tx 11n-20 Tx *2)	2412MHz 2437MHz 2462MHz

\*1) The test was performed on the representative mode/frequency that 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.

### **4.2 Configuration and peripherals**



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

**Description of EUT**

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Module	NW-01	8	Yamaha Corporation	EUT
B	Antenna	RFDPA240416IMA B303	001	Walsin Technology Corporation	EUT
C	Jig board	-	-	-	-
D	WIRELESS STREAMING SPEAKER	WX-010	G19	Yamaha Corporation	-

**List of cables used**

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.5	Unshielded	Unshielded	-
2	Antenna Cable	0.05	Shielded	Shielded	-

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## **SECTION 5: 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 1GHz]

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 1GHz]

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 300 MHz	300 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 *3)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: <u>12.2.5.2</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz
Test Distance	3m	4.3 m *1) (1 GHz – 10 GHz), 1 m *2) (10 GHz – 26.5 GHz)		4.3 m *1) (1 GHz – 10 GHz), 1 m *2) (10 GHz – 26.5 GHz)

\*1) Distance Factor:  $20 \times \log(4.3 \text{ m} / 3.0 \text{ m}) = 3.1 \text{ dB}$

\*2) Distance Factor:  $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

\*3) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r05"

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

The test was made on Speaker at the normal position, because antenna was built into Speaker and Speaker was intended to be used as horizontally mounted.

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**

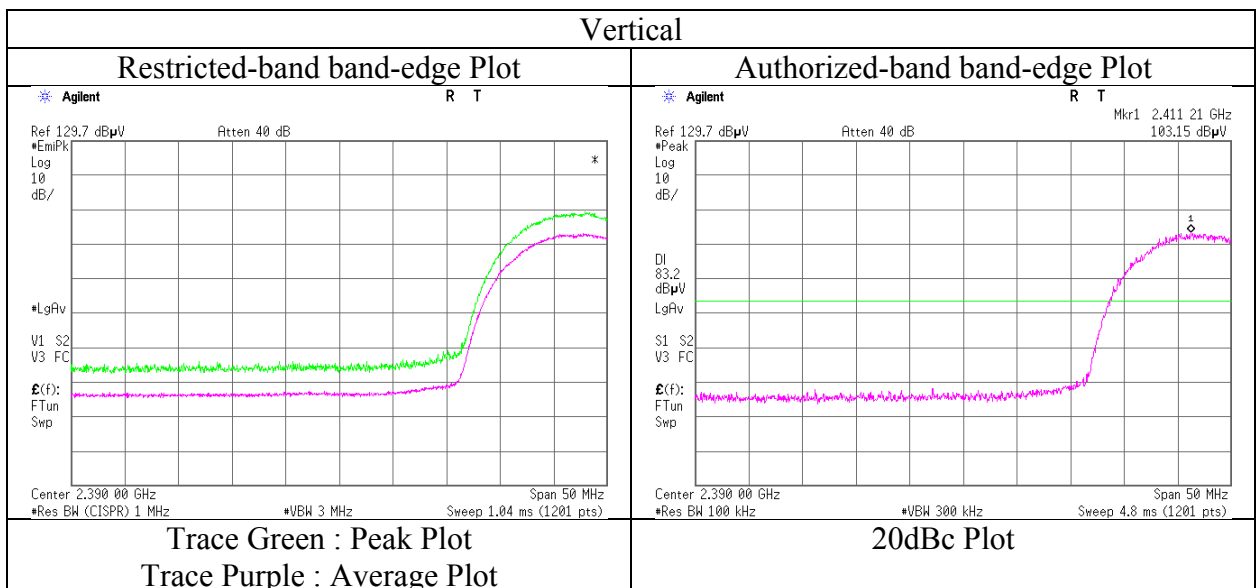
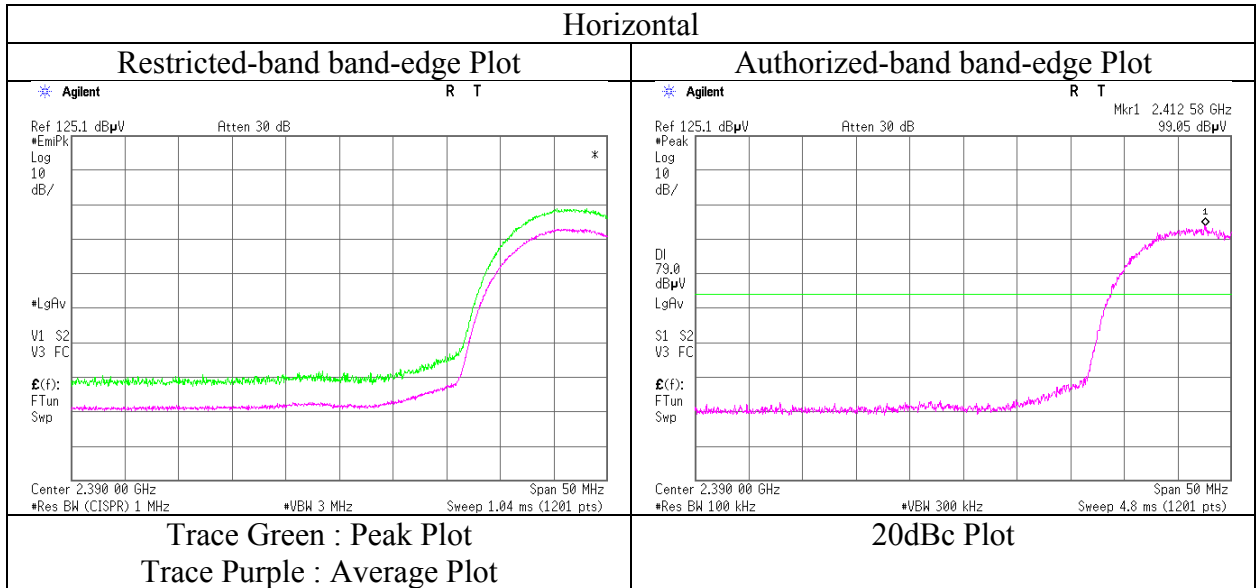
**Test data : APPENDIX**

**Test result : Pass**



## Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11160421H
Date	March 11, 2016
Temperature / Humidity	23 deg. C / 37 % RH
Engineer	Koji Yamamoto
	(1-10GHz)
Mode	Tx 11b 2412 MHz



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



## Radiated Spurious Emission

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber	
Report No.	11160421H	
Date	March 11, 2016	March 12, 2016
Temperature / Humidity	24 deg. C / 34 % RH	20 deg. C / 38 % RH
Engineer	Satofumi Matsuyama (1-10GHz)	Tomohisa Nakagawa (10-26.5GHz)
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	53.9	28.1	6.5	37.0	-	51.5	73.9	22.4	
Hori	4924.000	PK	43.5	33.3	8.9	37.2	-	48.5	73.9	25.4	Floor Noise
Hori	7386.000	PK	42.3	36.8	10.0	38.0	-	51.1	73.9	22.8	Floor Noise
Hori	9848.000	PK	43.8	38.2	10.8	39.2	-	53.6	73.9	20.3	Floor Noise
Hori	2483.500	AV	43.6	28.1	6.5	37.0	0.8	42.0	53.9	11.9	*1)
Hori	4924.000	AV	34.2	33.3	8.9	37.2	-	39.2	53.9	14.7	Floor Noise
Hori	7386.000	AV	34.1	36.8	10.0	38.0	-	42.9	53.9	11.0	Floor Noise
Hori	9848.000	AV	35.2	38.2	10.8	39.2	-	45.0	53.9	8.9	Floor Noise
Vert	2483.500	PK	57.6	28.1	6.5	37.0	-	55.2	73.9	18.7	
Vert	4924.000	PK	43.7	33.3	8.9	37.2	-	48.7	73.9	25.2	Floor Noise
Vert	7386.000	PK	42.7	36.8	10.0	38.0	-	51.5	73.9	22.4	Floor Noise
Vert	9848.000	PK	44.1	38.2	10.8	39.2	-	53.9	73.9	20.0	Floor Noise
Vert	2483.500	AV	48.5	28.1	6.5	37.0	0.8	46.9	53.9	7.0	*1)
Vert	4924.000	AV	34.2	33.3	8.9	37.2	-	39.2	53.9	14.7	Floor Noise
Vert	7386.000	AV	34.1	36.8	10.0	38.0	-	42.9	53.9	11.0	Floor Noise
Vert	9848.000	AV	35.2	38.2	10.8	39.2	-	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).

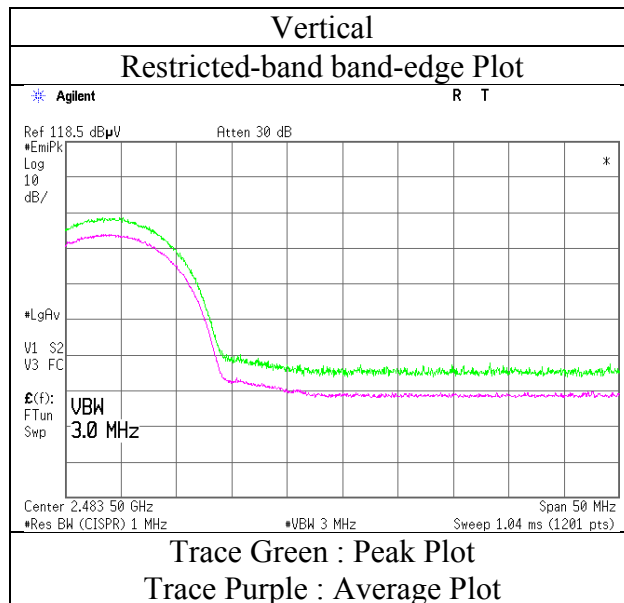
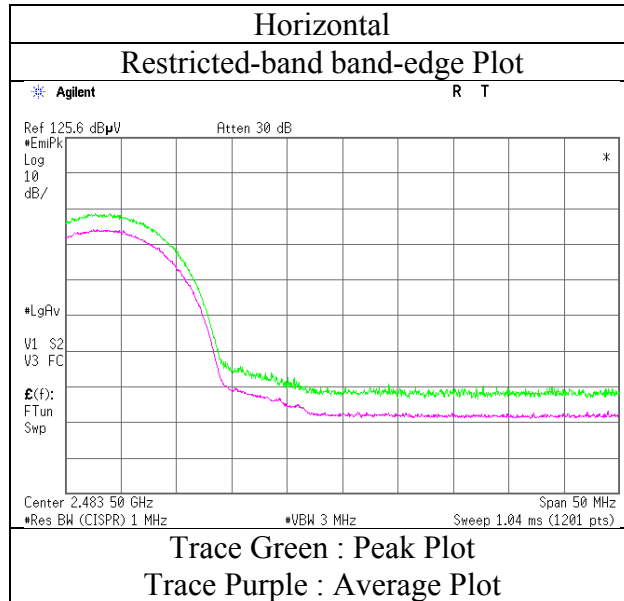
Distance factor: 1 GHz - 10 GHz 20log (4.3 m / 3.0 m) = 3.1 dB  
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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



## Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11160421H
Date	March 11, 2016
Temperature / Humidity	24 deg. C / 34 % RH
Engineer	Satofumi Matsuyama
	(1-10GHz)
Mode	Tx 11b 2462 MHz

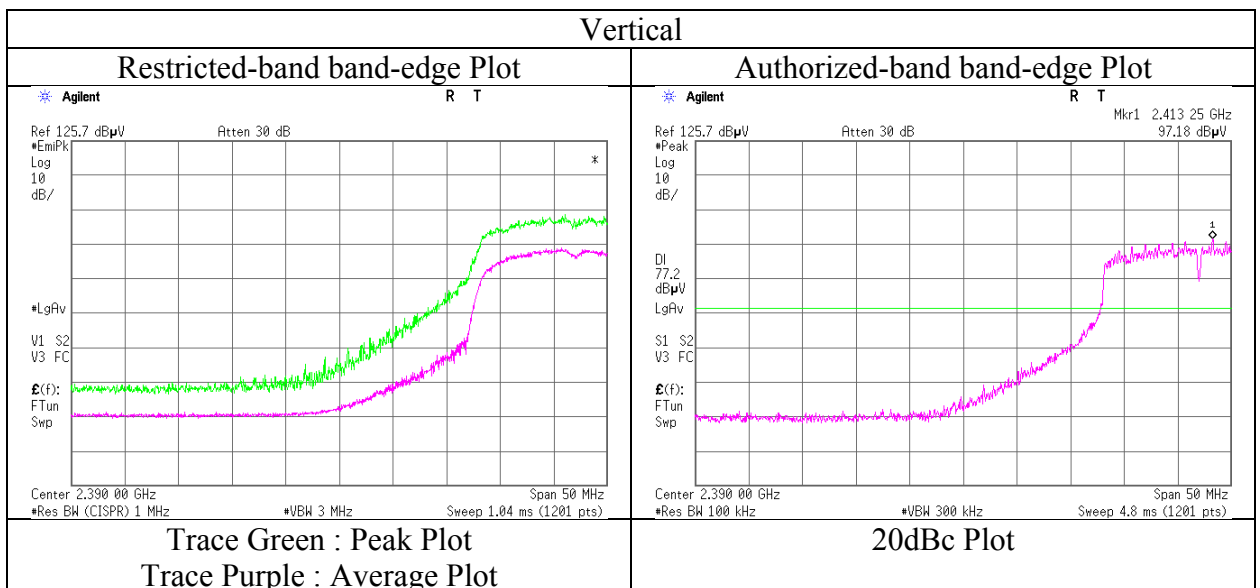
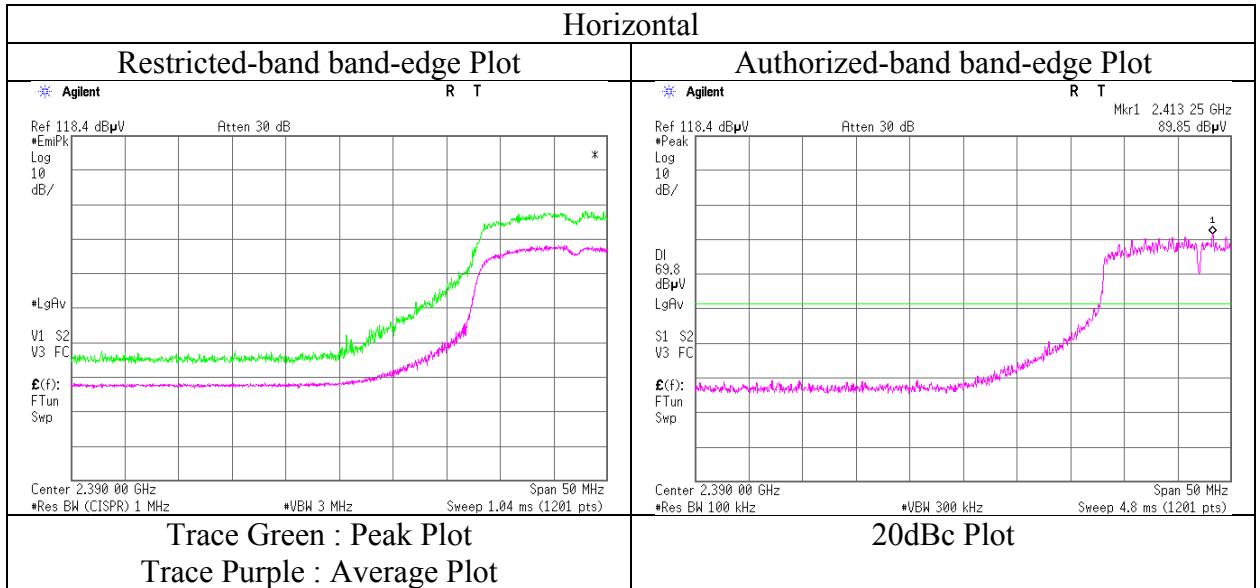


\* Final result of restricted band edge was shown in tabular data.



## Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11160421H
Date	March 11, 2016
Temperature / Humidity	23 deg. C / 33 % RH
Engineer	Koji Yamamoto
	(1-10GHz)
Mode	Tx 11n-20 2412 MHz



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

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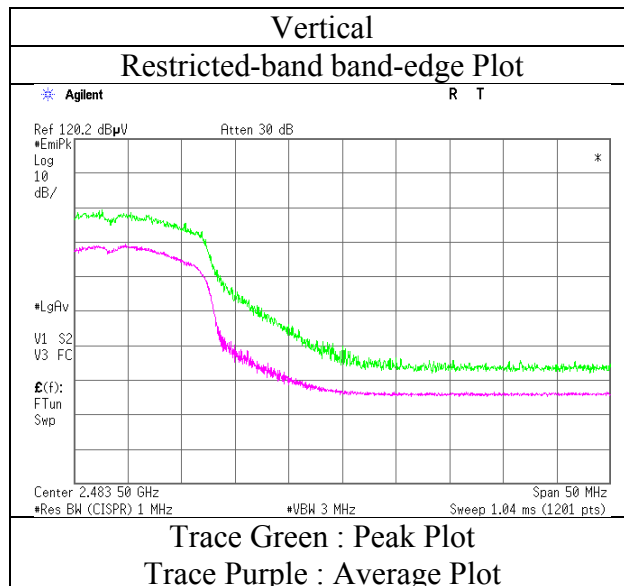
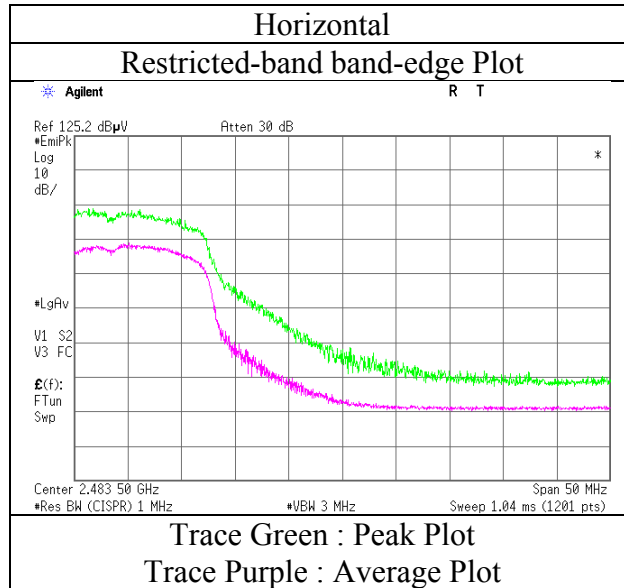
Facsimile : +81 596 24 8124





**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

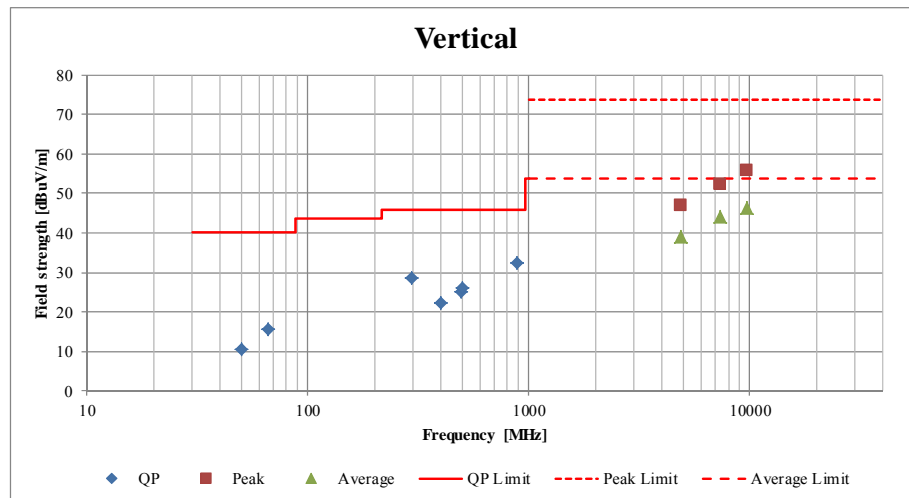
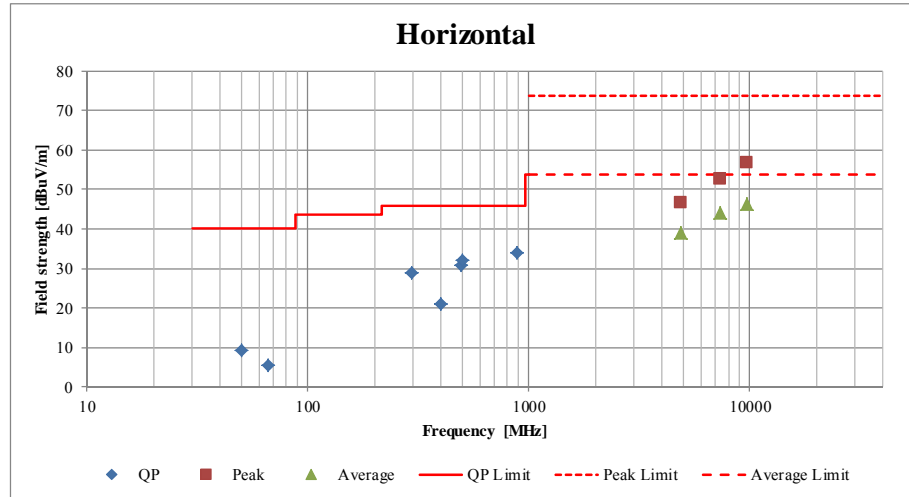
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11160421H
Date	March 11, 2016
Temperature / Humidity	23 deg. C / 33 % RH
Engineer	Koji Yamamoto
	(1-10GHz)
Mode	Tx 11n-20 2462 MHz



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

## Radiated Spurious Emission (Plot data, Worst case)

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber		
Report No.	11160421H		
Date	March 11, 2016	March 12, 2016	March 14, 2016
Temperature / Humidity	23 deg. C / 33 % RH	20 deg. C / 38 % RH	23 deg. C / 34 % RH
Engineer	Koji Yamamoto (1-10GHz)	Tomohisa Nakagawa (10-26.5GHz)	Hironobu Ohnishi (Below 1 GHz)
Mode	Tx 11n-20 2437 MHz		

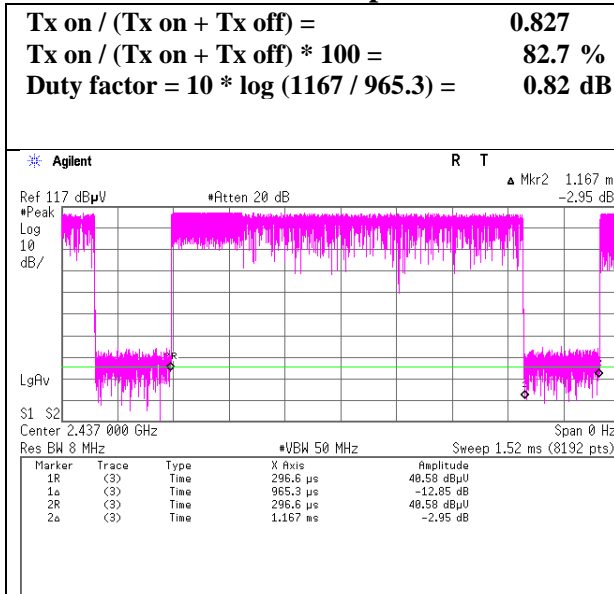


\*These plots data contains sufficient number to show the trend of characteristic features for EUT.

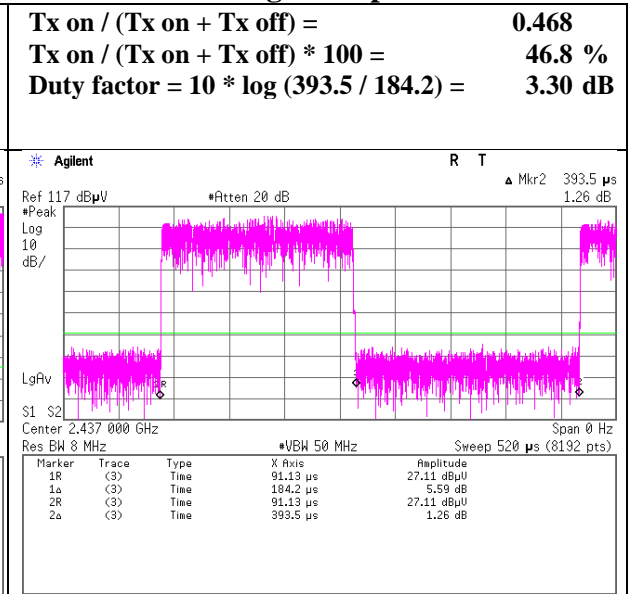
**Burst rate confirmation**  
 (Reference data)

Test place : Ise EMC Lab. No.11 Measurement Room  
 Report No. : 11160421H  
 Date : 01/13/2015  
 Temperature/ Humidity : 27deg. C / 20% RH  
 Engineer : Tomoki Matsui  
 Mode : 11b/g/n-20 Tx

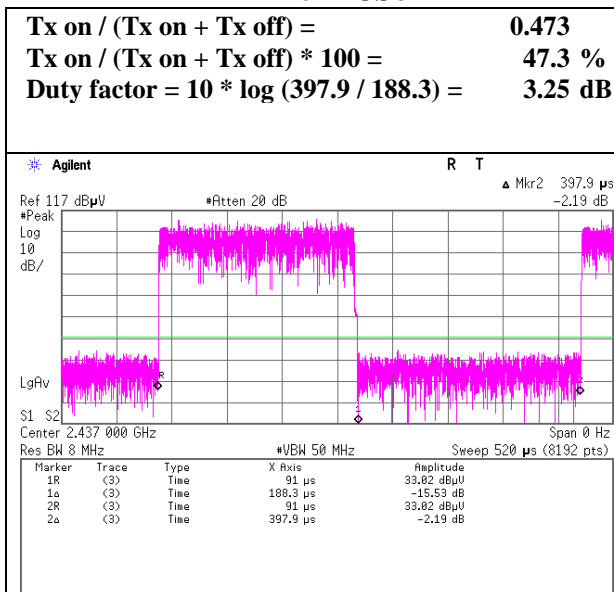
**11b 11Mbps**



**11g 54Mbps**



**11n-20 MCS6**





## **APPENDIX 2: Test instruments**

### **Test equipment (used on January 13, 2015)**

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MSA-14	Spectrum Analyzer	Agilent	E4440A	MY48250080	RE	2014/10/17 * 12
MPM-09	Power Meter	Anritsu	ML2495A	6K00003348	RE	2014/10/06 * 12
MPSE-12	Power sensor	Anritsu	MA2411B	011598	RE	2014/10/06 * 12
MCC-138	Microwave cable	HUBER+SUHNER	SUCOFLEX 102	37953/2	RE	2014/10/02 * 12
MAT-22	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	RE	2014/03/13 * 12

### **Test equipment (used on March 11 to 14, 2016)**

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2015/10/02 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE	2016/01/21 * 12
MJM-26	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2015/11/06 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2015/08/10 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	RE	2015/06/22 * 12
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2016/02/10 * 12
MMM-10	DIGITAL HiTESTER	Hioki	3805	051201148	RE	2016/01/18 * 12
MHF-26	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	RE	2015/09/17 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	00650	RE	2015/10/01 * 12
MHF-17	High Pass Filter 3.5-18.0GHz	TOKIMEC	TF323DCA	7001	RE	2015/09/17 * 12
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	100084	RE	2015/11/28 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2015/11/02 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2015/11/03 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2015/06/19 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2015/11/12 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2015/03/09 * 12

**The expiration date of the calibration is the end of the expired month.**

**All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.**

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

**Test Item: RE: Radiated Emission test**

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