



RADIO TEST REPORT

Test Report No. : 11500824H-A-R1

Applicant : Panasonic Corporation of North America
Type of Equipment : Body Worn Camera
Model No. : WV-TW370
FCC ID : ACJ9TAWV-TW370
Test regulation : FCC Part 15 Subpart C: 2016
(*WLAN, Bluetooth Low Energy part)
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
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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 11500824H-A. 11500824H-A is replaced with this report.

Date of test: November 8 to 25, 2016

Representative test engineer:

Tomoki Matsui
Engineer
Consumer Technology Division

Approved by:

Tsubasa Takayama
Engineer
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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Ise EMC Lab.

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13-EM-F0429

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SECTION 1: Customer information

Applicant

Company Name : Panasonic Corporation of North America
Address : Two Riverfront Plaza, Newark, NJ 07102-5490
Telephone Number : +1-201-348-7724
Facsimile Number : +1-201-392-4564
Contact Person : Vir Angelo Lontoc

Manufacturer

Company Name : Panasonic System Networks Co., Ltd.
Address : 4-1-62, Minoshima, Hakata-ku, Fukuoka 812-8531, Japan
Telephone Number : +81-50-3380-1993
Facsimile Number : +81-50-3380-2002
Contact Person : Yukio Kaneko

***Remarks:**

Panasonic Corporation of North America designates Panasonic System Networks Co., Ltd. as manufacturer of the product (Body Worn Camera).

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

2.1 Identification of E.U.T.

Type of Equipment : Body Worn Camera
Model No. : WV-TW370
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3.7 V
Receipt Date of Sample : November 19, 2016
Country of Mass-production : Japan
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: WV-TW370 (referred to as the EUT in this report) is a Body Worn Camera.

Radio Specification

Radio Type : Transceiver
Power Supply (inner) : DC3.7V (POWER), DC1.8V (IO)
Clock frequency (crystal) : 37.4 MHz

	IEEE802.11b ^{*1)}	IEEE802.11g/n (20 M band) ^{*1)}	IEEE802.11a/n/ac (20 M band)	IEEE802.11n/ac (40 M band)	IEEE802.11ac (80 M band)
Frequency of operation	2412 MHz to 2462 MHz ^{*2)}	2412 MHz to 2462 MHz ^{*2)}	5280 MHz to 5320 MHz 5500 MHz to 5580 MHz 5660 MHz to 5720 MHz 5745 MHz to 5825 MHz ^{*2)}	5310 MHz 5510 MHz 5550 MHz 5670 MHz 5710 MHz 5755 MHz ^{*2)} 5795 MHz ^{*2)}	5530 MHz 5690 MHz 5775 MHz ^{*2)}
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK, 256QAM(IEEE802.11ac only))		
Channel spacing	5MHz		20MHz	40MHz	80MHz
Antenna type	Chip Antenna				
Antenna Connector type	-				
Antenna Gain	-1.85 dBi (2.4 GHz Band) 0.3 dBi (5 GHz Band)				

	Bluetooth Ver.4.1 with EDR function / Bluetooth Low Energy ^{*1)}
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	BT: FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK) LE: GFSK
Channel spacing	BT: 1 MHz LE: 2 MHz
Antenna type	Chip Antenna
Antenna Connector type	-
Antenna Gain	-1.85 dBi

*1) This test report applies to WLAN (2.4 GHz Band only) and Bluetooth Low Energy.

*2) AP mode has only these frequencies.

*Wireless LAN and Bluetooth do not transmit simultaneously.

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

* The revision on November 14, 2016, does not affect the test specification applied to the EUT.

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 11.3 dB, 0.50800 MHz, N AV 6.4 dB, 0.50800 MHz, N	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 ----- IC: -	FCC: Section 15.247(a)(2) ----- IC: RSS-247 5.2(1)	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(4)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v03r05 ----- IC: -	FCC: Section 15.247(e) ----- IC: RSS-247 5.2(2)		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	1.7 dB 2390.000 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 EUT is a battery-operated device and test was performed with the full-charged battery. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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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	1.7 dB	2.8 dB	2.8 dB	2.9 dB	2.6 dB

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

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

Polarity	Radiated emission (Below 1GHz)			
	(3 m*) (+/-)		(10 m*) (+/-)	
	30 – 200 MHz	200 – 1000MHz	30 – 200 MHz	200 – 1000MHz
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 1GHz)				
(3 m*) (+/-)		(1 m*) (+/-)		(10 m*) (+/-)
1 – 6GHz	6 – 18GHz	10 – 26.5 GHz	26.5 – 40GHz	1 -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.

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)	54 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 7 (Short GI), PN9
Bluetooth Low Energy (BT LE)	-
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*The power value of the EUT was set for testing as follows (setting value might be different from product specification value); Power settings: WLAN: Same as production model BT LE: 2 dBm Software: bcm43455c0 *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.	

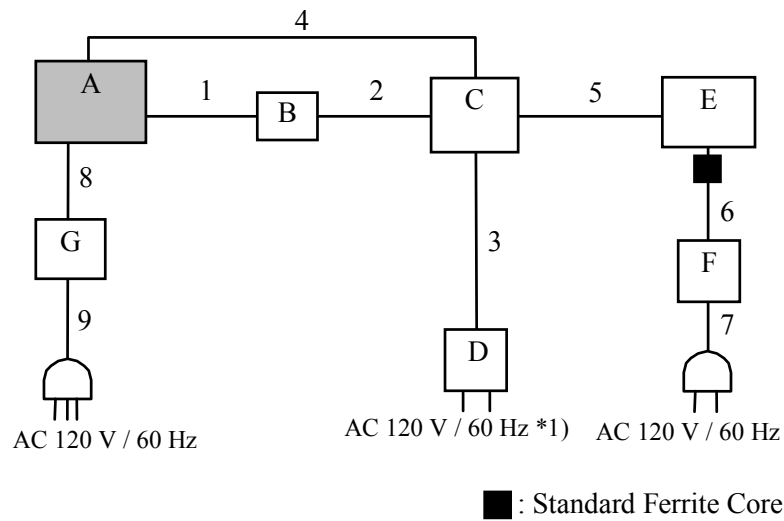
*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency	
Conducted Emission Spurious Emission (Conducted)	11n-20 Tx *1)	2462 MHz	
	BT LE Tx	2402 MHz	
		2440 MHz	
		2480 MHz	
Spurious Emission (Radiated)	11b Tx	2412 MHz	
	11n-20 Tx *2)	2437 MHz	
		2462 MHz	
		BT LE Tx	2402 MHz
	6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	11b Tx	2412 MHz
			11g Tx
11n-20 Tx		2462 MHz	
		BT LE Tx	2402 MHz
		2440 MHz	
		2480 MHz	

*1) The mode was tested as a representative, because it had the highest power at antenna terminal test.

*2) Since 11g and 11n-20 have the same modulation method and no differences in transmitting specification, test was performed on the representative mode that had the highest peak output power.

4.2 Configuration and peripherals



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

*1) Conducted Emission test was performed on this port.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Body Worn Camera	WV-TW370	14	Panasonic System Networks Co., Ltd.	EUT
B	Jig	-	-	-	-
C	USB Hub	U2H-AN4S	6604382	ELECOM	-
D	AC Adapter	CS12F050200FJ	6607085	ELECOM	-
E	Laptop PC	T440	0814PB030VNE	Lenovo	-
F	AC Adapter	ADLX65NCC2A	11S36200284ZZ1004654HF	Lenovo	-
G	Monitor	ET-0037-N	ETN2B00760026	BenQ	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Flat Cable	0.12	Unshielded	Unshielded	-
2	USB Cable	1.50	Shielded	Shielded	-
3	DC Cable	1.50	Unshielded	Unshielded	-
4	USB Cable	1.00 for CE* 2.40 for RE*	Shielded	Shielded	-
5	USB Cable	1.50	Shielded	Shielded	-
6	DC Cable	1.80	Unshielded	Unshielded	-
7	AC Cable	1.00	Unshielded	Unshielded	-
8	HDMI Cable	2.00	Shielded	Shielded	-
9	AC Cable	2.10	Unshielded	Unshielded	-

*CE: Conducted emission test, RE: Radiated 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.

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, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

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

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

The height of the measuring antenna varied between 1 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 m *3) (10 GHz – 26.5 GHz)		4.5 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 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 EUT has some clips and chargers as accessories (wearing tools).

The pre-check was conducted with each accessory (wearing tool), and the test was performed under the worst condition.

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 not detected 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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APPENDIX 1: Test data

Conducted Emission

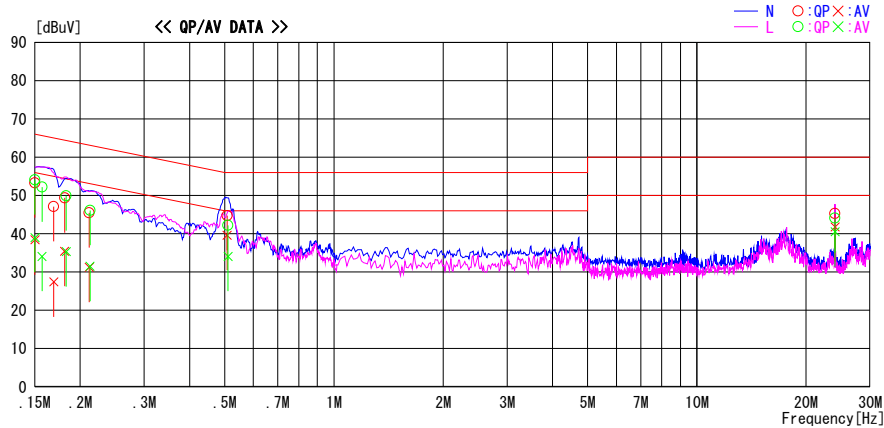
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2016/11/24

Report No. : 11500824H
Temp./Humi. : 25deg. C / 32% RH
Engineer : Tomoki Matsui

Mode / Remarks : Tx 11n-20 2462MHz

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	40.0	25.1	13.3	53.3	38.4	66.0	56.0	12.7	17.6	N	
0.16912	33.8	14.1	13.3	47.1	27.4	65.0	55.0	17.9	27.6	N	
0.18118	36.1	22.1	13.3	49.4	35.4	64.4	54.4	15.0	19.0	N	
0.21180	32.2	17.9	13.3	45.5	31.2	63.1	53.1	17.6	21.9	N	
0.50800	31.3	26.2	13.4	44.7	39.6	56.0	46.0	11.3	6.4	N	
24.00104	28.1	24.6	17.2	45.3	41.8	60.0	50.0	14.7	8.2	N	
0.15000	40.8	25.7	13.3	54.1	39.0	66.0	56.0	11.9	17.0	L	
0.15690	38.9	20.8	13.3	52.2	34.1	65.6	55.6	13.4	21.5	L	
0.18297	36.6	22.0	13.3	49.9	35.3	64.3	54.3	14.4	19.0	L	
0.21290	32.8	18.2	13.3	46.1	31.5	63.1	53.1	17.0	21.6	L	
0.51076	28.8	20.7	13.4	42.2	34.1	56.0	46.0	13.8	11.9	L	
24.00104	26.9	23.3	17.2	44.1	40.5	60.0	50.0	15.9	9.5	L	

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

Conducted Emission

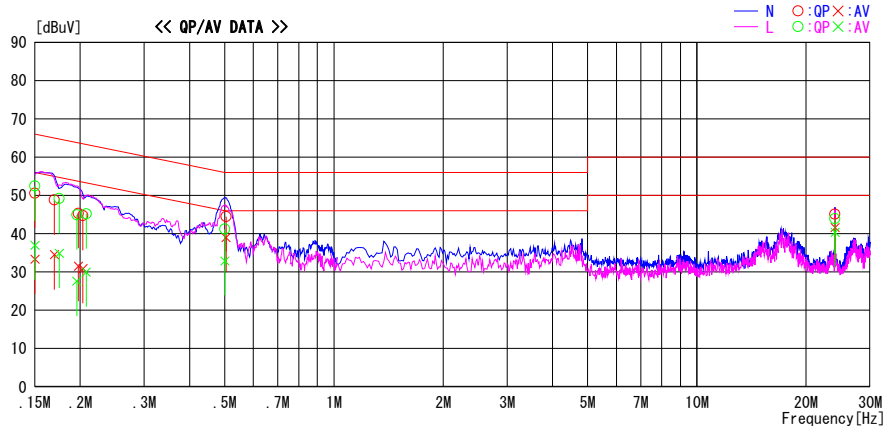
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2016/11/24

Report No. : 11500824H
 Temp./Humi. : 25deg. C / 32% RH
 Engineer : Tomoki Matsui

Mode / Remarks : Tx BTLE 2440MHz

LIMIT : FCC15.207 QP
FCC15.207 AV

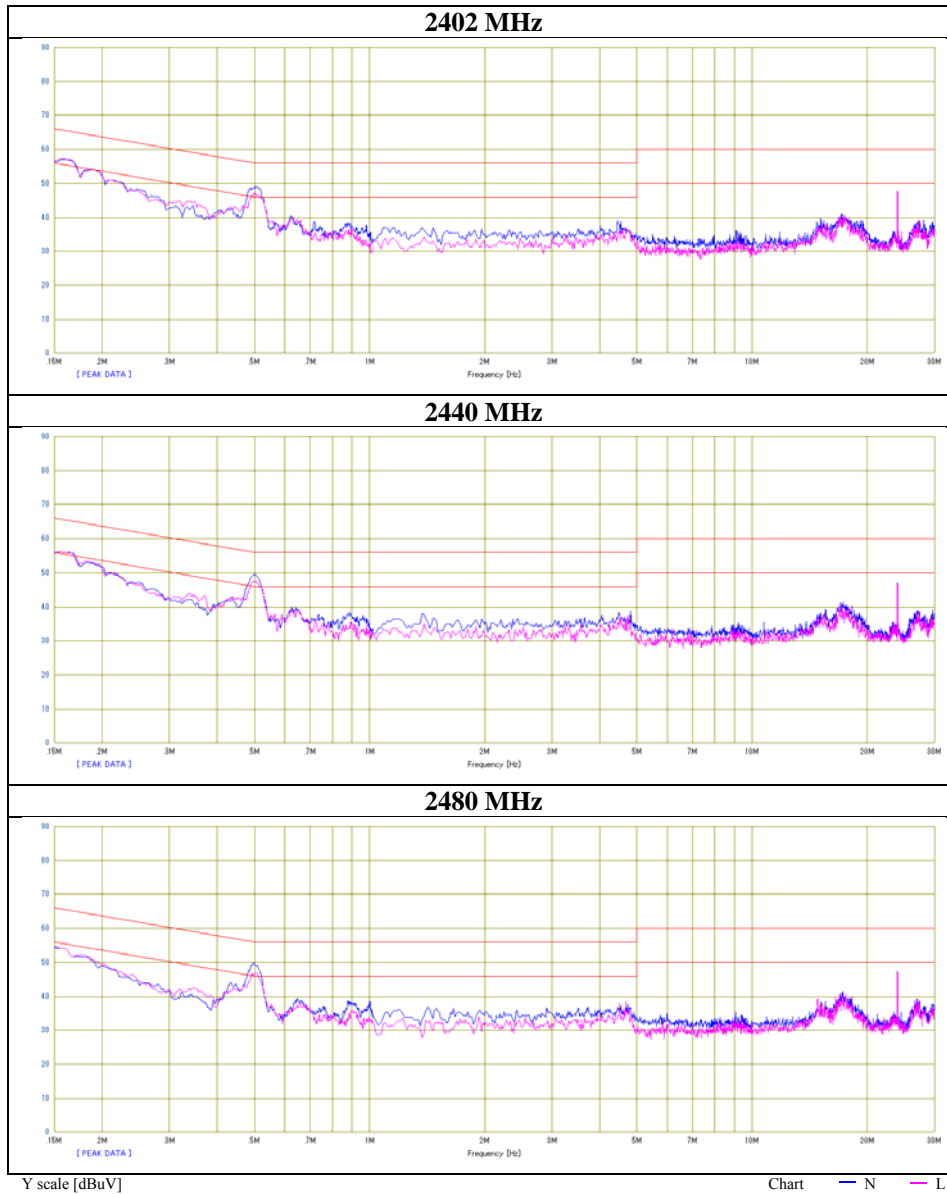


Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15000	37.3	20.0	13.3	50.6	33.3	66.0	56.0	15.4	22.7	N	
0.15000	39.2	23.7	13.3	52.5	37.0	66.0	56.0	13.5	19.0	L	
0.16970	35.5	21.2	13.3	48.8	34.5	65.0	55.0	16.2	20.5	N	
0.17504	35.9	21.6	13.3	49.2	34.9	64.7	54.7	15.5	19.8	L	
0.19572	31.6	14.3	13.3	44.9	27.6	63.8	53.8	18.9	26.2	L	
0.19760	32.0	18.2	13.3	45.3	31.5	63.7	53.7	18.4	22.2	N	
0.20344	31.4	17.6	13.3	44.7	30.9	63.5	53.5	18.8	22.6	N	
0.20768	31.9	16.7	13.3	45.2	30.0	63.3	53.3	18.1	23.3	L	
0.50080	27.8	19.5	13.4	41.2	32.9	56.0	46.0	14.8	13.1	L	
0.50460	31.1	25.6	13.4	44.5	39.0	56.0	46.0	11.5	7.0	N	
24.00096	27.9	24.4	17.2	45.1	41.6	60.0	50.0	14.9	8.4	N	
24.00096	26.7	23.1	17.2	43.9	40.3	60.0	50.0	16.1	9.7	L	

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

Conducted Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11500824H
Date	November 24, 2016
Temperature / Humidity	25 deg. C / 32 % RH
Engineer	Tomoki Matsui
Mode	Tx BT LE



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Ise EMC Lab.

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Telephone : +81 596 24 8999

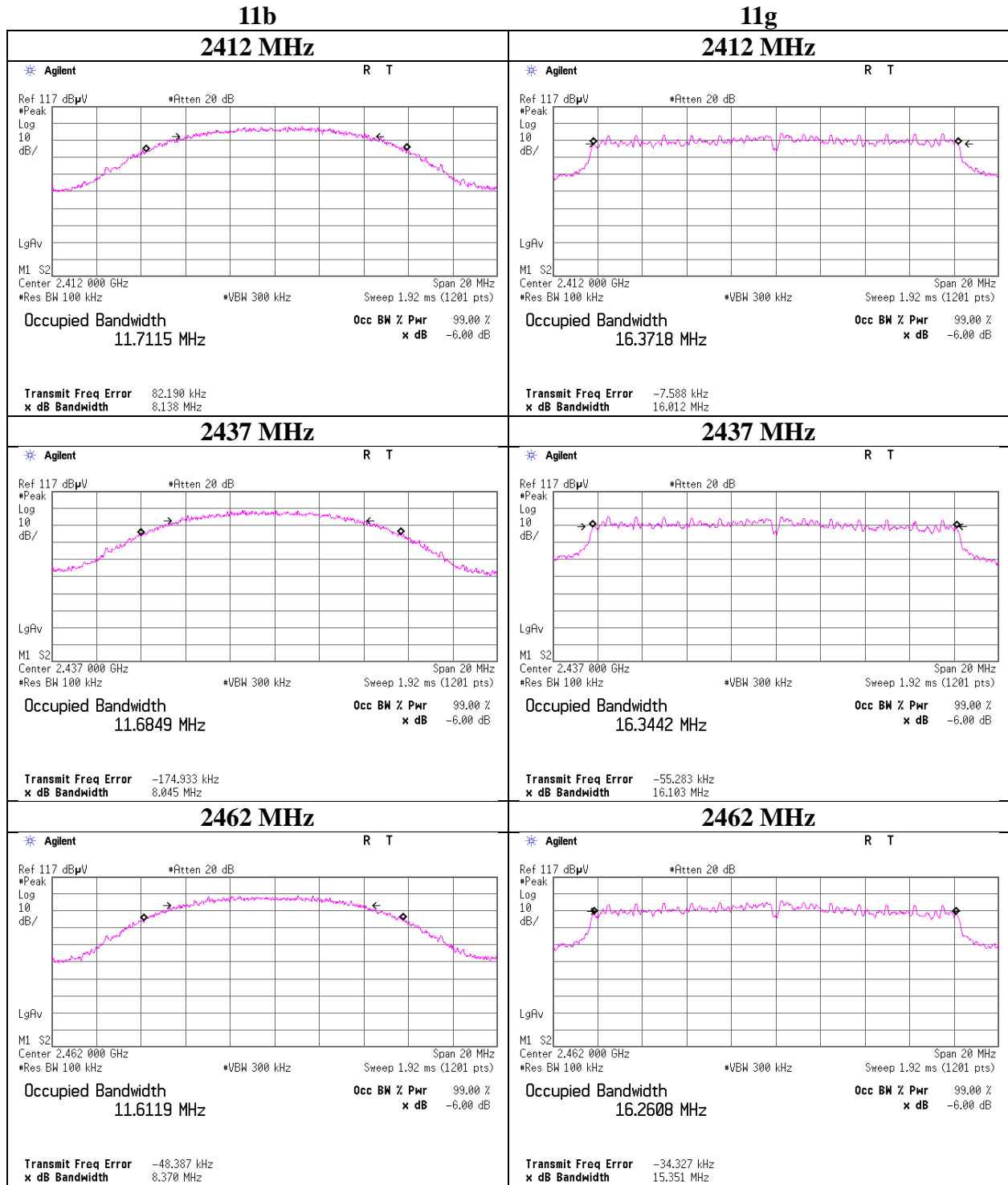
Facsimile : +81 596 24 8124

6dB Bandwidth

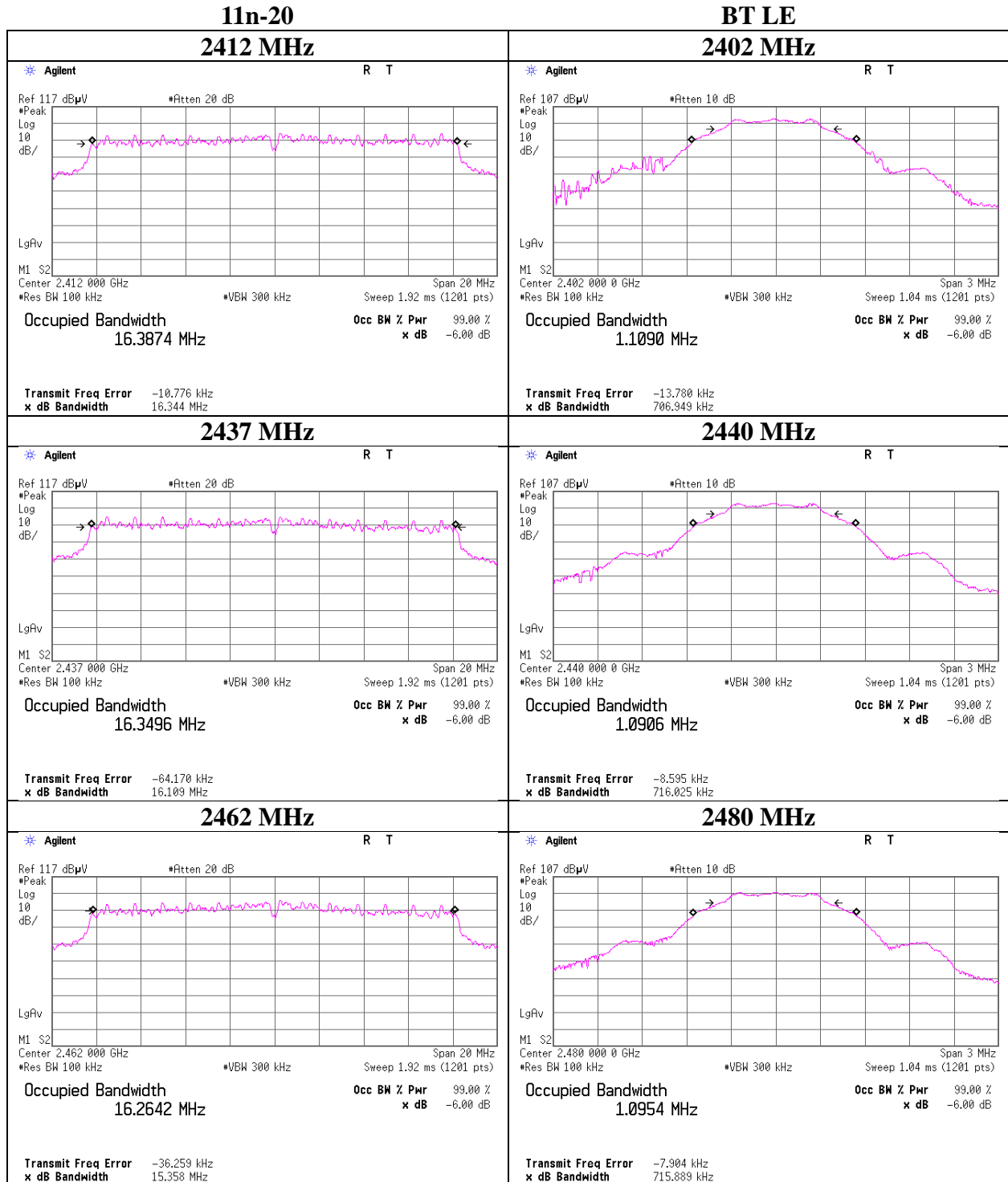
Test place Ise EMC Lab. No.3 Measurement Room
Report No. 11500824H
Date November 9, 2016
Temperature / Humidity 23 deg. C / 38 % RH
Engineer Koji Yamamoto
Mode Tx

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
11b	2412	8.138	> 500
	2437	8.045	> 500
	2462	8.370	> 500
11g	2412	16.012	> 500
	2437	16.103	> 500
	2462	15.351	> 500
11n-20	2412	16.344	> 500
	2437	16.109	> 500
	2462	15.358	> 500
BT LE	2402	0.707	> 500
	2440	0.716	> 500
	2480	0.716	> 500

6dB Bandwidth



6dB Bandwidth



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Maximum Peak Output Power

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11500824H
Date	November 8, 2016
Temperature / Humidity	22 deg. C / 58 % RH
Engineer	Ryota Yamanaka
Mode	Tx 11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2412	8.92	1.12	10.06	20.10	102.33	30.00	1000	9.90
2437	9.51	1.13	10.06	20.70	117.49	30.00	1000	9.30
2462	9.93	1.14	10.06	21.13	129.72	30.00	1000	8.87

Sample Calculation:

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

Antenna 1, 2437MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	8.66	
2	9.41	
5.5	9.47	
11	9.51	*

*: Worst Rate

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

Maximum Peak Output Power

Test place	Ise EMC Lab. No.3 Measurement Room	
Report No.	11500824H	
Date	November 8, 2016	November 25, 2016
Temperature / Humidity	22 deg. C / 58 % RH	24 deg. C / 45 % RH
Engineer	Ryota Yamanaka	Ryota Yamanaka
Mode	Tx 11g	

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2412	11.40	1.12	10.06	22.58	181.13	30.00	1000	7.42
2437	11.75	1.13	10.06	22.94	196.79	30.00	1000	7.06
2462	12.28	1.14	10.06	23.48	222.84	30.00	1000	6.52

Sample Calculation:

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

Antenna 1, 2437 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	11.87	
9	11.96	
12	12.02	
18	12.19	
24	11.80	
36	11.57	
48	12.63	
54	12.98	*

*: Worst Rate

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

*Difference between worst rate check data and formal test result is due to the different test condition.

Maximum Peak Output Power

Test place	Ise EMC Lab. No.3 Measurement Room	
Report No.	11500824H	
Date	November 8, 2016	November 25, 2016
Temperature / Humidity	22 deg. C / 58 % RH	24 deg. C / 45 % RH
Engineer	Ryota Yamanaka	Ryota Yamanaka
Mode	Tx 11n-20	

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2412	12.06	1.12	10.06	23.24	210.86	30.00	1000	6.76
2437	12.44	1.13	10.06	23.63	230.67	30.00	1000	6.37
2462	12.71	1.14	10.06	23.91	246.04	30.00	1000	6.09

Sample Calculation:

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

2437 MHz

Short GI

MCS Number	Reading [dBm]	Remark
0	12.58	
1	12.48	
2	12.52	
3	12.54	
4	12.50	
5	12.54	
6	12.56	
7	12.71	*

Long GI

MCS Number	Reading [dBm]	Remark
0	12.52	
1	12.30	
2	12.49	
3	12.51	
4	12.25	
5	12.36	
6	12.33	
7	12.55	

*: Worst Rate

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

*Difference between worst rate check data and formal test result is due to the different test condition.

Maximum Peak Output Power

Test place : Ise EMC Lab. No.3 Measurement Room
Report No. : 11500824H
Date : November 8, 2016
Temperature / Humidity : 22 deg. C / 58 % RH
Engineer : Ryota Yamanaka
Mode : Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-6.49	1.12	10.06	4.69	2.94	30.00	1000	25.31
2440	-6.16	1.13	10.06	5.03	3.18	30.00	1000	24.97
2480	-8.13	1.14	10.06	3.07	2.03	30.00	1000	26.93

Sample Calculation:

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

Average Output Power
(Reference data for RF Exposure)

Test place : Ise EMC Lab. No.3 Measurement Room
Report No. : 11500824H
Date : November 8, 2016
Temperature / Humidity : 22 deg. C / 58 % RH
Engineer : Ryota Yamanaka
Mode : Tx

BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Frame power)		Duty factor [dB]	Result (Burst power)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-10.41	1.12	10.06	0.77	1.19	3.61	4.38	2.74
2440	-10.09	1.13	10.06	1.10	1.29	3.61	4.71	2.96
2480	-12.21	1.14	10.06	-1.01	0.79	3.61	2.60	1.82

Sample Calculation:

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

Result (Burst power) = Frame power + Duty factor

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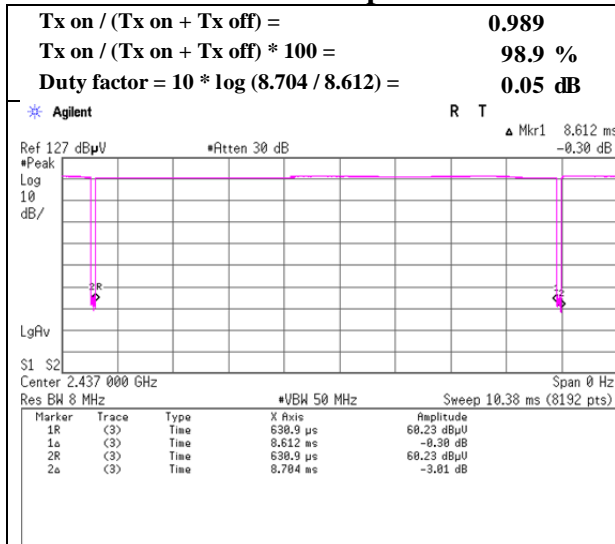
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

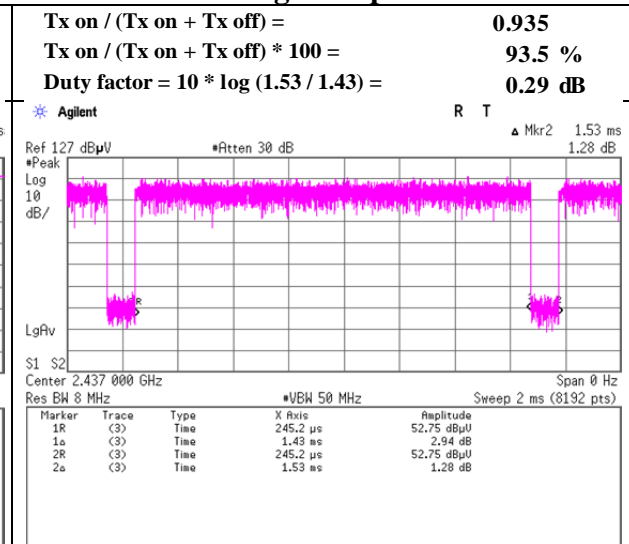
Burst rate confirmation

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11500824H
Date	December 6, 2016
Temperature / Humidity	23 deg. C / 46 % RH
Engineer	Ryota Yamanaka
Mode	Tx

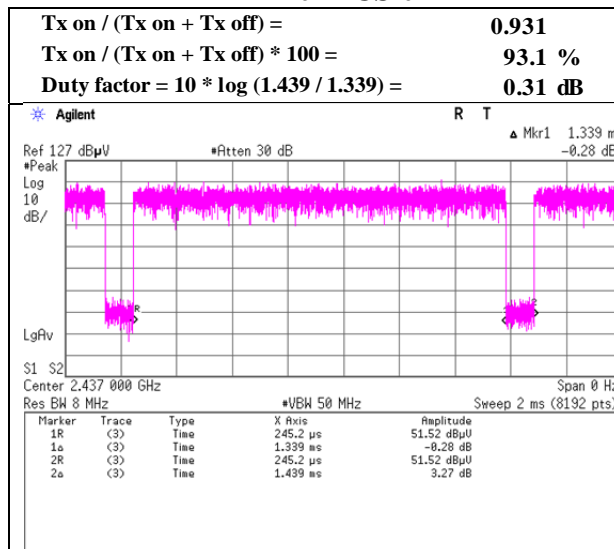
11b 1 Mbps



11g 6 Mbps



11n-20 MCS 0



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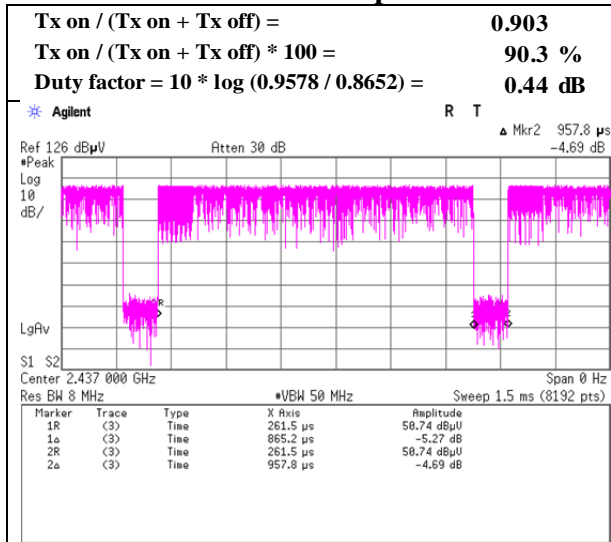
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

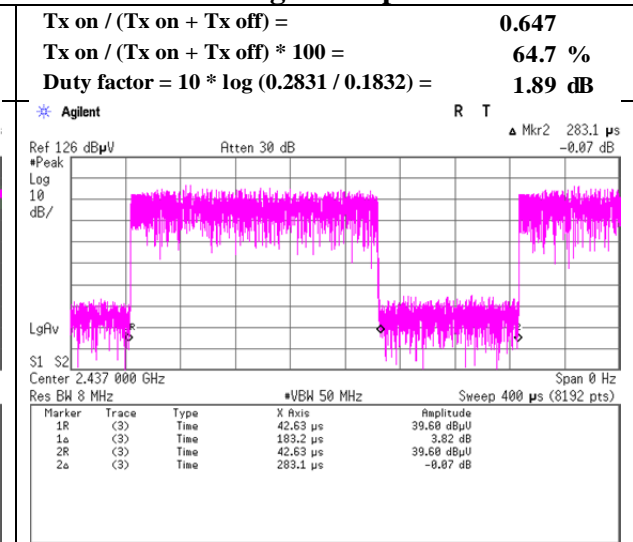
Burst rate confirmation

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11500824H
Date	November 21, 2016
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Tomoki Matsui
Mode	Tx

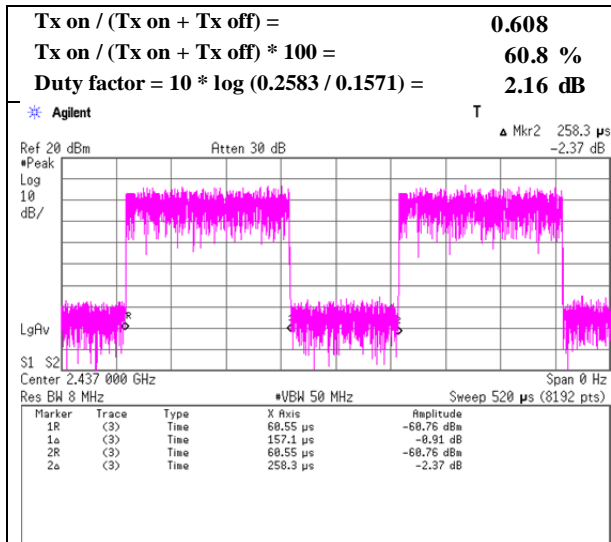
11b 11 Mbps



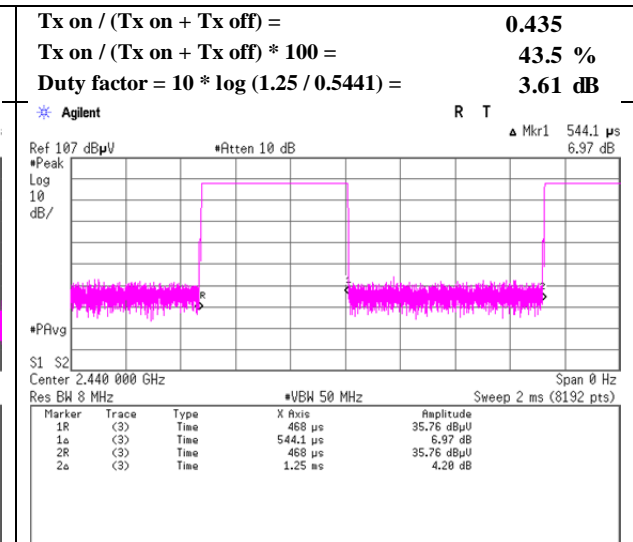
11g 54 Mbps



11n-20 MCS 7



BT LE



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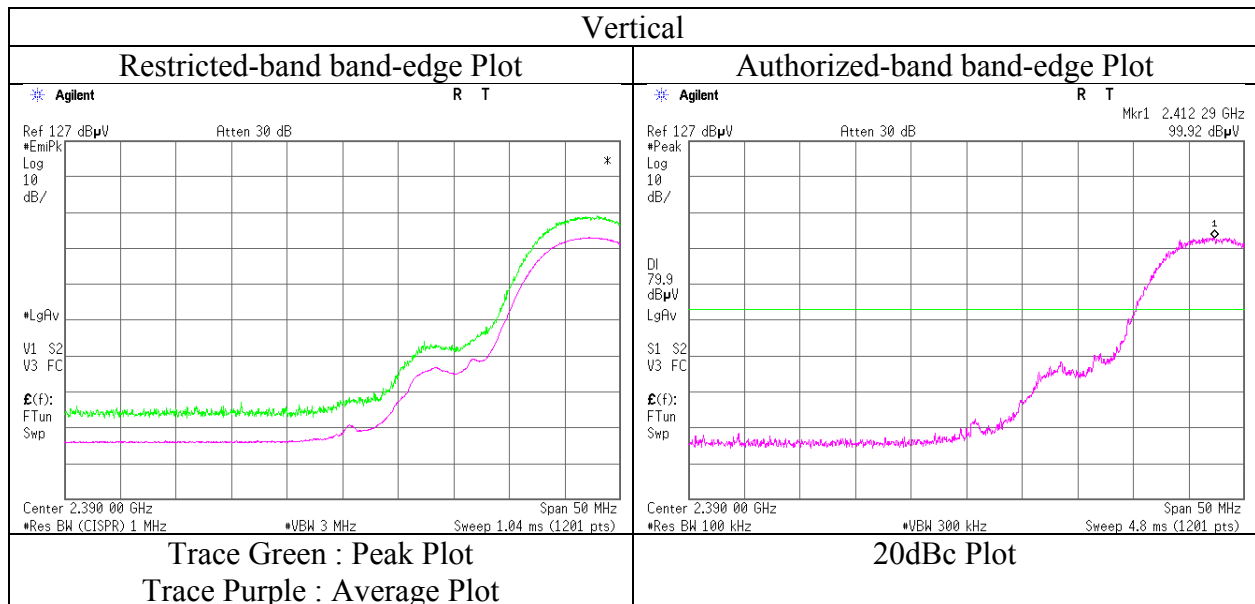
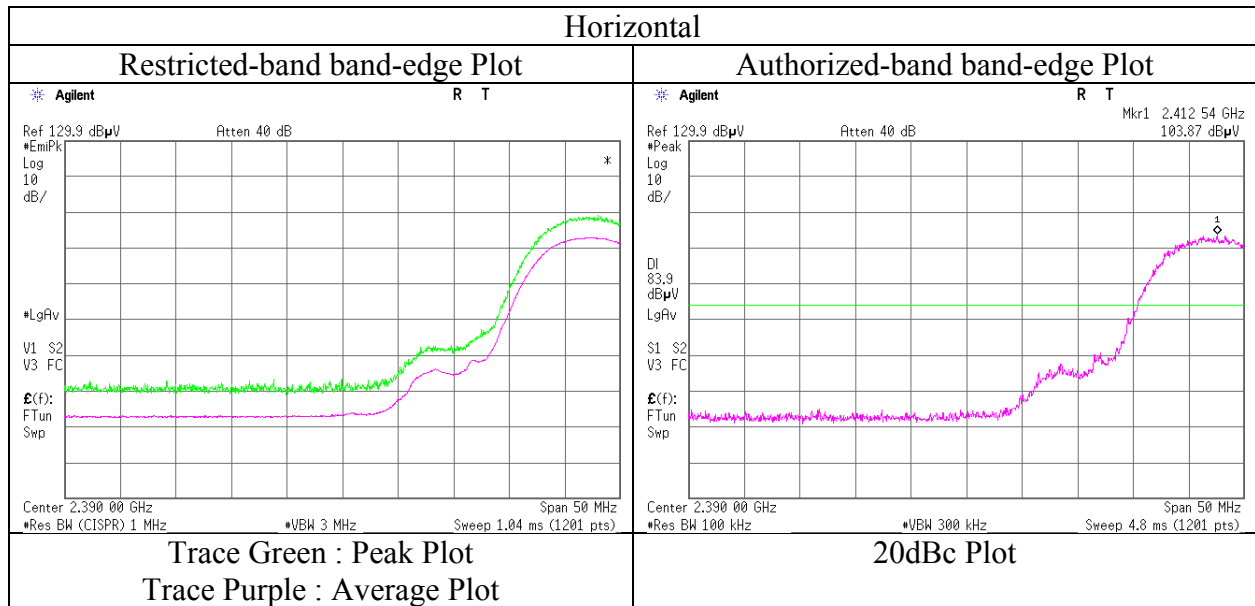
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11500824H
Date	November 21, 2016
Temperature / Humidity	24deg. C / 46 % RH
Engineer	Tomoki Matsui (1 GHz-10 GHz)
Mode	Tx 11b 2412 MHz



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

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11500824H
Date : November 21, 2016 November 23, 2016
Temperature / Humidity : 24deg. C / 46 % RH 21deg. C / 47 % RH
Engineer : Tomoki Matsui Keisuke Kawamura
 (1 GHz-10 GHz) (Above 10GHz)
Mode : Tx 11b 2437 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4874.000	PK	39.0	31.2	9.1	31.7	-	47.6	73.9	26.3	Floor noise
Hori	7311.000	PK	39.1	35.6	10.4	32.6	-	52.5	73.9	21.4	Floor noise
Hori	9748.000	PK	39.3	37.2	11.0	33.3	-	54.2	73.9	19.7	Floor noise
Hori	4874.000	AV	29.8	31.2	9.1	31.7	-	38.4	53.9	15.5	Floor noise
Hori	7311.000	AV	30.9	35.6	10.4	32.6	-	44.3	53.9	9.6	Floor noise
Hori	9748.000	AV	30.3	37.2	11.0	33.3	-	45.2	53.9	8.7	Floor noise
Vert	4874.000	PK	38.5	31.2	9.1	31.7	-	47.1	73.9	26.8	Floor noise
Vert	7311.000	PK	39.5	35.6	10.4	32.6	-	52.9	73.9	21.0	Floor noise
Vert	9748.000	PK	39.4	37.2	11.0	33.3	-	54.3	73.9	19.6	Floor noise
Vert	4874.000	AV	30.1	31.2	9.1	31.7	-	38.7	53.9	15.2	Floor noise
Vert	7311.000	AV	30.8	35.6	10.4	32.6	-	44.2	53.9	9.7	Floor noise
Vert	9748.000	AV	30.5	37.2	11.0	33.3	-	45.4	53.9	8.5	Floor noise

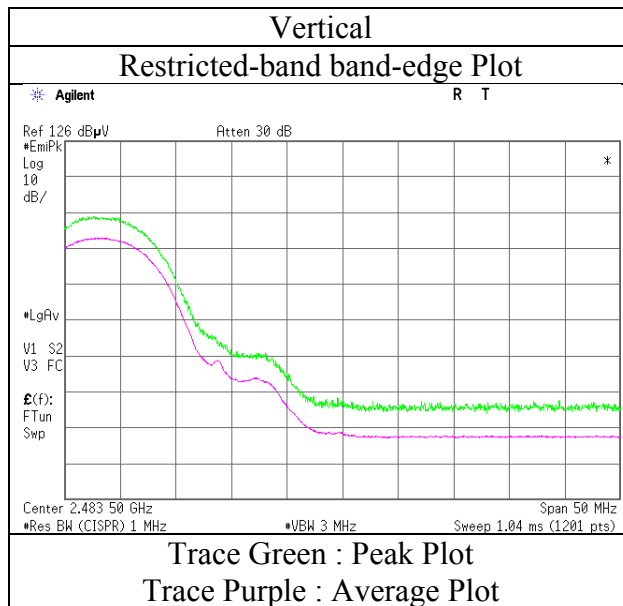
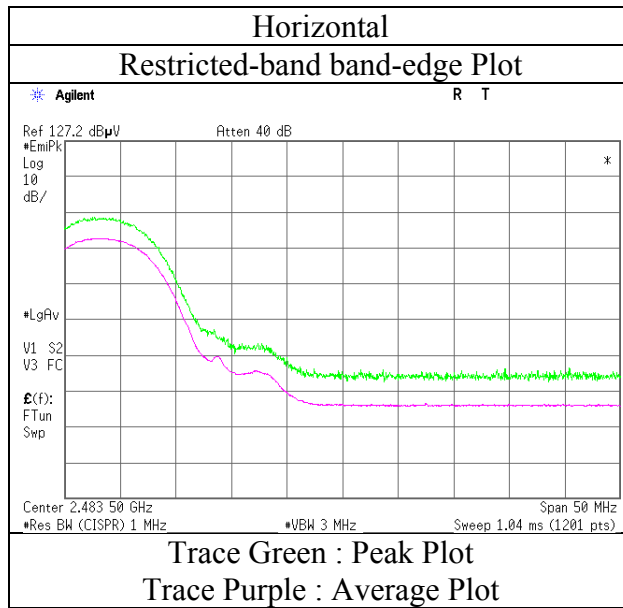
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

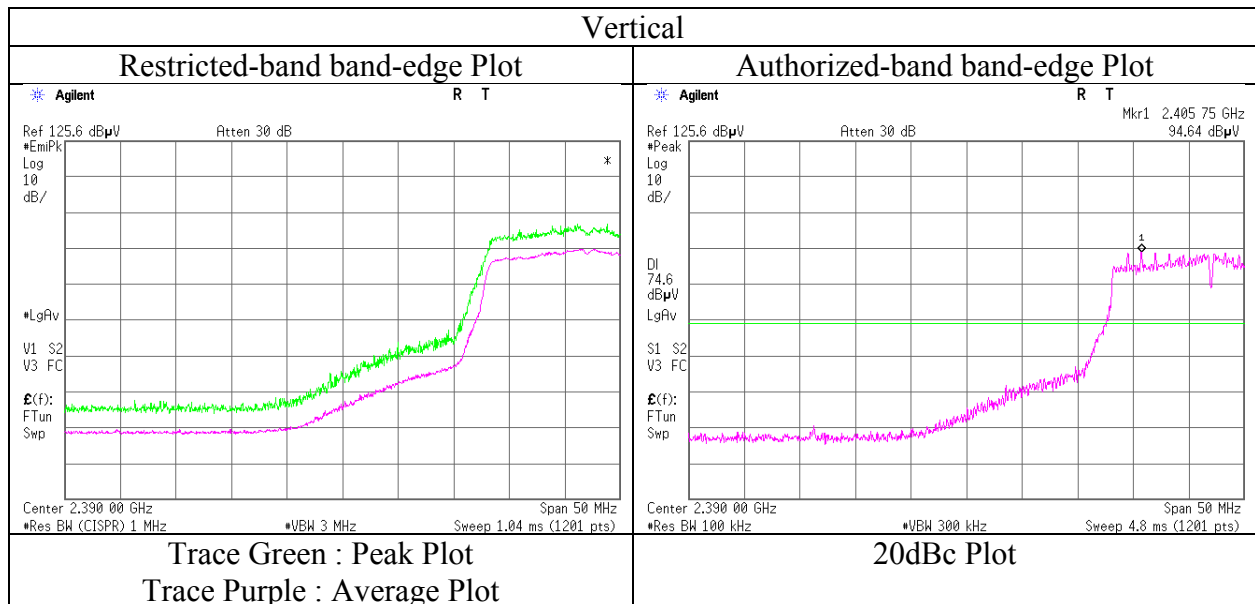
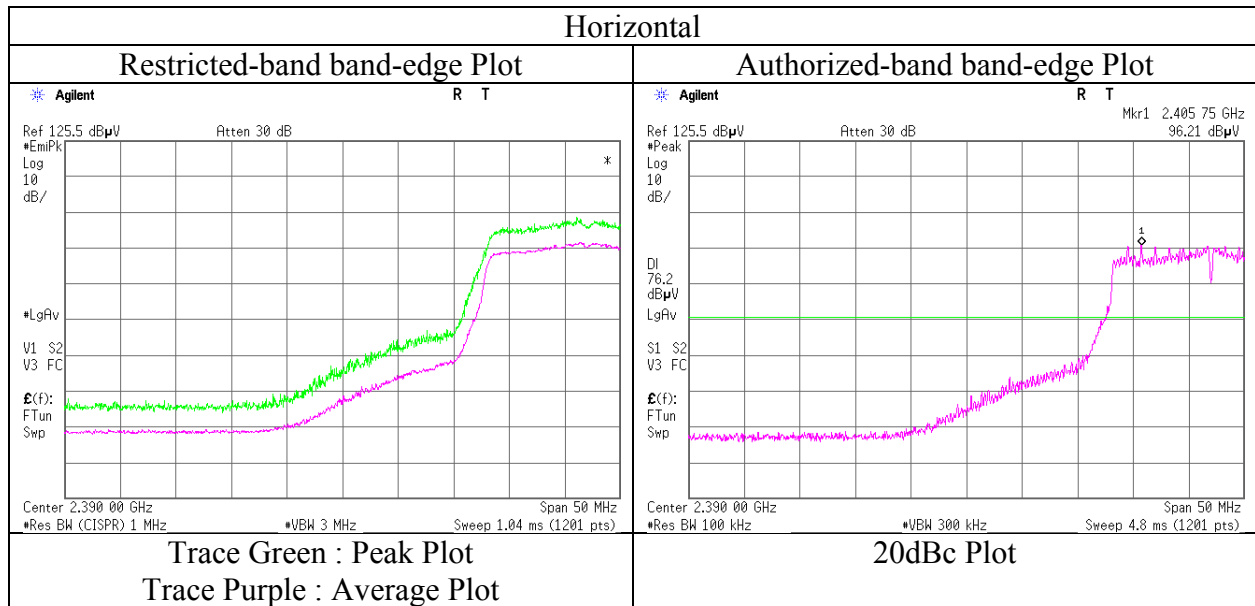
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11500824H
Date	November 21, 2016
Temperature / Humidity	24deg. C / 46 % RH
Engineer	Tomoki Matsui
	(1 GHz-10 GHz)
Mode	Tx 11b 2462 MHz



* 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.3 Semi Anechoic Chamber
Report No.	11500824H
Date	November 21, 2016
Temperature / Humidity	24deg. C / 46 % RH
Engineer	Tomoki Matsui
	(1 GHz-10 GHz)
Mode	Tx 11n-20 2412 MHz



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

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11500824H
Date : November 21, 2016 November 23, 2016
Temperature / Humidity : 24deg. C / 46 % RH 21deg. C / 47 % RH
Engineer : Tomoki Matsui Keisuke Kawamura
(1 GHz-10 GHz) (Above 10GHz)
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	4874.000	PK	39.0	31.2	9.1	31.7	-	47.6	73.9	26.3	Floor noise
Hori	7311.000	PK	39.1	35.6	10.4	32.6	-	52.5	73.9	21.4	Floor noise
Hori	9748.000	PK	39.3	37.2	11.0	33.3	-	54.2	73.9	19.7	Floor noise
Hori	4874.000	AV	29.8	31.2	9.1	31.7	-	38.4	53.9	15.5	Floor noise
Hori	7311.000	AV	30.9	35.6	10.4	32.6	-	44.3	53.9	9.6	Floor noise
Hori	9748.000	AV	30.3	37.2	11.0	33.3	-	45.2	53.9	8.7	Floor noise
Vert	4874.000	PK	38.5	31.2	9.1	31.7	-	47.1	73.9	26.8	Floor noise
Vert	7311.000	PK	39.5	35.6	10.4	32.6	-	52.9	73.9	21.0	Floor noise
Vert	9748.000	PK	39.4	37.2	11.0	33.3	-	54.3	73.9	19.6	Floor noise
Vert	4874.000	AV	30.1	31.2	9.1	31.7	-	38.7	53.9	15.2	Floor noise
Vert	7311.000	AV	30.8	35.6	10.4	32.6	-	44.2	53.9	9.7	Floor noise
Vert	9748.000	AV	30.5	37.2	11.0	33.3	-	45.4	53.9	8.5	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 $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.53\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11500824H
Date : November 21, 2016 November 23, 2016 November 23, 2016
Temperature / Humidity : 24deg. C / 46 % RH 21deg. C / 47 % RH 25deg. C / 39 % RH
Engineer : Tomoki Matsui Keisuke Kawamura Tomoki Matsui
(1 GHz-10 GHz) (Above 10GHz) (Below 1GHz)
Mode : Tx 11n-20 2462 MHz

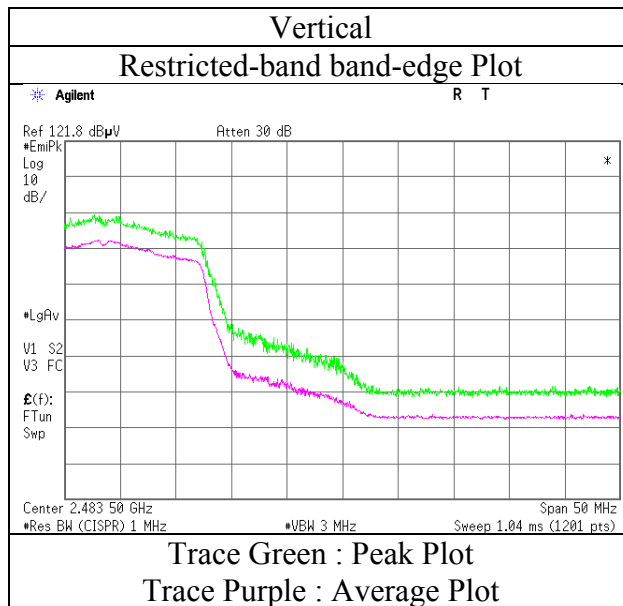
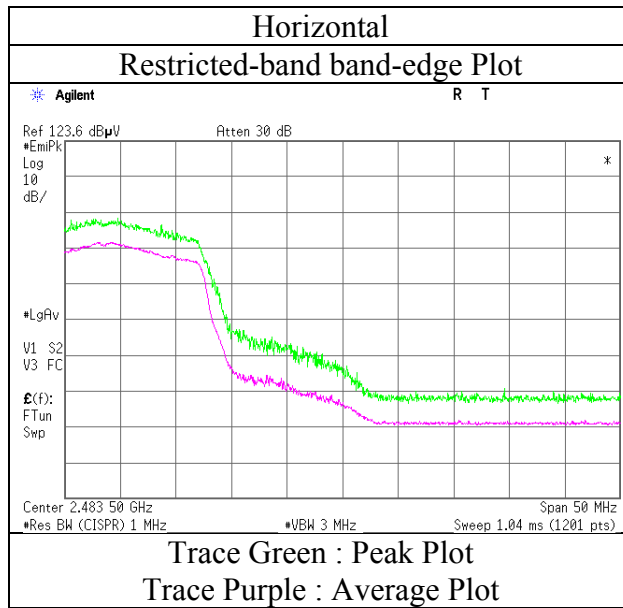
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	216.000	QP	49.5	11.8	9.2	32.0	-	38.5	43.5	5.0	
Hori	242.999	QP	49.4	12.4	9.4	32.0	-	39.2	46.0	6.8	
Hori	300.000	QP	49.3	13.5	9.9	31.9	-	40.8	46.0	5.2	
Hori	500.000	QP	42.0	17.6	11.3	32.0	-	38.9	46.0	7.1	
Hori	550.000	QP	41.1	18.4	11.6	32.0	-	39.1	46.0	6.9	
Hori	891.000	QP	39.0	22.0	13.4	31.0	-	43.4	46.0	2.6	
Hori	2483.500	PK	61.3	26.8	7.0	32.6	-	62.5	73.9	11.4	
Hori	4924.000	PK	39.8	31.4	9.1	31.7	-	48.6	73.9	25.3	Floor noise
Hori	7386.000	PK	39.6	35.5	10.3	32.7	-	52.7	73.9	21.2	Floor noise
Hori	9848.000	PK	39.6	37.2	11.1	33.3	-	54.6	73.9	19.3	Floor noise
Hori	2483.500	AV	46.6	26.8	7.0	32.6	2.2	50.0	53.9	3.9	*1)
Hori	4924.000	AV	29.5	31.4	9.1	31.7	-	38.3	53.9	15.6	Floor noise
Hori	7386.000	AV	30.4	35.5	10.3	32.7	-	43.5	53.9	10.4	Floor noise
Hori	9848.000	AV	30.8	37.2	11.1	33.3	-	45.8	53.9	8.1	Floor noise
Vert	88.000	QP	45.7	8.2	7.9	32.2	-	29.6	40.0	10.4	
Vert	216.000	QP	47.7	11.8	9.2	32.0	-	36.7	43.5	6.8	
Vert	242.999	QP	47.6	12.4	9.4	32.0	-	37.4	46.0	8.6	
Vert	300.000	QP	45.6	13.5	9.9	31.9	-	37.1	46.0	8.9	
Vert	550.000	QP	37.6	18.4	11.6	32.0	-	35.6	46.0	10.4	
Vert	891.000	QP	35.4	22.0	13.4	31.0	-	39.8	46.0	6.2	
Vert	2483.500	PK	59.9	26.8	7.0	32.6	-	61.1	73.9	12.8	
Vert	4924.000	PK	39.8	31.4	9.1	31.7	-	48.6	73.9	25.3	Floor noise
Vert	7386.000	PK	39.8	35.5	10.3	32.7	-	52.9	73.9	21.0	Floor noise
Vert	9848.000	PK	39.6	37.2	11.1	33.3	-	54.6	73.9	19.3	Floor noise
Vert	2483.500	AV	45.6	26.8	7.0	32.6	2.2	49.0	53.9	4.9	*1)
Vert	4924.000	AV	29.6	31.4	9.1	31.7	-	38.4	53.9	15.5	Floor noise
Vert	7386.000	AV	30.5	35.5	10.3	32.7	-	43.6	53.9	10.3	Floor noise
Vert	9848.000	AV	30.9	37.2	11.1	33.3	-	45.9	53.9	8.0	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(4.5 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)

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11500824H
Date	November 21, 2016
Temperature / Humidity	24deg. C / 46 % RH
Engineer	Tomoki Matsui
	(1 GHz-10 GHz)
Mode	Tx 11n-20 2462 MHz



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

Radiated Spurious Emission

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. 11500824H
Date November 21, 2016 November 23, 2016 November 24, 2016
Temperature / Humidity 23 deg. C / 45 % RH 21deg. C / 47 % RH 25deg. C / 32 % RH
Engineer Ryota Yamanaka Keisuke Kawamura Tomoki Matsui
(1 GHz -10 GHz) (Above 10GHz) (Below 1GHz)
Mode Tx BT LE 2402MHz

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	150.000	QP	38.3	15.1	8.6	32.1	-	29.9	43.5	13.6	
Hori	215.999	QP	49.3	11.8	9.2	32.0	-	38.3	43.5	5.2	
Hori	250.000	QP	51.1	12.5	9.5	32.0	-	41.1	46.0	4.9	
Hori	350.000	QP	44.8	14.6	10.3	31.9	-	37.8	46.0	8.2	
Hori	550.000	QP	39.7	18.4	11.6	32.0	-	37.7	46.0	8.3	
Hori	891.000	QP	37.4	22.0	13.4	31.0	-	41.8	46.0	4.2	
Hori	2390.000	PK	41.3	26.7	6.9	32.7	-	42.2	73.9	31.7	
Hori	4804.000	PK	39.2	31.0	9.1	31.8	-	47.5	73.9	26.4	Floor noise
Hori	7206.000	PK	40.7	35.7	10.4	32.6	-	54.2	73.9	19.7	Floor noise
Hori	9608.000	PK	40.5	37.2	11.0	33.2	-	55.5	73.9	18.4	Floor noise
Hori	2390.000	AV	31.1	26.7	6.9	32.7	3.6	35.6	53.9	18.3	*1)
Hori	4804.000	AV	29.6	31.0	9.1	31.8	-	37.9	53.9	16.0	Floor noise
Hori	7206.000	AV	30.4	35.7	10.4	32.6	-	43.9	53.9	10.0	Floor noise
Hori	9608.000	AV	30.0	37.2	11.0	33.2	-	45.0	53.9	8.9	Floor noise
Vert	53.428	QP	47.6	9.6	7.4	32.2	-	32.4	40.0	7.6	
Vert	111.190	QP	48.5	11.6	8.2	32.2	-	36.1	43.5	7.4	
Vert	215.999	QP	48.4	11.8	9.2	32.0	-	37.4	43.5	6.1	
Vert	250.000	QP	47.7	12.5	9.5	32.0	-	37.7	46.0	8.3	
Vert	350.000	QP	46.5	14.6	10.3	31.9	-	39.5	46.0	6.5	
Vert	891.000	QP	36.6	22.0	13.4	31.0	-	41.0	46.0	5.0	
Vert	2390.000	PK	41.3	26.7	6.9	32.7	-	42.2	73.9	31.7	
Vert	4804.000	PK	40.2	31.0	9.1	31.8	-	48.5	73.9	25.4	Floor noise
Vert	7206.000	PK	41.5	35.7	10.4	32.6	-	55.0	73.9	18.9	Floor noise
Vert	9608.000	PK	40.7	37.2	11.0	33.2	-	55.7	73.9	18.2	Floor noise
Vert	2390.000	AV	31.4	26.7	6.9	32.7	3.6	35.9	53.9	18.0	*1)
Vert	4804.000	AV	29.3	31.0	9.1	31.8	-	37.6	53.9	16.3	Floor noise
Vert	7206.000	AV	30.2	35.7	10.4	32.6	-	43.7	53.9	10.2	Floor noise
Vert	9608.000	AV	30.8	37.2	11.0	33.2	-	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(4.5 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	2402.000	PK	97.9	26.7	6.9	32.7	98.8	-	-	Carrier
Hori	2400.000	PK	41.9	26.7	6.9	32.7	42.8	78.8	36.0	
Vert	2402.000	PK	95.3	26.7	6.9	32.7	96.2	-	-	Carrier
Vert	2400.000	PK	40.3	26.7	6.9	32.7	41.2	76.2	35.0	

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

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Ise EMC Lab.

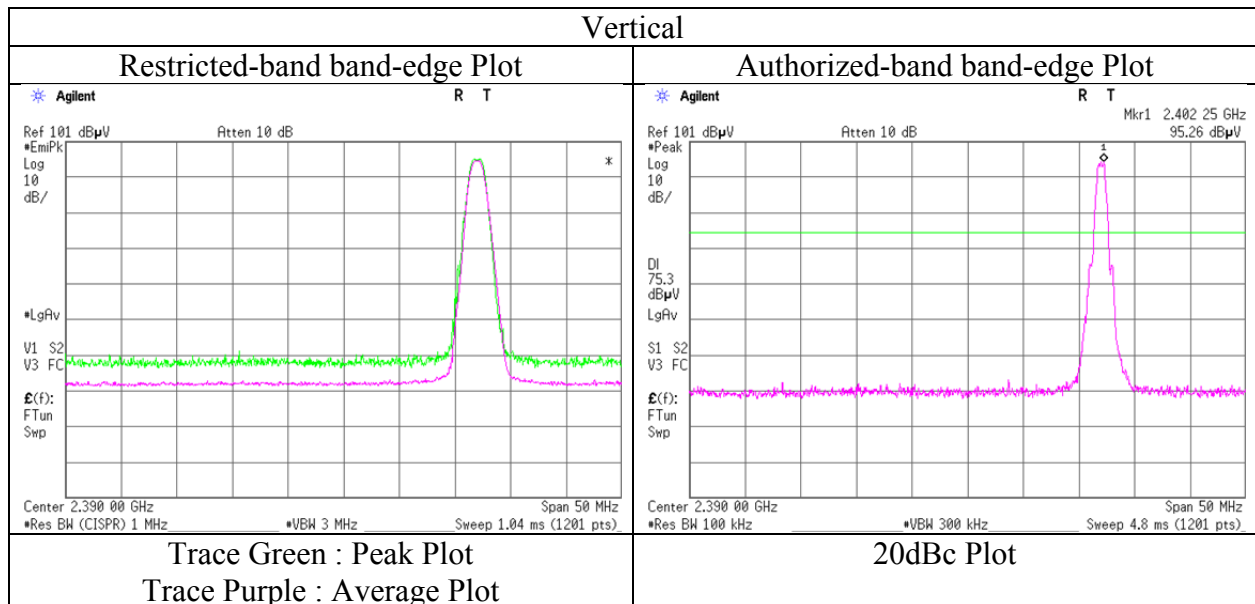
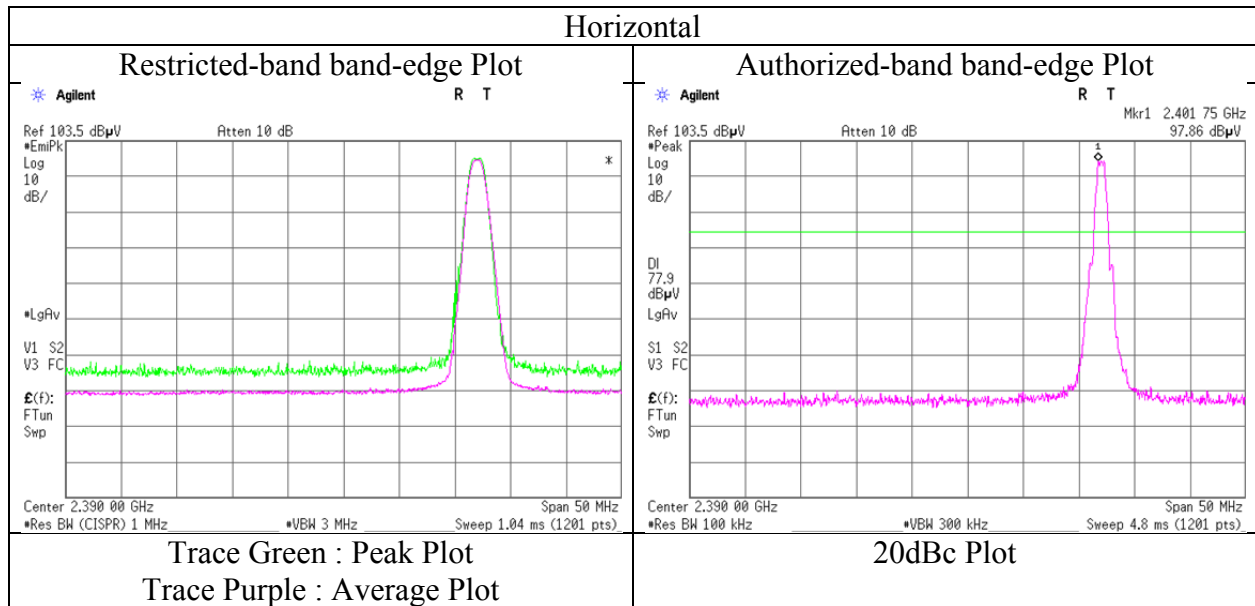
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11500824H
Date : November 21, 2016
Temperature / Humidity : 23 deg. C / 45 % RH
Engineer : Ryota Yamanaka
(1 GHz -10 GHz)
Mode : Tx BT LE 2402MHz



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

UL Japan, Inc.

Ise EMC Lab.

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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11500824H
Date : November 21, 2016 November 23, 2016 November 24, 2016
Temperature / Humidity : 23 deg. C / 45 % RH 21deg. C / 47 % RH 25deg. C / 32 % RH
Engineer : Ryota Yamanaka Keisuke Kawamura Tomoki Matsui
 (1 GHz -10 GHz) (Above 10GHz) (Below 1GHz)
Mode : Tx BT LE 2440MHz

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	150.000	QP	37.9	15.1	8.6	32.1	-	29.5	43.5	14.0	
Hori	215.999	QP	49.1	11.8	9.2	32.0	-	38.1	43.5	5.4	
Hori	250.000	QP	50.5	12.5	9.5	32.0	-	40.5	46.0	5.5	
Hori	350.000	QP	46.3	14.6	10.3	31.9	-	39.3	46.0	6.7	
Hori	550.000	QP	37.7	18.4	11.6	32.0	-	35.7	46.0	10.3	
Hori	891.000	QP	36.3	22.0	13.4	31.0	-	40.7	46.0	5.3	
Hori	4880.000	PK	40.2	31.3	9.1	31.7	-	48.9	73.9	25.0	Floor noise
Hori	7320.000	PK	41.0	35.6	10.3	32.6	-	54.3	73.9	19.6	Floor noise
Hori	9760.000	PK	40.2	37.2	11.0	33.3	-	55.1	73.9	18.8	Floor noise
Hori	4880.000	AV	31.4	31.3	9.1	31.7	-	40.1	53.9	13.8	Floor noise
Hori	7320.000	AV	32.6	35.6	10.3	32.6	-	45.9	53.9	8.0	Floor noise
Hori	9760.000	AV	32.3	37.2	11.0	33.3	-	47.2	53.9	6.7	Floor noise
Vert	51.985	QP	48.1	10.1	7.4	32.2	-	33.4	40.0	6.6	
Vert	111.174	QP	48.5	11.6	8.2	32.2	-	36.1	43.5	7.4	
Vert	215.999	QP	48.1	11.8	9.2	32.0	-	37.1	43.5	6.4	
Vert	250.000	QP	44.5	12.5	9.5	32.0	-	34.5	46.0	11.5	
Vert	350.000	QP	45.0	14.6	10.3	31.9	-	38.0	46.0	8.0	
Vert	891.000	QP	35.7	22.0	13.4	31.0	-	40.1	46.0	5.9	
Vert	4880.000	PK	40.3	31.3	9.1	31.7	-	49.0	73.9	24.9	Floor noise
Vert	7320.000	PK	41.0	35.6	10.3	32.6	-	54.3	73.9	19.6	Floor noise
Vert	9760.000	PK	40.2	37.2	11.0	33.3	-	55.1	73.9	18.8	Floor noise
Vert	4880.000	AV	31.5	31.3	9.1	31.7	-	40.2	53.9	13.7	Floor noise
Vert	7320.000	AV	32.7	35.6	10.3	32.6	-	46.0	53.9	7.9	Floor noise
Vert	9760.000	AV	32.2	37.2	11.0	33.3	-	47.1	53.9	6.8	Floor noise

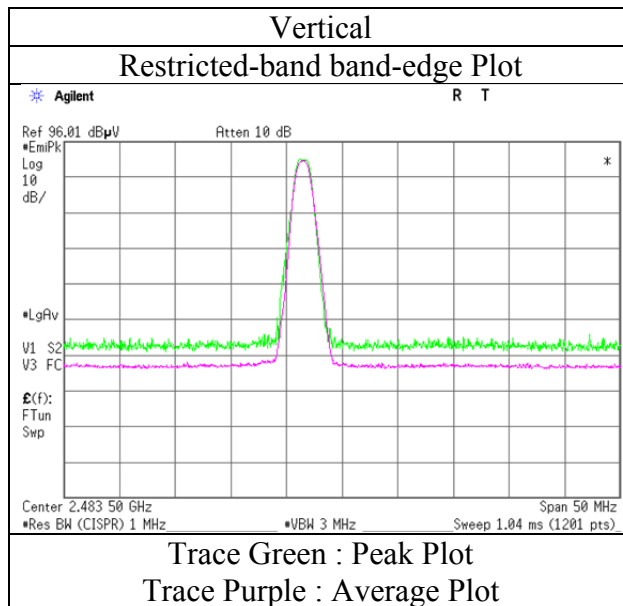
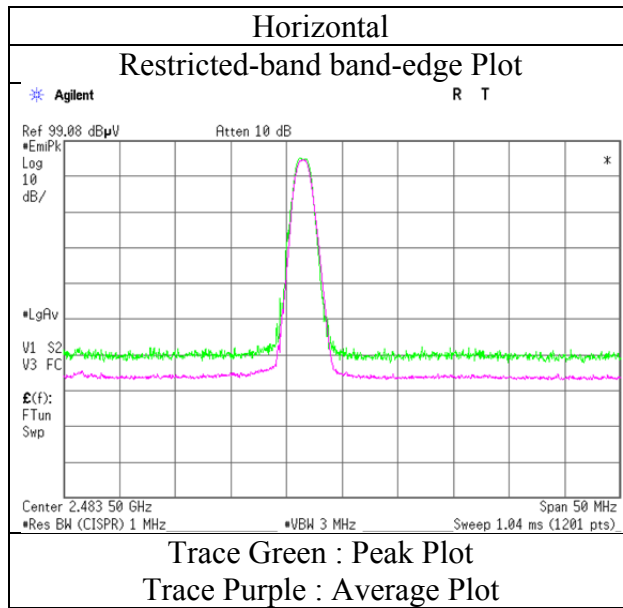
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

*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

Radiated Spurious Emission
(Reference Plot for band-edge)

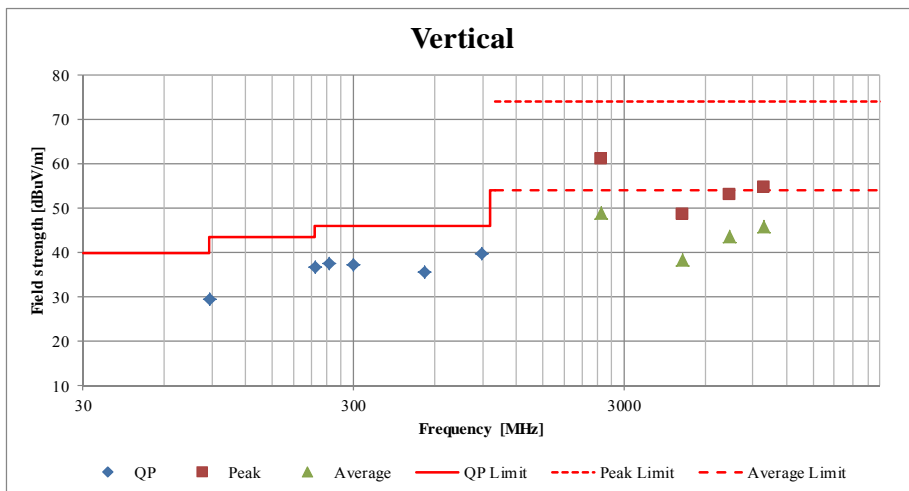
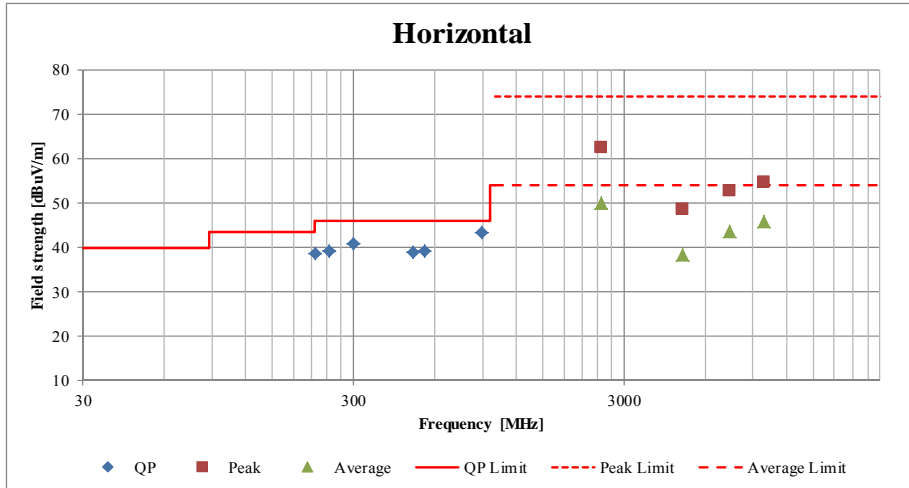
Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 11500824H
Date : November 21, 2016
Temperature / Humidity : 23 deg. C / 45 % RH
Engineer : Ryota Yamanaka
(1 GHz -10 GHz)
Mode : Tx BT LE 2480MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

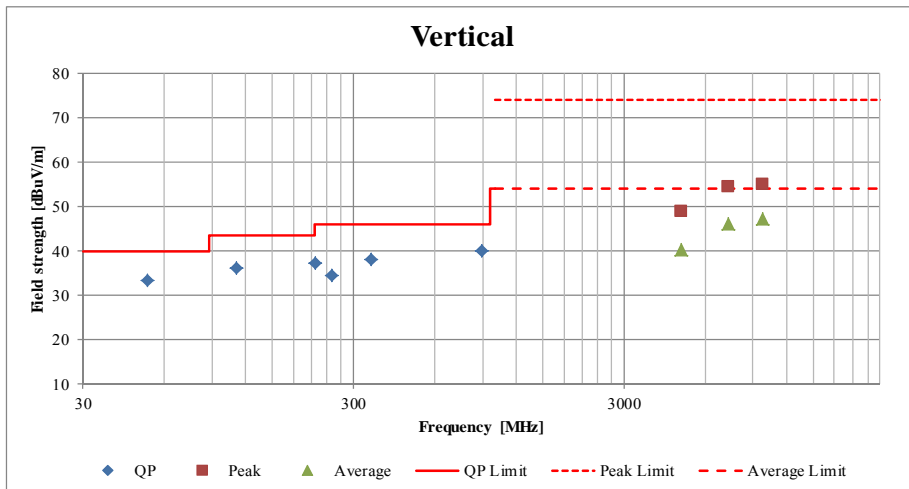
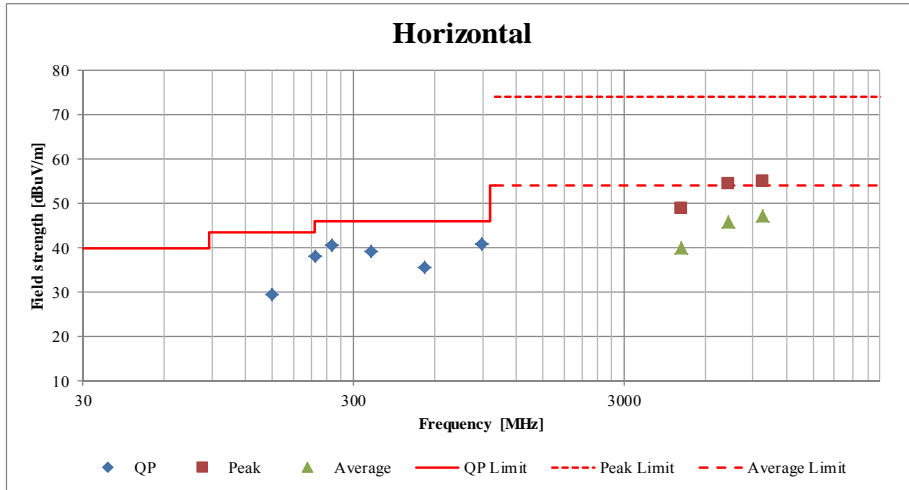
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber		
Report No.	11500824H		
Date	November 21, 2016	November 23, 2016	November 23, 2016
Temperature / Humidity	24deg. C / 46 % RH	21deg. C / 47 % RH	25deg. C / 39 % RH
Engineer	Tomoki Matsui	Keisuke Kawamura	Tomoki Matsui
	(1 GHz-10 GHz)	(Above 10GHz)	(Below 1GHz)
Mode	Tx 11n-20 2462 MHz		



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

Radiated Spurious Emission
(Plot data, Worst case)

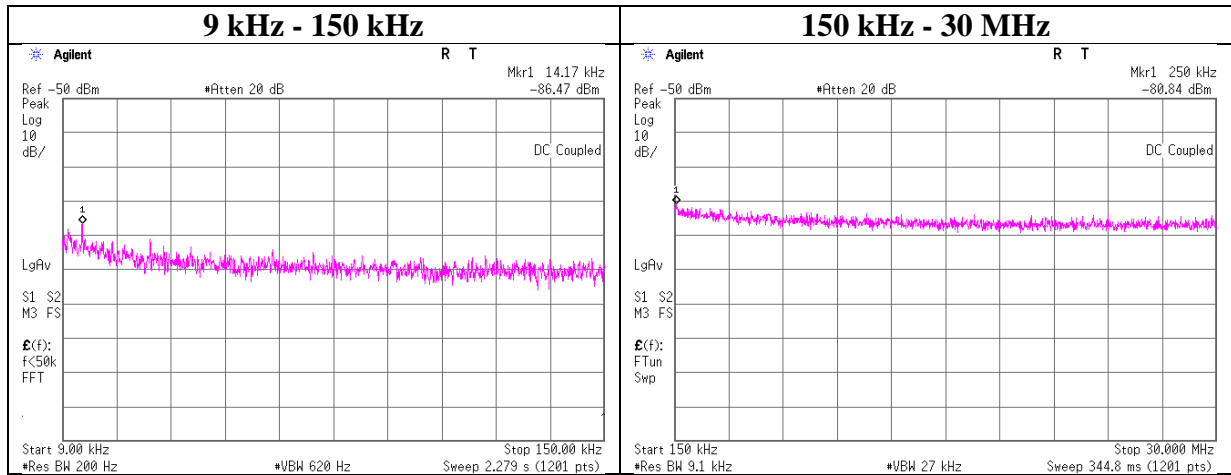
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber		
Report No.	11500824H		
Date	November 21, 2016	November 23, 2016	November 24, 2016
Temperature / Humidity	23 deg. C / 45 % RH	21deg. C / 47 % RH	25deg. C / 32 % RH
Engineer	Ryota Yamanaka (1 GHz -10 GHz)	Keisuke Kawamura (Above 10GHz)	Tomoki Matsui (Below 1GHz)
Mode	Tx BT LE 2440MHz		



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

Conducted Spurious Emission

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11500824H
Date	November 9, 2016
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Koji Yamamoto
Mode	Tx 11n-20 2462 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
14.17	-86.5	0.10	10.0	2.0	1	-74.4	300	6.0	-13.1	44.5	57.6	
250.00	-80.8	0.12	10.0	2.0	1	-68.7	300	6.0	-7.5	19.6	27.1	

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

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

* 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.

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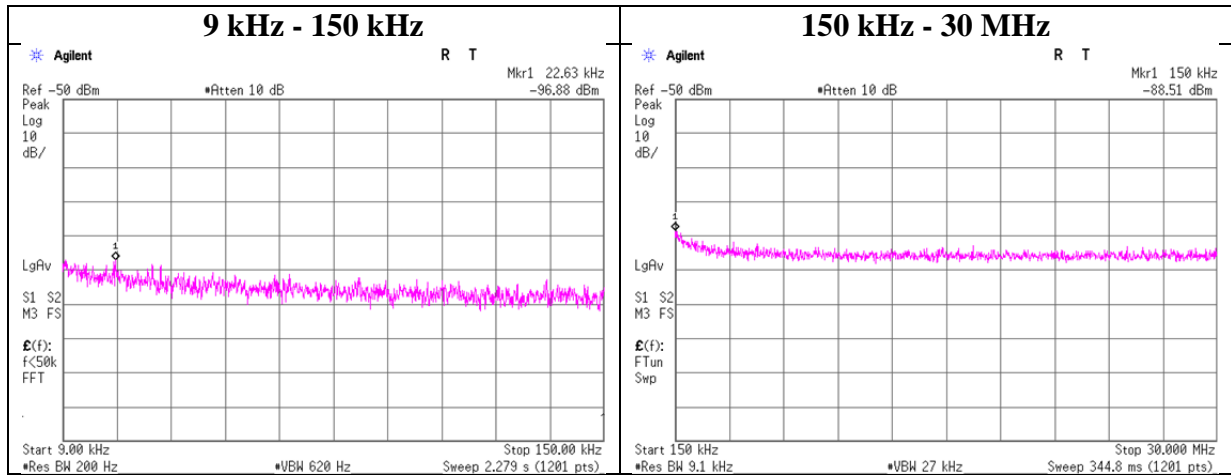
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Conducted Spurious Emission

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11500824H
Date	December 6, 2016
Temperature / Humidity	23 deg. C / 46 % RH
Engineer	Ryota Yamanaka
Mode	Tx BT LE 2402 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
22.63	-96.9	0.06	9.8	2.0	1	-85.0	300	6.0	-23.7	40.5	64.2	
150.00	-88.5	0.06	9.8	2.0	1	-76.6	300	6.0	-15.4	24.0	39.4	

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

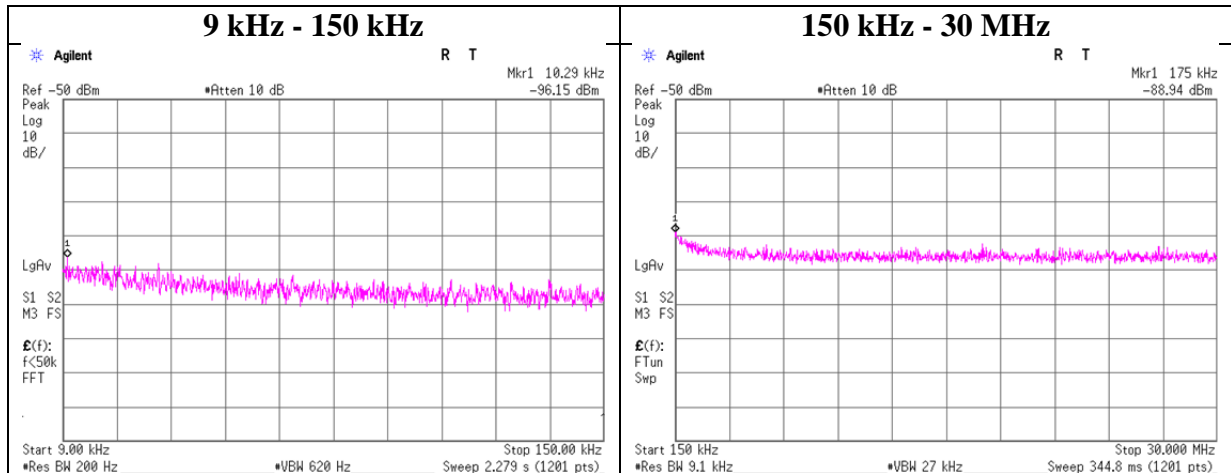
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

* 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.

Conducted Spurious Emission

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11500824H
Date	December 6, 2016
Temperature / Humidity	23 deg. C / 46 % RH
Engineer	Ryota Yamanaka
Mode	Tx BT LE 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.29	-96.2	0.06	9.8	2.0	1	-84.3	300	6.0	-23.0	47.3	70.3	
175.00	-88.9	0.06	9.8	2.0	1	-77.0	300	6.0	-15.8	22.7	38.5	

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

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

* 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.

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Ise EMC Lab.

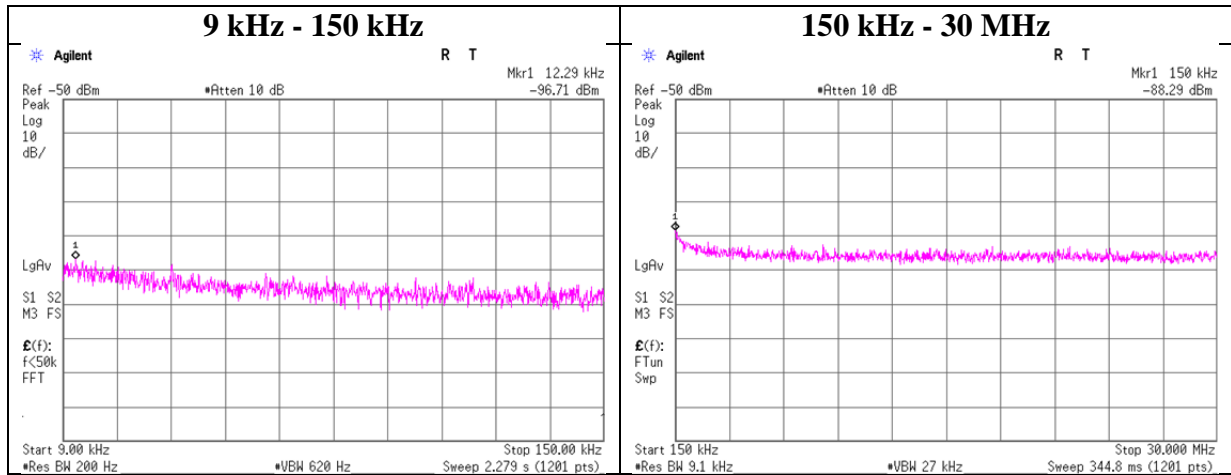
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11500824H
Date	December 6, 2016
Temperature / Humidity	23 deg. C / 46 % RH
Engineer	Ryota Yamanaka
Mode	Tx BT LE 2480 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
12.29	-96.7	0.06	9.8	2.0	1	-84.8	300	6.0	-23.6	45.8	69.4	
150.00	-88.3	0.06	9.8	2.0	1	-76.4	300	6.0	-15.1	24.0	39.1	

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

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

* 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.

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Ise EMC Lab.

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Facsimile : +81 596 24 8124

Power Density

Test place Ise EMC Lab. No.3 Measurement Room
Report No. 11500824H
Date November 9, 2016 November 25, 2016
Temperature / Humidity 23 deg. C / 38 % RH 24 deg. C / 45 % RH
Engineer Koji Yamamoto Ryota Yamanaka
Mode Tx

11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-16.54	1.12	10.06	-5.36	8.00	13.36
2437.00	-15.82	1.13	10.06	-4.63	8.00	12.63
2462.00	-15.95	1.14	10.06	-4.75	8.00	12.75

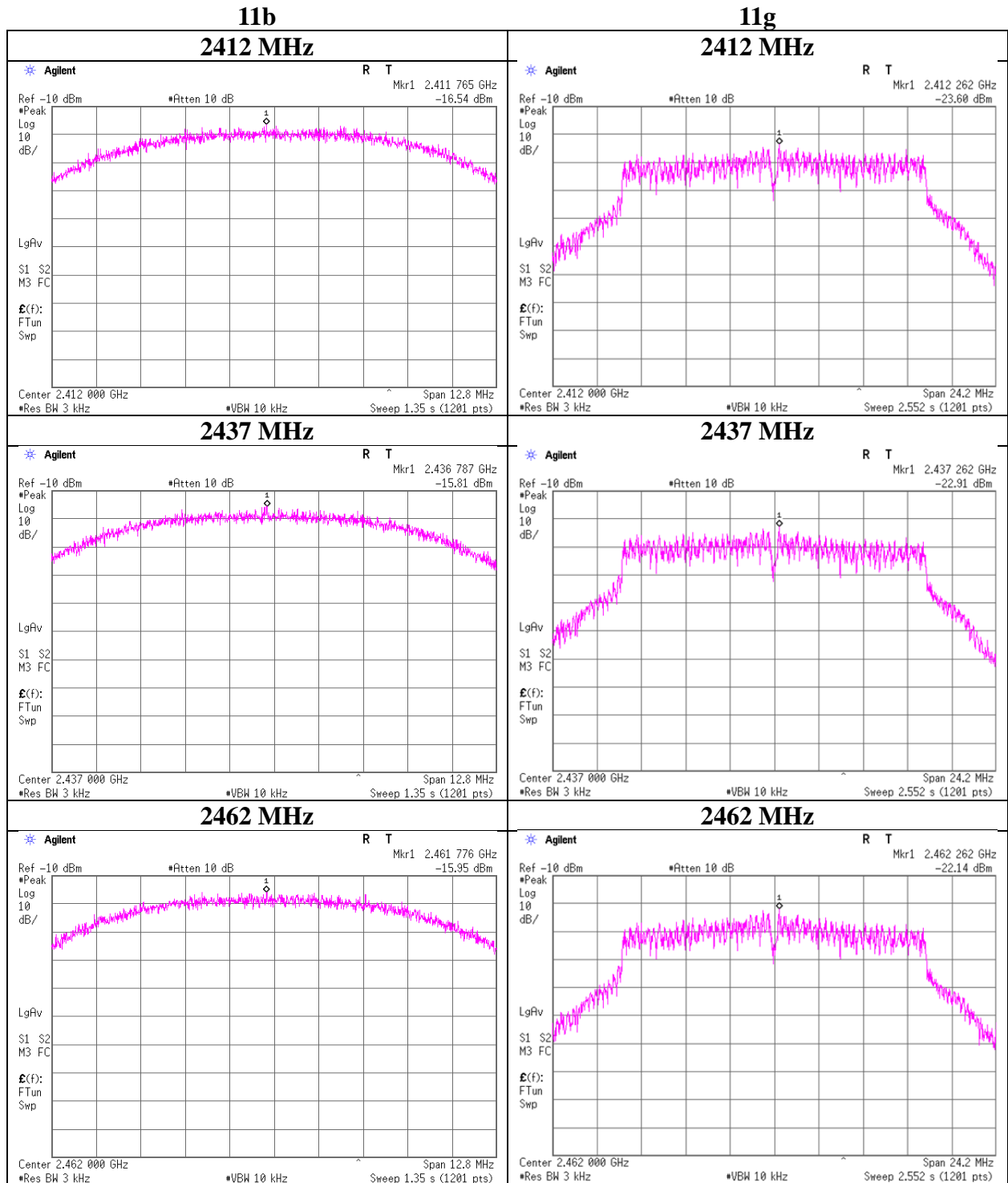
11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-23.54	1.12	10.06	-12.36	8.00	20.36
2437.00	-22.91	1.13	10.06	-11.72	8.00	19.72
2462.00	-22.14	1.14	10.06	-10.94	8.00	18.94

Sample Calculation:

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

Power Density



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Power Density

Test place	Ise EMC Lab. No.3 Measurement Room	
Report No.	11500824H	
Date	November 9, 2016	November 25, 2016
Temperature / Humidity	23 deg. C / 38 % RH	24 deg. C / 45 % RH
Engineer	Koji Yamamoto	Ryota Yamanaka
Mode	Tx	

11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-24.63	1.12	10.06	-13.45	8.00	21.45
2437.00	-23.27	1.13	10.06	-12.08	8.00	20.08
2462.00	-22.55	1.14	10.06	-11.35	8.00	19.35

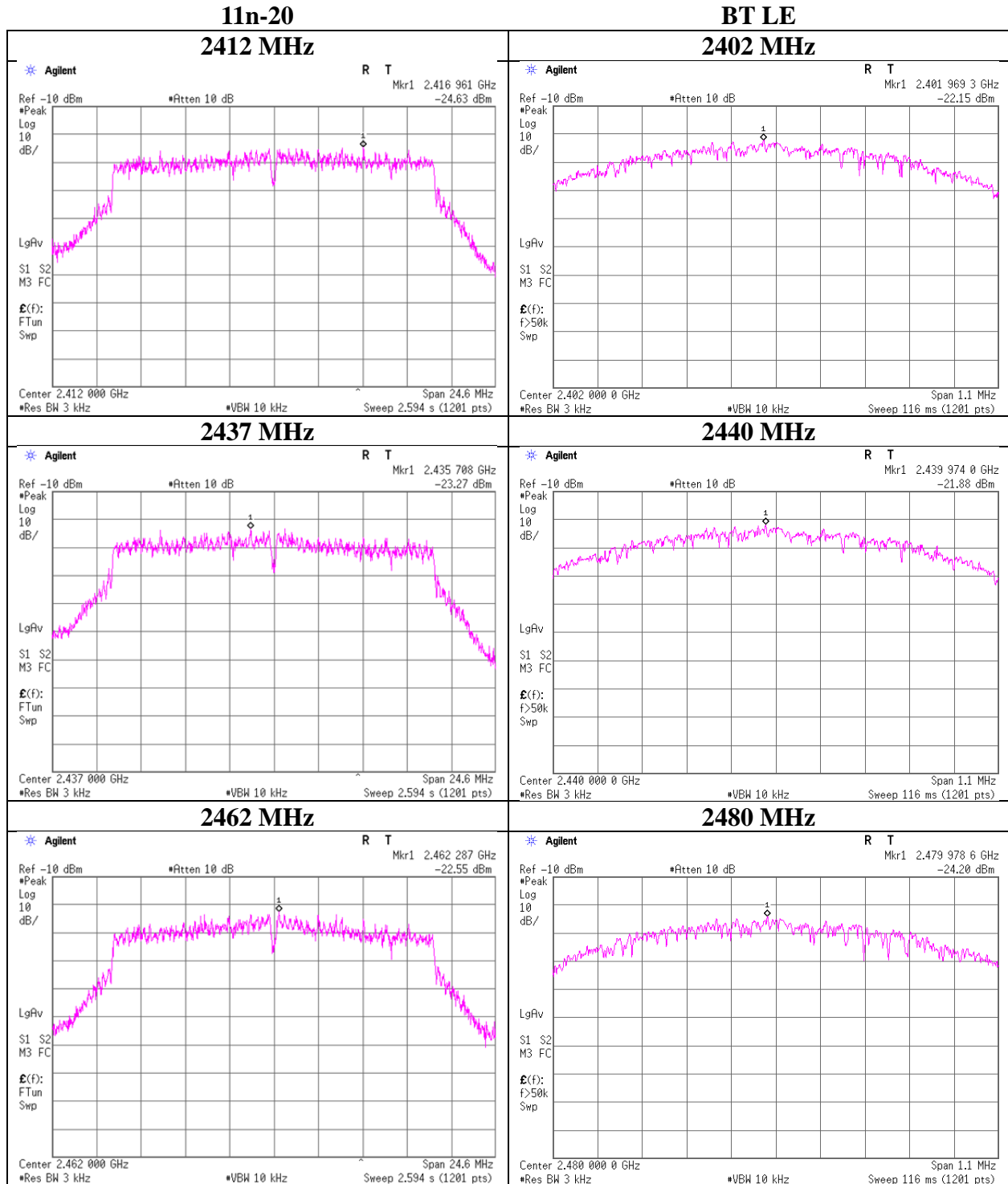
BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-22.15	1.12	10.06	-10.97	8.00	18.97
2440.00	-21.88	1.13	10.06	-10.69	8.00	18.69
2480.00	-24.20	1.14	10.06	-13.00	8.00	21.00

Sample Calculation:

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

Power Density



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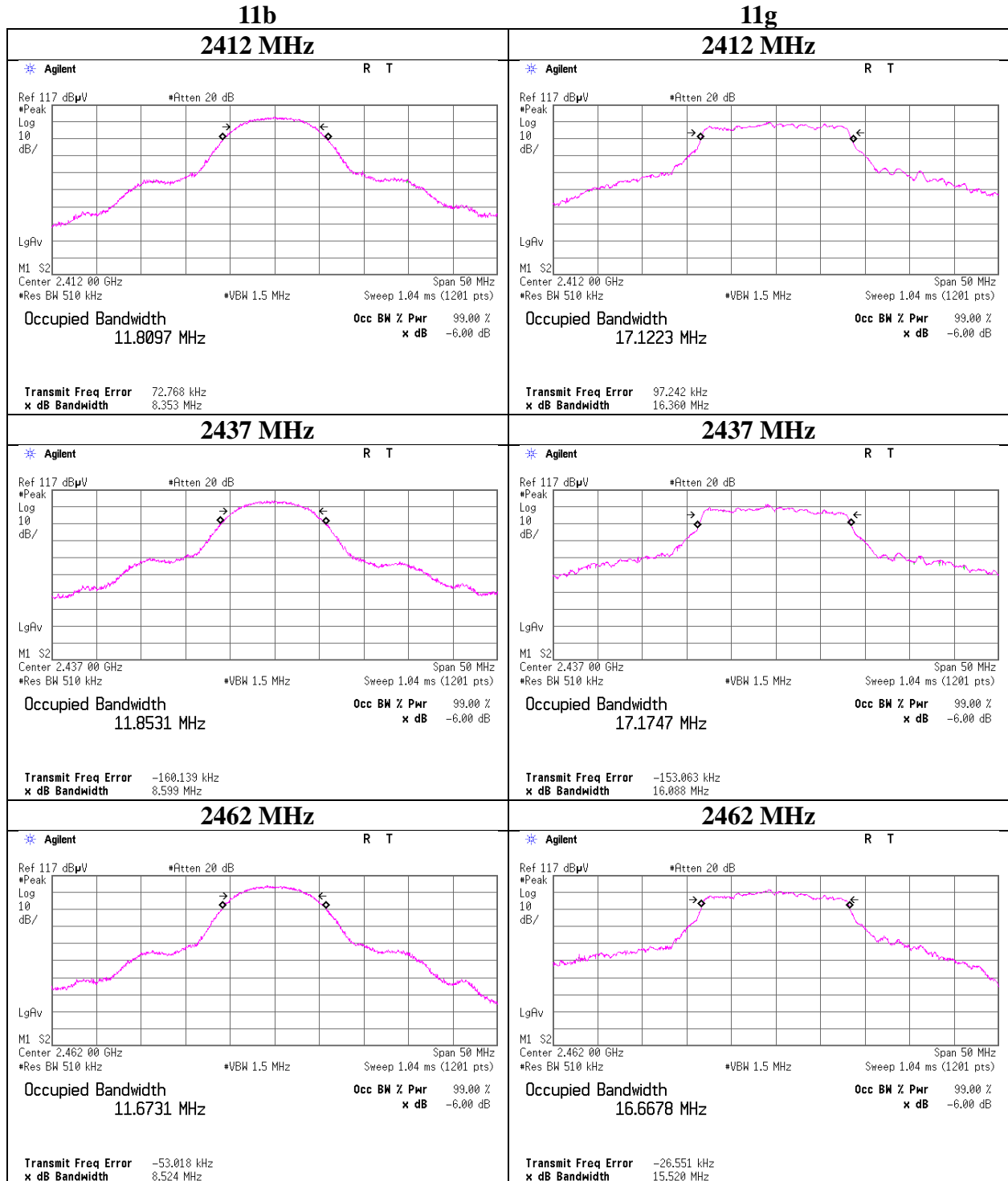
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99% Occupied Bandwidth

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11500824H
Date	November 9, 2016
Temperature / Humidity	23 deg. C / 38 % RH
Engineer	Koji Yamamoto
Mode	Tx



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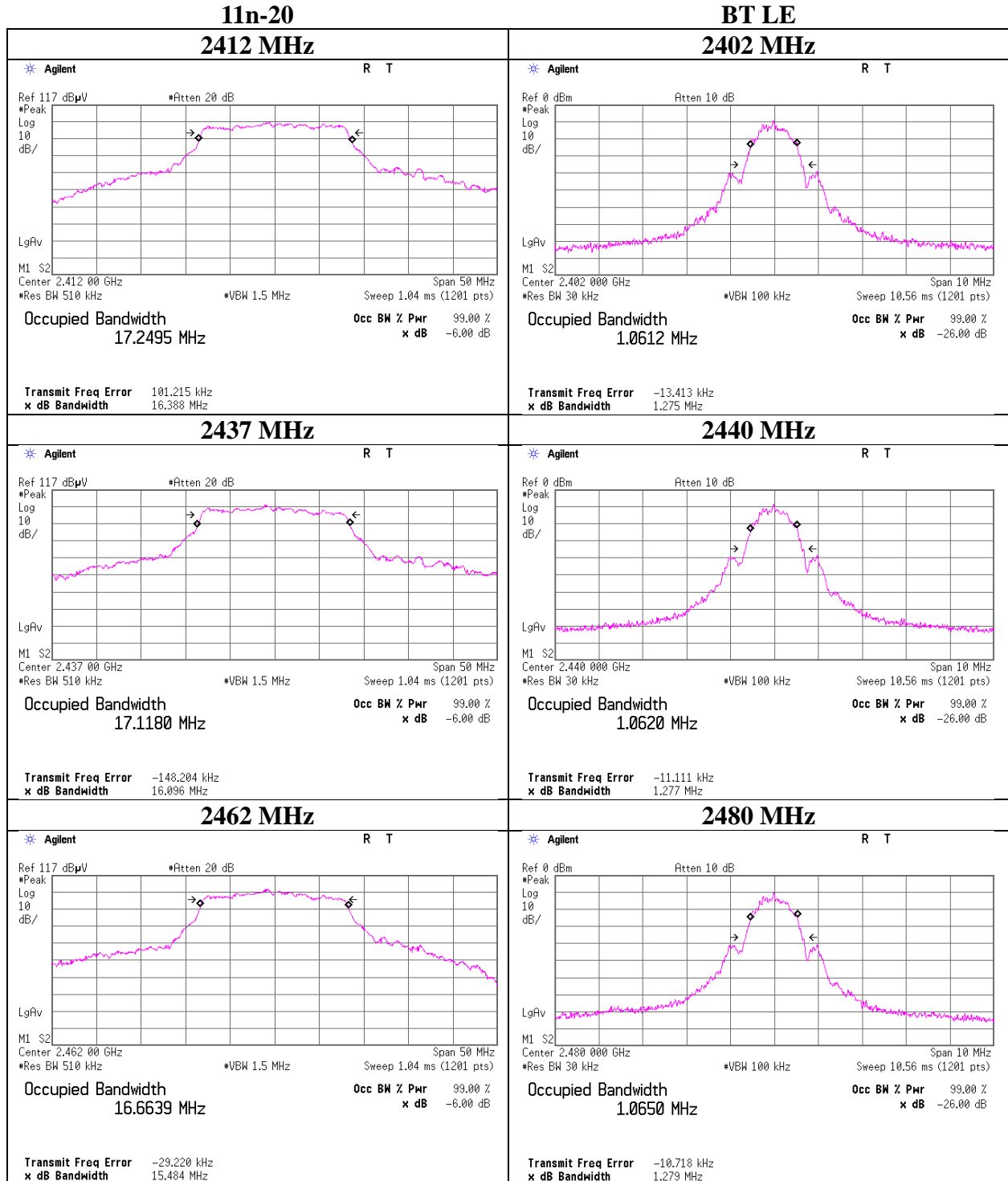
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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MOS-29	Thermo-Hygrometer	Custom	CTH-201	2901	AT	2016/01/21 * 12
MRENT-130	Spectrum Analyzer	Agilent	E4440A	MY46187750	AT	2016/06/03 * 12
MPM-08	Power Meter	Anritsu	ML2495A	6K00003338	AT	2016/10/07 * 12
MPSE-11	Power sensor	Anritsu	MA2411B	011737	AT	2016/10/07 * 12
MAT-58	Attenuator(10dB)	Suhner	6810.19.A	-	AT	2016/01/18 * 12
MCC-171	Microwave Cable	Junkosha	MWX221	1409S494	AT	2016/03/11 * 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	2016/01/21 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE/CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-16	Spectrum Analyzer	Agilent	E4440A	MY46186390	RE	2016/02/08 * 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
MHA-16	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	RE	2016/05/29 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE/CE	2016/01/13 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2016/09/21 * 12
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE/CE	2016/11/10 * 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	2016/01/30 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2016/07/26 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2016/04/05 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2016/03/24 * 12
MLS-23	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	CE(AE)	2016/07/07 * 12
MLS-24	LISN(AMN)	Schwarzbeck	NSLK8127	8127-730	CE(EUT)	2016/07/11 * 12
MTA-31	Terminator	TME	CT-01	-	CE	2016/01/12 * 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	2016/01/14 * 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: CE: Conducted Emission test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test**

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