



RADIO TEST REPORT

Test Report No. : 12669310S-A-R1

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : RF Module
Model No. : WSD-F21
FCC ID : BBQ-WSDF21
Test regulation : **FCC Part 15 Subpart C: 2018**
*Wireless LAN & Bluetooth Low Energy part
Test Result : **Complied (Refer to SECTION 3.2)**

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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 limits of the above regulation.
4. The test results in this test 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. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 12669310S-A. 12669310S-A is replaced with this report.

Date of test: February 19 to March 8, 2019

Representative test engineer: *K. Takeyama*
Kazutaka Takeyama
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Approved by: *A. Hayashi*
Akio Hayashi
Leader
Consumer Technology Division



CERTIFICATE 1266.03

- The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
 There is no testing item of "Non-accreditation".

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SECTION 1: Customer information

Company Name : CASIO COMPUTER CO., LTD.
Address : 2-1, Sakaecho 3 chome, Hamura-shi, Tokyo 205-8555 Japan
Telephone Number : +81-42-579-7282
Contact Person : Hiroaki Suzuki

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

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

2.1 Identification of E.U.T.

Type of Equipment : RF Module
Model No. : WSD-F21
Serial No. : Refer to SECTION 4, SECTION 4.2
Rating : DC 3.8 V (Battery), DC 5.0 V (USB)
Receipt Date of Sample : February 4, 2019
(Information from test lab.)
Country of Mass-production : Japan
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: WSD-F21 (referred to as the EUT in this report) is an RF Module.

Radio Specification

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

Radio Type : Transceiver
Frequency of Operation : 2412 MHz - 2462 MHz
Modulation : DSSS, OFDM
Antenna type : Inverted L type
Antenna Gain : -6.9 dBi
Clock frequency (Maximum) : 32.768 kHz

Bluetooth (Ver. 4.2 with EDR function)

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : BT: FHSS (GFSK, $\pi/4$ DQPSK, 8DPSK)
LE: GFSK
Antenna type : Inverted L type
Antenna Gain : -6.9 dBi
Clock frequency (Maximum) : 32.768 kHz

*This test report applies for WLAN and Bluetooth Low Energy parts.

**Wireless LAN and Bluetooth and Bluetooth Low Energy do not transmit simultaneously.

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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 March 12, 2018 and effective April 11, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928MHz,
2400-2483.5MHz, and 5725-5850MHz

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods	FCC: Section 15.207	23.0 dB, (DC 5 V line)	Complied a)	-
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8	0.59699 MHz, AV, N, Tx, 11g, 2437 MHz 0.59070 MHz, AV, N, Tx, BLE, 2440 MHz		
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r01	FCC: Section 15.247(a)(2)	See data.	Complied b)	Conducted
	IC: -	IC: RSS-247 5.2(a)			
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r01	FCC: Section 15.247(b)(3)	See data.	Complied c)	Conducted
	IC: RSS-Gen 6.12	IC: RSS-247 5.4(d)			
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r01	FCC: Section 15.247(e)	See data.	Complied d)	Conducted
	IC: -	IC: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r01	FCC: Section15.247(d)	5.1 dB 9648.000 MHz, AV, Hori. Tx 11b 2412 MHz	Complied# e),f)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)
	IC: RSS-Gen 6.13	IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

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

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r01 8.5 and 8.6.

- a) Refer to APPENDIX 1 (data of Conducted Emission)
- b) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
- c) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
- d) Refer to APPENDIX 1 (data of Power Density)
- e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
- f) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

Symbols:

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

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

FCC Part 15.31 (e)

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

FCC Part 15.203 Antenna requirement

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

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	RSS-Gen 6.7	IC: -	N/A	- a)	Conducted

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)

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

3.4 Uncertainty

EMI

There is no applicable rule of uncertainty in this applied standard. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.
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Item	Frequency range	Uncertainty (+/-)		
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.1 dB
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.7 dB
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.1 dB
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB
	6 GHz-18 GHz	5.4 dB	5.4 dB	5.4 dB
Radiated emission (Measurement distance: 1 m)	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB
	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB
	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 dB

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.81 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.53 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.95 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.21 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.90 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.04 dB
Spurious emission (Conducted) below 1GHz	1.8 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.7 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.3 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.4 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	0.61 %
Duty cycle and Time Measurement	0.012 %

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3.5 Test Location

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A2LA Certificate Number: 1266.03
FCC Test Firm Registration Number: 626366

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 shielded room	-	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	-	2.55 x 4.1 x 2.5	-	-

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)

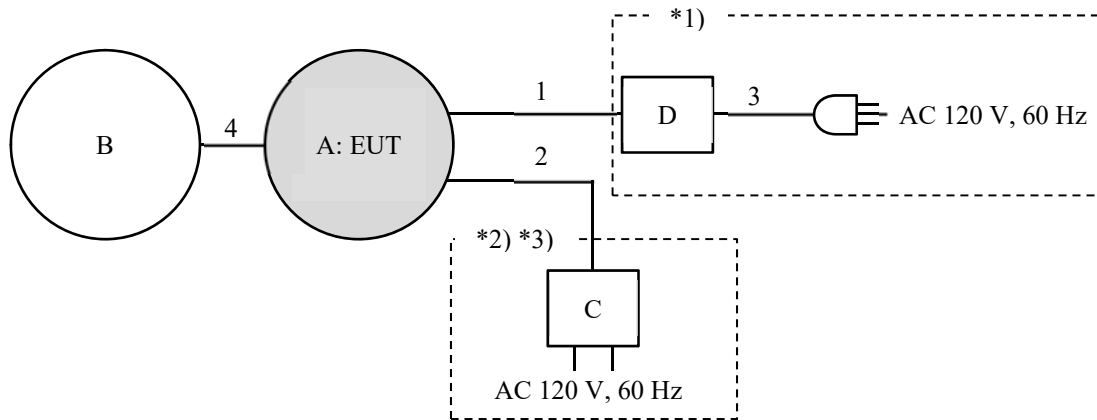
Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11b (11b)	2 Mbps, PN9
IEEE 802.11g (11g)	9 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 0, PN9
Bluetooth (BT) Low Energy (LE)	Maximum Packet Size, PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power	
For WLAN *Power of the EUT was set by the software as follows; Power settings: Fixed Software: WSD-F21-radio ver1.0	
For Bluetooth Low Energy Power settings: Fixed Software: WSD-F21-radio ver1.0	
*This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode (s)

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

4.2 Configuration and peripherals



*1) It is Open during Conducted Emission test with DC 5.0 V line.

*2) It is Open during Radiated Emission test and Conducted Emission test with DC 3.8 V line.

*3) Radiated emission has been tested with power supply of DC 3.8 V representatively. The RF part is constantly provided voltage through the regulator and it has been confirmed that the variation of power supply does not affect the test result.

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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	RF Module	WSD-F21	1 *4) 3 *5)	CASIO COMPUTER CO., LTD.	EUT
B	LCD	-	-	CASIO COMPUTER CO., LTD.	-
C	AC Adapter	AD-W50100U1	-	CASIO COMPUTER CO., LTD.	-
D	Power Supply (DC)	PAN60-10A	DE001677	Kikusui	-

*4) Used for Antenna Terminal conducted test

*5) Used for Conducted Emission test and Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	0.2 + 2.0	Unshielded	Unshielded	-
2	USB Cable	0.4	Shielded	Shielded	-
3	AC Cable	3.0	Unshielded	Unshielded	-
4	Signal	0.01	Unshielded	Unshielded	-

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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 itself (as a standalone equipment)

Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN / (AMN) to the input power source.

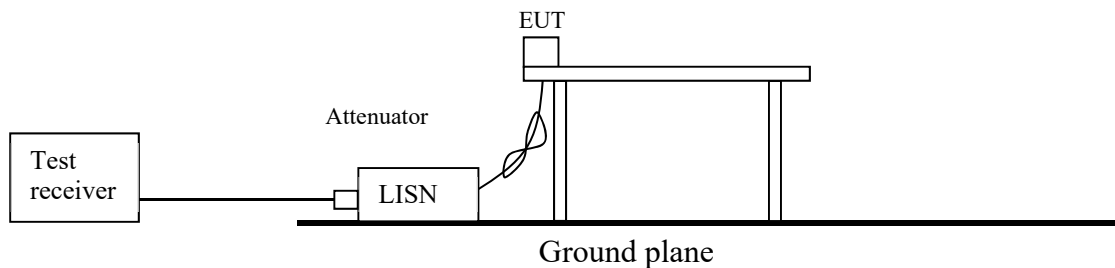
The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Shielded room. The EUT was connected to a LISN (AMN).

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

Figure 1: Test Setup



SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r01".

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 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) *3)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	*2) <u>11.12.2.5.2</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz

*1) Average Power Measurement was performed based on ANSI C63.10-2013.

*2) For 11b / 11g / 11n-20 testing.

*3) For BT LE testing. Measurement with Average detector was not performed. The limit for Average detector is applied to the measurement value with Peak detector used Averaging factor (Duty factor)

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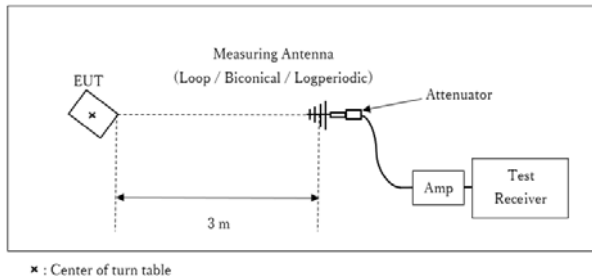
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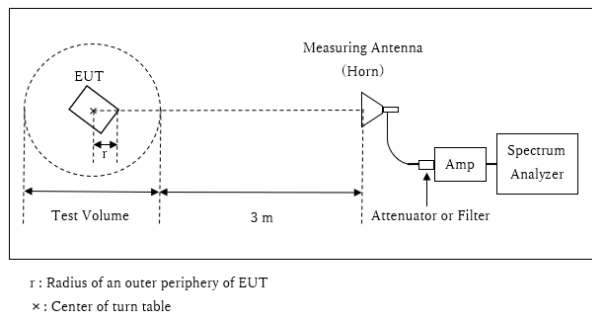
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

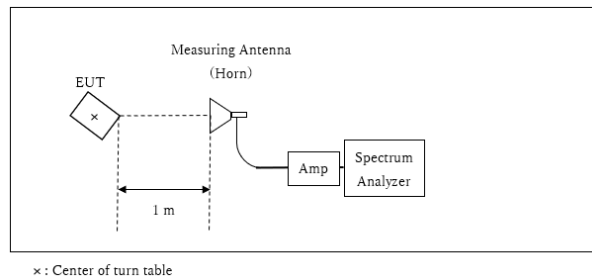
1 GHz - 13 GHz



Distance Factor: $20 \times \log(3.92 \text{ m} / 3.0 \text{ m}) = 2.32 \text{ dB}$
 * Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.92 \text{ m}$

Test Volume : 2.0 m
 (Test Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.08 \text{ m}$

13 GHz - 26.5 GHz



Distance Factor: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$
 *Test Distance: 1 m

- 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.

Test Antenna	Frequency	Carrier	Spurious			
			30 MHz-1 GHz	1 GHz -13 GHz	13 GHz -18 GHz	18 GHz -26.5 GHz
Horizontal	X	X	Y	X	X	X
Vertical	Y	Y	Y	Y	X	X

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	WLAN: 50 MHz BLE : 10 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	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.

*2) Reference data

*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".

*4) In the frequency range below 30 MHz, 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 = 10 kHz)

The test results and limit are rounded off to two decimals place, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission
(DC 3.8 V line)

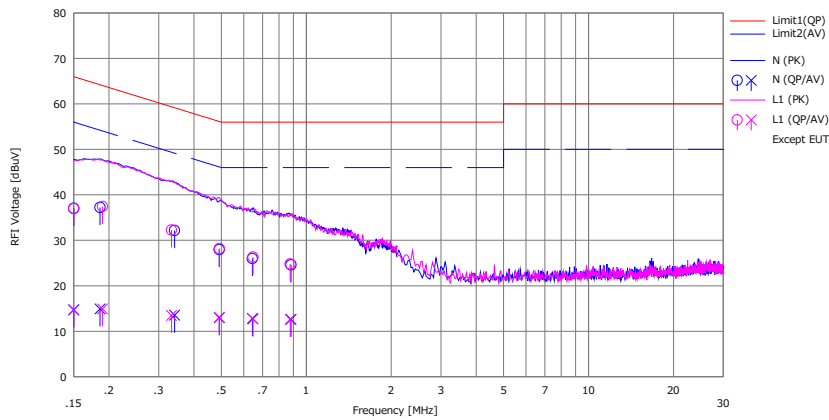
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2019/03/07

Mode : Tx 11g_2437 MHz
Power : AC 120 V / 60 Hz (EUT input: DC 3.8 V)
Temp./Humi. : 22 deg.C / 40 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yosuke Ishikawa



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	24.60	2.30	12.44	37.04	14.74	66.00	56.00	28.9	41.2	N	
2	0.18580	24.80	2.50	12.43	37.23	14.93	64.22	54.22	26.9	39.2	N	
3	0.34140	19.70	1.10	12.46	32.16	13.56	59.17	49.17	27.0	35.6	N	
4	0.49169	15.50	0.50	12.47	27.97	12.97	56.14	46.14	28.1	33.1	N	
5	0.64390	13.50	0.30	12.50	26.00	12.80	56.00	46.00	30.0	33.2	N	
6	0.88300	12.10	0.10	12.50	24.60	12.60	56.00	46.00	31.4	33.4	N	
7	0.15000	24.50	2.20	12.44	36.94	14.64	66.00	56.00	29.0	41.3	L1	
8	0.18960	25.00	2.50	12.43	37.43	14.93	64.05	54.05	26.6	39.1	L1	
9	0.33311	19.80	1.00	12.46	32.26	13.46	59.37	49.37	27.1	35.9	L1	
10	0.49179	15.70	0.60	12.47	28.17	13.07	56.14	46.14	27.9	33.0	L1	
11	0.64780	13.80	0.20	12.50	26.30	12.70	56.00	46.00	29.7	33.3	L1	
12	0.87640	12.30	0.10	12.50	24.80	12.60	56.00	46.00	31.2	33.4	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN: SLS-02

Conducted Emission
 (DC 3.8 V line)

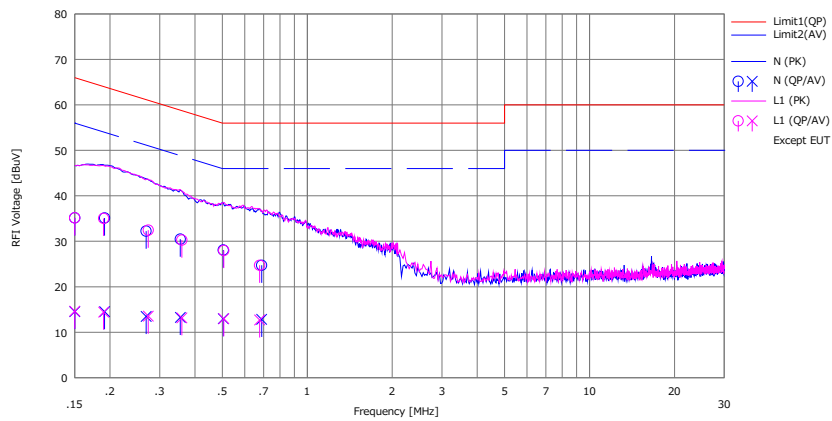
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
 Date : 2019/03/07

Mode : Tx, BLE, 2440 MHz
 Power : AC 120 V / 60 Hz (EUT input: DC 3.8 V)
 Temp./Humi. : 22 deg.C / 40 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yosuke Ishikawa



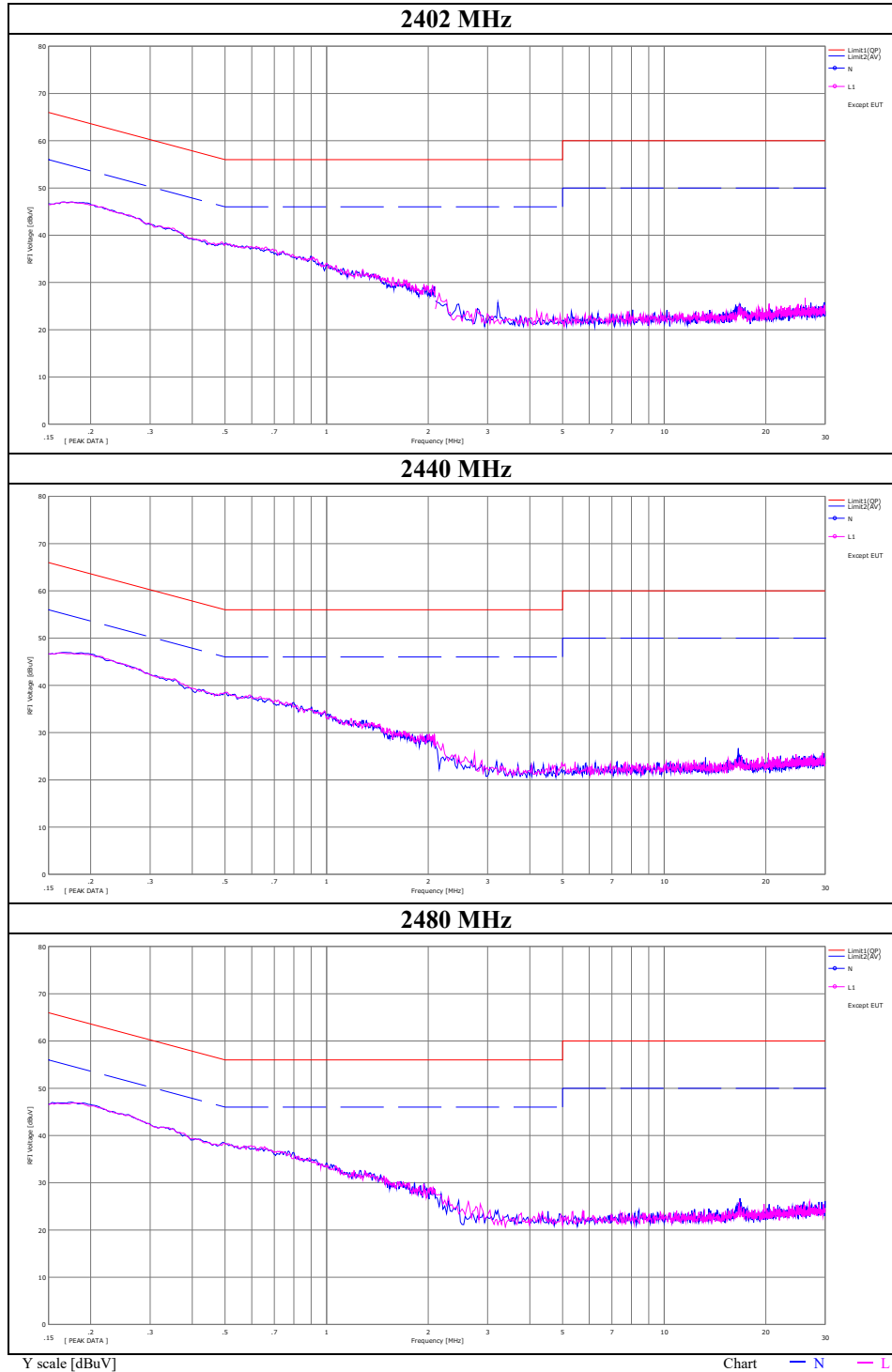
No.	Freq. [MHz]	Reading			C.Fac	Results		Limit		Margin		Phase	Comment
		(QP) [dBuV]	(AV) [dBuV]	[dB]		(QP) [dBuV]	(AV) [dBuV]	(QP) [dB]	(AV) [dB]				
1	0.15000	22.70	2.10	12.44	35.14	14.54	66.00	56.00	30.8	41.4	N		
2	0.19130	22.70	2.10	12.42	35.12	14.52	63.98	53.98	28.8	39.4	N		
3	0.26860	19.80	1.00	12.45	32.25	13.45	61.16	51.16	28.9	37.7	N		
4	0.35480	18.00	0.80	12.46	30.46	13.26	58.85	48.85	28.3	35.5	N		
5	0.50400	15.60	0.50	12.47	28.07	12.97	56.00	46.00	27.9	33.0	N		
6	0.68939	12.20	0.30	12.51	24.71	12.81	56.00	46.00	31.2	33.1	N		
7	0.15000	22.70	2.20	12.44	35.14	14.64	66.00	56.00	30.8	41.3	L1		
8	0.18990	22.60	2.00	12.43	35.03	14.43	64.04	54.04	29.0	39.6	L1		
9	0.27330	20.00	1.10	12.45	32.45	13.55	61.02	51.02	28.5	37.4	L1		
10	0.35940	17.80	0.70	12.46	30.26	13.16	58.74	48.74	28.4	35.5	L1		
11	0.50600	15.50	0.50	12.47	27.97	12.97	56.00	46.00	28.0	33.0	L1		
12	0.67780	12.20	0.20	12.51	24.71	12.71	56.00	46.00	31.2	33.2	L1		

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
 LISN: SLS-02

Conducted Emission

(DC 3.8 V line)

Test place	Shonan EMC Lab. No.3 Shielded room
Report No.	12669310S-A-R1
Date	October 7, 2015
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE



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Conducted Emission

(DC 5.0 V line)

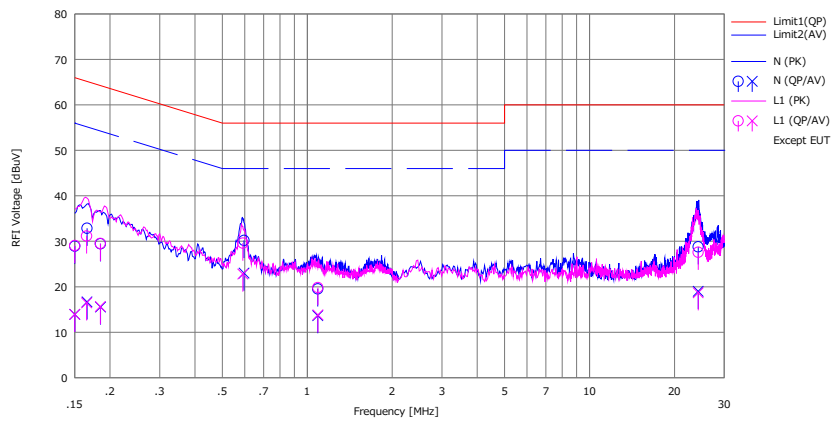
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
 Date : 2019/03/08

Mode : Tx 11g_2437 MHz
 Power : DC 5 V (AC adapter input: AC 120 V / 60 Hz)
 Temp./Humi. : 22 deg.C / 40 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yosuke Ishikawa



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		(QP) [dBuV]	(AV) [dBuV]		(QP) [dBuV]	(AV) [dBuV]	(QP) [dB]	(AV) [dB]	(QP) [dB]	(AV) [dB]		
1	0.15000	16.50	1.50	12.44	28.94	13.94	66.00	56.00	37.0	42.0	N	
2	0.16580	20.40	4.20	12.46	32.86	16.66	65.17	55.17	32.3	38.5	N	
3	0.18500	17.00	3.10	12.44	29.44	15.54	64.26	54.26	34.8	38.7	N	
4	0.59699	17.70	10.50	12.49	30.19	22.99	56.00	46.00	25.8	23.0	N	
5	1.08978	7.00	1.10	12.53	19.53	13.63	56.00	46.00	36.4	32.3	N	
6	24.26449	15.30	5.50	13.48	28.78	18.98	60.00	50.00	31.2	31.0	N	
7	0.15000	16.60	1.50	12.44	29.04	13.94	66.00	56.00	36.9	42.0	L1	
8	0.16520	18.70	4.00	12.46	31.16	16.46	65.20	55.20	34.0	38.7	L1	
9	0.18480	17.10	3.20	12.44	29.54	15.64	64.27	54.27	34.7	38.6	L1	
10	0.59120	17.10	10.30	12.49	29.59	22.79	56.00	46.00	26.4	23.2	L1	
11	1.09008	7.30	1.30	12.53	19.83	13.83	56.00	46.00	36.1	32.1	L1	
12	24.26179	14.10	5.20	13.48	27.58	18.68	60.00	50.00	32.4	31.3	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
 LISN: SLS-02

Conducted Emission (DC 5.0 V line)

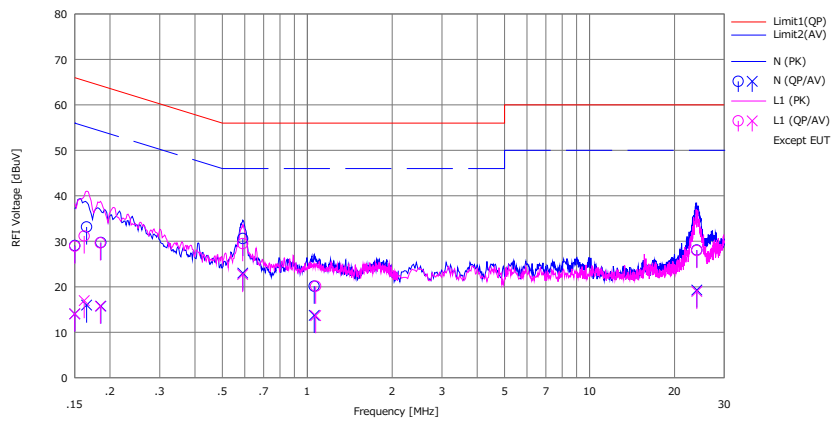
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2019/03/08

Mode : Tx, BLE, 2440 MHz
Power : DC 5 V (AC adapter input: AC 120 V / 60 Hz)
Temp./Humi. : 22 deg.C / 40 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yosuke Ishikawa



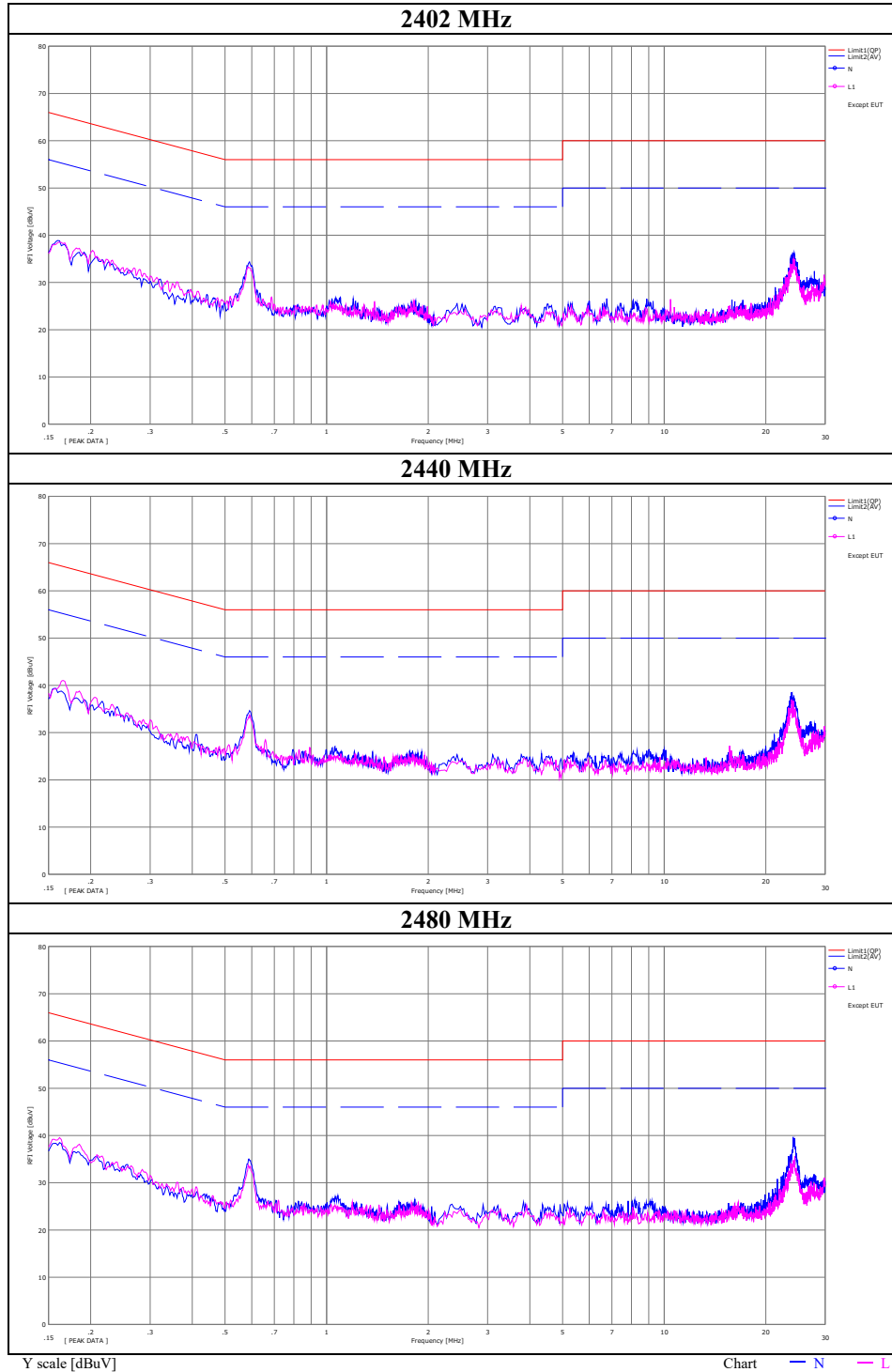
No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		(QP) [dBuV]	(AV) [dBuV]		[dB]	(QP) [dBuV]	(AV) [dBuV]	(QP) [dB]	(AV) [dB]			
1	0.15000	16.60	1.60	12.44	29.04	14.04	66.00	56.00	36.9	41.9	N	
2	0.16520	20.70	3.50	12.46	33.16	15.96	65.20	55.20	32.0	39.2	N	
3	0.18560	17.30	3.30	12.43	29.73	15.73	64.23	54.23	34.5	38.5	N	
4	0.59070	18.10	10.50	12.49	30.59	22.99	56.00	46.00	25.4	23.0	N	
5	1.05840	7.60	1.20	12.53	20.13	13.73	56.00	46.00	35.8	32.2	N	
6	23.98977	14.60	5.80	13.47	28.07	19.27	60.00	50.00	31.9	30.7	N	
7	0.15000	16.50	1.60	12.44	28.94	14.04	66.00	56.00	37.0	41.9	L1	
8	0.16211	18.70	4.50	12.45	31.15	16.95	65.36	55.36	34.2	38.4	L1	
9	0.18480	17.20	3.30	12.44	29.64	15.74	64.27	54.27	34.6	38.5	L1	
10	0.59040	17.00	10.20	12.49	29.49	22.69	56.00	46.00	26.5	23.3	L1	
11	1.07059	7.60	1.10	12.53	20.13	13.63	56.00	46.00	35.8	32.3	L1	
12	23.98317	14.50	5.50	13.47	27.97	18.97	60.00	50.00	32.0	31.0	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN: SLS-02

Conducted Emission

(DC 5.0 V line)

Test place	Shonan EMC Lab. No.3 Shielded room
Report No.	12669310S-A-R1
Date	March 8, 2019
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE



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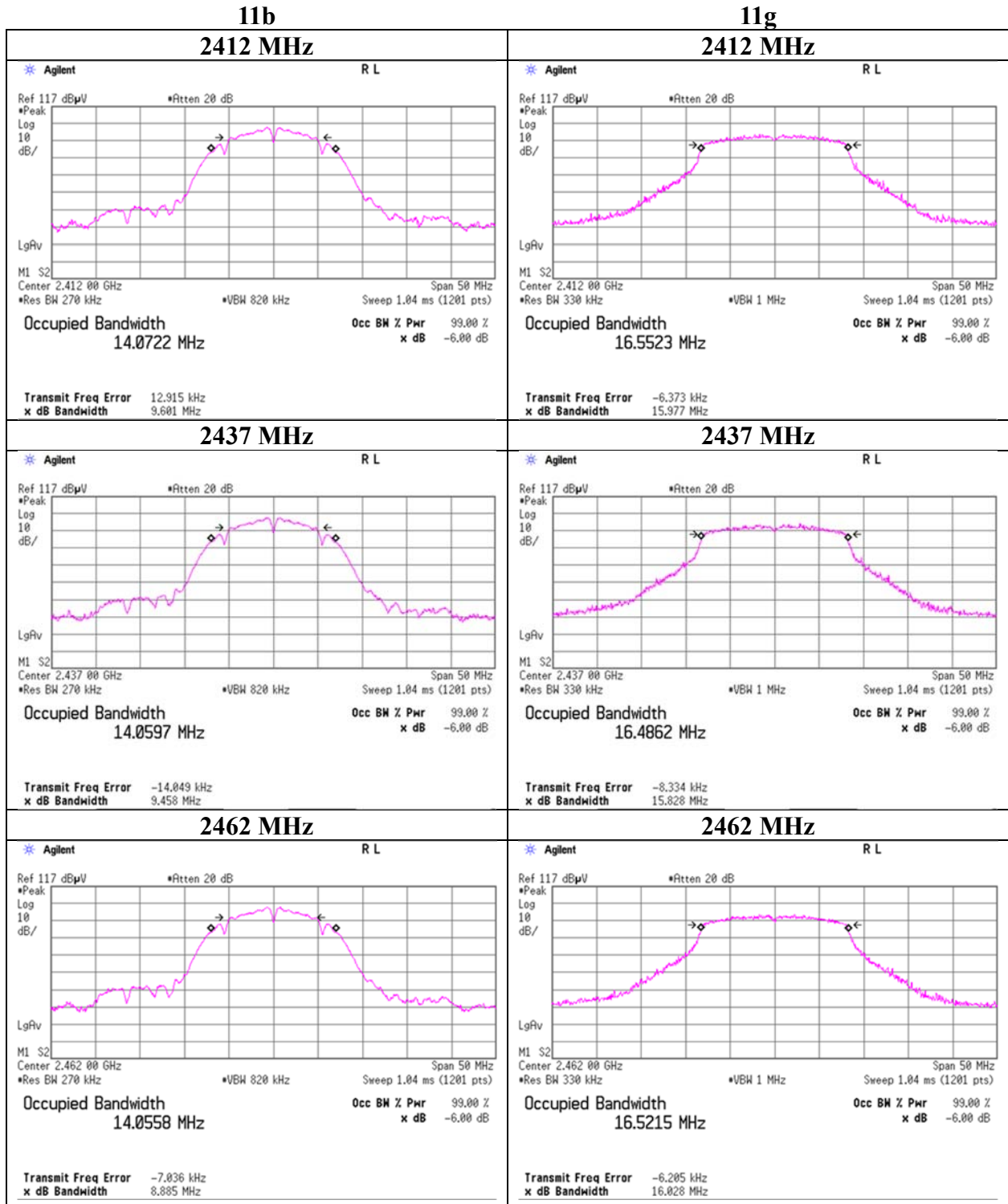
Facsimile : +81 463 50 6401

6 dB Bandwidth and 99 % Occupied Bandwidth

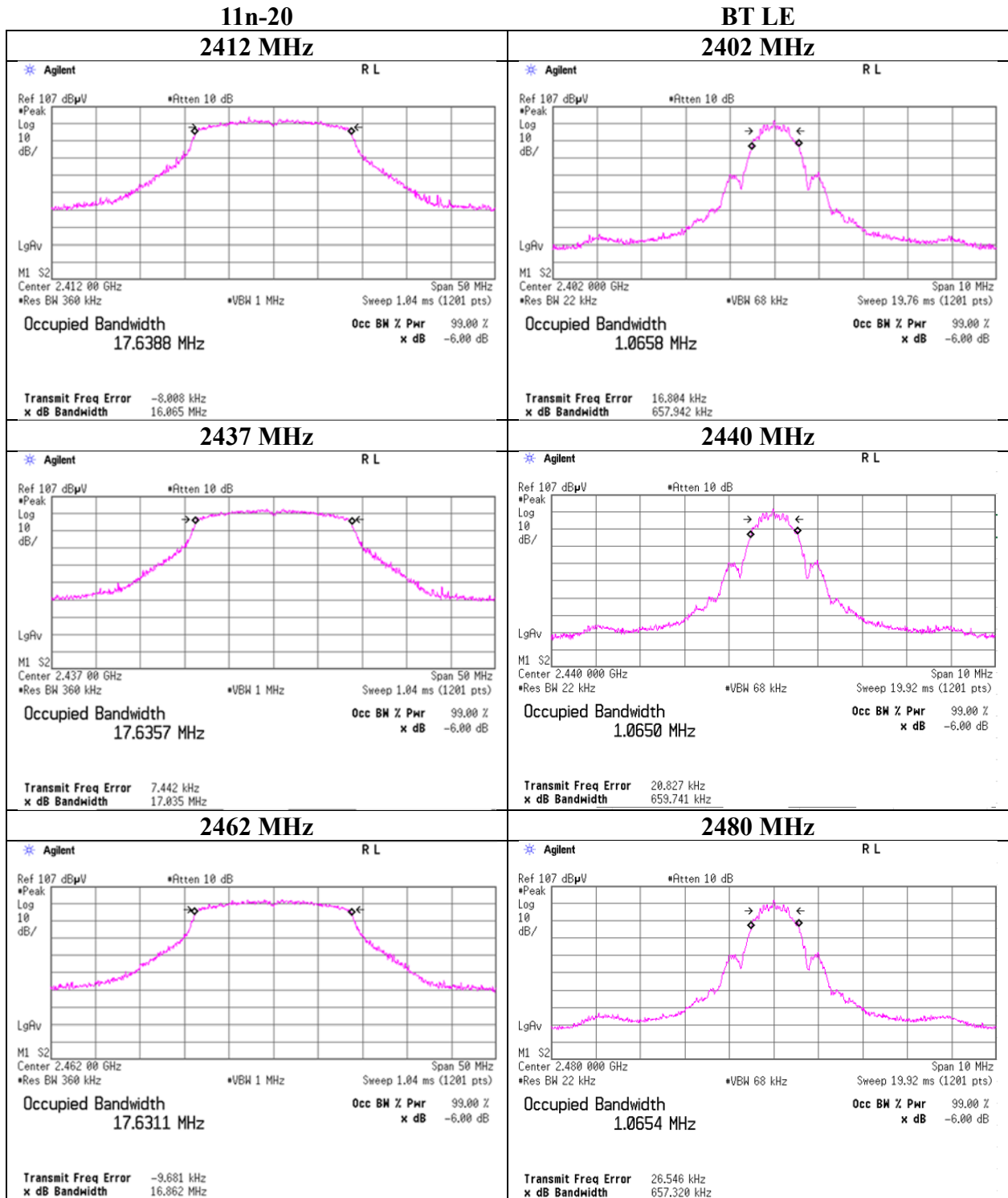
Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 21, 2019
Temperature / Humidity 24 deg. C / 34 % RH
Engineer Kazuya Noda
Mode Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	14072.2	8.054	> 0.5000
	2437	14059.7	8.819	> 0.5000
	2462	14055.8	9.595	> 0.5000
11g	2412	16552.3	15.132	> 0.5000
	2437	16486.2	15.181	> 0.5000
	2462	16521.5	15.149	> 0.5000
11n-20	2412	17638.8	15.150	> 0.5000
	2437	17635.7	15.097	> 0.5000
	2462	17631.1	15.125	> 0.5000
BT LE	2402	1065.8	0.748	> 0.5000
	2440	1065.0	0.725	> 0.5000
	2480	1065.4	0.730	> 0.5000

99%Occupied Bandwidth



99% Occupied Bandwidth



UL Japan, Inc.

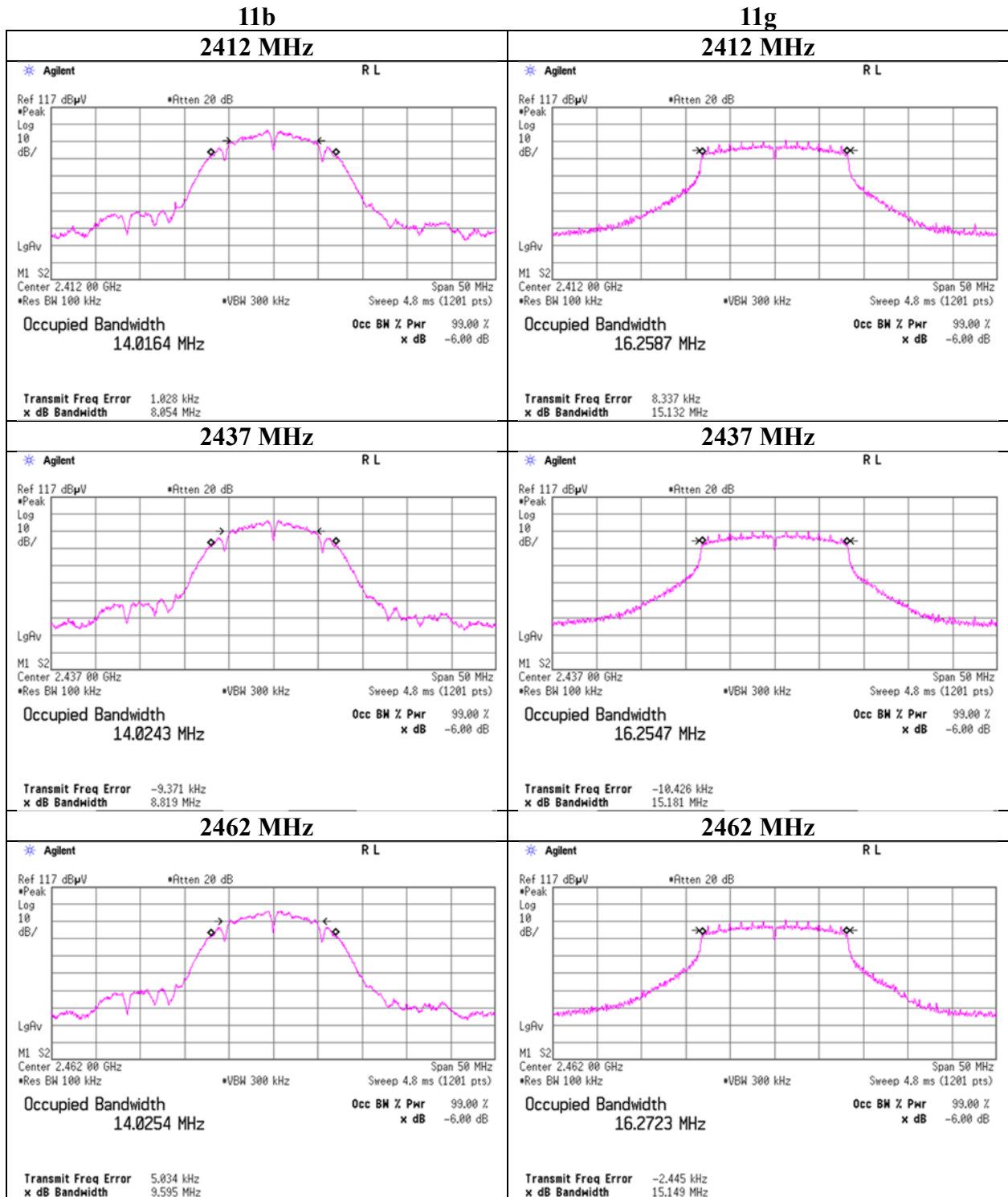
Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

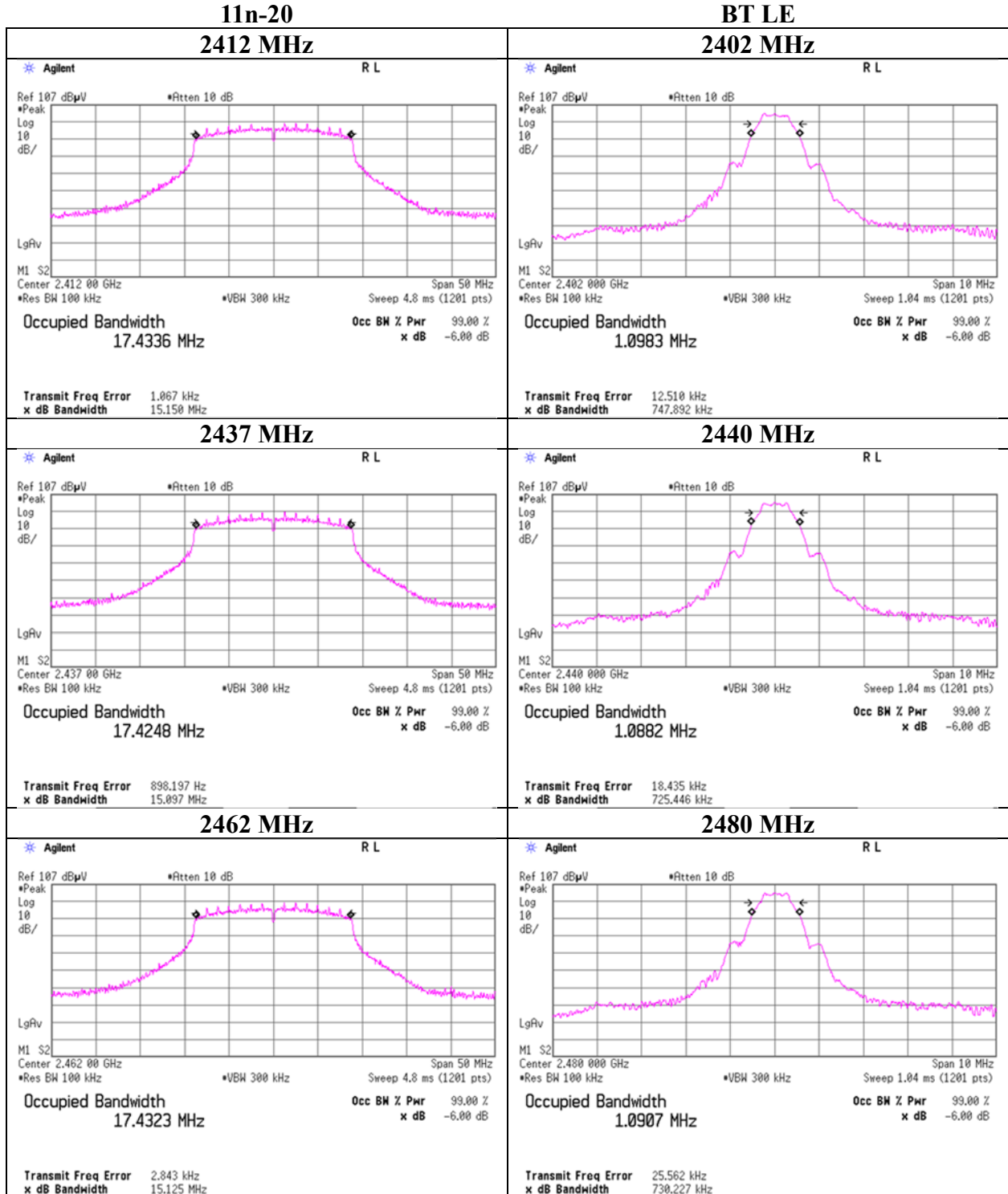
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6dB Bandwidth



6dB Bandwidth



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Facsimile : +81 463 50 6401

Maximum Peak Output Power

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 19, 2019
Temperature / Humidity 25 deg. C / 51 % RH
Engineer Makoto Hosaka
Mode Tx 11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power						e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]		
2412	7.90	1.63	9.82	19.35	86.10	30.00	1000	10.65	-6.90	12.45	17.58	36.02	4000	23.57	
2437	7.96	1.64	9.82	19.42	87.50	30.00	1000	10.58	-6.90	12.52	17.86	36.02	4000	23.50	
2462	7.72	1.65	9.82	19.19	82.99	30.00	1000	10.81	-6.90	12.29	16.94	36.02	4000	23.73	

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	7.83	
2	7.96	*
5.5	7.94	
11	7.87	

*: Worst Rate

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

Maximum Peak Output Power

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 19, 2019
Temperature / Humidity 25 deg. C / 51 % RH
Engineer Makoto Hosaka
Mode Tx 11g

Freq.	Reading	Cable Loss	Atten. Loss	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
				[dBm]	[mW]	[dBm]	[mW]			[dB]	[dBi]	[dBm]	[mW]	
2412	12.77	1.63	9.82	24.22	264.24	30.00	1000	5.78	-6.90	17.32	53.95	36.02	4000	18.70
2437	12.82	1.64	9.82	24.28	267.92	30.00	1000	5.72	-6.90	17.38	54.70	36.02	4000	18.64
2462	12.76	1.65	9.82	24.23	264.85	30.00	1000	5.77	-6.90	17.33	54.08	36.02	4000	18.69

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
6	12.79	
9	12.82	*
12	11.93	
18	11.77	
24	12.07	
36	12.02	
48	11.43	
54	11.67	

*: Worst Rate

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

Maximum Peak Output Power

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 19, 2019
Temperature / Humidity 25 deg. C / 51 % RH
Engineer Makoto Hosaka
Mode Tx 11n-20

Freq.	Reading	Cable Loss	Atten. Loss	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
				[dBm]	[mW]	[dBm]	[mW]			[dB]	[dBi]	[dBm]	[mW]	
2412	11.66	1.63	9.82	23.11	204.64	30.00	1000	6.89	-6.90	16.21	41.78	36.02	4000	19.81
2437	11.80	1.64	9.82	23.26	211.84	30.00	1000	6.74	-6.90	16.36	43.25	36.02	4000	19.66
2462	11.65	1.65	9.82	23.12	205.12	30.00	1000	6.88	-6.90	16.22	41.88	36.02	4000	19.80

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

Rate	Reading	Remark
[MCS]	[dBm]	
0	11.80	*
1	10.86	
2	10.81	
3	10.65	
4	10.45	
5	11.41	
6	10.56	
7	10.33	

*: Worst Rate

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

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Maximum Peak Output Power

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 19, 2019
Temperature / Humidity 25 deg. C / 51 % RH
Engineer Makoto Hosaka
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-3.96	1.62	9.82	7.48	5.60	30.00	1000	22.52	-6.90	0.58	1.14	36.02	4000	35.44
2440	-3.83	1.64	9.82	7.63	5.79	30.00	1000	22.37	-6.90	0.73	1.18	36.02	4000	35.29
2480	-3.93	1.65	9.82	7.54	5.68	30.00	1000	22.46	-6.90	0.64	1.16	36.02	4000	35.38

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

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Average Output Power
(Reference data for RF Exposure)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 19, 2019 March 7, 2019
Temperature / Humidity 25 deg. C / 51 % RH 21 deg. C / 41 % RH
Engineer Makoto Hosaka Kazutaka Takeyama
Mode Tx

11b 1 Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	4.72	1.63	9.82	16.17	41.40	0.05	16.22	41.88
2437	4.67	1.64	9.82	16.13	41.02	0.05	16.18	41.50
2462	4.59	1.65	9.82	16.06	40.36	0.05	16.11	40.83

11g 6 Mbps

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	0.82	1.63	9.82	12.27	16.87	0.28	12.55	17.99
2437	0.87	1.64	9.82	12.33	17.10	0.28	12.61	18.24
2462	0.75	1.65	9.82	12.22	16.67	0.28	12.50	17.78

11n-20 MCS 0

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2412	-0.25	1.63	9.82	11.20	13.18	0.31	11.51	14.16
2437	-0.31	1.64	9.82	11.15	13.03	0.31	11.46	14.00
2462	-0.53	1.65	9.82	10.94	12.42	0.31	11.25	13.34

BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-6.46	1.62	9.82	4.98	3.15	2.17	7.15	5.19
2440	-6.38	1.64	9.82	5.08	3.22	2.17	7.25	5.31
2480	-6.43	1.65	9.82	5.04	3.19	2.17	7.21	5.26

Sample Calculation:

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

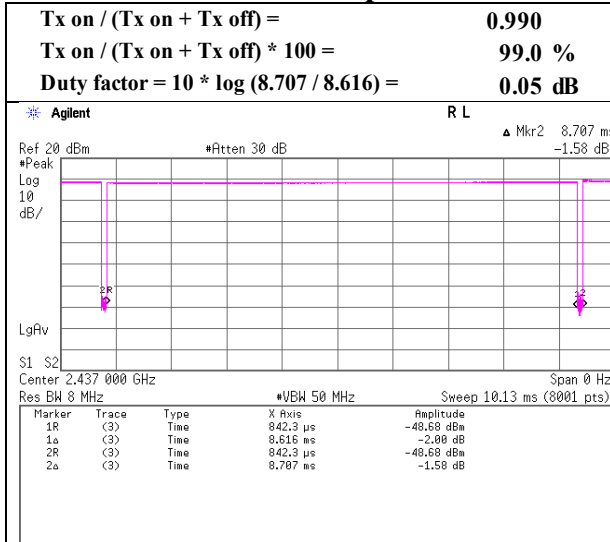
Result (Burst power average) = Time average + Duty factor

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

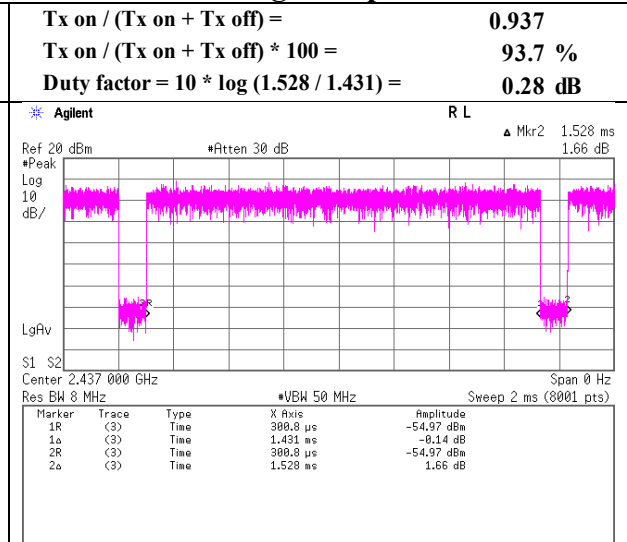
**Burst rate confirmation
(for Average Output Power)**

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 19, 2019
Temperature / Humidity 25 deg. C / 51 % RH
Engineer Makoto Hosaka
Mode Tx

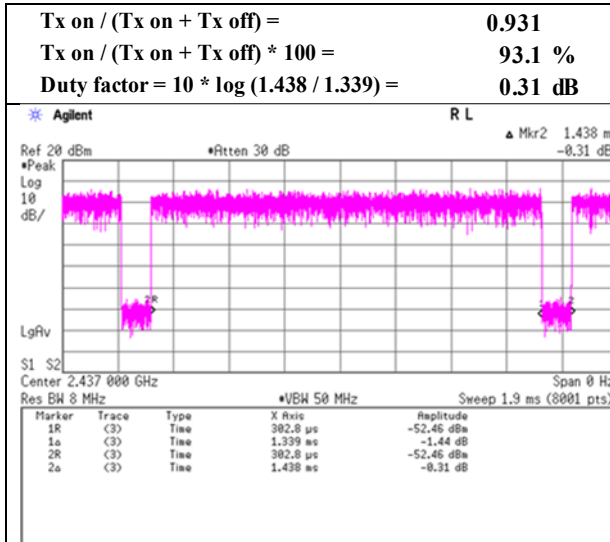
11b 1 Mbps



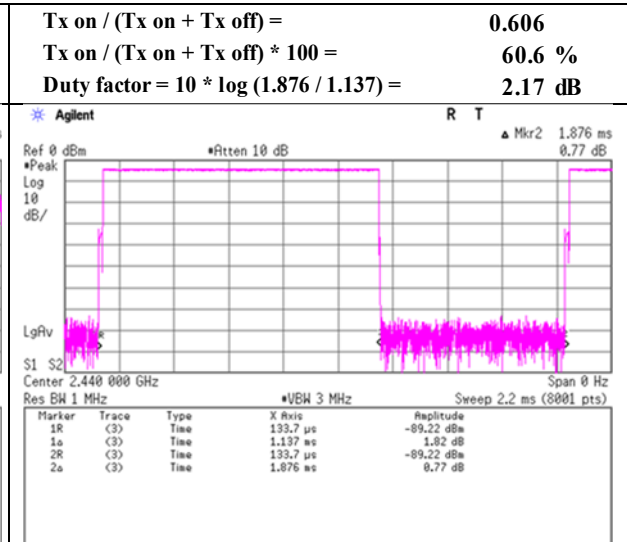
11g 6 Mbps



11n-20 MCS 0



BT LE

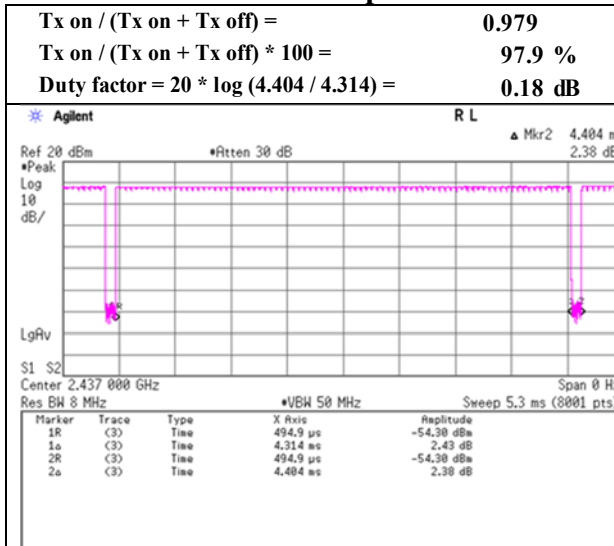


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

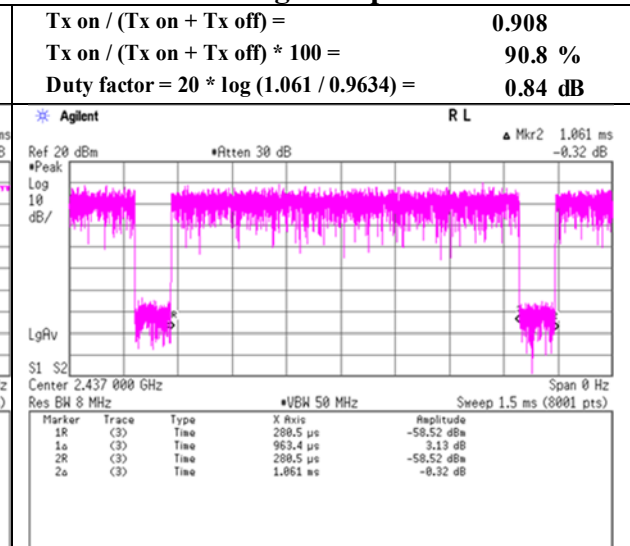
Burst rate confirmation
(for Radiated Spurious Emission)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 19, 2019
Temperature / Humidity 25 deg. C / 51 % RH
Engineer Makoto Hosaka
Mode Tx

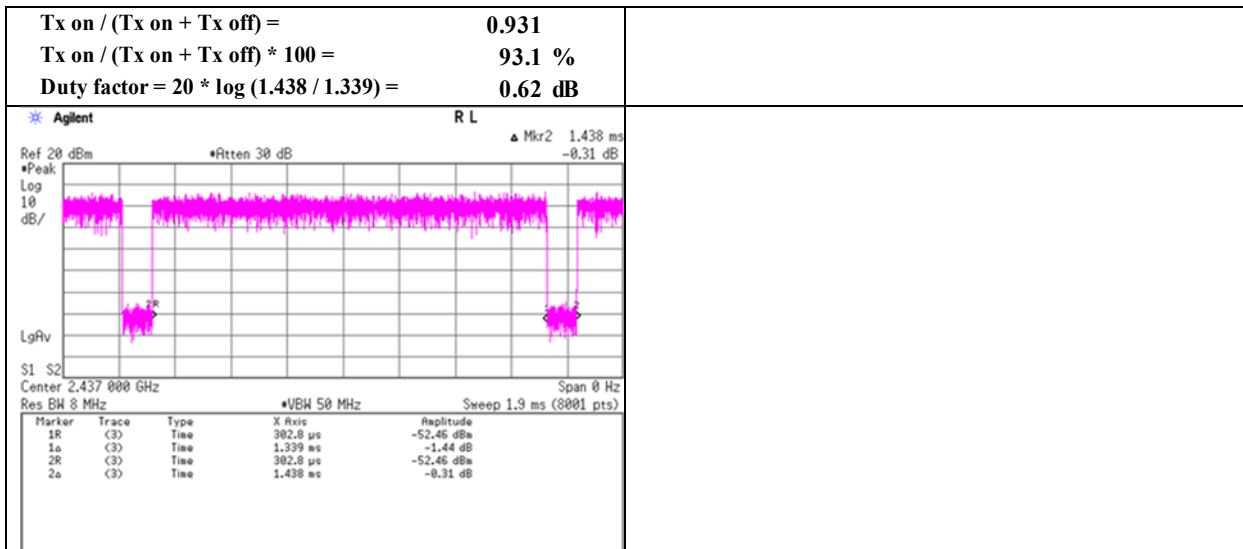
11b 2 Mbps



11g 9 Mbps



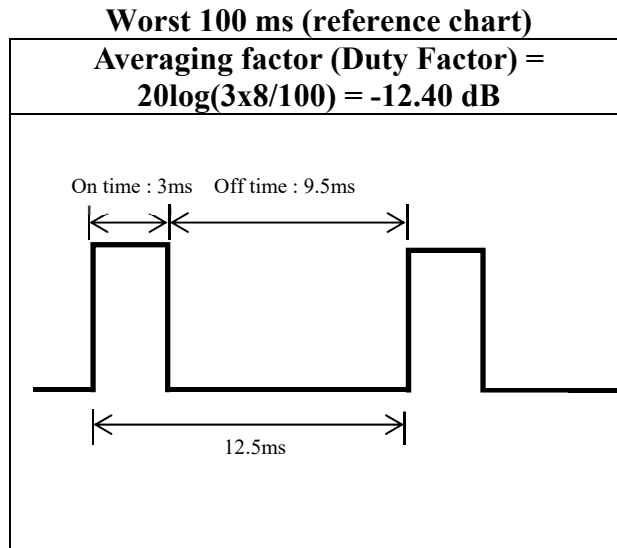
11n-20 MCS 0



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

Averaging factor (Duty factor) Calculation chart (For BT LE)

The information provided from the customer.



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

*Worst TX Duty cycle BLE is Advertising mode.

The actual measurement value was applied as Averaging factor (Duty Factor).

Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.2
Date	February 28, 2019	February 24, 2019	February 25, 2019
Temperature / Humidity	23 deg. C / 33 % RH	24 deg. C / 31 % RH	25 deg. C / 34 % RH
Engineer	Kazutaka Takeyama (1 GHz - 2.8 GHz)	Kazutaka Takeyama (2.8 GHz - 13 GHz)	Kazutaka Takeyama (13 GHz - 26.5 GHz)
Mode	Tx 11b 2412 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	54.54	27.91	14.05	39.46	2.32	59.36	73.90	14.5	146	4	
Hori.	4824.000	PK	49.43	31.46	7.44	42.88	2.32	47.77	73.90	26.1	169	15	
Hori.	7236.000	PK	48.61	36.85	9.21	42.98	2.32	54.01	73.90	19.8	150	0	floor noise
Hori.	9648.000	PK	48.28	38.64	10.62	43.13	2.32	56.73	73.90	17.1	150	0	floor noise
Hori.	7236.000	AV	40.03	36.85	9.21	42.98	2.32	45.43	53.90	8.4	150	0	floor noise
Hori.	9648.000	AV	40.34	38.64	10.62	43.13	2.32	48.79	53.90	5.1	150	0	floor noise
Vert.	2390.000	PK	48.14	27.91	14.05	39.46	2.32	52.96	73.90	20.9	166	39	
Vert.	4824.000	PK	48.66	31.46	7.44	42.88	2.32	47.00	73.90	26.9	198	358	
Vert.	7236.000	PK	48.35	36.85	9.21	42.98	2.32	53.75	73.90	20.1	150	0	floor noise
Vert.	9648.000	PK	47.91	38.64	10.62	43.13	2.32	56.36	73.90	17.5	150	0	floor noise
Vert.	7236.000	AV	39.14	36.85	9.21	42.98	2.32	44.54	53.90	9.3	150	0	floor noise
Vert.	9648.000	AV	38.61	38.64	10.62	43.13	2.32	47.06	53.90	6.8	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	38.73	27.91	14.05	39.46	0.18	2.32	43.73	53.90	10.1	*1)
Hori.	4824.000	AV	40.83	31.46	7.44	42.88	0.18	2.32	39.35	53.90	14.5	
Vert.	2390.000	AV	39.50	27.91	14.05	39.46	0.18	2.32	44.50	53.90	9.4	*1)
Vert.	4824.000	AV	39.98	31.46	7.44	42.88	0.18	2.32	38.50	53.90	15.4	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	93.88	27.88	14.07	39.46	2.32	98.69	-	-	Carrier
Hori.	2400.000	PK	45.07	27.91	14.06	39.46	2.32	49.90	78.69	28.7	
Vert.	2412.000	PK	93.28	27.88	14.07	39.46	2.32	98.09	-	-	Carrier
Vert.	2400.000	PK	43.42	27.91	14.06	39.46	2.32	48.25	78.09	29.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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Shonan EMC Lab.

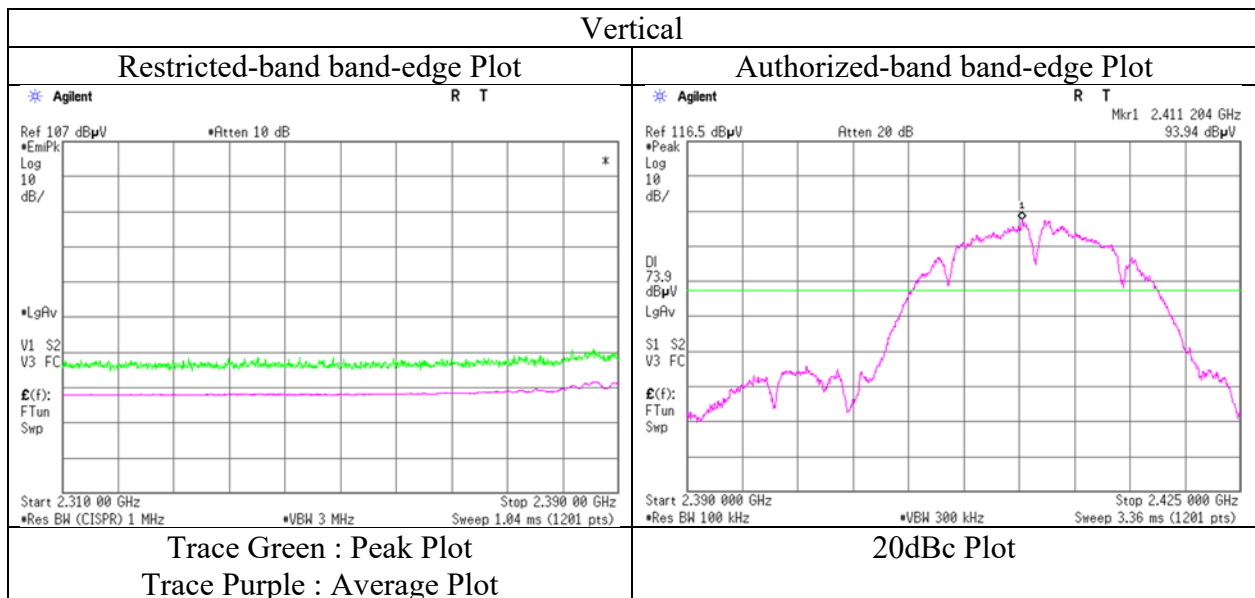
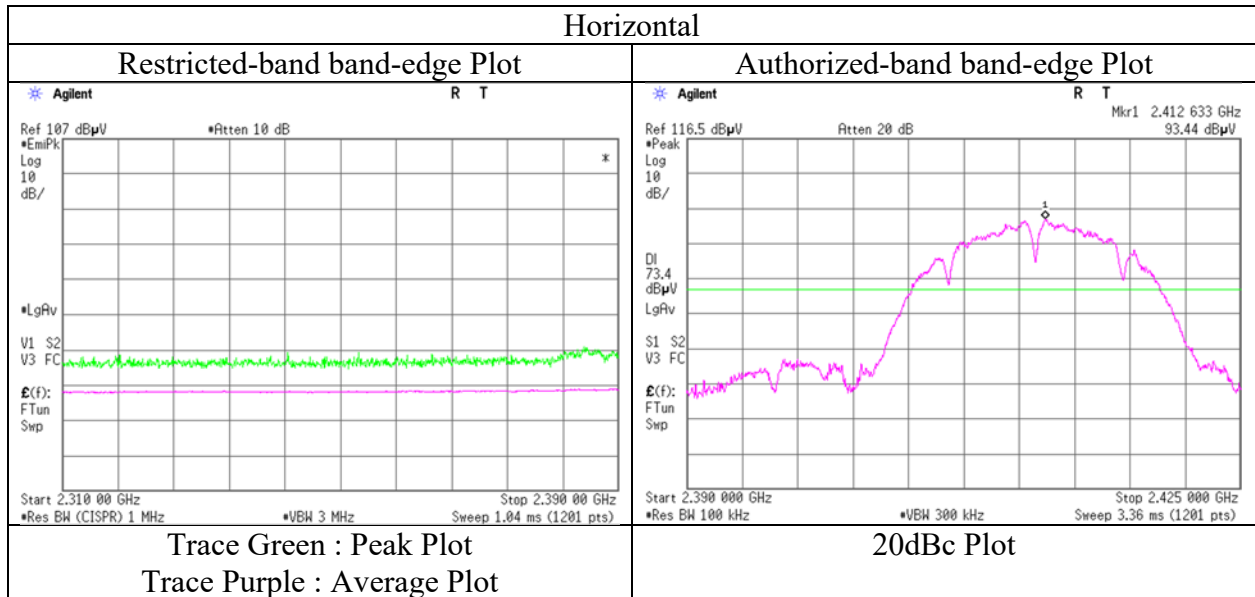
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date February 28, 2019
Temperature / Humidity 23 deg. C / 33 % RH
Engineer Kazutaka Takeyama
(1 GHz - 2.8 GHz)
Mode Tx 11b 2412 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12669310S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	February 28, 2019	February 25, 2019
Temperature / Humidity	23 deg. C / 33 % RH	25 deg. C / 34 % RH
Engineer	Kazutaka Takeyama	Kazutaka Takeyama
	(1 GHz – 2.8 GHz)	(2.8 GHz - 26.5 GHz)
Mode	Tx 11b 2437 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	4874.000	PK	47.41	31.17	6.63	39.50	2.32	48.03	73.90	25.8	141	2	
Hori.	7311.000	PK	46.41	36.82	7.69	39.35	2.32	53.89	73.90	20.0	150	0	floor noise
Hori.	9748.000	PK	46.35	38.55	8.89	39.42	2.32	56.69	73.90	17.2	150	0	floor noise
Hori.	7311.000	AV	36.26	36.82	7.69	39.35	2.32	43.74	53.90	10.1	150	0	floor noise
Hori.	9748.000	AV	36.35	38.55	8.89	39.42	2.32	46.69	53.90	7.2	150	0	floor noise
Vert.	4874.000	PK	47.14	31.17	6.63	39.50	2.32	47.76	73.90	26.1	138	24	
Vert.	7311.000	PK	46.53	36.82	7.69	39.35	2.32	54.01	73.90	19.8	150	0	floor noise
Vert.	9748.000	PK	46.13	38.55	8.89	39.42	2.32	56.47	73.90	17.4	150	0	floor noise
Vert.	7311.000	AV	36.43	36.82	7.69	39.35	2.32	43.91	53.90	9.9	150	0	floor noise
Vert.	9748.000	AV	36.44	38.55	8.89	39.42	2.32	46.78	53.90	7.1	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4874.000	AV	37.35	31.17	6.63	39.50	0.18	2.32	38.15	53.90	15.7	
Vert.	4874.000	AV	37.50	31.17	6.63	39.50	0.18	2.32	38.30	53.90	15.6	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

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Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.2
Date	February 28, 2019	February 24, 2019	February 25, 2019
Temperature / Humidity	23 deg. C / 33 % RH	24 deg. C / 31 % RH	25 deg. C / 34 % RH
Engineer	Kazutaka Takeyama (1 GHz – 2.8 GHz)	Kazutaka Takeyama (2.8 GHz - 13 GHz)	Kazutaka Takeyama (13 GHz – 26.5 GHz)
Mode	Tx 11b 2462 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	49.11	27.67	14.11	39.46	2.32	53.75	73.90	20.1	185	9	
Hori.	4924.000	PK	49.08	31.37	7.56	42.90	2.32	47.43	73.90	26.4	132	146	
Hori.	7386.000	PK	48.43	37.01	9.35	43.28	2.32	53.83	73.90	20.0	150	0	floor noise
Hori.	9848.000	PK	48.23	39.12	10.57	42.92	2.32	57.32	73.90	16.5	150	0	floor noise
Hori.	7386.000	AV	40.07	37.01	9.35	43.28	2.32	45.47	53.90	8.4	150	0	floor noise
Hori.	9848.000	AV	38.38	39.12	10.57	42.92	2.32	47.47	53.90	6.4	150	0	floor noise
Vert.	2483.500	PK	47.71	27.67	14.11	39.46	2.32	52.35	73.90	21.5	189	14	
Vert.	4924.000	PK	49.23	31.37	7.56	42.90	2.32	47.58	73.90	26.3	130	59	
Vert.	7386.000	PK	48.18	37.01	9.35	43.28	2.32	53.58	73.90	20.3	150	0	floor noise
Vert.	9848.000	PK	48.50	39.12	10.57	42.92	2.32	57.59	73.90	16.3	150	0	floor noise
Vert.	7386.000	AV	39.46	37.01	9.35	43.28	2.32	44.86	53.90	9.0	150	0	floor noise
Vert.	9848.000	AV	38.57	39.12	10.57	42.92	2.32	47.66	53.90	6.2	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	40.22	27.67	14.11	39.46	0.18	2.32	45.04	53.90	8.8	*1)
Hori.	4924.000	AV	40.56	31.37	7.56	42.90	0.18	2.32	39.09	53.90	14.8	
Vert.	2483.500	AV	39.00	27.67	14.11	39.46	0.18	2.32	43.82	53.90	10.0	*1)
Vert.	4924.000	AV	40.85	31.37	7.56	42.90	0.18	2.32	39.38	53.90	14.5	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

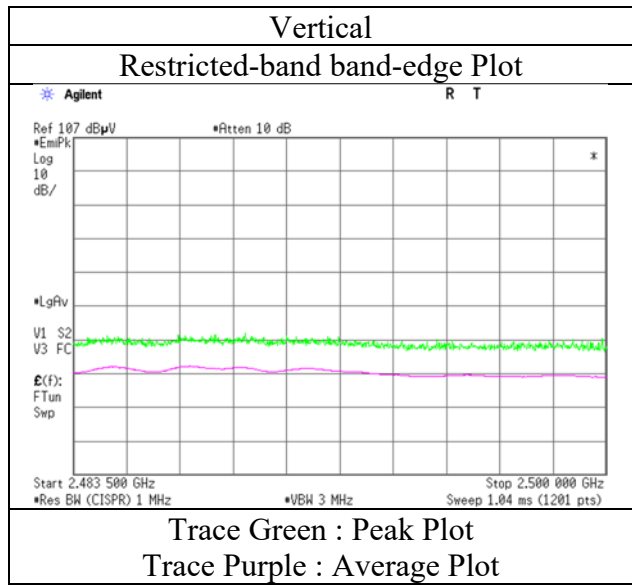
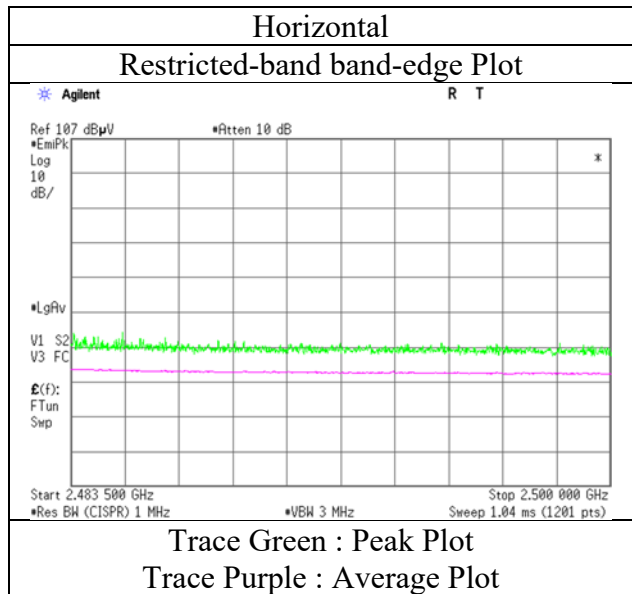
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date February 28, 2019
Temperature / Humidity 23 deg. C / 33 % RH
Engineer Kazutaka Takeyama
(1 GHz - 2.8 GHz)
Mode Tx 11b 2462 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12669310S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.2
Date	February 24, 2019	February 25, 2019
Temperature / Humidity	24 deg. C / 31 % RH	25 deg. C / 34 % RH
Engineer	Kazutaka Takeyama	Kazutaka Takeyama
	(1 GHz - 13 GHz)	(13 GHz - 26.5 GHz)
Mode	Tx 11g 2412 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	55.61	27.86	14.79	41.59	2.32	58.99	73.90	14.9	151	203	
Hori.	4824.000	PK	49.17	31.46	7.44	42.88	2.32	47.51	73.90	26.3	152	91	
Hori.	7236.000	PK	48.86	36.85	9.21	42.98	2.32	54.26	73.90	19.6	150	0	floor noise
Hori.	9648.000	PK	48.04	38.64	10.62	43.13	2.32	56.49	73.90	17.4	150	0	floor noise
Hori.	7236.000	AV	38.78	36.85	9.21	42.98	2.32	44.18	53.90	9.7	150	0	floor noise
Hori.	9648.000	AV	38.67	38.64	10.62	43.13	2.32	47.12	53.90	6.7	150	0	floor noise
Vert.	2390.000	PK	51.19	27.86	14.79	41.59	2.32	54.57	73.90	19.3	211	22	
Vert.	4824.000	PK	49.69	31.46	7.44	42.88	2.32	48.03	73.90	25.8	145	72	
Vert.	7236.000	PK	48.58	36.85	9.21	42.98	2.32	53.98	73.90	19.9	150	0	floor noise
Vert.	9648.000	PK	48.34	38.64	10.62	43.13	2.32	56.79	73.90	17.1	150	0	floor noise
Vert.	7236.000	AV	38.83	36.85	9.21	42.98	2.32	44.23	53.90	9.6	150	0	floor noise
Vert.	9648.000	AV	38.70	38.64	10.62	43.13	2.32	47.15	53.90	6.7	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	40.57	27.86	14.79	41.59	0.84	2.32	44.79	53.90	9.1	*1)
Hori.	4824.000	AV	39.26	31.46	7.44	42.88	0.84	2.32	38.44	53.90	15.4	
Vert.	2390.000	AV	40.70	27.86	14.79	41.59	0.84	2.32	44.92	53.90	8.9	*1)
Vert.	4824.000	AV	39.18	31.46	7.44	42.88	0.84	2.32	38.36	53.90	15.5	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	89.12	27.85	14.81	41.60	2.32	92.50	-	-	Carrier
Hori.	2400.000	PK	52.84	27.85	14.81	41.60	2.32	56.22	72.50	16.2	
Vert.	2412.000	PK	88.81	27.85	14.81	41.60	2.32	92.19	-	-	Carrier
Vert.	2400.000	PK	54.23	27.86	14.80	41.60	2.32	57.61	72.19	14.5	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

UL Japan, Inc.

Shonan EMC Lab.

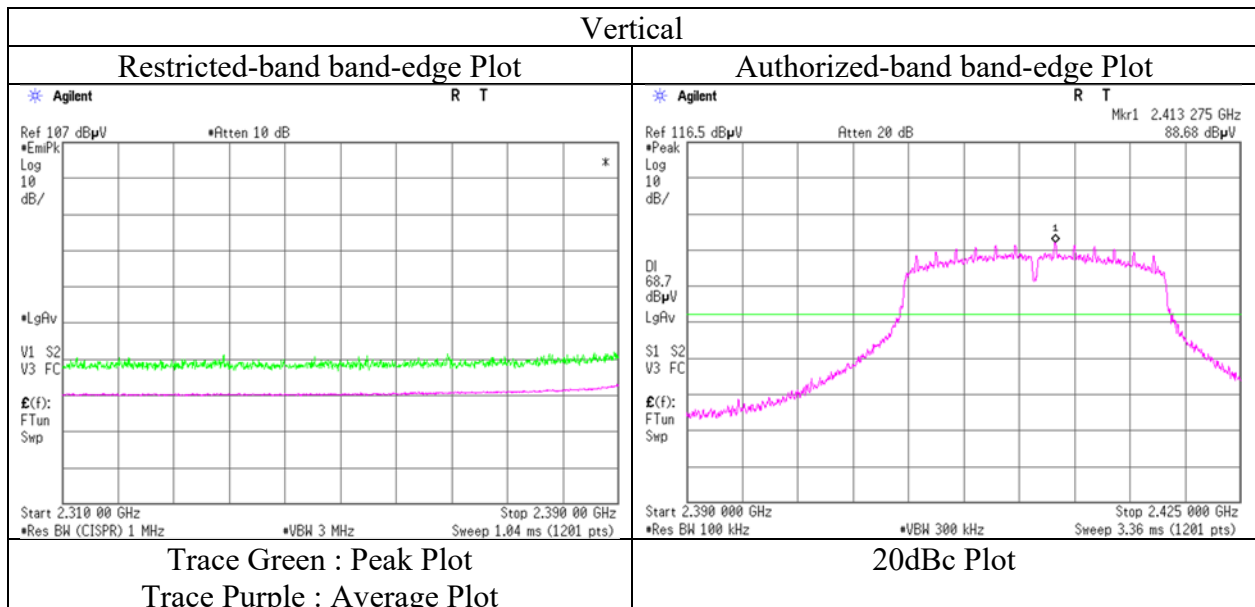
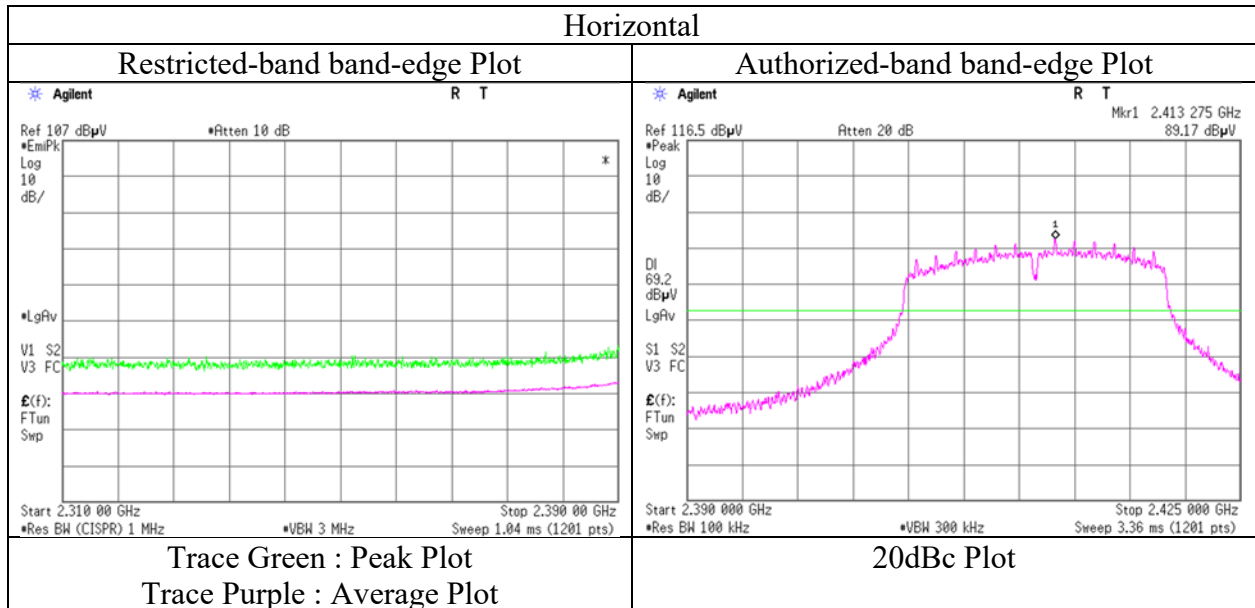
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date February 24, 2019
Temperature / Humidity 24 deg. C / 31 % RH
Engineer Kazutaka Takeyama
(1 GHz - 2.8 GHz)
Mode Tx 11g 2412 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.2	No.2
Date	February 20, 2019	February 28, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	23 deg. C / 33 % RH	25 deg. C / 34 % RH
Engineer	Yosuke Ishikawa	Kazutaka Takeyama	Kazutaka Takeyama
	(30 MHz - 1 GHz)	(1 GHz - 2.8 GHz)	(2.8 GHz - 26.5 GHz)
Mode	Tx 11g 2437 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	33.338	QP	23.70	17.37	7.10	31.84	0.00	16.33	40.00	23.6	193	215	
Hori.	187.510	QP	23.70	16.41	8.97	31.77	0.00	17.31	43.50	26.1	286	4	
Hori.	319.254	QP	30.30	14.24	7.04	31.77	0.00	19.81	46.00	26.1	100	19	
Hori.	375.347	QP	24.70	15.14	7.36	31.80	0.00	15.40	46.00	30.6	153	226	
Hori.	915.385	QP	23.80	22.13	9.71	31.24	0.00	24.40	46.00	21.6	100	309	
Hori.	4874.000	PK	47.37	31.17	6.63	39.50	2.32	47.99	73.90	25.9	137	80	
Hori.	7311.000	PK	46.57	36.82	7.69	39.35	2.32	54.05	73.90	19.8	150	0	floor noise
Hori.	9748.000	PK	46.36	38.55	8.89	39.42	2.32	56.70	73.90	17.2	150	0	floor noise
Hori.	7311.000	AV	36.36	36.82	7.69	39.35	2.32	43.84	53.90	10.0	150	0	floor noise
Hori.	9748.000	AV	36.07	38.55	8.89	39.42	2.32	46.41	53.90	7.4	150	0	floor noise
Vert.	67.826	QP	25.80	6.82	7.38	31.82	0.00	8.18	40.00	31.8	100	255	
Vert.	187.867	QP	23.70	16.49	8.98	31.77	0.00	17.40	43.50	26.1	100	105	
Vert.	247.215	QP	27.30	11.70	6.34	31.75	0.00	13.59	46.00	32.4	100	140	
Vert.	476.023	QP	25.20	17.15	7.80	31.89	0.00	18.26	46.00	27.7	100	1	
Vert.	905.532	QP	23.70	22.08	9.69	31.32	0.00	24.15	46.00	21.8	100	53	
Vert.	4874.000	PK	47.41	31.17	6.63	39.50	2.32	48.03	73.90	25.8	158	74	
Vert.	7311.000	PK	46.13	36.82	7.69	39.35	2.32	53.61	73.90	20.2	150	0	floor noise
Vert.	9748.000	PK	46.11	38.55	8.89	39.42	2.32	56.45	73.90	17.4	150	0	floor noise
Vert.	7311.000	AV	36.03	36.82	7.69	39.35	2.32	43.51	53.90	10.3	150	0	floor noise
Vert.	9748.000	AV	36.51	38.55	8.89	39.42	2.32	46.85	53.90	7.0	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4874.000	AV	37.20	31.17	6.63	39.50	0.84	2.32	38.66	53.90	15.2	
Vert.	4874.000	AV	37.26	31.17	6.63	39.50	0.84	2.32	38.72	53.90	15.1	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

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Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.2
Date	February 28, 2019	February 24, 2019	February 25, 2019
Temperature / Humidity	23 deg. C / 33 % RH	24 deg. C / 31 % RH	25 deg. C / 34 % RH
Engineer	Kazutaka Takeyama (1 GHz - 2.8 GHz)	Kazutaka Takeyama (2.8 GHz - 13 GHz)	Kazutaka Takeyama (13 GHz - 26.5 GHz)
Mode	Tx 11g 2462 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	51.02	27.65	14.88	41.62	2.32	54.25	73.90	19.6	128	11	
Hori.	4924.000	PK	49.46	31.37	7.56	42.90	2.32	47.81	73.90	26.0	147	104	
Hori.	7386.000	PK	48.22	37.01	9.35	43.28	2.32	53.62	73.90	20.2	150	0	floor noise
Hori.	9848.000	PK	48.02	39.12	10.57	42.92	2.32	57.11	73.90	16.7	150	0	floor noise
Hori.	7386.000	AV	39.29	37.01	9.35	43.28	2.32	44.69	53.90	9.2	150	0	floor noise
Hori.	9848.000	AV	38.74	39.12	10.57	42.92	2.32	47.83	53.90	6.0	150	0	floor noise
Vert.	2483.500	PK	53.25	27.65	14.88	41.62	2.32	56.48	73.90	17.4	148	357	
Vert.	4924.000	PK	49.78	31.37	7.56	42.90	2.32	48.13	73.90	25.7	153	69	
Vert.	7386.000	PK	48.25	37.01	9.35	43.28	2.32	53.65	73.90	20.2	150	0	floor noise
Vert.	9848.000	PK	46.90	39.12	10.57	42.92	2.32	55.99	73.90	17.9	150	0	floor noise
Vert.	7386.000	AV	39.40	37.01	9.35	43.28	2.32	44.80	53.90	9.1	150	0	floor noise
Vert.	9848.000	AV	38.56	39.12	10.57	42.92	2.32	47.65	53.90	6.2	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	40.66	27.65	14.88	41.62	0.84	2.32	44.73	53.90	9.1	*1)
Hori.	4924.000	AV	39.41	31.37	7.56	42.90	0.84	2.32	38.60	53.90	15.3	
Vert.	2483.500	AV	41.26	27.65	14.88	41.62	0.84	2.32	45.33	53.90	8.5	*1)
Vert.	4924.000	AV	39.62	31.37	7.56	42.90	0.84	2.32	38.81	53.90	15.0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

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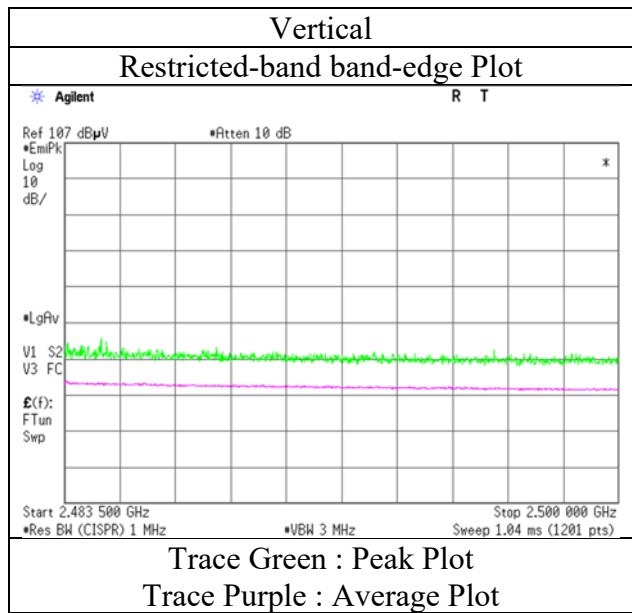
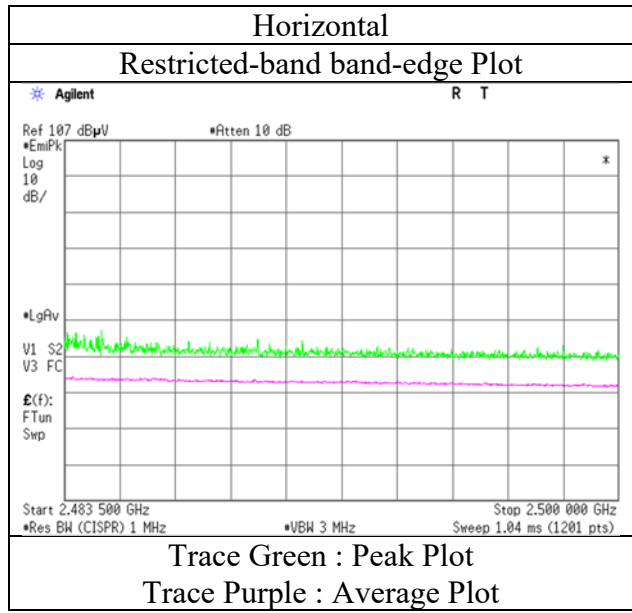
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date February 28, 2019
Temperature / Humidity 23 deg. C / 33 % RH
Engineer Kazutaka Takeyama
(1 GHz - 2.8 GHz)
Mode Tx 11g 2462 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.2
Date	February 28, 2019	February 24, 2019	February 25, 2019
Temperature / Humidity	23 deg. C / 33 % RH	24 deg. C / 31 % RH	25 deg. C / 34 % RH
Engineer	Kazutaka Takeyama (1 GHz - 2.8 GHz)	Kazutaka Takeyama (2.8 GHz - 13 GHz)	Kazutaka Takeyama (13 GHz - 26.5 GHz)
Mode	Tx 11n-20 2412 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	48.91	27.91	14.05	39.46	2.32	53.73	73.90	20.1	228	2	
Hori.	4824.000	PK	48.89	31.46	7.44	42.88	2.32	47.23	73.90	26.6	148	15	
Hori.	7236.000	PK	47.49	36.85	9.21	42.98	2.32	52.89	73.90	21.0	150	0	floor noise
Hori.	9648.000	PK	47.47	38.64	10.62	43.13	2.32	55.92	73.90	17.9	150	0	floor noise
Hori.	7236.000	AV	38.74	36.85	9.21	42.98	2.32	44.14	53.90	9.7	150	0	floor noise
Hori.	9648.000	AV	38.50	38.64	10.62	43.13	2.32	46.95	53.90	6.9	150	0	floor noise
Vert.	2390.000	PK	49.95	27.91	14.05	39.46	2.32	54.77	73.90	19.1	249	36	
Vert.	4824.000	PK	49.42	31.46	7.44	42.88	2.32	47.76	73.90	26.1	133	71	
Vert.	7236.000	PK	48.31	36.85	9.21	42.98	2.32	53.71	73.90	20.1	150	0	floor noise
Vert.	9648.000	PK	48.03	38.64	10.62	43.13	2.32	56.48	73.90	17.4	150	0	floor noise
Vert.	7236.000	AV	38.83	36.85	9.21	42.98	2.32	44.23	53.90	9.6	150	0	floor noise
Vert.	9648.000	AV	38.83	38.64	10.62	43.13	2.32	47.28	53.90	6.6	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	39.10	27.91	14.05	39.46	0.62	2.32	44.54	53.90	9.3	*1)
Hori.	4824.000	AV	39.15	31.46	7.44	42.88	0.62	2.32	38.11	53.90	15.7	
Vert.	2390.000	AV	38.52	27.91	14.05	39.46	0.62	2.32	43.96	53.90	9.9	*1)
Vert.	4824.000	AV	39.53	31.46	7.44	42.88	0.62	2.32	38.49	53.90	15.4	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	86.94	27.88	14.07	39.46	2.32	91.75	-	-	Carrier
Hori.	2400.000	PK	53.08	27.91	14.06	39.46	2.32	57.91	71.75	13.8	
Vert.	2412.000	PK	86.72	27.88	14.07	39.46	2.32	91.53	-	-	Carrier
Vert.	2400.000	PK	52.98	27.91	14.06	39.46	2.32	57.81	71.53	13.7	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

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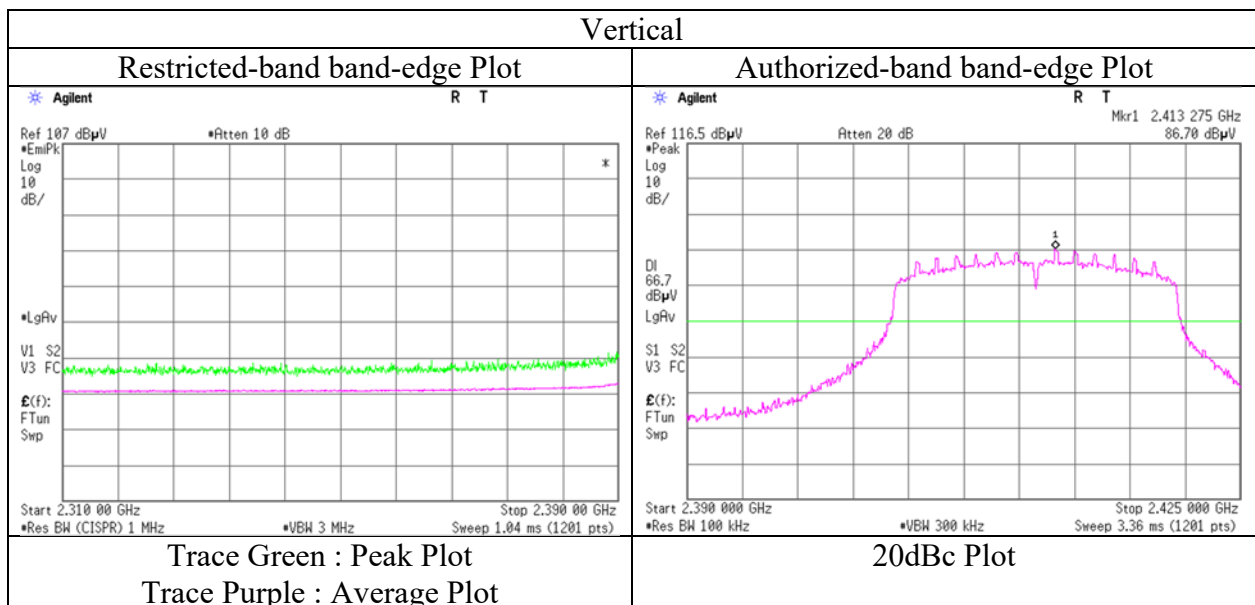
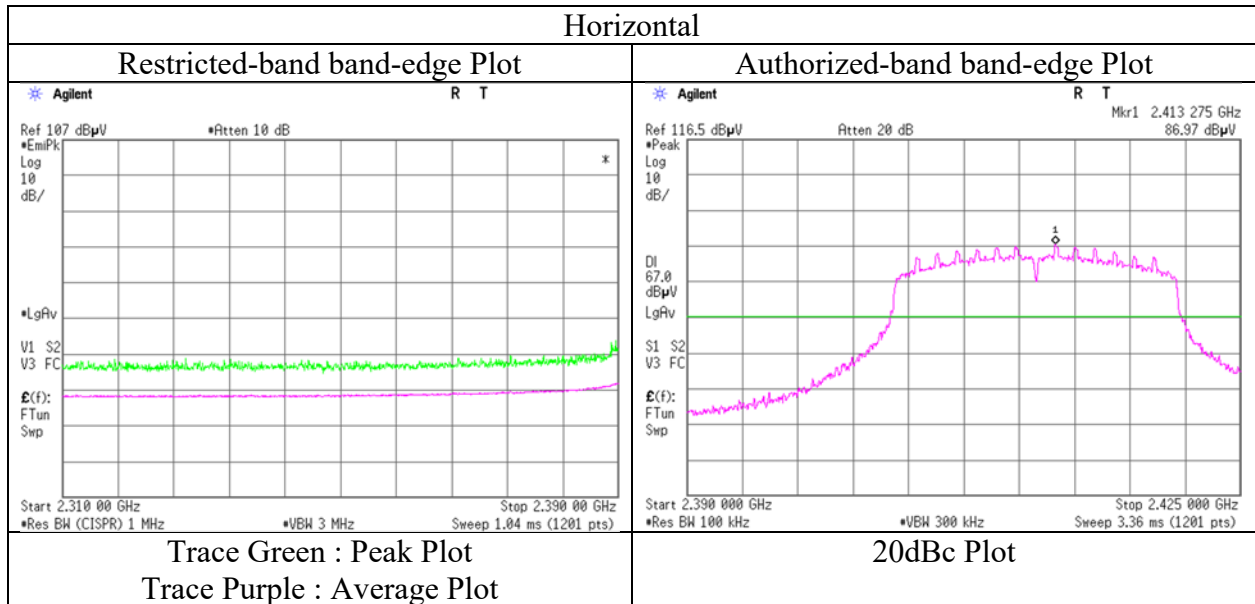
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date February 28, 2019
Temperature / Humidity 23 deg. C / 31 % RH
Engineer Kazutaka Takeyama
(1 GHz - 2.8 GHz)
Mode Tx 11n-20 2412 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12669310S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.2
Date	February 20, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	25 deg. C / 34 % RH
Engineer	Yosuke Ishikawa	Kazutaka Takeyama
	(30 MHz - 1 GHz)	(1 GHz - 26.5 GHz)
Mode	Tx 11n-20 2437 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	4874.000	PK	47.77	31.17	6.63	39.50	2.32	48.39	73.90	25.5	144	57	
Hori.	7311.000	PK	46.21	36.82	7.69	39.35	2.32	53.69	73.90	20.2	150	0	floor noise
Hori.	9748.000	PK	46.44	38.55	8.89	39.42	2.32	56.78	73.90	17.1	150	0	floor noise
Hori.	7311.000	AV	36.52	36.82	7.69	39.35	2.32	44.00	53.90	9.9	150	0	floor noise
Hori.	9748.000	AV	36.74	38.55	8.89	39.42	2.32	47.08	53.90	6.8	150	0	floor noise
Vert.	4874.000	PK	47.27	31.17	6.63	39.50	2.32	47.89	73.90	26.0	148	49	
Vert.	7311.000	PK	46.59	36.82	7.69	39.35	2.32	54.07	73.90	19.8	150	0	floor noise
Vert.	9748.000	PK	46.25	38.55	8.89	39.42	2.32	56.59	73.90	17.3	150	0	floor noise
Vert.	7311.000	AV	36.21	36.82	7.69	39.35	2.32	43.69	53.90	10.2	150	0	floor noise
Vert.	9748.000	AV	36.33	38.55	8.89	39.42	2.32	46.67	53.90	7.2	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4874.000	AV	37.74	31.17	6.63	39.50	0.62	2.32	38.98	53.90	14.9	
Vert.	4874.000	AV	37.41	31.17	6.63	39.50	0.62	2.32	38.65	53.90	15.2	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

Radiated Spurious Emission

Report No.	12669310S-A-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	No.1	No.2	No.3	No.2
Date	February 20, 2019	February 28, 2019	February 24, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	23 deg. C / 31 % RH	24 deg. C / 31 % RH	25 deg. C / 34 % RH
Engineer	Yosuke Ishikawa	Kazutaka Takeyama	Kazutaka Takeyama	Kazutaka Takeyama
	(30 MHz - 1 GHz)	(1 GHz - 2.8 GHz)	(2.8 GHz - 13 GHz)	(13 GHz - 26.5 GHz)
Mode	Tx 11n-20 2462 MHz			

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	50.47	27.67	14.11	39.46	2.32	55.11	73.90	18.7	188	11	
Hori.	4924.000	PK	49.11	31.37	7.56	42.90	2.32	47.46	73.90	26.4	169	54	
Hori.	7386.000	PK	48.89	37.01	9.35	43.28	2.32	54.29	73.90	19.6	150	0	floor noise
Hori.	9848.000	PK	48.88	39.12	10.57	42.92	2.32	57.97	73.90	15.9	150	0	floor noise
Hori.	7386.000	AV	38.75	37.01	9.35	43.28	2.32	44.15	53.90	9.7	150	0	floor noise
Hori.	9848.000	AV	37.99	39.12	10.57	42.92	2.32	47.08	53.90	6.8	150	0	floor noise
Vert.	2483.500	PK	51.55	27.67	14.11	39.46	2.32	56.19	73.90	17.7	184	5	
Vert.	4924.000	PK	49.97	31.37	7.56	42.90	2.32	48.32	73.90	25.5	158	85	
Vert.	7386.000	PK	48.60	37.01	9.35	43.28	2.32	54.00	73.90	19.9	150	0	floor noise
Vert.	9848.000	PK	48.11	39.12	10.57	42.92	2.32	57.20	73.90	16.7	150	0	floor noise
Vert.	7386.000	AV	39.31	37.01	9.35	43.28	2.32	44.71	53.90	9.1	150	0	floor noise
Vert.	9848.000	AV	38.75	39.12	10.57	42.92	2.32	47.84	53.90	6.0	150	0	floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	39.19	27.67	14.11	39.46	0.62	2.32	44.45	53.90	9.4	*1)
Hori.	4924.000	AV	38.49	31.37	7.56	42.90	0.62	2.32	37.46	53.90	16.4	
Vert.	2483.500	AV	39.51	27.67	14.11	39.46	0.62	2.32	44.77	53.90	9.1	*1)
Vert.	4924.000	AV	39.36	31.37	7.56	42.90	0.62	2.32	38.33	53.90	15.5	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

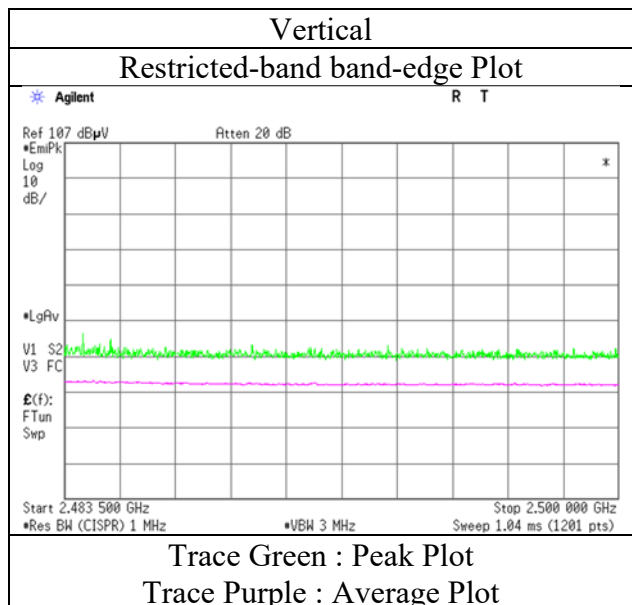
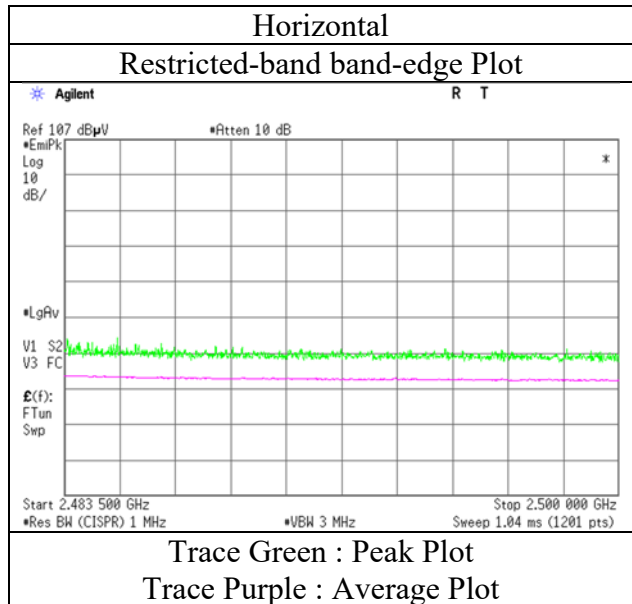
13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.2
Date February 28, 2019
Temperature / Humidity 23 deg. C / 31 % RH
Engineer Kazutaka Takeyama
(1 GHz - 2.8 GHz)
Mode Tx 11n-20 2412 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.2
Date	February 20, 2019	February 18, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	21 deg. C / 27 % RH	25 deg. C / 34 % RH
Engineer	Yosuke Ishikawa (30 MHz - 1 GHz)	Yosuke Ishikawa (1 GHz - 13 GHz)	Kazutaka Takeyama (13 GHz - 26.5 GHz)
Mode	Tx BT LE 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	30.546	QP	24.10	18.38	7.02	31.84	0.00	17.66	40.00	22.3	153	356	
Hori.	188.802	QP	24.20	16.57	8.99	31.77	0.00	17.99	43.50	25.5	258	140	
Hori.	365.869	QP	26.70	15.08	7.32	31.79	0.00	17.31	46.00	28.6	153	263	
Hori.	612.425	QP	24.30	19.59	8.37	32.02	0.00	20.24	46.00	25.7	147	52	
Hori.	924.707	QP	23.60	22.08	9.74	31.18	0.00	24.24	46.00	21.7	183	266	
Hori.	2390.000	PK	46.51	27.89	14.79	39.46	2.32	52.05	73.90	21.8	123	10	
Hori.	4804.000	PK	53.36	31.35	7.42	39.50	2.32	54.95	73.90	18.9	125	0	
Hori.	7206.000	PK	45.44	36.78	9.18	39.29	2.32	54.43	73.90	19.4	100	0	
Hori.	9608.000	PK	45.93	38.10	10.63	39.52	2.32	57.46	73.90	16.4	100	0	
Vert.	31.355	QP	23.70	18.05	7.04	31.84	0.00	16.95	40.00	23.0	100	217	
Vert.	67.471	QP	27.30	6.87	7.35	31.82	0.00	9.70	40.00	30.3	100	102	
Vert.	192.100	QP	23.80	16.54	9.00	31.77	0.00	17.57	43.50	25.9	100	143	
Vert.	604.364	QP	24.10	19.43	8.34	32.01	0.00	19.86	46.00	26.1	162	95	
Vert.	917.528	QP	23.50	22.11	9.72	31.23	0.00	24.10	46.00	21.9	100	90	
Vert.	2390.000	PK	45.59	27.89	14.79	39.46	2.32	51.13	73.90	22.7	152	0	
Vert.	4804.000	PK	52.26	31.35	7.42	39.50	2.32	53.85	73.90	20.0	100	1	
Vert.	7206.000	PK	45.06	36.78	9.18	39.29	2.32	54.05	73.90	19.8	150	0	
Vert.	9608.000	PK	45.09	38.10	10.63	39.52	2.32	56.62	73.90	17.2	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Averaging factor(Duty factor)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	PK	46.51	27.89	14.79	39.46	-12.40	2.32	39.65	53.90	14.3	*1)
Hori.	4804.000	PK	53.36	31.35	7.42	39.50	-12.40	2.32	42.55	53.90	11.4	
Hori.	7206.000	PK	45.44	36.78	9.18	39.29	-12.40	2.32	42.03	53.90	11.9	
Hori.	9608.000	PK	45.93	38.10	10.63	39.52	-12.40	2.32	45.06	53.90	8.8	
Vert.	2390.000	PK	45.59	27.89	14.79	39.46	-12.40	2.32	38.73	53.90	15.2	*1)
Vert.	4804.000	PK	52.26	31.35	7.42	39.50	-12.40	2.32	41.45	53.90	12.5	
Vert.	7206.000	PK	45.06	36.78	9.18	39.29	-12.40	2.32	41.65	53.90	12.3	
Vert.	9608.000	PK	45.09	38.10	10.63	39.52	-12.40	2.32	44.22	53.90	9.7	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Averaging Factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Averaging factor refer to "Averaging factor (Duty factor) Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	92.38	27.88	14.80	39.46	2.32	97.92	-	-	Carrier
Hori.	2400.000	PK	37.57	27.89	14.80	39.46	2.32	43.12	77.92	34.8	
Vert.	2402.000	PK	91.72	27.88	14.80	39.46	2.32	97.26	-	-	Carrier
Vert.	2400.000	PK	37.80	27.89	14.80	39.46	2.32	43.35	77.26	33.9	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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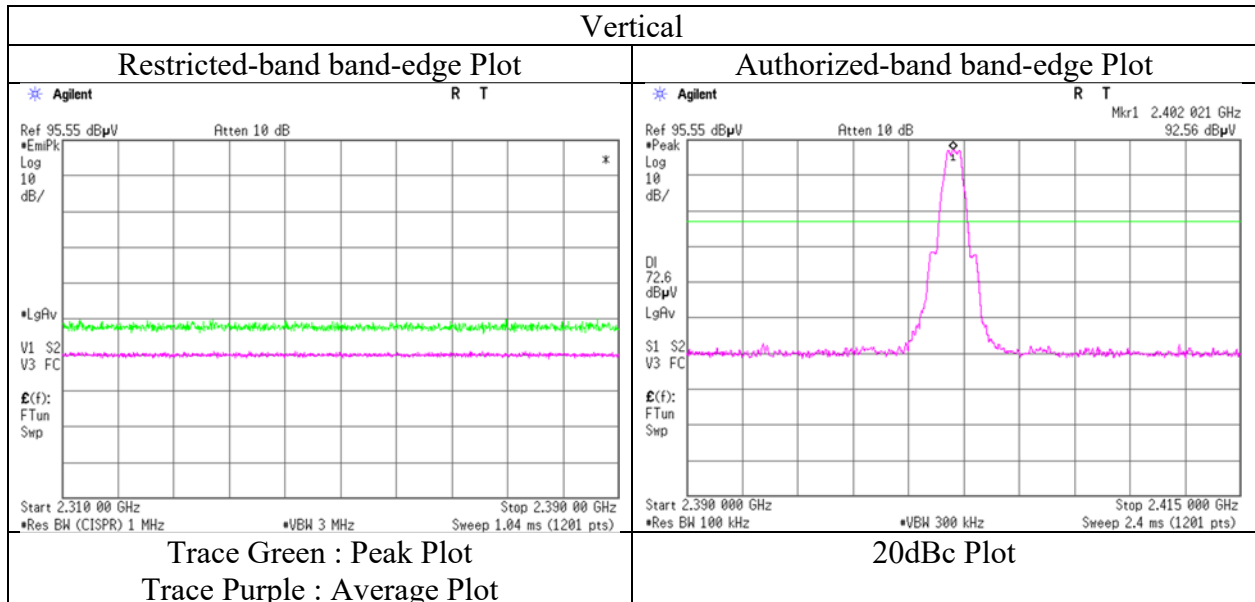
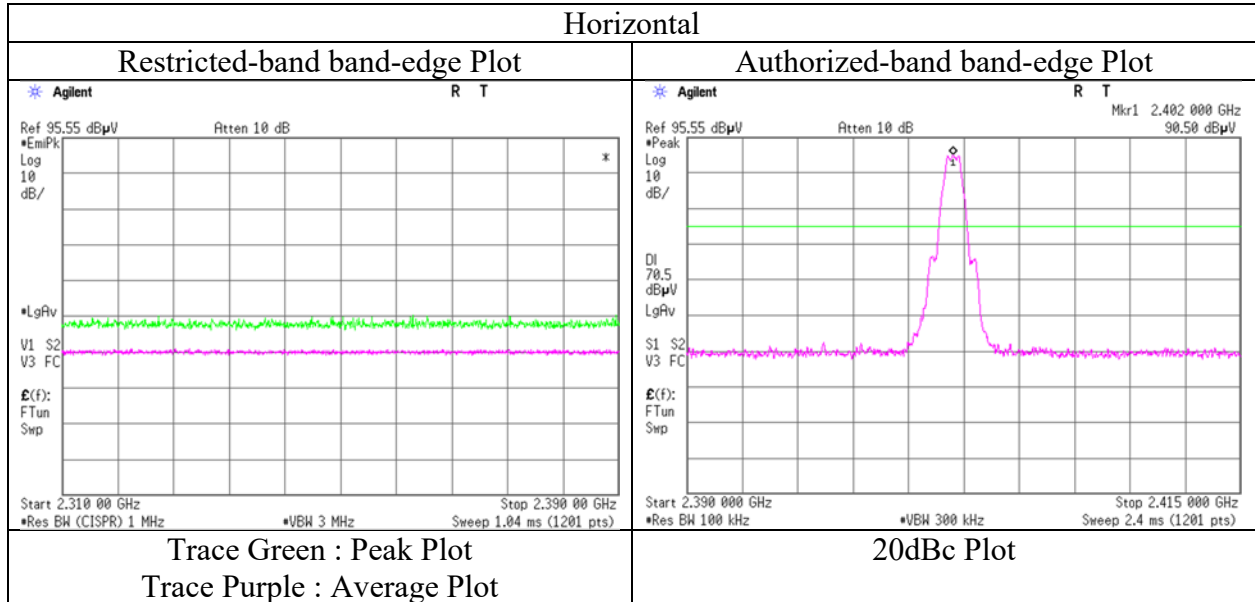
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.1
Date February 18, 2019
Temperature / Humidity 21 deg. C / 27 % RH
Engineer Yosuke Ishikawa
(1 GHz - 13 GHz)
Mode Tx BT LE 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.2
Date	February 20, 2019	February 18, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	21 deg. C / 27 % RH	25 deg. C / 34 % RH
Engineer	Yosuke Ishikawa	Yosuke Ishikawa	Kazutaka Takeyama
	(30 MHz - 1 GHz)	(1 GHz - 13 GHz)	(13 GHz - 26.5 GHz)
Mode	Tx BT LE 2440 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	33.152	QP	24.30	17.46	7.09	31.84	0.00	17.01	40.00	22.9	155	138	
Hori.	189.331	QP	23.60	16.56	8.98	31.77	0.00	17.37	43.50	26.1	253	119	
Hori.	325.841	QP	26.60	14.41	7.08	31.77	0.00	16.32	46.00	29.6	150	250	
Hori.	616.421	QP	24.10	19.62	8.39	32.02	0.00	20.09	46.00	25.9	150	204	
Hori.	915.144	QP	23.80	22.13	9.71	31.25	0.00	24.39	46.00	21.6	182	256	
Hori.	4880.000	PK	51.09	31.20	7.51	39.50	2.32	52.62	73.90	21.2	119	12	
Hori.	7320.000	PK	44.75	36.71	9.29	39.35	2.32	53.72	73.90	20.1	150	0	
Hori.	9760.000	PK	44.72	38.60	10.60	39.41	2.32	56.83	73.90	17.0	150	0	
Vert.	34.269	QP	23.70	16.96	7.11	31.84	0.00	15.93	40.00	24.0	100	337	
Vert.	68.402	QP	27.20	6.75	7.41	31.82	0.00	9.54	40.00	30.4	100	82	
Vert.	193.649	QP	24.00	16.67	9.02	31.77	0.00	17.92	43.50	25.5	100	41	
Vert.	628.193	QP	24.20	19.54	8.45	32.04	0.00	20.15	46.00	25.8	155	114	
Vert.	905.771	QP	23.70	22.08	9.69	31.32	0.00	24.15	46.00	21.8	100	232	
Vert.	4880.000	PK	49.19	31.20	7.51	39.50	2.32	50.72	73.90	23.1	100	1	
Vert.	7320.000	PK	44.39	36.71	9.29	39.35	2.32	53.36	73.90	20.5	150	0	
Vert.	9760.000	PK	45.30	38.60	10.60	39.41	2.32	57.41	73.90	16.4	150	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Peak measurement value with Averaging factor(Duty factor)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	PK	51.09	31.20	7.51	39.50	-12.40	2.32	40.22	53.90	13.7	
Hori.	7320.000	PK	44.75	36.71	9.29	39.35	-12.40	2.32	41.32	53.90	12.6	
Hori.	9760.000	PK	44.72	38.60	10.60	39.41	-12.40	2.32	44.43	53.90	9.5	
Vert.	4880.000	PK	49.19	31.20	7.51	39.50	-12.40	2.32	38.32	53.90	15.6	
Vert.	7320.000	PK	44.39	36.71	9.29	39.35	-12.40	2.32	40.96	53.90	12.9	
Vert.	9760.000	PK	45.30	38.60	10.60	39.41	-12.40	2.32	45.01	53.90	8.9	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Averaging Factor + Distance factor
Distance factor : 1 GHz - 13 GHz : $20\log(3.92\text{ m} / 3.0\text{ m}) = 2.32\text{ dB}$
13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Averaging factor refer to "Averaging factor (Duty factor) Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

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Radiated Spurious Emission

Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.2
Date	February 20, 2019	February 18, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	21 deg. C / 27 % RH	25 deg. C / 34 % RH
Engineer	Yosuke Ishikawa	Yosuke Ishikawa	Kazutaka Takeyama
	(30 MHz - 1 GHz)	(1 GHz - 13 GHz)	(13 GHz - 26.5 GHz)
Mode	Tx BT LE 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	31.144	QP	24.50	18.14	7.04	31.84	0.00	17.84	40.00	22.1	155	113	
Hori.	188.665	QP	24.00	16.56	8.98	31.77	0.00	17.77	43.50	25.7	255	157	
Hori.	373.581	QP	28.60	15.12	7.35	31.80	0.00	19.27	46.00	26.7	150	260	
Hori.	600.003	QP	24.70	19.31	8.32	32.00	0.00	20.33	46.00	25.6	145	23	
Hori.	918.038	QP	23.40	22.11	9.72	31.23	0.00	24.00	46.00	22.0	185	225	
Hori.	2483.500	PK	47.15	27.64	14.88	39.46	2.32	52.53	73.90	21.3	142	18	
Hori.	4960.000	PK	55.75	31.40	7.61	39.50	2.32	57.58	73.90	16.3	101	11	
Hori.	7440.000	PK	45.12	36.84	9.39	39.42	2.32	54.25	73.90	19.6	150	0	
Hori.	9920.000	PK	44.66	38.77	10.56	39.30	2.32	57.01	73.90	16.8	150	0	
Vert.	31.747	QP	23.80	17.89	7.05	31.84	0.00	16.90	40.00	23.1	100	240	
Vert.	67.824	QP	27.10	6.82	7.38	31.82	0.00	9.48	40.00	30.5	100	267	
Vert.	192.959	QP	24.00	16.67	9.01	31.77	0.00	17.91	43.50	25.5	100	151	
Vert.	610.646	QP	24.50	19.59	8.37	32.02	0.00	20.44	46.00	25.5	152	209	
Vert.	928.995	QP	23.70	22.10	9.75	31.14	0.00	24.41	46.00	21.5	100	96	
Vert.	2483.500	PK	47.47	27.64	14.88	39.46	2.32	52.85	73.90	21.0	106	11	
Vert.	4960.000	PK	55.54	31.40	7.61	39.50	2.32	57.37	73.90	16.5	141	284	
Vert.	7440.000	PK	44.47	36.84	9.39	39.42	2.32	53.60	73.90	20.3	150	0	
Vert.	9920.000	PK	45.56	38.77	10.56	39.30	2.32	57.91	73.90	15.9	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Averaging factor(Duty factor)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Averaging Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	PK	47.15	27.64	14.88	39.46	-12.40	2.32	40.13	53.90	13.8	*1)
Hori.	4960.000	PK	55.75	31.40	7.61	39.50	-12.40	2.32	45.18	53.90	8.7	
Hori.	7440.000	PK	45.12	36.84	9.39	39.42	-12.40	2.32	41.85	53.90	12.1	
Hori.	9920.000	PK	44.66	38.77	10.56	39.30	-12.40	2.32	44.61	53.90	9.3	
Vert.	2483.500	PK	47.47	27.64	14.88	39.46	-12.40	2.32	40.45	53.90	13.5	*1)
Vert.	4960.000	PK	55.54	31.40	7.61	39.50	-12.40	2.32	44.97	53.90	8.9	
Vert.	7440.000	PK	44.47	36.84	9.39	39.42	-12.40	2.32	41.20	53.90	12.7	
Vert.	9920.000	PK	45.56	38.77	10.56	39.30	-12.40	2.32	45.51	53.90	8.4	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Averaging Factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log(3.92 m / 3.0 m) = 2.32 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Averaging factor refer to "Averaging factor (Duty factor) Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

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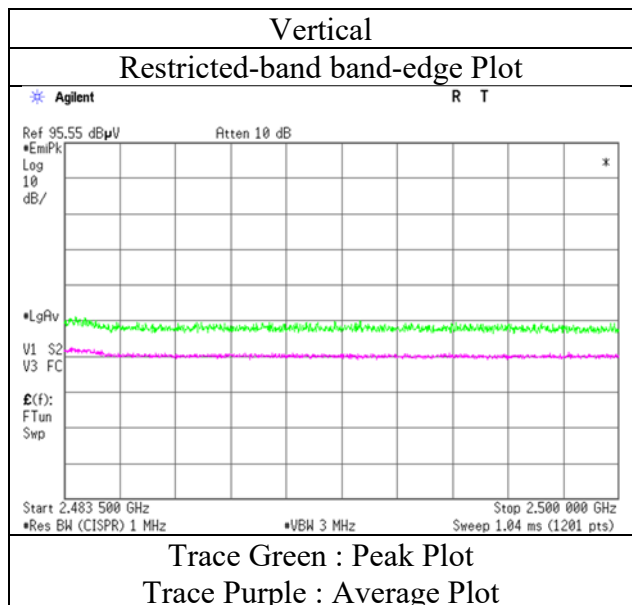
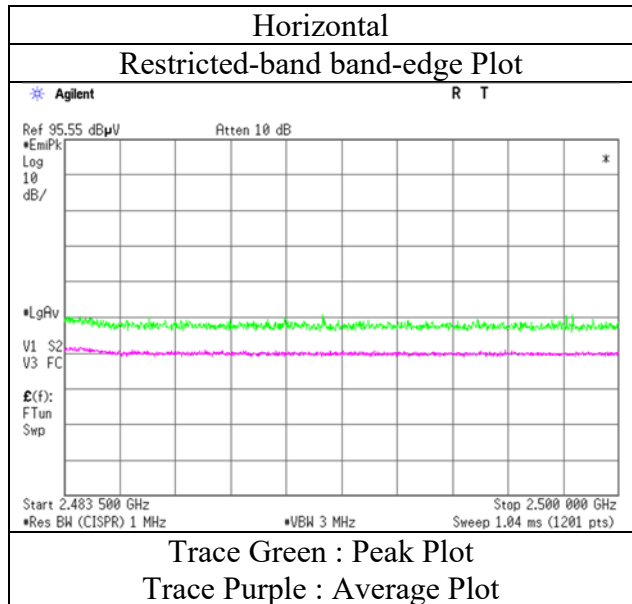
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Radiated Spurious Emission
(Reference Plot for band-edge)

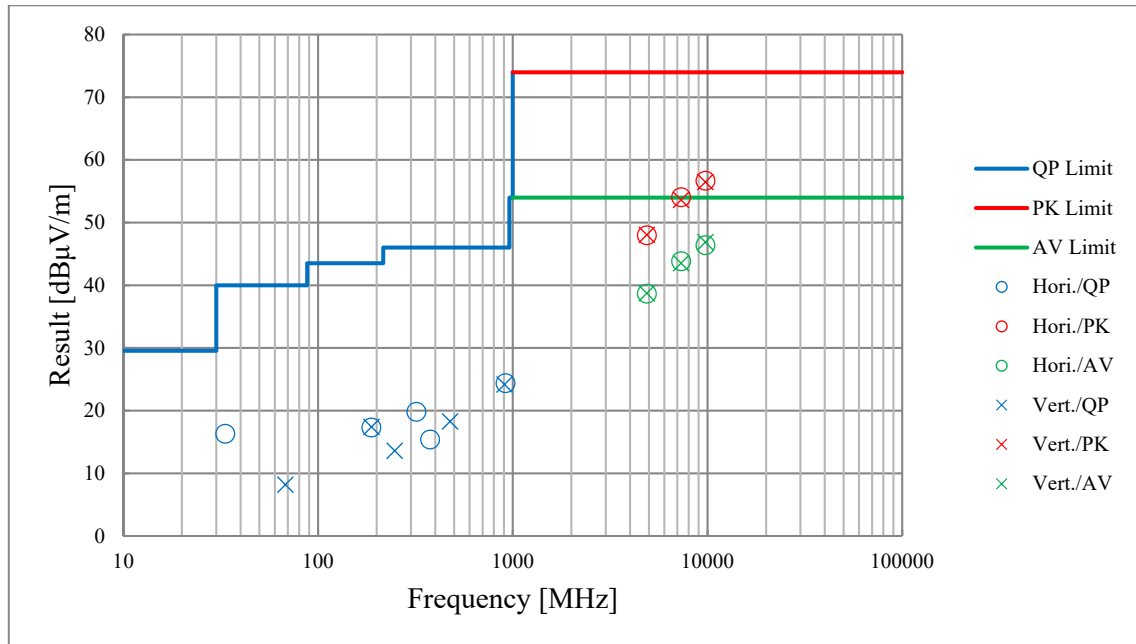
Report No. 12669310S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.1
Date February 18, 2019
Temperature / Humidity 21 deg. C / 27 % RH
Engineer Yosuke Ishikawa
(1 GHz - 13 GHz)
Mode Tx BT LE 2480 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case)

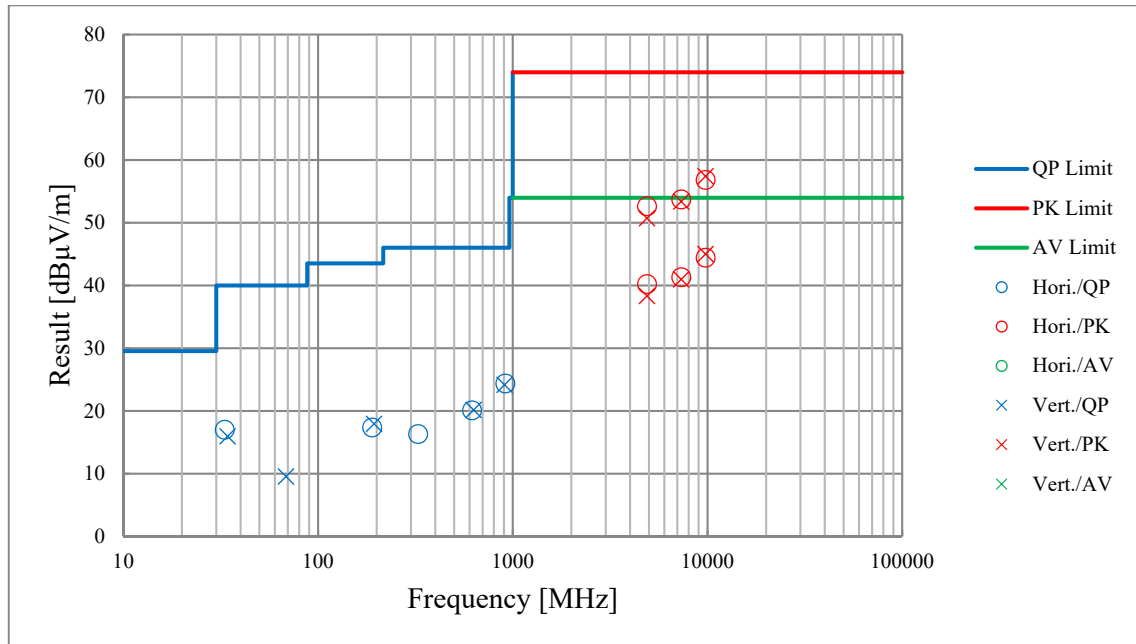
Report No.	12669310S-A-R1	No.2
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	
Date	February 20, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	25 deg. C / 34 % RH
Engineer	Yohsuke Ishikawa (30 MHz - 1 GHz)	Kazutaka Takeyama (1 GHz - 26.5 GHz)
Mode	Tx 11g 2437 MHz	



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

Radiated Spurious Emission
(Plot data, Worst case)

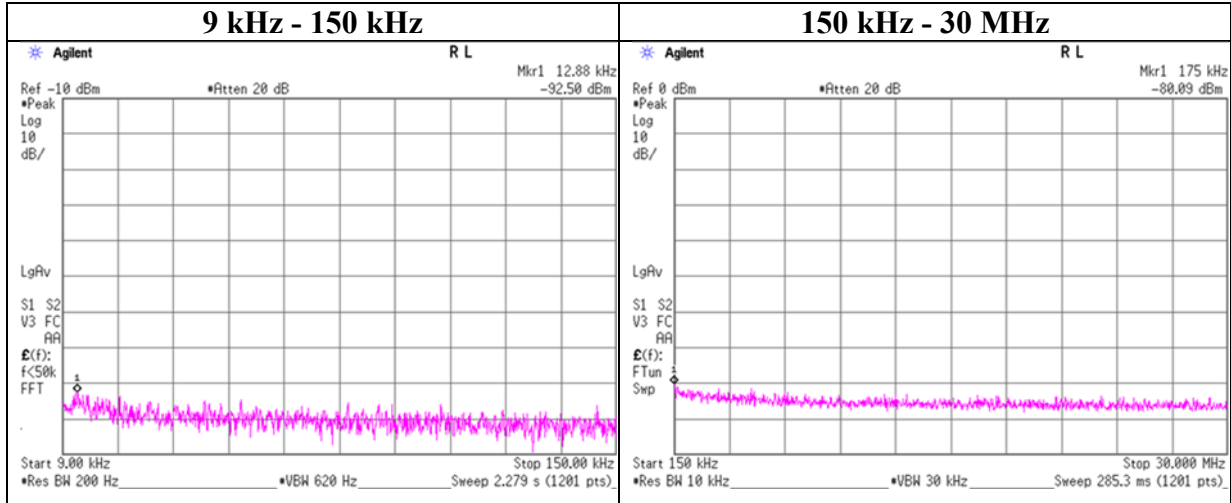
Report No.	12669310S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.1	No.1	No.2
Date	February 20, 2019	February 18, 2019	February 25, 2019
Temperature / Humidity	20 deg. C / 30 % RH	21 deg. C / 27 % RH	25 deg. C / 34 % RH
Engineer	Yosuke Ishikawa (30 MHz - 1 GHz)	Yosuke Ishikawa (1 GHz - 13 GHz)	Kazutaka Takeyama (13 GHz - 26.5 GHz)
Mode	Tx BT LE 2440 MHz		



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

Conducted Spurious Emission

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 21, 2019
Temperature / Humidity 24 deg. C / 34 % RH
Engineer Kazuya Noda
Mode Tx 11g 2437 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
12.88	-92.5	0.02	9.7	2.0	1	-80.7	300	6.0	-19.5	45.4	64.9	
175.00	-80.1	0.02	9.7	2.0	1	-68.3	300	6.0	-7.1	22.7	29.8	

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

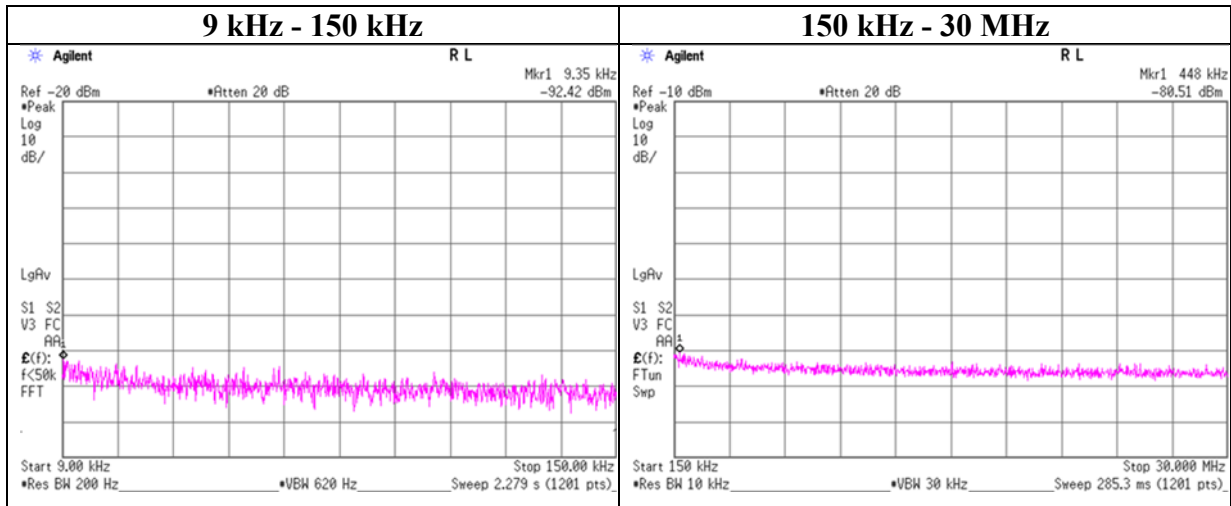
$$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$$

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

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 21, 2019
Temperature / Humidity 24 deg. C / 34 % RH
Engineer Kazuya Noda
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
9.35	-92.4	0.02	9.7	2.0	1	-80.7	300	6.0	-19.4	48.1	67.5	
448.00	-80.5	0.02	9.7	2.0	1	-68.7	300	6.0	-7.5	14.5	22.0	

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

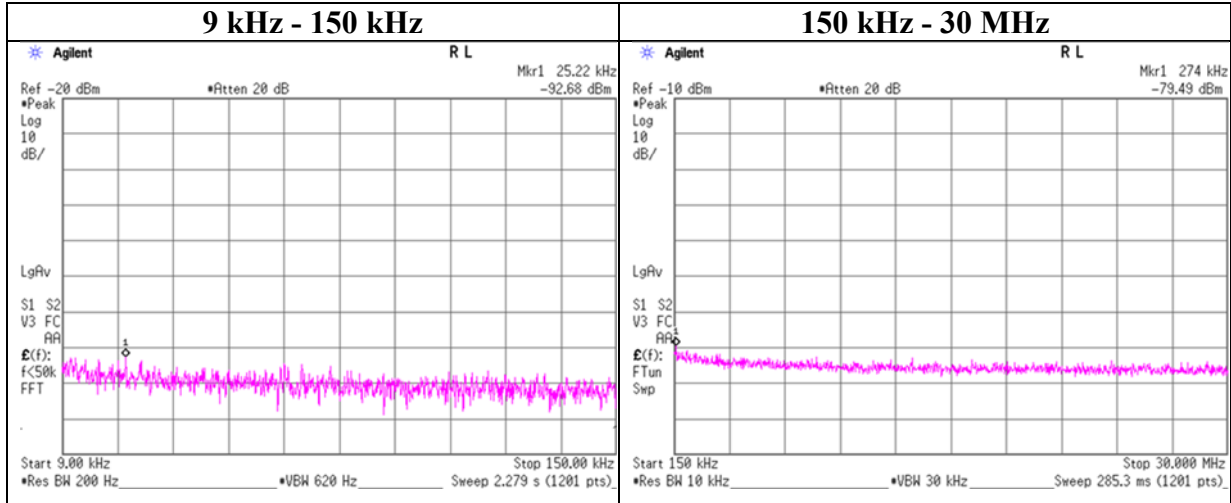
$$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$$

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

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 21, 2019
Temperature / Humidity 24 deg. C / 34 % RH
Engineer Kazuya Noda
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
25.22	-92.7	0.02	9.7	2.0	1	-80.9	300	6.0	-19.7	39.5	59.2	
274.00	-79.5	0.02	9.7	2.0	1	-67.7	300	6.0	-6.5	18.8	25.3	

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

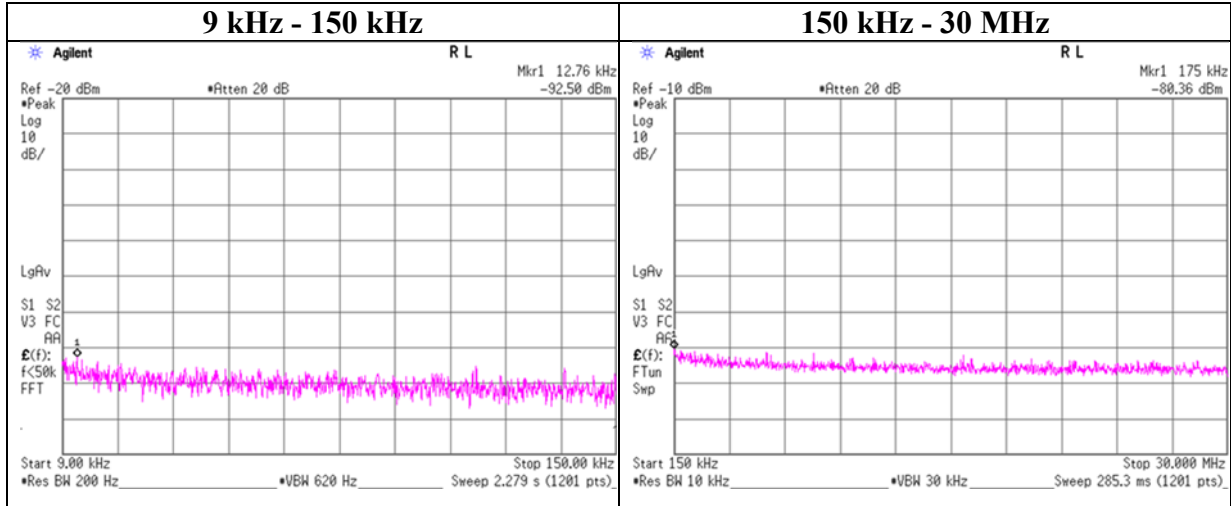
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$

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

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 21, 2019
Temperature / Humidity 24 deg. C / 34 % RH
Engineer Kazuya Noda
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
12.76	-92.5	0.02	9.7	2.0	1	-80.7	300	6.0	-19.5	45.4	64.9	
175.00	-80.4	0.02	9.7	2.0	1	-68.6	300	6.0	-7.3	22.7	30.0	

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

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

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.

Power Density

Report No. 12669310S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 21, 2019
Temperature / Humidity 24 deg. C / 34 % RH
Engineer Kazuya Noda
Mode Tx

11b

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412	-16.63	1.63	9.82	-5.18	8.00	13.18
2437	-15.36	1.64	9.82	-3.90	8.00	11.90
2462	-17.26	1.65	9.82	-5.79	8.00	13.79

11g

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412	-22.49	1.63	9.82	-11.04	8.00	19.04
2437	-22.87	1.64	9.82	-11.41	8.00	19.41
2462	-23.07	1.65	9.82	-11.60	8.00	19.60

11n-20

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2412	-25.02	1.63	9.82	-13.57	8.00	21.57
2437	-24.21	1.64	9.82	-12.75	8.00	20.75
2462	-24.44	1.65	9.82	-12.97	8.00	20.97

BT LE

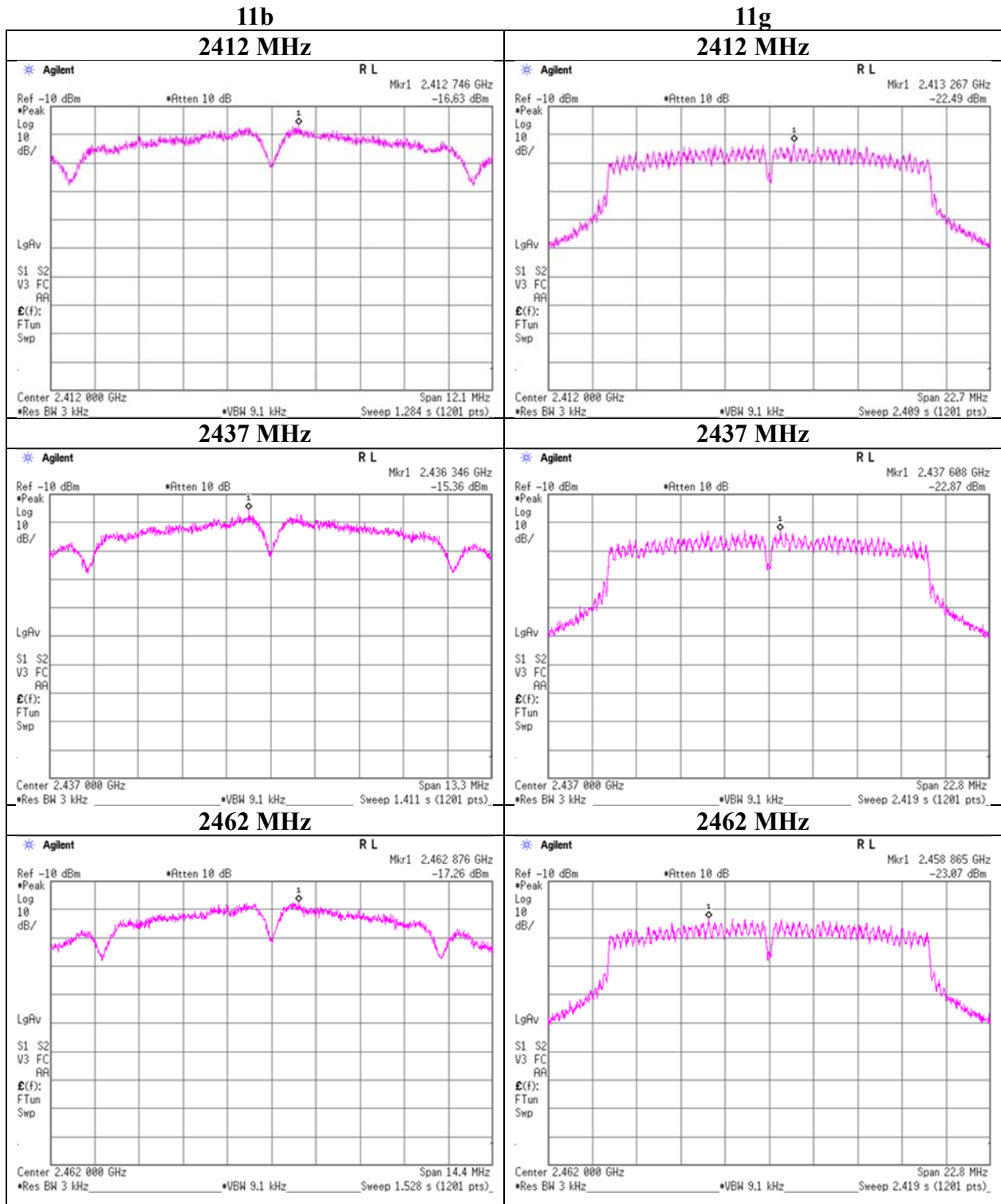
Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402	-19.62	1.63	9.82	-8.17	8.00	16.17
2440	-19.39	1.64	9.82	-7.93	8.00	15.93
2480	-19.61	1.65	9.82	-8.14	8.00	16.14

Sample Calculation:

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

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

Power Density



UL Japan, Inc.

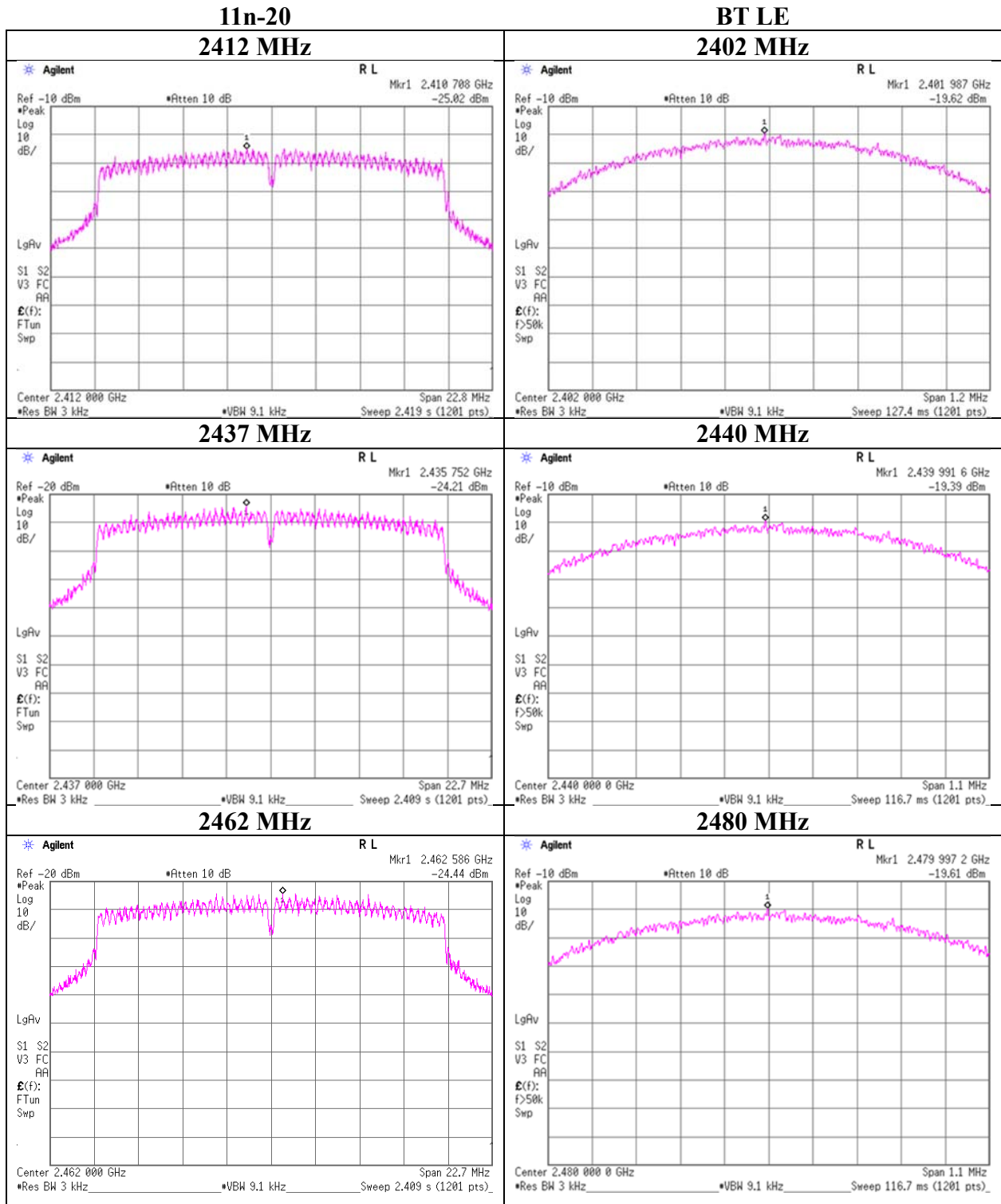
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Power Density



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APPENDIX 2: Test instruments

Test Instruments (1 / 2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SAT10-14	AT	154591	Attenuator	Weinschel Corp.	54A-10	81595	2018/4/20	2019/4/30	12
SCC-G32	AT	145183	Coaxial Cable	Junkosha	MWX241-02000KMSK MS	OCT-09-13-005	2018/11/25	2019/11/30	12
SOS-09	AT	146318	Humidity Indicator	A&D	AD-5681	4061484	2018/12/5	2019/12/31	12
SPM-06	AT	146267	Power Meter	ANRITSU	ML2495A	850009	2018/5/10	2019/5/31	12
SPSS-03	AT	146309	Power sensor	ANRITSU	MA2411B	917063	2018/5/10	2019/5/31	12
SSA-02	AT	145800	Spectrum Analyzer	AGILENT	E4448A	MY48250106	2018/3/5	2019/3/31	12
STS-05	AT	146212	Digital Hitester	HIOKI	3805-50	80997828	2018/10/16	2019/10/31	12
COTS-SEMI-5	RE,CE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE, ME,PE)	-	-	-	-
KAF-02	RE	144878	Pre Amplifier	HEWLETT PACKARD	8449B	3008A01268	2018/4/4	2019/4/30	12
KAT6-04	RE	144899	Attenuator	Inmet	18N-6dB	-	2018/12/25	2019/12/31	12
KJM-02	RE,CE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
KJM-09	RE,CE	145929	Measure	KOMELON	KMC-36	-	-	-	-
KSA-08	RE	145089	Spectrum Analyzer	AGILENT	E4446A	MY46180525	2018/10/7	2019/10/31	12
SAEC-01(NSA)	RE	145597	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	2018/5/29	2019/5/31	12
SAEC-01(SVSWR)	RE	145561	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	2018/7/19	2019/7/31	12
SAEC-02(SVSWR)	RE	145598	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	2018/7/15	2019/7/31	12
SAEC-03(SVSWR)	RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2018/7/17	2019/7/31	12
SAF-01	RE	145003	Pre Amplifier	SONOMA	310N	290211	2019/2/5	2020/2/29	12
SAF-04	RE	145127	Pre Amplifier	Toyo Corporation	TPA0118-36	2072554	2018/6/26	2019/6/30	12
SAF-06	RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2019/2/8	2020/2/29	12
SAT10-05	RE	145136	Attenuator(above1GHz)	AGILENT	8493C-010	74864	2018/11/25	2019/11/30	12
SAT10-06	RE	145137	Attenuator	AGILENT	8493C-010	74865	2018/11/25	2019/11/30	12
SAT3-09	RE	144959	Attenuator	JFW	50HF-003N	-	2018/8/23	2019/8/31	12
SBA-01	RE	145161	Biconical Antenna	Schwarzbeck	BBA9106	91032664	2018/6/5	2019/6/30	12
SCC-A1/A3/A5/A7/A8/A13/SRSE-01	RE	144967	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-269(RF Selector)	2018/4/9	2019/4/30	12
SCC-A2/A4/A6/A7/A8/A13/SRSE-01	RE	144968	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-269(RF Selector)	2018/4/9	2019/4/30	12
SCC-G05	RE	145039	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-037	2019/1/25	2020/1/31	12
SCC-G22	RE	145180	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	2018/5/11	2019/5/31	12
SCC-G40	RE	166491	Coaxial Cable	Junkosha	MWX221-01000NFSN MS/B	1612S005	2019/1/25	2020/1/31	12

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Test Instruments (2 / 2)

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SCC-G41	RE	151617	Coaxial Cable	Junkosha	MWX221-01000NFSN MS/B	1612S006	2019/1/25	2020/1/31	12
SCC-G43	RE	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104 E	SN MY 13406/4E	2018/7/10	2019/7/31	12
SCC-G44	RE	168300	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800070/4A	2018/3/28	2019/3/31	12
SFL-18	RE	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2018/4/20	2019/4/30	12
SHA-01	RE	145383	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	2018/7/23	2019/7/31	12
SHA-02	RE	145384	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	2018/7/23	2019/7/31	12
SHA-03	RE	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2018/7/23	2019/7/31	12
SJM-09	RE	145336	Measure	PROMART	SEN1935	-	-	-	-
SLA-05	RE	145527	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	193	2018/6/5	2019/6/30	12
SOS-01	RE	146316	Humidity Indicator	A&D	AD-5681	4062555	2018/10/25	2019/10/31	12
SOS-03	RE	146317	Humidity Indicator	A&D	AD-5681	4063325	2018/10/25	2019/10/31	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2018/10/25	2019/10/31	12
STR-07	RE	146209	Test Receiver	Rohde & Schwarz	ESU26	100484	2018/9/26	2019/9/30	12
STS-01	RE	145792	Digital Hitester	HIOKI	3805-50	80997812	2018/10/16	2019/10/31	12
STS-02	RE	145793	Digital Hitester	HIOKI	3805-50	80997819	2018/3/8	2019/3/31	12
STS-03	RE	146210	Digital Hitester	HIOKI	3805-50	80997823	2018/10/16	2019/10/31	12
SAT3-13	CE	150923	Attenuator	JFW	50HF-003N		2019/1/25	2020/1/31	12
SCC-C9/C10/SR SE-03	CE	145036	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141 PE/NS4906	-/0901-271(RF Selector)	2018/4/9	2019/4/30	12
SLS-02	CE	145539	LISN	Rohde & Schwarz	ENV216	100512	2019/2/20	2020/2/29	12
SOS-06	CE	146294	Humidity Indicator	A&D	AD-5681	4062118	2018/12/5	2019/12/31	12
STR-08	CE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2018/11/28	2019/11/30	12

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

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

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

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

Test item:

CE: Conducted Emission
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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