



RADIO TEST REPORT

Test Report No. : 11547841H-C

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : RF Module
Model No. : WSD-F20
FCC ID : BBQ-WSDF20
Test regulation : FCC Part 15 Subpart C: 2016
*BT Part
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
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6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)

Date of test: November 18 to December 13, 2016

Representative test engineer:

T. Shimada

Takumi Shimada

Engineer

Consumer Technology Division

Approved by:

Takayuki S.

Takayuki Shimada

Engineer

Consumer Technology Division



NVLAP LAB CODE: 200572-0

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Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

13-EM-F0429

CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Conducted Emission.....	10
SECTION 6: Radiated Spurious Emission	11
SECTION 7: Antenna Terminal Conducted Tests.....	13
APPENDIX 1: Test data	14
Conducted Emission	14
20dB Bandwidth and Carrier Frequency Separation.....	18
Number of Hopping Frequency	21
Dwell time.....	23
Maximum Peak Output Power	26
Average Output Power	27
Radiated Spurious Emission	29
Conducted Spurious Emission	40
Conducted Emission Band Edge compliance	46
99%Occupied Bandwidth	48
APPENDIX 2: Test instruments	50
APPENDIX 3: Photographs of test setup	52
Conducted Emission	52
Radiated Spurious Emission	53
Worst Case Position	54

SECTION 1: Customer information

Company Name : CASIO COMPUTER CO., LTD.
Address : 2-1, Sakaecho 3 chome, Hamura-shi, Tokyo 205-8555 Japan
Telephone Number : +81-42-579-7249
Contact Person : Takashi Suenaga

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

2.1 Identification of E.U.T.

Type of Equipment : RF Module
Model No. : WSD-F20
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3.8 V(Battery), DC5.0 V(USB)
Receipt Date of Sample : November 17, 2016
Country of Mass-production : Japan
Condition of EUT : 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-F20 (referred to as the EUT in this report) is a RF Module.

Radio Specification

Clock frequency(Crystal) : 32.768 KHz

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

Radio Type : Transceiver
Frequency of Operation : 2412 MHz - 2462 MHz
Modulation : DSSS, OFDM
Power Supply (radio part input) : DC 1.35 V
Antenna type : Reverse L type
Antenna Gain : -7.1 dBi

Bluetooth (Ver. 4.1 with EDR function)

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : BT: FHSS (GFSK, $\pi/4$ DQPSK, 8DPSK)
LE: GFSK
Power Supply (radio part input) : DC 1.35 V
Antenna type : Reverse L type
Antenna Gain : -7.1 dBi

*This test report applies for Bluetooth part.

**Wireless LAN and Bluetooth 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 November 14, 2016 and effective December 14, 2016

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

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

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	QP 9.7 dB, 10.35212 MHz, N AV 6.7 dB, 10.75213 MHz, N	Complied	-
Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (2)	See data.	Complied	Conducted
20dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (1)		Complied	Conducted
Number of Hopping Frequency	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (4)		Complied	Conducted
Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (4)		Complied	Conducted
Maximum Peak Output Power	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.12	FCC: Section15.247(a)(b)(1) IC: RSS-247 5.4 (2)		Complied	Conducted
Spurious Emission & Band Edge Compliance	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.13	FCC: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10		1.5 dB 73.930 MHz, QP, Vertical	Complied
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).					

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

FCC Part 15.31 (e)

This EUT provides stable voltage (DC 1.35 V) constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

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

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	N/A	-	Conducted

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

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k = 2$.
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Antenna terminal test Uncertainty (+/-)							
Power meter		Conducted emission and Power density			Conducted emission		Channel power
Below 1 GHz	Above 1 GHz	Below 1 GHz	1 GHz - 3 GHz	3 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz	
0.9 dB	1.0 dB	1.4 dB	1.7 dB	2.8 dB	2.8 dB	2.9 dB	2.6 dB

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

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

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

*Measurement distance

Conducted Emission test

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

Radiated emission test

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

3.5 Test Location

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Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	N/A	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m x 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

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

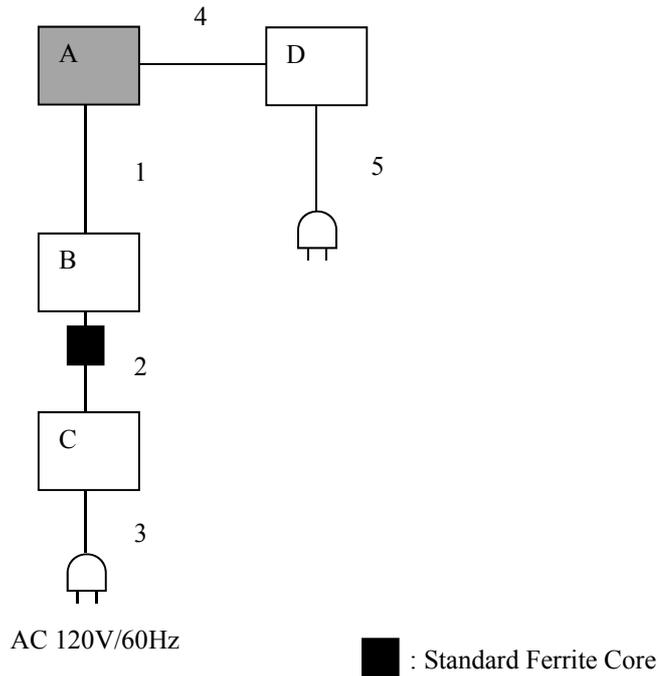
4.1 Operating Mode(s)

Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, Spurious Emission (Conducted/Radiated)	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Carrier Frequency Separation	Tx (Hopping On) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
20dB Bandwidth	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Number of Hopping Frequency	Tx (Hopping On) DH5, 3DH5	-
Dwell time	Tx (Hopping On), -DH1, DH3, DH5 -3DH1, 3DH3, 3DH5	-
Maximum Peak Output Power	Tx (Hopping Off) DH5, 2DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2441 MHz 2480 MHz
<p>*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test)</p> <p>*2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative.</p> <p>* It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all test items based on Bluetooth Core specification.</p> <p>*EUT has the power settings by the software as follows; Power settings: BDR: 6.5 dBm EDR: 3.5 dBm Software: Blue tool version 1.8.8.4 *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.</p>		

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	RF Module	WSD-F20	No.7 *1) No.2 *2)	CASIO COMPUTER CO., LTD.	EUT
B	Laptop PC	CF-N8HWCDPS	0CKSA09265	Panasonic	-
C	AC Adaptor	CF-AA6372B	6372BM610X10953E	Panasonic	-
D	DC Power Supply	PMC35-2A	13090501	KIKUSUI	*3)

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	2.0	Shielded	Shielded	-
2	DC Cable	1.1	Shielded	Shielded	-
3	AC Cable	0.9	Unshielded	Unshielded	-
4	DC Cable	0.1 *3) 2.0 *4)	Unshielded	Unshielded	-
5	AC Cable	2.3	Unshielded	Unshielded	*3)

*1) Used for Conducted Emission test and Radiated Emission test.

*2) Used for Antenna Terminal Conducted test only.

*3) Used for Conducted Emission test only.

*4) Used for Radiated Emission test only.

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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 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

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

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

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

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

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

SECTION 6: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

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

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

The height of the measuring antenna varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz *1)	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	4.5 m*2) (1 GHz – 10 GHz), 1.0 m*3) (10 GHz – 26.5 GHz)		4.5 m*2) (1 GHz – 10 GHz), 1.0 m*3) (10 GHz – 26.5 GHz)

*1) Although DA 00-705 accepts VBW = 10 Hz for AV measurements, it was confirmed that superfluous smoothing was not performed.

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

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

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

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

Measurement range : 30 MHz - 26.5 GHz
Test data : APPENDIX
Test result : Pass

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
20dB Bandwidth	3 MHz	30 kHz	100 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: 50MHz BW)
Carrier Frequency Separation	3 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	30 MHz	300 kHz	1 MHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	100 kHz, 1 MHz	300 kHz, 3 MHz	As necessary capture the entire dwell time per hopping channel	Peak	Clear Write	Spectrum Analyzer
Conducted Spurious Emission *3)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	9.1 kHz	27 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

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

*2) Reference data

*3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.

(9 kHz -150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz)

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

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

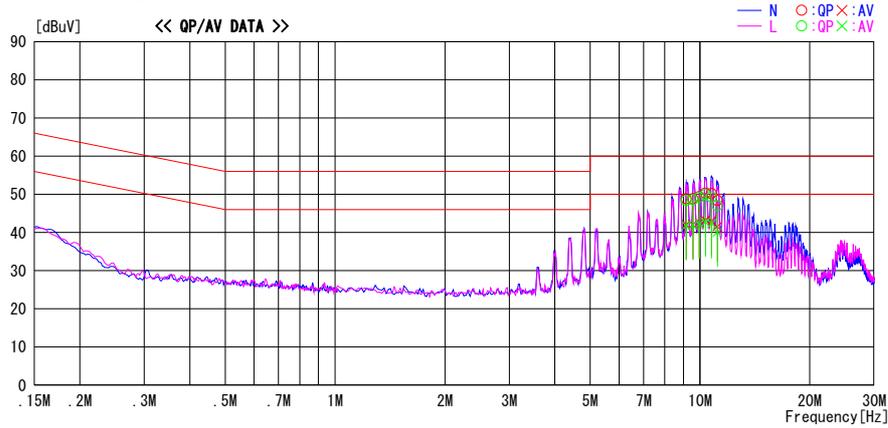
UL Japan, Inc. Ise EMC Lab. No.4 Semi Anechoic Chamber
Date : 2016/11/25

Report No. : 11547841H

Temp./Humi. : 23deg. C / 34% RH
Engineer : Takafumi Noguchi

Mode / Remarks : Tx DH5 2480MHz

LIMIT : FCC15.207 QP
FCC15.207 AV

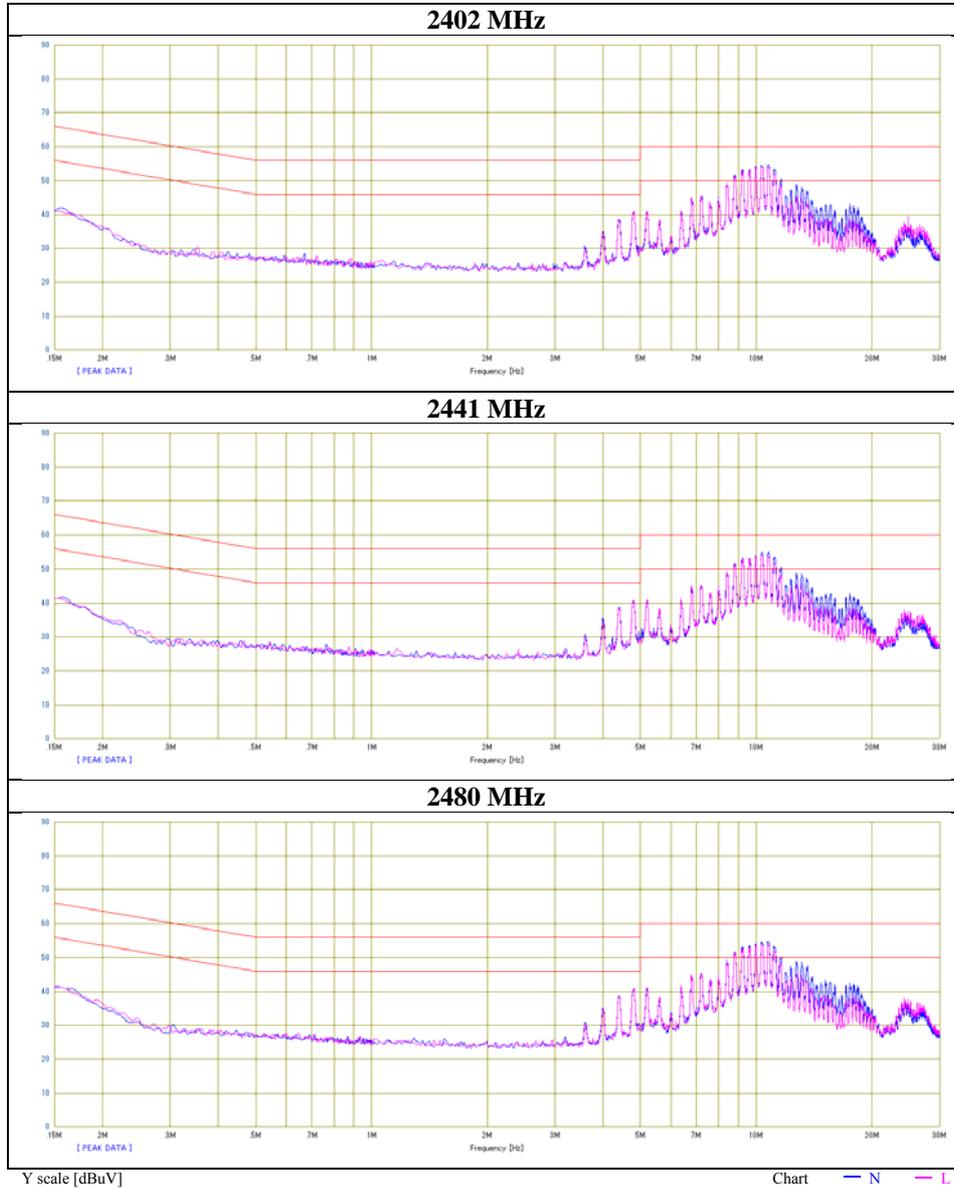


Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
9.16011	34.6	27.9	14.2	48.8	42.1	60.0	50.0	11.2	7.9	N	
9.56011	34.6	27.9	14.2	48.8	42.1	60.0	50.0	11.2	7.9	N	
9.96012	35.1	28.2	14.3	49.4	42.5	60.0	50.0	10.6	7.5	N	
10.35212	36.0	28.9	14.3	50.3	43.2	60.0	50.0	9.7	6.8	N	
10.75213	35.9	28.8	14.3	50.2	43.1	60.0	50.0	9.8	6.9	N	
11.15213	34.1	27.2	14.3	48.4	41.5	60.0	50.0	11.6	8.5	N	
9.16011	34.2	27.6	14.2	48.4	41.8	60.0	50.0	11.6	8.2	L	
9.56012	34.4	27.7	14.2	48.6	41.9	60.0	50.0	11.4	8.1	L	
9.96012	34.9	28.0	14.3	49.2	42.3	60.0	50.0	10.8	7.7	L	
10.35212	35.6	28.4	14.3	49.9	42.7	60.0	50.0	10.1	7.3	L	
10.75213	35.0	28.0	14.3	49.3	42.3	60.0	50.0	10.7	7.7	L	
11.15214	32.7	25.8	14.3	47.0	40.1	60.0	50.0	13.0	9.9	L	

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

Conducted Emission

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11547841H
Date	November 25, 2016
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Takafumi Noguchi
Mode	Tx, Hopping Off, DH5



Conducted Emission

DATA OF CONDUCTED EMISSION TEST

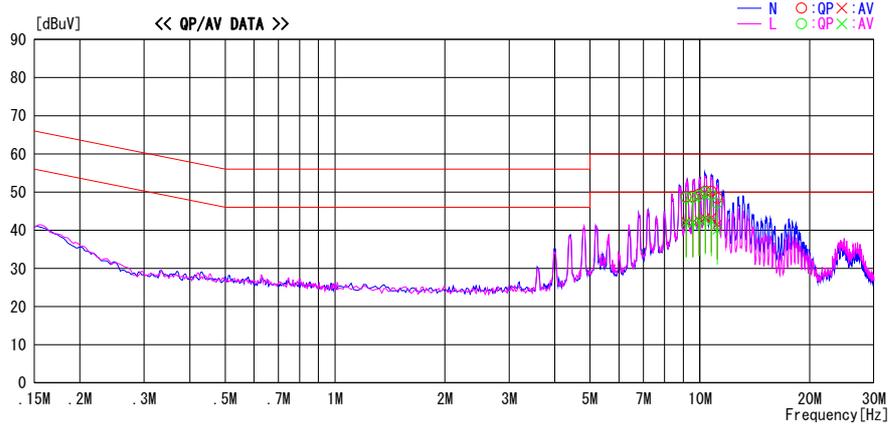
UL Japan, Inc. Ise EMC Lab. No. 4 Semi Anechoic Chamber
 Date : 2016/11/25

Report No. : 11547841H

Temp./Humi. : 23deg. C / 34% RH
 Engineer : Takafumi Noguchi

Mode / Remarks : Tx 3DHE 2480 MHz

LIMIT : FCC15.207 QP
 FCC15.207 AV

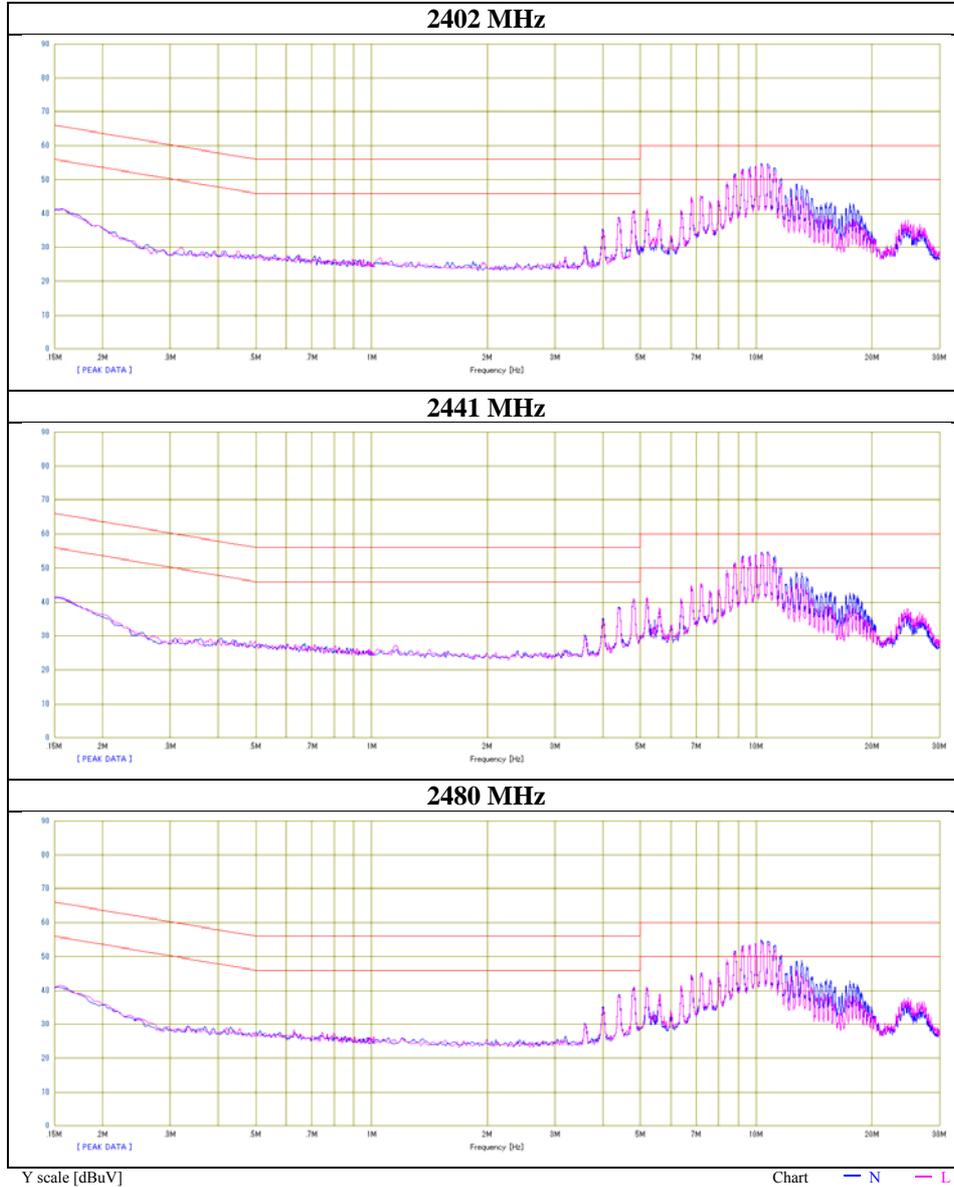


Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
9.16011	34.5	28.0	14.2	48.7	42.2	60.0	50.0	11.3	7.8	N	
9.56012	34.6	27.9	14.2	48.8	42.1	60.0	50.0	11.2	7.9	N	
9.96012	35.1	28.3	14.3	49.4	42.6	60.0	50.0	10.6	7.4	N	
10.35212	35.9	28.9	14.3	50.2	43.2	60.0	50.0	9.8	6.8	N	
10.75213	35.9	29.0	14.3	50.2	43.3	60.0	50.0	9.8	6.7	N	
11.15213	34.1	27.2	14.3	48.4	41.5	60.0	50.0	11.6	8.5	N	
9.16011	34.3	27.7	14.2	48.5	41.9	60.0	50.0	11.5	8.1	L	
9.56011	34.4	27.7	14.2	48.6	41.9	60.0	50.0	11.4	8.1	L	
9.96012	34.8	28.1	14.3	49.1	42.4	60.0	50.0	10.9	7.6	L	
10.35212	35.6	28.5	14.3	49.9	42.8	60.0	50.0	10.1	7.2	L	
10.75213	35.0	28.0	14.3	49.3	42.3	60.0	50.0	10.7	7.7	L	
11.15213	32.8	25.8	14.3	47.1	40.1	60.0	50.0	12.9	9.9	L	

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

Conducted Emission

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11547841H
Date	November 25, 2016
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Takafumi Noguchi
Mode	Tx, Hopping Off, 3DH5



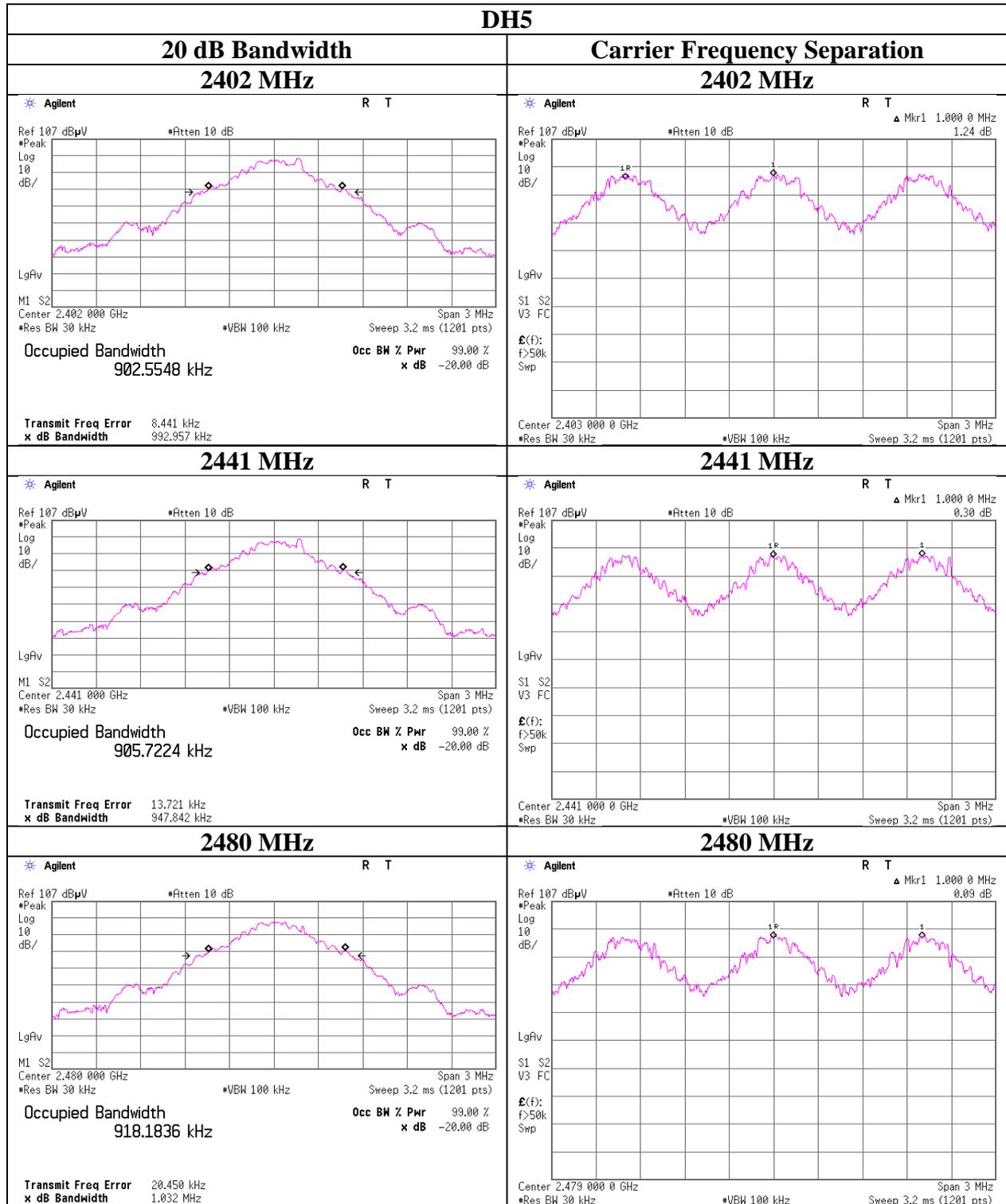
20dB Bandwidth and Carrier Frequency Separation

Test place : Ise EMC Lab. No.3 Measurement Room
Report No. : 11547841H
Date : November 18, 2016
Temperature / Humidity : 23 deg. C / 48 % RH
Engineer : Takumi Shimada
Mode : Tx

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.993	1.000	>= 0.662
DH5	2441.0	0.948	1.000	>= 0.632
DH5	2480.0	1.032	1.000	>= 0.688
3DH5	2402.0	1.313	1.000	>= 0.875
3DH5	2441.0	1.314	1.000	>= 0.876
3DH5	2480.0	1.315	1.000	>= 0.877

Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).
No limit applies to 20dB Bandwidth.

20dB Bandwidth and Carrier Frequency Separation



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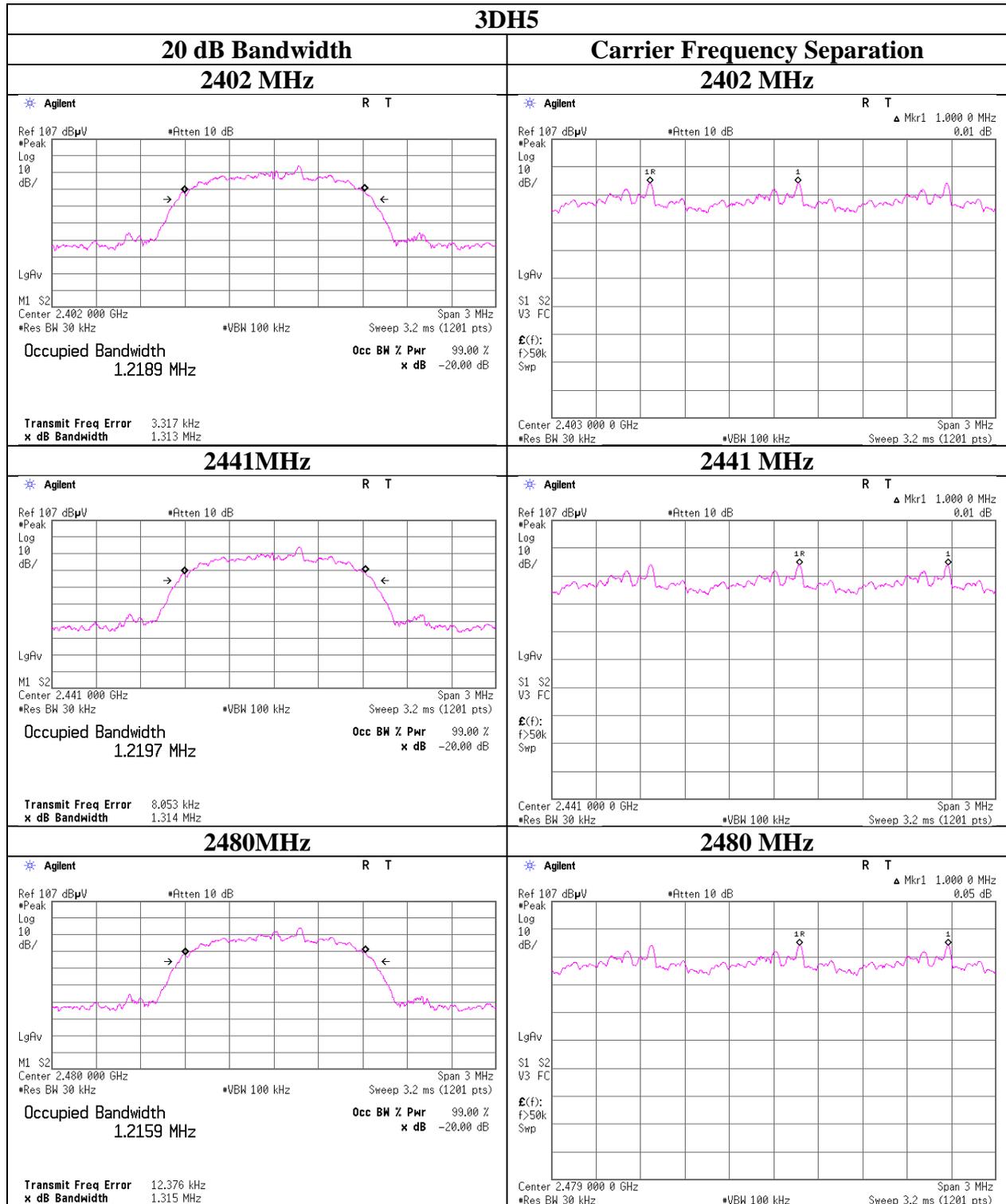
Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

20dB Bandwidth and Carrier Frequency Separation



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Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

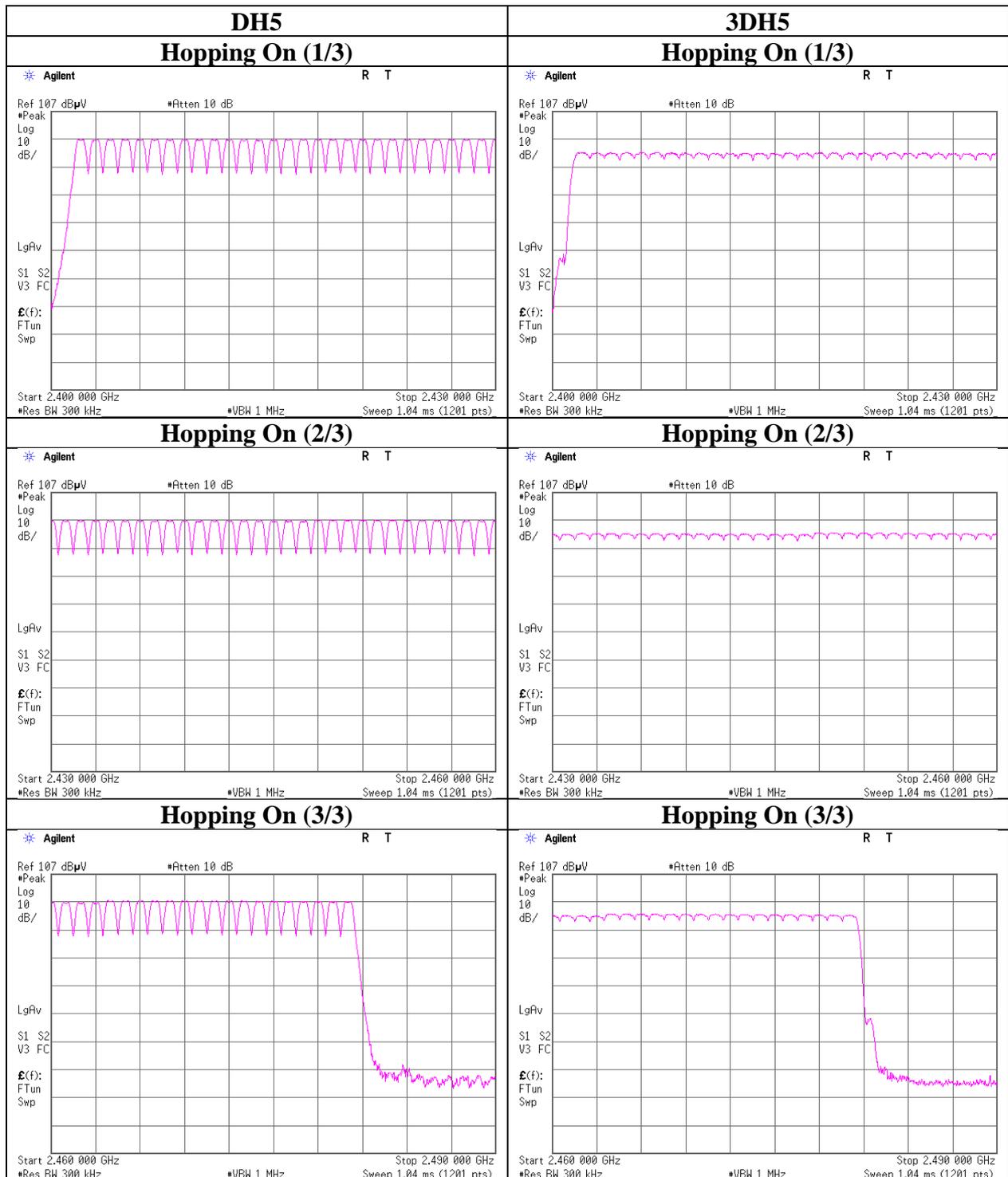
Number of Hopping Frequency

Test place Ise EMC Lab. No.3 Measurement Room
Report No. 11547841H
Date November 18, 2016
Temperature / Humidity 23 deg. C / 48 % RH
Engineer Takumi Shimada
Mode Tx, Hopping On

Mode	Number of channel [channels]	Limit [channels]
DH5	79	≥ 15
3DH5	79	≥ 15

Test was not performed at AFH mode whose number of hopping channel is 20 channels because this Bluetooth radio is in compliance of Bluetooth Specification.

Number of Hopping Frequency



Dwell time

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11547841H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 48 % RH
Engineer	Takumi Shimada
Mode	Tx, Hopping On

Mode	Number of transmission in a 31.6(79 Hopping x 0.4) / 12.8 (32 Hopping x 0.4) second period				Length of transmission [msec]	Result [msec]	Limit [msec]
DH1	50.6 times /	5 sec. x	31.6 sec. =	320 times	0.413	132	400
DH3	25.4 times /	5 sec. x	31.6 sec. =	161 times	1.684	271	400
DH5	17.4 times /	5 sec. x	31.6 sec. =	110 times	2.923	322	400
3DH1	50.6 times /	5 sec. x	31.6 sec. =	320 times	0.415	133	400
3DH3	26.2 times /	5 sec. x	31.6 sec. =	166 times	1.687	280	400
3DH5	15.8 times /	5 sec. x	31.6 sec. =	100 times	2.936	294	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

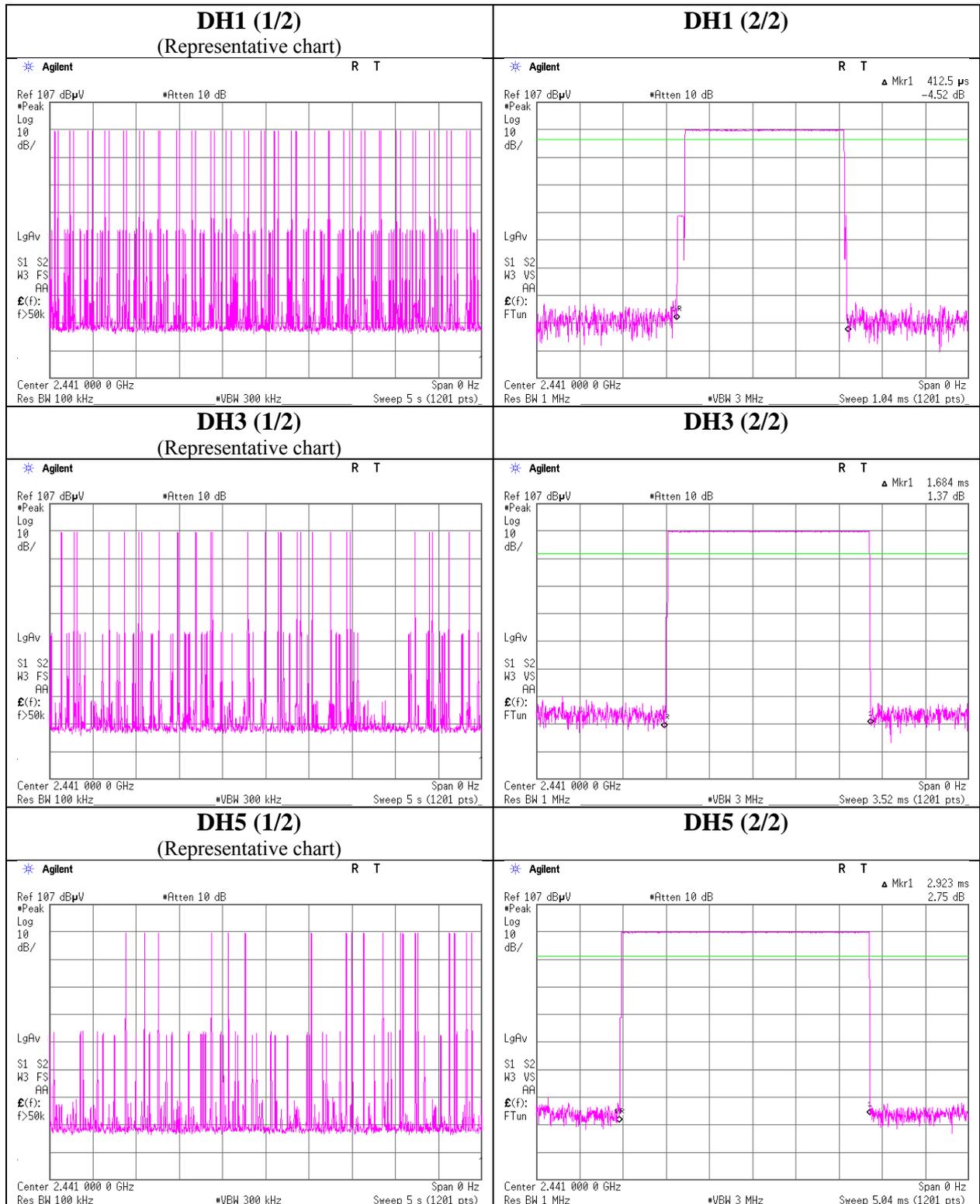
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	50	52	49	52	50	50.6
DH3	27	25	22	27	26	25.4
DH5	19	17	14	19	18	17.4
3DH1	51	51	51	50	50	50.6
3DH3	29	26	28	26	22	26.2
3DH5	18	14	16	17	14	15.8

Sample Calculation

Average = Summation (Sampling 1 to 5) / 5

This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in $N \times 0.4s$, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than $0.4s$ regardless of packet size. This is confirmed in the test report for $N = 79$.

Dwell time



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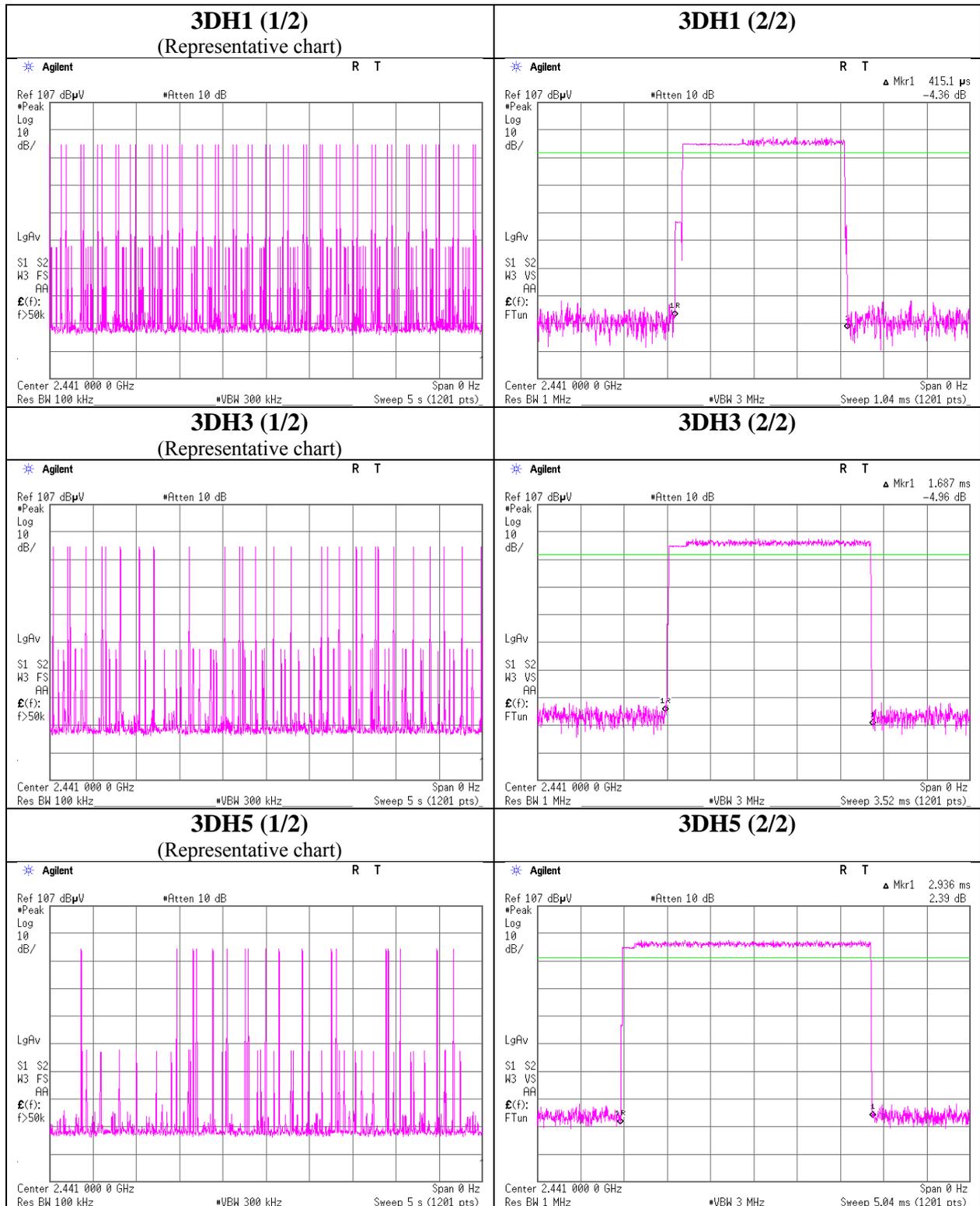
Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Dwell time



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Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Maximum Peak Output Power

Test place : Ise EMC Lab. No.11 Measurement Room
 Report No. : 11547841H
 Date : December 12, 2016
 Temperature / Humidity : 23 deg. C / 36 % RH
 Engineer : Yuta Moriya
 Mode : Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
					[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-1.61	1.13	10.03	9.55	9.01	20.96	125	11.42
DH5	2441.0	-1.59	1.14	10.03	9.58	9.07	20.96	125	11.39
DH5	2480.0	-1.58	1.14	10.03	9.59	9.09	20.96	125	11.38
2DH5	2402.0	-2.56	1.13	10.03	8.60	7.24	20.96	125	12.37
2DH5	2441.0	-2.67	1.14	10.03	8.50	7.07	20.96	125	12.47
2DH5	2480.0	-2.48	1.14	10.03	8.69	7.39	20.96	125	12.28
3DH5	2402.0	-2.47	1.13	10.03	8.69	7.39	20.96	125	12.28
3DH5	2441.0	-2.54	1.14	10.03	8.63	7.29	20.96	125	12.34
3DH5	2480.0	-2.35	1.14	10.03	8.82	7.61	20.96	125	12.15

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.

Test was not performed at AFH mode, because the decrease of number of channel (min: 20ch) at AFH mode does not influence on the output power and bandwidth of the EUT.

As this device had AFH mode and frequency separation could not meet the requirement of over 20dB BW without 2/3 relaxation, 125mW power limit was applied to it.

Average Output Power
(Reference data for SAR testing)

Test place : Ise EMC Lab. No.3 Measurement Room
Report No. : 11547841H
Date : December 12, 2016
Temperature / Humidity : 23 deg. C / 36 % RH
Engineer : Yuta Moriya
Mode : Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)	
					[dBm]	[mW]
DH5	2402.0	-3.06	1.13	10.03	8.10	6.45
DH5	2441.0	-3.16	1.14	10.03	8.01	6.32
DH5	2480.0	-3.05	1.14	10.03	8.12	6.48
2DH5	2402.0	-6.30	1.13	10.03	4.86	3.06
2DH5	2441.0	-6.34	1.14	10.03	4.83	3.04
2DH5	2480.0	-5.76	1.14	10.03	5.41	3.47
3DH5	2402.0	-6.41	1.13	10.03	4.75	2.98
3DH5	2441.0	-6.32	1.14	10.03	4.85	3.05
3DH5	2480.0	-5.76	1.14	10.03	5.41	3.47

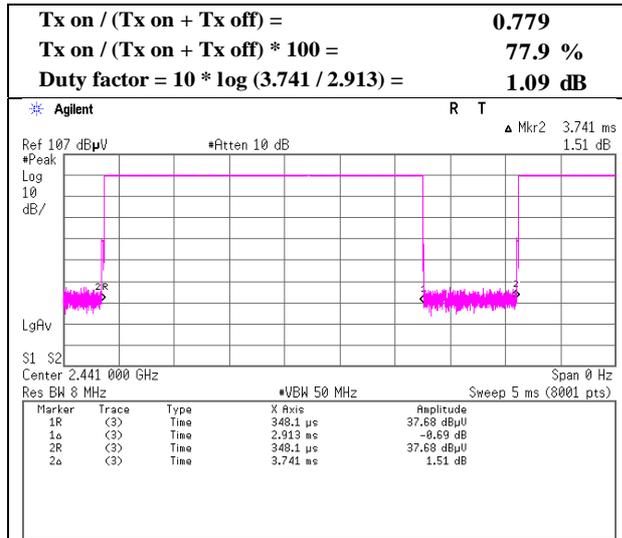
Sample Calculation:

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

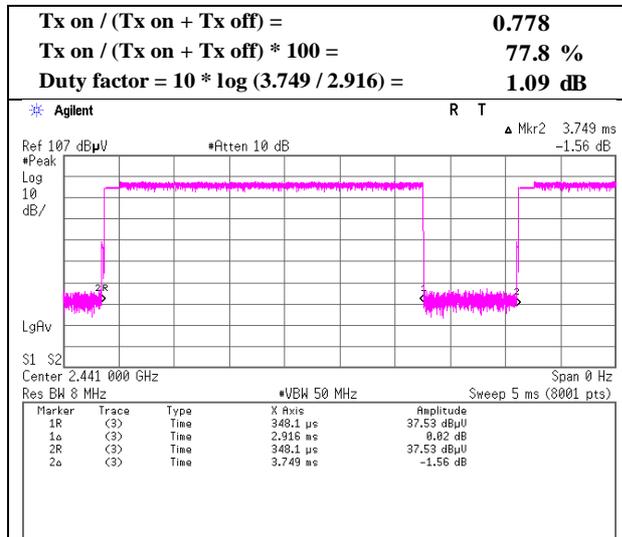
Burst Rate Confirmation

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11547841H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 48 % RH
Engineer	Takumi Shimada
Mode	Tx, Hopping Off

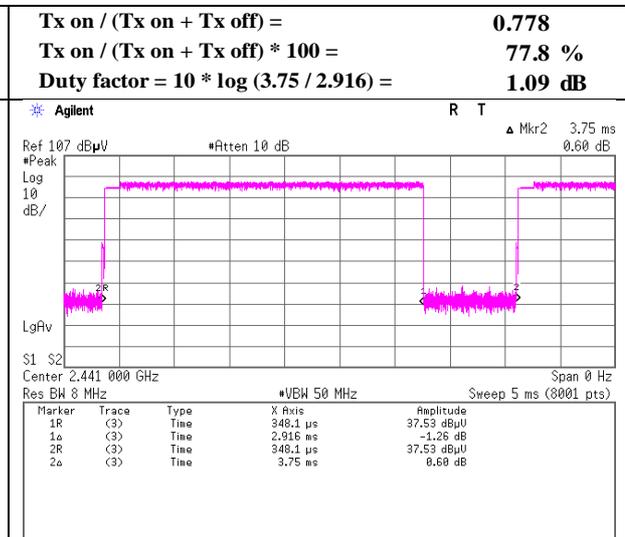
DH5



2DH5



3DH5



Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.2	No.4
Report No.	11547841H		
Date	December 12, 2016	December 13, 2016	November 20, 2016
Temperature / Humidity	23 deg. C / 30 % RH	21 deg. C / 31 % RH	22 deg. C / 43 % RH
Engineer	Takafumi Noguchi	Takafumi Noguchi	Hiroyuki Furutaka
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	54.419	QP	40.5	9.4	7.7	32.1	-	25.5	40.0	14.5	
Hori	74.760	QP	47.0	6.2	7.9	32.1	-	29.0	40.0	11.0	
Hori	126.073	QP	38.2	13.5	8.5	32.0	-	28.2	43.5	15.3	
Hori	178.004	QP	40.8	16.0	8.9	32.0	-	33.7	43.5	9.8	
Hori	243.196	QP	52.1	12.2	9.5	31.9	-	41.9	46.0	4.1	
Hori	720.793	QP	34.3	20.0	12.2	32.1	-	34.4	46.0	11.6	
Hori	2390.000	PK	41.5	27.4	6.7	32.1	-	43.5	73.9	30.4	
Hori	4804.000	PK	45.9	30.8	9.3	31.2	-	54.8	73.9	19.1	
Hori	7206.000	PK	41.2	36.2	8.8	32.4	-	53.8	73.9	20.1	Floor noise
Hori	9608.000	PK	41.2	38.4	9.4	32.7	-	56.3	73.9	17.6	Floor noise
Hori	2390.000	AV	29.8	27.4	6.7	32.1	-	31.8	53.9	22.1	
Hori	4804.000	AV	37.9	30.8	9.3	31.2	-	46.8	53.9	7.1	
Hori	7206.000	AV	29.2	36.2	8.8	32.4	-	41.8	53.9	12.1	Floor noise
Hori	9608.000	AV	29.2	38.4	9.4	32.7	-	44.3	53.9	9.6	Floor noise
Vert	37.595	QP	43.1	15.1	7.4	32.1	-	33.5	40.0	6.5	
Vert	54.422	QP	51.5	9.4	7.7	32.1	-	36.5	40.0	3.5	
Vert	68.364	QP	55.4	6.6	7.9	32.1	-	37.8	40.0	2.2	
Vert	84.641	QP	53.2	7.0	8.1	32.1	-	36.2	40.0	3.8	
Vert	125.983	QP	45.3	13.5	8.5	32.0	-	35.3	43.5	8.2	
Vert	241.599	QP	47.7	12.1	9.5	31.9	-	37.4	46.0	8.6	
Vert	2390.000	PK	41.6	27.4	6.7	32.1	-	43.6	73.9	30.3	
Vert	4804.000	PK	43.9	30.8	9.3	31.2	-	52.8	73.9	21.1	
Vert	7206.000	PK	42.0	36.2	8.8	32.4	-	54.6	73.9	19.3	Floor noise
Vert	9608.000	PK	41.1	38.4	9.4	32.7	-	56.2	73.9	17.7	Floor noise
Vert	2390.000	AV	29.2	27.4	6.7	32.1	-	31.2	53.9	22.7	
Vert	4804.000	AV	35.3	30.8	9.3	31.2	-	44.2	53.9	9.7	
Vert	7206.000	AV	29.0	36.2	8.8	32.4	-	41.6	53.9	12.3	Floor noise
Vert	9608.000	AV	29.3	38.4	9.4	32.7	-	44.4	53.9	9.5	Floor noise

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

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

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

***These results have sufficient margin without taking account Dwell time factor.**

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	92.5	27.4	6.7	32.1	94.5	-	-	Carrier
Hori	2400.000	PK	38.9	27.4	6.7	32.1	40.9	74.5	33.6	
Vert	2402.000	PK	91.0	27.4	6.7	32.1	93.0	-	-	Carrier
Vert	2400.000	PK	39.4	27.4	6.7	32.1	41.4	73.0	31.6	

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

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Ise EMC Lab.

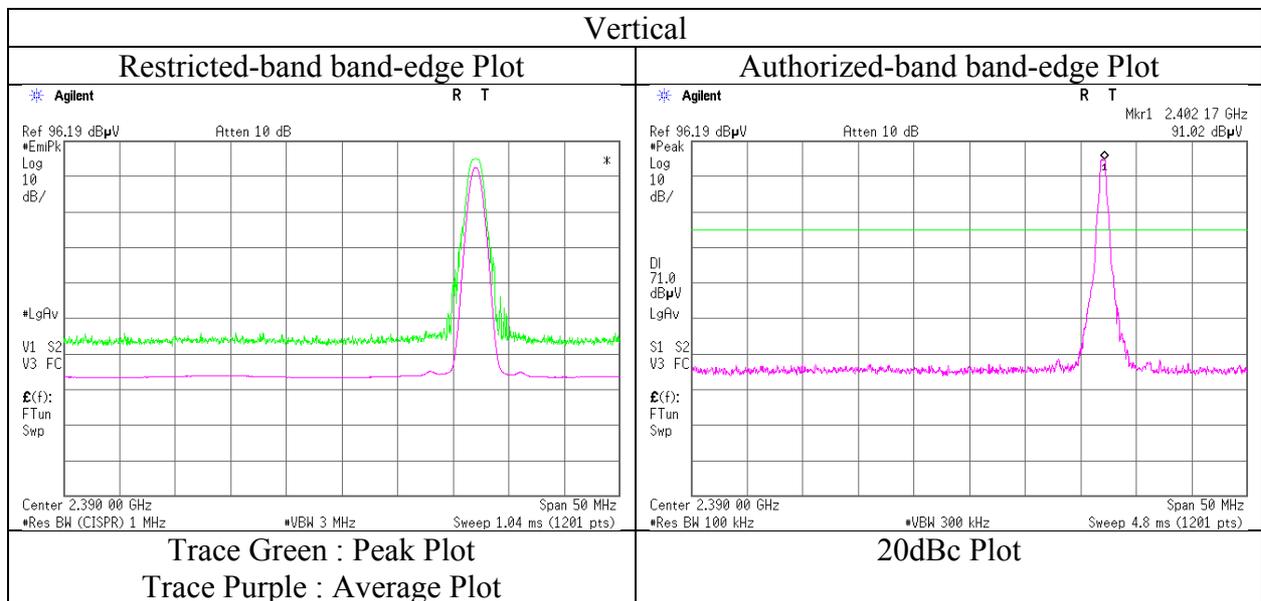
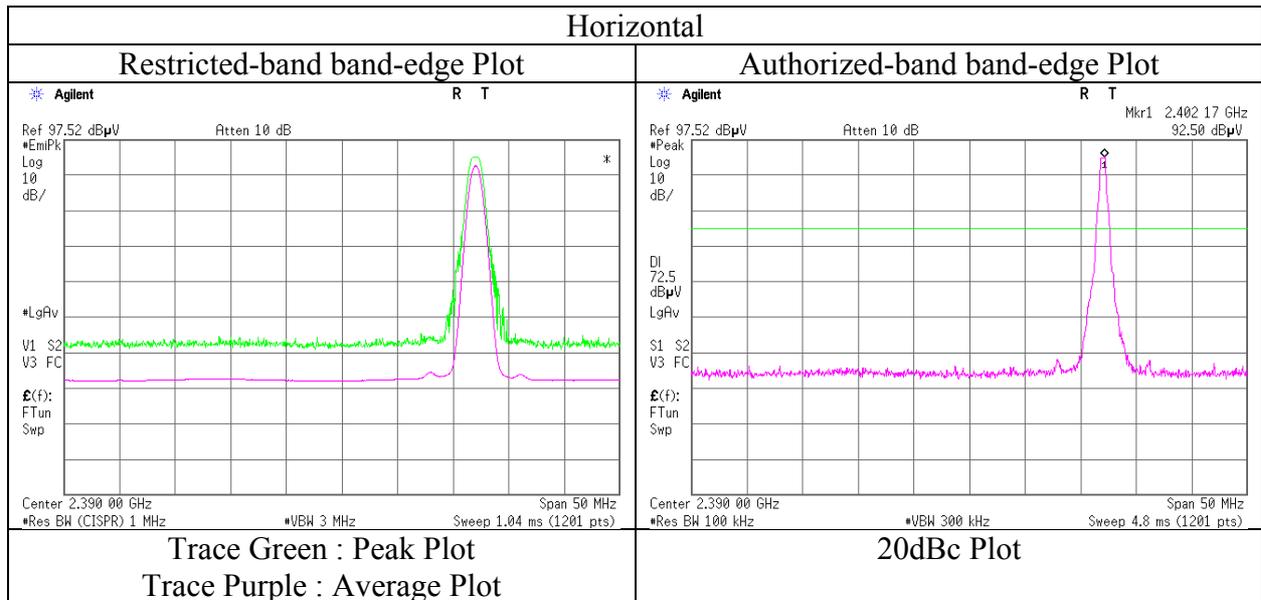
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Takafumi Noguchi (1 GHz -10 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz



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

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Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.2	No.4
Report No.	11547841H		
Date	December 12, 2016	December 13, 2016	November 20, 2016
Temperature / Humidity	23 deg. C / 30 % RH	21 deg. C / 31 % RH	22 deg. C / 43 % RH
Engineer	Takafumi Noguchi	Takafumi Noguchi	Hiroyuki Furutaka
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1GHz)
Mode	Tx, Hopping Off, DH5 2441MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	54.432	QP	40.5	9.4	7.7	32.1	-	25.5	40.0	14.5	
Hori	74.760	QP	48.1	6.2	7.9	32.1	-	30.1	40.0	9.9	
Hori	125.983	QP	41.4	13.5	8.5	32.0	-	31.4	43.5	12.1	
Hori	178.004	QP	41.2	16.0	8.9	32.0	-	34.1	43.5	9.4	
Hori	242.651	QP	53.4	12.2	9.5	31.9	-	43.2	46.0	2.8	
Hori	720.793	QP	34.1	20.0	12.2	32.1	-	34.2	46.0	11.8	
Hori	4882.000	PK	47.5	31.1	9.2	31.2	-	56.6	73.9	17.3	
Hori	7323.000	PK	41.4	36.4	8.8	32.5	-	54.1	73.9	19.8	Floor noise
Hori	9764.000	PK	41.2	38.6	9.5	32.8	-	56.5	73.9	17.4	Floor noise
Hori	4882.000	AV	41.6	31.1	9.2	31.2	-	50.7	53.9	3.2	
Hori	7323.000	AV	29.5	36.4	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Hori	9764.000	AV	29.4	38.6	9.5	32.8	-	44.7	53.9	9.2	Floor noise
Vert	37.595	QP	43.4	15.1	7.4	32.1	-	33.8	40.0	6.2	
Vert	54.422	QP	51.3	9.4	7.7	32.1	-	36.3	40.0	3.7	
Vert	68.364	QP	55.3	6.6	7.9	32.1	-	37.7	40.0	2.3	
Vert	84.639	QP	53.2	7.0	8.1	32.1	-	36.2	40.0	3.8	
Vert	125.980	QP	44.4	13.5	8.5	32.0	-	34.4	43.5	9.1	
Vert	241.601	QP	48.9	12.1	9.5	31.9	-	38.6	46.0	7.4	
Vert	4882.000	PK	46.8	31.1	9.2	31.2	-	55.9	73.9	18.0	
Vert	7323.000	PK	41.4	36.4	8.8	32.5	-	54.1	73.9	19.8	Floor noise
Vert	9764.000	PK	41.2	38.6	9.5	32.8	-	56.5	73.9	17.4	Floor noise
Vert	4882.000	AV	39.8	31.1	9.2	31.2	-	48.9	53.9	5.0	
Vert	7323.000	AV	29.5	36.4	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Vert	9764.000	AV	29.4	38.6	9.5	32.8	-	44.7	53.9	9.2	Floor noise

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

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

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

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.2	No.4
Report No.	11547841H		
Date	December 12, 2016	December 13, 2016	November 20, 2016
Temperature / Humidity	23 deg. C / 30 % RH	21 deg. C / 31 % RH	22 deg. C / 43 % RH
Engineer	Takafumi Noguchi	Takafumi Noguchi	Hiroyuki Furutaka
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	55.198	QP	39.9	9.2	7.7	32.1	-	24.7	40.0	15.3	
Hori	74.800	QP	48.7	6.2	7.9	32.1	-	30.7	40.0	9.3	
Hori	125.983	QP	41.1	13.5	8.5	32.0	-	31.1	43.5	12.4	
Hori	178.004	QP	41.0	16.0	8.9	32.0	-	33.9	43.5	9.6	
Hori	242.665	QP	53.4	12.2	9.5	31.9	-	43.2	46.0	2.8	
Hori	720.780	QP	34.1	20.0	12.2	32.1	-	34.2	46.0	11.8	
Hori	2483.500	PK	48.6	27.4	6.9	32.0	-	50.9	73.9	23.0	
Hori	4960.000	PK	48.8	31.4	9.3	31.1	-	58.4	73.9	15.5	
Hori	7440.000	PK	41.3	36.5	8.8	32.5	-	54.1	73.9	19.8	Floor noise
Hori	9920.000	PK	41.2	38.8	9.6	32.9	-	56.7	73.9	17.2	Floor noise
Hori	2483.500	AV	31.8	27.4	6.9	32.0	-	34.1	53.9	19.8	
Hori	4960.000	AV	42.6	31.4	9.3	31.1	-	52.2	53.9	1.7	
Hori	7440.000	AV	29.4	36.5	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Hori	9920.000	AV	29.1	38.8	9.6	32.9	-	44.6	53.9	9.3	Floor noise
Vert	37.595	QP	43.2	15.1	7.4	32.1	-	33.6	40.0	6.4	
Vert	54.423	QP	51.5	9.4	7.7	32.1	-	36.5	40.0	3.5	
Vert	68.364	QP	55.5	6.6	7.9	32.1	-	37.9	40.0	2.1	
Vert	84.643	QP	52.9	7.0	8.1	32.1	-	35.9	40.0	4.1	
Vert	125.980	QP	45.0	13.5	8.5	32.0	-	35.0	43.5	8.5	
Vert	241.601	QP	49.0	12.1	9.5	31.9	-	38.7	46.0	7.3	
Vert	2483.500	PK	47.7	27.4	6.9	32.0	-	50.0	73.9	23.9	
Vert	4960.000	PK	46.1	31.4	9.3	31.1	-	55.7	73.9	18.2	
Vert	7440.000	PK	41.3	36.5	8.8	32.5	-	54.1	73.9	19.8	Floor noise
Vert	9920.000	PK	41.2	38.8	9.6	32.9	-	56.7	73.9	17.2	Floor noise
Vert	2483.500	AV	30.7	27.4	6.9	32.0	-	33.0	53.9	20.9	
Vert	4960.000	AV	38.8	31.4	9.3	31.1	-	48.4	53.9	5.5	
Vert	7440.000	AV	29.4	36.5	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Vert	9920.000	AV	29.1	38.8	9.6	32.9	-	44.6	53.9	9.3	Floor noise

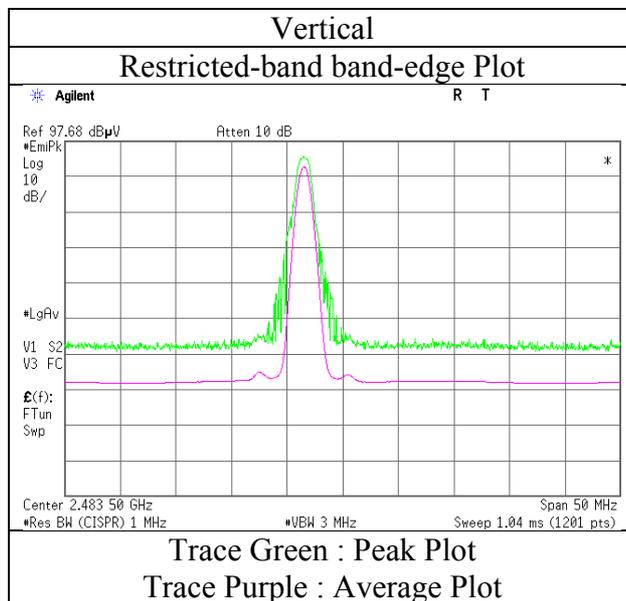
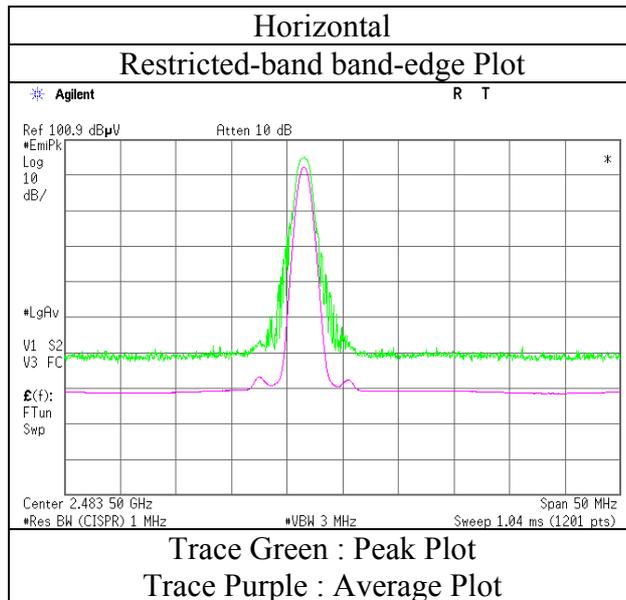
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 11547841H
Date : December 12, 2016
Temperature / Humidity : 23 deg. C / 30 % RH
Engineer : Takafumi Noguchi
(1 GHz -10 GHz)
Mode : Tx, Hopping Off, DH5 2480 MHz



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

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.2	No.4
Report No.	11547841H		
Date	December 12, 2016	December 13, 2016	November 20, 2016
Temperature / Humidity	23 deg. C / 30 % RH	21 deg. C / 31 % RH	22 deg. C / 43 % RH
Engineer	Takafumi Noguchi	Takafumi Noguchi	Hiroyuki Furutaka
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	55.175	QP	39.7	9.2	7.7	32.1	-	24.5	40.0	15.5	
Hori	73.890	QP	48.9	6.2	7.9	32.1	-	30.9	40.0	9.1	
Hori	125.980	QP	39.8	13.5	8.5	32.0	-	29.8	43.5	13.7	
Hori	177.218	QP	40.1	16.0	8.9	32.0	-	33.0	43.5	10.5	
Hori	241.992	QP	53.4	12.1	9.5	31.9	-	43.1	46.0	2.9	
Hori	720.000	QP	35.2	20.0	12.2	32.1	-	35.3	46.0	10.7	
Hori	2390.000	PK	42.9	27.4	6.7	32.1	-	44.9	73.9	29.0	
Hori	4804.000	PK	43.2	30.8	9.3	31.2	-	52.1	73.9	21.8	
Hori	7206.000	PK	41.2	36.2	8.8	32.4	-	53.8	73.9	20.1	Floor noise
Hori	9608.000	PK	41.2	38.4	9.4	32.7	-	56.3	73.9	17.6	Floor noise
Hori	2390.000	AV	29.2	27.4	6.7	32.1	-	31.2	53.9	22.7	
Hori	4804.000	AV	32.6	30.8	9.3	31.2	-	41.5	53.9	12.4	
Hori	7206.000	AV	29.2	36.2	8.8	32.4	-	41.8	53.9	12.1	Floor noise
Hori	9608.000	AV	29.2	38.4	9.4	32.7	-	44.3	53.9	9.6	Floor noise
Vert	37.595	QP	43.1	15.1	7.4	32.1	-	33.5	40.0	6.5	
Vert	54.423	QP	51.2	9.4	7.7	32.1	-	36.2	40.0	3.8	
Vert	68.361	QP	54.2	6.6	7.9	32.1	-	36.6	40.0	3.4	
Vert	73.930	QP	56.5	6.2	7.9	32.1	-	38.5	40.0	1.5	
Vert	84.640	QP	52.0	7.0	8.1	32.1	-	35.0	40.0	5.0	
Vert	125.976	QP	41.7	13.5	8.5	32.0	-	31.7	43.5	11.8	
Vert	241.600	QP	47.8	12.1	9.5	31.9	-	37.5	46.0	8.5	
Vert	2390.000	PK	42.2	27.4	6.7	32.1	-	44.2	73.9	29.7	
Vert	4804.000	PK	43.3	30.8	9.3	31.2	-	52.2	73.9	21.7	
Vert	7206.000	PK	40.9	36.2	8.8	32.4	-	53.5	73.9	20.4	Floor noise
Vert	9608.000	PK	41.1	38.4	9.4	32.7	-	56.2	73.9	17.7	Floor noise
Vert	2390.000	AV	29.2	27.4	6.7	32.1	-	31.2	53.9	22.7	
Vert	4804.000	AV	30.8	30.8	9.3	31.2	-	39.7	53.9	14.2	
Vert	7206.000	AV	28.9	36.2	8.8	32.4	-	41.5	53.9	12.4	Floor noise
Vert	9608.000	AV	29.2	38.4	9.4	32.7	-	44.3	53.9	9.6	Floor noise

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

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

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

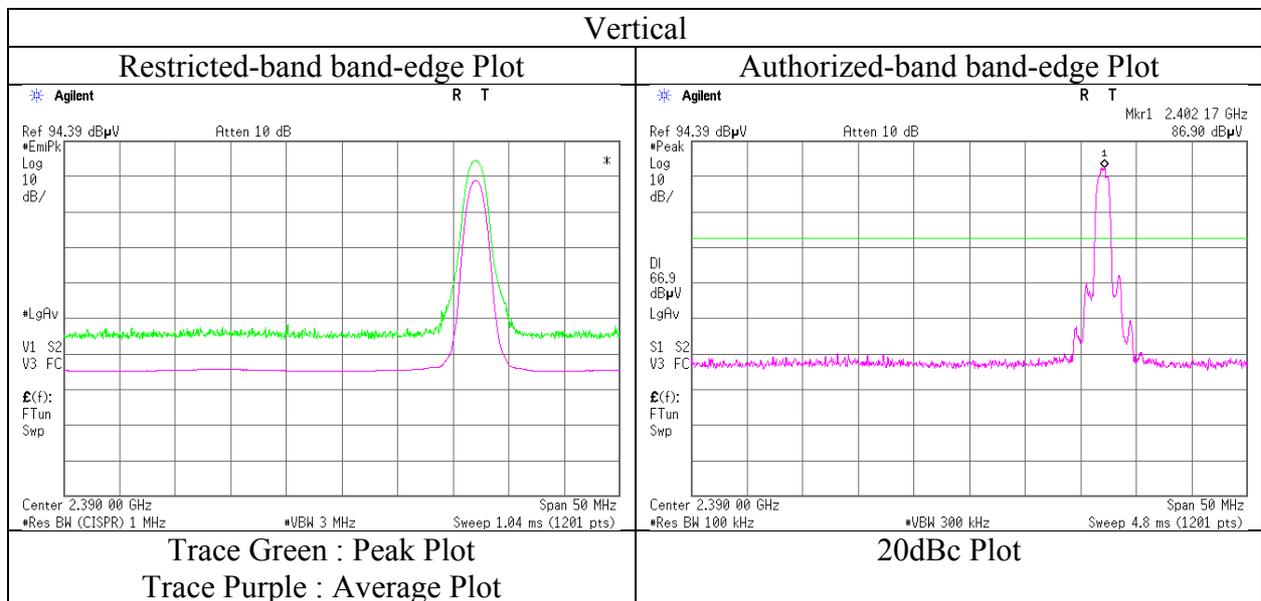
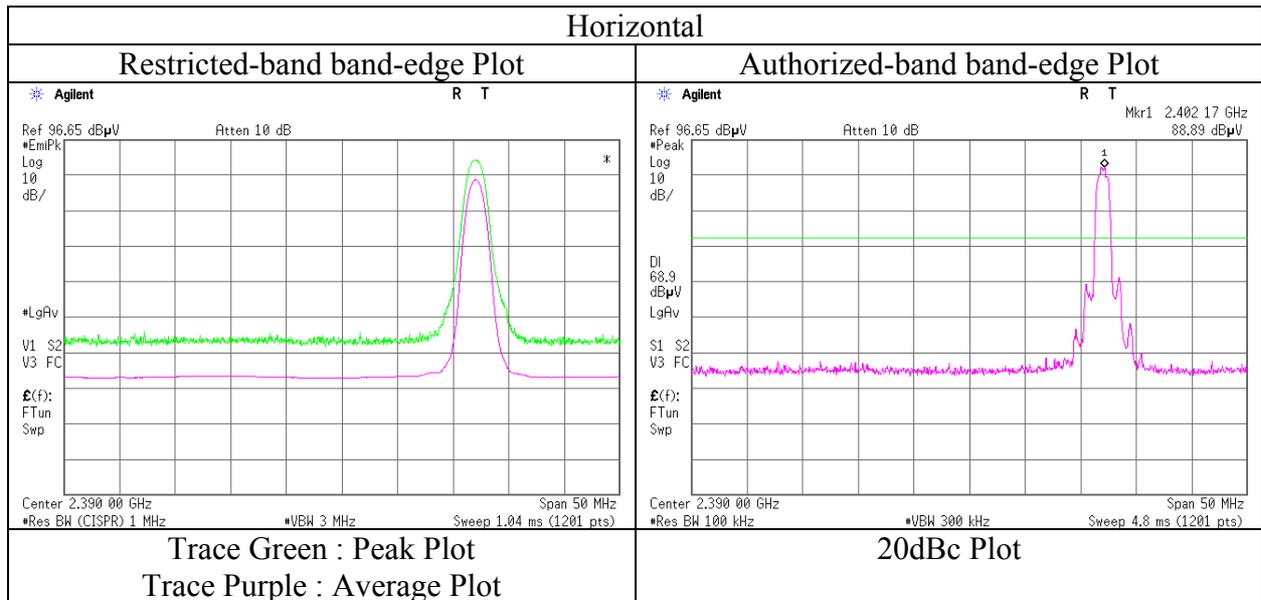
20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	88.9	27.4	6.7	32.1	90.9	-	-	Carrier
Hori	2400.000	PK	39.4	27.4	6.7	32.1	41.4	70.9	29.5	
Vert	2402.000	PK	86.9	27.4	6.7	32.1	88.9	-	-	Carrier
Vert	2400.000	PK	38.9	27.4	6.7	32.1	40.9	68.9	28.0	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Takafumi Noguchi
	(1 GHz -10 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz



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

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.2	No.4
Report No.	11547841H		
Date	December 12, 2016	December 13, 2016	November 20, 2016
Temperature / Humidity	23 deg. C / 30 % RH	21 deg. C / 31 % RH	22 deg. C / 43 % RH
Engineer	Takafumi Noguchi	Takafumi Noguchi	Hiroyuki Furutaka
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	55.175	QP	39.6	9.2	7.7	32.1	-	24.4	40.0	15.6	
Hori	73.889	QP	48.7	6.2	7.9	32.1	-	30.7	40.0	9.3	
Hori	134.000	QP	40.6	14.1	8.6	32.0	-	31.3	43.5	12.2	
Hori	177.218	QP	40.0	16.0	8.9	32.0	-	32.9	43.5	10.6	
Hori	241.990	QP	53.1	12.1	9.5	31.9	-	42.8	46.0	3.2	
Hori	720.000	QP	35.0	20.0	12.2	32.1	-	35.1	46.0	10.9	
Hori	4882.000	PK	46.3	31.1	9.2	31.2	-	55.4	73.9	18.5	
Hori	7323.000	PK	41.4	36.4	8.8	32.5	-	54.1	73.9	19.8	Floor noise
Hori	9764.000	PK	41.2	38.6	9.5	32.8	-	56.5	73.9	17.4	Floor noise
Hori	4882.000	AV	35.9	31.1	9.2	31.2	-	45.0	53.9	8.9	
Hori	7323.000	AV	29.5	36.4	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Hori	9764.000	AV	29.4	38.6	9.5	32.8	-	44.7	53.9	9.2	Floor noise
Vert	37.595	QP	43.2	15.1	7.4	32.1	-	33.6	40.0	6.4	
Vert	54.421	QP	51.0	9.4	7.7	32.1	-	36.0	40.0	4.0	
Vert	68.376	QP	54.0	6.6	7.9	32.1	-	36.4	40.0	3.6	
Vert	73.928	QP	56.4	6.2	7.9	32.1	-	38.4	40.0	1.6	
Vert	84.638	QP	51.9	7.0	8.1	32.1	-	34.9	40.0	5.1	
Vert	134.010	QP	44.6	14.1	8.6	32.0	-	35.3	43.5	8.2	
Vert	241.600	QP	47.6	12.1	9.5	31.9	-	37.3	46.0	8.7	
Vert	4882.000	PK	44.5	31.1	9.2	31.2	-	53.6	73.9	20.3	
Vert	7323.000	PK	41.4	36.4	8.8	32.5	-	54.1	73.9	19.8	Floor noise
Vert	9764.000	PK	41.2	38.6	9.5	32.8	-	56.5	73.9	17.4	Floor noise
Vert	4882.000	AV	34.4	31.1	9.2	31.2	-	43.5	53.9	10.4	
Vert	7323.000	AV	29.5	36.4	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Vert	9764.000	AV	29.4	38.6	9.5	32.8	-	44.7	53.9	9.2	Floor noise

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

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

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

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.2	No.4
Report No.	11547841H		
Date	December 12, 2016	December 13, 2016	November 20, 2016
Temperature / Humidity	23 deg. C / 30 % RH	21 deg. C / 31 % RH	22 deg. C / 43 % RH
Engineer	Takafumi Noguchi	Takafumi Noguchi	Hiroyuki Furutaka
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	55.100	QP	39.6	9.2	7.7	32.1	-	24.4	40.0	15.6	
Hori	75.000	QP	48.5	6.2	8.0	32.1	-	30.6	40.0	9.4	
Hori	134.010	QP	40.9	14.1	8.6	32.0	-	31.6	43.5	11.9	
Hori	177.215	QP	39.9	16.0	8.9	32.0	-	32.8	43.5	10.7	
Hori	241.990	QP	53.0	12.1	9.5	31.9	-	42.7	46.0	3.3	
Hori	720.000	QP	35.2	20.0	12.2	32.1	-	35.3	46.0	10.7	
Hori	2483.500	PK	45.4	27.4	6.9	32.0	-	47.7	73.9	26.2	
Hori	4960.000	PK	47.2	31.4	9.3	31.1	-	56.8	73.9	17.1	
Hori	7440.000	PK	41.3	36.5	8.8	32.5	-	54.1	73.9	19.8	Floor noise
Hori	9920.000	PK	41.2	38.8	9.6	32.9	-	56.7	73.9	17.2	Floor noise
Hori	2483.500	AV	31.1	27.4	6.9	32.0	-	33.4	53.9	20.5	
Hori	4960.000	AV	38.3	31.4	9.3	31.1	-	47.9	53.9	6.0	
Hori	7440.000	AV	29.4	36.5	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Hori	9920.000	AV	29.1	38.8	9.6	32.9	-	44.6	53.9	9.3	Floor noise
Vert	37.595	QP	43.1	15.1	7.4	32.1	-	33.5	40.0	6.5	
Vert	54.420	QP	51.0	9.4	7.7	32.1	-	36.0	40.0	4.0	
Vert	68.360	QP	54.0	6.6	7.9	32.1	-	36.4	40.0	3.6	
Vert	73.930	QP	56.4	6.2	7.9	32.1	-	38.4	40.0	1.6	
Vert	84.640	QP	51.8	7.0	8.1	32.1	-	34.8	40.0	5.2	
Vert	133.980	QP	44.5	14.1	8.6	32.0	-	35.2	43.5	8.3	
Vert	241.600	QP	47.8	12.1	9.5	31.9	-	37.5	46.0	8.5	
Vert	2483.500	PK	43.8	27.4	6.9	32.0	-	46.1	73.9	27.8	
Vert	4960.000	PK	44.4	31.4	9.3	31.1	-	54.0	73.9	19.9	
Vert	7440.000	PK	41.4	36.5	8.8	32.5	-	54.2	73.9	19.7	Floor noise
Vert	9920.000	PK	41.2	38.8	9.6	32.9	-	56.7	73.9	17.2	Floor noise
Vert	2483.500	AV	30.3	27.4	6.9	32.0	-	32.6	53.9	21.3	
Vert	4960.000	AV	34.4	31.4	9.3	31.1	-	44.0	53.9	9.9	
Vert	7440.000	AV	29.4	36.5	8.8	32.5	-	42.2	53.9	11.7	Floor noise
Vert	9920.000	AV	29.1	38.8	9.6	32.9	-	44.6	53.9	9.3	Floor noise

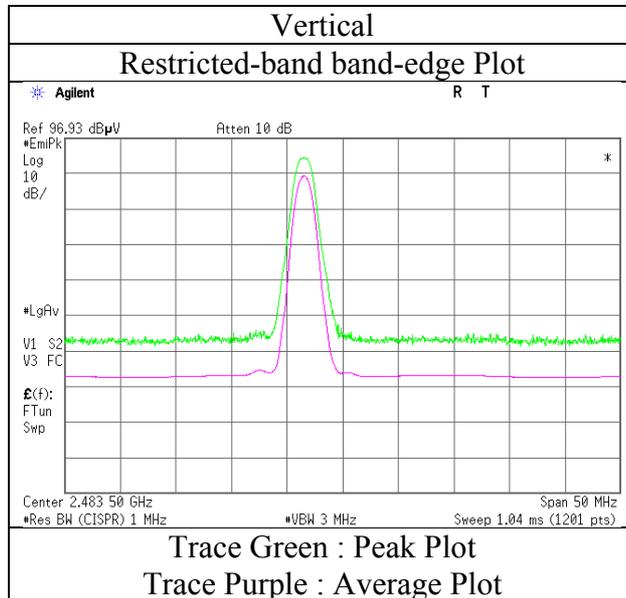
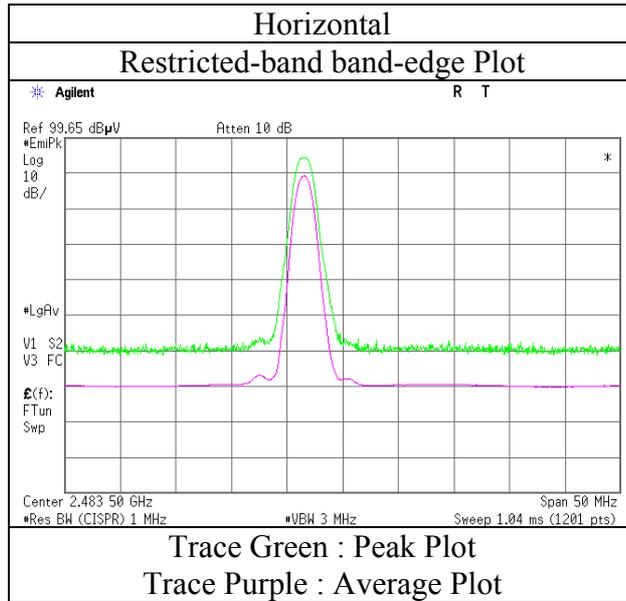
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

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

Radiated Spurious Emission
(Reference Plot for band-edge)

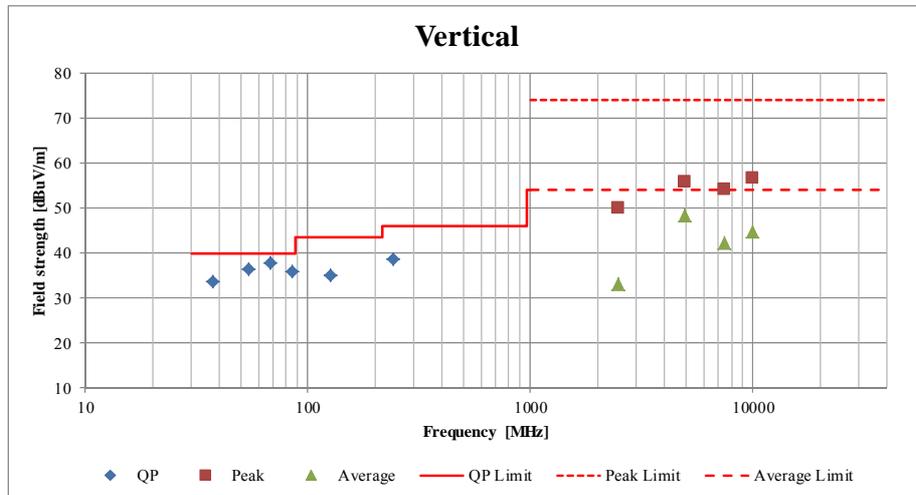
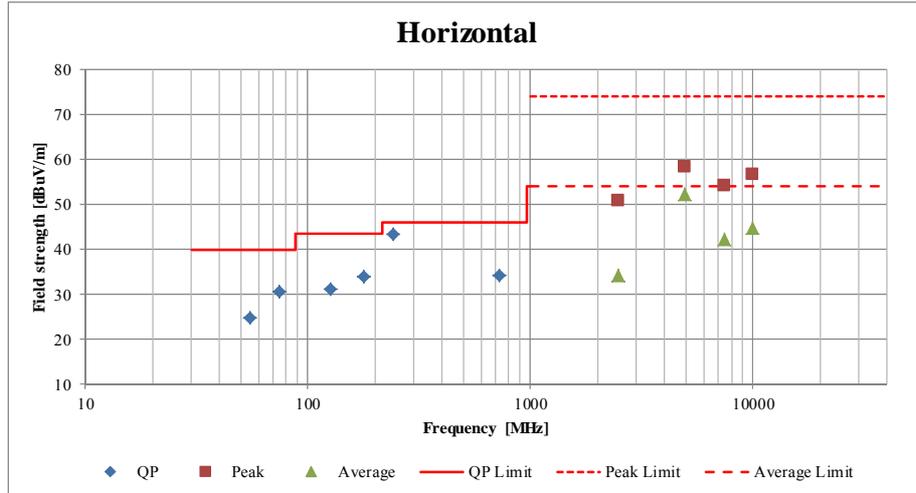
Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
 Report No. : 11547841H
 Date : December 12, 2016
 Temperature / Humidity : 23 deg. C / 30 % RH
 Engineer : Takafumi Noguchi
 (1 GHz -10 GHz)
 Mode : Tx, Hopping Off, 3DH5 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.2	No.4
Report No.	11547841H		
Date	December 12, 2016	December 13, 2016	November 20, 2016
Temperature / Humidity	23 deg. C / 30 % RH	21 deg. C / 31 % RH	22 deg. C / 43 % RH
Engineer	Takafumi Noguchi	Takafumi Noguchi	Hiroyuki Furutaka
Mode	(1 GHz -10 GHz) Tx, Hopping Off, DH5 2480 MHz	(10 GHz -26.5 GHz)	(Below 1GHz)

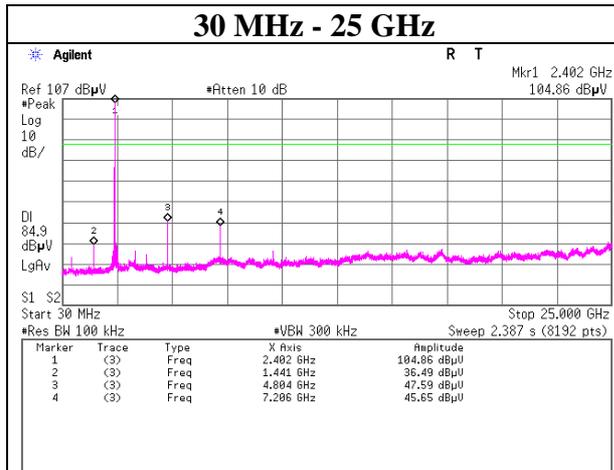
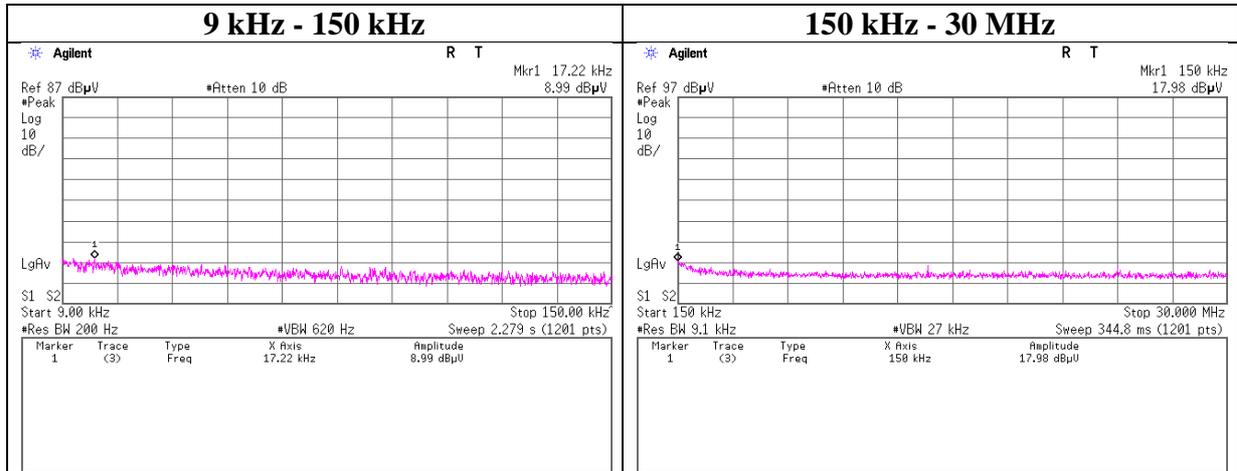


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off, DH5

2402 MHz



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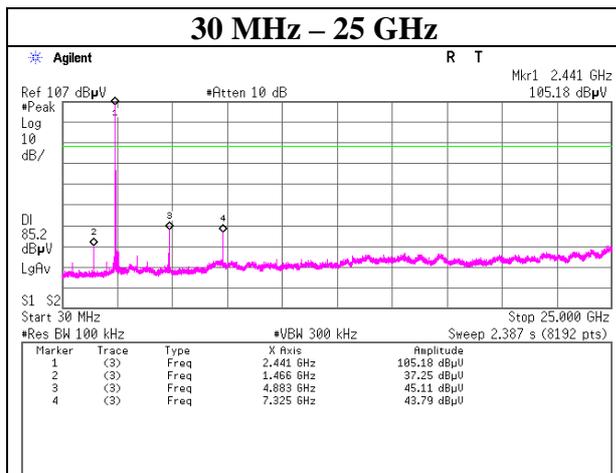
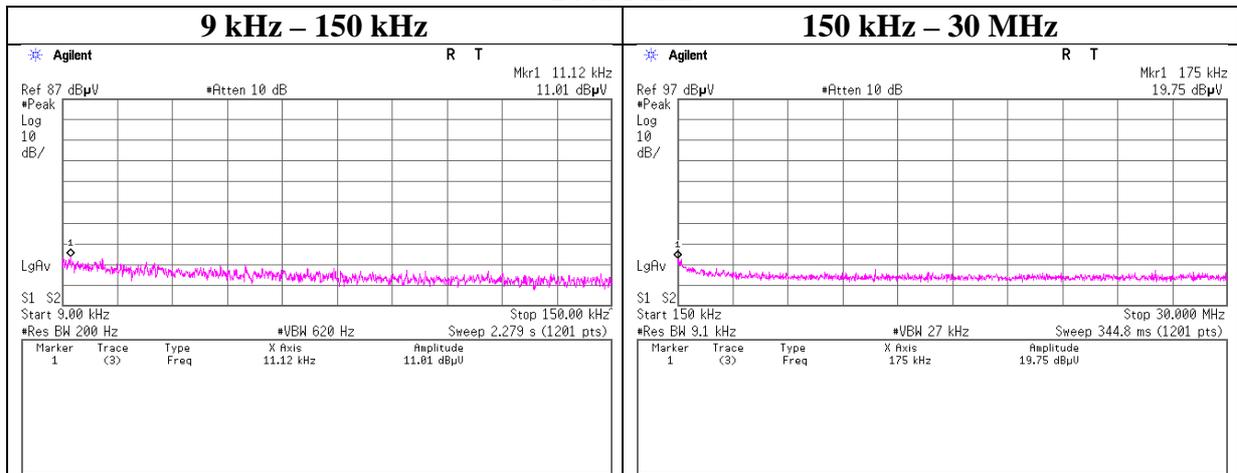
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off, DH5

2441 MHz



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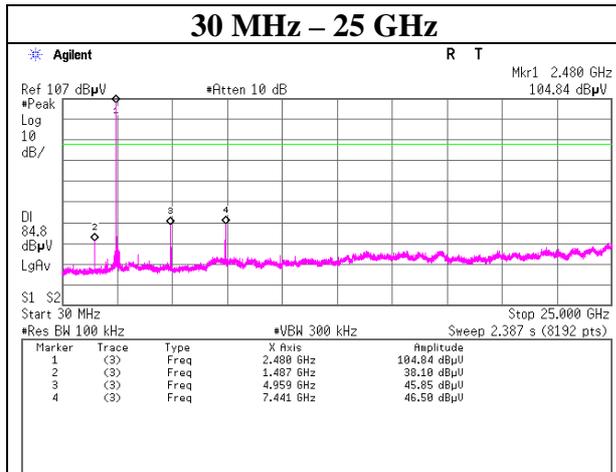
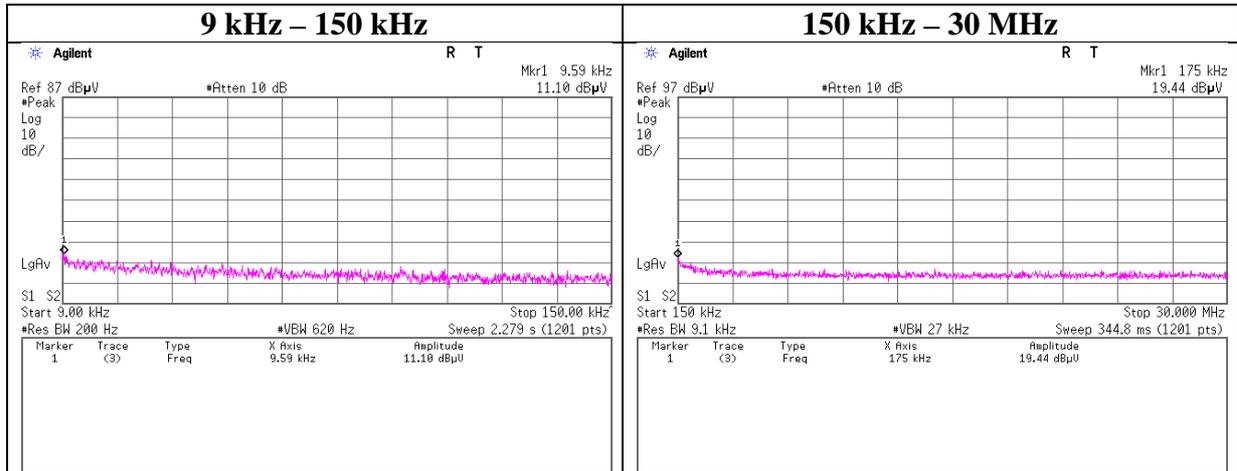
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off, DH5

2480 MHz



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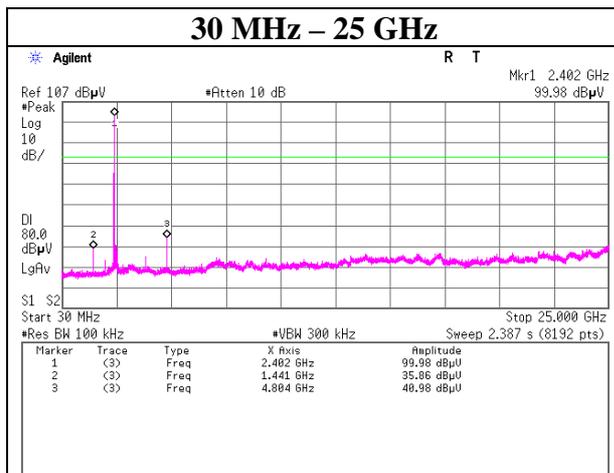
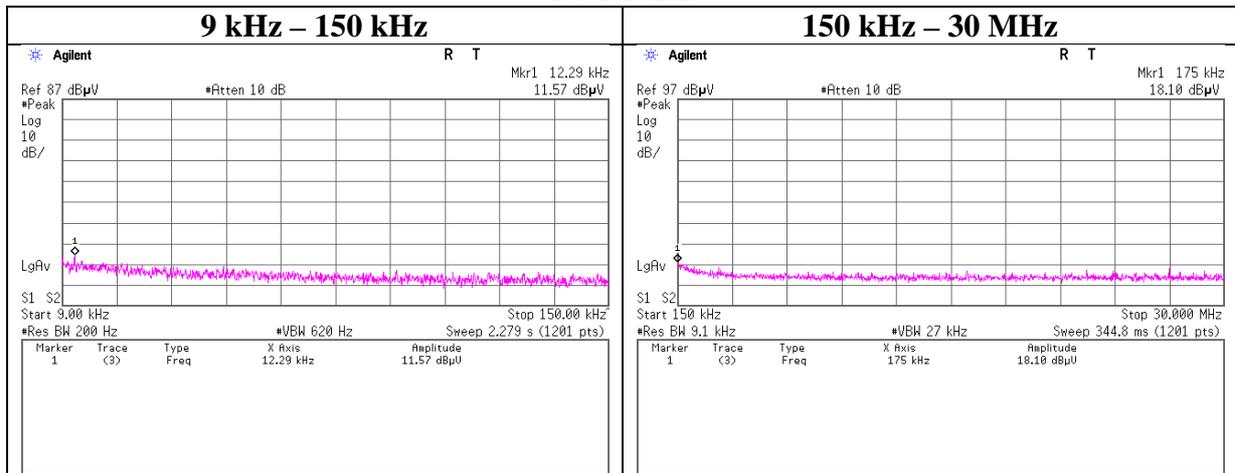
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off, 3DH5

2402 MHz



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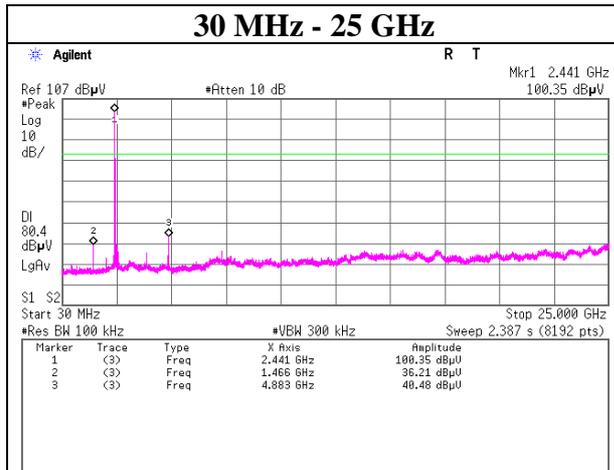
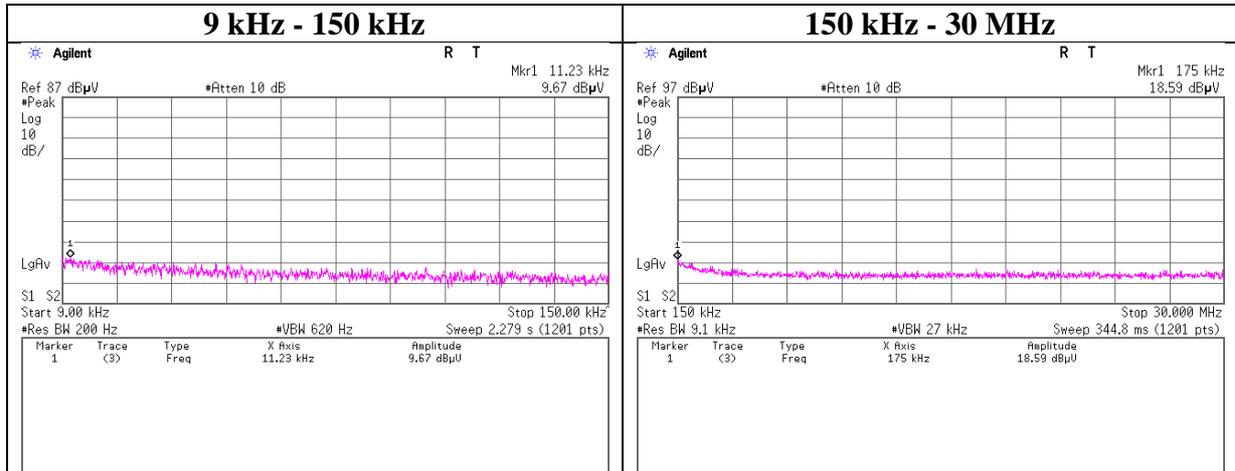
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off, 3DH5

2441 MHz



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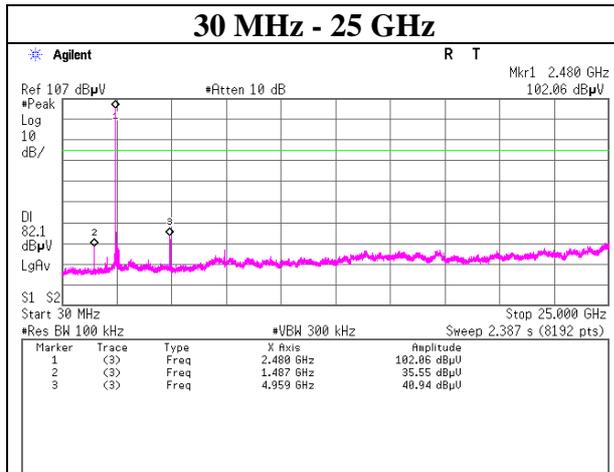
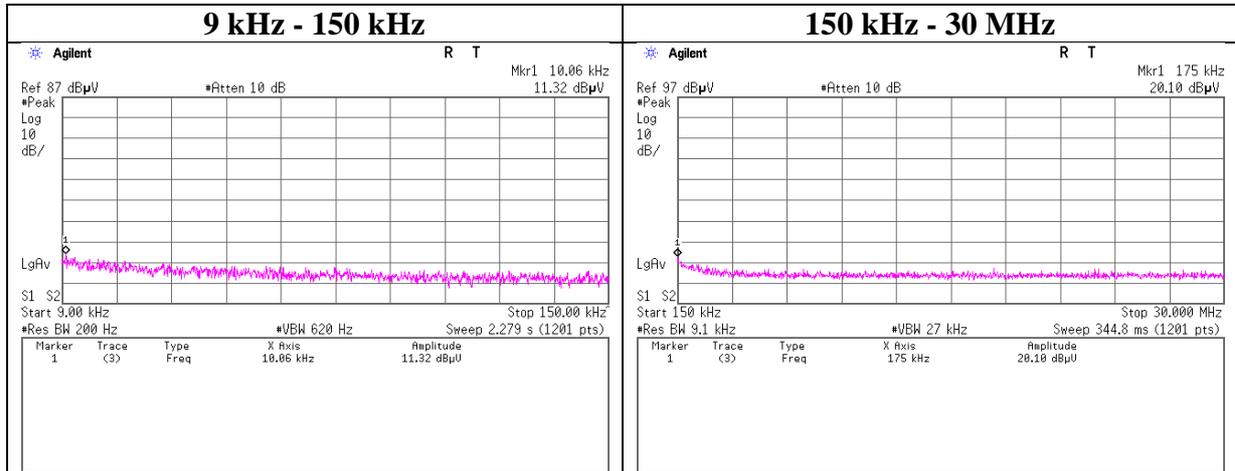
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off, 3DH5

2480 MHz



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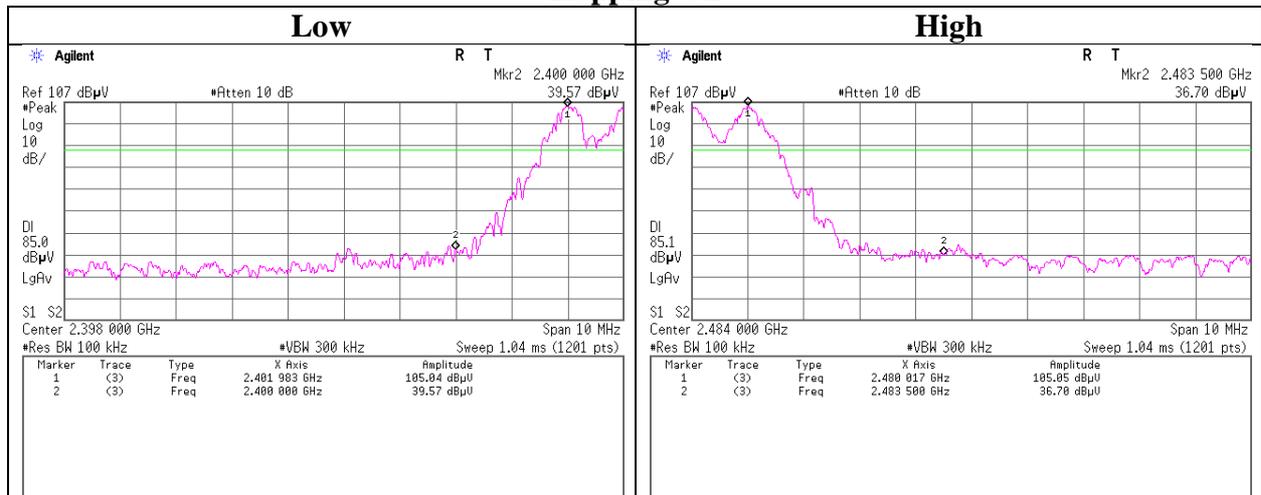
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

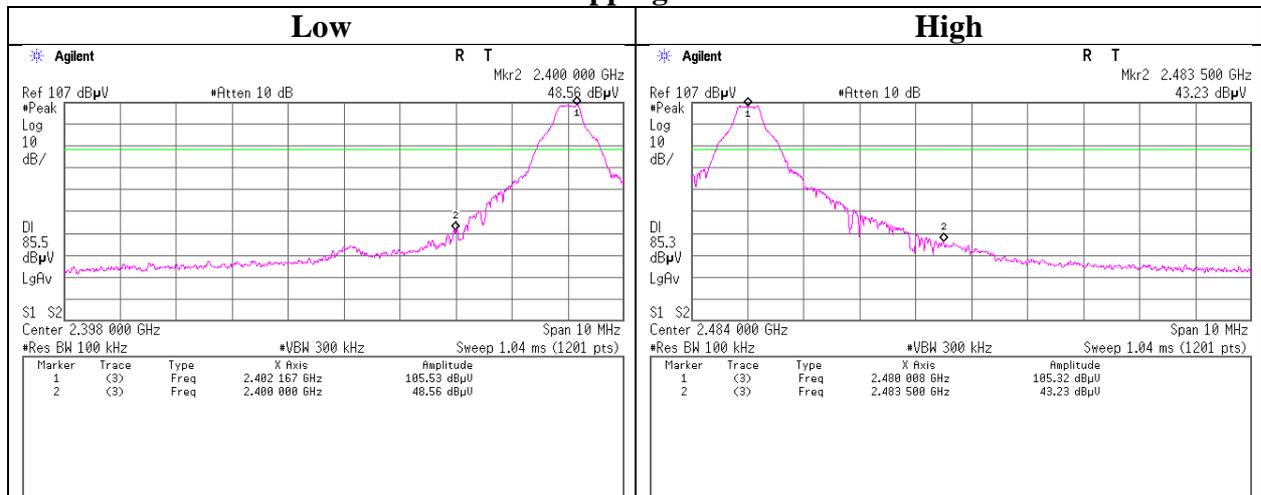
Conducted Emission Band Edge compliance

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx DH5

Hopping On



Hopping Off



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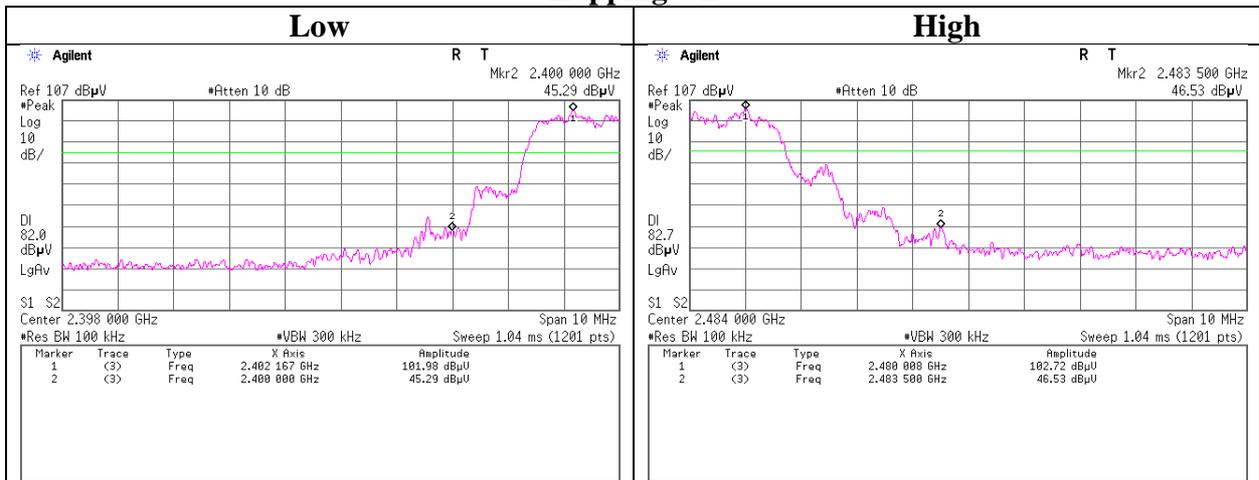
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

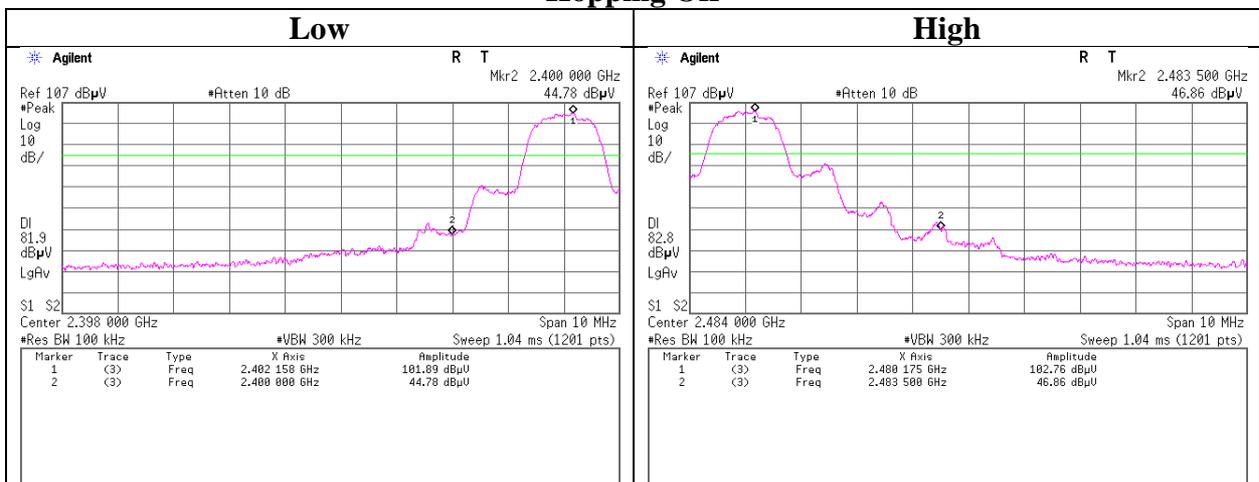
Conducted Emission Band Edge compliance

Test place	Ise EMC Lab. No.11 Measurement Room
Report No.	11547841H
Date	December 12, 2016
Temperature / Humidity	23 deg. C / 36 % RH
Engineer	Yuta Moriya
Mode	Tx 3DH5

Hopping On



Hopping Off



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Telephone : +81 596 24 8999

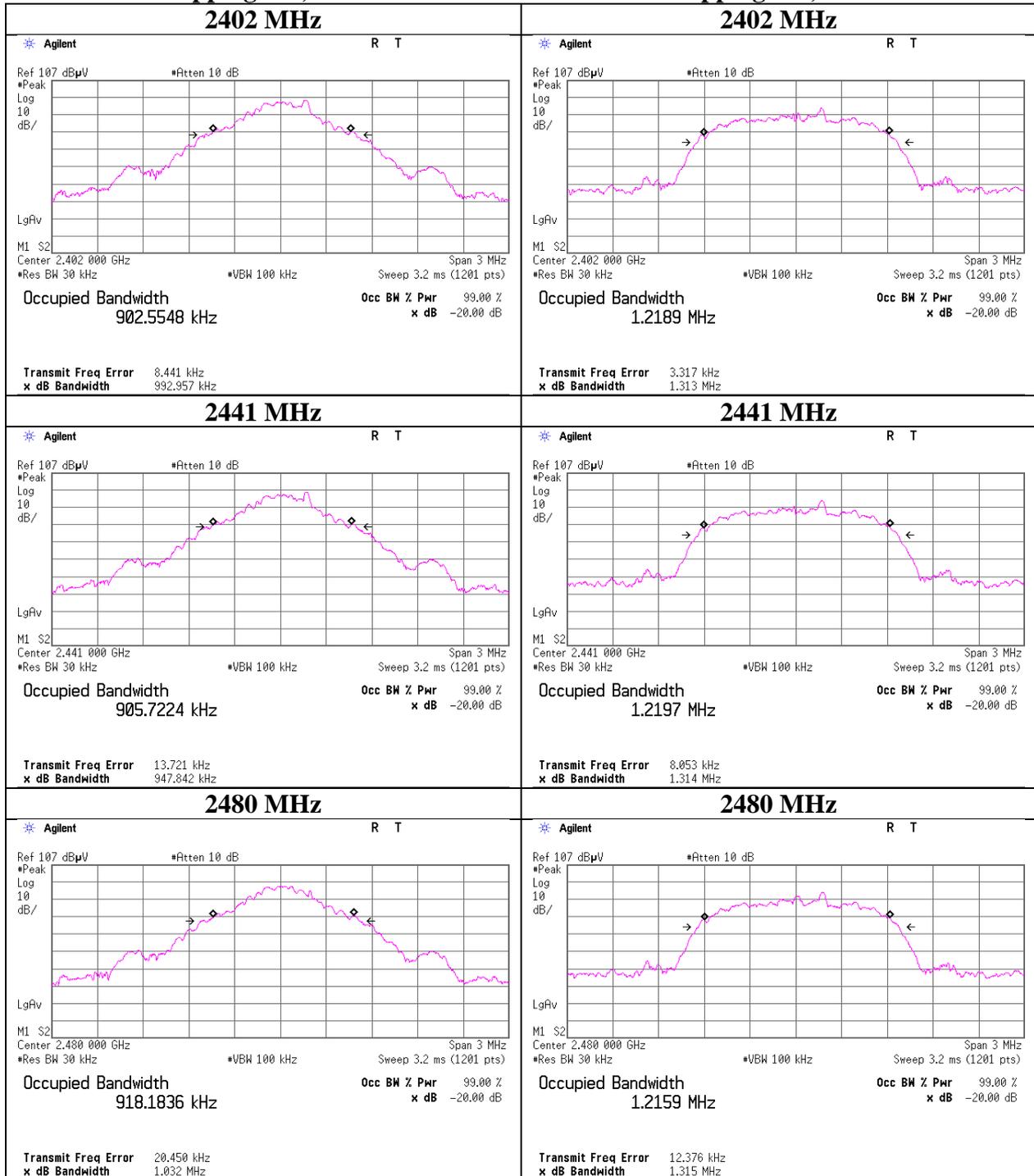
Facsimile : +81 596 24 8124

99% Occupied Bandwidth

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11547841H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 48 % RH
Engineer	Takumi Shimada
Mode	Tx Hopping Off

Hopping Off, DH5

Hopping Off, 3DH5



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Ise EMC Lab.

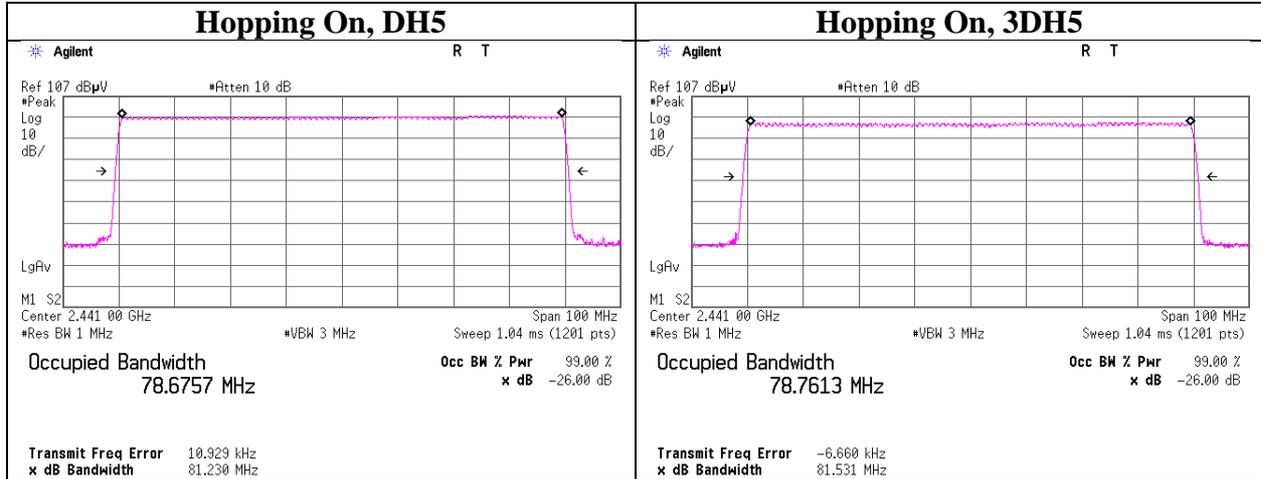
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

99% Occupied Bandwidth

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	11547841H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 48 % RH
Engineer	Takumi Shimada
Mode	Tx Hopping On



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Facsimile : +81 596 24 8124

APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MOS-29	Thermo-Hygrometer	Custom	CTH-201	2901	AT	2016/01/21 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	AT	2016/01/13 * 12
MOTS-MATM	Antenna Terminal Measurement Software	UL Japan	-	-	AT	-
MCC-144	Microwave Cable	Junkosha	MWX221	1207S407	AT	2016/08/02 * 12
MAT-57	Attenuator(10dB)	Suhner	6810.19.A	-	AT	2016/01/18 * 12
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	AT	2016/11/10 * 12
MPM-13	Power Meter	Anritsu	ML2495A	0824014	AT	2016/11/02 * 12
MPSE-18	Power sensor	Anritsu	MA2411B	0738174	AT	2016/11/02 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE/CE	2016/10/19 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE/CE	2016/01/21 * 12
MJM-26	Measure	KOMELON	KMC-36	-	RE/CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MRENT-126	Spectrum Analyzer	KEYSIGHT	E4440A	MY46185516	RE	2016/07/01 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2016/09/28 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	RE	2016/06/21 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	00650	RE	2016/10/21 * 12
MMM-10	DIGITAL HiTESTER	Hioki	3805	051201148	RE/CE	2016/01/18 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2016/06/24 * 12
MTR-10	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	RE/CE	2016/01/29 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2015/11/02 * 12 *1)
MLA-23	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	RE	2016/01/30 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2016/06/20 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2015/11/12 * 12 *1)
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2016/03/18 * 12
MHF-26	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	RE	2016/09/19 * 12
MLS-23	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	CE(AE)	2016/07/07 * 12
MLS-24	LISN(AMN)	Schwarzbeck	NSLK8127	8127-730	CE(EUT)	2016/07/11 * 12
MTA-53	Terminator	TME	CT-01BP	-	CE	2015/12/01 * 12
MAT-67	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	CE	2016/01/14 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/SFM1 41(5m)/421-010(1m)/sucoform141-PE(1 m)/RFM-E121(Swit cher)	-/04178	CE	2016/07/20 * 12
MSA-13	Spectrum Analyzer	Agilent	E4440A	MY46185823	RE	2016/06/17 * 12
MHF-06	High Pass Filter 3.5-24GHz	TOKIMEC	TF323DCA	601	RE	2016/05/16 * 12
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2016/08/02 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2016/12/13 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
MHA-06	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	RE	2016/02/29 * 12
MCC-216	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	RE	2016/08/29 * 12
MPA-10	Pre Amplifier	Agilent	8449B	3008A02142	RE	2016/01/19 * 12
MHA-02	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	RE	2016/02/29 * 12
MMM-01	Digital Tester	Fluke	FLUKE 26-3	78030611	RE	2016/08/23 * 12

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***1) This test equipment was used for the tests before the expiration date of the calibration.**

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

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

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

**Test Item: CE: Conducted Emission test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test**