



RADIO TEST REPORT

Test Report No. : 12344074H-C-R1

Applicant : **DENSO CORPORATION**
Type of Equipment : **Cockpit Control Unit (CCU)**
Model No. : **DNNS102**
FCC ID : **HYQDNNS102**
Test regulation : **FCC Part 15 Subpart C: 2018**
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.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. This report is a revised version of 12344074H-C. 12344074H-C is replaced with this report.

Date of test: June 8 to August 3, 2018

Representative test engineer:

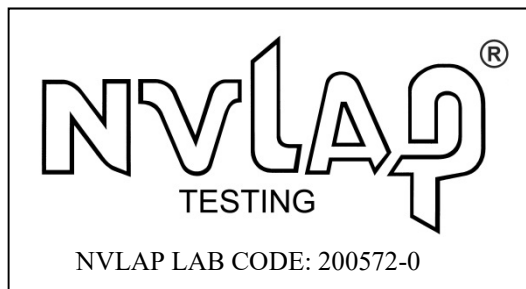
T. Noguchi

Takafumi Noguchi
Engineer
Consumer Technology Division

Approved by:

S. Matsuyama

Satofumi Matsuyama
Engineer
Consumer Technology Division



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SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1 Showa-cho, Kariya-shi, Aichi ken, 448-8661 Japan
Telephone Number	:	+81-566-20-3304
Facsimile Number	:	+81-566-25-4920
Contact Person	:	Naoto Makino

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

2.1 Identification of E.U.T.

Type of Equipment	:	Cockpit Control Unit (CCU)
Model No.	:	DNNS102
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 13.2 V
Receipt Date of Sample	:	June 3, 2018
Country of Mass-production	:	the United States of America
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: DNNS102 (referred to as the EUT in this report) is a Cockpit Control Unit (CCU).

Radio Specification

Feature of EUT:

Clock frequency(ies) in the system : 1.8 GHz (max.)
Operating Temperature : -30 deg. C to 65 deg. C

[AM/FM/HD/XM Radio]

	AM	FM	HD	XM
Equipment type	Receiver			
Frequency of operation	531 kHz to 1602 kHz	87.5 MHz to 108.0 MHz	AM: 531 kHz to 1602 kHz FM: 87.5 MHz to 108.0 MHz	2333.465 MHz to 2344.045 MHz
Channel spacing	9 kHz	50 kHz	AM: 9 kHz FM: 50 kHz	-
Antenna connector type	Receptacle Connector			High Frequency Connector

[Bluetooth (Ver4.2 BDR/EDR)]

	Bluetooth
Equipment type	Transceiver
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK)
Channel spacing	1 MHz
Antenna type	ASSEMBLY Bluetooth Antenna
Antenna Connector type	MHF PLUG
Antenna Gain	-0.88 dBi

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on 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

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

3.2 Procedures and results

Item	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	N/A	N/A	- *1)
Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (b)	See data.	Complied	Conducted
20dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (a)		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 (d)		Complied	Conducted
Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		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 (b)		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	3.3 dB 734.833 MHz, QP, Hori.	Complied#	Conducted/ Radiated (above 30 MHz) *2)

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

*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

*2) Radiated test was selected over 30 MHz based on section 15.247(d).

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 EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage.

Instead of a new battery, DC power supply was used for the test.

That does not affect the test result, therefore the EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the vehicle. 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	Complied	Conducted
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.					

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 $k=2$.

Antenna Terminal test

Test Item	Uncertainty (+/-)
RF output power	1.3 dB
Antenna terminal conducted emission / Power density / Burst power	
Below 3GHz	2.0 dB
Adjacent channel power / Channel power	
Below 3GHz	1.9 dB

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
	(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	4.9 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
	(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz	5.0 dB
	6 GHz to 18 GHz	5.3 dB
1 m	10 GHz to 26.5 GHz	5.8 dB
	26.5 GHz to 40 GHz	5.8 dB
10 m	1 GHz to 18 GHz	5.2 dB

3.5 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

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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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
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 DH5, 3DH5 -Hopping On	-
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
*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) *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. * 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. *EUT has the power settings by the software as follows; Power settings: BDR/EDR: 3 dBm Software: MSoC Ver: F11GBO11-O14 *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.		

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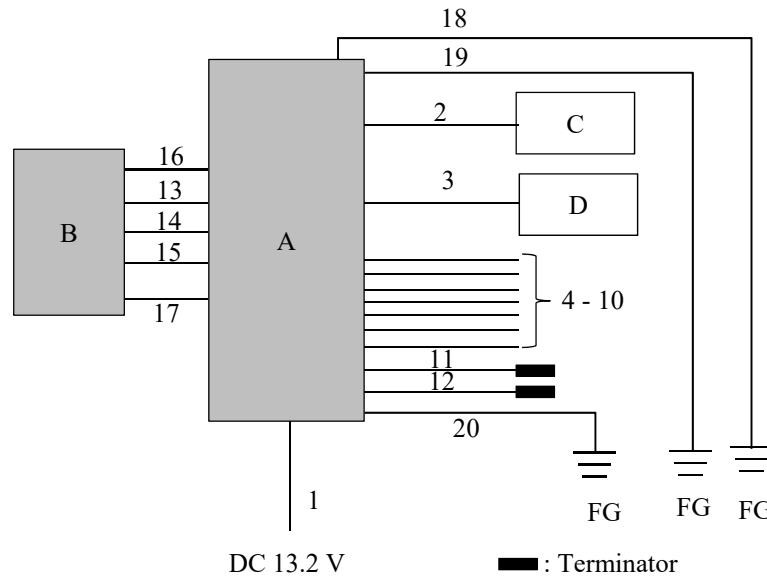
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4.2 Configuration and peripherals



* 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	Cockpit Control Unit (CCU)	DNNS102	468726302000305	DENSO CORPORATION	EUT
B	CID	86213AN60A	ASSY-K3-BASE-089	DENSO CORPORATION	EUT
C	Speaker	-	-	-	-
D	Speaker	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.5	Unshielded	Unshielded	-
2	Speaker Cable	1.0	Unshielded	Unshielded	-
3	Speaker Cable	1.0	Unshielded	Unshielded	-
4	Signal Cable	1.8	Unshielded	Unshielded	-
5	Mater Cable	1.7	Shielded	Shielded	-
6	USB Cable	2.0	Shielded	Shielded	-
7	USB Cable	2.0	Shielded	Shielded	-
8	USB Cable	2.0	Shielded	Shielded	-
9	XM Cable	1.0	Shielded	Shielded	-
10	Signal Cable	2.0	Unshielded	Unshielded	-
11	AM/FM Cable (Main)	1.0	Shielded	Shielded	-
12	AM/FM Cable (Sub)	1.0	Shielded	Shielded	-
13	DC Cable	0.2	Unshielded	Unshielded	-
14	Signal Cable	0.2	Shielded	Shielded	-
15	BT Cable	0.2	Shielded	Shielded	-
16	FG Cable	0.1	Unshielded	Unshielded	-
17	FG Cable	0.1	Unshielded	Unshielded	-
18	FG Cable	3.0	Unshielded	Unshielded	-
19	FG Cable	3.0	Unshielded	Unshielded	-
20	FG Cable	3.0	Unshielded	Unshielded	-

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SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.5 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.

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	4.0 m*2) (1 GHz - 10 GHz), 1.0 m*3) (10 GHz - 26.5 GHz),		4.0 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: $20 \times \log (4.0 \text{ m}/3.0 \text{ m}) = 2.5 \text{ dB}$

*3) 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 0 degree and 30 degree as tilt angle 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

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SECTION 6: 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 low enough as shown in the chart.							

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

Test data : APPENDIX
 Test result : Pass

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APPENDIX 1: Test data

20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation

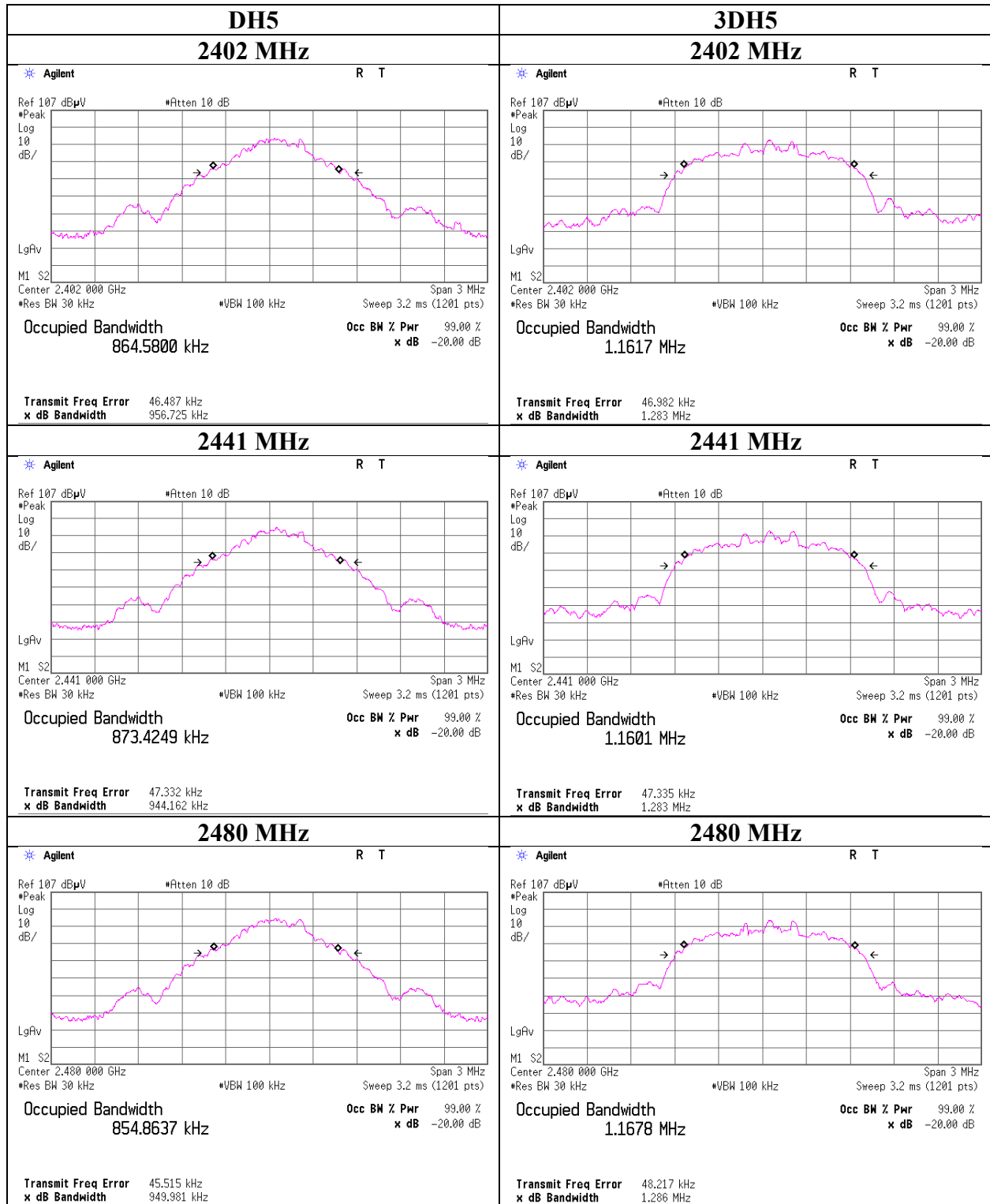
Report No. 12344074H
Test place Ise EMC Lab.
Measurement Room No.5
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	99% Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.957	864.580	1.000	≥ 0.638
DH5	2441.0	0.944	873.425	1.000	≥ 0.629
DH5	2480.0	0.950	854.864	1.000	≥ 0.633
DH5	Hopping On	-	78649.100	-	-
3DH5	2402.0	1.283	1161.700	1.000	≥ 0.855
3DH5	2441.0	1.283	1160.100	1.000	≥ 0.855
3DH5	2480.0	1.286	1167.800	1.000	≥ 0.857
3DH5	Hopping On	-	78702.400	-	-

Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).

No limit applies to 20dB Bandwidth.

20dB Bandwidth and 99% Occupied Bandwidth



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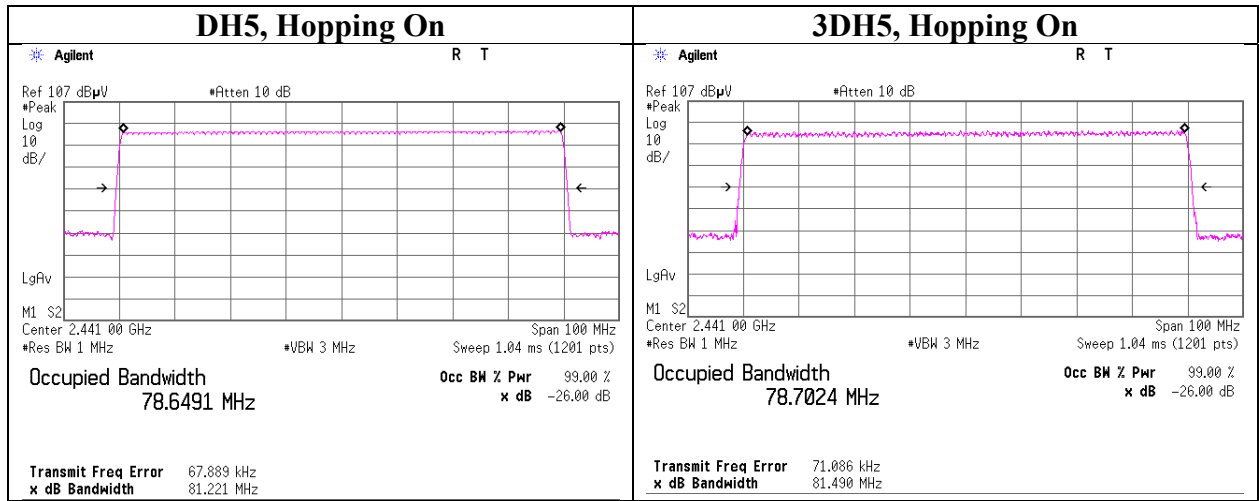
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20dB Bandwidth and 99% Occupied Bandwidth



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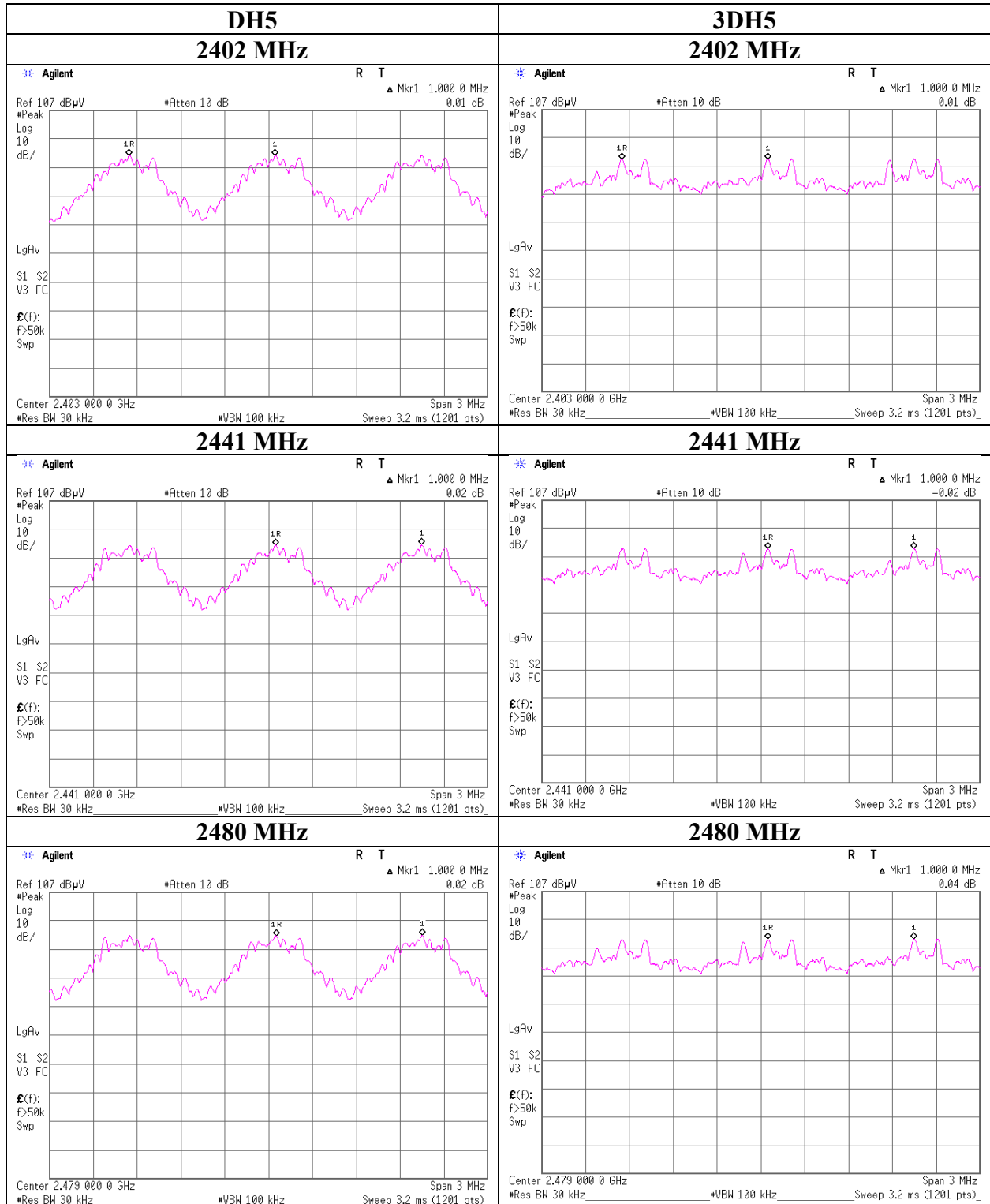
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Carrier Frequency Separation



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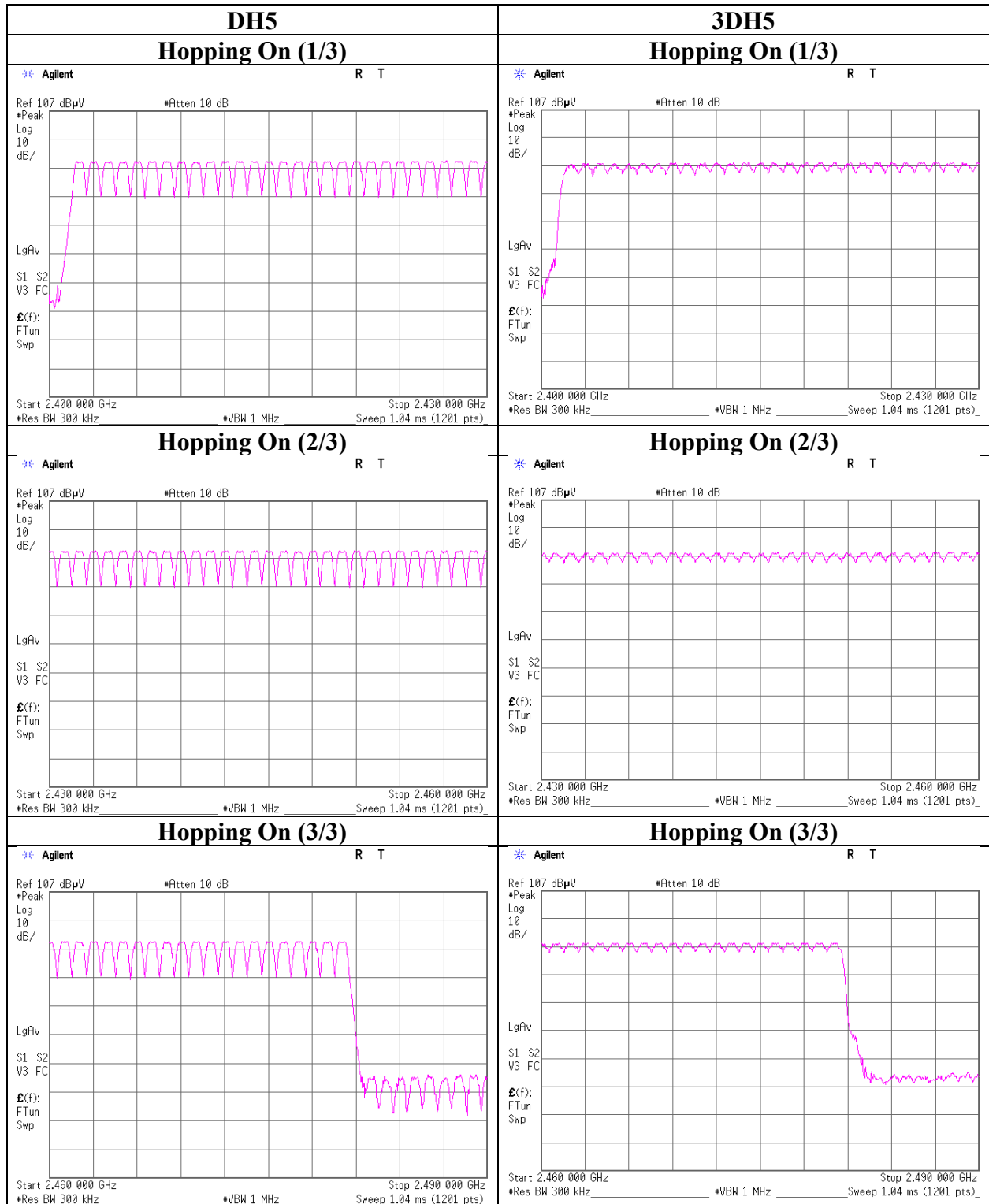
Number of Hopping Frequency

Report No. 12344074H
Test place Ise EMC Lab.
Measurement Room No.5
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
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



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Dwell time

Report No. 12344074H
Test place Ise EMC Lab.
Measurement Room No.5
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
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	48.2 times / 5 sec. x 31.6 sec. = 305 times	0.412	126	400
DH3	19.4 times / 5 sec. x 31.6 sec. = 123 times	1.669	205	400
DH5	15.2 times / 5 sec. x 31.6 sec. = 97 times	2.917	283	400
3DH1	49.0 times / 5 sec. x 31.6 sec. = 310 times	0.421	131	400
3DH3	21.6 times / 5 sec. x 31.6 sec. = 137 times	1.675	229	400
3DH5	15.8 times / 5 sec. x 31.6 sec. = 100 times	2.933	293	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

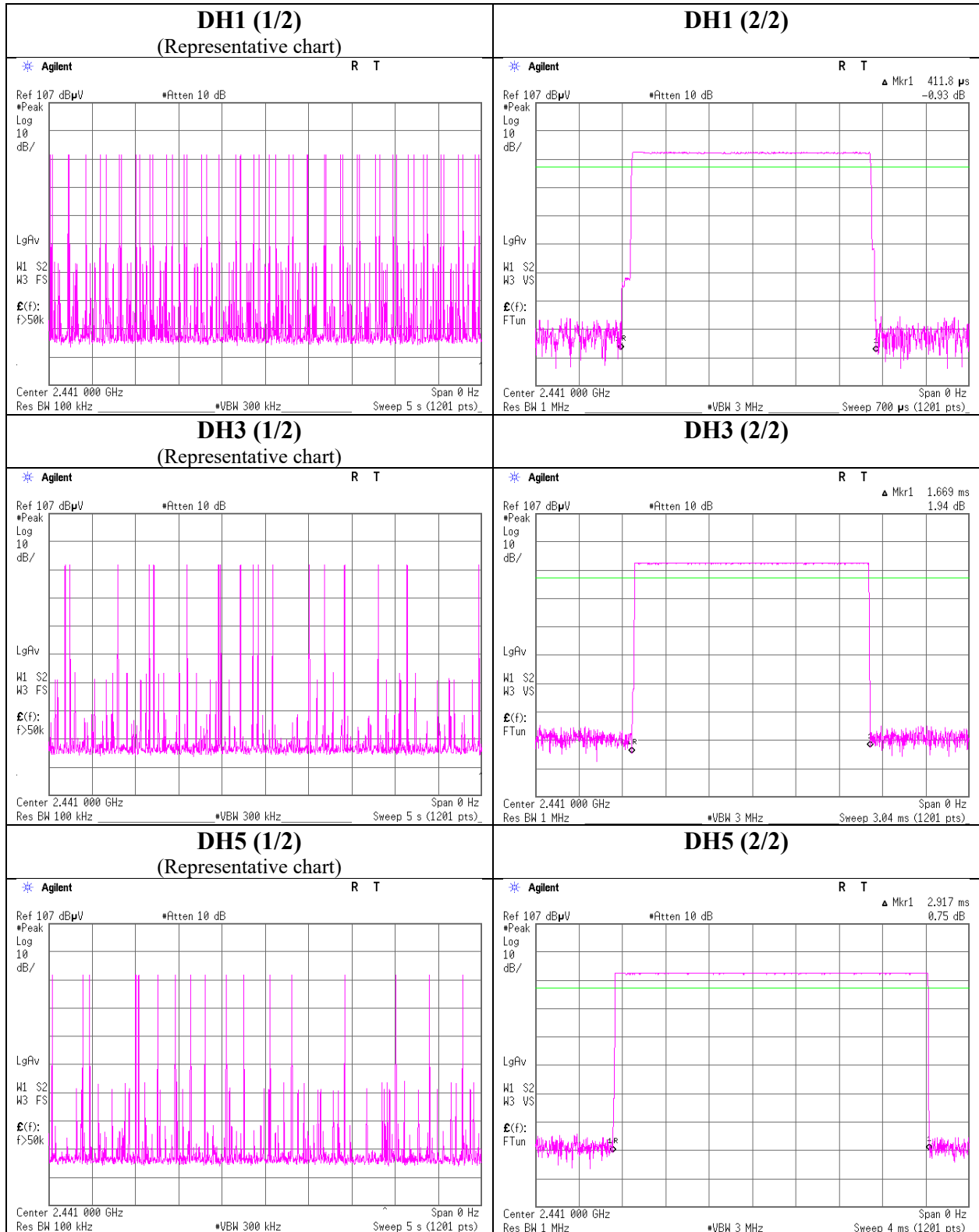
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	50	48	48	48	47	48.2
DH3	18	23	17	22	17	19.4
DH5	15	16	14	17	14	15.2
3DH1	50	49	49	50	47	49
3DH3	21	21	25	20	21	21.6
3DH5	15	18	15	15	16	15.8

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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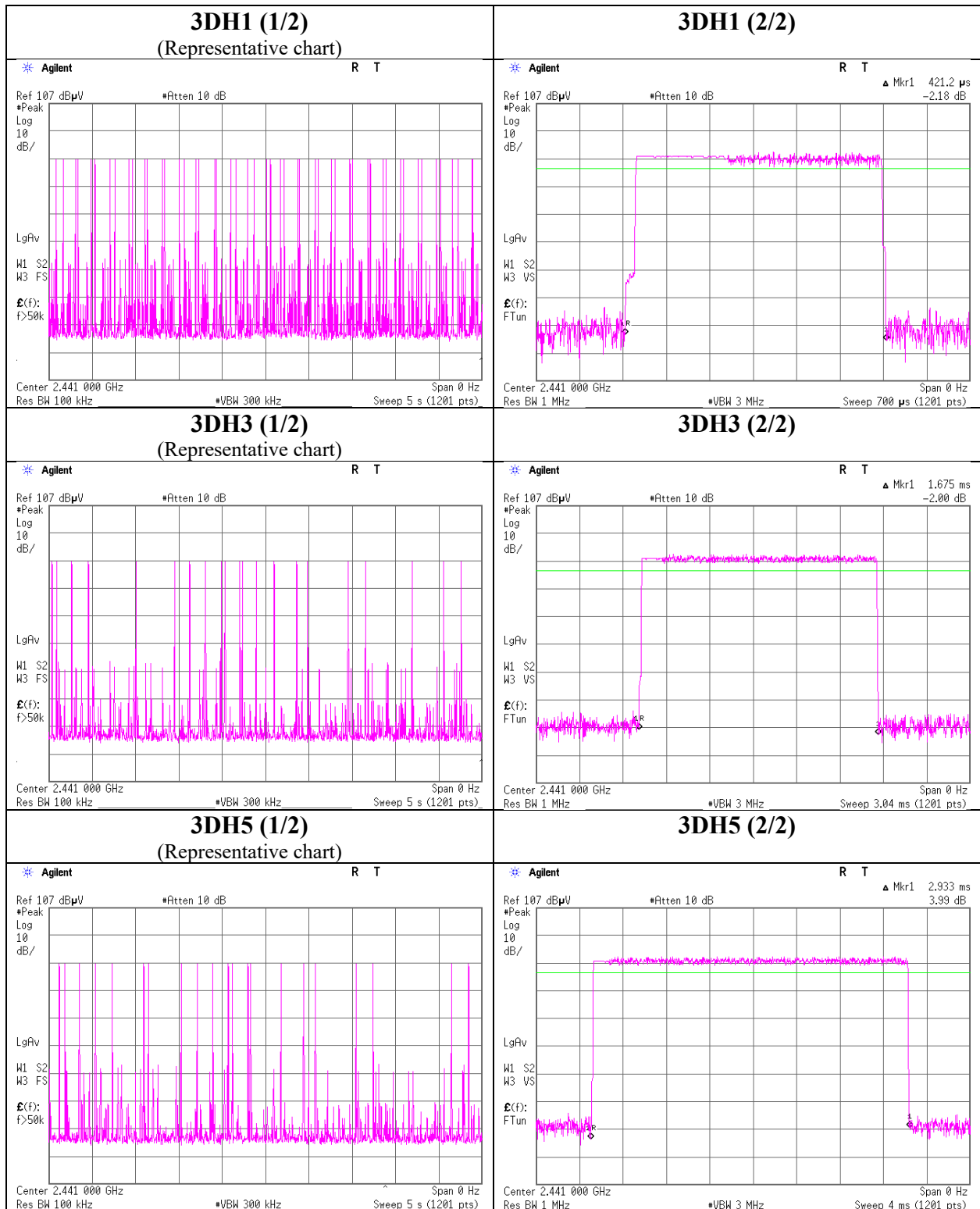
Ise EMC Lab.

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Dwell time



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Maximum Peak Output Power

Report No. 12344074H
Test place Ise EMC Lab. No.5 Measurement Room
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power				
					Result		Limit		Margin
					[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-13.93	1.50	10.06	-2.37	0.58	20.96	125	23.33
DH5	2441.0	-13.46	1.11	10.06	-2.29	0.59	20.96	125	23.25
DH5	2480.0	-13.38	1.23	10.06	-2.09	0.62	20.96	125	23.05
2DH5	2402.0	-14.26	1.50	10.06	-2.70	0.54	20.96	125	23.66
2DH5	2441.0	-13.65	1.11	10.06	-2.48	0.57	20.96	125	23.44
2DH5	2480.0	-13.55	1.23	10.06	-2.26	0.59	20.96	125	23.22
3DH5	2402.0	-13.71	1.50	10.06	-2.15	0.61	20.96	125	23.11
3DH5	2441.0	-13.07	1.11	10.06	-1.90	0.65	20.96	125	22.86
3DH5	2480.0	-12.88	1.23	10.06	-1.59	0.69	20.96	125	22.55

Sample Calculation:

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

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

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 RF Exposure)

Report No.	12344074H
Test place	Ise EMC Lab. No.5 Measurement Room
Date	August 3, 2018
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Takafumi Noguchi
Mode	Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
					[dBm]	[mW]		[dBm]	[mW]
DH5	2402.0	-15.54	1.50	10.06	-3.98	0.40	1.10	-2.88	0.51
DH5	2441.0	-15.01	1.11	10.06	-3.84	0.41	1.10	-2.74	0.53
DH5	2480.0	-14.93	1.23	10.06	-3.64	0.43	1.10	-2.54	0.56
2DH5	2402.0	-18.35	1.50	10.06	-6.79	0.21	1.08	-5.71	0.27
2DH5	2441.0	-17.57	1.11	10.06	-6.40	0.23	1.08	-5.32	0.29
2DH5	2480.0	-17.46	1.23	10.06	-6.17	0.24	1.08	-5.09	0.31
3DH5	2402.0	-18.30	1.50	10.06	-6.74	0.21	1.08	-5.66	0.27
3DH5	2441.0	-17.55	1.11	10.06	-6.38	0.23	1.08	-5.30	0.30
3DH5	2480.0	-17.32	1.23	10.06	-6.03	0.25	1.08	-4.95	0.32

Sample Calculation:

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

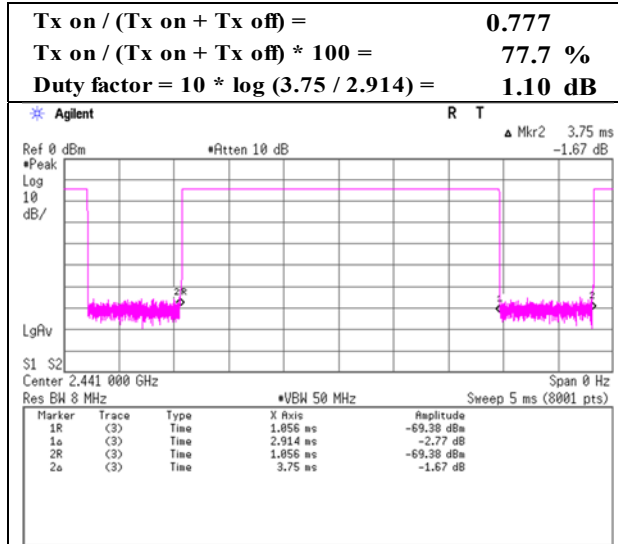
Result (Burst power average) = Time average + Duty factor

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

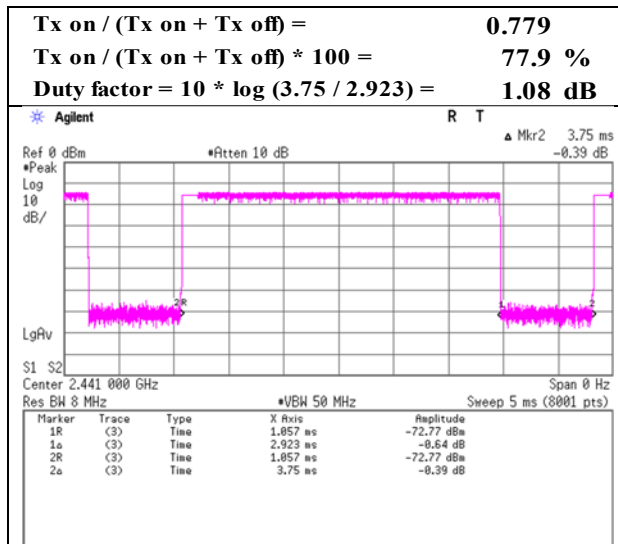
Burst Rate Confirmation

Report No. 12344074H
Test place Ise EMC Lab. No.5 Measurement Room
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off

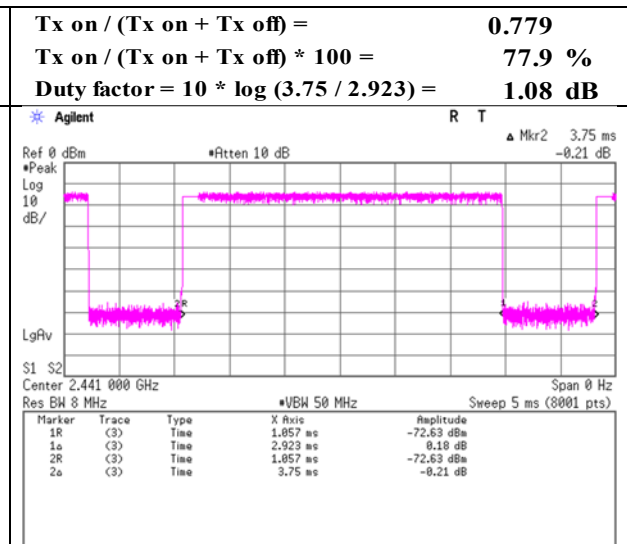
DH5



2DH5



3DH5



Radiated Spurious Emission

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 8, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 65 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Yuta Moriya	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
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	224.000	QP	40.4	11.6	9.3	32.0	-	29.3	46.0	16.7	
Hori	232.000	QP	43.0	11.7	9.4	32.0	-	32.1	46.0	13.9	
Hori	240.000	QP	41.0	11.7	9.5	32.0	-	30.2	46.0	15.8	
Hori	318.638	QP	34.6	13.9	10.1	32.0	-	26.6	46.0	19.4	
Hori	733.869	QP	41.9	20.3	12.4	32.0	-	42.6	46.0	3.4	
Hori	847.697	QP	32.8	21.6	12.9	31.5	-	35.8	46.0	10.2	
Hori	2390.000	PK	41.8	27.2	5.9	32.1	-	42.8	73.9	31.1	
Hori	4804.000	PK	40.3	31.3	8.1	31.3	-	48.4	73.9	25.5	Floor noise
Hori	7206.000	PK	45.7	35.8	9.5	32.4	-	58.6	73.9	15.3	
Hori	9608.000	PK	43.1	38.4	10.2	32.6	-	59.1	73.9	14.8	Floor noise
Hori	2390.000	AV	29.8	27.2	5.9	32.1	-	30.8	53.9	23.1	
Hori	4804.000	AV	27.1	31.3	8.1	31.3	-	35.2	53.9	18.7	Floor noise
Hori	7206.000	AV	33.0	35.8	9.5	32.4	-	45.9	53.9	8.0	
Hori	9608.000	AV	30.1	38.4	10.2	32.6	-	46.1	53.9	7.8	Floor noise
Vert	224.000	QP	40.1	11.6	9.3	32.0	-	29.0	46.0	17.0	
Vert	232.000	QP	42.2	11.7	9.4	32.0	-	31.3	46.0	14.7	
Vert	240.000	QP	42.3	11.7	9.5	32.0	-	31.5	46.0	14.5	
Vert	320.241	QP	32.1	14.0	10.1	32.0	-	24.2	46.0	21.8	
Vert	737.076	QP	37.2	20.3	12.4	32.0	-	37.9	46.0	8.1	
Vert	854.110	QP	33.6	21.7	12.9	31.4	-	36.8	46.0	9.2	
Vert	2390.000	PK	41.4	27.2	5.9	32.1	-	42.4	73.9	31.5	
Vert	4804.000	PK	41.1	31.3	8.1	31.3	-	49.2	73.9	24.7	Floor noise
Vert	7206.000	PK	44.5	35.8	9.5	32.4	-	57.4	73.9	16.5	
Vert	9608.000	PK	43.0	38.4	10.2	32.6	-	59.0	73.9	14.9	Floor noise
Vert	2390.000	AV	28.3	27.2	5.9	32.1	-	29.3	53.9	24.6	
Vert	4804.000	AV	27.4	31.3	8.1	31.3	-	35.5	53.9	18.4	Floor noise
Vert	7206.000	AV	32.9	35.8	9.5	32.4	-	45.8	53.9	8.1	
Vert	9608.000	AV	30.2	38.4	10.2	32.6	-	46.2	53.9	7.7	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 (4.0 m / 3.0 m) = 2.5 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	87.8	27.2	5.9	32.1	88.8	-	-	Carrier
Hori	2400.000	PK	35.4	27.2	5.9	32.1	36.4	68.8	32.4	
Vert	2402.000	PK	84.2	27.2	5.9	32.1	85.2	-	-	Carrier
Vert	2400.000	PK	34.8	27.2	5.9	32.1	35.8	65.2	29.4	

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

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB

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

UL Japan, Inc.

Ise EMC Lab.

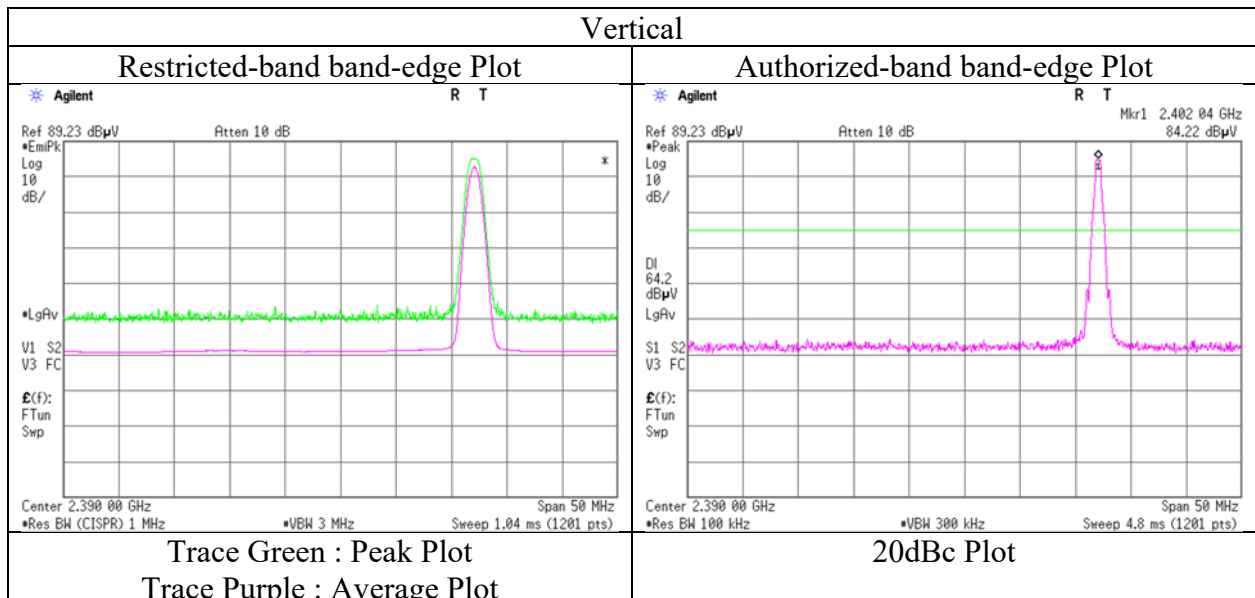
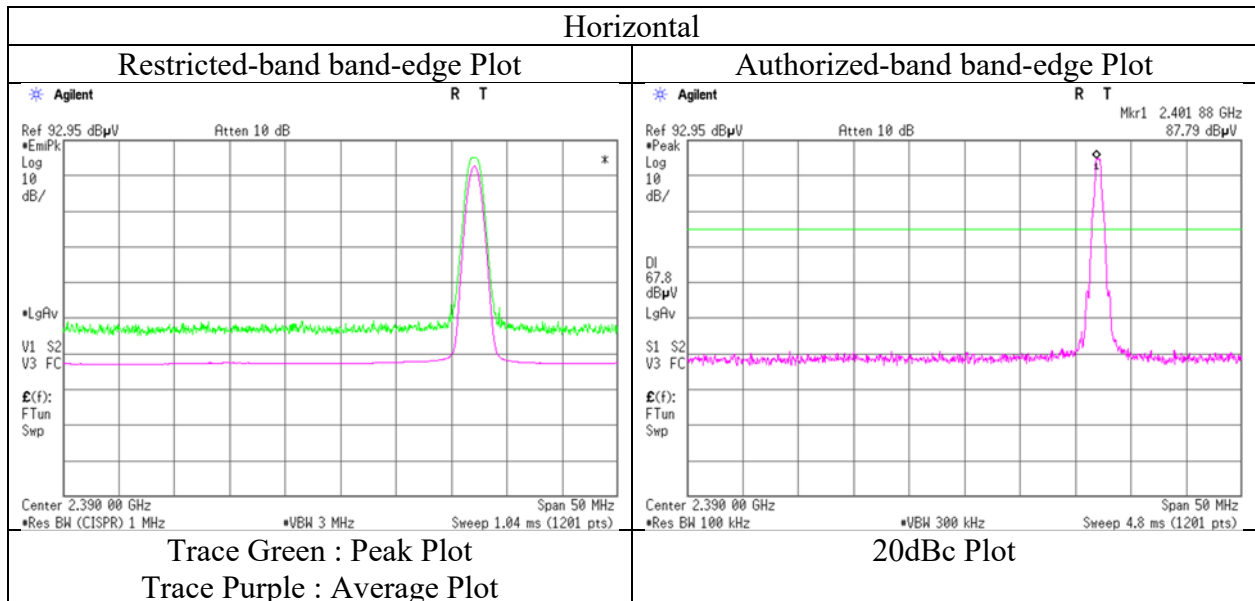
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 8, 2018
Temperature / Humidity	22 deg. C / 65 % RH
Engineer	Yuta Moriya
	(1 GHz -10 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 8, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 65 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Yuta Moriya	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, DH5 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	224.000	QP	40.3	11.6	9.3	32.0	-	29.2	46.0	16.8	
Hori	232.000	QP	43.1	11.7	9.4	32.0	-	32.2	46.0	13.8	
Hori	240.000	QP	41.2	11.7	9.5	32.0	-	30.4	46.0	15.6	
Hori	318.643	QP	34.5	13.9	10.1	32.0	-	26.5	46.0	19.5	
Hori	734.833	QP	42.0	20.3	12.4	32.0	-	42.7	46.0	3.3	
Hori	848.354	QP	32.6	21.6	12.9	31.5	-	35.6	46.0	10.4	
Hori	4882.000	PK	40.4	31.5	8.2	31.2	-	48.9	73.9	25.0	Floor noise
Hori	7323.000	PK	45.0	36.1	9.5	32.4	-	58.2	73.9	15.7	
Hori	9764.000	PK	43.0	38.5	10.2	32.7	-	59.0	73.9	14.9	Floor noise
Hori	4882.000	AV	28.0	31.5	8.2	31.2	-	36.5	53.9	17.4	Floor noise
Hori	7323.000	AV	35.0	36.1	9.5	32.4	-	48.2	53.9	5.7	
Hori	9764.000	AV	30.2	38.5	10.2	32.7	-	46.2	53.9	7.7	Floor noise
Vert	224.000	QP	40.1	11.6	9.3	32.0	-	29.0	46.0	17.0	
Vert	232.000	QP	42.3	11.7	9.4	32.0	-	31.4	46.0	14.6	
Vert	240.000	QP	42.2	11.7	9.5	32.0	-	31.4	46.0	14.6	
Vert	320.238	QP	32.3	14.0	10.1	32.0	-	24.4	46.0	21.6	
Vert	737.071	QP	37.4	20.3	12.4	32.0	-	38.1	46.0	7.9	
Vert	854.117	QP	33.3	21.7	12.9	31.4	-	36.5	46.0	9.5	
Vert	4882.000	PK	41.1	31.5	8.2	31.2	-	49.6	73.9	24.3	Floor noise
Vert	7323.000	PK	46.7	36.1	9.5	32.4	-	59.9	73.9	14.0	
Vert	9764.000	PK	42.5	38.5	10.2	32.7	-	58.5	73.9	15.4	Floor noise
Vert	4882.000	AV	27.9	31.5	8.2	31.2	-	36.4	53.9	17.5	Floor noise
Vert	7323.000	AV	37.1	36.1	9.5	32.4	-	50.3	53.9	3.6	
Vert	9764.000	AV	30.7	38.5	10.2	32.7	-	46.7	53.9	7.2	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 $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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

UL Japan, Inc.

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Radiated Spurious Emission

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 8, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 65 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Yuta Moriya	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
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	224.000	QP	40.4	11.6	9.3	32.0	-	29.3	46.0	16.7	
Hori	232.000	QP	43.3	11.7	9.4	32.0	-	32.4	46.0	13.6	
Hori	240.000	QP	41.1	11.7	9.5	32.0	-	30.3	46.0	15.7	
Hori	319.240	QP	34.2	14.0	10.1	32.0	-	26.3	46.0	19.7	
Hori	734.385	QP	41.8	20.3	12.4	32.0	-	42.5	46.0	3.5	
Hori	849.238	QP	32.1	21.6	12.9	31.5	-	35.1	46.0	10.9	
Hori	2483.500	PK	42.2	27.4	5.9	32.0	-	43.5	73.9	30.4	
Hori	4960.000	PK	40.5	31.6	8.2	31.2	-	49.1	73.9	24.8	Floor noise
Hori	7440.000	PK	43.1	36.3	9.5	32.5	-	56.4	73.9	17.5	
Hori	9920.000	PK	43.6	38.6	10.2	32.8	-	59.6	73.9	14.3	Floor noise
Hori	2483.500	AV	30.1	27.4	5.9	32.0	-	31.4	53.9	22.5	
Hori	4960.000	AV	28.1	31.6	8.2	31.2	-	36.7	53.9	17.2	Floor noise
Hori	7440.000	AV	32.4	36.3	9.5	32.5	-	45.7	53.9	8.2	
Hori	9920.000	AV	30.3	38.6	10.2	32.8	-	46.3	53.9	7.6	Floor noise
Vert	224.000	QP	40.2	11.6	9.3	32.0	-	29.1	46.0	16.9	
Vert	232.000	QP	42.1	11.7	9.4	32.0	-	31.2	46.0	14.8	
Vert	240.000	QP	42.4	11.7	9.5	32.0	-	31.6	46.0	14.4	
Vert	320.242	QP	32.4	14.0	10.1	32.0	-	24.5	46.0	21.5	
Vert	736.866	QP	37.6	20.3	12.4	32.0	-	38.3	46.0	7.7	
Vert	854.467	QP	33.2	21.7	12.9	31.4	-	36.4	46.0	9.6	
Vert	2483.500	PK	42.2	27.4	5.9	32.0	-	43.5	73.9	30.4	
Vert	4960.000	PK	41.2	31.6	8.2	31.2	-	49.8	73.9	24.1	Floor noise
Vert	7440.000	PK	45.5	36.3	9.5	32.5	-	58.8	73.9	15.1	
Vert	9920.000	PK	43.1	38.6	10.2	32.8	-	59.1	73.9	14.8	Floor noise
Vert	2483.500	AV	30.0	27.4	5.9	32.0	-	31.3	53.9	22.6	
Vert	4960.000	AV	27.8	31.6	8.2	31.2	-	36.4	53.9	17.5	Floor noise
Vert	7440.000	AV	35.4	36.3	9.5	32.5	-	48.7	53.9	5.2	
Vert	9920.000	AV	30.1	38.6	10.2	32.8	-	46.1	53.9	7.8	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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

UL Japan, Inc.

Ise EMC Lab.

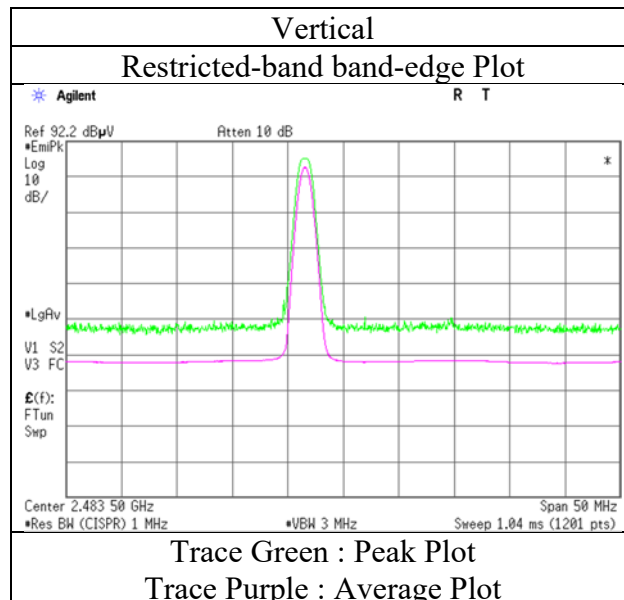
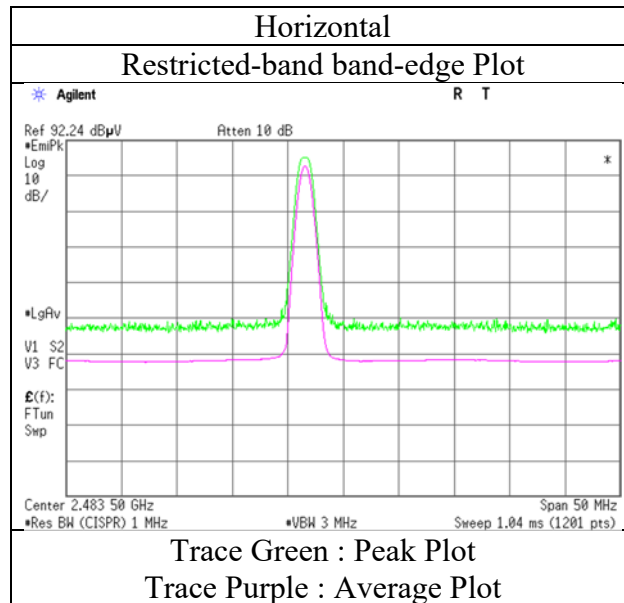
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Telephone : +81 596 24 8999

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 8, 2018
Temperature / Humidity	22 deg. C / 65 % RH
Engineer	Yuta Moriya (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

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 8, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 65 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Yuta Moriya	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
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	224.000	QP	40.1	11.6	9.3	32.0	-	29.0	46.0	17.0	
Hori	232.000	QP	43.5	11.7	9.4	32.0	-	32.6	46.0	13.4	
Hori	240.000	QP	41.2	11.7	9.5	32.0	-	30.4	46.0	15.6	
Hori	318.544	QP	34.4	13.9	10.1	32.0	-	26.4	46.0	19.6	
Hori	735.435	QP	41.5	20.3	12.4	32.0	-	42.2	46.0	3.8	
Hori	849.445	QP	32.3	21.6	12.9	31.5	-	35.3	46.0	10.7	
Hori	2390.000	PK	41.5	27.2	5.9	32.1	-	42.5	73.9	31.4	
Hori	4804.000	PK	40.2	31.3	8.1	31.3	-	48.3	73.9	25.6	Floor noise
Hori	7206.000	PK	44.7	35.8	9.5	32.4	-	57.6	73.9	16.3	
Hori	9608.000	PK	43.2	38.4	10.2	32.6	-	59.2	73.9	14.7	Floor noise
Hori	2390.000	AV	29.8	27.2	5.9	32.1	-	30.8	53.9	23.1	
Hori	4804.000	AV	27.5	31.3	8.1	31.3	-	35.6	53.9	18.3	Floor noise
Hori	7206.000	AV	33.9	35.8	9.5	32.4	-	46.8	53.9	7.1	
Hori	9608.000	AV	30.2	38.4	10.2	32.6	-	46.2	53.9	7.7	Floor noise
Vert	224.000	QP	40.0	11.6	9.3	32.0	-	28.9	46.0	17.1	
Vert	232.000	QP	42.3	11.7	9.4	32.0	-	31.4	46.0	14.6	
Vert	240.000	QP	42.6	11.7	9.5	32.0	-	31.8	46.0	14.2	
Vert	321.146	QP	32.4	14.0	10.1	32.0	-	24.5	46.0	21.5	
Vert	737.365	QP	37.8	20.3	12.4	32.0	-	38.5	46.0	7.5	
Vert	853.143	QP	33.2	21.7	12.9	31.4	-	36.4	46.0	9.6	
Vert	2390.000	PK	41.5	27.2	5.9	32.1	-	42.5	73.9	31.4	
Vert	4804.000	PK	41.6	31.3	8.1	31.3	-	49.7	73.9	24.2	Floor noise
Vert	7206.000	PK	45.0	35.8	9.5	32.4	-	57.9	73.9	16.0	
Vert	9608.000	PK	43.3	38.4	10.2	32.6	-	59.3	73.9	14.6	Floor noise
Vert	2390.000	AV	29.6	27.2	5.9	32.1	-	30.6	53.9	23.3	
Vert	4804.000	AV	28.2	31.3	8.1	31.3	-	36.3	53.9	17.6	Floor noise
Vert	7206.000	AV	33.5	35.8	9.5	32.4	-	46.4	53.9	7.5	
Vert	9608.000	AV	30.3	38.4	10.2	32.6	-	46.3	53.9	7.6	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 $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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	86.9	27.2	5.9	32.1	87.9	-	-	Carrier
Hori	2400.000	PK	36.5	27.2	5.9	32.1	37.5	67.9	30.4	
Vert	2402.000	PK	83.9	27.2	5.9	32.1	84.9	-	-	Carrier
Vert	2400.000	PK	35.2	27.2	5.9	32.1	36.2	64.9	28.7	

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

Distance factor: 1 GHz - 10 GHz $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$

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

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Ise EMC Lab.

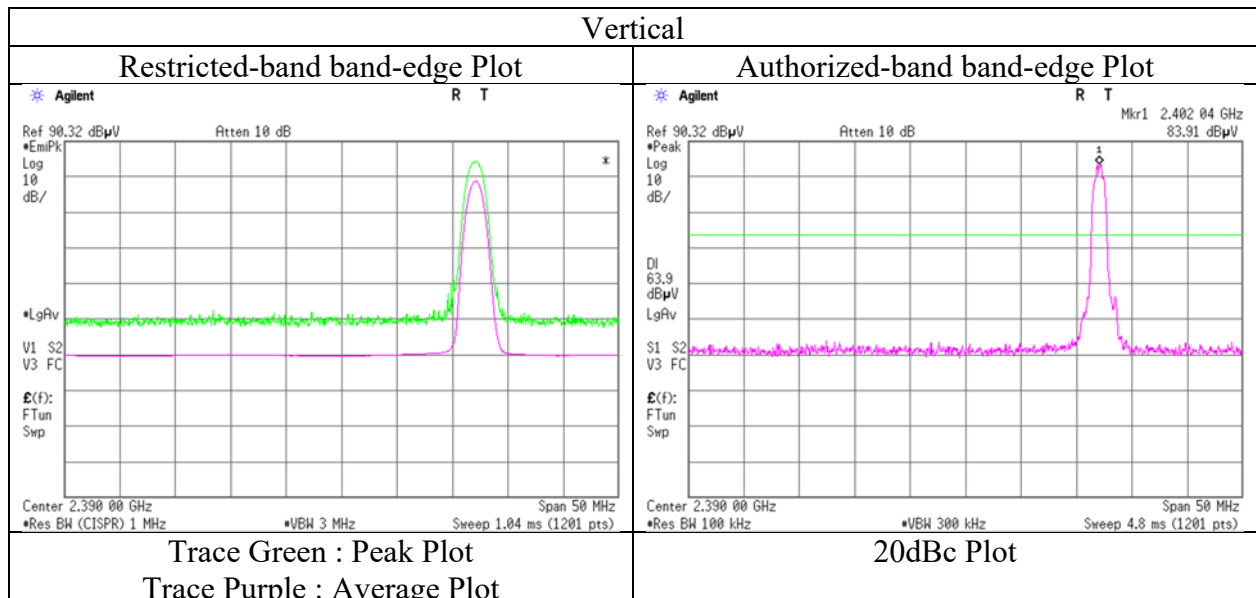
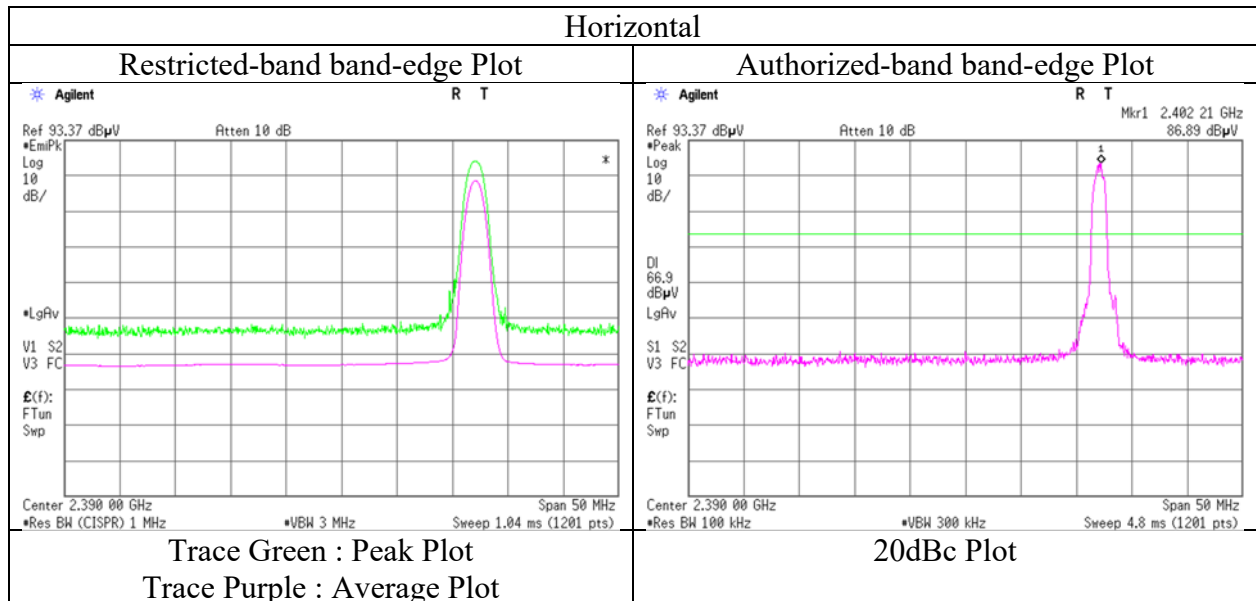
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 8, 2018
Temperature / Humidity	22 deg. C / 65 % RH
Engineer	Yuta Moriya
	(1 GHz -10 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz



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

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Ise EMC Lab.

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Radiated Spurious Emission

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 8, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 65 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Yuta Moriya	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
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	224.000	QP	40.3	11.6	9.3	32.0	-	29.2	46.0	16.8	
Hori	232.000	QP	43.8	11.7	9.4	32.0	-	32.9	46.0	13.1	
Hori	240.000	QP	41.1	11.7	9.5	32.0	-	30.3	46.0	15.7	
Hori	316.385	QP	34.2	13.9	10.1	32.0	-	26.2	46.0	19.8	
Hori	734.673	QP	41.7	20.3	12.4	32.0	-	42.4	46.0	3.6	
Hori	851.164	QP	32.7	21.6	12.9	31.4	-	35.8	46.0	10.2	
Hori	4882.000	PK	40.3	31.5	8.2	31.2	-	48.8	73.9	25.1	Floor noise
Hori	7323.000	PK	44.7	36.1	9.5	32.4	-	57.9	73.9	16.0	
Hori	9764.000	PK	43.1	38.5	10.2	32.7	-	59.1	73.9	14.8	Floor noise
Hori	4882.000	AV	28.1	31.5	8.2	31.2	-	36.6	53.9	17.3	Floor noise
Hori	7323.000	AV	33.5	36.1	9.5	32.4	-	46.7	53.9	7.2	
Hori	9764.000	AV	30.1	38.5	10.2	32.7	-	46.1	53.9	7.8	Floor noise
Vert	224.000	QP	40.1	11.6	9.3	32.0	-	29.0	46.0	17.0	
Vert	232.000	QP	42.2	11.7	9.4	32.0	-	31.3	46.0	14.7	
Vert	240.000	QP	42.5	11.7	9.5	32.0	-	31.7	46.0	14.3	
Vert	321.241	QP	32.1	14.0	10.1	32.0	-	24.2	46.0	21.8	
Vert	736.863	QP	38.0	20.3	12.4	32.0	-	38.7	46.0	7.3	
Vert	853.249	QP	34.9	21.7	12.9	31.4	-	38.1	46.0	7.9	
Vert	4882.000	PK	41.2	31.5	8.2	31.2	-	49.7	73.9	24.2	Floor noise
Vert	7323.000	PK	44.7	36.1	9.5	32.4	-	57.9	73.9	16.0	
Vert	9764.000	PK	42.4	38.5	10.2	32.7	-	58.4	73.9	15.5	Floor noise
Vert	4882.000	AV	27.7	31.5	8.2	31.2	-	36.2	53.9	17.7	Floor noise
Vert	7323.000	AV	32.5	36.1	9.5	32.4	-	45.7	53.9	8.2	
Vert	9764.000	AV	30.6	38.5	10.2	32.7	-	46.6	53.9	7.3	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 $20\log(4.0\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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

Radiated Spurious Emission

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 8, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 65 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Yuta Moriya	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
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	224.000	QP	40.5	11.6	9.3	32.0	-	29.4	46.0	16.6	
Hori	232.000	QP	44.0	11.7	9.4	32.0	-	33.1	46.0	12.9	
Hori	240.000	QP	41.3	11.7	9.5	32.0	-	30.5	46.0	15.5	
Hori	316.419	QP	34.3	13.9	10.1	32.0	-	26.3	46.0	19.7	
Hori	734.572	QP	41.9	20.3	12.4	32.0	-	42.6	46.0	3.4	
Hori	851.546	QP	32.5	21.6	12.9	31.4	-	35.6	46.0	10.4	
Hori	2483.500	PK	42.0	27.4	5.9	32.0	-	43.3	73.9	30.6	
Hori	4960.000	PK	40.4	31.6	8.2	31.2	-	49.0	73.9	24.9	Floor noise
Hori	7440.000	PK	42.8	36.3	9.5	32.5	-	56.1	73.9	17.8	
Hori	9920.000	PK	43.5	38.6	10.2	32.8	-	59.5	73.9	14.4	Floor noise
Hori	2483.500	AV	29.8	27.4	5.9	32.0	-	31.1	53.9	22.8	
Hori	4960.000	AV	28.0	31.6	8.2	31.2	-	36.6	53.9	17.3	Floor noise
Hori	7440.000	AV	31.6	36.3	9.5	32.5	-	44.9	53.9	9.0	
Hori	9920.000	AV	30.2	38.6	10.2	32.8	-	46.2	53.9	7.7	Floor noise
Vert	224.000	QP	40.2	11.6	9.3	32.0	-	29.1	46.0	16.9	
Vert	232.000	QP	42.2	11.7	9.4	32.0	-	31.3	46.0	14.7	
Vert	240.000	QP	42.5	11.7	9.5	32.0	-	31.7	46.0	14.3	
Vert	320.741	QP	32.2	14.0	10.1	32.0	-	24.3	46.0	21.7	
Vert	736.794	QP	37.8	20.3	12.4	32.0	-	38.5	46.0	7.5	
Vert	853.345	QP	35.2	21.7	12.9	31.4	-	38.4	46.0	7.6	
Vert	2483.500	PK	42.7	27.4	5.9	32.0	-	44.0	73.9	29.9	
Vert	4960.000	PK	41.3	31.6	8.2	31.2	-	49.9	73.9	24.0	Floor noise
Vert	7440.000	PK	44.5	36.3	9.5	32.5	-	57.8	73.9	16.1	
Vert	9920.000	PK	43.2	38.6	10.2	32.8	-	59.2	73.9	14.7	Floor noise
Vert	2483.500	AV	30.1	27.4	5.9	32.0	-	31.4	53.9	22.5	
Vert	4960.000	AV	27.7	31.6	8.2	31.2	-	36.3	53.9	17.6	Floor noise
Vert	7440.000	AV	33.3	36.3	9.5	32.5	-	46.6	53.9	7.3	
Vert	9920.000	AV	30.2	38.6	10.2	32.8	-	46.2	53.9	7.7	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 (4.0 m / 3.0 m) = 2.5 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.

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Ise EMC Lab.

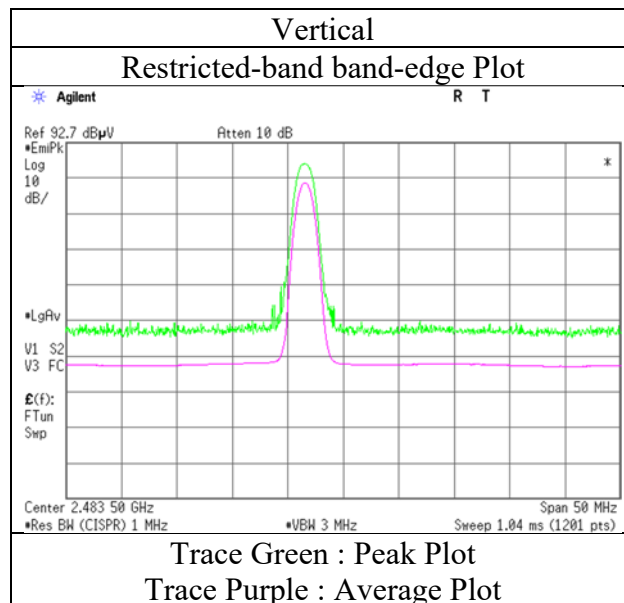
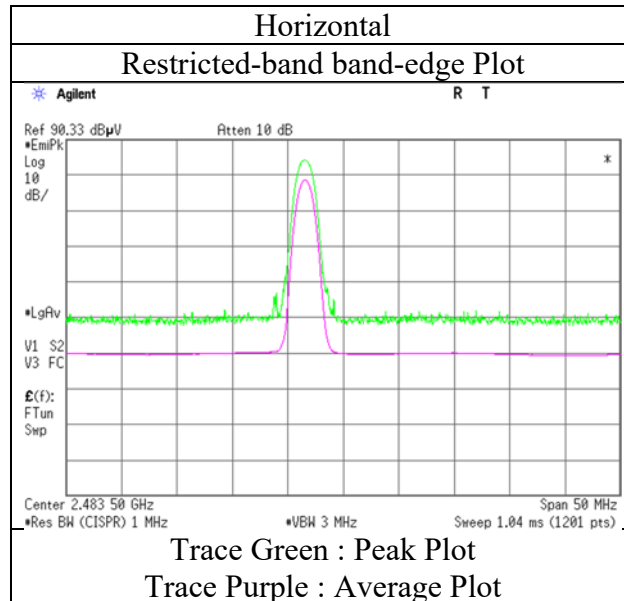
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Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 8, 2018
Temperature / Humidity	22 deg. C / 65 % RH
Engineer	Yuta Moriya
	(1 GHz -10 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz



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

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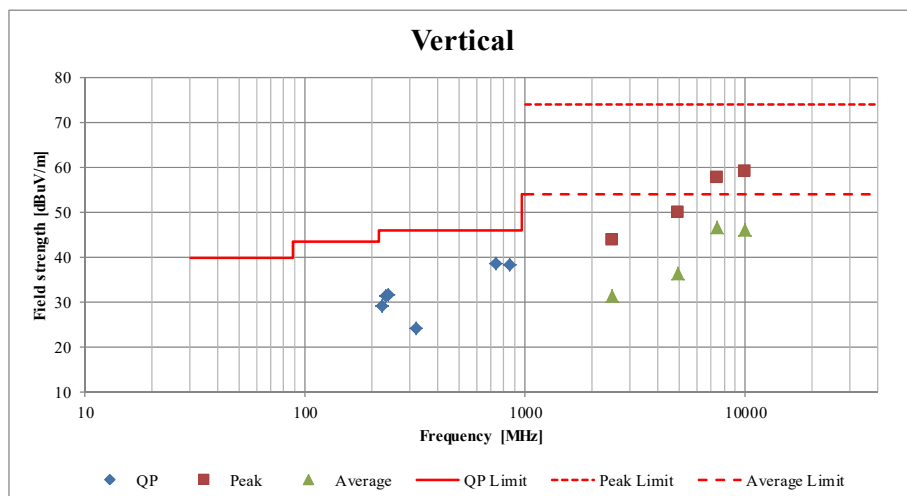
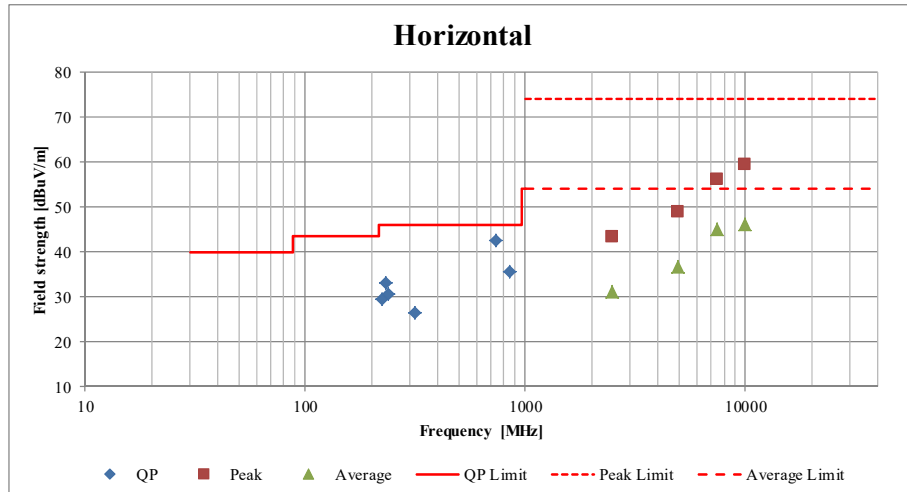
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Plot data, Worst case)

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 8, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 65 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Yuta Moriya (1 GHz -10 GHz)	Takumi Shimada (Above 10 GHz)	Takumi Shimada (Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz		



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

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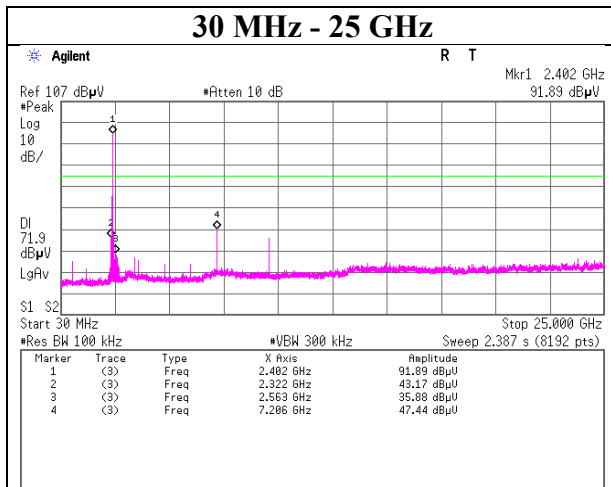
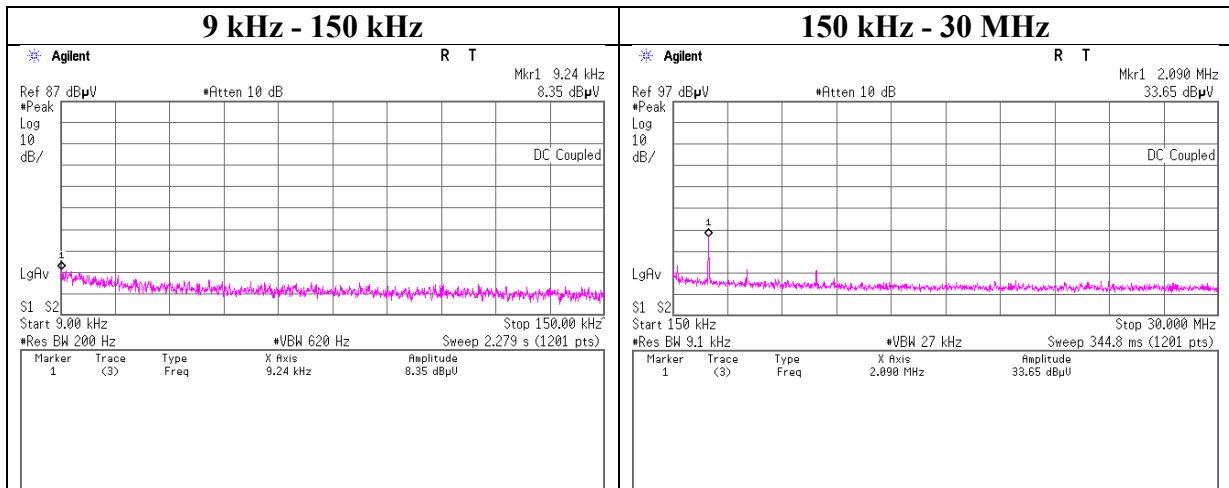
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12344074H
Test place Ise EMC Lab. No.5 Measurement Room
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off, DH5

2402 MHz



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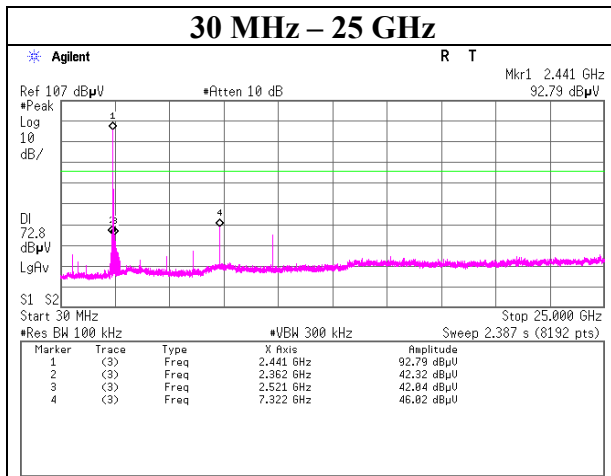
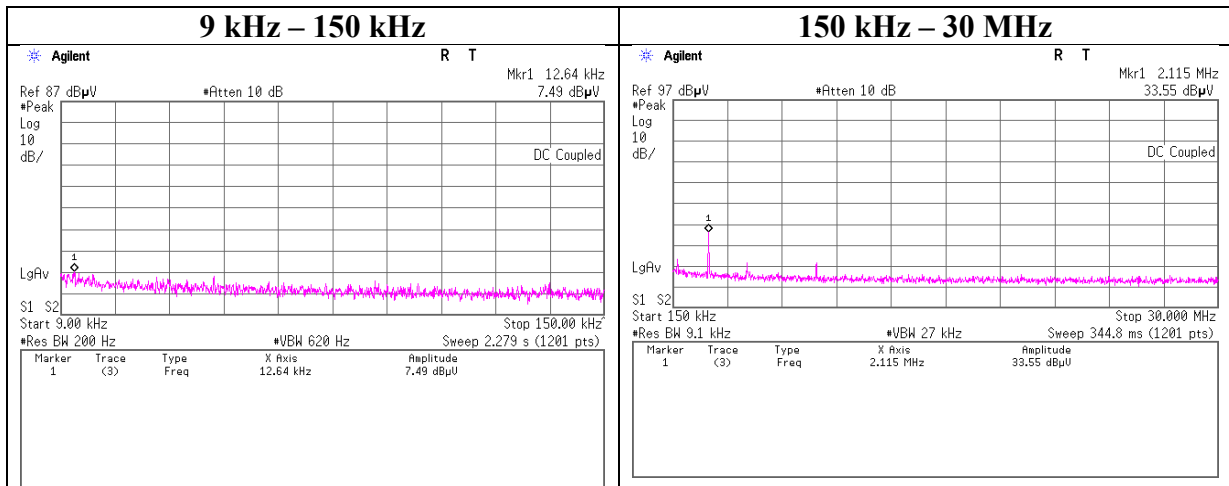
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	12344074H
Test place	Ise EMC Lab. No.5 Measurement Room
Date	August 3, 2018
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Takafumi Noguchi
Mode	Tx, Hopping Off, DH5

2441 MHz



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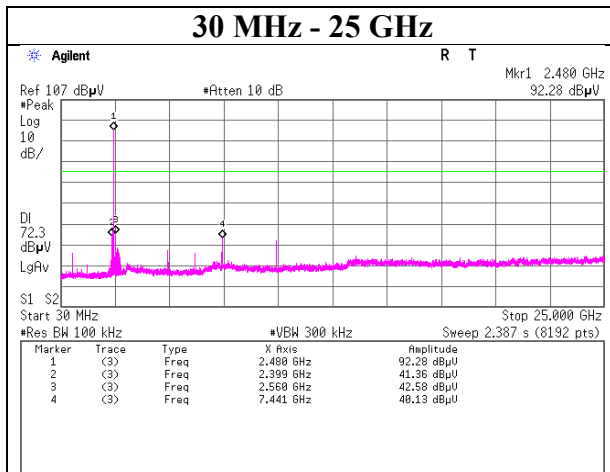
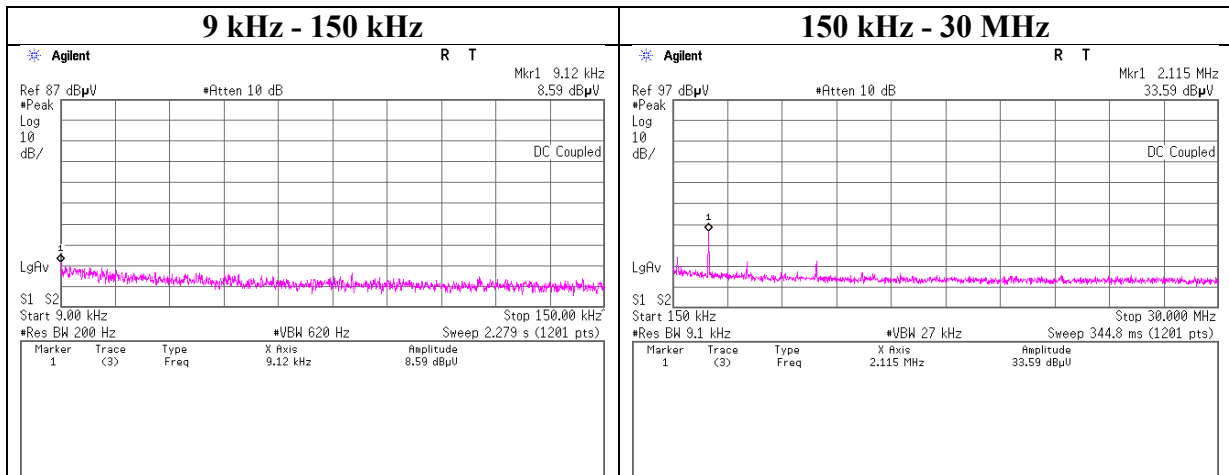
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12344074H
Test place Ise EMC Lab. No.5 Measurement Room
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off, DH5

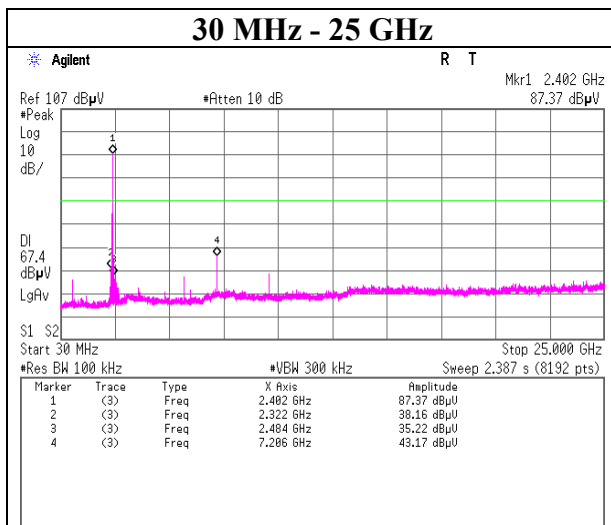
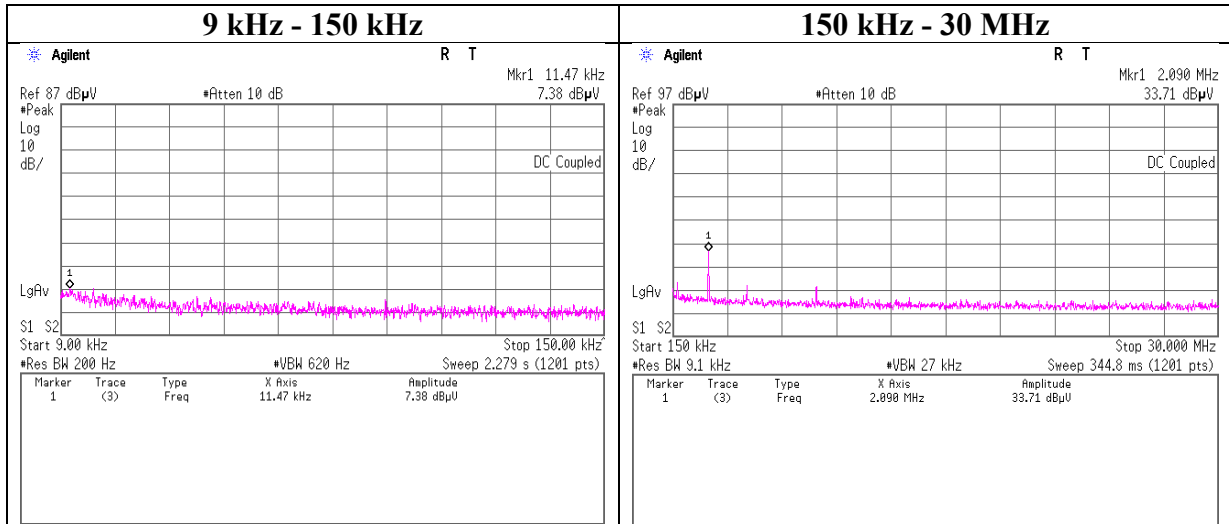
2480 MHz



Conducted Spurious Emission

Report No. 12344074H
Test place Ise EMC Lab. No.5 Measurement Room
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off, 3DH5

2402 MHz



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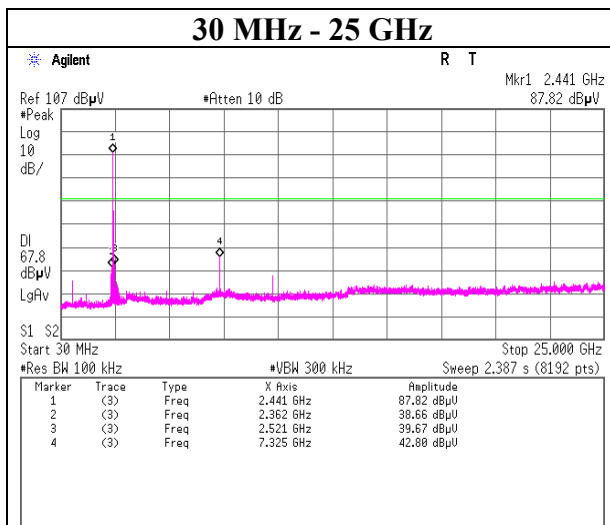
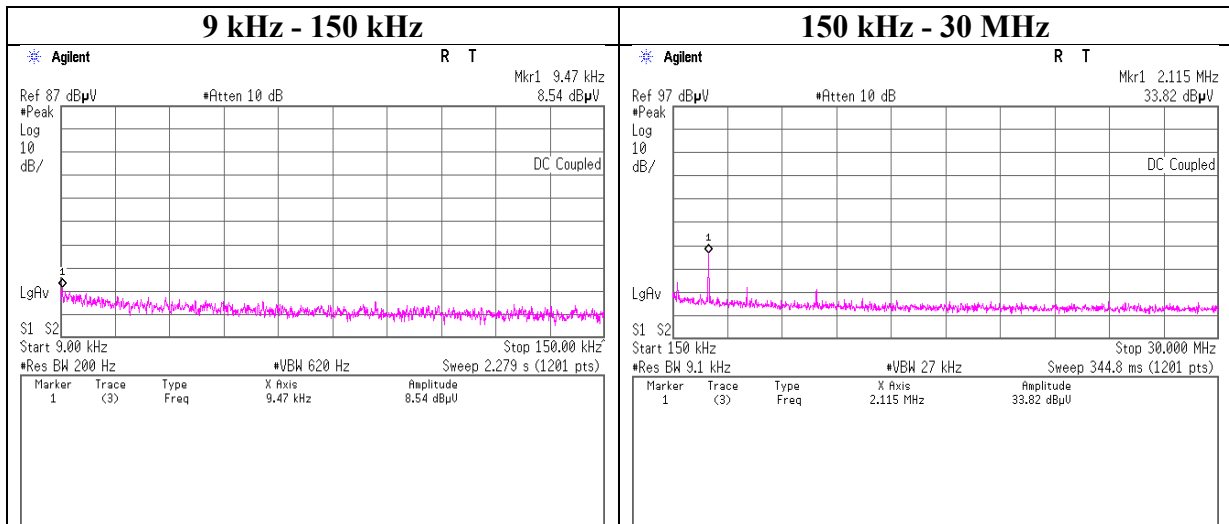
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12344074H
Test place Ise EMC Lab. No.5 Measurement Room
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off, 3DH5

2441 MHz



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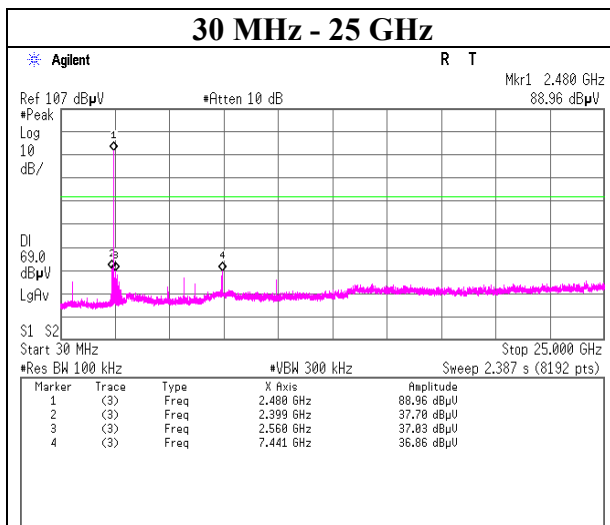
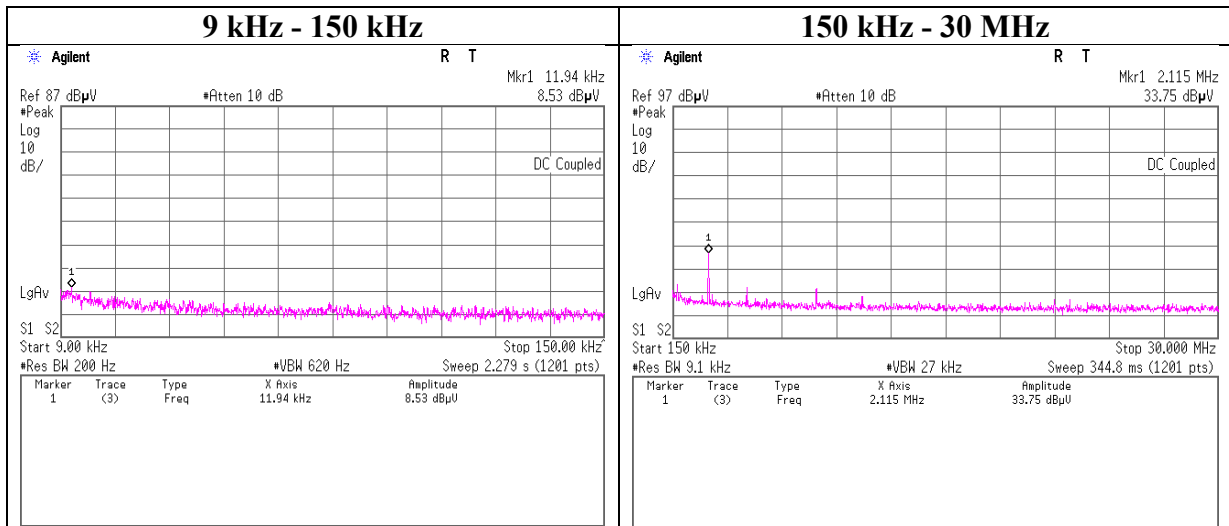
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	12344074H
Test place	Ise EMC Lab. No.5 Measurement Room
Date	August 3, 2018
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Takafumi Noguchi
Mode	Tx, Hopping Off, 3DH5

2480 MHz



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Ise EMC Lab.

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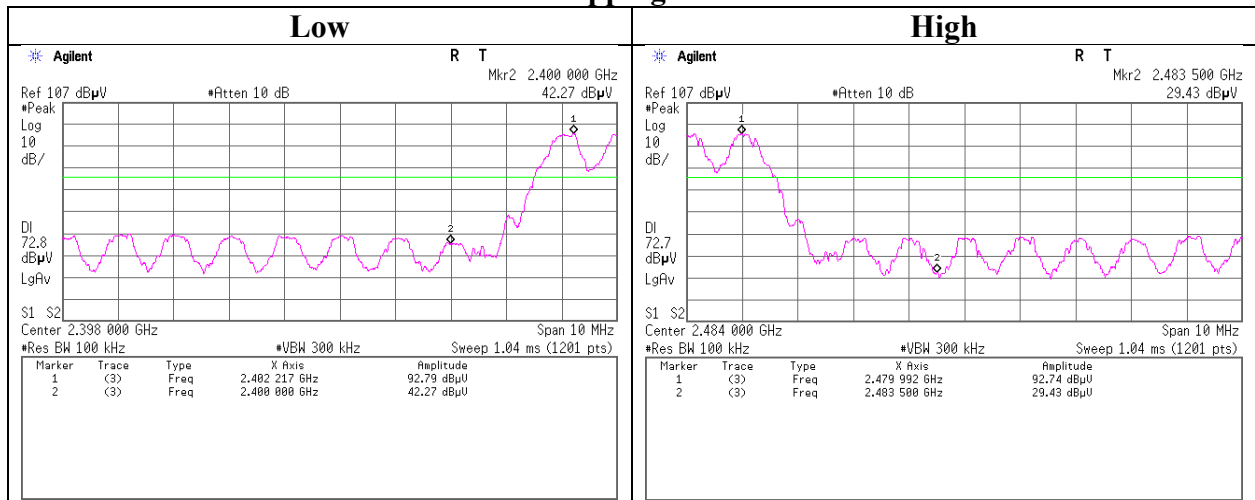
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

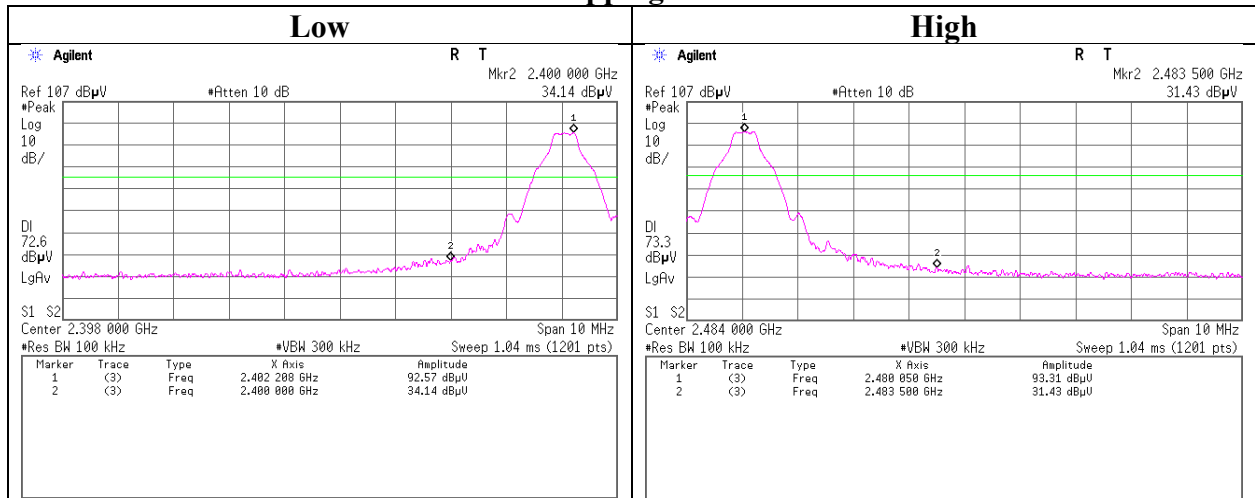
Conducted Emission Band Edge compliance

Report No.	12344074H
Test place	Ise EMC Lab. No.5 Measurement Room
Date	August 3, 2018
Temperature / Humidity	24 deg. C / 50 % RH
Engineer	Takafumi Noguchi
Mode	Tx DH5

Hopping On



Hopping Off



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Ise EMC Lab.

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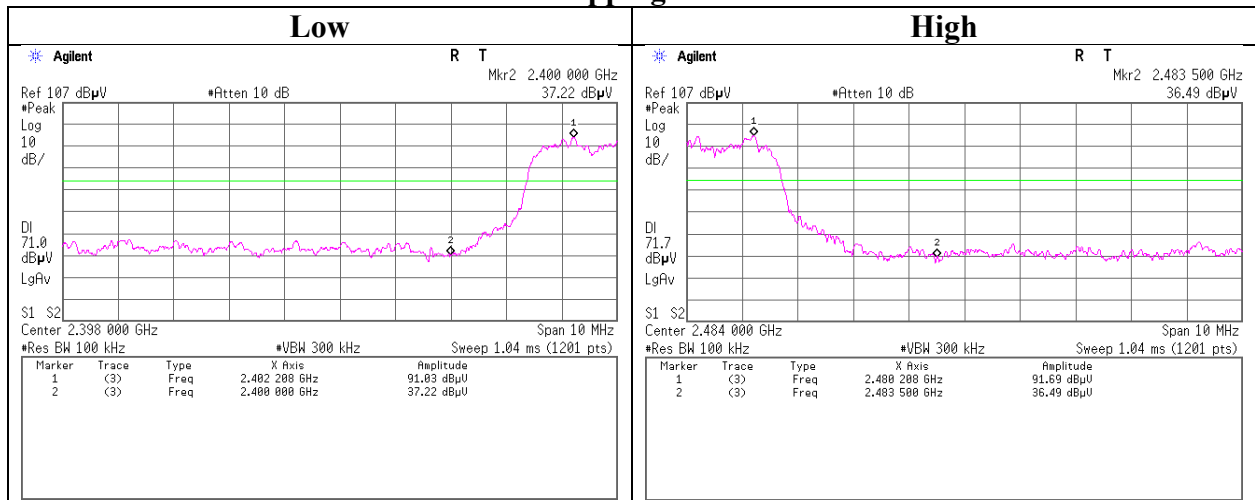
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

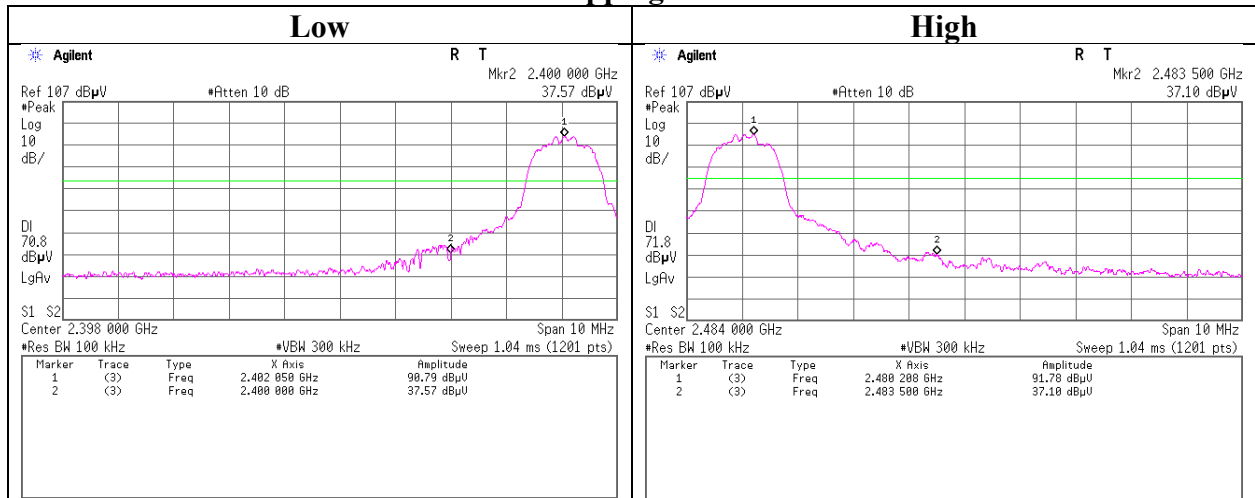
Conducted Emission Band Edge compliance

Report No. 12344074H
Test place Ise EMC Lab. No.5 Measurement Room
Date August 3, 2018
Temperature / Humidity 24 deg. C / 50 % RH
Engineer Takafumi Noguchi
Mode Tx 3DH5

Hopping On



Hopping Off



UL Japan, Inc.

Ise EMC Lab.

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APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	9/11/2017	9/30/2018	12
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	1/9/2018	1/31/2019	12
RE	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	6/14/2018	6/30/2019	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/6/2017	10/31/2018	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	2/25/2018	2/28/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	1/24/2018	1/31/2019	12
RE	142011	AC4 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	10/30/2017	10/31/2018	12
RE	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/14/2017	11/30/2018	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	1/30/2018	1/31/2019	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	11/23/2017	11/30/2018	12
RE	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	12/10/2017	12/31/2018	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/12/2017	10/31/2018	12
RE	141397	Coaxial Cable	UL Japan	-	-	6/13/2018	6/30/2019	12
RE	141506	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	6/29/2017	6/30/2018	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	11/5/1900	260833	2/27/2018	2/28/2019	12
AT	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/14/2017	11/30/2018	12
AT	141547	DIGITAL HiTESTER	HIOKI	3805	60500120	2/7/2018	2/28/2019	12
AT	141805	Power Meter	ANRITSU	ML2495A	6K00003338	10/13/2017	10/31/2018	12
AT	141563	Thermo-Hygrometer	CUSTOM	CTH-180	1701	01/24/2018	01/31/2019	12
AT	141334	Attenuator(10dB)	Suhner	6810.19.A	-	12/04/2017	12/31/2018	12
AT	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	09/20/2017	09/30/2018	12
AT	141840	Power sensor	ANRITSU	MA2411B	11737	10/13/2017	10/31/2018	12

*Hyphens for Last Calibration Date, Calibration Due Date and Cal Int 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: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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