



RADIO TEST REPORT

Test Report No. : 12477308H-A-R2

Applicant : **DENSO CORPORATION**
Type of Equipment : **Navigation ECU**
Model No. : **DNNS096**
FCC ID : **HYQDNNS096**
Test regulation : **FCC Part 15 Subpart C: 2018**
Test Result : **Complied**

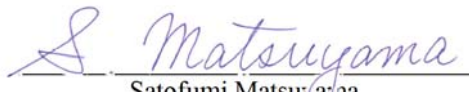
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3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative 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.
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8. This report is a revised version of 12477308H-A-R1. 12477308H-A-R1 is replaced with this report.

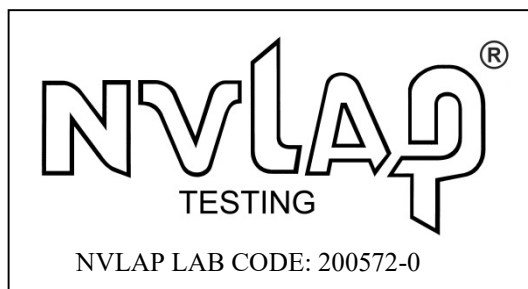
Date of test: September 28 to November 21, 2018

Representative test engineer:


Junki Nagatomi
Engineer
Consumer Technology Division

Approved by:


Satofumi Matsuyama
Engineer
Consumer Technology Division



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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12477308H-A

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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	:	+81-566-61-4675
Facsimile Number	:	+81-566-25-9799
Contact Person	:	Hirofumi Toyono

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

2.1 Identification of E.U.T.

Type of Equipment	:	Navigation ECU
Model No.	:	DNNS096
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample	:	September 25, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: DNNS096 (referred to as the EUT in this report) is a Navigation ECU.

Feature of EUT:

Clock frequency(ies) in the system : 12 MHz, 16.384 MHz, 25 MHz, 28.636 MHz, 53.946 MHz
(Main PCB Oscillator)
26 MHz (BT Crystal)
2816 MHz - 3462.4 MHz (FM LO 1st)
Operating Temperature : -30 deg. C to 65 deg. C

Radio Specification

[Bluetooth Ver. 3.0 (with EDR)]

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : FHSS, GFSK, $\pi/4$ DQPSK, 8DPSK
Antenna type : METAL PLATE Antenna
Antenna Gain : -4.3 dBi (Ave), -4.0 dBi (Max)

[GNSS]

Radio Type : Receiver
Frequency of Operation : GPS: 1575.42 MHz
Modulation : Spread Spectrum modulation, BPSK

[AM/FM Radio]

	AM	FM
Equipment type	Receiver	
Frequency of operation	530 kHz to 1710 kHz	87.7 MHz to 107.9 MHz
Antenna connector type	Receptacle Connector	

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 902-928 MHz,
2400-2483.5 MHz, and 5725-5850 MHz

* 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	N/A *1)	N/A	-
Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(a)(1) IC: RSS-247 5.1 (b)	See data.	Complied	Conducted
20dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(a)(1) IC: RSS-247 5.1 (a)		Complied	Conducted
Number of Hopping Frequency	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		Complied	Conducted
Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section 15.247(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: Section 15.247(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: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	1.2 dB 224.995 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 EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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 $k=2$.

Test Item	Uncertainty (+/-)
20 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %
Maximum Peak Output Power / Average Output Power	1.3 dB
Carrier Frequency Separation	0.42 %
Dwell time / Burst rate	0.10 %
Conducted Spurious Emission	2.7 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
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	3.1 x 5.0	-	-
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.

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 (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
*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: 51 EDR: 49 Software: CSR BlueTest Version 2.4 *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.		

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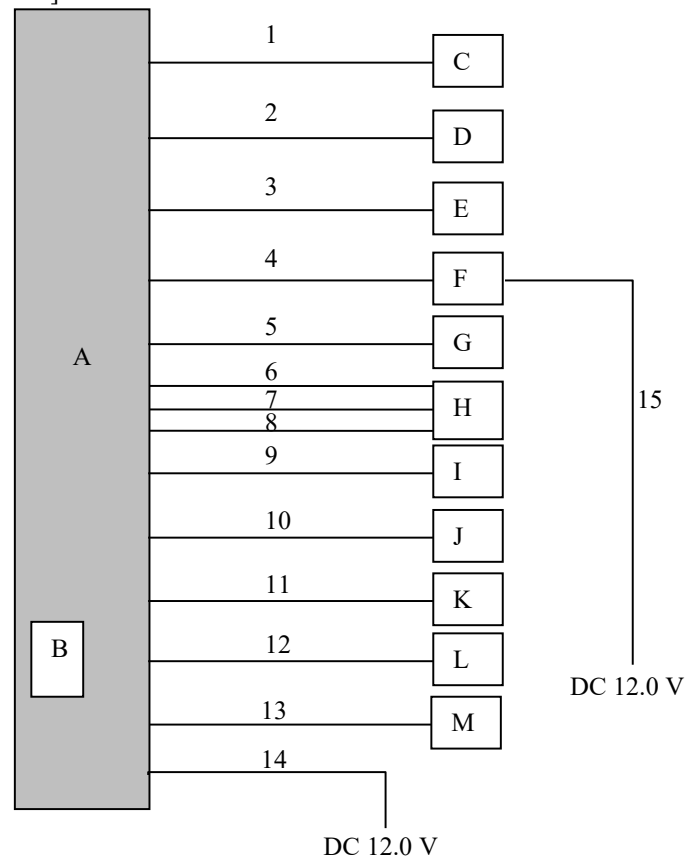
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4.2 Configuration and peripherals

[Radiated Spurious Emission]



* 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	Navigation ECU	DNNS096	468147007000041	DENSO CORPORATION	EUT
B	Micro SD	-	1739CK3804BG	TOYOTA	-
C	Back Camera	GP-KD5330RC	45C00005	-	-
D	Speaker Dummy	-	-	-	-
E	Steering SW	-	-	-	-
F	A/C ECU	88650-47510	277400-0851	DENSO CORPORATION	-
G	USB Memory	-	E3A0000992E4	I.O DATA	-
H	Extension Box	GEX-0128	NEGE077316US	PIONEER Corporation	-
I	Microphone	-	-	-	-
J	Switch	-	-	-	-
K	GPS Antenna	-	14630002	-	-
L	Radio Antenna	-	-	-	-
M	Radio Antenna	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	3.5	Unshielded	Unshielded	-
2	Signal Cable	3.3	Unshielded	Unshielded	-
3	Signal Cable	3.3	Unshielded	Unshielded	-
4	Signal Cable	3.3	Unshielded	Unshielded	-
5	USB Cable	1.1	Shielded	Shielded	-
6	Signal Cable	0.7	Unshielded	Unshielded	-
7	Signal Cable	2.0	Shielded	Shielded	-
8	Signal Cable	3.0	Shielded	Shielded	-
9	Signal Cable	9.0	Unshielded	Unshielded	-
10	Signal Cable	9.0	Unshielded	Unshielded	-
11	GPS Cable	3.0	Shielded	Shielded	-
12	Antenna Cable	4.5	Shielded	Shielded	-
13	Antenna Cable	4.5	Shielded	Shielded	-
14	DC Cable	4.5	Unshielded	Unshielded	-
15	DC Cable	3.0	Unshielded	Unshielded	-

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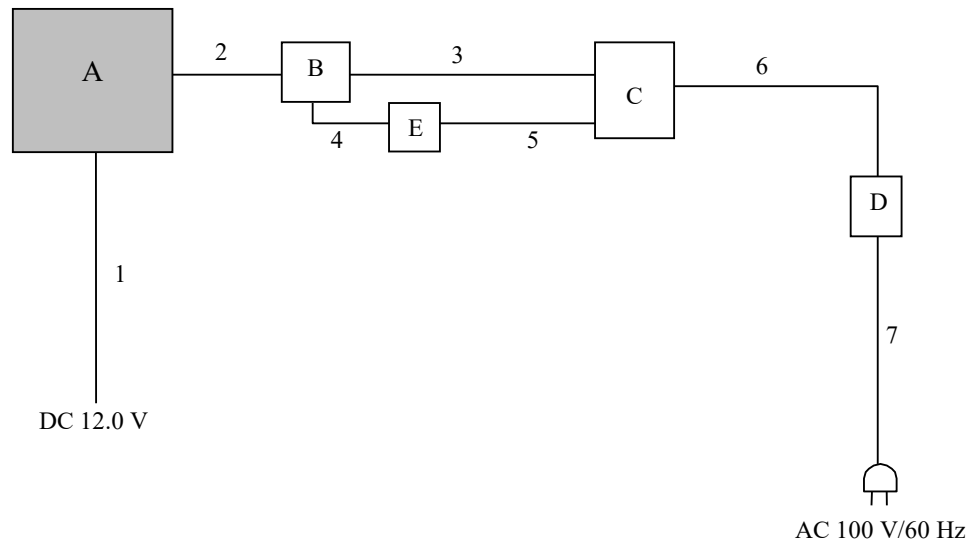
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[Antenna Terminal Conducted tests]



* 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	Navigation ECU	DNNS096	468147007000018	DENSO CORPORATION	EUT
B	Jig	-	-	-	-
C	LapTop PC	E6230	C2XTXY1	DELL	-
D	AC Adapter	HA65NS5-00	09RN2C	DELL	-
E	USB-SPI Conversion Connector	1324	264336	csr	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	6.0	Unshielded	Unshielded	-
2	Signal Cable	0.1	Unshielded	Unshielded	-
3	USB Cable	0.25	Shielded	Shielded	-
4	LAN Cable	1.0	Unshielded	Unshielded	-
5	USB Cable	2.0	Shielded	Shielded	-
6	DC Cable	1.8	Unshielded	Unshielded	-
7	AC Cable	0.9	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, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

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

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

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

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

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

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

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

Test Antennas are used as below;

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

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

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

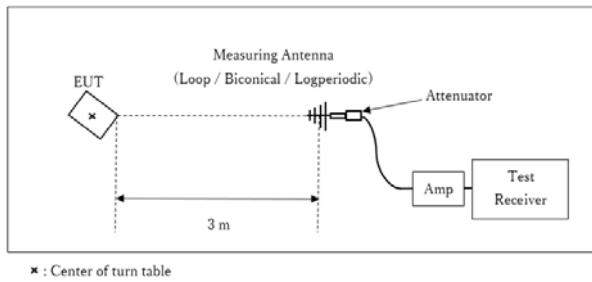
Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer *a)		Spectrum Analyzer
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz *1)	RBW: 100 kHz VBW: 300 kHz

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

*a) The Spectrum Analyzer was used in 3 dB resolution bandwidth.

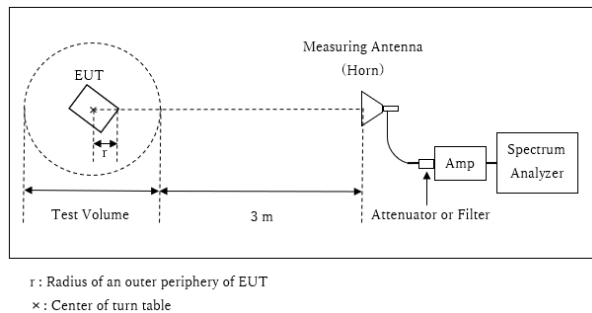
Figure 1: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 10 GHz



Distance Factor: $20 \times \log (4.4 \text{ m} / 3.0 \text{ m}) = 3.33 \text{ dB}$

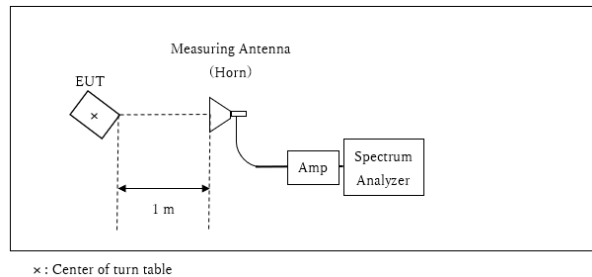
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 4.4 \text{ m}$

Test Volume : 3.0 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.1 \text{ m}$

10 GHz - 26.5 GHz



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

*Test Distance: 1 m

The test was made on EUT at the normal use position.

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 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	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold *1)	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. (9 kHz - 150 kHz: RBW = 200Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz).							

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

Test data	: APPENDIX
Test result	: Pass

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APPENDIX 1: Test data

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

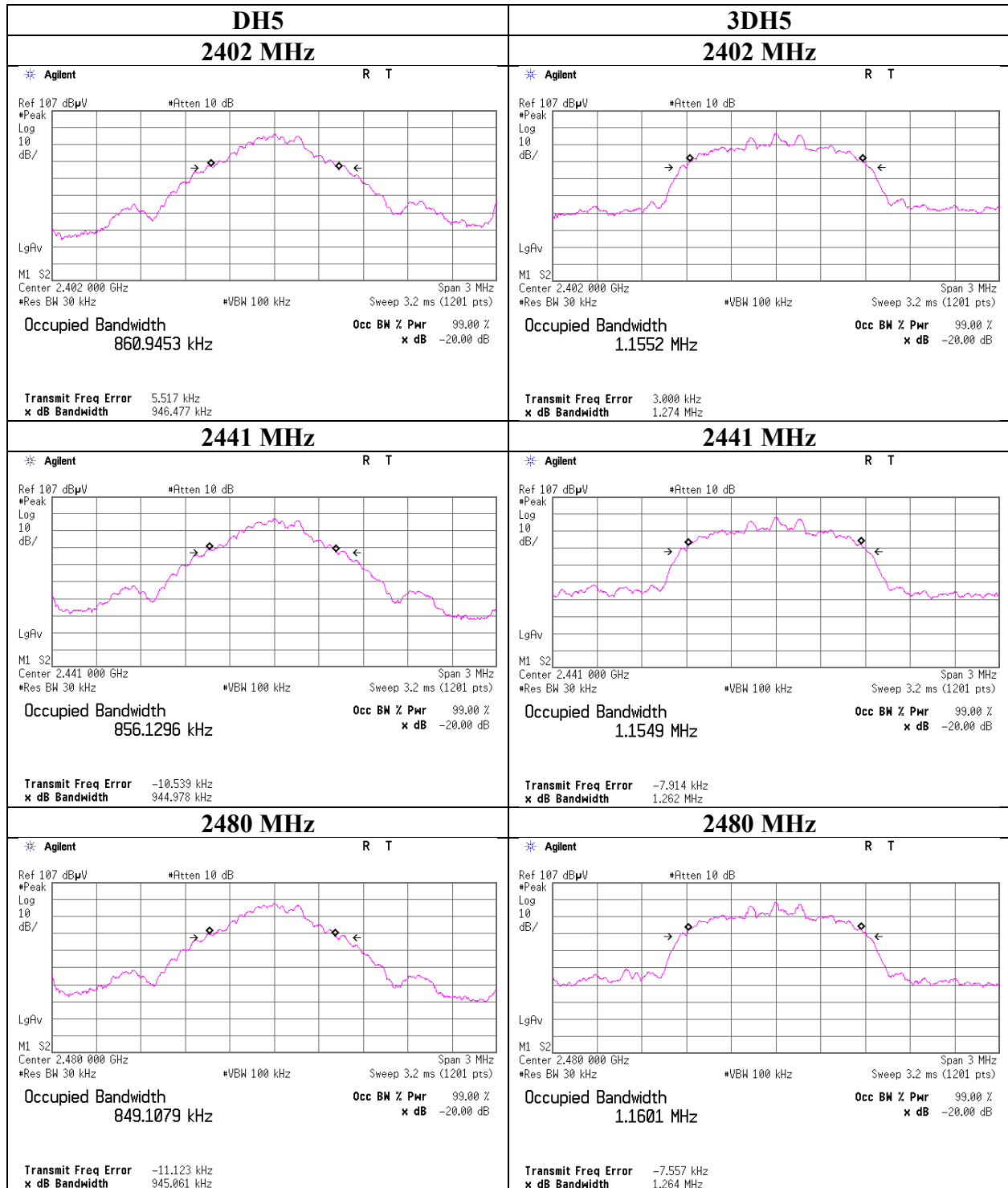
Report No.	12477308H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	October 1, 2018
Temperature / Humidity	23 deg. C / 51 % RH
Engineer	Junki Nagatomi
Mode	Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.947	0.861	1.000	≥ 0.631
DH5	2441.0	0.945	0.856	1.000	≥ 0.630
DH5	2480.0	0.945	0.849	1.000	≥ 0.630
DH5	Hopping On	-	78.582	-	-
3DH5	2402.0	1.274	1.155	1.000	≥ 0.849
3DH5	2441.0	1.262	1.155	1.000	≥ 0.841
3DH5	2480.0	1.264	1.160	1.000	≥ 0.843
3DH5	Hopping On	-	78.635	-	-

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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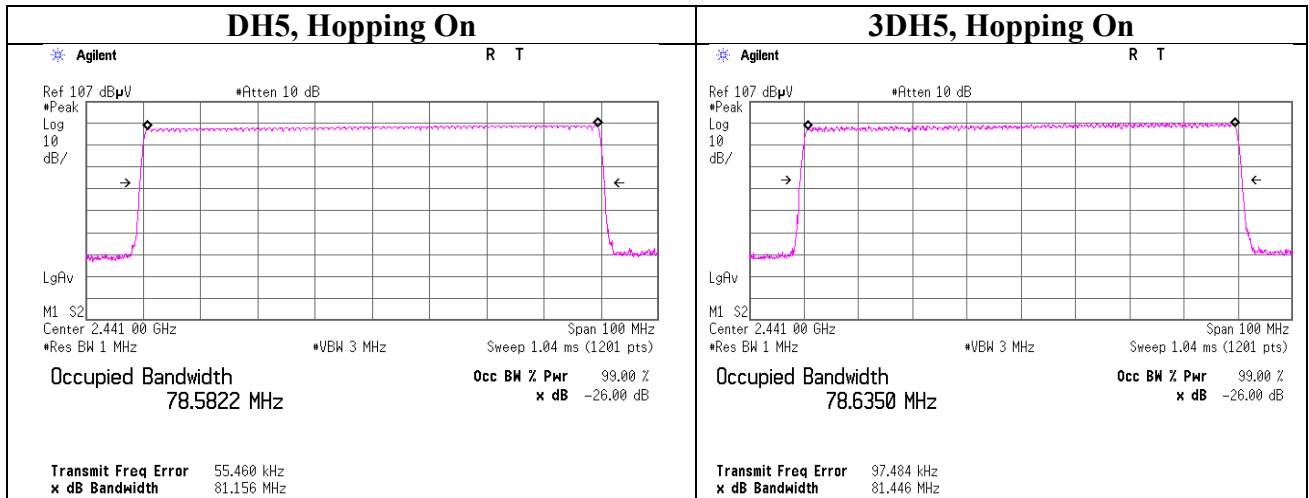
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99% Occupied Bandwidth



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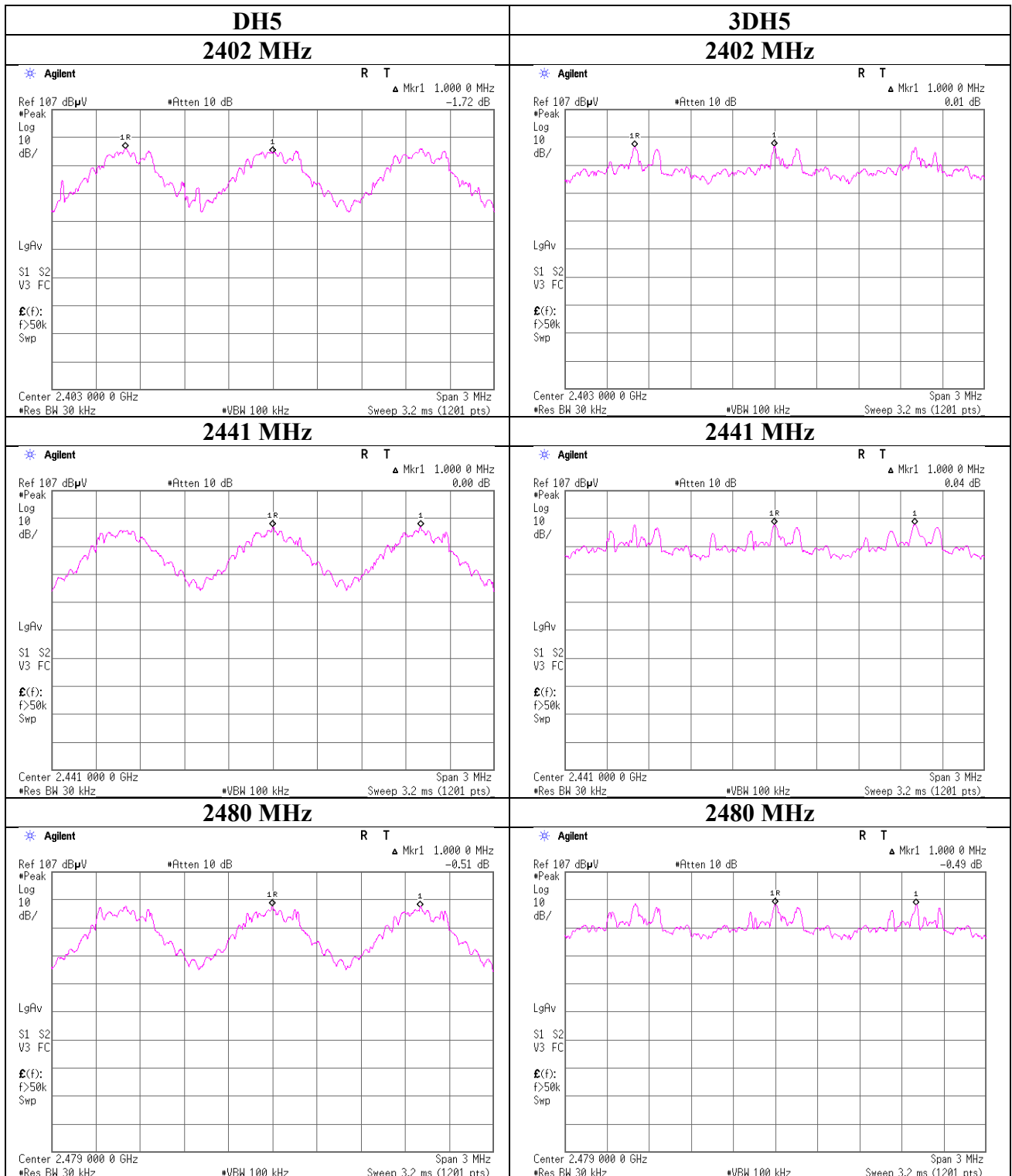
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Carrier Frequency Separation



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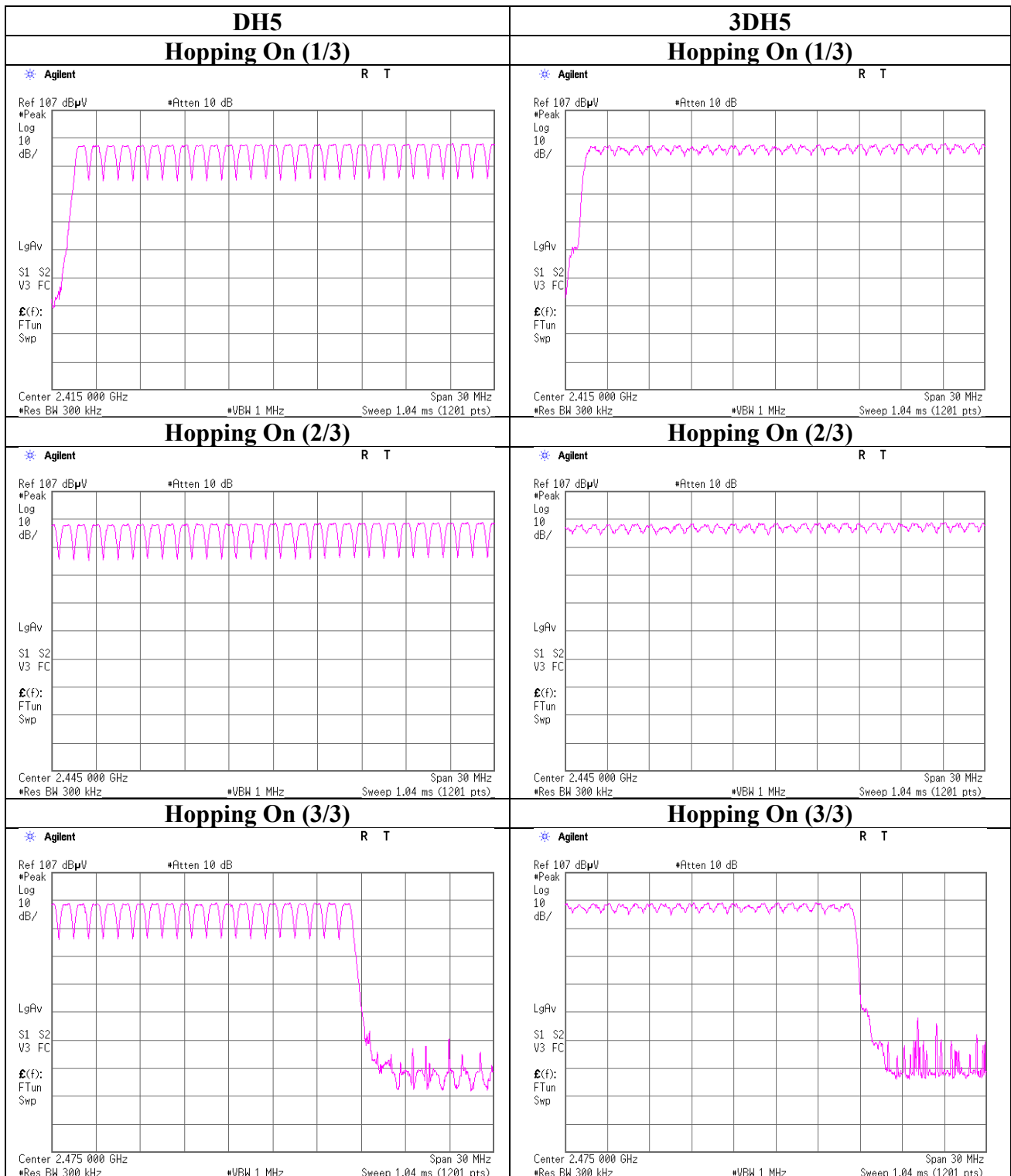
Number of Hopping Frequency

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
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. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
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	50.4 times	/	5 sec.	x	31.6 sec. = 319 times	0.440	140	400
DH3	26.0 times	/	5 sec.	x	31.6 sec. = 165 times	1.702	281	400
DH5	18.2 times	/	5 sec.	x	31.6 sec. = 116 times	2.953	343	400
3DH1	51.0 times	/	5 sec.	x	31.6 sec. = 323 times	0.447	144	400
3DH3	25.6 times	/	5 sec.	x	31.6 sec. = 162 times	1.700	275	400
3DH5	17.4 times	/	5 sec.	x	31.6 sec. = 110 times	2.969	327	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

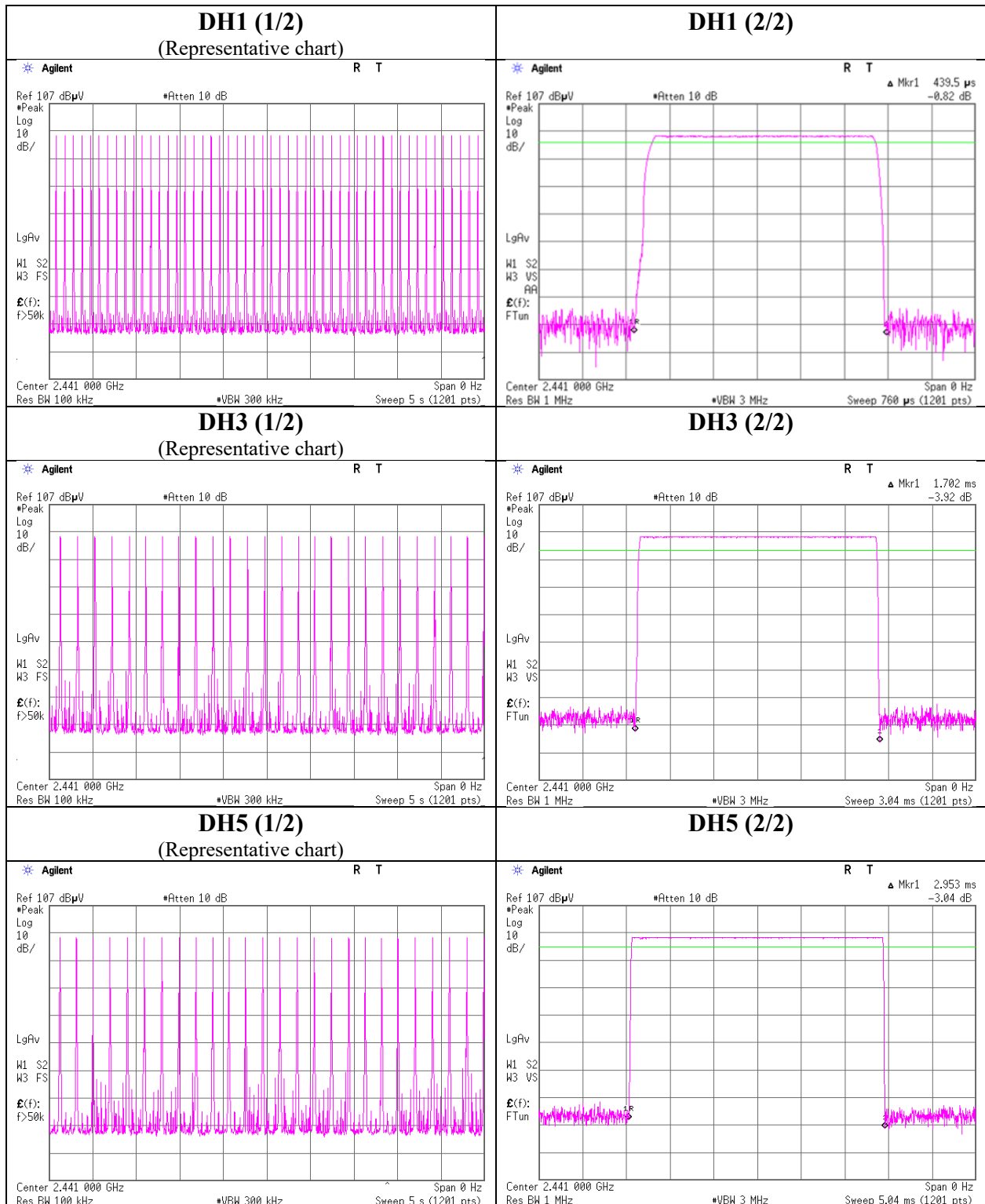
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	50	51	50	50	51	50.4
DH3	26	26	26	26	26	26
DH5	19	18	18	17	19	18.2
3DH1	51	51	51	51	51	51
3DH3	26	25	26	26	25	25.6
3DH5	17	19	17	17	17	17.4

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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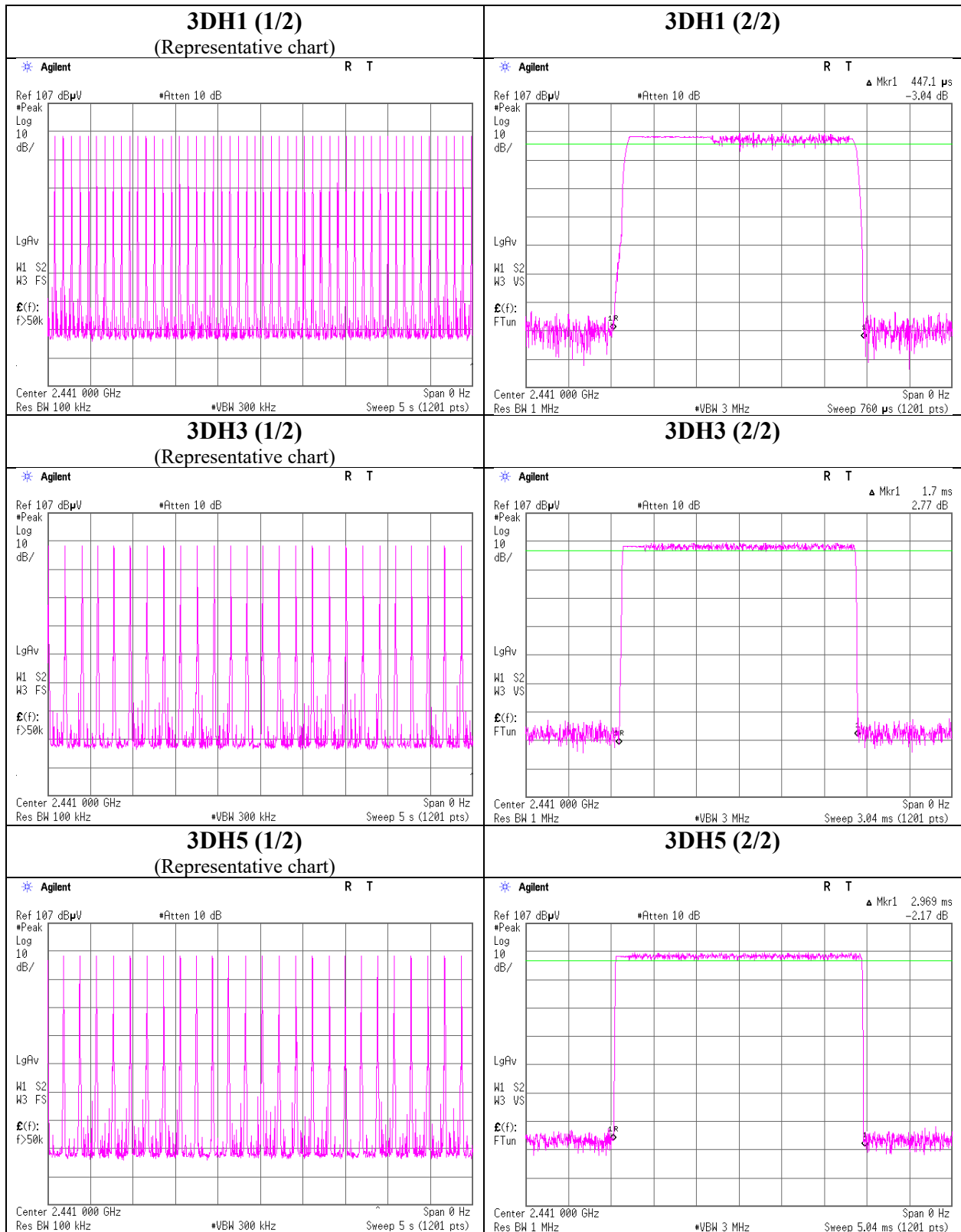
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Dwell time



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Maximum Peak Output Power

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
Mode Tx, Hopping Off

PK					Conducted Power					e.i.r.p. for RSS-247					
Mode	Freq. [MHz]	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
		[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-12.57	1.91	10.04	-0.62	0.87	20.96	125	21.58	-4.00	-4.62	0.35	36.02	4000	40.64
DH5	2441.0	-11.55	1.92	10.04	0.41	1.10	20.96	125	20.55	-4.00	-3.59	0.44	36.02	4000	39.61
DH5	2480.0	-10.93	1.95	10.04	1.06	1.28	20.96	125	19.90	-4.00	-2.94	0.51	36.02	4000	38.96
2DH5	2402.0	-11.48	1.91	10.04	0.47	1.11	20.96	125	20.49	-4.00	-3.53	0.44	36.02	4000	39.55
2DH5	2441.0	-10.38	1.92	10.04	1.58	1.44	20.96	125	19.38	-4.00	-2.42	0.57	36.02	4000	38.44
2DH5	2480.0	-9.75	1.95	10.04	2.24	1.67	20.96	125	18.72	-4.00	-1.76	0.67	36.02	4000	37.78
3DH5	2402.0	-11.07	1.91	10.04	0.88	1.22	20.96	125	20.08	-4.00	-3.12	0.49	36.02	4000	39.14
3DH5	2441.0	-9.95	1.92	10.04	2.01	1.59	20.96	125	18.95	-4.00	-1.99	0.63	36.02	4000	38.01
3DH5	2480.0	-9.33	1.95	10.04	2.66	1.85	20.96	125	18.30	-4.00	-1.34	0.73	36.02	4000	37.36

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 / SAR testing)

Report No.	12477308H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	October 1, 2018
Temperature / Humidity	23 deg. C / 51 % RH
Engineer	Junki Nagatomi
Mode	Tx, Hopping Off

AV

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	-14.14	1.91	10.04	-2.19	0.60	1.05	-1.14	0.77
DH5	2441.0	-13.11	1.92	10.04	-1.15	0.77	1.05	-0.10	0.98
DH5	2480.0	-12.49	1.95	10.04	-0.50	0.89	1.05	0.55	1.14
2DH5	2402.0	-15.19	1.91	10.04	-3.24	0.47	1.05	-2.19	0.60
2DH5	2441.0	-14.05	1.92	10.04	-2.09	0.62	1.05	-1.04	0.79
2DH5	2480.0	-13.41	1.95	10.04	-1.42	0.72	1.05	-0.37	0.92
3DH5	2402.0	-15.22	1.91	10.04	-3.27	0.47	1.04	-2.23	0.60
3DH5	2441.0	-14.07	1.92	10.04	-2.11	0.62	1.04	-1.07	0.78
3DH5	2480.0	-13.42	1.95	10.04	-1.43	0.72	1.04	-0.39	0.91

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.

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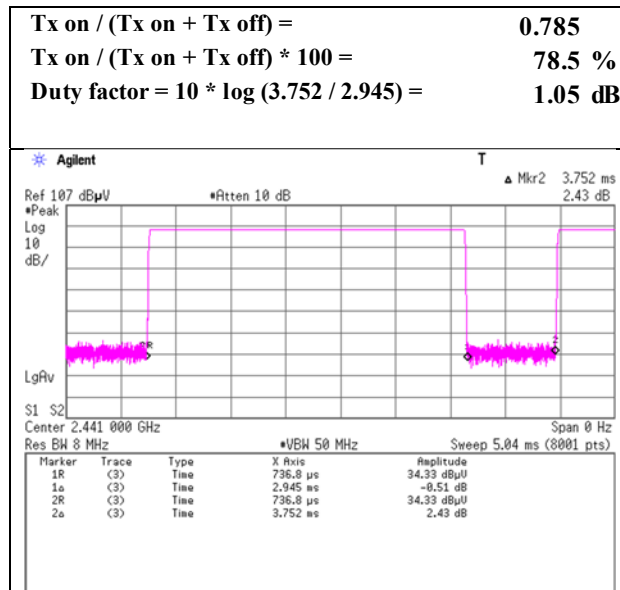
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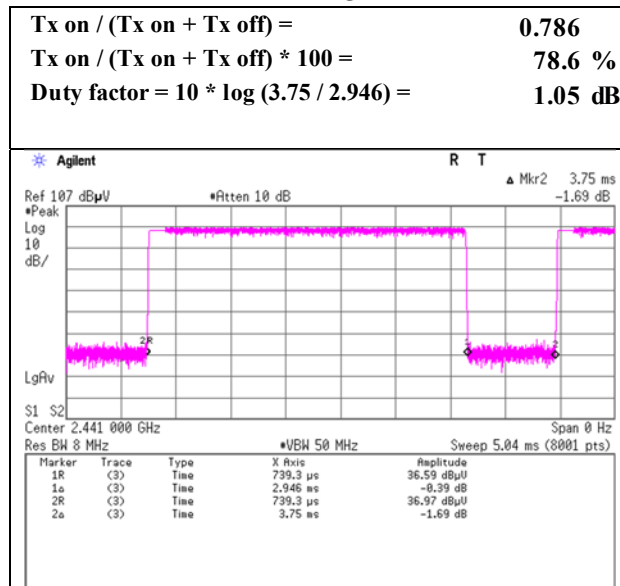
Burst Rate Confirmation

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
Mode Tx, Hopping Off

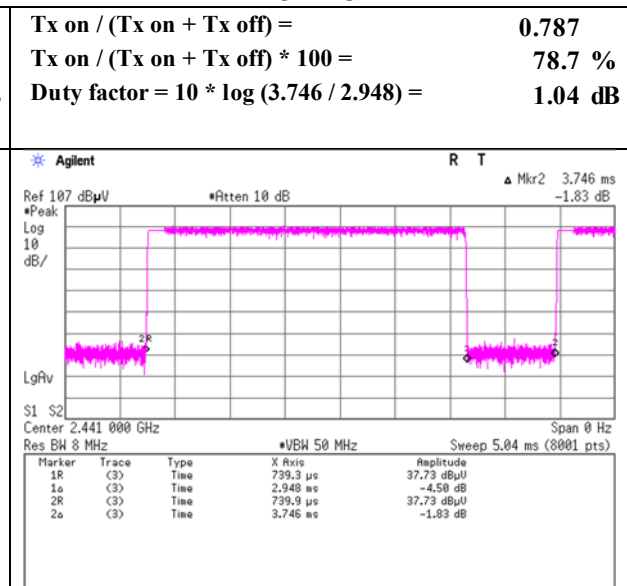
DH5



2DH5



3DH5



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Radiated Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3 No.4 No.4
Date September 28, 2018 October 29, 2018 October 30, 2018
Temperature / Humidity 23 deg. C / 60 % RH 21 deg. C / 43 % RH 24 deg. C / 37 % RH
Engineer Hiroyuki Furutaka Akihiko Maeda Akihiko Maeda
(1 GHz -10 GHz) (Below 1 GHz) (Above 10 GHz)
Mode Tx, Hopping Off, DH5 2402 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	215.998	QP	50.2	11.1	9.3	32.0	38.6	43.5	4.9	
Hori	224.995	QP	56.3	11.1	9.4	32.0	44.8	46.0	1.2	
Hori	246.939	QP	47.8	11.7	9.5	32.0	37.0	46.0	9.0	
Hori	283.981	QP	47.8	13.3	9.8	32.0	38.9	46.0	7.1	
Hori	321.019	QP	44.7	14.2	10.1	32.0	37.0	46.0	9.0	
Hori	935.993	QP	32.5	22.0	13.4	31.1	36.8	46.0	9.2	
Hori	1399.150	PK	57.8	25.4	5.8	34.2	54.8	73.9	19.1	
Hori	2390.000	PK	42.2	27.8	6.5	32.7	43.8	73.9	30.1	
Hori	3145.650	PK	46.7	29.1	7.0	32.4	50.4	73.9	23.5	
Hori	4804.000	PK	43.6	31.7	8.9	31.8	52.4	73.9	21.5	
Hori	7206.000	PK	42.5	35.7	10.1	32.6	55.7	73.9	18.2	Floor noise
Hori	9608.000	PK	43.9	38.6	10.5	33.3	59.7	73.9	14.2	Floor noise
Hori	1399.150	AV	36.4	25.4	5.8	34.2	33.4	53.9	20.5	
Hori	2390.000	AV	29.8	27.8	6.5	32.7	31.4	53.9	22.5	
Hori	3145.650	AV	40.5	29.1	7.0	32.4	44.2	53.9	9.7	
Hori	4804.000	AV	33.9	31.7	8.9	31.8	42.7	53.9	11.2	
Hori	7206.000	AV	30.9	35.7	10.1	32.6	44.1	53.9	9.8	Floor noise
Hori	9608.000	AV	32.1	38.6	10.5	33.3	47.9	53.9	6.0	Floor noise
Vert	215.998	QP	48.8	11.1	9.3	32.0	37.2	43.5	6.3	
Vert	224.995	QP	55.4	11.1	9.4	32.0	43.9	46.0	2.1	
Vert	246.939	QP	44.6	11.7	9.5	32.0	33.8	46.0	12.2	
Vert	283.981	QP	43.5	13.3	9.8	32.0	34.6	46.0	11.4	
Vert	321.019	QP	40.4	14.2	10.1	32.0	32.7	46.0	13.3	
Vert	935.993	QP	29.4	22.0	13.4	31.1	33.7	46.0	12.3	
Vert	1600.000	PK	51.0	25.0	6.0	33.7	48.3	73.9	25.6	
Vert	2390.000	PK	41.7	27.8	6.5	32.7	43.3	73.9	30.6	
Vert	3145.650	PK	45.4	29.1	7.0	32.4	49.1	73.9	24.8	
Vert	4804.000	PK	43.5	31.7	8.9	31.8	52.3	73.9	21.6	
Vert	7206.000	PK	43.5	35.7	10.1	32.6	56.7	73.9	17.2	Floor noise
Vert	9608.000	PK	44.1	38.6	10.5	33.3	59.9	73.9	14.0	Floor noise
Vert	1600.000	AV	44.7	25.0	6.0	33.7	42.0	53.9	11.9	
Vert	2390.000	AV	29.8	27.8	6.5	32.7	31.4	53.9	22.5	
Vert	3145.650	AV	37.4	29.1	7.0	32.4	41.1	53.9	12.8	
Vert	4804.000	AV	33.7	31.7	8.9	31.8	42.5	53.9	11.4	
Vert	7206.000	AV	30.9	35.7	10.1	32.6	44.1	53.9	9.8	Floor noise
Vert	9608.000	AV	32.0	38.6	10.5	33.3	47.8	53.9	6.1	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(4.4 m / 3.0 m) = 3.33 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	92.3	27.8	6.5	32.7	93.9	-	-	Carrier
Hori	2400.000	PK	38.4	27.8	6.5	32.7	40.0	73.9	33.9	
Vert	2402.000	PK	89.8	27.8	6.5	32.7	91.4	-	-	Carrier
Vert	2400.000	PK	37.1	27.8	6.5	32.7	38.7	71.4	32.7	

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

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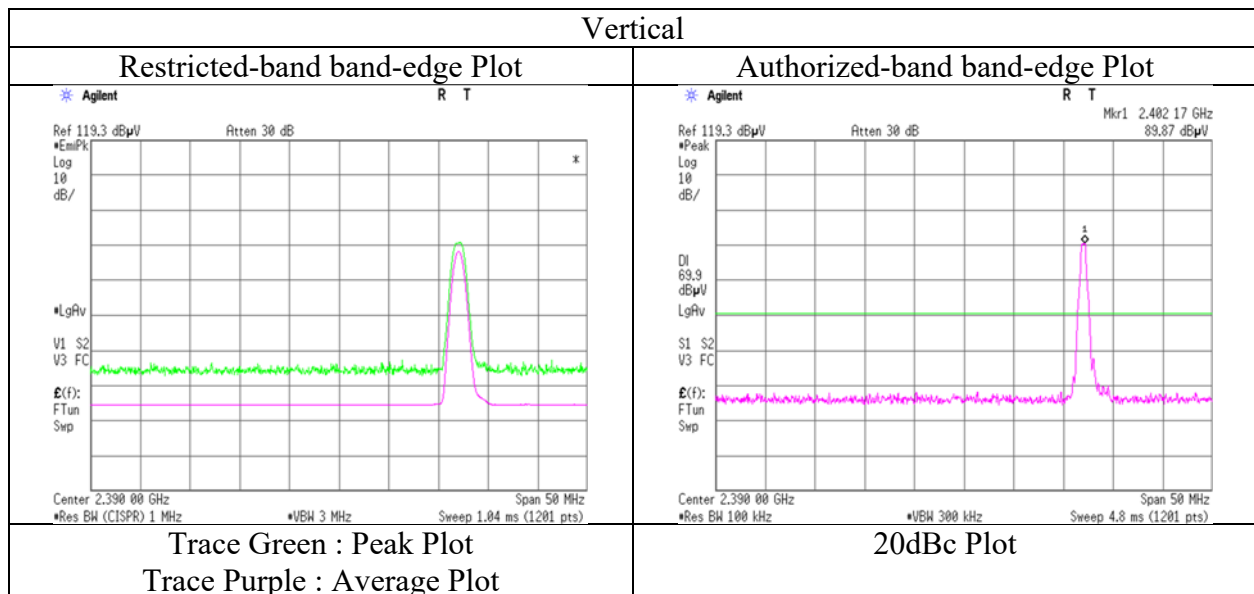
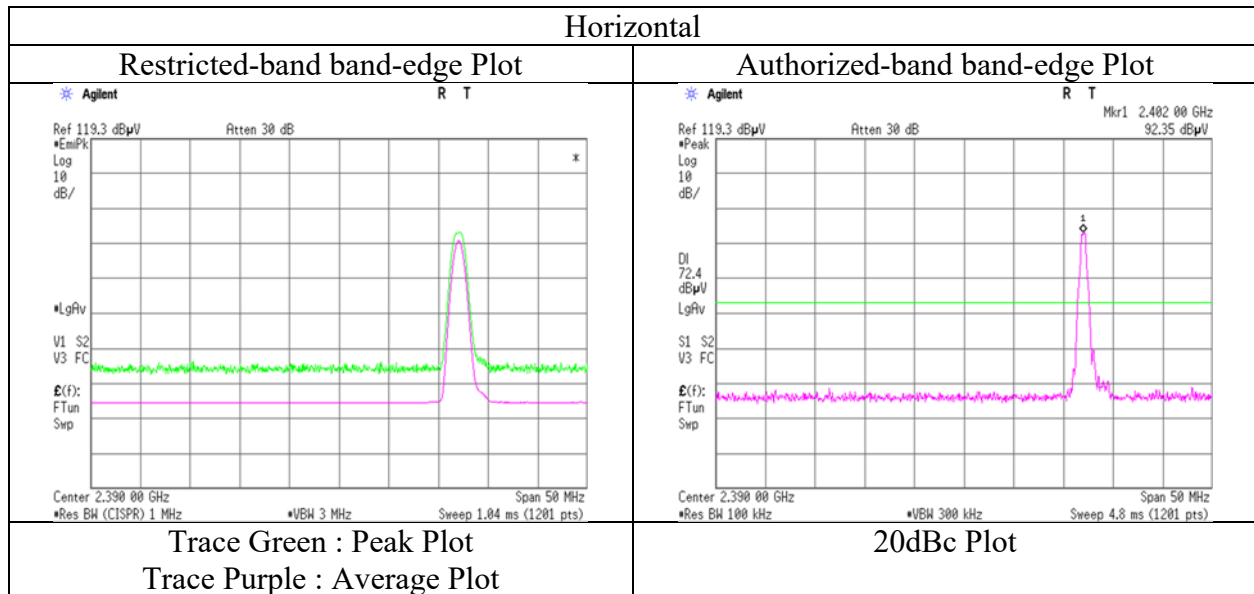
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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12477308H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	September 28, 2018
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka (1 GHz -10 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz



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

Radiated Spurious Emission

Report No.	12477308H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.4	No.4
Date	September 28, 2018	October 29, 2018	October 30, 2018
Temperature / Humidity	23 deg. C / 60 % RH	21 deg. C / 43 % RH	24 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka	Akihiko Maeda	Akihiko Maeda
	(1 GHz - 10 GHz)	(Below 1 GHz)	(Above 10 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	215.998	QP	51.0	11.1	9.3	32.0	-	39.4	43.5	4.1	
Hori	224.993	QP	56.2	11.1	9.4	32.0	-	44.7	46.0	1.3	
Hori	246.936	QP	46.4	11.7	9.5	32.0	-	35.6	46.0	10.4	
Hori	283.982	QP	47.8	13.3	9.8	32.0	-	38.9	46.0	7.1	
Hori	321.017	QP	43.4	14.2	10.1	32.0	-	35.7	46.0	10.3	
Hori	935.999	QP	32.7	22.0	13.4	31.1	-	37.0	46.0	9.0	
Hori	1399.150	PK	60.5	25.4	5.8	34.2	-	57.5	73.9	16.4	
Hori	3145.650	PK	47.8	29.1	7.0	32.4	-	51.5	73.9	22.4	
Hori	4882.000	PK	44.0	31.7	8.9	31.7	-	52.9	73.9	21.0	
Hori	7323.000	PK	42.6	36.3	10.1	32.7	-	56.3	73.9	17.6	Floor noise
Hori	9764.000	PK	44.0	39.1	10.5	33.4	-	60.2	73.9	13.7	Floor noise
Hori	1399.150	AV	36.4	25.4	5.8	34.2	-	33.4	53.9	20.5	
Hori	3145.650	AV	41.2	29.1	7.0	32.4	-	44.9	53.9	9.0	
Hori	4882.000	AV	33.3	31.7	8.9	31.7	-	42.2	53.9	11.7	
Hori	7323.000	AV	31.0	36.3	10.1	32.7	-	44.7	53.9	9.2	Floor noise
Hori	9764.000	AV	31.5	39.1	10.5	33.4	-	47.7	53.9	6.2	Floor noise
Vert	215.998	QP	49.0	11.1	9.3	32.0	-	37.4	43.5	6.1	
Vert	224.993	QP	53.6	11.1	9.4	32.0	-	42.1	46.0	3.9	
Vert	246.936	QP	44.9	11.7	9.5	32.0	-	34.1	46.0	11.9	
Vert	283.982	QP	43.7	13.3	9.8	32.0	-	34.8	46.0	11.2	
Vert	321.017	QP	39.8	14.2	10.1	32.0	-	32.1	46.0	13.9	
Vert	935.999	QP	29.3	22.0	13.4	31.1	-	33.6	46.0	12.4	
Vert	1399.150	PK	61.2	25.4	5.8	34.2	-	58.2	73.9	15.7	
Vert	3145.650	PK	46.9	29.1	7.0	32.4	-	50.6	73.9	23.3	
Vert	4882.000	PK	42.8	31.7	8.9	31.7	-	51.7	73.9	22.2	
Vert	7323.000	PK	42.0	36.3	10.1	32.7	-	55.7	73.9	18.2	Floor noise
Vert	9764.000	PK	43.0	39.1	10.5	33.4	-	59.2	73.9	14.7	Floor noise
Vert	1399.150	AV	36.7	25.4	5.8	34.2	-	33.7	53.9	20.2	
Vert	3145.650	AV	38.8	29.1	7.0	32.4	-	42.5	53.9	11.4	
Vert	4882.000	AV	32.2	31.7	8.9	31.7	-	41.1	53.9	12.8	
Vert	7323.000	AV	30.5	36.3	10.1	32.7	-	44.2	53.9	9.7	Floor noise
Vert	9764.000	AV	31.6	39.1	10.5	33.4	-	47.8	53.9	6.1	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 $20\log(4.4\text{ m} / 3.0\text{ m}) = 3.33\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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Radiated Spurious Emission

Report No.	12477308H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.4	No.4
Date	September 28, 2018	October 29, 2018	October 30, 2018
Temperature / Humidity	23 deg. C / 60 % RH	21 deg. C / 43 % RH	24 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka	Akihiko Maeda	Akihiko Maeda
	(1 GHz - 10 GHz)	(Below 1 GHz)	(Above 10 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	215.986	QP	51.1	11.1	9.3	32.0	-	39.5	43.5	4.0	
Hori	224.996	QP	56.2	11.1	9.4	32.0	-	44.7	46.0	1.3	
Hori	246.941	QP	46.3	11.7	9.5	32.0	-	35.5	46.0	10.5	
Hori	283.982	QP	47.5	13.3	9.8	32.0	-	38.6	46.0	7.4	
Hori	321.024	QP	43.4	14.2	10.1	32.0	-	35.7	46.0	10.3	
Hori	935.997	QP	32.5	22.0	13.4	31.1	-	36.8	46.0	9.2	
Hori	1399.150	PK	57.0	25.4	5.8	34.2	-	54.0	73.9	19.9	
Hori	2483.500	PK	42.6	27.5	6.6	32.7	-	44.0	73.9	29.9	
Hori	3145.650	PK	46.3	29.1	7.0	32.4	-	50.0	73.9	23.9	
Hori	4960.000	PK	43.6	31.8	8.9	31.7	-	52.6	73.9	21.3	
Hori	7440.000	PK	42.4	36.6	10.1	32.7	-	56.4	73.9	17.5	Floor noise
Hori	9920.000	PK	43.3	39.1	10.4	33.4	-	59.4	73.9	14.5	Floor noise
Hori	1399.150	AV	35.3	25.4	5.8	34.2	-	32.3	53.9	21.6	
Hori	2483.500	AV	30.5	27.5	6.6	32.7	-	31.9	53.9	22.0	
Hori	3145.650	AV	41.4	29.1	7.0	32.4	-	45.1	53.9	8.8	
Hori	4960.000	AV	32.9	31.8	8.9	31.7	-	41.9	53.9	12.0	
Hori	7440.000	AV	30.0	36.6	10.1	32.7	-	44.0	53.9	9.9	Floor noise
Hori	9920.000	AV	31.7	39.1	10.4	33.4	-	47.8	53.9	6.1	Floor noise
Vert	215.986	QP	48.8	11.1	9.3	32.0	-	37.2	43.5	6.3	
Vert	224.996	QP	53.5	11.1	9.4	32.0	-	42.0	46.0	4.0	
Vert	246.941	QP	44.9	11.7	9.5	32.0	-	34.1	46.0	11.9	
Vert	283.982	QP	43.4	13.3	9.8	32.0	-	34.5	46.0	11.5	
Vert	321.024	QP	39.3	14.2	10.1	32.0	-	31.6	46.0	14.4	
Vert	935.997	QP	29.3	22.0	13.4	31.1	-	33.6	46.0	12.4	
Vert	1399.150	PK	57.8	25.4	5.8	34.2	-	54.8	73.9	19.1	
Vert	2483.500	PK	42.8	27.5	6.6	32.7	-	44.2	73.9	29.7	
Vert	3145.650	PK	45.2	29.1	7.0	32.4	-	48.9	73.9	25.0	
Vert	4960.000	PK	43.4	31.8	8.9	31.7	-	52.4	73.9	21.5	
Vert	7440.000	PK	42.6	36.6	10.1	32.7	-	56.6	73.9	17.3	Floor noise
Vert	9920.000	PK	43.6	39.1	10.4	33.4	-	59.7	73.9	14.2	Floor noise
Vert	1399.150	AV	35.9	25.4	5.8	34.2	-	32.9	53.9	21.0	
Vert	2483.500	AV	30.4	27.5	6.6	32.7	-	31.8	53.9	22.1	
Vert	3145.650	AV	37.6	29.1	7.0	32.4	-	41.3	53.9	12.6	
Vert	4960.000	AV	35.0	31.8	8.9	31.7	-	44.0	53.9	9.9	
Vert	7440.000	AV	30.0	36.6	10.1	32.7	-	44.0	53.9	9.9	Floor noise
Vert	9920.000	AV	31.7	39.1	10.4	33.4	-	47.8	53.9	6.1	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 $20\log(4.4\text{ m} / 3.0\text{ m}) = 3.33\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

UL Japan, Inc.

Ise EMC Lab.

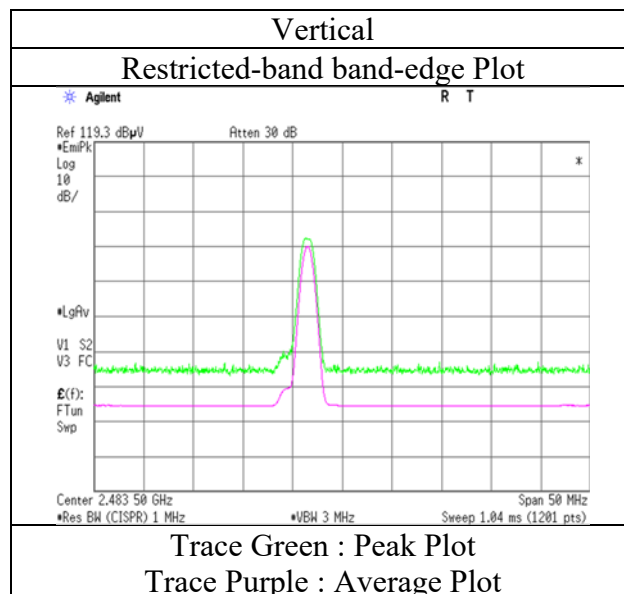
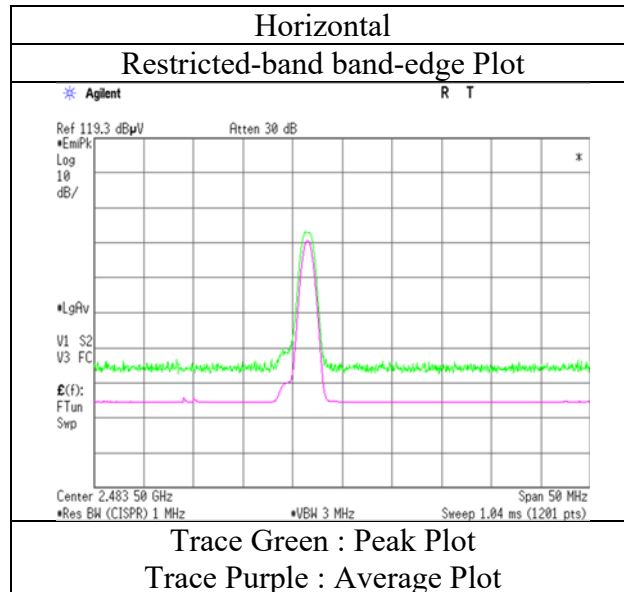
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12477308H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	September 28, 2018	March 15, 2017
Temperature / Humidity	23 deg. C / 60 % RH	
Engineer	Hiroyuki Furutaka	
	(1 GHz -10 GHz)	
Mode	Tx, Hopping Off, DH5 2480 MHz	



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

UL Japan, Inc.

Ise EMC Lab.

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

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Radiated Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 30, 2018 No.4 October 29, 2018 No.4 October 30, 2018
Temperature / Humidity 23 deg. C / 43 % RH 21 deg. C / 43 % RH 24 deg. C / 37 % RH
Engineer Hiroyuki Furutaka Akihiko Maeda Akihiko Maeda
(1 GHz - 10 GHz) (Below 1 GHz) (Above 10 GHz)
Mode Tx, Hopping Off, 3DH5 2402 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	215.989	QP	51.1	11.1	9.3	32.0	39.5	43.5	4.0	
Hori	224.996	QP	56.1	11.1	9.4	32.0	44.6	46.0	1.4	
Hori	246.940	QP	46.5	11.7	9.5	32.0	35.7	46.0	10.3	
Hori	283.982	QP	47.7	13.3	9.8	32.0	38.8	46.0	7.2	
Hori	321.026	QP	43.4	14.2	10.1	32.0	35.7	46.0	10.3	
Hori	935.995	QP	32.6	22.0	13.4	31.1	36.9	46.0	9.1	
Hori	1398.934	PK	53.8	24.7	5.9	32.8	51.6	73.9	22.3	
Hori	2390.000	PK	41.7	27.6	6.7	31.3	44.7	73.9	29.2	
Hori	3145.725	PK	44.2	28.8	7.1	31.0	49.1	73.9	24.8	
Hori	4804.000	PK	40.0	31.4	8.9	30.6	49.7	73.9	24.2	
Hori	7206.000	PK	40.1	36.2	9.9	31.8	54.4	73.9	19.5	Floor noise
Hori	9608.000	PK	40.3	37.9	11.1	32.1	57.2	73.9	16.7	Floor noise
Hori	1398.934	AV	33.5	24.7	5.9	32.8	31.3	53.9	22.6	
Hori	2390.000	AV	29.3	27.6	6.7	31.3	32.3	53.9	21.6	
Hori	3145.725	AV	38.0	28.8	7.1	31.0	42.9	53.9	11.0	
Hori	4804.000	AV	30.2	31.4	8.9	30.6	39.9	53.9	14.0	
Hori	7206.000	AV	29.6	36.2	9.9	31.8	43.9	53.9	10.0	Floor noise
Hori	9608.000	AV	29.3	37.9	11.1	32.1	46.2	53.9	7.7	Floor noise
Vert	215.989	QP	49.1	11.1	9.3	32.0	37.5	43.5	6.0	
Vert	224.996	QP	54.0	11.1	9.4	32.0	42.5	46.0	3.5	
Vert	246.940	QP	44.8	11.7	9.5	32.0	34.0	46.0	12.0	
Vert	283.982	QP	43.7	13.3	9.8	32.0	34.8	46.0	11.2	
Vert	321.026	QP	39.6	14.2	10.1	32.0	31.9	46.0	14.1	
Vert	935.993	QP	29.4	22.0	13.4	31.1	33.7	46.0	12.3	
Vert	1398.934	PK	58.9	24.7	5.9	32.8	56.7	73.9	17.2	
Vert	2390.000	PK	41.7	27.6	6.7	31.3	44.7	73.9	29.2	
Vert	3145.725	PK	43.7	28.8	7.1	31.0	48.6	73.9	25.3	
Vert	4804.000	PK	41.8	31.4	8.9	30.6	51.5	73.9	22.4	
Vert	7206.000	PK	41.4	36.2	9.9	31.8	55.7	73.9	18.2	Floor noise
Vert	9608.000	PK	41.9	37.9	11.1	32.1	58.8	73.9	15.1	Floor noise
Vert	1398.934	AV	36.0	24.7	5.9	32.8	33.8	53.9	20.1	
Vert	2390.000	AV	29.3	27.6	6.7	31.3	32.3	53.9	21.6	
Vert	3145.725	AV	35.7	28.8	7.1	31.0	40.6	53.9	13.3	
Vert	4804.000	AV	31.2	31.4	8.9	30.6	40.9	53.9	13.0	
Vert	7206.000	AV	29.6	36.2	9.9	31.8	43.9	53.9	10.0	Floor noise
Vert	9608.000	AV	29.3	37.9	11.1	32.1	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 (4.4 m / 3.0 m) = 3.33 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	93.7	27.6	6.7	31.3	96.7	-	-	Carrier
Hori	2400.000	PK	41.1	27.6	6.7	31.3	44.1	76.7	32.6	
Vert	2402.000	PK	88.3	27.6	6.7	31.3	91.3	-	-	Carrier
Vert	2400.000	PK	37.6	27.6	6.7	31.3	40.6	71.3	30.7	

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

UL Japan, Inc.

Ise EMC Lab.

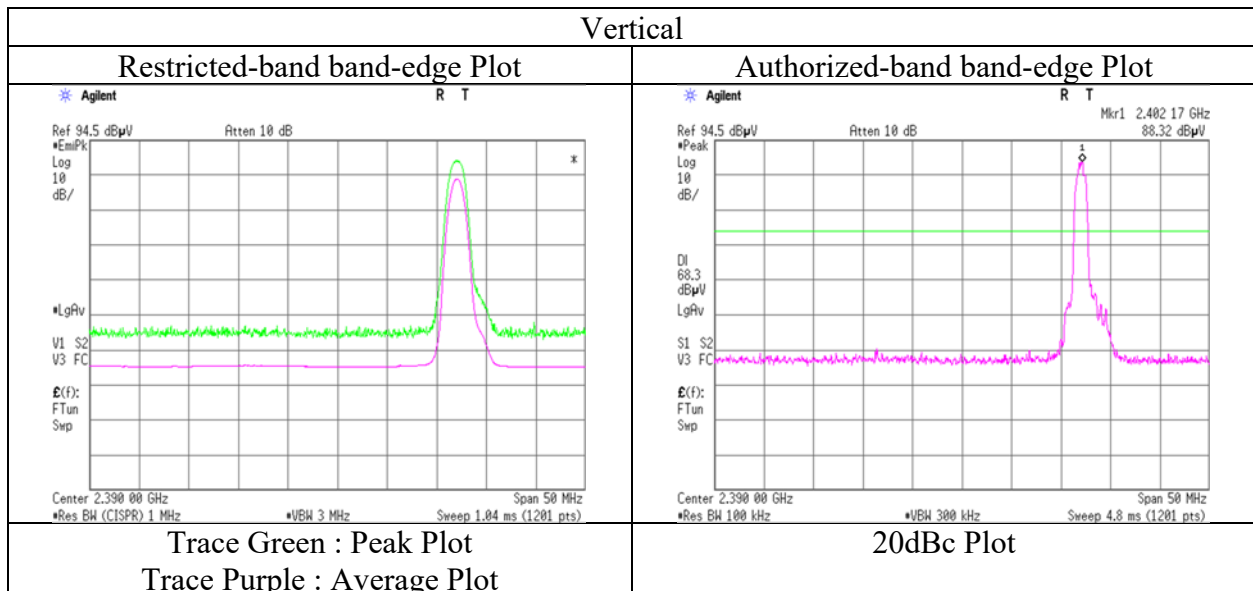
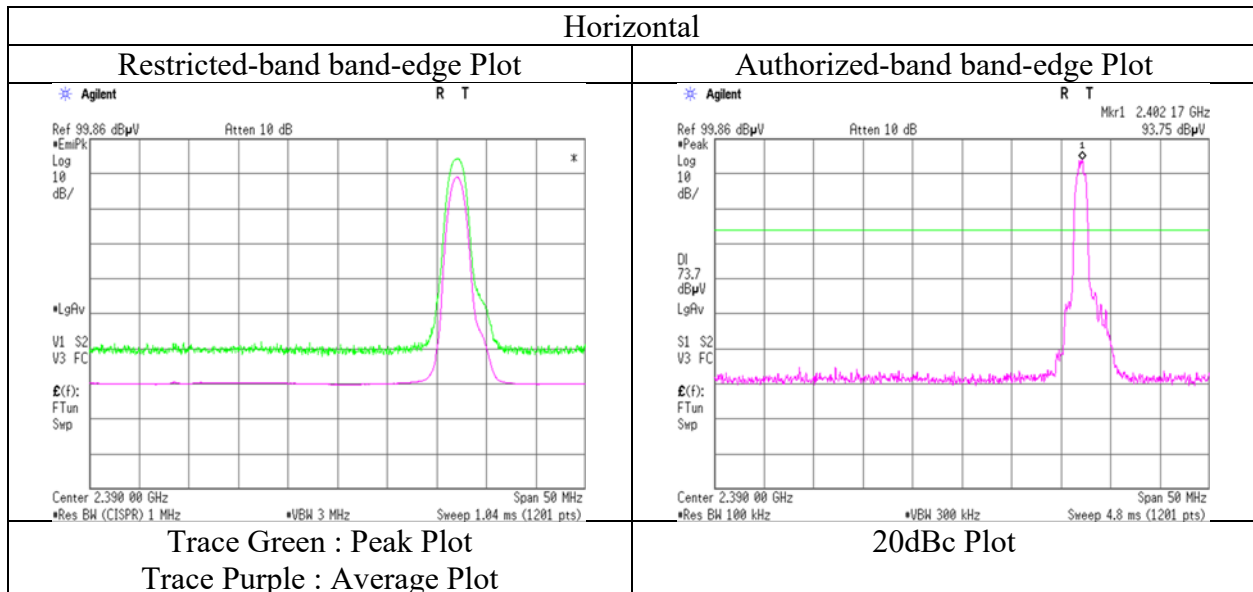
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12477308H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	October 30, 2018
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Hiroyuki Furutaka
	(1 GHz -10 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz



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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4 No.4
Date October 30, 2018 October 29, 2018
Temperature / Humidity 24 deg. C / 37 % RH 21 deg. C / 43 % RH
Engineer Akihiko Maeda Akihiko Maeda
(Above 1 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	215.993	QP	51.0	11.1	9.3	32.0	-	39.4	43.5	4.1	
Hori	224.996	QP	56.2	11.1	9.4	32.0	-	44.7	46.0	1.3	
Hori	246.939	QP	46.3	11.7	9.5	32.0	-	35.5	46.0	10.5	
Hori	283.984	QP	47.7	13.3	9.8	32.0	-	38.8	46.0	7.2	
Hori	321.027	QP	43.6	14.2	10.1	32.0	-	35.9	46.0	10.1	
Hori	935.997	QP	32.6	22.0	13.4	31.1	-	36.9	46.0	9.1	
Hori	1398.934	PK	56.6	24.7	5.9	32.8	-	54.4	73.9	19.5	
Hori	3145.725	PK	45.5	28.8	7.1	31.0	-	50.4	73.9	23.5	
Hori	4882.000	PK	40.4	31.5	8.9	30.6	-	50.2	73.9	23.7	
Hori	7323.000	PK	40.7	36.3	9.9	31.9	-	55.0	73.9	18.9	Floor noise
Hori	9764.000	PK	40.6	38.3	11.2	32.1	-	58.0	73.9	15.9	Floor noise
Hori	1398.934	AV	34.9	24.7	5.9	32.8	-	32.7	53.9	21.2	
Hori	3145.725	AV	39.6	28.8	7.1	31.0	-	44.5	53.9	9.4	
Hori	4882.000	AV	30.2	31.5	8.9	30.6	-	40.0	53.9	13.9	
Hori	7323.000	AV	29.7	36.3	9.9	31.9	-	44.0	53.9	9.9	Floor noise
Hori	9764.000	AV	29.4	38.3	11.2	32.1	-	46.8	53.9	7.1	Floor noise
Vert	215.993	QP	49.2	11.1	9.3	32.0	-	37.6	43.5	5.9	
Vert	224.996	QP	53.6	11.1	9.4	32.0	-	42.1	46.0	3.9	
Vert	246.939	QP	45.0	11.7	9.5	32.0	-	34.2	46.0	11.8	
Vert	283.984	QP	43.6	13.3	9.8	32.0	-	34.7	46.0	11.3	
Vert	321.027	QP	39.4	14.2	10.1	32.0	-	31.7	46.0	14.3	
Vert	935.997	QP	29.4	22.0	13.4	31.1	-	33.7	46.0	12.3	
Vert	1398.934	PK	61.3	24.7	5.9	32.8	-	59.1	73.9	14.8	
Vert	3145.725	PK	44.2	28.8	7.1	31.0	-	49.1	73.9	24.8	
Vert	4882.000	PK	42.1	31.5	8.9	30.6	-	51.9	73.9	22.0	
Vert	7323.000	PK	42.1	36.3	9.9	31.9	-	56.4	73.9	17.5	Floor noise
Vert	9764.000	PK	40.7	38.3	11.2	32.1	-	58.1	73.9	15.8	Floor noise
Vert	1398.934	AV	37.3	24.7	5.9	32.8	-	35.1	53.9	18.8	
Vert	3145.725	AV	36.6	28.8	7.1	31.0	-	41.5	53.9	12.4	
Vert	4882.000	AV	31.0	31.5	8.9	30.6	-	40.8	53.9	13.1	
Vert	7323.000	AV	29.8	36.3	9.9	31.9	-	44.1	53.9	9.8	Floor noise
Vert	9764.000	AV	29.4	38.3	11.2	32.1	-	46.8	53.9	7.1	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 $20\log(4.4\text{ m} / 3.0\text{ m}) = 3.33\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4 No.4
Date October 30, 2018 October 29, 2018
Temperature / Humidity 24 deg. C / 37 % RH 21 deg. C / 43 % RH
Engineer Akihiko Maeda Akihiko Maeda
(Above 1 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	215.999	QP	50.9	11.1	9.3	32.0	-	39.3	43.5	4.2	
Hori	224.996	QP	56.1	11.1	9.4	32.0	-	44.6	46.0	1.4	
Hori	246.935	QP	46.6	11.7	9.5	32.0	-	35.8	46.0	10.2	
Hori	283.980	QP	47.5	13.3	9.8	32.0	-	38.6	46.0	7.4	
Hori	321.019	QP	43.6	14.2	10.1	32.0	-	35.9	46.0	10.1	
Hori	935.996	QP	32.5	22.0	13.4	31.1	-	36.8	46.0	9.2	
Hori	1398.934	PK	56.3	24.7	5.9	32.8	-	54.1	73.9	19.8	
Hori	2483.500	PK	42.5	27.5	6.7	31.3	-	45.4	73.9	28.5	
Hori	3145.725	PK	44.9	28.8	7.1	31.0	-	49.8	73.9	24.1	
Hori	4960.000	PK	42.1	31.7	8.9	30.6	-	52.1	73.9	21.8	
Hori	7440.000	PK	41.3	36.4	9.9	31.9	-	55.7	73.9	18.2	Floor noise
Hori	9920.000	PK	40.8	38.4	11.3	32.2	-	58.3	73.9	15.6	Floor noise
Hori	1398.934	AV	34.8	24.7	5.9	32.8	-	32.6	53.9	21.3	
Hori	2483.500	AV	30.5	27.5	6.7	31.3	-	33.4	53.9	20.5	
Hori	3145.725	AV	39.2	28.8	7.1	31.0	-	44.1	53.9	9.8	
Hori	4960.000	AV	29.6	31.7	8.9	30.6	-	39.6	53.9	14.3	
Hori	7440.000	AV	29.5	36.4	9.9	31.9	-	43.9	53.9	10.0	Floor noise
Hori	9920.000	AV	29.6	38.4	11.3	32.2	-	47.1	53.9	6.8	Floor noise
Vert	215.999	QP	48.7	11.1	9.3	32.0	-	37.1	43.5	6.4	
Vert	224.996	QP	53.5	11.1	9.4	32.0	-	42.0	46.0	4.0	
Vert	246.935	QP	45.2	11.7	9.5	32.0	-	34.4	46.0	11.6	
Vert	283.980	QP	43.9	13.3	9.8	32.0	-	35.0	46.0	11.0	
Vert	321.019	QP	39.7	14.2	10.1	32.0	-	32.0	46.0	14.0	
Vert	935.996	QP	29.4	22.0	13.4	31.1	-	33.7	46.0	12.3	
Vert	1398.934	PK	61.9	24.7	5.9	32.8	-	59.7	73.9	14.2	
Vert	2483.500	PK	42.3	27.5	6.7	31.3	-	45.2	73.9	28.7	
Vert	3145.725	PK	43.7	28.8	7.1	31.0	-	48.6	73.9	25.3	
Vert	4960.000	PK	42.2	31.7	8.9	30.6	-	52.2	73.9	21.7	
Vert	7440.000	PK	41.4	36.4	9.9	31.9	-	55.8	73.9	18.1	Floor noise
Vert	9920.000	PK	42.0	38.4	11.3	32.2	-	59.5	73.9	14.4	Floor noise
Vert	1398.934	AV	37.4	24.7	5.9	32.8	-	35.2	53.9	18.7	
Vert	2483.500	AV	29.9	27.5	6.7	31.3	-	32.8	53.9	21.1	
Vert	3145.725	AV	36.5	28.8	7.1	31.0	-	41.4	53.9	12.5	
Vert	4960.000	AV	31.0	31.7	8.9	30.6	-	41.0	53.9	12.9	
Vert	7440.000	AV	29.6	36.4	9.9	31.9	-	44.0	53.9	9.9	Floor noise
Vert	9920.000	AV	29.5	38.4	11.3	32.2	-	47.0	53.9	6.9	Floor noise

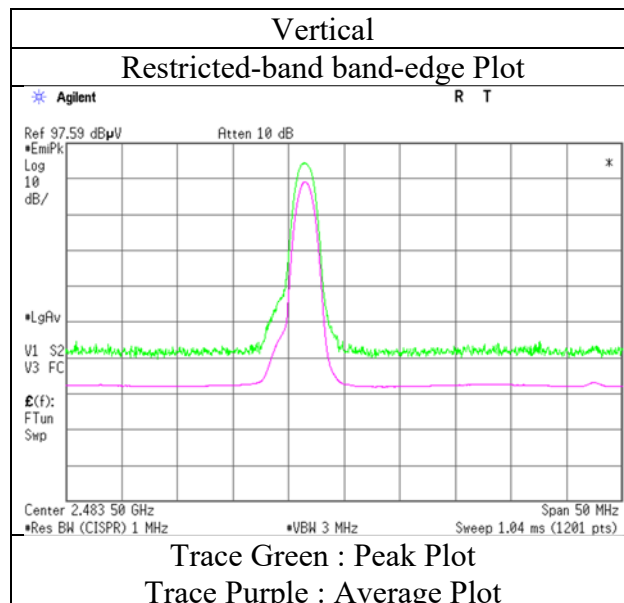
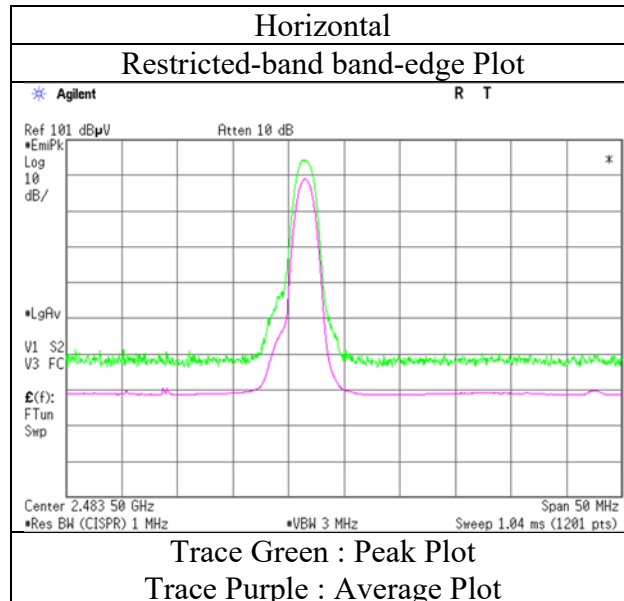
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

*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 (4.4 m / 3.0 m) = 3.33 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission (Reference Plot for band-edge)

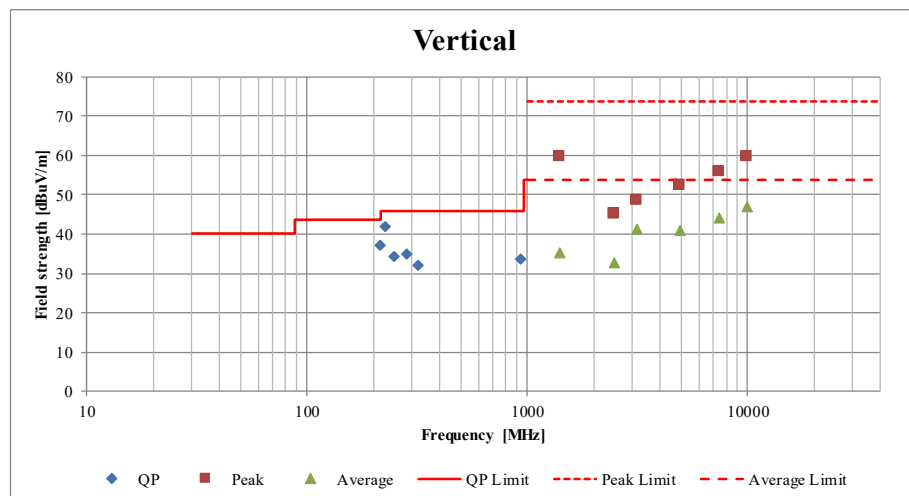
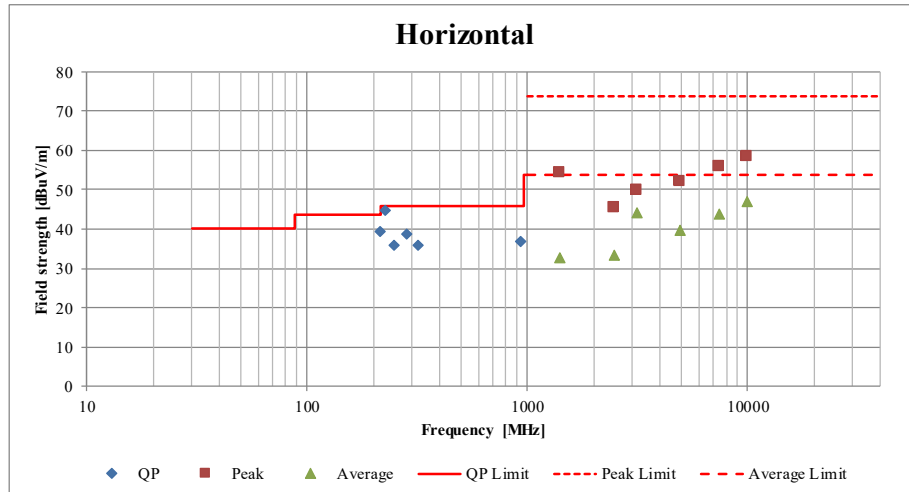
Report No.	12477308H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	October 30, 2018
Temperature / Humidity	24 deg. C / 37 % RH
Engineer	Akihiko Maeda (Above 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz



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

Radiated Spurious Emission (Plot data, Worst case)

Report No.	12477308H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 30, 2018	October 29, 2018
Temperature / Humidity	24 deg. C / 37 % RH	21 deg. C / 43 % RH
Engineer	Akihiko Maeda (Above 1 GHz)	Akihiko Maeda (Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz	

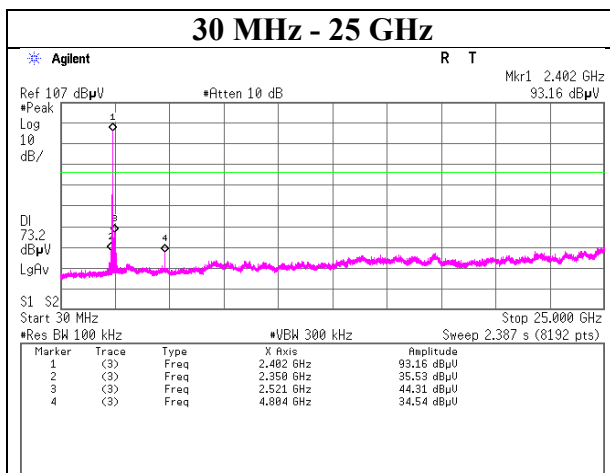
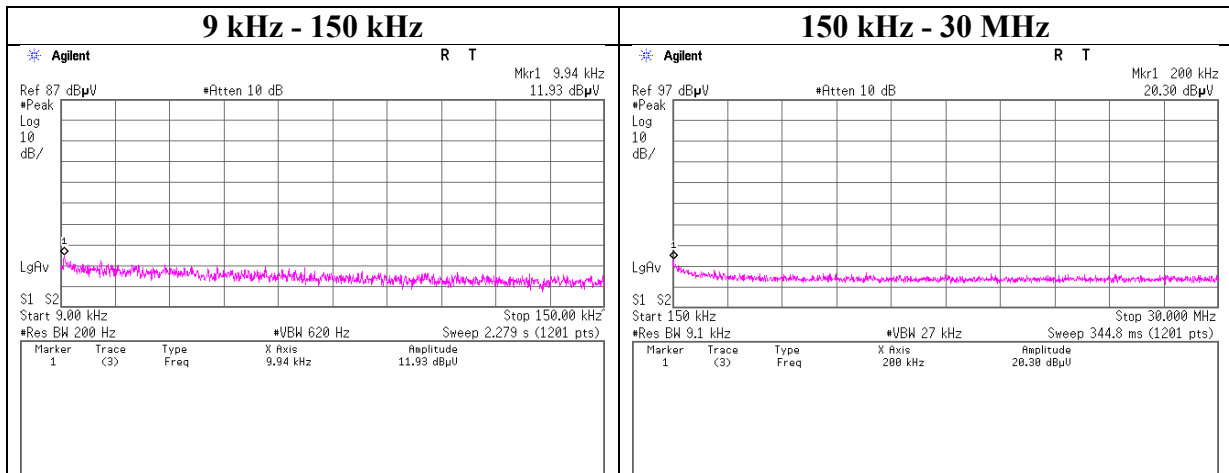


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
Mode Tx, Hopping Off, DH5

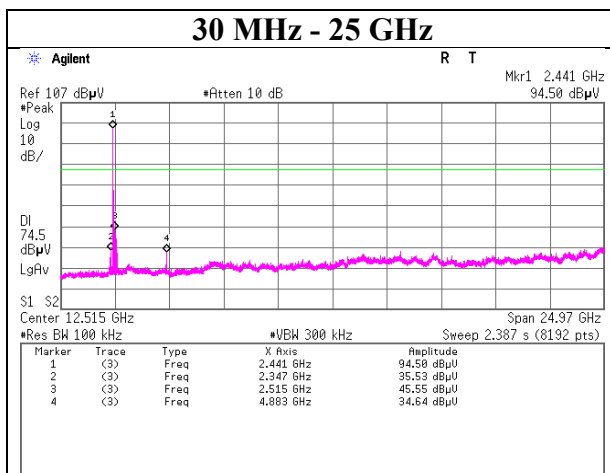
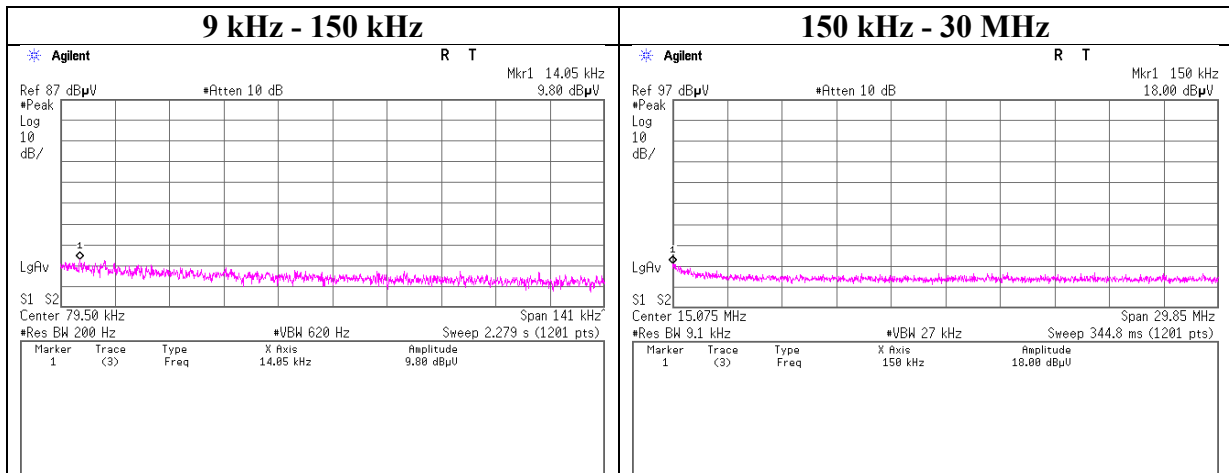
2402 MHz



Conducted Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
Mode Tx, Hopping Off, DH5

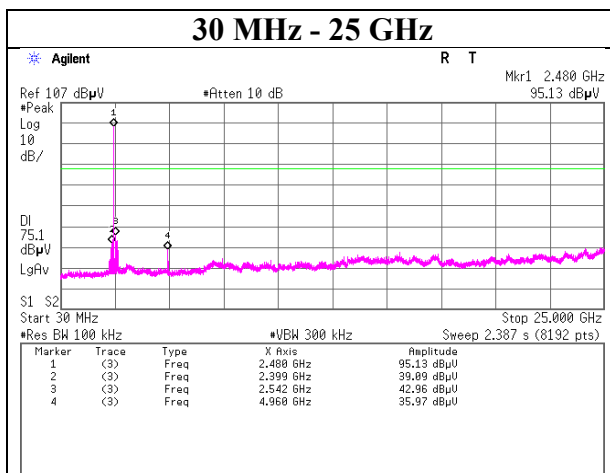
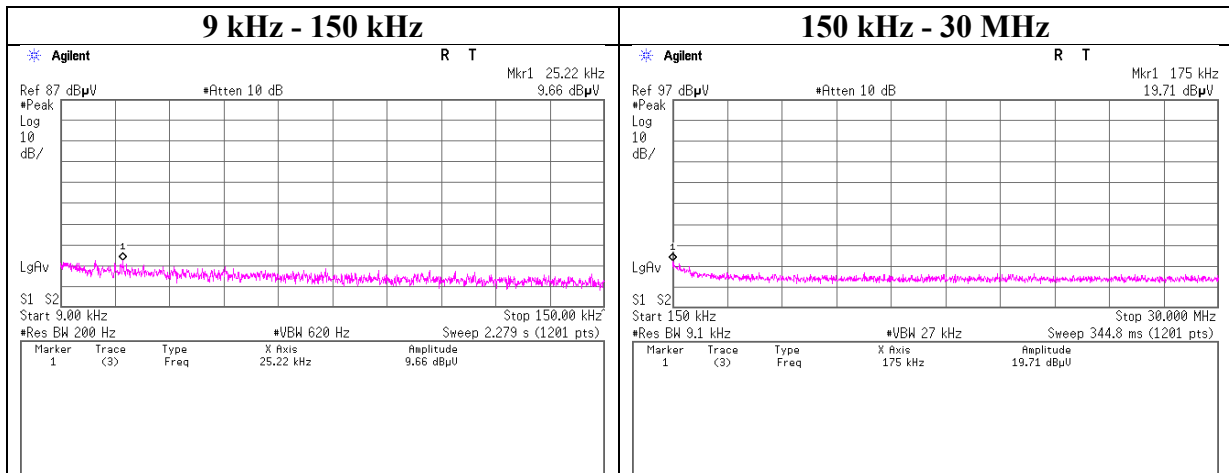
2441 MHz



Conducted Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
Mode Tx, Hopping Off, DH5

2480 MHz



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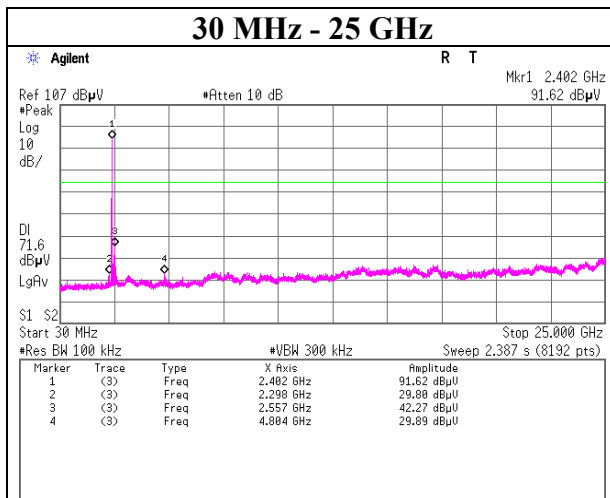
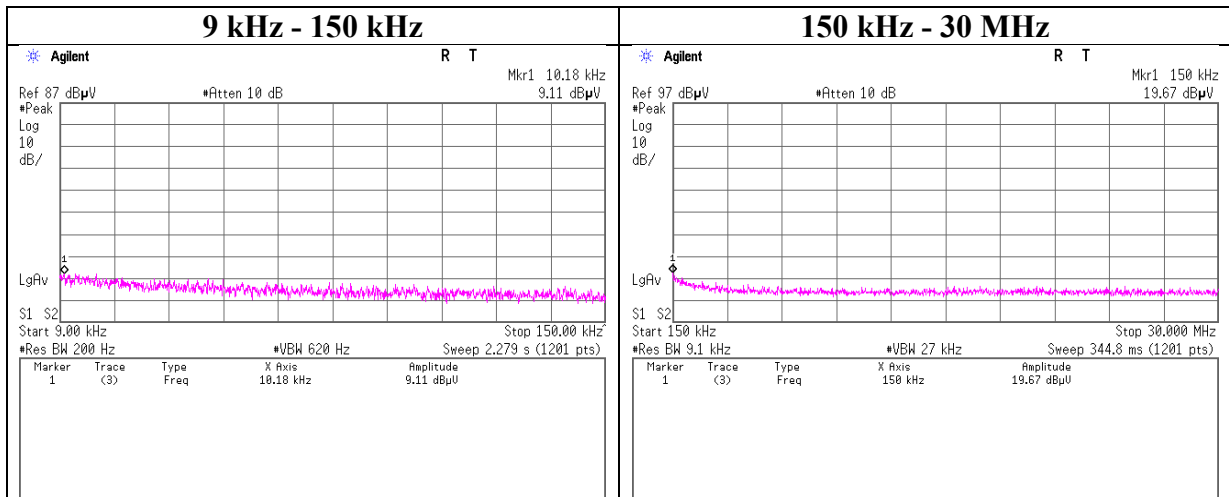
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
Mode Tx, Hopping Off, 3DH5

2402 MHz



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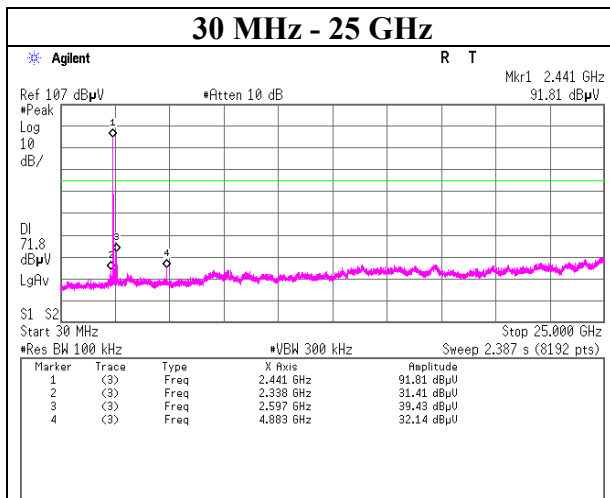
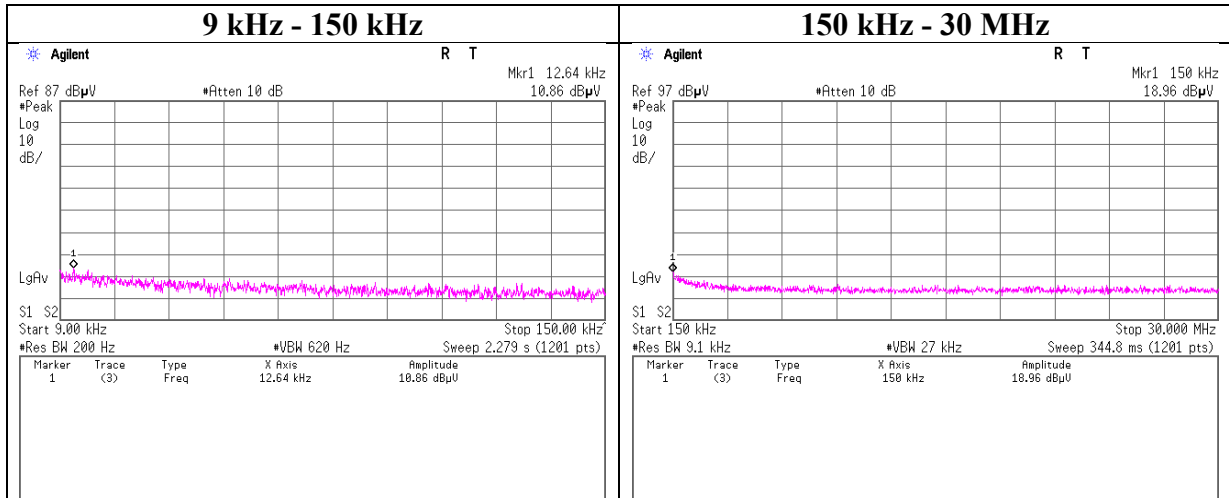
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 12477308H
Test place Ise EMC Lab. No.11 Measurement Room
Date October 1, 2018
Temperature / Humidity 23 deg. C / 51 % RH
Engineer Junki Nagatomi
Mode Tx, Hopping Off, 3DH5

2441 MHz



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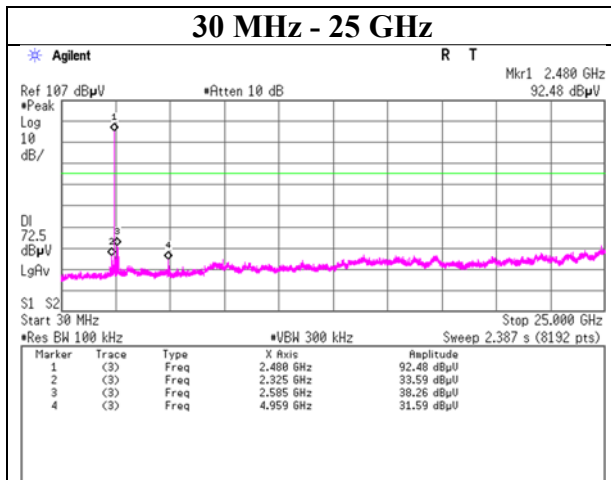
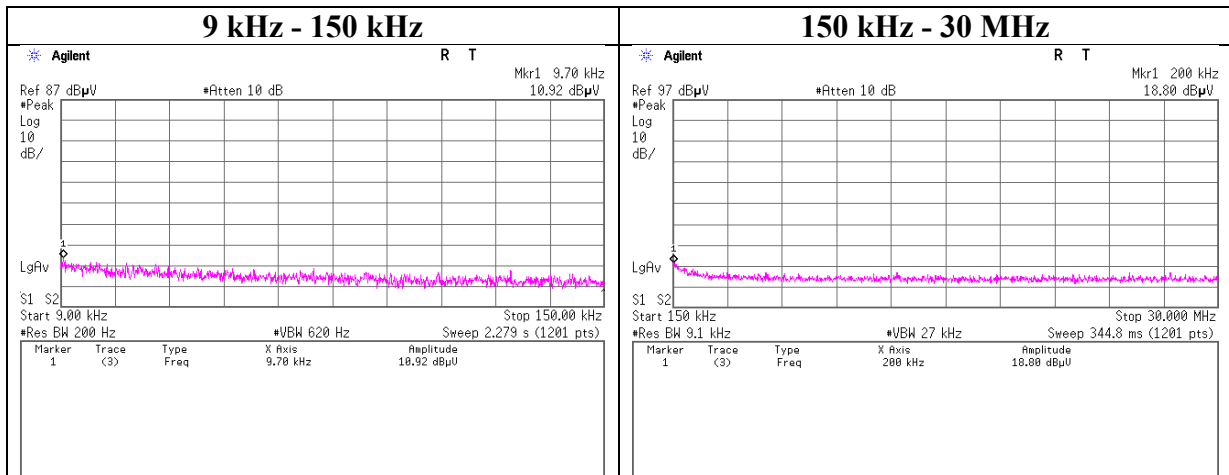
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	12477308H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	October 1, 2018
Temperature / Humidity	23 deg. C / 51 % RH
Engineer	Junki Nagatomi
Mode	Tx, Hopping Off, 3DH5

2480 MHz



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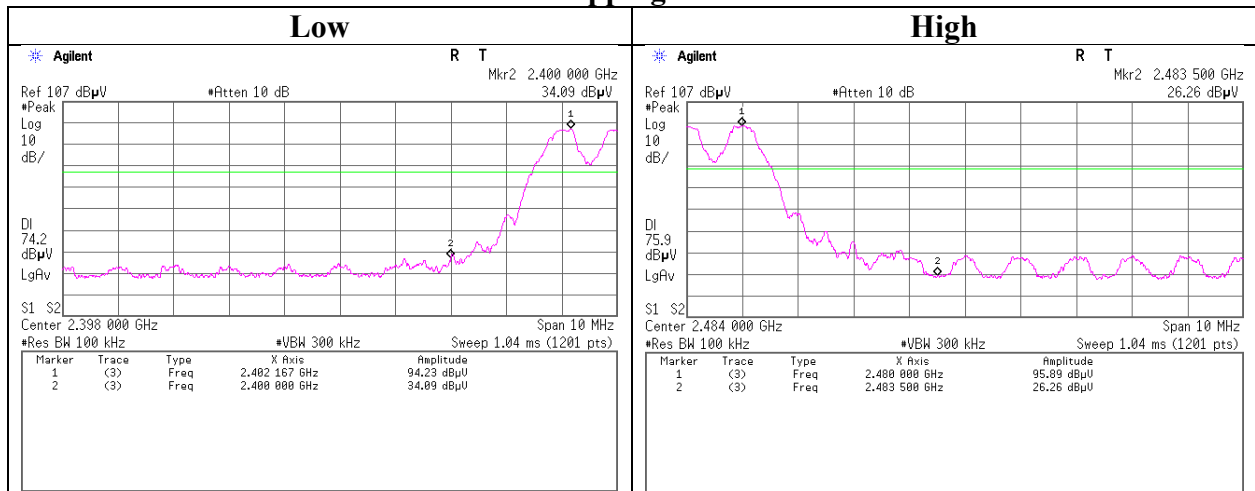
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

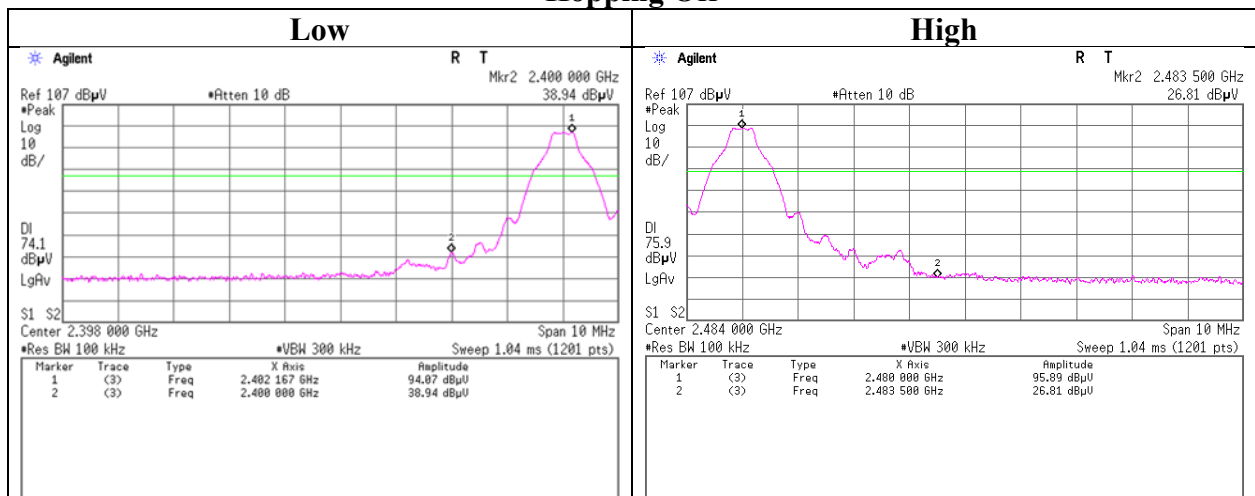
Conducted Emission Band Edge compliance

Report No.	12477308H	
Test place	Ise EMC Lab. No.11 Measurement Room	
Date	October 1, 2018	November 21, 2018
Temperature / Humidity	23 deg. C / 51 % RH	21 deg. C / 33 % RH
Engineer	Junki Nagatomi	Junki Nagatomi
Mode	Tx DH5	

Hopping On



Hopping Off



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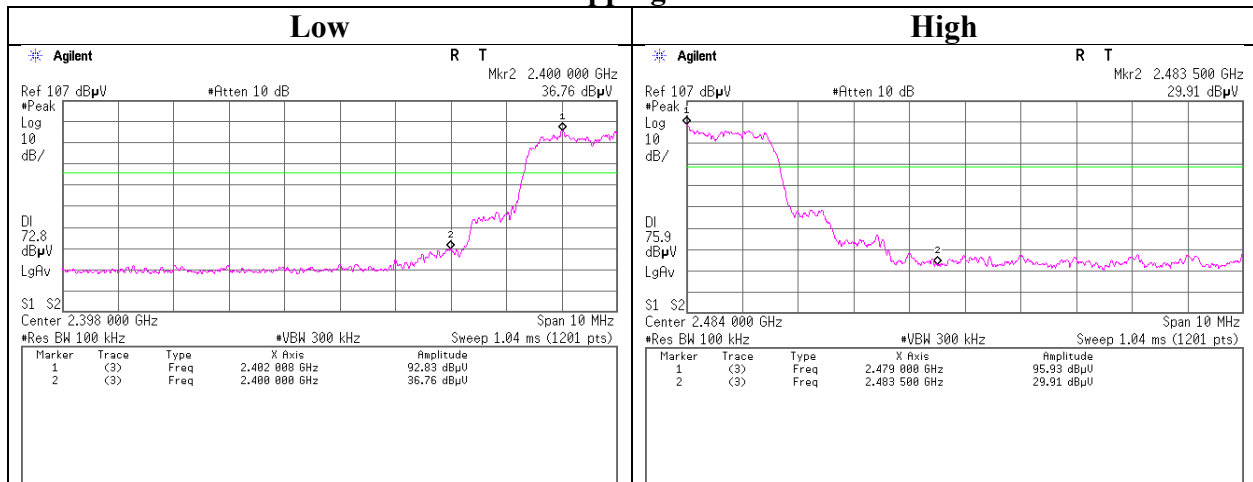
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

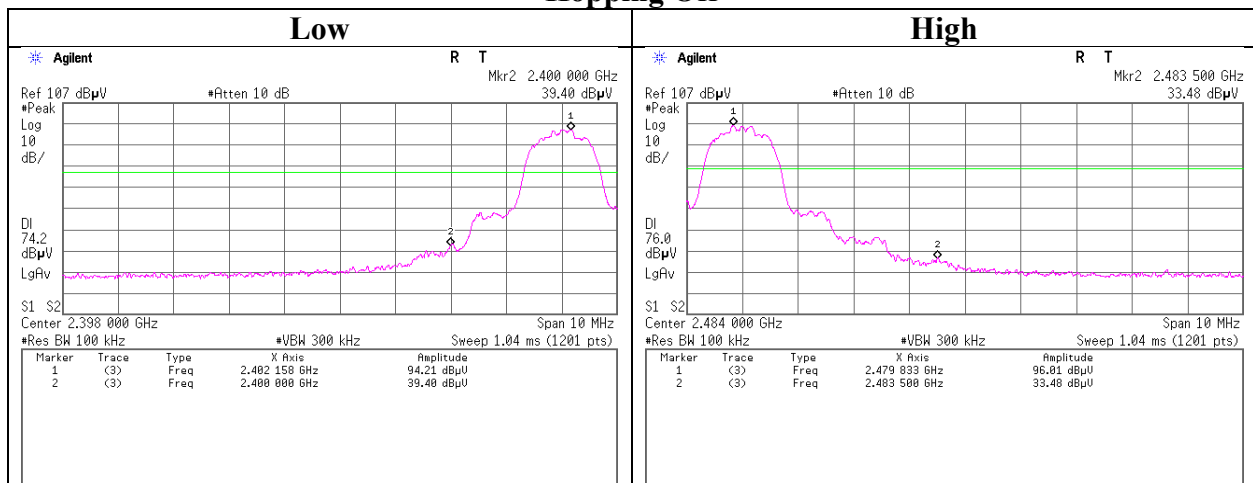
Conducted Emission Band Edge compliance

Report No.	12477308H
Test place	Ise EMC Lab. No.11 Measurement Room
Date	October 1, 2018
Temperature / Humidity	23 deg. C / 51 % RH
Engineer	Junki Nagatomi
Mode	Tx 3DH5

Hopping On



Hopping Off



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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	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/19/2018	09/30/2019	12
RE	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/14/2017	11/30/2018	12
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/24/2018	01/31/2019	12
RE	141417	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	05/07/2018	05/31/2019	12
RE	141580	MicroWave System Amplifier	AGILENT	83017A	MY39500779	03/13/2018	03/31/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141507	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	06/07/2018	06/30/2019	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/09/2018	01/31/2019	12
RE	142013	AC3 Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/06/2018	04/30/2019	12
AT	141269	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	03/12/2018	03/31/2019	12
AT	141535	Thermo-Hygrometer	CUSTOM	CTH-201	0001	12/21/2017	12/31/2018	12
AT	141884	Spectrum Analyzer	AGILENT	E4448A	MY44020357	11/02/2018	11/30/2019	12
AT	141830	Power sensor	ANRITSU	MA2411B	738285	05/21/2018	05/31/2019	12
AT	141809	Power Meter	ANRITSU	ML2495A	825002	05/21/2018	05/31/2019	12
AT	141557	DIGITAL HiTESTER	HIOKI	3805	70900530	01/15/2018	01/31/2019	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/03/2018	10/31/2019	12
RE	141397	Coaxial Cable	UL Japan	-	-	06/13/2018	06/30/2019	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	01/30/2018	01/31/2019	12
RE	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	06/01/2018	06/30/2019	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	06/01/2018	06/30/2019	12
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	01/09/2018	01/31/2019	12
RE	142011	AC4 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/28/2018	06/30/2020	24
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	01/24/2018	01/31/2019	12
RE	142017	AC4 Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/07/2018	04/20/2019	12
RE	141855	Spectrum Analyzer	AGILENT	E4440A	MY46187750	11/17/2017	11/30/2018	12
RE	141508	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	06/08/2018	06/30/2019	12
RE	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	06/14/2018	06/30/2019	12
RE	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	09/19/2018	09/30/2019	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/04/2018	10/31/2019	12
RE	141506	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170307	BBHA9170307	06/08/2018	06/30/2019	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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