




RADIO TEST REPORT


Test Report No. : 12782612H-A-R2

Applicant : DENSO TEN Limited
Type of Equipment : Car Audio
Model No. : TN0012A
FCC ID : BABTN0012A
Test regulation : FCC Part 15 Subpart C: 2019
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the 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. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12782612H-A-R1. 12782612H-A-R1 is replaced with this report.

Date of test: April 9 to 14, 2019

Representative test engineer: 
Akihiko Maeda
Engineer
Consumer Technology Division

Approved by: 
Tsubasa Takayama
Leader
Consumer Technology Division



This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
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SECTION 1: Customer information

Company Name : DENSO TEN Limited
Address : 2-28, Goshō-dori 1-Chome, Hyogo-ku, Kobe, 652-8510 JAPAN
Telephone Number : +81-78-682-2159
Facsimile Number : +81-78-671-7160
Contact Person : DAISUKE FUKII

The information provided from the customer is as follows;

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

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

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

2.1 Identification of E.U.T.

Type of Equipment : Car Audio
Model No. : TN0012A
Serial No. : Refer to SECTION 4.2
Rating : DC 12 V
Receipt Date of Sample : April 8, 2019
(Information from test lab.)
Country of Mass-production : Thailand
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: TN0012A (referred to as the EUT in this report) is a Car Audio.
There has 2 type for Left-hand steering wheel and Right-hand steering wheel.
The EUT is Right-hand steering wheel type.

General Specification

Clock frequency(ies) : 20 MHz (BT)
Operating Temperature : -20 deg. C - +65 deg. C

Radio Specification

Bluetooth (Ver.5.0 + EDR)

Equipment Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Type of Modulation : GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Type : Inverted-F PCB Antenna
Antenna Gain : 3.08 dBi

Broadcast Receiver

Radio Type : Receiver
Frequency of Operation : AM: 531 kHz - 1602 kHz
FM/RDS: 87.5 MHz - 108MHz
Channel spacing : AM: 9 kHz
FM: 0.05 MHz
RDS: 0.1 MHz
Antenna connector type : HFC II

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on June 4, 2019 and effective July 5, 2019 except 15.258

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

* The revision on June 4, 2019, does not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks	
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ----- IC: RSS-Gen 8.8	FCC: Section 15.207 ----- IC: RSS-Gen 8.8	-	N/A	*1)	
Carrier Frequency Separation	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 IC: -	FCC: Section 15.247(a)(1) ----- IC: RSS-247 5.1 (b)	See data.	Complied a)	Conducted	
20dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 IC: -	FCC: Section 15.247(a)(1) ----- IC: RSS-247 5.1 (a)		Complied a)	Conducted	
Number of Hopping Frequency	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 IC: -	FCC: Section 15.247(a)(1)(iii) ----- IC: RSS-247 5.1 (d)		Complied b)	Conducted	
Dwell time	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 IC: -	FCC: Section 15.247(a)(1)(iii) ----- IC: RSS-247 5.1 (d)		Complied c)	Conducted	
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(1) ----- IC: RSS-247 5.4 (b)		Complied d)	Conducted	
Spurious Emission & Band Edge Compliance	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 IC: RSS-Gen 6.13	FCC: Section 15.247(d) ----- IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10		10.0 dB 4882.00 MHz, AV, Hori.	Complied e) / f)	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).

a) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation)

b) Refer to APPENDIX 1 (data of Number of Hopping Frequency)

c) Refer to APPENDIX 1 (data of Dwell time)

d) Refer to APPENDIX 1 (data of Maximum Peak Output Power)

e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)

f) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

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

FCC Part 15.31 (e)

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

FCC Part 15.203 Antenna requirement

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

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3.3 Addition to standard

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

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

a) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation)

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

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

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.
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Antenna Terminal test

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) (Vertical)	4.8 dB
		5.0 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		4.9 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.0 dB
		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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Test site	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	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	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	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	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 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 (Hopping On) DH5, 3DH5	-
Dwell time	Tx (Hopping On), -DH1, DH3, DH5 -3DH1, 3DH3, 3DH5	-
Maximum Peak Output Power	Tx (Hopping Off) DH5, 2DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2441 MHz 2480 MHz
<p>*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test)</p> <p>*2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative.</p> <p>* It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all test items based on Bluetooth Core specification.</p> <p>*EUT has the power settings by the software as follows; Power settings: 0dBm Software: Diagnostics mode *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.</p>		

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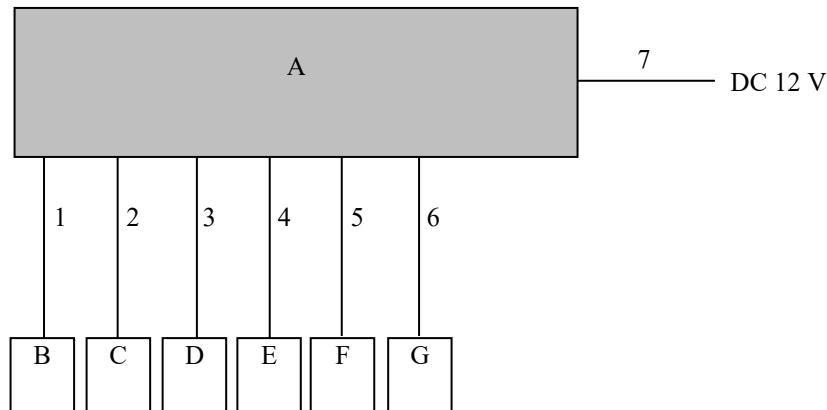
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4.2 Configuration and peripherals



* 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	Car Audio	TN0012A	100111896-0005 for RE* 100112975-0007 for AT*	DENSO TEN Limited	EUT
B	USB Memory	USM4GRB	-	SONY	-
C	Speaker Dummy	-	-	-	-
D	Steering Switch	84250-58150-BO	884-6S91	TOKAI RIKA	-
E	Camera	86790-62010	5XC300013	Panasonic	-
F	Microphone	86730-52020	-	KOJIMA INDUSTRIES	-
G	Radio Antenna AMP	86300-06250	PP100021	DENSO TEN Limited	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	3.0	Shielded	Shielded	-
2	Speaker Cable	3.7	Unshielded	Unshielded	-
3	Signal Cable	3.7	Unshielded	Unshielded	-
4	Signal Cable	3.7	Unshielded	Unshielded	-
5	Signal Cable	3.7	Unshielded	Unshielded	-
6	Radio Cable	3.1	Shielded	Shielded	-
7	DC Cable	4.0	Unshielded	Unshielded	-

*RE: Radiated Spurious Emission, AT: Antenna Terminal Conducted test

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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.

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

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).

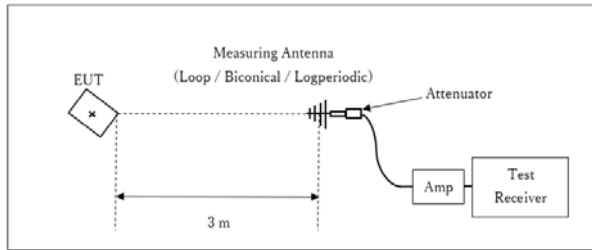
Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer *a)		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz

*1) Average Power Measurement was performed based on KDB 558074 D01 15.247 Meas Guidance v05r02.

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

Figure 2: Test Setup

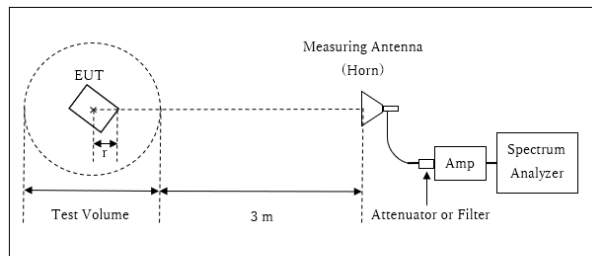
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: $20 \times \log(3.75 \text{ m} / 3.0 \text{ m}) = 1.94 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.75 \text{ m}$

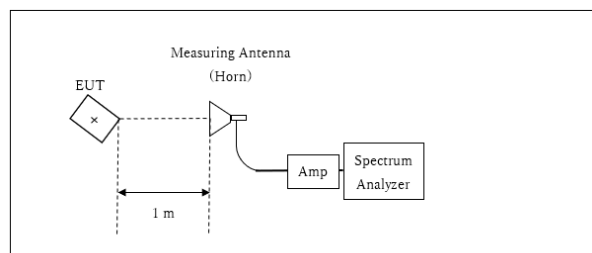
Test Volume : 1.5 m

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

r = 0.0 m

* The test was performed with r = 0.0 m since test was performed severer condition.

10 GHz - 26.5 GHz



× : Center of turn table

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 *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	200 kHz	620 kHz	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 = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz).							

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

Test data : APPENDIX
Test result : Pass

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APPENDIX 1: Test data

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

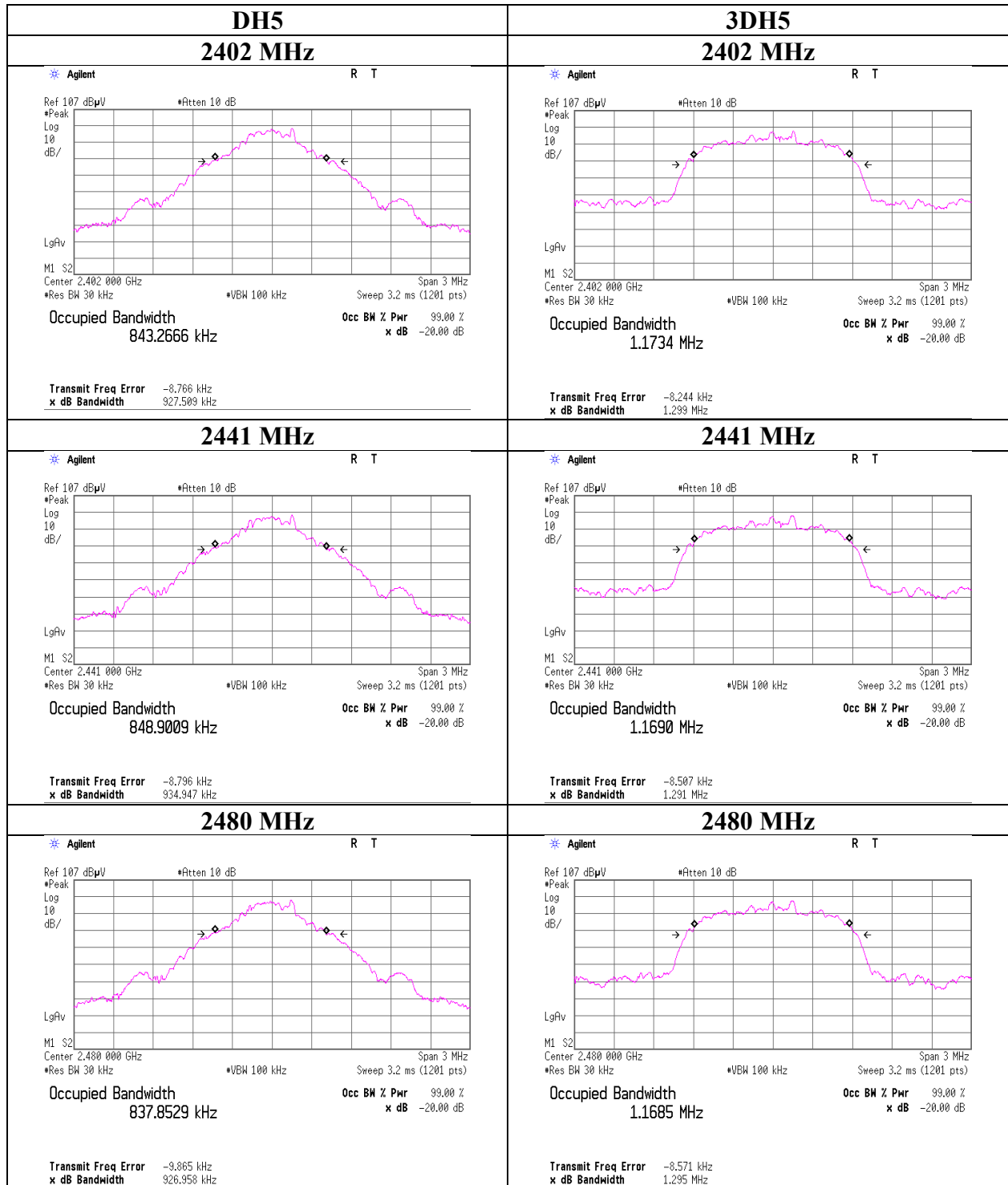
Report No. 12782612H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 10, 2019
Temperature / Humidity 26 deg. C / 32 % RH
Engineer Hiroyuki Furutaka
Mode Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	99% Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.928	843.267	1.000	≥ 0.619
DH5	2441.0	0.935	848.901	1.000	≥ 0.623
DH5	2480.0	0.927	837.853	1.000	≥ 0.618
DH5	Hopping On	-	78605.100	-	-
3DH5	2402.0	1.299	1173.400	1.000	≥ 0.866
3DH5	2441.0	1.291	1169.000	1.000	≥ 0.861
3DH5	2480.0	1.295	1168.500	1.000	≥ 0.863
3DH5	Hopping On	-	78772.200	-	-

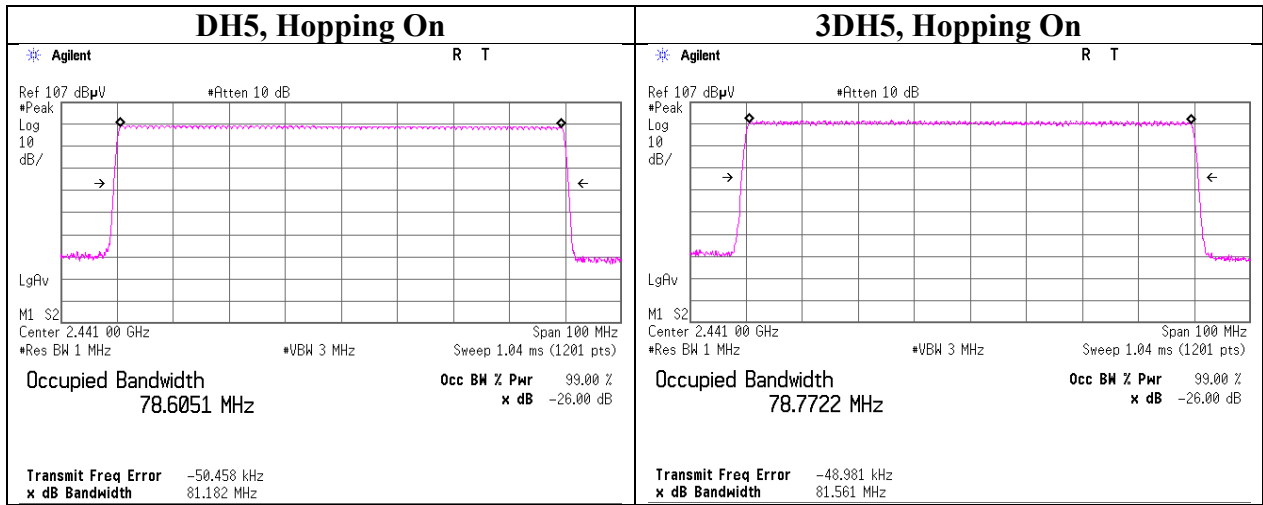
Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).

No limit applies to 20dB Bandwidth.

20dB Bandwidth and 99% Occupied Bandwidth



20dB Bandwidth and 99% Occupied Bandwidth



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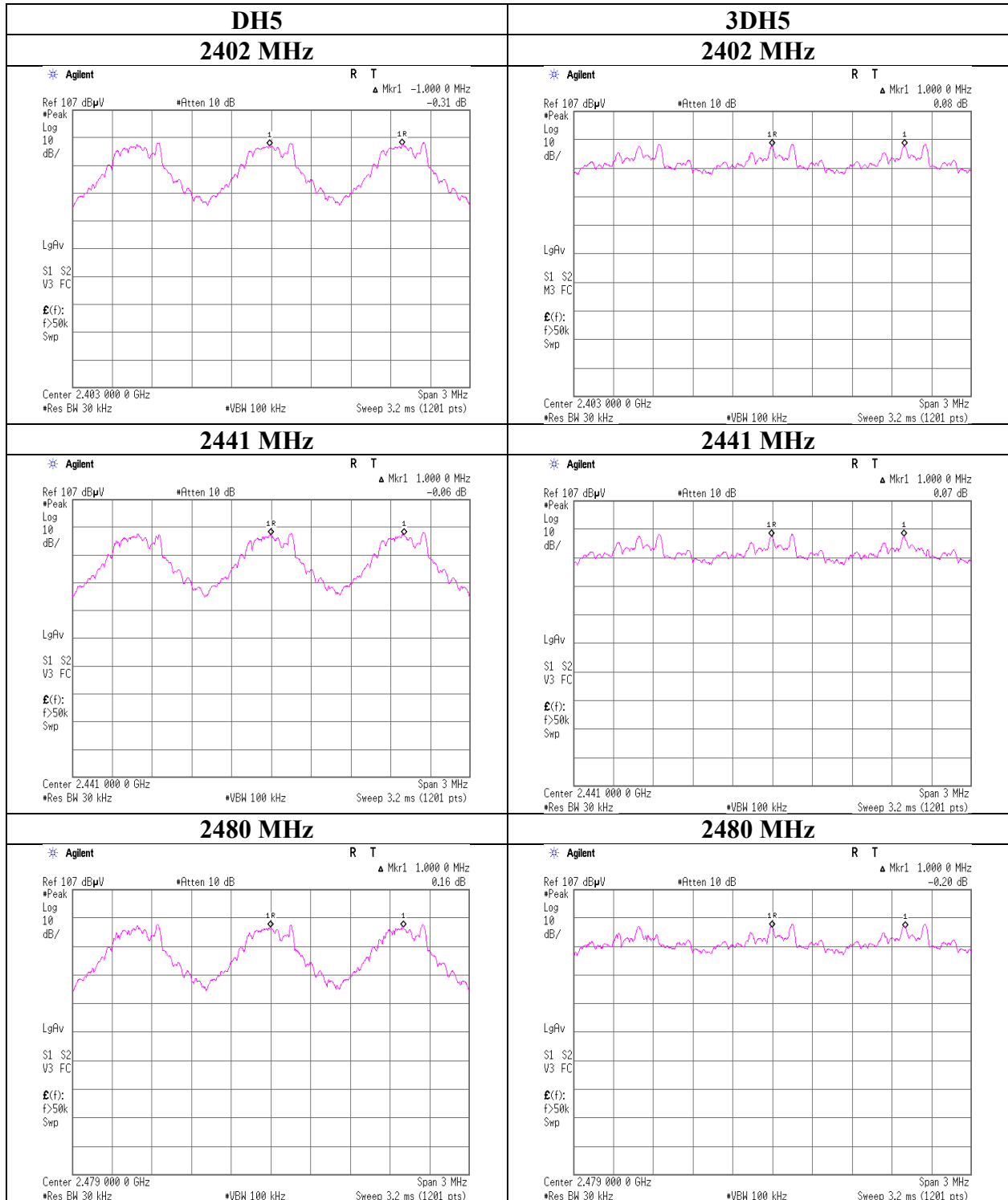
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Carrier Frequency Separation



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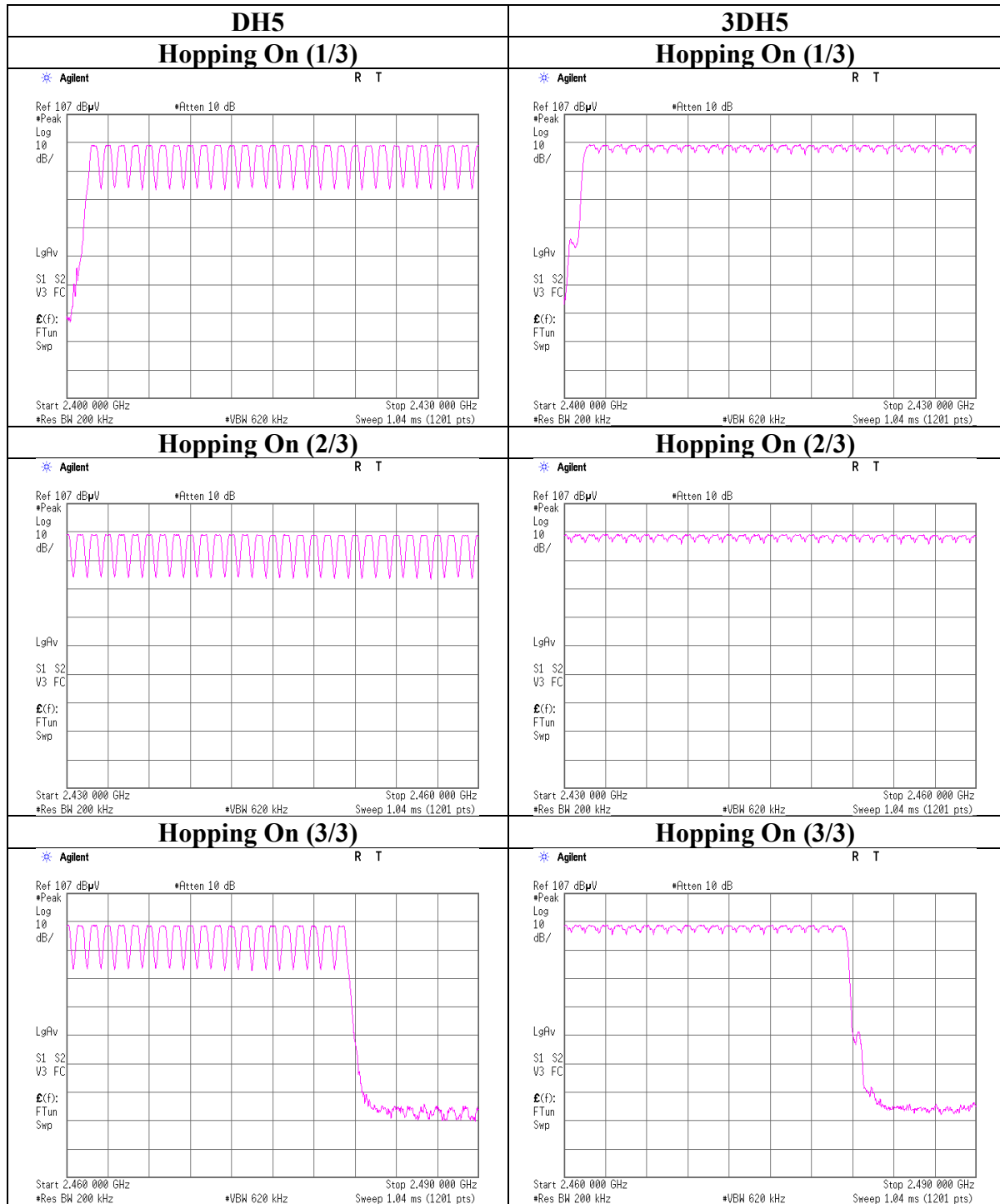
Number of Hopping Frequency

Report No. 12782612H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 10, 2019
Temperature / Humidity 26 deg. C / 32 % RH
Engineer Hiroyuki Furutaka
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. 12782612H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 10, 2019
Temperature / Humidity 26 deg. C / 32 % RH
Engineer Hiroyuki Furutaka
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]
	51.6 times / 5 sec.	x	31.6 sec. =			
DH1	51.6 times / 5 sec.	x	31.6 sec. = 327 times	0.449	147	400
DH3	26.2 times / 5 sec.	x	31.6 sec. = 166 times	1.713	284	400
DH5	19.0 times / 5 sec.	x	31.6 sec. = 121 times	2.960	358	400
3DH1	50.4 times / 5 sec.	x	31.6 sec. = 319 times	0.456	145	400
3DH3	27.0 times / 5 sec.	x	31.6 sec. = 171 times	1.718	294	400
3DH5	20.4 times / 5 sec.	x	31.6 sec. = 129 times	2.973	383	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

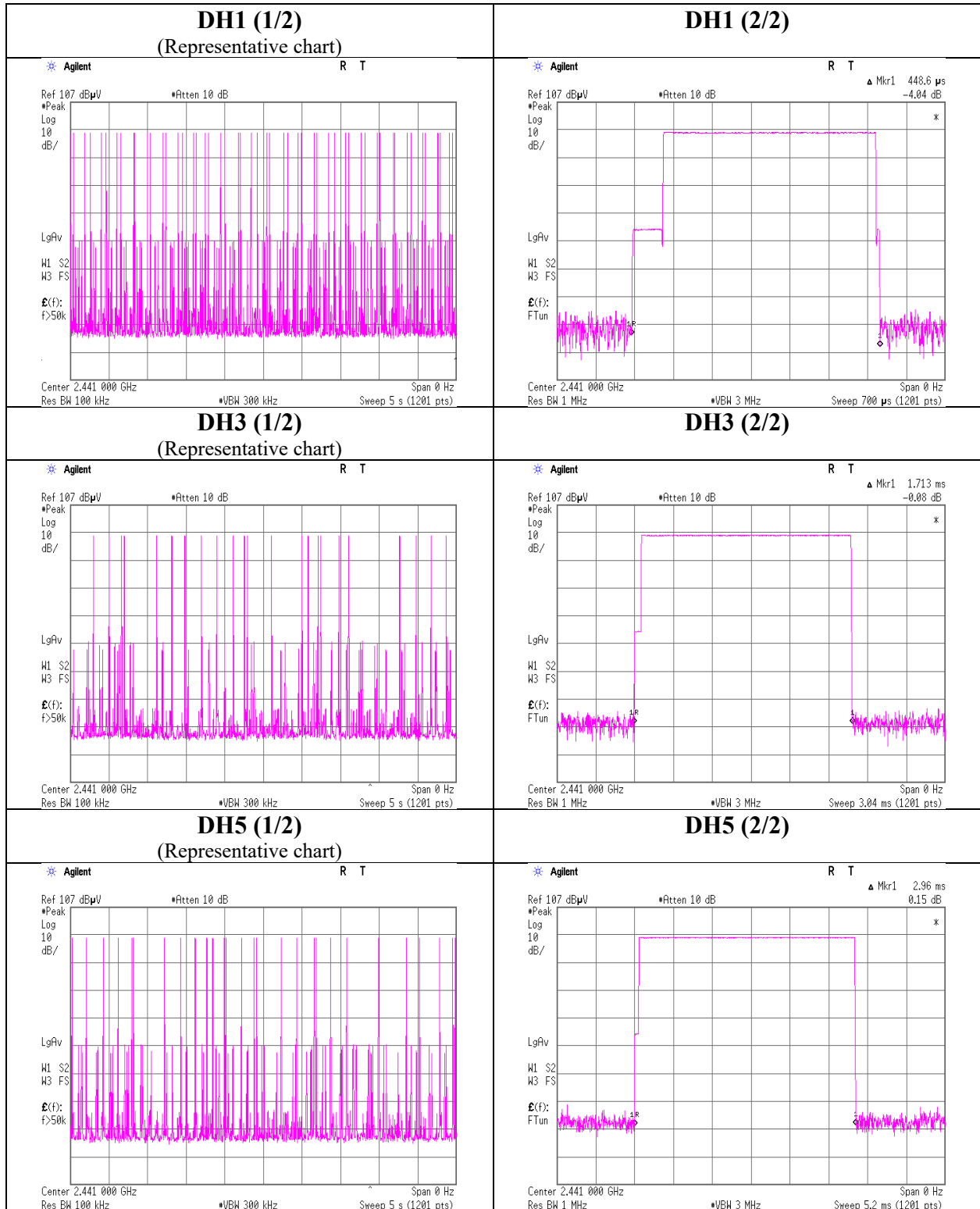
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	53	51	51	51	52	51.6
DH3	23	27	26	27	28	26.2
DH5	17	20	21	17	20	19.0
3DH1	51	50	51	51	49	50.4
3DH3	26	27	26	29	27	27.0
3DH5	25	18	23	17	19	20.4

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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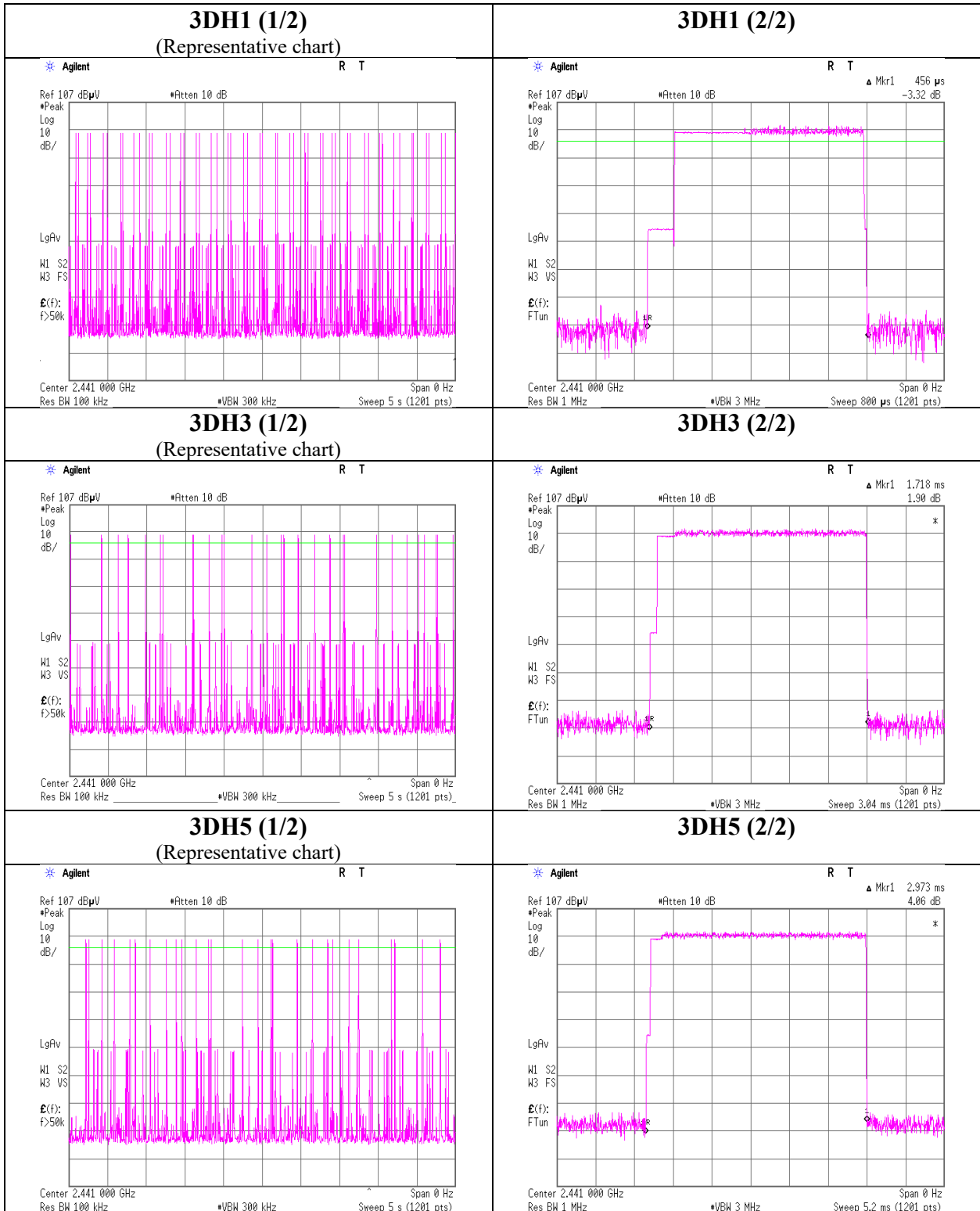
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Dwell time



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Maximum Peak Output Power

Report No. 12782612H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 9, 2019
Temperature / Humidity 25 deg. C / 33 % RH
Engineer Hiroyuki Furutaka
Mode Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
					Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
					[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-10.41	1.53	10.03	1.15	1.30	20.96	125	19.81	3.08	4.23	2.65	36.02	4000	31.79
DH5	2441.0	-10.53	1.54	10.04	1.05	1.27	20.96	125	19.91	3.08	4.13	2.59	36.02	4000	31.89
DH5	2480.0	-10.83	1.55	10.04	0.76	1.19	20.96	125	20.20	3.08	3.84	2.42	36.02	4000	32.18
2DH5	2402.0	-8.09	1.53	10.03	3.47	2.22	20.96	125	17.49	3.08	6.55	4.52	36.02	4000	29.47
2DH5	2441.0	-8.08	1.54	10.04	3.50	2.24	20.96	125	17.46	3.08	6.58	4.55	36.02	4000	29.44
2DH5	2480.0	-8.31	1.55	10.04	3.28	2.13	20.96	125	17.68	3.08	6.36	4.33	36.02	4000	29.66
3DH5	2402.0	-7.66	1.53	10.03	3.90	2.46	20.96	125	17.06	3.08	6.98	4.99	36.02	4000	29.04
3DH5	2441.0	-7.70	1.54	10.04	3.88	2.45	20.96	125	17.08	3.08	6.96	4.97	36.02	4000	29.06
3DH5	2480.0	-7.85	1.55	10.04	3.74	2.37	20.96	125	17.22	3.08	6.82	4.81	36.02	4000	29.20

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.

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Average Output Power
(Reference data for RF Exposure)

Report No. 12782612H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 9, 2019
Temperature / Humidity 25 deg. C / 33 % RH
Engineer Hiroyuki Furutaka
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	-12.22	1.53	10.03	-0.66	0.86	1.03	0.37	1.09
DH5	2441.0	-12.34	1.54	10.04	-0.76	0.84	1.03	0.27	1.06
DH5	2480.0	-12.72	1.55	10.04	-1.13	0.77	1.03	-0.10	0.98
2DH5	2402.0	-12.07	1.53	10.03	-0.51	0.89	1.03	0.52	1.13
2DH5	2441.0	-12.16	1.54	10.04	-0.58	0.87	1.03	0.45	1.11
2DH5	2480.0	-12.48	1.55	10.04	-0.89	0.81	1.03	0.14	1.03
3DH5	2402.0	-12.08	1.53	10.03	-0.52	0.89	1.03	0.51	1.12
3DH5	2441.0	-12.15	1.54	10.04	-0.57	0.88	1.03	0.46	1.11
3DH5	2480.0	-12.48	1.55	10.04	-0.89	0.81	1.03	0.14	1.03

Sample Calculation:

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

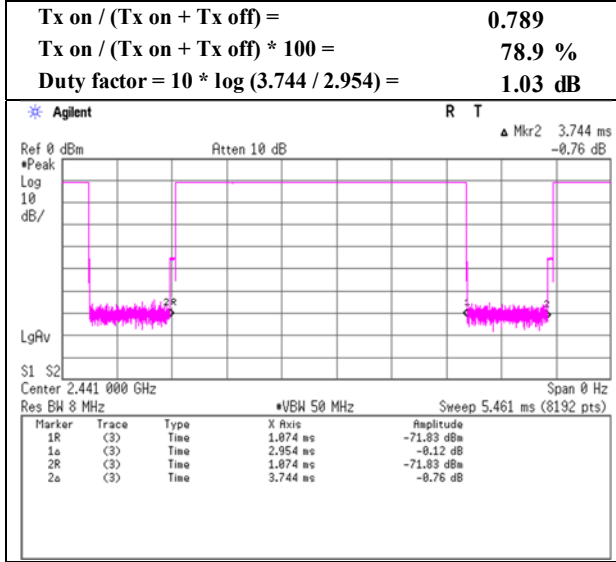
Result (Burst power average) = Time average + Duty factor

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

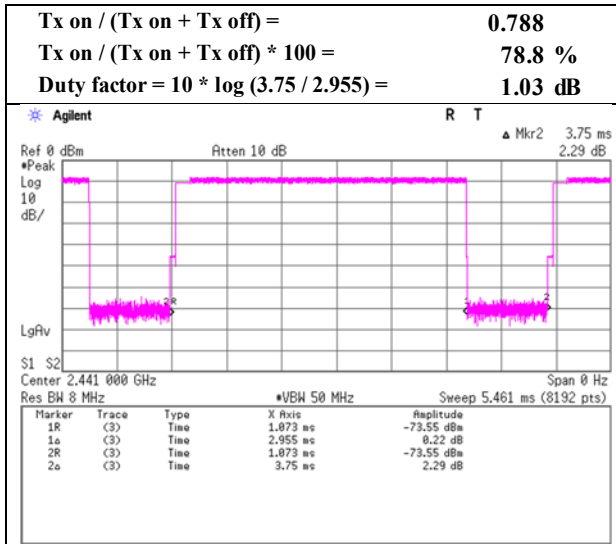
Burst Rate Confirmation

Report No. 12782612H
Test place Ise EMC Lab. No.6 Measurement Room
Date April 9, 2019
Temperature / Humidity 25 deg. C / 33 % RH
Engineer Hiroyuki Furutaka
Mode Tx, Hopping Off

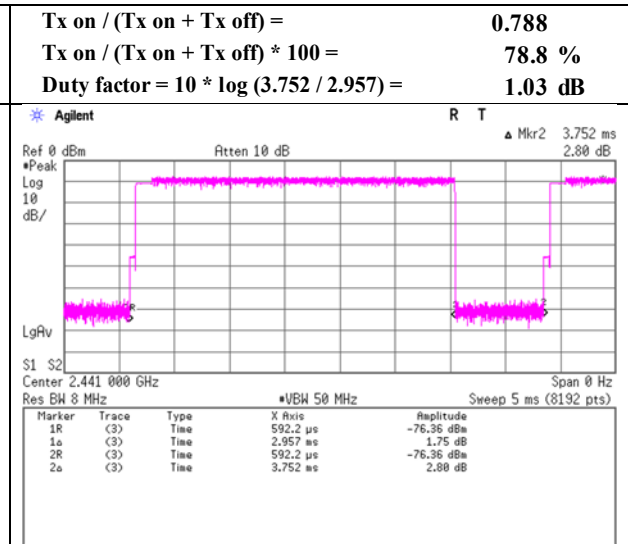
DH5



2DH5



3DH5



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Radiated Spurious Emission

Report No. 12782612H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2 No.2 No.2 No.2
Date April 11, 2019 April 12, 2019 April 14, 2019 April 14, 2019
Temperature / Humidity 21 deg. C / 32 % RH 20 deg. C / 35 % RH 21 deg. C / 32 % RH 21 deg. C / 32 % RH
Engineer Junki Nagatomi Junki Nagatomi Yuta Moriya Akihiko Maeda
(Below 1 GHz) (1 GHz - 10 GHz) (10 GHz - 18 GHz) (18 GHz - 26.5 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.	30.500	QP	25.2	18.4	6.7	30.5	-	19.7	40.0	20.3	
Hori.	73.876	QP	29.8	6.4	7.2	30.4	-	13.0	40.0	27.0	
Hori.	199.999	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Hori.	300.000	QP	23.7	13.5	8.8	29.2	-	16.9	46.0	29.1	
Hori.	614.392	QP	34.8	19.5	10.2	29.6	-	34.9	46.0	11.1	
Hori.	992.484	QP	23.8	22.4	11.6	27.5	-	30.3	53.9	23.6	
Hori.	2381.989	PK	47.5	27.6	5.2	34.3	-	46.0	73.9	27.9	
Hori.	2390.000	PK	44.1	27.7	5.2	34.3	-	42.7	73.9	31.2	
Hori.	4804.000	PK	46.2	31.2	7.3	33.5	-	51.3	73.9	22.6	
Hori.	7206.000	PK	42.2	35.5	8.4	33.4	-	52.7	73.9	21.2	Floor noise
Hori.	9608.000	PK	43.4	38.4	9.5	33.8	-	57.4	73.9	16.5	Floor noise
Hori.	2381.989	AV	39.4	27.6	5.2	34.3	1.0	39.0	53.9	14.9	*1)
Hori.	2390.000	AV	33.6	27.7	5.2	34.3	1.0	33.3	53.9	20.7	*1)
Hori.	4804.000	AV	37.6	31.2	7.3	33.5	1.0	43.7	53.9	10.2	
Hori.	7206.000	AV	32.0	35.5	8.4	33.4	-	42.5	53.9	11.4	Floor noise
Hori.	9608.000	AV	32.8	38.4	9.5	33.8	-	46.8	53.9	7.1	Floor noise
Vert.	30.500	QP	25.4	18.4	6.7	30.5	-	19.9	40.0	20.1	
Vert.	73.876	QP	30.1	6.3	7.9	32.2	-	12.1	40.0	27.9	
Vert.	199.999	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Vert.	300.000	QP	23.7	13.5	8.8	29.2	-	16.9	46.0	29.1	
Vert.	614.392	QP	31.1	19.5	10.2	29.6	-	31.2	46.0	14.8	
Vert.	992.484	QP	28.1	22.4	11.6	27.5	-	34.6	53.9	19.3	
Vert.	2381.989	PK	47.7	27.6	5.2	34.3	-	46.3	73.9	27.6	
Vert.	2390.000	PK	44.4	27.7	5.2	34.3	-	43.0	73.9	30.9	
Vert.	4804.000	PK	41.9	31.2	7.3	33.5	-	47.0	73.9	26.9	Floor noise
Vert.	7206.000	PK	42.3	35.5	8.4	33.4	-	52.8	73.9	21.1	Floor noise
Vert.	9608.000	PK	43.2	38.4	9.5	33.8	-	57.2	73.9	16.7	Floor noise
Vert.	2381.989	AV	40.8	27.6	5.2	34.3	1.0	40.4	53.9	13.5	*1)
Vert.	2390.000	AV	35.7	27.7	5.2	34.3	1.0	35.4	53.9	18.6	*1)
Vert.	4804.000	AV	31.8	31.2	7.3	33.5	-	36.9	53.9	17.0	Floor noise
Vert.	7206.000	AV	31.9	35.5	8.4	33.4	-	42.4	53.9	11.5	Floor noise
Vert.	9608.000	AV	32.5	38.4	9.5	33.8	-	46.5	53.9	7.4	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB

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

*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	99.7	27.7	5.2	34.3	98.4	-	-	Carrier
Hori.	2400.000	PK	39.7	27.8	5.2	34.3	38.4	78.4	40.0	
Vert.	2402.000	PK	99.7	27.7	5.2	34.3	98.4	-	-	Carrier
Vert.	2400.000	PK	40.5	27.8	5.2	34.3	39.2	78.4	39.2	

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB

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

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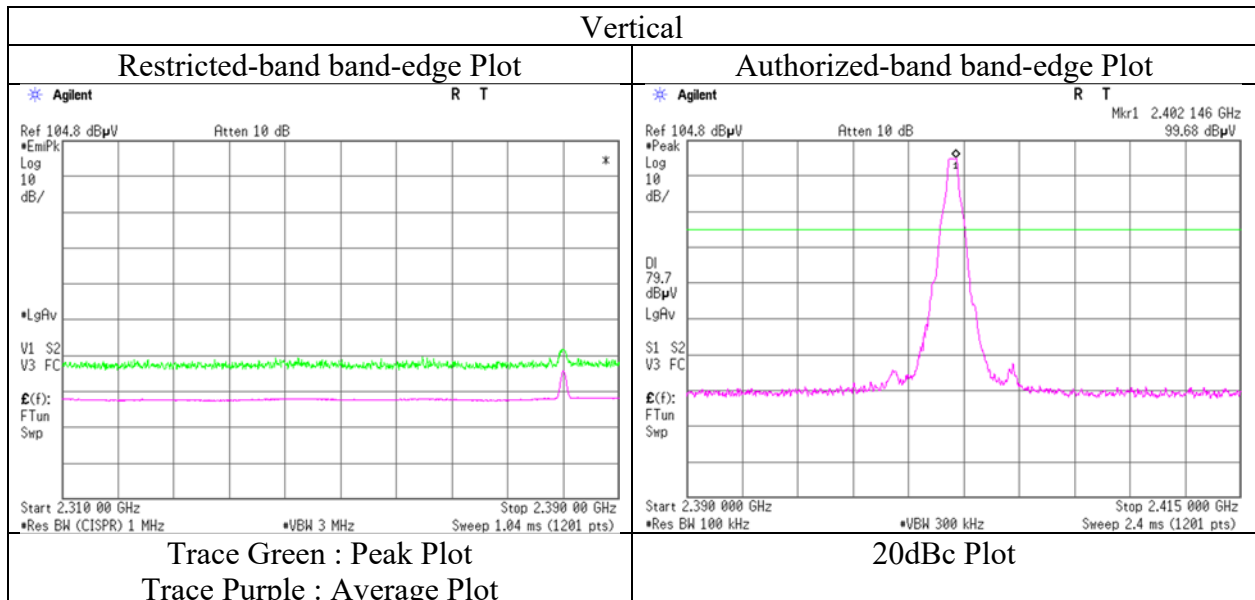
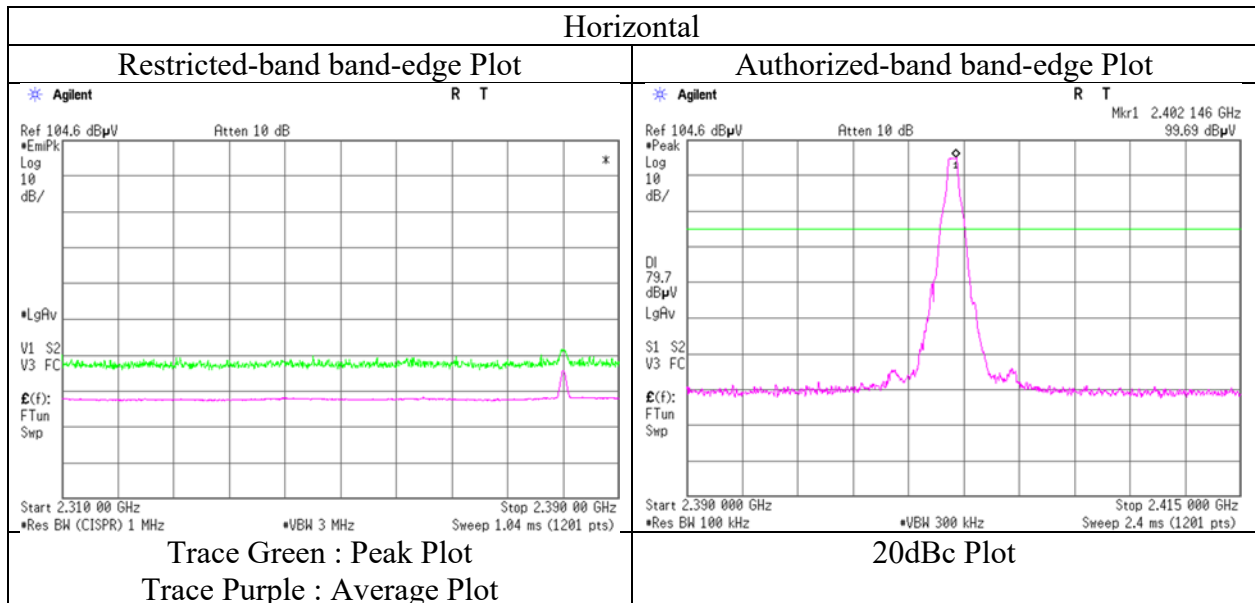
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12782612H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 12, 2019
Temperature / Humidity	20 deg. C / 35 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

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Radiated Spurious Emission

Report No. 12782612H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2 No.2 No.2 No.2
Date April 11, 2019 April 12, 2019 April 14, 2019 April 14, 2019
Temperature / Humidity 21 deg. C / 32 % RH 20 deg. C / 35 % RH 21 deg. C / 32 % RH 21 deg. C / 32 % RH
Engineer Junki Nagatomi Junki Nagatomi Yuta Moriya Akihiko Maeda
(Below 1 GHz) (1 GHz - 10 GHz) (10 GHz - 18 GHz) (18 GHz - 26.5 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.	30.500	QP	25.1	18.4	6.7	30.5	-	19.6	40.0	20.4	
Hori.	73.876	QP	29.6	6.3	7.9	32.2	-	11.6	40.0	28.4	
Hori.	199.990	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Hori.	300.000	QP	23.8	13.5	8.8	29.2	-	17.0	46.0	29.0	
Hori.	614.392	QP	34.9	19.5	10.2	29.6	-	35.0	46.0	11.0	
Hori.	992.484	QP	23.8	22.4	11.6	27.5	-	30.3	53.9	23.6	
Hori.	4882.000	PK	44.9	31.5	7.4	33.5	-	50.2	73.9	23.7	
Hori.	7323.000	PK	42.4	35.9	8.5	33.5	-	53.3	73.9	20.6	Floor noise
Hori.	9764.000	PK	43.5	38.6	9.6	33.8	-	57.9	73.9	16.0	Floor noise
Hori.	4882.000	AV	37.5	31.5	7.4	33.5	1.0	43.9	53.9	10.0	
Hori.	7323.000	AV	33.1	35.9	8.5	33.5	-	44.1	53.9	9.9	Floor noise
Hori.	9764.000	AV	33.3	38.6	9.6	33.8	-	47.7	53.9	6.2	Floor noise
Vert.	30.500	QP	25.3	18.4	6.7	30.5	-	19.8	40.0	20.2	
Vert.	73.876	QP	30.5	6.3	7.9	32.2	-	12.5	40.0	27.5	
Vert.	199.990	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Vert.	300.000	QP	23.7	13.5	8.8	29.2	-	16.9	46.0	29.1	
Vert.	614.392	QP	31.0	19.5	10.2	29.6	-	31.1	46.0	14.9	
Vert.	992.484	QP	27.8	22.4	11.6	27.5	-	34.3	53.9	19.6	
Vert.	4882.000	PK	42.1	31.5	7.4	33.5	-	47.5	73.9	26.5	Floor noise
Vert.	7323.000	PK	42.4	35.9	8.5	33.5	-	53.3	73.9	20.6	Floor noise
Vert.	9764.000	PK	43.5	38.6	9.6	33.8	-	57.9	73.9	16.0	Floor noise
Vert.	4882.000	AV	33.1	31.5	7.4	33.5	-	38.4	53.9	15.5	Floor noise
Vert.	7323.000	AV	33.2	35.9	8.5	33.5	-	44.1	53.9	9.8	Floor noise
Vert.	9764.000	AV	33.3	38.6	9.6	33.8	-	47.7	53.9	6.2	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No. 12782612H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2 No.2 No.2 No.2
Date April 11, 2019 April 12, 2019 April 14, 2019 April 14, 2019
Temperature / Humidity 21 deg. C / 32 % RH 20 deg. C / 35 % RH 21 deg. C / 32 % RH 21 deg. C / 32 % RH
Engineer Junki Nagatomi Junki Nagatomi Yuta Moriya Akihiko Maeda
(Below 1 GHz) (1 GHz - 10 GHz) (10 GHz - 18 GHz) (18 GHz - 26.5 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.	30.500	QP	25.2	18.4	6.7	30.5	-	19.7	40.0	20.3	
Hori.	73.876	QP	28.5	6.4	7.2	30.4	-	11.7	40.0	28.3	
Hori.	199.999	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Hori.	300.000	QP	23.6	13.5	8.8	29.2	-	16.8	46.0	29.2	
Hori.	614.392	QP	34.9	19.5	10.2	29.6	-	35.0	46.0	11.0	
Hori.	992.484	QP	23.7	22.4	11.6	27.5	-	30.2	53.9	23.7	
Hori.	2483.500	PK	46.3	27.5	5.2	34.2	-	44.9	73.9	29.1	
Hori.	4960.000	PK	42.5	31.7	7.4	33.5	-	48.1	73.9	25.8	
Hori.	7440.000	PK	42.8	36.1	8.5	33.5	-	53.9	73.9	20.0	Floor noise
Hori.	9920.000	PK	43.3	38.5	9.6	33.8	-	57.6	73.9	16.3	Floor noise
Hori.	2483.500	AV	37.1	27.5	5.2	34.2	1.0	36.6	53.9	17.3	*1)
Hori.	4960.000	AV	35.2	31.7	7.4	33.5	1.0	41.9	53.9	12.1	
Hori.	7440.000	AV	33.0	36.1	8.5	33.5	-	44.1	53.9	9.8	Floor noise
Hori.	9920.000	AV	33.2	38.5	9.6	33.8	-	47.5	53.9	6.4	Floor noise
Vert.	30.500	QP	25.0	18.4	6.7	30.5	-	19.5	40.0	20.5	
Vert.	73.876	QP	28.2	6.4	7.2	30.4	-	11.4	40.0	28.6	
Vert.	199.999	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Vert.	300.000	QP	23.7	13.5	8.8	29.2	-	16.9	46.0	29.1	
Vert.	614.392	QP	31.0	19.5	10.2	29.6	-	31.1	46.0	14.9	
Vert.	992.484	QP	28.2	22.4	11.6	27.5	-	34.7	53.9	19.2	
Vert.	2483.500	PK	45.4	27.5	5.2	34.2	-	43.9	73.9	30.0	
Vert.	4960.000	PK	41.3	31.7	7.4	33.5	-	46.9	73.9	27.1	Floor noise
Vert.	7440.000	PK	41.3	36.1	8.5	33.5	-	52.4	73.9	21.5	Floor noise
Vert.	9920.000	PK	43.2	38.5	9.6	33.8	-	57.6	73.9	16.4	Floor noise
Vert.	2483.500	AV	34.1	27.5	5.2	34.2	1.0	33.7	53.9	20.2	*1)
Vert.	4960.000	AV	31.4	31.7	7.4	33.5	-	37.0	53.9	16.9	Floor noise
Vert.	7440.000	AV	32.8	36.1	8.5	33.5	-	43.9	53.9	10.0	Floor noise
Vert.	9920.000	AV	33.0	38.5	9.6	33.8	-	47.3	53.9	6.6	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

*1) Not Out of Band emission(Leakage Power)

UL Japan, Inc.

Ise EMC Lab.

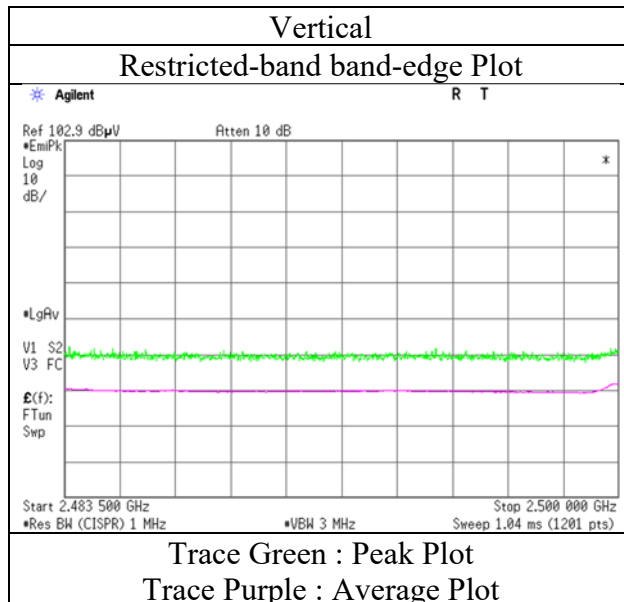
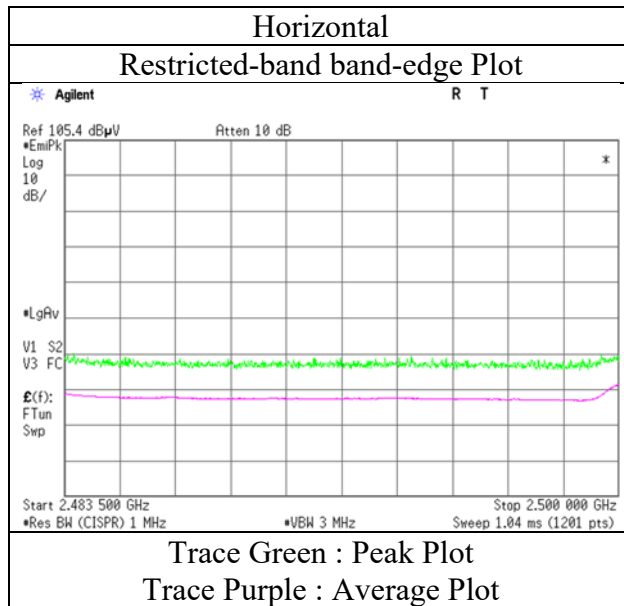
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12782612H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 12, 2019
Temperature / Humidity	20 deg. C / 35 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

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.	12782612H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	April 11, 2019	April 14, 2019	April 14, 2019
Temperature / Humidity	21 deg. C / 32 % RH	21 deg. C / 32 % RH	21 deg. C / 32 % RH
Engineer	Junki Nagatomi	Yuta Moriya	Akihiko Maeda
	(Below 1 GHz)	(1 GHz - 18 GHz)	(18 GHz - 26.5 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.	30.500	QP	25.2	18.4	6.7	30.5	-	19.7	40.0	20.3	
Hori.	73.876	QP	29.8	6.4	7.2	30.4	-	13.0	40.0	27.0	
Hori.	199.999	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Hori.	300.000	QP	23.7	13.5	8.8	29.2	-	16.9	46.0	29.1	
Hori.	614.392	QP	34.8	19.5	10.2	29.6	-	34.9	46.0	11.1	
Hori.	992.484	QP	23.8	22.4	11.6	27.5	-	30.3	53.9	23.6	
Hori.	2381.989	PK	47.5	27.6	5.2	34.3	-	46.0	73.9	27.9	
Hori.	2390.000	PK	44.1	27.7	5.2	34.3	-	42.7	73.9	31.2	
Hori.	4804.000	PK	46.2	31.2	7.3	33.5	-	51.3	73.9	22.6	
Hori.	7206.000	PK	42.2	35.5	8.4	33.4	-	52.7	73.9	21.2	Floor noise
Hori.	9608.000	PK	43.4	38.4	9.5	33.8	-	57.4	73.9	16.5	Floor noise
Hori.	2381.989	AV	39.4	27.6	5.2	34.3	1.0	39.0	53.9	14.9	*1)
Hori.	2390.000	AV	33.6	27.7	5.2	34.3	1.0	33.3	53.9	20.7	*1)
Hori.	4804.000	AV	37.6	31.2	7.3	33.5	1.0	43.7	53.9	10.2	
Hori.	7206.000	AV	32.0	35.5	8.4	33.4	-	42.5	53.9	11.4	Floor noise
Hori.	9608.000	AV	32.8	38.4	9.5	33.8	-	46.8	53.9	7.1	Floor noise
Vert.	30.500	QP	25.4	18.4	6.7	30.5	-	19.9	40.0	20.1	
Vert.	73.876	QP	30.1	6.3	7.9	32.2	-	12.1	40.0	27.9	
Vert.	199.999	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Vert.	300.000	QP	23.7	13.5	8.8	29.2	-	16.9	46.0	29.1	
Vert.	614.392	QP	31.1	19.5	10.2	29.6	-	31.2	46.0	14.8	
Vert.	992.484	QP	28.1	22.4	11.6	27.5	-	34.6	53.9	19.3	
Vert.	2381.989	PK	47.7	27.6	5.2	34.3	-	46.3	73.9	27.6	
Vert.	2390.000	PK	44.4	27.7	5.2	34.3	-	43.0	73.9	30.9	
Vert.	4804.000	PK	41.9	31.2	7.3	33.5	-	47.0	73.9	26.9	Floor noise
Vert.	7206.000	PK	42.3	35.5	8.4	33.4	-	52.8	73.9	21.1	Floor noise
Vert.	9608.000	PK	43.2	38.4	9.5	33.8	-	57.2	73.9	16.7	Floor noise
Vert.	2381.989	AV	40.8	27.6	5.2	34.3	1.0	40.4	53.9	13.5	*1)
Vert.	2390.000	AV	35.7	27.7	5.2	34.3	1.0	35.4	53.9	18.6	*1)
Vert.	4804.000	AV	31.8	31.2	7.3	33.5	-	36.9	53.9	17.0	Floor noise
Vert.	7206.000	AV	31.9	35.5	8.4	33.4	-	42.4	53.9	11.5	Floor noise
Vert.	9608.000	AV	32.5	38.4	9.5	33.8	-	46.5	53.9	7.4	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	100.2	27.7	5.2	34.3	98.9	-	-	Carrier
Hori.	2400.000	PK	42.0	27.8	5.2	34.3	40.7	78.9	38.2	
Vert.	2402.000	PK	99.3	27.7	5.2	34.3	98.0	-	-	Carrier
Vert.	2400.000	PK	40.8	27.8	5.2	34.3	39.5	78.0	38.5	

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

Distance factor: 1 GHz - 10 GHz $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$
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.

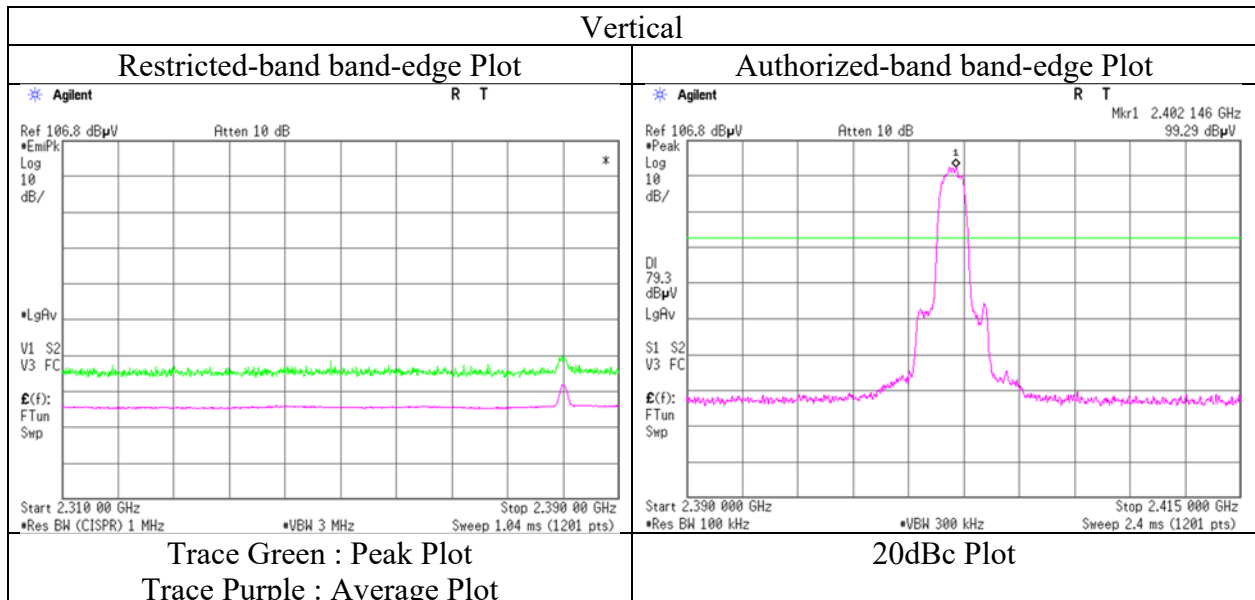
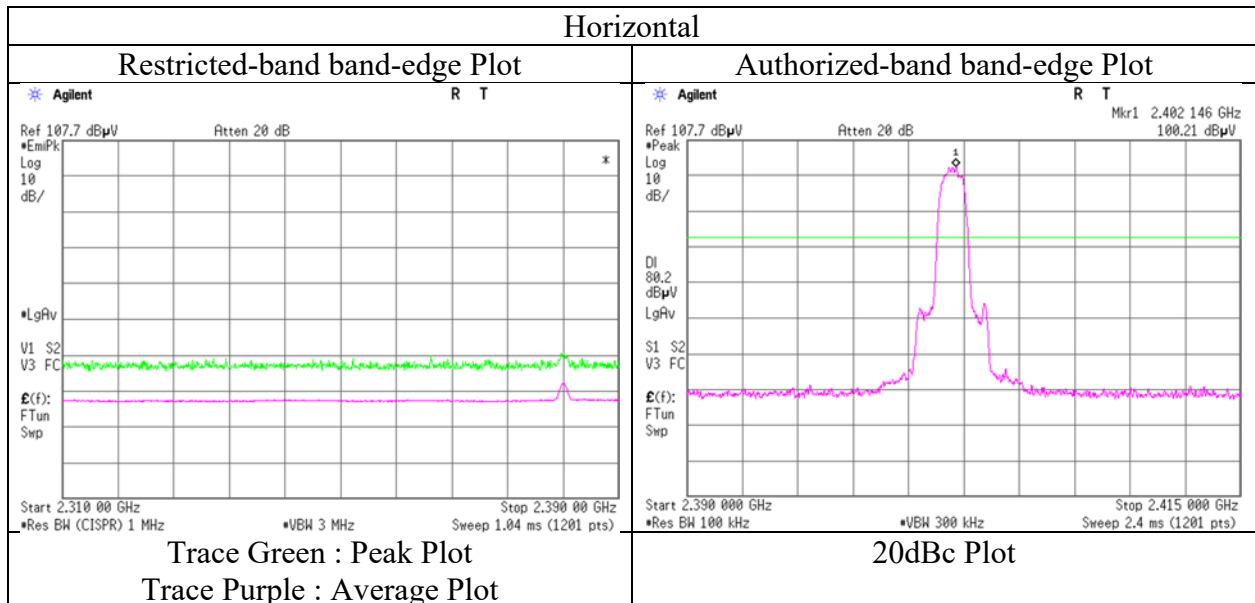
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12782612H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 14, 2019
Temperature / Humidity	21 deg. C / 32 % RH
Engineer	Yuta Moriya
	(1 GHz - 18 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

UL Japan, Inc.

Ise EMC Lab.

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

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Facsimile : +81 596 24 8124

Radiated Spurious Emission

Report No.	12782612H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	April 11, 2019	April 14, 2019	April 14, 2019
Temperature / Humidity	21 deg. C / 32 % RH	21 deg. C / 32 % RH	21 deg. C / 32 % RH
Engineer	Junki Nagatomi	Yuta Moriya	Akihiko Maeda
	(Below 1 GHz)	(1 GHz - 18 GHz)	(18 GHz - 26.5 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.	30.500	QP	25.1	18.4	6.7	30.5	-	19.6	40.0	20.4	
Hori.	73.876	QP	27.9	6.4	7.2	30.4	-	11.1	40.0	28.9	
Hori.	199.999	QP	24.0	16.8	8.2	29.6	-	19.3	43.5	24.2	
Hori.	300.000	QP	23.6	13.5	8.8	29.2	-	16.8	46.0	29.2	
Hori.	614.392	QP	35.2	19.5	10.2	29.6	-	35.3	46.0	10.7	
Hori.	992.484	QP	23.8	22.4	11.6	27.5	-	30.3	53.9	23.6	
Hori.	4882.000	PK	44.5	31.5	7.4	33.5	-	49.8	73.9	24.1	
Hori.	7323.000	PK	42.9	35.9	8.5	33.5	-	53.8	73.9	20.1	Floor noise
Hori.	9764.000	PK	43.0	38.6	9.6	33.8	-	57.4	73.9	16.5	Floor noise
Hori.	4882.000	AV	37.1	31.5	7.4	33.5	1.0	43.4	53.9	10.5	
Hori.	7323.000	AV	32.3	35.9	8.5	33.5	-	43.2	53.9	10.7	Floor noise
Hori.	9764.000	AV	32.6	38.6	9.6	33.8	-	47.0	53.9	6.9	Floor noise
Vert.	30.500	QP	25.1	18.4	6.7	30.5	-	19.6	40.0	20.4	
Vert.	73.876	QP	28.3	6.4	7.2	30.4	-	11.5	40.0	28.5	
Vert.	199.999	QP	23.9	16.8	8.2	29.6	-	19.2	43.5	24.3	
Vert.	300.000	QP	23.6	13.5	8.8	29.2	-	16.8	46.0	29.2	
Vert.	614.392	QP	31.8	19.5	10.2	29.6	-	31.9	46.0	14.1	
Vert.	992.484	QP	28.3	22.4	11.6	27.5	-	34.8	53.9	19.1	
Vert.	4882.000	PK	42.1	31.5	7.4	33.5	-	47.4	73.9	26.5	Floor noise
Vert.	7323.000	PK	42.9	35.9	8.5	33.5	-	53.8	73.9	20.1	Floor noise
Vert.	9764.000	PK	43.0	38.6	9.6	33.8	-	57.3	73.9	16.6	Floor noise
Vert.	4882.000	AV	31.1	31.5	7.4	33.5	-	36.4	53.9	17.5	Floor noise
Vert.	7323.000	AV	32.0	35.9	8.5	33.5	-	42.9	53.9	11.0	Floor noise
Vert.	9764.000	AV	32.7	38.6	9.6	33.8	-	47.0	53.9	6.9	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log(3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log(1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	12782612H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	April 11, 2019	April 14, 2019	April 14, 2019
Temperature / Humidity	21 deg. C / 32 % RH	21 deg. C / 32 % RH	21 deg. C / 32 % RH
Engineer	Junki Nagatomi	Yuta Moriya	Akihiko Maeda
	(Below 1 GHz)	(1 GHz - 18 GHz)	(18 GHz - 26.5 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.	30.500	QP	25.1	18.4	6.7	30.5	-	19.6	40.0	20.4	
Hori.	73.876	QP	28.4	6.4	7.2	30.4	-	11.6	40.0	28.4	
Hori.	199.999	QP	24.0	16.8	8.2	29.6	-	19.3	43.5	24.2	
Hori.	300.000	QP	23.7	13.5	8.8	29.2	-	16.9	46.0	29.1	
Hori.	614.392	QP	35.2	19.5	10.2	29.6	-	35.3	46.0	10.7	
Hori.	992.484	QP	23.6	22.4	11.6	27.5	-	30.1	53.9	23.8	
Hori.	2483.500	PK	46.4	27.5	5.2	34.2	-	44.9	73.9	29.0	
Hori.	4960.000	PK	43.4	31.7	7.4	33.5	-	49.0	73.9	24.9	
Hori.	7440.000	PK	42.0	36.1	8.5	33.5	-	53.1	73.9	20.8	Floor noise
Hori.	9920.000	PK	42.4	38.5	9.6	33.8	-	56.7	73.9	17.2	Floor noise
Hori.	2483.500	AV	35.2	27.5	5.2	34.2	1.0	34.7	53.9	19.2	*1)
Hori.	4960.000	AV	34.1	31.7	7.4	33.5	1.0	40.8	53.9	13.1	
Hori.	7440.000	AV	31.8	36.1	8.5	33.5	-	42.9	53.9	11.0	Floor noise
Hori.	9920.000	AV	32.9	38.5	9.6	33.8	-	47.2	53.9	6.7	Floor noise
Vert.	30.500	QP	24.9	18.4	6.7	30.5	-	19.4	40.0	20.6	
Vert.	73.876	QP	28.3	6.4	7.2	30.4	-	11.5	40.0	28.5	
Vert.	199.999	QP	24.0	16.8	8.2	29.6	-	19.3	43.5	24.2	
Vert.	300.000	QP	23.8	13.5	8.8	29.2	-	17.0	46.0	29.0	
Vert.	614.392	QP	31.9	19.5	10.2	29.6	-	32.0	46.0	14.0	
Vert.	992.484	QP	28.1	22.4	11.6	27.5	-	34.6	53.9	19.3	
Vert.	2483.500	PK	44.7	27.5	5.2	34.2	-	43.3	73.9	30.7	
Vert.	4960.000	PK	42.0	31.7	7.4	33.5	-	47.6	73.9	26.3	Floor noise
Vert.	7440.000	PK	42.1	36.1	8.5	33.5	-	53.2	73.9	20.7	Floor noise
Vert.	9920.000	PK	43.0	38.5	9.6	33.8	-	57.3	73.9	16.6	Floor noise
Vert.	2483.500	AV	36.2	27.5	5.2	34.2	1.0	35.8	53.9	18.2	*1)
Vert.	4960.000	AV	31.7	31.7	7.4	33.5	-	37.3	53.9	16.6	Floor noise
Vert.	7440.000	AV	31.8	36.1	8.5	33.5	-	43.0	53.9	11.0	Floor noise
Vert.	9920.000	AV	33.0	38.5	9.6	33.8	-	47.3	53.9	6.6	Floor noise

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

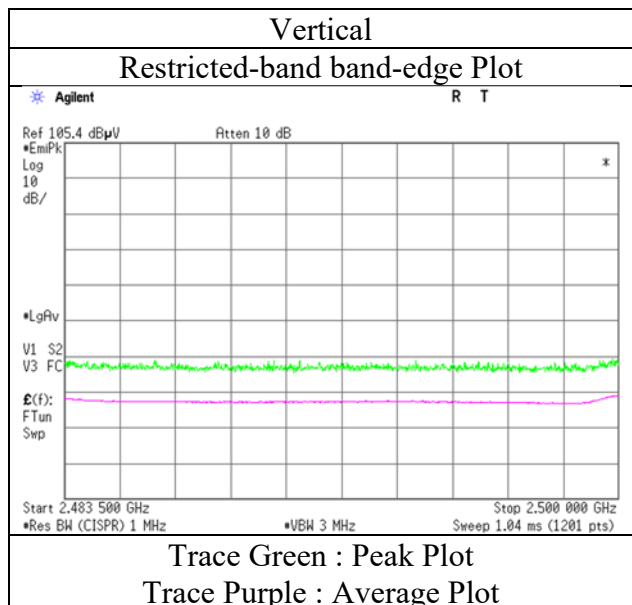
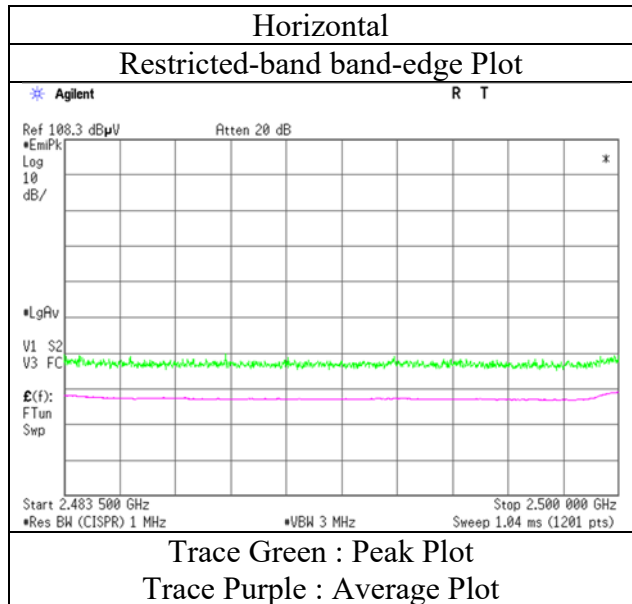
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

*1) Not Out of Band emission(Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

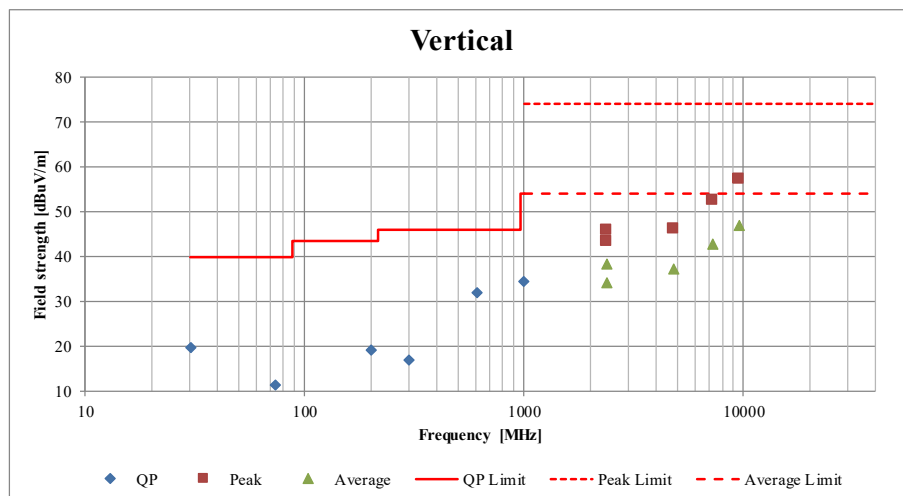
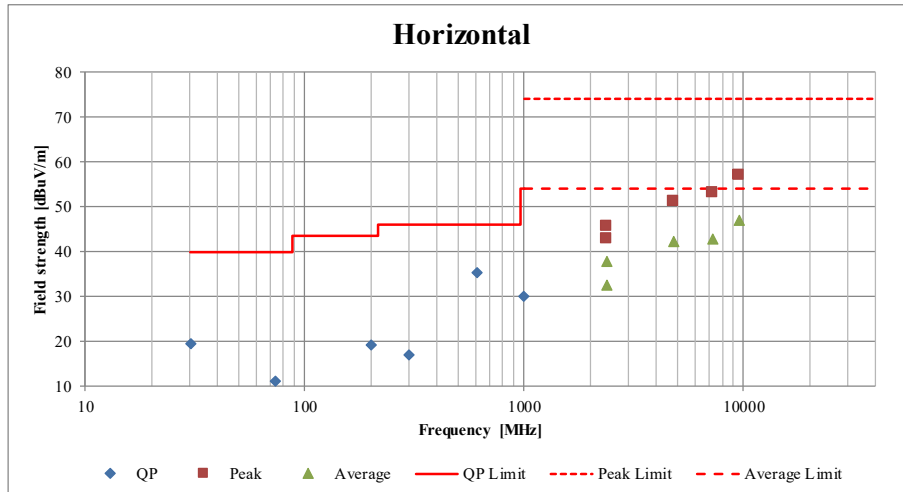
Report No. 12782612H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date April 14, 2019
Temperature / Humidity 21 deg. C / 32 % RH
Engineer Yuta Moriya
(1 GHz - 18 GHz)
Mode Tx, Hopping Off, 3DH5 2480 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	12782612H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	April 11, 2019	April 14, 2019	April 14, 2019
Temperature / Humidity	21 deg. C / 32 % RH	21 deg. C / 32 % RH	21 deg. C / 32 % RH
Engineer	Junki Nagatomi (Below 1 GHz)	Yuta Moriya (1 GHz - 18 GHz)	Akihiko Maeda (18 GHz - 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		

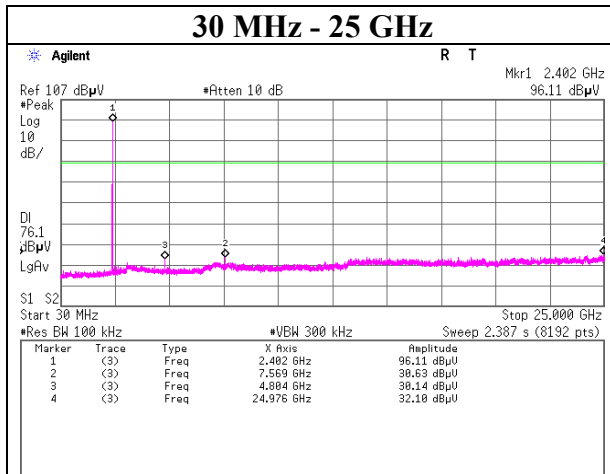
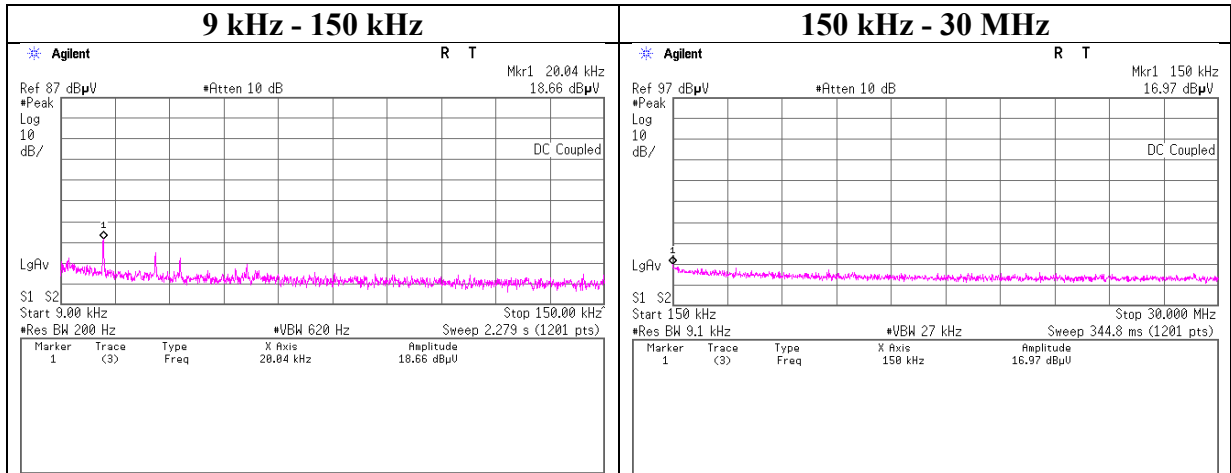


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx, Hopping Off, DH5

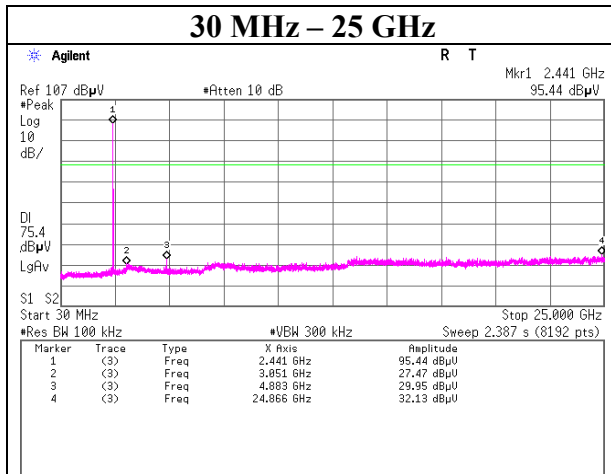
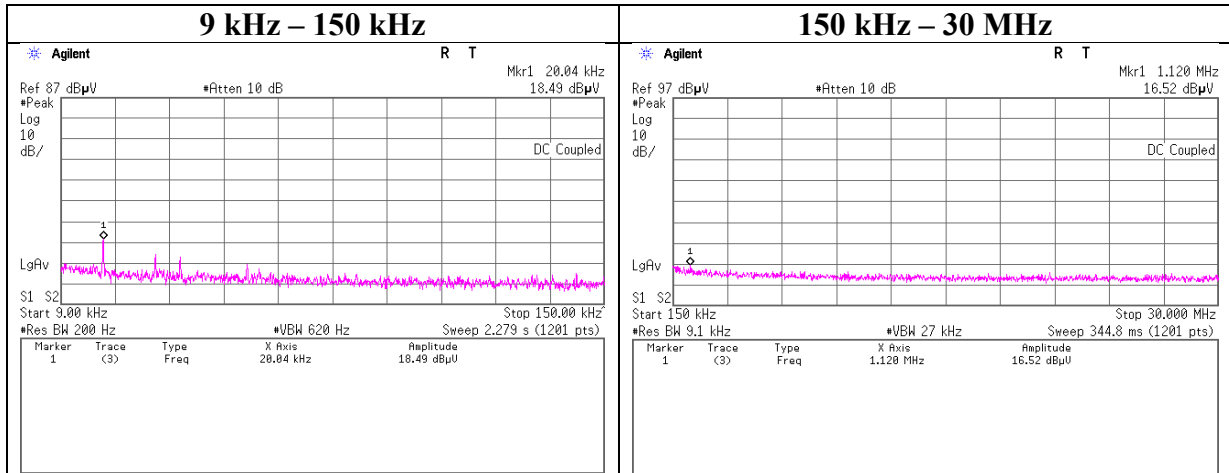
2402 MHz



Conducted Spurious Emission

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx, Hopping Off, DH5

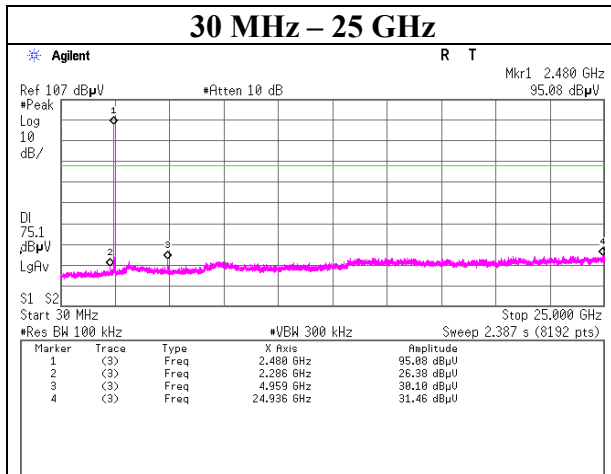
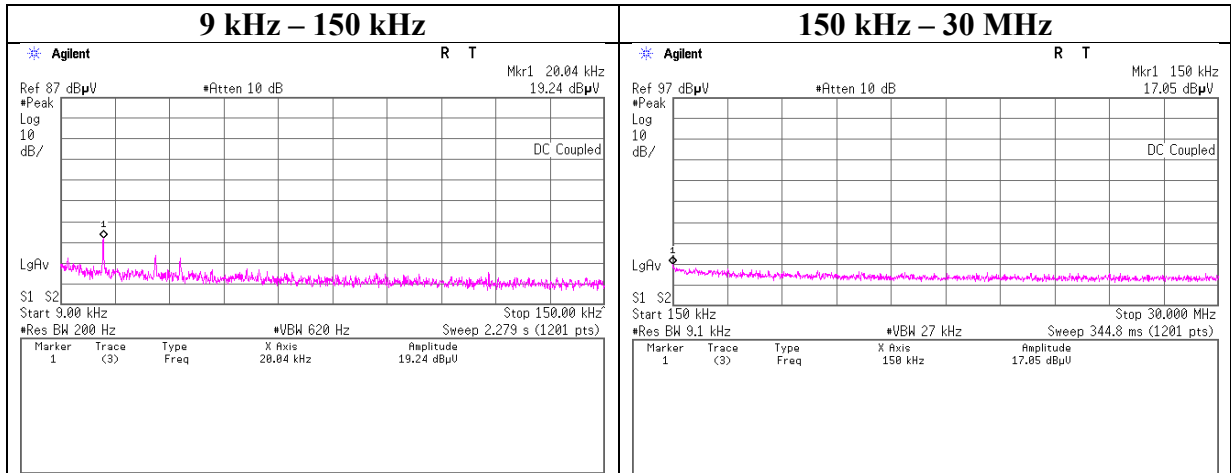
2441 MHz



Conducted Spurious Emission

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx, Hopping Off, DH5

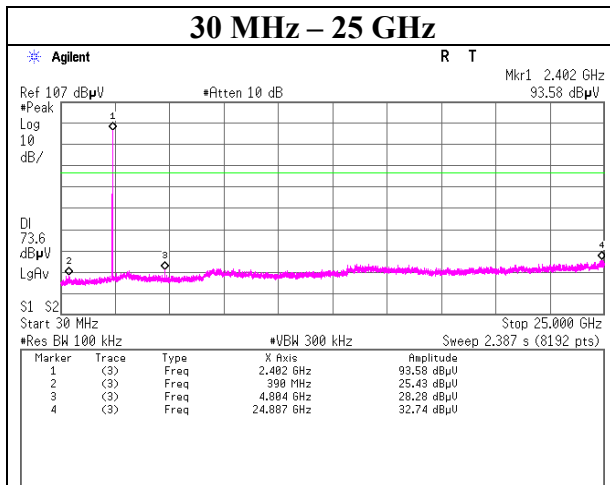
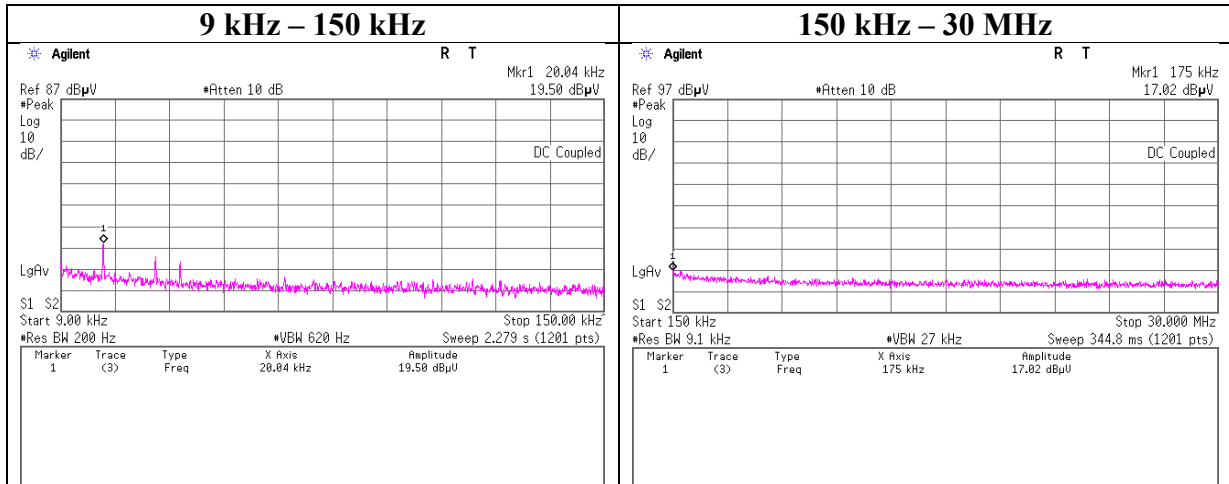
2480 MHz



Conducted Spurious Emission

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx, Hopping Off, 3DH5

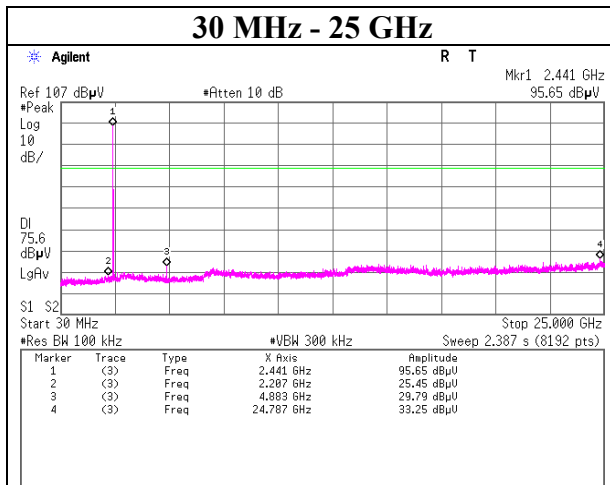
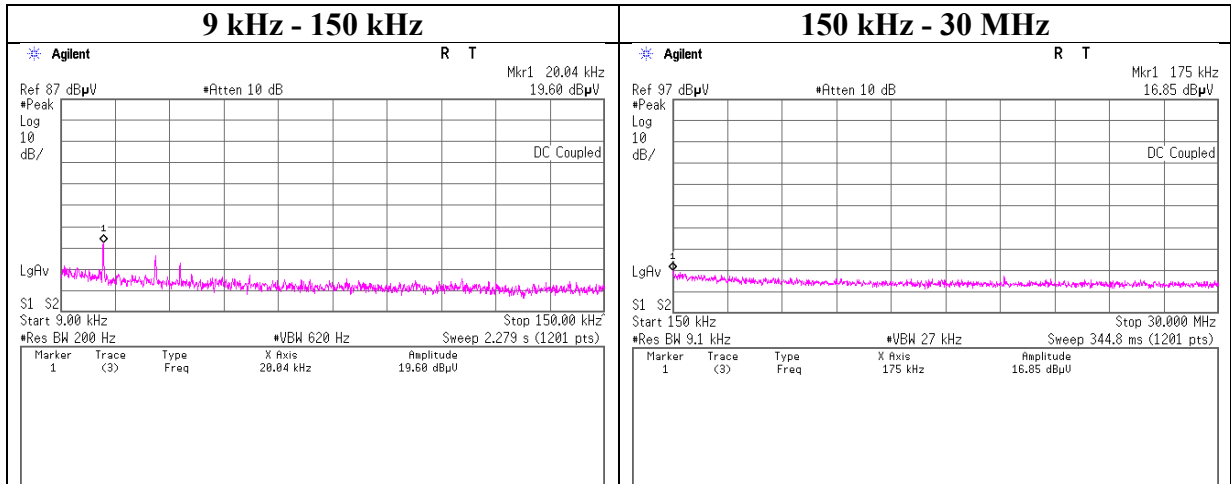
2402 MHz



Conducted Spurious Emission

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx, Hopping Off, 3DH5

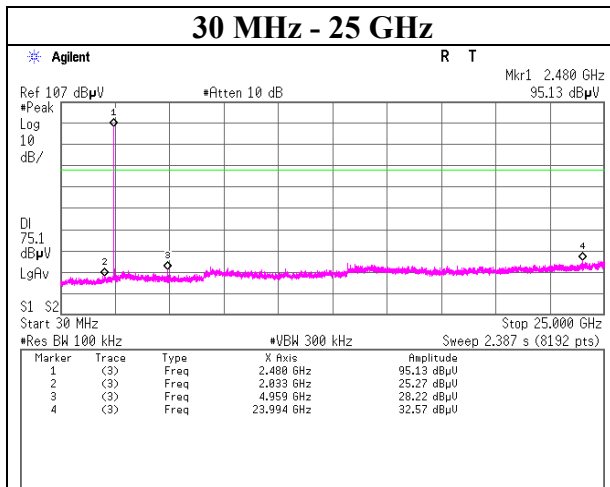
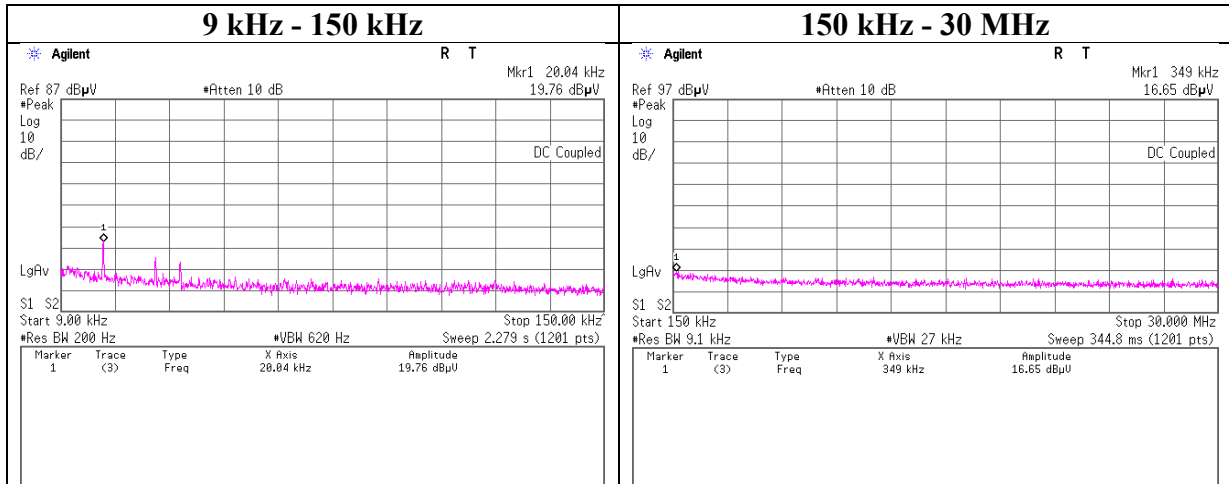
2441 MHz



Conducted Spurious Emission

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx, Hopping Off, 3DH5

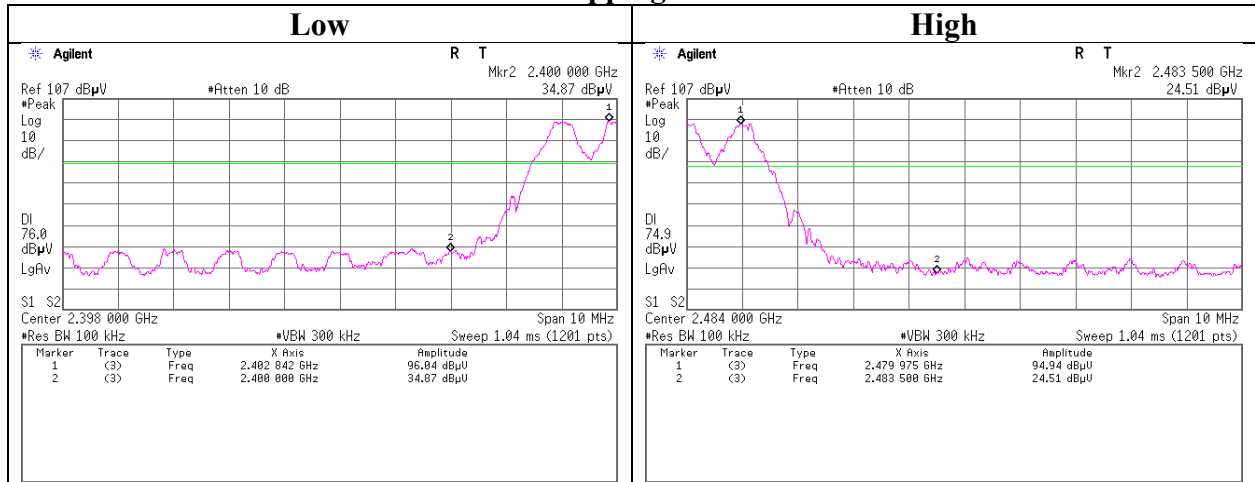
2480 MHz



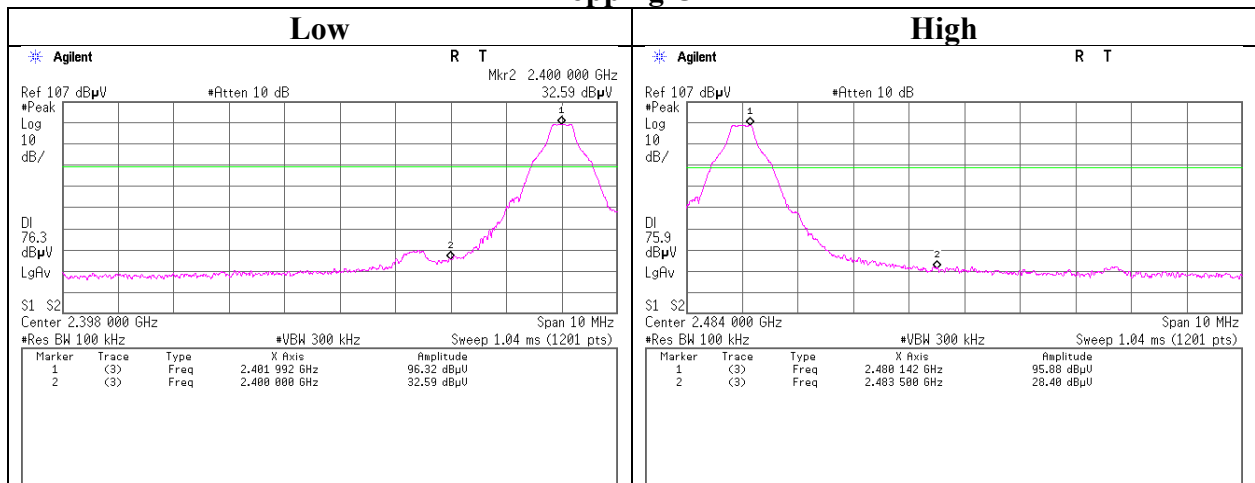
Conducted Emission Band Edge compliance

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx DH5

Hopping On



Hopping Off



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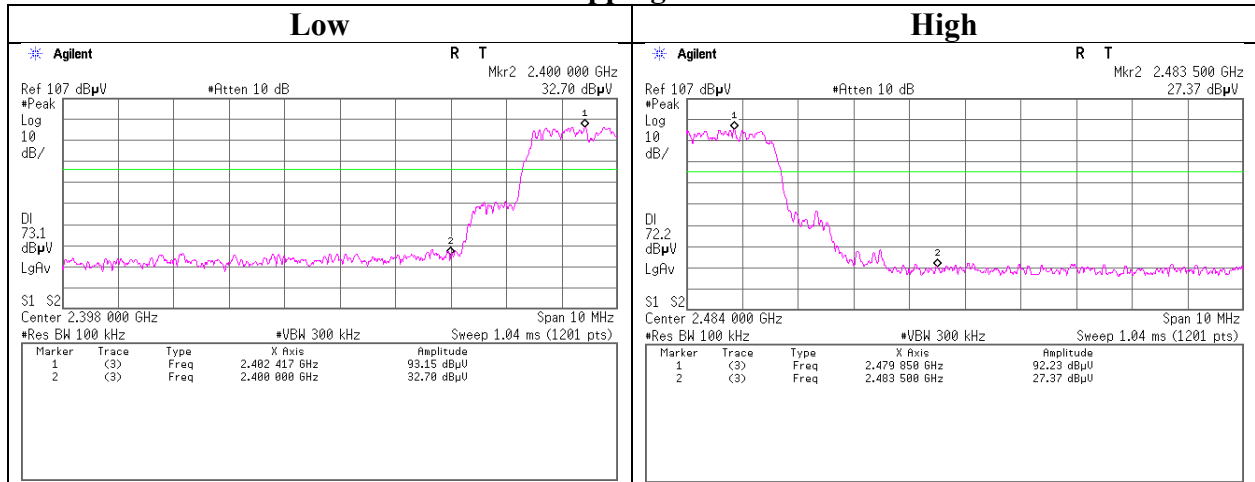
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

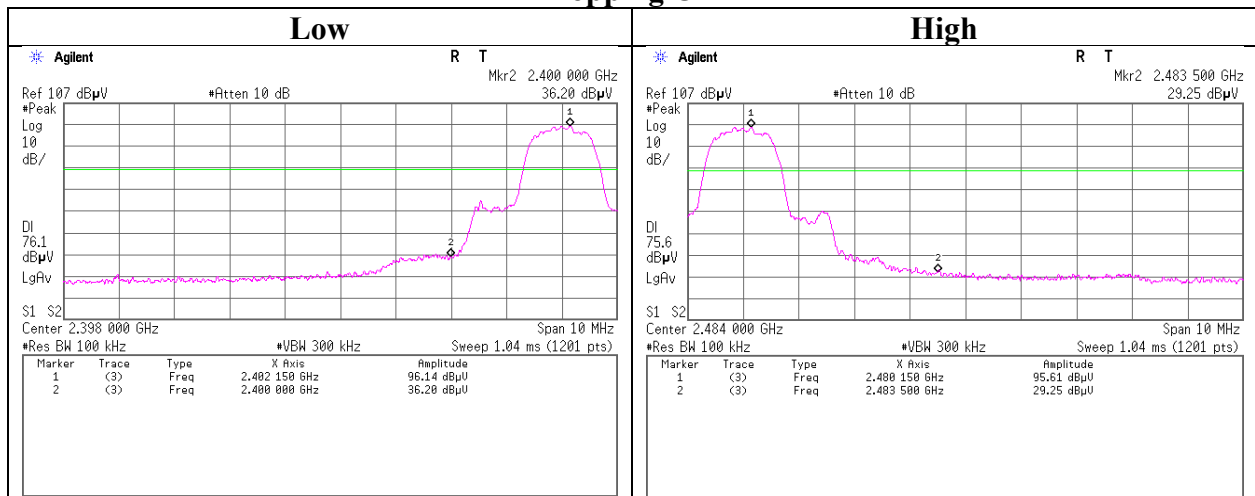
Conducted Emission Band Edge compliance

Report No. 12782612H
 Test place Ise EMC Lab. No.6 Measurement Room
 Date April 10, 2019
 Temperature / Humidity 26 deg. C / 32 % RH
 Engineer Hiroyuki Furutaka
 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
AT	141269	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	03/26/2019	03/31/2020	12
AT	141224	Microwave Cable	Junkosha	MWX221	1409S496	03/05/2019	03/31/2020	12
AT	141810	Power Meter	ANRITSU	ML2495A	824014	10/09/2018	10/31/2019	12
AT	141832	Power sensor	ANRITSU	MA2411B	738174	10/09/2018	10/31/2019	12
AT	141561	Thermo-Hygrometer	CUSTOM	CTH-201	1401	01/11/2019	01/31/2020	12
AT	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/29/2019	01/31/2020	12
AT	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	09/20/2018	09/30/2019	12
AT	141900	Spectrum Analyzer	AGILENT	E4440A	MY46185823	11/15/2018	11/30/2019	12
AT	141328	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	04/03/2019	04/30/2020	12
RE	141578	Pre Amplifier	AGILENT	8447D	2944A10845	09/19/2018	09/30/2019	12
RE/AT	142228	Measure	KOMELON	KMC-36	-	-	-	-
RE	142004	AC2 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	06/29/2018	06/30/2020	24
RE/AT	141556	Thermo-Hygrometer	CUSTOM	CTH-201	3	12/05/2018	12/31/2019	12
RE	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/08/2018	08/31/2019	12
RE/AT	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/21/2018	08/31/2019	12
RE	141317	Coaxial Cable	Fujikura/Agilent	-	-	02/25/2019	02/29/2020	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	06/01/2018	06/30/2019	12
RE	141203	Attenuator(6dB)	Weinschel Corp	-	BK7970	11/05/2018	11/30/2019	12
RE	141265	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	03/25/2019	03/31/2020	12
RE/AT	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141427	Biconical Antenna	Schwarzbeck	VHA9103B	8031	05/31/2018	05/31/2019	12
RE	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	2	09/19/2018	09/30/2019	12
RE/AT	141855	Spectrum Analyzer	AGILENT	E4440A	MY46187750	11/09/2018	11/30/2019	12
RE/AT	141579	Pre Amplifier	AGILENT	8449B	3008A02142	01/21/2019	01/31/2020	12
RE/AT	141392	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	08/08/2018	08/31/2019	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	06/06/2018	06/30/2019	12
RE	142006	AC2 Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/01/2019	04/30/2020	12
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	06/07/2018	06/30/2019	12

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

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

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

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

Test item: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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