




RADIO TEST REPORT


Test Report No. : 13328641H-A-R2

Applicant : Pioneer Corporation
Type of EUT : Car Audio with Bluetooth/ WLAN
Model Number of EUT : SN211
FCC ID : AJDK115
Test regulation : FCC Part 15 Subpart C: 2020
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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)
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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 U.S. Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 13328641H-A-R1. 13328641H-A-R1 is replaced with this report.

Date of test: April 22 to May 5, 2020

Representative test engineer: 
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Engineer
Consumer Technology Division

Approved by: 
Tsubasa Takayama
Leader
Consumer Technology Division



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 There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13328641H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13328641H-A	June 15, 2020	-	-
1	13328641H-A-R1	July 1, 2020	P.6	Deletion of sentence about simultaneously transmission.
1	13328641H-A-R1	July 1, 2020	P.11	Correction of Power setting value from 0 dBm to 5.2 dBm (both BDR/EDR)
2	13328641H-A-R2	July 8, 2020	P.27	Correction of calculation formula

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Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	MCS	Modulation and Coding Scheme
AC	Alternating Current	MRA	Mutual Recognition Arrangement
AFH	Adaptive Frequency Hopping	N/A	Not Applicable
AM	Amplitude Modulation	NIST	National Institute of Standards and Technology
Amp, AMP	Amplifier	NS	No signal detect.
ANSI	American National Standards Institute	NSA	Normalized Site Attenuation
Ant, ANT	Antenna	NVLAP	National Voluntary Laboratory Accreditation Program
AP	Access Point	OBW	Occupied Band Width
ASK	Amplitude Shift Keying	OFDM	Orthogonal Frequency Division Multiplexing
Atten., ATT	Attenuator	P/M	Power meter
AV	Average	PCB	Printed Circuit Board
BPSK	Binary Phase-Shift Keying	PER	Packet Error Rate
BR	Bluetooth Basic Rate	PHY	Physical Layer
BT	Bluetooth	PK	Peak
BT LE	Bluetooth Low Energy	PN	Pseudo random Noise
BW	BandWidth	PRBS	Pseudo-Random Bit Sequence
Cal Int	Calibration Interval	PSD	Power Spectral Density
CCK	Complementary Code Keying	QAM	Quadrature Amplitude Modulation
Ch., CH	Channel	QP	Quasi-Peak
CISPR	Comite International Special des Perturbations Radioelectriques	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	RBW	Resolution Band Width
DBPSK	Differential BPSK	RDS	Radio Data System
DC	Direct Current	RE	Radio Equipment
D-factor	Distance factor	RF	Radio Frequency
DFS	Dynamic Frequency Selection	RMS	Root Mean Square
DQPSK	Differential QPSK	RSS	Radio Standards Specifications
DSSS	Direct Sequence Spread Spectrum	Rx	Receiving
EDR	Enhanced Data Rate	SA, S/A	Spectrum Analyzer
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	SG	Signal Generator
EMC	ElectroMagnetic Compatibility	SVSWR	Site-Voltage Standing Wave Ratio
EMI	ElectroMagnetic Interference	TR	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
EU	European Union	Vert.	Vertical
EUT	Equipment Under Test	WLAN	Wireless LAN
Fac.	Factor		
FCC	Federal Communications Commission		
FHSS	Frequency Hopping Spread Spectrum		
FM	Frequency Modulation		
Freq.	Frequency		
FSK	Frequency Shift Keying		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		
ILAC	International Laboratory Accreditation Conference		
ISED	Innovation, Science and Economic Development Canada		
ISO	International Organization for Standardization		
JAB	Japan Accreditation Board		
LAN	Local Area Network		
LIMS	Laboratory Information Management System		

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CONTENTS	PAGE
SECTION 1: Customer information.....	5
SECTION 2: Equipment under test (EUT).....	5
SECTION 3: Test specification, procedures & results.....	7
SECTION 4: Operation of EUT during testing.....	11
SECTION 5: Radiated Spurious Emission	14
SECTION 6: Antenna Terminal Conducted Tests.....	16
APPENDIX 1: Test data	17
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation.....	17
Number of Hopping Frequency	21
Dwell time.....	23
Maximum Peak Output Power	26
Average Output Power.....	27
Radiated Spurious Emission	29
Conducted Spurious Emission	40
Conducted Emission Band Edge compliance	46
APPENDIX 2: Test instruments	48
APPENDIX 3: Photographs of test setup	49
Radiated Spurious Emission	49
Worst Case Position.....	50

SECTION 1: Customer information

Company Name : Pioneer Corporation
Address : 28-8, Honkomagome 2-chome, Bunkyo-ku, Tokyo 113-0021, Japan
Telephone Number : +81-49-228-7681
Facsimile Number : +81-49-228-6172
Contact Person : Yoshifumi Takahashi

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
 - Operating/Test Mode(s) (Mode(s)) on all the relevant pages
 - SECTION 1: Customer information
 - SECTION 2: Equipment under test (EUT) other than the Receipt Date
 - SECTION 4: Operation of EUT 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 (EUT)

2.1 Identification of EUT

Type : Car Audio with Bluetooth/ WLAN
Model Number : SN211
Serial Number : Refer to SECTION 4.2
Rating : DC 10 V -16 V, 10 A
Receipt Date : April 20, 2020
Country of Mass-production : Thailand
Condition : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification : No Modification by the test lab.

2.2 Product Description

Model: SN211 (referred to as the EUT in this report) is a Car Audio with Bluetooth/ WLAN.

Information of the Factory

Factory Name : PIONEER MANUFACTURING(THAILAND) CO., LTD.
Address : Rojana Industrial Park, 1/31 Moo 5
Tambol Kanham,
Amphur U-Thai
Pranakornsriyutthaya 13210 Thailand

Radio Specification

WLAN (IEEE 802.11a/n/ac)

Type of radio	IEEE802.11a/n/ac (20 M band)	IEEE802.11n/ac (40 M band)	IEEE802.11ac (80 M band)
Frequency of operation	5745 MHz - 5825 MHz	5755 MHz - 5795 MHz	5775 MHz
Type of modulation	OFDM (64QAM, 16QAM, QPSK, BPSK)		
Channel spacing	20 MHz	40 MHz	80 MHz
Antenna type	Internal Antenna		
Antenna Gain	-1.37 dBi		
Clock frequency (Maximum)	125 MHz		

Bluetooth (BR / EDR function) *1)

Type of radio	Bluetooth Version 4.2
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	FHSS
Channel spacing	1 MHz
Antenna type	Internal Antenna
Antenna Gain	-5.38 dBi
Clock frequency (Maximum)	125 MHz

[GNSS]

Radio Type : Receiver
Frequency of Operation : See table below.
Antenna type : External Antenna
Antenna Gain : 20 dBi

Supported GNSS and GNSS signals

GNSS	RNSS Frequency Band / Frequency [MHz]		
	1559 to 1610	1215 to 1300	1164 to 1215
BDS	<input type="checkbox"/> B1I 1561.098	-	-
Galileo	<input type="checkbox"/> E1 1575.42	<input type="checkbox"/> E6 1278.75	<input type="checkbox"/> E5a 1176.45 <input type="checkbox"/> E5b 1207.14
GLONASS	<input checked="" type="checkbox"/> G1 1598.063 - 1605.375	<input type="checkbox"/> G2 1242.9375 - 1248.625	-
GPS	<input checked="" type="checkbox"/> L1 1575.42	<input type="checkbox"/> L2 1227.6	<input type="checkbox"/> L5 1176.45
SBAS	<input type="checkbox"/> L1 1575.42	-	<input type="checkbox"/> L5 1176.45

- Supported GNSS signal
 Not supported GNSS signal

AM / FM / DAB

Type of radio	FM	AM	DAB
Equipment Type	Receiver		
Frequency of Operation	87.5 MHz to 108.0 MHz	522 kHz to 1629 kHz	Band III: 174.928 MHz to 239.200 MHz L-Band: 1452.96 MHz to 1490.624 MHz
Type of Modulation	FM	AM	OFDM
Antenna Connector Type	Custom	Custom	Custom
Impedance	75 ohm	75 ohm	50 ohm
Reception method	Conducted	Conducted	Conducted

* This test report applies to Bluetooth.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 26, 2020 and effective July 27, 2020 except 15.258

Title : FCC 47 CFR Part 15 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

* The revision does not affect the test result conducted before its effective date.

*The customer has declared that the EUT has complies with FCC Part 15 Subpart B as SDoC.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	N/A	N/A	*1)
Carrier Frequency Separation	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1) ISED: RSS-247 5.1 (b)	See data.	Complied a)	Conducted
20dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1) ISED: RSS-247 5.1 (a)		Complied a)	Conducted
Number of Hopping Frequency	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1)(iii) ISED: RSS-247 5.1 (d)		Complied b)	Conducted
Dwell time	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1)(iii) ISED: RSS-247 5.1 (d)		Complied c)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section 15.247(a)(b)(1) ISED: RSS-247 5.4 (b)		Complied d)	Conducted
Spurious Emission & Band Edge Compliance	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13	FCC: Section 15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10		9.8 dB 202.628 MHz, QP, Vert.	Complied e) / f)

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 the stable voltage constantly to RF part 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.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	ISED: RSS-Gen 6.7	ISED: -	N/A	- a)	Conducted
a) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99% Occupied Bandwidth and Carrier Frequency Separation)					

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

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3.4 Uncertainty

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	1.4 dB
Carrier Frequency Separation	0.42 %
Dwell time / Burst rate	0.10 %
Conducted Spurious Emission	2.6 dB

Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.4 dB
	0.15 MHz to 30 MHz	2.9 dB

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal) (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
		4.8 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.0 dB
		5.0 dB
3 m	1 GHz to 6 GHz	4.9 dB
	6 GHz to 18 GHz	5.2 dB
1 m	10 GHz to 26.5 GHz	5.5 dB
	26.5 GHz to 40 GHz	5.5 dB
0.5 m	26.5 GHz to 40 GHz	5.5 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.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
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.

SECTION 4: Operation of EUT 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) *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>*EUT has the power settings by the software as follows; Power settings: BDR: 5.2 dBm EDR: 5.2 dBm Software: R.A2.00.12.65.20.00.00 (Date: April 20, 2020, Storage location: EUT memory)</p> <p>*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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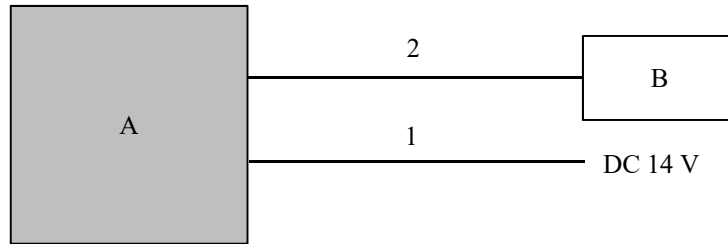
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4.2 Configuration and peripherals

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	Car Audio with Bluetooth / WLAN	SN211	KATA035	Pioneer Corporation	EUT
B	USB Memory	U202	1942QF0935MSQ 1RL1L	TOSHIBA	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC & Signal Cable	2.0	Unshielded	Unshielded	-
2	USB Cable	1.5	Shielded	Shielded	-

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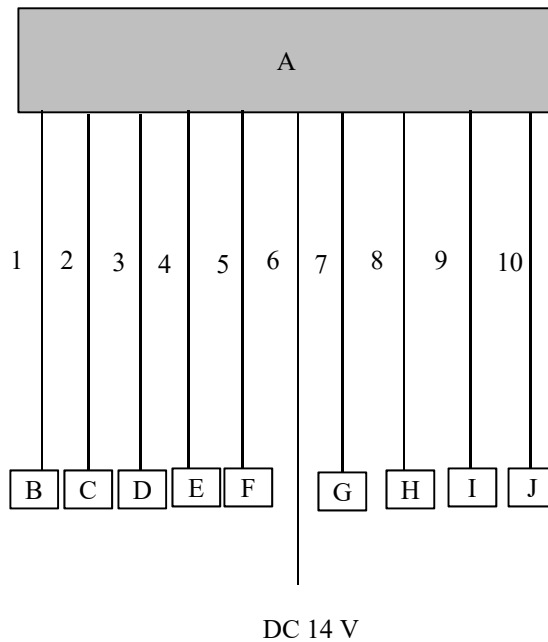
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Radiated Spurious Emission



* 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	Car Audio with Bluetooth / WLAN	SN211	KATA036	Pioneer Corporation	EUT
B	USB Memory	U202	1942QF0935MSQ 1RL1L	TOSHIBA	-
C	Terminator	-	-	-	-
D	GNSS Antenna	DA15-D010	A388619	MITSUMI ELEC.	-
E	Terminator	-	-	-	-
F	Jig Board	-	-	-	-
G	Mic	39813-59S00	-	-	-
H	Dummy Speaker	-	-	-	-
I	Camera	-	-	-	-
J	Terminator	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	2.0	Shielded	Shielded	-
2	DAB Cable	2.0	Shielded	Shielded	-
3	GNSS Antenna Cable	2.0	Shielded	Shielded	-
4	HDMI Cable	1.2	Shielded	Shielded	-
5	Signal Cable	2.0	Unshielded	Unshielded	-
6	DC Cable	2.8	Unshielded	Unshielded	-
7	MIC Cable	2.0	Unshielded	Unshielded	-
8	Speaker Cable	2.0	Unshielded	Unshielded	-
9	Signal Cable	2.2	Unshielded	Unshielded	-
10	AM/FM Cable	2.0	Shielded	Shielded	-

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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 m 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.

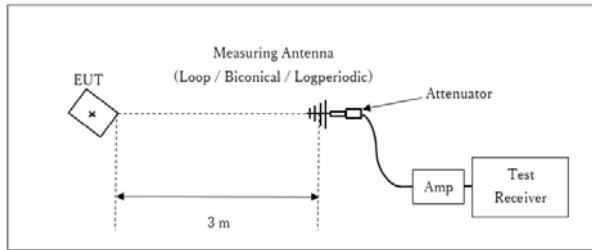
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		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.

Figure 2: Test Setup

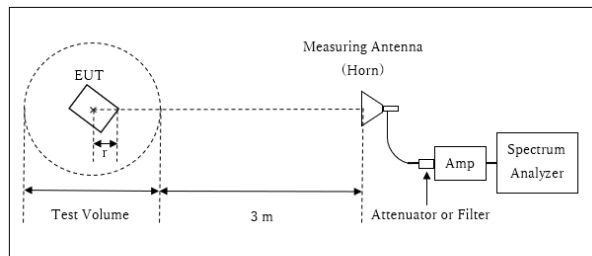
Below 1 GHz



× : 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: $20 \times \log (3.85 \text{ m} / 3.0 \text{ m}) = 2.17 \text{ dB}$

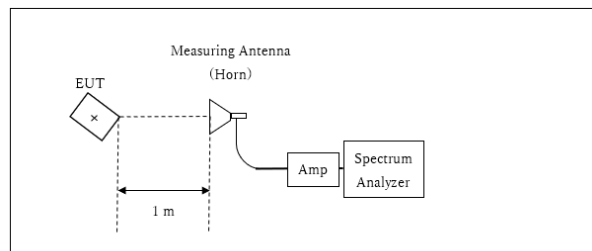
* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.85 \text{ m}$

Test Volume : 2.0 m

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

$r = 0.15 \text{ m}$

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 carrier level and noise levels were confirmed at each position of 0 degree and 40 degree as tilt angle of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

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

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) *4)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	9.1 kHz	27 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

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

*2) Reference data

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

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz -150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz)

*4) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

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

Test data : APPENDIX

Test result : Pass

APPENDIX 1: Test data

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

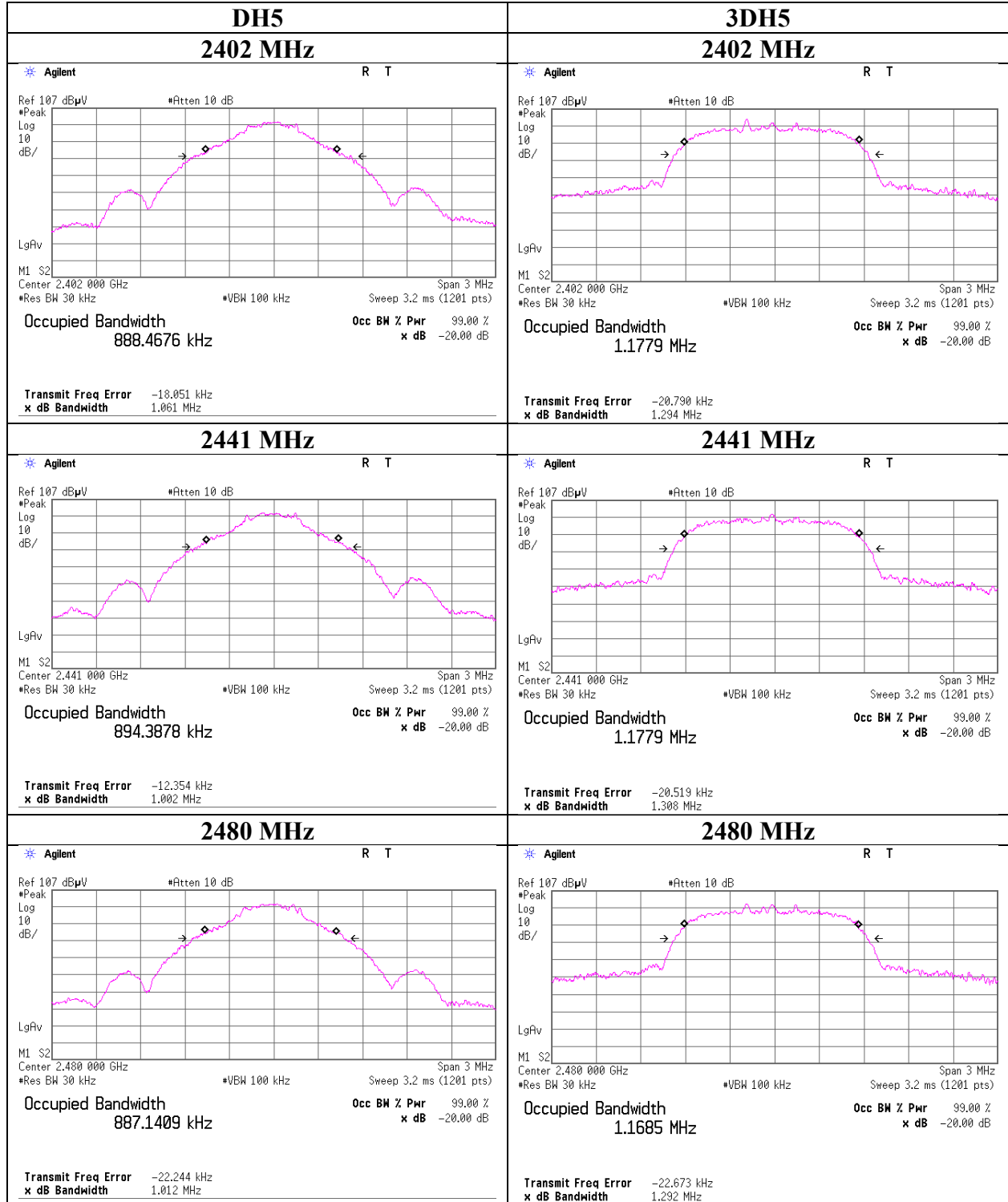
Report No. 13328641H
Test place Ise EMC Lab. No.8 Measurement Room
Date April 23, 2020
Temperature / Humidity 23 deg. C / 35 % RH
Engineer Hiroyuki Furutaka
Mode Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	99% Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	1.061	888.468	1.000	≥ 0.707
DH5	2441.0	1.002	894.388	1.000	≥ 0.668
DH5	2480.0	1.012	887.141	1.000	≥ 0.675
DH5	Hopping On	-	78656.200	-	-
3DH5	2402.0	1.294	1177.900	1.000	≥ 0.863
3DH5	2441.0	1.308	1177.900	1.000	≥ 0.872
3DH5	2480.0	1.292	1168.500	1.000	≥ 0.861
3DH5	Hopping On	81.522	78725.200	-	-

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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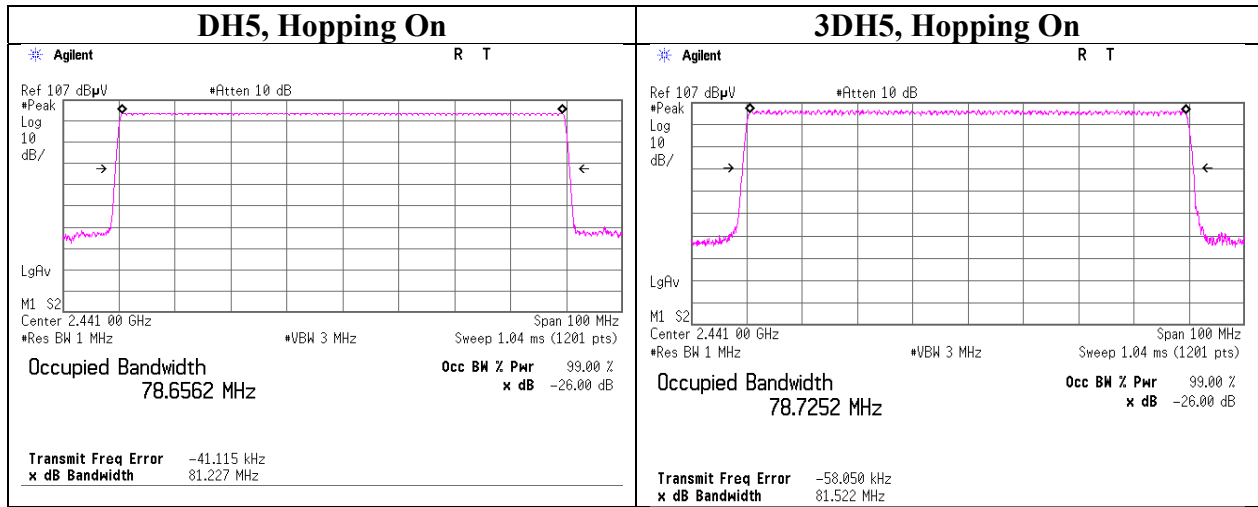
Ise EMC Lab.

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

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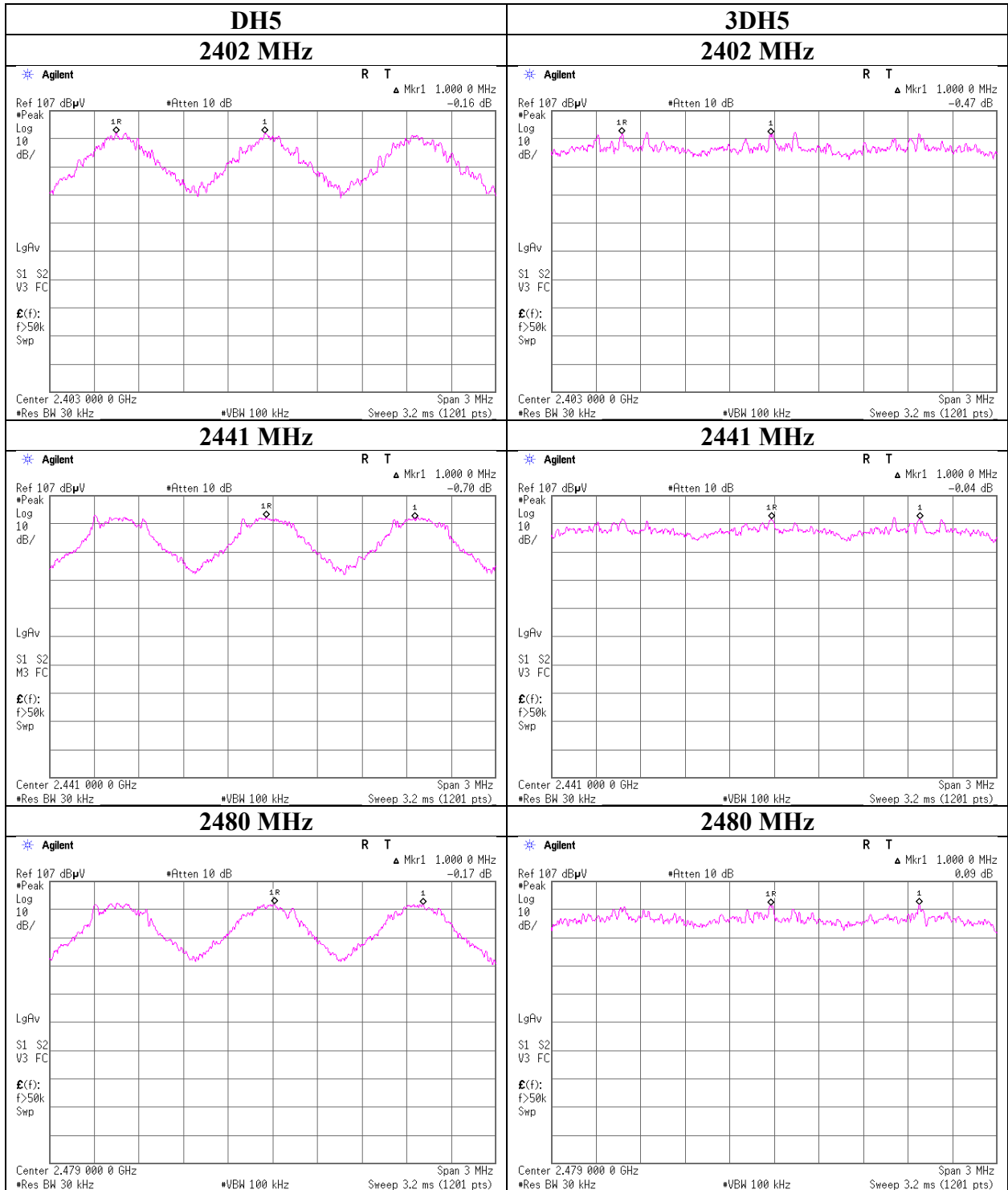
20dB Bandwidth and 99% Occupied Bandwidth



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Carrier Frequency Separation



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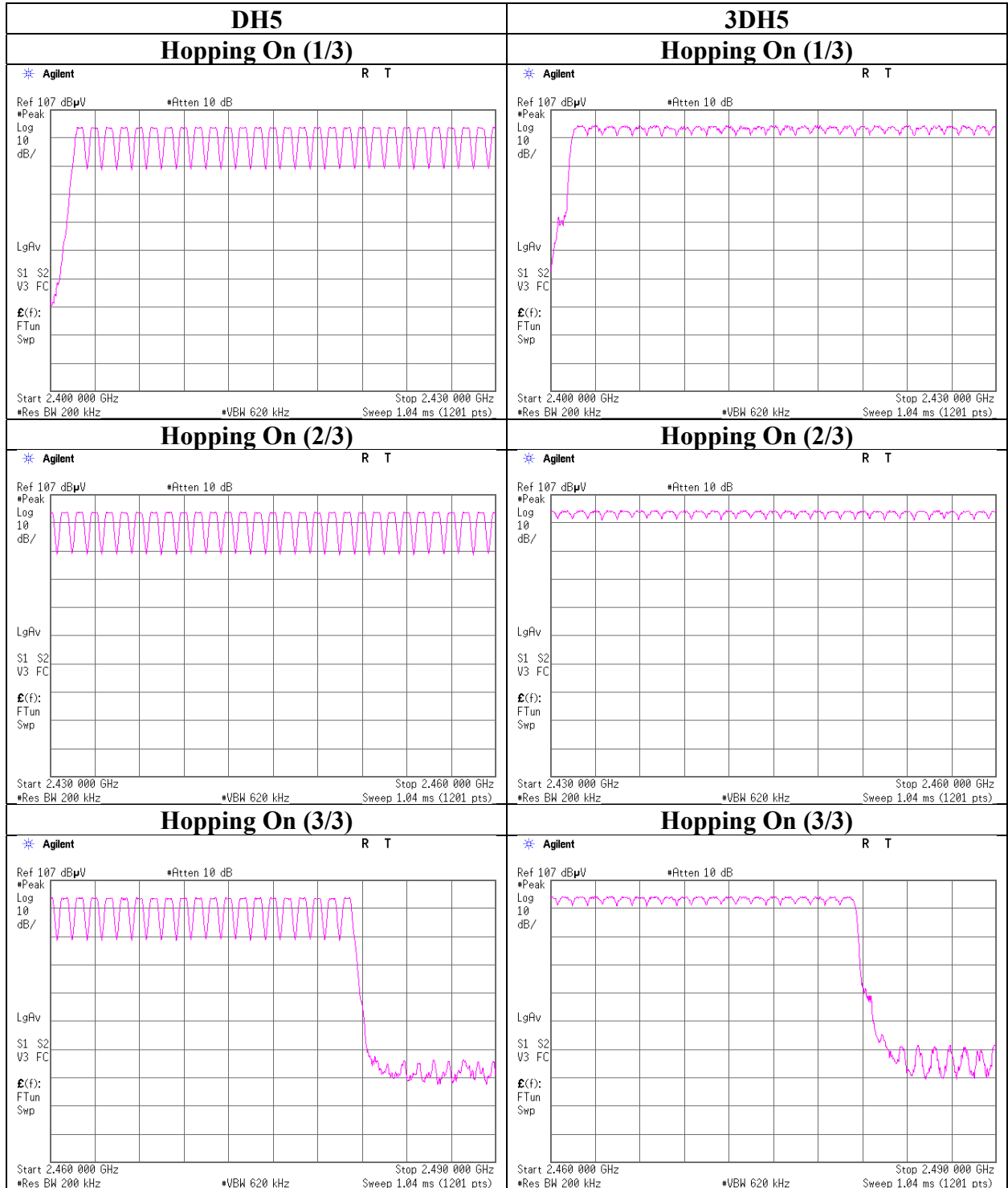
Number of Hopping Frequency

Report No. 13328641H
Test place Ise EMC Lab. No.8 Measurement Room
Date April 23, 2020
Temperature / Humidity 23 deg. C / 35 % 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



Dwell time

Report No. 13328641H
Test place Ise EMC Lab. No.8 Measurement Room
Date April 23, 2020
Temperature / Humidity 23 deg. C / 35 % 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]
DH1	49.6 times /	5 sec. x	31.6 sec. =	314 times	0.411	400
DH3	26.8 times /	5 sec. x	31.6 sec. =	170 times	1.675	400
DH5	21.2 times /	5 sec. x	31.6 sec. =	134 times	2.930	400
3DH1	50.2 times /	5 sec. x	31.6 sec. =	318 times	0.410	400
3DH3	24.8 times /	5 sec. x	31.6 sec. =	157 times	1.667	400
3DH5	21.0 times /	5 sec. x	31.6 sec. =	133 times	2.923	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

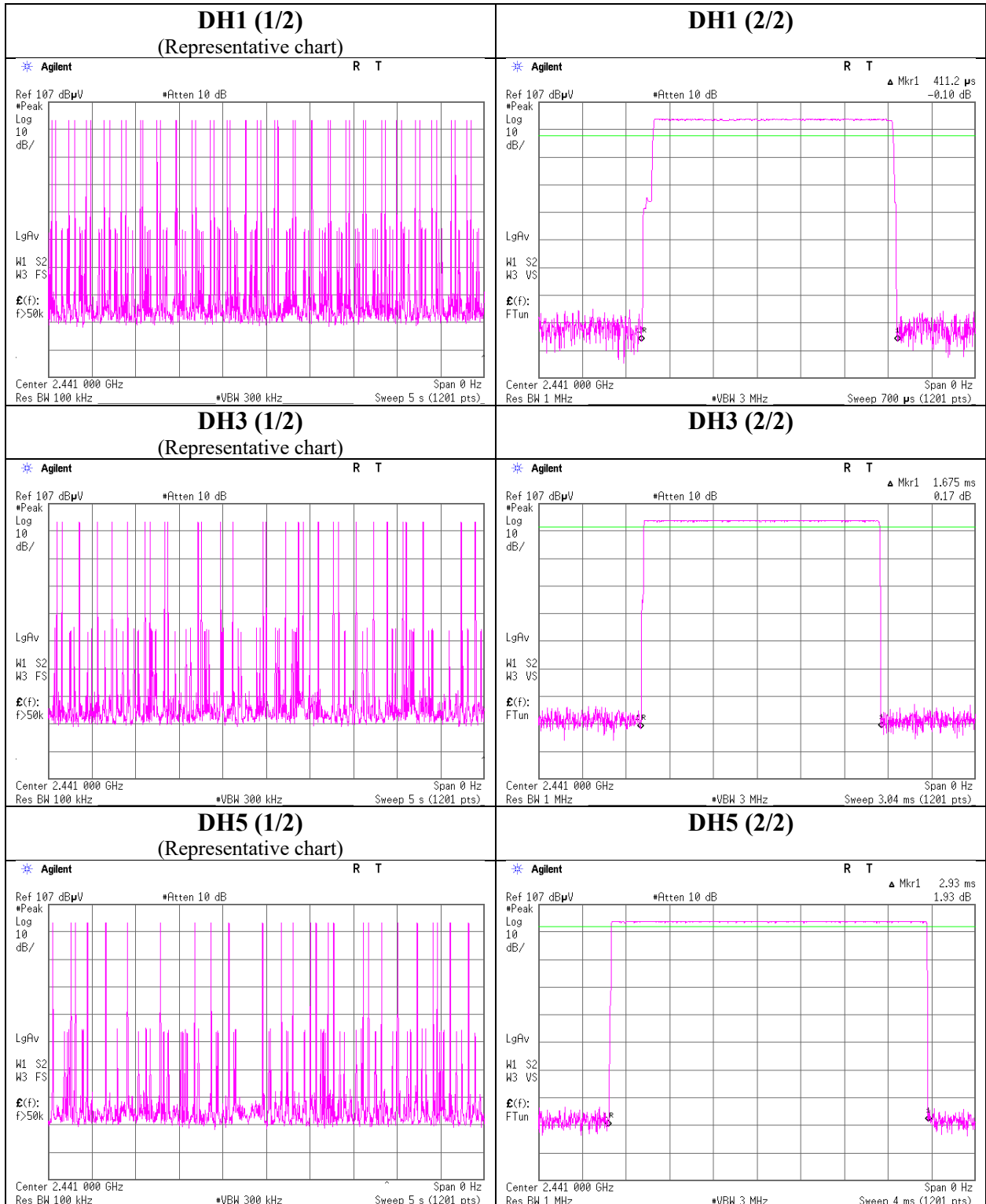
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	49	50	50	50	49	49.6
DH3	30	25	26	27	26	26.8
DH5	23	15	21	22	25	21.2
3DH1	50	51	49	50	51	50.2
3DH3	24	23	26	24	27	24.8
3DH5	19	20	21	25	20	21.0

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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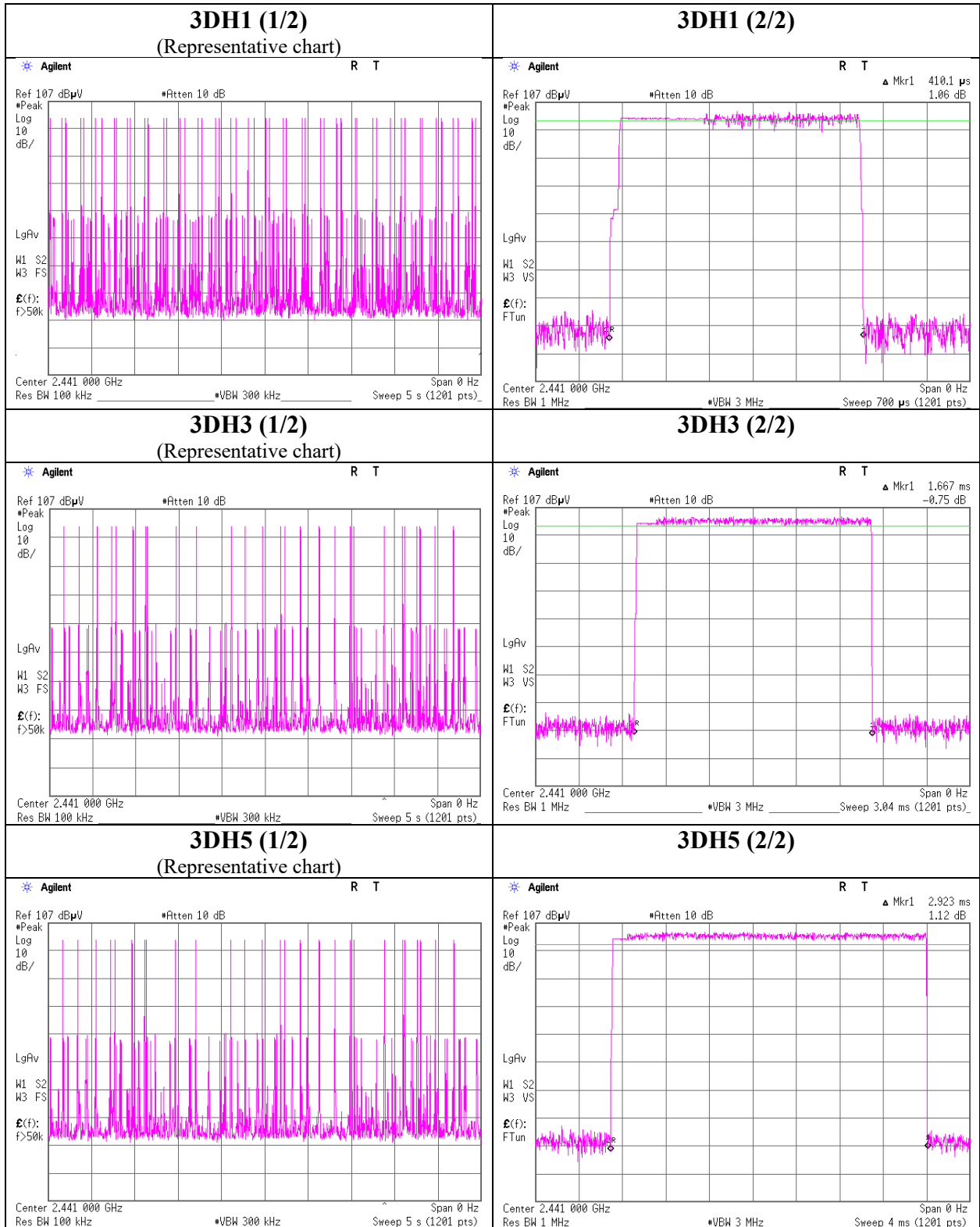
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Dwell time



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Maximum Peak Output Power

Report No. 13328641H
Test place Ise EMC Lab. No.8 Measurement Room
Date April 22, 2020
Temperature / Humidity 23 deg. C / 45 % 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	Antenna Gain [dBi]	Result		Limit		Margin
					[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-7.23	2.33	10.10	5.20	3.31	20.96	125	15.76	-5.38	-0.18	0.96	36.02	4000	36.20
DH5	2441.0	-7.11	2.34	10.10	5.33	3.41	20.96	125	15.63	-5.38	-0.05	0.99	36.02	4000	36.07
DH5	2480.0	-7.17	2.35	10.10	5.28	3.37	20.96	125	15.68	-5.38	-0.10	0.98	36.02	4000	36.12
2DH5	2402.0	-4.32	2.33	10.10	8.11	6.47	20.96	125	12.85	-5.38	2.73	1.87	36.02	4000	33.29
2DH5	2441.0	-4.34	2.34	10.10	8.10	6.46	20.96	125	12.86	-5.38	2.72	1.87	36.02	4000	33.30
2DH5	2480.0	-4.41	2.35	10.10	8.04	6.37	20.96	125	12.92	-5.38	2.66	1.85	36.02	4000	33.36
3DH5	2402.0	-4.05	2.33	10.10	8.38	6.89	20.96	125	12.58	-5.38	3.00	2.00	36.02	4000	33.02
3DH5	2441.0	-4.02	2.34	10.10	8.42	6.95	20.96	125	12.54	-5.38	3.04	2.01	36.02	4000	32.98
3DH5	2480.0	-4.12	2.35	10.10	8.33	6.81	20.96	125	12.63	-5.38	2.95	1.97	36.02	4000	33.07

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. 13328641H
Test place Ise EMC Lab. No.8 Measurement Room
Date April 22, 2020
Temperature / Humidity 23 deg. C / 45 % RH
Engineer Hiroyuki Furutaka
Mode Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)	
					[dBm]	[mW]
DH5	2402.0	-8.69	2.33	10.10	3.74	2.37
DH5	2441.0	-8.60	2.34	10.10	3.84	2.42
DH5	2480.0	-8.64	2.35	10.10	3.81	2.40
2DH5	2402.0	-8.22	2.33	10.10	4.21	2.64
2DH5	2441.0	-8.25	2.34	10.10	4.19	2.62
2DH5	2480.0	-8.39	2.35	10.10	4.06	2.55
3DH5	2402.0	-8.06	2.33	10.10	4.37	2.74
3DH5	2441.0	-8.03	2.34	10.10	4.41	2.76
3DH5	2480.0	-8.20	2.35	10.10	4.25	2.66

Sample Calculation:

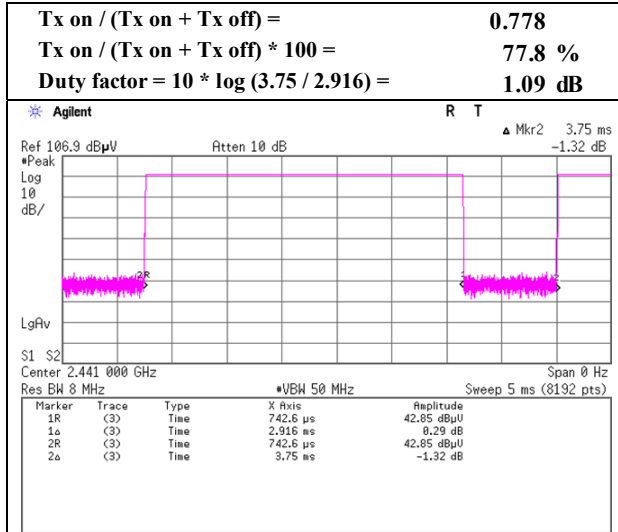
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

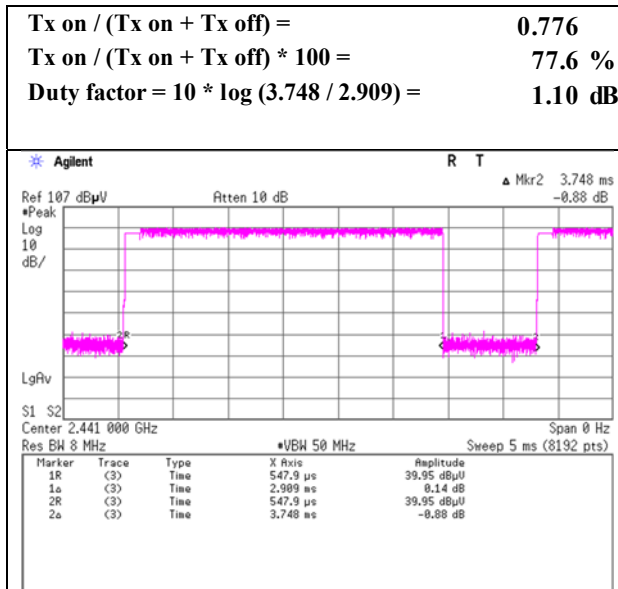
Burst Rate Confirmation

Report No. 13328641H
 Test place Ise EMC Lab. No.4 Semi Anechoic Chamber
 Date May 2, 2020
 Temperature / Humidity 22 deg. C / 50 % RH
 Engineer Junki Nagatomi
 Mode Tx, Hopping Off

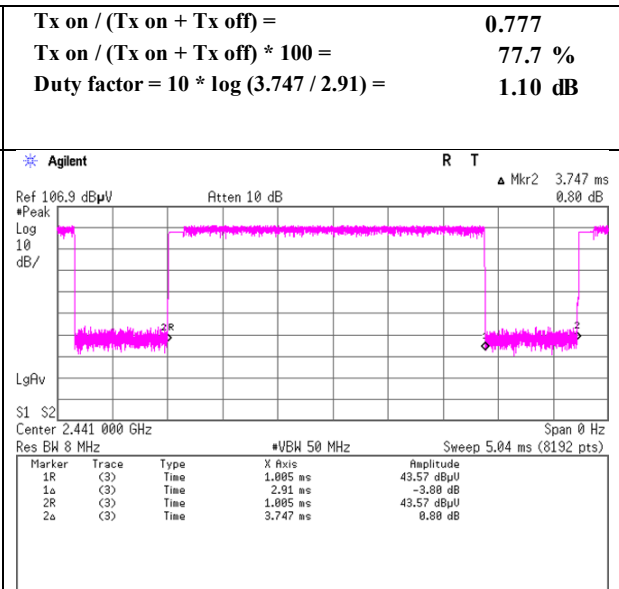
DH5



2DH5



3DH5



Radiated Spurious Emission

Report No.	13328641H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	May 2, 2020	May 2, 2020	May 5, 2020
Temperature / Humidity	22 deg. C / 50 % RH	22 deg. C / 53 % RH	23 deg. C / 43 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Ken Fujita
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	129.037	QP	31.5	13.8	8.4	31.9	-	21.8	43.5	21.7	
Hori.	172.096	QP	32.2	15.9	8.8	31.9	-	25.0	43.5	18.5	
Hori.	202.628	QP	35.5	11.5	9.0	31.8	-	24.2	43.5	19.3	
Hori.	208.684	QP	36.5	11.2	9.1	31.8	-	25.0	43.5	18.5	
Hori.	294.657	QP	39.3	13.5	9.7	31.8	-	30.7	46.0	15.3	
Hori.	637.289	QP	23.6	19.3	11.6	32.0	-	22.5	46.0	23.5	
Hori.	2390.000	PK	43.9	27.9	5.6	31.9	-	45.5	73.9	28.4	
Hori.	4804.000	PK	41.0	31.7	7.7	31.3	-	49.1	73.9	24.8	Floor noise
Hori.	7206.000	PK	42.7	36.2	9.2	32.4	-	55.7	73.9	18.2	Floor noise
Hori.	9608.000	PK	43.6	38.0	7.8	32.8	-	56.6	73.9	17.4	Floor noise
Hori.	2390.000	AV	34.4	27.9	5.6	31.9	1.1	37.1	53.9	16.8	*1)
Hori.	4804.000	AV	32.4	31.7	7.7	31.3	-	40.6	53.9	13.4	Floor noise
Hori.	7206.000	AV	34.8	36.2	9.2	32.4	-	47.8	53.9	6.1	Floor noise
Hori.	9608.000	AV	34.7	38.0	7.8	32.8	-	47.7	53.9	6.2	Floor noise
Vert.	129.037	QP	28.6	13.8	8.4	31.9	-	18.9	43.5	24.6	
Vert.	172.096	QP	31.5	15.9	8.8	31.9	-	24.3	43.5	19.2	
Vert.	202.628	QP	45.1	11.5	9.0	31.8	-	33.7	43.5	9.8	
Vert.	208.684	QP	43.0	11.2	9.1	31.8	-	31.5	43.5	12.0	
Vert.	294.657	QP	42.8	13.5	9.7	31.8	-	34.2	46.0	11.8	
Vert.	637.289	QP	28.5	19.3	11.6	32.0	-	27.4	46.0	18.6	
Vert.	2390.000	PK	42.3	27.9	5.6	31.9	-	43.9	73.9	30.0	
Vert.	4804.000	PK	41.2	31.7	7.7	31.3	-	49.4	73.9	24.5	Floor noise
Vert.	7206.000	PK	43.4	36.2	9.2	32.4	-	56.4	73.9	17.5	Floor noise
Vert.	9608.000	PK	43.7	38.0	7.8	32.8	-	56.7	73.9	17.2	Floor noise
Vert.	2390.000	AV	33.8	27.9	5.6	31.9	1.1	36.5	53.9	17.4	*1)
Vert.	4804.000	AV	32.4	31.7	7.7	31.3	-	40.6	53.9	13.4	Floor noise
Vert.	7206.000	AV	34.8	36.2	9.2	32.4	-	47.8	53.9	6.1	Floor noise
Vert.	9608.000	AV	34.7	38.0	7.8	32.8	-	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 (3.85 m / 3.0 m) = 2.17 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	97.4	27.9	5.6	31.9	99.0	-	-	Carrier
Hori.	2400.000	PK	37.3	27.9	5.6	31.9	38.9	79.0	40.1	
Vert.	2402.000	PK	94.8	27.9	5.6	31.9	96.4	-	-	Carrier
Vert.	2400.000	PK	35.3	27.9	5.6	31.9	36.9	76.4	39.5	

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

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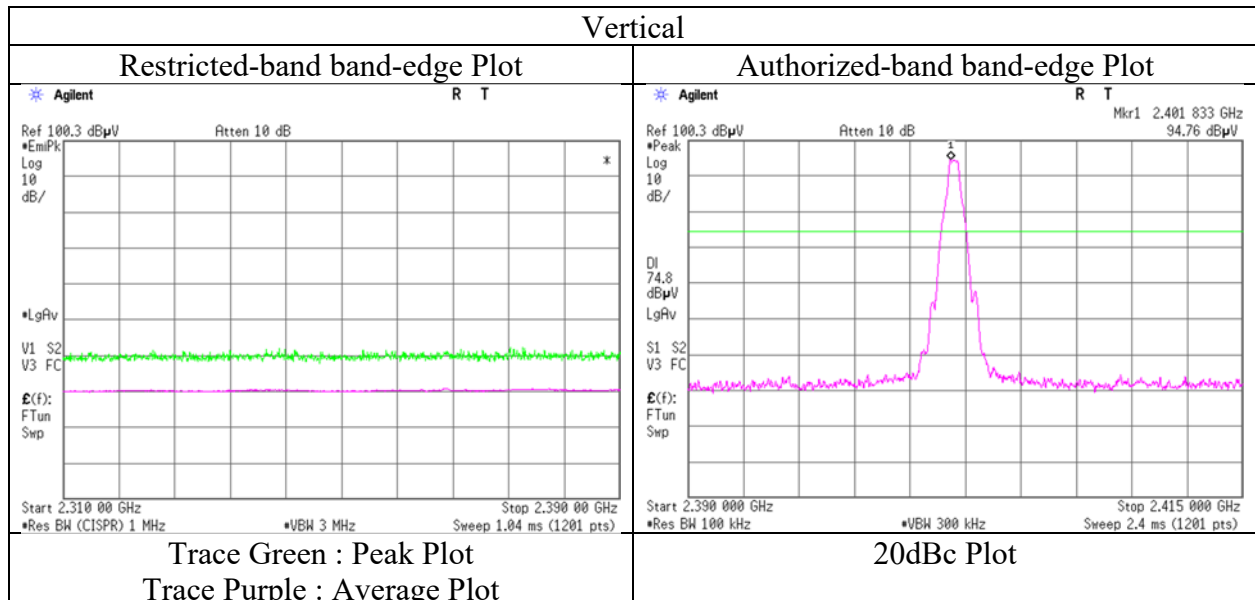
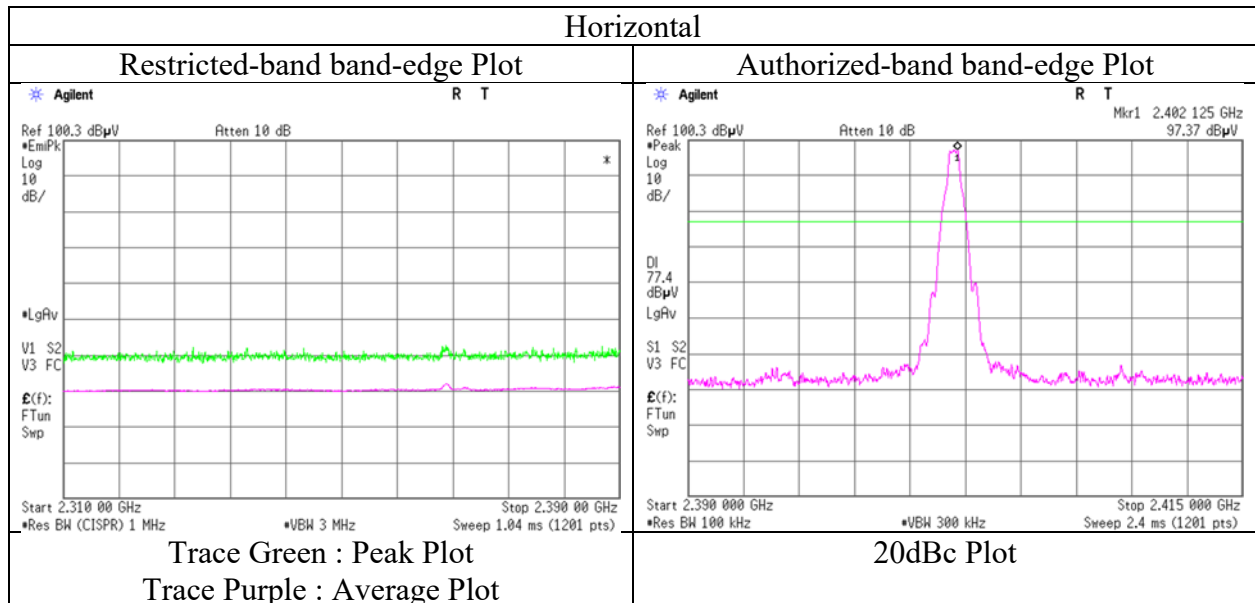
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13328641H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date May 2, 2020
Temperature / Humidity 22 deg. C / 50 % 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.

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No.	13328641H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	May 2, 2020	May 2, 2020	May 5, 2020
Temperature / Humidity	22 deg. C / 50 % RH	22 deg. C / 53 % RH	23 deg. C / 43 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Ken Fujita
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	79.907	QP	31.2	6.9	7.9	32.0	-	14.0	40.0	26.0	
Hori.	86.026	QP	32.8	7.9	7.9	31.9	-	16.7	40.0	23.4	
Hori.	172.056	QP	33.1	15.9	8.8	31.9	-	25.9	43.5	17.6	
Hori.	196.694	QP	34.8	16.5	9.0	31.8	-	28.5	43.5	15.0	
Hori.	208.674	QP	37.9	11.2	9.1	31.8	-	26.4	43.5	17.1	
Hori.	294.688	QP	40.2	13.5	9.7	31.8	-	31.6	46.0	14.4	
Hori.	4882.000	PK	40.4	31.6	7.8	31.2	-	48.5	73.9	25.4	Floor noise
Hori.	7323.000	PK	42.1	36.5	9.2	32.5	-	55.3	73.9	18.6	Floor noise
Hori.	9764.000	PK	42.9	38.3	7.8	32.9	-	56.1	73.9	17.8	Floor noise
Hori.	4882.000	AV	32.4	31.6	7.8	31.2	-	40.5	53.9	13.4	Floor noise
Hori.	7323.000	AV	33.8	36.5	9.2	32.5	-	47.1	53.9	6.9	Floor noise
Hori.	9764.000	AV	34.6	38.3	7.8	32.9	-	47.8	53.9	6.1	Floor noise
Vert.	79.907	QP	26.7	6.9	7.9	32.0	-	9.5	40.0	30.5	
Vert.	86.026	QP	29.8	7.9	7.9	31.9	-	13.7	40.0	26.4	
Vert.	172.056	QP	32.2	15.9	8.8	31.9	-	25.0	43.5	18.5	
Vert.	196.694	QP	36.7	16.5	9.0	31.8	-	30.4	43.5	13.1	
Vert.	208.674	QP	43.6	11.2	9.1	31.8	-	32.1	43.5	11.4	
Vert.	294.688	QP	42.1	13.5	9.7	31.8	-	33.5	46.0	12.5	
Vert.	4882.000	PK	40.9	31.6	7.8	31.2	-	49.0	73.9	24.9	Floor noise
Vert.	7323.000	PK	41.8	36.5	9.2	32.5	-	55.0	73.9	18.9	Floor noise
Vert.	9764.000	PK	43.0	38.3	7.8	32.9	-	56.2	73.9	17.7	Floor noise
Vert.	4882.000	AV	32.4	31.6	7.8	31.2	-	40.5	53.9	13.4	Floor noise
Vert.	7323.000	AV	33.8	36.5	9.2	32.5	-	47.1	53.9	6.9	Floor noise
Vert.	9764.000	AV	34.6	38.3	7.8	32.9	-	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 (3.85 m / 3.0 m) = 2.17 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	13328641H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	May 2, 2020	May 2, 2020	May 5, 2020
Temperature / Humidity	22 deg. C / 50 % RH	22 deg. C / 53 % RH	23 deg. C / 43 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Ken Fujita
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	79.933	QP	31.8	6.9	7.9	32.0	-	14.6	40.0	25.4	
Hori.	85.965	QP	33.1	7.9	7.9	31.9	-	16.9	40.0	23.1	
Hori.	172.075	QP	34.5	15.9	8.8	31.9	-	27.3	43.5	16.2	
Hori.	196.642	QP	36.9	16.5	9.0	31.8	-	30.5	43.5	13.0	
Hori.	220.667	QP	38.2	11.1	9.2	31.8	-	26.7	46.0	19.3	
Hori.	294.733	QP	43.7	13.5	9.7	31.8	-	35.1	46.0	10.9	
Hori.	2483.500	PK	46.1	27.7	5.7	31.8	-	47.6	73.9	26.3	
Hori.	2487.792	PK	47.0	27.7	5.7	31.8	-	48.5	73.9	25.4	
Hori.	4960.000	PK	42.0	31.6	7.8	31.2	-	50.2	73.9	23.7	Floor noise
Hori.	7440.000	PK	42.5	36.6	9.2	32.5	-	55.8	73.9	18.1	Floor noise
Hori.	9920.000	PK	43.9	38.5	7.9	33.0	-	57.2	73.9	16.7	Floor noise
Hori.	2483.500	AV	36.4	27.7	5.7	31.8	1.1	39.0	53.9	14.9	*1)
Hori.	2487.792	AV	38.1	27.7	5.7	31.8	1.1	40.7	53.9	13.2	
Hori.	4960.000	AV	32.5	31.6	7.8	31.2	-	40.7	53.9	13.2	Floor noise
Hori.	7440.000	AV	33.9	36.6	9.2	32.5	-	47.2	53.9	6.7	Floor noise
Hori.	9920.000	AV	33.5	38.5	7.9	33.0	-	46.8	53.9	7.1	Floor noise
Vert.	79.933	QP	27.6	6.9	7.9	32.0	-	10.4	40.0	29.6	
Vert.	85.965	QP	28.8	7.9	7.9	31.9	-	12.6	40.0	27.4	
Vert.	172.075	QP	32.3	15.9	8.8	31.9	-	25.1	43.5	18.4	
Vert.	196.642	QP	36.7	16.5	9.0	31.8	-	30.4	43.5	13.1	
Vert.	220.667	QP	38.7	11.1	9.2	31.8	-	27.2	46.0	18.8	
Vert.	294.733	QP	42.3	13.5	9.7	31.8	-	33.7	46.0	12.3	
Vert.	2483.500	PK	44.5	27.7	5.7	31.8	-	46.0	73.9	27.9	
Vert.	2487.792	PK	45.6	27.7	5.7	31.8	-	47.1	73.9	26.8	
Vert.	4960.000	PK	41.2	31.6	7.8	31.2	-	49.3	73.9	24.6	Floor noise
Vert.	7440.000	PK	42.7	36.6	9.2	32.5	-	56.0	73.9	18.0	Floor noise
Vert.	9920.000	PK	42.2	38.5	7.9	33.0	-	55.6	73.9	18.3	Floor noise
Vert.	2483.500	AV	35.7	27.7	5.7	31.8	1.1	38.3	53.9	15.6	*1)
Vert.	2487.792	AV	36.8	27.7	5.7	31.8	1.1	39.4	53.9	14.5	
Vert.	4960.000	AV	32.5	31.6	7.8	31.2	-	40.7	53.9	13.2	Floor noise
Vert.	7440.000	AV	33.9	36.6	9.2	32.5	-	47.2	53.9	6.7	Floor noise
Vert.	9920.000	AV	33.5	38.5	7.9	33.0	-	46.8	53.9	7.1	Floor noise

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

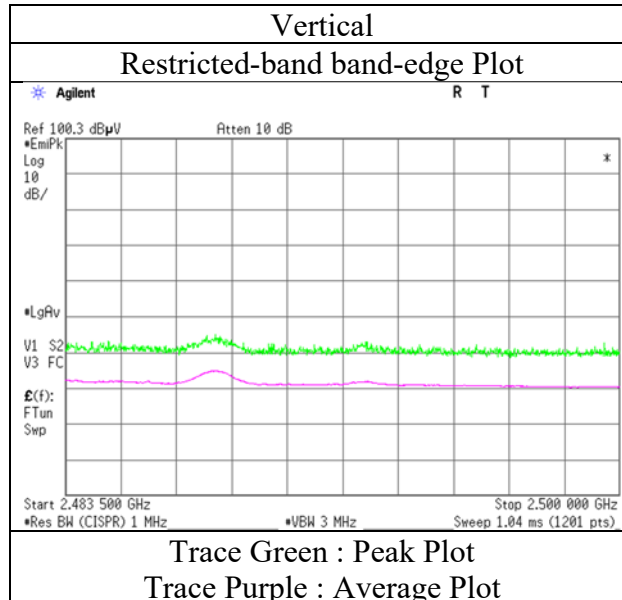
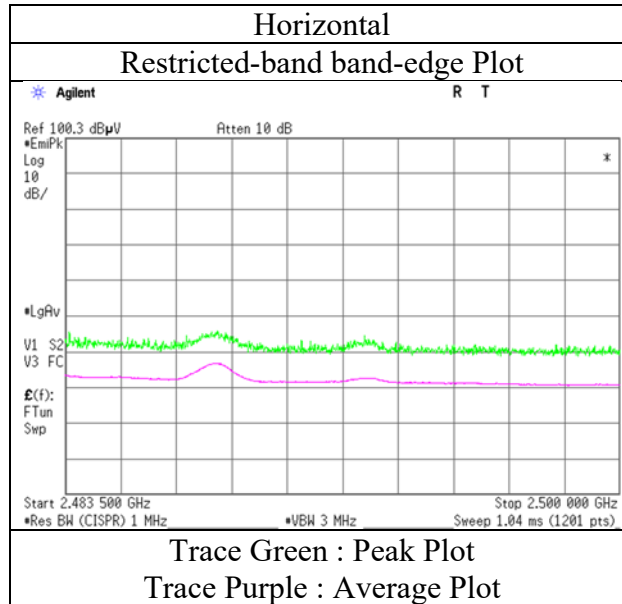
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.85 m / 3.0 m) = 2.17 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13328641H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date May 2, 2020
Temperature / Humidity 22 deg. C / 50 % 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.

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Radiated Spurious Emission

Report No.	13328641H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	May 2, 2020	May 2, 2020	May 5, 2020
Temperature / Humidity	22 deg. C / 50 % RH	22 deg. C / 53 % RH	23 deg. C / 43 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Ken Fujita
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	79.942	QP	33.1	6.9	7.9	32.0	-	15.9	40.0	24.1	
Hori.	85.949	QP	32.1	7.9	7.9	31.9	-	15.9	40.0	24.1	
Hori.	172.050	QP	34.4	15.9	8.8	31.9	-	27.2	43.5	16.3	
Hori.	196.681	QP	36.1	16.5	9.0	31.8	-	29.8	43.5	13.7	
Hori.	208.669	QP	37.5	11.2	9.1	31.8	-	26.0	43.5	17.5	
Hori.	294.641	QP	43.3	13.5	9.7	31.8	-	34.7	46.0	11.3	
Hori.	2390.000	PK	43.6	27.9	5.6	31.9	-	45.1	73.9	28.8	
Hori.	4804.000	PK	41.7	31.7	7.7	31.3	-	49.8	73.9	24.1	Floor noise
Hori.	7206.000	PK	43.0	36.2	9.2	32.4	-	56.0	73.9	17.9	Floor noise
Hori.	9608.000	PK	44.0	38.0	7.8	32.8	-	57.0	73.9	16.9	Floor noise
Hori.	2390.000	AV	34.5	27.9	5.6	31.9	1.1	37.2	53.9	16.7	*1)
Hori.	4804.000	AV	32.3	31.7	7.7	31.3	-	40.4	53.9	13.5	Floor noise
Hori.	7206.000	AV	34.4	36.2	9.2	32.4	-	47.4	53.9	6.5	Floor noise
Hori.	9608.000	AV	34.8	38.0	7.8	32.8	-	47.8	53.9	6.1	Floor noise
Vert.	79.942	QP	25.1	6.9	7.9	32.0	-	7.9	40.0	32.1	
Vert.	85.949	QP	30.0	7.9	7.9	31.9	-	13.8	40.0	26.2	
Vert.	172.050	QP	33.9	15.9	8.8	31.9	-	26.7	43.5	16.8	
Vert.	196.681	QP	35.2	16.5	9.0	31.8	-	28.9	43.5	14.6	
Vert.	208.669	QP	44.1	11.2	9.1	31.8	-	32.6	43.5	10.9	
Vert.	294.641	QP	42.1	13.5	9.7	31.8	-	33.5	46.0	12.5	
Vert.	2390.000	PK	42.2	27.9	5.6	31.9	-	43.8	73.9	30.1	
Vert.	4804.000	PK	40.7	31.7	7.7	31.3	-	48.9	73.9	25.0	Floor noise
Vert.	7206.000	PK	43.2	36.2	9.2	32.4	-	56.2	73.9	17.7	Floor noise
Vert.	9608.000	PK	43.3	38.0	7.8	32.8	-	56.3	73.9	17.6	Floor noise
Vert.	2390.000	AV	33.9	27.9	5.6	31.9	1.1	36.6	53.9	17.3	*1)
Vert.	4804.000	AV	32.3	31.7	7.7	31.3	-	40.4	53.9	13.5	Floor noise
Vert.	7206.000	AV	34.4	36.2	9.2	32.4	-	47.4	53.9	6.5	Floor noise
Vert.	9608.000	AV	34.8	38.0	7.8	32.8	-	47.8	53.9	6.1	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 (3.85 m / 3.0 m) = 2.17 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	96.9	27.9	5.6	31.9	98.5	-	-	Carrier
Hori.	2400.000	PK	45.2	27.9	5.6	31.9	46.8	78.5	31.6	
Vert.	2402.000	PK	95.0	27.9	5.6	31.9	96.5	-	-	Carrier
Vert.	2400.000	PK	43.0	27.9	5.6	31.9	44.6	76.5	32.0	

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

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Ise EMC Lab.

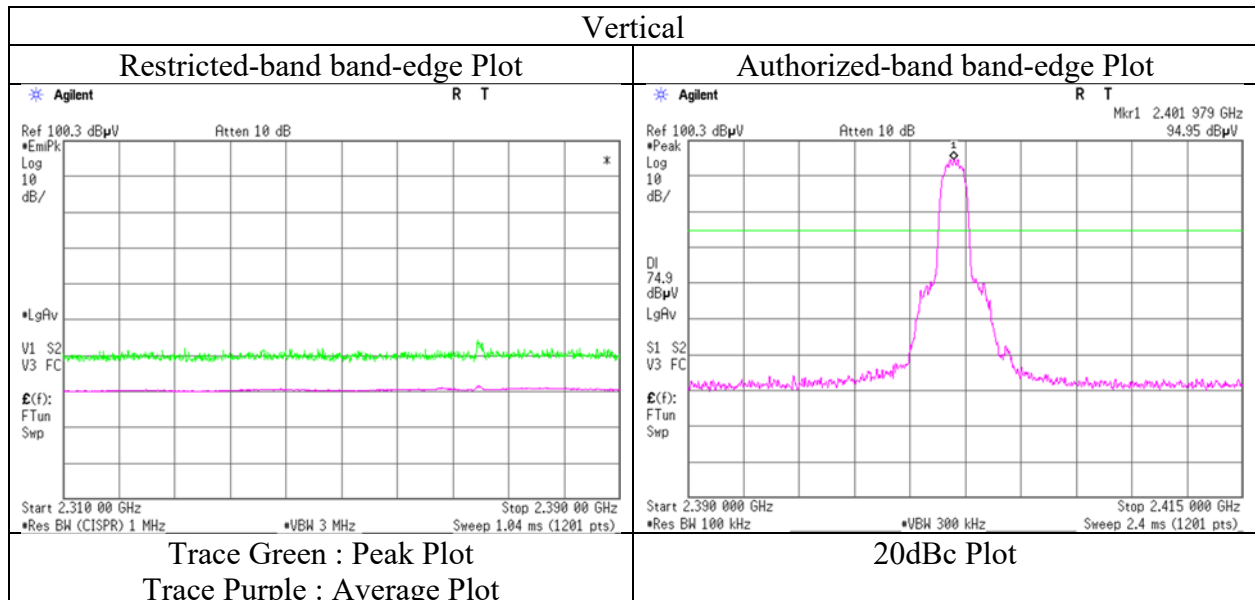
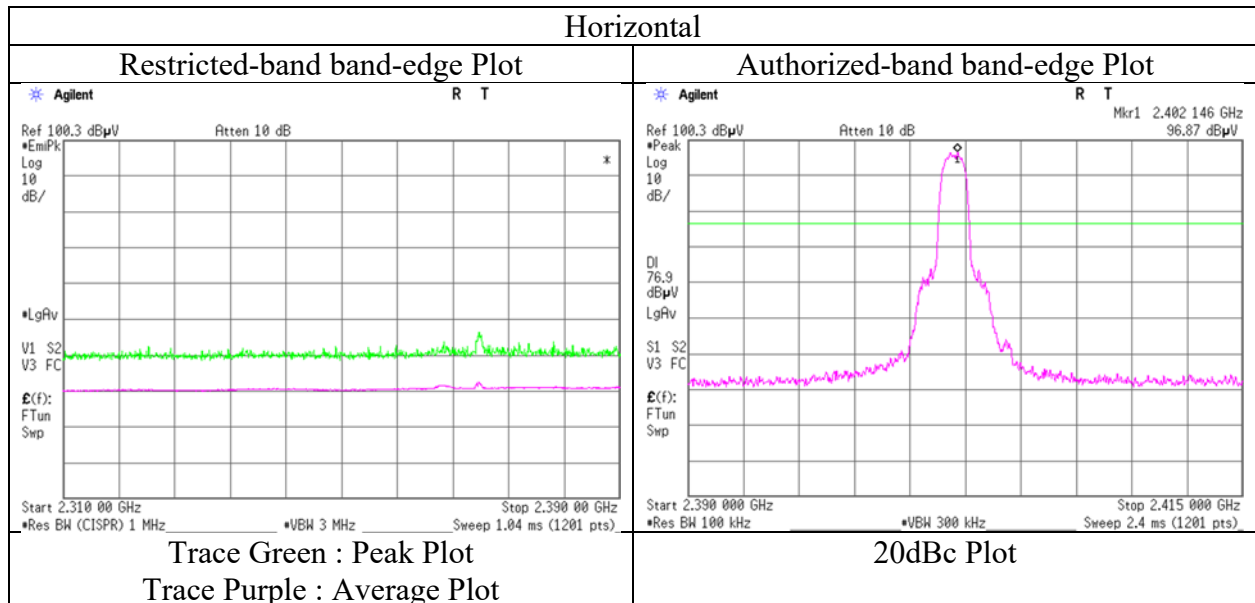
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13328641H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date May 2, 2020
Temperature / Humidity 22 deg. C / 50 % RH
Engineer Junki Nagatomi
(1 GHz -10 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.

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Radiated Spurious Emission

Report No.	13328641H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	May 2, 2020	May 2, 2020	May 5, 2020
Temperature / Humidity	22 deg. C / 50 % RH	22 deg. C / 53 % RH	23 deg. C / 43 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Ken Fujita
	(1 GHz -10 GHz)	(10 GHz -26.5 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.	79.819	QP	32.4	6.8	7.9	32.0	-	15.2	40.0	24.9	
Hori.	86.042	QP	32.5	7.9	7.9	31.9	-	16.4	40.0	23.6	
Hori.	172.099	QP	35.4	15.9	8.8	31.9	-	28.2	43.5	15.3	
Hori.	196.720	QP	36.5	16.5	9.0	31.8	-	30.2	43.5	13.3	
Hori.	208.651	QP	38.2	11.2	9.1	31.8	-	26.7	43.5	16.8	
Hori.	294.714	QP	43.2	13.5	9.7	31.8	-	34.6	46.0	11.4	
Hori.	4882.000	PK	41.4	31.6	7.8	31.2	-	49.5	73.9	24.4	Floor noise
Hori.	7323.000	PK	42.6	36.5	9.2	32.5	-	55.8	73.9	18.1	Floor noise
Hori.	9764.000	PK	43.1	38.3	7.8	32.9	-	56.3	73.9	17.6	Floor noise
Hori.	4882.000	AV	32.8	31.6	7.8	31.2	-	41.0	53.9	13.0	Floor noise
Hori.	7323.000	AV	33.9	36.5	9.2	32.5	-	47.1	53.9	6.8	Floor noise
Hori.	9764.000	AV	34.7	38.3	7.8	32.9	-	47.9	53.9	6.0	Floor noise
Vert.	79.819	QP	25.4	6.8	7.9	32.0	-	8.2	40.0	31.8	
Vert.	86.042	QP	30.2	7.9	7.9	31.9	-	14.1	40.0	25.9	
Vert.	172.099	QP	30.4	15.9	8.8	31.9	-	23.1	43.5	20.4	
Vert.	196.720	QP	34.1	16.5	9.0	31.8	-	27.8	43.5	15.7	
Vert.	208.651	QP	43.2	11.2	9.1	31.8	-	31.7	43.5	11.8	
Vert.	294.714	QP	41.6	13.5	9.7	31.8	-	33.0	46.0	13.0	
Vert.	4882.000	PK	41.1	31.6	7.8	31.2	-	49.2	73.9	24.7	Floor noise
Vert.	7323.000	PK	42.2	36.5	9.2	32.5	-	55.4	73.9	18.5	Floor noise
Vert.	9764.000	PK	43.4	38.3	7.8	32.9	-	56.6	73.9	17.3	Floor noise
Vert.	4882.000	AV	32.8	31.6	7.8	31.2	-	41.0	53.9	13.0	Floor noise
Vert.	7323.000	AV	33.9	36.5	9.2	32.5	-	47.1	53.9	6.8	Floor noise
Vert.	9764.000	AV	34.7	38.3	7.8	32.9	-	47.9	53.9	6.0	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 (3.85 m / 3.0 m) = 2.17 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	13328641H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	May 2, 2020	May 2, 2020	May 5, 2020
Temperature / Humidity	22 deg. C / 50 % RH	22 deg. C / 53 % RH	23 deg. C / 43 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Ken Fujita
	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz		

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
79.848	QP	32.2	6.8	7.9	32.0	-	15.0	40.0	25.0	
86.115	QP	32.5	7.9	7.9	31.9	-	16.4	40.0	23.6	
196.603	QP	35.5	16.5	9.0	31.8	-	29.1	43.5	14.4	
202.569	QP	36.8	11.5	9.0	31.8	-	25.4	43.5	18.1	
208.717	QP	37.1	11.2	9.1	31.8	-	25.6	43.5	17.9	
294.668	QP	40.1	13.5	9.7	31.8	-	31.5	46.0	14.5	
2483.500	PK	50.0	27.7	5.7	31.8	-	51.5	73.9	22.4	
4960.000	PK	41.1	31.6	7.8	31.2	-	49.3	73.9	24.6	Floor noise
7440.000	PK	42.3	36.6	9.2	32.5	-	55.6	73.9	18.3	Floor noise
9920.000	PK	44.2	38.5	7.9	33.0	-	57.5	73.9	16.4	Floor noise
2483.500	AV	40.3	27.7	5.7	31.8	1.1	42.9	53.9	11.0	*1)
4960.000	AV	32.9	31.6	7.8	31.2	-	41.1	53.9	12.9	Floor noise
7440.000	AV	33.9	36.6	9.2	32.5	-	47.2	53.9	6.7	Floor noise
9920.000	AV	34.5	38.5	7.9	33.0	-	47.9	53.9	6.0	Floor noise
79.848	QP	24.3	6.8	7.9	32.0	-	7.1	40.0	32.9	
86.115	QP	30.1	7.9	7.9	31.9	-	14.0	40.0	26.0	
196.603	QP	31.3	16.5	9.0	31.8	-	24.9	43.5	18.6	
202.569	QP	45.2	11.5	9.0	31.8	-	33.9	43.5	9.7	
208.717	QP	43.2	11.2	9.1	31.8	-	31.6	43.5	11.9	
294.668	QP	41.8	13.5	9.7	31.8	-	33.2	46.0	12.8	
2483.500	PK	47.3	27.7	5.7	31.8	-	48.9	73.9	25.0	
4960.000	PK	41.5	31.6	7.8	31.2	-	49.7	73.9	24.2	Floor noise
7440.000	PK	42.7	36.6	9.2	32.5	-	55.9	73.9	18.0	Floor noise
9920.000	PK	44.5	38.5	7.9	33.0	-	57.8	73.9	16.1	Floor noise
2483.500	AV	37.3	27.7	5.7	31.8	1.1	39.9	53.9	14.0	*1)
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7440.000	AV	33.9	36.6	9.2	32.5	-	47.2	53.9	6.7	Floor noise
9920.000	AV	34.5	38.5	7.9	33.0	-	47.9	53.9	6.0	Floor noise

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

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

factor: 1 GHz - 10 GHz $20\log(3.85\text{ m} / 3.0\text{ m}) = 2.17\text{ dB}$

10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

out of Band emission(Leakage Power)

UL Japan, Inc.

Ise EMC Lab.

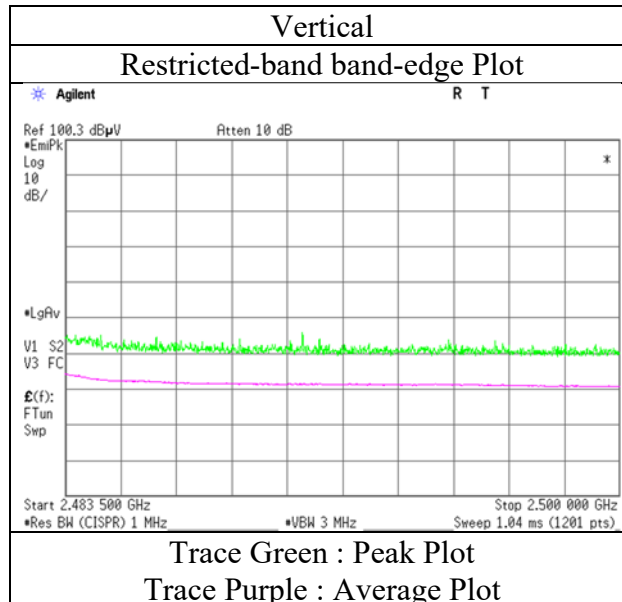
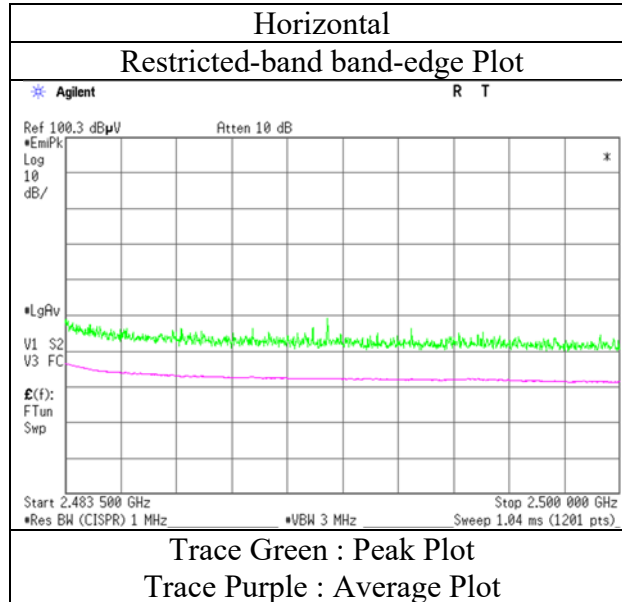
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Radiated Spurious Emission
(Reference Plot for band-edge)

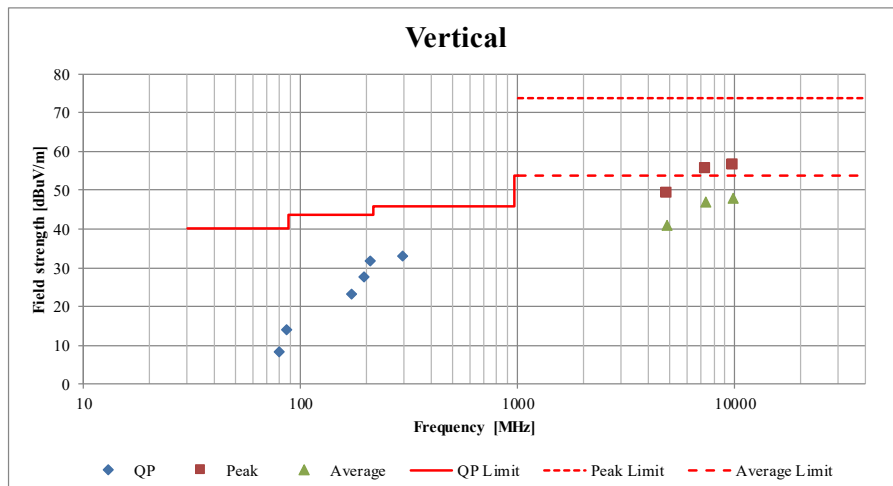
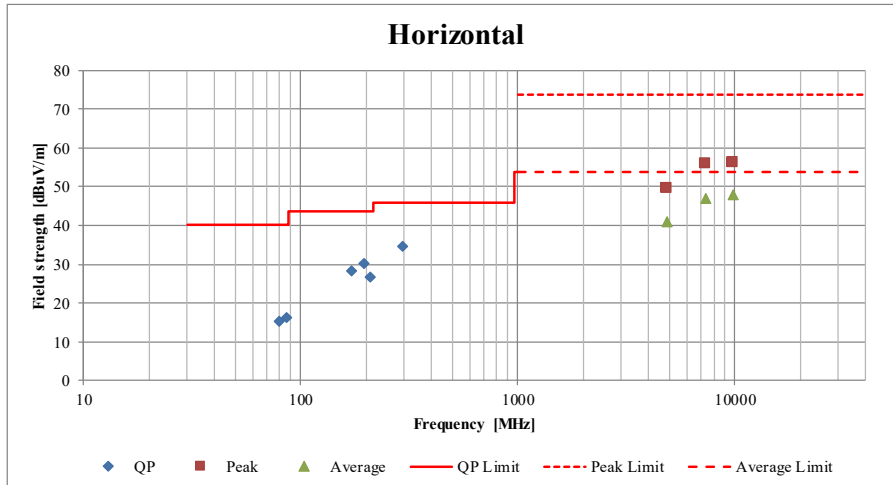
Report No. 13328641H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date May 2, 2020
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Engineer Junki Nagatomi
(1 GHz -10 GHz)
Mode Tx, Hopping Off, 3DH5 2480 MHz



* 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.	13328641H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	May 2, 2020	May 2, 2020	May 5, 2020
Temperature / Humidity	22 deg. C / 50 % RH	22 deg. C / 53 % RH	23 deg. C / 43 % RH
Engineer	Junki Nagatomi (1 GHz -10 GHz)	Junki Nagatomi (10 GHz -26.5 GHz)	Ken Fujita (Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz		

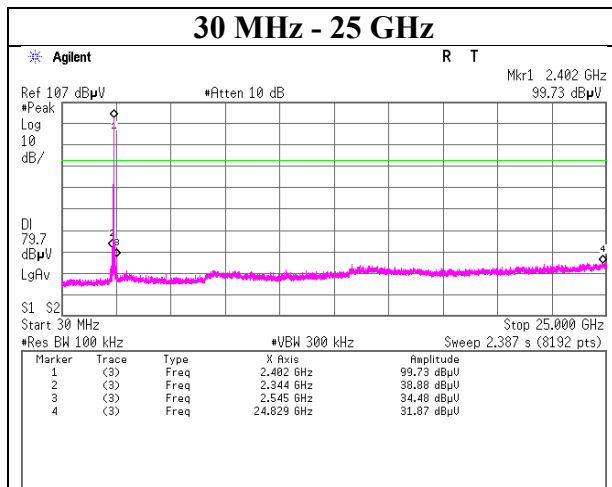
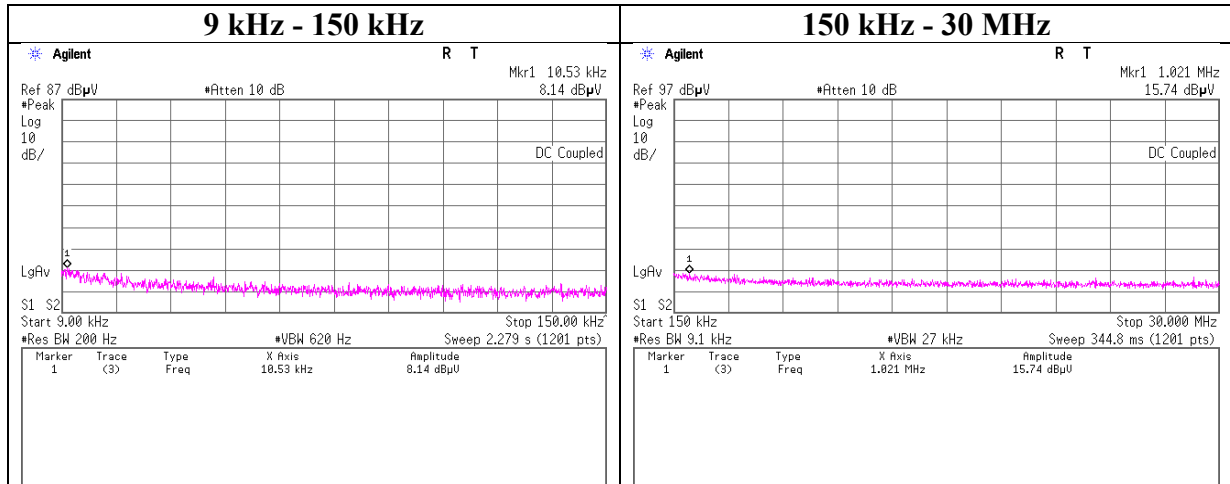


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Report No.	13328641H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	April 22, 2020
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, DH5

2402 MHz



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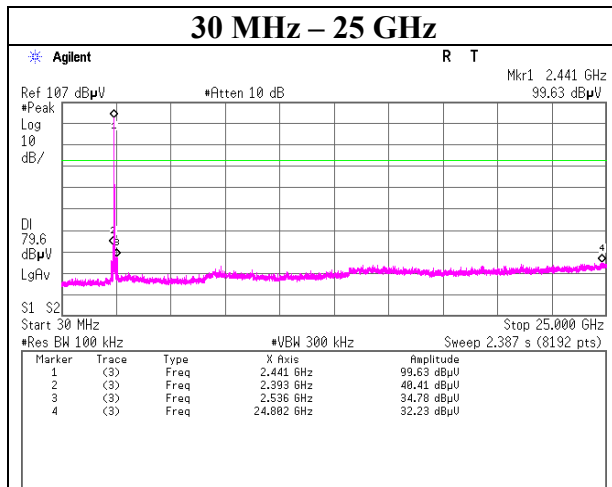
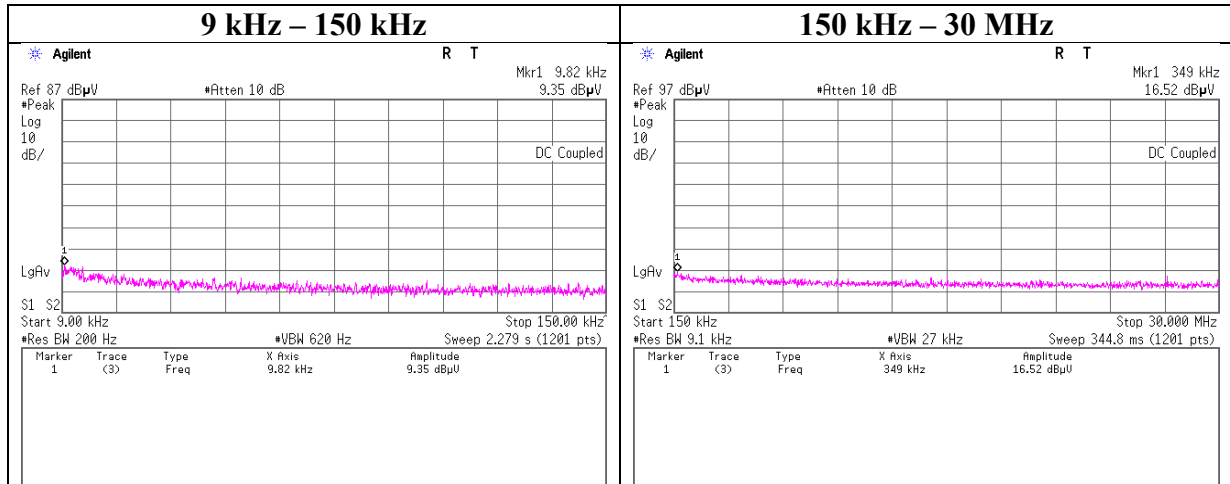
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	13328641H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	April 22, 2020
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, DH5

2441 MHz



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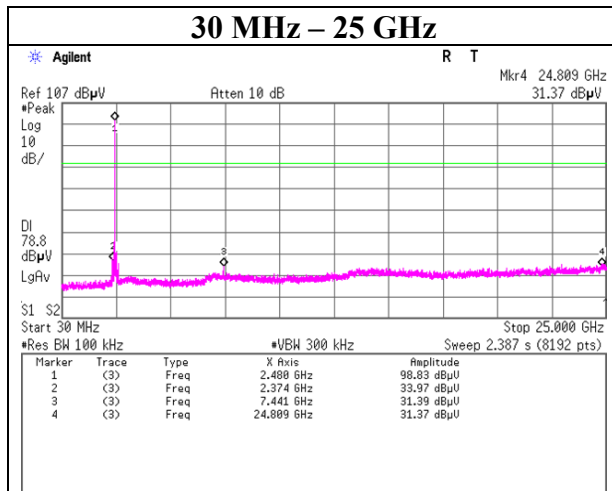
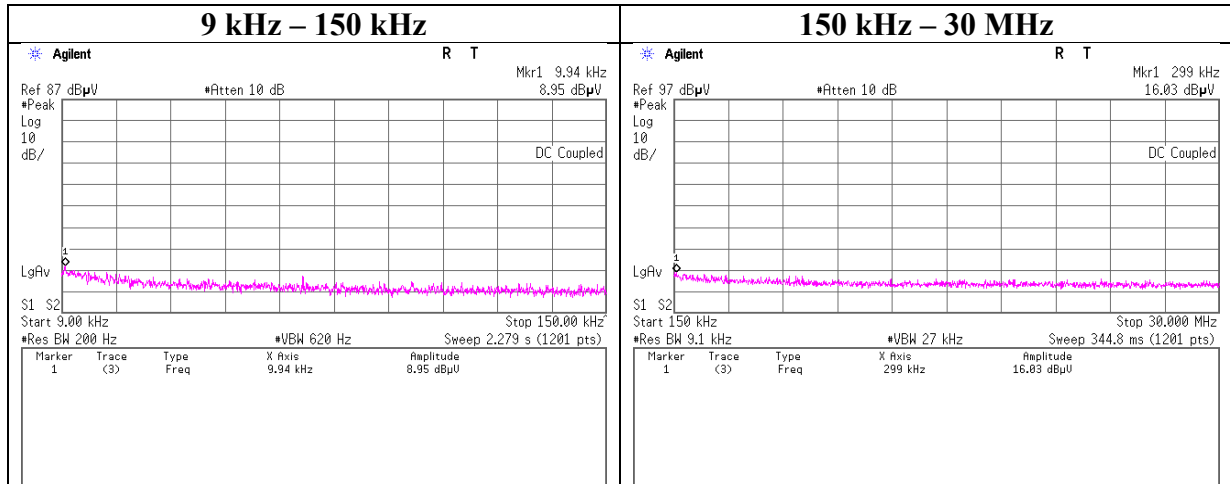
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	13328641H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	April 22, 2020
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, DH5

2480 MHz



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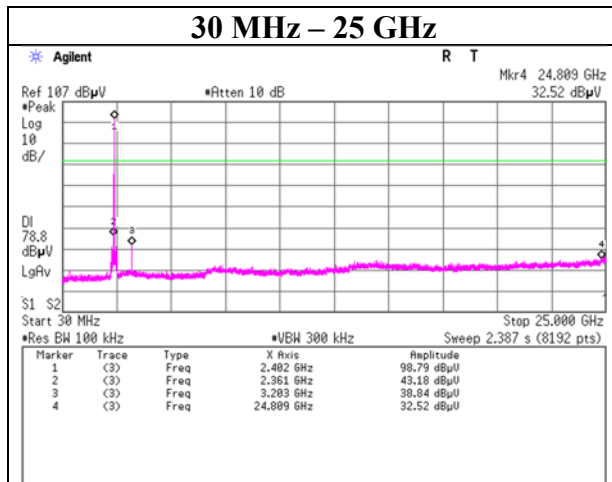
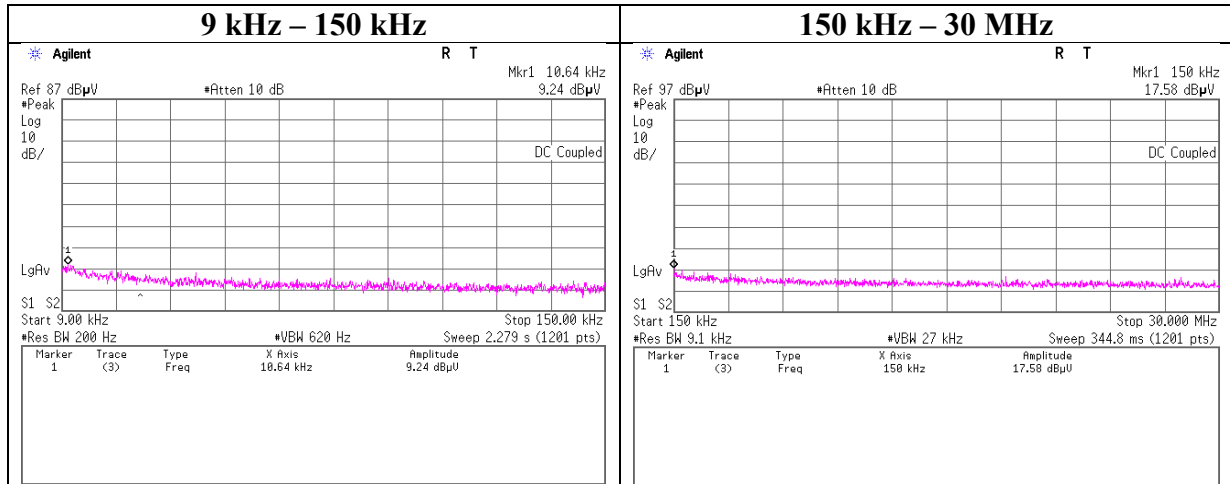
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	13328641H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	April 22, 2020
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, 3DH5

2402 MHz



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Ise EMC Lab.

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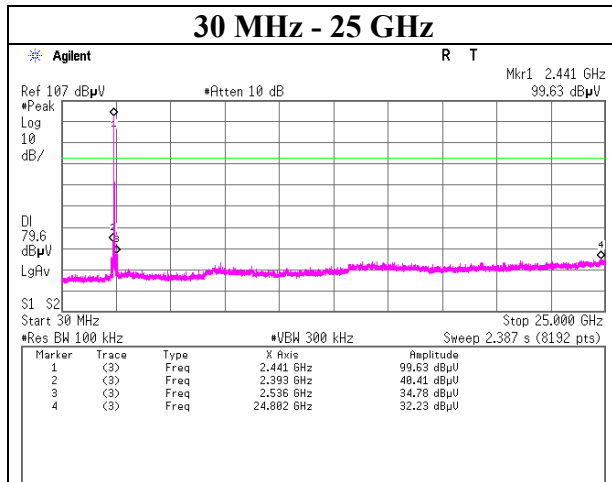
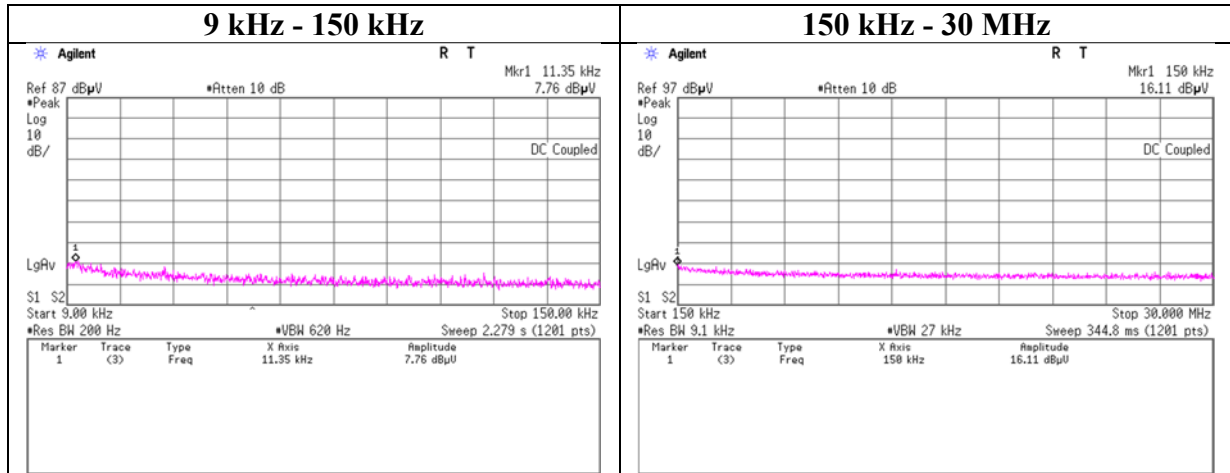
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	13328641H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	April 22, 2020
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, 3DH5

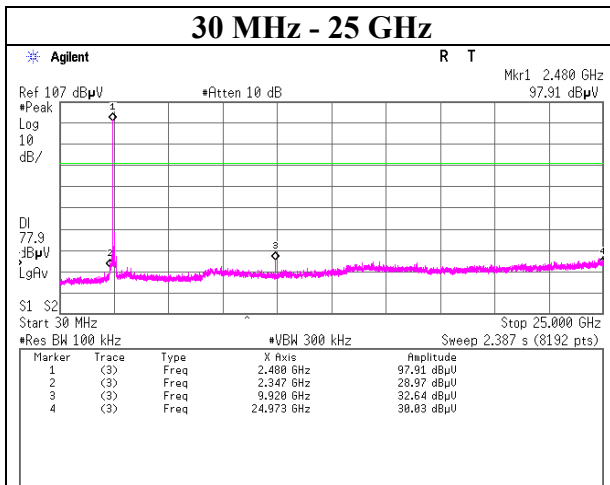
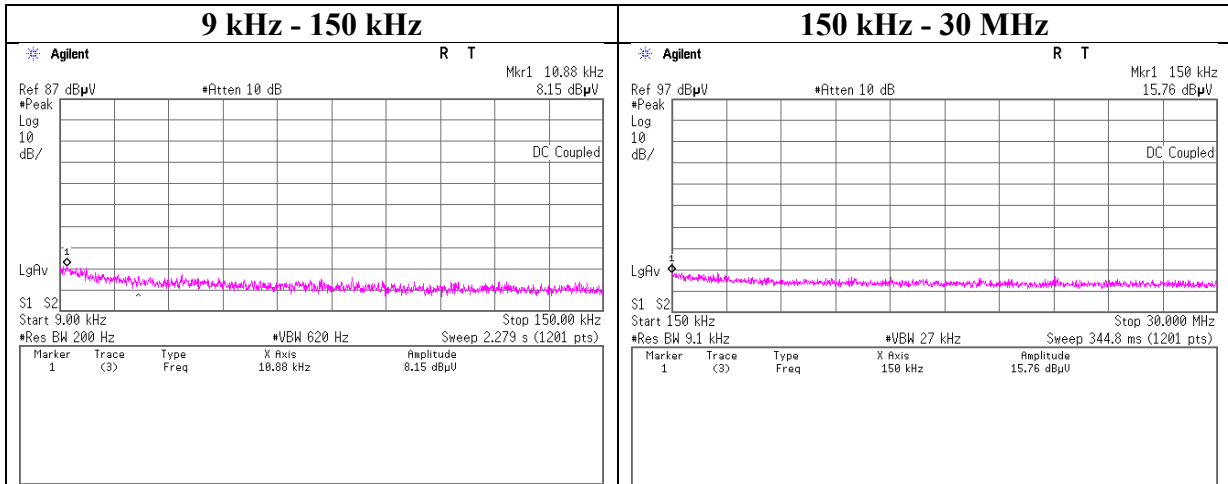
2441 MHz



Conducted Spurious Emission

Report No.	13328641H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	April 22, 2020
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, 3DH5

2480 MHz



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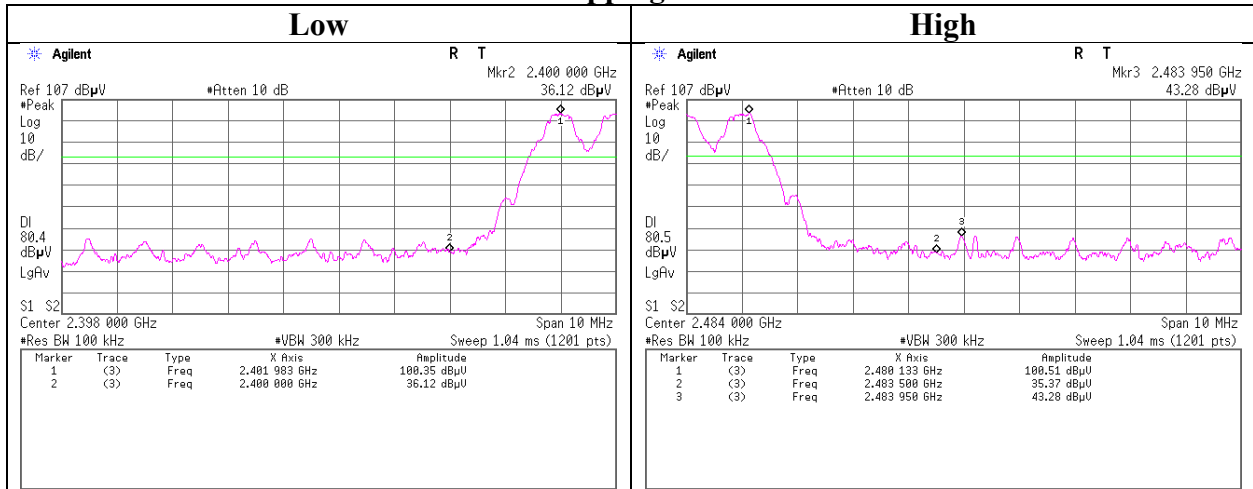
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

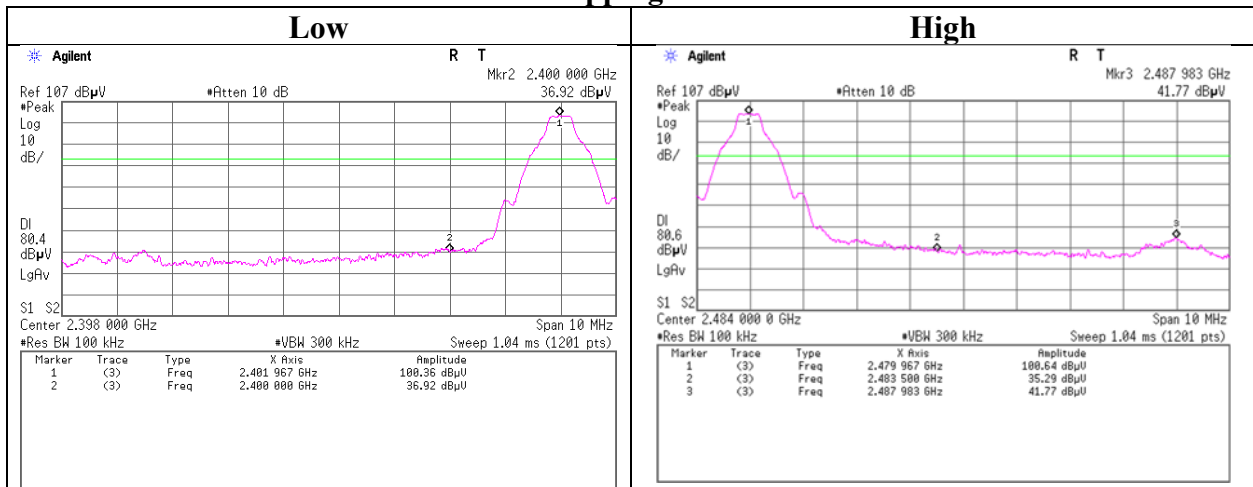
Conducted Emission Band Edge compliance

Report No. 13328641H
 Test place Ise EMC Lab. No.8 Measurement Room
 Date April 22, 2020
 Temperature / Humidity 23 deg. C / 45 % RH
 Engineer Hiroyuki Furutaka
 Mode Tx, DH5

Hopping On



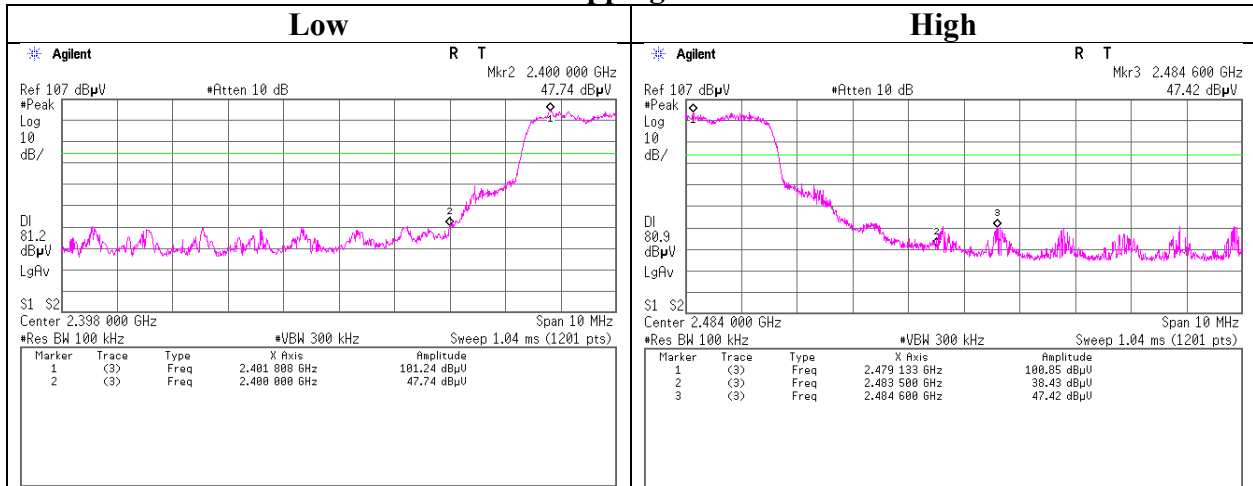
Hopping Off



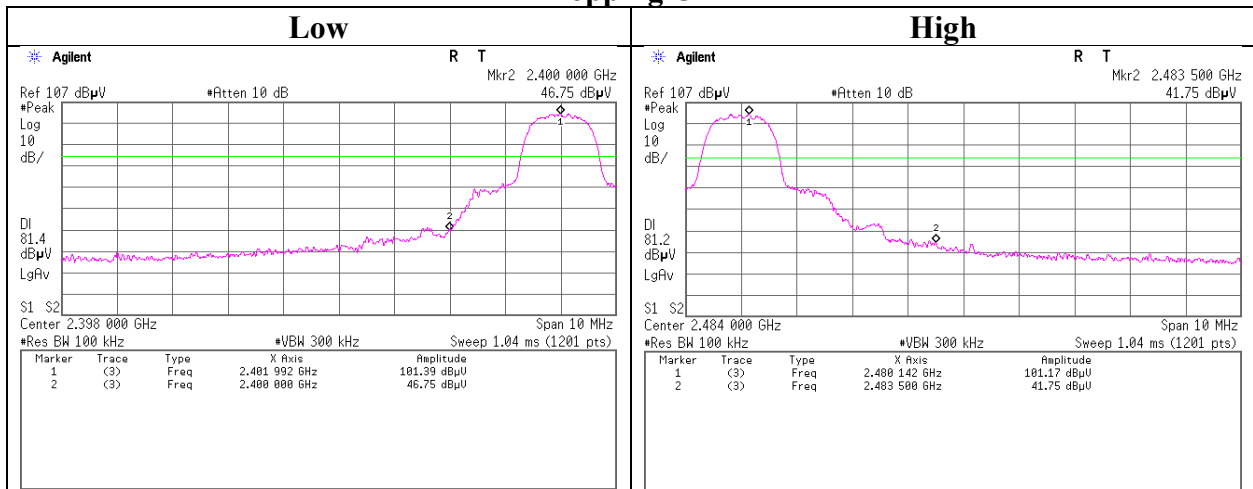
Conducted Emission Band Edge compliance

Report No.	13328641H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	April 22, 2020
Temperature / Humidity	23 deg. C / 45 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, 3DH5

Hopping On



Hopping Off



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APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	MAT-23	141361	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	04/21/2020	12
AT	MCC-55	141326	Microwave Cable	Suhner	SUCOFLEX101	2874(1m) / 2877(5m)	03/24/2020	12
AT	MSA-13	141900	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46185823	-	-
AT	MPM-12	141809	Power Meter	ANRITSU	ML2495A	825002	05/07/2020	12
AT	MPSE-17	141830	Power sensor	ANRITSU	MA2411B	738285	05/07/2020	12
AT	MOS-28	141567	Thermo-Hygrometer	CUSTOM	CTH-201	0008	01/07/2020	12
AT	MMM-16	141360	DIGITAL HiTESTER	Hioki	3805	70900532	01/06/2020	12
AT	MAT-10	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/07/2019	12
AT	MCC-64	141327	Coaxial Cable	UL Japan	-	-	02/04/2020	12
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM	CTH-201	0010	01/07/2020	12
RE	MMM-10	141545	DIGITAL HiTESTER	Hioki	3805	51201148	01/06/2020	12
RE	MJM-26	142227	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-M EMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-04 -SVSWR	142017	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/04/2019	24
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	557	05/22/2020	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	650	10/16/2019	12
RE	MCC-141	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	06/17/2019	12
RE	MHF-26	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	09/11/2019	12
RE	MSA-04	141885	Spectrum Analyzer	Keysight Technologies Inc	E4448A	US44300523	11/21/2019	12
RE	MHA-17	141506	Horn Antenna 15-40GHz	Schwarzbeck Mess - Elektronik	BBHA9170	BBHA9170307	10/08/2019	12
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/05/2020	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103+BBA910 6	1302	08/24/2019	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	03/24/2020	12
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-192	08/24/2019	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/18/2020	12
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/28/2018	24

*Hyphens for Last Calibration 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.

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

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

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

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