



RADIO TEST REPORT

Test Report No. : 13980589H-A-R1

Applicant : DENSO TEN Limited
Type of EUT : Car Audio
Model Number of EUT : TN0035A
FCC ID : BABTN0035A
Test regulation : FCC Part 15 Subpart C: 2021
Test Result : Complied (Refer to SECTION 3)

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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.
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6. This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13980589H-A. 13980589H-A is replaced with this report.

Date of test: September 7 to October 4, 2021

Representative test engineer:


Kiyoshiro Okazaki
Engineer

Approved by:


Tsubasa Takayama
Leader



CERTIFICATE 5107.02

- The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
 There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13980589H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13980589H-A	November 18, 2021	-	-
1	13980589H-A-R1	January 13, 2022	P. 6	Correction of Remarks of Spurious Emission & Band Edge Compliance from *1) to *2)

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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.....	6
SECTION 4: Operation of EUT during testing.....	9
SECTION 5: Radiated Spurious Emission	13
SECTION 6: Antenna Terminal Conducted Tests.....	15
APPENDIX 1: Test data	16
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation	16
Number of Hopping Frequency	20
Dwell time.....	22
Maximum Peak Output Power.....	25
Average Output Power.....	26
Radiated Spurious Emission	28
Conducted Spurious Emission	39
Conducted Emission Band Edge compliance	45
APPENDIX 2: Test instruments	47
APPENDIX 3: Photographs of test setup	49
Radiated Spurious Emission	49
Radiated Spurious Emission	50
Antenna Terminal Conducted Tests.....	51

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
Contact Person : Daisuke Fukii

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
Model Number : TN0035A
Serial Number : Refer to SECTION 4.2
Receipt Date : September 5, 2021
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: TN0035A (referred to as the EUT in this report) is a Car Audio.

General Specification

Rating : DC 12 V

Radio Specification

Bluetooth Ver.5.0 with EDR function	
Radio Type	Transceiver
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK)
Channel spacing	1 MHz
Antenna type	Inverted F PCB Antenna
Antenna Connector type	None
Antenna Gain	-1.08 dBi (Peak)
Clock Frequency (Maximum)	20 MHz

Broadcast Receiver	
Radio Type	Receiver
Frequency of Operation	AM: 531 kHz - 1602 kHz FM, RDS: 87.5 MHz - 108.0 MHz DAB: 174.928 MHz - 229.072 MHz
Type of modulation	AM: AM FM(RDS): FM DAB: OFDM
Antenna connector type	HFC IV

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021

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

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	*1)
Carrier Frequency Separation	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section15.247(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: Section15.247(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: Section15.247(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: Section15.247(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: Section15.247(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: Section15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	10.0 dB 4960.0 MHz, AV, Vert.	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	ISED: RSS-Gen 6.7	ISED: -	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)

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

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

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
10 m	1 GHz to 18 GHz	5.2 dB

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3.5 Test Location

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*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

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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.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

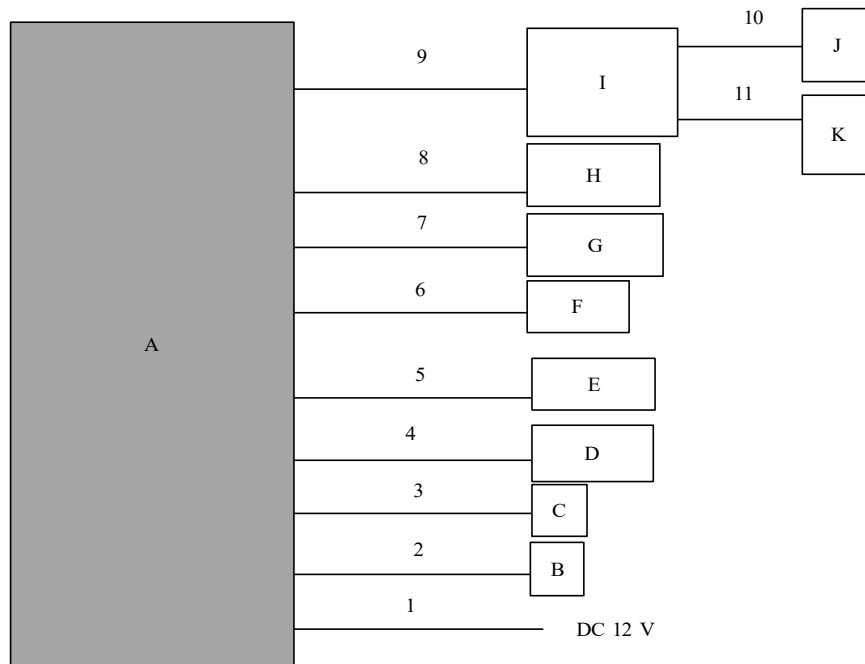
Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, Spurious Emission (Conducted/Radiated)	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Carrier Frequency Separation	Tx (Hopping On) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
20dB Bandwidth	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Number of Hopping Frequency	Tx (Hopping On) DH5, 3DH5	-
Dwell time	Tx (Hopping On), -DH1, DH3, DH5 -3DH1, 3DH3, 3DH5	-
Maximum Peak Output Power	Tx (Hopping Off) DH5, 2DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2441 MHz 2480 MHz
<p>*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test)</p> <p>*2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative.</p> <p>* It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all the test items based on Bluetooth Core specification.</p> <p>*EUT has the power settings by the software as follows; Power settings: 0 dBm Software: Bluetooth test software V1.0.0 (Date: August 27,2021, 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>		

4.2 Configuration and peripherals

Radiated Emission test



* 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	TN0035A	100174648-0002	DENSO TEN Limited	EUT
B	Microphone	86730-78010 (SDD303)	0LC000059	Panasonic	-
C	Camera	86790-62010 (GP-KD63B1RC)	8ZC300213	Panasonic	-
D	Steering Switch	84250-58150-BO	884-6191	-	-
E	Speaker Dummy	EDA2(MID) SP Dummy	DUMMY-210906 -002	DENSO TEN Limited	-
F	AM/FM SharkFin Antenna	86760-K0010	AM/FM ANT-210906-001	YOKOWO	-
G	DAB Antenna AMP	863C0-60050	PQB02907	DENSO TEN Limited	-
H	GNSS Antenna	86880-78010	UI 034339	HARADA	-
I	USB I/F BOX	86190-78020	500864	Panasonic	-
J	USB memory	RUF3-K8GA-BK/N	P90611	Buffalo	-
K	iPhone	MD297B/A	C34JJ55EDTWD	Apple	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.5	Unshielded	Unshielded	-
2	MiC Cable	3.5	Unshielded	Unshielded	-
3	Camera Cable	3.5	Unshielded	Unshielded	-
4	System Cable	3.5	Unshielded	Unshielded	-
5	Speaker Cable	3.5	Unshielded	Unshielded	-
6	Antenna Cable	1.0	Shielded	Shielded	-
7	Antenna Cable	2.6	Shielded	Shielded	-
8	Antenna Cable	1.0	Shielded	Shielded	-
9	Signal Cable	0.5	Unshielded	Unshielded	-
10	USB Cable	2.0	Shielded	Shielded	-
11	USB Cable	1.0	Shielded	Shielded	-

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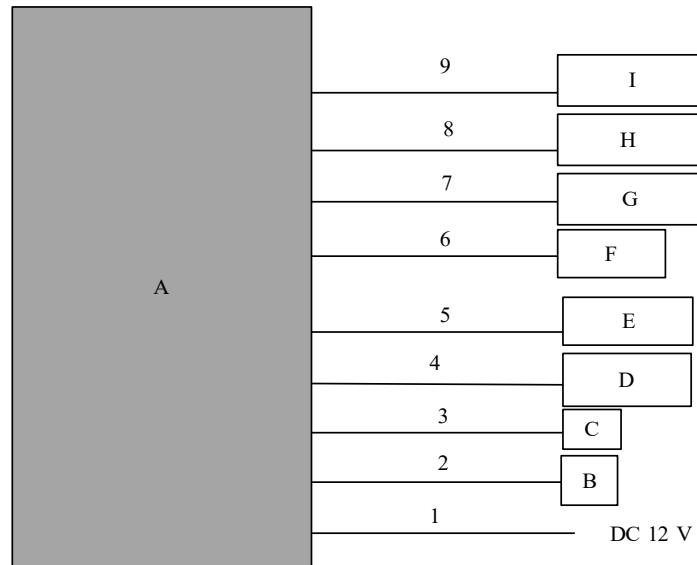
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Antenna Terminal Conducted test



* 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	TN0035A	100174648-0001	DENSO TEN Limited	EUT
B	Microphone	86730-78010 (SDD303)	0LC000059	Panasonic	-
C	Camera	86790-62010 (GP-KD63B1RC)	8ZC300213	Panasonic	-
D	Steering Switch	84250-58150-BO	884-6191	-	-
E	Speaker Dummy	EDA2(MID) SP Dummy	DUMMY-210906-002	DENSO TEN Limited	-
F	AM/FM SharkFin Antenna	86760-K0010	AM/FM ANT-210906-001	YOKOWO	-
G	DAB Antenna AMP	863C0-60050	PQB02907	DENSO TEN Limited	-
H	GNSS Antenna	86880-78010	UI 034339	HARADA	-
I	USB I/F BOX	86190-78020	500864	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.5	Unshielded	Unshielded	-
2	MiC Cable	3.5	Unshielded	Unshielded	-
3	Camera Cable	3.5	Unshielded	Unshielded	-
4	System Cable	3.5	Unshielded	Unshielded	-
5	Speaker Cable	3.5	Unshielded	Unshielded	-
6	Antenna Cable	1.0	Shielded	Shielded	-
7	Antenna Cable	2.6	Shielded	Shielded	-
8	Antenna Cable	1.0	Shielded	Shielded	-
9	Signal Cable	0.5	Unshielded	Unshielded	-

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SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

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

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 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.

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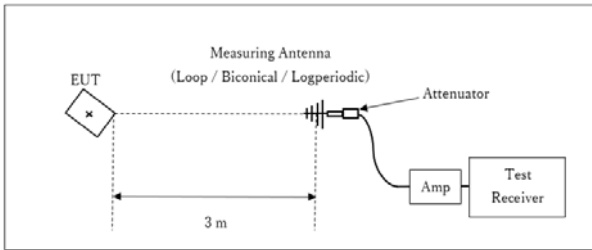
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Figure 1: Test Setup

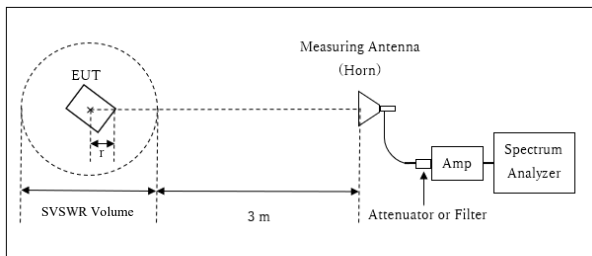
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

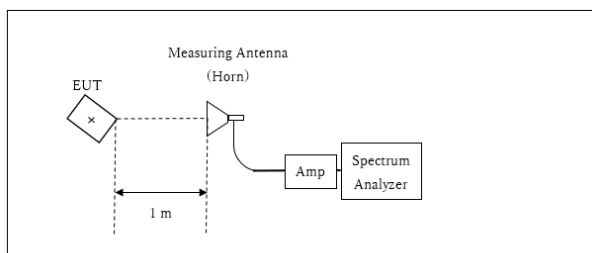


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: $20 \times \log(3.9 \text{ m} / 3.0 \text{ m}) = 2.28 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.9 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.1 m

10 GHz - 26.5 GHz



× : Center of turn table

Distance Factor: $20 \times \log(1.0 \text{ m}^* / 3.0 \text{ m}) = -9.54 \text{ dB}$
*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) *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) The measurement was performed with Max Hold since the duty cycle was not 100 %.

*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).

*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

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APPENDIX 1: Test data

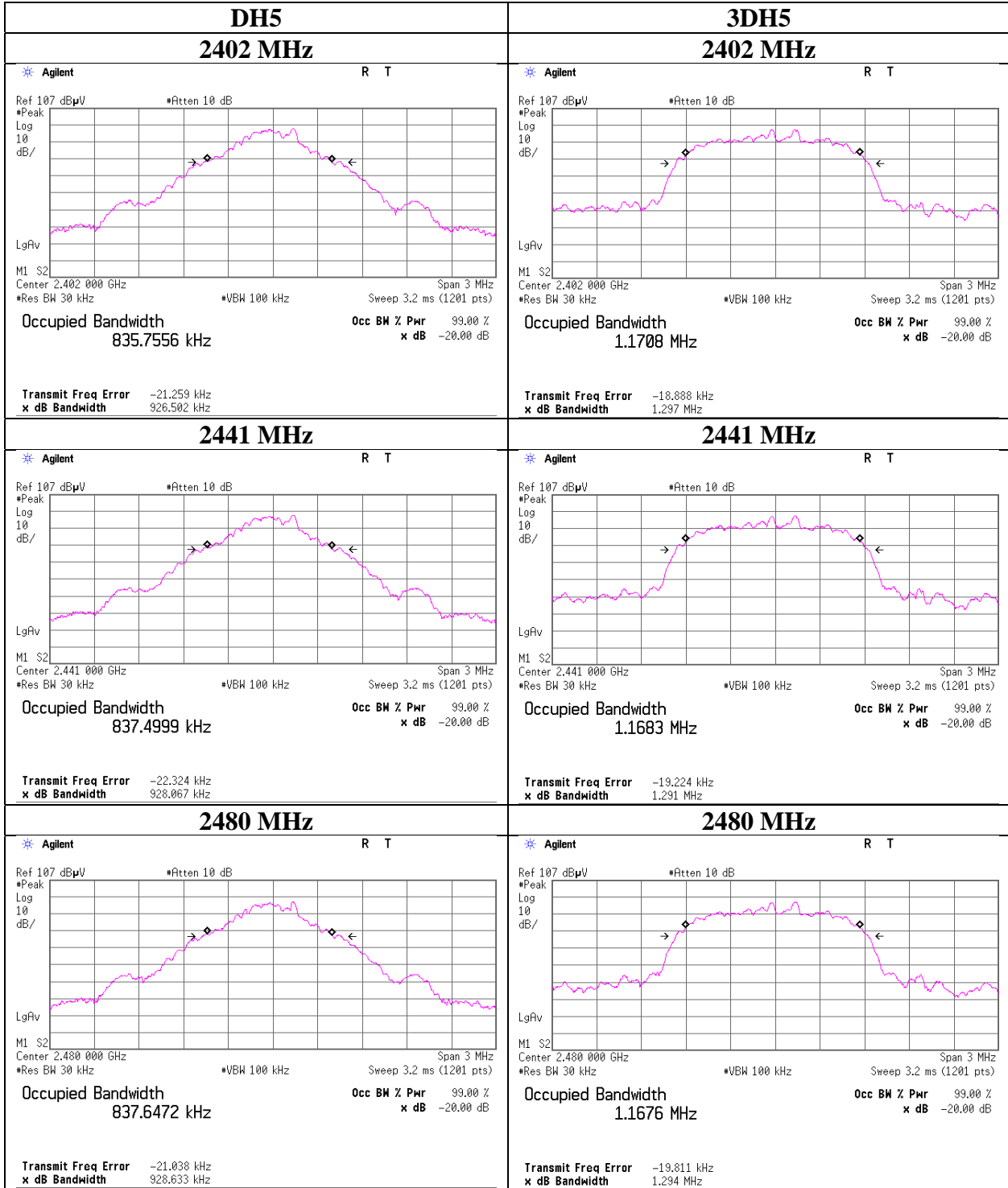
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation

Report No. 13980589H
Test place Ise EMC Lab. No.8 Measurement Room
Date September 8, 2021
Temperature / Humidity 24 deg. C / 60 % RH
Engineer Hiroyuki Furutaka
Mode Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.927	835.756	1.000	>= 0.618
DH5	2441.0	0.928	837.500	1.000	>= 0.619
DH5	2480.0	0.929	837.647	1.000	>= 0.619
DH5	Hopping On	-	78616.500	-	-
3DH5	2402.0	1.297	1170.800	1.000	>= 0.865
3DH5	2441.0	1.291	1168.300	1.000	>= 0.861
3DH5	2480.0	1.294	1167.600	1.000	>= 0.863
3DH5	Hopping On	-	78705.800	-	-

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

20dB Bandwidth and 99% Occupied Bandwidth



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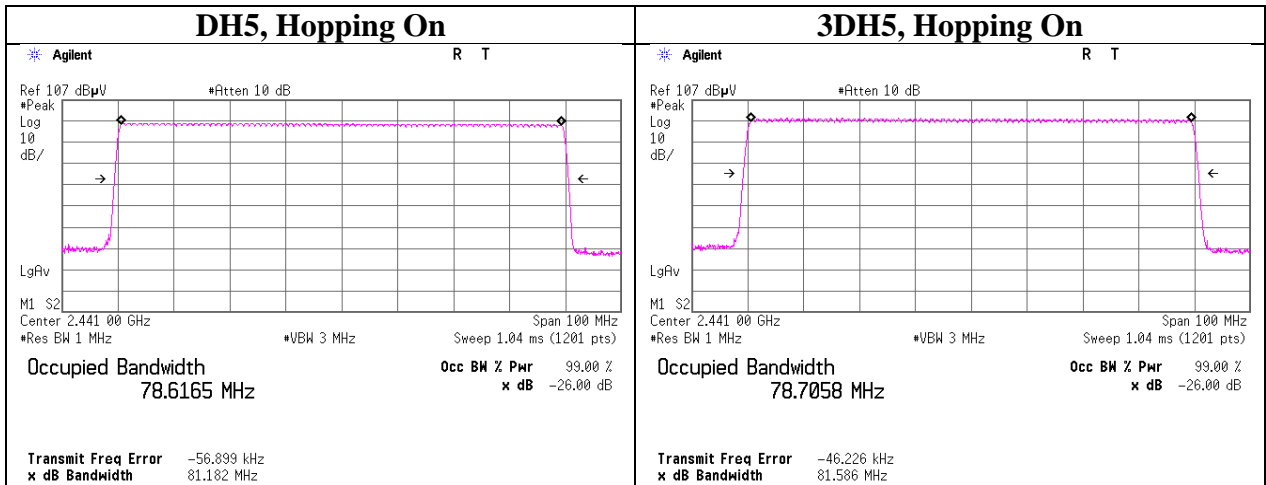
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20dB Bandwidth and 99% Occupied Bandwidth



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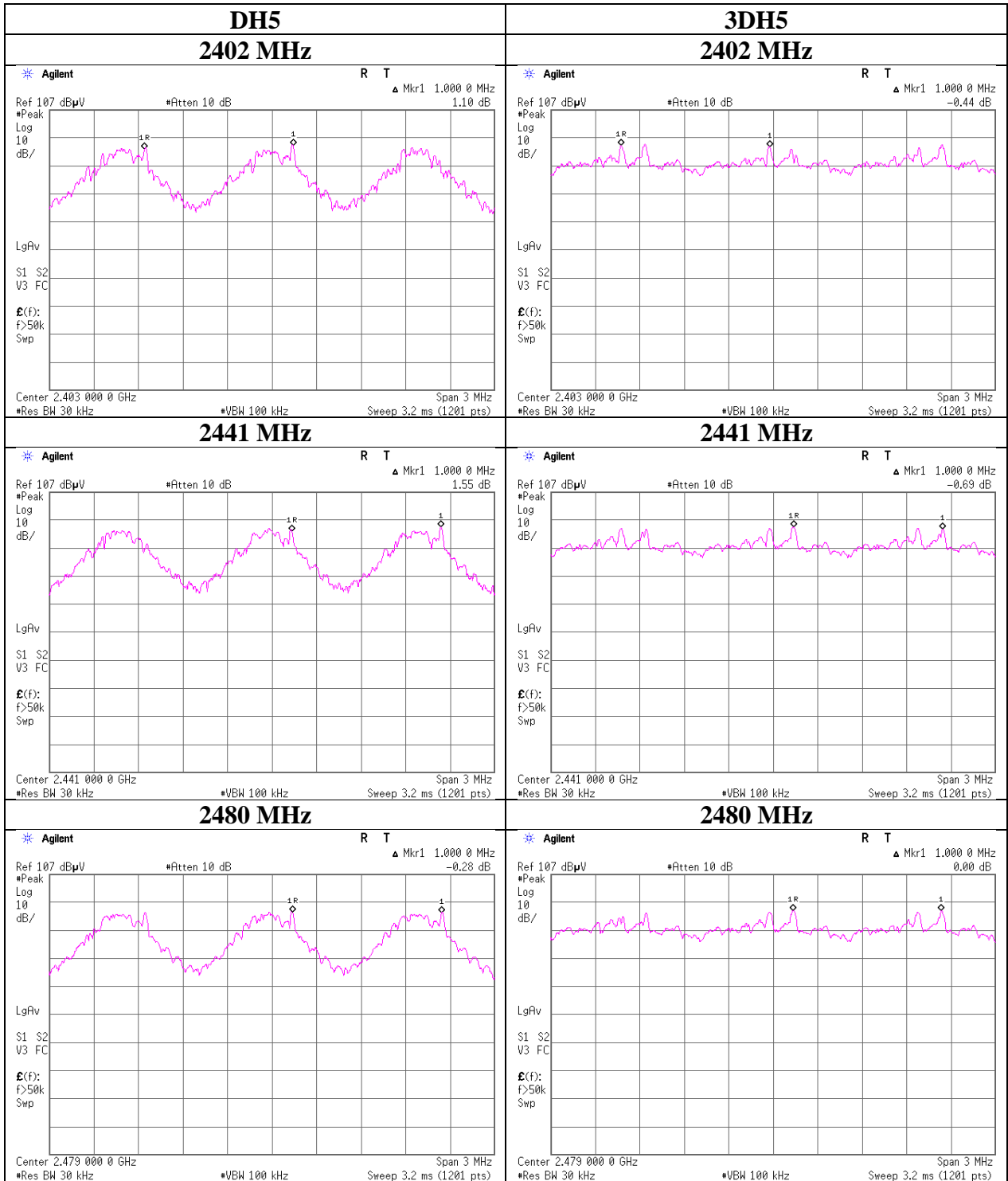
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Carrier Frequency Separation



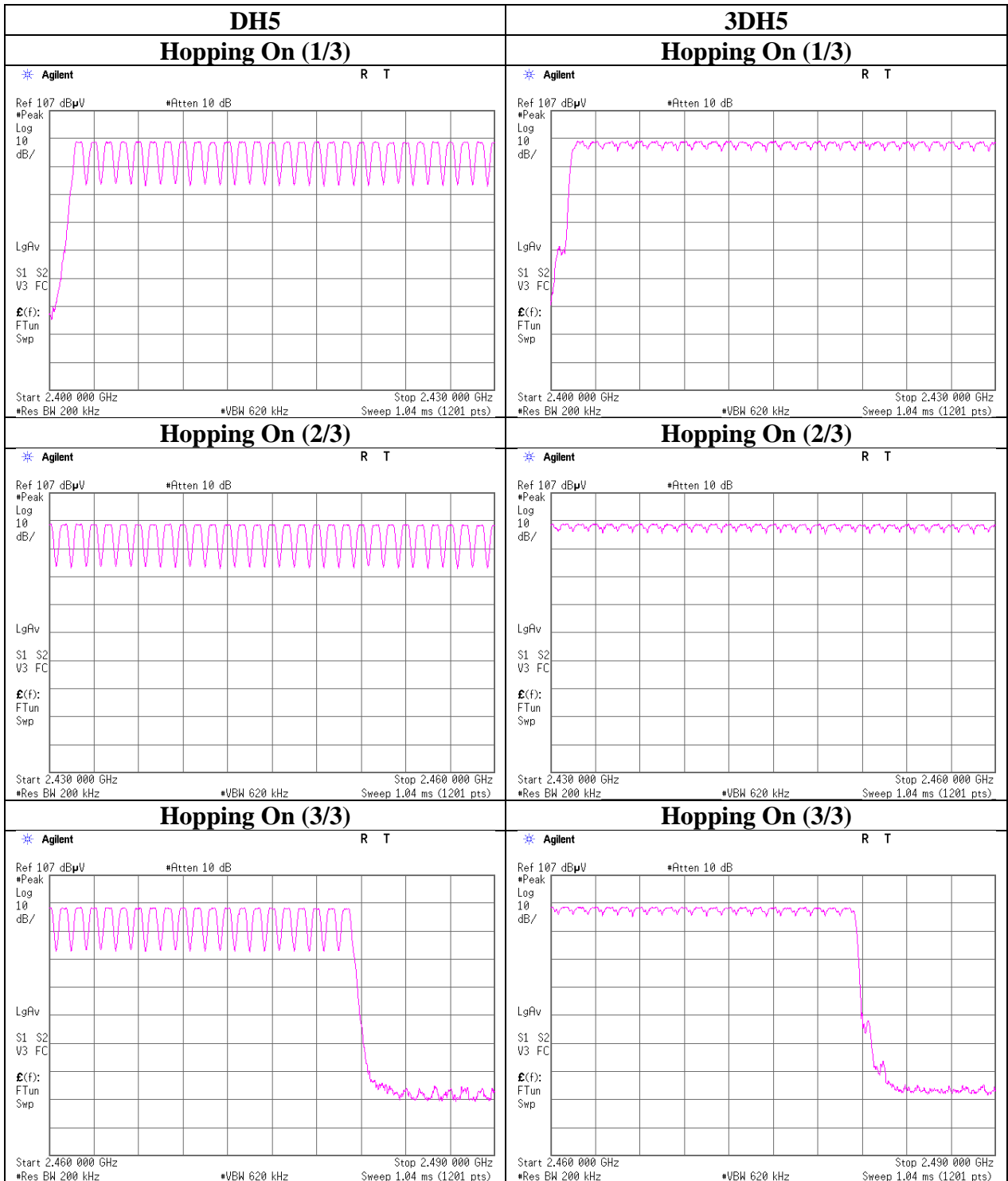
Number of Hopping Frequency

Report No. 13980589H
Test place Ise EMC Lab. No.8 Measurement Room
Date September 8, 2021
Temperature / Humidity 24 deg. C / 60 % 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. 13980589H
Test place Ise EMC Lab. No.8 Measurement Room
Date September 8, 2021
Temperature / Humidity 24 deg. C / 60 % 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	50.2 times /	5 sec. x	31.6 sec. =	318 times	0.450	143	400
DH3	28.2 times /	5 sec. x	31.6 sec. =	179 times	1.718	308	400
DH5	20.6 times /	5 sec. x	31.6 sec. =	131 times	2.997	393	400
3DH1	50.8 times /	5 sec. x	31.6 sec. =	322 times	0.457	147	400
3DH3	26.0 times /	5 sec. x	31.6 sec. =	165 times	1.733	286	400
3DH5	21.0 times /	5 sec. x	31.6 sec. =	133 times	2.967	395	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	51	51	50	50	49	50.2
DH3	29	27	27	28	30	28.2
DH5	19	21	22	20	21	20.6
3DH1	52	50	49	51	52	50.8
3DH3	27	23	25	26	29	26
3DH5	18	20	21	22	24	21

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 $N = 79$.

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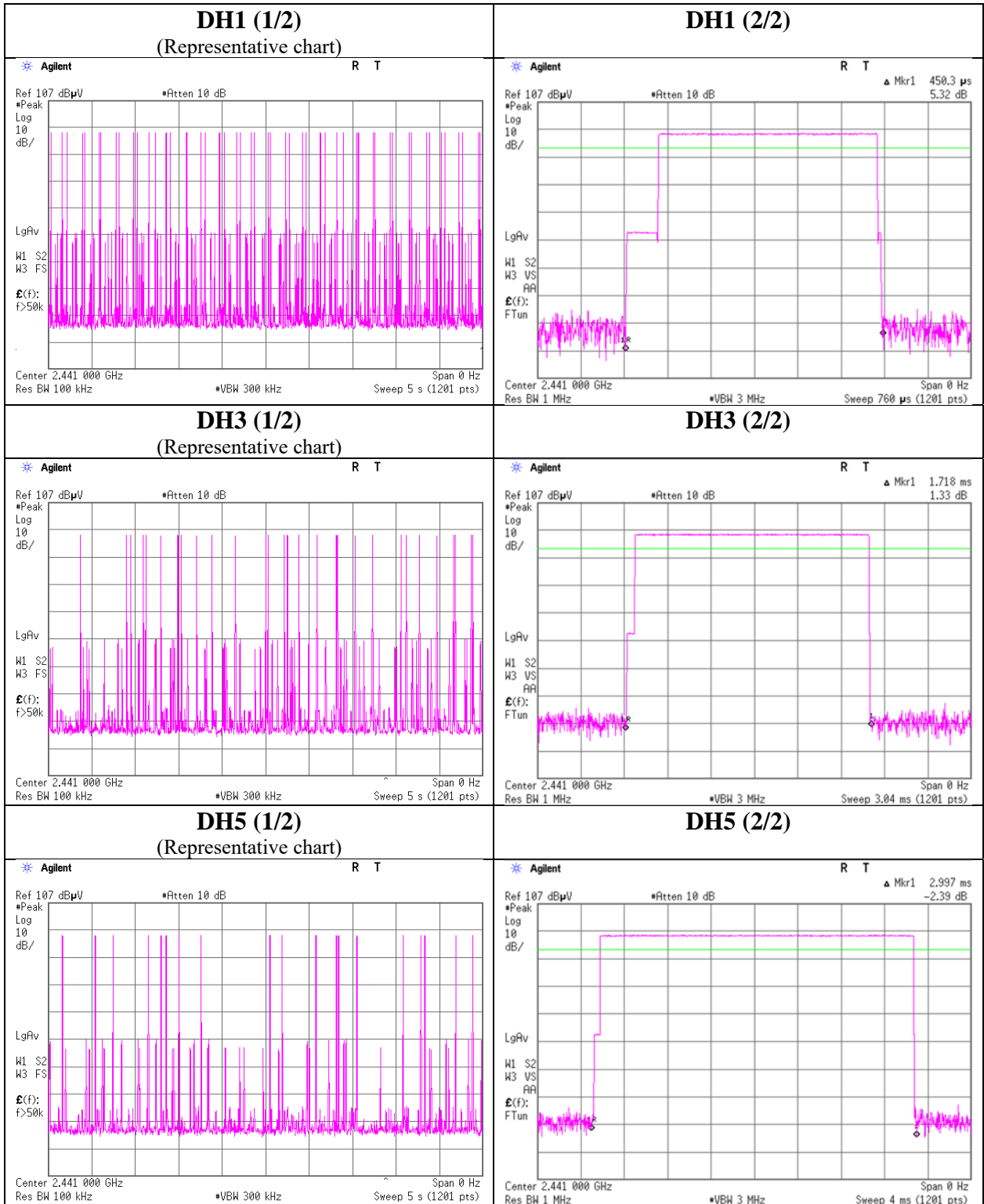
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Dwell time



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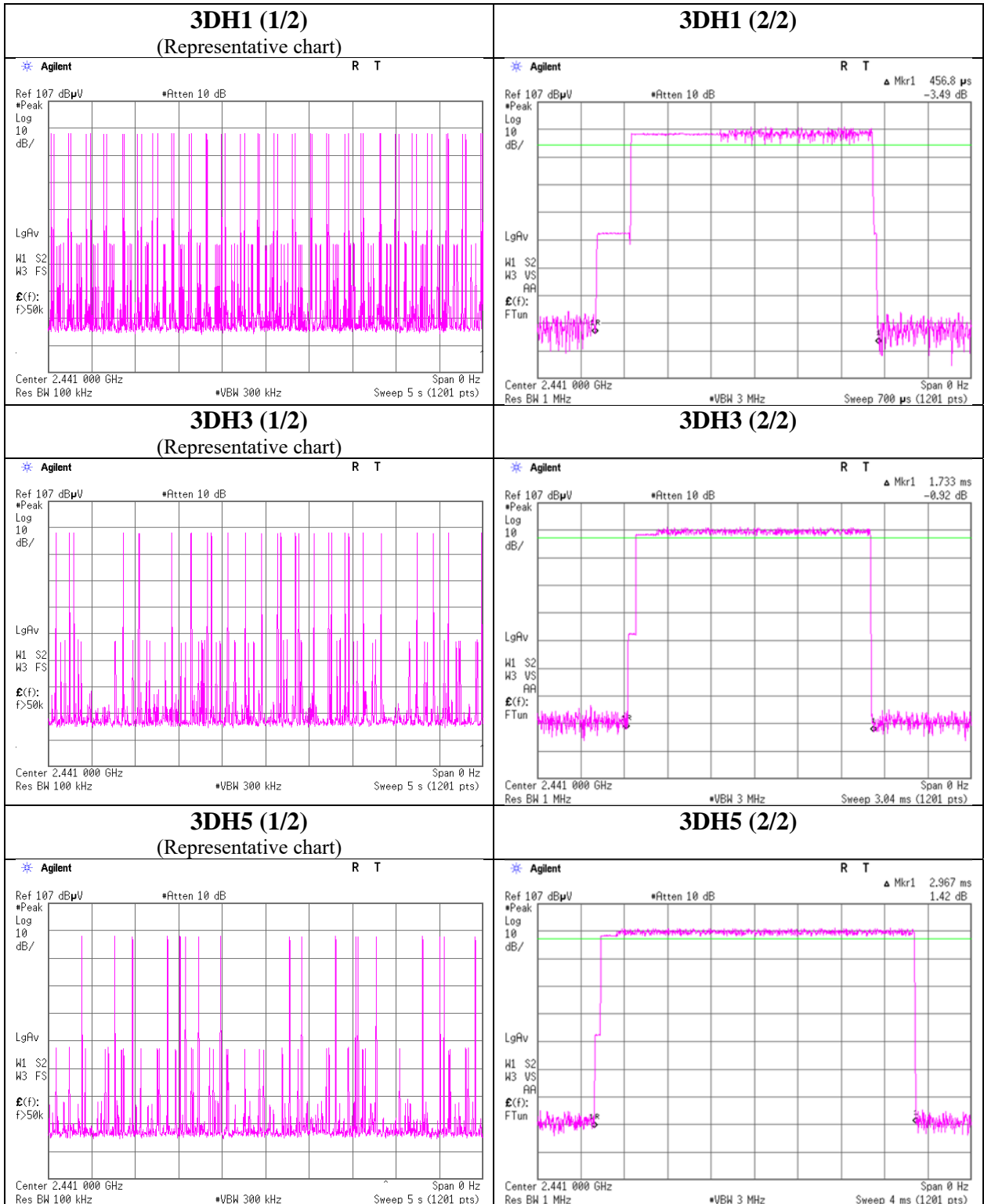
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Dwell time



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Maximum Peak Output Power

Report No. 13980589H
Test place Ise EMC Lab. No.8 Measurement Room
Date September 7, 2021
Temperature / Humidity 23 deg. C / 58 % 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	-11.21	1.50	10.07	0.36	1.09	20.96	125	20.60	-1.08	-0.72	0.85	36.02	4000	36.74
DH5	2441.0	-11.36	1.51	10.07	0.22	1.05	20.96	125	20.74	-1.08	-0.86	0.82	36.02	4000	36.88
DH5	2480.0	-11.72	1.52	10.06	-0.14	0.97	20.96	125	21.10	-1.08	-1.22	0.76	36.02	4000	37.24
2DH5	2402.0	-8.75	1.50	10.07	2.82	1.91	20.96	125	18.14	-1.08	1.74	1.49	36.02	4000	34.28
2DH5	2441.0	-8.86	1.51	10.07	2.72	1.87	20.96	125	18.24	-1.08	1.64	1.46	36.02	4000	34.38
2DH5	2480.0	-9.21	1.52	10.06	2.37	1.73	20.96	125	18.59	-1.08	1.29	1.35	36.02	4000	34.73
3DH5	2402.0	-8.37	1.50	10.07	3.20	2.09	20.96	125	17.76	-1.08	2.12	1.63	36.02	4000	33.90
3DH5	2441.0	-8.51	1.51	10.07	3.07	2.03	20.96	125	17.89	-1.08	1.99	1.58	36.02	4000	34.03
3DH5	2480.0	-8.88	1.52	10.06	2.70	1.86	20.96	125	18.26	-1.08	1.62	1.45	36.02	4000	34.40

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 / SAR testing)

Report No. 13980589H
Test place Ise EMC Lab. No.8 Measurement Room
Date September 7, 2021
Temperature / Humidity 23 deg. C / 58 % 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	-12.79	1.50	10.07	-1.22	0.76	1.04	-0.18	0.96
DH5	2441.0	-13.01	1.51	10.07	-1.43	0.72	1.04	-0.39	0.91
DH5	2480.0	-13.43	1.52	10.06	-1.85	0.65	1.04	-0.81	0.83
2DH5	2402.0	-12.62	1.50	10.07	-1.05	0.79	1.04	-0.01	1.00
2DH5	2441.0	-12.78	1.51	10.07	-1.20	0.76	1.04	-0.16	0.96
2DH5	2480.0	-13.19	1.52	10.06	-1.61	0.69	1.04	-0.57	0.88
3DH5	2402.0	-12.59	1.50	10.07	-1.02	0.79	1.03	0.01	1.00
3DH5	2441.0	-12.77	1.51	10.07	-1.19	0.76	1.03	-0.16	0.96
3DH5	2480.0	-13.18	1.52	10.06	-1.60	0.69	1.03	-0.57	0.88

Sample Calculation:

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

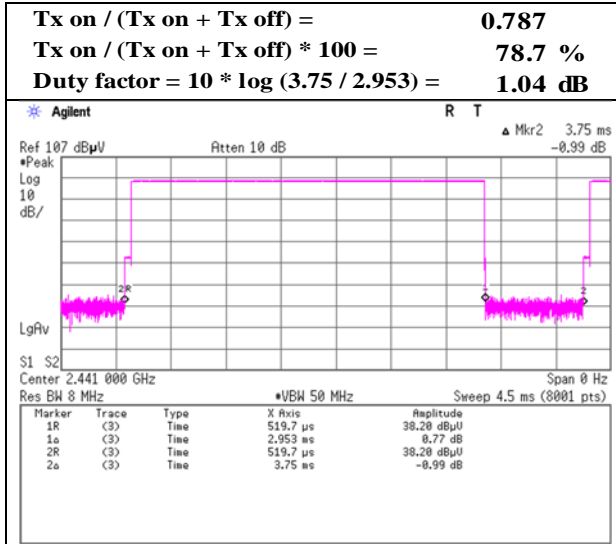
Result (Burst power average) = Time average + Duty factor

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

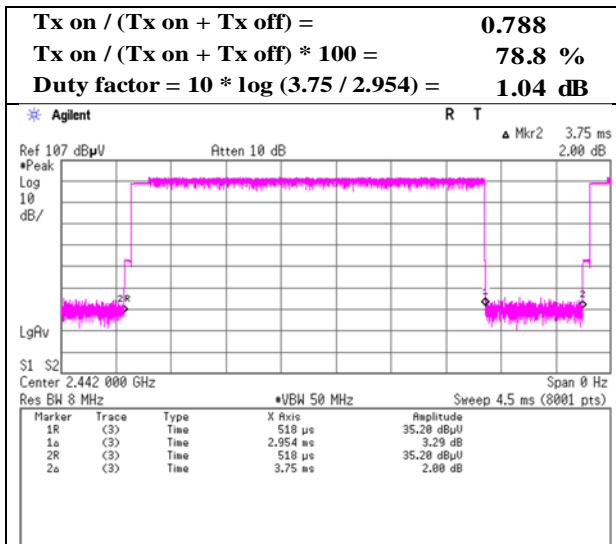
Burst Rate Confirmation

Report No. 13980589H
Test place Ise EMC Lab. No.8 Measurement Room
Date September 7, 2021
Temperature / Humidity 23 deg. C / 58 % RH
Engineer Hiroyuki Furutaka
Mode Tx, Hopping Off

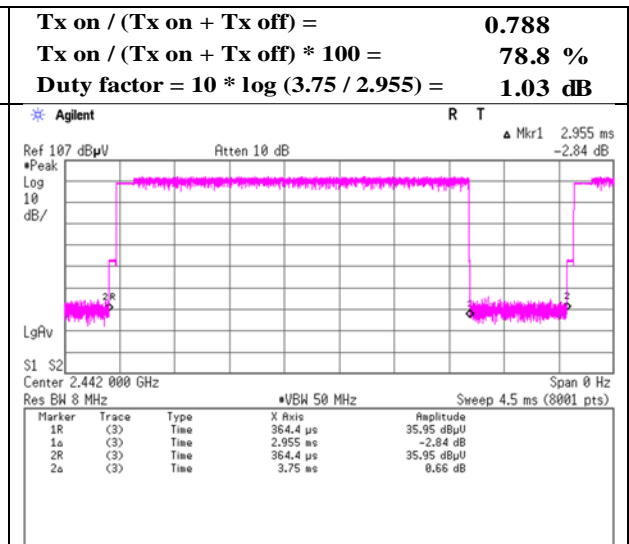
DH5



2DH5



3DH5



Radiated Spurious Emission

Report No.	13980589H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	October 4, 2021	October 4, 2021	October 4, 2021
Temperature / Humidity	22 deg. C / 67 % RH	22 deg. C / 67 % RH	22 deg. C / 67 % RH
Engineer	Nachi Konegawa	Kiyoshiro Okazaki	Kiyoshiro Okazaki
	(1 GHz - 10 GHz)	(30 MHz - 1 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	87.5	29.7	-	8.1	7.9	32.0	-	13.7	-	40.0	-	26.3	-	
Hori.	99.7	32.2	-	10.2	8.0	32.0	-	18.4	-	43.5	-	25.1	-	
Hori.	173.1	21.4	-	16.0	8.6	31.9	-	14.1	-	43.5	-	29.4	-	
Hori.	209.9	30.3	-	11.5	8.9	31.9	-	18.8	-	43.5	-	24.7	-	
Hori.	296.0	35.4	-	13.7	9.5	31.9	-	26.8	-	46.0	-	19.2	-	
Hori.	329.6	40.4	-	14.8	9.8	31.9	-	33.1	-	46.0	-	12.9	-	
Hori.	892.8	27.1	-	22.3	12.3	31.2	-	30.5	-	46.0	-	15.5	-	
Hori.	2390.0	41.6	33.6	27.8	5.3	31.8	1.0	42.9	35.8	73.9	53.9	31.0	18.1	*1)
Hori.	4804.0	41.3	34.6	31.6	7.5	31.2	-	49.3	42.5	73.9	53.9	24.6	11.4	Floor noise
Hori.	7206.0	42.4	34.7	36.2	8.7	32.4	-	54.9	47.1	73.9	53.9	19.1	6.8	Floor noise
Hori.	9608.0	42.4	32.2	38.0	9.6	32.6	-	57.4	47.2	73.9	53.9	16.5	6.7	Floor noise
Vert.	87.5	31.3	-	8.1	7.9	32.0	-	15.3	-	40.0	-	24.7	-	
Vert.	99.7	33.2	-	10.2	8.0	32.0	-	19.4	-	43.5	-	24.1	-	
Vert.	173.1	27.4	-	16.0	8.6	31.9	-	20.1	-	43.5	-	23.4	-	
Vert.	209.9	32.5	-	11.5	8.9	31.9	-	21.0	-	43.5	-	22.5	-	
Vert.	296.0	26.1	-	13.7	9.5	31.9	-	17.5	-	46.0	-	28.5	-	
Vert.	329.6	25.4	-	14.8	9.8	31.9	-	18.1	-	46.0	-	27.9	-	
Vert.	892.8	26.5	-	22.3	12.3	31.2	-	29.9	-	46.0	-	16.1	-	
Vert.	2390.0	42.2	33.6	27.8	5.3	31.8	1.0	43.5	35.9	73.9	53.9	30.5	18.0	*1)
Vert.	4804.0	41.2	33.6	31.6	7.5	31.2	-	49.1	41.5	73.9	53.9	24.8	12.4	Floor noise
Vert.	7206.0	42.5	34.3	36.2	8.7	32.4	-	54.9	46.7	73.9	53.9	19.0	7.2	Floor noise
Vert.	9608.0	43.5	32.1	38.0	9.6	32.6	-	58.5	47.1	73.9	53.9	15.4	6.8	Floor noise

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

Result (AV)= 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).

*QP detector was used up to 1GHz.

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

20dBc Data Sheet

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.0	87.5	27.8	5.3	31.8	88.7	-	-	Carrier
Hori.	2400.0	33.8	27.8	5.3	31.8	35.0	68.7	33.7	
Vert.	2402.0	91.4	27.8	5.3	31.8	92.6	-	-	Carrier
Vert.	2400.0	34.3	27.8	5.3	31.8	35.5	72.6	37.1	

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

Distance factor: 1 GHz - 10 GHz 20log(3.9 m / 3.0 m) = 2.28 dB

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

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Ise EMC Lab.

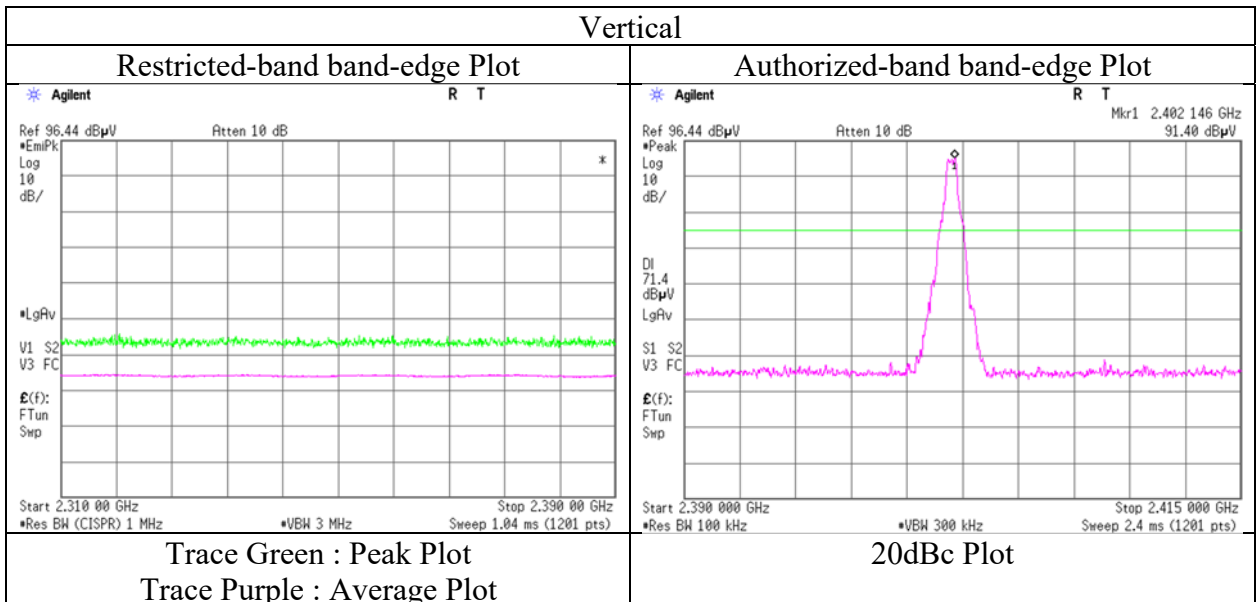
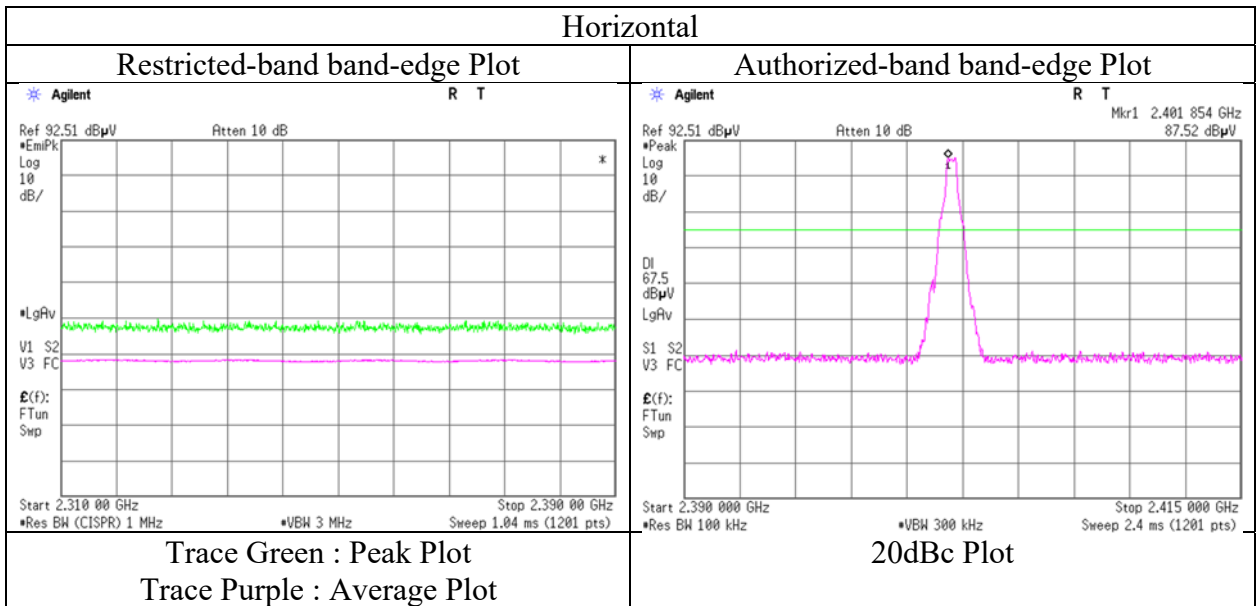
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13980589H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 4, 2021
Temperature / Humidity 22 deg. C / 67 % RH
Engineer Nachi Konegawa
(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.

Radiated Spurious Emission

Report No.	13980589H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	March 15, 2017	October 4, 2021	October 4, 2021
Temperature / Humidity	22 deg. C / 67 % RH	22 deg. C / 67 % RH	22 deg. C / 67 % RH
Engineer	Nachi Konegawa	Kiyoshiro Okazaki	Kiyoshiro Okazaki
	(1 GHz - 10 GHz)	(30 MHz - 1 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	87.1	29.8	-	8.1	7.9	32.0	-	13.7	-	40.0	-	26.3	-	
Hori.	99.7	32.4	-	10.2	8.0	32.0	-	18.6	-	43.5	-	24.9	-	
Hori.	173.8	21.3	-	16.1	8.6	31.9	-	14.0	-	43.5	-	29.5	-	
Hori.	211.2	30.5	-	11.5	8.9	31.9	-	19.0	-	43.5	-	24.5	-	
Hori.	294.4	35.6	-	13.7	9.5	31.9	-	27.0	-	46.0	-	19.0	-	
Hori.	329.6	40.5	-	14.8	9.8	31.9	-	33.2	-	46.0	-	12.8	-	
Hori.	881.6	27.0	-	22.2	12.3	31.3	-	30.2	-	46.0	-	15.8	-	
Hori.	4882.0	40.5	32.4	31.6	7.6	31.2	-	48.5	40.4	73.9	53.9	25.4	13.5	Floor noise
Hori.	7323.0	42.1	33.6	36.3	8.6	32.4	-	54.6	46.1	73.9	53.9	19.3	7.8	Floor noise
Hori.	9764.0	41.2	32.5	38.4	9.6	32.7	-	56.6	47.9	73.9	53.9	17.3	6.0	Floor noise
Vert.	87.1	31.3	-	8.1	7.9	32.0	-	15.2	-	40.0	-	24.8	-	
Vert.	99.7	33.4	-	10.2	8.0	32.0	-	19.6	-	43.5	-	23.9	-	
Vert.	173.8	27.5	-	16.1	8.6	31.9	-	20.2	-	43.5	-	23.3	-	
Vert.	211.2	32.1	-	11.5	8.9	31.9	-	20.6	-	43.5	-	22.9	-	
Vert.	294.4	26.5	-	13.7	9.5	31.9	-	17.9	-	46.0	-	28.1	-	
Vert.	329.6	25.4	-	14.8	9.8	31.9	-	18.1	-	46.0	-	27.9	-	
Vert.	881.6	26.4	-	22.2	12.3	31.3	-	29.6	-	46.0	-	16.4	-	
Vert.	4882.0	40.7	32.4	31.6	7.6	31.2	-	48.7	40.4	73.9	53.9	25.2	13.5	Floor noise
Vert.	7323.0	41.9	33.6	36.3	8.6	32.4	-	54.4	46.1	73.9	53.9	19.5	7.8	Floor noise
Vert.	9764.0	42.4	32.4	38.4	9.6	32.7	-	57.7	47.7	73.9	53.9	16.2	6.2	Floor noise

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

Result (AV)= 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).

*QP detector was used up to 1GHz.

Distance factor: 1 GHz - 10 GHz 20log(3.9 m / 3.0 m) = 2.28 dB
 10 GHz - 26.5 GHz 20log(1.0 m / 3.0 m) = -9.5 dB

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No.	13980589H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.4	No.4
Date	October 4, 2021	October 4, 2021	October 4, 2021
Temperature / Humidity	22 deg. C / 67 % RH	22 deg. C / 67 % RH	22 deg. C / 67 % RH
Engineer	Nachi Konegawa	Kiyoshiro Okazaki	Kiyoshiro Okazaki
	(1 GHz - 10 GHz)	(30 MHz - 1 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	86.4	29.9	-	7.9	7.9	32.0	-	13.7	-	40.0	-	26.4	-	
Hori.	99.0	32.3	-	10.1	8.0	32.0	-	18.4	-	43.5	-	25.1	-	
Hori.	174.5	22.0	-	16.0	8.6	31.9	-	14.7	-	43.5	-	28.8	-	
Hori.	209.6	30.3	-	11.5	8.9	31.9	-	18.8	-	43.5	-	24.7	-	
Hori.	296.0	35.4	-	13.7	9.5	31.9	-	26.8	-	46.0	-	19.2	-	
Hori.	329.6	40.2	-	14.8	9.8	31.9	-	32.9	-	46.0	-	13.1	-	
Hori.	875.2	26.7	-	22.1	12.3	31.3	-	29.8	-	46.0	-	16.2	-	
Hori.	2483.5	42.5	33.5	27.7	5.4	31.8	1.0	43.7	35.7	73.9	53.9	30.2	18.2	*1)
Hori.	4960.0	41.2	32.6	31.7	7.6	31.2	-	49.4	40.7	73.9	53.9	24.6	13.2	Floor noise
Hori.	7440.0	41.3	33.4	36.5	8.6	32.5	-	54.0	46.0	73.9	53.9	19.9	7.9	Floor noise
Hori.	9920.0	42.2	32.2	38.6	9.7	32.7	-	57.7	47.6	73.9	53.9	16.2	6.3	Floor noise
Vert.	86.4	31.4	-	7.9	7.9	32.0	-	15.2	-	40.0	-	24.9	-	
Vert.	99.0	33.2	-	10.1	8.0	32.0	-	19.3	-	43.5	-	24.2	-	
Vert.	174.5	27.6	-	16.0	8.6	31.9	-	20.3	-	43.5	-	23.2	-	
Vert.	209.6	32.4	-	11.5	8.9	31.9	-	20.9	-	43.5	-	22.6	-	
Vert.	296.0	26.3	-	13.7	9.5	31.9	-	17.7	-	46.0	-	28.3	-	
Vert.	329.6	25.6	-	14.8	9.8	31.9	-	18.3	-	46.0	-	27.7	-	
Vert.	875.2	26.8	-	22.1	12.3	31.3	-	29.9	-	46.0	-	16.1	-	
Vert.	2483.5	42.0	33.8	27.7	5.4	31.8	1.0	43.2	36.0	73.9	53.9	30.7	17.9	*1)
Vert.	4960.0	41.3	32.5	31.7	7.6	31.2	-	49.5	40.7	73.9	53.9	24.5	13.2	Floor noise
Vert.	7440.0	41.3	33.5	36.5	8.6	32.5	-	53.9	46.1	73.9	53.9	20.0	7.8	Floor noise
Vert.	9920.0	42.1	32.1	38.6	9.7	32.7	-	57.5	47.6	73.9	53.9	16.4	6.4	Floor noise

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

Result (AV)= 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).

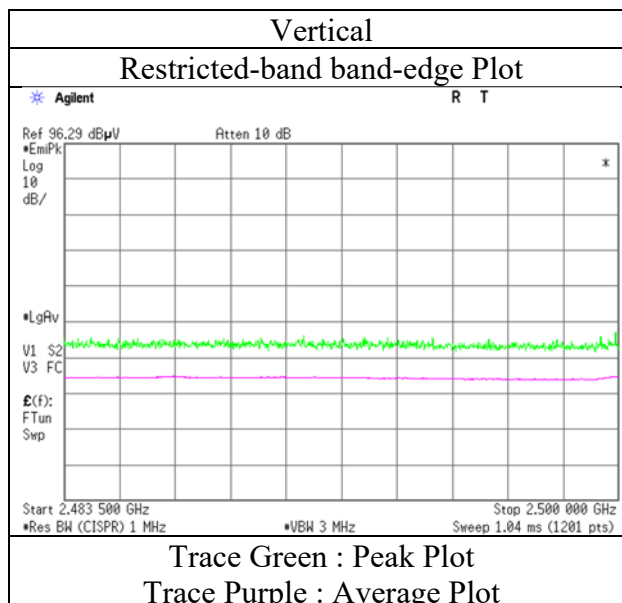
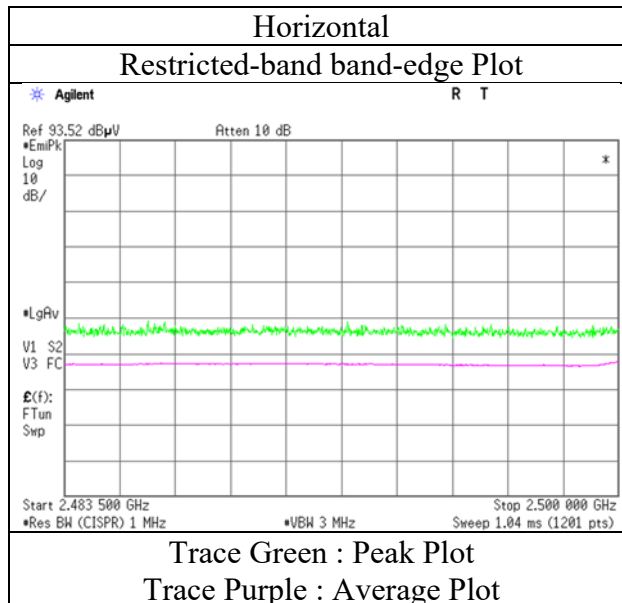
*QP detector was used up to 1GHz.

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

Distance factor: 1 GHz - 10 GHz $20\log(3.9\text{ m} / 3.0\text{ m}) = 2.28\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13980589H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 4, 2021
Temperature / Humidity 22 deg. C / 67 % RH
Engineer Nachi Konegawa
(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.

Radiated Spurious Emission

Report No. 13980589H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 4, 2021
Temperature / Humidity 22 deg. C / 67 % RH
Engineer Kiyoshiro Okazaki
(30 MHz - 26.5 GHz)
Mode Tx, Hopping Off, 3DH5 2402 MHz

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	86.7	29.7	-	8.0	7.9	32.0	-	13.5	-	40.0	-	26.5	-	
Hori.	99.4	32.6	-	10.2	8.0	32.0	-	18.7	-	43.5	-	24.8	-	
Hori.	174.2	24.0	-	16.0	8.6	31.9	-	16.7	-	43.5	-	26.8	-	
Hori.	209.6	30.8	-	11.5	8.9	31.9	-	19.3	-	43.5	-	24.2	-	
Hori.	296.0	35.5	-	13.7	9.5	31.9	-	26.9	-	46.0	-	19.1	-	
Hori.	329.6	41.7	-	14.8	9.8	31.9	-	34.4	-	46.0	-	11.6	-	
Hori.	2390.0	42.1	33.6	27.8	5.3	31.8	-	43.3	34.8	73.9	53.9	30.6	19.1	*1)
Hori.	4804.0	38.3	33.0	31.6	7.5	31.2	-	46.3	40.9	73.9	53.9	27.6	13.0	Floor noise
Hori.	7206.0	38.2	31.4	36.2	8.7	32.4	-	50.6	43.9	73.9	53.9	23.3	10.1	Floor noise
Hori.	9608.0	38.0	31.2	38.0	9.6	32.6	-	53.1	46.2	73.9	53.9	20.8	7.7	Floor noise
Vert.	86.7	31.4	-	8.0	7.9	32.0	-	15.2	-	40.0	-	24.8	-	
Vert.	99.4	33.6	-	10.2	8.0	32.0	-	19.7	-	43.5	-	23.8	-	
Vert.	174.2	27.6	-	16.0	8.6	31.9	-	20.3	-	43.5	-	23.2	-	
Vert.	209.6	32.7	-	11.5	8.9	31.9	-	21.2	-	43.5	-	22.3	-	
Vert.	296.0	26.3	-	13.7	9.5	31.9	-	17.7	-	46.0	-	28.3	-	
Vert.	329.6	26.6	-	14.8	9.8	31.9	-	19.3	-	46.0	-	26.7	-	
Vert.	2390.0	42.0	33.7	27.8	5.3	31.8	1.0	43.2	36.0	73.9	53.9	30.7	18.0	*1)
Vert.	4804.0	41.6	34.2	31.6	7.5	31.2	-	49.6	42.2	73.9	53.9	24.3	11.7	
Vert.	7206.0	38.0	31.3	36.2	8.7	32.4	-	50.4	43.7	73.9	53.9	23.5	10.2	Floor noise
Vert.	9608.0	38.1	31.6	38.0	9.6	32.6	-	53.1	46.6	73.9	53.9	20.8	7.3	Floor noise

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

Result (AV)= 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).

*QP detector was used up to 1GHz.

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

20dBc Data Sheet

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.0	85.3	27.8	5.3	31.8	86.5	-	-	Carrier
Hori.	2400.0	33.7	27.8	5.3	31.8	35.0	66.5	31.6	
Vert.	2402.0	91.6	27.8	5.3	31.8	92.9	-	-	Carrier
Vert.	2400.0	35.7	27.8	5.3	31.8	36.9	72.9	36.0	

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

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Ise EMC Lab.

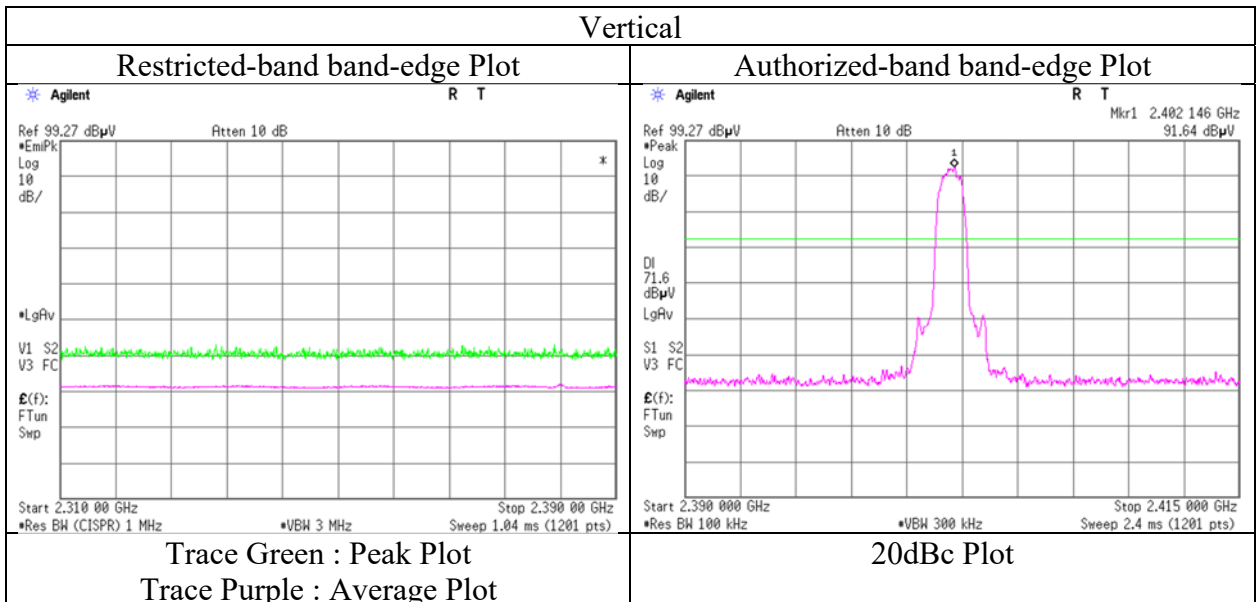
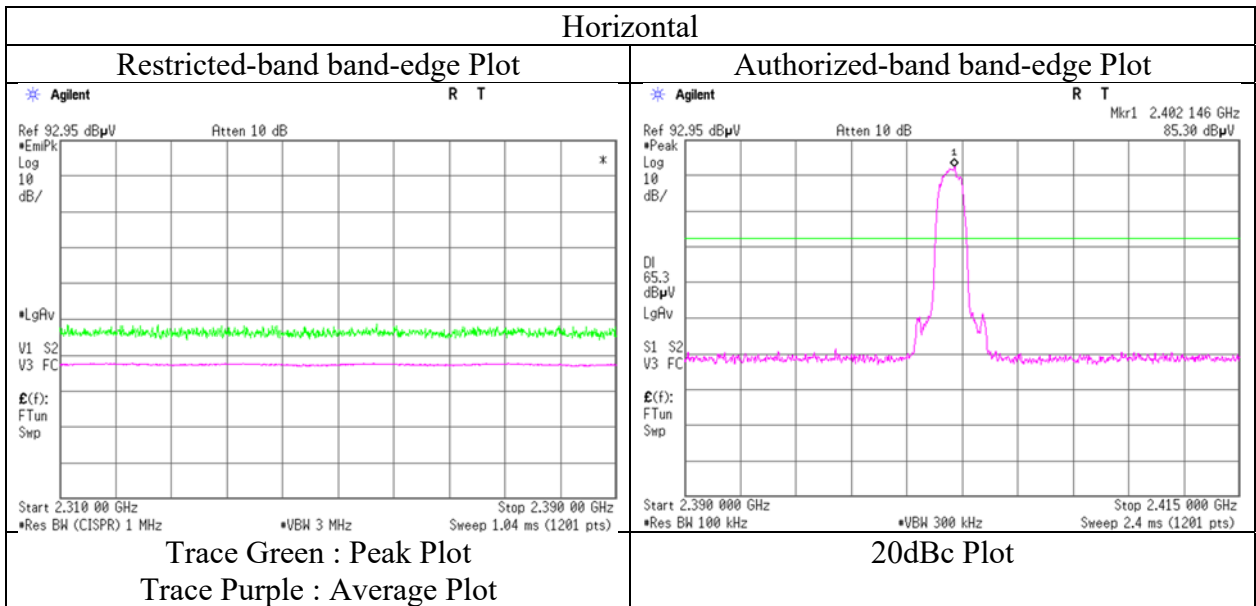
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Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13980589H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 4, 2021
Temperature / Humidity 22 deg. C / 67 % RH
Engineer Kiyoshiro Okazaki
(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.

Radiated Spurious Emission

Report No. 13980589H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 4, 2021
Temperature / Humidity 22 deg. C / 67 % RH
Engineer Kiyoshiro Okazaki
(30 MHz - 26.5 GHz)
Mode Tx, Hopping Off, 3DH5 2441 MHz

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	87.1	29.6	-	8.1	7.9	32.0	-	13.5	-	40.0	-	26.5	-	
Hori.	100.4	32.4	-	10.4	8.0	32.0	-	18.8	-	43.5	-	24.8	-	
Hori.	173.5	23.7	-	16.0	8.6	31.9	-	16.4	-	43.5	-	27.1	-	
Hori.	211.2	30.5	-	11.5	8.9	31.9	-	19.0	-	43.5	-	24.5	-	
Hori.	292.8	35.8	-	13.7	9.5	31.9	-	27.2	-	46.0	-	18.9	-	
Hori.	332.8	40.5	-	14.9	9.8	31.9	-	33.3	-	46.0	-	12.7	-	
Hori.	4882.0	37.0	33.0	31.6	7.6	31.2	-	45.0	41.0	73.9	53.9	28.9	12.9	Floor noise
Hori.	7323.0	37.2	31.5	36.3	8.6	32.4	-	49.7	43.9	73.9	53.9	24.2	10.0	Floor noise
Hori.	9764.0	37.7	31.5	38.4	9.6	32.7	-	53.0	46.9	73.9	53.9	20.9	7.1	Floor noise
Vert.	87.1	31.2	-	8.1	7.9	32.0	-	15.1	-	40.0	-	24.9	-	
Vert.	100.4	33.5	-	10.4	8.0	32.0	-	19.9	-	43.5	-	23.7	-	
Vert.	173.5	27.5	-	16.0	8.6	31.9	-	20.2	-	43.5	-	23.3	-	
Vert.	211.2	32.5	-	11.5	8.9	31.9	-	21.0	-	43.5	-	22.5	-	
Vert.	292.8	26.7	-	13.7	9.5	31.9	-	18.1	-	46.0	-	28.0	-	
Vert.	332.8	26.1	-	14.9	9.8	31.9	-	18.9	-	46.0	-	27.1	-	
Vert.	4882.0	37.4	33.0	31.6	7.6	31.2	-	45.4	41.0	73.9	53.9	28.5	12.9	Floor noise
Vert.	7323.0	37.9	31.6	36.3	8.6	32.4	-	50.4	44.1	73.9	53.9	23.5	9.8	Floor noise
Vert.	9764.0	37.7	31.2	38.4	9.6	32.7	-	53.0	46.6	73.9	53.9	20.9	7.3	Floor noise

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

Result (AV)= 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).

*QP detector was used up to 1GHz.

Distance factor: 1 GHz - 10 GHz 20log(3.9 m / 3.0 m) = 2.28 dB
 10 GHz - 26.5 GHz 20log(1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No. 13980589H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 4, 2021
Temperature / Humidity 22 deg. C / 67 % RH
Engineer Kiyoshiro Okazaki
(30 MHz - 26.5 GHz)
Mode Tx, Hopping Off, 3DH5 2480 MHz

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	86.1	29.7	-	7.9	7.8	32.0	-	13.4	-	40.0	-	26.6	-	
Hori.	99.0	32.6	-	10.1	8.0	32.0	-	18.7	-	43.5	-	24.8	-	
Hori.	176.2	23.5	-	16.0	8.6	31.9	-	16.2	-	43.5	-	27.3	-	
Hori.	211.2	30.4	-	11.5	8.9	31.9	-	18.9	-	43.5	-	24.6	-	
Hori.	296.0	35.6	-	13.7	9.5	31.9	-	27.0	-	46.0	-	19.0	-	
Hori.	336.0	40.2	-	15.0	9.8	31.9	-	33.1	-	46.0	-	12.9	-	
Hori.	875.2	27.0	-	22.1	12.3	31.3	-	30.1	-	46.0	-	15.9	-	
Hori.	2483.5	43.3	33.5	27.7	5.4	31.8	1.0	44.5	35.7	73.9	53.9	29.4	18.2	*1)
Hori.	4960.0	38.0	32.7	31.7	7.6	31.2	-	46.2	40.9	73.9	53.9	27.7	13.0	Floor noise
Hori.	7440.0	37.4	31.3	36.5	8.6	32.5	-	50.0	43.9	73.9	53.9	23.9	10.0	Floor noise
Hori.	9920.0	37.1	31.3	38.6	9.7	32.7	-	52.6	46.7	73.9	53.9	21.3	7.2	Floor noise
Vert.	86.1	31.4	-	7.9	7.8	32.0	-	15.1	-	40.0	-	24.9	-	
Vert.	99.0	33.4	-	10.1	8.0	32.0	-	19.5	-	43.5	-	24.0	-	
Vert.	176.2	27.6	-	16.0	8.6	31.9	-	20.3	-	43.5	-	23.2	-	
Vert.	211.2	32.4	-	11.5	8.9	31.9	-	20.9	-	43.5	-	22.6	-	
Vert.	296.0	26.4	-	13.7	9.5	31.9	-	17.8	-	46.0	-	28.2	-	
Vert.	336.0	25.9	-	15.0	9.8	31.9	-	18.8	-	46.0	-	27.2	-	
Vert.	875.2	27.0	-	22.1	12.3	31.3	-	30.1	-	46.0	-	15.9	-	
Vert.	2483.5	42.7	33.8	27.7	5.4	31.8	1.0	43.9	36.0	73.9	53.9	30.0	17.9	*1)
Vert.	4960.0	40.5	34.8	31.7	7.6	31.2	1.0	48.6	43.9	73.9	53.9	25.3	10.0	
Vert.	7440.0	37.4	31.5	36.5	8.6	32.5	-	50.1	44.2	73.9	53.9	23.8	9.8	Floor noise
Vert.	9920.0	36.6	31.8	38.6	9.7	32.7	-	52.0	47.2	73.9	53.9	21.9	6.7	Floor noise

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

Result (AV)= 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).

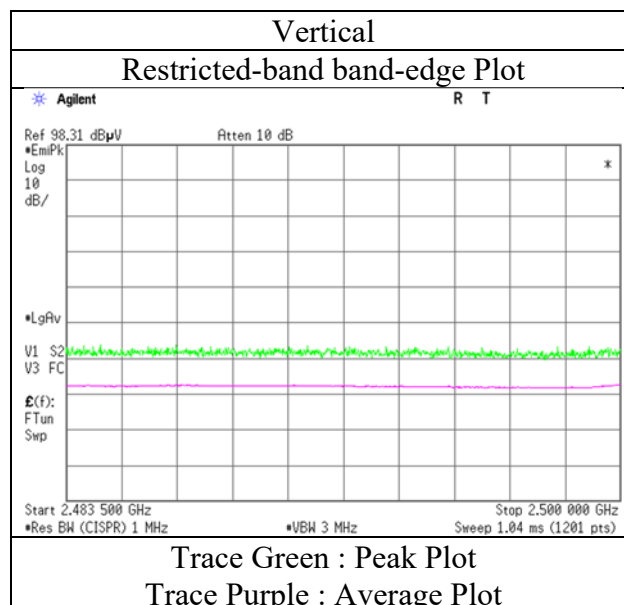
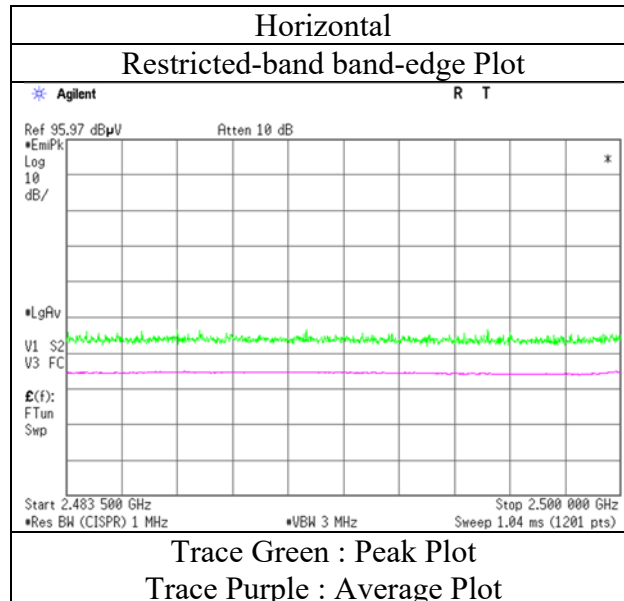
*QP detector was used up to 1GHz.

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

Distance factor: 1 GHz - 10 GHz 20log(3.9 m / 3.0 m) = 2.28 dB
10 GHz - 26.5 GHz 20log(1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

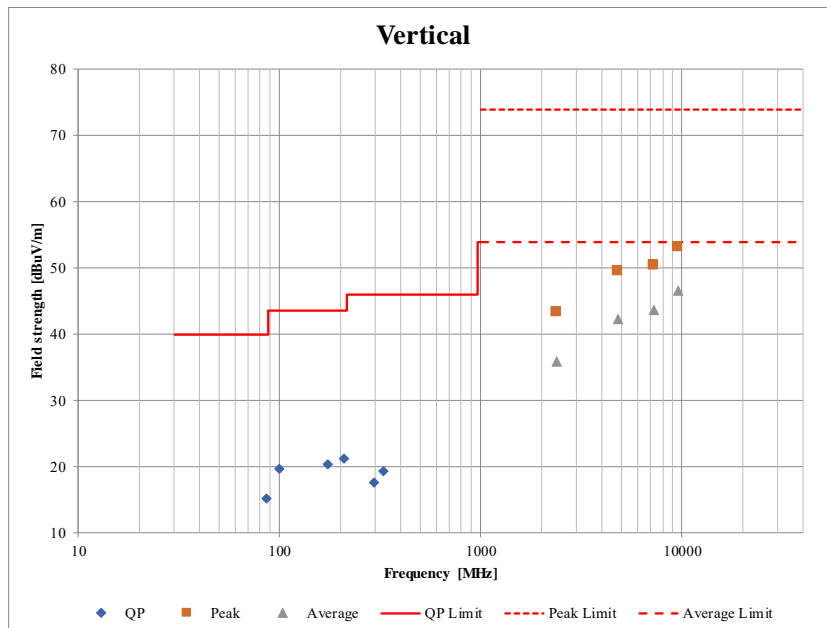
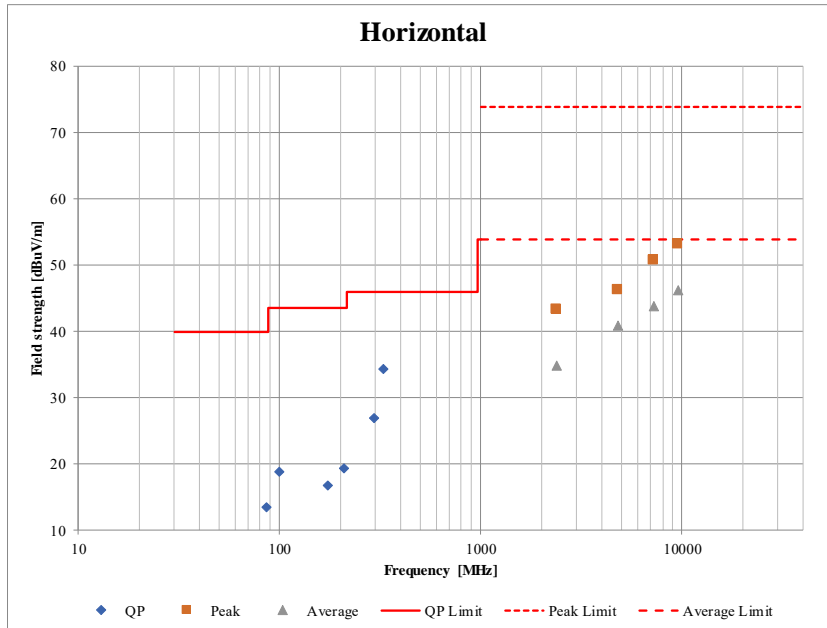
Report No. 13980589H
Test place No.4
Semi Anechoic Chamber October 4, 2021
Date 22 deg. C / 67 % RH
Temperature / Humidity Kiyoshiro Okazaki
Engineer No.2
(1 GHz - 10 GHz)
Mode Tx, Hopping Off, 3DH5 2480 MHz



* 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. 13980589H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date October 4, 2021
Temperature / Humidity 22 deg. C / 67 % RH
Engineer Kiyoshiro Okazaki
(30 MHz -26.5 GHz)
Mode Tx, Hopping Off, 3DH5 2402 MHz

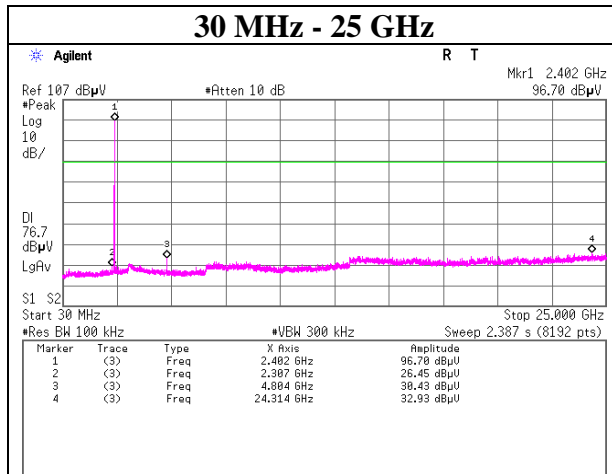
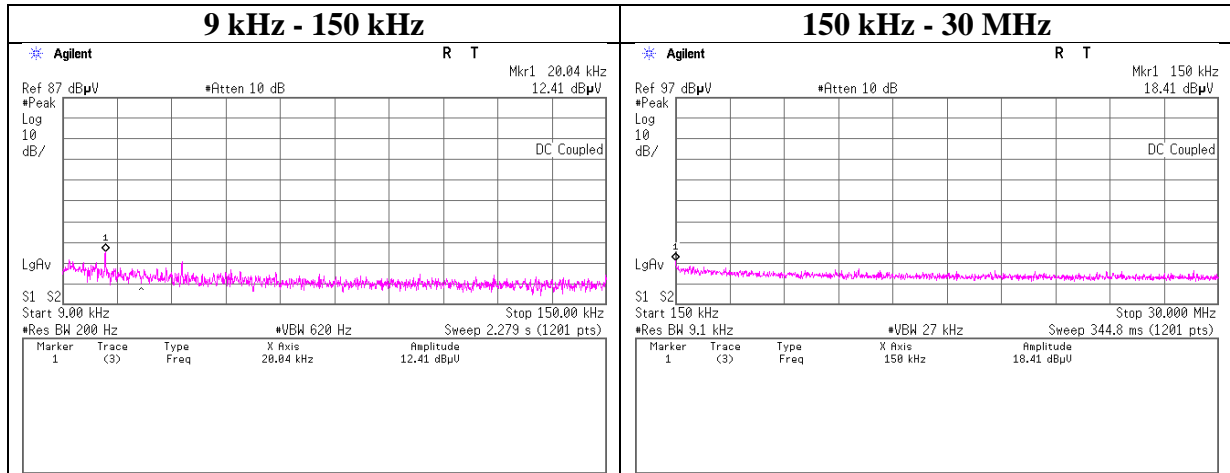


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Report No.	13980589H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 8, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, DH5

2402 MHz



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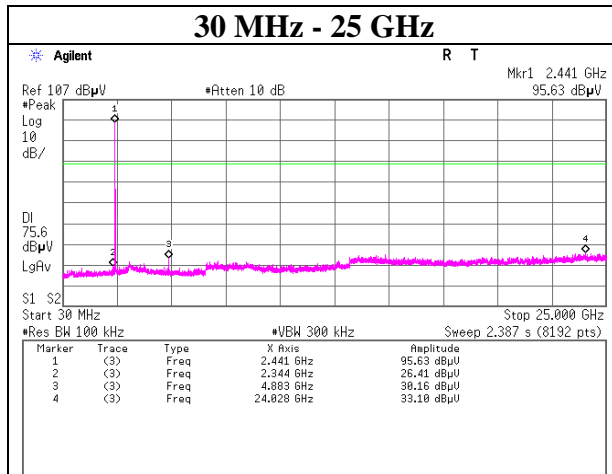
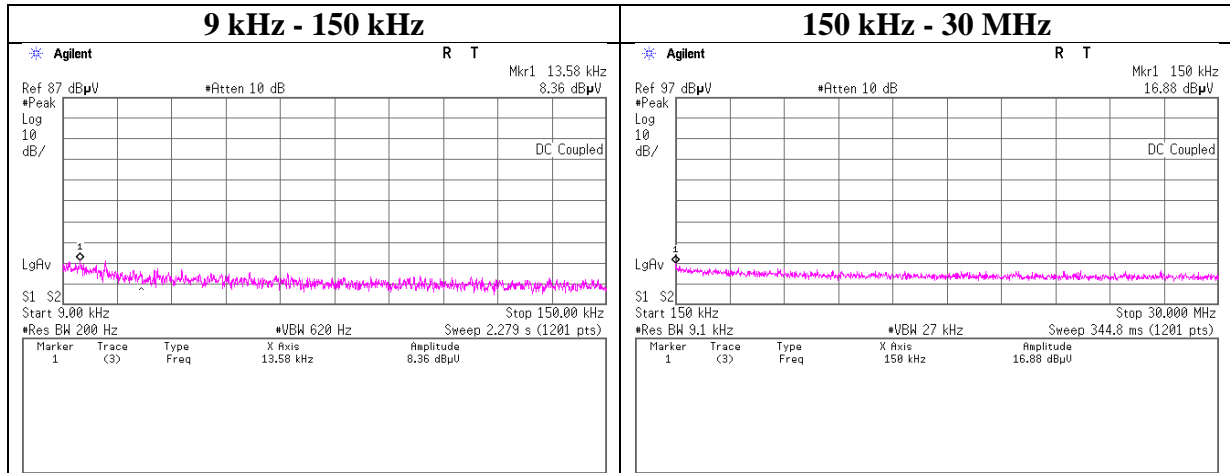
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	13980589H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 8, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, DH5

2441 MHz



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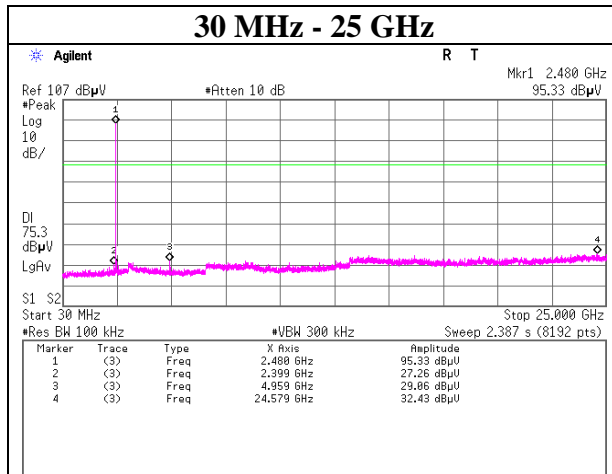
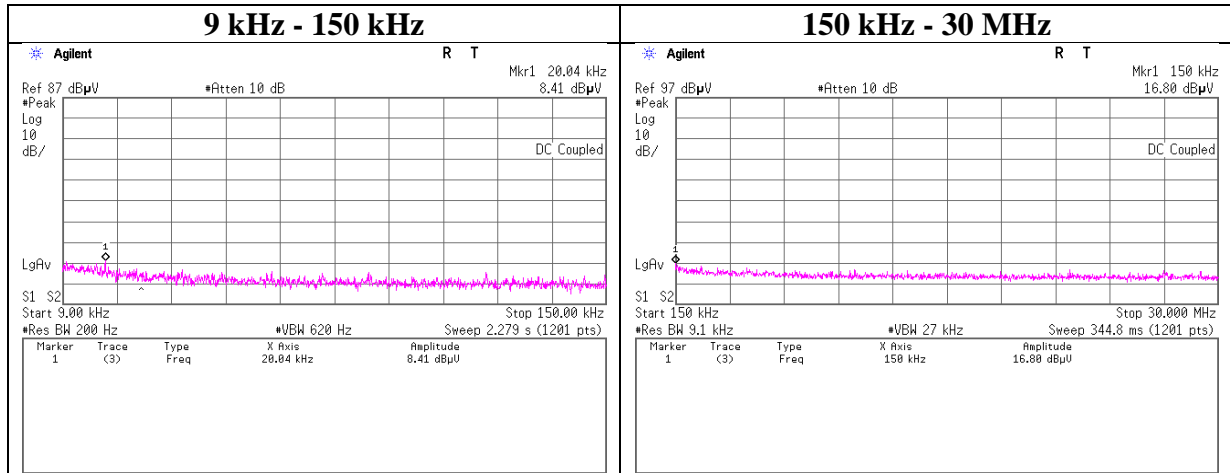
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	13980589H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 8, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, DH5

2480 MHz



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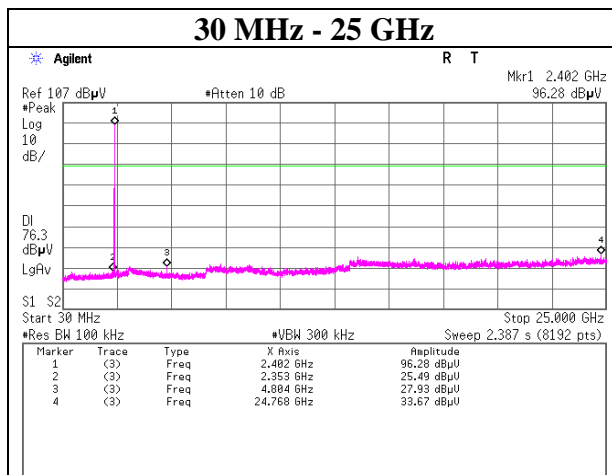
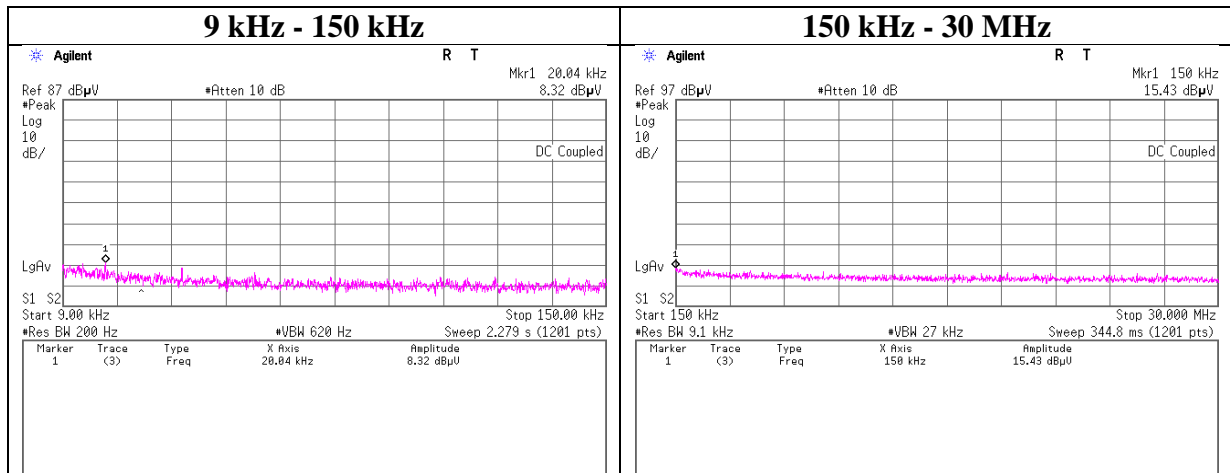
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No.	13980589H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 8, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, 3DH5

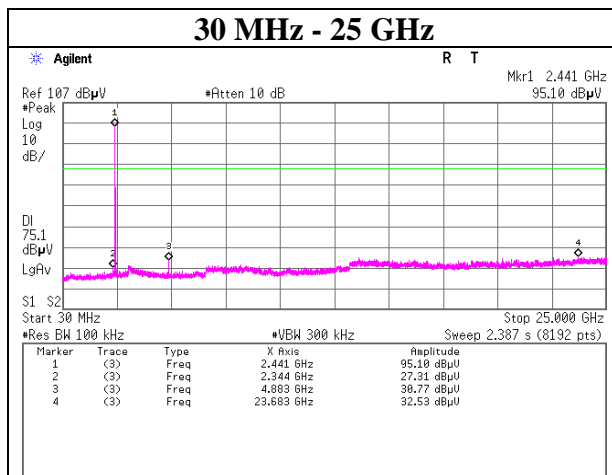
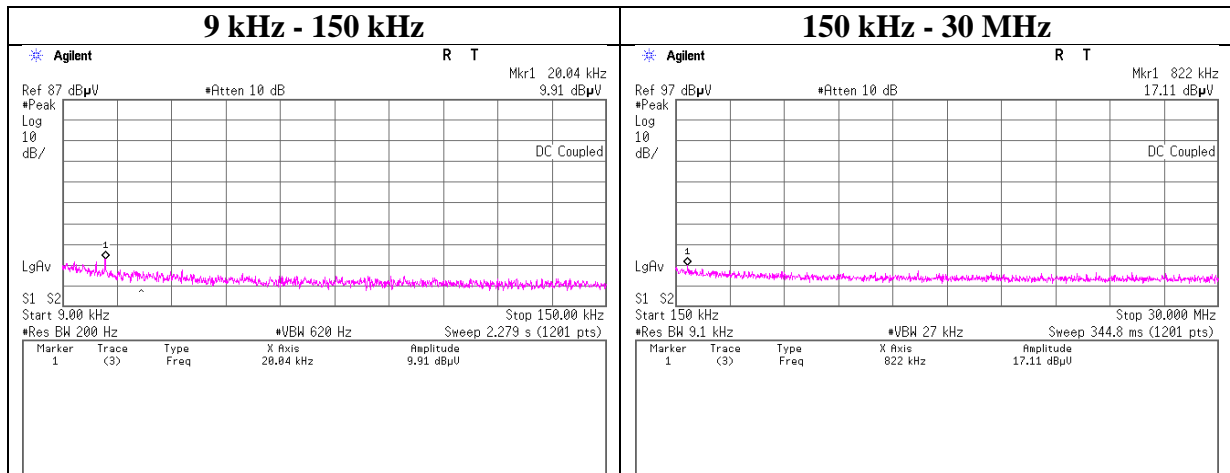
2402 MHz



Conducted Spurious Emission

Report No.	13980589H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 8, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, 3DH5

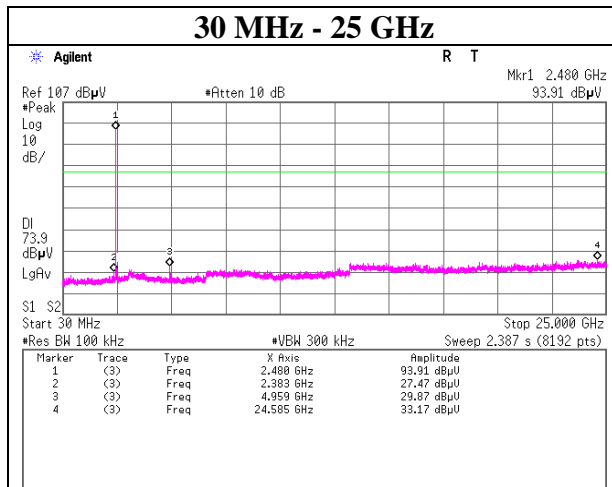
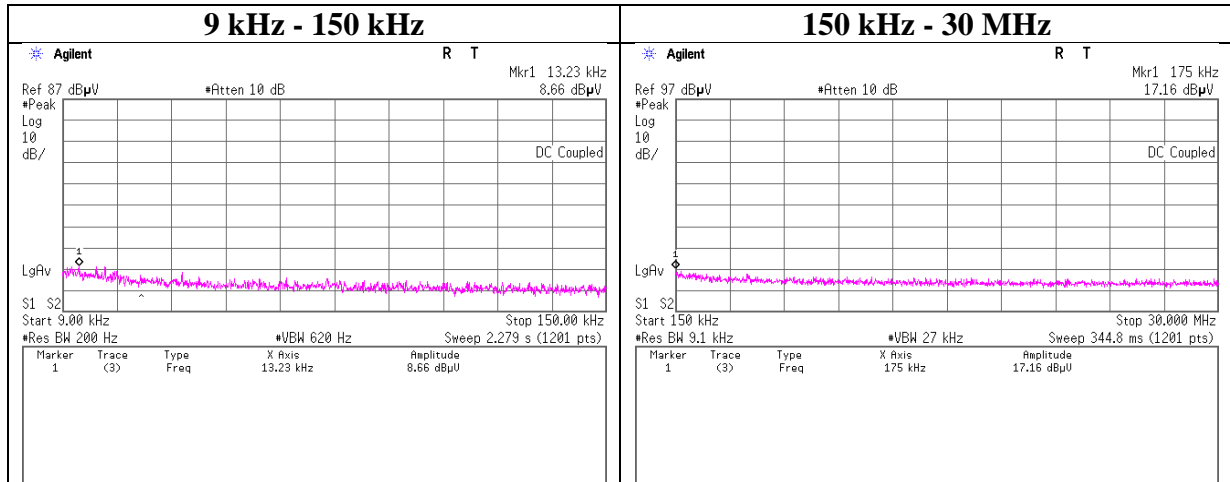
2441 MHz



Conducted Spurious Emission

Report No.	13980589H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 8, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, 3DH5

2480 MHz



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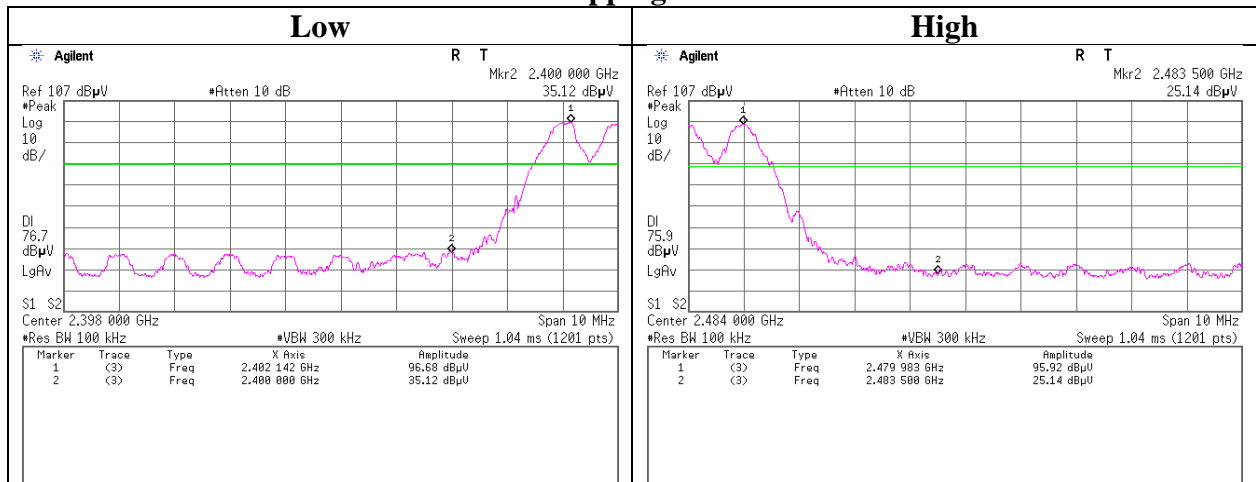
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

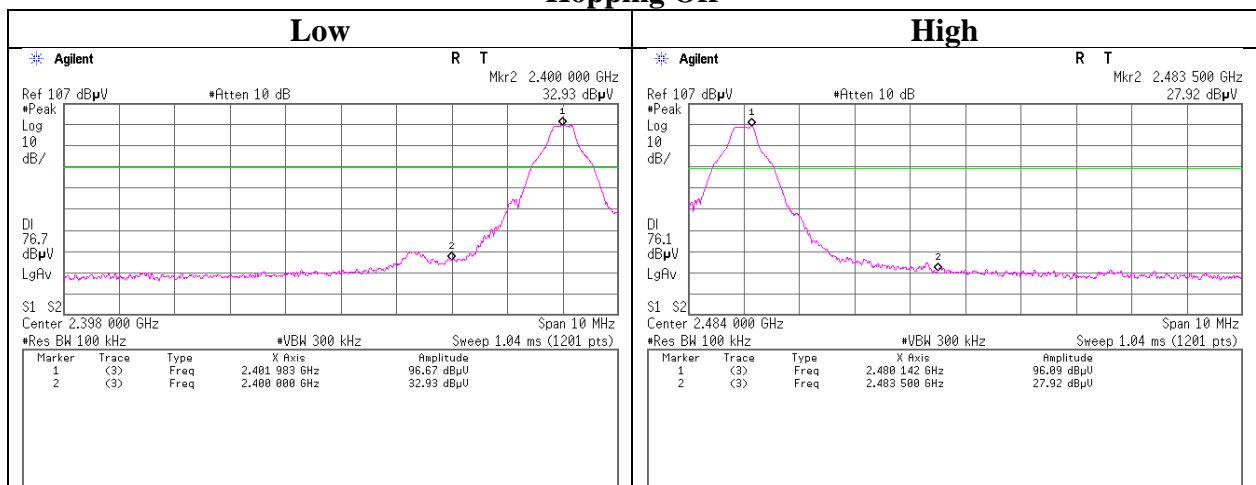
Conducted Emission Band Edge compliance

Report No.	13980589H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	September 8, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx DH5

Hopping On



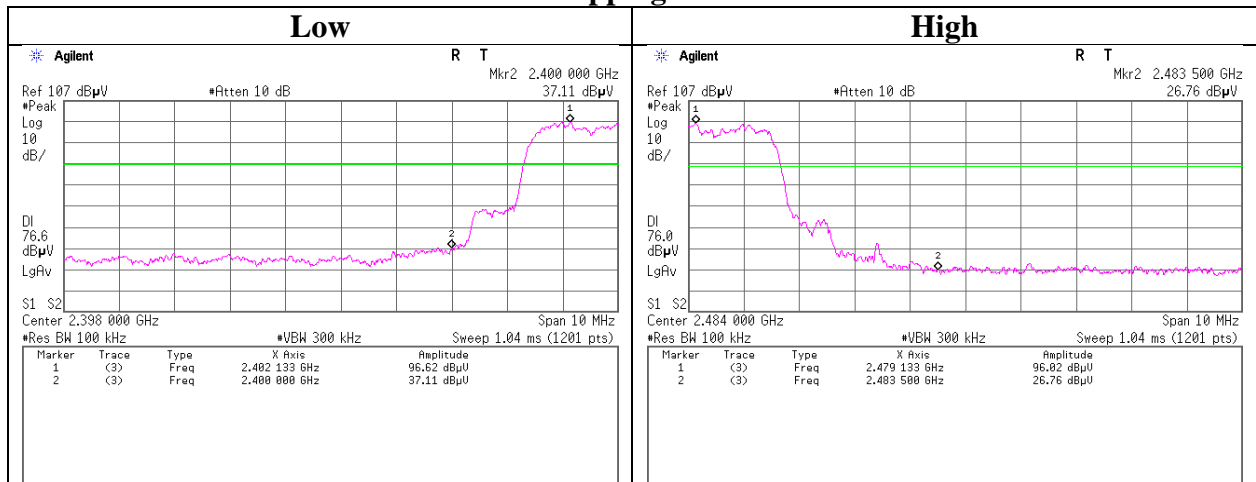
Hopping Off



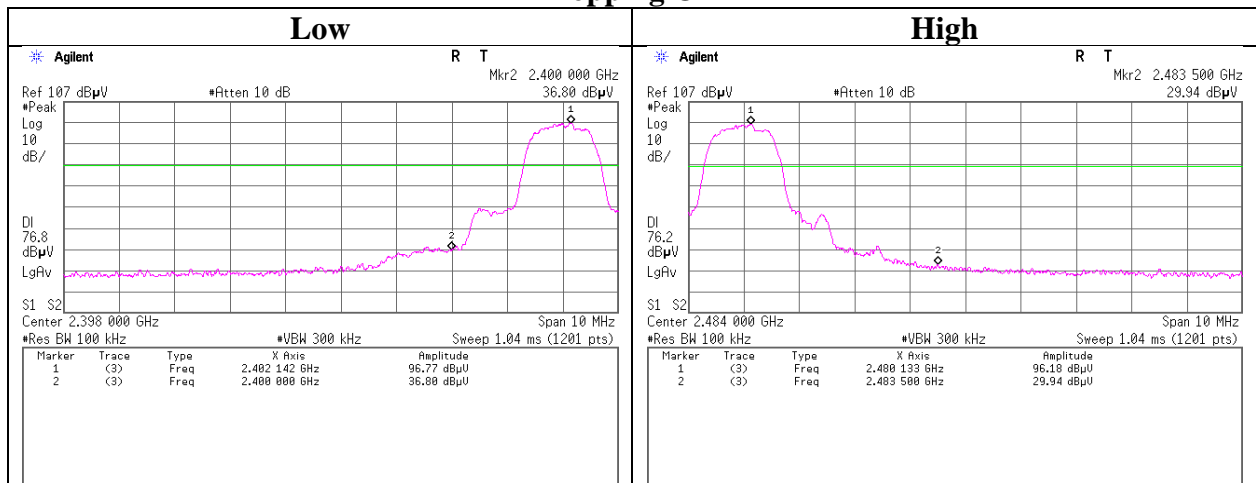
Conducted Emission Band Edge compliance

Report No.	13980589H		
Test place	Ise EMC Lab. No.8 Measurement Room		
Date	September 8, 2021	September 8, 2021	
Temperature / Humidity	24 deg. C / 60 % RH	24 deg. C / 60 % RH	
Engineer	Hiroyuki Furutaka	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
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/25/2020	24
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/15/2021	12
RE	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/10/2021	12
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	557	05/10/2021	12
RE	MCC-257	208936	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537061/126E / 537076/126E	07/18/2021	12
RE	MHF-26	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	09/30/2021	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/19/2020	12
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/25/2020	24
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/15/2021	12
RE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/07/2021	12
RE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-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	04/12/2021	24
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/02/2021	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	VHA 91031302	08/28/2021	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	11/06/2020	12
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-192	08/28/2021	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/18/2021	12
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	03/09/2021	12
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	557	05/10/2021	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/19/2020	12
RE	MCC-257	208936	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537061/126E / 537076/126E	07/18/2021	12
RE	MHF-26	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	09/30/2021	12
RE	MHA-02	141503	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	06/28/2021	12
RE	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/10/2021	12
AT	MRENT-130	141855	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187750	11/18/2020	12
AT	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/18/2021	12
AT	MPSE-18	141832	Power sensor	Anritsu Corporation	MA2411B	738174	12/14/2020	12
AT	MCC-138	141410	Microwave cable	Huber+Suhner	SUCOFLEX 102	37953/2	09/30/2021	12
AT	MAT-20	141173	Attenuator(10dB) (above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-110	-	12/07/2020	12
AT	MOS-28	141567	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0008	01/15/2021	12
AT	MMM-17	141557	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	70900530	01/07/2021	12
AT	MCC-64	141327	Coaxial Cable	UL Japan	-	-	02/03/2021	12
AT	MAT-26	141244	Attenuator(10dB)	Weinschel - API Technologies Corp	WA8-10-34	A198	02/24/2021	12

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*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