





# RADIO TEST REPORT

## Test Report No. 14757979H-A

Customer	Sony Interactive Entertainment Inc.
Description of EUT	Wireless Controller
Model Number of EUT	CFI-ZAC1
FCC ID	AK8CFIZAC1
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	May 9, 2023
Remarks	-

<b>Representative Test Engineer</b>	<b>Approved By</b>
	
Kiyoshiro Okazaki Engineer	Takayuki Shimada Leader
 	
CERTIFICATE 5107.02	
<input type="checkbox"/> The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.	
<input checked="" type="checkbox"/> There is no testing item of "Non-accreditation".	

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- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

## **REVISION HISTORY**

**Original Test Report No.: 14757979H-A**

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14757979H-A	May 9, 2023	-

**Reference: Abbreviations (Including words undescribed in this report)**

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

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## **SECTION 1: Customer Information**

Company Name	Sony Interactive Entertainment Inc.
Brand Name	SONY
Address	1-7-1 Konan, Minato-ku, Tokyo, 108-0075 Japan
Telephone Number	+81-50-3807-5639
Contact Person	Miho Nakamura

The information provided from the customer is as follows;

- Customer, Description 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 and Test 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**

Description	Wireless Controller
Model Number	CFI-ZAC1
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	April 17, 2023
Test Date	April 17 and 18, 2023

### **2.2 Product Description**

#### **General Specification**

Rating	DC 5 V (USB Bus Power) DC 3.7 V (Battery)
Operating temperature	5 deg. C to 35 deg. C

#### **Radio Specification**

##### **Bluetooth (BR / EDR)**

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS (GFSK, $\pi/4$ DQPSK, 8 DPSK)
Antenna Gain	3.4 dBi

## SECTION 3: Test Specification, Procedures & Results

### 3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
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

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

### 3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks	
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	19.16 dB, 0.16762 MHz, QP, N	Complied	-	
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	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	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	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	Conducted	
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section15.247(b)(1) ISED: RSS-247 5.4 (b)		Complied	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		14.4 dB 300.5 MHz, QP, Vertical	Complied	Conducted/ Radiated (above 30 MHz) *1)
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred. *1) Radiated test was selected over 30 MHz based on section 15.247(d).						

#### **FCC Part 15.31 (e)**

The EUT is a battery-operated device and test was performed with the full-charged battery. This EUT provides 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	-	Conducted

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

### 3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement. Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

#### Conducted emission

Item	Frequency Range	Unit	Calculated Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	dB	3.7
	0.15 MHz to 30 MHz	dB	3.3

#### Radiated emission

Measurement distance	Frequency Range	Unit	Calculated Uncertainty (+/-)
3 m	9 kHz to 30 MHz	dB	3.3
10 m		dB	3.1
3 m	30 MHz to 200 MHz	Horizontal	4.8
		Vertical	5.0
	200 MHz to 1000 MHz	Horizontal	5.1
		Vertical	6.2
10 m	30 MHz to 200 MHz	Horizontal	4.8
		Vertical	4.8
	200 MHz to 1000 MHz	Horizontal	4.9
		Vertical	5.0
3 m	1 GHz to 6 GHz	dB	4.9
	6 GHz to 18 GHz	dB	5.2
1 m	10 GHz to 26.5 GHz	dB	5.5
	26.5 GHz to 40 GHz	dB	5.4
10 m	1 GHz to 18 GHz	dB	5.3

#### Antenna Terminal Conducted Tests

Item	Unit	Calculated Uncertainty (+/-)
Antenna Terminated Conducted Emission / Power density / Burst power	dB	3.3
Adjacent Channel Power (ACP)	dB	2.3
Bandwidth (OBW)	%	1.0
Time Readout (Time span upto 100 msec)	%	0.1
Time Readout (Time span upto 1000 msec)	%	0.1
Time Readout (Time span upto 60 sec)	%	0.0
Power Measurement (Power meter)	dB	2.0
Frequency Readout (Frequency counter)	ppm	0.7
Frequency Readout (Spectrum analyzer frequency readout function)	ppm	1.6
Temperature (Constant temperature bath)	deg. C	0.8
Humidity (Constant temperature bath)	%HR	2.8
Modulation Characteristics	%	6.9
Frequency for Mobile	ppm	0.1

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

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

Telephone: +81-596-24-8999

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

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

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	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

\* Size of vertical conducting plane (for Conducted Emission test): 2.0 x 3.0 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)

Mode	Remarks*
Bluetooth (BT)	BR / EDR, Payload: PRBS9
<p>*EUT has the power settings by the software as follows;</p> <p>Power Setting: 7</p> <p>Software: BT Tool Version: W1645 (Date: 2016.10.31 Storage location: Driven by connected PC)</p> <p>Firmware: PlayStation Wireless Controller FW for function Control, Version: 0.1.66 (Date: 2023.03.22 / Storage location: IC101)</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>	

#### Details of Operating Mode(s)

Test Item	Mode	Hopping	Tested Frequency
Conducted Emission, Radiated Spurious Emission (Below 1 GHz)	Tx 3DH5 *1)	Off	2402 MHz
Radiated Spurious Emission (Above 1 GHz), Conducted Spurious Emission	Tx DH5 Tx 3DH5	Off	2402 MHz 2441 MHz 2480 MHz
Carrier Frequency Separation	Tx DH5 Tx 3DH5	On	2402 MHz 2441 MHz 2480 MHz
20dB Bandwidth	Tx DH5 Tx 3DH5	Off	2402 MHz 2441 MHz 2480 MHz
Number of Hopping Frequency	Tx DH5 Tx 3DH5	On	-
Dwell time	Tx DH1, DH3, DH5 Tx 3DH1, 3DH3, 3DH5	On	-
Maximum Peak Output Power	Tx DH5 Tx 2DH5 Tx 3DH5	Off	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5 Tx 3DH5	On ----- Off	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx DH5 Tx 3DH5	On ----- Off	2402 MHz 2441 MHz 2480 MHz

\*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test)

\*2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative.

\*It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all the test items based on Bluetooth Core specification.

\*1) Conducted emissions and Spurious emissions for frequencies below 1 GHz were limited to the channel that had the highest power during the antenna terminal test, as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands.

## 4.2 Configuration and Peripherals

**This page has been submitted for a separate exhibit.**

## **SECTION 5: Conducted Emission**

### **Test Procedure and Conditions**

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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

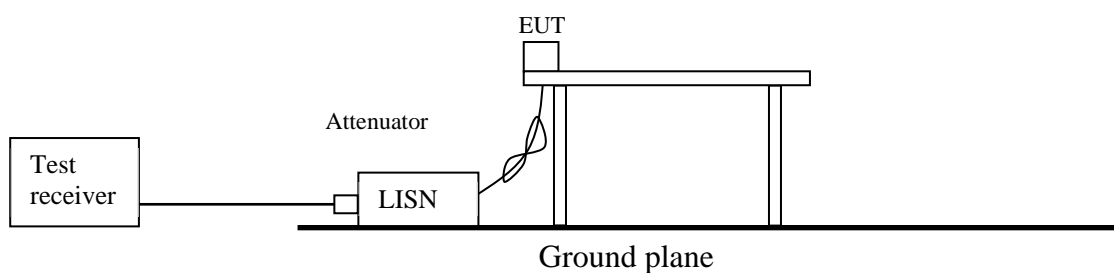
The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

<b>Detector</b>	<b>: QP and CISPR AV</b>
<b>Measurement Range</b>	<b>: 0.15 MHz to 30 MHz</b>
<b>Test Data</b>	<b>: APPENDIX</b>
<b>Test Result</b>	<b>: Pass</b>

**Figure 1: Test Setup**



## **SECTION 6: 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. 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 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.

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

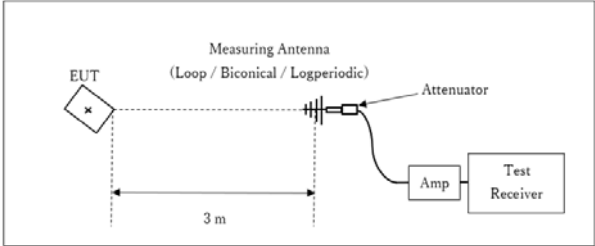
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired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

Figure 2: Test Setup

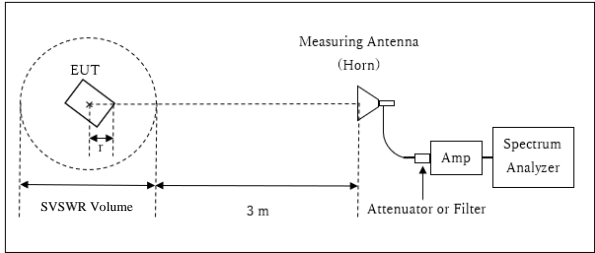
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz

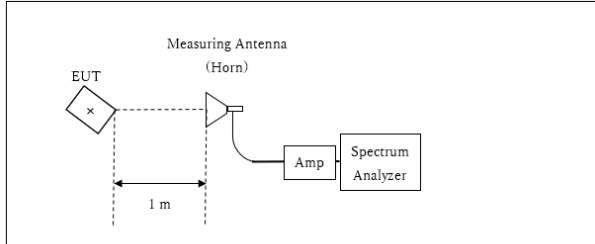


r : Radius of an outer periphery of EUT  
 x : Center of turn table

Distance Factor:  $20 \times \log(3.7 \text{ m} / 3.0 \text{ m}) = 1.83 \text{ dB}$   
 \* Test Distance:  $(3 + \text{SVSWR Volume} / 2) - r = 3.7 \text{ m}$

SVSWR Volume : 1.5 m  
 (SVSWR Volume has been calibrated based on CISPR 16-1-4.)  
 $r = 0.05 \text{ m}$

10 GHz to 30 GHz



x : 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 X, Y and Z axes 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 to 30 GHz  
 Test Data : APPENDIX  
 Test Result : Pass

## SECTION 7: 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	-	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 *2) *3)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	9.1 kHz	27 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

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

\*2) 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)

\*3) 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.

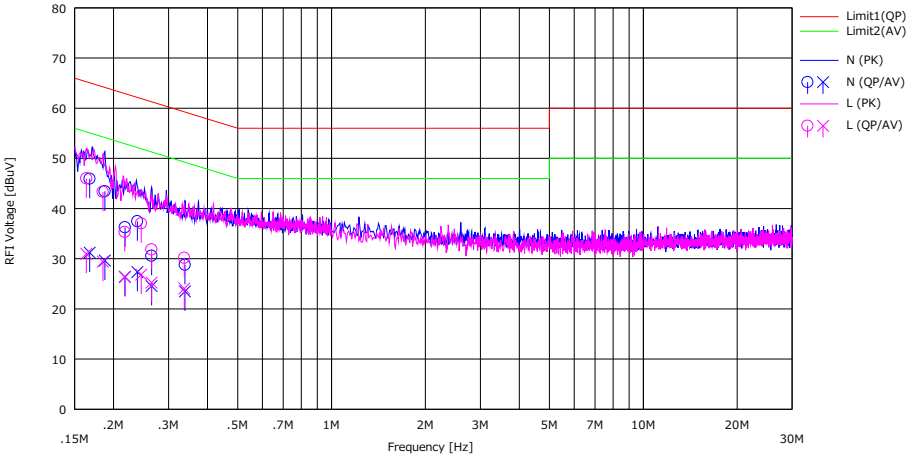
**Test Data** : APPENDIX  
**Test Result** : Pass

**APPENDIX 1: Test data**

**Conducted Emission**

Test place Ise EMC Lab. No.2 Semi Anechoic Chamber  
 Date April 18, 2023  
 Temperature / Humidity 22 deg. C / 45 % RH  
 Engineer Kiyoshiro Okazaki  
 Mode Tx, Hopping Off, 3DH5 2402 MHz

Limit : FCC\_Part 15 Subpart C(15.207)



No.	Freq. [MHz]	Reading		LISN [dB]	LOSS [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]			<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.16762	32.70	18.00	0.05	13.17	45.92	31.22	65.08	55.08	19.16	23.86	N	
2	0.18740	30.20	16.40	0.05	13.18	43.43	29.63	64.15	54.15	20.72	24.52	N	
3	0.21751	23.00	13.10	0.05	13.19	36.24	26.34	62.91	52.91	26.67	26.57	N	
4	0.23840	24.20	14.10	0.05	13.19	37.44	27.34	62.15	52.15	24.71	24.81	N	
5	0.26475	17.30	11.30	0.05	13.20	30.55	24.55	61.28	51.28	30.73	26.73	N	
6	0.33870	15.50	10.20	0.05	13.22	28.77	23.47	59.24	49.24	30.47	25.77	N	
7	0.16360	32.80	17.80	0.02	13.17	45.99	30.99	65.28	55.28	19.29	24.29	L	
8	0.18485	30.10	16.20	0.03	13.18	43.31	29.41	64.26	54.26	20.95	24.85	L	
9	0.21721	22.10	13.20	0.03	13.19	35.32	26.42	62.92	52.92	27.60	26.50	L	
10	0.24520	23.80	13.60	0.03	13.20	37.03	26.83	61.92	51.92	24.89	25.09	L	
11	0.26475	18.60	12.00	0.04	13.20	31.84	25.24	61.28	51.28	29.44	26.04	L	
12	0.33700	16.90	10.80	0.04	13.22	30.16	24.06	59.28	49.28	29.12	25.22	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)  
 Except for the above table: adequate margin data below the limits.

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

Test place                    Ise EMC Lab. No.11 Measurement Room  
Date                            April 18, 2023  
Temperature / Humidity    22 deg. C / 48 % RH  
Engineer                     Nachi Konegawa  
Mode                          Tx, Hopping Off, Tx, Hopping On

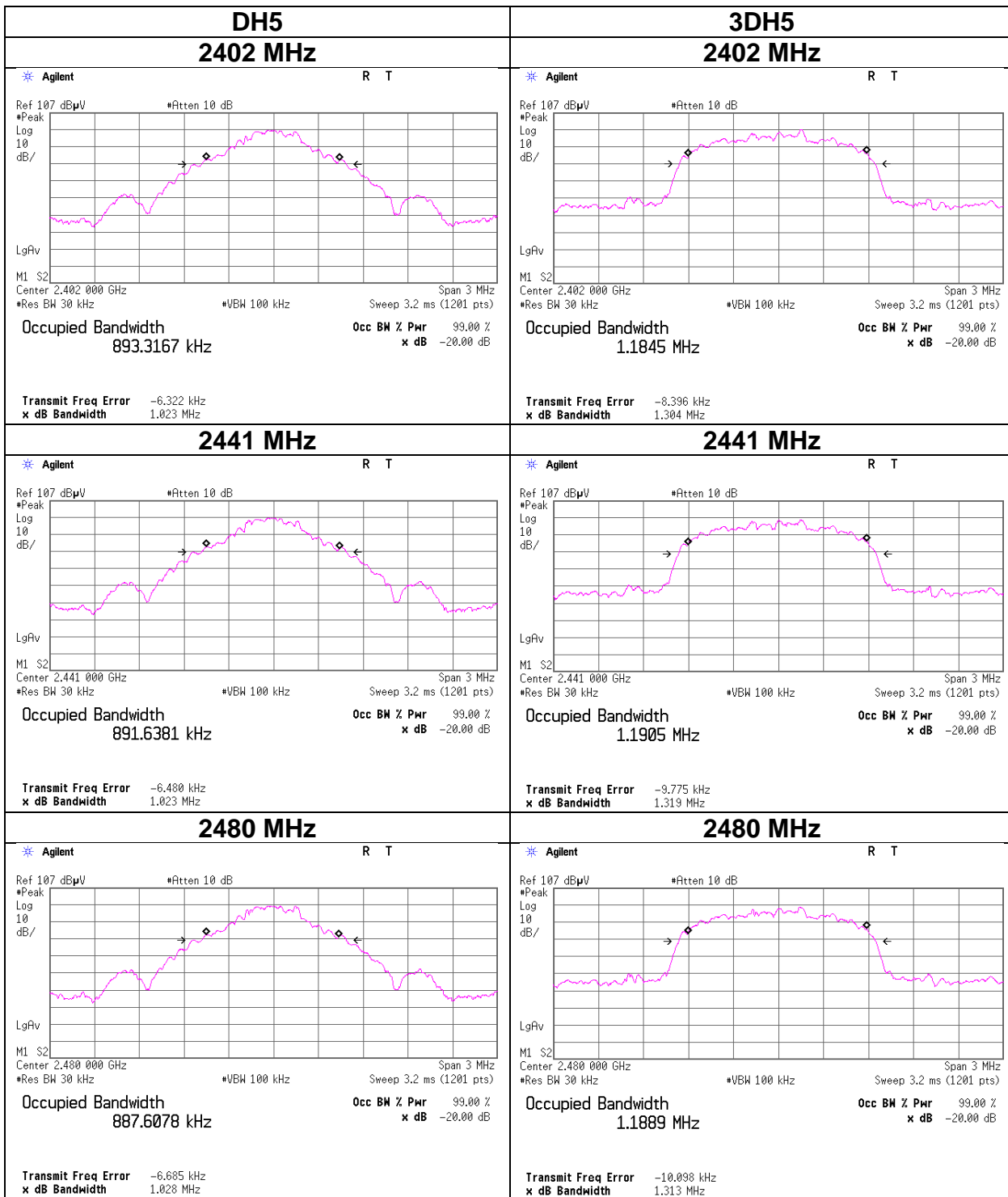
Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	1.023	893.317	1.000	>= 0.682
DH5	2441.0	1.023	891.638	1.000	>= 0.682
DH5	2480.0	1.028	887.608	1.000	>= 0.685
DH5	Hopping On	-	<b>78623.700</b>	-	-
3DH5	2402.0	1.304	1184.500	1.000	>= 0.869
3DH5	2441.0	1.319	1190.500	1.000	>= 0.879
3DH5	2480.0	1.313	1188.900	1.000	>= 0.875
3DH5	Hopping On	-	<b>78695.800</b>	-	-

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

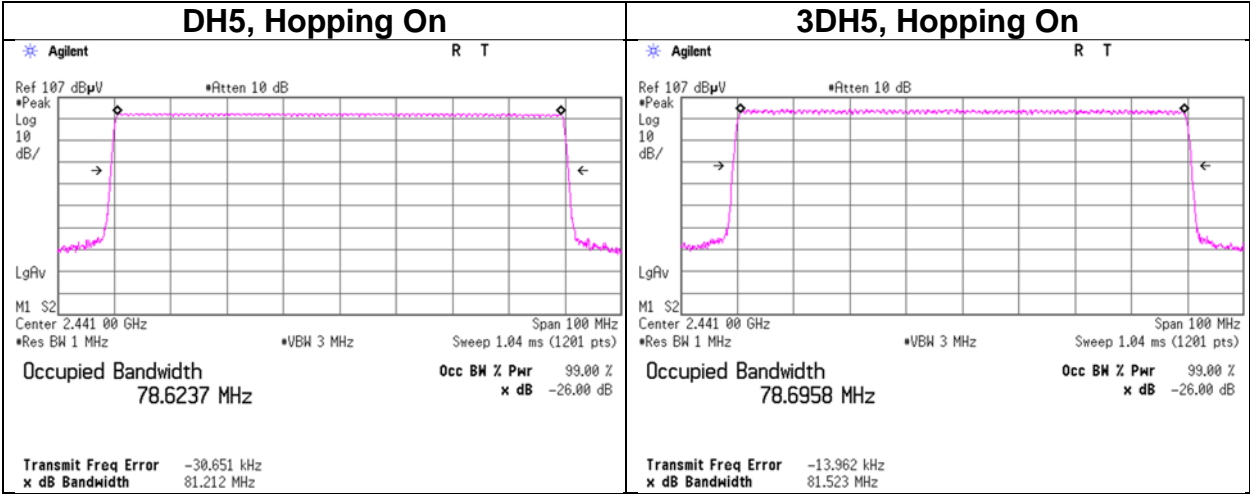
No limit applies to 20 dB Bandwidth.



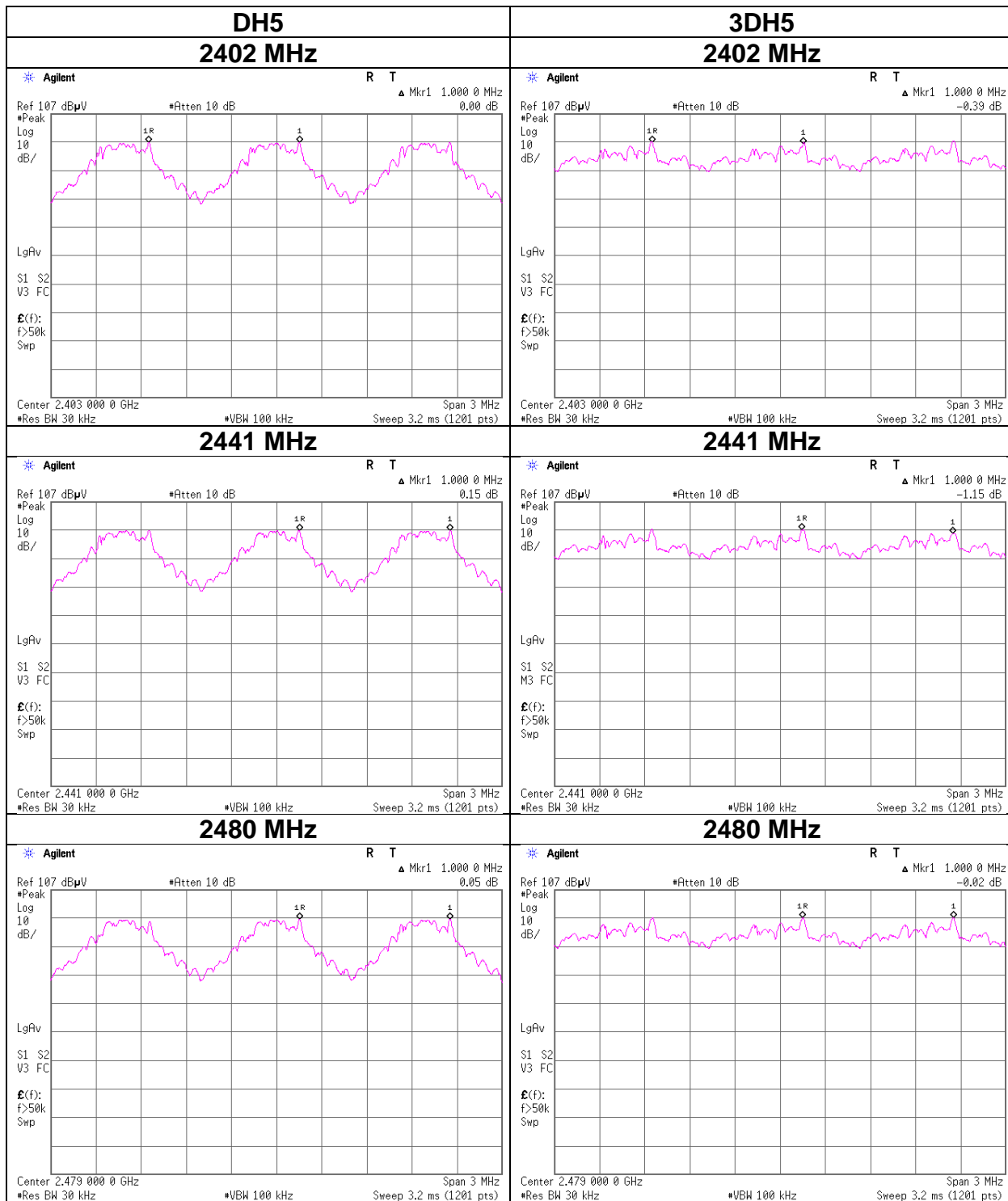
**20dB Bandwidth and 99% Occupied Bandwidth**



**20dB Bandwidth and 99% Occupied Bandwidth**



### Carrier Frequency Separation



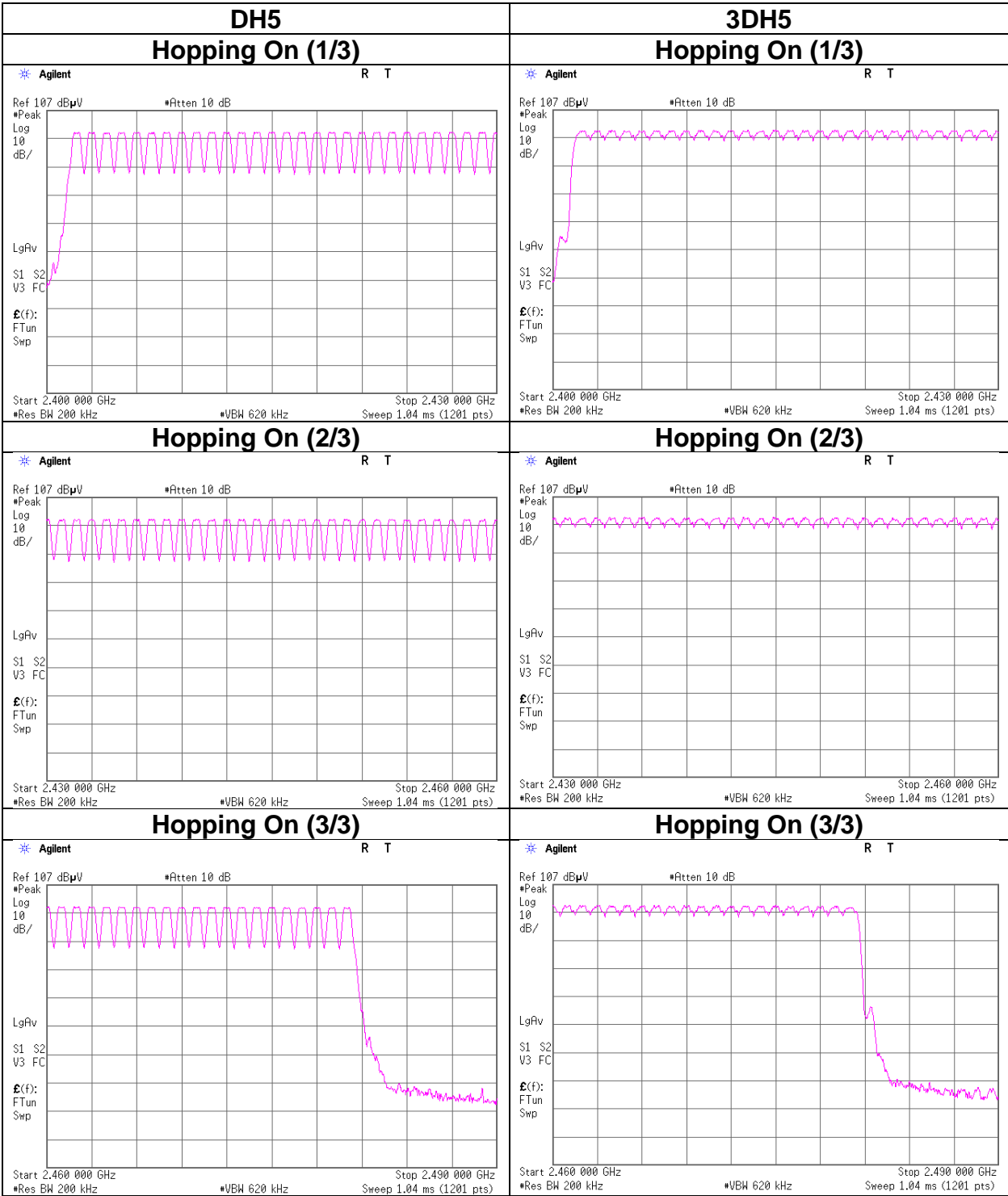
**Number of Hopping Frequency**

Test place                    Ise EMC Lab. No.11 Measurement Room  
Date                            April 18, 2023  
Temperature / Humidity    22 deg. C / 48 % RH  
Engineer                      Nachi Konegawa  
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

Test place	Ise EMC Lab. No.11 Measurement Room
Date	April 18, 2023
Temperature / Humidity	22 deg. C / 48 % RH
Engineer	Nachi Konegawa
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 [ms]	Result [ms]	Limit [ms]
DH1	49.8 times / 5 s x 31.6 s = 315 times	0.389	123	400
DH3	26.4 times / 5 s x 31.6 s = 167 times	1.662	278	400
DH5	21.6 times / 5 s x 31.6 s = 137 times	2.900	397	400
3DH1	49.6 times / 5 s x 31.6 s = 314 times	0.398	125	400
3DH3	26.4 times / 5 s x 31.6 s = 167 times	1.652	276	400
3DH5	20.8 times / 5 s x 31.6 s = 132 times	2.913	385	400

Sample Calculation

Result = Number of transmission x Length of transmission

\*Average data of 5 tests.(except Inquiry)

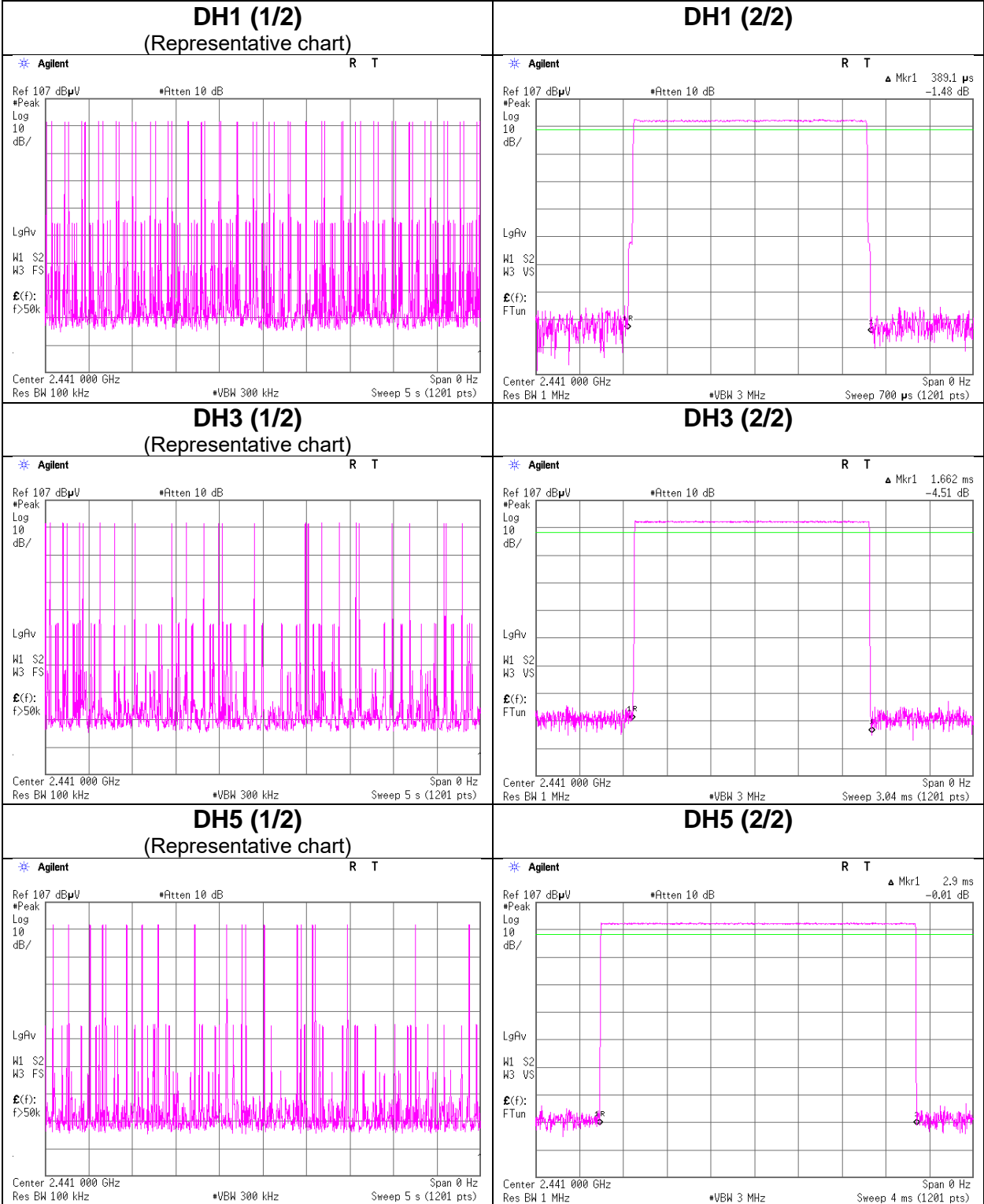
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	50	51	49	50	49	49.8
DH3	27	25	28	22	30	26.4
DH5	20	23	22	22	21	21.6
3DH1	50	51	49	49	49	49.6
3DH3	24	26	28	26	28	26.4
3DH5	21	18	20	22	23	20.8

Sample Calculation

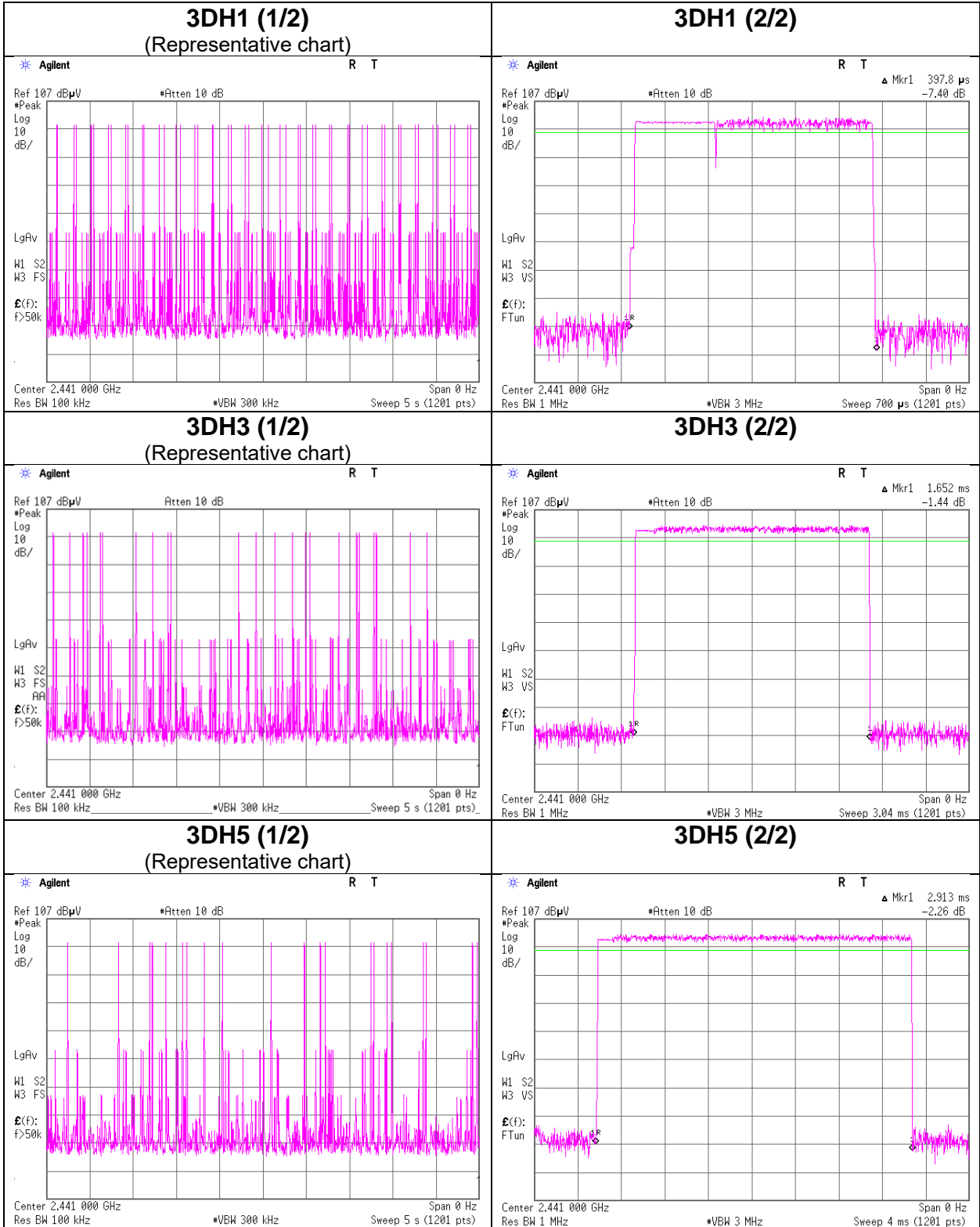
Average = Summation (Sampling 1 to 5) / 5

This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in  $N \times 0.4$  s, where  $N$  is the number of channels being used in the hopping sequence ( $20 \leq N \leq 79$ ), is always less than 0.4 s regardless of packet size. This is confirmed in the test report for  $N = 79$ .

**Dwell time**



**Dwell time**





## Maximum Peak Output Power

Test place                   Ise EMC Lab. No.11 Measurement Room  
Date                            April 18, 2023  
Temperature / Humidity    22 deg. C / 48 % RH  
Engineer                    Nachi Konegawa  
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	-7.00	0.54	9.75	3.29	2.13	20.96	125	17.67	3.40	6.69	4.67	36.02	4000	29.33
DH5	2441.0	-6.87	0.54	9.75	<b>3.42</b>	<b>2.20</b>	20.96	125	17.54	3.40	<b>6.82</b>	<b>4.81</b>	36.02	4000	29.20
DH5	2480.0	-7.30	0.54	9.75	2.99	1.99	20.96	125	17.97	3.40	6.39	4.36	36.02	4000	29.63
2DH5	2402.0	-4.69	0.54	9.75	5.60	3.63	20.96	125	15.36	3.40	9.00	7.94	36.02	4000	27.02
2DH5	2441.0	-4.67	0.54	9.75	<b>5.62</b>	<b>3.65</b>	20.96	125	15.34	3.40	<b>9.02</b>	<b>7.98</b>	36.02	4000	27.00
2DH5	2480.0	-5.01	0.54	9.75	5.28	3.37	20.96	125	15.68	3.40	8.68	7.38	36.02	4000	27.34
3DH5	2402.0	-4.39	0.54	9.75	<b>5.90</b>	<b>3.89</b>	20.96	125	15.06	3.40	<b>9.30</b>	<b>8.51</b>	36.02	4000	26.72
3DH5	2441.0	-4.41	0.54	9.75	5.88	3.87	20.96	125	15.08	3.40	9.28	8.47	36.02	4000	26.74
3DH5	2480.0	-4.76	0.54	9.75	5.53	3.57	20.96	125	15.43	3.40	8.93	7.82	36.02	4000	27.09

Sample Calculation:

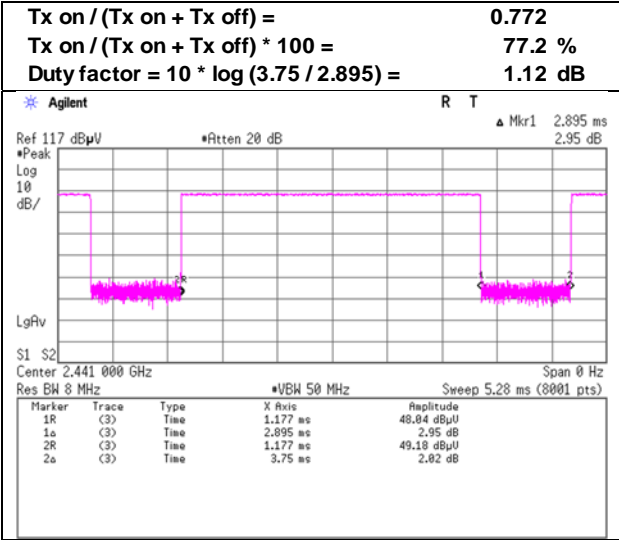
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss  
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Test was not performed at AFH mode, because the decrease of number of channel (min: 20 ch) 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 20 dB BW without 2/3 relaxation, 125 mW power limit was applied to it.

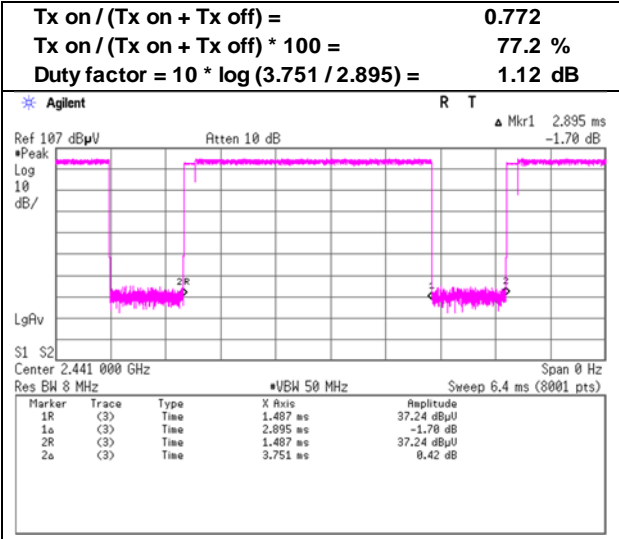
**Burst Rate Confirmation**

Test place	Ise EMC Lab.	No. 11 Measurement Room
Date	April 17, 2023	April 18, 2023
Temperature / Humidity	23 deg. C / 43 % RH	22 deg. C / 48 % RH
Engineer	Kiyoshiro Okazaki	Nachi Konegawa
Mode	Tx, Hopping Off	

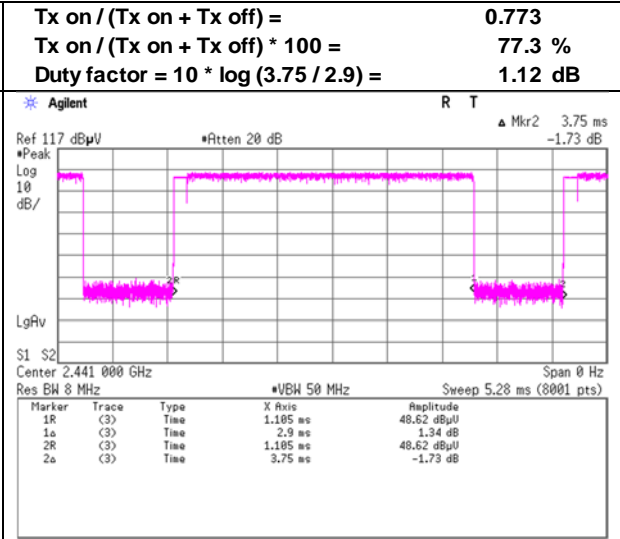
**DH5**



**2DH5**



**3DH5**



## Radiated Spurious Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2023
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kiyoshiro Okazaki
	(1 GHz to 30 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.	2390.0	46.8	35.9	27.6	5.0	34.9	1.1	44.4	34.7	73.9	53.9	29.5	19.3	*1)
Hori.	4804.0	43.1	33.2	31.6	7.2	34.1	-	47.8	37.9	73.9	53.9	26.1	16.0	Floor noise
Hori.	7206.0	42.6	34.3	35.9	8.5	34.0	-	52.9	44.6	73.9	53.9	21.0	9.3	Floor noise
Hori.	9608.0	42.3	33.5	38.8	9.1	34.7	-	55.6	46.7	73.9	53.9	18.3	7.2	Floor noise
Vert.	2390.0	46.8	36.7	27.6	5.0	34.9	1.1	44.4	35.5	73.9	53.9	29.5	18.4	*1)
Vert.	4804.0	43.1	33.7	31.6	7.2	34.1	-	47.8	38.4	73.9	53.9	26.1	15.5	Floor noise
Vert.	7206.0	42.9	34.2	35.9	8.5	34.0	-	53.3	44.6	73.9	53.9	20.6	9.3	Floor noise
Vert.	9608.0	42.7	33.6	38.8	9.1	34.7	-	55.9	46.8	73.9	53.9	18.0	7.1	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)

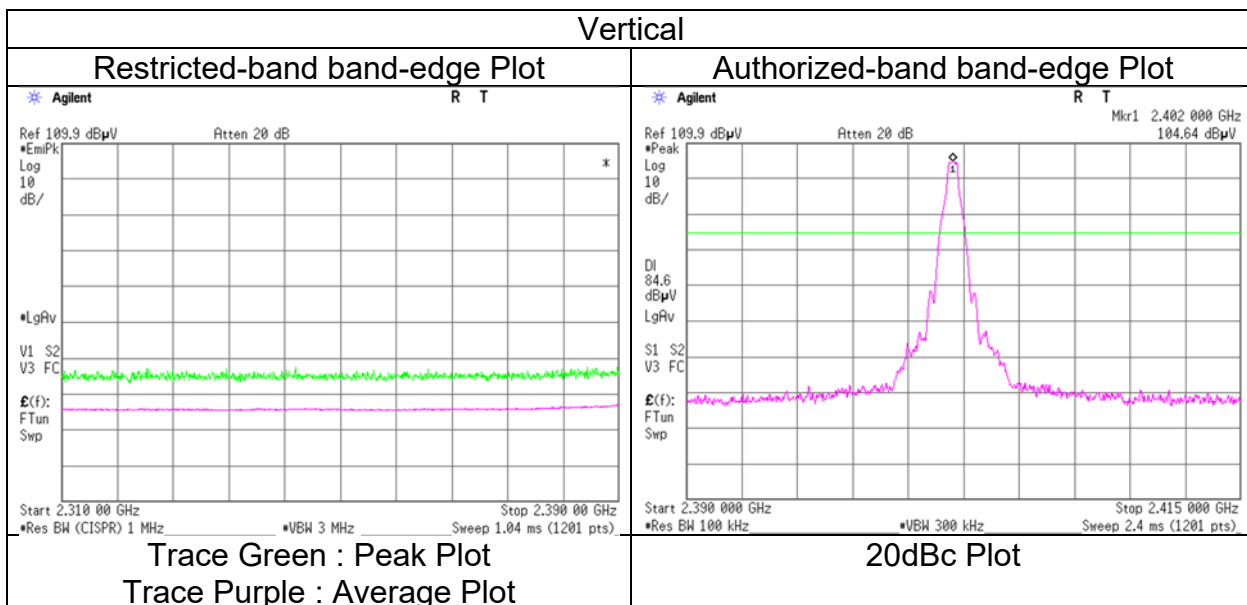
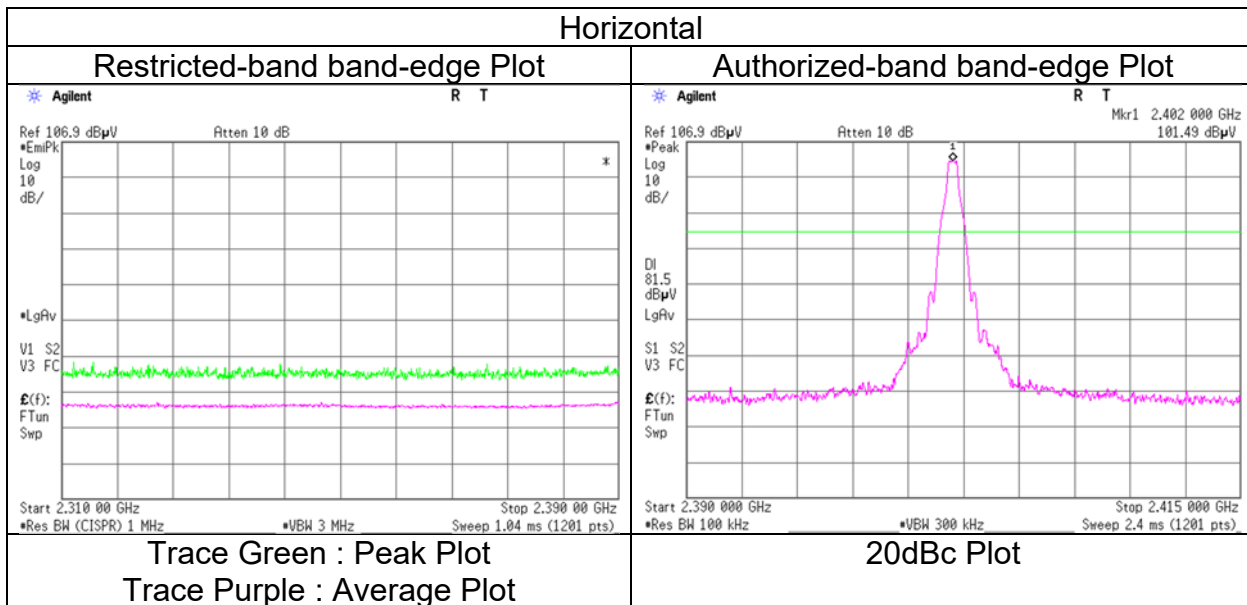
### 20dBc Data Sheet

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	101.5	27.6	5.0	34.9	99.1	-	-	Carrier
Hori.	2400.0	52.0	27.6	5.0	34.9	49.7	79.1	29.5	
Vert.	2402.0	104.6	27.6	5.0	34.9	102.3	-	-	Carrier
Vert.	2400.0	55.1	27.6	5.0	34.9	52.7	82.3	29.6	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)  
 Distance factor:    1 GHz - 10 GHz       20log (3.7 m / 3.0 m) = 1.83 dB  
                       10 GHz - 30 GHz      20log (1.0 m / 3.0 m) = -9.5 dB

## Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2023
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kiyoshiro Okazaki
	(1 GHz to 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

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2023
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kiyoshiro Okazaki
	(1 GHz to 30 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.	4882.0	43.2	33.6	31.7	7.3	34.2	-	48.0	38.4	73.9	53.9	25.9	15.5	Floor noise
Hori.	7323.0	42.9	34.2	36.1	8.5	34.1	-	53.4	44.6	73.9	53.9	20.5	9.3	Floor noise
Hori.	9764.0	42.4	33.5	39.2	9.1	34.7	-	56.0	47.1	73.9	53.9	17.9	6.8	Floor noise
Vert.	4882.0	43.2	33.7	31.7	7.3	34.2	-	48.0	38.5	73.9	53.9	25.9	15.4	Floor noise
Vert.	7323.0	43.0	34.3	36.1	8.5	34.1	-	53.5	44.8	73.9	53.9	20.5	9.2	Floor noise
Vert.	9764.0	42.6	33.6	39.2	9.1	34.7	-	56.2	47.2	73.9	53.9	17.7	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.

Distance factor:	1 GHz - 10 GHz	$20\log(3.7\text{ m} / 3.0\text{ m}) = 1.83\text{ dB}$
	10 GHz - 30 GHz	$20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

### Radiated Spurious Emission

Test place                                    Ise EMC Lab.  
Semi Anechoic Chamber                No.2  
Date    April 17, 2023  
Temperature / Humidity                23 deg. C / 43 % RH  
Engineer                                      Kiyoshiro Okazaki  
    (1 GHz to 30 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.	2483.5	47.6	37.4	27.5	5.1	34.9	1.1	45.2	36.2	73.9	53.9	28.7	17.7	*1)
Hori.	4960.0	43.5	33.5	31.8	7.3	34.2	-	48.5	38.4	73.9	53.9	25.4	15.5	Floor noise
Hori.	7440.0	43.0	34.2	36.2	8.5	34.1	-	53.6	44.8	73.9	53.9	20.3	9.1	Floor noise
Hori.	9920.0	42.7	33.6	39.2	9.2	34.7	-	56.3	47.2	73.9	53.9	17.6	6.7	Floor noise
Vert.	2483.5	49.2	39.5	27.5	5.1	34.9	1.1	46.8	38.3	73.9	53.9	27.1	15.7	*1)
Vert.	4960.0	43.2	33.6	31.8	7.3	34.2	-	48.2	38.5	73.9	53.9	25.8	15.4	Floor noise
Vert.	7440.0	42.9	34.5	36.2	8.5	34.1	-	53.4	45.1	73.9	53.9	20.5	8.8	Floor noise
Vert.	9920.0	42.5	33.5	39.2	9.2	34.7	-	56.1	47.1	73.9	53.9	17.8	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

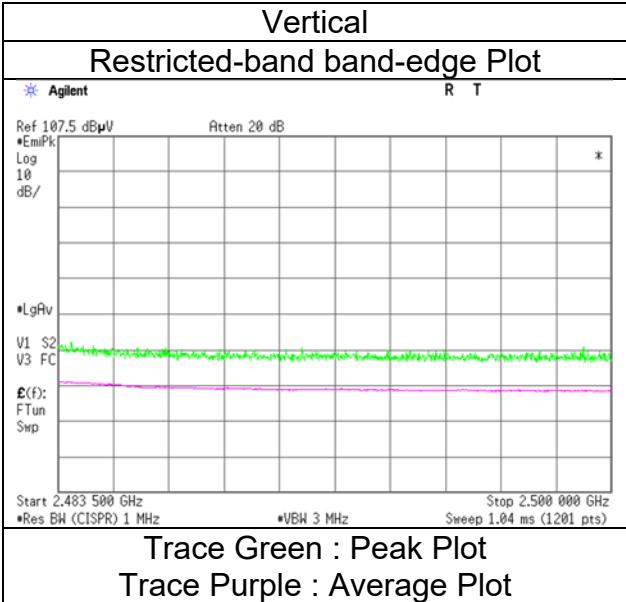
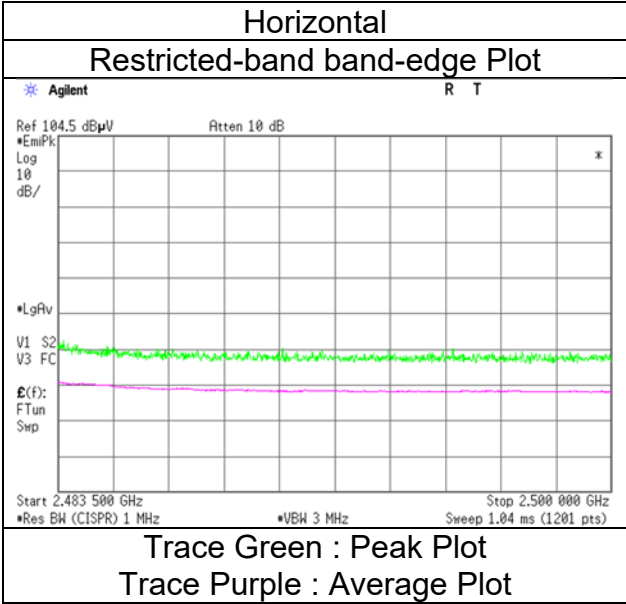
\*1) Not Out of Band emission(Leakage Power)

Distance factor:            1 GHz - 10 GHz             $20\log(3.7\text{ m} / 3.0\text{ m}) = 1.83\text{ dB}$   
                                      10 GHz - 30 GHz         $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

**Radiated Spurious Emission  
(Reference Plot for band-edge)**

Test place  
Semi Anechoic Chamber  
Date  
Temperature / Humidity  
Engineer  
Mode

Ise EMC Lab.  
No.2  
April 17, 2023  
23 deg. C / 43 % RH  
Kiyoshiro Okazaki  
(1 GHz to 10 GHz)  
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

Test place	Ise EMC Lab.	No.2
Semi Anechoic Chamber	No.2	No.2
Date	April 17, 2023	April 18, 2023
Temperature / Humidity	23 deg. C / 43 % RH	22 deg. C / 41 % RH
Engineer	Kiyoshiro Okazaki	Ken Fujita
	(1 GHz to 30 GHz)	(30 MHz to 1000 MHz)
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.	30.8	22.4	-	18.5	6.6	28.6	-	19.0	-	40.0	-	21.0	-	
Hori.	44.2	21.9	-	13.5	6.8	28.6	-	13.6	-	40.0	-	26.4	-	
Hori.	162.3	22.6	-	15.5	7.8	28.2	-	17.7	-	43.5	-	25.8	-	
Hori.	225.7	25.3	-	12.0	8.3	27.9	-	17.7	-	46.0	-	28.3	-	
Hori.	300.5	32.9	-	13.9	8.7	27.8	-	27.8	-	46.0	-	18.2	-	
Hori.	372.6	34.2	-	15.3	9.1	28.2	-	30.4	-	46.0	-	15.7	-	
Hori.	2390.0	45.8	35.7	27.6	5.0	34.9	1.1	43.4	34.4	73.9	53.9	30.5	19.5	*1)
Hori.	4804.0	43.3	33.7	31.6	7.2	34.1	-	48.0	38.4	73.9	53.9	25.9	15.5	Floor noise
Hori.	7206.0	42.4	34.5	35.9	8.5	34.0	-	52.8	44.9	73.9	53.9	21.1	9.0	Floor noise
Hori.	9608.0	42.4	33.4	38.8	9.1	34.7	-	55.6	46.6	73.9	53.9	18.3	7.3	Floor noise
Vert.	30.8	25.1	-	18.5	6.6	28.6	-	21.7	-	40.0	-	18.3	-	
Vert.	44.2	25.1	-	13.5	6.8	28.6	-	16.8	-	40.0	-	23.2	-	
Vert.	162.3	24.8	-	15.5	7.8	28.2	-	19.9	-	43.5	-	23.6	-	
Vert.	225.7	23.2	-	12.0	8.3	27.9	-	15.6	-	46.0	-	30.4	-	
Vert.	300.5	36.7	-	13.9	8.7	27.8	-	31.6	-	46.0	-	14.4	-	
Vert.	372.6	33.7	-	15.3	9.1	28.2	-	29.9	-	46.0	-	16.2	-	
Vert.	2390.0	46.9	36.7	27.6	5.0	34.9	1.1	44.5	35.4	73.9	53.9	29.4	18.5	*1)
Vert.	4804.0	43.2	33.7	31.6	7.2	34.1	-	48.0	38.4	73.9	53.9	26.0	15.5	Floor noise
Vert.	7206.0	42.6	34.8	35.9	8.5	34.0	-	53.0	45.1	73.9	53.9	21.0	8.8	Floor noise
Vert.	9608.0	42.4	33.4	38.8	9.1	34.7	-	55.6	46.6	73.9	53.9	18.3	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**

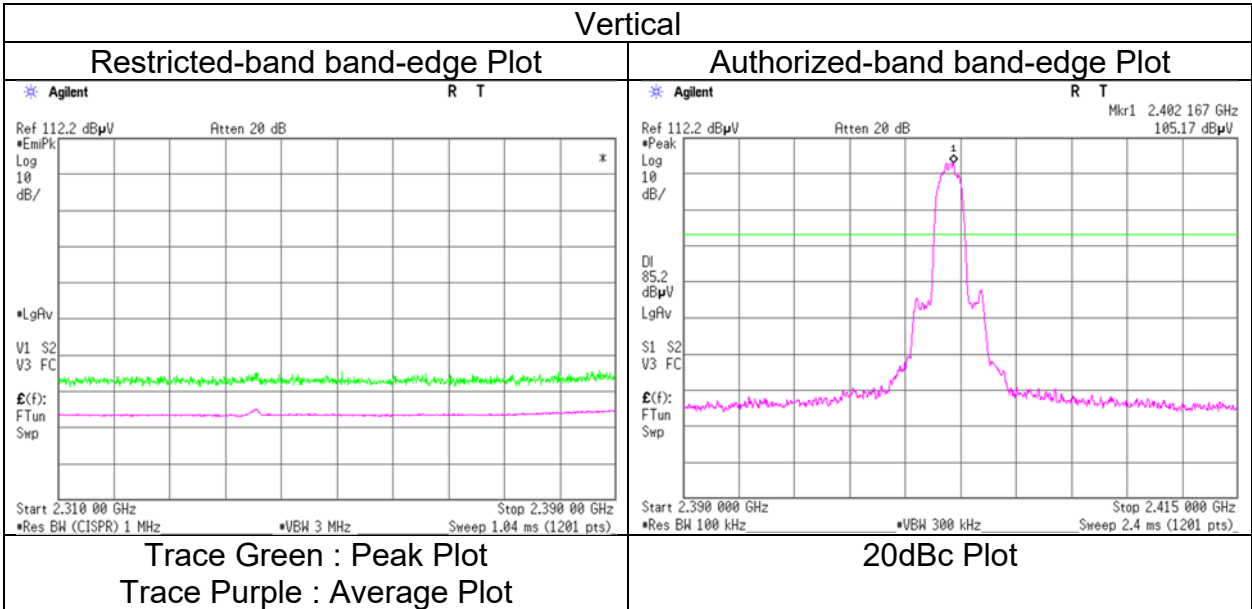
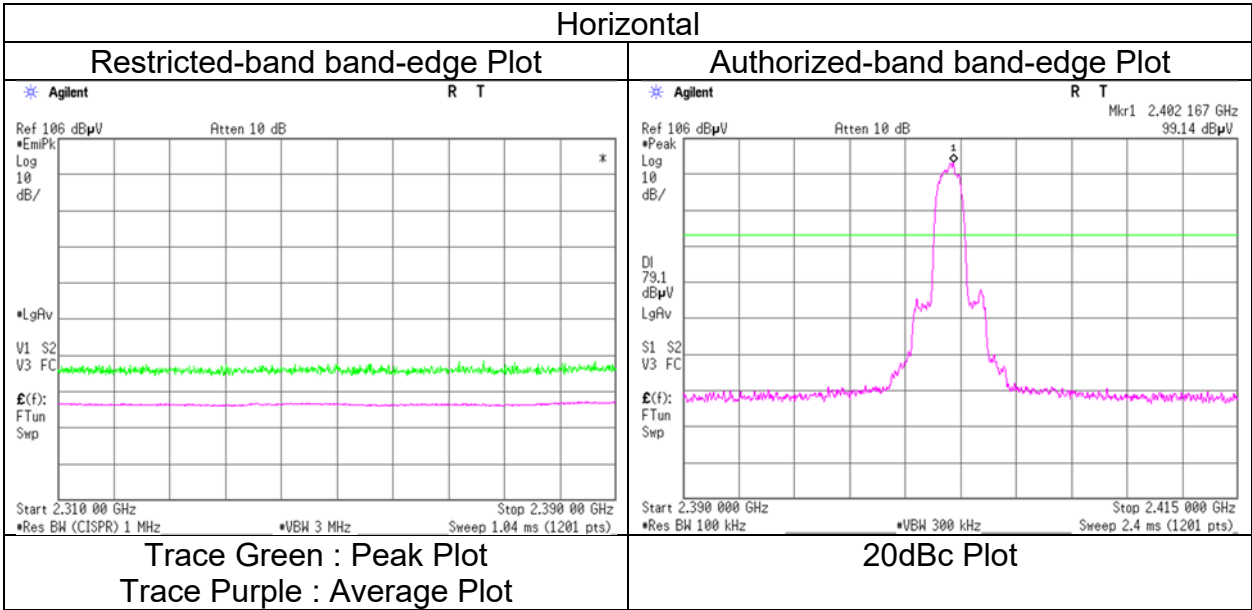
Polarity	Frequency	Reading (PK)	Ant Factor	Loss	Gain	Result	Limit	Margin	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
Hori.	2402.0	99.1	27.6	5.0	34.9	96.8	-	-	Carrier
Hori.	2400.0	45.8	27.6	5.0	34.9	43.5	76.8	33.3	
Vert.	2402.0	105.2	27.6	5.0	34.9	102.8	-	-	Carrier
Vert.	2400.0	50.0	27.6	5.0	34.9	47.7	82.8	35.1	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)  
 Distance factor: 1 GHz - 10 GHz      20log (3.7 m / 3.0 m) = 1.83 dB  
 10 GHz - 30 GHz      20log (1.0 m / 3.0 m) = -9.5 dB



**Radiated Spurious Emission  
 (Reference Plot for band-edge)**

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2023
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kiyoshiro Okazaki
	(1 GHz to 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

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2023
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kiyoshiro Okazaki
	(1 GHz to 30 GHz)
Mode	Tx, Hopping Off, 3DH5 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.	4882.0	43.3	33.5	31.7	6.5	34.2	-	47.4	37.6	73.9	53.9	26.5	16.3	Floor noise
Hori.	7323.0	42.6	34.4	36.1	7.7	34.1	-	52.2	44.0	73.9	53.9	21.7	9.9	Floor noise
Hori.	9764.0	42.4	33.4	39.2	8.5	34.7	-	55.4	46.4	73.9	53.9	18.5	7.5	Floor noise
Vert.	4882.0	43.3	33.5	31.7	6.5	34.2	-	47.3	37.5	73.9	53.9	26.6	16.4	Floor noise
Vert.	7323.0	42.7	34.6	36.1	7.7	34.1	-	52.3	44.2	73.9	53.9	21.6	9.7	Floor noise
Vert.	9764.0	42.4	33.3	39.2	8.5	34.7	-	55.4	46.3	73.9	53.9	18.5	7.6	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	$20\log(3.7\text{ m} / 3.0\text{ m}) = 1.83\text{ dB}$
	10 GHz - 30 GHz	$20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

## Radiated Spurious Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2023
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Kiyoshiro Okazaki (1 GHz to 30 GHz)
Mode	Tx, Hopping Off, 3DH5 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.	2483.5	47.3	37.7	27.5	5.1	34.9	1.1	44.9	36.4	73.9	53.9	29.0	17.5	*1)
Hori.	4960.0	43.3	33.5	31.8	7.3	34.2	-	48.3	38.4	73.9	53.9	25.6	15.5	Floor noise
Hori.	7440.0	42.7	34.5	36.2	8.5	34.1	-	53.2	45.1	73.9	53.9	20.7	8.8	Floor noise
Hori.	9920.0	42.6	33.3	39.2	9.2	34.7	-	56.2	46.9	73.9	53.9	17.8	7.0	Floor noise
Vert.	2483.5	51.2	40.0	27.5	5.1	34.9	1.1	48.8	38.7	73.9	53.9	25.1	15.2	*1)
Vert.	4960.0	43.3	33.5	31.8	7.3	34.2	-	48.3	38.4	73.9	53.9	25.6	15.5	Floor noise
Vert.	7440.0	42.6	34.6	36.2	8.5	34.1	-	53.1	45.2	73.9	53.9	20.8	8.7	Floor noise
Vert.	9920.0	42.3	33.3	39.2	9.2	34.7	-	55.9	46.9	73.9	53.9	18.0	7.0	Floor noise

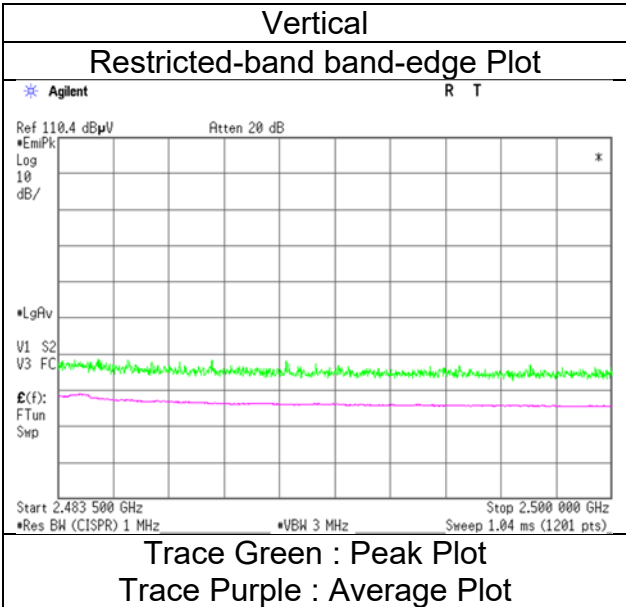
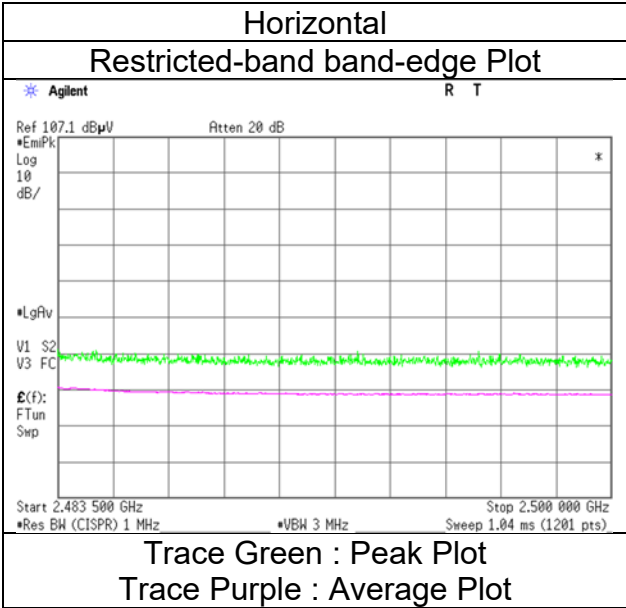
Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)  
 Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor  
 \*Other frequency noises omitted in this report 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 (3.7 m / 3.0 m) = 1.83 dB
	10 GHz - 30 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

**Radiated Spurious Emission  
(Reference Plot for band-edge)**

Test place  
Semi Anechoic Chamber  
Date  
Temperature / Humidity  
Engineer  
Mode

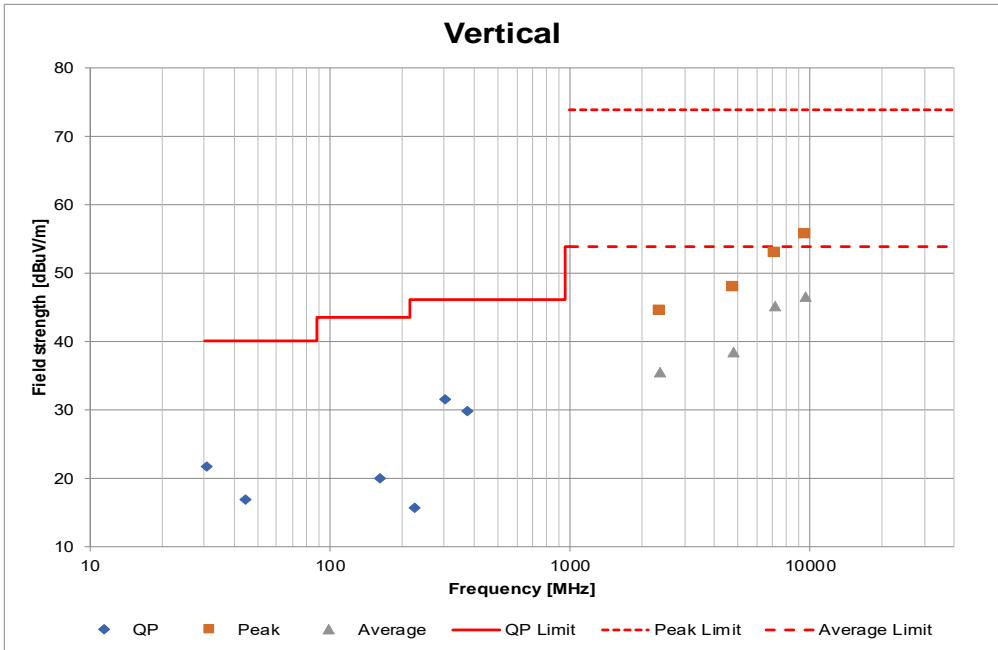
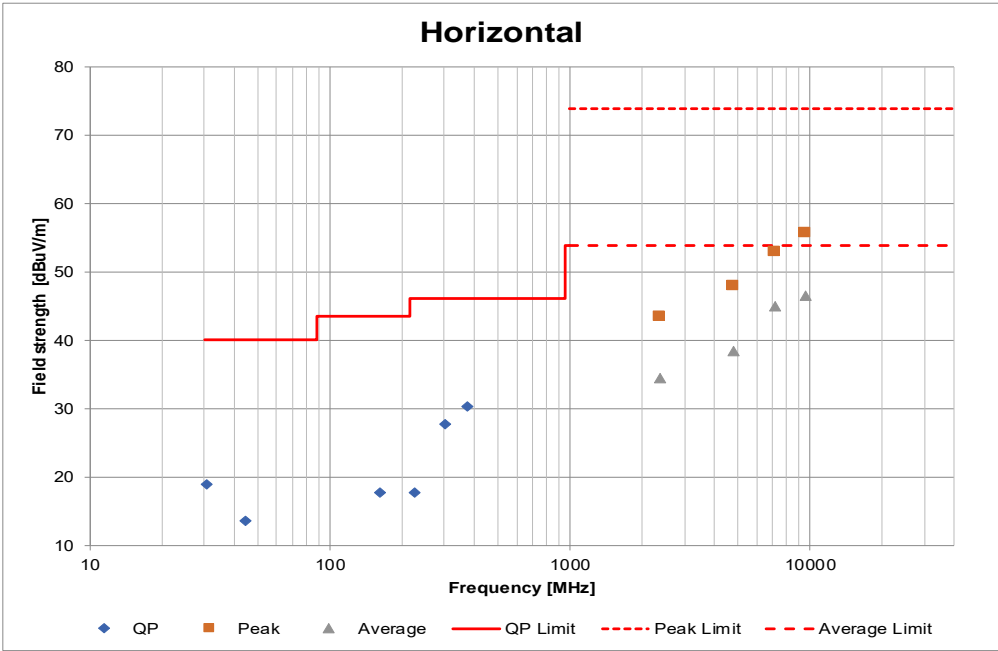
Ise EMC Lab.  
No.2  
April 17, 2023  
23 deg. C / 43 % RH  
Kiyoshiro Okazaki  
(1 GHz to 10 GHz)  
Tx, Hopping Off, 3DH5 2480 MHz



\* 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 mode for Maximum Peak Output Power)**

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	April 17, 2023	April 18, 2023
Temperature / Humidity	23 deg. C / 43 % RH	22 deg. C / 41 % RH
Engineer	Kiyoshiro Okazaki	Ken Fujita
	(1 GHz to 30 GHz)	(30 MHz to 1000 MHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz	

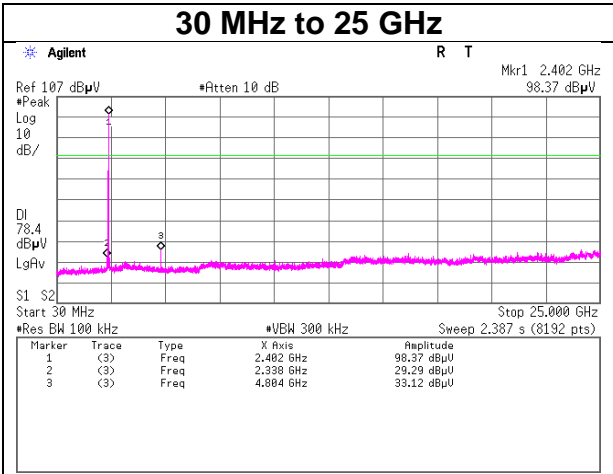
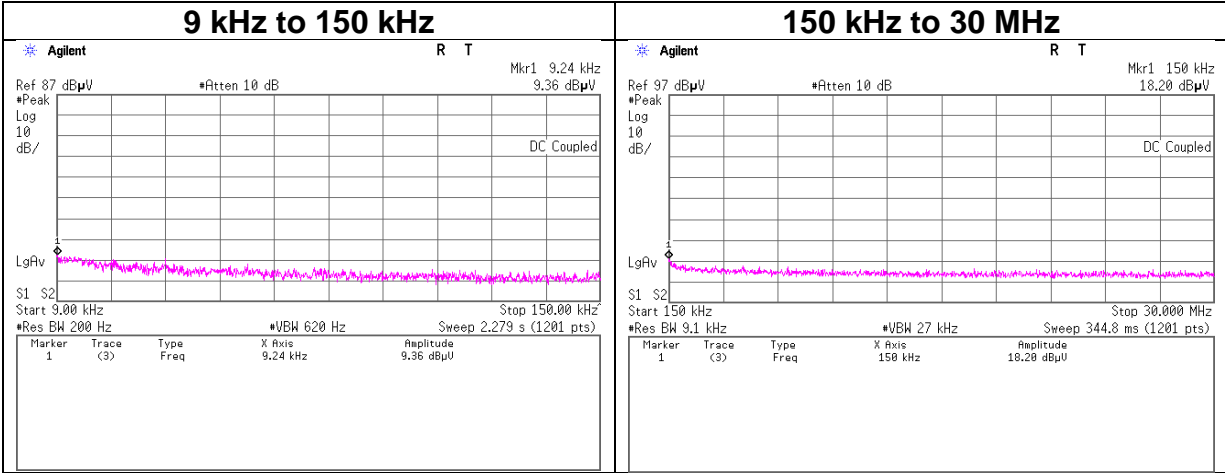


\*These plots data contain sufficient number to show the trend of characteristic features for EUT.

**Conducted Spurious Emission**

Test place Ise EMC Lab. No.11 Measurement Room  
 Date April 18, 2023  
 Temperature / Humidity 22 deg. C / 48 % RH  
 Engineer Nachi Konegawa  
 Mode Tx, Hopping Off, DH5

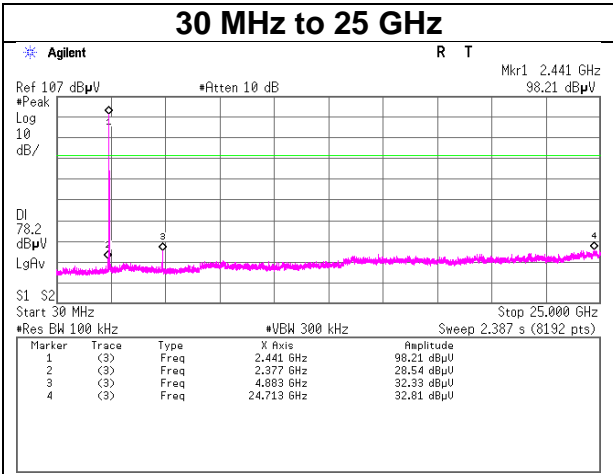
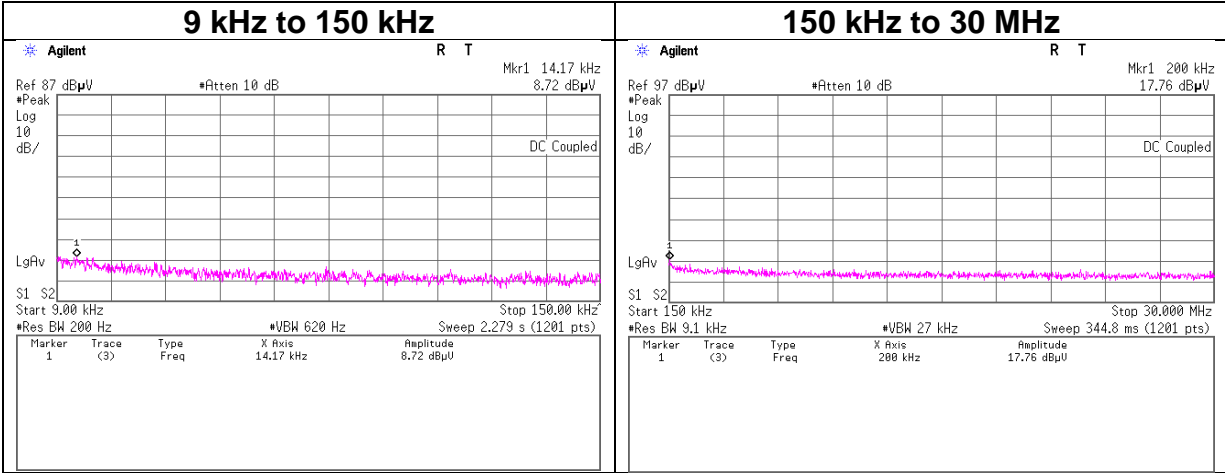
**2402 MHz**



**Conducted Spurious Emission**

Test place                    Ise EMC Lab. No.11 Measurement Room  
 Date                            April 18, 2023  
 Temperature / Humidity    22 deg. C / 48 % RH  
 Engineer                      Nachi Konegawa  
 Mode                            Tx, Hopping Off, DH5

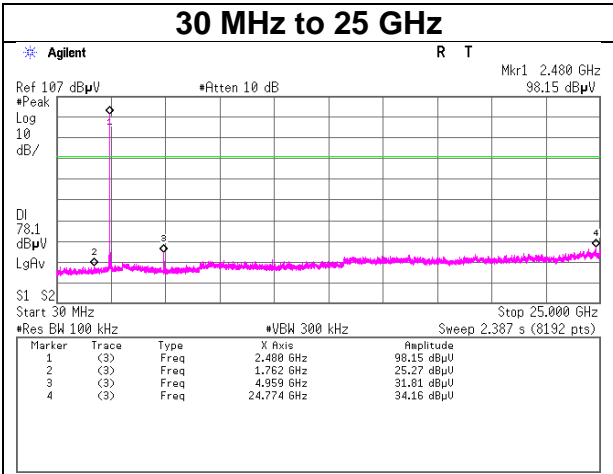
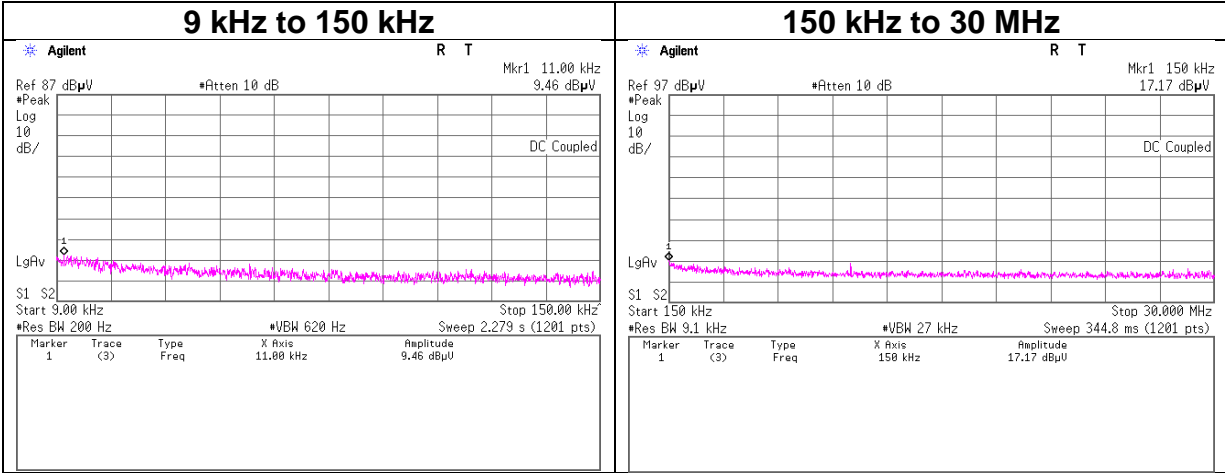
**2441 MHz**



**Conducted Spurious Emission**

Test place                    Ise EMC Lab. No.11 Measurement Room  
 Date                            April 18, 2023  
 Temperature / Humidity    22 deg. C / 48 % RH  
 Engineer                      Nachi Konegawa  
 Mode                            Tx, Hopping Off, DH5

**2480 MHz**

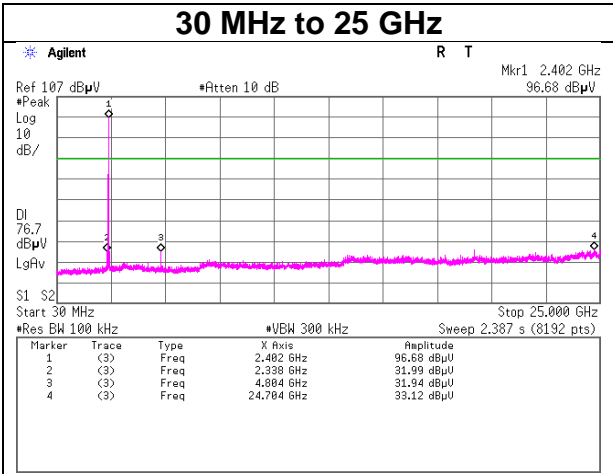
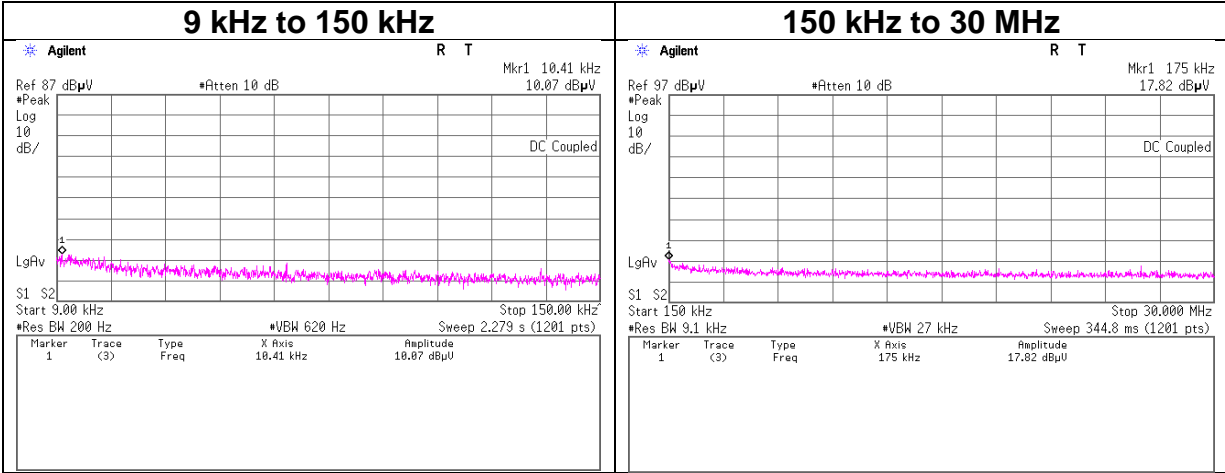




**Conducted Spurious Emission**

Test place                    Ise EMC Lab. No.11 Measurement Room  
 Date                            April 18, 2023  
 Temperature / Humidity    22 deg. C / 48 % RH  
 Engineer                      Nachi Konegawa  
 Mode                            Tx, Hopping Off, 3DH5

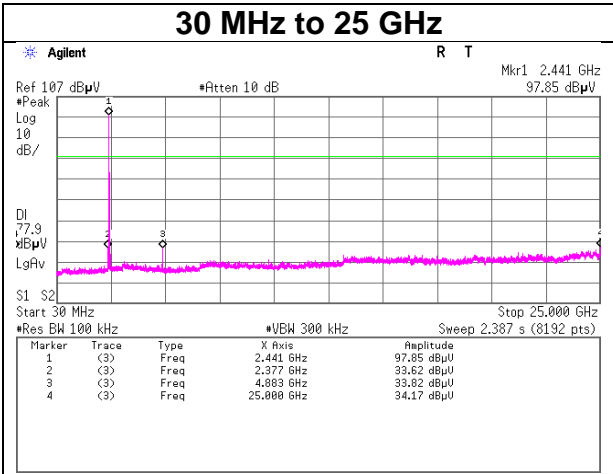
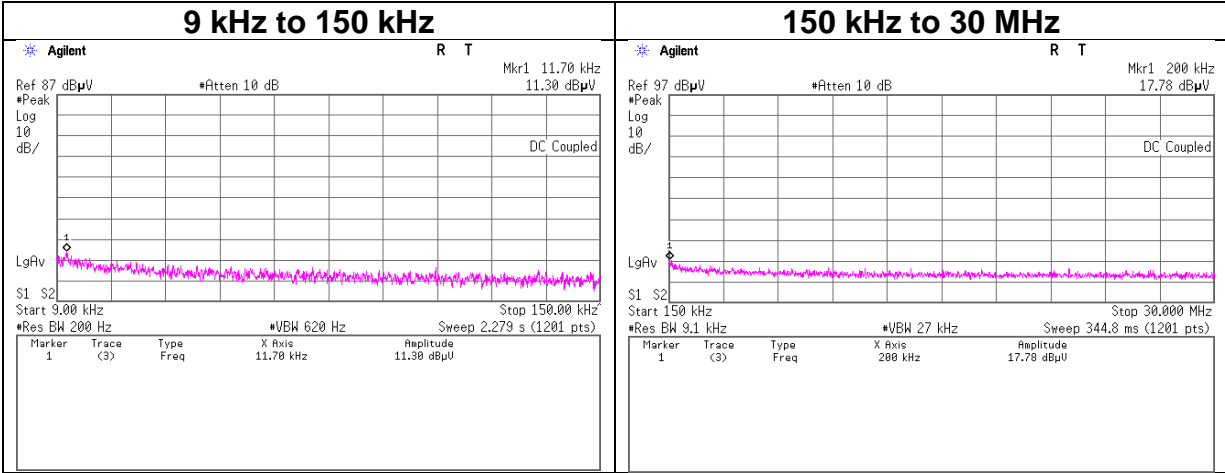
**2402 MHz**



**Conducted Spurious Emission**

Test place                    Ise EMC Lab. No.11 Measurement Room  
 Date                            April 18, 2023  
 Temperature / Humidity    22 deg. C / 48 % RH  
 Engineer                      Nachi Konegawa  
 Mode                            Tx, Hopping Off, 3DH5

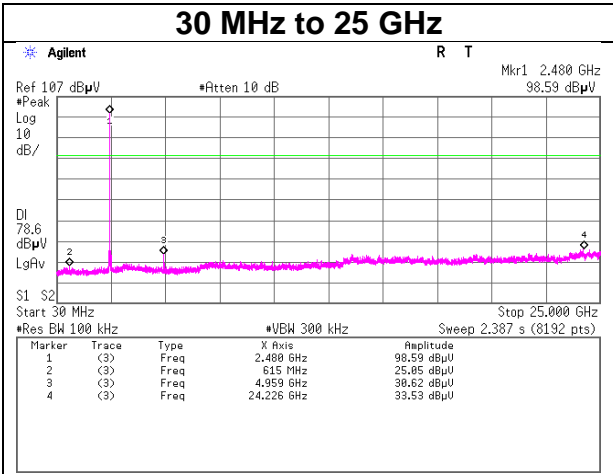
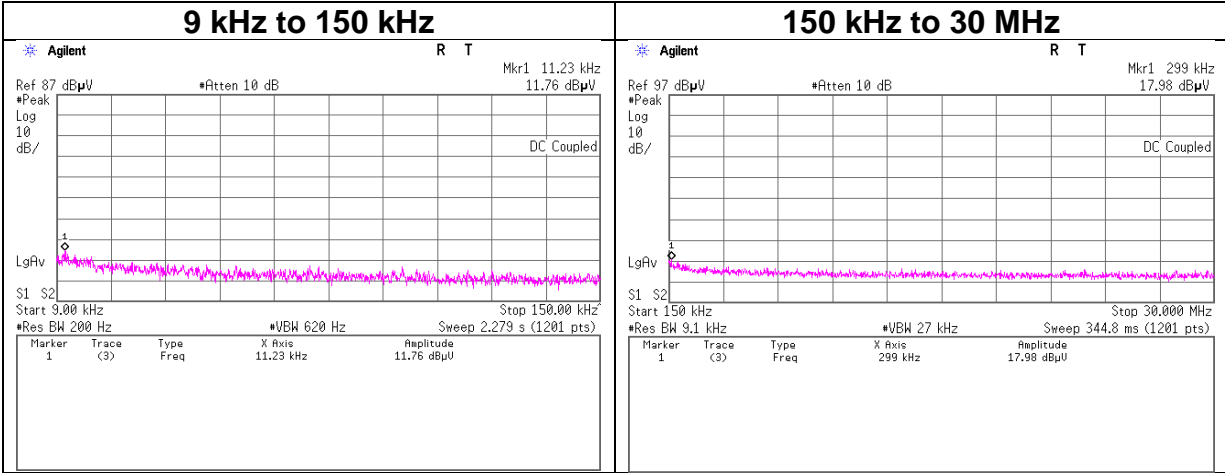
**2441 MHz**



**Conducted Spurious Emission**

Test place                    Ise EMC Lab. No.11 Measurement Room  
 Date                            April 18, 2023  
 Temperature / Humidity    22 deg. C / 48 % RH  
 Engineer                      Nachi Konegawa  
 Mode                            Tx, Hopping Off, 3DH5

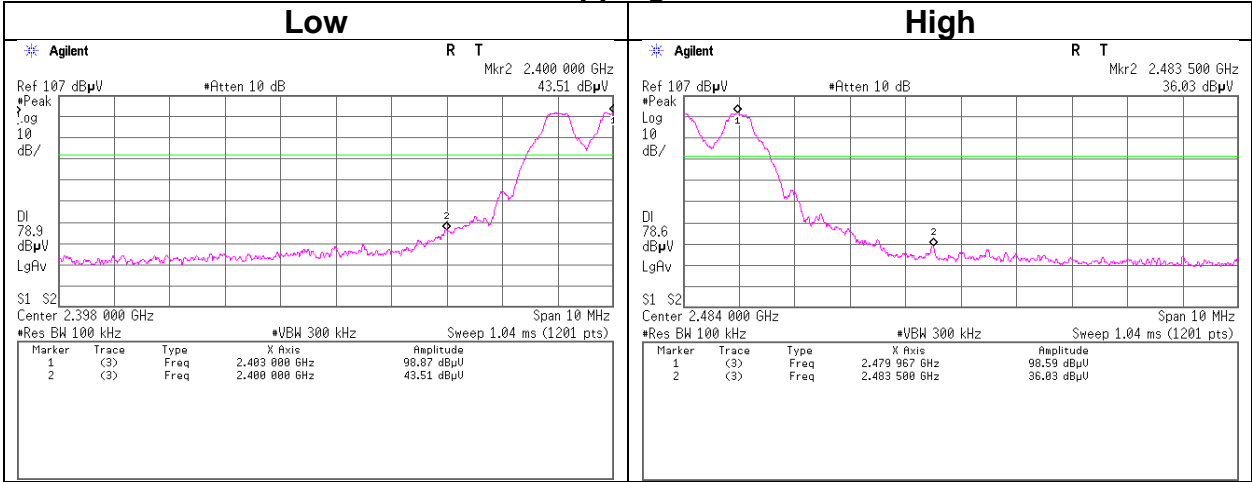
**2480 MHz**



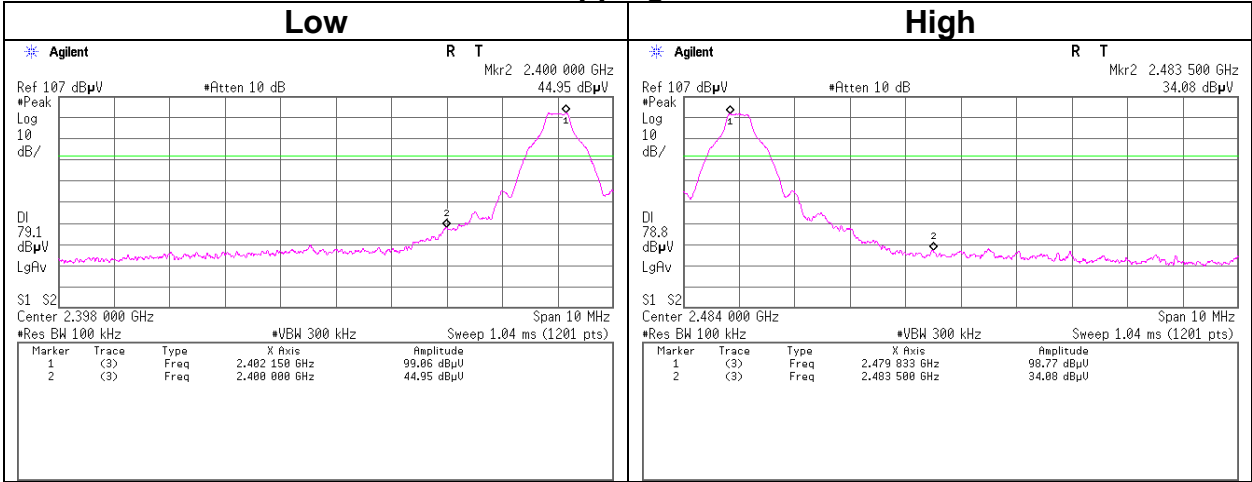
**Conducted Emission Band Edge compliance**

Test place Ise EMC Lab. No.11 Measurement Room  
 Date April 18, 2023  
 Temperature / Humidity 22 deg. C / 48 % RH  
 Engineer Nachi Konegawa  
 Mode Tx DH5

**Hopping On**



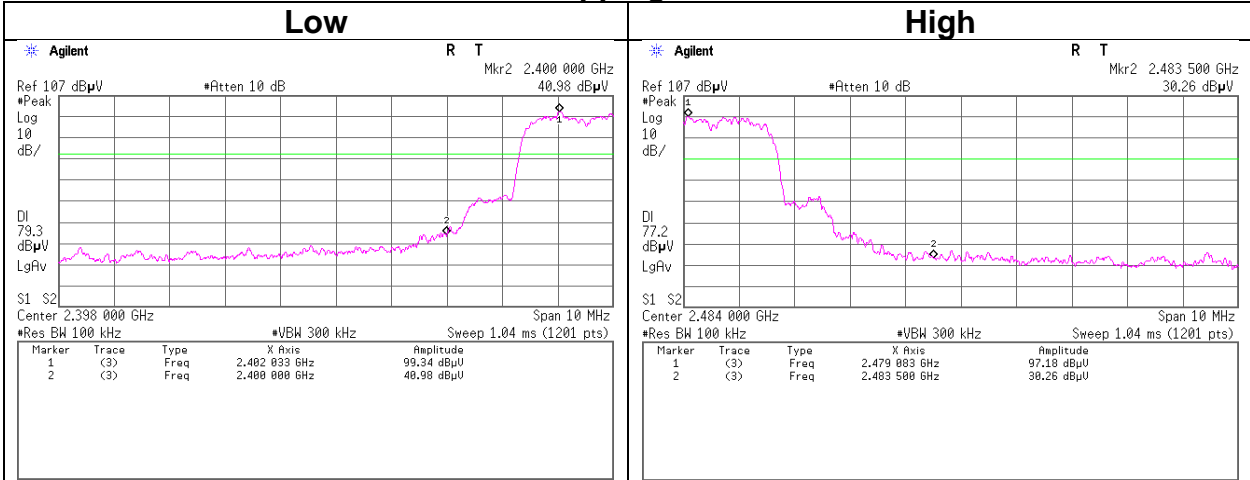
**Hopping Off**



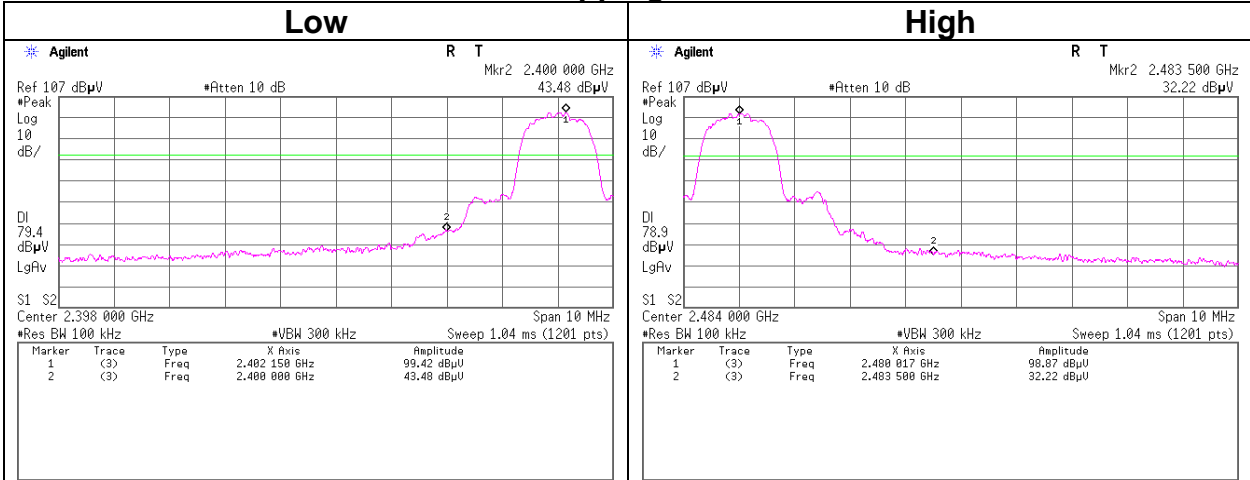
**Conducted Emission Band Edge compliance**

Test place                    Ise EMC Lab. No.11 Measurement Room  
 Date                            April 18, 2023  
 Temperature / Humidity    22 deg. C / 48 % RH  
 Engineer                      Nachi Konegawa  
 Mode                            Tx 3DH5

**Hopping On**



**Hopping Off**



## APPENDIX 2: Test Instruments

### Test Equipment (1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	MAT-89	141419	Attenuator	Weinschel Associates	WA56-10	56100305	05/12/2022	12
AT	MCC-245	197220	Microwave cable	Huber+Suhner	SF126E/11PC35/11PC35/2000MM	537003/126E	03/08/2023	12
AT	MMM-12	141547	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	60500120	02/02/2023	12
AT	MOS-44	192347	Thermo-Hygrometer	Mother tool	MT-893	-	12/17/2022	12
AT	MPM-08	141805	Power Meter	Anritsu Corporation	ML2495A	6K00003338	07/04/2022	12
AT	MPSE-11	141840	Power sensor	Anritsu Corporation	MA2411B	11737	07/04/2022	12
AT	MSA-15	141902	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187105	09/27/2022	12
CE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
CE	MAEC-02	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/30/2022	24
CE	MAT-64	141290	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	12/22/2022	12
CE	MCC-13	141222	Coaxial Cable	Fujikura,HP,Mini-Circuits,Fujikura	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	02/01/2023	12
CE	MJM-27	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
CE	MLS-23	141357	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-729	07/28/2022	12
CE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/12/2022	12
CE	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/17/2022	12
CE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	07/29/2022	12
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-02	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/30/2022	24
RE	MAEC-02-SVSWR	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/09/2021	24
RE	MAT-112	220646	Attenuator	Huber+Suhner	6806 N-50-1	-	03/17/2023	12
RE	MBA-08	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+BBA9106	08031	07/30/2022	12
RE	MCC-12	141317	Coaxial Cable	UL Japan	-	-	09/27/2022	12
RE	MCC-218	141394	Microwave Cable	Junkosha	MWX221	1607S141(1 m)/1608S264(5 m)	09/12/2022	12
RE	MCC-224	160324	Coaxial Cable	Huber+Suhner	SUCOFLEX 102A	MY009/2A	10/19/2022	12
RE	MHA-17	141506	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170307	07/22/2022	12
RE	MHA-29	141517	Horn Antenna 26.5-40GHz	ETS-Lindgren	3160-10	152399	11/14/2022	12
RE	MHF-25	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/07/2022	12
RE	MJM-27	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	MLA-21	141265	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/30/2022	12
RE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/12/2022	12
RE	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/17/2022	12

**Test Equipment (2/2)**

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MPA-10	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	02/14/2023	12
RE	MPA-22	141588	Pre Amplifier	L3 Narda-MITEQ	AMF-6F-2600400-33-8P / AMF-4F-2600400-33-8P	1871355 / 1871328	01/24/2023	12
RE	MPA-24	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/02/2023	12
RE	MHA-06	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/20/2022	12
RE	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	02/20/2023	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	07/29/2022	12

\*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:           CE: Conducted Emission  
                          RE: Radiated Emission  
                          AT: Antenna Terminal Conducted