RADIO TEST REPORT

Test Report No. 15573085H-B-R1

Customer	**Panasonic Corporation of North America**
Description of EUT	**Wireless Transmitter**
Model Number of EUT	**SH-GNW30**
FCC ID	**ACJ-SH-GNW30**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**February 3, 2025**
Remarks	**Bluetooth (BR / EDR) parts**

Representative Test Engineer	Approved By
Yuta Moriya Engineer	Takumi Shimada Engineer

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. 15573085H-B

This report is a revised version of 15573085H-B. 15573085H-B is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15573085H-B	January 29, 2025	-
1	15573085H-B-R1	February 3, 2025	**Section 2.1** -Modified test date. November 25, 2024 to January 20, 2025 → November 25 to December 13, 2024 **Section 2.2** **General Specification** -Modified rating. DC 5 V → DC 12 V **Section 3.2** -Modified worst margin for Spurious Emission & Band Edge Compliance. 9.7 dB →11.3 dB **Section 4.1** -Deletion of Simultaneous transmission. **APPENDIX 1 Test data** **[Radiated Spurious Emission]** -Deletion of data for Mode: Tx, Hopping Off, DH5 2402 MHz + Tx Wireless 2.4 GHz Audio module 2440.35 MHz. -Deletion of below note. *These results have sufficient margin without taking account Duty cycle correction factor. **APPENDIX 2 Test Instruments** -Modified last calibration date for LIMS ID: 141950. 11/20/2023 →11/28/2024

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS PAGE

SECTION 1: Customer Information

Company Name	Panasonic Corporation of North America *
Address	Two Riverfront Plaza, 9th Floor Newark New Jersey United States 07 102-5490
Contact Person	Ben Botros

*Remarks:
Panasonic Entertainment & Communication Co., Ltd. is on behalf of the applicant: Panasonic Corporation of North America (Company incorporated abroad).

The information provided by 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

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Wireless Transmitter
Model Number	SH-GNW30
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	November 25, 2024
Test Date	November 25 to December 13, 2024

2.2 Product Description

General Specification

Rating	DC 12 V
Operating temperature	5 deg. C to 35 deg. C

Radio Specification

This report contains data provided by the customer which can impact the validity of results. UL Japan, Inc. is only responsible for the validity of results after the integration of the data provided by the customer.
The data provided by the customer is marked “a)” in the table below.

Bluetooth (Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK
Antenna Gain[a)]	1.8 dBi

Bluetooth (BR / EDR)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS (GFSK, π/4 DQPSK, 8 DPSK)
Antenna Gain[a)]	1.8 dBi

Wireless 2.4 GHz Audio module *1)

Equipment Type	Transceiver
Frequency of Operation	2406.35 MHz to 2476.35 MHz
Type of Modulation	pi/4-shifted DQPSK
Antenna Gain	3.9 dBi

*1) The Wireless 2.4 GHz Audio module (Model number: SWA20) already certified as FCC ID: NKR-SWA20.

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	**FCC:** Section 15.207	11.33 dB, 0.79184 MHz, AV, L	Complied	-
	ISED: RSS-Gen 8.8	**ISED:** RSS-Gen 8.8			
Carrier Frequency Separation	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)	See data.	Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (b)			
20dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (a)			
Number of Hopping Frequency	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)(iii)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (d)			
Dwell time	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)(iii)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (d)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(b)(1)		Complied	Conducted
	ISED: RSS-Gen 6.12	**ISED:** RSS-247 5.4 (b)			
Spurious Emission & Band Edge Compliance	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	11.3 dB 4804.0 MHz, AV, Horizontal	Complied	Conducted/ Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

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)
This EUT provides the 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.

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)	0.15 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	dB	5.0
		Vertical	dB	5.0
	200 MHz to 1000 MHz	Horizontal	dB	5.2
		Vertical	dB	6.2
10 m	30 MHz to 200 MHz	Horizontal	dB	5.5
		Vertical	dB	5.4
	200 MHz to 1000 MHz	Horizontal	dB	5.5
		Vertical	dB	5.5
3 m	1 GHz to 6 GHz		dB	5.1
	6 GHz to 18 GHz		dB	5.4
1 m	10 GHz to 18 GHz		dB	5.4
	18 GHz to 26.5 GHz		dB	5.3
	26.5 GHz to 40 GHz		dB	4.8
0.5 m	26.5 GHz to 40 GHz		dB	5.0

Antenna Terminal Conducted

Item	Unit	Calculated Uncertainty (+/-)
Antenna terminated conducted emission / Power density / Burst power	dB	3.47
Adjacent channel power (ACP)	dB	2.28
Bandwidth (OBW)	%	0.96
Time readout (time span upto 100 msec)	%	0.11
Time readout (time span upto 1000 msec)	%	0.11
Time readout (time span upto 60 sec)	%	0.02
Power measurement (Power meter < 8 GHz)	dB	1.46
Power measurement (Call box < 6 GHz)	dB	1.69
Frequency readout (Frequency counter)	ppm	0.67
Frequency readout (Spectrum analyzer frequency readout function)	ppm	2.13
Temperature (constant temperature bath)	deg. C	0.69
Humidity (constant temperature bath)	%RH	2.98
Modulation characteristics	%	6.93
Frequency for mobile	ppm	0.08
Contention-based protocol	dB	2.26

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, No.4, and No.5 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

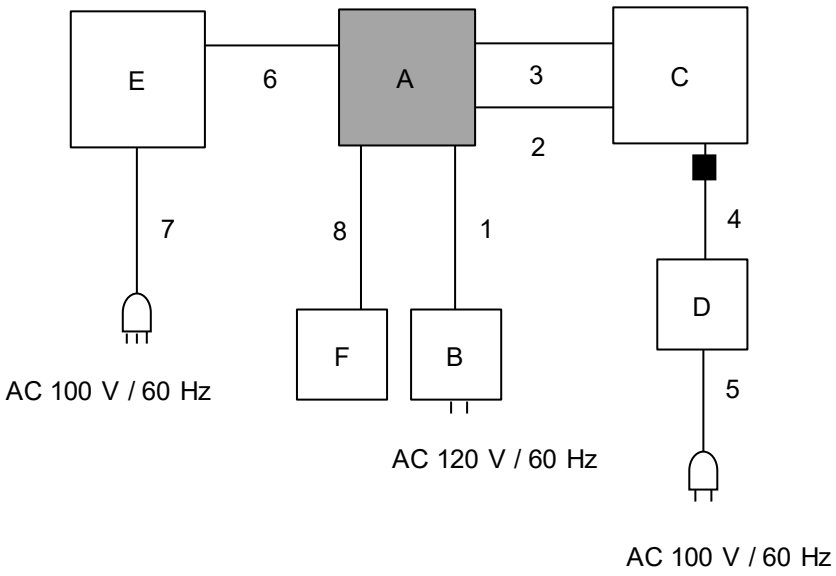
4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth (BT)	BR / EDR, Payload: PRBS9
*EUT has the power settings by the software as follows; Power Setting: 6 dBm Software: RTLBTAPP Version: 5.2.4.20 (Date: August 28, 2024, Storage location: Driven by connected PC) *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.	

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



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

*As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 120 V of the worst voltage as representative.

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	Wireless Transmitter	SH-GNW30	No.4	Panasonic Entertainment & Communication Co., Ltd.	EUT
B	AC Adapter	SAE0005	23352R	Panasonic	-
C	Laptop	CF-SV7RDAVS	9IKSC48031	Panasonic	-
D	AC Adapter	CF-AA64L2C M1	64L2CM118712770A	Panasonic	-
E	Monitor	M237WSK	107KCBD2Q445	LG	-
F	Earphones	-	-	-	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.2	Unshielded	Unshielded	-
2	USB Cable	1.0	Shielded	Shielded	-
3	HDMI Cable	3.0	Shielded	Shielded	-
4	DC Cable	1.8	Unshielded	Unshielded	-
5	AC Cable	0.9	Unshielded	Unshielded	-
6	HDMI Cable	3.0	Shielded	Shielded	-
7	AC Cable	1.8	Unshielded	Unshielded	-
8	Earphone cable	1.1	Unshielded	Unshielded	-

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.

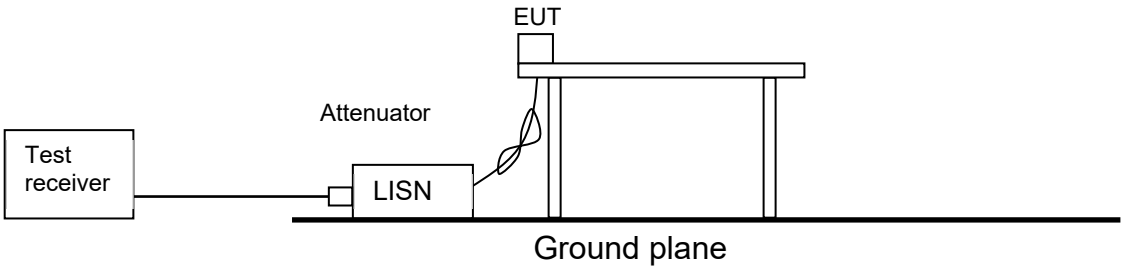
For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (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.

Test results are rounded off and limit are rounded down, so some differences might be observed.

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

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, 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. 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

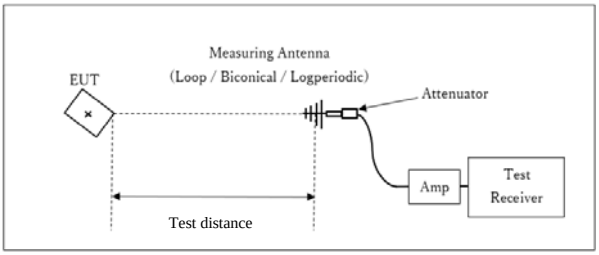
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired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

Figure 2: Test Setup

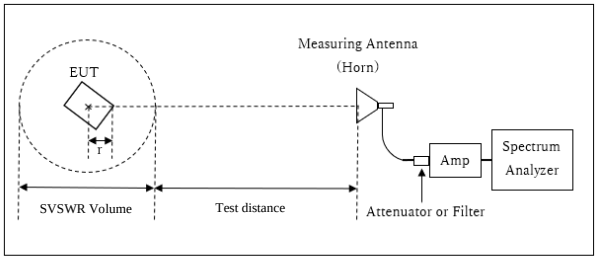
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



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

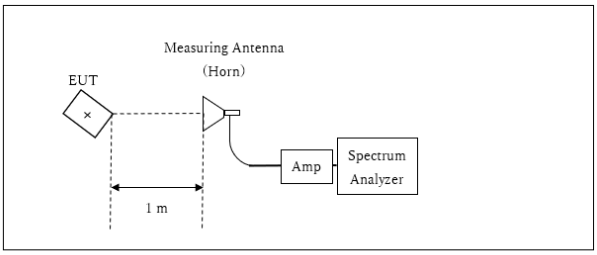
[1 GHz to 6 GHz]
Distance Factor: 20 x log (3.95 m* / 3.0 m) = 2.39dB
*(Test Distance + SVSWR Volume /2) - r = 3.95 m

Test Distance: 3 m
SVSWR Volume: 2 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r: 0.05m

[6 GHz to 10 GHz]
Distance Factor: 20 x log (4.95 m* / 3.0 m) = 4.35 dB
*(Test Distance + SVSWR Volume /2) - r = 4.95 m

Test Distance: 4.3 m
SVSWR Volume: 1.4 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r: 0.05 m

10 GHz to 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.54 dB
*Test Distance: 1 m

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

Test results are rounded off and limit are rounded down, so some differences might be observed.

Measurement Range : 30 MHz to 26.5 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/ 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	10 kHz	30 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz -150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 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 Ohmes. 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.

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

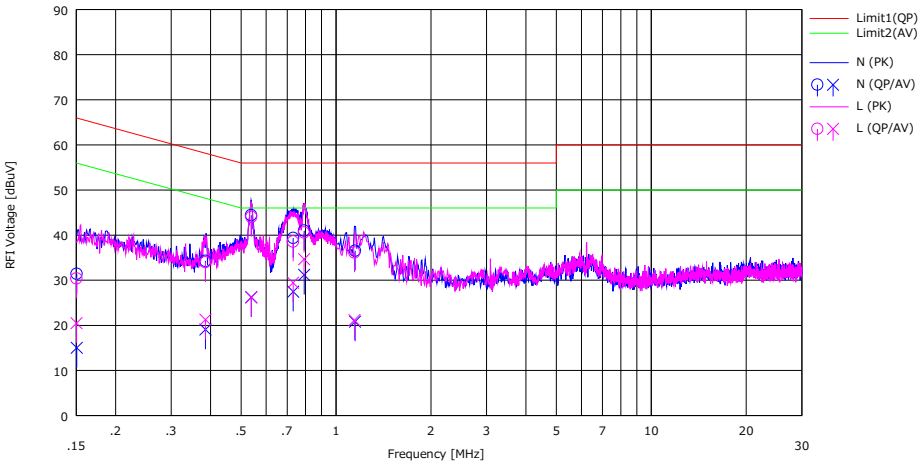
Test Data : APPENDIX
Test Result : Pass

APPENDIX 1: Test data

Conducted Emission

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Date	December 13, 2024
Temperature / Humidity	20 deg. C / 50 % RH
Engineer	Tetsuro Yoshida
Mode	Tx, Hopping Off, 3DH5 2402 MHz

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq.	Reading ⟨QP⟩	Reading ⟨AV⟩	LISN	LOSS	Results ⟨QP⟩	Results ⟨AV⟩	Limit ⟨QP⟩	Limit ⟨AV⟩	Margin ⟨QP⟩	Margin ⟨AV⟩	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15054	18.30	1.90	0.13	12.99	31.42	15.02	65.97	55.97	34.55	40.95	N	
2	0.38535	21.10	5.90	0.13	13.05	34.28	19.08	58.16	48.16	23.88	29.08	N	
3	0.53851	31.20	13.00	0.14	13.08	44.42	26.22	56.00	46.00	11.58	19.78	N	
4	0.73164	26.10	14.20	0.15	13.11	39.36	27.46	56.00	46.00	16.64	18.54	N	
5	0.79281	27.70	17.90	0.15	13.12	40.97	31.17	56.00	46.00	15.03	14.83	N	
6	1.14934	23.20	7.50	0.17	13.17	36.54	20.84	56.00	46.00	19.46	25.16	N	
7	0.15035	17.30	7.40	0.11	12.99	30.40	20.50	65.98	55.98	35.58	35.48	L	
8	0.38552	20.80	8.10	0.13	13.05	33.98	21.28	58.16	48.16	24.18	26.88	L	
9	0.53916	30.80	13.00	0.14	13.08	44.02	26.22	56.00	46.00	11.98	19.78	L	
10	0.73144	25.30	16.20	0.15	13.11	38.56	29.46	56.00	46.00	17.44	16.54	L	
11	0.79184	27.30	21.40	0.15	13.12	40.57	34.67	56.00	46.00	15.43	11.33	L	
12	1.14414	22.80	7.80	0.17	13.17	36.14	21.14	56.00	46.00	19.86	24.86	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.

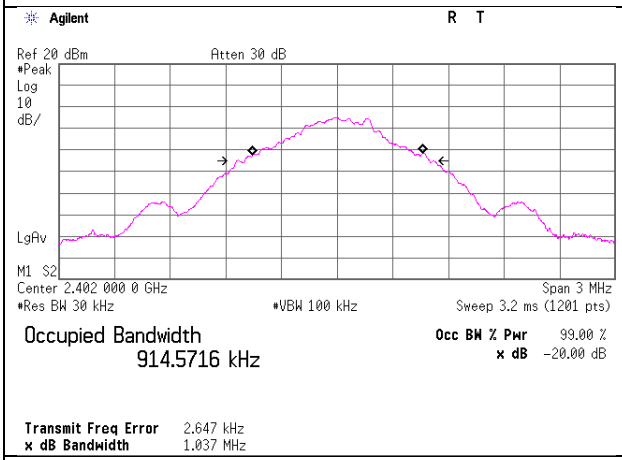
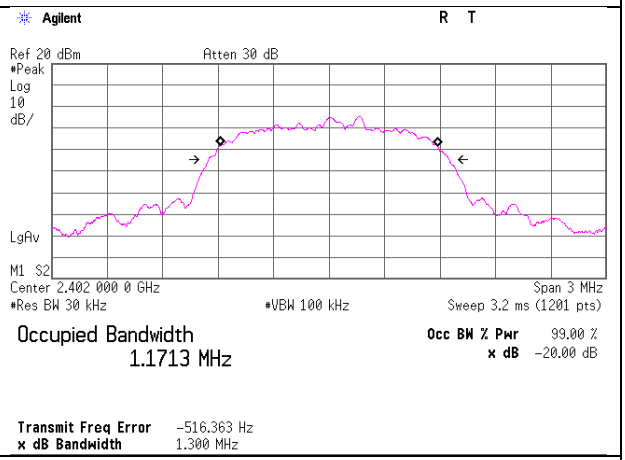
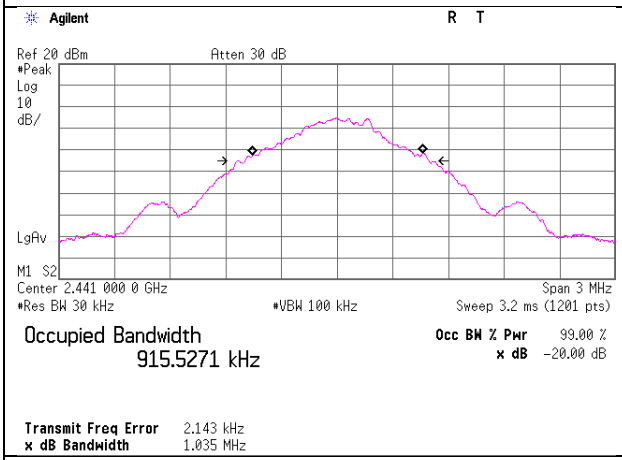
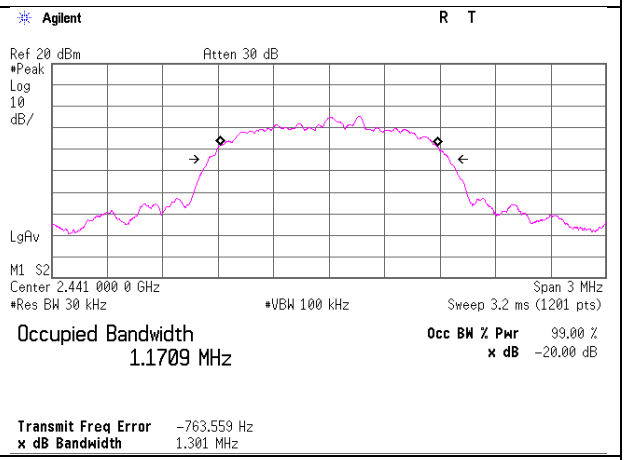
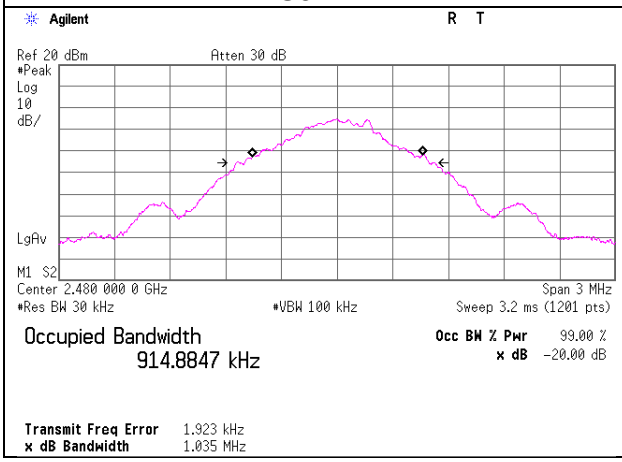
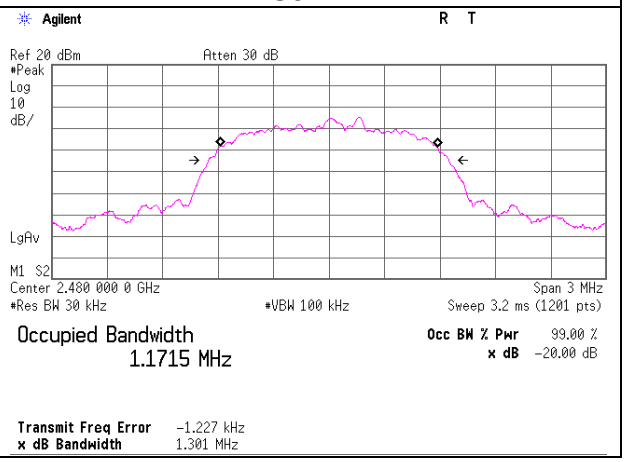
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation

Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % 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	1.037	914.572	1.000	>= 0.691
DH5	2441.0	1.035	***915.527***	1.000	>= 0.690
DH5	2480.0	1.035	914.885	1.000	>= 0.690
DH5	Hopping On	-	78666.500	-	-
3DH5	2402.0	1.300	1171.300	1.000	>= 0.867
3DH5	2441.0	1.301	1170.900	1.000	>= 0.867
3DH5	2480.0	1.301	***1171.500***	1.000	>= 0.867
3DH5	Hopping On	-	78730.500	-	-

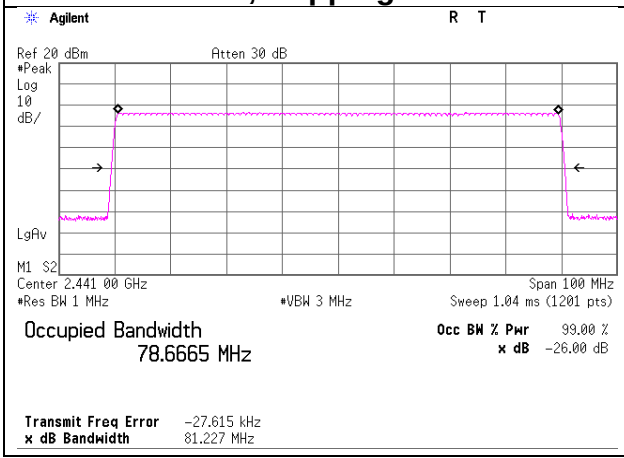
Limit: Two-thirds of 20 dB Bandwidth or 25 kHz (whichever is greater).
No limit applies to 20 dB Bandwidth.

20dB Bandwidth and 99% Occupied Bandwidth

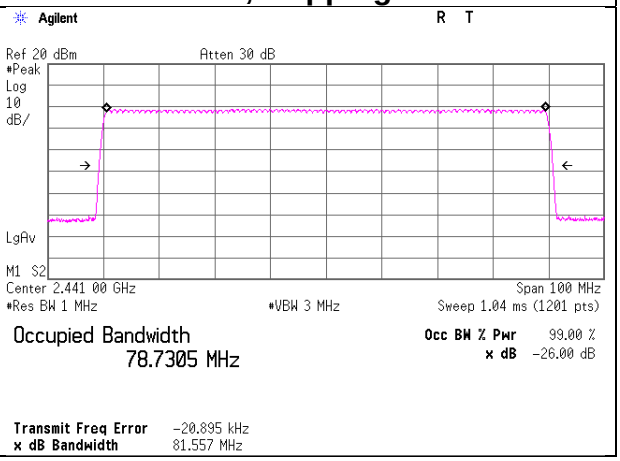
DH5	3DH5
2402 MHz	**2402 MHz**
	
2441 MHz	**2441 MHz**
	
2480 MHz	**2480 MHz**
	

20dB Bandwidth and 99% Occupied Bandwidth

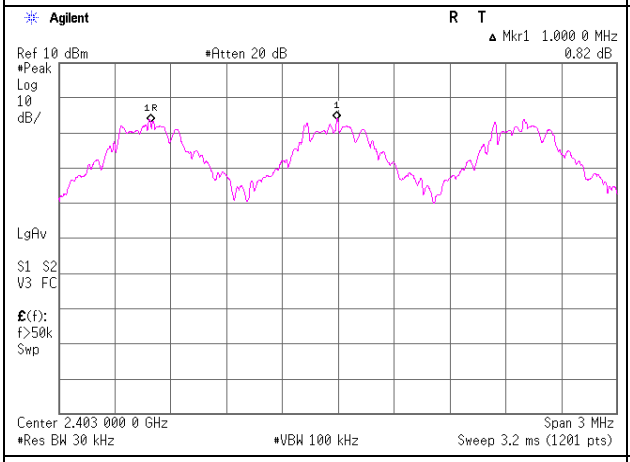
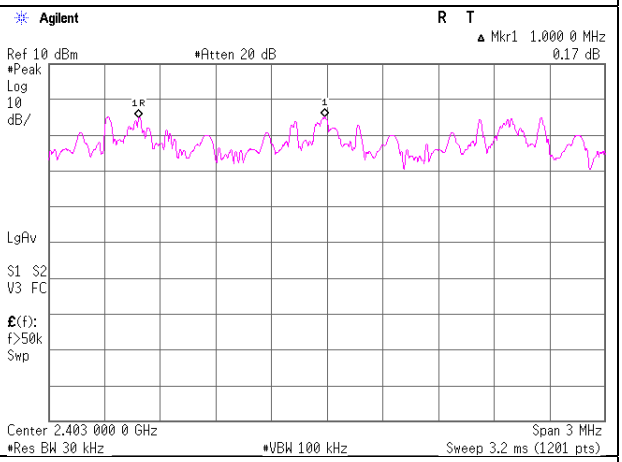
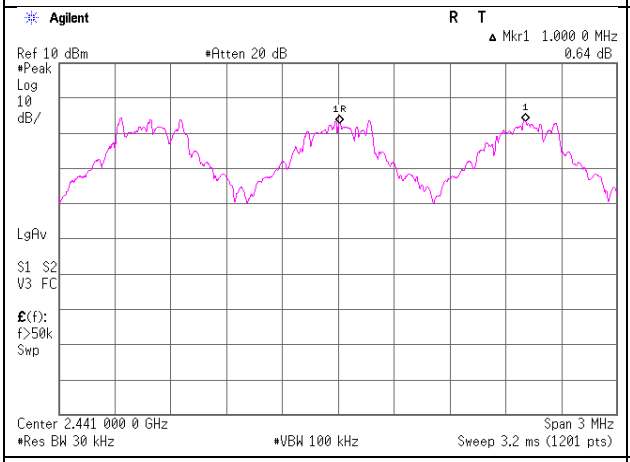
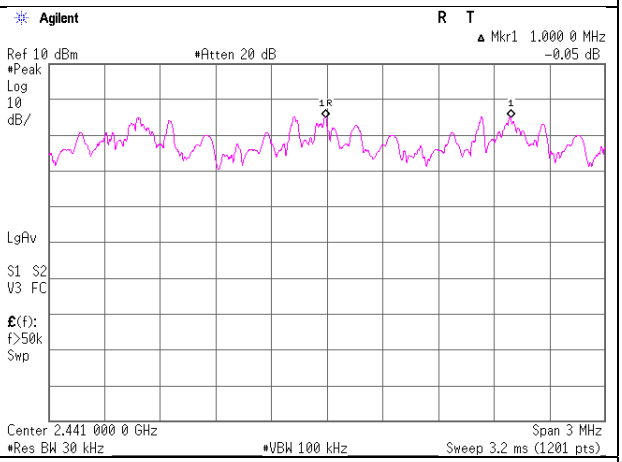
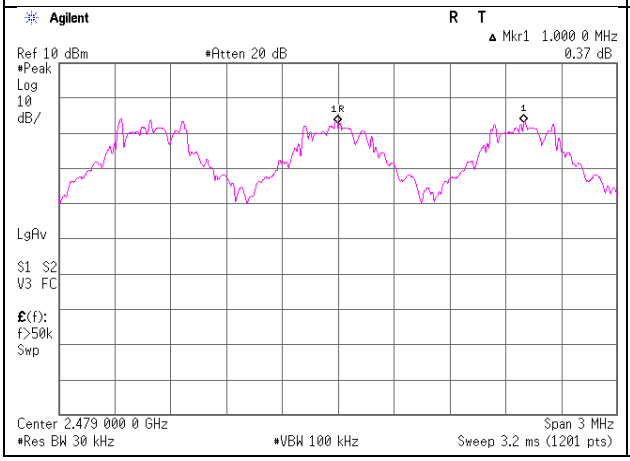
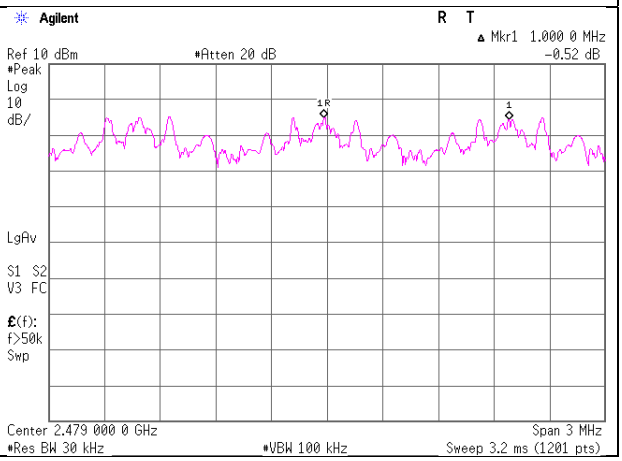
DH5, Hopping On



3DH5, Hopping On



Carrier Frequency Separation

DH5	3DH5
2402 MHz	2402 MHz
	
2441 MHz	2441 MHz
	
2480 MHz	2480 MHz
	

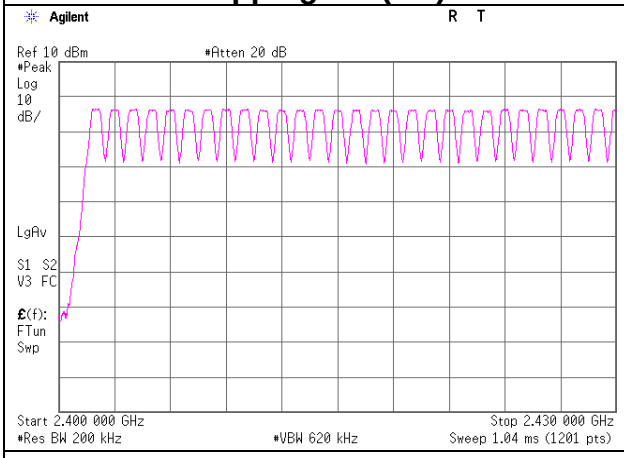
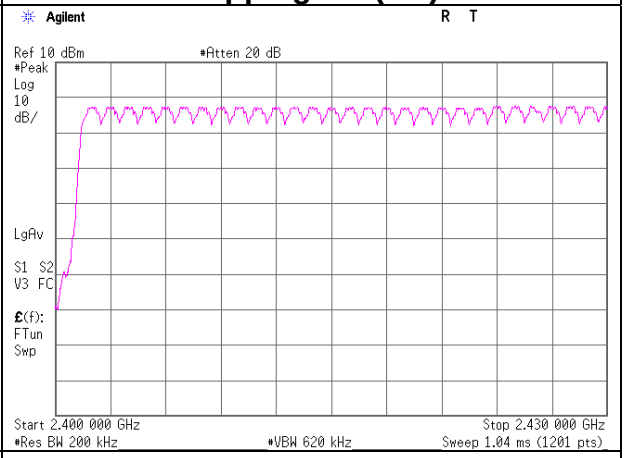
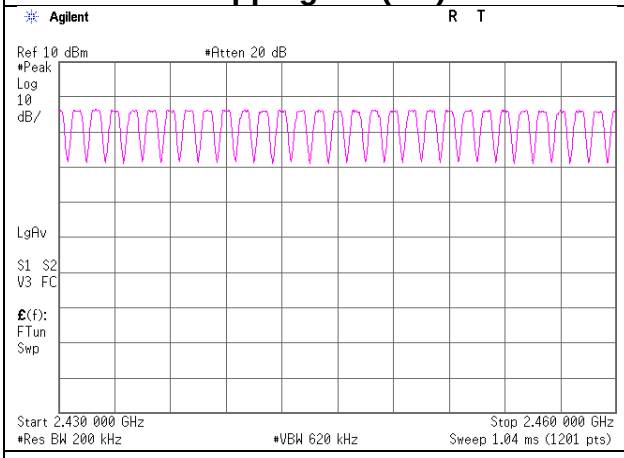
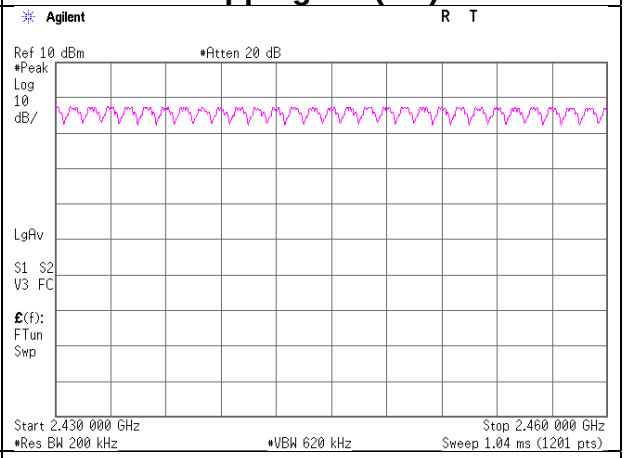
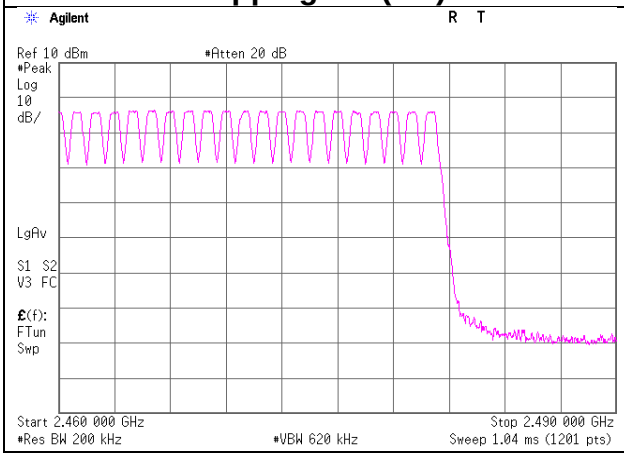
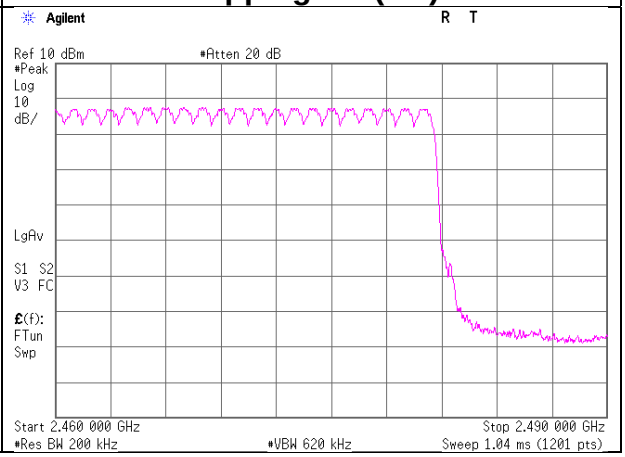
Number of Hopping Frequency

Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % 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

DH5	3DH5
Hopping On (1/3)	Hopping On (1/3)
	
Hopping On (2/3)	Hopping On (2/3)
	
Hopping On (3/3)	Hopping On (3/3)
	

Dwell time

Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % 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	0.396	125	400
DH3	25.6 times / 5 s x 31.6 s = 162 times	1.662	269	400
DH5	18.0 times / 5 s x 31.6 s = 114 times	2.900	331	400
3DH1	49.6 times / 5 s x 31.6 s = 314 times	0.405	127	400
3DH3	25.8 times / 5 s x 31.6 s = 164 times	1.664	273	400
3DH5	19.6 times / 5 s x 31.6 s = 124 times	2.913	361	400

Sample Calculation
Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

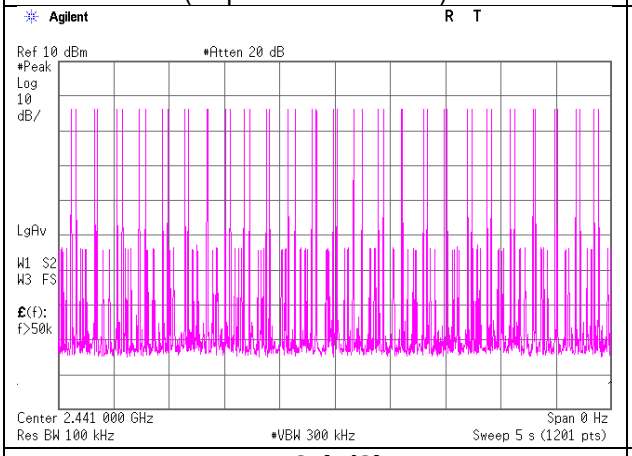
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	49	50	50	50	50	49.8
DH3	28	24	27	24	25	25.6
DH5	18	16	21	17	18	18
3DH1	49	50	50	50	49	49.6
3DH3	27	26	24	26	26	25.8
3DH5	16	23	22	18	19	19.6

Sample Calculation
Average = Summation (Sampling 1 to 5) / 5

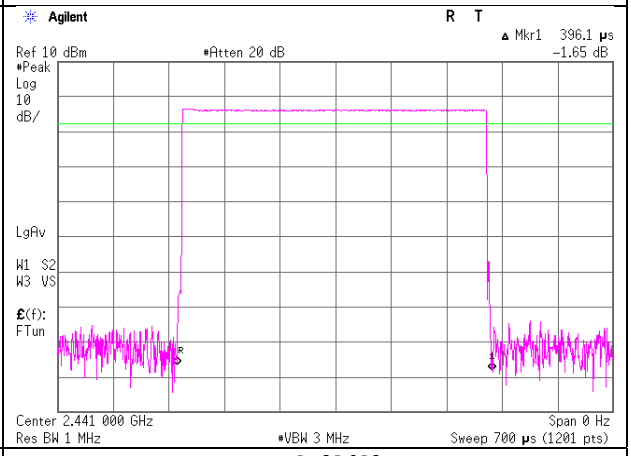
This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in N x 0.4 s, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than 0.4 s regardless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

Dwell time

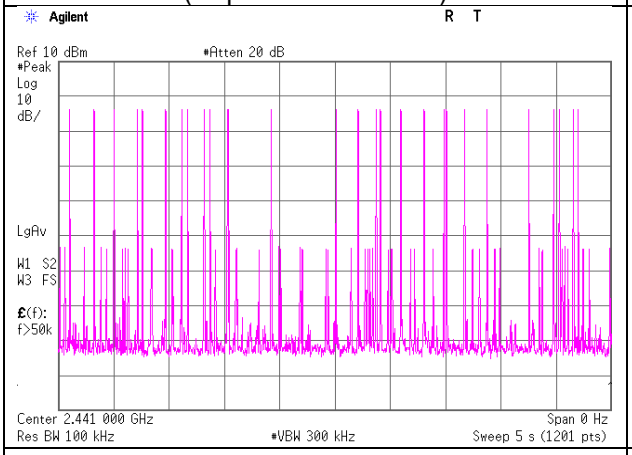
DH1 (1/2)
(Representative chart)



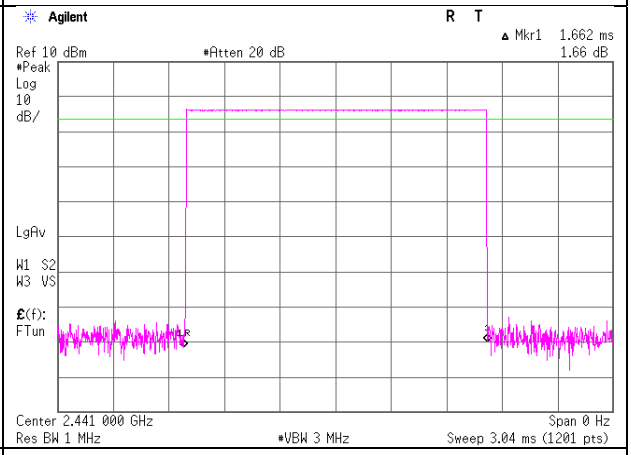
DH1 (2/2)



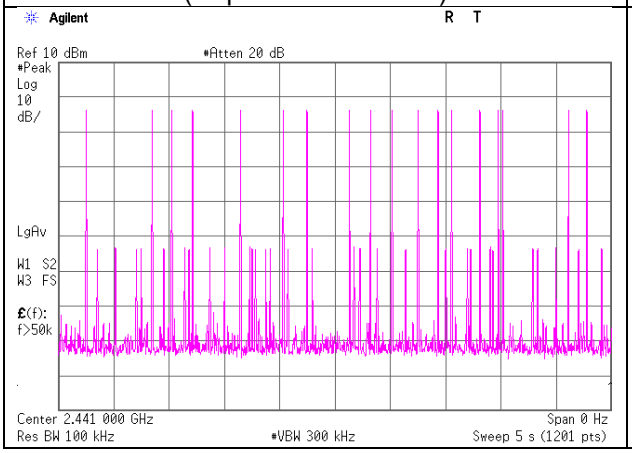
DH3 (1/2)
(Representative chart)



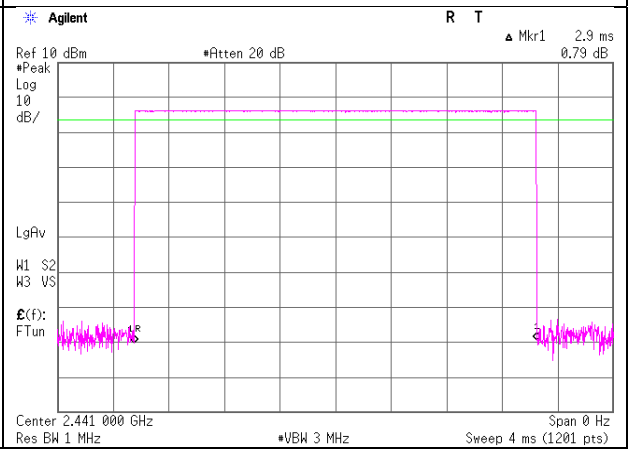
DH3 (2/2)



DH5 (1/2)
(Representative chart)

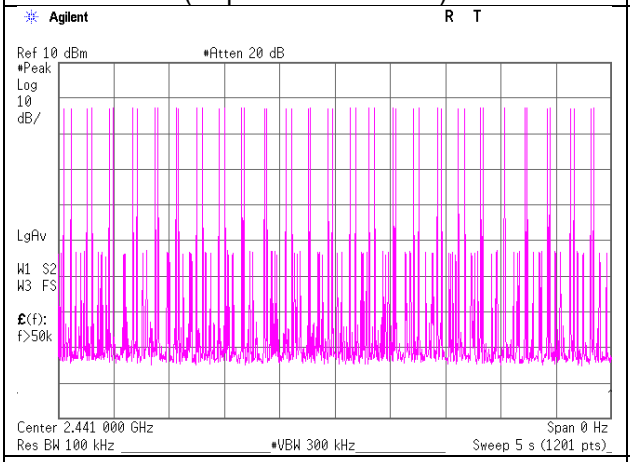


DH5 (2/2)

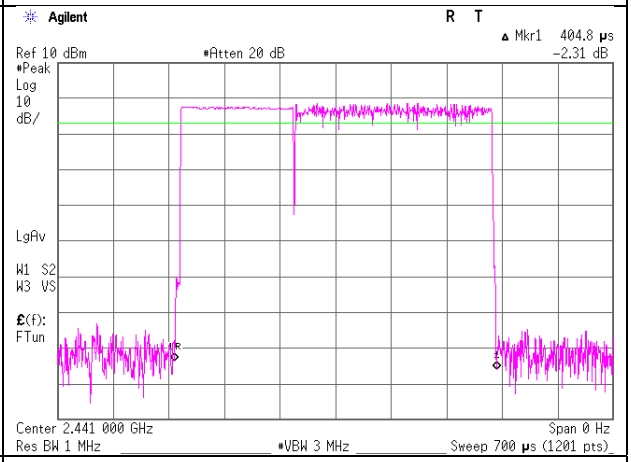


Dwell time

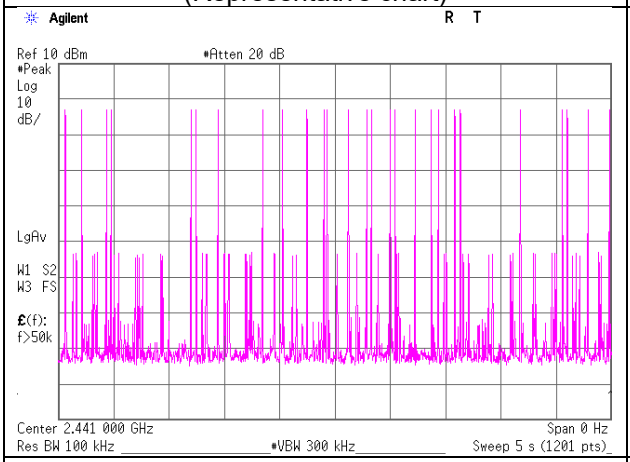
3DH1 (1/2)
(Representative chart)



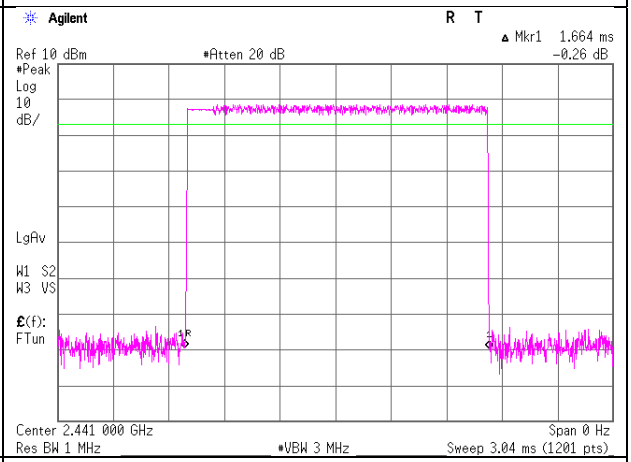
3DH1 (2/2)



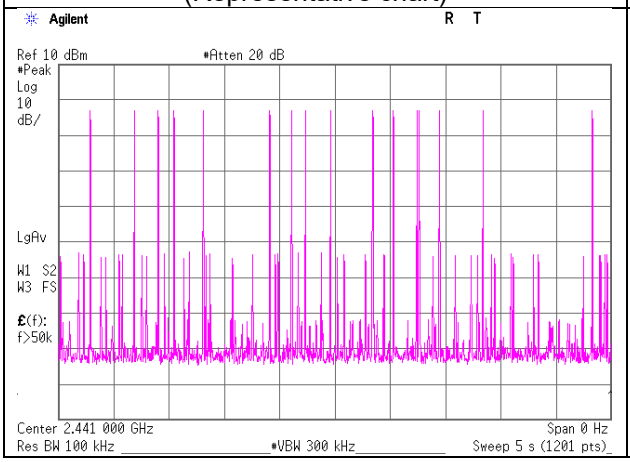
3DH3 (1/2)
(Representative chart)



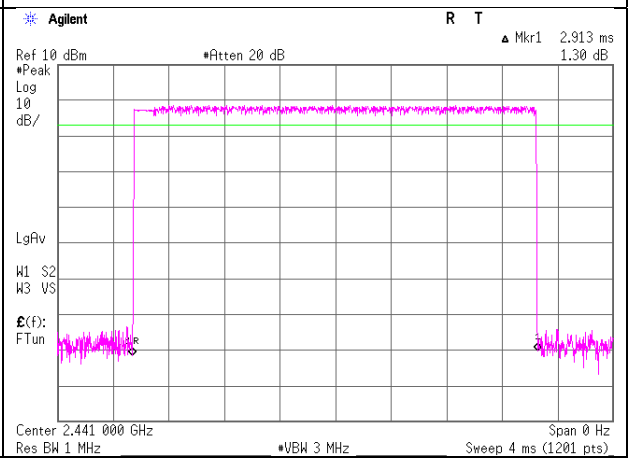
3DH3 (2/2)



3DH5 (1/2)
(Representative chart)



3DH5 (2/2)



Maximum Peak Output Power

Test place	Ise EMC Lab. No.3 Measurement Room
Date	November 27, 2024
Temperature / Humidity	23 deg. C / 58 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off

					Conducted Power					e.i.r.p. for RSS-247					
Mode	Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
DH5	2402.0	-4.05	0.35	10.07	***6.37***	***4.34***	20.96	125	14.59	1.80	***8.17***	***6.56***	36.02	4000	27.85
DH5	2441.0	-4.30	0.35	10.07	6.12	4.09	20.96	125	14.84	1.80	7.92	6.19	36.02	4000	28.10
DH5	2480.0	-4.46	0.35	10.07	5.96	3.94	20.96	125	15.00	1.80	7.76	5.97	36.02	4000	28.26
2DH5	2402.0	-1.78	0.35	10.07	***8.64***	***7.31***	20.96	125	12.32	1.80	***10.44***	***11.07***	36.02	4000	25.58
2DH5	2441.0	-2.04	0.35	10.07	8.38	6.89	20.96	125	12.58	1.80	10.18	10.42	36.02	4000	25.84
2DH5	2480.0	-2.06	0.35	10.07	8.36	6.85	20.96	125	12.60	1.80	10.16	10.38	36.02	4000	25.86
3DH5	2402.0	-1.26	0.35	10.07	***9.16***	***8.24***	20.96	125	11.80	1.80	***10.96***	***12.47***	36.02	4000	25.06
3DH5	2441.0	-1.54	0.35	10.07	8.88	7.73	20.96	125	12.08	1.80	10.68	11.69	36.02	4000	25.34
3DH5	2480.0	-1.58	0.35	10.07	8.84	7.66	20.96	125	12.12	1.80	10.64	11.59	36.02	4000	25.38

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.

Average Output Power
(Reference data for RF Exposure)

Test place	Ise EMC Lab. No.3 Measurement Room
Date	November 27, 2024
Temperature / Humidity	23 deg. C / 58 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off

Mode	Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
DH5	2402.0	-5.22	0.35	10.07	***5.20***	***3.31***	1.11	***6.31***	***4.28***
DH5	2441.0	-5.50	0.35	10.07	4.92	3.10	1.11	6.03	4.01
DH5	2480.0	-5.66	0.35	10.07	4.76	2.99	1.11	5.87	3.86
2DH5	2402.0	-5.30	0.35	10.07	***5.12***	***3.25***	1.08	***6.20***	***4.17***
2DH5	2441.0	-5.56	0.35	10.07	4.86	3.06	1.08	5.94	3.93
2DH5	2480.0	-5.66	0.35	10.07	4.76	2.99	1.08	5.84	3.84
3DH5	2402.0	-5.29	0.35	10.07	***5.13***	***3.26***	1.08	***6.21***	***4.18***
3DH5	2441.0	-5.55	0.35	10.07	4.87	3.07	1.08	5.95	3.94
3DH5	2480.0	-5.70	0.35	10.07	4.72	2.96	1.08	5.80	3.80

Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

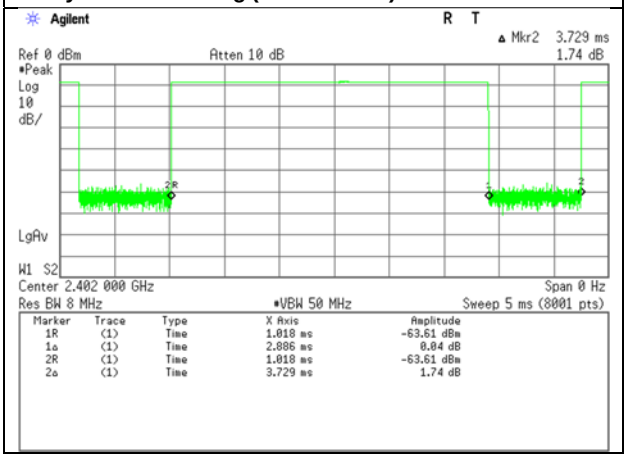
*The equipment and cables were not used for factor 0 dB of the data sheets.

Burst Rate Confirmation

Test place	Ise EMC Lab. No.3 Measurement Room
Date	November 27, 2024
Temperature / Humidity	23 deg. C / 58 % RH
Engineer	Yuta Moriya
Mode	Tx, Hopping Off

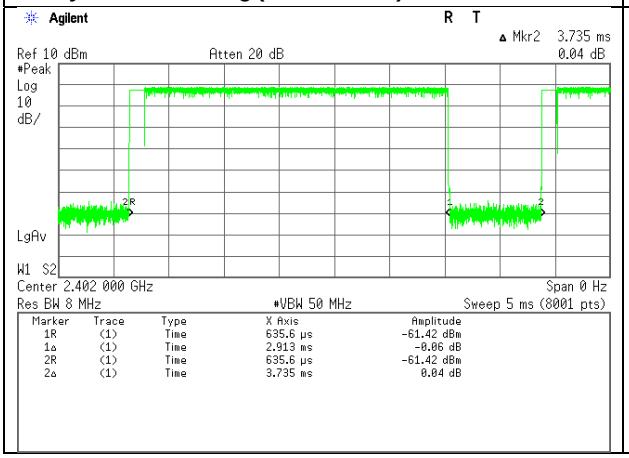
DH5

Tx on / (Tx on + Tx off) =	0.774
Tx on / (Tx on + Tx off) * 100 =	77.4 %
Duty factor = 10 * log (3.729 / 2.886) =	1.11 dB



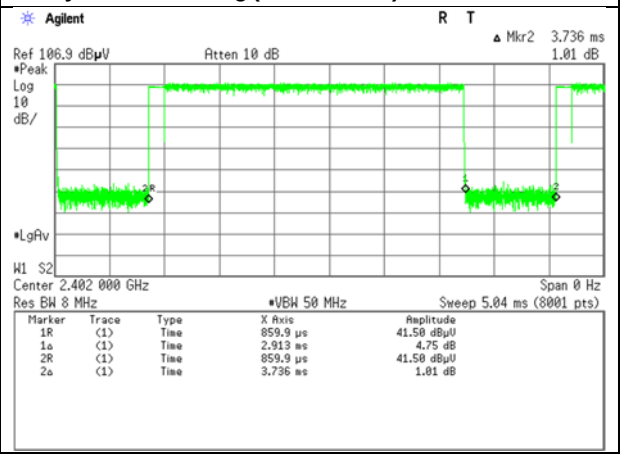
2DH5

Tx on / (Tx on + Tx off) =	0.780
Tx on / (Tx on + Tx off) * 100 =	78.0 %
Duty factor = 10 * log (3.735 / 2.913) =	1.08 dB



3DH5

Tx on / (Tx on + Tx off) =	0.780
Tx on / (Tx on + Tx off) * 100 =	78.0 %
Duty factor = 10 * log (3.736 / 2.913) =	1.08 dB



Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	November 25, 2024	November 26, 2024
Temperature / Humidity	22 deg. C / 42 % RH	22 deg. C / 65 % RH
Engineer	Yuta Moriya	Tomoya Sone
	(1 GHz to 6 GHz)	(Above 6 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	43.5	35.3	27.5	5.4	32.2	1.1	44.2	37.1	73.9	53.9	29.7	16.8	*1)
Hori.	4804.0	40.5	33.8	31.4	7.5	31.2	1.1	48.3	42.6	73.9	53.9	25.6	11.3	*2)
Hori.	7206.0	41.1	31.6	35.6	10.8	32.0	-	55.4	45.9	73.9	53.9	18.5	8.0	Floor noise
Hori.	9608.0	41.3	32.3	35.6	11.2	32.6	-	55.4	46.4	73.9	53.9	18.5	7.5	Floor noise
Vert.	2390.0	42.1	34.9	27.5	5.4	32.2	1.1	42.8	36.7	73.9	53.9	31.1	17.2	*1)
Vert.	4804.0	40.4	32.3	31.4	7.5	31.2	1.1	48.2	41.2	73.9	53.9	25.7	12.7	*2)
Vert.	7206.0	41.0	31.5	35.6	10.8	32.0	-	55.3	45.8	73.9	53.9	18.6	8.1	Floor noise
Vert.	9608.0	41.2	32.2	35.6	11.2	32.6	-	55.3	46.3	73.9	53.9	18.6	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.
*1) Not Out of Band emission(Leakage Power)
*2) Noise synchronized with duty of carrier freqency

20dBc Data Sheet

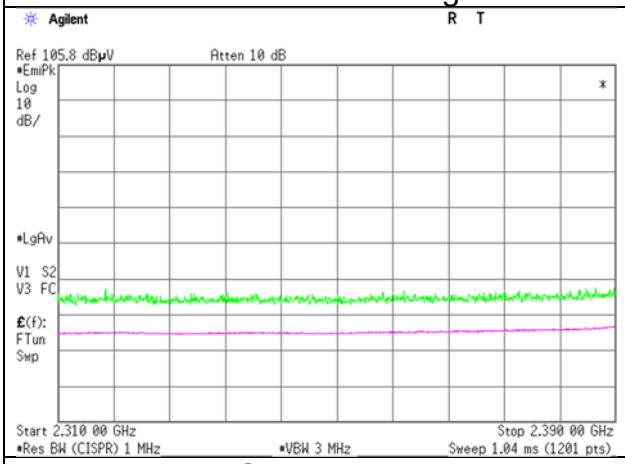
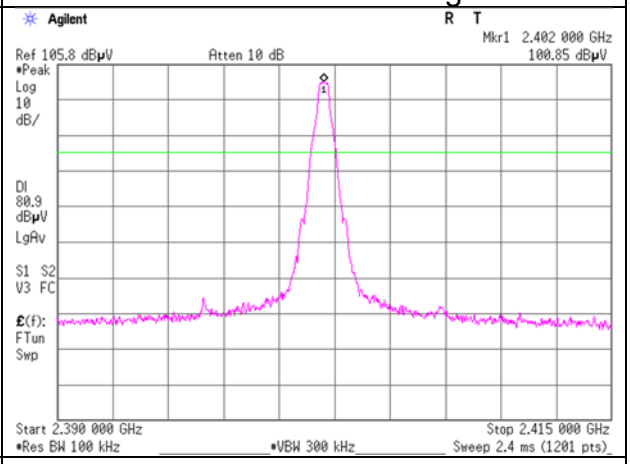
Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.0	100.9	27.5	5.4	32.2	101.5	-	-	Carrier
Hori.	2400.0	42.2	27.5	5.4	32.2	42.8	81.5	38.7	
Vert.	2402.0	98.2	27.5	5.4	32.2	98.9	-	-	Carrier
Vert.	2400.0	40.6	27.5	5.4	32.2	41.3	78.9	37.6	

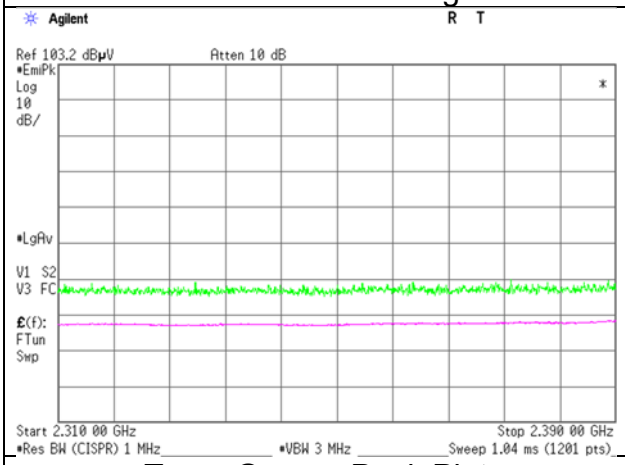
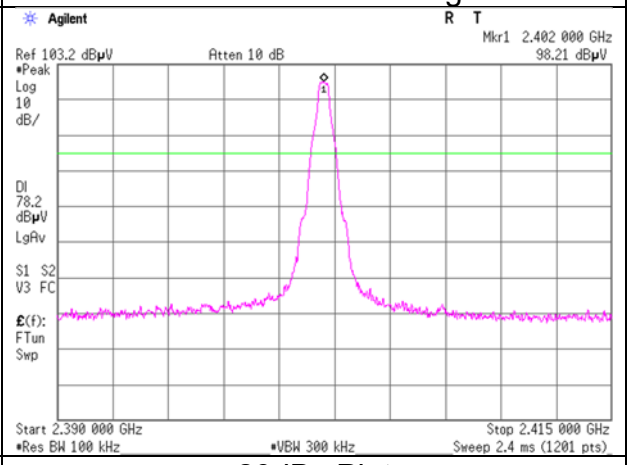
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor:	1 GHz - 6 GHz	20log (3.95 m / 3.0 m) = 2.39 dB
	6 GHz - 10 GHz	20log (4.95 m / 3.0 m) = 4.35 dB
	10 GHz - 26.5 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.3
Date	November 25, 2024
Temperature / Humidity	22 deg. C / 42 % RH
Engineer	Yuta Moriya
	(1 GHz to 6 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	November 26, 2024	November 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH	22 deg. C / 65 % RH
Engineer	Yuta Moriya	Tomoya Sone
	(1 GHz to 6 GHz)	(Above 6 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	38.4	31.0	31.4	7.6	31.2	-	46.3	38.8	73.9	53.9	27.6	15.1	Floor noise
Hori.	7323.0	41.4	31.9	35.6	10.7	32.1	-	55.6	46.2	73.9	53.9	18.3	7.7	Floor noise
Hori.	9764.0	42.0	31.5	35.9	11.3	32.7	-	56.5	46.0	73.9	53.9	17.4	7.9	Floor noise
Vert.	4882.0	38.3	31.0	31.4	7.6	31.2	-	46.2	38.8	73.9	53.9	27.7	15.1	Floor noise
Vert.	7323.0	41.3	31.8	35.6	10.7	32.1	-	55.5	46.1	73.9	53.9	18.4	7.8	Floor noise
Vert.	9764.0	41.9	31.4	35.9	11.3	32.7	-	56.4	45.9	73.9	53.9	17.5	8.0	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.

Distance factor:	1 GHz - 6 GHz	20log (3.95 m / 3.0 m) = 2.39 dB
	6 GHz - 10 GHz	20log (4.95 m / 3.0 m) = 4.35 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	November 26, 2024	November 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH	22 deg. C / 65 % RH
Engineer	Yuta Moriya	Tomoya Sone
	(1 GHz to 6 GHz)	(Above 6 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	45.8	37.0	27.4	5.4	32.2	1.1	46.5	38.7	73.9	53.9	27.5	15.2	*1)
Hori.	4960.0	39.1	31.5	31.6	7.6	31.1	-	47.1	39.5	73.9	53.9	26.8	14.4	Floor noise
Hori.	7440.0	41.0	31.8	35.5	10.7	32.1	-	55.0	45.9	73.9	53.9	18.9	8.0	Floor noise
Hori.	9920.0	41.2	31.7	36.1	11.3	32.8	-	55.9	46.3	73.9	53.9	18.1	7.6	Floor noise
Vert.	2483.5	44.3	36.4	27.4	5.4	32.2	1.1	45.0	38.2	73.9	53.9	28.9	15.8	*1)
Vert.	4960.0	39.1	31.5	31.6	7.6	31.1	-	47.1	39.5	73.9	53.9	26.8	14.4	Floor noise
Vert.	7440.0	40.9	31.7	35.5	10.7	32.1	-	54.9	45.8	73.9	53.9	19.0	8.1	Floor noise
Vert.	9920.0	41.1	31.6	36.1	11.3	32.8	-	55.8	46.2	73.9	53.9	18.2	7.7	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)

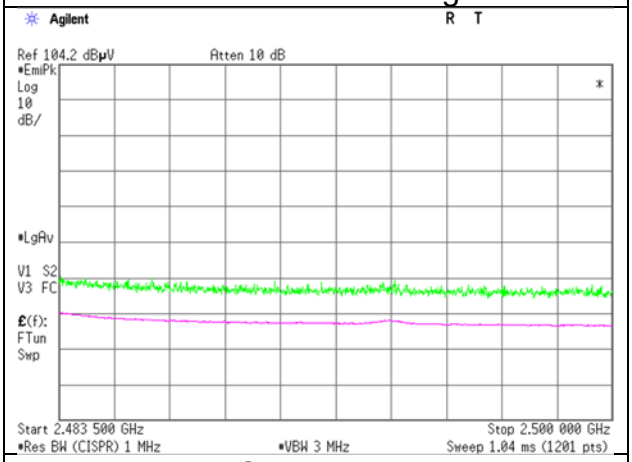
Distance factor:	1 GHz - 6 GHz	20log (3.95 m / 3.0 m) = 2.39 dB
	6 GHz - 10 GHz	20log (4.95 m / 3.0 m) = 4.35 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	November 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH
Engineer	Yuta Moriya
	(1 GHz to 6 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz

Horizontal

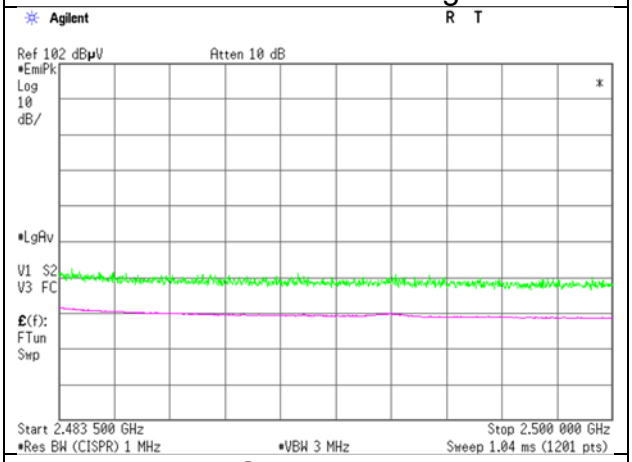
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

* 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.3	No.3	No.3
Date	November 26, 2024	November 26, 2024	November 27, 2024
Temperature / Humidity	23 deg. C / 59 % RH	22 deg. C / 65 % RH	23 deg. C / 45 % RH
Engineer	Yuta Moriya	Tomoya Sone	Tomoya Sone
	(1 GHz to 6 GHz)	(Above 6 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 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.	43.9	24.8	-	13.3	7.2	32.2	-	13.1	-	40.0	-	26.9	-	
Hori.	111.3	27.2	-	12.0	8.0	32.1	-	15.1	-	43.5	-	28.4	-	
Hori.	171.9	28.7	-	16.0	8.6	32.1	-	21.2	-	43.5	-	22.3	-	
Hori.	270.4	23.1	-	12.9	9.5	32.0	-	13.5	-	46.0	-	32.5	-	
Hori.	364.8	22.7	-	15.1	10.1	32.0	-	15.9	-	46.0	-	30.1	-	
Hori.	450.2	22.1	-	16.6	10.7	32.0	-	17.3	-	46.0	-	28.7	-	
Hori.	2390.0	45.1	35.8	27.5	5.4	32.2	1.1	45.8	37.6	73.9	53.9	28.1	16.4	*1)
Hori.	4804.0	40.8	32.5	31.4	7.5	31.2	1.1	48.6	41.4	73.9	53.9	25.3	12.5	*2)
Hori.	7206.0	41.2	31.7	35.6	10.8	32.0	-	55.5	46.0	73.9	53.9	18.4	7.9	Floor noise
Hori.	9608.0	41.4	32.4	35.6	11.2	32.6	-	55.5	46.5	73.9	53.9	18.4	7.4	Floor noise
Vert.	43.9	37.4	-	13.3	7.2	32.2	-	25.7	-	40.0	-	14.3	-	
Vert.	111.3	27.6	-	12.0	8.0	32.1	-	15.5	-	43.5	-	28.0	-	
Vert.	171.9	25.7	-	16.0	8.6	32.1	-	18.2	-	43.5	-	25.3	-	
Vert.	270.4	23.3	-	12.9	9.5	32.0	-	13.7	-	46.0	-	32.3	-	
Vert.	364.8	24.7	-	15.1	10.1	32.0	-	17.9	-	46.0	-	28.1	-	
Vert.	450.2	22.4	-	16.6	10.7	32.0	-	17.6	-	46.0	-	28.4	-	
Vert.	2390.0	43.1	34.8	27.5	5.4	32.2	1.1	43.8	36.6	73.9	53.9	30.1	17.3	*1)
Vert.	4804.0	38.9	31.4	31.4	7.5	31.2	-	46.7	39.2	73.9	53.9	27.2	14.7	Floor noise
Vert.	7206.0	41.1	31.6	35.6	10.8	32.0	-	55.4	45.9	73.9	53.9	18.5	8.0	Floor noise
Vert.	9608.0	41.3	32.3	35.6	11.2	32.6	-	55.4	46.4	73.9	53.9	18.5	7.5	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)
*2) Noise synchronized with duty of carrier freqency

20dBc Data Sheet

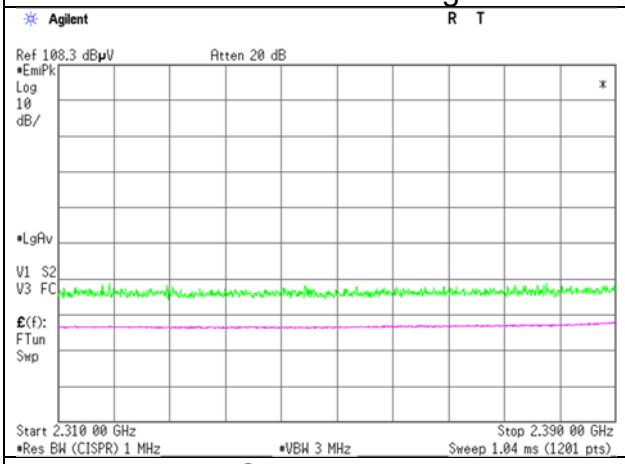
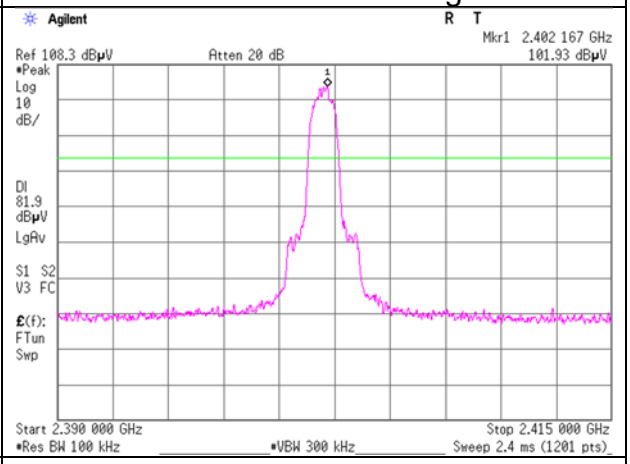
Polarity	Frequency	Reading (PK)	Ant Factor	Loss	Gain	Result	Limit	Margin	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
Hori.	2402.0	101.9	27.5	5.4	32.2	102.6	-	-	Carrier
Hori.	2400.0	43.5	27.5	5.4	32.2	44.2	82.6	38.4	
Vert.	2402.0	99.6	27.5	5.4	32.2	100.2	-	-	Carrier
Vert.	2400.0	42.3	27.5	5.4	32.2	43.0	80.2	37.2	

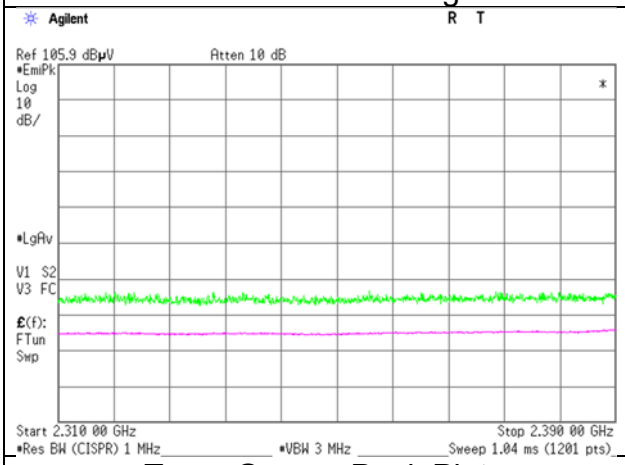
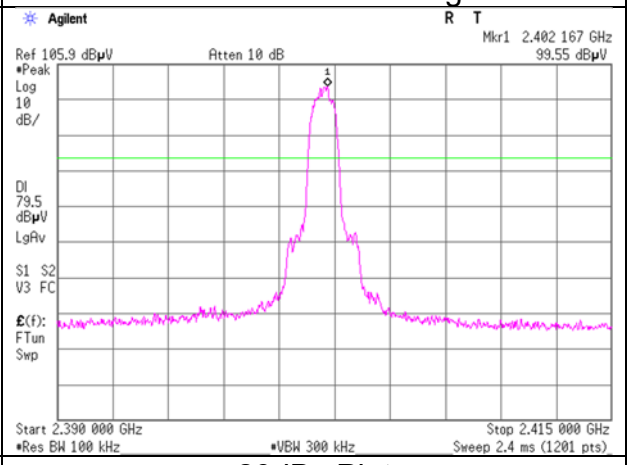
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor:	1 GHz - 6 GHz	20log (3.95 m / 3.0 m) = 2.39 dB
	6 GHz - 10 GHz	20log (4.95 m / 3.0 m) = 4.35 dB
	10 GHz - 26.5 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.3
Date	November 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH
Engineer	Yuta Moriya
	(1 GHz to 6 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	November 26, 2024	November 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH	22 deg. C / 65 % RH
Engineer	Yuta Moriya	Tomoya Sone
	(1 GHz to 6 GHz)	(Above 6 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	38.7	31.5	31.4	7.6	31.2	-	46.6	39.4	73.9	53.9	27.3	14.6	Floor noise
Hori.	7323.0	41.3	31.8	35.6	10.7	32.1	-	55.5	46.1	73.9	53.9	18.4	7.8	Floor noise
Hori.	9764.0	41.9	31.4	35.9	11.3	32.7	-	56.4	45.9	73.9	53.9	17.5	8.0	Floor noise
Vert.	4882.0	38.8	31.5	31.4	7.6	31.2	-	46.6	39.3	73.9	53.9	27.3	14.6	Floor noise
Vert.	7323.0	41.2	31.7	35.6	10.7	32.1	-	55.4	46.0	73.9	53.9	18.5	7.9	Floor noise
Vert.	9764.0	41.8	31.3	35.9	11.3	32.7	-	56.3	45.8	73.9	53.9	17.6	8.1	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.

Distance factor:	1 GHz - 6 GHz	20log (3.95 m / 3.0 m) = 2.39 dB
	6 GHz - 10 GHz	20log (4.95 m / 3.0 m) = 4.35 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	November 26, 2024	November 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH	22 deg. C / 65 % RH
Engineer	Yuta Moriya	Tomoya Sone
	(1 GHz to 6 GHz)	(Above 6 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	45.6	37.2	27.4	5.4	32.2	1.1	46.2	38.9	73.9	53.9	27.7	15.0	*1)
Hori.	4960.0	38.6	31.2	31.6	7.6	31.1	-	46.6	39.2	73.9	53.9	27.3	14.7	Floor noise
Hori.	7440.0	41.0	31.9	35.5	10.7	32.1	-	55.1	46.0	73.9	53.9	18.8	7.9	Floor noise
Hori.	9920.0	41.3	31.7	36.1	11.3	32.8	-	55.9	46.4	73.9	53.9	18.0	7.5	Floor noise
Vert.	2483.5	45.0	36.7	27.4	5.4	32.2	1.1	45.6	38.4	73.9	53.9	28.3	15.5	*1)
Vert.	4960.0	38.6	31.2	31.6	7.6	31.1	-	46.6	39.2	73.9	53.9	27.3	14.7	Floor noise
Vert.	7440.0	40.9	31.8	35.5	10.7	32.1	-	55.0	45.9	73.9	53.9	18.9	8.1	Floor noise
Vert.	9920.0	41.2	31.6	36.1	11.3	32.8	-	55.8	46.3	73.9	53.9	18.1	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.
*1) Not Out of Band emission(Leakage Power)

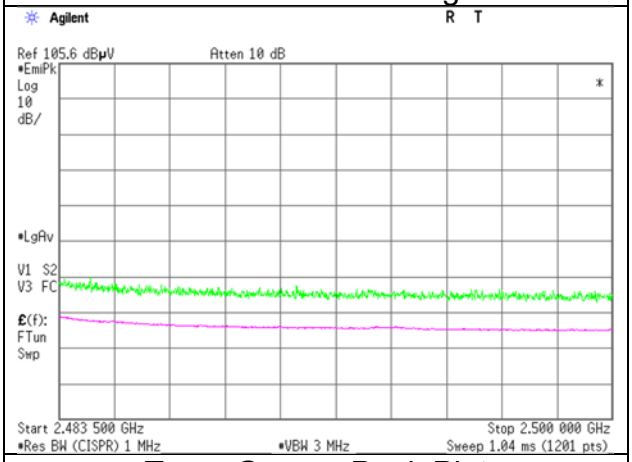
Distance factor:	1 GHz - 6 GHz	20log (3.95 m / 3.0 m) = 2.39 dB
	6 GHz - 10 GHz	20log (4.95 m / 3.0 m) = 4.35 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	November 26, 2024
Temperature / Humidity	23 deg. C / 59 % RH
Engineer	Yuta Moriya
	(1 GHz to 6 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz

Horizontal

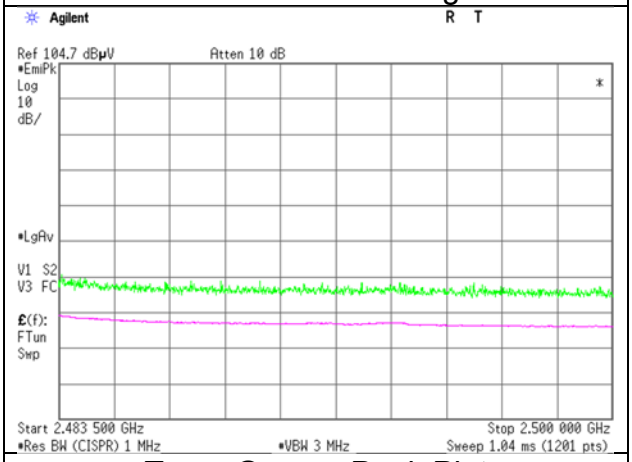
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

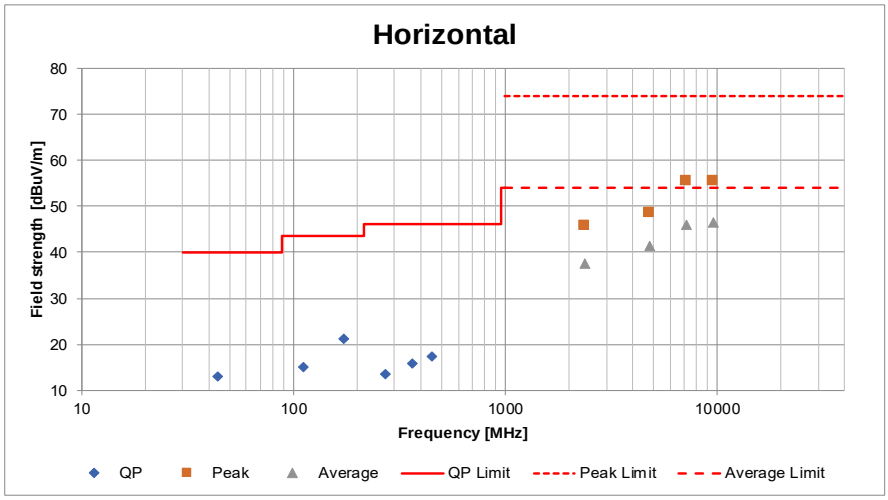


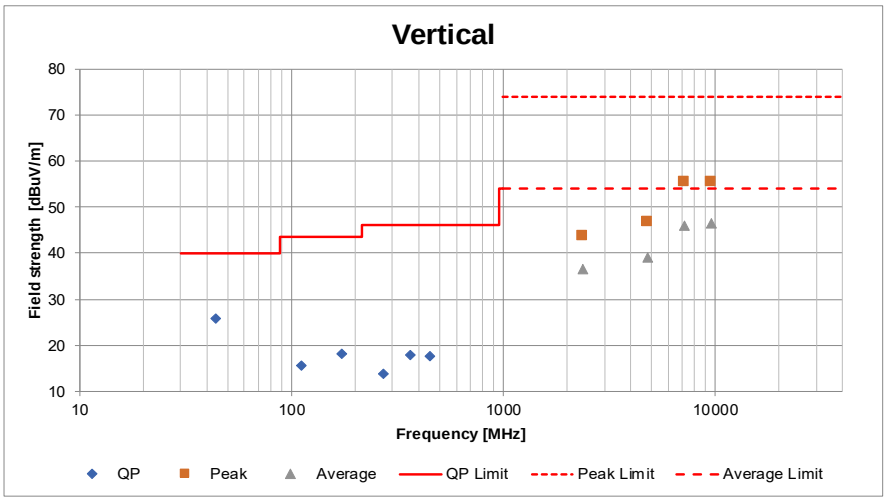
Trace Green : Peak Plot
Trace Purple : Average Plot

* 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.3	No.3	No.3
Date	November 26, 2024	November 26, 2024	November 27, 2024
Temperature / Humidity	23 deg. C / 59 % RH	22 deg. C / 65 % RH	23 deg. C / 45 % RH
Engineer	Yuta Moriya	Tomoya Sone	Tomoya Sone
	(1 GHz to 6 GHz)	(Above 6 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		





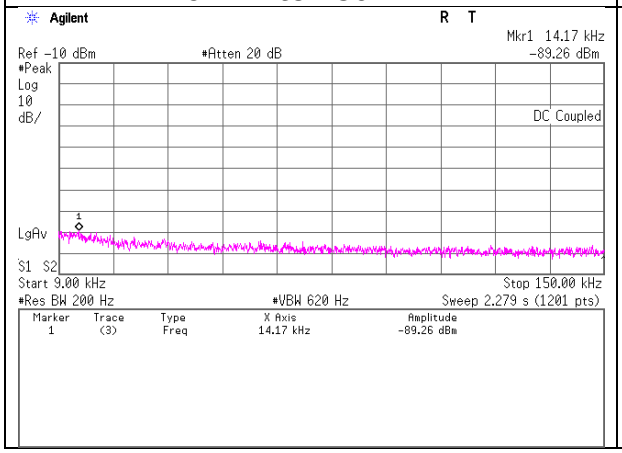
*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

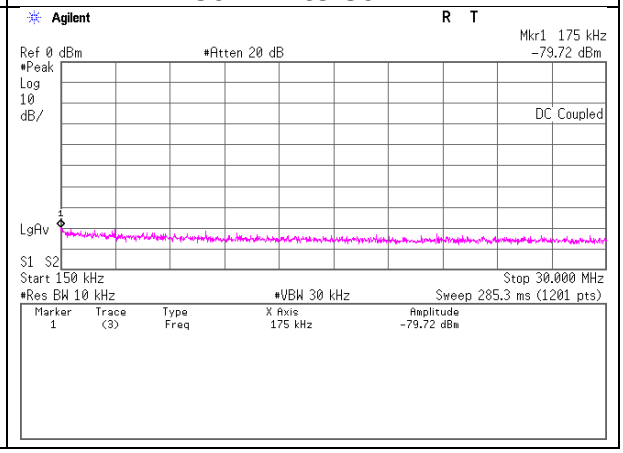
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx, Hopping Off, DH5

2402 MHz

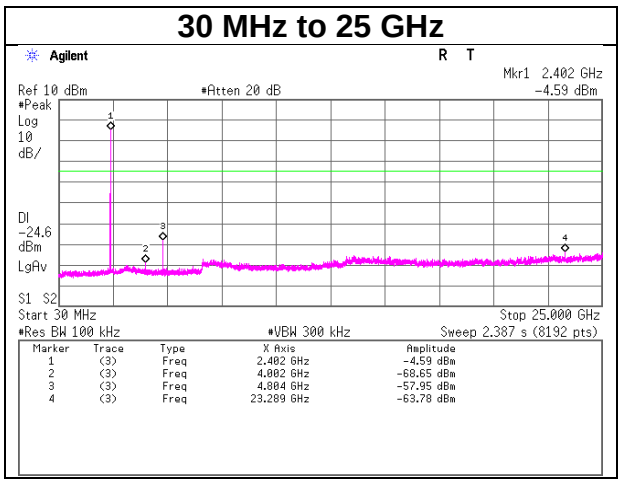
9 kHz to 150 kHz



150 kHz to 30 MHz



30 MHz to 25 GHz

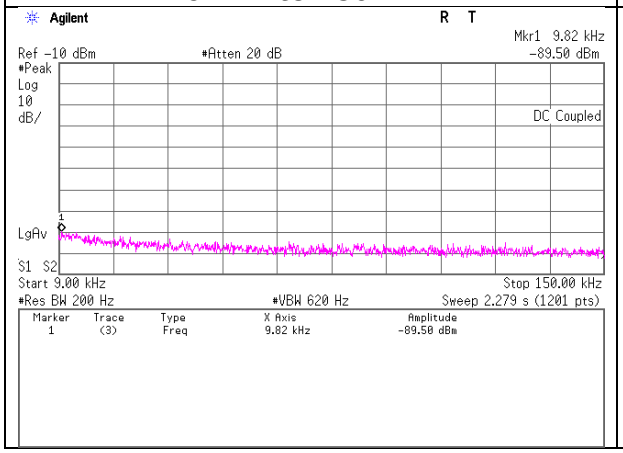


Conducted Spurious Emission

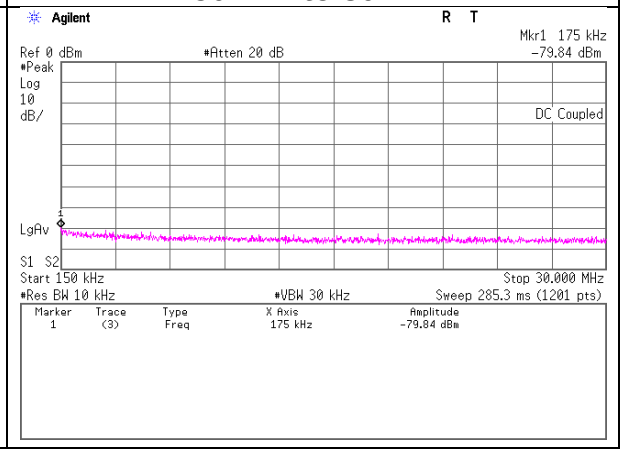
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx, Hopping Off, DH5

2441 MHz

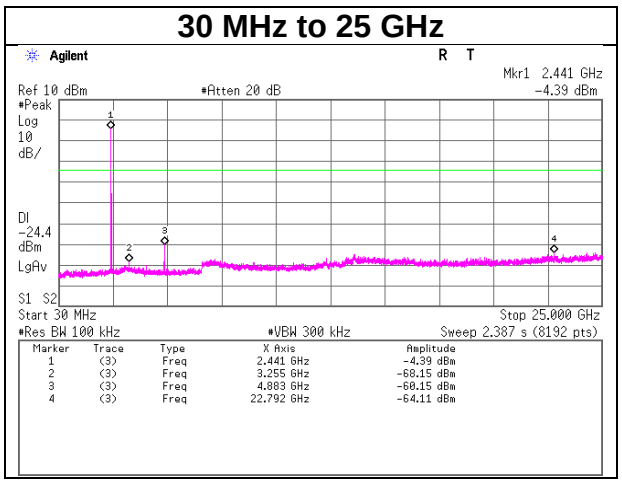
9 kHz to 150 kHz



150 kHz to 30 MHz



30 MHz to 25 GHz

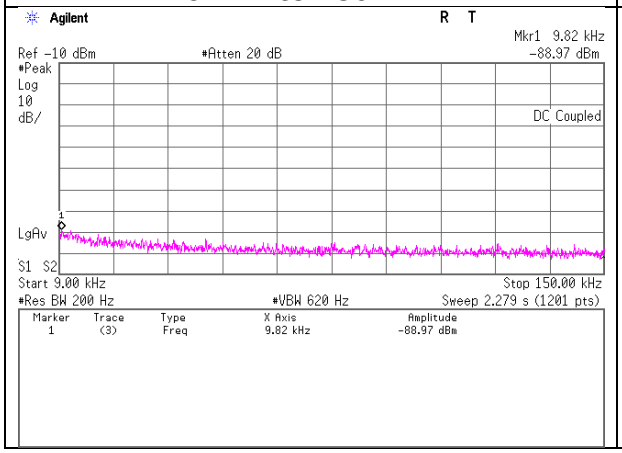


Conducted Spurious Emission

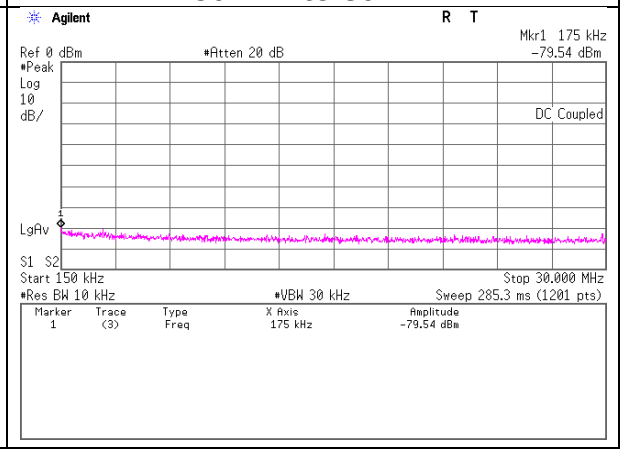
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx, Hopping Off, DH5

2480 MHz

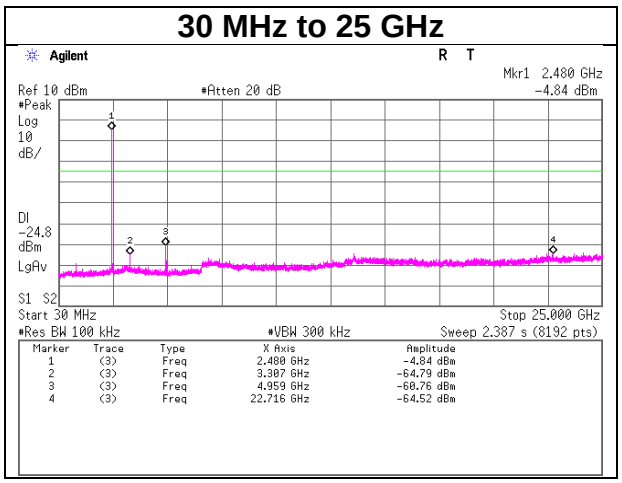
9 kHz to 150 kHz



150 kHz to 30 MHz



30 MHz to 25 GHz

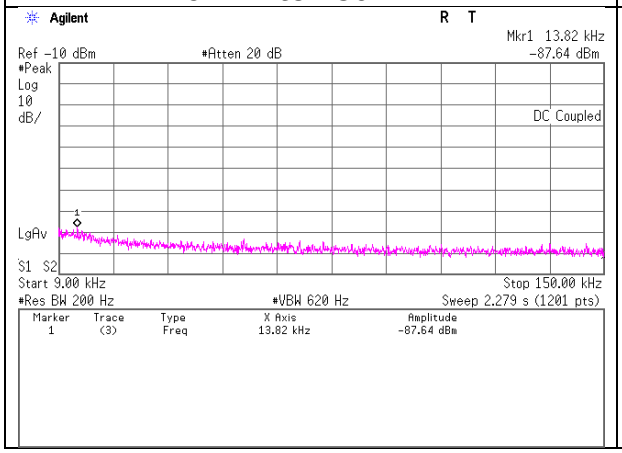


Conducted Spurious Emission

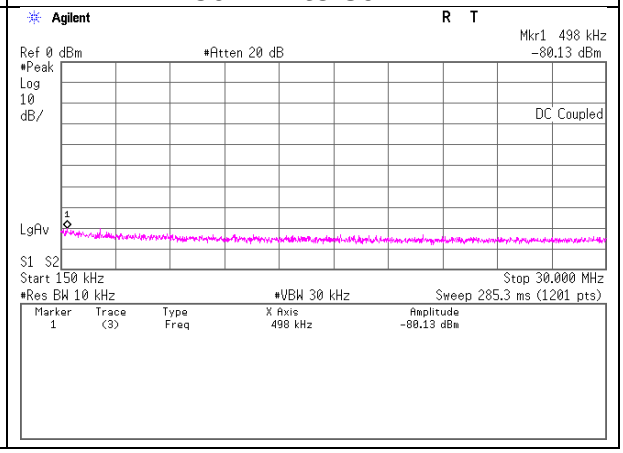
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx, Hopping Off, 3DH5

2402 MHz

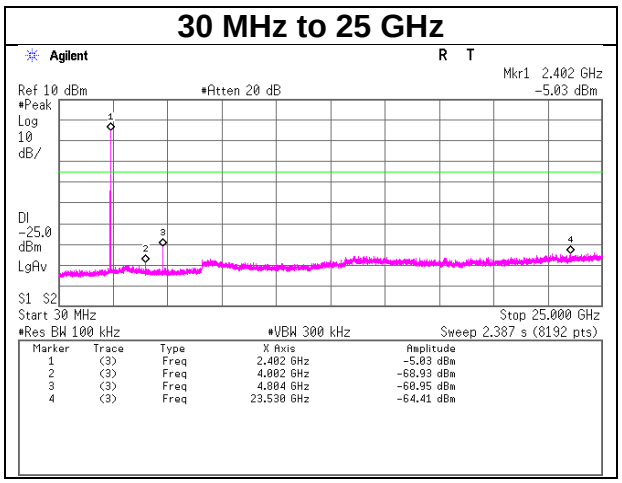
9 kHz to 150 kHz



150 kHz to 30 MHz



30 MHz to 25 GHz

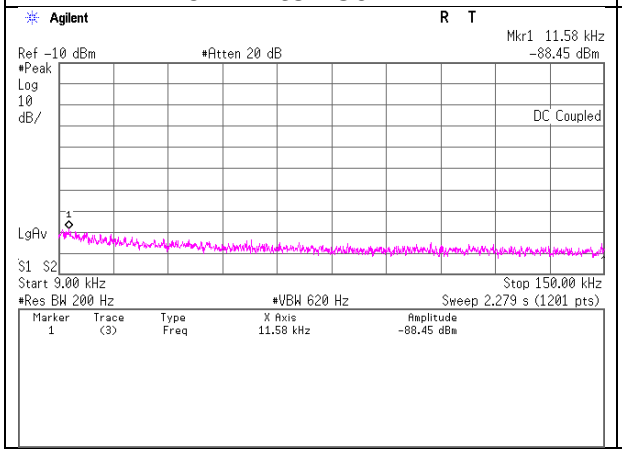


Conducted Spurious Emission

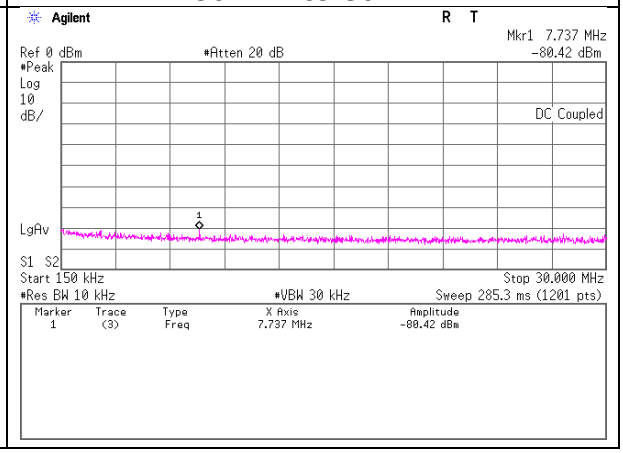
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx, Hopping Off, 3DH5

2441 MHz

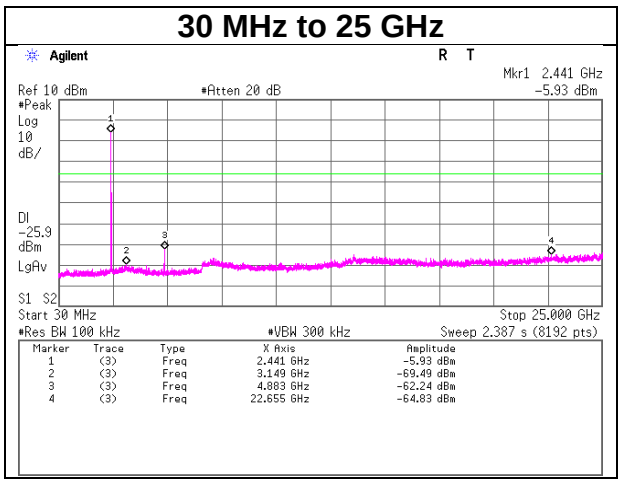
9 kHz to 150 kHz



150 kHz to 30 MHz



30 MHz to 25 GHz

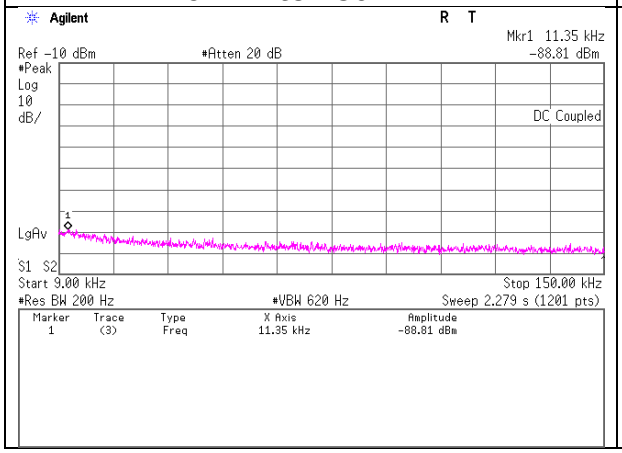


Conducted Spurious Emission

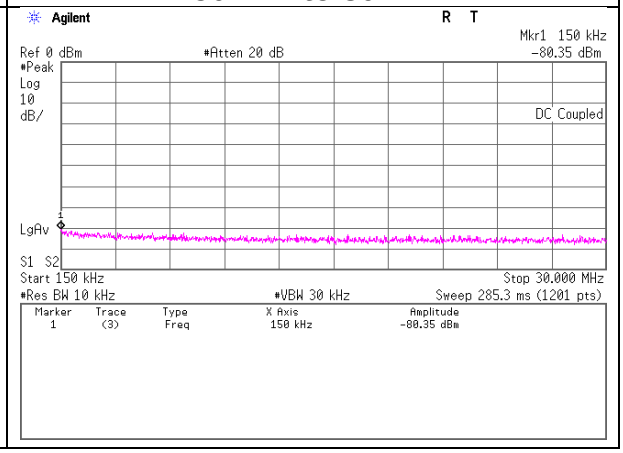
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx, Hopping Off, 3DH5

2480 MHz

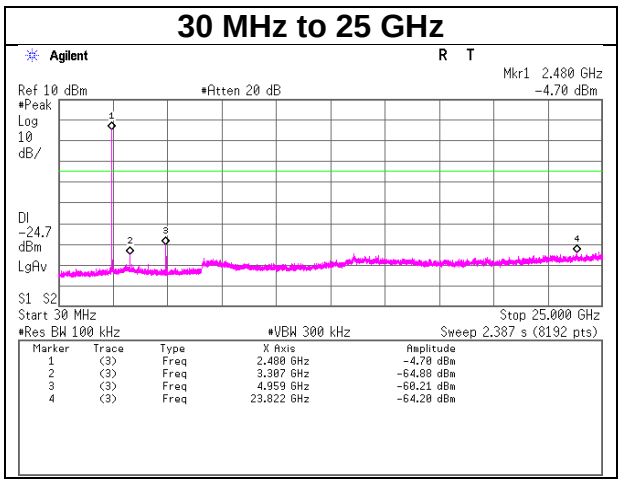
9 kHz to 150 kHz



150 kHz to 30 MHz



30 MHz to 25 GHz

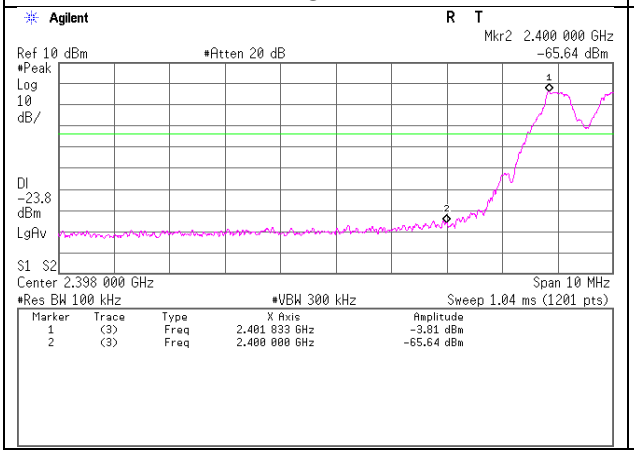


Conducted Emission Band Edge compliance

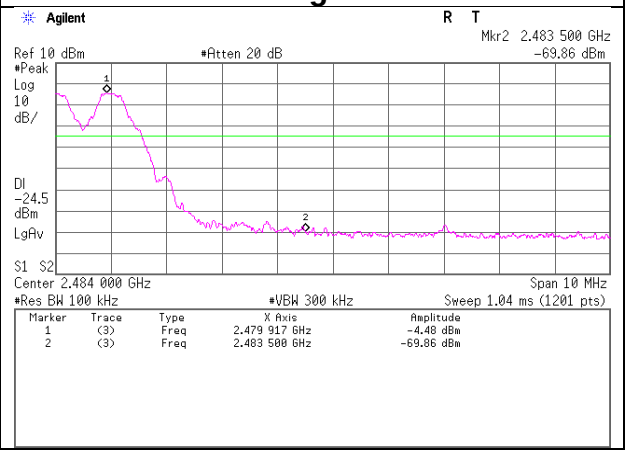
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx DH5

Hopping On

Low

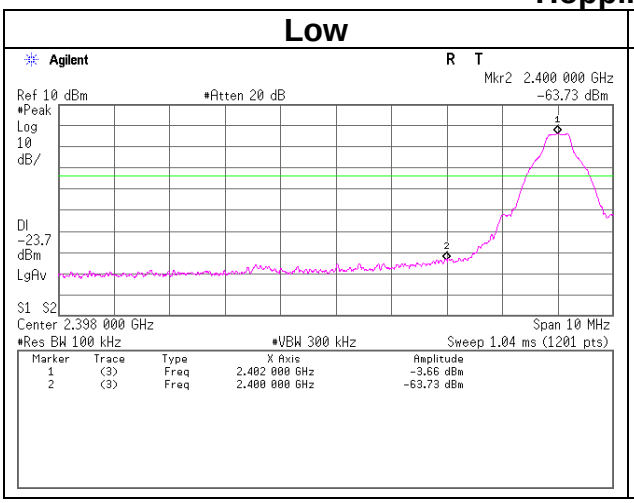


High

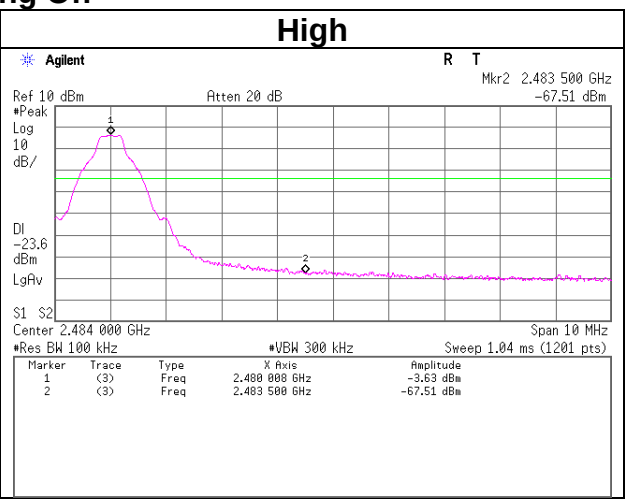


Hopping Off

Low



High

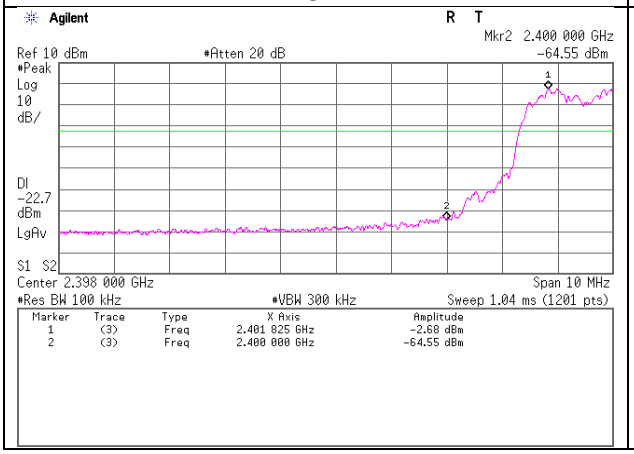


Conducted Emission Band Edge compliance

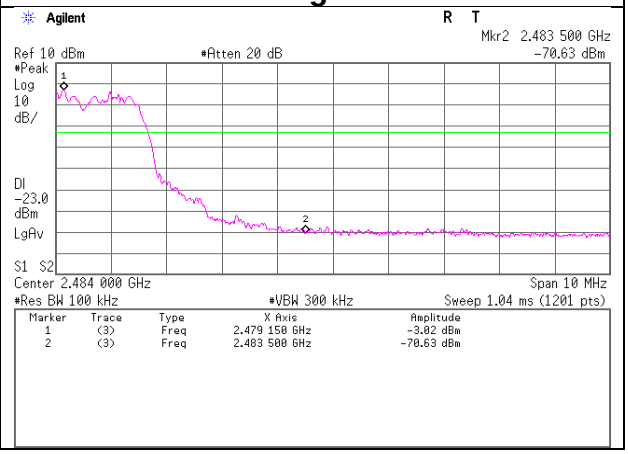
Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 9, 2024
Temperature / Humidity	23 deg. C / 32 % RH
Engineer	Nachi Konegawa
Mode	Tx 3DH5

Hopping On

Low

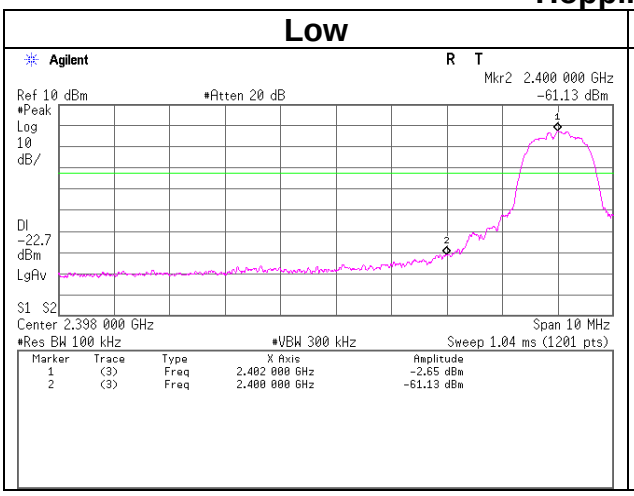


High

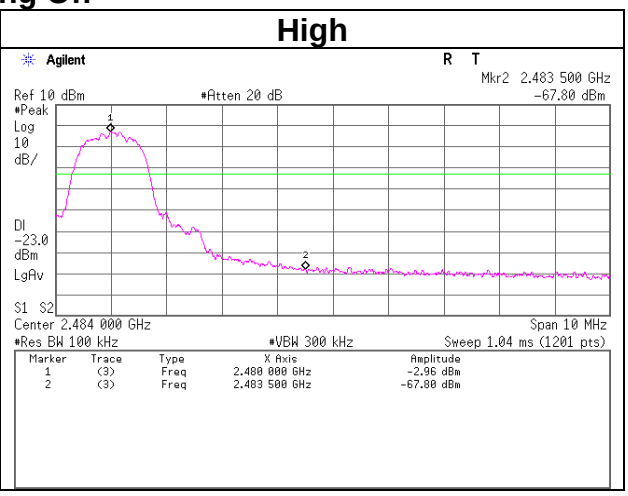


Hopping Off

Low



High



APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	141156	Attenuator (10dB)	Weinschel Corp	2	BL1173	11/11/2024	12
AT	141334	Attenuator (10dB)	Suhner	6810.19.A	-	12/02/2024	12
AT	141419	Attenuator	Weinschel Associates	WA56-10	56100305	05/22/2024	12
AT	141805	Power Meter	Anritsu Corporation	ML2495A	6K00003338	08/22/2024	12
AT	141840	Power sensor	Anritsu Corporation	MA2411B	011737	08/22/2024	12
AT	141855	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187750	11/14/2024	12
AT	244711	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202105	01/25/2024	12
CE	141215	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W/3D-2W/ RG400u/ RFM-E421(SW)	-/ 01068(Switcher)	06/24/2024	12
CE	141290	Attenuator (13dB)	JFW Industries, Inc.	50FP-013H2 N	-	12/10/2024	12
CE	141357	LISN (AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-729	07/09/2024	12
CE	141358	LISN (AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-730	07/09/2024	12
CE	141530	Digital Tester	Fluke Corporation	FLUKE 26-3	78030621	02/01/2024	12
CE	141568	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	2901	01/10/2024	12
CE	141925	Terminator	TME	CT-01	-	11/19/2024	12
CE	141950	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	11/28/2024	12
CE	141998	AC1_Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	12/06/2023	24
CE	142226	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
CE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	141232	High Pass Filter 3.5-18.0GHz	UL-ISE	HPF SELECTOR	001	09/13/2024	12
RE	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-191	08/23/2024	12
RE	141323	Coaxial cable	UL-ISE	-	-	09/13/2024	12
RE	141424	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+ BBA9106	1915	03/15/2024	12
RE	141507	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	258	11/11/2024	12
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170306	07/19/2024	12
RE	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	051201197	01/31/2024	12
RE	141580	Microwave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	03/08/2024	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/17/2024	12
RE	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	05/09/2024	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	06/05/2024	12
RE	142008	AC3_Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	12/11/2023	24
RE	142013	AC3_Semi Anechoic Chamber (SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/12/2023	24
RE	142183	Measure	KOMELON	KMC-36	-	10/21/2024	12
RE	142314	Attenuator	Pasternack Enterprises	PE7390-6	D/C 1504	06/06/2024	12
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	244709	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202103	01/25/2024	12
RE	245787	Double Ridge Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	689	03/06/2024	12
RE	246001	Microwave Cable	Huber+Suhner	SF103/11PC35/ 11PC35/1000mm / SF126E/5000mm	800673(1m) / 610204(5m)	03/06/2024	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:

AT: Antenna Terminal Conducted test
CE: Conducted Emission
RE: Radiated Emission