

RADIO TEST REPORT

Test Report No. 15398805H-B

Customer	DENSO TEN Limited
Description of EUT	Car Audio
Model Number of EUT	TN0047A
FCC ID	BABTN0047A
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	October 15, 2024
Remarks	Bluetooth (BR / EDR) parts

Representative Test EngineerShousei Hamaguchi
Engineer**Approved By**Ryota Yamanaka
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".

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 23.0

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- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 15398805H-B

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15398805H-B	October 15, 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

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SECTION 1: Customer Information

Company Name	DENSO TEN Limited
Address	2-28, Goshō-dori 1-Chome, Hyogo-ku, KOBE 652-8510 JAPAN
Telephone Number	+81 78 682 2159
Contact Person	Kaoru Abe

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	Car Audio
Model Number	TN0047A
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	August 9, 2024
Test Date	August 26 to September 2, 2024

2.2 Product Description

General Specification

Rating	DC 12 V
Operating temperature	-20 deg. C to 65 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.

Radio Specification-1/2

[WLAN (IEEE802.11b/11g/11n-20)]

Equipment Type	Transceiver
Frequency of Operation	2437 MHz
Type of Modulation	DSSS, OFDM
Antenna Gain	-0.57 dBi

[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 ^{*a)}	-0.49 dBi

Radio Specification-2/2

WLAN (IEEE802.11a/11n-20/11ac-20/11n-40/11ac-40/11ac-80)

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band	5765 MHz
	40 MHz Band	5755 MHz
	80 MHz Band	5775 MHz
Type of Modulation	OFDM	
Antenna Gain	0.31 dBi	

[AM/FM/DAB]

Equipment Type	Receiver
Frequency of Operation	AM: 530 kHz to 1625 kHz FM: Band II: 87.5 MHz to 108.0 MHz DAB (Band III): 174.928 MHz to 239.200 MHz
Type of Modulation	AM FM DAB: OFDM
Antenna Connector Type	HFC IV
Impedance	AM, FM: 75 ohm DAB: 50 ohm

* WLAN and Bluetooth do not transmit simultaneously.

2.3 Variant models

There has five types; A, B, C, D, E and H. Tests were performed to Type A (base model) as representative model.

Frequency of Operation for WLAN is as following table.

	Type A (EUT)	Type B	Type C		Type D		Type E	Type H
	A-1	B-1	C-1 C-2	C-3 C-4	D-1 D-2	D-3 D-4	E-1 E-2	H-1, H-2
5735 MHz to 5815 MHz	Y	Y	Y	-	Y	-	Y	Y
2426 MHz to 2448 MHz	Y	-	-	Y	-	Y	-	-

*Wireless block hardware is the same as Type A.

Wifi frequency can be selected between 2.4 GHz or 5 GHz by the product's built-in software.

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

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	-	N/A	*1)
Carrier Frequency Separation	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section15.247(a)(1) ISED: RSS-247 5.1 (b)	See data.	Complied	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	8.5 dB 400.00 MHz, QP, Vertical	Complied	Conducted/ Radiated (above 30 MHz) *2)

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) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

*2) Radiated test was selected over 30 MHz based on section 15.247(d).

FCC Part 15.31 (e)

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

FCC Part 15.203 Antenna requirement

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

3.3 Addition to Standard

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
99% Occupied Bandwidth	ISED: RSS-Gen 6.7	ISED: -	N/A	-	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 $k = 2$.

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	4.7
		Vertical	dB	4.7
	200 MHz to 1000 MHz	Horizontal	dB	4.8
		Vertical	dB	6.0
10 m	30 MHz to 200 MHz	Horizontal	dB	5.2
		Vertical	dB	5.1
	200 MHz to 1000 MHz	Horizontal	dB	5.2
		Vertical	dB	5.2
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.

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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	-	-

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: BR: 6.5 dBm EDR: 6 dBm Software: Bluetooth test software V1.0 (Date: August 8, 2024, Storage location: EUT memory) *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
Radiated Spurious Emission (Below 1 GHz)	Tx 3DH5 *1)	Off	2441 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

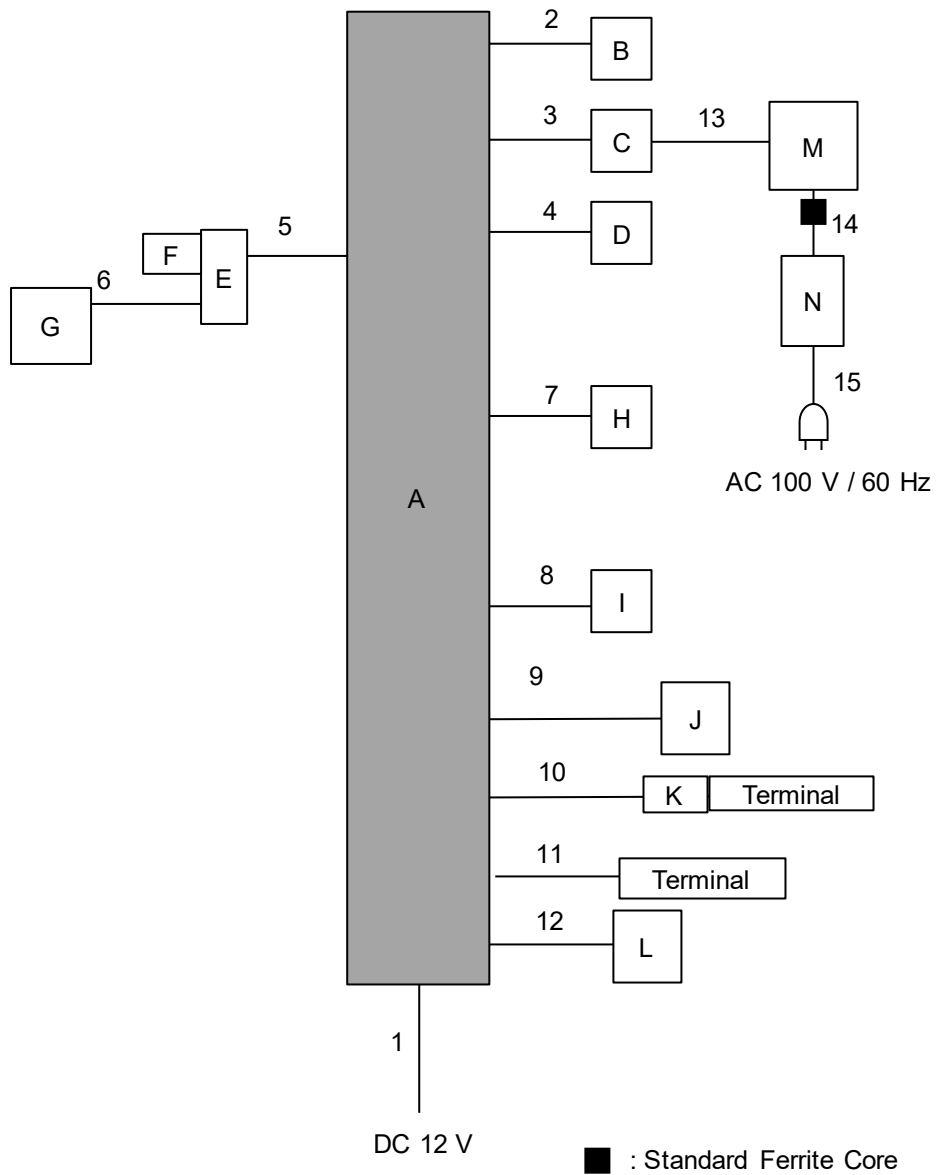
*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test)

*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.

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	Car Audio	TN0047A	100292248-0004	DENSO TEN Limited	EUT
B	Micro Phone	86730-78010	31C043761	Panasonic	-
C	Jig board	-	-	-	-
D	Digital Camera	867B0-78070	THX4235Q05385	Panasonic	-
E	USB I/F BOX	86190-78020	500870	Panasonic	-
F	USB Memory	RUF3-K16GB	P10416	Buffalo Inc.	-
G	iPod touch	MC540J/A	C3RJ4SLADT75	Apple	-
H	Steering Switch	84250-58150-BO	NO2	-	-
I	GNSS Antenna	86880-78010	34347	Harada Industry Co., Ltd.	-
J	Speaker Dummy	SP Dummy	DUMMY-210810-001	DENSO TEN Limited	-
K	AM / FM Dummy	AM / FM Dummy	NO1	DENSO TEN Limited	-
L	Analog Camera	86790-60670	D310026	Panasonic	-
M	Laptop PC	CF-N8HWCDPS	0BKSA08729	Panasonic	*1)
N	AC Adapter	CF-AA6372B	6372BM610909023E	Panasonic	*1)

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	5.0	Unshielded	Unshielded	-
2	Signal Cable	3.0	Unshielded	Unshielded	-
3	Flat Cable	0.1	Unshielded	Unshielded	-
4	Signal Cable	5.0	Unshielded	Unshielded	-
5	Signal Cable	3.0	Unshielded	Unshielded	-
6	USB Cable	1.0	Shielded	Shielded	-
7	Signal Cable	3.0	Unshielded	Unshielded	-
8	GNSS Antenna Cable	3.0	Shielded	Shielded	-
9	Speaker Cable	3.0	Unshielded	Unshielded	-
10	AM / FM Cable	0.2	Shielded	Shielded	-
11	DAB Cable	3.5	Unshielded	Unshielded	-
12	Signal Cable	3.0	Unshielded	Unshielded	-
13	USB Cable	0.9	Shielded	Shielded	*1)
14	DC Cable	1.0	Unshielded	Unshielded	*1)
15	AC Cable	0.8	Unshielded	Unshielded	*1)

*1) Antenna Terminal Conducted test only

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

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

[For above 1 GHz]

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

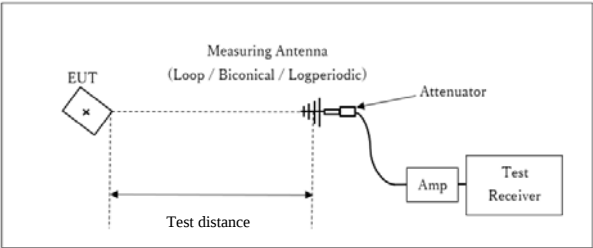
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired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

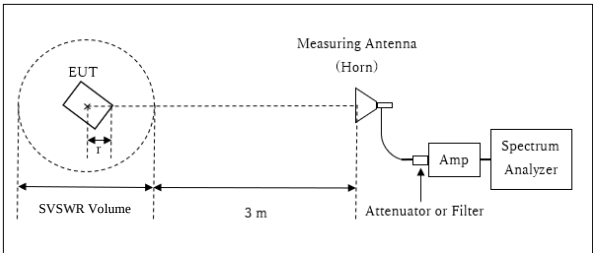
Figure 1: Test Setup

Below 1 GHz



Test Distance: 3 m

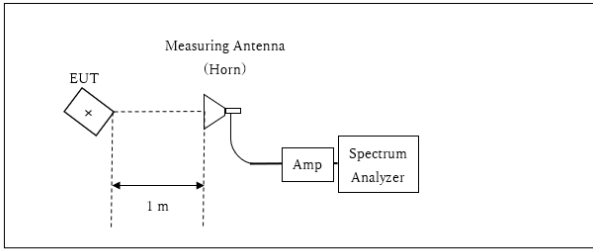
1 GHz to 10 GHz



Distance Factor: $20 \times \log (3.55 \text{ m} / 3.0 \text{ m}) = 1.47 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.55 \text{ m}$

SVSWR Volume : 1.5 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.2 \text{ m}$

10 GHz to 26.5 GHz



Distance Factor: $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$
*Test Distance: 1 m

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

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 6: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument Used
20dB Bandwidth	3 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold *1)	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.

① Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 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 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.

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

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

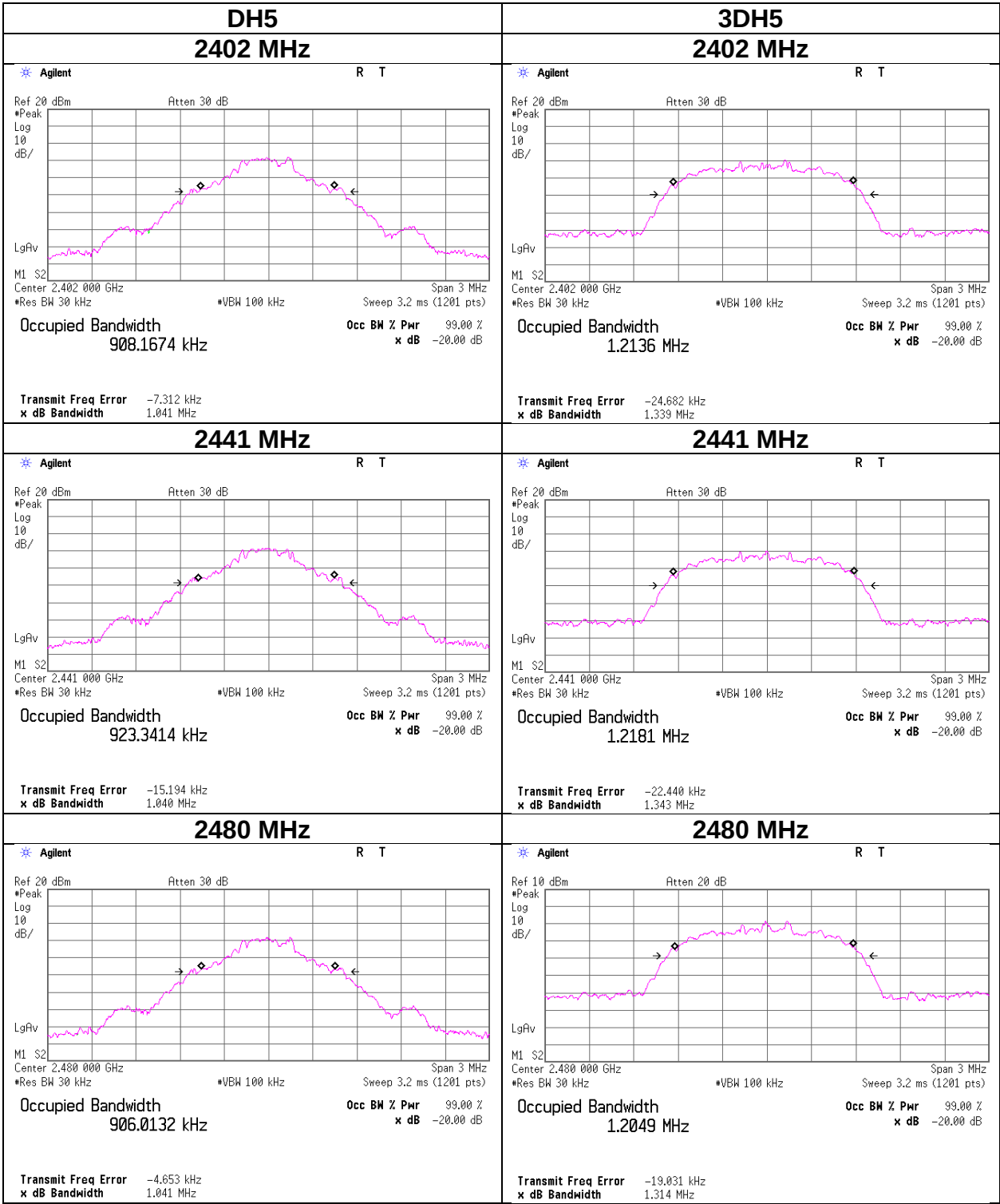
Test place	Ise EMC Lab. No.8 Measurement Room
Date	August 28, 2024
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Shousei Hamaguchi
Mode	Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	1.041	908.167	1.000	>= 0.694
DH5	2441.0	1.040	923.341	1.000	>= 0.693
DH5	2480.0	1.041	906.013	1.000	>= 0.694
DH5	Hopping On	-	78598.100	-	-
3DH5	2402.0	1.339	1213.576	1.000	>= 0.893
3DH5	2441.0	1.343	1218.104	1.000	>= 0.895
3DH5	2480.0	1.314	1204.914	1.000	>= 0.876
3DH5	Hopping On	-	78691.200	-	-

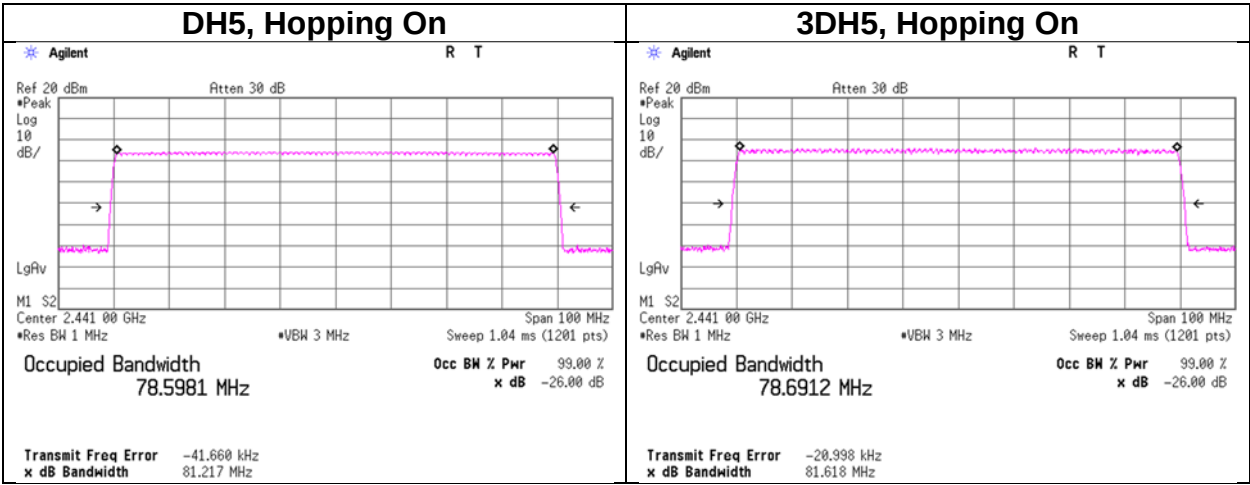
Limit: Two-thirds of 20 dB Bandwidth or 25 kHz (whichever is greater).

No limit applies to 20 dB Bandwidth.

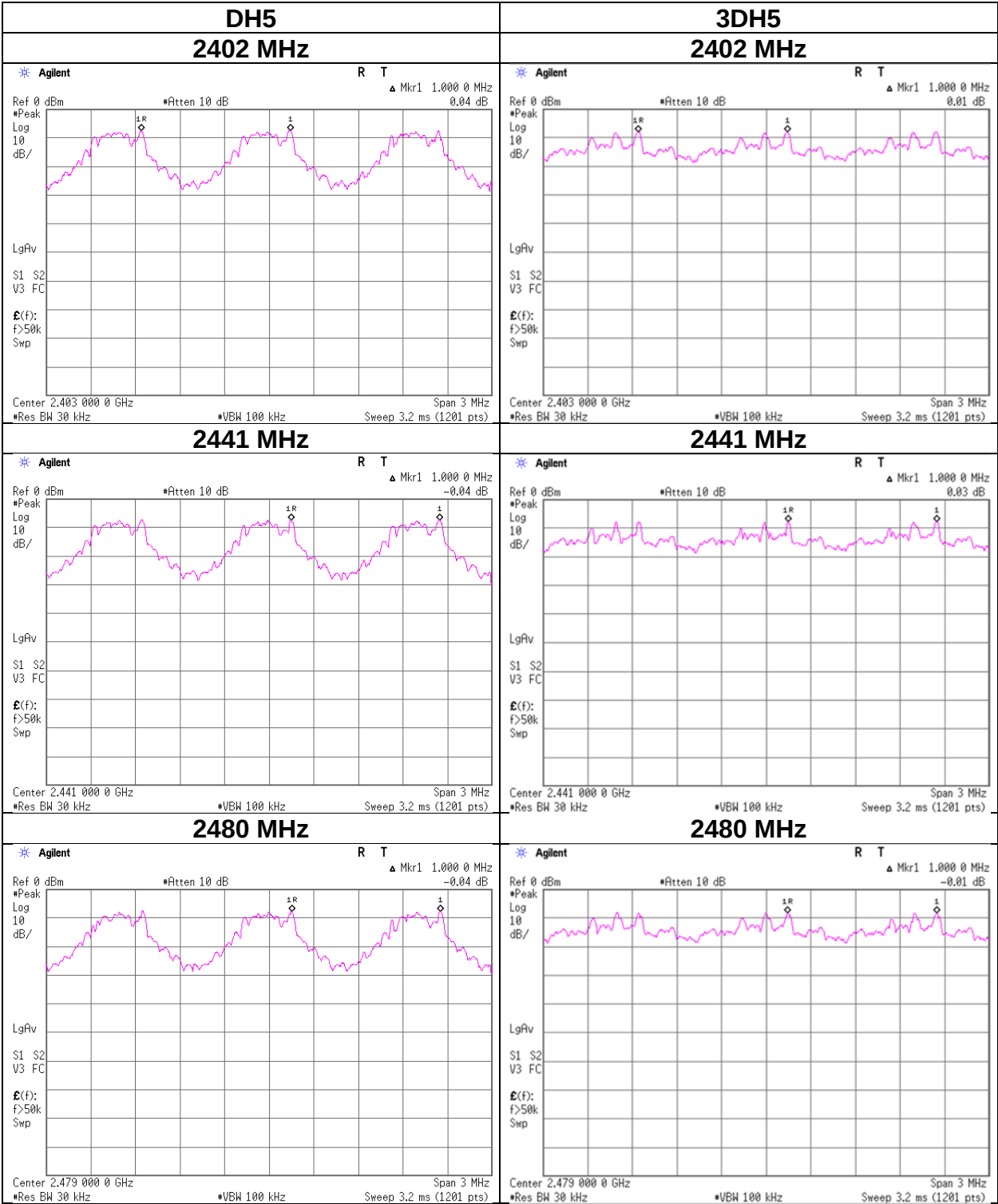
20dB Bandwidth and 99% Occupied Bandwidth



20dB Bandwidth and 99% Occupied Bandwidth



Carrier Frequency Separation



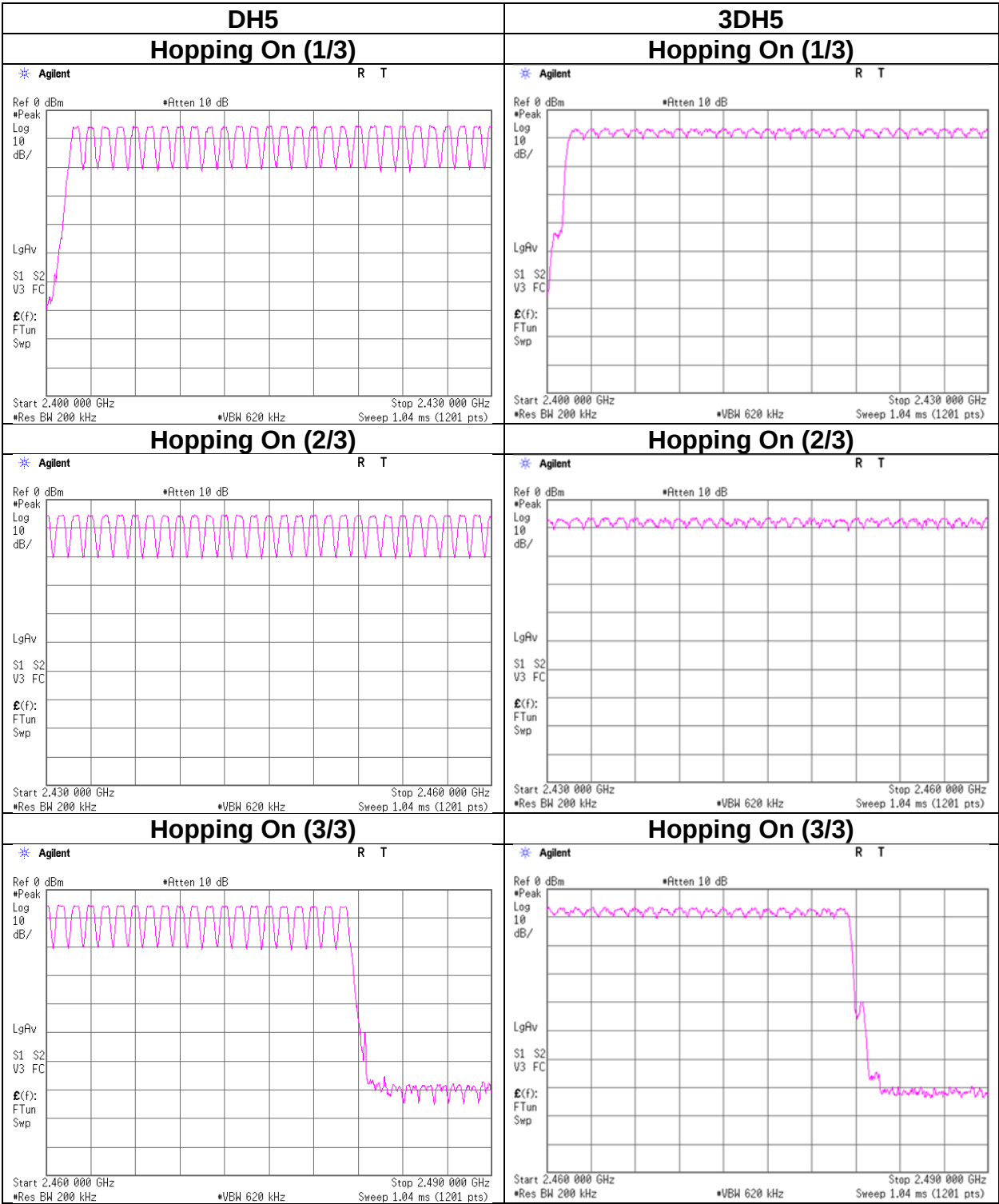
Number of Hopping Frequency

Test place	Ise EMC Lab. No.8 Measurement Room
Date	August 28, 2024
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Shousei Hamaguchi
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.8 Measurement Room
Date August 28, 2024
Temperature / Humidity 23 deg. C / 60 % RH
Engineer Shousei Hamaguchi
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	50.2 times	/	5 s	x	31.6 s	= 318 times	0.423	134	400
DH3	26.2 times	/	5 s	x	31.6 s	= 166 times	1.685	280	400
DH5	19.2 times	/	5 s	x	31.6 s	= 122 times	2.933	358	400
3DH1	51.2 times	/	5 s	x	31.6 s	= 324 times	0.426	138	400
3DH3	27.6 times	/	5 s	x	31.6 s	= 175 times	1.687	295	400
3DH5	19.6 times	/	5 s	x	31.6 s	= 124 times	2.940	365	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

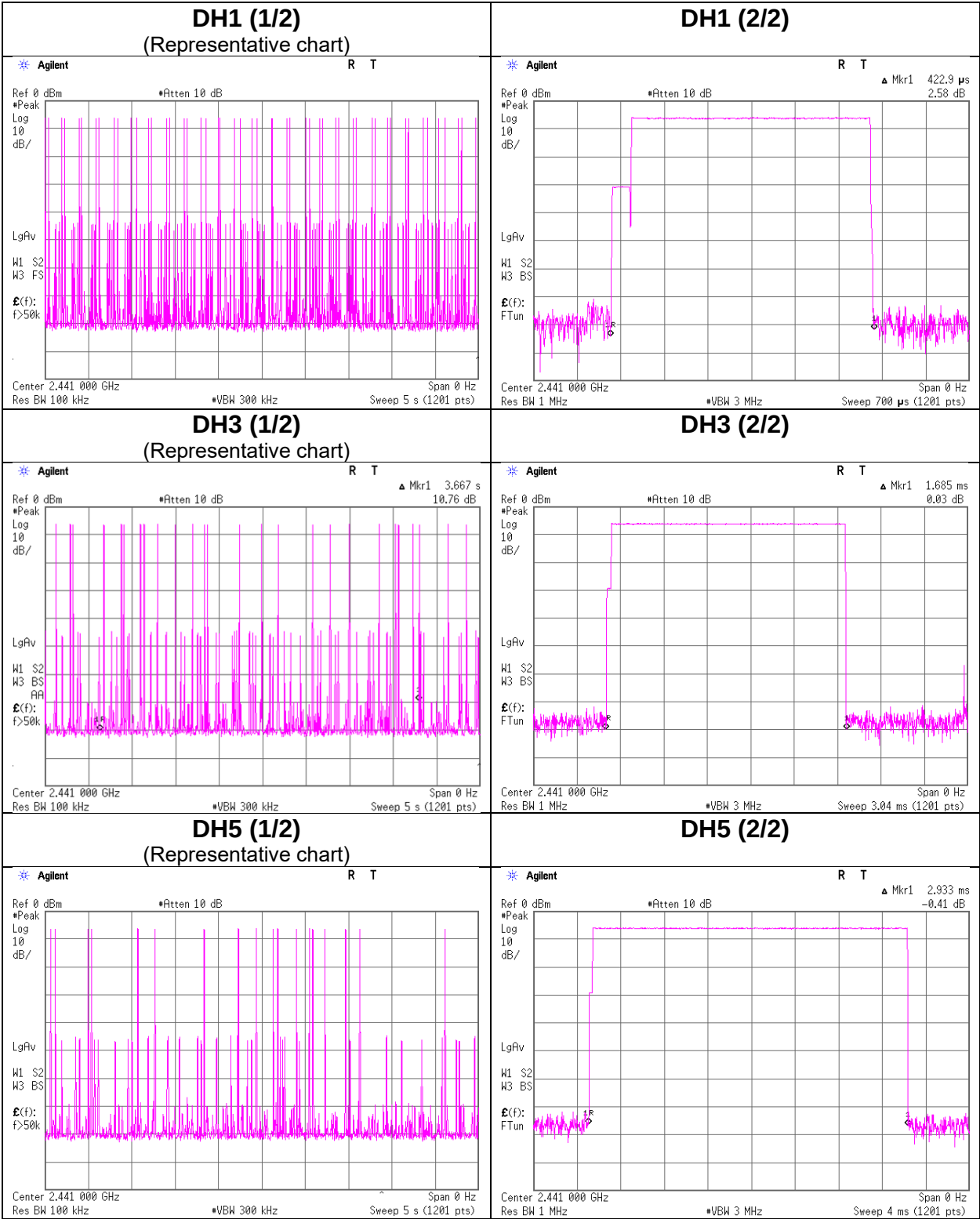
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	52	50	50	49	50	50.2
DH3	26	26	25	26	28	26.2
DH5	18	20	21	20	17	19.2
3DH1	51	52	50	52	51	51.2
3DH3	28	23	31	28	28	27.6
3DH5	18	18	21	21	20	19.6

Sample Calculation

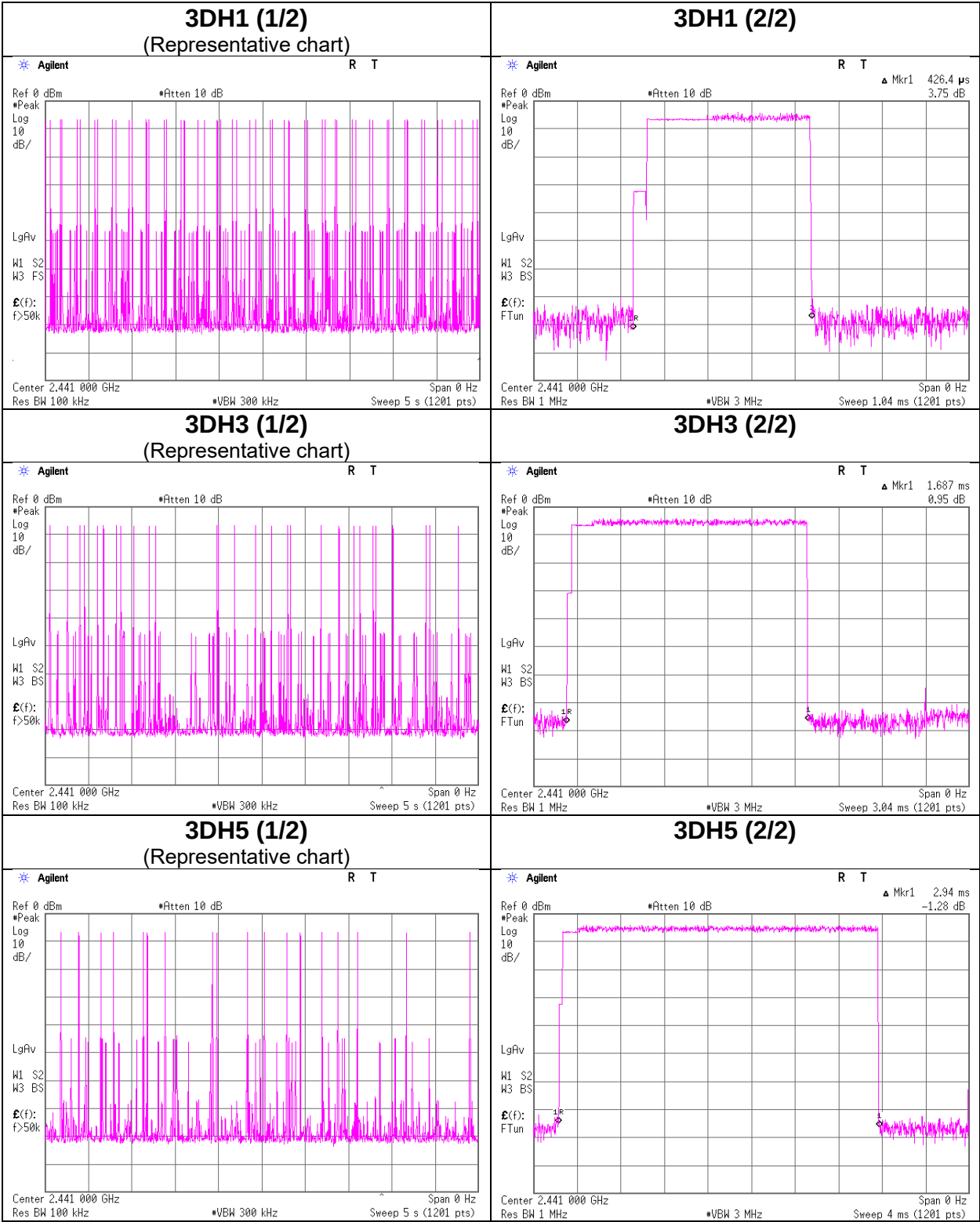
Average = Summation (Sampling 1 to 5) / 5

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 $N \times 0.4$ 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.8 Measurement Room
Date August 26, 2024
Temperature / Humidity 23 deg. C / 60 % RH
Engineer Shousei Hamaguchi
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
					[dBm]	[mW]	[dBm]	[mW]			[dB]	[dBm]	[mW]	[dBm]	
DH5	2402.0	-5.82	1.76	10.07	6.01	3.99	20.96	125	14.95	-0.49	5.52	3.57	36.02	4000	30.50
DH5	2441.0	-5.22	1.71	10.07	6.56	4.53	20.96	125	14.40	-0.49	6.07	4.04	36.02	4000	29.95
DH5	2480.0	-6.02	1.78	10.07	5.83	3.83	20.96	125	15.13	-0.49	5.34	3.42	36.02	4000	30.68
2DH5	2402.0	-4.40	1.76	10.07	7.43	5.54	20.96	125	13.53	-0.49	6.94	4.95	36.02	4000	29.08
2DH5	2441.0	-3.86	1.71	10.07	7.92	6.19	20.96	125	13.04	-0.49	7.43	5.53	36.02	4000	28.59
2DH5	2480.0	-4.62	1.78	10.07	7.23	5.29	20.96	125	13.73	-0.49	6.74	4.72	36.02	4000	29.28
3DH5	2402.0	-4.03	1.76	10.07	7.80	6.03	20.96	125	13.16	-0.49	7.31	5.39	36.02	4000	28.71
3DH5	2441.0	-3.49	1.71	10.07	8.29	6.74	20.96	125	12.67	-0.49	7.80	6.02	36.02	4000	28.22
3DH5	2480.0	-4.24	1.78	10.07	7.61	5.77	20.96	125	13.35	-0.49	7.12	5.15	36.02	4000	28.90

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.8 Measurement Room
Date	August 26, 2024
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Shousei Hamaguchi
Mode	Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
					[dBm]	[mW]		[dBm]	[mW]
DH5	2402.0	-7.25	1.76	10.07	4.58	2.87	1.07	5.65	3.68
DH5	2441.0	-6.64	1.71	10.07	5.14	3.27	1.07	6.21	4.18
DH5	2480.0	-7.42	1.78	10.07	4.43	2.77	1.07	5.50	3.55
2DH5	2402.0	-8.02	1.76	10.07	3.81	2.41	1.07	4.88	3.08
2DH5	2441.0	-7.41	1.71	10.07	4.37	2.73	1.07	5.44	3.50
2DH5	2480.0	-8.22	1.78	10.07	3.63	2.31	1.07	4.70	2.95
3DH5	2402.0	-8.02	1.76	10.07	3.81	2.41	1.07	4.88	3.08
3DH5	2441.0	-7.40	1.71	10.07	4.38	2.74	1.07	5.45	3.51
3DH5	2480.0	-8.21	1.78	10.07	3.64	2.31	1.07	4.71	2.96

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.8 Measurement Room

Date

August 26, 2024

Temperature / Humidity

23 deg. C / 60 % RH

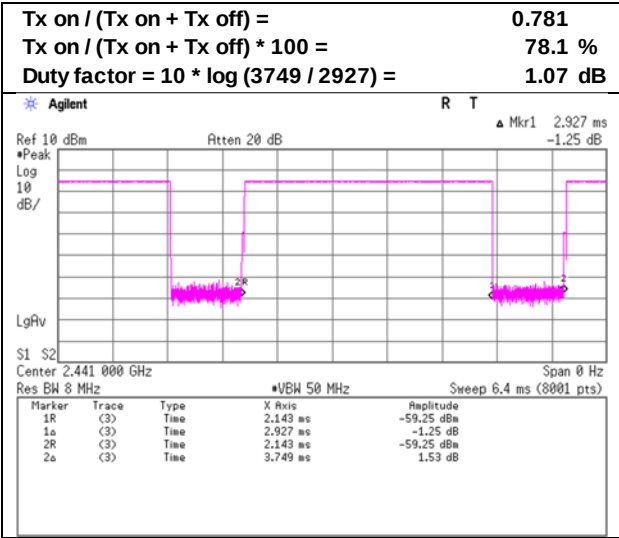
Engineer

Shousei Hamaguchi

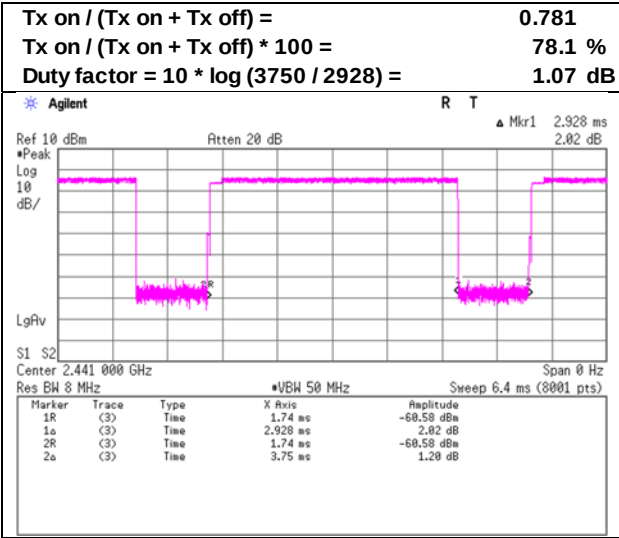
Mode

Tx, Hopping Off

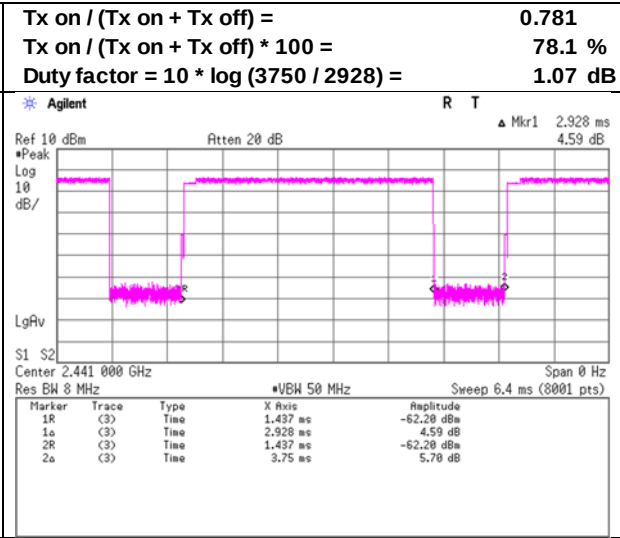
DH5



2DH5



3DH5



Radiated Spurious Emission

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab.
No.2
August 29, 2024
20 deg. C / 57 % RH
Shousei Hamaguchi
(1 GHz to 10 GHz)
Tx, Hopping Off, DH5 2402 MHz

No.2
September 1, 2024
22 deg. C / 71 % RH
Tetsuro Yoshida
(Above 10 GHz)

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.	2390.0	42.1	33.4	27.7	4.5	32.2	1.1	42.0	34.4	73.9	53.9	31.9	19.5	*1)
Hori.	4804.0	40.4	32.3	31.6	6.6	31.2	-	47.3	39.2	73.9	53.9	26.6	14.7	Floor noise
Hori.	7206.0	40.9	33.8	35.6	7.7	32.0	-	52.2	45.1	73.9	53.9	21.7	8.8	Floor noise
Hori.	9608.0	41.4	33.4	35.6	8.3	32.6	-	52.6	44.6	73.9	53.9	21.3	9.3	Floor noise
Vert.	2390.0	41.5	31.6	27.7	4.5	32.2	1.1	41.4	32.5	73.9	53.9	32.5	21.4	*1)
Vert.	4804.0	40.4	32.3	31.6	6.6	31.2	-	47.3	39.2	73.9	53.9	26.6	14.7	Floor noise
Vert.	7206.0	40.9	33.8	35.6	7.7	32.0	-	52.2	45.1	73.9	53.9	21.7	8.8	Floor noise
Vert.	9608.0	41.4	33.4	35.6	8.3	32.6	-	52.6	44.6	73.9	53.9	21.3	9.3	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)

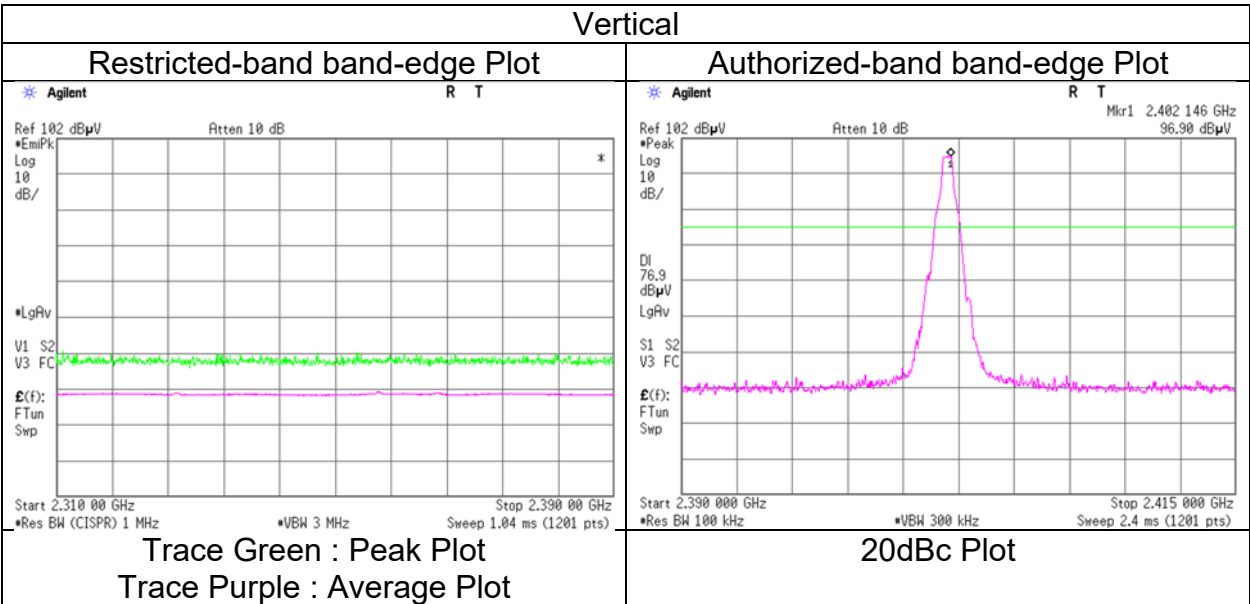
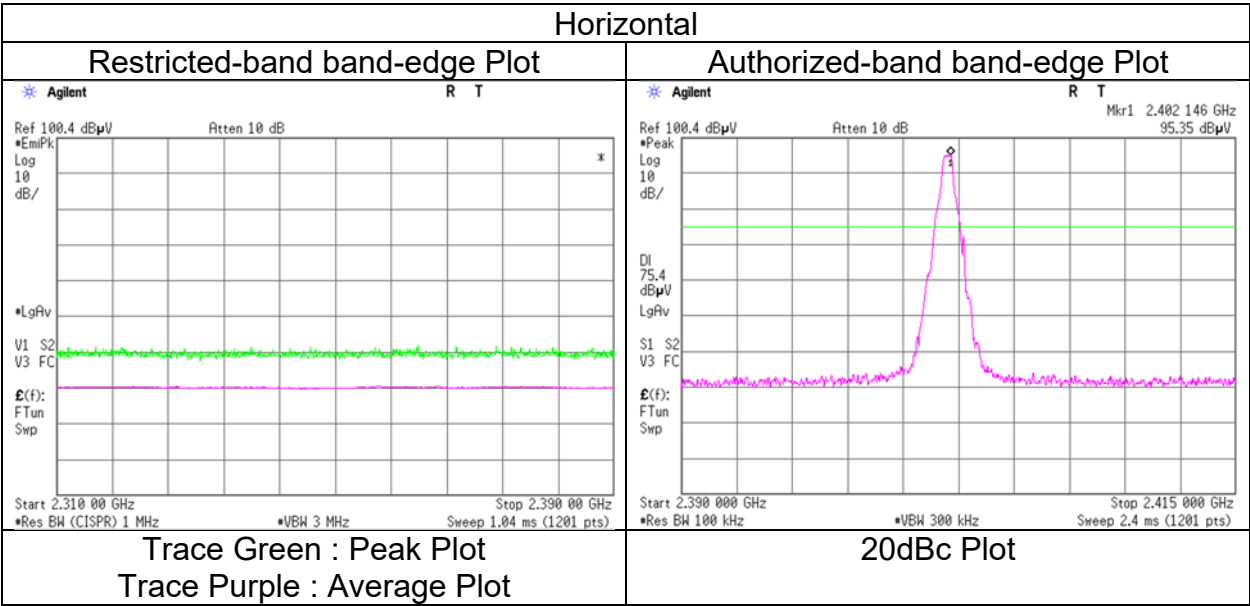
20dBc Data Sheet

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	95.4	27.6	4.5	32.2	95.3	-	-	Carrier
Hori.	2400.0	36.2	27.6	4.5	32.2	36.1	75.3	39.2	
Vert.	2402.0	96.9	27.6	4.5	32.2	96.8	-	-	Carrier
Vert.	2400.0	36.1	27.6	4.5	32.2	36.0	76.8	40.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Distance factor: 1 GHz - 6 GHz 20log (3.55 m / 3.0 m) = 1.47 dB
6 GHz - 10 GHz 20log (3.55 m / 3.0 m) = 1.47 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.2
Date	August 29, 2024
Temperature / Humidity	20 deg. C / 57 % RH
Engineer	Shousei Hamaguchi
	(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 and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	August 29, 2024	September 1, 2024
Temperature / Humidity	20 deg. C / 57 % RH	22 deg. C / 71 % RH
Engineer	Shousei Hamaguchi (1 GHz to 10 GHz)	Tetsuro Yoshida (Above 10 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz	

Polarity	Frequency	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	40.8	32.4	31.6	6.6	31.2	-	47.9	39.5	73.9	53.9	26.0	14.4	Floor noise
Hori.	7323.0	41.4	33.7	35.6	7.7	32.1	-	52.7	44.9	73.9	53.9	21.2	9.0	Floor noise
Hori.	9764.0	41.5	33.3	35.9	8.3	32.7	-	53.1	44.9	73.9	53.9	20.8	9.0	Floor noise
Vert.	4882.0	40.8	32.4	31.6	6.6	31.2	-	47.9	39.5	73.9	53.9	26.0	14.4	Floor noise
Vert.	7323.0	41.4	33.7	35.6	7.7	32.1	-	52.7	44.9	73.9	53.9	21.2	9.0	Floor noise
Vert.	9764.0	41.5	33.3	35.9	8.3	32.7	-	53.1	44.9	73.9	53.9	20.8	9.0	Floor noise

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

$$\text{Result (AV)} = \text{Reading} + \text{Ant Factor} + \text{Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz))} - \text{Gain(Amplifier)} + \text{Duty factor}$$

*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	$20\log(3.55\text{ m} / 3.0\text{ m}) = 1.47\text{ dB}$
	6 GHz - 10 GHz	$20\log(3.55\text{ m} / 3.0\text{ m}) = 1.47\text{ dB}$
	10 GHz - 26.5 GHz	$20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab.
No.2
August 29, 2024
20 deg. C / 57 % RH
Shousei Hamaguchi
(1 GHz to 10 GHz)
Tx, Hopping Off, DH5 2480 MHz

No.2
September 1, 2024
22 deg. C / 71 % RH
Tetsuro Yoshida
(Above 10 GHz)

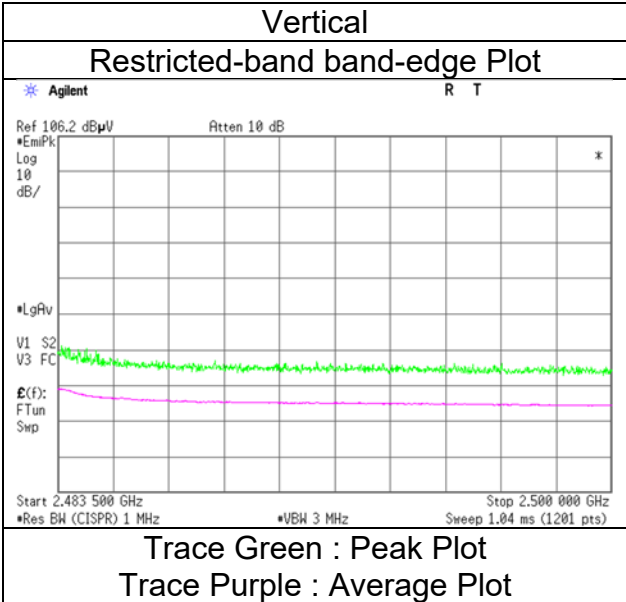
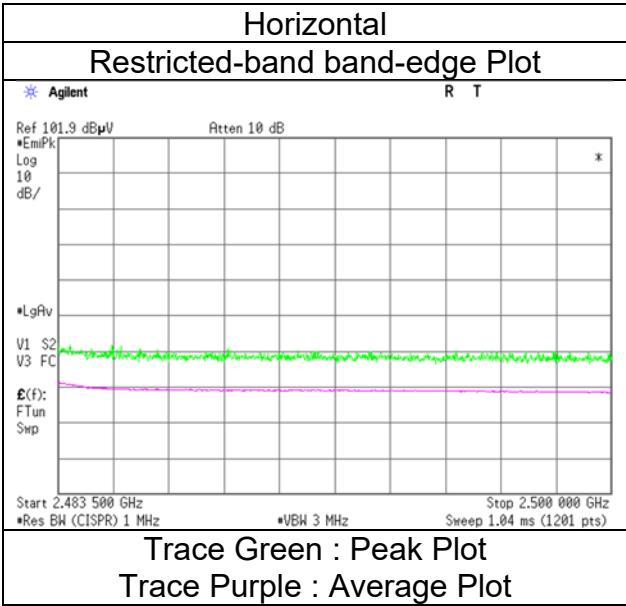
Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	2483.5	44.7	33.3	27.5	4.5	32.2	1.1	44.5	34.2	73.9	53.9	29.4	19.7	*1)
Hori.	4960.0	39.9	32.4	31.7	6.6	31.1	-	47.0	39.6	73.9	53.9	26.9	14.3	Floor noise
Hori.	7440.0	40.8	33.0	35.5	7.7	32.1	-	51.9	44.1	73.9	53.9	22.0	9.8	Floor noise
Hori.	9920.0	41.6	33.5	36.1	8.4	32.8	-	53.3	45.2	73.9	53.9	20.6	8.7	Floor noise
Vert.	2483.5	47.7	34.5	27.5	4.5	32.2	1.1	47.5	35.5	73.9	53.9	26.4	18.4	*1)
Vert.	4960.0	39.9	32.4	31.7	6.6	31.1	-	47.0	39.6	73.9	53.9	26.9	14.3	Floor noise
Vert.	7440.0	40.8	33.0	35.5	7.7	32.1	-	51.9	44.1	73.9	53.9	22.0	9.8	Floor noise
Vert.	9920.0	41.6	33.5	36.1	8.4	32.8	-	53.3	45.2	73.9	53.9	20.6	8.7	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 (3.55 m / 3.0 m) = 1.47 dB
6 GHz - 10 GHz 20log (3.55 m / 3.0 m) = 1.47 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for bandto edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	August 29, 2024
Temperature / Humidity	20 deg. C / 57 % RH
Engineer	Shousei Hamaguchi
	(1 GHz to 10 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz



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

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	August 29, 2024	September 1, 2024
Temperature / Humidity	20 deg. C / 57 % RH	22 deg. C / 71 % RH
Engineer	Shousei Hamaguchi (1 GHz to 10 GHz)	Tetsuro Yoshida (Above 10 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.	2390.0	41.7	32.1	27.7	4.5	32.2	1.1	41.6	33.0	73.9	53.9	32.3	20.9	*1)
Hori.	4804.0	40.4	32.3	31.6	6.6	31.2	-	47.3	39.2	73.9	53.9	26.6	14.7	Floor noise
Hori.	7206.0	40.9	33.8	35.6	7.7	32.0	-	52.2	45.1	73.9	53.9	21.7	8.8	Floor noise
Hori.	9608.0	41.4	33.4	35.6	8.3	32.6	-	52.6	44.6	73.9	53.9	21.3	9.3	Floor noise
Vert.	2390.0	42.3	33.7	27.7	4.5	32.2	1.1	42.2	34.7	73.9	53.9	31.7	19.2	*1)
Vert.	4804.0	40.4	32.3	31.6	6.6	31.2	-	47.3	39.2	73.9	53.9	26.6	14.7	Floor noise
Vert.	7206.0	40.9	33.8	35.6	7.7	32.0	-	52.2	45.1	73.9	53.9	21.7	8.8	Floor noise
Vert.	9608.0	41.4	33.4	35.6	8.3	32.6	-	52.6	44.6	73.9	53.9	21.3	9.3	Floor noise

*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

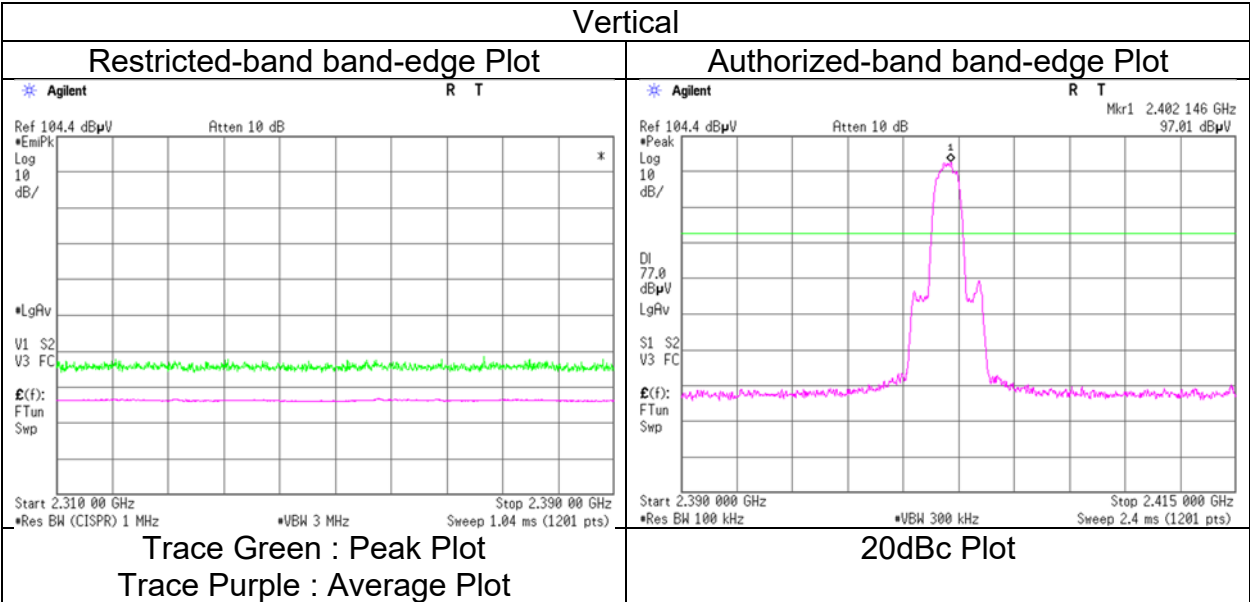
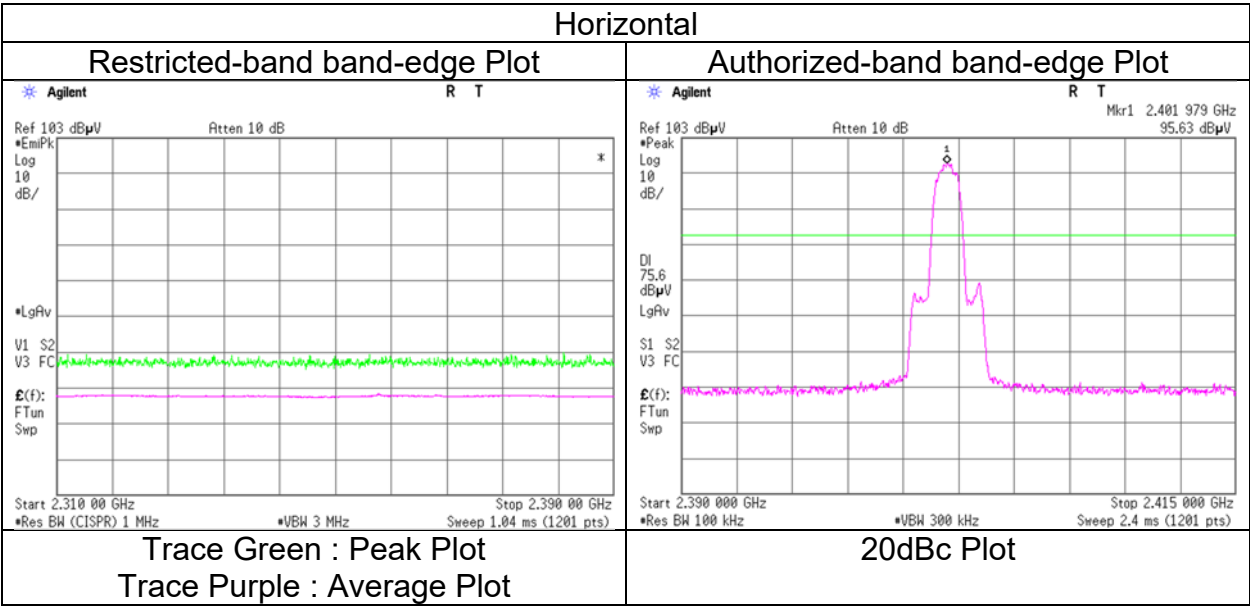
Polarity	Frequency	Reading (PK)	Ant Factor	Loss	Gain	Result	Limit	Margin	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
Hori.	2402.0	95.6	27.6	4.5	32.2	95.5	-	-	Carrier
Hori.	2400.0	36.3	27.6	4.5	32.2	36.2	75.5	39.3	
Vert.	2402.0	97.0	27.6	4.5	32.2	96.9	-	-	Carrier
Vert.	2400.0	38.4	27.6	4.5	32.2	38.3	76.9	38.6	

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

Distance factor:	1 GHz - 6 GHz	$20\log(3.55 \text{ m} / 3.0 \text{ m}) = 1.47 \text{ dB}$
	6 GHz - 10 GHz	$20\log(3.55 \text{ m} / 3.0 \text{ m}) = 1.47 \text{ dB}$
	10 GHz - 26.5 GHz	$20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	August 29, 2024
Temperature / Humidity	20 deg. C / 57 % RH
Engineer	Shousei Hamaguchi
	(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 and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer

Mode

Ise EMC Lab.
No.2
August 29, 2024
20 deg. C / 57 % RH
Shousei Hamaguchi
(1 GHz to 10 GHz)
Tx, Hopping Off, 3DH5 2441 MHz

No.2
September 1, 2024
22 deg. C / 71 % RH
Tetsuro Yoshida
(Above 10 GHz)

No.2
September 2, 2024
22 deg. C / 74 % RH
Tetsuro Yoshida
(Below 1 GHz)

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.	66.0	31.4	-	6.8	7.5	32.2	-	13.5	-	40.0	-	26.6	-	
Hori.	200.0	37.3	-	16.6	8.9	32.1	-	30.7	-	43.5	-	12.8	-	
Hori.	400.0	40.8	-	15.6	10.3	32.0	-	34.8	-	46.0	-	11.2	-	
Hori.	438.7	30.1	-	16.2	10.6	32.0	-	24.8	-	46.0	-	21.2	-	
Hori.	890.1	31.4	-	22.0	12.9	31.0	-	35.2	-	46.0	-	10.8	-	
Hori.	1000.0	33.6	-	22.3	13.4	30.4	-	38.9	-	53.9	-	15.0	-	
Hori.	4882.0	40.8	32.4	31.6	6.6	31.2	-	47.9	39.5	73.9	53.9	26.0	14.4	Floor noise
Hori.	7323.0	41.4	33.7	35.6	7.7	32.1	-	52.7	44.9	73.9	53.9	21.2	9.0	Floor noise
Hori.	9764.0	41.5	33.3	35.9	8.3	32.7	-	53.1	44.9	73.9	53.9	20.8	9.0	Floor noise
Vert.	66.0	34.7	-	6.8	7.5	32.2	-	16.8	-	40.0	-	23.3	-	
Vert.	200.0	36.5	-	16.6	8.9	32.1	-	29.9	-	43.5	-	13.6	-	
Vert.	400.0	43.5	-	15.6	10.3	32.0	-	37.5	-	46.0	-	8.5	-	
Vert.	438.8	34.9	-	16.2	10.6	32.0	-	29.6	-	46.0	-	16.4	-	
Vert.	891.1	22.1	-	22.0	12.9	31.0	-	25.9	-	46.0	-	20.1	-	
Vert.	1000.0	32.0	-	22.3	13.4	30.4	-	37.3	-	53.9	-	16.6	-	
Vert.	4882.0	40.8	32.4	31.6	6.6	31.2	-	47.9	39.5	73.9	53.9	26.0	14.4	Floor noise
Vert.	7323.0	41.4	33.7	35.6	7.7	32.1	-	52.7	44.9	73.9	53.9	21.2	9.0	Floor noise
Vert.	9764.0	41.5	33.3	35.9	8.3	32.7	-	53.1	44.9	73.9	53.9	20.8	9.0	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 (3.55 m / 3.0 m) = 1.47 dB
 6 GHz - 10 GHz 20log (3.55 m / 3.0 m) = 1.47 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.2	No.2
Date	August 29, 2024	September 1, 2024
Temperature / Humidity	20 deg. C / 57 % RH	22 deg. C / 71 % RH
Engineer	Shousei Hamaguchi (1 GHz to 10 GHz)	Tetsuro Yoshida (Above 10 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz	

Polarity	Frequency	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/Vert]	[MHz]													
Hori.	2483.5	46.1	33.3	27.5	4.5	32.2	1.1	46.0	34.2	73.9	53.9	27.9	19.7	*1)
Hori.	4960.0	39.9	32.4	31.7	6.6	31.1	-	47.0	39.6	73.9	53.9	26.9	14.3	Floor noise
Hori.	7440.0	40.8	33.0	35.5	7.7	32.1	-	51.9	44.1	73.9	53.9	22.0	9.8	Floor noise
Hori.	9920.0	41.6	33.5	36.1	8.4	32.8	-	53.3	45.2	73.9	53.9	20.6	8.7	Floor noise
Vert.	2483.5	47.2	34.7	27.5	4.5	32.2	1.1	47.1	35.6	73.9	53.9	26.8	18.3	*1)
Vert.	4960.0	39.9	32.4	31.7	6.6	31.1	-	47.0	39.6	73.9	53.9	26.9	14.3	Floor noise
Vert.	7440.0	40.8	33.0	35.5	7.7	32.1	-	51.9	44.1	73.9	53.9	22.0	9.8	Floor noise
Vert.	9920.0	41.6	33.5	36.1	8.4	32.8	-	53.3	45.2	73.9	53.9	20.6	8.7	Floor noise

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

$$\text{Result (AV)} = \text{Reading} + \text{Ant Factor} + \text{Loss (Cable+Attenuator+Filter+Distance factor (above 1 GHz))} - \text{Gain (Amplifier)} + \text{Duty factor}$$

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

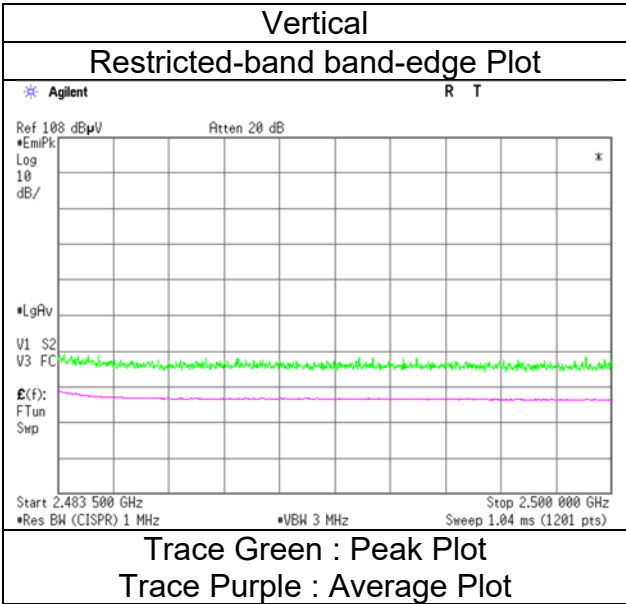
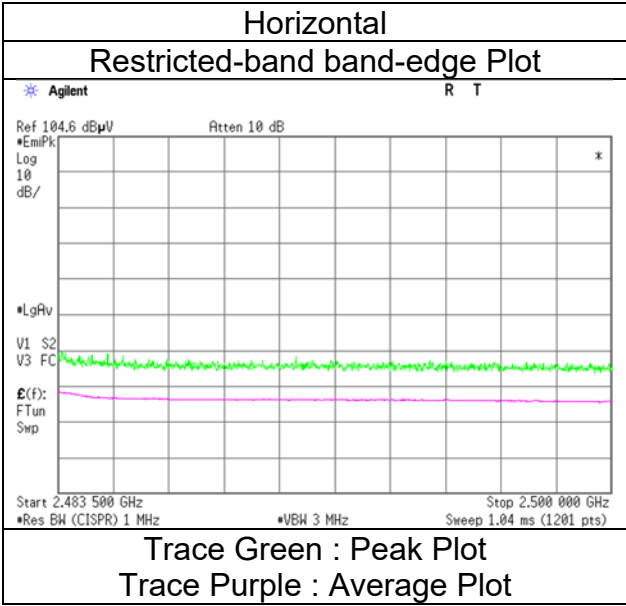
*QP detector was used up to 1GHz.

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

Distance factor:	1 GHz - 6 GHz	$20\log(3.55 \text{ m} / 3.0 \text{ m}) = 1.47 \text{ dB}$
	6 GHz - 10 GHz	$20\log(3.55 \text{ m} / 3.0 \text{ m}) = 1.47 \text{ dB}$
	10 GHz - 26.5 GHz	$20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

Radiated Spurious Emission
(Reference Plot for band-edge)

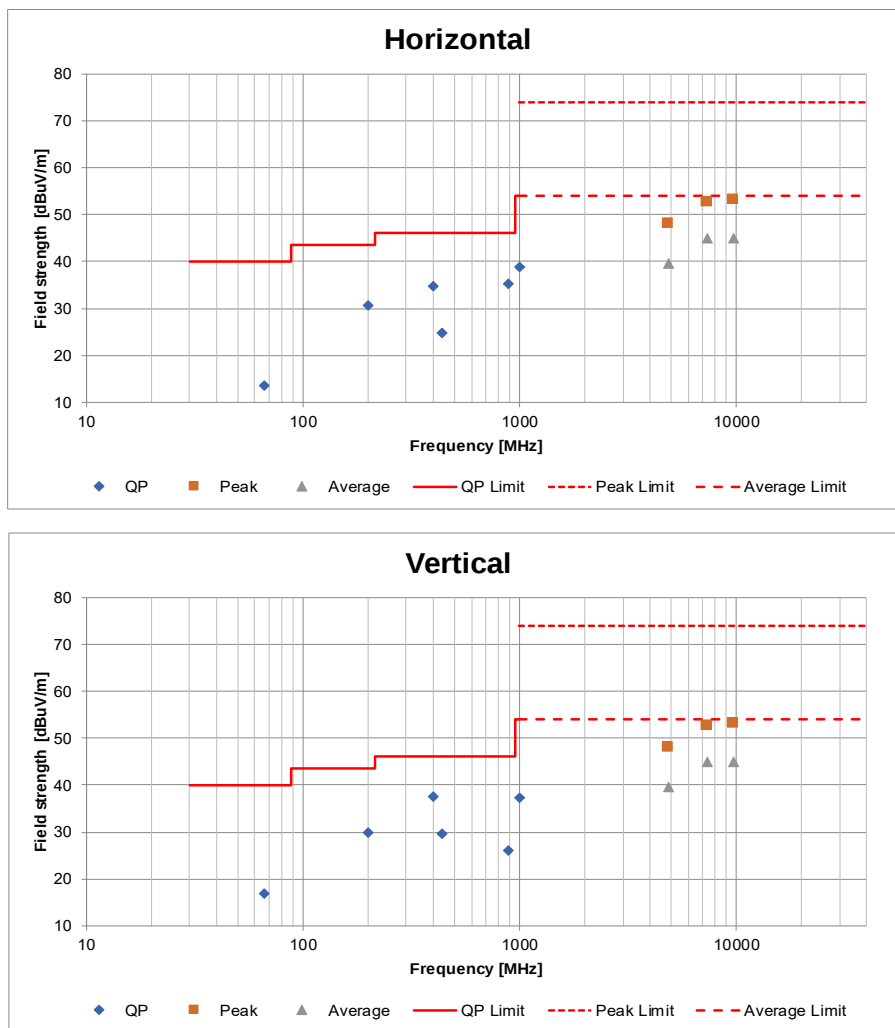
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	August 29, 2024
Temperature / Humidity	20 deg. C / 57 % RH
Engineer	Shousei Hamaguchi
	(1 GHz to 10 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz



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

Radiated Spurious Emission (Plot data, Worst case mode for Maximum Peak Output Power)

Test place	Ise EMC Lab.	No.2	No.2
Semi Anechoic Chamber	No.2	September 1, 2024	September 2, 2024
Date	August 29, 2024	22 deg. C / 71 % RH	22 deg. C / 74 % RH
Temperature / Humidity	20 deg. C / 57 % RH	Tetsuro Yoshida	Tetsuro Yoshida
Engineer	Shousei Hamaguchi	(Above 10 GHz)	(Below 1 GHz)
Mode	(1 GHz to 10 GHz)		
	Tx, Hopping Off, 3DH5 2441 MHz		



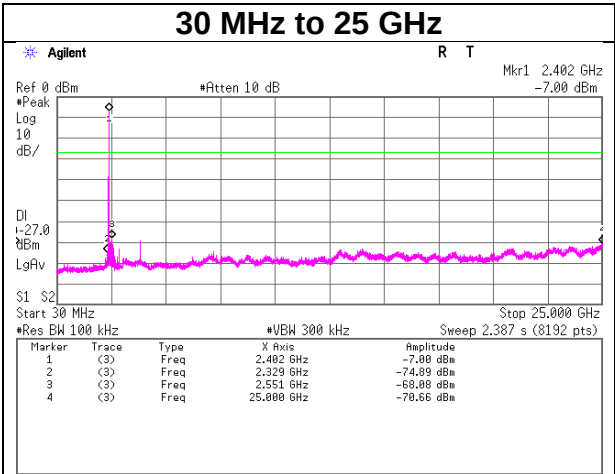
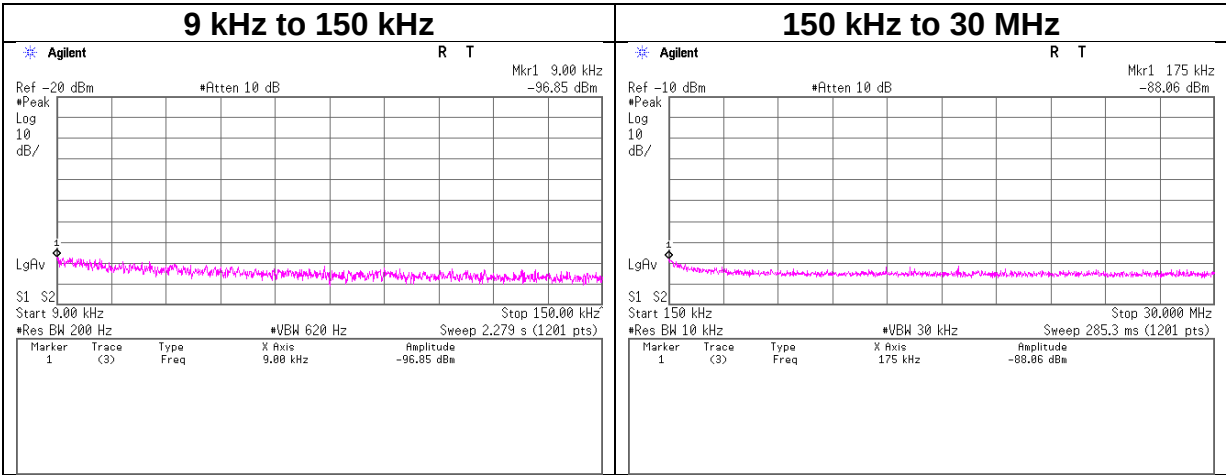
*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.8 Measurement Room
August 28, 2024
23 deg. C / 60 % RH
Shousei Hamaguchi
Tx, Hopping Off, DH5

2402 MHz

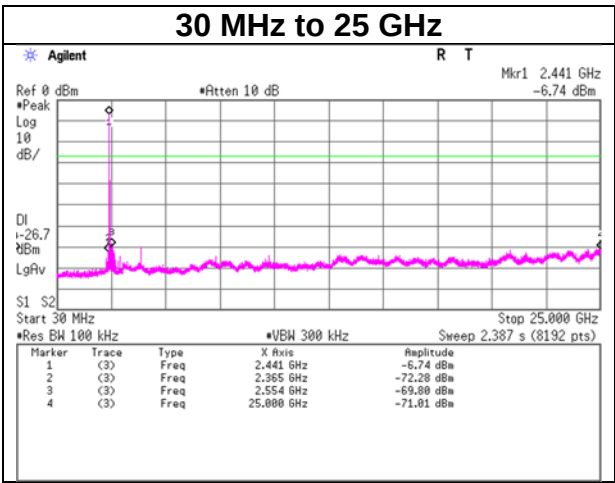
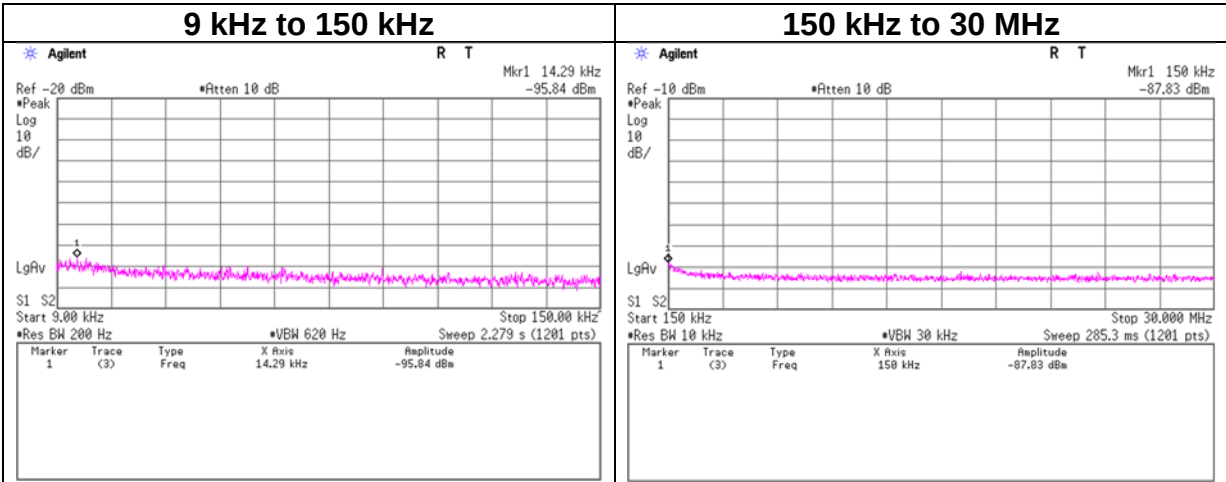


Conducted Spurious Emission

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.8 Measurement Room
August 28, 2024
23 deg. C / 60 % RH
Shousei Hamaguchi
Tx, Hopping Off, DH5

2441 MHz

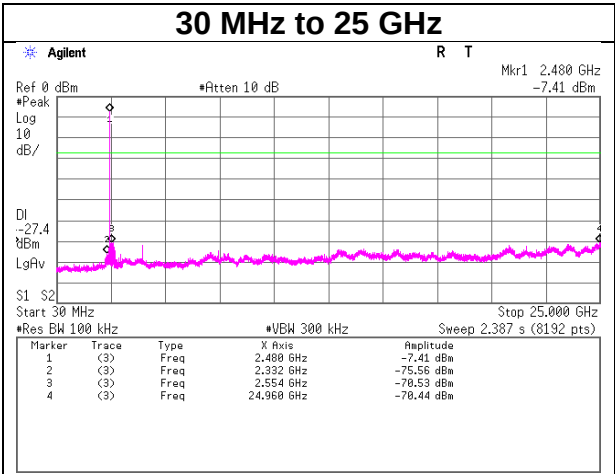
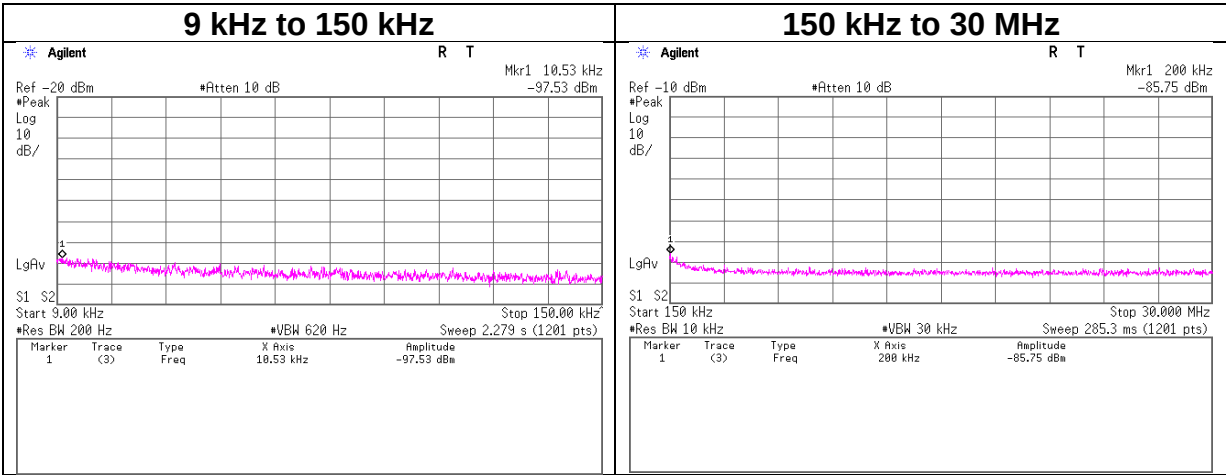


Conducted Spurious Emission

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.8 Measurement Room
August 28, 2024
23 deg. C / 60 % RH
Shousei Hamaguchi
Tx, Hopping Off, DH5

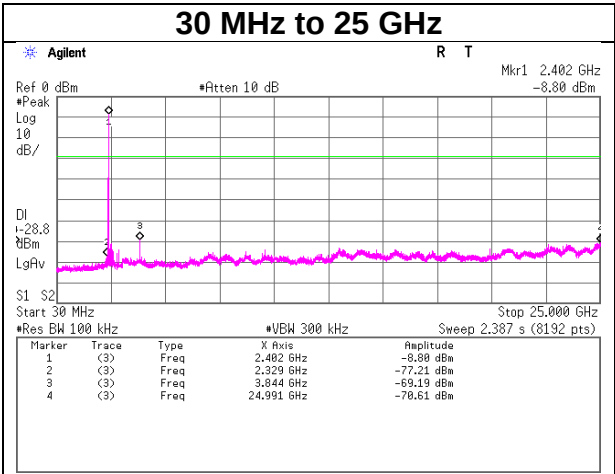
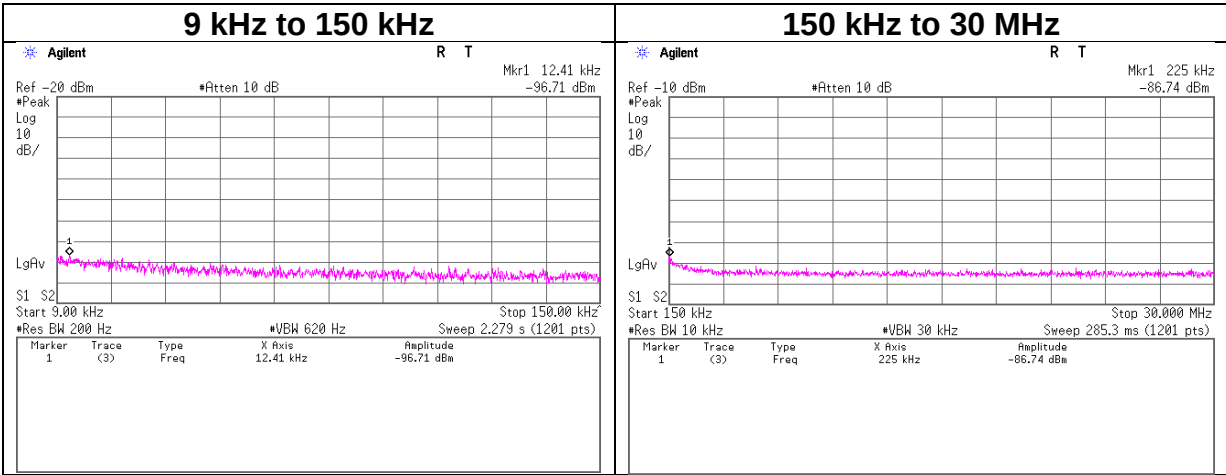
2480 MHz



Conducted Spurious Emission

Test place Ise EMC Lab. No.8 Measurement Room
Date August 28, 2024
Temperature / Humidity 23 deg. C / 60 % RH
Engineer Shousei Hamaguchi
Mode Tx, Hopping Off, 3DH5

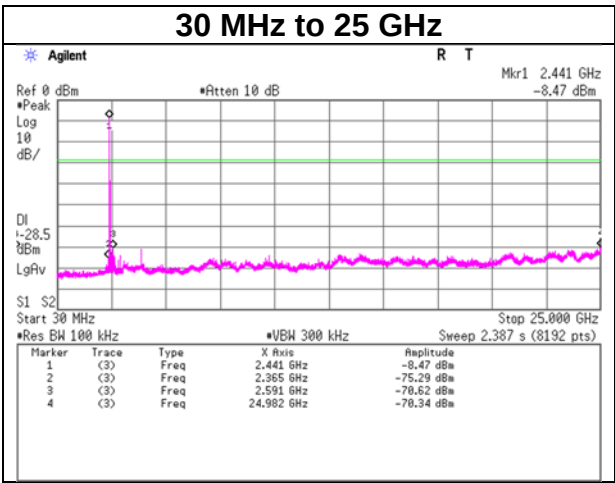
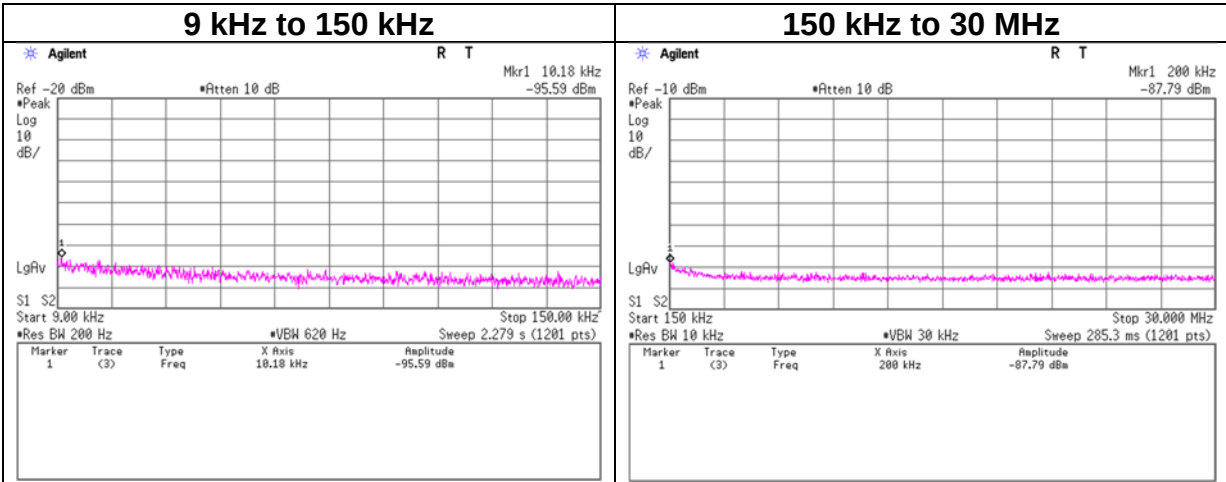
2402 MHz



Conducted Spurious Emission

Test place Ise EMC Lab. No.8 Measurement Room
Date August 28, 2024
Temperature / Humidity 23 deg. C / 60 % RH
Engineer Shousei Hamaguchi
Mode Tx, Hopping Off, 3DH5

2441 MHz

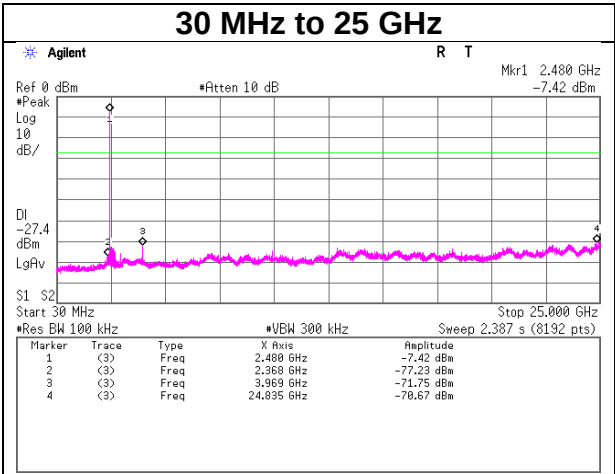
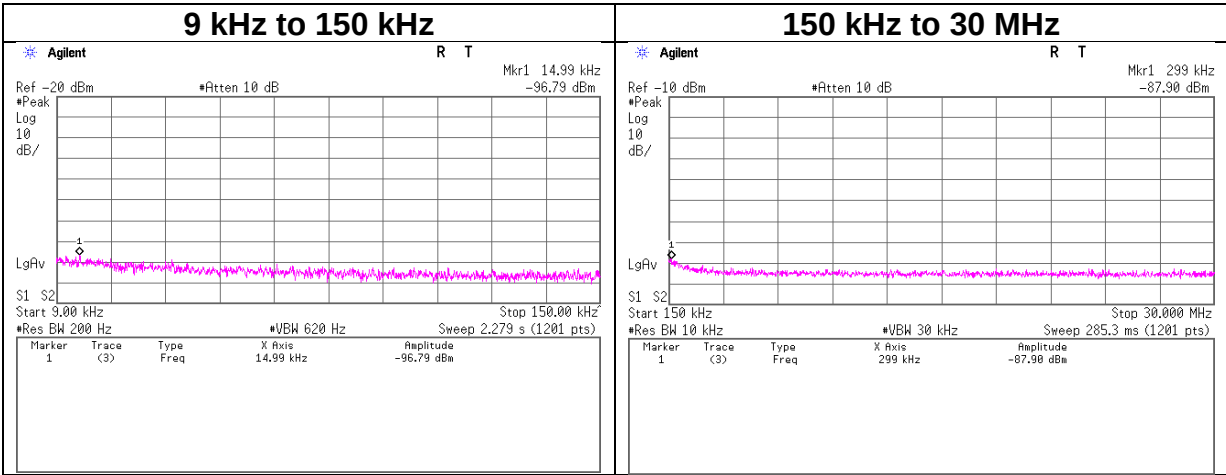


Conducted Spurious Emission

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.8 Measurement Room
August 28, 2024
23 deg. C / 60 % RH
Shousei Hamaguchi
Tx, Hopping Off, 3DH5

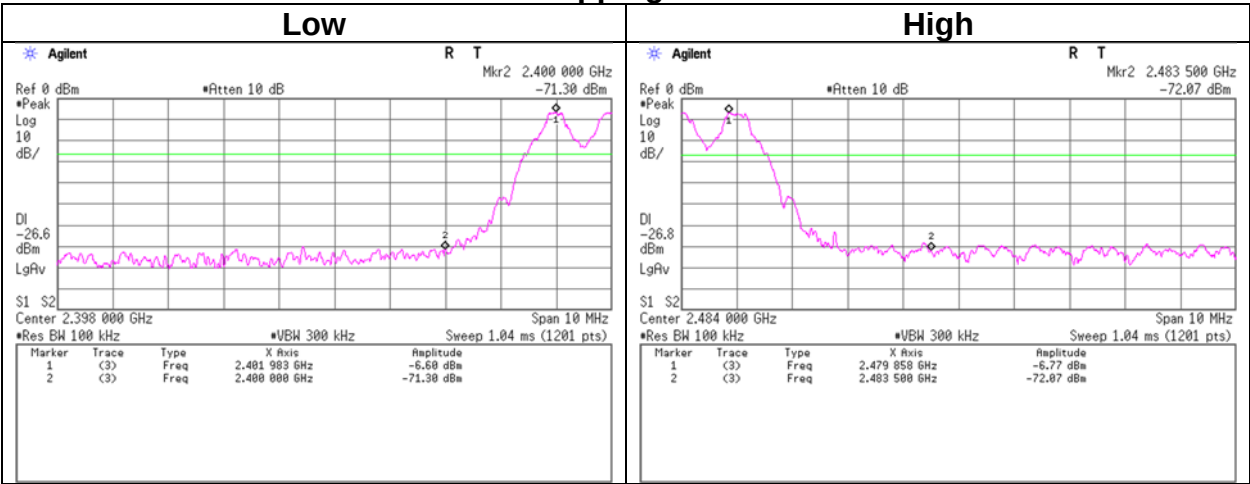
2480 MHz



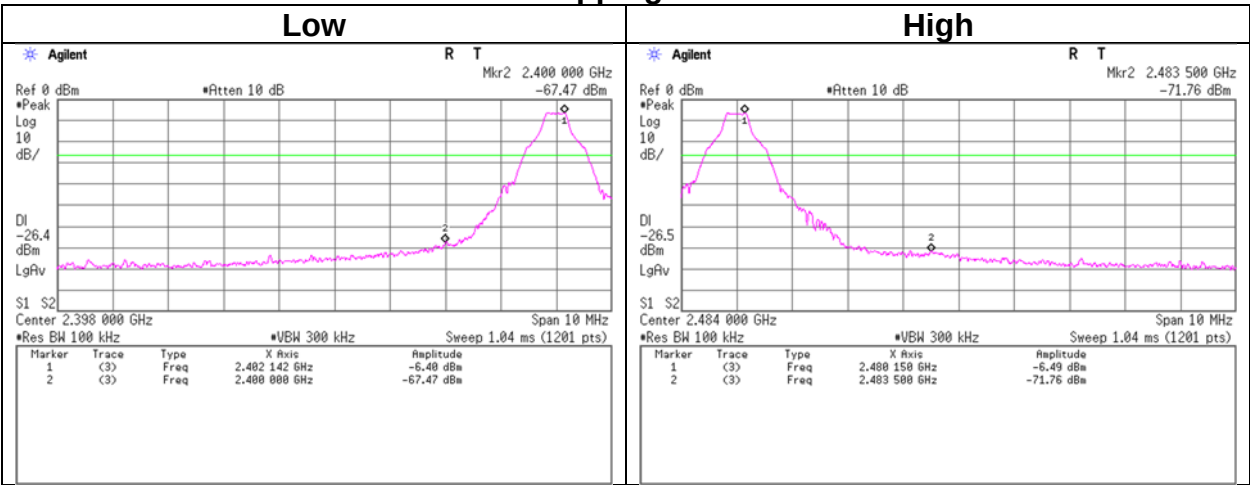
Conducted Emission Band Edge compliance

Test place Ise EMC Lab. No.8 Measurement Room
Date August 28, 2024
Temperature / Humidity 23 deg. C / 60 % RH
Engineer Shousei Hamaguchi
Mode Tx DH5

Hopping On



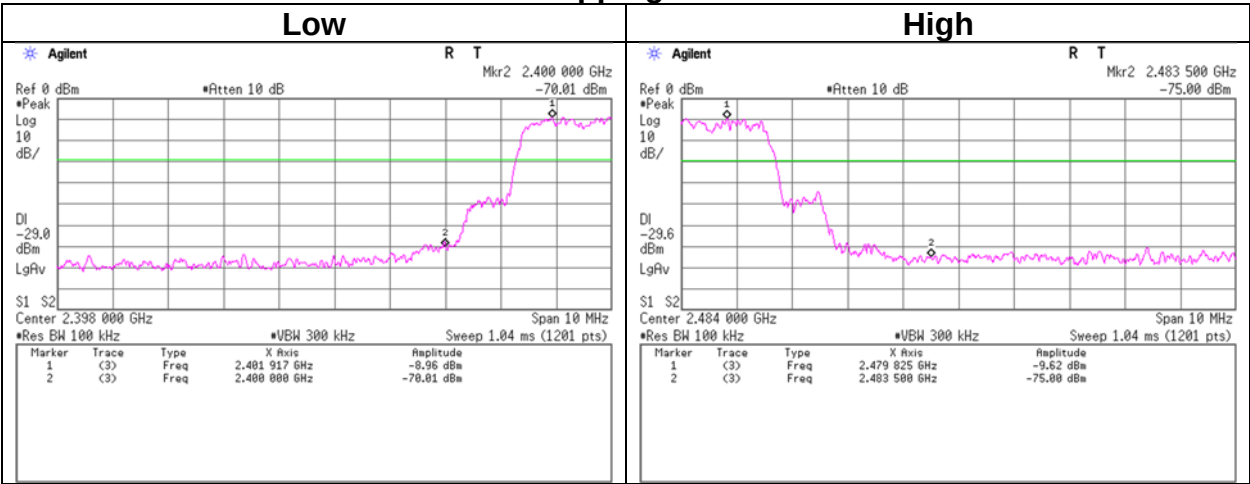
Hopping Off



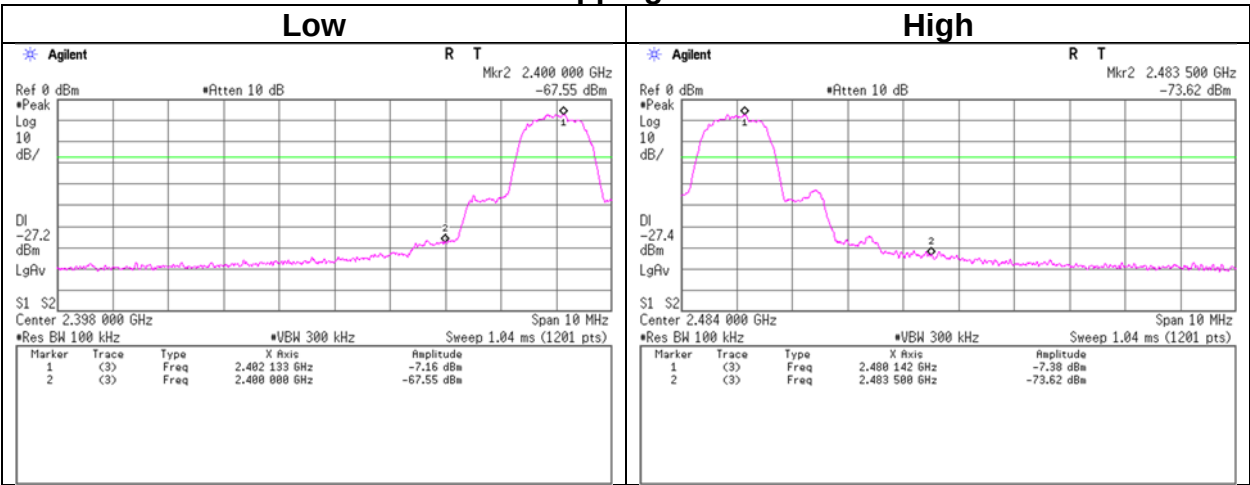
Conducted Emission Band Edge compliance

Test place Ise EMC Lab. No.8 Measurement Room
Date August 28, 2024
Temperature / Humidity 23 deg. C / 60 % RH
Engineer Shousei Hamaguchi
Mode Tx 3DH5

Hopping On



Hopping Off



APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/04/2023	12
RE	141323	Coaxial cable	UL Japan	-	-	09/10/2023	12
RE	141424	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103 +BBA9106	1915	03/15/2024	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/17/2023	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	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/06/2024	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	141902	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187105	05/30/2024	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	06/05/2024	12
RE	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/17/2023	24
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	12/11/2023	24
RE	142183	Measure	KOMELON	KMC-36	-	10/20/2023	12
RE	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
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	242170	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	00728	11/29/2023	12
RE	244707	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202102	01/25/2024	12
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
AT	141244	Attenuator(10dB)	Weinschel - API Technologies Corp	WA8-10-34	A198	02/17/2024	12
AT	141327	Coaxial Cable	UL Japan	-	-	02/09/2024	12
AT	141334	Attenuator(10dB)	Suhner	6810.19.A	-	12/12/2023	12
AT	141414	Microwave Cable	Junkosha	MWX221	1207S407	07/06/2024	12
AT	141557	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	070900530	01/31/2024	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	141885	Spectrum Analyzer	Keysight Technologies Inc	E4448A	US44300523	11/29/2023	12
AT	244711	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202105	01/25/2024	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

RE: Radiated Emission