

RADIO TEST REPORT

Test Report No. 14854382S-AC-R1

Customer	Murata Manufacturing Co., Ltd.
Description of EUT	Communication Module
Model Number of EUT	2CX
FCC ID	VPYLBEE5QG2CX
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	September 19, 2024
Remarks	Bluetooth (BR / EDR) parts

Representative Test Engineer



Kenichi Adachi
Engineer

Approved By



Kazutaka Takeyama
Leader



CERTIFICATE 1266.03

- ☐ 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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It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
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- The information provided by the customer for this report is identified in SECTION 1.
- The laboratory is not responsible for information provided by the customer which can impact the validity of the results.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 14854382S-AC

This report is a revised version of 14854382S-AC. 14854382S-AC is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents																																																																																				
- (Original)	14854382S-AC	August 27, 2024	-																																																																																				
1	14854382S-AC-R1	September 19, 2024	Clause 2.2 Corrected transmission patterns from; <table><tr><th>Port</th><th>Mode</th><th>Config 1</th><th>Config 2</th><th>Config 3</th><th>Config 5</th><th>Config 6</th></tr><tr><td>2G_CH0</td><td>Bluetooth</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit *1)</td><td>Transmit</td></tr><tr><td>5G_CH0</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit *1)</td><td>Transmit</td></tr><tr><td>5G_CH0</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>Transmit</td><td>-</td><td>-</td></tr><tr><td>2G_CH1</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>-</td><td>Transmit *1)</td><td>-</td></tr><tr><td>5G_CH1</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>Transmit</td><td>-</td><td>-</td></tr></table> to; <table><tr><th>Port</th><th>Mode</th><th>Config 1</th><th>Config 2</th><th>Config 3</th><th>Config 4</th><th>Config 5</th></tr><tr><td>2G_CH0</td><td>Bluetooth</td><td>-</td><td>Transmit</td><td>Transmit</td><td>Transmit</td><td>Transmit *1)</td></tr><tr><td>5G_CH0</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit *1)</td></tr><tr><td>5G_CH0</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit</td><td>-</td></tr><tr><td>2G_CH1</td><td>2.4 GHz</td><td>-</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit *1)</td></tr><tr><td>5G_CH1</td><td>5 GHz / 6 GHz</td><td>Transmit</td><td>-</td><td>-</td><td>Transmit</td><td>-</td></tr></table> Clause 3.2 <u>Spurious Emission & Band Edge Compliance</u> Corrected from “2042 MHz” to “2402 MHz”. <u>FCC Part 15.31 (e)</u> Deleted “regardless of input voltage”. <u>FCC Part 15.203 Antenna requirement</u> Corrected from; “The EUT has a unique coupling/antenna connector (U.FL).” to; “The EUT has an external antenna connector, but it is installed inside the end product by the professionals.”	Port	Mode	Config 1	Config 2	Config 3	Config 5	Config 6	2G_CH0	Bluetooth	-	Transmit	Transmit	Transmit *1)	Transmit	5G_CH0	2.4 GHz	-	Transmit	Transmit	Transmit *1)	Transmit	5G_CH0	5 GHz / 6 GHz	Transmit	-	Transmit	-	-	2G_CH1	2.4 GHz	-	Transmit	-	Transmit *1)	-	5G_CH1	5 GHz / 6 GHz	Transmit	-	Transmit	-	-	Port	Mode	Config 1	Config 2	Config 3	Config 4	Config 5	2G_CH0	Bluetooth	-	Transmit	Transmit	Transmit	Transmit *1)	5G_CH0	2.4 GHz	-	Transmit	-	-	Transmit *1)	5G_CH0	5 GHz / 6 GHz	Transmit	-	-	Transmit	-	2G_CH1	2.4 GHz	-	Transmit	-	-	Transmit *1)	5G_CH1	5 GHz / 6 GHz	Transmit	-	-	Transmit	-
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Revision	Test Report No.	Date	Page Revised Contents
			Appendix 1 (Test Data) <u>Carrier Frequency Separation</u> Corrected plot data of 3DH5 (2402 MHz / 2480 MHz).
			<u>Radiated Emission</u> Corrected title of DH5 2480 MHz from; (Reference Plot for bandto edge) to; (Reference Plot for band-edge)
			Appendix 2 (Test equipment) Deleted *1) and the following note: "The expiration*1) This test equipment was used for the tests before the expiration date of the calibration."

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
APD	Absorbed Power Density	LIMS	Laboratory Information Management System
ASK	Amplitude Shift Keying	MCS	Modulation and Coding Scheme
Atten., ATT	Attenuator	MRA	Mutual Recognition Arrangement
AV	Average	N/A	Not Applicable
BPSK	Binary Phase-Shift Keying	NIST	National Institute of Standards and Technology
BR	Bluetooth Basic Rate	NS	No signal detect.
BT	Bluetooth	NSA	Normalized Site Attenuation
BT LE	Bluetooth Low Energy	NVLAP	National Voluntary Laboratory Accreditation Program
BW	BandWidth	OBW	Occupied Band Width
Cal Int	Calibration Interval	OFDM	Orthogonal Frequency Division Multiplexing
CCK	Complementary Code Keying	OFDMA	Orthogonal Frequency Division Multiple Access
Ch., CH	Channel	P/M	Power meter
CISPR	Comite International Special des Perturbations Radioelectriques	PCB	Printed Circuit Board
CW	Continuous Wave	PER	Packet Error Rate
DBPSK	Differential BPSK	PHY	Physical Layer
DC	Direct Current	PK	Peak
D-factor	Distance factor	PN	Pseudo random Noise
DFS	Dynamic Frequency Selection	PP	Preamble Puncturing
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SAR	Specific Absorption Rate
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
HPF	High-Pass Filter	WLAN	Wireless LAN
ICES	Interference-Causing Equipment Standard	WPT	Wireless Power Transmit

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SECTION 1: Customer Information

Company Name	Murata Manufacturing Co., Ltd.
Address	1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Telephone Number	+81-50-1737-2801
Contact Person	Kenji Hayashikoshi

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	Communication Module
Model Number	2CX
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	June 16, 2023
Test Date	September 7, 2023 to July 1, 2024

2.2 Product Description

General Specification

Rating	VPH_PA_2G_CH0 : 3.85 V (typical) (3.00 V to 4.60 V)
	VPH_PA_2G_CH1 : 3.85 V (typical) (3.00 V to 4.60 V)
	VPH_PA_5G_CH0 : 3.85 V (typical) (3.00 V to 4.60 V)
	VPH_PA_5G_CH1 : 3.85 V (typical) (3.00 V to 4.60 V)
	VDD18_DIG_IO : 1.80 V (typical) (1.71 V to 2.10 V)
	AON_RFACMN_LDO_IN : 0.95 V (typical) (0.90 V to 2.10 V)
	WLCX_BT_LDO_IN / WLMX_LDO_IN : 0.95 V (typical) (0.90 V to 2.10 V)
	RFA0P8_LDO_IN : 0.95 V (typical) (0.90 V to 2.10 V)
	RFA12_LDO_IN : 1.35 V (typical) (1.30 V to 2.10 V)
	RFA17_LDO_IN : 1.90 V (typical) (1.85 V to 2.10 V)
	PCIE0P92_LDO_IN : 1.35 V (typical) (1.28 V to 2.10 V)
	PCIE18_LDO_IN : 1.90 V (typical) (1.85 V to 2.10 V)
Operating temperature	-30 deg. C to +85 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 (BR/EDR/BTLE)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS, GFSK / $\pi/4$ -DQPSK, 8DPSK / GFSK
Antenna Type	Monopole Antenna
Antenna Gain ^{a)}	2G_CH0: -0.23 dBi

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

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	CCK, DSSS, OFDM
	OFDMA: (20 MHz band): 26/52/106/242-tone RU
Antenna Type	Monopole Antenna, Slot antenna
Antenna Gain ^{a)}	2G_CH0: -0.23 dBi (monopole antenna) 2G_CH1: +1.60 dBi (monopole antenna) +1.65 dBi (slot antenna)

WLAN (IEEE802.11a/11n-20/11ac-20/11ax-20/11n-40/11ac-40/11ax-40/11ac-80/11ax-80/11ax-160)

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band:	5180 MHz to 5240 MHz 5260 MHz to 5320 MHz 5500 MHz to 5720 MHz 5745 MHz to 5825 MHz 5955 MHz to 6415 MHz 6435 MHz to 6515 MHz 6535 MHz to 6875 MHz (*6875 MHz:straddle ch) 6895 MHz to 7095 MHz
	40 MHz Band	5190 MHz to 5230 MHz 5270 MHz to 5310 MHz 5510 MHz to 5710 MHz 5755 MHz to 5795 MHz 5965 MHz to 6405 MHz 6445 MHz to 6525 MHz (*6525 MHz:straddle ch) 6565 MHz to 6885 MHz (*6885 MHz:straddle ch) 6925 MHz to 7085 MHz
	80 MHz band	5210 MHz 5290 MHz 5530 MHz to 5690 MHz 5775 MHz 5985 MHz to 6385 MHz 6465 MHz to 6545 MHz (*6545 MHz:straddle ch) 6625 MHz to 6865 MHz (*6865 MHz:straddle ch) 6945 MHz to 7025 MHz
	160 MHz band	5250 MHz 5570 MHz 6025 MHz to 6345 MHz 6505 MHz (*6505 MHz:straddle ch) 6665 MHz to 6825 MHz (*6825 MHz:straddle ch) 6985 MHz
Type of Modulation	OFDM	
	OFDMA (IEEE802.11ax only)	(20 MHz band): 26/52/106/242-tone RU
		(40 MHz band): 26/52/106/242/484-tone RU
		(80 MHz band): 26/52/106/242/484/996-tone RU
		(160 MHz band): 26/52/106/242/484/996/2x996-tone RU
Antenna Type	Monopole Antenna, Slot antenna	
Antenna Gain ^{a)}	U-NII-1, -2A, -2C, -3, 5180 MHz to 5825 MHz	5G_CH0: +0.51 dBi (monopole antenna) 5G_CH1: +0.57 dBi (monopole antenna) +1.13 dBi (slot antenna)
	U-NII-5, -6, -7, -8, 5955 MHz to 7095 MHz	5G_CH0: -1.36 dBi (monopole antenna) 5G_CH1: -1.25 dBi (monopole antenna) -1.14 dBi (slot antenna)

Transmission patterns

Port	Mode	Config.1	Config.2	Config.3	Config.4	Config.5
2G_CH0	Bluetooth	-	-	Transmit	Transmit	Transmit *1)
5G_CH0	2.4 GHz	-	Transmit	-	-	Transmit *1)
5G_CH0	5 GHz / 6 GHz	Transmit	-	-	Transmit	-
2G_CH1	2.4 GHz	-	Transmit	-	-	Transmit *1)
5G_CH1	5 GHz / 6 GHz	Transmit	-	-	Transmit	-

*1) WLAN and Bluetooth do not transmit simultaneously.

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	18.7 dB 0.416640 MHz, QP, N 0.416640 MHz, QP, L1 Mode: TX, 3DH5 2402 MHz	Complied	-
Carrier Frequency Separation	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section15.247(a)(1) ISED: RSS-247 5.1 (b)	See data.	Complied	Conducted
20 dB 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	3.6 dB 4804.000 MHz, AV, Vert., Mode: TX, Hopping Off, 3DH5 2402 MHz	Complied	Conducted/ Radiated (above 30 MHz) *1)
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred. *1) Radiated test was selected over 30 MHz based on section 15.247(d).					

FCC Part 15.31 (e)

The module is constantly provided with the stable voltage from the host device. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The EUT has an external antenna connector, but it is installed inside the end product by the professionals. Therefore the equipment complies with the requirement of 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 $k = 2$.

Item	Frequency range	Uncertainty (+/-)
Conducted Emission (AC Mains) LISN	150 kHz to 30 MHz	3.2 dB
Radiated Emission (Measurement distance: 3 m)	9 kHz to 30 MHz	3.3 dB
	30 MHz to 200 MHz	4.9 dB
	200 MHz to 1 GHz	6.2 dB
	1 GHz to 6 GHz	4.7 dB
	6 GHz to 18 GHz	5.3 dB
	18 GHz to 40 GHz	5.5 dB
Radiated Emission (Measurement distance: 1 m)	1 GHz to 18 GHz	5.6 dB
	18 GHz to 40 GHz	5.8 dB

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)	1.3 dB
Power Measurement above 1 GHz (Peak Detector)	1.8 dB
Spurious Emission (Conducted) below 1 GHz	0.91 dB
Conducted Emissions Power Density Measurement 1 GHz to 3 GHz	1.3 dB
Conducted Emissions Power Density Measurement 3 GHz to 18 GHz	2.5 dB
Spurious Emission (Conducted) 18 GHz to 26.5 GHz	2.8 dB
Spurious Emission (Conducted) 26.5 GHz to 40 GHz	2.6 dB
Bandwidth Measurement	0.012 %
Duty Cycle and Time Measurement	0.27 %
Temperature	2.2 deg.C.
Humidity	4.0 %
Voltage	0.74 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.

1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 Japan

Telephone: +81-463-50-6400

A2LA Certificate Number: 1266.03

(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test room	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber (SAC1)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber (SAC2)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber (SAC3)	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber (SAC4)	8.1 x 5.1 x 3.55	8.1 x 5.1	-
Wireless anechoic chamber 1 (WAC1)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
Wireless anechoic chamber 2 (WAC2)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
No.1 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 Shielded room	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	2.55 x 4.1 x 2.5	-	-
No.2 Measurement room	4.5 x 3.5 x 2.5	-	-
Wireless shielded room 1	3.0 x 4.5 x 2.7	3.0 x 4.5	-
Wireless shielded room 2	3.0 x 4.5 x 2.7	3.0 x 4.5	-

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)

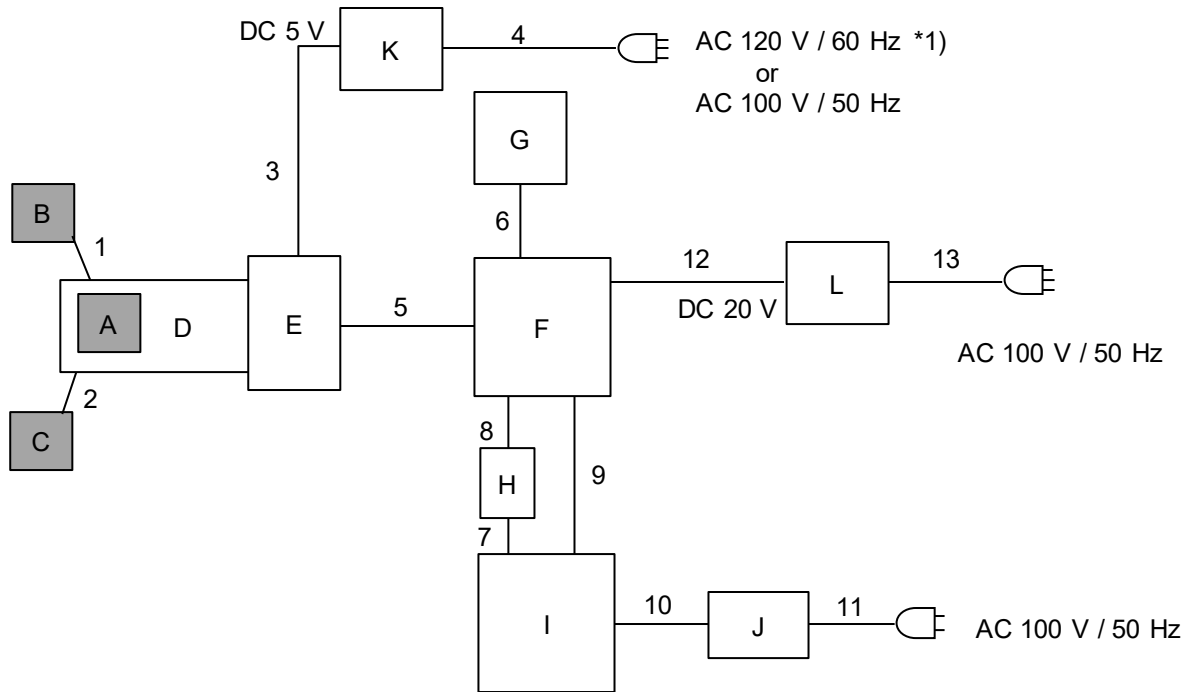
Mode	Remarks*
Bluetooth (BT)	BR / EDR, Payload: PRBS9
*EUT has the power settings by the software as follows; Power Setting: DH5: 10, 3DH5: 10.6 Software: QSPR Version 5.0-00202 (Date: 2021.12.1, Storage location: Driven by connected PC) *This setting of software is the worst case. Any conditions under 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	Off	2402 MHz 2441 MHz 2480 MHz
20 dB 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
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

<For Conducted Emission and Radiated Emission Tests>



*1) For Conducted Emission test.

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

Description of EUT and Support Equipment

No.	Item	Model Number	Serial Number	Manufacturer	Remarks
A	Communication Module	2CX	A-1 *1) A-2	Murata	EUT
B	Antenna (monopole)	chain0_monopole_2.4GHz	#12	SONY	EUT
C	Antenna (monopole)	chain1_monopole_2.4GHz	#8	SONY	EUT *2)
D	Jig Board	P2ML10932	A-2	Murata	-
E	LDO Board	P2ML8516	A-2	Murata	-
F	Mini PC	Brix	A-2	GIGABYTE	-
G	SSD	SSD370S	C78637-2668	Transcend	-
H	Ethernet-USB Adaptor	ETG5-US3	BC500102349C	I/O DATA	-
I	Laptop PC	HQAMB407	2F4A7B36-42D1-4E7B-9A50-E92517A62729	Dynabook Inc.	-
J	AC Adaptor	PA5177U-1ACA	K80611667CGD	Dynabook Inc.	-
K	DC Power supply	PAN35-10A	CY003459	Kikusui Electronics Corp.	-
L	DC Power supply	PAN35-10A	CY002947	Kikusui Electronics Corp.	-

*1) Used for Conducted Emission test.

*2) Not used for Bluetooth transmission/reception.

List of Cables Used

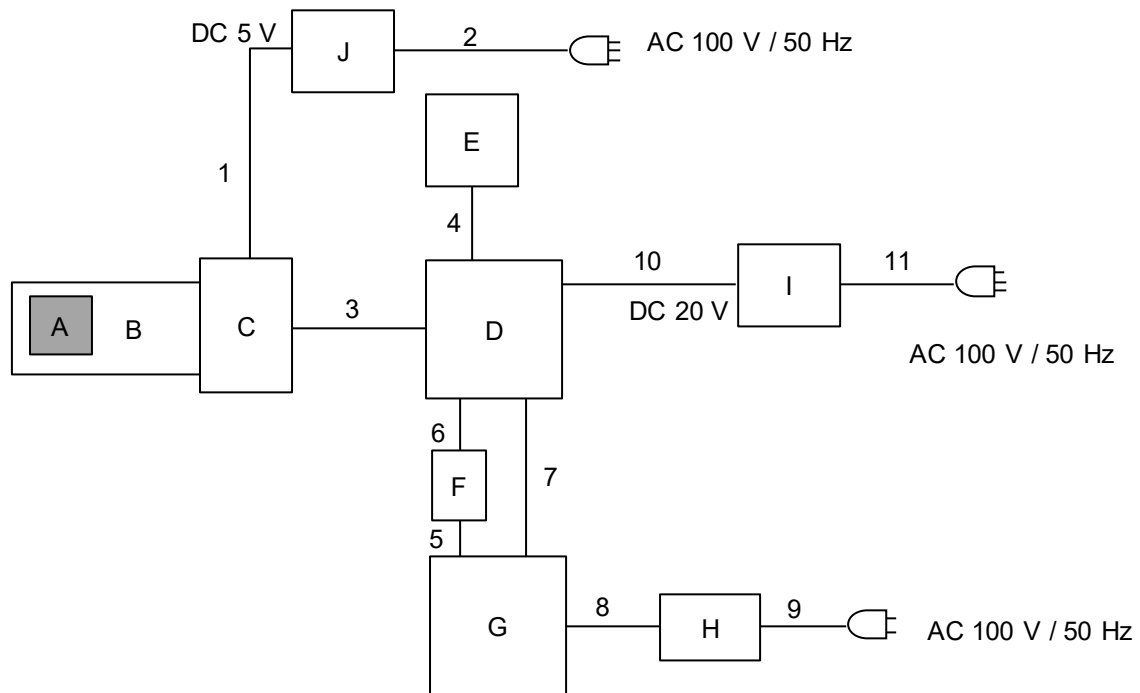
No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna	0.1	Shielded	Shielded	-
2	Antenna	0.1	Shielded	Shielded	-
3	DC	1.7	Unshielded	Unshielded	-
4	AC	2.8	Unshielded	Unshielded	-
5	Signal	1.0 *1) *3) 0.15 *2)	Unshielded	Unshielded	-
6	Signal	0.1	Shielded	Shielded	-
7	USB	0.06	Shielded	Shielded	-
8	Ether	2.0	Unshielded	Unshielded	-
9	USB	0.5 *1) 2.5 *2) *3)	Shielded	Shielded	-
10	DC	0.4	Unshielded	Unshielded	-
11	AC	1.7	Unshielded	Unshielded	-
12	DC	1.0 *1) *3) 2.5 *2)	Unshielded	Unshielded	-
13	AC	2.8	Unshielded	Unshielded	-

*1) Used for Radiated Emission test for Above 1 GHz.

*2) Used for Radiated Emission test for Below 1 GHz.

*3) Used for Conducted Emission test.

<For Antenna Terminal Conducted Test>



Description of EUT and Support Equipment

No.	Item	Model Number	Serial Number	Manufacturer	Remarks
A	Communication Module	2CX	A-1	Murata	EUT
B	Jig Board	P2ML10932	A-1	Murata	-
C	LDO Board	P2ML8516	A-1	Murata	-
D	Mini PC	Brix	A-1	GIGABYTE	-
E	SSD	SSD370S	C78637-2668	Transcend	-
F	Ethernet-USB Adaptor	ETG5-US3	BC500102349C	I/O DATA	-
G	Laptop PC	HQAMB407	2F4A7B36-42D1-4E7B-9A50-E92517A62729	Dynabook Inc.	-
H	AC Adaptor	PA5177U-1ACA	K80611667CGD	Dynabook Inc.	-
I	DC Power supply	PWR800M	QJ003485	Kikusui Electronics Corp.	-
J	DC power supply	PW8-5ADPS	14086035	TEXIO	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	1.7	Unshielded	Unshielded	-
2	AC	2.8	Unshielded	Unshielded	-
3	Signal	0.15	Unshielded	Unshielded	-
4	Signal	0.1	Shielded	Shielded	-
5	USB	0.06	Shielded	Shielded	-
6	Ether	1.0	Unshielded	Unshielded	-
7	USB	0.5	Shielded	Shielded	-
8	DC	0.4	Unshielded	Unshielded	-
9	AC	1.7	Unshielded	Unshielded	-
10	DC	1.0	Unshielded	Unshielded	-
11	AC	2.8	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.

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.

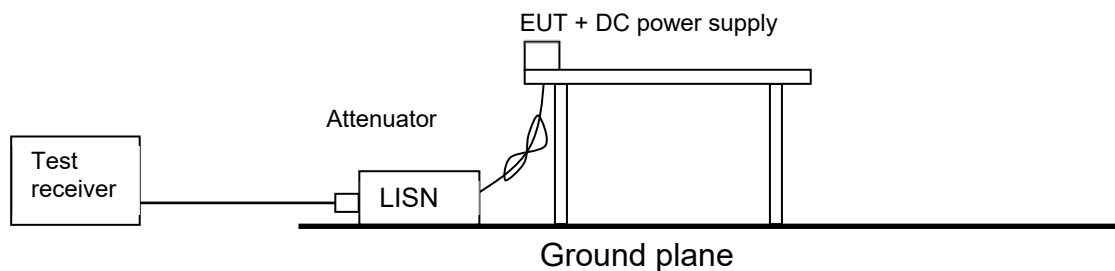
The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Shielded Room. The EUT was connected to a LISN (AMN).

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, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane. Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

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

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

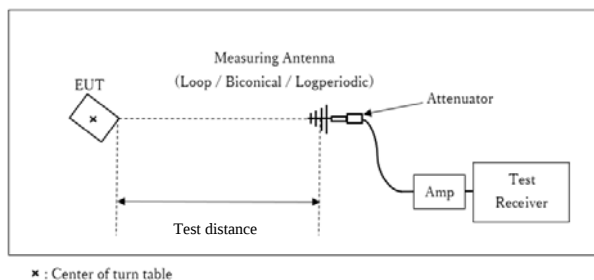
Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer *a)		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 1/T (T: burst length, refer to Burst rate confirmation sheet) Detector: Peak	RBW: 100 kHz VBW: 300 kHz

*1) Average Power Measurement was performed based on KDB 558074 D01 15.247 Meas Guidance v05r02.

*a) The Spectrum Analyzer was used in 3 dB resolution bandwidth.

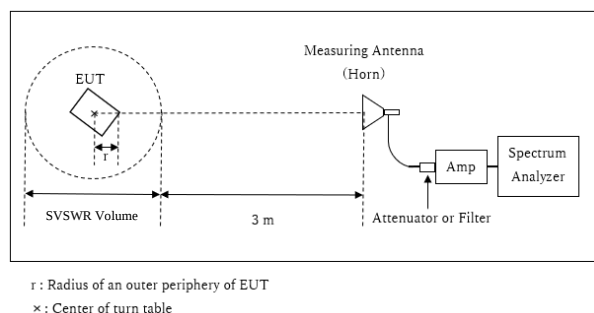
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

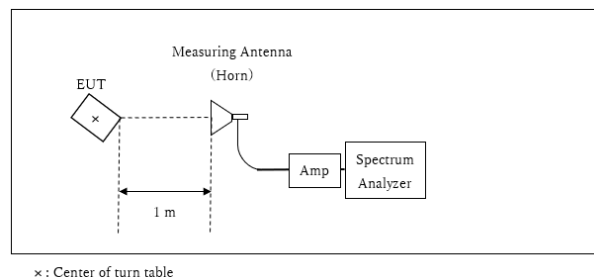
1 GHz to 10 GHz



Distance Factor: $20 \times \log (3.86 \text{ m} / 3.0 \text{ m}) = 2.19\text{dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.86 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.14 \text{ m}$

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 carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

	Antenna polarization	Carrier	Spurious (30 MHz - 1 GHz)	Spurious (1 GHz - 2.8 GHz)	Spurious (2.8 GHz - 10 GHz)	Spurious (10 GHz - 18 GHz)	Spurious (18 GHz - 26.5 GHz)
Module	Horizontal	Y	X	Y	Y	X	X
	Vertical	Y	Z	Y	Y	X	X
Antenna (2G_CH0)	Horizontal	X	X	X	X	X	X
	Vertical	Y	X	Y	Y	X	X

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
20 dB 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: 160 MHz BW)
Carrier Frequency Separation	3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	30 MHz	100 kHz	300 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 30 MHz, 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 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

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

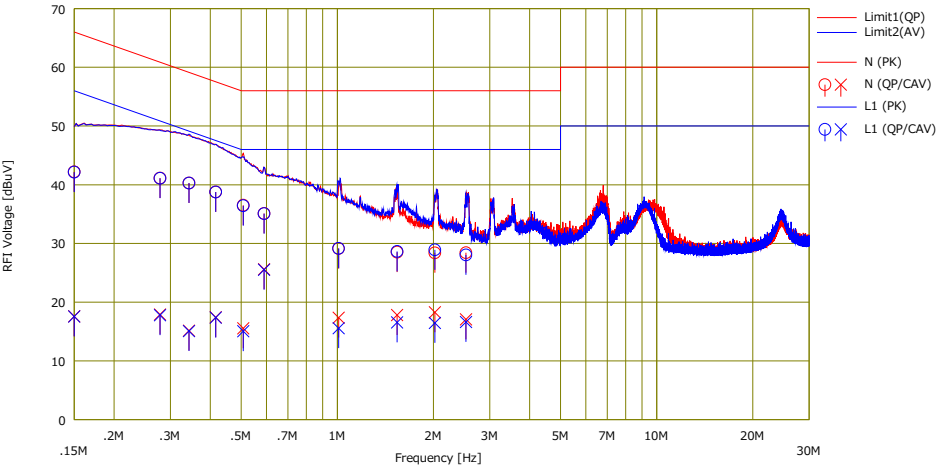
UL Japan,Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2024/07/01

Mode : Tx, 3DH5 2402 MHz
Power : DC 5.0 V (AC 120 V / 60 Hz)
Temp./Humi. : 23 deg.C. / 39 %RH

Remarks : -

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yusuke Tanikawara

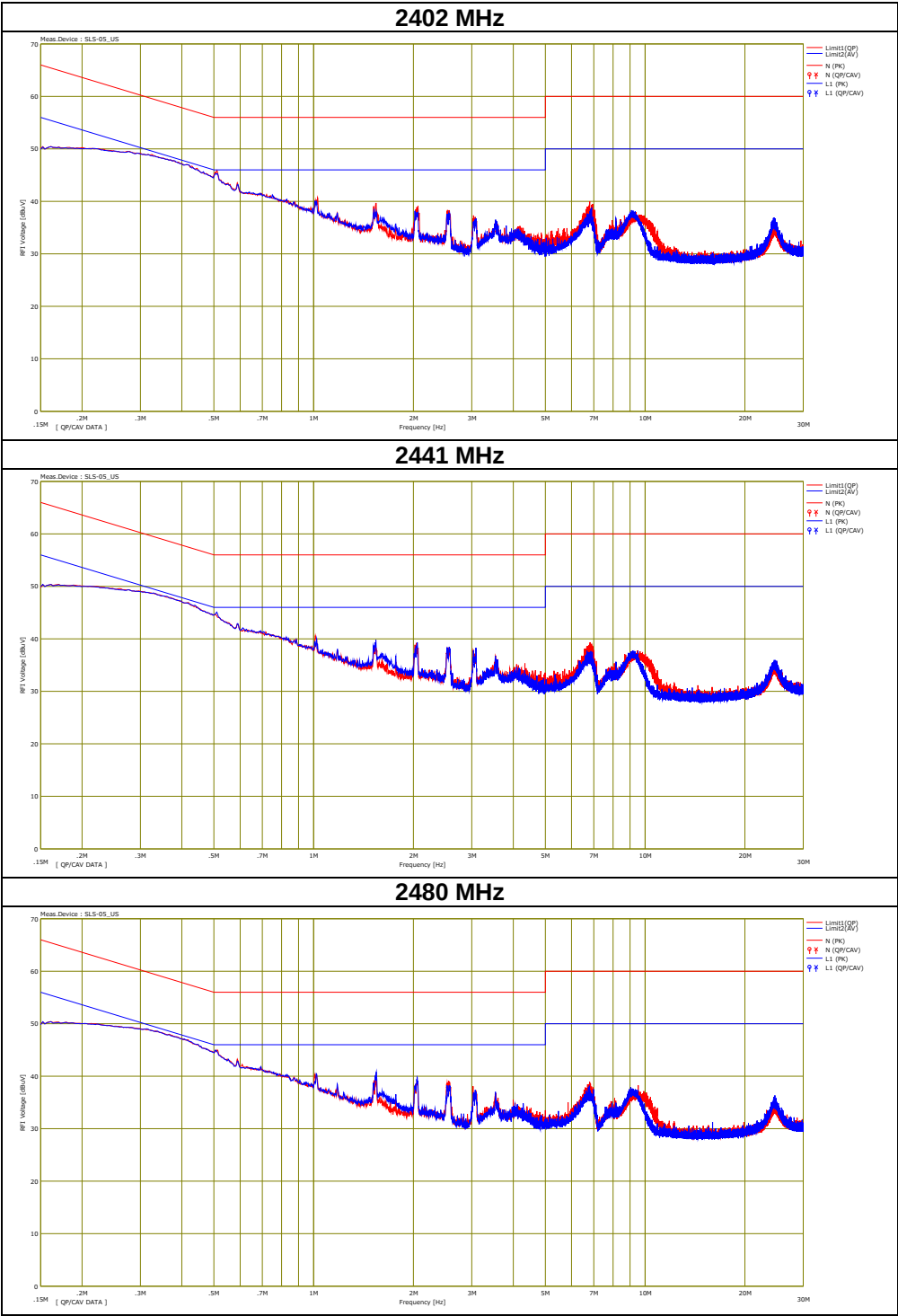


No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<CAV>		<QP>	<CAV>	<QP>	<AV>	<QP>	<AV>		
		[dBuV]	[dBuV]		[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15002	26.81	2.21	15.39	42.20	17.60	66.00	56.00	23.8	38.4	N	
2	0.27873	25.72	2.50	15.41	41.13	17.91	60.85	50.85	19.7	32.9	N	
3	0.34350	24.88	-0.24	15.40	40.28	15.16	59.12	49.12	18.8	33.9	N	
4	0.41640	23.36	2.02	15.40	38.76	17.42	57.52	47.52	18.7	30.1	N	
5	0.50769	21.08	0.12	15.43	36.51	15.55	56.00	46.00	19.4	30.4	N	
6	0.59002	19.67	10.18	15.43	35.10	25.61	56.00	46.00	20.9	20.3	N	
7	1.00969	13.68	1.91	15.45	29.13	17.36	56.00	46.00	26.8	28.6	N	
8	1.53978	13.04	2.34	15.47	28.51	17.81	56.00	46.00	27.4	28.1	N	
9	2.01960	12.92	2.79	15.48	28.40	18.27	56.00	46.00	27.6	27.7	N	
10	2.52902	12.90	1.56	15.52	28.42	17.08	56.00	46.00	27.5	28.9	N	
11	0.15002	26.74	2.16	15.40	42.14	17.56	66.00	56.00	23.8	38.4	L1	
12	0.27873	25.69	2.38	15.41	41.10	17.79	60.85	50.85	19.7	33.0	L1	
13	0.34350	24.88	-0.32	15.40	40.28	15.08	59.12	49.12	18.8	34.0	L1	
14	0.41640	23.34	1.97	15.41	38.75	17.38	57.52	47.52	18.7	30.1	L1	
15	0.50769	21.01	-0.36	15.42	36.43	15.06	56.00	46.00	19.5	30.9	L1	
16	0.59002	19.64	10.10	15.42	35.06	25.52	56.00	46.00	20.9	20.4	L1	
17	1.00969	13.73	0.14	15.43	29.16	15.57	56.00	46.00	26.8	30.4	L1	
18	1.53978	13.19	1.11	15.45	28.64	16.56	56.00	46.00	27.3	29.4	L1	
19	2.01960	13.39	0.95	15.51	28.90	16.46	56.00	46.00	27.1	29.5	L1	
20	2.52902	12.53	1.13	15.51	28.04	16.64	56.00	46.00	27.9	29.3	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN)=145542

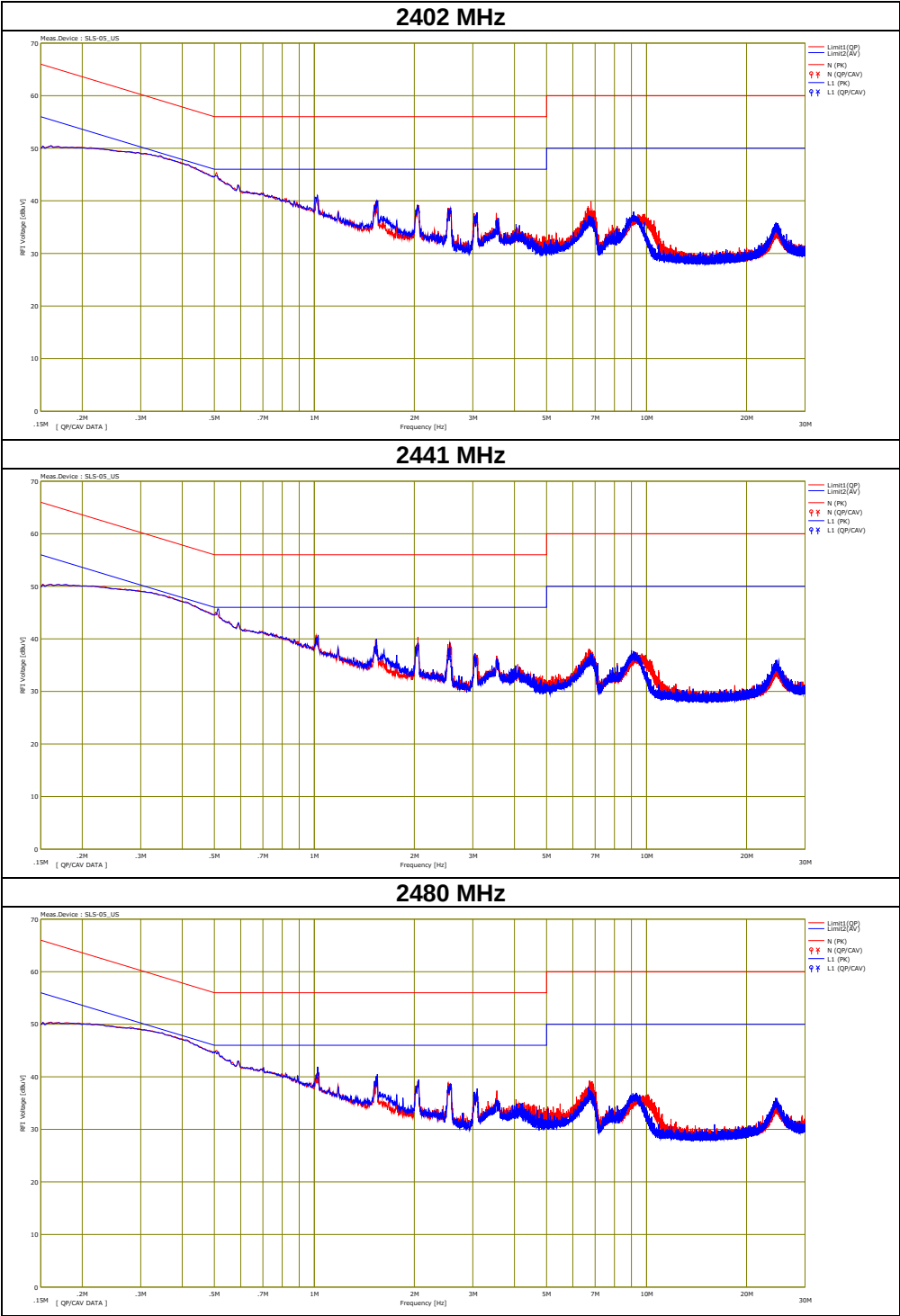
Conducted Emission

Test place	Shonan EMC Lab. No.3 Shielded Room
Date	July 1, 2024
Temperature / Humidity	23 deg. C / 39 % RH
Engineer	Yusuke Tanikawara
Mode	Tx, Hopping Off, DH5



Conducted Emission

Test place	Shonan EMC Lab. No.3 Shielded Room
Date	July 1, 2024
Temperature / Humidity	23 deg. C / 39 % RH
Engineer	Yusuke Tanikawara
Mode	Tx, Hopping Off, 3DH5



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

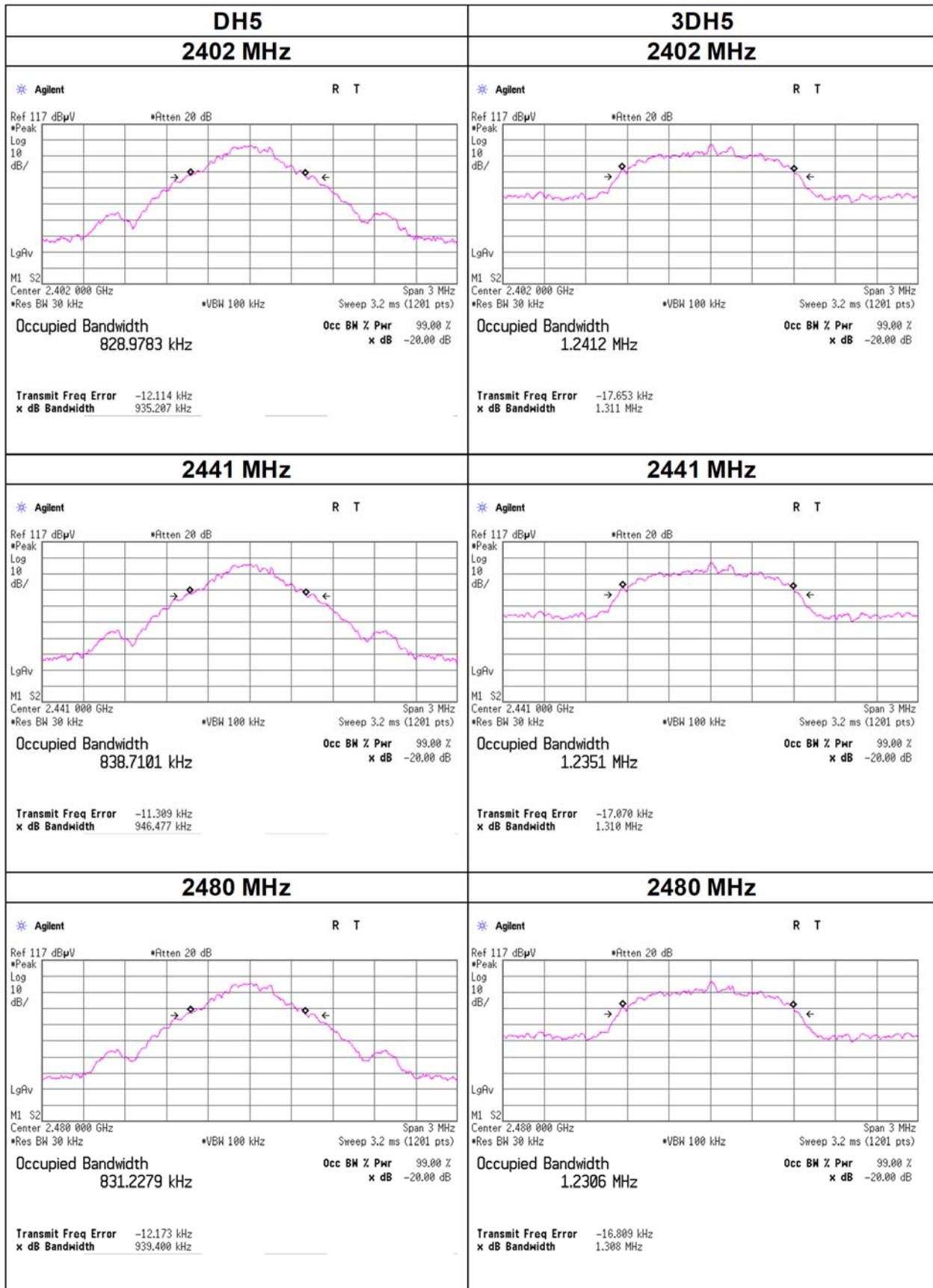
Test place	Shonan EMC Lab. No.2 Measurement Room	
Date	September 7, 2023	September 8, 2023
Temperature / Humidity	23 deg. C / 55 % RH	24 deg. C / 58 % RH
Engineer	Miku Ikudome	Miku Ikudome
Mode	Tx, Hopping Off, Tx, Hopping On	

Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.935	829.0	1.000	≥ 0.623
DH5	2441.0	0.946	838.7	1.000	≥ 0.631
DH5	2480.0	0.939	831.2	1.000	≥ 0.626
DH5	Hopping On	-	78617.8	-	-
3DH5	2402.0	1.311	1241.2	1.000	≥ 0.874
3DH5	2441.0	1.310	1235.1	1.000	≥ 0.873
3DH5	2480.0	1.308	1230.6	1.000	≥ 0.872
3DH5	Hopping On	-	78840.1	-	-

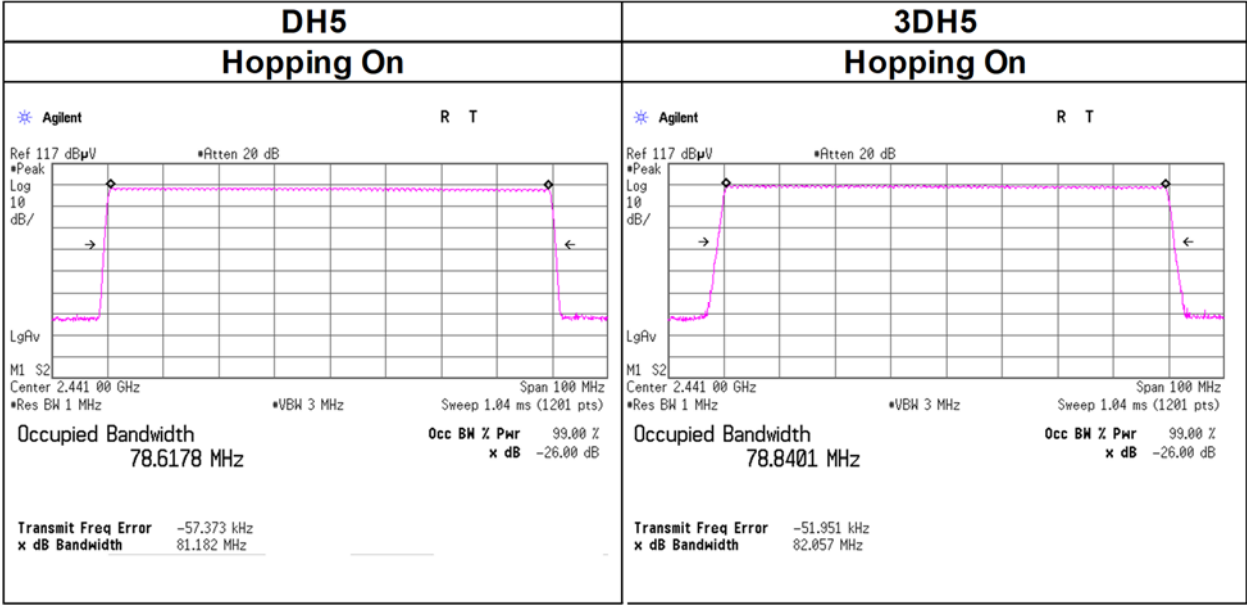
Limit: Two-thirds of 20 dB Bandwidth or 25 kHz (whichever is greater).

No limit applies to 20 dB Bandwidth.

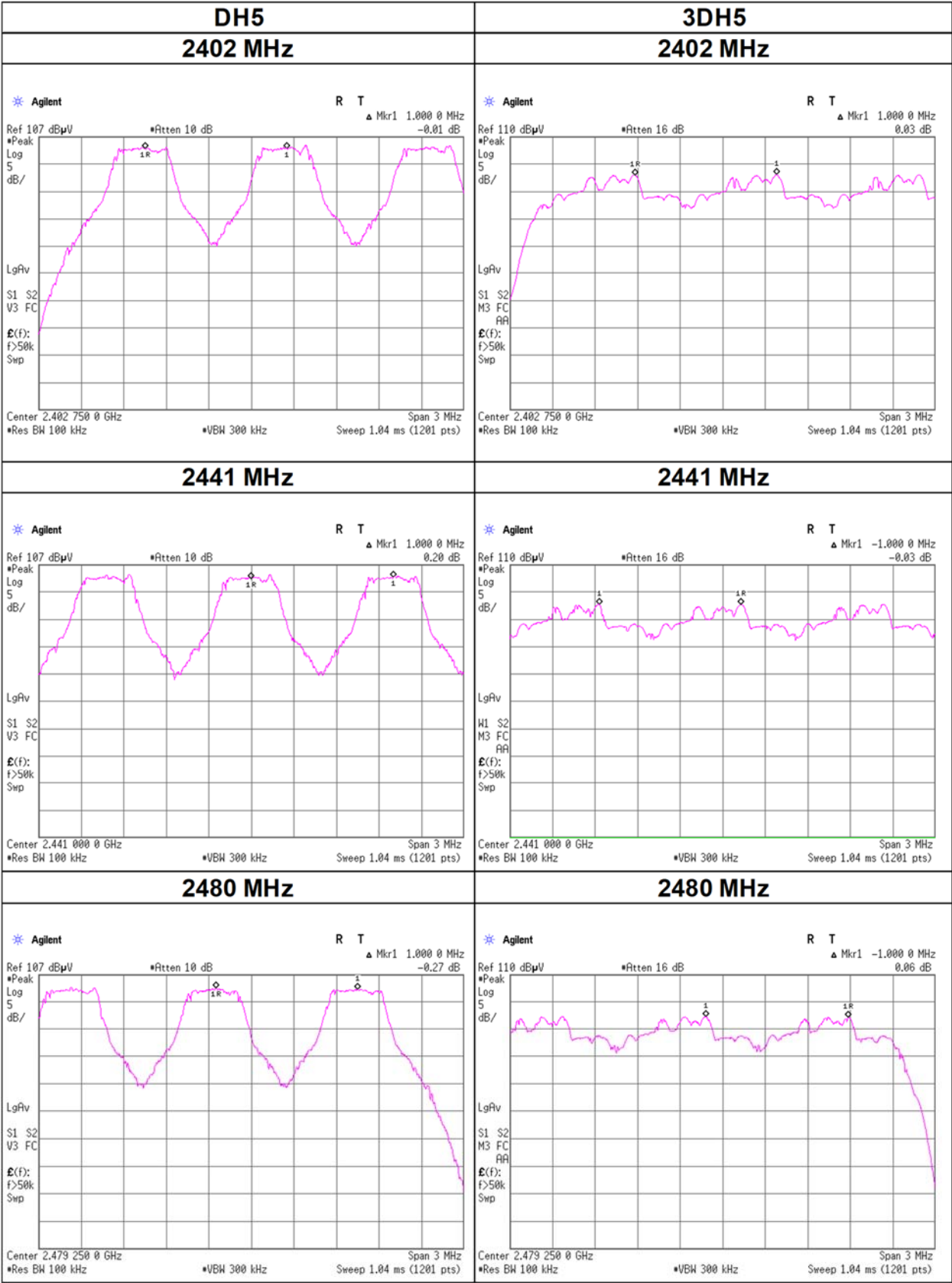
20 dB Bandwidth and 99 % Occupied Bandwidth



20 dB Bandwidth and 99 % Occupied Bandwidth



Carrier Frequency Separation



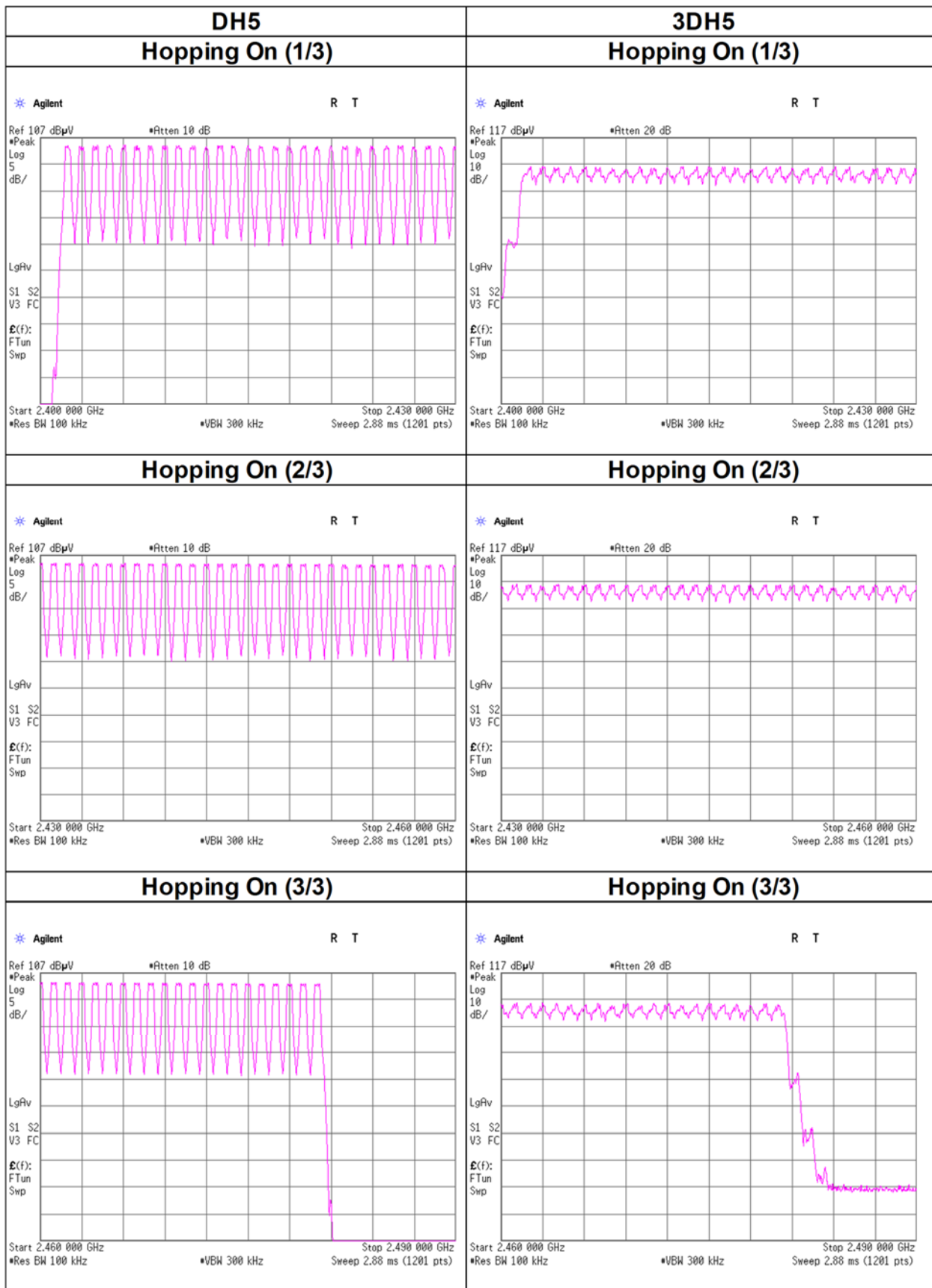
Number of Hopping Frequency

Test place	Shonan EMC Lab. No.2 Measurement Room	
Date	September 8, 2023	September 11, 2023
Temperature / Humidity	24 deg. C / 58 % RH	23 deg. C / 54 % RH
Engineer	Miku Ikudome	Ken Fujita
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	Shonan EMC Lab. No.2 Measurement Room	
Date	September 8, 2023	September 11, 2023
Temperature / Humidity	24 deg. C / 58 % RH	23 deg. C / 54 % RH
Engineer	Miku Ikudome	Ken Fujita
Mode	Tx, Hopping On	

Mode	Number of transmission in a 31.6 (79 Hopping x 0.4)	Length of transmission [ms]	Result [ms]	Limit [ms]
DH1	50.2 times / 5 s x 31.6 s = 318 times	0.404	128	400
DH3	27.0 times / 5 s x 31.6 s = 171 times	1.662	284	400
DH5	21.2 times / 5 s x 31.6 s = 134 times	2.911	390	400
3DH1	50.6 times / 5 s x 31.6 s = 320 times	0.412	132	400
3DH3	26.8 times / 5 s x 31.6 s = 170 times	1.690	287	400
3DH5	21.0 times / 5 s x 31.6 s = 133 times	2.940	391	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.

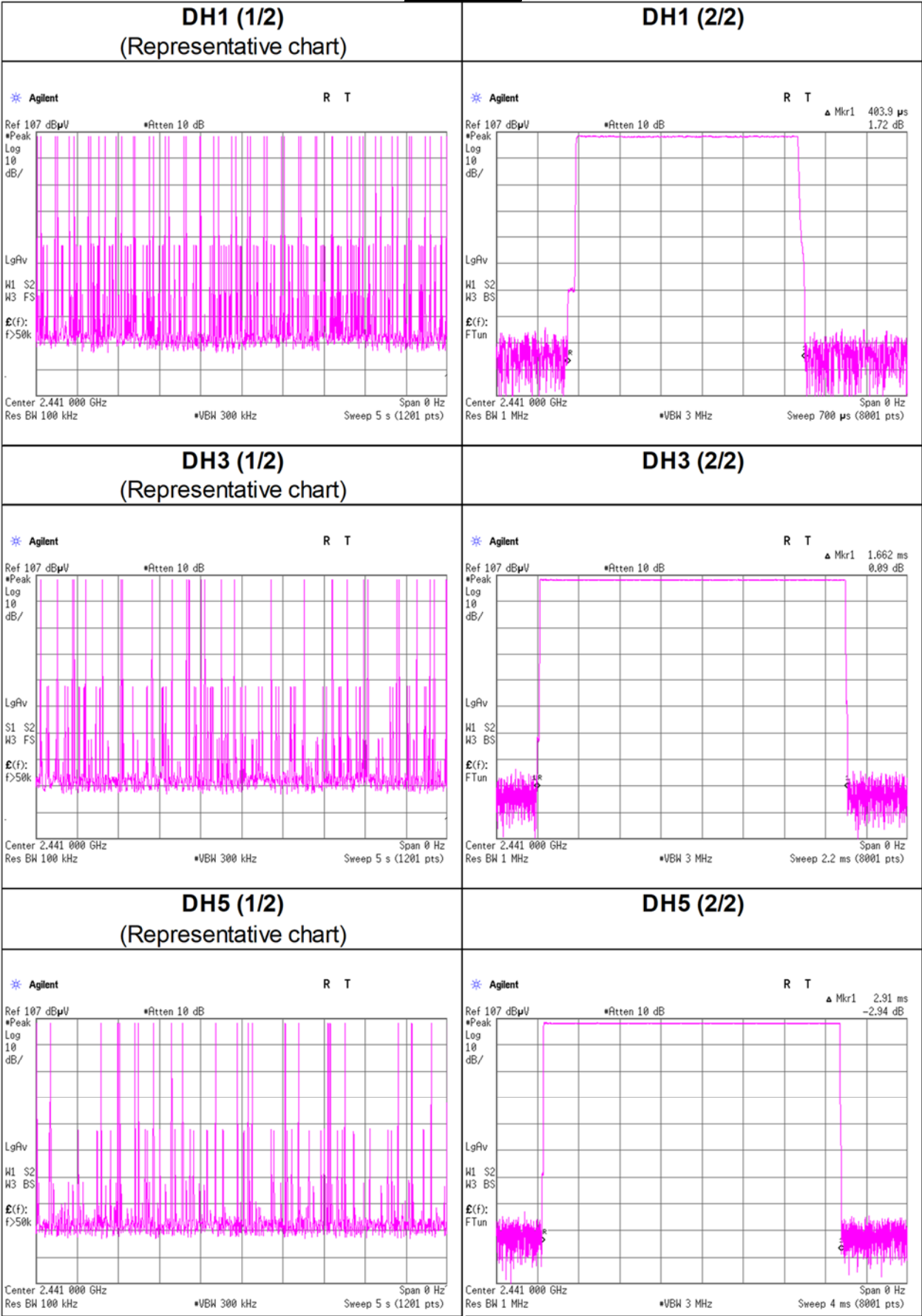
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	52	50	51	49	49	50.2
DH3	28	27	31	23	26	27
DH5	23	17	18	26	22	21.2
3DH1	51	50	52	50	50	50.6
3DH3	28	27	26	27	26	26.8
3DH5	22	21	22	20	20	21

Sample Calculation

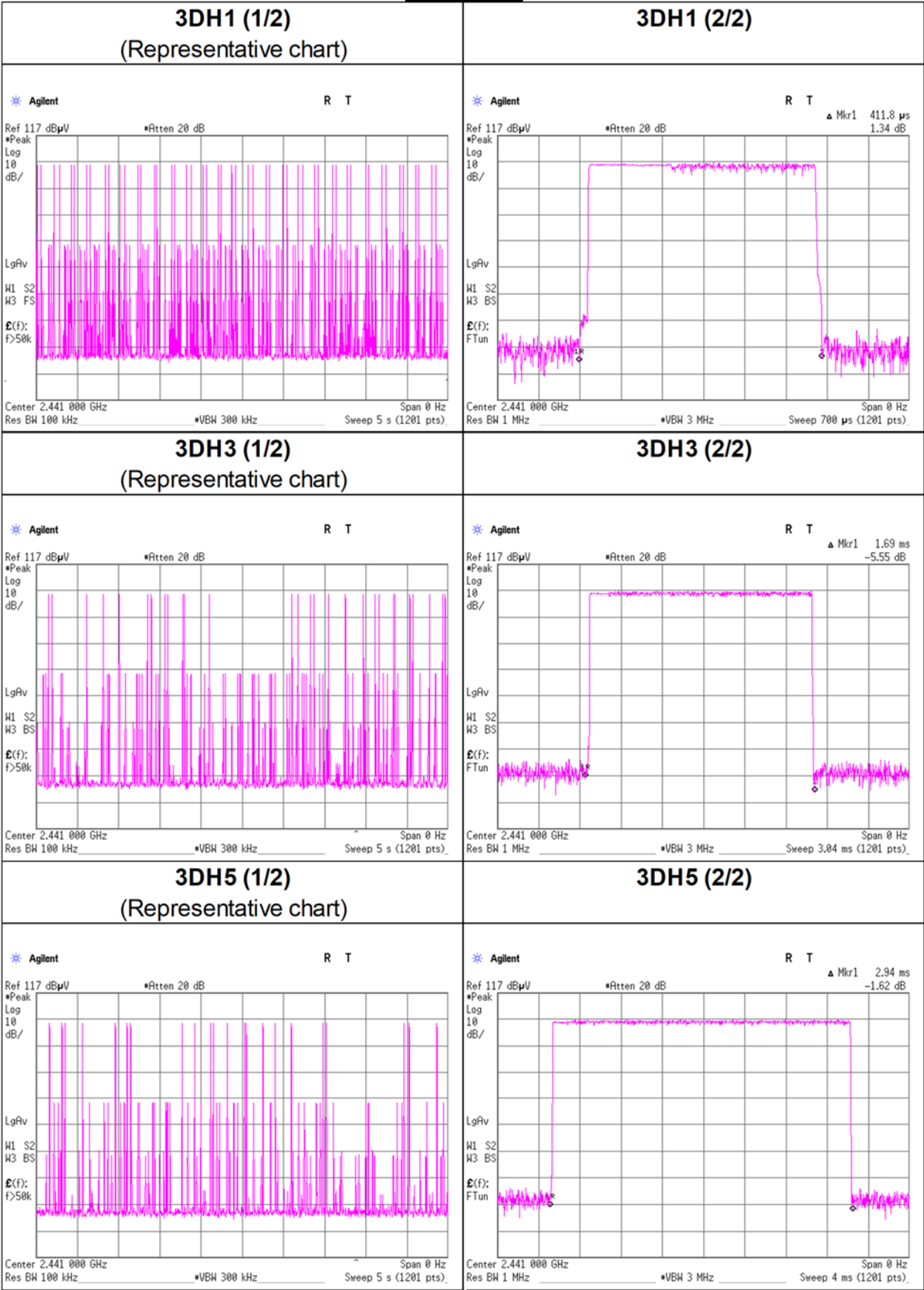
Average = Summation (Sampling 1 to 5) / 5

This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in $N \times 0.4$ 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 Shonan EMC Lab. No.2 Measurement Room
Date September 7, 2023
Temperature / Humidity 23 deg. C / 55 % RH
Engineer Miku Ikudome
Mode Tx, Hopping Off

Maximum peak output power

					Conducted Power					e.i.r.p. for RSS-247					
Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
					[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]			
DH5	2402	-1.50	1.62	9.88	10.00	10.00	20.97	125	10.97	-0.23	9.77	9.48	36.02	4000	26.25
DH5	2441	-1.68	1.63	9.88	9.83	9.62	20.97	125	11.14	-0.23	9.60	9.12	36.02	4000	26.42
DH5	2480	-2.11	1.66	9.89	9.44	8.79	20.97	125	11.53	-0.23	9.21	8.34	36.02	4000	26.81
2DH5	2402	-0.22	1.62	9.88	11.28	13.43	20.97	125	9.69	-0.23	11.05	12.74	36.02	4000	24.97
2DH5	2441	-0.34	1.63	9.88	11.17	13.09	20.97	125	9.80	-0.23	10.94	12.42	36.02	4000	25.08
2DH5	2480	-0.66	1.66	9.89	10.89	12.27	20.97	125	10.08	-0.23	10.66	11.64	36.02	4000	25.36
3DH5	2402	-0.07	1.62	9.88	11.43	13.90	20.97	125	9.54	-0.23	11.20	13.18	36.02	4000	24.82
3DH5	2441	-0.15	1.63	9.88	11.36	13.68	20.97	125	9.61	-0.23	11.13	12.97	36.02	4000	24.89
3DH5	2480	-0.40	1.66	9.89	11.15	13.03	20.97	125	9.82	-0.23	10.92	12.36	36.02	4000	25.10

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

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

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	Shonan EMC Lab. No.2 Measurement Room
Date	September 7, 2023
Temperature / Humidity	23 deg. C / 55 % RH
Engineer	Miku Ikudome
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	-2.83	1.62	9.88	8.67	7.36	1.11	9.78	9.52
DH5	2441	-3.03	1.63	9.88	8.48	7.05	1.11	9.59	9.11
DH5	2480	-3.48	1.66	9.89	8.07	6.41	1.11	9.18	8.29
2DH5	2402	-2.71	1.62	9.88	8.79	7.57	1.12	9.91	9.79
2DH5	2441	-2.90	1.63	9.88	8.61	7.26	1.12	9.73	9.39
2DH5	2480	-3.32	1.66	9.89	8.23	6.65	1.12	9.35	8.60
3DH5	2402	-2.70	1.62	9.88	8.80	7.59	1.12	9.92	9.81
3DH5	2441	-2.88	1.63	9.88	8.63	7.29	1.12	9.75	9.43
3DH5	2480	-3.31	1.66	9.89	8.24	6.67	1.12	9.36	8.62

Sample Calculation:

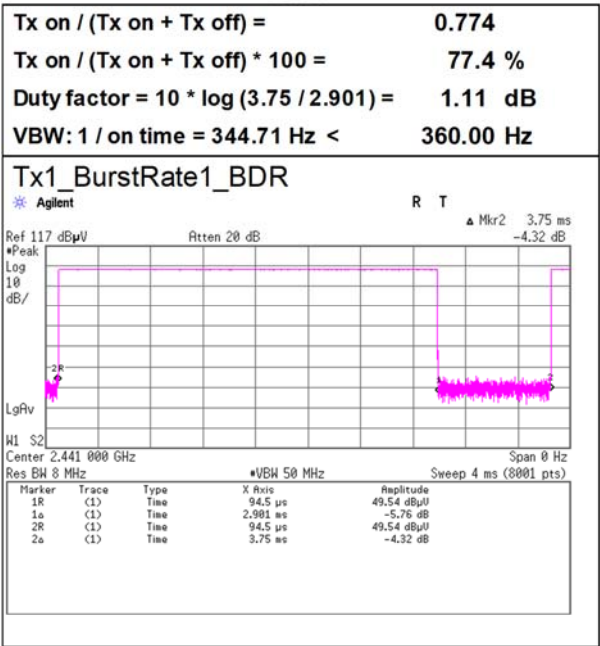
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

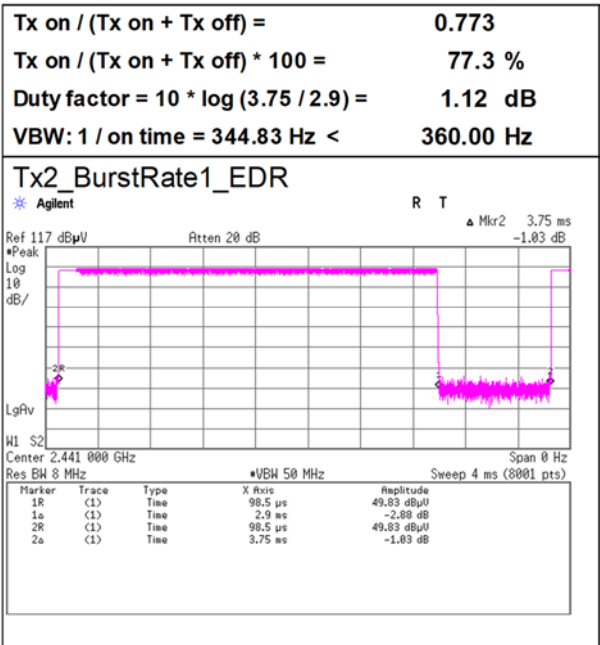
Burst Rate Confirmation

Test place Shonan EMC Lab. No.2 Measurement Room
Date September 7, 2023
Temperature / Humidity 23 deg. C / 55 % RH
Engineer Miku Ikudome
Mode Tx, Hopping Off

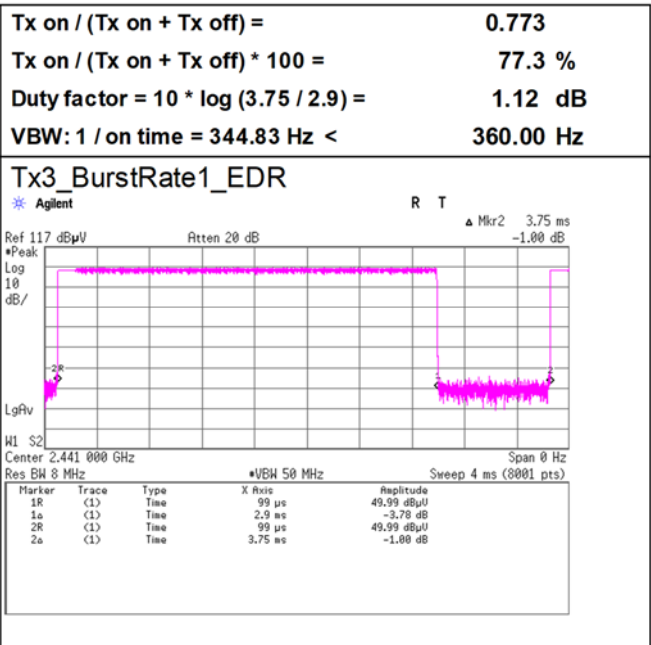
DH5



2DH5



3DH5



Radiated Spurious Emission

Test place Shonan EMC Lab.
Semi Anechoic Chamber WAC 1
Date September 10, 2023 September 8, 2023
Temperature / Humidity 25 deg. C / 66 % RH 24 deg. C / 70 % RH
Engineer Yohsuke Matsuzawa Makoto Hosaka
(1 GHz to 10 GHz) (10 GHz to 26.5 GHz)
Mode Tx, Hopping Off, DH5 2402 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	44.87	27.77	12.57	36.58	2.19	50.82	73.9	23.0	115	37	-
Hori.	4804.000	PK	50.55	31.53	4.68	36.14	2.19	52.81	73.9	21.0	159	59	-
Hori.	7206.000	PK	44.76	36.19	5.55	36.35	2.19	52.34	73.9	21.5	150	0	-
Hori.	9608.000	PK	45.15	38.64	6.35	36.49	2.19	55.84	73.9	18.0	150	0	-
Hori.	2390.000	AV	33.38	27.77	12.57	36.58	2.19	39.33	53.9	14.5	115	37	VBW: 360 Hz
Hori.	4804.000	AV	43.87	31.53	4.68	36.14	2.19	46.13	53.9	7.7	159	59	VBW: 360 Hz
Hori.	7206.000	AV	32.73	36.19	5.55	36.35	2.19	40.31	53.9	13.5	150	0	VBW: 360 Hz, Floor noise
Hori.	9608.000	AV	32.57	38.64	6.35	36.49	2.19	43.26	53.9	10.6	150	0	VBW: 360 Hz, Floor noise
Vert.	2390.000	PK	44.55	27.77	12.57	36.58	2.19	50.50	73.9	23.4	130	26	-
Vert.	4804.000	PK	51.72	31.53	4.68	36.14	2.19	53.98	73.9	19.9	100	213	-
Vert.	7206.000	PK	45.05	36.19	5.55	36.35	2.19	52.63	73.9	21.2	150	0	-
Vert.	9608.000	PK	45.53	38.64	6.35	36.49	2.19	56.22	73.9	17.6	150	0	-
Vert.	2390.000	AV	33.36	27.77	12.57	36.58	2.19	39.31	53.9	14.5	130	26	VBW: 360 Hz
Vert.	4804.000	AV	47.18	31.53	4.68	36.14	2.19	49.44	53.9	4.4	100	213	VBW: 360 Hz
Vert.	7206.000	AV	32.63	36.19	5.55	36.35	2.19	40.21	53.9	13.6	150	0	VBW: 360 Hz, Floor noise
Vert.	9608.000	AV	33.66	38.64	6.35	36.49	2.19	44.35	53.9	9.5	150	0	VBW: 360 Hz, Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

*These results have sufficient margin without taking account Duty cycle correction factor.

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	97.26	27.76	12.57	36.58	2.19	103.20	-	-	Carrier
Hori.	2400.000	PK	38.67	27.76	12.57	36.58	2.19	44.61	83.2	38.5	-
Vert.	2402.000	PK	97.73	27.76	12.57	36.58	2.19	103.67	-	-	Carrier
Vert.	2400.000	PK	38.47	27.76	12.57	36.58	2.19	44.41	83.6	39.1	-

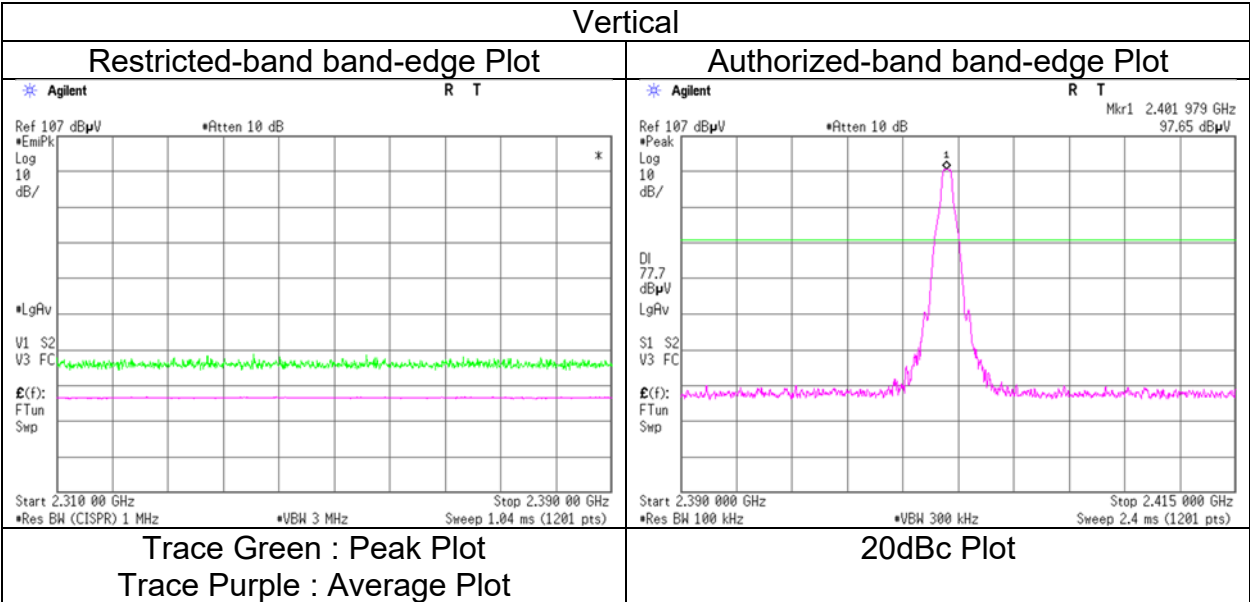
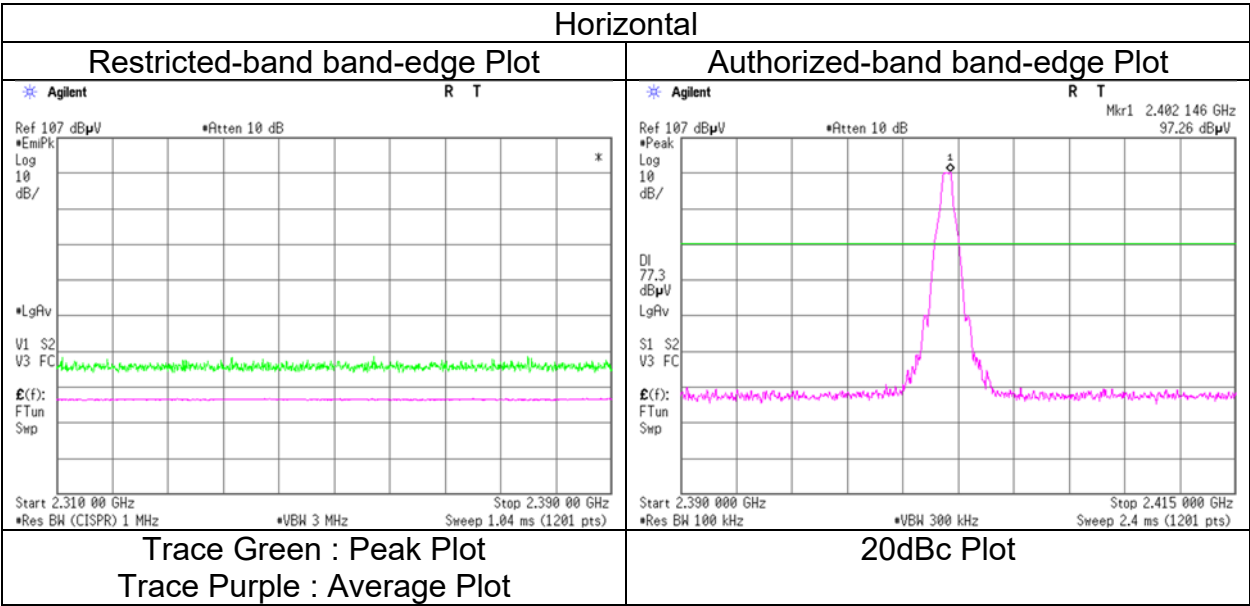
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	WAC 1
Date	September 10, 2023
Temperature / Humidity	25 deg. C / 66 % RH
Engineer	Yohsuke Matsuzawa
	(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	Shonan EMC Lab.	
Semi Anechoic Chamber	WAC 1	WAC 1
Date	September 11, 2023	September 8, 2023
Temperature / Humidity	25 deg. C / 60 % RH	24 deg. C / 70 % RH
Engineer	Yohsuke Matsuzawa	Makoto Hosaka
	(1 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	4882.000	PK	48.95	31.62	4.70	36.11	2.19	51.35	73.9	22.5	366	64	-
Hori.	7323.000	PK	43.98	36.27	5.61	36.37	2.19	51.68	73.9	22.2	150	0	-
Hori.	9764.000	PK	44.28	39.01	6.40	36.41	2.19	55.47	73.9	18.4	150	0	-
Hori.	4882.000	AV	42.41	31.62	4.70	36.11	2.19	44.81	53.9	9.0	366	64	VBW:360 Hz
Hori.	7323.000	AV	34.85	36.27	5.61	36.37	2.19	42.55	53.9	11.3	150	0	VBW:360 Hz floornoise
Hori.	9764.000	AV	34.91	39.01	6.40	36.41	2.19	46.10	53.9	7.8	150	0	VBW:360 Hz floornoise
Vert.	4882.000	PK	50.23	31.62	4.70	36.11	2.19	52.63	73.9	21.2	146	243	-
Vert.	7323.000	PK	43.61	36.27	5.61	36.37	2.19	51.31	73.9	22.5	150	0	-
Vert.	9764.000	PK	45.21	39.01	6.40	36.41	2.19	56.40	73.9	17.5	150	0	-
Vert.	4882.000	AV	45.14	31.62	4.70	36.11	2.19	47.54	53.9	6.3	146	243	VBW:360 Hz
Vert.	7323.000	AV	34.90	36.27	5.61	36.37	2.19	42.60	53.9	11.3	150	0	VBW:360 Hz floornoise
Vert.	9764.000	AV	35.15	39.01	6.40	36.41	2.19	46.34	53.9	7.5	150	0	VBW:360 Hz floornoise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	WAC 1	WAC 1
Date	September 11, 2023	September 8, 2023
Temperature / Humidity	25 deg. C / 60 % RH	24 deg. C / 70 % RH
Engineer	Yohsuke Matsuzawa	Makoto Hosaka
	(1 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	47.52	27.75	12.62	36.57	2.19	53.51	73.9	20.3	144	84	-
Hori.	4960.000	PK	48.13	31.72	4.73	36.08	2.19	50.69	73.9	23.2	122	60	-
Hori.	7440.000	PK	43.62	36.45	5.67	36.39	2.19	51.54	73.9	22.3	150	0	-
Hori.	9920.000	PK	44.69	38.86	6.46	36.34	2.19	55.86	73.9	18.0	150	0	-
Hori.	2483.500	AV	33.73	27.75	12.62	36.57	2.19	39.72	53.9	14.1	144	84	VBW:360 Hz
Hori.	4960.000	AV	38.24	31.72	4.73	36.08	2.19	40.80	53.9	13.1	122	60	VBW:360 Hz
Hori.	7440.000	AV	33.50	36.45	5.67	36.39	2.19	41.42	53.9	12.4	150	0	VBW:360 Hz floornoise
Hori.	9920.000	AV	34.99	38.86	6.46	36.34	2.19	46.16	53.9	7.7	150	0	VBW:360 Hz floornoise
Vert.	2483.500	PK	46.80	27.75	12.62	36.57	2.19	52.79	73.9	21.1	170	27	-
Vert.	4960.000	PK	48.21	31.72	4.73	36.08	2.19	50.77	73.9	23.1	144	238	-
Vert.	7440.000	PK	44.28	36.45	5.67	36.39	2.19	52.20	73.9	21.7	150	0	-
Vert.	9920.000	PK	45.07	38.86	6.46	36.34	2.19	56.24	73.9	17.6	150	0	-
Vert.	2483.500	AV	33.86	27.75	12.62	36.57	2.19	39.85	53.9	14.0	170	27	VBW:360 Hz
Vert.	4960.000	AV	41.64	31.72	4.73	36.08	2.19	44.20	53.9	9.7	144	238	VBW:360 Hz
Vert.	7440.000	AV	34.83	36.45	5.67	36.39	2.19	42.75	53.9	11.1	150	0	VBW:360 Hz floornoise
Vert.	9920.000	AV	35.09	38.86	6.46	36.34	2.19	46.26	53.9	7.6	150	0	VBW:360 Hz floornoise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

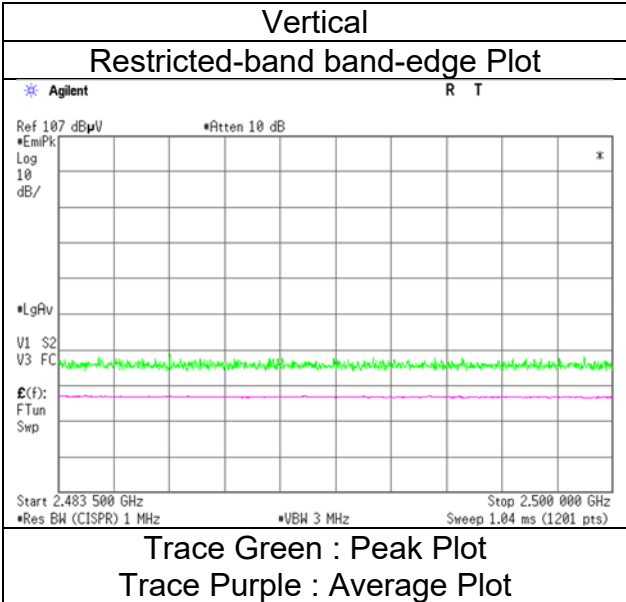
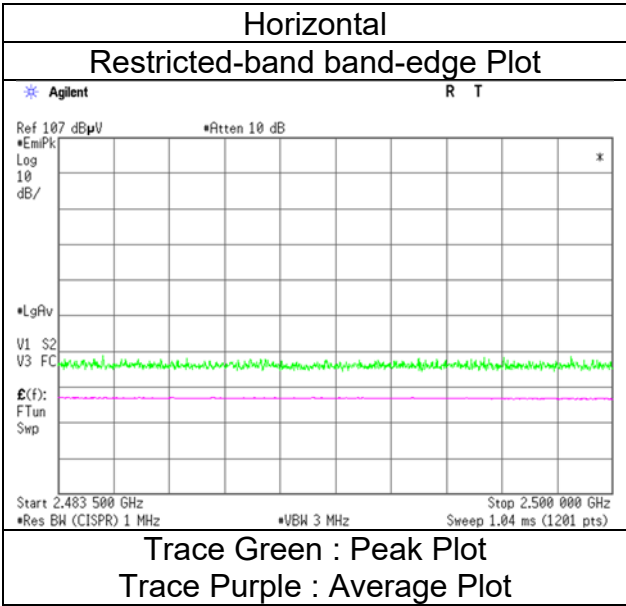
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer

Mode

Shonan EMC Lab.
WAC 1
September 11, 2023
25 deg. C / 60 % RH
Yohsuke Matsuzawa
(1 GHz to 10 GHz)
Tx, Hopping Off, DH5 2480 MHz



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

Radiated Spurious Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	WAC 1	WAC 1	WAC 1
Date	October 28, 2023	September 11, 2023	September 8, 2023
Temperature / Humidity	21 deg. C / 51 % RH	25 deg. C / 60 % RH	24 deg. C / 70 % RH
Engineer	Miku Ikudome	Yohsuke Matsuzawa	Makoto Hosaka
	(30 MHz to 1000 MHz)	(1 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	159.398	QP	47.80	12.07	7.15	33.03	0.00	33.99	43.5	9.5	225	183	-
Hori.	168.036	QP	47.25	12.47	7.23	33.02	0.00	33.93	43.5	9.5	283	203	-
Hori.	182.312	QP	45.84	13.38	7.19	32.99	0.00	33.42	43.5	10.0	288	35	-
Hori.	215.992	QP	43.09	11.03	7.16	32.92	0.00	28.36	43.5	15.1	159	54	-
Hori.	2390.000	PK	45.56	27.77	12.57	36.58	2.19	51.51	73.9	22.3	148	73	-
Hori.	4804.000	PK	53.95	31.53	4.68	36.14	2.19	56.21	73.9	17.6	193	63	-
Hori.	7206.000	PK	44.18	36.19	5.55	36.35	2.19	51.76	73.9	22.1	150	0	-
Hori.	9608.000	PK	44.74	38.64	6.35	36.49	2.19	55.43	73.9	18.4	150	0	-
Hori.	2390.000	AV	33.52	27.77	12.57	36.58	2.19	39.47	53.9	14.4	148	73	VBW: 360 Hz
Hori.	4804.000	AV	43.61	31.53	4.68	36.14	2.19	45.87	53.9	8.0	193	63	VBW: 360 Hz
Hori.	7206.000	AV	32.68	36.19	5.55	36.35	2.19	40.26	53.9	13.6	150	0	VBW: 360 Hz Floor noise
Hori.	9608.000	AV	32.33	38.64	6.35	36.49	2.19	43.02	53.9	10.8	150	0	VBW: 360 Hz Floor noise
Vert.	100.001	QP	43.10	9.51	6.88	33.09	0.00	26.40	43.5	17.1	100	105	-
Vert.	167.991	QP	47.10	12.47	7.23	33.02	0.00	33.78	43.5	9.7	100	317	-
Vert.	175.028	QP	46.41	12.91	7.25	33.00	0.00	33.57	43.5	9.9	100	315	-
Vert.	2390.000	PK	45.12	27.77	12.57	36.58	2.19	51.07	73.9	22.8	188	27	-
Vert.	4804.000	PK	55.40	31.53	4.68	36.14	2.19	57.66	73.9	16.2	123	243	-
Vert.	7206.000	PK	44.12	36.19	5.55	36.35	2.19	51.70	73.9	22.2	150	0	-
Vert.	9608.000	PK	43.70	38.64	6.35	36.49	2.19	54.39	73.9	19.5	150	0	-
Vert.	2390.000	AV	33.43	27.77	12.57	36.58	2.19	39.38	53.9	14.5	188	27	VBW: 360 Hz
Vert.	4804.000	AV	48.01	31.53	4.68	36.14	2.19	50.27	53.9	3.6	123	243	VBW: 360 Hz
Vert.	7206.000	AV	32.53	36.19	5.55	36.35	2.19	40.11	53.9	13.7	150	0	VBW: 360 Hz Floor noise
Vert.	9608.000	AV	32.76	38.64	6.35	36.49	2.19	43.45	53.9	10.4	150	0	VBW: 360 Hz Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.86 m / 3.0 m) = 2.19 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	98.27	27.76	12.57	36.58	2.19	104.21	-	-	Carrier
Hori.	2400.000	PK	57.34	27.76	12.57	36.58	2.19	63.28	84.2	20.9	-
Vert.	2402.000	PK	98.26	27.76	12.57	36.58	2.19	104.20	-	-	Carrier
Vert.	2400.000	PK	50.52	27.76	12.57	36.58	2.19	56.46	84.2	27.7	-

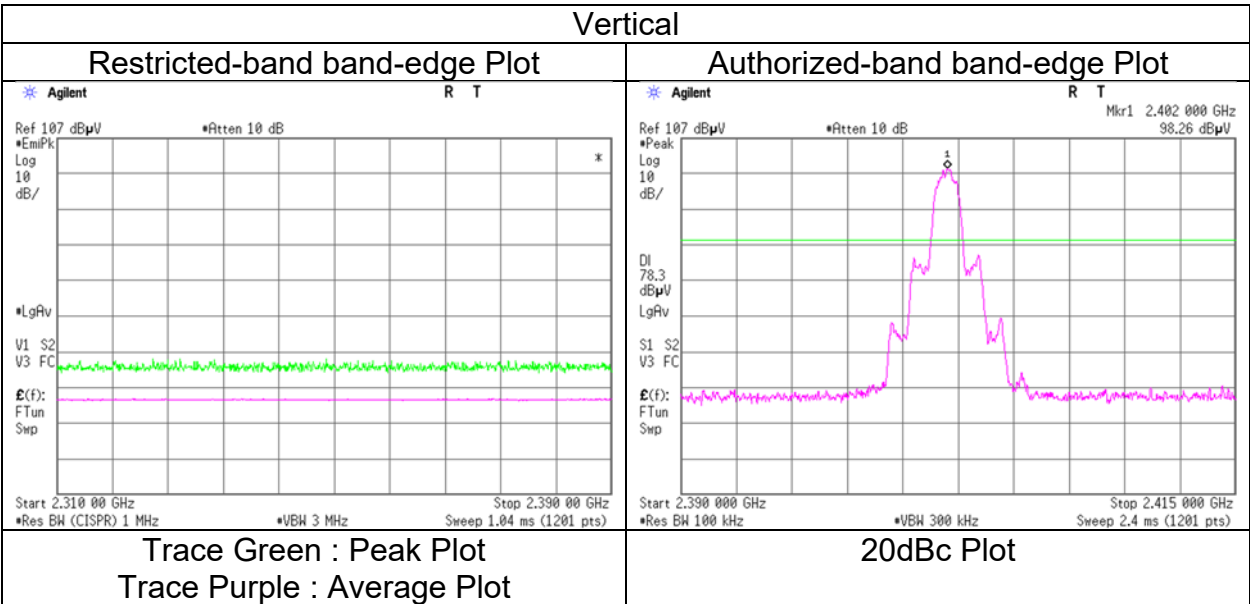
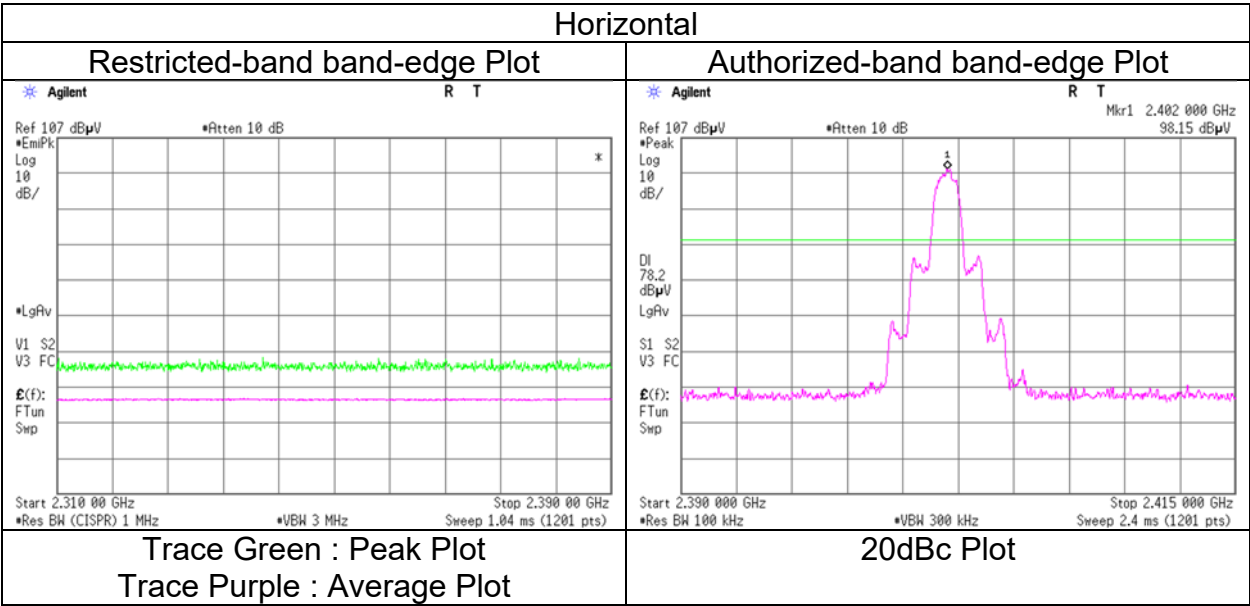
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.86 m / 3.0 m) = 2.19 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	WAC 1
Date	September 11, 2023
Temperature / Humidity	25 deg. C / 60 % RH
Engineer	Yohsuke Matsuzawa
	(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	Shonan EMC Lab.	
Semi Anechoic Chamber	WAC 1	WAC 1
Date	September 11, 2023	September 8, 2023
Temperature / Humidity	25 deg. C / 60 % RH	24 deg. C / 70 % RH
Engineer	Yohsuke Matsuzawa	Makoto Hosaka
	(1 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	4882.000	PK	50.32	31.62	4.70	36.11	2.19	52.72	73.9	21.1	169	64	-
Hori.	7323.000	PK	44.72	36.27	5.61	36.37	2.19	52.42	73.9	21.4	150	0	-
Hori.	9764.000	PK	45.28	39.01	6.40	36.41	2.19	56.47	73.9	17.4	150	0	-
Hori.	4882.000	AV	41.65	31.62	4.70	36.11	2.19	44.05	53.9	9.8	169	64	VBW:360 Hz
Hori.	7323.000	AV	32.69	36.27	5.61	36.37	2.19	40.39	53.9	13.5	150	0	VBW:360 Hz floornoise
Hori.	9764.000	AV	33.08	39.01	6.40	36.41	2.19	44.27	53.9	9.6	150	0	VBW:360 Hz floornoise
Vert.	4882.000	PK	52.06	31.62	4.70	36.11	2.19	54.46	73.9	19.4	143	242	-
Vert.	7323.000	PK	44.63	36.27	5.61	36.37	2.19	52.33	73.9	21.5	150	0	-
Vert.	9764.000	PK	43.74	39.01	6.40	36.41	2.19	54.93	73.9	18.9	150	0	-
Vert.	4882.000	AV	44.71	31.62	4.70	36.11	2.19	47.11	53.9	6.7	143	242	VBW:360 Hz
Vert.	7323.000	AV	32.75	36.27	5.61	36.37	2.19	40.45	53.9	13.4	150	0	VBW:360 Hz floornoise
Vert.	9764.000	AV	33.17	39.01	6.40	36.41	2.19	44.36	53.9	9.5	150	0	VBW:360 Hz floornoise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	WAC 1	WAC 1
Date	September 11, 2023	September 8, 2023
Temperature / Humidity	25 deg. C / 60 % RH	24 deg. C / 70 % RH
Engineer	Yohsuke Matsuzawa	Makoto Hosaka
	(1 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	50.28	27.75	12.62	36.57	2.19	56.27	73.9	17.6	143	88	-
Hori.	4960.000	PK	46.15	31.72	4.73	36.08	2.19	48.71	73.9	25.1	249	57	-
Hori.	7440.000	PK	43.68	36.45	5.67	36.39	2.19	51.60	73.9	22.3	150	0	-
Hori.	9920.000	PK	43.84	38.86	6.46	36.34	2.19	55.01	73.9	18.8	150	0	-
Hori.	2483.500	AV	35.08	27.75	12.62	36.57	2.19	41.07	53.9	12.8	143	88	VBW:360 Hz
Hori.	4960.000	AV	37.79	31.72	4.73	36.08	2.19	40.35	53.9	13.5	249	57	VBW:360 Hz
Hori.	7440.000	AV	32.65	36.45	5.67	36.39	2.19	40.57	53.9	13.3	150	0	VBW:360 Hz floornoise
Hori.	9920.000	AV	32.95	38.86	6.46	36.34	2.19	44.12	53.9	9.7	150	0	VBW:360 Hz floornoise
Vert.	2483.500	PK	50.12	27.75	12.62	36.57	2.19	56.11	73.9	17.7	161	29	-
Vert.	4960.000	PK	48.97	31.72	4.73	36.08	2.19	51.53	73.9	22.3	151	242	-
Vert.	7440.000	PK	43.43	36.45	5.67	36.39	2.19	51.35	73.9	22.5	150	0	-
Vert.	9920.000	PK	43.63	38.86	6.46	36.34	2.19	54.80	73.9	19.1	150	0	-
Vert.	2483.500	AV	35.14	27.75	12.62	36.57	2.19	41.13	53.9	12.7	161	29	VBW:360 Hz
Vert.	4960.000	AV	40.53	31.72	4.73	36.08	2.19	43.09	53.9	10.8	151	242	VBW:360 Hz
Vert.	7440.000	AV	32.69	36.45	5.67	36.39	2.19	40.61	53.9	13.2	150	0	VBW:360 Hz floornoise
Vert.	9920.000	AV	33.04	38.86	6.46	36.34	2.19	44.21	53.9	9.6	150	0	VBW:360 Hz floornoise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

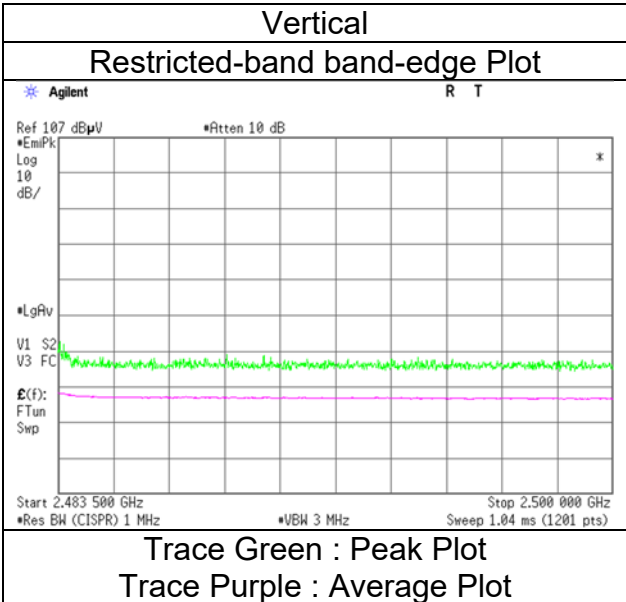
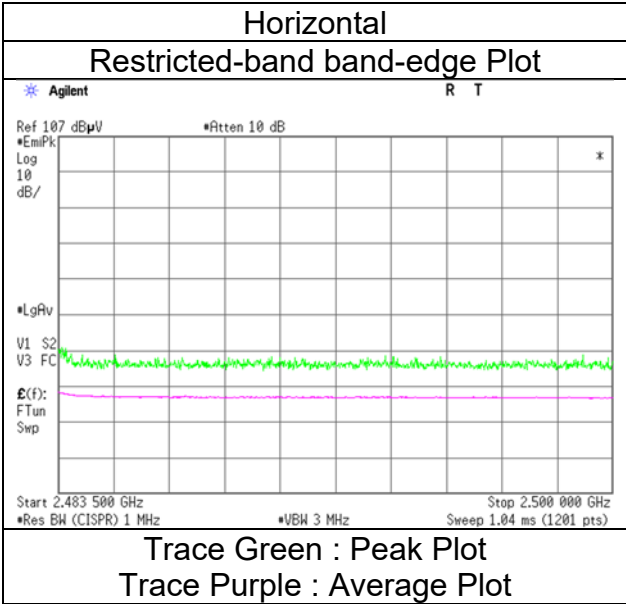
Distance factor : 1 GHz - 10 GHz : $20\log(3.86\text{ m} / 3.0\text{ m}) = 2.19\text{ dB}$

10 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

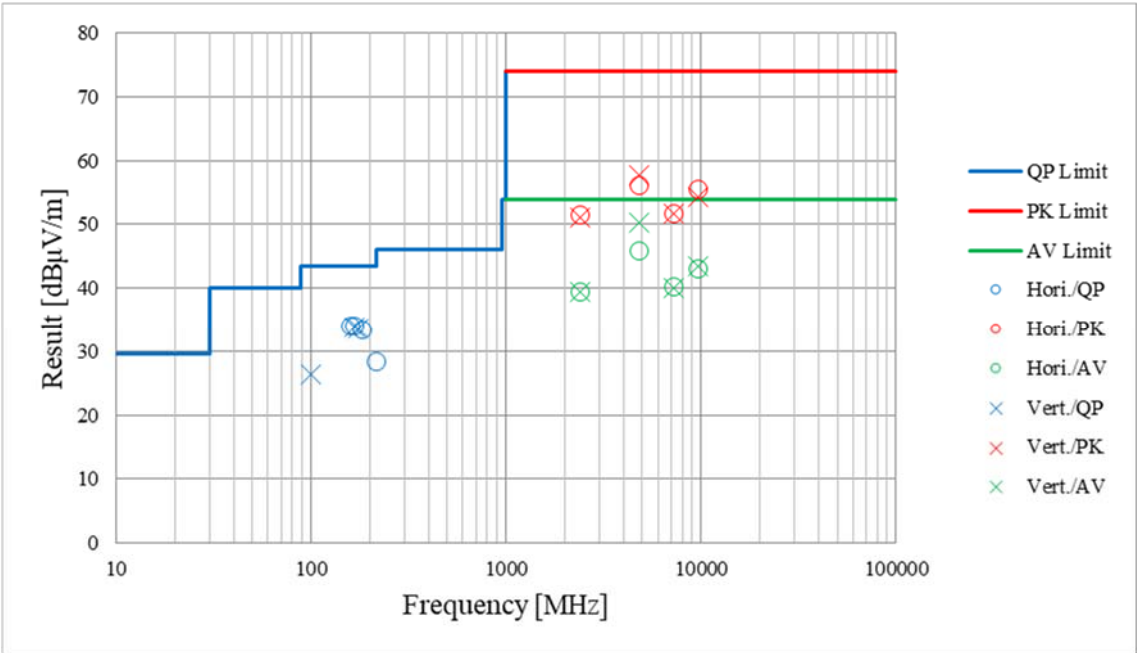
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	WAC 1
Date	September 11, 2023
Temperature / Humidity	25 deg. C / 60 % RH
Engineer	Yohsuke Matsuzawa
	(1 GHz to 10 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz



* 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	Shonan EMC Lab.		
Semi Anechoic Chamber	WAC 1	WAC 1	WAC 1
Date	October 28, 2023	September 11, 2023	September 8, 2023
Temperature / Humidity	21 deg. C / 51 % RH	25 deg. C / 60 % RH	24 deg. C / 70 % RH
Engineer	Miku Ikudome	Yohsuke Matsuzawa	Makoto Hosaka
	(30 MHz to 1000 MHz)	(1 GHz to 10 GHz)	(10 GHz to 26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		

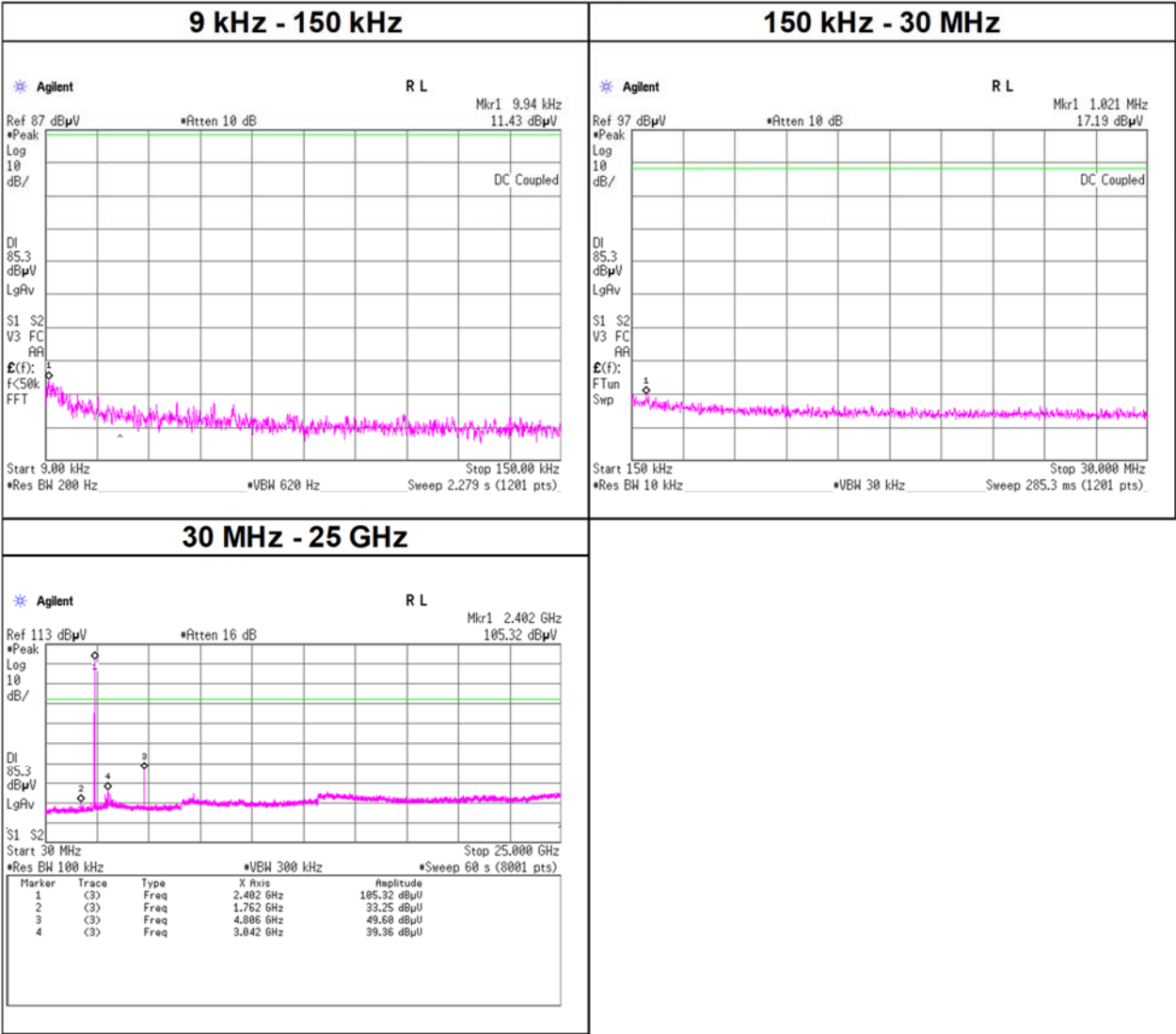


*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place Shonan EMC Lab. No.2 Measurement Room
Date September 16, 2023
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping Off, DH5

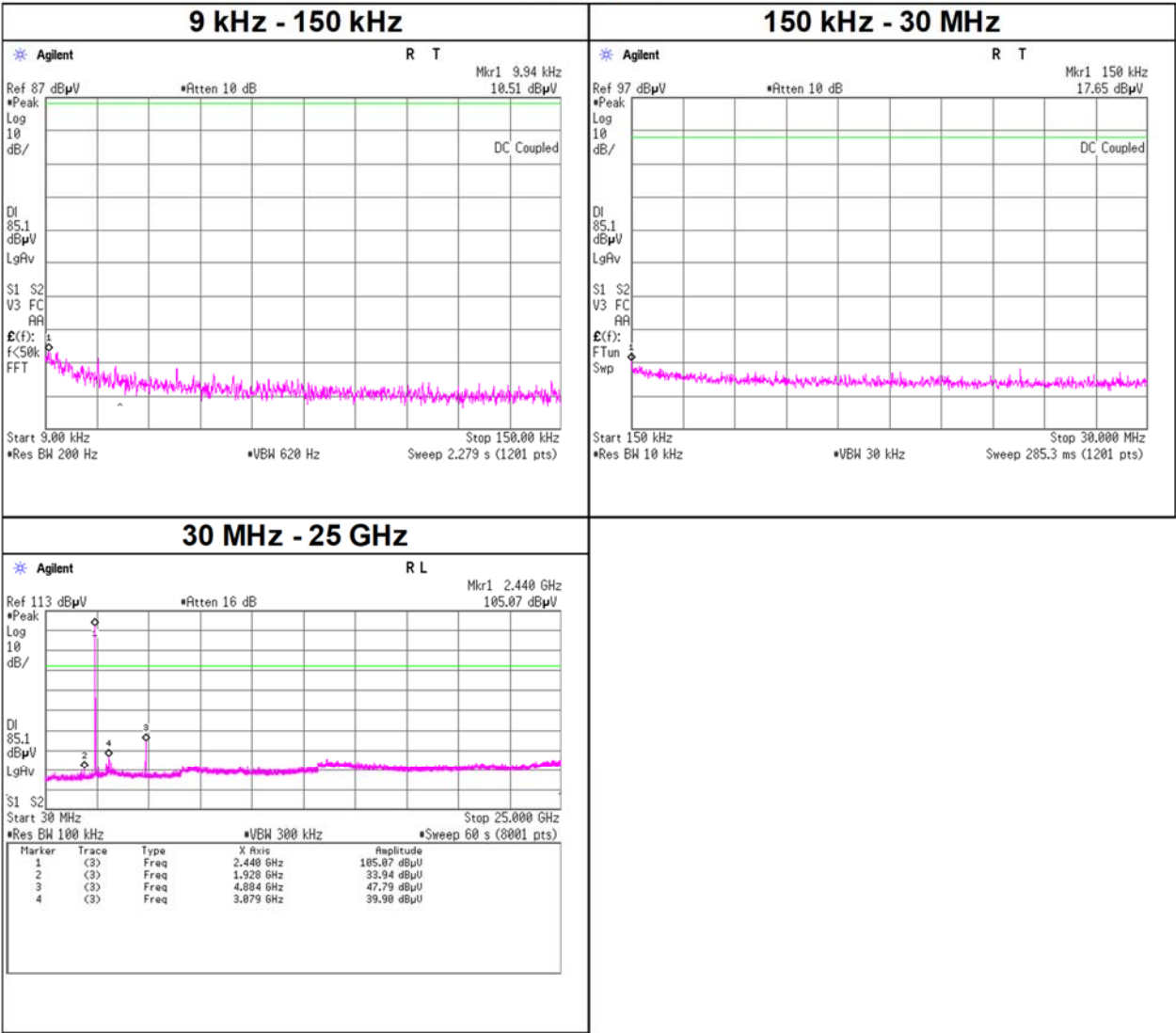
2402 MHz



Conducted Spurious Emission

Test place Shonan EMC Lab. No.2 Measurement Room
Date September 16, 2023
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping Off, DH5

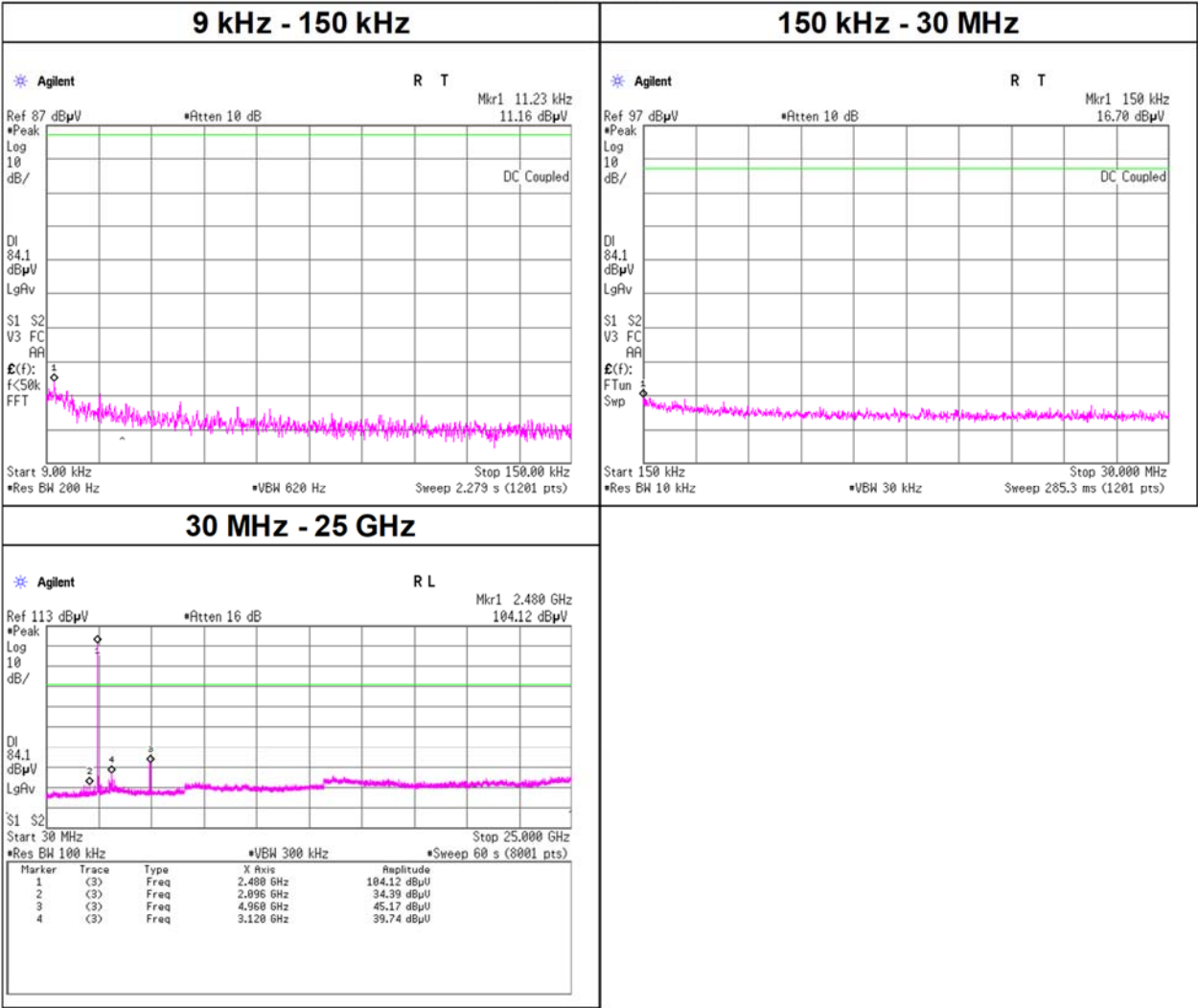
2441 MHz



Conducted Spurious Emission

Test place Shonan EMC Lab. No.2 Measurement Room
Date September 16, 2023
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping Off, DH5

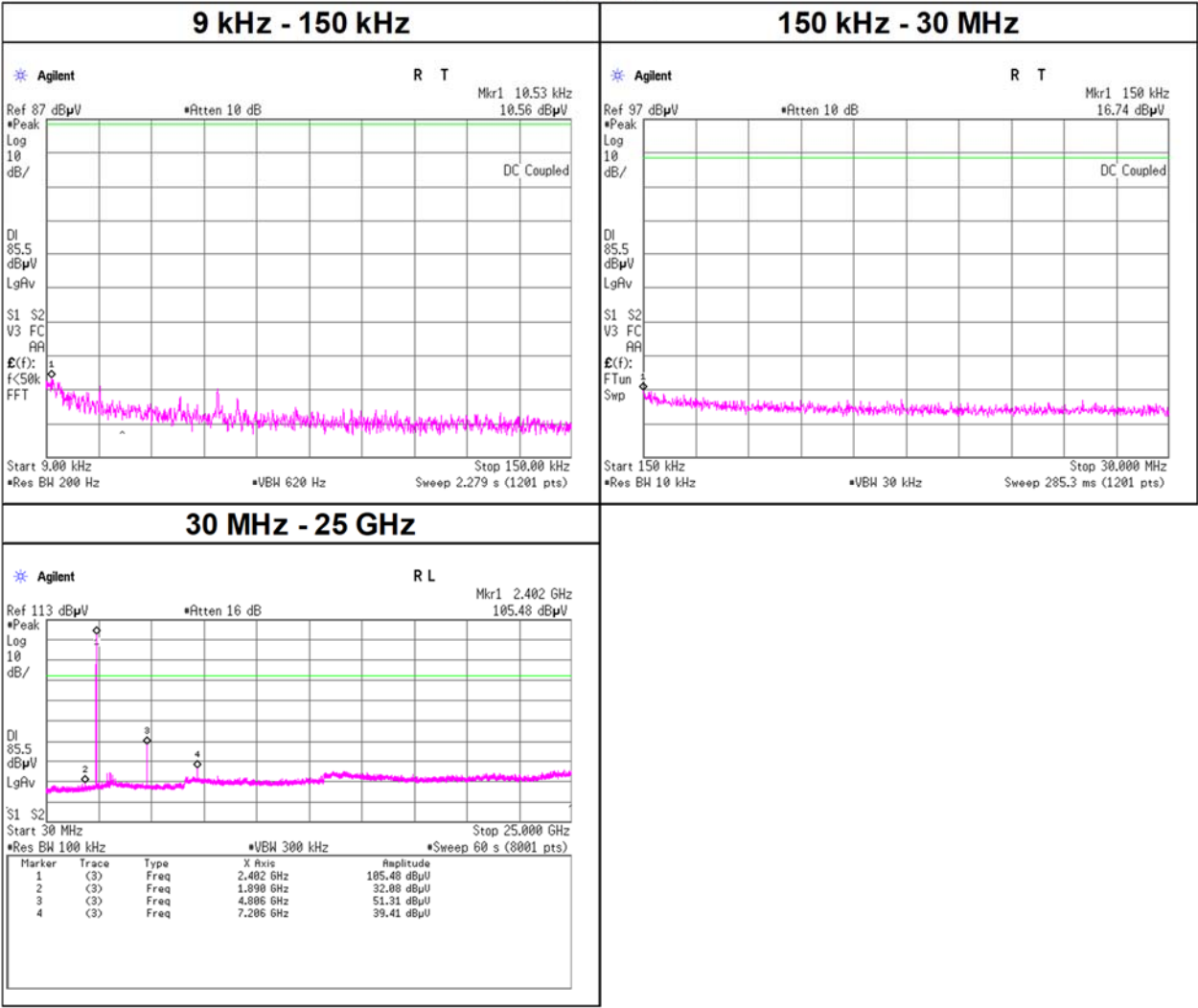
2480 MHz



Conducted Spurious Emission

Test place Shonan EMC Lab. No.2 Measurement Room
Date September 16, 2023
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping Off, 3DH5

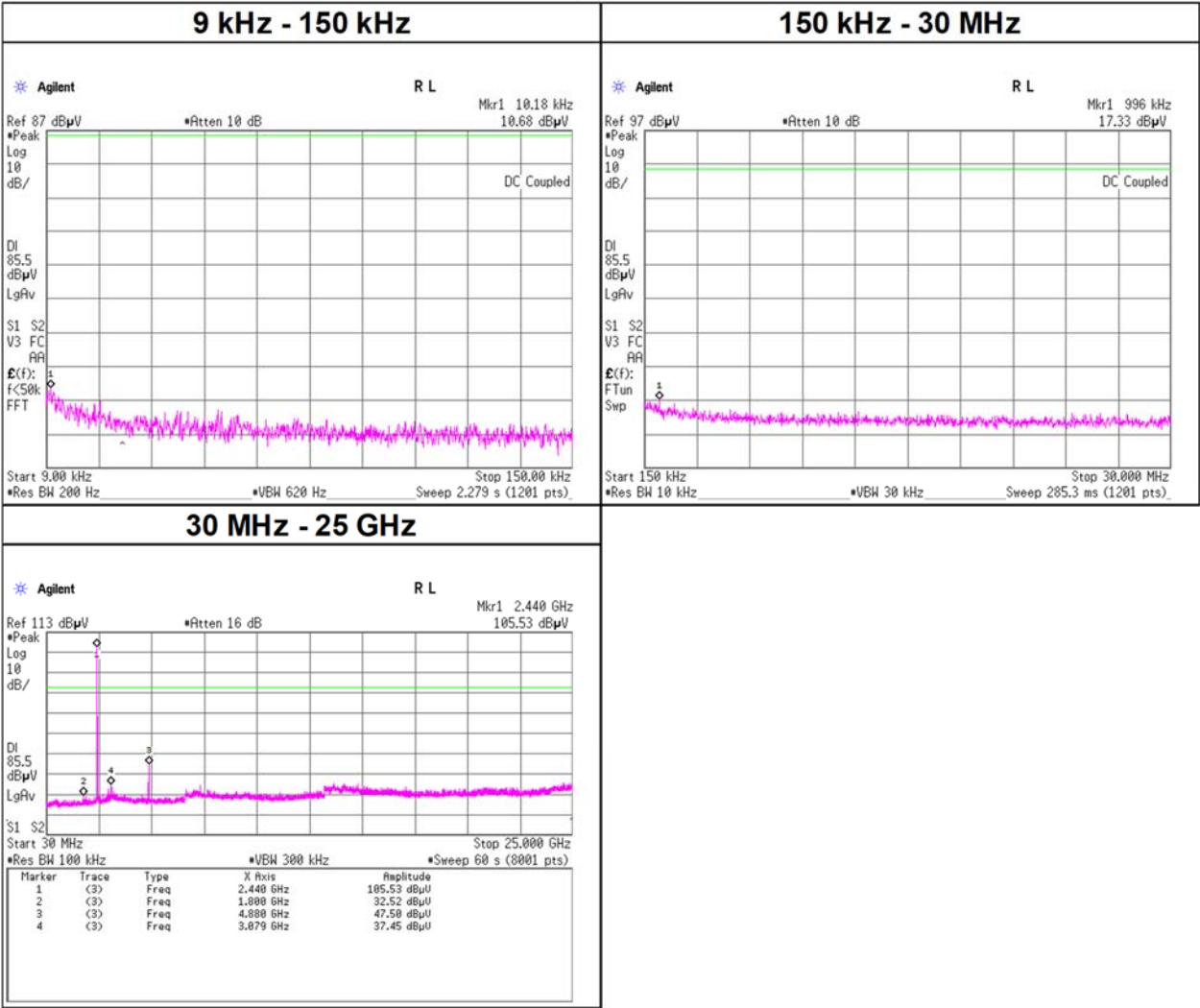
2402 MHz



Conducted Spurious Emission

Test place Shonan EMC Lab. No.2 Measurement Room
Date September 16, 2023
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping Off, 3DH5

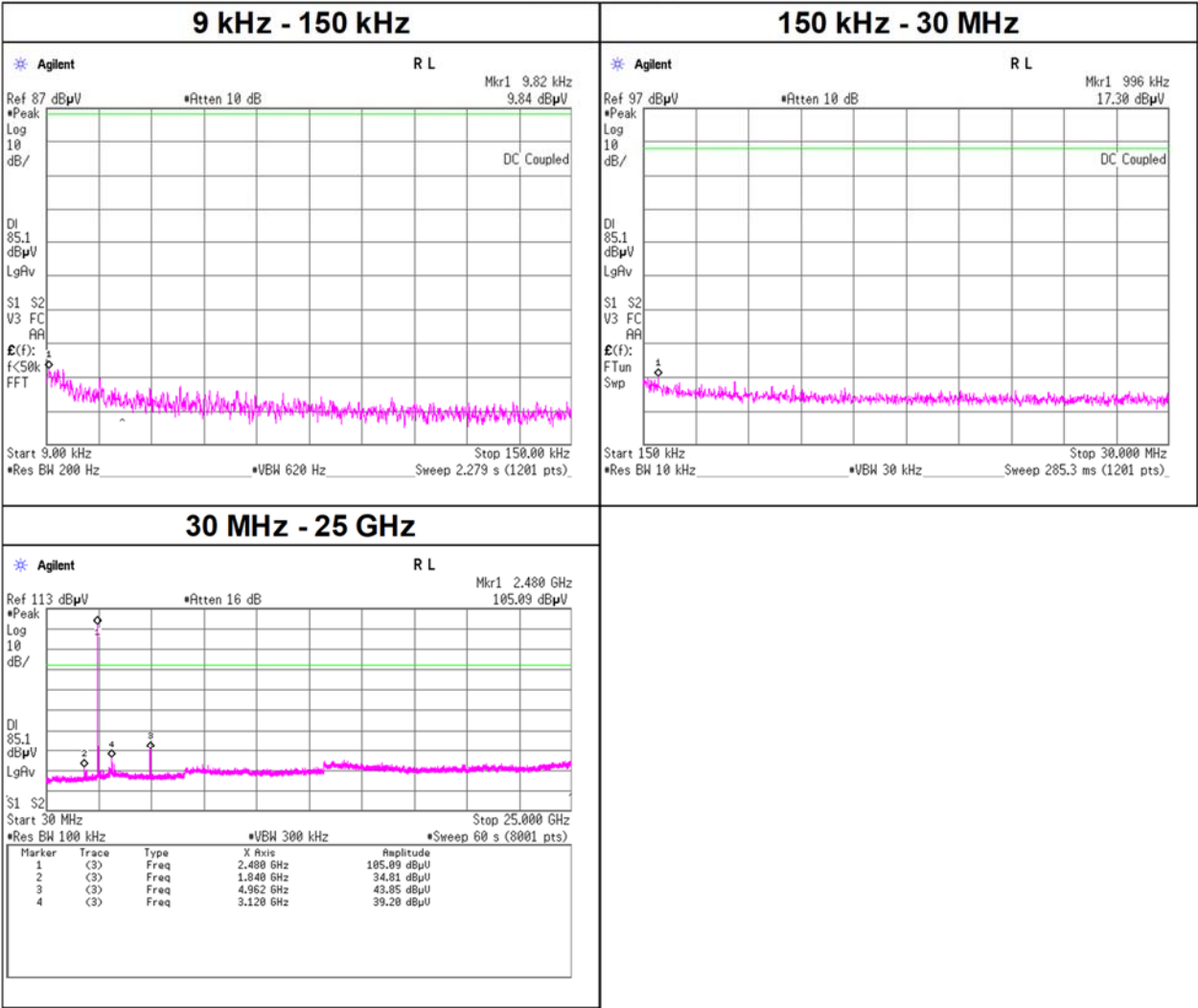
2441 MHz



Conducted Spurious Emission

Test place Shonan EMC Lab. No.2 Measurement Room
Date September 16, 2023
Temperature / Humidity 26 deg. C / 45 % RH
Engineer Kenichi Adachi
Mode Tx, Hopping Off, 3DH5

2480 MHz



APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	145095	Digital Tester	SANWA	PC500	7019224	2024/05/29	12
AT	145110	Digital Tester	SANWA	PC500	7019240	2024/05/29	12
AT	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2023/10/13	12
AT	145801	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250152	2024/02/27	12
AT	146190	Terminator	TME	CT-01 BP	-	2023/12/08	12
AT	146198	Terminator	TME	CT-01 BP	-	2024/02/16	12
AT	146207	Terminator	JFW	50T-128	-	2023/11/22	12
AT	146212	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997828	2023/09/25	12
AT	146247	Power Meter	Keysight Technologies Inc	8990B	MY51000272	2024/05/14	12
AT	146310	Power sensor	Keysight Technologies Inc	N1923A	MY5326009	2024/05/14	12
AT	146311	Power sensor	Keysight Technologies Inc	N1923A	MY5349008	2024/05/14	12
AT	146362	Thermo-Hygrometer	CUSTOM. Inc	CTH-190	K-07	2023/08/03	12
AT	150461	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186392	2023/05/02	12
AT	160494	Attenuator	Weinschel Corp.	54A-10	83420	2023/12/12	12
AT	160495	Attenuator	Weinschel Corp.	54A-20	86752	2023/12/08	12
AT	160496	Attenuator	Weinschel Corp.	54A-20	87636	2023/12/08	12
AT	160899	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46185516	2023/12/29	12
AT	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2023/09/28	12
AT	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2023/09/28	12
AT	169912	Power sensor	Keysight Technologies Inc	N1923A	MY57290005	2023/09/28	12
AT	171614	Terminator	Weinschel - API Technologies Corp	M1459A	88995	2024/05/10	12
AT	171615	Terminator	Weinschel - API Technologies Corp	M1459A	88997	2024/05/09	12
AT	171616	Terminator	Weinschel - API Technologies Corp	M1459A	89025	2024/05/09	12
AT	179106	Coaxial Cable	Junkosha	MWX241-01000KMSKMS/B	1901Q061-R	2024/04/10	12
AT	179107	Coaxial Cable	Junkosha	MWX241-01000KMSKMS/B	1901Q062-R	2024/04/10	12
AT	191845	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2023/08/07	12
AT	196937	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803605/2	2024/03/07	12
AT	196941	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803093/2	2024/03/07	12
AT	235604	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY45300743	2024/05/23	12
CE	145035	Coaxial Cable	Suhner	RG223U	-	2024/04/01	12
CE	145541	LISN	Rohde & Schwarz	ENV216	100514	2024/02/06	12
CE	145542	LISN	Rohde & Schwarz	ENV216	100516	2024/02/06	12
CE	145746	Terminator	TME	CT-01 BP	-	2023/12/08	12
CE	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2023/09/25	12
CE	146294	Humidity Indicator	A&D Company	AD-5681	4062118	-	-
CE	146432	Tape Measure	TAJIMA	GL19-55	-	-	-
CE	199786	Attenuator	JFW	50HF-006N	-	2024/06/14	12
CE	213530	Test Receiver	Rohde & Schwarz	ESW44	103068	2024/02/22	12
CE,RE	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	Ver 3.1.0546	-	-
RE	144878	Pre Amplifier	Hewlett Packard	8449B	3008A01268	2024/04/04	12
RE	144941	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	230	2024/05/13	12
RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2024/03/05	12
RE	145137	Attenuator	Keysight Technologies Inc	8493C-010	74865	2023/10/11	12
RE	145178	Coaxial Cable	Suhner	SUCOFLEX 102A	1188/2A	2023/08/23	12
RE	145301	Highpass Filter	Micro-Tronics	HPM50111	51	2023/10/13	12
RE	145512	Horn Antenna	ETS-Lindgren	3160-09	00094868	2023/06/12	12
RE	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2024/03/25	12
RE	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2024/03/05	12
RE	194684	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	695	2024/03/11	12
RE	200009	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575617/4	2024/06/05	12
RE	207280	Tape Measure	ASKUL	-	-	-	-
RE	235267	Test Receiver	Rohde & Schwarz	ESW44	103018	2024/03/05	12
RE	235639	DIGITAL MULTIMETER	HIOKI E.E. CORPORATION	DT4261	230313156	2024/05/29	12
RE	235735	Thermo-Hygrometer	CUSTOM. Inc	CTH-230	-	2024/04/28	12
RE	236616	Semi-Anechoic Chamber	TDK	SWAC-01(SVSWR)	1	2024/06/04	12
RE	236708	Coaxial Cable	Hayashi-Repic co., Ltd.	NMS079B-GL310C-SMS117B-2m	47256-02-03	2024/05/09	12
RE	236755	Coaxial Cable	Huber+Suhner	SF106/11N/11N/6000	2001166	2023/05/23	12
RE	239643	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	2306S021	2023/08/22	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