RADIO TEST REPORT

Test Report No. 14747914S-A

Customer	**Panasonic Automotive Systems Co., Ltd.**
Description of EUT	**Car Navigation**
Model Number of EUT	**AT2403**
FCC ID	**ACJ932AT2403**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**October 25, 2024**
Remarks	**Bluetooth (BR / EDR) parts** **Antenna Terminal Conducted Tests**

Representative Test Engineer	**Approved By**
Kouki Yamada Engineer	Shinichi Takano Engineer

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".

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REVISION HISTORY

Original Test Report No.: 14747914S-A

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14747914S-A	October 25, 2024	-

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer Information

Company Name	Panasonic Automotive Systems Co., Ltd. *1)
Address	4261, Ikonobe-cho, Tsuzuki-ku, Yokohama-shi, Kanagawa-ken 224-8520, Japan
Telephone Number	+81-50-1802-5117
Contact Person	Daisuke Takahata

*1) The Grantee name in the FCC application is “Panasonic Corporation of North America”.

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 Navigation
Model Number	AT2403
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	April 3, 2023
Test Date	April 20 and 21, 2023

2.2 Product Description

General Specification

Rating	DC 13.2 V
Operating temperature	-30 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.

Bluetooth (BR / EDR / BT LE)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	FHSS, GFSK / π/4-DQPSK, 8DPSK / GFSK
Antenna Gain[a)]	4.00 dBi

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

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
	OFDMA: (20 MHz band): 26/52/106/242-tone RU
Antenna Gain[a)]	4.00 dBi

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

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band	5180 MHz to 5240 MHz 5745 MHz to 5825 MHz
	40 MHz Band	5190 MHz to 5230 MHz 5755 MHz to 5795 MHz
	80 MHz Band	5210 MHz, 5775 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
Antenna Gain[a)]	RF0: 5.00 dBi, RF1: 5.00 dBi	

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

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

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207	-	N/A	*1)
	ISED: RSS-Gen 8.8	**ISED:** RSS-Gen 8.8			
Carrier Frequency Separation	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)	See data.	Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (b)			
20 dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (a)			
Number of Hopping Frequency	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)(iii)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (d)			
Dwell time	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)(iii)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (d)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(b)(1)		Complied	Conducted
	ISED: RSS-Gen 6.12	**ISED:** RSS-247 5.4 (b)			
Spurious Emission & Band Edge Compliance	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	See data.	Complied	Conducted
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred. *1) The test is not applicable since the EUT does not have AC Mains.					

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the RF Part regardless of input voltage.
Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the 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.

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: 9 (Setting Value)
Software: bluetooth_serial Version: 3
(Date: 2023.04.18, Storage location: Driven by connected PC)

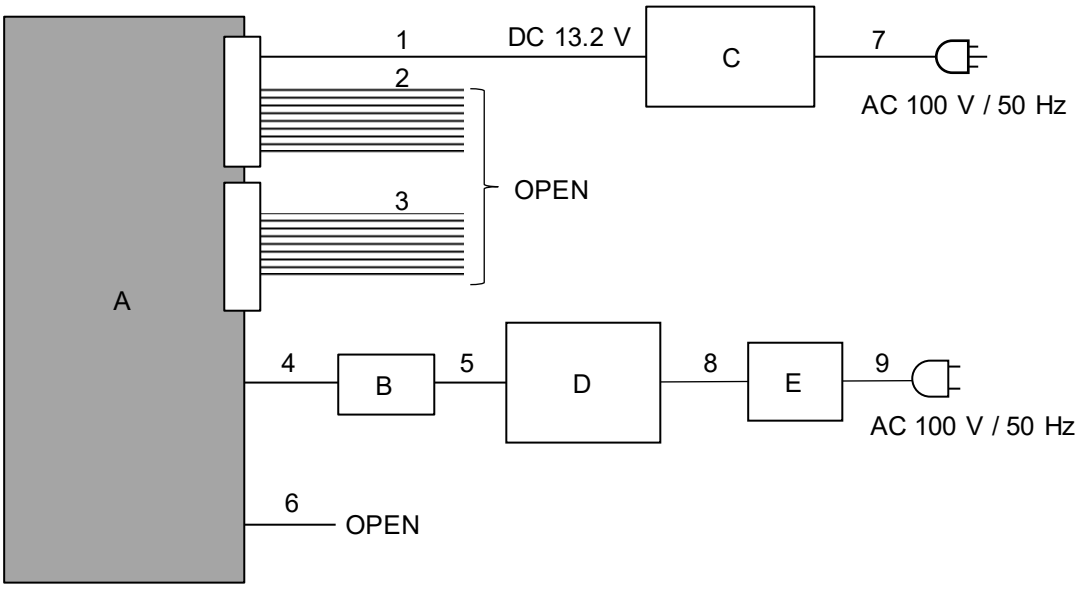
*This setting of software is the worst case.
Any conditions under the normal use do not exceed the condition of setting.
In addition, end users cannot change the settings of the output power of the product.

Details of Operating Mode(s)

Test Item	Mode	Hopping	Tested Frequency
Conducted 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
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
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.

4.2 Configuration and Peripherals



Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	Car Navigation	AT2403	008	Panasonic	EUT
B	Jig Board	-	-	-	-
C	Power Supply(DC)	PAN35-10A	DE001677	KIKUSUI	-
D	Laptop Computer	ThinkPad E14 Gen2	PF397TQG	LENOVO	-
E	AC Adapter	ADLX65YCC2D	8SSA10R16922C2TJ19M1368	LENOVO	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	1.0 + 1.9	Unshielded	Unshielded	-
2	Signal	1.0	Unshielded	Unshielded	-
3	Signal	1.0	Unshielded	Unshielded	-
4	Signal	0.1	Unshielded	Unshielded	-
5	USB	0.8	Shielded	Shielded	-
6	Signal	0.1	Unshielded	Unshielded	-
7	AC	2.0	Unshielded	Unshielded	-
8	DC	1.8	Unshielded	Unshielded	-
9	AC	0.9	Unshielded	Unshielded	-

SECTION 5: 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	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	13 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz -150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)
*4) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 – 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

Test Data : APPENDIX
Test Result : Pass

APPENDIX 1: Test data

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

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, Tx, Hopping On

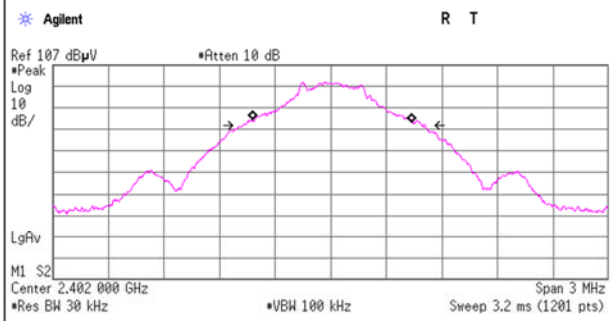
Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.984	861.4	1.000	>= 0.656
DH5	2441.0	0.965	866.2	1.000	>= 0.643
DH5	2480.0	0.957	855.1	1.000	>= 0.638
DH5	Hopping On	-	78640.3	-	-
3DH5	2402.0	1.312	1183.0	1.000	>= 0.875
3DH5	2441.0	1.318	1190.9	1.000	>= 0.879
3DH5	2480.0	1.311	1175.5	1.000	>= 0.874
3DH5	Hopping On	-	78794.4	-	-

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

DH5

2402 MHz

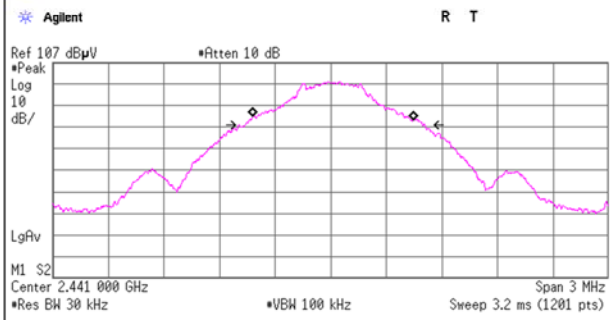


Occupied Bandwidth
861.3971 kHz

Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error 7.860 kHz
x dB Bandwidth 983.783 kHz

2441 MHz

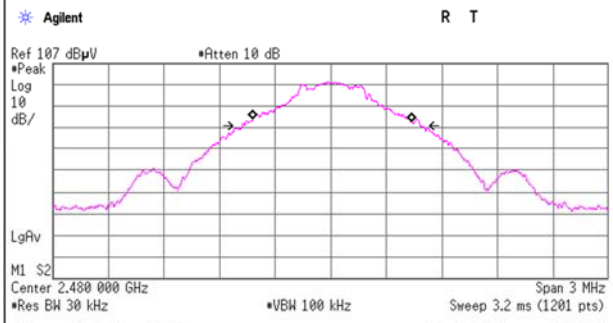


Occupied Bandwidth
866.2437 kHz

Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error 11.183 kHz
x dB Bandwidth 965.279 kHz

2480 MHz



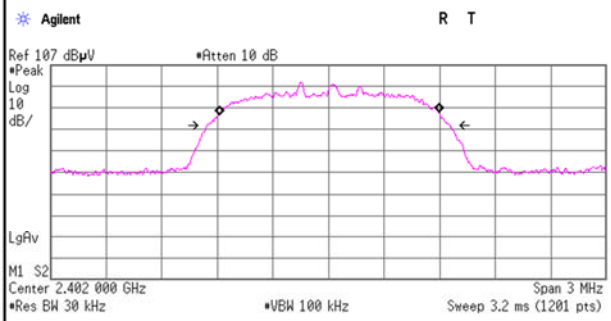
Occupied Bandwidth
855.0754 kHz

Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error 7.838 kHz
x dB Bandwidth 956.836 kHz

3DH5

2402 MHz

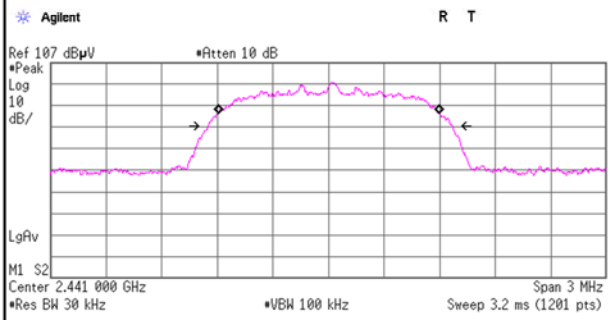


Occupied Bandwidth
1.1830 MHz

Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error 3.656 kHz
x dB Bandwidth 1.312 MHz

2441 MHz

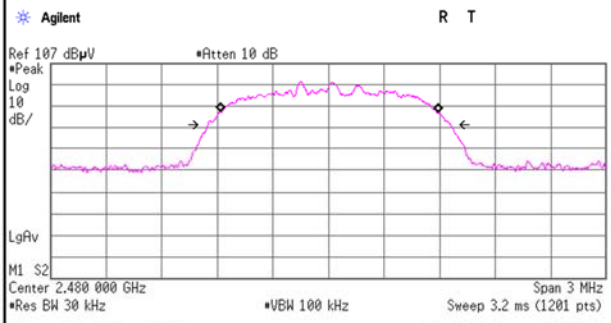


Occupied Bandwidth
1.1909 MHz

Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error 4.547 kHz
x dB Bandwidth 1.318 MHz

2480 MHz



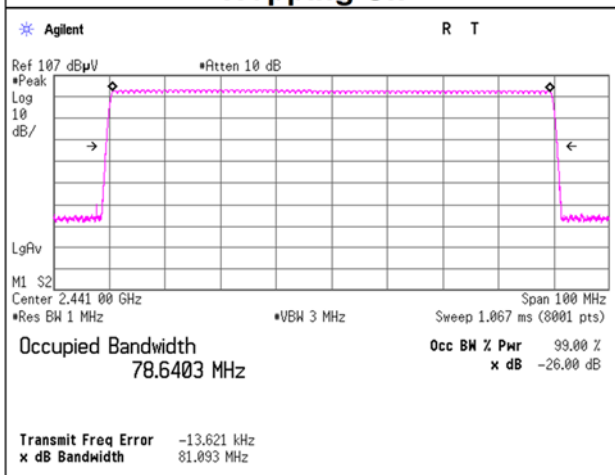
Occupied Bandwidth
1.1755 MHz

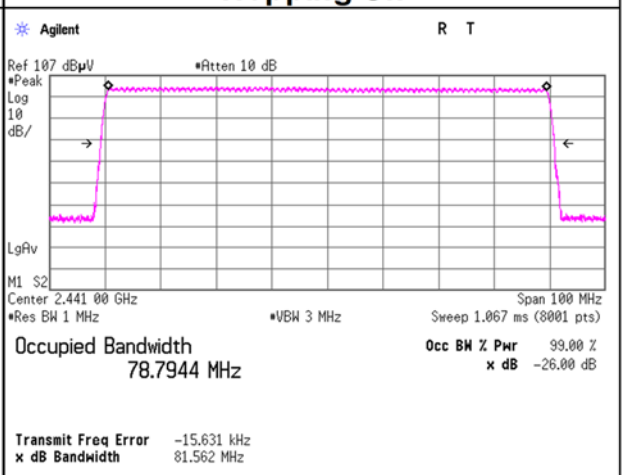
Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error 5.604 kHz
x dB Bandwidth 1.311 MHz

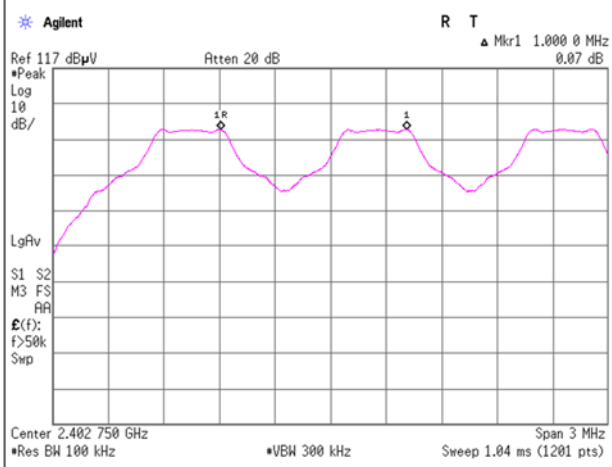
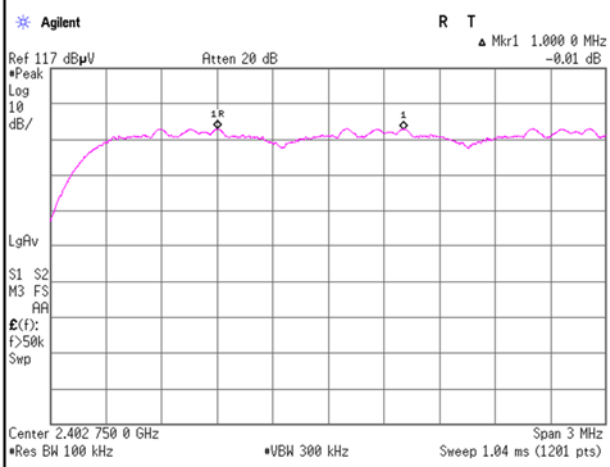
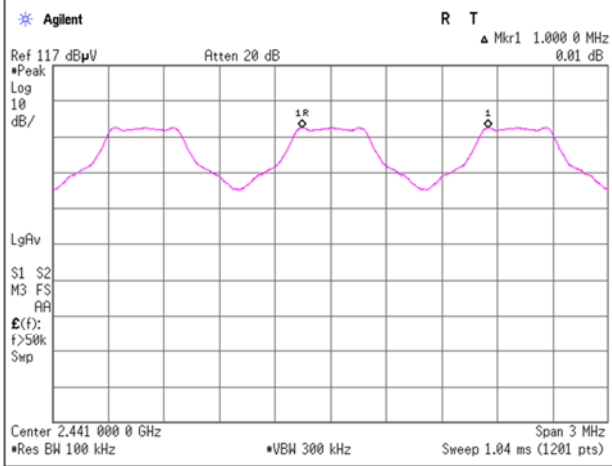
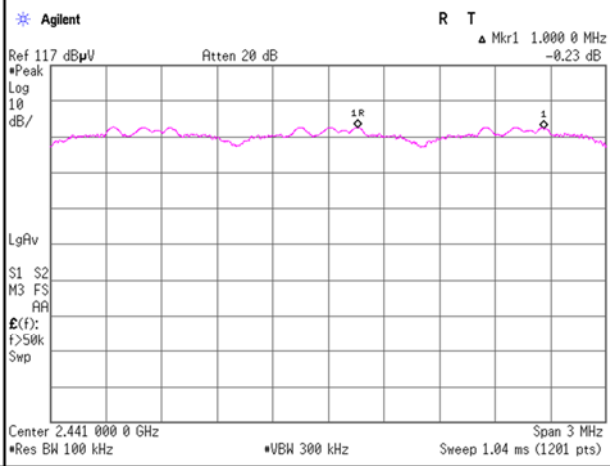
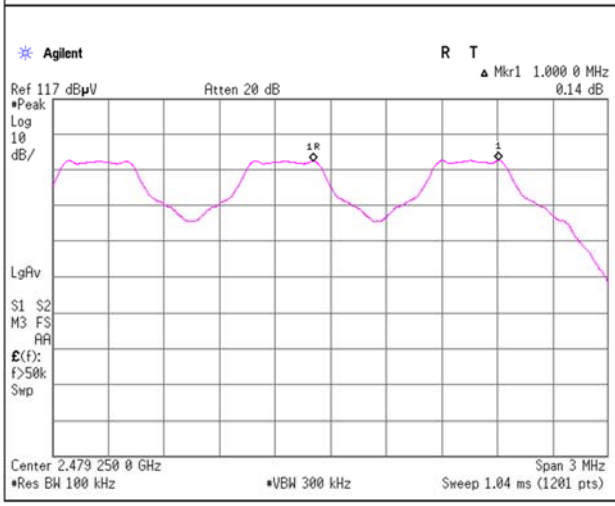
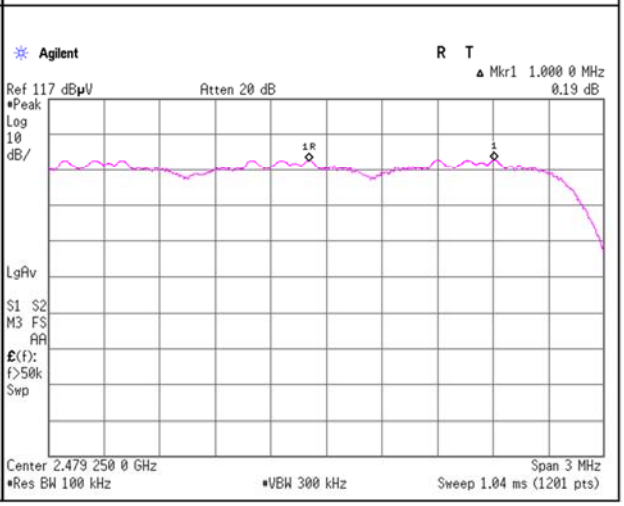
20 dB Bandwidth and 99 % Occupied Bandwidth

DH5	3DH5
Hopping On	Hopping On





Carrier Frequency Separation

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

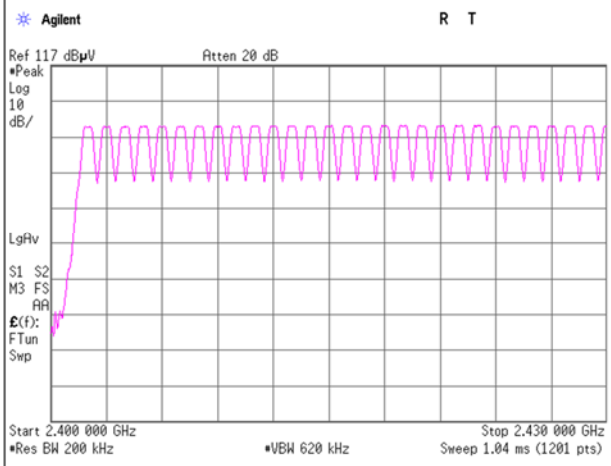
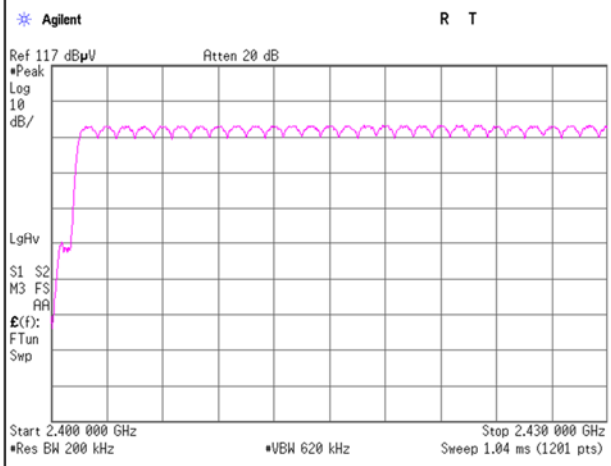
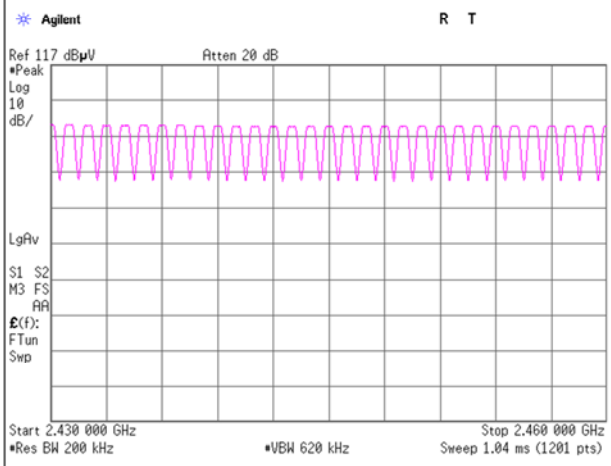
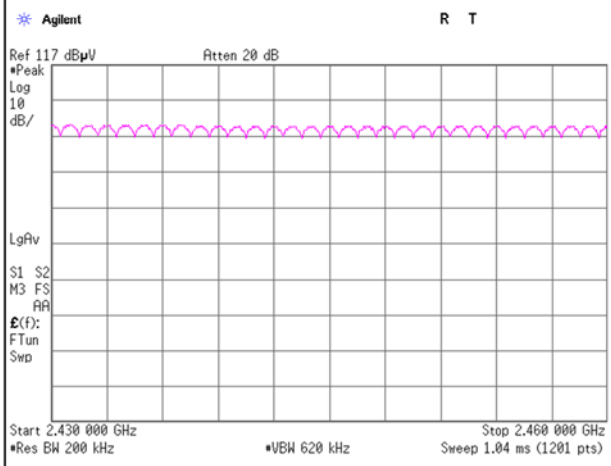
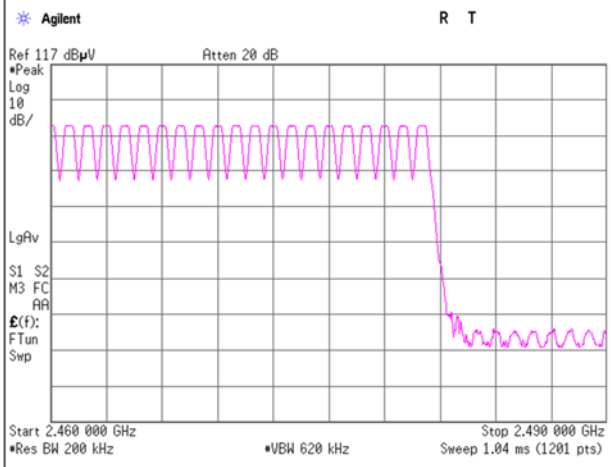
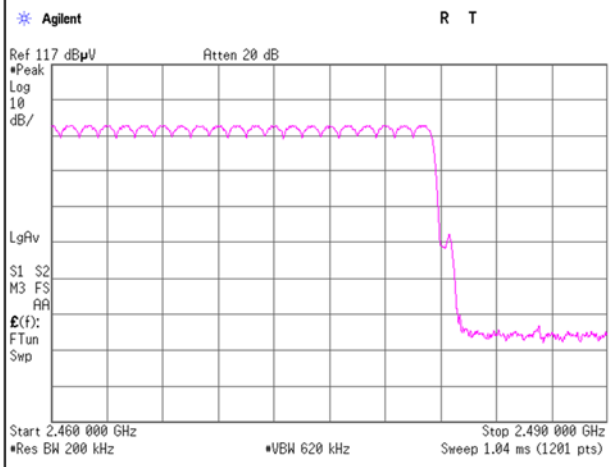
Number of Hopping Frequency

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping On

Mode	Number of channel [channels]	Limit [channels]
DH5	79	>= 15
3DH5	79	>= 15

Test was not performed at AFH mode whose number of hopping channel is 20 channels because this Bluetooth radio is in compliance of Bluetooth Specification.

Number of Hopping Frequency

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

Dwell time

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
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	49.4 times / 5 s x 31.6 s = 313 times	0.407	127	400
DH3	26.6 times / 5 s x 31.6 s = 169 times	1.662	281	400
DH5	19.8 times / 5 s x 31.6 s = 126 times	2.911	367	400
3DH1	51.2 times / 5 s x 31.6 s = 324 times	0.411	133	400
3DH3	24.6 times / 5 s x 31.6 s = 156 times	1.662	259	400
3DH5	19.0 times / 5 s x 31.6 s = 121 times	2.915	353	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	50	50	50	51	46	49.4
DH3	26	25	28	26	28	26.6
DH5	20	19	19	20	21	19.8
3DH1	50	52	50	52	52	51.2
3DH3	22	30	27	22	22	24.6
3DH5	20	18	21	18	18	19

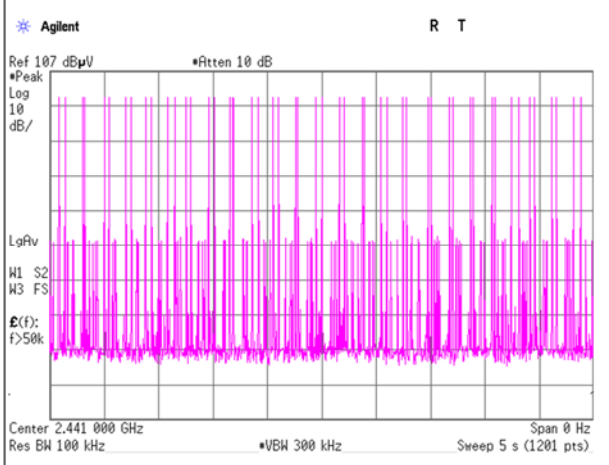
Sample Calculation

Average = Summation (Sampling 1 to 5) / 5

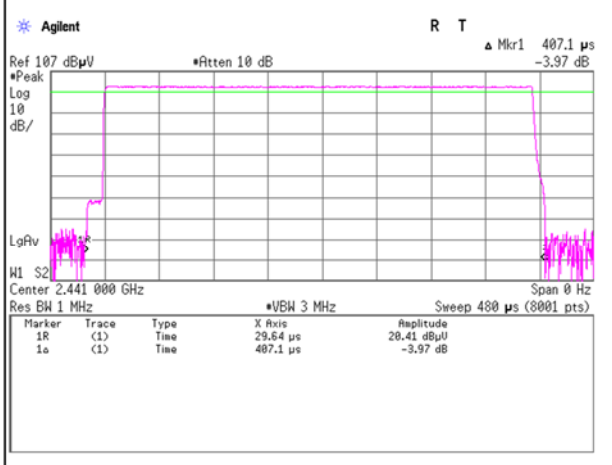
This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in N x 0.4 s, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than 0.4 s regardless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

Dwell time

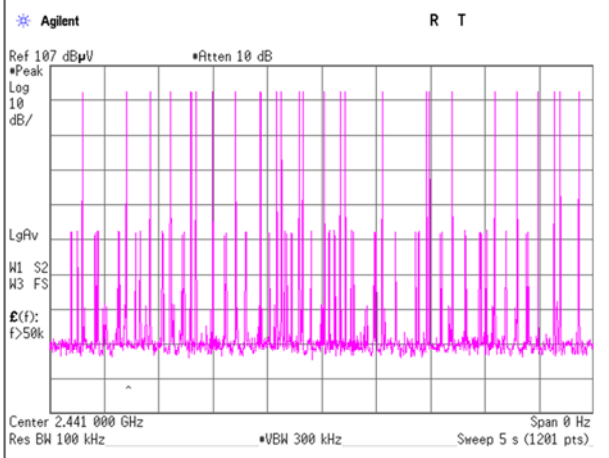
DH1 (1/2)
(Representative chart)



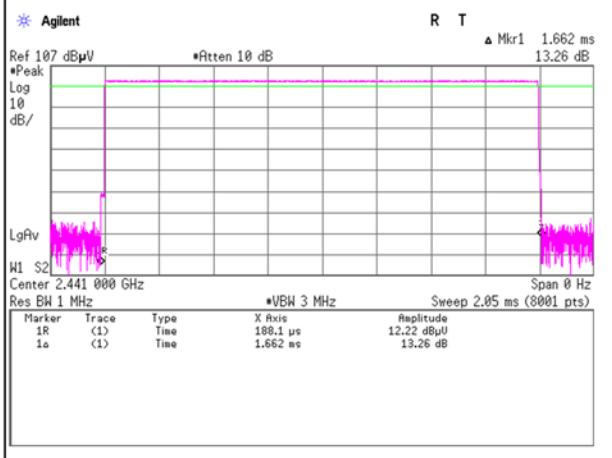
DH1 (2/2)



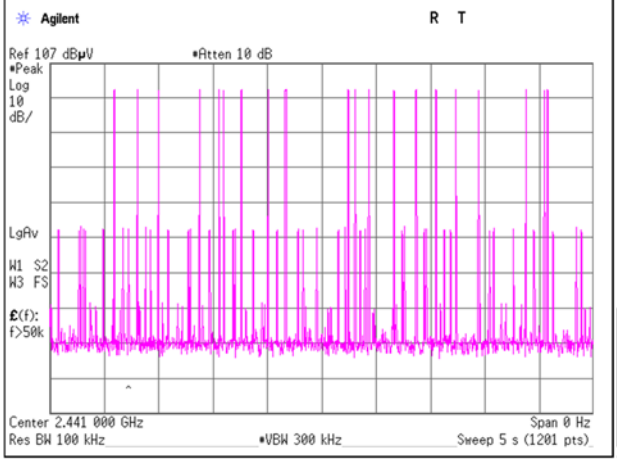
DH3 (1/2)
(Representative chart)



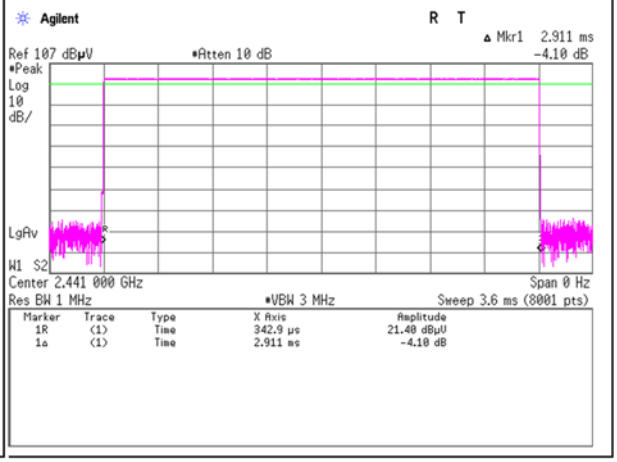
DH3 (2/2)



DH5 (1/2)
(Representative chart)

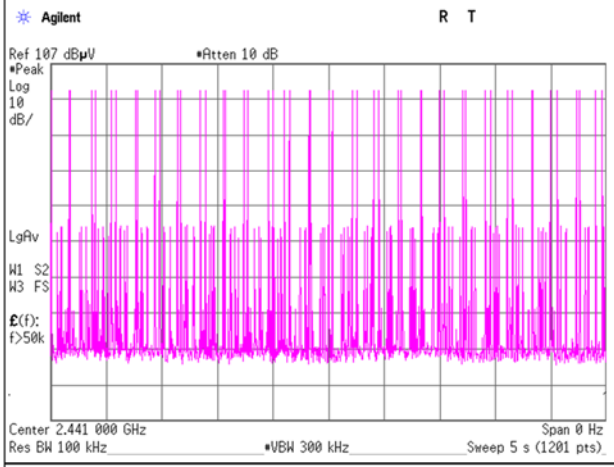


DH5 (2/2)

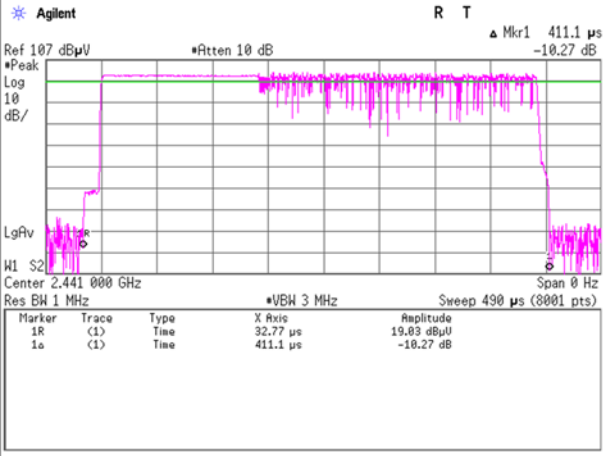


Dwell time

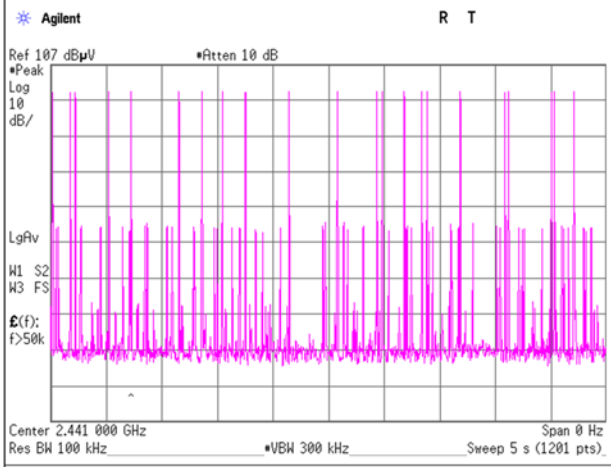
3DH1 (1/2)
(Representative chart)



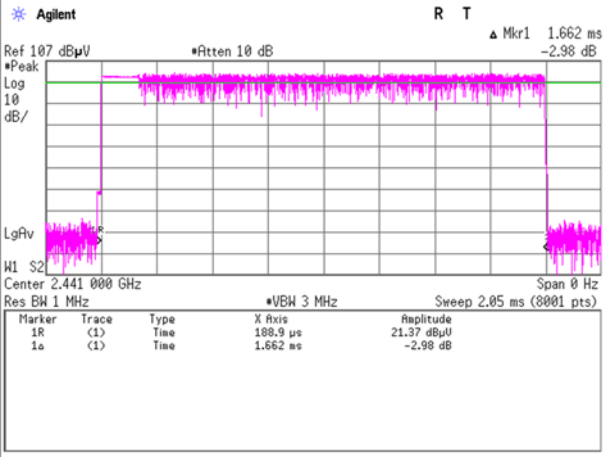
3DH1 (2/2)



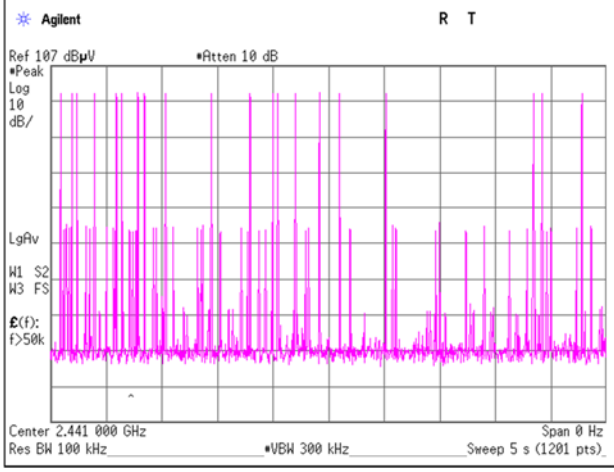
3DH3 (1/2)
(Representative chart)



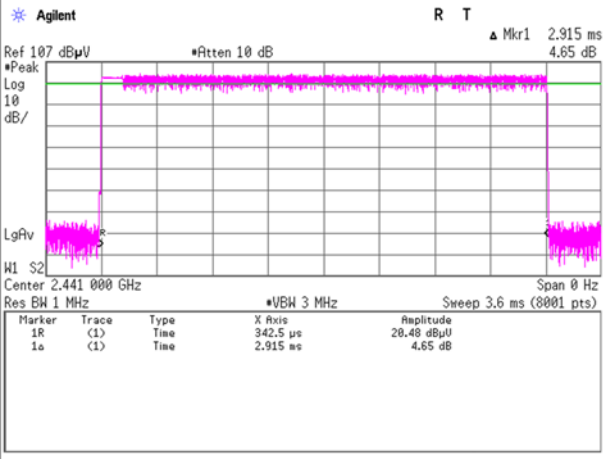
3DH3 (2/2)



3DH5 (1/2)
(Representative chart)



3DH5 (2/2)



Maximum Peak Output Power

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 20, 2023
Temperature / Humidity	27 deg. C / 46 % RH
Engineer	Kouki Yamada
Mode	Tx, Hopping Off

Maximum peak output power

					Conducted Power					e.i.r.p. for RSS-247					
Mode	Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
DH5	2402	-6.80	2.30	9.64	5.14	3.27	20.97	125	15.83	4.00	9.14	8.20	36.02	4000	26.88
DH5	2441	-7.10	2.31	9.64	4.85	3.05	20.97	125	16.12	4.00	8.85	7.67	36.02	4000	27.17
DH5	2480	-6.98	2.33	9.64	4.99	3.16	20.97	125	15.98	4.00	8.99	7.93	36.02	4000	27.03
2DH5	2402	-5.30	2.30	9.64	6.64	4.61	20.97	125	14.33	4.00	10.64	11.59	36.02	4000	25.38
2DH5	2441	-5.61	2.31	9.64	6.34	4.31	20.97	125	14.63	4.00	10.34	10.81	36.02	4000	25.68
2DH5	2480	-5.49	2.33	9.64	6.48	4.45	20.97	125	14.49	4.00	10.48	11.17	36.02	4000	25.54
3DH5	2402	-4.91	2.30	9.64	7.03	5.05	20.97	125	13.94	4.00	11.03	12.68	36.02	4000	24.99
3DH5	2441	-5.18	2.31	9.64	6.77	4.75	20.97	125	14.20	4.00	10.77	11.94	36.02	4000	25.25
3DH5	2480	-5.08	2.33	9.64	6.89	4.89	20.97	125	14.08	4.00	10.89	12.27	36.02	4000	25.13

Sample Calculation:
Result = Reading + Cable Loss + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

All comparison were carried out on same frequency and measurement factors.

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 power (Reference data for RF Exposure)

Mode	Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
DH5	2402	-8.45	2.30	9.64	3.49	2.23	1.09	4.58	2.87
DH5	2441	-8.78	2.31	9.64	3.17	2.07	1.09	4.26	2.67
DH5	2480	-8.64	2.33	9.64	3.33	2.15	1.09	4.42	2.77
2DH5	2402	-8.95	2.30	9.64	2.99	1.99	1.09	4.08	2.56
2DH5	2441	-9.29	2.31	9.64	2.66	1.85	1.09	3.75	2.37
2DH5	2480	-9.12	2.33	9.64	2.85	1.93	1.09	3.94	2.48
3DH5	2402	-8.94	2.30	9.64	3.00	2.00	1.09	4.09	2.56
3DH5	2441	-9.29	2.31	9.64	2.66	1.85	1.09	3.75	2.37
3DH5	2480	-9.11	2.33	9.64	2.86	1.93	1.09	3.95	2.48

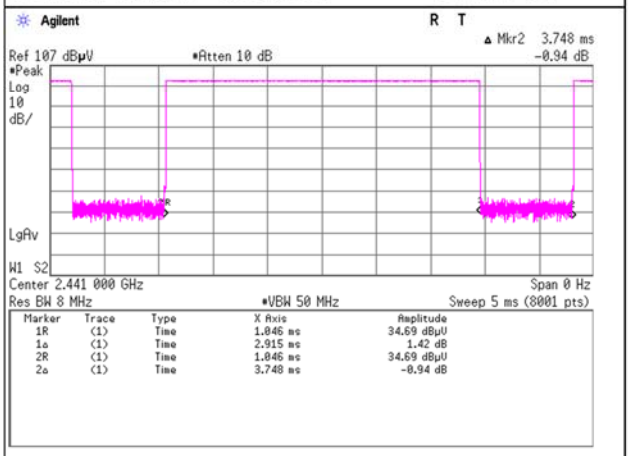
Sample Calculation:
Result (Time average) = Reading + Cable Loss + Attenuator Loss
Result (Burst power average) = Result (Time average) + Duty factor

Burst Rate Confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 20, 2023
Temperature / Humidity	27 deg. C / 46 % RH
Engineer	Kouki Yamada
Mode	Tx, Hopping Off

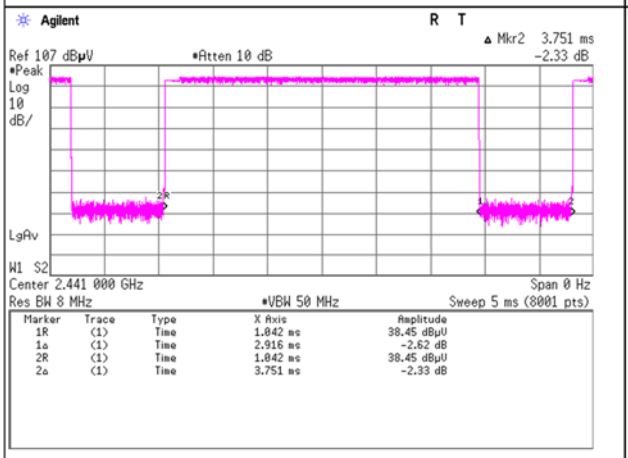
DH5

Tx on / (Tx on + Tx off) =	0.778
Tx on / (Tx on + Tx off) * 100 =	77.8 %
Duty factor = 10 * log (3.748 / 2.915) =	1.09 dB
VBW: 1 / on time = 343.08 Hz <	360.00 Hz



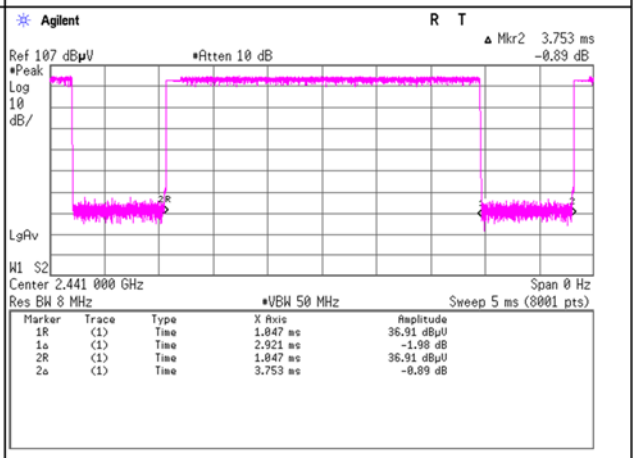
2DH5

Tx on / (Tx on + Tx off) =	0.777
Tx on / (Tx on + Tx off) * 100 =	77.7 %
Duty factor = 10 * log (3.751 / 2.916) =	1.09 dB
VBW: 1 / on time = 342.98 Hz <	360.00 Hz



3DH5

Tx on / (Tx on + Tx off) =	0.778
Tx on / (Tx on + Tx off) * 100 =	77.8 %
Duty factor = 10 * log (3.753 / 2.921) =	1.09 dB
VBW: 1 / on time = 342.39 Hz <	360.00 Hz

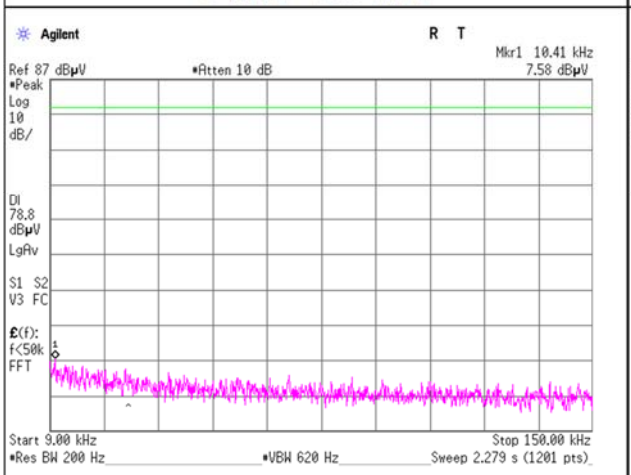


Conducted Spurious Emission

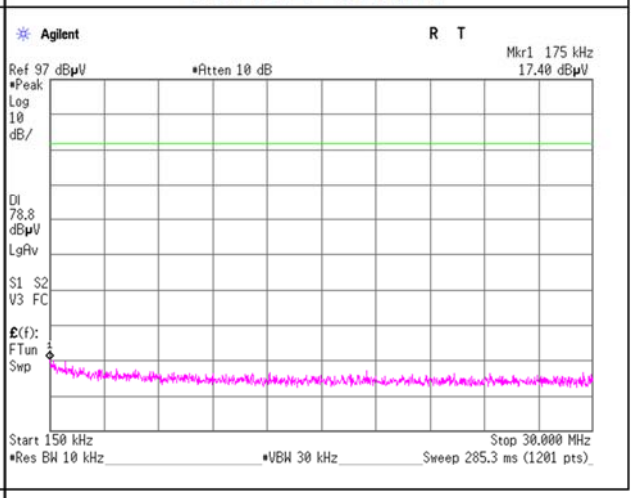
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, DH5

2402 MHz

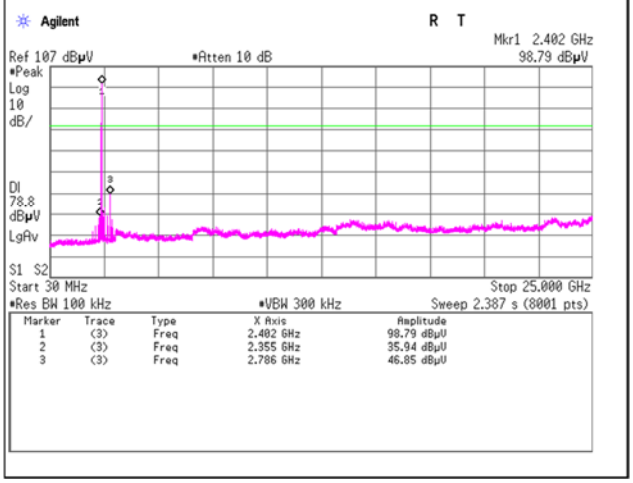
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

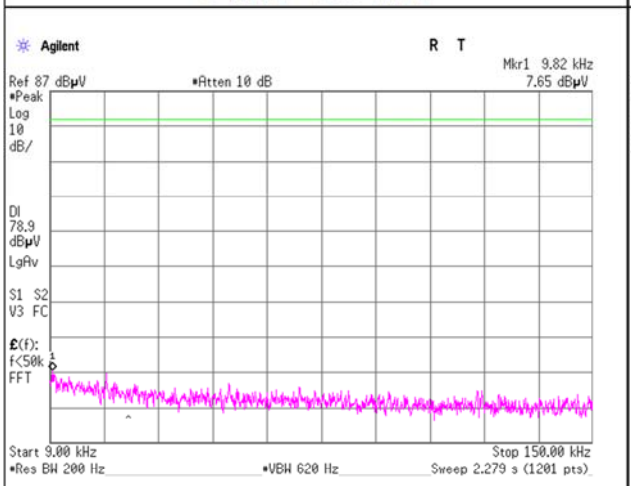


Conducted Spurious Emission

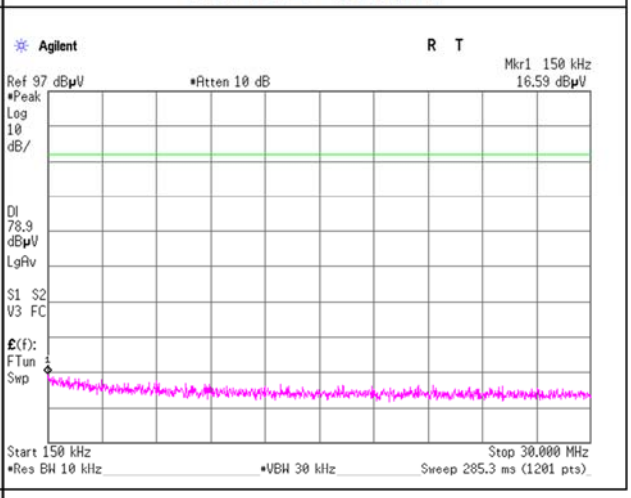
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, DH5

2441 MHz

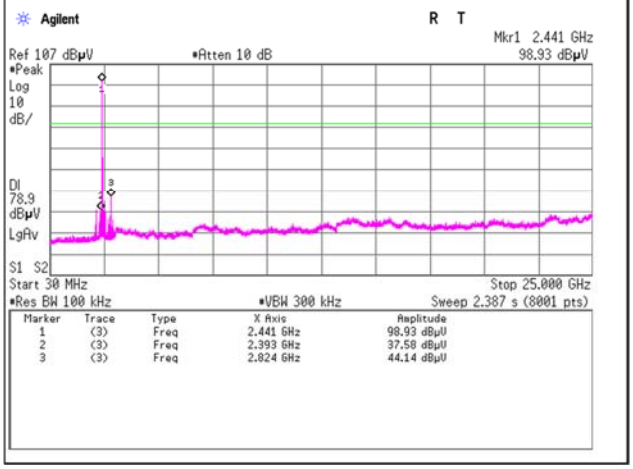
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

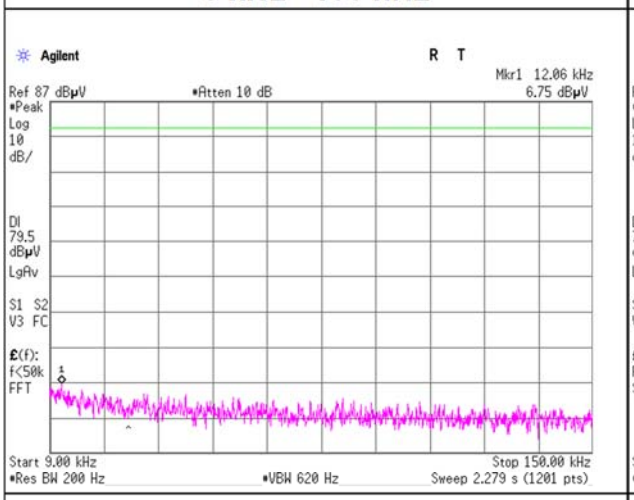


Conducted Spurious Emission

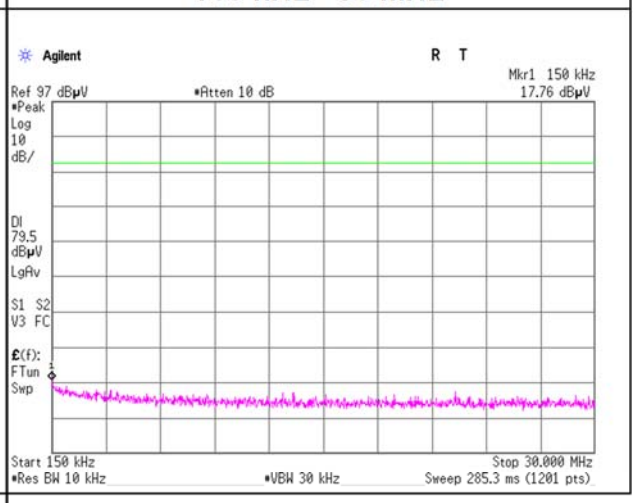
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, DH5

2480 MHz

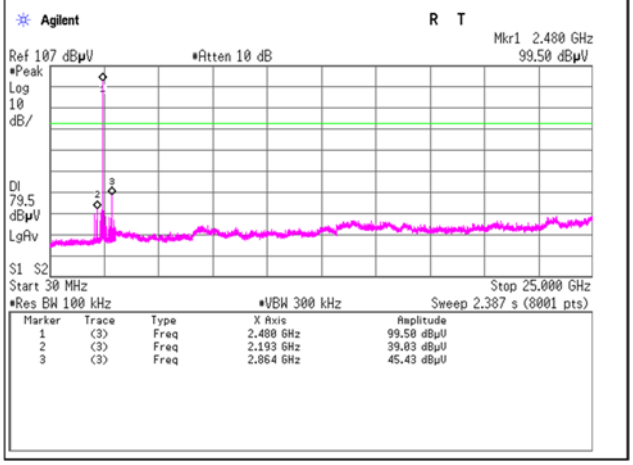
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

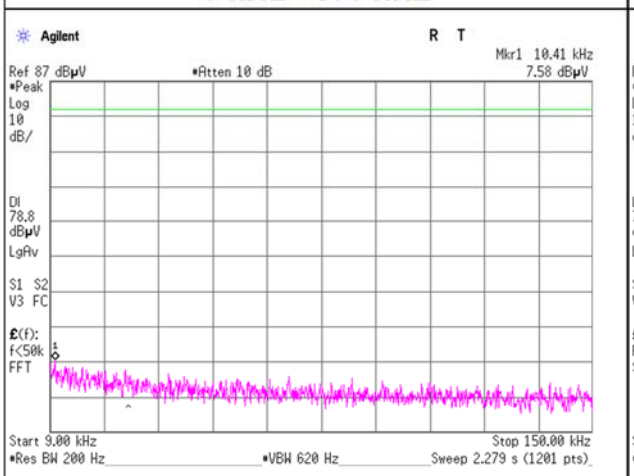


Conducted Spurious Emission

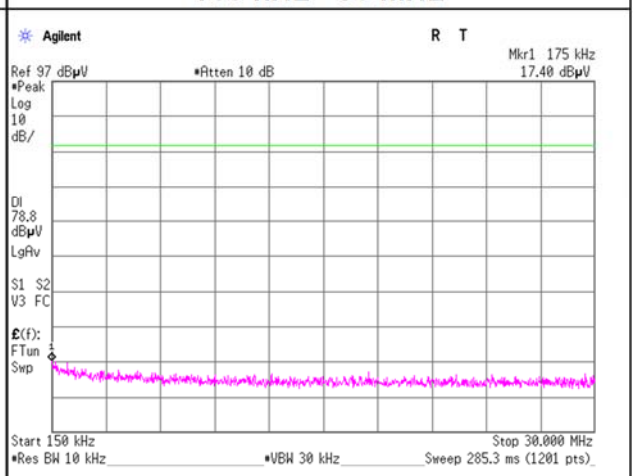
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, 3DH5

2402 MHz

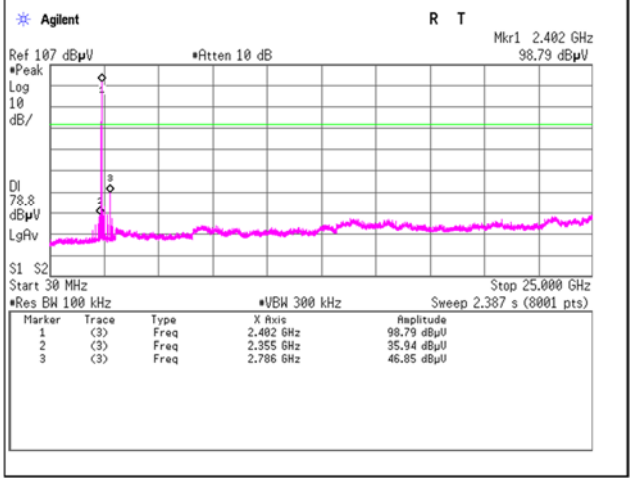
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

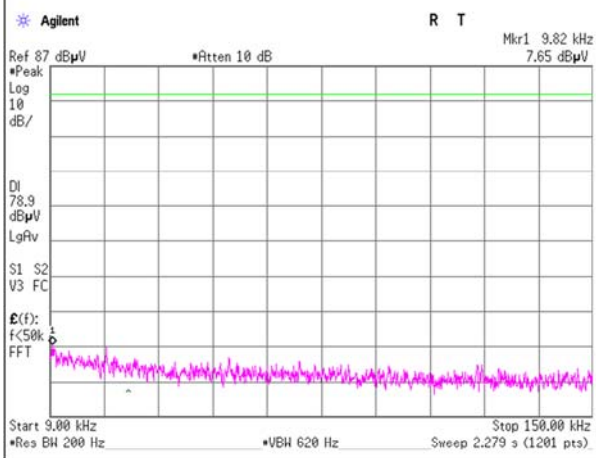


Conducted Spurious Emission

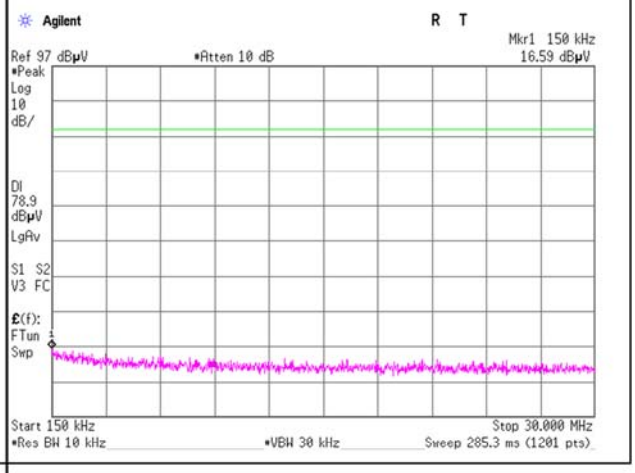
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, 3DH5

2441 MHz

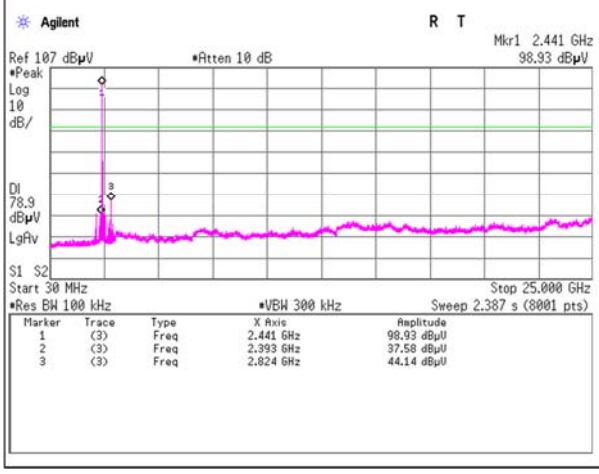
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

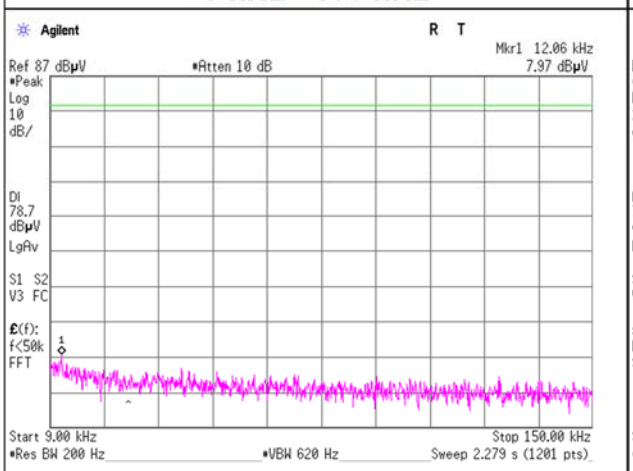


Conducted Spurious Emission

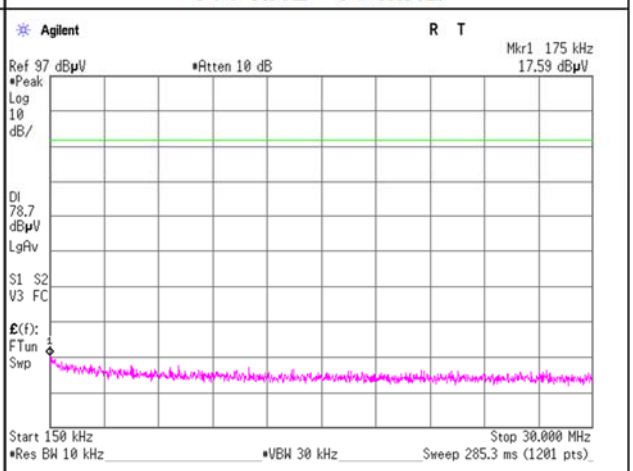
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, 3DH5

2480 MHz

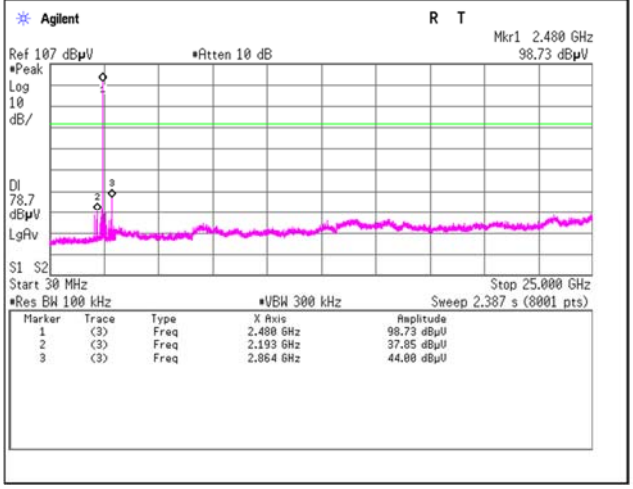
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

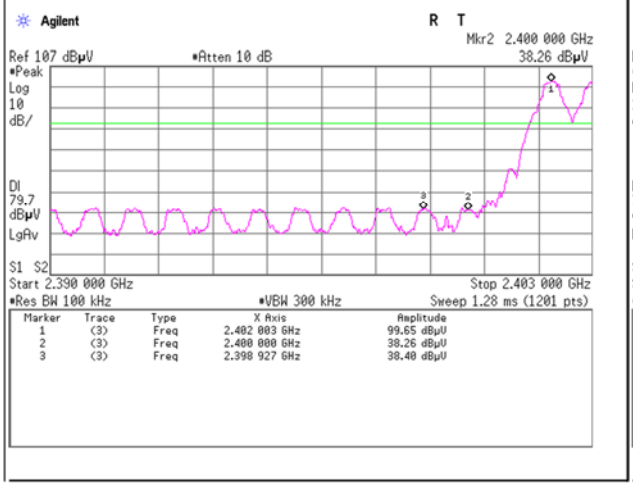


Conducted Emission Band Edge compliance

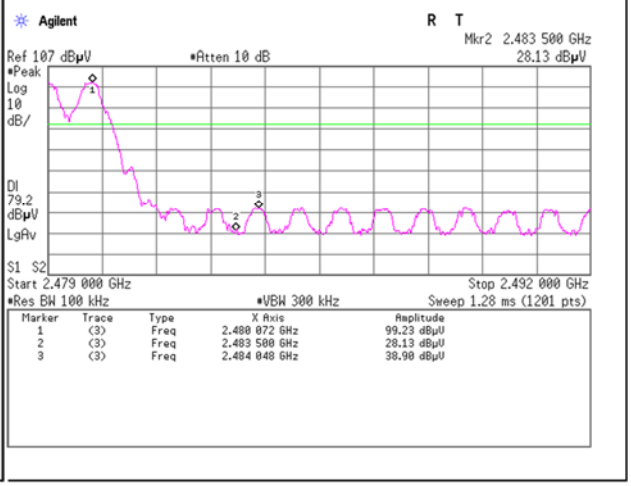
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx DH5

Hopping On

Low

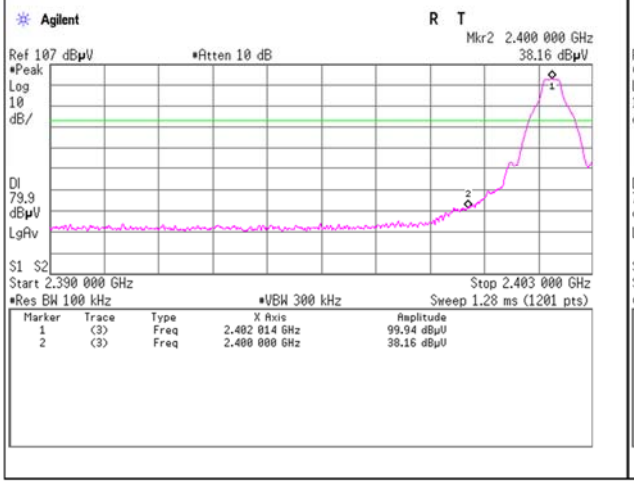


High

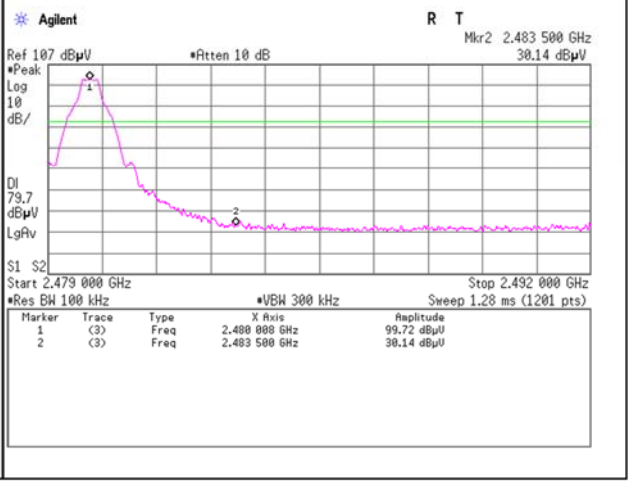


Hopping Off

Low



High

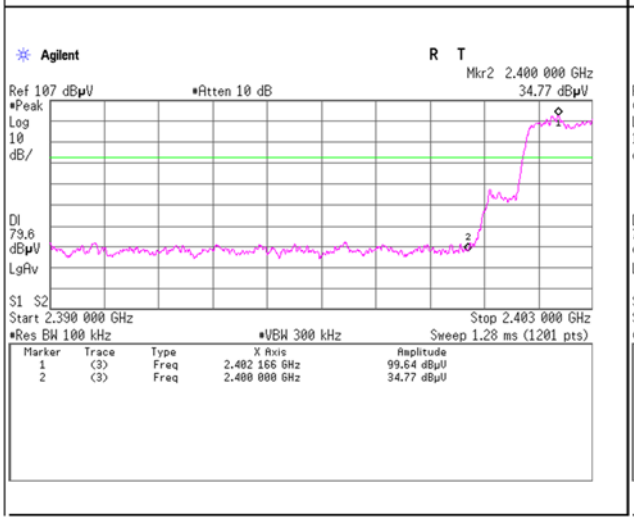


Conducted Emission Band Edge compliance

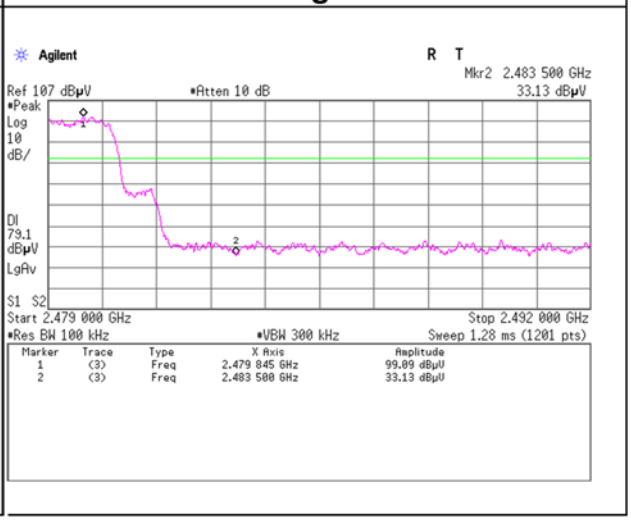
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	April 21, 2023
Temperature / Humidity	26 deg. C / 38 % RH
Engineer	Yosuke Murakami
Mode	Tx 3DH5

Hopping On

Low

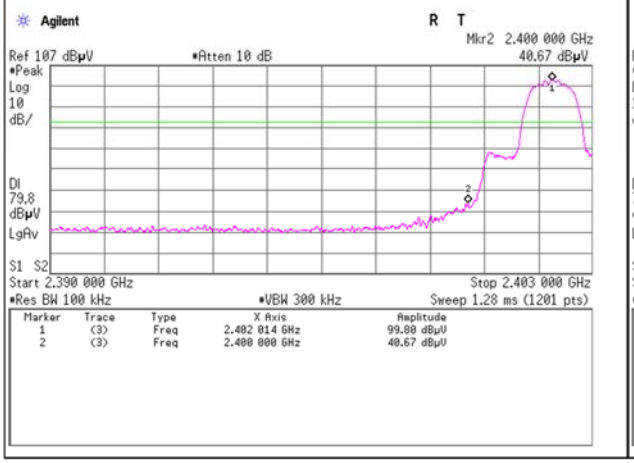


High

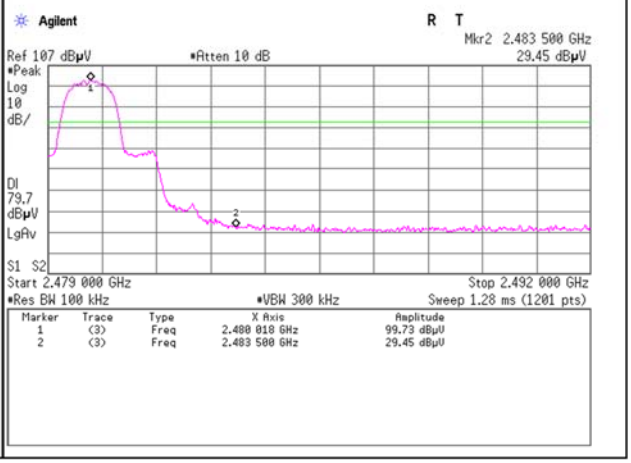


Hopping Off

Low



High



APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	145111	Digital Tester	SANWA	PC500	7019232	2022/09/20	12
AT	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2022/10/20	12
AT	145801	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250152	2022/08/04	12
AT	146062	Terminator	Hirose Electric	HRM-TMP-05(40)	-	-	-
AT	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2022/11/08	12
AT	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2022/11/08	12
AT	179106	Coaxial Cable	Junkosha	MWX241-01000KMSKMS/B	1901Q061-R	2023/04/12	12
AT	191845	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2022/08/08	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