



RADIO TEST REPORT

Test Report No. 14219579S-B

Customer	PIONEER CORPORATION
Description of EUT	Display Audio
Model Number of EUT	AVH-0239ZT
FCC ID	AJDK120
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied (Refer to SECTION 3)
Issue Date	May 31, 2022
Remarks	Bluetooth (BR / EDR) part(s) Antenna Terminal Conducted Tests only

Representative Test Engineer

Takahiro Kawakami
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# 20.0

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

REVISION HISTORY

Original Test Report No.: 14219579S-B

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14219579S-B	May 31, 2022	-

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	PIONEER CORPORATION
Address	25-1 Yamada, Kawagoe-shi, Saitama-ken 350-8555, JAPAN
Telephone Number	+81-49-228-7787
Contact Person	Shigeru Yoshida

The information provided from the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing
- * The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Display Audio
Model Number	AVH-0239ZT
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	March 1, 2022
Test Date	March 2, 2022

2.2 Product Description

The EUT has following similar models.

Product description	Model number	Feature							
		Bluetooth	WiFi	GNSS	steering position of vehicle	type of vehicle	voice recognition	premium sound	destination
Display Audio*	AVH-0239ZT	A	A	A	Left	B	A	NA	South America
Display Audio	AVH-0039ZT	A	A	A	Left	B	A	NA	Southeast Asia
Display Audio	AVH-0139ZT	A	A	A	Right	B	A	NA	Southeast Asia
Display Audio	AVH-0339ZT	A	A	A	Right	B	NA	NA	Malaysia
Display Audio	AVH-0439ZT	A	A	A	Right	B	A	NA	South America
Display Audio	AVH-0539ZT	A	A	A	Right	B	A	NA	Indonesia
Display Audio	AVH-0639ZT	A	A	A	Right	B	A	A	Thailand
Display Audio	AVH-0639ZT	A	A	A	Right	B	A	A	Thailand
Display Audio	AVH-0739ZT	A	A	A	Left	B	A	A	Southeast Asia
Display Audio	AVH-0939ZY	A	A	A	Right	B	NA	NA	Southeast Asia
Display Audio	AVH-1039ZY	A	A	A	Right	B	NA	NA	Asia
Display Audio	AVH-1139ZY	A	A	A	Left	B	NA	NA	South America
Display Audio	AVH-1239ZY	A	A	A	Right	B	NA	NA	Southeast Asia
Display Audio	AVH-0539ZY	A	A	A	Right	C	NA	NA	Southeast Asia
Display Audio	AVH-0639ZY	A	A	A	Left	C	NA	NA	Southeast Asia
Display Audio	AVH-0739ZY	A	A	A	Left	C	NA	NA	South America
Display Audio	AVH-0839ZY	A	A	A	Right	C	NA	NA	South America

* Tested model, A: Applicable, NA: Not Applicable

General Specification

Rating	DC 13.2 V (DC 10.5 V to 16 V)
Operating temperature	-20 deg. C to +65 deg. C

Radio Specification

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

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band:	5745 MHz
	40 MHz Band:	5755 MHz
	80 MHz Band:	5775 MHz
Type of Modulation	DSSS, OFDM	
Antenna Type	Internal Antenna	
Antenna Gain: G_{ANT}	-3.77 dBi	

Bluetooth (BR / EDR)

Equipment Type	Transceiver	
Frequency of Operation	2402 MHz to 2480 MHz	
Type of Modulation	GFSK, $\pi/4$ - DQPSK , 8DPSK	
Antenna Type	Internal Antenna	
Antenna Gain	-3.60 dBi	

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C FCC Part 15 final revised on April 1, 2022 and effective May 2, 2022
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

* The revision does not affect the test result conducted before its effective date.

* The customer has declared that the EUT has complied with FCC Part 15 Subpart B as SDoC.

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	-	N/A	*1)
Carrier Frequency Separation	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section15.247(a)(1) ISED: RSS-247 5.1 (b)	See data.	Complied a)	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 a)	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 b)	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 c)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section15.247(a)(b)(1) ISED: RSS-247 5.4 (b)		Complied d)	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		Complied e)	Conducted (below 30 MHz)

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.

- a) Refer to APPENDIX 1 (data of 20 dB Bandwidth, 99 %Occupied Bandwidth and Carrier Frequency Separation)
b) Refer to APPENDIX 1 (data of Number of Hopping Frequency)
c) Refer to APPENDIX 1 (data of Dwell time)
d) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration

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	- a)	Conducted
a) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation)					

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

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	1.2 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	2.0 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	1.2 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.3 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.3 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.3 dB
Spurious emission (Conducted) below 1GHz	0.93 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.92 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.3 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.3 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.3 dB
Bandwidth Measurement	0.012 %

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, Facsimile: +81 463 50 6401

A2LA Certificate Number: 1266.03

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

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
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	-	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

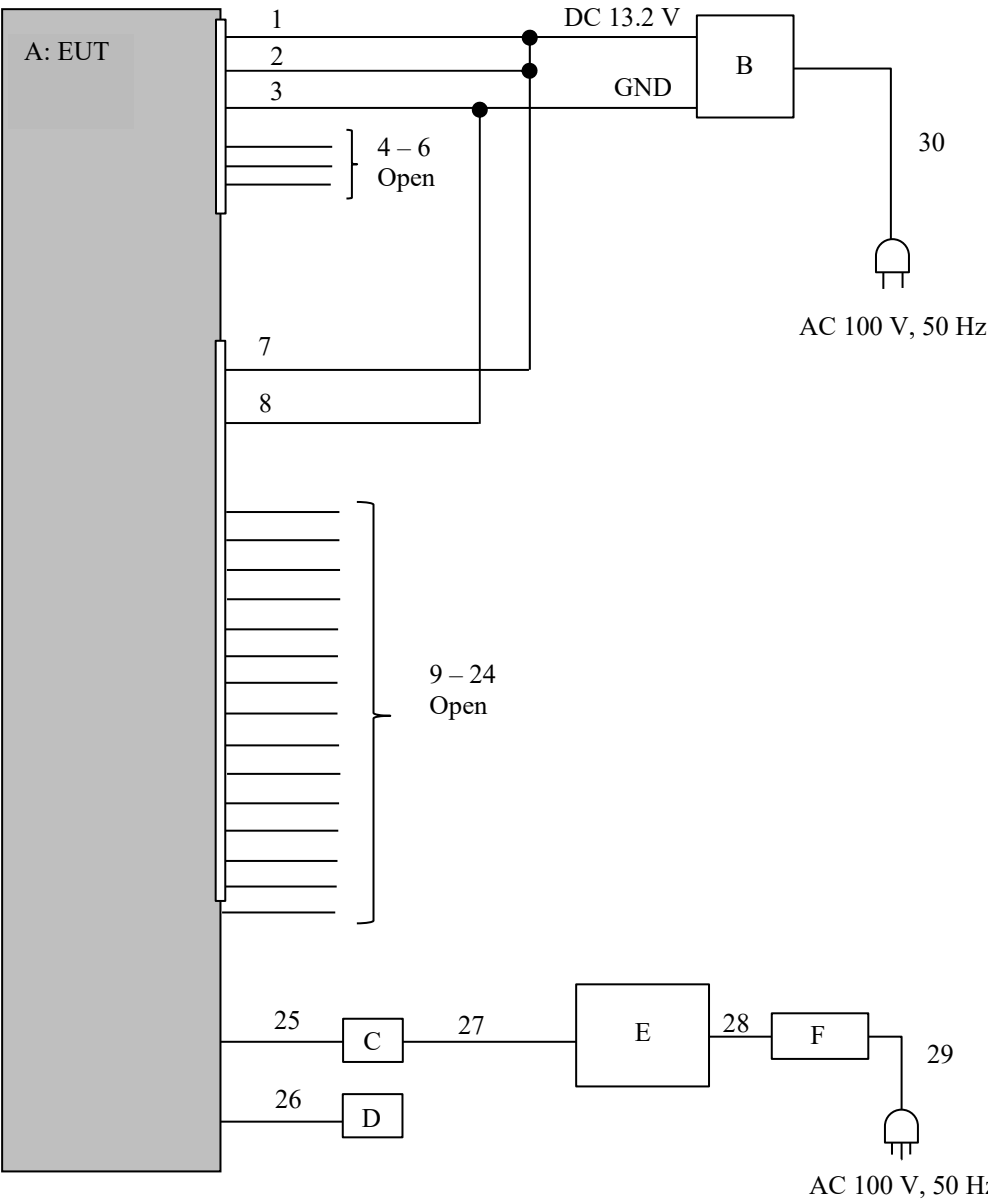
4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth (BT)	BR / EDR, Payload: PRBS9
*EUT has the power settings by the software as follows; Power Setting: 4 dBm Software: Tas0801.exe, Version: 00201200 (Date: 2022.02 02, Storage location: EUT memory) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

Details of Operating Mode(s)

Test Item	Mode	Hopping	Tested Frequency
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 *1)	Tx DH1, DH3, DH5 Tx 3DH1, 3DH3, 3DH5	On	-
Maximum Peak Output Power	Tx DH5 Tx 2DH5 Tx 3DH5	Off	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5 Tx 3DH5	On ----- Off	2402 MHz 2480 MHz
99 % Occupied Bandwidth	Tx DH5 Tx 3DH5	On ----- Off	2402 MHz 2441 MHz 2480 MHz
*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test) *2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative. *It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all the test items based on Bluetooth Core specification.			
*1) The maximum duty cycle of EDR could not be output in the test mode provided by the EUT. Dwell time was measured using a Wireless Connectivity Tester set to the maximum duty cycle.			

4.2 Configuration and Peripherals



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

Description of EUT and Support Equipment

No.	Item	Model Number	Serial Number	Manufacturer	Remarks
A	Display Audio	AVH-0239ZT	K1BA090	PIONEER CORPORATION	EUT
B	Power Supply (DC)	PAN35-10A	ML002085	KIKUSUI	-
C	Jig Board	-	-	-	-
D	Jig Board	-	-	-	-
E	Laptop Computer	PC-VJ23LLZGR	66000071A	NEC	-
F	AC Adapter	ADP-45TD E	6115924DB	NEC	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	ACC	0.5 + 1.8	Unshielded	Unshielded	-
2	B+	0.5 + 1.8	Unshielded	Unshielded	-
3	GND	0.5 + 1.8	Unshielded	Unshielded	-
4	FR+	0.5	Unshielded	Unshielded	-
5	FR-	0.5	Unshielded	Unshielded	-
6	FL+	0.5	Unshielded	Unshielded	-
7	B+	1.0 + 1.8	Unshielded	Unshielded	-
8	GND	1.0 + 1.8	Unshielded	Unshielded	-
9	V+	1.0	Unshielded	Unshielded	-
10	V-	1.0	Unshielded	Unshielded	-
11	CGND	1.0	Unshielded	Unshielded	-
12	CA+	1.0	Unshielded	Unshielded	-
13	IVI+	1.0	Unshielded	Unshielded	-
14	IVI-	1.0	Unshielded	Unshielded	-
15	ISLD	1.0	Unshielded	Unshielded	-
16	CSW+	1.0	Unshielded	Unshielded	-
17	FRSW	1.0	Unshielded	Unshielded	-
18	TX2+	1.0	Unshielded	Unshielded	-
19	TX2-	1.0	Unshielded	Unshielded	-
20	TX3+	1.0	Unshielded	Unshielded	-
21	TX3-	1.0	Unshielded	Unshielded	-
22	CNH1	1.0	Unshielded	Unshielded	-
23	CNL1	1.0	Unshielded	Unshielded	-
24	ADP3	1.0	Unshielded	Unshielded	-
25	Signal	0.15	Unshielded	Unshielded	*1)
26	Signal	0.25	Unshielded	Unshielded	*1)
27	USB	1.0	Shielded	Shielded	-
28	DC	1.8	Unshielded	Unshielded	-
29	AC	0.9	Unshielded	Unshielded	-
30	AC	2.0	Unshielded	Unshielded	-

*1) This cable is for testing and is not included with products.

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	30 kHz	100 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 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 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

Test Data : APPENDIX

Test Result : Pass

APPENDIX 1: Test data

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

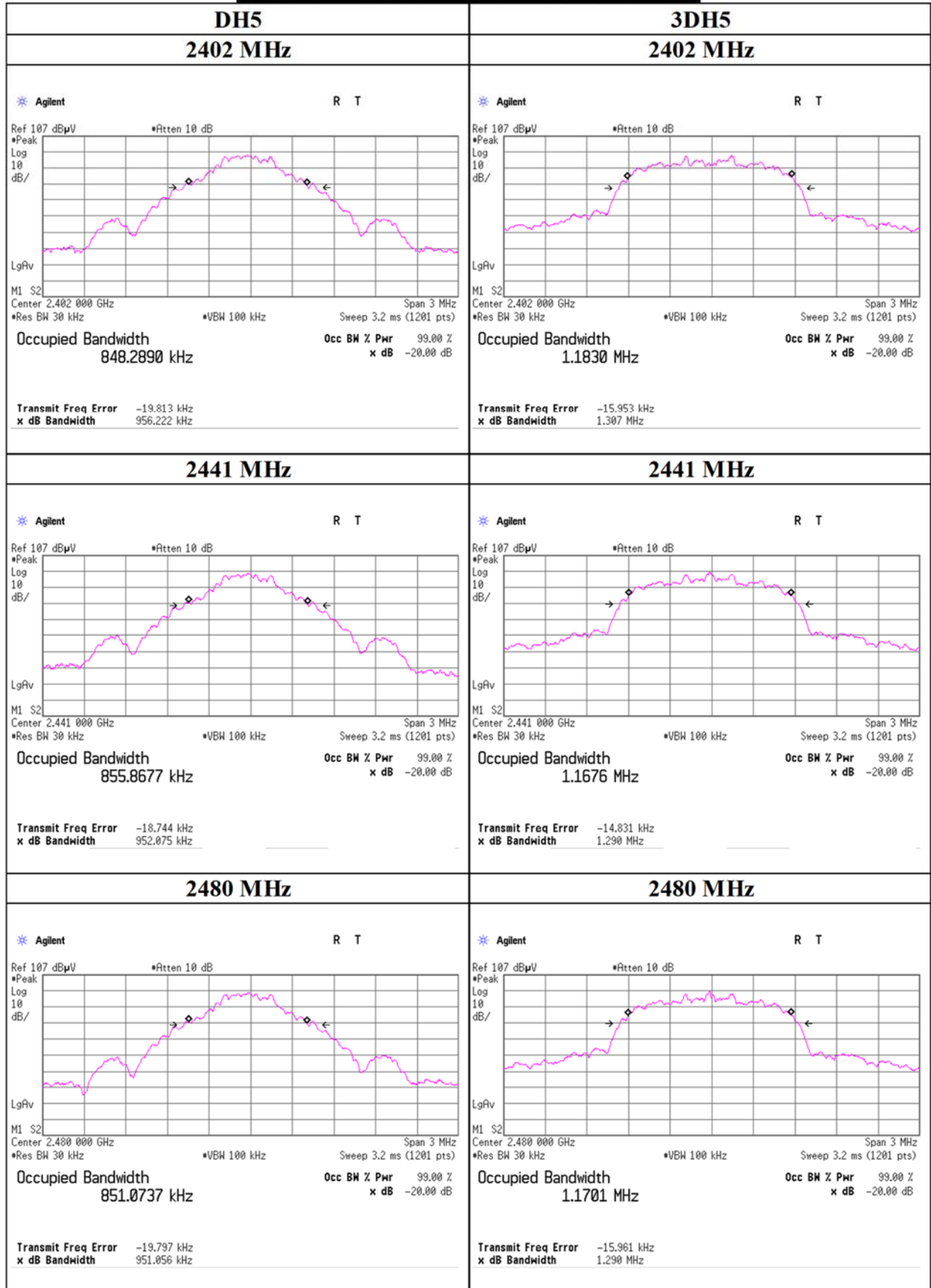
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 2, 2022
Temperature / Humidity	24 deg. C / 51 % RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.956	848.3	1.000	≥ 0.637
DH5	2441.0	0.952	855.9	1.000	≥ 0.635
DH5	2480.0	0.951	851.1	1.000	≥ 0.634
DH5	Hopping On	-	78634.4	-	-
3DH5	2402.0	1.307	1183.0	1.000	≥ 0.871
3DH5	2441.0	1.290	1167.6	1.000	≥ 0.860
3DH5	2480.0	1.290	1170.1	1.000	≥ 0.860
3DH5	Hopping On	-	78773.8	-	-

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

No limit applies to 20 dB Bandwidth.

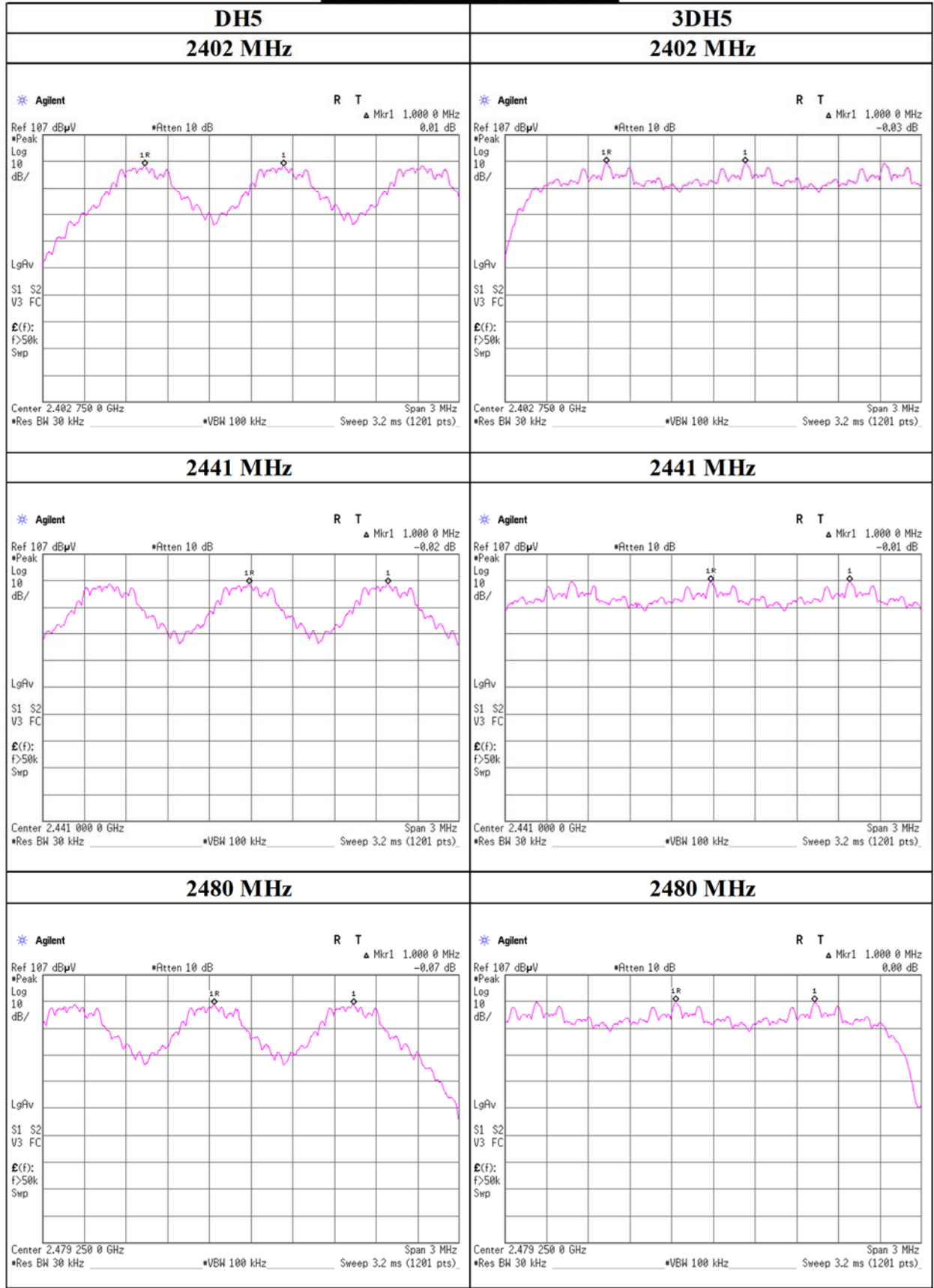
20 dB Bandwidth & 99 % Occupied Bandwidth



20 dB Bandwidth & 99 % Occupied Bandwidth



Carrier Frequency Separation



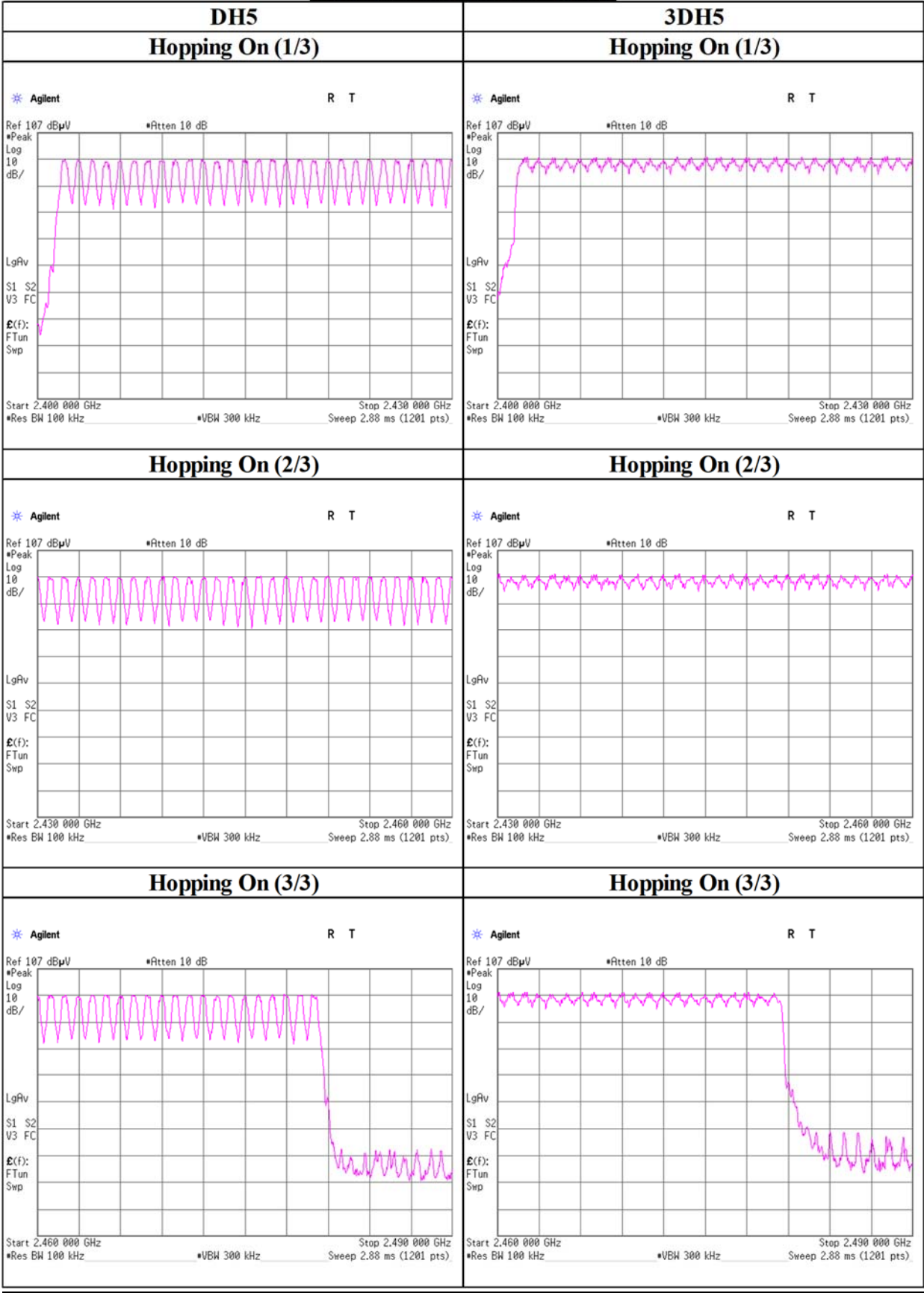
Number of Hopping Frequency

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 2, 2022
Temperature / Humidity	24 deg. C / 51 % RH
Engineer	Takahiro Kawakami
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.5 Shielded Room
Date March 2, 2022
Temperature / Humidity 24 deg. C / 51 % RH
Engineer Takahiro Kawakami
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	50.4 times / 5 s x 31.6 s = 319 times	0.405	129	400
DH3	26.4 times / 5 s x 31.6 s = 167 times	1.662	278	400
DH5	17.8 times / 5 s x 31.6 s = 113 times	2.910	329	400
3DH1	51.2 times / 5 s x 31.6 s = 324 times	0.408	132	400
3DH3	27.6 times / 5 s x 31.6 s = 175 times	1.661	291	400
3DH5	18.6 times / 5 s x 31.6 s = 118 times	2.912	344	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.

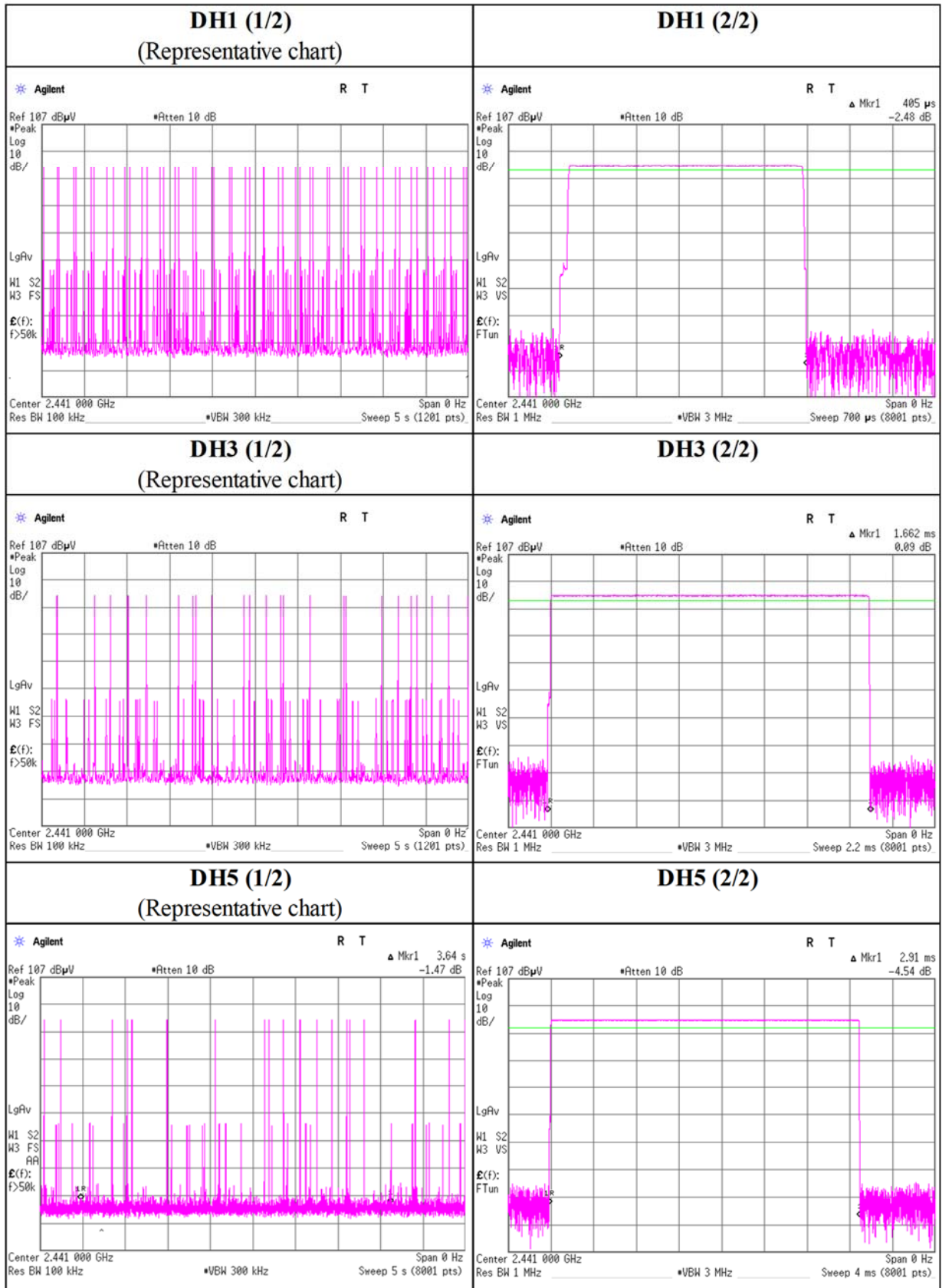
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	51	50	50	51	50	50.4
DH3	24	29	24	27	28	26.4
DH5	19	17	15	19	19	17.8
3DH1	51	53	50	51	51	51.2
3DH3	26	30	26	28	28	27.6
3DH5	16	18	16	22	21	18.6

Sample Calculation

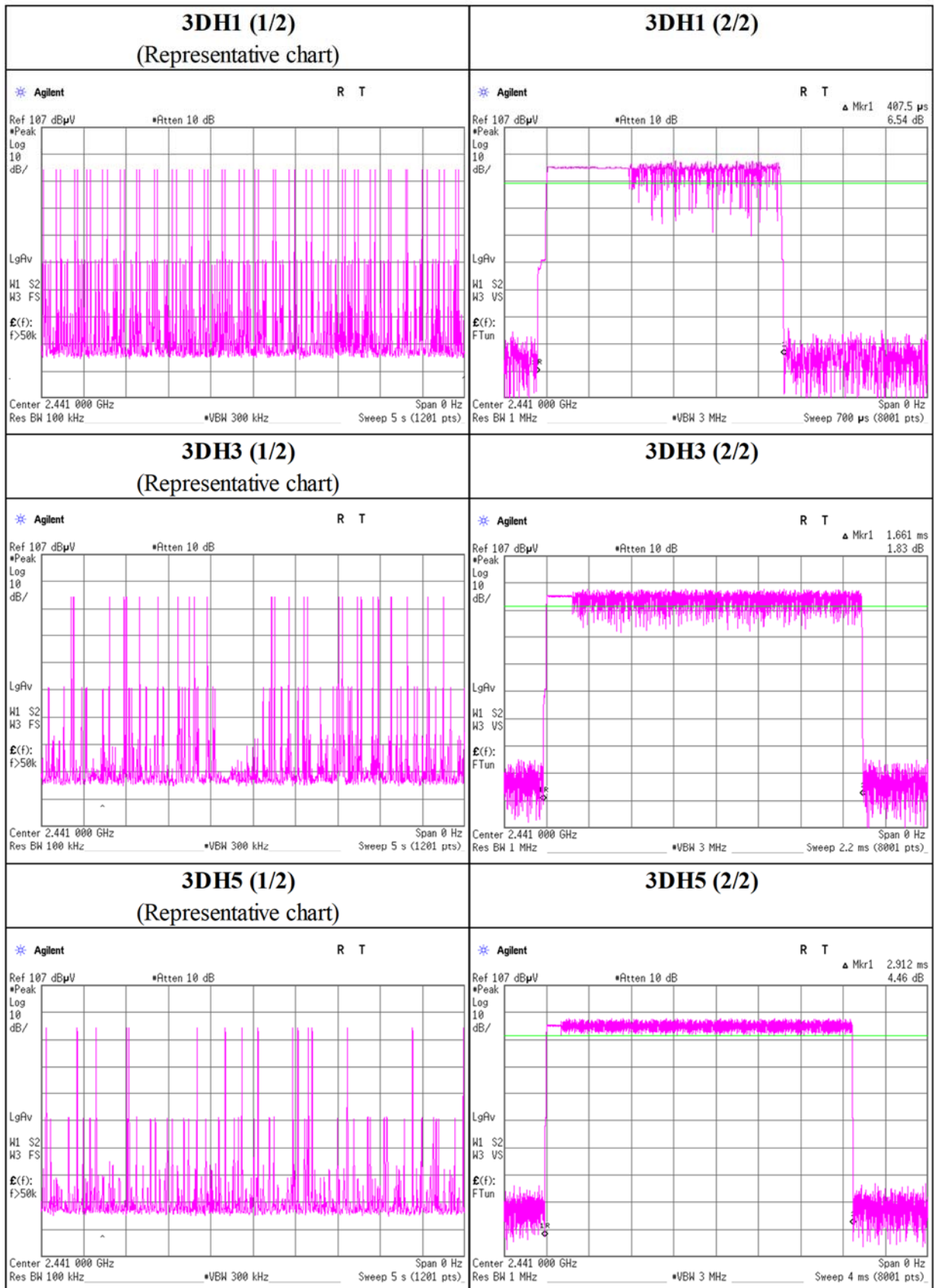
Average = Summation (Sampling 1 to 5) / 5

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

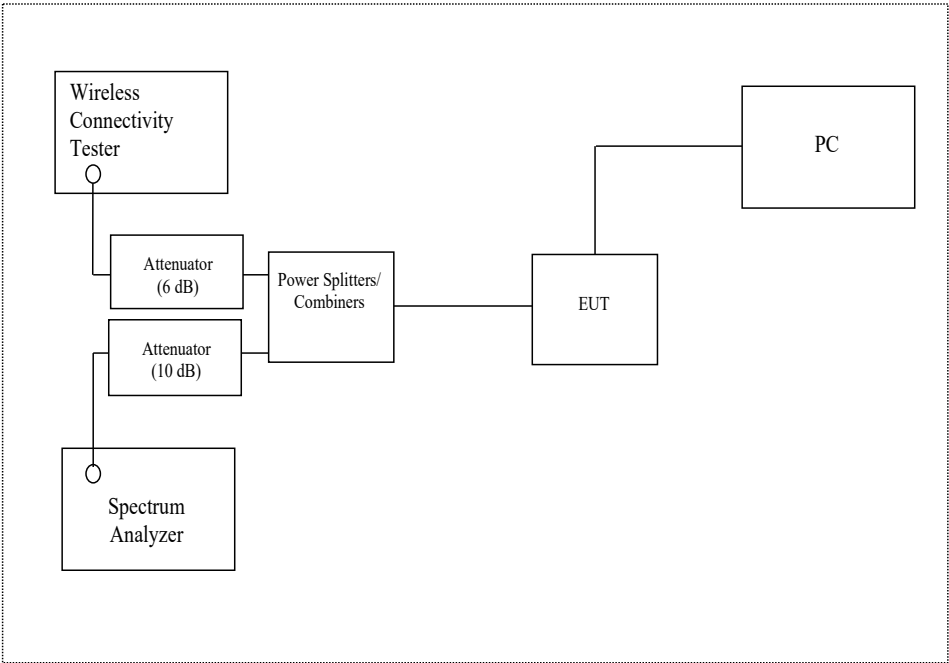
Dwell time



Dwell time



Block Diagram of Dwell time



Maximum Peak Output Power / Average power

Test place Shonan EMC Lab. No.5 Shielded Room
Date March 2, 2022
Temperature / Humidity 24 deg. C / 51 % RH
Engineer Takahiro Kawakami
Mode Tx, Hopping Off

Maximum peak output power

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
					Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit		Margin [dB]
					[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
DH5	2402	-9.14	1.99	10.17	3.02	2.00	20.97	125	17.95	-3.60	-0.58	0.87	36.02	4000	36.60
DH5	2441	-8.79	2.00	10.18	3.39	2.18	20.97	125	17.58	-3.60	-0.21	0.95	36.02	4000	36.23
DH5	2480	-8.67	2.01	10.18	3.52	2.25	20.97	125	17.45	-3.60	-0.08	0.98	36.02	4000	36.10
2DH5	2402	-6.55	1.99	10.17	5.61	3.64	20.97	125	15.36	-3.60	2.01	1.59	36.02	4000	34.01
2DH5	2441	-6.15	2.00	10.18	6.03	4.01	20.97	125	14.94	-3.60	2.43	1.75	36.02	4000	33.59
2DH5	2480	-5.95	2.01	10.18	6.24	4.21	20.97	125	14.73	-3.60	2.64	1.84	36.02	4000	33.38
3DH5	2402	-6.28	1.99	10.17	5.88	3.87	20.97	125	15.09	-3.60	2.28	1.69	36.02	4000	33.74
3DH5	2441	-5.82	2.00	10.18	6.36	4.33	20.97	125	14.61	-3.60	2.76	1.89	36.02	4000	33.26
3DH5	2480	-5.66	2.01	10.18	6.53	4.50	20.97	125	14.44	-3.60	2.93	1.96	36.02	4000	33.09

Sample Calculation:

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

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

Test was not performed at AFH mode, because the decrease of number of channel (min: 20 ch) at AFH mode does not influence on the output power and bandwidth of the EUT.
As this device had AFH mode and frequency separation could not meet the requirement of over 20 dB BW without 2/3 relaxation, 125 mW power limit was applied to it.

Average power (Reference data for RF Exposure)

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	-10.64	1.99	10.17	1.52	1.42	1.10	2.62	1.83
DH5	2441	-10.27	2.00	10.18	1.91	1.55	1.10	3.01	2.00
DH5	2480	-10.12	2.01	10.18	2.07	1.61	1.10	3.17	2.08
2DH5	2402	-10.51	1.99	10.17	1.65	1.46	1.16	2.81	1.91
2DH5	2441	-10.09	2.00	10.18	2.09	1.62	1.16	3.25	2.11
2DH5	2480	-9.92	2.01	10.18	2.27	1.69	1.16	3.43	2.20
3DH5	2402	-10.84	1.99	10.17	1.32	1.36	1.49	2.81	1.91
3DH5	2441	-10.42	2.00	10.18	1.76	1.50	1.49	3.25	2.12
3DH5	2480	-10.25	2.01	10.18	1.94	1.56	1.49	3.43	2.21

Sample Calculation:

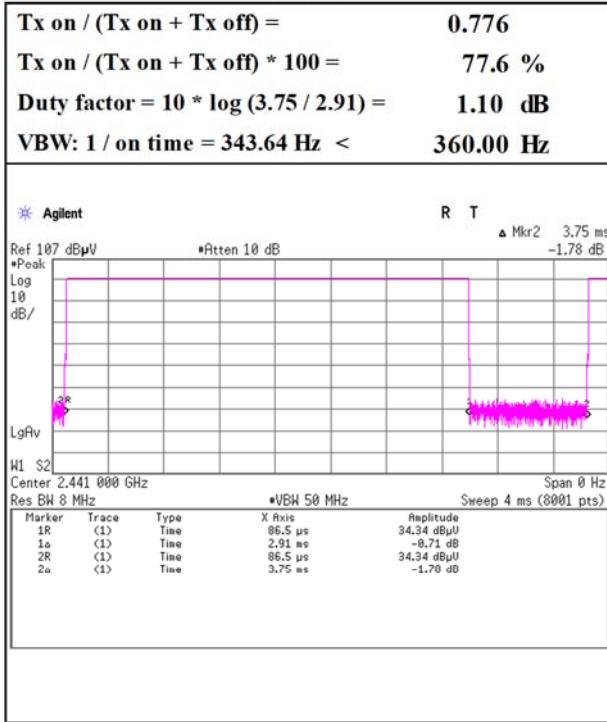
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

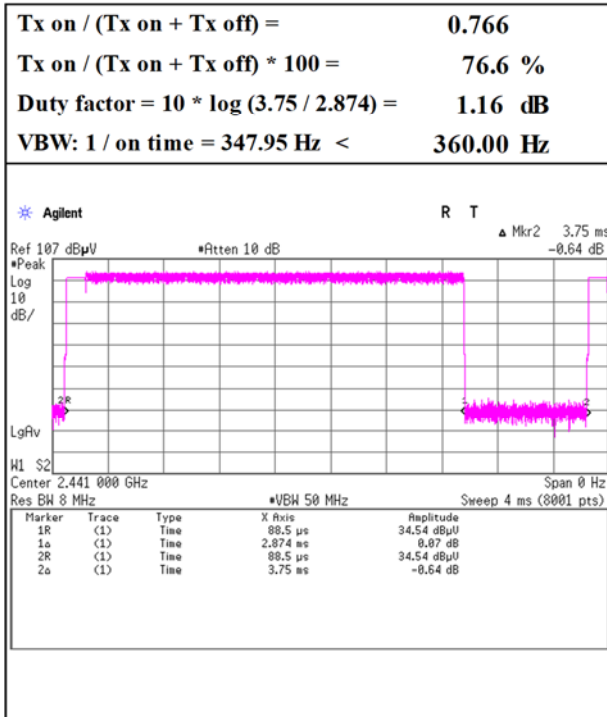
Burst Rate Confirmation

Test place Shonan EMC Lab. No.5 Shielded Room
Date March 2, 2022
Temperature / Humidity 24 deg. C / 51 % RH
Engineer Takahiro Kawakami
Mode Tx, Hopping Off

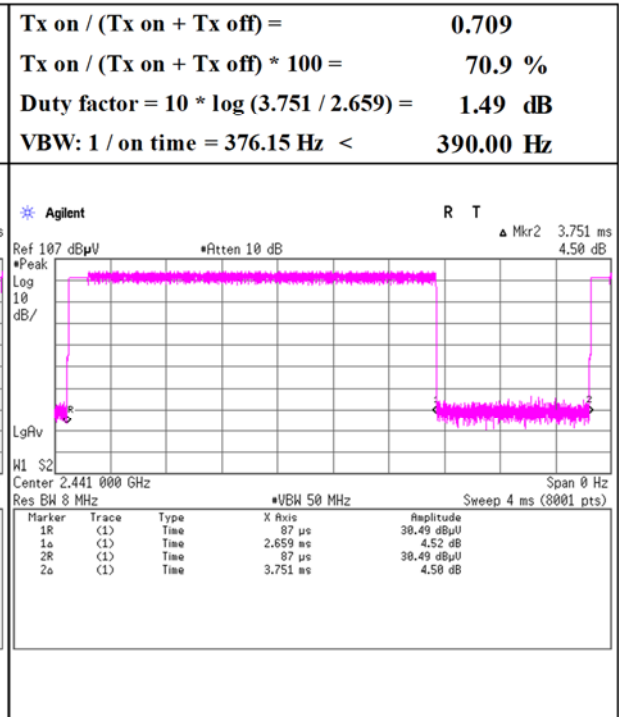
DH5



2DH5



3DH5



Conducted Spurious Emission

Test placeShonan EMC Lab. No.5 Shielded Room

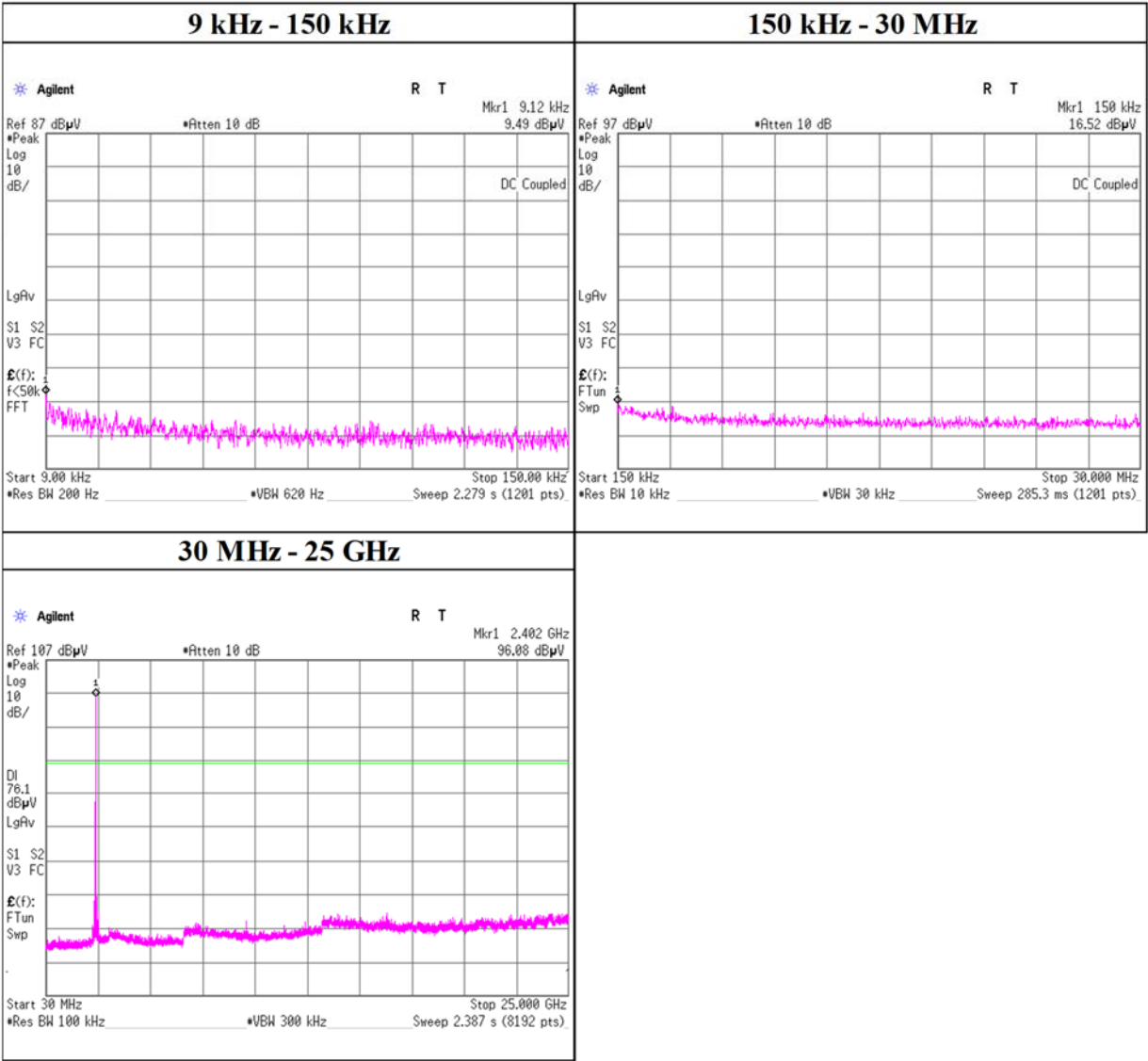
DateMarch 2, 2022

Temperature / Humidity24 deg. C / 51 % RH

EngineerTakahiro Kawakami

ModeTx, Hopping Off, DH5

2402 MHz



Conducted Spurious Emission

Test placeShonan EMC Lab. No.5 Shielded Room

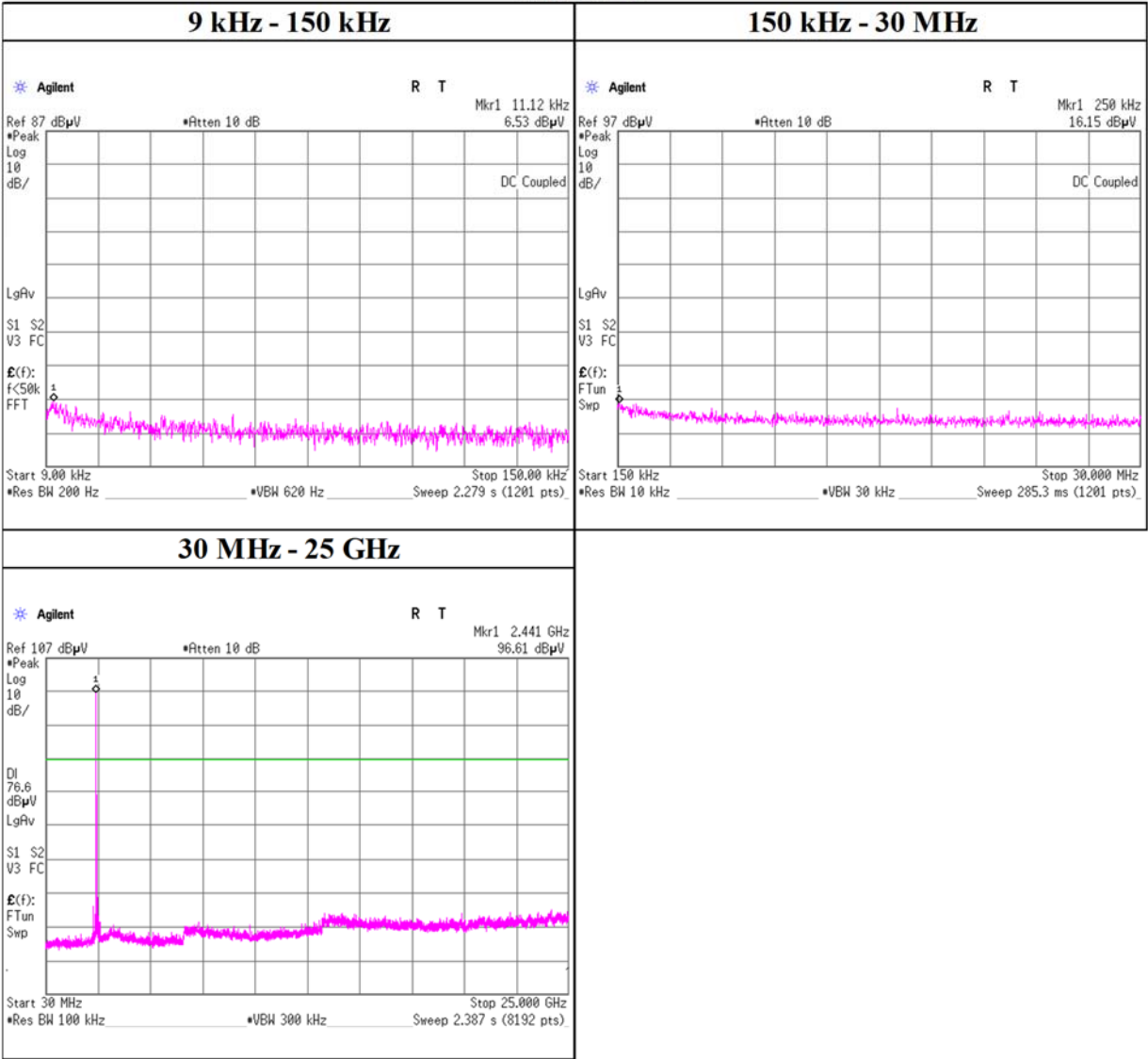
DateMarch 2, 2022

Temperature / Humidity24 deg. C / 51 % RH

EngineerTakahiro Kawakami

ModeTx, Hopping Off, DH5

2441 MHz



Conducted Spurious Emission

Test placeShonan EMC Lab. No.5 Shielded Room

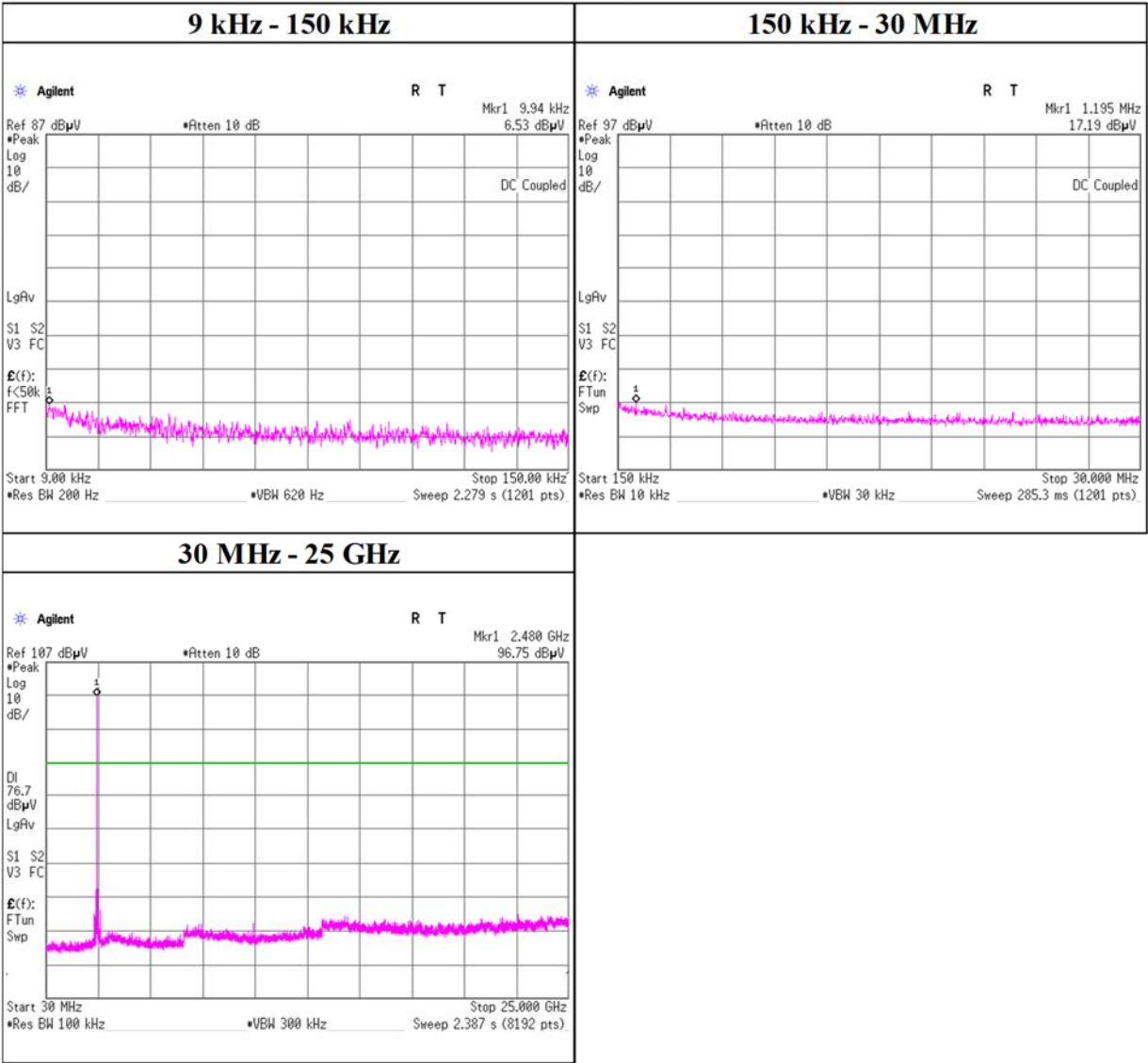
DateMarch 2, 2022

Temperature / Humidity24 deg. C / 51 % RH

EngineerTakahiro Kawakami

ModeTx, Hopping Off, DH5

2480 MHz



Conducted Spurious Emission

Test placeShonan EMC Lab. No.5 Shielded Room

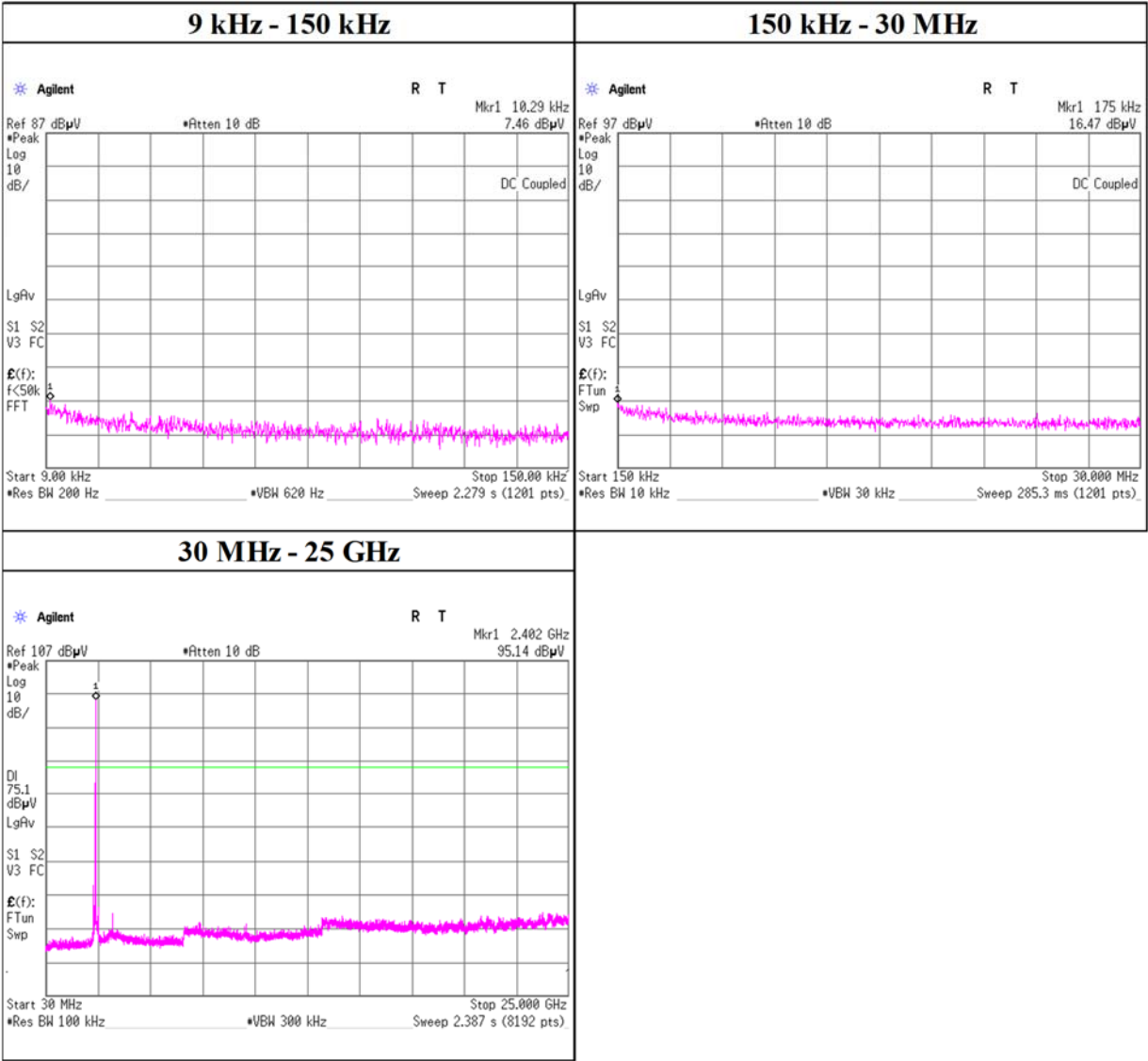
DateMarch 2, 2022

Temperature / Humidity24 deg. C / 51 % RH

EngineerTakahiro Kawakami

ModeTx, Hopping Off, 3DH5

2402 MHz



Conducted Spurious Emission

Test placeShonan EMC Lab. No.5 Shielded Room

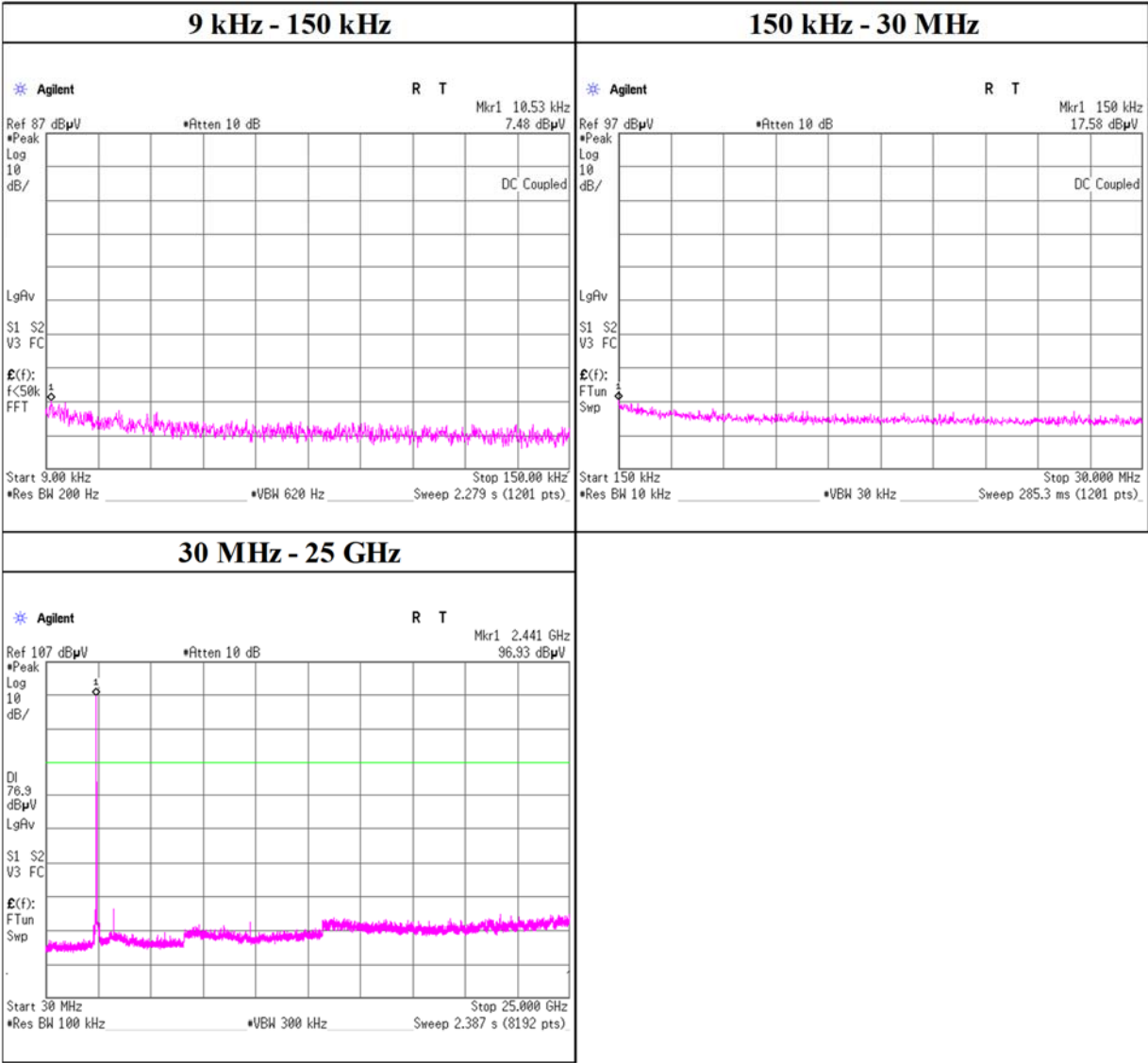
DateMarch 2, 2022

Temperature / Humidity24 deg. C / 51 % RH

EngineerTakahiro Kawakami

ModeTx, Hopping Off, 3DH5

2441 MHz



Conducted Spurious Emission

Test placeShonan EMC Lab. No.5 Shielded Room

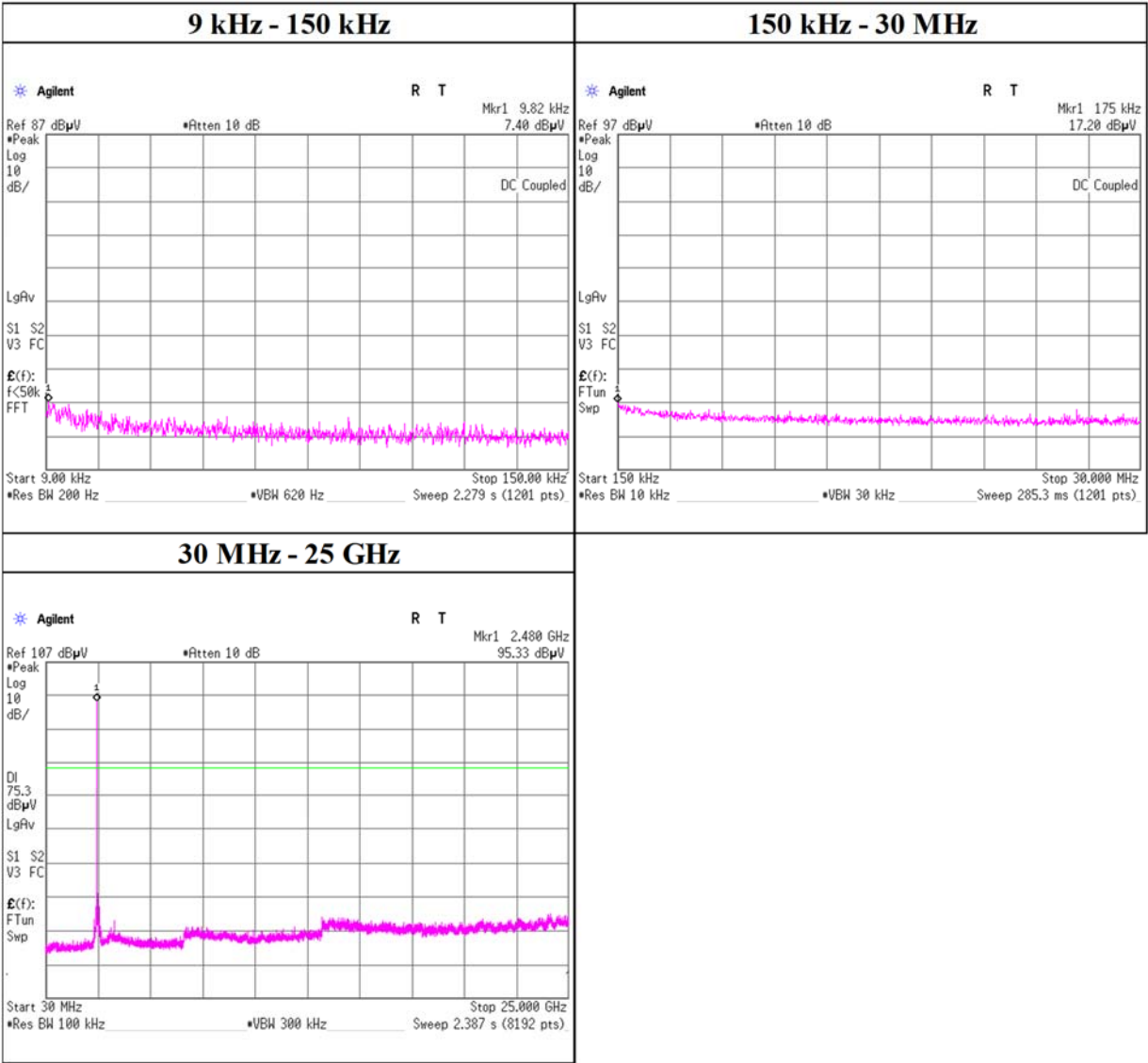
DateMarch 2, 2022

Temperature / Humidity24 deg. C / 51 % RH

EngineerTakahiro Kawakami

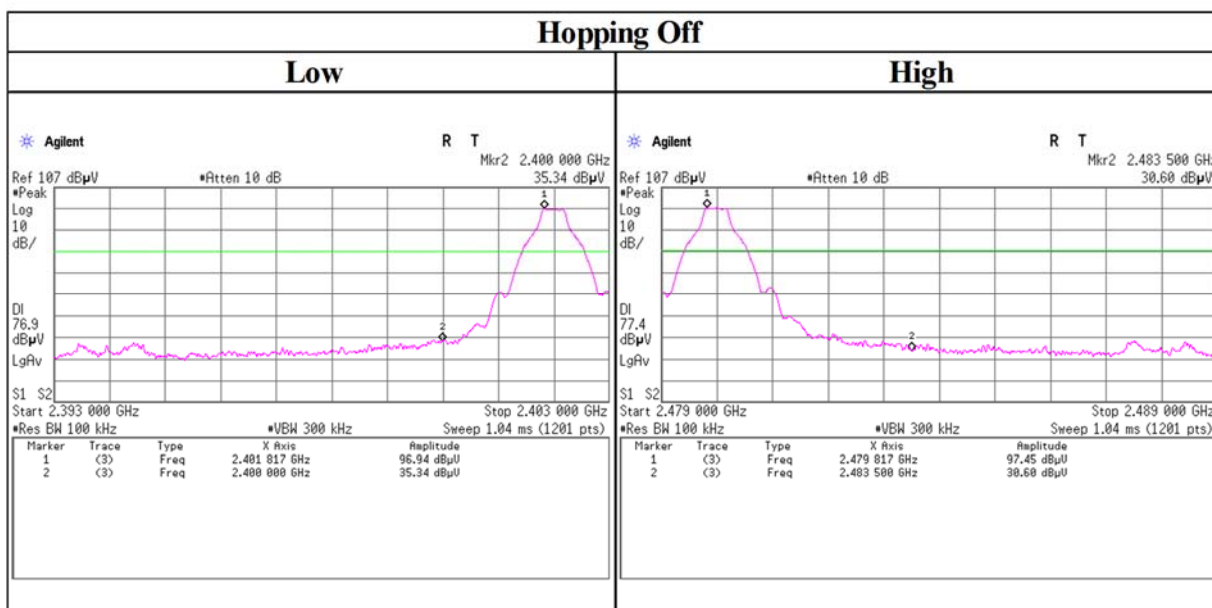
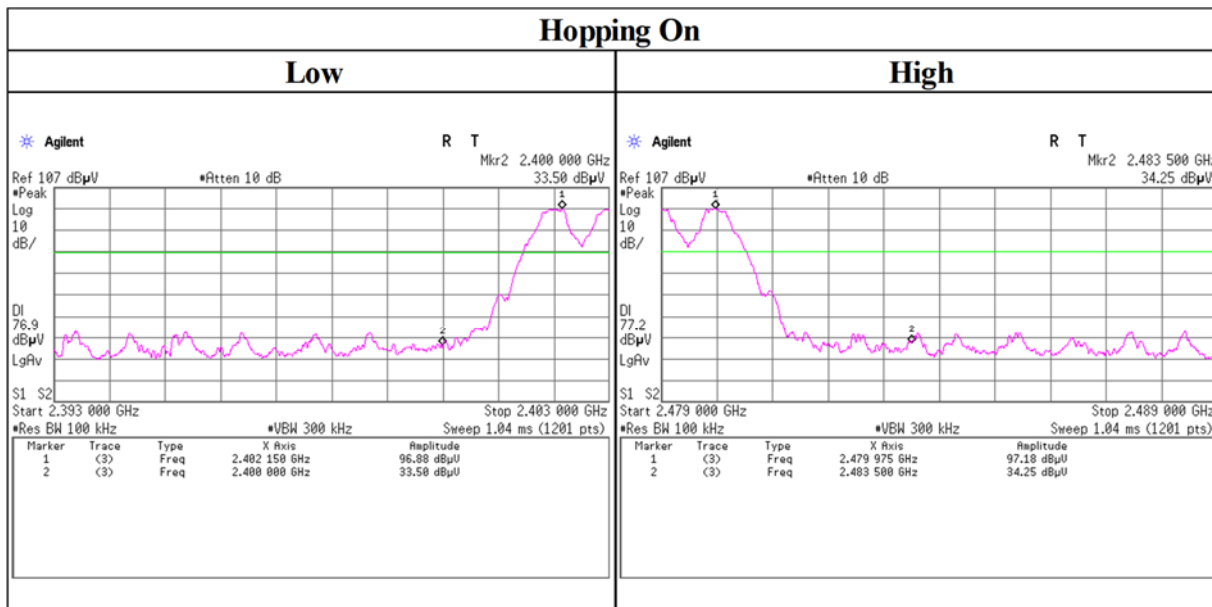
ModeTx, Hopping Off, 3DH5

2480 MHz



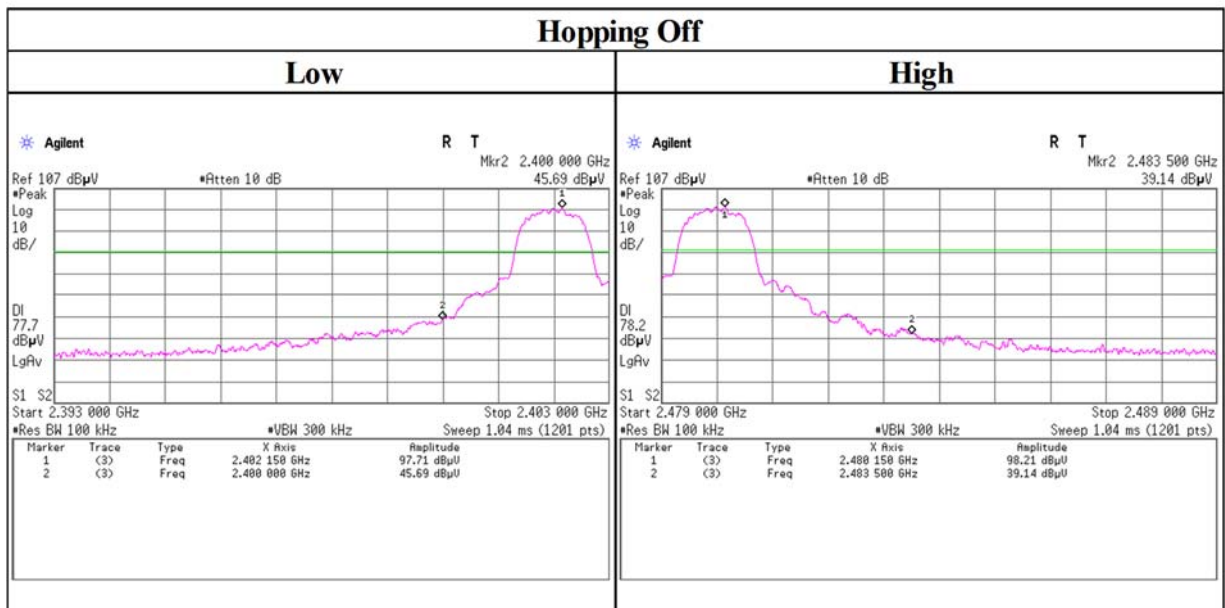
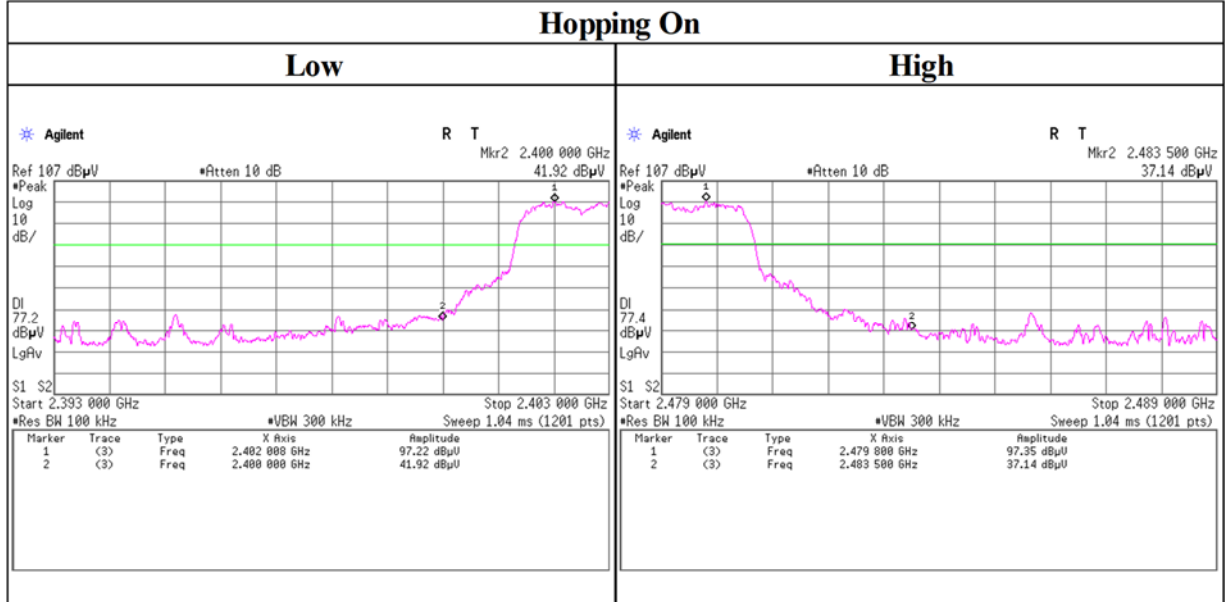
Conducted Emission Band Edge compliance

Test place Shonan EMC Lab. No.5 Shielded Room
Date March 2, 2022
Temperature / Humidity 24 deg. C / 51 % RH
Engineer Takahiro Kawakami
Mode Tx, DH5



Conducted Emission Band Edge compliance

Test place Shonan EMC Lab. No.5 Shielded Room
Date March 2, 2022
Temperature / Humidity 24 deg. C / 51 % RH
Engineer Takahiro Kawakami
Mode Tx, 3DH5



APPENDIX 2: Test Instruments

Test Equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	SAT10-15	160493	Attenuator	Weinschel Corp.	54A-10	83406	2021/12/07	12
AT	SAT6-16	197976	Attenuator	JFW	50HF-006	-	2021/04/08	12
AT	SBT-01	158576	Wireless Connectivity Tester	Rohde & Schwarz	CMW270	101015	2021/06/04	12
AT	SCC-G14	145175	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	2021/12/06	12
AT	SCC-G53	179107	Coaxial Cable	Junkosha	MWX241-01000KMSKMS/B	1901Q062-R	2021/04/02	12
AT	SOS-27	191845	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
AT	SPM-13	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2022/01/25	12
AT	SPSC-03	146253	Power Splitters/Combiners	Mini-Circuits	ZFSC-2-10G+	-	2021/11/05	12
AT	SPSS-06	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2022/01/25	12
AT	SRENT-22	202830	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250036	2021/12/01	12
AT	STM-G6	146207	Terminator	JFW	50T-128	-	2021/11/09	12
AT	STS-05	146212	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997828	2021/09/14	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