



RADIO TEST REPORT

Test Report No. : 13408107S-A

Applicant : Panasonic Corporation
Type of EUT : Car Navigation
Model Number of EUT : AT2104
FCC ID : ACJ932AT2104
Test regulation : FCC Part 15 Subpart C: 2020
*Bluetooth BR/EDR part
Test Item : Antenna Terminal Conducted Tests
Test Result : Complied (Refer to SECTION 3.2)

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3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.

Date of test: July 16 to August 18, 2020

Representative test engineer: K. Noda
Kazuya Noda
Engineer
Consumer Technology Division

Approved by: S. Takano
Shinichi Takano
Engineer
Consumer Technology Division



CERTIFICATE 1266.03

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
- ☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13408107S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13408107S-A	September 29, 2020	-	-

Reference: Abbreviations (Including words undescribed in this report)

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

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CONTENTS	PAGE
SECTION 1: Customer information.....	5
SECTION 2: Equipment under test (EUT).....	5
SECTION 3: Test specification, procedures & results.....	7
SECTION 4: Operation of EUT during testing.....	10
SECTION 5: Antenna Terminal Conducted Tests.....	13
APPENDIX 1: Test data	14
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation	14
Number of Hopping Frequency	18
Dwell time.....	20
Maximum Peak Output Power	23
Average Output Power.....	24
Conducted Spurious Emission	27
Conducted Emission Band Edge compliance	33
APPENDIX 2: Test instruments	35
APPENDIX 3: Photographs of test setup	36
Antenna Terminal Conducted Tests.....	36

SECTION 1: Customer information

Company Name	:	Panasonic Corporation
Address	:	4261 Ikonobe-cho, Tsuzuki-ku, Yokohama-shi, Kanagawa-ken, 224-8520, Japan
Telephone Number	:	+81-50-3689-7112
Contact Person	:	Takahisa Sakai

The information provided from the customer is as follows;

- Applicant, Type 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
- 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

Type	:	Car Navigation
Model Number	:	AT2104
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 13.2 V
Receipt Date	:	June 29, 2020
Country of Mass-production	:	Japan, Mexico, Czech Republic
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: AT2104 (referred to as the EUT in this report) are a Car Navigation.

There are 2 type for AT2104; Hi type(14 inch Display) and Lo type(8 inch Display). The same radio module and antenna are installed in these models, however the substrate pattern and antenna arrangement are different.

Radio Specification

	IEEE802.11b	IEEE802.11g		IEEE802.11n (20 MHz band)	IEEE802.11n (40 MHz band)
Frequency of operation	2412 MHz - 2462 MHz	2412 MHz - 2462 MHz		2412 MHz – 2462 MHz, 5180 MHz – 5240 MHz, 5745 MHz – 5825 MHz	5190 MHz, 5230 MHz, 5755 MHz, 5795 MHz
Channel spacing	5 MHz			2.4 GHz band: 5 MHz 5 GHz band: 20 MHz	40 MHz
Modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)		OFDM (64QAM, 16QAM, QPSK, BPSK)	
	IEEE802.11a	IEEE802.11ac (20 MHz band)		IEEE802.11ac (40 MHz band)	IEEE802.11ac (80 MHz band)
Frequency of operation	5180 MHz – 5240 MHz, 5745 MHz – 5825 MHz	5180 MHz – 5240 MHz, 5745 MHz – 5825 MHz		5190 MHz, 5230 MHz, 5755 MHz, 5795 MHz	5210 MHz, 5775 MHz
Channel spacing	20 MHz			40 MHz	80 MHz
Modulation	OFDM (64QAM, 16QAM, QPSK, BPSK)		OFDM (256QAM,16QAM,QPSK,BPSK)		
	Bluetooth (BR/EDR)		Bluetooth Low Energy		
Frequency of operation	2402 MHz – 2480 MHz		2402 MHz – 2480 MHz		
Channel spacing	1 MHz		2 MHz		
Modulation	FHSS, GFSK, π /4DQPSK, 8DPSK		FHSS, GFSK		
Antenna type	Inverted F type antenna				
Antenna Gain	Hi type (14 inch Display)	RF0	2.4 GHz WLAN	-0.83 dBi	
			U-NII-1	2.17 dBi	
			U-NII-3	2.37 dBi	
		RF1	BT, BT LE	-0.13 dBi	
			U-NII-1	2.59 dBi	
			U-NII-3	2.64 dBi	
	Lo type (8 inch Display)	RF0	2.4 GHz WLAN	2.25 dBi	
			U-NII-1	1.41 dBi	
			U-NII-3	0.99 dBi	
		RF1	BT, BT LE	-0.22 dBi	
U-NII-1			1.08 dBi		
U-NII-3	2.14 dBi				
Antenna Connector type	U.FL connector				
Operating Temperature	-30 deg. C to + 65 deg. C				

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 26, 2020 and effective July 27, 2020

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.

* 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 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	See data.	Complied e)	Conducted

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*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.

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

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.

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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 20 dB 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 $k = 2$.
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Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.98 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.75 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.12 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.06 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.24 dB
Spurious emission (Conducted) below 1GHz	0.9 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.9 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.9 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.0 dB
Bandwidth Measurement	0.07 %
Duty cycle and Time Measurement	0.262 %
Temperature	0.95 deg.C.
Voltage	0.83 %

3.5 Test Location

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A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

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

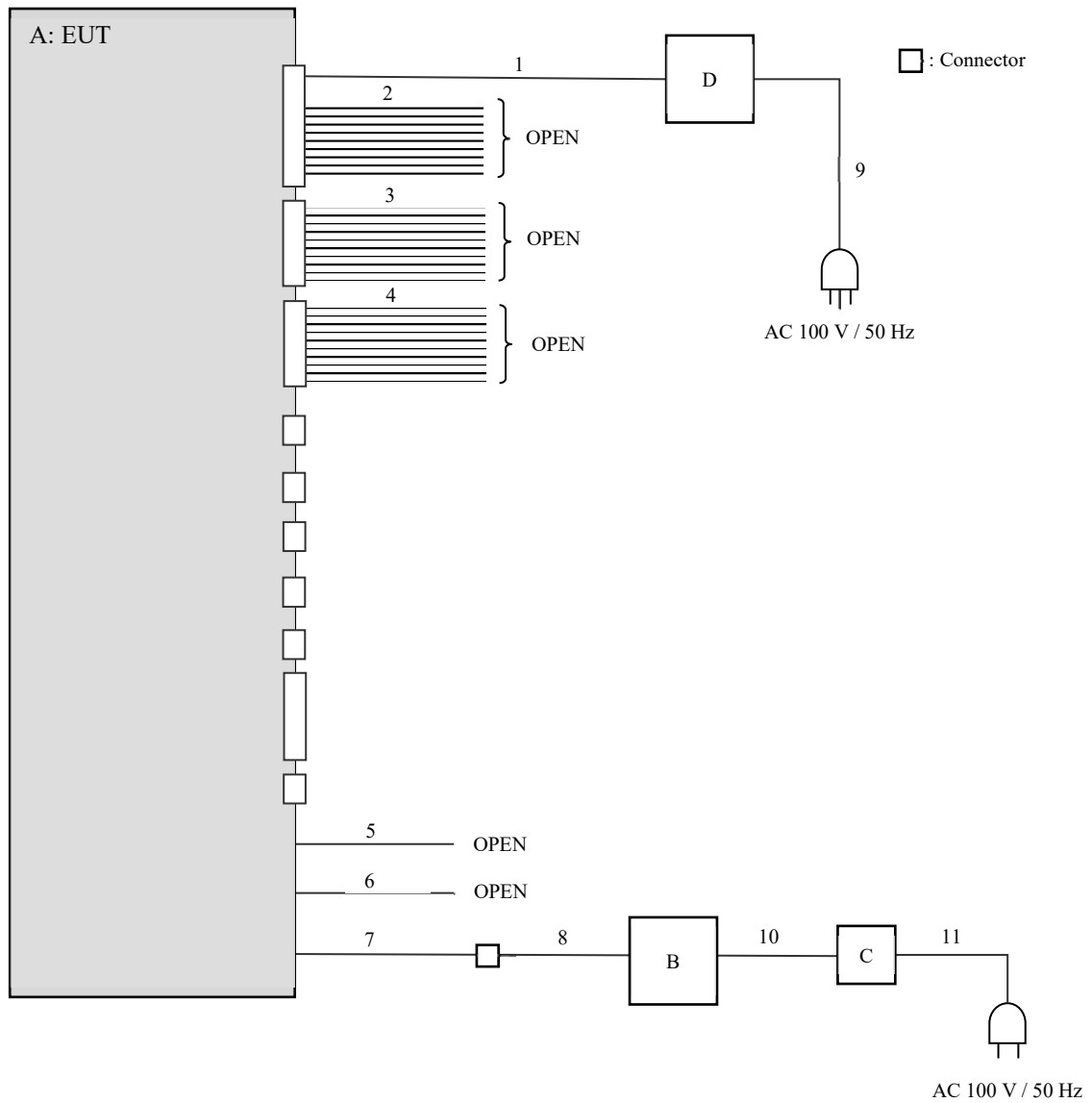
4.1 Operating Mode(s)

Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, Spurious Emission (Conducted/Radiated)	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Carrier Frequency Separation	Tx (Hopping On) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
20dB Bandwidth	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Number of Hopping Frequency	Tx (Hopping On) DH5, 3DH5	-
Dwell time	Tx (Hopping On), -DH1, DH3, DH5 -3DH1, 3DH3, 3DH5	-
Maximum Peak Output Power	Tx (Hopping Off) DH5, 2DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx DH5, 3DH5 -Hopping On -Hopping 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. *EUT has the power settings by the software as follows; Power settings: Fixed Software: Labtool Version: 2.0.0.71 (Date: 2020.05.29, 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.		

4.2 Configuration and peripherals



Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Car Navigation	AT2104 Lo type (8 inch Display)	500107	Panasonic Corporation	EUT
B	Laptop Computer	7666-77J	LV-B8R1X 08/05	Lenovo	-
C	AC Adapter	42T4422	11S92P1154Z1DXF 1DBFDN	Lenovo	-
D	Power Supply (DC)	PAN35-10A	ML002085	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	1.0	Unshielded	Unshielded	-
2	Signal	0.2	Unshielded	Unshielded	-
3	Signal	0.2	Unshielded	Unshielded	-
4	Signal	0.2	Shielded	Shielded	-
5	Signal	0.1	Unshielded	Unshielded	*1)
6	Signal	0.2	Unshielded	Unshielded	*1)
7	UART	0.3	Unshielded	Unshielded	*1)
8	UART-USB	1.8	Shielded	Shielded	-
9	AC	2.0	Unshielded	Unshielded	-
10	DC	1.8	Unshielded	Unshielded	-
11	AC	0.9	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	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 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

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APPENDIX 1: Test data

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

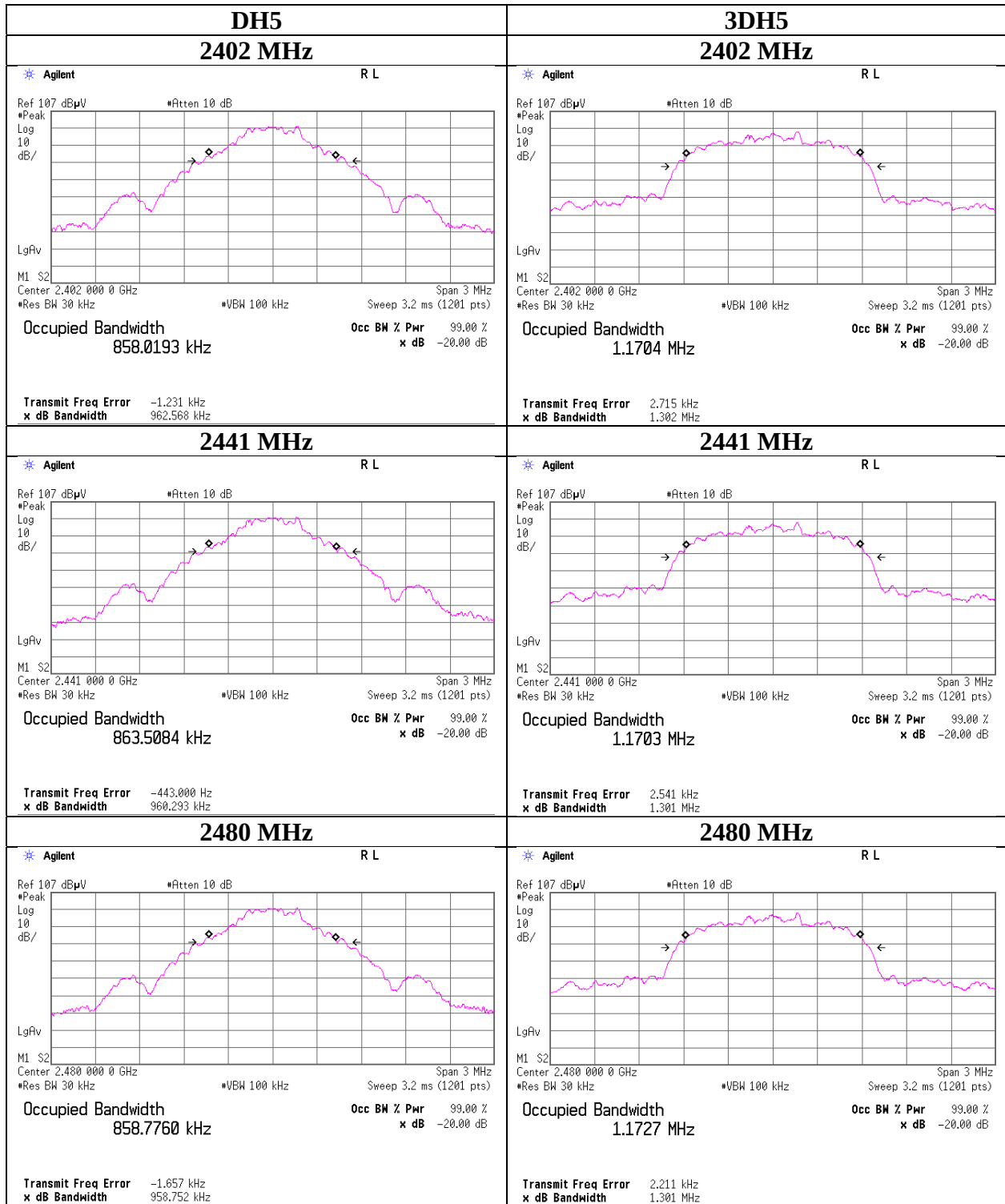
Report No.	13408107S-A
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 14, 2020
Temperature / Humidity	24 deg. C / 61 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off, Tx, Hopping On

Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.963	858.019	1.000	≥ 0.642
DH5	2441.0	0.960	863.508	1.000	≥ 0.640
DH5	2480.0	0.959	858.776	1.000	≥ 0.639
DH5	Hopping On	-	78674.4	-	-
3DH5	2402.0	1.302	1170.4	1.000	≥ 0.868
3DH5	2441.0	1.301	1170.3	1.000	≥ 0.867
3DH5	2480.0	1.301	1172.7	1.000	≥ 0.867
3DH5	Hopping On	-	78733.5	-	-

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

No limit applies to 20dB Bandwidth.

20 dB Bandwidth and 99 % Occupied Bandwidth



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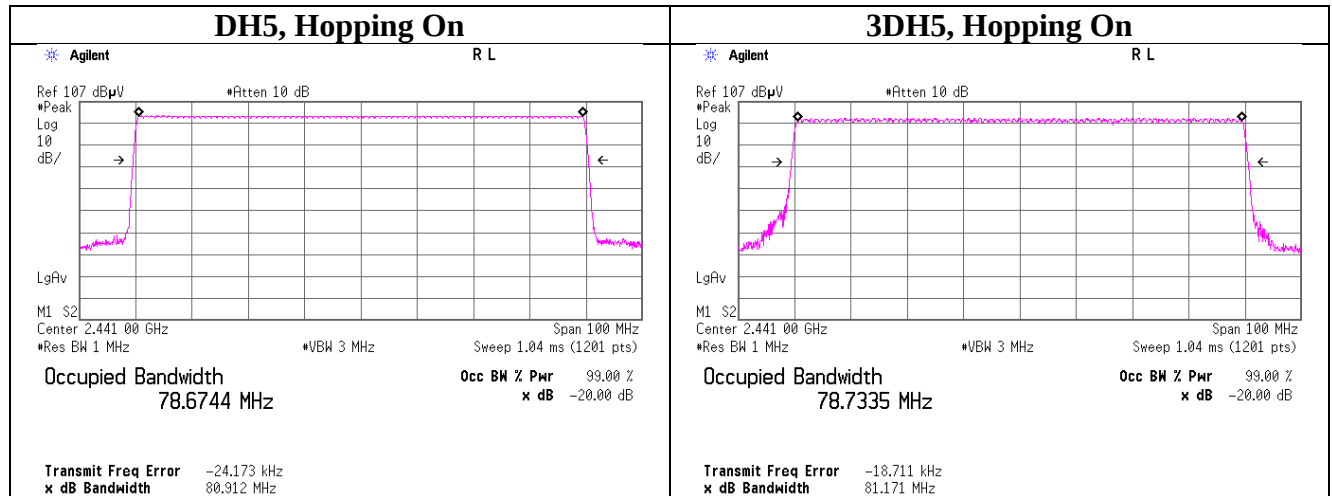
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20 dB Bandwidth and 99 % Occupied Bandwidth



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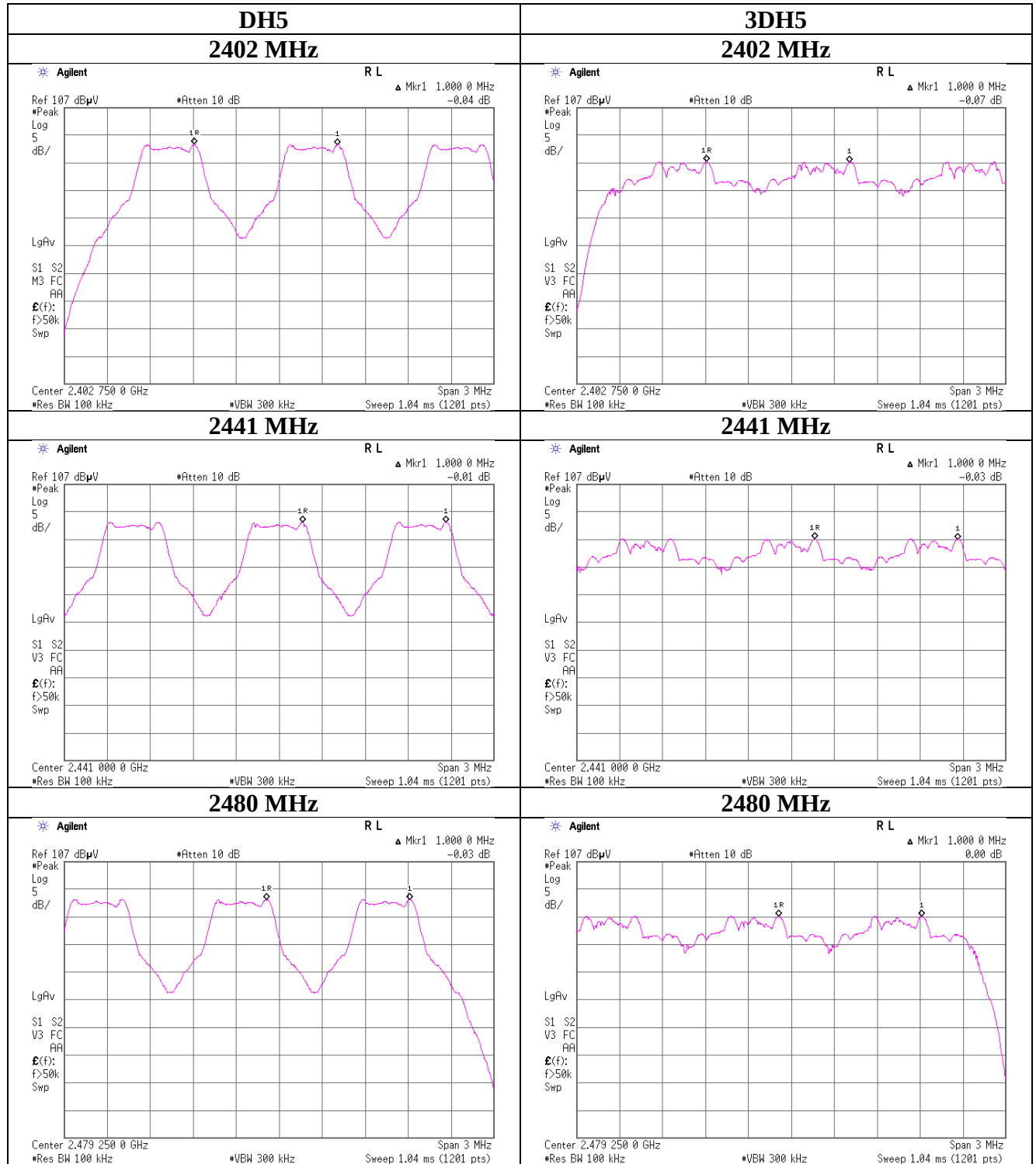
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Carrier Frequency Separation



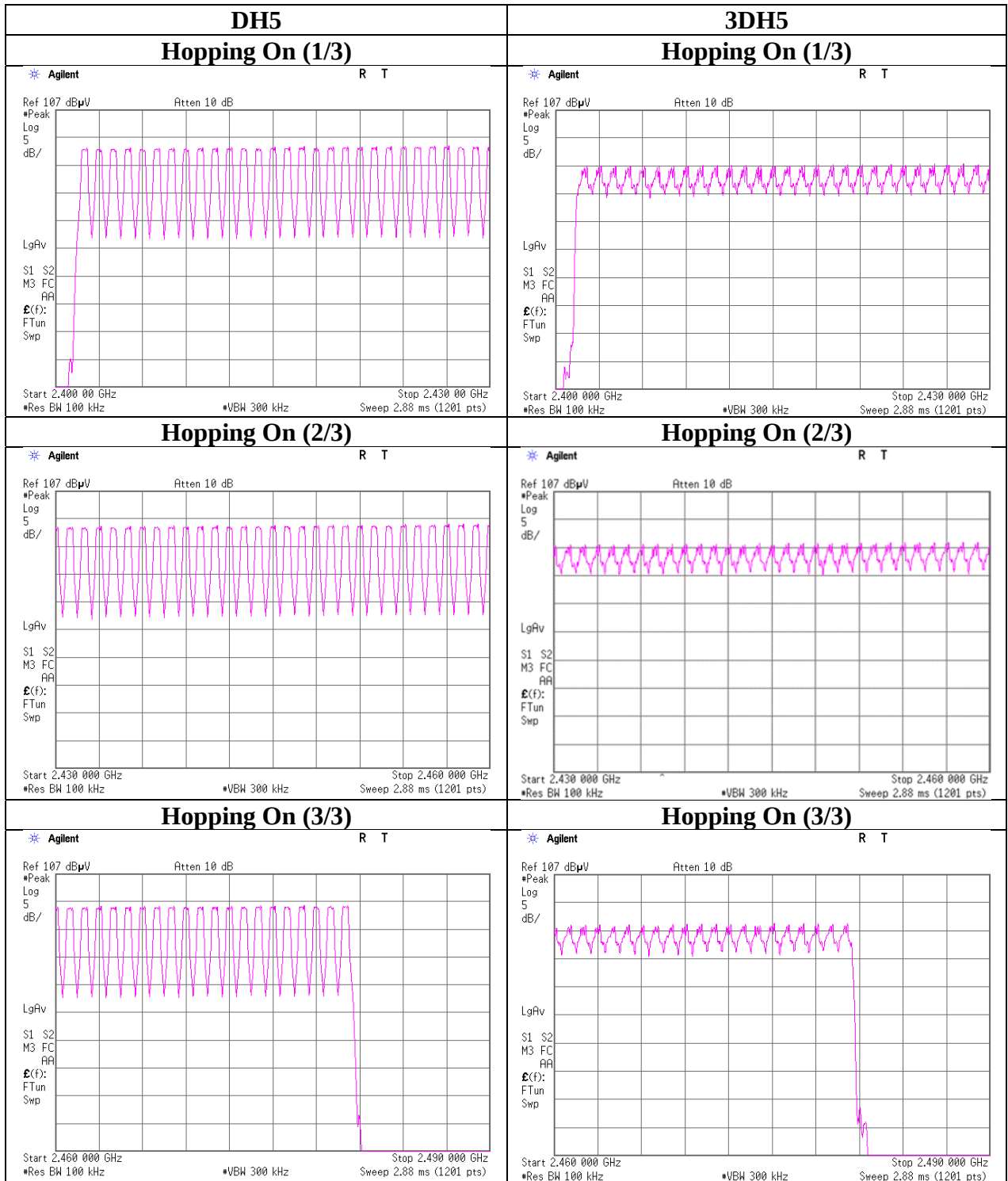
Number of Hopping Frequency

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 14, 2020
Temperature / Humidity 24 deg. C / 61 % RH
Engineer Kazuya Noda
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

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 14, 2020
Temperature / Humidity 24 deg. C / 61 % RH
Engineer Kazuya Noda
Mode Tx, Hopping On

Mode	Number of transmission in a 31.6(79 Hopping x 0.4) / 12.8 (32 Hopping x 0.4) second period		Length of transmission [msec]	Result [msec]	Limit [msec]
DH1	49.4 times / 5 sec. x	31.6 sec. = 313 times	0.393	123	400
DH3	26.4 times / 5 sec. x	31.6 sec. = 167 times	1.649	275	400
DH5	20.6 times / 5 sec. x	31.6 sec. = 131 times	2.898	380	400
3DH1	49.2 times / 5 sec. x	31.6 sec. = 311 times	0.393	122	400
3DH3	28.2 times / 5 sec. x	31.6 sec. = 179 times	1.646	295	400
3DH5	21.6 times / 5 sec. x	31.6 sec. = 137 times	2.896	397	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

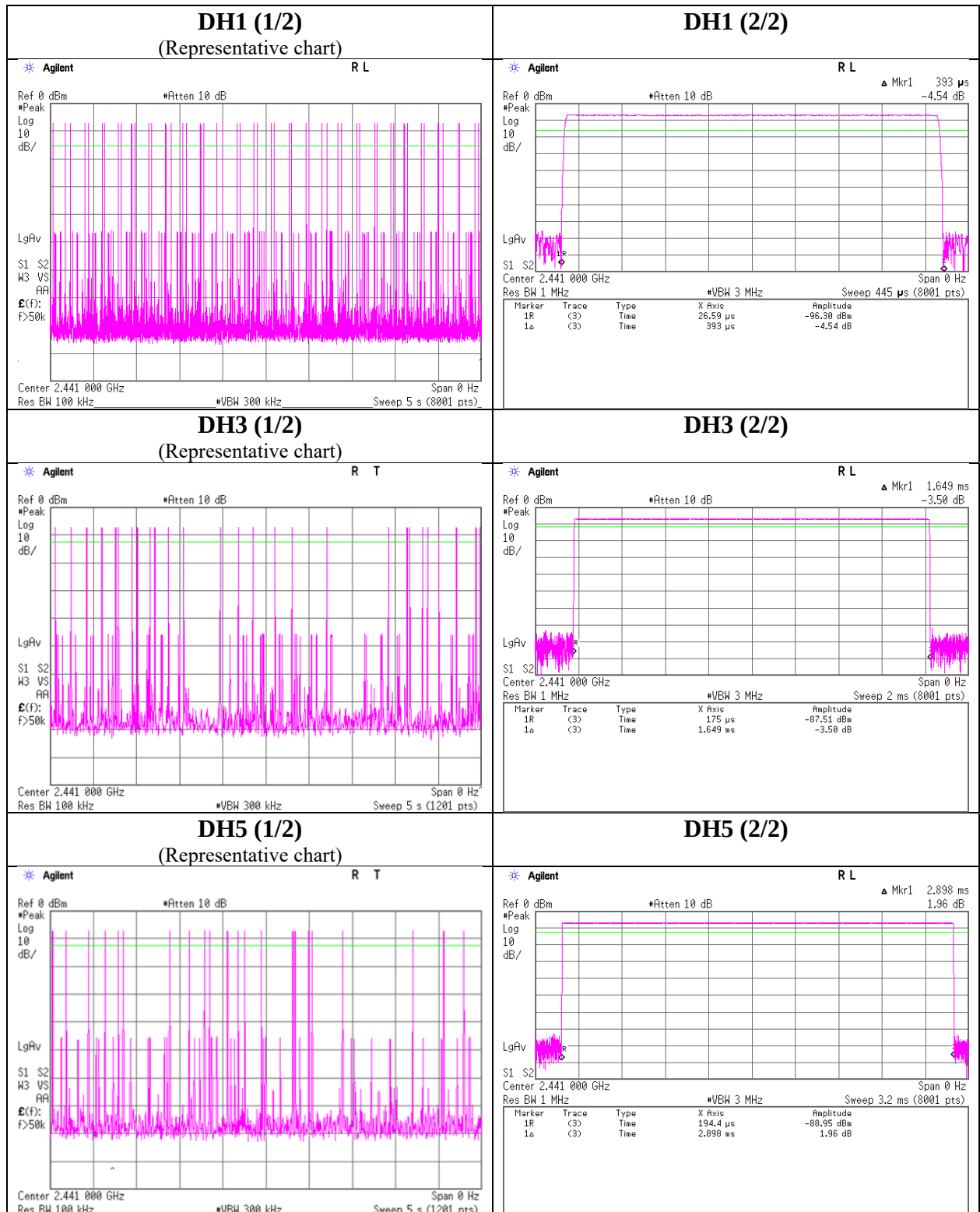
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	50	50	50	48	49	49.4
DH3	27	25	26	27	27	26.4
DH5	22	21	20	21	19	20.6
3DH1	49	50	49	48	50	49.2
3DH3	29	29	26	28	29	28.2
3DH5	22	20	23	21	22	21.6

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 $N \times 0.4s$, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than $0.4s$ regardless of packet size. This is confirmed in the test report for $N = 79$.

Dwell time



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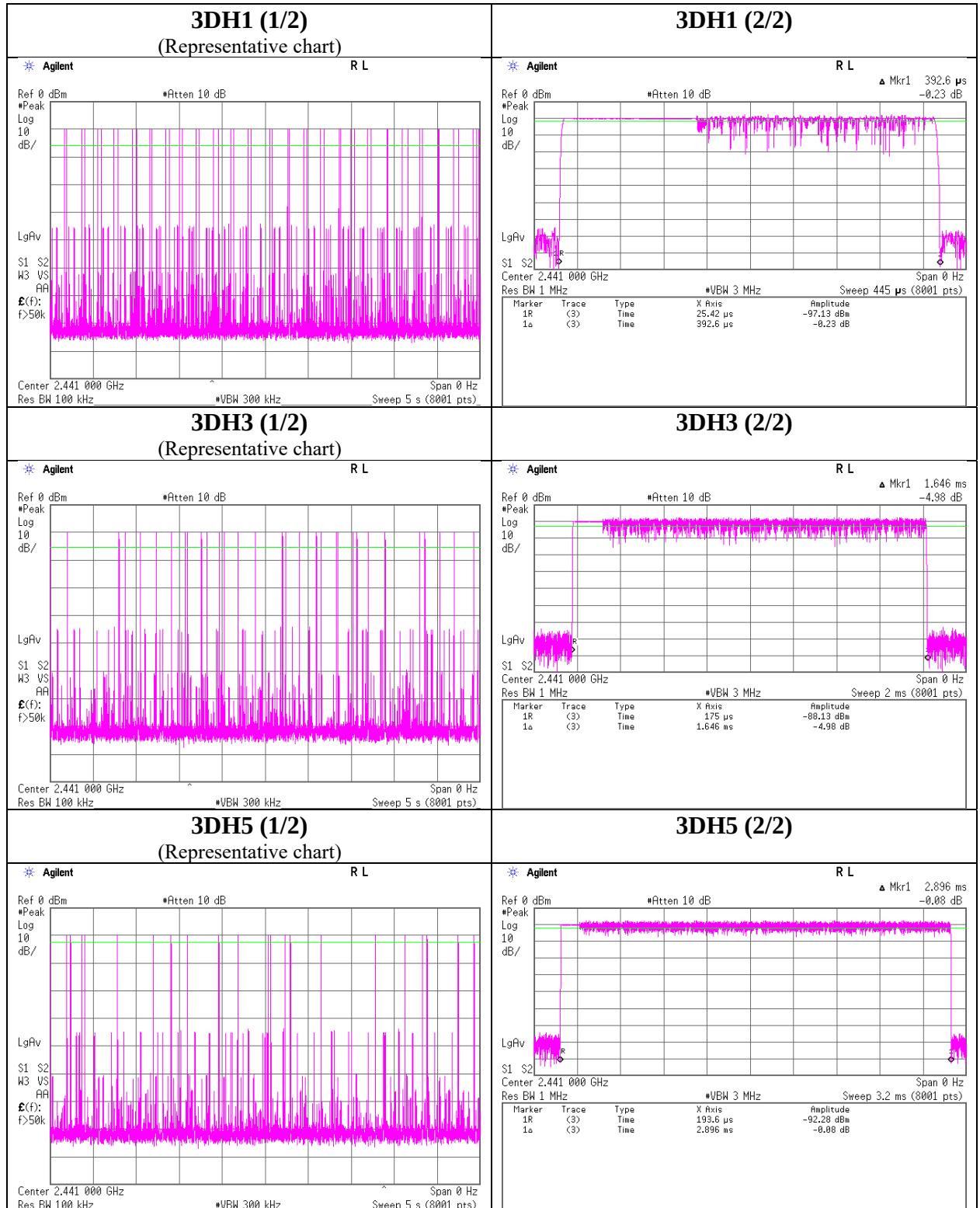
Shonan EMC Lab.

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

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Facsimile : +81 596 24 8124

Dwell time



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Maximum Peak Output Power

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 16, 2020
Temperature / Humidity 24 deg. C / 58 % RH
Engineer Shiro Kobayashi
Mode Tx, Hopping Off

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 *1) [dBi]	Result		Limit		Margin [dB]
					[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-6.02	2.29	9.88	6.15	4.12	20.96	125	14.81	-0.13	6.02	4.00	36.02	4000	30.00
DH5	2441.0	-6.20	2.30	9.88	5.98	3.96	20.96	125	14.98	-0.13	5.85	3.85	36.02	4000	30.17
DH5	2480.0	-6.33	2.31	9.88	5.86	3.85	20.96	125	15.10	-0.13	5.73	3.74	36.02	4000	30.29
2DH5	2402.0	-6.76	2.29	9.88	5.41	3.48	20.96	125	15.55	-0.13	5.28	3.37	36.02	4000	30.74
2DH5	2441.0	-6.92	2.30	9.88	5.26	3.36	20.96	125	15.70	-0.13	5.13	3.26	36.02	4000	30.89
2DH5	2480.0	-7.01	2.31	9.88	5.18	3.30	20.96	125	15.78	-0.13	5.05	3.20	36.02	4000	30.97
3DH5	2402.0	-6.48	2.29	9.88	5.69	3.71	20.96	125	15.27	-0.13	5.56	3.60	36.02	4000	30.46
3DH5	2441.0	-6.65	2.30	9.88	5.53	3.57	20.96	125	15.43	-0.13	5.40	3.47	36.02	4000	30.62
3DH5	2480.0	-6.78	2.31	9.88	5.41	3.48	20.96	125	15.55	-0.13	5.28	3.37	36.02	4000	30.74

*1) Antenna Gain applied the higher of the two models.

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: 20ch) 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 20dB BW without 2/3 relaxation, 125mW power limit was applied to it.

Average Output Power (Reference data for RF Exposure)

Report No.	13408107S-A
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	July 16, 2020
Temperature / Humidity	24 deg. C / 58 % RH
Engineer	Shiro Kobayashi
Mode	Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
					[dBm]	[mW]		[dBm]	[mW]
DH5	2402.0	-7.35	2.29	9.88	4.82	3.03	1.12	5.94	3.93
DH5	2441.0	-7.51	2.30	9.88	4.67	2.93	1.12	5.79	3.79
DH5	2480.0	-7.66	2.31	9.88	4.53	2.84	1.12	5.65	3.67
2DH5	2402.0	-10.46	2.29	9.88	1.71	1.48	1.12	2.83	1.92
2DH5	2441.0	-10.63	2.30	9.88	1.55	1.43	1.12	2.67	1.85
2DH5	2480.0	-10.70	2.31	9.88	1.49	1.41	1.12	2.61	1.82
3DH5	2402.0	-10.45	2.29	9.88	1.72	1.49	1.12	2.84	1.92
3DH5	2441.0	-10.62	2.30	9.88	1.56	1.43	1.12	2.68	1.85
3DH5	2480.0	-10.70	2.31	9.88	1.49	1.41	1.12	2.61	1.82

Sample Calculation:

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

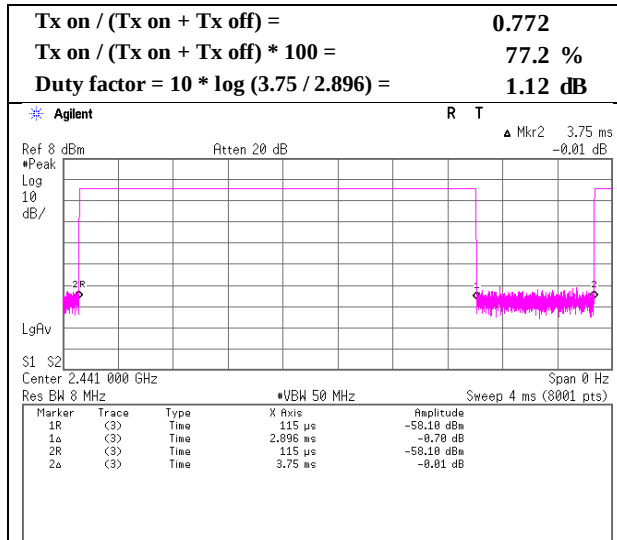
Result (Burst power average) = Time average + Duty factor

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

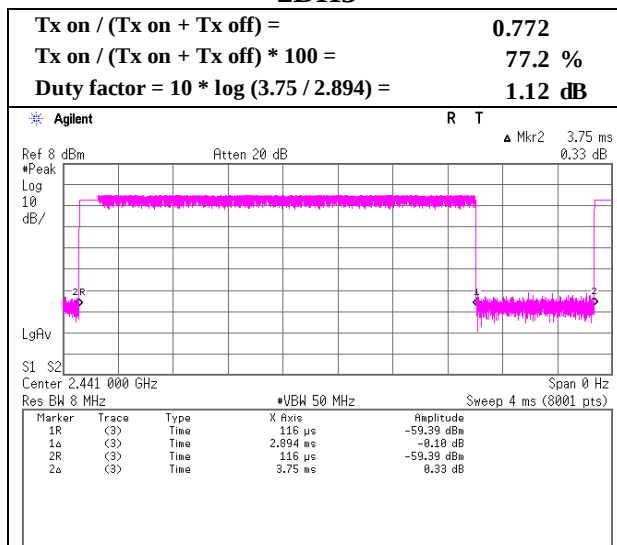
Burst Rate Confirmation

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date July 16, 2020
Temperature / Humidity 24 deg. C / 58 % RH
Engineer Shiro Kobayashi
Mode Tx, Hopping Off

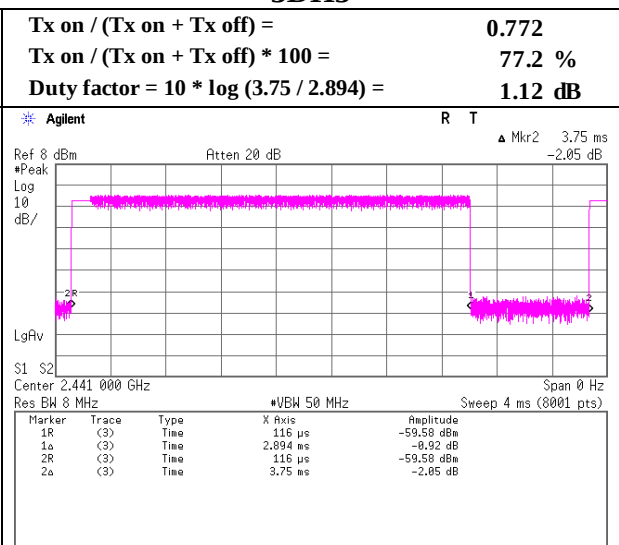
DH5



2DH5

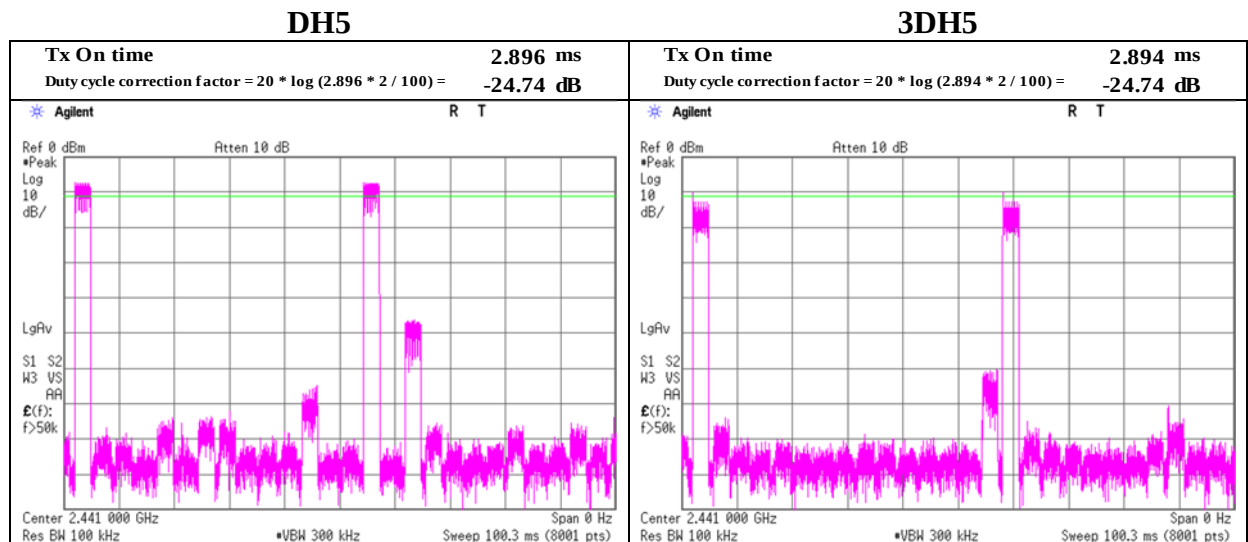


3DH5



Duty cycle correction factor

Report No.	13408107S-A
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 18, 2020
Temperature / Humidity	24 deg. C / 40 % RH
Engineer	Shiro Kobayashi
Mode	Tx, Hopping On

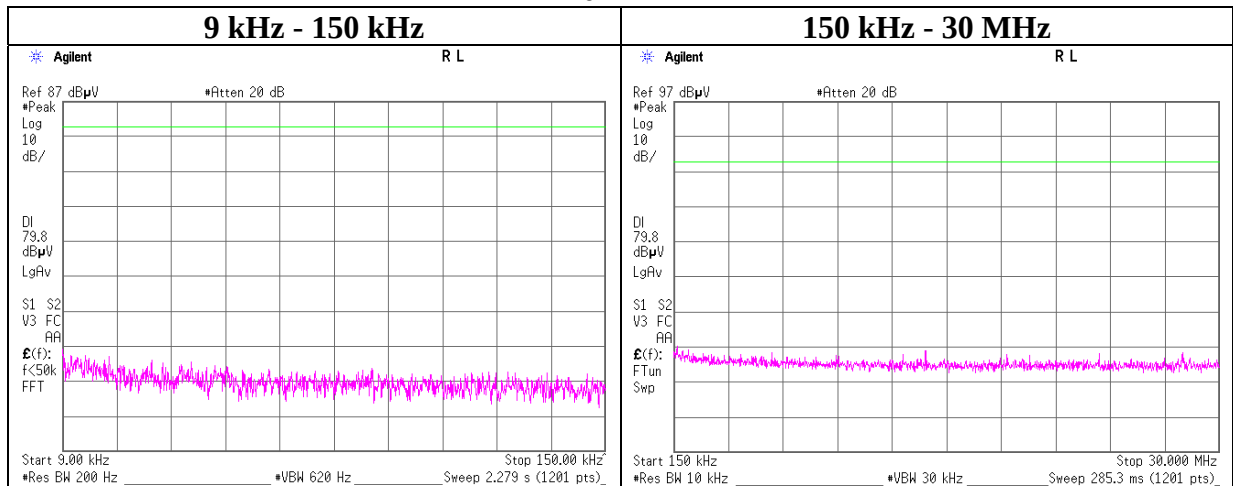


As for Tx On time, refer to “Burst Rate Confirmation”.

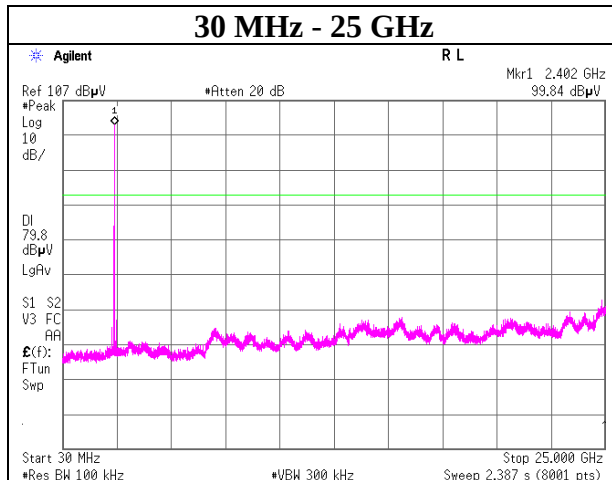
Conducted Spurious Emission

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 6, 2020
Temperature / Humidity 24 deg. C / 58 % RH
Engineer Shiro Kobayashi
Mode Tx, Hopping Off, DH5

2402 MHz



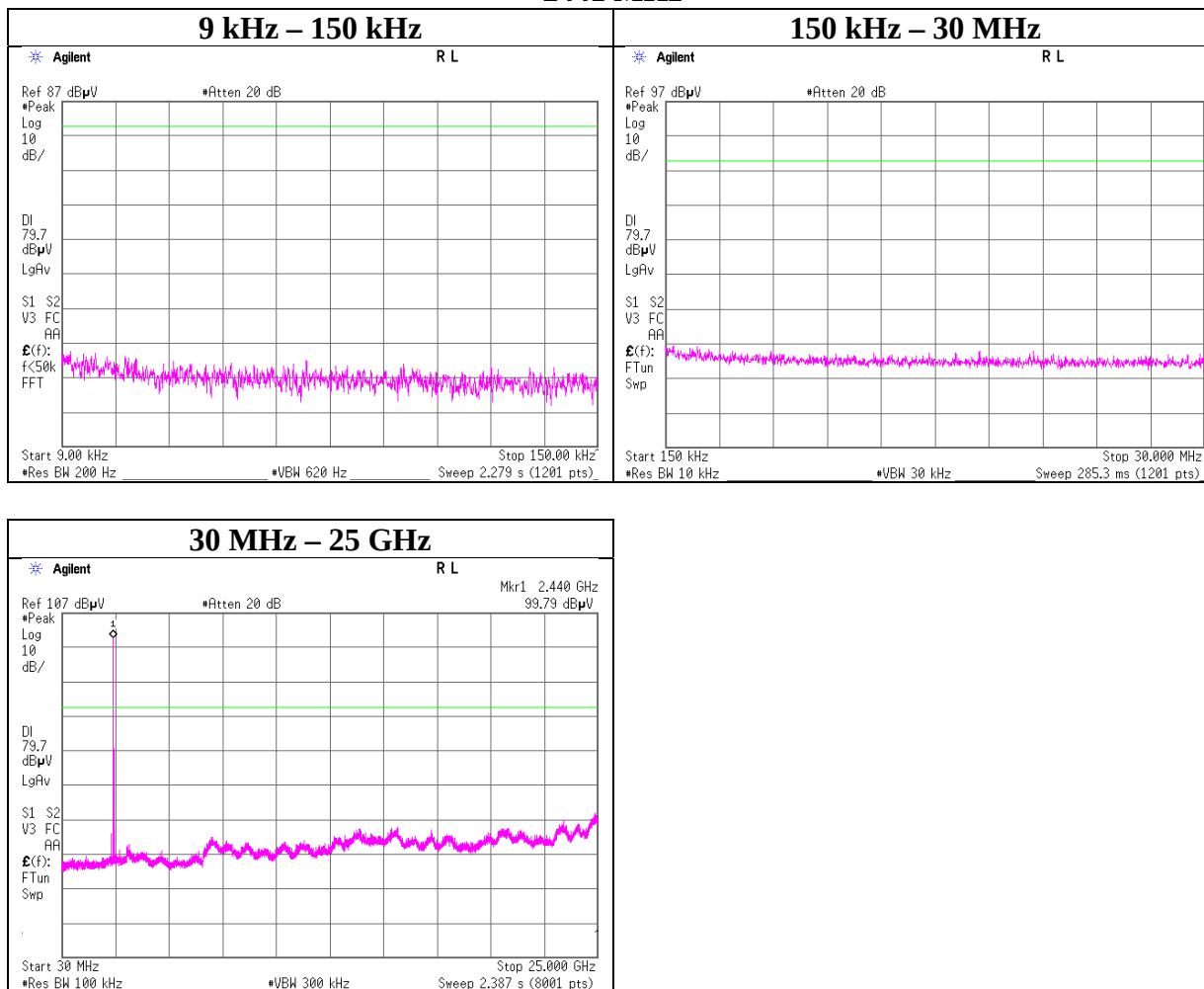
30 MHz - 25 GHz



Conducted Spurious Emission

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 6, 2020
Temperature / Humidity 24 deg. C / 58 % RH
Engineer Shiro Kobayashi
Mode Tx, Hopping Off, DH5

2441 MHz



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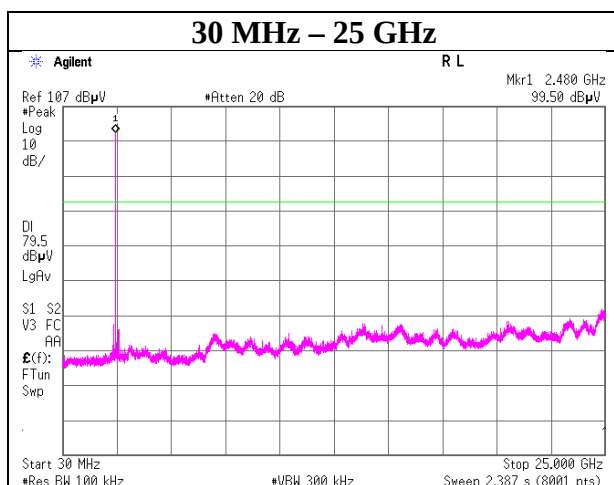
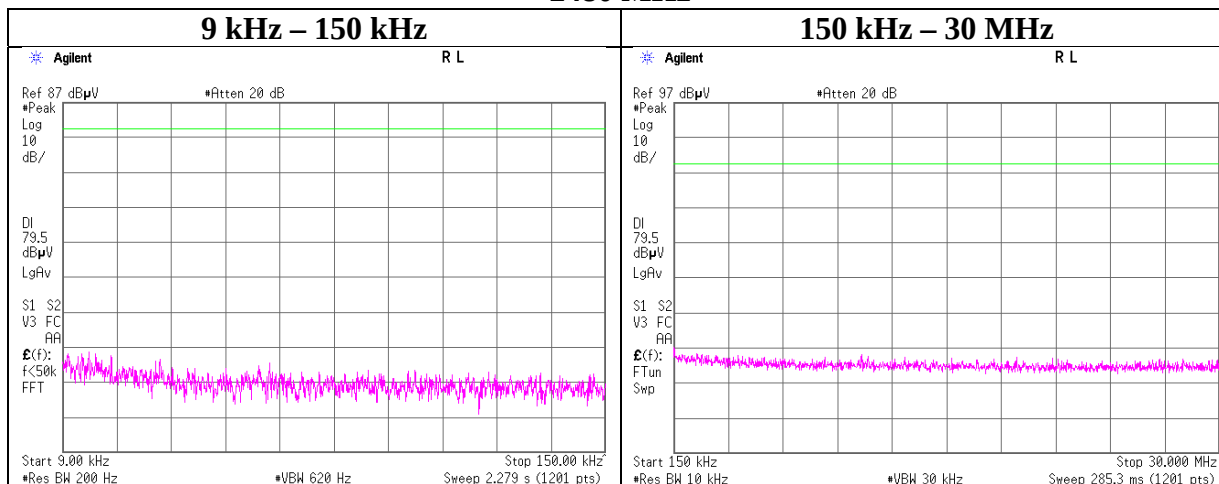
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 6, 2020
Temperature / Humidity 24 deg. C / 58 % RH
Engineer Shiro Kobayashi
Mode Tx, Hopping Off, DH5

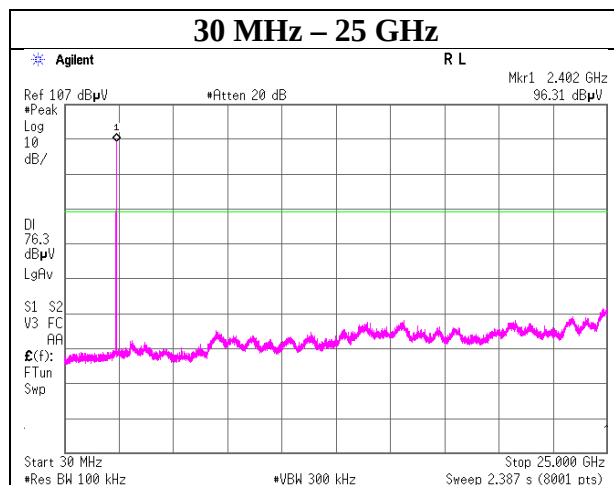
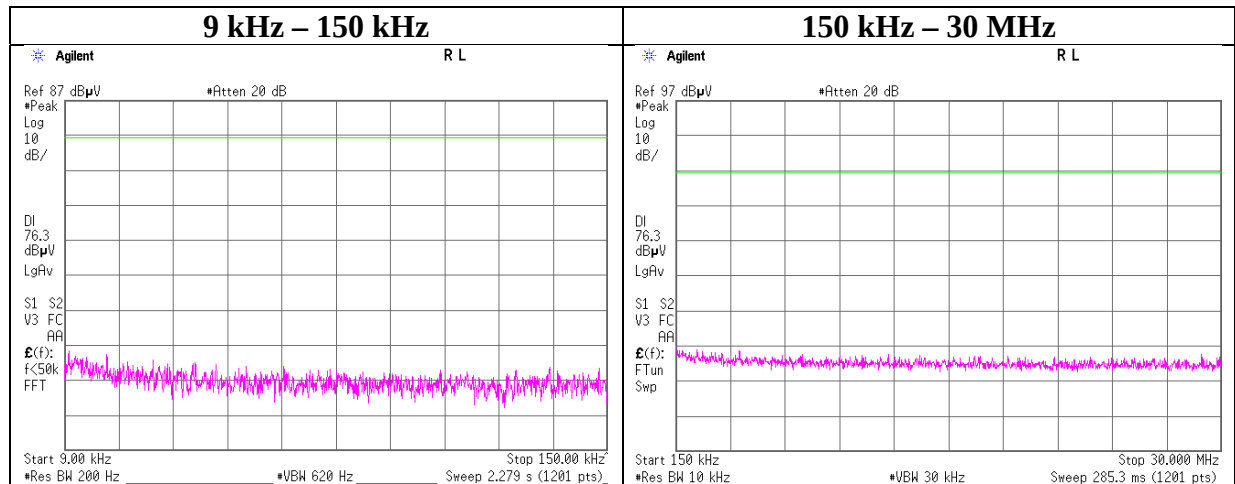
2480 MHz



Conducted Spurious Emission

Report No.	13408107S-A
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	24 deg. C / 58 % RH
Engineer	Shiro Kobayashi
Mode	Tx, Hopping Off, 3DH5

2402 MHz



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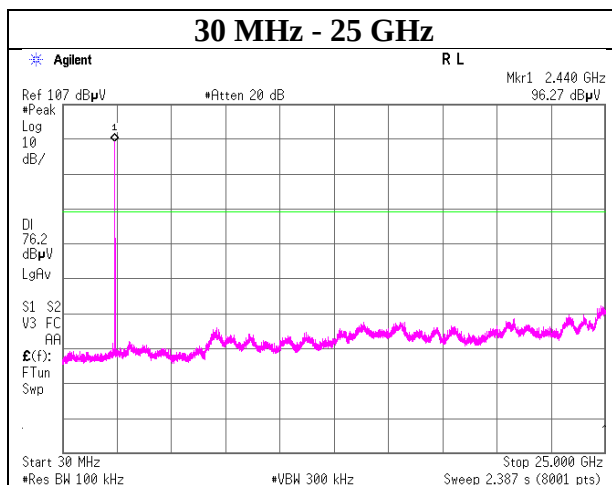
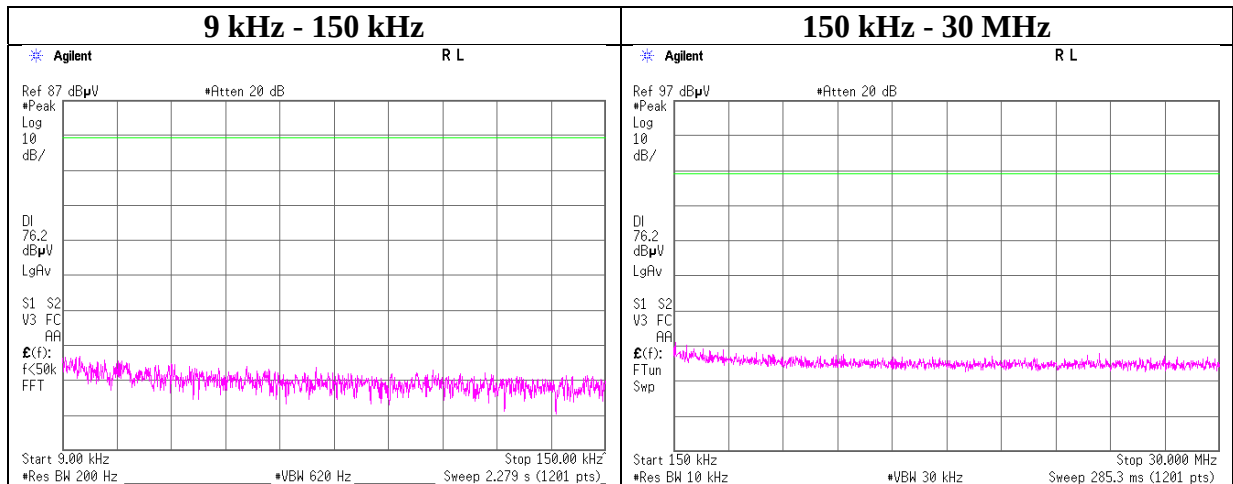
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 6, 2020
Temperature / Humidity 24 deg. C / 58 % RH
Engineer Shiro Kobayashi
Mode Tx, Hopping Off, 3DH5

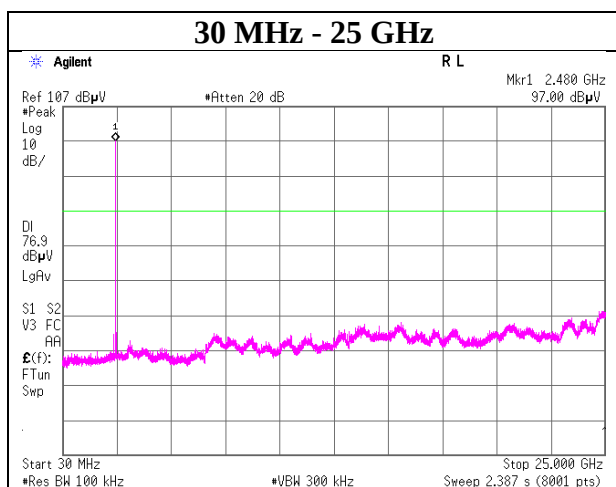
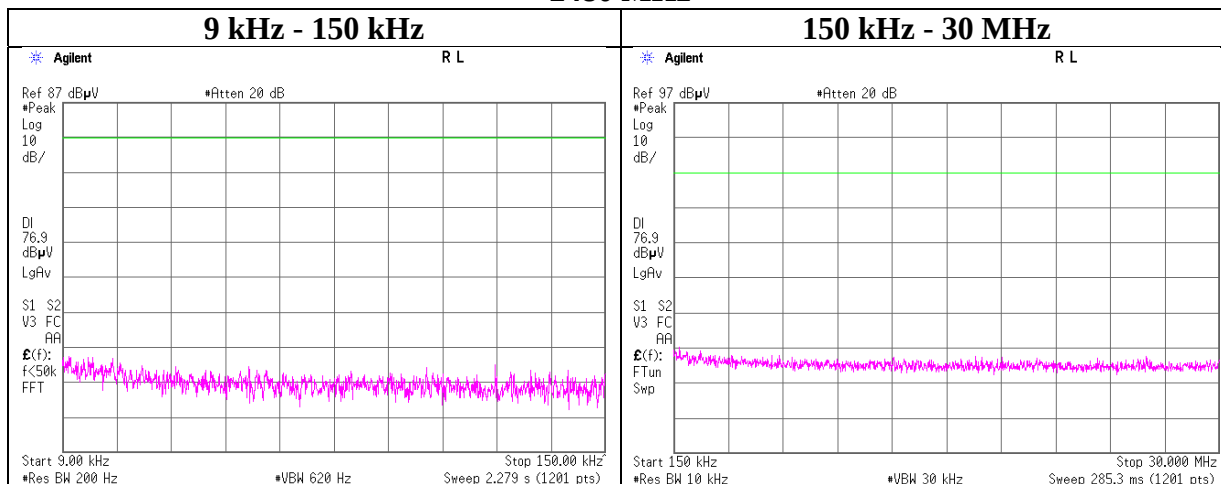
2441 MHz



Conducted Spurious Emission

Report No.	13408107S-A
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 6, 2020
Temperature / Humidity	24 deg. C / 58 % RH
Engineer	Shiro Kobayashi
Mode	Tx, Hopping Off, 3DH5

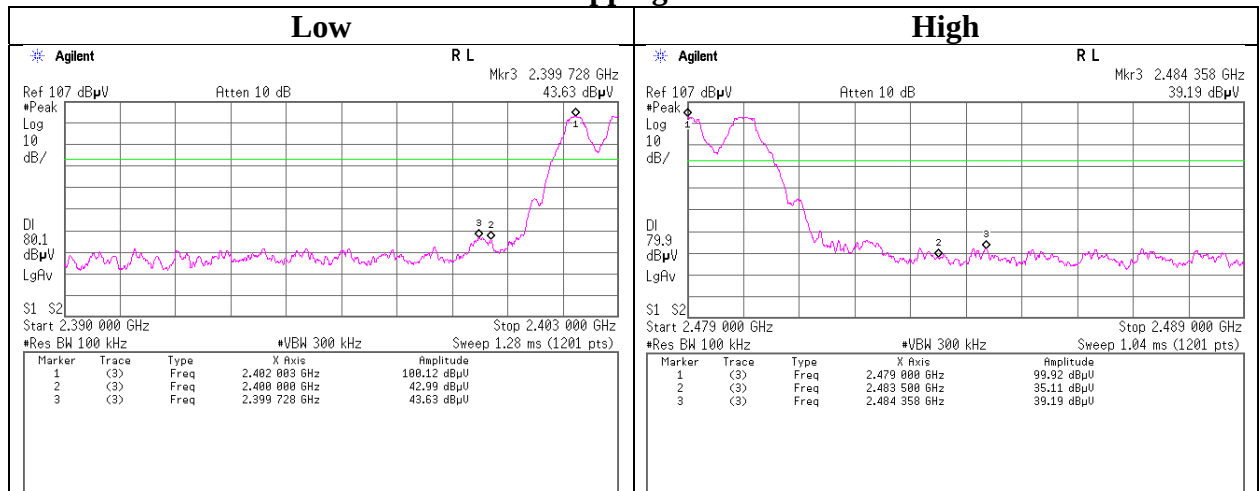
2480 MHz



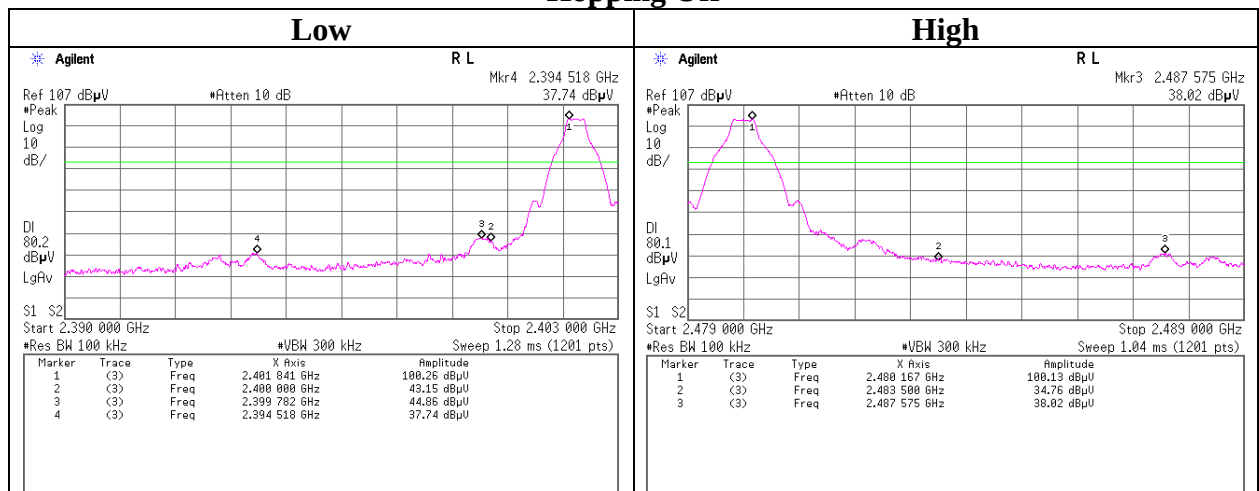
Conducted Emission Band Edge compliance

Report No. 13408107S-A
Test place Shonan EMC Lab. No.5 Shielded Room
Date August 14, 2020
Temperature / Humidity 24 deg. C / 61 % RH
Engineer Kazuya Noda
Mode Tx DH5

Hopping On



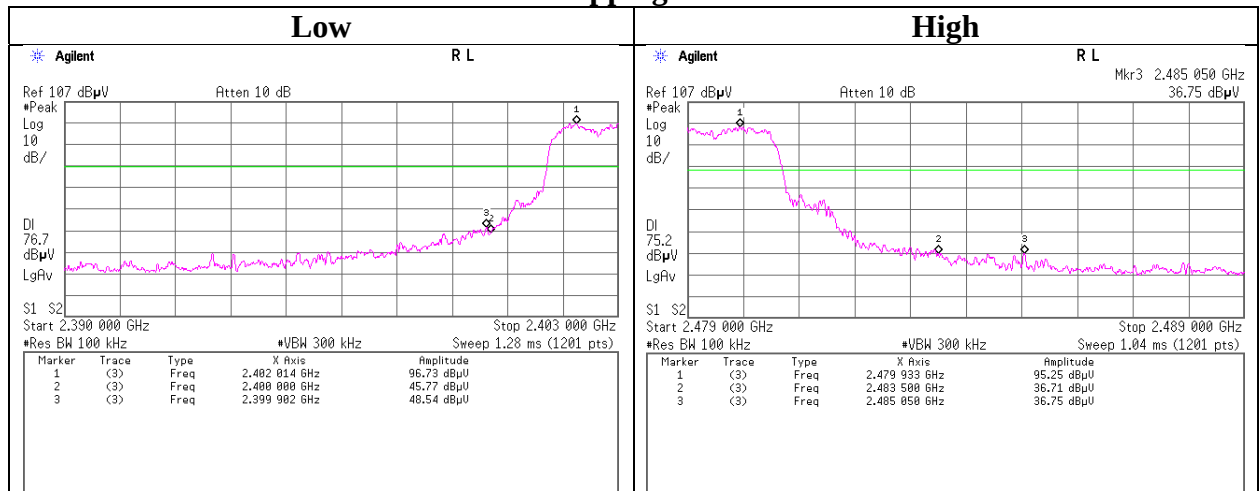
Hopping Off



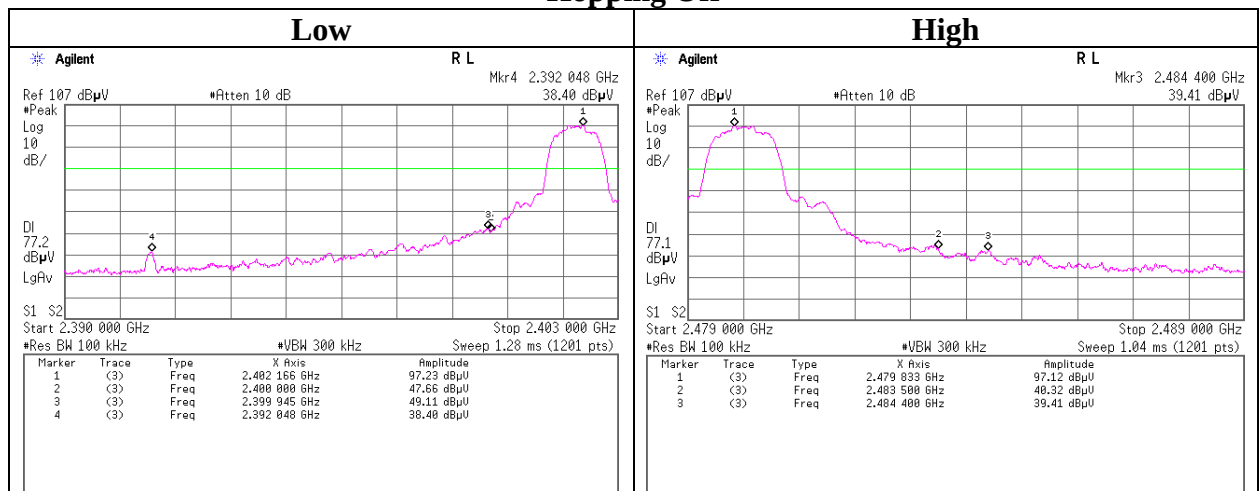
Conducted Emission Band Edge compliance

Report No.	13408107S-A
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 14, 2020
Temperature / Humidity	24 deg. C / 61 % RH
Engineer	Kazuya Noda
Mode	Tx 3DH5

Hopping On



Hopping Off



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APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KSA-08	145089	Spectrum Analyzer	Keysight Technologies Inc	E4446A	MY46180525	2019/11/05	12
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2019/10/01	12
AT	SAT10-16	160494	Attenuator	Weinschel Corp.	54A-10	83420	2019/12/12	12
AT	SCC-G66	196947	Coaxial Cable	HUBER+SUNER	SUCOFLEX 102	803478/2	2020/03/10	12
AT	SOS-19	175823	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2019/12/19	12
AT	SPM-07	146247	Power Meter	Keysight Technologies Inc	8990B	MY5100272	2020/05/27	12
AT	SPSS-05	146311	Power sensor	Keysight Technologies Inc	N1923A	MY5349008	2020/05/27	12
AT	STM-G6	146207	Terminator	JFW	50T-128	-	2019/11/05	12
AT	STS-05	146212	Digital Hitester	Hioki	3805-50	80997828	2019/10/01	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