RADIO TEST REPORT

Test Report No. : 13977035S-B

Applicant	:	**ALPS ALPINE CO., LTD.**
Type of EUT	:	**Head unit**
Model Number of EUT	:	**AH00ICB**
FCC ID	:	**A269ZUA165**
Test regulation	:	**FCC Part 15 Subpart C: 2021** *** Bluetooth BR/EDR part**
Test item	:	**Antenna Terminal Conducted Tests**
Test Result	:	**Complied (Refer to SECTION 3)**

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2. The results in this report apply only to the sample tested.
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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6. This test report covers Radio technical requirements.
   It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
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: October 25 to November 15, 2021

Representative test engineer: T. Kawakami
Takahiro Kawakami
Engineer

Approved by: K. Noda
Kazuya Noda
Leader

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".

REVISION HISTORY

Original Test Report No.: 13977035S-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13977035S-B	January 31, 2022	-	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation
AC	Alternating Current
AFH	Adaptive Frequency Hopping
AM	Amplitude Modulation
Amp, AMP	Amplifier
ANSI	American National Standards Institute
Ant, ANT	Antenna
AP	Access Point
ASK	Amplitude Shift Keying
Atten., ATT	Attenuator
AV	Average
BPSK	Binary Phase-Shift Keying
BR	Bluetooth Basic Rate
BT	Bluetooth
BT LE	Bluetooth Low Energy
BW	BandWidth
Cal Int	Calibration Interval
CCK	Complementary Code Keying
Ch., CH	Channel
CISPR	Comite International Special des Perturbations Radioelectriques
CW	Continuous Wave
DBPSK	Differential BPSK
DC	Direct Current
D-factor	Distance factor
DFS	Dynamic Frequency Selection
DQPSK	Differential QPSK
DSSS	Direct Sequence Spread Spectrum
DUT	Device Under Test
EDR	Enhanced Data Rate
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EN	European Norm
ERP, e.r.p.	Effective Radiated Power
ETSI	European Telecommunications Standards Institute
EU	European Union
EUT	Equipment Under Test
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
MCS	Modulation and Coding Scheme
MRA	Mutual Recognition Arrangement
N/A	Not Applicable
NIST	National Institute of Standards and Technology
NS	No signal detect.
NSA	Normalized Site Attenuation
OBW	Occupied BandWidth
OFDM	Orthogonal Frequency Division Multiplexing
P/M	Power meter
PCB	Printed Circuit Board
PER	Packet Error Rate
PHY	Physical Layer
PK	Peak
PN	Pseudo random Noise
PRBS	Pseudo-Random Bit Sequence
PSD	Power Spectral Density
QAM	Quadrature Amplitude Modulation
QP	Quasi-Peak
QPSK	Quadrature Phase Shift Keying
RBW	Resolution BandWidth
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
RNSS	Radio Navigation Satellite Service
RSS	Radio Standards Specifications
Rx	Receiving
SA, S/A	Spectrum Analyzer
SG	Signal Generator
SVSWR	Site-Voltage Standing Wave Ratio
TR, T/R	Test Receiver
Tx	Transmitting
VBW	Video BandWidth
Vert.	Vertical
WLAN	Wireless LAN

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SECTION 1: Customer information

Company Name	:	ALPS ALPINE CO., LTD.
Address	:	20-1 Yoshima Industrial park, Iwaki, Fukushima, Japan 970-1192
Telephone Number	:	+81-246-36-4111
Contact Person	:	Kenji Nagase

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	:	Head unit
Model Number	:	AH00ICB
Serial Number	:	Refer to SECTION 4.2
Receipt Date	:	October 18, 2021
Condition	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: AH00ICB (referred to as the EUT in this report) is a Head unit.

The EUT has following similar model:

Model Name	Details
AH00ICB (EUT)	External amplifier model
AH00ICB 1	Internal amplifier model

General Specification

Rating	:	DC 13.2 V
Operating Temperature	:	-30 deg. C - +70 deg. C

Radio Specification

Bluetooth

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Antenna type	:	Planar Inverted-F Antenna
Modulation	:	FHSS (GFSK, π/4-DQPSK, 8DPSK)
Antenna Gain	:	-0.2 dBi

Bluetooth Low Energy

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Antenna type	:	Planar Inverted-F Antenna
Modulation	:	GFSK
Antenna Gain	:	-0.2 dBi

WLAN 2.4 GHz (IEEE802.11b/g/n-20)

Radio Type	:	Transceiver
Frequency of Operation	:	2412 MHz - 2462 MHz
Antenna type	:	Planar Inverted-F Antenna
Modulation	:	DSSS (CCK, DQPSK, DBPSK) OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Gain	:	-0.2 dBi

WLAN 5 GHz (IEEE802.11a/n-20/n-40/ac-20/ac-40/ac-80)

Radio Type	:	Transceiver
Frequency of Operation	:	5180 MHz - 5825 MHz
Antenna type	:	Planar Inverted-F Antenna
Modulation	:	OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Gain	:	+2.71 dBi (Chain1) +2.71 dBi (Chain2)

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021

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	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 a)	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 a)	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 b)	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 c)	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (d)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(b)(1)		Complied d)	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 e)	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 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.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % Occupied Bandwidth	**ISED:** RSS-Gen 6.7	**ISED:** -	N/A	Complied 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 1 GHz	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 %
Duty cycle and Time Measurement	0.27 %
Temperature_SCH-01	0.93 deg.C.
Humidity_SCH-01	4.1 %
Temperature_SCH-02	2.0 deg.C.
Humidity_SCH-02	6.6 %
Voltage	0.97 %

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)

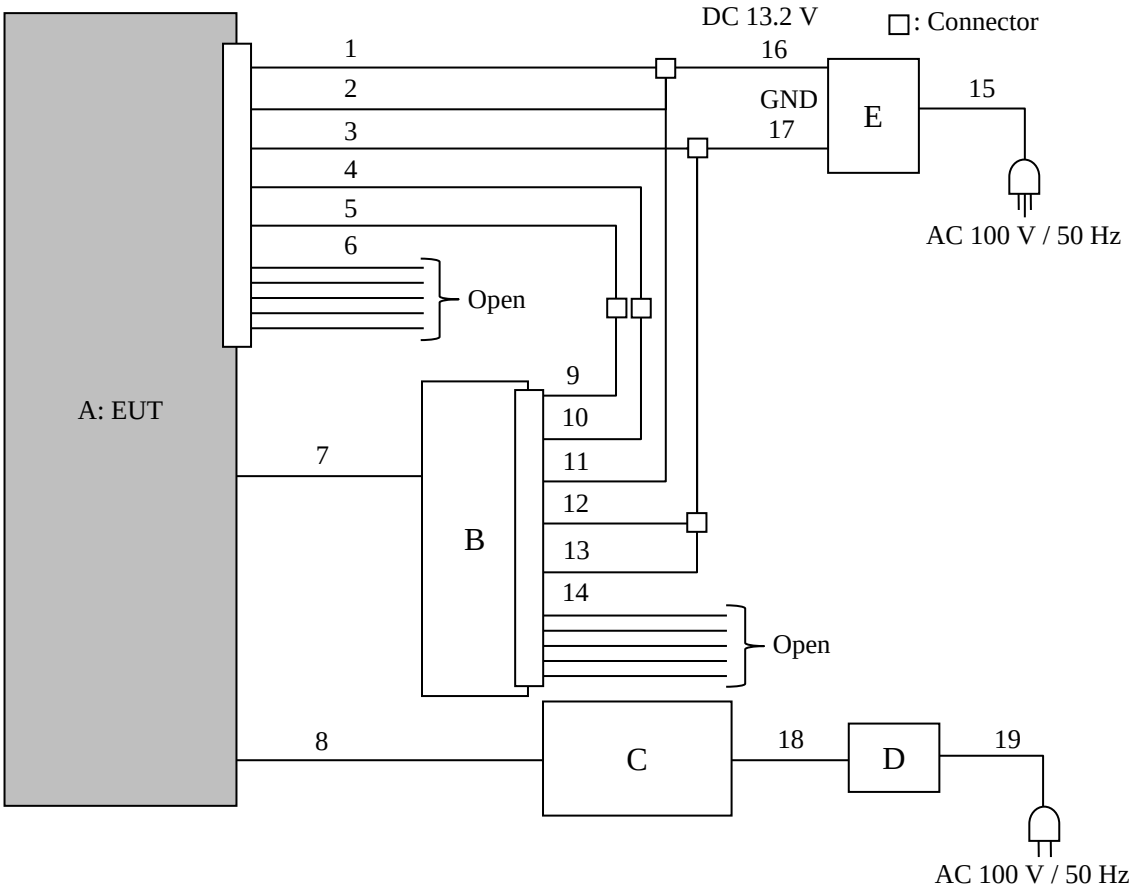
Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, Spurious Emission (Conducted)	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
20 dB 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: 8 (setting value)
Software: QRCT (Qualcomm Radio Control Toolkit) v4.0.00195.0
(Date: 2021.10.18, 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.

4.2 Configuration and peripherals



Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Head unit	AH00ICB	73	ALPS ALPINE	EUT
B	Display	QH00159A	114	ALPS ALPINE	-
C	Laptop Computer	7666-77J	LV-B8R1X 08/05	Lenovo	-
D	AC Adapter	42T4422	11S92P1154Z1DXF1DBFDN	Lenovo	-
E	Power Supply (DC)	PW16-5ADP	19100034	TEXIO	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	+B	2.2	Unshielded	Unshielded	-
2	ACC	2.2	Unshielded	Unshielded	-
3	GND	2.2	Unshielded	Unshielded	-
4	BCAN H	2.2	Unshielded	Unshielded	-
5	BCAN L	2.2	Unshielded	Unshielded	-
6	Signal	2.2	Unshielded	Unshielded	-
7	GVIF	2.4	Shielded	Shielded	-
8	USB	2.2 + 1.0	Shielded	Shielded	-
9	BCAN L	0.6	Unshielded	Unshielded	-
10	BCAN H	0.6	Unshielded	Unshielded	-
11	+B	0.6	Unshielded	Unshielded	-
12	GND	0.6	Unshielded	Unshielded	-
13	DISP CONT	0.6	Unshielded	Unshielded	-
14	Signal	0.6	Unshielded	Unshielded	-
15	AC	2.0	Unshielded	Unshielded	-
16	DC+	2.0	Unshielded	Unshielded	-
17	DC-	2.0	Unshielded	Unshielded	-
18	DC	1.8	Unshielded	Unshielded	-
19	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	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 or 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 30 MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz -150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)
*4) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 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.

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

Report No.	13977035S-B	
Test place	Shonan EMC Lab.	
	No.1 Measurement Room	No.5 Shielded Room
Date	October 25, 2021	November 9, 2021
Temperature / Humidity	23 deg. C / 41 % RH	24 deg. C / 42 % RH
Engineer	Kenichi Adachi	Miku Ikudome
Mode	Tx, Hopping Off, Tx, Hopping On	

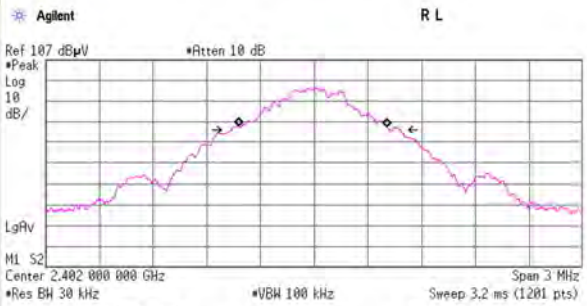
Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.942	829.7	1.000	>= 0.628
DH5	2441.0	0.930	825.8	1.000	>= 0.620
DH5	2480.0	0.939	829.4	1.000	>= 0.626
DH5	Hopping On	-	78536.3	-	-
3DH5	2402.0	1.302	1179.7	1.000	>= 0.868
3DH5	2441.0	1.303	1179.4	1.000	>= 0.869
3DH5	2480.0	1.302	1179.1	1.000	>= 0.868
3DH5	Hopping On	-	78692.8	-	-

Limit: Two-thirds of 20 dB Bandwidth or 25 kHz (whichever is greater).
No limit applies to 20 dB Bandwidth.

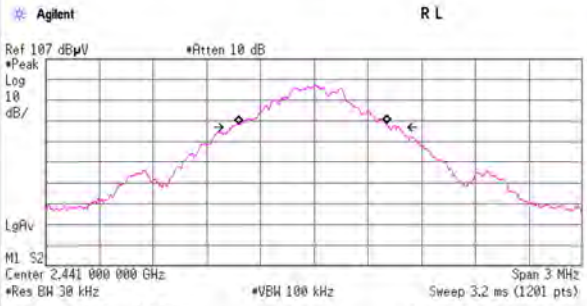
20 dB Bandwidth & 99 % Occupied Bandwidth

DH5

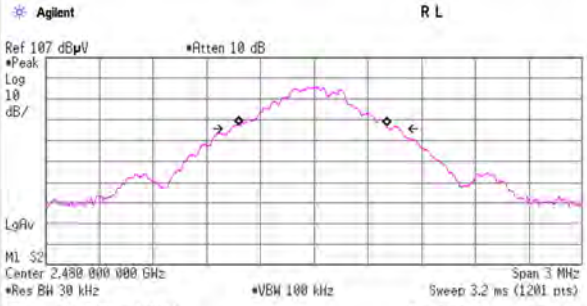
2402 MHz



2441 MHz

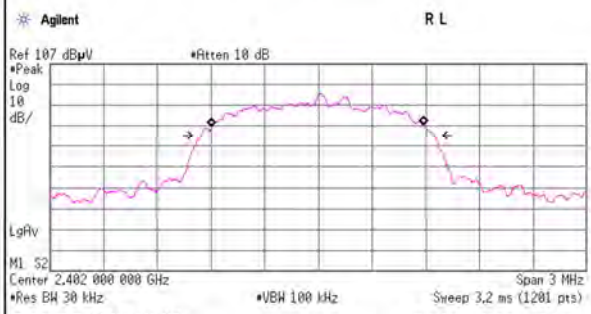


2480 MHz



3DH5

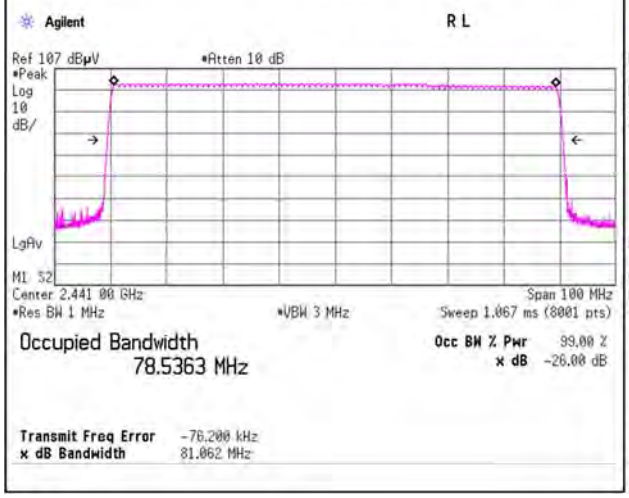
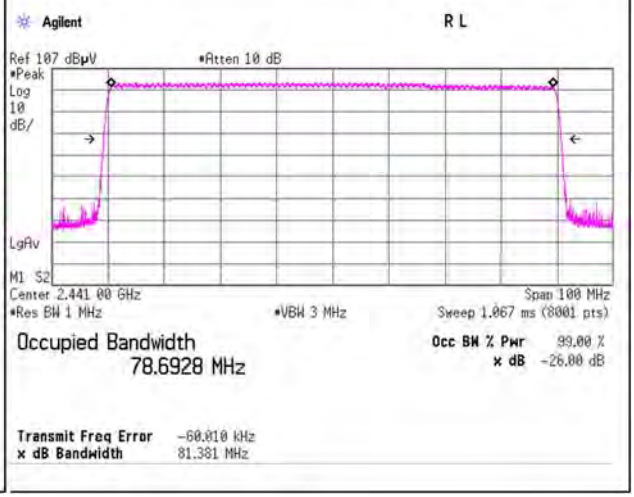
2402 MHz



2441 MHz

2480 MHz

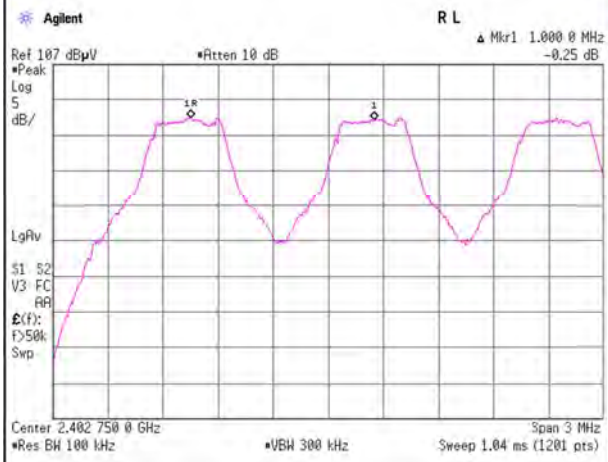
20 dB Bandwidth & 99 % Occupied Bandwidth

DH5	3DH5
Hopping On	Hopping On
	

Carrier Frequency Separation

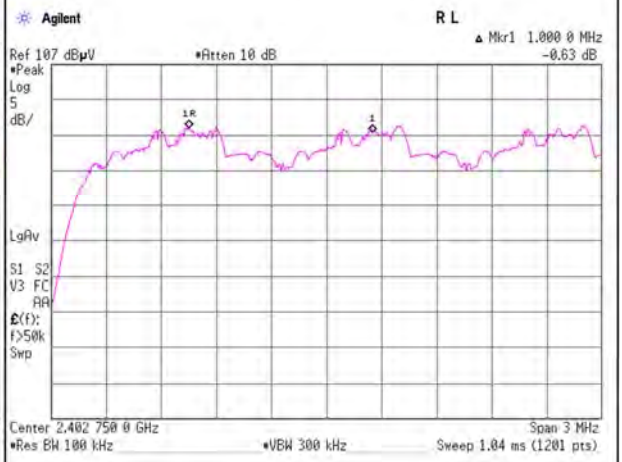
DH5

2402 MHz

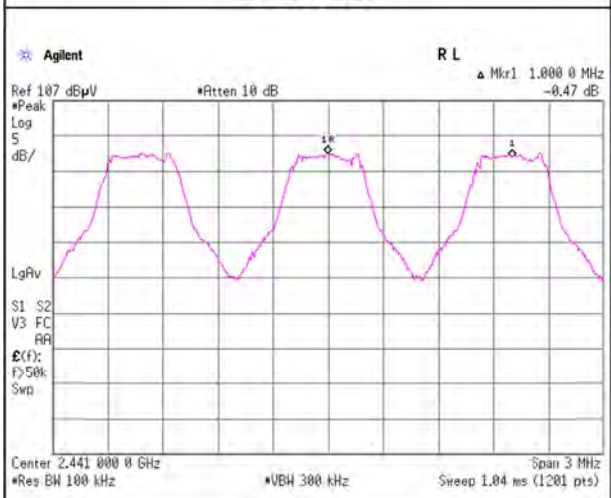


3DH5

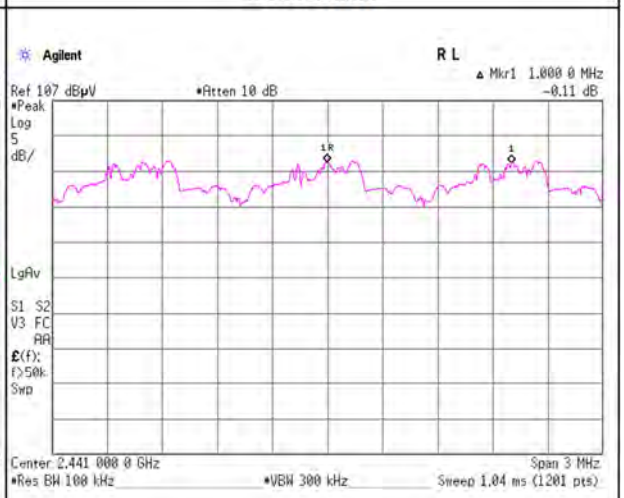
2402 MHz



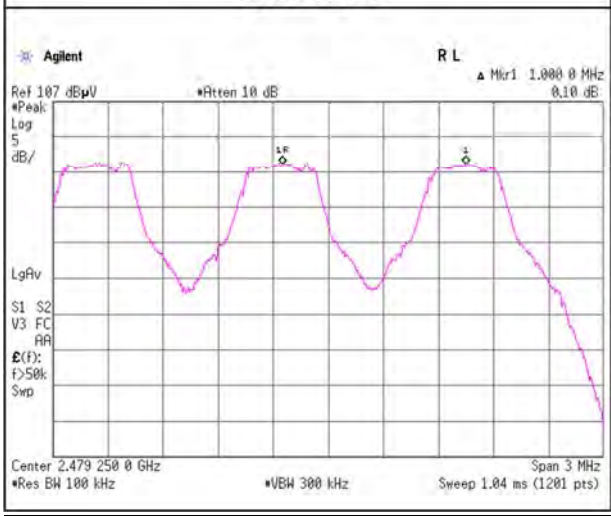
2441 MHz



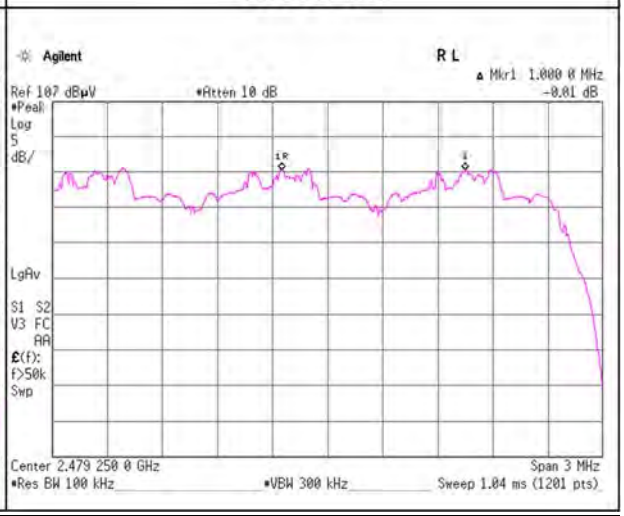
2441 MHz



2480 MHz



2480 MHz



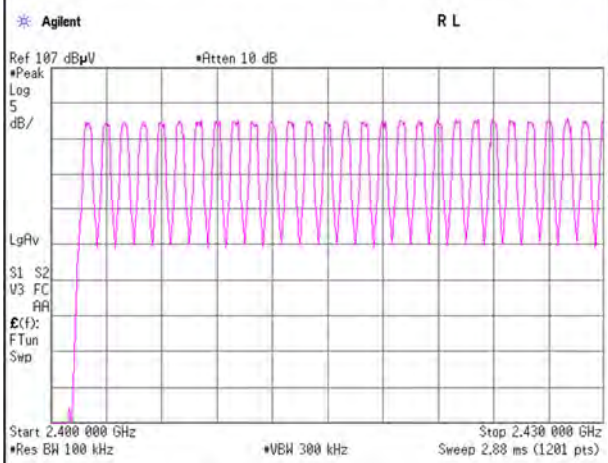
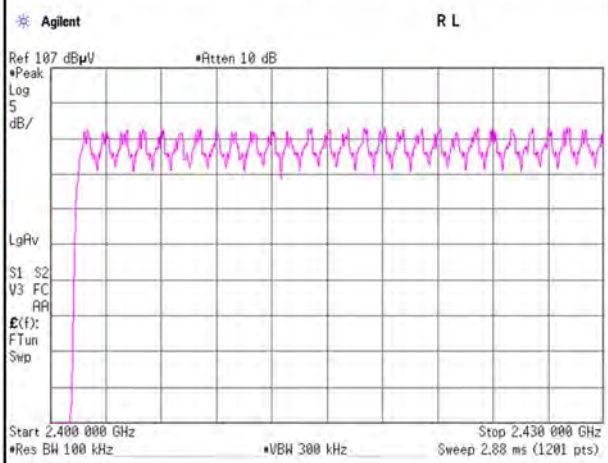
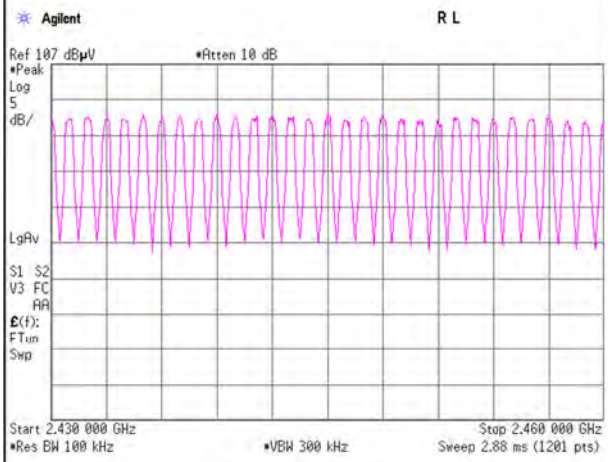
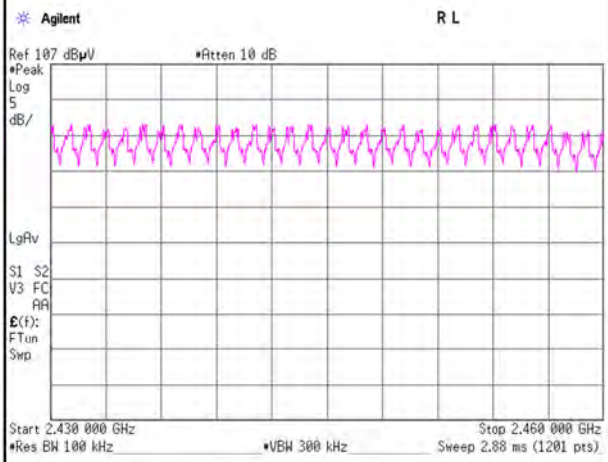
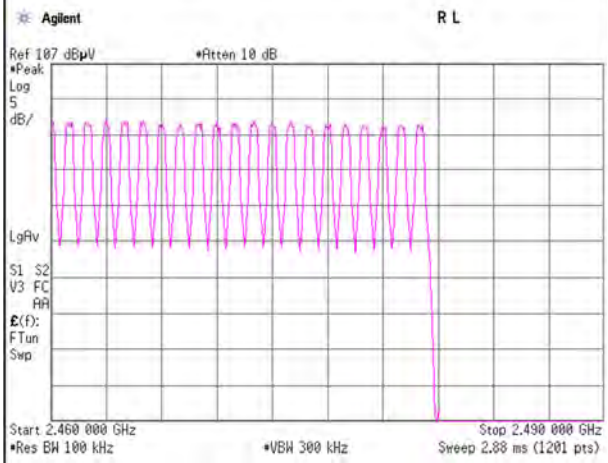
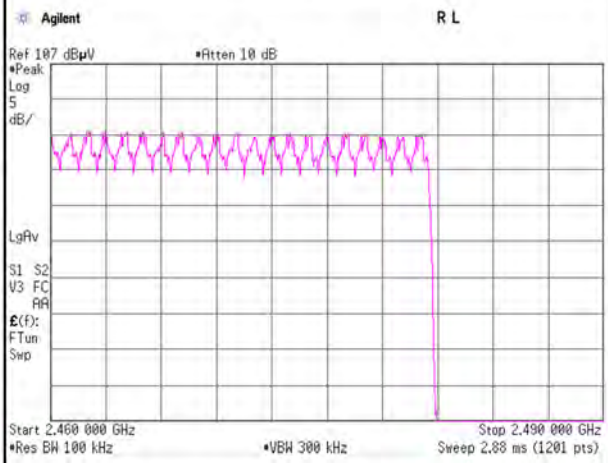
Number of Hopping Frequency

Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 9, 2021
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	Miku Ikudome
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

Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 9, 2021
Temperature / Humidity	24 deg. C / 42 % RH
Engineer	Miku Ikudome
Mode	Tx, Hopping On

Mode	Number of transmission in a 31.6 (79 Hopping x 0.4)	Length of transmission [ms]	Result [ms]	Limit [ms]
DH1	50.2 times / 5 s x 31.6 s = 318 times	0.407	129	400
DH3	26.4 times / 5 s x 31.6 s = 167 times	1.672	279	400
DH5	21.4 times / 5 s x 31.6 s = 136 times	2.918	397	400
3DH1	49.6 times / 5 s x 31.6 s = 314 times	0.411	129	400
3DH3	26.6 times / 5 s x 31.6 s = 169 times	1.669	282	400
3DH5	21.4 times / 5 s x 31.6 s = 136 times	2.924	398	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	52	51	48	50	50.2
DH3	27	26	28	25	26	26.4
DH5	22	22	22	21	20	21.4
3DH1	50	49	48	50	51	49.6
3DH3	25	26	28	28	26	26.6
3DH5	22	23	22	19	21	21.4

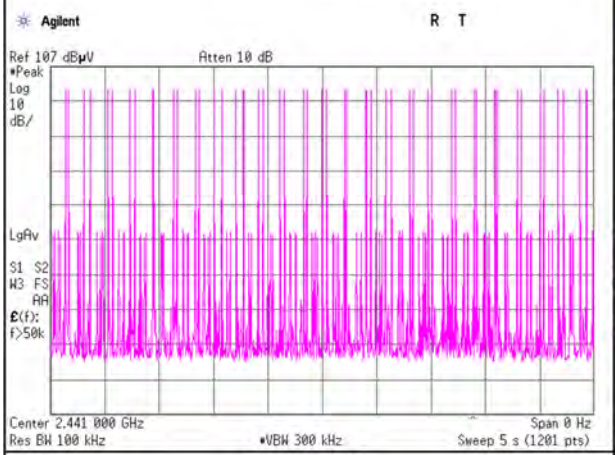
Sample Calculation

Average = Summation (Sampling 1 to 5) / 5

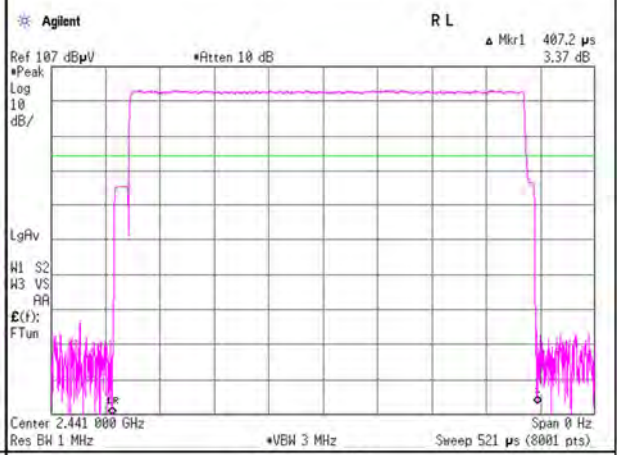
This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in N x 0.4 s, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than 0.4 s regardless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

Dwell time

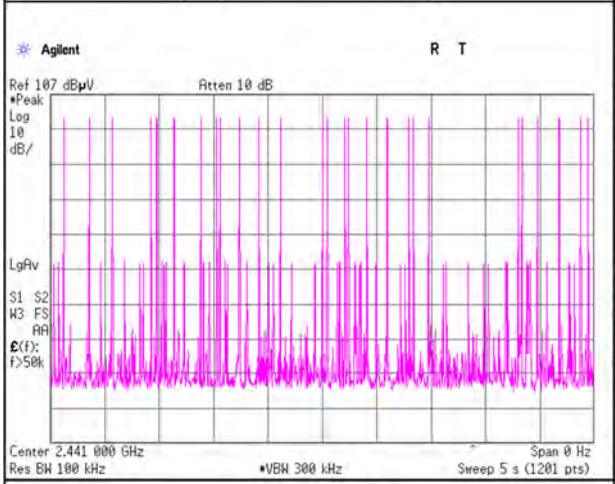
DH1 (1/2)
(Representative chart)



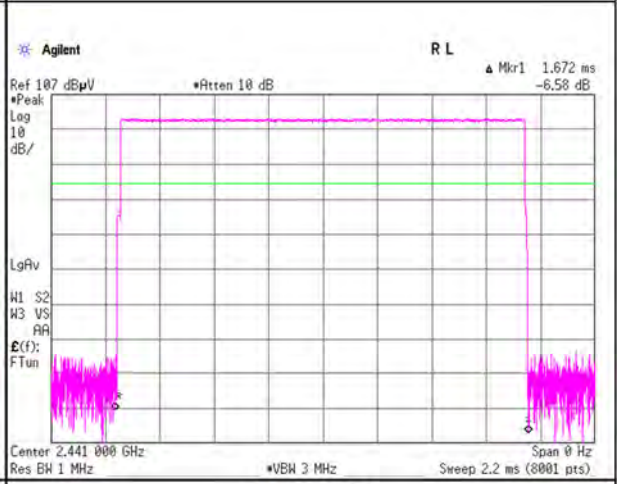
DH1 (2/2)



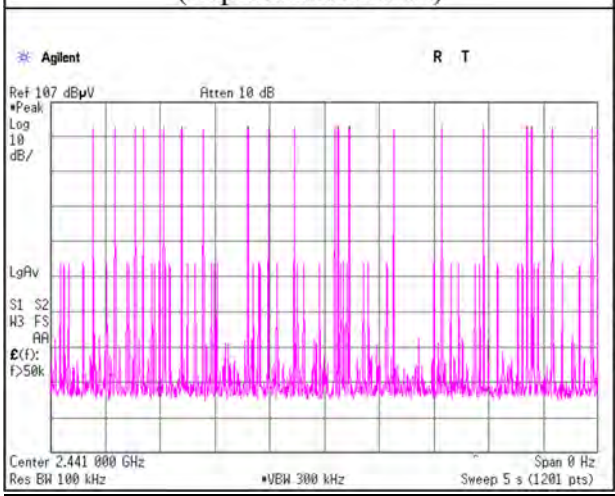
DH3 (1/2)
(Representative chart)



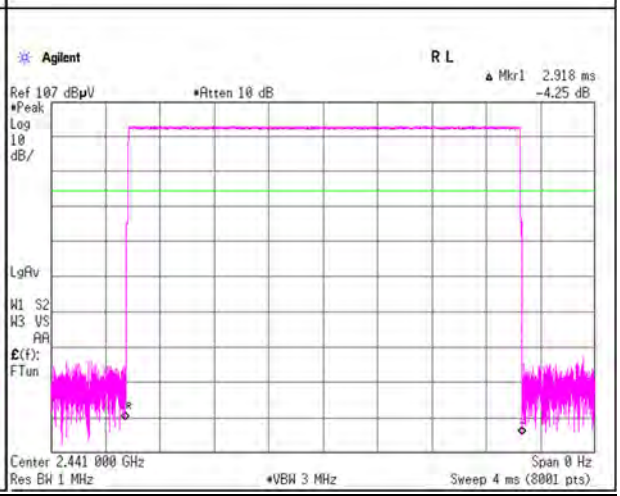
DH3 (2/2)



DH5 (1/2)
(Representative chart)

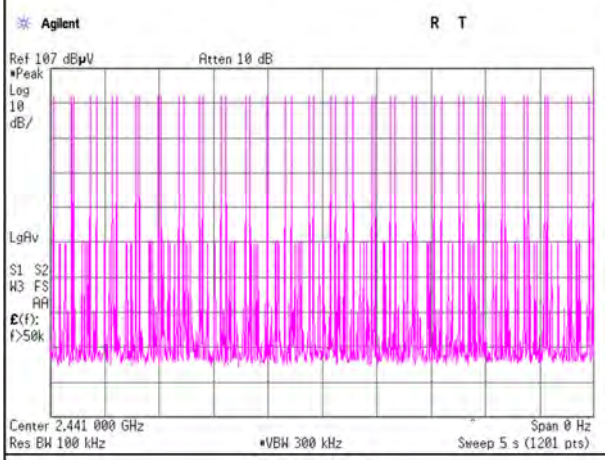


DH5 (2/2)

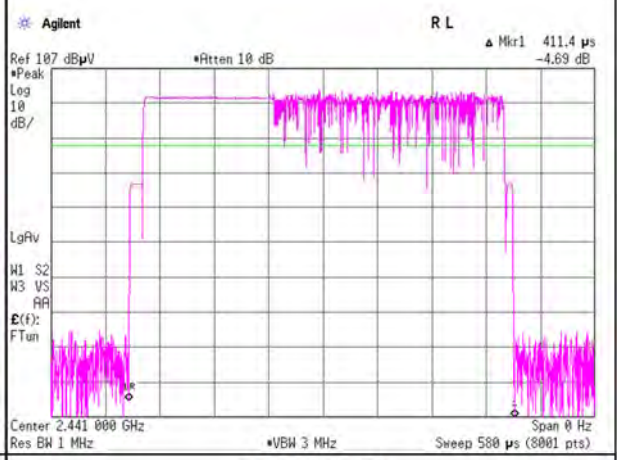


Dwell time

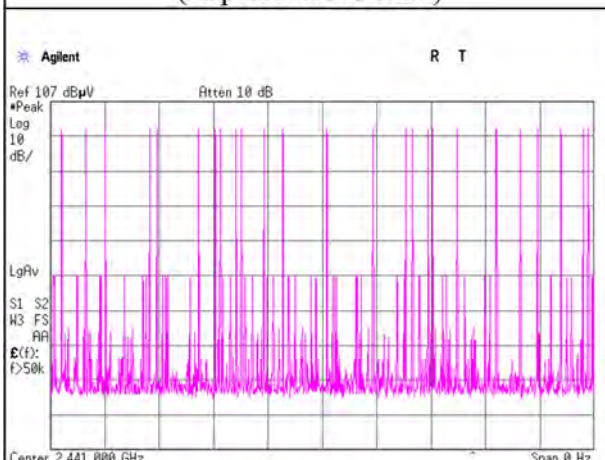
3DH1 (1/2)
(Representative chart)



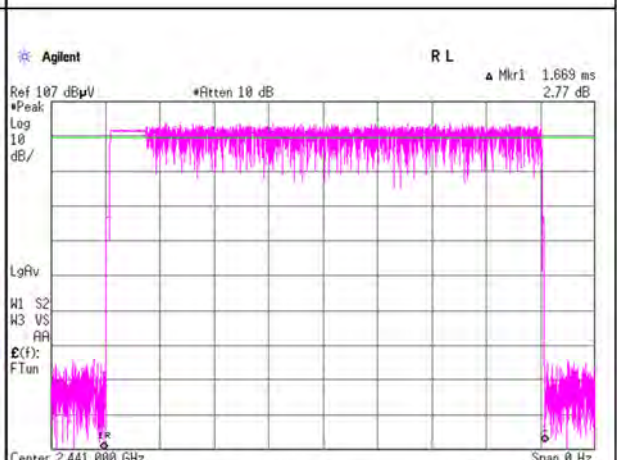
3DH1 (2/2)



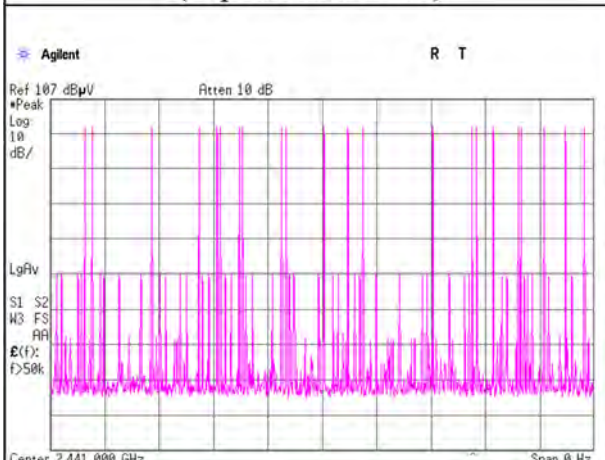
3DH3 (1/2)
(Representative chart)



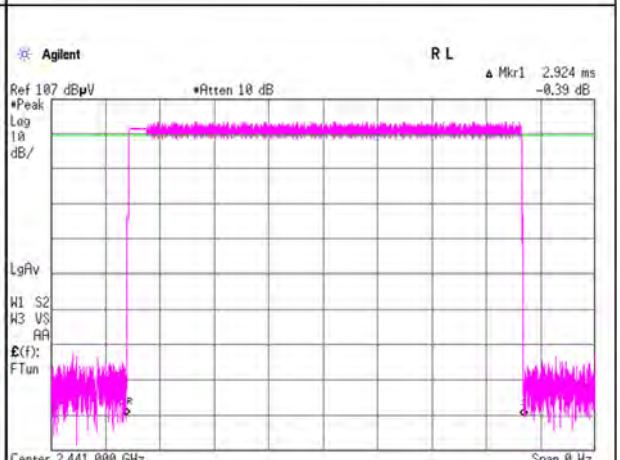
3DH3 (2/2)



3DH5 (1/2)
(Representative chart)



3DH5 (2/2)



Maximum Peak Output Power

Report No.	13977035S-B
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	October 25, 2021
Temperature / Humidity	23 deg. C / 41 % RH
Engineer	Kenichi Adachi
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	-11.08	1.70	9.64	0.26	1.06	20.97	125	20.71	-0.20	0.06	1.01	36.02	4000	35.96
DH5	2441	-10.62	1.72	9.64	0.74	1.19	20.97	125	20.23	-0.20	0.54	1.13	36.02	4000	35.48
DH5	2480	-11.56	1.73	9.64	-0.19	0.96	20.97	125	21.16	-0.20	-0.39	0.91	36.02	4000	36.41
2DH5	2402	-10.61	1.70	9.64	0.73	1.18	20.97	125	20.24	-0.20	0.53	1.13	36.02	4000	35.49
2DH5	2441	-10.13	1.72	9.64	1.23	1.33	20.97	125	19.74	-0.20	1.03	1.27	36.02	4000	34.99
2DH5	2480	-11.12	1.73	9.64	0.25	1.06	20.97	125	20.72	-0.20	0.05	1.01	36.02	4000	35.97
3DH5	2402	-10.05	1.70	9.64	1.29	1.35	20.97	125	19.68	-0.20	1.09	1.29	36.02	4000	34.93
3DH5	2441	-9.58	1.72	9.64	1.78	1.51	20.97	125	19.19	-0.20	1.58	1.44	36.02	4000	34.44
3DH5	2480	-10.51	1.73	9.64	0.86	1.22	20.97	125	20.11	-0.20	0.66	1.16	36.02	4000	35.36

Sample Calculation:
Result = Reading + Cable Loss + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain
*The equipment and cables were not used for factor 0 dB of the data sheets.

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	-12.68	1.70	9.64	-1.34	0.73	1.10	-0.24	0.95
DH5	2441	-12.21	1.72	9.64	-0.85	0.82	1.10	0.25	1.06
DH5	2480	-13.23	1.73	9.64	-1.86	0.65	1.10	-0.76	0.84
2DH5	2402	-14.15	1.70	9.64	-2.81	0.52	1.10	-1.71	0.67
2DH5	2441	-13.65	1.72	9.64	-2.29	0.59	1.10	-1.19	0.76
2DH5	2480	-14.67	1.73	9.64	-3.30	0.47	1.10	-2.20	0.60
3DH5	2402	-14.15	1.70	9.64	-2.81	0.52	1.10	-1.71	0.67
3DH5	2441	-13.65	1.72	9.64	-2.29	0.59	1.10	-1.19	0.76
3DH5	2480	-14.67	1.73	9.64	-3.30	0.47	1.10	-2.20	0.60

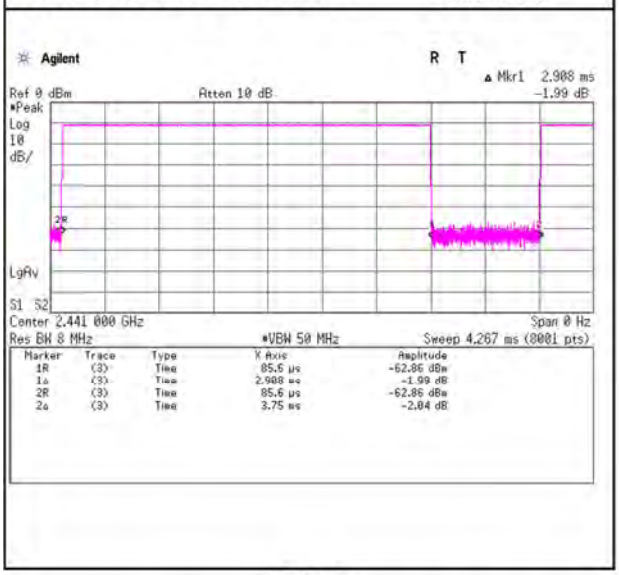
Sample Calculation:
Result (Time average) = Reading + Cable Loss + Attenuator Loss
Result (Burst power average) = Result (Time average) + Duty factor
*The equipment and cables were not used for factor 0 dB of the data sheets.

Burst Rate Confirmation

Report No.	13977035S-B
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	October 25, 2021
Temperature / Humidity	23 deg. C / 41 % RH
Engineer	Kenichi Adachi
Mode	Tx, Hopping Off

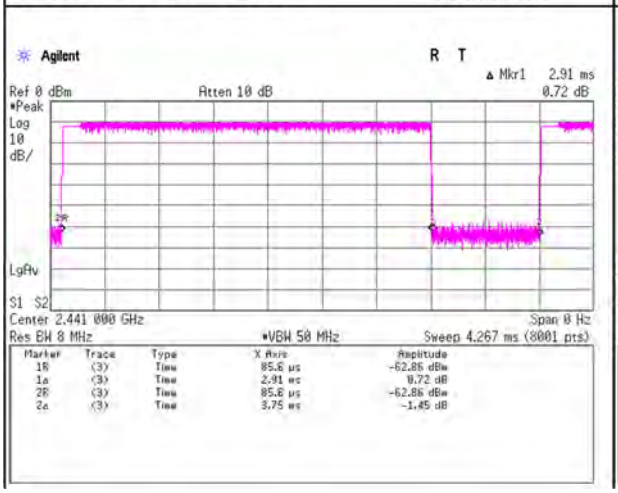
DH5

Tx on / (Tx on + Tx off) =	0.775
Tx on / (Tx on + Tx off) * 100 =	77.5 %
Duty factor = 10 * log (3.75 / 2.908) =	1.10 dB
VBW: 1 / on time = 343.86 Hz <	360.00 Hz



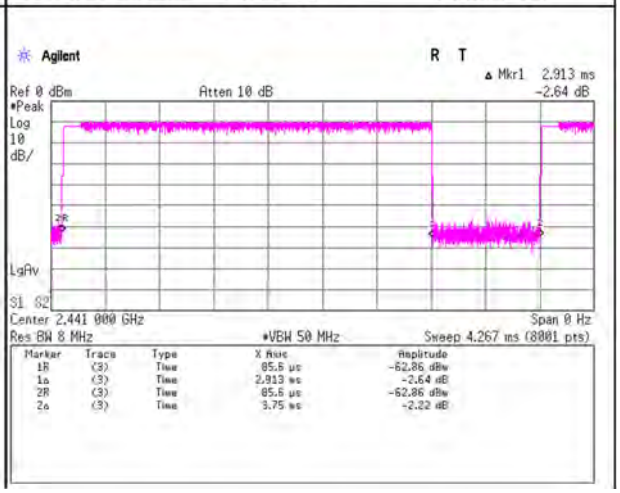
2DH5

Tx on / (Tx on + Tx off) =	0.776
Tx on / (Tx on + Tx off) * 100 =	77.6 %
Duty factor = 10 * log (3.75 / 2.91) =	1.10 dB
VBW: 1 / on time = 343.6 Hz <	360.00 Hz



3DH5

Tx on / (Tx on + Tx off) =	0.777
Tx on / (Tx on + Tx off) * 100 =	77.7 %
Duty factor = 10 * log (3.75 / 2.913) =	1.10 dB
VBW: 1 / on time = 343.29 Hz <	360.00 Hz

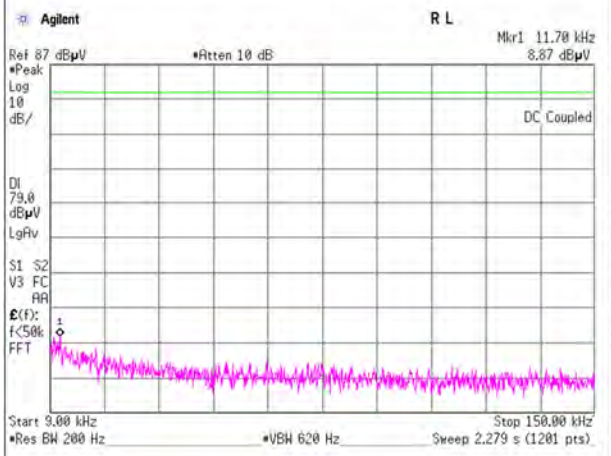


Conducted Spurious Emission

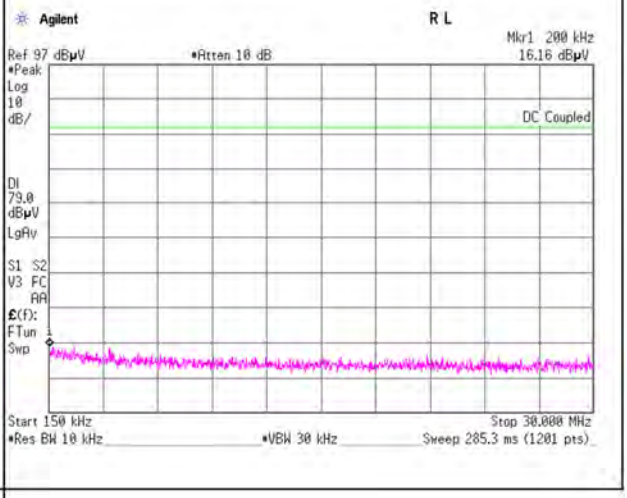
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, DH5

2402 MHz

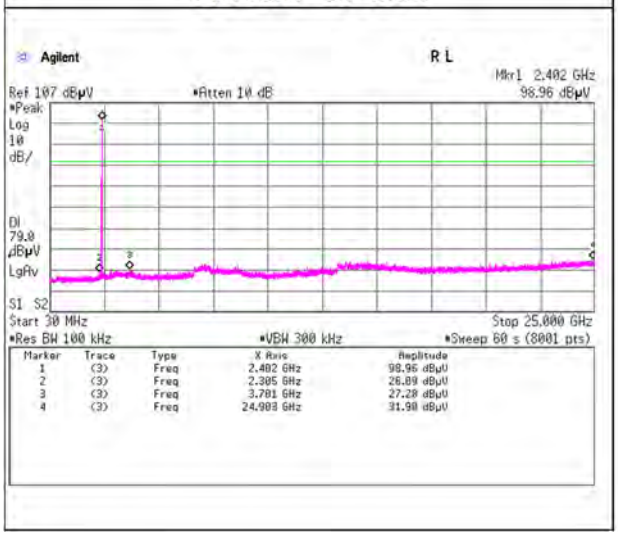
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

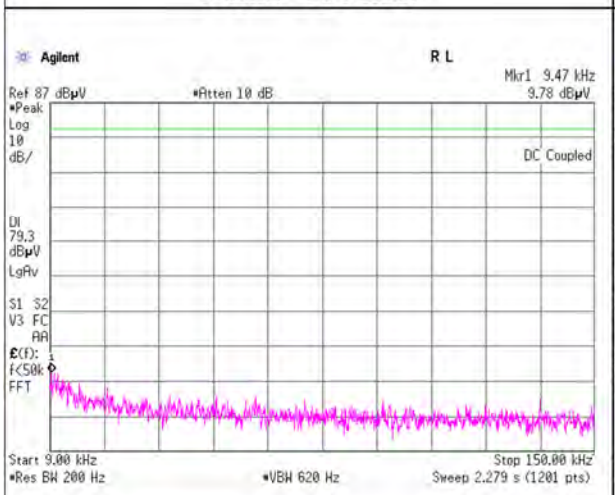


Conducted Spurious Emission

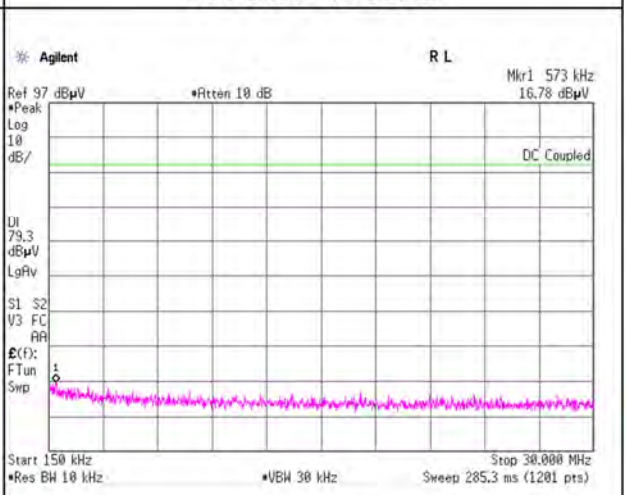
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, DH5

2441 MHz

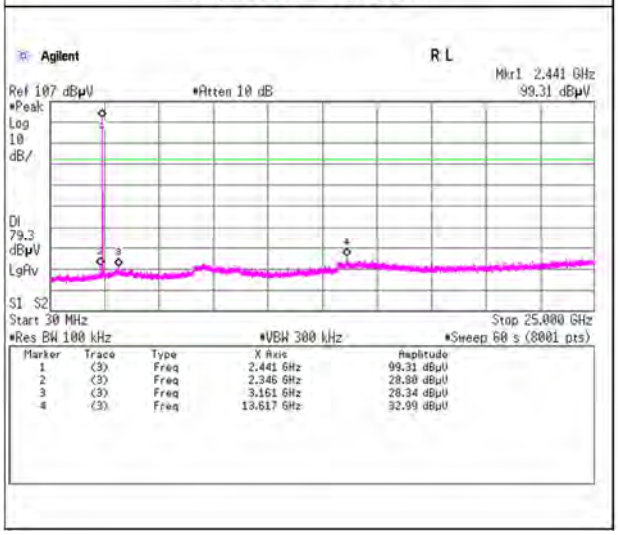
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

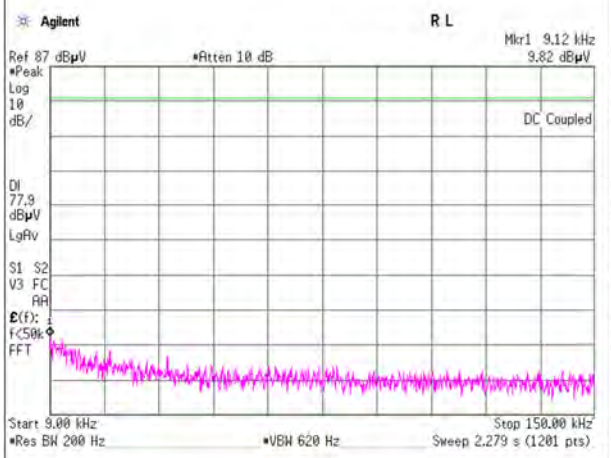


Conducted Spurious Emission

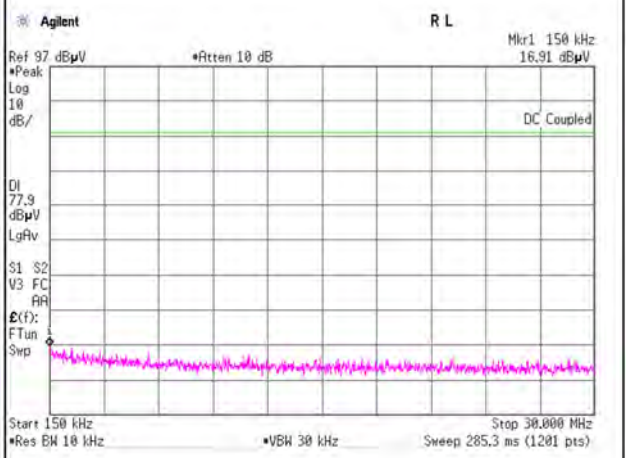
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, DH5

2480 MHz

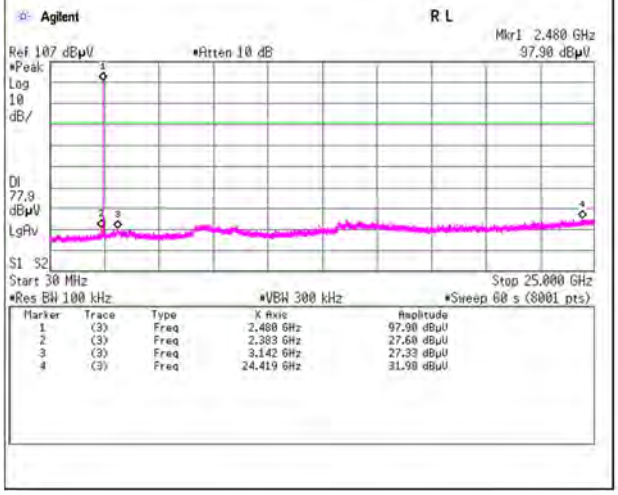
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

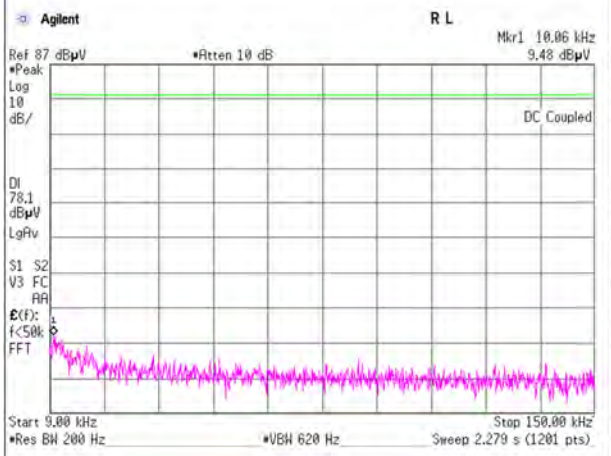


Conducted Spurious Emission

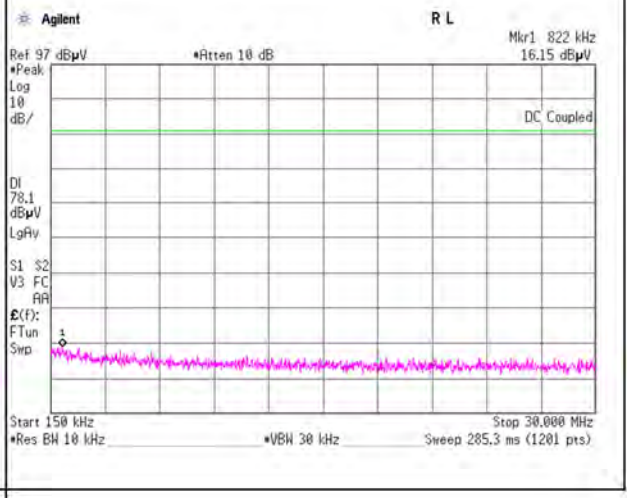
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, 3DH5

2402 MHz

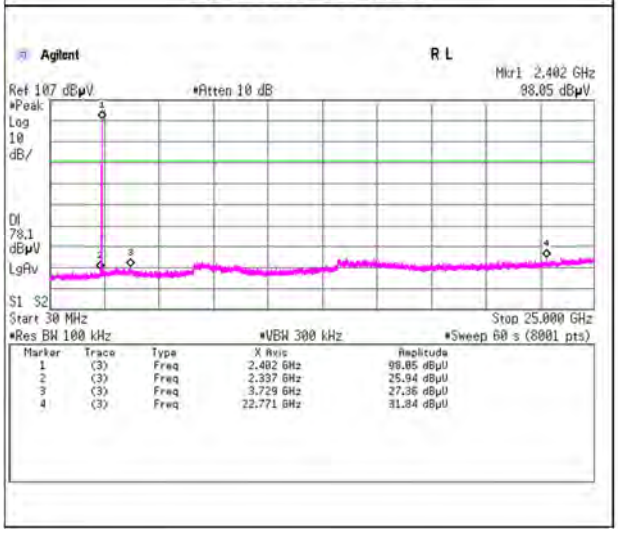
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

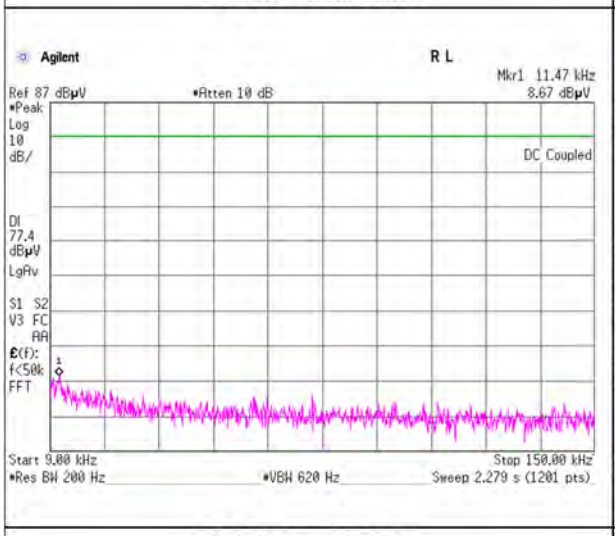


Conducted Spurious Emission

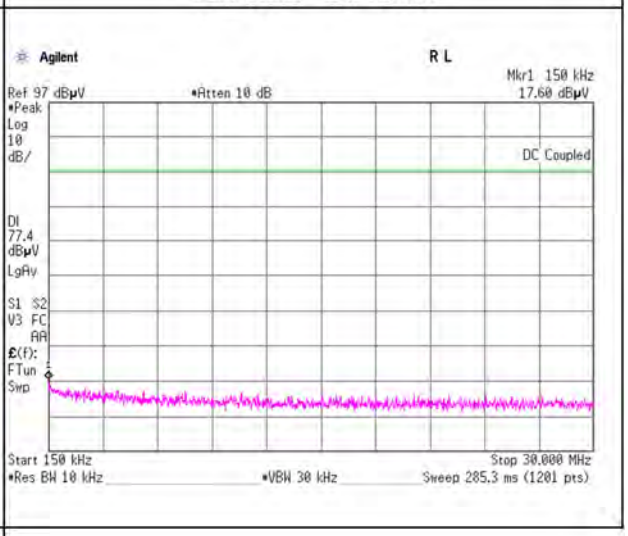
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, 3DH5

2441 MHz

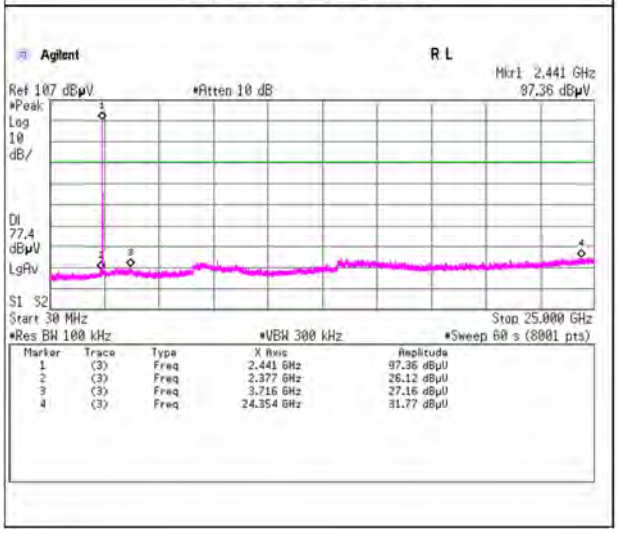
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

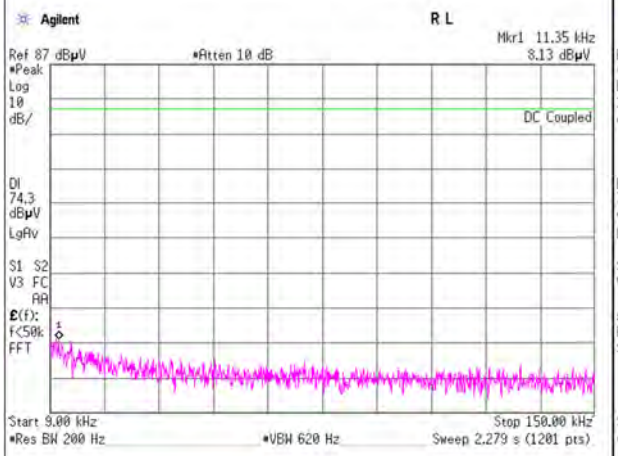


Conducted Spurious Emission

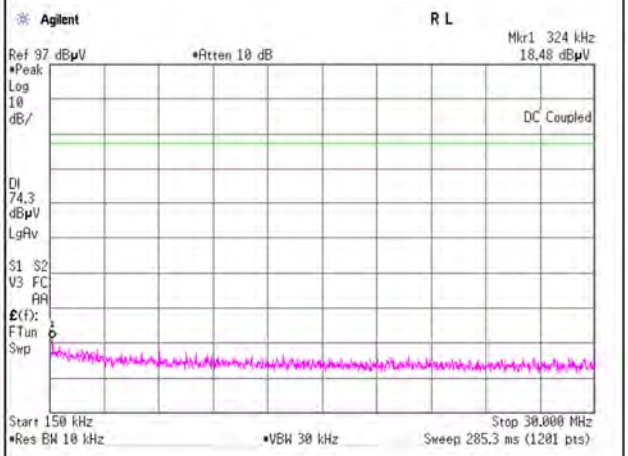
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, 3DH5

2480 MHz

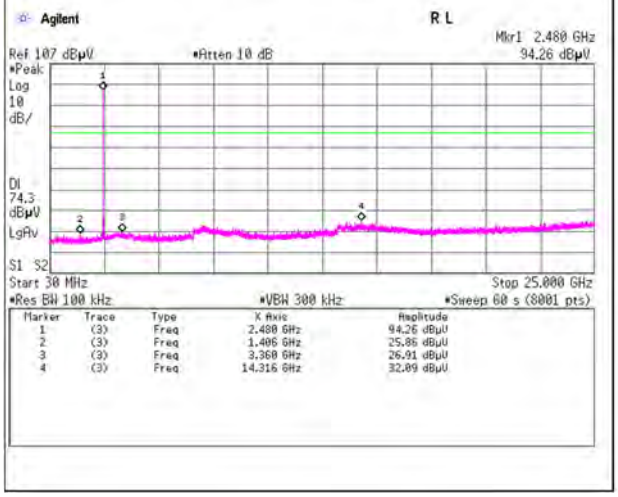
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

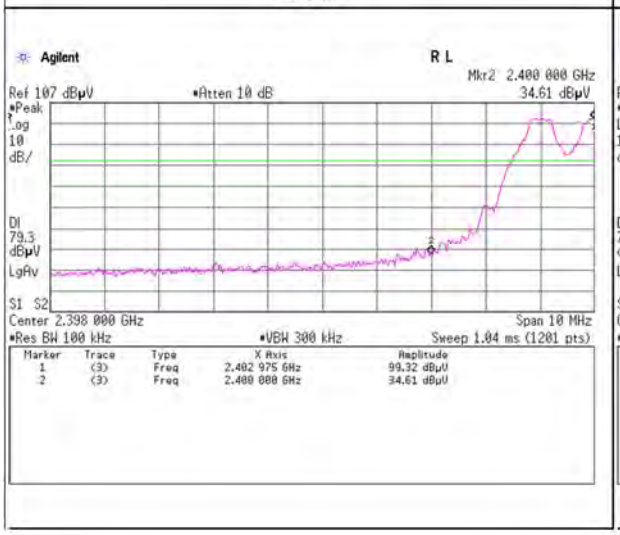


Conducted Emission Band Edge compliance

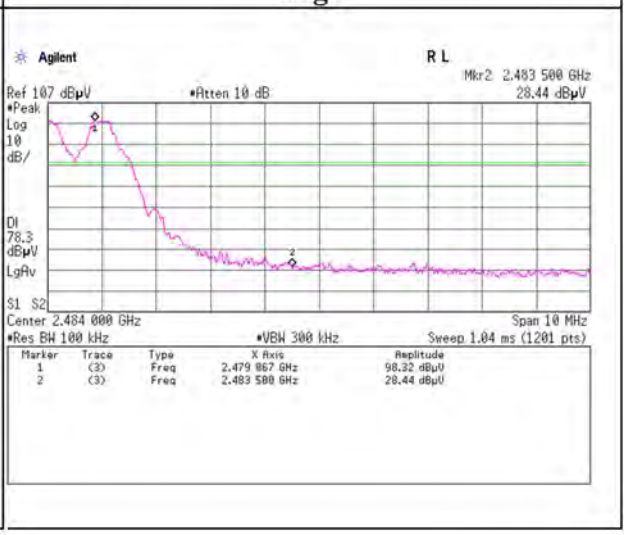
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx DH5

Hopping On

Low

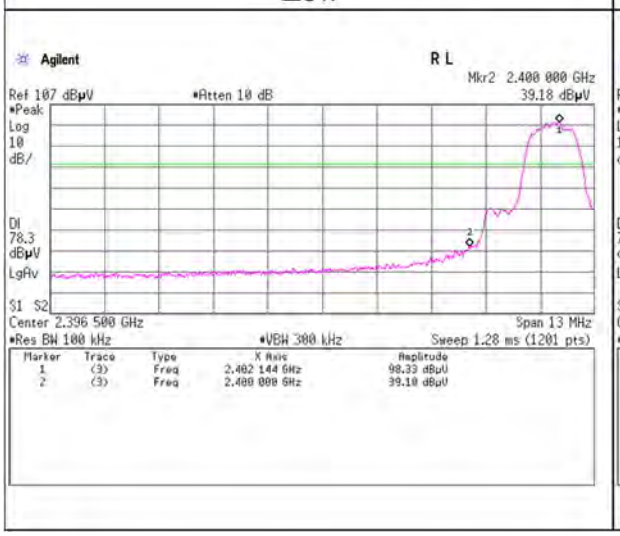


High

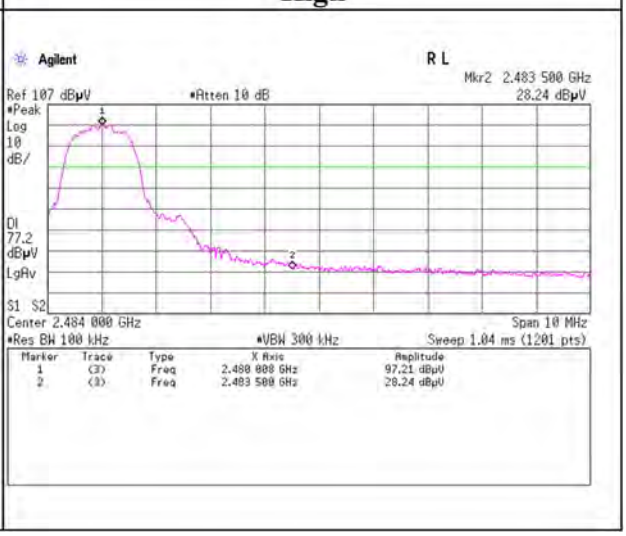


Hopping Off

Low



High

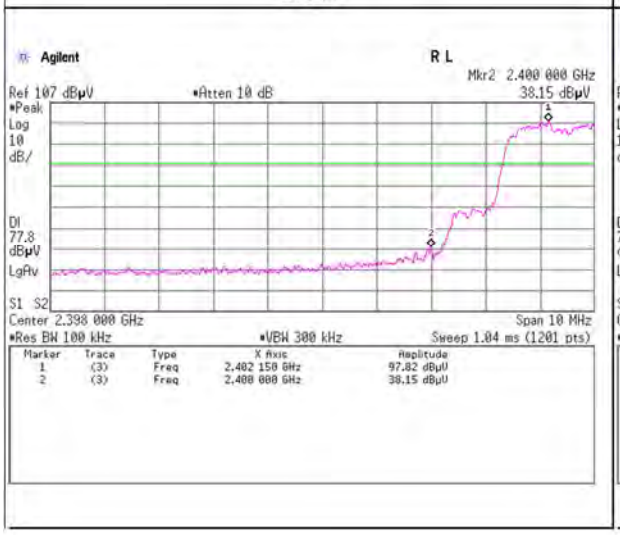


Conducted Emission Band Edge compliance

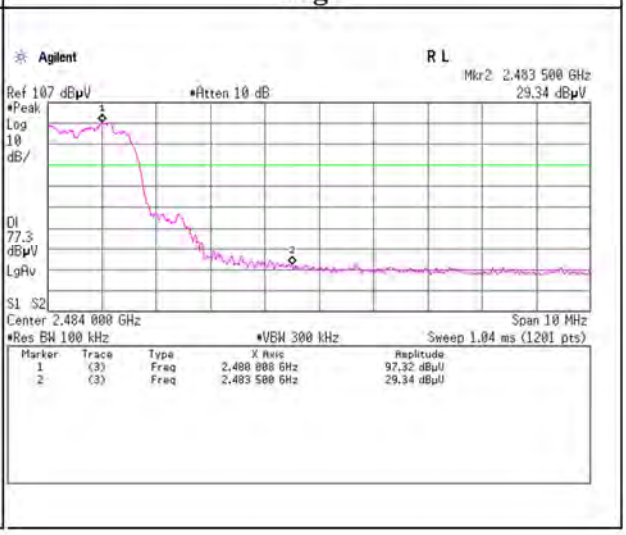
Report No.	13977035S-B
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 15, 2021
Temperature / Humidity	21 deg. C / 30 % RH
Engineer	Takahiro Kawakami
Mode	Tx 3DH5

Hopping On

Low

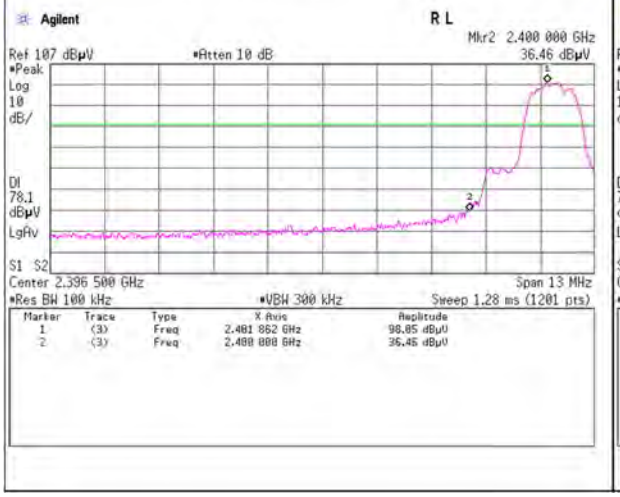


High

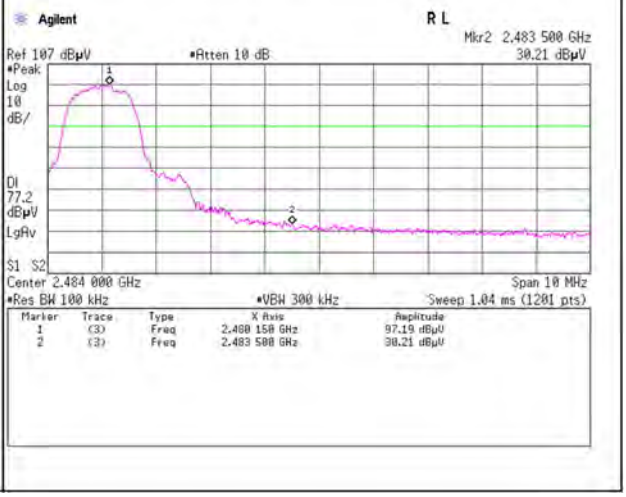


Hopping Off

Low



High



APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KTS-08	145095	Digital Tester	SANWA	PC500	7019224	2021/04/26	12
AT	SAT10-09	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2021/10/05	12
AT	SCC-G14	145175	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	2020/12/21	12
AT	SCC-H22	197396	Microwave cable	RS Pro	R-132G7210 100CO	-	2021/04/08	12
AT	SCC-H23	199603	Microwave cable	RS Pro	R-132G7210 100CO	-	2021/06/14	12
AT	SOS-27	191845	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
AT	SOS-28	191846	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
AT	SPM-06	146267	Power Meter	Anritsu Corporation	ML2495A	850009	2021/05/25	12
AT	SPSS-03	146309	Power sensor	Anritsu Corporation	MA2411B	917063	2021/05/25	12
AT	SRENT-09	150461	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186392	2021/02/22	12
AT	SRENT-15	160899	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46185516	2021/01/26	12
AT	STM-G7	171614	Terminator	Weinschel - API Technologies Corp	M1459A	88995	2021/05/17	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 Tests