RADIO TEST REPORT

Test Report No. : 13722221S-B-R1

Applicant	:	**ALPS ALPINE CO., LTD.**
Type of EUT	:	**Display Audio**
Model Number of EUT	:	**Music Halo**
FCC ID	:	**A269ZUA164**
Test regulation	:	**FCC Part 15 Subpart C: 2021** ***Bluetooth BR/EDR part**
Test Result	:	**Complied (Refer to SECTION 3)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
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.
10. This report is a revised version of 13722221S-B. 13722221S-B is replaced with this report.

Date of test: August 16 to 31, 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.: 13722221S-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13722221S-B	September 24, 2021	-	-
1	13722221S-B-R1	September 29, 2021	P.5	Correction of Size From: 178 x 167.26 x 100 (Width x Length x Height (mm)) To: DISPLAY SIZE: 171 x 17.7 x 96 (Width x Length x Height (mm)) CHASSIS SIZE: 178 x 149.6 x 50 (Width x Length x Height (mm))
			P.6	Correction of Frequency of Operation. - WLAN 2.4GHz (IEEE802.11b/g/n-20) From: 2412 MHz - 2472 MHz To: 2412 MHz - 2462 MHz
			P.6	Correction of Antenna type - Bluetooth - Bluetooth Low Energy - WLAN 2.4 GHz - WLAN 5 GHz From: Internal Chip Antenna To: Multilayer Chip Antenna

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
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
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
NVLAP	National Voluntary Laboratory Accreditation Program
OBW	Occupied Band Width
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	Quadri-Phase Shift Keying
RBW	Resolution Band Width
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
RSS	Radio Standards Specifications
Rx	Receiving
SA, S/A	Spectrum Analyzer
SG	Signal Generator
SVSWR	Site-Voltage Standing Wave Ratio
TR	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 Prefecture 970-1192 Japan
Telephone Number	:	+81-246-36-4111

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	:	Display Audio
Model Number	:	Music Halo
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 14.4 V
Receipt Date	:	June 21, 2021
Condition	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Size	:	DISPLAY SIZE: 171 x 17.7 x 96 (Width x Length x Height (mm)) CHASSIS SIZE: 178 x 149.6 x 50 (Width x Length x Height (mm))
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: Music Halo (referred to as the EUT in this report) is a Display Audio.

General Specification

Clock frequency(ies) in the system	:	1400 MHz (Max)
Operating Temperature	:	-20 deg. C - +60 deg. C

Radio Specification

Bluetooth

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Antenna type	:	Multilayer Chip Antenna
Modulation	:	FHSS (GFSK, π/4-DQPSK, 8DPSK)
Antenna Gain	:	-3.0 dBi

Bluetooth Low Energy

Equipment Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480MHz
Antenna type	:	Multilayer Chip Antenna
Type of Modulation	:	GFSK
Antenna Gain	:	-3.0 dBi

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

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

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

Radio Type	:	Transceiver
Frequency of Operation	:	5745 MHz - 5825 MHz
Antenna type	:	Multilayer Chip Antenna
Modulation	:	OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Gain	:	-3.7 dBi

GNSS

Radio Type	:	Receiver
Frequency of Operation	:	See table below.
Antenna type	:	External Patch Antenna
Antenna Gain	:	32.5 dBi

Supported GNSS and GNSS signals

GNSS	RNSS Frequency Band / Frequency [MHz]		
	1559 to 1610	1215 to 1300	1164 to 1215
BDS	☐B1l 1561.098	-	-
Galileo	☒E1 1575.42	☐E6 1278.75	☐E5a 1176.45 ☐E5b 1207.14
GLONASS	☒G1 1598.0625 - 1605.375	☐G2 1242.9375 - 1248.625	-
GPS	☒L1 1575.42	☐L2 1227.6	☐L5 1176.45
SBAS	☒L1 1575.42	-	☐L5 1176.45

☒ Supported GNSS signal
☐ Not supported GNSS signal

Broadcast

Frequency of Operation	:	AM :	530 kHz to 1710 kHz (Analog) 530 kHz to 1710 kHz (Digital)
		FM :	87.7 MHz to 107.9 MHz(Analog) 87.9 MHz to 107.9 MHz(Digital)

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specificatin : 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)			
20dB 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)	3.4 dB 400.000 MHz, QP, Hori. Mode: Tx, DH5 2441 MHz	Complied# e) / f)	Conducted/ Radiated (above 30 MHz) *2)
	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
*2) Radiated test was selected over 30 MHz based on section 15.247(d)

a) Refer to APPENDIX 1 (data of 20dB 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)
f) Refer to APPENDIX 1 (data of Radiated 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	- g)	Conducted
g) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)					

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.

Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4,5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.6 dB	2.56dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	2.7 dB	2.7 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.0 dB	-
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB	-
	6 GHz-18 GHz	5.4 dB	5.4 dB	5.4 dB	-
	18 GHz-40 GHz	5.3 dB	5.3 dB	5.3 dB	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB	-
	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	1.4 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.6 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.2 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.91 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.2 dB
Spurious emission (Conducted) below 1GHz	0.87 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.96 dB
Spurious emission (Conducted) 3 GHz-18 GHz	3.0 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.2 dB
Bandwidth Measurement	0.012 %
Duty cycle and Time Measurement	0.27 %
Temperature_SCH-01	0.87 deg.C.
Humidity_SCH-01	4.3 %
Temperature_SCH-02	2.0 deg.C.
Humidity_SCH-02	6.6 %
Voltage	0.86 %

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
Spurious Emission (Conducted)	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Spurious Emission (Radiated) (Below 1 GHz)	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Spurious Emission (Radiated) (Above 1 GHz)	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.

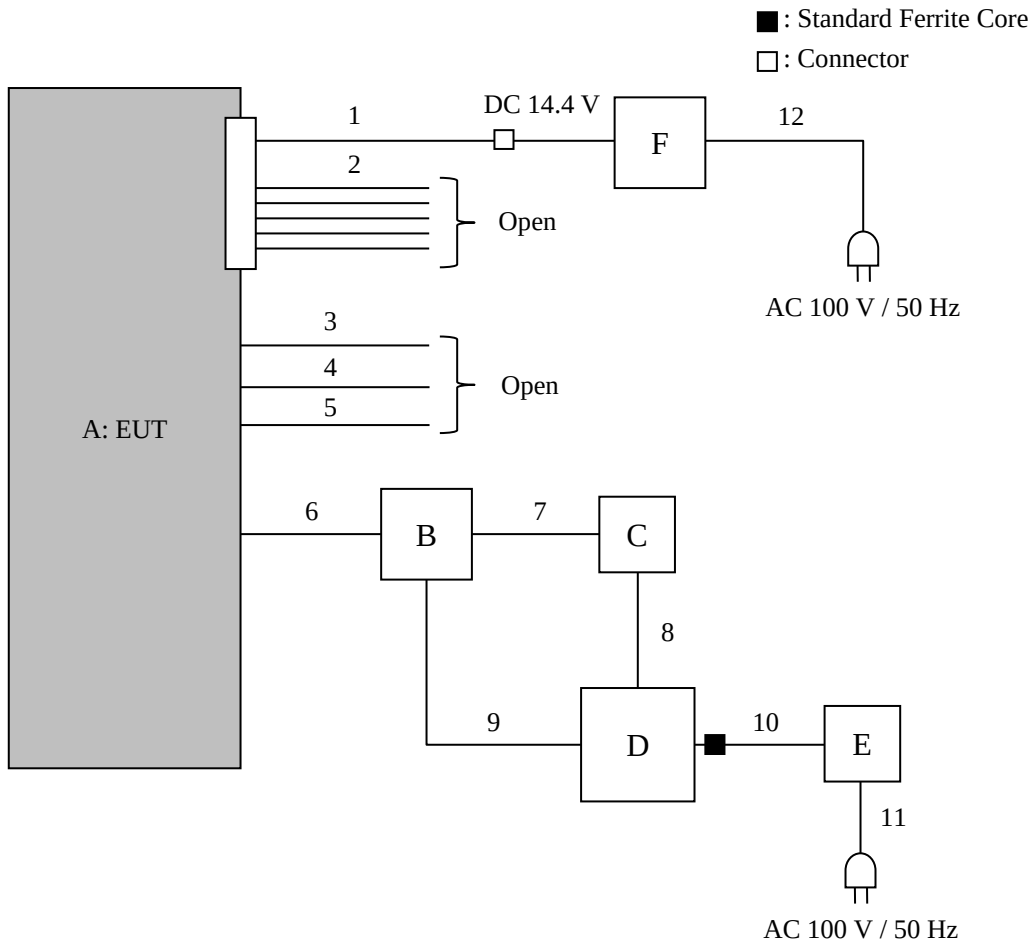
*EUT has the power settings by the software as follows;
Power settings: 1 dBm

Software: Dut labtool Version 2.0.0.96
(Date: 2017.5.2, Storage location: Driven by or 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.

*1) The mode was tested as a representative, because it had the highest power at antenna terminal test.

4.2 Configuration and peripherals

<for Antenna terminal Conducted test>



Description of EUT and Support equipment

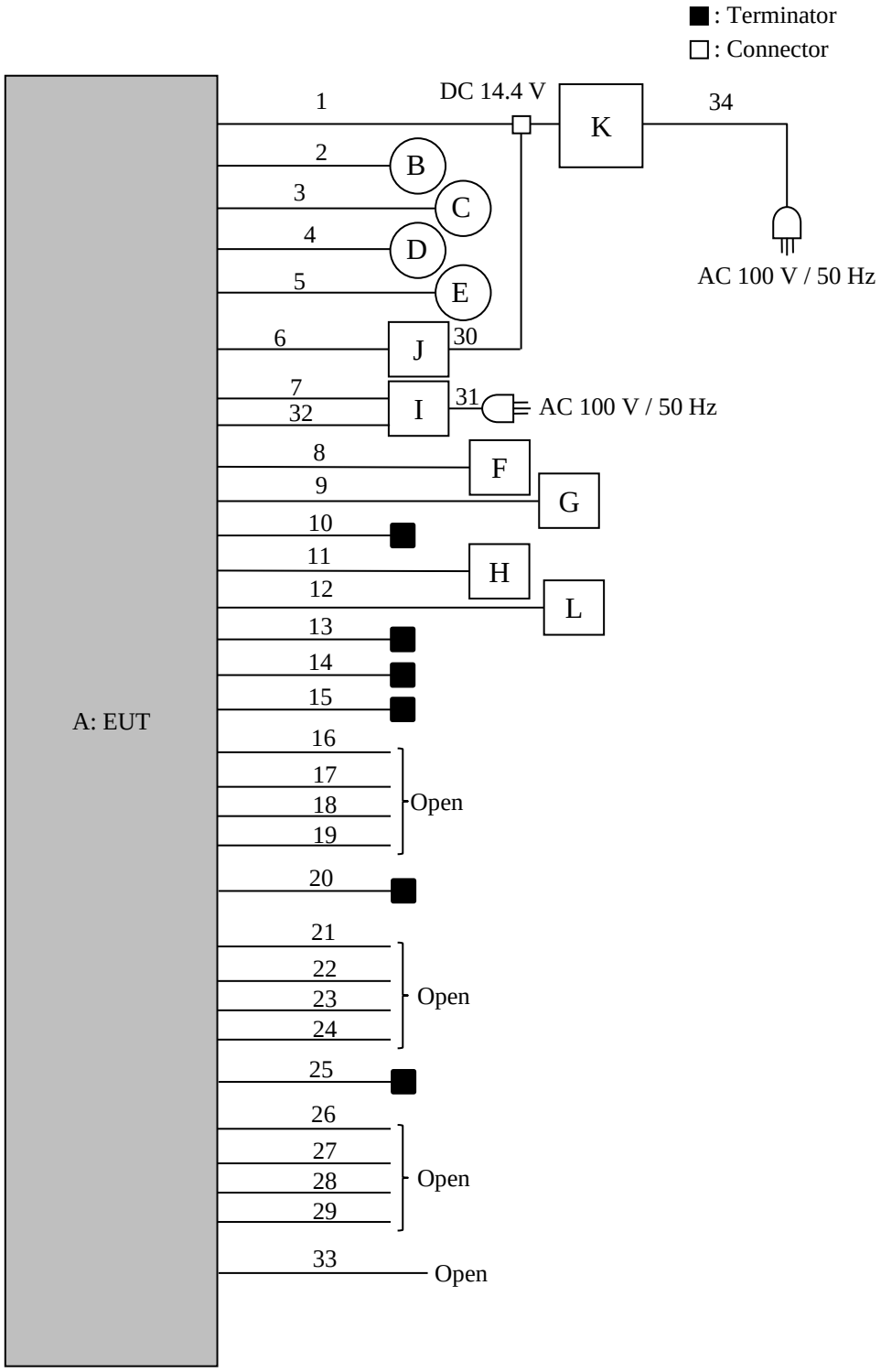
No.	Item	Model number	Serial number	Manufacturer	Remark
A	Display Audio	Music Halo	3	ALPS ALPINE CO., LTD.	EUT
B	Debug board	-	-	-	-
C	LAN USB Adapter	EDC-FUA2-B	9BL213400922A	ELECOM	-
D	Laptop Computer	7666-77J	LV-B8R1X 08/05	Lenovo	-
E	AC Adapter	42T4422	11S92P1154Z1DXF1DBFDN	Lenovo	-
F	Power Supply(DC)	PAN35-10A	ML002085	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC	0.45 + 1.0	Unshielded	Unshielded	-
2	Signal	0.2	Unshielded	Unshielded	-
3	USB	1.0	Shielded	Shielded	-
4	USB	1.0	Shielded	Shielded	-
5	FM	0.15	Shielded	Shielded	-
6	Signal	0.2	Unshielded	Unshielded	*1)
7	LAN	1.0	Unshielded	Unshielded	-
8	USB	0.15	Shielded	Shielded	-
9	USB	0.8	Shielded	Shielded	-
10	DC	1.8	Unshielded	Unshielded	Laptop Computer
11	AC	0.9	Unshielded	Unshielded	Laptop Computer
12	AC	1.0	Unshielded	Unshielded	-

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

<for Radiated emission test>



Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Display Audio	Music Halo	2	ALPS ALPINE CO., LTD.	EUT
B	Speaker	KFC-RS160	-	KENWOOD	-
C	Speaker	KFC-RS160	-	KENWOOD	-
D	Speaker	KFC-RS160	-	KENWOOD	-
E	Speaker	KFC-RS160	-	KENWOOD	-
F	USB Memory	USM16GU	-	Sony	-
G	Smart Phone	A1332	87124GKWE00	Apple	-
H	GPS Antenna	YOP-5270AL04	-	YOKOWO	-
I	Blu-ray Player	BDP-120	IHDL019601 JP	Pioneer	-
J	12.8 Inch WXGA Rear Vision	PXH12X-R-B	PXH12XRBR80920 412	ALPS ALPINE CO., LTD.	-
K	Power Supply (DC)	PAN35-10A	NA000955	KIKUSUI	-
L	SiriusXM Tuner	SXV100A	-	Fusion	

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC	2.2	Unshielded	Unshielded	-
2	Speaker (Front R)	2.0 + 1.9	Unshielded	Unshielded	-
3	Speaker (Front L)	2.0 + 1.9	Unshielded	Unshielded	-
4	Speaker (Rear R)	2.0 + 1.9	Unshielded	Unshielded	-
5	Speaker (Rear L)	2.0 + 1.9	Unshielded	Unshielded	-
6	HDMI OUT	4.8	Shielded	Shielded	-
7	HDMI IN	1.8	Shielded	Shielded	-
8	USB	1.0	Shielded	Shielded	-
9	USB	1.0 + 1.0	Shielded	Shielded	-
10	Radio Antenna	0.15 + 1.1	Shielded	Shielded	-
11	GPS Antenna	2.5	Shielded	Shielded	-
12	Sirius	0.6 + 0.2	Shielded	Shielded	-
13	Front out	0.3 + 1.5	Unshielded	Unshielded	-
14	Rear out	0.2 + 1.5	Unshielded	Unshielded	-
15	SUBW	0.15 + 1.5	Unshielded	Unshielded	-
16	HDMI-REM-OUT	2.1	Unshielded	Unshielded	-
17	AUX-REM-OUT	2.1	Unshielded	Unshielded	-
18	STEERING REMOTE	0.1 + 1.0	Unshielded	Unshielded	-
19	AUX-REM-IN	0.2 + 1.5	Unshielded	Unshielded	-
20	AUX 2	3.2	Unshielded	Unshielded	-
21	AMP REMO	2.2	Unshielded	Unshielded	-
22	P.ANT	2.2	Unshielded	Unshielded	-
23	REVERSE	2.2	Unshielded	Unshielded	-
24	SPEED SENSOR	2.0	Unshielded	Unshielded	-
25	MIC IN	0.2+1.5	Unshielded	Unshielded	-
26	LIN	2.0	Unshielded	Unshielded	-
27	REAR CAMERA	2.0	Unshielded	Unshielded	-
28	FRONT CAMERA	2.0	Unshielded	Unshielded	-
29	CONNECT2 I/F	2.0	Unshielded	Unshielded	-
30	DC	0.2 + 5.6	Unshielded	Unshielded	-
31	AC	2	Unshielded	Unshielded	-
32	AUX IN	3	Unshielded	Unshielded	-
33	signal	0.2	Unshielded	Unshielded	*1)
34	AC	2	Unshielded	Unshielded	-

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

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

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

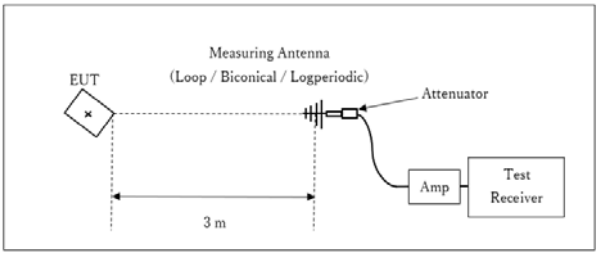
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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

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

Figure 2: Test Setup

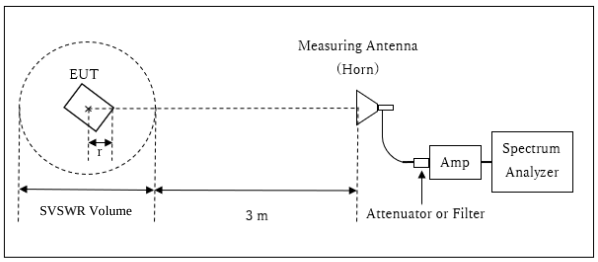
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

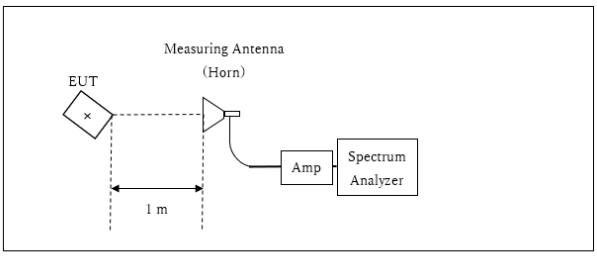


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.88 m / 3.0 m) = 2.24 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.88 m

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.12 m

10 GHz – 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.54 dB
*Test Distance: 1 m

- The carrier level and noise levels were confirmed at each position of 0 deg and 30 deg of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Antenna polarization	Carrier	Spurious (30 MHz - 1 GHz)	Spurious (1 GHz - 2.8 GHz)	Spurious (2.8 GHz - 10 GHz)	Spurious (10 GHz - 18 GHz)	Spurious (18 GHz - 26.5 GHz)
Horizontal	0 deg.	0 deg.	0 deg.	30 deg.	0 deg.	0 deg.
Vertical	30 deg.	0 deg.	30 deg.	30 deg.	0 deg.	0 deg.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 30 MHz – 26.5 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: 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
20dB 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: 160MHz 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 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

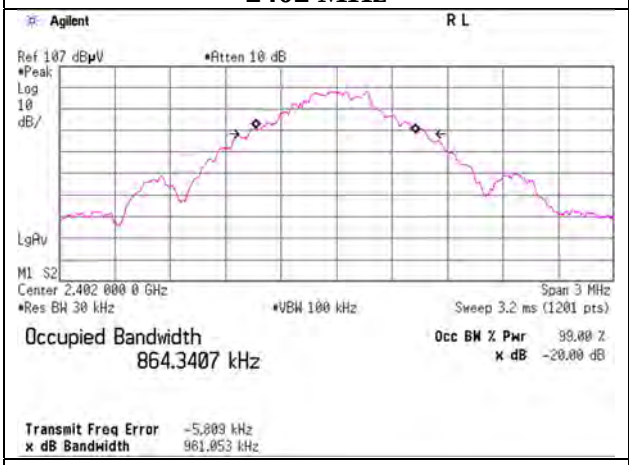
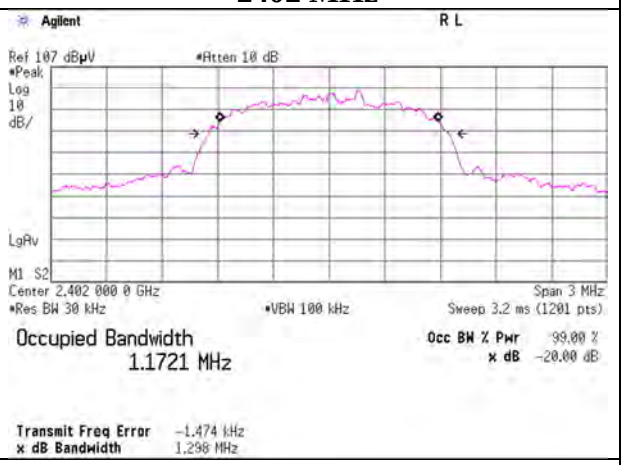
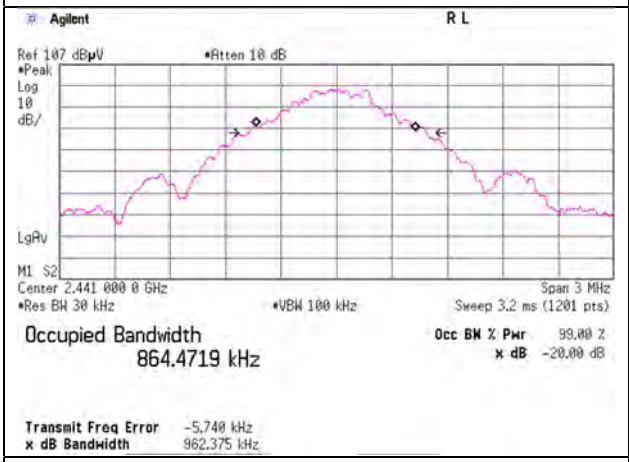
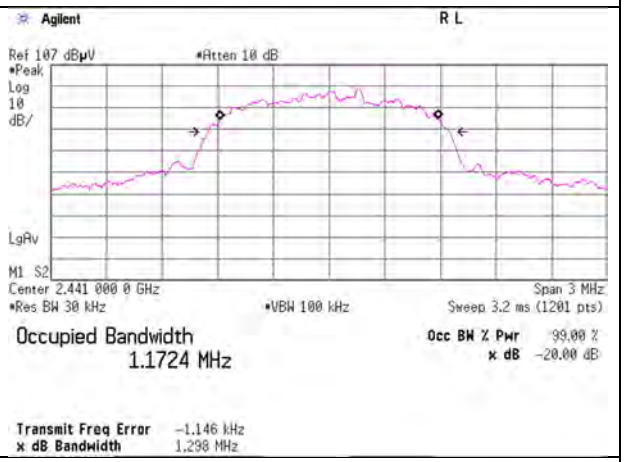
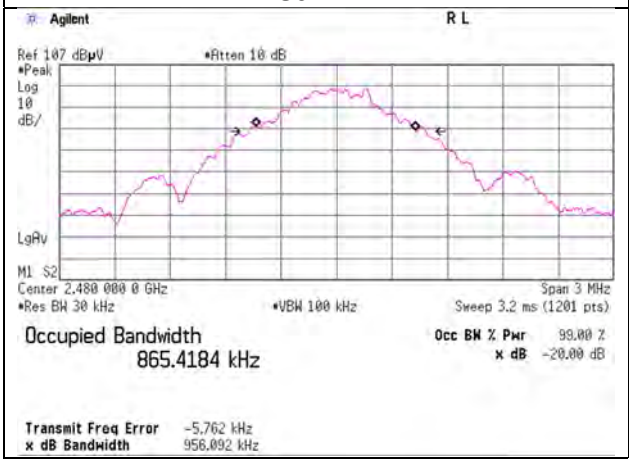
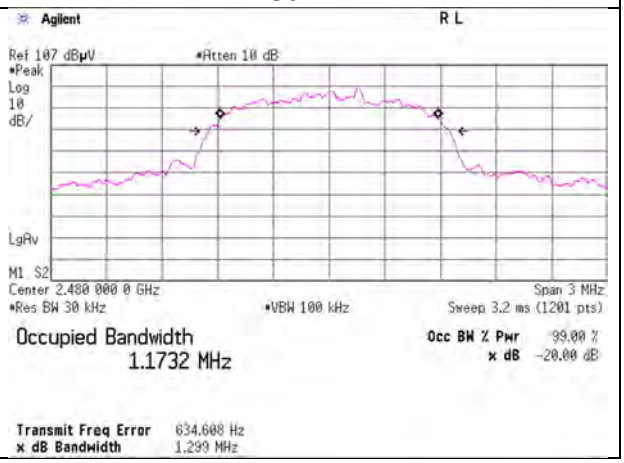
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, Tx, Hopping On

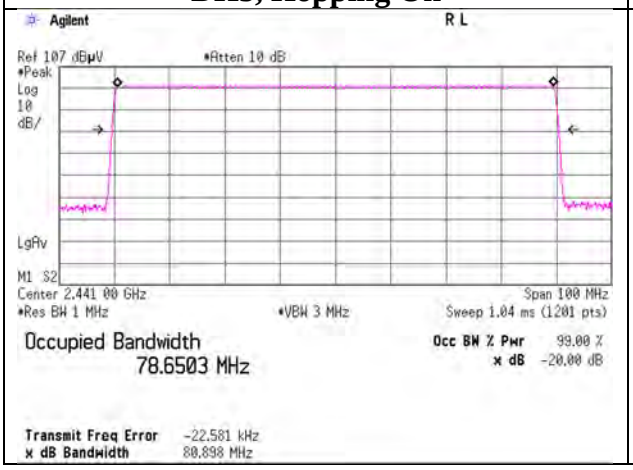
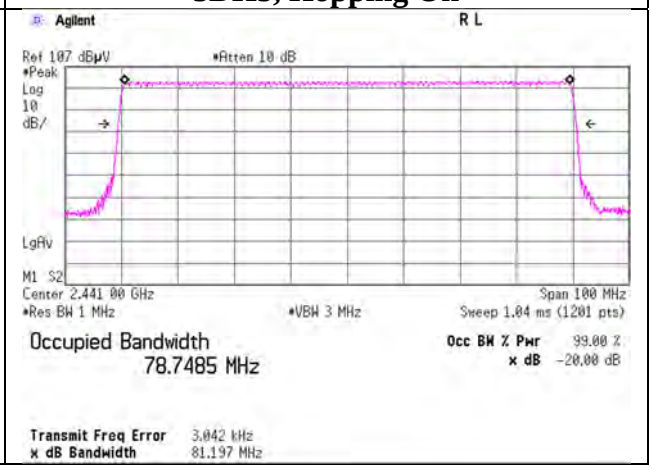
Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.961	864.3	1.000	>= 0.641
DH5	2441.0	0.962	864.5	1.000	>= 0.641
DH5	2480.0	0.956	865.4	1.000	>= 0.637
DH5	Hopping On	-	78650.3	-	-
3DH5	2402.0	1.298	1172.1	1.000	>= 0.865
3DH5	2441.0	1.298	1172.4	1.000	>= 0.865
3DH5	2480.0	1.299	1173.2	1.000	>= 0.866
3DH5	Hopping On	-	78748.5	-	-

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

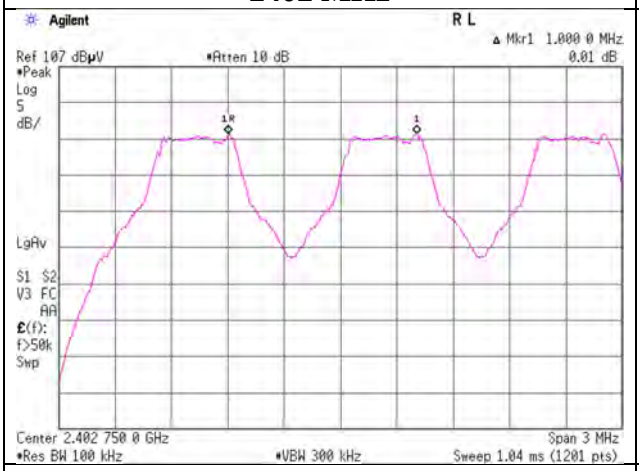
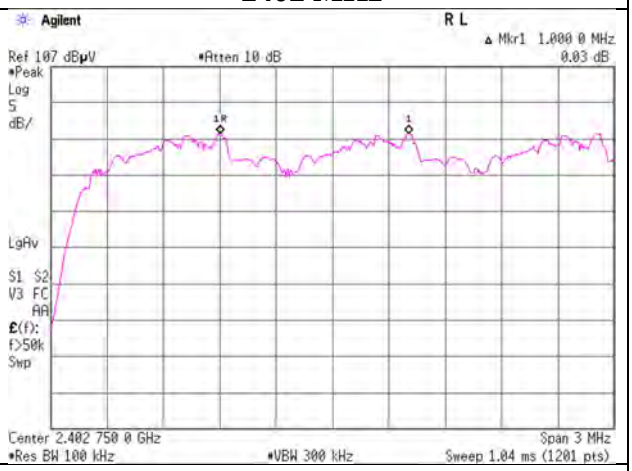
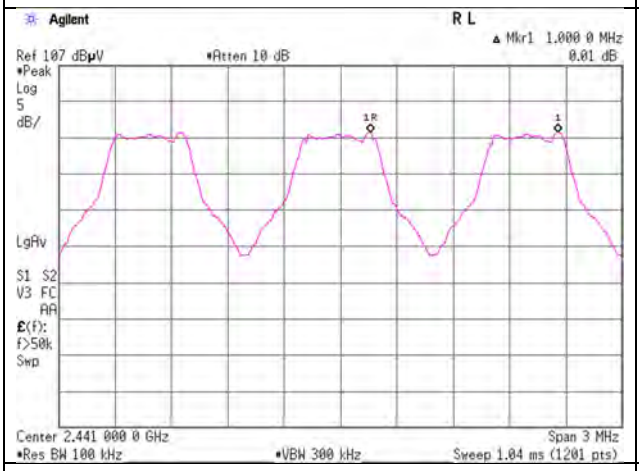
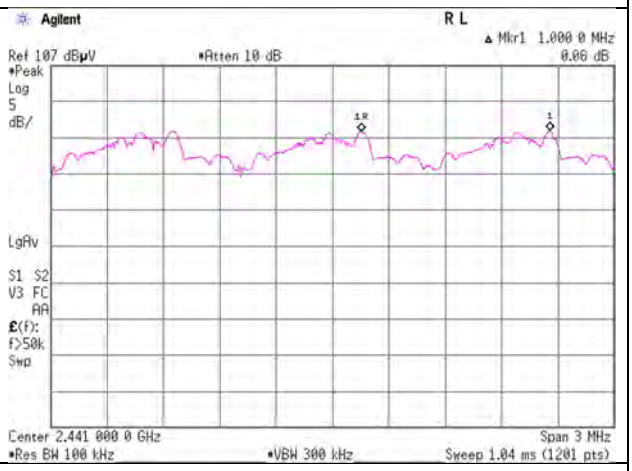
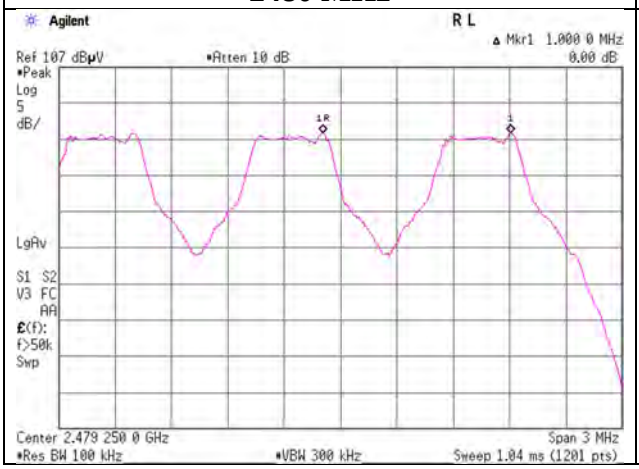
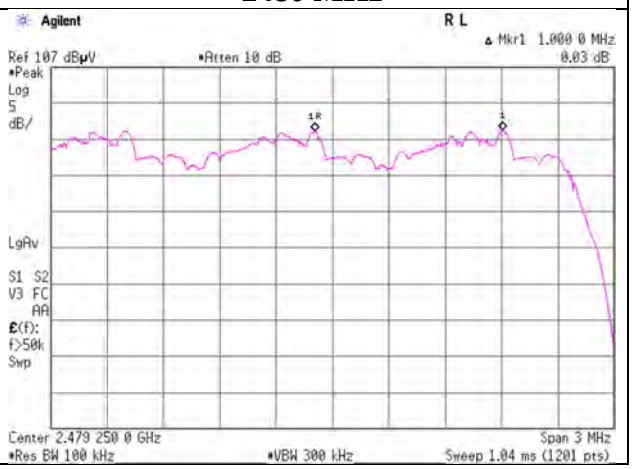
20dB Bandwidth and 99% Occupied Bandwidth

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

20dB Bandwidth and 99% Occupied Bandwidth

DH5, Hopping On	3DH5, Hopping On
	

Carrier Frequency Separation

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

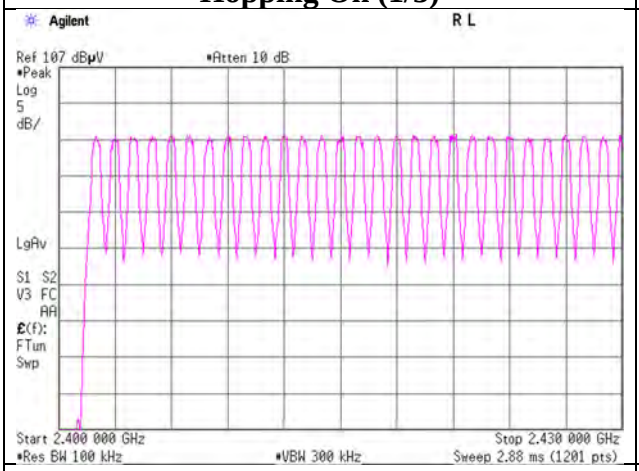
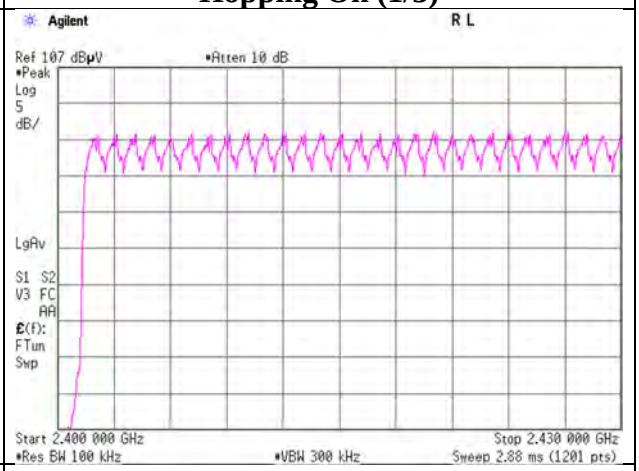
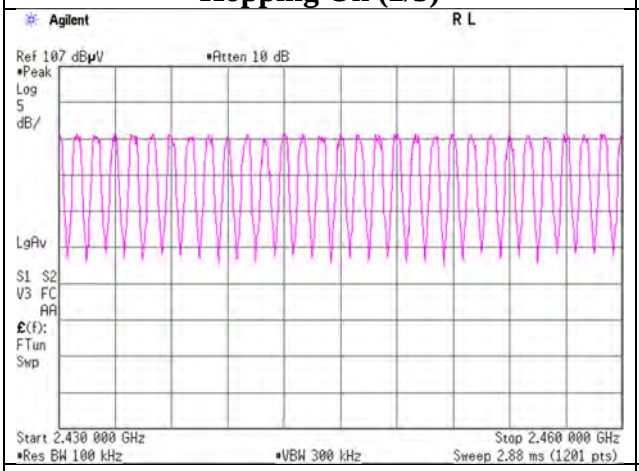
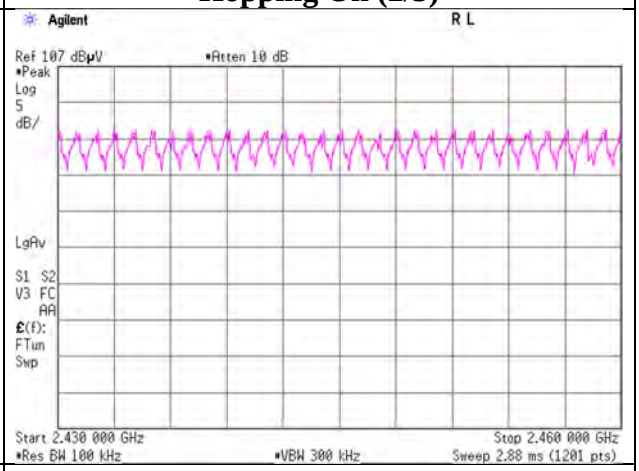
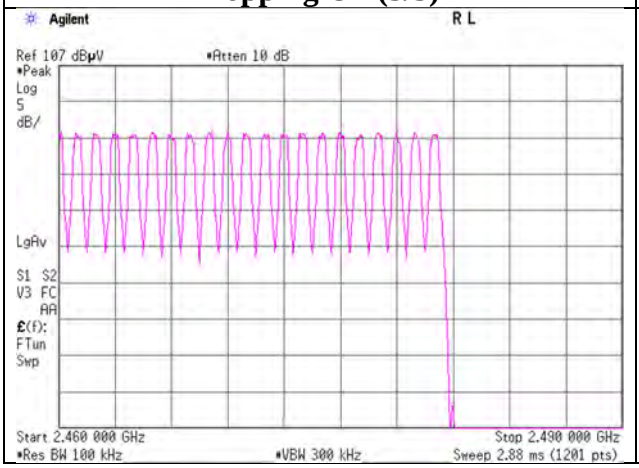
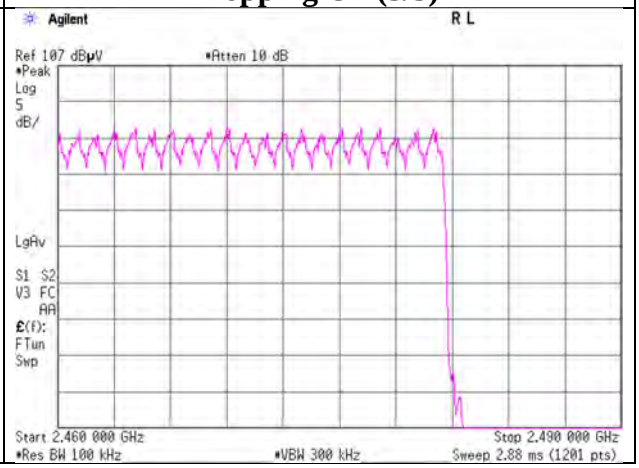
Number of Hopping Frequency

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping On

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

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

Number of Hopping Frequency

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

Dwell time

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
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	48.4 times / 5 sec. x 31.6 sec. = 306 times	0.405	124	400
DH3	26.2 times / 5 sec. x 31.6 sec. = 166 times	1.662	276	400
DH5	18.0 times / 5 sec. x 31.6 sec. = 114 times	2.910	332	400
3DH1	49.6 times / 5 sec. x 31.6 sec. = 314 times	0.407	128	400
3DH3	26.4 times / 5 sec. x 31.6 sec. = 167 times	1.659	277	400
3DH5	19.0 times / 5 sec. x 31.6 sec. = 121 times	2.909	352	400

Sample Calculation
Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

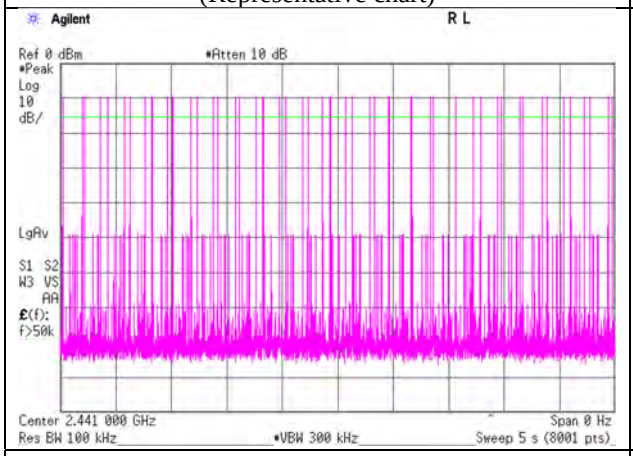
Mode	Sampling [times] 1	2	3	4	5	Average [times]
DH1	48	49	48	50	47	48.4
DH3	24	29	30	24	24	26.2
DH5	16	20	16	19	19	18
3DH1	51	50	49	49	49	49.6
3DH3	26	28	24	26	28	26.4
3DH5	19	19	18	21	18	19

Sample Calculation
Average = Summation (Sampling 1 to 5) / 5

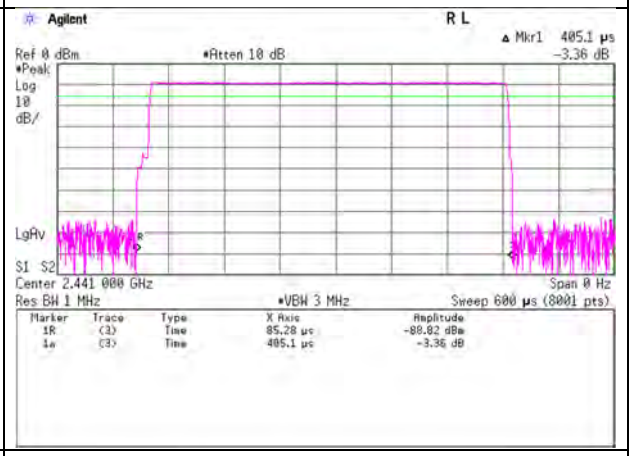
This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in N x 0.4 s, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than 0.4 s regardless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

Dwell time

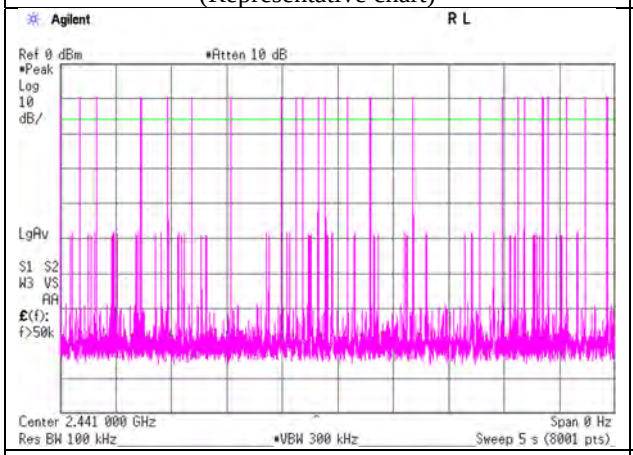
DH1 (1/2)
(Representative chart)



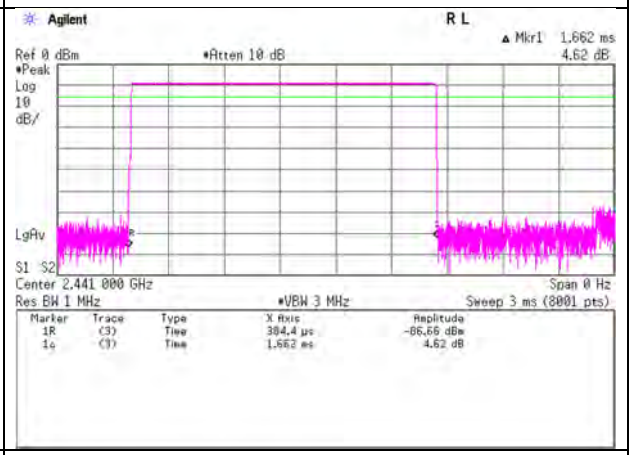
DH1 (2/2)



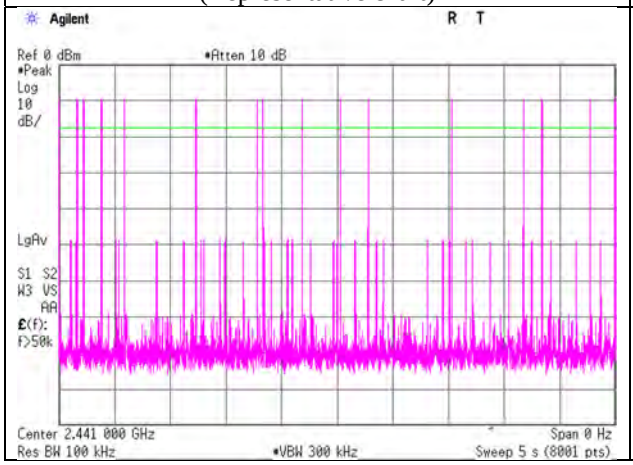
DH3 (1/2)
(Representative chart)



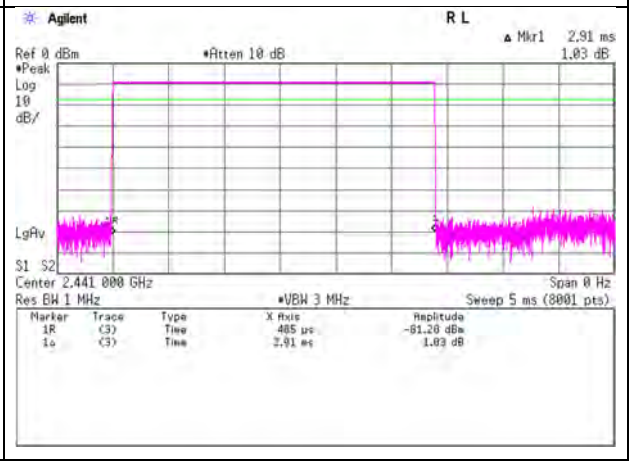
DH3 (2/2)



DH5 (1/2)
(Representative chart)

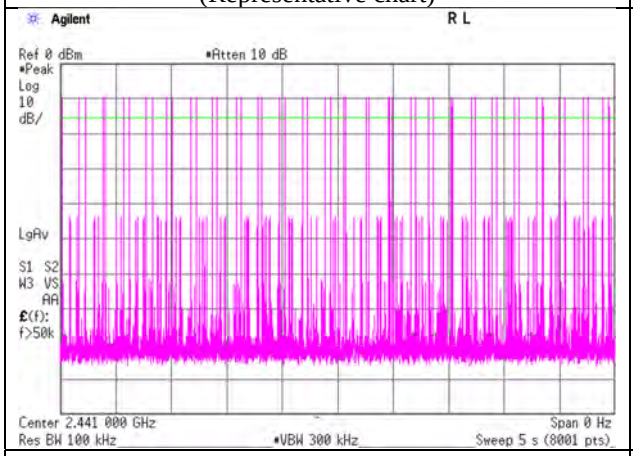


DH5 (2/2)

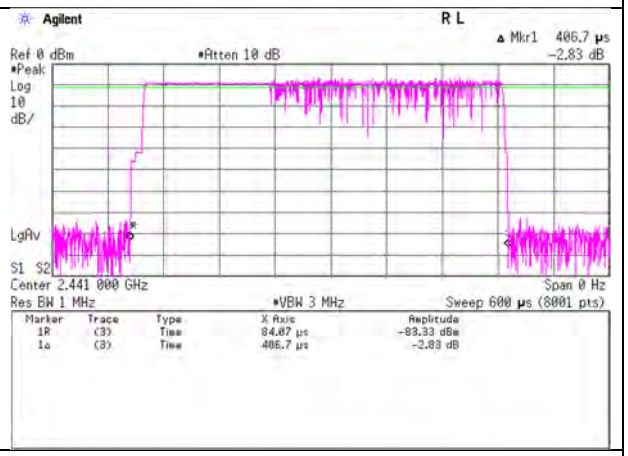


Dwell time

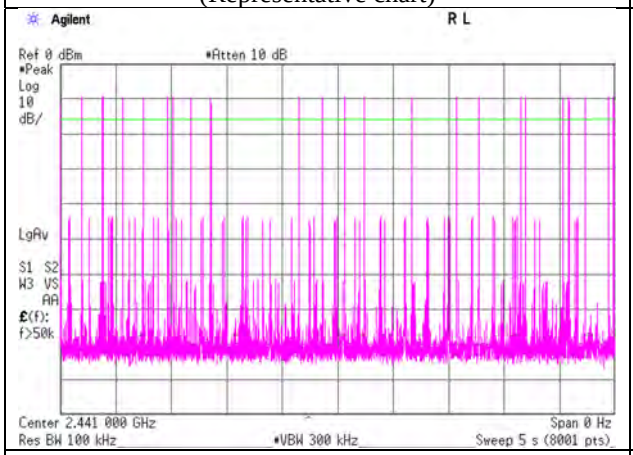
3DH1 (1/2)
(Representative chart)



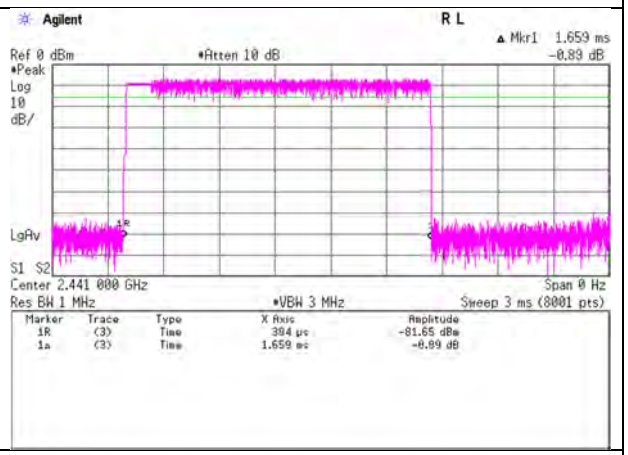
3DH1 (2/2)



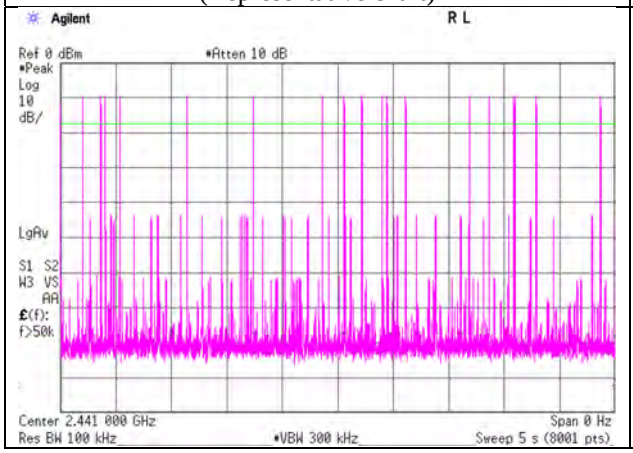
3DH3 (1/2)
(Representative chart)



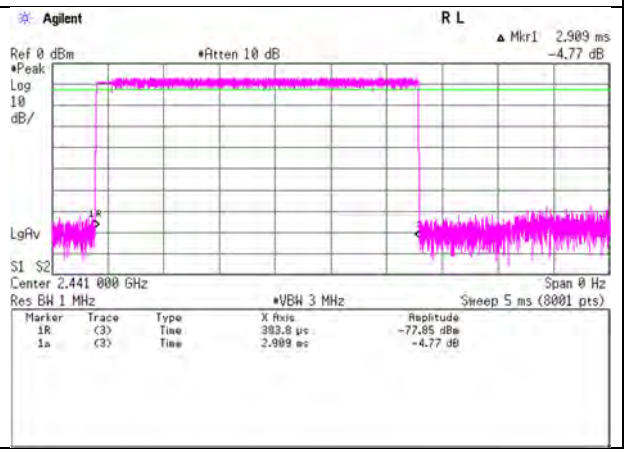
3DH3 (2/2)



3DH5 (1/2)
(Representative chart)



3DH5 (2/2)



Maximum Peak Output Power

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 16, 2021
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off

					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	2402.0	-9.42	1.65	9.94	2.17	1.65	20.96	125	18.79	-3.00	-0.83	0.83	36.02	4000	36.85
DH5	2441.0	-9.39	1.66	9.94	2.21	1.66	20.96	125	18.75	-3.00	-0.79	0.83	36.02	4000	36.81
DH5	2480.0	-9.27	1.66	9.94	2.33	1.71	20.96	125	18.63	-3.00	-0.67	0.86	36.02	4000	36.69
2DH5	2402.0	-7.03	1.65	9.94	4.56	2.86	20.96	125	16.40	-3.00	1.56	1.43	36.02	4000	34.46
2DH5	2441.0	-6.91	1.66	9.94	4.69	2.94	20.96	125	16.27	-3.00	1.69	1.48	36.02	4000	34.33
2DH5	2480.0	-6.63	1.66	9.94	4.97	3.14	20.96	125	15.99	-3.00	1.97	1.57	36.02	4000	34.05
3DH5	2402.0	-6.74	1.65	9.94	4.85	3.05	20.96	125	16.11	-3.00	1.85	1.53	36.02	4000	34.17
3DH5	2441.0	-6.61	1.66	9.94	4.99	3.16	20.96	125	15.97	-3.00	1.99	1.58	36.02	4000	34.03
3DH5	2480.0	-6.32	1.66	9.94	5.28	3.37	20.96	125	15.68	-3.00	2.28	1.69	36.02	4000	33.74

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.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 16, 2021
Temperature / Humidity	22 deg. C / 56 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off

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	2402.0	-10.88	1.65	9.94	0.71	1.18	1.10	1.81	1.52
DH5	2441.0	-10.82	1.66	9.94	0.78	1.20	1.10	1.88	1.54
DH5	2480.0	-10.70	1.66	9.94	0.90	1.23	1.10	2.00	1.58
2DH5	2402.0	-10.88	1.65	9.94	0.71	1.18	1.11	1.82	1.52
2DH5	2441.0	-10.72	1.66	9.94	0.88	1.22	1.11	1.99	1.58
2DH5	2480.0	-10.46	1.66	9.94	1.14	1.30	1.11	2.25	1.68
3DH5	2402.0	-10.87	1.65	9.94	0.72	1.18	1.11	1.83	1.52
3DH5	2441.0	-10.71	1.66	9.94	0.89	1.23	1.11	2.00	1.58
3DH5	2480.0	-10.45	1.66	9.94	1.15	1.30	1.11	2.26	1.68

Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

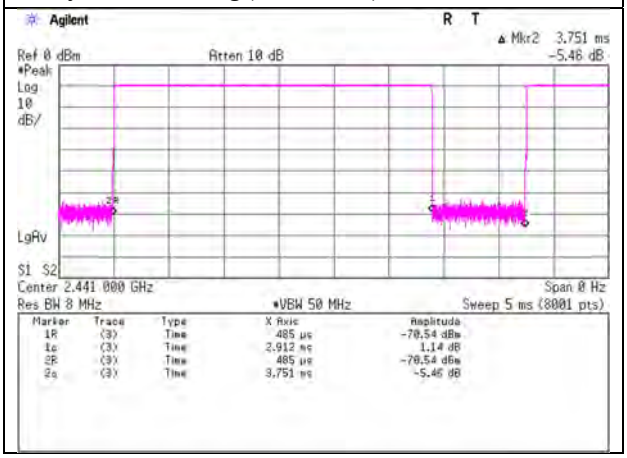
*The equipment and cables were not used for factor 0 dB of the data sheets.

Burst Rate Confirmation

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off

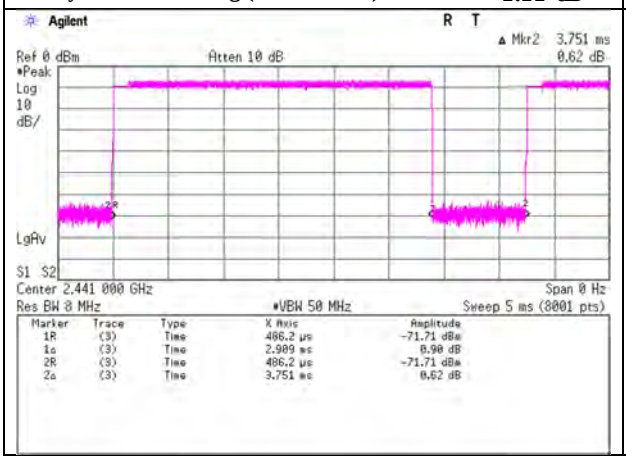
DH5

Tx on / (Tx on + Tx off) =	**0.776**
Tx on / (Tx on + Tx off) * 100 =	**77.6 %**
Duty factor = 10 * log (3.751 / 2.912) =	**1.10 dB**



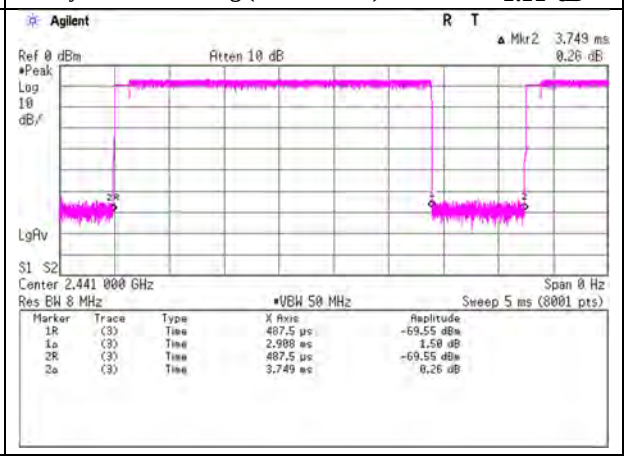
2DH5

Tx on / (Tx on + Tx off) =	**0.776**
Tx on / (Tx on + Tx off) * 100 =	**77.6 %**
Duty factor = 10 * log (3.751 / 2.909) =	**1.11 dB**



3DH5

Tx on / (Tx on + Tx off) =	**0.776**
Tx on / (Tx on + Tx off) * 100 =	**77.6 %**
Duty factor = 10 * log (3.749 / 2.908) =	**1.11 dB**



Radiated Spurious Emission

Report No.	13722221S-B-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 20, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	22 deg.C, 48 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Takahiro Suzuki	Takahiro Kawakami	Yasumasa Owaki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz			

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	129.919	QP	48.00	13.85	7.39	32.11	0.00	37.13	43.5	6.3	217	86	-
Hori.	195.066	QP	40.13	16.42	7.83	32.05	0.00	32.33	43.5	11.1	193	132	-
Hori.	259.798	QP	49.84	12.44	8.35	31.98	0.00	38.65	46.0	7.3	133	159	-
Hori.	400.000	QP	49.22	15.92	9.06	31.94	0.00	42.26	46.0	**3.7**	100	139	-
Hori.	445.498	QP	46.31	16.49	9.28	31.93	0.00	40.15	46.0	5.8	100	143	-
Hori.	712.711	QP	39.95	19.99	10.33	31.81	0.00	38.46	46.0	7.5	132	137	-
Hori.	2390.000	PK	47.80	28.33	14.42	41.62	2.24	51.17	73.9	22.7	151	125	-
Hori.	4804.000	PK	48.19	31.77	6.88	42.89	2.24	46.19	73.9	27.7	159	286	-
Hori.	7206.000	PK	48.83	37.37	8.25	43.39	2.24	53.30	73.9	20.6	150	0	-
Hori.	9608.000	PK	48.68	39.12	9.45	43.18	2.24	56.31	73.9	17.5	150	0	-
Hori.	2390.000	AV	35.47	28.33	14.42	41.62	2.24	38.84	53.9	15.0	151	125	VBW:360 Hz
Hori.	4804.000	AV	37.26	31.77	6.88	42.89	2.24	35.26	53.9	18.6	159	286	VBW:360 Hz
Hori.	7206.000	AV	37.24	37.37	8.25	43.39	2.24	41.71	53.9	12.1	150	0	VBW:360 Hz Floor noise
Hori.	9608.000	AV	37.32	39.12	9.45	43.18	2.24	44.95	53.9	8.9	150	0	VBW:360 Hz Floor noise
Vert.	109.058	QP	43.78	11.74	7.25	32.12	0.00	30.65	43.5	12.8	100	124	-
Vert.	129.919	QP	47.59	13.85	7.39	32.11	0.00	36.72	43.5	6.7	100	109	-
Vert.	163.224	QP	46.76	15.29	7.87	32.08	0.00	37.84	43.5	5.6	100	343	-
Vert.	688.125	QP	37.84	19.77	10.24	31.85	0.00	36.00	46.0	10.0	100	23	-
Vert.	712.708	QP	41.57	19.99	10.33	31.81	0.00	40.08	46.0	5.9	104	14	-
Vert.	881.111	QP	33.23	21.92	10.88	31.14	0.00	34.89	46.0	11.1	100	351	-
Vert.	2390.000	PK	47.64	28.33	14.42	41.62	2.24	51.01	73.9	22.8	148	330	-
Vert.	4200.000	PK	51.56	30.36	6.58	42.51	2.24	48.23	73.9	25.6	191	202	-
Vert.	4804.000	PK	48.22	31.77	6.88	42.89	2.24	46.22	73.9	27.6	185	189	-
Vert.	7206.000	PK	48.02	37.37	8.25	43.39	2.24	52.49	73.9	21.4	175	167	-
Vert.	9608.000	PK	48.56	39.12	9.45	43.18	2.24	56.19	73.9	17.7	150	0	-
Vert.	2390.000	AV	35.66	28.33	14.42	41.62	2.24	39.03	53.9	14.8	148	330	VBW:360 Hz
Vert.	4200.000	AV	44.93	30.36	6.58	42.51	2.24	41.60	53.9	12.3	191	202	VBW:10 Hz
Vert.	4804.000	AV	38.08	31.77	6.88	42.89	2.24	36.08	53.9	17.8	185	189	VBW:360 Hz
Vert.	7206.000	AV	37.72	37.37	8.25	43.39	2.24	42.19	53.9	11.7	175	167	VBW:360 Hz
Vert.	9608.000	AV	37.39	39.12	9.45	43.18	2.24	45.02	53.9	8.8	150	0	VBW:360 Hz Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
*These results have sufficient margin without taking account Duty cycle correction factor.

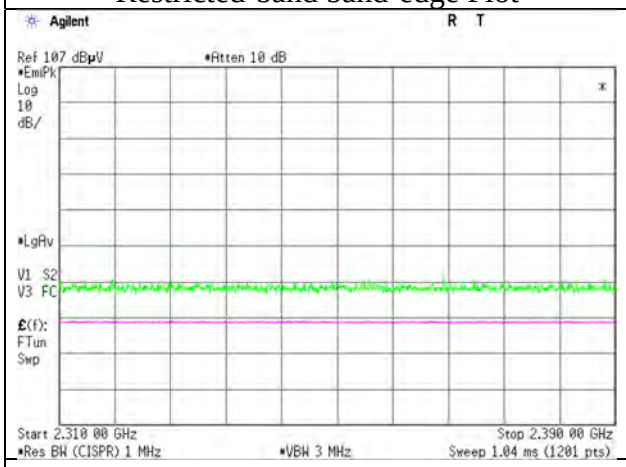
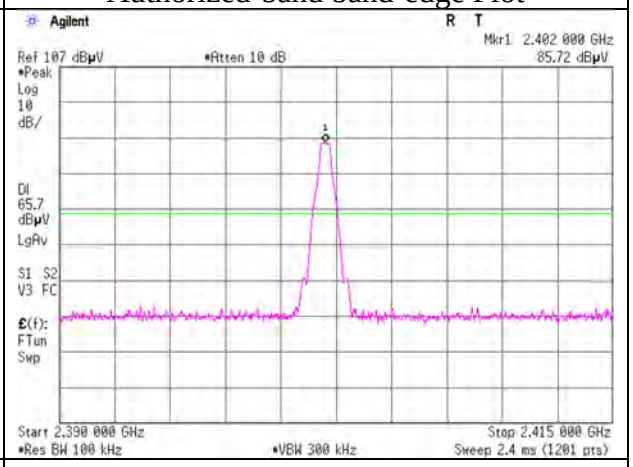
20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

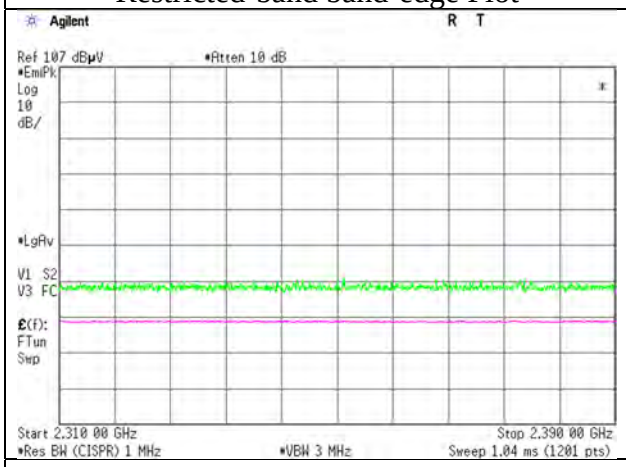
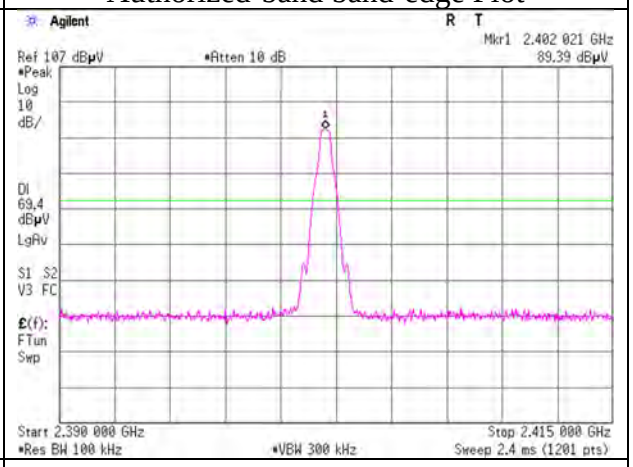
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	85.57	28.31	14.44	41.63	2.24	88.93	-	-	Carrier
Hori.	2400.000	PK	39.06	28.31	14.44	41.63	2.24	42.42	68.9	26.4	-
Vert.	2402.000	PK	88.95	28.31	14.44	41.63	2.24	92.31	-	-	Carrier
Vert.	2400.000	PK	39.73	28.31	14.44	41.63	2.24	43.09	72.3	29.2	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	August 17, 2021
Temperature / Humidity	23 deg.C, 63 %RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, DH5 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Report No.	13722221S-B-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 20, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	22 deg.C, 48 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Takahiro Suzuki	Takahiro Kawakami	Yasumasa Owaki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz			

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	129.904	QP	47.42	13.85	7.39	32.11	0.00	36.55	43.5	6.9	225	85	-
Hori.	199.987	QP	41.08	16.50	7.85	32.05	0.00	33.38	43.5	10.1	254	167	-
Hori.	259.804	QP	49.27	12.44	8.35	31.98	0.00	38.08	46.0	7.9	136	173	-
Hori.	400.000	QP	49.53	15.92	9.06	31.94	0.00	42.57	46.0	**3.4**	100	132	-
Hori.	445.503	QP	45.19	16.49	9.28	31.93	0.00	39.03	46.0	6.9	100	146	-
Hori.	638.979	QP	41.31	19.24	10.03	31.92	0.00	38.66	46.0	7.3	122	74	-
Hori.	712.699	QP	41.05	19.99	10.33	31.81	0.00	39.56	46.0	6.4	126	131	-
Hori.	4882.000	PK	48.14	31.87	6.93	42.89	2.24	46.29	73.9	27.6	153	237	-
Hori.	7323.000	PK	47.88	37.54	8.32	43.52	2.24	52.46	73.9	21.4	150	0	-
Hori.	9764.000	PK	47.64	39.41	9.52	42.97	2.24	55.84	73.9	18.0	150	0	-
Hori.	4882.000	AV	37.11	31.87	6.93	42.89	2.24	35.26	53.9	18.6	153	237	VBW:360 Hz
Hori.	7323.000	AV	36.25	37.54	8.32	43.52	2.24	40.83	53.9	13.0	150	0	VBW:360 Hz Floor noise
Hori.	9764.000	AV	36.12	39.41	9.52	42.97	2.24	44.32	53.9	9.5	150	0	VBW:360 Hz Floor noise
Vert.	108.480	QP	45.16	11.65	7.24	32.12	0.00	31.93	43.5	11.5	100	53	-
Vert.	163.200	QP	43.38	15.28	7.87	32.08	0.00	34.45	43.5	9.0	100	336	-
Vert.	192.378	QP	37.88	16.36	7.82	32.06	0.00	30.00	43.5	13.5	100	8	-
Vert.	712.700	QP	42.76	19.99	10.33	31.81	0.00	41.27	46.0	4.7	100	17	-
Vert.	881.111	QP	32.69	21.92	10.88	31.14	0.00	34.35	46.0	11.6	100	352	-
Vert.	4200.000	PK	51.94	30.36	6.58	42.51	2.24	48.61	73.9	25.2	193	202	-
Vert.	4882.000	PK	48.25	31.87	6.93	42.89	2.24	46.40	73.9	27.5	150	185	-
Vert.	7323.000	PK	47.76	37.54	8.32	43.52	2.24	52.34	73.9	21.5	182	173	-
Vert.	9764.000	PK	47.26	39.41	9.52	42.97	2.24	55.46	73.9	18.4	150	0	-
Vert.	4200.000	AV	45.05	30.36	6.58	42.51	2.24	41.72	53.9	12.1	193	202	VBW:10 Hz
Vert.	4882.000	AV	37.92	31.87	6.93	42.89	2.24	36.07	53.9	17.8	150	185	VBW:360 Hz
Vert.	7323.000	AV	36.76	37.54	8.32	43.52	2.24	41.34	53.9	12.5	182	173	VBW:360 Hz
Vert.	9764.000	AV	36.09	39.41	9.52	42.97	2.24	44.29	53.9	9.6	150	0	VBW:360 Hz Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Report No.	13722221S-B-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 20, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	22 deg.C, 48 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Takahiro Suzuki	Takahiro Kawakami	Yasumasa Owaki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz			

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	129.899	QP	46.79	13.85	7.39	32.11	0.00	35.92	43.5	7.5	246	82	-
Hori.	199.987	QP	41.25	16.50	7.85	32.05	0.00	33.55	43.5	9.9	186	174	-
Hori.	259.802	QP	48.99	12.44	8.35	31.98	0.00	37.80	46.0	8.2	127	154	-
Hori.	400.000	QP	49.46	15.92	9.06	31.94	0.00	42.50	46.0	**3.5**	100	139	-
Hori.	445.497	QP	46.03	16.49	9.28	31.93	0.00	39.87	46.0	6.1	100	148	-
Hori.	712.702	QP	39.84	19.99	10.33	31.81	0.00	38.35	46.0	7.6	100	239	-
Hori.	844.351	QP	35.00	21.35	10.77	31.35	0.00	35.77	46.0	10.2	100	125	-
Hori.	2483.500	PK	48.08	28.24	14.52	41.65	2.24	51.43	73.9	22.4	141	180	-
Hori.	2487.928	PK	49.30	28.24	14.52	41.66	2.24	52.64	73.9	21.2	136	181	-
Hori.	4960.000	PK	47.37	32.14	6.99	42.89	2.24	45.85	73.9	28.0	163	232	-
Hori.	7440.000	PK	47.72	37.62	8.37	43.65	2.24	52.30	73.9	21.6	150	0	-
Hori.	9920.000	PK	46.35	39.30	9.59	42.77	2.24	54.71	73.9	19.1	150	0	-
Hori.	2483.500	AV	35.88	28.24	14.52	41.65	2.24	39.23	53.9	14.6	141	180	VBW:360 Hz
Hori.	2487.928	AV	36.42	28.24	14.52	41.66	2.24	39.76	53.9	14.1	136	181	VBW:360 Hz
Hori.	4960.000	AV	37.16	32.14	6.99	42.89	2.24	35.64	53.9	18.2	163	232	VBW:360 Hz
Hori.	7440.000	AV	36.72	37.62	8.37	43.65	2.24	41.30	53.9	12.6	150	0	VBW:360 Hz Floor noise
Hori.	9920.000	AV	35.71	39.30	9.59	42.77	2.24	44.07	53.9	9.8	150	0	VBW:360 Hz Floor noise
Vert.	108.481	QP	44.34	11.65	7.24	32.12	0.00	31.11	43.5	12.3	100	149	-
Vert.	162.628	QP	43.51	15.26	7.86	32.08	0.00	34.55	43.5	8.9	100	343	-
Vert.	400.000	QP	44.75	15.92	9.06	31.94	0.00	37.79	46.0	8.2	100	23	-
Vert.	712.702	QP	41.92	19.99	10.33	31.81	0.00	40.43	46.0	5.5	105	16	-
Vert.	800.000	QP	36.16	20.74	10.61	31.55	0.00	35.96	46.0	10.0	100	164	-
Vert.	2483.500	PK	48.81	28.24	14.52	41.65	2.24	52.16	73.9	21.7	119	163	-
Vert.	2487.983	PK	49.38	28.24	14.52	41.66	2.24	52.72	73.9	21.1	201	170	-
Vert.	4200.000	PK	51.74	30.36	6.58	42.51	2.24	48.41	73.9	25.4	196	200	-
Vert.	4960.000	PK	47.93	32.14	6.99	42.89	2.24	46.41	73.9	27.4	151	181	-
Vert.	7440.000	PK	47.13	37.62	8.37	43.65	2.24	51.71	73.9	22.1	175	195	-
Vert.	9920.000	PK	47.21	39.30	9.59	42.77	2.24	55.57	73.9	18.3	150	0	-
Vert.	2483.500	AV	36.19	28.24	14.52	41.65	2.24	39.54	53.9	14.3	119	163	VBW:360 Hz
Vert.	2487.983	AV	37.02	28.24	14.52	41.66	2.24	40.36	53.9	13.5	201	170	VBW:360 Hz
Vert.	4200.000	AV	44.78	30.36	6.58	42.51	2.24	41.45	53.9	12.4	196	200	VBW:10 Hz
Vert.	4960.000	AV	37.06	32.14	6.99	42.89	2.24	35.54	53.9	18.3	151	181	VBW:360 Hz
Vert.	7440.000	AV	36.55	37.62	8.37	43.65	2.24	41.13	53.9	12.7	175	195	VBW:360 Hz
Vert.	9920.000	AV	35.82	39.30	9.59	42.77	2.24	44.18	53.9	9.7	150	0	VBW:360 Hz Floor noise

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

Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB

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

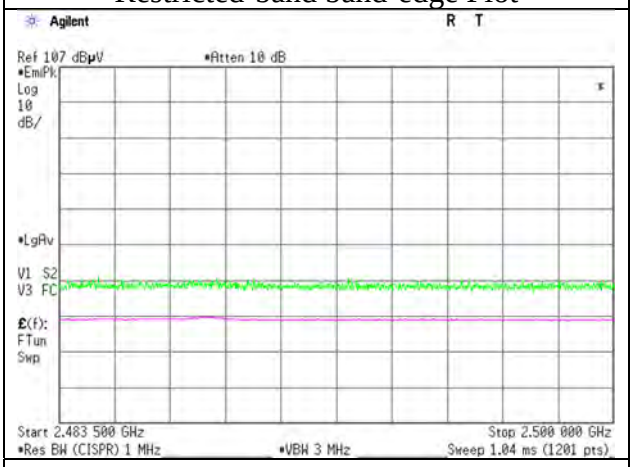
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	August 17, 2021
Temperature / Humidity	23 deg.C, 63 %RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, DH5 2480 MHz

Horizontal

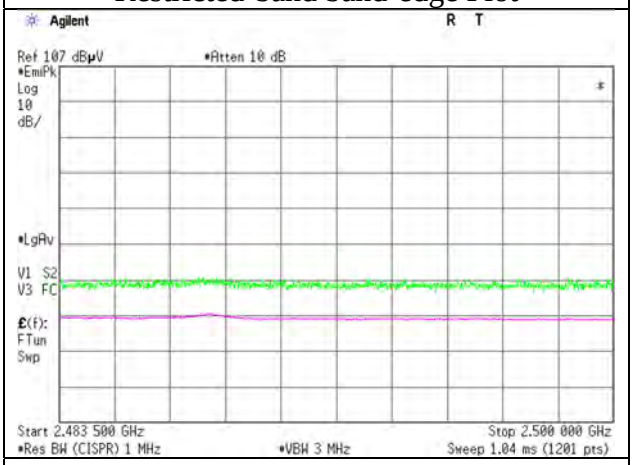
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission

Report No.	13722221S-B-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 20, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	22 deg.C, 48 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Takahiro Suzuki	Takahiro Kawakami	Yasumasa Owaki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz			

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	129.906	QP	45.78	13.85	7.39	32.11	0.00	34.91	43.5	8.5	238	90	-
Hori.	199.965	QP	42.04	16.50	7.85	32.05	0.00	34.34	43.5	9.1	180	173	-
Hori.	259.799	QP	47.87	12.44	8.35	31.98	0.00	36.68	46.0	9.3	136	163	-
Hori.	400.000	QP	49.36	15.92	9.06	31.94	0.00	42.40	46.0	**3.6**	100	137	-
Hori.	445.496	QP	45.63	16.49	9.28	31.93	0.00	39.47	46.0	6.5	100	146	-
Hori.	638.976	QP	39.42	19.24	10.03	31.92	0.00	36.77	46.0	9.2	109	208	-
Hori.	712.705	QP	42.88	19.99	10.33	31.81	0.00	41.39	46.0	4.6	129	132	-
Hori.	2390.000	PK	47.50	28.33	14.42	41.62	2.24	50.87	73.9	23.0	155	128	-
Hori.	4804.000	PK	48.12	31.77	6.88	42.89	2.24	46.12	73.9	27.7	158	289	-
Hori.	7206.000	PK	48.89	37.37	8.25	43.39	2.24	53.36	73.9	20.5	150	0	-
Hori.	9608.000	PK	48.14	39.12	9.45	43.18	2.24	55.77	73.9	18.1	150	0	-
Hori.	2390.000	AV	35.51	28.33	14.42	41.62	2.24	38.88	53.9	15.0	155	128	VBW:360 Hz
Hori.	4804.000	AV	37.21	31.77	6.88	42.89	2.24	35.21	53.9	18.6	158	289	VBW:360 Hz
Hori.	7206.000	AV	37.08	37.37	8.25	43.39	2.24	41.55	53.9	12.3	150	0	VBW:360 Hz Floor noise
Hori.	9608.000	AV	37.48	39.12	9.45	43.18	2.24	45.11	53.9	8.7	150	0	VBW:360 Hz Floor noise
Vert.	108.482	QP	44.24	11.65	7.24	32.12	0.00	31.01	43.5	12.4	100	143	-
Vert.	162.629	QP	40.69	15.26	7.86	32.08	0.00	31.73	43.5	11.7	100	343	-
Vert.	400.000	QP	44.98	15.92	9.06	31.94	0.00	38.02	46.0	7.9	100	1	-
Vert.	712.706	QP	43.05	19.99	10.33	31.81	0.00	41.56	46.0	4.4	115	11	-
Vert.	844.349	QP	34.26	21.35	10.77	31.35	0.00	35.03	46.0	10.9	100	81	-
Vert.	2390.000	PK	47.34	28.33	14.42	41.62	2.24	50.71	73.9	23.1	233	160	-
Vert.	4200.000	PK	51.48	30.36	6.58	42.51	2.24	48.15	73.9	25.7	192	201	-
Vert.	4804.000	PK	48.89	31.77	6.88	42.89	2.24	46.89	73.9	27.0	192	188	-
Vert.	7206.000	PK	48.58	37.37	8.25	43.39	2.24	53.05	73.9	20.8	150	0	-
Vert.	9608.000	PK	48.40	39.12	9.45	43.18	2.24	56.03	73.9	17.8	150	0	-
Vert.	2390.000	AV	35.54	28.33	14.42	41.62	2.24	38.91	53.9	14.9	233	160	VBW:360 Hz
Vert.	4200.000	AV	44.88	30.36	6.58	42.51	2.24	41.55	53.9	12.3	192	201	VBW:10 Hz
Vert.	4804.000	AV	37.80	31.77	6.88	42.89	2.24	35.80	53.9	18.1	192	188	VBW:360 Hz
Vert.	7206.000	AV	37.70	37.37	8.25	43.39	2.24	42.17	53.9	11.7	150	0	VBW:360 Hz Floor noise
Vert.	9608.000	AV	37.97	39.12	9.45	43.18	2.24	45.60	53.9	8.3	150	0	VBW:360 Hz Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
*These results have sufficient margin without taking account Duty cycle correction factor.

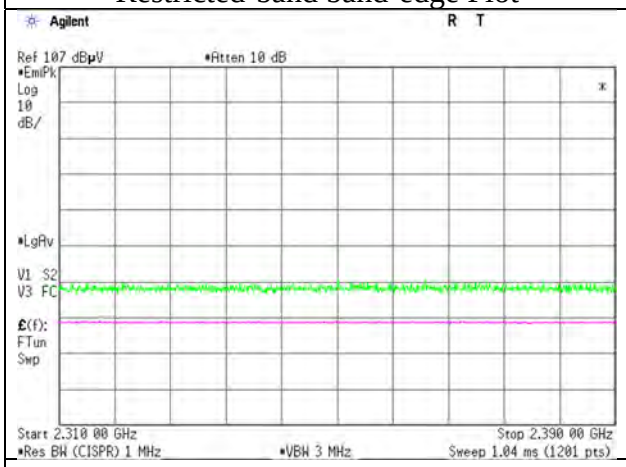
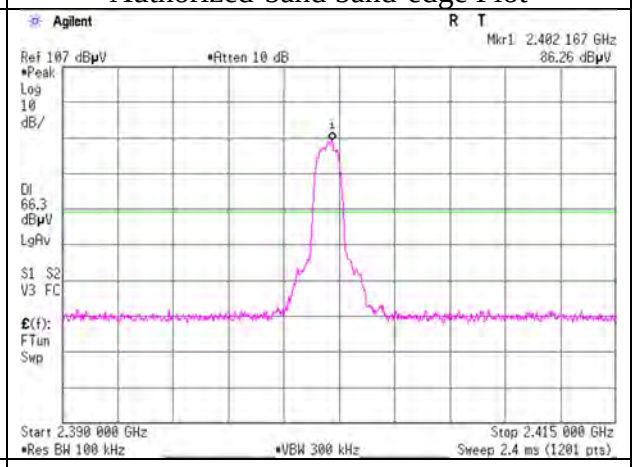
20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

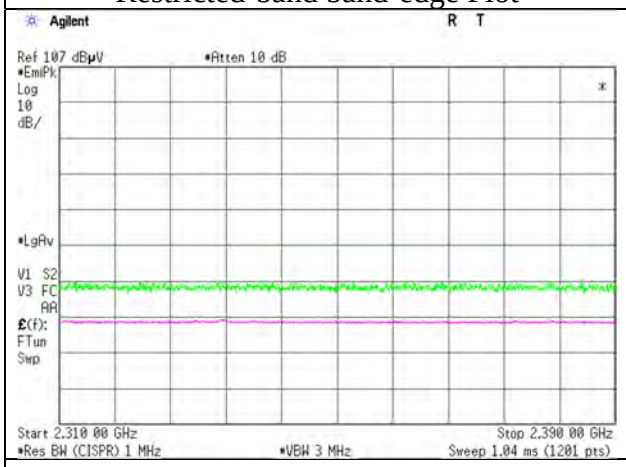
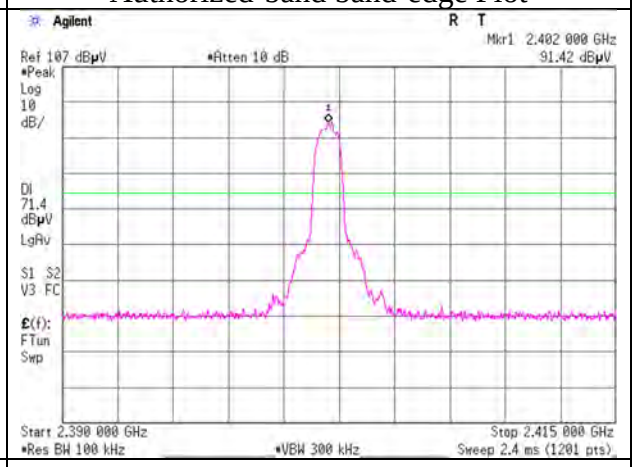
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	86.16	28.31	14.44	41.63	2.24	89.52	-	-	Carrier
Hori.	2400.000	PK	39.96	28.31	14.44	41.63	2.24	43.32	69.5	26.1	-
Vert.	2402.000	PK	91.19	28.31	14.44	41.63	2.24	94.55	-	-	Carrier
Vert.	2400.000	PK	42.15	28.31	14.44	41.63	2.24	45.51	74.5	28.9	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	August 17, 2021
Temperature / Humidity	23 deg.C, 63 %RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, 3DH5 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Report No.	13722221S-B-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 20, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	22 deg.C, 48 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Takahiro Suzuki	Takahiro Kawakami	Yasumasa Owaki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz			

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	129.901	QP	45.80	13.85	7.39	32.11	0.00	34.93	43.5	8.5	236	270	-
Hori.	199.999	QP	41.40	16.50	7.86	32.05	0.00	33.71	43.5	9.7	168	83	-
Hori.	259.799	QP	48.10	12.44	8.35	31.98	0.00	36.91	46.0	9.0	143	165	-
Hori.	399.996	QP	47.20	15.92	9.06	31.94	0.00	40.24	46.0	**5.7**	116	191	-
Hori.	445.496	QP	44.40	16.49	9.28	31.93	0.00	38.24	46.0	7.7	100	168	-
Hori.	638.973	QP	39.80	19.24	10.03	31.92	0.00	37.15	46.0	8.8	100	354	-
Hori.	663.550	QP	40.20	19.33	10.13	31.90	0.00	37.76	46.0	8.2	100	336	-
Hori.	712.699	QP	39.10	19.99	10.33	31.81	0.00	37.61	46.0	8.3	100	184	-
Hori.	737.279	QP	36.70	20.20	10.40	31.77	0.00	35.53	46.0	10.4	158	228	-
Hori.	4882.000	PK	48.19	31.87	6.93	42.89	2.24	46.34	73.9	27.5	154	238	-
Hori.	7323.000	PK	47.68	37.54	8.32	43.52	2.24	52.26	73.9	21.6	150	0	-
Hori.	9764.000	PK	47.24	39.41	9.52	42.97	2.24	55.44	73.9	18.4	150	0	-
Hori.	4882.000	AV	37.10	31.87	6.93	42.89	2.24	35.25	53.9	18.6	154	238	VBW:360 Hz
Hori.	7323.000	AV	36.31	37.54	8.32	43.52	2.24	40.89	53.9	13.0	150	0	VBW:360 Hz Floor noise
Hori.	9764.000	AV	36.09	39.41	9.52	42.97	2.24	44.29	53.9	9.6	150	0	VBW:360 Hz Floor noise
Vert.	129.901	QP	46.80	13.85	7.39	32.11	0.00	35.93	43.5	7.5	100	67	-
Vert.	399.997	QP	43.40	15.92	9.06	31.94	0.00	36.44	46.0	9.5	158	183	-
Vert.	712.702	QP	38.30	19.99	10.33	31.81	0.00	36.81	46.0	9.1	168	0	-
Vert.	4200.000	PK	51.51	30.36	6.58	42.51	2.24	48.18	73.9	25.7	193	202	-
Vert.	4882.000	PK	48.38	31.87	6.93	42.89	2.24	46.53	73.9	27.3	154	185	-
Vert.	7323.000	PK	48.22	37.54	8.32	43.52	2.24	52.80	73.9	21.1	150	0	-
Vert.	9764.000	PK	47.67	39.41	9.52	42.97	2.24	55.87	73.9	18.0	150	0	-
Vert.	4200.000	AV	44.22	30.36	6.58	42.51	2.24	40.89	53.9	13.0	193	202	VBW:10 Hz
Vert.	4882.000	AV	37.53	31.87	6.93	42.89	2.24	35.68	53.9	18.2	154	185	VBW:360 Hz
Vert.	7323.000	AV	36.35	37.54	8.32	43.52	2.24	40.93	53.9	12.9	150	0	VBW:360 Hz Floor noise
Vert.	9764.000	AV	36.00	39.41	9.52	42.97	2.24	44.20	53.9	9.7	150	0	VBW:360 Hz Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Report No.	13722221S-B-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 20, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	22 deg.C, 48 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Takahiro Suzuki	Takahiro Kawakami	Yasumasa Owaki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz			

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	129.902	QP	43.50	13.85	7.39	32.11	0.00	32.63	43.5	10.8	236	271	-
Hori.	199.999	QP	41.70	16.50	7.86	32.05	0.00	34.01	43.5	9.4	165	82	-
Hori.	259.799	QP	48.10	12.44	8.35	31.98	0.00	36.91	46.0	9.0	142	164	-
Hori.	399.999	QP	47.00	15.92	9.06	31.94	0.00	40.04	46.0	**5.9**	118	189	-
Hori.	445.497	QP	44.00	16.49	9.28	31.93	0.00	37.84	46.0	8.1	100	169	-
Hori.	688.125	QP	37.70	19.77	10.24	31.85	0.00	35.86	46.0	10.1	100	344	-
Hori.	712.700	QP	38.90	19.99	10.33	31.81	0.00	37.41	46.0	8.5	100	184	-
Hori.	844.348	QP	35.00	21.35	10.77	31.35	0.00	35.77	46.0	10.2	151	294	-
Hori.	2483.500	PK	48.38	28.24	14.52	41.65	2.24	51.73	73.9	22.1	153	180	-
Hori.	4960.000	PK	47.29	32.14	6.99	42.89	2.24	45.77	73.9	28.1	161	232	-
Hori.	7440.000	PK	47.77	37.62	8.37	43.65	2.24	52.35	73.9	21.5	150	0	-
Hori.	9920.000	PK	46.64	39.30	9.59	42.77	2.24	55.00	73.9	18.9	150	0	-
Hori.	2483.500	AV	35.94	28.24	14.52	41.65	2.24	39.29	53.9	14.6	153	180	VBW:360 Hz
Hori.	4960.000	AV	37.32	32.14	6.99	42.89	2.24	35.80	53.9	18.1	161	232	VBW:360 Hz
Hori.	7440.000	AV	36.68	37.62	8.37	43.65	2.24	41.26	53.9	12.6	150	0	VBW:360 Hz Floor noise
Hori.	9920.000	AV	35.76	39.30	9.59	42.77	2.24	44.12	53.9	9.7	150	0	VBW:360 Hz Floor noise
Vert.	129.900	QP	43.20	13.85	7.39	32.11	0.00	32.33	43.5	11.1	100	68	-
Vert.	399.998	QP	43.40	15.92	9.06	31.94	0.00	36.44	46.0	9.5	161	181	-
Vert.	712.701	QP	36.30	19.99	10.33	31.81	0.00	34.81	46.0	11.1	168	1	-
Vert.	799.992	QP	36.30	20.74	10.61	31.55	0.00	36.10	46.0	9.9	153	207	-
Vert.	2483.500	PK	50.28	28.24	14.52	41.65	2.24	53.63	73.9	20.2	280	158	-
Vert.	2484.242	PK	50.85	28.24	14.52	41.65	2.24	54.20	73.9	19.7	278	154	-
Vert.	4200.000	PK	51.63	30.36	6.58	42.51	2.24	48.30	73.9	25.6	194	201	-
Vert.	4960.000	PK	47.99	32.14	6.99	42.89	2.24	46.47	73.9	27.4	150	182	-
Vert.	7440.000	PK	47.45	37.62	8.37	43.65	2.24	52.03	73.9	21.8	150	0	-
Vert.	9920.000	PK	47.12	39.30	9.59	42.77	2.24	55.48	73.9	18.4	150	0	-
Vert.	2483.500	AV	37.16	28.24	14.52	41.65	2.24	40.51	53.9	13.3	280	158	VBW:360 Hz
Vert.	2484.242	AV	36.64	28.24	14.52	41.65	2.24	39.99	53.9	13.9	278	154	VBW:360 Hz
Vert.	4200.000	AV	44.64	30.36	6.58	42.51	2.24	41.31	53.9	12.5	194	201	VBW:10 Hz
Vert.	4960.000	AV	37.12	32.14	6.99	42.89	2.24	35.60	53.9	18.3	150	182	VBW:360 Hz
Vert.	7440.000	AV	36.67	37.62	8.37	43.65	2.24	41.25	53.9	12.6	150	0	VBW:360 Hz Floor noise
Vert.	9920.000	AV	35.88	39.30	9.59	42.77	2.24	44.24	53.9	9.6	150	0	VBW:360 Hz Floor noise

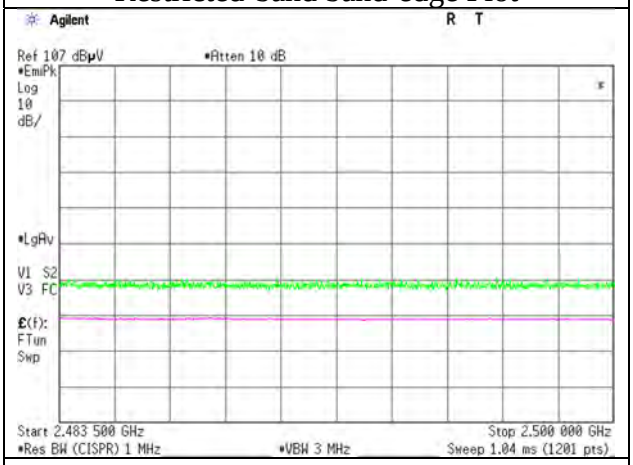
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-B-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	August 17, 2021
Temperature / Humidity	23 deg.C, 63 %RH
Engineer	Takahiro Kawakami
Mode	Tx, Hopping Off, 3DH5 2480 MHz

Horizontal

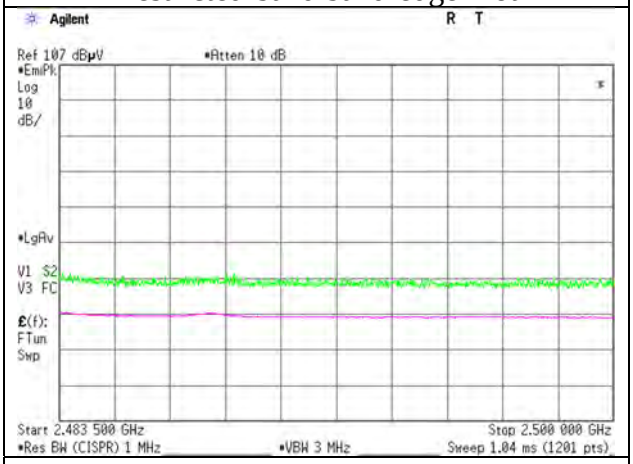
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

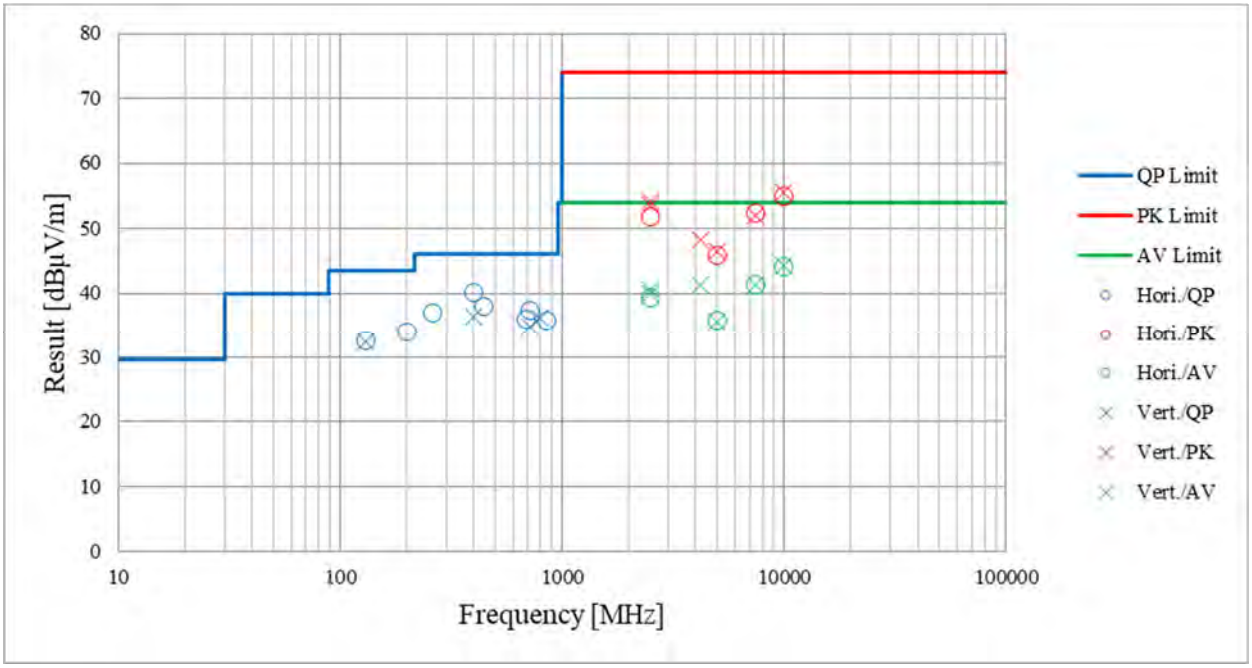


Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	13722221S-B-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 20, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	22 deg.C, 48 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Takahiro Suzuki	Takahiro Kawakami	Yasumasa Owaki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz			



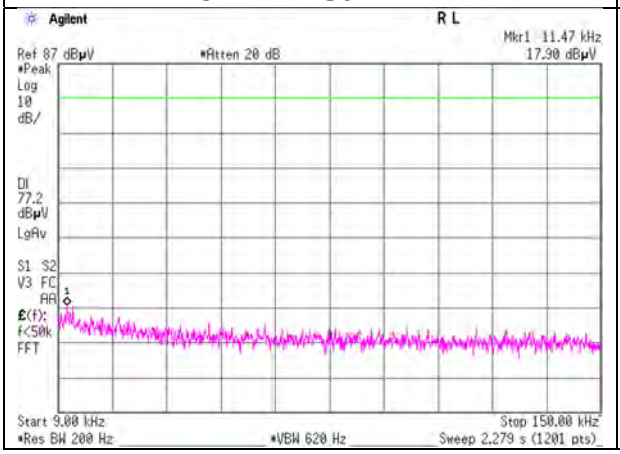
*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

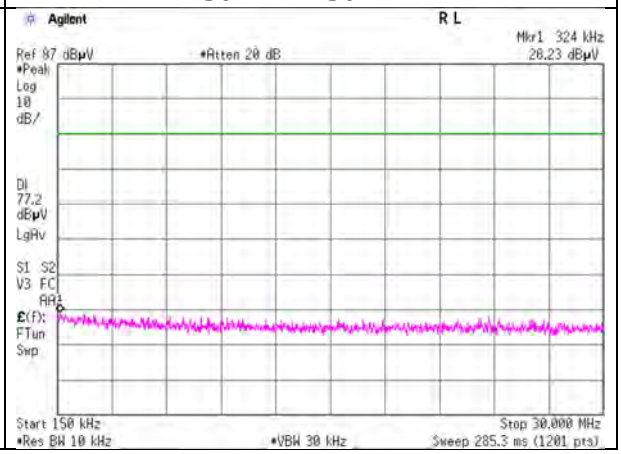
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, DH5

2402 MHz

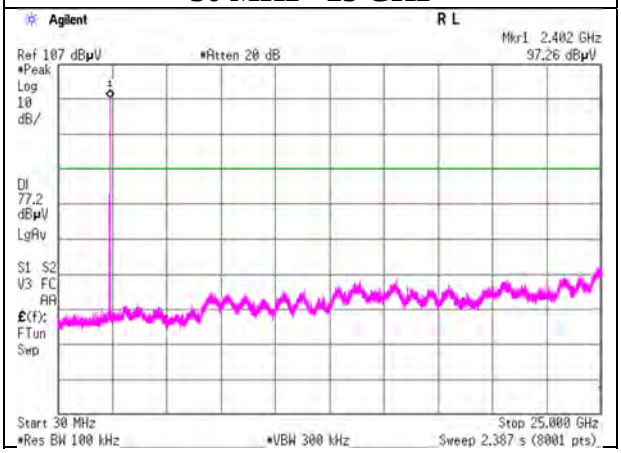
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

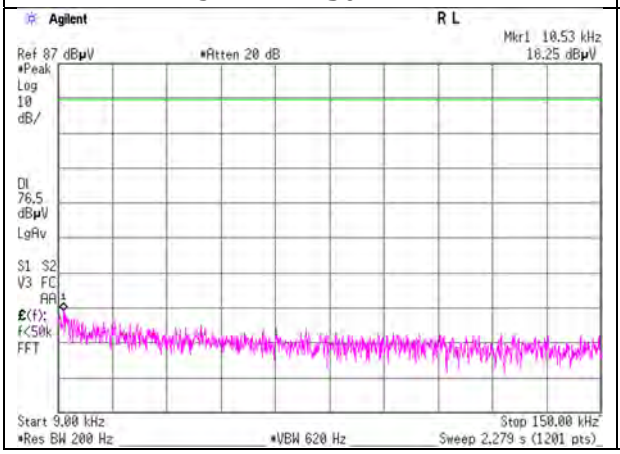


Conducted Spurious Emission

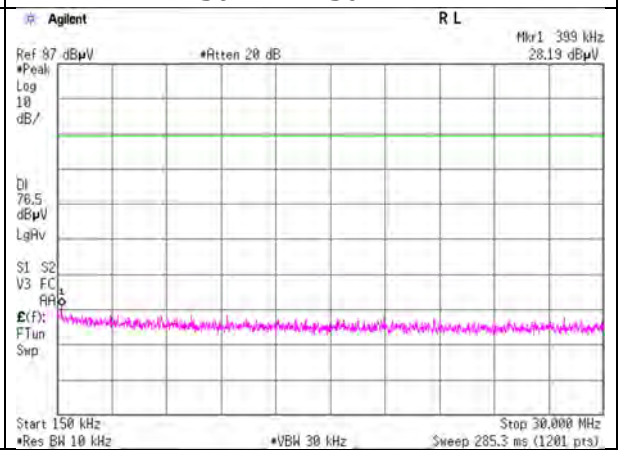
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, DH5

2441 MHz

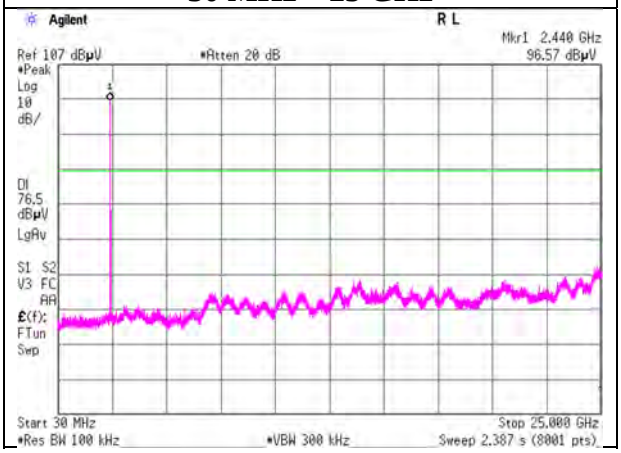
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 25 GHz

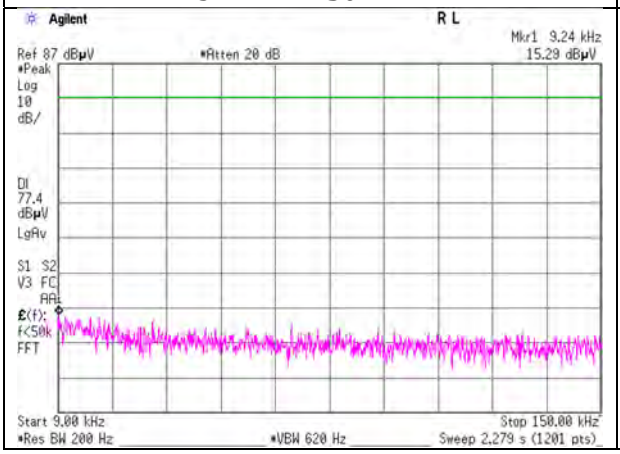


Conducted Spurious Emission

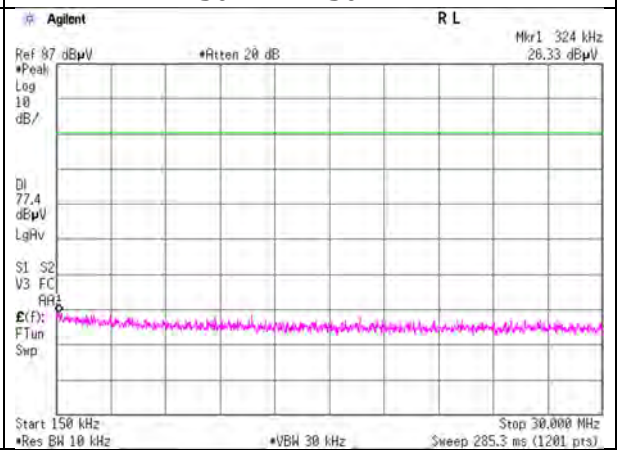
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, DH5

2480 MHz

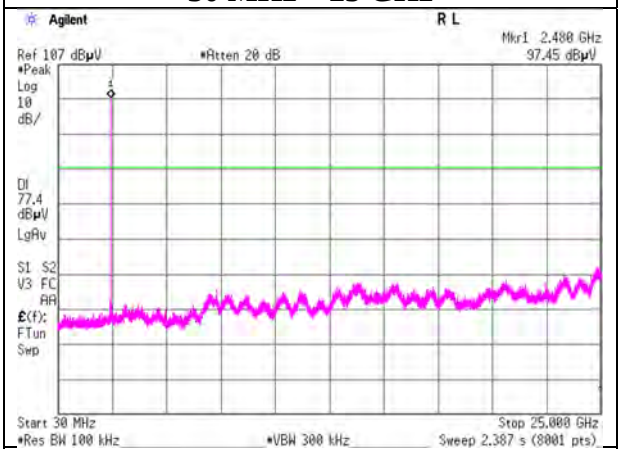
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 25 GHz

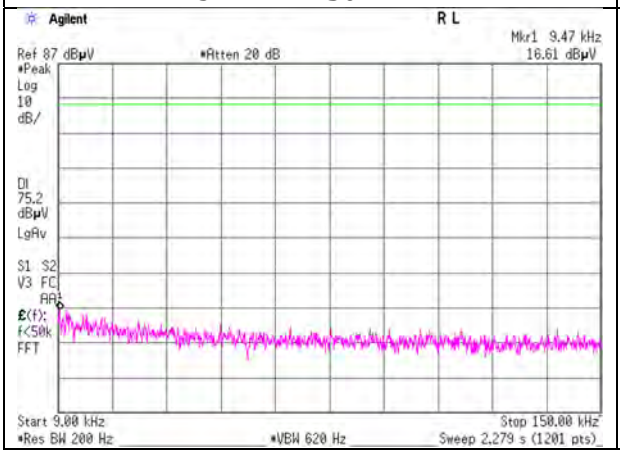


Conducted Spurious Emission

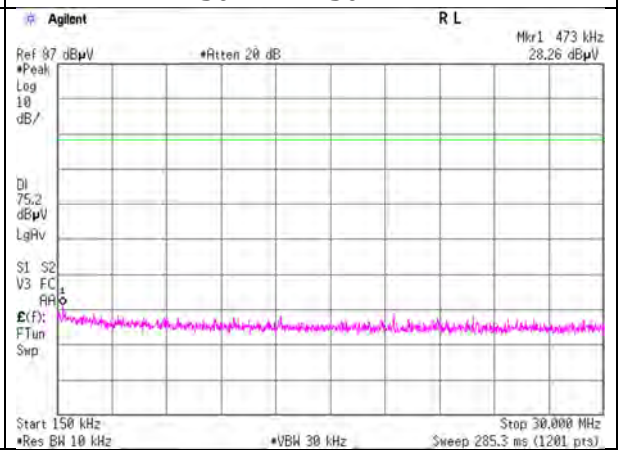
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, 3DH5

2402 MHz

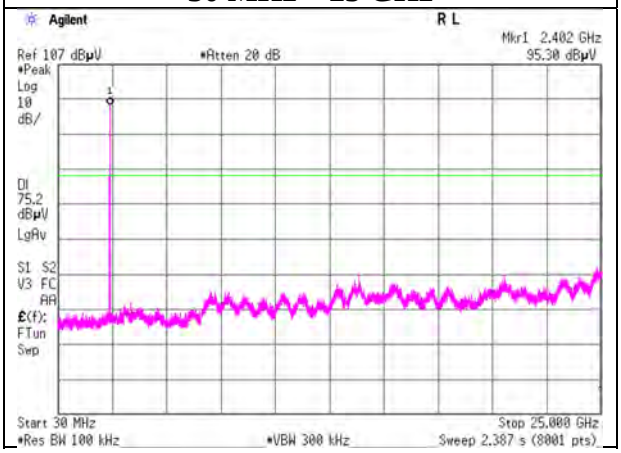
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 25 GHz

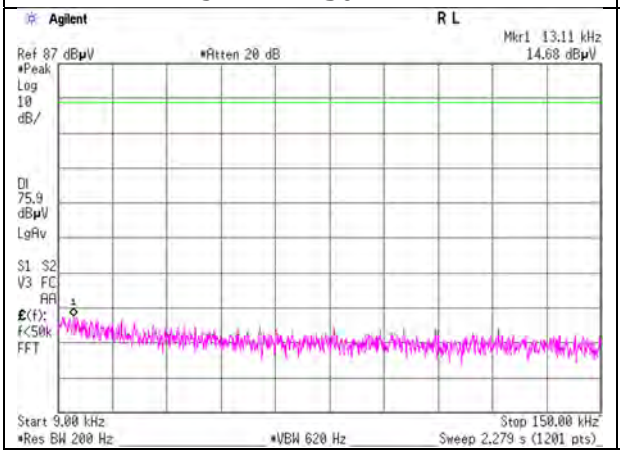


Conducted Spurious Emission

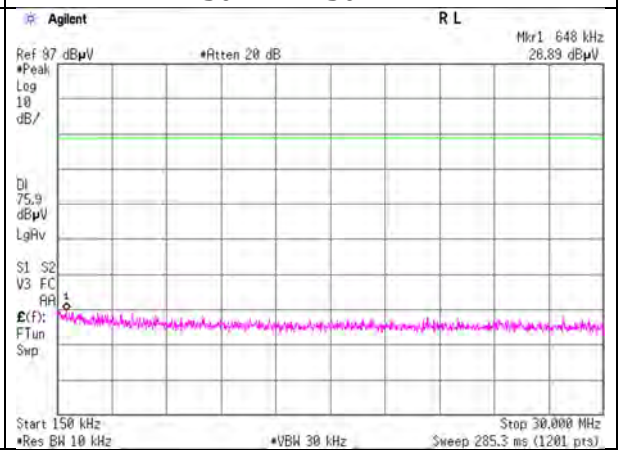
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, 3DH5

2441 MHz

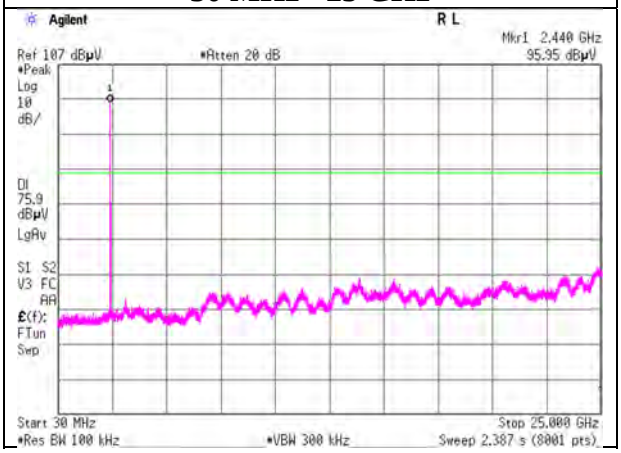
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

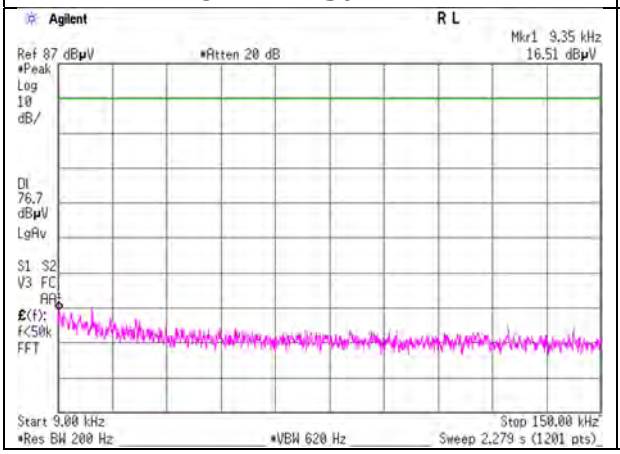


Conducted Spurious Emission

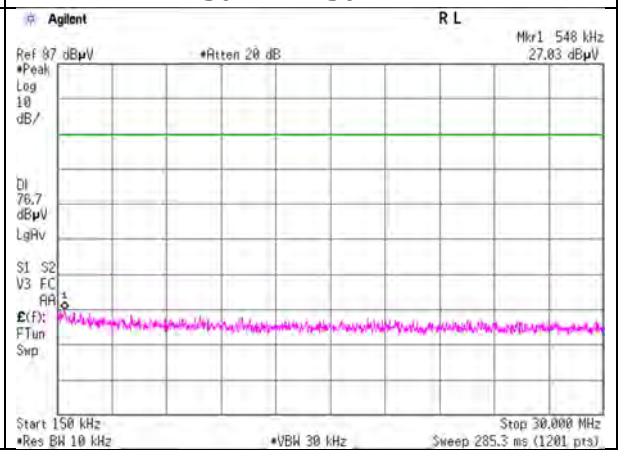
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx, Hopping Off, 3DH5

2480 MHz

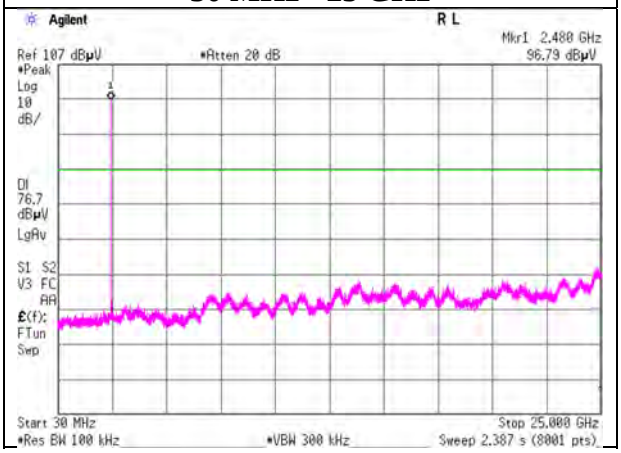
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 25 GHz

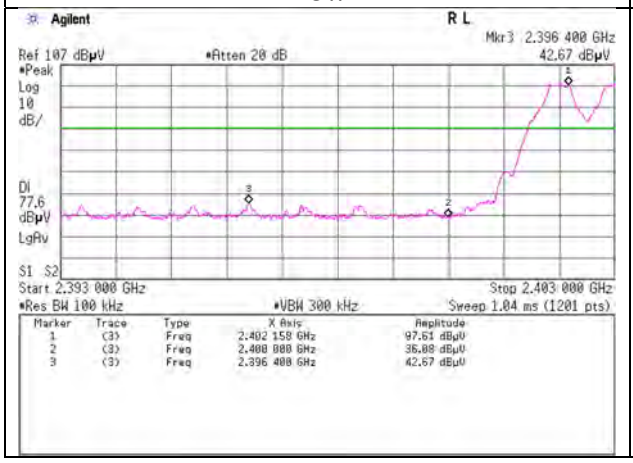


Conducted Emission Band Edge compliance

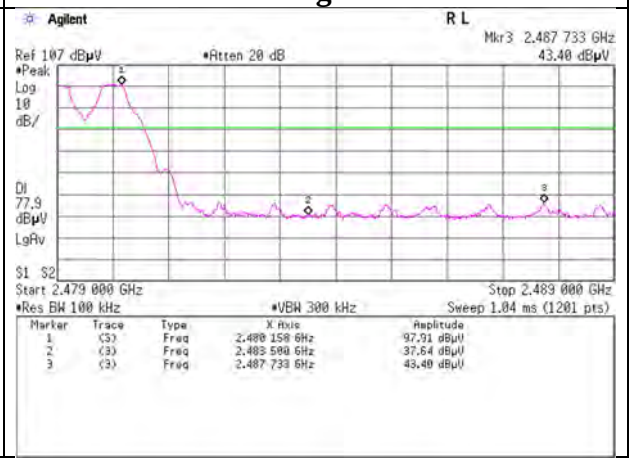
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx DH5

Hopping On

Low

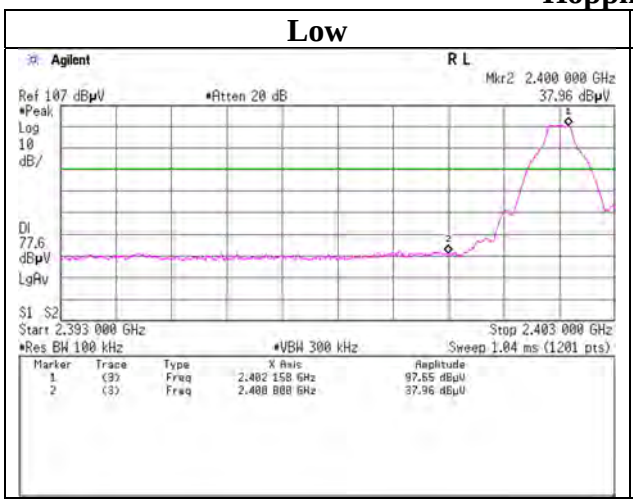


High

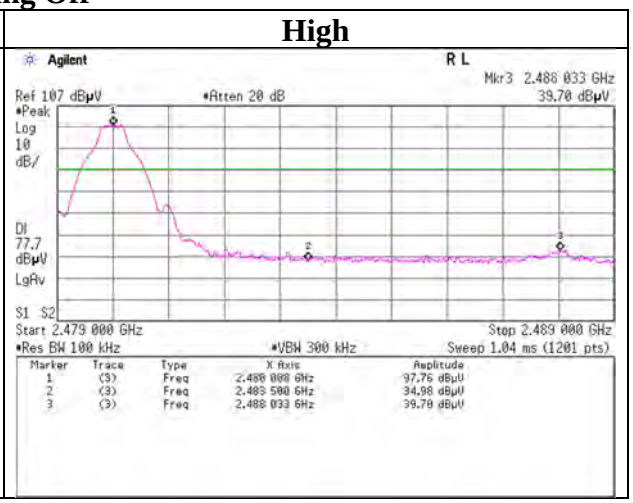


Hopping Off

Low



High

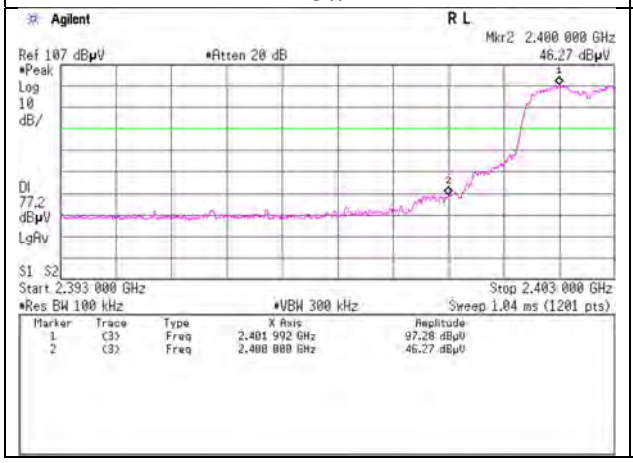


Conducted Emission Band Edge compliance

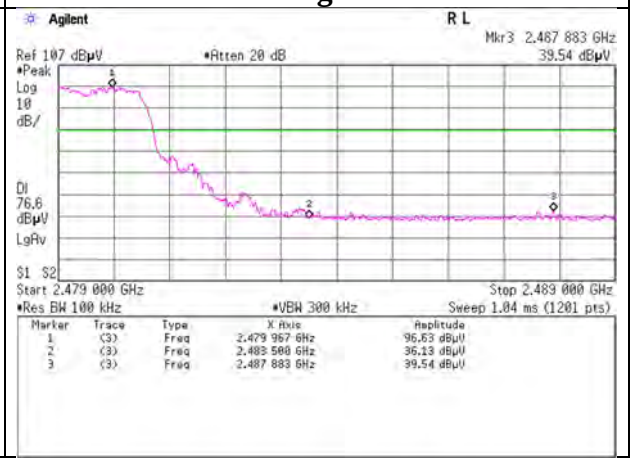
Report No.	13722221S-B-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 17, 2021
Temperature / Humidity	24 deg. C / 60 % RH
Engineer	Yosuke Murakami
Mode	Tx 3DH5

Hopping On

Low

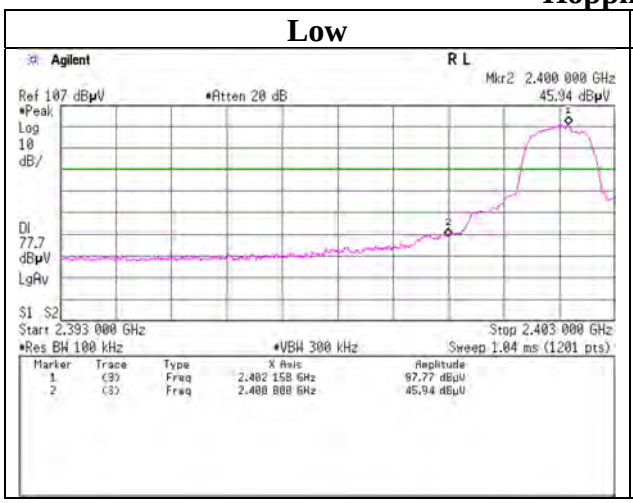


High

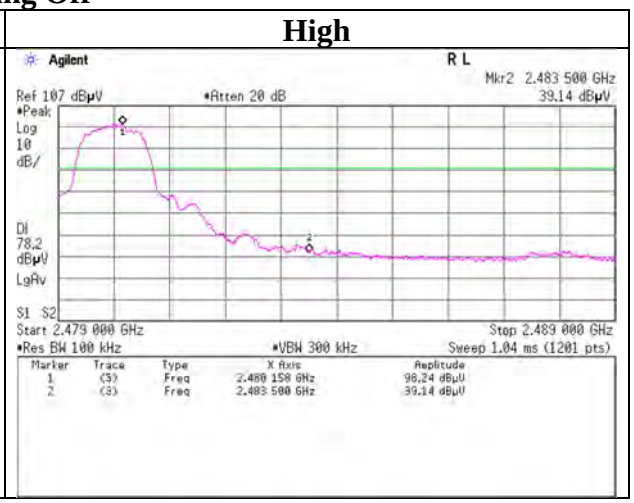


Hopping Off

Low



High



APPENDIX 2: Test instruments

Test equipment (1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2020/10/21	12
AT	SAT10-24	204928	Attenuator	Weinschel Corp.	54A-10	-	2021/02/09	12
AT	SCC-G65	196942	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803416/2	2021/03/01	12
AT	SOS-19	175823	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2020/10/01	12
AT	SPM-13	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2021/01/25	12
AT	SPSS-06	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2021/01/25	12
AT	STM-06	145763	Terminator	TME	CT-01 BP	-	2020/12/07	12
AT	KSA-08	145089	Spectrum Analyzer	Keysight Technologies Inc	E4446A	MY46180525	2020/11/24	12
RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3 (RE,CE,ME,PE)	-	-	-
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	SAEC-03 (NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2021/04/27	12
RE	SAEC-03 (SVSWR)	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2021/05/21	12
RE	SAF-03	145126	Pre Amplifier	SONOMA	310N	290213	2021/02/10	12
RE	SAF-06	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2021/02/08	12
RE	SAF-08	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2021/03/01	12
RE	SAT10-05	145136	Attenuator	Keysight Technologies Inc	8493C-010	74864	2020/10/05	12
RE	SAT10-06	145137	Attenuator	Keysight Technologies Inc	8493C-010	74865	2020/10/05	12
RE	SAT6-13	167094	Attenuator	JFW	50HF-006N	-	2021/02/10	12
RE	SBA-03	145023	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032666	2021/05/15	12
RE	SCC-C1/C2/C3/C4/C5/C10/SRSE-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271 (RF Selector)	2021/04/12	12

Test equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	SCC-G15	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2021/03/01	12
RE	SCC-G40	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	2021/01/19	12
RE	SCC-G43	156380	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	SN MY 13406/4E	2021/05/17	12
RE	SCC-G57	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2021/05/18	12
RE	SCC-G58	183047	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800287/4A	2021/05/17	12
RE	SCC-G70	200010	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575618/4	2021/07/06	12
RE	SFL-02	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2020/10/05	12
RE	SFL-18	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2021/04/08	12
RE	SHA-03	145501	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-739	2021/06/14	12
RE	SHA-04	145512	Horn Antenna	ETS-Lindgren	3160-09	00094868	2021/06/14	12
RE	SHA-10	194685	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	711	2021/03/03	12
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	196	2021/05/15	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
RE	SSA-02	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2021/04/13	12
RE	STR-08	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2020/12/02	12
RE	STS-03	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2020/10/19	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: **RE: Radiated Emission test**
AT: Antenna Terminal Conducted test