RADIO TEST REPORT

Test Report No. : 13722221S-A-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** **Wireless LAN 2.4 GHz band and Bluetooth low energy part**
Test Result	:	**Complied (Refer to SECTION 3)**

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3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13722221S-A. 13722221S-A is replaced with this report.

Date of test: August 13 to September 3, 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".

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REVISION HISTORY

Original Test Report No.: 13722221S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13722221S-A	September 24, 2021	-	-
1	13722221S-A-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 **ISED:** RSS-Gen 8.8	**FCC:** Section 15.207 **ISED:** RSS-Gen 8.8	N/A	N/A	*1)
6dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section 15.247(a)(2) **ISED:** RSS-247 5.2(a)	See data.	Complied a)	Conducted
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** RSS-Gen 6.12	**FCC:** Section 15.247(b)(3) **ISED:** RSS-247 5.4(d)		Complied b)	Conducted
Power Density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section 15.247(e) **ISED:** RSS-247 5.2(b)		Complied c)	Conducted
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** RSS-Gen 6.13	**FCC:** Section15.247(d) **ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	3.6 dB 4824 MHz, AV, Vert. Mode: Tx 11b 2412 MHz	Complied# d), e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

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) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
c) Refer to APPENDIX 1 (data of Power Density)
d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
e) 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	- f)	Conducted
f) 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
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.6 dB	2.56dB
Radiated emission	9 kHz-30 MHz	3.0 dB	2.7 dB	2.7 dB
(Measurement distance: 3 m)	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	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB
(Measurement distance: 1 m)	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

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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)

Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11b (11b)	1 Mbps, PN9
IEEE 802.11g (11g)	6 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 0, PN9
Bluetooth Low Energy (BT LE)	Uncoded 1M-PHY, Maximum Packet Size, PRBS9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows; Power settings: WLAN 14 dBm, BT LE: 4 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.	

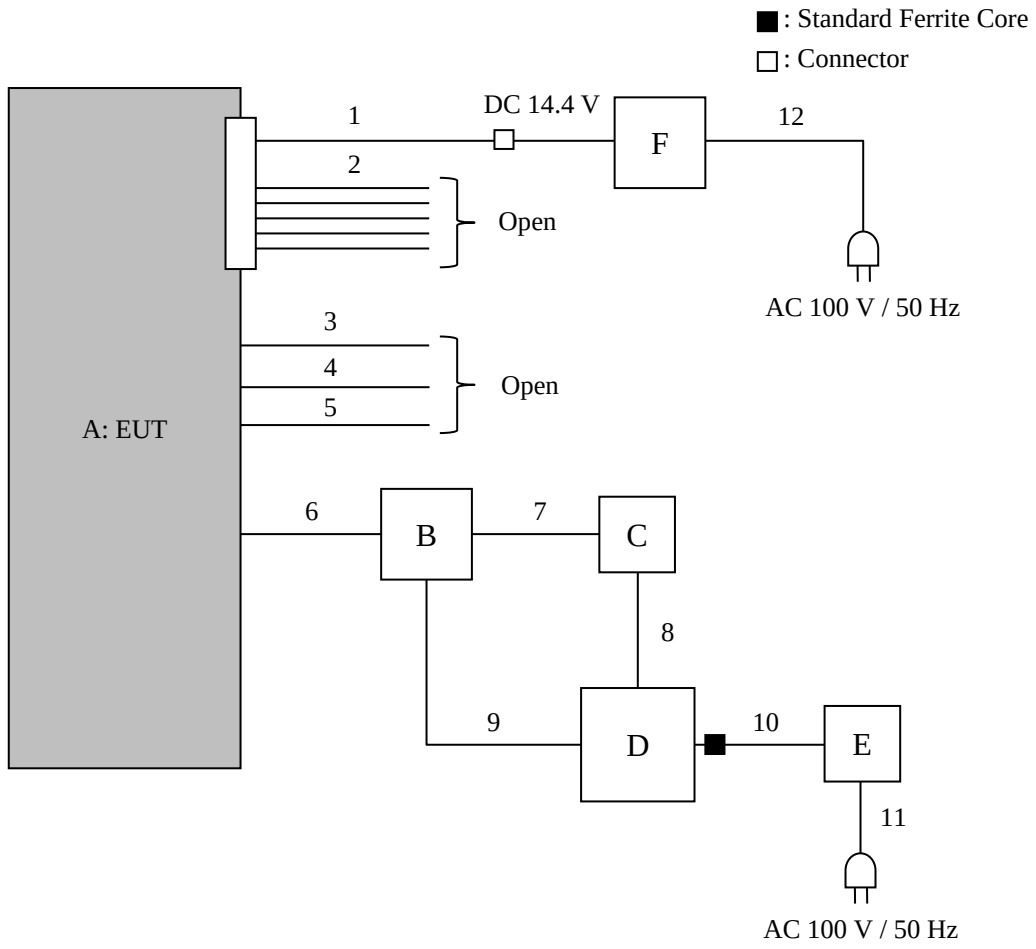
*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Spurious Emission (Below 1 GHz)	11n-20 Tx *1)	2462 MHz
	BT LE Tx	2402 MHz 2440 MHz 2480 MHz
Spurious Emission (Above 1 GHz)	11b/11g/11n-20 Tx	2412 MHz 2437 MHz 2462 MHz
	BT LE Tx	2402 MHz 2440 MHz 2480 MHz
6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	11b/11g/11n-20 Tx	2412 MHz 2437 MHz 2462 MHz
	BT LE Tx	2402 MHz 2440 MHz 2480 MHz

*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

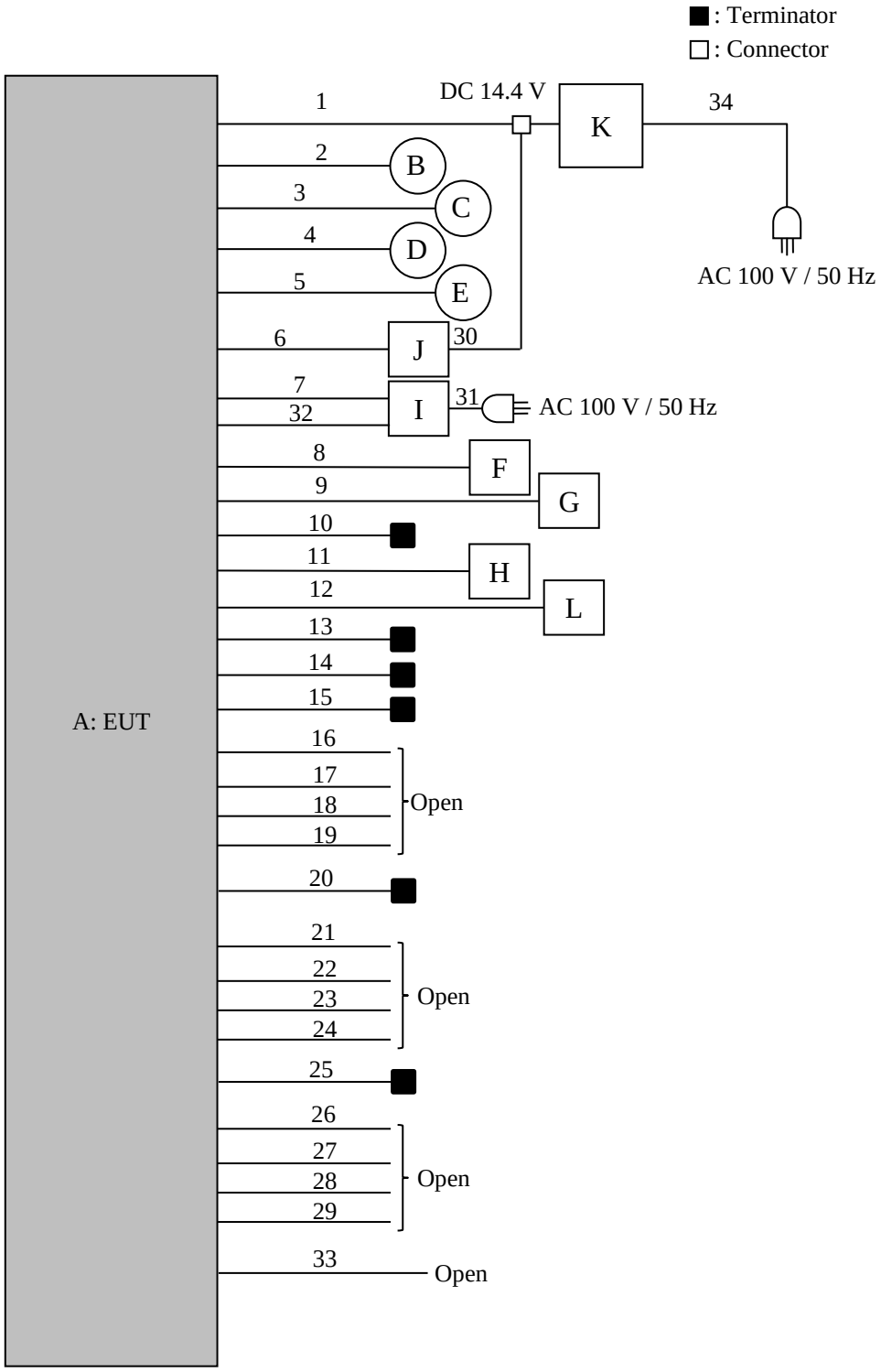
No.	Item	Model number	Serial number	Manufacturer	Remark
A	Display Audio	Music Halo	3	ALPS ALPINE	EUT
B	Debug board	-	-	-	-
C	LAN USB Adapter	EDC-FUA2-B	9BL213400922A	ELECOM	-
D	Laptop Computer	7666-77J	LV-B8R1X 08/05	Lenovo	-
E	AC Adapter	42T4422	11S92P1154Z1DXF1DBFDN	Lenovo	-
F	Power Supply(DC)	PAN35-10A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

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[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.

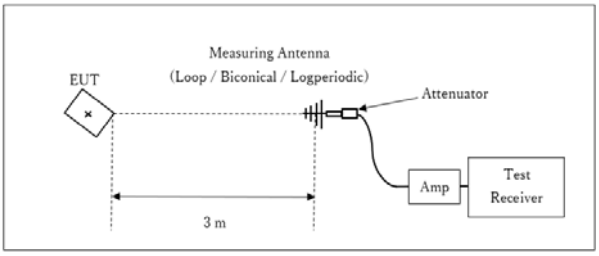
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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	11.12.2.5.2 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz

*1) Average Power Measurement was performed based on ANSI C63.10-2013.

Figure 2: Test Setup

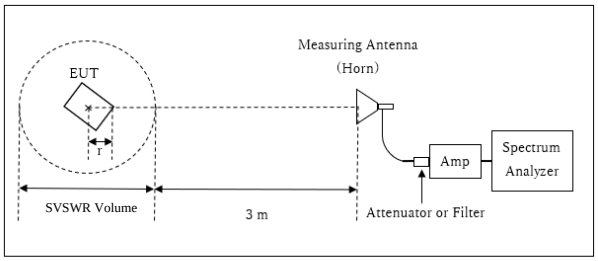
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

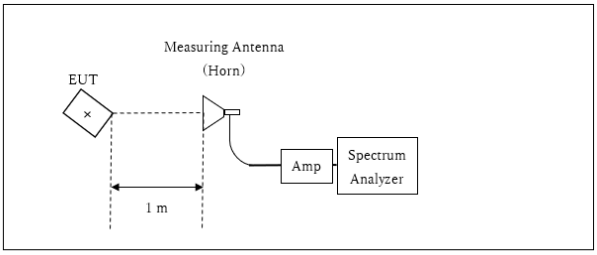


r : Radius of an outer periphery of EUT
× : Center of turn table

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.

WLAN

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	30 deg.	0 deg.	30 deg.	30 deg.	0 deg.	0 deg.
Vertical	30 deg.	0 deg.	30 deg.	30 deg.	0 deg.	0 deg.

BT LE

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
6dB Bandwidth	50 MHz (WLAN) 10 MHz (BT LE)	100 kHz	300 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)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4) *5)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
*4) 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)
*5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 – 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

Test data : **APPENDIX**
Test result : **Pass**

APPENDIX 1: Test data

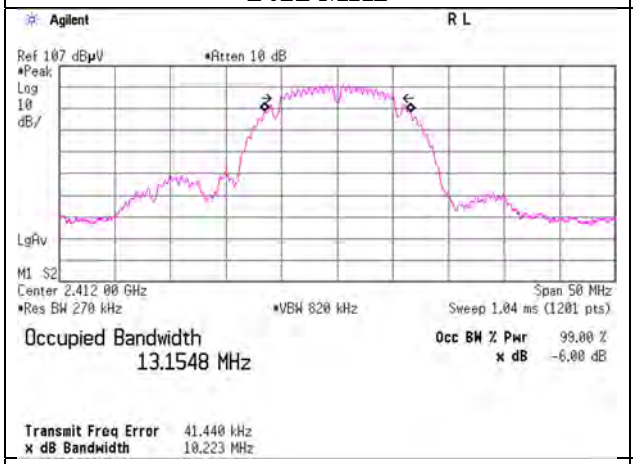
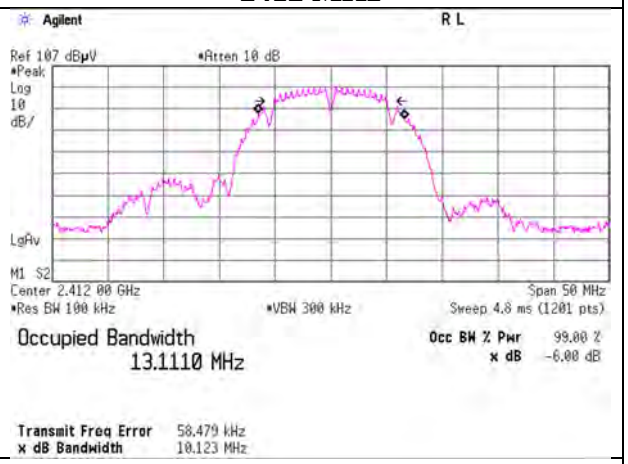
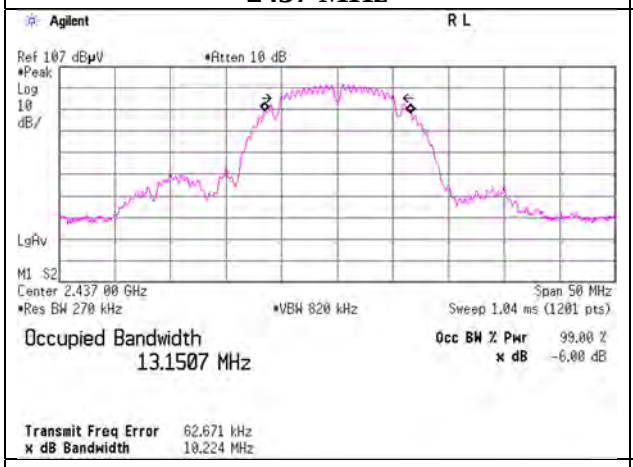
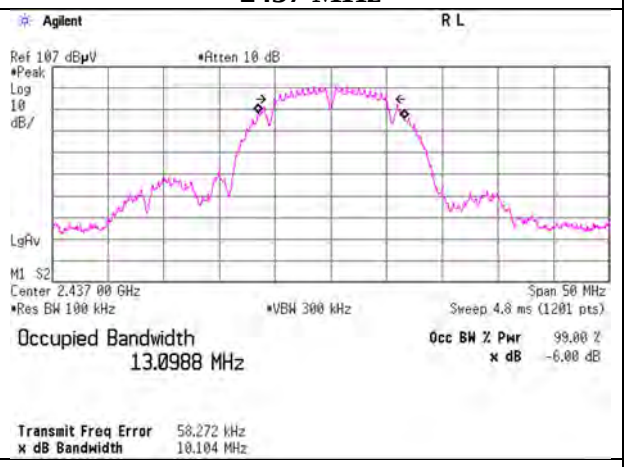
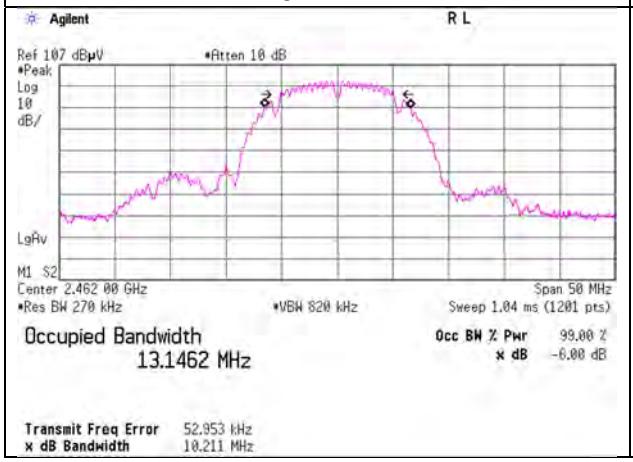
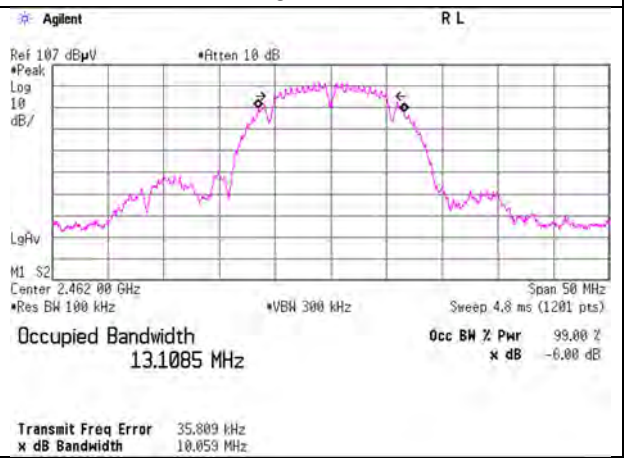
99 % Occupied Bandwidth and 6 dB Bandwidth

Report No.	13722221S-A-R1	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	August 17, 2021	August 31, 2021
Temperature / Humidity	24 deg. C / 60 % RH	24 deg. C / 53 % RH
Engineer	Yosuke Murakami	Takahiro Kawakami
Mode	Tx	

Mode	Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
11b	2412	13154.8	10.123	> 0.5000
	2437	13150.7	10.104	> 0.5000
	2462	13146.2	10.059	> 0.5000
11g	2412	16778.7	16.370	> 0.5000
	2437	16746.0	16.381	> 0.5000
	2462	16763.6	16.374	> 0.5000
11n-20	2412	17733.9	17.308	> 0.5000
	2437	17724.2	17.366	> 0.5000
	2462	17704.4	17.350	> 0.5000
BT LE	2402	1033.4	0.718	> 0.5000
	2440	1036.2	0.725	> 0.5000
	2480	1036.0	0.728	> 0.5000

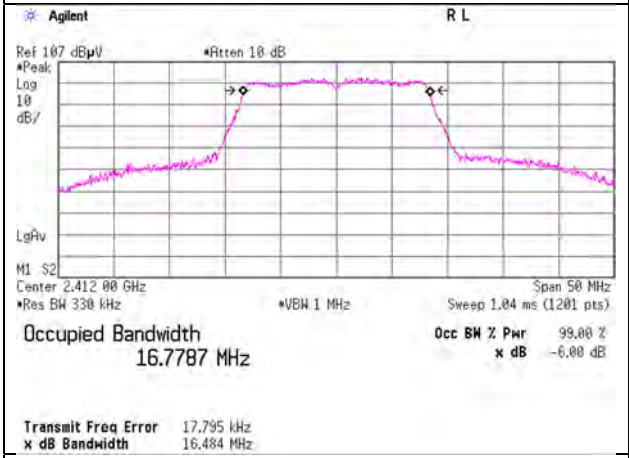
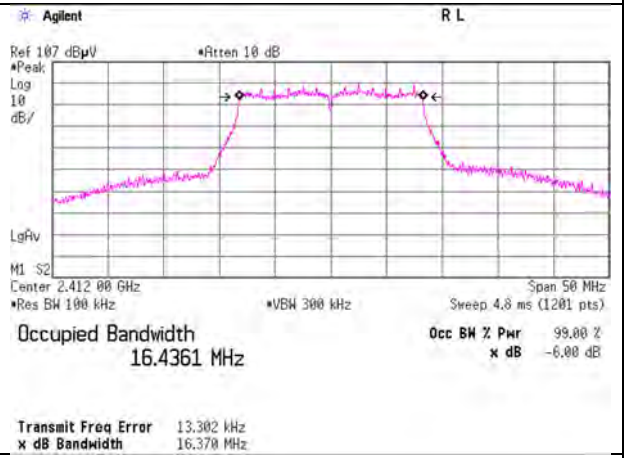
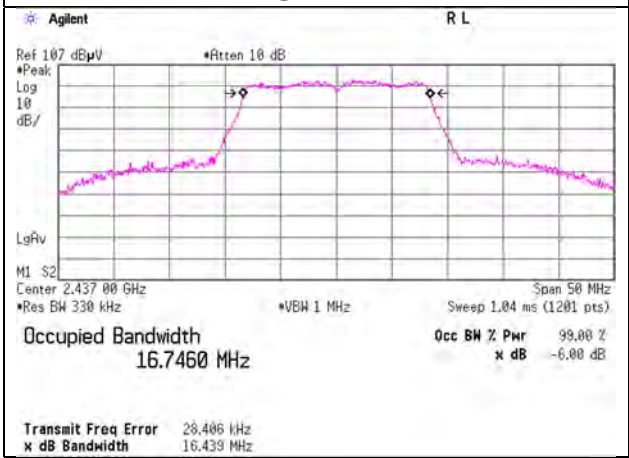
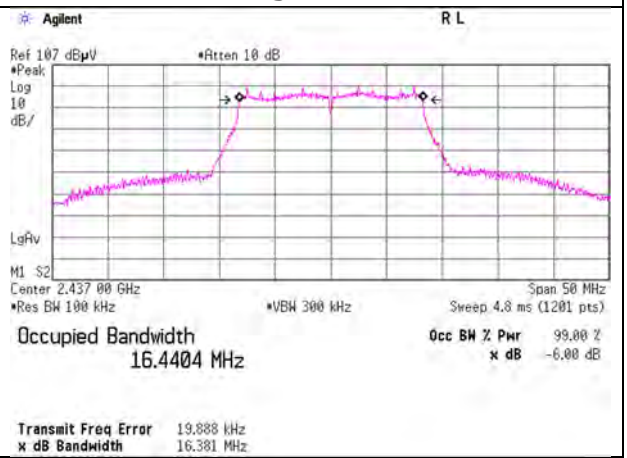
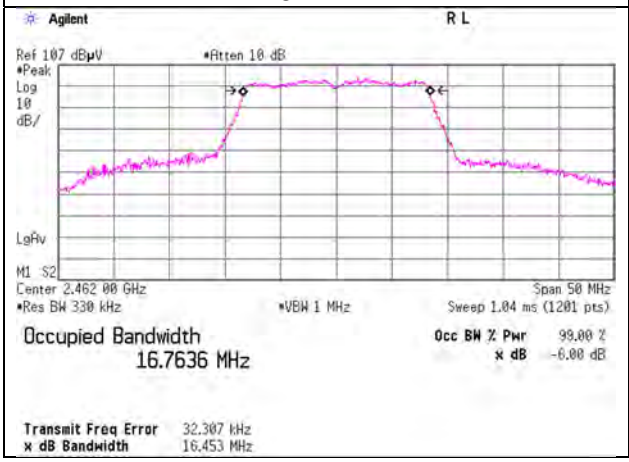
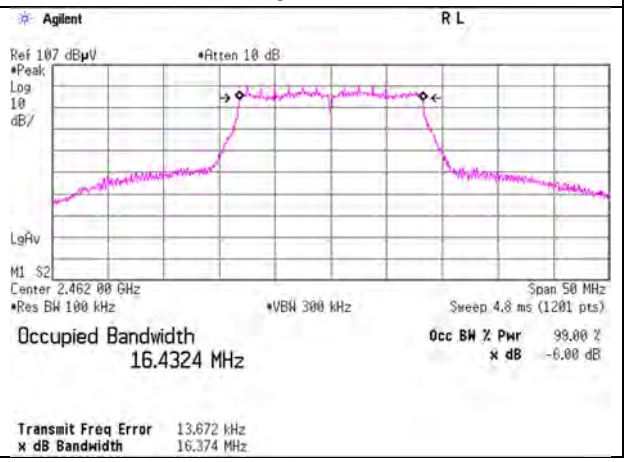
99 % Occupied Bandwidth and 6 dB Bandwidth

11b

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

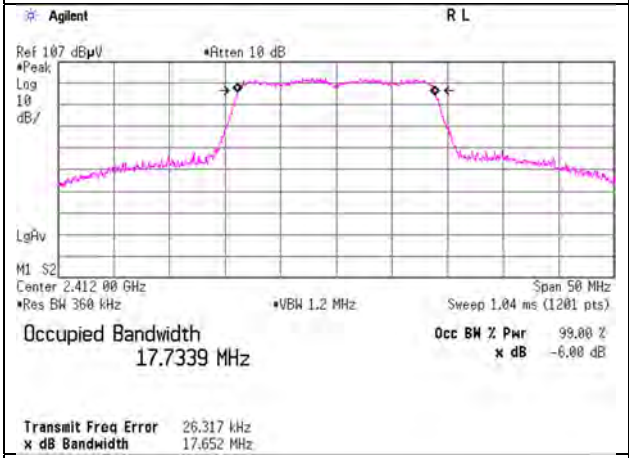
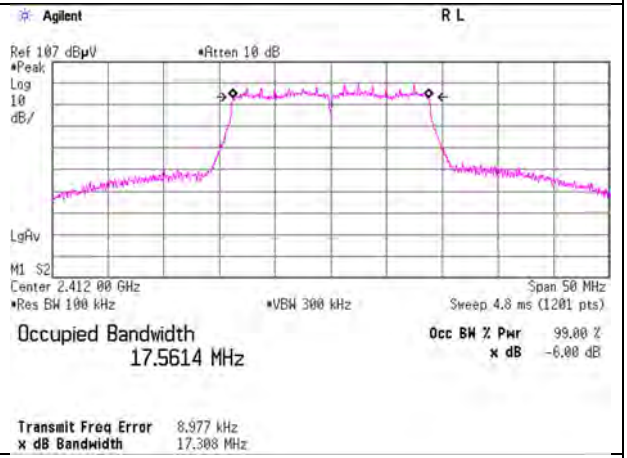
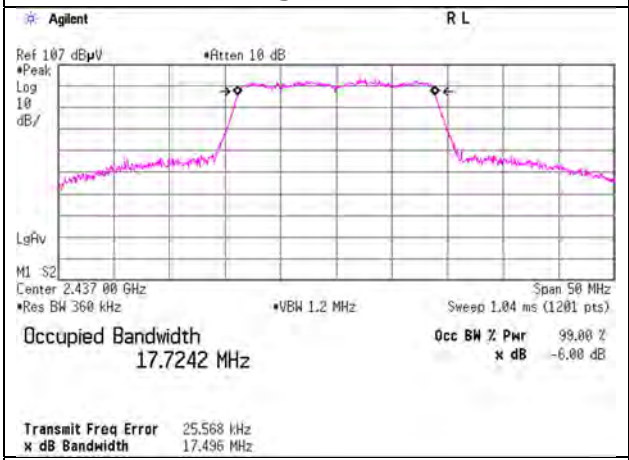
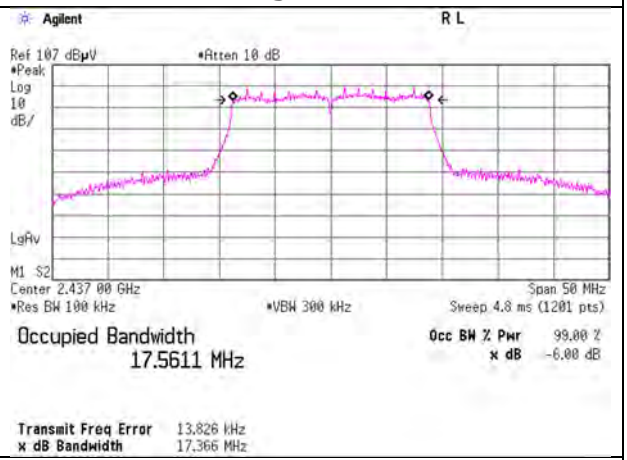
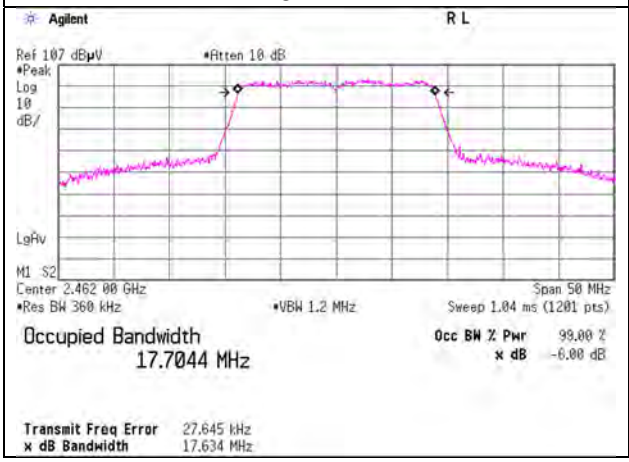
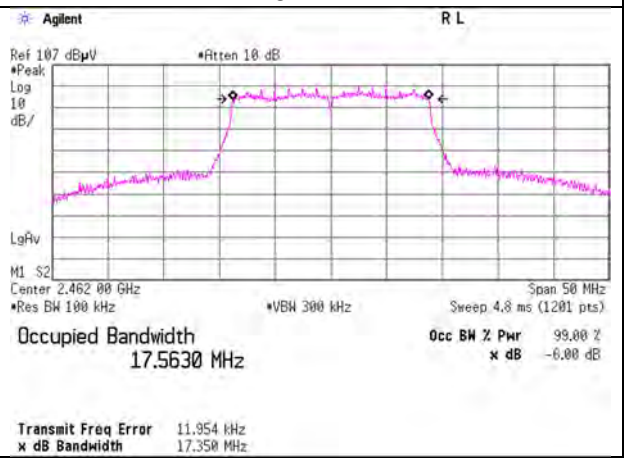
99 % Occupied Bandwidth and 6 dB Bandwidth

11g

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

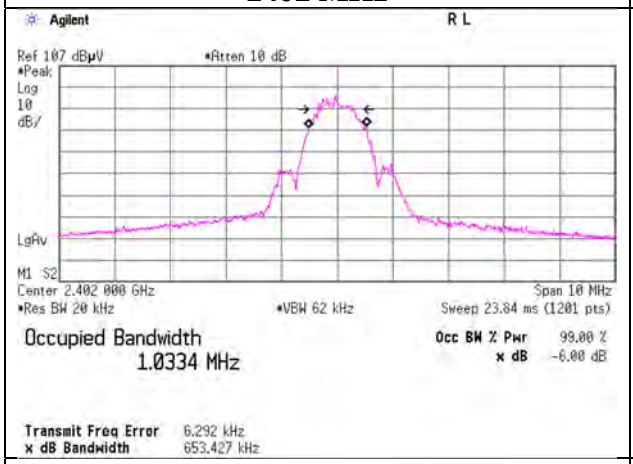
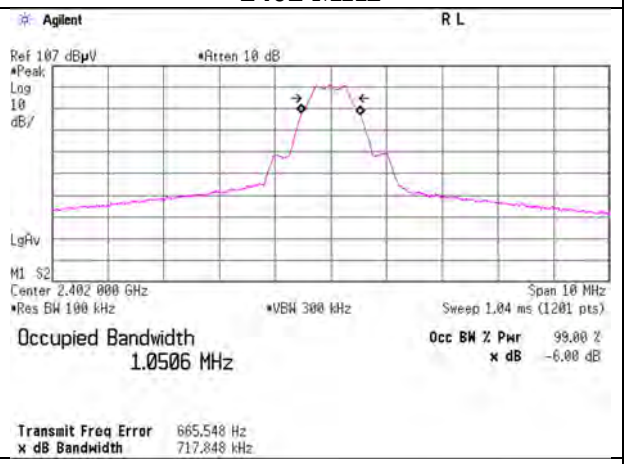
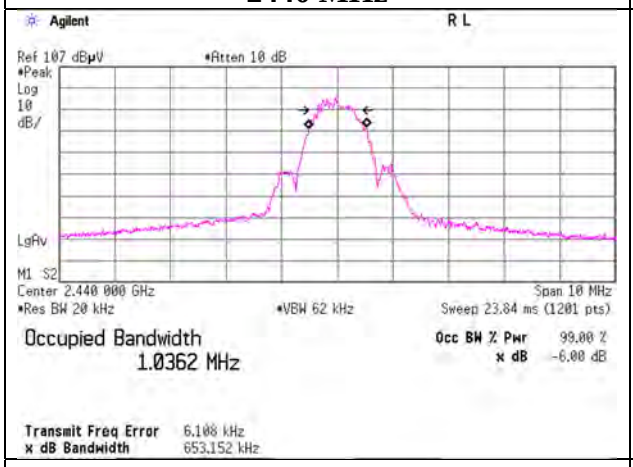
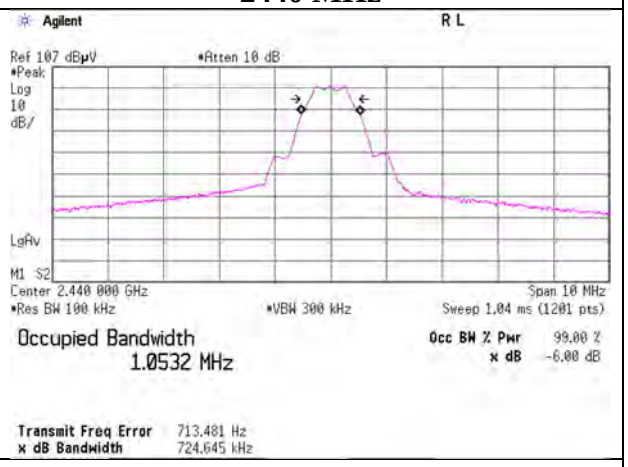
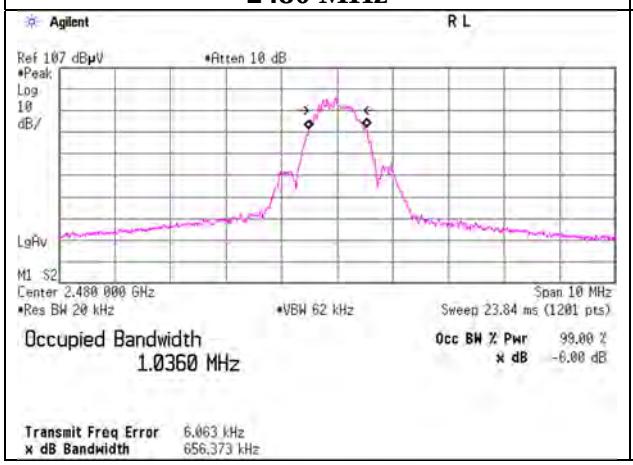
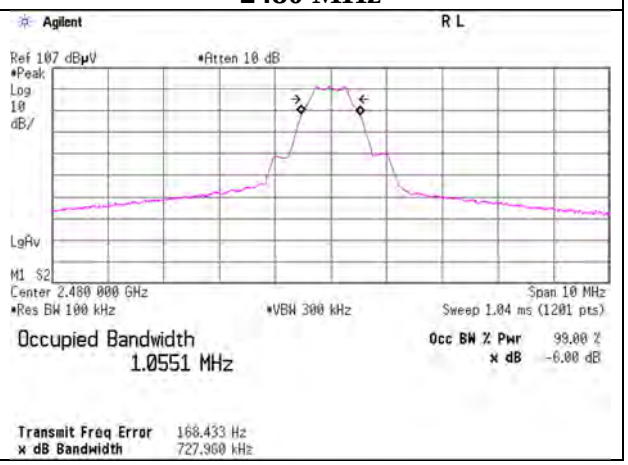
99 % Occupied Bandwidth and 6 dB Bandwidth

11n-20

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE

99 % Occupied Bandwidth	6 dB Bandwidth
2402 MHz	**2402 MHz**
	
2440 MHz	**2440 MHz**
	
2480 MHz	**2480 MHz**
	

Maximum Peak Output Power

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 31, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Takahiro Kawakami
Mode	Tx 11b

				Conducted Power					e.i.r.p. for RSS-247					
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]
2412	2.71	1.65	9.94	14.30	26.92	30.00	1000	15.70	-0.20	14.10	25.70	36.02	4000	21.92
2437	2.95	1.66	9.94	14.55	28.51	30.00	1000	15.45	-0.20	14.35	27.23	36.02	4000	21.67
2462	3.64	1.66	9.94	15.24	33.42	30.00	1000	14.76	-0.20	15.04	31.92	36.02	4000	20.98

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + 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.

2437MHz

Rate [Mbps]	Reading [dBm]	Remark
1	2.95	*
2	2.91	-
5.5	2.35	-
11	2.41	-

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 31, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Takahiro Kawakami
Mode	Tx 11g

				Conducted Power					e.i.r.p. for RSS-247					
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]
2412	10.96	1.65	9.94	22.55	179.89	30.00	1000	7.45	-0.20	22.35	171.79	36.02	4000	13.67
2437	11.36	1.66	9.94	22.96	197.70	30.00	1000	7.04	-0.20	22.76	188.80	36.02	4000	13.26
2462	11.99	1.66	9.94	23.59	228.56	30.00	1000	6.41	-0.20	23.39	218.27	36.02	4000	12.63

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + 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.

2437 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	11.36	*
9	11.21	-
12	10.61	-
18	10.80	-
24	10.81	-
36	9.98	-
48	10.79	-
54	10.95	-

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 31, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Takahiro Kawakami
Mode	Tx 11n-20

				Conducted Power					e.i.r.p. for RSS-247					
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]
2412	10.54	1.65	9.94	22.13	163.31	30.00	1000	7.87	-0.20	21.93	155.96	36.02	4000	14.09
2437	10.13	1.66	9.94	21.73	148.94	30.00	1000	8.27	-0.20	21.53	142.23	36.02	4000	14.49
2462	12.31	1.66	9.94	23.91	246.04	30.00	1000	6.09	-0.20	23.71	234.96	36.02	4000	12.31

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + 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.

2437 MHz

Rate [MCS]	Reading [dBm]	Remark
0	10.13	*
1	9.64	-
2	9.59	-
3	9.17	-
4	9.11	-
5	9.28	-
6	9.31	-
7	9.36	-

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	13722221S-A-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 BT LE

				Conducted Power					e.i.r.p. for RSS-247					
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]
2402	-8.27	1.65	9.94	3.32	2.15	30.00	1000	26.68	-3.00	0.32	1.08	36.02	4000	35.70
2440	-8.26	1.66	9.94	3.34	2.16	30.00	1000	26.66	-3.00	0.34	1.08	36.02	4000	35.68
2480	-8.19	1.66	9.94	3.41	2.19	30.00	1000	26.59	-3.00	0.41	1.10	36.02	4000	35.61

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Average Output Power
(Reference data for RF Exposure)

Report No.	13722221S-A-R1	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	August 16, 2021	August 31, 2021
Temperature / Humidity	22 deg. C / 56 % RH	24 deg. C / 53 % RH
Engineer	Yosuke Murakami	Takahiro Kawakami
Mode	Tx	

11b **1 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-0.49	1.65	9.94	11.10	12.88	0.03	11.13	12.97
2437	-0.30	1.66	9.94	11.30	13.49	0.03	11.33	13.58
2462	0.41	1.66	9.94	12.01	15.89	0.03	12.04	16.00

11g **6 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-0.10	1.65	9.94	11.49	14.09	0.15	11.64	14.59
2437	0.52	1.66	9.94	12.12	16.29	0.15	12.27	16.87
2462	0.90	1.66	9.94	12.50	17.78	0.15	12.65	18.41

11n-20 **MCS 0**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-0.30	1.65	9.94	11.29	13.46	0.17	11.46	14.00
2437	0.65	1.66	9.94	12.25	16.79	0.17	12.42	17.46
2462	1.00	1.66	9.94	12.60	18.20	0.17	12.77	18.92

BT LE

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-10.71	1.65	9.94	0.88	1.22	2.05	2.93	1.96
2440	-10.70	1.66	9.94	0.90	1.23	2.05	2.95	1.97
2480	-10.65	1.66	9.94	0.95	1.24	2.05	3.00	2.00

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

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

The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.

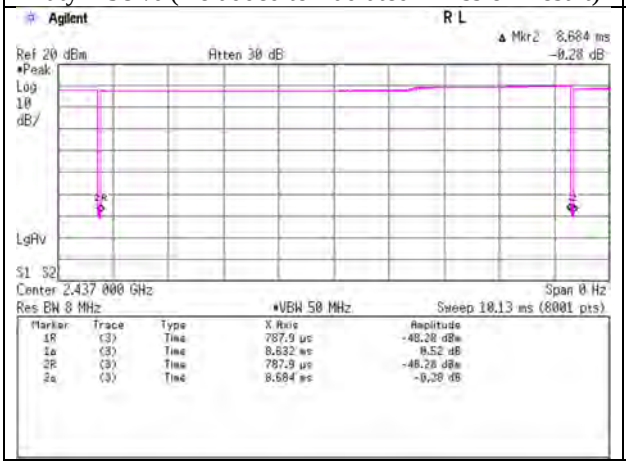
Burst rate confirmation

Report No.	13722221S-A-R1	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	August 17, 2021	August 18, 2021
Temperature / Humidity	24 deg. C / 60 % RH	25 deg. C / 55 % RH
Engineer	Yosuke Murakami	Yosuke Murakami
Mode	Tx	

11b 1 Mbps

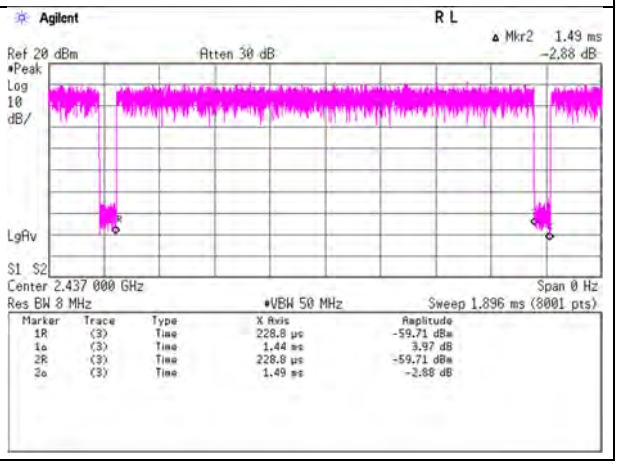
Tx on / (Tx on + Tx off) =	**0.994**
Tx on / (Tx on + Tx off) * 100 =	**99.4 %**
Duty factor = 10 * log (8.684 / 8.632) =	**0.03 dB**

Duty > 98 % (No added to Radiated Emission Result)



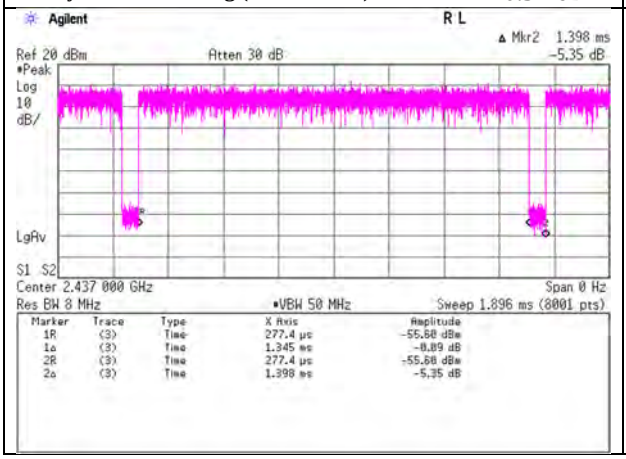
11g 6 Mbps

Tx on / (Tx on + Tx off) =	**0.966**
Tx on / (Tx on + Tx off) * 100 =	**96.6 %**
Duty factor = 10 * log (1.49 / 1.44) =	**0.15 dB**
Duty factor = 20 * log (1.49 / 1.44) =	**0.30 dB**



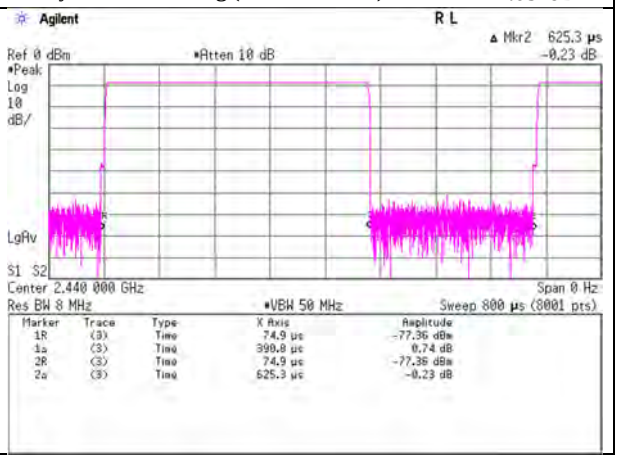
11n-20 MCS 0

Tx on / (Tx on + Tx off) =	**0.962**
Tx on / (Tx on + Tx off) * 100 =	**96.2 %**
Duty factor = 10 * log (1.398 / 1.345) =	**0.17 dB**
Duty factor = 20 * log (1.398 / 1.345) =	**0.34 dB**



BT LE

Tx on / (Tx on + Tx off) =	**0.625**
Tx on / (Tx on + Tx off) * 100 =	**62.5 %**
Duty factor = 10 * log (0.6253 / 0.3908) =	**2.05 dB**
Duty factor = 20 * log (0.6253 / 0.3908) =	**4.09 dB**



* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Radiated Spurious Emission

Report No.	13722221S-A-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	1	3
Date	August 31, 2021	September 3, 2021
Temperature / Humidity	24 deg.C, 56 %RH	23 deg.C, 60 %RH
Engineer	Yusuke Tanikawara (1 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx 11b 2412 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.	2390.000	PK	46.52	27.73	14.82	39.61	2.24	51.70	73.9	22.2	155	81	-
Hori.	4824.000	PK	50.72	31.23	7.60	39.69	2.24	52.10	73.9	21.8	273	104	-
Hori.	7236.000	PK	46.22	36.60	9.35	39.48	2.24	54.93	73.9	18.9	150	0	-
Hori.	9648.000	PK	47.96	38.27	10.94	39.66	2.24	59.75	73.9	14.1	150	0	-
Hori.	2390.000	AV	35.90	27.73	14.82	39.61	2.24	41.08	53.9	12.8	155	81	*1)
Hori.	4824.000	AV	45.82	31.23	7.60	39.69	2.24	47.20	53.9	6.7	273	104	-
Hori.	7236.000	AV	36.94	36.60	9.35	39.48	2.24	45.65	53.9	8.2	150	0	Floor noise
Hori.	9648.000	AV	37.89	38.27	10.94	39.66	2.24	49.68	53.9	4.2	150	0	Floor noise
Vert.	2390.000	PK	45.90	27.73	14.82	39.61	2.24	51.08	73.9	22.8	138	203	-
Vert.	4199.998	PK	48.74	29.79	7.24	39.59	2.24	48.42	73.9	25.4	224	198	-
Vert.	4824.000	PK	52.88	31.23	7.60	39.69	2.24	54.26	73.9	19.6	219	155	-
Vert.	7236.000	PK	46.03	36.60	9.35	39.48	2.24	54.74	73.9	19.1	150	0	-
Vert.	9648.000	PK	48.03	38.27	10.94	39.66	2.24	59.82	73.9	14.0	150	0	-
Vert.	2390.000	AV	35.36	27.73	14.82	39.61	2.24	40.54	53.9	13.3	138	203	*1)
Vert.	4199.998	AV	42.27	29.79	7.24	39.59	2.24	41.95	53.9	11.9	224	198	-
Vert.	4824.000	AV	48.87	31.23	7.60	39.69	2.24	50.25	53.9	**3.6**	219	155	-
Vert.	7236.000	AV	36.85	36.60	9.35	39.48	2.24	45.56	53.9	8.3	150	0	Floor noise
Vert.	9648.000	AV	37.82	38.27	10.94	39.66	2.24	49.61	53.9	4.2	150	0	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
*1) Not out of band emission (Leakage Power)

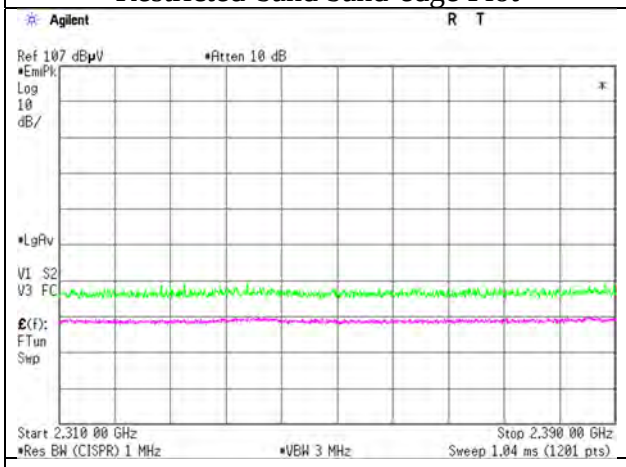
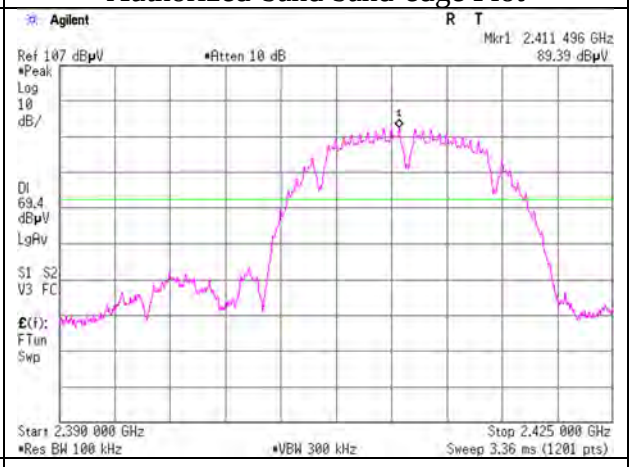
20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

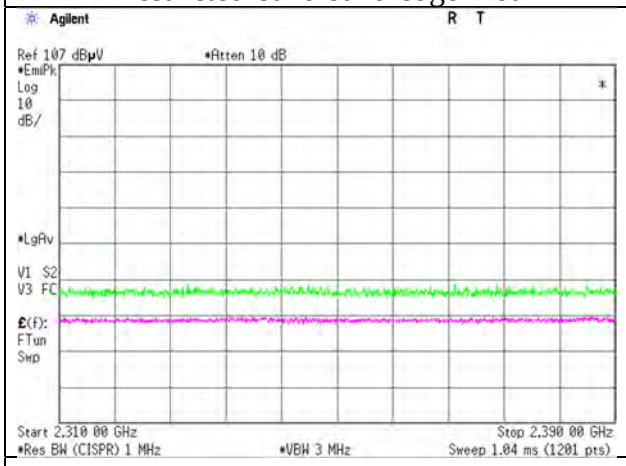
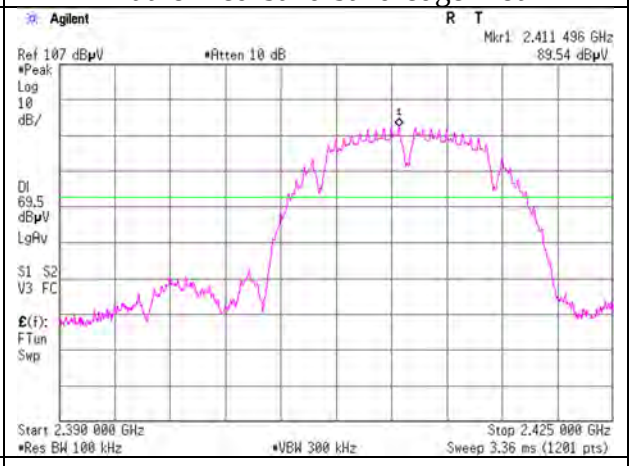
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	89.01	27.69	14.84	39.62	2.24	94.16	-	-	Carrier
Hori.	2396.993	PK	49.47	27.72	14.83	39.61	2.24	54.65	74.1	19.4	-
Hori.	2400.000	PK	42.93	27.71	14.83	39.62	2.24	48.09	74.1	26.0	-
Vert.	2412.000	PK	89.06	27.69	14.84	39.62	2.24	94.21	-	-	Carrier
Vert.	2396.982	PK	47.76	27.72	14.83	39.61	2.24	52.94	74.2	21.2	-
Vert.	2400.000	PK	42.30	27.71	14.83	39.62	2.24	47.46	74.2	26.7	-

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-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara
Mode	Tx 11b 2412 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-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	1	2	3
Date	August 31, 2021	September 2, 2021	September 3, 2021
Temperature / Humidity	24 deg.C, 56 %RH	23 deg.C, 58 %RH	23 deg.C, 60 %RH
Engineer	Yusuke Tanikawara (1 GHz -2.8 GHz)	Takahiro Suzuki (2.8 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx 11b 2437 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.	4874.000	PK	52.72	31.77	6.65	38.58	2.24	54.80	73.9	19.1	198	162	-
Hori.	7311.000	PK	46.12	37.73	8.10	39.22	2.24	54.97	73.9	18.9	150	0	-
Hori.	9748.000	PK	46.15	39.40	9.36	39.73	2.24	57.42	73.9	16.4	150	0	-
Hori.	4874.000	AV	47.32	31.77	6.65	38.58	2.24	49.40	53.9	**4.5**	198	162	-
Hori.	7311.000	AV	33.43	37.73	8.10	39.22	2.24	42.28	53.9	11.6	150	0	Floor noise
Hori.	9748.000	AV	34.28	39.40	9.36	39.73	2.24	45.55	53.9	8.3	150	0	Floor noise
Vert.	4874.000	PK	52.14	31.77	6.65	38.58	2.24	54.22	73.9	19.6	152	140	-
Vert.	7311.000	PK	45.93	37.73	8.10	39.22	2.24	54.78	73.9	19.1	150	0	-
Vert.	9748.000	PK	46.07	39.40	9.36	39.73	2.24	57.34	73.9	16.5	150	0	-
Vert.	4874.000	AV	46.38	31.77	6.65	38.58	2.24	48.46	53.9	5.4	152	140	-
Vert.	7311.000	AV	34.08	37.73	8.10	39.22	2.24	42.93	53.9	10.9	150	0	Floor noise
Vert.	9748.000	AV	34.21	39.40	9.36	39.73	2.24	45.48	53.9	8.4	150	0	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

Radiated Spurious Emission

Report No.	13722221S-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	1	2	3
Date	August 31, 2021	September 2, 2021	September 3, 2021
Temperature / Humidity	24 deg.C, 56 %RH	23 deg.C, 58 %RH	23 deg.C, 60 %RH
Engineer	Yusuke Tanikawara (1 GHz -2.8 GHz)	Takahiro Suzuki (2.8 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx 11b 2462 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.	2483.500	PK	46.53	27.61	14.93	39.64	2.24	51.67	73.9	22.2	151	76	-
Hori.	4199.956	PK	47.52	30.68	6.28	38.28	2.24	48.44	73.9	25.4	184	130	-
Hori.	4924.000	PK	49.81	31.89	6.69	38.61	2.24	52.02	73.9	21.8	179	91	-
Hori.	7386.000	PK	45.29	37.82	8.13	39.25	2.24	54.23	73.9	19.6	150	0	-
Hori.	9848.000	PK	45.75	39.55	9.41	39.75	2.24	57.20	73.9	16.7	150	0	-
Hori.	2483.500	AV	36.42	27.61	14.93	39.64	2.24	41.56	53.9	12.3	151	76	-
Hori.	4199.956	AV	35.16	30.68	6.28	38.28	2.24	36.08	53.9	17.8	184	130	-
Hori.	4924.000	AV	42.08	31.89	6.69	38.61	2.24	44.29	53.9	9.6	179	91	-
Hori.	7386.000	AV	33.98	37.82	8.13	39.25	2.24	42.92	53.9	10.9	150	0	Floor noise
Hori.	9848.000	AV	33.72	39.55	9.41	39.75	2.24	45.17	53.9	8.7	150	0	Floor noise
Vert.	2483.500	PK	45.57	27.61	14.93	39.64	2.24	50.71	73.9	23.1	239	226	-
Vert.	4199.956	PK	50.31	30.68	6.28	38.28	2.24	51.23	73.9	22.6	211	205	-
Vert.	4924.000	PK	53.01	31.89	6.69	38.61	2.24	55.22	73.9	18.6	187	151	-
Vert.	7386.000	PK	48.13	37.82	8.13	39.25	2.24	57.07	73.9	16.8	139	173	-
Vert.	9848.000	PK	46.07	39.55	9.41	39.75	2.24	57.52	73.9	16.3	150	0	-
Vert.	2483.500	AV	35.78	27.61	14.93	39.64	2.24	40.92	53.9	12.9	239	226	-
Vert.	4199.956	AV	42.14	30.68	6.28	38.28	2.24	43.06	53.9	10.8	211	205	-
Vert.	4924.000	AV	47.61	31.89	6.69	38.61	2.24	49.82	53.9	**4.0**	187	151	-
Vert.	7386.000	AV	34.76	37.82	8.13	39.25	2.24	43.70	53.9	10.2	139	173	-
Vert.	9848.000	AV	34.41	39.55	9.41	39.75	2.24	45.86	53.9	8.0	150	0	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

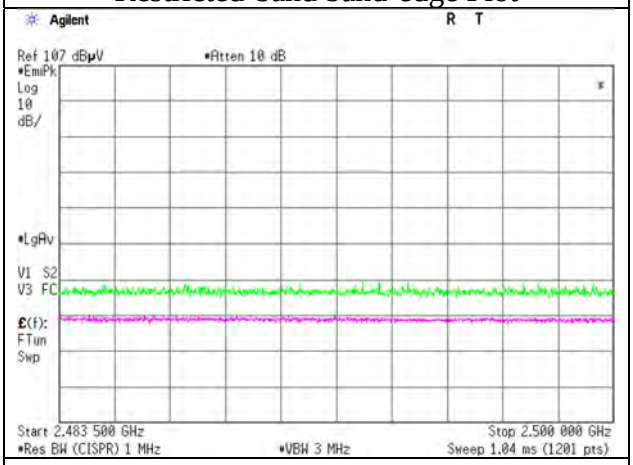
*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara
Mode	Tx 11b 2462 MHz

Horizontal

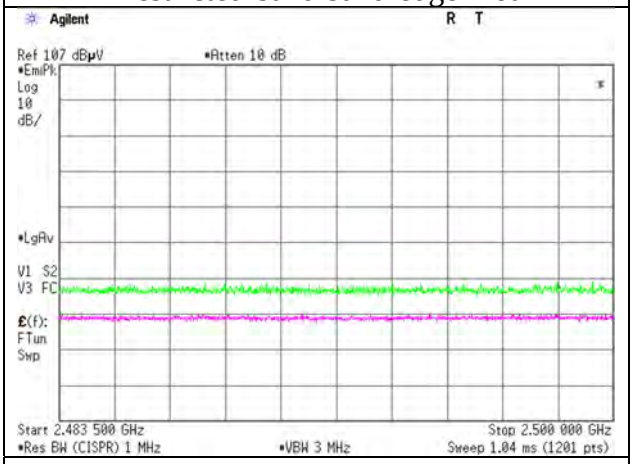
Restricted-band band-edge Plot



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-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara (1 GHz -2.8 GHz)
Mode	Tx 11g 2412 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.	2390.000	PK	53.88	27.73	14.82	39.61	2.24	59.06	73.9	14.8	153	212	-
Vert.	2390.000	PK	51.56	27.73	14.82	39.61	2.24	56.74	73.9	17.1	135	193	-

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	39.67	27.73	14.82	39.61	0.30	2.24	45.15	53.9	**8.7**	*1)
Vert.	2390.000	AV	38.27	27.73	14.82	39.61	0.30	2.24	43.75	53.9	10.1	*1)

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + 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
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

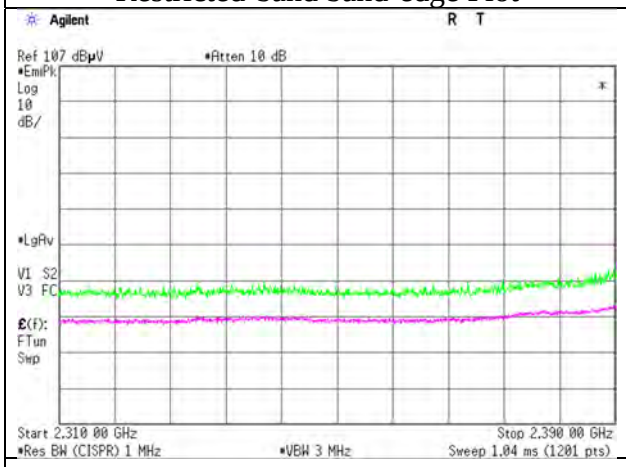
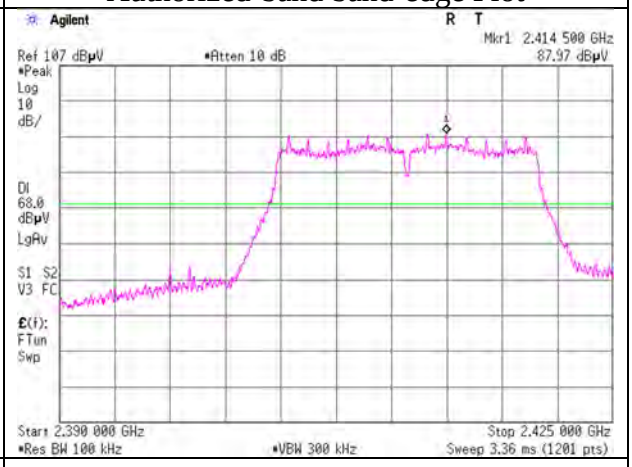
20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

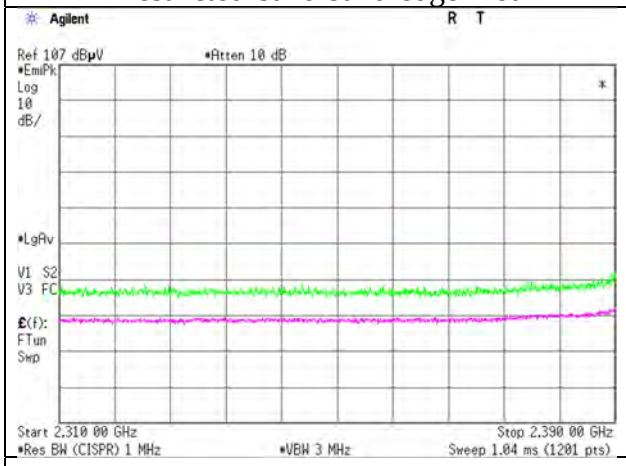
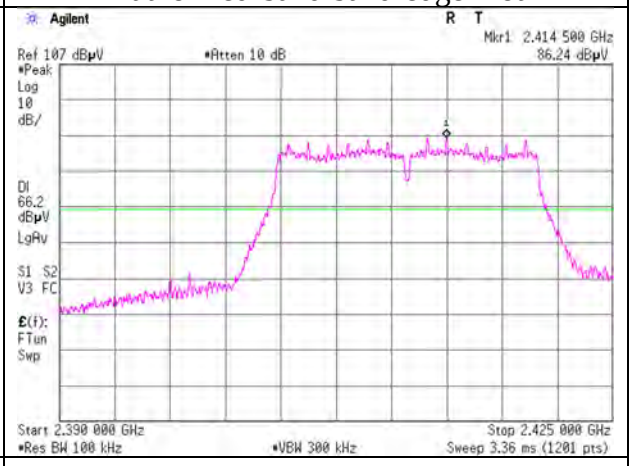
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	87.64	27.69	14.84	39.62	2.24	92.79	-	-	Carrier
Hori.	2398.260	PK	50.43	27.71	14.83	39.62	2.24	55.59	72.7	17.1	-
Hori.	2400.000	PK	46.23	27.71	14.83	39.62	2.24	51.39	72.7	21.3	-
Vert.	2412.000	PK	86.27	27.69	14.84	39.62	2.24	91.42	-	-	Carrier
Vert.	2398.249	PK	48.93	27.71	14.83	39.62	2.24	54.09	71.4	17.3	-
Vert.	2400.000	PK	45.16	27.71	14.83	39.62	2.24	50.32	71.4	21.0	-

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-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara
Mode	Tx 11g 2412 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-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara (1 GHz -2.8 GHz)
Mode	Tx 11g 2462 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.	2483.500	PK	55.65	27.61	14.93	39.64	2.24	60.79	73.9	13.1	159	73	-
Vert.	2483.500	PK	55.54	27.61	14.93	39.64	2.24	60.68	73.9	13.2	230	230	-

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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	42.46	27.61	14.93	39.64	0.30	2.24	47.90	53.9	6.0	*1)
Vert.	2483.500	AV	42.91	27.61	14.93	39.64	0.30	2.24	48.35	53.9	**5.5**	*1)

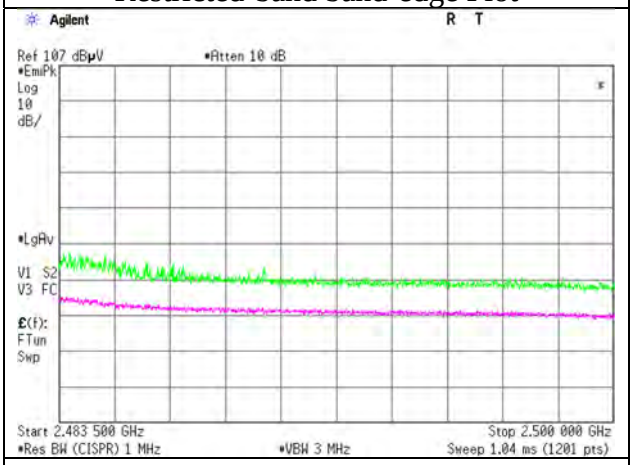
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara
Mode	Tx 11g 2462 MHz

Horizontal

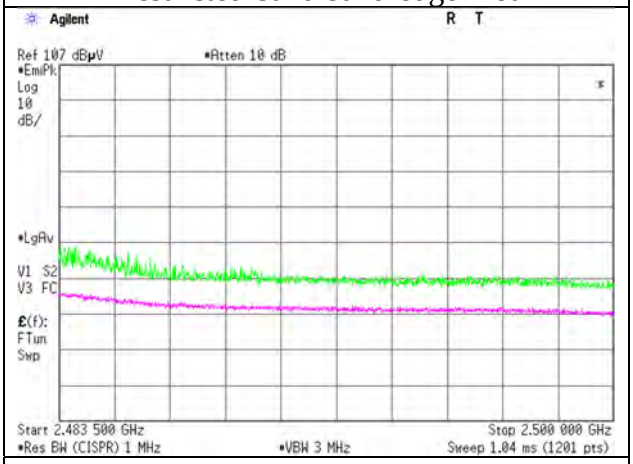
Restricted-band band-edge Plot



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-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	1	2	3
Date	August 31, 2021	September 2, 2021	September 3, 2021
Temperature / Humidity	24 deg.C, 56 %RH	23 deg.C, 58 %RH	23 deg.C, 60 %RH
Engineer	Yusuke Tanikawara (1 GHz -2.8 GHz)	Takahiro Suzuki (2.8 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx 11n-20 2412 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.	2390.000	PK	56.89	27.73	14.82	39.61	2.24	62.07	73.9	11.8	157	78	-
Hori.	4824.000	PK	49.00	31.77	6.63	38.56	2.24	51.08	73.9	22.8	228	80	-
Hori.	7236.000	PK	47.55	37.63	8.05	39.18	2.24	56.29	73.9	17.6	150	0	-
Hori.	9648.000	PK	47.35	39.10	9.32	39.71	2.24	58.30	73.9	15.6	150	0	-
Hori.	7236.000	AV	35.03	37.63	8.05	39.18	2.24	43.77	53.9	10.1	150	0	Floor noise
Hori.	9648.000	AV	34.78	39.10	9.32	39.71	2.24	45.73	53.9	8.1	150	0	Floor noise
Vert.	2390.000	PK	55.87	27.73	14.82	39.61	2.24	61.05	73.9	12.8	132	203	-
Vert.	4824.000	PK	52.99	31.77	6.63	38.56	2.24	55.07	73.9	18.8	202	157	-
Vert.	7236.000	PK	47.36	37.63	8.05	39.18	2.24	56.10	73.9	17.8	150	0	-
Vert.	9648.000	PK	48.39	39.10	9.32	39.71	2.24	59.34	73.9	14.5	150	0	-
Vert.	7236.000	AV	34.49	37.63	8.05	39.18	2.24	43.23	53.9	10.6	150	0	Floor noise
Vert.	9648.000	AV	35.07	39.10	9.32	39.71	2.24	46.02	53.9	7.8	150	0	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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	42.03	27.73	14.82	39.61	0.34	2.24	47.55	53.9	**6.3**	*1)
Hori.	4824.000	AV	36.42	31.77	6.63	38.56	0.34	2.24	38.84	53.9	15.0	-
Vert.	2390.000	AV	41.62	27.73	14.82	39.61	0.34	2.24	47.14	53.9	6.7	*1)
Vert.	4824.000	AV	39.12	31.77	6.63	38.56	0.34	2.24	41.54	53.9	12.3	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + 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
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

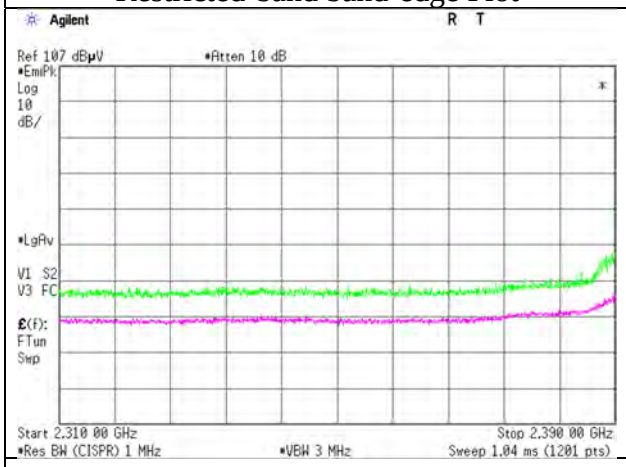
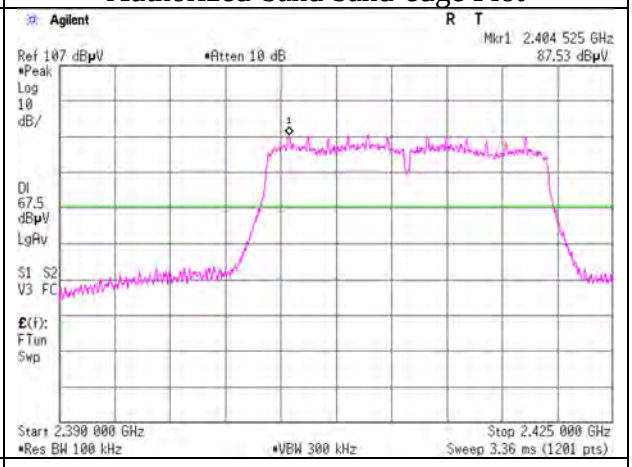
20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

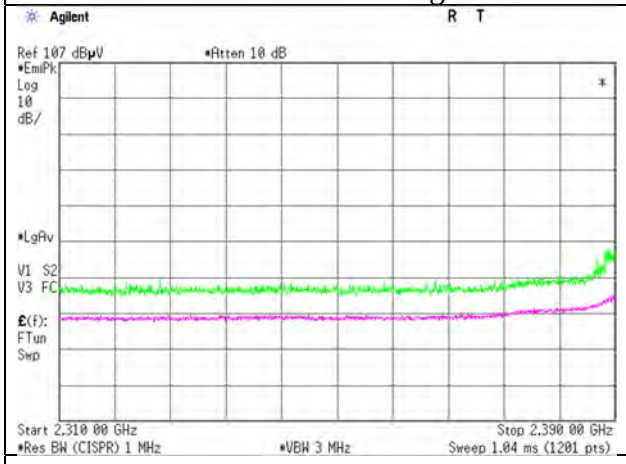
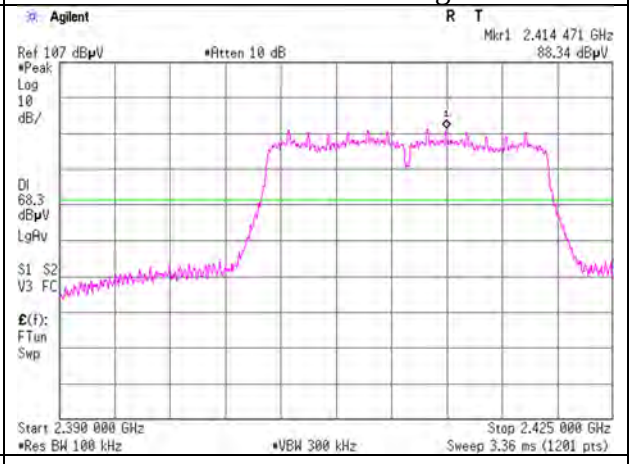
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	87.19	27.69	14.84	39.62	2.24	92.34	-	-	Carrier
Hori.	2398.266	PK	50.65	27.71	14.83	39.62	2.24	55.81	72.3	16.4	-
Hori.	2400.000	PK	49.23	27.71	14.83	39.62	2.24	54.39	72.3	17.9	-
Vert.	2412.000	PK	87.97	27.69	14.84	39.62	2.24	93.12	-	-	Carrier
Vert.	2396.973	PK	50.93	27.72	14.83	39.61	2.24	56.11	73.1	16.9	-
Vert.	2400.000	PK	49.55	27.71	14.83	39.62	2.24	54.71	73.1	18.3	-

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-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara
Mode	Tx 11n-20 2412 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-A-R1		
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	1	2	3
Date	August 31, 2021	September 2, 2021	September 3, 2021
Temperature / Humidity	24 deg.C, 56 %RH	23 deg.C, 58 %RH	23 deg.C, 60 %RH
Engineer	Yusuke Tanikawara (1 GHz -2.8 GHz)	Takahiro Suzuki (2.8 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx 11n-20 2437 MHz		

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.	4874.000	PK	49.07	31.77	6.65	38.58	2.24	51.15	73.9	22.7	180	79	-
Hori.	7311.000	PK	45.51	37.73	8.10	39.22	2.24	54.36	73.9	19.5	150	0	-
Hori.	9748.000	PK	45.81	39.40	9.36	39.73	2.24	57.08	73.9	16.8	150	0	-
Hori.	7311.000	AV	34.26	37.73	8.10	39.22	2.24	43.11	53.9	10.7	150	0	Floor noise
Hori.	9748.000	AV	34.35	39.40	9.36	39.73	2.24	45.62	53.9	8.2	150	0	Floor noise
Vert.	4874.000	PK	52.37	31.77	6.65	38.58	2.24	54.45	73.9	19.4	234	155	-
Vert.	7311.000	PK	46.59	37.73	8.10	39.22	2.24	55.44	73.9	18.4	150	0	-
Vert.	9748.000	PK	45.65	39.40	9.36	39.73	2.24	56.92	73.9	16.9	150	0	-
Vert.	7311.000	AV	33.64	37.73	8.10	39.22	2.24	42.49	53.9	11.4	150	0	Floor noise
Vert.	9748.000	AV	35.11	39.40	9.36	39.73	2.24	46.38	53.9	**7.5**	150	0	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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4874.000	AV	35.67	31.77	6.65	38.58	0.34	2.24	38.09	53.9	15.8	-
Vert.	4874.000	AV	38.86	31.77	6.65	38.58	0.34	2.24	41.28	53.9	12.6	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + 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
Duty factor refer to "Burst rate confirmation" sheet.

Radiated Spurious Emission

Report No.	13722221S-A-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	1	2	3
Date	August 22, 2021	August 31, 2021	September 2, 2021	September 3, 2021
Temperature / Humidity	25 deg.C, 54 %RH	24 deg.C, 56 %RH	23 deg.C, 58 %RH	23 deg.C, 60 %RH
Engineer	Hiromasa Sato	Yusuke Tanikawara	Takahiro Suzuki	Takahiro Kawakami
	(30 MHz -1 GHz)	(1 GHz -2.8 GHz)	(2.8 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx 11n-20 2462 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	42.40	13.85	7.39	32.11	0.00	31.53	43.5	11.9	237	280	-
Hori.	199.999	QP	38.80	16.50	7.86	32.05	0.00	31.11	43.5	12.3	165	83	-
Hori.	259.800	QP	47.80	12.44	8.35	31.98	0.00	36.61	46.0	9.3	141	163	-
Hori.	399.998	QP	49.10	15.92	9.06	31.94	0.00	42.14	46.0	**3.8**	115	185	-
Hori.	445.496	QP	43.30	16.49	9.28	31.93	0.00	37.14	46.0	8.8	100	168	-
Hori.	688.125	QP	36.30	19.77	10.24	31.85	0.00	34.46	46.0	11.5	100	339	-
Hori.	712.700	QP	41.10	19.99	10.33	31.81	0.00	39.61	46.0	6.3	100	183	-
Hori.	844.344	QP	35.60	21.35	10.77	31.35	0.00	36.37	46.0	9.6	151	297	-
Hori.	2483.500	PK	56.33	27.61	14.93	39.64	2.24	61.47	73.9	12.4	293	79	-
Hori.	4199.938	PK	47.66	30.68	6.28	38.28	2.24	48.58	73.9	25.3	182	133	-
Hori.	4924.000	PK	48.05	31.89	6.69	38.61	2.24	50.26	73.9	23.6	159	76	-
Hori.	7386.000	PK	46.92	37.82	8.13	39.25	2.24	55.86	73.9	18.0	151	306	-
Hori.	9848.000	PK	47.47	39.55	9.41	39.75	2.24	58.92	73.9	14.9	150	0	-
Hori.	4199.938	AV	35.37	30.68	6.28	38.28	2.24	36.29	53.9	17.6	182	133	-
Hori.	9848.000	AV	34.16	39.55	9.41	39.75	2.24	45.61	53.9	8.2	150	0	Floor noise
Vert.	129.899	QP	42.50	13.85	7.39	32.11	0.00	31.63	43.5	11.8	100	67	-
Vert.	399.996	QP	44.80	15.92	9.06	31.94	0.00	37.84	46.0	8.1	159	183	-
Vert.	688.125	QP	37.40	19.77	10.24	31.85	0.00	35.56	46.0	10.4	157	358	-
Vert.	799.992	QP	36.00	20.74	10.61	31.55	0.00	35.80	46.0	10.2	159	196	-
Vert.	2483.500	PK	57.25	27.61	14.93	39.64	2.24	62.39	73.9	11.5	128	201	-
Vert.	4199.938	PK	50.94	30.68	6.28	38.28	2.24	51.86	73.9	22.0	208	198	-
Vert.	4924.000	PK	51.53	31.89	6.69	38.61	2.24	53.74	73.9	20.1	189	149	-
Vert.	7386.000	PK	51.93	37.82	8.13	39.25	2.24	60.87	73.9	13.0	131	167	-
Vert.	9848.000	PK	46.73	39.55	9.41	39.75	2.24	58.18	73.9	15.7	150	0	-
Vert.	4199.938	AV	42.26	30.68	6.28	38.28	2.24	43.18	53.9	10.7	208	198	-
Vert.	9848.000	AV	34.22	39.55	9.41	39.75	2.24	45.67	53.9	8.2	150	0	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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	42.98	27.61	14.93	39.64	0.34	2.24	48.46	53.9	5.4	*1)
Hori.	4924.000	AV	35.09	31.89	6.69	38.61	0.34	2.24	37.64	53.9	16.2	-
Hori.	7386.000	AV	34.26	37.82	8.13	39.25	0.34	2.24	43.54	53.9	10.3	-
Vert.	2483.500	AV	43.99	27.61	14.93	39.64	0.34	2.24	49.47	53.9	4.4	*1)
Vert.	4924.000	AV	38.58	31.89	6.69	38.61	0.34	2.24	41.13	53.9	12.7	-
Vert.	7386.000	AV	38.49	37.82	8.13	39.25	0.34	2.24	47.77	53.9	6.1	-

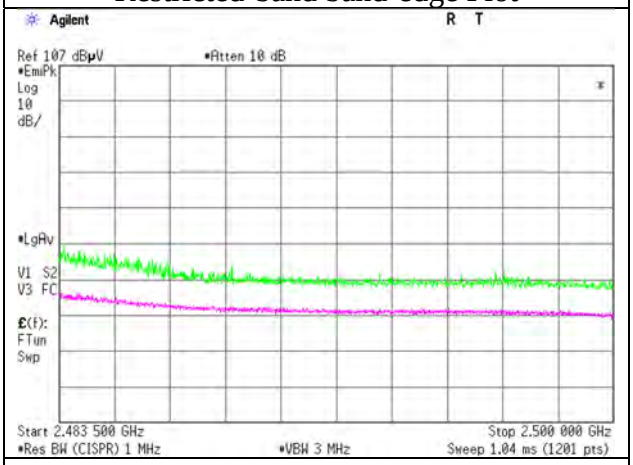
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	1
Date	August 31, 2021
Temperature / Humidity	24 deg.C, 56 %RH
Engineer	Yusuke Tanikawara
Mode	Tx 11n-20 2462 MHz

Horizontal

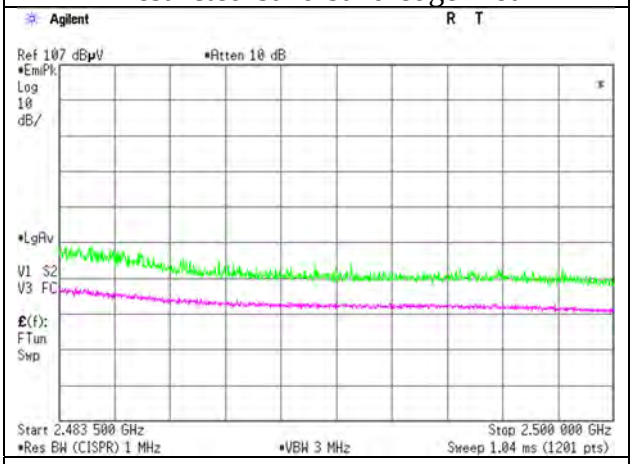
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

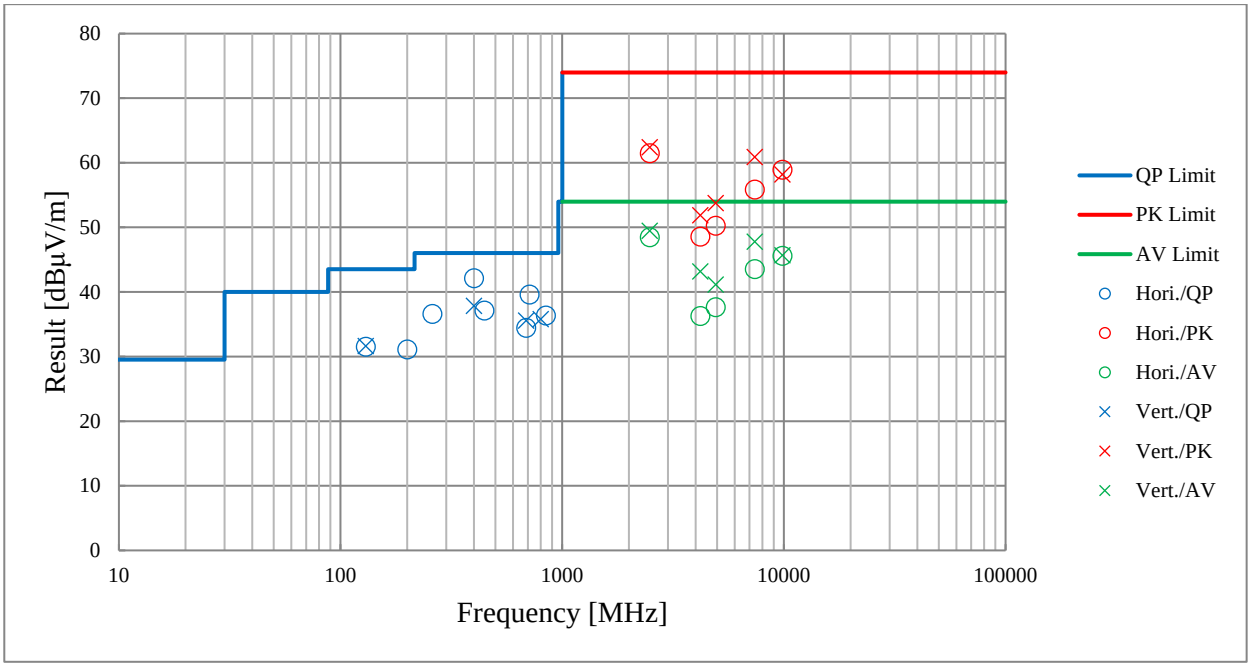


Trace Green : Peak Plot
Trace Purple : Average Plot

* 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-A-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	1	2	3
Date	August 22, 2021	August 31, 2021	September 2, 2021	September 3, 2021
Temperature / Humidity	25 deg.C, 54 %RH	24 deg.C, 56 %RH	23 deg.C, 58 %RH	23 deg.C, 60 %RH
Engineer	Hiromasa Sato (30 MHz -1 GHz)	Yusuke Tanikawara (1 GHz -2.8 GHz)	Takahiro Suzuki (2.8 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx 11n-20 2462 MHz			



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

Radiated Spurious Emission

Report No.	13722221S-A-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 22, 2021	August 17, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	25 deg.C, 54 %RH	23 deg.C, 63 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Hiromasa Sato	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 BT LE 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.	129.901	QP	42.70	13.85	7.39	32.11	0.00	31.83	43.5	11.6	235	231	-
Hori.	199.999	QP	38.00	16.50	7.86	32.05	0.00	30.31	43.5	13.1	166	82	-
Hori.	259.800	QP	48.00	12.44	8.35	31.98	0.00	36.81	46.0	9.1	141	164	-
Hori.	399.996	QP	47.70	15.92	9.06	31.94	0.00	40.74	46.0	**5.2**	115	181	-
Hori.	445.495	QP	43.60	16.49	9.28	31.93	0.00	37.44	46.0	8.5	100	170	-
Hori.	688.126	QP	36.30	19.77	10.24	31.85	0.00	34.46	46.0	11.5	100	338	-
Hori.	712.695	QP	41.00	19.99	10.33	31.81	0.00	39.51	46.0	6.4	100	185	-
Hori.	737.207	QP	35.50	20.20	10.40	31.77	0.00	34.33	46.0	11.6	154	223	-
Hori.	844.345	QP	35.60	21.35	10.77	31.35	0.00	36.37	46.0	9.6	149	295	-
Hori.	2390.000	PK	47.67	28.33	14.42	41.62	2.24	51.04	73.9	22.8	154	129	-
Hori.	4804.000	PK	48.91	31.77	6.88	42.89	2.24	46.91	73.9	26.9	164	296	-
Hori.	7206.000	PK	48.46	37.37	8.25	43.39	2.24	52.93	73.9	20.9	150	0	-
Hori.	9608.000	PK	49.02	39.12	9.45	43.18	2.24	56.65	73.9	17.2	150	0	-
Hori.	7206.000	AV	39.82	37.37	8.25	43.39	2.24	44.29	53.9	9.6	150	0	Floor noise
Hori.	9608.000	AV	39.87	39.12	9.45	43.18	2.24	47.50	53.9	6.4	150	0	Floor noise
Vert.	129.902	QP	43.20	13.85	7.39	32.11	0.00	32.33	43.5	11.1	100	66	-
Vert.	399.998	QP	44.60	15.92	9.06	31.94	0.00	37.64	46.0	8.3	157	185	-
Vert.	712.700	QP	37.90	19.99	10.33	31.81	0.00	36.41	46.0	9.5	168	0	-
Vert.	2390.000	PK	50.42	28.33	14.42	41.62	2.24	53.79	73.9	20.1	302	157	-
Vert.	4200.000	PK	52.11	30.36	6.58	42.51	2.24	48.78	73.9	25.1	194	202	-
Vert.	4804.000	PK	48.82	31.77	6.88	42.89	2.24	46.82	73.9	27.0	157	188	-
Vert.	7206.000	PK	48.19	37.37	8.25	43.39	2.24	52.66	73.9	21.2	150	0	-
Vert.	9608.000	PK	49.28	39.12	9.45	43.18	2.24	56.91	73.9	16.9	150	0	-
Vert.	4200.000	AV	45.69	30.36	6.58	42.51	2.24	42.36	53.9	11.5	194	202	-
Vert.	7206.000	AV	39.35	37.37	8.25	43.39	2.24	43.82	53.9	10.0	150	0	Floor noise
Vert.	9608.000	AV	39.99	39.12	9.45	43.18	2.24	47.62	53.9	6.2	150	0	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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	38.12	28.33	14.42	41.62	4.09	2.24	45.58	53.9	8.3	*1)
Hori.	4804.000	AV	39.50	31.77	6.88	42.89	4.09	2.24	41.59	53.9	12.3	-
Vert.	2390.000	AV	37.39	28.33	14.42	41.62	4.09	2.24	44.85	53.9	9.0	*1)
Vert.	4804.000	AV	40.06	31.77	6.88	42.89	4.09	2.24	42.15	53.9	11.7	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + 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
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

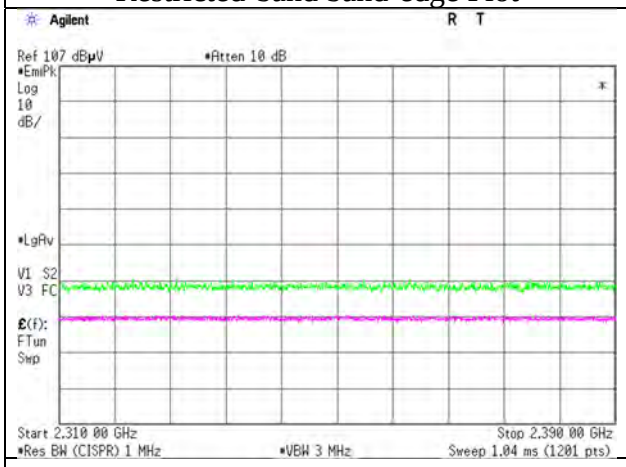
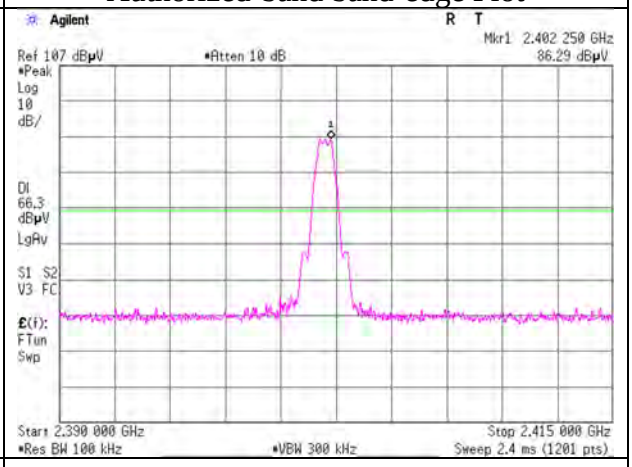
20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

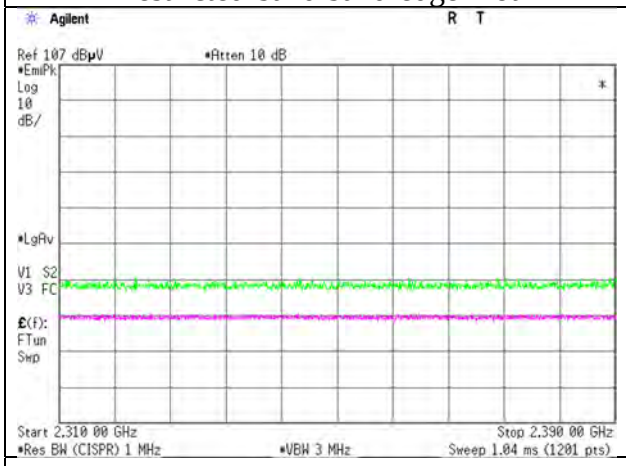
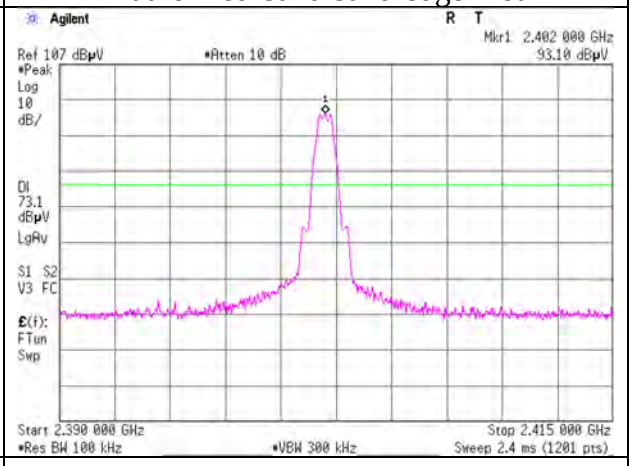
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	86.40	28.31	14.44	41.63	2.24	89.76	-	-	Carrier
Hori.	2400.000	PK	42.37	28.31	14.44	41.63	2.24	45.73	69.7	23.9	-
Vert.	2402.000	PK	93.47	28.31	14.44	41.63	2.24	96.83	-	-	Carrier
Vert.	2400.000	PK	46.09	28.31	14.44	41.63	2.24	49.45	76.8	27.3	-

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-A-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 BT LE 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-A-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 22, 2021	August 24, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	25 deg.C, 54 %RH	24 deg.C, 57 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Hiromasa Sato (30 MHz -1 GHz)	Takahiro Kawakami (1 GHz -2.8 GHz)	Yasumasa Owaki (2.8 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx BT LE 2440 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.	129.900	QP	43.00	13.85	7.39	32.11	0.00	32.13	43.5	11.3	235	281	-
Hori.	199.999	QP	40.80	16.50	7.86	32.05	0.00	33.11	43.5	10.3	167	86	-
Hori.	259.799	QP	48.00	12.44	8.35	31.98	0.00	36.81	46.0	9.1	142	163	-
Hori.	399.998	QP	47.30	15.92	9.06	31.94	0.00	40.34	46.0	5.6	115	184	-
Hori.	445.493	QP	43.80	16.49	9.28	31.93	0.00	37.64	46.0	8.3	100	168	-
Hori.	663.551	QP	39.10	19.33	10.13	31.90	0.00	36.66	46.0	9.3	100	336	-
Hori.	712.643	QP	42.60	19.99	10.33	31.81	0.00	41.11	46.0	**4.8**	100	181	-
Hori.	4880.000	PK	48.61	31.87	6.93	42.89	2.24	46.76	73.9	27.1	191	233	-
Hori.	7320.000	PK	48.45	37.53	8.32	43.52	2.24	53.02	73.9	20.8	150	0	-
Hori.	9760.000	PK	47.60	39.41	9.51	42.98	2.24	55.78	73.9	18.1	150	0	-
Hori.	7320.000	AV	39.07	37.53	8.32	43.52	2.24	43.64	53.9	10.2	150	0	Floor noise
Hori.	9760.000	AV	38.76	39.41	9.51	42.98	2.24	46.94	53.9	6.9	150	0	Floor noise
Vert.	129.902	QP	42.80	13.85	7.39	32.11	0.00	31.93	43.5	11.5	100	69	-
Vert.	399.999	QP	44.00	15.92	9.06	31.94	0.00	37.04	46.0	8.9	157	189	-
Vert.	712.700	QP	39.40	19.99	10.33	31.81	0.00	37.91	46.0	8.0	167	1	-
Vert.	881.107	QP	33.50	21.92	10.88	31.14	0.00	35.16	46.0	10.8	100	357	-
Vert.	891.001	QP	31.80	21.95	10.90	31.08	0.00	33.57	46.0	12.4	100	356	-
Vert.	4200.000	PK	51.77	30.36	6.58	42.51	2.24	48.44	73.9	25.4	194	203	-
Vert.	4880.000	PK	48.79	31.87	6.93	42.89	2.24	46.94	73.9	26.9	154	186	-
Vert.	7320.000	PK	47.84	37.53	8.32	43.52	2.24	52.41	73.9	21.4	150	0	-
Vert.	9760.000	PK	47.39	39.41	9.51	42.98	2.24	55.57	73.9	18.3	150	0	-
Vert.	4200.000	AV	45.32	30.36	6.58	42.51	2.24	41.99	53.9	11.9	194	203	-
Vert.	7320.000	AV	38.65	37.53	8.32	43.52	2.24	43.22	53.9	10.6	150	0	Floor noise
Vert.	9760.000	AV	38.57	39.41	9.51	42.98	2.24	46.75	53.9	7.1	150	0	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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	39.02	31.87	6.93	42.89	4.09	2.24	41.26	53.9	12.6	-
Vert.	4880.000	AV	39.70	31.87	6.93	42.89	4.09	2.24	41.94	53.9	11.9	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + 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
Duty factor refer to "Burst rate confirmation" sheet.

Radiated Spurious Emission

Report No.	13722221S-A-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 22, 2021	August 24, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	25 deg.C, 54 %RH	24 deg.C, 57 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Hiromasa Sato	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 BT LE 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.	129.901	QP	43.50	13.85	7.39	32.11	0.00	32.63	43.5	10.8	232	269	-
Hori.	199.999	QP	41.10	16.50	7.86	32.05	0.00	33.41	43.5	10.0	164	80	-
Hori.	259.800	QP	47.80	12.44	8.35	31.98	0.00	36.61	46.0	9.3	140	166	-
Hori.	399.997	QP	47.50	15.92	9.06	31.94	0.00	40.54	46.0	**5.4**	117	184	-
Hori.	445.498	QP	43.50	16.49	9.28	31.93	0.00	37.34	46.0	8.6	100	167	-
Hori.	638.972	QP	37.50	19.24	10.03	31.92	0.00	34.85	46.0	11.1	100	346	-
Hori.	712.697	QP	40.40	19.99	10.33	31.81	0.00	38.91	46.0	7.0	100	66	-
Hori.	844.339	QP	35.70	21.35	10.77	31.35	0.00	36.47	46.0	9.5	152	297	-
Hori.	2483.500	PK	53.90	28.24	14.52	41.65	2.24	57.25	73.9	16.6	400	149	-
Hori.	4960.000	PK	47.49	32.14	6.99	42.89	2.24	45.97	73.9	27.9	185	226	-
Hori.	7440.000	PK	47.82	37.62	8.37	43.65	2.24	52.40	73.9	21.5	150	0	-
Hori.	9920.000	PK	46.88	39.30	9.59	42.77	2.24	55.24	73.9	18.6	150	0	-
Hori.	7440.000	AV	38.80	37.62	8.37	43.65	2.24	43.38	53.9	10.5	150	0	Floor noise
Hori.	9920.000	AV	37.69	39.30	9.59	42.77	2.24	46.05	53.9	7.8	150	0	Floor noise
Vert.	129.900	QP	43.10	13.85	7.39	32.11	0.00	32.23	43.5	11.2	100	69	-
Vert.	399.998	QP	44.00	15.92	9.06	31.94	0.00	37.04	46.0	8.9	156	184	-
Vert.	712.703	QP	37.20	19.99	10.33	31.81	0.00	35.71	46.0	10.2	167	3	-
Vert.	881.107	QP	33.40	21.92	10.88	31.14	0.00	35.06	46.0	10.9	100	358	-
Vert.	2483.500	PK	59.17	28.24	14.52	41.65	2.24	62.52	73.9	11.3	221	166	-
Vert.	2488.065	PK	53.78	28.24	14.52	41.66	2.24	57.12	73.9	16.7	221	166	-
Vert.	4200.000	PK	52.03	30.36	6.58	42.51	2.24	48.70	73.9	25.2	194	201	-
Vert.	4960.000	PK	47.81	32.14	6.99	42.89	2.24	46.29	73.9	27.6	150	186	-
Vert.	7440.000	PK	48.23	37.62	8.37	43.65	2.24	52.81	73.9	21.0	150	0	-
Vert.	9920.000	PK	46.95	39.30	9.59	42.77	2.24	55.31	73.9	18.5	150	0	-
Vert.	4200.000	AV	46.01	30.36	6.58	42.51	2.24	42.68	53.9	11.2	194	201	-
Vert.	7440.000	AV	38.82	37.62	8.37	43.65	2.24	43.40	53.9	10.5	150	0	Floor noise
Vert.	9920.000	AV	37.61	39.30	9.59	42.77	2.24	45.97	53.9	7.9	150	0	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

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	38.51	28.24	14.52	41.65	4.09	2.24	45.95	53.9	7.9	*1)
Hori.	4960.000	AV	38.75	32.14	6.99	42.89	4.09	2.24	41.32	53.9	12.5	-
Vert.	2483.500	AV	40.13	28.24	14.52	41.65	4.09	2.24	47.57	53.9	6.3	*1)
Vert.	2488.065	AV	39.79	28.24	14.52	41.66	4.09	2.24	47.22	53.9	6.6	*1)
Vert.	4960.000	AV	38.02	32.14	6.99	42.89	4.09	2.24	40.59	53.9	13.3	-

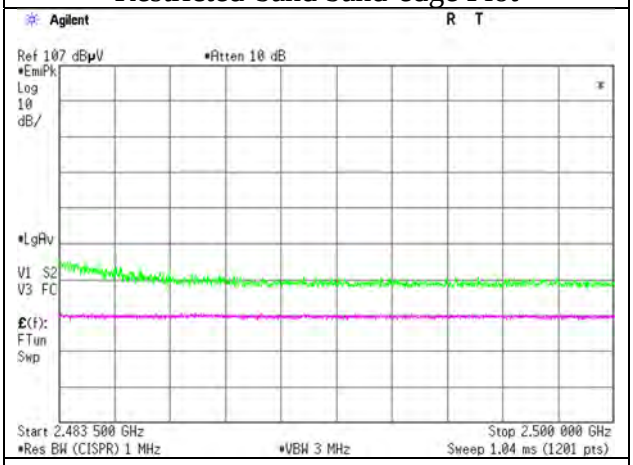
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.88 m / 3.0 m) = 2.24 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	3
Date	August 24, 2021
Temperature / Humidity	24 deg.C, 57 %RH
Engineer	Takahiro Kawakami
Mode	Tx BT LE 2480 MHz

Horizontal

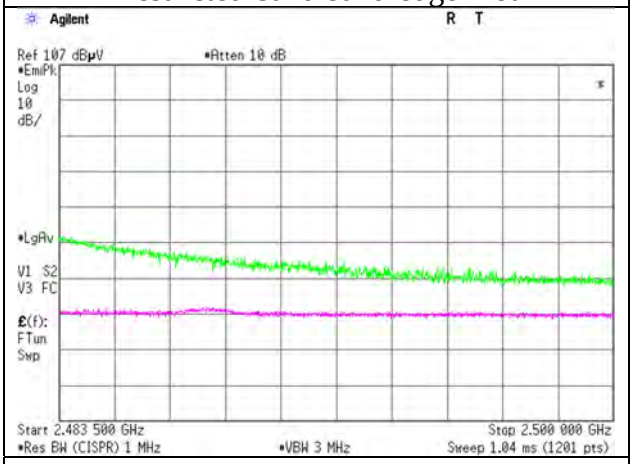
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

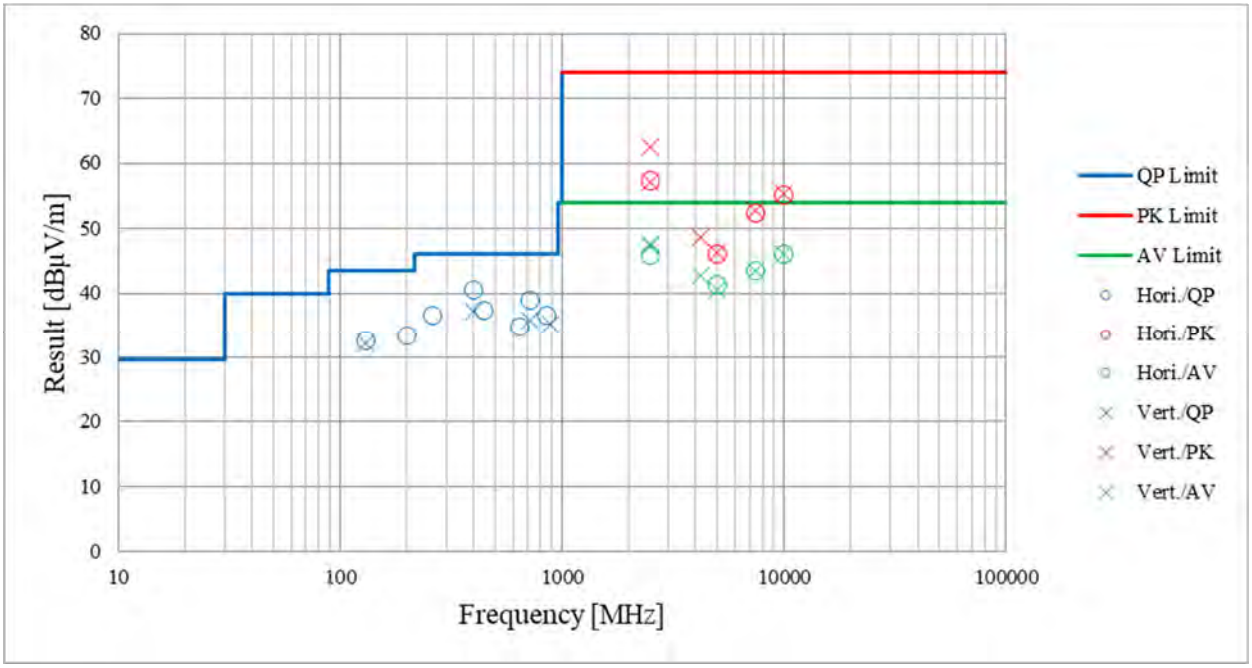


Trace Green : Peak Plot
Trace Purple : Average Plot

* 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-A-R1			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	3	3	3	3
Date	August 22, 2021	August 24, 2021	August 29, 2021	August 31, 2021
Temperature / Humidity	25 deg.C, 54 %RH	24 deg.C, 57 %RH	21 deg.C, 57 %RH	23 deg.C, 62 %RH
Engineer	Hiromasa Sato (30 MHz -1 GHz)	Takahiro Kawakami (1 GHz -2.8 GHz)	Yasumasa Owaki (2.8 GHz -10 GHz)	Takahiro Kawakami (10 GHz -26.5 GHz)
Mode	Tx BT LE 2480 MHz			

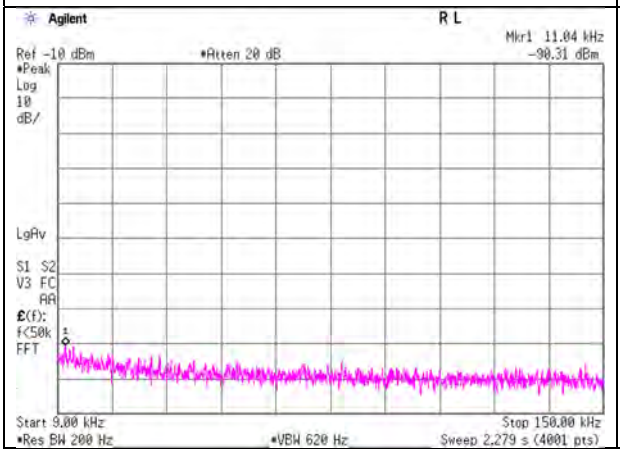


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

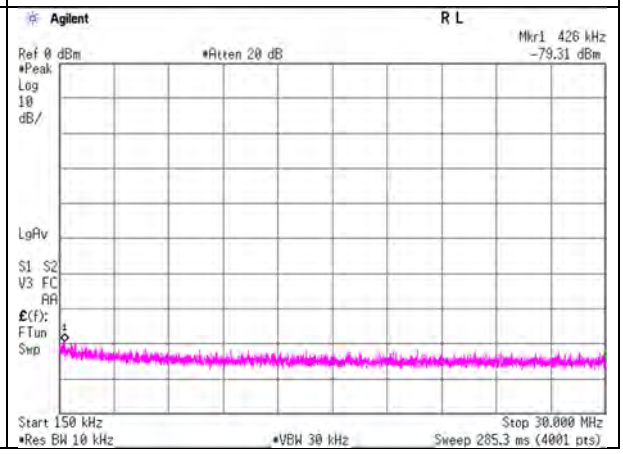
Conducted Spurious Emission

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 18, 2021
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Yosuke Murakami
Mode	Tx 11n-20 2462 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.04	-90.3	0.01	9.9	2.0	1	-78.4	300	6.0	-17.2	46.7	63.9	-
426.00	-79.3	0.01	9.9	2.0	1	-67.4	300	6.0	-6.2	15.0	21.2	-

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

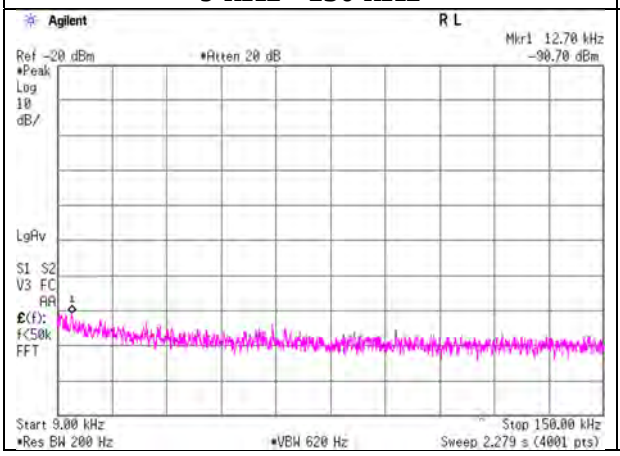
N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

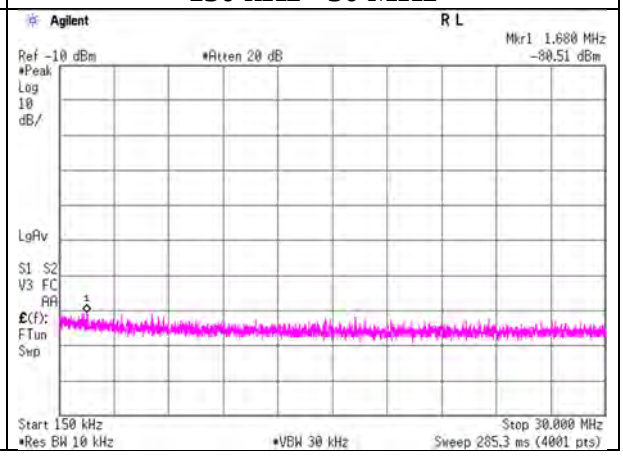
Conducted Spurious Emission

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 13, 2021
Temperature / Humidity	26 deg. C / 46 % RH
Engineer	Shunsaku Yumi
Mode	Tx BT LE 2402 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12.70	-90.7	0.01	9.9	2.0	1	-78.8	300	6.0	-17.6	45.5	63.1	-
1680.00	-80.5	0.02	9.9	2.0	1	-68.6	30	6.0	12.6	23.0	10.4	-

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

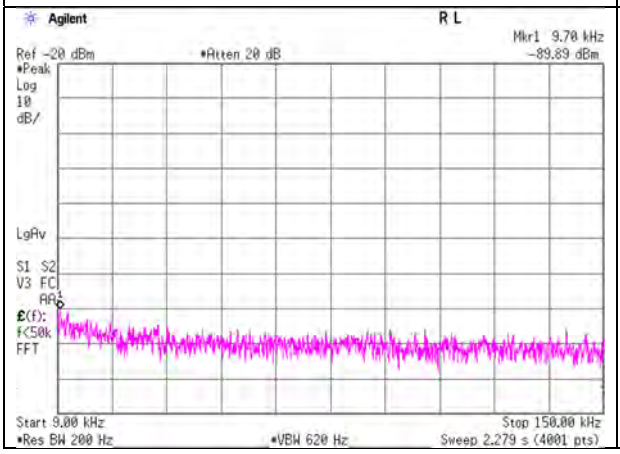
N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

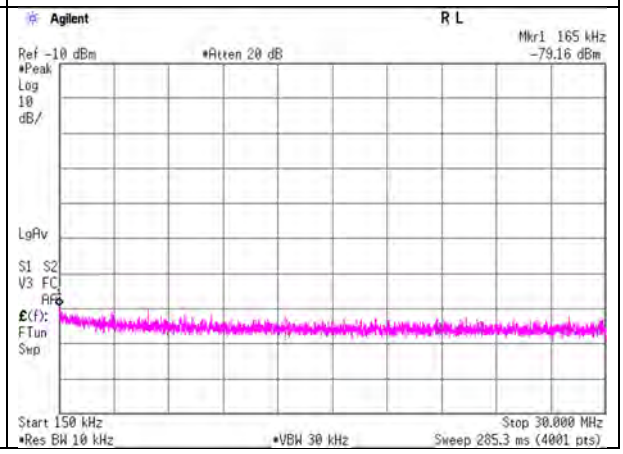
Conducted Spurious Emission

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 13, 2021
Temperature / Humidity	26 deg. C / 46 % RH
Engineer	Shunsaku Yumi
Mode	Tx BT LE 2440 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.70	-89.9	0.01	9.9	2.0	1	-78.0	300	6.0	-16.8	47.8	64.6	-
165.00	-79.2	0.01	9.9	2.0	1	-67.3	300	6.0	-6.0	23.2	29.2	-

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

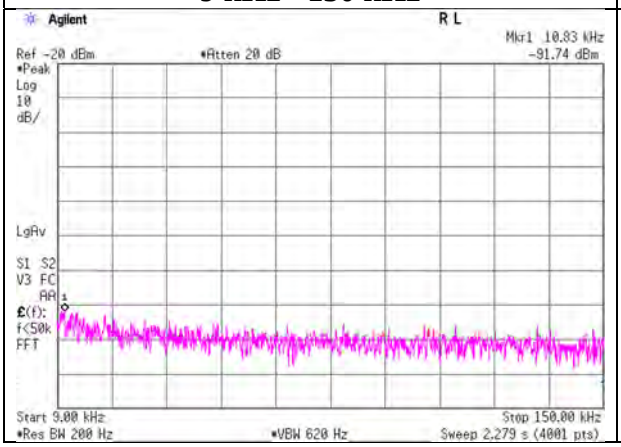
N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

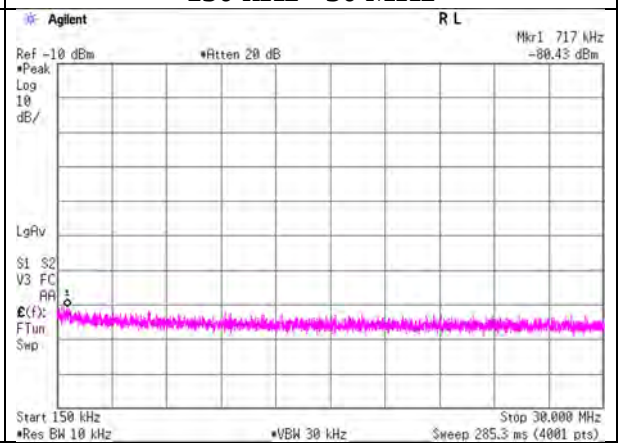
Conducted Spurious Emission

Report No.	13722221S-A-R1
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	August 13, 2021
Temperature / Humidity	26 deg. C / 46 % RH
Engineer	Shunsaku Yumi
Mode	Tx BT LE 2480 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.83	-91.7	0.01	9.9	2.0	1	-79.9	300	6.0	-18.6	46.9	65.5	-
717.00	-80.4	0.01	9.9	2.0	1	-68.6	30	6.0	12.7	30.4	17.7	-

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Power Density

Report No.	13722221S-A-R1	
Test place	Shonan EMC Lab. No.5 Shielded Room	
Date	August 17, 2021	August 31, 2021
Temperature / Humidity	24 deg. C / 60 % RH	24 deg. C / 53 % RH
Engineer	Yosuke Murakami	Takahiro Kawakami
Mode	Tx	

11b

Freq. [MHz]	Reading dBm / 3 kHz	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2412	-24.15	1.65	9.94	-12.56	8.00	20.56
2437	-23.34	1.66	9.94	-11.74	8.00	19.74
2462	-22.56	1.66	9.94	-10.96	8.00	18.96

11g

Freq. [MHz]	Reading dBm / 3 kHz	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2412	-25.36	1.65	9.94	-13.77	8.00	21.77
2437	-25.41	1.66	9.94	-13.81	8.00	21.81
2462	-24.81	1.66	9.94	-13.21	8.00	21.21

11n-20

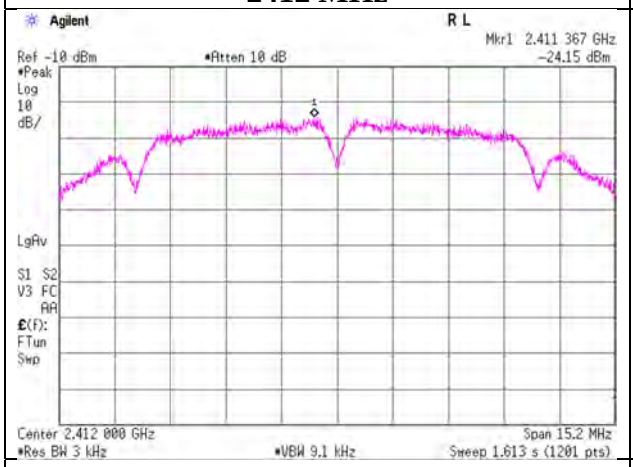
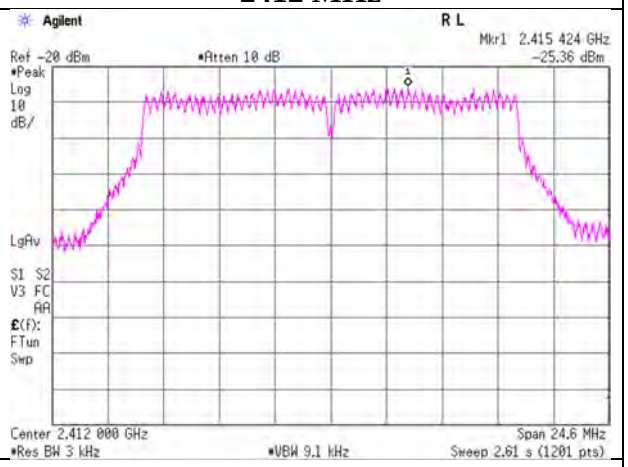
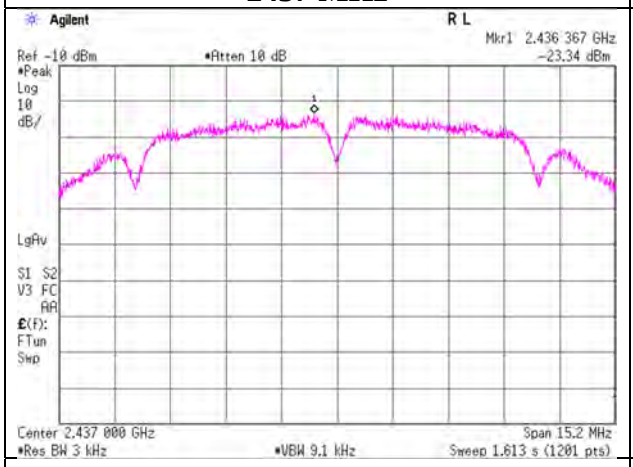
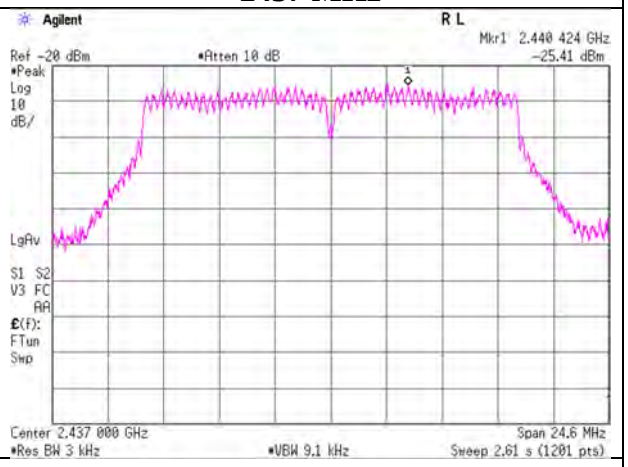
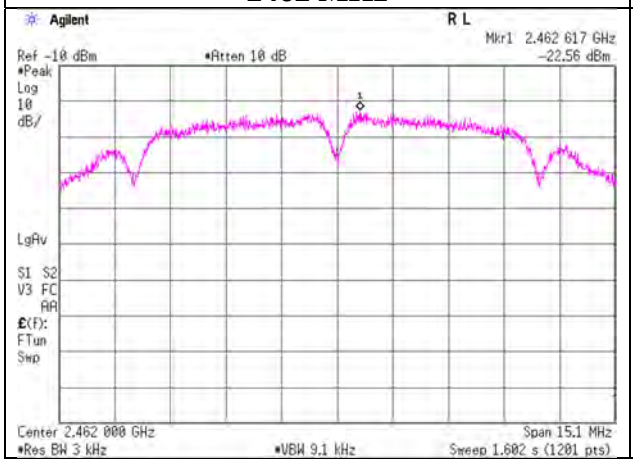
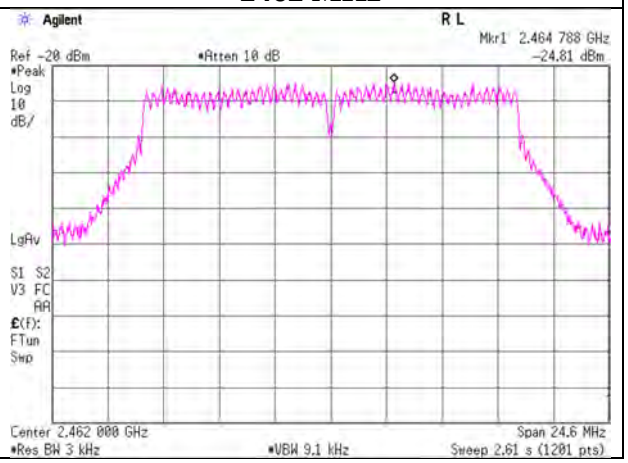
Freq. [MHz]	Reading dBm / 3 kHz	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2412	-24.64	1.65	9.94	-13.05	8.00	21.05
2437	-24.02	1.66	9.94	-12.42	8.00	20.42
2462	-22.28	1.66	9.94	-10.68	8.00	18.68

BT LE

Freq. [MHz]	Reading dBm / 3 kHz	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2402	-23.63	1.65	9.94	-12.04	8.00	20.04
2440	-23.61	1.66	9.94	-12.01	8.00	20.01
2480	-23.24	1.66	9.94	-11.64	8.00	19.64

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

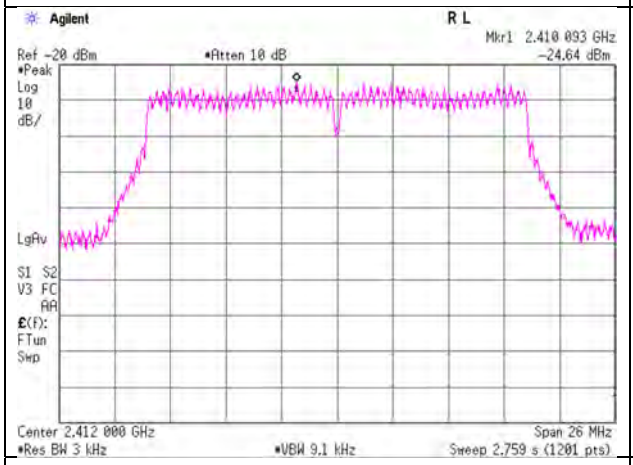
Power Density

11b	11g
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

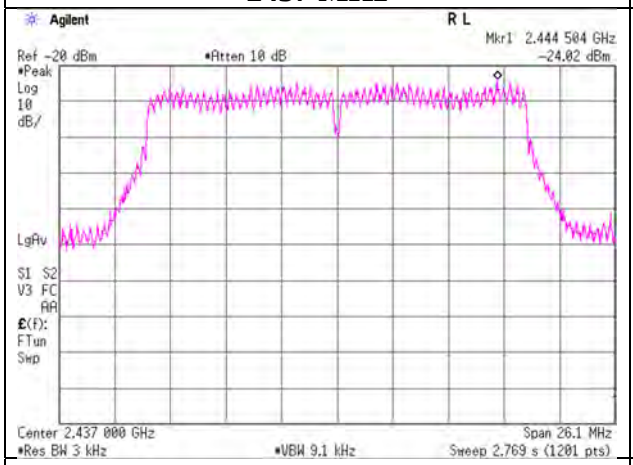
Power Density

11n-20

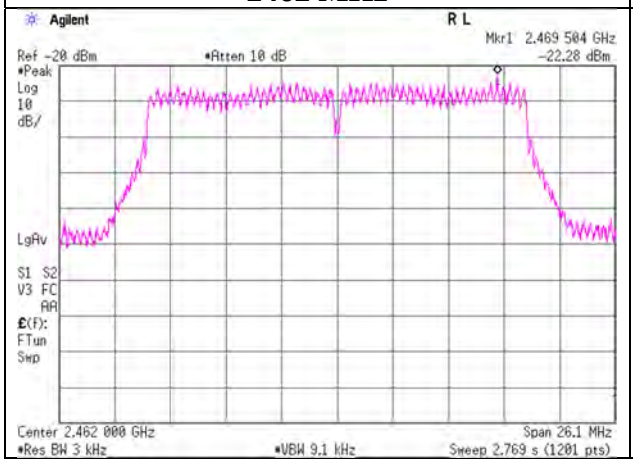
2412 MHz



2437 MHz

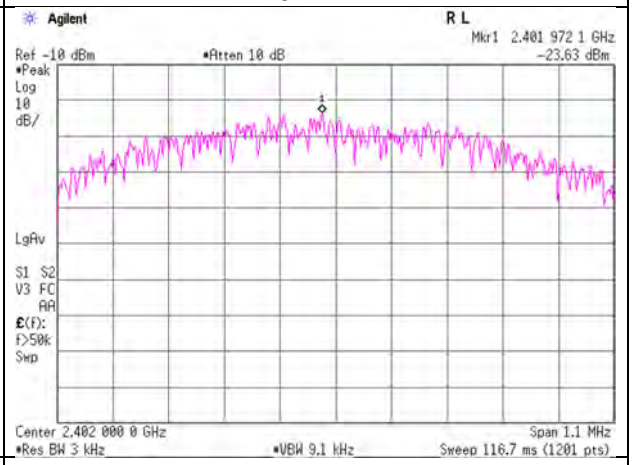


2462 MHz

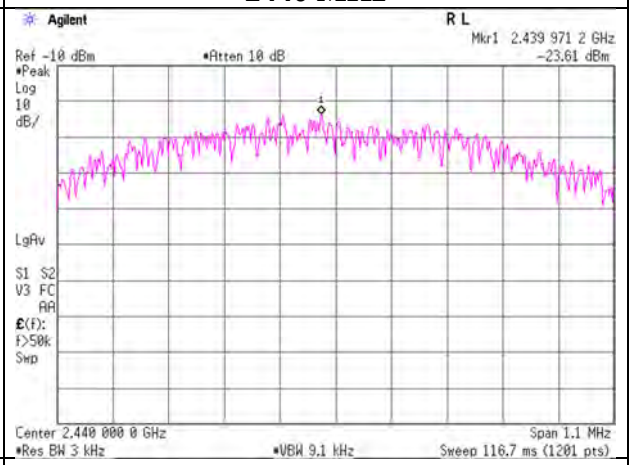


BT LE

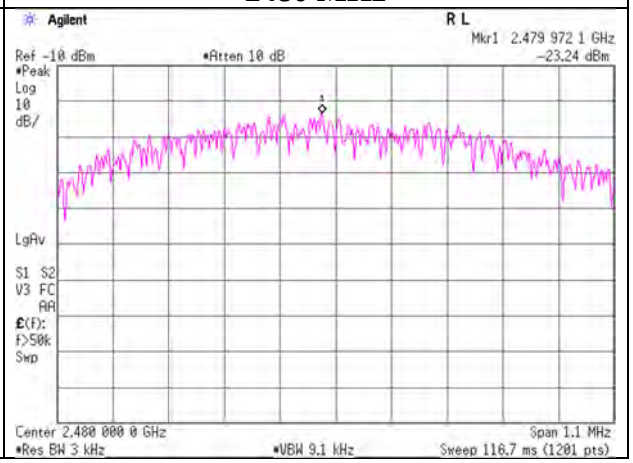
2402 MHz



2440 MHz



2480 MHz



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	SOS-27	191845	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	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	SRENT-22	202830	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250036	2020/11/24	12
AT	STM-06	145763	Terminator	TME	CT-01 BP	-	2020/12/07	12
AT	STM-G11	204923	Terminator	Weinschel - API Technologies Corp	M1459A	110101	2021/02/09	12
AT,RE	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	KJM-09	145929	Measure	KOMELON	KMC-36	-	-	-
RE	SAEC-01 (SVSWR)	145561	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	2021/05/09	12
RE	SAEC-02 (SVSWR)	145598	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	2021/05/20	12
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-04	145127	Pre Amplifier	Toyo Corporation	TPA0118-36	2072554	2021/05/17	12
RE	SAF-05	145128	Pre Amplifier	Toyo Corporation	TPA0118-36	1440490	2021/05/17	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-G05	145039	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-037	2021/01/26	12
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-G41	151617	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S006	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-G50	178573	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	MY13407/4E	2021/03/01	12
RE	SCC-G51	178572	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800288 /4A	2021/03/01	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-G62	196985	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803650/2	2021/03/01	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-01	145383	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-725	2021/05/20	12
RE	SHA-02	145384	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-726	2021/06/14	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	SJM-20	207277	Measuring	ASKUL	-	-	-	-
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	196	2021/05/15	12
RE	SOS-20	191837	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
RE	SOS-21	191838	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	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-01	145792	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997812	2020/10/19	12
RE	STS-02	145793	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997819	2021/04/28	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