RADIO TEST REPORT

Test Report No. : 13251464S-A-R2

Applicant	:	**Sony Corporation**
Type of EUT	:	**Communication Module**
Model Number of EUT	:	**M1502**
FCC ID	:	**AK8M1502**
Test regulation	:	**FCC Part 15 Subpart C: 2019**
Test Result	:	**Complied (Refer to SECTION 3.2)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.
   It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13251464S-A-R1. 13251464S-A-R1 is replaced with this report.

Date of test: March 6 to 12, 2020

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

Approved by: H. Shirasawa
Hikaru Shirasawa
Engineer
Consumer Technology Division

CERTIFICATE 1266.03

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

REVISION HISTORY

Original Test Report No.: 13251464S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13251464S-A	March 27, 2020	-	-
1	13251464S-A-R1	April 8, 2020	P.7	Modification of note from “d) Refer to APPENDIX 1 (data of 6 dB Bandwidth)” to “f) Refer to APPENDIX 1 (data of 6 dB Bandwidth)”
			P.7	Addition of “The EUT was tested as the hybrid system equipment in accordance with KDB 558074 D01 15.247 Meas Guidance v05r02 Section 10.”
2	13251464S-A-R2	May 19, 2020	P.1	Correction of Date of test: from “March 6 to 12, 2019” to “March 6 to 12, 2020”
			P.7	Update of Results - Number of Hopping Frequency - 6dB Bandwidth from “Complied” to “N/A”
				Addition of remarks: “Therefore, Number of Hopping Frequency and 6dB Bandwidth were not applicable.”
				Update of specification from: **Specification** **FCC:** Section 15.207 **ISED:** RSS-Gen 8.8 **FCC:** Section15.247(a)(1) **ISED:** RSS-247 5.1 (b) **FCC:** Section15.247(a)(1) **ISED:** RSS-247 5.1 (a) **FCC:** Section15.247(a)(1)(iii) **ISED:** RSS-247 5.1 (d) **FCC:** Section15.247(a)(1)(iii) **ISED:** RSS-247 5.1 (d) **FCC:** Section15.247(b)(3) **ISED:** RSS-247 5.4 (b) **FCC:** Section 15.247(a)(2) **ISED:** RSS-247 5.2(a) **FCC:** Section 15.247(e) **ISED:** RSS-247 5.2(b) **FCC:** Section15.247(d) **ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10 to: **Specification** **FCC:** Section 15.207 **ISED:** RSS-Gen 8.8 **FCC:** Section15.247(a)(1) **ISED:** RSS-247 5.1 (b) **FCC:** Section15.215(c) **ISED:** - **FCC:** Section15.247(a)(1)(i) **ISED:** RSS-247 5.1 (c) **FCC:** Section15.247(f) **ISED:** RSS-247 5.3 (a) **FCC:** Section15.247(b)(3) **ISED:** RSS-247 5.4 (d) **FCC:** Section 15.247(a)(2) **ISED:** RSS-247 5.2(a) **FCC:** Section 15.247(f) **ISED:** RSS-247 5.3(b) **FCC:** Section15.247(d) **ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10
				Correction of FCC Part 15.203/212 Antenna requirement from: The EUT has a unique antenna connector (SMA Reverse). Therefore the equipment complies with the requirement of 15.203 to: The EUT is mounted to the jig board and the jig board has a unique antenna connector (SMA Reverse). Therefore, the equipment complies with the antenna requirement.
			P.11	Correction of remarks of No. C to "EUT"
				Correction of No.1 cable name: from “Signal Cable” to “DC, GND”
				Correction of No.2 cable remarks: from “7 Wire” to “8 Wire”
			P.26 to P.31	Correction of Date of test: from “March 6, 2017” and “March 7, 2017” to “March 6, 2020” and “March 7, 2020”
			P.36	Modification of Mode: from “Tx, Hopping Off, Tx, Hopping On” to “Tx, Hopping Off”

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

CONTENTS PAGE

SECTION 1: Customer information **5**
SECTION 2: Equipment under test (EUT) **5**
SECTION 3: Test specification, procedures & results **6**
SECTION 4: Operation of EUT during testing **10**
SECTION 5: Conducted Emission **12**
SECTION 6: Radiated Spurious Emission **13**
SECTION 7: Antenna Terminal Conducted Tests **15**
APPENDIX 1: Test data **16**
Conducted Emission 16
20 dB Bandwidth, 99 %Occupied Bandwidth, and Carrier Frequency Separation 19
Number of Hopping Frequency 22
Dwell time 23
The maximum conducted output power 24
Radiated Spurious Emission 26
Conducted Spurious Emission 32
Conducted Emission Band Edge compliance 35
6 dB Bandwidth 36
Maximum power spectral density 38
APPENDIX 2: Test instruments **40**
APPENDIX 3: Photographs of test setup **42**
Conducted Emission 42
Radiated Spurious Emission 43
Worst Case Position 44

SECTION 1: Customer information

Company Name	:	Sony Corporation
Address	:	1-7-1 Konan, Minato-ku, Tokyo 108-0075, Japan
Telephone Number	:	+81-50-3750-9613
Facsimile Number	:	+81-50-3750-6540
Contact Person	:	Ryo Takata

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)
- 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 of Equipment	:	Communication Module
Model No.	:	M1502
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 3.3 V
Receipt Date of Sample (Information from test lab.)	:	March 6, 2020
Country / Area of Mass-production	:	Taiwan
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab.

2.2 Product Description

Model: M1502 (referred to as the EUT in this report) is a Communication Module.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	902.4 MHz – 907.2 MHz
Modulation	:	π /2 Shift BPSK + linear chirp modulation
Antenna type	:	λ/2 monopole antenna
Antenna Gain	:	3 dBi
Operating temperature range	:	-25 deg.C to +85 deg.C
Clock frequency (Maximum)	:	26 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258 * The revisions made after testing date do not affect the test specification applied to the EUT.
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

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	17.4 dB, 0.15000 MHz, L1, QP Mode: Tx_904.8 MHz	Complied a)	-
Carrier Frequency Separation	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section15.247(a)(1) **ISED:** RSS-247 5.1 (b)	See data.	Complied b)	Conducted
20dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section15.215(c) **ISED:** -		Complied b)	Conducted
Number of Hopping Frequency	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section15.247(a)(1)(i) **ISED:** RSS-247 5.1 (c)		N/A c)	Conducted
Dwell time	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section15.247(f) **ISED:** RSS-247 5.3 (a)		Complied d)	Conducted
The maximum conducted output power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** RSS-Gen 6.12	**FCC:** Section15.247(b)(3) **ISED:** RSS-247 5.4 (d)		Complied e)	Conducted
6dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section 15.247(a)(2) **ISED:** RSS-247 5.2(a)		N/A f)	Conducted
Maximum power spectral density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section 15.247(f) **ISED:** RSS-247 5.3(b)		Complied g)	Conducted
Spurious Emission & Band Edge Compliance	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** RSS-Gen 6.13	**FCC:** Section15.247(d) **ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	6.8 dB 40.001 MHz, QP, Vert Mode: Tx, 902.4 MHz	Complied h) / i)	Conducted/ Radiated (above 30 MHz) *1)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*1) Radiated test was selected over 30 MHz based on section 15.247(d).
a) Refer to APPENDIX 1 (data of Conducted Emission)
b) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation)
c) Refer to APPENDIX 1 (data of Number of Hopping Frequency)
d) Refer to APPENDIX 1 (data of Dwell time)
e) Refer to APPENDIX 1 (data of Average Output Power)
f) Refer to APPENDIX 1 (data of 6 dB Bandwidth)
g) Refer to APPENDIX 1 (data of Power Density)
h) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
i) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

The EUT was tested as the hybrid system equipment in accordance with KDB 558074 D01 15.247 Meas Guidance v05r02 Section 10. Therefore, Number of Hopping Frequency and 6dB Bandwidth were not applicable.

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 has the power supply regulator. However one of the input voltages to RF part doesn't go through the regulator. The stable voltage will be supplied by the end product, which will be required to have a power supply regulator. Therefore, the EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The EUT is mounted to the jig board and the jig board has a unique antenna connector (SMA Reverse). Therefore, the equipment complies with the antenna requirement.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% OccupiedBandwidth	**ISED:** RSS-Gen 6.7	**ISED:** -	N/A	- b)	Conducted
b) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation)					

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

3.4 Uncertainty

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

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

Shonan EMC Lab.

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	2.5 dB
Radiated emission	9 kHz-30 MHz	3.0 dB	3.0 dB	3.0 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	4.9 dB	4.9 dB	4.9 dB
	6 GHz-18 GHz	5.5 dB	5.5 dB	5.5 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	0.98 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.75 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.89 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.12 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.06 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.24 dB
Spurious emission (Conducted) below 1GHz	0.9 dB
Spurious emission (Conducted) 1 GHz-3 GHz	0.9 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.9 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.6 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.0 dB
Bandwidth Measurement	0.07 %
Duty cycle and Time Measurement	0.262 %
Temperature	0.95 deg.C.

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401
A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	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

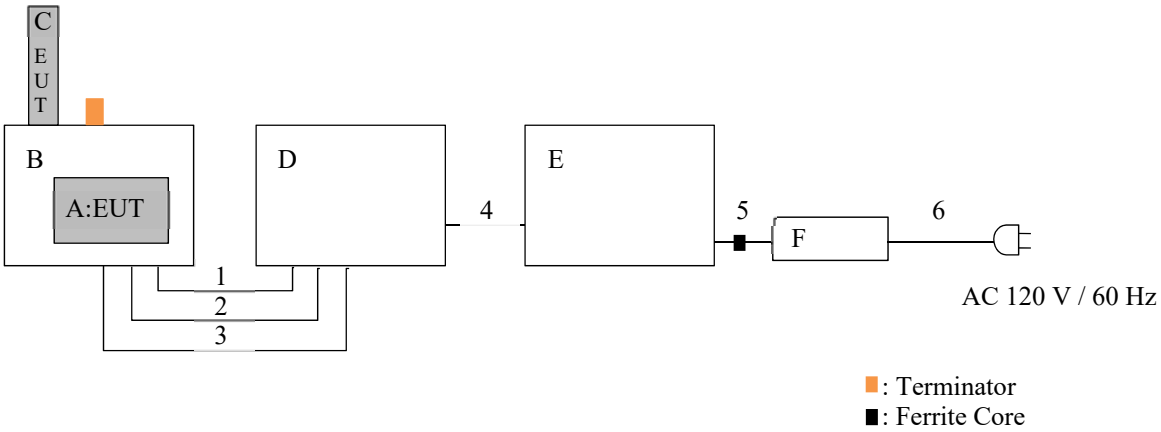
4.1 Operating Mode(s)

Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, Spurious Emission (Conducted) 20dB Bandwidth 6dB Bandwidth The maximum conducted output power Maximum power spectral density	Tx (Hopping Off)	902.4 MHz 904.8 MHz 907.2 MHz
Carrier Frequency Separation	Tx (Hopping On)	902.4 MHz 904.8 MHz 907.2 MHz
Number of Hopping Frequency	Tx (Hopping On)	-
Dwell time	Tx (Hopping On),	-
Band Edge Compliance (Conducted)	Tx -Hopping On -Hopping Off	902.4 MHz 907.2 MHz
99% Occupied Bandwidth	Tx -Hopping On -Hopping Off	902.4 MHz 904.8 MHz 907.2 MHz
*EUT has the power settings by the software as follows; Power settings: 0x00000010 Software: FW Ver TU105 5E51A3F6 (Date: 2020.2.28, Storage location: Driven by connected PC) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals



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

*As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 120 V of the worst voltage as representative.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Communication Module	M1502	13677	SONY	EUT
B	Jig	CXM1502GR-DK	L3677	SONY	-
C	ANT	-	-	STAF	EUT
D	Jig	MB1136 C-04	218030084	STMicroelectronics	-
E	Laptop PC	ThinkPad X250 20CLS8P200	PC0DLE7M	LENOVO	-
F	AC Adapter	ADLX45DLC2A	10E75792	LENOVO	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC, GND	0.3	Unshielded	Unshielded	6 Wire
2	Signal Cable	0.3	Unshielded	Unshielded	8 Wire
3	Signal Cable	0.3	Unshielded	Unshielded	8 Wire
4	USB Cable	1.5	Shielded	Shielded	-
5	DC Cable	1.5	Unshielded	Unshielded	-
6	AC Cable	0.8	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

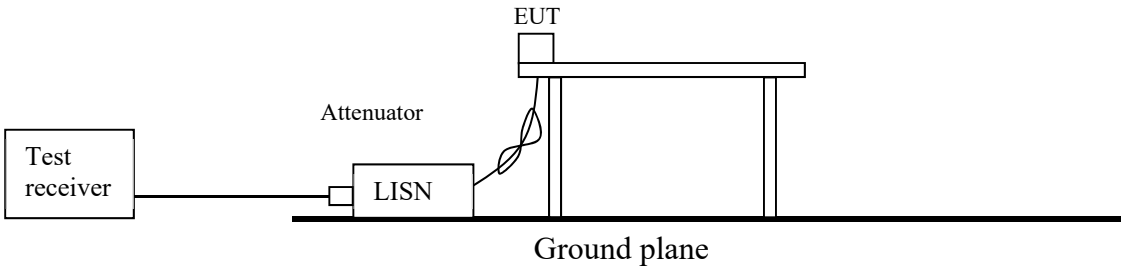
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Shielded Room.
The EUT was connected to a LISN (AMN).
An overview sweep with peak detection has been performed.

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

Detector : **QP and CISPR AV**
Measurement range : **0.15 MHz - 30 MHz**
Test data : **APPENDIX**
Test result : **Pass**

Figure 1: Test Setup



SECTION 6: Radiated Spurious Emission

Test Procedure

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

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

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

Test Antennas are used as below;

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

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 30 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.

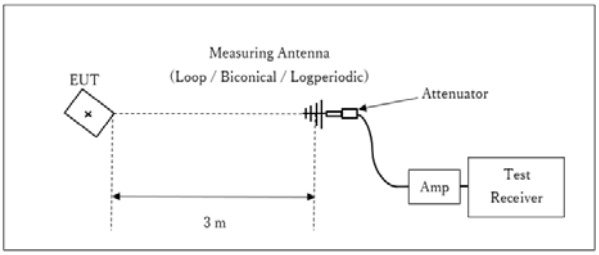
30 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		30 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

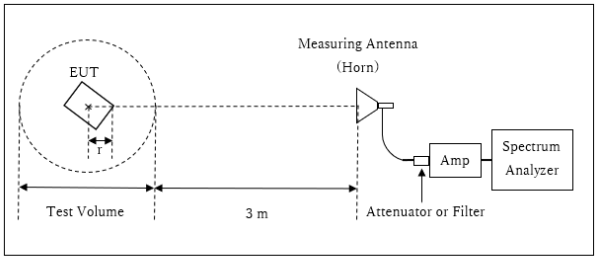
Below 1 GHz



× : 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 (3.89 m / 3.0 m) = 2.26 dB
* Test Distance: (3 + Test Volume /2) - r = 3.89 m

Test Volume : 2.0 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.11 m

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Worst position:

	Carrier	Spurious	
		Below 1 GHz	1 GHz - 10 GHz
Horizontal	Y	Y	Z
Vertical	Z	Z	Y

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

Measurement range : 30 MHz - 10 GHz
Test data : APPENDIX
Test result : Pass

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
20dB Bandwidth	500 kHz	5 kHz	16 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
The maximum conducted output power	-	-	-	Auto	Average	-	Power Meter (Sensor: 160 MHz BW)
Carrier Frequency Separation	Wide enough to capture the peaks of two adjacent channels.	30 kHz	91 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	5.5 MHz	30 kHz	91 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	100 kHz,	300 kHz,	As necessary capture the entire dwell time per hopping channel	Peak	Clear Write	Spectrum Analyzer
Conducted Spurious Emission *2)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
6dB Bandwidth	1.5 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum power spectral density	1.5 times the 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Average (1000 traces)	Clear Write	Spectrum Analyzer *3)

*1) Peak hold was applied as Worst-case measurement.
*2) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
*3) Section 11.10.5 Method AVGPSD-2 of "ANSI C63.10-2013
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 = 9.1 kHz)

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

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

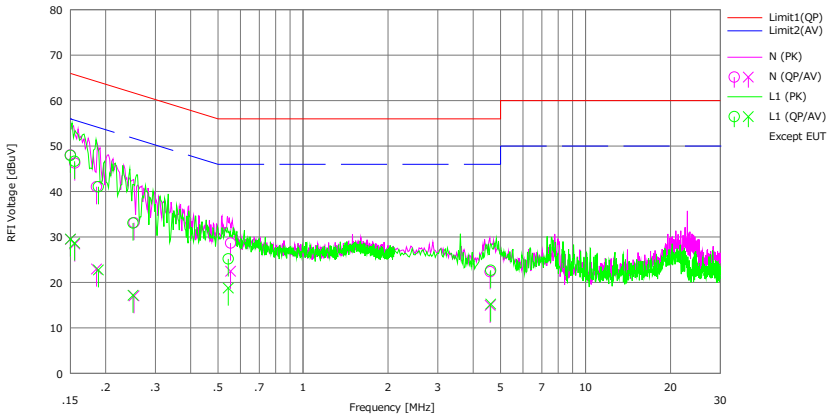
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2020/03/12

Mode : Tx_902.4 MHz

Power : AC 120 V / 60 Hz
Temp./Humi. : 21 deg.C / 41 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yohsuke Matsuzawa



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		(QP)	(AV)		(QP)	(AV)	(QP)	(AV)	(QP)	(AV)		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	35.60	17.00	12.45	48.05	29.45	66.00	56.00	17.9	26.5	N	
2	0.15552	33.80	16.00	12.45	46.25	28.45	65.70	55.70	19.4	27.2	N	
3	0.18567	28.60	10.50	12.45	41.05	22.95	64.23	54.23	23.1	31.2	N	
4	0.25200	20.70	4.60	12.46	33.16	17.06	61.69	51.69	28.5	34.6	N	
5	0.55377	16.20	10.00	12.46	28.66	22.46	56.00	46.00	27.3	23.5	N	
6	4.59787	9.70	2.30	12.66	22.36	14.96	56.00	46.00	33.6	31.0	N	
7	0.15000	35.50	17.10	12.46	47.96	29.56	66.00	56.00	18.0	26.4	L1	
8	0.15533	34.20	16.20	12.46	46.66	28.66	65.71	55.71	19.0	27.0	L1	
9	0.18852	28.60	10.30	12.47	41.07	22.77	64.10	54.10	23.0	31.3	L1	
10	0.24996	20.60	4.70	12.47	33.07	17.17	61.76	51.76	28.6	34.5	L1	
11	0.54367	12.70	6.30	12.48	25.18	18.78	56.00	46.00	30.8	27.2	L1	
12	4.61770	10.00	2.60	12.66	22.66	15.26	56.00	46.00	33.3	30.7	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN):SLS-02

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

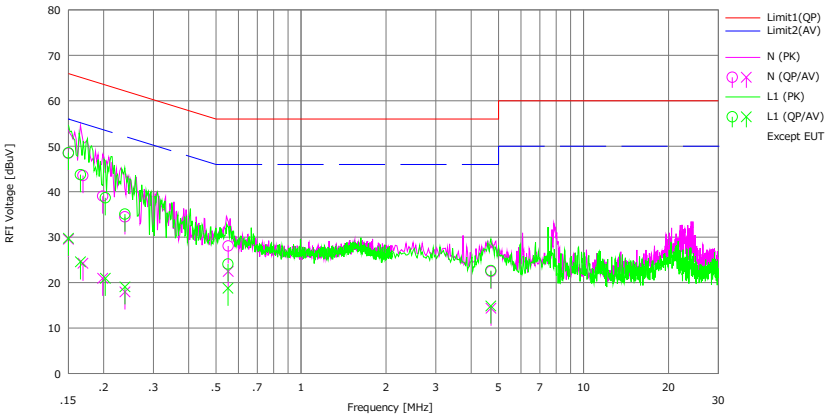
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2020/03/12

Mode : Tx_904.8 MHz

Power : AC 120 V / 60 Hz
Temp./Humi. : 21 deg.C / 41 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yohsuke Matsuzawa



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		(QP)	(AV)		(QP)	(AV)	(QP)	(AV)	(QP)	(AV)		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	36.00	17.10	12.45	48.45	29.55	66.00	56.00	17.5	26.4	N	
2	0.16896	31.10	11.80	12.46	43.56	24.26	65.01	55.01	21.4	30.7	N	
3	0.19847	26.60	8.50	12.44	39.04	20.94	63.67	53.67	24.6	32.7	N	
4	0.23782	22.00	5.50	12.46	34.46	17.96	62.17	52.17	27.7	34.2	N	
5	0.55203	15.60	10.00	12.46	28.06	22.46	56.00	46.00	27.9	23.5	N	
6	4.70344	9.80	1.70	12.67	22.47	14.37	56.00	46.00	33.5	31.6	N	
7	0.15000	36.10	17.30	12.46	48.56	29.76	66.00	56.00	17.4	26.2	L1	
8	0.16561	31.30	12.10	12.46	43.76	24.56	65.18	55.18	21.4	30.6	L1	
9	0.20271	26.20	8.50	12.47	38.67	20.97	63.50	53.50	24.8	32.5	L1	
10	0.23781	22.60	6.60	12.47	35.07	19.07	62.17	52.17	27.1	33.1	L1	
11	0.55083	11.60	6.30	12.48	24.08	18.78	56.00	46.00	31.9	27.2	L1	
12	4.69522	10.00	2.20	12.65	22.65	14.85	56.00	46.00	33.3	31.1	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN):SLS-02

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

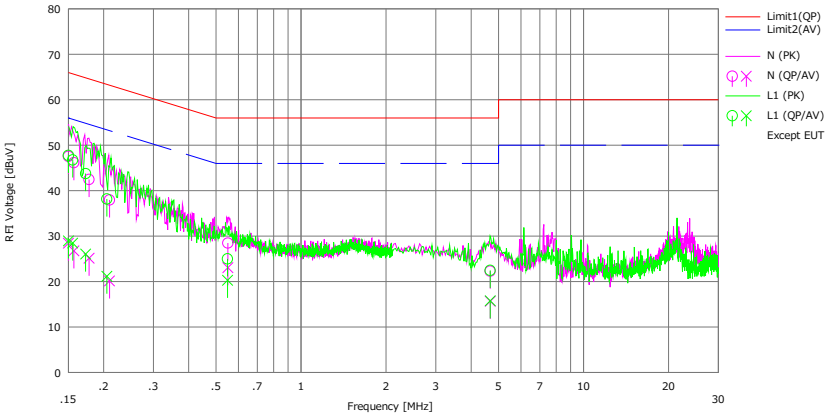
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2020/03/12

Mode : Tx_907.2 MHz

Power : AC 120 V / 60 Hz
Temp./Humi. : 21 deg.C / 41 %RH

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yohsuke Matsuzawa



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		(QP)	(AV)		(QP)	(AV)	(QP)	(AV)	(QP)	(AV)		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	35.10	16.00	12.45	47.55	28.45	66.00	56.00	18.4	27.5	N	
2	0.15682	33.70	14.30	12.45	46.15	26.75	65.63	55.63	19.4	28.8	N	
3	0.17758	30.00	12.70	12.45	42.45	25.15	64.60	54.60	22.1	29.4	N	
4	0.20978	25.50	7.70	12.44	37.94	20.14	63.21	53.21	25.2	33.0	N	
5	0.55072	16.00	10.60	12.46	28.46	23.06	56.00	46.00	27.5	22.9	N	
6	4.67393	9.60	3.00	12.67	22.27	15.67	56.00	46.00	33.7	30.3	N	
7	0.15000	35.30	16.50	12.46	47.76	28.96	66.00	56.00	18.2	27.0	L1	
8	0.15536	34.30	16.00	12.46	46.76	28.46	65.71	55.71	18.9	27.2	L1	
9	0.17267	31.30	13.60	12.46	43.76	26.06	64.83	54.83	21.0	28.7	L1	
10	0.20517	25.70	8.70	12.47	38.17	21.17	63.40	53.40	25.2	32.2	L1	
11	0.54896	12.50	7.80	12.48	24.98	20.28	56.00	46.00	31.0	25.7	L1	
12	4.67323	9.80	3.10	12.66	22.46	15.76	56.00	46.00	33.5	30.2	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN):SLS-02

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

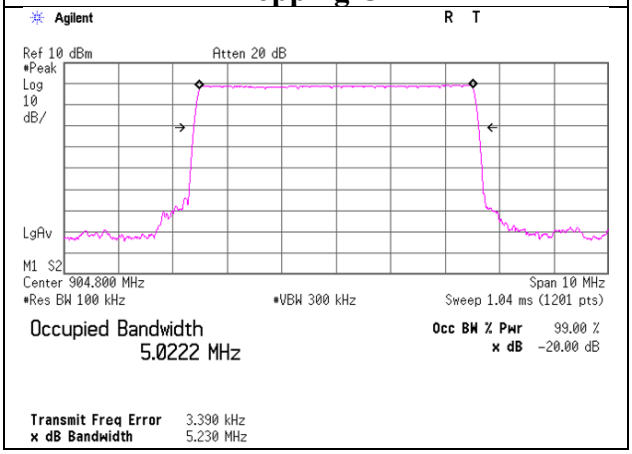
Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off, Tx, Hopping On

Freq. [MHz]	20dB Bandwidth [MHz]	99% Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
902.4	0.177	163.061	0.200	>= 0.177
904.8	0.177	163.035	0.200	>= 0.177
907.2	0.177	163.055	0.200	>= 0.177
Hopping On	-	5022.200	-	-

Limit: 20dB Bandwidth or 25kHz (whichever is greater).

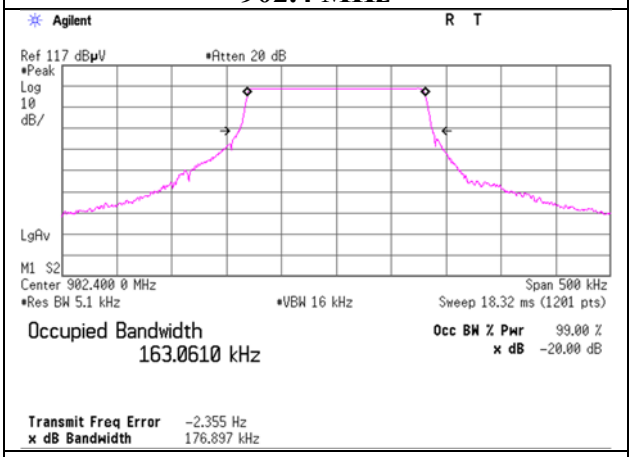
99 % Occupied Bandwidth

Hopping On

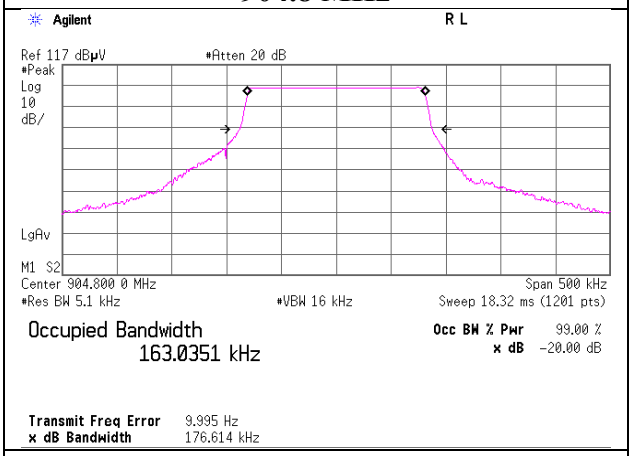


20 dB Bandwidth and 99% Occupied Bandwidth

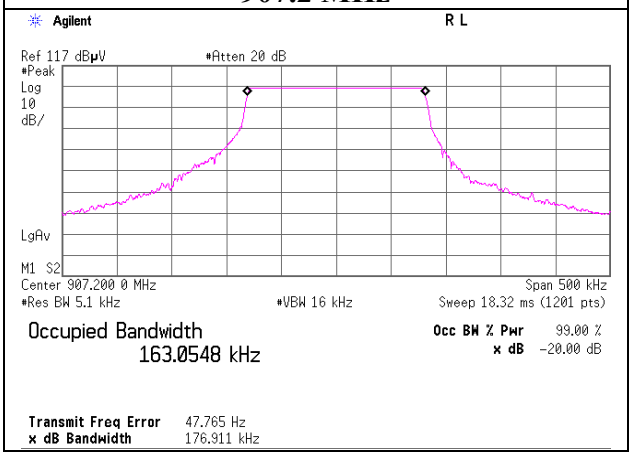
902.4 MHz



904.8 MHz

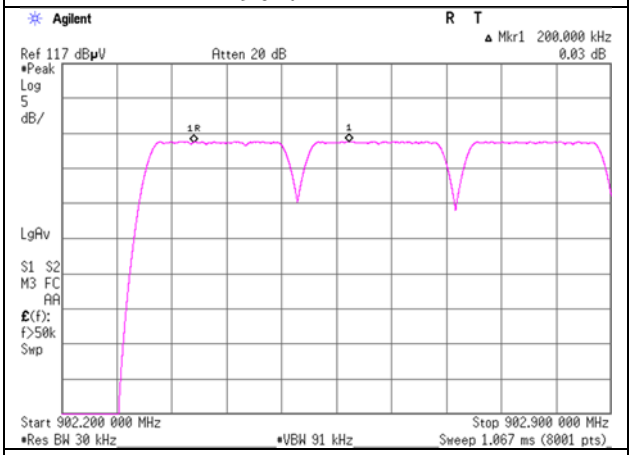


907.2 MHz

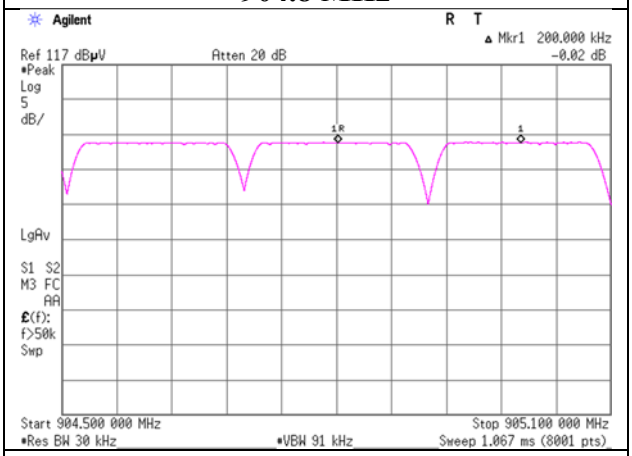


Carrier Frequency Separation

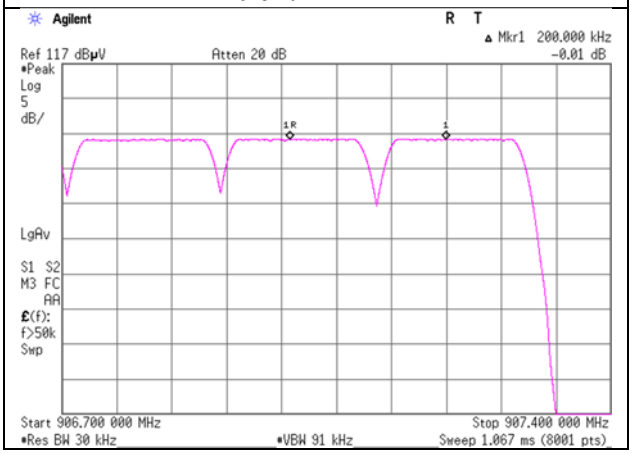
902.4 MHz



904.8 MHz



907.2 MHz

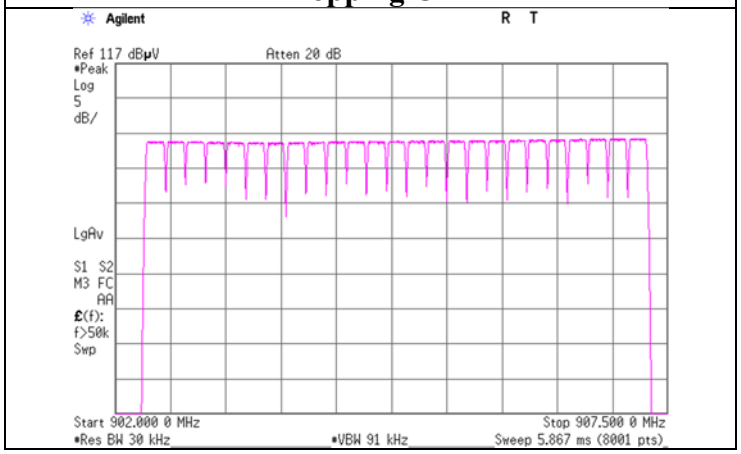


Number of Hopping Frequency

Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping On

Number of channel [channels]
25

Hopping On

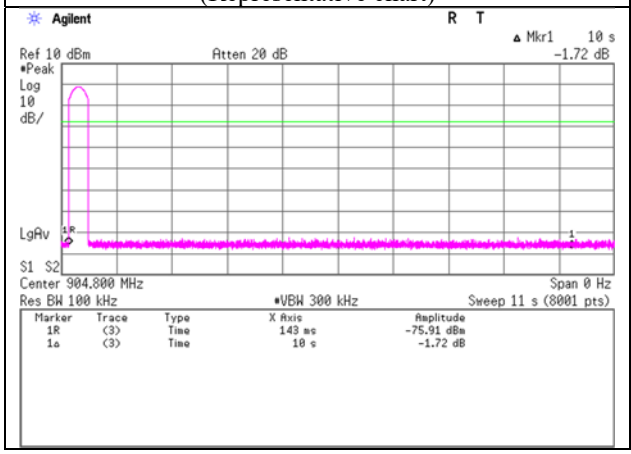
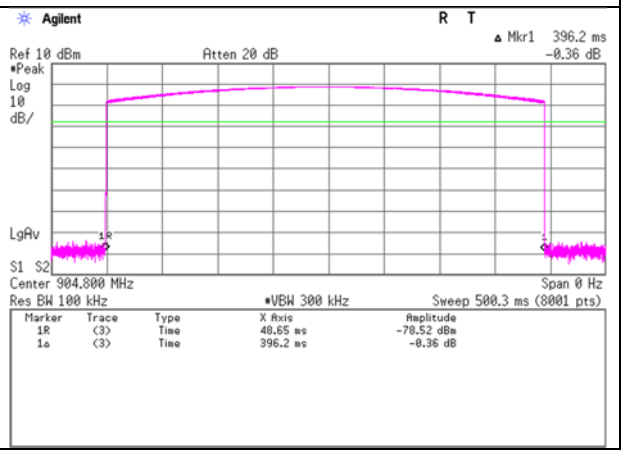


Dwell time

Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	March 11, 2020
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping On

Number of transmission in a 10 s (25 Hopping x 0.4)	Length of transmission time [msec]	Result [msec]	Limit [msec]
1 times	396.200	396.200	400

Sample Calculation
Result = Number of transmission x Length of transmission

Number of Transmission (Representative chart)	Length of transmission time
	

The maximum conducted output power

Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off

Detector : Average

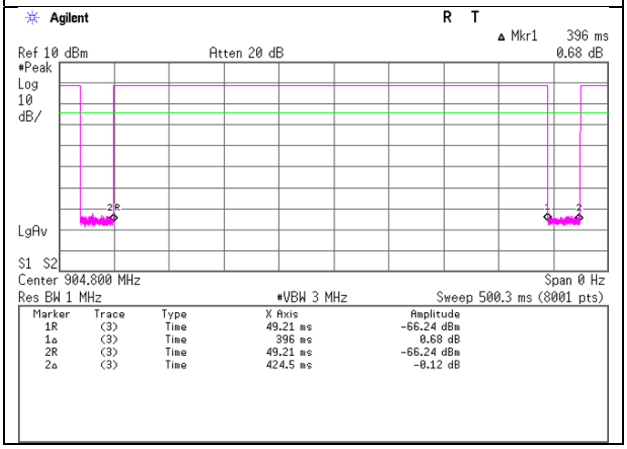
Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)		Limit		Margin	e.i.r.p. for RSS-247 Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
902.4	-1.38	0.56	19.86	19.04	80.17	0.30	19.34	85.90	30.00	1000	10.66	3.00	22.04	159.96	36.02	4000	13.98
904.8	-1.29	0.56	19.86	19.13	81.85	0.30	19.43	87.70	30.00	1000	10.57	3.00	22.13	163.31	36.02	4000	13.89
907.2	-0.93	0.56	19.86	19.49	88.92	0.30	19.79	95.28	30.00	1000	10.21	3.00	22.49	177.42	36.02	4000	13.53

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

Burst Rate Confirmation

Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No. 5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off

Tx on / (Tx on + Tx off) =	**0.933**
Tx on / (Tx on + Tx off) * 100 = (for The maximum conducted output power test)	**93.3 %**
Duty factor = 10 * log (424.5 / 396) = (for Radiated Spurious Emission test)	**0.30 dB**
Duty factor = 20 * log (424.5 / 396) =	**0.60 dB**



Radiated Spurious Emission

Report No.	13251464S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 6, 2020	March 7, 2020
Temperature / Humidity	20 deg. C / 33 % RH	22 deg. C / 31 % RH
Engineer	Yusuke Tanikawara (30 MHz -1 GHz)	Kazuya Noda (1 GHz -10 GHz)
Mode	Tx, Hopping Off 902.4 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.	299.538	QP	25.60	13.52	18.64	31.96	0.00	25.80	46.00	20.2	100	229	
Hori.	2707.200	PK	49.92	28.42	4.91	41.75	2.26	43.76	73.90	30.1	137	68	
Hori.	3609.600	PK	49.12	29.52	5.59	42.22	2.26	44.27	73.90	29.6	141	203	
Hori.	4512.000	PK	54.28	30.91	6.19	42.88	2.26	50.76	73.90	23.1	137	294	
Hori.	5414.400	PK	52.30	32.21	6.84	43.40	2.26	50.21	73.90	23.6	134	285	
Hori.	7219.200	PK	49.36	37.23	7.85	43.40	2.26	53.30	73.90	20.6	115	299	
Hori.	8121.600	PK	48.38	37.90	8.27	43.10	2.26	53.71	73.90	20.1	100	0	
Hori.	9024.000	PK	48.45	38.08	8.91	43.10	2.26	54.60	73.90	19.3	100	0	
Vert.	40.001	QP	34.10	14.74	16.49	32.17	0.00	33.16	40.00	**6.8**	100	273	
Vert.	2707.200	PK	48.72	28.42	4.91	41.75	2.26	42.56	73.90	31.3	133	157	
Vert.	3609.600	PK	48.92	29.52	5.59	42.22	2.26	44.07	73.90	29.8	137	273	
Vert.	4512.000	PK	54.29	30.91	6.19	42.88	2.26	50.77	73.90	23.1	131	267	
Vert.	5414.400	PK	51.94	32.21	6.84	43.40	2.26	49.85	73.90	24.0	125	262	
Vert.	7219.200	PK	50.25	37.23	7.85	43.40	2.26	54.19	73.90	19.7	147	287	
Vert.	8121.600	PK	49.14	37.90	8.27	43.10	2.26	54.47	73.90	19.4	100	0	
Vert.	9024.000	PK	48.51	38.08	8.91	43.10	2.26	54.66	73.90	19.2	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 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.	2707.200	AV	40.67	28.42	4.91	41.75	0.60	2.26	35.11	53.9	18.7	
Hori.	3609.600	AV	39.22	29.52	5.59	42.22	0.60	2.26	34.97	53.9	18.9	
Hori.	4512.000	AV	47.67	30.91	6.19	42.88	0.60	2.26	44.75	53.9	9.1	
Hori.	5414.400	AV	44.06	32.21	6.84	43.40	0.60	2.26	42.57	53.9	11.3	
Hori.	7219.200	AV	39.70	37.23	7.85	43.40	0.60	2.26	44.24	53.9	9.6	
Hori.	8121.600	AV	38.55	37.90	8.27	43.10	0.60	2.26	44.48	53.9	9.4	
Hori.	9024.000	AV	38.75	38.08	8.91	43.10	0.60	2.26	45.50	53.9	**8.4**	
Vert.	2707.200	AV	38.95	28.42	4.91	41.75	0.60	2.26	33.39	53.9	20.5	
Vert.	3609.600	AV	38.91	29.52	5.59	42.22	0.60	2.26	34.66	53.9	19.2	
Vert.	4512.000	AV	47.89	30.91	6.19	42.88	0.60	2.26	44.97	53.9	8.9	
Vert.	5414.400	AV	43.91	32.21	6.84	43.40	0.60	2.26	42.42	53.9	11.4	
Vert.	7219.200	AV	39.87	37.23	7.85	43.40	0.60	2.26	44.41	53.9	9.4	
Vert.	8121.600	AV	38.62	37.90	8.27	43.10	0.60	2.26	44.55	53.9	9.3	
Vert.	9024.000	AV	38.71	38.08	8.91	43.10	0.60	2.26	45.46	53.9	**8.4**	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB
Duty factor refer to "Duty factor Calculation chart" sheet.
*1) Not out of band emission (Leakage Power)

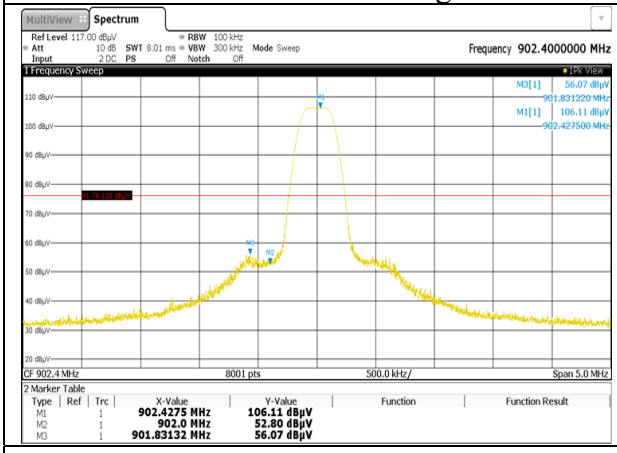
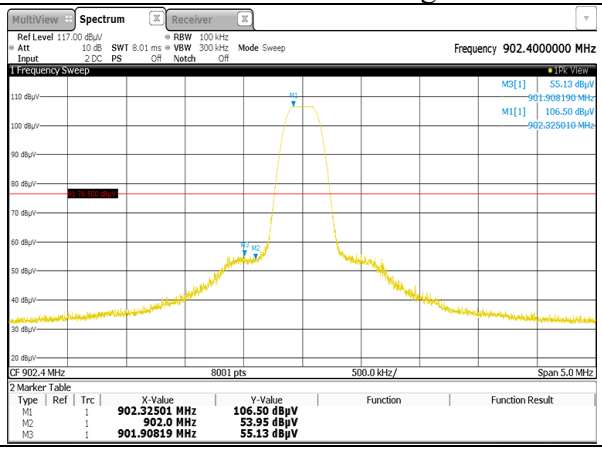
30 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

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.	902.400	PK	106.11	21.51	20.91	31.03	0.00	117.50	-	-	Carrier
Hori.	901.831	PK	56.97	21.50	20.91	31.03	0.00	68.35	87.50	19.2	
Hori.	902.000	PK	53.56	21.50	20.91	31.03	0.00	64.94	87.50	22.6	
Hori.	928.000	PK	33.40	21.69	20.99	30.82	0.00	45.26	87.50	42.2	
Hori.	928.411	PK	35.32	21.68	20.99	30.82	0.00	47.17	87.50	40.3	
Hori.	1804.800	PK	56.40	25.61	4.43	41.37	2.26	47.33	87.50	40.2	
Hori.	6316.800	PK	53.42	34.04	7.47	43.54	2.26	53.65	87.50	33.9	
Vert.	902.400	PK	106.37	21.51	20.91	31.03	0.00	117.76	-	-	Carrier
Vert.	901.908	PK	55.76	21.50	20.91	31.03	0.00	67.14	87.76	20.6	
Vert.	902.000	PK	54.67	21.50	20.91	31.03	0.00	66.05	87.76	21.7	
Vert.	928.000	PK	33.62	21.69	20.99	30.82	0.00	45.48	87.76	42.3	
Vert.	928.396	PK	35.40	21.68	20.99	30.82	0.00	47.25	87.76	40.5	
Vert.	1804.800	PK	57.61	25.61	4.43	41.37	2.26	48.54	87.76	39.2	
Vert.	6316.800	PK	53.25	34.04	7.47	43.54	2.26	53.48	87.76	34.3	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13251464S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	March 6, 2020
Temperature / Humidity	20 deg. C / 33 % RH
Engineer	Yusuke Tanikawara
Mode	Tx, Hopping Off 902.4 MHz

Horizontal	Vertical
Authorized-band band-edge Plot	Authorized-band band-edge Plot
	
30 dBc Plot	30 dBc 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.	13251464S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 6, 2020	March 7, 2020
Temperature / Humidity	20 deg. C / 33 % RH	22 deg. C / 31 % RH
Engineer	Yusuke Tanikawara (30 MHz -1 GHz)	Kazuya Noda (1 GHz -10 GHz)
Mode	Tx, Hopping Off 904.8 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.	299.507	QP	25.80	13.52	18.64	31.96	0.00	26.00	46.00	20.0	100	302	
Hori.	2714.400	PK	49.84	28.44	4.92	41.76	2.26	43.70	73.90	30.2	161	339	
Hori.	3619.200	PK	49.63	29.55	5.60	42.22	2.26	44.82	73.90	29.0	132	227	
Hori.	4524.000	PK	54.31	30.93	6.19	42.88	2.26	50.81	73.90	23.0	131	286	
Hori.	5428.800	PK	53.79	32.26	6.86	43.41	2.26	51.76	73.90	22.1	113	312	
Hori.	7238.400	PK	48.62	37.26	7.86	43.41	2.26	52.59	73.90	21.3	168	272	
Hori.	8143.200	PK	48.54	37.80	8.27	43.12	2.26	53.75	73.90	20.1	100	0	
Hori.	9048.000	PK	49.23	38.16	8.92	43.11	2.26	55.46	73.90	18.4	100	0	
Vert.	40.002	QP	34.00	14.74	16.49	32.17	0.00	33.06	40.00	**6.9**	100	267	
Vert.	2714.400	PK	49.31	28.44	4.92	41.76	2.26	43.17	73.90	30.7	147	215	
Vert.	3619.200	PK	48.47	29.55	5.60	42.22	2.26	43.66	73.90	30.2	215	259	
Vert.	4524.000	PK	54.96	30.93	6.19	42.88	2.26	51.46	73.90	22.4	144	263	
Vert.	5428.800	PK	52.59	32.26	6.86	43.41	2.26	50.56	73.90	23.3	103	246	
Vert.	7238.400	PK	49.23	37.26	7.86	43.41	2.26	53.20	73.90	20.7	162	270	
Vert.	8143.200	PK	48.61	37.80	8.27	43.12	2.26	53.82	73.90	20.0	100	0	
Vert.	9048.000	PK	49.28	38.16	8.92	43.11	2.26	55.51	73.90	18.3	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 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.	2714.400	AV	40.81	28.44	4.92	41.76	0.60	2.26	35.27	53.9	18.6	
Hori.	3619.200	AV	39.36	29.55	5.60	42.22	0.60	2.26	35.15	53.9	18.7	
Hori.	4524.000	AV	48.66	30.93	6.19	42.88	0.60	2.26	45.76	53.9	8.1	
Hori.	5428.800	AV	45.81	32.26	6.86	43.41	0.60	2.26	44.38	53.9	9.5	
Hori.	7238.400	AV	38.92	37.26	7.86	43.41	0.60	2.26	43.49	53.9	10.4	
Hori.	8143.200	AV	38.51	37.80	8.27	43.12	0.60	2.26	44.32	53.9	9.5	
Hori.	9048.000	AV	38.71	38.16	8.92	43.11	0.60	2.26	45.54	53.9	8.3	
Vert.	2714.400	AV	39.18	28.44	4.92	41.76	0.60	2.26	33.64	53.9	20.2	
Vert.	3619.200	AV	38.83	29.55	5.60	42.22	0.60	2.26	34.62	53.9	19.2	
Vert.	4524.000	AV	49.13	30.93	6.19	42.88	0.60	2.26	46.23	53.9	**7.6**	
Vert.	5428.800	AV	44.29	32.26	6.86	43.41	0.60	2.26	42.86	53.9	11.0	
Vert.	7238.400	AV	39.29	37.26	7.86	43.41	0.60	2.26	43.86	53.9	10.0	
Vert.	8143.200	AV	38.60	37.80	8.27	43.12	0.60	2.26	44.41	53.9	9.4	
Vert.	9048.000	AV	38.75	38.16	8.92	43.11	0.60	2.26	45.58	53.9	8.3	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB
Duty factor refer to "Duty factor Calculation chart" sheet.
*1) Not out of band emission (Leakage Power)

30 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.	904.800	PK	106.50	21.53	20.92	31.01	0.00	117.94	-	-	Carrier
Hori.	898.314	PK	33.42	21.51	20.90	31.06	0.00	44.77	87.94	43.2	
Hori.	902.000	PK	33.62	21.50	20.91	31.03	0.00	45.00	87.94	42.9	
Hori.	928.000	PK	32.51	21.69	20.99	30.82	0.00	44.37	87.94	43.6	
Hori.	930.757	PK	35.17	21.65	21.00	30.80	0.00	47.02	87.94	40.9	
Hori.	1809.600	PK	55.86	25.64	4.43	41.37	2.26	46.82	87.94	41.1	
Hori.	6333.600	PK	48.34	34.10	7.48	43.55	2.26	48.63	87.94	39.3	
Vert.	904.800	PK	106.61	21.53	20.92	31.01	0.00	118.05	-	-	Carrier
Vert.	898.301	PK	33.99	21.51	20.90	31.06	0.00	45.34	88.05	42.7	
Vert.	902.000	PK	34.42	21.50	20.91	31.03	0.00	45.80	88.05	42.3	
Vert.	928.000	PK	33.65	21.69	20.99	30.82	0.00	45.51	88.05	42.5	
Vert.	930.809	PK	35.52	21.65	21.00	30.80	0.00	47.37	88.05	40.7	
Vert.	1809.600	PK	58.01	25.64	4.43	41.37	2.26	48.97	88.05	39.1	
Vert.	6333.600	PK	47.94	34.10	7.48	43.55	2.26	48.23	88.05	39.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

Radiated Spurious Emission

Report No.	13251464S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 6, 2020	March 7, 2020
Temperature / Humidity	20 deg. C / 33 % RH	22 deg. C / 31 % RH
Engineer	Yusuke Tanikawara (30 MHz -1 GHz)	Kazuya Noda (1 GHz -10 GHz)
Mode	Tx, Hopping Off 907.2 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.	302.940	QP	25.10	13.54	18.67	31.96	0.00	25.35	46.00	20.6	100	296	
Hori.	2721.600	PK	50.05	28.46	4.93	41.76	2.26	43.94	73.90	29.9	103	318	
Hori.	3628.800	PK	49.14	29.57	5.59	42.23	2.26	44.33	73.90	29.5	178	233	
Hori.	4536.000	PK	53.75	30.95	6.20	42.89	2.26	50.27	73.90	23.6	136	289	
Hori.	5443.200	PK	52.37	32.29	6.86	43.43	2.26	50.35	73.90	23.5	146	228	
Hori.	7257.600	PK	48.23	37.28	7.88	43.43	2.26	52.22	73.90	21.6	135	247	
Hori.	8164.800	PK	48.57	37.68	8.29	43.14	2.26	53.66	73.90	20.2	100	0	
Hori.	9072.000	PK	48.41	38.28	8.94	43.12	2.26	54.77	73.90	19.1	100	0	
Vert.	40.002	QP	33.90	14.74	16.49	32.17	0.00	32.96	40.00	**7.0**	100	283	
Vert.	2721.600	PK	50.25	28.46	4.93	41.76	2.26	44.14	73.90	29.7	117	229	
Vert.	3628.800	PK	48.42	29.57	5.59	42.23	2.26	43.61	73.90	30.2	136	221	
Vert.	4536.000	PK	54.28	30.95	6.20	42.89	2.26	50.80	73.90	23.1	138	265	
Vert.	5443.200	PK	49.56	32.29	6.86	43.43	2.26	47.54	73.90	26.3	121	215	
Vert.	7257.600	PK	48.31	37.28	7.88	43.43	2.26	52.30	73.90	21.6	131	287	
Vert.	8164.800	PK	48.91	37.68	8.29	43.14	2.26	54.00	73.90	19.9	100	0	
Vert.	9072.000	PK	48.93	38.28	8.94	43.12	2.26	55.29	73.90	18.6	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 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.	2721.600	AV	41.05	28.46	4.93	41.76	0.60	2.26	35.54	53.9	18.3	
Hori.	3628.800	AV	38.71	29.57	5.59	42.23	0.60	2.26	34.50	53.9	19.4	
Hori.	4536.000	AV	47.30	30.95	6.20	42.89	0.60	2.26	44.42	53.9	9.4	
Hori.	5443.200	AV	44.56	32.29	6.86	43.43	0.60	2.26	43.14	53.9	10.7	
Hori.	7257.600	AV	38.44	37.28	7.88	43.43	0.60	2.26	43.03	53.9	10.8	
Hori.	8164.800	AV	38.53	37.68	8.29	43.14	0.60	2.26	44.22	53.9	9.6	
Hori.	9072.000	AV	38.45	38.28	8.94	43.12	0.60	2.26	45.41	53.9	8.4	
Vert.	2721.600	AV	41.26	28.46	4.93	41.76	0.60	2.26	35.75	53.9	18.1	
Vert.	3628.800	AV	38.48	29.57	5.59	42.23	0.60	2.26	34.27	53.9	19.6	
Vert.	4536.000	AV	48.32	30.95	6.20	42.89	0.60	2.26	45.44	53.9	8.4	
Vert.	5443.200	AV	40.02	32.29	6.86	43.43	0.60	2.26	38.60	53.9	15.3	
Vert.	7257.600	AV	38.55	37.28	7.88	43.43	0.60	2.26	43.14	53.9	10.7	
Vert.	8164.800	AV	38.40	37.68	8.29	43.14	0.60	2.26	44.09	53.9	9.8	
Vert.	9072.000	AV	38.62	38.28	8.94	43.12	0.60	2.26	45.58	53.9	**8.3**	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB
Duty factor refer to "Duty factor Calculation chart" sheet.
*1) Not out of band emission (Leakage Power)

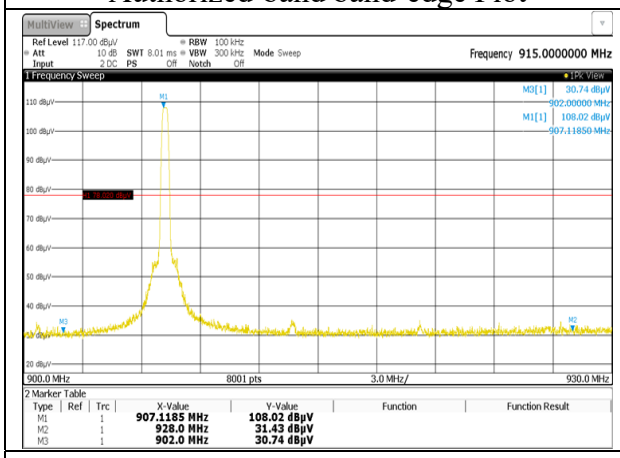
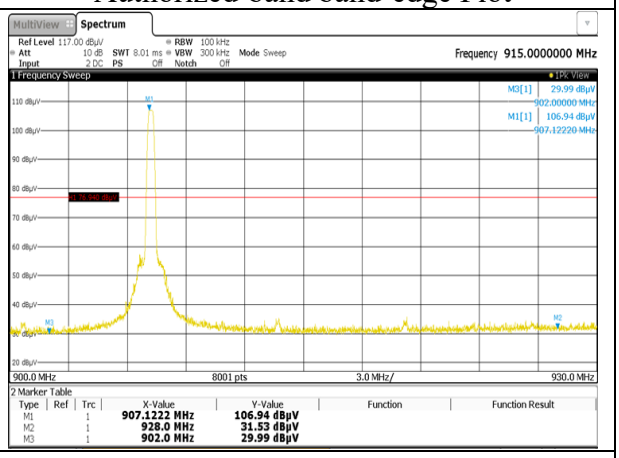
30 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

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.	907.200	PK	108.02	21.55	20.92	30.99	0.00	119.50	-	-	Carrier
Hori.	900.721	PK	34.30	21.49	20.90	31.04	0.00	45.65	89.50	43.9	
Hori.	902.000	PK	32.02	21.50	20.91	31.03	0.00	43.40	89.50	46.1	
Hori.	928.000	PK	33.20	21.69	20.99	30.82	0.00	45.06	89.50	44.4	
Hori.	933.268	PK	35.86	21.63	21.01	30.78	0.00	47.72	89.50	41.8	
Hori.	1814.400	PK	55.98	25.67	4.43	41.38	2.26	46.96	89.50	42.5	
Hori.	6350.400	PK	55.70	34.17	7.49	43.56	2.26	56.06	89.50	33.4	
Vert.	907.200	PK	106.94	21.55	20.92	30.99	0.00	118.42	-	-	Carrier
Vert.	900.689	PK	33.89	21.49	20.90	31.04	0.00	45.24	88.42	43.2	
Vert.	902.000	PK	33.45	21.50	20.91	31.03	0.00	44.83	88.42	43.6	
Vert.	928.000	PK	32.94	21.69	20.99	30.82	0.00	44.80	88.42	43.6	
Vert.	933.198	PK	35.83	21.64	21.01	30.78	0.00	47.70	88.42	40.7	
Vert.	1814.400	PK	59.28	25.67	4.43	41.38	2.26	50.26	88.42	38.2	
Vert.	6350.400	PK	55.73	34.17	7.49	43.56	2.26	56.09	88.42	32.3	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.89 m / 3.0 m) = 2.26 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

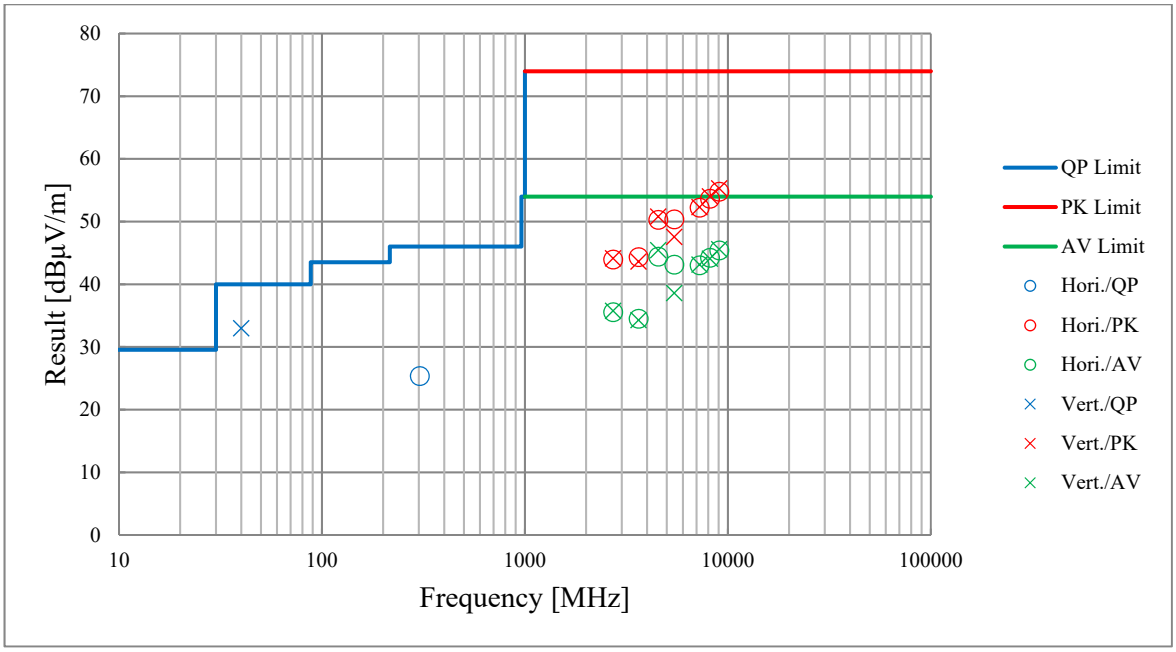
Report No.	13251464S-A-R2
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	March 6, 2020
Temperature / Humidity	20 deg. C / 33 % RH
Engineer	Yusuke Tanikawara
Mode	Tx, Hopping Off 907.2 MHz

Horizontal	Vertical
Authorized-band band-edge Plot	Authorized-band band-edge Plot
	
30 dBc Plot	30 dBc 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.	13251464S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	March 6, 2020	March 7, 2020
Temperature / Humidity	20 deg. C / 33 % RH	22 deg. C / 31 % RH
Engineer	Yusuke Tanikawara (30 MHz -1 GHz)	Kazuya Noda (1 GHz -10 GHz)
Mode	Tx, Hopping Off 907.2 MHz	



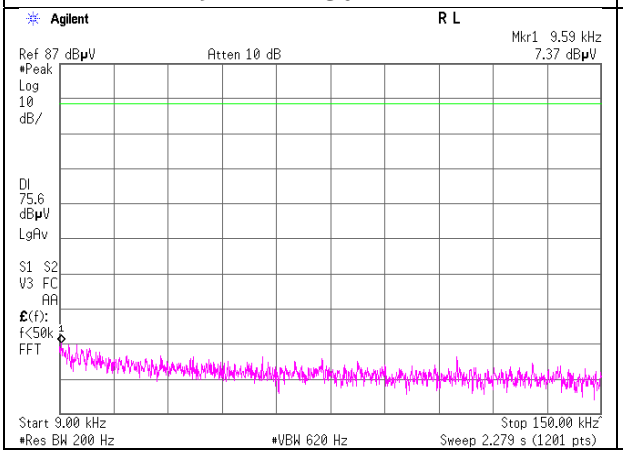
*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

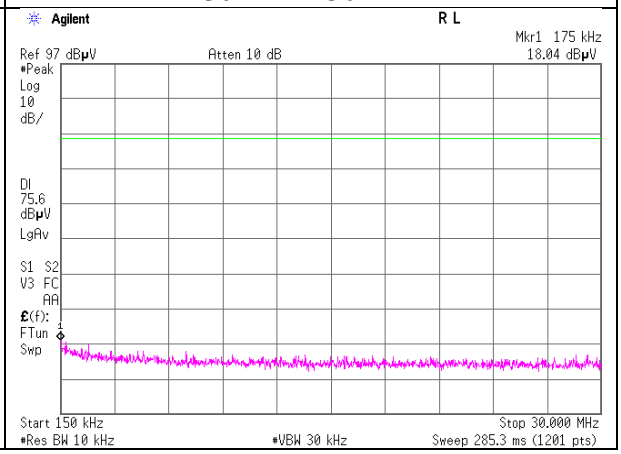
Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off

902.4 MHz

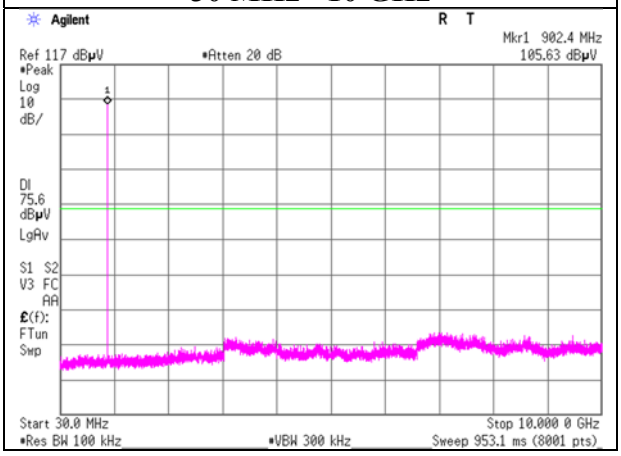
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 10 GHz

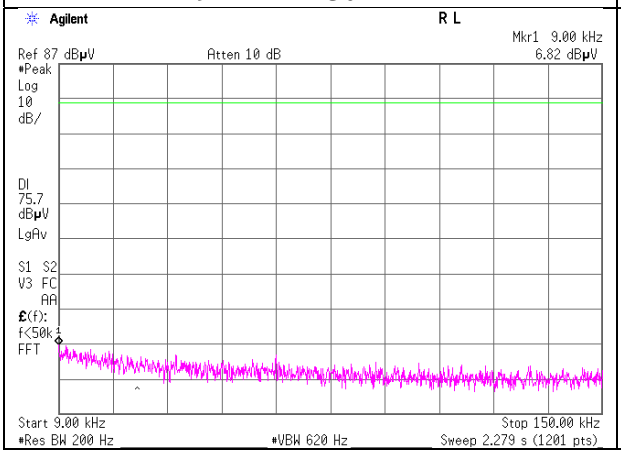


Conducted Spurious Emission

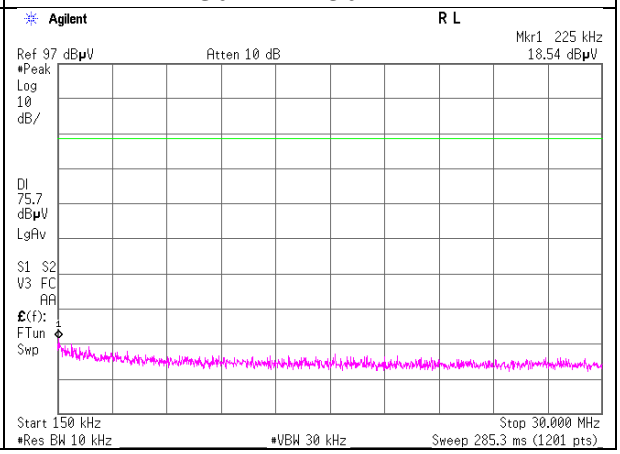
Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off

904.8 MHz

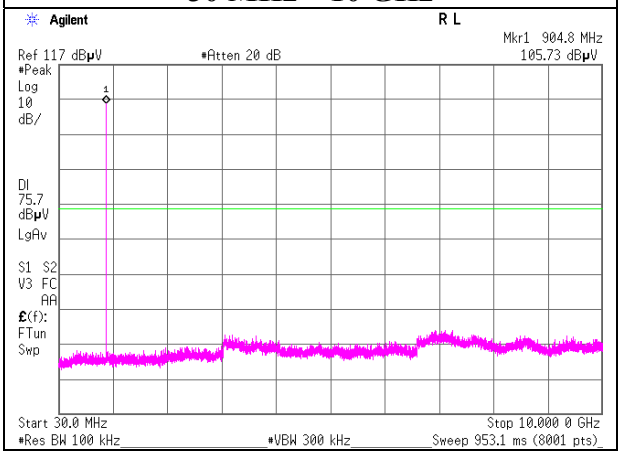
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 10 GHz

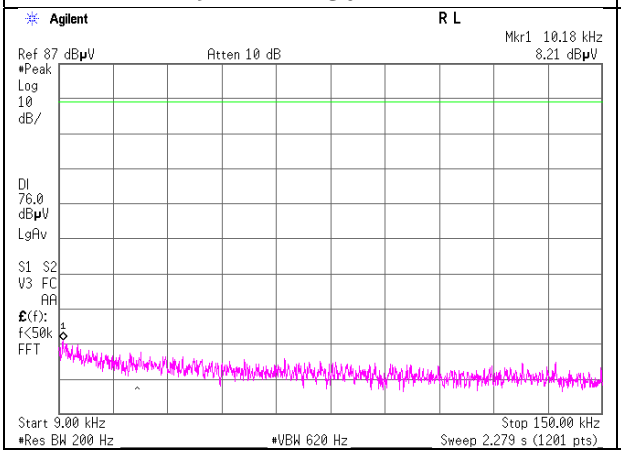


Conducted Spurious Emission

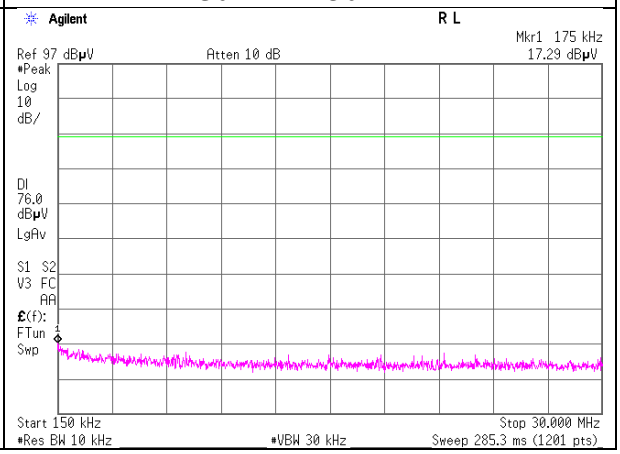
Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off

907.2 MHz

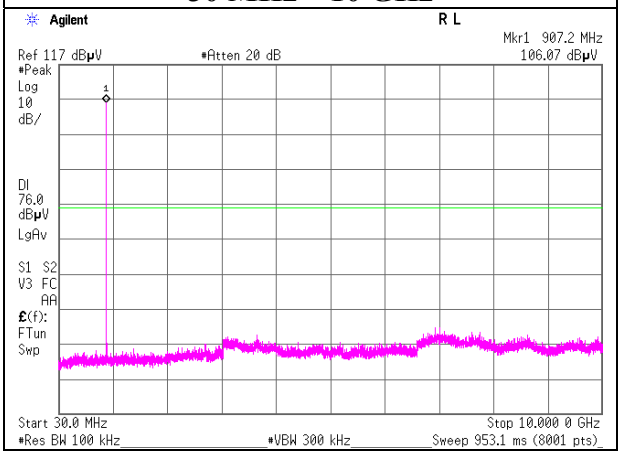
9 kHz – 150 kHz



150 kHz – 30 MHz



30 MHz – 10 GHz

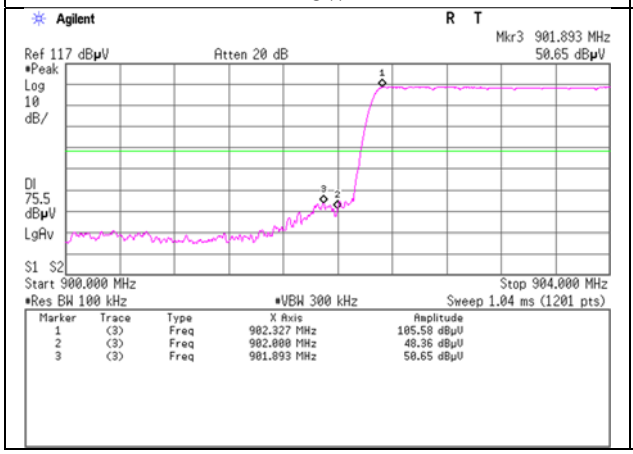


Conducted Emission Band Edge compliance

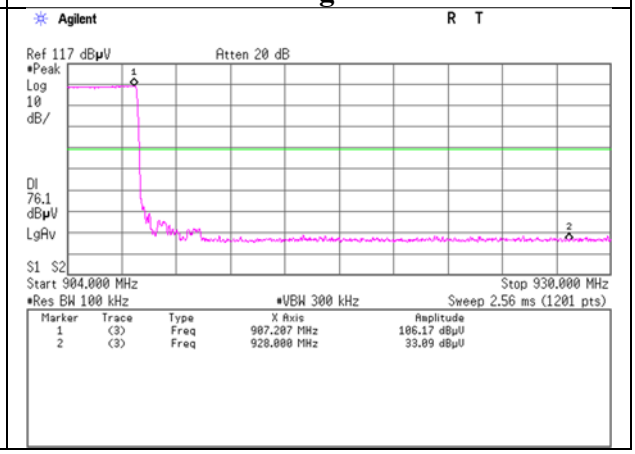
Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx

Hopping On

Low

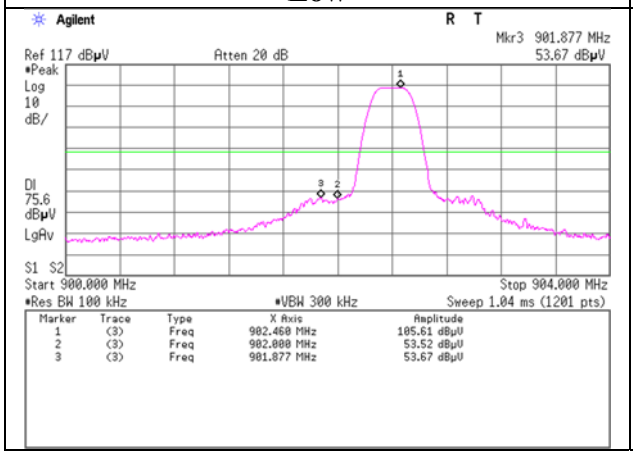


High

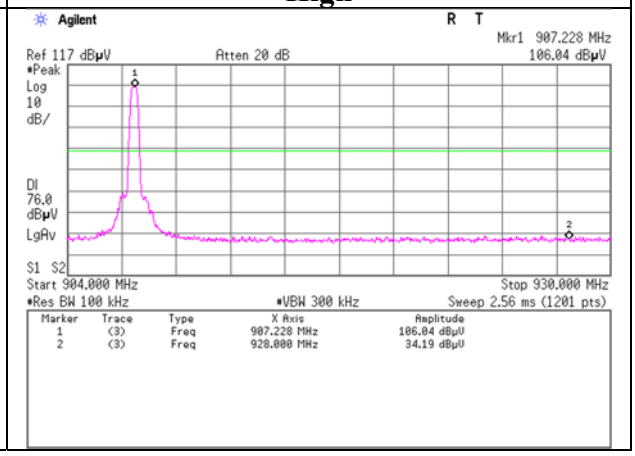


Hopping Off

Low



High



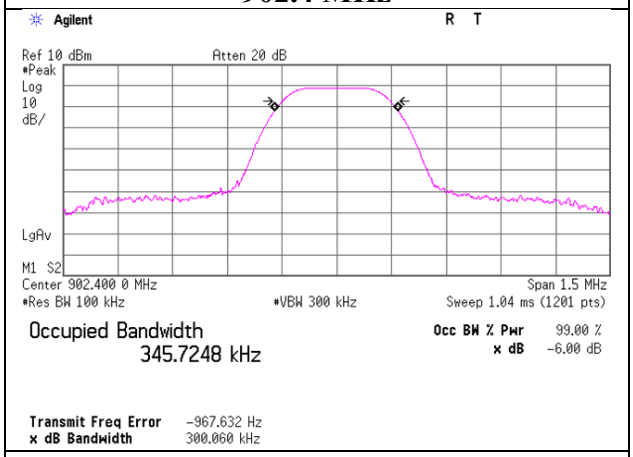
6 dB Bandwidth

Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx, Hopping Off

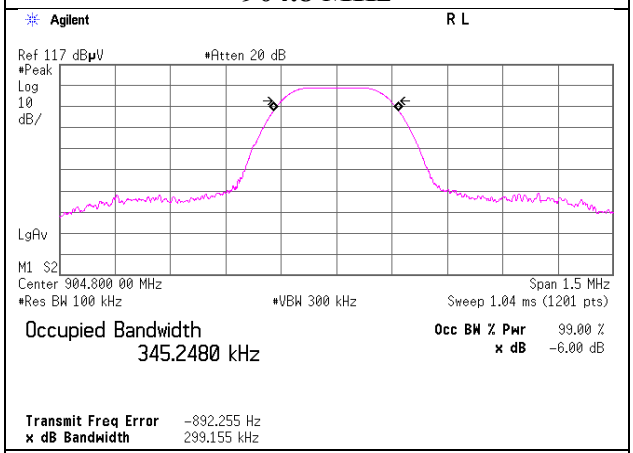
Freq. [MHz]	6 dB Bandwidth [MHz]
902.4	0.300
904.8	0.299
907.2	0.300

6 dB Bandwidth

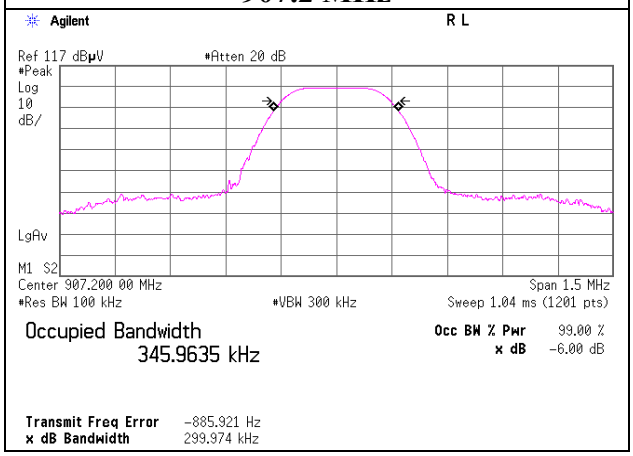
902.4 MHz



904.8 MHz



907.2 MHz



Maximum power spectral density

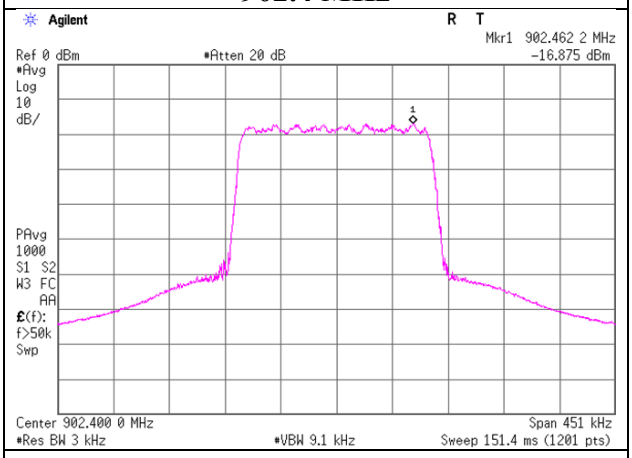
Report No.	13251464S-A-R2
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	March 9, 2020
Temperature / Humidity	20 deg. C / 44 % RH
Engineer	Kazuya Noda
Mode	Tx

Freq. [MHz]	Reading (Average) [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Duty factor [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
902.4	-16.88	0.56	19.86	0.30	3.85	8.00	4.16
904.8	-16.20	0.56	19.86	0.30	4.52	8.00	3.48
907.2	-16.40	0.56	19.86	0.30	4.32	8.00	3.68

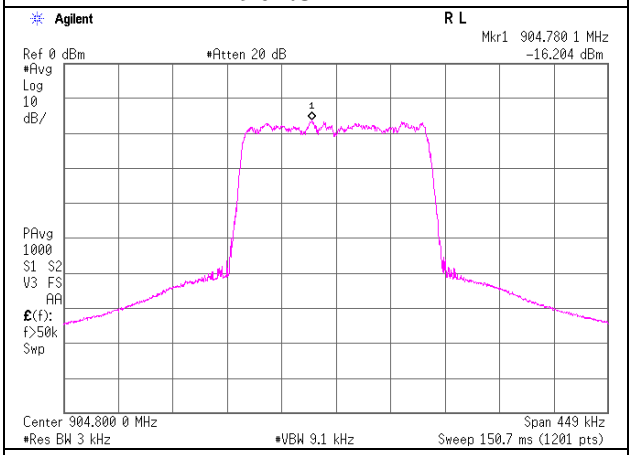
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss + Duty factor

Maximum power spectral density

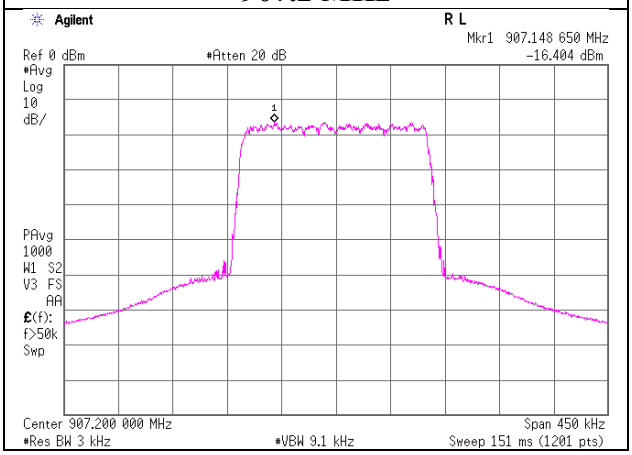
902.4 MHz



904.8 MHz



907.2 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	2019/10/01	12
AT	SAT20-06	145146	Attenuator	Weinschel Corp.	54A-20	31506	2019/04/16	12
AT	SCC-G31	145042	Coaxial Cable	Junkosha	MWX241-01000KMSKMS	OCT-08-13-046	2019/04/16	12
AT	SOS-19	175823	Humidity Indicator	CUSTOM	CTH-201	-	2019/12/19	12
AT	SPM-13	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2020/01/28	12
AT	SPSS-06	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2020/01/28	12
AT	SSA-03	145801	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250152	2019/08/08	12
AT,CE	STM-G8	171615	Terminator	Weinschel - API Technologies Corp	M1459A	88997	2019/07/04	12
CE	KJM-09	145929	Measure	KOMELON	KMC-36	-	-	-
CE	SAT3-13	150923	Attenuator	JFW	50HF-003N	-	2020/01/30	12
CE	SCC-C9	145035	Coaxial Cable	Suhner	RG223U	-	2019/04/19	12
CE	SLS-02	145539	LISN	Rohde & Schwarz	ENV216	100512	2020/02/18	12
CE	SOS-16	167990	Humidity Indicator	CUSTOM	CTH-202	708Q08R	2019/12/19	12
CE	STR-01	145790	Test Receiver	Rohde & Schwarz	ESU40	100093	2019/04/14	12
CE	STS-01	145792	Digital Hitester	Hioki	3805-50	80997812	2019/10/01	12
CE,RE	COTS-SEMI-5	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-

Test equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	SAEC-03(NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2019/04/08	12
RE	SAEC-03(SVSWR)	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2019/05/03	12
RE	SAF-03	145126	Pre Amplifier	SONOMA	310N	290213	2020/02/19	12
RE	SAF-06	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2020/02/20	12
RE	SAT20-01	145142	Attenuator(above1GHz)	Keysight Technologies Inc	8493C-020	74889	2019/11/06	12
RE	SAT6-13	167094	Attenuator	JFW	50HF-006N	-	2020/02/21	12
RE	SBA-03	145023	Biconical Antenna	Schwarzbeck	BBA9106	91032666	2019/05/07	12
RE	SCC-C1/C2/C3/C4/C5/C10/SRSE-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2019/04/19	12
RE	SCC-G40	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	2020/01/08	12
RE	SCC-G43	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104_E	SN MY 13406/4E	2019/07/03	12
RE	SCC-G58	183047	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800287/4A	2019/07/23	12
RE	SFL-22	168802	Highpass Filter	MICRO-TRONICS	HPM50114	G035	2019/04/16	12
RE	SHA-03	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2019/06/26	12
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	196	2019/05/07	12
RE	SOS-05	146293	Humidity Indicator	A&D	AD-5681	4062518	2019/10/08	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM	CTH-201	-	2019/12/12	12
RE	SSA-02	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2019/04/04	12
RE	STR-08	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2019/11/22	12
RE	STS-03	146210	Digital Hitester	Hioki	3805-50	80997823	2019/10/01	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item: **CE: Conducted Emission test**
RE: Radiated Emission test
AT: Antenna Terminal Conducted test