RADIO TEST REPORT

Test Report No.: 14586577H-A-R1

Customer	**Rockwell Automation, Inc.**
Description of EUT	**UHF RFID Transceiver 58UHF Short US Band**
Model Number of EUT	**58UHF-TR-100-SR15US**
FCC ID	**USM-58UHF-SR**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**February 15, 2023**
Remarks	**-**

Representative Test Engineer

Junya Okuno
Engineer

Approved By

Ryota Yamanaka
Engineer

CERTIFICATE 5107.02

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

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 21.0

ANNOUNCEMENT

- This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
- The results in this report apply only to the sample tested. (Laboratory was not involved in sampling.)
- This sample tested is in compliance with the limits of the above regulation.
- The test results in this test report are traceable to the national or international standards.
- This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
- This test report covers Radio technical requirements.
  It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
- The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
- The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 14586577H-A

This report is a revised version of 14586577H-A. 14586577H-A is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14586577H-A	February 13, 2023	-
1	14586577H-A-R1	February 15, 2023	Correction of EUT's model number in Clause 4.2
1	14586577H-A-R1	February 15, 2023	Correction of the Measurement Range in SECTION 6; From 30 MHz to 26.5 GHz To 30 MHz to 10 GHz

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS **PAGE**

SECTION 1: Customer Information

Company Name	Rockwell Automation, Inc.
Address	2 Executive Drive, Chelmsford, MA 01824, United States
Telephone Number	+1-9784463208
Contact Person	James Dogul

The information provided from the customer is as follows;
- Customer, Description 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 and Test 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

Description	UHF RFID Transceiver 58UHF Short US Band
Model Number	58UHF-TR-100-SR15US
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	November 23, 2022 for Hopping Off mode February 1, 2023 for Hopping On mode
Test Date	December 19, 2022 to February 2, 2023

2.2 Product Description

General Specification

Rating	DC 24 V

Radio Specification

Equipment Type	Transceiver
Frequency of Operation	902.75 MHz to 927.25 MHz
Type of Modulation	FHSS
Antenna Gain	3.62 dBi

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207	10.34 dB, 21.64126 MHz, AV, Phase L	Complied a)	-
	ISED: RSS-Gen 8.8	**ISED:** RSS-Gen 8.8			
Carrier Frequency Separation	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)	See data.	Complied b)	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (c)			
20dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)		Complied b)	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (a)			
Number of Hopping Frequency	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)(iii)		Complied c)	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (c)			
Dwell time	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(a)(1)(iii)		Complied d)	Conducted
	ISED: -	**ISED:** RSS-247 5.1 (c)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(b)(2)		Complied e)	Conducted
	ISED: RSS-Gen 6.12	**ISED:** RSS-247 5.4 (a)			
Spurious Emission & Band Edge Compliance	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	0.3 dB 3611.0 MHz, Vertical, AV	Complied f) / g)	Conducted/ Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred. *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 Maximum Peak Output Power) f) Refer to APPENDIX 1 (data of Conducted Spurious Emission) g) Refer to APPENDIX 1 (data of Radiated Spurious Emission)					

FCC Part 15.31 (e)

This EUT provides the stable voltage constantly to RF part regardless of input voltage.
Therefore, this 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	-	Conducted

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Conducted emission

Using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.7 dB
	0.15 MHz to 30 MHz	3.3 dB

Radiated emission

Measurement distance	Frequency range		Uncertainty (+/-)
3 m	9 kHz to 30 MHz		3.2 dB
10 m			3.0 dB
3 m	30 MHz to 200 MHz	Horizontal	4.8 dB
		Vertical	5.0 dB
	200 MHz to 1000 MHz	Horizontal	5.1 dB
		Vertical	6.2 dB
10 m	30 MHz to 200 MHz	Horizontal	4.8 dB
		Vertical	4.8 dB
	200 MHz to 1000 MHz	Horizontal	5.0 dB
		Vertical	5.0 dB
3 m	1 GHz to 6 GHz		4.9 dB
	6 GHz to 18 GHz		5.2 dB
1 m	10 GHz to 26.5 GHz		5.4 dB
	26.5 GHz to 40 GHz		5.4 dB
10 m	1 GHz to 18 GHz		5.4 dB

Antenna Terminal test

Test Item	Uncertainty (+/-)
20 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %
Maximum Peak Output Power / Average Output Power	1.5 dB
Carrier Frequency Separation	0.42 %
Dwell time / Burst rate	0.10 %
Conducted Spurious Emission	2.7 dB

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919
ISED Lab Company Number: 2973C / CAB identifier: JP0002
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan
Telephone: +81-596-24-8999

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

* Size of vertical conducting plane (for Conducted Emission test): 2.0 x 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

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)

Mode	Remarks*
Transmitting (Tx) - Miller-4 (Profile Index 2)	-

*EUT has the power settings by the software as follows;
Power Setting: 24 dBm
Software: v1.3.907 (for Hopping Off)
v1.5.302 (for Hopping On)
(Date: 2022.12.19, Storage location: EUT memory)

*This setting of software is the worst case.
Any conditions under the normal use do not exceed the condition of setting.
In addition, end users cannot change the settings of the output power of the product.

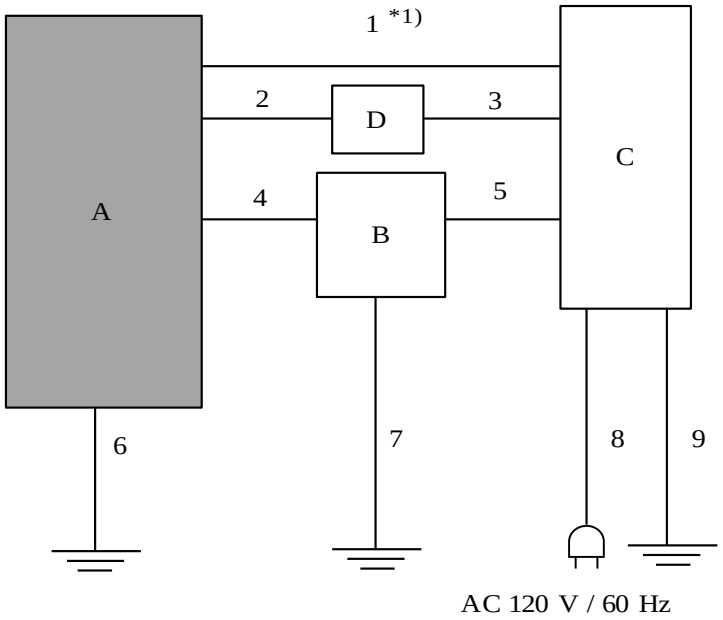
Details of Operating Mode(s)

Test Item	Mode	Hopping	Tested Frequency
Conducted Emission *2), Radiated Spurious Emission (Below 1 GHz) *2)	Tx	Off	915.25 MHz *1)
20dB Bandwidth, Carrier Frequency Separation, Maximum Peak Output Power, Conducted Spurious Emission, Radiated Spurious Emission (Above 1 GHz) *2)	Tx	Off	902.75 MHz 915.25 MHz 927.25 MHz
Number of Hopping Frequency	Tx	On	-
Dwell time	Tx	On	902.75 MHz 915.25 MHz 927.25 MHz
Band Edge Compliance (Conducted)	Tx	On	902.75 MHz
		Off	927.25 MHz
99% Occupied Bandwidth	Tx	On	902.75 MHz
		Off	915.25 MHz 927.25 MHz

*1) Conducted emissions for frequencies below 1 GHz was limited to the channel that had the highest power during the antenna terminal test, as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands.
*2) Conducted Emission and Radiated Spurious Emission tests were performed with Circle polarized wave. Other test items were tested with the vertical polarized wave.

4.2 Configuration and Peripherals

Conducted Emission and Radiated Emission tests



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

Description of EUT and Support Equipment

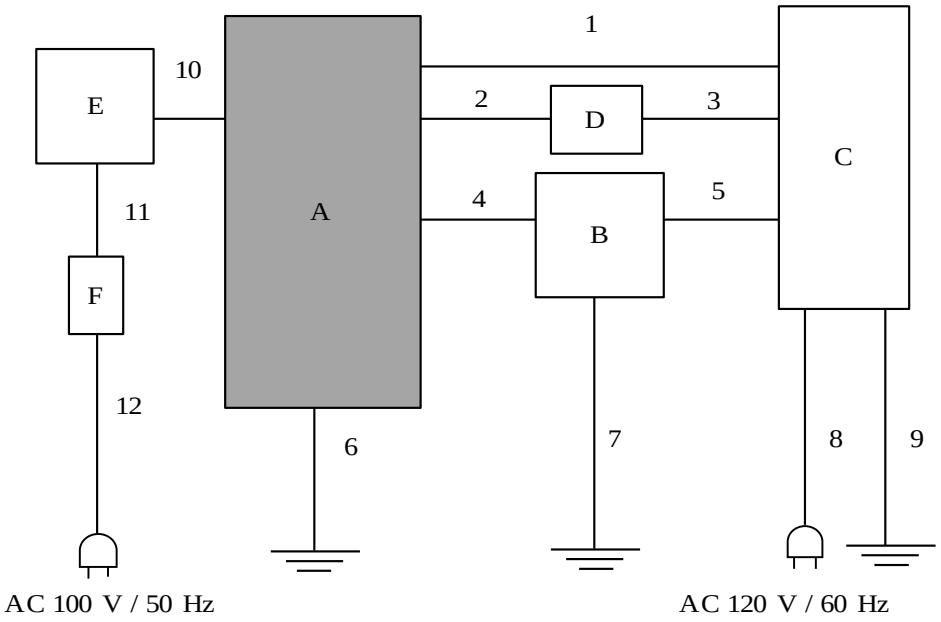
No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	UHF RFID Transceiver 58UHF Short US Band	58UHF-TR-100-SR15US	No.37	Rockwell Automation, Inc.	EUT
B	Controller	5069-L340ERM	51468720	Rockwell Automation, Inc.	-
C	DC Supply	1606-XLE80E	19759635	Rockwell Automation, Inc.	-
D	Resistance	BGR15	-	KOA	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC and Signal Cable	1.50	Unshielded	Unshielded	*1) Tested by CE*
2	DC Cable	1.25	Unshielded	Unshielded	-
3	DC Cable	0.75	Unshielded	Unshielded	-
4	LAN Cable	2.0	Shielded	Shielded	-
5	DC Cable	0.9	Unshielded	Unshielded	-
6	Earth Cable	1.0 for CE* 3.0 for RE*	Unshielded	Unshielded	-
7	Earth Cable	1.0	Unshielded	Unshielded	-
8	AC Cable	1.8	Unshielded	Unshielded	-
9	Earth Cable	2.0 for CE* 1.0 for RE*	Unshielded	Unshielded	-

*CE: Conducted Emission, RE: Radiated Emission

Antenna Terminal Conducted tests



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

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	UHF RFID Transceiver 58UHF Short US Band	58UHF-TR-100-SR15US	No.37 *1) No.40 *2)	Rockwell Automation, Inc.	EUT
B	Controller	5069-L340ERM	51468720	Rockwell Automation, Inc.	-
C	DC Supply	1606-XLE80E	19759635	Rockwell Automation, Inc.	-
D	Resistance	BGR15	-	KOA	-
E	Laptop PC	PR63PBAA337AD7X	6F053983H	TOSHIBA	-
F	AC Adapter	PA51770-1ACA	G71C000GZ120	TOSHIBA	-

*1) Used for Hopping Off mode
*2) Used for Hopping On mode

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC and Signal Cable	1.50	Unshielded	Unshielded	-
2	DC Cable	1.25	Unshielded	Unshielded	-
3	DC Cable	0.75	Unshielded	Unshielded	-
4	LAN Cable	1.0	Shielded	Shielded	-
5	DC Cable	0.9	Unshielded	Unshielded	-
6	Earth Cable	1.0	Unshielded	Unshielded	-
7	Earth Cable	1.0	Unshielded	Unshielded	-
8	AC Cable	1.8	Unshielded	Unshielded	-
9	Earth Cable	1.0	Unshielded	Unshielded	-
10	USB Cable	1.8	Shielded	Shielded	-
11	DC Cable	2.0	Unshielded	Unshielded	-
12	AC Cable	1.0	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.

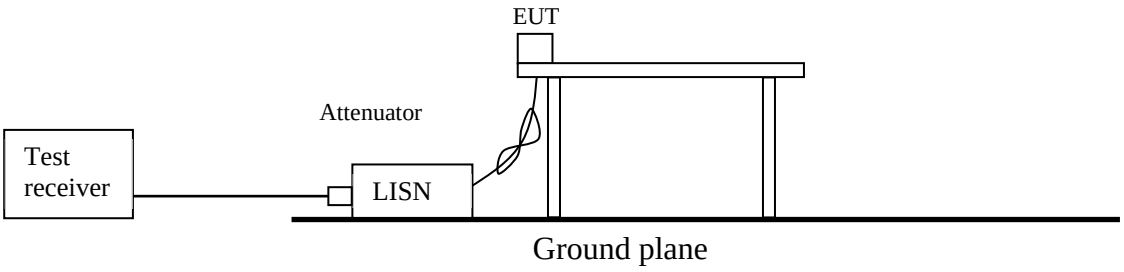
For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.
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 to 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 1.5 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. 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 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.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

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

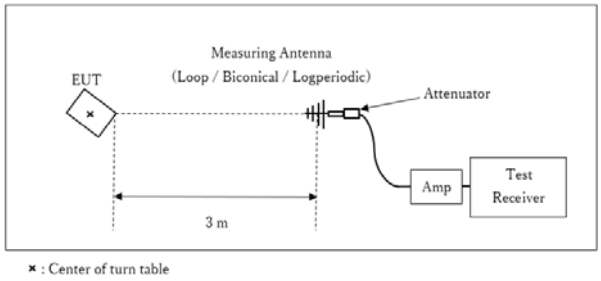
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz

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

Figure 2: Test Setup

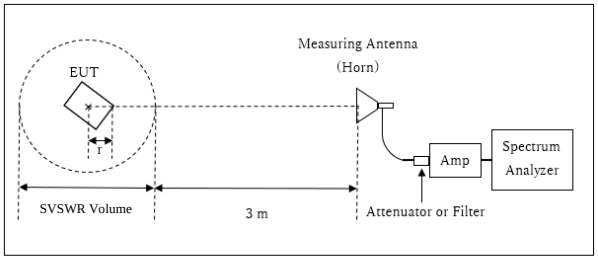
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



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

Distance Factor: 20 x log (3.95 m / 3.0 m) = 2.39 dB
Test Distance: (3 + SVSWR Volume /2) – r = 3.95 m

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.05 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.

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

Measurement Range : **30 MHz to 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	300 kHz	3 kHz	9.1 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: 50MHz BW)
Carrier Frequency Separation	1.5 MHz	10 kHz	30 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	40 MHz	68 kHz	200 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	100 kHz, 470 kHz	300 kHz, 1.5 MHz	As necessary capture the entire dwell time per hopping channel	Peak	Clear Write	Spectrum Analyzer
Conducted Spurious Emission *3) *4)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	9.1 kHz	27 kHz				
	30 MHz to 10 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz).
*4) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 – 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

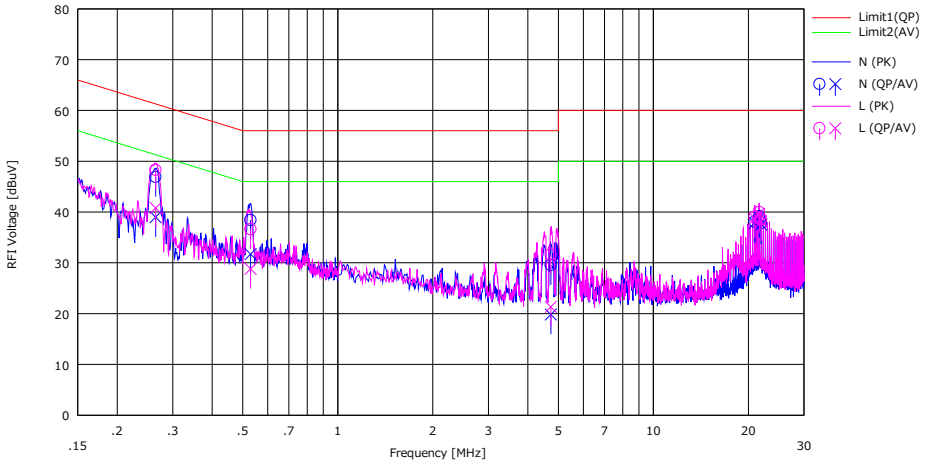
Test Data : **APPENDIX**
Test Result : **Pass**

APPENDIX 1: Test data

Conducted Emission

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	20 deg. C / 35 % RH
Engineer	Junya Okuno
Mode	Tx, Hopping Off, 915.25 MHz

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq.	Reading ⟨QP⟩	Reading ⟨AV⟩	LISN	LOSS	Results ⟨QP⟩	Results ⟨AV⟩	Limit ⟨QP⟩	Limit ⟨AV⟩	Margin ⟨QP⟩	Margin ⟨AV⟩	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.26465	33.70	25.80	0.04	13.15	46.89	38.99	61.28	51.28	14.39	12.29	N	
2	0.52948	25.20	18.50	0.04	13.17	38.41	31.71	56.00	46.00	17.59	14.29	N	
3	4.73400	16.00	6.30	0.11	13.42	29.53	19.83	56.00	46.00	26.47	26.17	N	
4	20.96641	23.80	23.60	0.41	13.87	38.08	37.88	60.00	50.00	21.92	12.12	N	
5	21.64126	24.80	24.50	0.44	13.88	39.12	38.82	60.00	50.00	20.88	11.18	N	
6	21.97865	23.50	23.20	0.45	13.89	37.84	37.54	60.00	50.00	22.16	12.46	N	
7	0.26465	35.10	27.60	0.04	13.15	48.29	40.79	61.28	51.28	12.99	10.49	L	
8	0.52948	23.40	15.60	0.04	13.17	36.61	28.81	56.00	46.00	19.39	17.19	L	
9	4.73400	18.10	7.80	0.11	13.42	31.63	21.33	56.00	46.00	24.37	24.67	L	
10	20.96641	24.80	24.50	0.37	13.87	39.04	38.74	60.00	50.00	20.96	11.26	L	
11	21.64126	25.70	25.40	0.38	13.88	39.96	39.66	60.00	50.00	20.04	10.34	L	
12	21.97865	24.30	23.90	0.38	13.89	38.57	38.17	60.00	50.00	21.43	11.83	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

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

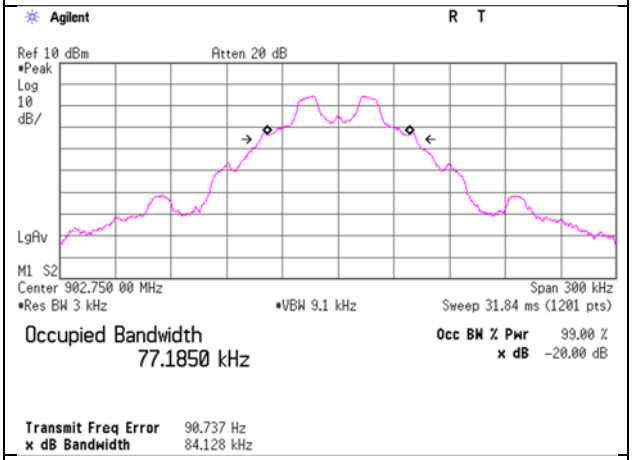
Test place	Ise EMC Lab.	
	No.8 Measurement Room	No.3 Anechoic Chamber
Date	December 19, 2022	February 2, 2023
Temperature / Humidity	24 deg. C / 31 % RH	21 deg. C / 39 % RH
Engineer	Hiroyuki Furutaka	Keiya Ido
Mode	Tx, Hopping Off / Tx, Hopping On	

Freq. [MHz]	20 dB Bandwidth [MHz]	Limit for 20dB Bandwidth [MHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
902.75	0.084	0.500	77.185	0.500	>= 0.084
915.25	0.084	0.500	77.017	0.500	>= 0.084
927.25	0.084	0.500	77.425	0.500	>= 0.084
Hopping On	-	-	25481.700	-	-

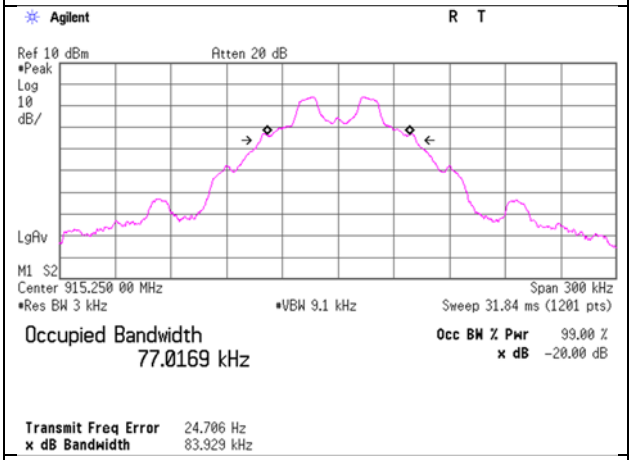
Limit: 20dB Bandwidth or 25 kHz (whichever is greater).

20dB Bandwidth and 99% Occupied Bandwidth

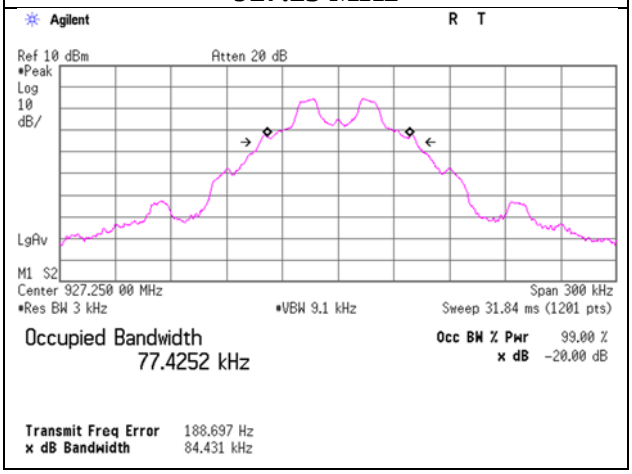
902.75 MHz



915.25 MHz

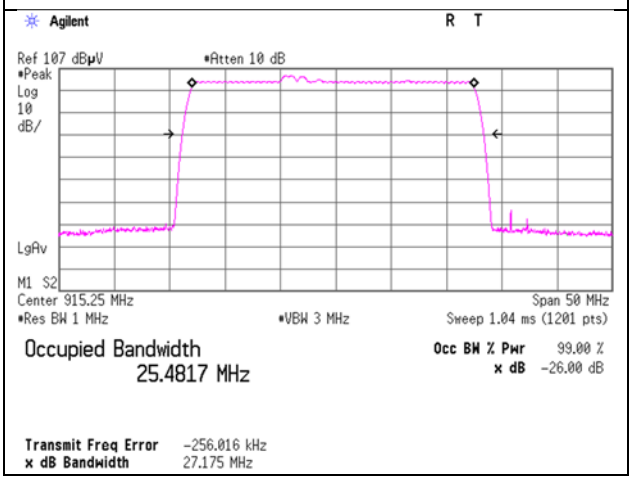


927.25 MHz



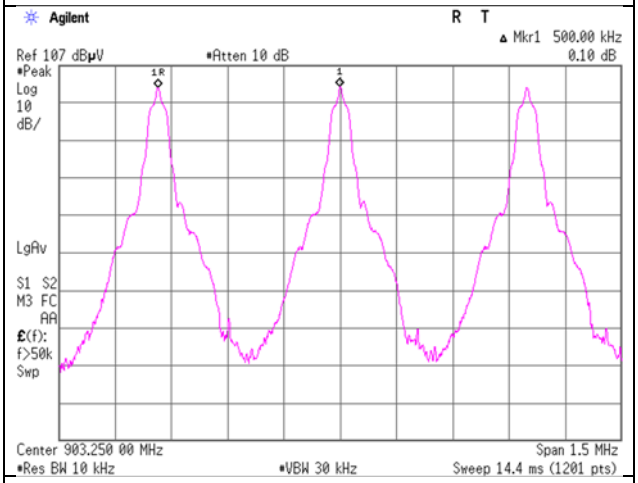
20dB Bandwidth and 99% Occupied Bandwidth

Hopping On

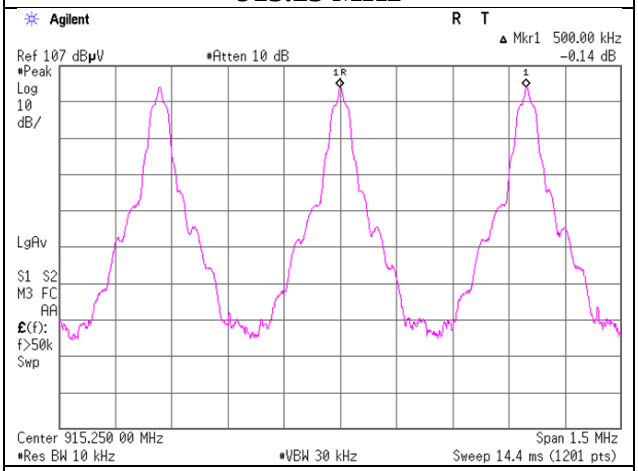


Carrier Frequency Separation

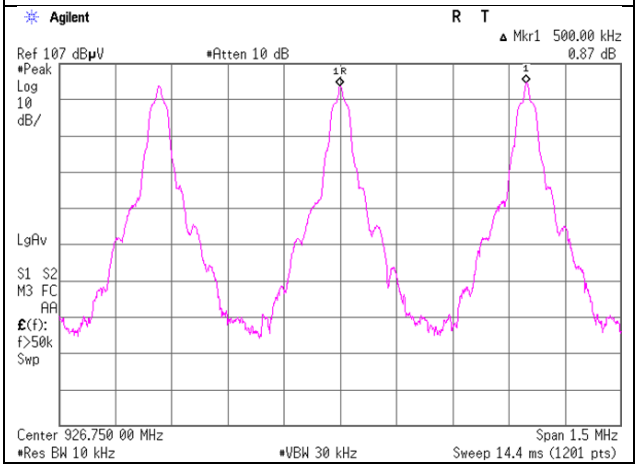
902.75 MHz



915.25 MHz



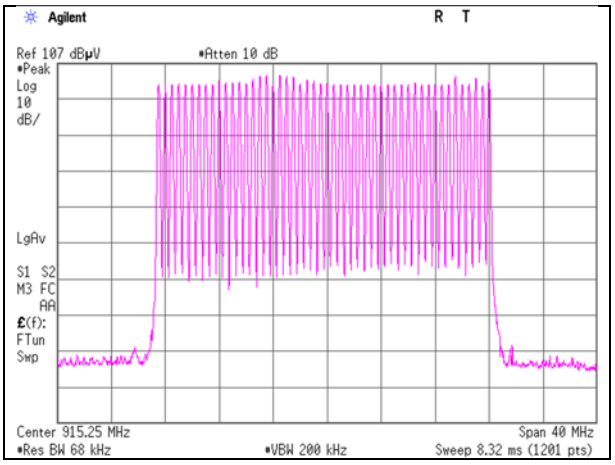
927.25 MHz



Number of Hopping Frequency

Test place	Ise EMC Lab. No.8 Measurement Room
Date	December 19, 2022
Temperature / Humidity	24 deg. C / 31 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping On

Number of channel [channels]	Limit [channels]
50	>= 50



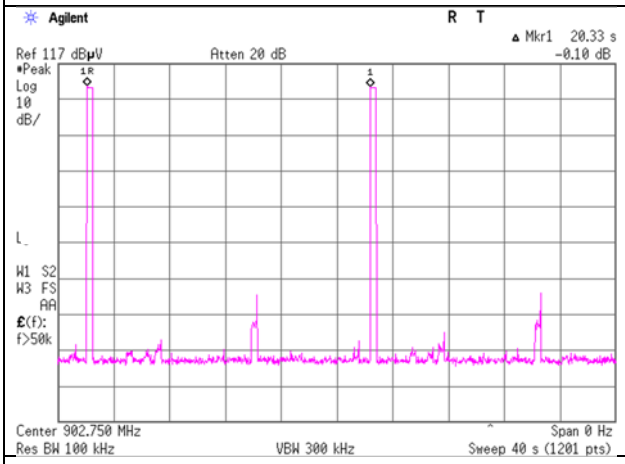
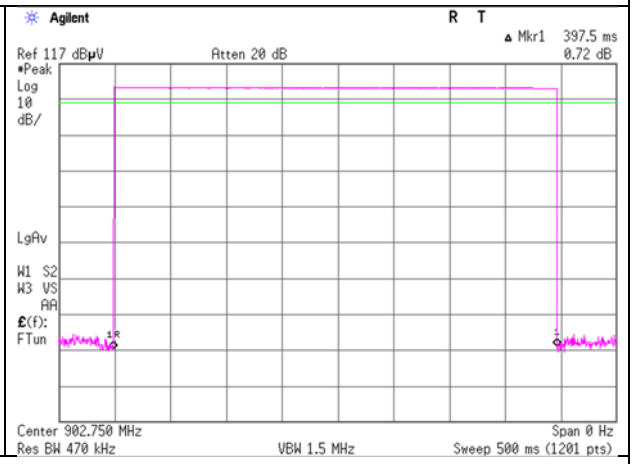
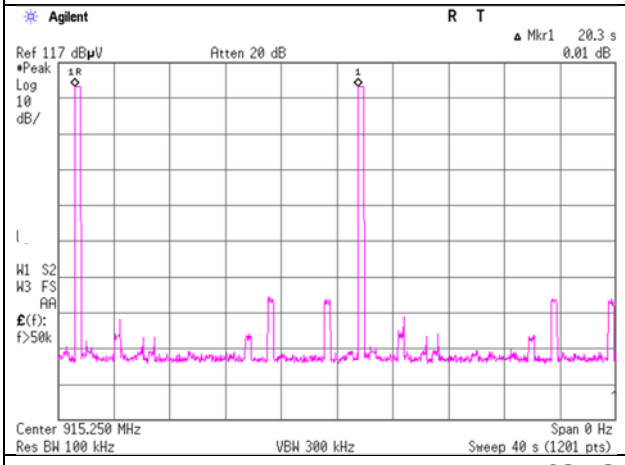
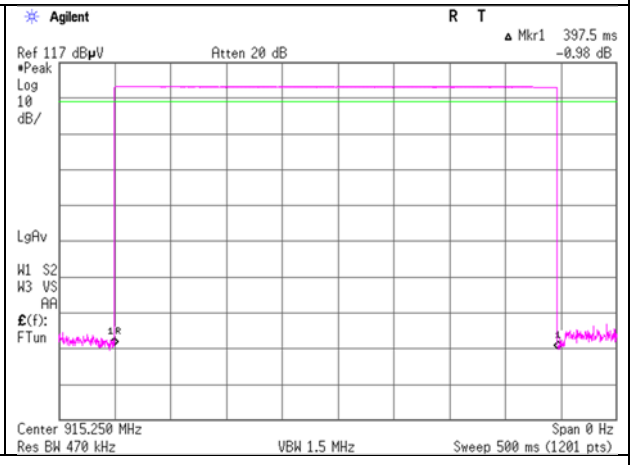
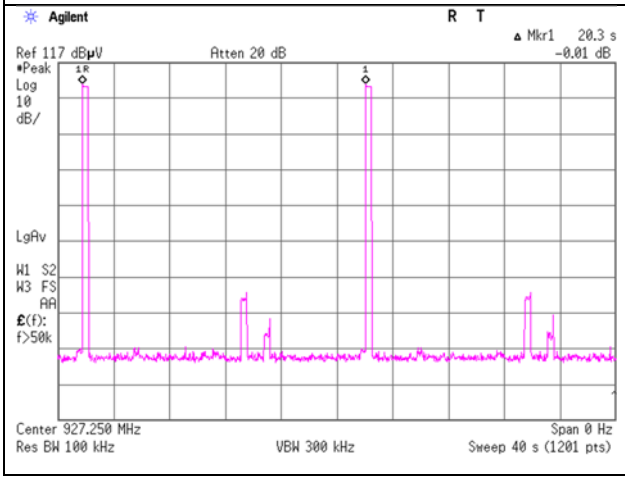
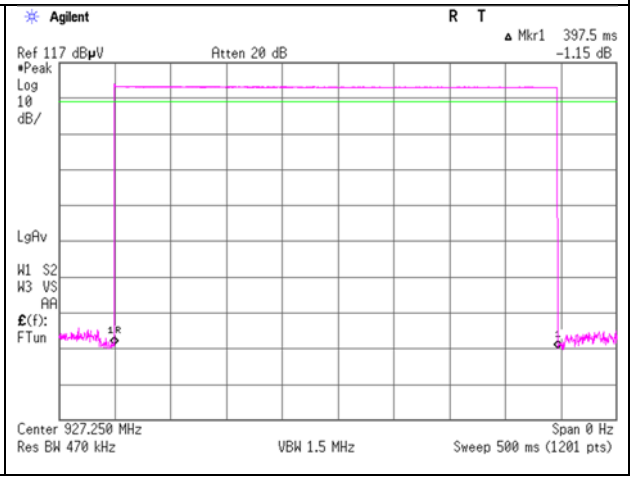
Dwell time

Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 16, 2023
Temperature / Humidity	22 deg. C / 32 % RH
Engineer	Junya Okuno
Mode	Tx, Hopping On

Frequency [MHz]	Number of transmiusson in 20 sec period	Length of transmission [msec]	Result [msec]	Limit [msec]
902.75	1	397.500	397.5	400
915.25	1	397.500	397.5	400
927.25	1	397.500	397.5	400

Sample Calculation
Result = Number of transmission x Length of transmission

Dwell time

Sampling (Representative chart)	Transmit Time
902.75 MHz	
	
915.25 MHz	
	
927.25 MHz	
	

Maximum Peak Output Power

Test place	Ise EMC Lab. No.3 Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	21 deg. C / 39 % RH
Engineer	Keiya Ido
Mode	Tx, Hopping Off

				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]
902.75	2.29	0.41	19.96	22.66	184.50	30.00	1000	7.34	3.62	26.28	424.62	36.02	4000	9.74
915.25	2.40	0.41	19.96	22.77	189.23	30.00	1000	7.23	3.62	26.39	435.51	36.02	4000	9.63
927.25	2.39	0.42	19.96	22.77	189.23	30.00	1000	7.23	3.62	26.39	435.51	36.02	4000	9.63

Sample Calculation:
Result = Reading + Cable Loss + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Average Output Power
(Reference data for RF Exposure)

Test place	Ise EMC Lab. No.3 Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	21 deg. C / 39 % RH
Engineer	Keiya Ido
Mode	Tx, Hopping Off

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
902.75	0.22	0.41	19.96	20.59	114.55	0.00	20.59	114.55
915.25	0.30	0.41	19.96	20.67	116.68	0.00	20.67	116.68
927.25	0.28	0.42	19.96	20.66	116.41	0.00	20.66	116.41

Sample Calculation:
Result (Time average) = Reading + Cable Loss + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

Maximum Peak Output Power (Worst Polarization Check)

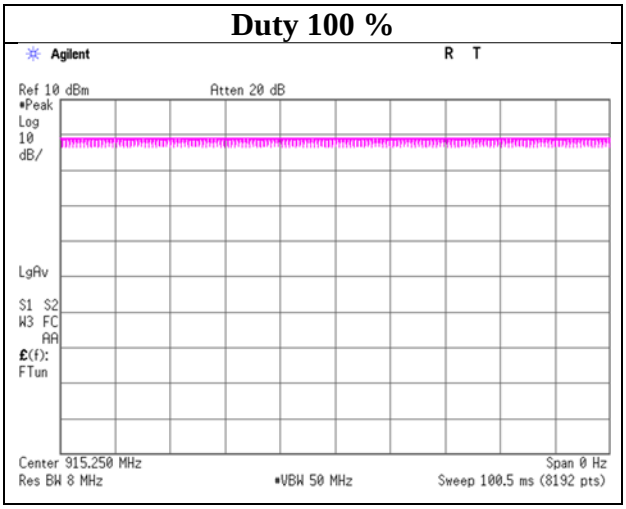
Test place	Ise EMC Lab. No.3 Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	21 deg. C / 39 % RH
Engineer	Keiya Ido
Mode	Tx, Hopping Off

Antenna Polarization	Freq. [MHz]	Reading Hori. [dBm]	Reading Vert. [dBm]	Sum [dBm]	Remarks
Circle	915.25	-0.78	-0.66	2.29	*Sum is Hori + Vert
Hori.	915.25	2.39	-	-	
Vert.	915.25	-	***2.81***	-	

Burst Rate Confirmation

Test place	Ise EMC Lab. No.3 Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	21 deg. C / 39 % RH
Engineer	Keiya Ido
Mode	Tx, Hopping Off

Duty 100 %



Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	February 1, 2023	February 1, 2023
Temperature / Humidity	22 deg. C / 33 % RH	22 deg. C / 32 % RH
Engineer	Yuta Moriya	Keiya Ido
	(Below 1 GHz)	(Above 1 GHz)
Mode	Tx, Hopping Off, 902.75 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	2708.3	57.9	55.0	28.0	5.9	36.3	-	55.5	52.6	73.9	53.9	18.4	1.3	
Hori.	3611.0	52.6	48.5	29.1	7.1	36.1	-	52.8	48.7	73.9	53.9	21.1	5.2	
Hori.	4513.8	49.7	44.1	30.9	7.0	35.8	-	51.9	46.3	73.9	53.9	22.0	7.7	
Hori.	5416.5	49.2	42.1	31.7	7.2	35.7	-	52.4	45.3	73.9	53.9	21.5	8.6	
Hori.	7222.0	46.4	38.5	35.9	7.6	35.9	-	54.0	46.2	73.9	53.9	19.9	7.7	
Hori.	8124.8	44.8	36.4	36.7	7.9	36.0	-	53.3	44.9	73.9	53.9	20.6	9.0	
Hori.	9027.5	43.7	35.5	37.5	8.2	36.1	-	53.3	45.1	73.9	53.9	20.6	8.8	Floor noise
Vert.	2708.3	59.6	55.7	28.0	5.9	36.3	-	57.3	53.4	73.9	53.9	16.6	0.5	
Vert.	3611.0	56.9	53.4	29.1	7.1	36.1	-	57.1	53.6	73.9	53.9	16.8	0.3	
Vert.	4513.8	49.1	43.6	30.9	7.0	35.8	-	51.2	45.7	73.9	53.9	22.7	8.2	
Vert.	5416.5	48.5	42.9	31.7	7.2	35.7	-	51.7	46.2	73.9	53.9	22.2	7.8	
Vert.	7222.0	45.3	37.4	35.9	7.6	35.9	-	52.9	45.0	73.9	53.9	21.0	8.9	
Vert.	8124.8	43.2	36.4	36.7	7.9	36.0	-	51.7	44.8	73.9	53.9	22.2	9.1	
Vert.	9027.5	43.7	35.5	37.5	8.2	36.1	-	53.3	45.1	73.9	53.9	20.6	8.8	Floor noise

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

20dBc Data Sheet

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	902.8	86.4	22.3	14.2	0.0	122.8	-	-	Carrier
Hori.	902.0	25.2	22.3	14.2	0.0	61.6	102.8	41.2	
Hori.	1805.5	72.3	25.3	5.9	36.4	67.2	102.8	35.6	
Hori.	6319.3	43.7	33.2	7.4	35.7	48.6	102.8	54.2	
Vert.	902.8	85.4	22.3	14.2	0.0	121.9	-	-	Carrier
Vert.	902.0	25.6	22.3	14.2	0.0	62.0	101.9	39.8	
Vert.	1805.5	71.0	25.3	5.9	36.4	65.8	101.9	36.0	
Vert.	6319.3	49.4	33.2	7.4	35.7	54.3	101.9	47.6	

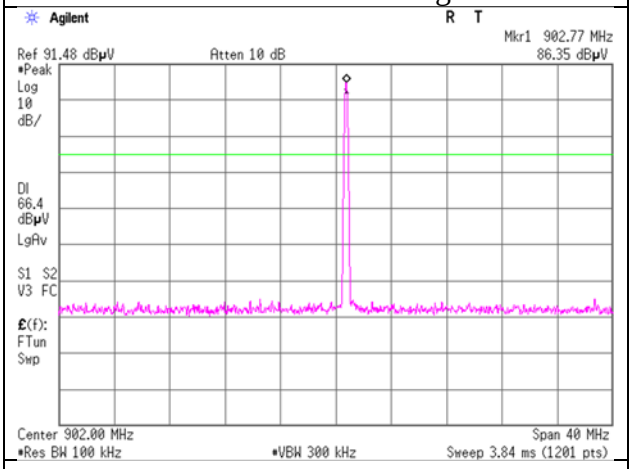
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)
Distance factor: 1 GHz - 10 GHz 20log (3.95 m / 3.0 m) = 2.39 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	February 1, 2023
Temperature / Humidity	22 deg. C / 33 % RH
Engineer	Yuta Moriya
	(Below 1 GHz)
Mode	Tx, Hopping Off, 902.75MHz

Horizontal

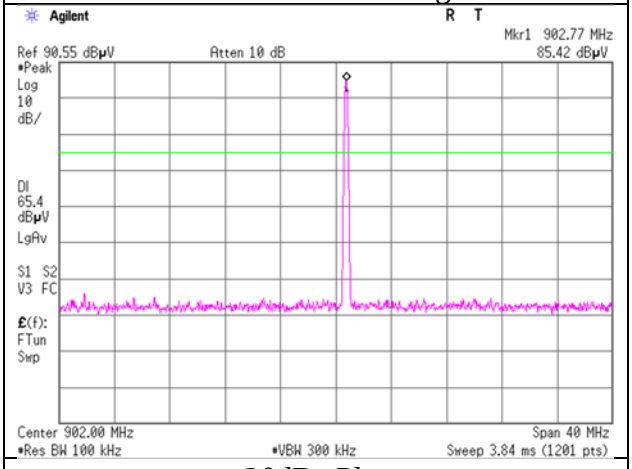
Authorized-band band-edge Plot



20dBc Plot

Vertical

Authorized-band band-edge 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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	February 1, 2023	February 1, 2023
Temperature / Humidity	22 deg. C / 32 % RH	22 deg. C / 33 % RH
Engineer	Keiya Ido	Yuta Moriya
	(Above 1 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 915.25 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	40.7	24.3	-	14.7	6.8	28.6	-	17.3	-	40.0	-	22.7	-	
Hori.	70.9	22.3	-	6.4	7.2	28.5	-	7.4	-	40.0	-	32.6	-	
Hori.	168.0	37.6	-	15.7	8.0	28.2	-	33.1	-	43.5	-	10.4	-	
Hori.	269.4	36.3	-	13.4	8.7	27.7	-	30.7	-	46.0	-	15.3	-	
Hori.	291.6	33.1	-	13.9	8.8	27.7	-	28.2	-	46.0	-	17.9	-	
Hori.	358.8	23.8	-	15.3	9.3	28.1	-	20.2	-	46.0	-	25.8	-	
Hori.	2745.8	55.5	51.5	28.2	6.0	36.3	-	53.3	49.3	73.9	53.9	20.6	4.6	
Hori.	3661.0	53.7	49.2	29.3	7.1	36.0	-	54.1	49.5	73.9	53.9	19.9	4.4	
Hori.	4576.3	49.5	43.5	31.0	7.0	35.8	-	51.8	45.7	73.9	53.9	22.1	8.2	
Hori.	5491.5	50.0	44.7	31.8	7.2	35.7	-	53.4	48.0	73.9	53.9	20.6	5.9	
Hori.	7322.0	45.4	37.3	36.1	7.6	35.9	-	53.2	45.1	73.9	53.9	20.7	8.8	
Hori.	8237.3	44.0	35.0	36.3	7.9	36.0	-	52.1	43.1	73.9	53.9	21.8	10.8	Floor noise
Hori.	9152.5	43.4	34.6	38.1	8.2	36.1	-	53.6	44.7	73.9	53.9	20.3	9.2	Floor noise
Vert.	40.7	39.5	-	14.7	6.8	28.6	-	32.5	-	40.0	-	7.5	-	
Vert.	70.9	37.9	-	6.4	7.2	28.5	-	23.0	-	40.0	-	17.0	-	
Vert.	168.0	33.8	-	15.7	8.0	28.2	-	29.3	-	43.5	-	14.2	-	
Vert.	269.4	43.5	-	13.4	8.7	27.7	-	37.9	-	46.0	-	8.1	-	
Vert.	295.6	36.9	-	13.9	8.9	27.7	-	32.0	-	46.0	-	14.1	-	
Vert.	362.7	33.1	-	15.3	9.3	28.2	-	29.5	-	46.0	-	16.5	-	
Vert.	2745.8	57.3	54.0	28.2	6.0	36.3	-	55.1	51.8	73.9	53.9	18.8	2.1	
Vert.	3661.0	53.0	48.9	29.3	7.1	36.0	-	53.3	49.2	73.9	53.9	20.6	4.7	
Vert.	4576.3	48.4	42.0	31.0	7.0	35.8	-	50.7	44.3	73.9	53.9	23.2	9.6	
Vert.	5491.5	48.6	43.5	31.8	7.2	35.7	-	51.9	46.8	73.9	53.9	22.0	7.1	
Vert.	7322.0	45.5	36.8	36.1	7.6	35.9	-	53.3	44.6	73.9	53.9	20.6	9.3	
Vert.	8237.3	44.3	35.2	36.3	7.9	36.0	-	52.5	43.4	73.9	53.9	21.4	10.5	Floor noise
Vert.	9152.5	43.4	34.9	38.1	8.2	36.1	-	53.5	45.1	73.9	53.9	20.4	8.8	Floor noise

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

*QP detector was used up to 1GHz.

20dBc Data Sheet

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	915.3	85.8	22.3	14.3	0.0	122.3	-	-	Carrier
Hori.	1830.5	68.9	25.4	5.9	36.3	63.8	102.3	38.5	
Hori.	6406.8	42.4	33.6	7.4	35.7	47.7	102.3	54.6	
Vert.	915.3	86.3	22.3	14.3	0.0	122.9	-	-	Carrier
Vert.	1830.5	63.0	25.4	5.9	36.3	57.9	102.9	44.9	
Vert.	6406.8	44.8	33.6	7.4	35.7	50.1	102.9	52.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (3.95 m / 3.0 m) = 2.39 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	February 1, 2023	February 1, 2023
Temperature / Humidity	22 deg. C / 33 % RH	22 deg. C / 32 % RH
Engineer	Yuta Moriya	Keiya Ido
	(Below 1 GHz)	(Above 1 GHz)
Mode	Tx, Hopping Off, 927.25 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	2781.8	56.7	52.9	28.3	6.0	36.3	-	54.7	50.9	73.9	53.9	19.2	3.0	
Hori.	3709.0	55.5	51.5	29.4	7.0	36.0	-	55.9	51.9	73.9	53.9	18.1	2.0	
Hori.	4636.3	50.1	44.8	31.2	7.0	35.8	-	52.5	47.2	73.9	53.9	21.5	6.7	
Hori.	5563.5	50.8	44.9	31.7	7.3	35.7	-	54.1	48.2	73.9	53.9	19.8	5.7	
Hori.	7418.0	46.4	39.2	36.2	7.7	35.9	-	54.4	47.2	73.9	53.9	19.6	6.7	
Hori.	8345.3	44.3	35.5	36.2	8.0	36.1	-	52.4	43.6	73.9	53.9	21.5	10.3	Floor noise
Hori.	9272.5	43.4	35.6	38.6	8.3	36.2	-	54.1	46.3	73.9	53.9	19.8	7.6	Floor noise
Vert.	2781.8	57.7	53.5	28.3	6.0	36.3	-	55.6	51.4	73.9	53.9	18.3	2.5	
Vert.	3709.0	55.1	51.5	29.4	7.0	36.0	-	55.5	51.9	73.9	53.9	18.4	2.0	
Vert.	4636.3	48.5	42.3	31.2	7.0	35.8	-	50.9	44.7	73.9	53.9	23.0	9.2	
Vert.	5563.5	49.7	43.7	31.7	7.3	35.7	-	53.1	47.1	73.9	53.9	20.9	6.8	
Vert.	7418.0	45.4	37.4	36.2	7.7	35.9	-	53.4	45.4	73.9	53.9	20.5	8.5	
Vert.	8345.3	44.6	35.5	36.2	8.0	36.1	-	52.7	43.7	73.9	53.9	21.2	10.3	Floor noise
Vert.	9272.5	43.5	35.6	38.6	8.3	36.2	-	54.2	46.2	73.9	53.9	19.7	7.7	Floor noise

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

*QP detector was used up to 1GHz.

20dBc Data Sheet

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	927.3	85.8	22.3	14.3	0.0	122.5	-	-	Carrier
Hori.	928.0	25.0	22.3	14.3	0.0	61.6	102.5	40.9	
Hori.	1854.5	72.7	25.5	6.0	36.3	67.8	102.5	34.7	
Hori.	6490.8	46.7	34.0	7.5	35.8	52.3	102.5	50.1	
Vert.	927.3	85.2	22.3	14.3	0.0	121.8	-	-	Carrier
Vert.	928.0	24.8	22.3	14.3	0.0	61.5	101.8	40.3	
Vert.	1854.5	65.5	25.5	6.0	36.3	60.6	101.8	41.2	
Vert.	6490.8	46.0	34.0	7.5	35.8	51.7	101.8	50.1	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

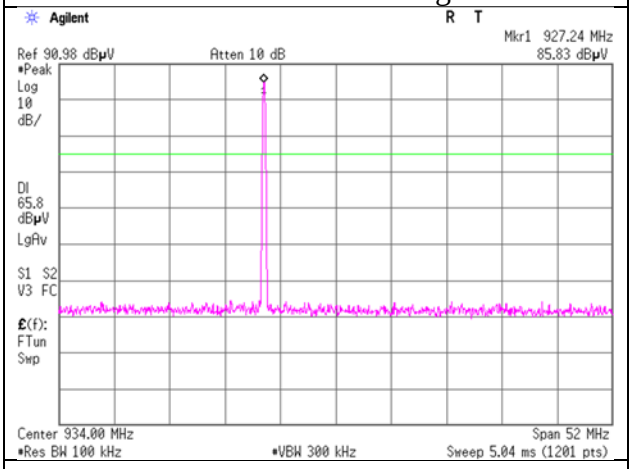
Distance factor: 1 GHz - 10 GHz 20log (3.95 m / 3.0 m) = 2.39 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	February 1, 2023
Temperature / Humidity	22 deg. C / 33 % RH
Engineer	Yuta Moriya
	(Below 1 GHz)
Mode	Tx, Hopping Off, 927.25 MHz

Horizontal

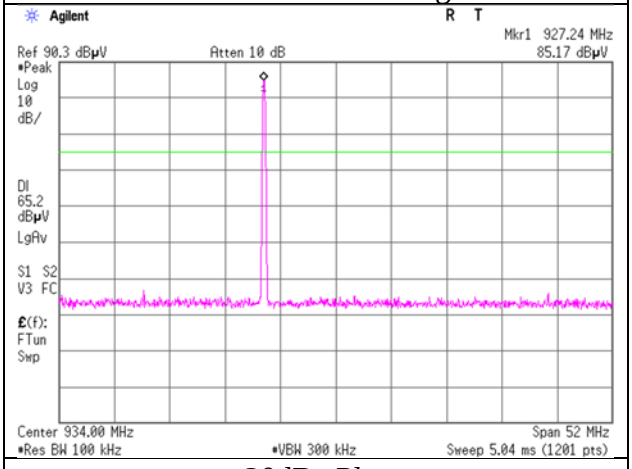
Authorized-band band-edge Plot



20dBc Plot

Vertical

Authorized-band band-edge Plot

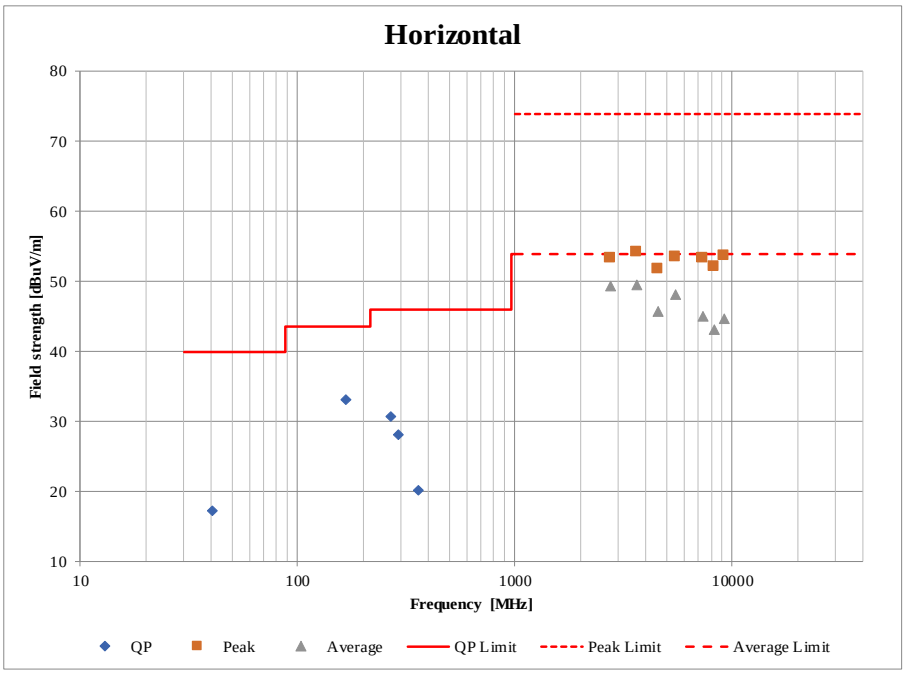


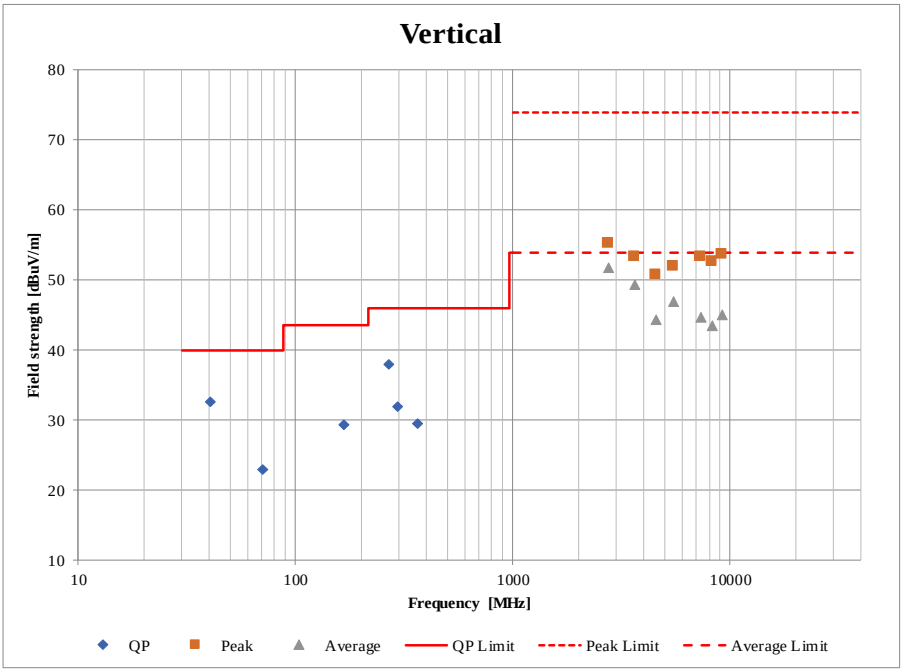
20dBc Plot

* 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
(Plot data, Worst case mode for Maximum Peak Output Power)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	February 1, 2023	February 1, 2023
Temperature / Humidity	22 deg. C / 32 % RH	22 deg. C / 33 % RH
Engineer	Keiya Ido	Yuta Moriya
	(Above 1 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 915.25 MHz	





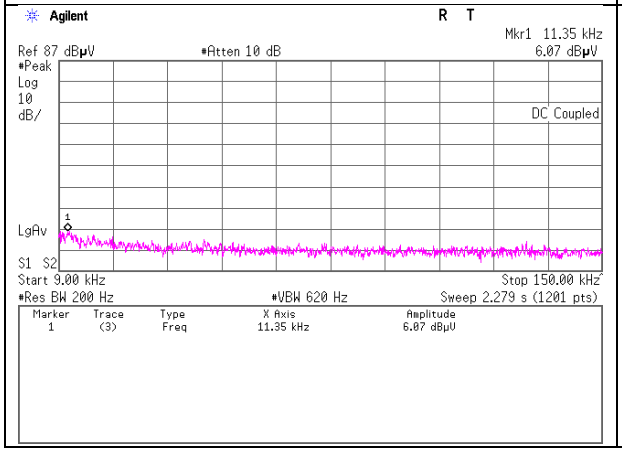
*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

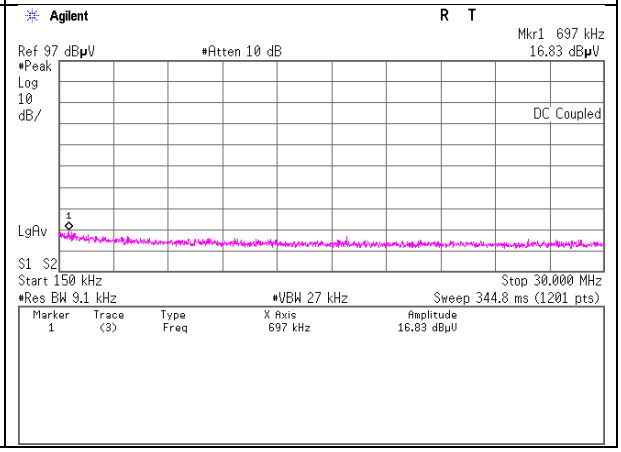
Test place	Ise EMC Lab. No.3 Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	21 deg. C / 39 % RH
Engineer	Keiya Ido
Mode	Tx, Hopping Off

902.75 MHz

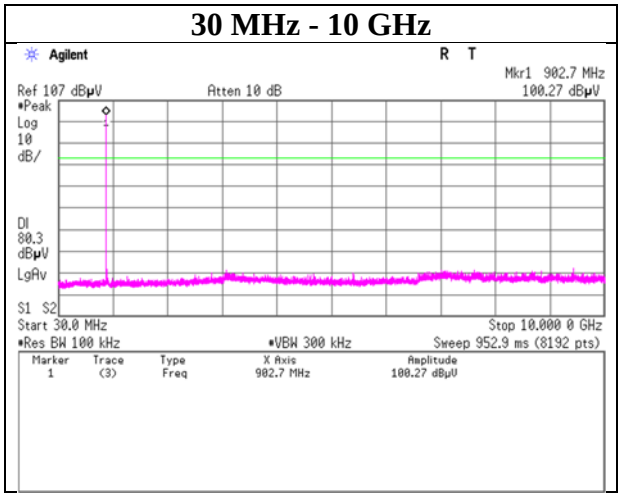
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 10 GHz

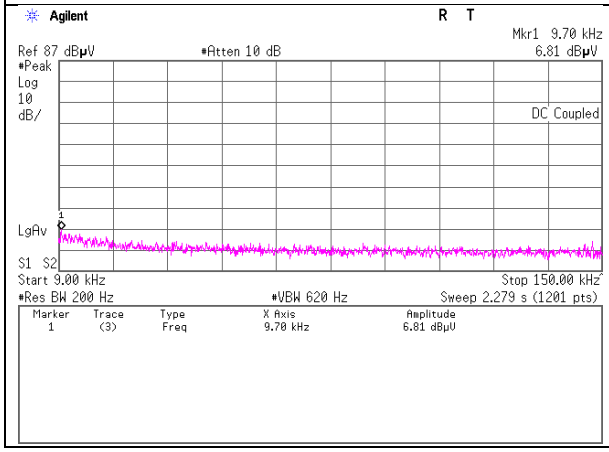


Conducted Spurious Emission

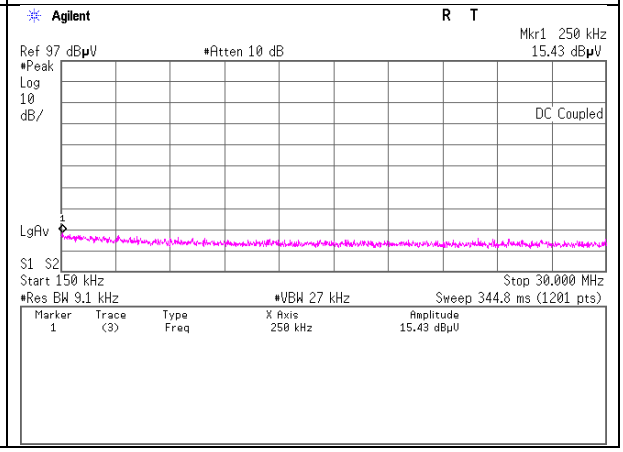
Test place	Ise EMC Lab. No.3 Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	21 deg. C / 39 % RH
Engineer	Keiya Ido
Mode	Tx, Hopping Off

915.25 MHz

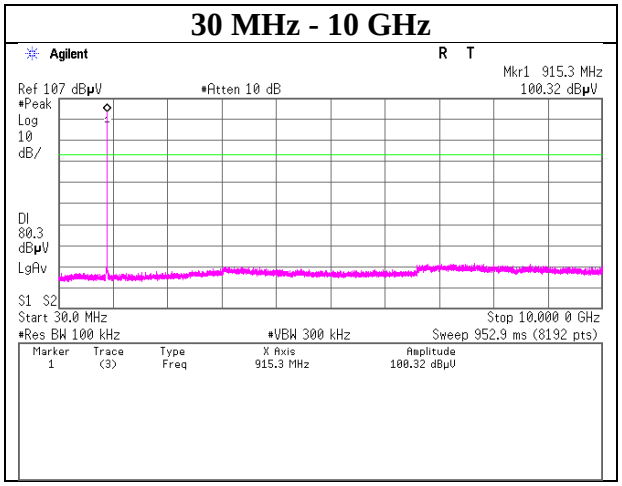
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 10 GHz

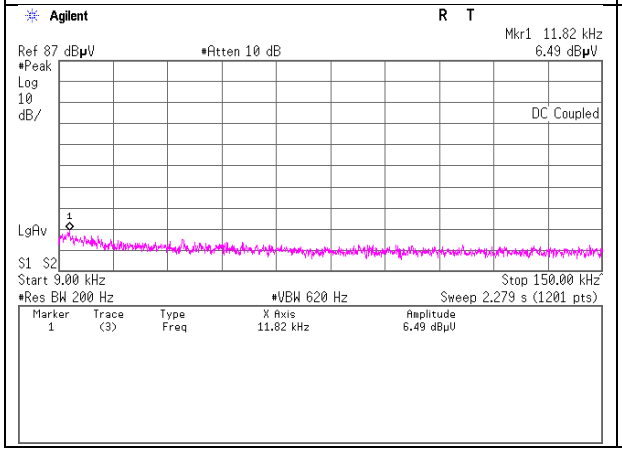


Conducted Spurious Emission

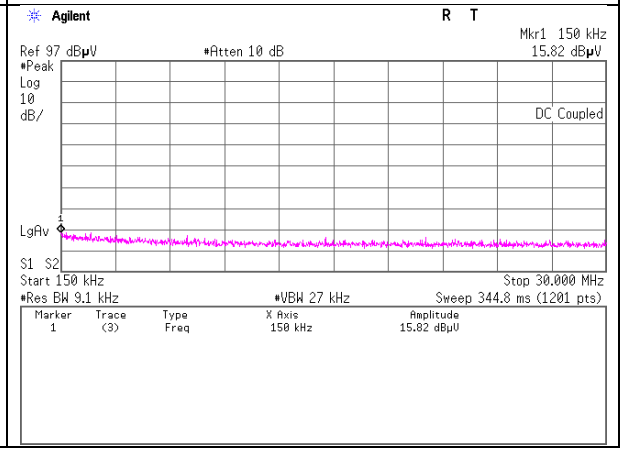
Test place	Ise EMC Lab. No.3 Anechoic Chamber
Date	February 2, 2023
Temperature / Humidity	21 deg. C / 39 % RH
Engineer	Keiya Ido
Mode	Tx, Hopping Off

927.25 MHz

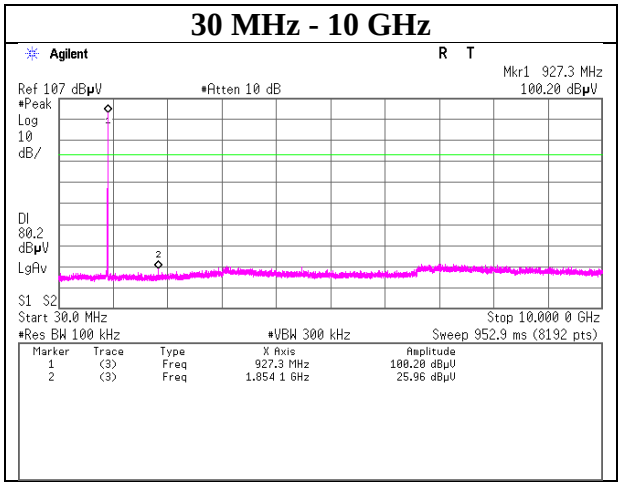
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 10 GHz

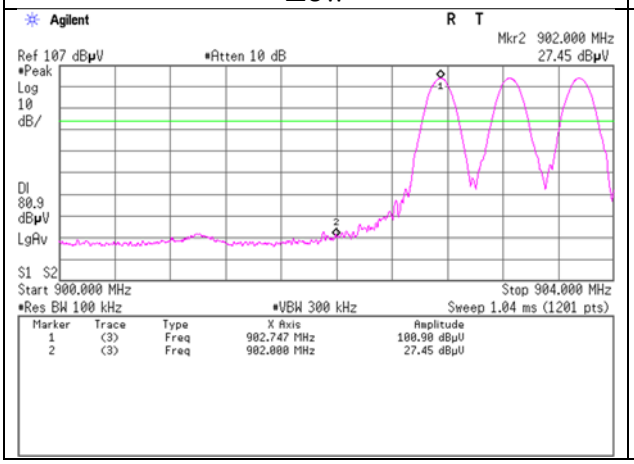


Conducted Emission Band Edge compliance

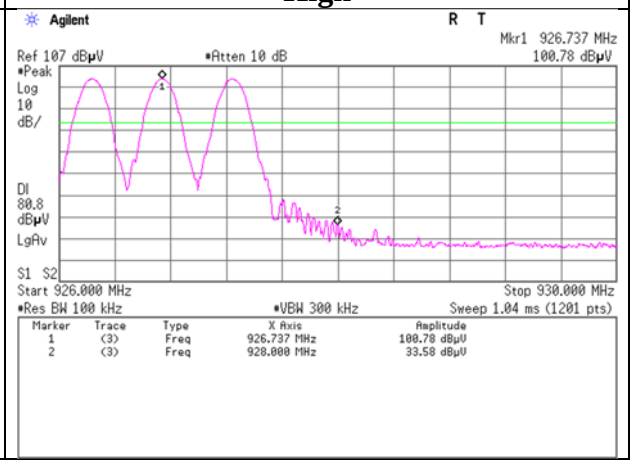
Test place	Ise EMC Lab.	
	No.8 Measurement Room	No.3 Anechoic Chamber
Date	December 19, 2022	February 2, 2023
Temperature / Humidity	24 deg. C / 31 % RH	21 deg. C / 39 % RH
Engineer	Hiroyuki Furutaka	Keiya Ido
Mode	Tx, Hopping Off / Tx, Hopping On	

Hopping On

Low

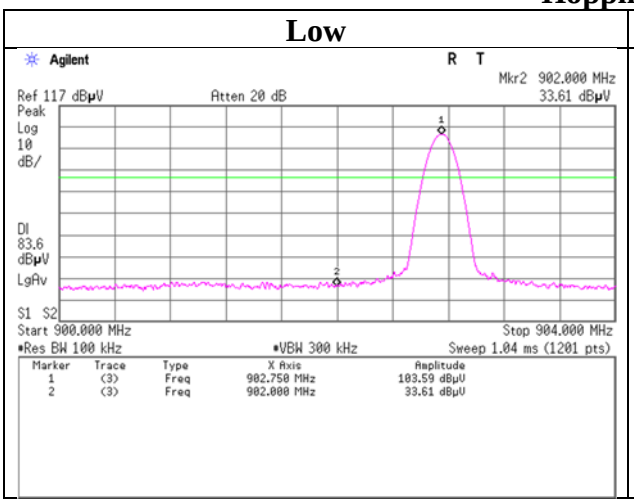


High

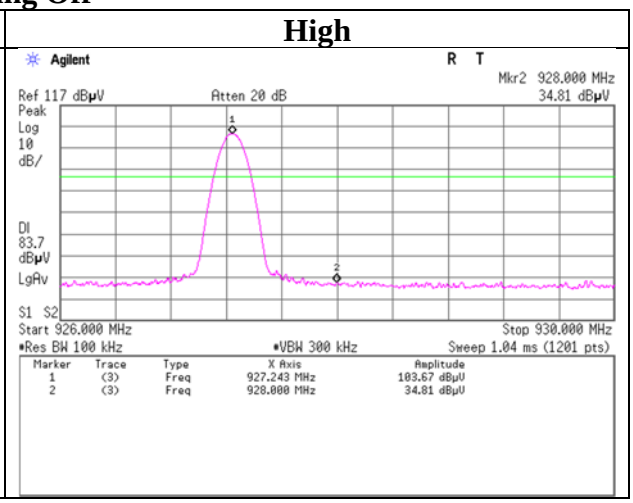


Hopping Off

Low



High



APPENDIX 2: Test Instruments

Test Equipment (1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
CE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/23/2022	24
CE	MAT-67	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/22/2022	12
CE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/ sucoform141-PE/ 421-010/ RFM-E321(SW)	-/00640	07/09/2022	12
CE	MJM-16	142183	Measure	KOMELON	KMC-36	-	10/03/2022	12
CE	MLS-24	141358	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-730	07/28/2022	12
CE	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/17/2023	12
CE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/13/2023	12
CE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	07/29/2022	12
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	KBA-05	141198	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+ BBA9106	2513	05/14/2022	12
RE	MAEC-01	141998	AC1_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	06/28/2022	24
RE	MAEC-01-SVSWR	141994	AC1_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 10m	DA-06881	04/05/2021	24
RE	MAT-08	141213	Attenuator(6dB)	Weinschel Corp	2	BK7971	11/19/2022	12
RE	MCC-02	141350	Coaxial Cable	Suhner/storm/Agilent/ TSJ	-	-	03/08/2022	12
RE	MCC-217	141393	Microwave Cable	Junkosha	MWX221	1604S254(1 m) / 1608S088(5 m)	08/02/2022	12
RE	MCC-38	141395	Coaxial Cable	UL Japan	-	-	11/18/2022	12
RE	MHA-05	141511	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	253	09/20/2022	12
RE	MHF-03	141402	High pass Filter 1.4-5.0GHz	Mini-Circuits	VHF-1320	10411	08/01/2022	12
RE	MHF-04	141403	High Pass Filter 1.22-4.60GHz	Mini-Circuits	VHF-1200	10435	08/01/2022	12
RE	MHF-18	141408	High Pass Filter 3.5-18.0GHz	TOKIMEC	TF323DCA	7002	09/07/2022	12
RE	MJM-25	142226	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	MLA-20	141264	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	189	05/14/2022	12
RE	MMM-09	141533	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201195	01/18/2023	12
RE	MOS-27	141566	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	A08Q26	01/13/2023	12
RE	MPA-19	141585	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	2023/02/02	12

Test Equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MPA-01	141576	Pre Amplifier	Keysight Technologies Inc	8449B	3008A01671	02/22/2022	12
RE	MRF-12	192072	Band Rejection Filter(902-928MHz)	Wakoh Communication Industrial Co., Ltd.	WFR-481	19122541	03/02/2022	12
RE	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	02/18/2022	12
RE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	07/29/2022	12
AT	MAT-112	220646	Attenuator	Huber+Suhner	6806_N-50-1	-	06/07/2022	12
AT	MAT-17	141171	Attenuator(20dB)_ DC-1GHz_N	Weinschel Corp	MODEL 1	BG0143	12/22/2022	12
AT	MAT-21	141174	Attenuator(20dB)(above 1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	01/20/2023	12
AT	MCC-210	141289	Microwave Cable	RS Pro	R-132G7210200CD	-	04/14/2022	12
AT	MCC-211	141322	Microwave Cable	RS Pro	R-132G7210200CD	-	04/14/2022	12
AT	MCC-38	141395	Coaxial Cable	UL Japan	-	-	11/18/2022	12
AT	MJM-27	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
AT	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/17/2023	12
AT	MMM-18	141558	Digital Tester (TRUE RMS MULTIMETER)	Fluke Corporation	115	17930030	05/17/2022	12
AT	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/13/2023	12
AT	MOS-14	141561	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1401	01/13/2023	12
AT	MOS-28	141567	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0008	01/13/2023	12
AT	MPM-13	141810	Power Meter	Anritsu Corporation	ML2495A	824014	12/26/2022	12
AT	MPSE-18	141832	Power sensor	Anritsu Corporation	MA2411B	738174	12/26/2022	12
AT	MRENT-130	141855	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187750	12/01/2022	12
AT	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/31/2022	12
AT	MSA-14	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	01/16/2023	12
AT	MTA-36	142820	Terminator	Baumer	50Ω SMA	-	-	-

***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**
RE: Radiated Emission
AT: Antenna Terminal Conducted