



RADIO TEST REPORT

Test Report No. : 12987093S-B-R1

Applicant : Yokogawa Electric Corporation
Type of Equipment : Wireless Vibration Sensor
Model No. : XS770A
FCC ID : SGJ-WFC016
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 12987093S-B. 12987093S-B is replaced with this report.

Date of test: August 2 to 13, 2019

Representative test engineer:

M. Hosaka

Makoto Hosaka
Engineer
Consumer Technology Division

Approved by:

K. Takeyama

Kazutaka Takeyama
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".

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

REVISION HISTORY

Original Test Report No.: 12987093S-B

[illegible]

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	MRA	Mutual Recognition Arrangement
AC	Alternating Current	NIST	National Institute of Standards and Technology
AFH	Adaptive Frequency Hopping	NS	No signal detect.
AM	Amplitude Modulation	NSA	Normalized Site Attenuation
Amp, AMP	Amplifier	NVLAP	National Voluntary Laboratory Accreditation Program
ANSI	American National Standards Institute	OBW	Occupied Band Width
Ant, ANT	Antenna	OFDM	Orthogonal Frequency Division Multiplexing
AP	Access Point	P/M	Power meter
ASK	Amplitude Shift Keying	PCB	Printed Circuit Board
Atten., ATT	Attenuator	PER	Packet Error Rate
AV	Average	PHY	Physical Layer
BPSK	Binary Phase-Shift Keying	PK	Peak
BR	Bluetooth Basic Rate	PN	Pseudo random Noise
BT	Bluetooth	PRBS	Pseudo-Random Bit Sequence
BT LE	Bluetooth Low Energy	PSD	Power Spectral Density
BW	BandWidth	QAM	Quadrature Amplitude Modulation
Cal Int	Calibration Interval	QP	Quasi-Peak
CCK	Complementary Code Keying	QPSK	Quadri-Phase Shift Keying
Ch., CH	Channel	RBW	Resolution Band Width
CISPR	Comite International Special des Perturbations Radioelectriques	RDS	Radio Data System
CW	Continuous Wave	RE	Radio Equipment
DBPSK	Differential BPSK	RF	Radio Frequency
DC	Direct Current	RMS	Root Mean Square
DFS	Dynamic Frequency Selection	RSS	Radio Standards Specifications
DQPSK	Differential QPSK	Rx	Receiving
DSSS	Direct Sequence Spread Spectrum	SA, S/A	Spectrum Analyzer
EDR	Enhanced Data Rate	SG	Signal Generator
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	SVSWR	Site-Voltage Standing Wave Ratio
EMC	ElectroMagnetic Compatibility	TR	Test Receiver
EMI	ElectroMagnetic Interference	Tx	Transmitting
EN	European Norm	VBW	Video BandWidth
ERP, e.r.p.	Effective Radiated Power	Vert.	Vertical
EU	European Union	WLAN	Wireless LAN
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		

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

CONTENTS	PAGE
SECTION 1: Customer information.....	5
SECTION 2: Equipment under test (E.U.T.).....	5
SECTION 3: Test specification, procedures & results.....	6
SECTION 4: Operation of E.U.T. during testing.....	9
SECTION 5: Radiated Spurious Emission	10
SECTION 6: Antenna Terminal Conducted Tests.....	12
APPENDIX 1: Test data	13
6 dB Bandwidth and 99 % Occupied Bandwidth.....	13
Maximum Peak Output Power	15
Average Output Power	16
Radiated Spurious Emission	18
Conducted Spurious Emission	24
Power Density	27
APPENDIX 2: Test instruments	29
APPENDIX 3: Photographs of test setup	30
Radiated Spurious Emission	30

SECTION 1: Customer information

Company Name	:	Yokogawa Electric Corporation
Address	:	2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750 Japan
Telephone Number	:	+81-422-52-5885
Facsimile Number	:	+81-422-52-2102
Contact Person	:	Yuuji Aono

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., 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 (E.U.T.)
- SECTION 4: Operation of E.U.T. 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 (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Wireless Vibration Sensor
Model No.	:	XS770A
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 3.6 V
Receipt Date of Sample (Information from test lab.)	:	August 2, 2019
Country of Mass-production	:	Japan
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: XS770A (referred to as the EUT in this report) is a Wireless Vibration Sensor.

General Specification

Clock frequencies in the system	:	32.768 kHz (RTC), 11 MHz (CPU), 32 MHz (Transceiver IC)
---------------------------------	---	---

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	903.0 MHz - 914.2 MHz
Modulation	:	LoRa, CSS
Antenna type	:	Built-in omni-directinal antenna
Antenna gain	:	-1.5 dBi
Operating temperature range	:	-20 deg.C to +85 deg.C

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

Title : FCC 47CFR 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

* The revision on July 19, 2019, does not affect the test specification applied to the EUT.

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods	FCC: Section 15.207	-	N/A	*1)
	ISED: RSS-Gen 8.8	ISED: RSS-Gen 8.8			
6 dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(a)(2)	See data.	Complied a)	Conducted
	ISED: -	ISED: RSS-247 5.2(a)		Complied b)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(b)(3)		Complied c)	Conducted
	ISED: RSS-Gen 6.12	ISED: RSS-247 5.4(d)		Complied d), e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(e)			
	ISED: -	ISED: RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(d)	5.5 dB 1806.00 MHz, AV, Vertical Mode: Tx 903.0 MHz	Complied d), e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
	ISED: RSS-Gen 6.13	ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*1) The test is not applicable since the EUT has no AC mains.

*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)

b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)

c) Refer to APPENDIX 1 (data of Power Density)

d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)

e) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

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

FCC Part 15.31 (e)

The EUT is a battery-operated device and test was performed with the full-charged battery. 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.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % Occupied Bandwidth	RSS-Gen 6.7	ISED: -	N/A	- a)	Conducted
a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)					

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

3.4 Uncertainty

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

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

Shonan EMC Lab.

Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 dB	2.9 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.1 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.7 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.1 dB	-
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB	-
	6 GHz-18 GHz	5.4 dB	5.4 dB	5.4 dB	-
	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB	-
	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 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	0.81 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.53 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.95 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.21 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.90 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.04 dB
Spurious emission (Conducted) below 1GHz	1.8 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.7 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.3 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.4 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	0.61 %
Duty cycle and Time Measurement	0.012 %

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

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 E.U.T. during testing

4.1 Operating Mode(s)

Mode	Tested frequency
Tx (Transmitting), 500 kHz mode, SF8	903.0 MHz, 907.8 MHz, 914.2 MHz
*Transmitting duty was 100 % on all tests.	
*Power of the EUT was set by the software as follows; Power settings: fixed Software: ModbusAccessToolForEMCTest.exe Ver. 1.0.0.0 *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

A: EUT

* Test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless Vibration Sensor	XS770A	TH002	Yokogawa Electric Corporation	EUT

SECTION 5: Radiated Spurious Emission

Test Procedure

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

[For below 1 GHz]

EUT was placed on a platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

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

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: <u>11.12.2.5.3</u> RBW: 1 MHz VBW: 10 Hz 1/T (T: burst length, refer to Burst rate confirmation sheet (duty 100%)) Detector: Peak Trace: max hold	RBW: 100 kHz VBW: 300 kHz

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

UL Japan, Inc.

Shonan EMC Lab.

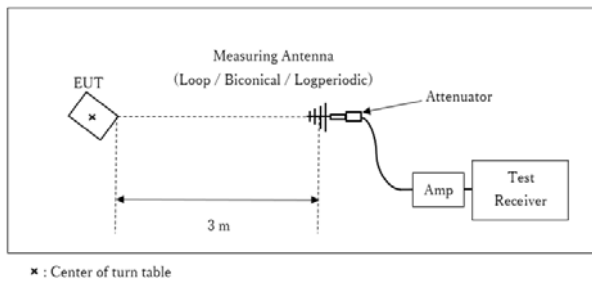
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

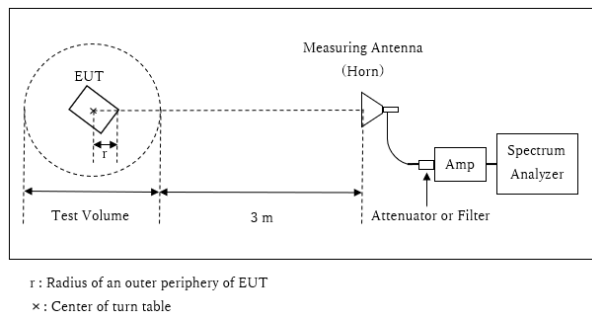
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz - 10 GHz



Distance Factor: $20 \times \log (3.976 \text{ m} / 3.0 \text{ m}) = 2.45 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.976 \text{ m}$

Test Volume : 2.0 m

(Test Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.024 \text{ m}$

The EUT was tested in the direction normally used.

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 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6 dB Bandwidth	3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013". *4 In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.							

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

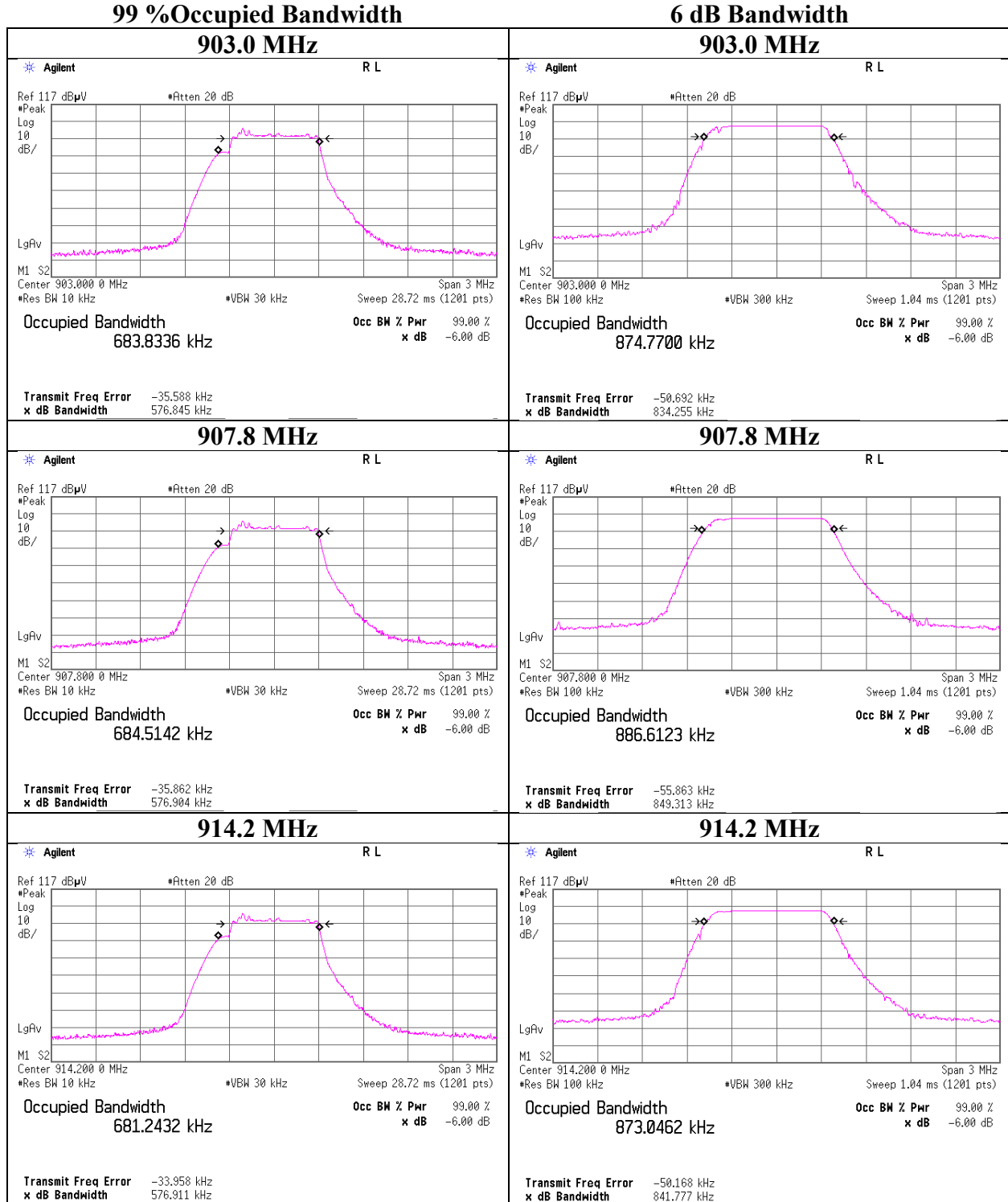
APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12987093S-B-R1
Test place Shonan EMC Lab. No.1 Measurement Room
Date August 7, 2019
Temperature / Humidity 24 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx

Mode	Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
SF8	903.0	683.8	0.834	> 0.5000
	907.8	684.5	0.849	> 0.5000
	914.2	681.2	0.842	> 0.5000

99 %Occupied Bandwidth and 6 dB Bandwidth



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

Maximum Peak Output Power

Report No. 12987093S-B-R1
Test place Shonan EMC Lab. No.3 Shielded Room
Date August 2, 2019
Temperature / Humidity 24 deg. C / 69 % RH
Engineer Kenichi Adachi
Mode Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin	Antenna Gain [dBi]	Result		Limit		Margin
				[dBm]	[mW]	[dBm]	[mW]	[dB]		[dBm]	[mW]	[dBm]	[mW]	[dB]
903.0	-2.67	0.90	9.58	7.81	6.04	30.00	1000	22.19	-1.50	6.31	4.28	36.02	4000	29.71
907.8	-2.75	0.90	9.58	7.73	5.93	30.00	1000	22.27	-1.50	6.23	4.20	36.02	4000	29.79
914.2	-2.80	0.91	9.58	7.69	5.87	30.00	1000	22.31	-1.50	6.19	4.16	36.02	4000	29.83

Sample Calculation:

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

e.i.r.p. Result = Conducted Power Result + Antenna Gain

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

Average Output Power
(Reference data for RF Exposure)

Report No. 12987093S-B-R1
Test place Shonan EMC Lab. No.3 Shielded Room
Date August 2, 2019
Temperature / Humidity 24 deg. C / 69 % RH
Engineer Kenichi Adachi
Mode Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
903.0	-2.80	0.90	9.58	7.68	5.86	0.00	7.68	5.86
907.8	-2.86	0.90	9.58	7.62	5.78	0.00	7.62	5.78
914.2	-2.92	0.91	9.58	7.57	5.71	0.00	7.57	5.71

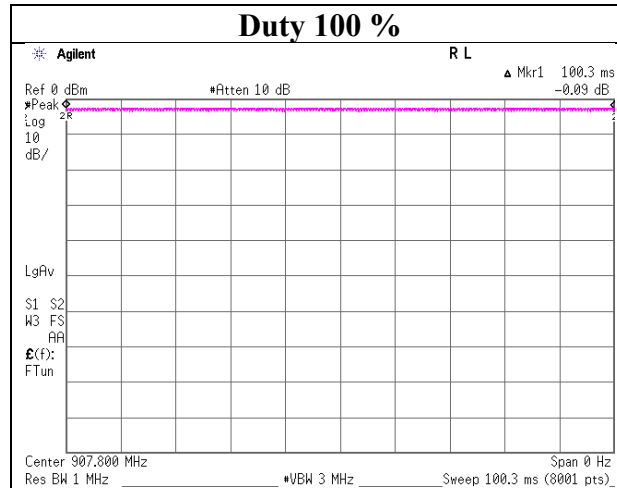
Sample Calculation:

Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Time average + Duty factor

Burst rate confirmation

Report No. 12987093S-B-R1
Test place Shonan EMC Lab. No.1 Measurement Room
Date August 7, 2019
Temperature / Humidity 24 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx



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

Radiated Spurious Emission

Report No.	12987093S-B-R1	No.1
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber		
Date	August 13, 2019	August 9, 2019
Temperature / Humidity	25 deg. C / 65 % RH	25deg. C / 68% RH
Engineer	Makoto Hosaka	Hiromasa Sato
	(30 MHz - 1 GHz)	(1 GHz - 10 GHz)
Mode	Tx 903.0 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.	858.842	QP	23.00	21.75	19.82	31.54	0.00	33.03	46.00	12.9	100	147	
Hori.	887.174	QP	22.90	22.13	19.93	31.41	0.00	33.55	46.00	12.4	150	168	
Hori.	902.000	QP	23.10	22.10	19.99	31.33	0.00	33.86	46.00	12.1	165	66	
Hori.	1806.000	PK	52.74	25.59	4.46	39.40	2.45	45.84	73.90	28.0	201	110	
Hori.	2709.000	PK	54.87	28.33	4.86	39.61	2.45	50.90	73.90	23.0	139	139	
Hori.	3612.000	PK	47.87	29.52	5.59	39.57	2.45	45.86	73.90	28.0	243	255	
Hori.	4515.000	PK	50.76	30.97	6.16	39.82	2.45	50.52	73.90	23.3	112	183	
Hori.	5418.000	PK	48.16	32.17	6.89	39.77	2.45	49.90	73.90	24.0	152	180	
Hori.	6321.000	PK	48.36	34.04	7.54	40.00	2.45	52.39	73.90	21.5	184	239	
Hori.	7224.000	PK	44.56	37.17	7.95	39.54	2.45	52.59	73.90	21.3	150	0	
Hori.	8127.000	PK	45.24	37.66	8.33	39.25	2.45	54.43	73.90	19.4	150	1	
Hori.	9030.000	PK	46.13	37.67	8.95	39.73	2.45	55.47	73.90	18.4	179	218	
Hori.	1806.000	AV	46.97	25.59	4.46	39.40	2.45	40.07	53.90	13.8	201	110	
Hori.	2709.000	AV	48.39	28.33	4.86	39.61	2.45	44.42	53.90	9.4	139	139	
Hori.	3612.000	AV	37.10	29.52	5.59	39.57	2.45	35.09	53.90	18.8	243	255	
Hori.	4515.000	AV	39.01	30.97	6.16	39.82	2.45	38.77	53.90	15.1	112	183	
Hori.	5418.000	AV	36.02	32.17	6.89	39.77	2.45	37.76	53.90	16.1	152	180	
Hori.	6321.000	AV	35.89	34.04	7.54	40.00	2.45	39.92	53.90	13.9	184	239	
Hori.	7224.000	AV	32.33	37.17	7.95	39.54	2.45	40.36	53.90	13.5	150	0	
Hori.	8127.000	AV	32.34	37.66	8.33	39.25	2.45	41.53	53.90	12.3	150	1	
Hori.	9030.000	AV	33.37	37.67	8.95	39.73	2.45	42.71	53.90	11.1	179	218	
Vert.	858.842	QP	23.00	21.75	19.82	31.54	0.00	33.03	46.00	12.9	100	249	
Vert.	887.174	QP	23.10	22.13	19.93	31.41	0.00	33.75	46.00	12.2	100	26	
Vert.	902.000	QP	27.70	22.10	19.99	31.33	0.00	38.46	46.00	7.5	120	135	
Vert.	1806.000	PK	59.16	25.59	4.46	39.40	2.45	52.26	73.90	21.6	110	177	
Vert.	2709.000	PK	54.91	28.33	4.86	39.61	2.45	50.94	73.90	22.9	198	63	
Vert.	3612.000	PK	51.03	29.52	5.59	39.57	2.45	49.02	73.90	24.8	301	322	
Vert.	4515.000	PK	50.54	30.97	6.16	39.82	2.45	50.30	73.90	23.6	192	292	
Vert.	5418.000	PK	48.31	32.17	6.89	39.77	2.45	50.05	73.90	23.8	164	330	
Vert.	6321.000	PK	46.97	34.04	7.54	40.00	2.45	51.00	73.90	22.9	133	256	
Vert.	7224.000	PK	45.06	37.17	7.95	39.54	2.45	53.09	73.90	20.8	150	359	
Vert.	8127.000	PK	45.58	37.66	8.33	39.25	2.45	54.77	73.90	19.1	150	0	
Vert.	9030.000	PK	46.11	37.67	8.95	39.73	2.45	55.45	73.90	18.4	150	1	
Vert.	1806.000	AV	55.21	25.59	4.46	39.40	2.45	48.31	53.90	5.5	110	177	
Vert.	2709.000	AV	48.04	28.33	4.86	39.61	2.45	44.07	53.90	9.8	198	63	
Vert.	3612.000	AV	40.04	29.52	5.59	39.57	2.45	38.03	53.90	15.8	301	322	
Vert.	4515.000	AV	38.81	30.97	6.16	39.82	2.45	38.57	53.90	15.3	192	292	
Vert.	5418.000	AV	36.39	32.17	6.89	39.77	2.45	38.13	53.90	15.7	164	330	
Vert.	6321.000	AV	34.06	34.04	7.54	40.00	2.45	38.09	53.90	15.8	133	256	
Vert.	7224.000	AV	32.25	37.17	7.95	39.54	2.45	40.28	53.90	13.6	150	359	
Vert.	8127.000	AV	32.33	37.66	8.33	39.25	2.45	41.52	53.90	12.3	150	0	
Vert.	9030.000	AV	33.00	37.67	8.95	39.73	2.45	42.34	53.90	11.5	150	1	

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

Distance factor : 1 GHz - 10 GHz : $20\log(3.976 \text{ m} / 3.0 \text{ m}) = 2.45 \text{ dB}$

UL Japan, Inc.

Shonan EMC Lab.

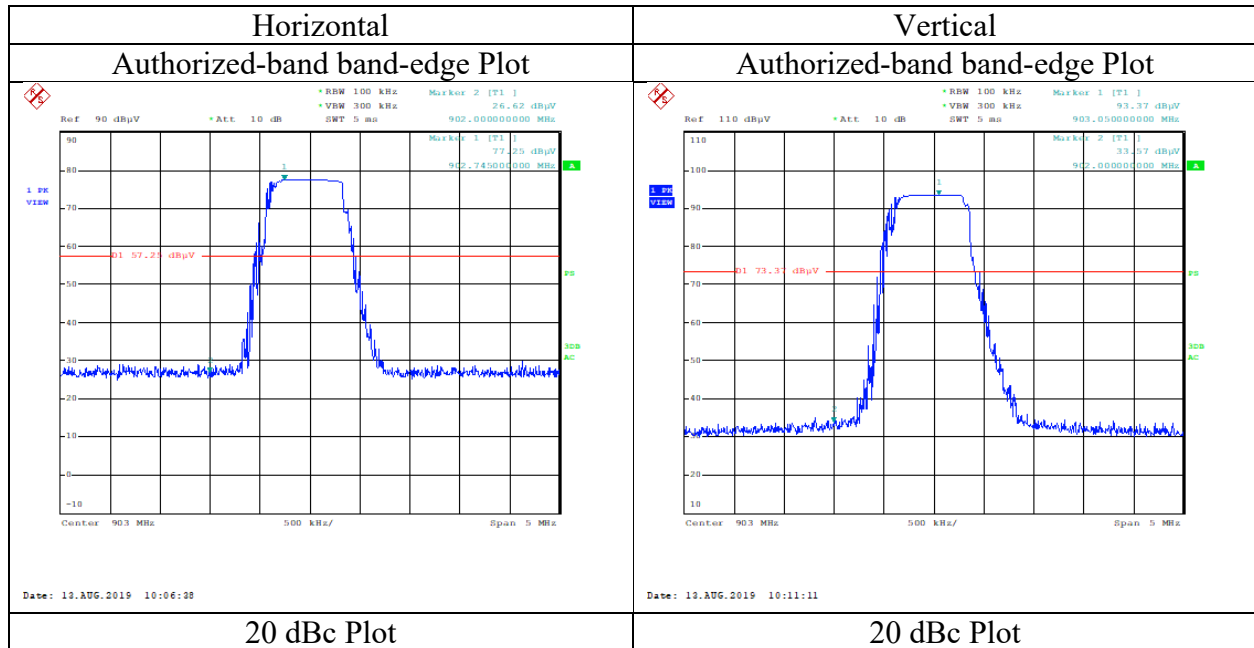
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12987093S-B-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.1
Date	August 13, 2019
Temperature / Humidity	25 deg. C / 65 % RH
Engineer	Makoto Hosaka
	(30 MHz - 1 GHz)
Mode	Tx 903.0 MHz



* 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.	12987093S-B-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	August 13, 2019	August 9, 2019
Temperature / Humidity	25 deg. C / 65 % RH	25deg. C / 68% RH
Engineer	Makoto Hosaka	Hiromasa Sato
	(30 MHz - 1 GHz)	(1 GHz - 10 GHz)
Mode	Tx 907.8 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.	467.967	QP	22.90	16.93	18.30	31.86	0.00	26.27	46.00	19.7	100	36	
Hori.	902.000	QP	23.00	22.10	19.99	31.33	0.00	33.76	46.00	12.2	231	30	
Hori.	928.000	QP	22.80	22.00	20.09	31.11	0.00	33.78	46.00	12.2	231	30	
Hori.	1815.600	PK	51.85	25.62	4.46	39.40	2.45	44.98	73.90	28.9	224	125	
Hori.	2723.400	PK	52.37	28.37	4.86	39.61	2.45	48.44	73.90	25.4	107	164	
Hori.	3631.200	PK	52.75	29.56	5.60	39.57	2.45	50.79	73.90	23.1	134	221	
Hori.	4539.000	PK	51.38	31.03	6.19	39.81	2.45	51.24	73.90	22.6	237	19	
Hori.	5446.800	PK	48.18	32.24	6.91	39.77	2.45	50.01	73.90	23.8	155	176	
Hori.	6354.600	PK	50.26	34.20	7.57	39.98	2.45	54.50	73.90	19.4	241	247	
Hori.	7262.400	PK	45.60	37.18	7.98	39.56	2.45	53.65	73.90	20.2	127	149	
Hori.	8170.200	PK	45.42	37.45	8.35	39.26	2.45	54.41	73.90	19.4	150	1	
Hori.	9078.000	PK	46.39	37.82	9.02	39.73	2.45	55.95	73.90	17.9	116	202	
Hori.	1815.600	AV	45.58	25.62	4.46	39.40	2.45	38.71	53.90	15.1	224	125	
Hori.	2723.400	AV	46.34	28.37	4.86	39.61	2.45	42.41	53.90	11.4	107	164	
Hori.	3631.200	AV	39.81	29.56	5.60	39.57	2.45	37.85	53.90	16.0	134	221	
Hori.	4539.000	AV	40.65	31.03	6.19	39.81	2.45	40.51	53.90	13.3	237	19	
Hori.	5446.800	AV	34.96	32.24	6.91	39.77	2.45	36.79	53.90	17.1	155	176	
Hori.	6354.600	AV	37.21	34.20	7.57	39.98	2.45	41.45	53.90	12.4	241	247	
Hori.	7262.400	AV	32.69	37.18	7.98	39.56	2.45	40.74	53.90	13.1	127	149	
Hori.	8170.200	AV	32.55	37.45	8.35	39.26	2.45	41.54	53.90	12.3	150	1	
Hori.	9078.000	AV	33.54	37.82	9.02	39.73	2.45	43.10	53.90	10.8	116	202	
Vert.	572.788	QP	23.20	18.45	18.60	31.96	0.00	28.29	46.00	17.7	100	292	
Vert.	902.000	QP	23.30	22.10	19.99	31.33	0.00	34.06	46.00	11.9	121	136	
Vert.	928.000	QP	22.90	22.00	20.09	31.11	0.00	33.88	46.00	12.1	121	136	
Vert.	1815.600	PK	56.97	25.62	4.46	39.40	2.45	50.10	73.90	23.8	111	181	
Vert.	2723.400	PK	53.33	28.37	4.86	39.61	2.45	49.40	73.90	24.5	117	47	
Vert.	3631.200	PK	51.36	29.56	5.60	39.57	2.45	49.40	73.90	24.5	277	316	
Vert.	4539.000	PK	51.51	31.03	6.19	39.81	2.45	51.37	73.90	22.5	175	283	
Vert.	5446.800	PK	48.03	32.24	6.91	39.77	2.45	49.86	73.90	24.0	177	322	
Vert.	6354.600	PK	48.60	34.20	7.57	39.98	2.45	52.84	73.90	21.0	113	12	
Vert.	7262.400	PK	47.40	37.18	7.98	39.56	2.45	55.45	73.90	18.4	150	0	
Vert.	8170.200	PK	45.09	37.45	8.35	39.26	2.45	54.08	73.90	19.8	150	359	
Vert.	9078.000	PK	45.65	37.82	9.02	39.73	2.45	55.21	73.90	18.6	194	259	
Vert.	1815.600	AV	52.81	25.62	4.46	39.40	2.45	45.94	53.90	7.9	111	181	
Vert.	2723.400	AV	43.93	28.37	4.86	39.61	2.45	40.00	53.90	13.9	117	47	
Vert.	3631.200	AV	42.45	29.56	5.60	39.57	2.45	40.49	53.90	13.4	277	316	
Vert.	4539.000	AV	40.09	31.03	6.19	39.81	2.45	39.95	53.90	13.9	175	283	
Vert.	5446.800	AV	35.41	32.24	6.91	39.77	2.45	37.24	53.90	16.6	177	322	
Vert.	6354.600	AV	35.12	34.20	7.57	39.98	2.45	39.36	53.90	14.5	113	12	
Vert.	7262.400	AV	32.49	37.18	7.98	39.56	2.45	40.54	53.90	13.3	150	0	
Vert.	8170.200	AV	32.46	37.45	8.35	39.26	2.45	41.45	53.90	12.4	150	359	
Vert.	9078.000	AV	33.26	37.82	9.02	39.73	2.45	42.82	53.90	11.0	194	259	

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

Distance factor : 1 GHz - 10 GHz : 20log (3.976 m / 3.0 m) = 2.45 dB

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

Radiated Spurious Emission

Report No.	12987093S-B-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	August 13, 2019	August 9, 2019
Temperature / Humidity	25 deg. C / 65 % RH	25deg. C / 68% RH
Engineer	Makoto Hosaka	Hiromasa Sato
	(30 MHz - 1 GHz)	(1 GHz - 10 GHz)
Mode	Tx 914.2 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.	496.037	QP	22.90	17.66	18.34	31.87	0.00	27.03	46.00	18.9	100	264	
Hori.	928.000	QP	22.90	22.00	20.09	31.11	0.00	33.88	46.00	12.1	230	30	
Hori.	1828.400	PK	52.44	25.65	4.45	39.41	2.45	45.58	73.90	28.3	240	104	
Hori.	2742.600	PK	51.91	28.42	4.87	39.61	2.45	48.04	73.90	25.8	116	134	
Hori.	3656.800	PK	51.42	29.62	5.61	39.57	2.45	49.53	73.90	24.3	285	234	
Hori.	4571.000	PK	51.98	31.10	6.21	39.80	2.45	51.94	73.90	21.9	210	15	
Hori.	5485.200	PK	50.13	32.31	6.95	39.78	2.45	52.06	73.90	21.8	116	177	
Hori.	6399.400	PK	50.22	34.42	7.59	39.95	2.45	54.73	73.90	19.1	270	239	
Hori.	7313.600	PK	45.81	37.23	8.01	39.60	2.45	53.90	73.90	20.0	145	295	
Hori.	8227.800	PK	45.27	37.18	8.39	39.29	2.45	54.00	73.90	19.9	150	1	
Hori.	9142.000	PK	45.76	38.08	9.08	39.75	2.45	55.62	73.90	18.2	160	203	
Hori.	1828.400	AV	46.66	25.65	4.45	39.41	2.45	39.80	53.90	14.1	240	104	
Hori.	2742.600	AV	43.61	28.42	4.87	39.61	2.45	39.74	53.90	14.1	116	134	
Hori.	3656.800	AV	41.90	29.62	5.61	39.57	2.45	40.01	53.90	13.8	285	234	
Hori.	4571.000	AV	42.04	31.10	6.21	39.80	2.45	42.00	53.90	11.9	210	15	
Hori.	5485.200	AV	37.73	32.31	6.95	39.78	2.45	39.66	53.90	14.2	116	177	
Hori.	6399.400	AV	38.01	34.42	7.59	39.95	2.45	42.52	53.90	11.3	270	239	
Hori.	7313.600	AV	32.77	37.23	8.01	39.60	2.45	40.86	53.90	13.0	145	295	
Hori.	8227.800	AV	32.40	37.18	8.39	39.29	2.45	41.13	53.90	12.7	150	1	
Hori.	9142.000	AV	33.27	38.08	9.08	39.75	2.45	43.13	53.90	10.7	160	203	
Vert.	402.302	QP	23.90	15.85	18.14	31.81	0.00	26.08	46.00	19.9	100	73	
Vert.	928.000	QP	23.50	22.00	20.09	31.11	0.00	34.48	46.00	11.5	120	139	
Vert.	1828.400	PK	55.97	25.65	4.45	39.41	2.45	49.11	73.90	24.7	161	181	
Vert.	2742.600	PK	51.41	28.42	4.87	39.61	2.45	47.54	73.90	26.3	161	75	
Vert.	3656.800	PK	52.70	29.62	5.61	39.57	2.45	50.81	73.90	23.0	319	311	
Vert.	4571.000	PK	52.53	31.10	6.21	39.80	2.45	52.49	73.90	21.4	180	291	
Vert.	5485.200	PK	50.52	32.31	6.95	39.78	2.45	52.45	73.90	21.4	170	336	
Vert.	6399.400	PK	47.16	34.42	7.59	39.95	2.45	51.67	73.90	22.2	141	94	
Vert.	7313.600	PK	45.35	37.23	8.01	39.60	2.45	53.44	73.90	20.4	150	359	
Vert.	8227.800	PK	45.09	37.18	8.39	39.29	2.45	53.82	73.90	20.0	150	1	
Vert.	9142.000	PK	45.00	38.08	9.08	39.75	2.45	54.86	73.90	19.0	220	266	
Vert.	1828.400	AV	51.26	25.65	4.45	39.41	2.45	44.40	53.90	9.5	161	181	
Vert.	2742.600	AV	42.94	28.42	4.87	39.61	2.45	39.07	53.90	14.8	161	75	
Vert.	3656.800	AV	44.19	29.62	5.61	39.57	2.45	42.30	53.90	11.6	319	311	
Vert.	4571.000	AV	42.21	31.10	6.21	39.80	2.45	42.17	53.90	11.7	180	291	
Vert.	5485.200	AV	38.83	32.31	6.95	39.78	2.45	40.76	53.90	13.1	170	336	
Vert.	6399.400	AV	34.46	34.42	7.59	39.95	2.45	38.97	53.90	14.9	141	94	
Vert.	7313.600	AV	32.40	37.23	8.01	39.60	2.45	40.49	53.90	13.4	150	359	
Vert.	8227.800	AV	32.41	37.18	8.39	39.29	2.45	41.14	53.90	12.7	150	1	
Vert.	9142.000	AV	32.88	38.08	9.08	39.75	2.45	42.74	53.90	11.1	220	266	

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

Distance factor : 1 GHz - 10 GHz : 20log (3.976 m / 3.0 m) = 2.45 dB

UL Japan, Inc.

Shonan EMC Lab.

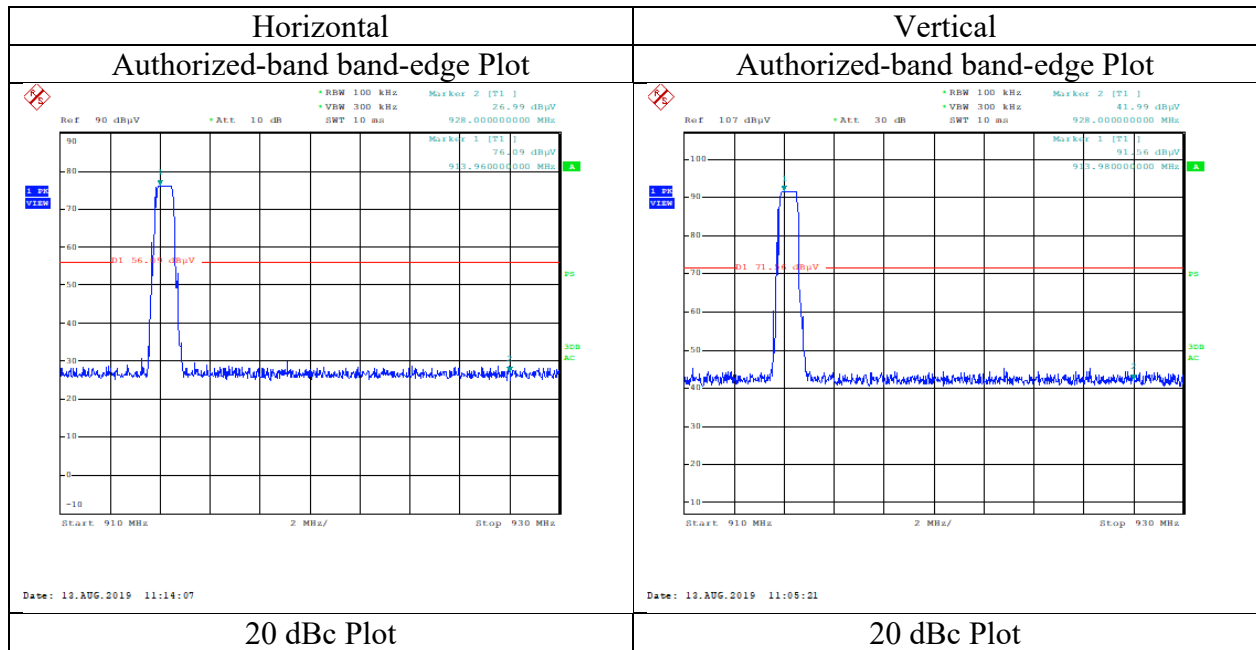
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12987093S-B-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.1
Date	August 13, 2019
Temperature / Humidity	25 deg. C / 65 % RH
Engineer	Makoto Hosaka (30 MHz - 1 GHz)
Mode	Tx 914.2 MHz

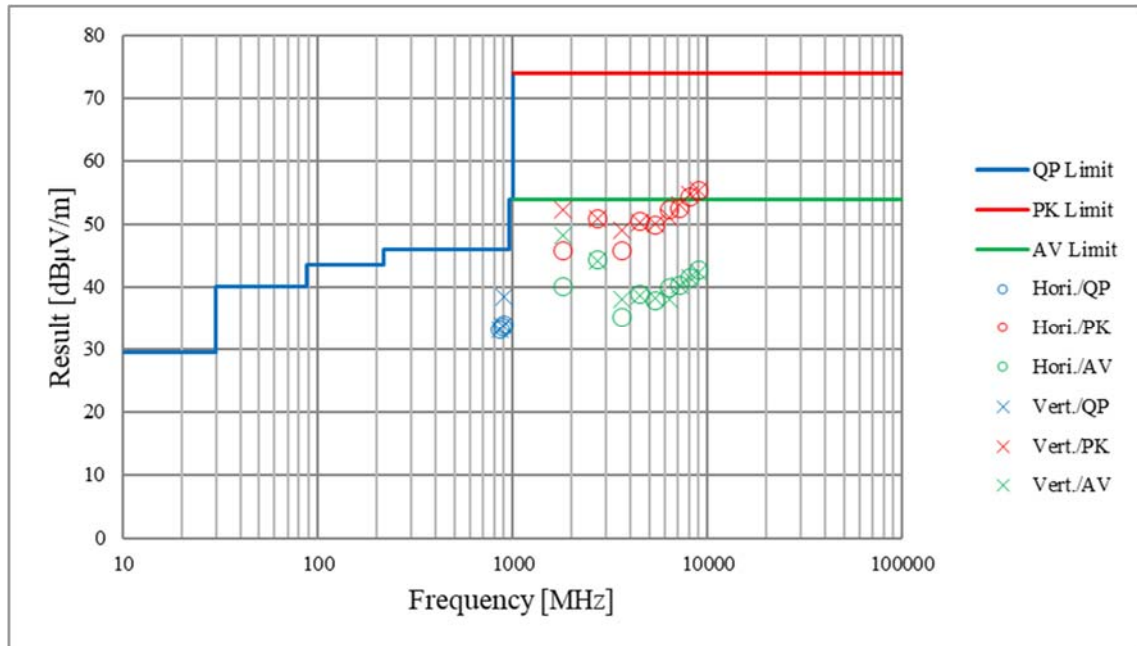


* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case)

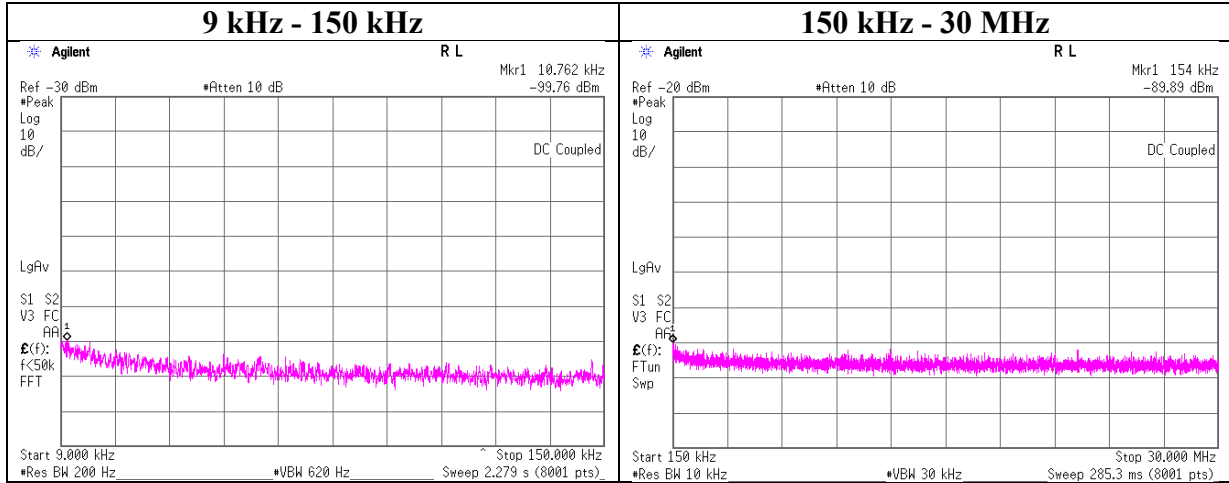
Report No.	12987093S-B-R1	No.1
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	
Date	August 13, 2019	August 9, 2019
Temperature / Humidity	25 deg. C / 65 % RH	25deg. C / 68% RH
Engineer	Makoto Hosaka (30 MHz - 1 GHz)	Hiromasa Sato (1 GHz - 10 GHz)
Mode	Tx 903.0 MHz	



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

Conducted Spurious Emission

Report No.	12987093S-B-R1
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 7, 2019
Temperature / Humidity	24 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx 903.0 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain*	N (Number of Output)	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]		[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
10.762	-99.8	0.01	9.55	2.0	1	-88.2	300	6.0	-26.9	46.9	73.8	
154	-89.9	0.01	9.55	2.0	1	-78.3	300	6.0	-17.1	23.8	40.9	

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

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

N: Number of output

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

UL Japan, Inc.

Shonan EMC Lab.

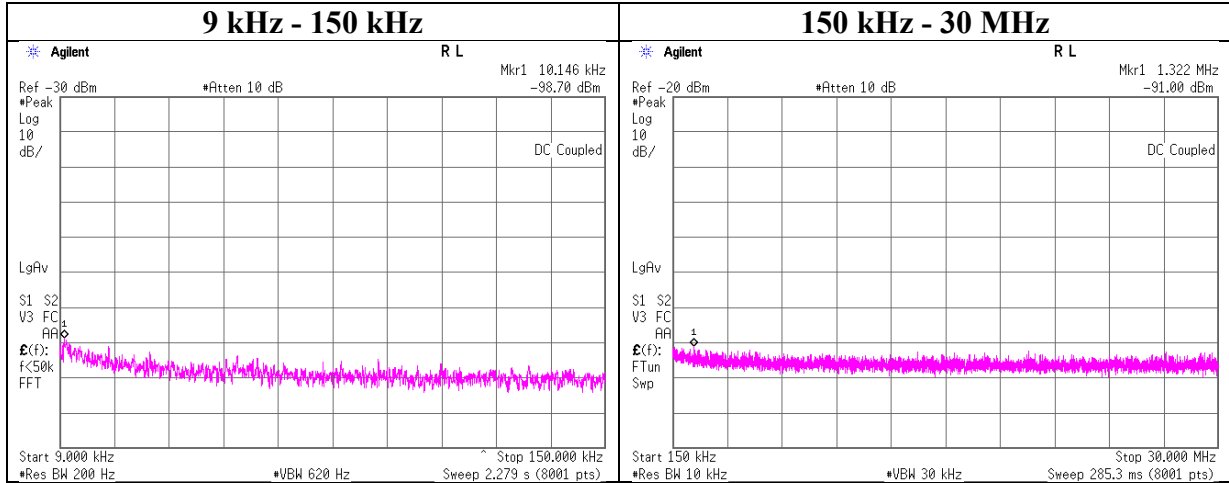
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Conducted Spurious Emission

Report No.	12987093S-B-R1
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 7, 2019
Temperature / Humidity	24 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx 907.8 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.146	-98.7	0.01	9.55	2.0	1	-87.1	300	6.0	-25.9	47.4	73.3	
1322	-91.0	0.02	9.54	2.0	1	-79.4	30	6.0	1.8	25.1	23.3	

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

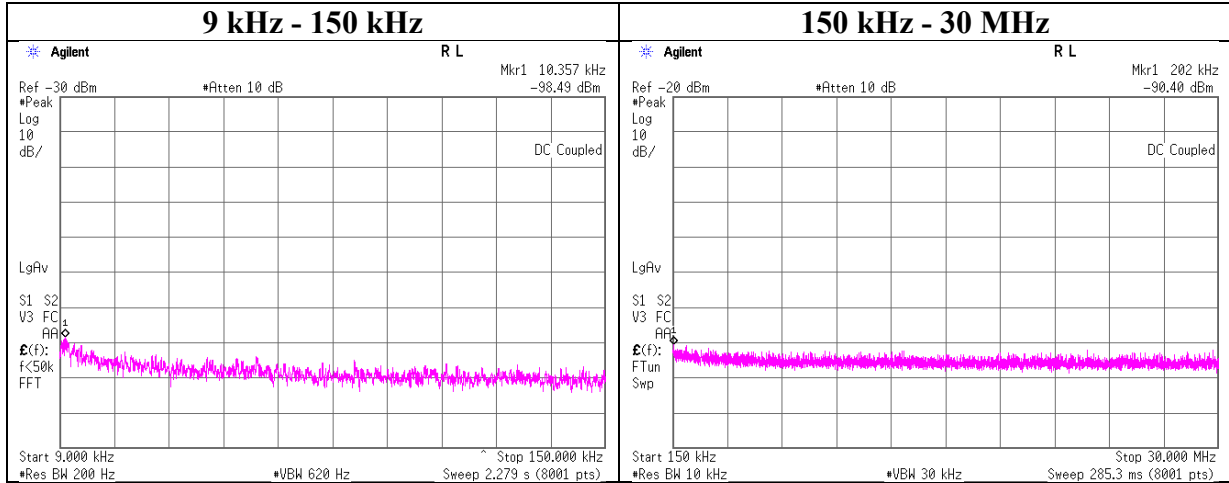
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

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

Conducted Spurious Emission

Report No.	12987093S-B-R1
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 7, 2019
Temperature / Humidity	24 deg. C / 49 % RH
Engineer	Hiromasa Sato
Mode	Tx 914.2 MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain*	N (Number of Output)	EIRP	Distance	Ground bounce	E (field strength)	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]		[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
10.357	-98.5	0.01	9.55	2.0	1	-86.9	300	6.0	-25.7	47.2	72.9	
202	-90.4	0.01	9.55	2.0	1	-78.8	300	6.0	-17.6	21.4	39.0	

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

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

N: Number of output

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

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

Power Density

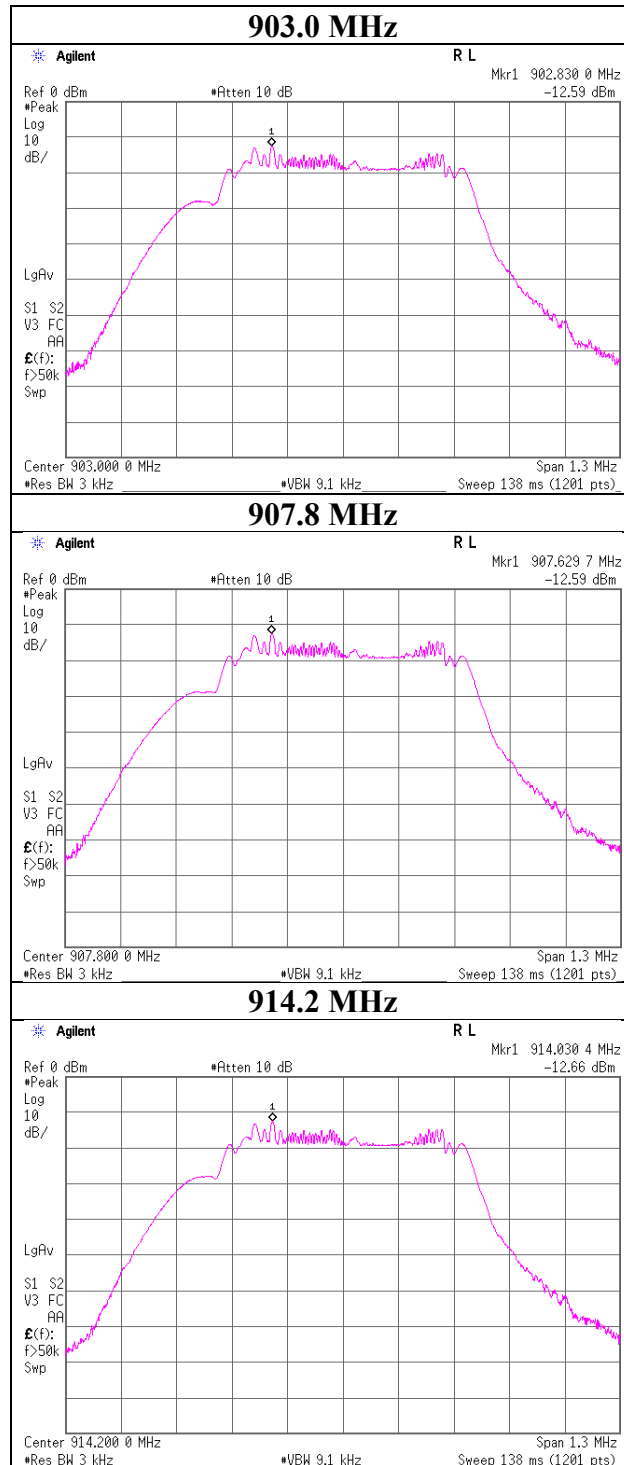
Report No. 12987093S-B-R1
Test place Shonan EMC Lab. No.1 Measurement Room
Date August 7, 2019
Temperature / Humidity 24 deg. C / 49 % RH
Engineer Hiromasa Sato
Mode Tx

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
903.0	-12.59	0.90	9.58	-2.11	8.00	10.11
907.8	-12.59	0.90	9.58	-2.11	8.00	10.11
914.2	-12.66	0.91	9.58	-2.17	8.00	10.17

Sample Calculation:

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

Power Density



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

APPENDIX 2: Test instruments

Test Instruments

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SAT10-09	AT	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2018/11/25	2019/11/30	12
SCC-G12	AT	145040	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	2019/3/27	2020/3/31	12
SOS-13	AT	146321	Humidity Indicator	CUSTOM	CTH-202	Q.C.17	2018/12/5	2019/12/31	12
SPM-06	AT	146267	Power Meter	ANRITSU	ML2495A	850009	2019/5/22	2020/5/31	12
SPSS-03	AT	146309	Power sensor	ANRITSU	MA2411B	917063	2019/5/22	2020/5/31	12
SRENT-09	AT	150461	Spectrum Analyzer	AGILENT (KEYSIGHT)	E4440A	MY46186392	2019/1/3	2020/1/31	12
COTS-SEMI-5	RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,M E,PE)	-	-	-	-
KAT6-04	RE	144899	Attenuator	Inmet	18N-6dB	-	2018/12/25	2019/12/31	12
KJM-09	RE	145929	Measure	KOMELON	KMC-36	-	-	-	-
SAEC-01(NSA)	RE	145597	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	2019/4/2	2020/4/30	12
SAEC-01(SVSWR)	RE	145561	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	2019/5/6	2020/5/30	12
SAF-01	RE	145003	Pre Amplifier	SONOMA	310N	290211	2019/2/5	2020/2/29	12
SAF-04	RE	145127	Pre Amplifier	Toyo Corporation	TPA0118-36	2072554	2019/6/4	2020/6/30	12
SAT10-01	RE	145133	Attenuator	JFW	50HF-010N	-	2019/2/5	2020/2/29	12
SAT10-06	RE	145137	Attenuator	AGILENT	8493C-010	74865	2018/11/25	2019/11/30	12
SAT3-09	RE	144959	Attenuator	JFW	50HF-003N	-	2019/8/6	2020/8/31	12
SBA-01	RE	145161	Biconical Antenna	Schwarzbeck	BBA9106	91032664	2019/4/1	2020/4/30	12
SCC-A1/A3/A5/A7/A8/A13/SRSE-01	RE	144967	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-269(RF Selector)	2019/4/19	2020/4/30	12
SCC-A2/A4/A6/A7/A8/A13/SRSE-01	RE	144968	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141P	-/0901-269(RF Selector)	2019/4/19	2020/4/30	12
SCC-G41	RE	151617	Coaxial Cable	Junkosha	MWX221-01000NFSNM S/B	1612S006	2019/1/25	2020/1/31	12
SCC-G50	RE	178573	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104 E	MY13407/4E	2019/3/26	2020/3/31	12
SCC-G51	RE	178572	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800288/4A	2019/3/26	2020/3/31	12
SFL-22	RE	168802	Highpass Filter	MICRO-TRONICS	HPM50114	G035	2019/4/16	2020/4/30	12
SHA-01	RE	145383	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	2019/5/9	2020/5/31	12
SLA-05	RE	145527	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	193	2019/4/1	2020/4/30	12
SOS-01	RE	146316	Humidity Indicator	A&D	AD-5681	4062555	2018/10/25	2019/10/31	12
STR-01	RE	145790	Test Receiver	Rohde & Schwarz	ESU40	100093	2019/4/14	2020/4/30	12

*Hyphens for Last Calibration Date, Calibration Due 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.

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

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test item: RE: Radiated Emission test, AT: Antenna Terminal Conducted test

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