



RADIO TEST REPORT


Test Report No. : 13153638S-A-R1

Applicant : Yokogawa Electric Corporation
Type of EUT : Wireless Communication Module
Model Number of EUT : XS110A
FCC ID : SGJ-WFC017
Test regulation : FCC Part 15 Subpart C: 2020
* Tx 125 kHz mode
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. his report is a revised version of 13153638S-A. 13153638S-A is replaced with this report.

Date of test: February 14 to 22, 2020
April 8, 2020

Representative test engineer: 
Hiromasa Sato
Engineer
Consumer Technology Division

Approved by: 
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.: 13153638S-A

| Revision | Test report No. | Date | Page revised | Contents |
|--------------|-----------------|----------------|--------------|---|
| - (Original) | 13153638S-A | April 17, 2020 | - | - |
| 1 | 13153638S-A-R1 | May 13, 2020 | 1 | Update of test specification From "FCC Part 15 Subpart C: 2019" To "FCC Part 15 Subpart C: 2020" |
| | | | 6 | Update of test specification From "FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258" To "FCC Part 15 final revised on April 1, 2020 and effective June 1, 2020 except 15.258 * The revision does not affect the test result conducted before its effective date." |
| | | | 15 | Addition of remarks "**5)" |

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

Reference: Abbreviations (Including words undescribed in this report)

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

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 (EUT)..... | 5 |
| SECTION 3: Test specification, procedures & results..... | 6 |
| SECTION 4: Operation of EUT during testing..... | 10 |
| SECTION 5: Radiated Spurious Emission | 13 |
| SECTION 6: Antenna Terminal Conducted Tests..... | 15 |
| APPENDIX 1: Test data | 16 |
| 20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation..... | 16 |
| Dwell time..... | 22 |
| Maximum Peak Output Power | 25 |
| Average Output Power | 26 |
| Radiated Spurious Emission | 28 |
| Conducted Spurious Emission | 34 |
| 6 dB Bandwidth | 38 |
| Power Density | 41 |
| APPENDIX 2: Test instruments | 44 |
| APPENDIX 3: Photographs of test setup | 46 |
| Radiated Spurious Emission | 46 |
| Pre-check of Worst Case Position..... | 47 |

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 : Atsunori Okada

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT)
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type of Equipment : Wireless Communication Module
Model No. : XS110A
Serial No. : Refer to SECTION 4.2
Rating : DC 3.6 V
Receipt Date of Sample : January 30, 2020
(Information from test lab.)
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: XS110A (referred to as the EUT in this report) is a Wireless Communication Module.

General Specification

Clock frequencies in the system : CPU: 11 MHz
External CLK HIGH: 12 MHz
External CLK LOW: 32.768 kHz
TCXO: 32 MHz

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 902 MHz – 928 MHz
* 902.3 MHz - 914.9 MHz (Tx 125 kHz mode)
* 903.0 MHz - 914.2 MHz (Tx 500 kHz mode)
Modulation : LoRa, CSS
Antenna type : Built-in omni-directional antenna
Antenna Gain : -1.4 dBi
Operating temperature range : -40 deg.C to +85 deg.C

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

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on April 1, 2020 and effective June 1, 2020 except 15.258
* The revision does not affect the test result conducted before its effective date.

Title : FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

* Also the EUT complies with FCC Part 15 Subpart B

3.2 Procedures and results

| Item | Test Procedure | Specification | Worst Margin | Results | Remarks |
|--|--|---|--------------|--|------------------|
| Conducted Emission | FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8 | FCC: Section 15.207 ISED: RSS-Gen 8.8 | - | N/A | *1) |
| Carrier Frequency Separation | FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: - | FCC: Section15.247(a)(1) ISED: RSS-247 5.1 (b) | See data. | Complied a) | Conducted |
| 20 dB Bandwidth | FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: - | FCC: Section15.247(a)(1)(i) ISED: RSS-247 5.1 (a) | | Complied a) | Conducted |
| Dwell time | FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: - | FCC: Section15.247(f) ISED: RSS-247 5.1 (c) | | Complied b) | Conducted |
| Maximum Peak Output Power | FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12 | FCC: Section15.247(a)(b)(2) ISED: RSS-247 5.4 (a) | | Complied c) | Conducted |
| Spurious Emission & Band Edge Compliance | FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13 | FCC: Section15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10 | | 5.4 dB 6316.100 MHz, AV, Horizontal Mode: Tx, 125 kHz mode, SF10, 902.3 MHz | Complied d) / e) |
| 6 dB Bandwidth | FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: - | FCC: Section 15.247(a)(2) ISED: RSS-247 5.2(a) | See data. | Complied f) | Conducted |
| Power Density | FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: - | FCC: Section 15.247(f) ISED: RSS-247 5.2(b) | | Complied g) | Conducted |

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).

a) Refer to APPENDIX 1 (data of 20 dB Bandwidth, 99 %Occupied Bandwidth and Carrier Frequency Separation)

b) Refer to APPENDIX 1 (data of Dwell time)

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

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

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

f) Refer to APPENDIX 1 (data of 6 dB Bandwidth)

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

The EUT was tested as the hybrid system equipment in accordance with KDB 558074 D01 15.247 Meas Guidance v05r02 Section 10.

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

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.

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

3.3 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 20 dB Bandwidth, 99 %Occupied Bandwidth and Carrier Frequency Separation) | | | | | |

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

3.4 Uncertainty

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

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

Shonan EMC Lab.

| Item | Frequency range | Uncertainty (+/-) | | | |
|--|-----------------|-------------------|----------------|----------------|----------------|
| | | No. 1 SAC / SR | No. 2 SAC / SR | No. 3 SAC / SR | No. 4,5,6,8 SR |
| Conducted emission (AC Mains) LISN | 150 kHz-30 MHz | 2.6 dB | 2.6 dB | 2.5 dB | 2.6 dB |
| Radiated emission (Measurement distance: 3 m) | 9 kHz-30 MHz | 3.0 dB | 3.0 dB | 3.0 dB | - |
| | 30 MHz-200 MHz | 4.6 dB | 4.6 dB | 4.6 dB | - |
| | 200 MHz-1 GHz | 6.0 dB | 6.0 dB | 6.0 dB | - |
| | 1 GHz-6 GHz | 4.9 dB | 4.9 dB | 4.9 dB | - |
| | 6 GHz-18 GHz | 5.5 dB | 5.5 dB | 5.5 dB | - |
| | 18 GHz-40 GHz | 5.4 dB | 5.4 dB | 5.4 dB | - |
| Radiated emission (Measurement distance: 1 m) | 1 GHz-18 GHz | 5.8 dB | 5.8 dB | 5.8 dB | - |
| | 18 GHz-40 GHz | 5.7 dB | 5.7 dB | 5.7 dB | - |

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

| Antenna terminal test | Uncertainty (+/-) |
|---|-------------------|
| Power Measurement above 1 GHz (Average Detector)_SPM-06 | 0.98 dB |
| Power Measurement above 1 GHz (Peak Detector)_SPM-06 | 1.75 dB |
| Power Measurement above 1 GHz (Average Detector)_SPM-07 | 0.89 dB |
| Power Measurement above 1 GHz (Peak Detector)_SPM-07 | 1.12 dB |
| Power Measurement above 1 GHz (Average Detector)_SPM-13 | 1.06 dB |
| Power Measurement above 1 GHz (Peak Detector)_SPM-13 | 1.24 dB |
| Spurious emission (Conducted) below 1GHz | 0.9 dB |
| Spurious emission (Conducted) 1 GHz-3 GHz | 0.9 dB |
| Spurious emission (Conducted) 3 GHz-18 GHz | 2.9 dB |
| Spurious emission (Conducted) 18 GHz-26.5 GHz | 2.6 dB |
| Spurious emission (Conducted) 26.5 GHz-40 GHz | 2.0 dB |
| Bandwidth Measurement | 0.07 % |
| Duty cycle and Time Measurement | 0.262 % |
| Temperature | 0.95 deg.C. |
| Voltage | 0.83 % |

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 EUT during testing

4.1 Operating Mode(s)

Details of Operating Mode(s)

| Test Item | Mode | Tested frequency *2) |
|---|--|-------------------------------------|
| Spurious Emission (Conducted/Radiated) | Tx (Transmitting), Hopping Off, 125 kHz mode, SF10 *1) | 902.3 MHz 908.5 MHz 914.9 MHz |
| Carrier Frequency Separation | Tx (Transmitting), Hopping On, 125 kHz mode, SF10 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping On, 125 kHz mode, SF9 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping On, 125 kHz mode, SF8 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping On, 125 kHz mode, SF7 | 902.3 MHz 908.5 MHz 914.9 MHz |
| 20 dB Bandwidth | Tx (Transmitting), Hopping Off, 125 kHz mode, SF10 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF9 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF8 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF7 | 902.3 MHz 908.5 MHz 914.9 MHz |
| Dwell time | Tx (Transmitting), Hopping On, 125 kHz mode, SF10 | - |
| | Tx (Transmitting), Hopping On, 125 kHz mode, SF9 | - |
| | Tx (Transmitting), Hopping On, 125 kHz mode, SF8 | - |
| | Tx (Transmitting), Hopping On, 125 kHz mode, SF7 | - |
| Maximum Peak Output Power | Tx (Transmitting), Hopping Off, 125 kHz mode, SF10 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF9 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF8 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF7 | 902.3 MHz 908.5 MHz 914.9 MHz |
| Band Edge Compliance (Conducted) | Tx (Transmitting), 125 kHz mode, SF10 -Hopping On -Hopping Off | 902.3 MHz 914.9 MHz |

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

| | | |
|--|---|-------------------------------------|
| 99 % Occupied Bandwidth | Tx (Transmitting),125 kHz mode, SF10 -Hopping On -Hopping Off | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting),125 kHz mode, SF9 -Hopping On -Hopping Off | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting),125 kHz mode, SF8 -Hopping On -Hopping Off | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting),125 kHz mode, SF7 -Hopping On -Hopping Off | 902.3 MHz 908.5 MHz 914.9 MHz |
| 6 dB Bandwidth | Tx (Transmitting), Hopping Off, 125 kHz mode, SF10 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF9 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF8 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF7 | 902.3 MHz 908.5 MHz 914.9 MHz |
| Power Density | Tx (Transmitting), Hopping Off, 125 kHz mode, SF10 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF9 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF8 | 902.3 MHz 908.5 MHz 914.9 MHz |
| | Tx (Transmitting), Hopping Off, 125 kHz mode, SF7 | 902.3 MHz 908.5 MHz 914.9 MHz |
| <p>*1) As a result of preliminary test, the formal test was performed with the worst condition was determined based on the test result of Maximum Peak Output Power</p> <p>*2) Tested frequency (Low channel/Middle channel/High channel) has been chosen from Tx 125 kHz mode.</p> <p>*EUT has the power settings by the software as follows; Power settings: fixed Software (Firmware): XS110A Wireless Communication Module Version: R0.21.01r (Date: 2020/1/28)</p> <p>*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.</p> | | |

4.2 Configuration and peripherals

| |
|---------------|
| A: EUT |
| B |

* Test data was taken under worse case conditions.

Description of EUT

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|-----|-------------------------------|--------------|---------------|-------------------------------|---------|
| A | Wireless Communication Module | XS110A | 91V809468 | Yokogawa Electric Corporation | EUT |
| B | Connector cover | - | - | Yokogawa Electric Corporation | - |

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.0 m by 0.5 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.

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

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

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

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

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

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

Test Antennas are used as below;

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

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

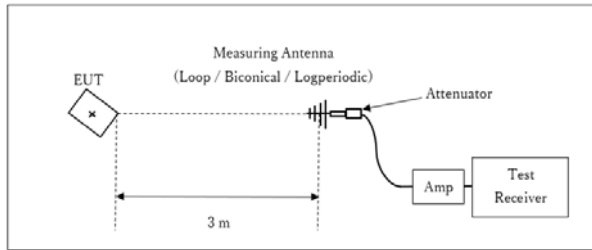
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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

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

Figure 2: Test Setup

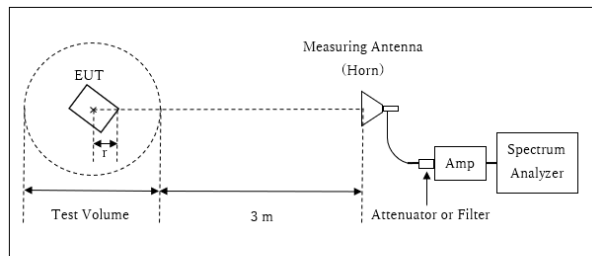
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

× : Center of turn table

Distance Factor: $20 \times \log(3.93 \text{ m} / 3.0 \text{ m}) = 2.35 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.93 \text{ m}$

Test Volume : 2.0 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.07 \text{ m}$

- 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.

| Antenna polarization \ Frequency | Spurious | | |
|----------------------------------|----------|-------------|----------------|
| | Carrier | Below 1 GHz | 1 GHz – 10 GHz |
| Horizontal | Y | Z | Y |
| Vertical | X | Y | Z |

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 |
|---|---|-----------------|--------------------|--|------------------|--------------|----------------------------------|
| 20 dB Bandwidth | 500 kHz | 5.1 kHz | 16 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| 99 % Occupied Bandwidth *1) | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto | Peak | Max Hold *1) | Spectrum Analyzer |
| Maximum Peak Output Power | - | - | - | Auto | Peak Average *2) | - | Power Meter (Sensor: 160 MHz BW) |
| Carrier Frequency Separation | 600 kHz | 30 kHz | 91 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| Dwell Time | Zero Span | 100 kHz | 300 kHz | As necessary capture the entire dwell time per hopping channel | Peak | Clear Write | Spectrum Analyzer |
| Conducted Spurious Emission *3) *5) | 9 kHz to 150 kHz | 200 Hz | 620 Hz | Auto | Peak | Max Hold | Spectrum Analyzer |
| | 150 kHz to 30 MHz | 10 kHz | 30 kHz | | | | |
| | 30 MHz to 25 GHz | 100 kHz | 300 kHz | | | | |
| Conducted Spurious Emission Band Edge compliance | 5 MHz or 40 MHz | 100 kHz | 300 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| 6 dB Bandwidth | 3 MHz | 100 kHz | 300 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| Peak Power Density | 1.5 times the 6 dB Bandwidth | 3 kHz | 9.1 kHz | Auto | Peak | Max Hold | Spectrum Analyzer *4) |
| *1) The measurement was performed with Max Hold. Peak hold was applied as Worst-case measurement. *2) Reference data *3) In the frequency range below 30 MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9 kHz -150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz) *4) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013" *5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 - 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit. | | | | | | | |

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

Test data : APPENDIX
Test result : Pass

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 1: Test data

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

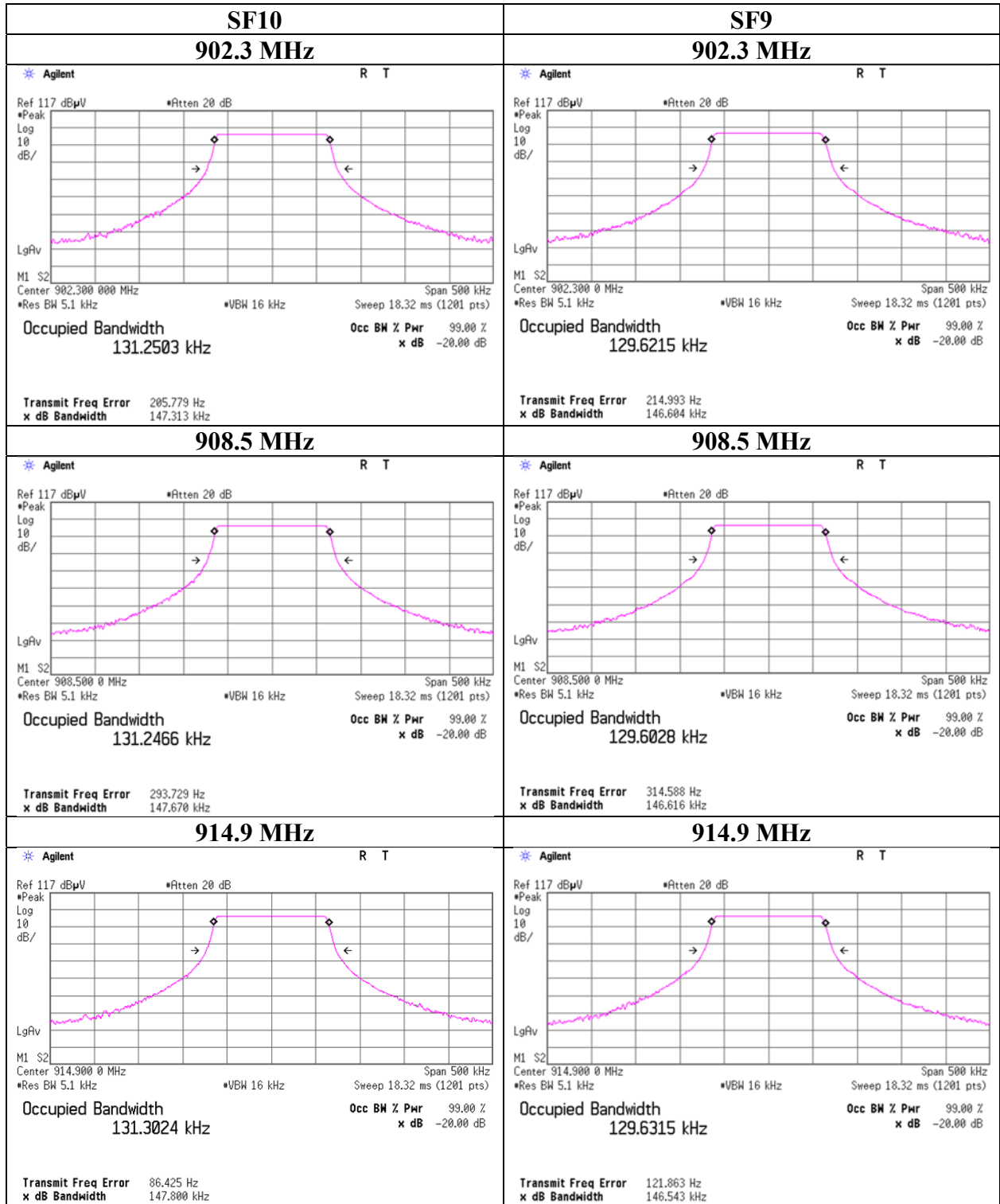
Report No. 13153638S-A-R1
Test place Shonan EMC Lab. No.5 Shield Room
Date February 14, 2020 February 19, 2020
Temperature / Humidity 26 deg. C / 48 % RH 23 deg. C / 39 % RH
Engineer Hiromasa Sato Toshinori Yamada
Mode Tx, Hopping Off, Tx, Hopping On

| Mode | Freq. [MHz] | 20 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] | Carrier Frequency Separation [kHz] | Limit for Carrier Frequency separation [kHz] |
|------|----------------|--------------------------|-------------------------------------|--|--|
| SF10 | 902.3 | 147.313 | 131.250 | 200.000 | >= 147.313 |
| SF10 | 908.5 | 147.670 | 131.247 | 200.000 | >= 147.670 |
| SF10 | 914.9 | 147.800 | 131.302 | 200.000 | >= 147.800 |
| SF10 | Hopping On | - | 12928.900 | - | - |
| SF9 | 902.3 | 146.604 | 129.622 | 200.000 | >= 146.604 |
| SF9 | 908.5 | 146.616 | 129.603 | 200.000 | >= 146.616 |
| SF9 | 914.9 | 146.543 | 129.632 | 200.000 | >= 146.543 |
| SF9 | Hopping On | - | 12937.400 | - | - |
| SF8 | 902.3 | 146.272 | 127.702 | 200.000 | >= 146.272 |
| SF8 | 908.5 | 146.234 | 127.695 | 200.000 | >= 146.234 |
| SF8 | 914.9 | 146.266 | 127.700 | 200.000 | >= 146.266 |
| SF8 | Hopping On | - | 12876.100 | - | - |
| SF7 | 902.3 | 145.177 | 128.162 | 200.000 | >= 145.177 |
| SF7 | 908.5 | 145.131 | 128.129 | 200.000 | >= 145.131 |
| SF7 | 914.9 | 145.173 | 128.123 | 200.000 | >= 145.173 |
| SF7 | Hopping On | - | 12924.000 | - | - |

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

20 dB Bandwidth limit is 500 kHz or less than. (902 - 928 MHz)

20 dB Bandwidth and 99 % Occupied Bandwidth



UL Japan, Inc.

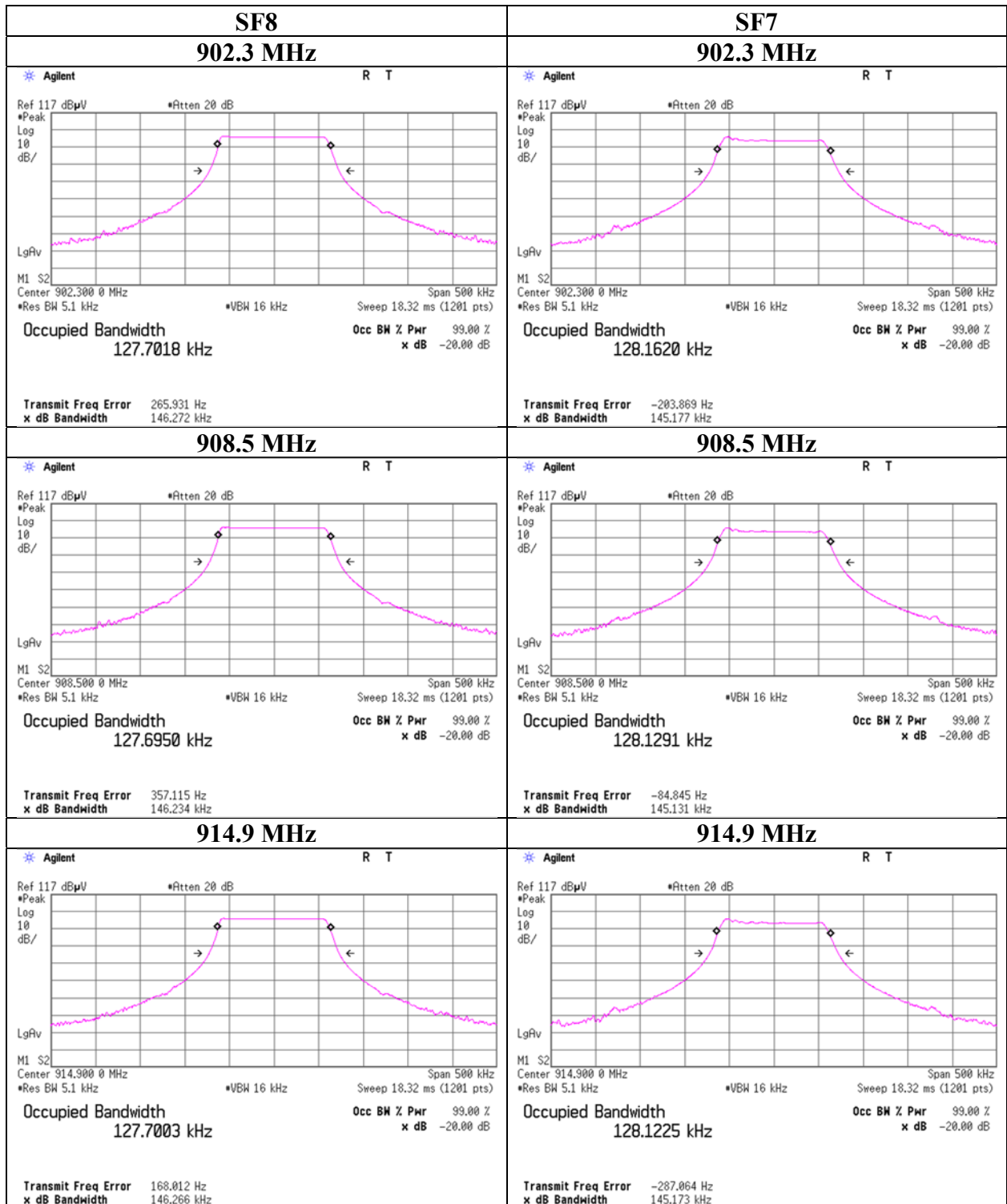
Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

20 dB Bandwidth and 99 % Occupied Bandwidth



UL Japan, Inc.

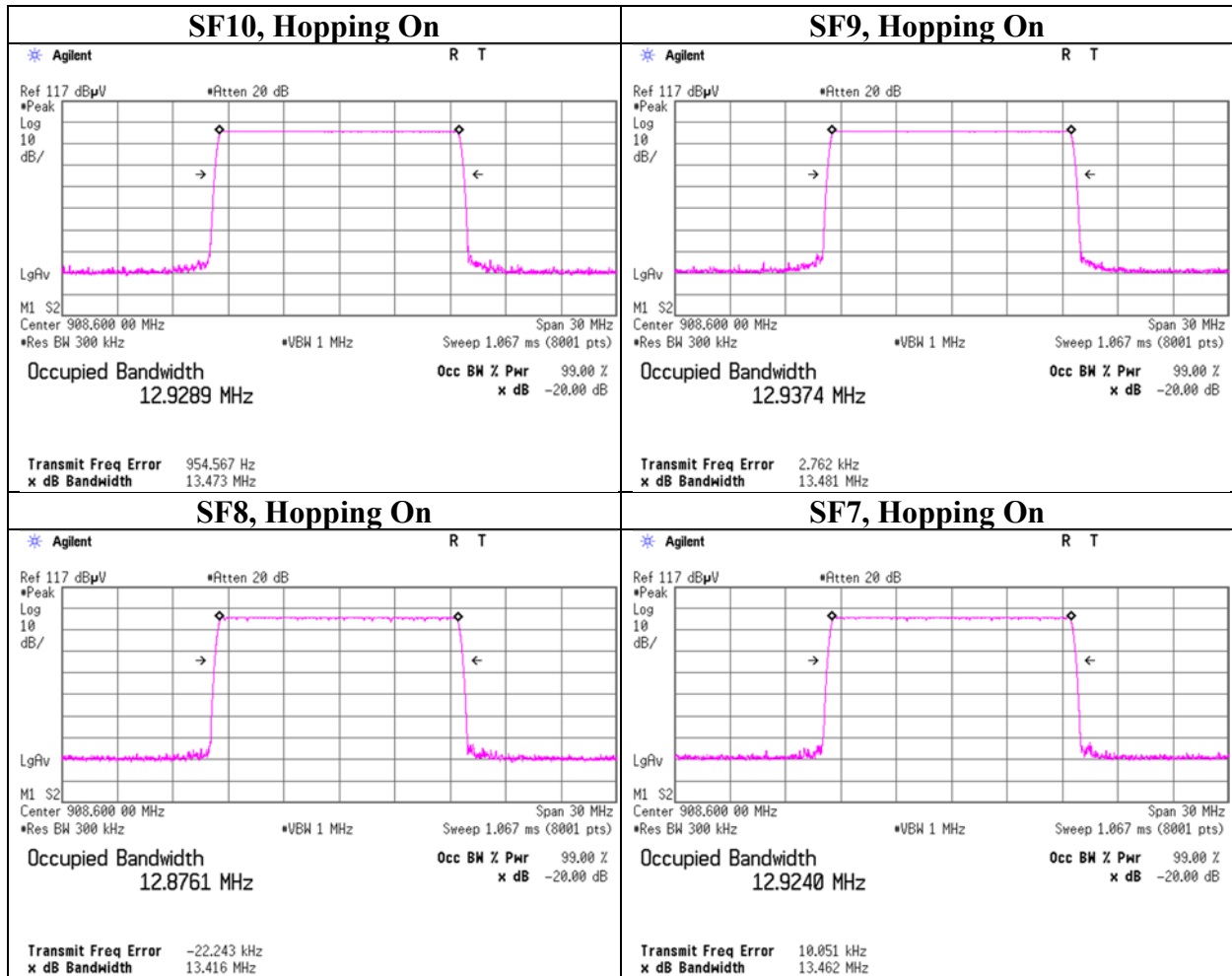
Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

99 % Occupied Bandwidth



UL Japan, Inc.

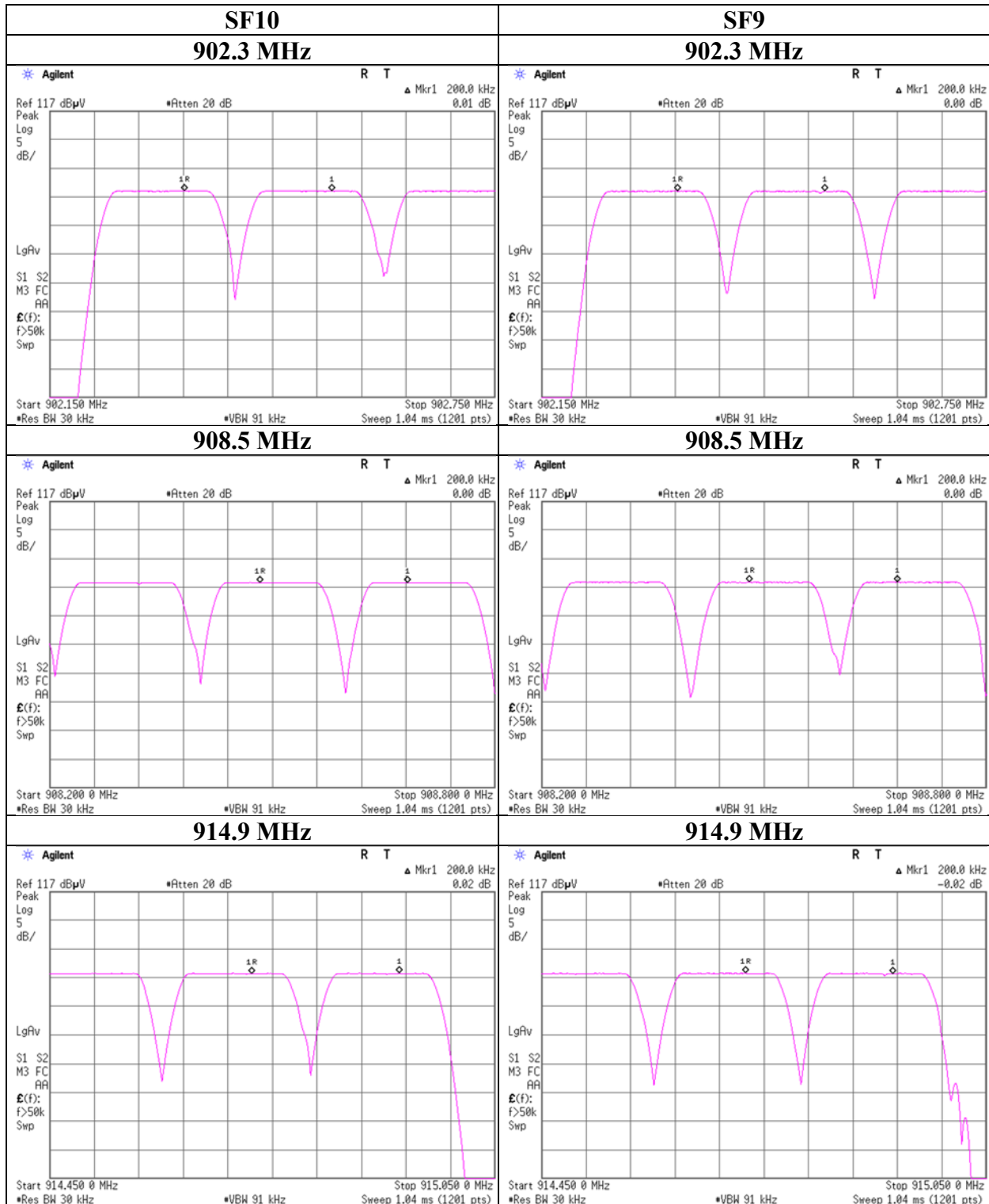
Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Carrier Frequency Separation



UL Japan, Inc.

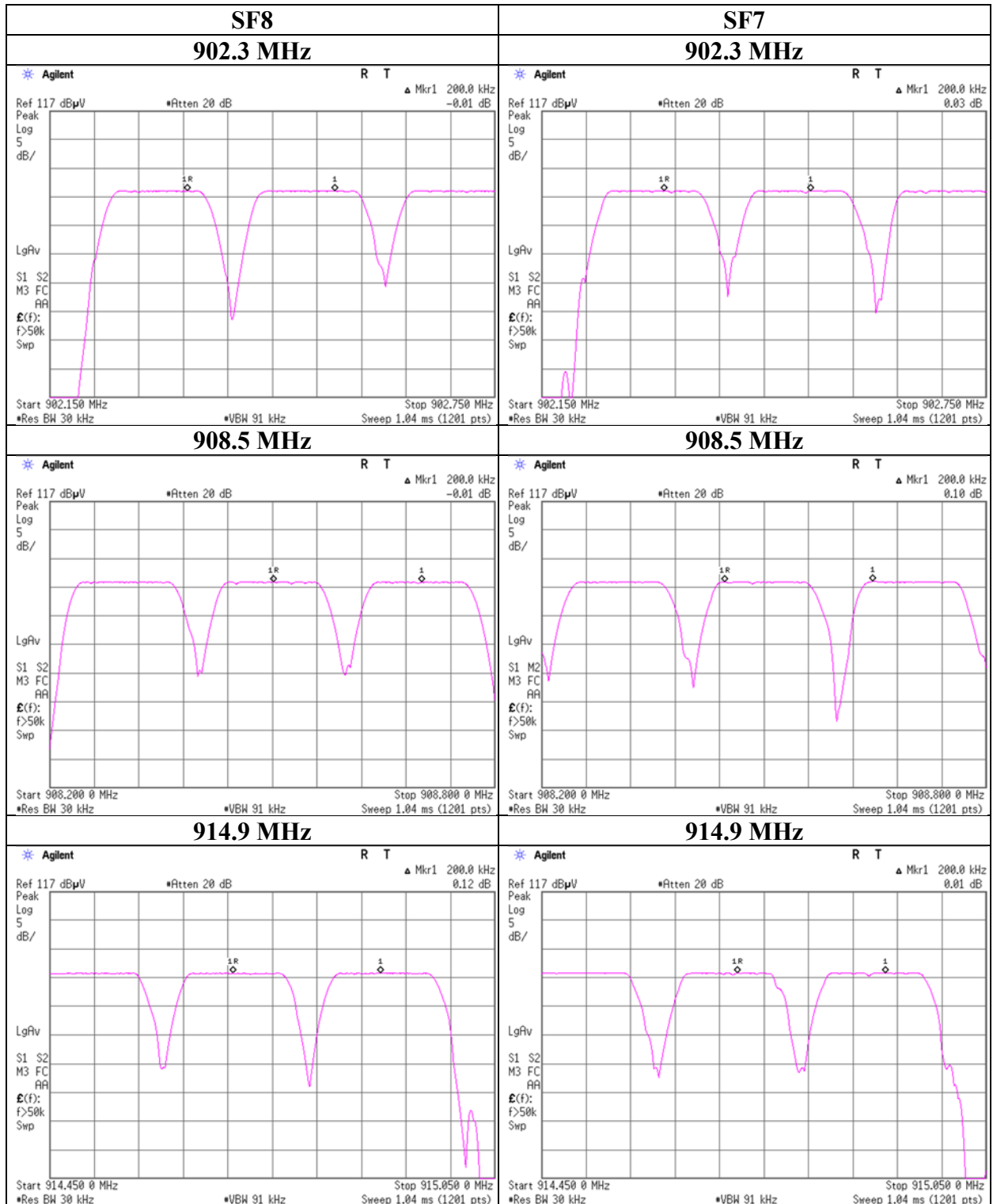
Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Carrier Frequency Separation



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

Dwell time

Report No. 13153638S-A-R1
Test place Shonan EMC Lab. No.5 Shield Room
Date April 8, 2020
Temperature / Humidity 24 deg. C / 37 % RH
Engineer Toshinori Yamada
Mode Tx, Hopping On

| Mode | Number of transmission in a 25.6 second period | | | | Length of transmission [msec] | Result [msec] | Limit [msec] | | |
|------|---|---|-----------|---|-------------------------------------|------------------|-----------------|-----|-----|
| SF10 | 1.0 times | / | 25.6 sec. | x | 25.6 sec. = | 1 times | 371.0 | 371 | 400 |
| SF9 | 1.0 times | / | 25.6 sec. | x | 25.6 sec. = | 1 times | 206.1 | 206 | 400 |
| SF8 | 1.0 times | / | 25.6 sec. | x | 25.6 sec. = | 1 times | 113.3 | 113 | 400 |
| SF7 | 1.0 times | / | 25.6 sec. | x | 25.6 sec. = | 1 times | 61.8 | 62 | 400 |

Sample Calculation

Time period in seconds = the number of hopping frequencies × 0.4 = 25.6 second period

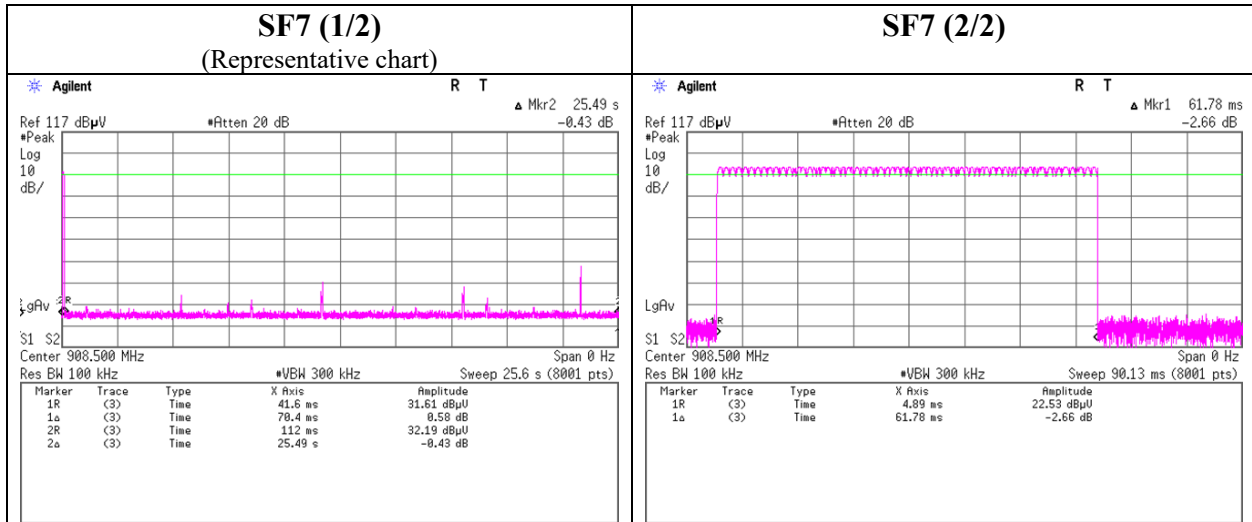
(The number of hopping frequencies = 64)

Result = Number of transmission x Length of transmission

Dwell time



Dwell time



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. 13153638S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 14, 2020
Temperature / Humidity 26 deg. C / 48 % RH
Engineer Hiromasa Sato
Mode Tx, Hopping Off

| Mode | Freq. [MHz] | Reading [dBm] | Cable Loss [dB] | Atten. Loss [dB] | Conducted Power | | | | | e.i.r.p. for RSS-247 | | | | | |
|------|----------------|------------------|-----------------------|------------------------|-----------------|------|-------|------|----------------|--------------------------|--------|------|-------|------|----------------|
| | | | | | Result | | Limit | | Margin [dB] | Antenna Gain [dBi] | Result | | Limit | | Margin [dB] |
| | | | | | [dBm] | [mW] | [dBm] | [mW] | | | [dBm] | [mW] | [dBm] | [mW] | |
| SF10 | 902.3 | -4.01 | 0.90 | 9.75 | 6.64 | 4.61 | 30.00 | 1000 | 23.36 | -1.40 | 5.24 | 3.34 | 36.02 | 4000 | 30.78 |
| SF10 | 908.5 | -4.13 | 0.90 | 9.75 | 6.52 | 4.49 | 30.00 | 1000 | 23.48 | -1.40 | 5.12 | 3.25 | 36.02 | 4000 | 30.90 |
| SF10 | 914.9 | -4.21 | 0.91 | 9.75 | 6.45 | 4.42 | 30.00 | 1000 | 23.55 | -1.40 | 5.05 | 3.20 | 36.02 | 4000 | 30.97 |
| SF9 | 902.3 | -4.03 | 0.90 | 9.75 | 6.62 | 4.59 | 30.00 | 1000 | 23.38 | -1.40 | 5.22 | 3.33 | 36.02 | 4000 | 30.80 |
| SF9 | 908.5 | -4.14 | 0.90 | 9.75 | 6.51 | 4.48 | 30.00 | 1000 | 23.49 | -1.40 | 5.11 | 3.24 | 36.02 | 4000 | 30.91 |
| SF9 | 914.9 | -4.23 | 0.91 | 9.75 | 6.43 | 4.40 | 30.00 | 1000 | 23.57 | -1.40 | 5.03 | 3.18 | 36.02 | 4000 | 30.99 |
| SF8 | 902.3 | -4.02 | 0.90 | 9.75 | 6.63 | 4.60 | 30.00 | 1000 | 23.37 | -1.40 | 5.23 | 3.33 | 36.02 | 4000 | 30.79 |
| SF8 | 908.5 | -4.15 | 0.90 | 9.75 | 6.50 | 4.47 | 30.00 | 1000 | 23.50 | -1.40 | 5.10 | 3.24 | 36.02 | 4000 | 30.92 |
| SF8 | 914.9 | -4.23 | 0.91 | 9.75 | 6.43 | 4.40 | 30.00 | 1000 | 23.57 | -1.40 | 5.03 | 3.18 | 36.02 | 4000 | 30.99 |
| SF7 | 902.3 | -4.04 | 0.90 | 9.75 | 6.61 | 4.58 | 30.00 | 1000 | 23.39 | -1.40 | 5.21 | 3.32 | 36.02 | 4000 | 30.81 |
| SF7 | 908.5 | -4.15 | 0.90 | 9.75 | 6.50 | 4.47 | 30.00 | 1000 | 23.50 | -1.40 | 5.10 | 3.24 | 36.02 | 4000 | 30.92 |
| SF7 | 914.9 | -4.23 | 0.91 | 9.75 | 6.43 | 4.40 | 30.00 | 1000 | 23.57 | -1.40 | 5.03 | 3.18 | 36.02 | 4000 | 30.99 |

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. 13153638S-A-R1
Test place Shonan EMC Lab. No.5 Shielded Room
Date February 14, 2020
Temperature / Humidity 26 deg. C / 48 % RH
Engineer Hiromasa Sato
Mode Tx, Hopping Off

| Mode | Freq. [MHz] | Reading [dBm] | Cable Loss [dB] | Atten. Loss [dB] | Result (Time average) | | Duty factor [dB] | Result (Burst power average) | |
|------|----------------|------------------|-----------------------|------------------------|--------------------------|------|------------------------|---------------------------------|------|
| | | | | | [dBm] | [mW] | | [dBm] | [mW] |
| SF10 | 902.3 | -4.03 | 0.90 | 9.75 | 6.62 | 4.59 | 0.00 | 6.62 | 4.59 |
| SF10 | 908.5 | -4.28 | 0.90 | 9.75 | 6.37 | 4.34 | 0.00 | 6.37 | 4.34 |
| SF10 | 914.9 | -4.35 | 0.91 | 9.75 | 6.31 | 4.28 | 0.00 | 6.31 | 4.28 |
| SF9 | 902.3 | -4.14 | 0.90 | 9.75 | 6.51 | 4.48 | 0.00 | 6.51 | 4.48 |
| SF9 | 908.5 | -4.28 | 0.90 | 9.75 | 6.37 | 4.34 | 0.00 | 6.37 | 4.34 |
| SF9 | 914.9 | -4.36 | 0.91 | 9.75 | 6.30 | 4.27 | 0.00 | 6.30 | 4.27 |
| SF8 | 902.3 | -4.15 | 0.90 | 9.75 | 6.50 | 4.47 | 0.00 | 6.50 | 4.47 |
| SF8 | 908.5 | -4.28 | 0.90 | 9.75 | 6.37 | 4.34 | 0.00 | 6.37 | 4.34 |
| SF8 | 914.9 | -4.36 | 0.91 | 9.75 | 6.30 | 4.27 | 0.00 | 6.30 | 4.27 |
| SF7 | 902.3 | -4.15 | 0.90 | 9.75 | 6.50 | 4.47 | 0.00 | 6.50 | 4.47 |
| SF7 | 908.5 | -4.28 | 0.90 | 9.75 | 6.37 | 4.34 | 0.00 | 6.37 | 4.34 |
| SF7 | 914.9 | -4.35 | 0.91 | 9.75 | 6.31 | 4.28 | 0.00 | 6.31 | 4.28 |

Sample Calculation:

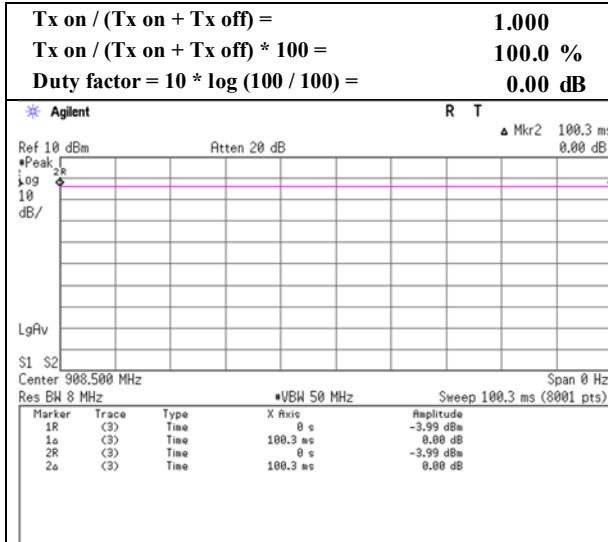
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

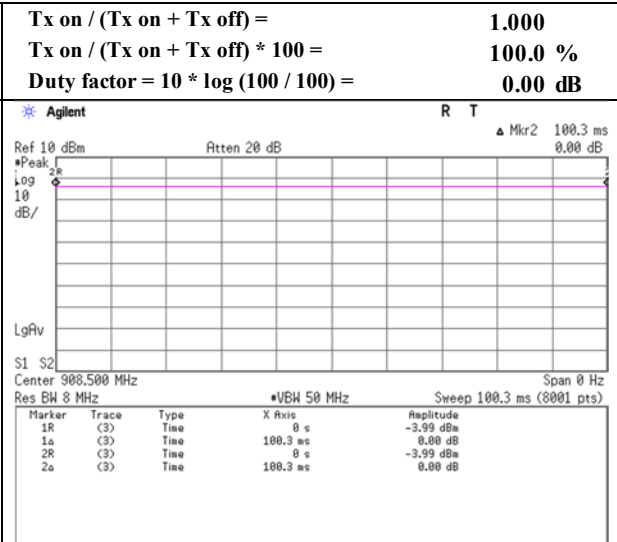
Burst Rate Confirmation

Report No. 13153638S-A-R1
Test place Shonan EMC Lab. No.1 Measurement Room
Date February 14, 2020
Temperature / Humidity 26 deg. C / 48 % RH
Engineer Hiromasa Sato
Mode Tx, Hopping Off

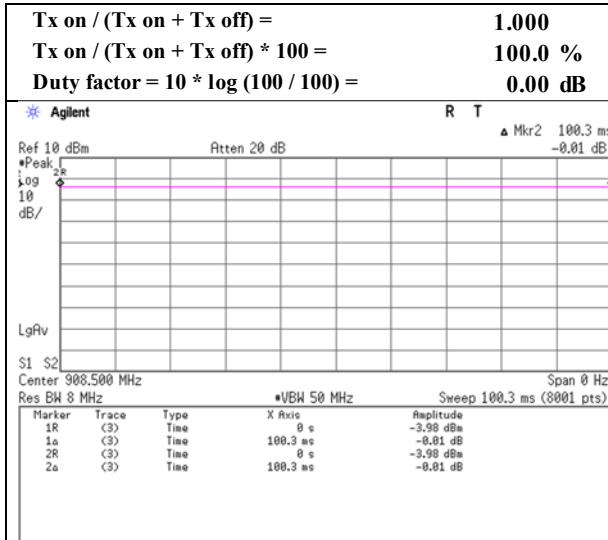
SF10



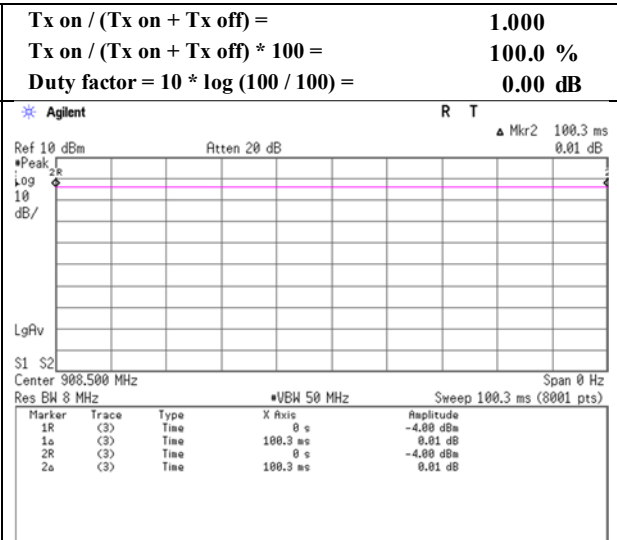
SF9



SF8



SF7



Radiated Spurious Emission

| | | |
|------------------------------------|--|---------------------------------|
| Report No. | 13153638S-A-R1 | |
| Test place (Semi-Anechoic Chamber) | No.1 | No.2 |
| Date | February 17, 2020 | February 16, 2020 |
| Temperature / Humidity | 23 deg. C / 40 % RH | 22 deg. C / 41 % RH |
| Engineer | Kazuya Noda (30 MHz - 1 GHz) | Kazuya Noda (1 GHz - 10 GHz) |
| Mode | Tx, Hopping Off, 125 kHz mode, SF10, 902.3 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. | 400.836 | QP | 39.20 | 15.81 | 8.03 | 31.81 | 0.00 | 31.23 | 46.0 | 14.7 | 100 | 131 | |
| Hori. | 1804.600 | PK | 47.55 | 25.66 | 4.39 | 38.95 | 2.35 | 41.00 | 73.9 | 32.9 | 126 | 175 | |
| Hori. | 2706.900 | PK | 48.28 | 28.34 | 4.82 | 38.53 | 2.35 | 45.26 | 73.9 | 28.6 | 113 | 219 | |
| Hori. | 3609.200 | PK | 50.02 | 29.45 | 5.55 | 38.17 | 2.35 | 49.20 | 73.9 | 24.7 | 222 | 260 | |
| Hori. | 4511.500 | PK | 47.65 | 31.06 | 6.12 | 38.54 | 2.35 | 48.64 | 73.9 | 25.2 | 220 | 157 | |
| Hori. | 5413.800 | PK | 47.76 | 32.20 | 6.78 | 38.77 | 2.35 | 50.32 | 73.9 | 23.5 | 100 | 39 | |
| Hori. | 6316.100 | PK | 50.19 | 34.04 | 7.42 | 39.03 | 2.35 | 54.97 | 73.9 | 18.9 | 221 | 14 | |
| Hori. | 7218.400 | PK | 46.17 | 37.30 | 7.81 | 39.17 | 2.35 | 54.46 | 73.9 | 19.4 | 114 | 107 | |
| Hori. | 8120.700 | PK | 45.37 | 37.98 | 8.25 | 39.42 | 2.35 | 54.53 | 73.9 | 19.3 | 252 | 257 | |
| Hori. | 9023.000 | PK | 46.69 | 37.96 | 8.87 | 39.81 | 2.35 | 56.06 | 73.9 | 17.8 | 105 | 233 | |
| Hori. | 1804.600 | AV | 39.14 | 25.66 | 4.39 | 38.95 | 2.35 | 32.59 | 53.9 | 21.3 | 126 | 175 | |
| Hori. | 2706.900 | AV | 41.54 | 28.34 | 4.82 | 38.53 | 2.35 | 38.52 | 53.9 | 15.3 | 113 | 219 | |
| Hori. | 3609.200 | AV | 43.51 | 29.45 | 5.55 | 38.17 | 2.35 | 42.69 | 53.9 | 11.2 | 222 | 260 | |
| Hori. | 4511.500 | AV | 38.58 | 31.06 | 6.12 | 38.54 | 2.35 | 39.57 | 53.9 | 14.3 | 220 | 157 | |
| Hori. | 5413.800 | AV | 39.93 | 32.20 | 6.78 | 38.77 | 2.35 | 42.49 | 53.9 | 11.4 | 100 | 39 | |
| Hori. | 6316.100 | AV | 43.67 | 34.04 | 7.42 | 39.03 | 2.35 | 48.45 | 53.9 | 5.4 | 221 | 14 | |
| Hori. | 7218.400 | AV | 35.11 | 37.30 | 7.81 | 39.17 | 2.35 | 43.40 | 53.9 | 10.5 | 114 | 107 | |
| Hori. | 8120.700 | AV | 33.91 | 37.98 | 8.25 | 39.42 | 2.35 | 43.07 | 53.9 | 10.8 | 252 | 257 | |
| Hori. | 9023.000 | AV | 35.47 | 37.96 | 8.87 | 39.81 | 2.35 | 44.84 | 53.9 | 9.0 | 105 | 233 | |
| Vert. | 400.854 | QP | 38.80 | 15.81 | 8.03 | 31.81 | 0.00 | 30.83 | 46.0 | 15.1 | 100 | 94 | |
| Vert. | 1804.600 | PK | 47.24 | 25.66 | 4.39 | 38.95 | 2.35 | 40.69 | 73.9 | 33.2 | 145 | 177 | |
| Vert. | 2706.900 | PK | 50.29 | 28.34 | 4.82 | 38.53 | 2.35 | 47.27 | 73.9 | 26.6 | 143 | 262 | |
| Vert. | 3609.200 | PK | 49.27 | 29.45 | 5.55 | 38.17 | 2.35 | 48.45 | 73.9 | 25.4 | 163 | 243 | |
| Vert. | 4511.500 | PK | 46.95 | 31.06 | 6.12 | 38.54 | 2.35 | 47.94 | 73.9 | 25.9 | 160 | 22 | |
| Vert. | 5413.800 | PK | 48.06 | 32.20 | 6.78 | 38.77 | 2.35 | 50.62 | 73.9 | 23.2 | 100 | 297 | |
| Vert. | 6316.100 | PK | 49.54 | 34.04 | 7.42 | 39.03 | 2.35 | 54.32 | 73.9 | 19.5 | 105 | 25 | |
| Vert. | 7218.400 | PK | 45.84 | 37.30 | 7.81 | 39.17 | 2.35 | 54.13 | 73.9 | 19.7 | 100 | 239 | |
| Vert. | 8120.700 | PK | 45.41 | 37.98 | 8.25 | 39.42 | 2.35 | 54.57 | 73.9 | 19.3 | 119 | 2 | |
| Vert. | 9023.000 | PK | 46.01 | 37.96 | 8.87 | 39.81 | 2.35 | 55.38 | 73.9 | 18.5 | 288 | 255 | |
| Vert. | 1804.600 | AV | 38.87 | 25.66 | 4.39 | 38.95 | 2.35 | 32.32 | 53.9 | 21.5 | 145 | 177 | |
| Vert. | 2706.900 | AV | 44.85 | 28.34 | 4.82 | 38.53 | 2.35 | 41.83 | 53.9 | 12.0 | 143 | 262 | |
| Vert. | 3609.200 | AV | 42.62 | 29.45 | 5.55 | 38.17 | 2.35 | 41.80 | 53.9 | 12.1 | 163 | 243 | |
| Vert. | 4511.500 | AV | 37.14 | 31.06 | 6.12 | 38.54 | 2.35 | 38.13 | 53.9 | 15.7 | 160 | 22 | |
| Vert. | 5413.800 | AV | 39.10 | 32.20 | 6.78 | 38.77 | 2.35 | 41.66 | 53.9 | 12.2 | 100 | 297 | |
| Vert. | 6316.100 | AV | 42.29 | 34.04 | 7.42 | 39.03 | 2.35 | 47.07 | 53.9 | 6.8 | 105 | 25 | |
| Vert. | 7218.400 | AV | 34.51 | 37.30 | 7.81 | 39.17 | 2.35 | 42.80 | 53.9 | 11.1 | 100 | 239 | |
| Vert. | 8120.700 | AV | 33.32 | 37.98 | 8.25 | 39.42 | 2.35 | 42.48 | 53.9 | 11.4 | 119 | 2 | |
| Vert. | 9023.000 | AV | 34.59 | 37.96 | 8.87 | 39.81 | 2.35 | 43.96 | 53.9 | 9.9 | 288 | 255 | |

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

Distance factor : 1 GHz - 10 GHz : 20log(3.93 m / 3.0 m) = 2.35 dB

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

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Distance Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|----------------------|-----------------|----------------|-------------|---------|
| Hori. | 902.300 | PK | 103.89 | 22.10 | 9.86 | 31.33 | 0.00 | 104.52 | - | - | Carrier |
| Hori. | 902.000 | PK | 60.81 | 22.10 | 9.86 | 31.33 | 0.00 | 61.44 | 84.52 | 23.0 | |
| Vert. | 902.300 | PK | 102.20 | 22.10 | 9.86 | 31.33 | 0.00 | 102.83 | - | - | Carrier |
| Vert. | 902.000 | PK | 58.27 | 22.10 | 9.86 | 31.33 | 0.00 | 58.90 | 82.83 | 23.9 | |

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

Distance factor : 1 GHz - 10 GHz : 20log(3.93 m / 3.0 m) = 2.35 dB

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

UL Japan, Inc.

Shonan EMC Lab.

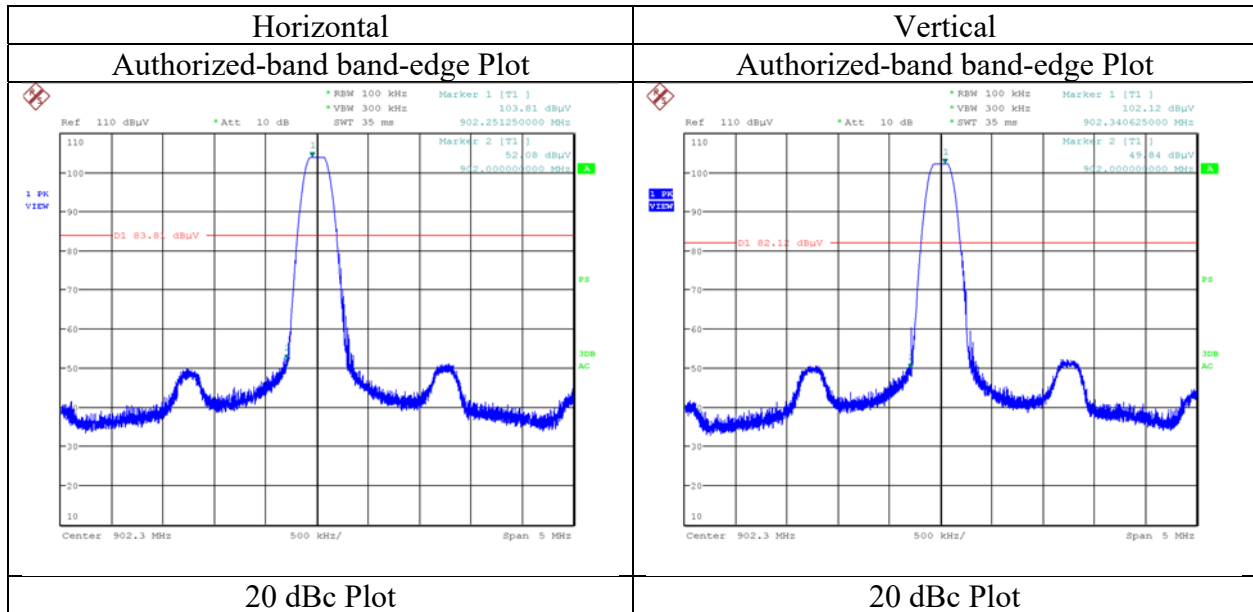
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13153638S-A-R1
Test place (Semi-Anechoic Chamber) No.1
Date February 17, 2020
Temperature / Humidity 23 deg. C / 40 % RH
Engineer Kazuya Noda
(30 MHz - 1 GHz)
Mode Tx, Hopping Off, 125 kHz mode, SF10, 902.3 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. | 13153638S-A-R1 | |
| Test place (Semi-Anechoic Chamber) | No.1 | No.2 |
| Date | February 17, 2020 | February 16, 2020 |
| Temperature / Humidity | 23 deg. C / 40 % RH | 22 deg. C / 41 % RH |
| Engineer | Kazuya Noda (30 MHz - 1 GHz) | Kazuya Noda (1 GHz - 10 GHz) |
| Mode | Tx, Hopping Off, 125 kHz mode, SF10, 908.5 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. | 400.764 | QP | 39.10 | 15.81 | 8.03 | 31.81 | 0.00 | 31.13 | 46.0 | 14.8 | 100 | 142 | |
| Hori. | 902.000 | QP | 26.60 | 22.10 | 9.86 | 31.33 | 0.00 | 27.23 | 46.0 | 18.7 | 100 | 222 | |
| Hori. | 928.000 | QP | 24.90 | 22.00 | 9.96 | 31.11 | 0.00 | 25.75 | 46.0 | 20.2 | 100 | 222 | |
| Hori. | 1817.000 | PK | 47.51 | 25.73 | 4.39 | 38.95 | 2.35 | 41.03 | 73.9 | 32.8 | 201 | 168 | |
| Hori. | 2725.500 | PK | 47.86 | 28.39 | 4.84 | 38.52 | 2.35 | 44.92 | 73.9 | 28.9 | 111 | 219 | |
| Hori. | 3634.000 | PK | 48.88 | 29.54 | 5.55 | 38.17 | 2.35 | 48.15 | 73.9 | 25.7 | 259 | 258 | |
| Hori. | 4542.500 | PK | 47.75 | 31.13 | 6.13 | 38.54 | 2.35 | 48.82 | 73.9 | 25.0 | 179 | 156 | |
| Hori. | 5451.000 | PK | 48.26 | 32.25 | 6.81 | 38.79 | 2.35 | 50.88 | 73.9 | 23.0 | 100 | 39 | |
| Hori. | 6359.500 | PK | 49.56 | 34.25 | 7.44 | 39.02 | 2.35 | 54.58 | 73.9 | 19.3 | 175 | 12 | |
| Hori. | 7268.000 | PK | 46.25 | 37.35 | 7.84 | 39.25 | 2.35 | 54.54 | 73.9 | 19.3 | 117 | 108 | |
| Hori. | 8176.500 | PK | 45.68 | 37.73 | 8.29 | 39.45 | 2.35 | 54.60 | 73.9 | 19.3 | 119 | 313 | |
| Hori. | 9085.000 | PK | 46.23 | 38.15 | 8.92 | 39.81 | 2.35 | 55.84 | 73.9 | 18.0 | 102 | 232 | |
| Hori. | 1817.000 | AV | 38.18 | 25.73 | 4.39 | 38.95 | 2.35 | 31.70 | 53.9 | 22.2 | 201 | 168 | |
| Hori. | 2725.500 | AV | 41.59 | 28.39 | 4.84 | 38.52 | 2.35 | 38.65 | 53.9 | 15.2 | 111 | 219 | |
| Hori. | 3634.000 | AV | 43.12 | 29.54 | 5.55 | 38.17 | 2.35 | 42.39 | 53.9 | 11.5 | 259 | 258 | |
| Hori. | 4542.500 | AV | 39.31 | 31.13 | 6.13 | 38.54 | 2.35 | 40.38 | 53.9 | 13.5 | 179 | 156 | |
| Hori. | 5451.000 | AV | 40.65 | 32.25 | 6.81 | 38.79 | 2.35 | 43.27 | 53.9 | 10.6 | 100 | 39 | |
| Hori. | 6359.500 | AV | 42.37 | 34.25 | 7.44 | 39.02 | 2.35 | 47.39 | 53.9 | 6.5 | 175 | 12 | |
| Hori. | 7268.000 | AV | 34.41 | 37.35 | 7.84 | 39.25 | 2.35 | 42.70 | 53.9 | 11.2 | 117 | 108 | |
| Hori. | 8176.500 | AV | 33.38 | 37.73 | 8.29 | 39.45 | 2.35 | 42.30 | 53.9 | 11.6 | 119 | 313 | |
| Hori. | 9085.000 | AV | 35.16 | 38.15 | 8.92 | 39.81 | 2.35 | 44.77 | 53.9 | 9.1 | 102 | 232 | |
| Vert. | 400.794 | QP | 38.70 | 15.81 | 8.03 | 31.81 | 0.00 | 30.73 | 46.0 | 15.2 | 138 | 85 | |
| Vert. | 902.000 | QP | 25.90 | 22.10 | 9.86 | 31.33 | 0.00 | 26.53 | 46.0 | 19.4 | 117 | 122 | |
| Vert. | 928.000 | QP | 24.30 | 22.00 | 9.96 | 31.11 | 0.00 | 25.15 | 46.0 | 20.8 | 117 | 122 | |
| Vert. | 1817.000 | PK | 46.73 | 25.73 | 4.39 | 38.95 | 2.35 | 40.25 | 73.9 | 33.6 | 144 | 175 | |
| Vert. | 2725.500 | PK | 50.41 | 28.39 | 4.84 | 38.52 | 2.35 | 47.47 | 73.9 | 26.4 | 126 | 267 | |
| Vert. | 3634.000 | PK | 49.65 | 29.54 | 5.55 | 38.17 | 2.35 | 48.92 | 73.9 | 24.9 | 152 | 241 | |
| Vert. | 4542.500 | PK | 46.13 | 31.13 | 6.13 | 38.54 | 2.35 | 47.20 | 73.9 | 26.7 | 148 | 26 | |
| Vert. | 5451.000 | PK | 47.56 | 32.25 | 6.81 | 38.79 | 2.35 | 50.18 | 73.9 | 23.7 | 100 | 294 | |
| Vert. | 6359.500 | PK | 49.26 | 34.25 | 7.44 | 39.02 | 2.35 | 54.28 | 73.9 | 19.6 | 102 | 22 | |
| Vert. | 7268.000 | PK | 45.65 | 37.35 | 7.84 | 39.25 | 2.35 | 53.94 | 73.9 | 19.9 | 105 | 18 | |
| Vert. | 8176.500 | PK | 46.42 | 37.73 | 8.29 | 39.45 | 2.35 | 55.34 | 73.9 | 18.5 | 113 | 1 | |
| Vert. | 9085.000 | PK | 46.28 | 38.15 | 8.92 | 39.81 | 2.35 | 55.89 | 73.9 | 18.0 | 291 | 257 | |
| Vert. | 1817.000 | AV | 37.38 | 25.73 | 4.39 | 38.95 | 2.35 | 30.90 | 53.9 | 23.0 | 144 | 175 | |
| Vert. | 2725.500 | AV | 45.02 | 28.39 | 4.84 | 38.52 | 2.35 | 42.08 | 53.9 | 11.8 | 126 | 267 | |
| Vert. | 3634.000 | AV | 43.59 | 29.54 | 5.55 | 38.17 | 2.35 | 42.86 | 53.9 | 11.0 | 152 | 241 | |
| Vert. | 4542.500 | AV | 36.02 | 31.13 | 6.13 | 38.54 | 2.35 | 37.09 | 53.9 | 16.8 | 148 | 26 | |
| Vert. | 5451.000 | AV | 37.89 | 32.25 | 6.81 | 38.79 | 2.35 | 40.51 | 53.9 | 13.3 | 100 | 294 | |
| Vert. | 6359.500 | AV | 41.16 | 34.25 | 7.44 | 39.02 | 2.35 | 46.18 | 53.9 | 7.7 | 102 | 22 | |
| Vert. | 7268.000 | AV | 32.97 | 37.35 | 7.84 | 39.25 | 2.35 | 41.26 | 53.9 | 12.6 | 105 | 18 | |
| Vert. | 8176.500 | AV | 32.17 | 37.73 | 8.29 | 39.45 | 2.35 | 41.09 | 53.9 | 12.8 | 113 | 1 | |
| Vert. | 9085.000 | AV | 33.98 | 38.15 | 8.92 | 39.81 | 2.35 | 43.59 | 53.9 | 10.3 | 291 | 257 | |

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log(3.93 m / 3.0 m) = 2.35 dB

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

Radiated Spurious Emission

| | | |
|------------------------------------|--|---------------------------------|
| Report No. | 13153638S-A-R1 | |
| Test place (Semi-Anechoic Chamber) | No.1 | No.2 |
| Date | February 17, 2020 | February 16, 2020 |
| Temperature / Humidity | 23 deg. C / 40 % RH | 22 deg. C / 41 % RH |
| Engineer | Kazuya Noda (30 MHz - 1 GHz) | Kazuya Noda (1 GHz - 10 GHz) |
| Mode | Tx, Hopping Off, 125 kHz mode, SF10, 914.9 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. | 400.888 | QP | 39.00 | 15.81 | 8.03 | 31.81 | 0.00 | 31.03 | 46.0 | 14.9 | 100 | 139 | |
| Hori. | 928.000 | QP | 25.30 | 22.00 | 9.96 | 31.11 | 0.00 | 26.15 | 46.0 | 19.8 | 100 | 222 | |
| Hori. | 1829.800 | PK | 47.12 | 25.81 | 4.38 | 38.95 | 2.35 | 40.71 | 73.9 | 33.1 | 158 | 148 | |
| Hori. | 2744.700 | PK | 49.17 | 28.45 | 4.85 | 38.52 | 2.35 | 46.30 | 73.9 | 27.6 | 105 | 213 | |
| Hori. | 3659.600 | PK | 49.89 | 29.63 | 5.57 | 38.16 | 2.35 | 49.28 | 73.9 | 24.6 | 324 | 246 | |
| Hori. | 4574.500 | PK | 47.53 | 31.21 | 6.17 | 38.54 | 2.35 | 48.72 | 73.9 | 25.1 | 100 | 207 | |
| Hori. | 5489.400 | PK | 47.56 | 32.27 | 6.83 | 38.81 | 2.35 | 50.20 | 73.9 | 23.7 | 100 | 34 | |
| Hori. | 6404.300 | PK | 47.56 | 34.43 | 7.46 | 39.01 | 2.35 | 52.79 | 73.9 | 21.1 | 119 | 79 | |
| Hori. | 7319.200 | PK | 45.82 | 37.42 | 7.85 | 39.33 | 2.35 | 54.11 | 73.9 | 19.7 | 134 | 28 | |
| Hori. | 8234.100 | PK | 44.79 | 37.48 | 8.32 | 39.48 | 2.35 | 53.46 | 73.9 | 20.4 | 102 | 324 | |
| Hori. | 9149.000 | PK | 45.72 | 38.39 | 8.94 | 39.81 | 2.35 | 55.59 | 73.9 | 18.3 | 104 | 233 | |
| Hori. | 1829.800 | AV | 38.74 | 25.81 | 4.38 | 38.95 | 2.35 | 32.33 | 53.9 | 21.5 | 158 | 148 | |
| Hori. | 2744.700 | AV | 42.98 | 28.45 | 4.85 | 38.52 | 2.35 | 40.11 | 53.9 | 13.7 | 105 | 213 | |
| Hori. | 3659.600 | AV | 44.61 | 29.63 | 5.57 | 38.16 | 2.35 | 44.00 | 53.9 | 9.9 | 324 | 246 | |
| Hori. | 4574.500 | AV | 40.34 | 31.21 | 6.17 | 38.54 | 2.35 | 41.53 | 53.9 | 12.3 | 100 | 207 | |
| Hori. | 5489.400 | AV | 39.83 | 32.27 | 6.83 | 38.81 | 2.35 | 42.47 | 53.9 | 11.4 | 100 | 34 | |
| Hori. | 6404.300 | AV | 40.18 | 34.43 | 7.46 | 39.01 | 2.35 | 45.41 | 53.9 | 8.4 | 119 | 79 | |
| Hori. | 7319.200 | AV | 34.15 | 37.42 | 7.85 | 39.33 | 2.35 | 42.44 | 53.9 | 11.4 | 134 | 28 | |
| Hori. | 8234.100 | AV | 33.70 | 37.48 | 8.32 | 39.48 | 2.35 | 42.37 | 53.9 | 11.5 | 102 | 324 | |
| Hori. | 9149.000 | AV | 34.77 | 38.39 | 8.94 | 39.81 | 2.35 | 44.64 | 53.9 | 9.2 | 104 | 233 | |
| Vert. | 401.971 | QP | 38.30 | 15.84 | 8.03 | 31.81 | 0.00 | 30.36 | 46.0 | 15.6 | 141 | 96 | |
| Vert. | 928.000 | QP | 24.70 | 22.00 | 9.96 | 31.11 | 0.00 | 25.55 | 46.0 | 20.4 | 115 | 121 | |
| Vert. | 1829.800 | PK | 46.84 | 25.81 | 4.38 | 38.95 | 2.35 | 40.43 | 73.9 | 33.4 | 141 | 155 | |
| Vert. | 2744.700 | PK | 51.03 | 28.45 | 4.85 | 38.52 | 2.35 | 48.16 | 73.9 | 25.7 | 144 | 266 | |
| Vert. | 3659.600 | PK | 49.76 | 29.63 | 5.57 | 38.16 | 2.35 | 49.15 | 73.9 | 24.7 | 161 | 237 | |
| Vert. | 4574.500 | PK | 46.04 | 31.21 | 6.17 | 38.54 | 2.35 | 47.23 | 73.9 | 26.6 | 102 | 122 | |
| Vert. | 5489.400 | PK | 47.73 | 32.27 | 6.83 | 38.81 | 2.35 | 50.37 | 73.9 | 23.5 | 100 | 298 | |
| Vert. | 6404.300 | PK | 48.12 | 34.43 | 7.46 | 39.01 | 2.35 | 53.35 | 73.9 | 20.5 | 101 | 23 | |
| Vert. | 7319.200 | PK | 44.95 | 37.42 | 7.85 | 39.33 | 2.35 | 53.24 | 73.9 | 20.6 | 104 | 21 | |
| Vert. | 8234.100 | PK | 45.75 | 37.48 | 8.32 | 39.48 | 2.35 | 54.42 | 73.9 | 19.4 | 109 | 4 | |
| Vert. | 9149.000 | PK | 46.43 | 38.39 | 8.94 | 39.81 | 2.35 | 56.30 | 73.9 | 17.6 | 274 | 253 | |
| Vert. | 1829.800 | AV | 37.38 | 25.81 | 4.38 | 38.95 | 2.35 | 30.97 | 53.9 | 22.9 | 141 | 155 | |
| Vert. | 2744.700 | AV | 46.11 | 28.45 | 4.85 | 38.52 | 2.35 | 43.24 | 53.9 | 10.6 | 144 | 266 | |
| Vert. | 3659.600 | AV | 44.72 | 29.63 | 5.57 | 38.16 | 2.35 | 44.11 | 53.9 | 9.7 | 161 | 237 | |
| Vert. | 4574.500 | AV | 37.09 | 31.21 | 6.17 | 38.54 | 2.35 | 38.28 | 53.9 | 15.6 | 102 | 122 | |
| Vert. | 5489.400 | AV | 37.78 | 32.27 | 6.83 | 38.81 | 2.35 | 40.42 | 53.9 | 13.4 | 100 | 298 | |
| Vert. | 6404.300 | AV | 39.83 | 34.43 | 7.46 | 39.01 | 2.35 | 45.06 | 53.9 | 8.8 | 101 | 23 | |
| Vert. | 7319.200 | AV | 33.95 | 37.42 | 7.85 | 39.33 | 2.35 | 42.24 | 53.9 | 11.6 | 104 | 21 | |
| Vert. | 8234.100 | AV | 33.34 | 37.48 | 8.32 | 39.48 | 2.35 | 42.01 | 53.9 | 11.8 | 109 | 4 | |
| Vert. | 9149.000 | AV | 34.63 | 38.39 | 8.94 | 39.81 | 2.35 | 44.50 | 53.9 | 9.4 | 274 | 253 | |

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB

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

UL Japan, Inc.

Shonan EMC Lab.

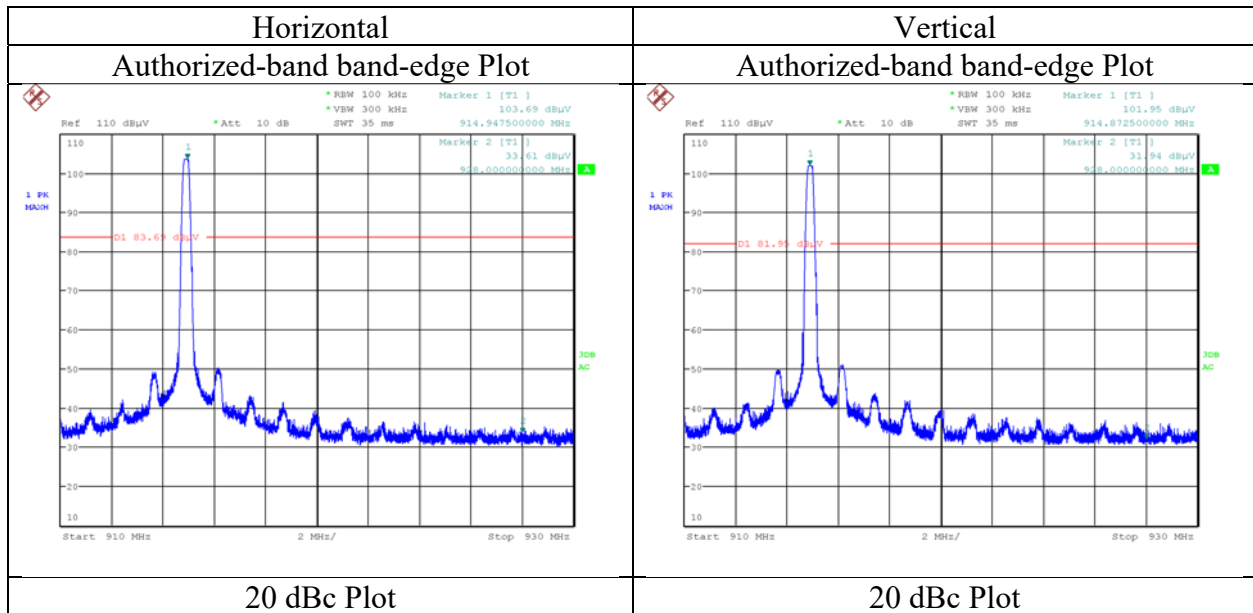
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 13153638S-A-R1
Test place (Semi-Anechoic Chamber) No.1
Date February 17, 2020
Temperature / Humidity 23 deg. C / 40 % RH
Engineer Kazuya Noda
(30 MHz - 1 GHz)
Mode Tx, Hopping Off, 125 kHz mode, SF10, 914.9 MHz

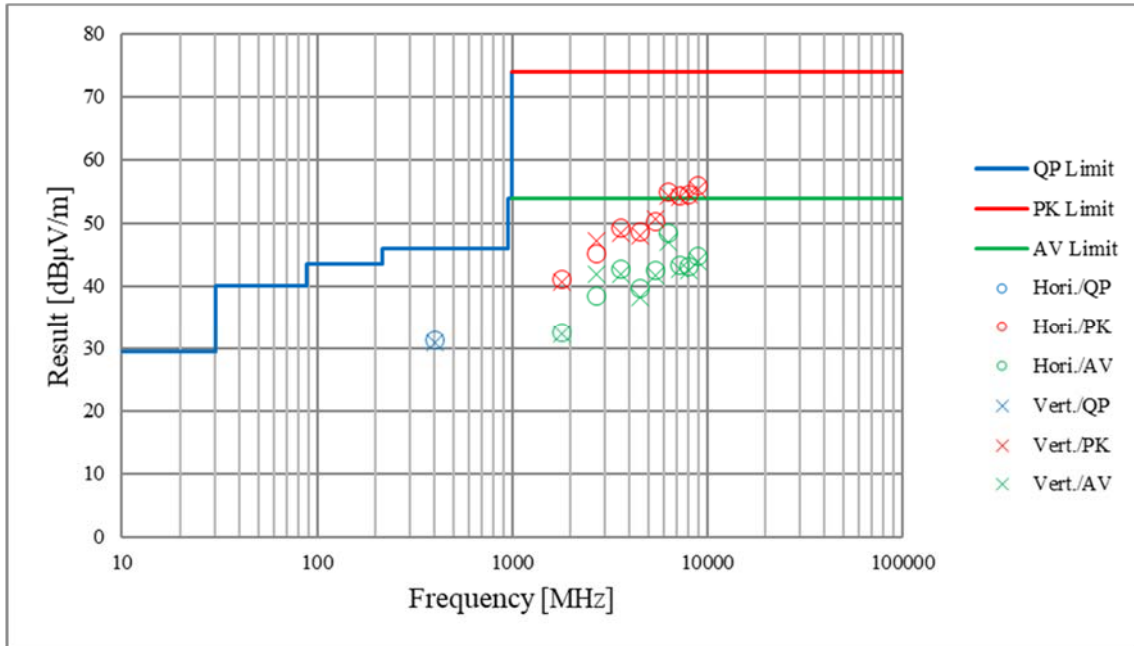


* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

Radiated Spurious Emission
(Plot data, Worst case)

| | | |
|------------------------------------|--|---------------------------------|
| Report No. | 13153638S-A-R1 | |
| Test place (Semi-Anechoic Chamber) | No.1 | No.2 |
| Date | February 17, 2020 | February 16, 2020 |
| Temperature / Humidity | 23 deg. C / 40 % RH | 22 deg. C / 41 % RH |
| Engineer | Kazuya Noda (30 MHz - 1 GHz) | Kazuya Noda (1 GHz - 10 GHz) |
| Mode | Tx, Hopping Off, 125 kHz mode, SF10, 902.3 MHz | |

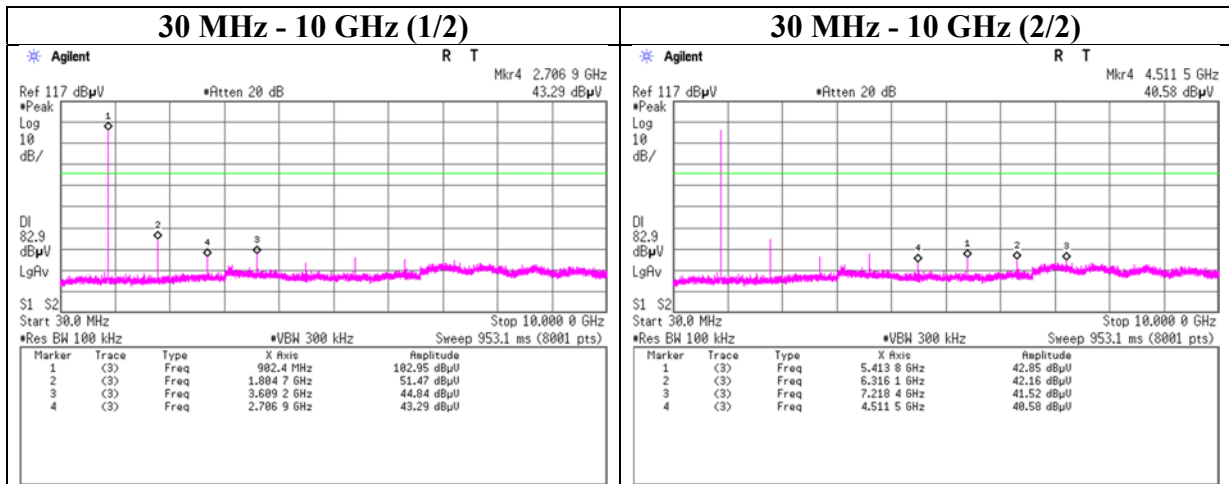
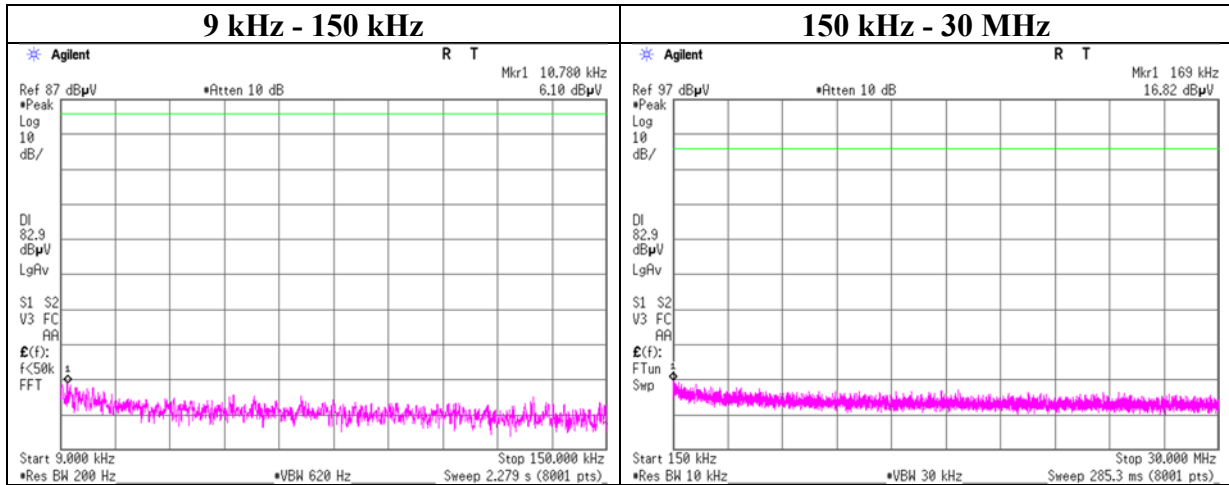


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Report No. 13153638S-A-R1
 Test place Shonan EMC Lab. No.5 Shield Room
 Date February 22, 2020
 Temperature / Humidity 22 deg. C / 50 % RH
 Engineer Toshinori Yamada
 Mode Tx, Hopping Off, 125 kHz mode, SF10

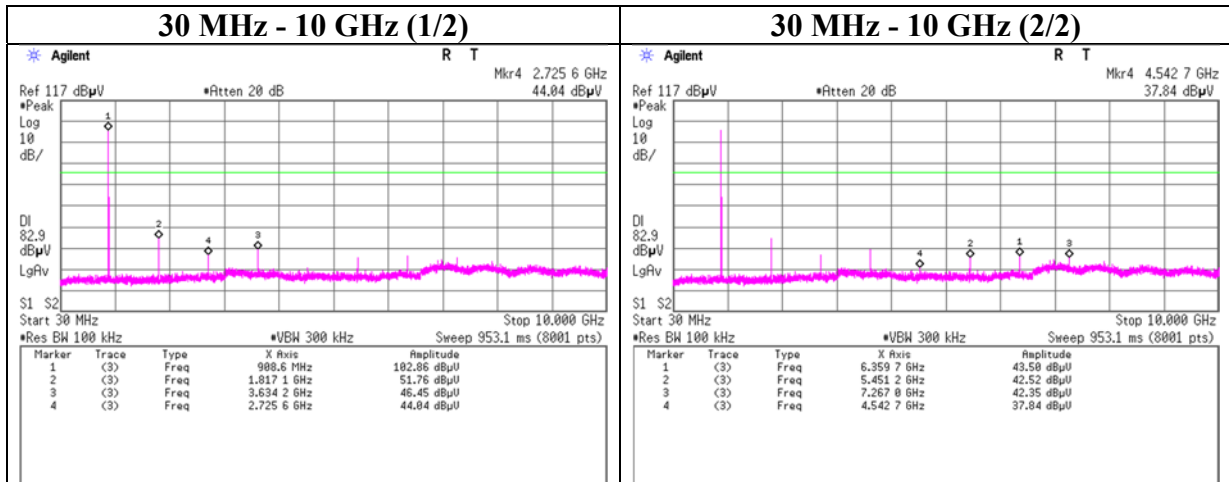
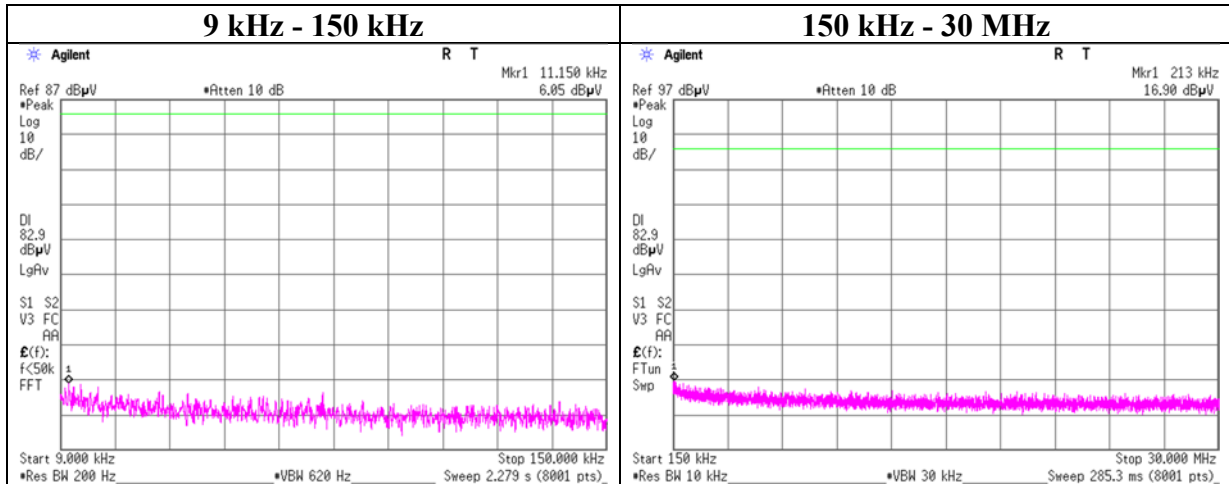
902.3 MHz



Conducted Spurious Emission

Report No. 13153638S-A-R1
Test place Shonan EMC Lab. No.5 Shield Room
Date February 22, 2020
Temperature / Humidity 22 deg. C / 50 % RH
Engineer Toshinori Yamada
Mode Tx, Hopping Off, 125 kHz mode, SF10

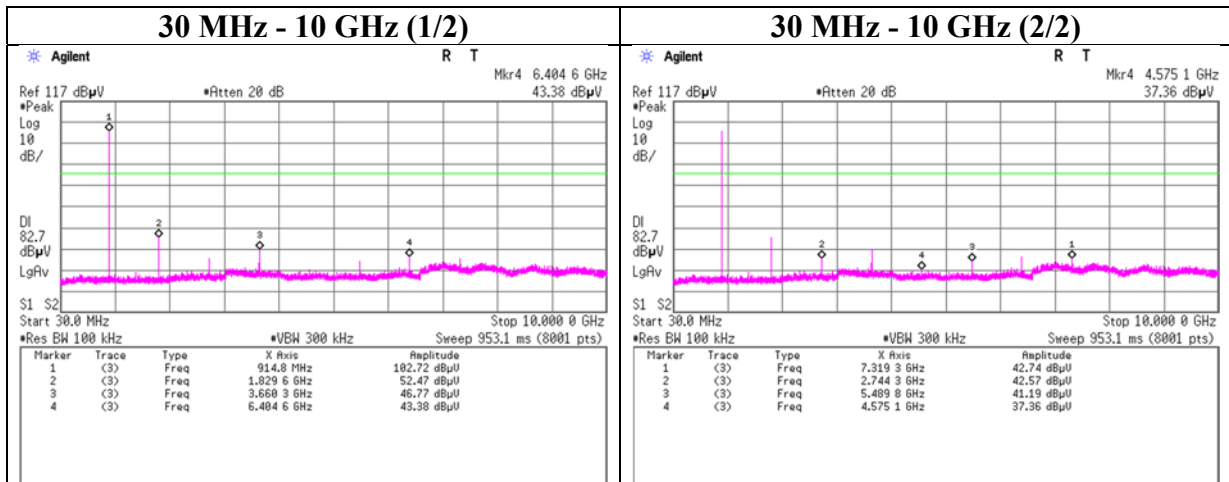
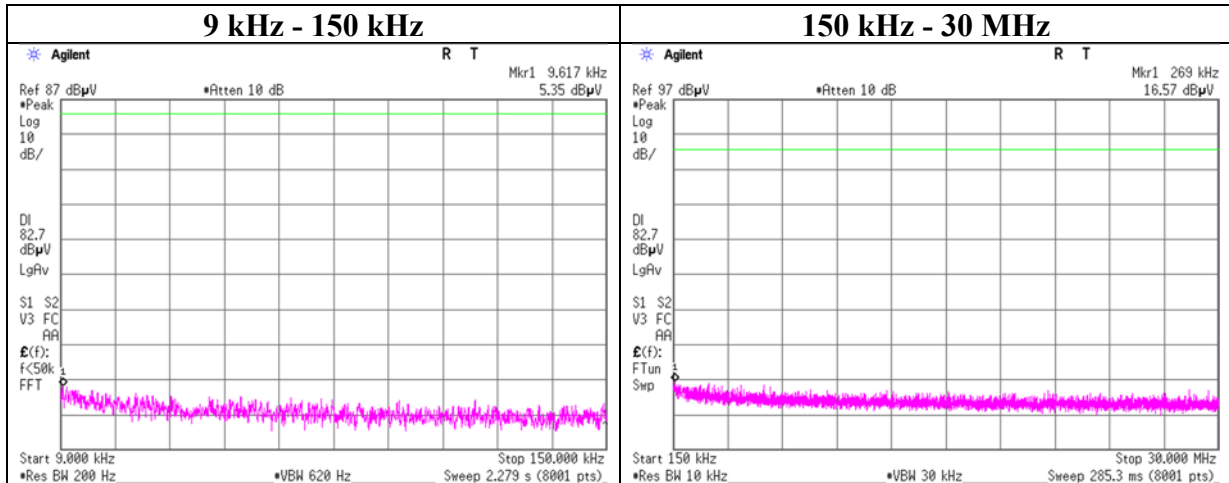
908.5 MHz



Conducted Spurious Emission

Report No. 13153638S-A-R1
 Test place Shonan EMC Lab. No.5 Shield Room
 Date February 22, 2020
 Temperature / Humidity 22 deg. C / 50 % RH
 Engineer Toshinori Yamada
 Mode Tx, Hopping Off, 125 kHz mode, SF10

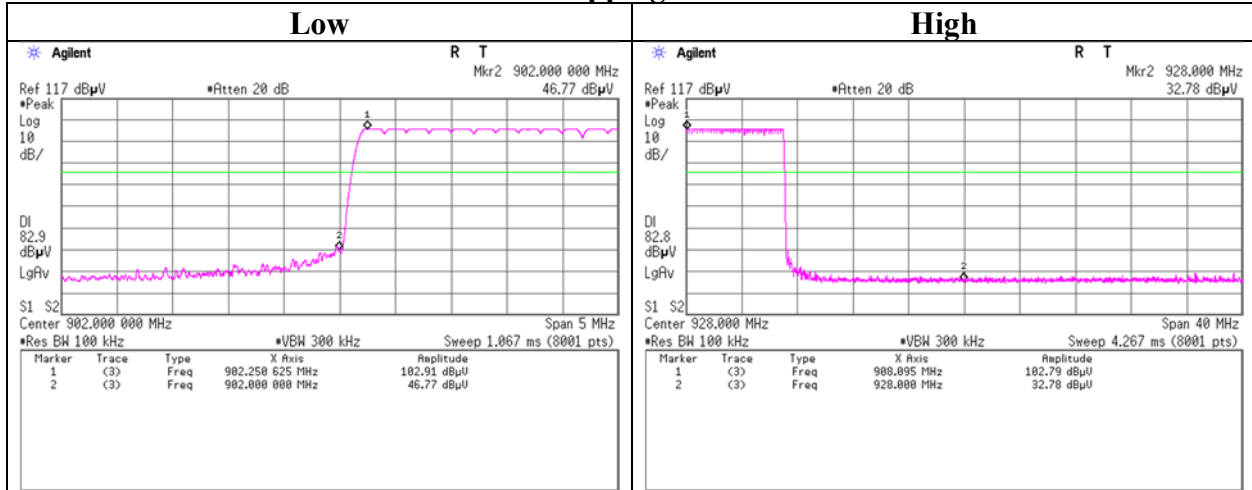
914.9 MHz



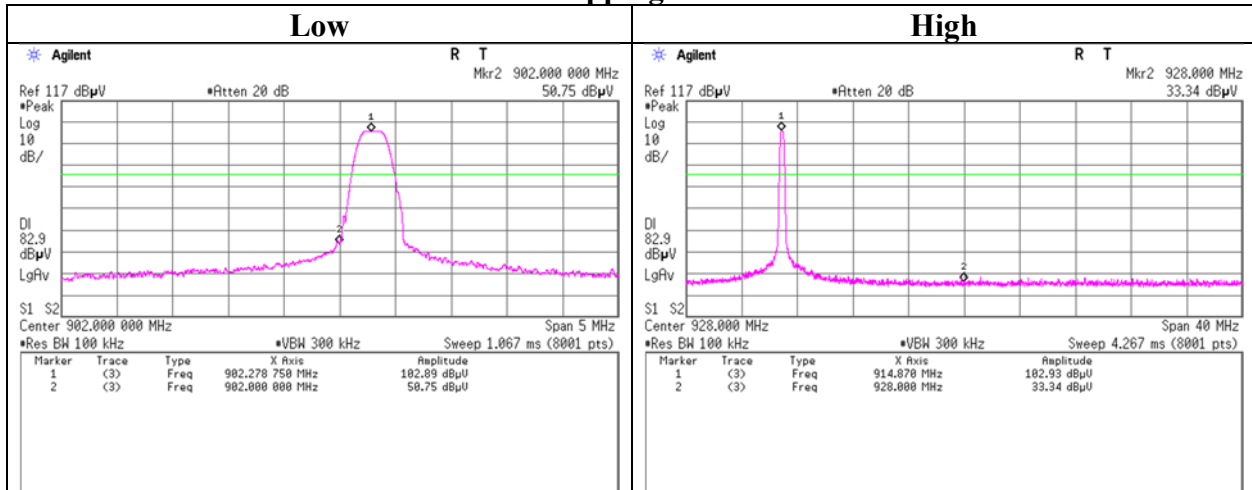
Conducted Emission Band Edge compliance

Report No. 13153638S-A-R1
 Test place Shonan EMC Lab. No.5 Shield Room
 Date February 19, 2020
 Temperature / Humidity 23 deg. C / 39 % RH
 Engineer Toshinori Yamada
 Mode Tx, Hopping Off, 125 kHz mode, SF10

Hopping On



Hopping Off



UL Japan, Inc.

Shonan EMC Lab.

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

Telephone : +81 463 50 6400

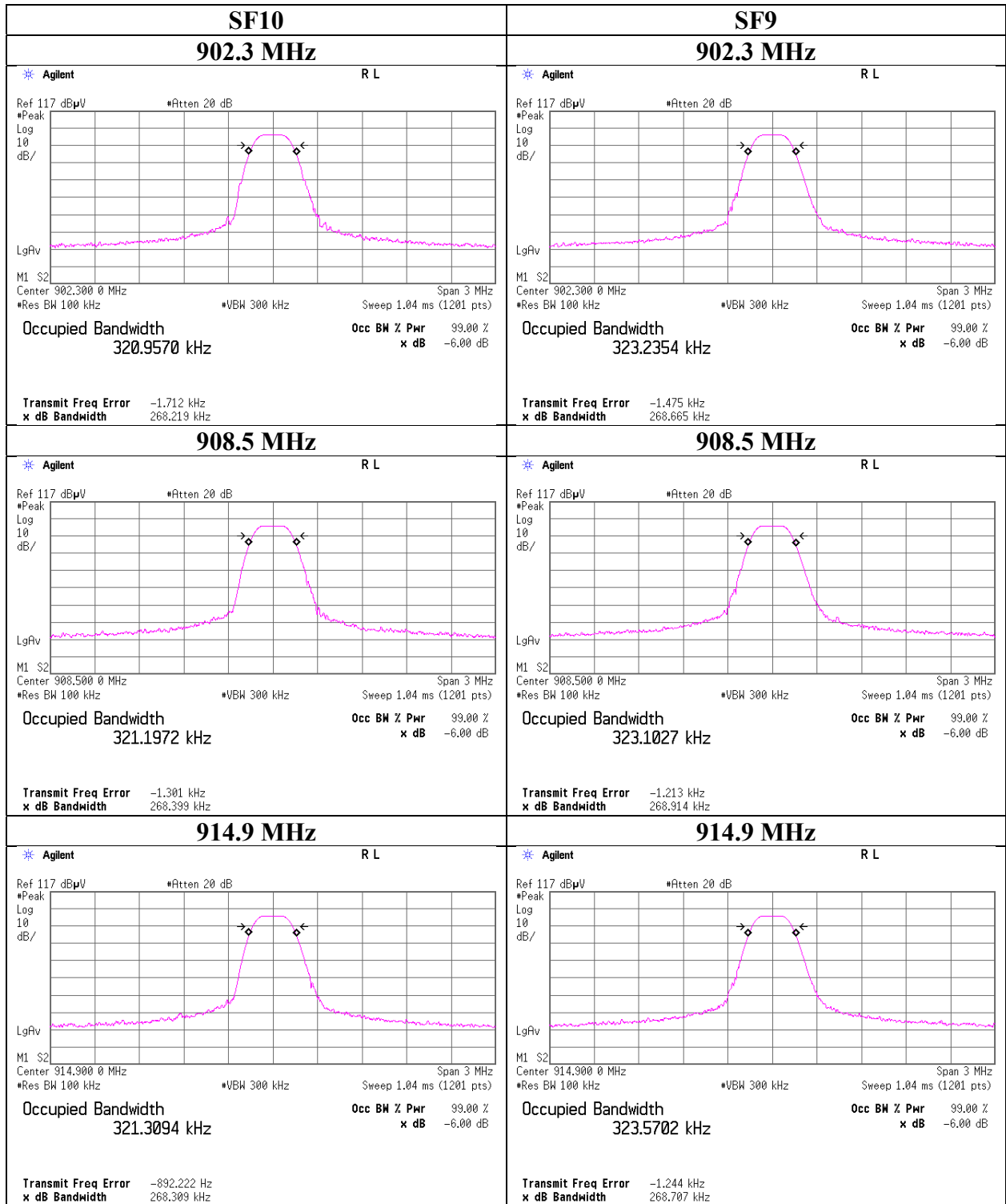
Facsimile : +81 463 50 6401

6 dB Bandwidth
(Reference data for Power Density testing)

Report No. 13153638S-A-R1
Test place Shonan EMC Lab. No.1 Measurement Room
Date February 14, 2020
Temperature / Humidity 26 deg. C / 48 % RH
Engineer Hiromasa Sato
Mode Tx

| Mode | Frequency | 6 dB Bandwidth |
|------|-----------|----------------|
| | [MHz] | [MHz] |
| SF10 | 902.3 | 0.268 |
| SF10 | 908.5 | 0.268 |
| SF10 | 914.9 | 0.268 |
| SF9 | 902.3 | 0.269 |
| SF9 | 908.5 | 0.269 |
| SF9 | 914.9 | 0.269 |
| SF8 | 902.3 | 0.268 |
| SF8 | 908.5 | 0.268 |
| SF8 | 914.9 | 0.268 |
| SF7 | 902.3 | 0.266 |
| SF7 | 908.5 | 0.266 |
| SF7 | 914.9 | 0.266 |

6 dB Bandwidth



UL Japan, Inc.

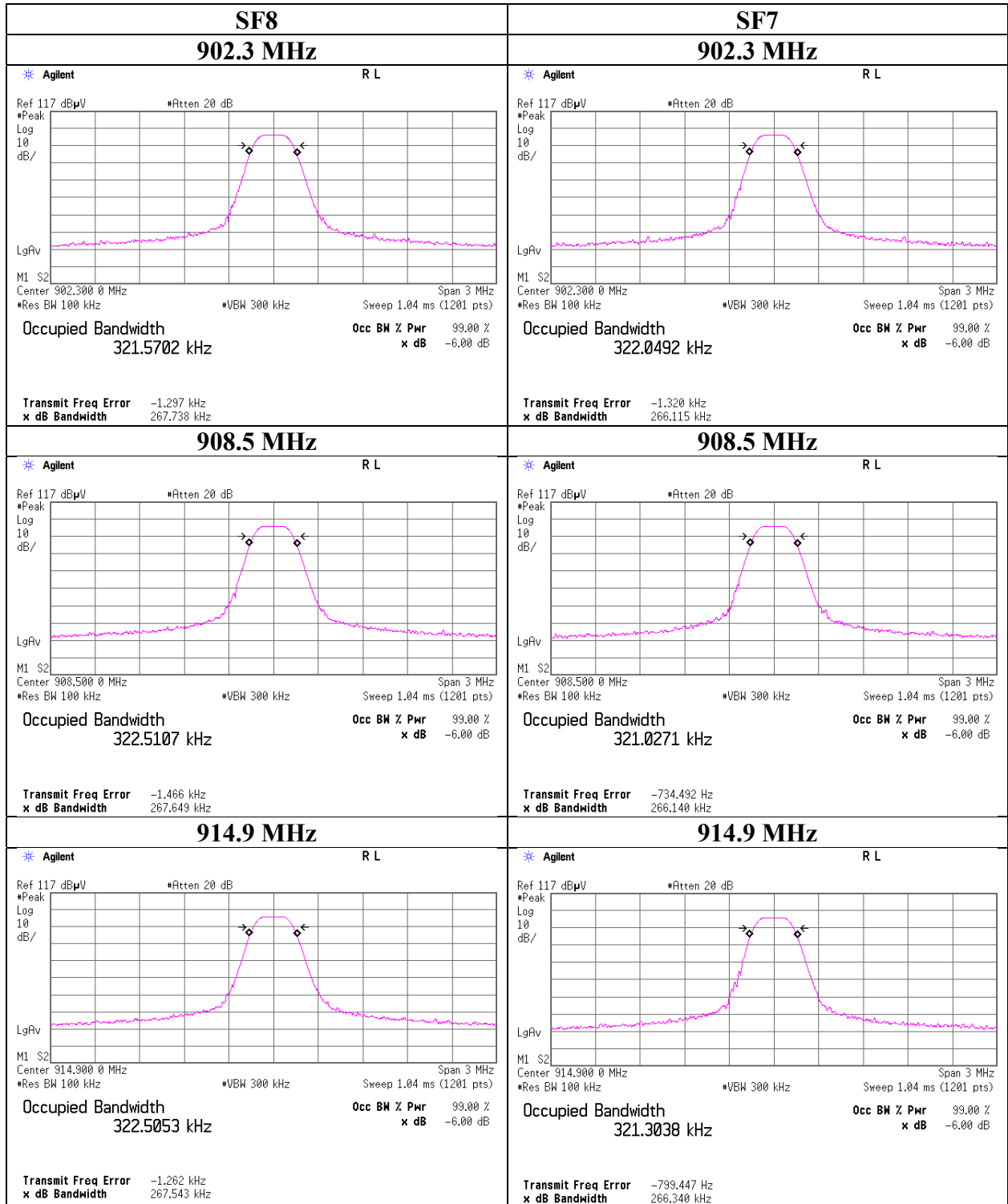
Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

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

Power Density

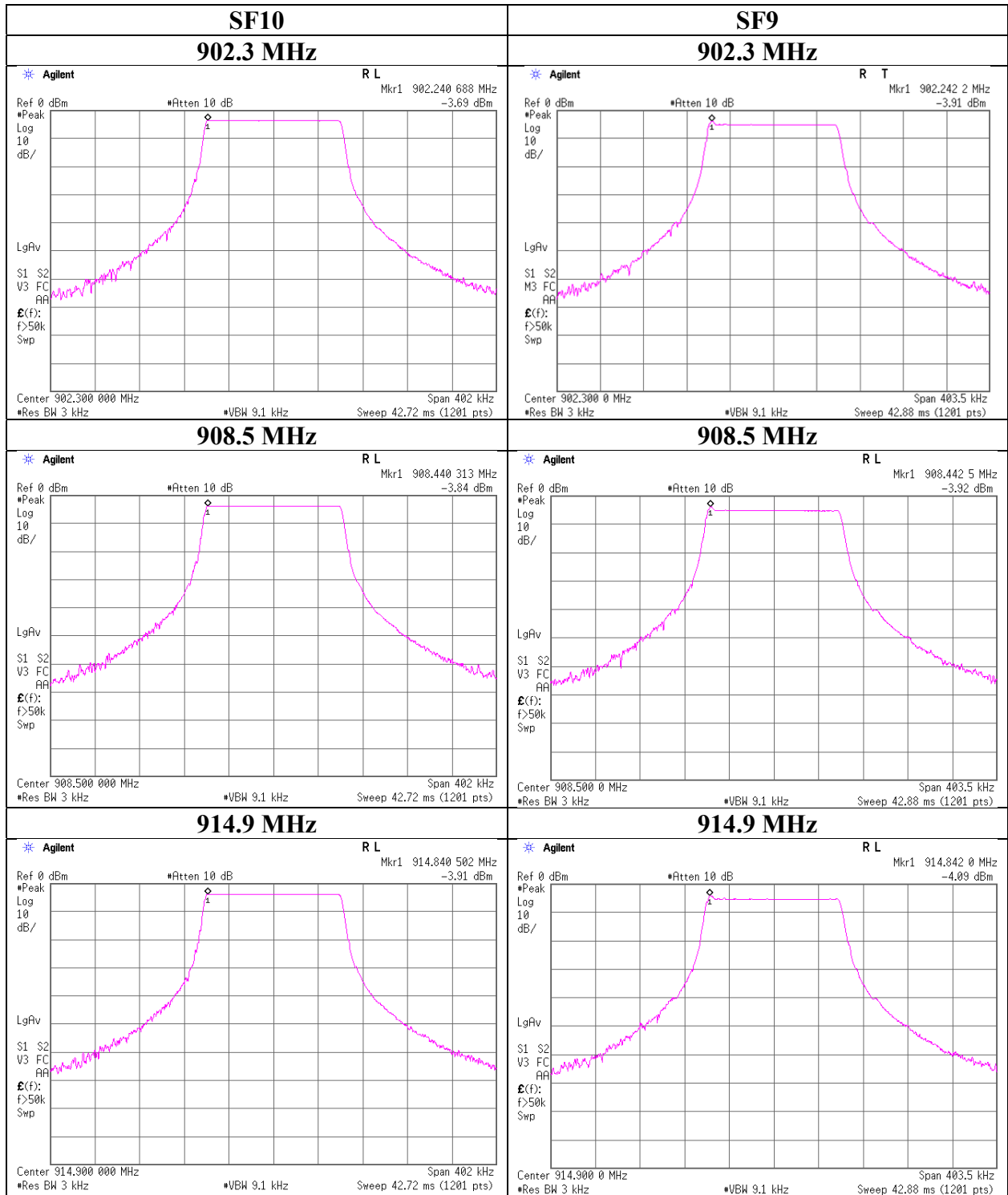
Report No. 13153638S-A-R1
Test place Shonan EMC Lab. No.1 Measurement Room
Date February 14, 2020
Temperature / Humidity 26 deg. C / 48 % RH
Engineer Hiromasa Sato
Mode Tx

| Mode | Freq. [MHz] | Reading [dBm] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm] | Limit [dBm] | Margin [dB] |
|------|----------------|------------------|-----------------------|------------------------|-----------------|----------------|----------------|
| SF10 | 902.3 | -3.69 | 0.90 | 9.75 | 6.96 | 8.00 | 1.04 |
| SF10 | 908.5 | -3.84 | 0.90 | 9.75 | 6.81 | 8.00 | 1.19 |
| SF10 | 914.9 | -3.91 | 0.91 | 9.75 | 6.75 | 8.00 | 1.25 |
| SF9 | 902.3 | -3.91 | 0.90 | 9.75 | 6.74 | 8.00 | 1.26 |
| SF9 | 908.5 | -3.92 | 0.90 | 9.75 | 6.73 | 8.00 | 1.27 |
| SF9 | 914.9 | -4.09 | 0.91 | 9.75 | 6.57 | 8.00 | 1.43 |
| SF8 | 902.3 | -4.58 | 0.90 | 9.75 | 6.07 | 8.00 | 1.93 |
| SF8 | 908.5 | -4.70 | 0.90 | 9.75 | 5.95 | 8.00 | 2.05 |
| SF8 | 914.9 | -4.83 | 0.91 | 9.75 | 5.83 | 8.00 | 2.17 |
| SF7 | 902.3 | -6.06 | 0.90 | 9.75 | 4.59 | 8.00 | 3.41 |
| SF7 | 908.5 | -6.19 | 0.90 | 9.75 | 4.46 | 8.00 | 3.54 |
| SF7 | 914.9 | -6.30 | 0.91 | 9.75 | 4.36 | 8.00 | 3.64 |

Sample Calculation:

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

Power Density



UL Japan, Inc.

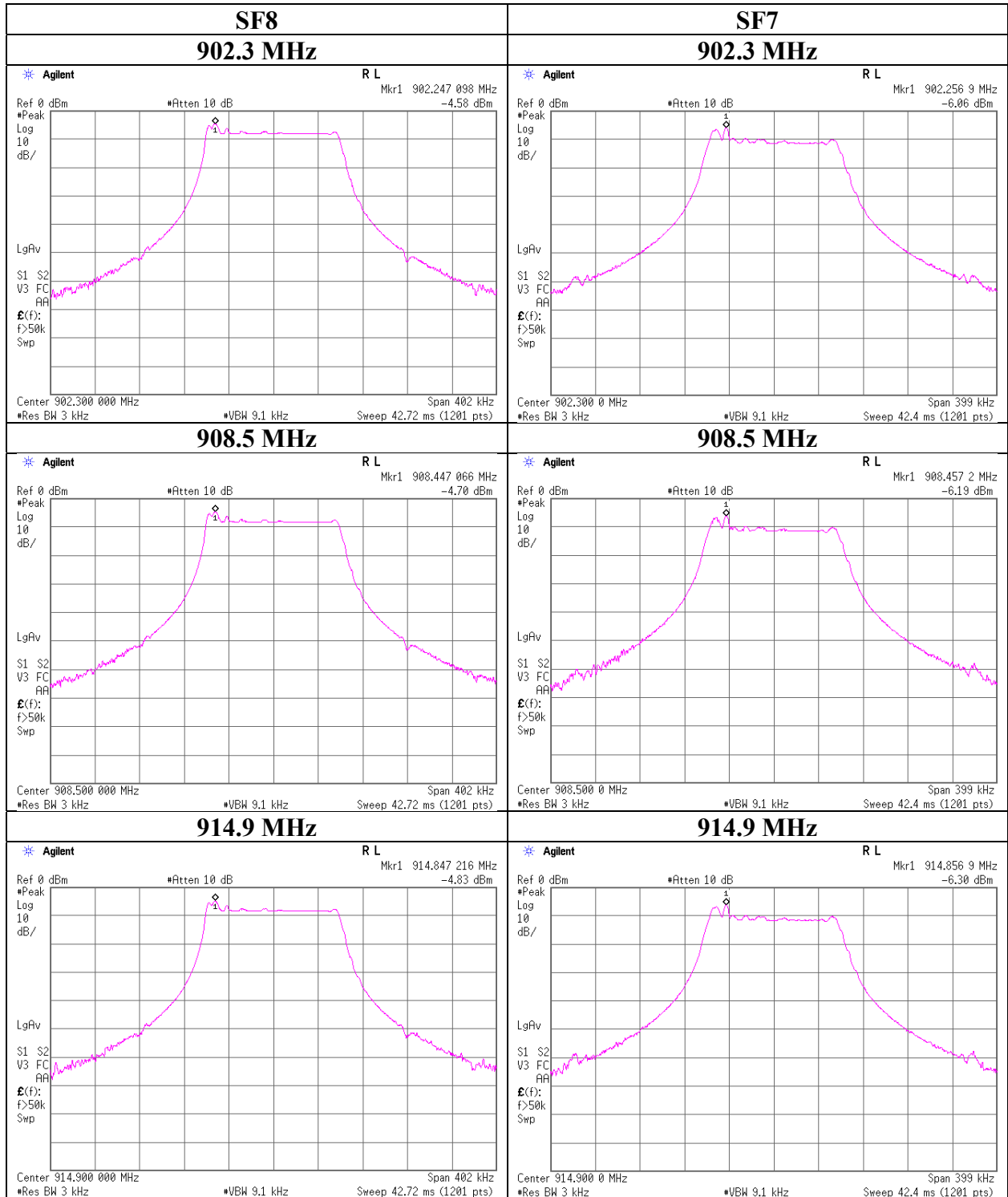
Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

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 equipment (1/2)

| Test Name | Local ID | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Calibration Interval (Month) |
|-----------|--------------------------------|---------|---------------------------|--------------------------------------|--|-------------------------|-----------------------|------------------------------|
| RE | COTS-SEMI-5 | 170932 | EMI Software | TSJ | TEPTO-DV3(RE,CE,ME,PE) | - | - | - |
| RE | KAT6-04 | 144899 | Attenuator | Inmet | 18N-6dB | - | 2019/12/05 | 12 |
| RE | KJM-09 | 145929 | Measure | KOMELON | KMC-36 | - | - | - |
| RE | SAEC-01(NSA) | 145597 | Semi-Anechoic Chamber | TDK | SAEC-01(NSA) | 1 | 2019/04/02 | 12 |
| RE | SAEC-02(SVSWR) | 145598 | Semi-Anechoic Chamber | TDK | SAEC-02(SVSWR) | 2 | 2019/05/09 | 12 |
| RE | SAF-01 | 145003 | Pre Amplifier | SONOMA | 310N | 290211 | 2019/02/05 | 12 |
| RE | SAF-05 | 145128 | Pre Amplifier | Toyo Corporation | TPA0118-36 | 1440490 | 2019/07/12 | 12 |
| RE | SAT20-01 | 145142 | Attenuator(above 1GHz) | Keysight Technologies Inc | 8493C-020 | 74889 | 2019/11/06 | 12 |
| RE | SAT3-09 | 144959 | Attenuator | JFW | 50HF-003N | - | 2019/08/06 | 12 |
| RE | SBA-01 | 145161 | Biconical Antenna | Schwarzbeck | BBA9106 | 91032664 | 2019/04/01 | 12 |
| RE | SCC-A1/A3/A5/A7/A8/A13/SRSE-01 | 144967 | Coaxial Cable&RF Selector | Fujikura/Fujikura/Suhner/Suhner/TOYO | 8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906 | -/0901-269(RF Selector) | 2019/04/19 | 12 |
| RE | SCC-A2/A4/A6/A7/A8/A13/SRSE-01 | 144968 | Coaxial Cable&RF Selector | Fujikura/Fujikura/Suhner/Suhner/TOYO | 8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906 | -/0901-269(RF Selector) | 2019/04/19 | 12 |
| RE | SCC-G41 | 151617 | Coaxial Cable | Junkosha | MWX221-01000NFSNMS/B | 1612S006 | 2020/01/08 | 12 |
| RE | SCC-G50 | 178573 | Coaxial Cable | HUBER+SUNER | SUCOFLEX_104 E | MY13407/4E | 2019/03/26 | 12 |
| RE | SCC-G51 | 178572 | Coaxial Cable | HUBER+SUNER | SUCOFLEX 104 | 800288 /4A | 2019/03/26 | 12 |
| RE | SFL-22 | 168802 | Highpass Filter | MICRO-TRONICS | HPM50114 | G035 | 2019/04/16 | 12 |
| RE | SHA-02 | 145384 | Horn Antenna | Schwarzbeck | BBHA9120D | 9120D-726 | 2019/06/26 | 12 |
| RE | SJM-09 | 145336 | Measure | PROMART | SEN1935 | - | - | - |
| RE | SLA-05 | 145527 | Logperiodic Antenna | Schwarzbeck | VUSLP9111B | 193 | 2019/04/01 | 12 |
| RE | SOS-20 | 191837 | Humidity Indicator | CUSTOM | CTH-201 | - | 2019/12/12 | 12 |
| RE | SOS-21 | 191838 | Humidity Indicator | CUSTOM | CTH-201 | - | 2019/12/12 | 12 |
| RE | STR-01 | 145790 | Test Receiver | Rohde & Schwarz | ESU40 | 100093 | 2019/04/14 | 12 |
| RE | STS-01 | 145792 | Digital Hitester | HIOKI | 3805-50 | 80997812 | 2019/10/01 | 12 |
| RE | STS-02 | 145793 | Digital Hitester | HIOKI | 3805-50 | 80997819 | 2019/04/02 | 12 |

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

Test equipment (2/2)

| Test Name | Local ID | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Calibration Interval (Month) |
|-----------|----------|---------|--------------------|-----------------------------|--------------|------------|-----------------------|------------------------------|
| AT | SAT10-13 | 151610 | Attenuator | Weinschel Corp. | 54A-10 | 81626 | 2019/03/27 | 12 |
| AT | SAT10-14 | 154591 | Attenuator | Weinschel Corp. | 54A-10 | 81595 | 2019/04/16 | 12 |
| AT | SCC-G12 | 145040 | Coaxial Cable | Suhner | SUCOFLEX 102 | 30790/2 | 2019/03/27 | 12 |
| AT | SOS-27 | 191845 | Humidity Indicator | Not Indicated or Known | CTH-201 | - | 2019/12/12 | 12 |
| AT | SPM-13 | 169910 | Power Meter | EMC Instruments Corporation | 8990B | MY51000448 | 2020/01/28 | 12 |
| AT | SPSS-06 | 169911 | Power sensor | EMC Instruments Corporation | N1923A | MY57270004 | 2020/01/28 | 12 |
| AT,RE | SSA-02 | 145800 | Spectrum Analyzer | Keysight Technologies Inc | E4448A | MY48250106 | 2019/04/04 | 12 |

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

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

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

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