# 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.
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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:**
Makoto Hosaka
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".

# REVISION HISTORY

## Original Test Report No.: 12987093S-B

| Revision | Test report No. | Date | Page revised | Contents |
|---|---|---|---|---|
| - (Original) | 12987093S-B | September 2, 2019 | - | - |
| 1 | 12987093S-B-R1 | September 12, 2019 | P6 | Update: IC => ISED |
| | | | P10 | Addition 10 Hz to VBW.<br>Update: IC => ISED |
| | | | P28 | Change of captured image of 907.8MHz |
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# Reference: Abbreviations (Including words undescribed in this report)

| | |
|---|---|
| A2LA | The American Association for Laboratory Accreditation |
| AC | Alternating Current |
| AFH | Adaptive Frequency Hopping |
| AM | Amplitude Modulation |
| Amp, AMP | Amplifier |
| ANSI | American National Standards Institute |
| Ant, ANT | Antenna |
| AP | Access Point |
| ASK | Amplitude Shift Keying |
| Atten., ATT | Attenuator |
| AV | Average |
| BPSK | Binary Phase-Shift Keying |
| BR | Bluetooth Basic Rate |
| BT | Bluetooth |
| BT LE | Bluetooth Low Energy |
| BW | BandWidth |
| Cal Int | Calibration Interval |
| CCK | Complementary Code Keying |
| Ch., CH | Channel |
| CISPR | Comite International Special des Perturbations Radioelectriques |
| CW | Continuous Wave |
| DBPSK | Differential BPSK |
| DC | Direct Current |
| DFS | Dynamic Frequency Selection |
| DQPSK | Differential QPSK |
| DSSS | Direct Sequence Spread Spectrum |
| EDR | Enhanced Data Rate |
| EIRP, e.i.r.p. | Equivalent Isotropically Radiated Power |
| EMC | ElectroMagnetic Compatibility |
| EMI | ElectroMagnetic Interference |
| EN | European Norm |
| ERP, e.r.p. | Effective Radiated Power |
| EU | European Union |
| EUT | Equipment Under Test |
| Fac. | Factor |
| FCC | Federal Communications Commission |
| FHSS | Frequency Hopping Spread Spectrum |
| FM | Frequency Modulation |
| Freq. | Frequency |
| FSK | Frequency Shift Keying |
| GFSK | Gaussian Frequency-Shift Keying |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| Hori. | Horizontal |
| ICES | Interference-Causing Equipment Standard |
| IEC | International Electrotechnical Commission |
| IEEE | Institute of Electrical and Electronics Engineers |
| IF | Intermediate Frequency |
| ILAC | International Laboratory Accreditation Conference |
| ISED | Innovation, Science and Economic Development Canada |
| ISO | International Organization for Standardization |
| JAB | Japan Accreditation Board |
| LAN | Local Area Network |
| LIMS | Laboratory Information Management System |
| MCS | Modulation and Coding Scheme |
| MRA | Mutual Recognition Arrangement |
| NIST | National Institute of Standards and Technology |
| NS | No signal detect. |
| NSA | Normalized Site Attenuation |
| NVLAP | National Voluntary Laboratory Accreditation Program |
| OBW | Occupied Band Width |
| OFDM | Orthogonal Frequency Division Multiplexing |
| P/M | Power meter |
| PCB | Printed Circuit Board |
| PER | Packet Error Rate |
| PHY | Physical Layer |
| PK | Peak |
| PN | Pseudo random Noise |
| PRBS | Pseudo-Random Bit Sequence |
| PSD | Power Spectral Density |
| QAM | Quadrature Amplitude Modulation |
| QP | Quasi-Peak |
| QPSK | Quadri-Phase Shift Keying |
| RBW | Resolution Band Width |
| RDS | Radio Data System |
| RE | Radio Equipment |
| RF | Radio Frequency |
| RMS | Root Mean Square |
| RSS | Radio Standards Specifications |
| Rx | Receiving |
| SA, S/A | Spectrum Analyzer |
| SG | Signal Generator |
| SVSWR | Site-Voltage Standing Wave Ratio |
| TR | Test Receiver |
| Tx | Transmitting |
| VBW | Video BandWidth |
| Vert. | Vertical |
| WLAN | Wireless LAN |

**CONTENTS** **PAGE**

# SECTION 1: Customer information

| | | |
|---|---|---|
| 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<br>**ISED:** RSS-Gen 8.8 | **FCC:** Section 15.207<br>**ISED:** RSS-Gen 8.8 | - | N/A | *1) |
| 6 dB Bandwidth | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02<br>**ISED:** - | **FCC:** Section 15.247(a)(2)<br>**ISED:** RSS-247 5.2(a) | See data. | Complied a) | Conducted |
| Maximum Peak Output Power | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02<br>**ISED:** RSS-Gen 6.12 | **FCC:** Section 15.247(b)(3)<br>**ISED:** RSS-247 5.4(d) | | Complied b) | Conducted |
| Power Density | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02<br>**ISED:** - | **FCC:** Section 15.247(e)<br>**ISED:** RSS-247 5.2(b) | | Complied c) | Conducted |
| Spurious Emission Restricted Band Edges | **FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02<br>**ISED:** RSS-Gen 6.13 | **FCC:** Section15.247(d)<br>**ISED:** RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10 | 5.5 dB<br>1806.00 MHz, AV, Vertical<br>Mode: Tx 903.0 MHz | Complied d), e) | Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2) |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT 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.

**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 % |

## 3.5 Test Location

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Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401
A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

| 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

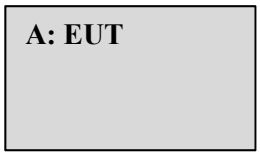
Refer to APPENDIX.

# 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;<br>Power settings: fixed<br>Software: ModbusAccessToolForEMCTest.exe Ver. 1.0.0.0<br>*This setting of software is the worst case.<br>Any conditions under the normal use do not exceed the condition of setting.<br>In addition, end users cannot change the settings of the output power of the product. | |

## 4.2 Configuration and peripherals




* 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.

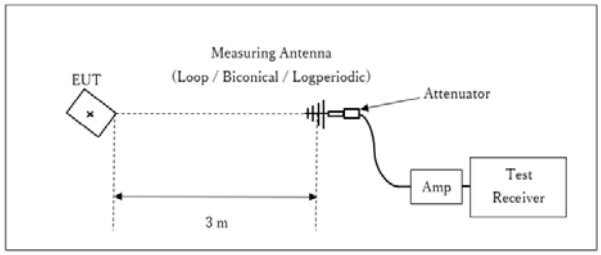
**20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).**

| 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<br>VBW: 3 MHz | Average Power Method:<br>11.12.2.5.3<br>RBW: 1 MHz<br>VBW: 10 Hz<br>1/T (T: burst length, refer to Burst rate confirmation sheet (duty 100%))<br>Detector: Peak<br>Trace: max hold | RBW: 100 kHz<br>VBW: 300 kHz |

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

**Figure 2: Test Setup**

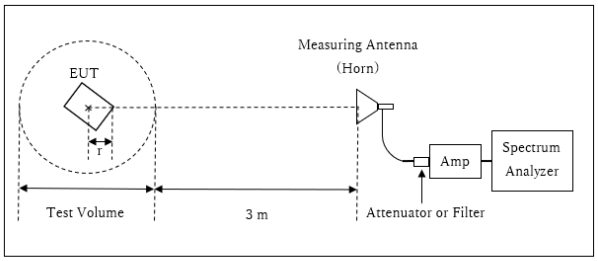
Below 1 GHz




× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz




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

Distance Factor: 20 x log (3.976 m / 3.0 m) = 2.45 dB
* Test Distance: (3 + Test Volume /2) - r = 3.976 m

Test Volume : 2.0 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.024m

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**

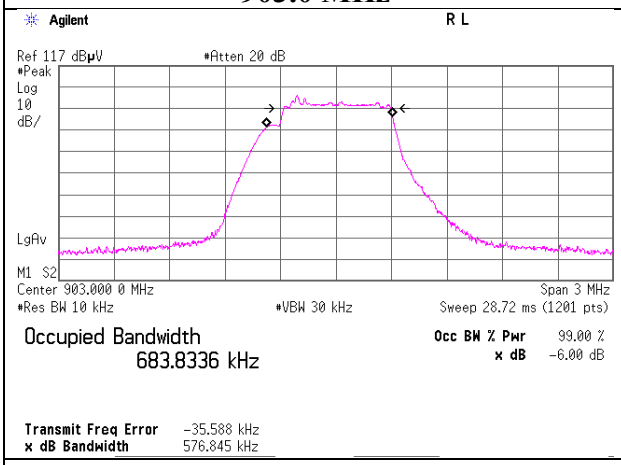
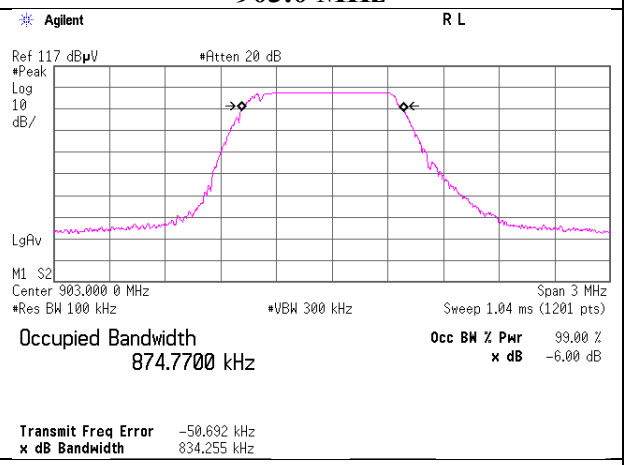
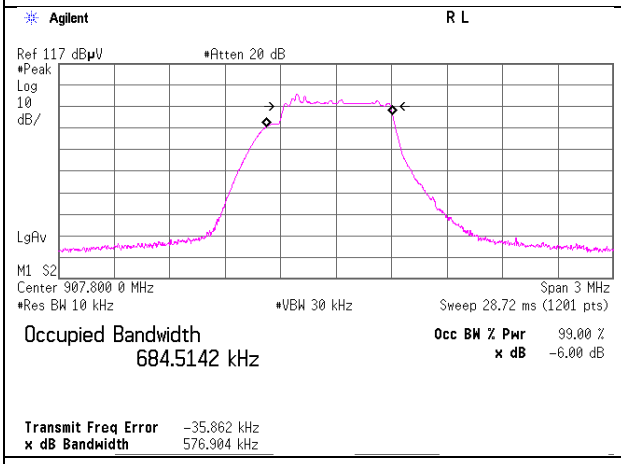
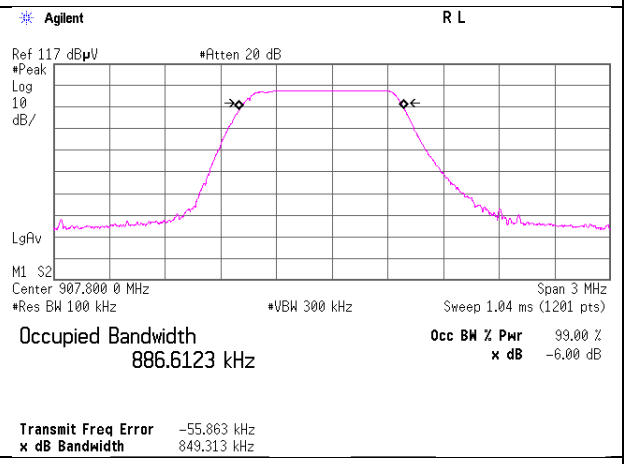
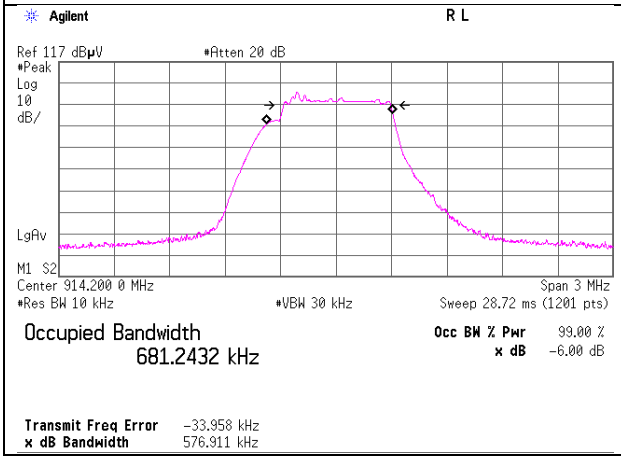
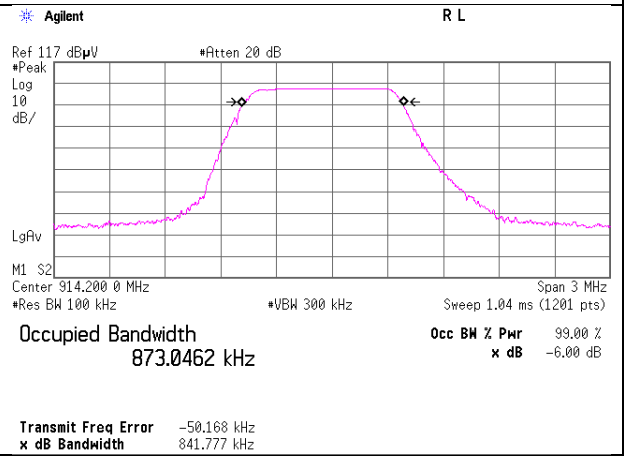
# APPENDIX 1: Test data

## 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

| 99 %Occupied Bandwidth | 6 dB Bandwidth |
|---|---|
| **903.0 MHz** | **903.0 MHz** |
|  |  |
| **907.8 MHz** | **907.8 MHz** |
|  |  |
| **914.2 MHz** | **914.2 MHz** |
|  |  |

# 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 |

| | | | | Conducted Power | | | | | e.i.r.p. for RSS-247 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Reading | Cable Loss | Atten. Loss | Result | | Limit | | Margin | Antenna Gain | Result | | Limit | | Margin |
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dBm] | [mW] | [dB] | [dBi] | [dBm] | [mW] | [dBm] | [mW] | [dB] |
| 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

# Average Output Power
# (Reference data for RF Exposure)

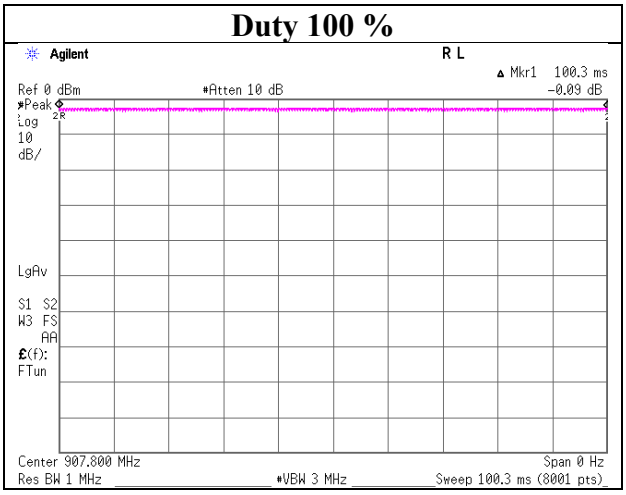
| | |
|---|---|
| Report No. | 12987093S-B-R1 |
| Test place | Shonan EMC Lab. No.3 Shielded Room |
| Date | August 2, 2019 |
| Temperature / Humidity | 24 deg. C / 69 % RH |
| Engineer | Kenichi Adachi |
| Mode | Tx |

| Freq. | Reading | Cable Loss | Atten. Loss | Result (Time average) | | Duty factor | Result (Burst power average) | |
|---|---|---|---|---|---|---|---|---|
| [MHz] | [dBm] | [dB] | [dB] | [dBm] | [mW] | [dB] | [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 | |
| 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 903.0 MHz | |

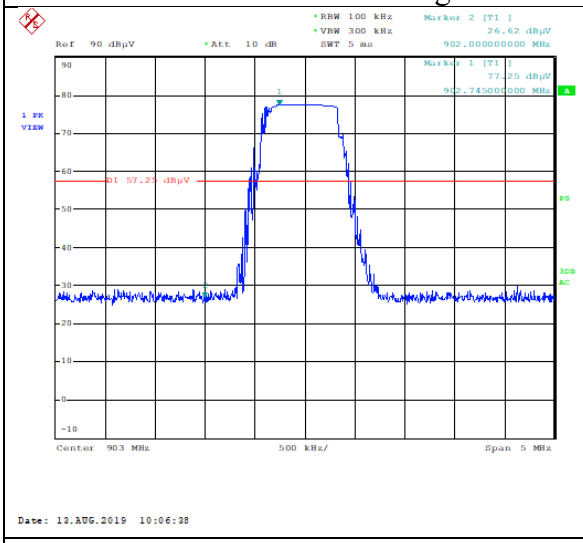
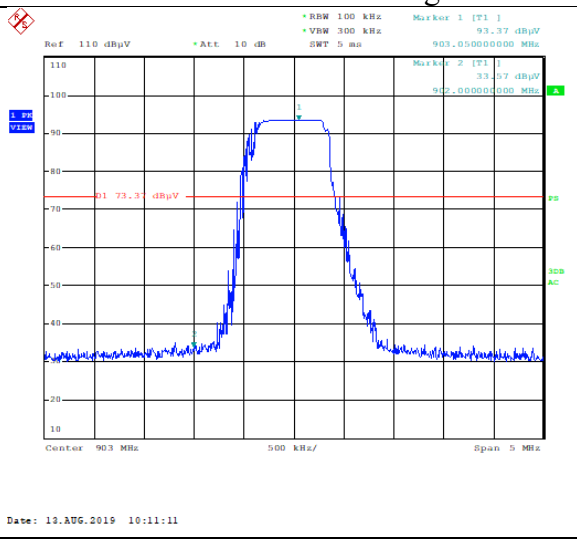
(* PK: Peak, AV: Average, QP: Quasi-Peak)

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

# 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 |

| Horizontal | Vertical |
|---|---|
| Authorized-band band-edge Plot | Authorized-band band-edge Plot |
|  |  |
| 20 dBc Plot | 20 dBc Plot |

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

# Radiated Spurious Emission

| | | |
|---|---|---|
| Report No. | 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(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.976 m / 3.0 m) = 2.45 dB

# 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 | |

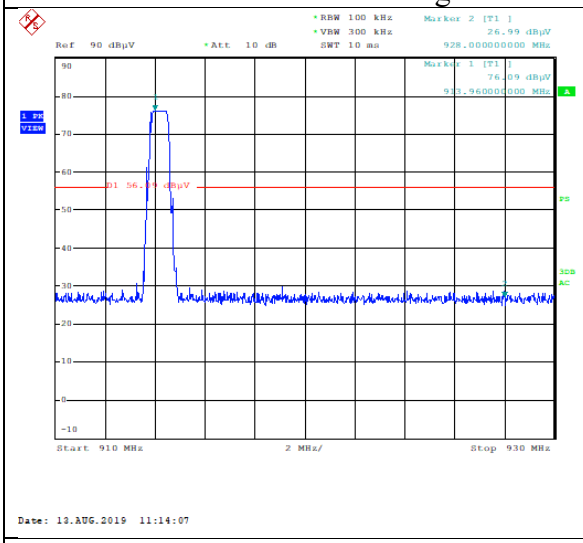
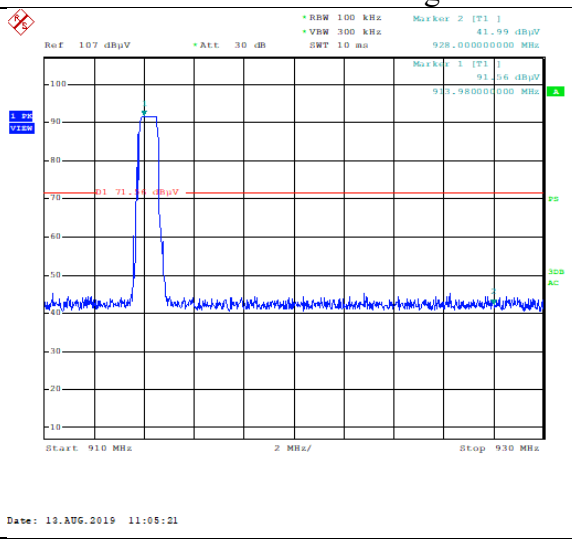
(* PK: Peak, AV: Average, QP: Quasi-Peak)

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

## Radiated Spurious Emission
## (Reference Plot for band-edge)

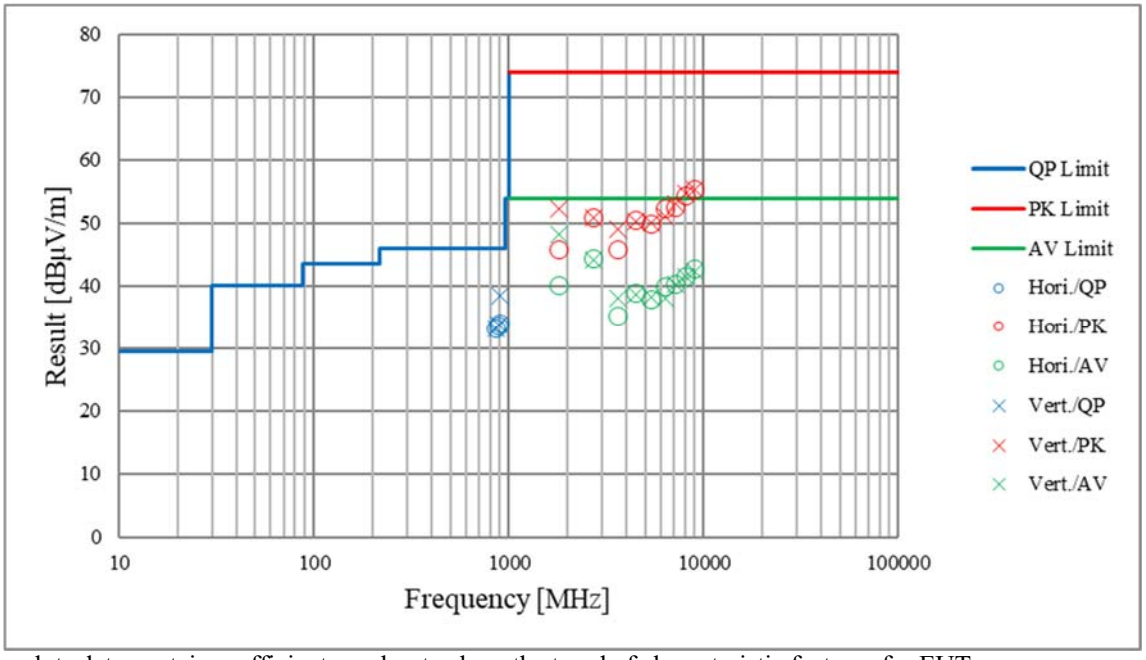
| | |
|---|---|
| Report No. | 12987093S-B-R1 |
| Test place | Shonan EMC Lab. |
| Semi Anechoic Chamber | No.1 |
| Date | August 13, 2019 |
| Temperature / Humidity | 25 deg. C / 65 % RH |
| Engineer | Makoto Hosaka |
| | (30 MHz - 1 GHz) |
| Mode | Tx 914.2 MHz |

| Horizontal | Vertical |
|---|---|
| Authorized-band band-edge Plot | Authorized-band band-edge Plot |
|  |  |
| 20 dBc Plot | 20 dBc Plot |

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

# Radiated Spurious Emission
## (Plot data, Worst case)

| | | |
|---|---|---|
| Report No. | 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 903.0 MHz | |

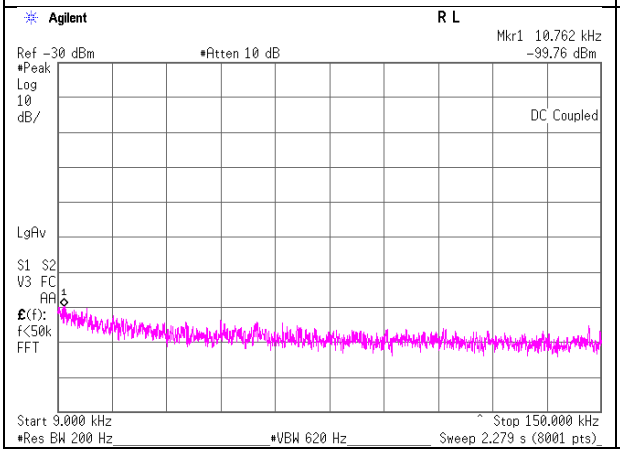



*These plots data contains sufficient number to show the trend of characteristic features for EUT.

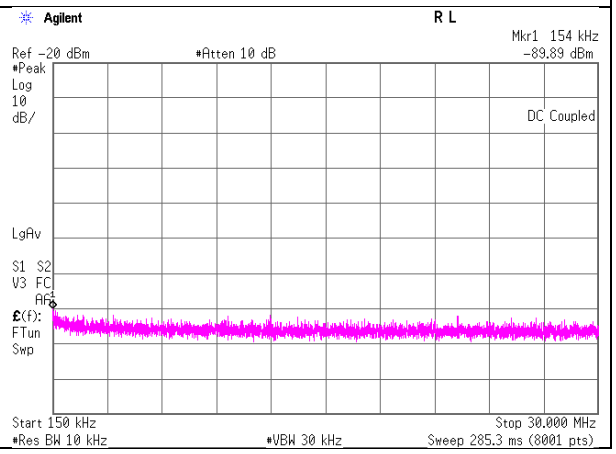
# Conducted Spurious Emission

| | |
|---|---|
| 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 |

## 9 kHz - 150 kHz




## 150 kHz - 30 MHz




| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain* [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.762 | -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)

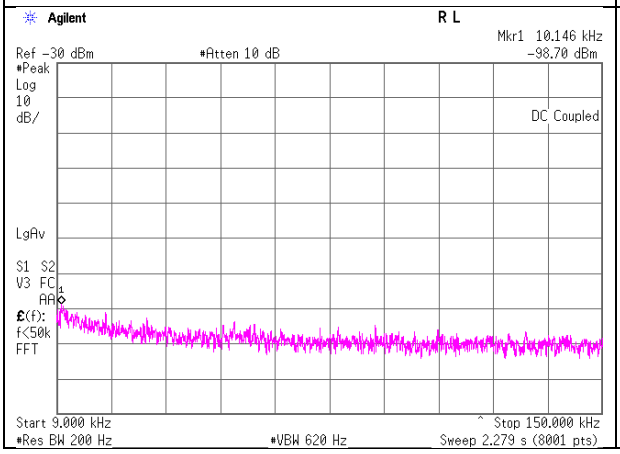
N: Number of output

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

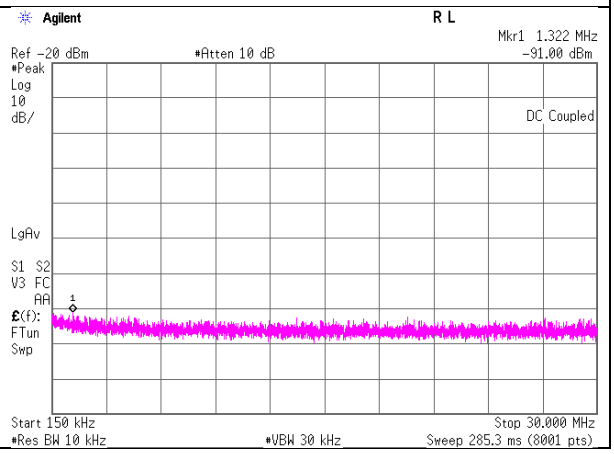
# Conducted Spurious Emission

| | |
|---|---|
| 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 |

## 9 kHz - 150 kHz




## 150 kHz - 30 MHz




| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain* [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.146 | -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 [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

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

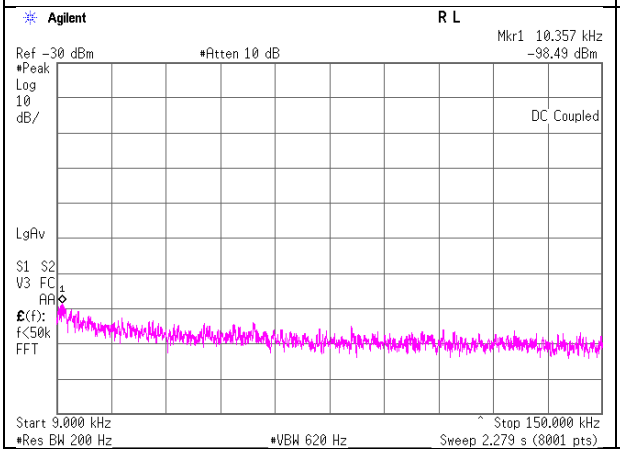
N: Number of output

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

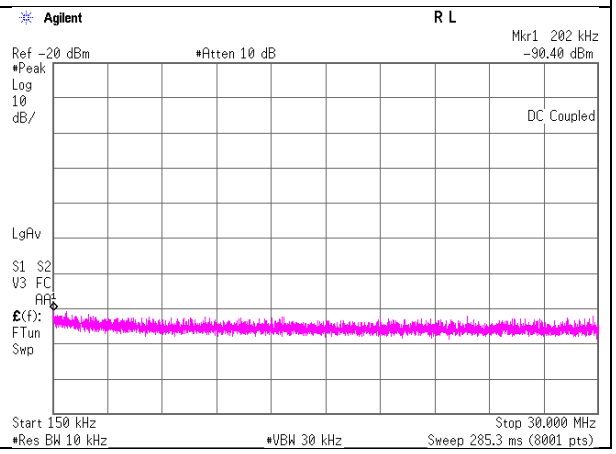
# Conducted Spurious Emission

| | |
|---|---|
| Report No. | 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 |

## 9 kHz - 150 kHz




## 150 kHz - 30 MHz




| Frequency [kHz] | Reading [dBm] | Cable Loss [dB] | Attenuator Loss [dB] | Antenna Gain* [dBi] | N (Number of Output) | EIRP [dBm] | Distance [m] | Ground bounce [dB] | E (field strength) [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.357 | -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.

# Power Density

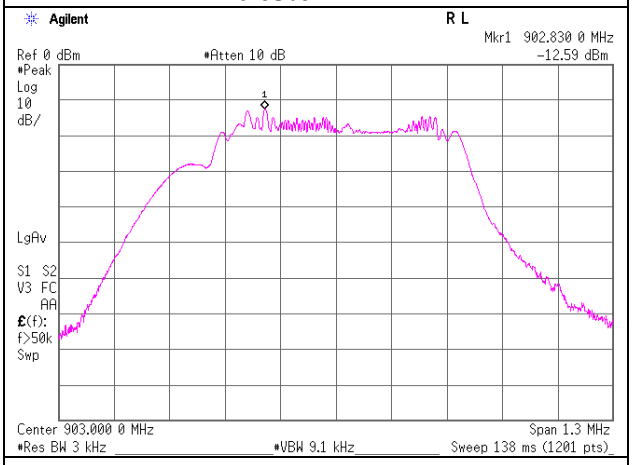
| | |
|---|---|
| Report No. | 12987093S-B-R1 |
| Test place | Shonan EMC Lab. No.1 Measurement Room |
| Date | August 7, 2019 |
| Temperature / Humidity | 24 deg. C / 49 % RH |
| Engineer | Hiromasa Sato |
| Mode | Tx |

| Freq. [MHz] | Reading [dBm] | Cable Loss [dB] | Atten. Loss [dB] | Result [dBm] | Limit [dBm] | Margin [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 |

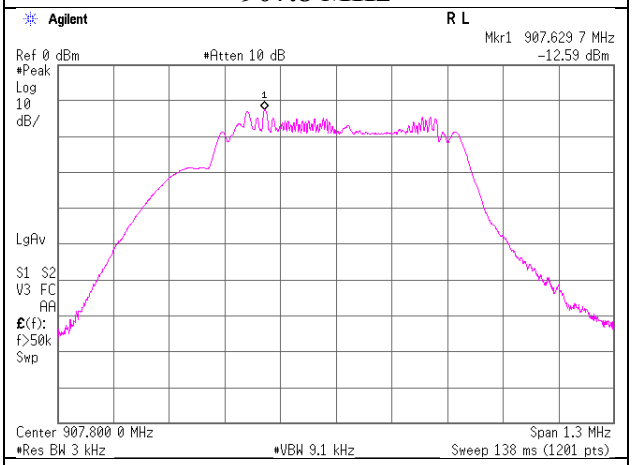
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

# Power Density

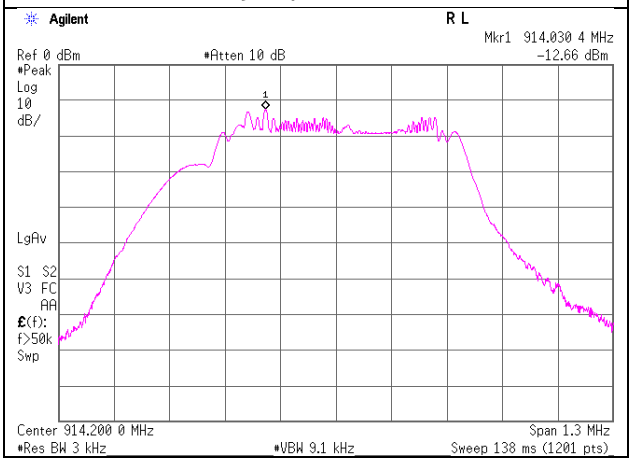
## 903.0 MHz




## 907.8 MHz




## 914.2 MHz



# 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 | MY46186 392 | 2019/1/3 | 2020/1/31 | 12 |
| COTS-SEMI-5 | RE | 170932 | EMI Software | TSJ | TEPTO-DV3(RE,CE,ME,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/Suhner/TOYO | 8D2W/12DSFA/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/Suhner/TOYO | 8D2W/12DSFA/141PE/141PE/141PE/141P | -/0901-269(RF Selector) | 2019/4/19 | 2020/4/30 | 12 |
| SCC-G41 | RE | 151617 | Coaxial Cable | Junkosha | MWX221-01000NFSNMS/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**