# RADIO TEST REPORT

## Test Report No. : 13397619H-A-R2

| | | |
|---|---|---|
| **Applicant** | : | **YOSHIKAWA KOGYO Co.,Ltd.** |
| **Type of EUT** | : | **DETECTOR** |
| **Model Number of EUT** | : | **YS-F-R023A** |
| **FCC ID** | : | **2AWRK-YS-RA0848** |
| **Test regulation** | : | **FCC Part 15 Subpart C: 2020** |
| **Test Result** | : | **Complied (Refer to SECTION 3.2)** |

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7. The all test items in this test report are conducted by UL Japan, Inc. Ise 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 13397619H-A-R1. 13397619H-A-R1 is replaced with this report.

**Date of test:** June 27 to July 12, 2020

**Representative test engineer:**
T. Noguchi
Takafumi Noguchi
Engineer
Consumer Technology Division

**Approved by:**
S. Miyazono
Shinichi Miyazono
Engineer
Consumer Technology Division

CERTIFICATE 5107.02

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

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# REVISION HISTORY

## Original Test Report No.: 13397619H-A

| Revision | Test report No. | Date | Page revised | Contents |
|---|---|---|---|---|
| - (Original) | 13397619H-A | August 4, 2020 | - | - |
| 1 | 13397619H-A-R1 | August 24, 2020 | P.5 | Correction of Radio type of Transmitter part in Clause 2.2;<br>From Transceiver to Transmitter |
| 1 | 13397619H-A-R1 | August 24, 2020 | P.6 | Correction of FCC Part 15.31 (e) in Clause 3.2;<br><br>From<br>The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage. Instead of a new battery, DC power supply was used for the test.<br>That does not affect the test result, therefore the EUT complies with the requirement.<br><br>to<br>This EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement. |
| 1 | 13397619H-A-R1 | August 24, 2020 | P.10 | Correcton of Support equipment information in Clause 4.2;<br><Mode number of No. C><br>From XVR3B04 to YS-F-V027A-R<br><br><Item and Model number of No.D><br>From Small Speaker, YS-K-S003A-M<br>to Speaker, YS-F-S003A |
| 1 | 13397619H-A-R1 | August 24, 2020 | P.18 | Correction of notation "*2)" |
| 2 | 13397619H-A-R2 | August 28, 2020 | P.5 | Addition of “Intermediate Frequency: 10.7 MHz” in Receiver part of Clause 2.2 |
| 2 | 13397619H-A-R2 | August 28, 2020 | P.6 | Update for FCC version in Clause 3.1;<br>From FCC Part 15 final revised on May 26, 2020 and effective July 27, 2020 except 15.258<br>To FCC Part 15 final revised on June 26, 2020 and effective July 27, 2020 |
| 2 | 13397619H-A-R2 | August 28, 2020 | P.6 | Deletion of unnecessary description from Clause 3.2. |

# Reference: Abbreviations (Including words undescribed in this report)

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

## CONTENTS PAGE

# SECTION 1: Customer information

| | | |
|---|---|---|
| Company Name | : | YOSHIKAWA KOGYO Co.,Ltd. |
| Address | : | 8-1 Hibikinokita Wakamatsu-ku Kitakyusyu City Fukuoka 808-0138 Japan |
| Telephone Number | : | +81-93-695-3093 |
| Facsimile Number | : | +81-93-695-3094 |
| Contact Person | : | Toshiharu Konomi |

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) other than the Receipt Date
- SECTION 4: Operation of EUT during testing

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

# SECTION 2: Equipment under test (EUT)

## 2.1 Identification of EUT

| | | |
|---|---|---|
| Type | : | DETECTOR |
| Model Number | : | YS-F-R023A |
| Serial Number | : | Refer to SECTION 4.2 |
| Rating | : | DC 48 V / 2 A |
| Receipt Date | : | June 19, 2020 |
| Country of Mass-production | : | Japan |
| Condition | : | Production prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification | : | No Modification by the test lab |

## 2.2 Product Description

Model: YS-F-R023A (referred to as the EUT in this report) is a DETECTOR.

**Radio Specification**

**[Transmitter part]**

| | | |
|---|---|---|
| Radio Type | : | Transmitter |
| Frequency of Operation | : | 125 kHz |
| Modulation | : | ASK |
| Antenna type | : | Internal Antenna |
| Clock frequency (Maximum) | : | CPU 8 MHz |

**[Receiver part]**

| | | |
|---|---|---|
| Radio Type | : | Receiver |
| Frequency of Operation | : | 315 MHz |
| Intermediate Frequency | : | 10.7 MHz |

# SECTION 3: Test specification, procedures & results

## 3.1 Test Specification

| | | |
|---|---|---|
| Test Specification | : | FCC Part 15 Subpart C<br>FCC Part 15 final revised on June 26, 2020 and effective July 27, 2020 |
| Title | : | FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators<br>Section 15.207 Conducted limits<br>Section 15.209 Radiated emission limits; general requirements. |

* The revision does not affect the test result conducted before its effective date.
* Also the EUT complies with FCC Part 15 Subpart B.

## 3.2 Procedures and results

| Item | Test Procedure | Specification | Remarks | Deviation | Worst margin | Results |
|---|---|---|---|---|---|---|
| Conducted Emission | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>RSS-Gen 8.8 | <FCC><br>Section 15.207<br><ISED><br>RSS-Gen 8.8 | - | N/A | N/A | N/A<br>*1) |
| Electric Field Strength of Fundamental Emission | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>RSS-Gen 6.5, 6.12 | <FCC><br>Section 15.209<br><ISED><br>RSS-210 4.4<br>RSS-Gen 8.9 | Radiated | N/A | 7.2 dB<br>125 kHz, 0 deg.<br>Peak with Duty factor | Complied<br>a) |
| Electric Field Strength of Spurious Emission | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>RSS-Gen 6.5, 6.6, 6.13 | <FCC><br>Section 15.209<br><ISED><br>RSS-210 4.4<br>RSS-Gen 8.9 | Radiated | N/A | 0.4 dB<br>40.750 MHz,<br>Vertical, QP | Complied#<br>a) |
| -26 dB Bandwidth | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>- | <FCC><br>Reference data<br><ISED><br>- | Radiated | N/A | N/A | Complied<br>b) |

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 is not the device that is designed to be connected to the public utility (AC) power line.

a) Refer to APPENDIX 1 (data of Radiated emission)
b) Refer to APPENDIX 1 (data of -26 dB Bandwidth and 99 % Occupied Bandwidth)

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. |

**FCC Part 15.31 (e)**
This EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

**FCC Part 15.203 Antenna requirement**
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

### 3.3 Addition to standard

| Item | Test Procedure | Specification | Remarks | Deviation | Worst margin | Results |
|---|---|---|---|---|---|---|
| 99 % Occupied Band Width | RSS-Gen 6.7 | - | Radiated | N/A | N/A | - |
| Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422. | | | | | | |

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 following 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.

**Radiated emission**

| Measurement distance | Frequency range | | Uncertainty (+/-) |
|---|---|---|---|
| 3 m | 9 kHz to 30 MHz | | 3.3 dB |
| 10 m | | | 3.2 dB |
| 3 m | 30 MHz to 200 MHz | (Horizontal) | 4.8 dB |
| | | (Vertical) | 5.0 dB |
| | 200 MHz to 1000 MHz | (Horizontal) | 5.2 dB |
| | | (Vertical) | 6.3 dB |
| 10 m | 30 MHz to 200 MHz | (Horizontal) | 4.8 dB |
| | | (Vertical) | 4.8 dB |
| | 200 MHz to 1000 MHz | (Horizontal) | 5.0 dB |
| | | (Vertical) | 5.0 dB |
| 3 m | 1 GHz to 6 GHz | | 4.9 dB |
| | 6 GHz to 18 GHz | | 5.2 dB |
| 1 m | 10 GHz to 26.5 GHz | | 5.5 dB |
| | 26.5 GHz to 40 GHz | | 5.5 dB |
| 10 m | 1 GHz to 18 GHz | | 5.2 dB |

**Antenna Terminal test**

| Test Item | Uncertainty (+/-) |
|---|---|
| -26 dB Bandwidth / 99 % Occupied Bandwidth | 0.96 % |

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

| Test site | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms | Maximum measurement distance |
|---|---|---|---|---|
| No.1 semi-anechoic chamber | 19.2 x 11.2 x 7.7 | 7.0 x 6.0 | No.1 Power source room | 10 m |
| No.2 semi-anechoic chamber | 7.5 x 5.8 x 5.2 | 4.0 x 4.0 | - | 3 m |
| No.3 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.3 Preparation room | 3 m |
| No.3 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.4 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.4 Preparation room | 3 m |
| No.4 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.5 semi-anechoic chamber | 6.0 x 6.0 x 3.9 | 6.0 x 6.0 | - | - |
| No.5 measurement room | 6.4 x 6.4 x 3.0 | 6.4 x 6.4 | - | - |
| No.6 shielded room | 4.0 x 4.5 x 2.7 | 4.0 x 4.5 | - | - |
| No.6 measurement room | 4.75 x 5.4 x 3.0 | 4.75 x 4.15 | - | - |
| No.7 shielded room | 4.7 x 7.5 x 2.7 | 4.7 x 7.5 | - | - |
| No.8 measurement room | 3.1 x 5.0 x 2.7 | 3.1 x 5.0 | - | - |
| No.9 measurement room | 8.8 x 4.6 x 2.8 | 2.4 x 2.4 | - | - |
| No.11 measurement room | 6.2 x 4.7 x 3.0 | 4.8 x 4.6 | - | - |

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

### 3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

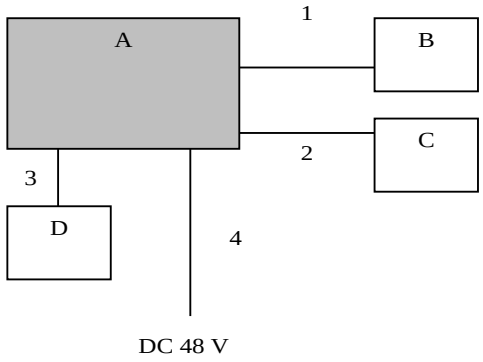
# SECTION 4: Operation of EUT during testing

## 4.1 Operating Modes

| Test mode | Remarks |
|---|---|
| 1) Continuous Transmitting mode | - |
| * EUT was set by the software as follows;<br>Software: v21.81.05<br>(Date: 2020.6.23, Storage location: EUT memory)<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. | |

Justification : The system was configured in typical fashion (as a user would normally use it) for testing.

## 4.2 Configuration and peripherals




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

**Description of EUT and Support equipment**

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|---|---|---|---|---|---|
| A | DETECTOR | YS-F-R023A | 001573 *1)<br>002059 *2)<br>002048 *3) | YOSHIKAWA KOGYO Co.,Ltd. | EUT |
| B | UHF Antenna | - | - | YOSHIKAWA KOGYO Co.,Ltd. | - |
| C | Indicator lamp | YS-F-V027A-R | - | Schneider Electric | - |
| D | Speaker | YS-F-S003A | 01238 | YOSHIKAWA KOGYO Co.,Ltd. | - |

*1) Used for Radiated emission test (Above 30 MHz).
*2) Used for Duty cycle test.
*3) Used for Radiated emission test (Below 30 MHz) and -26 dB Bandwidth and 99 % Occupied Bandwidth tests.

**List of cables used**

| No. | Name | Length (m) | Shield | | Remarks |
|---|---|---|---|---|---|
| | | | Cable | Connector | |
| 1 | Signal Cable | 4.0 | Unshielded | Unshielded | - |
| 2 | Signal Cable | 5.7 | Unshielded | Unshielded | - |
| 3 | Signal Cable | 5.2 | Unshielded | Unshielded | - |
| 4 | DC Cable | 2.2 | Unshielded | Unshielded | - |

## SECTION 5: Radiated emission (Fundamental and Spurious Emission)

**Test Procedure**

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

Frequency : From 9 kHz to 30 MHz
The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., and 135 deg.) and horizontal polarization.
*Refer to Figure 1 about Direction of the Loop Antenna.

Frequency: From 30 MHz to 1 GHz
The measuring antenna height varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization.

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 | Below 30 MHz | 30 MHz to 200 MHz | 200 MHz to 1 GHz |
|---|---|---|---|
| Antenna Type | Loop | Biconical | Logperiodic |

| Frequency | From 9 kHz to 90 kHz and From 110 kHz to 150 kHz | From 90 kHz to 110 kHz | From 150 kHz to 490 kHz | From 490 kHz to 30 MHz | From 30 MHz to 1 GHz |
|---|---|---|---|---|---|
| Instrument used | Test Receiver | | | | |
| Detector | PK / AV | QP | PK / AV | QP | QP |
| IF Bandwidth | 200 Hz | 200 Hz | 9 kHz | 9 kHz | 120 kHz |
| Test Distance | 3 m *1) | 3 m *1) | 3 m *1) | 3 m *2) | 3 m |

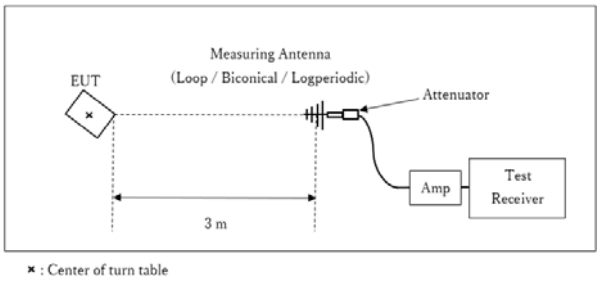
*1) Distance Factor: 40 x log (3 m / 300 m) = -80 dB
*2) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane.
However test results were confirmed to pass against standard limit.

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 - 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

[Test Setup]
Below 1 GHz




Test Distance: 3 m

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

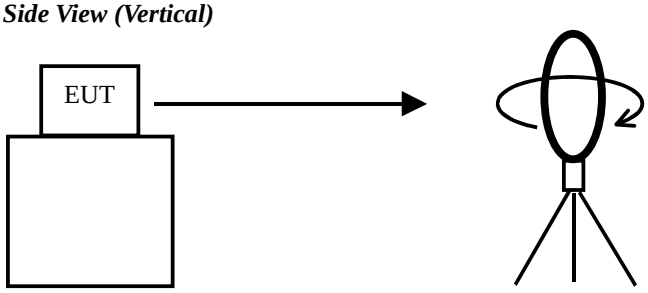
The test results and limit are rounded off to one decimal place, so some differences might be observed.

**Measurement range** : **9 kHz - 1 GHz**
**Test data** : **APPENDIX 1**
**Test result** : **Pass**

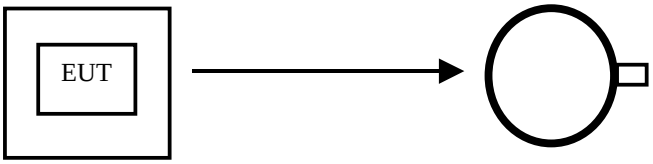
Date: June 27, 2020 Test engineer: Takafumi Noguchi
July 12, 2020 Yuta Moriya

**Figure 1: Direction of the Loop Antenna**

***Side View (Vertical)***

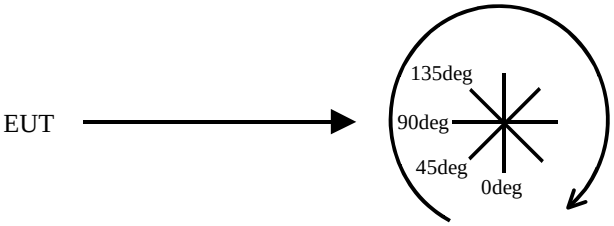



***Top View (Horizontal)***




Antenna was not rotated.

***Top View (Vertical)***




Front side: 0 deg.
Forward direction: clockwise

## SECTION 6: -26 dB Bandwidth

**Test Procedure**

The test was measured with a spectrum analyzer using a test fixture.

| Test | Span | RBW | VBW | Sweep | Detector | Trace | Instrument used |
|---|---|---|---|---|---|---|---|
| -26 dB Bandwidth | 62 kHz | 620 Hz | 1.8 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |

**Test data : APPENDIX 1**
**Test result : Pass**

## SECTION 7: 99 % Occupied Bandwidth

**Test Procedure**

The test was measured with a spectrum analyzer using a test fixture.

| Test | Span | RBW | VBW | Sweep | Detector | Trace | Instrument used |
|---|---|---|---|---|---|---|---|
| 99 % Occupied Bandwidth | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto | Peak *1) | Max Hold *1) | Spectrum Analyzer |
| *1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %. Peak hold was applied as Worst-case measurement. | | | | | | | |

**Test data : APPENDIX 1**
**Test result : Pass**

# APPENDIX 1: Test data

## Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

| | |
|---|---|
| Report No. | 13397619H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.1 |
| Date | June 27, 2020 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takafumi Noguchi |
| Mode | Mode 1 |

**PK or QP**

| Ant Deg [deg] or Polarity [Hori/Vert | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0deg | 0.125 | PK | 78.8 | 19.9 | -74.0 | 0.0 | - | 24.7 | 45.6 | 20.9 | Fundamental |
| 0deg | 0.250 | PK | 46.0 | 19.9 | -74.0 | 0.0 | - | -8.1 | 39.6 | 47.7 | |
| 0deg | 0.375 | PK | 47.0 | 19.9 | -73.9 | 0.0 | - | -7.1 | 36.1 | 43.2 | |
| 0deg | 0.500 | QP | 34.0 | 19.8 | -33.9 | 0.0 | - | 19.9 | 33.6 | 13.7 | |
| 0deg | 0.625 | QP | 36.9 | 19.8 | -33.9 | 0.0 | - | 22.8 | 31.7 | 8.9 | |
| 0deg | 0.750 | QP | 29.5 | 19.8 | -33.9 | 0.0 | - | 15.4 | 30.1 | 14.7 | |
| 0deg | 0.875 | QP | 28.8 | 19.8 | -33.9 | 0.0 | - | 14.7 | 28.7 | 14.0 | |
| 0deg | 1.000 | QP | 26.1 | 19.8 | -33.8 | 0.0 | - | 12.0 | 27.6 | 15.6 | |
| 0deg | 1.125 | QP | 22.6 | 19.8 | -33.8 | 0.0 | - | 8.6 | 26.5 | 17.9 | |
| 0deg | 1.250 | QP | 23.5 | 19.8 | -33.8 | 0.0 | - | 9.5 | 25.6 | 16.1 | |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier)

**PK with Duty factor**

| Ant Deg [deg] | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0deg | 0.125 | PK | 78.8 | 19.9 | -74.0 | 0.0 | -6.3 | 18.4 | 25.6 | 7.2 | |
| 0deg | 0.250 | PK | 46.0 | 19.9 | -74.0 | 0.0 | -6.3 | -14.4 | 19.6 | 34.0 | |
| 0deg | 0.375 | PK | 47.0 | 19.9 | -73.9 | 0.0 | -6.3 | -13.4 | 16.1 | 29.5 | |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

| Ant Deg [deg] | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0deg | 0.125 | PK | 78.8 | 19.9 | 6.0 | 0.0 | - | 104.7 | - | - | Fundamental |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier)

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

* Gain 0.0 dB shows that the pre amplifier was not used to avoid the influence of carrier power.

*The test result is rounded off to one or two decimal places, so some differences might be observed.

# Radiated Emission above 30 MHz (Spurious Emission)

| | |
|---|---|
| Report No. | 13397619H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.2 |
| Date | July 12, 2020 |
| Temperature / Humidity | 22 deg. C / 62 % RH |
| Engineer | Yuta Moriya |
| Mode | Mode 1 |

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| Hori. | 30.693 | QP | 27.4 | 13.1 | 7.0 | 28.6 | 18.9 | 40.0 | 21.1 | |
| Hori. | 40.750 | QP | 32.5 | 11.0 | 7.2 | 28.6 | 22.1 | 40.0 | 17.9 | |
| Hori. | 44.750 | QP | 41.5 | 10.5 | 7.3 | 28.6 | 30.6 | 40.0 | 9.4 | |
| Hori. | 62.125 | QP | 39.6 | 9.0 | 7.5 | 28.6 | 27.6 | 40.0 | 12.4 | |
| Hori. | 79.500 | QP | 38.3 | 8.9 | 7.7 | 28.6 | 26.4 | 40.0 | 13.6 | |
| Hori. | 124.000 | QP | 38.3 | 11.0 | 8.2 | 28.4 | 29.1 | 43.5 | 14.4 | |
| Vert. | 30.500 | QP | 47.1 | 13.1 | 7.0 | 28.6 | 38.6 | 40.0 | 1.4 | |
| Vert. | 40.750 | QP | 50.0 | 11.0 | 7.2 | 28.6 | 39.6 | 40.0 | 0.4 | |
| Vert. | 44.750 | QP | 47.8 | 10.5 | 7.3 | 28.6 | 36.9 | 40.0 | 3.1 | |
| Vert. | 62.125 | QP | 41.4 | 9.0 | 7.5 | 28.6 | 29.4 | 40.0 | 10.6 | |
| Vert. | 79.500 | QP | 43.2 | 8.9 | 7.7 | 28.6 | 31.3 | 40.0 | 8.7 | |
| Vert. | 124.000 | QP | 51.3 | 11.0 | 8.2 | 28.4 | 42.1 | 43.5 | 1.4 | |

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amplifier)

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

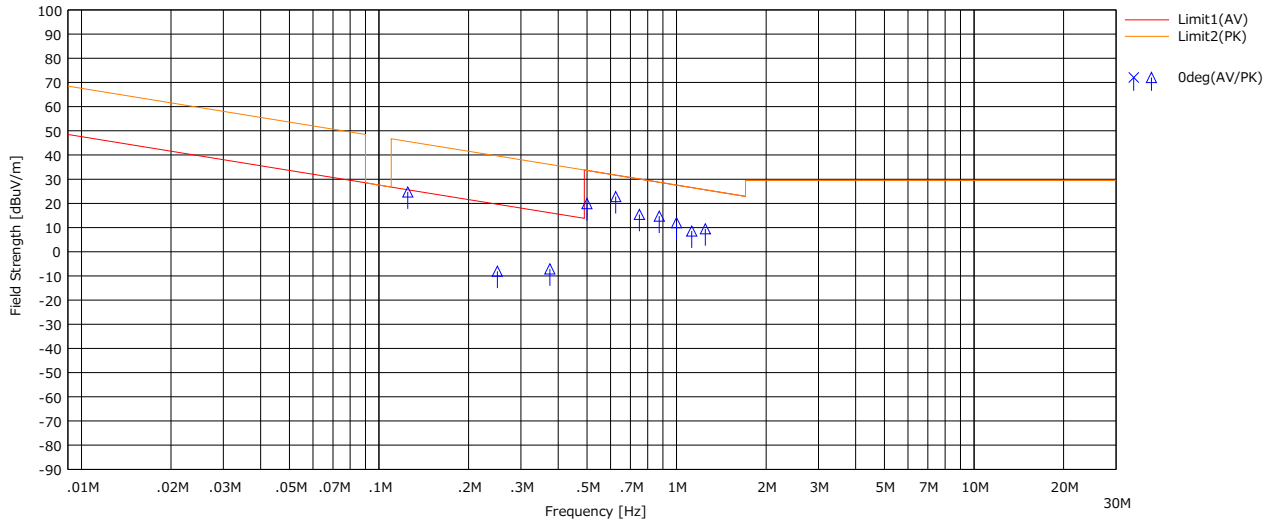
*The test result is rounded off to one or two decimal places, so some differences might be observed.

# Radiated Emission Plot data, Worst case

| | | |
|---|---|---|
| Report No. | 13397619H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.1 | No.2 |
| Date | June 27, 2020 | July 12, 2020 |
| Temperature / Humidity | 23 deg. C / 68 % RH | 22 deg. C / 62 % RH |
| Engineer | Takafumi Noguchi | Yuta Moriya |
| Mode | Mode 1 | |

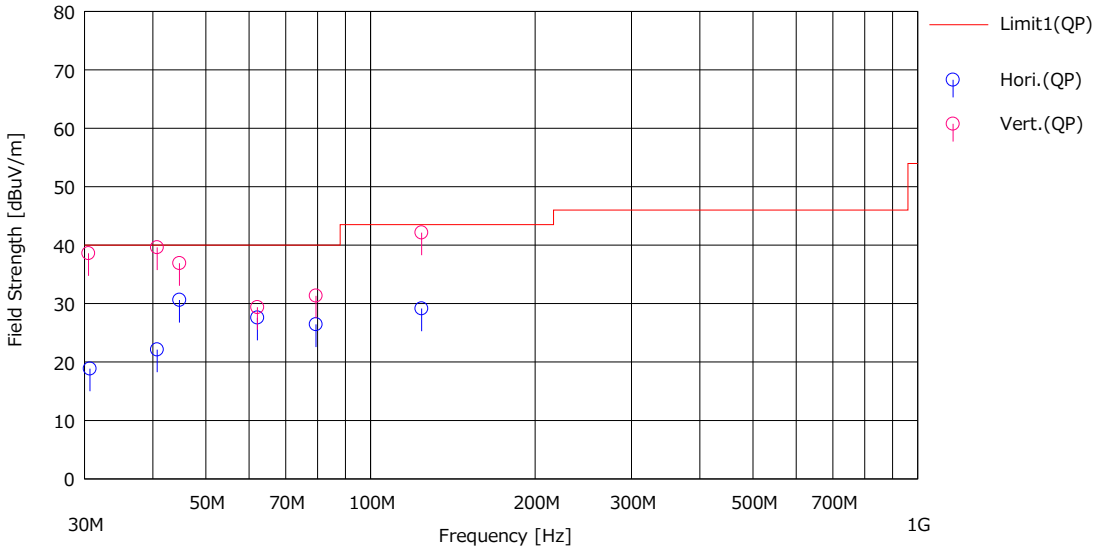
## (below 30MHz)

Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP




* Data above 490 kHz were measured using a QP detector.

## (above 30MHz)




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

**UL Japan, Inc.**
**Ise EMC Lab.**
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

# Duty Cycle

| | |
|---|---|
| Report No. | 13397619H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.2 |
| Date | July 3, 2020 |
| Temperature / Humidity | 25 deg. C / 53% RH |
| Engineer | Tomohisa Nakagawa |
| Mode | Mode 1 |

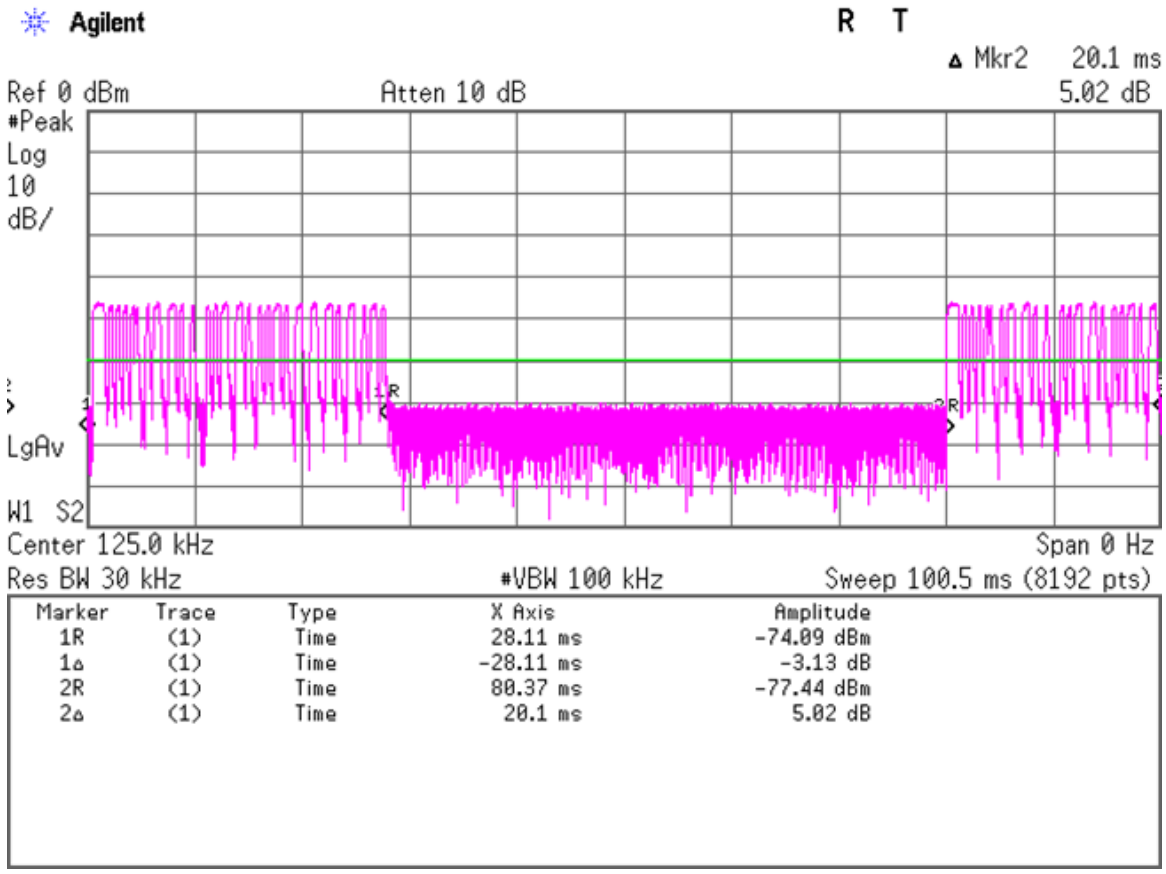
| Type | Times | ON time(One pulse) [ms] | ON time(in 100ms) [ms] |
|---|---|---|---|
| A | 1 | 28.11 | 28.11 |
| B | 1 | 20.10 | 20.10 |

*1)ON time(in 100ms) = Times * ON time(One pulse)
*2)The train of pulses was exceeding 100msec, and that sampled 100msec was the worst case against the pulse train.

**(Total)**

| ON time [ms] | Cycle [ms] | Duty (On time/Cycle) | Duty [dB] |
|---|---|---|---|
| 48.21 | 100.00 | 0.48 | -6.34 |

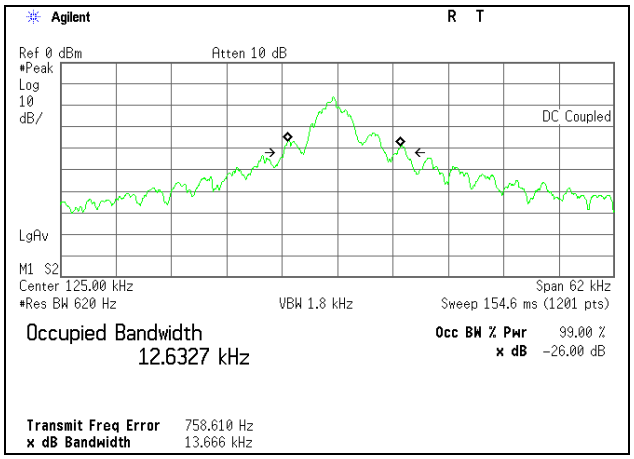
*3)ON time = Type A's ON time (in 100ms) + Type B's ON time (in 100ms)
*4)Duty = 20log10(ON time/Cycle)



# -26 dB Bandwidth and 99 % Occupied Bandwidth

| | |
|---|---|
| Report No. | 13397619H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.1 |
| Date | June 27, 2020 |
| Temperature / Humidity | 23 deg. C / 68 % RH |
| Engineer | Takafumi Noguchi |
| Mode | Mode 1 |

| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---|---|
| 13.666 | 12.6327 |



# APPENDIX 2: Test instruments

**Test equipment**

| Test Item | Local ID | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Cal Int |
|---|---|---|---|---|---|---|---|---|
| RE | MAEC-01 | 141998 | AC1_Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 10m | DA-06881 | 06/08/2020 | 24 |
| RE | MOS-27 | 141566 | Thermo-Hygrometer | CUSTOM | CTH-201 | A08Q26 | 01/07/2020 | 12 |
| RE | MMM-03 | 141530 | Digital Tester | Fluke Corporation | FLUKE 26-3 | 78030621 | 08/20/2019 | 12 |
| RE | MJM-25 | 142226 | Measure | KOMELON | KMC-36 | - | - | - |
| RE | COTS-MEMI-02 | 178648 | EMI measurement program | TSJ (Techno Science Japan) | TEPTO-DV | - | - | - |
| RE | MTR-09 | 141950 | EMI Test Receiver | Rohde & Schwarz | ESU26 | 100412 | 06/03/2020 | 12 |
| RE | MLPA-01 | 141254 | Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 100017 | 10/04/2019 | 12 |
| RE | MCC-143 | 141413 | Coaxial Cable | UL Japan | - | - | 06/18/2020 | 12 |
| RE | MCC-03 | 141215 | Coaxial Cable | Fujikura/Suhner/TSJ | 5D-2W/3D-2W/RG400u/RFM-E421(SW) | -/01068(Switcher) | 06/25/2020 | 12 |
| RE | MAT-08 | 141213 | Attenuator(6dB) | Weinschel Corp | 2 | BK7971 | 11/14/2019 | 12 |
| RE | MSA-15 | 141902 | Spectrum Analyzer | Keysight Technologies Inc | E4440A | MY46187105 | 10/09/2019 | 12 |
| RE | MAEC-02 | 142004 | AC2_Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-06902 | 05/26/2020 | 24 |
| RE | MOS-41 | 192300 | Thermo-Hygrometer | CUSTOM | CTH-201 | 0013 | 12/19/2019 | 12 |
| RE | MMM-01 | 141542 | Digital Tester | Fluke Corporation | FLUKE 26-3 | 78030611 | 08/20/2019 | 12 |
| RE | MJM-27 | 142228 | Measure | KOMELON | KMC-36 | - | - | - |
| RE | MAT-07 | 141203 | Attenuator(6dB) | Weinschel Corp | 2 | BK7970 | 11/07/2019 | 12 |
| RE | MCC-12 | 141317 | Coaxial Cable | Fujikura/Agilent | - | - | 09/03/2019 | 12 |
| RE | MPA-24 | 141594 | Pre Amplifier | Keysight Technologies Inc | 8447D | 2944A10150 | 02/10/2020 | 12 |
| RE | MTR-03 | 141942 | Test Receiver | Rohde & Schwarz | ESCI | 100300 | 08/08/2019 | 12 |
| RE | MSA-04 | 141885 | Spectrum Analyzer | Keysight Technologies Inc | E4448A | US44300523 | 11/21/2019 | 12 |
| RE | LA-17 | 160924 | Logperiodic Antenna | Schwarzbeck Mess - Elektronik | VUSLP9111B | 225 | 11/29/2019 | 12 |
| RE | YBA-03 | 197990 | Biconical Antenna | Schwarzbeck Mess - Elektronik | VHBB 9124 + BBA 9106 | 01365 | 05/17/2020 | 12 |
| RE | MSA-10 | 141899 | Spectrum Analyzer | Keysight Technologies Inc | E4448A | MY46180655 | 08/07/2019 | 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: Spurious emission**