

# RADIO TEST REPORT

## Test Report No. 14946217H-C-R1

|                     |                       |
|---------------------|-----------------------|
| Customer            | SHIMANO INC.          |
| Description of EUT  | Dual Control Lever    |
| Model Number of EUT | 0SL1                  |
| FCC ID              | WY7-0SL1              |
| Test Regulation     | FCC Part 15 Subpart C |
| Test Result         | Complied              |
| Issue Date          | December 4, 2023      |
| Remarks             | -                     |

**Representative Test Engineer**Takafumi Noguchi  
Engineer**Approved By**Takayuki Shimada  
Leader

CERTIFICATE 5107.02

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

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- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

## **REVISION HISTORY**

### **Original Test Report No.: 14946217H-C**

This report is a revised version of 14946217H-C. 14946217H-C is replaced with this report.

| Revision        | Test Report No. | Date               | Page Revised Contents                                                                                                                    |
|-----------------|-----------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| -<br>(Original) | 14946217H-C     | September 27, 2023 | -                                                                                                                                        |
| 1               | 14946217H-C-R1  | December 4, 2023   | <b><u>Clause 4.1</u></b><br>Added information of software (Date and Storage location):<br>"Date: 2023.9.4, Storage location: EUT memory" |
| 1               | 14946217H-C-R1  | December 4, 2023   | <b><u>Clause 4.2</u></b><br>Added explanatory note:<br>"* Jig battery (DC 7.4 V) was ... to RF part regardless of input voltage."        |
| 1               | 14946217H-C-R1  | December 4, 2023   | <b><u>APPENDIX 1: Test Data</u></b><br>Modified plot data of Spurious Emission                                                           |

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

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

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## **SECTION 1: Customer Information**

|                  |                                                               |
|------------------|---------------------------------------------------------------|
| Company Name     | SHIMANO INC.                                                  |
| Address          | 3-77 Oimatsu-cho, Sakai-ku, Sakai City, Osaka 590-8577, Japan |
| Telephone Number | +81-72-223-7019                                               |
| Contact Person   | Osamu Kariyama                                                |

The information provided from the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

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

## **SECTION 2: Equipment Under Test (EUT)**

### **2.1 Identification of EUT**

|               |                                                                                           |
|---------------|-------------------------------------------------------------------------------------------|
| Description   | Dual Control Lever                                                                        |
| Model Number  | 0SL1                                                                                      |
| Serial Number | Refer to SECTION 4.2                                                                      |
| Condition     | Production prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification  | No Modification by the test lab                                                           |
| Receipt Date  | September 3, 2023                                                                         |
| Test Date     | September 4 to 12, 2023                                                                   |

### **2.2 Product Description**

#### **General Specification**

|                       |                         |
|-----------------------|-------------------------|
| Rating                | DC 6.0 V (Battery)      |
| Operating temperature | -10 deg. C to 50 deg. C |

#### **Radio Specification**

##### **[SHIMANO ORIGINAL]**

|                        |             |
|------------------------|-------------|
| Equipment Type         | Transceiver |
| Frequency of Operation | 2478 MHz    |
| Type of Modulation     | GFSK        |
| Antenna Gain           | 0.09 dBi    |

## SECTION 3: Test Specification, Procedures & Results

### 3.1 Test Specification

|                    |                                                                                                                                                                                                              |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Specification | FCC Part 15 Subpart C<br>The latest version on the first day of the testing period                                                                                                                           |
| Title              | FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators<br>Section 15.207 Conducted limits<br>Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,<br>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<br>6. Standard test methods<br>ISED: RSS-Gen 8.8      | FCC: Section 15.207<br>ISED: RSS-Gen 8.8                                   | -                                      | N/A      | *1)                                                         |
| 6dB Bandwidth                           | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: -            | FCC: Section 15.247(a)(2)<br>ISED: RSS-247 5.2(a)                          | See data.                              | Complied | Conducted                                                   |
| Maximum Peak Output Power               | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: RSS-Gen 6.12 | FCC: Section 15.247(b)(3)<br>ISED: RSS-247 5.4(d)                          |                                        | Complied | Conducted                                                   |
| Power Density                           | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: -            | FCC: Section 15.247(e)<br>ISED: RSS-247 5.2(b)                             |                                        | Complied | Conducted                                                   |
| Spurious Emission Restricted Band Edges | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: RSS-Gen 6.13 | FCC: Section 15.247(d)<br>ISED: RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10 | 1.2 dB<br>2483.5 MHz<br>Horizontal, AV | Complied | Conducted (below 30 MHz)/<br>Radiated (above 30 MHz)<br>*2) |

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

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

\*1) 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.

\*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.

#### **FCC Part 15.31 (e)**

This EUT provides stable voltage constantly to RF part regardless of input voltage. Therefore, this EUT complies with the requirement.

#### **FCC Part 15.203 Antenna requirement**

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

### 3.3 Addition to Standard

| Item                   | Test Procedure    | Specification | Worst Margin | Results | Remarks   |
|------------------------|-------------------|---------------|--------------|---------|-----------|
| 99% Occupied Bandwidth | ISED: RSS-Gen 6.7 | ISED: -       | N/A          | -       | Conducted |

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

### 3.4 Uncertainty

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

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

#### Radiated emission

| Measurement distance | Frequency Range     |            | Unit | Calculated Uncertainty (+/-) |
|----------------------|---------------------|------------|------|------------------------------|
| 3 m                  | 9 kHz to 30 MHz     |            | dB   | 3.3                          |
| 10 m                 |                     |            | dB   | 3.1                          |
| 3 m                  | 30 MHz to 200 MHz   | Horizontal | dB   | 4.8                          |
|                      |                     | Vertical   | dB   | 5.0                          |
|                      | 200 MHz to 1000 MHz | Horizontal | dB   | 5.1                          |
|                      |                     | Vertical   | dB   | 6.2                          |
| 10 m                 | 30 MHz to 200 MHz   | Horizontal | dB   | 4.8                          |
|                      |                     | Vertical   | dB   | 4.8                          |
|                      | 200 MHz to 1000 MHz | Horizontal | dB   | 4.9                          |
|                      |                     | Vertical   | dB   | 5.0                          |
| 3 m                  | 1 GHz to 6 GHz      |            | dB   | 4.9                          |
|                      | 6 GHz to 18 GHz     |            | dB   | 5.2                          |
| 1 m                  | 10 GHz to 26.5 GHz  |            | dB   | 5.5                          |
|                      | 26.5 GHz to 40 GHz  |            | dB   | 5.4                          |
| 10 m                 | 1 GHz to 18 GHz     |            | dB   | 5.3                          |

#### Antenna Terminal Conducted Tests

| Item                                                                | Unit   | Calculated Uncertainty (+/-) |
|---------------------------------------------------------------------|--------|------------------------------|
| Antenna Terminated Conducted Emission / Power Density / Burst Power | dB     | 3.28                         |
| Adjacent Channel Power (ACP)                                        | dB     | 2.27                         |
| Bandwidth (OBW)                                                     | %      | 0.96                         |
| Time Readout (Time span upto 100 msec)                              | %      | 0.11                         |
| Time Readout (Time span upto 1000 msec)                             | %      | 0.11                         |
| Time Readout (Time span upto 60 sec)                                | %      | 0.02                         |
| Power Measurement (Power meter)                                     | dB     | 1.50                         |
| Frequency Readout (Frequency counter)                               | ppm    | 0.67                         |
| Frequency Readout (Spectrum analyzer frequency readout function)    | ppm    | 1.61                         |
| Temperature (Constant temperature bath)                             | deg. C | 0.78                         |
| Humidity (Constant temperature bath)                                | %RH    | 2.80                         |
| Modulation Characteristics                                          | %      | 6.93                         |
| Frequency for Mobile                                                | ppm    | 0.08                         |

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan

Telephone: +81-596-24-8999

A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

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

### 3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

## SECTION 4: Operation of EUT during testing

### 4.1 Operating Mode(s)

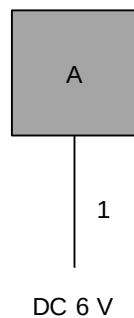
| Mode                                                                                                                                                                                                                 | Remarks*                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| SHIMANO ORIGINAL                                                                                                                                                                                                     | Maximum Packet Size, SCRAMBLED |
| *Transmitting duty was 100 % on all tests.                                                                                                                                                                           |                                |
| *Power of the EUT was set by the software as follows;<br>Power Setting: 0 dBm<br>Software: OSL1.4.15.249.1<br>(Date: 2023.9.4, Storage location: EUT memory)                                                         |                                |
| *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. |                                |

\*The Details of Operating Mode(s)

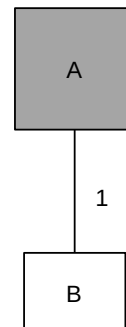
| Test Item                                                                                                                                                | Operating Mode                     | Tested Frequency |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------|
| 99% Occupied Bandwidth,<br>6 dB Bandwidth,<br>Maximum Peak Output Power,<br>Radiated Spurious Emission,<br>Conducted Spurious Emission,<br>Power Density | Transmitting (Tx) SHIMANO ORIGINAL | 2478 MHz         |

### 4.2 Configuration and Peripherals

For Antenna Terminal Conducted (AT)



For Radiated Emission (RE)



- \* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.
- \* The test was conducted using DC supply or jig battery since they didn't affect the RF characteristics.
- \* Jig battery (DC 7.4 V) was used for RE, but it did not affect the test result because this EUT provided the stable voltage constantly to RF part regardless of input voltage.

#### Description of EUT and Support Equipment

| No. | Item               | Model Number | Serial Number                            | Manufacturer | Remarks |
|-----|--------------------|--------------|------------------------------------------|--------------|---------|
| A   | Dual Control Lever | OSL1         | OSLVHA40008 for AT<br>OSLVHA40020 for RE | SHIMANO INC. | EUT     |
| B   | Li-ion Battery     | BT-DN300     | 7HKVEK079DA                              | SHIMANO INC. | -       |

#### List of Cables Used

| No. | Name     | Length (m)               | Shield Cable | Connector  | Remarks |
|-----|----------|--------------------------|--------------|------------|---------|
| 1   | DC Cable | 1.0 for AT<br>1.2 for RE | Unshielded   | Unshielded | -       |

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

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane. Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

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

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

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

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

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

### Test Antennas are used as below;

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

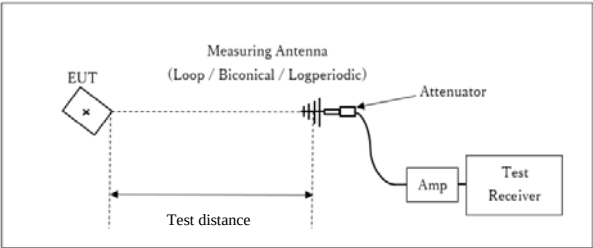
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired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

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

|                 |               |                          |                                                                                                                                                                                                                                             |                              |
|-----------------|---------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Frequency       | Below 1 GHz   | Above 1 GHz              |                                                                                                                                                                                                                                             | 20 dBc                       |
| Instrument Used | Test Receiver | Spectrum Analyzer        |                                                                                                                                                                                                                                             | Spectrum Analyzer            |
| Detector        | QP            | PK                       | AV                                                                                                                                                                                                                                          | PK                           |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz | <u>11.12.2.5.1</u><br>RBW: 1 MHz<br>VBW: 3 MHz<br>Detector:<br>Power Averaging (RMS)<br>Trace: 100 traces<br><u>11.12.2.5.2</u><br>The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results. | RBW: 100 kHz<br>VBW: 300 kHz |

Figure 2: Test Setup

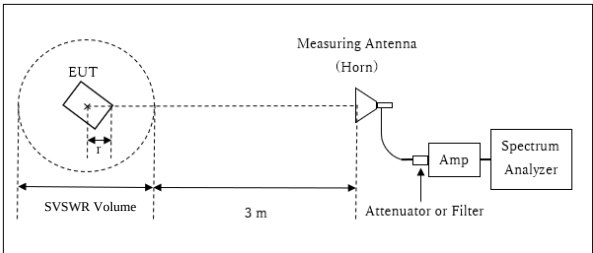
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz

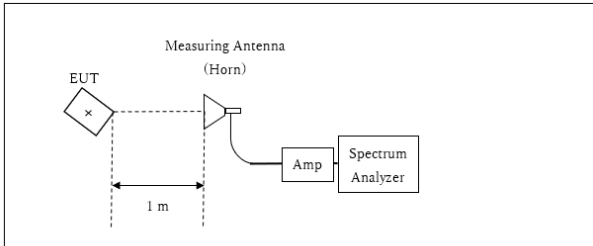


r : Radius of an outer periphery of EUT  
x : Center of turn table

Distance Factor:  $20 \times \log (3.95 \text{ m} / 3.0 \text{ m}) = 2.39 \text{ dB}$   
\* Test Distance:  $(3 + \text{SVSWR Volume} / 2) - r = 3.95 \text{ m}$

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

10 GHz to 26.5 GHz



x : Center of turn table

Distance Factor:  $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$   
\*Test Distance: 1 m

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

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

Measurement Range : 30 MHz to 26.5 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                    |
|-------------------------------------|-----------------------------------------|-----------------|--------------------|------------|----------------------|----------|------------------------------------|
| 6dB Bandwidth                       | 2 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/<br>Average *2) | -        | Power Meter<br>(Sensor: 50 MHz BW) |
| Peak Power Density                  | 1.5 times the 6dB Bandwidth             | 3 kHz           | 10 kHz             | Auto       | Peak                 | Max Hold | Spectrum Analyzer *3)              |
| Conducted Spurious Emission *4) *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             |            |                      |          |                                    |

\*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.

(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)

\*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

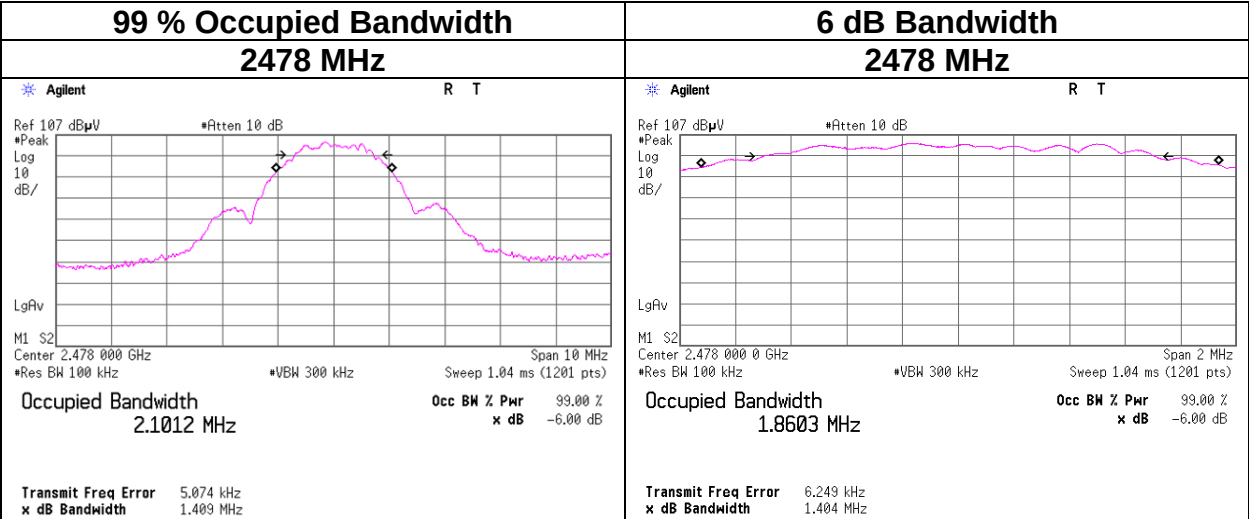
Test Result : Pass

APPENDIX 1: Test Data

99 % Occupied Bandwidth and 6 dB Bandwidth

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Date                   | September 4, 2023                  |
| Temperature / Humidity | 24 deg. C / 43 % RH                |
| Engineer               | Takafumi Noguchi                   |
| Mode                   | Tx SHIMANO ORIGINAL                |

| Mode | Frequency<br>[MHz] | 99% Occupied<br>Bandwidth<br>[kHz] | 6dB Bandwidth<br>[MHz] | Limit for<br>6dB Bandwidth<br>[MHz] |
|------|--------------------|------------------------------------|------------------------|-------------------------------------|
| Tx   | 2478               | 2101.2                             | 1.404                  | > 0.5000                            |



## Maximum Peak Output Power

Test place                      Ise EMC Lab. No.6 Measurement Room  
Date                              September 4, 2023  
Temperature / Humidity      24 deg. C / 43 % RH  
Engineer                        Takafumi Noguchi  
Mode                              Tx SHIMANO ORIGINAL

| Freq. | Reading | Cable Loss | Atten. Loss | Conducted Power |      |       |      |        | e.i.r.p. for RSS-247 |        |       |       |       |        |
|-------|---------|------------|-------------|-----------------|------|-------|------|--------|----------------------|--------|-------|-------|-------|--------|
|       |         |            |             | Result          |      | Limit |      | Margin | Antenna Gain         | Result |       | Limit |       | Margin |
|       |         |            |             | [dBm]           | [mW] | [dBm] | [mW] |        |                      | [dB]   | [dBm] | [mW]  | [dBm] |        |
| [MHz] | [dBm]   | [dB]       | [dB]        |                 |      |       |      |        |                      |        |       |       |       |        |
| 2478  | -0.77   | 0.20       | 9.52        | 8.95            | 7.85 | 30.00 | 1000 | 21.05  | 0.09                 | 9.04   | 8.02  | 36.02 | 4000  | 26.98  |

Sample Calculation:

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

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

\*The equipment and cables were not used for factor 0 dB of the data sheets.

---

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

|                        |                                    |
|------------------------|------------------------------------|
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Date                   | September 4, 2023                  |
| Temperature / Humidity | 24 deg. C / 43 % RH                |
| Engineer               | Takafumi Noguchi                   |
| Mode                   | Tx SHIMANO ORIGINAL                |

| Freq.<br>[MHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Atten.<br>Loss<br>[dB] | Result<br>(Time average) |      | Duty<br>factor<br>[dB] | Result<br>(Burst power average) |      |
|----------------|------------------|-----------------------|------------------------|--------------------------|------|------------------------|---------------------------------|------|
|                |                  |                       |                        | [dBm]                    | [mW] |                        | [dBm]                           | [mW] |
| 2478           | -1.14            | 0.20                  | 9.52                   | 8.58                     | 7.21 | 0.00                   | 8.58                            | 7.21 |

Sample Calculation:

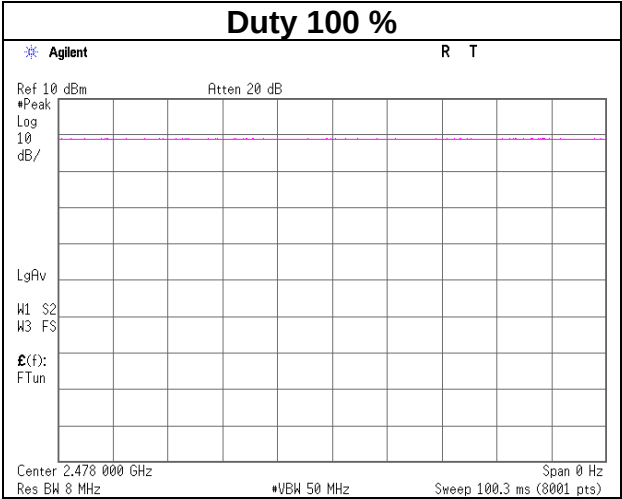
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

\*The equipment and cables were not used for factor 0 dB of the data sheets.

Burst rate confirmation

Test place Ise EMC Lab. No.6 Measurement Room  
Date September 4, 2023  
Temperature / Humidity 24 deg. C / 43 % RH  
Engineer Takafumi Noguchi  
Mode Tx SHIMANO ORIGINAL



## Radiated Spurious Emission

Test place  
Semi Anechoic Chamber  
Date  
Temperature / Humidity  
Engineer

Ise EMC Lab.  
No.3  
September 11, 2023  
22 deg. C / 59 % RH

No.1  
September 12, 2023  
22 deg. C / 47 % RH  
Tetsuro Yoshida  
(Below 1 GHz)

Mode

Tx SIMANO ORIGINAL

| Polarity    | Frequency | Reading<br>(QP / PK) | Reading<br>(AV) | Ant.<br>Factor | Loss | Gain | Duty<br>Factor | Result<br>(QP / PK) | Result<br>(AV) | Limit<br>(QP / PK) | Limit<br>(AV) | Margin<br>(QP / PK) | Margin<br>(AV) | Remark      |
|-------------|-----------|----------------------|-----------------|----------------|------|------|----------------|---------------------|----------------|--------------------|---------------|---------------------|----------------|-------------|
| [Hori/Vert] | [MHz]     | [dBuV]               | [dBuV]          | [dBm]          | [dB] | [dB] | [dB]           | [dBuV/m]            | [dBuV/m]       | [dBuV/m]           | [dBuV/m]      | [dB]                | [dB]           |             |
| Hori.       | 54.8      | 28.0                 | -               | 9.3            | 7.7  | 38.8 | -              | 6.3                 | -              | 40.0               | -             | 33.7                | -              |             |
| Hori.       | 67.7      | 28.1                 | -               | 6.6            | 7.9  | 38.8 | -              | 3.8                 | -              | 40.0               | -             | 36.2                | -              |             |
| Hori.       | 71.4      | 28.1                 | -               | 6.5            | 8.0  | 38.8 | -              | 3.8                 | -              | 40.0               | -             | 36.2                | -              |             |
| Hori.       | 168.8     | 28.2                 | -               | 15.7           | 9.2  | 38.9 | -              | 14.2                | -              | 43.5               | -             | 29.2                | -              |             |
| Hori.       | 257.6     | 27.5                 | -               | 12.0           | 10.0 | 38.8 | -              | 10.8                | -              | 46.0               | -             | 35.1                | -              |             |
| Hori.       | 456.1     | 27.0                 | -               | 16.7           | 11.6 | 38.3 | -              | 16.9                | -              | 46.0               | -             | 29.1                | -              |             |
| Hori.       | 2390.0    | 42.4                 | 33.8            | 27.7           | 5.4  | 32.4 | -              | 43.0                | 34.4           | 73.9               | 53.9          | 30.9                | 19.5           |             |
| Hori.       | 2483.5    | 62.6                 | 52.1            | 27.5           | 5.4  | 32.4 | -              | 63.1                | 52.7           | 73.9               | 53.9          | 10.8                | 1.2            |             |
| Hori.       | 4956.0    | 42.1                 | 34.2            | 31.6           | 7.5  | 31.4 | -              | 49.8                | 41.9           | 73.9               | 53.9          | 24.1                | 12.0           |             |
| Hori.       | 7434.0    | 41.7                 | 33.7            | 36.2           | 8.7  | 32.4 | -              | 54.2                | 46.2           | 73.9               | 53.9          | 19.7                | 7.7            | Floor noise |
| Hori.       | 9912.0    | 41.1                 | 32.5            | 39.1           | 9.2  | 33.1 | -              | 56.4                | 47.8           | 73.9               | 53.9          | 17.5                | 6.1            | Floor noise |
| Vert.       | 55.3      | 27.9                 | -               | 9.1            | 7.7  | 38.8 | -              | 6.0                 | -              | 40.0               | -             | 34.0                | -              |             |
| Vert.       | 67.3      | 28.2                 | -               | 6.6            | 7.9  | 38.8 | -              | 3.9                 | -              | 40.0               | -             | 36.1                | -              |             |
| Vert.       | 71.5      | 28.1                 | -               | 6.5            | 8.0  | 38.8 | -              | 3.8                 | -              | 40.0               | -             | 36.2                | -              |             |
| Vert.       | 168.7     | 28.3                 | -               | 15.7           | 9.2  | 38.9 | -              | 14.3                | -              | 43.5               | -             | 29.2                | -              |             |
| Vert.       | 257.6     | 27.6                 | -               | 12.0           | 10.0 | 38.8 | -              | 10.9                | -              | 46.0               | -             | 35.1                | -              |             |
| Vert.       | 456.0     | 27.1                 | -               | 16.7           | 11.6 | 38.3 | -              | 17.0                | -              | 46.0               | -             | 29.0                | -              |             |
| Vert.       | 2390.0    | 42.2                 | 33.5            | 27.7           | 5.4  | 32.4 | -              | 42.8                | 34.1           | 73.9               | 53.9          | 31.1                | 19.8           |             |
| Vert.       | 2483.5    | 61.8                 | 51.1            | 27.5           | 5.4  | 32.4 | -              | 62.4                | 51.7           | 73.9               | 53.9          | 11.5                | 2.2            |             |
| Vert.       | 4956.0    | 44.8                 | 38.3            | 31.6           | 7.5  | 31.4 | -              | 52.5                | 46.0           | 73.9               | 53.9          | 21.4                | 7.9            |             |
| Vert.       | 7434.0    | 41.7                 | 33.8            | 36.2           | 8.7  | 32.4 | -              | 54.2                | 46.3           | 73.9               | 53.9          | 19.7                | 7.7            | Floor noise |
| Vert.       | 9912.0    | 41.2                 | 32.5            | 39.1           | 9.2  | 33.1 | -              | 56.5                | 47.8           | 73.9               | 53.9          | 17.5                | 6.1            | Floor noise |

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

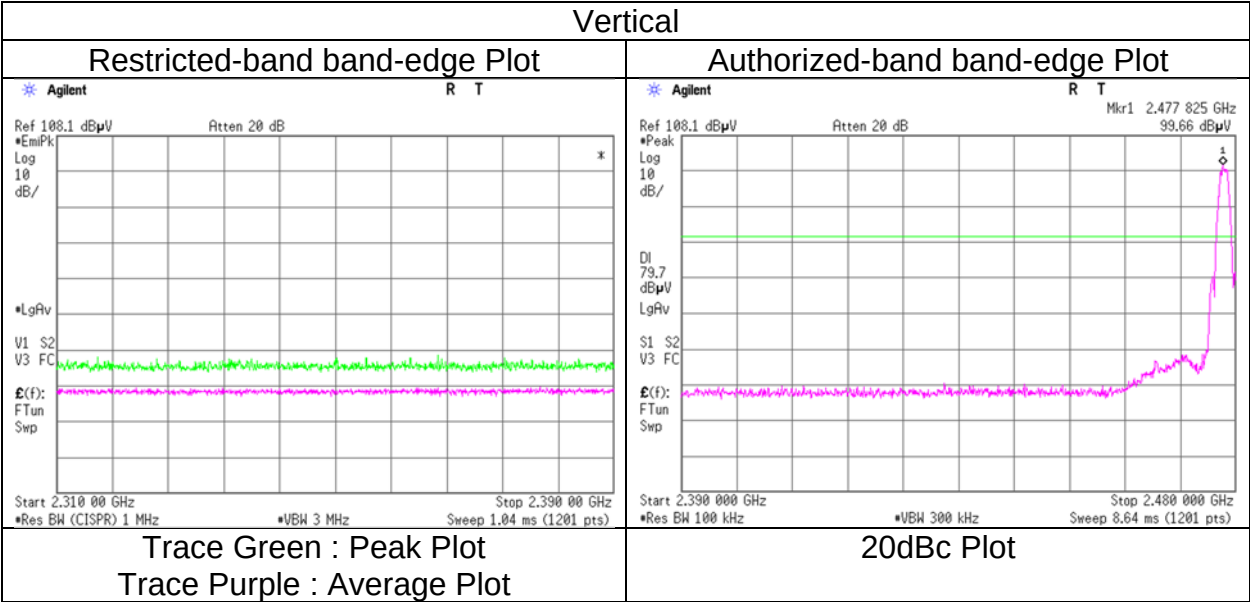
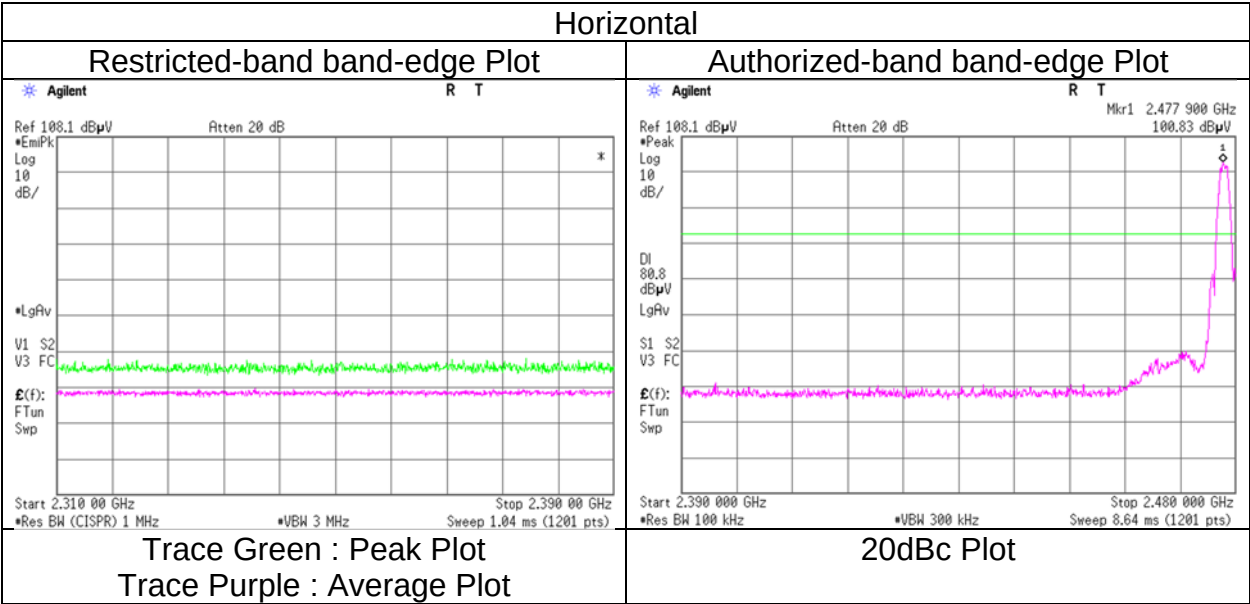
## 20dBc Data Sheet

| 20dB Card Sheet |           |              |            |      |      |          |          |        |         |
|-----------------|-----------|--------------|------------|------|------|----------|----------|--------|---------|
| Polarity        | Frequency | Reading (PK) | Ant Factor | Loss | Gain | Result   | Limit    | Margin | Remark  |
| [Hori/Vert]     | [MHz]     | [dBuV]       | [dB/m]     | [dB] | [dB] | [dBuV/m] | [dBuV/m] | [dB]   |         |
| Hori.           | 2478.0    | 100.8        | 27.5       | 5.4  | 32.4 | 101.4    | -        |        | Carrier |
| Hori.           | 2480.0    | 34.0         | 27.6       | 5.4  | 32.4 | 34.6     | 81.4     | 46.8   |         |
| Vert.           | 2478.0    | 99.7         | 27.5       | 5.4  | 32.4 | 100.2    | -        |        | Carrier |
| Vert.           | 2480.0    | 34.0         | 27.6       | 5.4  | 32.4 | 34.6     | 80.2     | 45.7   |         |

|                                                                                                               |                   |                                                            |
|---------------------------------------------------------------------------------------------------------------|-------------------|------------------------------------------------------------|
| Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) |                   |                                                            |
| Distance factor:                                                                                              | 1 GHz - 10 GHz    | $20\log(3.95 \text{ m} / 3.0 \text{ m}) = 2.39 \text{ dB}$ |
|                                                                                                               | 10 GHz - 26.5 GHz | $20\log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$  |

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

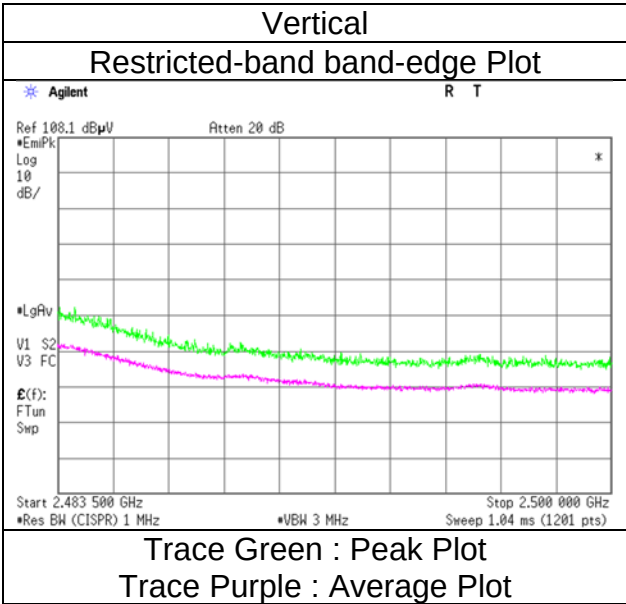
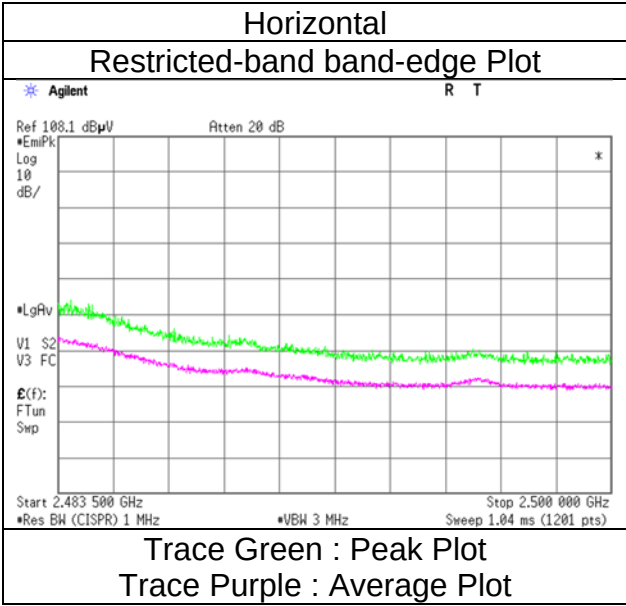
|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.3                |
| Date                   | September 11, 2023  |
| Temperature / Humidity | 22 deg. C / 59 % RH |
| Engineer               | Tetsuro Yoshida     |
|                        | (1 GHz to 10 GHz)   |
| Mode                   | Tx SIMANO ORIGINAL  |



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

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

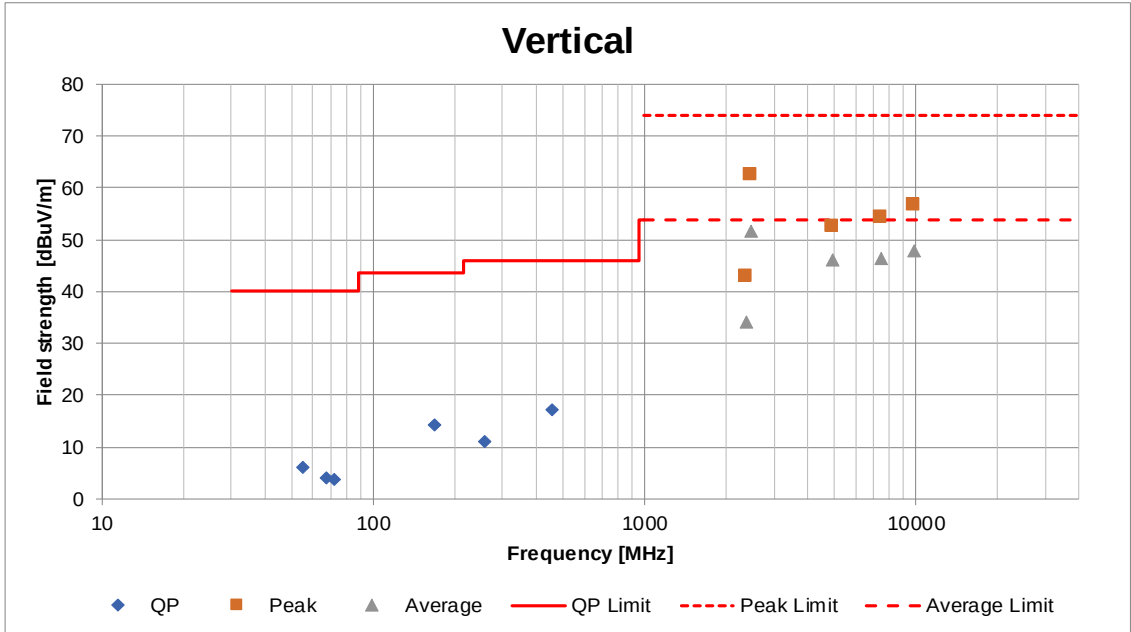
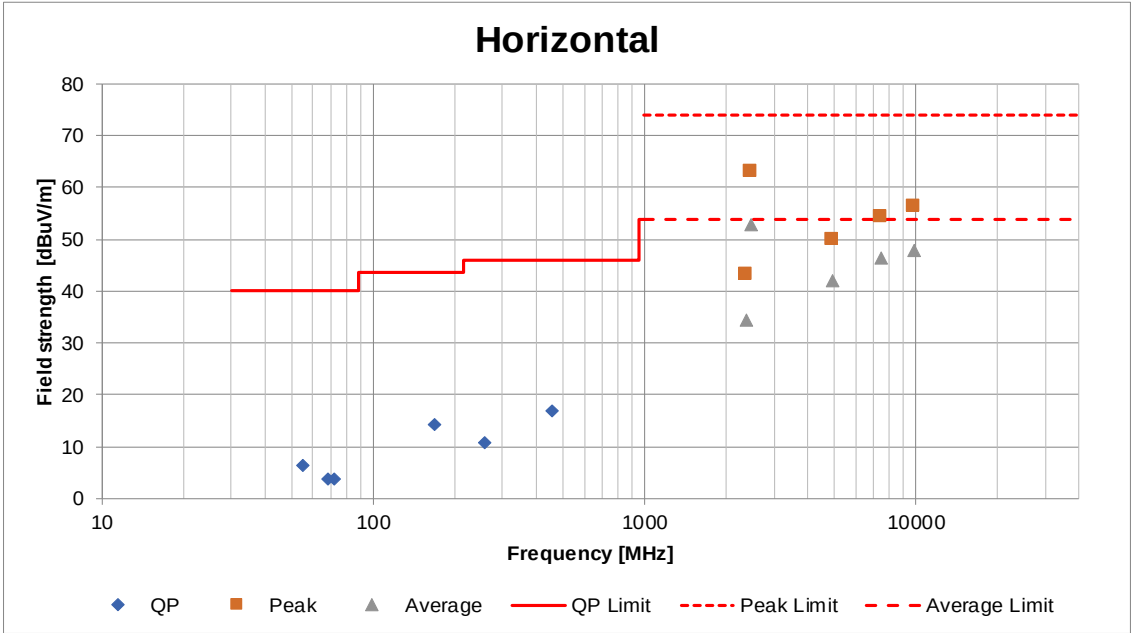
|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.3                |
| Date                   | September 11, 2023  |
| Temperature / Humidity | 22 deg. C / 59 % RH |
| Engineer               | Tetsuro Yoshida     |
|                        | (1 GHz to 10 GHz)   |
| Mode                   | Tx SIMANO ORIGINAL  |



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

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

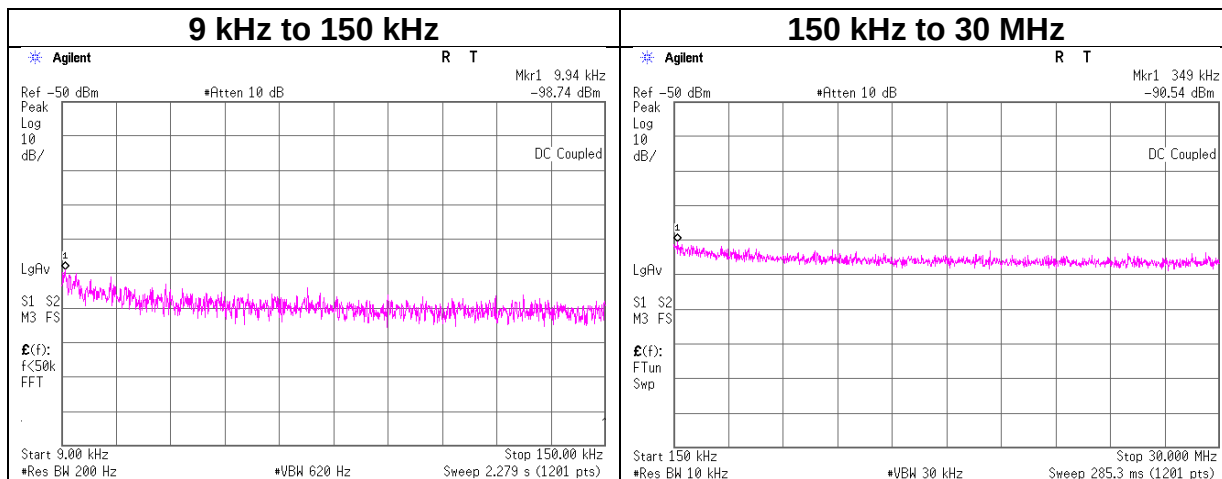
|                        |                     |                     |
|------------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab.        | No.1                |
| Semi Anechoic Chamber  | No.3                | September 12, 2023  |
| Date                   | September 11, 2023  | 22 deg. C / 47 % RH |
| Temperature / Humidity | 22 deg. C / 59 % RH | Tetsuro Yoshida     |
| Engineer               | Tetsuro Yoshida     | (Above 1 GHz)       |
|                        | (Below 1 GHz)       |                     |
| Mode                   | Tx SIMANO ORIGINAL  |                     |



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

## Conducted Spurious Emission

Test place Ise EMC Lab. No.6 Measurement Room  
Date September 4, 2023  
Temperature / Humidity 24 deg. C / 43 % RH  
Engineer Takafumi Noguchi  
Mode Tx SHIMANO ORIGINAL



| Frequency<br>[kHz] | Reading<br>[dBm] | Cable<br>Loss<br>[dB] | Attenuator<br>Loss<br>[dB] | Antenna<br>Gain*<br>[dBi] | N<br>(Number<br>of Output) | EIRP<br>[dBm] | Distance<br>[m] | Ground<br>bounce<br>[dB] | E<br>(field strength)<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|--------------------|------------------|-----------------------|----------------------------|---------------------------|----------------------------|---------------|-----------------|--------------------------|-----------------------------------|-------------------|----------------|--------|
| 9.94               | -98.7            | 0.20                  | 9.8                        | 2.0                       | 1                          | -86.7         | 300             | 6.0                      | -25.4                             | 47.6              | 73.0           |        |
| 349.00             | -90.5            | 0.20                  | 9.8                        | 2.0                       | 1                          | -78.5         | 300             | 6.0                      | -17.2                             | 16.7              | 33.9           |        |

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

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

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.

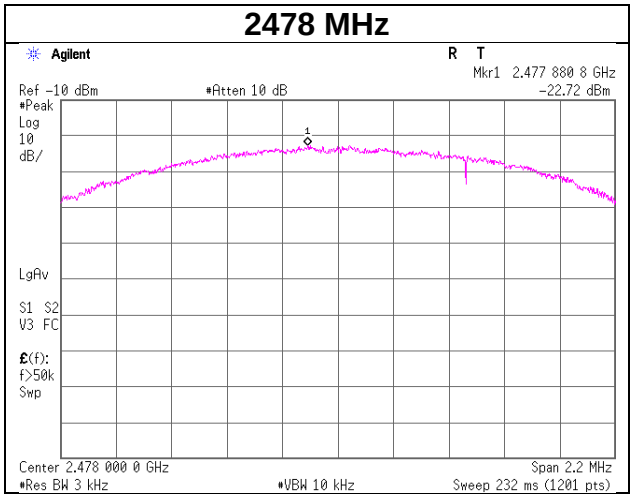
Power Density

Test place Ise EMC Lab. No.6 Measurement Room  
Date September 4, 2023  
Temperature / Humidity 24 deg. C / 43 % RH  
Engineer Takafumi Noguchi  
Mode Tx SHIMANO ORIGINAL

| Freq. | Reading       | Cable Loss | Atten. Loss | Result        | Limit         | Margin |
|-------|---------------|------------|-------------|---------------|---------------|--------|
| [MHz] | [dBm / 3 kHz] | [dB]       | [dB]        | [dBm / 3 kHz] | [dBm / 3 kHz] | [dB]   |
| 2478  | -22.72        | 0.20       | 9.52        | -13.00        | 8.00          | 21.00  |

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

\*The equipment and cables were not used for factor 0 dB of the data sheets.



## APPENDIX 2: Test Instruments

### Test Equipment

| Test Item | Local ID      | LIMS ID | Description                         | Manufacturer                    | Model                             | Serial                    | Last Calibration Date | Cal Int |
|-----------|---------------|---------|-------------------------------------|---------------------------------|-----------------------------------|---------------------------|-----------------------|---------|
| AT        | MAT-10        | 141156  | Attenuator(10dB)                    | Weinschel Corp                  | 2                                 | BL1173                    | 11/10/2022            | 12      |
| AT        | MAT-90        | 141223  | Attenuator                          | Weinschel Associates            | WA56-10                           | 56100306                  | 05/18/2023            | 12      |
| AT        | MMM-18        | 141558  | Digital Tester(TRUE RMS MULTIMETER) | Fluke Corporation               | 115                               | 17930030                  | 05/29/2023            | 12      |
| AT        | MOS-14        | 141561  | Thermo-Hygrometer                   | CUSTOM. Inc                     | CTH-201                           | 1401                      | 01/13/2023            | 12      |
| AT        | MPM-12        | 141809  | Power Meter                         | Anritsu Corporation             | ML2495A                           | 825002                    | 05/26/2023            | 12      |
| AT        | MPSE-17       | 141830  | Power sensor                        | Anritsu Corporation             | MA2411B                           | 738285                    | 05/26/2023            | 12      |
| AT        | MSA-13        | 141900  | Spectrum Analyzer                   | Keysight Technologies Inc       | E4440A                            | MY46185823                | 06/16/2023            | 12      |
| RE        | COTS-MEMI-02  | 178648  | EMI measurement program             | TSJ (Techno Science Japan)      | TEPTO-DV                          | -                         | -                     | -       |
| RE        | KBA-05        | 141198  | Biconical Antenna                   | Schwarzbeck Mess-Elektronik OHG | VHA9103+BBA9106                   | 2513                      | 06/06/2023            | 12      |
| RE        | LA-17         | 160924  | Logperiodic Antenna                 | Schwarzbeck Mess-Elektronik OHG | VUSLP9111B                        | 225                       | 11/12/2022            | 12      |
| RE        | MAEC-01       | 141998  | AC1_Semi Anechoic Chamber(NSA)      | TDK                             | Semi Anechoic Chamber 10m         | DA-06881                  | 06/28/2022            | 24      |
| RE        | MAEC-03-SVSWR | 142013  | AC3_Semi Anechoic Chamber(SVSWR)    | TDK                             | Semi Anechoic Chamber 3m          | DA-10005                  | 04/12/2023            | 24      |
| RE        | MAT-08        | 141213  | Attenuator(6dB)                     | Weinschel Corp                  | 2                                 | BK7971                    | 11/19/2022            | 12      |
| RE        | MCC-02        | 141350  | Coaxial Cable                       | Suhner/storm/Agilent /TSJ       | -                                 | -                         | 03/03/2023            | 12      |
| RE        | MCC-265       | 234602  | Microwave Cable                     | Huber+Suhner                    | SF126E/11PC35/11PC35/1000M, 5000M | 537063/126E / 537074/126E | 03/16/2023            | 12      |
| RE        | MHA-20        | 141507  | Horn Antenna 1-18GHz                | Schwarzbeck Mess-Elektronik OHG | BBHA9120D                         | 258                       | 11/14/2022            | 12      |
| RE        | MHF-25        | 141232  | High Pass Filter 3.5-18.0GHz        | UL Japan                        | HPF SELECTOR                      | 001                       | 09/04/2023            | 12      |
| RE        | MJM-16        | 142183  | Measure                             | KOMELON                         | KMC-36                            | -                         | 10/03/2022            | 12      |
| RE        | MJM-25        | 142226  | Measure, Tape, Steel                | KOMELON                         | KMC-36                            | -                         | -                     | -       |
| RE        | MMM-03        | 141530  | Digital Tester                      | Fluke Corporation               | FLUKE 26-3                        | 78030621                  | 01/18/2023            | 12      |
| RE        | MMM-08        | 141532  | DIGITAL HiTESTER                    | HIOKI E.E. CORPORATION          | 3805                              | 51201197                  | 01/17/2023            | 12      |
| RE        | MOS-13        | 141554  | Thermo-Hygrometer                   | CUSTOM. Inc                     | CTH-201                           | 1301                      | 01/13/2023            | 12      |
| RE        | MOS-27        | 141566  | Thermo-Hygrometer                   | CUSTOM. Inc                     | CTH-201                           | A08Q26                    | 01/13/2023            | 12      |
| RE        | MPA-11        | 141580  | MicroWave System Amplifier          | Keysight Technologies Inc       | 83017A                            | MY39500779                | 03/08/2023            | 12      |
| RE        | MPA-19        | 141585  | Pre Amplifier                       | L3 Narda-MITEQ                  | MLA-10K01-B01-35                  | 1237616                   | 02/02/2023            | 12      |
| RE        | MSA-03        | 141884  | Spectrum Analyzer                   | Keysight Technologies Inc       | E4448A                            | MY44020357                | 03/13/2023            | 12      |
| RE        | MTR-09        | 141950  | EMI Test Receiver                   | Rohde & Schwarz                 | ESU26                             | 100412                    | 10/11/2022            | 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:

AT: Antenna Terminal Conducted test

RE: Radiated Emission