



# **RADIO TEST REPORT**

**Test Report No. : 13525956H-C**

**Applicant** : SHIMANO INC.  
**Type of EUT** : Wireless Module  
**Model Number of EUT** : 927A  
**FCC ID** : WY7-927A  
**Test regulation** : FCC Part 15 Subpart C: 2020  
**Test Result** : Complied (Refer to SECTION 3.2)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.  
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. 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.

**Date of test:** October 12 to 18, 2020

**Representative test engineer:**

*Y. Yamazaki*

Yuichiro Yamazaki  
Engineer

Consumer Technology Division

**Approved by:**

*Takayuki S.*

Takayuki Shimada  
Leader  
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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**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## **REVISION HISTORY**

**Original Test Report No.: 13525956H-C**

| Revision     | Test report No. | Date              | Page revised | Contents |
|--------------|-----------------|-------------------|--------------|----------|
| - (Original) | 13525956H-C     | November 24, 2020 | -            | -        |

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

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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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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                                              |
| Facsimile Number | : | +81-72-223-3266                                              |
| Contact Person   | : | Toshihiko Takahashi                                          |

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                       | : | Wireless Module                                                                           |
| Model Number               | : | 927A                                                                                      |
| Serial Number              | : | Refer to SECTION 4.2                                                                      |
| Rating                     | : | DC 2.4 V                                                                                  |
| Receipt Date               | : | October 7, 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: 927A (referred to as the EUT in this report) is a Wireless Module.

### **General Specification**

|                       |   |                          |
|-----------------------|---|--------------------------|
| Operating Temperature | : | -10 deg. C to +50 deg. C |
|-----------------------|---|--------------------------|

### **Radio Specification**

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

|                         |   |                  |
|-------------------------|---|------------------|
| Radio Type              | : | Transceiver      |
| Frequency of Operation  | : | 2478 MHz         |
| Modulation              | : | GFSK             |
| Antenna type            | : | Monopole Antenna |
| Antenna Gain            | : | -2.5 dBi         |
| Maximum Clock frequency | : | 24 MHz           |

### **SECTION 3: Test specification, procedures & results**

#### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on October 13, 2020

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

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

#### **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                                   | 31.50 dB<br>0.15000 MHz,<br>Phase: L, QP | Complied<br>a)     | -                                                                 |
| 6dB Bandwidth                                 | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: -            | FCC: Section<br>15.247(a)(2)<br>ISED: RSS-247 5.2(a)                       | See data.                                | Complied<br>b)     | Conducted                                                         |
| Maximum Peak<br>Output Power                  | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: RSS-Gen 6.12 | FCC: Section<br>15.247(b)(3)<br>ISED: RSS-247 5.4(d)                       |                                          | Complied<br>c)     | 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<br>d)     | Conducted                                                         |
| Spurious Emission<br>Restricted Band<br>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 | 6.1 dB<br>2483.500 MHz<br>Horizontal, AV | Complied<br>e), f) | Conducted<br>(below 30 MHz)/<br>Radiated<br>(above 30 MHz)<br>*1) |

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

\*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

- a) Refer to APPENDIX 1 (data of Conducted Emission)  
b) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)  
c) Refer to APPENDIX 1 (data of Maximum Peak Output Power)  
d) Refer to APPENDIX 1 (data of Power Density)  
e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)  
f) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

Symbols:

|           |                                                                                                             |
|-----------|-------------------------------------------------------------------------------------------------------------|
| Complied  | The data of this test item has enough margin, more than the measurement uncertainty.                        |
| Complied# | The data of this test item meets the limits unless the measurement uncertainty is taken into consideration. |

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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

The RF Module has its own regulator.

The RF Module is constantly provided voltage through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

### **FCC Part 15.203/212 Antenna requirement**

The antenna is not removable from 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          | -<br>a) | Conducted |
| a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth) |                   |               |              |         |           |

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

## **3.4 Uncertainty**

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

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

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### **Antenna Terminal test**

| Test Item                                        | Uncertainty (+/-) |
|--------------------------------------------------|-------------------|
| 20 dB Bandwidth / 99 % Occupied Bandwidth        | 0.96 %            |
| Maximum Peak Output Power / Average Output Power | 1.4 dB            |
| Carrier Frequency Separation                     | 0.42 %            |
| Dwell time / Burst rate                          | 0.10 %            |
| Conducted Spurious Emission                      | 2.6 dB            |

### **Conducted emission**

| using Item | Frequency range       | Uncertainty (+/-) |
|------------|-----------------------|-------------------|
| AMN (LISN) | 0.009 MHz to 0.15 MHz | 3.4 dB            |
|            | 0.15 MHz to 30 MHz    | 2.9 dB            |

### **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)<br>(Vertical)   | 4.8 dB            |
|                      |                                                | 5.0 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal)<br>(Vertical) | 5.2 dB            |
|                      |                                                | 6.3 dB            |
| 10 m                 | 30 MHz to 200 MHz (Horizontal)<br>(Vertical)   | 4.8 dB            |
|                      |                                                | 4.8 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal)<br>(Vertical) | 5.0 dB            |
|                      |                                                | 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            |

**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

### 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

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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.

**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

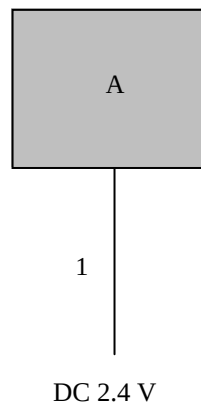
## **SECTION 4: Operation of EUT during testing**

### **4.1 Operating Mode(s)**

| Mode                                                                                                                                                                                                                                                                                                                                                                                            | Remarks*                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Transmitting (Tx)                                                                                                                                                                                                                                                                                                                                                                               | Maximum Packet Size, SCRAMBLED |
| *Transmitting duty was 100 % on all tests.                                                                                                                                                                                                                                                                                                                                                      |                                |
| *Power of the EUT was set by the software as follows;<br>Power settings: -5 dBm<br>Software: STR9250_4.15.9.2.dat<br>(Date: October 12, 2020, 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. |                                |

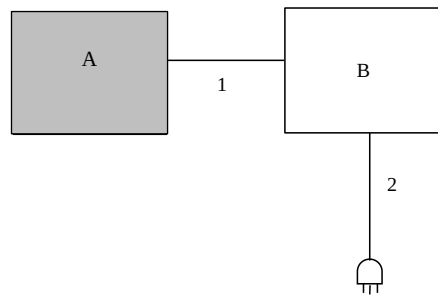
### **4.2 Configuration and peripherals**

#### **Antenna Terminal Conducted Tests and Radiated Spurious Emission test**



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

## Conducted Emission test



AC 120 V / 60 Hz

\* 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   | Wireless Module | 927A         | 153 for AT*<br>155 for RE, CE* | SHIMANO INC. | EUT     |
| B   | DC Power Supply | PMC35-2A     | 13090501                       | Kikusui      | -       |

### List of cables used

| No. | Name     | Length (m) | Shield     |            | Remarks |
|-----|----------|------------|------------|------------|---------|
|     |          |            | Cable      | Connector  |         |
| 1   | DC Cable | 0.5        | Unshielded | Unshielded | -       |
| 2   | AC Cable | 1.5        | Unshielded | Unshielded | -       |

\* AT: Antenna Terminal Conducted Tests, RE: Radiated Spurious Emission test, CE: Conducted Emission test

**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

## **SECTION 5: Conducted Emission**

### **Test Procedure and conditions**

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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

I/O cable and AC cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN(AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber or a Measurement Room.

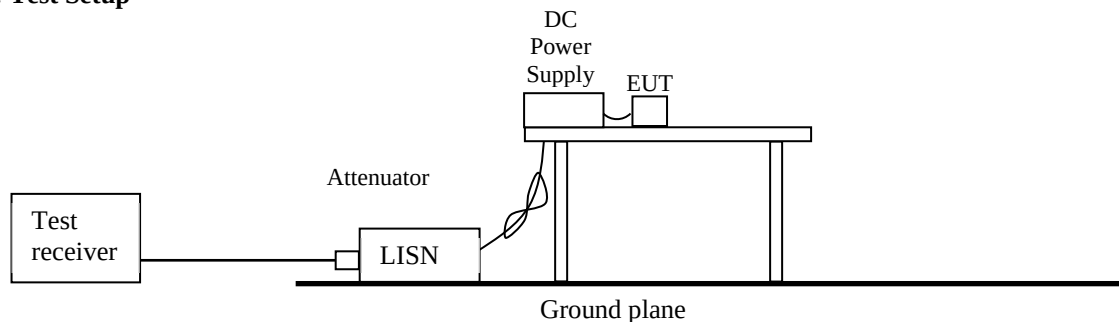
The EUT was connected to a LISN (AMN) through the DC power supply.

An overview sweep with peak detection has been performed.

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

|                          |                            |
|--------------------------|----------------------------|
| <b>Detector</b>          | <b>: QP and CISPR AV</b>   |
| <b>Measurement range</b> | <b>: 0.15 MHz - 30 MHz</b> |
| <b>Test data</b>         | <b>: APPENDIX</b>          |
| <b>Test result</b>       | <b>: Pass</b>              |

**Figure 1: Test Setup**



## **SECTION 6: 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, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

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

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

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

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

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

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

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

### **Test Antennas are used as below;**

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

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

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

|                 |               |                          |                                                                                                    |                              |
|-----------------|---------------|--------------------------|----------------------------------------------------------------------------------------------------|------------------------------|
| Frequency       | Below 1 GHz   | Above 1 GHz              |                                                                                                    | 20 dBc                       |
| Instrument used | Test Receiver | Spectrum Analyzer        |                                                                                                    | Spectrum Analyzer            |
| Detector        | QP            | PK                       | AV *1)                                                                                             | PK                           |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz | 11.12.2.5.1<br>RBW: 1 MHz<br>VBW: 3 MHz<br>Detector:<br>Power Averaging (RMS)<br>Trace: 100 traces | RBW: 100 kHz<br>VBW: 300 kHz |

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

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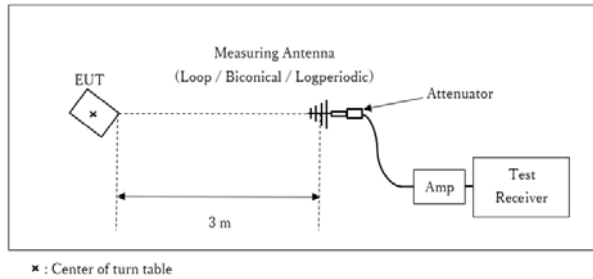
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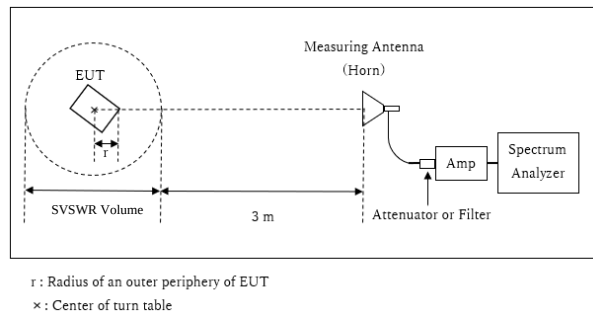
**Figure 2: Test Setup**

Below 1 GHz



Test Distance: 3 m

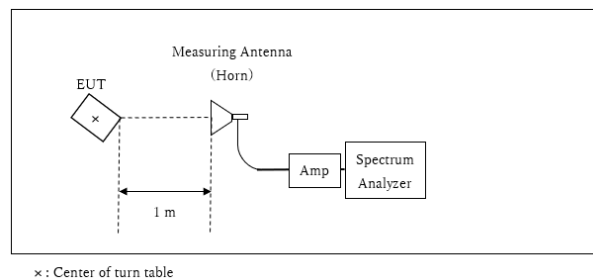
1 GHz - 10 GHz



Distance Factor:  $20 \times \log (3.65 \text{ m} / 3.0 \text{ m}) = 1.70 \text{ dB}$   
\* Test Distance:  $(3 + \text{SVSWR Volume} / 2) - r = 3.65 \text{ m}$

SVSWR Volume : 1.5 m  
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)  
r = 0.10 m

10 GHz - 26.5 GHz



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 - 26.5 GHz |
| Test data         | : APPENDIX          |
| Test result       | : Pass              |

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## **SECTION 7: 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3 MHz                                   | 100 kHz         | 300 kHz            | Auto       | Peak                 | Max Hold    | Spectrum Analyzer                  |
| 99% Occupied Bandwidth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto       | Sample               | Clear Write | Spectrum Analyzer                  |
| Maximum Peak Output Power                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                       | -               | -                  | Auto       | Peak/<br>Average *1) | -           | 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 *2)              |
| Conducted Spurious Emission *3) *4)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 9kHz to 150kHz                          | 200 Hz          | 620 Hz             | Auto       | Peak                 | Max Hold    | Spectrum Analyzer                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 150kHz to 30MHz                         | 9.1 kHz         | 27 kHz             |            |                      |             |                                    |
| *1) Reference data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                         |                 |                    |            |                      |             |                                    |
| *2) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                         |                 |                    |            |                      |             |                                    |
| *3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.<br>Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.                                                                                                                                                                                                                                                                                                                                                         |                                         |                 |                    |            |                      |             |                                    |
| *4) 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.

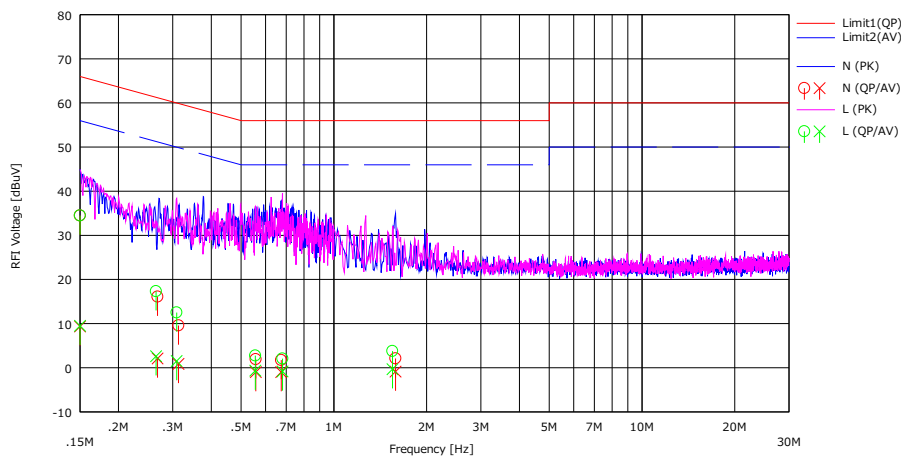
**Test data** : APPENDIX  
**Test result** : Pass

## APPENDIX 1: Test data

### Conducted Emission

Report No. 13525956H  
Test place Ise EMC Lab. No.2 Semi Anechoic Chamber  
Date October 18, 2020  
Temperature / Humidity 24 deg. C / 55 % RH  
Engineer Yuichiro Yamazaki  
Mode Tx SHIMANO ORIGINAL

Limit : FCC\_Part 15 Subpart C(15.207)



| No. | Freq.<br>[MHz] | Reading        |                | LISN<br>[dB] | LOSS<br>[dB] | Results        |                | Limit          |                | Margin       |              | Phase | Comment |
|-----|----------------|----------------|----------------|--------------|--------------|----------------|----------------|----------------|----------------|--------------|--------------|-------|---------|
|     |                | <QP><br>[dBuV] | <AV><br>[dBuV] |              |              | <QP><br>[dBuV] | <AV><br>[dBuV] | <QP><br>[dBuV] | <AV><br>[dBuV] | <QP><br>[dB] | <AV><br>[dB] |       |         |
| 1   | 0.15000        | 21.20          | -3.90          | 0.07         | 13.20        | 34.47          | 9.37           | 66.00          | 56.00          | 31.53        | 46.63        | N     |         |
| 2   | 0.26788        | 2.80           | -11.20         | 0.06         | 13.22        | 16.08          | 2.08           | 61.20          | 51.20          | 45.12        | 49.12        | N     |         |
| 3   | 0.31320        | -3.70          | -12.40         | 0.06         | 13.22        | 9.58           | 0.88           | 59.90          | 49.90          | 50.32        | 49.02        | N     |         |
| 4   | 0.55800        | -11.40         | -14.30         | 0.06         | 13.25        | 1.91           | -0.99          | 56.00          | 46.00          | 54.09        | 46.99        | N     |         |
| 5   | 0.67445        | -11.60         | -14.30         | 0.06         | 13.26        | 1.72           | -0.98          | 56.00          | 46.00          | 54.28        | 46.98        | N     |         |
| 6   | 1.58500        | -11.30         | -14.30         | 0.08         | 13.34        | 2.12           | -0.88          | 56.00          | 46.00          | 53.88        | 46.88        | N     |         |
| 7   | 0.15000        | 21.20          | -3.80          | 0.10         | 13.20        | 34.50          | 9.50           | 66.00          | 56.00          | 31.50        | 46.50        | L     |         |
| 8   | 0.26482        | 4.00           | -10.70         | 0.10         | 13.22        | 17.32          | 2.62           | 61.30          | 51.30          | 43.98        | 48.68        | L     |         |
| 9   | 0.30895        | -0.80          | -11.80         | 0.10         | 13.22        | 12.52          | 1.52           | 60.00          | 50.00          | 47.48        | 48.48        | L     |         |
| 10  | 0.55630        | -10.60         | -14.00         | 0.10         | 13.25        | 2.75           | -0.65          | 56.00          | 46.00          | 53.25        | 46.65        | L     |         |
| 11  | 0.68125        | -11.30         | -14.20         | 0.11         | 13.26        | 2.07           | -0.83          | 56.00          | 46.00          | 53.93        | 46.83        | L     |         |
| 12  | 1.54900        | -9.70          | -13.80         | 0.13         | 13.33        | 3.76           | -0.34          | 56.00          | 46.00          | 52.24        | 46.34        | L     |         |

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)  
Except for the above table: adequate margin data below the limits.

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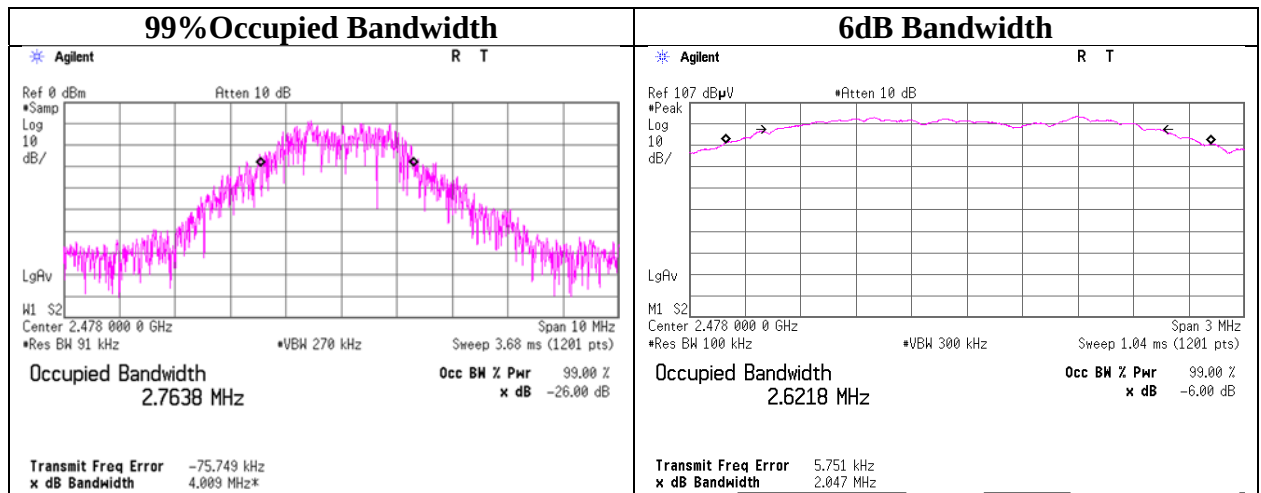
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## 6 dB Bandwidth and 99 % Occupied Bandwidth

|                        |                                    |
|------------------------|------------------------------------|
| Report No.             | 13525956H                          |
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Date                   | October 12, 2020                   |
| Temperature / Humidity | 24 deg. C / 63 % RH                |
| Engineer               | Yuichiro Yamazaki                  |
| 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               | 2763.8                             | 2.047                  | > 0.5000                            |



## Maximum Peak Output Power

Report No. 13525956H  
Test place Ise EMC Lab. No.6 Measurement Room  
Date October 12, 2020  
Temperature / Humidity 24 deg. C / 63 % RH  
Engineer Yuichiro Yamazaki  
Mode Tx SHIMANO ORIGINAL

| Freq. | Reading | Cable<br>Loss | Atten.<br>Loss | Conducted Power |      |       |      |        | e.i.r.p. for RSS-247 |        |      |       |      |        |
|-------|---------|---------------|----------------|-----------------|------|-------|------|--------|----------------------|--------|------|-------|------|--------|
|       |         |               |                | Result          |      | Limit |      | Margin | Antenna<br>Gain      | Result |      | Limit |      | Margin |
|       |         |               |                | [dBm]           | [mW] | [dBm] | [mW] |        |                      | [dBm]  | [mW] | [dBm] | [mW] |        |
| 2478  | -2.27   | 1.65          | 10.03          | 9.41            | 8.73 | 30.00 | 1000 | 20.59  | -2.50                | 6.91   | 4.91 | 36.02 | 4000 | 29.11  |

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)**

Report No. 13525956H  
Test place Ise EMC Lab. No.6 Measurement Room  
Date October 12, 2020  
Temperature / Humidity 24 deg. C / 63 % RH  
Engineer Yuichiro Yamazaki  
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           | -2.59            | 1.65                  | 10.03                  | 9.09                     | 8.11 | 0.00                   | 9.09                            | 8.11 |

Sample Calculation:

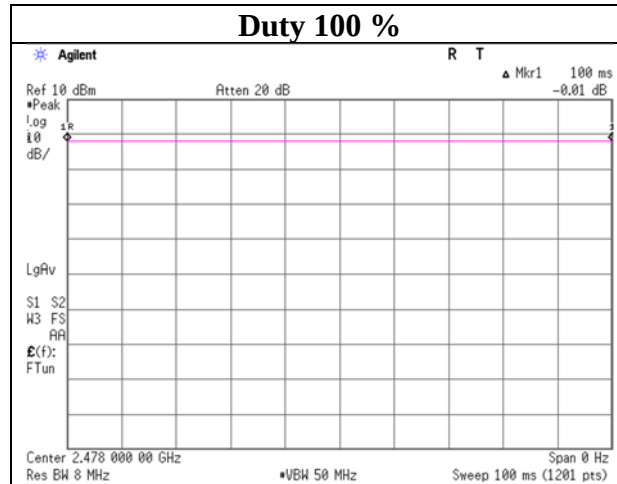
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

Report No. 13525956H  
Test place Ise EMC Lab. No.6 Measurement Room  
Date October 12, 2020  
Temperature / Humidity 24 deg. C / 63 % RH  
Engineer Yuichiro Yamazaki  
Mode Tx SHIMANO ORIGINAL



## Radiated Spurious Emission

Report No. 13525956H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date October 15, 2020 October 18, 2020  
Temperature / Humidity 21 deg. C / 55 % RH 23 deg. C / 53 % RH  
Engineer Junya Okuno Tomohisa Nakagawa  
(Above 1 GHz) (Below 1 GHz)  
Mode Tx SHIMANO ORIGINAL

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|------------------|-----------------|----------------|-------------|-------------|
| Hori.    | 49.560          | QP       | 21.4           | 11.3            | 7.0       | 28.6      | -                | 11.1            | 40.0           | 28.9        |             |
| Hori.    | 99.120          | QP       | 21.4           | 9.9             | 7.5       | 28.5      | -                | 10.3            | 43.5           | 33.2        |             |
| Hori.    | 198.240         | QP       | 20.7           | 16.1            | 8.2       | 28.1      | -                | 16.9            | 43.5           | 26.6        |             |
| Hori.    | 247.800         | QP       | 20.5           | 11.8            | 8.5       | 27.8      | -                | 12.9            | 46.0           | 33.1        |             |
| Hori.    | 495.600         | QP       | 21.4           | 17.8            | 9.8       | 29.2      | -                | 19.8            | 46.0           | 26.2        |             |
| Hori.    | 743.400         | QP       | 21.3           | 20.1            | 10.7      | 29.3      | -                | 22.9            | 46.0           | 23.1        |             |
| Hori.    | 2390.000        | PK       | 44.8           | 27.6            | 5.1       | 35.2      | -                | 42.2            | 73.9           | 31.7        |             |
| Hori.    | 2483.500        | PK       | 66.1           | 27.4            | 5.1       | 35.2      | -                | 63.4            | 73.9           | 10.5        |             |
| Hori.    | 4956.000        | PK       | 45.2           | 31.6            | 7.2       | 34.5      | -                | 49.5            | 73.9           | 24.4        |             |
| Hori.    | 7434.000        | PK       | 42.4           | 36.0            | 8.7       | 34.4      | -                | 52.6            | 73.9           | 21.3        | Floor noise |
| Hori.    | 9912.000        | PK       | 37.7           | 38.9            | 9.1       | 34.9      | -                | 50.8            | 73.9           | 23.1        | Floor noise |
| Hori.    | 2390.000        | AV       | 35.8           | 27.6            | 5.1       | 35.2      | -                | 33.2            | 53.9           | 20.7        |             |
| Hori.    | 2483.500        | AV       | 50.5           | 27.4            | 5.1       | 35.2      | -                | 47.8            | 53.9           | 6.1         |             |
| Hori.    | 4956.000        | AV       | 35.7           | 31.6            | 7.2       | 34.5      | -                | 40.0            | 53.9           | 13.9        |             |
| Hori.    | 7434.000        | AV       | 34.3           | 36.0            | 8.7       | 34.4      | -                | 44.6            | 53.9           | 9.3         | Floor noise |
| Hori.    | 9912.000        | AV       | 32.6           | 38.9            | 9.1       | 34.9      | -                | 45.7            | 53.9           | 8.2         | Floor noise |
| Vert.    | 49.560          | QP       | 21.4           | 11.3            | 7.0       | 28.6      | -                | 11.1            | 40.0           | 28.9        |             |
| Vert.    | 99.120          | QP       | 21.4           | 9.9             | 7.5       | 28.5      | -                | 10.3            | 43.5           | 33.2        |             |
| Vert.    | 198.240         | QP       | 20.7           | 16.1            | 8.2       | 28.1      | -                | 16.9            | 43.5           | 26.6        |             |
| Vert.    | 247.800         | QP       | 20.4           | 11.8            | 8.5       | 27.8      | -                | 12.8            | 46.0           | 33.2        |             |
| Vert.    | 495.600         | QP       | 21.4           | 17.8            | 9.8       | 29.2      | -                | 19.8            | 46.0           | 26.2        |             |
| Vert.    | 743.400         | QP       | 21.3           | 20.1            | 10.7      | 29.3      | -                | 22.9            | 46.0           | 23.1        |             |
| Vert.    | 2390.000        | PK       | 44.3           | 27.6            | 5.1       | 35.2      | -                | 41.7            | 73.9           | 32.2        |             |
| Vert.    | 2483.500        | PK       | 60.2           | 27.4            | 5.1       | 35.2      | -                | 57.6            | 73.9           | 16.3        |             |
| Vert.    | 4956.000        | PK       | 43.7           | 31.6            | 7.2       | 34.5      | -                | 48.0            | 73.9           | 25.9        |             |
| Vert.    | 7434.000        | PK       | 43.1           | 36.0            | 8.7       | 34.4      | -                | 53.3            | 73.9           | 20.6        | Floor noise |
| Vert.    | 9912.000        | PK       | 43.2           | 38.9            | 9.1       | 34.9      | -                | 56.3            | 73.9           | 17.6        | Floor noise |
| Vert.    | 2390.000        | AV       | 35.4           | 27.6            | 5.1       | 35.2      | -                | 32.8            | 53.9           | 21.1        |             |
| Vert.    | 2483.500        | AV       | 45.0           | 27.4            | 5.1       | 35.2      | -                | 42.4            | 53.9           | 11.5        |             |
| Vert.    | 4956.000        | AV       | 36.6           | 31.6            | 7.2       | 34.5      | -                | 40.9            | 53.9           | 13.0        |             |
| Vert.    | 7434.000        | AV       | 34.2           | 36.0            | 8.7       | 34.4      | -                | 44.5            | 53.9           | 9.4         | Floor noise |
| Vert.    | 9912.000        | AV       | 32.3           | 38.9            | 9.1       | 34.9      | -                | 45.5            | 53.9           | 8.4         | Floor noise |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

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

Distance factor: 1 GHz - 10 GHz 20log (3.65 m / 3.0 m) = 1.70 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

### 20dBc Data Sheet

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark  |
|----------|-----------------|----------|----------------|-------------------|-----------|-----------|-----------------|----------------|-------------|---------|
| Hori     | 2478.000        | PK       | 101.1          | 27.4              | 5.1       | 35.2      | 98.4            | -              | -           | Carrier |
| Hori     | 2400.000        | PK       | 36.2           | 25.6              | 5.1       | 35.2      | 31.6            | 78.4           | 46.8        |         |
| Vert     | 2478.000        | PK       | 95.9           | 27.4              | 5.1       | 35.2      | 93.2            | -              | -           | Carrier |
| Vert     | 2400.000        | PK       | 36.6           | 27.6              | 5.1       | 35.2      | 34.0            | 73.2           | 39.2        |         |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

Distance factor: 1 GHz - 10 GHz 20log (3.65 m / 3.0 m) = 1.70 dB

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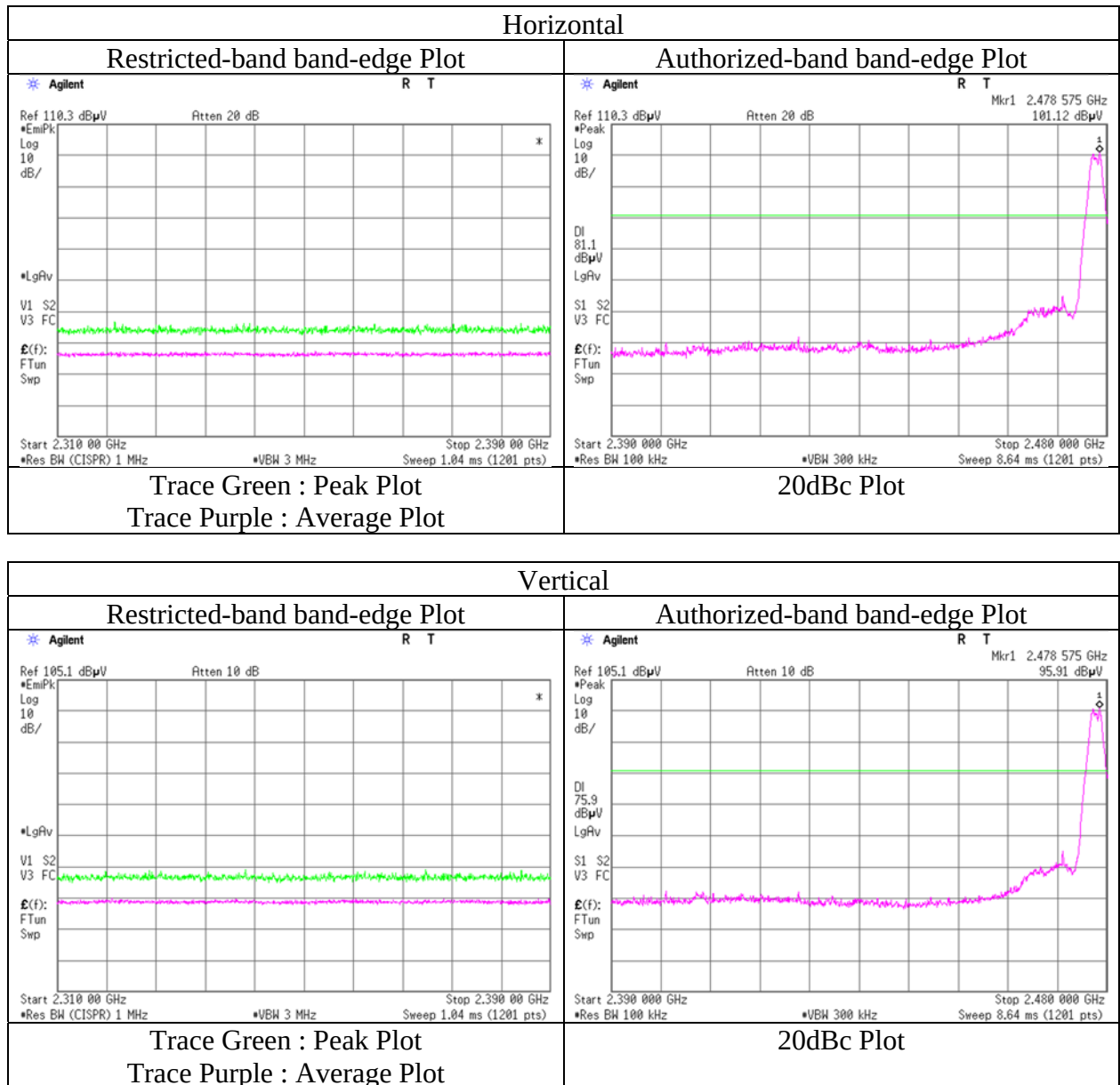
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

|                        |                     |
|------------------------|---------------------|
| Report No.             | 13525956H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | October 15, 2020    |
| Temperature / Humidity | 21 deg. C / 55 % RH |
| Engineer               | Junya Okuno         |
| Mode                   | Tx SHIMANO 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.

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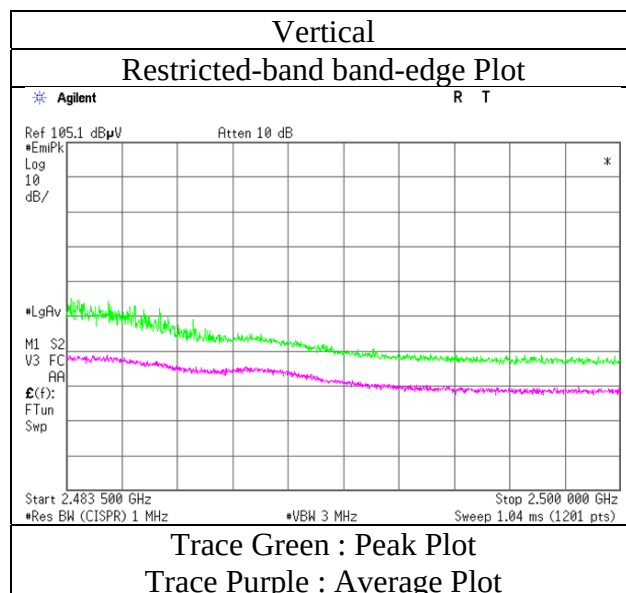
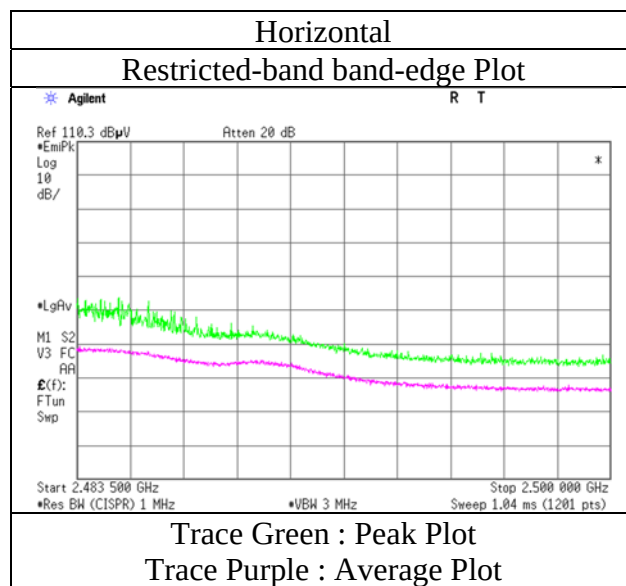
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

|                        |                     |
|------------------------|---------------------|
| Report No.             | 13525956H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.2                |
| Date                   | October 15, 2020    |
| Temperature / Humidity | 21 deg. C / 55 % RH |
| Engineer               | Junya Okuno         |
| Mode                   | Tx SHIMANO 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.

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**Ise EMC Lab.**

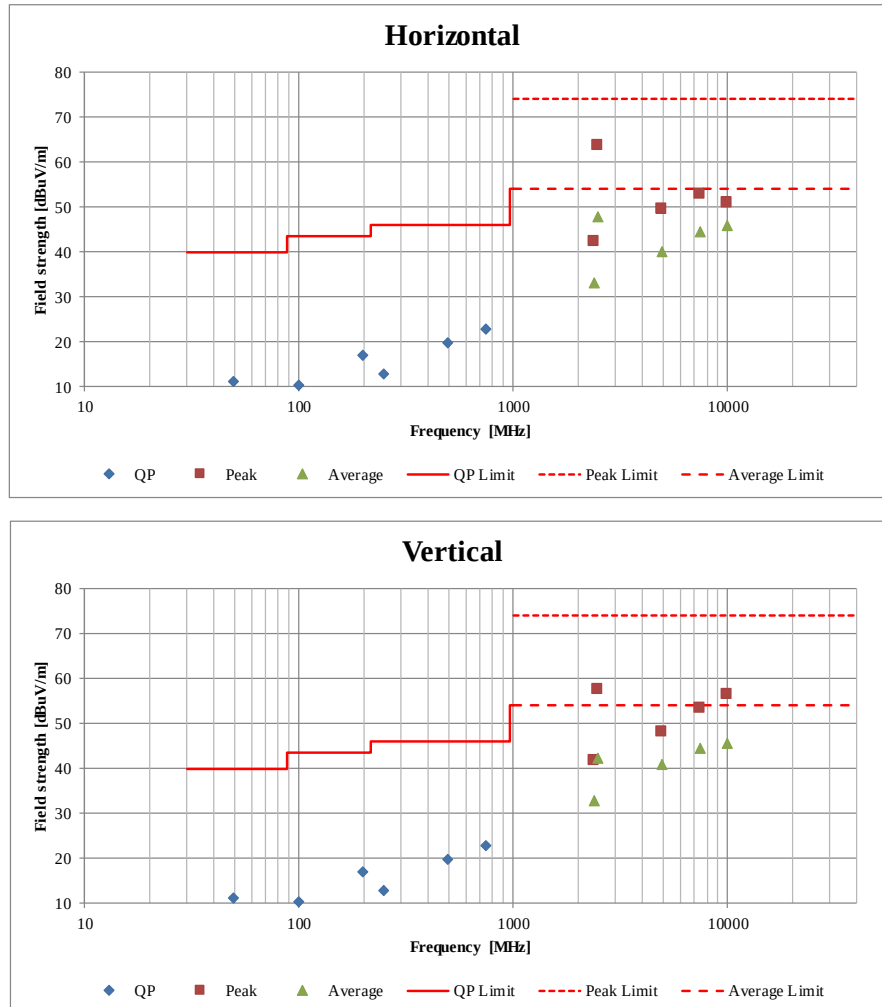
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## Radiated Spurious Emission (Plot data, Worst case)

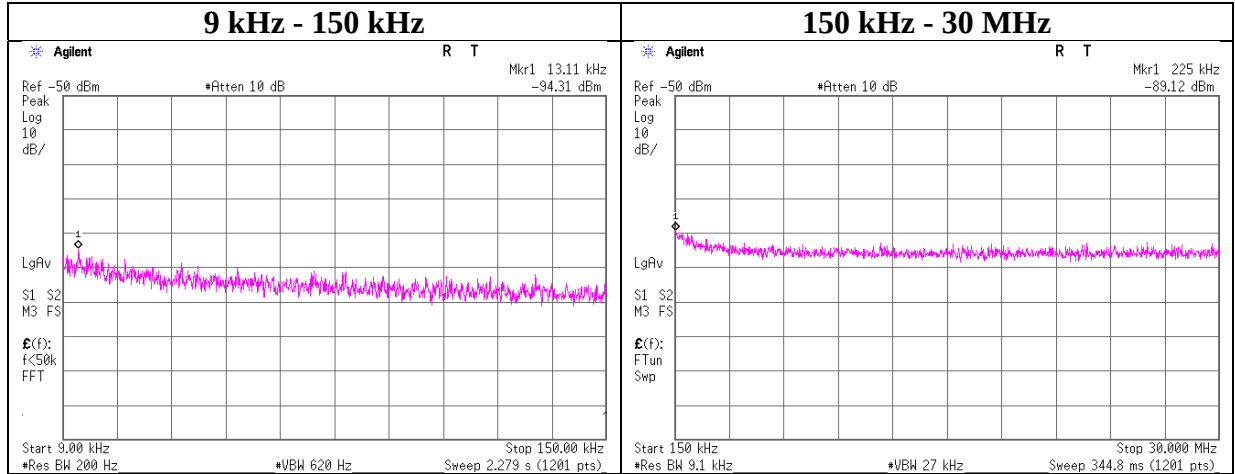
|                        |                              |                                    |
|------------------------|------------------------------|------------------------------------|
| Report No.             | 13525956H                    |                                    |
| Test place             | Ise EMC Lab.                 |                                    |
| Semi Anechoic Chamber  | No.2                         | No.2                               |
| Date                   | October 15, 2020             | October 18, 2020                   |
| Temperature / Humidity | 21 deg. C / 55 % RH          | 23 deg. C / 53 % RH                |
| Engineer               | Junya Okuno<br>(Above 1 GHz) | Tomohisa Nakagawa<br>(Below 1 GHz) |
| Mode                   | Tx SHIMANO ORIGINAL          |                                    |



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

## Conducted Spurious Emission

|                        |                                    |
|------------------------|------------------------------------|
| Report No.             | 13525956H                          |
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Date                   | October 12, 2020                   |
| Temperature / Humidity | 24 deg. C / 63 % RH                |
| Engineer               | Yuichiro Yamazaki                  |
| 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 |
|--------------------|------------------|-----------------------|----------------------------|---------------------------|----------------------------|---------------|-----------------|--------------------------|-----------------------------------|-------------------|----------------|--------|
| 13.11              | -94.3            | 1.65                  | 9.87                       | 2.0                       | 1                          | -80.8         | 300             | 6.0                      | -19.5                             | 45.2              | 64.7           |        |
| 225.00             | -89.1            | 1.65                  | 9.85                       | 2.0                       | 1                          | -75.6         | 300             | 6.0                      | -14.4                             | 20.5              | 34.9           |        |

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

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

N: Number of output

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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Power Density

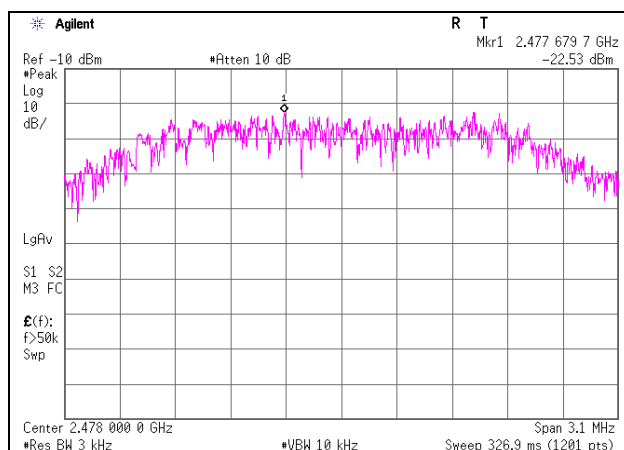
|                        |                                    |
|------------------------|------------------------------------|
| Report No.             | 13525956H                          |
| Test place             | Ise EMC Lab. No.6 Measurement Room |
| Date                   | October 12, 2020                   |
| Temperature / Humidity | 24 deg. C / 63 % RH                |
| Engineer               | Yuichiro Yamazaki                  |
| Mode                   | Tx SHIMANO ORIGINAL                |

| Freq. | Reading | Cable Loss | Atten. Loss | Result | Limit | Margin |
|-------|---------|------------|-------------|--------|-------|--------|
| [MHz] | [dBm]   | [dB]       | [dB]        | [dBm]  | [dBm] | [dB]   |
| 2478  | -22.53  | 1.65       | 10.03       | -10.85 | 8.00  | 18.85  |

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.



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## APPENDIX 2: Test instruments

### Test equipment

| Test Item | Local ID      | LIMS ID | Description                      | Manufacturer                       | Model                                      | Serial                        | Last Calibration Date | Cal Int |
|-----------|---------------|---------|----------------------------------|------------------------------------|--------------------------------------------|-------------------------------|-----------------------|---------|
| AT        | MOS-14        | 141561  | Thermo-Hygrometer                | CUSTOM. Inc                        | CTH-201                                    | 1401                          | 2020/01/07            | 12      |
| AT        | MMM-12        | 141547  | DIGITAL HiTESTER                 | Hioki                              | 3805                                       | 60500120                      | 2020/02/03            | 12      |
| AT        | MJM-24        | 142225  | Measure                          | ASKUL                              | -                                          | -                             | -                     | -       |
| AT        | MSA-04        | 141885  | Spectrum Analyzer                | Keysight Technologies Inc          | E4448A                                     | US44300523                    | 2019/11/21            | 12      |
| AT        | MPM-08        | 141805  | Power Meter                      | ANRITSU                            | ML2495A                                    | 6K00003338                    | 2020/10/15            | 12      |
| AT        | MPSE-11       | 141840  | Power sensor                     | ANRITSU                            | MA2411B                                    | 11737                         | 2020/10/15            | 12      |
| AT        | MAT-57        | 141333  | Attenuator(10dB)                 | Suhner                             | 6810.19.A                                  | -                             | 2019/12/09            | 12      |
| AT        | MAT-11        | 142292  | Attenuator(10dB)                 | Weinschel Corp                     | 2                                          | BK8909                        | -                     | -       |
| RE        | MAEC-02       | 142004  | AC2_Semi Anechoic Chamber(NSA)   | TDK                                | Semi Anechoic Chamber 3m                   | DA-06902                      | 2020/05/26            | 24      |
| RE        | MOS-41        | 192300  | Thermo-Hygrometer                | CUSTOM. Inc                        | CTH-201                                    | 0013                          | 2019/12/19            | 12      |
| RE        | MMM-01        | 141542  | Digital Tester                   | Fluke Corporation                  | FLUKE 26-3                                 | 78030611                      | 2020/08/18            | 12      |
| RE        | MJM-27        | 142228  | Measure                          | KOMELON                            | KMC-36                                     | -                             | -                     | -       |
| RE        | COTS-MEMI-02  | 178648  | EMI measurement program          | TSJ (Techno Science Japan)         | TEPTO-DV                                   | -                             | -                     | -       |
| RE        | MHA-06        | 141512  | Horn Antenna 1-18GHz             | Schwarzbeck Mess - Elektronik      | BBHA9120D                                  | 254                           | 2020/09/14            | 12      |
| RE        | MCC-217       | 141393  | Microwave Cable                  | Junkosha                           | MWX221                                     | 1604S254(1 m) / 1608S088(5 m) | 2020/08/03            | 12      |
| RE        | MPA-10        | 141579  | Pre Amplifier                    | Keysight Technologies Inc          | 8449B                                      | 3008A02142                    | 2020/01/07            | 12      |
| RE        | MHF-25        | 141232  | High Pass Filter 3.5-18.0GHz     | UL Japan                           | HPF SELECTOR                               | 001                           | 2020/09/23            | 12      |
| RE        | MSA-13        | 141900  | Spectrum Analyzer                | Keysight Technologies Inc          | E4440A                                     | MY46185823                    | 2020/09/24            | 12      |
| RE        | MHA-02        | 141503  | Horn Antenna 18-26.5GHz          | EMCO                               | 3160-09                                    | 1265                          | 2020/06/15            | 12      |
| RE        | MAEC-02-SVSWR | 142006  | AC2_Semi Anechoic Chamber(SVSWR) | TDK                                | Semi Anechoic Chamber 3m                   | DA-06902                      | 2019/04/01            | 24      |
| RE        | MAT-07        | 141203  | Attenuator(6dB)                  | Weinschel Corp                     | 2                                          | BK7970                        | 2019/11/07            | 12      |
| RE        | MBA-08        | 141427  | Biconical Antenna                | Schwarzbeck Mess - Elektronik      | VHA9103B+BBA9106                           | 8031                          | 2020/07/29            | 12      |
| RE        | MCC-12        | 141317  | Coaxial Cable                    | UL Japan Inc.                      | -                                          | -                             | 2020/09/25            | 12      |
| RE        | MLA-21        | 141265  | Logperiodic Antenna(200-1000MHz) | Schwarzbeck Mess - Elektronik      | VUSLP9111B                                 | 9111B-190                     | 2020/07/29            | 12      |
| RE        | MPA-09        | 141578  | Pre Amplifier                    | Keysight Technologies Inc          | 8447D                                      | 2944A10845                    | -                     | -       |
| RE        | MTR-03        | 141942  | Test Receiver                    | Rohde & Schwarz                    | ESCI                                       | 100300                        | 2020/08/18            | 12      |
| CE        | MAEC-02       | 142004  | AC2_Semi Anechoic Chamber(NSA)   | TDK                                | Semi Anechoic Chamber 3m                   | DA-06902                      | 2020/05/26            | 24      |
| CE        | MOS-41        | 192300  | Thermo-Hygrometer                | CUSTOM. Inc                        | CTH-201                                    | 0013                          | 2019/12/19            | 12      |
| CE        | MMM-01        | 141542  | Digital Tester                   | Fluke Corporation                  | FLUKE 26-3                                 | 78030611                      | 2020/08/18            | 12      |
| CE        | MJM-27        | 142228  | Measure                          | KOMELON                            | KMC-36                                     | -                             | -                     | -       |
| CE        | COTS-MEMI-02  | 178648  | EMI measurement program          | TSJ (Techno Science Japan)         | TEPTO-DV                                   | -                             | -                     | -       |
| CE        | MLS-23        | 141357  | LISN(AMN)                        | Schwarzbeck Mess - Elektronik      | NSLK8127                                   | 8127-729                      | 2020/07/22            | 12      |
| CE        | MCC-13        | 141222  | Coaxial Cable                    | Fujikura,HP,Mini-Circuits,Fujikura | 3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m) | -                             | 2020/02/25            | 12      |
| CE        | MAT-67        | 141248  | Attenuator                       | JFW Industries, Inc.               | 50FP-013H2 N                               | -                             | 2019/12/02            | 12      |
| CE        | MTR-09        | 141950  | EMI Test Receiver                | Rohde & Schwarz                    | ESU26                                      | 100412                        | 2020/06/03            | 12      |

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\*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:           CE: Conducted Emission test  
                      RE: Radiated Emission test  
                      AT: Antenna Terminal Conducted test