




# RADIO TEST REPORT

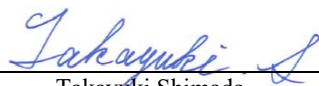
**Test Report No. : 12985473H-R2**

**Applicant** : Panasonic Corporation  
**Type of Equipment** : Magi'c Box  
**Model No.** : ZERS1901  
**FCC ID** : 2AM4XZERS01  
**Test regulation** : FCC Part 15 Subpart C: 2019  
**Test Result** : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
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7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12985473H-R.12985473H-R1 replaced with this report.

**Date of test:** September 29 and 30, 2019

**Representative test engineer:**   
 Akihiko Maeda  
 Engineer  
 Consumer Technology Division

**Approved by:**   
 Takayuki Shimada  
 Leader  
 Consumer Technology Division



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## REVISION HISTORY

Original Test Report No.: 12985473H

| Revision     | Test report No. | Date             | Page revised | Contents  |
|--------------|-----------------|------------------|--------------|---|
| - (Original) | 12985473H       | October 9, 2019  | -            | -   |
| 1            | 12985473H-R1    | October 21, 2019 | P 11         | Correction of explanatory note *1)                                |
| 1            | 12985473H-R1    | October 21, 2019 | P 15         | Deletion of explanatory note                                      |
| 1            | 12985473H-R1    | October 21, 2019 | P 18         | Correction of explanatory note for duty factor                    |
| 1            | 12985473H-R1    | October 21, 2019 | P 22         | Correction of test data   |
| 2            | 12985473H-R2    | October 23, 2019 | P22          | Correction of explanatory note *2)<br>Addition of reference chart |

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## 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                        |         |   |

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## **SECTION 1: Customer information**

Company Name : Panasonic Corporation  
Address : 1006 Kadoma, Kadoma City, Osaka, 571-8506 Japan  
Telephone Number : +81-50-3487-8129  
Contact Person : Masaaki Noda

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No., FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

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

## **SECTION 2: Equipment under test (E.U.T.)**

### **2.1 Identification of E.U.T.**

Type of Equipment : Magi'c Box  
Model No. : ZERS1901  
Serial No. : Refer to SECTION 4.2  
Rating : DC 3 V to DC 15 V  
Receipt Date of Sample : September 12, 2019  
(Information from test lab.)  
Country of Mass-production : Japan  
Condition of EUT : Engineering prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Modification of EUT : No Modification by the test lab.

### **2.2 Product Description**

Model: ZERS1901 (referred to as the EUT in this report) is a Magi'c Box.

### **Radio Specification**

Radio Type : Transceiver  
Frequency of Operation : 2478 MHz  
Modulation : 2-GFSK, 2Mbps  
Antenna type : Chip Antenna  
Antenna Gain : -6 dBi  
Clock frequency (Maximum) : RF: 24 MHz, MPU: 16 MHz

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

**3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

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

\* Also the EUT complies with FCC Part 15 Subpart B.

**3.2 Procedures and results**

| Item                                    | Test Procedure  | Specification   | Worst margin                               | Results             | Remarks   |
|---|---|---|--|---------------------|---|
| Conducted Emission                      | FCC: ANSI C63.10-2013<br>6. Standard test methods<br>ISED: RSS-Gen 8.8      | FCC: Section 15.207<br>-----<br>ISED: RSS-Gen 8.8                                   | N/A  | N/A                 | *1)   |
| 6dB Bandwidth                           | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: -            | FCC: Section<br>15.247(a)(2)<br>-----<br>ISED: RSS-247 5.2(a)                       | See data.                                  | Complied<br>a)      | Conducted   |
| Maximum Peak 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>-----<br>ISED: RSS-247 5.4(d)                       |  | Complied<br>b)      | Conducted   |
| Power Density                           | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02<br>ISED: -            | FCC: Section 15.247(e)<br>-----<br>ISED: RSS-247 5.2(b)                             |  | Complied<br>c)      | 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>-----<br>ISED: RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10 | 3.1 dB<br>14868.000 MHz, PK,<br>Horizontal | Complied#<br>d), e) | Conducted<br>(below 30 MHz)/<br>Radiated<br>(above 30 MHz)<br>*2) |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.  
\*1) The test was not performed on since the EUT does not have AC Power ports.  
\*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.  
a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)  
b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)  
c) Refer to APPENDIX 1 (data of Power Density)  
d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)  
e) Refer to APPENDIX 1 (data of Radiated Spurious Emission)  
Symbols:  
Complied The data of this test item has enough margin, more than the measurement uncertainty.  
Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

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

**FCC Part 15.31 (e)**

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  | 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 | 1.3 dB            |
| Carrier Frequency Separation                     | 0.42 %            |
| Dwell time / Burst rate                          | 0.10 %            |
| Conducted Spurious Emission                      | 2.7 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            |
|                      |  | 4.9 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal)<br>(Vertical) | 5.0 dB            |
|                      |  | 5.0 dB            |
| 3 m                  | 1 GHz to 6 GHz                                 | 5.0 dB            |
|                      | 6 GHz to 18 GHz                                | 5.3 dB            |
| 1 m                  | 10 GHz to 26.5 GHz                             | 5.8 dB            |
|                      | 26.5 GHz to 40 GHz                             | 5.8 dB            |
| 10 m                 | 1 GHz to 18 GHz                                | 5.2 dB            |

### 3.5 Test Location

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\*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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

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

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

Refer to APPENDIX.



## **SECTION 4: Operation of E.U.T. during testing**

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

| <b>Mode</b>   | <b>Remarks*</b> |
|---|-----------------|
| Transmitting (Tx)   | PN9             |
| *All tests except for Duty confirmation test was performed with transmitting duty was 100 %.  |                 |
| *Power of the EUT was set by the software as follows;<br>Power settings: 0x3f00<br>*This setting of software is the worst case.<br>Any conditions under the normal use do not exceed the condition of setting.<br>In addition, end users cannot change the settings of the output power of the product. |                 |

\*The details of Operating mode(s)

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

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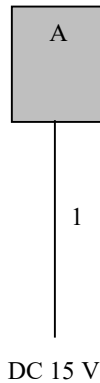
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#### 4.2 Configuration and peripherals



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

##### Description of EUT and Support equipment

| No. | Item       | Model number | Serial number  | Manufacturer          | Remarks |
|-----|------------|--------------|--|-----------------------|---------|
| A   | Magi'c Box | ZERS1901     | FFFF370F0001: for AT*<br>FFFF370F0002: for other tests | Panasonic Corporation | EUT     |

\*AT: Antenna Terminal conducted test

##### List of cables used

| No. | Name     | Length (m) | Shield     |            | Remarks |
|-----|----------|------------|------------|------------|---------|
|     |          |            | Cable      | Connector  |         |
| 1   | DC Cable | 3.0        | 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.

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.

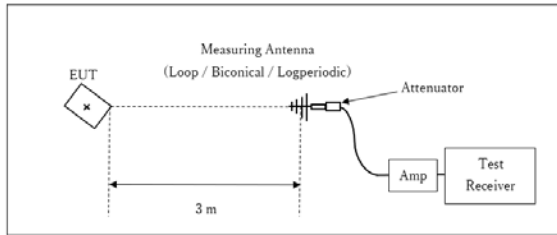
**20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).**

|                 |               |                          |                           |                              |
|-----------------|---------------|--------------------------|---------------------------|------------------------------|
| Frequency       | Below 1 GHz   | Above 1 GHz              |                           | 20 dBc                       |
| Instrument used | Test Receiver | Spectrum Analyzer        |                           | Spectrum Analyzer            |
| Detector        | QP            | PK                       | AV                        | PK                           |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz | Peak with Duty Factor *1) | RBW: 100 kHz<br>VBW: 300 kHz |

\*1) For Pulse emission: The Average value was calculated by reducing Duty factor from PK (PK value – Duty factor).  
For Duty factor, please refer to Page 22.

**Figure 2: Test Setup**

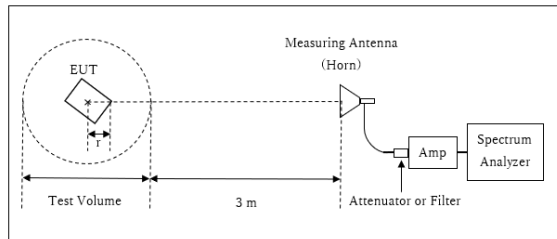
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



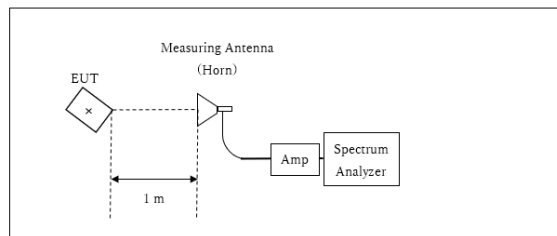
r : Radius of an outer periphery of EUT  
 × : Center of turn table

Distance Factor:  $20 \times \log(3.75 \text{ m} / 3.0 \text{ m}) = 1.94 \text{ dB}$   
 \* Test Distance:  $(3 + \text{Test Volume} / 2) - r = 3.75 \text{ m}$

Test Volume : 1.5 m  
 (Test Volume has been calibrated based on CISPR 16-1-4.)  
 r = 0.0 m

\*The test was performed with r = 0.0 m since test was performed severer condition.

10 GHz - 26.5 GHz



× : 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 - 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  | 5 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 (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)  | 9kHz to 150kHz                          | 200 Hz          | 620 Hz             | Auto       | Peak                 | Max Hold | Spectrum Analyzer               |
|  | 150kHz to 30MHz                         | 9.1 kHz         | 27 kHz             |            |                      |          |                                 |
| *1) Peak hold was applied as Worst-case measurement.<br>*2) Reference data<br>*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".<br>*4) 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.<br>(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz) |   |                 |                    |            |                      |          |                                 |

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

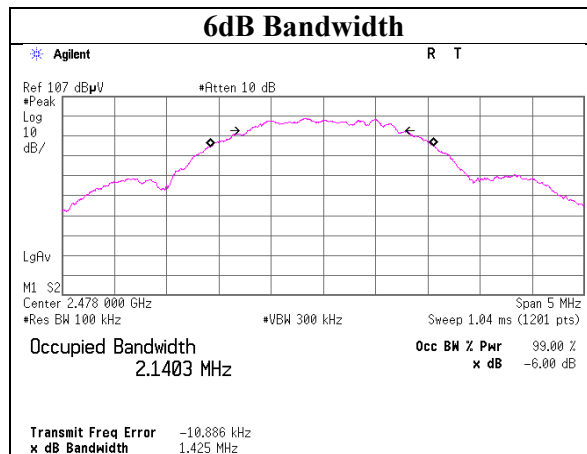
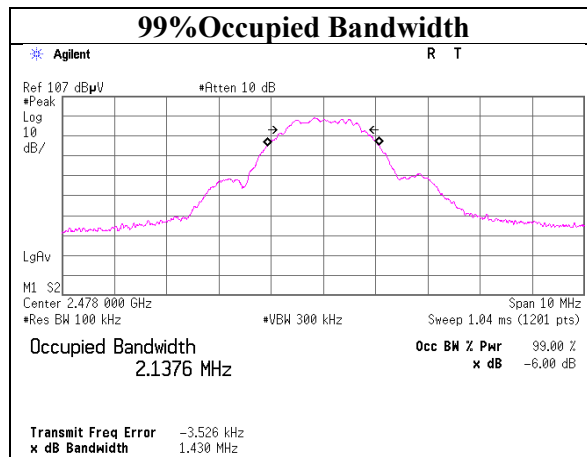
**Test data** : APPENDIX  
**Test result** : Pass

**APPENDIX 1: Test data**

**6 dB Bandwidth and 99 % Occupied Bandwidth**

Report No. 12985473H  
 Test place Ise EMC Lab. No.4 Measurement Room  
 Date September 30, 2019  
 Temperature / Humidity 24 deg. C / 56 % RH  
 Engineer Akihiko Maeda  
 Mode Tx

| Frequency<br>[MHz] | 99% Occupied<br>Bandwidth<br>[kHz] | 6dB Bandwidth<br>[MHz] | Limit for<br>6dB Bandwidth<br>[MHz] |
|--------------------|------------------------------------|------------------------|-------------------------------------|
| 2478               | 2137.6                             | 1.425                  | > 0.5000                            |



### Maximum Peak Output Power

Report No. 12985473H  
 Test place Ise EMC Lab. No.4 Measurement Room  
 Date September 30, 2019  
 Temperature / Humidity 24 deg. C / 56 % RH  
 Engineer Akihiko Maeda  
 Mode Tx

| 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]   | [dBi] | [dBm] | [mW] |        |
| 2478  | -8.55   | 1.00       | 10.10       | 2.55            | 1.80 | 30.00 | 1000 | 27.45  | -6                   | -3.45  | 0.45  | 36.02 | 4000 | 39.47  |

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)**

Report No. 12985473H  
Test place Ise EMC Lab. No.4 Measurement Room  
Date September 30, 2019  
Temperature / Humidity 24 deg. C / 56 % RH  
Engineer Akihiko Maeda  
Mode Tx

| 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           | -8.83            | 1.00                  | 10.10                  | 2.27                     | 1.69 | 0.00                   | 2.27                            | 1.69 |

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.



### Radiated Spurious Emission

|                        |                                |                                |
|------------------------|--------------------------------|--------------------------------|
| Report No.             | 12985473H                      |                                |
| Test place             | Ise EMC Lab.                   |                                |
| Semi Anechoic Chamber  | No.2                           | No.4                           |
| Date                   | September 29, 2019             | September 29, 2019             |
| Temperature / Humidity | 26 deg. C / 54 % RH            | 23 deg. C / 67 % RH            |
| Engineer               | Akihiko Maeda<br>(Above 1 GHz) | Akihiko Maeda<br>(Below 1 GHz) |
| Mode                   | Tx 2478 MHz                    |                                |

| 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.    | 63.749          | QP       | 21.7           | 7.0             | 8.0       | 32.2      | -                | 4.5             | 40.0           | 35.5        |        |
| Hori.    | 71.130          | QP       | 21.5           | 6.3             | 8.1       | 32.1      | -                | 3.7             | 40.0           | 36.3        |        |
| Hori.    | 75.462          | QP       | 21.7           | 6.5             | 8.1       | 32.1      | -                | 4.2             | 40.0           | 35.8        |        |
| Hori.    | 79.075          | QP       | 21.6           | 6.7             | 8.2       | 32.1      | -                | 4.4             | 40.0           | 35.6        |        |
| Hori.    | 82.875          | QP       | 21.6           | 7.3             | 8.2       | 32.1      | -                | 5.0             | 40.0           | 35.0        |        |
| Hori.    | 96.015          | QP       | 21.9           | 9.6             | 8.4       | 32.1      | -                | 7.7             | 43.5           | 35.8        |        |
| Hori.    | 2390.000        | PK       | 43.2           | 27.3            | 5.3       | 34.3      | -                | 41.5            | 73.9           | 32.4        |        |
| Hori.    | 2483.500        | PK       | 44.3           | 28.1            | 5.4       | 34.2      | -                | 43.6            | 73.9           | 30.3        |        |
| Hori.    | 4956.000        | PK       | 51.4           | 31.9            | 7.6       | 33.5      | -                | 57.4            | 73.9           | 16.5        |        |
| Hori.    | 7434.000        | PK       | 50.1           | 36.3            | 8.9       | 33.5      | -                | 61.8            | 73.9           | 12.1        |        |
| Hori.    | 9912.000        | PK       | 51.4           | 38.8            | 9.8       | 33.8      | -                | 66.1            | 73.9           | 7.8         |        |
| Hori.    | 12390.000       | PK       | 55.2           | 38.6            | -0.8      | 32.8      | -                | 60.2            | 73.9           | 13.7        |        |
| Hori.    | 14868.000       | PK       | 62.2           | 40.7            | 0.2       | 32.3      | -                | 70.8            | 73.9           | 3.1         |        |
| Hori.    | 17346.000       | PK       | 56.9           | 41.1            | 1.3       | 32.1      | -                | 67.1            | 73.9           | 6.8         |        |
| Hori.    | 19824.000       | PK       | 51.6           | 40.3            | -1.3      | 32.3      | -                | 58.4            | 73.9           | 15.5        |        |
| Hori.    | 24780.000       | PK       | 52.6           | 40.5            | 0.0       | 32.2      | -                | 60.9            | 73.9           | 13.0        |        |
| Vert.    | 63.749          | QP       | 22.7           | 7.0             | 8.0       | 32.2      | -                | 5.5             | 40.0           | 34.5        |        |
| Vert.    | 71.130          | QP       | 25.1           | 6.3             | 8.1       | 32.1      | -                | 7.3             | 40.0           | 32.7        |        |
| Vert.    | 75.462          | QP       | 27.5           | 6.5             | 8.1       | 32.1      | -                | 10.0            | 40.0           | 30.0        |        |
| Vert.    | 79.075          | QP       | 29.1           | 6.7             | 8.2       | 32.1      | -                | 11.9            | 40.0           | 28.1        |        |
| Vert.    | 82.875          | QP       | 26.1           | 7.3             | 8.2       | 32.1      | -                | 9.5             | 40.0           | 30.5        |        |
| Vert.    | 96.015          | QP       | 27.4           | 9.6             | 8.4       | 32.1      | -                | 13.2            | 43.5           | 30.3        |        |
| Vert.    | 2390.000        | PK       | 43.6           | 27.3            | 5.3       | 34.3      | -                | 41.9            | 73.9           | 32.0        |        |
| Vert.    | 2483.500        | PK       | 43.9           | 28.1            | 5.4       | 34.2      | -                | 43.2            | 73.9           | 30.7        |        |
| Vert.    | 4956.000        | PK       | 52.6           | 31.9            | 7.6       | 33.5      | -                | 58.6            | 73.9           | 15.3        |        |
| Vert.    | 7434.000        | PK       | 48.8           | 36.3            | 8.9       | 33.5      | -                | 60.5            | 73.9           | 13.4        |        |
| Vert.    | 9912.000        | PK       | 52.0           | 38.8            | 9.8       | 33.8      | -                | 66.7            | 73.9           | 7.2         |        |
| Vert.    | 12390.000       | PK       | 56.7           | 38.6            | -0.8      | 32.8      | -                | 61.7            | 73.9           | 12.2        |        |
| Vert.    | 14868.000       | PK       | 60.3           | 40.7            | 0.2       | 32.3      | -                | 68.9            | 73.9           | 5.0         |        |
| Vert.    | 17346.000       | PK       | 59.5           | 41.1            | 1.3       | 32.1      | -                | 69.7            | 73.9           | 4.2         |        |
| Vert.    | 19824.000       | PK       | 52.7           | 40.3            | -1.3      | 32.3      | -                | 59.5            | 73.9           | 14.4        |        |
| Vert.    | 24780.000       | PK       | 55.1           | 40.5            | 0.0       | 32.2      | -                | 63.4            | 73.9           | 10.5        |        |

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 (3.75 m / 3.0 m) = 1.94 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       | 81.4           | 28.0              | 5.4       | 34.2      | 80.6            | -              | -           | Carrier |
| Hori.    | 2400.000        | PK       | 35.2           | 27.0              | 5.3       | 34.3      | 33.3            | 60.6           | 27.3        |         |
| Vert.    | 2478.000        | PK       | 81.6           | 28.0              | 5.4       | 34.2      | 80.8            | -              | -           | Carrier |
| Vert.    | 2400.000        | PK       | 34.5           | 27.0              | 5.3       | 34.3      | 32.6            | 60.8           | 28.2        |         |

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5dB

**PK with Duty factor**

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|--------|
| Hori.    | 2390.000           | PK       | 43.2              | 27.3                    | 5.3          | 34.3         | -20.5                  | 21.0               | 53.9              | 32.9           | *      |
| Hori.    | 2483.500           | PK       | 44.3              | 28.1                    | 5.4          | 34.2         | -20.5                  | 23.1               | 53.9              | 30.8           | *      |
| Hori.    | 4956.000           | PK       | 51.4              | 31.9                    | 7.6          | 33.5         | -20.5                  | 36.9               | 53.9              | 17.0           | *      |
| Hori.    | 7434.000           | PK       | 50.1              | 36.3                    | 8.9          | 33.5         | -20.5                  | 41.3               | 53.9              | 12.6           | *      |
| Hori.    | 9912.000           | PK       | 51.4              | 38.8                    | 9.8          | 33.8         | -20.5                  | 45.6               | 53.9              | 8.3            | *      |
| Hori.    | 12390.000          | PK       | 55.2              | 38.6                    | -0.8         | 32.8         | -20.5                  | 39.7               | 53.9              | 14.2           | *      |
| Hori.    | 14868.000          | PK       | 62.2              | 40.7                    | 0.2          | 32.3         | -20.5                  | 50.3               | 53.9              | 3.6            | *      |
| Hori.    | 17346.000          | PK       | 56.9              | 41.1                    | 1.3          | 32.1         | -20.5                  | 46.6               | 53.9              | 7.3            | *      |
| Hori.    | 19824.000          | PK       | 51.6              | 40.3                    | -1.3         | 32.3         | -20.5                  | 37.9               | 53.9              | 16.0           | *      |
| Hori.    | 24780.000          | PK       | 52.6              | 40.5                    | 0.0          | 32.2         | -20.5                  | 40.4               | 53.9              | 13.5           | *      |
| Vert.    | 2390.000           | PK       | 43.6              | 27.3                    | 5.3          | 34.3         | -20.5                  | 21.4               | 53.9              | 32.5           | *      |
| Vert.    | 2483.500           | PK       | 43.9              | 28.1                    | 5.4          | 34.2         | -20.5                  | 22.7               | 53.9              | 31.2           | *      |
| Vert.    | 4956.000           | PK       | 52.6              | 31.9                    | 7.6          | 33.5         | -20.5                  | 38.1               | 53.9              | 15.8           | *      |
| Vert.    | 7434.000           | PK       | 48.8              | 36.3                    | 8.9          | 33.5         | -20.5                  | 40.0               | 53.9              | 13.9           | *      |
| Vert.    | 9912.000           | PK       | 52.0              | 38.8                    | 9.8          | 33.8         | -20.5                  | 46.2               | 53.9              | 7.7            | *      |
| Vert.    | 12390.000          | PK       | 56.7              | 38.6                    | -0.8         | 32.8         | -20.5                  | 41.2               | 53.9              | 12.7           | *      |
| Vert.    | 14868.000          | PK       | 60.3              | 40.7                    | 0.2          | 32.3         | -20.5                  | 48.4               | 53.9              | 5.5            | *      |
| Vert.    | 17346.000          | PK       | 59.5              | 41.1                    | 1.3          | 32.1         | -20.5                  | 49.2               | 53.9              | 4.7            | *      |
| Vert.    | 19824.000          | PK       | 52.7              | 40.3                    | -1.3         | 32.3         | -20.5                  | 39.0               | 53.9              | 14.9           | *      |
| Vert.    | 24780.000          | PK       | 55.1              | 40.5                    | 0.0          | 32.2         | -20.5                  | 42.9               | 53.9              | 11.0           | *      |

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

- Gain(Amplifier) + Duty factor (Refer to Duty confirmation data sheet)

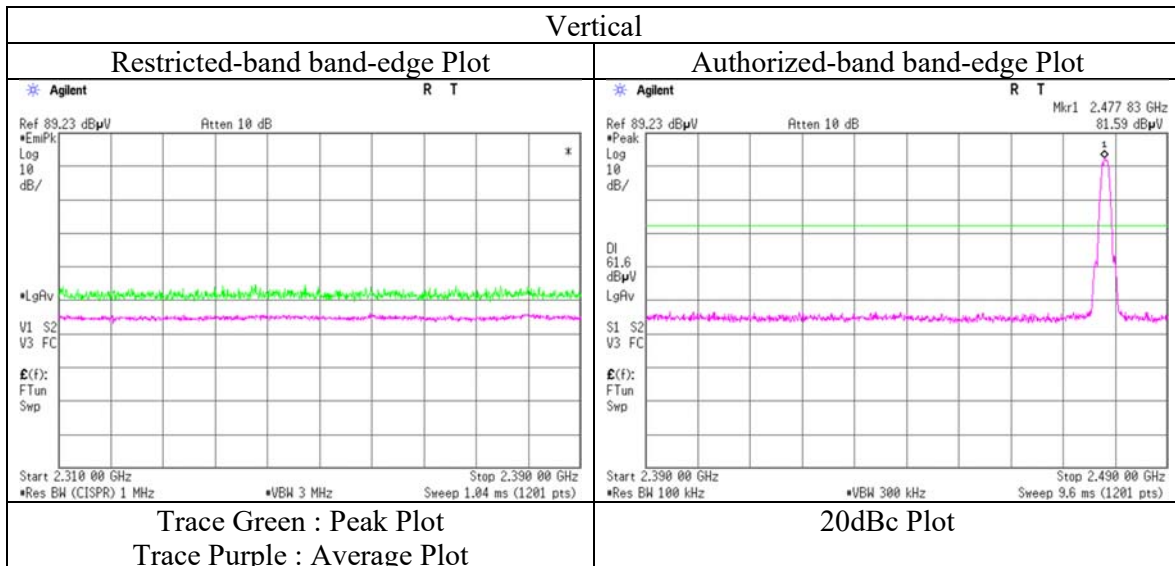
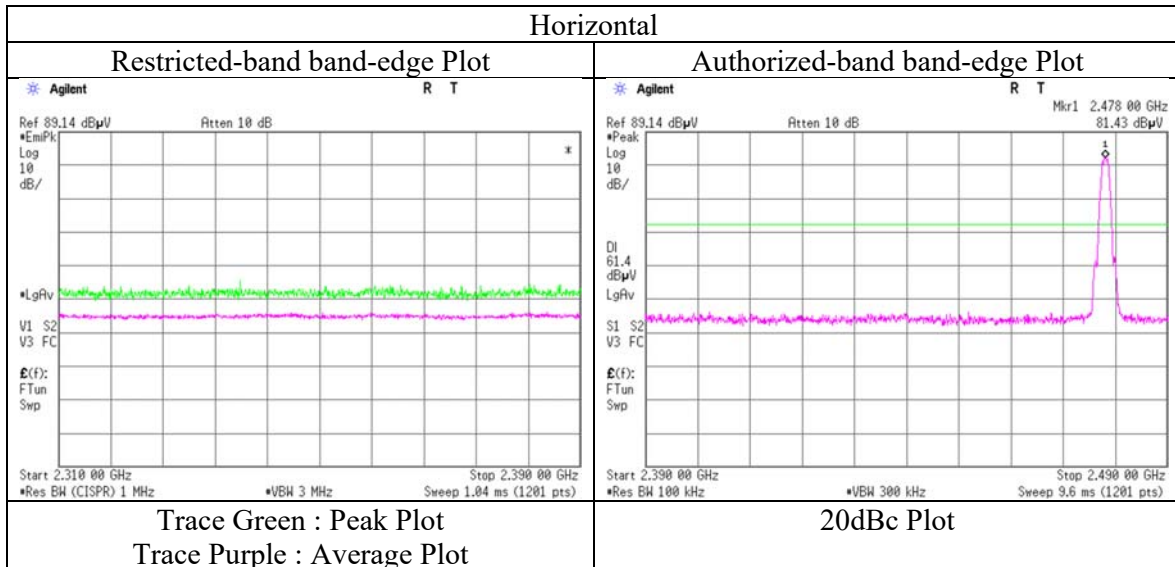
\*Above noise was synchronized with carrier frequency.

Distance factor: 1 GHz - 10 GHz  $20\log(3.75\text{ m} / 3.0\text{ m}) = 1.94\text{ dB}$   
 10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

\* Duty Factor was calculated with the 1 Data transmission period.

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

Report No. 12985473H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date September 29, 2019  
Temperature / Humidity 26 deg. C / 54 % RH  
Engineer Akihiko Maeda  
(Above 1 GHz)  
Mode Tx 2478 MHz

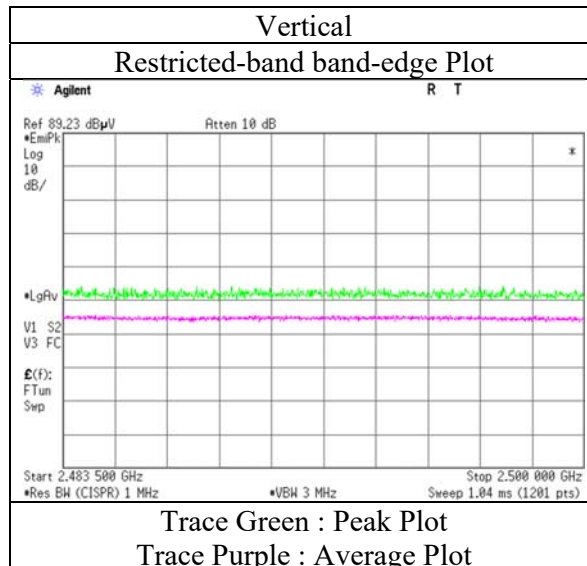
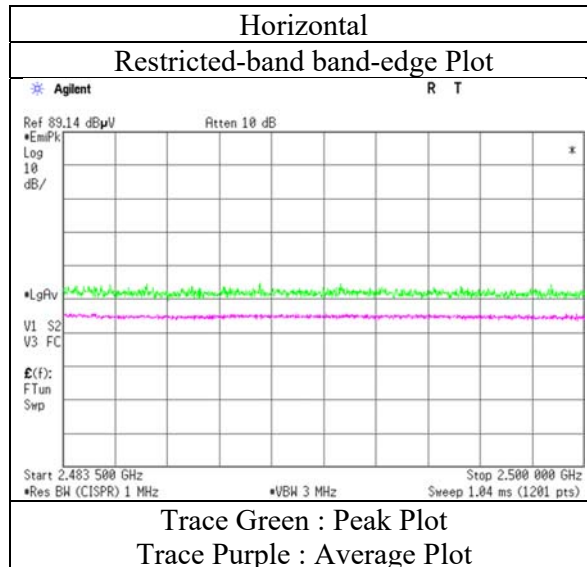


\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

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

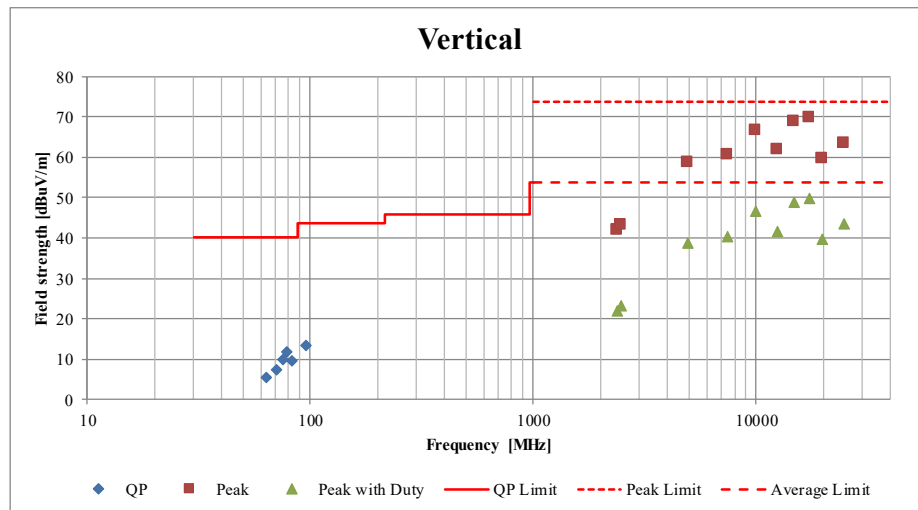
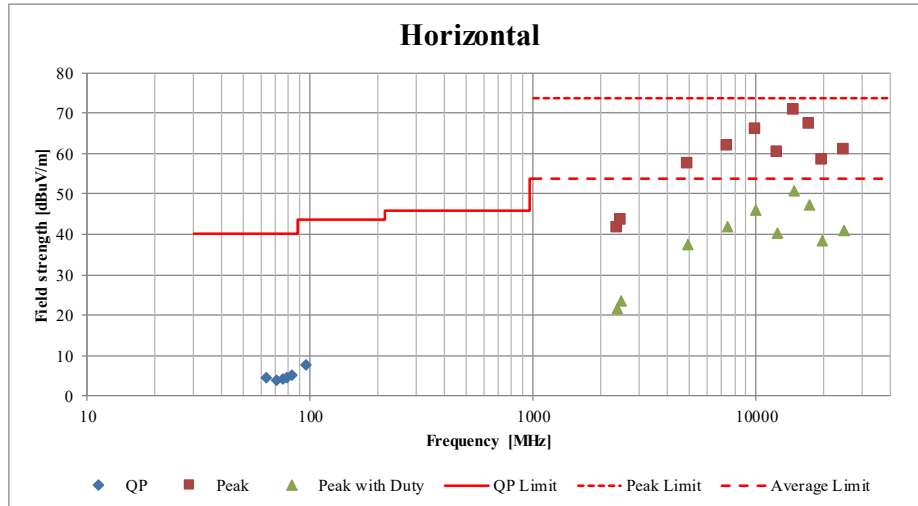
|                        |                                |
|------------------------|--------------------------------|
| Report No.             | 12985473H                      |
| Test place             | Ise EMC Lab.                   |
| Semi Anechoic Chamber  | No.2                           |
| Date                   | September 29, 2019             |
| Temperature / Humidity | 26 deg. C / 54 % RH            |
| Engineer               | Akihiko Maeda<br>(Above 1 GHz) |
| Mode                   | Tx 2478 MHz                    |



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

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

|                        |                                |                                |
|------------------------|--------------------------------|--------------------------------|
| Report No.             | 12985473H                      |                                |
| Test place             | Ise EMC Lab.                   |                                |
| Semi Anechoic Chamber  | No.2                           | No.4                           |
| Date                   | September 29, 2019             | September 29, 2019             |
| Temperature / Humidity | 26 deg. C / 54 % RH            | 23 deg. C / 67 % RH            |
| Engineer               | Akihiko Maeda<br>(Above 1 GHz) | Akihiko Maeda<br>(Below 1 GHz) |
| Mode                   | Tx 2478 MHz                    |                                |



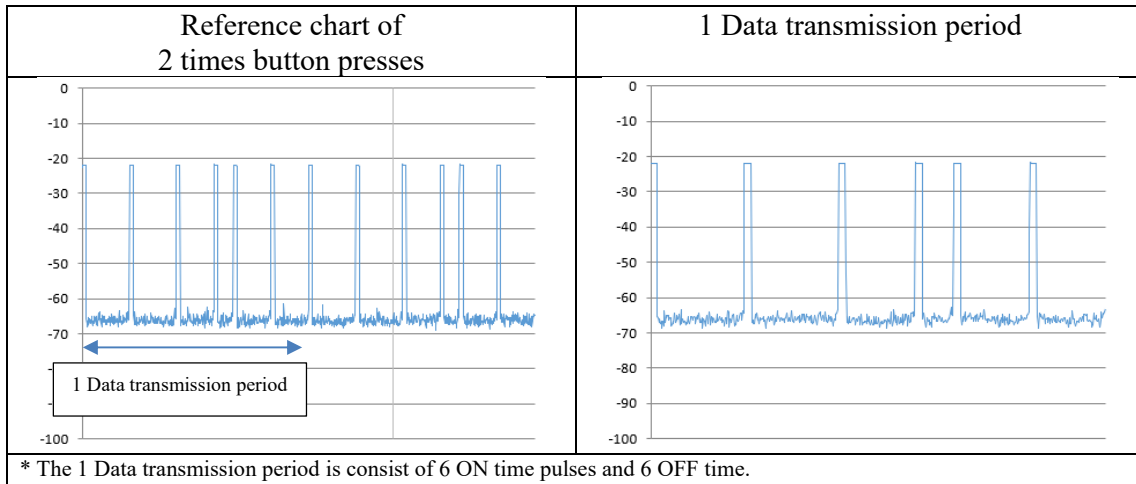
\*These plots data contains sufficient number to show the trend of characteristic features for EUT.

### Duty confirmation

|                        |                                    |
|------------------------|------------------------------------|
| Report No.             | 12985473H                          |
| Test place             | Ise EMC Lab. No.4 Measurement Room |
| Date                   | September 30, 2019                 |
| Temperature / Humidity | 24 deg. C / 56 % RH                |
| Engineer               | Akihiko Maeda                      |
| Mode                   | Tx                                 |

| Measured ON time *1)<br>[ms] | 1 Data Transmission<br>period *2)<br>[ms] | Duty cycle *3) | Duty factor *4)<br>[dB] |
|------------------------------|---|----------------|-------------------------|
| 0.69                         | 7.27                                      | 0.095          | -20.5                   |

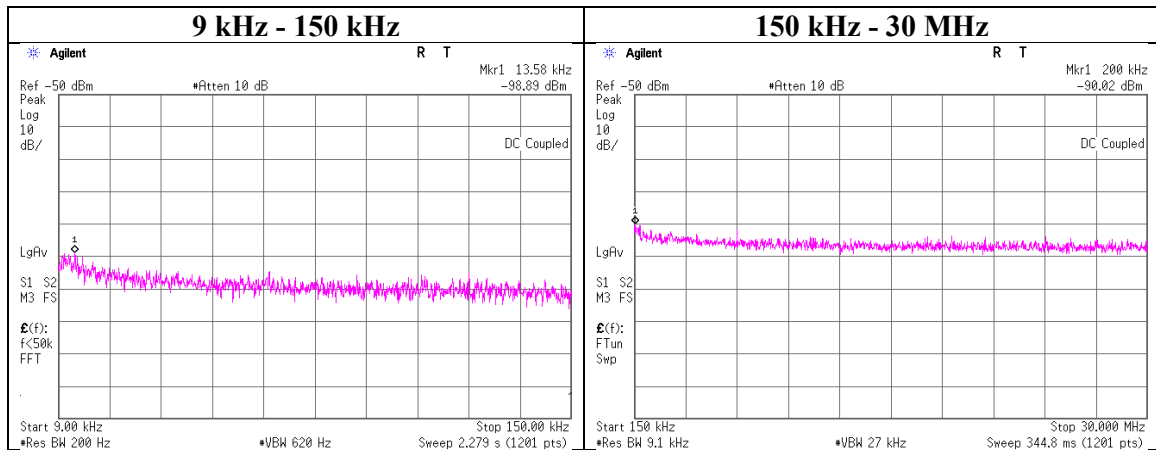
\*1) Measured ON Time = (Number of analyzer bins showing transmission) \* (dwell time per bin)  
 \*2) 1 Data Transmission period = (Number of analyzer bins showing ON and OFF time at the worst case) \* (dwell time per bin)  
 \*3) Duty cycle = Measured ON time / 1 Data transmission period  
 \*4) Duty factor =  $20\log_{10}(\text{Duty Cycle})$



\* The signal monitoring equipment consists of a spectrum analyzer with the capacity to display 8001 bins on the horizontal axis.  
 \* A time-domain resolution of 0.00125 msec/bin is achievable with a 10 msec sweep time  
 \* Measured ON time is calculated by multiplying the number of bins during an observation period by the dwell time per bin, with the analyzer set to peak detection.

### Conducted Spurious Emission

|                        |                                    |
|------------------------|------------------------------------|
| Report No.             | 12985473H                          |
| Test place             | Ise EMC Lab. No.4 Measurement Room |
| Date                   | September 30, 2019                 |
| Temperature / Humidity | 24 deg. C / 56 % RH                |
| Engineer               | Akihiko Maeda                      |
| Mode                   | Tx 2478 MHz                        |



| 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 |
|--------------------|------------------|-----------------------|----------------------------|---------------------------|----------------------------|---------------|-----------------|--------------------------|-----------------------------------|-------------------|----------------|--------|
| 13.58              | -98.9            | 1.00                  | 9.8                        | 2.0                       | 1                          | -86.1         | 300             | 6.0                      | -24.8                             | 44.9              | 69.7           |        |
| 200.00             | -90.0            | 1.00                  | 9.8                        | 2.0                       | 1                          | -77.2         | 300             | 6.0                      | -16.0                             | 21.5              | 37.5           |        |

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

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

N: Number of output

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

### Power Density

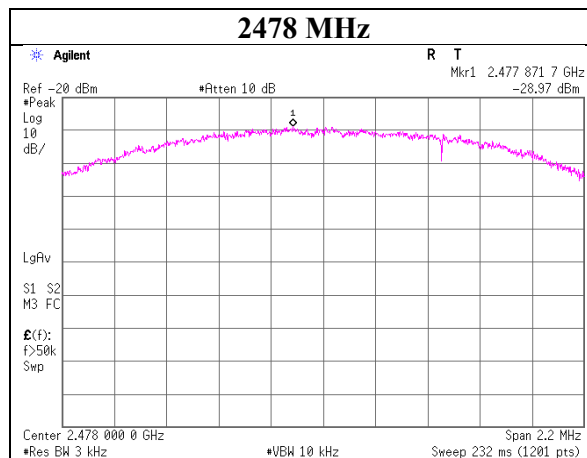
Report No. 12985473H  
 Test place Ise EMC Lab. No.4 Measurement Room  
 Date September 30, 2019  
 Temperature / Humidity 24 deg. C / 56 % RH  
 Engineer Akihiko Maeda  
 Mode Tx

| Freq. | Reading | Cable Loss | Atten. Loss | Result | Limit | Margin |
|-------|---------|------------|-------------|--------|-------|--------|
| [MHz] | [dBm]   | [dB]       | [dB]        | [dBm]  | [dBm] | [dB]   |
| 2478  | -28.97  | 1.00       | 10.10       | -17.87 | 8.00  | 25.87  |

Sample Calculation:

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

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





**APPENDIX 2: Test instruments**

**Test Instruments**

| Test Item | LIMS ID | Description                       | Manufacturer      | Model                    | Serial                        | Last Calibration Date | Calibration Due Date | Cal Int |
|-----------|---------|-----------------------------------|-------------------|--------------------------|-------------------------------|-----------------------|----------------------|---------|
| RE        | 142006  | AC2_Semi Anechoic Chamber(SVSWR)  | TDK               | Semi Anechoic Chamber 3m | DA-06902                      | 04/01/2019            | 04/30/2021           | 24      |
| RE        | 178648  | EMI measurement program           | TSJ               | TEPTO-DV                 | -                             | -                     | -                    | -       |
| RE        | 141542  | Digital Tester                    | Fluke Corporation | FLUKE 26-3               | 78030611                      | 08/20/2019            | 08/31/2020           | 12      |
| RE        | 142226  | Measure                           | KOMELON           | KMC-36                   | -                             | -                     | -                    | -       |
| RE/AT     | 141900  | Spectrum Analyzer                 | AGILENT           | E4440A                   | MY46185823                    | 11/15/2018            | 11/30/2019           | 12      |
| RE        | 141950  | EMI Test Receiver                 | Rohde & Schwarz   | ESU26                    | 100412                        | 06/27/2019            | 06/30/2020           | 12      |
| RE        | 141512  | Horn Antenna 1-18GHz              | Schwarzbeck       | BBHA9120D                | 254                           | 05/09/2019            | 05/31/2020           | 12      |
| RE        | 141392  | Microwave Cable                   | Junkosha          | MWX221                   | 1604S253(1 m) / 1608S087(5 m) | 08/06/2019            | 08/31/2020           | 12      |
| RE        | 141579  | Pre Amplifier                     | AGILENT           | 8449B                    | 3008A02142                    | 01/21/2019            | 01/31/2020           | 12      |
| RE        | 141296  | High Pass Filter 3.5-18.0GHz      | UL Japan          | HPF SELECTOR             | 002                           | 09/11/2019            | 09/30/2020           | 12      |
| RE        | 141503  | Horn Antenna 18-26.5GHz           | EMCO              | 3160-09                  | 1265                          | 04/12/2019            | 04/30/2020           | 12      |
| RE        | 142011  | AC4_Semi Anechoic Chamber(NSA)    | TDK               | Semi Anechoic Chamber 3m | DA-10005                      | 06/28/2018            | 06/30/2020           | 24      |
| RE        | 141562  | Thermo-Hygrometer                 | CUSTOM            | CTH-201                  | 0010                          | 01/11/2019            | 01/31/2020           | 12      |
| RE        | 141547  | DIGITAL HiTESTER                  | HIOKI             | 3805                     | 60500120                      | 02/25/2019            | 02/29/2020           | 12      |
| RE        | 142227  | Measure                           | KOMELON           | KMC-36                   | -                             | -                     | -                    | -       |
| RE        | 141899  | Spectrum Analyzer                 | AGILENT           | E4448A                   | MY46180655                    | 08/07/2019            | 08/31/2020           | 12      |
| RE        | 141425  | Biconical Antenna                 | Schwarzbeck       | VHA9103+BBA9106          | 1302                          | 08/24/2019            | 08/31/2020           | 12      |
| RE        | 141267  | Logperiodic Antenna (200-1000MHz) | Schwarzbeck       | VUSLP9111B               | 9111B-192                     | 08/24/2019            | 08/31/2020           | 12      |
| RE        | 141331  | Attenuator(6dB)                   | TME               | UFA-01                   | -                             | 02/05/2019            | 02/29/2020           | 12      |
| RE        | 141397  | Coaxial Cable                     | UL Japan          | -                        | -                             | 06/18/2019            | 06/30/2020           | 12      |
| RE        | 141583  | Pre Amplifier                     | SONOMA INSTRUMENT | 310                      | 260833                        | 02/08/2019            | 02/29/2020           | 12      |
| RE        | 141556  | Thermo-Hygrometer                 | CUSTOM            | CTH-201                  | 0003                          | 12/05/2018            | 12/31/2019           | 12      |
| AT        | 141810  | Power Meter                       | ANRITSU           | ML2495A                  | 824014                        | 10/09/2018            | 10/31/2019           | 12      |
| AT        | 141832  | Power sensor                      | ANRITSU           | MA2411B                  | 738174                        | 10/09/2018            | 10/31/2019           | 12      |
| AT        | 141532  | DIGITAL HiTESTER                  | HIOKI             | 3805                     | 51201197                      | 01/29/2019            | 01/31/2020           | 12      |
| AT        | 141568  | Thermo-Hygrometer                 | CUSTOM            | CTH-201                  | 2901                          | 01/11/2019            | 01/31/2020           | 12      |
| AT        | 141361  | Attenuator(10dB) 1-18GHz          | Orient Microwave  | BX10-0476-00             | -                             | 03/04/2019            | 03/31/2020           | 12      |
| AT        | 141156  | Attenuator(10dB)                  | Weinschel Corp    | 2                        | BL1173                        | 11/02/2018            | 11/30/2019           | 12      |

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

The expiration date of the calibration is the end of the expired month.

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

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

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

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