

# TEST REPORT

For

## RFID Module

In conformity with

### FCC CFR 47 Part15 Subpart C / RSS-210 Issue 9

**Model** : T-2212C  
**FCC ID** : WSLT-2212  
**IC ID** : 8213A-T2212  
**Report No.** : ERY1709Z13R1  
**Issue Date** : September 13, 2017

**Prepared for**

YUYAMA Mfg. Co., Ltd  
1-2-12, Koudushima, Toyonaka City, Osaka-fu, 561-0843 Japan

**Prepared by**

SGS RF Technologies Inc.  
3-5-23, Kitayamata, Tsuzuki-ku Yokohama-city, 224-0021 Japan  
Telephone: +81+(0)45-550-3520  
FAX: +81+(0)45-592-7506

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SGS RF Technologies Inc. is managed to ISO17025 and has the necessary knowledge and test facilities for testing according to the referenced standards. The test results in this report apply only to the sample tested.

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## History

| Report No.   | Date               | Revisions   | Issued By |
|--------------|--------------------|---|-----------|
| ERY1706Z05R1 | June 5, 2017       | Initial Issue   | K. Onishi |
| ERY1709Z07R1 | September 7, 2017  | Correct error (page 8)<br>Retest the fundamental emission (page 11) | K. Onishi |
| ERY1709Z13R1 | September 13, 2017 | Added test data of RF module (clause 2.2, 2.3)                      | K. Onishi |
|              |                    |   |           |

## 1 General information


### 1.1 Product description

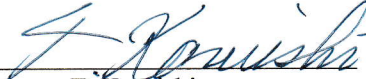
|                               |  |
|-------------------------------|--|
| Test item                     | : RFID Module  |
| Manufacturer                  | : TSUKASA ELECTRIC CO., LTD                                    |
| Address                       | : 87-2, yoshio-cho, Miyakonojo-city, Miyazaki, 885-0006, Japan |
| Model                         | : T-2212C  |
| FCC ID                        | : WSLT-2212  |
| IC ID                         | : 8213A-T2212  |
| Serial numbers                | : 170519-1, 170519-2   |
| Transmitting Frequency        | : 13.56 MHz  |
| Type of Modulation            | : ASK  |
| Operating temperature range   | : -20 to +50 degree C  |
| Receipt date of EUT           | : May 10, 2017   |
| Nominal power source voltages | : DC 3.3V  |

### 1.2 Test(s) performed/ Summary of test result

|                        |   |
|------------------------|---|
| Test specification(s)  | : FCC CFR 47. Part 15 Subpart C (October 1, 2016)<br>RSS-210 Issue 9, RSS-Gen Issue 4 |
| Test method(s)         | : ANSI C63.10: 2013   |
| Test(s) started        | : May 9, 2017   |
| Test(s) completed      | : September 13, 2017  |
| Purpose of test(s)     | : Certification for FCC / ISED  |
| Summary of test result | : Complied  |

Note: The above judgment is only based on the measurement data and it does not include the measurement uncertainty. Accordingly, the statement below is applied to the test result.  
 The EUT complies with the limit required in the standard in case that the margin is not less than the measurement uncertainty in the Laboratory.  
 Compliance of the EUT is more probable than non-compliance is case that the margin is less than the measurement uncertainty in the Laboratory.

Test engineer :   
 K. Onishi  
 EMC testing Department

Reviewer :   
 T. Karuishi  
 Manager  
 EMC testing Department

### 1.3 Test facility

#### [Yokohama Laboratory]

Address: 472, Nippa-cho, Kohoku-ku, Yokohama, 223-0057, Japan  
TEL: +81-45-534-0645  
FAX: +81-45-534-0646

Accredited by National Voluntary Laboratory Accreditation Program (NVLAP) for the emission tests stated in the scope of the certificate under Certificate Number 200780-0

Registered by Industry Canada (IC): The registered facility number is as follows;  
Test site (Semi-Anechoic chamber 3m): 6974A-1

Registered by Voluntary Control Council for Interference by Information Technology Equipment (VCCI)  
Each registered facility number is as follows;  
Test site A-0045

#### [Kitayamata laboratory]

Address: 3-5-23, Kitayamata, Tsuzuki-ku, Yokohama, 224-0021, Japan  
TEL: +81-45-550-3520  
FAX: +81-45-592-7506

Accredited by National Voluntary Laboratory Accreditation Program (NVLAP) for the emission tests stated in the scope of the certificate under Certificate Number 200780-0

Registered by Industry Canada (IC): The registered facility number is as follows;  
Test site (Semi-Anechoic chamber 3m): 21105-1

Registered by Voluntary Control Council for Interference by Information Technology Equipment (VCCI)  
Each registered facility number is as follows;  
Test site A-0212

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.



## 1.4 Measurement uncertainty

The treatment of uncertainty is based on the general matters on the definition of uncertainty in “Guide to the expression of uncertainty in measurement (GUM)” published by ISO. The Lab’s uncertainty is determined by referring ETSI TR 100 028-1 V1.4.1 (2001-12).

The uncertainty of the measurement result in the level of confidence of approximately 95% (k=2) is as follows;

|  |          |
|--|----------|
| Conducted emission (150 kHz - 30 MHz): | ± 3.4 dB |
| Radiated emission (9 kHz - 30 MHz):    | ± 3.3 dB |
| Radiated emission (30 MHz - 1000 MHz): | ± 6.1 dB |

## 1.5 Summary of test results

| Requirements                               | Section in FCC   | Section in RSS | Section in this report | Results  |
|--|------------------|----------------|------------------------|----------|
| Occupied bandwidth                         | 15.215 (c)       | RSS-Gen 6.6    | 2.1                    | -        |
| Radiated Emissions between 9 kHz to 30 MHz | 15.225 (a) - (d) | RSS-210 B6     | 2.2                    | Complied |
| Radiated Emissions between 30 to 1000 MHz  | 15.209           | RSS-Gen 8.9    | 2.3                    | Complied |
| Carrier Frequency Stability                | 15.225 (e)       | RSS-210 B6     | 2.4                    | Complied |
| AC Power Line Conducted Emissions          | 15.207           | RSS-Gen 8.8    | 2.5                    | Complied |

The field strength of spurious emission was measured in three orthogonal EUT positions (X-Plane, Y- Plane and Z- Plane).

## 1.6 Setup of equipment under test (EUT)

### 1.6.1 Test configuration of EUT

The test configuration of the EUT refers to following Tables.

*Table: EUT*

| No. | Equipment   | Model name | S/N      | Note             |
|-----|-------------|------------|----------|------------------|
| A1  | RFID Module | T-2212C    | 170519-1 | For Radiated     |
| A2  | RFID Module | T-2212C    | 170519-2 | For AC Conducted |

*Table: Support equipment*

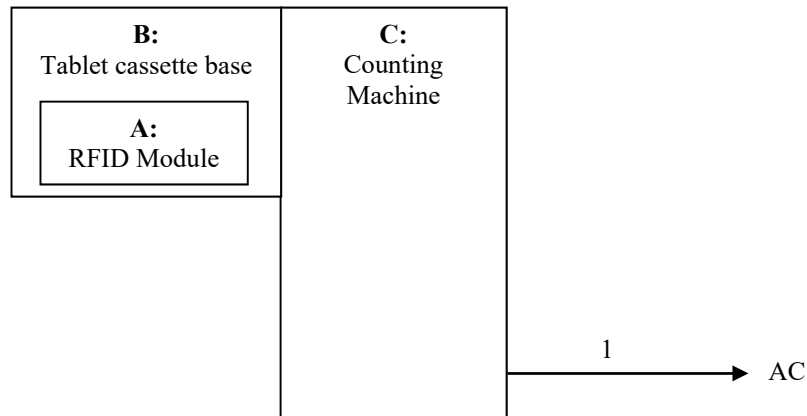
| No. | Item                 | Manufacturer              | Model Name | S/N |
|-----|----------------------|---------------------------|------------|-----|
| B   | Tablet cassette base | TSUKASA ELECTRIC CO., LTD | TG-F321    | -   |
| C   | Counting Machine     | YUYAMA Mfg. Co., Ltd.     | -          | -   |
| D   | Jig                  | -                         | -          | -   |

*Table: Cable connected to the EUT*

| No. | Cable Name | From | To | Shielded | Ferrite | Length [m] |
|-----|------------|------|----|----------|---------|------------|
| 1   | AC Cable   | C    | AC | No       | No      | 1.8        |
| 2   | Data Cable | A    | D  | No       | No      | 0.1        |
| 3   | DC Cable   | D    | DC | No       | No      | 0.4        |

### 1.6.2 Setup diagram of tested system:

[Configuration 1]



[Configuration 2]



### **1.6.3 Operating condition:**

Operating mode:

Transmission mode (Duty cycle 15%)

## **1.7 Equipment modifications**

No modifications have been made to the equipment in order to achieve compliance with the applicable standards described in clause 1.2.

## **1.8 Deviation from the standard**

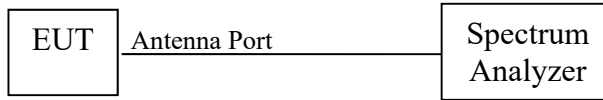
No deviations from the standards described in clause 1.2.

## 2 Test procedure and test data

### 2.1 Occupied Bandwidth (99 %)

#### Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



#### Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 6.9.3

- RBW: 1 to 5 % of OBW
- VBW > 3 x RBW
- Span: OBW x 1.5 to 5
- Trace: Max hold

#### Limitation

There are no limitations.  
 The measurement value is used for the emission designator.

#### Test equipment used (refer to List of utilized test equipment)

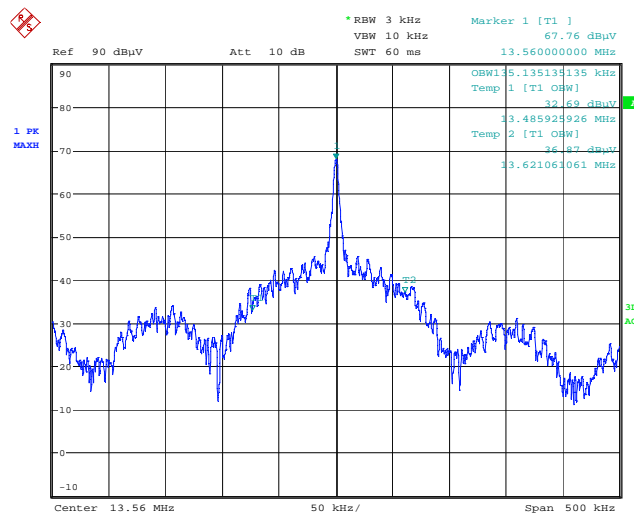
|      |      |      |  |  |  |
|------|------|------|--|--|--|
| TR05 | CL11 | LP06 |  |  |  |
|------|------|------|--|--|--|

#### Test Date

Tested Date: May 9, 2017      Temperature: 22 degC  
 Humidity: 42 %      Atmos. Press: 1018 hPa

#### Test results

| Transmission Frequency<br>[MHz] | 99% Bandwidth<br>[kHz] |
|---------------------------------|------------------------|
| 13.56                           | 135.14                 |

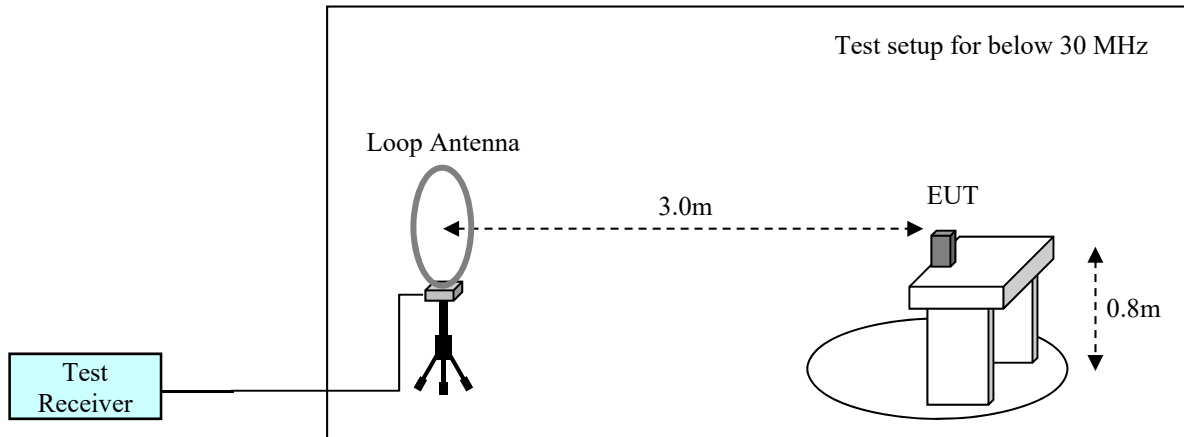




## 2.2 Transmitter radiated spurious emissions between 9 kHz to 30 MHz

### Test setup

Test setup was implemented according to the method of ANSI C63.10 clause 6.4.



### Test procedure

Measurement procedures were implemented according to the method of ANSI C63.10: 2013 clauses 6.4. The EUT is placed on a non-conducted table which is 0.8m height from a ground plane and the measurement antenna to EUT distance is 3 meters. The turn table is rotated for 360 degrees to determine the maximum emission level.

In the frequency range of 9 kHz to 30 MHz, a calibrated loop antenna was positioned with its plane vertical at the distance 3m from the EUT with an extrapolation of corrected distance factor and rotated about its vertical axis for maximum response at each azimuth about the EUT. For certain applications, the loop antenna also needs to be positioned horizontally. The lowest height of the loop antenna shall be 1 m above the ground.

EUT is placed at three different orientations (X, Y and Z axis) in order to find the worst orientation.

The spectrum analyzer and receiver are set to the followings;

Below 30 MHz:

RBW=10 kHz, VBW= 30 kHz, final measurement is carried out with a receiver RBW of 9 kHz (QP)

**Applicable rule and limitation**

§15.205 / RSS-Gen 8.10 restricted bands of operation

| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 - 0.110       | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15    |
| 0.490 - 0.510       | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46   |
| 2.1735 - 2.1905     | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75   |
| 4.125 - 4.128       | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5   |
| 4.17725 - 4.17775   | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2     |
| 4.20725 - 4.20775   | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5     |
| 6.215 - 6.218       | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7   |
| 6.26775 - 6.26825   | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4  |
| 6.31175 - 6.31225   | 123 - 138             | 2200 - 2300     | 14.47 - 14.5  |
| 8.291 - 8.294       | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2  |
| 8.362 - 8.366       | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4   |
| 8.37625 - 8.38675   | 156.7 - 156.9         | 2690 - 2900     | 22.01 - 23.12 |
| 8.41425 - 8.41475   | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0   |
| 12.29 - 12.293      | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8   |
| 12.51975 - 12.52025 | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5  |
| 12.57675 - 12.57725 | 322 - 335.4           | 3600 - 4400     | (1)           |

§15.209 / RSS-Gen 8.9 general requirements

| Frequency (MHz) | Field Strength (uV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 0.009 - 0.490   | 2400/F (kHz)          | 300                      |
| 0.490 - 1.705   | 24000/F (kHz)         | 30                       |
| 1.705 - 30.0    | 30                    | 30                       |

In the emission table above, the tighter limit applies at the band edges.

The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz.

Radiated emission limits in the above bands are based on measurements employing an average detector.

§15.225 / RSS-210 B6 Operation within the band 13.110 – 14.010 MHz

| Frequency (MHz) | Field strength @30m (uV/m) | Field strength @30m (dBuV/m) | Field strength @3m (dBuV/m) |
|-----------------|----------------------------|------------------------------|-----------------------------|
| 13.110 - 13.410 | 106                        | 40.5                         | 61.8                        |
| 13.410 - 13.553 | 334                        | 50.5                         | 71.8                        |
| 13.553 - 13.567 | 15,848                     | 84.0                         | 105.3                       |
| 13.567 - 13.710 | 334                        | 50.5                         | 71.8                        |
| 13.710 - 14.010 | 106                        | 40.5                         | 61.8                        |

$\text{dBuV/m} = 20 \times \log(\text{uV/m})$ , Corrected distance factor (refer to ANSI C63.10 6.4.4.2)

The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the above radiated emission limits in § 15.209 / RSS-Gen 8.9.

**Test equipment used (refer to List of utilized test equipment)**

|      |      |      |      |  |
|------|------|------|------|--|
| AC01 | LP05 | CL11 | TR06 |  |
|------|------|------|------|--|

**Test software used**

EMI1 Ver. 5.4

**Test results - Complied with requirement.**

**Test Data**

§15.225 (a), (b), (c) / RSS-210 B6 (a), (b), (c) Fundamental emission

Operating mode: Transmission mode  
 Test configuration: 1  
 EUT condition: Z-plane (Maximum condition)  
 Test site: Yokohama Laboratory  
 Measurement distance: 3 m

| Frequency (MHz) | Reading at 3m (dBuV) | Detector  | Corr. Factor (dB) | Result (dBuV/m) | Limit at 3m (dBuV/m) | Margin (dB) | Ant          |
|-----------------|----------------------|-----------|-------------------|-----------------|----------------------|-------------|--------------|
| 13.55980        | 42.4                 | PK        | 10.8              | 53.2            | 105.3                | 52.1        | 0deg         |
| <b>13.55945</b> | <b>44.4</b>          | <b>PK</b> | <b>10.8</b>       | <b>55.2</b>     | <b>105.3</b>         | <b>50.1</b> | <b>90deg</b> |

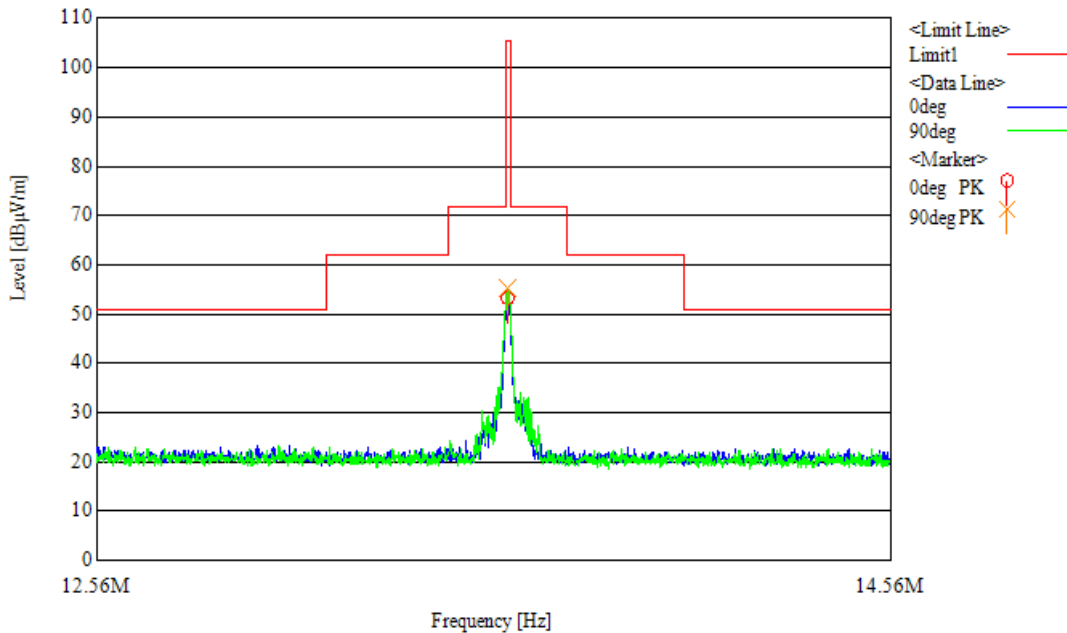
Correction Factor [dB] = Antenna Factor [dB/m] + Cable Loss [dB]

Sample calculation at 13.55945 MHz result as follow:

$$\text{Result [dBuV]} = \text{Reading} + \text{C.F} = 44.4 + 10.8 = 55.2 \text{ [dBuV/m]}$$

$$\text{Margin} = \text{Limit} - \text{Result} = 105.3 - 55.2 = 50.1 \text{ [dB]}$$

**Graphical express of test result**



Tested Date: September 7, 2017  
 Humidity: 66 %

Temperature: 19 degree C  
 Atmos. Press: 1006 hPa

Operating mode: Transmission mode  
 Test configuration: 2  
 EUT condition: Z-plane (Maximum condition)  
 Test site: Yokohama Laboratory  
 Measurement distance: 3 m

| Frequency (MHz) | Reading at 3m (dBuV) | Detector  | Corr. Factor (dB) | Result (dBuV/m) | Limit at 3m (dBuV/m) | Margin (dB) | Ant          |
|-----------------|----------------------|-----------|-------------------|-----------------|----------------------|-------------|--------------|
| 13.56100        | 42.4                 | PK        | 10.8              | 53.2            | 105.3                | 52.1        | 0deg         |
| <b>13.56010</b> | <b>44.5</b>          | <b>PK</b> | <b>10.8</b>       | <b>55.3</b>     | <b>105.3</b>         | <b>50.0</b> | <b>90deg</b> |

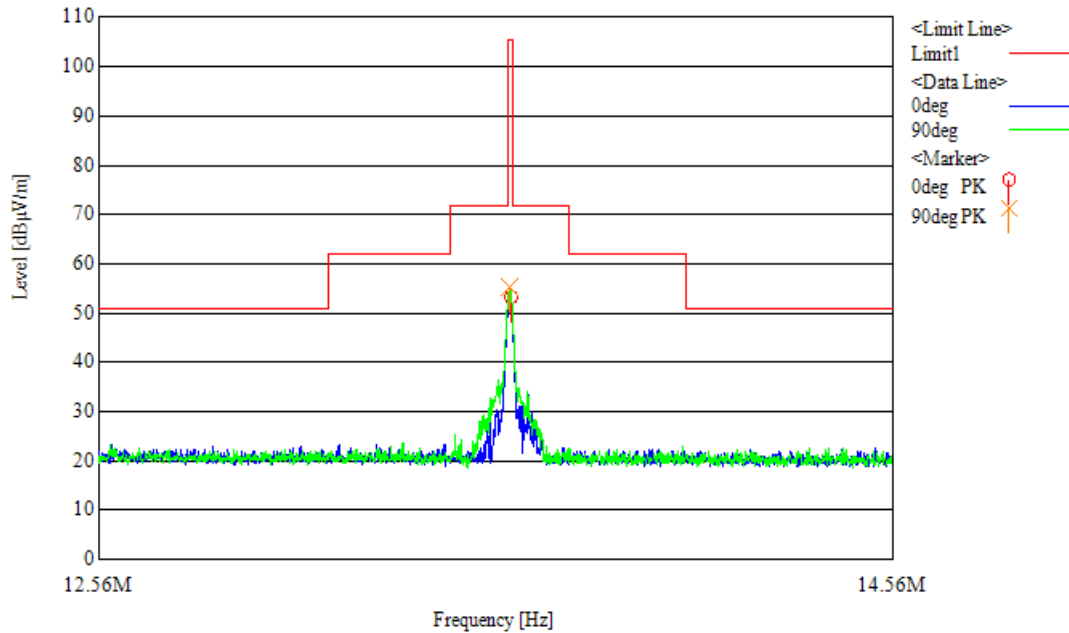
Correction Factor [dB] = Antenna Factor [dB/m] + Cable Loss [dB]

Sample calculation at 13.56010 MHz result as follow:

$$\text{Result [dBuV]} = \text{Reading} + \text{C.F} = 44.5 + 10.8 = 55.3 \text{ [dBuV/m]}$$

$$\text{Margin} = \text{Limit} - \text{Result} = 105.3 - 55.3 = 50.0 \text{ [dB]}$$

### Graphical express of test result



Tested Date: September 13, 2017  
 Humidity: 66 %

Temperature: 20 degree C  
 Atmos. Press: 1013 hPa

§15.225 (d) / RSS-210 B6 (d) Harmonics and spurious emission between 9 kHz to 30MHz

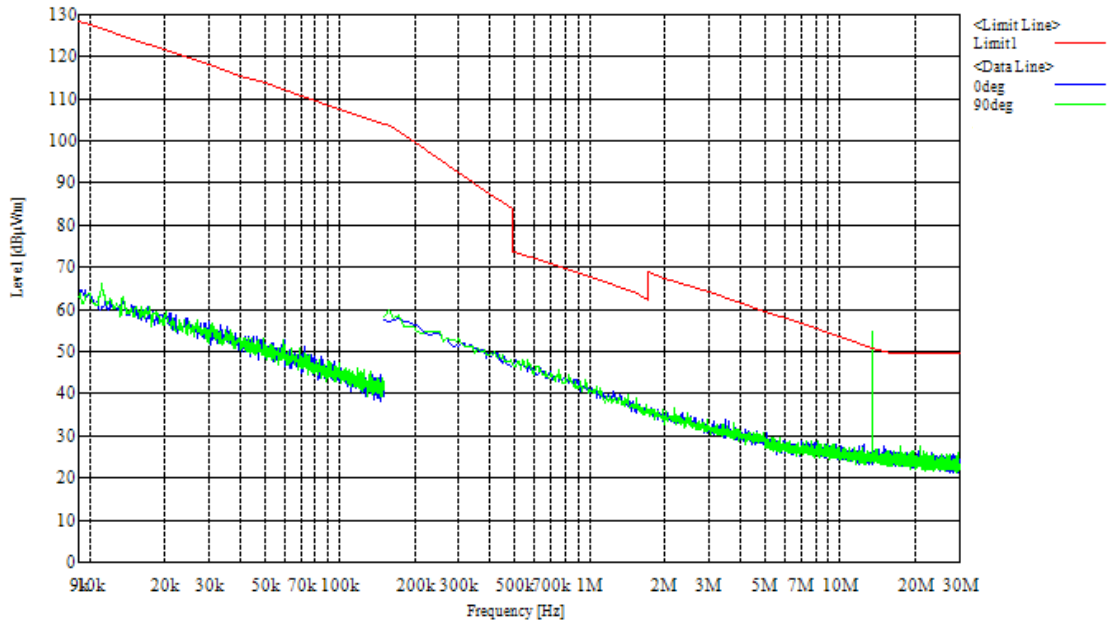
Operating mode: Transmission mode  
 Test configuration: 1  
 EUT condition: Z-plane (Maximum condition)  
 Test site: Yokohama Laboratory  
 Measurement distance: 3 m

| Frequency (MHz) | Reading at 3m (dBuV) | Detector (QP/Ave) | Corr. Factor (dB) | Result (dBuV/m) | Limit at 3m (dBuV/m) | Margin (dB) | Ant |
|-----------------|----------------------|-------------------|-------------------|-----------------|----------------------|-------------|-----|
| -               | -                    | -                 | -                 | -               | -                    | -           | -   |
| -               | -                    | -                 | -                 | -               | -                    | -           | -   |

Correction Factor [dB] = Antenna Factor [dB/m] + Cable Loss [dB]

**There is no spurious emission greater than the noise floor.**

Graphical express of test result (9 kHz – 30MHz)



Tested Date: May 9, 2017  
 Humidity: 42 %

Temperature: 22 degree C  
 Atmos. Press: 1018 hPa

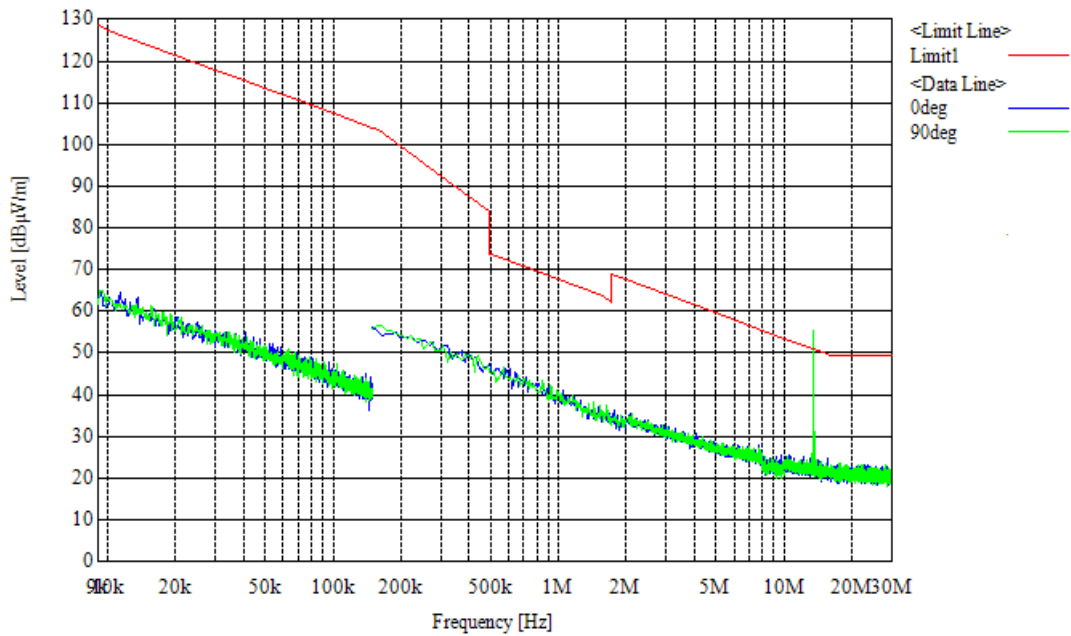
Operating mode: Transmission mode  
 Test configuration: 2  
 EUT condition: Z-plane (Maximum condition)  
 Test site: Yokohama Laboratory  
 Measurement distance: 3 m

| Frequency (MHz) | Reading at 3m (dBuV) | Detector (QP/Ave) | Corr. Factor (dB) | Result (dBuV/m) | Limit at 3m (dBuV/m) | Margin (dB) | Ant |
|-----------------|----------------------|-------------------|-------------------|-----------------|----------------------|-------------|-----|
| -               | -                    | -                 | -                 | -               | -                    | -           | -   |
| -               | -                    | -                 | -                 | -               | -                    | -           | -   |

Correction Factor [dB] = Antenna Factor [dB/m] + Cable Loss [dB]

**There is no spurious emission greater than the noise floor.**

**Graphical express of test result (9 kHz – 30MHz)**



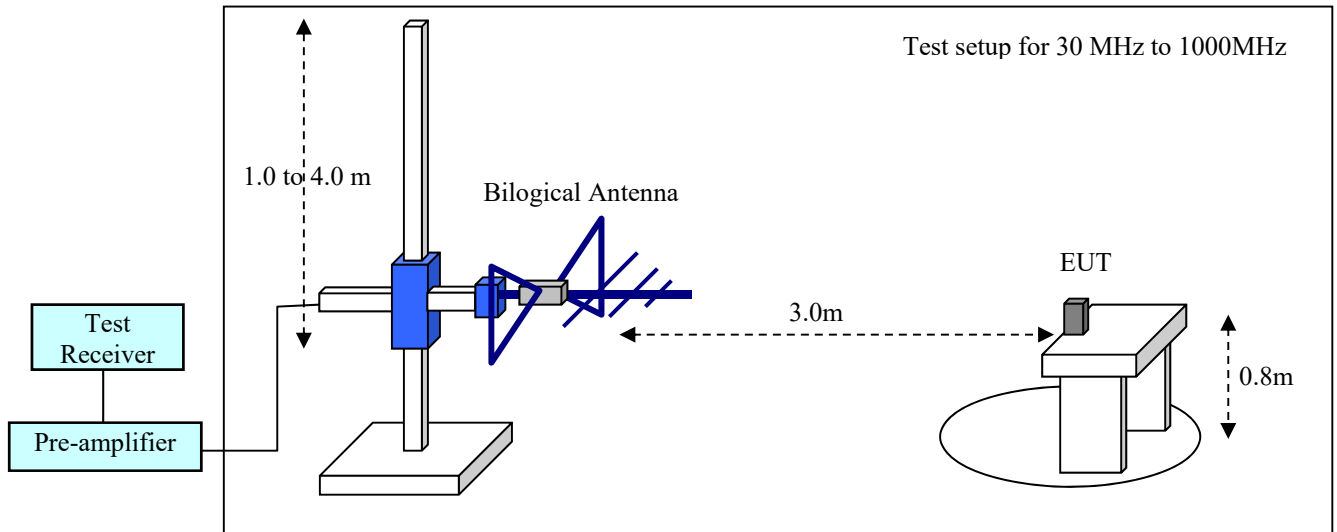
Tested Date: September 13, 2017  
 Humidity: 66 %

Temperature: 20 degree C  
 Atmos. Press: 1013 hPa

### 2.3 Transmitter radiated spurious emissions between 30MHz to 1000MHz

#### Test setup

Test setup was implemented according to the method of ANSI C63.10 clause 6.



#### Test procedure

Measurement procedures were implemented according to the method of ANSI C63.10: 2013 clauses 6.5.

Exploratory radiated measurements were performed at the measurement distance of 3 meters using broadband antennas and a spectrum analyzer. The EUT was set up in its typical configuration and arrangement, and operated in its various modes.

For each mode of operation required to be tested, the frequency spectrum were monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) were explored to produce the emission that has the highest amplitude relative to the limit.

Based on the exploratory measurement results, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. This investigation was performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. EUT was placed at three different orientations (X, Y and Z axis) in order to find the worst orientation.

#### Applicable rule and limitation

§15.209 / RSS-Gen 8.9 general requirements

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Measurement Distance (m) | Field Strength (uV/m) | Field Strength (dBuV/m) |
|-----------------|--------------------------|-----------------------|-------------------------|
| 30 – 88         | 3                        | 100                   | 40.0                    |
| 88 –216         | 3                        | 150                   | 43.5                    |
| 216 – 960       | 3                        | 200                   | 46.0                    |
| Above 960       | 3                        | 500                   | 53.9                    |

In the emission table above, the tighter limit applies at the band edges.

The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

**Test equipment used (refer to List of utilized test equipment)**

|          |      |      |      |      |  |  |  |
|----------|------|------|------|------|--|--|--|
| AC01(EM) | CL11 | TR06 | PR15 | BA07 |  |  |  |
|----------|------|------|------|------|--|--|--|

**Test software used**

EMI1 Ver. 5.4

**Test results - Complied with requirement.**



**Test Data**

Tested Date: September 13, 2017

Temperature: 20 degree C  
 Humidity: 66 %  
 Atmos. Press: 1013 hPa

Operating mode: Transmission mode  
 Test configuration: 1  
 EUT condition: Z-plane (Maximum condition)  
 Test site: Yokohama Laboratory  
 Measurement distance: 3 m

§15.225(d) Harmonics and spurious emission between 30MHz to 1000MHz (refer 15.209)

| No. | Frequency [MHz] | Reading [dBμV] | Factor [dB/m] | Loss [dB]  | Gain [dB]   | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Ant.         |
|-----|-----------------|----------------|---------------|------------|-------------|-----------------|----------------|-------------|--------------|
| 1   | 311.880         | 44.1           | 13.7          | 9.5        | 30.2        | 37.1            | 46.0           | 8.9         | Hori.        |
| 2   | <b>339.001</b>  | <b>48.0</b>    | <b>14.6</b>   | <b>9.7</b> | <b>30.2</b> | <b>42.1</b>     | <b>46.0</b>    | <b>3.9</b>  | <b>Hori.</b> |
| 3   | 352.539         | 45.7           | 15.0          | 9.8        | 30.2        | 40.3            | 46.0           | 5.7         | Hori.        |
| 4   | 366.121         | 46.9           | 15.4          | 9.9        | 30.2        | 42.0            | 46.0           | 4.0         | Hori.        |
| 5   | 74.325          | 43.6           | 8.3           | 7.5        | 30.3        | 29.1            | 40.0           | 10.9        | Vert.        |
| 6   | 108.077         | 38.8           | 11.5          | 7.8        | 30.2        | 27.9            | 43.5           | 15.6        | Vert.        |

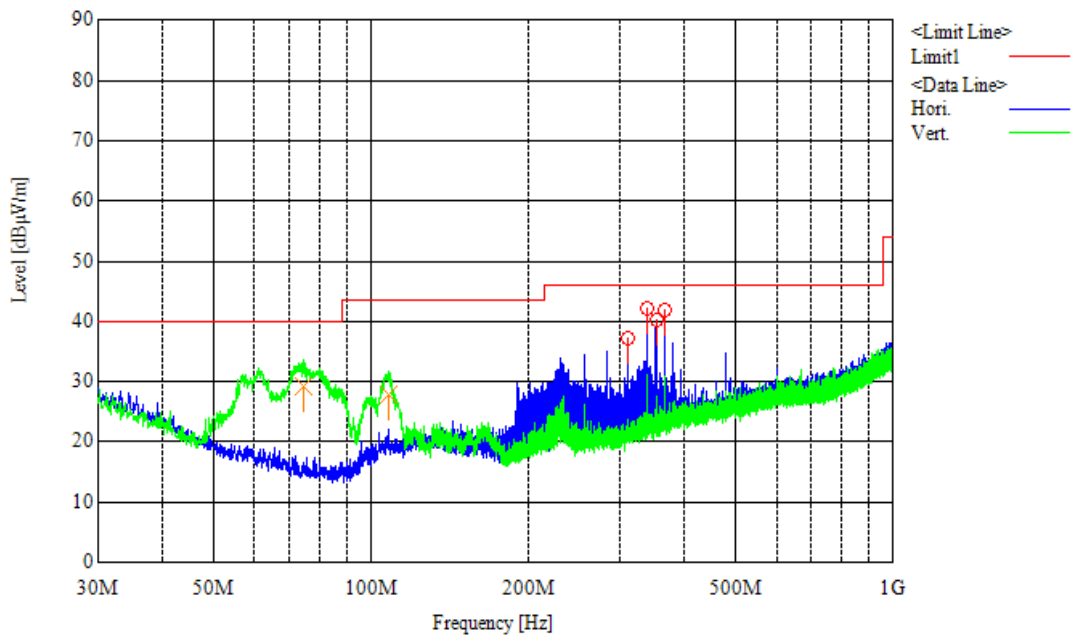
**Calculation method**

The Correction Factors and RESULT are calculated as followings.

$$\text{Correction Factor [dB/m]} = \text{FACTOR [dB/m]} + \text{CABLE LOSS [dB]} - \text{GAIN [dB]}$$

$$\text{RESULT [dBuV/m]} = \text{READING [dBuV]} + \text{Correction Factor [dB/m]}$$

**Graphical express of test result (30MHz-1000MHz)**



Tested Date: September 13, 2017

Temperature: 20 degree C  
 Humidity: 66 %  
 Atmos. Press: 1013 hPa

Operating mode: Transmission mode  
 Test configuration: 2  
 EUT condition: X-plane (Maximum condition)  
 Test site: Yokohama Laboratory  
 Measurement distance: 3 m

§15.225(d) Harmonics and spurious emission between 30MHz to 1000MHz (refer 15.209)

| No.      | Frequency [MHz] | Reading [dBμV] | Factor [dB/m] | Loss [dB]  | Gain [dB]   | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Ant.         |
|----------|-----------------|----------------|---------------|------------|-------------|-----------------|----------------|-------------|--------------|
| 1        | 284.755         | 47.8           | 13.1          | 9.3        | 30.2        | 40.0            | 46.0           | 6.0         | Hori.        |
| 2        | 311.877         | 50.1           | 13.7          | 9.5        | 30.2        | 43.1            | 46.0           | 2.9         | Hori.        |
| 3        | 338.993         | 48.6           | 14.6          | 9.7        | 30.2        | 42.7            | 46.0           | 3.3         | Hori.        |
| <b>4</b> | <b>366.127</b>  | <b>49.4</b>    | <b>15.4</b>   | <b>9.9</b> | <b>30.2</b> | <b>44.5</b>     | <b>46.0</b>    | <b>1.5</b>  | <b>Hori.</b> |
| 5        | 379.668         | 47.2           | 15.7          | 10.0       | 30.3        | 42.6            | 46.0           | 3.4         | Hori.        |
| 6        | 393.229         | 46.8           | 16.1          | 10.1       | 30.3        | 42.7            | 46.0           | 3.3         | Hori.        |

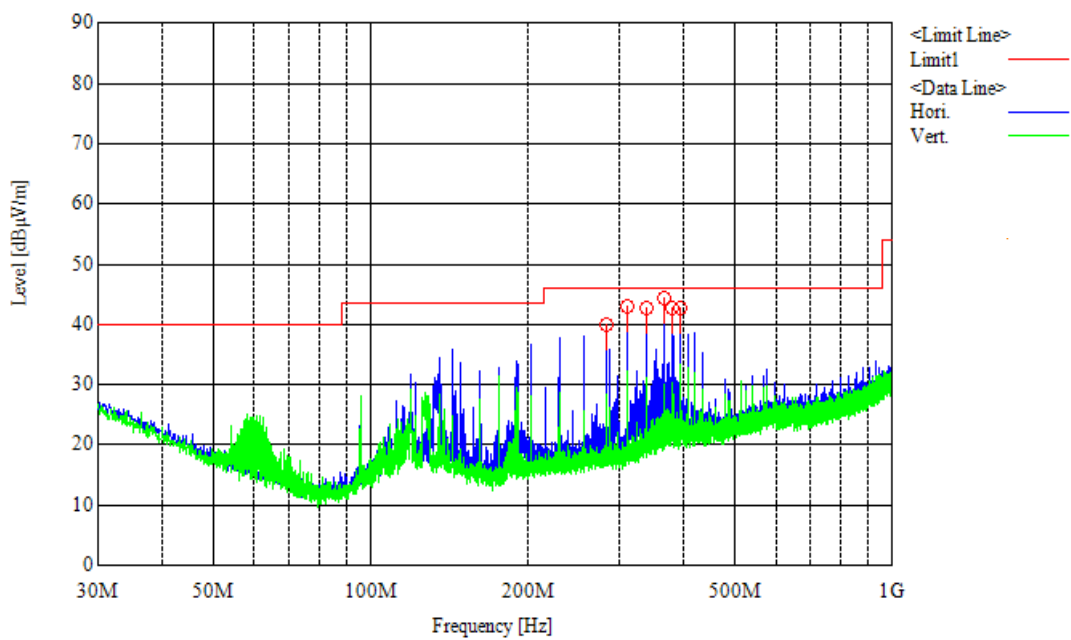
**Calculation method**

The Correction Factors and RESULT are calculated as followings.

$$\text{Correction Factor [dB/m]} = \text{FACTOR [dB/m]} + \text{CABLE LOSS [dB]} - \text{GAIN [dB]}$$

$$\text{RESULT [dBuV/m]} = \text{READING [dBuV]} + \text{Correction Factor [dB/m]}$$

**Graphical express of test result (30MHz-1000MHz)**



## 2.4 Frequency stability

### Test setup

Test setup was implemented according to the method of ANSI C63.10: 2013 clauses 6.8 “Frequency stability tests”.

### Test procedure

Measurement procedures were implemented according to the test method of ANSI C63.10: 2013 clause 6.8.1.

Place the de-energized EUT in the temperature test chamber. Supply the EUT with nominal ac voltage, or install a new or fully charged battery in the EUT. An antenna was connected to the antenna output connector of the EUT if possible.

The frequency counter was connected to the measurement antenna with a suitable length of coaxial cable.

The environmental chamber set to the highest temperature specified in applicable regulation.

Allow sufficient time (approximately 30 minutes) for the temperature of the chamber to stabilize.

Turn the EUT on and measure the EUT operating frequency at startup, and two, five, and ten minutes after startup.

The measurements were performed that the temperature chamber set to reduce the lowest temperature specified in applicable regulation.

### Applicable rule and limitation

§15.225 (e) / RSS-210 B6: Frequency tolerance

| Test items             | Variation ranges     |                  | Limit    |
|------------------------|----------------------|------------------|----------|
| Temperature variations | -20 to +50 degrees C | 3.3 +/-10% VDC * | +/-0.01% |

Note1: The above operating range is declared by manufacturer.

### Test equipment used (refer to List of utilized test equipment)

|      |      |  |  |
|------|------|--|--|
| TR06 | TC01 |  |  |
|------|------|--|--|

Test results - Complied with requirement.

### Test Data

Tested Date: June 2, 2017

Temperature: 22 degree C

Humidity: 55 %

Atmos. Press: 994 hPa

Operating mode: Transmission mode

| Temp. (Degrees) | Voltages (V) | Measured Frequency (MHz) |                   |                   |                   | Worst Deviation (%) | Limit (%) |
|-----------------|--------------|--------------------------|-------------------|-------------------|-------------------|---------------------|-----------|
|                 |              | Start-up                 | 2 min.            | 5 min.            | 10 min.           |                     |           |
| -20             | 3.30         | <b>13.5598544</b>        | 13.5598572        | 13.5598564        | 13.5598572        | -0.0011             | +/-0.01   |
| -10             | 3.30         | <b>13.5598976</b>        | 13.5598988        | 13.5598988        | 13.5598980        | -0.0008             | +/-0.01   |
| 0               | 3.30         | 13.5599112               | <b>13.5599104</b> | 13.5599112        | <b>13.5599104</b> | -0.0007             | +/-0.01   |
| 10              | 3.30         | 13.5599036               | <b>13.5599024</b> | 13.5599032        | <b>13.5599024</b> | -0.0007             | +/-0.01   |
| 20              | 3.63         | 13.5598904               | 13.5598888        | 13.5598892        | <b>13.5598884</b> | -0.0008             | +/-0.01   |
|                 | 3.30         | <b>13.5598800</b>        | 13.5598812        | 13.5598816        | 13.5598816        | -0.0009             | +/-0.01   |
|                 | 2.97         | 13.5598780               | 13.5598772        | <b>13.5598764</b> | 13.5598772        | -0.0009             | +/-0.01   |
| 30              | 3.30         | 13.5598544               | 13.5598532        | 13.5598524        | <b>13.5598516</b> | -0.0011             | +/-0.01   |
| 40              | 3.30         | <b>13.5598292</b>        | 13.5598300        | <b>13.5598292</b> | 13.5598300        | -0.0013             | +/-0.01   |
| 50              | 3.30         | <b>13.5598156</b>        | 13.5598164        | <b>13.5598156</b> | 13.5598164        | <b>-0.0014</b>      | +/-0.01   |

## 2.5 AC power line conducted emissions

### Test setup

Test setup was implemented according to the method of ANSI C63.10: 2013 clause 6.2.

### Test procedure

Measurement procedures were implemented according to the method of ANSI C63.10: 2013 clauses 6.2 “Standard test method for ac power line conducted emissions from unlicensed wireless devices”.

Exploratory measurements were used the spectrum analyzer to identify the frequency of the emission that has the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable positions, and with a typical system equipment configuration and arrangement.

Final ac power line conducted emission measurements were performed based on the exploratory tests.

The EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit are selected for the final measurement.

When the measurement value is grater than average limitation the average detection measurements were performed.

### Applicable rule and limitation

§15.207 (a) / RSS-Gen 8.8: AC power line conducted limits

| Frequency of Emission (MHz) | Conducted Limit (dBuV) |            |
|-----------------------------|------------------------|------------|
|                             | Quasi-peak             | Average    |
| 0.15-0.5                    | 66 to 56 *             | 56 to 46 * |
| 0.5-5                       | 56                     | 46         |
| 5-30                        | 60                     | 50         |

\* Decreases with the logarithm of the frequency. The lower limit applies at the band edges.

### Test equipment used (refer to List of utilized test equipment)

|      |      |      |  |  |  |  |
|------|------|------|--|--|--|--|
| TR06 | CL18 | LN05 |  |  |  |  |
|------|------|------|--|--|--|--|

### Test software used

EMI Ver. 5.2

**Test results - Complied with requirement.**

### Test Data

Tested Date: May 9, 2017

Temperature: 22 degree C

Humidity: 42 %

Atmos. Press: 1018 hPa

Operating mode: Transmission mode

| No.      | Frequency [MHz] | Reading     |           | C.F. [dB]   | Result      |           | Limit       |           | Margin      |         | PHASE     |
|----------|-----------------|-------------|-----------|-------------|-------------|-----------|-------------|-----------|-------------|---------|-----------|
|          |                 | QP [dBuV]   | AV [dBuV] |             | QP [dBuV]   | AV [dBuV] | QP [dBuV]   | AV [dBuV] | QP [dB]     | AV [dB] |           |
| 1        | 0.20420         | 32.0        | 13.3      | 10.2        | 42.2        | 23.5      | 63.4        | 53.4      | 21.2        | 29.9    | Va        |
| 2        | 0.28863         | 23.3        | 5.6       | 10.1        | 33.4        | 15.7      | 60.6        | 50.6      | 27.2        | 34.9    | Va        |
| 3        | 0.39186         | 14.7        | 0.6       | 10.1        | 24.8        | 10.7      | 58.0        | 48.0      | 33.2        | 37.3    | Va        |
| <b>4</b> | <b>0.19878</b>  | <b>33.9</b> | 13.2      | <b>10.2</b> | <b>44.1</b> | 23.4      | <b>63.7</b> | 53.7      | <b>19.6</b> | 30.3    | <b>Vb</b> |
| 5        | 0.29617         | 24.1        | 7.3       | 10.1        | 34.2        | 17.4      | 60.3        | 50.3      | 26.1        | 32.9    | Vb        |
| 6        | 0.38693         | 17.9        | 2.0       | 10.1        | 28.0        | 12.1      | 58.1        | 48.1      | 30.1        | 36.0    | Vb        |

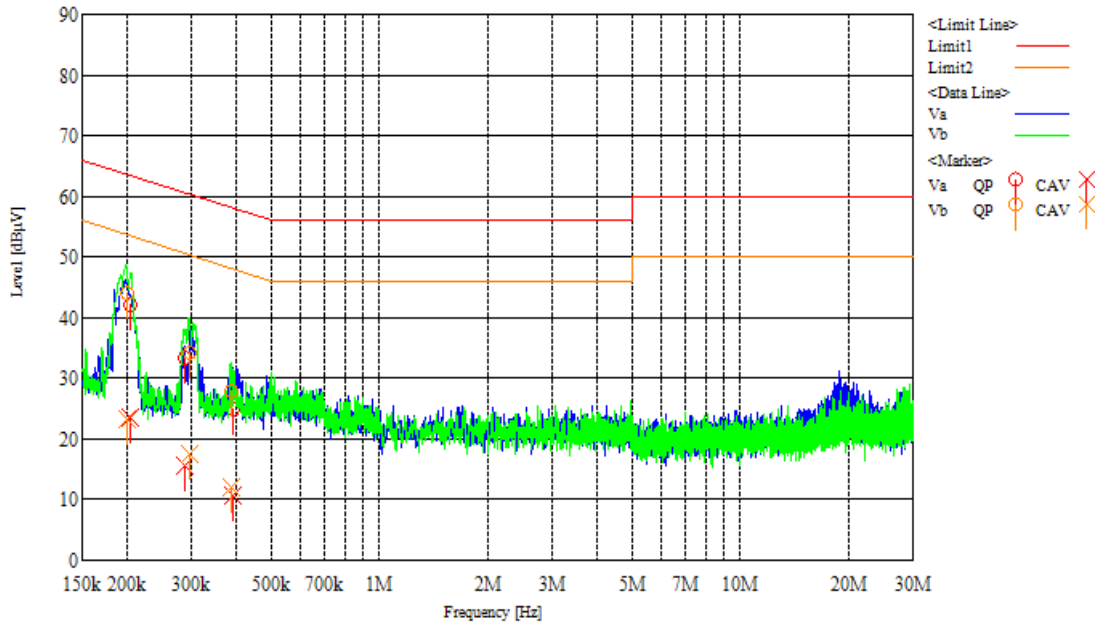
The power line conducted emission voltage is calculated by adding the LISN factor and Cable loss attenuation from the measured reading. The calculation is as follows:

$$\text{Result} = \text{Reading} + \text{C. F}$$

$$\text{where C.F} = \text{LISN Factor} + \text{Cable Loss} \quad [\text{dB}]$$

**Graphical express of test result (0.15 MHz-30MHz)**

**AC Power line conducted emission. (With dummy load)**



#### 4 List of utilized test equipment/ calibration

| RFT ID No. | Kind of Equipment and Precision  | Manufacturer    | Model No. | Serial Number | Calibration Date | Calibrated until |
|------------|----------------------------------|-----------------|-----------|---------------|------------------|------------------|
| AC01(EM)   | Anechoic Chamber (1st test room) | JSE             | 203397C   | -             | 2017/04/22       | 2018/04/30       |
| BA07       | Biological Antenna               | TESEQ           | CBL6143A  | 26670         | 2016/12/20       | 2017/12/31       |
| CL11       | Antenna Cable for RE             | RFT             | -         | -             | 2017/03/22       | 2018/03/31       |
| CL18       | Antenna Cable for CE             | RFT             | -         | -             | 2017/03/22       | 2018/03/31       |
| LP06       | Loop Antenna                     | ETS-Lindgren    | 6502      | 00164299      | 2017/03/16       | 2018/03/31       |
| LN05       | LISN                             | Kyoritsu        | KNW-407F  | 8-1773-2      | 2017/05/25       | 2018/05/31       |
| PR21       | Pre. Amplifier                   | Anritsu         | MH648A    | 6200467119    | 2016/12/20       | 2017/12/31       |
| TR06       | Test Receiver (F/W : 3.93 SP2)   | Rohde & Schwarz | ESU26     | 100002        | 2016/09/29       | 2017/09/30       |
| TC01       | Temperature Chamber              | ESPEC           | SH-641    | 92000964      | 2016/12/09       | 2017/12/31       |

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.