

FCC TEST REPORT

FOR

TownSteel Inc.

TS Smart Interconnect Lock

Test Model: e-Genius 5000-BLE-55

Additional Model No.: e-Genius 7000-BLE-55, Prodigy 5000-BLE-55

Prepared for : TownSteel Inc.
Address : 17901 Railroad Street, City of Industry, California, United States

Prepared by : Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample : October 22, 2018
Number of tested samples : 1
Serial number : Prototype
Date of Test : October 22, 2018~November 19, 2018
Date of Report : November 19, 2018

FCC TEST REPORT

FCC CFR 47 PART 15 C (15.225)

Report Reference No. : LCS181025040AEA

Date of Issue : November 19, 2018

Testing Laboratory Name : Shenzhen LCS Compliance Testing Laboratory Ltd.

Address : 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue,
Bao'an District, Shenzhen, Guangdong, China

Testing Location/ Procedure..... : Full application of Harmonised standards ■
Partial application of Harmonised standards □
Other standard testing method □

Applicant's Name..... : TownSteel Inc.

Address : 17901 Railroad Street, City of Industry, California, United States

Test Specification

Standard..... : FCC CFR 47 PART 15 C(15.225)

Test Report Form No. : LCSEMC-1.0

TRF Originator : Shenzhen LCS Compliance Testing Laboratory Ltd.

Master TRF : Dated 2011-03

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Test Item Description. : TS Smart Interconnect Lock

Trade Mark..... : N/A

Test Model : e-Genius 5000-BLE-55

Ratings : DC 6V by 4*AA Battery

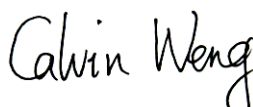
Result : Positive

Compiled by:



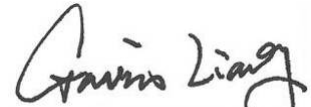
Dick Su/ Administrators

Supervised by:



Calvin Weng/ Technique principal

Approved by:



Gavin Liang/ Manager

FCC -- TEST REPORT

| | |
|--|---|
| Test Report No. : LCS181025040AEA | <u>November 19, 2018</u> Date of issue |
|--|---|

| | |
|--------------------------|--|
| Test Model..... | : e-Genius 5000-BLE-55 |
| EUT..... | : TS Smart Interconnect Lock |
| Applicant..... | : TownSteel Inc. |
| Address..... | : 17901 Railroad Street, City of Industry, California, United States |
| Telephone..... | : / |
| Fax..... | : / |
| Manufacturer..... | : TownSteel Inc. |
| Address..... | : 17901 Railroad Street, City of Industry, California, United States |
| Telephone..... | : / |
| Fax..... | : / |
| Factory..... | : TownSteel Inc. |
| Address..... | : 17901 Railroad Street, City of Industry, California, United States |
| Telephone..... | : / |
| Fax..... | : / |

| | |
|--------------------|-----------------|
| Test Result | Positive |
|--------------------|-----------------|

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

| Revision | Issue Date | Revisions | Revised By |
|----------|-------------------|---------------|-------------|
| 000 | November 19, 2018 | Initial Issue | Gavin Liang |
| | | | |
| | | | |

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1. GENERAL INFORMATION

1.1 Description of Device (EUT)

| | |
|-------------------------------|--|
| EUT | : TS Smart Interconnect Lock |
| Test Model | : e-Genius 5000-BLE-55 |
| Model Number | : e-Genius 5000-BLE-55, e-Genius 7000-BLE-55, Prodigy 5000-BLE-55 |
| Model Declaration | : PCB board, structure and internal of these model(s) are the same, Only model's name, shell colors, side of frame and shell materials are different for these models. |
| Hardware Version | : XIC HW V2.0 |
| Software Version | : XIC FW V2.0 |
| Power Supply | : DC 6V by 4*AA Battery |
| RFID Technology | |
| Operating Frequency | : 13.56 MHz |
| Channel Number | : 1 |
| Modulation Technology | : ASK |
| Antenna Description | : Internal Antenna, -2.0dBi (Max.) |
| Bluetooth | |
| Bluetooth Operation frequency | : 2402MHz-2480MHz |
| Bluetooth Version | : 4.2 |
| Bluetooth Channel Number | : 40 Channels |
| Bluetooth Channel Spacing | : 2MHz |
| Bluetooth Modulation Type | : GFSK |
| Antenna Description | : Internal Antenna, 2.23 dBi |

1.2 Host System Configuration List and Details

| Manufacturer | Description | Model | Serial Number | Certificate |
|--------------|-------------|-------|---------------|-------------|
| -- | -- | -- | --- | -- |

1.3 External I/O

| I/O Port Description | Quantity | Cable |
|----------------------|----------|-------|
| -- | -- | -- |

1.4 Description of Test Facility

FCC Registration Number is 899208.

Industry Canada Registration Number is 9642A-1.

ESMD Registration Number is ARCB0108.

UL Registration Number is 100571-492.

TUV SUD Registration Number is SCN1081.

TUV RH Registration Number is UA 50296516-001.

NVLAP Registration Code is 600167-0.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5 Statement of The Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6 Measurement Uncertainty

| Test Item | Frequency Range | Uncertainty | Note |
|------------------------|-----------------|-------------|------|
| Radiation Uncertainty | 9KHz~30MHz | ±3.10dB | (1) |
| | 30MHz~200MHz | ±2.96dB | (1) |
| | 200MHz~1000MHz | ±3.10dB | (1) |
| | 1GHz~26.5GHz | ±3.80dB | (1) |
| | 26.5GHz~40GHz | ±3.90dB | (1) |
| Conduction Uncertainty | 150kHz~30MHz | ±1.63dB | (1) |
| Power disturbance | 30MHz~300MHz | ±1.60dB | (1) |

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.7 Description of Test Modes

The EUT has been tested under operating condition.

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode.

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the RFID tag provided by client to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.225 under the FCC Rules Part 15 Subpart C.

2.3 General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013.

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The EUT was operated in the RFID tag provided by client to fix the TX frequency that was for the purpose of the measurements.

3.3. Special Accessories

| No. | Equipment | Manufacturer | Model No. | Serial No. | Length | shielded/ unshielded | Notes |
|-----|---------------|--------------|-----------|------------|--------|-------------------------|-------|
| 1 | PC | Lenovo | Ideapad | A131101550 | / | / | DOC |
| 2 | Power adapter | Lenovo | CPA-A090 | 36200414 | 1.00m | unshielded | DOC |

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

| Applied Standard: FCC Part 15 Subpart C | | |
|---|----------------------|--------|
| Test Items | FCC Rules | Result |
| AC Line Conducted Emissions | §15.207(a) | N/A* |
| Field Strength of Fundamental Emissions | §15.225(a)(b)(c) | PASS |
| Radiated Emissions | §15.225(d) & §15.209 | PASS |
| 20dB Bandwidth | § 2.1049 | PASS |
| Frequency Stability | §15.225(e) | PASS |
| Antenna Requirement | §15.203 | PASS |

Remark:

1. Note 1 – Test results inside test report;
2. Note 2 – N/A*: Not Applicable!

5. RADIATED MEASUREMENT

5.1. Radiated Emission

5.1.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | GHz |
|-------------------|---------------------|---------------|-------------|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| \1\ 0.495-0.505 | 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 | (\2\) |
| 13.36-13.41 | | | |

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009~0.490 | 2400/F(KHz) | 300 |
| 0.490~1.705 | 24000/F(KHz) | 30 |
| 1.705~30.0 | 30 | 30 |
| 30~88 | 100 | 3 |
| 88~216 | 150 | 3 |
| 216~960 | 200 | 3 |
| Above 960 | 500 | 3 |

5.1.2. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Start Frequency | 1000 MHz |
| Stop Frequency | 10 th carrier harmonic |
| RB / VB (Emission in restricted band) | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |
| RB / VB (Emission in non-restricted band) | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |

| Receiver Parameter | Setting |
|------------------------|--|
| Attenuation | Auto |
| Start ~ Stop Frequency | 9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG |
| Start ~ Stop Frequency | 150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB/VB 120kHz/1MHz for QP |

5.1.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 0.8 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP detector with an EMI receiver.
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

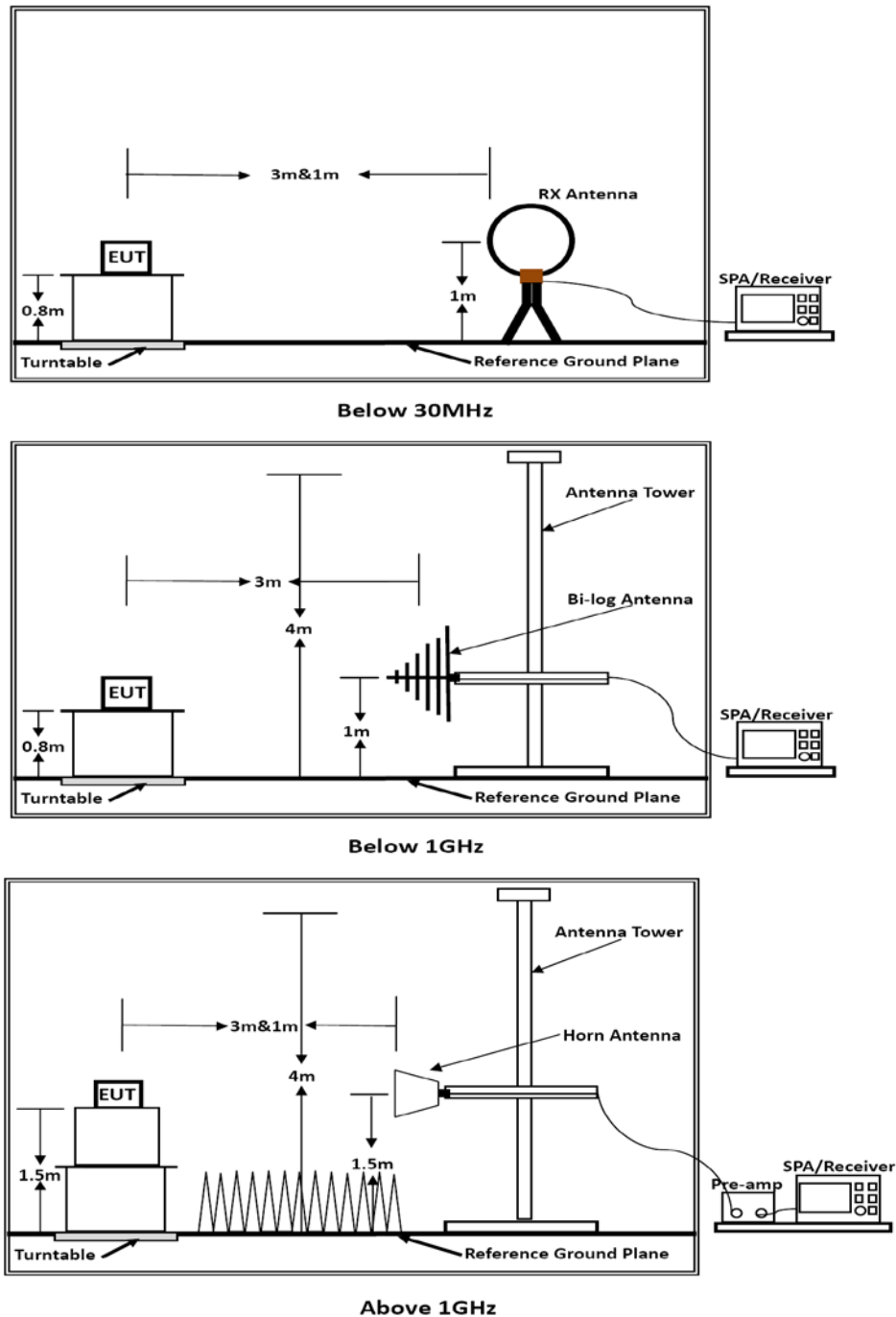
Premeasurement:

- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

5.1.4. Test Setup Layout



Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1m]})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.1.5. Test Results

PASS.

The test data please refer to following page:

9 KHz~30MHz

Note: Only recorded the worst test result.

| Freq. MHz | Antenna Pol. | Reading dBuV | Factor dB | Measured dBuV/m | Limit dBuV/m | Margin dB | Remark |
|-----------|--------------|--------------|-----------|-----------------|--------------|-----------|--------|
| 0.20 | H | -- | -- | -- | 101.41 | -- | -- |
| 0.56 | H | -- | -- | -- | 72.58 | -- | -- |
| 5.04 | H | 0.10 | 18.3 | 18.40 | 69.5 | -51.10 | QP |
| 10.12 | H | -1.60 | 19.3 | 17.70 | 69.5 | -51.80 | QP |
| 13.56 | H | 12.01 | 19.0 | 31.01 | 124.0 | -92.99 | QP |
| 16.33 | H | -2.52 | 19.0 | 16.48 | 69.5 | -53.02 | QP |
| 19.84 | H | -2.31 | 18.9 | 16.59 | 69.5 | -52.91 | QP |
| 29.76 | H | -2.31 | 18.6 | 16.29 | 69.5 | -53.21 | QP |

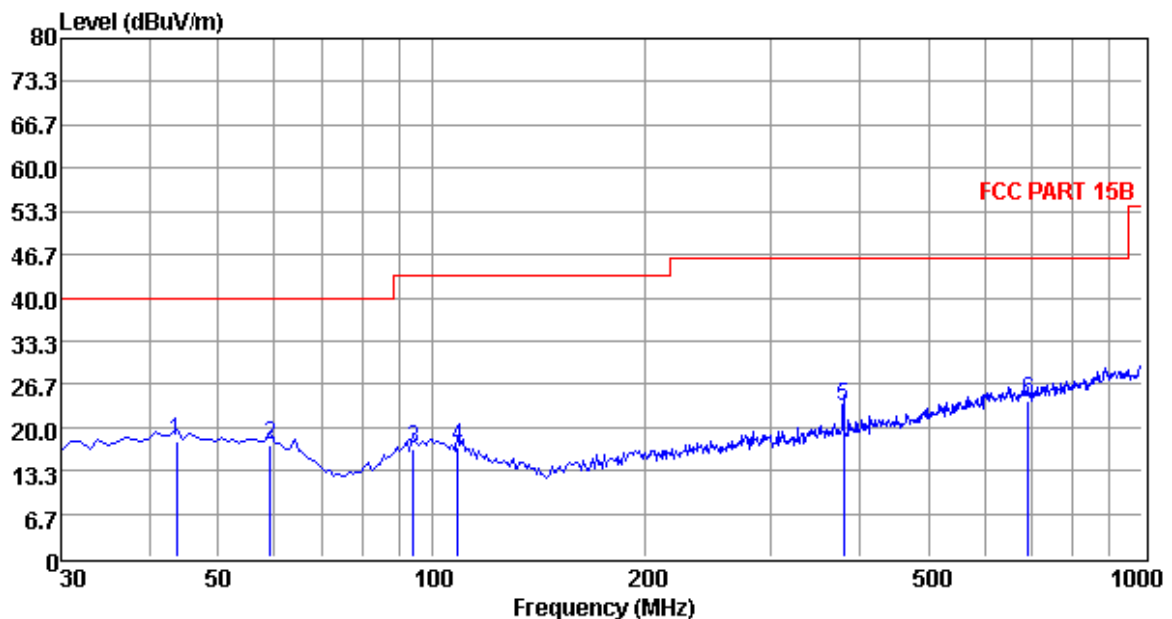
*Note: Emission Level= Reading Level + Antenna Factor + Cable Loss

Margin = Emission Limit – Emission Values

“--” means noise floor.

30MHz ~ 1GHz

Horizontal



pol:

HORIZONTAL

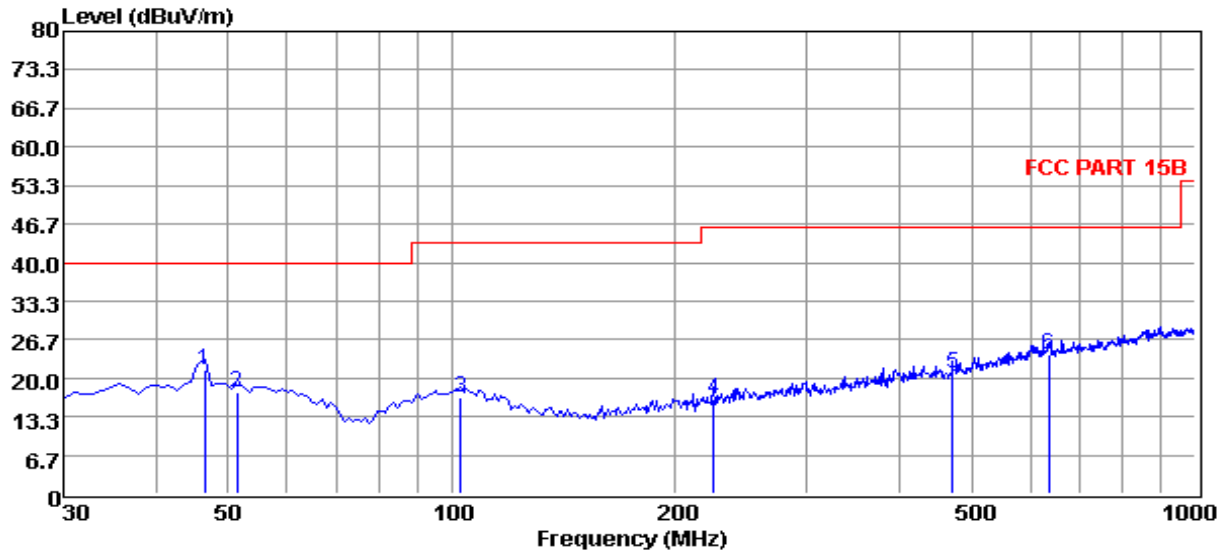
| | Freq | Reading | CabLos | Antfac | Measured | Limit | Over | Remark |
|---|--------|---------|--------|--------|----------|--------|--------|--------|
| | MHz | dBuV | dB | dB/m | dBuV/m | dBuV/m | dB | |
| 1 | 43.58 | 3.77 | 0.41 | 13.56 | 17.74 | 40.00 | -22.26 | QP |
| 2 | 59.10 | 4.11 | 0.49 | 12.75 | 17.35 | 40.00 | -22.65 | QP |
| 3 | 94.02 | 3.47 | 0.58 | 12.66 | 16.71 | 43.50 | -26.79 | QP |
| 4 | 108.57 | 3.75 | 0.68 | 12.38 | 16.81 | 43.50 | -26.69 | QP |
| 5 | 380.17 | 7.35 | 1.18 | 14.59 | 23.12 | 46.00 | -22.88 | QP |
| 6 | 691.54 | 3.67 | 1.66 | 18.78 | 24.11 | 46.00 | -21.89 | QP |

Note: 1. All readings are Quasi-peak values.

2. Measured= Reading + Antenna Factor + Cable Loss

3. The emission that are 20dB below the official limit are not reported

Vertical



pol:

VERTICAL

| | Freq | Reading | CabLos | Antfac | Measured | Limit | Over | Remark |
|---|--------|---------|--------|--------|----------|--------|--------|--------|
| | MHz | dBuV | dB | dB/m | dBuV/m | dBuV/m | dB | |
| 1 | 46.49 | 7.52 | 0.35 | 13.46 | 21.33 | 40.00 | -18.67 | QP |
| 2 | 51.34 | 3.85 | 0.54 | 13.19 | 17.58 | 40.00 | -22.42 | QP |
| 3 | 102.75 | 3.06 | 0.60 | 12.91 | 16.57 | 43.50 | -26.93 | QP |
| 4 | 224.97 | 4.14 | 0.89 | 11.42 | 16.45 | 46.00 | -29.55 | QP |
| 5 | 471.35 | 3.59 | 1.38 | 15.86 | 20.83 | 46.00 | -25.17 | QP |
| 6 | 635.28 | 3.93 | 1.71 | 18.58 | 24.22 | 46.00 | -21.78 | QP |

Note: 1. All readings are Quasi-peak values.

2. Measured= Reading + Antenna Factor + Cable Loss

3. The emission that ate 20db blow the official limit are not reported

Note:

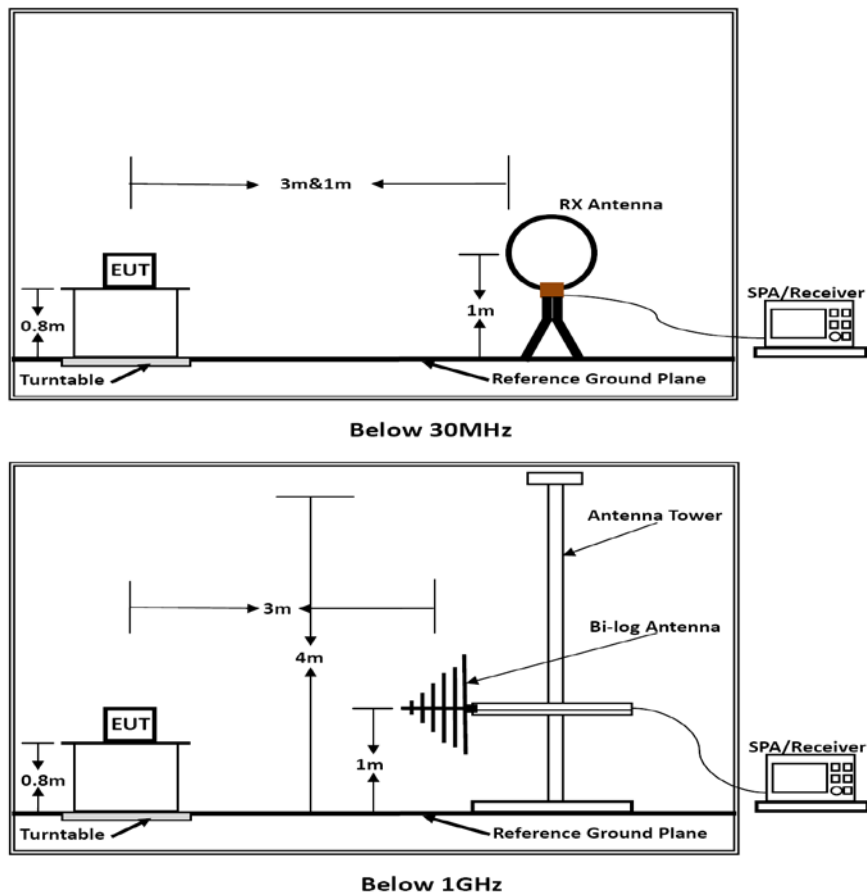
1). Pre-scan all modes and recorded the worst case results in this report.

2). Emission level (dBuV/m) = 20 log Emission level (uV/m).

3). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

5.2. Field Strength of Fundamental Emissions and Mask Measurement

5.2.1. Block Diagram of Test Setup



5.2.2. Field strength of fundamental emissions limit and Mask limit

The field strength of fundamental emissions shall not exceed 15848 microvolts/meter at 30 meters. The emissions limit in this paragraph is based on measurement instrumentation employing a QP detector.

| Frequencies (MHz) | Field Strength (microvolts/meter) | Field Strength (dB μ V/m) at 10m | Field Strength (dB μ V/m) at 3m |
|--------------------|-----------------------------------|--------------------------------------|-------------------------------------|
| 13.553 ~ 13.567MHz | 15848 at 30m | 103.08 (QP) | 124 (QP) |

Mask Limit:

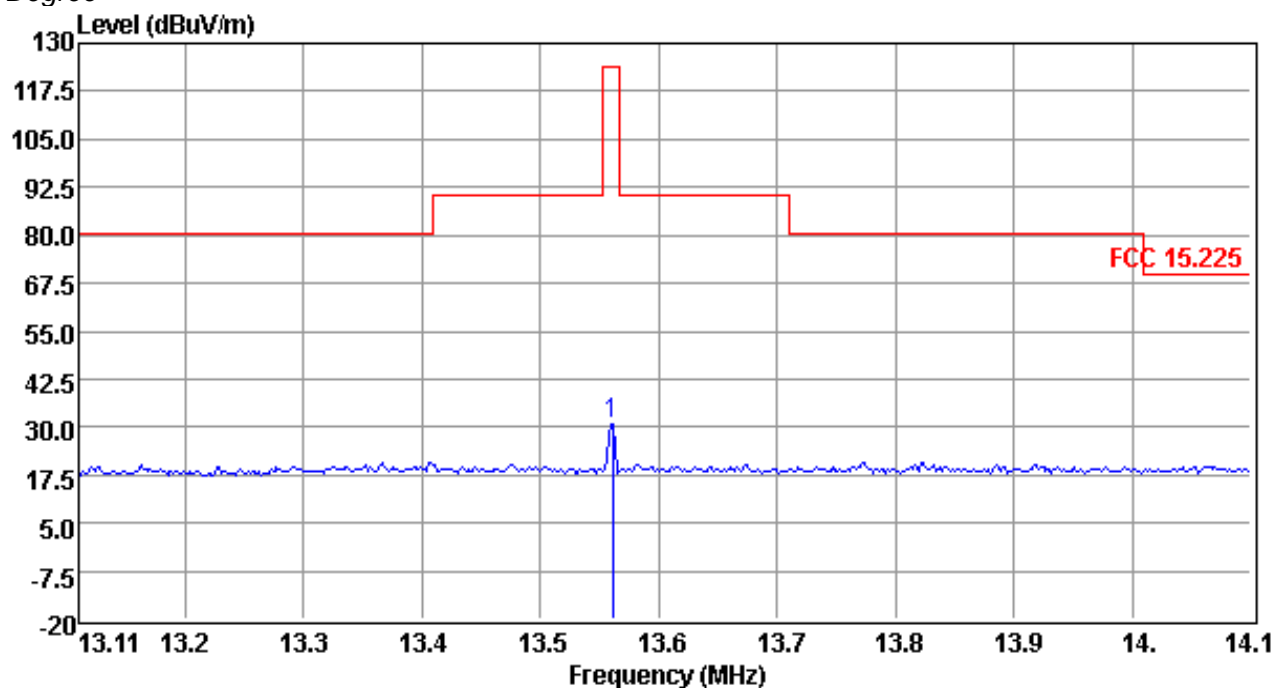
| Frequency (MHz) | Limit (dB μ V/m) | Distance (m) |
|-----------------|----------------------|--------------|
| 1.705-13.110 | 69.5 | 3 |
| 13.110-13.410 | 80.5 | 3 |
| 13.410-13.553 | 90.5 | 3 |
| 13.553-13.567 | 124.0 | 3 |
| 13.567-13.710 | 90.5 | 3 |
| 13.710-14.010 | 80.5 | 3 |
| 14.010-30.000 | 69.5 | 3 |

5.2.3. Test Results

PASS.

The test data please refer to following page:

90 Degree



| | Freq.(MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Pol. | Remark |
|---|------------|----------------|-------------|-----------------|----------------|------|--------|
| 1 | 13.56 | 12.01 | 19 | 31.01 | 124 | H | QP |

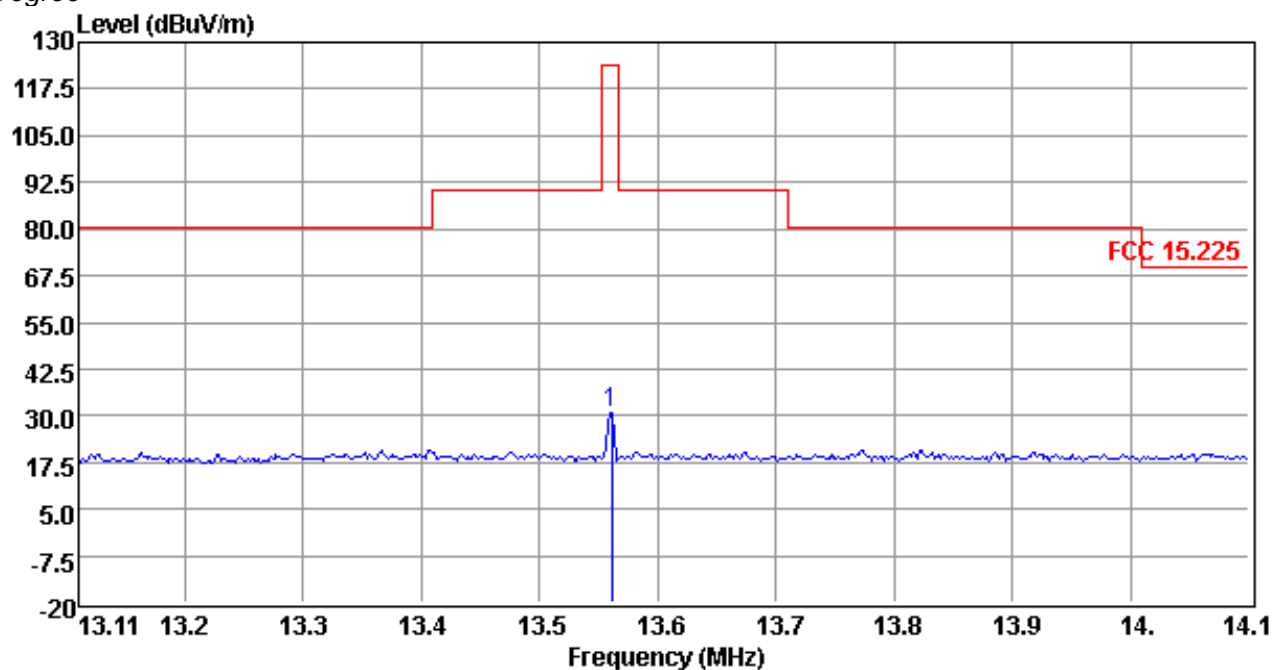
*Note: Factor= Antenna Factor + Cable Loss

Emission level (dB μ V/m) = 20 log Emission level (μ V/m).

Measured distance is 3m.

All emissions emit from non-NFC function of digital unintentional emissions. All NFC's spurious emissions are below 20dB of limits.

0 Degree



| | Freq.(MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Pol. | Remark |
|---|------------|----------------|-------------|-----------------|----------------|------|--------|
| 1 | 13.56 | 12.00 | 19 | 31.00 | 124 | H | QP |

*Note: Factor= Antenna Factor + Cable Loss

Emission level (dBuV/m) = 20 log Emission level (μV/m).

Measured distance is 3m.

All emissions emit from non-NFC function of digital unintentional emissions. All NFC's spurious emissions are below 20dB of limits.

6. BANDWIDTH OF THE OPERATING FREQUENCY

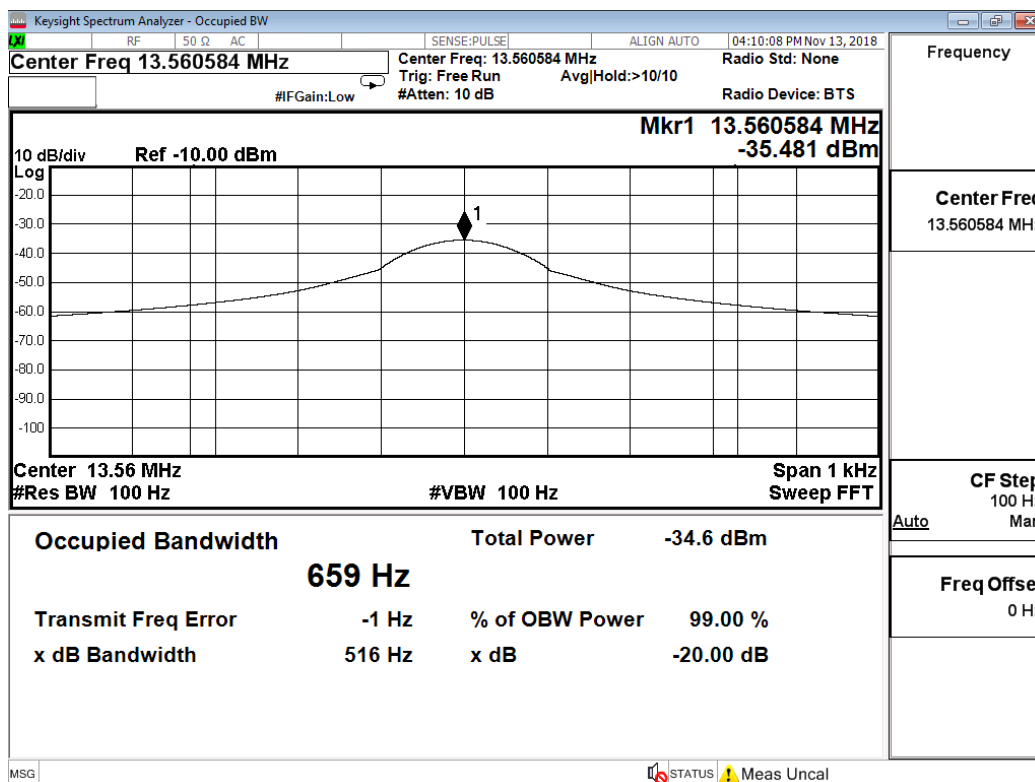
6.1. Standard Applicable

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (13.553 ~ 13.567MHz).

6.2. Test Result

| | |
|-------------------------|----------------------------|
| EUT | TS Smart Interconnect Lock |
| RBW | 100Hz |
| VBW | 100Hz |
| SPAN | 500Hz |
| Carrier Frequency (MHz) | 20dB Bandwidth (KHz) |
| 13.56 | 0.516 |

Please refer to the test plot:



7. FREQUENCY STABILITY MEASUREMENT

7.1 Standard Applicable

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% (100ppm) of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

7.2 Test Result

Voltage vs. Frequency Stability

| Voltage (V) | Measurement Frequency (MHz) |
|----------------------|-----------------------------|
| DC 6.90V | 13.56059 |
| DC 6.00V | 13.56061 |
| DC 5.10V | 13.56058 |
| Max. Deviation (MHz) | 0.00061 |
| Max. Deviation (ppm) | 44.982 |

Temperature vs. Frequency Stability

| Temperature (°C) | Measurement Frequency (MHz) |
|----------------------|-----------------------------|
| -20 | 13.56062 |
| -10 | 13.56058 |
| 0 | 13.56060 |
| 10 | 13.56061 |
| 20 | 13.56061 |
| 30 | 13.56061 |
| 40 | 13.56063 |
| 50 | 13.56063 |
| Max. Deviation (MHz) | 0.00063 |
| Max. Deviation (ppm) | 46.457 |

8. LINE CONDUCTED EMISSIONS (NOT APPLICABLE)

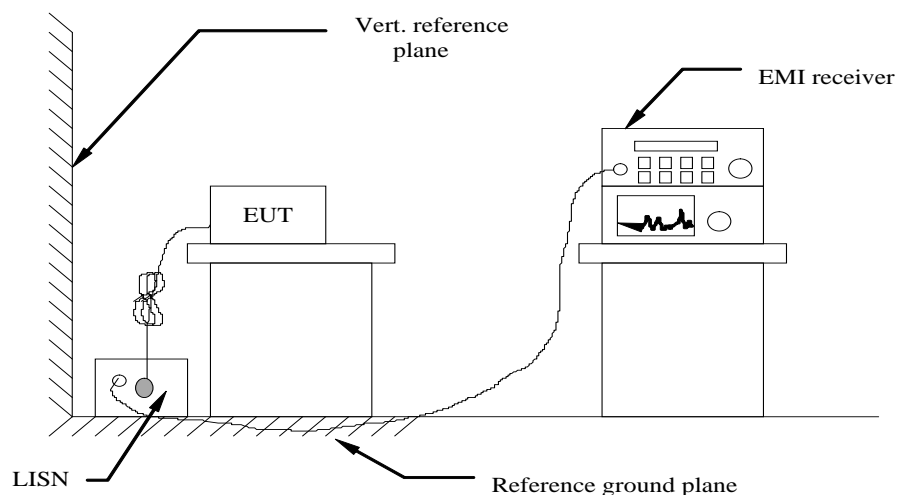
8.1. Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

| Frequency Range (MHz) | Limits (dB μ V) | |
|--------------------------|---------------------|----------|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

* Decreasing linearly with the logarithm of the frequency

8.2. Block Diagram of Test Setup



8.3. Test Results

Not Applicable!!

The device was powered by AA battery!!!

9. ANTENNA REQUIREMENTS

9.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

9.2 Antenna Connected Construction

9.2.1. Standard Applicable

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

9.2.2. Antenna Connector Construction

The gains of antenna used for transmitting is -2.0dBi, and the antenna is a Coil Antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

NFC and BT share difference antenna.

9.2.3. Results: Compliance.

10. LIST OF MEASURING EQUIPMENTS

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Next Cal. |
|------|--------------------------|--------------------|------------------------------|-------------|------------|------------|
| 1 | Power Sensor | R&S | NRV-Z81 | 100458 | 2018-06-16 | 2019-06-15 |
| 2 | Power Sensor | R&S | NRV-Z32 | 10057 | 2018-06-16 | 2019-06-15 |
| 3 | Power Meter | R&S | NRVS | 100444 | 2018-06-16 | 2019-06-15 |
| 4 | DC Filter | MPE | 23872C | N/A | 2018-06-16 | 2019-06-15 |
| 5 | RF Cable | Harbour Industries | 1452 | N/A | 2018-06-16 | 2019-06-15 |
| 6 | SMA Connector | Harbour Industries | 9625 | N/A | 2018-06-16 | 2019-06-15 |
| 7 | Spectrum Analyzer | Agilent | N9020A | MY49100699 | 2018-06-16 | 2019-06-15 |
| 8 | Signal analyzer | Agilent | E4448A(PIFA mixers to 40GHz) | US44300469 | 2018-06-16 | 2019-06-15 |
| 9 | RF Cable | Hubersuhner | Sucoflex104 | FP2RX2 | 2018-06-16 | 2019-06-15 |
| 10 | 3m Semi Anechoic Chamber | SIDT FRANKONIA | SAC-3M | 03CH03-HY | 2018-06-16 | 2019-06-15 |
| 11 | Amplifier | SCHAFFNER | COA9231A | 18667 | 2018-06-16 | 2019-06-15 |
| 12 | Amplifier | Agilent | 8449B | 3008A02120 | 2018-06-16 | 2019-06-15 |
| 13 | Amplifier | MITEQ | AMF-6F-260400 | 9121372 | 2018-06-16 | 2019-06-15 |
| 14 | Loop Antenna | R&S | HFH2-Z2 | 860004/001 | 2018-06-16 | 2019-06-15 |
| 15 | By-log Antenna | SCHWARZBECK | VULB9163 | 9163-470 | 2018-06-16 | 2019-06-15 |
| 16 | Horn Antenna | EMCO | 3115 | 6741 | 2018-06-16 | 2019-06-15 |
| 17 | Horn Antenna | SCHWARZBECK | BBHA9170 | BBHA9170154 | 2018-06-16 | 2019-06-15 |
| 18 | RF Cable-R03m | Jye Bao | RG142 | CB021 | 2018-06-16 | 2019-06-15 |
| 19 | RF Cable-HIGH | SUHNER | SUCOFLEX 106 | 03CH03-HY | 2018-06-16 | 2019-06-15 |
| 20 | EMI Test Receiver | R&S | ESCI | 101142 | 2018-06-16 | 2019-06-15 |
| 21 | Artificial Mains | R&S | ENV216 | 101288 | 2018-06-16 | 2019-06-15 |
| 22 | EMI Test Software | AUDIX | E3 | N/A | N/A | N/A |
| 23 | Spectrum Analyzer | R&S | FSP40 | 100503 | 2018-06-16 | 2019-06-15 |

11. TEST SETUP PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

12. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

13. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

-----THE END OF REPORT-----