

RF TEST REPORT



Report No.: FCC IC_SL16101001-SFE-020_DSS_Rev 1.0
Supersede Report No.: FCC IC_SL16101001-SFE-020_DSS

| | | |
|---|-----|---|
| Applicant | : | Lighthouse AI, Inc |
| Product Name | : | Lighthouse |
| Model No. | : | A1 |
| Test Standard | : | 47 CFR 15.247 RSS-247 Issue 1.0, May 2015 |
| Test Method | : | ANSI C63.10: 2013 RSS-Gen Issue 4, Nov 2014 FCC Public Notice DA 00-705 |
| FCC ID | : | 2ALIS-A1 |
| IC ID | : | 22555-A1 |
| Dates of test | : | 02/14/2017 – 02/22/2017 |
| Issue Date | : | 05/12/2017 |
| Test Result | : | <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail |
| Equipment complied with the specification | [X] | |
| Equipment did not comply with the specification | [] | |

This Test Report is Issued Under the Authority of:

| | |
|------------------|-------------------|
| | |
| Rachana Khanduri | Chen Ge |
| Test Engineer | Engineer Reviewer |

Issued By:
SIEMIC Laboratories
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Accreditations for Conformity Assessment

| Country/Region | Accreditation Body | Scope |
|----------------|------------------------|-----------------------------------|
| USA | FCC, A2LA | EMC, RF/Wireless, Telecom |
| Canada | IC, A2LA, NIST | EMC, RF/Wireless, Telecom |
| Taiwan | BSMI, NCC, NIST | EMC, RF, Telecom, Safety |
| Hong Kong | OFTA, NIST | RF/Wireless, Telecom |
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| Mexico | NOM, COFETEL, Caniety | Safety, EMC, RF/Wireless, Telecom |
| Europe | A2LA, NIST | EMC, RF, Telecom, Safety |
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Accreditations for Product Certifications

| Country | Accreditation Body | Scope |
|-----------|--------------------|-----------------------|
| USA | FCC TCB, NIST | EMC, RF, Telecom |
| Canada | IC FCB, NIST | EMC, RF, Telecom |
| Singapore | iDA, NIST | EMC, RF, Telecom |
| EU | NB | EMC & R&TTE Directive |
| Japan | MIC (RCB 208) | RF, Telecom |
| Hong Kong | OFTA (US002) | RF, Telecom |

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1 Report Revision History

| Report No. | Report Version | Description | Issue Date |
|--|----------------|----------------|------------|
| FCC IC_RF_SL16101001_SFE-020_DSS | None | Original | 03/30/2017 |
| FCC IC_RF_SL16101001_SFE-020_DSS_Rev 1.0 | Rev 1.0 | Updated FCC ID | 05/12/2017 |
| | | | |
| | | | |
| | | | |

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Lighthouse AI, Inc

Product: Lighthouse

Model: A1

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

| | | |
|----------------------|---|---|
| Applicant Name | : | Lighthouse AI, Inc |
| Applicant Address | : | 380 Portage Avenue, Palo Alto, CA |
| Manufacturer Name | : | Hon Hai Precision Industry CO, LTD (Foxconn) |
| Manufacturer Address | : | NANNING FUGUI PRECISION INDUSTRIAL CO.,LTD. B FACTORIES AREA,FOXCONN NANNING SCITECH PARK,NO.51,TONGLE, NANNING CITY, GUANGXI PROVINCE, CHINA-530031 |

4 Test site information

| | |
|----------------------|---|
| Lab performing tests | SIEMIC Laboratories |
| Lab Address | 775 Montague Expressway, Milpitas, CA 95035 |
| FCC Test Site No. | 881796 |
| IC Test Site No. | 4842D-2 |
| VCCI Test Site No. | A0133 |

5 Modification

| Index | Item | Description | Note |
|-------|------|-------------|------|
| - | - | - | - |
| | | | |
| | | | |
| | | | |
| | | | |

6 EUT Information

6.1 EUT Description

| | | |
|---------------------------|---|---|
| Product Name | : | Lighthouse |
| Model No. | : | A1 |
| Trade Name | : | Lighthouse AI |
| Serial No. | : | A1003170012 |
| Input Power | : | 100-240VAC,50/60Hz |
| Power Adapter Manu/Model | : | 2ABS048F US |
| Power Adapter SN | : | 11-16120136-00145 |
| Product Hardware version | : | v3.2 |
| Product Software version | : | build-alexandria-1079 |
| Radio Hardware version | : | WCN-3660B-0-79WLNSP-TR-05-1 |
| Radio Software version | : | CNSS.PR.2.0.1.2.c1-00021-M8936BAAAANAZW-1 |
| Date of EUT received | : | 02/06/2017 |
| Equipment Class/ Category | : | DTS, UNII |
| Port/Connectors | : | None |

6.2 Spec for BT Radio

| Radio Type | Bluetooth (Ver4.0+EDR) |
|------------------------|------------------------|
| Operating Frequency | 2402MHz-2480MHz |
| Modulation | FHSS (BDR, EDR) |
| Channel Spacing | 1MHz (BDR, EDR) |
| Antenna Type | Dipole |
| Antenna Gain | 2.6 dBi |
| Antenna Connector Type | U.FL connector |

Channel List

| Type | Channel No. | Frequency (MHz) | Power Setting |
|--------------------------------|-------------|-----------------|---------------|
| Bluetooth(BRD) 2402-2480MHz | 0 | 2402 | 9 |
| | 39 | 2441 | 9 |
| | 78 | 2480 | 9 |
| Bluetooth(EDR) 2402-2480MHz | 0 | 2402 | 9 |
| | 39 | 2441 | 9 |
| | 78 | 2480 | 9 |

6.3 EUT test modes/configuration Description

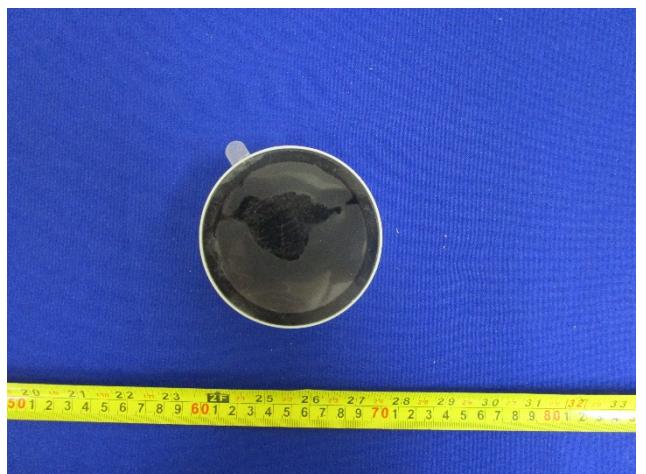
| Mode | Note |
|-----------|--------------|
| Bluetooth | BDR (GFSK) |
| Bluetooth | EDR (8-DPSK) |

6.4 EUT Photos-External



EUT – Front View

EUT – Rear View



EUT – Top View

EUT – Bottom View



EUT – Left Side View

EUT – Right Side View

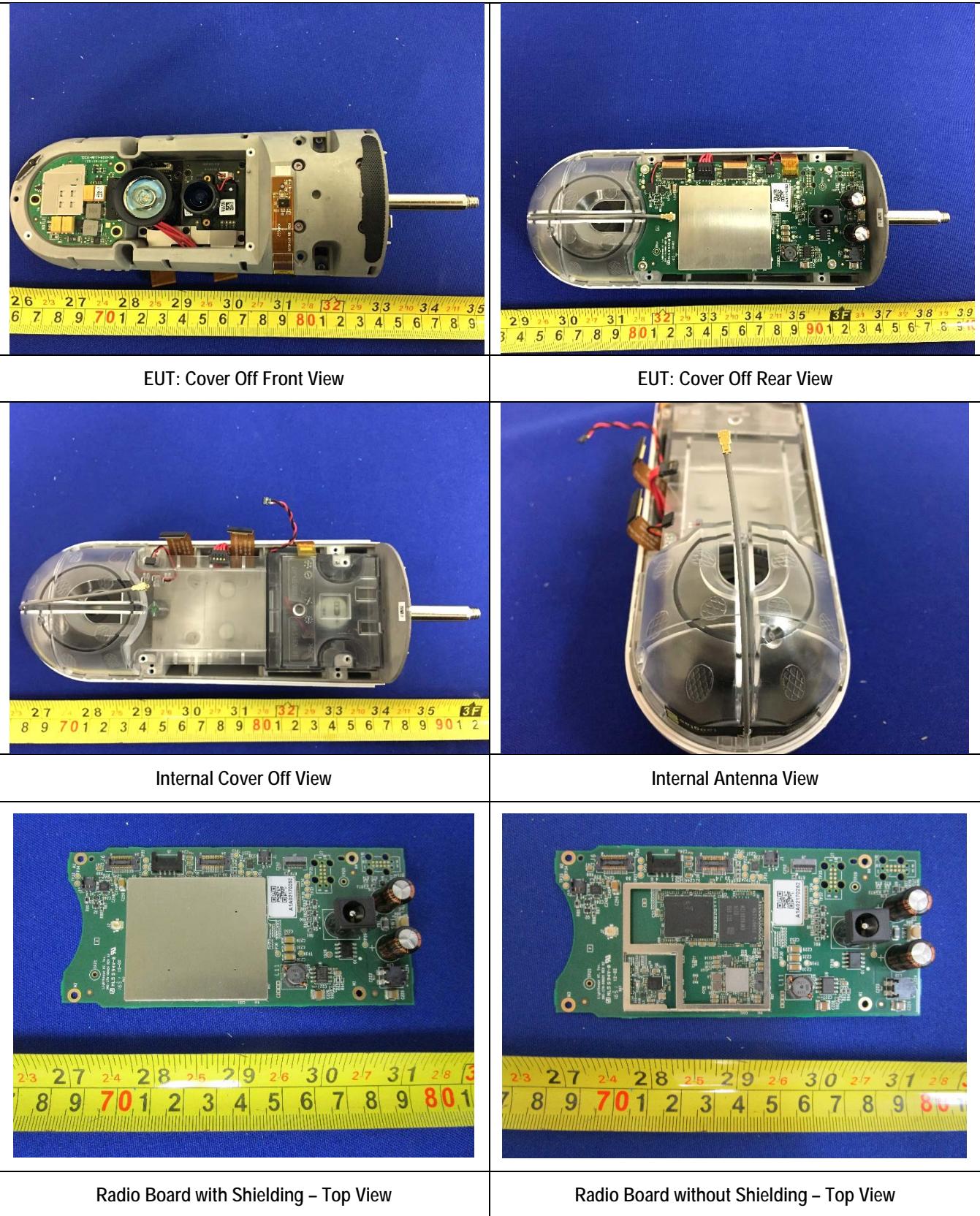


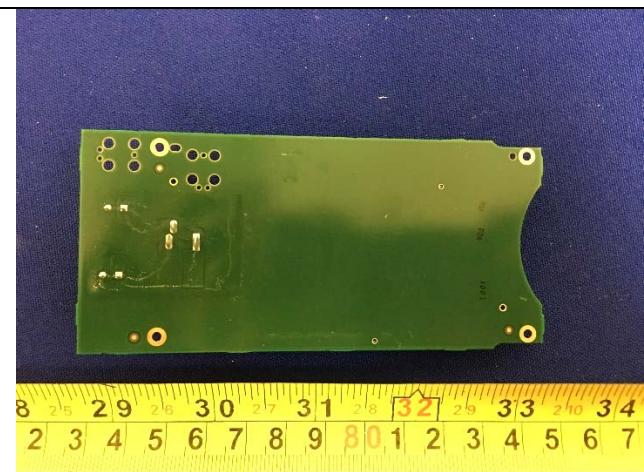
Support Equipment Power Supply Top View



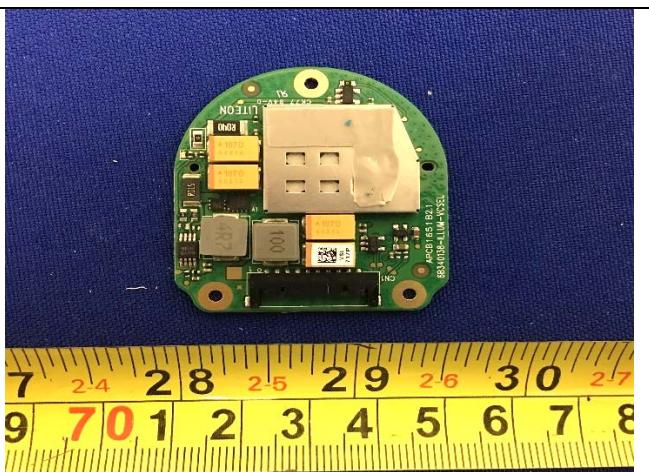
Support Equipment Power Supply Bottom View

6.5 EUT Photos – Internal





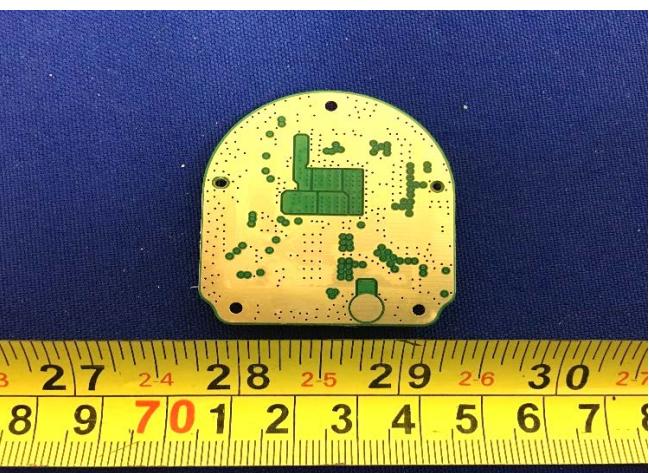
Radio Board without Shielding – Bottom View



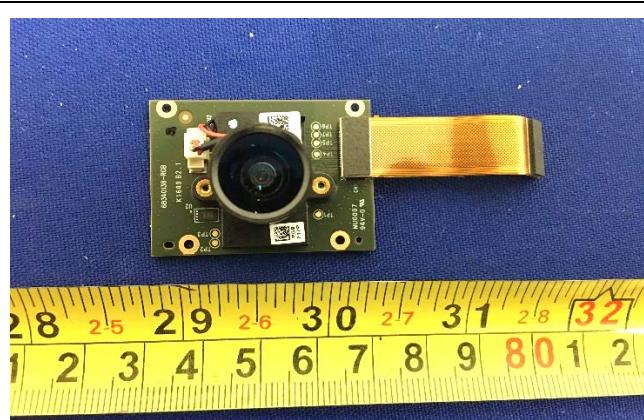
Internal PCBA 1 with Shielding Top View



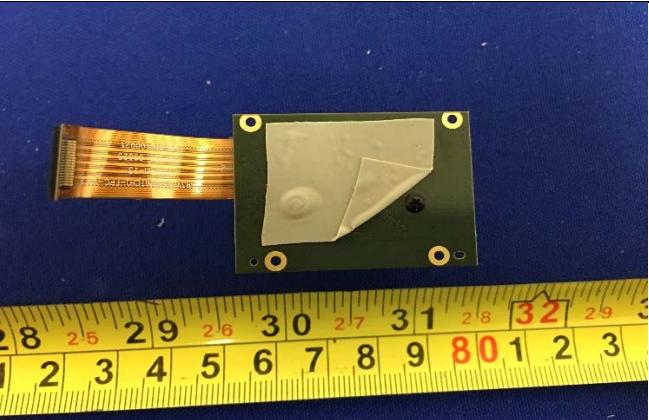
Internal PCBA 1 without Shielding Top View



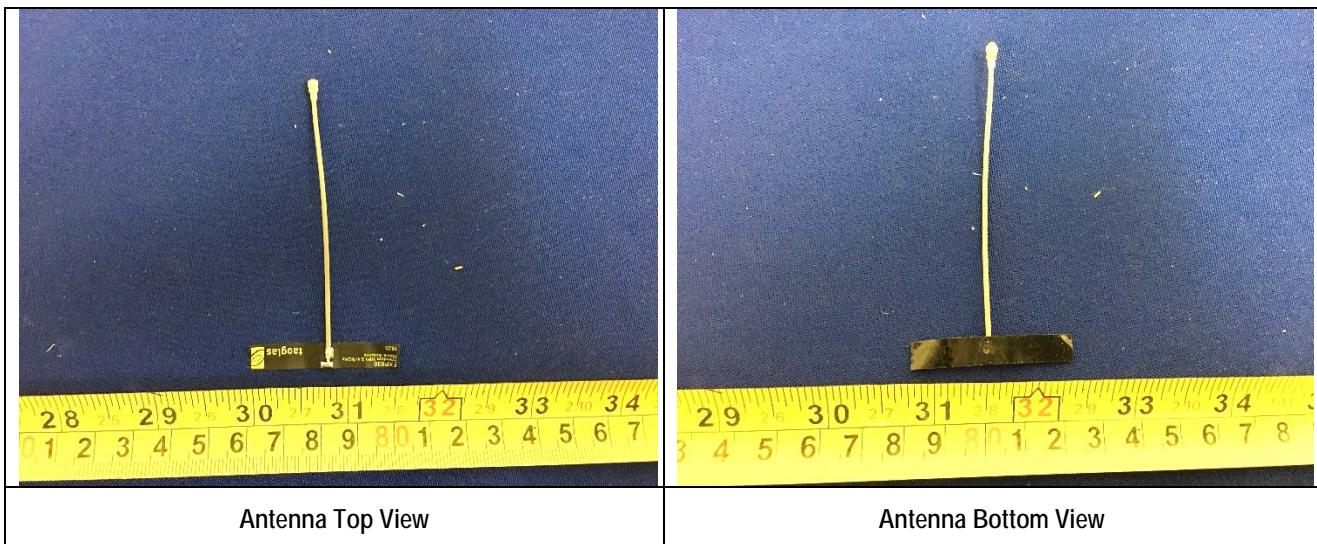
Internal PCBA 1 Bottom View



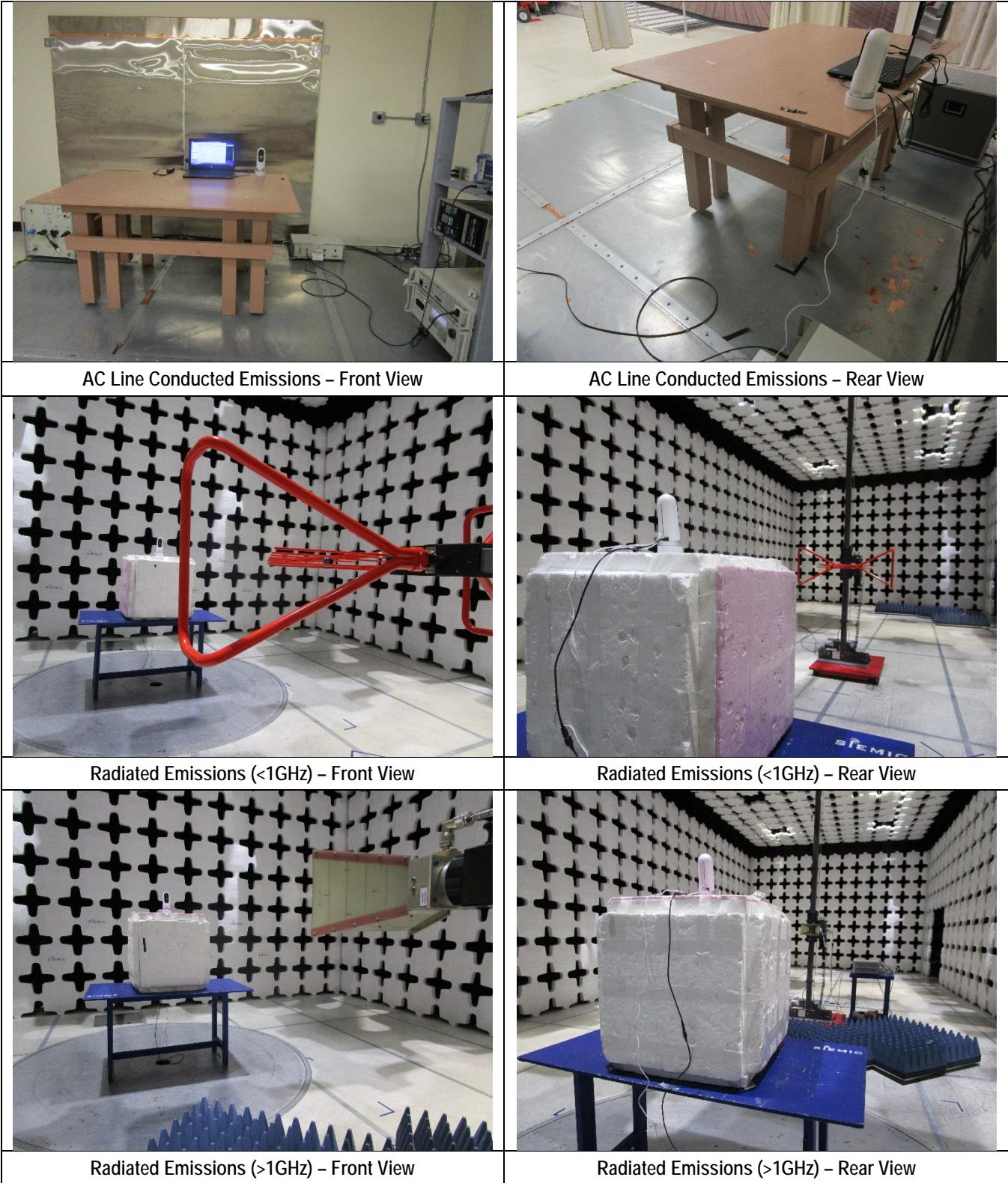
Internal PCBA 2 Top View



Internal PCBA 2 Bottom View



6.6 EUT Test Setup Photos



7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

| Item | Supporting Equipment Description | Model | Serial Number | Manufacturer | Note |
|------|----------------------------------|-------|---------------|--------------|------|
| 1 | Laptop | N/A | 3YZQ162 | Dell | - |
| | | | | | |
| | | | | | |

7.2 Cabling Description

| Name | Connection Start | | Connection Stop | | Length / shielding Info | | Note |
|------|------------------|----------|-----------------|----------|-------------------------|------------|------|
| | From | I/O Port | To | I/O Port | Length (m) | Shielding | |
| USB | EUT | I/O Port | Laptop | USB | 1 | Unshielded | - |
| | | | | | | | |

7.3 Test Software Description

| Test Item | Software | Description |
|------------|----------|---|
| RF Testing | QRCT | Set the EUT to transmit continuously in different test mode |
| | | |
| | | |

8 Test Summary

| Test Item | Test standard | | Test Method/Procedure | | Pass / Fail |
|--------------------------------|---------------|--------------|-----------------------|--|-------------|
| Restricted Band of Operation | FCC | 15.205 | FCC | ANSI C63.10: 2013 Public Notice DA 00-705 | |
| | IC | RSS Gen 8.10 | | RSS Gen Issue 4: 2014 | |
| AC Conducted Emissions Voltage | FCC | 15.207(a) | FCC | ANSI C63.10: 2013 | |
| | IC | RSS Gen 8.8 | | RSS Gen Issue 4: 2014 | |

DSS Band Requirement

| Test Item | Test standard | | Test Method/Procedure | | Pass / Fail |
|---|---|----------------|-----------------------|-------------------------|-------------|
| Channel Separation | FCC | 15.247 (a)(1) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.1.5) | IC | - | |
| 20dB Occupied Bandwidth | FCC | 15.247(a)(1) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.1.2) | IC | - | |
| 99% Occupied Bandwidth | FCC | 15.247(a)(2) | FCC | | |
| | IC | RSS Gen 6.6 | IC | RSS Gen Issue 4: 2014 - | |
| Number of Hopping Channels | FCC | 15.247(a)(1) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.1.5) | IC | - | |
| Band Edge and Radiated Spurious Emissions | FCC | 15.247(d) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247(5.5) | IC | - | |
| Time of Occupancy | FCC | 15.247(a)(1) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.1.5) | IC | - | |
| Output Power | FCC | 15.247(b) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.4.2) | IC | - | |
| Receiver Spurious Emissions | FCC | 15.247(d) | FCC | - | |
| | IC | RSS Gen (7.1) | IC | RSS Gen (7.1) | |
| Antenna Gain > 6 dBi | FCC | 15.247(e) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.4.6) | IC | - | |
| Power Spectral Density | FCC | 15.247(e) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.2.2) | IC | - | |
| Hybrid System Requirement | FCC | 15.247(f) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.3) | IC | - | |
| Hopping Capability | FCC | 15.247(g) | FCC | Public Notice DA 00-705 | |
| | IC | RSS247 (5.1.5) | IC | - | |
| RF Exposure requirement | FCC | 15.247(i) | FCC | Public Notice DA 00-705 | |
| | IC | RSS Gen(3.2) | IC | - | |
| Remark | 1. All measurement uncertainties are not taken into consideration for all presented test result. 2. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual. | | | | |

9 Measurement Uncertainty

9.1 Conducted Emissions

The test is to measure the conducted emissions to the mains port of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the LISN
- Uncertainty of cables
- Uncertainty due to the mismatches
- Etc, see the below table for details

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|-----------------------------------|------------|--------------------------|----------|-------------------------|----------------------|
| Receiver Reading | 0.12 | Rectangular | 1.732 | 1 | 0.069284 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.105 |
| Filter Insertion Loss | 0.25 | Normal | 2 | 1 | 0.125 |
| LISN Insertion Loss | 0.40 | Normal | 2 | 1 | 0.20 |
| Receiver CW accuracy | 0.5 | Rectangular | 1.732 | 1 | 0.2886836 |
| Pulse Amplitude Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| PRF Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| Mismatch LISN - Receiver | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| LISN Impedance | 2.5 | Triangular | 2.449 | 1 | 1.0208248 |
| Combined Standard Uncertainty | | | | | 1.928133 |
| Expanded Uncertainty (K=2) | | | | | 3.856266 |

The total derived measurement uncertainty is +/- 3.86 dB.

9.2 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|-----------------------------------|------------|--------------------------|----------|-------------------------|----------------------|
| Receiver Reading | 0.12 | Rectangular | 1.732 | 1 | 0.069284 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.105 |
| Filter Insertion Loss | 0.25 | Normal | 2 | 1 | 0.125 |
| Antenna Factor | 0.65 | Normal | 2 | 1 | 0.325 |
| Receiver CW accuracy | 0.5 | Rectangular | 1.732 | 1 | 0.2886836 |
| Pulse Amplitude Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| PRF Response | 1.5 | Rectangular | 1.732 | 1 | 0.86605081 |
| Mismatch Filter - Receiver | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| NSA Calibration | 4.0 | U-Shape | 1.414 | 1 | 2.8288543 |
| Combined Standard Uncertainty | | | | | 3.0059131 |
| Expanded Uncertainty (K=2) | | | | | 6.0118262 |

The total derived measurement uncertainty is +/- 6.00 dB.

9.3 Radiated Emissions (1GHz to 40GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|-----------------------------------|------------|--------------------------|----------|-------------------------|----------------------|
| Receiver Reading | 0.12 | Rectangular | 1.732 | 1 | 0.0692840 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.1050000 |
| Filter Insertion Loss | 0.25 | Normal | 2 | 1 | 0.1250000 |
| Antenna Factor | 0.65 | Normal | 2 | 1 | 0.3250000 |
| Receiver CW accuracy | 0.5 | Rectangular | 1.732 | 1 | 0.2886836 |
| Pulse Amplitude Response | 1.5 | Rectangular | 1.732 | 1 | 0.8660508 |
| PRF Response | 1.5 | Rectangular | 1.732 | 1 | 0.8660508 |
| Mismatch Filter - Receiver | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| VSWR Calibration | 2.0 | U-Shape | 1.414 | 1 | 1.4144272 |
| Combined Standard Uncertainty | | | | | 4.2363 |
| Expanded Uncertainty (K=2) | | | | | 8.4726 |

The total derived measurement uncertainty is +/- 8.47 dB.

9.4 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

| Source of Uncertainty | Value (dB) | Probability Distribution | Division | Sensitivity Coefficient | Expanded Uncertainty |
|-----------------------------------|------------|--------------------------|----------|-------------------------|----------------------|
| Reference Level | 0.12 | Rectangular | 1.732 | 1 | 0.069284 |
| Cable Insertion Loss | 0.21 | Normal | 2 | 1 | 0.105 |
| Attenuator | 0.25 | Normal | 2 | 1 | 0.125 |
| Mismatch | 0.25 | U-Shape | 1.414 | 1 | 0.1768033 |
| Combined Standard Uncertainty | | | | | 0.476087 |
| Expanded Uncertainty (K=2) | | | | | 0.952174 |

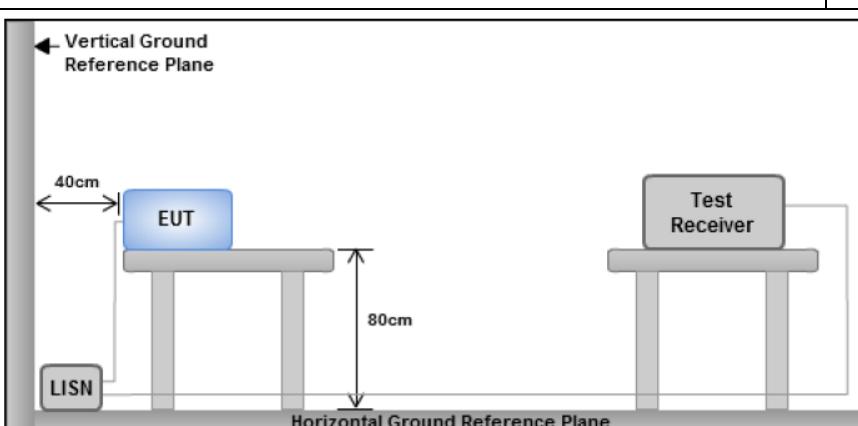
The total derived measurement uncertainty is +/- 0.95 dB.

10 Measurements, Examination and Derived Results

10.1 Conducted Emissions

Conducted Emission Limit

| Frequency ranges (MHz) | Limit (dBuV) | |
|------------------------|--------------|---------|
| | QP | Average |
| 0.15 ~ 0.5 | 66 – 56 | 56 – 46 |
| 0.5 ~ 5 | 56 | 46 |
| 5 ~ 30 | 60 | 50 |

| Spec | Item | Requirement | Applicable |
|--------------|------|---|---|
| 47CFR§15.207 | a) | For Low-power radio-frequency devices that 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 the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges. | <input checked="" type="checkbox"/> |
| Test Setup | |  <p>Note: 1. Support units were connected to second LISN. 2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes</p> | |
| Procedure | | | <ul style="list-style-type: none"> - The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B. - The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains. - The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable. - All other supporting equipment was powered separately from another main supply. |
| Remark | | | EUT tested with AC 120V 60Hz |
| Result | | | <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail |

Test Data Yes N/A

Test Plot Yes (See below) N/A

Test was done by Rachana Khanduri at Conducted Emission Test Site.