



REPORT No. : SZ17120153W01

TEST REPORT

APPLICANT : Golden Mark (HK) Limited

PRODUCT NAME : Smart Hub

MODEL NAME : ZL-100

BRAND NAME : N/A

FCC ID : 2AMY9ZL100

STANDARD(S) : 47 CFR Part 15 Subpart C

TEST DATE : 2018-01-23 to 2018-01-25

ISSUE DATE : 2018-01-30

Tested by: Wu Junke
Wu Junke (Test Engineer)

Approved by: Peng Huarui
Peng Huarui (Supervisor)

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MORLAB

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REPORT No. : SZ17120153W01

| Change History | | |
|----------------|------------|-------------------|
| Issue | Date | Reason for change |
| 1.0 | 2018-01-30 | First edition |
| | | |



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

| | |
|------------------------------|---|
| Applicant: | Golden Mark (HK) Limited |
| Applicant Address: | 6/F., Kimberley Plaza, 45-47 Kimberley Road, Tsim Sha Tsui, Kowloon, Hong Kong, China |
| Manufacturer: | Golden Mark (HK) Limited |
| Manufacturer Address: | 6/F., Kimberley Plaza, 45-47 Kimberley Road, Tsim Sha Tsui, Kowloon, Hong Kong, China |

1.2. Equipment Under Test (EUT) Description

| | |
|-----------------------------|-------------------------------|
| Product Name: | Smart Hub |
| Serial No: | (N/A, marked #1 by test site) |
| Hardware Version: | N/A |
| Software Version: | N/A |
| Operating Frequency: | 908.4MHz; 916.0MHz |
| Antenna Type: | PCB Antenna |
| Antenna Gain: | 2 dBi |

Note 1: The EUT is only operating at 908.4MHz and 916MHz.

Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

| No | Identity | Document Title |
|----|----------------------------------|-------------------------|
| 1 | 47 CFR Part 15 (10-1-15 Edition) | Radio Frequency Devices |

Test detailed items/section required by FCC rules and results are as below:

| No. | Section | Description | Test Date | Test Engineer | Result |
|-----|----------------------|---|--------------|---------------|--------|
| 1 | 15.203 | Antenna Requirement | N/A | N/A | PASS |
| 2 | 15.215 | Bandwidth | Jan 23, 2018 | Wu Junke | PASS |
| 3 | 15.207 | Conducted Emission | Jan 24, 2018 | Wu Junke | PASS |
| 4 | 15.249(a) | Field strength | Jan 23, 2018 | Wu Junke | PASS |
| 5 | 15.209, 15.249(a) | Radiated Emission and field strength of harmonics | Jan 23, 2018 | Wu Junke | PASS |

Note 1: The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013.

1.4. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

| | |
|-----------------------------|---------|
| Temperature (°C): | 15 - 35 |
| Relative Humidity (%): | 30 -60 |
| Atmospheric Pressure (kPa): | 86-106 |



2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 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.

2.1.2. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

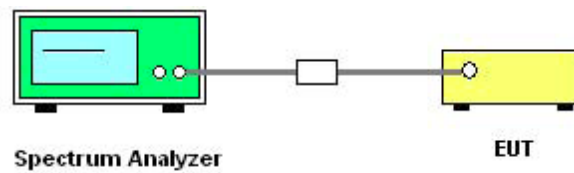
2.2. Bandwidth

2.2.1. Requirement

Refer to FCC 15.215

2.2.2. Test Description

A. Test Set:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 10 kHz. In order to make an accurate measurement, set the span greater than RBW.

B. Equipments List:

Please reference ANNEX A(1.5).

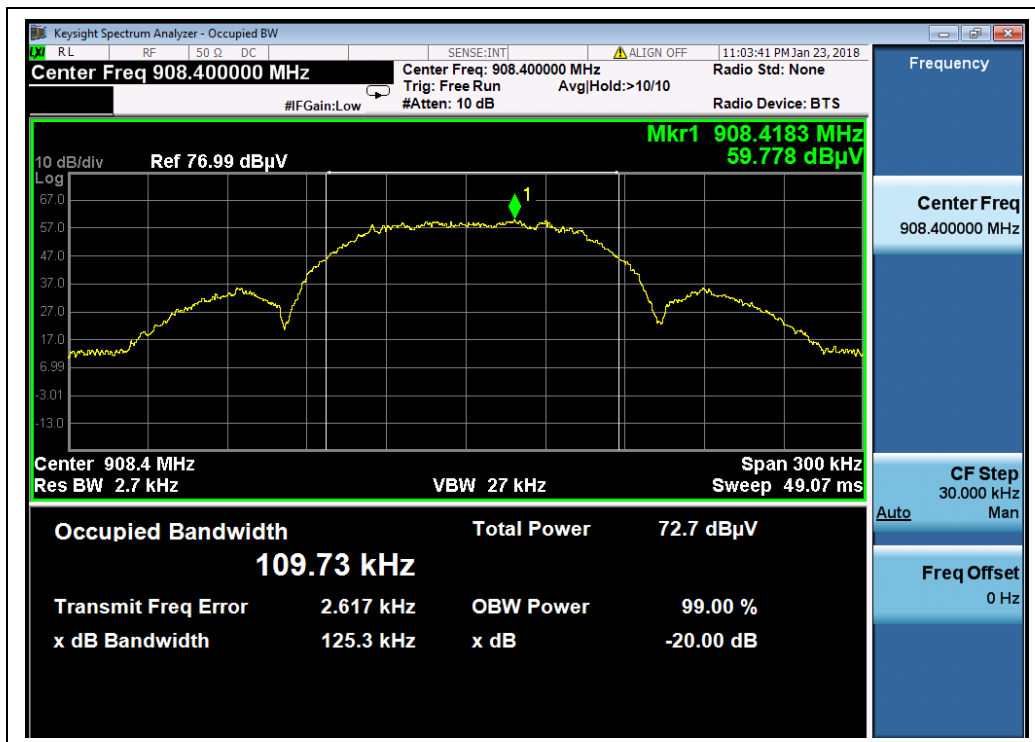
2.2.3. Test Result

A. Test Verdict:

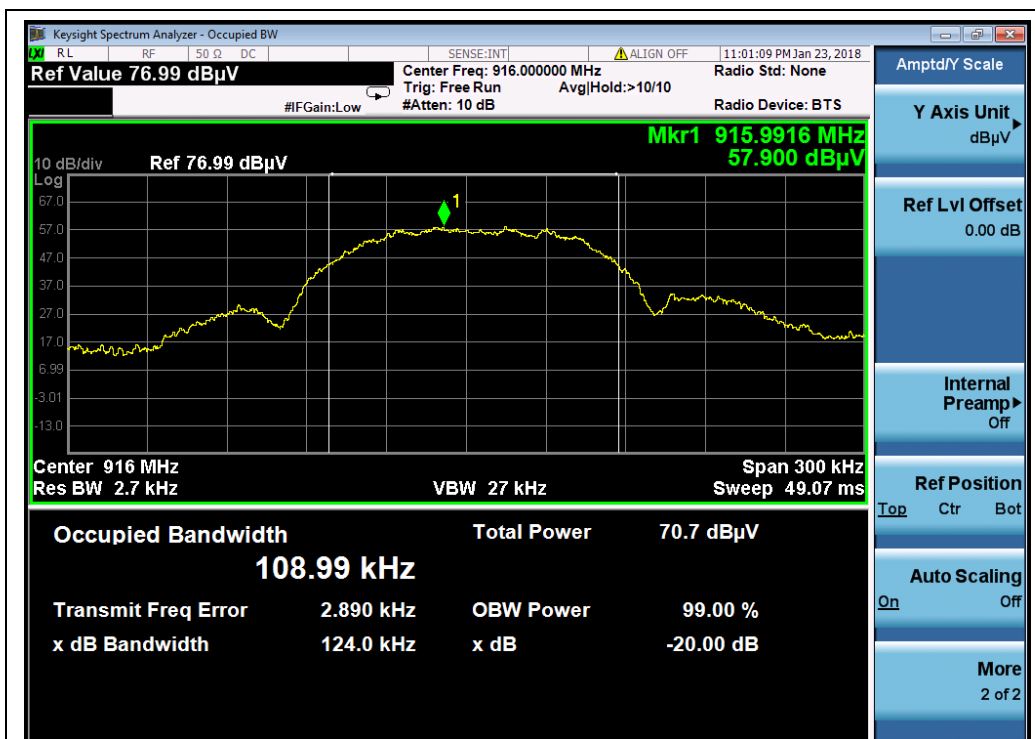
| Channel | Frequency (MHz) | 20 dB Bandwidth (kHz) | Result |
|---------|-----------------|-----------------------|--------|
| 1 | 908.4 | 125.3 | PASS |
| 2 | 916.0 | 124.0 | PASS |



B. Test Plots:



(Channel 1: 908.4MHz)



(Channel 2: 916.0 MHz)

2.3. Conducted Emission

2.3.1. Requirement

According to FCC section 15.207, for an intentional radiator 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 within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

| Frequency (MHz) | range | Conducted Limit (dB μ V) | |
|--------------------|-------|------------------------------|----------|
| | | Quai-peak | Average |
| 0.15 - 0.50 | | 66 to 56 | 56 to 46 |
| 0.50 - 5 | | 56 | 46 |
| 5 - 30 | | 60 | 50 |

NOTE:

- The lower limit shall apply at the band edges.
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.3.2. Test Description

A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.

B. Equipments List:

Please reference ANNEX A(1.5).

2.3.3. Test Result

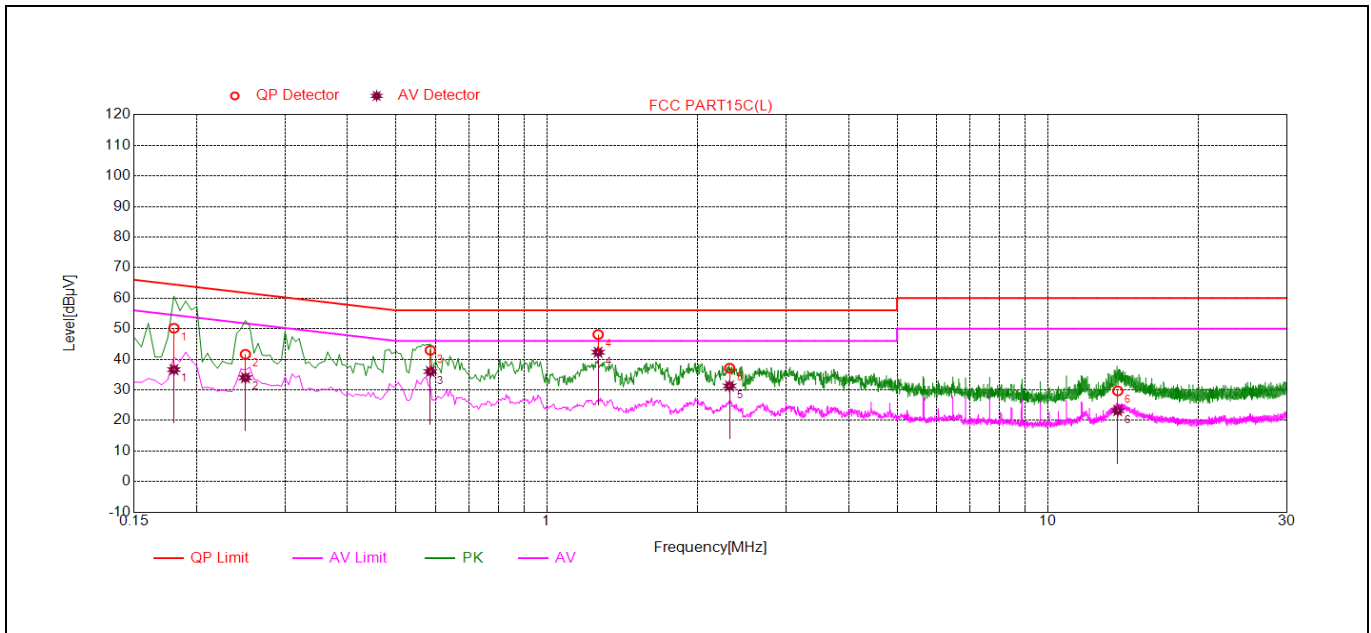
The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

A. Test setup:

The EUT configuration of the emission tests is EUT + Link.

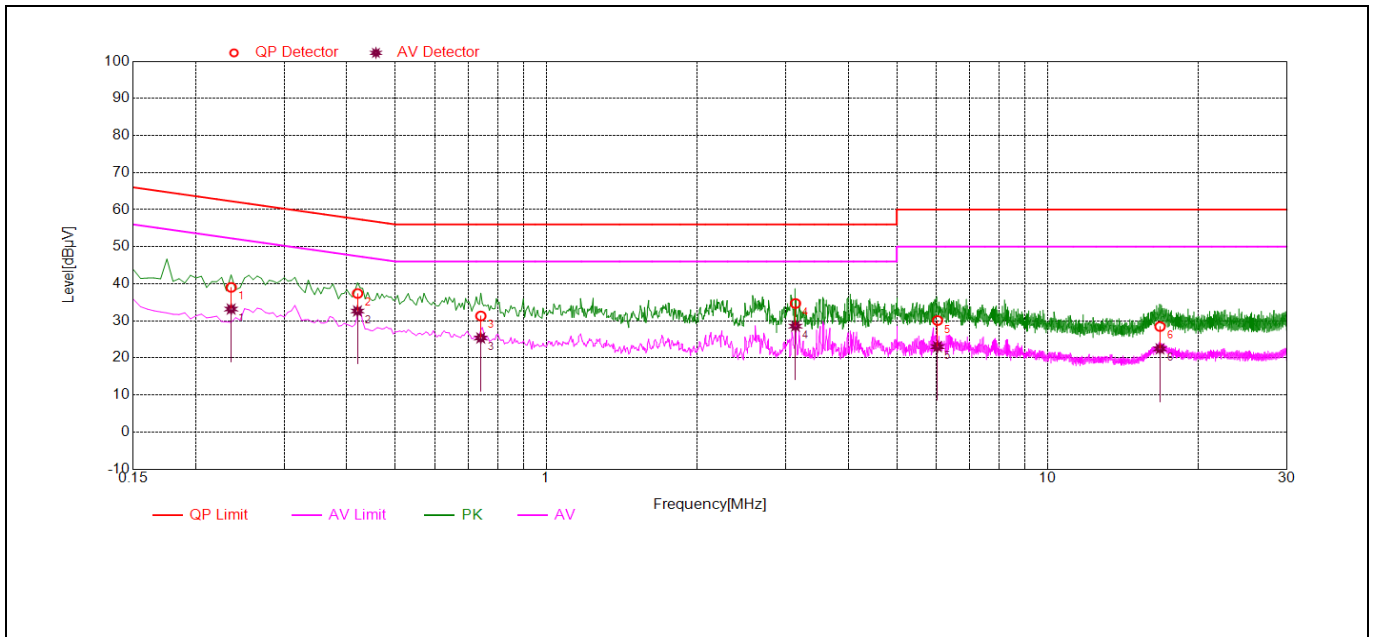
Note: The test voltage is AC 120V/60Hz.

B. Test Plots:



(L Phase)

| NO. | Fre. (MHz) | Emission Level (dBμV) | | Limit (dBμV) | | Power-line | Verdict |
|-----|---------------|-----------------------|---------|--------------|---------|------------|---------|
| | | Quai-peak | Average | Quai-peak | Average | | |
| 1 | 0.18 | 50.17 | 36.64 | 64.49 | 54.49 | Line | PASS |
| 2 | 0.25 | 41.66 | 33.99 | 61.76 | 51.76 | | PASS |
| 3 | 0.59 | 42.96 | 36.00 | 56.00 | 46.00 | | PASS |
| 4 | 1.27 | 48.13 | 42.32 | 56.00 | 46.00 | | PASS |
| 5 | 2.31 | 37.11 | 31.28 | 56.00 | 46.00 | | PASS |
| 6 | 13.79 | 29.66 | 23.21 | 60.00 | 50.00 | | PASS |



(N Phase)

| NO. | Fre. (MHz) | Emission Level (dBμV) | | Limit (dBμV) | | Power-line | Verdict |
|-----|---------------|-----------------------|---------|--------------|---------|------------|---------|
| | | Quai-peak | Average | Quai-peak | Average | | |
| 1 | 0.24 | 39.02 | 33.18 | 62.27 | 52.27 | Line | PASS |
| 2 | 0.42 | 37.38 | 32.65 | 57.45 | 47.45 | | PASS |
| 3 | 0.74 | 31.32 | 25.38 | 56.00 | 46.00 | | PASS |
| 4 | 3.14 | 34.68 | 28.56 | 56.00 | 46.00 | | PASS |
| 5 | 6.03 | 30.09 | 23.03 | 60.00 | 50.00 | | PASS |
| 6 | 16.76 | 28.47 | 22.45 | 60.00 | 50.00 | | PASS |

2.4. Field strength of fundamental

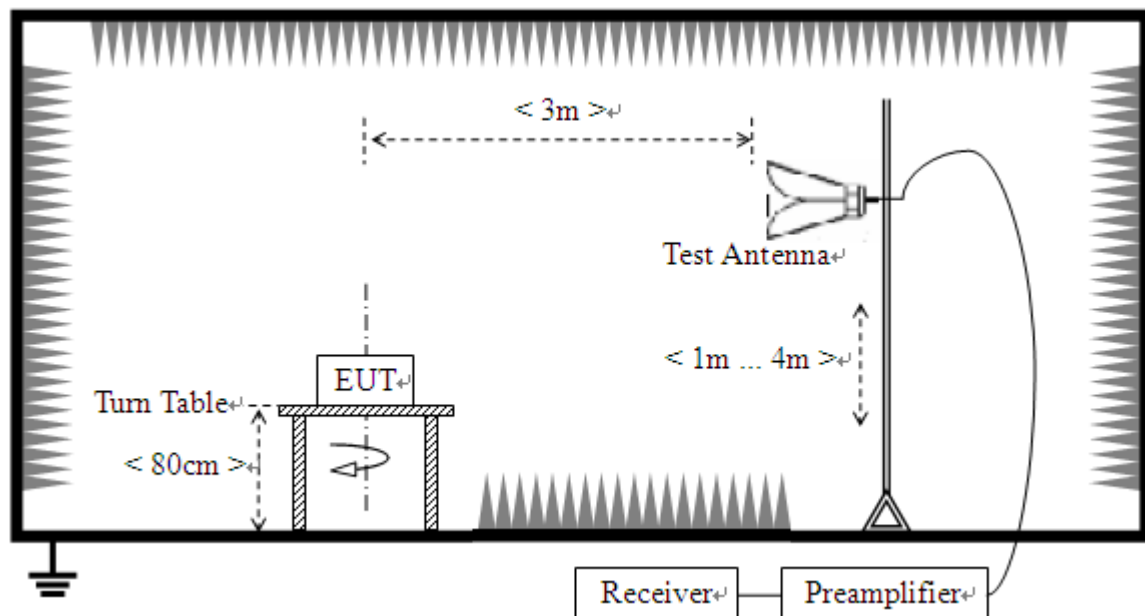
2.4.1. Requirement

According to FCC section 15.249(a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|-----------------------|--|--|
| 902-928 MHz | 50 | 500 |
| 2400-2483.5 MHz | 50 | 500 |
| 5725-5875 MHz | 50 | 500 |
| 24.0-24.25 GHz | 250 | 2500 |

2.4.2. Test Description

A. Test Setup:



The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

**B. Equipments List:**

Please reference ANNEX A(1.5).

2.4.3. Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 120 kHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

2.4.4. Test Result

The measurement results are obtained as below:

$E \text{ [dB}\mu\text{V/m]} = U_R + A_T + A_{\text{Factor}} \text{ [dB]}; A_T = L_{\text{Cable loss}} \text{ [dB]} - G_{\text{preamp}} \text{ [dB]}$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

During the test, the total correction Factor A_T and A_{Factor} were built in test software.

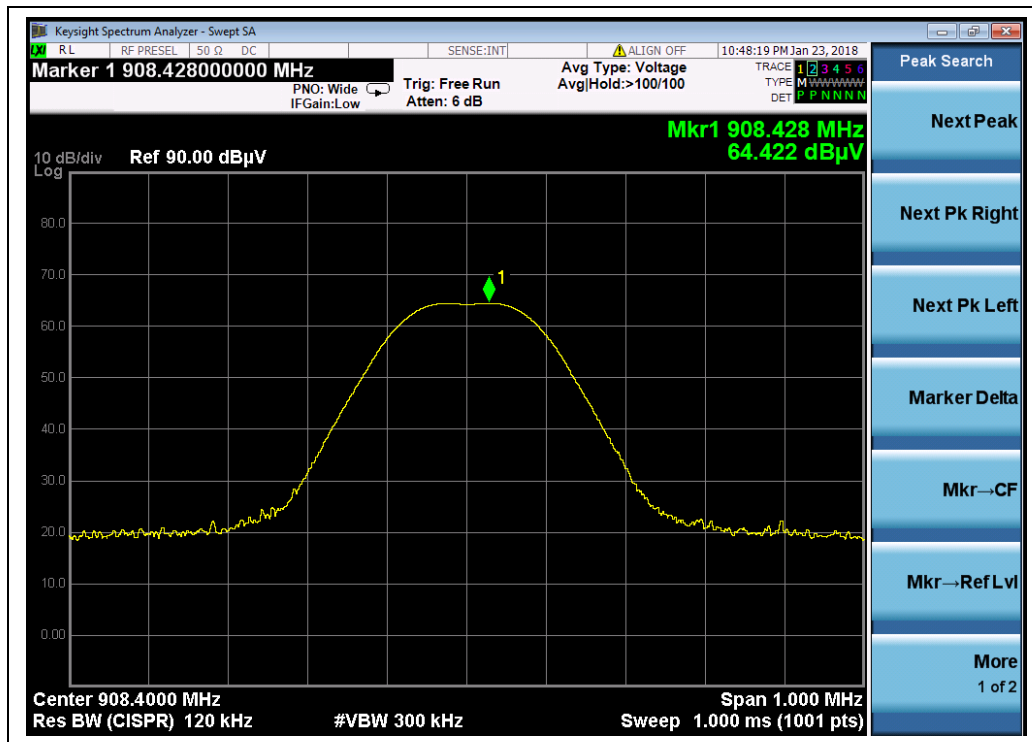
Note: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report

A. Test Verdict:

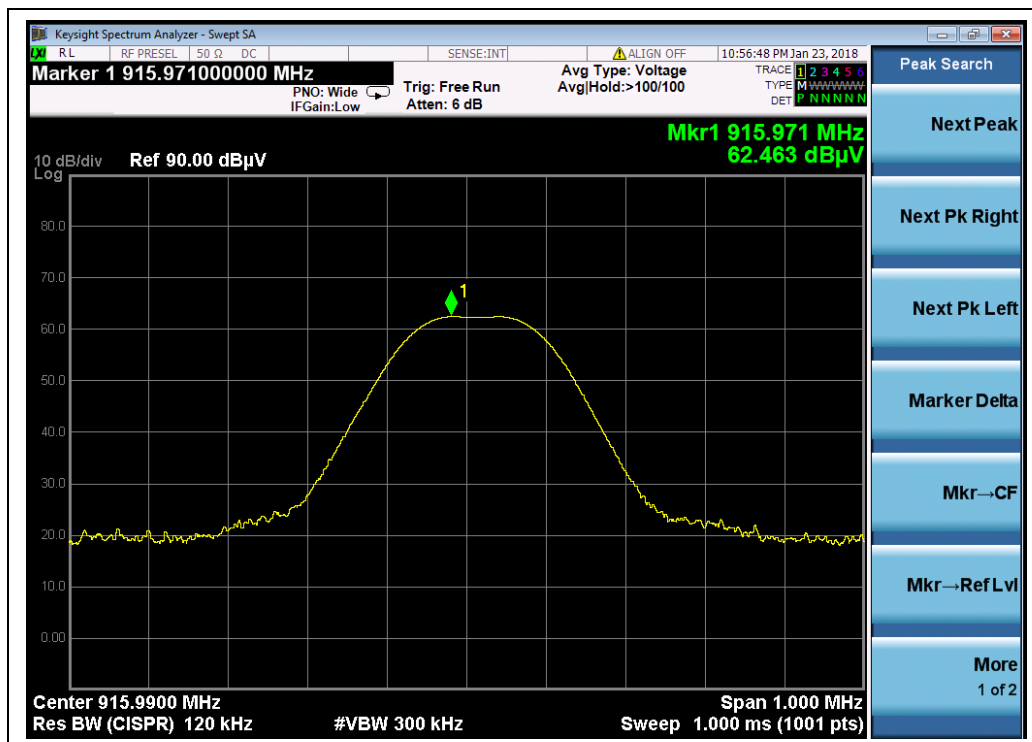
| Frequency (MHz) | Detector | Receiver Reading U_R (dBuV) | A_T (dB) | A_{Factor} (dB@3m) | Max. Emission E (dB μ V/m) | Limit (dB μ V/m) | Verdict |
|--------------------|----------|--|------------|--------------------------------|---|-------------------------|---------|
| | PK/ AV | | | | | | |
| 908.4 | PK | 64.42 | 2.24 | 28.50 | 95.16 | 113.98 | Pass |
| 916.0 | PK | 62.46 | 2.24 | 28.50 | 93.20 | 113.98 | Pass |



B. Test Plot:



(Channel 1: 908.4MHz)



(Channel 2: 916.0 MHz)

2.5. Radiated Emission and field strength of harmonics

2.5.1. Requirement

According to section 15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|-----------------------|--|--|
| 902-928 MHz | 50 | 500 |
| 2400-2483.5 MHz | 50 | 500 |
| 5725-5875 MHz | 50 | 500 |
| 24.0-24.25 GHz | 250 | 2500 |

According to section 15.249(d), Emission Radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in Section 15.209:

| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) | Field Strength Limitation at 3m Measurement Distance | |
|-----------------|-----------------------|--------------------------|--|------------------------|
| | | | (uV/m) | (dBuV/m) |
| 0.009 - 0.490 | 2400/F(kHz) | 300 | 10000* 2400/F(KHz) | 20log 2400/F(KHz) + 80 |
| 0.490 - 1.705 | 24000/F(kHz) | 30 | 100* 2400/F(KHz) | 20log 2400/F(KHz) + 40 |
| 1.705 - 30.0 | 30 | 30 | 100*30 | 20log 30 + 40 |
| 30 - 88 | 100 | 3 | 100 | 20log 100 |
| 88 - 216 | 150 | 3 | 150 | 20log 150 |
| 216 - 960 | 200 | 3 | 200 | 20log 200 |
| Above 960 | 500 | 3 | 500 | 20log 500 |

According to section 15.249(e), for frequencies above 1000MHz, the above field strength limits are based on average limits. The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20dB under any condition of modulation.

Note:

- 1) The tighter limit shall apply at the boundary between two frequency range.
- 2) Limitation expressed in dBuV/m is calculated by 20log Emission Level(uV/m).
- 3) If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula of $Ld1 = Ld2 * (d2/d1)^2$.

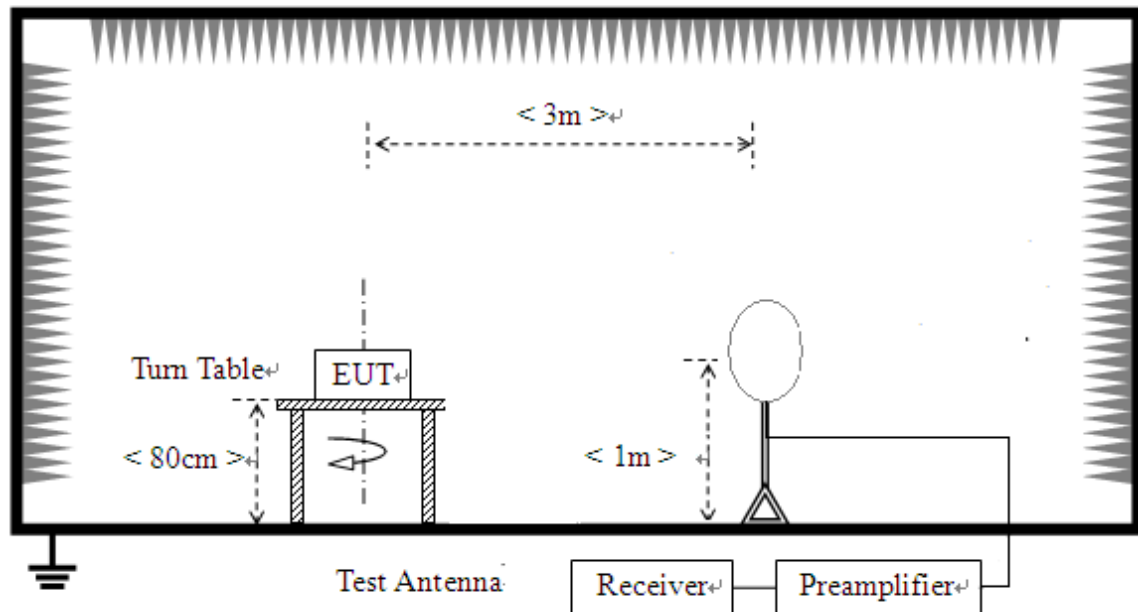
Example: F.S Limit at 30m distance is 30uV/m, then F.S Limitation at 3m distance is adjusted as

$$Ld1 = L1 = 30uV/m * (10)^2 = 100 * 30uV/m$$

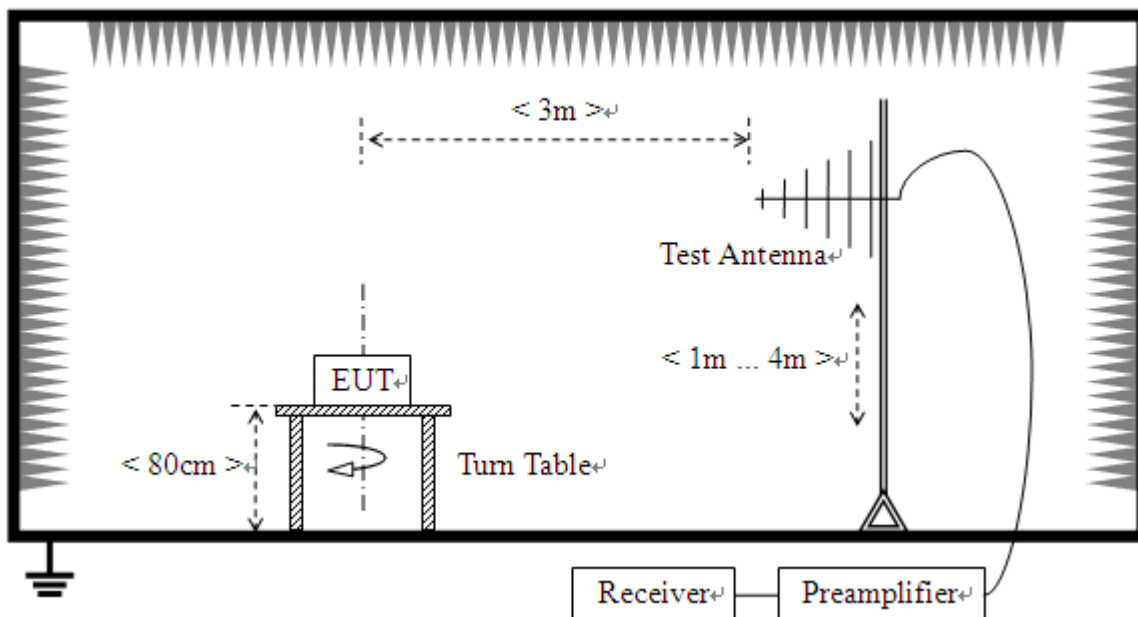
2.5.2. Test Description

A. Test Setup:

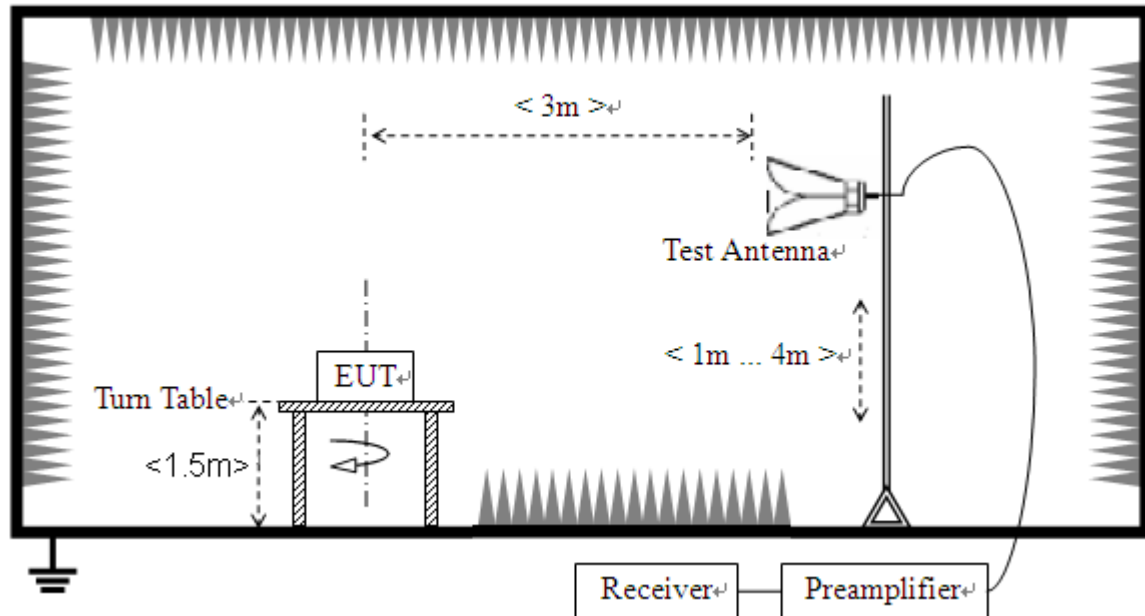
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz. Test site have a minimum area of the ground plane covered with RF absorbing material as specified in Figure 6 of ANSI C63.4: 2014.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10:2013. For radiated emissions below or equal to 1GHz, The EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10:2013.

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

- In the frequency range of 9 kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant



emissions, with polarization oriented for maximum response. The test antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final test antenna elevation shall be that which maximizes the emissions. The test antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The emission levels at both horizontal and vertical polarizations should be tested.

B. Equipments List:

Please reference ANNEX A(1.5).

2.5.3. Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V/m]} = U_R + A_T + A_{\text{Factor}} \text{ [dB]}; A_T = L_{\text{Cable loss}} \text{ [dB]} - G_{\text{preamp}} \text{ [dB]}$$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

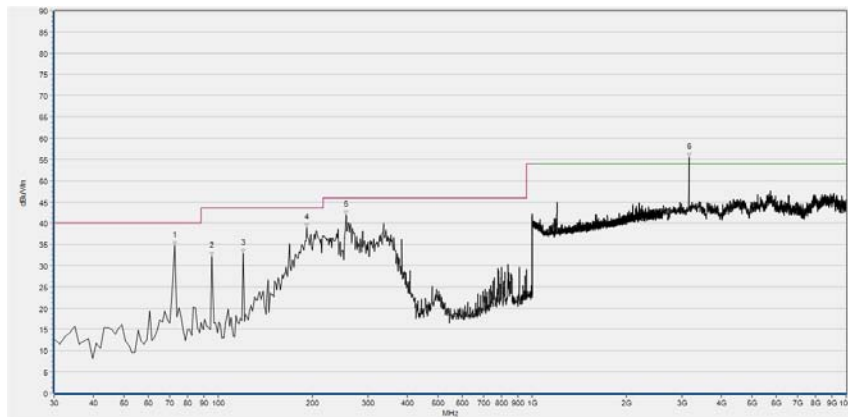
During the test, the total correction Factor A_T and A_{Factor} were built in test software.

Note: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.



Test Plots



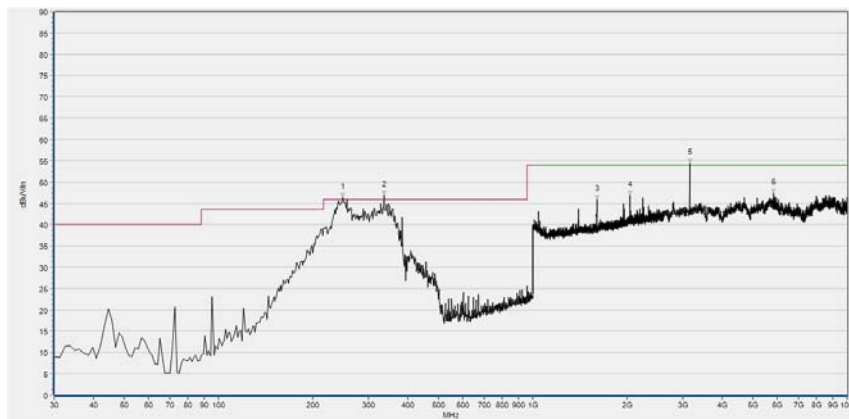
| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|------------|---------|
| 72.491 | 34.77 | N/A | N/A | N/A | 40.00 | N/A | Horizontal | PASS |
| 95.557 | 32.18 | N/A | N/A | N/A | 43.50 | N/A | Horizontal | PASS |
| 119.837 | 32.86 | N/A | N/A | N/A | 43.50 | N/A | Horizontal | PASS |
| 191.464 | 38.89 | N/A | N/A | N/A | 43.50 | N/A | Horizontal | PASS |
| 254.593 | 41.83 | N/A | N/A | N/A | 46.00 | N/A | Horizontal | PASS |
| 3155.300 | 56.89 | N/A | 50.80 | 74.0 | N/A | 54.00 | Horizontal | PASS |

(908.4MHz, Antenna Horizontal, 30MHz to 25GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|----------|---------|
| 72.491 | 34.45 | N/A | N/A | N/A | 40.00 | N/A | Vertical | PASS |
| 95.557 | 33.83 | N/A | N/A | N/A | 43.50 | N/A | Vertical | PASS |
| 240.025 | 38.31 | N/A | N/A | N/A | 46.00 | N/A | Vertical | PASS |
| 327.434 | 36.38 | N/A | N/A | N/A | 46.00 | N/A | Vertical | PASS |
| 2199.200 | 51.68 | N/A | N/A | 74.0 | N/A | 54.0 | Vertical | PASS |
| 3155.000 | 54.98 | N/A | 46.58 | 74.0 | N/A | 54.0 | Vertical | PASS |

(908.4MHz, Antenna Vertical, 30MHz to 25GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|------------|---------|
| 248.523 | 46.47 | 42.59 | N/A | N/A | 46.00 | N/A | Horizontal | PASS |
| 335.932 | 46.92 | 41.95 | N/A | N/A | 46.00 | N/A | Horizontal | PASS |
| 1599.280 | 45.86 | N/A | N/A | 74.0 | N/A | 54.00 | Horizontal | PASS |
| 2041.056 | 46.87 | N/A | N/A | 74.0 | N/A | 54.00 | Horizontal | PASS |
| 3153.992 | 54.45 | N/A | 42.68 | 74.0 | N/A | 54.00 | Horizontal | PASS |
| 5834.334 | 47.37 | N/A | N/A | 74.0 | N/A | 54.00 | Horizontal | PASS |

(916MHz, Antenna Horizontal, 30MHz to 25GHz)



| Fre. (MHz) | Pk (dBμV/m) | QP (dBμV/m) | AV (dBμV/m) | Limit-PK (dBμV/m) | Limit-QP (dBμV/m) | Limit-AV (dBμV/m) | Antenna | Verdict |
|---------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|----------|---------|
| 72.491 | 34.51 | N/A | N/A | N/A | 40.00 | N/A | Vertical | PASS |
| 95.557 | 34.54 | N/A | N/A | N/A | 43.50 | N/A | Vertical | PASS |
| 235.169 | 38.32 | N/A | N/A | N/A | 46.00 | N/A | Vertical | PASS |
| 328.648 | 36.82 | N/A | N/A | N/A | 40.00 | N/A | Vertical | PASS |
| 2192.797 | 52.59 | N/A | N/A | 74.0 | N/A | 54.00 | Vertical | PASS |
| 3155.000 | 54.89 | N/A | 47.36 | 74.0 | N/A | 54.00 | Vertical | PASS |

(916MHz, Antenna Vertical, 30MHz to 25GHz)



Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

| Test items | Uncertainty |
|-------------------|---------------------|
| Bandwidth | $\pm 5\%$ |
| Radiated Emission | $\pm 2.95\text{dB}$ |

This uncertainty represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$



Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

| | |
|--------------------------------------|--|
| Company Name: | Shenzhen Morlab Communications Technology Co., Ltd. |
| Department: | Morlab Laboratory |
| Address: | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, Guangdong Province, P. R. China |
| Responsible Test Lab Manager: | Mr. Su Feng |
| Telephone: | +86 755 36698555 |
| Facsimile: | +86 755 36698525 |

2. Identification of the Responsible Testing Location

| | |
|-----------------|--|
| Name: | Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory |
| Address: | FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, Guangdong Province, P. R. China |

3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192.



4. Test Equipments Utilized

4.1 Radiated Test Equipments

| Equipment Name | Serial No. | Type | Manufacturer | Cal. Date | Cal. Due |
|--------------------------------------|------------|------------|----------------|------------|------------|
| Receiver | MY54130016 | N9038A | Agilent | 2017.05.17 | 2018.05.16 |
| Test Antenna - Bi-Log | 9163-519 | VULB 9163 | Schwarzbeck | 2017.05.14 | 2018.05.13 |
| Test Antenna - Horn | 9170C-531 | BBHA9170 | Schwarzbeck | 2017.09.13 | 2018.09.12 |
| Test Antenna - Loop | 1519-022 | FMZB1519 | Schwarzbeck | 2017.03.07 | 2018.03.06 |
| Test Antenna - Horn | 01774 | BBHA 9120D | Schwarzbeck | 2017.09.13 | 2018.09.12 |
| Coaxial cable (N male) (9KHz-30MHz) | CB04 | EMC04 | Morlab | N/A | N/A |
| Coaxial cable (N male) (30MHz-26GHz) | CB02 | EMC02 | Morlab | N/A | N/A |
| Coaxial cable (N male) (30MHz-26GHz) | CB03 | EMC03 | Morlab | N/A | N/A |
| 1-18GHz pre-Amplifier | MA02 | TS-PR18 | Rohde& Schwarz | 2017.05.17 | 2018.05.16 |
| 18-26.5GHz pre-Amplifier | MA03 | TS-PR18 | Rohde& Schwarz | 2017.05.17 | 2018.05.16 |
| Anechoic Chamber | N/A | 9m*6m*6m | CRT | 2017.11.19 | 2020.11.18 |

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