



RF TEST REPORT

Report No.: SET2023-01168

Product Name: LoRaWAN Sensor Terminal

Model No.: FST100

FCC ID: 2A8OE-FST100

Applicant: Xiamen Four-Faith Communication Technology Co., Ltd.

Address: 11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.

Dates of Testing: 01/10/2023 - 03/01/2023

Issued by: CCIC Southern Testing Co., Ltd.

Lab Location: Electronic Testing Building, No. 43 Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China.

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Test Report

Product.....: LoRaWAN Sensor Terminal

Trade Name: Four-Faith

Applicant.....: Xiamen Four-Faith Communication Technology Co., Ltd.

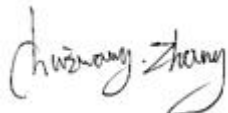
Applicant Address.....: 11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.

Manufacturer.....: Xiamen Four-Faith Communication Technology Co., Ltd.


Manufacturer Address.....: 11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.

Test Standards.....: 47 CFR Part 15 Subpart C
ANSI C63.10-2013

Test Result.....: Pass

Tested by:  2023.03.01

Chuiwang Zhang, Test Engineer

Reviewed by.....:  2023.03.01

Chris You, Senior Engineer

Approved by.....:  2023.03.01

Tao Hou, Manager

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| Change History | | |
|----------------|------------|-------------------|
| Issue | Date | Reason for change |
| 1.0 | 2023.03.01 | First edition |
| | | |
| | | |

1. General Information

1.1. EUT Description

| | |
|-----------------|--|
| Product Name | LoRaWAN Sensor Terminal |
| Model No. | FST100 |
| Frequency Range | LoRa: 902MHz~928MHz |
| Channel Number | 126 |
| Data Rate | SF12, SF11, SF10, SF9, SF8, SF7, SF6, SF5 |
| Modulation Type | LoRa |
| Antenna Type | Internal Antenna |
| Antenna Gain | 1.63dBi |
| Power supply | Disposable Lithium Battery 3.6V/4100mAh*2(Parallel connection) |

Note 1: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.2. Test Standards and Results

The purpose of the report is to conduct testing according to the following FCC certification standards:

| No. | Identity | Document Title |
|-----|-----------------------------|---|
| 1 | 47 CFR Part 15 Subpart C | Radio Frequency Devices |
| 2 | ANSI C63.10-2013 | American National Standard for Testing Unlicensed Wireless Devices |

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

| No. | Section in CFR 47 | Description | Result |
|-----|-------------------------------|--|--------|
| 1 | 15.203 15.247(c) | Antenna Requirement | PASS |
| 2 | 15.247(b)(3) | Peak Conducted Output Power | PASS |
| 3 | 15.247(a)(2) | 6dB and 99% Bandwidth | PASS |
| 4 | 15.247(d) | Conducted Band Edges and Spurious Emission | PASS |
| 5 | 15.247(e) | Power spectral density (PSD) | PASS |
| 6 | 15.207 | AC Power Line Conducted Emission | PASS |
| 7 | 15.209 15.205 15.247(d) | Radiated Band Edges and Spurious Emission | PASS |

Note 1: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10-2013.

Note 2: These RF tests were performed according to the method of measurements prescribed in KDB 558074 D01 15.247 Meas Guidance v05r02.

1.3. Channel List

| Operating frequency (Unit: MHz) | | | | | |
|---------------------------------|-------|-------|--------------|-------|--------------|
| 902.5 | 906.7 | 910.9 | 915.1 | 919.3 | 923.5 |
| 902.7 | 906.9 | 911.1 | 915.3 | 919.5 | 923.7 |
| 902.9 | 907.1 | 911.3 | 915.5 | 919.7 | 923.9 |
| 903.1 | 907.3 | 911.5 | 915.7 | 919.9 | 924.1 |
| 903.3 | 907.5 | 911.7 | 915.9 | 920.1 | 924.3 |
| 903.5 | 907.7 | 911.9 | 916.1 | 920.3 | 924.5 |
| 903.7 | 907.9 | 912.1 | 916.3 | 920.5 | 924.7 |
| 903.9 | 908.1 | 912.3 | 916.5 | 920.7 | 924.9 |
| 904.1 | 908.3 | 912.5 | 916.7 | 920.9 | 925.1 |
| 904.3 | 908.5 | 912.7 | 916.9 | 921.1 | 925.3 |
| 904.5 | 908.7 | 912.9 | 917.1 | 921.3 | 925.5 |
| 904.7 | 908.9 | 913.1 | 917.3 | 921.5 | 925.7 |
| 904.9 | 909.1 | 913.3 | 917.5 | 921.7 | 925.9 |
| 905.1 | 909.3 | 913.5 | 917.7 | 921.9 | 926.1 |
| 905.3 | 909.5 | 913.7 | 917.9 | 922.1 | 926.3 |
| 905.5 | 909.7 | 913.9 | 918.1 | 922.3 | 926.5 |
| 905.7 | 909.9 | 914.1 | 918.3 | 922.5 | 926.7 |
| 905.9 | 910.1 | 914.3 | 918.5 | 922.7 | 926.9 |
| 906.1 | 910.3 | 914.5 | 918.7 | 922.9 | 927.1 |
| 906.3 | 910.5 | 914.7 | 918.9 | 923.1 | 927.3 |
| 906.5 | 910.7 | 914.9 | 919.1 | 923.3 | 927.5 |

Note 1: $F(\text{MHz}) = 902.5 + 0.2 * n$ ($0 \leq n \leq 125$).

Note 2: Frequency 902.5MHz, 915.1MHz and 927.5MHz selected for LoRa as Lowest, Middle and Highest channel.

1.4. Test environment and mode

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

| Operating Environment | |
|--------------------------------|---|
| Temperature | 15°C - 35°C |
| Humidity | 30% -60% |
| Atmospheric Pressure | 86KPa-106KPa |
| Test mode: | |
| Continuously transmitting mode | Keep the EUT in continuous transmitting with modulation |

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

| Test Items | Modulation Type | Data Rate | Channel |
|---|-----------------|-----------|---------|
| Peak Conducted Output Power Power Spectral Density 6dB and 99% Bandwidth Conducted and Spurious Emission Radiated and Spurious Emission | LoRa | SF12 | L, M, H |
| Conducted Band Edge | LoRa | SF12 | L, H |

Table for Supporting Units

| No. | Equipment | Brand Name | Model Name | Manufacturer | Serial No. | Note |
|-----|-----------|------------|------------|--------------|------------|---------|
| 1 | Laptop | HP | TPN-Q221 | HP | 5CD14347QB | FCC DOC |

1.5. EUT Operation Test Setup

For RF test items, an engineering test program was provided and enable to make EUT transmitting.

1.6. Facilities and Accreditations

FCC-Registration No.: 406086

CCIC Southern Testing Co., Ltd EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Designation Number: CN1283, valid time is until April 19th, 2023.

ISED Registration: 11185A-1

CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on Aug. 04, 2016, valid time is until Jun. 30th, 2023.

A2LA Code: 5721.01

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.

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2. Test 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.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

2.1.2. Antenna Information

Antenna Category: Internal Antenna

A internal Antenna was soldered to the antenna port of EUT via an adaptor cable, can't be removed.

Antenna General Information:

| No. | EUT | Operating frequency range | Ant. Type | Ant. Gain |
|-----|-------------------------|---------------------------|-----------|-----------|
| 1 | LoRaWAN Sensor Terminal | 902-928MHz | Internal | 3.03dBi |

2.1.3. Result: comply

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

2.2. Maximum Conducted Output Power

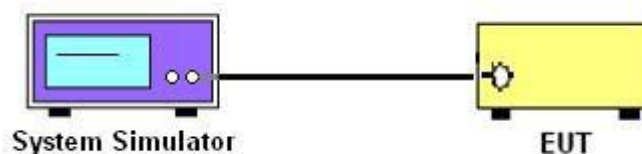
2.2.1. Limit of Peak Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



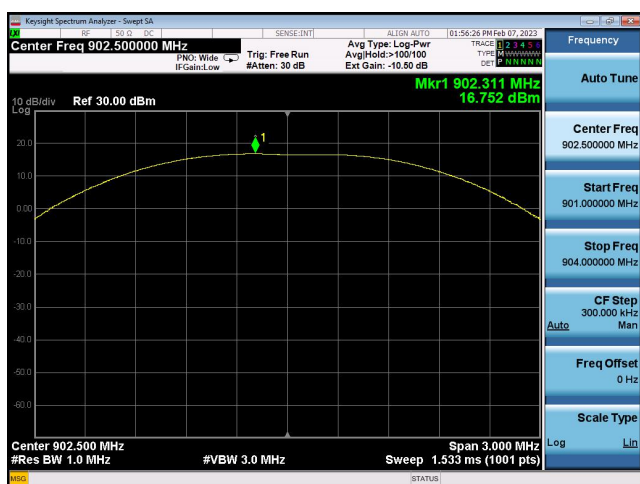
2.2.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.9.1.1.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:
 $RBW \geq DTS \text{ bandwidth}$ / $VBW \geq 3 * RBW$ / Sweep time: Auto couple / Detector mode: Peak /
 Trace mode: Max hold / Allow trace to fully stabilize / Use peak marker function to determine the peak amplitude level.
5. Record the measurement results in the test report.

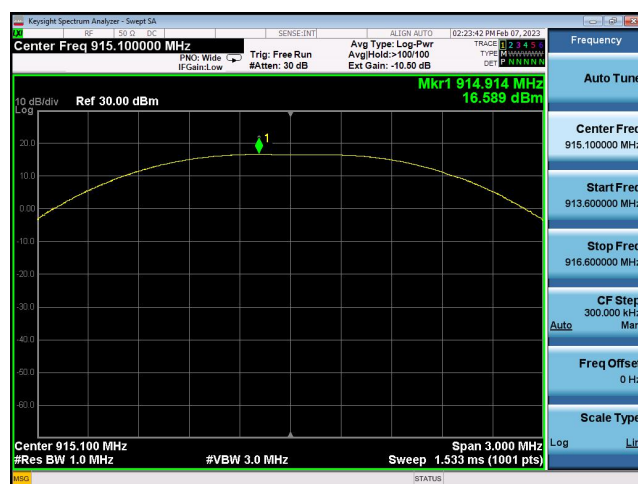
2.2.5. Test Result of Peak Output Power

| Test Frequency | Conducted Power(dBm) | Limit(dBm) | Result |
|----------------|----------------------|------------|--------|
| 902.5 | 16.752 | 30 | Pass |
| 915.1 | 16.589 | | Pass |
| 927.5 | 16.393 | | Pass |

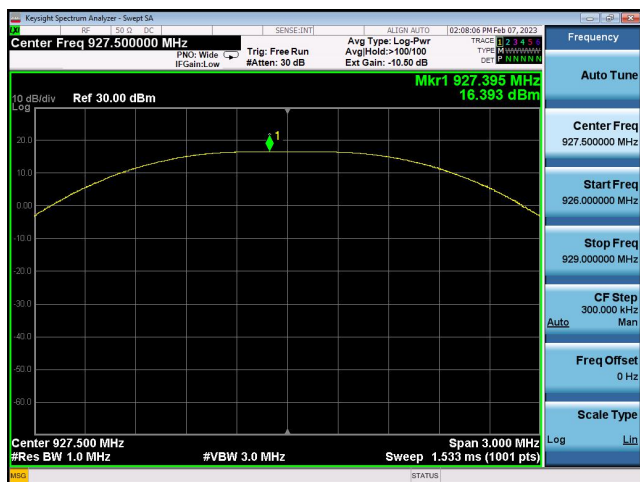
Output Power: 902.5MHz



Output Power: 915.1MHz



Output Power: 927.5MHz



2.3. 6dB and 99% Bandwidth

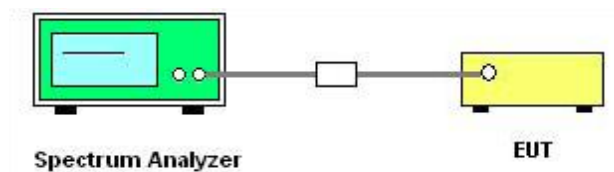
2.3.1. Limit of 6dB and 99% Bandwidth

The minimum 6 dB Occupied bandwidth shall be at least 500 kHz.

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the spectrum analyzer “Channel Bandwidth” function to easurement the 6dB EBW and 99% OBW.
5. For 6dB EBW Use the following spectrum analyzer settings:
RBW: 100kHz / VBW: 300kHz / Detector: Peak / Trace mode: Max hold / Sweep time: Auto couple / Allow trace to fully stabilize.
6. For 99% OBW Use the following spectrum analyzer settings:
Set RBW = approximately 1% EBW or 1.5 times to 5.0 times the OBW, $VBW \geq 3 \times RBW$.
7. Record the measurement results in the test report.

2.3.5. Test Results of 6dB and 99% Bandwidth

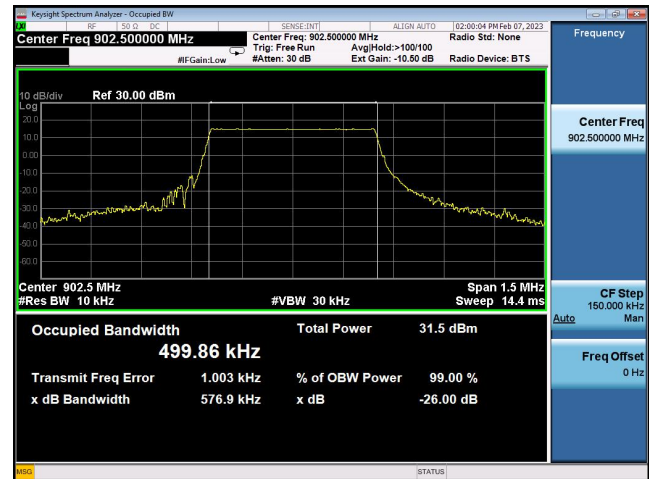
| Test Frequency | 6dB EBW(kHz) | Limit(kHz) | Result |
|----------------|--------------|------------|--------|
| 902.5 | 638.4 | ≥ 500 | Pass |
| 915.1 | 635.9 | | Pass |
| 927.5 | 639.4 | | Pass |

| Test Frequency | 99% OBW(MHz) | Limit(kHz) | Result |
|----------------|--------------|------------|--------|
| 902.5 | 499.86 | N/A | Pass |
| 915.1 | 500.79 | | Pass |
| 927.5 | 500.03 | | Pass |

6dB Bandwidth: 902.5MHz



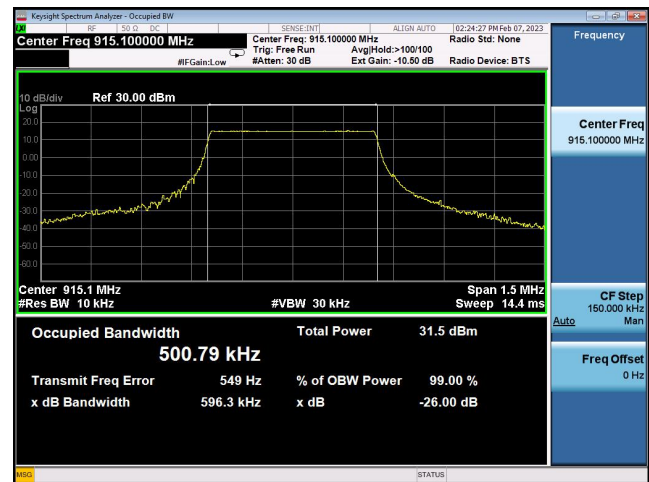
99% Bandwidth: 902.5MHz



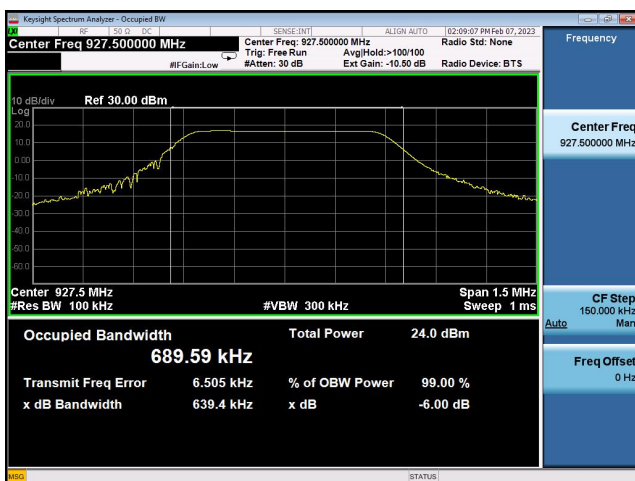
6dB Bandwidth: 915.1MHz



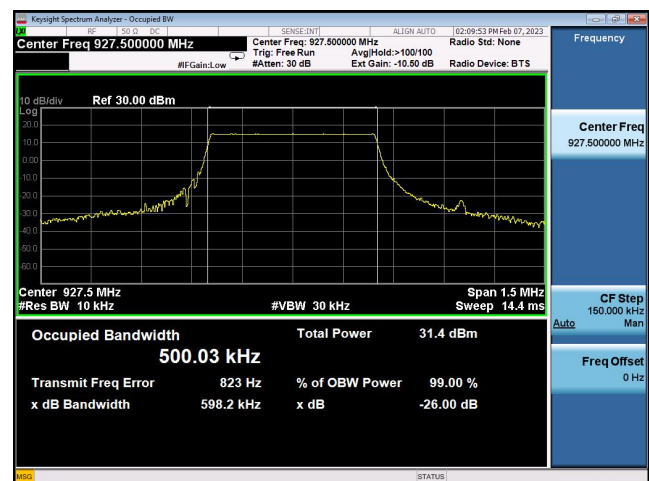
99% Bandwidth: 915.1MHz



6dB Bandwidth: 927.5MHz



99% Bandwidth: 927.5MHz



2.4. Power spectral density (PSD)

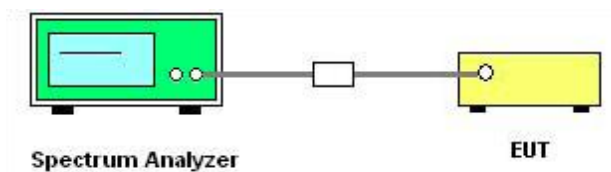
2.4.1. Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.10.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

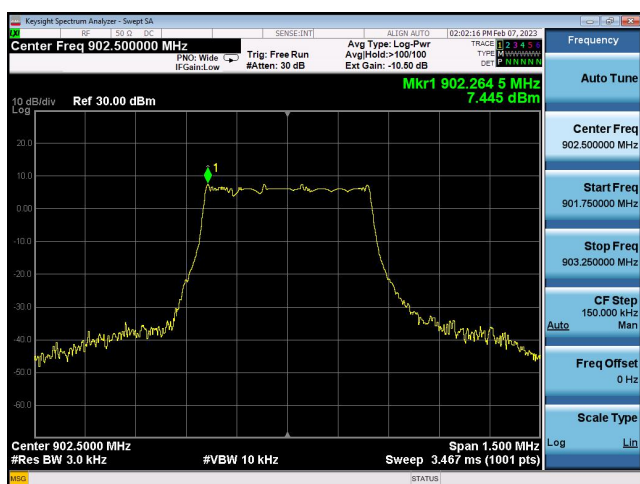
Set instrument center frequency to DTS channel center frequency / Set the span to 1.5 times the DTS bandwidth / RBW: 3kHz / VBW: 10kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum power level.

5. Record the measurement results in the test report.

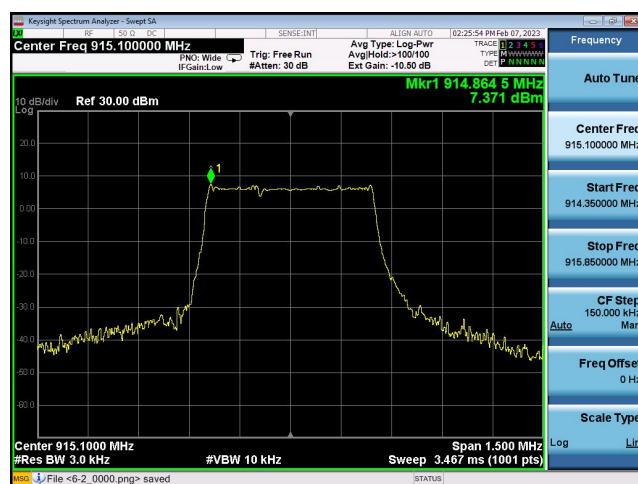
2.4.5. Test Results of Power spectral density

| Test Frequency | PSD(dBm/3kHz) | Limit(dBm/3kHz) | Result |
|----------------|---------------|-----------------|--------|
| 902.5 | 7.445 | 8 | Pass |
| 915.1 | 7.371 | | Pass |
| 927.5 | 7.574 | | Pass |

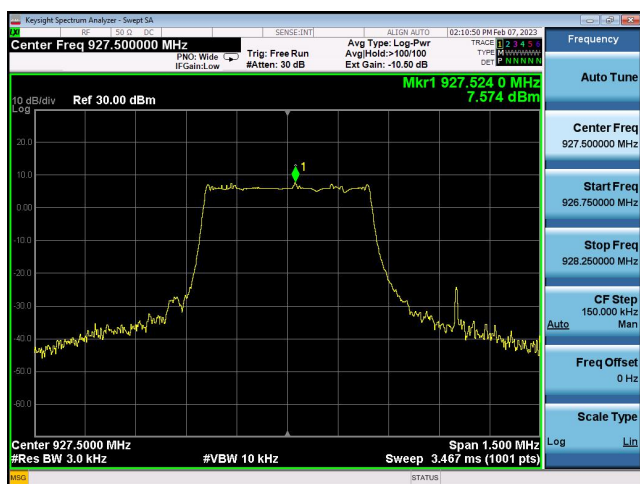
Power spectral density: 902.5MHz



Power spectral density: 915.1MHz



Power spectral density: 927.5MHz



2.5. Conducted Band Edges and Spurious Emissions

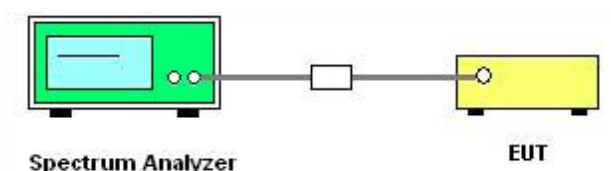
2.5.1. Limit of Conducted Band Edges and Spurious Emissions

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup



2.5.4. Test Procedure

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 Section 11.11 and 11.13.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings:

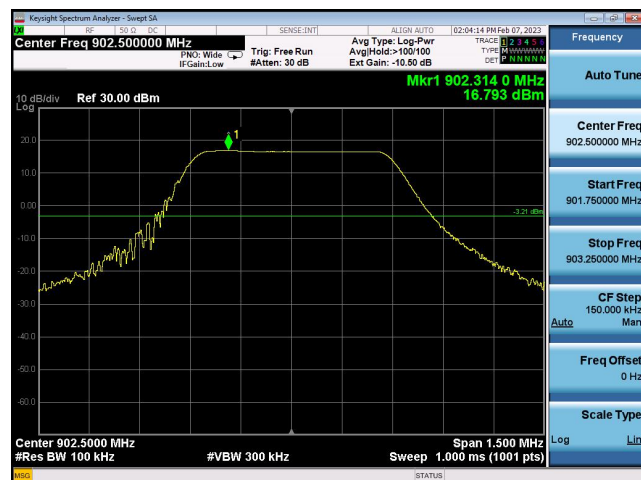
Reference level measurement: Set spectrum analyzer center frequency to DTS channel center frequency / Set the span to ≥ 1.5 times the DTS bandwidth / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum PSD level and attenuate it by 20dB.

Emission level measurement: Set the center frequency and span to encompass frequency range to be measured / RBW: 100kHz / VBW: 300kHz / Detector: Peak / Sweep time: Auto couple / Trace mode: Max hold / Allow trace to fully stabilize / Use the peak marker function to determine the maximum amplitude level.

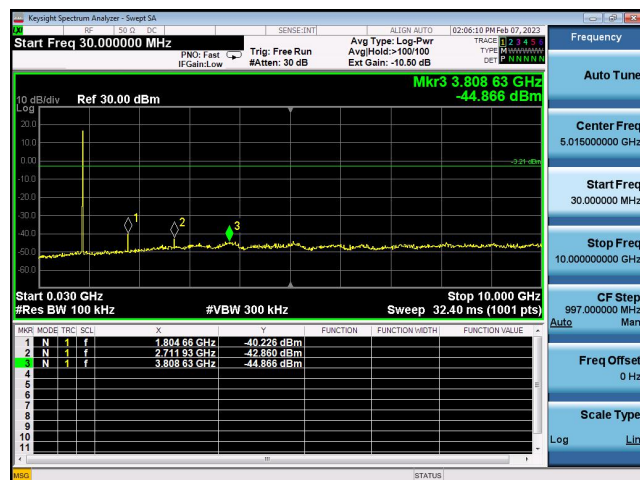
5. Record the measurement results in the test report.

2.5.5. Test Results of Conducted Band Edges and Spurious Emissions

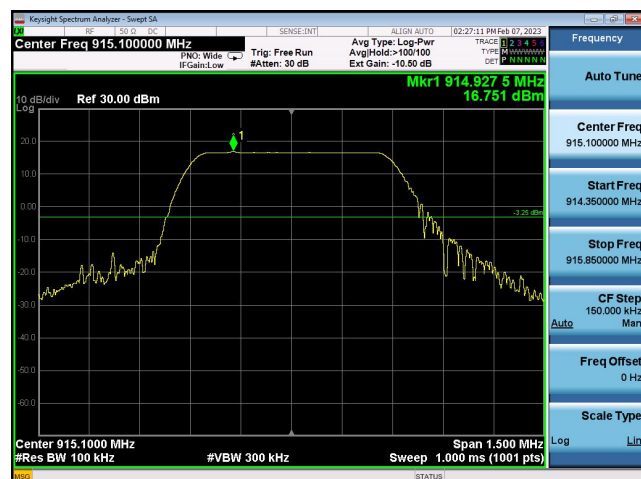
Referecy Level: 902.5MHz



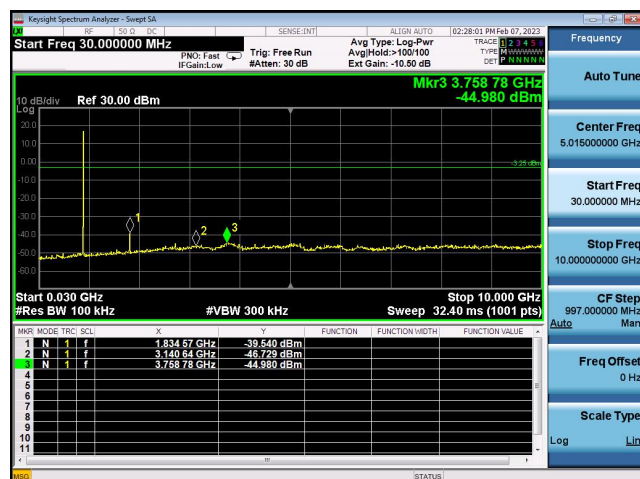
Conducted Spurious Emission: 902.5MHz



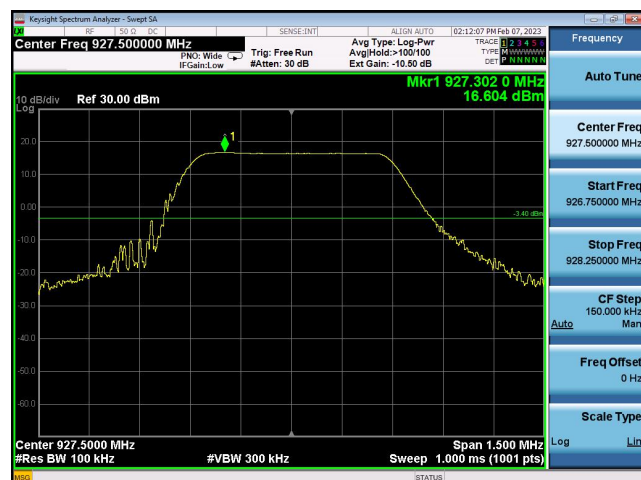
Referecy Level: 915.1MHz



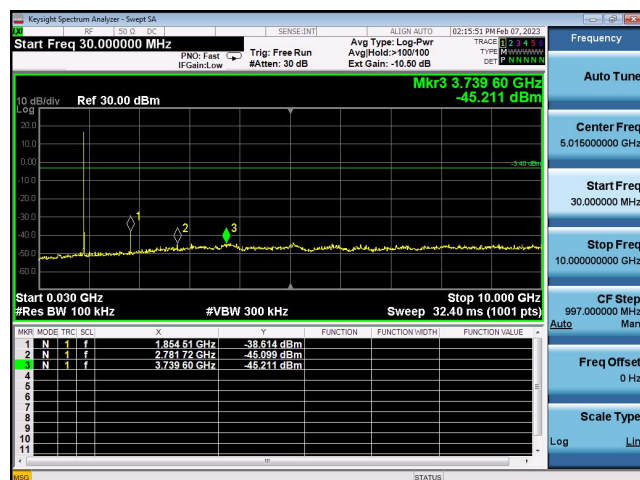
Conducted Spurious Emission: 915.1MHz



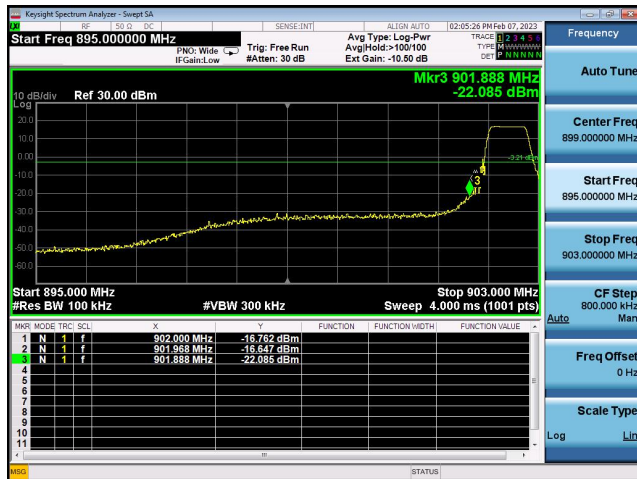
Referecy Level: 927.5MHz



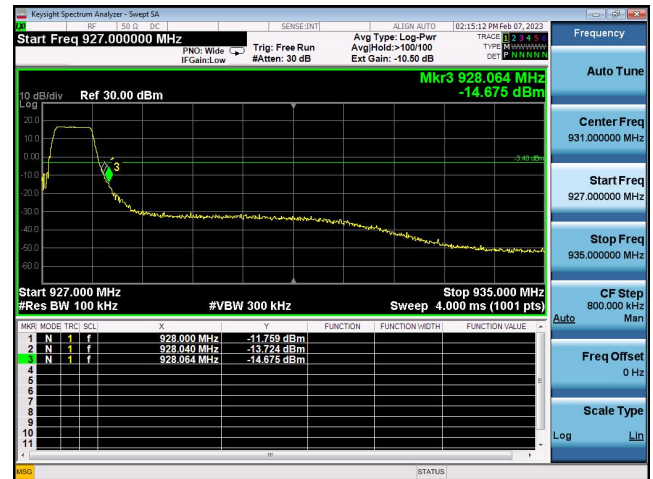
Conducted Spurious Emission: 927.5MHz



Conducted Band Edge: 902.5MHz



Conducted Band Edge: 927.5MHz



2.6. Radiated Band Edge and Spurious Emission

2.6.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level. If the transmitter uses an RMS average conducted power limit, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

§15.209(a) Radiated emission limits:

| Frequency (MHz) | Field Strength ($\mu\text{V/m}$) | 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 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

Restricted bands of operation refer to §15.205 (a):

| 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 | / | / | / |

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

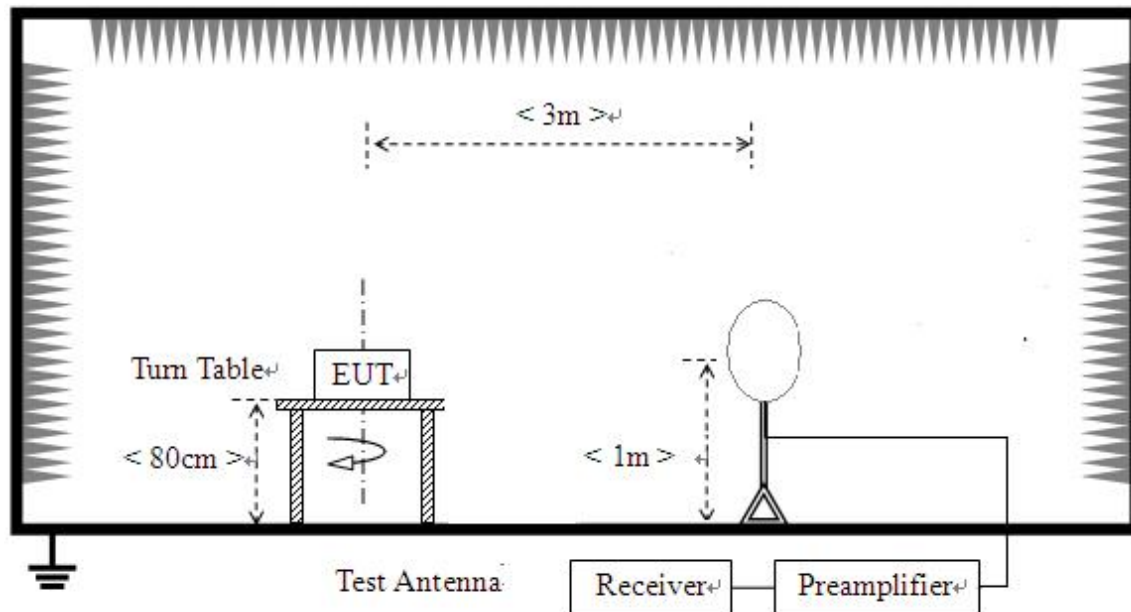
²Above 38.6.

2.6.2. Measuring Instruments

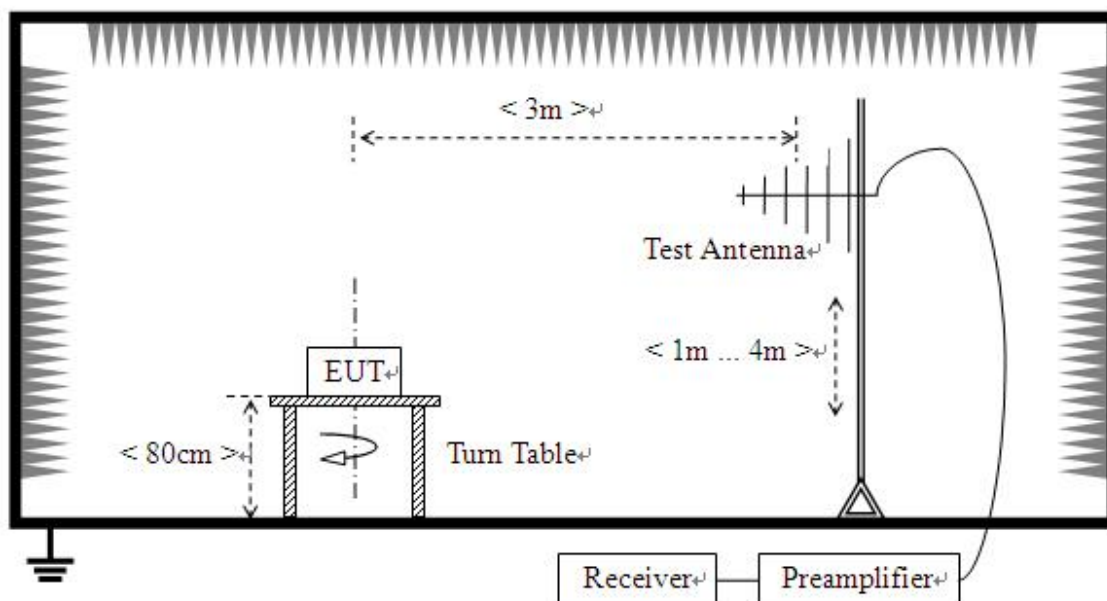
The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup

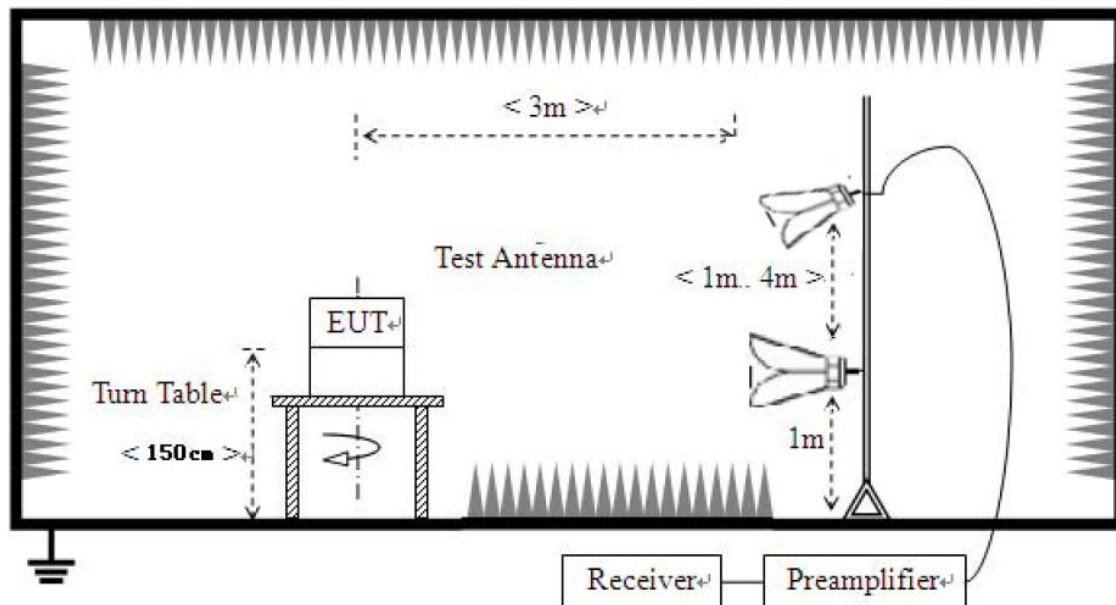
For radiated emissions from 9 kHz to 30 MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



2.6.4. Test Procedures

1. The EUT was placed on the top of a rotating table 0.8m for below 1GHz and 1.5m for above 1GHz above the ground at a 3 meters semi-anechoic chamber.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then

reported in a data sheet.

7. For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement 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 measurement antenna elevation shall be that which maximizes the emissions. The measurement 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.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. 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.

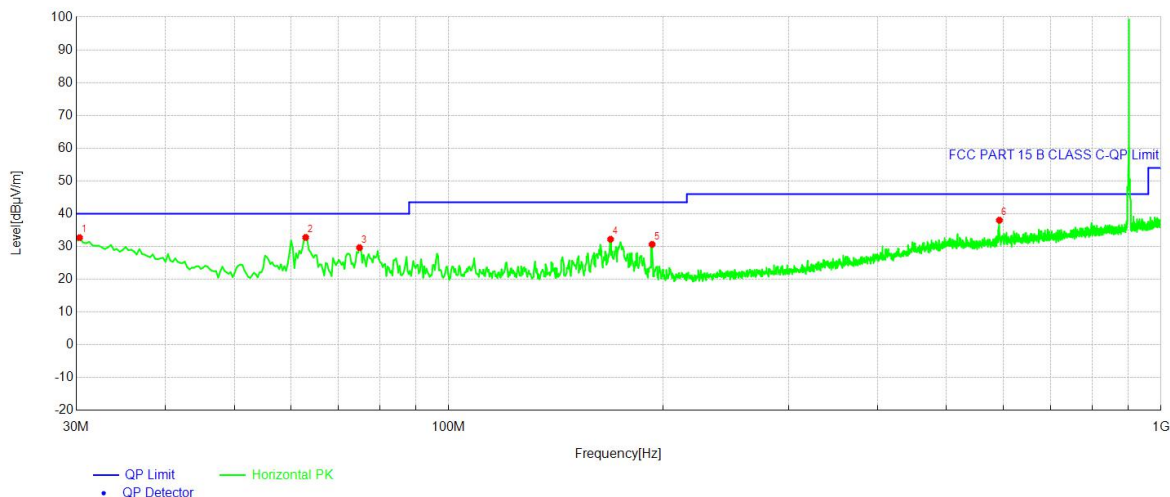
2.6.5. Test Results of Radiated Band Edge and Spurious Emission

NOTE 1: For 9 kHz to 30MHz, The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

NOTE 2: For 30MHz to 1GHz, All of the EUT Configure mode were tested and found 902.5MHz channel is the worst mode, the worst case is recorded in this report.

NOTE 3: Antenna height and turntable angle are the worst positions, the worst case is recorded in this report.

For 30MHz to 1000MHz

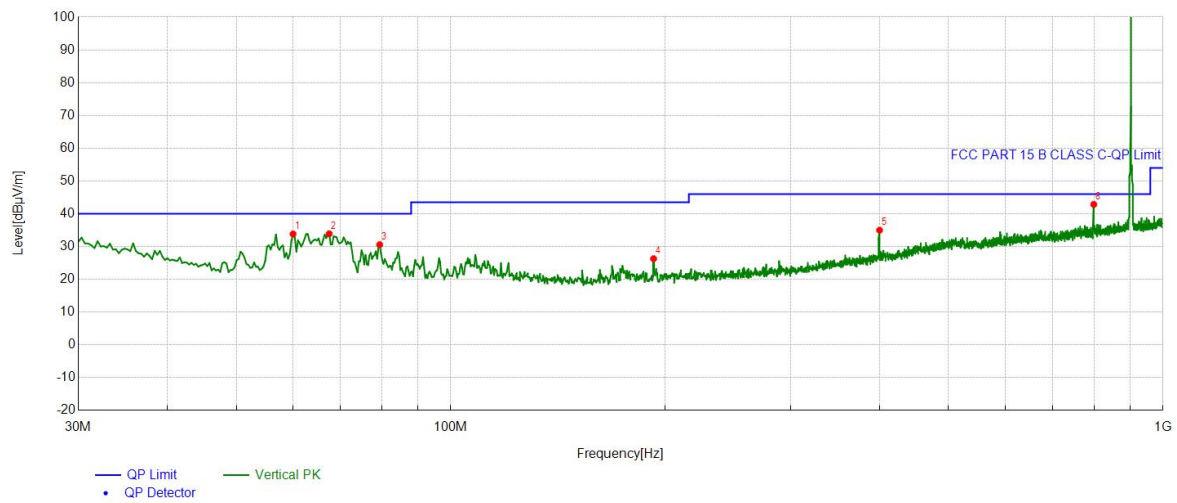


| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-----------------|-------------|-----------|------------|
| 1 | 30.32 | 32.72 | 19.11 | 40.00 | 7.28 | 100 | 180 | Horizontal |
| 2 | 62.99 | 32.78 | 6.68 | 40.00 | 7.22 | 100 | 200 | Horizontal |
| 3 | 74.96 | 29.67 | 8.93 | 40.00 | 10.33 | 100 | 10 | Horizontal |
| 4 | 168.76 | 32.22 | 9.97 | 43.50 | 11.28 | 100 | 110 | Horizontal |
| 5 | 193.01 | 30.67 | 10.40 | 43.50 | 12.83 | 100 | 250 | Horizontal |
| 6 | 593.11 | 38.03 | 20.66 | 46.00 | 7.97 | 100 | 340 | Horizontal |

Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.



| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-----------------|-------------|-----------|----------|
| 1 | 60.08 | 33.83 | 6.12 | 40.00 | 6.17 | 100 | 360 | Vertical |
| 2 | 67.52 | 33.89 | 7.54 | 40.00 | 6.11 | 100 | 120 | Vertical |
| 3 | 79.49 | 30.58 | 9.76 | 40.00 | 9.42 | 100 | 300 | Vertical |
| 4 | 192.69 | 26.30 | 10.39 | 43.50 | 17.20 | 100 | 280 | Vertical |
| 5 | 400.02 | 34.98 | 16.69 | 46.00 | 11.02 | 100 | 140 | Vertical |
| 6 | 799.47 | 42.85 | 23.51 | 46.00 | 3.15 | 100 | 100 | Vertical |

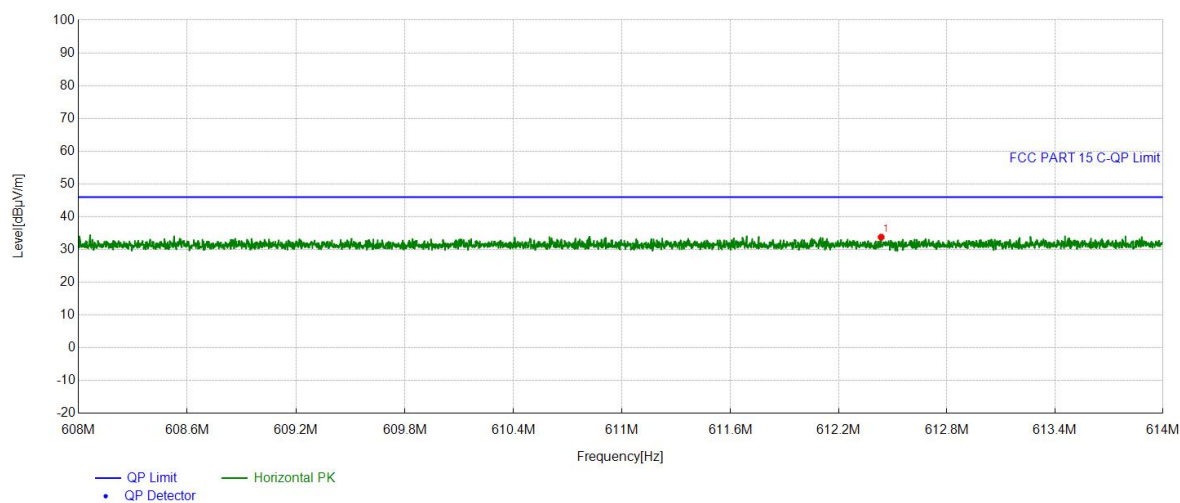
Test Result : Pass

Remark:

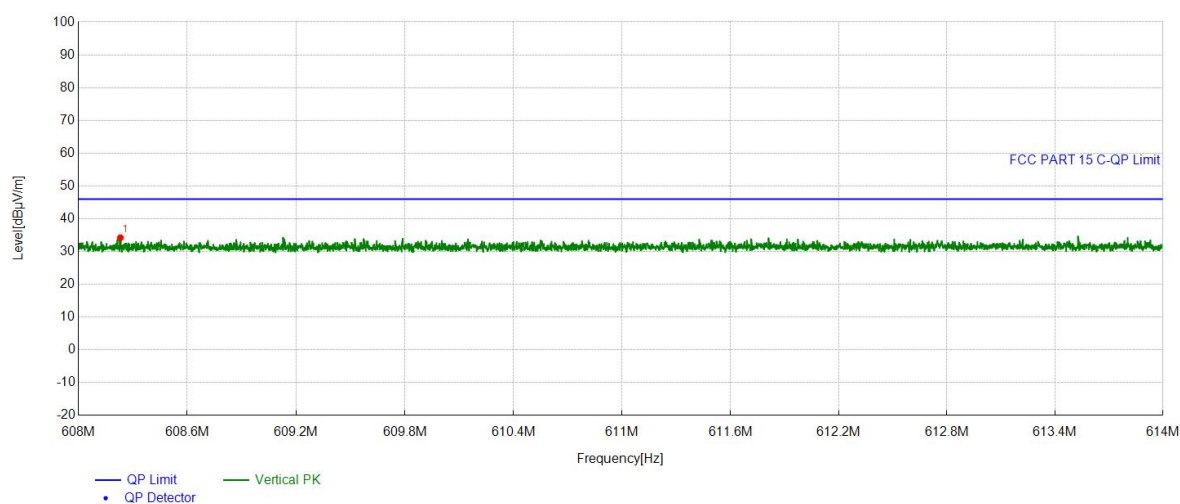
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge

902.5MHz: Horizontal



902.5MHz: Vertical



| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Height [cm] | Angle [°] | Polarity |
|-----|----------------|-------------------|----------------|-------------------|--------------------|----------------|--------------|------------|
| 1 | 612.44 | 33.79 | 20.78 | 46.00 | 12.21 | 100 | 100 | Horizontal |
| 2 | 608.23 | 34.21 | 20.70 | 46.00 | 11.79 | 100 | 180 | Vertical |

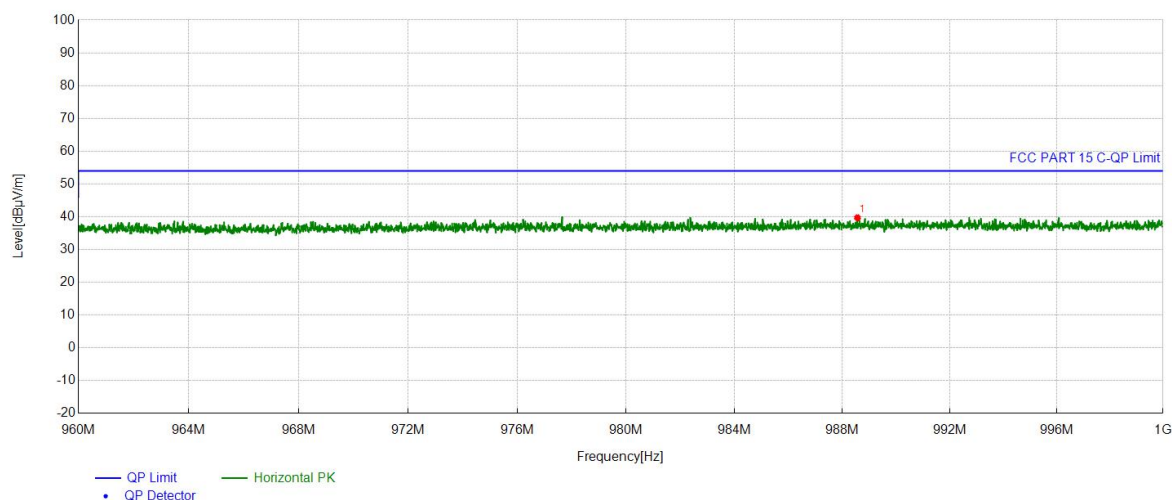
Test Result : Pass

Remark:

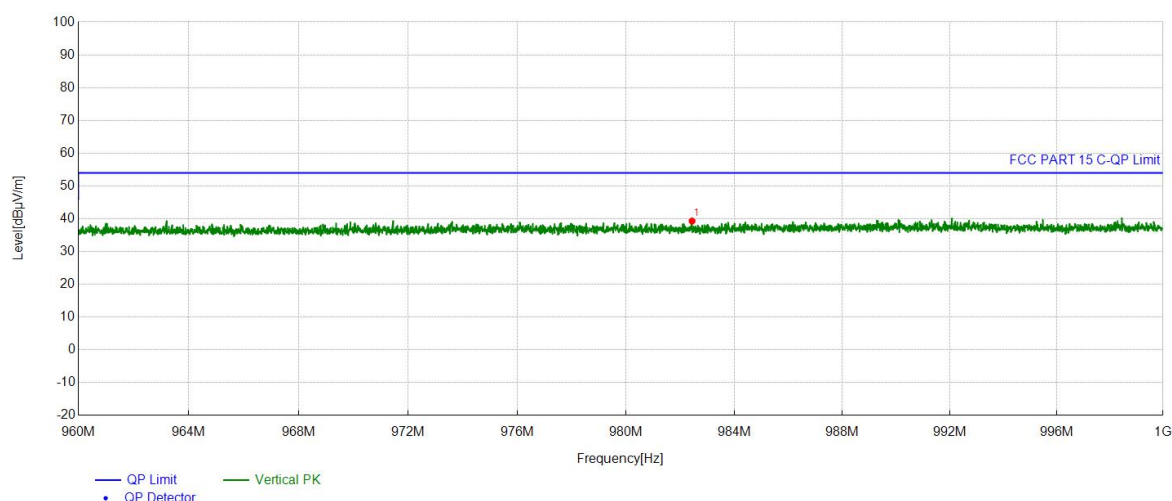
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge

927.5MHz: Horizontal



927.5MHz: Vertical



| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-----------------|-------------|-----------|------------|
| 1 | 988.57 | 39.70 | 25.83 | 54.00 | 14.30 | 100 | 150 | Horizontal |
| 2 | 982.43 | 39.30 | 25.72 | 54.00 | 14.70 | 100 | 60 | Vertical |

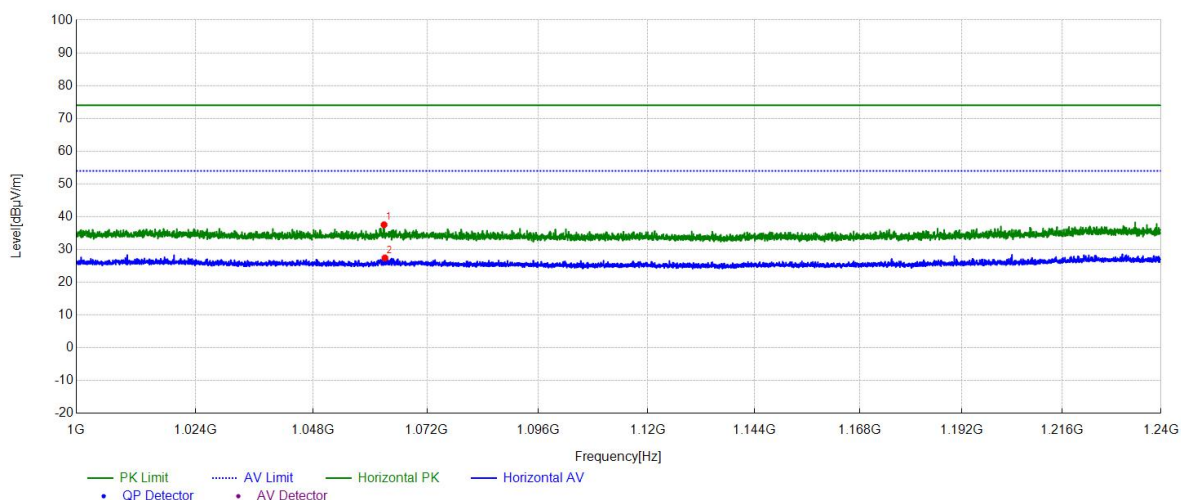
Test Result : Pass

Remark:

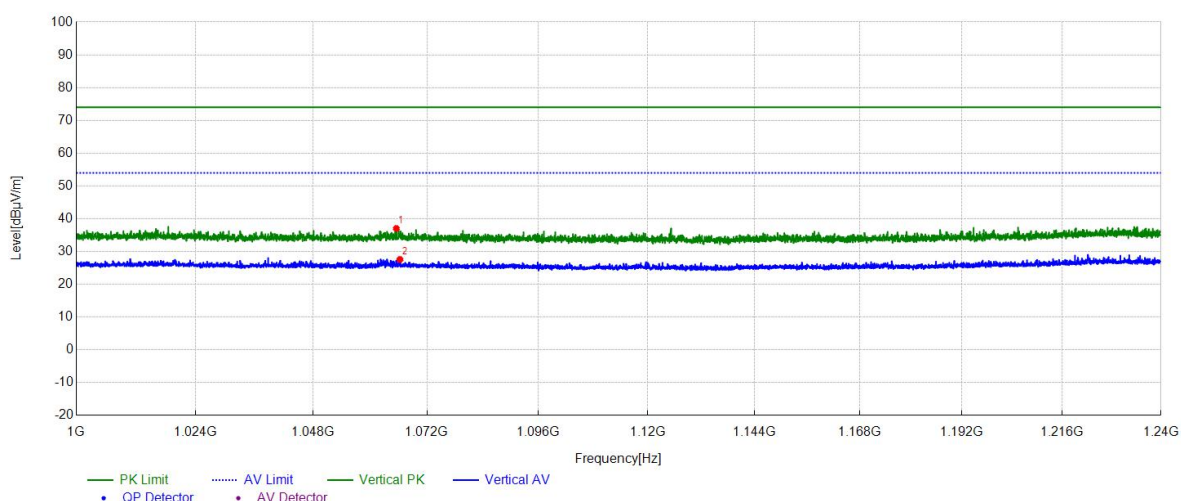
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

Restricted-band band-edge

927.5MHz: Horizontal



927.5MHz: Vertical



Suspected List

| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin[dBμV/m] | Trace | Height [cm] | Angle [°] | Polarity |
|-----|----------------|-------------------|----------------|-------------------|----------------|-------|----------------|--------------|------------|
| 1 | 1062.94 | 37.56 | -12.79 | 74.00 | 36.44 | PK | 150 | 110 | Horizontal |
| 2 | 1063.13 | 27.43 | -12.79 | 54.00 | 26.57 | AV | 150 | 80 | Horizontal |
| 3 | 1065.53 | 37.03 | -12.81 | 74.00 | 36.97 | PK | 150 | 230 | Vertical |
| 4 | 1066.30 | 27.59 | -12.82 | 54.00 | 26.41 | AV | 150 | 80 | Vertical |

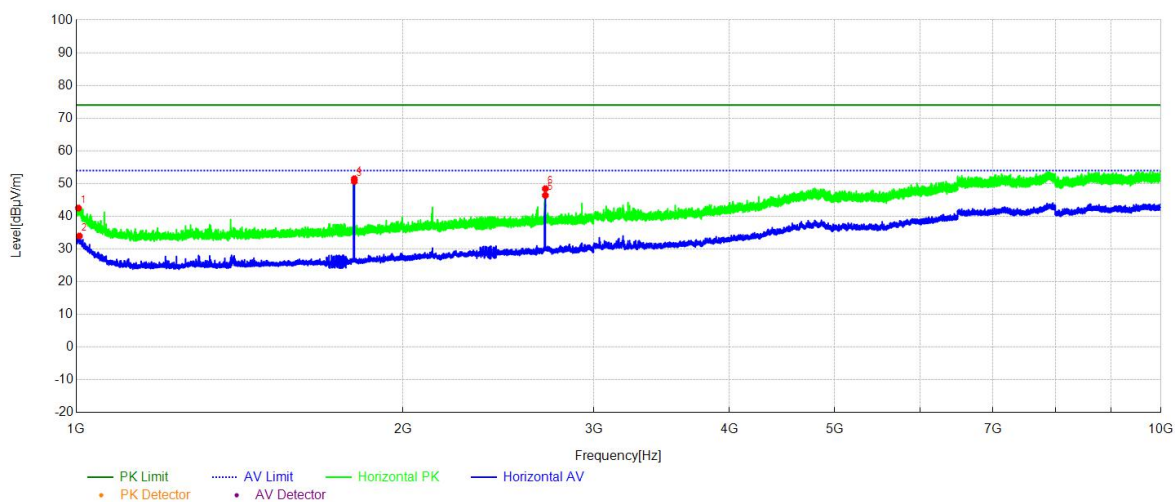
Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

For 1GHz to 10GHz

LoRa_902.5MHz



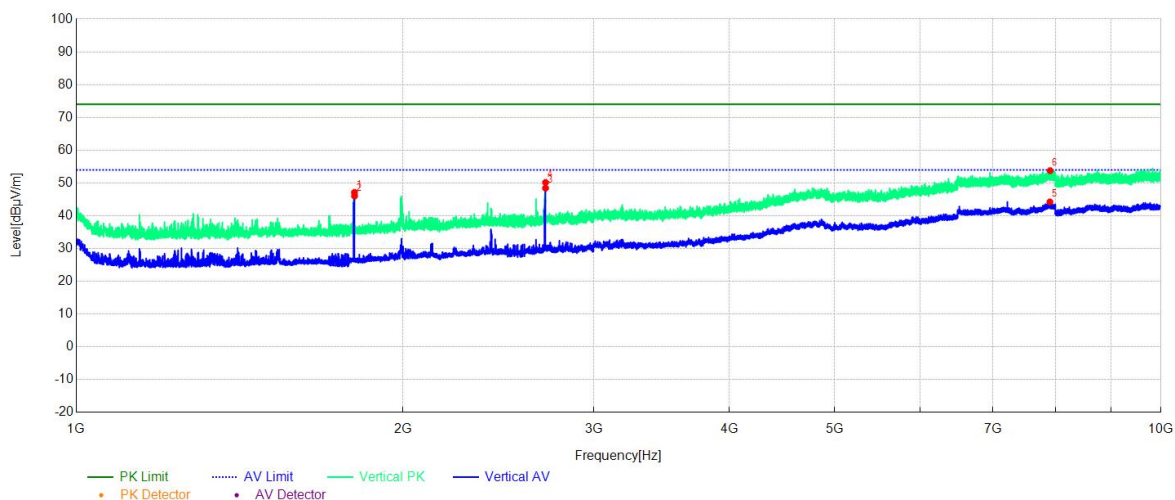
| Suspected List | | | | | | | | | |
|----------------|-------------|----------------|-------------|----------------|-----------------|-------|-------------|-----------|------------|
| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Trace | Height [cm] | Angle [°] | Polarity |
| 1 | 1004.6 | 42.52 | -12.29 | 74.00 | 31.48 | PK | 150 | 221 | Horizontal |
| 2 | 1006.6 | 33.99 | -12.32 | 54.00 | 20.01 | AV | 150 | 221 | Horizontal |
| 3 | 1804.4 | 50.66 | -11.42 | 54.00 | 3.34 | AV | 150 | 168 | Horizontal |
| 4 | 1804.4 | 51.48 | -11.42 | 74.00 | 22.52 | PK | 150 | 168 | Horizontal |
| 5 | 2706.9 | 46.40 | -7.98 | 54.00 | 7.60 | AV | 150 | 348 | Horizontal |
| 6 | 2706.9 | 48.43 | -7.98 | 74.00 | 25.57 | PK | 150 | 348 | Horizontal |

Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_902.5MHz



Suspected List

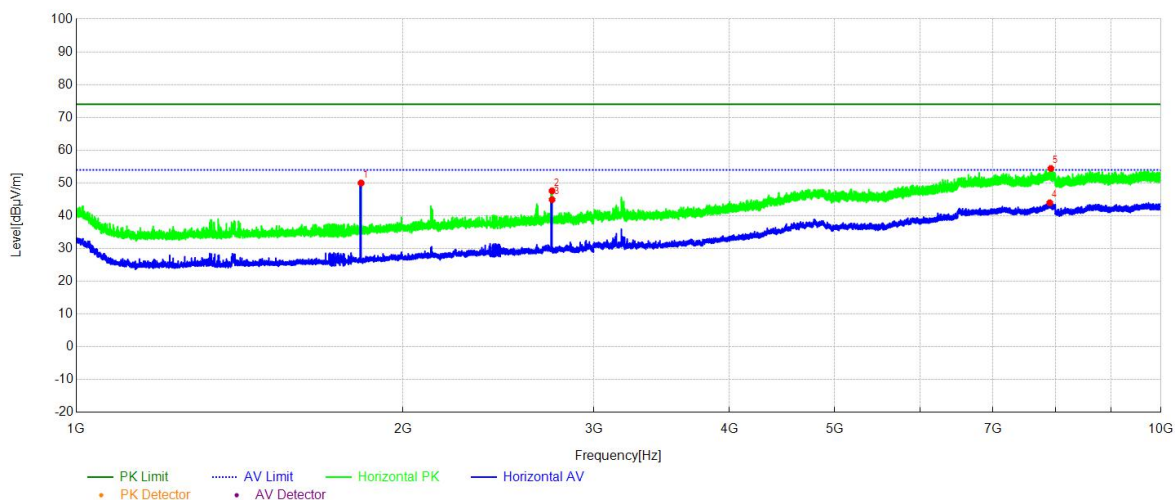
| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Trace | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-----------------|-------|-------------|-----------|----------|
| 1 | 1805.0 | 47.14 | -11.42 | 74.00 | 26.86 | PK | 150 | 105 | Vertical |
| 2 | 1805.4 | 46.01 | -11.42 | 54.00 | 7.99 | AV | 150 | 140 | Vertical |
| 3 | 2707.9 | 48.43 | -7.98 | 54.00 | 5.57 | AV | 150 | 239 | Vertical |
| 4 | 2707.9 | 50.16 | -7.98 | 74.00 | 23.84 | PK | 150 | 239 | Vertical |
| 5 | 7899.0 | 44.22 | 7.49 | 54.00 | 9.78 | AV | 150 | 9 | Vertical |
| 6 | 7903.2 | 53.76 | 7.47 | 74.00 | 20.24 | PK | 150 | 190 | Vertical |

Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_915.1MHz



Suspected List

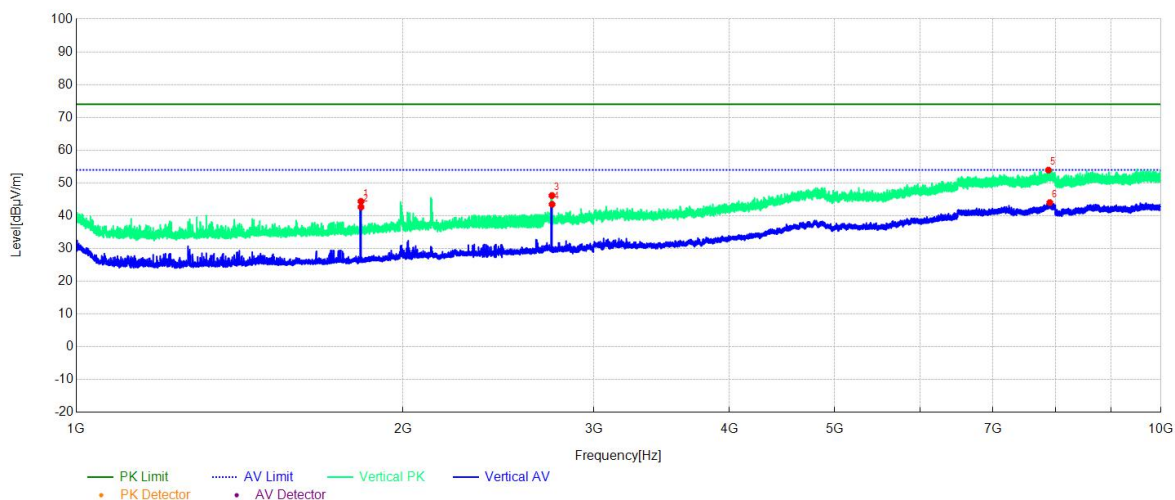
| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Trace | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-----------------|-------|-------------|-----------|------------|
| 1 | 1830.6 | 49.99 | -11.35 | 74.00 | 24.01 | PK | 150 | 165 | Horizontal |
| 2 | 2745.5 | 47.59 | -7.90 | 74.00 | 26.41 | PK | 150 | 344 | Horizontal |
| 3 | 2745.7 | 44.93 | -7.90 | 54.00 | 9.07 | AV | 150 | 344 | Horizontal |
| 4 | 7897.6 | 43.93 | 7.48 | 54.00 | 10.07 | AV | 150 | 0 | Horizontal |
| 5 | 7915.5 | 54.41 | 7.42 | 74.00 | 19.59 | PK | 150 | 41 | Horizontal |
| 6 | 1830.6 | 49.99 | -11.35 | 74.00 | 24.01 | PK | 150 | 165 | Horizontal |

Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_915.1MHz



Suspected List

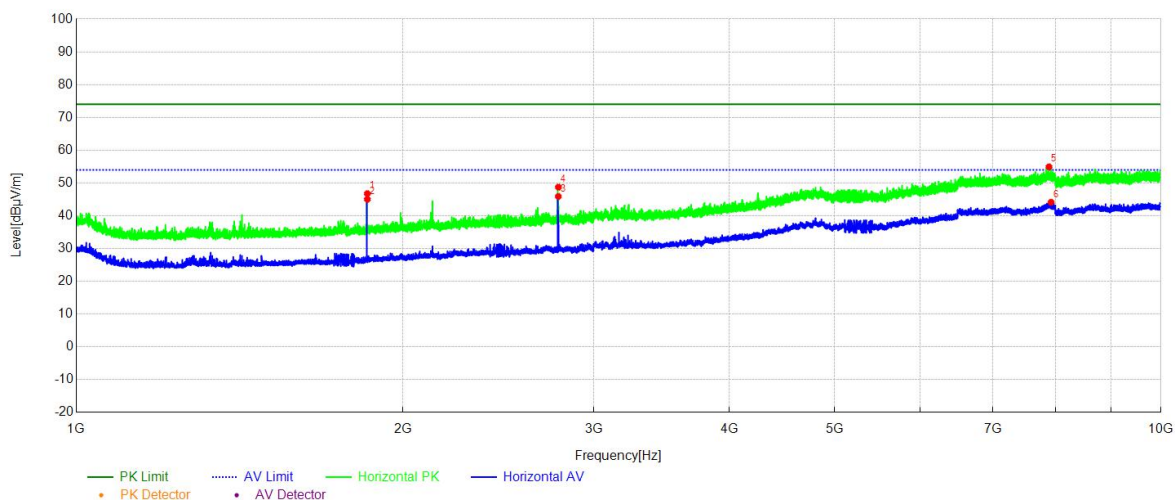
| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Trace | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-----------------|-------|-------------|-----------|----------|
| 1 | 1830.0 | 44.39 | -11.35 | 74.00 | 29.61 | PK | 150 | 256 | Vertical |
| 2 | 1830.2 | 42.66 | -11.35 | 54.00 | 11.34 | AV | 150 | 132 | Vertical |
| 3 | 2744.9 | 46.16 | -7.90 | 74.00 | 27.84 | PK | 150 | 264 | Vertical |
| 4 | 2745.7 | 43.50 | -7.90 | 54.00 | 10.50 | AV | 150 | 256 | Vertical |
| 5 | 7875.2 | 53.92 | 7.30 | 74.00 | 20.08 | PK | 150 | 121 | Vertical |
| 6 | 7898.0 | 44.00 | 7.49 | 54.00 | 10.00 | AV | 150 | 237 | Vertical |

Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_927.5MHz



Suspected List

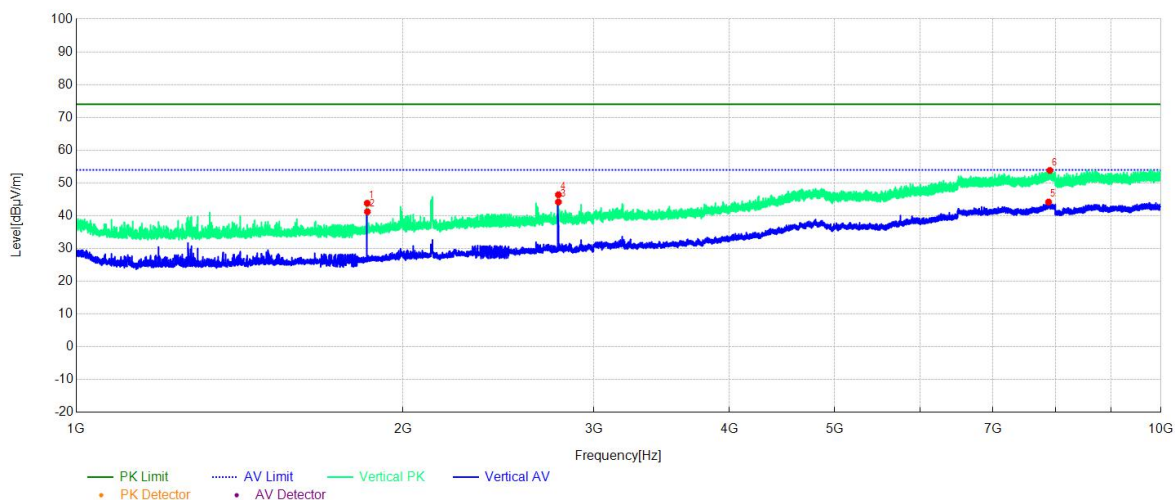
| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Trace | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-----------------|-------|-------------|-----------|------------|
| 1 | 1854.8 | 46.75 | -11.27 | 74.00 | 27.25 | PK | 150 | 173 | Horizontal |
| 2 | 1855.0 | 45.03 | -11.27 | 54.00 | 8.97 | AV | 150 | 181 | Horizontal |
| 3 | 2782.1 | 45.89 | -7.82 | 54.00 | 8.11 | AV | 150 | 347 | Horizontal |
| 4 | 2782.9 | 48.73 | -7.82 | 74.00 | 25.27 | PK | 150 | 3 | Horizontal |
| 5 | 7883.6 | 54.90 | 7.37 | 74.00 | 19.10 | PK | 150 | 238 | Horizontal |
| 6 | 7919.0 | 44.12 | 7.41 | 54.00 | 9.88 | AV | 150 | 267 | Horizontal |

Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

LoRa_927.5MHz



| Suspected List | | | | | | | | | |
|----------------|-------------|----------------|-------------|----------------|-----------------|-------|-------------|-----------|----------|
| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dBμV/m] | Trace | Height [cm] | Angle [°] | Polarity |
| 1 | 1854.4 | 43.82 | -11.27 | 74.00 | 30.18 | PK | 150 | 312 | Vertical |
| 2 | 1855.2 | 41.23 | -11.27 | 54.00 | 12.77 | AV | 150 | 312 | Vertical |
| 3 | 2782.7 | 44.20 | -7.82 | 54.00 | 9.80 | AV | 150 | 233 | Vertical |
| 4 | 2782.9 | 46.41 | -7.82 | 74.00 | 27.59 | PK | 150 | 219 | Vertical |
| 5 | 7877.7 | 44.19 | 7.32 | 54.00 | 9.81 | AV | 150 | 87 | Vertical |
| 6 | 7898.3 | 53.82 | 7.49 | 74.00 | 20.18 | PK | 150 | 259 | Vertical |

Test Result : Pass

Remark:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB).
3. Margin value = Limit value - Emission Level.
4. The other emission levels were very low against the limit.

2.7. AC Power Line Conducted Emission

2.7.1. Limit of AC Power Line Conducted Emission

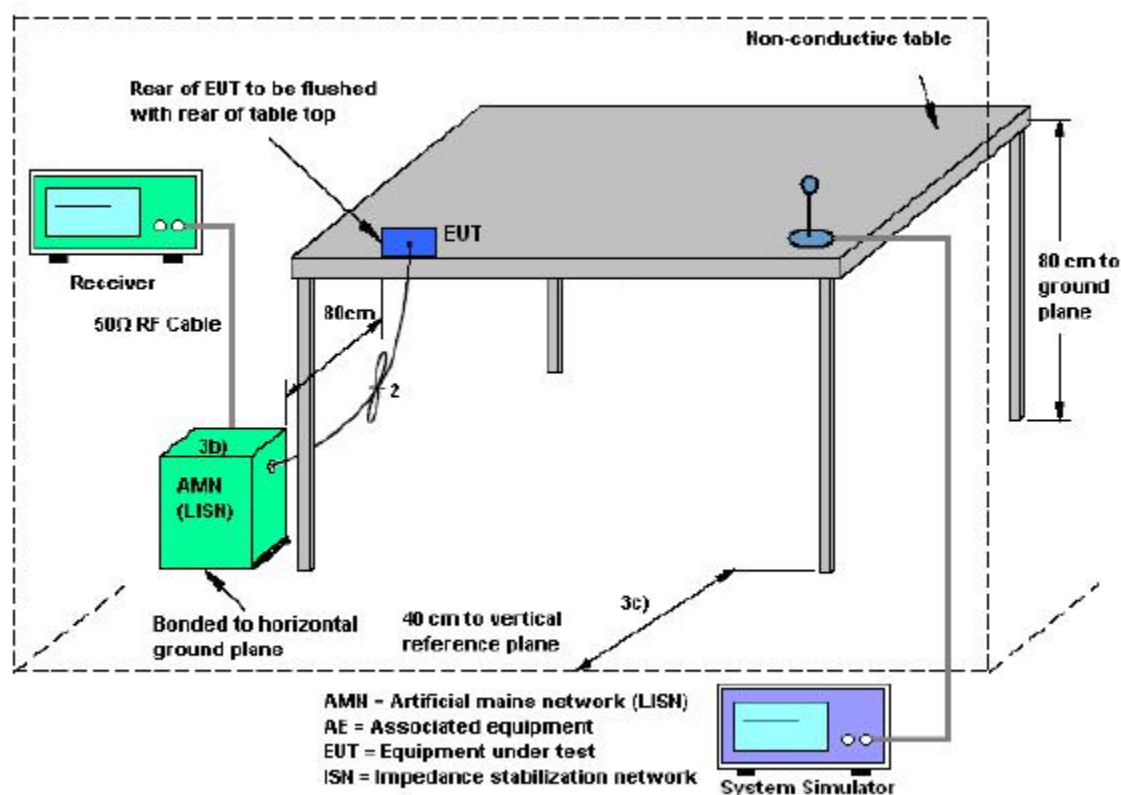
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency range (MHz) | 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 |

2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.7.3. Test Setup



2.7.4. Test Procedures

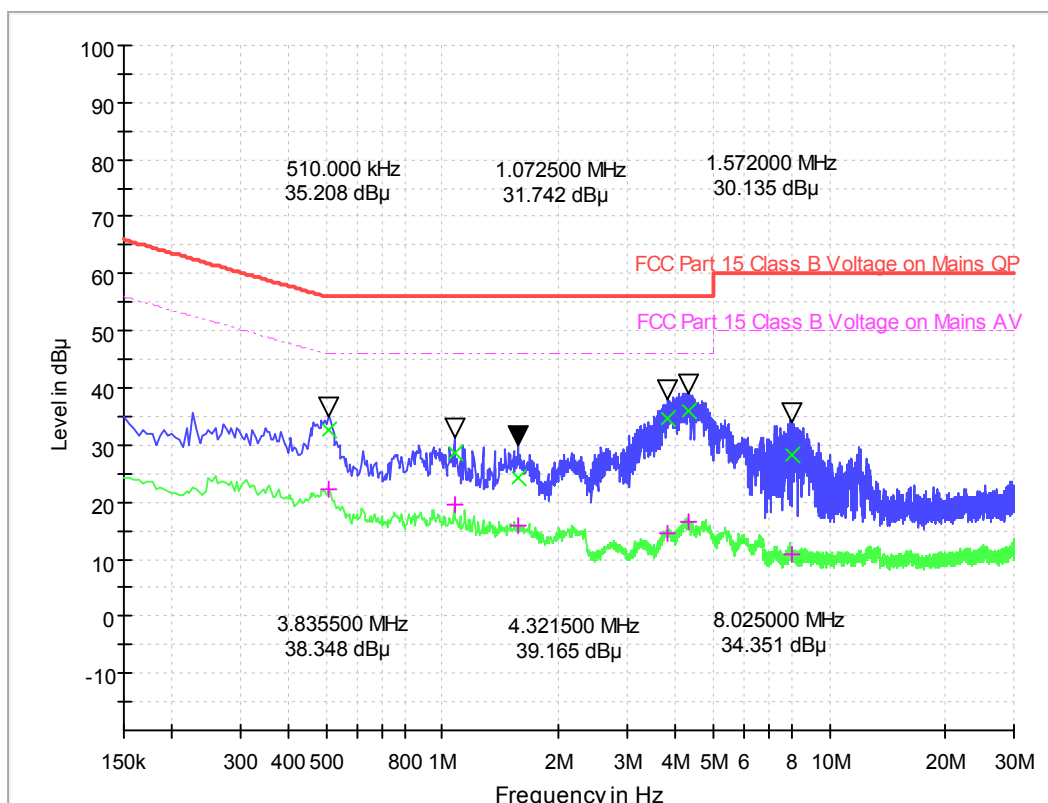
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 micrometry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

2.7.5. Test Results of Conducted Emission

NOTE 1: The EUT configuration of the emission tests is LoRa Link + Charging from Adapter.

NOTE 2: All of the EUT Configure mode were tested and found 915.1MHz channel is the worst mode, the worst case is recorded in this report.

Line Phase



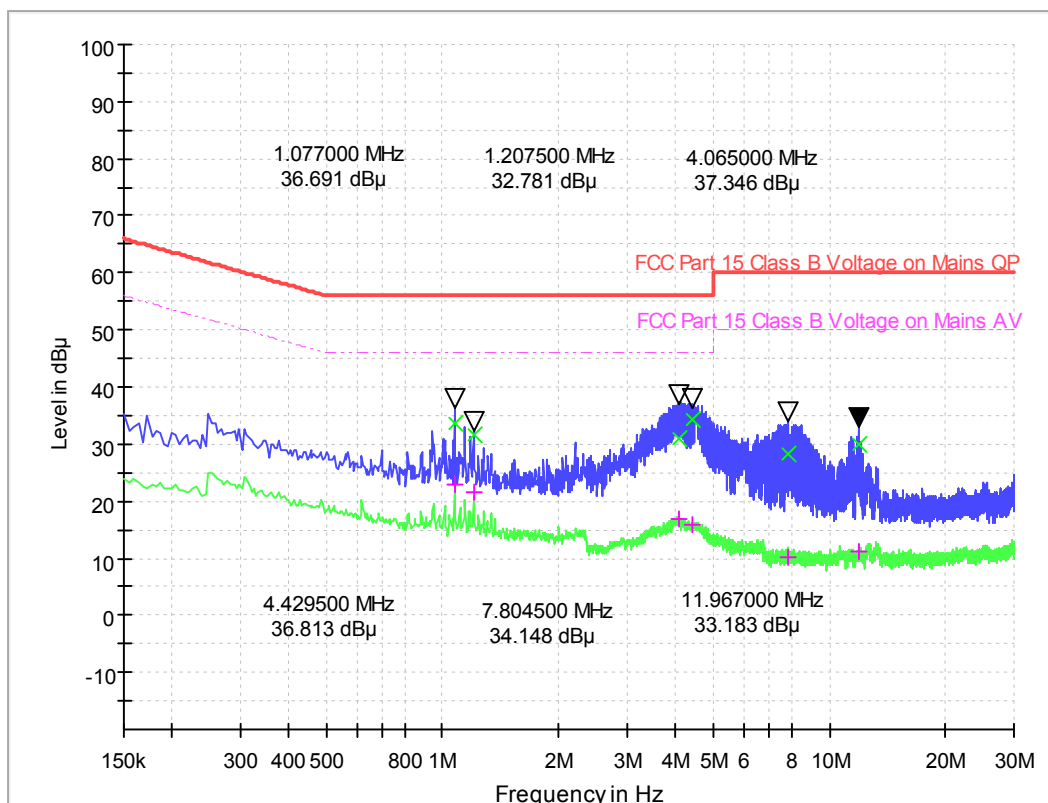
| Frequency (MHz) | QuasiPeak (dB μ V) | Average (dB μ V) | Cabel Loss (dB) | Corr.Factor (dB) | Margin - QPK (dB) | Limit - QPK (dB μ V) | Margin - AV (dB) | Limit - AV (dB μ V) |
|-----------------|--------------------|------------------|-----------------|------------------|-------------------|----------------------|------------------|---------------------|
| 0.510000 | 32.63 | 22.10 | 0.2 | 10.2 | 23.37 | 56.0 | 23.90 | 46.0 |
| 1.072500 | 28.59 | 19.41 | 0.2 | 10.2 | 27.41 | 56.0 | 26.59 | 46.0 |
| 1.572000 | 24.35 | 15.86 | 0.2 | 10.2 | 31.65 | 56.0 | 30.14 | 46.0 |
| 3.835500 | 34.51 | 14.58 | 0.2 | 10.2 | 21.49 | 56.0 | 31.42 | 46.0 |
| 4.321500 | 36.08 | 16.37 | 0.2 | 10.2 | 19.92 | 56.0 | 29.63 | 46.0 |
| 8.025000 | 28.16 | 10.89 | 0.2 | 10.2 | 31.84 | 60.0 | 39.11 | 50.0 |

Test Result : Pass

Remark:

1. Correction factor = Cabel loss+ attenuation factor.
2. attenuation factor = 10dB.

Neutral Phase



| Frequency (MHz) | QuasiPeak (dB μ V) | Average (dB μ V) | Cabel Loss (dB) | Corr.Factor (dB) | Margin - QPK (dB) | Limit - QPK (dB μ V) | Margin - AV (dB) | Limit - AV (dB μ V) |
|-----------------|--------------------|------------------|-----------------|------------------|-------------------|----------------------|------------------|---------------------|
| 1.077000 | 33.63 | 22.97 | 0.3 | 10.3 | 22.37 | 56.0 | 23.03 | 46.0 |
| 1.207500 | 31.55 | 21.58 | 0.3 | 10.3 | 24.45 | 56.0 | 24.42 | 46.0 |
| 4.065000 | 31.06 | 16.91 | 0.2 | 10.2 | 24.94 | 56.0 | 29.09 | 46.0 |
| 4.429500 | 34.40 | 16.01 | 0.3 | 10.3 | 21.60 | 56.0 | 29.99 | 46.0 |
| 7.804500 | 28.23 | 10.21 | 0.6 | 10.6 | 31.77 | 60.0 | 39.79 | 50.0 |
| 11.967000 | 29.81 | 11.16 | 2.0 | 12.0 | 30.19 | 60.0 | 38.84 | 50.0 |

Test Result : Pass

Remark:

1. Correction factor = Cabel loss+ attenuation factor.
2. attenuation factor = 10dB.

3. List of measuring equipment

| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Cal Date | Due Date |
|------|-----------------------------------|---------------|---------------------------|------------|------------|------------|
| 1 | EMI Test Receiver | ROHDE&SCHWARZ | ESW26 | A180502935 | 2022.07.21 | 2023.07.20 |
| 2 | 5M Anechoic Chamber | Albatross | SAC-5MAC 12.8x6.8x6.4m | A0304210 | 2019.03.25 | 2023.03.24 |
| 3 | Loop Antenna | Schwarz beck | HFH2-Z2 | A0304220 | 2022.05.02 | 2025.05.01 |
| 4 | Broadband antenna (30MHz~1GHz) | R&S | HL562 | A0304224 | 2020.06.19 | 2023.06.18 |
| 5 | EMI Horn Ant. (1-18G) | ETC | 1209 | A150402241 | 2021.01.02 | 2024.01.01 |
| 6 | Horn antenna (18GHz~26.5GHz) | AR | AT4510 | A0804450 | 2020.06.19 | 2023.06.18 |
| 7 | Amplifier 30M~1GHz | MILMEGA | 80RF1000-10004 | A140101634 | 2022.12.13 | 2023.12.12 |
| 8 | Amplifier 1G~18GHz | MILMEGA | AS0104R-800/400 | A160302517 | 2022.12.13 | 2023.12.12 |
| 9 | Spectrum Analyzer | KEYSIGHT | N9030A | A160702554 | 2022.03.25 | 2023.03.24 |
| 10 | Test Receiver | KEYSIGHT | N9038A | A141202036 | 2022.07.21 | 2023.07.20 |
| 11 | LISN | ROHDE&SCHWARZ | ENV216 | A140701847 | 2022.07.21 | 2023.07.20 |
| 12 | Cable | MATCHING PAD | W7 | / | 2022.07.21 | 2023.07.20 |

4. Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All the measurement uncertainty value were shown with a coverage $K=2$ to indicate 95% level of confidence . The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of AC Power Line Conducted Emission Measurement (150KHz~30MHz)

| | |
|---|-------|
| Measuring Uncertainty for a level of confidence of 95%($U=2U_c(y)$) | 2.8dB |
|---|-------|

Uncertainty of Radiated Emission Measurement (9KHz~30MHz)

| | |
|---|-------|
| Measuring Uncertainty for a level of confidence of 95%($U=2U_c(y)$) | 3.5dB |
|---|-------|

Uncertainty of Radiated Emission Measurement (30MHz~1GHz)

| | |
|---|--------|
| Measuring Uncertainty for a level of confidence of 95%($U=2U_c(y)$) | 3.91dB |
|---|--------|

Uncertainty of Radiated Emission Measurement (1GHz~18GHz)

| | |
|---|-------|
| Measuring Uncertainty for a level of confidence of 95%($U=2U_c(y)$) | 4.5dB |
|---|-------|

Uncertainty of Radiated Emission Measurement (18GHz~40GHz)

| | |
|---|-------|
| Measuring Uncertainty for a level of confidence of 95%($U=2U_c(y)$) | 4.9dB |
|---|-------|

Uncertainty of RF Conducted Measurement (9KHz~40GHz)

| | |
|---|-------|
| Measuring Uncertainty for a level of confidence of 95%($U=2U_c(y)$) | 1.3dB |
|---|-------|

****END OF REPORT****