

TEST REPORT

| | |
|------------------------|--|
| Product Name | : SX1262 868/915M LoRaWAN/GNSS HAT |
| Brand Name | : N/A |
| Model | : SX1262 868/915M LoRaWAN/GNSS HAT |
| | SX1262 868/915M LoRaWAN HAT, Core1262-HF, Core1262-LF |
| Series Model | : Pico-LoRa-SX1262-868M, Pico-LoRa-SX1262-915M, SX1262-LoRa-DTU-HF, SX1262-LoRa-DTU-HF-Kit, SX1262 868M LoRa HAT, SX1262 915M LoRa HAT |
| FCC ID | : 2BHC7-WAVESHARE2502 |
| Applicant | : Shenzhen waveshare Electronics Co.,Ltd. |
| Address | : 202 2F, World Trade Plaza Funan Community Futian Street, Futian District, Shenzhen |
| Manufacturer | : Shenzhen waveshare Electronics Co.,Ltd. |
| Address | : 202 2F, World Trade Plaza Funan Community Futian Street, Futian District, Shenzhen |
| Standard(s) | : FCC CFR Title 47 Part 15 Subpart C Section 15.247 |
| Date of Receipt | : Jan. 09, 2025 |
| Date of Test | : Jan. 10, 2025~ Jan. 16, 2025 |
| Issued Date | : Jan. 17, 2025 |

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Note: This device has been tested and found to comply with the standard(s) listed, this 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. This report shall not be reproduced except in full, without the written approval of Guangdong Asia Hongke Test Technology Limited. If there is a need to alter or revise this document, the right belongs to Guangdong Asia Hongke Test Technology Limited, and it should give a prior written notice of the revision document. This test report must not be used by the client to claim product endorsement.

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Report Revise Record

| Report Version | Issued Date | Notes |
|----------------|---------------|-----------------|
| M1 | Jan. 17, 2025 | Initial Release |

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1 TEST SUMMARY

1.1 Test Standards

The tests were performed according to following standards:

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ANSI C63.10: 2013: American National Standard for Testing Unlicensed Wireless Devices

KDB558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spreda Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules

1.2 Test Summary

| Test Item | Section in 47 CFR | Result |
|---|---------------------|--------|
| Antenna requirement | §15.203 | Pass |
| On Time and Duty Cycle | / | / |
| AC Power Line Conducted Emission | § 15.207(a) | Pass |
| Conducted Peak Output Power | §15.247 (b)(3) | Pass |
| Channel Bandwidth | §15.247 (a)(2) | Pass |
| Power Spectral Density | §15.247 (e) | Pass |
| Transmitter Radiated Spurious Emission | §15.205/15.209 | Pass |
| Restricted Bands | §15.205/15.209 | PASS |
| Conducted Unwanted emissions and Bandedge | §15.205, §15.247(d) | Pass |

1.3 Test Facility

Test Laboratory:

Guangdong Asia Hongke Test Technology Limited

B1/F, Building 11, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

The test facility is recognized, certified or accredited by the following organizations:

FCC-Registration No.: 251906 Designation Number: CN1376

Guangdong Asia Hongke Test Technology Limited 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.

IC —Registration No.: 31737 CAB identifier: CN0165

The 3m Semi-anechoic chamber of Guangdong Asia Hongke Test Technology Limited has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 31737

A2LA-Lab Cert. No.: 7133.01

Guangdong Asia Hongke Test Technology Limited has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

1.4 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 according 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 Guangdong Asia Hongke Test Technology Limited's quality system according 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.

Hereafter the best measurement capability for Asia Hongke laboratory is reported:

| Test | Measurement Uncertainty | Notes |
|-------------------------------|---------------------------|-------|
| Power Line Conducted Emission | 9KHz~30MHz ± 1.20 dB | (1) |
| Radiated Emission | 9KHz~30MHz ± 3.10 dB | (1) |
| Radiated Emission | 30MHz~1GHz ± 3.75 dB | (1) |
| Radiated Emission | 1GHz~18GHz ± 3.88 dB | (1) |
| Radiated Emission | 18GHz-40GHz ± 3.88 dB | (1) |
| RF power, conducted | 30MHz~6GHz ± 0.16 dB | (1) |
| RF power density, conducted | ± 0.24 dB | (1) |
| Spurious emissions, conducted | ± 0.21 dB | (1) |
| Temperature | ± 1 °C | (1) |
| Humidity | ± 3 % | (1) |
| DC and low frequency voltages | ± 1.5 % | (1) |
| Time | ± 2 % | (1) |
| Duty cycle | ± 2 % | (1) |
| Bandwidth | $\pm 1.5 \times 10^{-6}$ | (1) |

The report uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty Multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

2 GENERAL INFORMATION

2.1 Environmental conditions

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

| | |
|---------------------|---------|
| Normal Temperature: | 25°C |
| Relative Humidity: | 55 % |
| Air Pressure: | 101 kPa |

2.2 General Description of EUT

| | |
|---|---|
| Product Name: | SX1262 868/915M LoRaWAN/GNSS HAT |
| Model: | SX1262 868/915M LoRaWAN/GNSS HAT |
| Serial Model: | SX1262 868/915M LoRaWAN HAT, Core1262-HF, Core1262-LF Pico-LoRa-SX1262-868M, Pico-LoRa-SX1262-915M, SX1262-LoRa-DTU-HF, SX1262-LoRa-DTU-HF-Kit, SX1262 868M LoRa HAT, SX1262 915M LoRa HAT |
| Power Rating: | Input: DC 5V/3A |
| Hardware Version: | N/A |
| Software Version: | N/A |
| Sample(s) Status: | AiTDG-250109017-1(Normal sample) AiTDG-250109017-2(Engineer sample) |
| Lora 500KHz(DTS): | |
| Operation frequency: | 903MHz~914.2MHz |
| Modulation: | LoRa |
| Channel number: | 8 |
| Channel separation: | 1.6MHz |
| Antenna type: | External antenna |
| Antenna gain: | 2.0 dBi |
| Remark: The above DUT's information was declared by manufacturer. For more detailed features description, please refer to the manufacturer's specifications or the User's Manual. | |

2.3 Description of Test Modes and Test Frequency

There are 8 channels provided to the EUT and Channel 64/68/71 were selected to test.

Operation Frequency List:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|-----------|-----------------|-----------|-----------------|
| 64 | 903.00 | 68 | 909.40 |
| 65 | 904.60 | 69 | 911.00 |
| 66 | 906.20 | 70 | 912.60 |
| 67 | 907.80 | 71 | 914.20 |

Note: The line display in grey were the channel selected for testing

Exploratory testing was performed under each mode combination test channel; only the final measurement of the worst combination was made and recorded in this report.

| Test case | Exploratory measurement | | | Final measurement Recorded In Report | | |
|---|-------------------------|-----------|---|--------------------------------------|-----------|---|
| | Mode | Date rate | Channel | Mode | Date rate | Channel |
| Maximum output power | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest |
| Power spectral density | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest |
| -6dB bandwidth | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest |
| Conducted Spurious Emissions | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest |
| Conducted Band edge | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest |
| Radiated Emissions Above 1GHz | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest |
| Radiated Emissions Below 1GHz& Radiated Band edge | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest |
| Conducted Emissions 9KHz-30 MHz | LoRa | Lora DR4 | <input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest | GFSK | Lora DR4 | <input checked="" type="checkbox"/> Middle |

Note: DR means DateRate refer to LoRaWAN Specification as below:

| DataRate | Configuration | Indicative physical bit rate [bit/sec] |
|----------|----------------------|--|
| 0 | LoRa: SF10 / 125 kHz | 980 |
| 1 | LoRa: SF9 / 125 kHz | 1760 |
| 2 | LoRa: SF8 / 125 kHz | 3125 |
| 3 | LoRa: SF7 / 125 kHz | 5470 |
| 4 | LoRa: SF8 / 500 kHz | 12500 |

Power setting during the test:

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Power Parameters:

| Test Software Version | CMD command | | |
|-----------------------|-------------|---------|---------|
| Channel | Low | Middle | High |
| Lora | default | default | default |

2.4 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

| Description | Manufacturer | Model | Serial No. | Provided by | Other |
|-------------|--------------|---------------|------------|--------------|-------|
| Adapter | / | BI18-050300-I | / | Manufacturer | / |
| / | / | / | / | / | / |

2.5 Equipment List for the Test

| No | Test Equipment | Manufacturer | Model No | Serial No | Cal. Date | Cal. Due Date |
|----|-------------------------------------|--------------|-----------------|-----------------|------------|---------------|
| 1 | EMI Measuring Receiver | R&S | ESR | 101160 | 2024.09.25 | 2025.09.24 |
| 2 | Spectrum Analyzer | R&S | FSV40 | 101470 | 2024.09.23 | 2025.09.22 |
| 3 | Low Noise Pre Amplifier | SCHWARZBECK | BBV 9745 | 00282 | 2024.09.25 | 2025.09.24 |
| 4 | Low Noise Pre Amplifier | CESHENG | CSKJLNA23101 6A | CSKJLNA231016 A | 2024.09.25 | 2025.09.24 |
| 5 | Passive Loop | ETS | 6512 | 00165355 | 2024.08.29 | 2027.08.28 |
| 6 | TRILOG Super Broadband test Antenna | SCHWARZBECK | VULB9168 | 01434 | 2024.08.29 | 2027.08.28 |
| 7 | Broadband Horn Antenna | Schwarzbeck | BBHA 9120D | 452 | 2024.08.29 | 2027.08.28 |
| 8 | Horn Antenna 15-40GHz | SCHWARZBECK | BBHA9170 | BBHA9170367 | 2024.08.28 | 2027.08.27 |
| 9 | 6dB Attenuator | JFW | 50FPE-006 | 4360846-949-1 | 2024.09.24 | 2025.09.23 |
| 10 | EMI Test Receiver | R&S | ESPI | 100771 | 2024.09.25 | 2025.09.24 |
| 11 | LISN | R&S | NNLK 8129 | 8130179 | 2024.09.24 | 2025.09.23 |
| 12 | LISN | R&S | ESH3-Z5 | 892785/016 | 2024.09.23 | 2025.09.22 |
| 13 | Pulse Limiter | R&S | ESH3-Z2 | 102789 | 2024.09.24 | 2025.09.23 |
| 14 | RF Automatic Test system | TST | TSTPASS | 21033016 | 2024.09.25 | 2025.09.24 |
| 15 | Vector Signal Generator | Agilent | N5182A | MY50143009 | 2024.09.25 | 2025.09.24 |
| 16 | Analog signal generator | Agilent | E8257 | MY51554256 | 2024.09.25 | 2025.09.24 |
| 17 | Spectrum Analyzer | Agilent | N9020A | MY51289843 | 2024.09.25 | 2025.09.24 |
| 18 | Spectrum Analyzer | Agilent | N9020A | MY53421570 | 2024.09.25 | 2025.09.24 |

| | | | | | | |
|----|-------------------------------------|---------|------------|-------------------|------------|------------|
| 19 | Power Sensor | Agilent | 8481A | MY41097697 | 2024.09.25 | 2025.09.24 |
| 20 | Wideband Radio communication tester | R&S | CMW500 | 1201.0002K50 | 2024.09.24 | 2025.09.23 |
| 21 | DC power supply | ZHAOXIN | RXN-305D-2 | 28070002559 | N/A | N/A |
| 22 | RE Software | EZ | EZ-EMC_RE | Ver.AIT-03A | N/A | N/A |
| 23 | CE Software | EZ | EZ-EMC_CE | Ver.AIT-03A | N/A | N/A |
| 24 | RF Software | TST | TSTPASS | Version 2.0 | N/A | N/A |
| 25 | RF Software | cesheng | WCS-WCN | Version 2024.6.20 | N/A | N/A |
| 26 | temporary antenna connector(Note) | NTS | R001 | N/A | N/A | N/A |

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

3 TEST CONDITIONS AND RESULTS

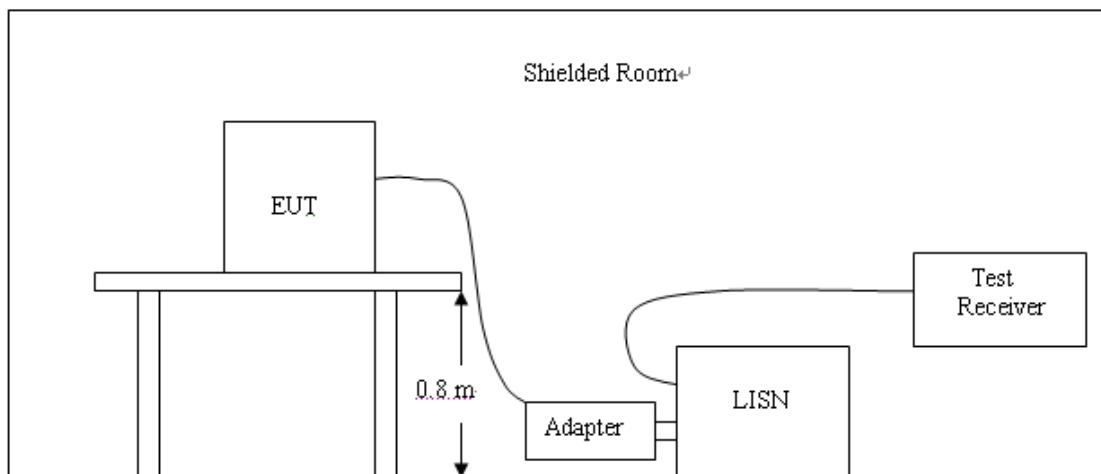
3.1 Conducted Emissions Test

LIMIT

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

* Decreases with the logarithm of the frequency.

TEST CONFIGURATION

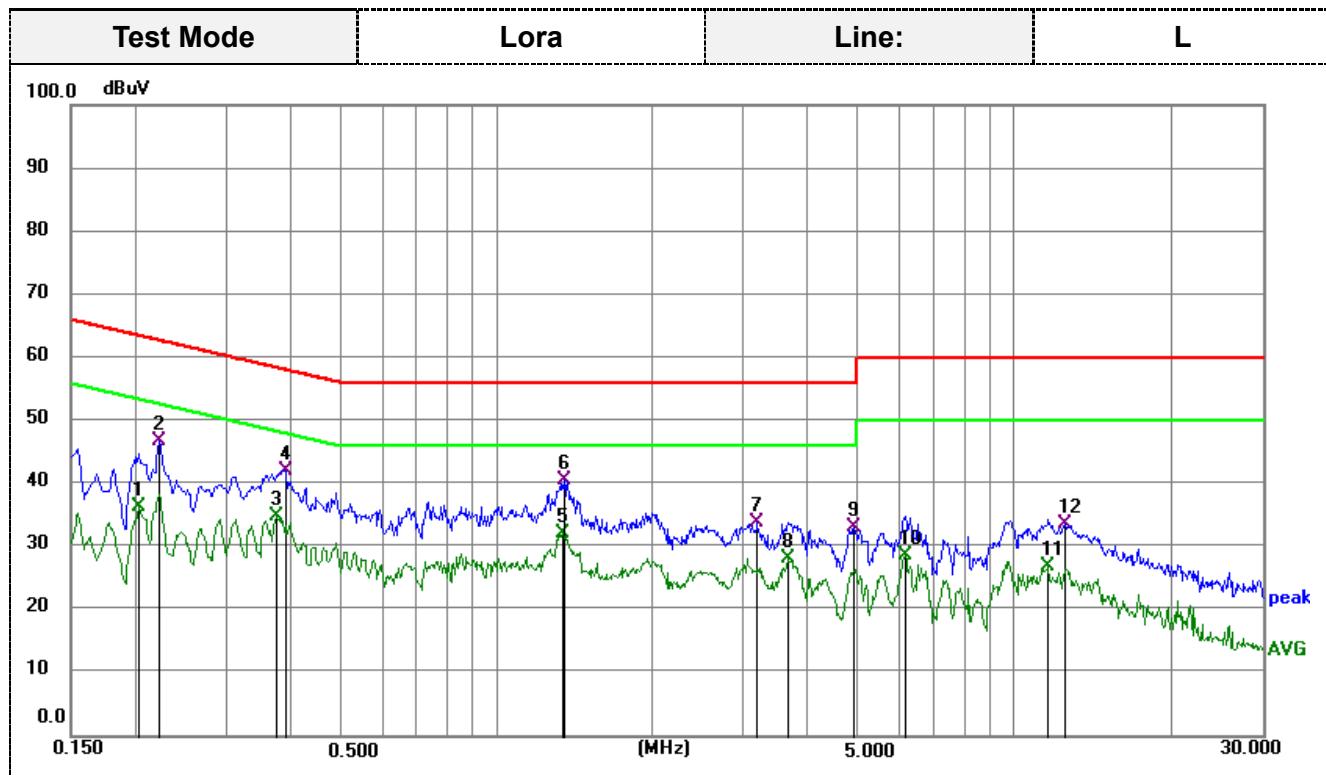


TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

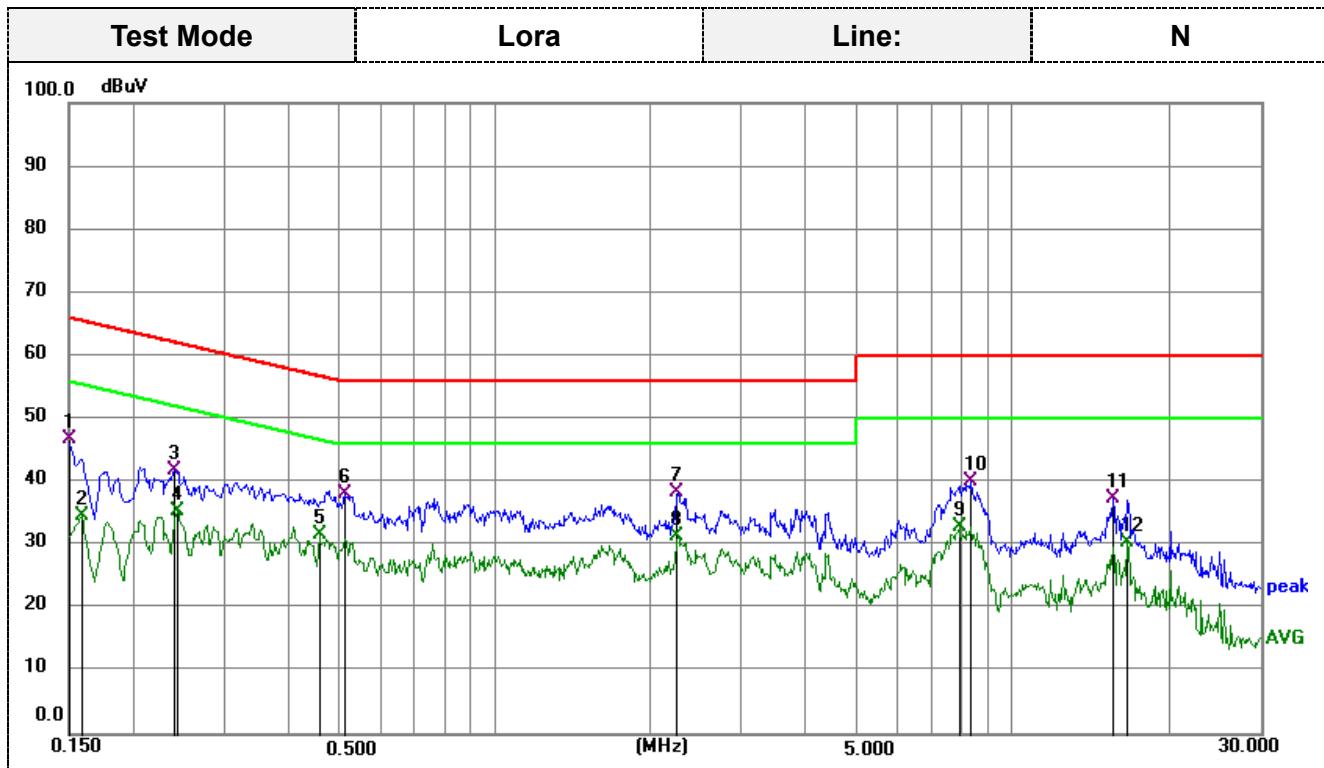
TEST RESULTS

Remark: Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:



Remark: Correct Factor = Insertion loss of LISN + Cable loss + Insertion loss of Pulse Limiter;
Measurement Result = Reading Level +Correct Factor;
Margin = Measurement Result- Limit

| No. | Frequency (MHz) | Reading (dBuV) | Correct (dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|-----|--------------------|-------------------|-----------------|------------------|-----------------|----------------|--------|
| | | | | | | | |
| 1 | 0.2028 | 25.70 | 10.70 | 36.40 | 53.50 | -17.10 | AVG |
| 2 | 0.2220 | 35.97 | 10.70 | 46.67 | 62.74 | -16.07 | QP |
| 3 | 0.3750 | 24.29 | 10.69 | 34.98 | 48.39 | -13.41 | AVG |
| 4 | 0.3885 | 31.48 | 10.69 | 42.17 | 58.10 | -15.93 | QP |
| 5 | 1.3380 | 21.38 | 10.69 | 32.07 | 46.00 | -13.93 | AVG |
| 6 | 1.3513 | 29.82 | 10.69 | 40.51 | 56.00 | -15.49 | QP |
| 7 | 3.1740 | 22.97 | 10.80 | 33.77 | 56.00 | -22.23 | QP |
| 8 | 3.6510 | 17.18 | 10.98 | 28.16 | 46.00 | -17.84 | AVG |
| 9 | 4.8930 | 22.21 | 11.02 | 33.23 | 56.00 | -22.77 | QP |
| 10 | 6.1350 | 17.64 | 11.03 | 28.67 | 50.00 | -21.33 | AVG |
| 11 | 11.5663 | 15.74 | 11.24 | 26.98 | 50.00 | -23.02 | AVG |
| 12 | 12.4664 | 22.21 | 11.31 | 33.52 | 60.00 | -26.48 | QP |



Remark: Correct Factor = Insertion loss of LISN + Cable loss + Insertion loss of Pulse Limiter;
Measurement Result = Reading Level +Correct Factor;

Margin = Measurement Result- Limit

| No. | Frequency (MHz) | Reading (dBuV) | Correct (dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|-----|--------------------|-------------------|-----------------|------------------|-----------------|----------------|--------|
| 1 | 0.1500 | 34.98 | 11.84 | 46.82 | 66.00 | -19.18 | QP |
| 2 | 0.1590 | 23.88 | 10.78 | 34.66 | 55.52 | -20.86 | AVG |
| 3 | 0.2400 | 31.22 | 10.69 | 41.91 | 62.10 | -20.19 | QP |
| 4 | 0.2430 | 24.64 | 10.69 | 35.33 | 51.99 | -16.66 | AVG |
| 5 | 0.4560 | 21.06 | 10.69 | 31.75 | 46.77 | -15.02 | AVG |
| 6 | 0.5100 | 27.44 | 10.69 | 38.13 | 56.00 | -17.87 | QP |
| 7 | 2.2559 | 27.56 | 10.78 | 38.34 | 56.00 | -17.66 | QP |
| 8 | 2.2559 | 20.65 | 10.78 | 31.43 | 46.00 | -14.57 | AVG |
| 9 | 7.8540 | 21.77 | 11.04 | 32.81 | 50.00 | -17.19 | AVG |
| 10 | 8.2903 | 29.08 | 11.04 | 40.12 | 60.00 | -19.88 | QP |
| 11 | 15.6074 | 25.91 | 11.49 | 37.40 | 60.00 | -22.60 | QP |
| 12 | 16.6470 | 18.99 | 11.53 | 30.52 | 50.00 | -19.48 | AVG |

3.2 Radiated Emissions and Band Edge

Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

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)

For intentional device, according to RSS-Gen section 8.9, the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

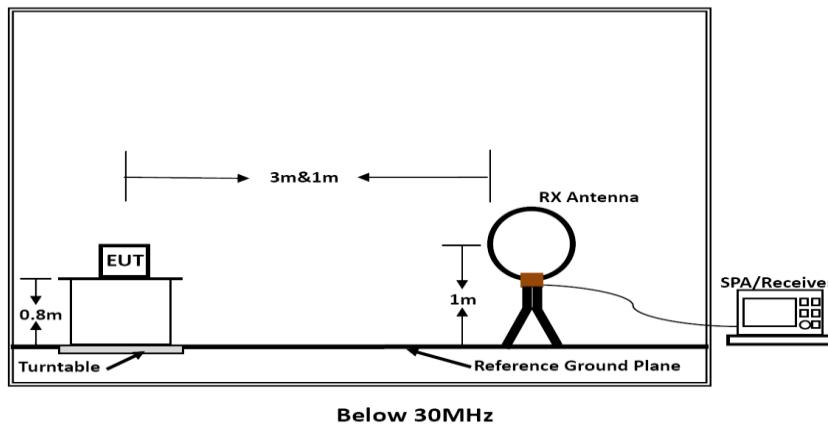
In addition, radiated emissions which fall in the restricted bands, as defined in RSS-Gen section 8.10, must also comply with the radiated emission limits specified in RSS-Gen section 8.9

Radiated emission limits

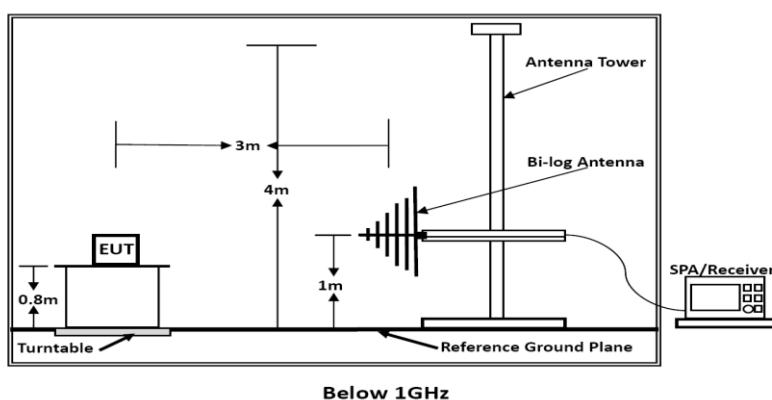
| Frequency (MHz) | Distance (Meters) | Radiated (dB μ V/m) | Radiated (μ V/m) |
|-----------------|-------------------|--|-----------------------|
| 0.009-0.49 | 3 | $20\log(2400/F(\text{KHz}))+40\log(300/3)$ | $2400/F(\text{KHz})$ |
| 0.49-1.705 | 3 | $20\log(24000/F(\text{KHz}))+40\log(30/3)$ | $24000/F(\text{KHz})$ |
| 1.705-30 | 3 | $20\log(30)+40\log(30/3)$ | 30 |
| 30-88 | 3 | 40.0 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

TEST CONFIGURATION

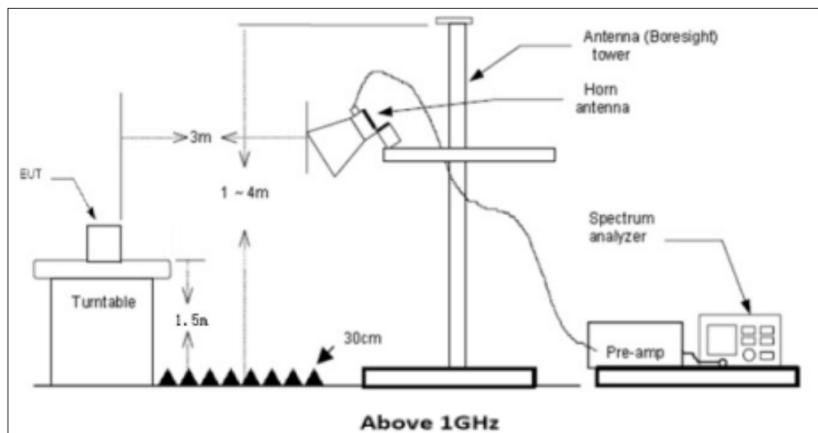
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



Test Procedure

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 10GHz.
6. The distance between test antenna and EUT as following table states:

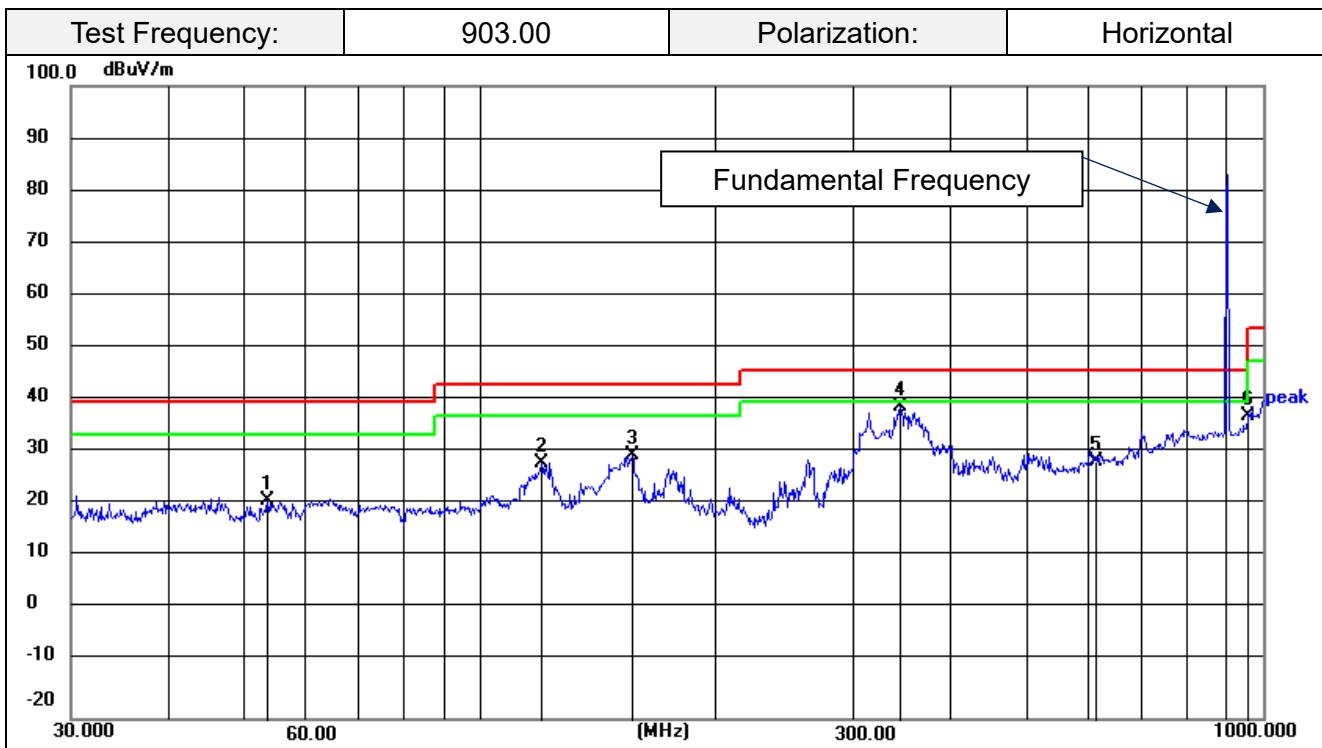
| Test Frequency range | Test Antenna Type | Test Distance |
|----------------------|---------------------|---------------|
| 9KHz-30MHz | Active Loop Antenna | 3 |
| 30MHz-1GHz | Bilog Antenna | 3 |
| 1GHz-18GHz | Horn Antenna | 3 |

7. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|----------------------|---|----------|
| 9KHz-150KHz | RBW=200Hz/VBW=3KHz,Sweep time=Auto | QP |
| 150KHz-30MHz | RBW=9KHz/VBW=100KHz,Sweep time=Auto | QP |
| 30MHz-1GHz | RBW=120KHz/VBW=1000KHz,Sweep time=Auto | QP |
| Above 1GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

TEST RESULTS

Remark: Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and The emission levels from 9kHz to 30MHz are attenuated 20dB below the limit and not recorded in report.

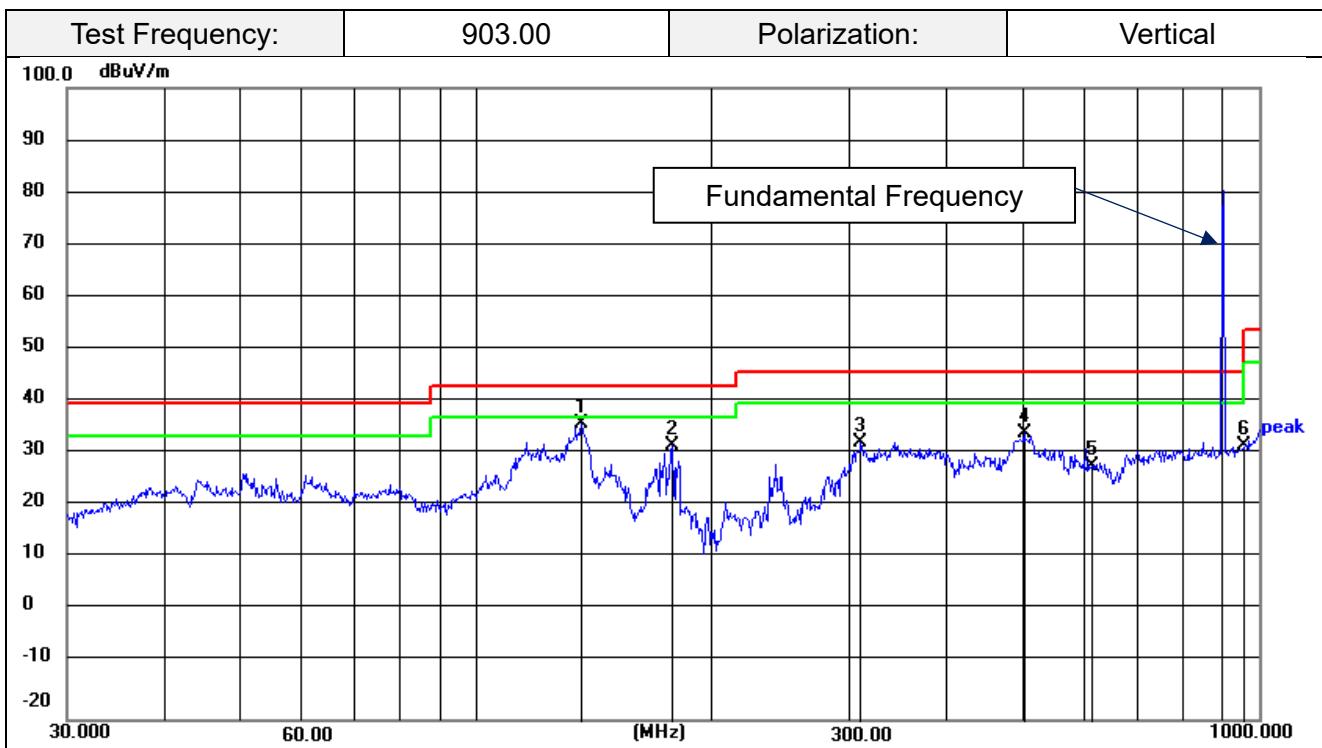
For 30MHz-1GHz

Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin= Emission Level - Limit.

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Det. |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|------|
| 1 | 53.5052 | 38.45 | -16.91 | 21.54 | 40.00 | -18.46 | QP |
| 2 | 119.8555 | 46.92 | -18.40 | 28.52 | 43.50 | -14.98 | QP |
| 3 | 156.4576 | 46.45 | -16.53 | 29.92 | 43.50 | -13.58 | QP |
| 4 | 344.3854 | 54.97 | -15.86 | 39.11 | 46.00 | -6.89 | QP |
| 5 | 614.0000 | 38.32 | -9.41 | 28.91 | 46.00 | -17.09 | QP |
| 6 | 960.0000 | 41.03 | -3.47 | 37.56 | 46.00 | -8.44 | QP |

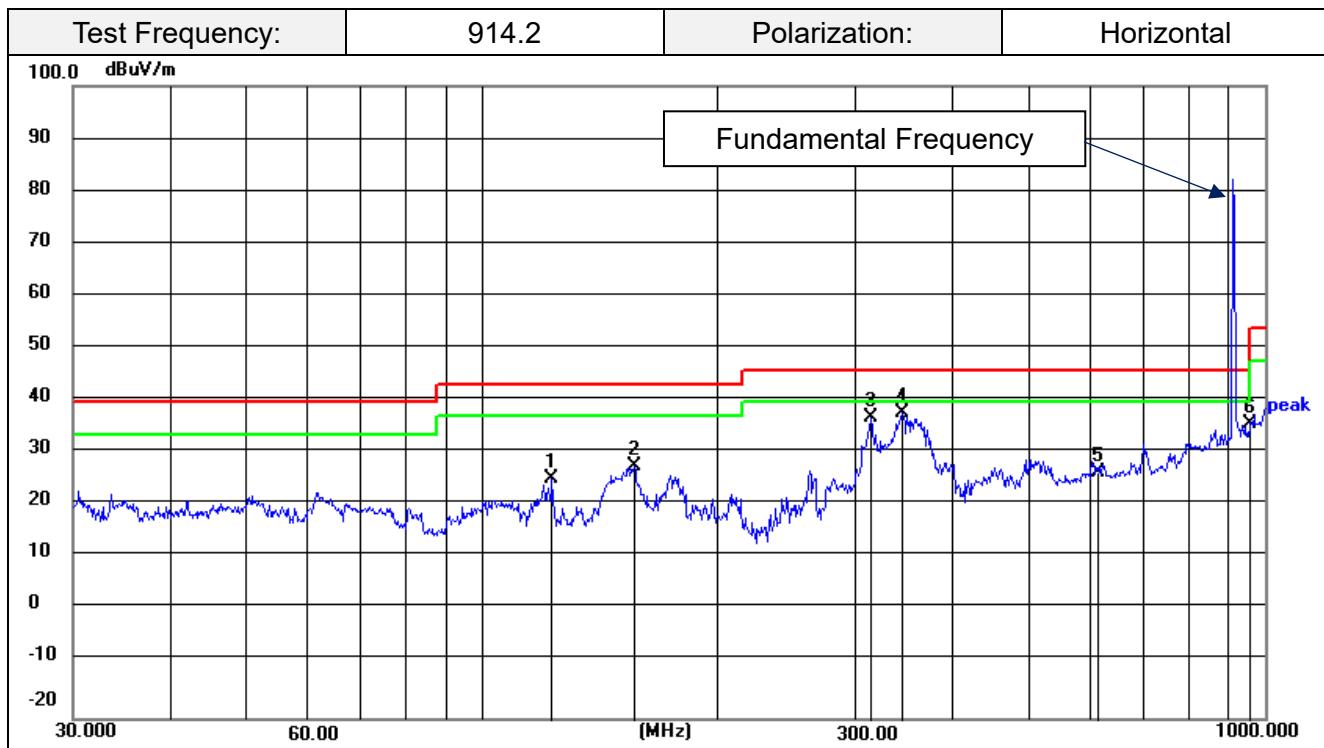

Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin= Emission Level - Limit.

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Det. |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|------|
| 1 | 136.4598 | 53.69 | -17.46 | 36.23 | 43.50 | -7.27 | QP |
| 2 | 178.1324 | 50.21 | -18.03 | 32.18 | 43.50 | -11.32 | QP |
| 3 | 309.9977 | 49.31 | -16.66 | 32.65 | 46.00 | -13.35 | QP |
| 4 | 501.1790 | 46.97 | -12.50 | 34.47 | 46.00 | -11.53 | QP |
| 5 | 614.0000 | 37.53 | -9.41 | 28.12 | 46.00 | -17.88 | QP |
| 6 | 960.0000 | 35.49 | -3.47 | 32.02 | 46.00 | -13.98 | QP |

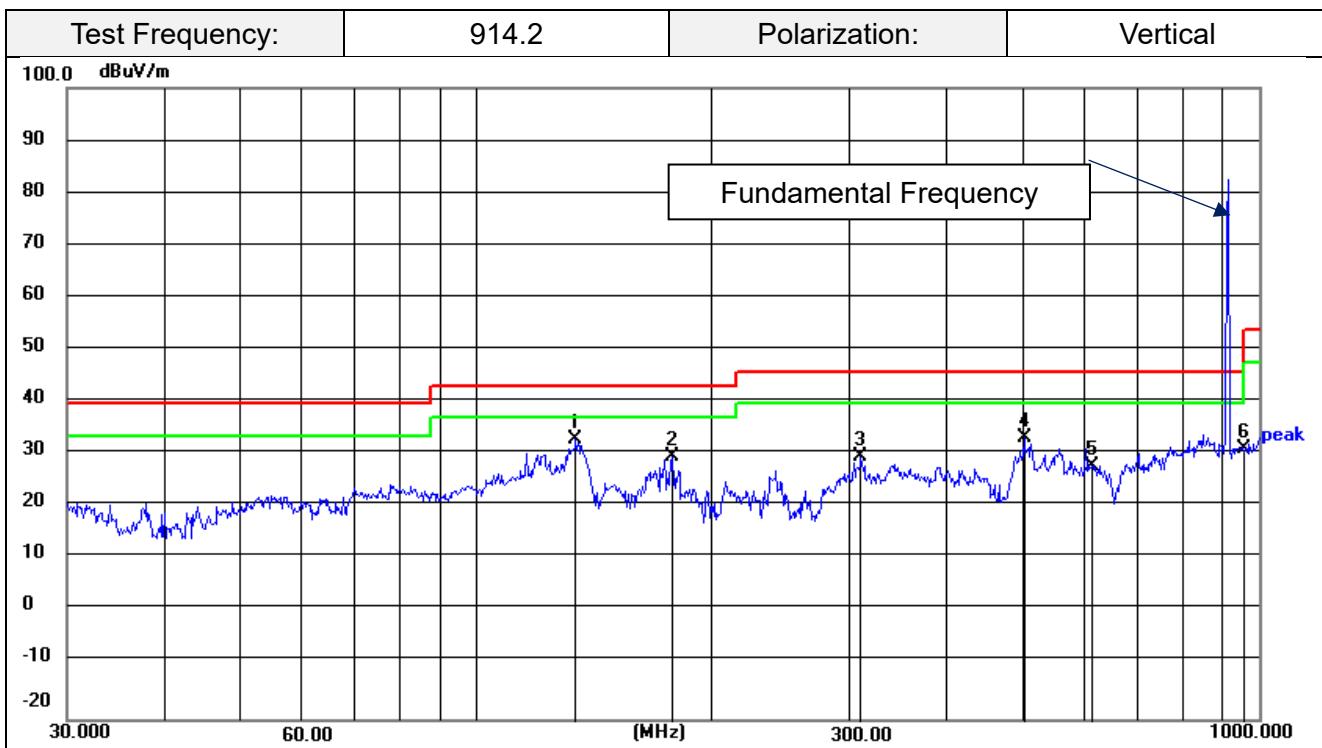

Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin= Emission Level - Limit.

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Det. |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|------|
| 1 | 122.8340 | 43.72 | -18.20 | 25.52 | 43.50 | -17.98 | QP |
| 2 | 156.4576 | 44.45 | -16.53 | 27.92 | 43.50 | -15.58 | QP |
| 3 | 314.3763 | 53.58 | -16.53 | 37.05 | 46.00 | -8.95 | QP |
| 4 | 344.3854 | 53.97 | -15.86 | 38.11 | 46.00 | -7.89 | QP |
| 5 | 614.0000 | 36.32 | -9.41 | 26.91 | 46.00 | -19.09 | QP |
| 6 | 960.0000 | 39.53 | -3.47 | 36.06 | 46.00 | -9.94 | QP |


Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin= Emission Level - Limit.

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Det. |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|------|
| 1 | 134.0880 | 50.82 | -17.54 | 33.28 | 43.50 | -10.22 | QP |
| 2 | 178.1322 | 48.21 | -18.03 | 30.18 | 43.50 | -13.32 | QP |
| 3 | 309.9977 | 46.81 | -16.66 | 30.15 | 46.00 | -15.85 | QP |
| 4 | 501.1790 | 45.97 | -12.50 | 33.47 | 46.00 | -12.53 | QP |
| 5 | 614.0000 | 37.53 | -9.41 | 28.12 | 46.00 | -17.88 | QP |
| 6 | 960.0000 | 34.99 | -3.47 | 31.52 | 46.00 | -14.48 | QP |

For 1GHz to 10GHz

Above 1GHz

| Frequency(MHz): | | 903.00 | | Polarity: | Horizontal | |
|--------------------|----------------------------------|--------|-------------------------------------|-----------|------------|------------------|
| Frequency (MHz) | Meter Reading (dB μ V) | Factor | Emission Level (dB μ V/m) | Limits | Margin | Detector Type |
| 1805.40 | 72.57 | -16.73 | 55.84 | 74 | -18.16 | PEAK |
| 1805.40 | 66.70 | -16.73 | 49.97 | 54 | -4.03 | AVG |
| 2708.30 | 66.15 | -13.02 | 53.13 | 74 | -20.87 | PEAK |
| -- | -- | -- | -- | -- | -- | AVG |

| Frequency(MHz): | | 903.00 | | Polarity: | VERTICAL | |
|--------------------|----------------------------------|--------|-------------------------------------|-----------|----------|------------------|
| Frequency (MHz) | Meter Reading (dB μ V) | Factor | Emission Level (dB μ V/m) | Limits | Margin | Detector Type |
| 1805.40 | 73.44 | -16.73 | 56.71 | 74 | -17.29 | PEAK |
| 1805.40 | 65.94 | -16.73 | 49.21 | 54 | -4.79 | AVG |
| 2708.30 | 66.41 | -13.02 | 53.39 | 74 | -20.61 | PEAK |
| -- | -- | -- | -- | -- | -- | AVG |

| Frequency(MHz): | | 909.40 | | Polarity: | Horizontal | |
|--------------------|----------------------------------|--------|-------------------------------------|-----------|------------|------------------|
| Frequency (MHz) | Meter Reading (dB μ V) | Factor | Emission Level (dB μ V/m) | Limits | Margin | Detector Type |
| 1818.35 | 73.96 | -16.59 | 57.37 | 74 | -16.63 | PEAK |
| 1818.35 | 66.66 | -16.59 | 50.07 | 54 | -3.93 | AVG |
| 2729.15 | 64.28 | -12.74 | 51.54 | 74 | -22.46 | PEAK |
| -- | -- | -- | -- | -- | -- | AVG |

| Frequency(MHz): | | 909.40 | | Polarity: | VERTICAL | |
|--------------------|----------------------------------|--------|-------------------------------------|-----------|----------|------------------|
| Frequency (MHz) | Meter Reading (dB μ V) | Factor | Emission Level (dB μ V/m) | Limits | Margin | Detector Type |
| 1818.35 | 74.09 | -16.59 | 57.50 | 74 | -16.50 | PEAK |
| 1818.35 | 67.20 | -16.59 | 50.61 | 54 | -3.39 | AVG |
| 2729.15 | 64.50 | -12.74 | 51.76 | 74 | -22.24 | PEAK |
| -- | -- | -- | -- | -- | -- | AVG |

| Frequency(MHz): | | 914.20 | | Polarity: | Horizontal | |
|-----------------|---------------|--------|----------------|----------------|------------|---------------|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dB μ V) | (dB/m) | (dB μ V/m) | (dB μ V/m) | (dB) | |
| 1828.65 | 47.02 | -16.48 | 58.85 | 74 | -15.15 | PEAK |
| 1828.65 | 65.87 | -16.48 | 49.39 | 54 | -4.61 | AVG |
| 2743.25 | 46.47 | -12.55 | 53.74 | 74 | -20.26 | PEAK |
| -- | -- | -- | -- | -- | -- | AVG |

| Frequency(MHz): | | 914.20 | | Polarity: | VERTICAL | |
|-----------------|---------------|--------|----------------|----------------|----------|---------------|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dB μ V) | (dB/m) | (dB μ V/m) | (dB μ V/m) | (dB) | |
| 1828.65 | 45.63 | -16.48 | 59.91 | 74 | -14.09 | PEAK |
| 1828.65 | 65.46 | -16.48 | 48.98 | 54 | -5.02 | AVG |
| 2743.25 | 45.02 | -12.55 | 54.71 | 74 | -19.29 | PEAK |
| 2743.25 | 56.45 | -12.55 | 43.90 | 54 | -10.10 | AVG |

REMARKS:

1. Emission level (dB μ V/m) = Reading (dB μ V)+ Factor (dB/m)
2. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Emission level- Limit value.
4. -- Mean the PK detector measured value is below average limit.
5. Other emission levels are attenuated 20dB below the limit and not recorded in report.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

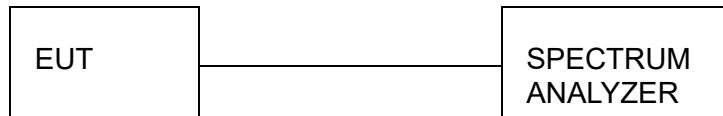
3.3 Maximum Peak Conducted Output Power Limit

The maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W.

Test Procedure

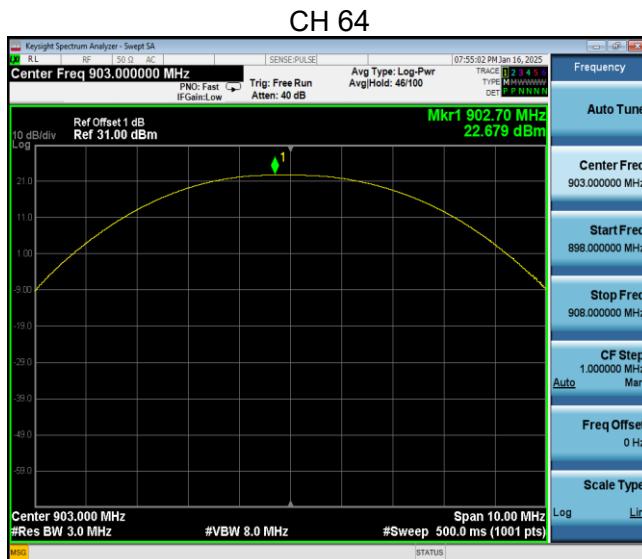
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the SPECTRUM ANALYZER.

Test Configuration



Test Results

| Type | Channel | Output power (dBm) | Limit (dBm) | Result |
|------|---------|--------------------|-------------|--------|
| Lora | 64 | 22.679 | 30.00 | Pass |
| | 68 | 22.340 | | |
| | 71 | 22.096 | | |



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3.4 Power Spectral Density

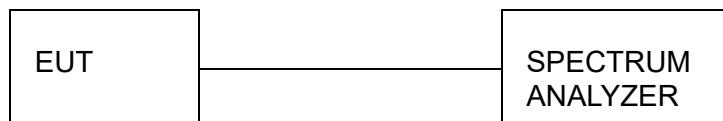
Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW \geq 3 kHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to 1.5 times the DTS channel bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11. The resulting peak PSD level must be 8dBm.

Test Configuration



Test Results

| Type | Channel | Power Spectral Density (dBm/3KHz) | Limit (dBm/3KHz) | Result |
|------|---------|-----------------------------------|------------------|--------|
| Lora | 64 | 5.123 | 8.00 | Pass |
| | 68 | 6.035 | | |
| | 71 | 5.478 | | |

Test plot as follows:

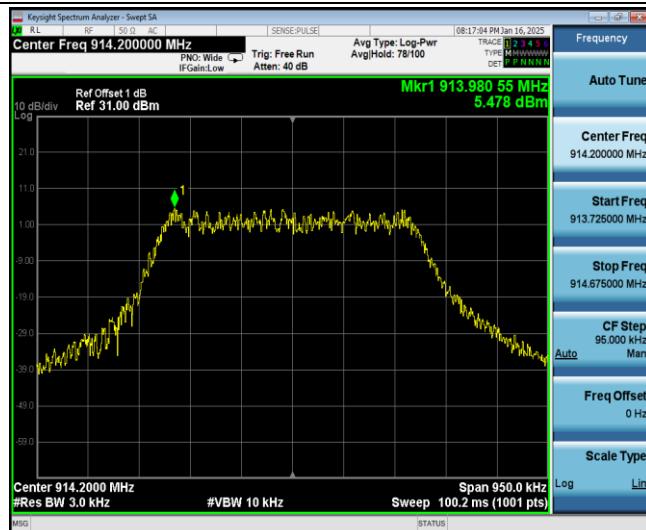
Lora



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3.5 6dB Bandwidth

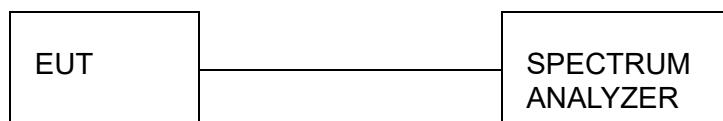
Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

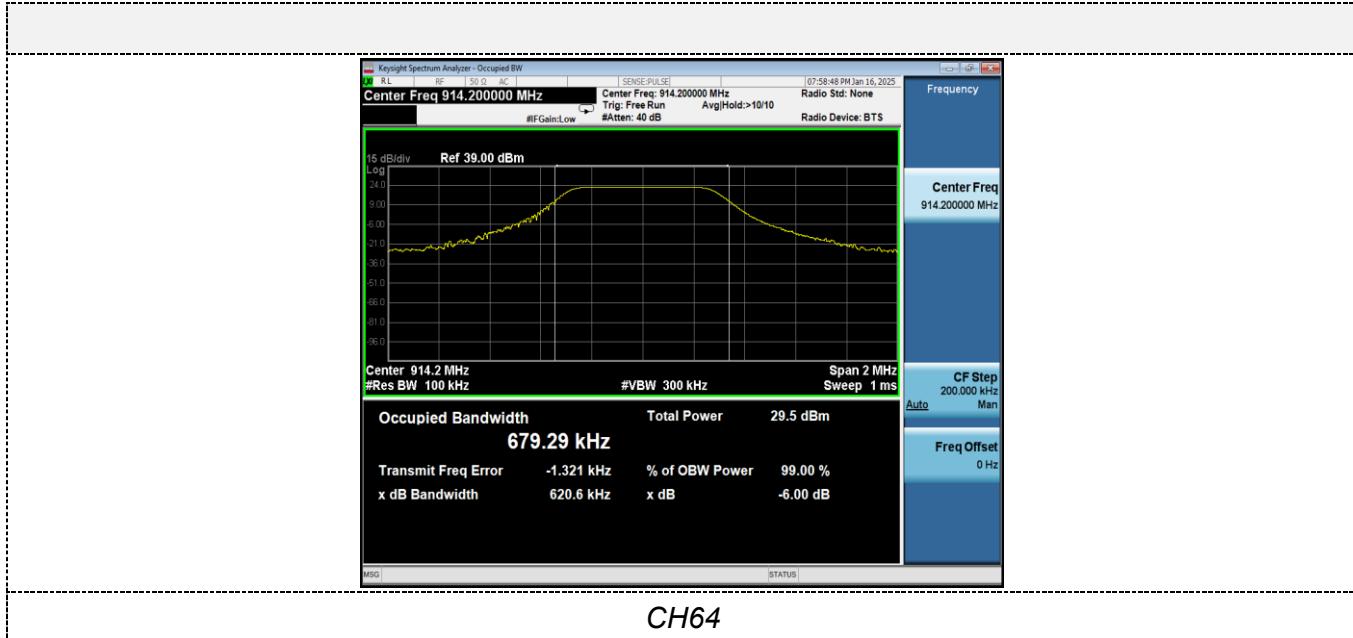
Test Configuration

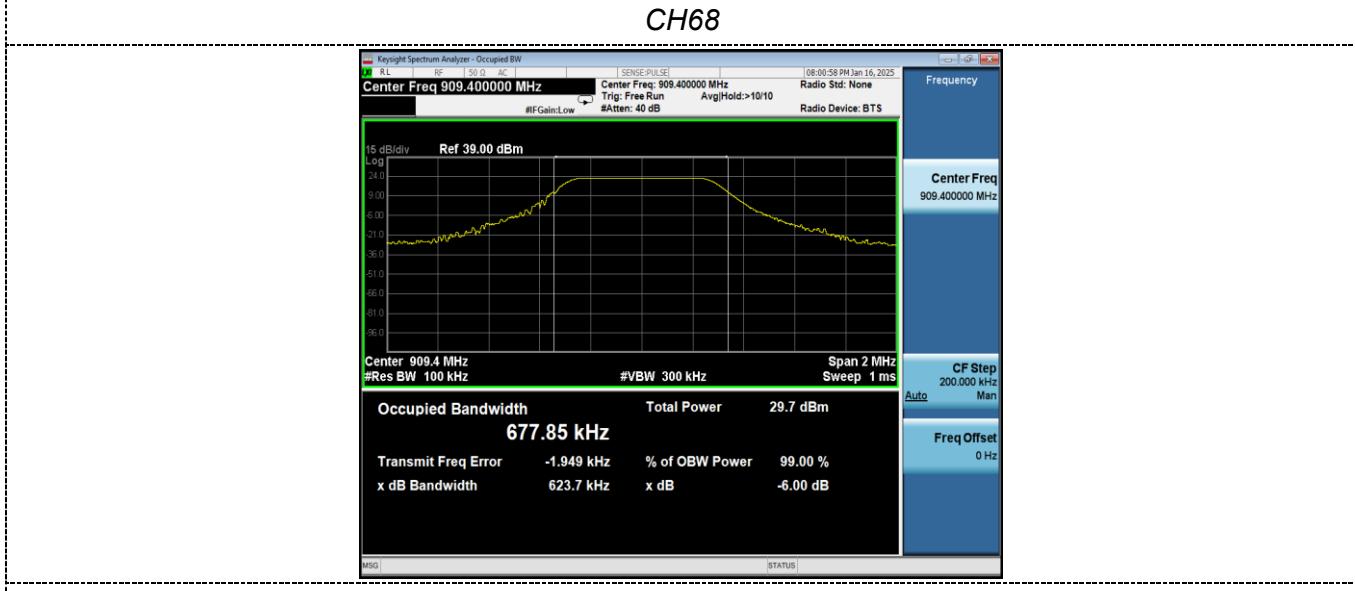


Test Results

| Type | Channel | 6dB Bandwidth (KHz) | Limit (KHz) | Result |
|------|---------|---------------------|-------------|--------|
| Lora | 64 | 620.6 | ≥ 500 | Pass |
| | 68 | 623.6 | | |
| | 71 | 623.7 | | |

Test plot as follows:





3.6 99% Bandwidth

Limit

N/A

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

RBW=1% to 5% of the OBW

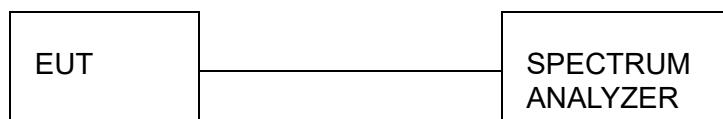
VBW=approximately 3 X RBW

Detector=Peak

Trace Mode: Max Hold

Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recorded.

Test Configuration



Test Results

| Type | Channel | 99% Bandwidth (KHz) | Limit (KHz) | Result |
|------|---------|---------------------|-------------|--------|
| Lora | 64 | 501.68 | N/A | Pass |
| | 68 | 501.02 | | |
| | 71 | 502.51 | | |

Test plot as follows:


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3.7 Out-of-band Emissions

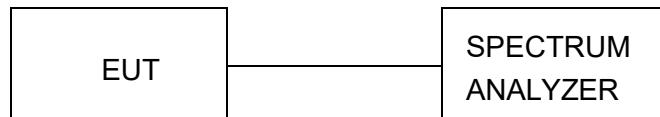
Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

Test Configuration

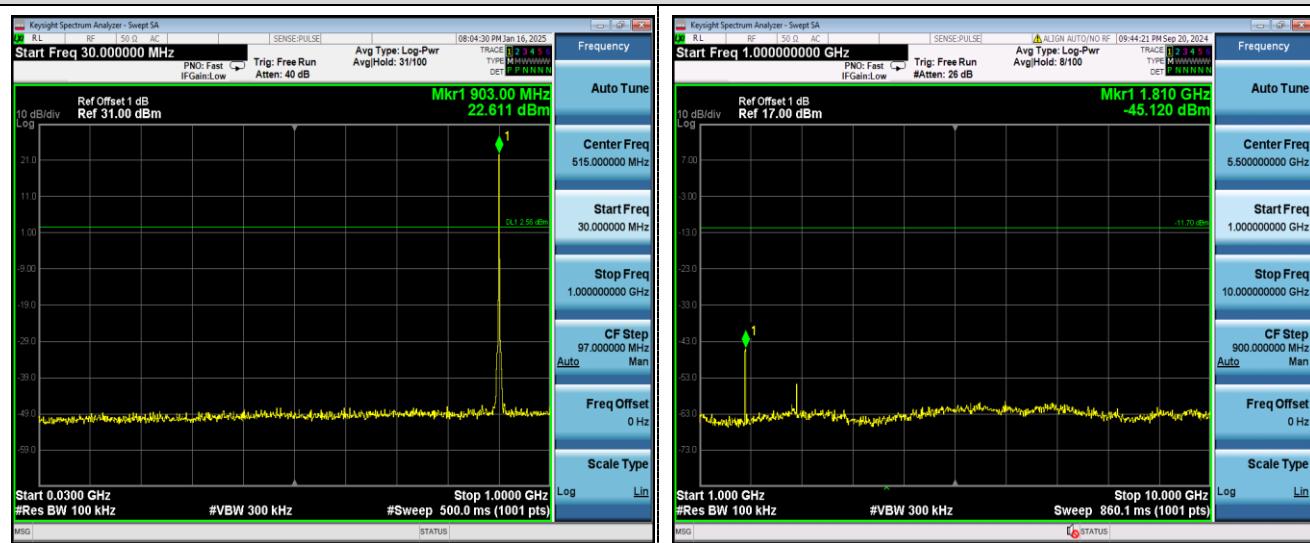


Test Results

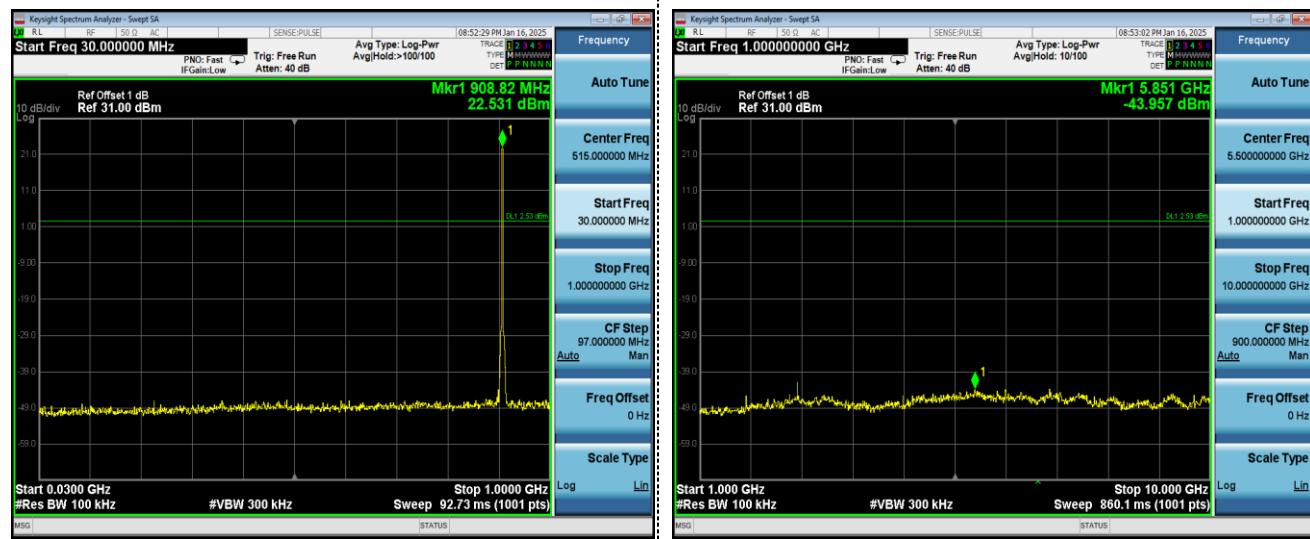
Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

Test plot as follows:

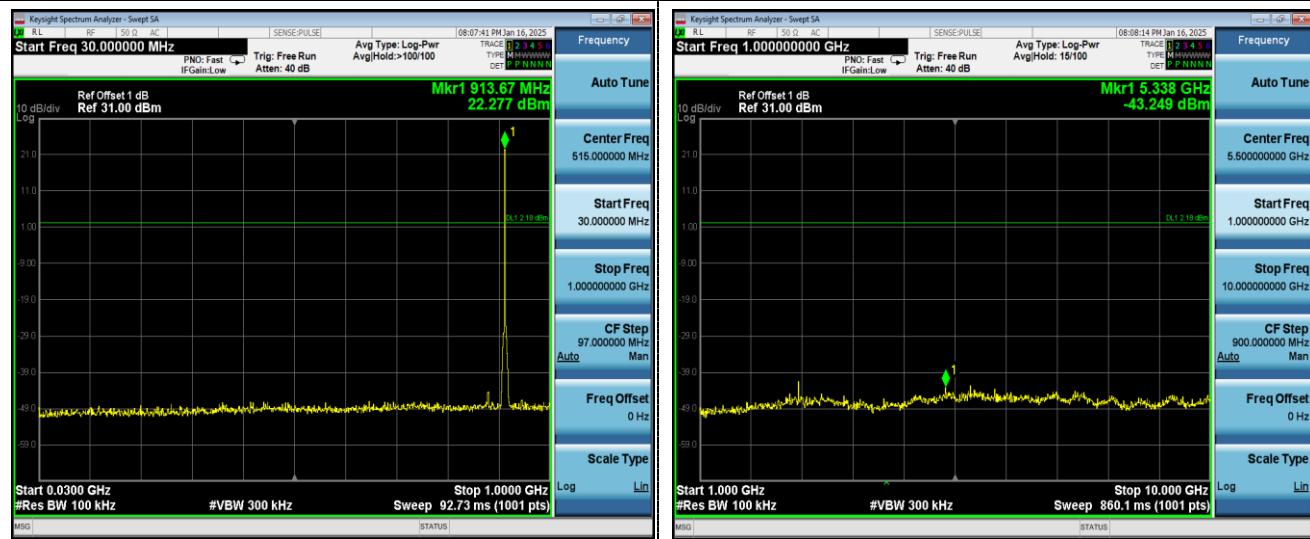
Lora



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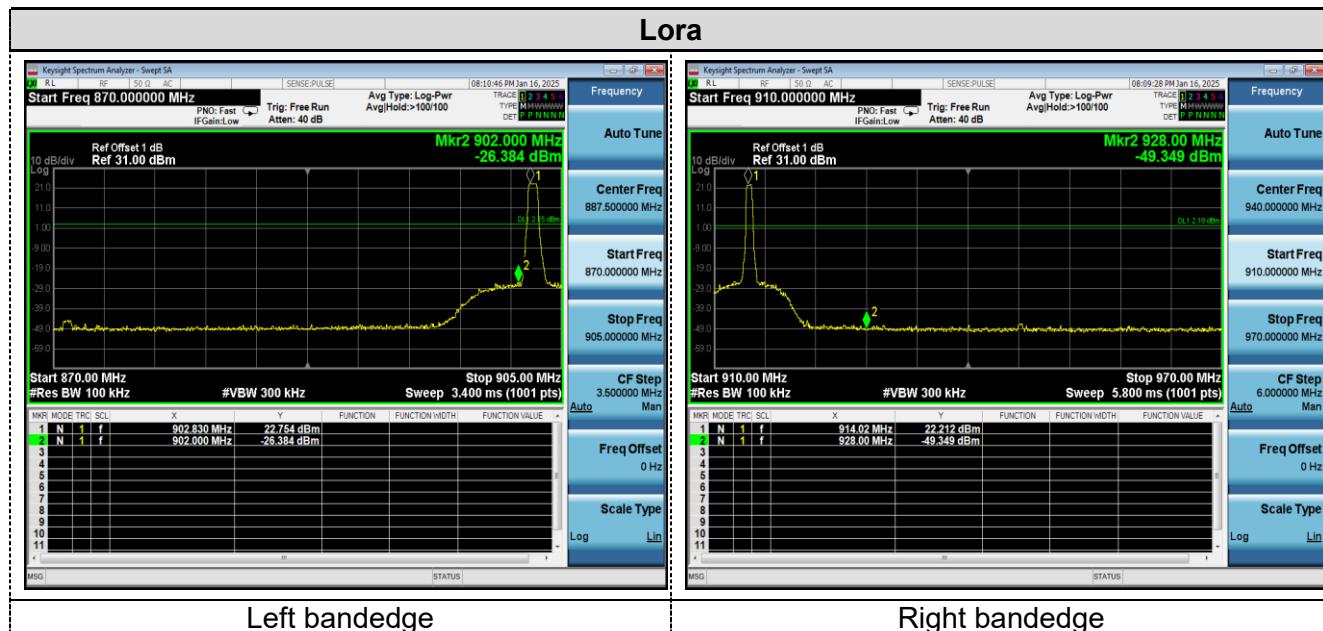


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Band-edge Measurements for RF Conducted Emissions:



3.8 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

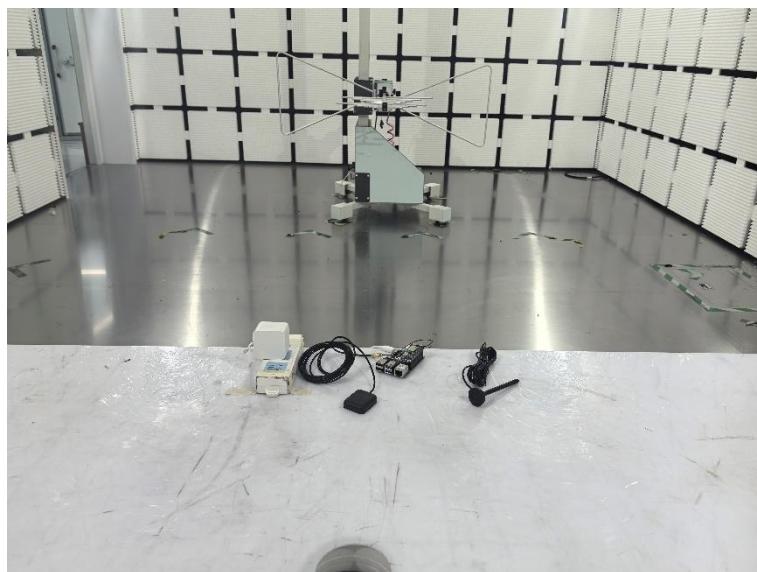
FCC CFR Title 47 Part 15 Subpart C Section 15.247(b) (4):

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Result

The maximum gain of antenna was 2.0dBi with impedance 50Ω .

4 Test Setup Photographs of EUT



5 External Photographs of EUT

Please refer to separated files test report No.: AiTDG-250109017FW1.

6 Internal Photographs of EUT

Please refer to separated files test report No.: AiTDG-250109017FW1.

***** End of Report *****