# FCC Test Report

Report No: FCS202304002W01

Issued for

| | |
|---|---|
| Applicant: | SHANDONG GOLDENCELL POWER TECHNOLOGY CO.,LTD. |
| Address: | No.X6699 Guangming Boulevard,Hightech District Zaozhuang City Shandong Province No. 3 floor |
| Product Name: | portable power station |
| Brand Name: | N/A |
| Model Name: | Thunder 280 |
| Series Model: | N/A |
| FCC ID: | 2BC4G-T280 |

Issued By: Flux Compliance Service Laboratory
Add: Room 105 Floor Bao hao Technology Building 1 NO.15 Gong ye West Road Hi-Tech Industrial, Song shan lake Dongguan
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# TEST RESULT CERTIFICATION

| | |
|---|---|
| Applicant's Name..... : | SHANDONG GOLDENCELL POWER TECHNOLOGY CO.,LTD. |
| Address..... : | No.X6699 Guangming Boulevard,Hightech District Zaozhuang City Shandong Province No. 3 floor |
| Manufacture's Name..... : | SHANDONG GOLDENCELL POWER TECHNOLOGY CO.,LTD. |
| Address..... : | No.X6699 Guangming Boulevard,Hightech District Zaozhuang City Shandong Province No. 3 floor |

**Product Description**

| | |
|---|---|
| Product Name..... : | portable power station |
| Brand Name.....: | N/A |
| Model Name..... : | Thunder 280 |
| Series Model.....: | N/A |
| Test Standards.....: | FCC Rules and Regulations Part 15 Subpart C, Section 247 |
| Test Procedure.....: | ANSI C63.10:2013 |

This device described above has been tested by Flux Compliance Service Laboratory, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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**Date of Test**.....:

| | |
|---|---|
| Date (s) of performance of tests. : | Apr 11, 2023 ~ Jun 13, 2023 |
| Date of Issue.....: | Jun 13, 2023 |
| Test Result..... : | Pass |

Tested by : Scott shen

(Scott Shen)

Reviewed by : Duke Qian

(Duke Qian)

Approved by : Jack Wang

(Jack Wang)

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## Revision History

| Rev. | Issue Date | Effect Page | Contents |
|---|---|---|---|
| 00 | Jun 13, 2023 | N/A | N/A |
| | | | |

# 1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02

| FCC Part 15.247,Subpart C | | | |
|---|---|---|---|
| Standard Section | Test Item | Judgment | Remark |
| 15.207 | Conducted Emission | PASS | -- |
| 15.247 (b)(3) | Output Power | PASS | -- |
| 15.209 | Radiated Spurious Emission | PASS | -- |
| 15.247(d) | Conducted Spurious & Band Edge Emission | PASS | -- |
| 15.247 (e) | Power Spectral Density | PASS | -- |
| 15.247(a)(2) | 6dB Bandwidth<br>99% Bandwidth | PASS | -- |
| 15.205 | Restricted bands of operation | PASS | -- |
| Part 15.247(d)/part 15.209(a) | Band Edge Emission | PASS | -- |
| 15.203 | Antenna Requirement | PASS | -- |

NOTE:

(1)" N/A" denotes test is not applicable in this Test Report

(2) All tests are according to ANSI C63.10-2013

## 1.1 TEST FACTORY

| | |
|---|---|
| Company Name: | Flux Compliance Service Laboratory |
| Address: | Room 105 Floor Bao hao Technology Building 1 NO.15 Gong ye West Road Hi-Tech Industrial, Song shan lake Dongguan |
| Telephone: | +86-769-27280901 |
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FCC Test Firm Registration Number: 514908
Designation number: CN0127
A2LA accreditation number：5545.01
ISED Number：25801
CAB ID ： CN0097

| Organization | CAB identifier | Scope / Recognition Date (yyyy-mm-dd) | Expiration (yyyy-mm-dd) |
|---|---|---|---|
| FLUX COMPLIANCE SERVICE LABORATORY<br><br>Baohao Technology Building 1 No. 15 Gongye West Road Hi-Tech Industrial Park Songsham Lake Dongguan, Guangdong. 523808 PRC.<br><br>**ISED#: 25801**<br>Contact: Andy Yue<br>andy-vue@fcs-lab.com | CN0097 | RSS-102(RFExp) (2020-01-09)<br><br>RSS-GEN (2020-01-09)<br><br>RSS-210 (2020-01-09)<br>RSS-247 (2020-01-09) | **RECOGNIZED UNTIL: 2023-12-31**<br><br>A2LA ISO/IEC 17025: 2017 Expires: 2023-12-31 |

## 1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ±**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** %.

| No. | Item | Uncertainty |
|---|---|---|
| 1 | RF output power, conducted | ±0.71dB |
| 2 | Unwanted Emissions, conducted | ±2.988 dB |
| 3 | Conducted Emission (9KHz-150KHz) | ±4.13 dB |
| 4 | All emissions radiated (9KHz -30MHz) | ±3.1 dB |
| 5 | Conducted Emission (150KHz-30MHz) | ±4.74 dB |
| 6 | All emissions,radiated(<1G) 30MHz-1000MHz | ±5.2 dB |
| 7 | All emissions,radiated 1GHz -18GHz | ±4.66 dB |
| 8 | All emissions,radiated 18GHz -40GHz | ±4.31 dB |
| 9 | Occupied bandwidth | ±0.3 dB |
| 10 | PSD | ±0.4 dB |

# 2. GENERAL INFORMATION

## 2.1 GENERAL DESCRIPTION OF THE EUT

| | |
|---|---|
| Product Name | portable power station |
| Trade Name | N/A |
| Model Name | Thunder 280 |
| Series Model | N/A |
| Model Difference | N/A |
| Product Description | Operation Frequency: 2402-2480 MHz<br>Modulation Type: GFSK<br>Radio Technology: BLE<br>Bluetooth Configuration: LE<br>Number Of Channel: 40 CH<br>Antenna Gain (dBi) -0.68<br>Transmitter rate: 1MHz |
| Channel List | Please refer to the Note 2. |
| Power Supply | Input Parameter：DC:10-60V,10A<br>AC Input:100~120V 50/60Hz<br>AC Output:120V/60Hz/450W<br>USB-A Output（x2）:MAX 22.5W<br>USB-C Output：MAX 100W<br>DC Output: MAX 12VDC 10A |
| Battery | 277Wh（23.1VDC 12Ah） |
| Hardware version number | V1.0 |
| Software version number | V1.0 |
| Connecting I/O Port(s) | Please refer to the User's Manual |

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2. Channel List

| Channel | Freq.(MHz) | Channel | Freq.(MHz) | Channel | Freq.(MHz) | Channel | Freq.(MHz) |
|---|---|---|---|---|---|---|---|
| 0 | 2402 | 10 | 2422 | 20 | 2442 | 30 | 2462 |
| 1 | 2404 | 11 | 2424 | 21 | 2444 | 31 | 2464 |
| 2 | 2406 | 12 | 2426 | 22 | 2446 | 32 | 2466 |
| 3 | 2408 | 13 | 2428 | 23 | 2448 | 33 | 2468 |
| 4 | 2410 | 14 | 2430 | 24 | 2450 | 34 | 2470 |
| 5 | 2412 | 15 | 2432 | 25 | 2452 | 35 | 2472 |
| 6 | 2414 | 16 | 2434 | 26 | 2454 | 36 | 2474 |
| 7 | 2416 | 17 | 2436 | 27 | 2456 | 37 | 2476 |
| 8 | 2418 | 18 | 2438 | 28 | 2458 | 38 | 2478 |
| 9 | 2420 | 19 | 2440 | 29 | 2460 | 39 | 2480 |

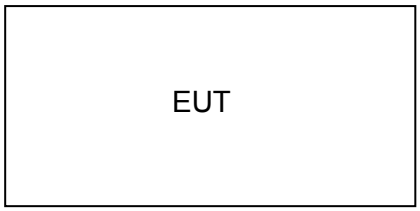
3. Table for Filed Antenna

| Ant. | Brand | Model Name | Antenna Type | Connector | Gain (dBi) | NOTE |
|---|---|---|---|---|---|---|
| 1 | NA | N/A | PCB Antenna | N/A | -0.68 | Antenna |

## 2.2 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

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.

Block diagram of EUT configuration for test




Test software: FCC TestTool V2.0

The test softeware was used to control EUT work in continuous TX mode, and select test channel, Wireless mode as below table

| No. | Test model descrption |
|---|---|
| 1 | Low channel GFSK |
| 2 | Middle channel GFSK |
| 3 | High channel GFSK |

Note:

1. All the test modes can be supply by battery, only the result of the worst case recorded in the report. GFSK mode is worst mode.
2. For radiated emission, 3 axis were chosen for testing for each applicable mode.
3. The EUT used fully charge battery when tested.
4. During the test, the dutycycle>98%, the test voltage was tuned from 85% to 115% of the Nominal rate supply votage, and found that the worst case was the nominal rated supply condition, So the report just shows that condition's data

## 2.3 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

| Item | Equipment | Mfr/Brand | Model/Type No. | Serial No. | Note |
|---|---|---|---|---|---|
| 1 | N/A | N/A | N/A | N/A | N/A |
| | | | | | |

Support units

| Item | Equipment | Mfr/Brand | Model/Type No. | Serial No. | Note |
|---|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | | |

Note:

(1) The support equipment was authorized by Declaration of Confirmation.
(2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
(3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.

## 2.4 EQUIPMENTS LIST

Radiation Test equipment

| Kind of Equipment | Manufacturer | Type No. | Company No. | Last calibration | Calibrated until |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESRP 3 | FCS-E001 | 2022.08.30 | 2023.08.29 |
| Signal Analyzer | R&S | FSV40-N | FCS-E012 | 2022.08.30 | 2023.08.29 |
| Active loop Antenna | ZHINAN | ZN30900C | FCS-E013 | 2022.08.30 | 2023.08.29 |
| Bilog Antenna | SCHWARZBECK | VULB 9168 | FCS-E002 | 2022.08.30 | 2023.08.29 |
| Horn Antenna | SCHWARZBECK | BBHA 9120D | FCS-E003 | 2022.08.30 | 2023.08.29 |
| SHF-EHF Horn Antenna (18G-40GHz) | A-INFO | LB-180400-KF | FCS-E018 | 2022.08.30 | 2023.08.29 |
| Pre-Amplifier(0.1M-3G Hz) | EMCI | EM330N | FCS-E004 | 2022.08.30 | 2023.08.29 |
| Pre-Amplifier (1G-18GHz) | N/A | TSAMP-0518SE | FCS-E014 | 2022.08.30 | 2023.08.29 |
| Pre-Amplifier (18G-40GHz) | TERA-MW | TRLA-0400 | FCS-E019 | 2022.08.30 | 2023.08.29 |
| Temperature & Humidity | HTC-1 | victor | FCS-E005 | 2022.08.30 | 2023.08.29 |
| Testing Software | EZ-EMC(Ver.STSLAB 03A1 RE) | | | | |

Conduction Test equipment

| Kind of Equipment | Manufacturer | Type No. | Company No. | Last calibration | Calibrated until |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESPI | FCS-E020 | 2022.08.30 | 2023.08.29 |
| LISN | R&S | ENV216 | FCS-E007 | 2022.08.30 | 2023.08.29 |
| LISN | ETS | 3810/2NM | FCS-E009 | 2022.08.30 | 2023.08.29 |
| Temperature & Humidity | HTC-1 | victor | FCS-E008 | 2022.08.30 | 2023.08.29 |
| Testing Software | EZ-EMC(Ver.EMC-CON 3A1.1) | | | | |

RF Connected Test

| Kind of Equipment | Manufacturer | Type No. | Company No. | Last calibration | Calibrated until |
|---|---|---|---|---|---|
| MXA SIGNAL Analyzer | Keysight | N9020A | FCS-E015 | 2022.08.30 | 2023.08.29 |
| Spectrum Analyzer | Agilent | E4447A | MY50180039 | 2022.08.30 | 2023.08.29 |
| Spectrum Analyzer | R&S | FSV-40 | 101499 | 2022.08.30 | 2023.08.29 |
| Power Sensor | Agilent | UX2021XA | FCS-E021 | 2022.08.30 | 2023.08.29 |
| Testing Software | EZ-EMC(Ver.STSLAB 03A1 RE) | | | | |

The latest calibration date is 2023.08.29-2024.08.28

# 3. CONDUCTED EMISSION MEASUREMENT

## 3.1 LIMIT

Operating frequency band. In case the emission fall within the restricted band specified on Part 207(a) limit in the table below has to be followed.

| FREQUENCY (MHz) | Conducted Emissionlimit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 -0.5 | 66 - 56 * | 56 - 46 * |
| 0.50 -5.0 | 56.00 | 46.00 |
| 5.0 -30.0 | 60.00 | 50.00 |

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

## 3.2 TEST PROCEDURE

The following table is the setting of the receiver

| Receiver Parameters | Setting |
|---|---|
| Attenuation | 10 dB |
| Start Frequency | 0.15 MHz |
| Stop Frequency | 30 MHz |
| IF Bandwidth | 9 kHz |

a. The EUT was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

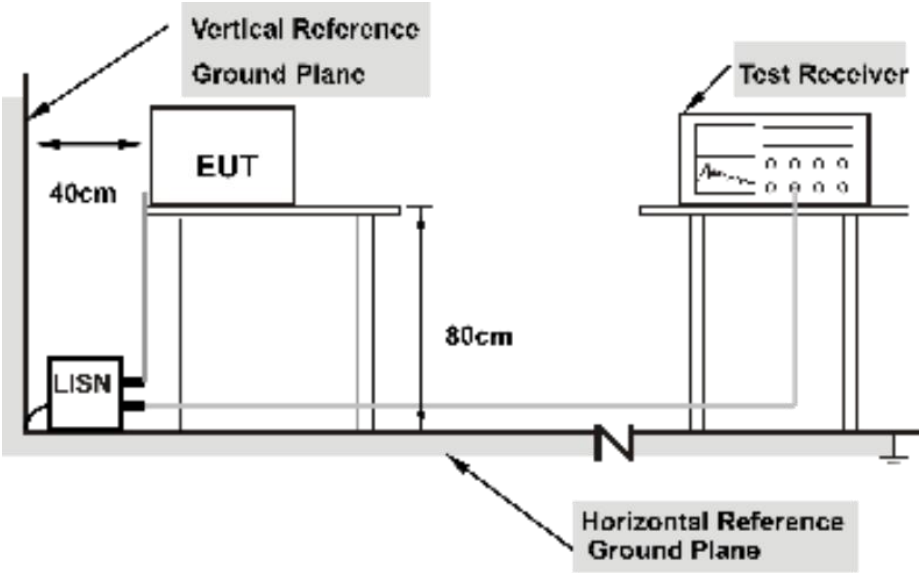
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

d. LISN at least 80 cm from nearest part of EUT chassis.

e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3 TEST SETUP

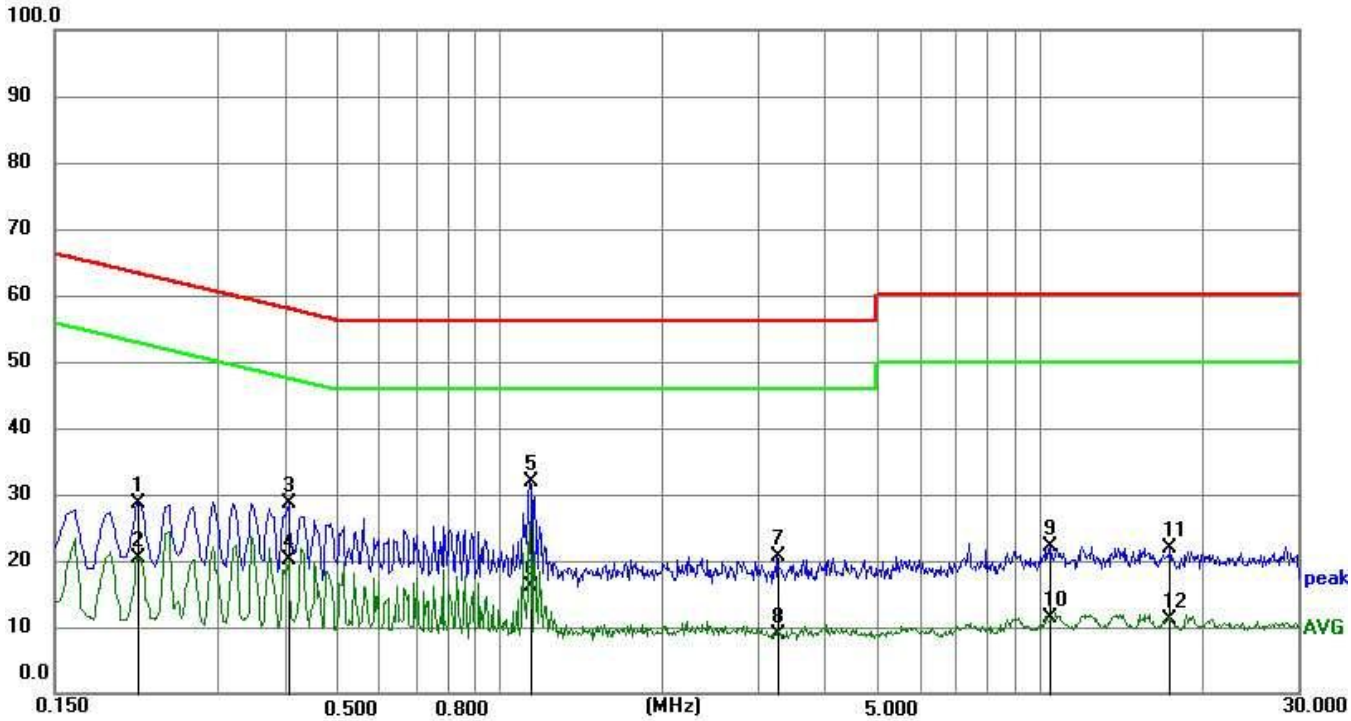



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

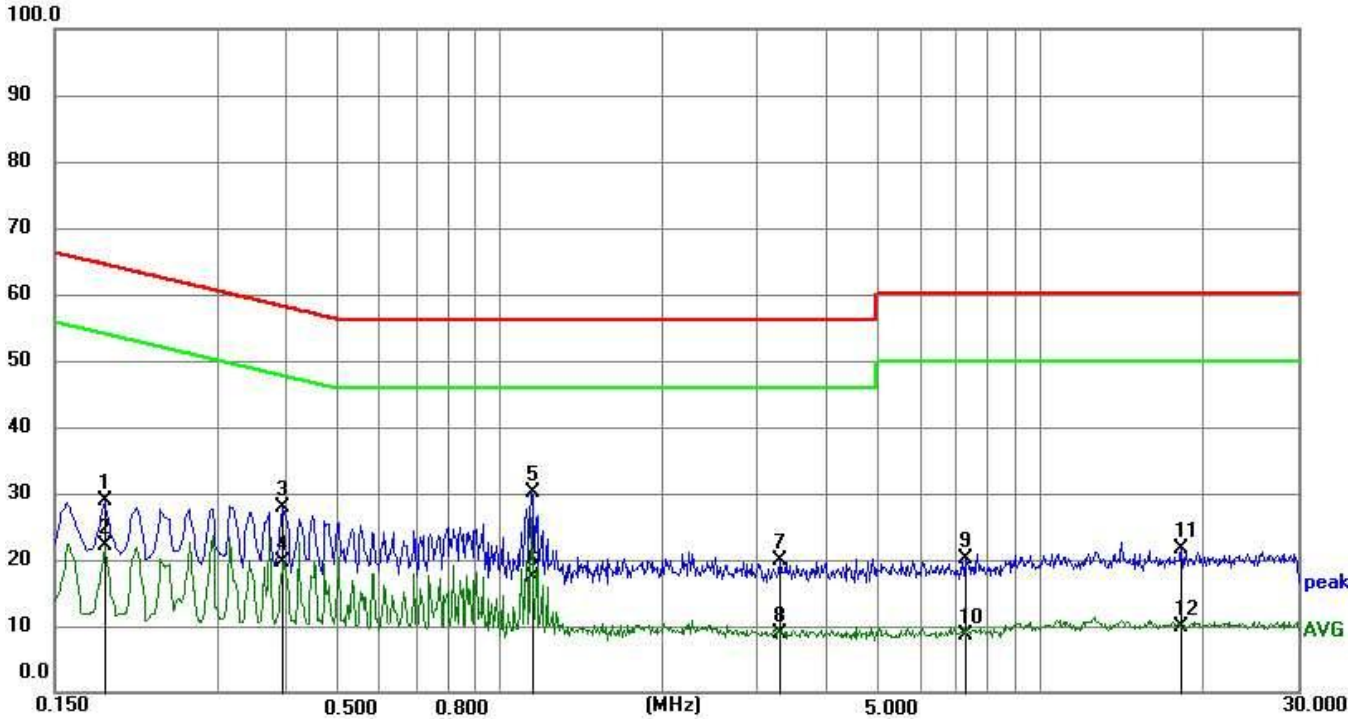
3.4 TEST RESULTS

| | | | |
|---|---|---|---|
| Temperature: | 25℃ | Relative Humidity: | 50% |
| Test Mode: | GFSK | Test Voltage: | AC 110V |
| Result: | L | Result: | Pass |




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.2130 | 18.61 | 10.07 | 28.68 | 63.09 | 34.41 | QP |
| 2 | 0.2130 | 10.43 | 10.07 | 20.50 | 53.09 | 32.59 | AVG |
| 3 | 0.4065 | 18.63 | 10.02 | 28.65 | 57.72 | 29.07 | QP |
| 4 | 0.4065 | 10.20 | 10.02 | 20.22 | 47.72 | 27.50 | AVG |
| 5 | 1. 1355 | 21.82 | 10.00 | 31.82 | 56.00 | 24. 18 | QP |
| 6 | 1. 1355 | 6.04 | 10.00 | 16.04 | 46.00 | 29.96 | AVG |
| 7 | 3.2685 | 10.80 | 9.93 | 20.73 | 56.00 | 35.27 | QP |
| 8 | 3.2685 | -0.98 | 9.93 | 8.95 | 46.00 | 37.05 | AVG |
| 9 | 10.4550 | 12.38 | 9.80 | 22. 18 | 60.00 | 37.82 | QP |
| 10 | 10.4550 | 1.46 | 9.80 | 11.26 | 50.00 | 38.74 | AVG |
| 11 | 17.4300 | 11.96 | 9.88 | 21.84 | 60.00 | 38. 16 | QP |
| 12 | 17.4300 | 1.36 | 9.88 | 11.24 | 50.00 | 38.76 | AVG |

| Temperature: | 25℃ | Relative Humidity: | 50% |
|---|---|---|---|
| Test Mode: | GFSK | Test Voltage: | AC 110V |
| Result: | N | Result: | Pass |




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0. 1860 | 18.90 | 10.06 | 28.96 | 64.21 | 35.25 | QP |
| 2 | 0. 1860 | 11.96 | 10.06 | 22.02 | 54.21 | 32. 19 | AVG |
| 3 | 0.3975 | 17.78 | 10.00 | 27.78 | 57.91 | 30. 13 | QP |
| 4 | 0.3975 | 9.69 | 10.00 | 19.69 | 47.91 | 28.22 | AVG |
| 5 | 1. 1445 | 20.26 | 9.99 | 30.25 | 56.00 | 25.75 | QP |
| 6 | 1. 1445 | 7.31 | 9.99 | 17.30 | 46.00 | 28.70 | AVG |
| 7 | 3.2955 | 9.99 | 9.93 | 19.92 | 56.00 | 36.08 | QP |
| 8 | 3.2955 | - 1.03 | 9.93 | 8.90 | 46.00 | 37. 10 | AVG |
| 9 | 7.2825 | 10.40 | 9.83 | 20.23 | 60.00 | 39.77 | QP |
| 10 | 7.2825 | - 1. 19 | 9.83 | 8.64 | 50.00 | 41.36 | AVG |
| 11 | 18.2760 | 11.64 | 9.94 | 21.58 | 60.00 | 38.42 | QP |
| 12 | 18.2760 | 0.06 | 9.94 | 10.00 | 50.00 | 40.00 | AVG |

Remark:

1. All readings are Quasi-Peak and Average values

# 4. 6DB BANDWIDTH

## 4.1 Limit

| FCC Part 15.247,Subpart C<br>RSS-Gen Clause 6.7 | | | | |
|---|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247(a)(2) | 6dB Bandwidth | >= 500KHz | 2400-2483.5 | PASS |
| RSS-Gen Clause 6.7 | 99% Bandwidth | For reporting purposes only. | 2400-2483.5 | PASS |

## 4.2 Test Procedure

(1) Connect EUT's antenna output to spectrum analyzer by RF cable.

(2) Set the spectrum analyzer as follows

RBW: 100kHz

VBW: 300kHz

Detector Mode: AVG

Sweep time: auto

Trace mode Max hold

(3) Allow the trace to stabilize, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

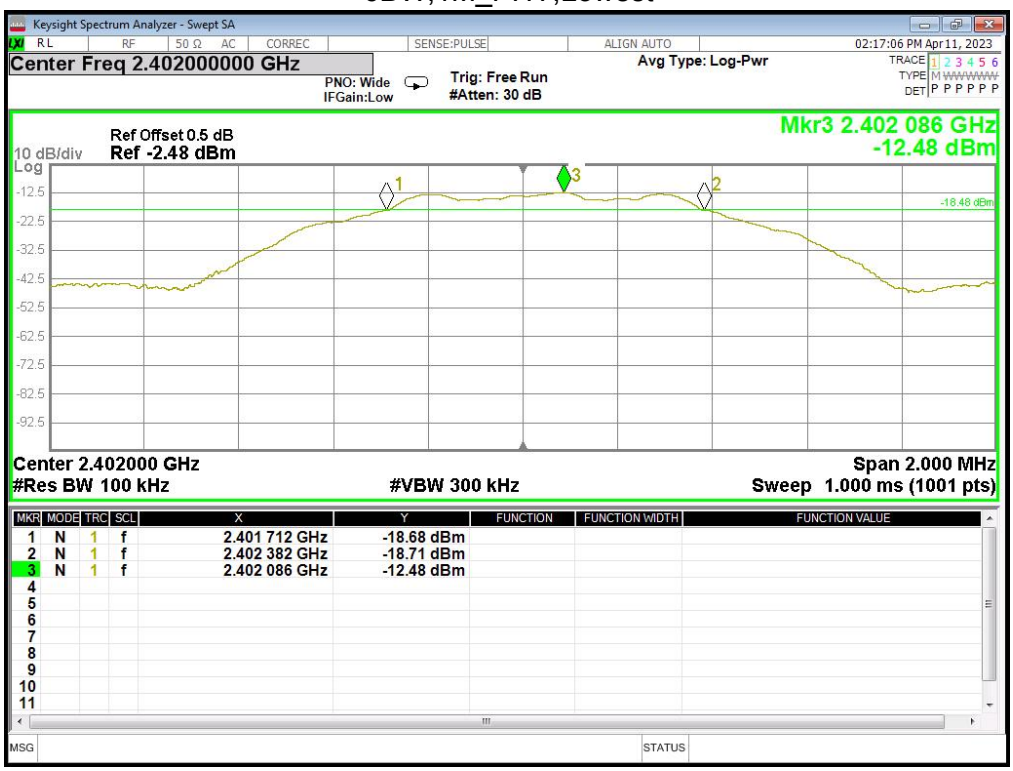
## 4.3 Test setup

## 4.4 Test results

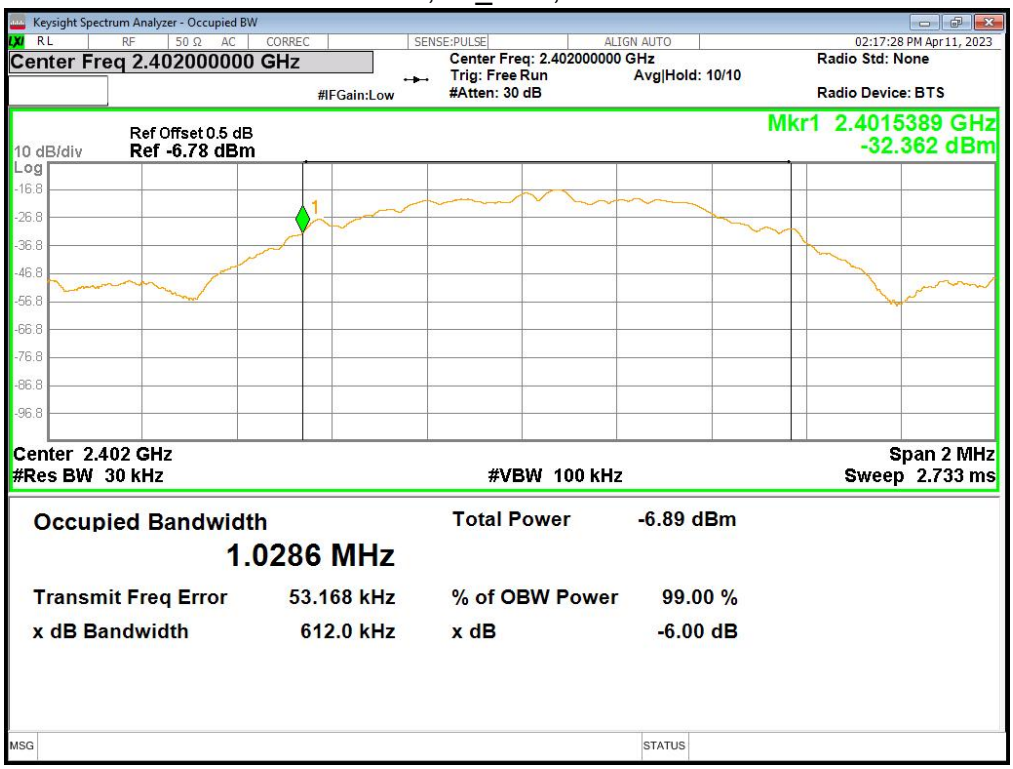
| TestMode | Channel (MHz) | 6dB Bandwidth (MHz) | 99% Bandwidth(MHz) | Limit [MHz] | Verdict |
|---|---|---|---|---|---|
| Lowest | 2402MHz | 0.670 | 1.029 | 0.5 | Pass |
| Middle | 2440MHz | 0.666 | 1.028 | 0.5 | Pass |
| Highest | 2480MHz | 0.674 | 1.025 | 0.5 | Pass |

## 4.5 Original Test Data

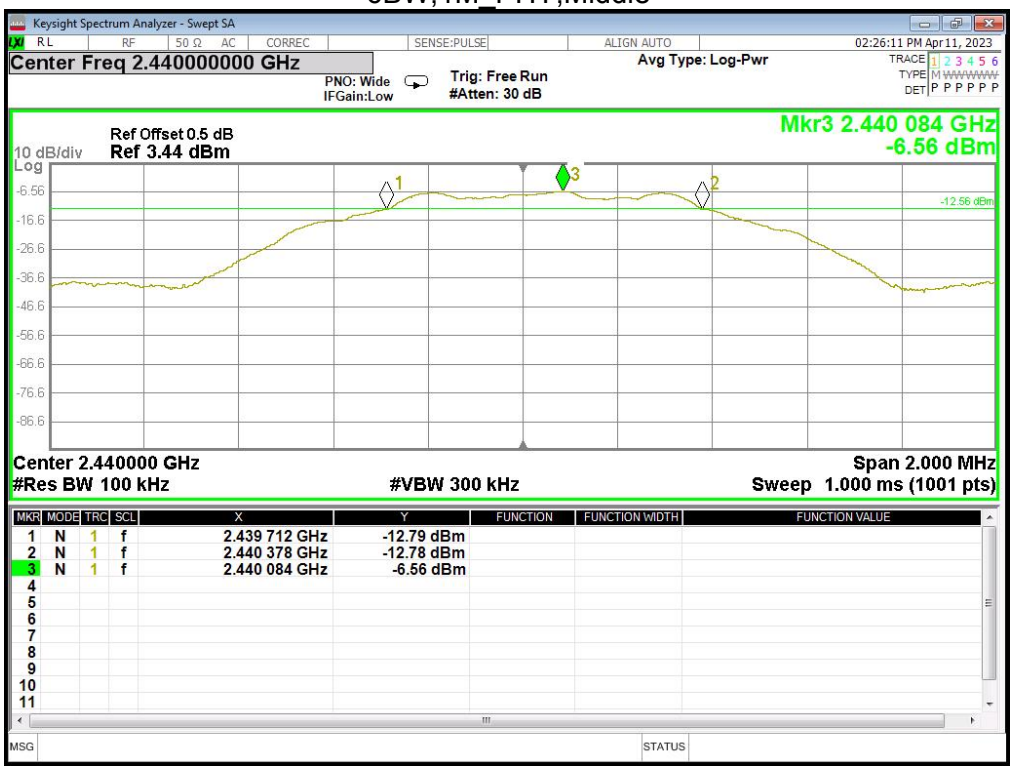
6BW,1M_PHY,Lowest



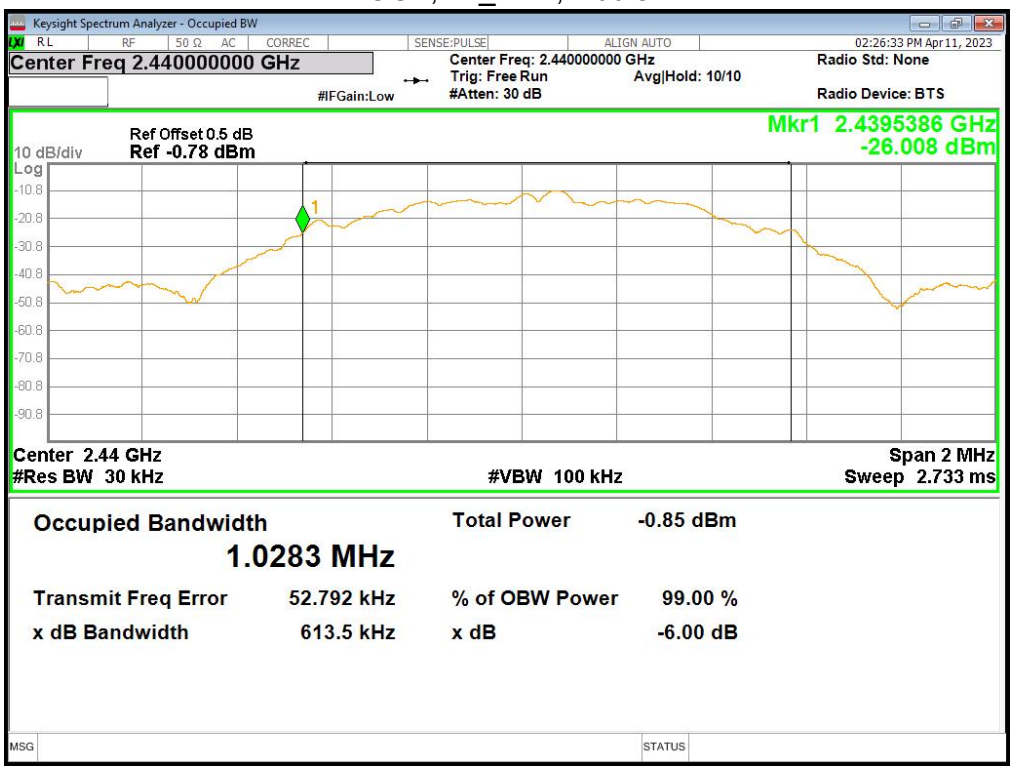

OCB,1M_PHY,Lowest



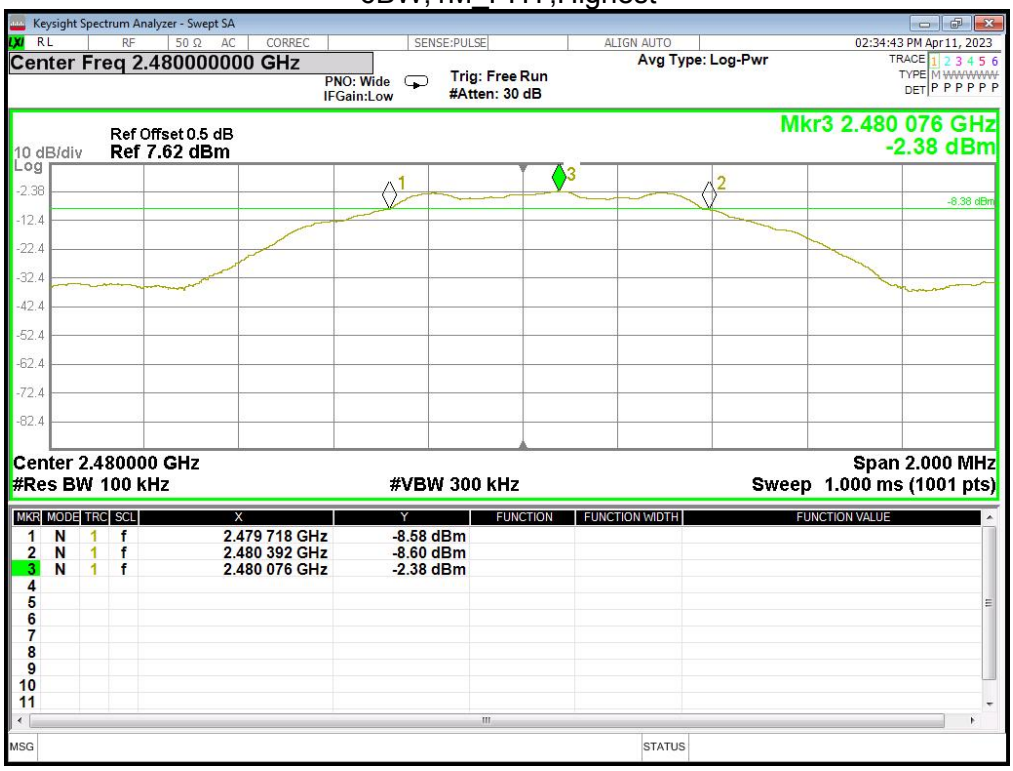
6BW,1M_PHY,Middle



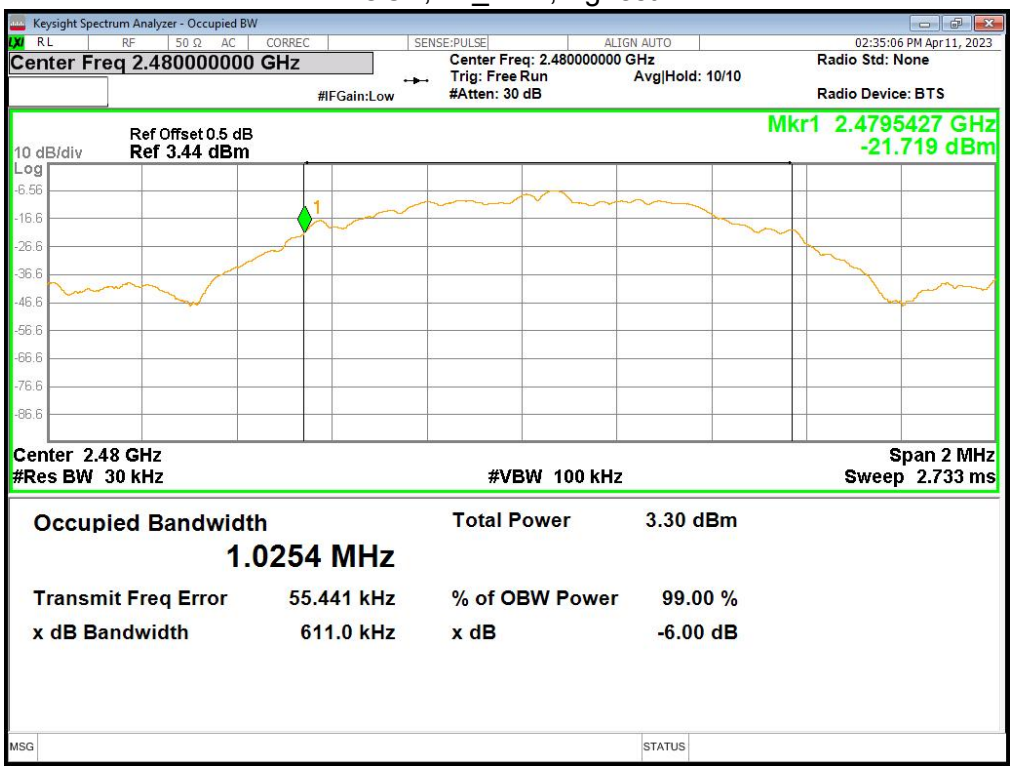

OCB,1M_PHY,Middle



6BW,1M_PHY,Highest




OCB,1M_PHY,Highest



# 5. CONDUCTED OUTPUT POWER

## 5.1 LIMIT

| FCC Part 15 Subpart C | | | |
|---|---|---|---|
| Section | Test Item | Limit | Frequency Range |
| 15.247(b)(3) | Peak output power | Power <1W(30dBm) | 2400-2483.5 |

## 5.2 TEST PROCEDURE

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in The block diagram adove.

(2) The EUT was set to continuously transmitting in the max power during the test.

## 5.3 TEST SETUP

## 5.5 TEST RESULTS

| TestMode | Channel (MHz) | Result（dBm） | Limit（dBm） | Verdict |
|---|---|---|---|---|
| Lowest | 2402MHz | 2.56 | 30 | Pass |
| Middle | 2440MHz | 2.48 | 30 | Pass |
| Highest | 2480MHz | 2.42 | 30 | Pass |

# 6. BAND EDGE AND SPURIOUS(CONDUCTED)

## 6.1 LIMIT

In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 30dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

## 6.2 TEST PROCEDURE

(1) Connect EUT's antenna output to spectrum analyzer by RF cable.

(2) Establish a reference level by using the following procedure:

| | |
|---|---|
| Center frequency | DTS Channel center frequency |
| RBW: | 100kHz |
| VBW: | 300kHz |
| Span | 1.5times the DTS bandwidth |
| Detector Mode: | Peak |
| Sweep time: | auto |
| Trace mode | Max hold |

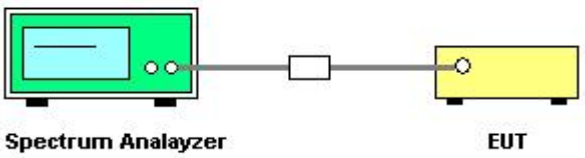
(3) Establish Allow the trace to stabilize, use the peak marker function to determine the maximum peak power level to establish the reference level.

(4) Set the spectrum analyzer as follows:

| | |
|---|---|
| RBW: | 100kHz |
| VBW: | 300kHz |
| Span | Encompass frequency range to be measured |
| Number of measurement points | ≥span/RBW |
| Detector Mode: | Peak |
| Sweep time: | auto |
| Trace mode | Max hold |

(5) Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude of all unwanted emissions outside of the authorized frequency band

## 6.3 TEST SETUP



## 6.4 TEST RESULTS

| Eut set mode | CH or Frequency | Result |
|---|---|---|
| GFSK | CH0 | Pass |
| | CH39 | Pass |

## 6.5 Original test data

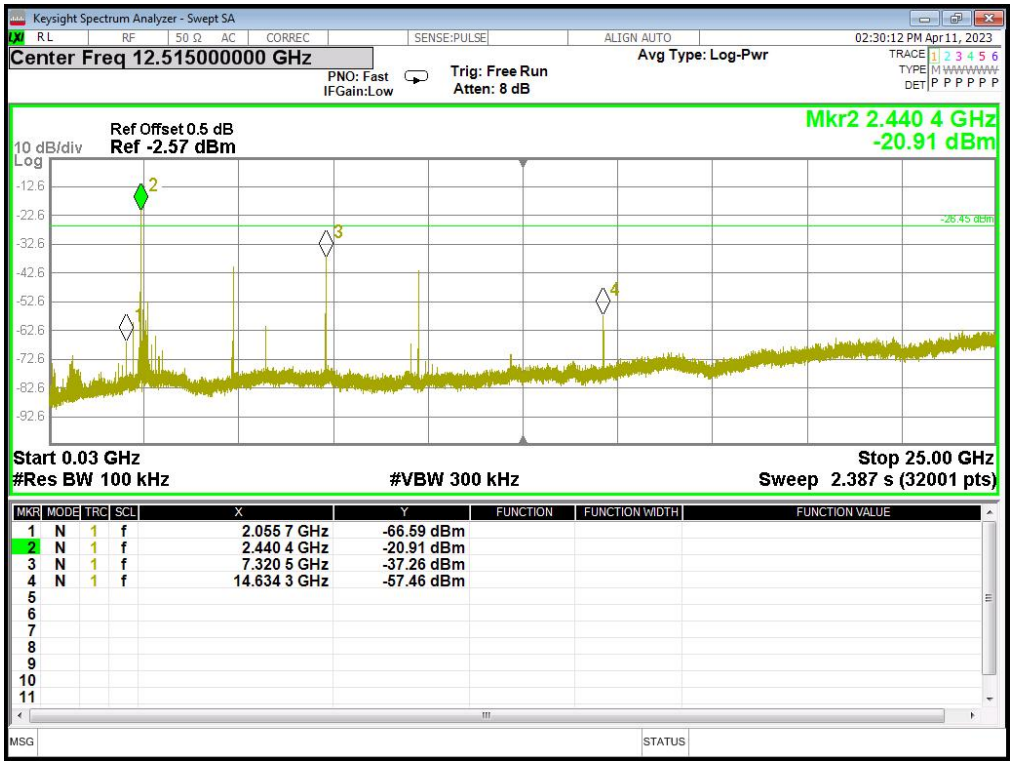
CH0 2402MHZ

CH39 2480MHZ

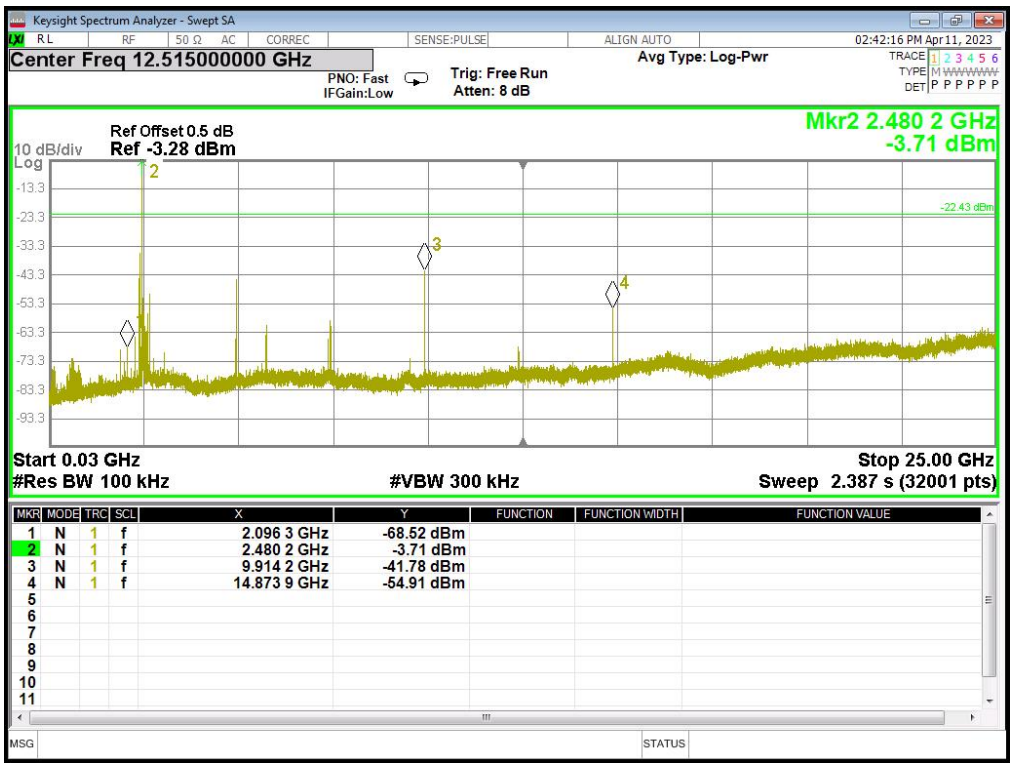
Spurious emissions

Low 2402MHz 0.3GHz-25GHz

MIDDLE 2440MHZ 0.3GHZ-25GHZ



High 2480MHz 0.3GHz-25GHz



# 7. POWER SPECTRAL DENSITY

## 7.1 LIMIT

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

## 7.2 TEST PROCEDURE

(1) Connect EUT's antenna output to spectrum analyzer by RF cable.

(2) Set the spectrum analyzer as follows:

| | |
|---|---|
| Center frequency | DTS Channel center frequency |
| RBW: | 3 kHz ≤ RBW ≤ 100 kHz |
| VBW: | ≥ 3RBW |
| Span | 1.5 times the DTS bandwidth |
| Detector Mode: | Peak |
| Sweep time: | auto |
| Trace mode | Max hold |

(3) Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude level within the RBW

(4) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

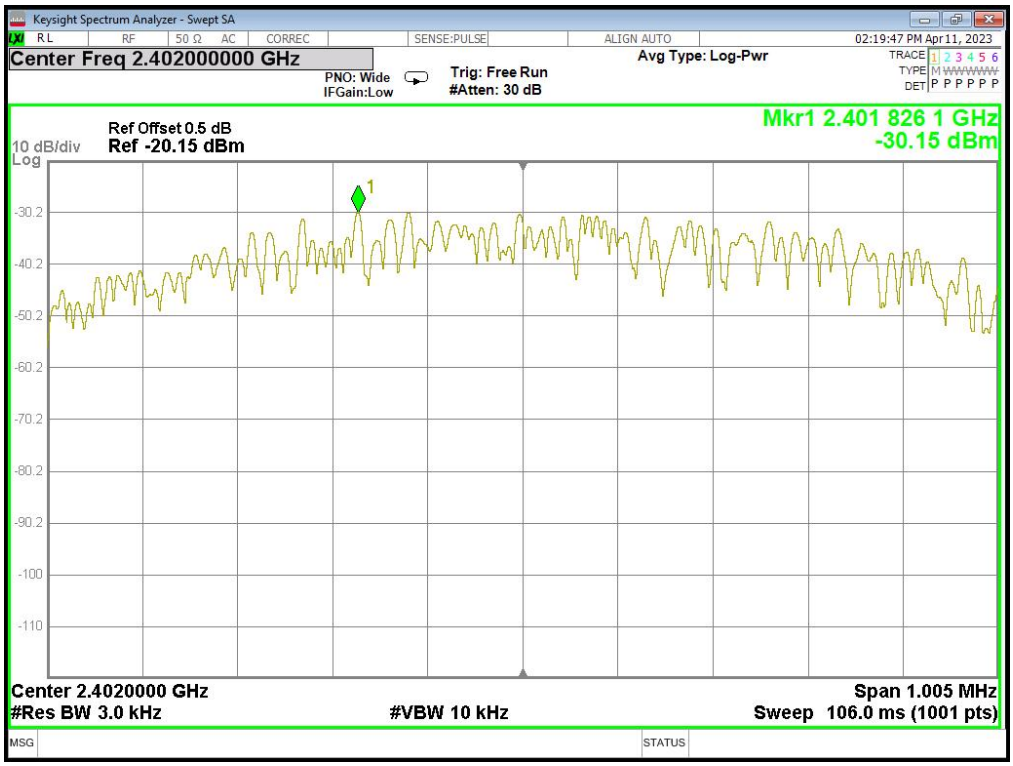
## 7.3 TEST SETUP

## 7.4 TEST RESULTS

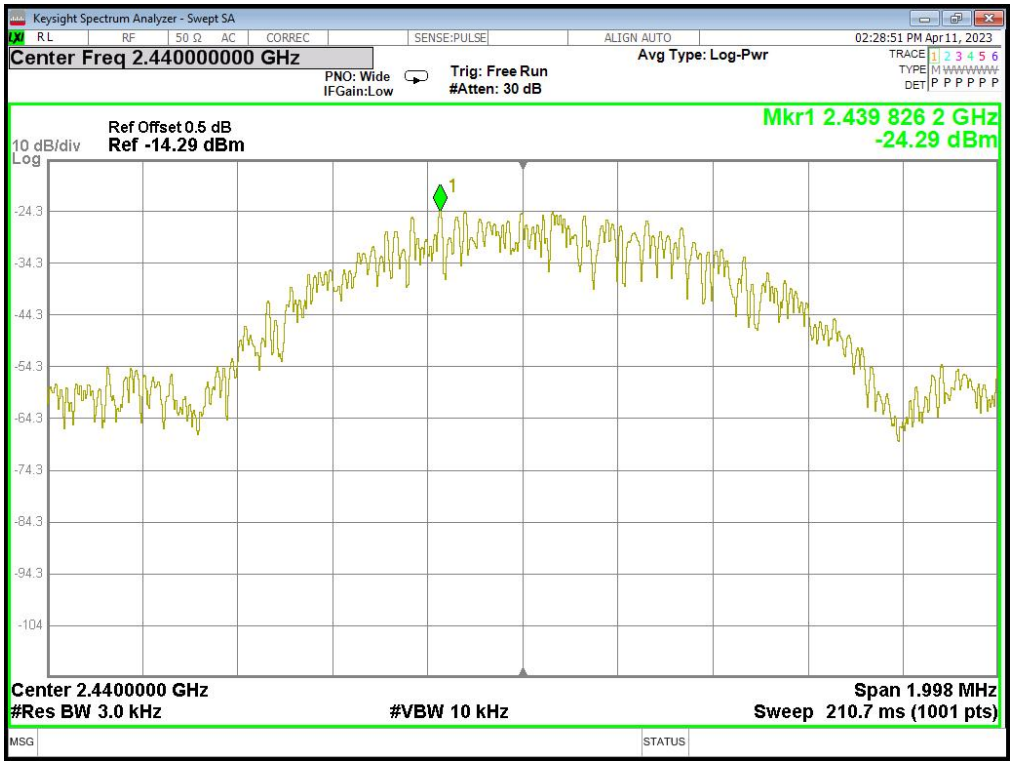
| TestMode | Channel (MHz) | Result (dBm/3KHz) | Limit (dBm/3KHz) | Verdict |
|---|---|---|---|---|
| GFSK | 2402MHz | -30.15 | 8 | Pass |
| GFSK | 2440MHz | -24.29 | 8 | Pass |
| GFSK | 2480MHz | -20.01 | 8 | Pass |

7.5 original test data

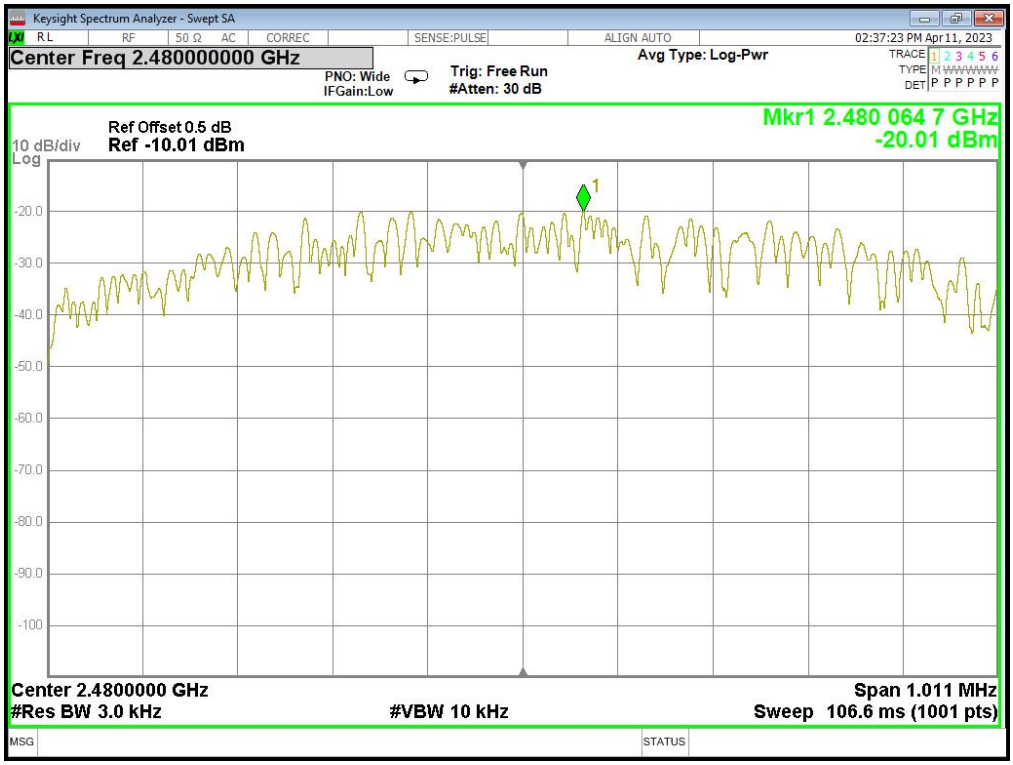
GFSK-2402MHz




GFSK-2440MHz



GFSK-2480MHz



# 8. RADIATED EMISSION MEASUREMENT

## 8.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a) limit in the table and according to ANSI C63.10-2013 below has to be followed

LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 1000MHz)

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

LIMITS OF RADIATED EMISSION MEASUREMENT (1GHz-25 GHz)

| FREQUENCY (MHz) | (dBuV/m) (at 3M) | |
|---|---|---|
| | PEAK | AVERAGE |
| Above 1000 | 74 | 54 |

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

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

For Radiated Emission

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Detector | Peak/AV |
| Start Frequency | 1000 MHz(Peak/AV) |
| Stop Frequency | 10th carrier hamonic(Peak/AV) |
| RB / VB (emission in restricted band) | PK=1MHz / 1MHz, AV=1 MHz /10 Hz |

For Band edge

| Spectrum Parameter | Setting |
|---|---|
| Detector | Peak/AV |
| Start/Stop Frequency | Lower Band Edge: 2300 to 2403 MHz<br>Upper Band Edge: 2479 to 2500 MHz |
| RB / VB (emission in restricted band) | PK=1MHz / 1MHz, AV=1 MHz / 10 Hz |

| **Receiver Parameter** | **Setting** |
|---|---|
| Attenuation | Auto |
| Start ~ Stop Frequency | 9kHz~90kHz / RB 200Hz for PK & AV |
| Start ~ Stop Frequency | 90kHz~110kHz / RB 200Hz for QP |
| Start ~ Stop Frequency | 110kHz~490kHz / RB 200Hz for PK & AV |
| Start ~ Stop Frequency | 490kHz~30MHz / RB 9kHz for QP |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB 120kHz for QP |

8.2 TEST PROCEDURE

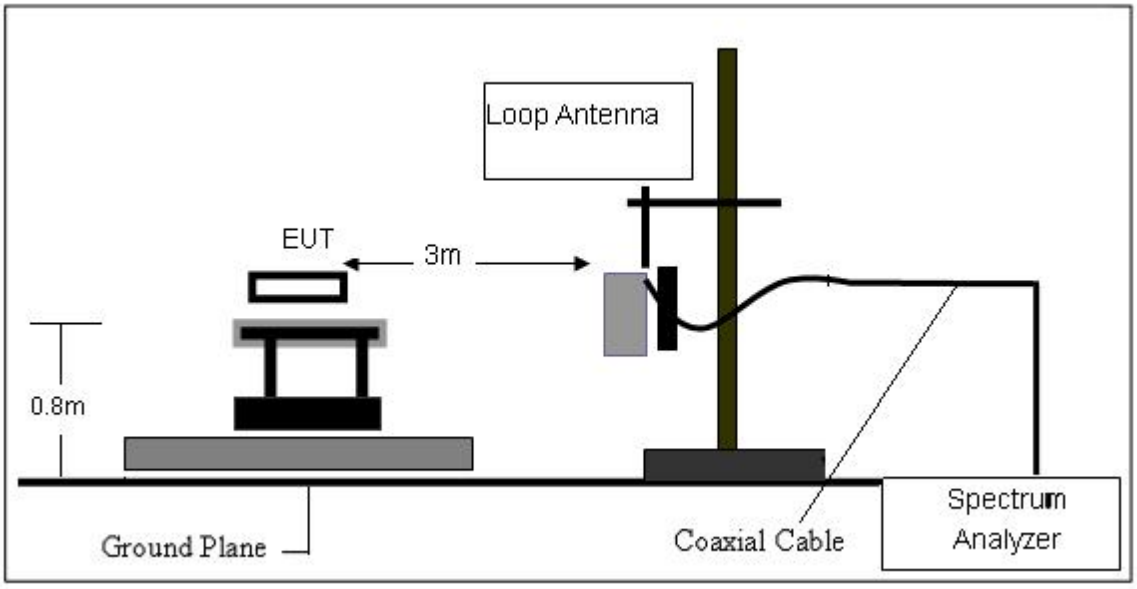
a. The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz,and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 meters (above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m(above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then QuasiPeak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

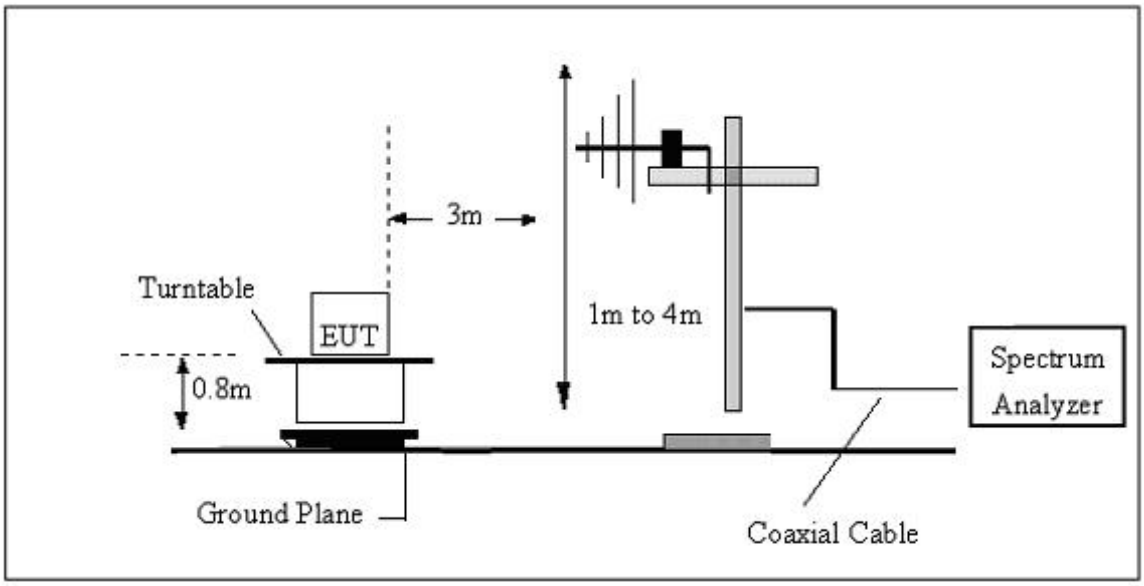
Both horizontal and vertical antenna polarities were tested
and performed pretest to three orthogonal axis. The worst case emissions were reported

8.3 TESTSETUP

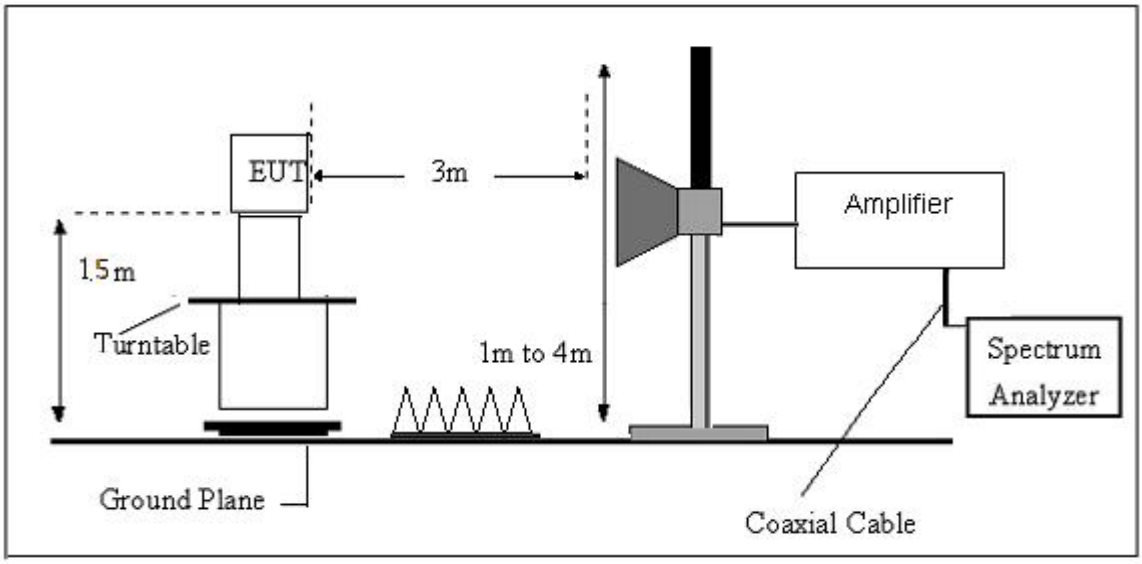
(A) Radiated Emission Test-Up Frequency Below 30MHz




(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



## 8.4. TEST RESULTS

(9KHz-30MHz)

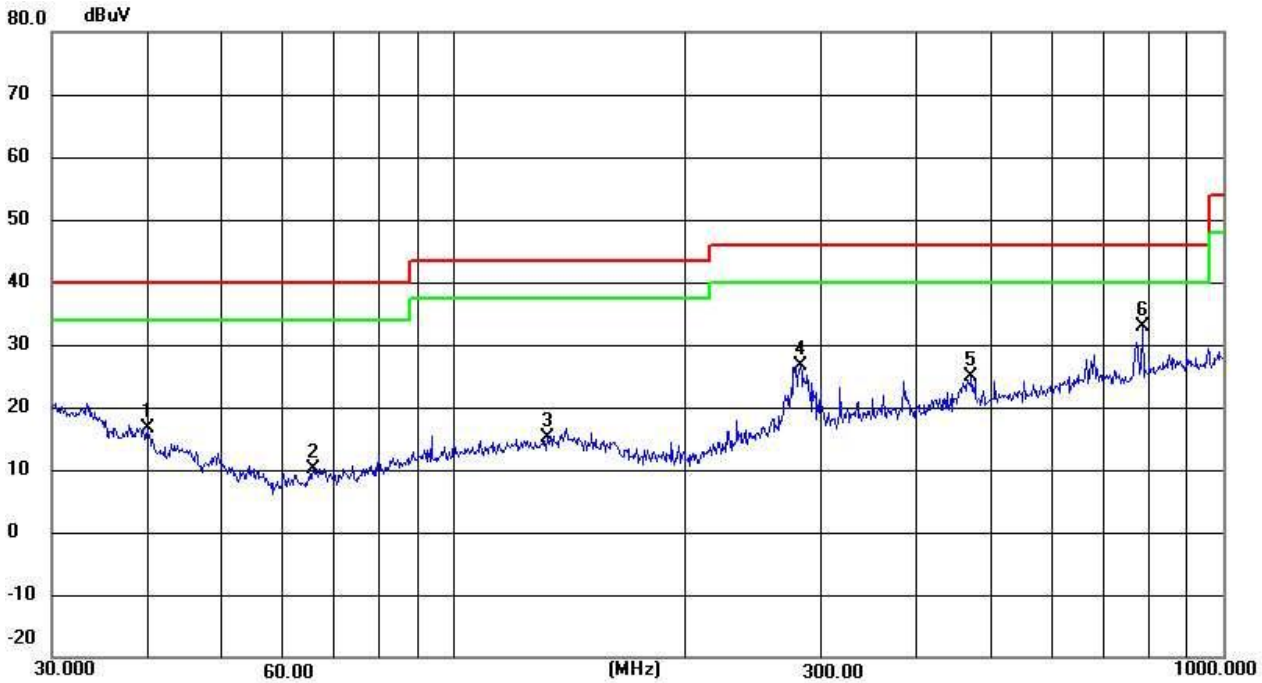
| | | | |
|---|---|---|---|
| Temperature: | 22.7℃ | Relative Humidity: | 61% |
| Test Voltage: | AC 110V | Test Mode: | GFSK |

| Freq. | Reading | Limit | Margin | State | Test Result |
|---|---|---|---|---|---|
| (MHz) | (dBuV/m) | (dBuV/m) | (dB) | P/F | |
| -- | -- | -- | -- | -- | PASS |
| -- | -- | -- | -- | -- | PASS |

Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits (dBuv) + distance extrapolation factor.

## 9. RADIATED EMISSION (30MHZ-1000MHZ)

| | | | |
|---|---|---|---|
| Temperature: | 24.7℃ | Relative Humidity: | 61% |
| Test Voltage: | AC 110V | Phase: | Horizontal |
| Test Mode: | GFSK | | |



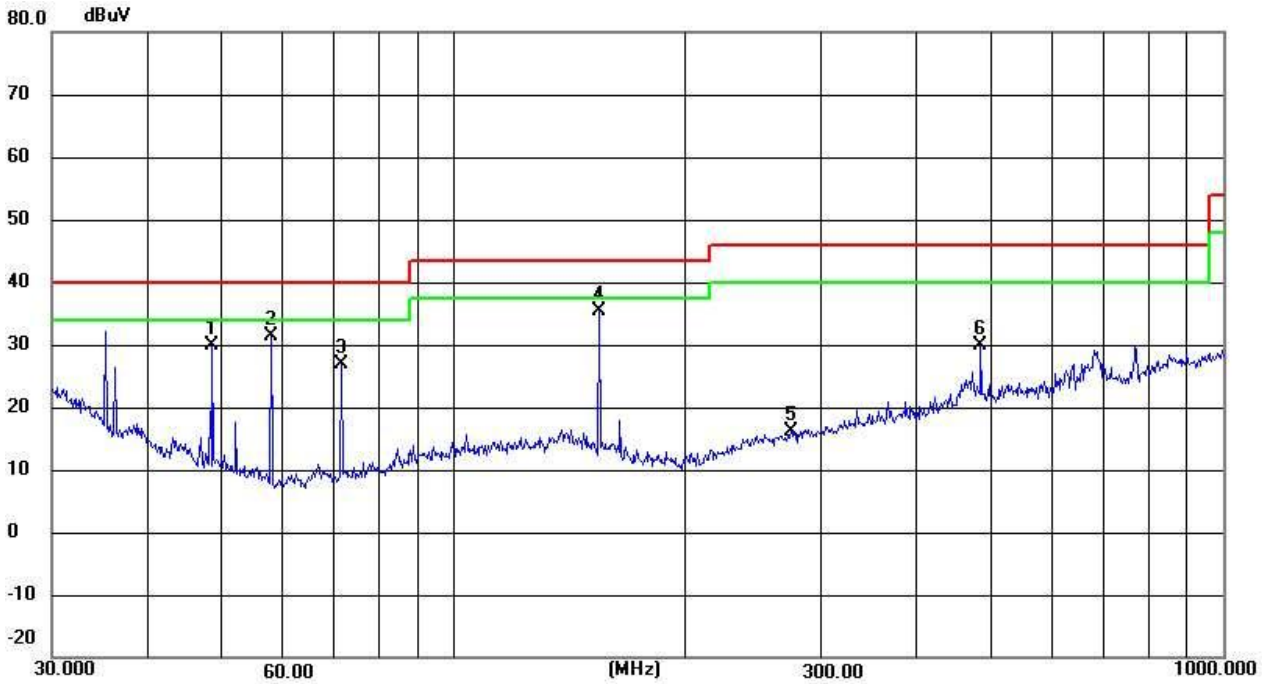

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 39.9942 | 30.42 | -13.87 | 16.55 | 40.00 | -23.45 | QP |
| 2 | 65.5727 | 30.54 | -20.31 | 10.23 | 40.00 | -29.77 | QP |
| 3 | 132.2206 | 47.40 | -32.27 | 15.13 | 43.50 | -28.37 | QP |
| 4 | 281.9946 | 58.69 | -32.12 | 26.57 | 46.00 | -19.43 | QP |
| 5 | 470.5232 | 56.72 | -31.93 | 24.79 | 46.00 | -21.21 | QP |
| 6 | 785.0935 | 64.29 | -31.52 | 32.77 | 46.00 | -13.23 | QP |

Note: 1. Margin = Result (Result =Reading + Factor )–Limit

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

| | | | |
|---|---|---|---|
| Temperature: | 22.7℃ | Relative Humidity: | 61% |
| Test Voltage: | AC 110V | Phase: | Vertical |
| Test Mode: | GFSK | | |




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 48.5016 | 47.26 | - 17.30 | 29.96 | 40.00 | -10.04 | QP |
| 2 | 57.7962 | 51.71 | -20.34 | 31.37 | 40.00 | -8.63 | QP |
| 3 | 71.3300 | 59.05 | -32.24 | 26.81 | 40.00 | - 13. 19 | QP |
| 4 | 154.2786 | 67.64 | -32.25 | 35.39 | 43.50 | -8. 11 | QP |
| 5 | 274.1939 | 48.23 | -32. 13 | 16.10 | 46.00 | -29.90 | QP |
| 6 | 483.9094 | 61.70 | -31.92 | 29.78 | 46.00 | -16.22 | QP |

Note: 1. Margin = Result (Result =Reading + Factor )–Limit

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

■ 9.1 RADIATED EMISSION ABOVE 1GHZ

## Lowest channel

**Peak value:**

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|---|---|
| 4804.00 | 36.04 | 31.78 | 8.60 | 32.09 | 44.33 | 74.00 | -29.67 | Vertical |
| 7206.00 | 30.99 | 36.15 | 11.65 | 32.00 | 46.79 | 74.00 | -27.21 | Vertical |
| 9608.00 | 30.72 | 37.95 | 14.14 | 31.62 | 51.19 | 74.00 | -22.81 | Vertical |
| 12010.00 | * | | | | | 74.00 | | Vertical |
| 14412.00 | * | | | | | 74.00 | | Vertical |
| 4804.00 | 40.06 | 31.78 | 8.60 | 32.09 | 48.35 | 74.00 | -25.65 | Horizontal |
| 7206.00 | 32.63 | 36.15 | 11.65 | 32.00 | 48.43 | 74.00 | -25.57 | Horizontal |
| 9608.00 | 30.02 | 37.95 | 14.14 | 31.62 | 50.49 | 74.00 | -23.51 | Horizontal |
| 12010.00 | * | | | | | 74.00 | | Horizontal |
| 14412.00 | * | | | | | 74.00 | | Horizontal |

**Average value:**

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|---|---|
| 4804.00 | 25.09 | 31.78 | 8.60 | 32.09 | 33.38 | 54.00 | -20.62 | Vertical |
| 7206.00 | 19.82 | 36.15 | 11.65 | 32.00 | 35.62 | 54.00 | -18.38 | Vertical |
| 9608.00 | 18.97 | 37.95 | 14.14 | 31.62 | 39.44 | 54.00 | -14.56 | Vertical |
| 12010.00 | * | | | | | 54.00 | | Vertical |
| 14412.00 | * | | | | | 54.00 | | Vertical |
| 4804.00 | 29.18 | 31.78 | 8.60 | 32.09 | 37.47 | 54.00 | -16.53 | Horizontal |
| 7206.00 | 21.91 | 36.15 | 11.65 | 32.00 | 37.71 | 54.00 | -16.29 | Horizontal |
| 9608.00 | 18.60 | 37.95 | 14.14 | 31.62 | 39.07 | 54.00 | -14.93 | Horizontal |
| 12010.00 | * | | | | | 54.00 | | Horizontal |
| 14412.00 | * | | | | | 54.00 | | Horizontal |

*Remarks:*

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
3. *"*", means this data is the too weak instrument of signal is unable to test.*

## Middle channel

**Peak value:**

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|---|---|
| 4880.00 | 36.07 | 31.85 | 8.67 | 32.12 | 44.47 | 74.00 | -29.53 | Vertical |
| 7320.00 | 31.01 | 36.37 | 11.72 | 31.89 | 47.21 | 74.00 | -26.79 | Vertical |
| 9760.00 | 30.74 | 38.35 | 14.25 | 31.62 | 51.72 | 74.00 | -22.28 | Vertical |
| 12200.00 | * | | | | | 74.00 | | Vertical |
| 14640.00 | * | | | | | 74.00 | | Vertical |
| 4880.00 | 40.10 | 31.85 | 8.67 | 32.12 | 48.50 | 74.00 | -25.50 | Horizontal |
| 7320.00 | 32.66 | 36.37 | 11.72 | 31.89 | 48.86 | 74.00 | -25.14 | Horizontal |
| 9760.00 | 30.04 | 38.35 | 14.25 | 31.62 | 51.02 | 74.00 | -22.98 | Horizontal |
| 12200.00 | * | | | | | 74.00 | | Horizontal |
| 14640.00 | * | | | | | 74.00 | | Horizontal |

**Average value:**

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|---|---|
| 4880.00 | 25.12 | 31.85 | 8.67 | 32.12 | 33.52 | 54.00 | -20.48 | Vertical |
| 7320.00 | 19.84 | 36.37 | 11.72 | 31.89 | 36.04 | 54.00 | -17.96 | Vertical |
| 9760.00 | 18.99 | 38.35 | 14.25 | 31.62 | 39.97 | 54.00 | -14.03 | Vertical |
| 12200.00 | * | | | | | 54.00 | | Vertical |
| 14640.00 | * | | | | | 54.00 | | Vertical |
| 4880.00 | 29.22 | 31.85 | 8.67 | 32.12 | 37.62 | 54.00 | -16.38 | Horizontal |
| 7320.00 | 21.93 | 36.37 | 11.72 | 31.89 | 38.13 | 54.00 | -15.87 | Horizontal |
| 9760.00 | 18.62 | 38.35 | 14.25 | 31.62 | 39.60 | 54.00 | -14.40 | Horizontal |
| 12200.00 | * | | | | | 54.00 | | Horizontal |
| 14640.00 | * | | | | | 54.00 | | Horizontal |

*Remarks:*

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
3. *"*", means this data is the too weak instrument of signal is unable to test.*

## Highest channel

**Peak value:**

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|---|---|
| 4960.00 | 35.88 | 31.93 | 8.73 | 32.16 | 44.38 | 74.00 | -29.62 | Vertical |
| 7440.00 | 30.89 | 36.59 | 11.79 | 31.78 | 47.49 | 74.00 | -26.51 | Vertical |
| 9920.00 | 30.63 | 38.81 | 14.38 | 31.88 | 51.94 | 74.00 | -22.06 | Vertical |
| 12400.00 | * | | | | | 74.00 | | Vertical |
| 14880.00 | * | | | | | 74.00 | | Vertical |
| 4960.00 | 39.88 | 31.93 | 8.73 | 32.16 | 48.38 | 74.00 | -25.62 | Horizontal |
| 7440.00 | 32.52 | 36.59 | 11.79 | 31.78 | 49.12 | 74.00 | -24.88 | Horizontal |
| 9920.00 | 29.92 | 38.81 | 14.38 | 31.88 | 51.23 | 74.00 | -22.77 | Horizontal |
| 12400.00 | * | | | | | 74.00 | | Horizontal |
| 14880.00 | * | | | | | 74.00 | | Horizontal |

**Average value:**

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|---|---|
| 4960.00 | 25.01 | 31.93 | 8.73 | 32.16 | 33.51 | 54.00 | -20.49 | Vertical |
| 7440.00 | 19.76 | 36.59 | 11.79 | 31.78 | 36.36 | 54.00 | -17.64 | Vertical |
| 9920.00 | 18.92 | 38.81 | 14.38 | 31.88 | 40.23 | 54.00 | -13.77 | Vertical |
| 12400.00 | * | | | | | 54.00 | | Vertical |
| 14880.00 | * | | | | | 54.00 | | Vertical |
| 4960.00 | 29.08 | 31.93 | 8.73 | 32.16 | 37.58 | 54.00 | -16.42 | Horizontal |
| 7440.00 | 21.84 | 36.59 | 11.79 | 31.78 | 38.44 | 54.00 | -15.56 | Horizontal |
| 9920.00 | 18.54 | 38.81 | 14.38 | 31.88 | 39.85 | 54.00 | -14.15 | Horizontal |
| 12400.00 | * | | | | | 54.00 | | Horizontal |
| 14880.00 | * | | | | | 54.00 | | Horizontal |

*Remarks:*

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
3. *"*", means this data is the too weak instrument of signal is unable to test.*

## 9.2 RADIATED BAND EDGE DATA

Remark: All restriction band have been tested, and only the worst case is shown in report

Low CH (GFSK)

Peak value:

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
|---|---|---|---|---|---|---|---|---|
| 2390.00 | 39.87 | 27.59 | 5.38 | 30.18 | 42.66 | 74.00 | -31.34 | Horizontal |
| 2400.00 | 56.22 | 27.58 | 5.39 | 30.18 | 59.01 | 74.00 | -14.99 | Horizontal |
| 2390.00 | 40.13 | 27.59 | 5.38 | 30.18 | 42.92 | 74.00 | -31.08 | Vertical |
| 2400.00 | 57.94 | 27.58 | 5.39 | 30.18 | 60.73 | 74.00 | -13.27 | Vertical |

Average value:

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
|---|---|---|---|---|---|---|---|---|
| 2390.00 | 31.10 | 27.59 | 5.38 | 30.18 | 33.89 | 54.00 | -20.11 | Horizontal |
| 2400.00 | 42.16 | 27.58 | 5.39 | 30.18 | 44.95 | 54.00 | -9.06 | Horizontal |
| 2390.00 | 30.83 | 27.59 | 5.38 | 30.18 | 33.62 | 54.00 | -20.38 | Vertical |
| 2400.00 | 43.52 | 27.58 | 5.39 | 30.18 | 46.31 | 54.00 | -7.69 | Vertical |

High CH(GFSK)

Peak value:

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
|---|---|---|---|---|---|---|---|---|
| 2483.50 | 41.61 | 27.53 | 5.47 | 29.93 | 44.68 | 74.00 | -29.32 | Horizontal |
| 2500.00 | 41.36 | 27.55 | 5.49 | 29.93 | 44.47 | 74.00 | -29.53 | Horizontal |
| 2483.50 | 41.95 | 27.53 | 5.47 | 29.93 | 45.02 | 74.00 | -28.98 | Vertical |
| 2500.00 | 42.07 | 27.55 | 5.49 | 29.93 | 45.18 | 74.00 | -28.82 | Vertical |

Average value:

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
|---|---|---|---|---|---|---|---|---|
| 2483.50 | 33.89 | 27.53 | 5.47 | 29.93 | 36.96 | 54.00 | -17.04 | Horizontal |
| 2500.00 | 32.32 | 27.55 | 5.49 | 29.93 | 35.43 | 54.00 | -18.57 | Horizontal |
| 2483.50 | 34.85 | 27.53 | 5.47 | 29.93 | 37.92 | 54.00 | -16.08 | Vertical |
| 2500.00 | 31.99 | 27.55 | 5.49 | 29.93 | 35.10 | 54.00 | -18.90 | Vertical |

*Remark:*

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*

# 10. ANTENNA REQUIREMENT

## 10.1 STANDARD REQUIREMENT

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. And according to FCC 47 CFR Section 15.247 (b), 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.

## 10.2 RESULT

The antennas used for this product are PCB antenna and no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is -0.68 dBi.

※※※※※END OF THE REPORT※※※※※