# Industrial Internet Innovation Center (Shanghai) Co.,Ltd.

# FCC BT TEST REPORT

| | |
|---|---|
| **PRODUCT** | 4G Smart Phone |
| **BRAND** | MobiWire,MobiWire,Vodafone,Orange |
| **MODEL** | H5028,Smart Green,Vodafone Lite,Orange Neva sparkle |
| **APPLICANT** | MobiWire SAS |
| **FCC ID** | QPN-H5028 |
| **ISSUE DATE** | November 7, 2022 |
| **STANDARD(S)** | FCC Part15 |

| **Prepared by:** ***Tao Lingyan*** | **Reviewed by:** ***Yang Fan*** | **Approved by:** ***Zhang Min*** |
|---|---|---|
| ***Signature*** | ***Signature*** | ***Signature*** |

# CONTENTS

# 1. Summary of Test Report

## 1.1 Test Standard(s)

| No. | Test Standard(s) | Title | Version |
|---|---|---|---|
| 1 | FCC Part15 | FCC CFR 47, Part 15, Subpart C:<br>15.205 Restricted bands of operation;<br>15.209 Radiated emission limits, general requirements;<br>15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz. | 2020 |

## 1.2 Reference Documents

| No. | Title | Title | Version |
|---|---|---|---|
| 1 | ANSI C63.10 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices | 2013 |
| 2 | KDB 558074 | Guidance for Performing Compliance Measurements on Frequency Hopping Spread Spectrum systems (DSS) Operating Under §15.247 | 2019 |

## 1.3 Summary of Test Results

| Measurement Items | Sub-clause of Part15C | Verdict |
|---|---|---|
| Maximum Peak Output Power | 15.247(b) | Pass |
| 20dB Occupied Bandwidth | 15.247(a) | Pass |
| 99% Occupied Bandwidth | 15.247(a) | Pass |
| Band Edges Compliance | 15.247 (d) | Pass |
| Time Of Occupancy (Dwell Time) | 15.247(a) | Pass |
| Carrier Frequency Separation | 15.247(a) | Pass |
| Number Of Hopping Channels | 15.247(a) | Pass |
| Transmitter Spurious Emission-Conducted | 15.247(d) | Pass |
| Transmitter Spurious Emission-Radiated | 15.247,15.209,15.205 | Pass |
| AC Powerline Conducted Emission | 15.207 | Pass |

NOTE:
The H5028,Smart Green,Vodafone Lite,Orange Neva sparkle, manufactured by MobiWire SAS is a new product for testing.
Industrial Internet Innovation Center (Shanghai) Co., Ltd. only performed test cases which identified with Pass/Fail/Inc result in section 1.2.
Industrial Internet Innovation Center (Shanghai) Co., Ltd. has verified that the compliance of the tested device specified in section 4 of this test report is successfully evaluated according to the procedure and test methods as defined in type certification requirement listed in section 1 of this test report.

a. All the test data for each data were verified, but only the worst case was reported.

b.The GFSK, π/4 DQPSK and 8DPSK were set in DH1 for GFSK, 2-DH1 for π/4 DQPSK, 3-DH1 for 8DPSK.

c.The DC and low frequency voltages' measurement uncertainty is ±2%.

### 1.4 Data Provided by Applicant

| No. | Item(s) | Data |
|---|---|---|
| 1 | Antenna gain of EUT | -1 dBi |
| Note: The data of 1.4 is provided by the customer may affect the validity of the test results in this report, and the impact and consequences of this shall be undertaken by the customer. | | |

# 2. General Information of The Laboratory

## 2.1 Testing Laboratory

| | |
|---|---|
| Lab Name | Industrial Internet Innovation Center (Shanghai) Co.,Ltd. |
| Address | Building 4，No. 766，Jingang Road，Pudong，Shanghai，China |
| Telephone | 021-68866880 |
| FCC Registration No. | 958356 |
| FCC Designation No. | CN1177 |

## 2.2 Laboratory Environmental Requirements

| | |
|---|---|
| Temperature | 15℃~35℃ |
| Relative Humidity | 25%RH~75%RH |
| Atmospheric Pressure | 101kPa |

## 2.3 Project Information

| | |
|---|---|
| Project Manager | Xu Yuting |
| Test Date | September 4,2022 to October 20, 2022 |

# 3. General Information of The Customer

## 3.1 Applicant

| | |
|---|---|
| Company | MobiWire SAS |
| Address | 107 Boulevard de la Mission Marchand, 92400 Courbevoie, France. |
| Telephone | +33625028368 |

## 3.2 Manufacturer

| | |
|---|---|
| Company | MobiWire SAS |
| Address | 107 Boulevard de la Mission Marchand, 92400 Courbevoie, France. |

# 4. General Information of The Product

## 4.1 Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Product | 4G Smart Phone |
| Model | H5028,Smart Green,Vodafone Lite,Orange Neva sparkle |
| Date of Receipt | September 4,2022/ September 22,2022 |
| EUT ID* | S01aa/S06aa |
| SN/IMEI | S01aa:352243540003670<br>352243540003688<br>S06aa:352243540002615<br>352243540002623 |
| Supported Radio Technology and Bands | GSM850/GSM900/DCS1800/PCS1900<br>WCDMA Band I/II/V/VIII<br>LTE Band 1/3/7/20/28<br>BT5.0 BR/EDR/BLE<br>WLAN 802.11 b/g/n<br>WLAN 802.11 a/n<br>BT5.0 BR/EDR/BLE<br>GPS/GLONASS/Gallileo<br>FM |
| Hardware Version | V01A |
| Software Version | Mobiwire_H5028_V01 |
| FCC ID | QPN-H5028 |
| NOTE：EUT ID is the internal identification code of the laboratory. | |

## 4.2 Description for Auxiliary Equipment (AE)

| AE ID* | Description | Model | SN/Remark |
|---|---|---|---|
| AE1 | RF Cable | N/A | N/A |
| NOTE：AE ID is the internal identification code of the laboratory. | | | |

## 4.3 Additional Information

| | |
|---|---|
| Bluetooth Frequency | 2402MHz-2480MHz |
| Bluetooth Channel | Ch0-78 |
| Bluetooth Modulation | GFSK; π/4 DQPSK; 8DPSK |

# 5. Test Configuration Information

## 5.1 Laboratory Environmental Conditions

### 5.1.1 Permanent Facilities

| | | | |
|---|---|---|---|
| Relative Humidity | Min. = 45 %, Max. = 55 % | | |
| Atmospheric Pressure | 101kPa | | |
| Temperature | Normal | Minimum | Maximum |
| | 25℃ | -10℃ | 55℃ |
| Working Voltage of EUT | Normal | Minimum | Maximum |
| | 3.8V | 3.6V | 4.2V |

## 5.2 Test Equipments Utilized

### 5.2.1 Conducted Test System

| No. | Name | Model | S/N | Manufacturer | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Programmable Power Supply | Keithley 2303 | 4039070 | Starpoint | May 10, 2021 | 1.5 Years |
| 2 | Vector Signal Generator | SMBV100A | 257904 | R&S | February 21, 2022 | 1 Year |
| 3 | Temperature box | B-TF-107C | BTF107C-201804107 | Boyi | May 10, 2021 | 1.5 Years |
| 4 | Spectrum Analyzer | FSQ40 | 200063 | R&S | Novemb er 02, | 1 Year |
| 5 | USB Wideband Power Senser | U2021XA | MY56410009 | Keysight | February 21, 2022 | 1 Year |
| 6 | Simultaneous Sampling DQA | U2531A | TW56183514 | Agilent | March 02, 2022 | 1 Year |
| 7 | Vector Signal Generator | SMU200A | 104684 | R&S | May 10, 2021 | 1.5 Years |
| 8 | Wireless communication comprehensive tester | CMW270 | 100919 | R&S | May 10, 2021 | 1.5 Years |
| 9 | Eagle Test Software | Eagle V3.3 | N/A | ECIT | N/A | N/A |

### 5.2.2 Radiated Emission Test System

| No. | Name | Model | S/N | Manufacturer | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Universal Radio Communication Tester | CMU200 | 123123 | R&S | 2021/5/10 | 1.5 year |
| 2 | Universal Radio Communication Tester | CMW500 | 104178 | R&S | 2021/5/10 | 1.5 year |
| 3 | EMI Test Receiver | ESU40 | 100307 | R&S | 2022/2/23 | 1 year |
| 4 | TRILOG Broadband Antenna | VULB9163 | VULB9163-515 | Schwarzbeck | 2022/3/11 | 1 year |
| 5 | Double- ridged Waveguide Antenna | ETS-3117 | 00135890 | ETS | 2022/3/9 | 2 years |
| 6 | Horn Antenna | 3160-09 | LM6321 | ETS | 2021/2/3 | 3 years |
| 7 | Horn Antenna | 3160-10 | LM5942 | ETS | 2021/2/3 | 3 years |
| 8 | Pre-amplifier | SCU08F1 | 8320024 | R&S | 2021/5/10 | 1.5 year |
| 9 | Pre-amplifier | SCU18 | 10155 | R&S | 2021/5/10 | 1.5 year |
| 10 | Pre-amplifier | SCU26 | 10025 | R&S | 2021/5/10 | 1.5 year |
| 11 | Pre-amplifier | SCU40 | 10020 | R&S | 2021/5/10 | 1.5 year |
| 12 | 2-Line V-Network | ENV216 | 101380 | R&S | 44613 | 1 year |
| 13 | EMI Test Receiver | ESCI | 101235 | R&S | 44615 | 1 year |
| 14 | EMI Test software | EMC32 V9.15 | N/A | R&S | N/A | N/A |
| 15 | EMI Test software | EMC32 V10.35.02 | N/A | R&S | N/A | N/A |

### 5.2.3 Test Environment

**Shielding Room1** (6.0 meters×3.0 meters×2.7 meters) did not exceed following limits along the conducted RF performance testing:

| | |
|---|---|
| Temperature | Min. = 15 ℃, Max. = 35 ℃ |
| Relative humidity | Min. = 20 %, Max. = 75 % |
| Shielding effectiveness | > 100 dB |
| Ground system resistance | < 0.5 Ω |
| Temperature | Min. = 15 ℃, Max. = 35 ℃ |

**Control room** did not exceed following limits along the EMC testing:

| | |
|---|---|
| Temperature | Min. = 15 ℃, Max. = 35 ℃ |
| Relative humidity | Min. =30 %, Max. = 60 % |

| | |
|---|---|
| Shielding effectiveness | > 100 dB |
| Electrical insulation | > 10 kΩ |
| Ground system resistance | < 0.5 Ω |

**Fully-anechoic chamber1** (9.8 meters×6.7 meters×6.7 meters) did not exceed following limits along the EMC testing:

| | |
|---|---|
| Temperature | Min. = 15 ℃, Max. = 35 ℃ |
| Relative humidity | Min. = 25 %, Max. = 75 % |
| Shielding effectiveness | > 100 dB |
| Electrical insulation | > 10 kΩ |
| Ground system resistance | < 0.5 Ω |
| VSWR | Between 0 and 6 dB, from 1GHz to 18GHz |
| Site Attenuation Deviation | Between -4 and 4 dB,30MHz to 1GHz |

## 5.3 Measurement Uncertainty

| Measurement Items | Range | Confidence Level | Calculated Uncertainty |
|---|---|---|---|
| Peak Output Power-Conducted | 2402MHz-2480MHz | 95% | 0.544dB |
| Frequency Band Edges-Conducted | 2402MHz-2480MHz | 95% | 0.544dB |
| Conducted Emission | 9KHz-30MHz | 95% | 0.89dB |
| Conducted Emission | 30MHz-2GHz | 95% | 0.90dB |
| Conducted Emission | 2GHz-3.6GHz | 95% | 0.88dB |
| Conducted Emission | 3.6GHz-8GHz | 95% | 0.96dB |
| Conducted Emission | 8GHz-20GHz | 95% | 0.94dB |
| Conducted Emission | 20GHz-22GHz | 95% | 0.88dB |
| Conducted Emission | 22GHz-26GHz | 95% | 0.86dB |
| Transmitter Spurious Emission-Radiated | 9KHz-30MHz | 95% | 5.66dB |
| Transmitter Spurious Emission-Radiated | 30MHz-1000MHz | 95% | 4.98dB |
| Transmitter Spurious Emission-Radiated | 1000MHz -18000MHz | 95% | 5.06dB |
| Transmitter Spurious Emission- | 18000MHz -40000MHz | 95% | 5.20dB |

| | | | |
|---|---|---|---|
| Radiated | | | |
| Dwell Time | 2402MHz-2480MHz | 95% | 0.218ms |
| 20dB Bandwidth | 2402MHz-2480MHz | 95% | 62.04Hz |
| AC Power line Conducted Emission | 0.15MHz-30MHz | 95% | 3.66 dB |

# 6. Test Results

## 6.1 Peak Output Power-Conducted

### 6.1.1 Measurement Limit

| Standard | Limit (dBm) |
|---|---|
| FCC 47 Part 15.247(b)(3) | <30 |

### 6.1.2 Test Condition

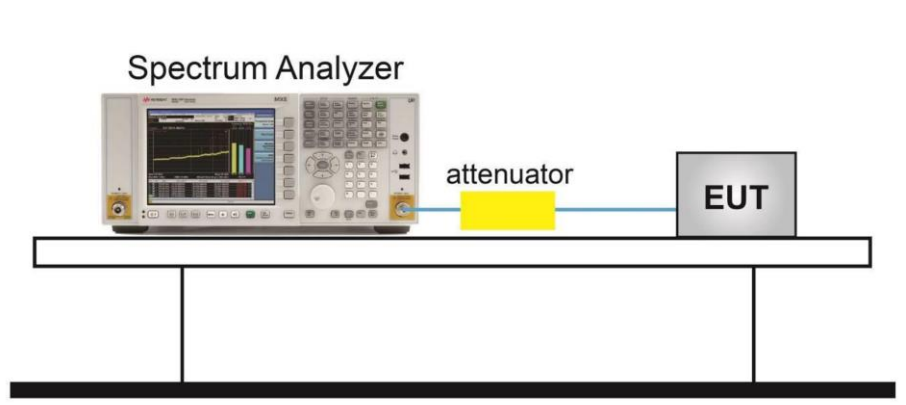
| Hopping Mode | RBW | VBW | Span | Sweeptime |
|---|---|---|---|---|
| Hopping OFF | 3MHz | 10MHz | 9MHz | Auto |

### 6.1.3 Test Procedure

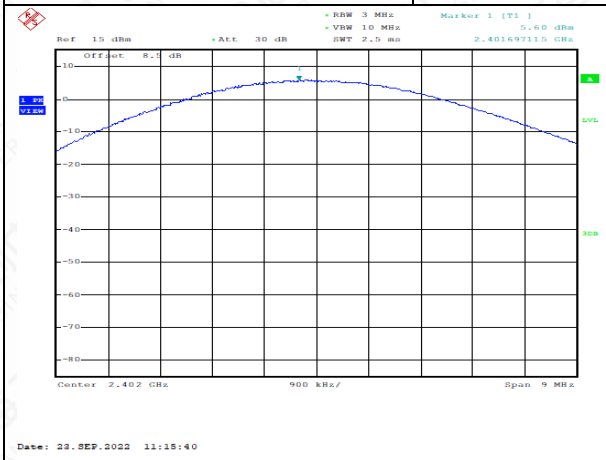
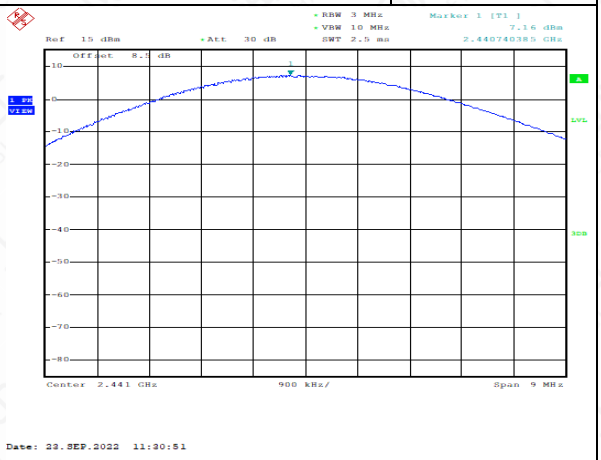
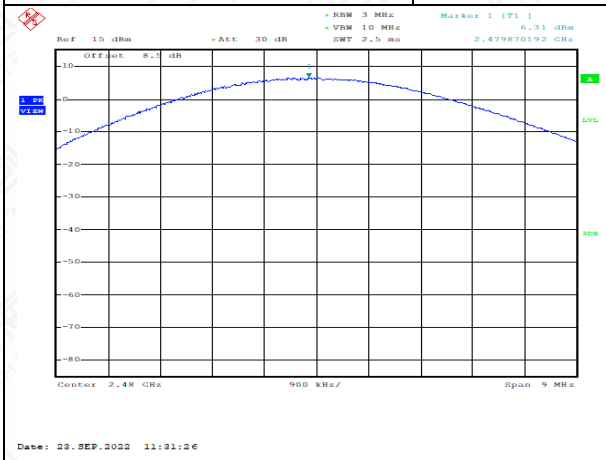
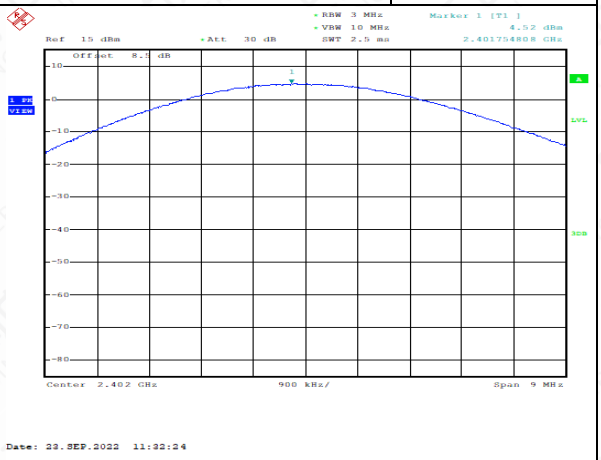
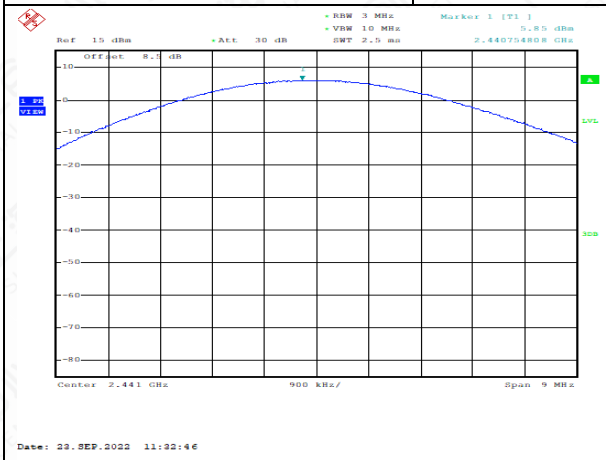
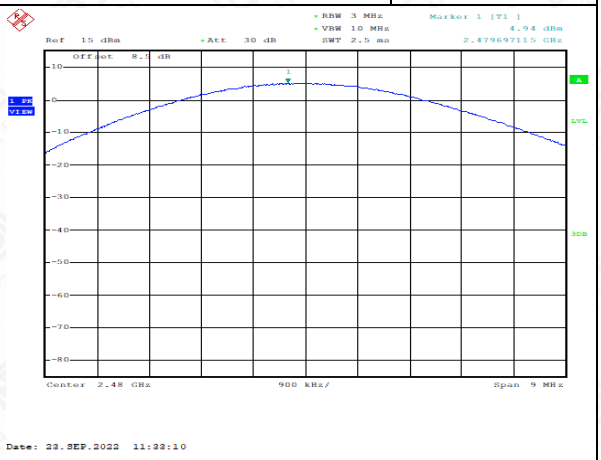
The measurement is according to ANSI C63.10 clause 7.8.5.

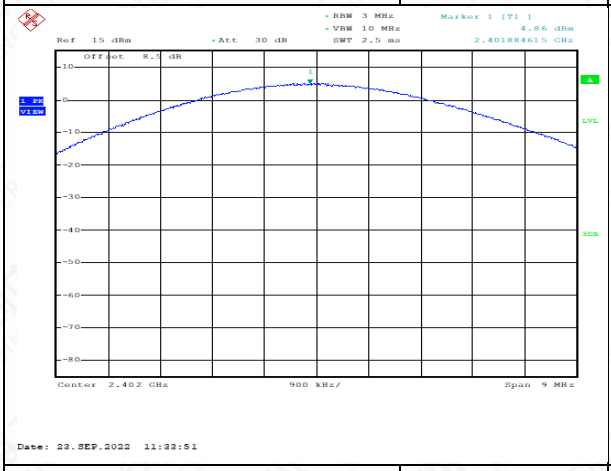
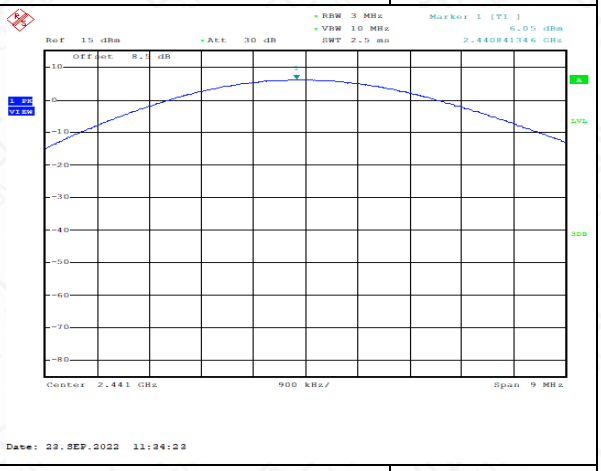
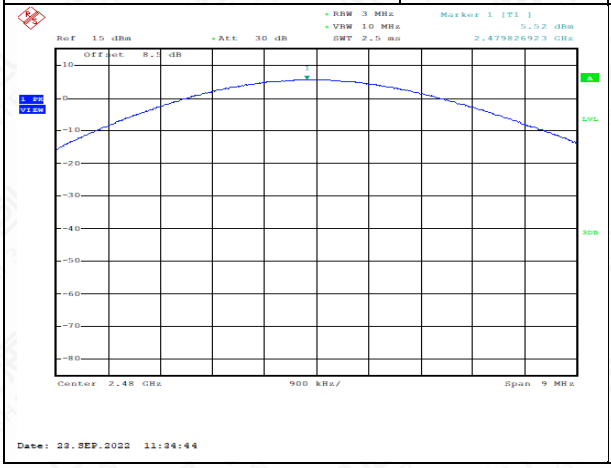
1. The output power of EUT was connected to the spectrum analyzer and CMW 270 by cable and divide. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Measure the conducted output power and record the results it

### 6.1.4 Test setup



**Measurement Results**

| Peak Conducted Output Power GFSK, CH0 (dBm) | 5.60 | Peak Conducted Output Power GFSK, CH39 (dBm) | 7.16 |
|---|---|---|---|
|  | |  | |
| Peak Conducted Output Power GFSK, CH78 (dBm) | 6.31 | Peak Conducted Output Power π/4 DQPSK, CH0 (dBm) | 4.52 |
|  | |  | |
| Peak Conducted Output Power π /4 DQPSK, CH39 (dBm) | 5.85 | Peak Conducted Output Power π/4 DQPSK, CH78 (dBm) | 4.94 |
|  | |  | |

| Peak Conducted Output Power 8DPSK, CH0 (dBm) | 4.86 | Peak Conducted Output Power 8DPSK, CH39 (dBm) | 6.05 |
|---|---|---|---|
|  | |  | |
| Peak Conducted Output Power 8DPSK, CH78 (dBm) | 5.52 | / | / |
|  | | / | |

## 6.2 Frequency Band Edges-Conducted

### 6.2.1 Measurement Limit

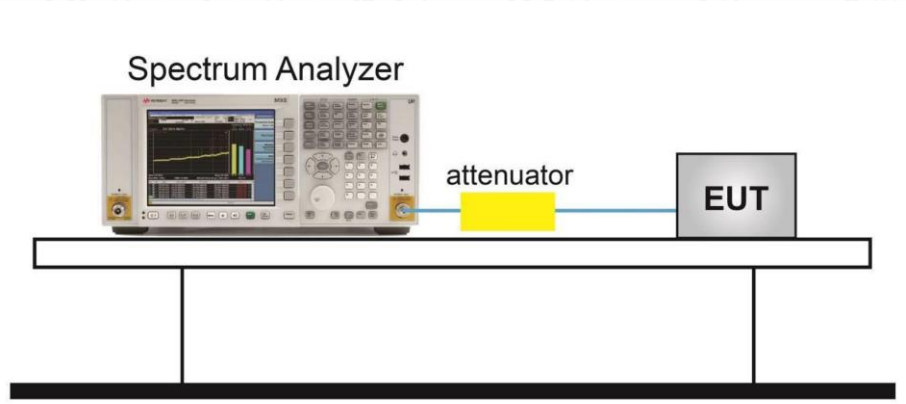
| Standard | Limit(dBc) |
|---|---|
| FCC 47 CFR Part 15.247(d) | >20 |

### 6.2.2 Test procedures

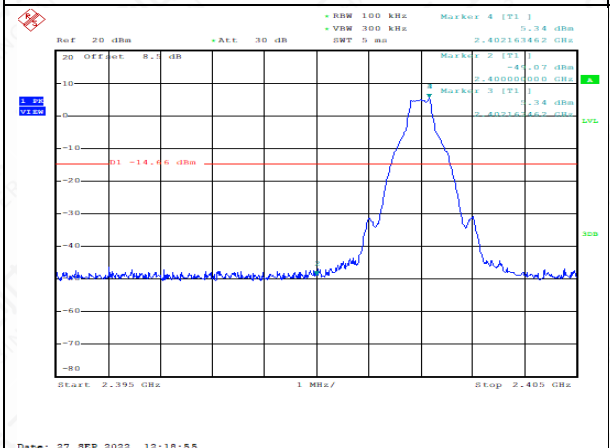
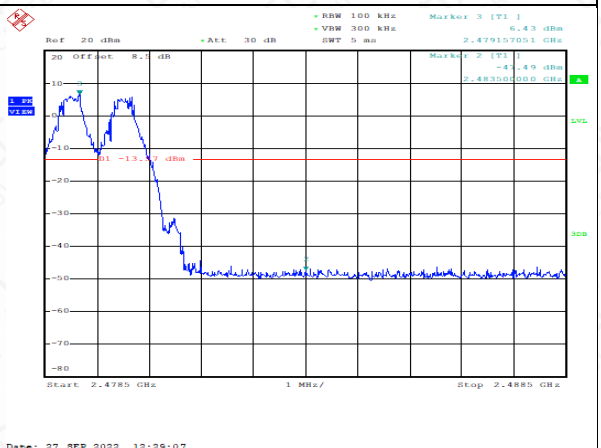
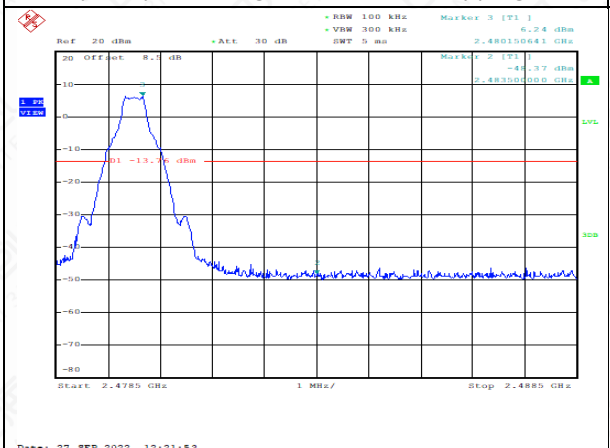
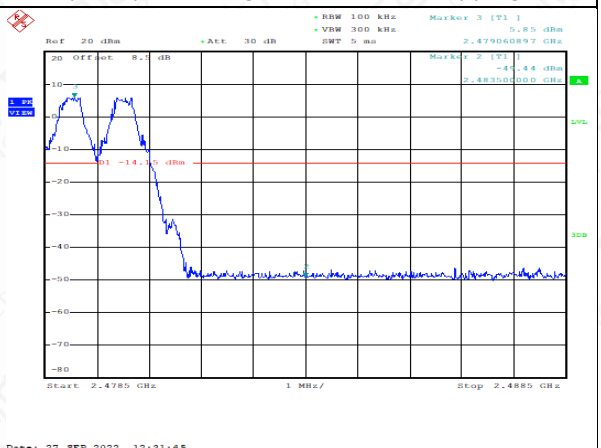
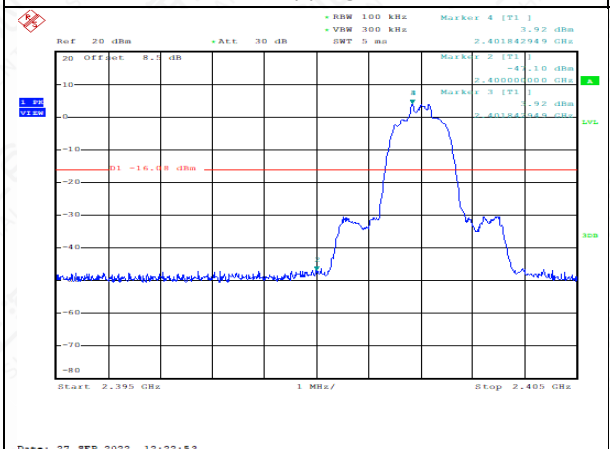
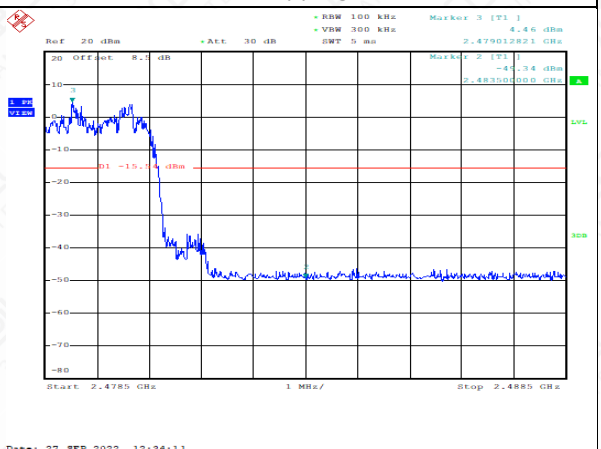
The measurement is according to ANSI C63.10 clause 7.8.6.

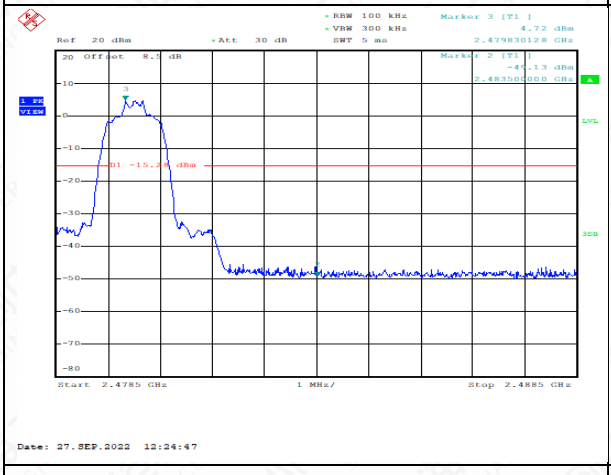
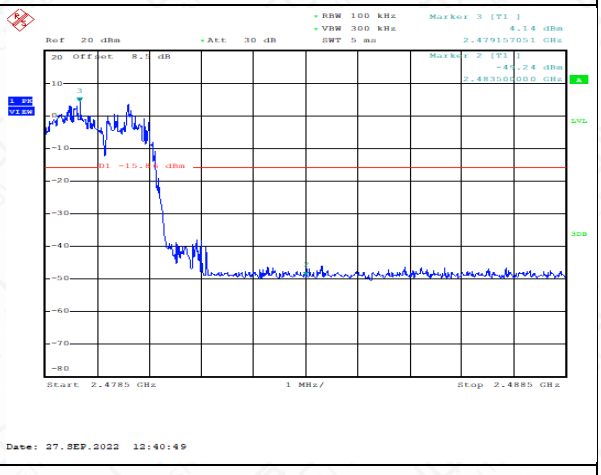
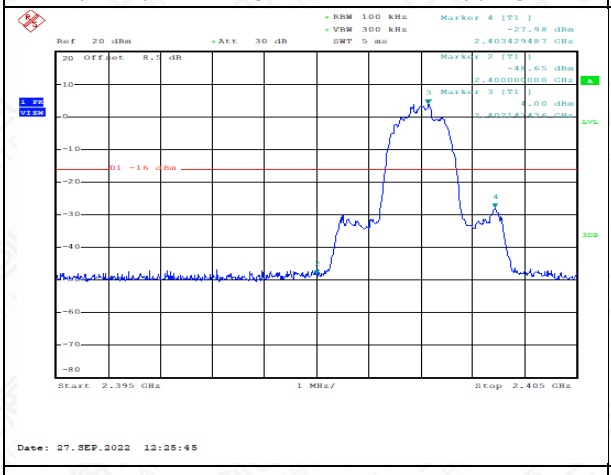
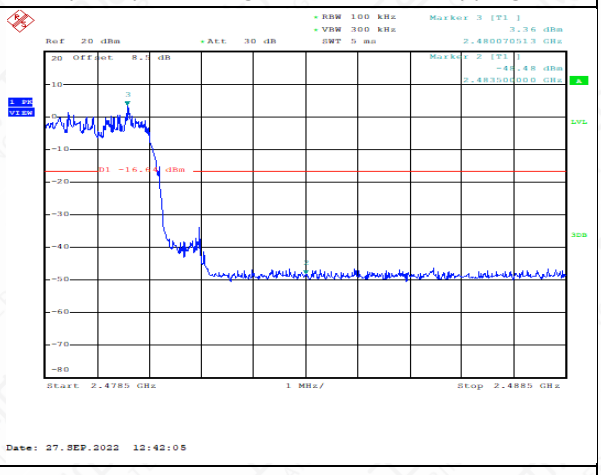
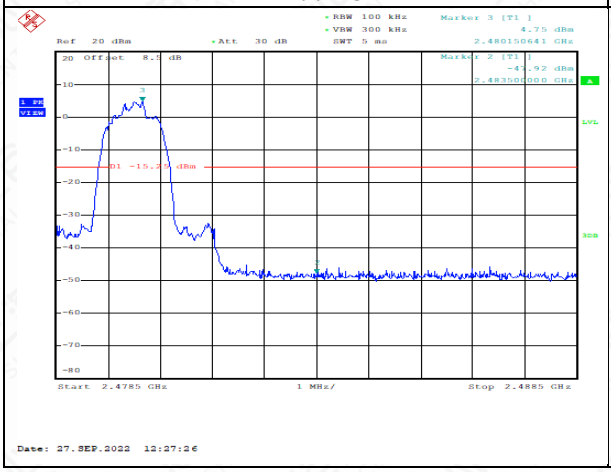
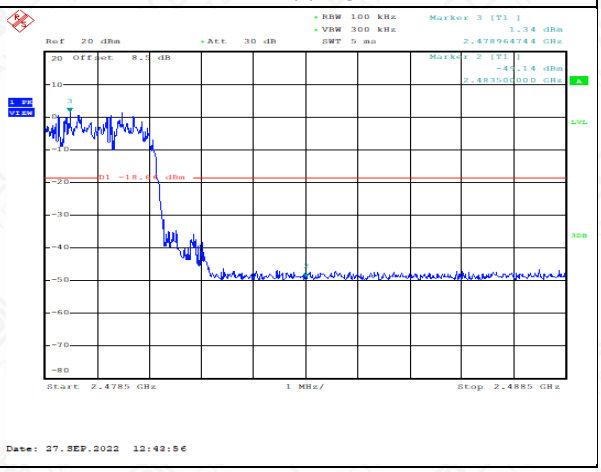
1. Connect the EUT to spectrum analyzer.
2. Set RBW=1MHz, VBW=3MHz, span more than 1.5 times channel bandwidth (2MHz).
3. Detector =peak, sweep time=auto couple, trace mode=max hold.Allow sweep to continue until the trace stabilizes.

### 6.2.3 Test setup



**Measurement Result**

| Frequency Band Edge: GFSK, Ch0, Hopping OFF | Frequency Band Edge: GFSK, Ch0, Hopping ON |
|---|---|
|  |  |
| Frequency Band Edge: GFSK,Ch78, Hopping OFF | Frequency Band Edge: GFSK, Ch78, Hopping ON |
|  |  |
| Frequency Band Edge: π/4 DQPSK, Ch0, Hopping OFF | Frequency Band Edge: π/4 DQPSK, Ch0, Hopping ON |
|  |  |

| Frequency Band Edge: π/4 DQPSK, Ch78, Hopping OFF | Frequency Band Edge: π/4 DQPSK, Ch78, Hopping ON |
|---|---|
|  |  |
| Frequency Band Edge: 8DPSK,Ch0, Hopping OFF | Frequency Band Edge: 8DPSK, Ch0, Hopping ON |
|  |  |
| Frequency Band Edge:8DPSK, Ch78, Hopping OFF | Frequency Band Edge: 8DPSK, Ch78, Hopping ON |
|  |  |

## 6.3 Conducted Emission

### 6.3.1 Measurement Limt

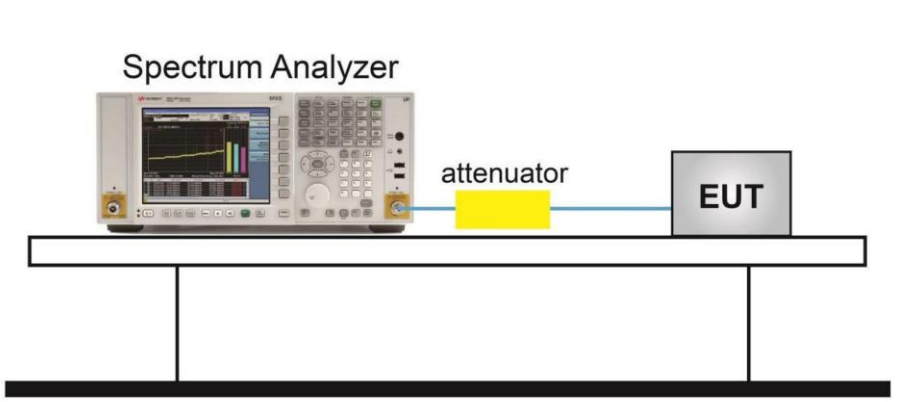
| Standard | Limit |
|---|---|
| FCC 47 CFR Part15.247 (d) | 20dB below peak output power in 100KHz |

### 6.3.2 Test procedures

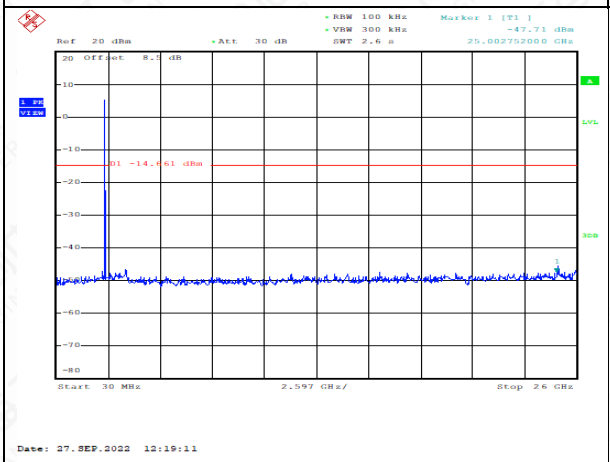
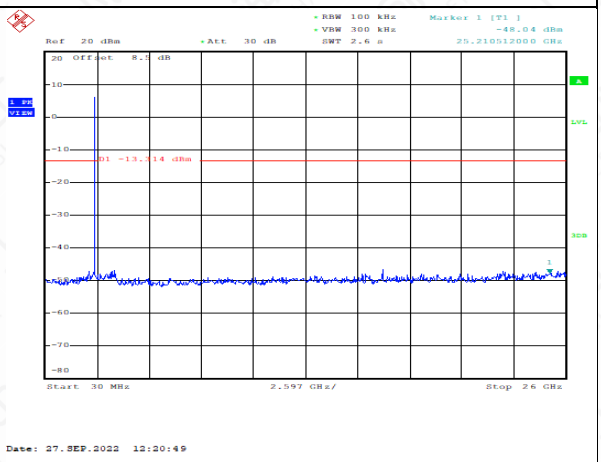
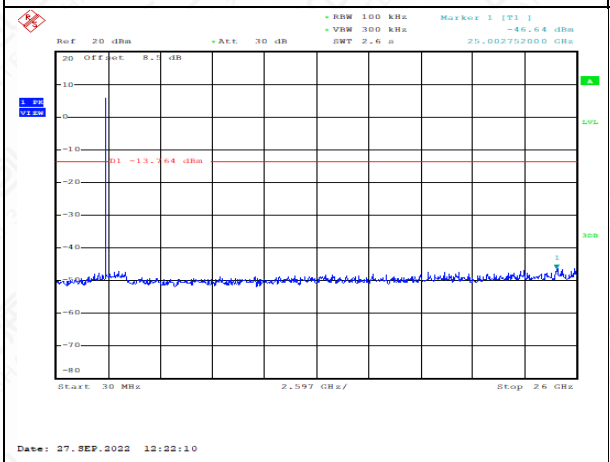
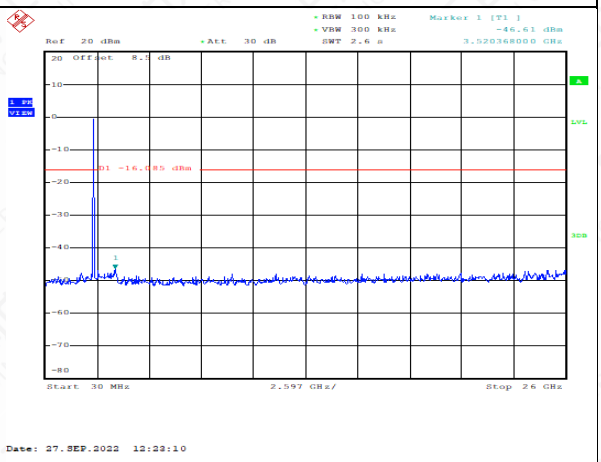
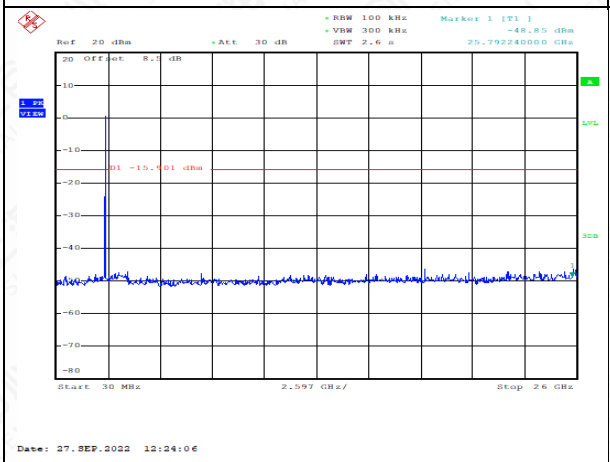
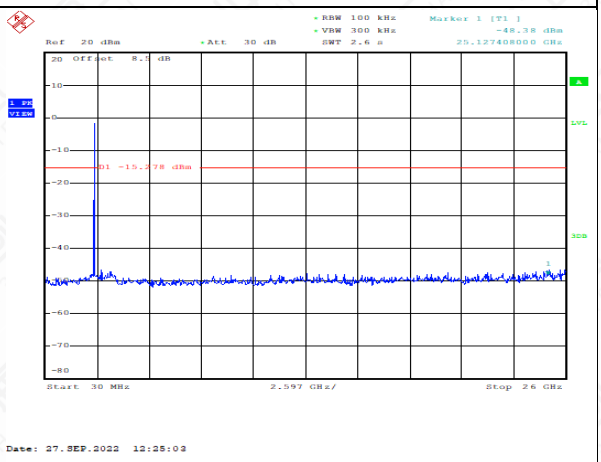
The measurement is according to ANSI C63.10 clause 7.8.8.

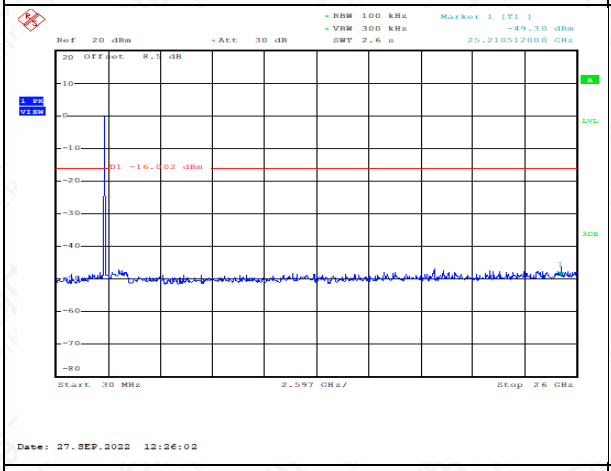
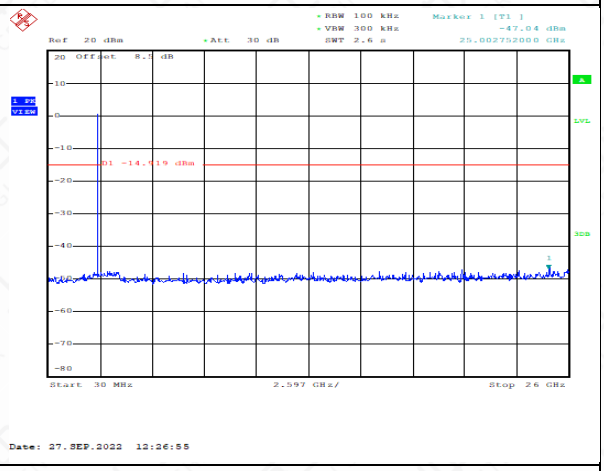
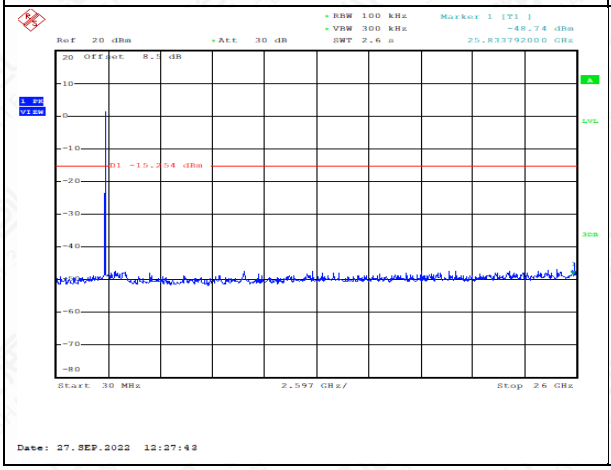
1. Connect the EUT to spectrum analyzer.
2. Set RBW=100kHz, VBW=300kHz.
3. Detector =peak, sweep time=auto couple, trace mode=max hold

### 6.3.3 Test Setup



**Measurement Results**

| Conducted spurious emission: GFSK, Ch0, 30MHz~26GHz | Conducted spurious emission: GFSK, Ch39, 30MHz~26GHz |
|---|---|
|  |  |
| Conducted spurious emission: GFSK, Ch78, 30MHz~26GHz | Conducted spurious emission: π/4 DQPSK, Ch0, 30MHz~26GHz |
|  |  |
| Conducted spurious emission: π/4 DQPSK, Ch39, 30MHz~26GHz | Conducted spurious emission: π/4 DQPSK, Ch78, 30MHz~26GHz |
|  |  |

| Conducted spurious emission:<br>8DPSK, Ch0, 30MHz~26GHz | Conducted spurious emission:<br>8DPSK, Ch39, 30MHz~26GHz |
|---|---|
|  |  |
| Conducted spurious emission:<br>8DPSK, Ch78, 30MHz~26GHz | / |
|  | / |

Note: 1. The out-of- limit signal in the picture is the main frequency signal.

2. The test data below 30MHz is more than 20dB lower than the limit value, so it is not provided in the report.

## 6.4 Radiated Emission

6.4.1 Measurement Limit

| Standard | Limit |
|---|---|
| FCC 47 CFR Part 15.247, 15.205, 15.209 | 20dB below peak output power |

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) (see 15.205(c)).

Limit in restricted band

| Frequency of emission (MHz) | Field strength (mV/m) | Field strength (dBuV/m) |
|---|---|---|
| 0.009~0.49 | 2400/F (kHz) | 129-94 |
| 0.49~1.705 | 24000/F (kHz) | 74-63 |
| 1.705~30 | 30 | 70 |
| 30~88 | 100 | 40 |
| 88~216 | 150 | 43.5 |
| 216~960 | 200 | 46 |
| Above 960 | 500 | 54 |

6.4.2 Test Method

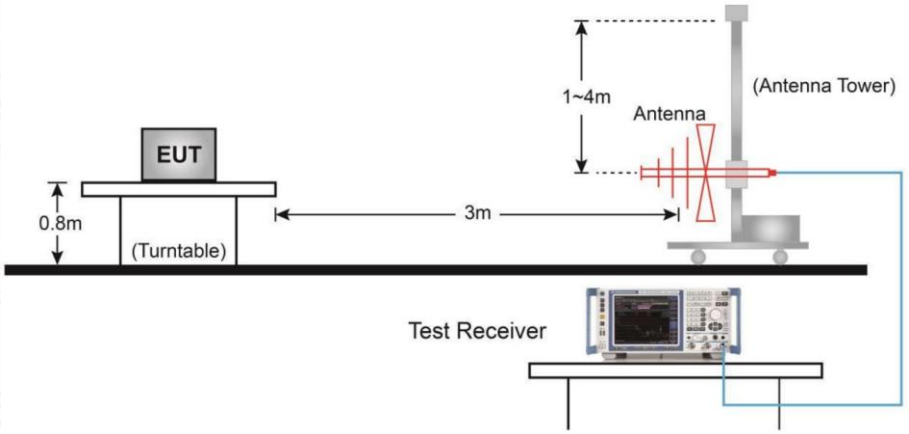
Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. but it may be larger or smaller to accommodate various sized EUTs. For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also ANSI C63.10-2013 section 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

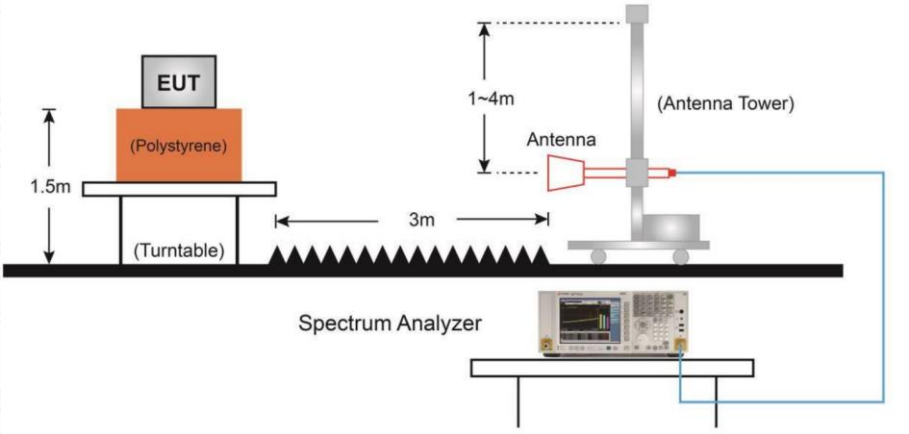
| Frequency of emission | RBW/VBW | Sweep Time (s) |
|---|---|---|
| 0.009~30 | 9KHz/30KHz | Auto |
| 30~1000 | 100KHz/300KHz | 5 |
| 1000~4000 | 1MHz/3MHz | 15 |
| 4000~18000 | 1MHz/3MHz | 40 |
| 18000~26500 | 1MHz/3MHz | 20 |

6.4.3 Test Setup

Below 1GHz Test Setup




Above 1GHz Test Setup



**Measurement Results**

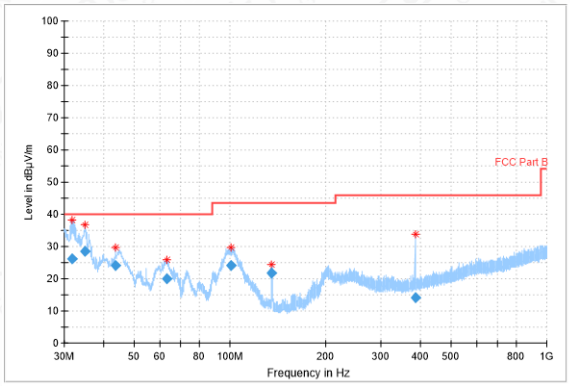
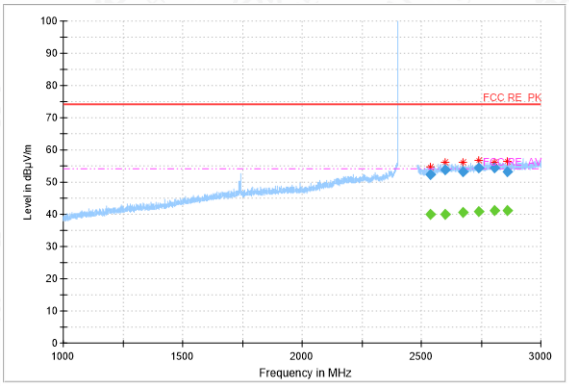
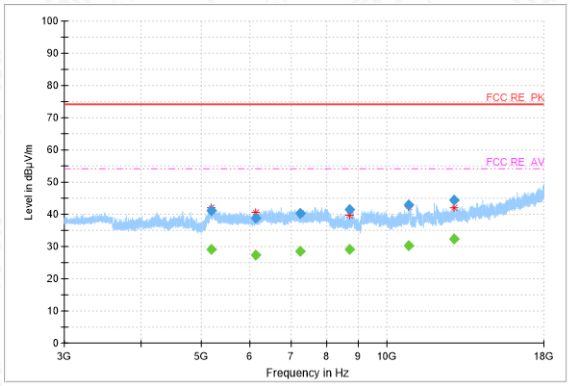
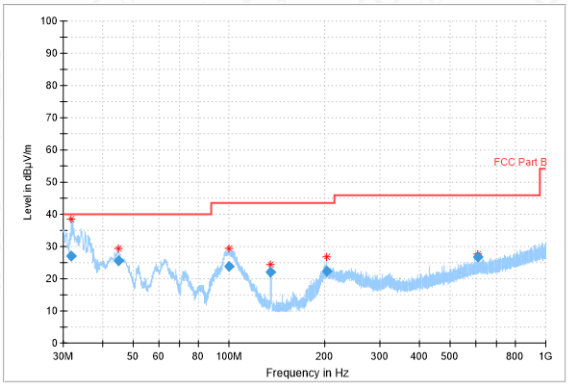
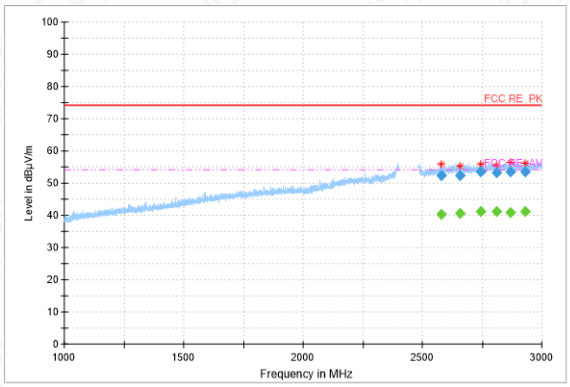
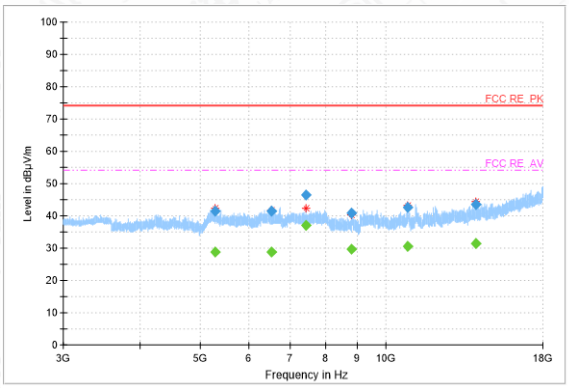
A “reference path loss” is established and ARpi is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.

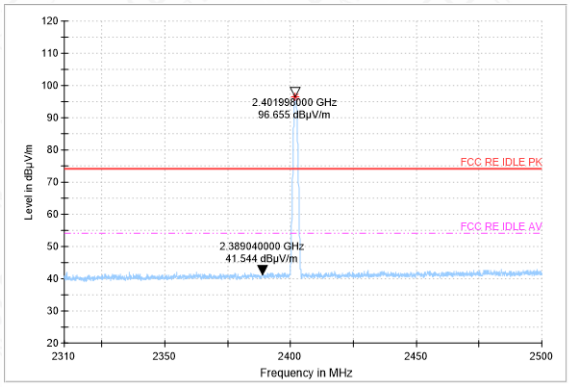
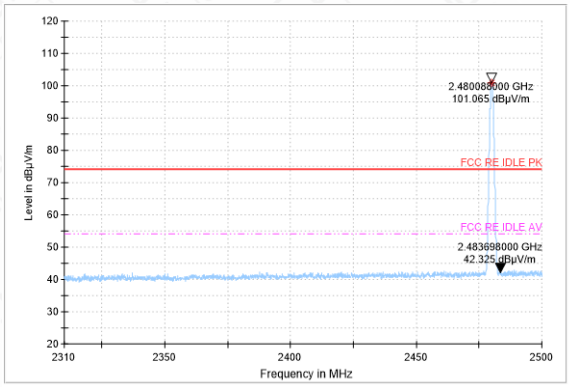
The measurement results are obtained as described below:

ARpi = Cable loss + Antenna Factor-Preamplifier gain

Result=PMea + ARpi

The test data below 30MHz is more than 20dB lower than the limit value, so it is not provided in the report.

| Radiated emission: GFSK, Ch0, 30MHz~1GHz | Radiated emission: GFSK, Ch0, 1GHz~3GHz |
|---|---|
|  |  |
| **Radiated emission: GFSK, Ch0, 3GHz~18GHz** | **Radiated emission: GFSK, Ch78, 30MHz~1GHz** |
|  |  |
| **Radiated emission: GFSK, Ch78, 1GHz~3GHz** | **Radiated emission: GFSK, Ch78, 3GHz~18GHz** |
|  |  |

| Bandedge (Low): GFSK, low channel | Bandedge (High): GFSK, high channel |
|---|---|
|  |  |



Note: The out-of- limit signal in the picture is the main frequency signal.

GFSK Ch0 30MHz-1GHz

| Frequency (MHz) | Result (dBµV/m) | ARpl (dB) | PMea (dBµV/m) | Polarity |
|---|---|---|---|---|
| 31.9 | 26.19 | -14.3 | 40.49 | V |
| 34.9 | 28.43 | -14 | 42.43 | V |
| 43.5 | 24.07 | -12.5 | 36.57 | V |
| 63.1 | 19.93 | -13.4 | 33.33 | V |
| 100.5 | 24.23 | -13.3 | 37.53 | V |
| 135.7 | 21.66 | -16.7 | 38.36 | H |

GFSK Ch0 1GHz-3GHz

| Frequency (MHz) | Result (dBµV/m) | ARpl (dB) | PMea (dBµV/m) | Polarity |
|---|---|---|---|---|
| 2538.3 | 52.38 | 14.9 | 37.48 | H |
| 2600.1 | 53.83 | 15.5 | 38.33 | H |
| 2672.2 | 53.15 | 15.9 | 37.25 | V |
| 2740.0 | 54.43 | 16.2 | 38.23 | V |
| 2807.1 | 54.32 | 16.6 | 37.72 | V |
| 2859.2 | 53.32 | 16.7 | 36.62 | H |

GFSK Ch0 1GHz-3GHz (Average)

| Frequency (MHz) | Result (dBµV/m) | ARpl (dB) | PMea (dBµV/m) | Polarity |
|---|---|---|---|---|
| 2740.0 | 41.01 | 16.2 | 24.81 | V |
| 2807.1 | 41.18 | 16.6 | 24.58 | V |

GFSK Ch0 3GHz-18GHz

| Frequency (MHz) | Result (dBµV/m) | ARpl (dB) | PMea (dBµV/m) | Polarity |
|---|---|---|---|---|
| 5201.6 | 41.11 | -0.9 | 42.01 | V |
| 6128.0 | 38.8 | -3.5 | 42.3 | V |
| 7239.3 | 40.36 | -2.2 | 42.56 | H |

| | | | | |
|---|---|---|---|---|
| 8699.5 | 41.52 | -1.9 | 43.42 | H |
| 10860.5 | 43.08 | 1.1 | 41.98 | V |
| 12875.0 | 44.36 | 3.2 | 41.16 | H |

GFSK Ch78 30MHz-1GHz

| Frequency (MHz) | Result (dBµV/m) | ARpl (dB) | PMea (dBµV/m) | Polarity |
|---|---|---|---|---|
| 31.8 | 26.94 | -14.3 | 41.24 | V |
| 44.8 | 25.5 | -12.4 | 37.9 | V |
| 100.1 | 23.71 | -13.3 | 37.01 | V |
| 135.6 | 21.95 | -16.6 | 38.55 | H |
| 203.0 | 22.5 | -13.7 | 36.2 | H |
| 609.0 | 26.79 | -3.1 | 29.89 | H |

GFSK Ch78 1GHz-3GHz

| Frequency (MHz) | Result (dBµV/m) | ARpl (dB) | PMea (dBµV/m) | Polarity |
|---|---|---|---|---|
| 2576.5 | 52.4 | 15.3 | 37.1 | H |
| 2655.9 | 52.48 | 15.9 | 36.58 | V |
| 2744.5 | 53.62 | 16.2 | 37.42 | H |
| 2808.9 | 53.13 | 16.6 | 36.53 | V |
| 2867.1 | 53.48 | 16.7 | 36.78 | H |
| 2930.3 | 53.59 | 16.8 | 36.79 | V |

GFSK Ch78 3GHz-18GHz

| Frequency (MHz) | Result (dBµV/m) | ARpl (dB) | PMea (dBµV/m) | Polarity |
|---|---|---|---|---|
| 5295.0 | 41.6 | -2.5 | 44.1 | H |
| 6536.7 | 41.38 | -2.5 | 43.88 | H |
| 7440.0 | 46.49 | -2.4 | 48.89 | V |
| 8816.1 | 40.94 | -1.4 | 42.34 | H |
| 10860.3 | 42.78 | 1.1 | 41.68 | H |
| 14006.1 | 43.57 | 4.7 | 38.87 | V |

## 6.5 Time Of Occupancy (Dwell Time)

### 6.5.1 Measurement Limit

| Standard | Limit(ms) |
|---|---|
| FCC 47 Part 15.247 (a) (1) (iii) | <400 |

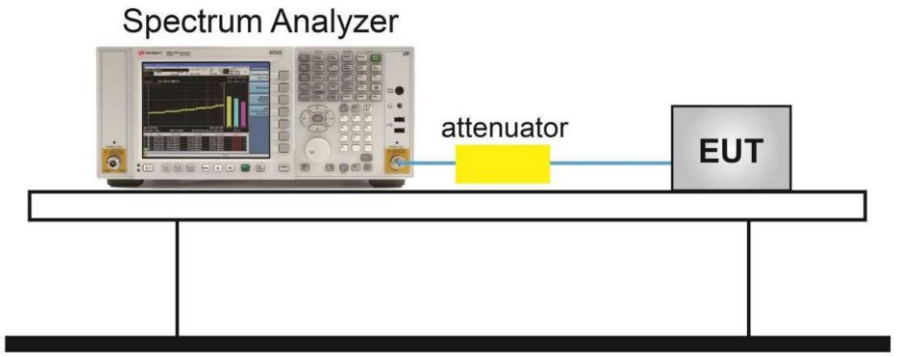
### 6.5.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.4

1. Connect the EUT through cable and divide with CMW 270 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 8.
4. Span: Zero span, centered on a hopping channel.
5. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
6. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to showtwo successive hops on a channel.
7. Detector function: Peak.
8. Trace: Max hold.
9. Use the marker-delta function, and record it.

Note： For AFH mode, Test Period = 0.4 (second/ channel) x 20 Channel = 8 sec,
For FHSS mode, Test Period = 0.4 (second/ channel) x 79 Channel = 31.6 sec,
So the Time of Occupancy (Dwell Time) of AFH mode= Time of Occupancy (Dwell Time) of FHSS mode / 79 Channel x 20 Channel.

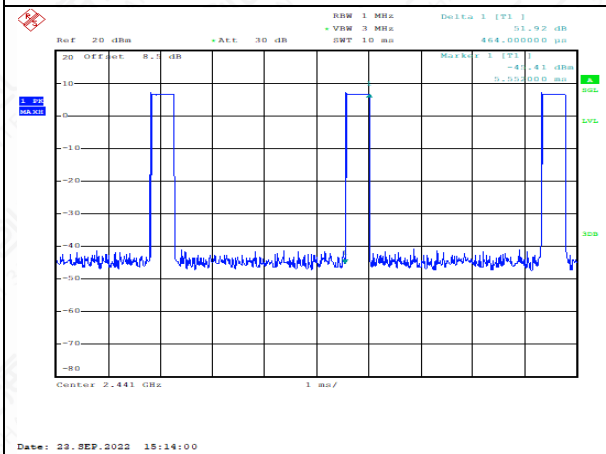
### 6.5.3 Test Setup



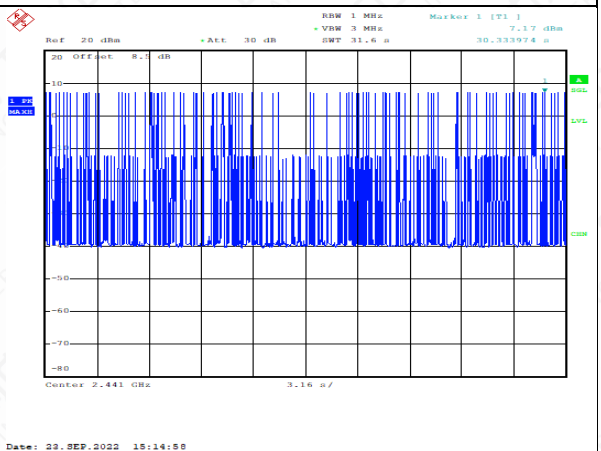
**Measurement Result**

| Modulation type | Frequency (MHz) | Time slot length (ms) | Hop Number | Dwell Time (ms) | Limit (ms) | Conclusion |
|---|---|---|---|---|---|---|
| GFSK DH5 | 2402-2480 | 0.46 | 88 | 40.83 | 400 | P |
| π/4 DQPSK 2DH5 | 2402-2480 | 0.38 | 88 | 33.79 | 400 | P |
| 8DPSK 3DH5 | 2402-2480 | 0.32 | 64 | 20.48 | 400 | P |
| Note: Dwell time = time slot length * hop rate | | | | | | |

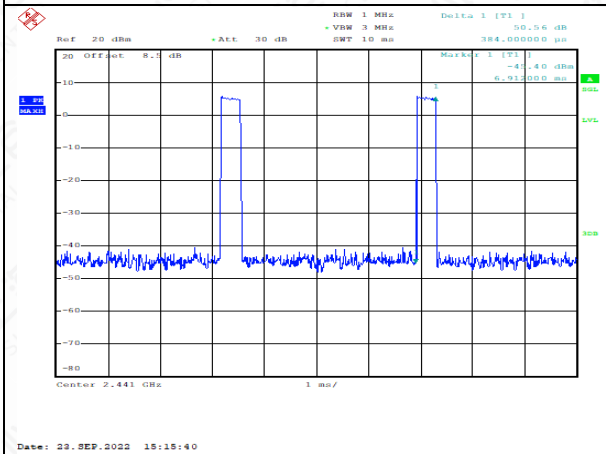
For GFSK, Ch39,Packet DH5
Time of occupancy (Dwell Time)



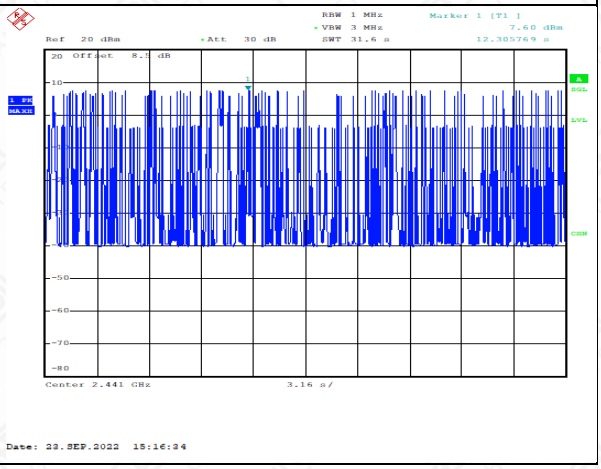

For GFSK, Ch39,Packet DH5
Number of Transmissions Measurement

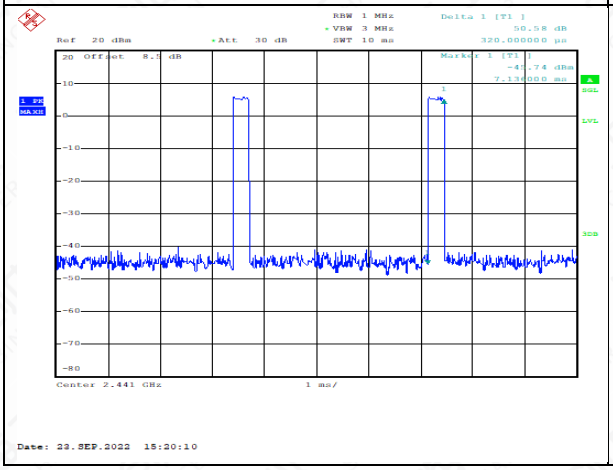
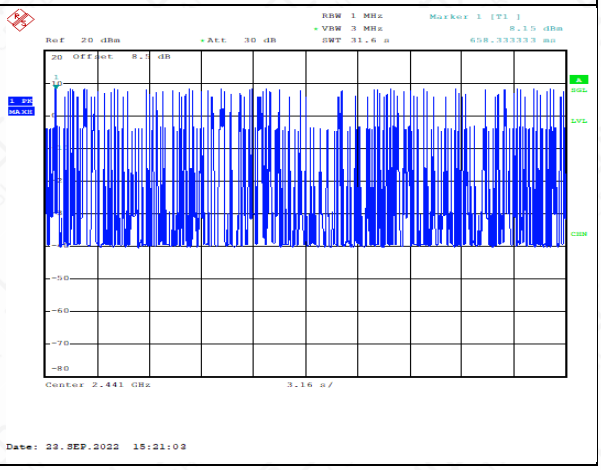



For π/4 DQPSK, Ch39,Packet 2DH5
Time of occupancy (Dwell Time)




For π/4 DQPSK, Ch39,Packet 2DH5
Number of Transmissions Measurement



| For 8DPSK, Ch39,Packet 3DH5<br>Time of occupancy (Dwell Time) | For 8DPSK, Ch39,Packet 3DH5<br>Number of Transmissions Measurement |
|---|---|
|  |  |

## 6.6 20dB Bandwidth

### 6.6.1 Measurement Limit

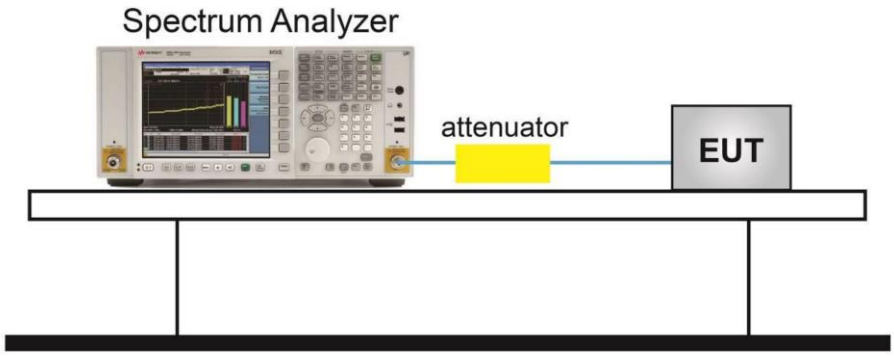
| Standard | Limit |
|---|---|
| FCC 47 Part 15.247(d) | 20dB below peak output power in 100KHz bandwidth |

### 6.6.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.7

1. Connect the EUT through cable and divide with CMW 270 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 7.
4. Span: two or five times of OBW
5. RBW= 1% to 5% of the OBW; VBW is approximately three times of RBW; Max Hold.
6. Select the max peak, and N DB DOWN=20dB.
7. Record the results.

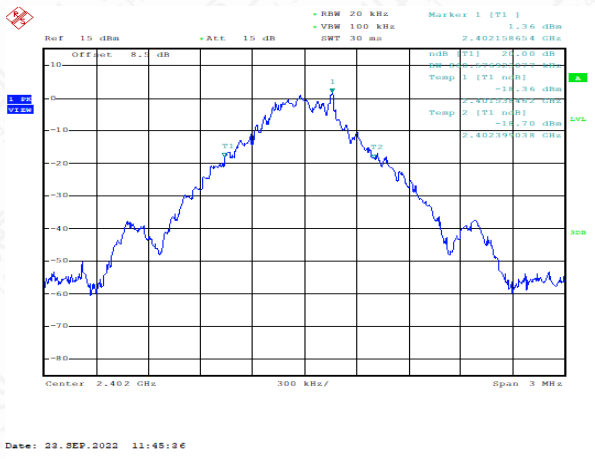
### 6.6.3 Test Setup



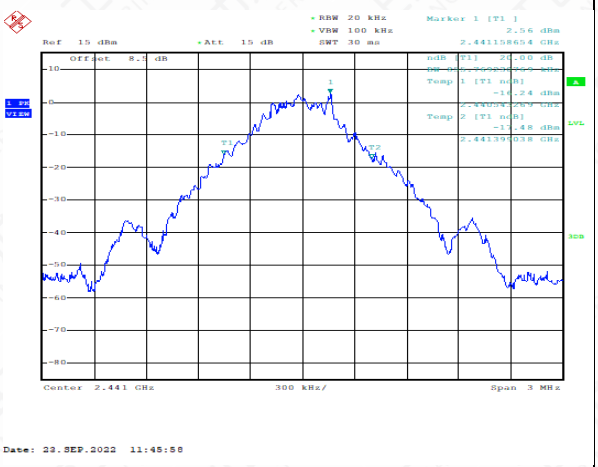
**Measurement Result**

| Modulation type | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---|---|---|
| GFSK DH5 | 2402 | 0.860 |
| | 2441 | 0.855 |
| | 2480 | 0.860 |
| π/4 DQPSK 2DH5 | 2402 | 1.250 |
| | 2441 | 1.221 |
| | 2480 | 1.250 |
| 8DPSK 3DH5 | 2402 | 1.264 |
| | 2441 | 1.269 |
| | 2480 | 1.269 |

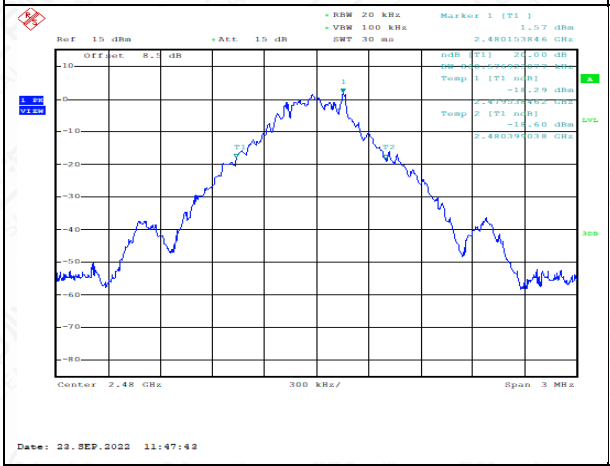
20dB Bandwidth: GFSK, Ch0



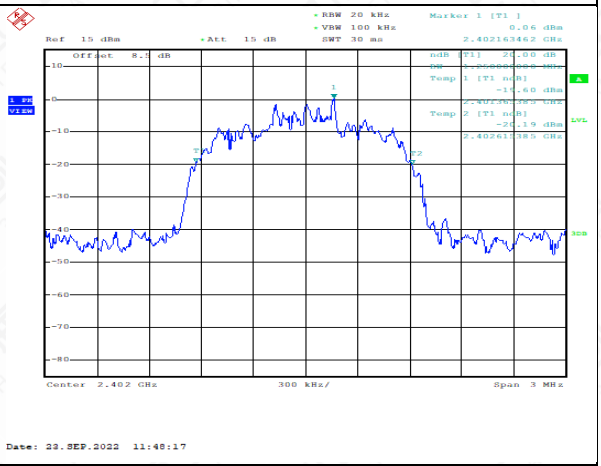

20dB Bandwidth: GFSK, Ch39

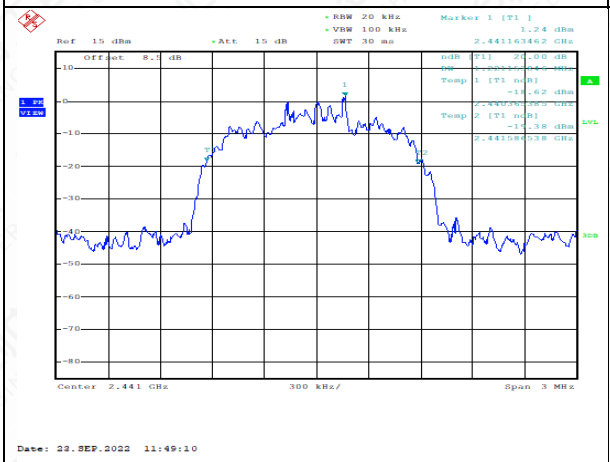
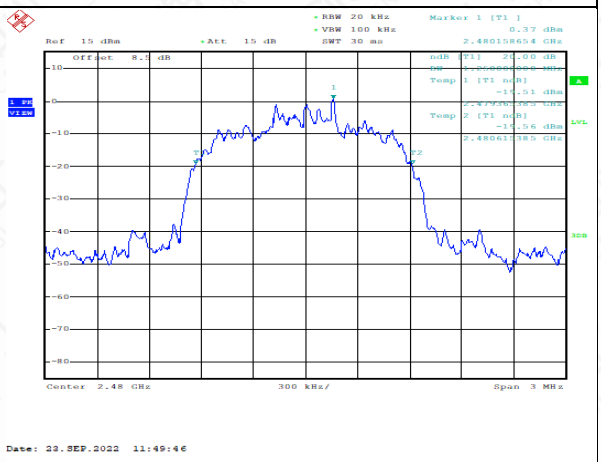
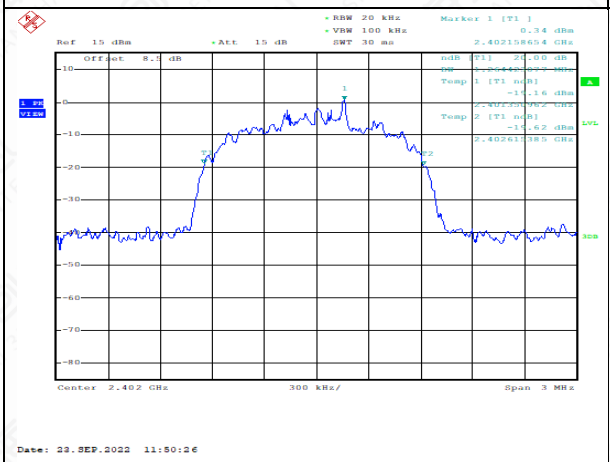
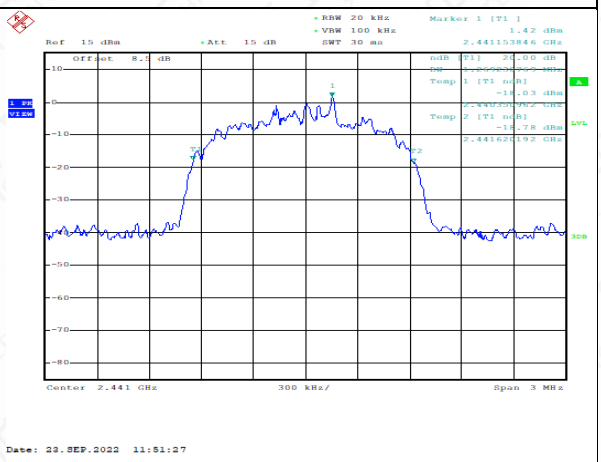
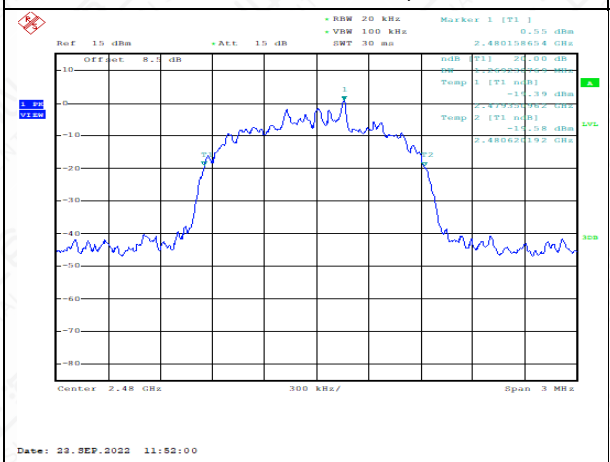



20dB Bandwidth: GFSK, Ch78




20dB Bandwidth: π/4 DQPSK, Ch0



| 20dB Bandwidth: π/4 DQPSK, Ch39 | 20dB Bandwidth: π/4 DQPSK, Ch78 |
|---|---|
|  |  |
| 20dB Bandwidth: 8DPSK, Ch0 | 20dB Bandwidth: 8DPSK, Ch39 |
|  |  |
| 20dB Bandwidth: 8DPSK, Ch78 | / |
|  | / |

## 6.7 99% Occupied Bandwidth

### 6.7.1 Measurement Limit

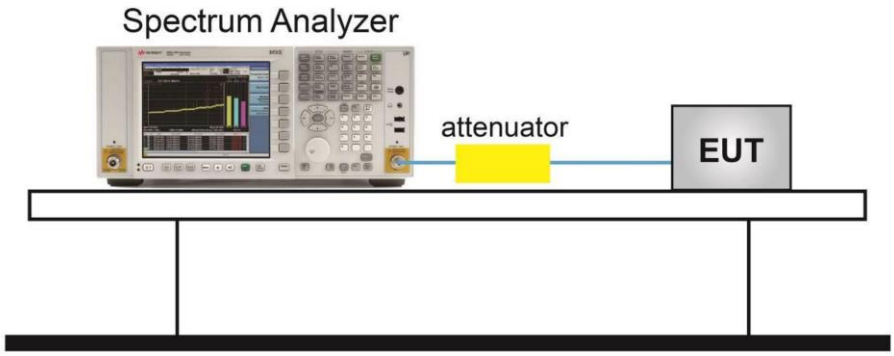
| Standard | Limit |
|---|---|
| N/A | N/A |

### 6.7.2 Test procedures

The measurement is according to ANSI C63.10 clause 6.9.3.

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Set RBW shall be in the range of 1% to 5% of the OBW.
4. Set the VBW ≥ [3 × RBW].
5. Detector = peak.
6. Trace mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize.
9. 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.

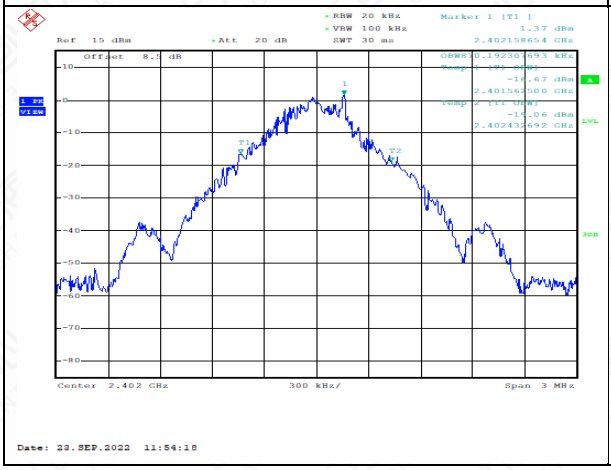
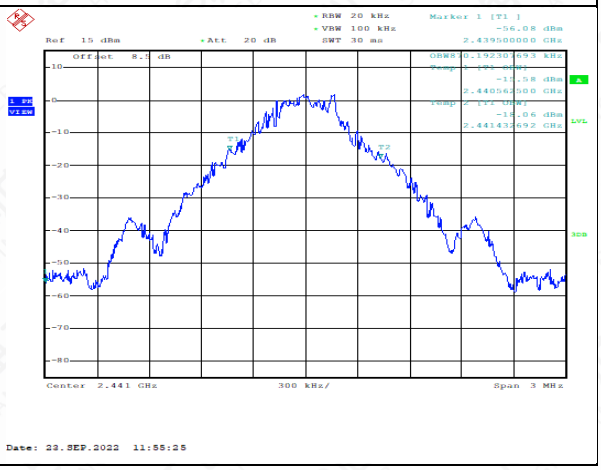
### 6.7.3 Test setup



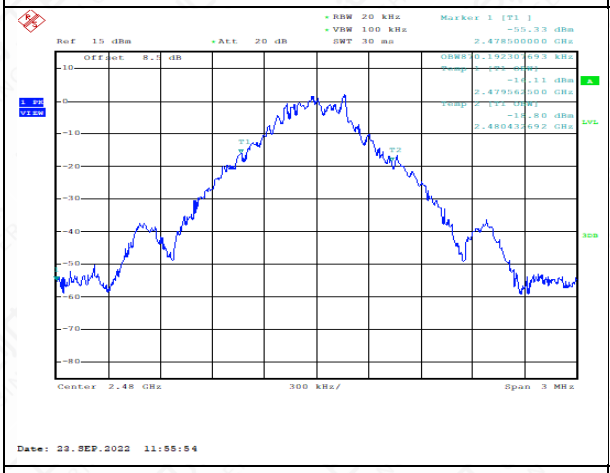
**Measurement Result**

| Modulation type | Channel | 99% Bandwidth (MHz) |
|---|---|---|
| GFSK DH5 | 2402 | 0.870 |
| | 2441 | 0.870 |
| | 2480 | 0.870 |
| π/4 DQPSK 2DH5 | 2402 | 1.158 |
| | 2441 | 1.153 |
| | 2480 | 1.158 |
| 8DPSK 3DH5 | 2402 | 1.201 |
| | 2441 | 1.192 |
| | 2480 | 1.187 |

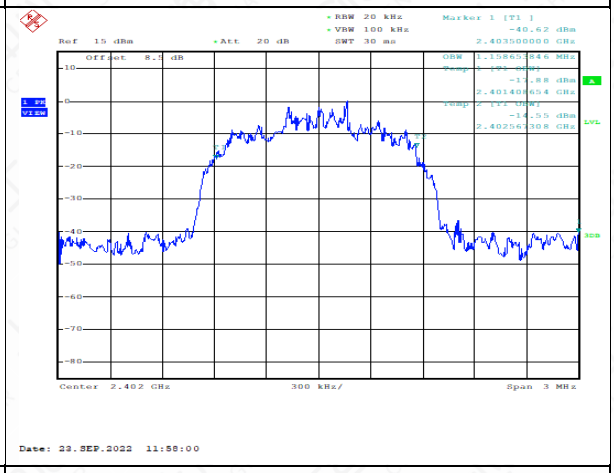
Test graphs as below

| 99% Bandwidth: GFSK, Ch0 | 99% Bandwidth: GFSK, Ch39 |
|---|---|
|  |  |

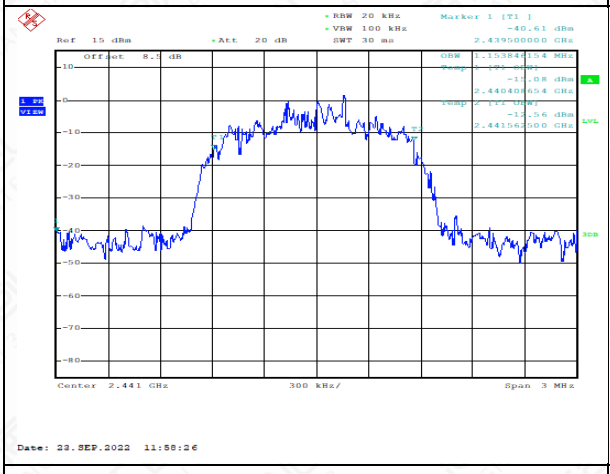
99% Bandwidth: GFSK, Ch78



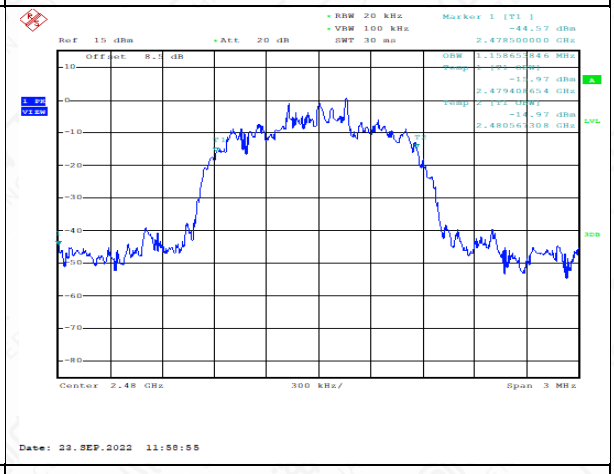

99% Bandwidth: DQPSK, Ch0



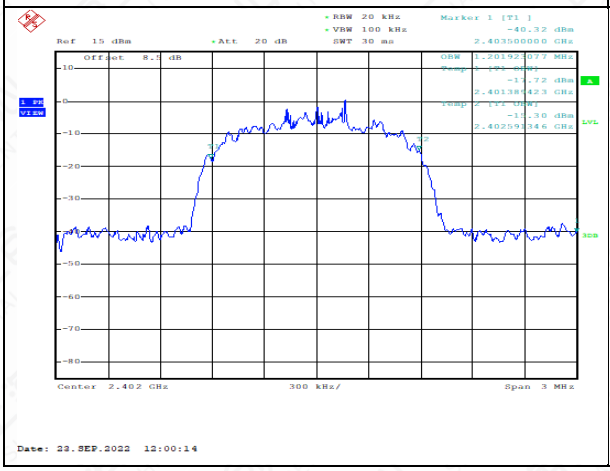

99% Bandwidth: DQPSK, Ch39



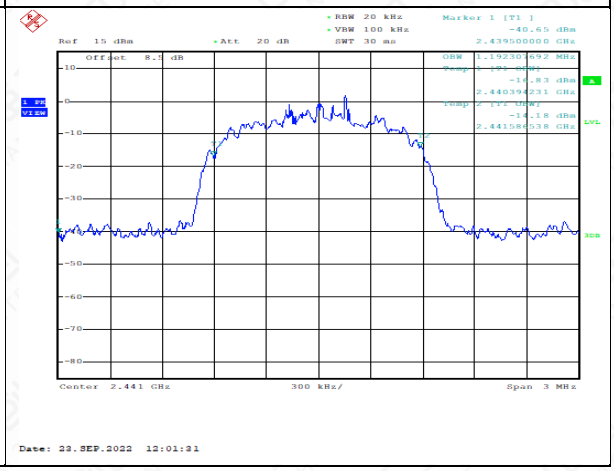

99% Bandwidth: DQPSK, Ch78

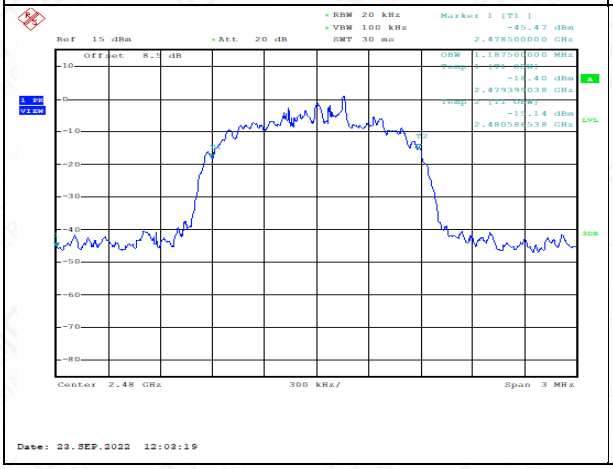



99% Bandwidth: 8DPSK, Ch0




99% Bandwidth: 8DPSK, Ch39



| 99% Bandwidth: 8DPSK, Ch78 | / |
| --- | --- |
|  | / |

## 6.8 Carrier Frequency Separation

6.8.1 Measurement Limit

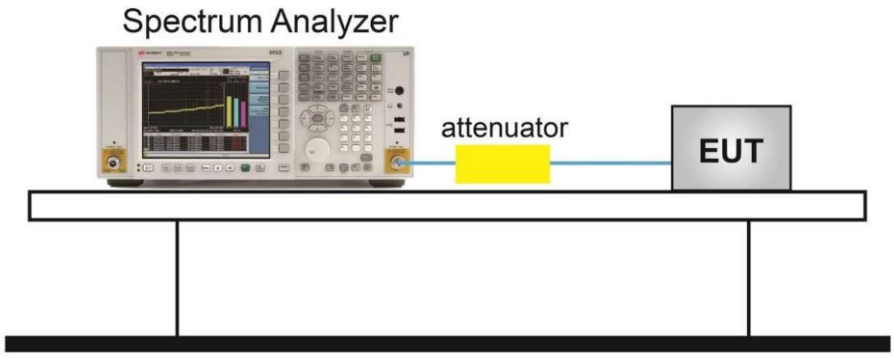
| Standard | Limit(KHz) |
|---|---|
| FCC 47 Part 15.247 (a) (1) | Over 25KHz or (2/3)*20dB bandwidth |

6.8.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.2.

1. Connect the EUT through cable and divide with CBT32 and spectrum analyzer.
2. Enable the EUT transmit in hopping mode.
3. Span: Wide enough to capture the peaks of two adjacent channels.
4. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
5. Video (or average) bandwidth (VBW) ≥ RBW.
6. Sweep: Auto.
7. Detector function: Peak.
8. Trace: Max hold.
9. Allow the trace to stabilize.S

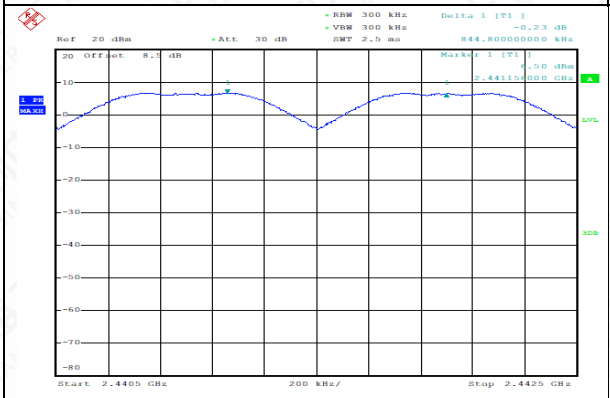
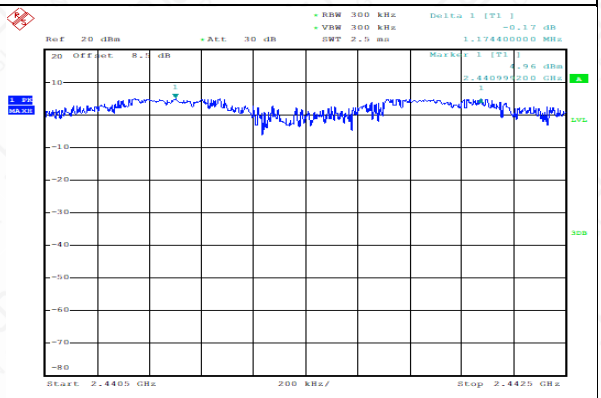
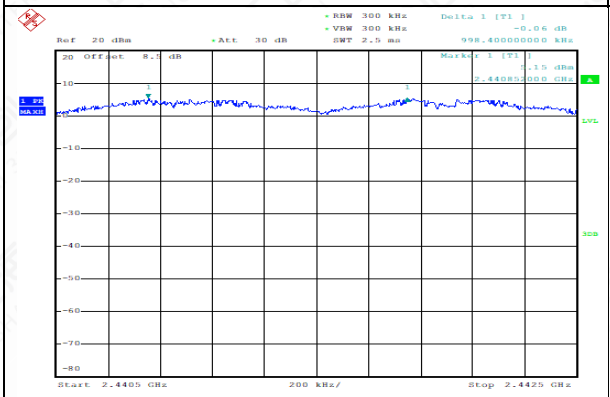
6.8.3 Test Setup




**Measurement Result**

| Modulation type | Frequency (MHz) | Carrier separation measurement (KHz) |
|---|---|---|
| GFSK DH5 | 2441 | 844.8 |
| π/4 DQPSK 2DH5 | 2441 | 1174.4 |

| | | |
|---|---|---|
| 8DPSK 3DH5 | 2441 | 998.4 |

| Carrier separation measurement: GFSK, Ch39 | Carrier separation measurement: π/4 DQPSK, Ch39 |
|---|---|
|  |  |
| Carrier separation measurement: 8DPSK, Ch39 | / |
|  | / |

## 6.9 Number Of Hopping Channels

### 6.9.1 Measurement Limit

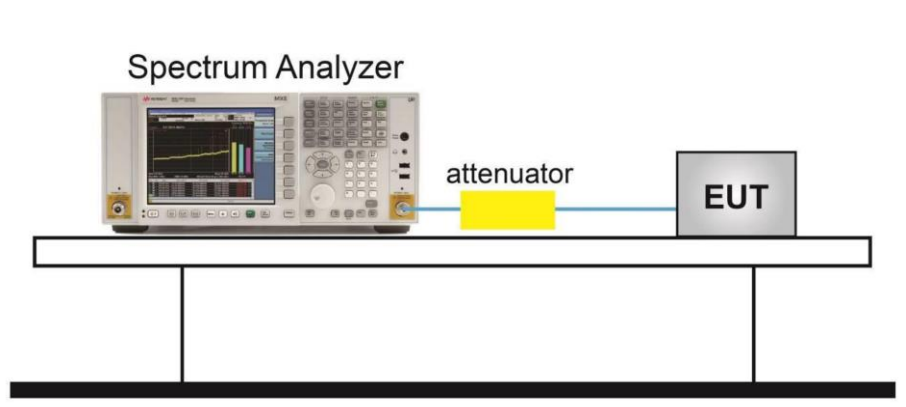
| Standard | Limit |
|---|---|
| FCC 47 CFR Part 15.247 (a)(1)(iii) | At least 15 non-overlapping channels |

### 6.9.2 Test procedure

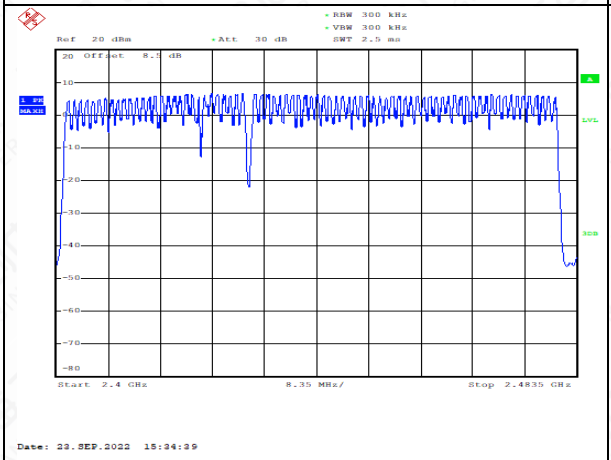
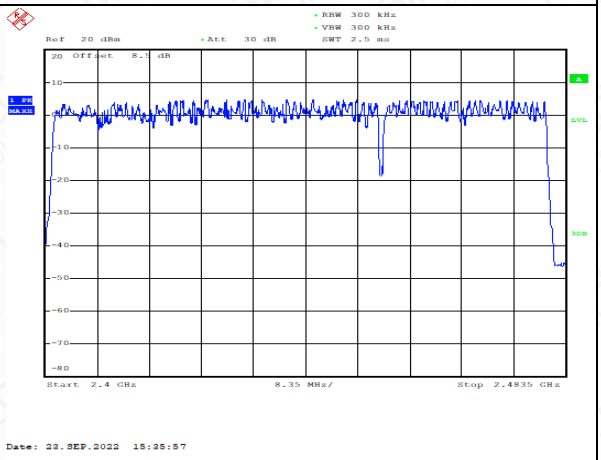
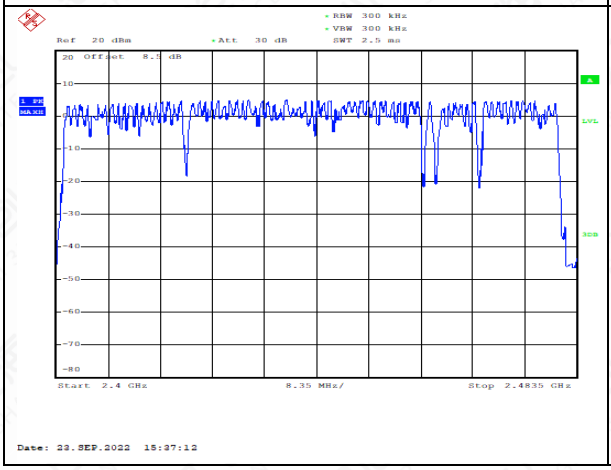
The measurement is according to ANSI C63.10 clause 7.8.3.

1. Connect the EUT through cable and divide with CMW 270 and spectrum analyzer.
2. Enable the EUT transmit in hopping mode.
3. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
4. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
5. VBW ≥ RBW.
6. Sweep: Auto.
7. Detector function: Peak.
8. Trace: Max hold.
9. Allow the trace to stabilize.
10. Record the test results.

### 6.9.3 Test Setup



**Measurement Result**

| Number of hopping frequency GFSK Ch0~78:79 | Number of hopping frequency π/4 DQPSK Ch0~78:79 |
|---|---|
|  |  |
| Number of hopping frequency 8DPSK Ch0~78:79 | |
|  | |

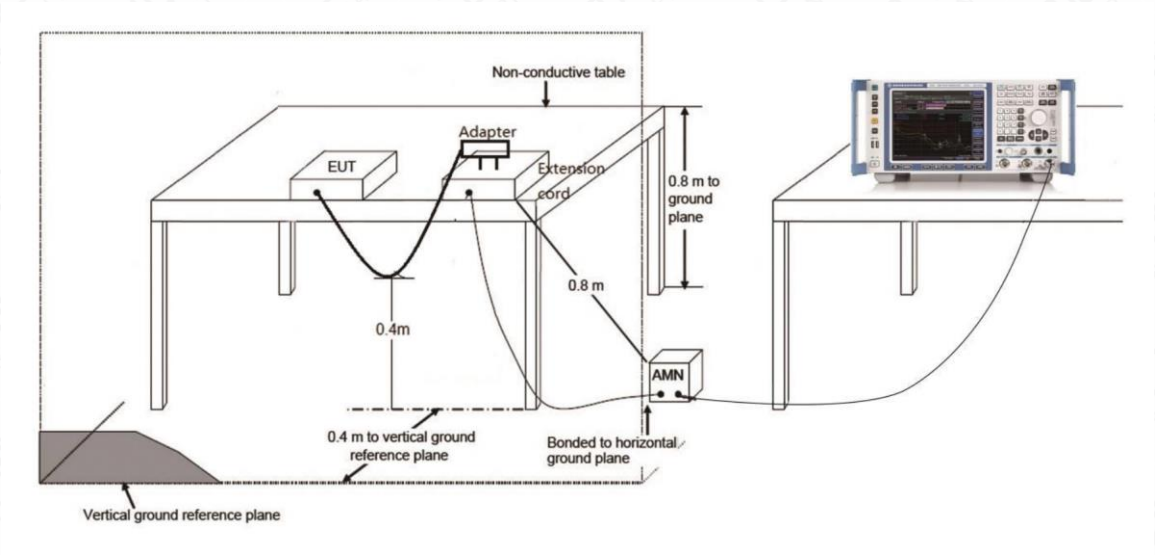
## 6.10 AC Powerline Conducted Emission

6.10.1 Method of Measurement: ANSI C63.10-2013-clause 6.2

1. The one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT.
2. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed.
3. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation.
4. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.36 Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

6.10.2 Test Setup



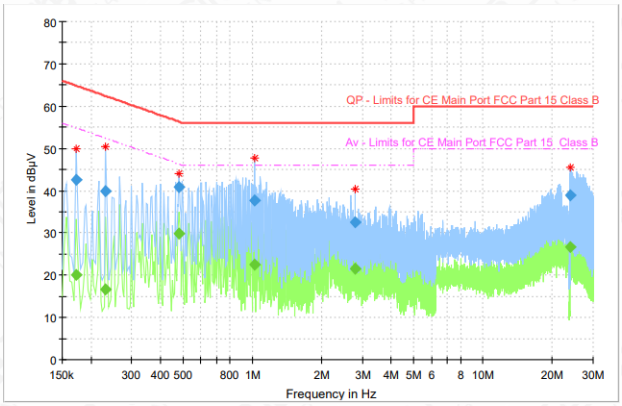

6.10.3 Test Condition

| Voltage（V） | Frequency（Hz） |
|---|---|
| 120 | 60 |

Measurement Result and limit
(Quasi-peak-average Limit)

| Frequency range (MHz) | Quasi-peak Limit (dBμV) | Average Limit (dBμV) | Conclusion |
|---|---|---|---|
| 0.15 to 0.5 | 66 to 56 | 56 to 46 | P |
| 0.5 to 5 | 56 | 46 | |
| 5 to 30 | 60 | 50 | |
| NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz. | | | |

Mainly Supply

| CA02 | / |
|---|---|
|  | / |



**CA02**

| Frequency (MHz) | QuasiPeak (dBµV) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 0.172388 | --- | 20.15 | 54.85 | 34.69 | 15000.0 | 9.000 | L1 | ON | 9.6 |
| 0.172388 | 42.59 | --- | 64.85 | 22.26 | 15000.0 | 9.000 | L1 | ON | 9.6 |
| 0.232088 | --- | 16.53 | 52.38 | 35.84 | 15000.0 | 9.000 | N | ON | 6.2 |
| 0.232088 | 39.90 | --- | 62.38 | 22.47 | 15000.0 | 9.000 | N | ON | 6.2 |
| 0.482081 | 40.97 | --- | 56.30 | 15.33 | 15000.0 | 9.000 | L1 | ON | 9.6 |
| 0.482081 | --- | 29.79 | 46.30 | 16.51 | 15000.0 | 9.000 | L1 | ON | 9.6 |
| 1.023113 | 37.63 | --- | 56.00 | 18.37 | 15000.0 | 9.000 | L1 | ON | 9.6 |
| 1.023113 | --- | 22.45 | 46.00 | 23.55 | 15000.0 | 9.000 | L1 | ON | 9.6 |
| 2.802919 | --- | 21.45 | 46.00 | 24.55 | 15000.0 | 9.000 | N | ON | 9.7 |
| 2.802919 | 32.65 | --- | 56.00 | 23.35 | 15000.0 | 9.000 | N | ON | 9.7 |
| 23.906869 | --- | 26.66 | 50.00 | 23.34 | 15000.0 | 9.000 | N | ON | 10.2 |
| 23.906869 | 38.84 | --- | 60.00 | 21.16 | 15000.0 | 9.000 | N | ON | 10.2 |

# Annex A: Revised History

| Version | Revised Content |
|---|---|
| V00 | Initial |

## Annex B: Accreditation Certificate

Accredited Laboratory

A2LA has accredited

INDUSTRIAL INTERNET INNOVATION CENTER (SHANGHAI) CO., LTD.

*Shanghai, People's Republic of China*

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 12th day of April 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3682.01
Valid to February 28, 2023

*For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.*

**END OF REPORT**