

FCC TEST REPORT

FCC ID: 2A16IHV-FM25

Product : BLUETOOTH CAR MP3 MODULATOR

Model Name : HV-FM25,HV-FM201BT,HV-FM202BT,HV-FM203BT,HV-FM205BT,HV-FM206BT,HV-FM207BT,HV-FM208BT,HV-FM209BT,HV-FM210BT

Brand : HAVIT

Report No. : PTC801712160722E-FC01

Prepared for

Guangzhou Havit Technology Co.,LTD
ROOM 1307,13F,PHASE 2(B,C BUILDING) OF POLY WORLD TRADE CENTER,NO.1000,
XINGANG EAST ROAD,HAIZHU DISTRICT,GUANGZHOU,GUANGDONG,China

Prepared by

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TEST RESULT CERTIFICATION

Applicant's name : Guangzhou Havit Technology Co.,LTD

Address : ROOM 1307,13F,PHASE 2(B,C BUILDING) OF POLY WORLD TRADE CENTER,NO.1000, XINGANG EAST ROAD,HAIZHU DISTRICT,GUANGZHOU, GUANGDONG, China

Manufacture's name : Guangzhou Havit Technology Co.,LTD

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Product name : BLUETOOTH CAR MP3 MODULATOR

Model name : HV-FM25,HV-FM201BT,HV-FM202BT,HV-FM203BT,HV-FM205BT,HV-FM206BT,HV-FM207BT,HV-FM208BT,HV-FM209BT,HV-FM210BT

Standards : FCC CFR47 Part 15 Section 15.247

Test procedure : ANSI C63.10:2013,DA 00-705

Test Date : Jul. 29, 2016 ~Aug. 22, 2016

Date of Issue : Aug.24, 2016

Test Result : Pass

This device described above has been tested by PTC, and 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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2 Test Summary

| Test Items | Test Requirement | Result |
|-----------------------------|----------------------------------|--------|
| Radiated Spurious Emissions | 15.205(a) 15.209 15.247(d) | PASS |
| Band edge | 15.247(d) 15.205(a) | PASS |
| Conduct Emission | 15.207 | N/A |
| 20dB Bandwidth | 15.247(a)(1) | PASS |
| MaximumPeak Output Power | 15.247(b)(1) | PASS |
| Frequency Separation | 15.247(a)(1) | PASS |
| Number of Hopping Frequency | 15.247(a)(1)(iii) | PASS |
| Dwell time | 15.247(a)(1)(iii) | PASS |
| Antenna Requirement | 15.203 | PASS |

Remark:

N/A: Not Applicable



3 General Information

3.1 General Description of E.U.T

| | | |
|-----------------------|---|------------------------------------------------------------------------------------------------------------|
| Product Name | : | BLUETOOTH CAR MP3 MODULATOR |
| Model Name | : | HV-FM25,HV-FM201BT,HV-FM202BT,HV-FM203BT,HV-FM205BT,HV-FM206BT,HV-FM207BT,HV-FM208BT,HV-FM209BT,HV-FM210BT |
| Model Description | : | Just the model names and colors are different. |
| Bluetooth Version | : | V4.0(With BLE) |
| Operating frequency | : | 2402-2480MHz,79channels |
| Antenna installation: | : | PCB printed Antenna |
| Antenna Gain: | : | 0dBi |
| The BT oscillator: | : | 40MkHz |
| Type of Modulation | : | GFSK, Pi/4DQPSK, 8DPSK |
| Power supply | : | DC 12V |



3.2 Channel List

| BT | | | | | | | |
|---------|-----------------|---------|-----------------|---------|-----------------|---------|-----------------|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 0 | 2402 | 1 | 2403 | 2 | 2404 | 3 | 2405 |
| 4 | 2406 | 5 | 2407 | 6 | 2408 | 7 | 2409 |
| 8 | 2410 | 9 | 2411 | 10 | 2412 | 11 | 2413 |
| 12 | 2414 | 13 | 2415 | 14 | 2416 | 15 | 2417 |
| 16 | 2418 | 17 | 2419 | 18 | 2420 | 19 | 2421 |
| 20 | 2422 | 21 | 2423 | 22 | 2424 | 23 | 2425 |
| 24 | 2426 | 25 | 2427 | 26 | 2428 | 27 | 2429 |
| 28 | 2430 | 29 | 2431 | 30 | 2432 | 31 | 2433 |
| 32 | 2434 | 33 | 2435 | 34 | 2436 | 35 | 2437 |
| 36 | 2438 | 37 | 2439 | 38 | 2440 | 39 | 2441 |
| 40 | 2442 | 41 | 2443 | 42 | 2444 | 43 | 2445 |
| 44 | 2446 | 45 | 2447 | 46 | 2448 | 47 | 2449 |
| 48 | 2450 | 49 | 2451 | 50 | 2452 | 51 | 2453 |
| 52 | 2454 | 53 | 2455 | 54 | 2456 | 55 | 2457 |
| 56 | 2458 | 57 | 2459 | 58 | 2460 | 59 | 2461 |
| 60 | 2462 | 61 | 2463 | 62 | 2464 | 63 | 2465 |
| 64 | 2466 | 65 | 2467 | 66 | 2468 | 67 | 2469 |
| 68 | 2470 | 69 | 2471 | 70 | 2472 | 71 | 2473 |
| 72 | 2474 | 73 | 2475 | 74 | 2476 | 75 | 2477 |
| 76 | 2478 | 77 | 2479 | 78 | 2480 | - | - |

3.3 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

| Test mode | Low channel | Middle channel | High channel |
|------------------------------------------------|------------------|----------------|--------------|
| Transmitting | 2402MHz | 2441MHz | 2480MHz |
| Hopping | 2402-2480MHz | | |
| Tests Carried Out Under FCC part 15.207&15.209 | | | |
| Test Item | Test Mode | | |
| Conduction Emission, 0.15MHz to 30MHz | BT Communication | | |
| Radiated Emission, 30M-1GHz | BT Communication | | |



3.4 Test Voltage

| Normal Test Voltage | Item |
|---------------------|--------------------|
| DC 12V | Conducted Emission |
| DC 12V | Radiated Emission |
| Remark: N/A | |



4 Equipment During Test

4.1 Equipments List

| RF Conducted Test | | | | | | | |
|---------------------|---------------------------|---------------|-----------|--------------------------------|------------------|------------------|--------------------|
| Item | Kind of Equipment | Manufacturer | Type No. | Serial No. | Last calibration | Calibrated until | Calibration period |
| 1 | EMC Analyzer (9k~26.5GHz) | Agilent | E4407B | MY45109572 | July 15, 2016 | July 14, 2017 | 1 year |
| 2 | EXA Signal Analyzer | Keysight | N9010A | MY50520207 526B25MPB W7X | July 15, 2016 | July 14, 2017 | 1 year |
| 3 | EMI Test Receiver | R&S | ESCI | 101155 | July 15, 2016 | July 14, 2017 | 1 year |
| Radiated Emissions | | | | | | | |
| Item | Kind of Equipment | Manufacturer | Type No. | Serial No. | Last calibration | Calibrated until | Calibration period |
| 1 | EMI Test Receiver | Rohde&Schwarz | ESCI | 101417 | July 15, 2016 | July 14, 2017 | 1 year |
| 2 | Trilog Broadband Antenna | SCHWARZECK | VULB9160 | 9160-3355 | July 15, 2016 | July 14, 2017 | 1 year |
| 3 | Amplifier | EM | EM-30180 | 060538 | July 15, 2016 | July 14, 2017 | 1 year |
| 4 | Horn Antenna | SCHWARZECK | BBHA9120D | 9120D-1246 | July 15, 2016 | July 14, 2017 | 1 year |
| 5 | Loop Antenna | SCHWARZECK | FMZB1516 | 9130D-1243 | July 15, 2016 | July 14, 2017 | 1 year |
| Conducted Emissions | | | | | | | |
| Item | Kind of Equipment | Manufacturer | Type No. | Serial No. | Last calibration | Calibrated until | Calibration period |
| 1 | EMI Test Receiver | R&S | ESCI | 101155 | July 15, 2016 | July 14, 2017 | 1 year |
| 2 | LISN | SCHWARZECK | NSLK 8128 | 8128-289 | July 15, 2016 | July 14, 2017 | 1 year |
| 3 | Cable | LARGE | RF300 | - | July 15, 2016 | July 14, 2017 | 1 year |



4.2 Measurement Uncertainty

| Parameter | Uncertainty |
|-----------------------------------|--------------------------|
| RF output power, conducted | ±1.0dB |
| Power Spectral Density, conducted | ±2.2dB |
| Radio Frequency | ± 1 x 10 ⁻⁶ |
| Bandwidth | ± 1.5 x 10 ⁻⁶ |
| Time | ±2% |
| Duty Cycle | ±2% |
| Temperature | ±1°C |
| Humidity | ±5% |
| DC and low frequency voltages | ±3% |
| Conducted Emissions(150kHz~30MHz) | ±3.64dB |
| Radiated Emission(30MHz~1GHz) | ±5.03dB |
| Radiated Emission(1GHz~25GHz) | ±4.74dB |



5 Radiated Spurious Emissions

Test Requirement: : FCC CFR47 Part 15 Section 15.209 & 15.247
 Test Method: : ANSI C63.10:2013,DA 00-705
 Test Result: : PASS
 Measurement Distance: : 3m
 Limit: : See the follow table

| Frequency (MHz) | Field Strength | | Field Strength Limit at 3m Measurement Dist | |
|-----------------|-----------------------|--------------|---------------------------------------------|---------------------------------------|
| | uV/m | Distance (m) | uV/m | dBuV/m |
| 0.009 ~ 0.490 | $2400/F(\text{kHz})$ | 300 | $10000 * 2400/F(\text{kHz})$ | $20\log^{(2400/F(\text{kHz}))} + 80$ |
| 0.490 ~ 1.705 | $24000/F(\text{kHz})$ | 30 | $100 * 24000/F(\text{kHz})$ | $20\log^{(24000/F(\text{kHz}))} + 40$ |
| 1.705 ~ 30 | 30 | 30 | $100 * 30$ | $20\log^{(30)} + 40$ |
| 30 ~ 88 | 100 | 3 | 100 | $20\log^{(100)}$ |
| 88 ~ 216 | 150 | 3 | 150 | $20\log^{(150)}$ |
| 216 ~ 960 | 200 | 3 | 200 | $20\log^{(200)}$ |
| Above 960 | 500 | 3 | 500 | $20\log^{(500)}$ |

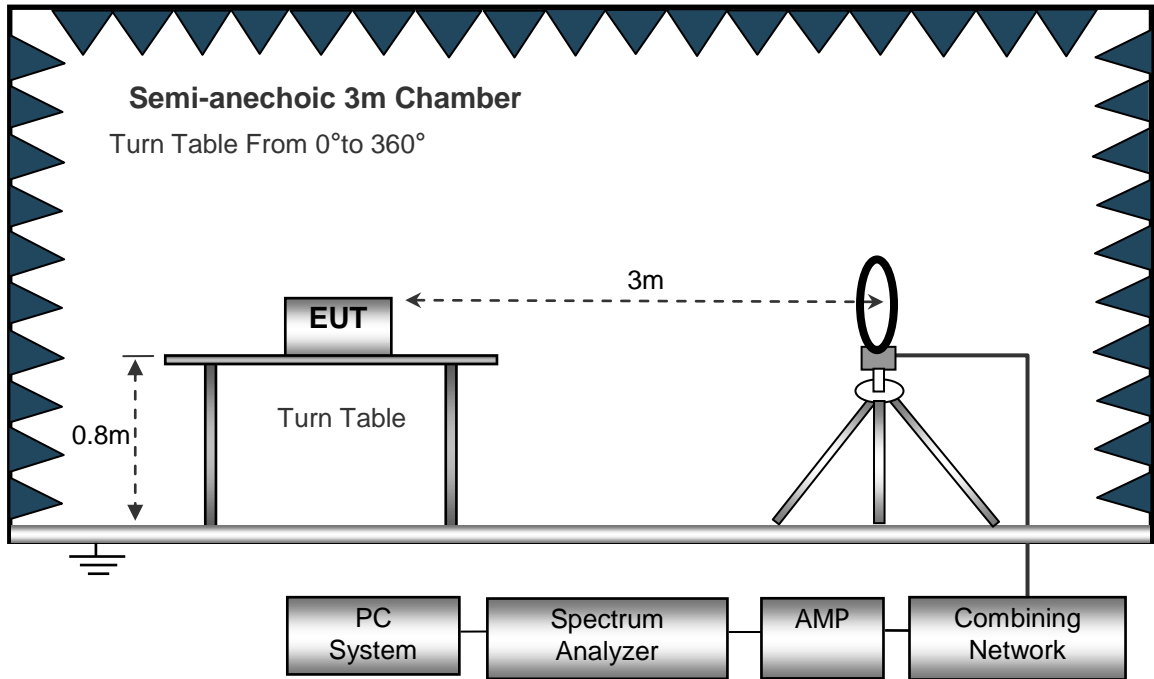
5.1 EUT Operation

Operating Environment :
 Temperature: : 23.5 °C
 Humidity: : 51.1 % RH
 Atmospheric Pressure: : 101.2kPa
 EUT Operation : : Refer to section 3.3

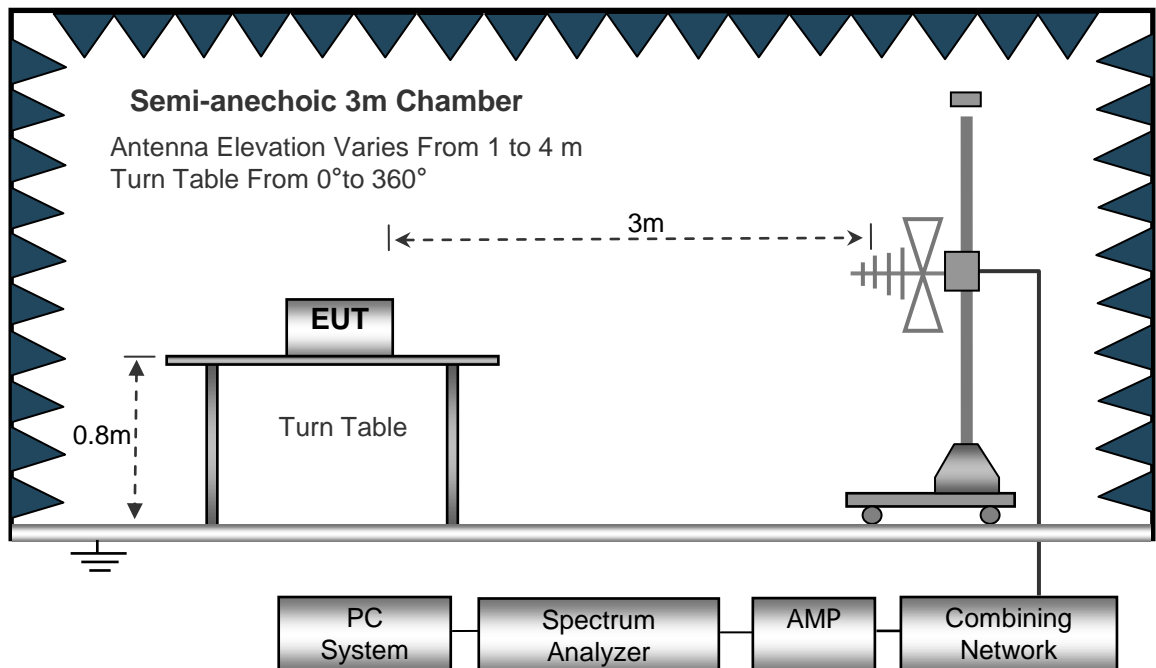
5.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

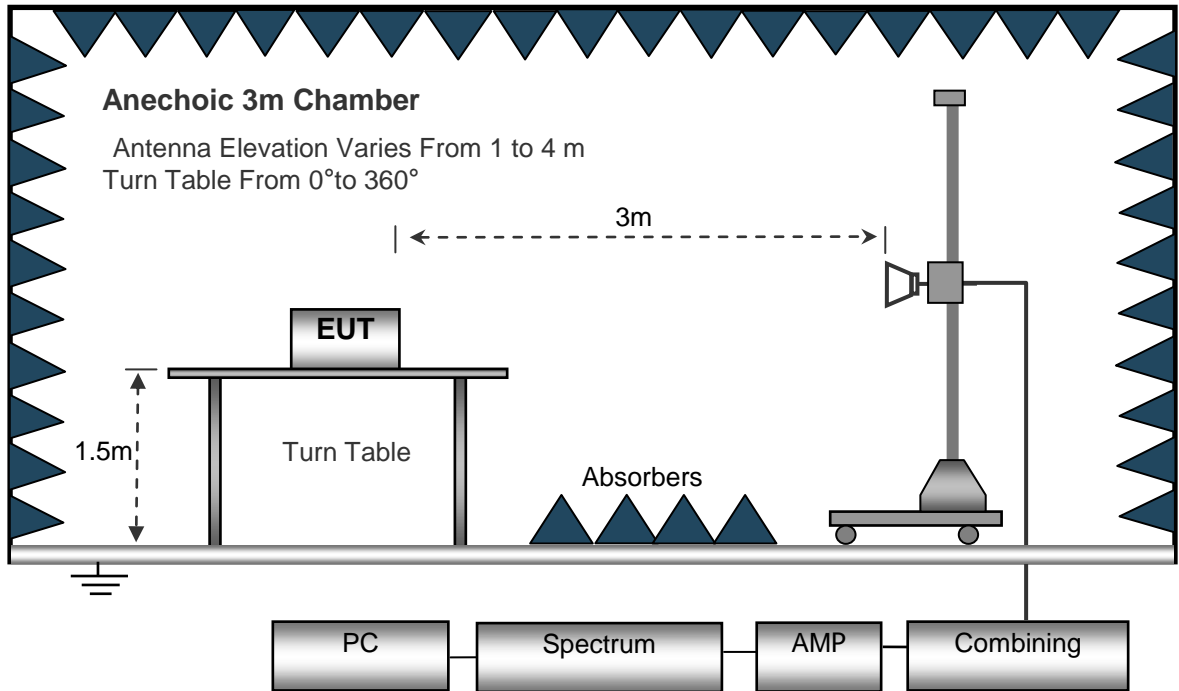
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



5.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed..... Auto
 IF Bandwidth.....10kHz
 Video Bandwidth10kHz
 Resolution Bandwidth10kHz

30MHz ~ 1GHz

Sweep Speed..... Auto
 Detector.....PK
 Resolution Bandwidth100kHz
 Video Bandwidth300kHz

Above 1GHz

Sweep Speed..... Auto
 Detector.....PK
 Resolution Bandwidth1MHz
 Video Bandwidth3MHz
 Detector.....Ave.
 Resolution Bandwidth1MHz
 Video Bandwidth10Hz



5.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.



5.5 Summary of Test Results

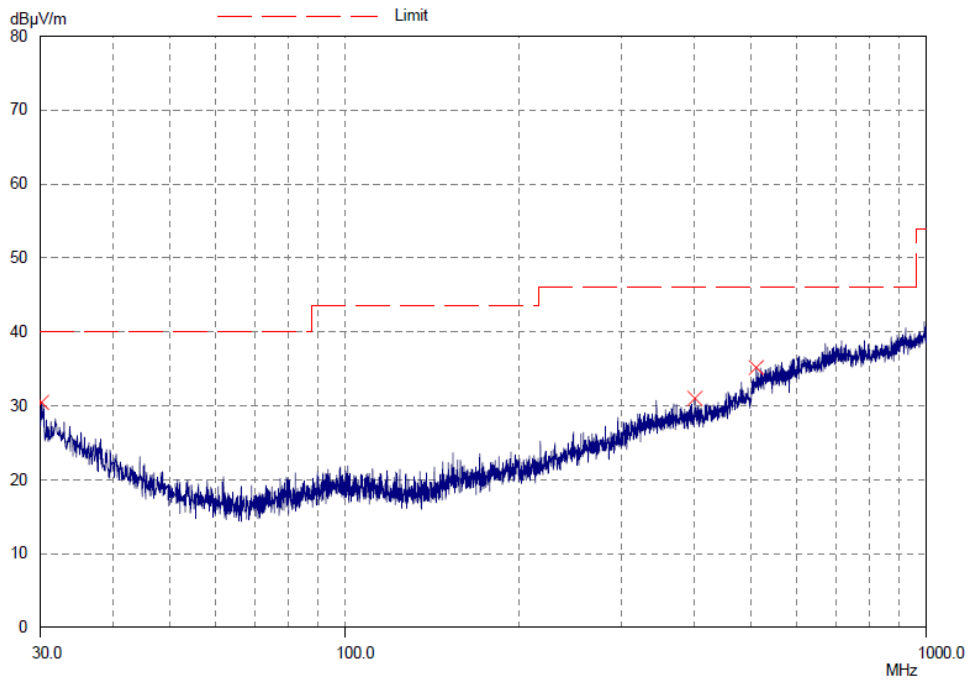
Test Frequency: Below 30MHz

The measurements were more than 30 dB below the limit and not reported.

Test Frequency: 30MHz ~ 1GHz

Note: the data display worst case mode with GFSK 2402MHz

Antenna Polarization: Horizontal



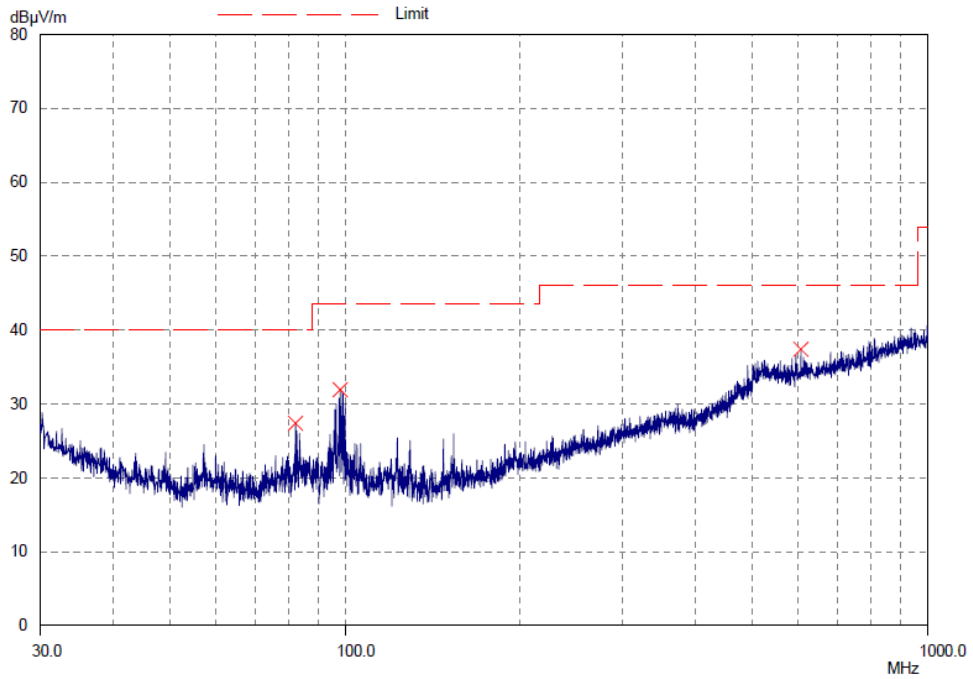
Peak Search Results

| Frequency MHz | QP Level dBµV/m | QP Limit dBµV/m | QP Delta dB |
|------------------|--------------------|--------------------|----------------|
| 30.125 | 30.40 | 40.00 | 9.60 |
| 400.4375 | 31.10 | 46.00 | 14.90 |
| 510.5625 | 35.10 | 46.00 | 10.90 |

| Frequency MHz | Level dBµV/m | Limit dBµV/m | Delta dB |
|------------------|-----------------|-----------------|-------------|
|------------------|-----------------|-----------------|-------------|



Antenna Polarization: Vertical



Peak Search Results

| Frequency MHz | QP Level dBµV/m | QP Limit dBµV/m | QP Delta dB |
|------------------|--------------------|--------------------|----------------|
| 82.1875 | 27.30 | 40.00 | 12.70 |
| 98.125 | 31.90 | 43.50 | 11.60 |
| 605.875 | 37.40 | 46.00 | 8.60 |

| Frequency MHz | Level dBµV/m | Limit dBµV/m | Delta dB |
|------------------|-----------------|-----------------|-------------|
|------------------|-----------------|-----------------|-------------|



Test Frequency: 1GHz ~ 18GHz

| Frequency | Receiver Reading | Detector | Corrected Factor | Corrected Amplitude | Limit | Margin |
|-------------------------------------------------------------|------------------|-------------|------------------|---------------------|----------|--------|
| (MHz) | (dBμV) | (PK/QP/Ave) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK Low Channel | | | | | | |
| Harmonic& Spurious Emission | | | | | | |
| 1144.27 | 51.44 | PK | -19.54 | 31.9 | 74 | -42.1 |
| 1144.27 | 48.67 | Ave | -19.54 | 29.13 | 54 | -24.87 |
| 4804.00 | 56.52 | PK | -1.06 | 55.46 | 74 | -18.54 |
| 4804.00 | 43.81 | Ave | -1.06 | 42.75 | 54 | -11.25 |
| 7206.00 | 57.94 | PK | 1.33 | 59.27 | 74 | -14.73 |
| 7206.00 | 49.66 | Ave | 1.33 | 50.99 | 54 | -3.01 |
| Restricted bands Emission | | | | | | |
| 2309.11 | 55.35 | PK | -13.19 | 42.16 | 74 | -31.84 |
| 2309.11 | 49.88 | Ave | -13.19 | 36.69 | 54 | -17.31 |
| 2390.00 | 52.65 | PK | -13.14 | 39.51 | 74 | -34.49 |
| 2390.00 | 49.34 | Ave | -13.14 | 36.2 | 54 | -17.8 |
| 2496.13 | 54.19 | PK | -13.08 | 41.11 | 74 | -32.89 |
| 2496.13 | 48.25 | Ave | -13.08 | 35.17 | 54 | -18.83 |
| Remark: | | | | | | |
| 1. Corrected Factor=ANT Factor + Cable Loss – Amp Gain | | | | | | |
| 2. The data display worst state in the horizontal direction | | | | | | |



| Frequency | Receiver Reading | Detector | Corrected Factor | Corrected Amplitude | Limit | Margin |
|-------------------------------------------------------------|------------------|-------------|------------------|---------------------|----------|--------|
| (MHz) | (dBμV) | (PK/QP/Ave) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK Middle Channel | | | | | | |
| Harmonic& Spurious Emission | | | | | | |
| 1146.37 | 55.69 | PK | -19.54 | 36.15 | 74 | -37.85 |
| 1146.37 | 42.65 | Ave | -19.54 | 23.11 | 54 | -30.89 |
| 4882.00 | 57.68 | PK | -0.93 | 56.75 | 74 | -17.25 |
| 4882.00 | 42.68 | Ave | -0.93 | 41.75 | 54 | -12.25 |
| 7323.00 | 57.11 | PK | 1.67 | 58.78 | 74 | -15.22 |
| 7323.00 | 42.59 | Ave | 1.67 | 44.26 | 54 | -9.74 |
| Restricted bands Emission | | | | | | |
| 2309.58 | 55.46 | PK | -13.19 | 42.27 | 74 | -31.73 |
| 2309.58 | 48.28 | Ave | -13.19 | 35.09 | 54 | -18.91 |
| 2365.32 | 52.34 | PK | -13.14 | 39.2 | 74 | -34.8 |
| 2365.32 | 48.51 | Ave | -13.14 | 35.37 | 54 | -18.63 |
| 2485.11 | 55.67 | PK | -13.08 | 42.59 | 74 | -31.41 |
| 2485.11 | 48.89 | Ave | -13.08 | 35.81 | 54 | -18.19 |
| Remark: | | | | | | |
| 1. Corrected Factor=ANT Factor + Cable Loss – Amp Gain | | | | | | |
| 2. The data display worst state in the horizontal direction | | | | | | |



| Frequency | Receiver Reading | Detector | Corrected Factor | Corrected Amplitude | Limit | Margin |
|-------------------------------------------------------------|------------------|-------------|------------------|---------------------|----------|--------|
| (MHz) | (dBμV) | (PK/QP/Ave) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| GFSK High Channel | | | | | | |
| Harmonic& Spurious Emission | | | | | | |
| 1150.36 | 56.23 | PK | -19.54 | 36.69 | 74 | -37.31 |
| 1150.36 | 42.55 | Ave | -19.54 | 23.01 | 54 | -30.99 |
| 4960.00 | 57.12 | PK | -0.87 | 56.25 | 74 | -17.75 |
| 4960.00 | 41.88 | Ave | -0.87 | 41.01 | 54 | -12.99 |
| 7440.00 | 56.97 | PK | 1.84 | 58.81 | 74 | -15.19 |
| 7440.00 | 41.33 | Ave | 1.84 | 43.17 | 54 | -10.83 |
| Restricted bands Emission | | | | | | |
| 2338.69 | 53.42 | PK | -13.19 | 40.23 | 74 | -33.77 |
| 2338.69 | 40.13 | Ave | -13.19 | 26.94 | 54 | -27.06 |
| 2381.58 | 57.42 | PK | -13.14 | 44.28 | 74 | -29.72 |
| 2381.58 | 41.37 | Ave | -13.14 | 28.23 | 54 | -25.77 |
| 2483.50 | 49.68 | PK | -13.08 | 36.6 | 74 | -37.4 |
| 2483.50 | 40.21 | Ave | -13.08 | 27.13 | 54 | -26.87 |
| Remark: | | | | | | |
| 1. Corrected Factor=ANT Factor + Cable Loss – Amp Gain | | | | | | |
| 2. The data display worst state in the horizontal direction | | | | | | |



| Frequency | Receiver Reading | Detector | Corrected Factor | Corrected Amplitude | Limit | Margin |
|-------------------------------------------------------------|------------------|-------------|------------------|---------------------|----------|--------|
| (MHz) | (dBμV) | (PK/QP/Ave) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| 8DPSK Low Channel | | | | | | |
| Harmonic& Spurious Emission | | | | | | |
| 1180.51 | 58.25 | PK | -19.51 | 38.74 | 74 | -35.26 |
| 1180.51 | 42.48 | Ave | -19.51 | 22.97 | 54 | -31.03 |
| 4804.00 | 57.32 | PK | -1.06 | 56.26 | 74 | -17.74 |
| 4804.00 | 41.27 | Ave | -1.06 | 40.21 | 54 | -13.79 |
| 7206.00 | 57.41 | PK | 1.33 | 58.74 | 74 | -15.26 |
| 7206.00 | 43.6 | Ave | 1.33 | 44.93 | 54 | -9.07 |
| Restricted bands Emission | | | | | | |
| 2314.82 | 55.89 | PK | -13.19 | 42.7 | 74 | -31.3 |
| 2314.82 | 44.75 | Ave | -13.19 | 31.56 | 54 | -22.44 |
| 2390.00 | 58.26 | PK | -13.14 | 45.12 | 74 | -28.88 |
| 2390.00 | 44.59 | Ave | -13.14 | 31.45 | 54 | -22.55 |
| 2495.47 | 59.81 | PK | -13.08 | 46.73 | 74 | -27.27 |
| 2495.47 | 41.39 | Ave | -13.08 | 28.31 | 54 | -25.69 |
| Remark: | | | | | | |
| 1. Corrected Factor=ANT Factor + Cable Loss – Amp Gain | | | | | | |
| 2. The data display worst state in the horizontal direction | | | | | | |



| Frequency | Receiver Reading | Detector | Corrected Factor | Corrected Amplitude | Limit | Margin |
|-------------------------------------------------------------|------------------|-------------|------------------|---------------------|----------|--------|
| (MHz) | (dBμV) | (PK/QP/Ave) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| 8DPSK Middle Channel | | | | | | |
| Harmonic& Spurious Emission | | | | | | |
| 1180.82 | 59.53 | PK | -19.51 | 40.02 | 74 | -33.98 |
| 1180.82 | 43.98 | Ave | -19.51 | 24.47 | 54 | -29.53 |
| 4882.00 | 58.23 | PK | -0.93 | 57.3 | 74 | -16.7 |
| 4882.00 | 42.48 | Ave | -0.93 | 41.55 | 54 | -12.45 |
| 7323.00 | 55.34 | PK | 1.67 | 57.01 | 74 | -16.99 |
| 7323.00 | 47.22 | Ave | 1.67 | 48.89 | 54 | -5.11 |
| Restricted bands Emission | | | | | | |
| 2310.56 | 55.1 | PK | -13.19 | 41.91 | 74 | -32.09 |
| 2310.56 | 43.35 | Ave | -13.19 | 30.16 | 54 | -23.84 |
| 2370.58 | 57.18 | PK | -13.14 | 44.04 | 74 | -29.96 |
| 2370.58 | 42.44 | Ave | -13.14 | 29.3 | 54 | -24.7 |
| 2491.11 | 56.31 | PK | -13.08 | 43.23 | 74 | -30.77 |
| 2491.11 | 44.29 | Ave | -13.08 | 31.21 | 54 | -22.79 |
| Remark: | | | | | | |
| 1. Corrected Factor=ANT Factor + Cable Loss – Amp Gain | | | | | | |
| 2. The data display worst state in the horizontal direction | | | | | | |



| Frequency | Receiver Reading | Detector | Corrected Factor | Corrected Amplitude | Limit | Margin |
|-------------------------------------------------------------|------------------|-------------|------------------|---------------------|----------|--------|
| (MHz) | (dBμV) | (PK/QP/Ave) | (dB) | (dBμV/m) | (dBμV/m) | (dB) |
| 8DPSK High Channel | | | | | | |
| Harmonic& Spurious Emission | | | | | | |
| 1187.36 | 57.32 | PK | -19.51 | 37.81 | 74 | -36.19 |
| 1187.36 | 44.81 | Ave | -19.51 | 25.3 | 54 | -28.7 |
| 4960.00 | 58.57 | PK | -0.87 | 57.7 | 74 | -16.3 |
| 4960.00 | 43.38 | Ave | -0.87 | 42.51 | 54 | -11.49 |
| 7440.00 | 59.49 | PK | 1.84 | 61.33 | 74 | -12.67 |
| 7440.00 | 41.82 | Ave | 1.84 | 43.66 | 54 | -10.34 |
| Restricted bands Emission | | | | | | |
| 2335.36 | 56.85 | PK | -13.19 | 43.66 | 74 | -30.34 |
| 2335.36 | 44.61 | Ave | -13.19 | 31.42 | 54 | -22.58 |
| 2385.28 | 58.4 | PK | -13.14 | 45.26 | 74 | -28.74 |
| 2385.28 | 45.74 | Ave | -13.14 | 32.6 | 54 | -21.4 |
| 2483.50 | 57.37 | PK | -13.08 | 44.29 | 74 | -29.71 |
| 2483.50 | 44.25 | Ave | -13.08 | 31.17 | 54 | -22.83 |
| Remark: | | | | | | |
| 1. Corrected Factor=ANT Factor + Cable Loss – Amp Gain | | | | | | |
| 2. The data display worst state in the horizontal direction | | | | | | |

Test Frequency: 18-25GHz

The measurements were more than 20 dB below the limit and not reported

- Remark :
1. The testing has been conformed to 10*2480 =24800MHz.
 2. All other emissions more than 30dB below the limit
 - 3: Only the worst data (GFSK/8DPSK modulation mode) were reported.



6 Conducted Spurious Emissions

- Test Requirement : FCC CFR47 Part 15 Section 15.247
- Test Method : ANSI C63.10 2013
- Test Limit : In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
- Test Result : PASS

6.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer:

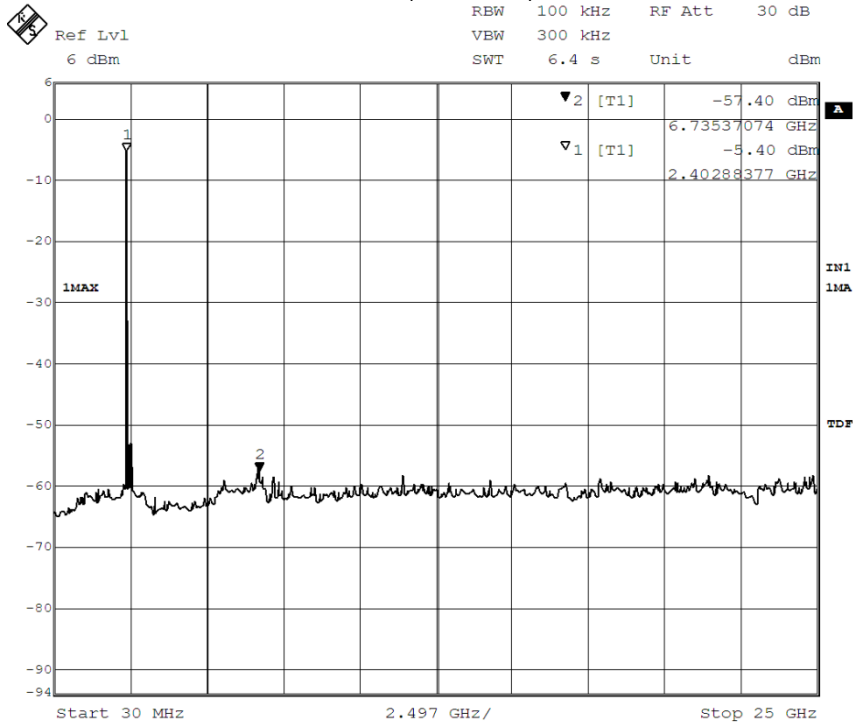
RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

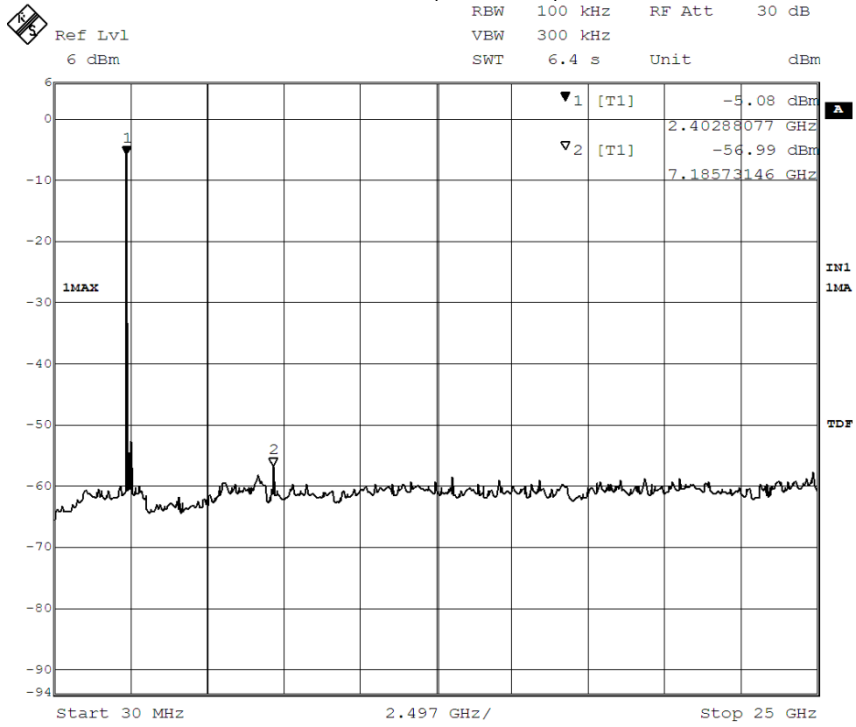
6.2 Test Result

Remark: only the worst data(2402MHz) were reported.

GFSK(2402MHz)

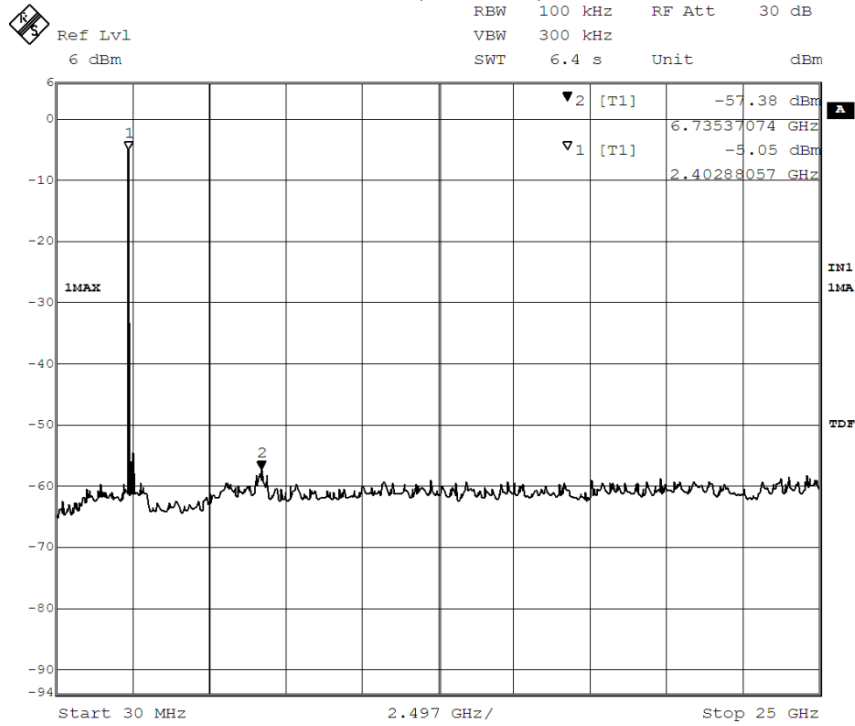


I/QDQPSK(2402MHz)





8DPSK(2402MHz)



7 Band Edge Measurement

| | | |
|------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : | Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)). |
| Test Method | : | ANSI C63.10:2013,DA 00-705 |
| Test Limit | : | Regulation 15.247 (d),In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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)). |
| Test Mode | : | Transmitting & Hopping |
| Remark | : | The worst case was recorded. |

7.1 Test Procedure

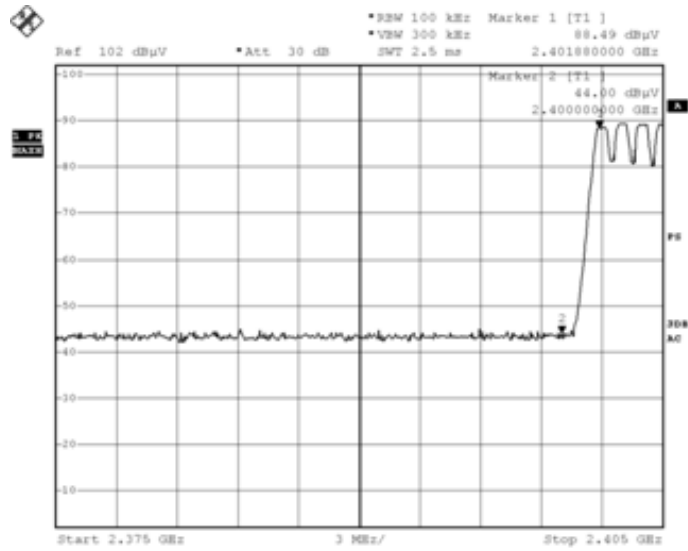
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

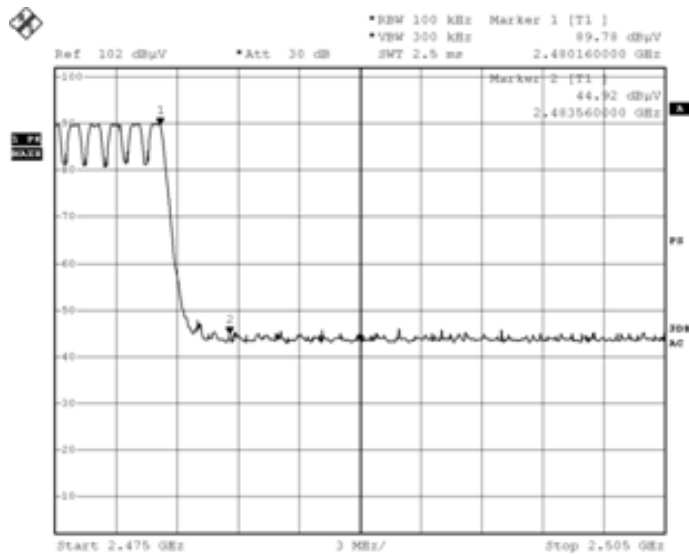
7.2 Test Result

| Modulation | Mode | Band edge | Value | Limit | Result |
|-----------------------------------------------------------------------------------------------------|---------|-----------|-------|-------|--------|
| GFSK | Hopping | Left | 44.00 | 68.49 | Pass |
| | | Right | 44.92 | 69.78 | Pass |
| Pi/4 DQPSK | Hopping | Left | 44.00 | 66.74 | Pass |
| | | Right | 44.39 | 69.83 | Pass |
| 8DPSK | Hopping | Left | 45.18 | 66.67 | Pass |
| | | Right | 44.49 | 69.73 | Pass |
| Remark: Hopping with worst case | | | | | |
| The limit is 20dB below the maximum peak level, please refer to the display line of the follow plot | | | | | |

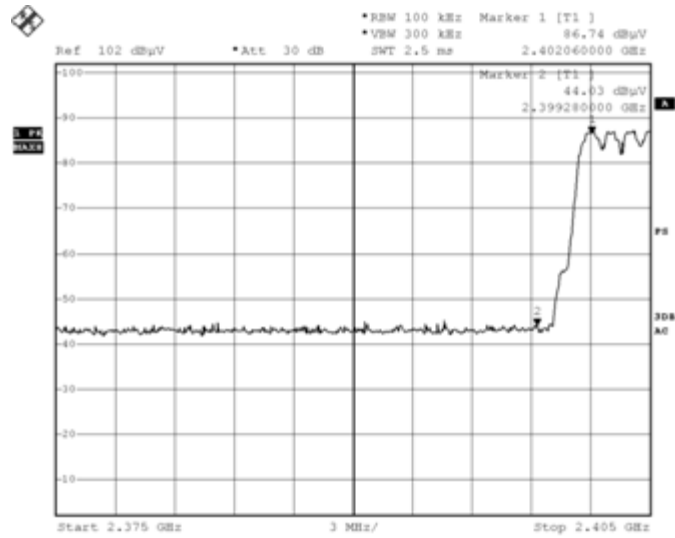
Hopping in GFSK Band edge-left side



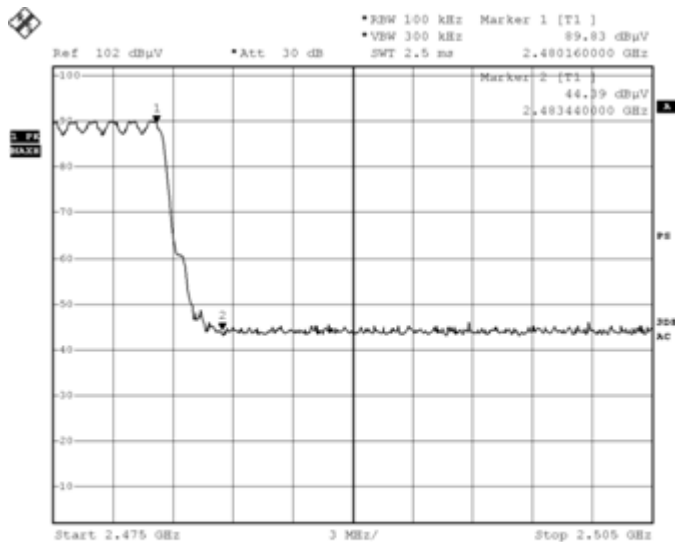
Hopping in GFSK Band edge-right side



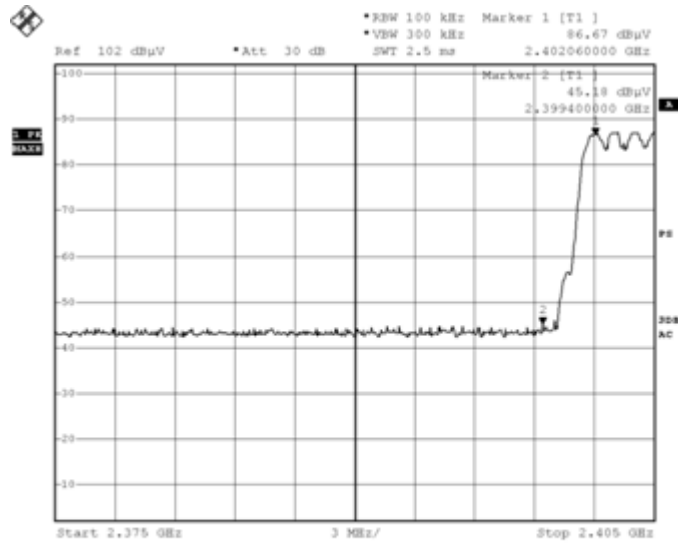
Hopping in Pi/4 DQPSK Band edge-left side



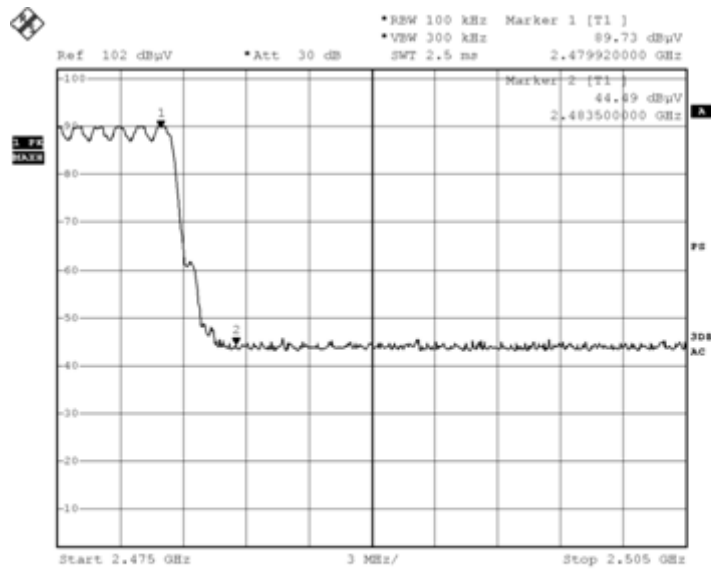
Hopping in Pi/4 DQPSK Band edge-right side



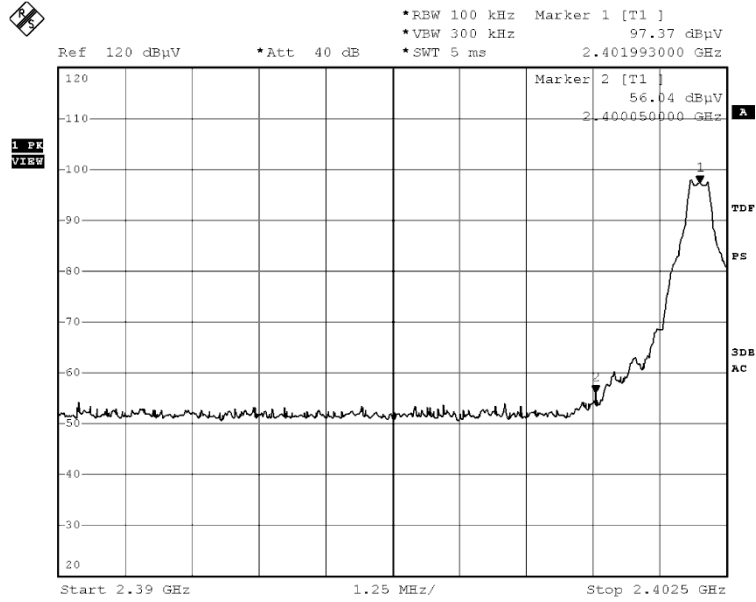
Hopping in 8DPSK Band edge-left side



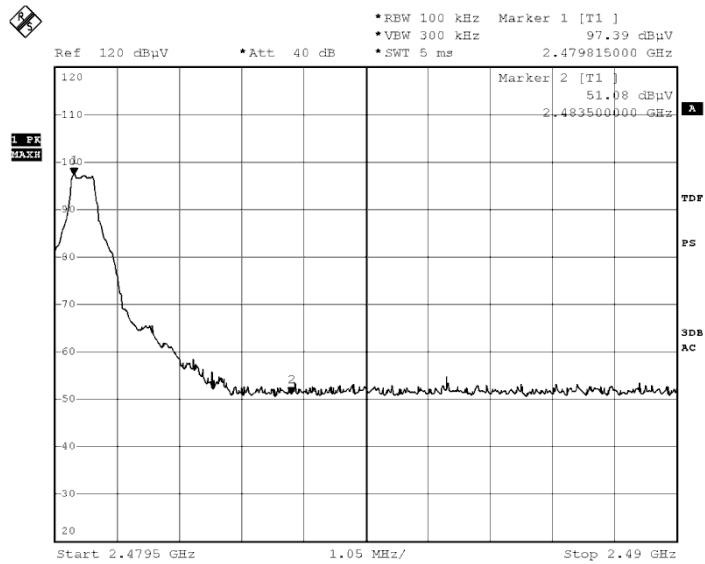
Hopping in 8DPSK Band edge-right side



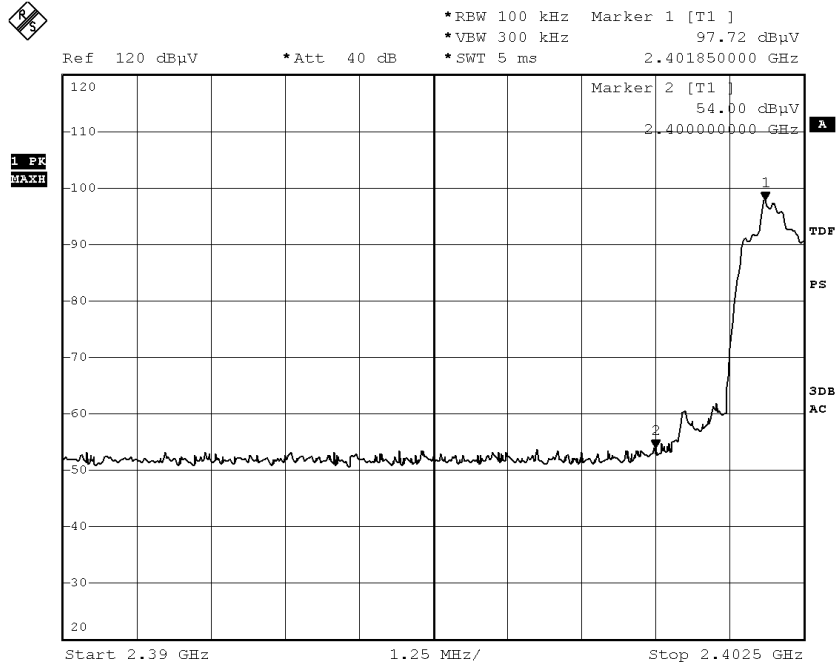
Signal in GFSK Band edge-left side



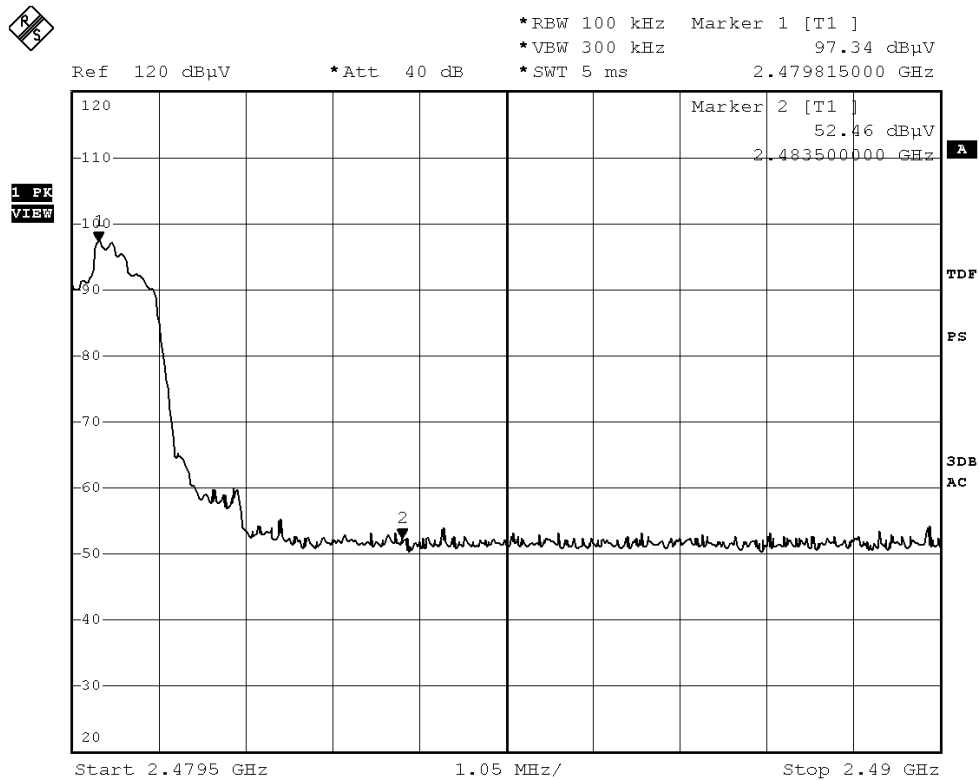
Signal in GFSK Band edge-right side



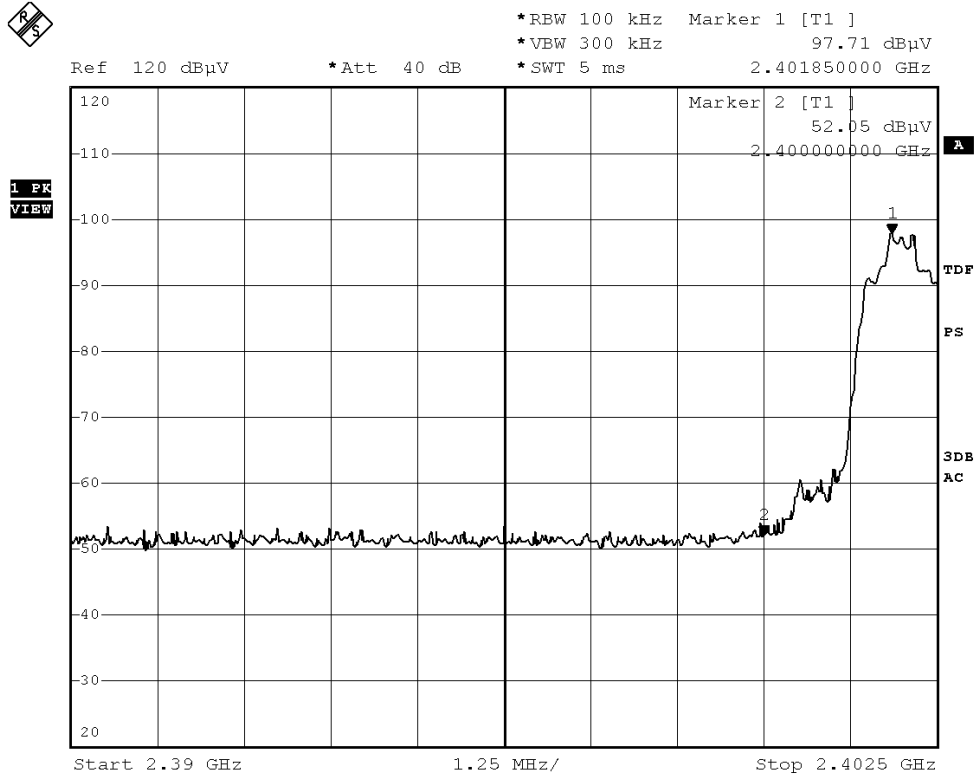
Signal in PI/4DQPSK Band edge-left side



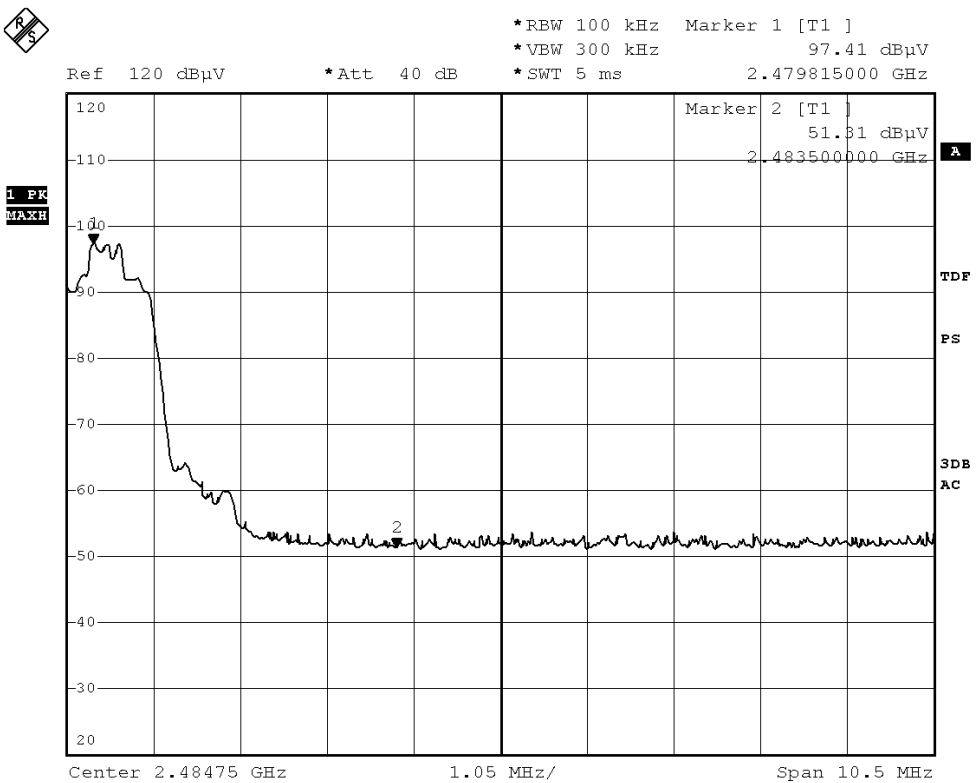
Signal in PI/4DQPSK Band edge-right side



Signal in 8DPSK Band edge-left side



Signal in GFSK Band edge-right side





8 20 dB Bandwidth Measurement

TestRequirement : FCC CFR47 Part 15 Section 15.247
Test Method : ANSI C63.10:2013,DA 00-705
Test Mode : Refer to section 3.3

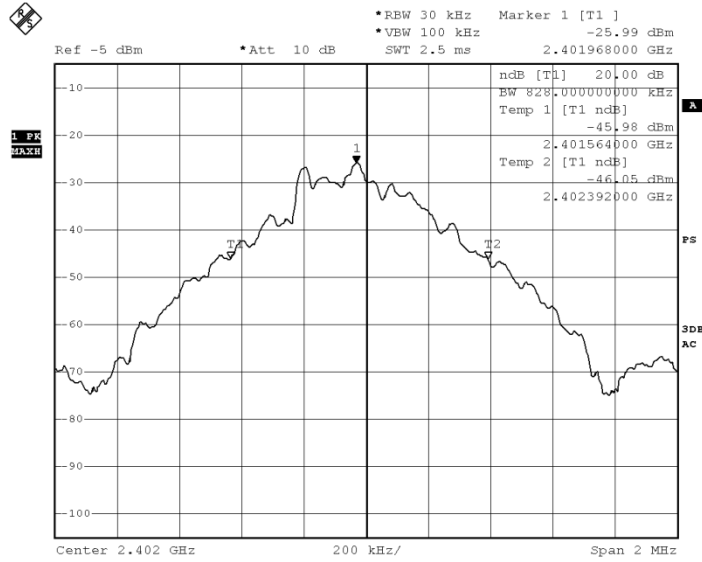
8.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

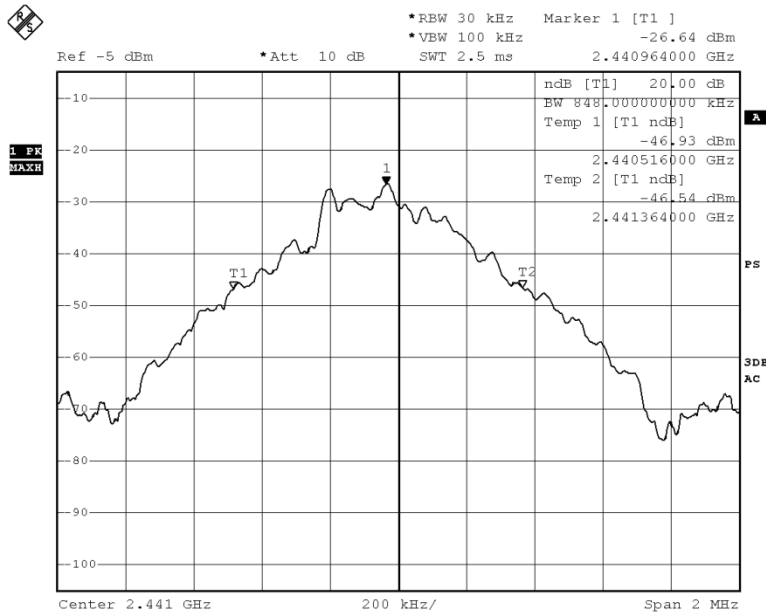
8.2 Test Result

| Modulation | Test Channel | Bandwidth(MHz) |
|------------|--------------|----------------|
| GFSK | Low | 0.828 |
| GFSK | Middle | 0.848 |
| GFSK | High | 0.812 |
| Pi/4 DQPSK | Low | 1.210 |
| Pi/4 DQPSK | Middle | 1.225 |
| Pi/4 DQPSK | High | 1.220 |
| 8DPSK | Low | 1.205 |
| 8DPSK | Middle | 1.210 |
| 8DPSK | High | 1.215 |

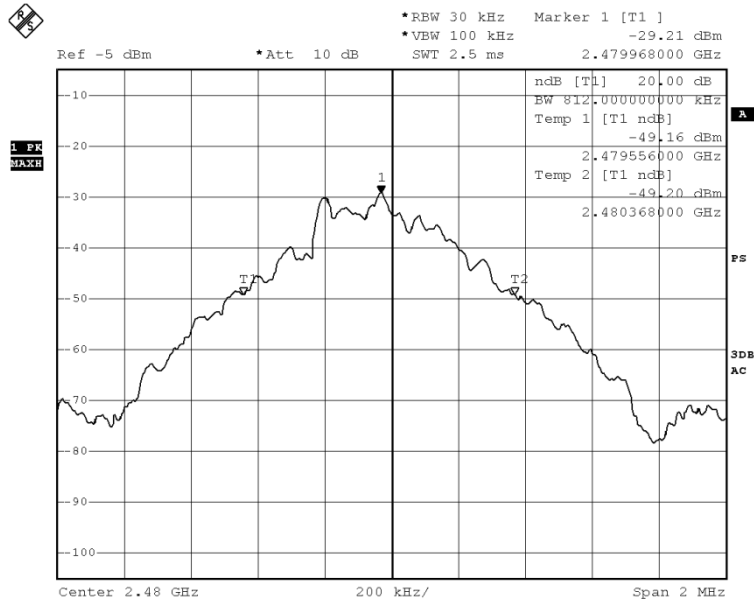
GFSK Low Channel



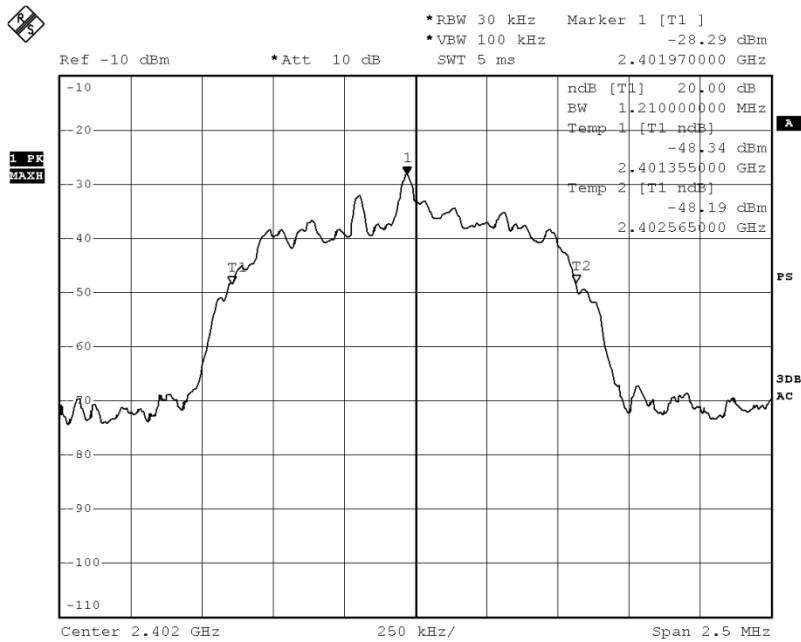
GFSK Middle Channel



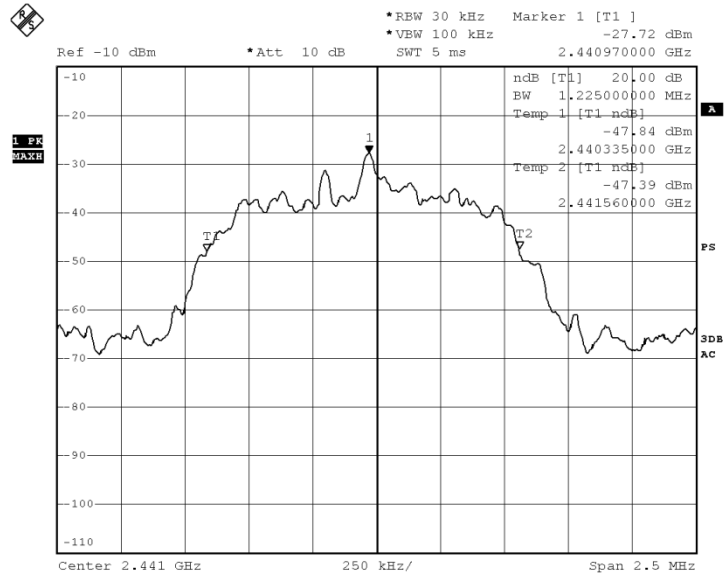
GFSKHigh Channel



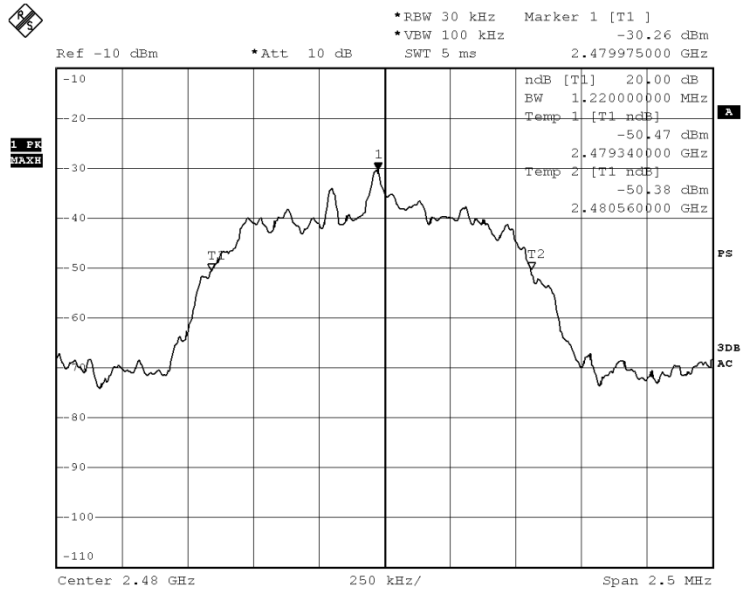
Pi/4DQPSK LowChannel



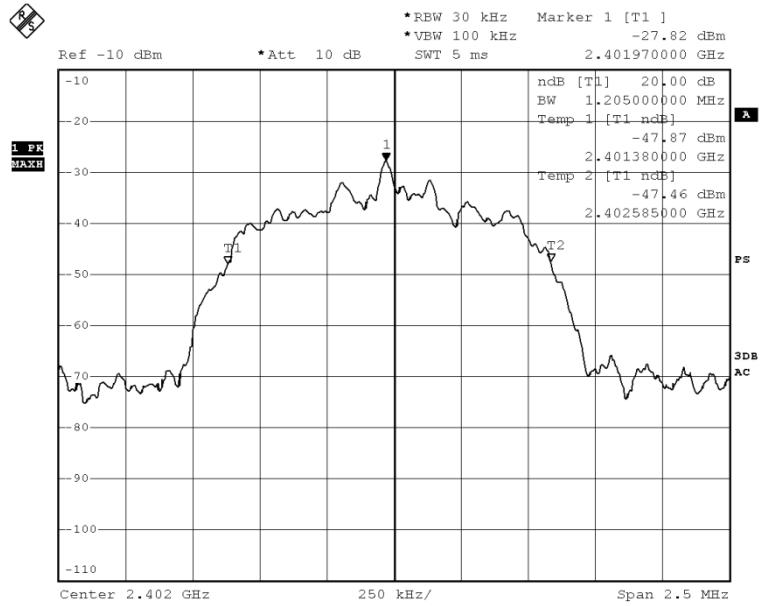
Pi/4DQPSK Middle Channel



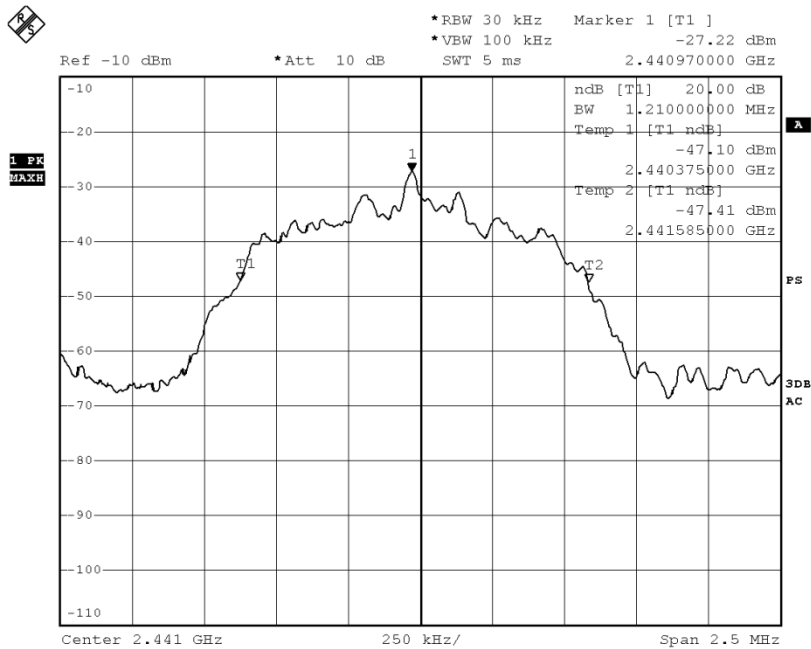
Pi/4DQPSK High Channel



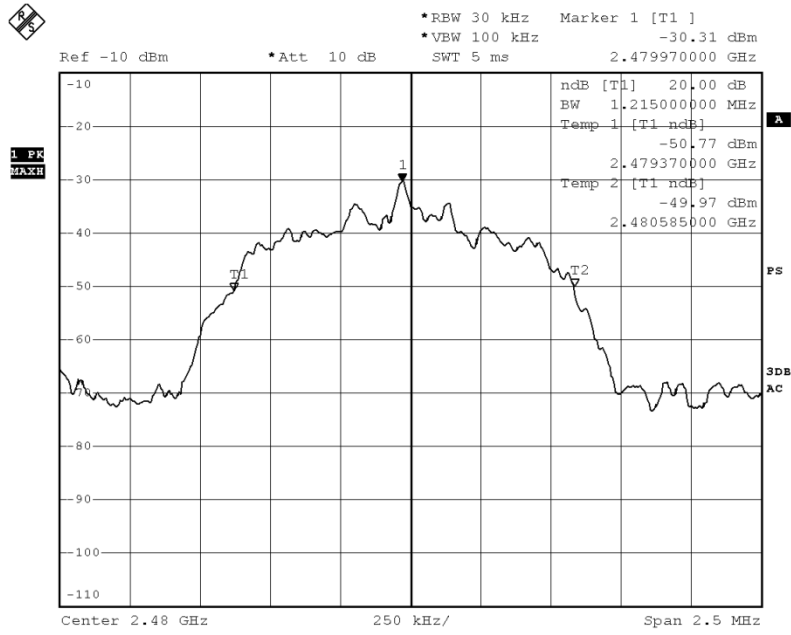
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel



9 Maximum Peak Output Power

| | | |
|------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : | FCC CFR47 Part 15 Section 15.247 |
| Test Method | : | ANSI C63.10:2013,DA 00-705 |
| Test Limit | : | 0.125W (frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.). |
| Test Mode | : | Refer to section 3.3 |

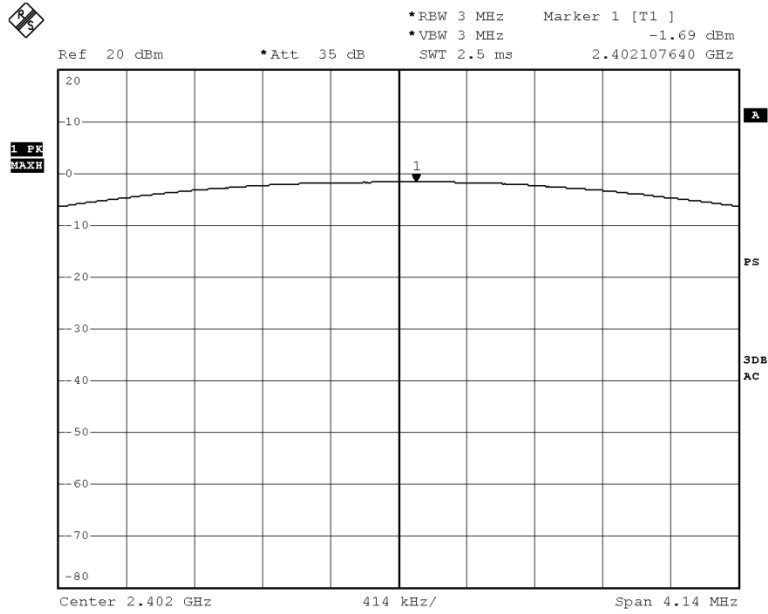
9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyser: RBW = 3MHz. VBW =3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

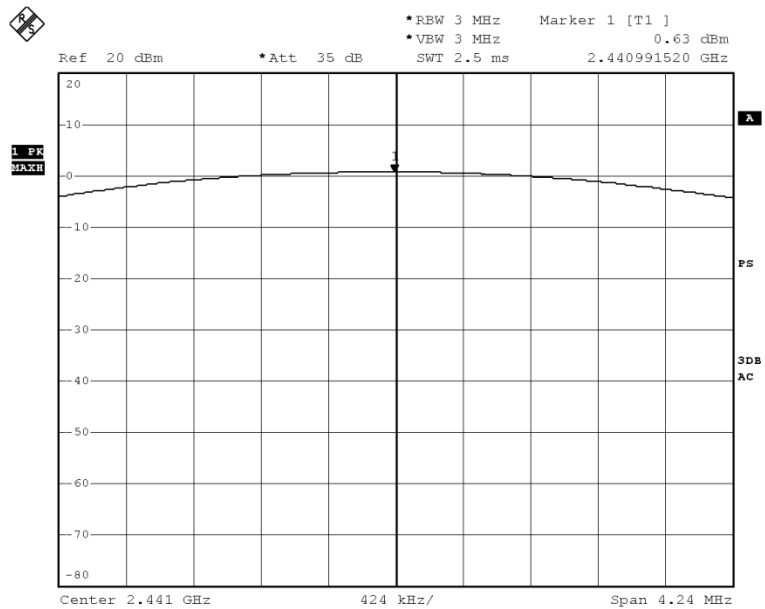
9.2 Test Result

| Modulation | Test Channel | Output Power (dBm) | Limit (dBm) |
|------------|--------------|--------------------|-------------|
| GFSK | Low | -1.69 | 30 |
| GFSK | Middle | 0.63 | 30 |
| GFSK | High | 1.54 | 30 |
| Pi/4 DQPSK | Low | -3.17 | 20.97 |
| Pi/4 DQPSK | Middle | -0.07 | 20.97 |
| Pi/4 DQPSK | High | 0.57 | 20.97 |
| 8DPSK | Low | -2.74 | 20.97 |
| 8DPSK | Middle | 0.12 | 20.97 |
| 8DPSK | High | 0.89 | 20.97 |

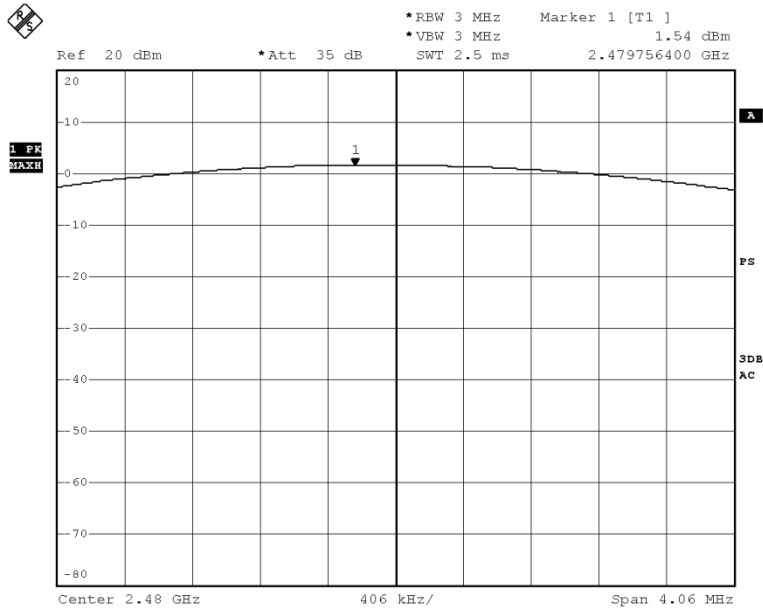
GFSK Low Channel



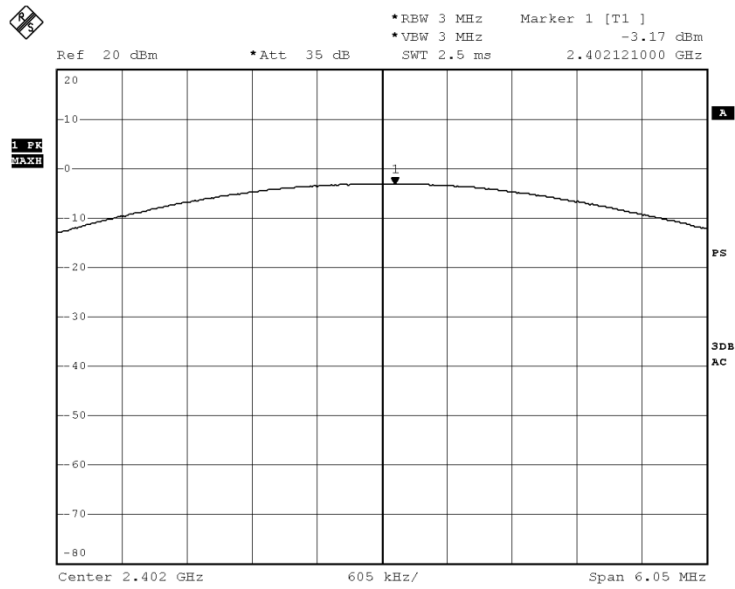
GFSK Middle Channel



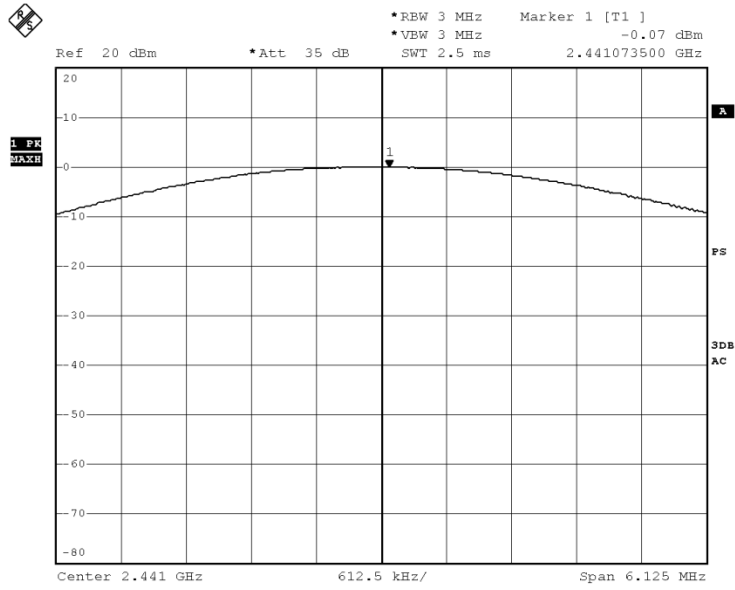
GFSKHigh Channel



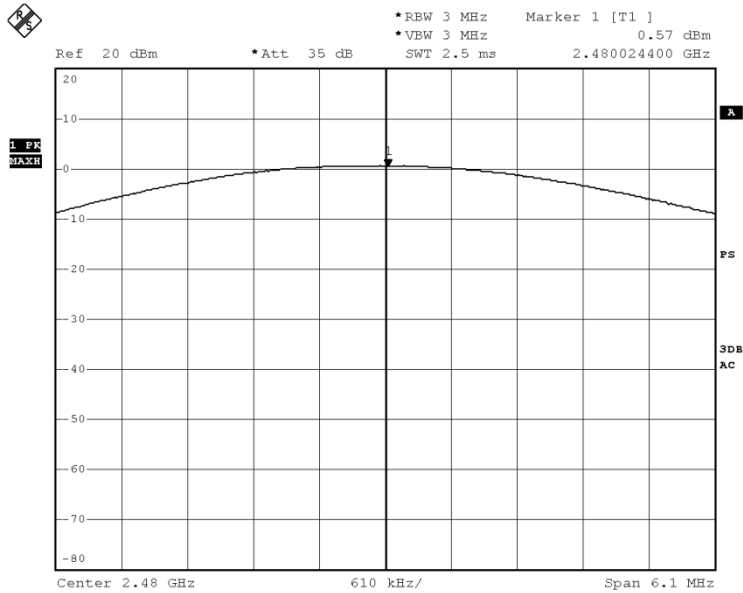
Pi/4DQPSK LowChannel



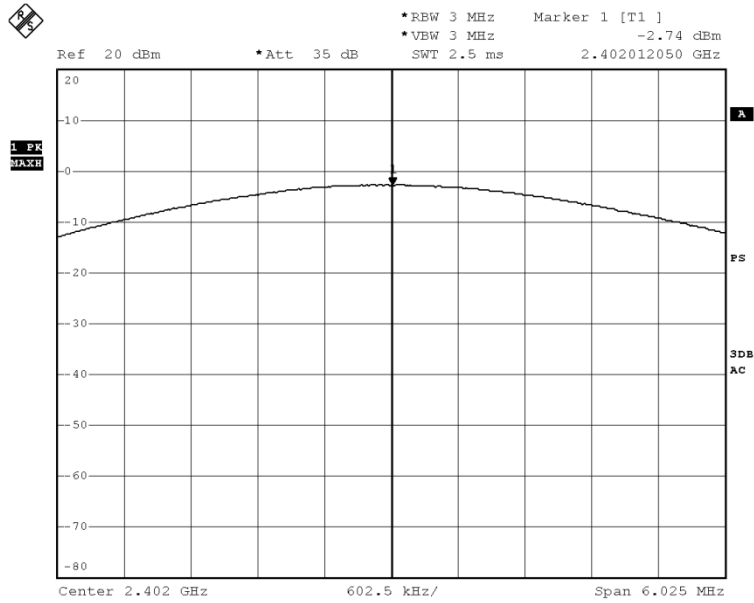
Pi/4DQPSK Middle Channel



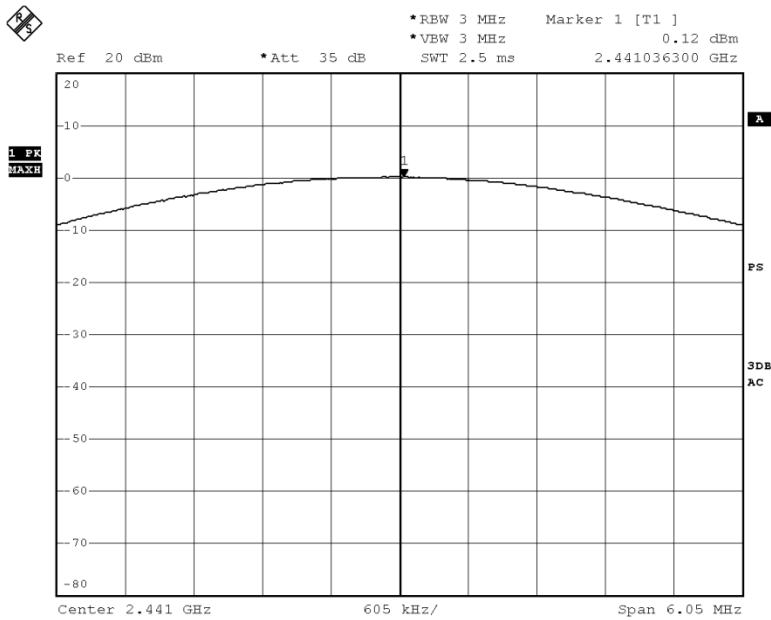
Pi/4DQPSK High Channel



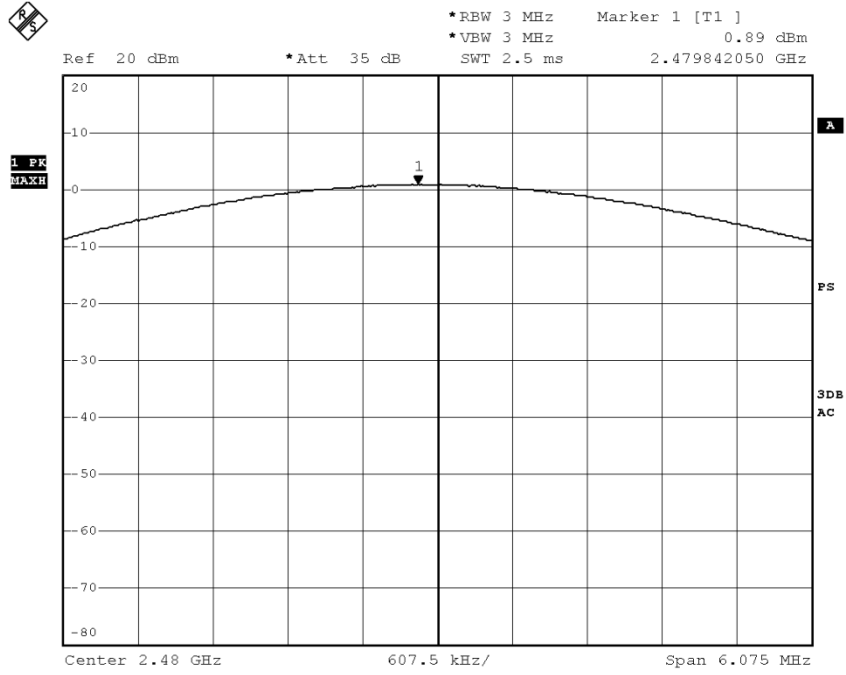
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel



10 Hopping Channel Separation

| | |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247 |
| Test Method | : ANSI C63.10:2013,DA 00-705 |
| Test Limit | : Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125W. |
| Test Mode | : Hopping |

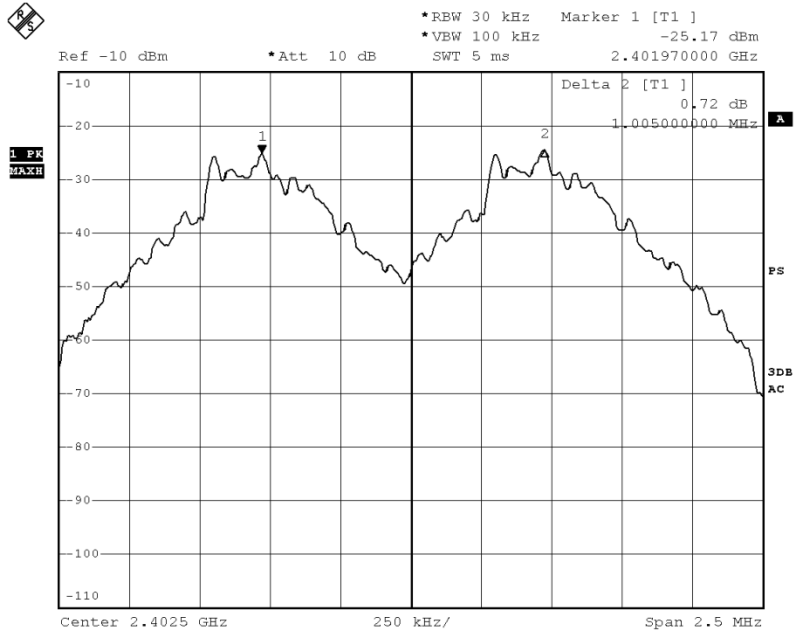
10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz , Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

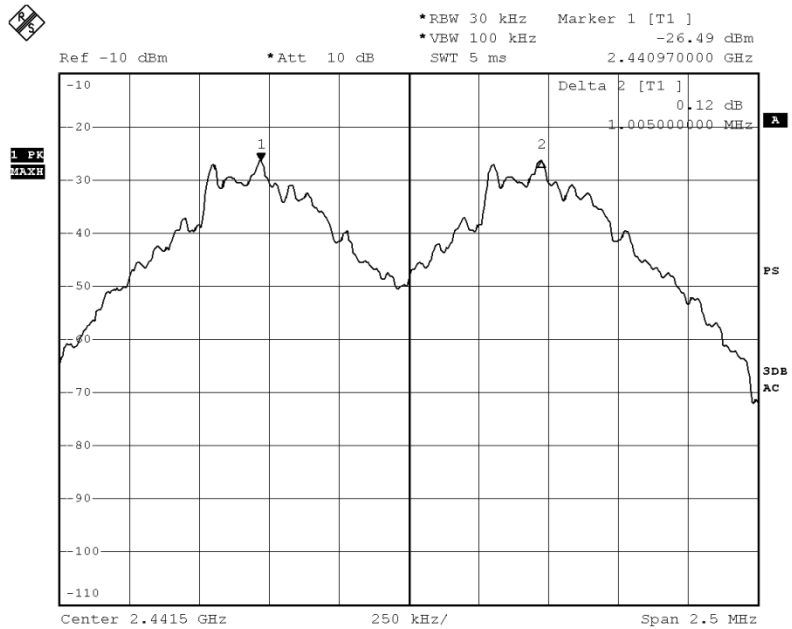
10.2 Test Result

| Modulation | Test Channel | Separation (MHz) | Limit (MHz) | Result |
|------------|--------------|------------------|-------------|--------|
| GFSK | Low | 1.005 | 0.552 | PASS |
| GFSK | Middle | 1.005 | 0.565 | PASS |
| GFSK | High | 1.005 | 0.541 | PASS |
| Pi/4 DQPSK | Low | 1.005 | 0.807 | PASS |
| Pi/4 DQPSK | Middle | 1.000 | 0.817 | PASS |
| Pi/4 DQPSK | High | 1.005 | 0.813 | PASS |
| 8DPSK | Low | 1.000 | 0.803 | PASS |
| 8DPSK | Middle | 1.005 | 0.807 | PASS |
| 8DPSK | High | 1.005 | 0.810 | PASS |

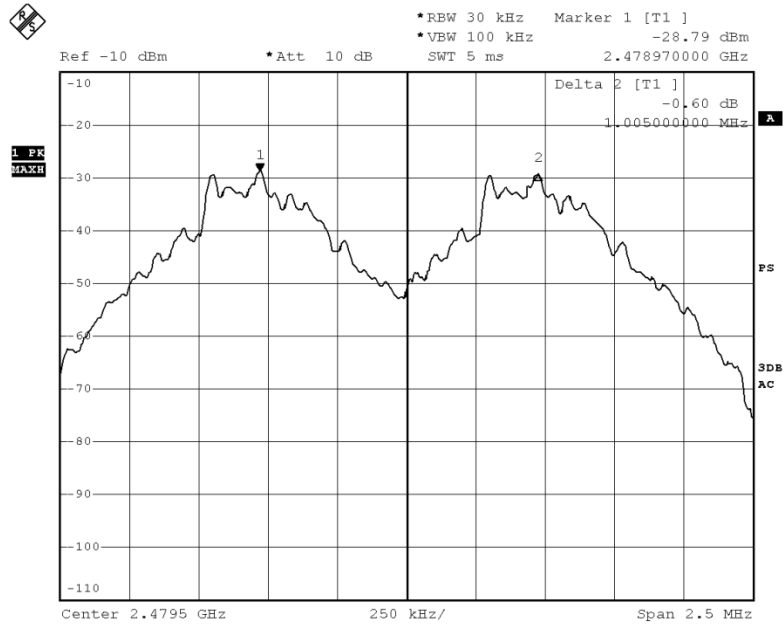
GFSK Low Channel



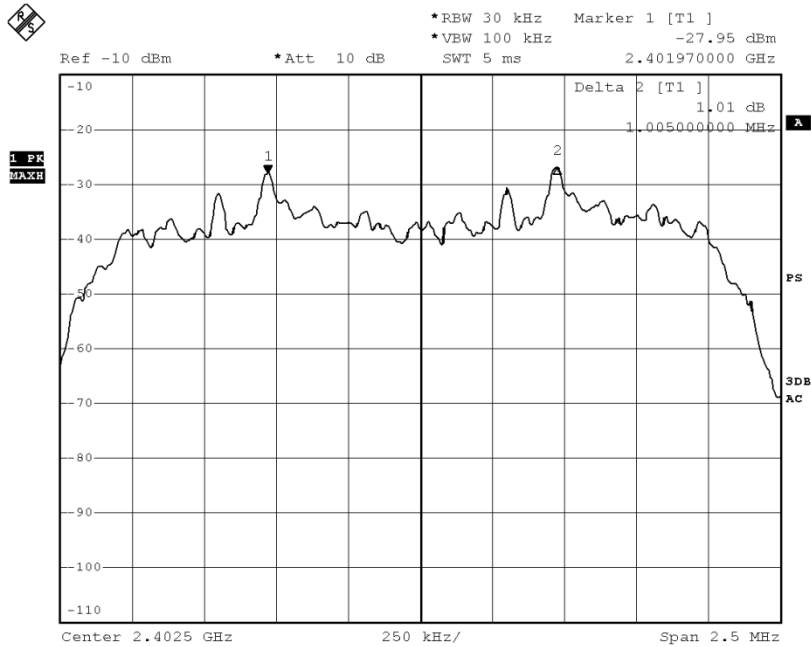
GFSK Middle Channel



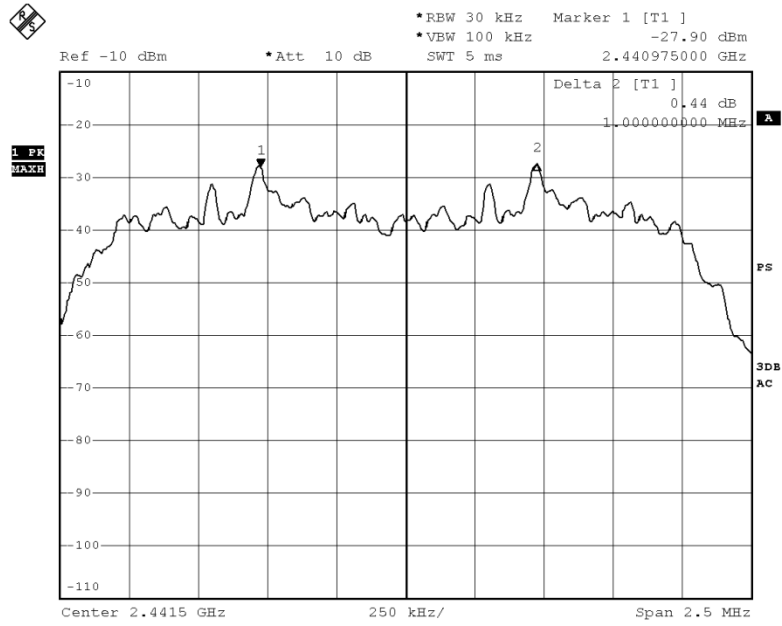
GFSKHigh Channel



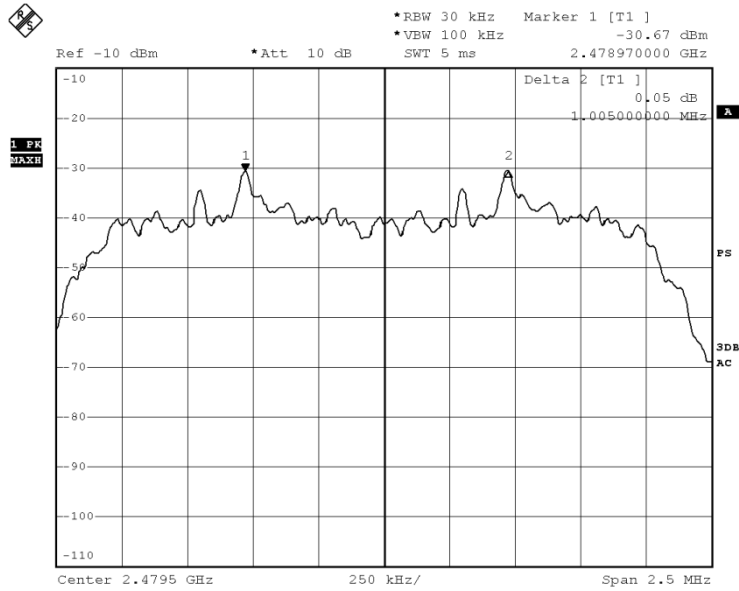
Pi/4DQPSK LowChannel



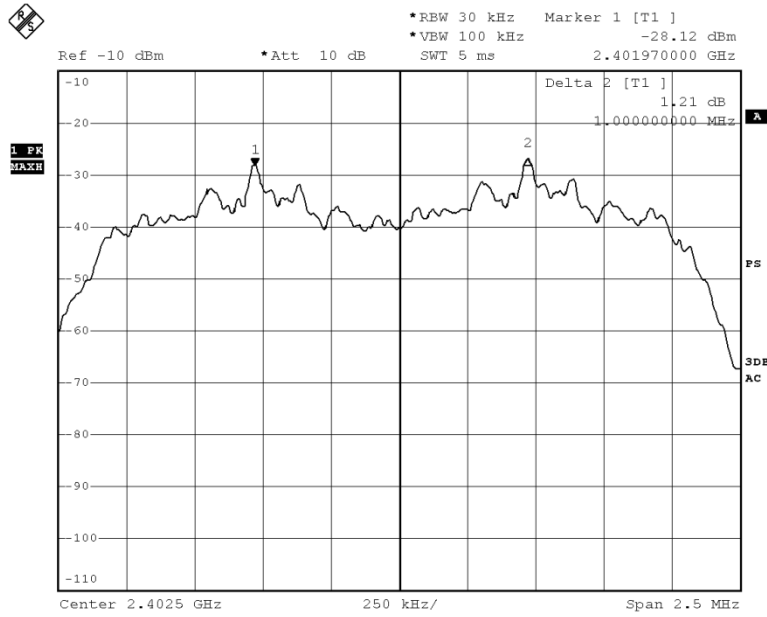
Pi/4DQPSK Middle Channel



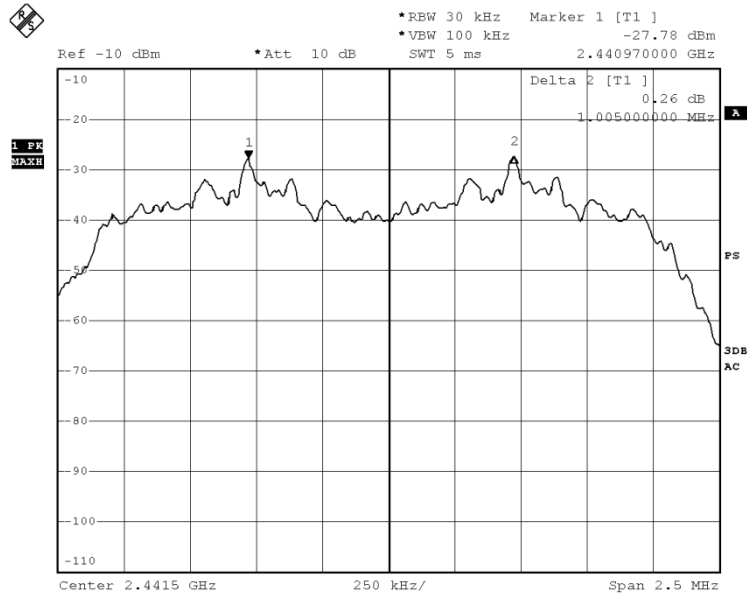
Pi/4DQPSK High Channel



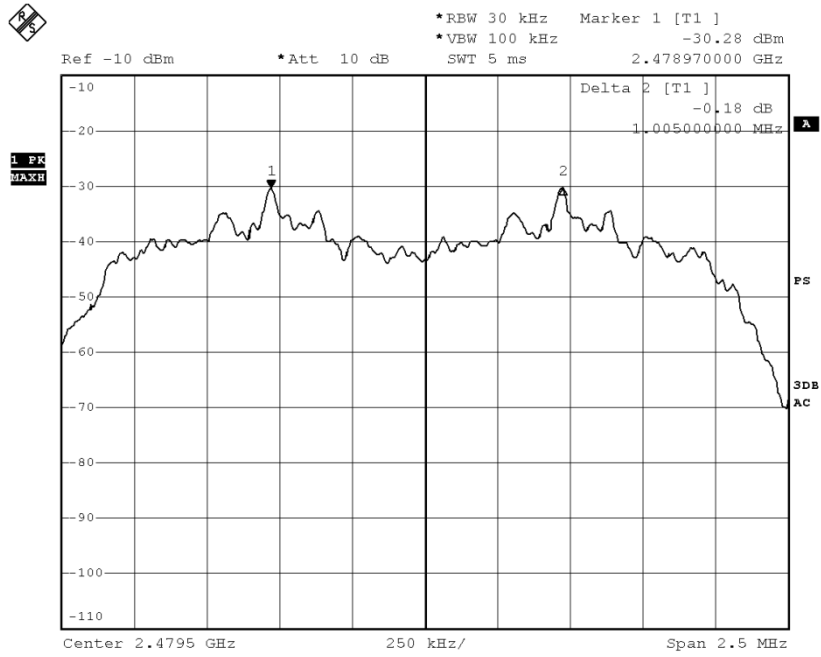
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel





11 Number of Hopping Frequency

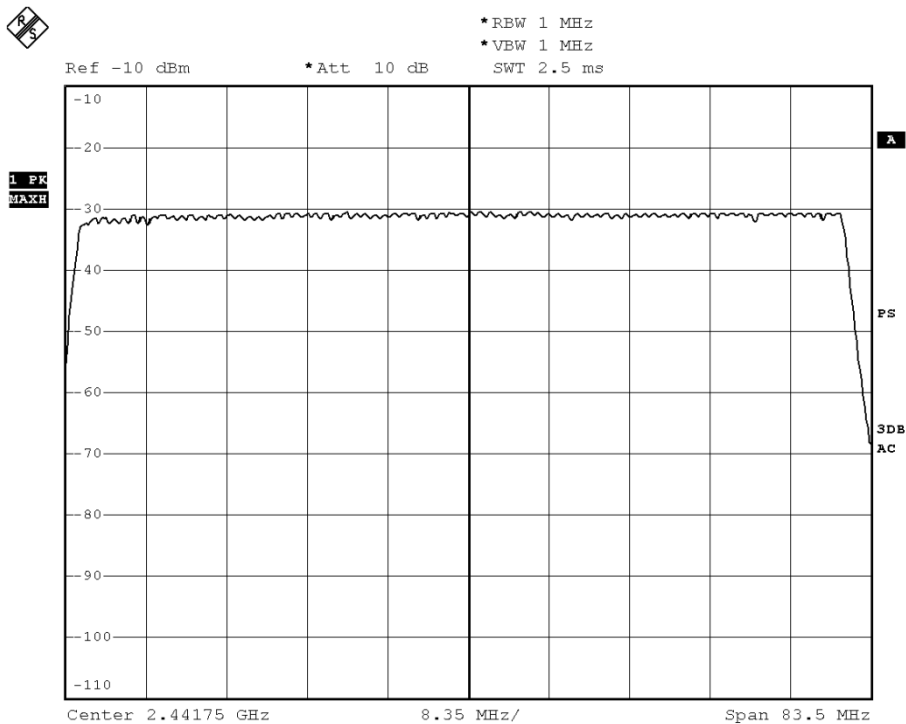
- Test Requirement : FCC CFR47 Part 15 Section 15.247
- Test Method : ANSI C63.10:2013,DA 00-705
- Test Limit : Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
- Test Mode : Hopping(GFSK)

11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 1MHz. VBW = 1MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.483GHz. Sweep=auto;

11.2 Test Result

| Channel Number | Limit |
|----------------|-------|
| 79 | ≥15 |





12 Dwell Time

| | |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247 |
| Test Method | : ANSI C63.10:2013,DA 00-705 |
| Test Limit | : Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. |
| Test Mode | : Hopping |
| Remark | : The worst case(8DPSK,3DH5) was recorded |

12.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

12.2 Test Result

DH5 Packet permit maximum $1600 / 79 / 6$ hops per second in each channel (5 time slots RX, 1 time slot TX).

DH3 Packet permit maximum $1600 / 79 / 4$ hops per second in each channel (3 time slots RX, 1 time slot TX).

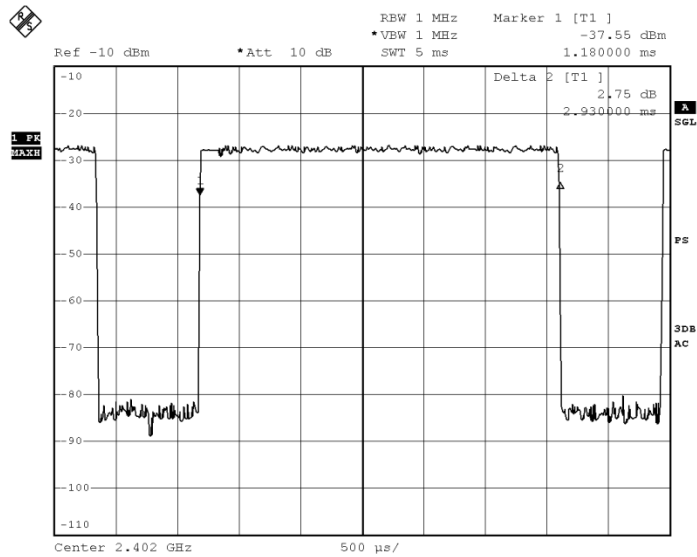
DH1 Packet permit maximum $1600 / 79 / 2$ hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

| Data Packet | Dwell Time(s) |
|-------------------------------------------------------------------------------------|------------------------------------|
| DH5/2DH5/3DH5 | $1600/79/6*0.4*79*(MkrDelta)/1000$ |
| DH3/2DH3/3DH3 | $1600/79/4*0.4*79*(MkrDelta)/1000$ |
| DH1/2DH1/3DH1 | $1600/79/2*0.4*79*(MkrDelta)/1000$ |
| Remark: Mkr Delta is once pulse time. Only the worst data(DH5) were show as follow. | |

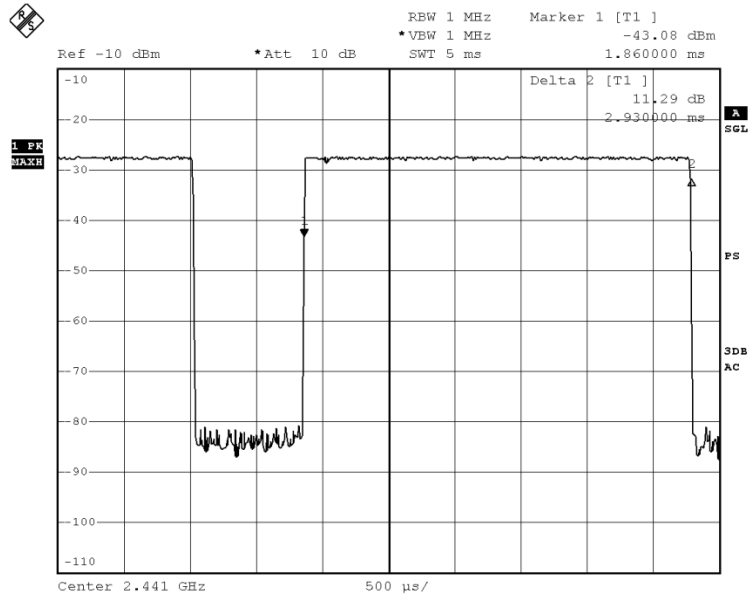


| Modulation | Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|------------|-------------|---------|----------------|---------------|-----------|
| 8DPSK | 3DH5 | Low | 2.930 | 0.313 | 0.4 |
| | | middle | 2.930 | 0.313 | 0.4 |
| | | High | 2.930 | 0.313 | 0.4 |
| Pi/4DQOPSK | 3DH5 | Low | 2.930 | 0.313 | 0.4 |
| | | middle | 2.930 | 0.313 | 0.4 |
| | | High | 2.930 | 0.313 | 0.4 |
| GFSK | 3DH5 | Low | 2.930 | 0.313 | 0.4 |
| | | middle | 2.930 | 0.313 | 0.4 |
| | | High | 2.930 | 0.313 | 0.4 |

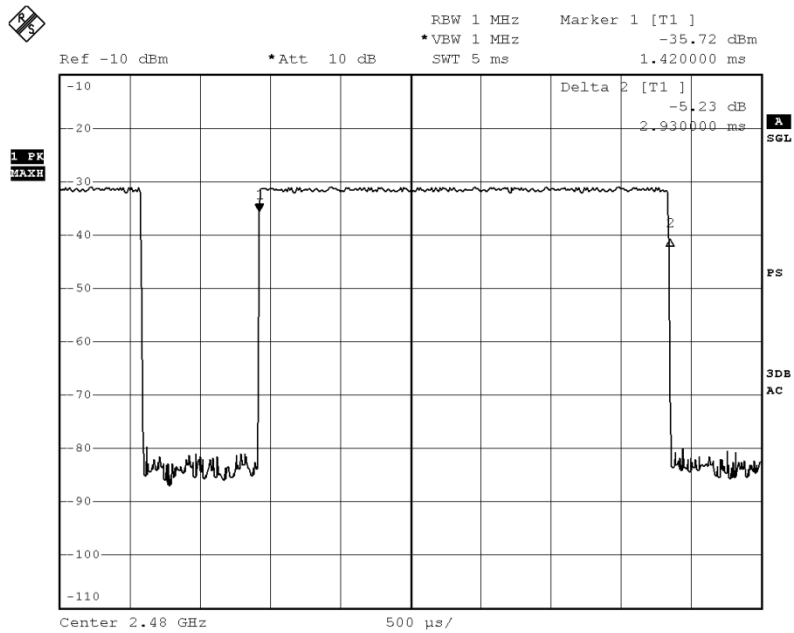
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel





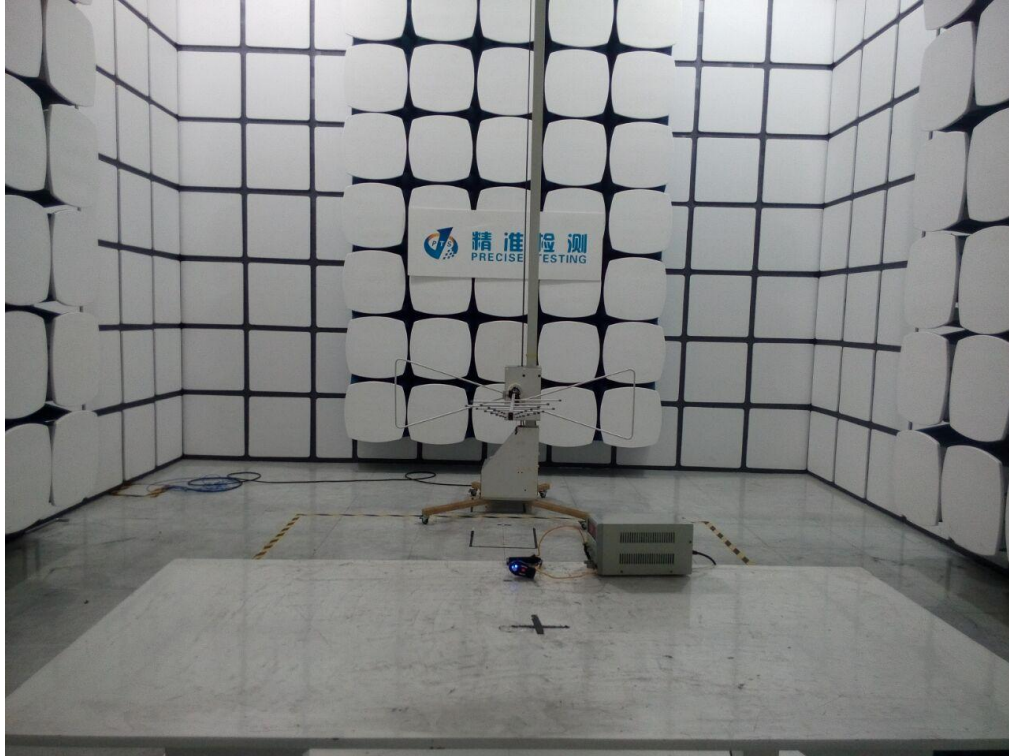
13 Antenna Requirement

According to the FCC part15.203, a transmitter can only be sold or operated with antennas with which it was approved. This product has a PCB printed antenna, it meet the requirement of this section.



14 Test Setup

Spurious Emissions
From 30MHz-1000MHz



Above 1GHz



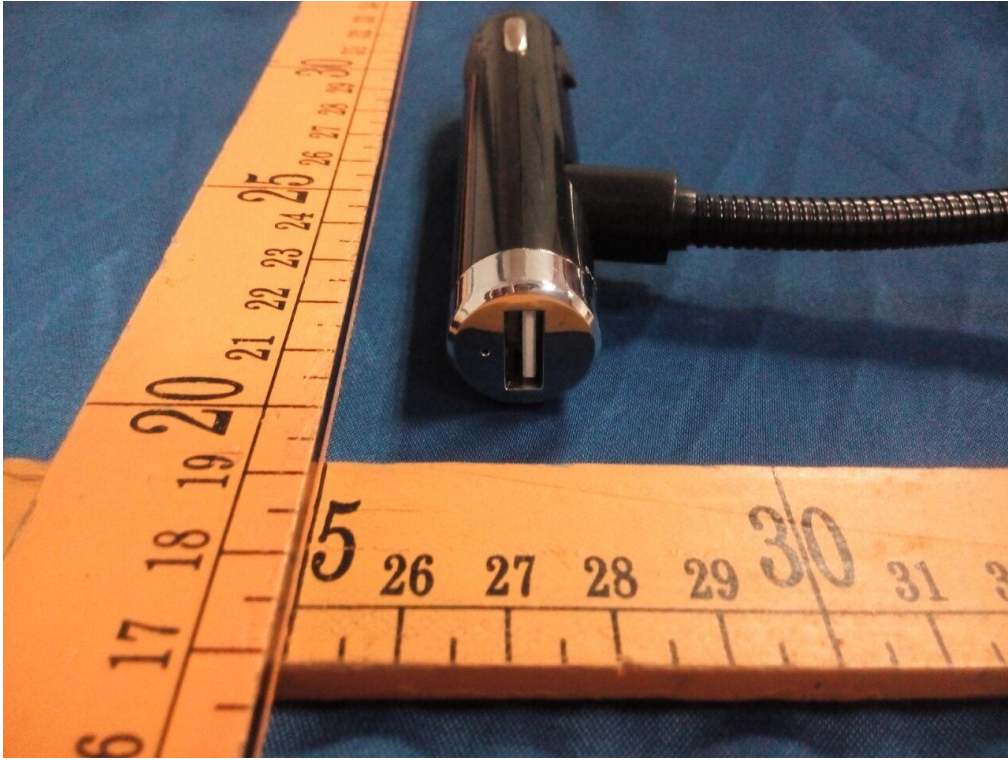


15 EUT Photos

External Photos

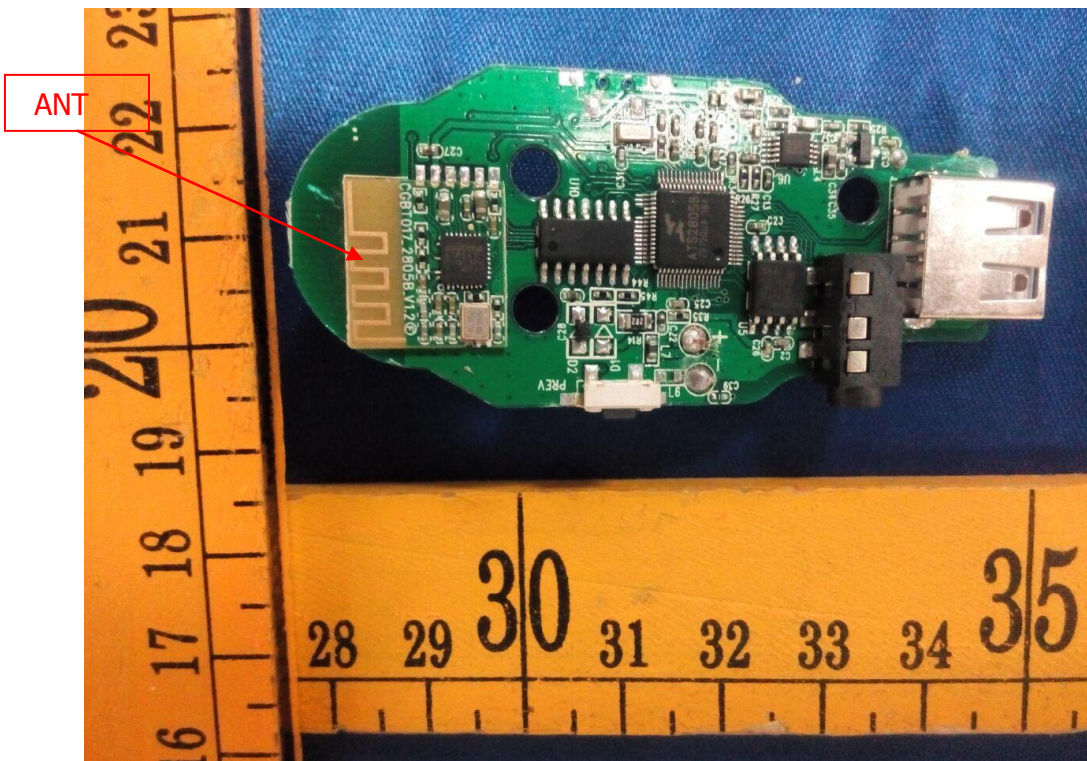
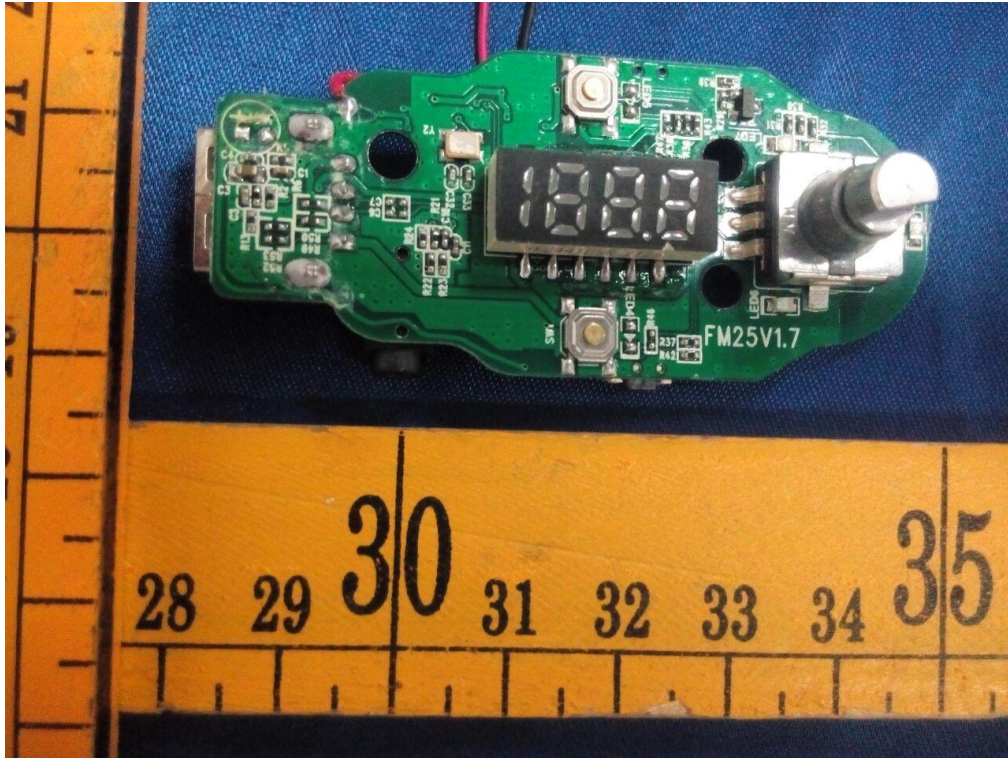


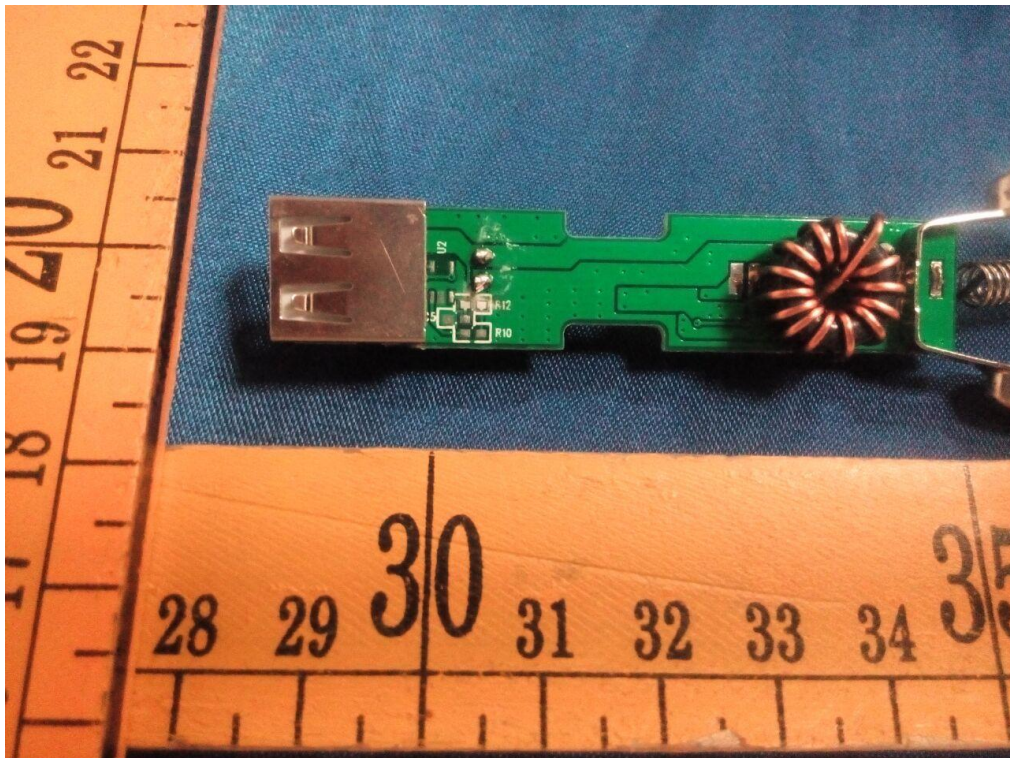
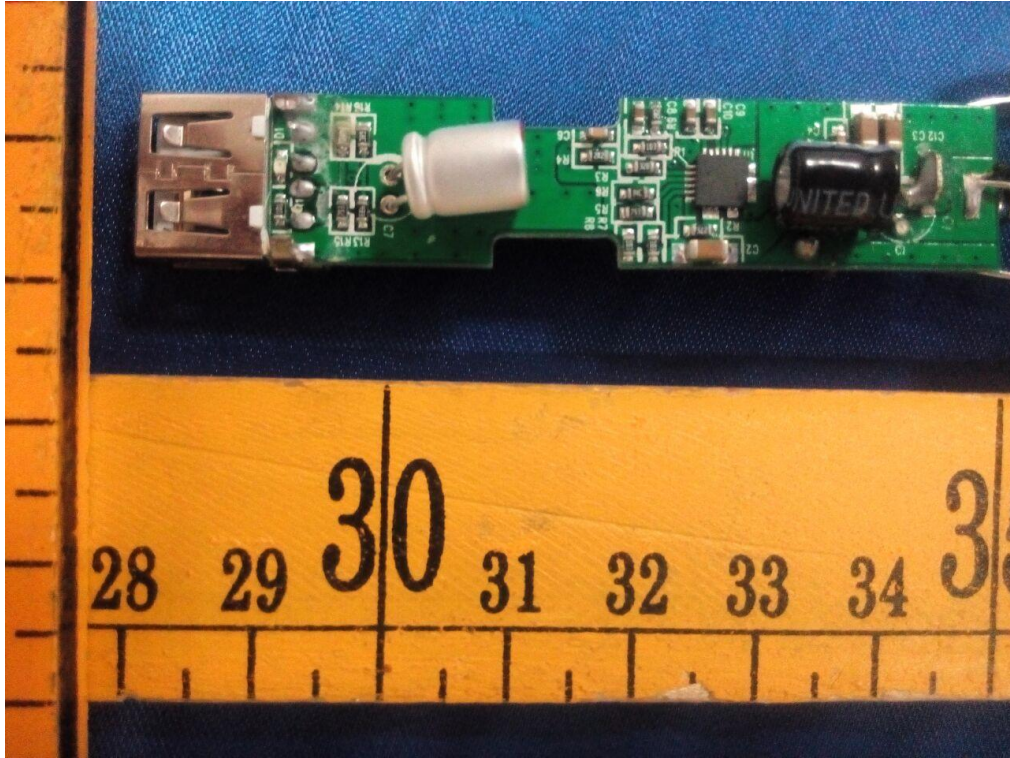






Internal Photos





*****THE END REPORT*****