SGS-CSTC Standards Technical Services Ltd.

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# FCC REPORT

| | |
|---|---|
| **Application No:** | SZEM1207003936RF |
| **Applicant:** | Shenzhen Roman Technology CO., LTD |
| **Manufacturer:** | Shenzhen Roman Technology CO., LTD |
| **Factory:** | Shenzhen Roman Technology CO., LTD |
| **Product Name:** | Bluetooth headset |
| **Model No.(EUT):** | R505 |
| **Add Model No.:** | R6250, R95, R6320, R6330, R6310, R4, R208, H700, R520, R6290, R525, R535, Easypal_B4, R505B, S351, R831, R832, R833, R834, R835, R836, R837, R838, R839 |
| **FCC ID:** | YGKBC6X |
| **Standards:** | 47 CFR Part 15, Subpart C (2011) |
| **Date of Receipt:** | 2012-07-17 |
| **Date of Test:** | 2012-07-20 to 2012-07-26 |
| **Date of Issue:** | 2012-08-29 |
| **Test Result:** | **PASS *** |

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:


Jack Zhang
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.
The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

# 2 Test Summary

| Test Item | Test Requirement | Test method | Result |
|---|---|---|---|
| **Antenna Requirement** | 47 CFR Part 15, Subpart C Section 15.203/15.247 (c) | ANSI C63.10 (2009) | PASS |
| **AC Power Line Conducted Emission** | 47 CFR Part 15, Subpart C Section 15.207 | ANSI C63.10 (2009) | PASS |
| **Conducted Peak Output Power** | 47 CFR Part 15, Subpart C Section 15.247 (b)(1) | ANSI C63.10 (2009) | PASS |
| **20dB Occupied Bandwidth** | 47 CFR Part 15, Subpart C Section 15.247 (a)(1) | ANSI C63.10 (2009) | PASS |
| **Carrier Frequencies Separation** | 47 CFR Part 15, Subpart C Section 15.247 (a)(1) | ANSI C63.10 (2009) | PASS |
| **Hopping Channel Number** | 47 CFR Part 15, Subpart C Section 15.247 (b) | ANSI C63.10 (2009) | PASS |
| **Dwell Time** | 47 CFR Part 15, Subpart C Section 15.247 (a)(1) | ANSI C63.10 (2009) | PASS |
| **Pseudorandom Frequency Hopping Sequence** | 47 CFR Part 15, Subpart C Section 15.247(b)(4)&TCB Exclusion List (7 July 2002) | ANSI C63.10 (2009) | PASS |
| **Band-edge for RF Conducted Emissions** | 47 CFR Part 15, Subpart C Section 15.247(d) | ANSI C63.10 (2009) | PASS |
| **RF Conducted Spurious Emissions** | 47 CFR Part 15, Subpart C Section 15.247(d) | ANSI C63.10 (2009) | PASS |
| **Radiated Spurious emissions** | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 (2009) | PASS |
| **Band Edge (Radiated Emission)** | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 (2009) | PASS |

Remark:

Model No.: R505, R6250, R95, R6320, R6330, R6310, R4, R208, H700, R520, R6290, R525, R535, EASYPAL_B4 , R505B, S351, R831, R832, R833, R834, R835, R836, R837, R838, R839.

Only the Model R505 was tested, since the electrical circuit design, layout, components used and internal wiring were identical for all above models. Only different on the plastic housing and model name.

# 3 Contents

# 4 General Information

## 4.1 Client Information

| | |
|---|---|
| Applicant: | Shenzhen Roman Technology CO., LTD |
| Address of Applicant: | Floor 4, building C, Fengmenao Industrial Park, Gangtou |
| Manufacturer: | Shenzhen Roman Technology CO., LTD |
| Address of Manufacturer: | Floor 4, building C, Fengmenao Industrial Park, Gangtou |
| Factory: | Shenzhen Roman Technology CO., LTD |
| Address of Factory: | Floor 4, building C, Fengmenao Industrial Park, Gangtou |

## 4.2 General Description of EUT

| | |
|---|---|
| Name: | Bluetooth headset |
| Model No.: | R505, R6250, R95, R6320, R6330, R6310, R4, R208, H700, R520, R6290, R525, R535, EASYPAL_B4, R505B, S351, R831, R832, R833, R834, R835, R836, R837, R838, R839 |
| Operation Frequency: | 2402MHz~2480MHz |
| Bluetooth Version: | V3.0+EDR |
| Modulation Technique: | Frequency Hopping Spread Spectrum(FHSS) |
| Modulation Type: | GFSK, π/4DQPSK, 8DPSK |
| Number of Channel: | 79 |
| Sample Type: | Portable production |
| Test Power Grade: | 255(manufacturer declare ) |
| Test Software of EUT: | CSR blue suite (manufacturer declare ) |
| Antenna Type | Integral |
| Antenna Gain | 0dBi |
| Power Supply: | DC 5V charge by USB Port<br>DC 3.7V rechargeable battery |
| Test Voltage: | AC 120V/60Hz |

| Operation Frequency each of channel | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 1 | 2402MHz | 21 | 2422MHz | 41 | 2442MHz | 61 | 2462MHz |
| 2 | 2403MHz | 22 | 2423MHz | 42 | 2443MHz | 62 | 2463MHz |
| 3 | 2404MHz | 23 | 2424MHz | 43 | 2444MHz | 63 | 2464MHz |
| 4 | 2405MHz | 24 | 2425MHz | 44 | 2445MHz | 64 | 2465MHz |
| 5 | 2406MHz | 25 | 2426MHz | 45 | 2446MHz | 65 | 2466MHz |
| 6 | 2407MHz | 26 | 2427MHz | 46 | 2447MHz | 66 | 2467MHz |
| 7 | 2408MHz | 27 | 2428MHz | 47 | 2448MHz | 67 | 2468MHz |
| 8 | 2409MHz | 28 | 2429MHz | 48 | 2449MHz | 68 | 2469MHz |
| 9 | 2410MHz | 29 | 2430MHz | 49 | 2450MHz | 69 | 2470MHz |
| 10 | 2411MHz | 30 | 2431MHz | 50 | 2451MHz | 70 | 2471MHz |
| 11 | 2412MHz | 31 | 2432MHz | 51 | 2452MHz | 71 | 2472MHz |
| 12 | 2413MHz | 32 | 2433MHz | 52 | 2453MHz | 72 | 2473MHz |
| 13 | 2414MHz | 33 | 2434MHz | 53 | 2454MHz | 73 | 2474MHz |
| 14 | 2415MHz | 34 | 2435MHz | 54 | 2455MHz | 74 | 2475MHz |
| 15 | 2416MHz | 35 | 2436MHz | 55 | 2456MHz | 75 | 2476MHz |
| 16 | 2417MHz | 36 | 2437MHz | 56 | 2457MHz | 76 | 2477MHz |
| 17 | 2418MHz | 37 | 2438MHz | 57 | 2458MHz | 77 | 2478MHz |
| 18 | 2419MHz | 38 | 2439MHz | 58 | 2459MHz | 78 | 2479MHz |
| 19 | 2420MHz | 39 | 2440MHz | 59 | 2460MHz | 79 | 2480MHz |
| 20 | 2421MHz | 40 | 2441MHz | 60 | 2461MHz | | |

Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel | Frequency |
|---|---|
| The Lowest channel | 2402MHz |
| The Middle channel | 2441MHz |
| The Highest channel | 2480MHz |

## 4.3 Test Environment

| Operating Environment: | |
|---|---|
| Temperature: | 27.0 °C |
| Humidity: | 56 % RH |
| Atmospheric Pressure: | 1005mbar |

## 4.4 Description of Support Units

The EUT was tested with associated equipment as below:

| Description | Manufacturer | Model No. |
|---|---|---|
| Notebook | Lenovo | T42 |
| PC | IBM | 8172 |
| LCD-displaying | Lenovo | L1711pC |
| KEYBOARD | IBM | SK-8115 |
| MOUSE | Lenovo | MO28UOA |
| Coder | HengTong ELECTRON | HT4000 |
| Printer | Canon | BJC-1000SP |

## 4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch E&E Lab,
No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.
Tel: +86 755 2601 2053 Fax: +86 755 2671 0594
No tests were sub-contracted.

## 4.6 Test Facility

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

- **CNAS (No. CNAS L2929)**
  CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.
- **VCCI**
  The 3m Semi-anechoic chamber, Full-anechoic Chamber and Shielded Room (7.5m x 4.0m x 3.0m) of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2197, G-416, T-1153 and C-2383 respectively.
- **FCC – Registration No.: 556682**
  SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.: 556682.
- **Industry Canada (IC)**
  The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1.

## 4.7 Deviation from Standards

None.

## 4.8 Abnormalities from Standard Conditions

None.

## 4.9 Other Information Requested by the Customer

None.

## 4.10 Test Instruments List

| RE in Chamber | | | | | |
|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal.Due date (yyyy-mm-dd)** |
| 1 | 3m Semi-Anechoic Chamber | ETS-LINDGREN | N/A | SEL0017 | 2013-06-10 |
| 2 | EMI Test Receiver | Rohde & Schwarz | ESIB26 | SEL0023 | 2013-05-17 |
| 3 | EMI Test software | AUDIX | E3 | SEL0050 | N/A |
| 4 | BiConiLog Antenna (26-3000MHz) | ETS-LINDGREN | 3142C | SEL0015 | 2012-10-29 |
| 5 | Double-ridged horn (1-18GHz) | ETS-LINDGREN | 3117 | SEL0006 | 2012-10-29 |
| 6 | Horn Antenna (18-26GHz) | ETS-LINDGREN | 3160 | SEL0076 | 2012-10-29 |
| 7 | Pre-amplifier (0.1-1300MHz) | Agilent Technologies | 8447D | SEL0053 | 2013-05-17 |
| 8 | Pre-Amplifier (0.1-26.5GHz) | Compliance Directions Systems Inc. | PAP-0126 | SEL0168 | 2012-11-26 |
| 9 | Coaxial cable | SGS | N/A | SEL0027 | 2013-05-59 |
| 10 | Coaxial cable | SGS | N/A | SEL0189 | 2013-05-29 |
| 11 | Coaxial cable | SGS | N/A | SEL0121 | 2013-05-29 |
| 12 | Coaxial cable | SGS | N/A | SEL0178 | 2013-05-29 |
| 13 | Band filter | Amindeon | 82346 | SEL0094 | 2013-05-17 |
| 14 | Barometer | Chang Chun | DYM3 | SEL0088 | 2013-05-24 |
| 15 | DC Power Supply | Zhao Xin | RXN-305D | SEL0117 | 2012-10-23 |
| 16 | Humidity/ Temperature Indicator | Shanhai Qixiang | ZJ1-2B | SEL0103 | 2012-10-27 |
| 17 | Signal Generator (10M-27GHz) | Rohde & Schwarz | SMR27 | SEL0067 | 2013-05-17 |
| 18 | Signal Generator | Rohde & Schwarz | SMY01 | SEL0155 | 2012-10-23 |
| 19 | Loop Antenna | Beijing Daze | ZN30401 | SEL0203 | 2013-06-04 |

| Conducted Emission | | | | | |
|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal.Due date (yyyy-mm-dd)** |
| 1 | Shielding Room | ZhongYu Electron | GB-88 | SEL0042 | 2013-06-10 |
| 2 | LISN | Rohde & Schwarz | ENV216 | SEL0152 | 2012-10-23 |
| 3 | LISN | ETS-LINDGREN | 3816/2 | SEL0021 | 2013-5-17 |
| 4 | 8 Line ISN | Fischer Custom Communications Inc. | FCC-TLISN-T8-02 | SEL0162 | 2012-11-11 |
| 5 | 4 Line ISN | Fischer Custom Communications Inc. | FCC-TLISN-T4-02 | SEL0163 | 2012-11-11 |
| 6 | 2 Line ISN | Fischer Custom Communications Inc. | FCC-TLISN-T2-02 | SEL0164 | 2012-11-11 |
| 7 | EMI Test Receiver | Rohde & Schwarz | ESCI | SEL0022 | 2013-5-17 |
| 8 | Coaxial Cable | SGS | N/A | SEL0025 | 2013-05-29 |
| 9 | DC Power Supply | Zhao Xin | RXN-305D | SEL0117 | 2012-10-23 |
| 10 | Humidity/ Temperature Indicator | Shanhai Qixiang | ZJ1-2B | SEL0103 | 2012-10-27 |
| 11 | Barometer | Chang Chun | DYM3 | SEL0088 | 2013-05-24 |

| RF connected test | | | | | |
|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal.Due date (yyyy-mm-dd))** |
| 1 | DC Power Supply | Zhao Xin | RXN-305D | SEL0117 | 2012-10-23 |
| 2 | Humidity/ Temperature Indicator | HYGRO | ZJ1-2B | SEL0033 | 2012-10-27 |
| 3 | Spectrum Analyzer | Rohde & Schwarz | FSP | SEL0154 | 2012-10-23 |
| 4 | Coaxial cable | SGS | N/A | SEL0178 | 2013-05-29 |
| 5 | Coaxial cable | SGS | N/A | SEL0179 | 2013-05-29 |
| 6 | Barometer | ChangChun | DYM3 | SEL0088 | 2013-05-24 |
| 7 | Signal Generator | Rohde & Schwarz | SML03 | SEL0068 | 2013-05-17 |
| 8 | Band filter | amideon | 82346 | SEL0094 | 2013-05-17 |
| 9 | POWER METER | R & S | NRVS | SEL0144 | 2012-10-23 |
| 10 | Attenuator | Beijin feihang taida | TST-2-6dB | SEL0205 | 2013-05-17 |
| 11 | Power Divider(splitter) | Agilent Technologies | 11636B | SEL0130 | 2012-11-29 |

# 5 Test results and Measurement Data

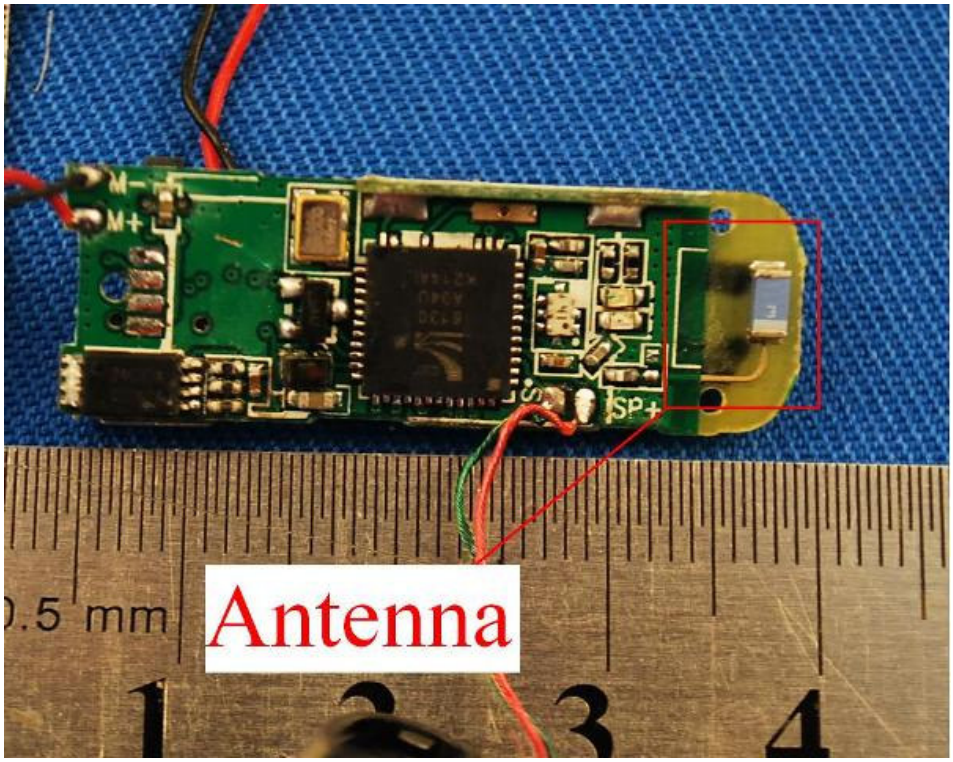
## 5.1 Antenna Requirement

| | |
|---|---|
| **Standard requirement:** | 47 CFR Part 15C Section 15.203 /247(c) |

15.203 requirement:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
15.247(b) (4) requirement:
The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

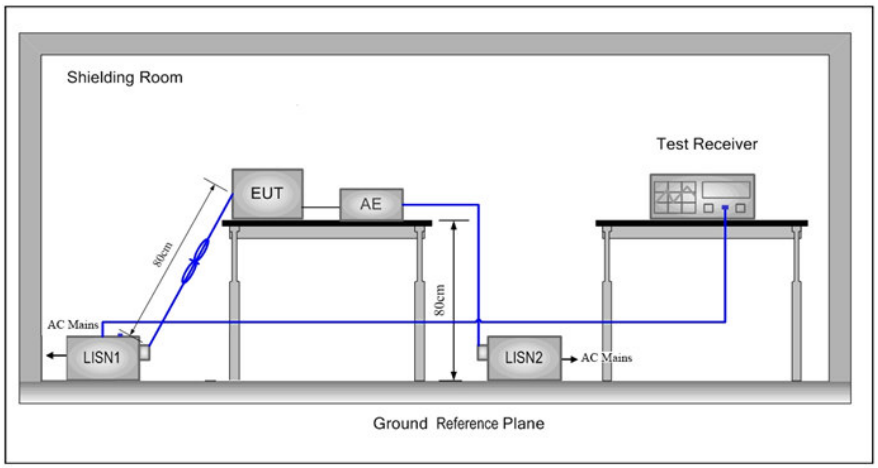
| | |
|---|---|
| **EUT Antenna:** | |

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.



## 5.2 Conducted Emissions

<table>
<tr><td>Test Requirement:</td><td>47 CFR Part 15C Section 15.207</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10: 2009</td></tr>
<tr><td>Test Frequency Range:</td><td>150kHz to 30MHz</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><th rowspan="2">Frequency range (MHz)</th><th colspan="2">Limit (dBuV)</th></tr>
<tr><th>Quasi-peak</th><th>Average</th></tr>
<tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr>
<tr><td>0.5-5</td><td>56</td><td>46</td></tr>
<tr><td>5-30</td><td>60</td><td>50</td></tr>
</table>
* Decreases with the logarithm of the frequency.
</td></tr>
<tr><td>Test Procedure:</td><td>1) The mains terminal disturbance voltage test was conducted in a shielded room.<br>2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.<br>3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,<br>4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.<br>5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2009 on conducted measurement.</td></tr>
</table>

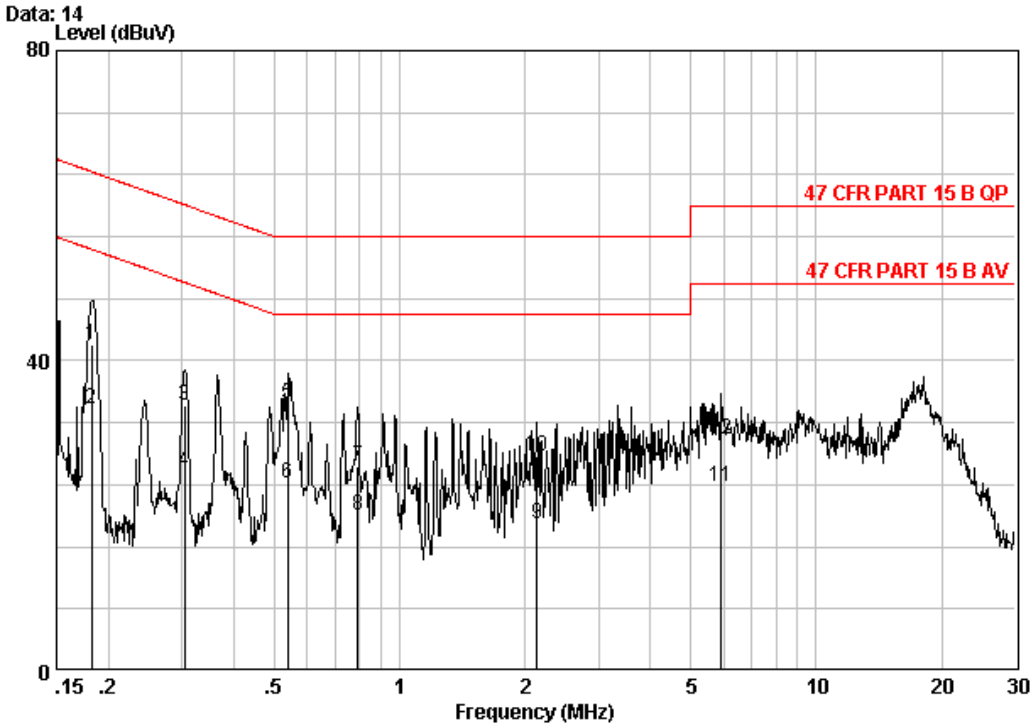
| | |
|---|---|
| Test Setup: |  |
| Test Mode: | Charge+Transmitting mode |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

**Measurement Data**

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

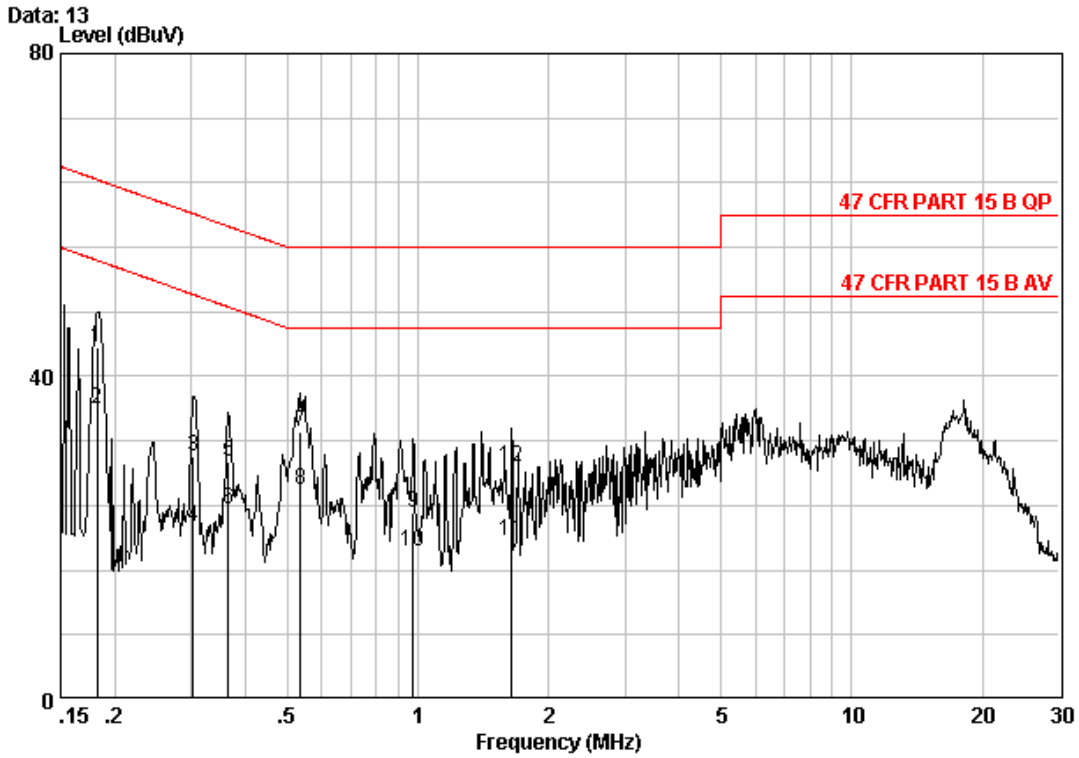
Live line:




Site : Shielding Room
Condition : 47 CFR PART 15 B QP CE LINE
Job No. : 3936RF
Mode : Charge + Transmitting

| | Freq | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB | dBuV | dBuV | dBuV | dB | |
| 1 | 0.18249 | 0.02 | 9.70 | 32.39 | 42.11 | 64.37 | -22.26 | QP |
| 2 @ | 0.18249 | 0.02 | 9.70 | 23.99 | 33.71 | 54.37 | -20.67 | Average |
| 3 | 0.30509 | 0.01 | 9.71 | 24.53 | 34.25 | 60.10 | -25.86 | QP |
| 4 | 0.30509 | 0.01 | 9.71 | 16.09 | 25.80 | 50.10 | -24.30 | Average |
| 5 | 0.53782 | 0.01 | 9.80 | 24.59 | 34.40 | 56.00 | -21.60 | QP |
| 6 | 0.53782 | 0.01 | 9.80 | 14.44 | 24.26 | 46.00 | -21.74 | Average |
| 7 | 0.79180 | 0.02 | 9.80 | 16.53 | 26.35 | 56.00 | -29.65 | QP |
| 8 | 0.79180 | 0.02 | 9.80 | 10.20 | 20.02 | 46.00 | -25.98 | Average |
| 9 | 2.133 | 0.02 | 9.81 | 9.20 | 19.03 | 46.00 | -26.97 | Average |
| 10 | 2.133 | 0.02 | 9.81 | 17.92 | 27.75 | 56.00 | -28.25 | QP |
| 11 | 5.929 | 0.01 | 9.90 | 13.93 | 23.84 | 50.00 | -26.16 | Average |
| 12 | 5.929 | 0.01 | 9.90 | 20.03 | 29.94 | 60.00 | -30.06 | QP |

Neutral line:




Site : Shielding Room
Condition : 47 CFR PART 15 B QP CE NEUTRAL
Job No. : 3936RF
Mode : Charge + Transmitting

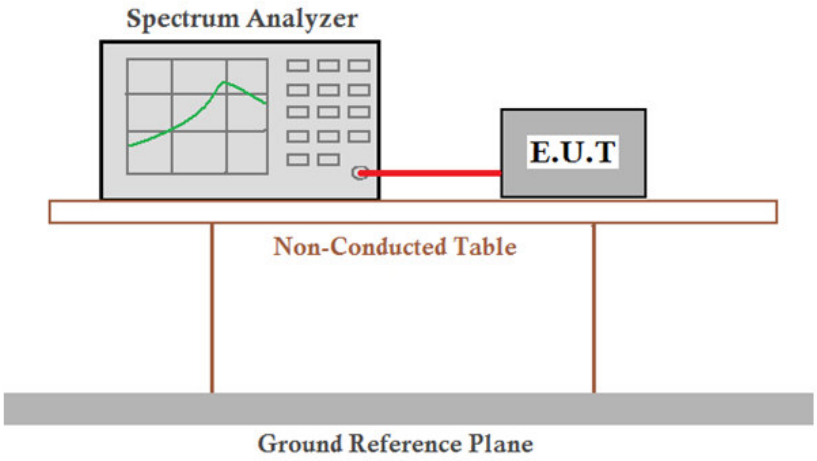
| | Freq | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB | dBuV | dBuV | dBuV | dB | |
| 1 @ | 0.18249 | 0.02 | 9.70 | 33.81 | 43.53 | 64.37 | -20.84 | QP |
| 2 @ | 0.18249 | 0.02 | 9.70 | 26.26 | 35.98 | 54.37 | -18.39 | Average |
| 3 | 0.30348 | 0.01 | 9.71 | 20.44 | 30.16 | 60.15 | -29.99 | QP |
| 4 | 0.30348 | 0.01 | 9.71 | 11.74 | 21.46 | 50.15 | -28.69 | Average |
| 5 | 0.36531 | 0.01 | 9.77 | 19.65 | 29.43 | 58.61 | -29.18 | QP |
| 6 | 0.36531 | 0.01 | 9.77 | 13.76 | 23.54 | 48.61 | -25.06 | Average |
| 7 | 0.53498 | 0.01 | 9.80 | 23.38 | 33.19 | 56.00 | -22.81 | QP |
| 8 @ | 0.53498 | 0.01 | 9.80 | 16.02 | 25.84 | 46.00 | -20.16 | Average |
| 9 | 0.97354 | 0.02 | 9.80 | 13.36 | 23.18 | 56.00 | -32.82 | QP |
| 10 | 0.97354 | 0.02 | 9.80 | 8.53 | 18.35 | 46.00 | -27.65 | Average |
| 11 | 1.645 | 0.02 | 9.80 | 9.80 | 19.62 | 46.00 | -26.38 | Average |
| 12 | 1.645 | 0.02 | 9.80 | 19.05 | 28.87 | 56.00 | -27.13 | QP |

*Notes:*

*1. The following Quasi-Peak and Average measurements were performed on the EUT:*

*2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.*

## 5.3 Conducted Peak Output Power

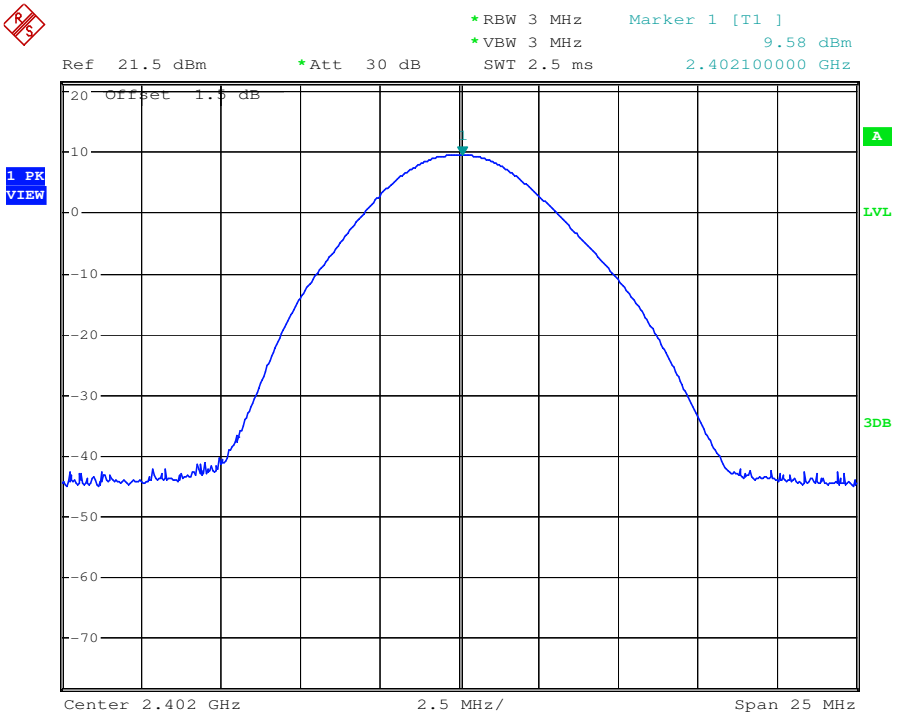
| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (b)(1) |
| Test Method: | ANSI C63.10:2009 |
| Test Setup: |  <br>*Remark:*<br>*Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.* |
| Limit: | 30dBm |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type |
| Final Test Mode: | Through Pre-scan, find the DH1 of date type is the worse case of GFSK modulation type, 2-DH1 of date type is worse case of π/4DQPSK modulation type, 3-DH1 of date type is worse case of 8DPSK modulation type. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

**Measurement Data**

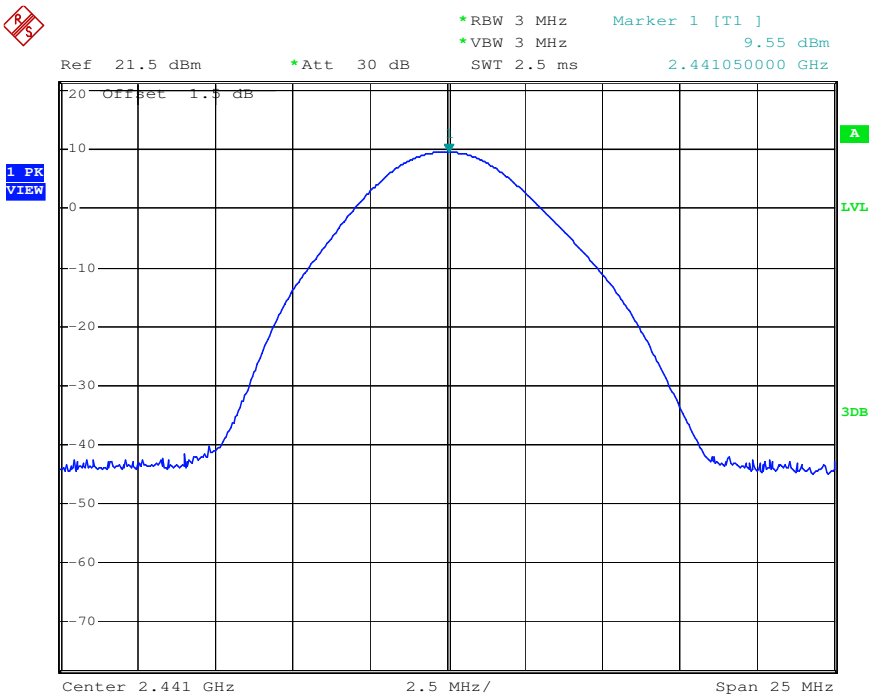
| GFSK mode | | | |
|---|---|---|---|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 9.58 | 30.00 | Pass |
| Middle | 9.55 | 30.00 | Pass |
| Highest | 9.23 | 30.00 | Pass |
| π/4DQPSK mode | | | |
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 8.16 | 30.00 | Pass |
| Middle | 8.42 | 30.00 | Pass |
| Highest | 7.90 | 30.00 | Pass |
| 8DPSK mode | | | |
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 8.89 | 30.00 | Pass |
| Middle | 8.66 | 30.00 | Pass |
| Highest | 8.17 | 30.00 | Pass |

**Test plot as follows:**

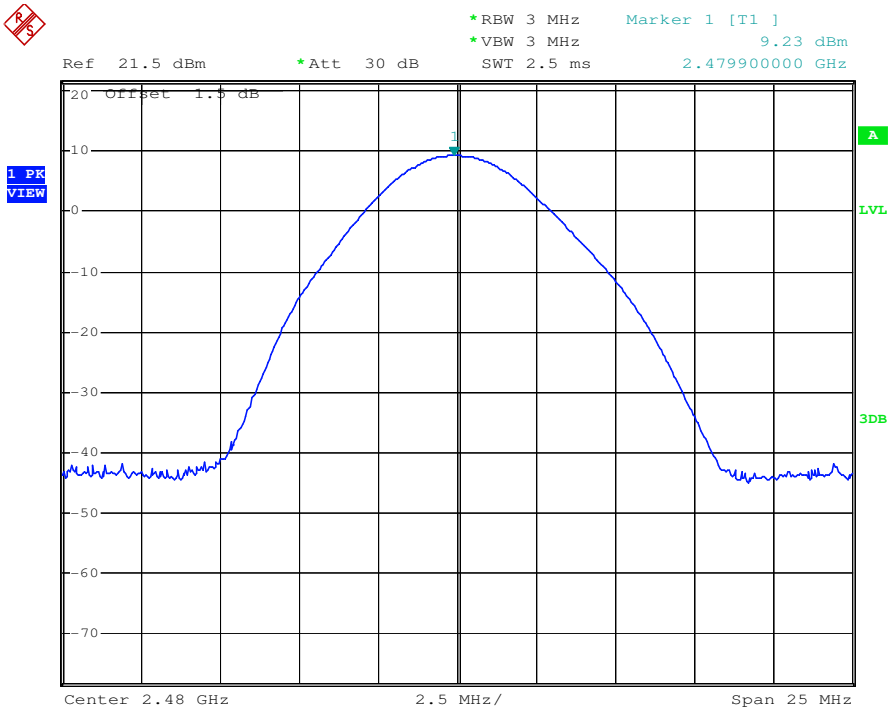
| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|



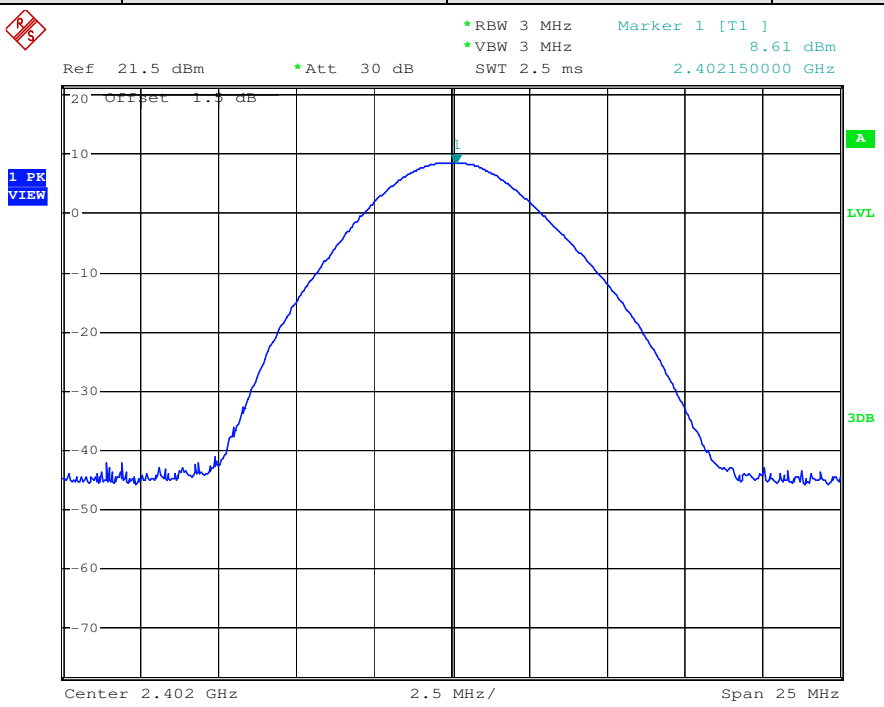

| Test mode: Transmitting | GFSK | Test channel: | Middle |
|---|---|---|---|



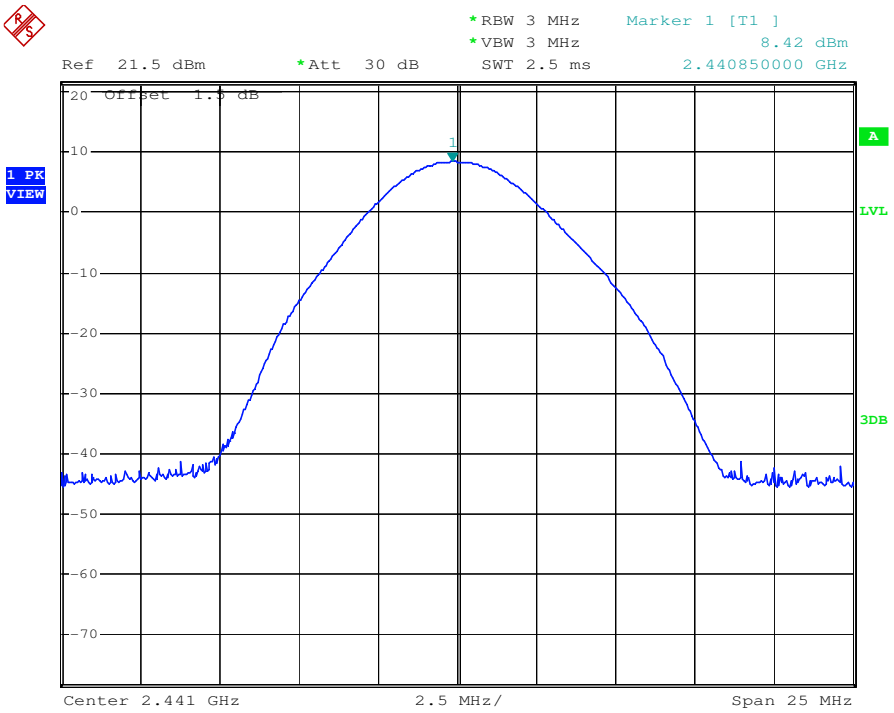
| Test mode: Transmitting | GFSK | Test channel: | Highest |
|---|---|---|---|



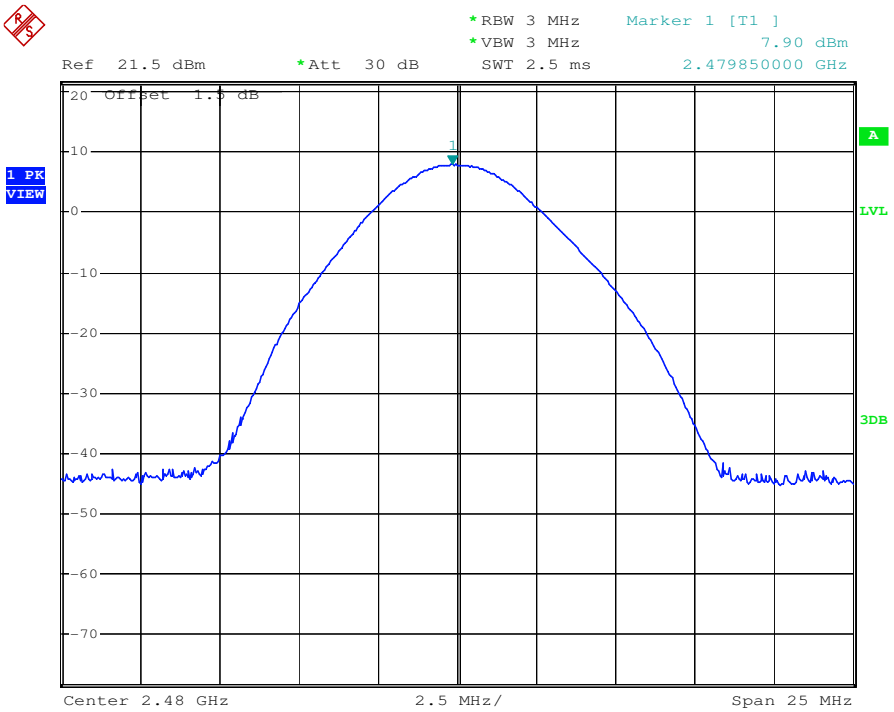

| Test mode: Transmitting | π/4DQPSK | Test channel: | Lowest |
|---|---|---|---|



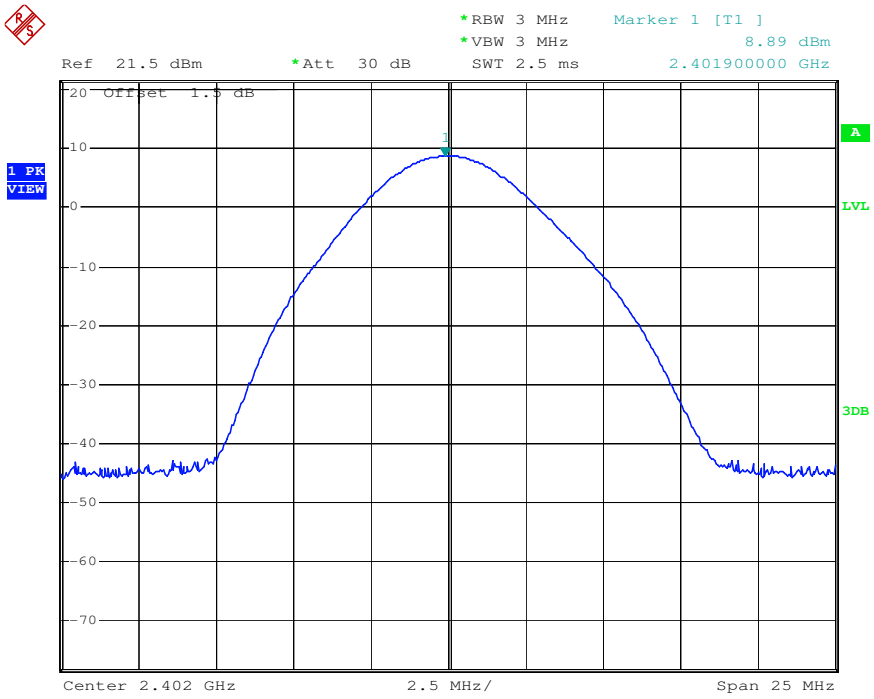
| Test mode: Transmitting | π/4DQPSK | Test channel: | Middle |
|---|---|---|---|



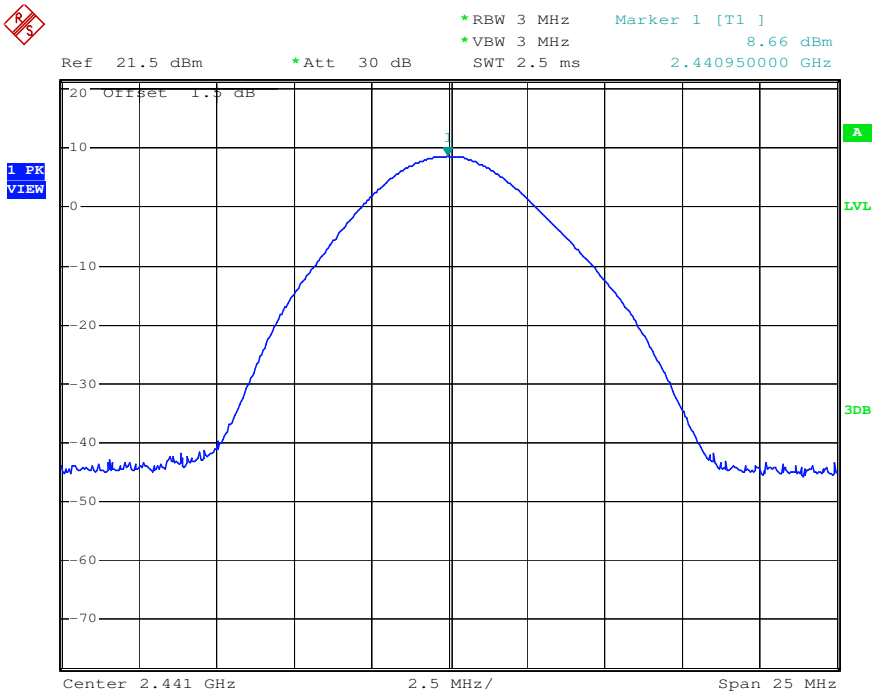

| Test mode: Transmitting | π/4DQPSK | Test channel: | Highest |
|---|---|---|---|



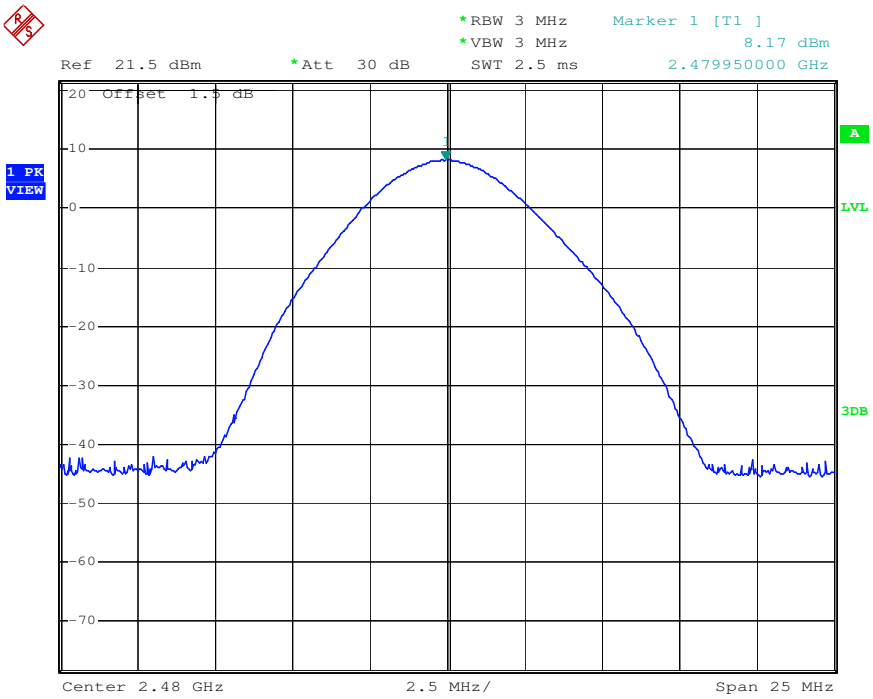
| Test mode: Transmitting | 8DPSK | Test channel: | Lowest |
|---|---|---|---|



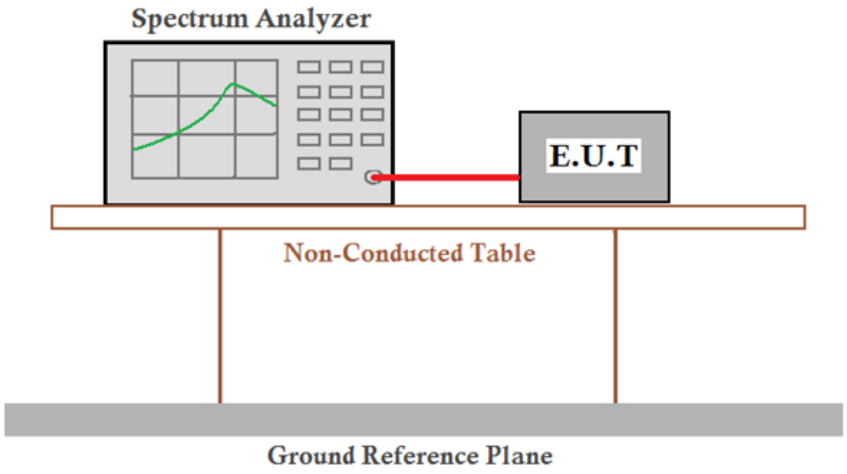

| Test mode: Transmitting | 8DPSK | Test channel: | Middle |
|---|---|---|---|



| Test mode: Transmitting | 8DPSK | Test channel: | Highest |
|---|---|---|---|



## 5.4 20dB Occupy Bandwidth

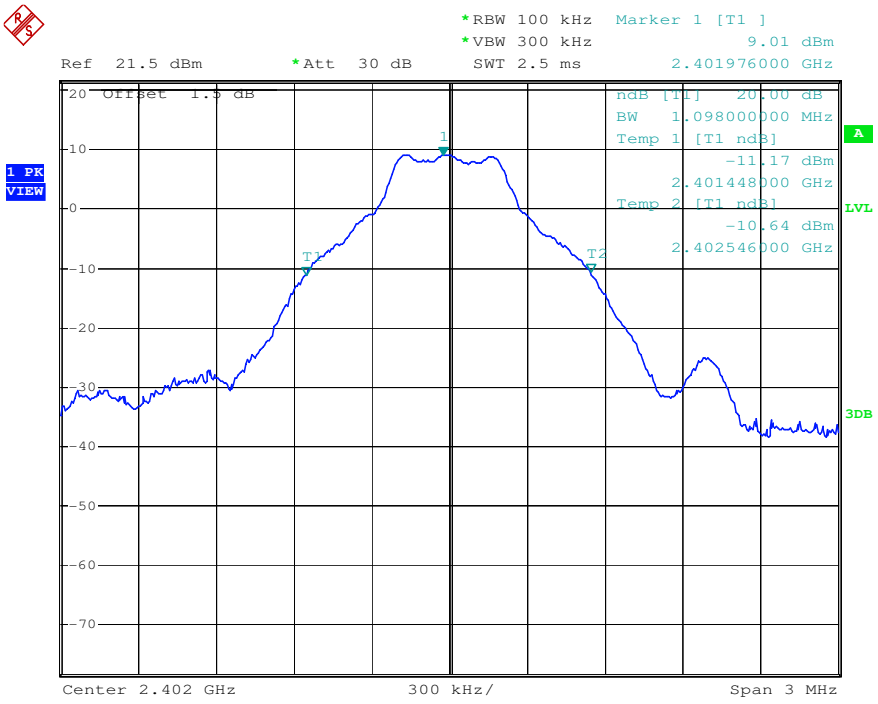
| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(1) |
| Test Method: | ANSI C63.10:2009 |
| Test Setup: |  |
| Limit: | NA |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type |
| Final Test Mode: | Through Pre-scan, find the DH1 of date type is the worse case of GFSK modulation type, 2-DH1 of date type is worse case of π/4DQPSK modulation type, 3-DH1 of date type is worse case of 8DPSK modulation type.. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

**Measurement Data**

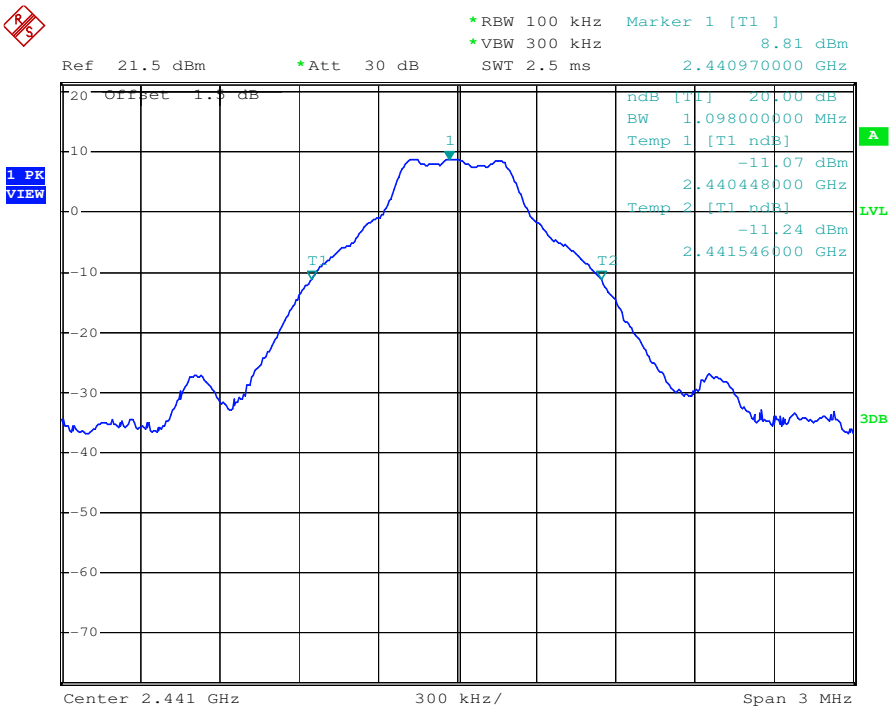
| Test channel | 20dB Occupy Bandwidth (kHz) | | |
|---|---|---|---|
| | GFSK | π/4DQPSK | 8DPSK |
| Lowest | 1098 | 1386 | 1344 |
| Middle | 1098 | 1374 | 1344 |
| Highest | 1104 | 1356 | 1350 |

**Test plot as follows:**

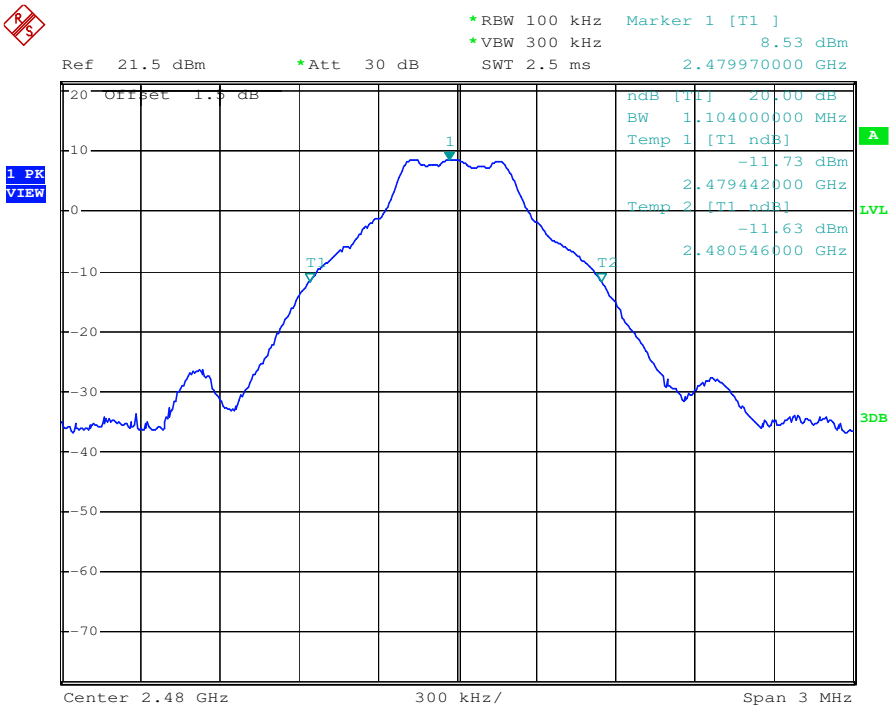
| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|



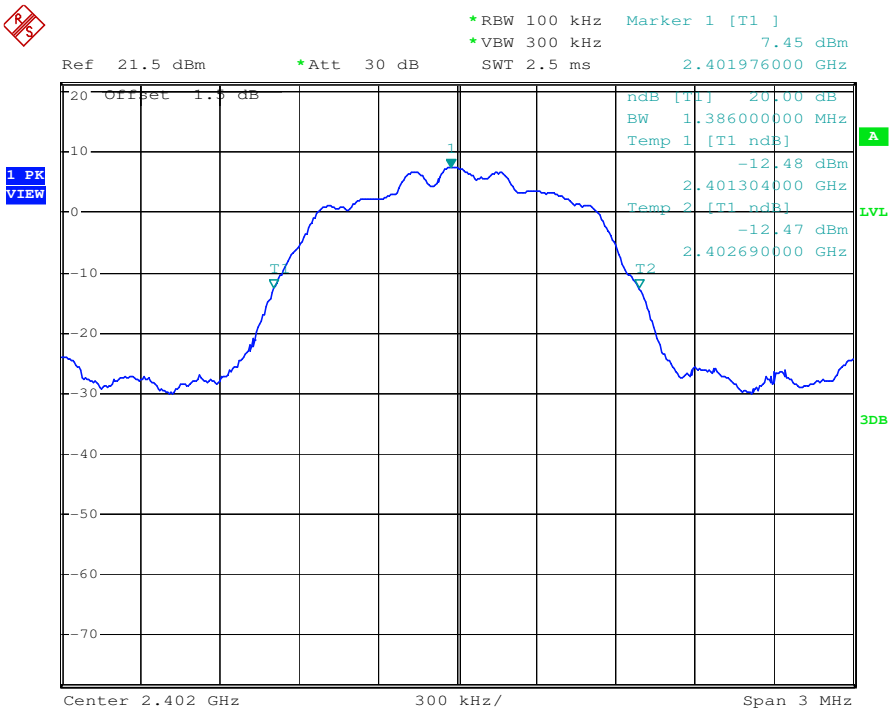

| Test mode: | GFSK | Test channel: | Middle |
|---|---|---|---|



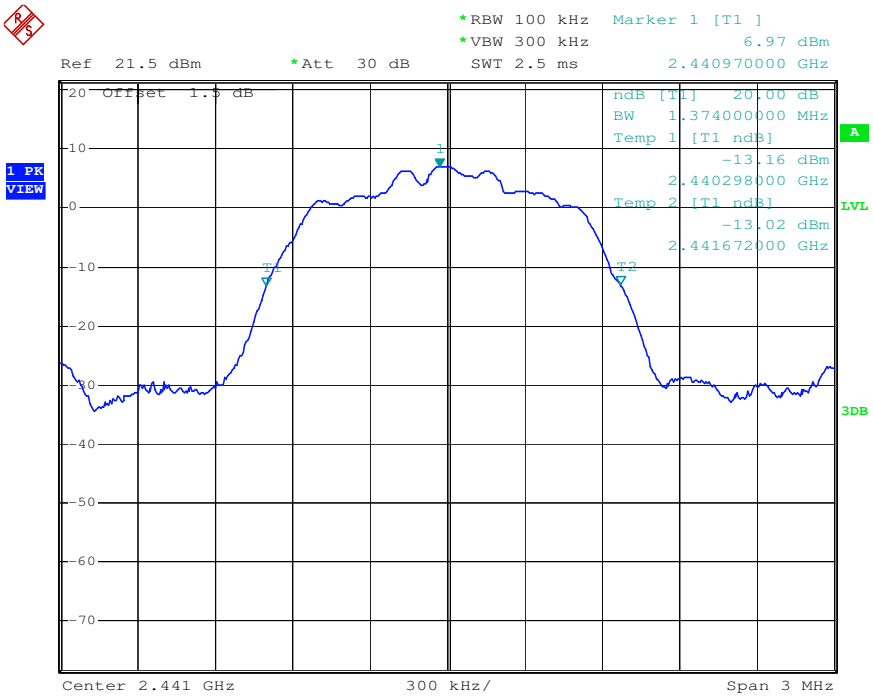
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|



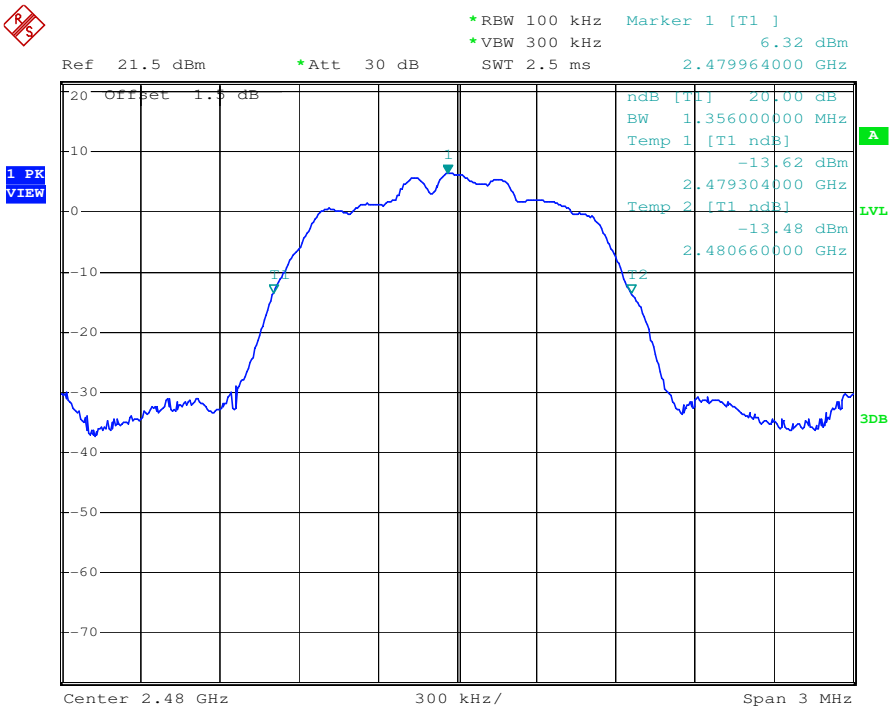

| Test mode: | π/4DQPSK | Test channel: | Lowest |
|---|---|---|---|



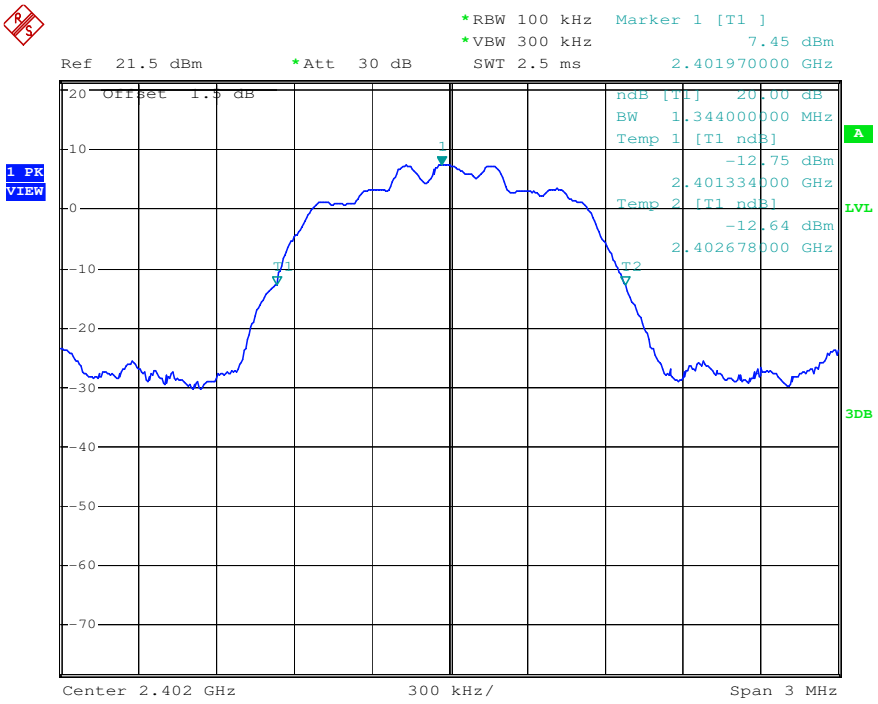
| Test mode: | π/4DQPSK | Test channel: | Middle |
|---|---|---|---|



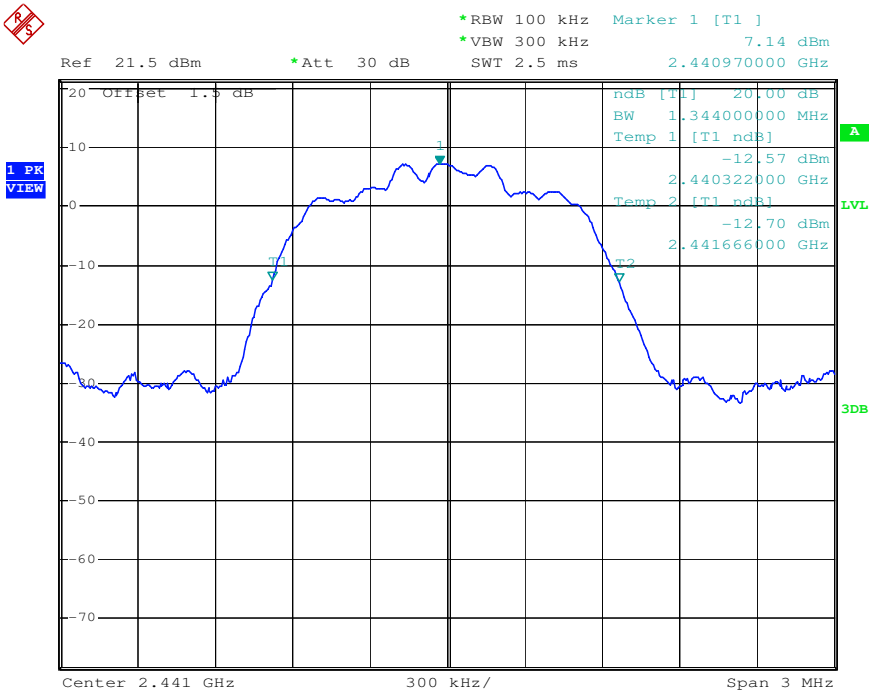

| Test mode: | π/4DQPSK | Test channel: | Highest |
|---|---|---|---|



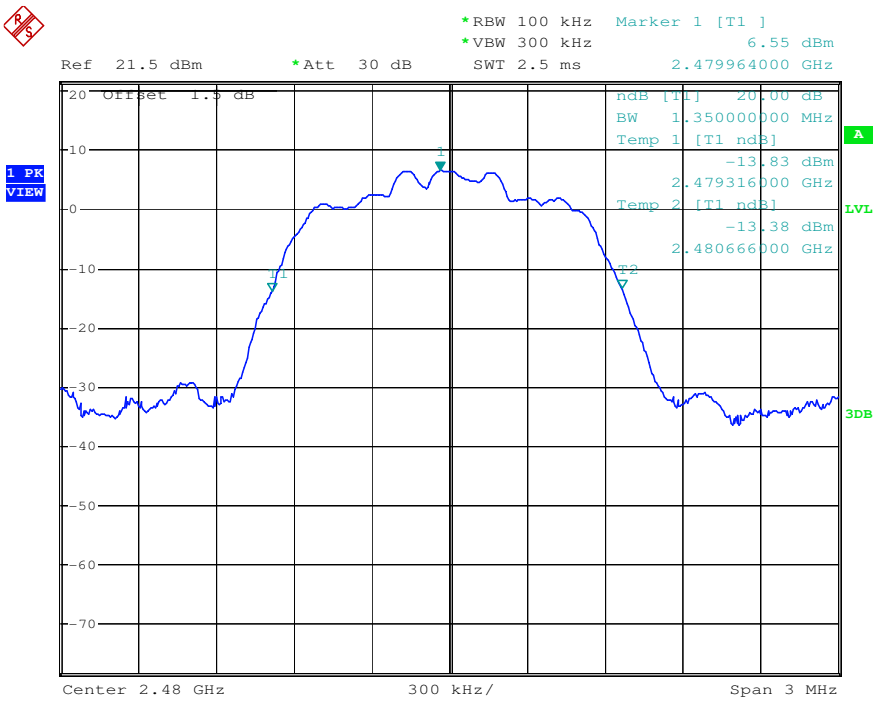
| Test mode: | 8DPSK | Test channel: | Lowest |
|---|---|---|---|



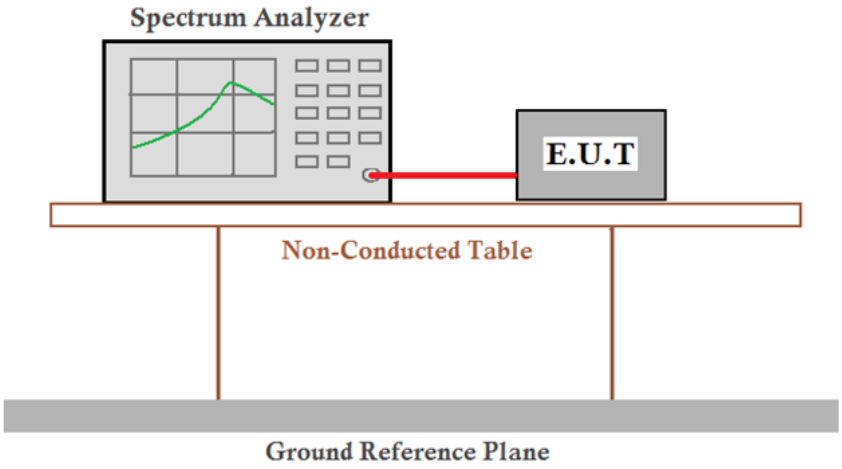

| Test mode: | 8DPSK | Test channel: | Middle |
|---|---|---|---|



| Test mode: | 8DPSK | Test channel: | Highest |
|---|---|---|---|



## 5.5 Carrier Frequencies Separation

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(1) |
| Test Method: | ANSI C63.10:2009 |
| Test Setup: |  |
| Limit: | 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater) |
| Exploratory Test Mode: | Hopping transmitting with all kind of modulation and all kind of data type |
| Final Test Mode: | Through Pre-scan, find the DH1 of date type is the worse case of GFSK modulation type, 2-DH1 of date type is worse case of π/4DQPSK modulation type, 3-DH1 of date type is worse case of 8DPSK modulation type. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

**Measurement Data**

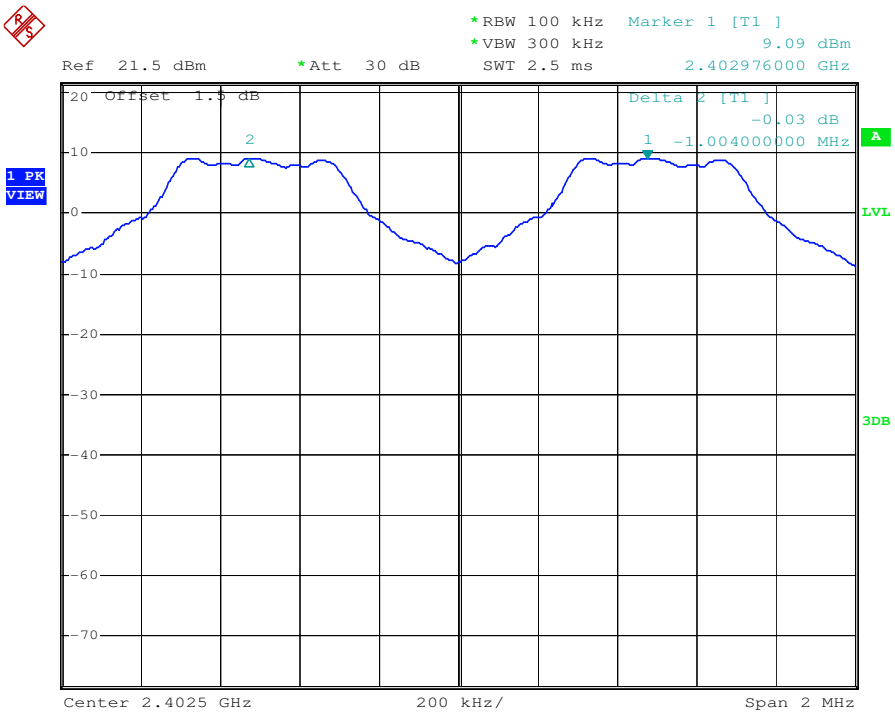
| GFSK mode | | | |
|---|---|---|---|
| Test channel | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest | 1004 | ≥924 | Pass |
| Middle | 1008 | ≥924 | Pass |
| Highest | 1004 | ≥924 | Pass |
| π/4DQPSK mode | | | |
| Test channel | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest | 1000 | ≥924 | Pass |
| Middle | 1000 | ≥924 | Pass |
| Highest | 1004 | ≥924 | Pass |
| 8DPSK mode | | | |
| Test channel | Carrier Frequencies Separation (kHz) | Limit (kHz) | Result |
| Lowest | 1012 | ≥924 | Pass |
| Middle | 1000 | ≥924 | Pass |
| Highest | 1004 | ≥924 | Pass |

Note: According to section 5.4,

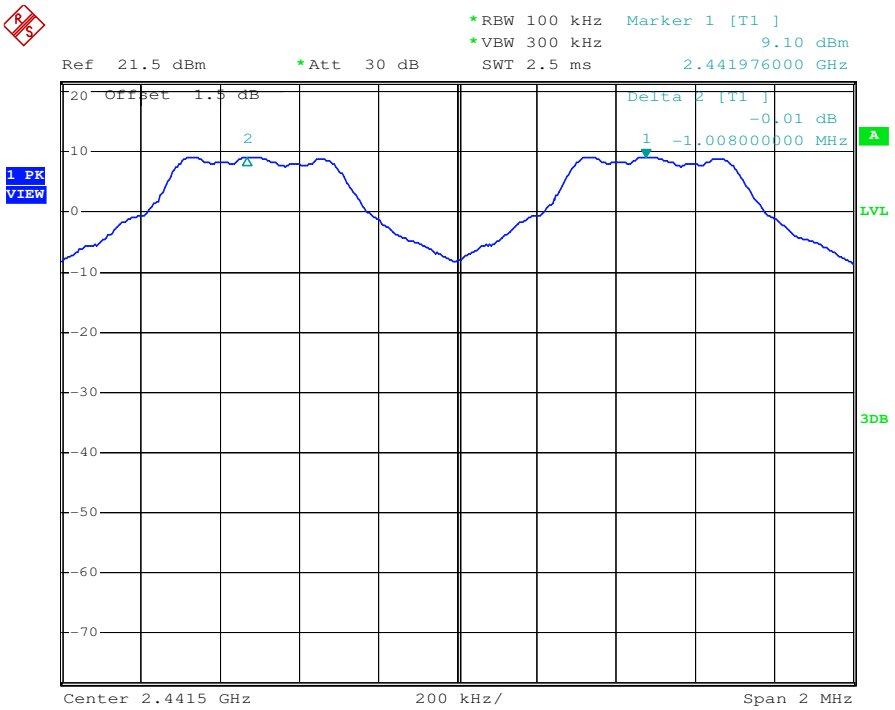
| Mode | 20dB bandwidth (kHz) (worse case) | Limit (kHz) (Carrier Frequencies Separation) |
|---|---|---|
| GFSK | 1104 | 736 |
| π/4DQPSK | 1386 | 924 |
| 8DPSK | 1350 | 900 |

**Test plot as follows:**

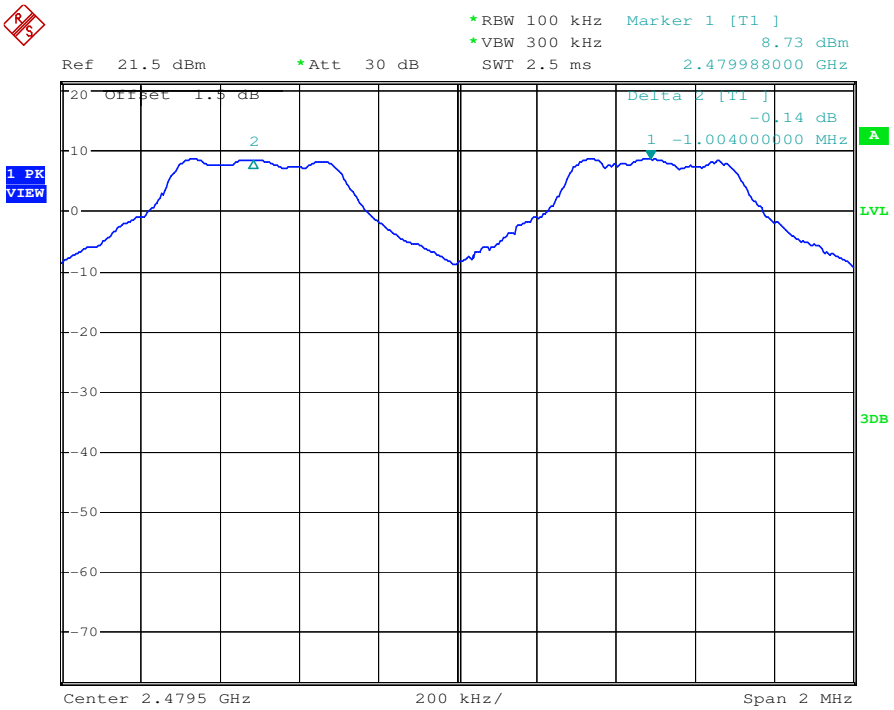
| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|



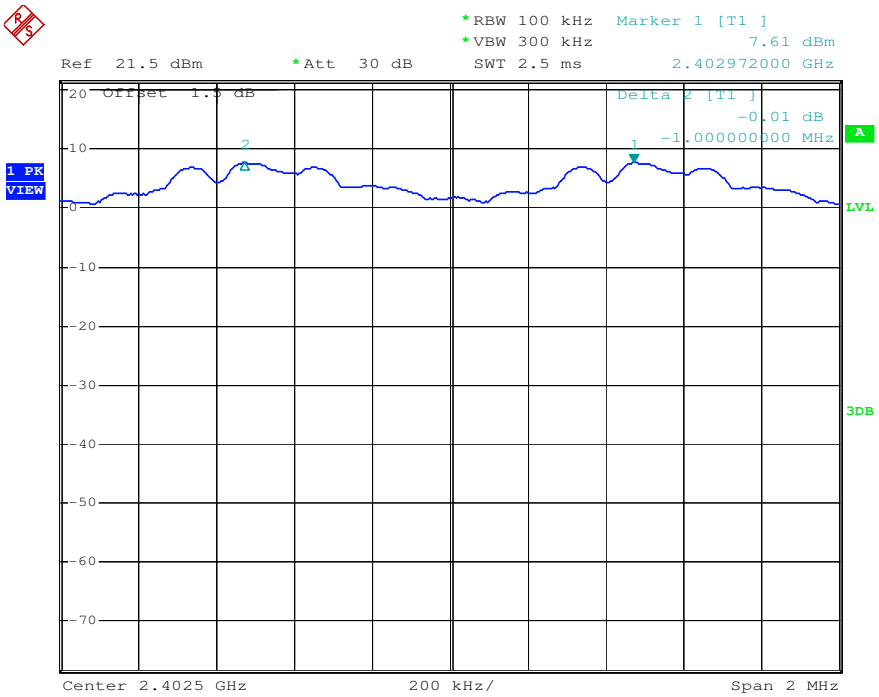

| Test mode: | GFSK | Test channel: | Middle |
|---|---|---|---|



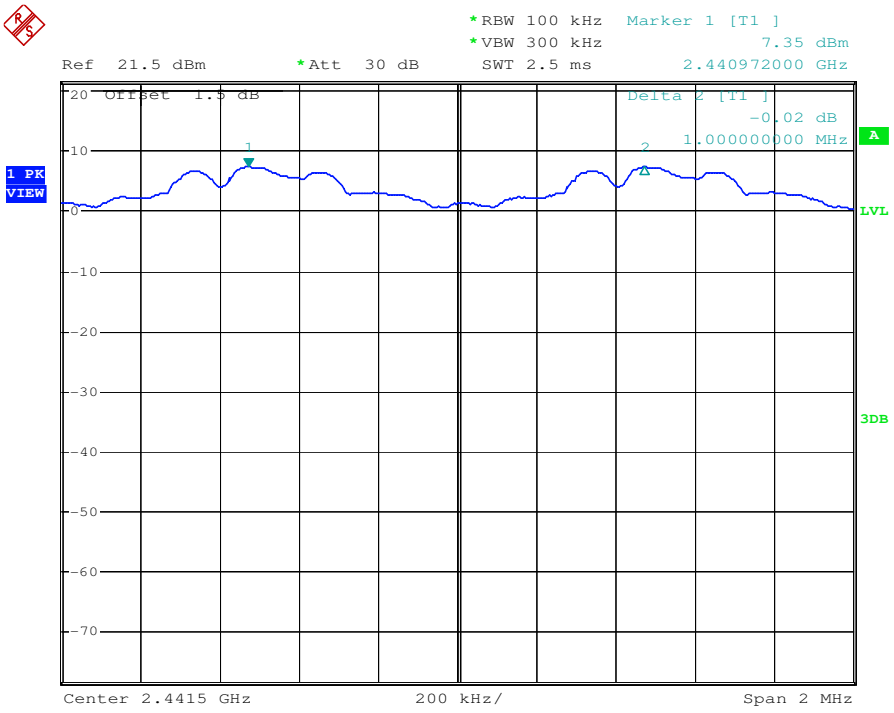
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|



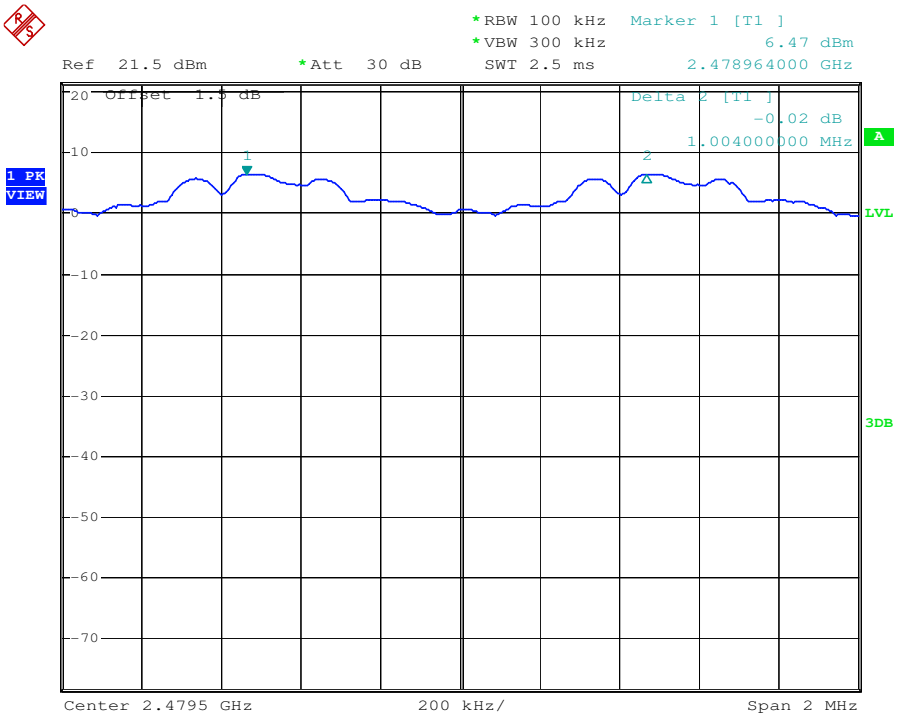

| Test mode: | π/4DQPSK | Test channel: | Lowest |
|---|---|---|---|



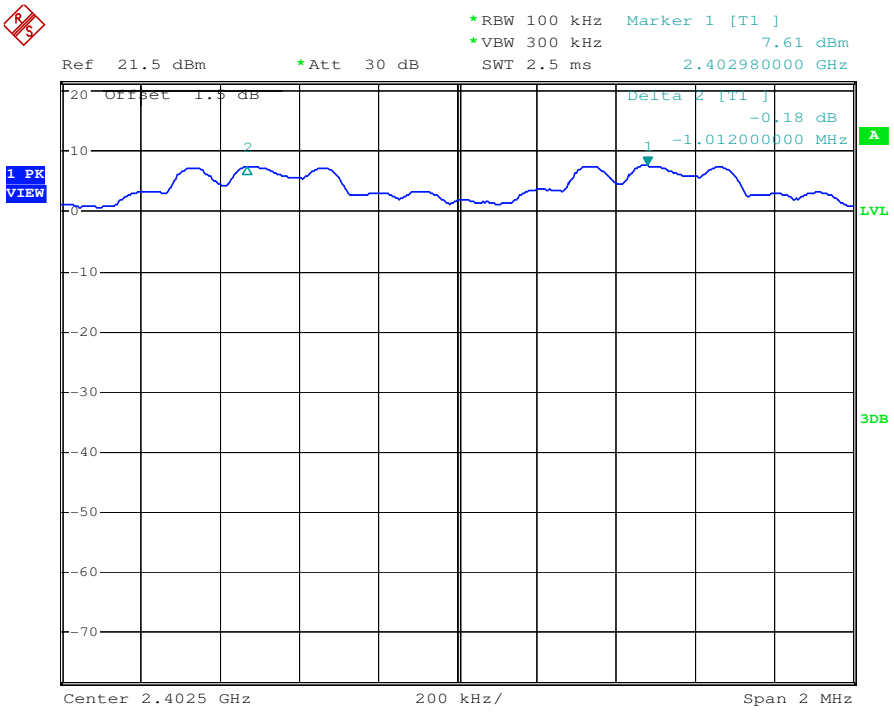
| Test mode: | π/4DQPSK | Test channel: | Middle |
|---|---|---|---|



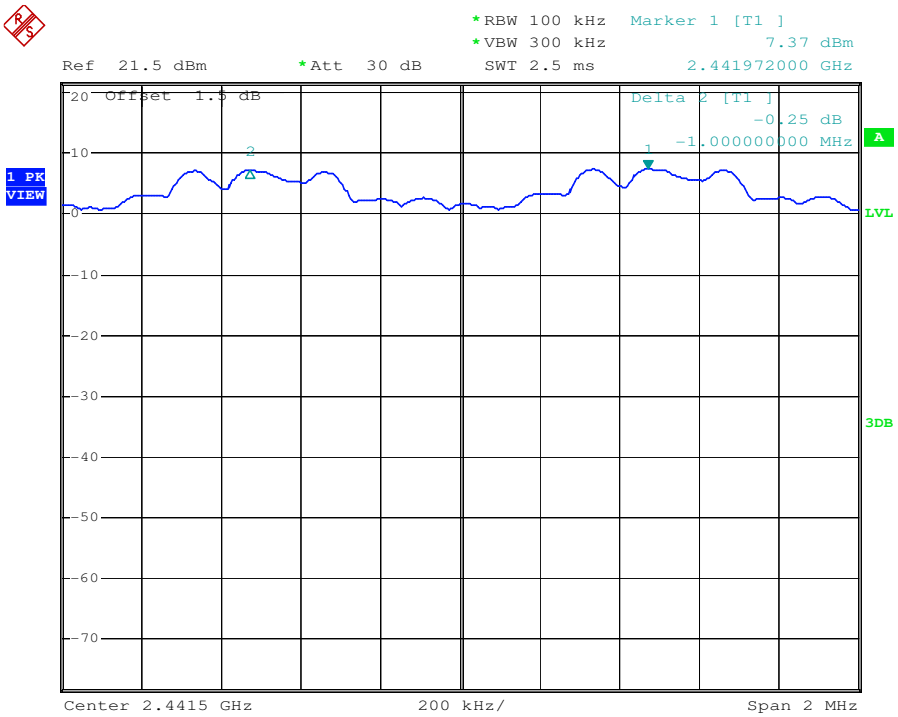

| Test mode: | π/4DQPSK | Test channel: | Highest |
|---|---|---|---|



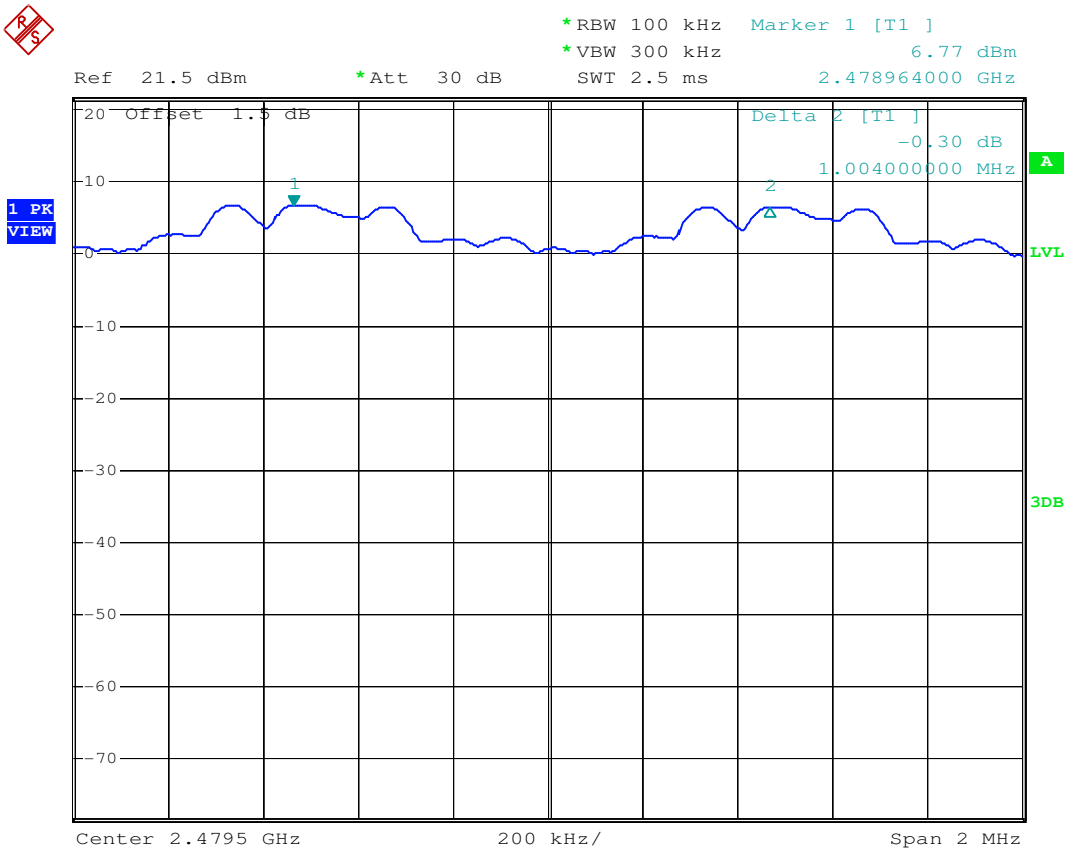
| Test mode: | 8DPSK | Test channel: | Lowest |
|---|---|---|---|



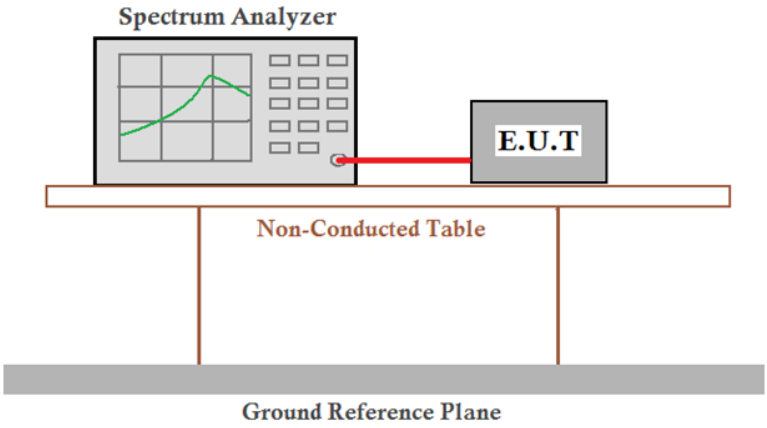

| Test mode: | 8DPSK | Test channel: | Middle |
|---|---|---|---|



| Test mode: | 8DPSK | Test channel: | Highest |
|---|---|---|---|



## 5.6 Hopping Channel Number

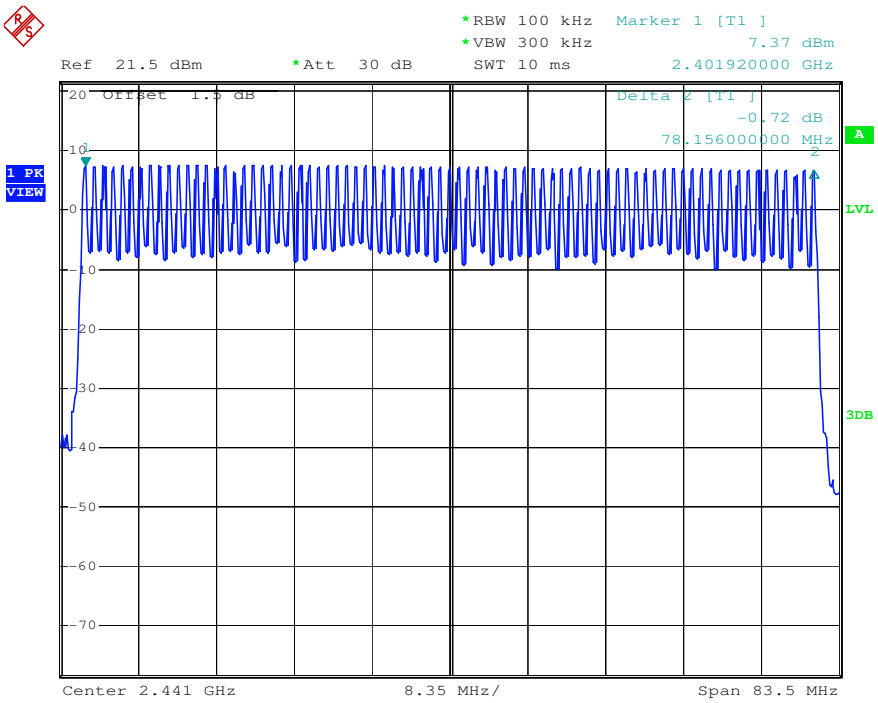
| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (b) |
| Test Method: | ANSI C63.10:2009 |
| Test Setup: |  |
| Limit: | At least 15 channels |
| Test Mode: | Hopping transmitting with all kind of modulation |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

**Measurement Data**

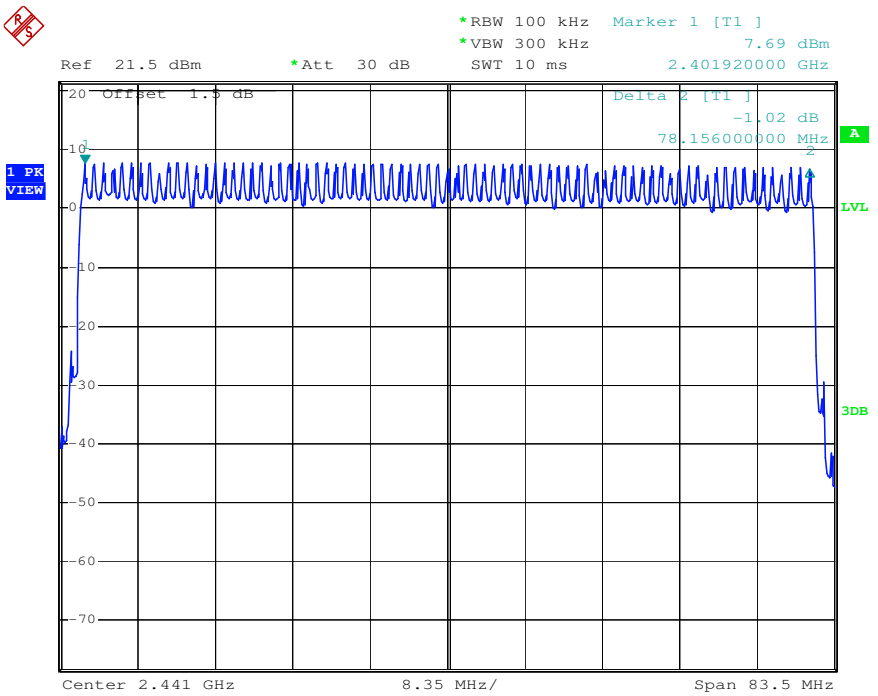
| Mode | Hopping channel numbers | Limit |
|---|---|---|
| GFSK | 79 | ≥15 |
| π/4DQPSK | 79 | ≥15 |
| 8DPSK | 79 | ≥15 |

**Test plot as follows:**

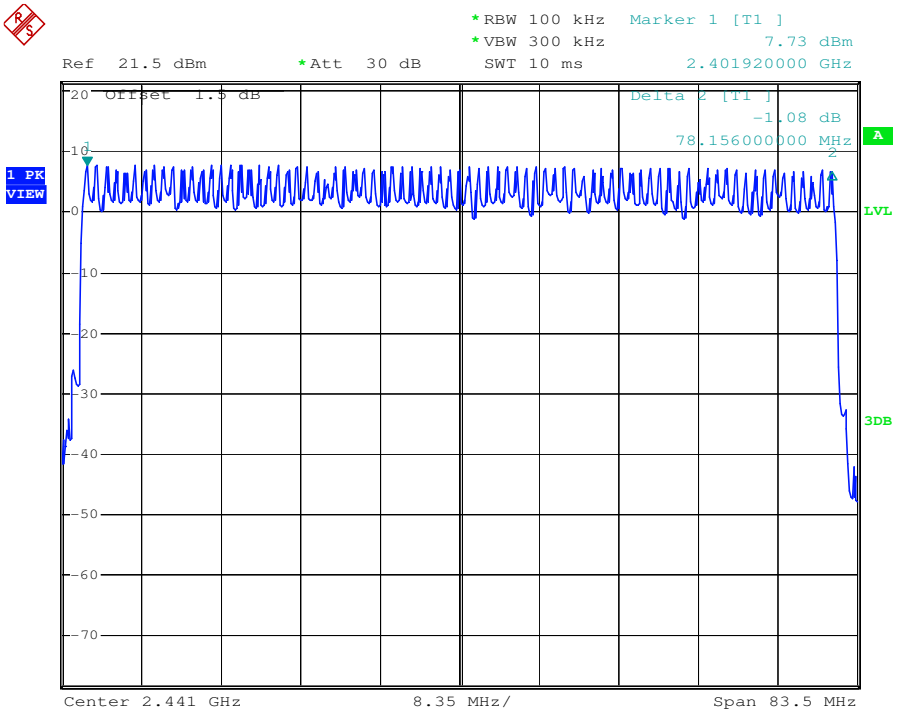
| Test mode: | GFSK |
|---|---|



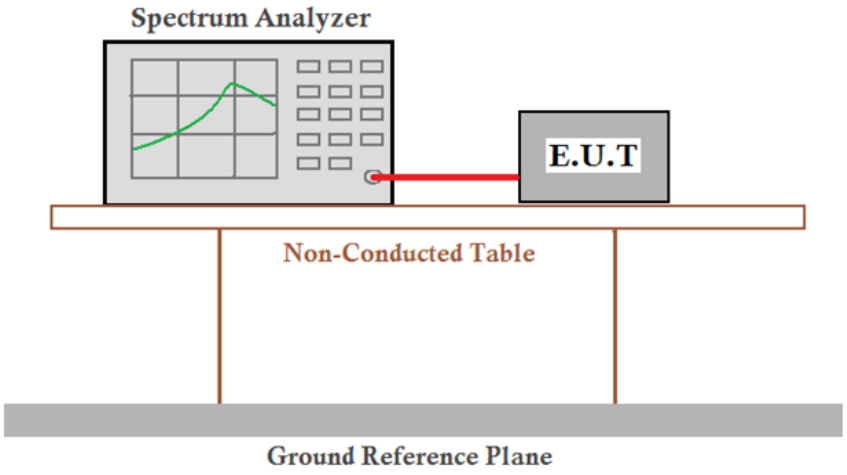

| Test mode: | π/4DQPSK |
|---|---|



| Test mode: | 8DPSK |
|---|---|



## 5.7 Dwell Time

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(1) |
| Test Method: | ANSI C63.10:2009 |
| Test Setup: |  |
| Instruments Used: | Refer to section 4.10 for details |
| Test Mode: | Hopping transmitting with all kind of modulation and all kind of data type. |
| Limit: | 0.4 Second |
| Test Results: | Pass |

**Measurement Data**

| Mode | Packet | Dwell time (second) | Limit (second) |
|---|---|---|---|
| GFSK | DH1 | 0.1696 | 0.4 |
| | DH3 | 0.2848 | 0.4 |
| | DH5 | 0.3241 | 0.4 |
| π/4DQPSK | 2-DH1 | 0.1744 | 0.4 |
| | 2-DH3 | 0.2856 | 0.4 |
| | 2-DH5 | 0.1967 | 0.4 |
| 8DPSK | 3-DH1 | 0.1744 | 0.4 |
| | 3-DH3 | 0.2872 | 0.4 |
| | 3-DH5 | 0.3251 | 0.4 |

**Test Result:**

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

The lowest channel (2402MHz), middle channel (2441MHz), highest channel (2480MHz) as below

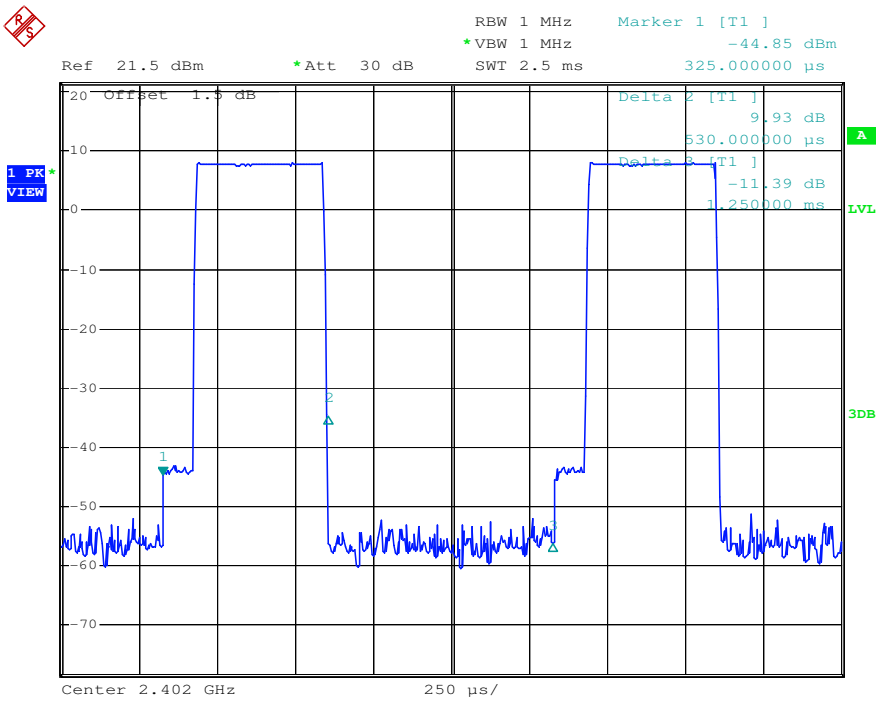
DH1 time slot=0.530(ms)*(1600/ (2*79))*31.6=169.6 ms

DH3 time slot=1.78(ms)*(1600/ (4*79))*31.6=284.8ms

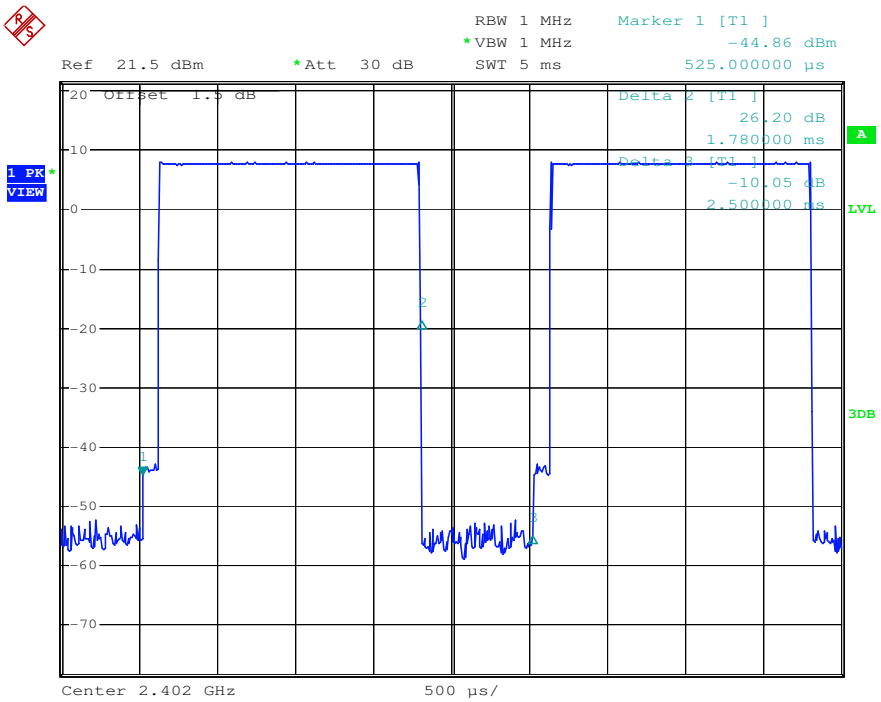
DH5 time slot=3.04(ms)*(1600/ (6*79))*31.6=324.1ms

**Test plot as follows:**

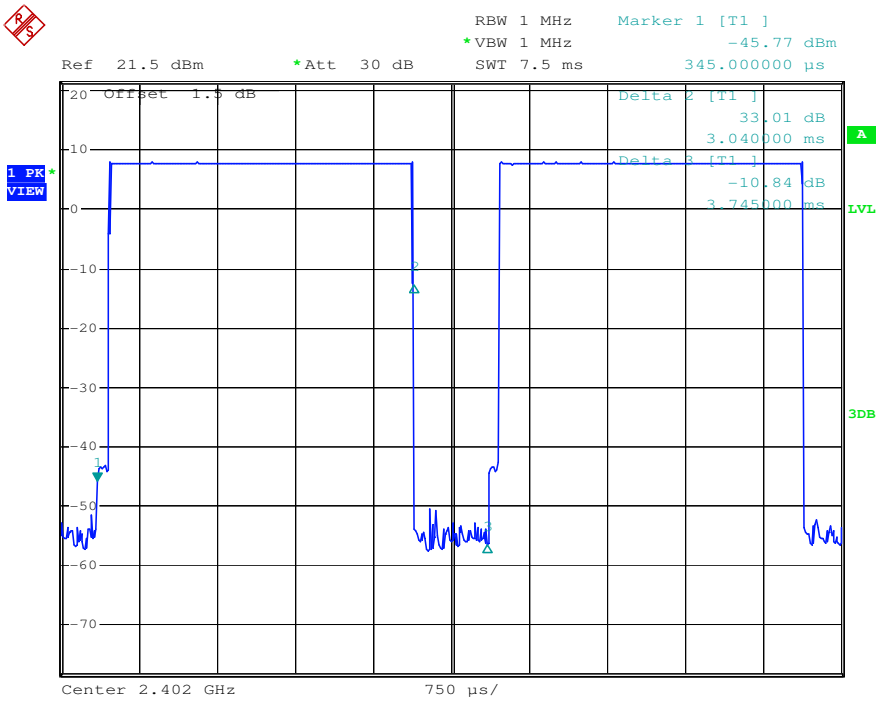
| Test Packet: | DH1 |
|---|---|



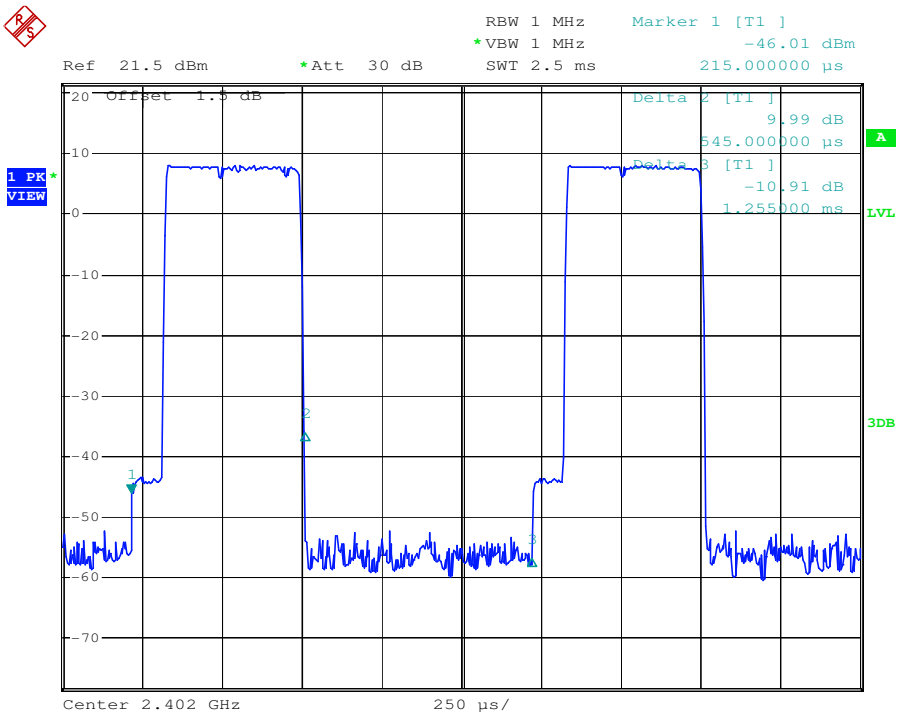

| Test Packet: | DH3 |
|---|---|



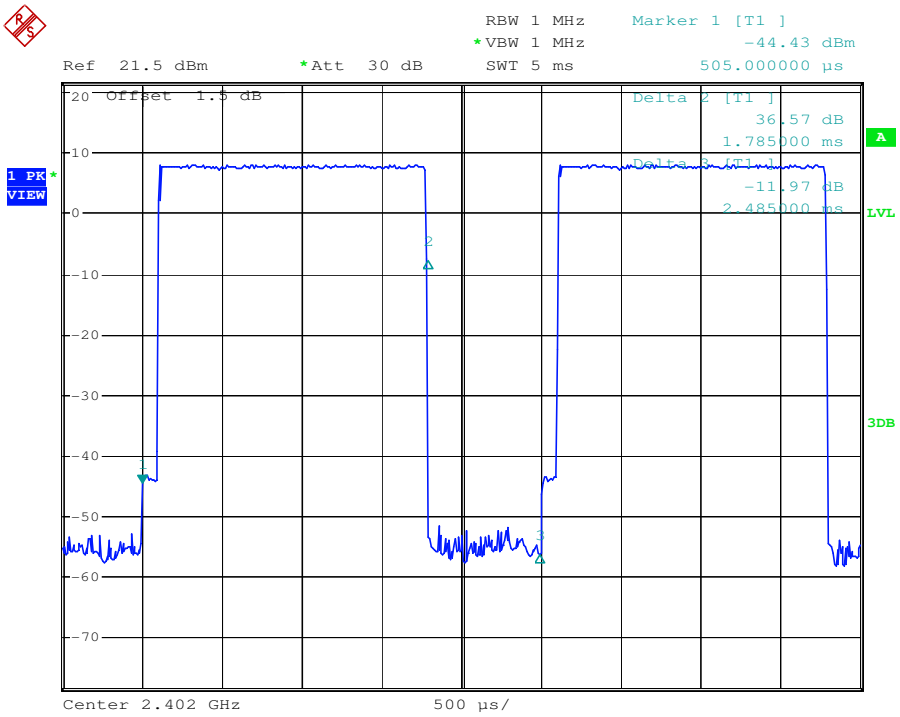
| Test Packet: | DH5 |
|---|---|



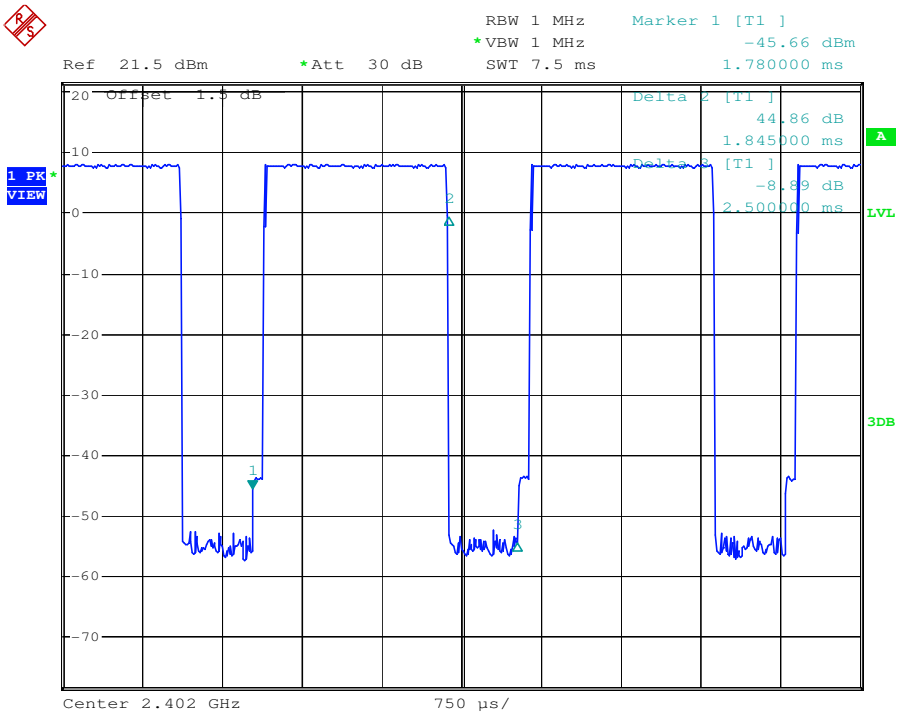

| Test Packet: | 2-DH1 |
|---|---|



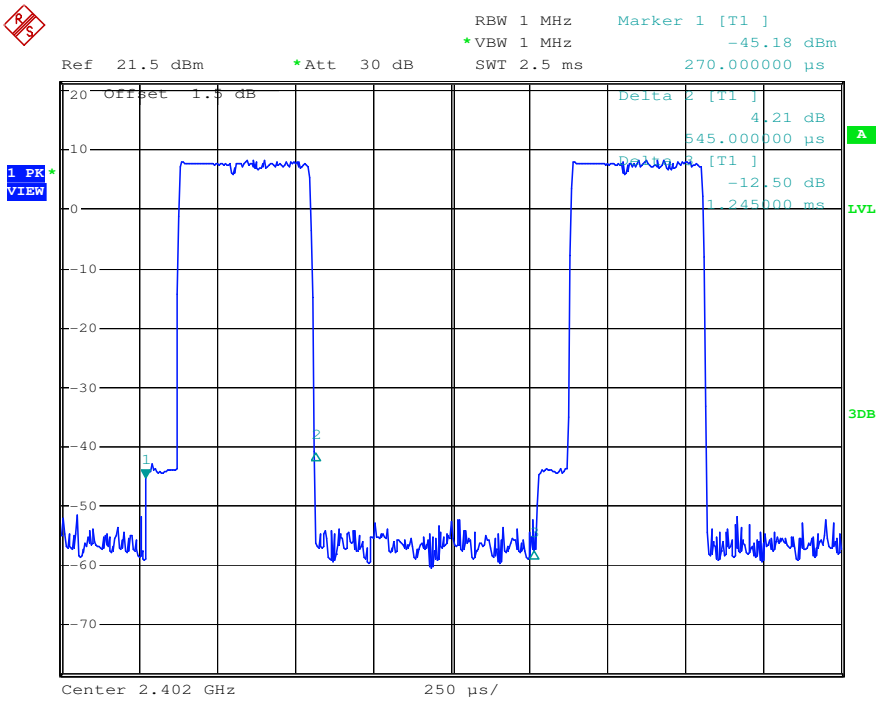
| Test Packet: | 2-DH3 |
|---|---|



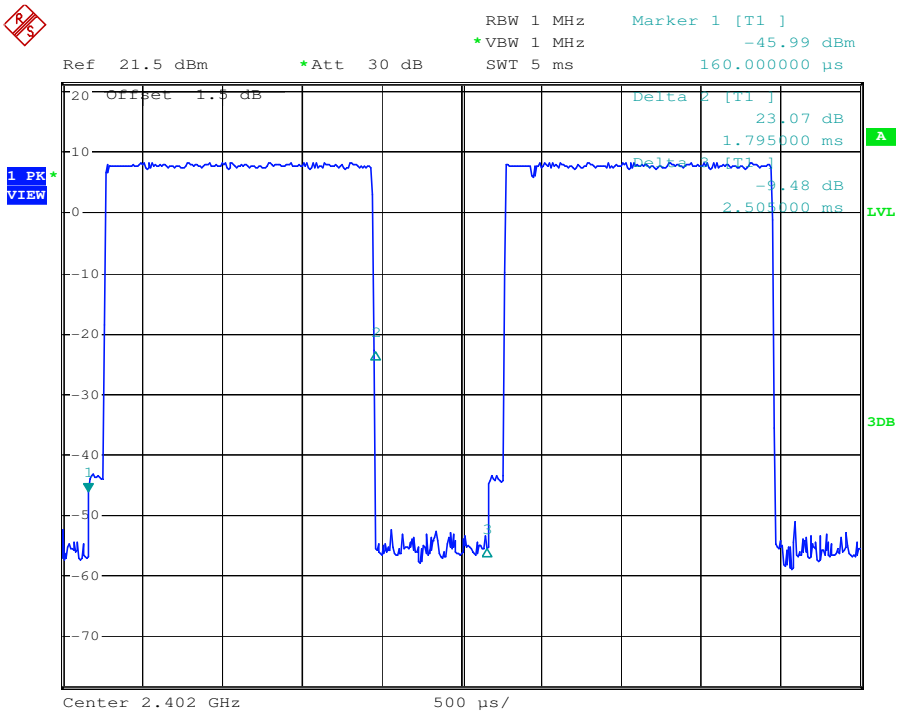

| Test Packet: | 2-DH5 |
|---|---|



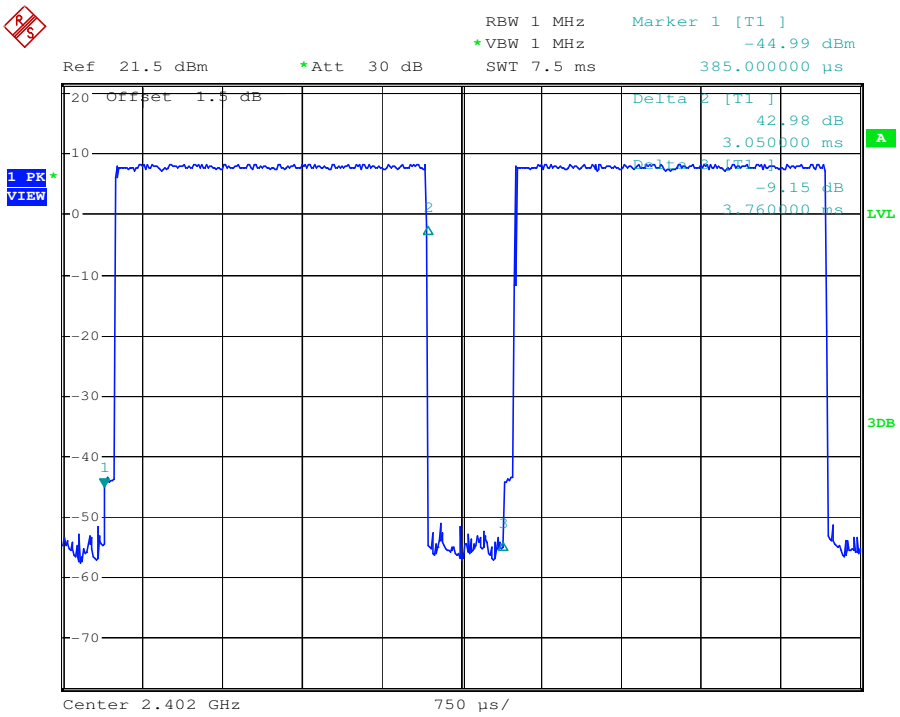
| Test Packet: | 3-DH1 |
|---|---|



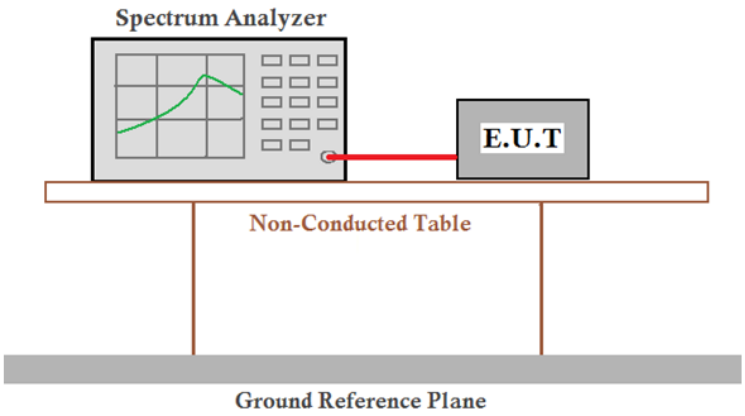

| Test Packet: | 3-DH3 |
|---|---|



| Test Packet: | 3-DH5 |
|---|---|

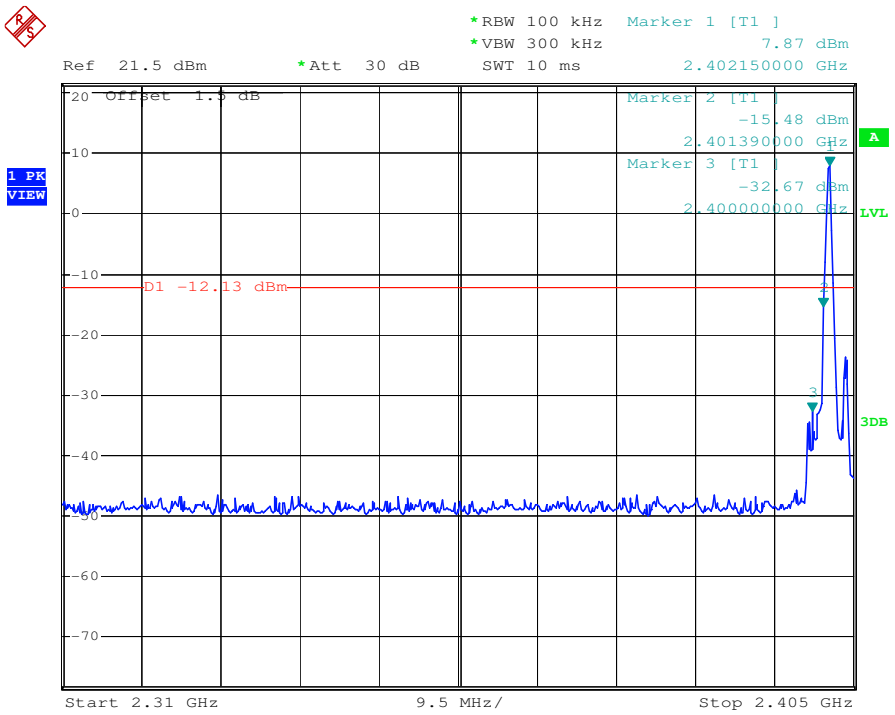


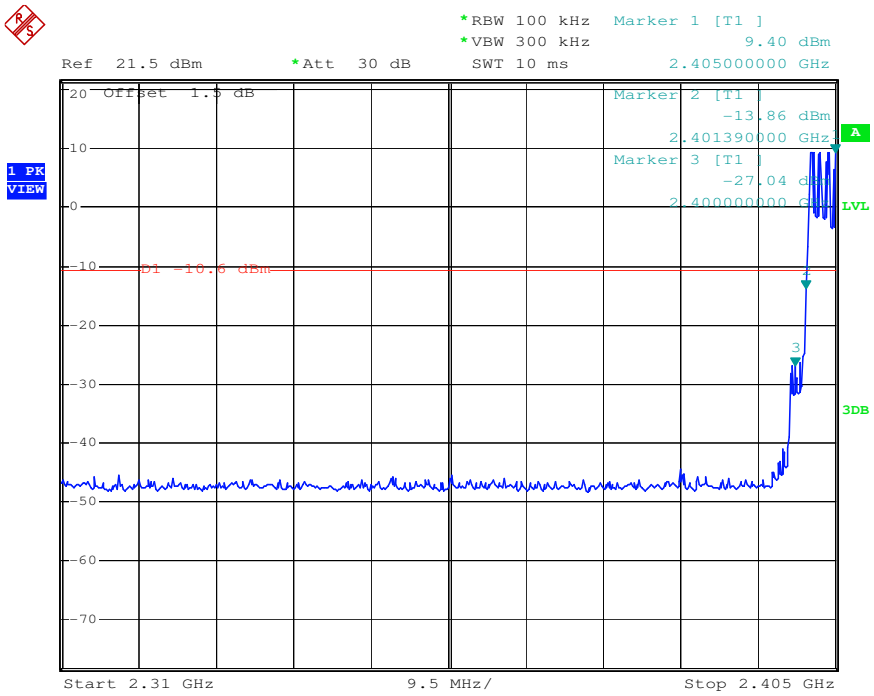
## 5.8 Band-edge for RF Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | ANSI C63.10:2009 |
| Test Setup: |  <br>Remark:<br>Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer. |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Exploratory Test Mode: | Hopping transmitting with all kind of modulation and all kind of data type |
| Final Test Mode: | Through Pre-scan, find the DH5 of date type is the worse case of GFSK modulation type, 2-DH5 of date type is worse case of π/4DQPSK modulation type, 3-DH5 of date type is worse case of 8DPSK modulation type. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

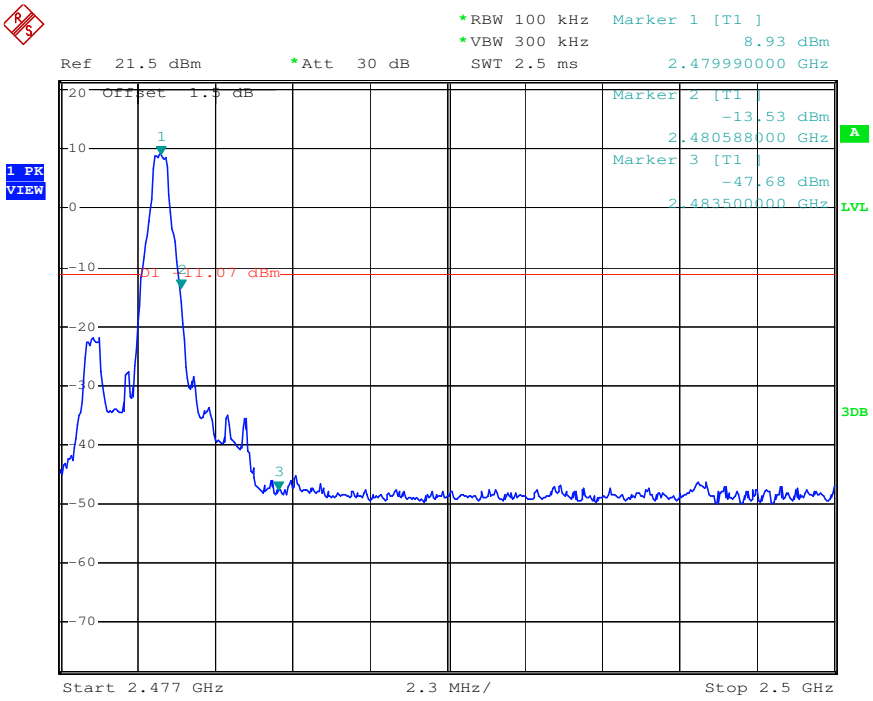
**Test plot as follows:**

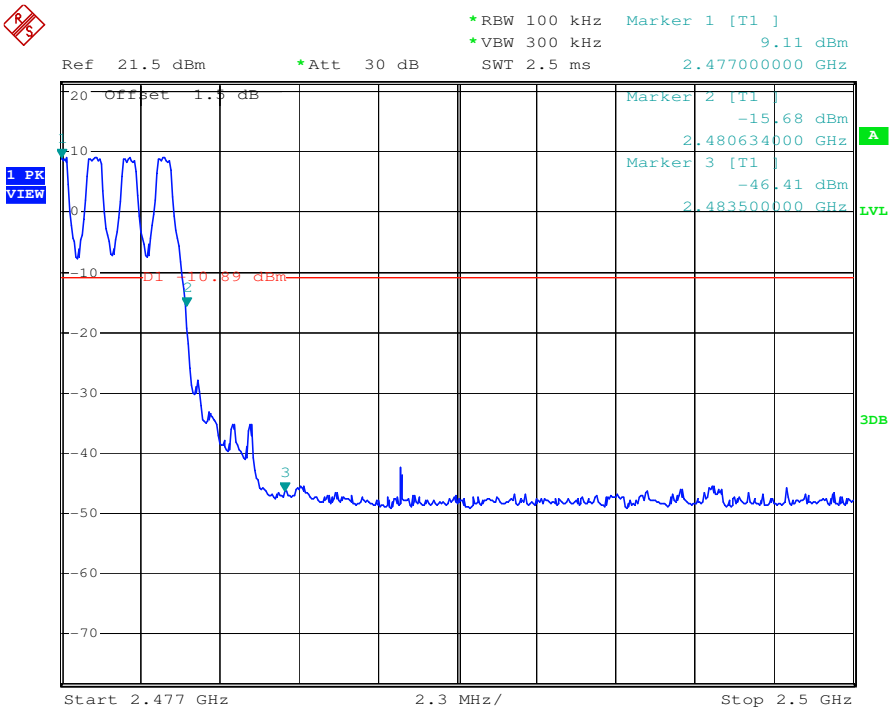
| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|



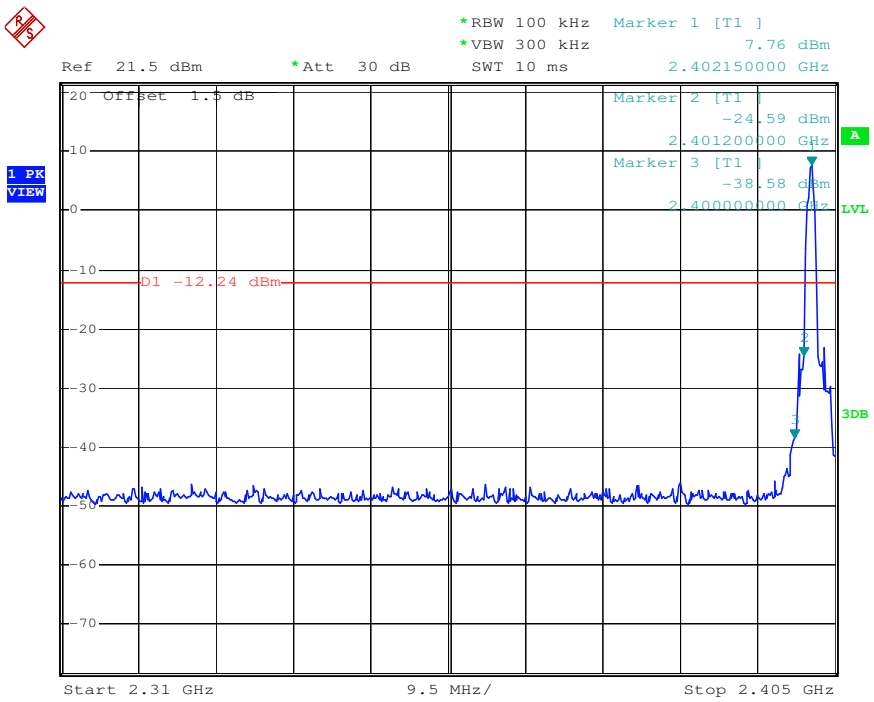



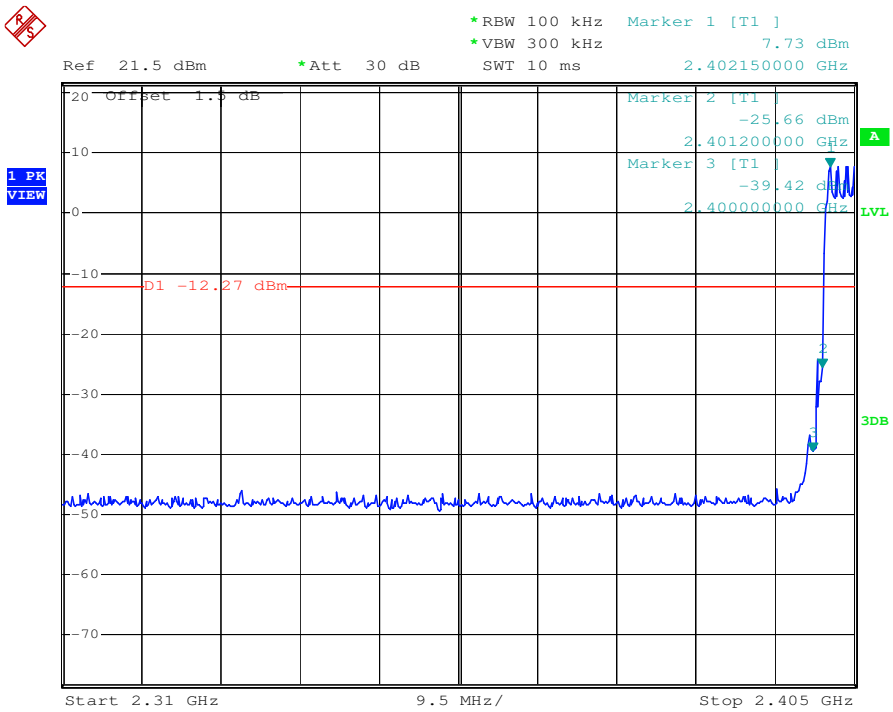
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|



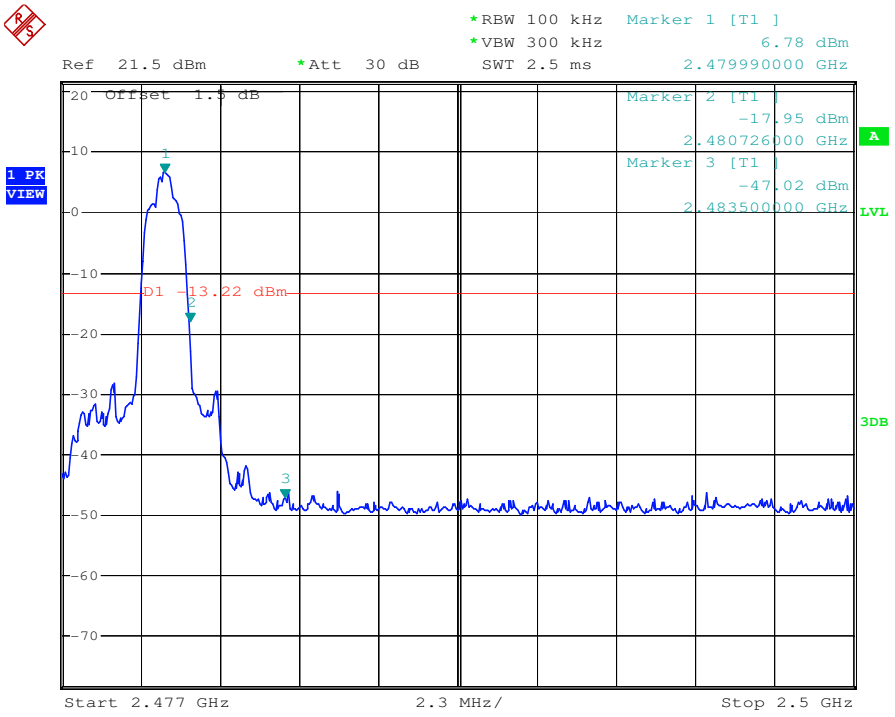



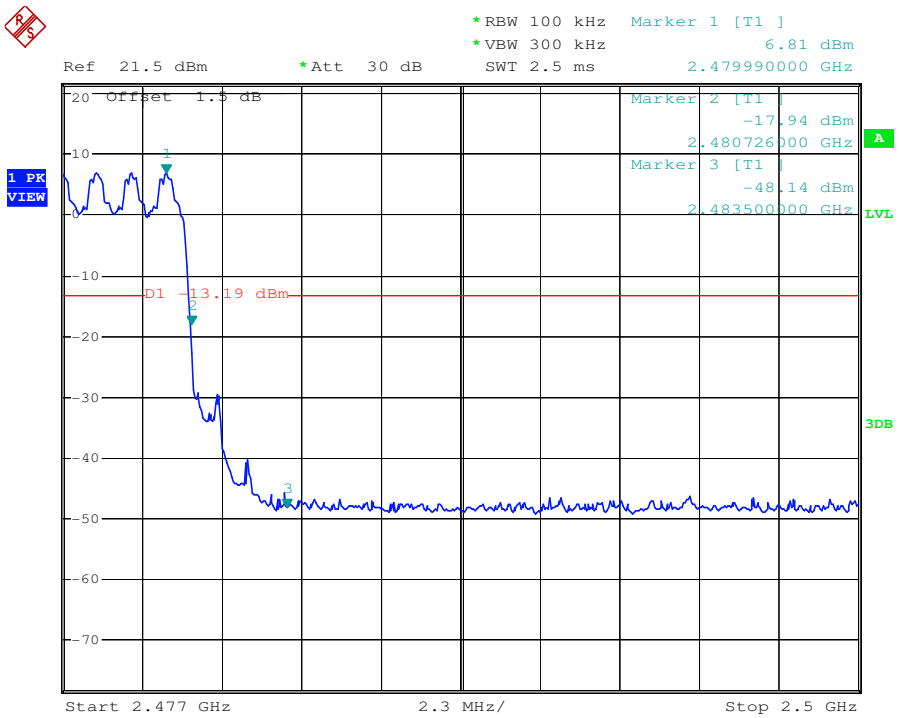
| Test mode: | π/4DQPSK | Test channel: | Lowest |
|---|---|---|---|



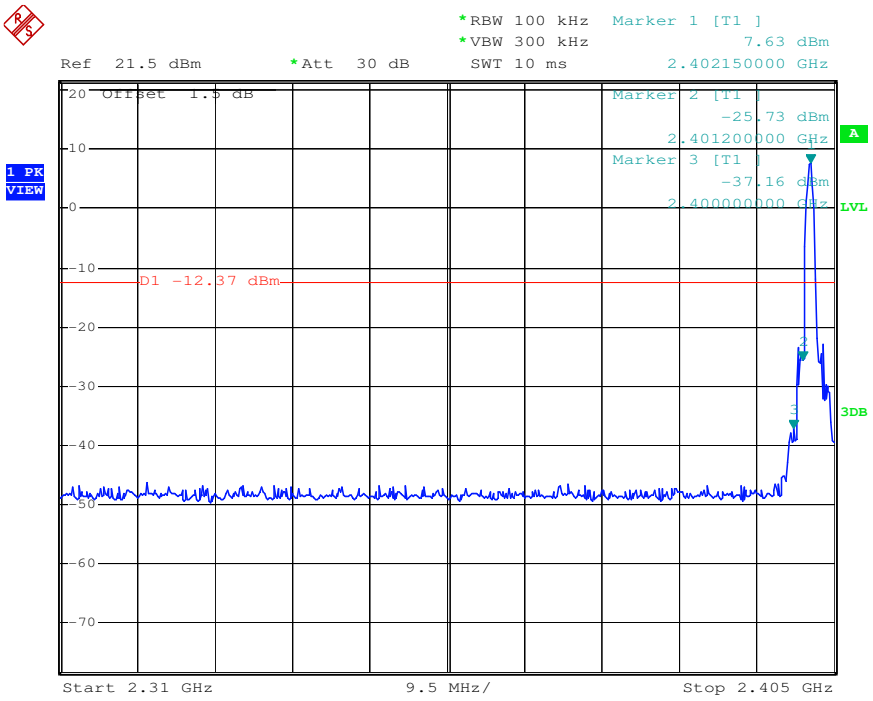



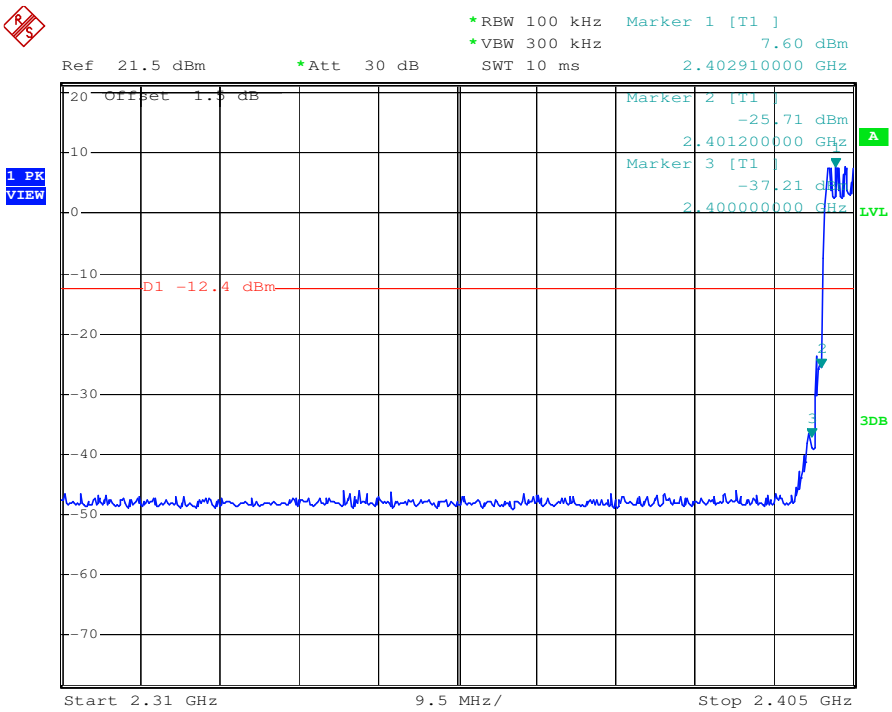
| Test mode: | π/4DQPSK | Test channel: | Highest |
|---|---|---|---|



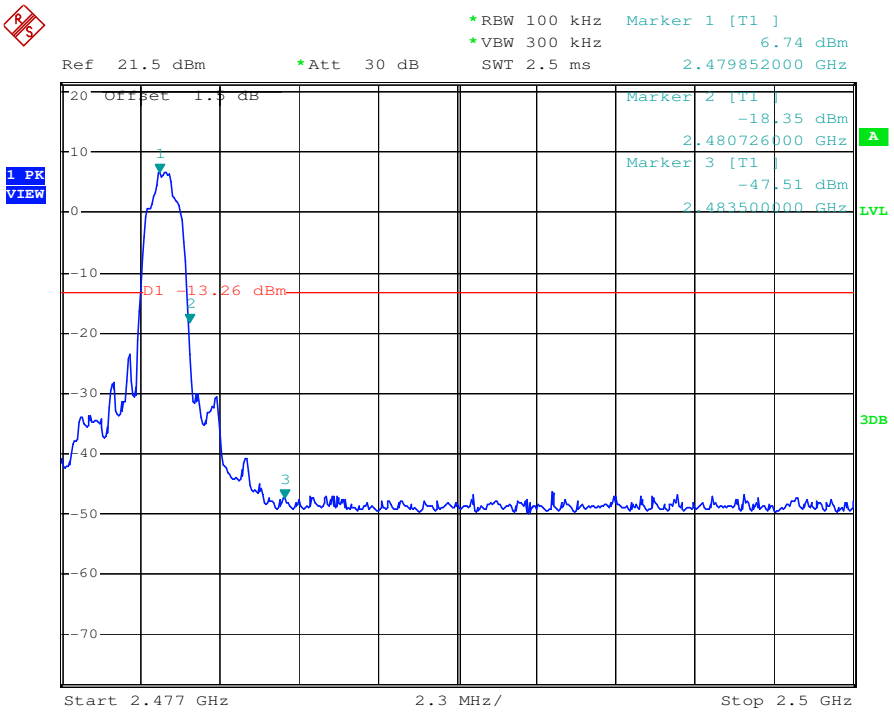



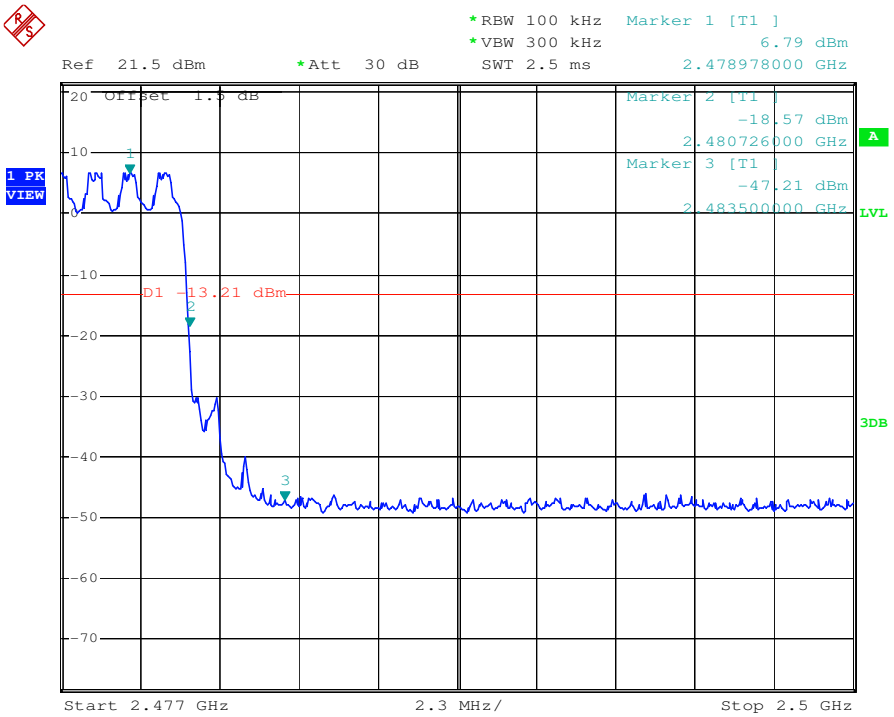
| Test mode: | 8DPSK | Test channel: | Lowest |
|---|---|---|---|



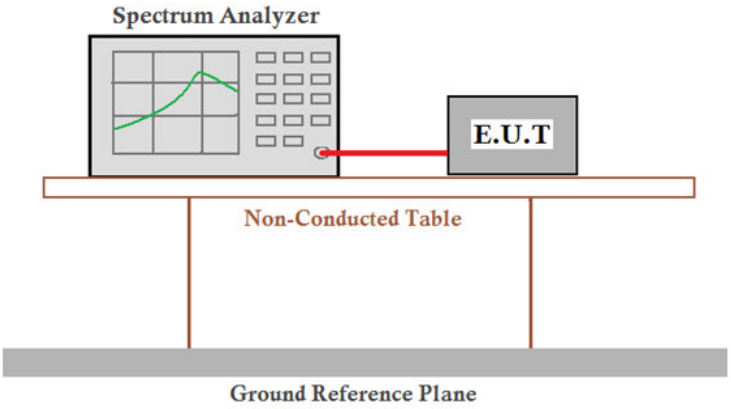



| Test mode: | 8DPSK | Test channel: | Highest |
|---|---|---|---|

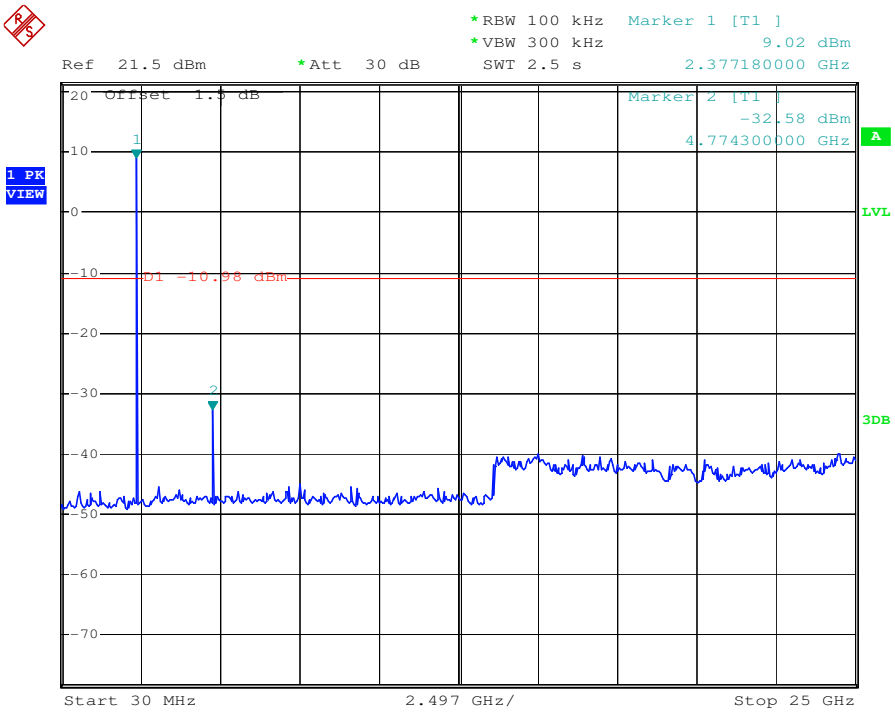


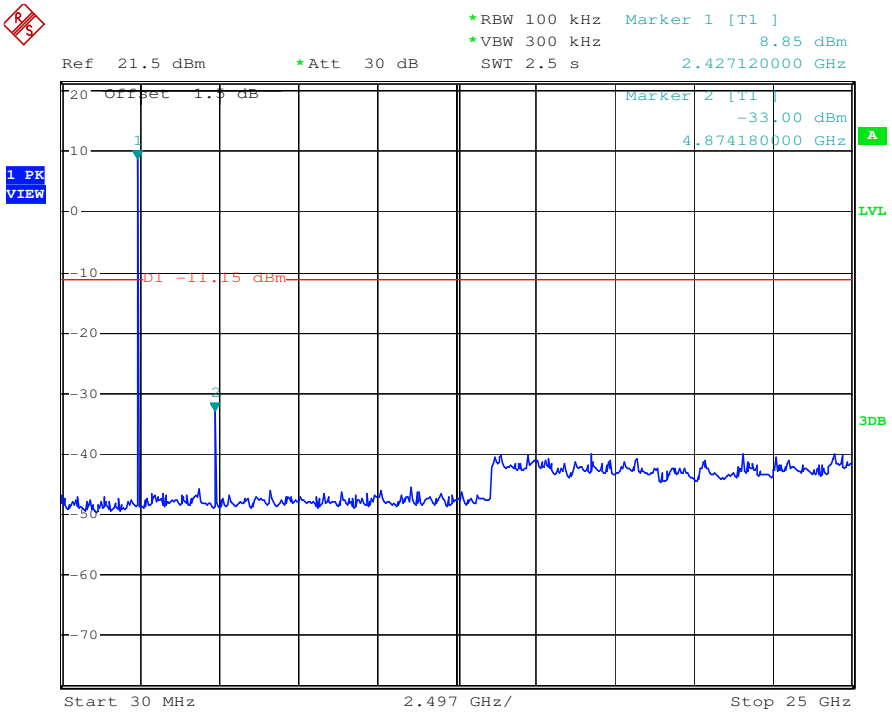
## 5.9 Spurious RF Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | ANSI C63.10:2009 |
| Test Setup: |  <br>Remark:<br>Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer. |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type |
| Final Test Mode: | Through Pre-scan, find the DH5 of date type is the worse case of GFSK modulation type, 2-DH5 of date type is worse case of π/4DQPSK modulation type, 3-DH5 of date type is worse case of 8DPSK modulation type. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

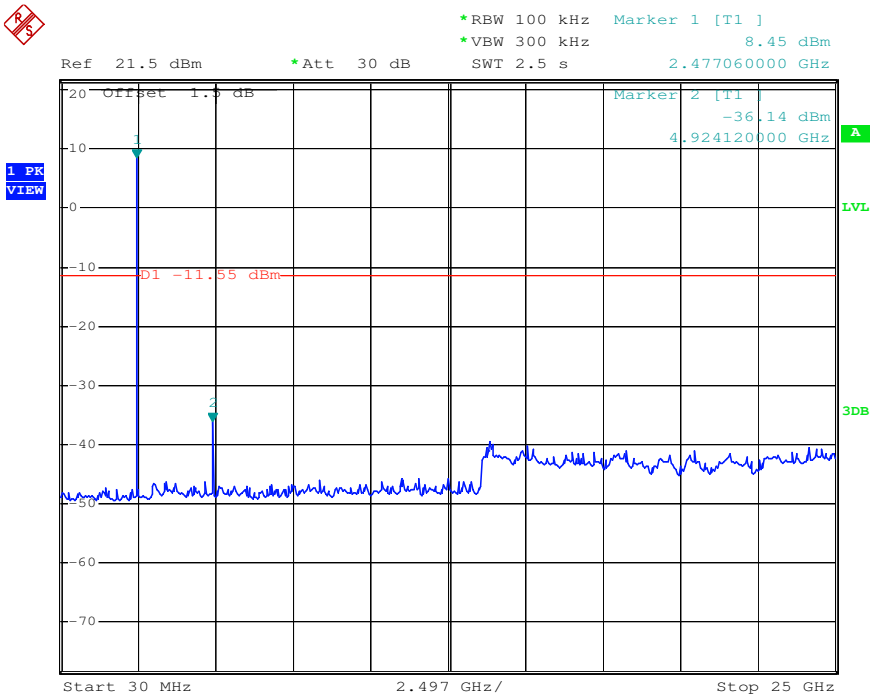
| Test mode: | GFSK | Test channel: | Lowest |
|---|---|---|---|



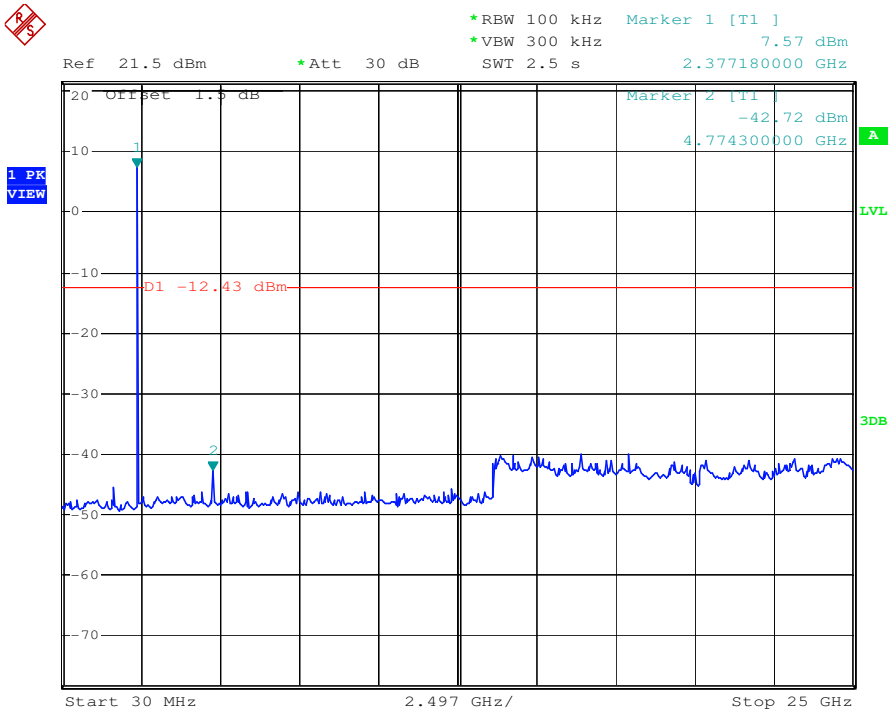

| Test mode: | GFSK | Test channel: | Middle |
|---|---|---|---|



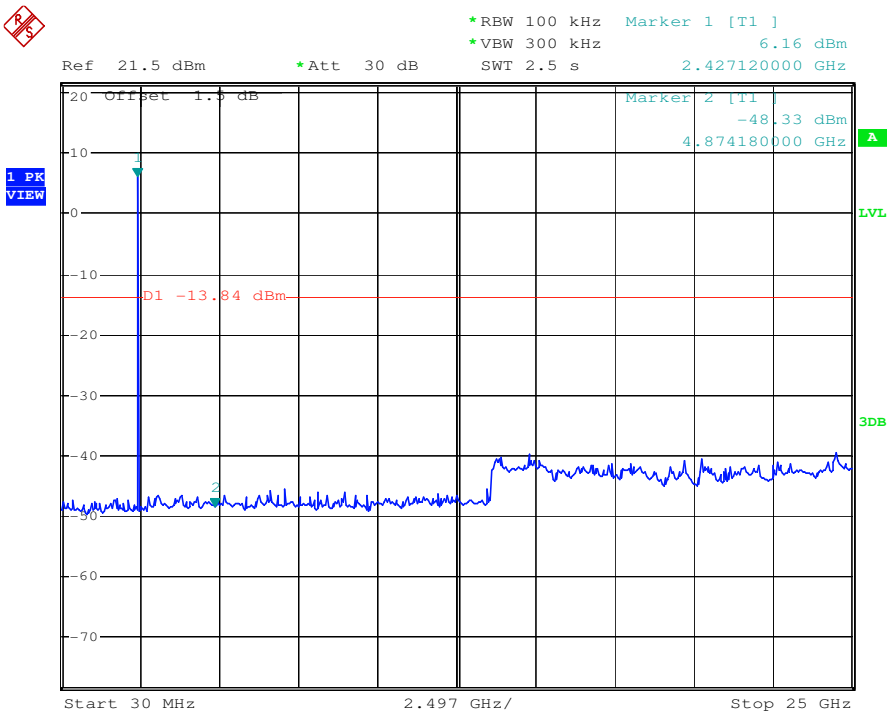
| Test mode: | GFSK | Test channel: | Highest |
|---|---|---|---|



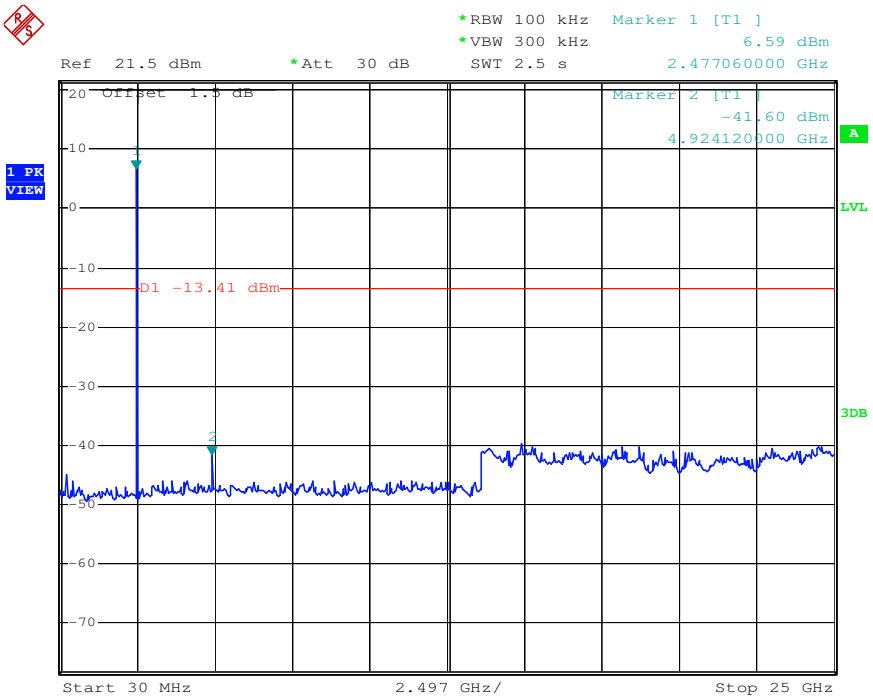

| Test mode: | π/4DQPSK | Test channel: | Lowest |
|---|---|---|---|



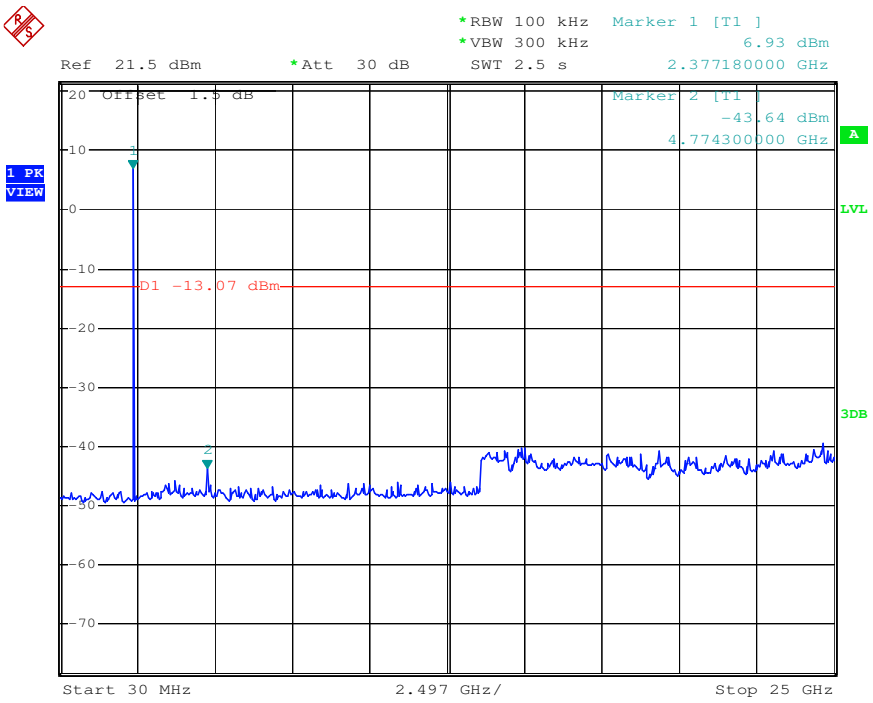
| Test mode: | π/4DQPSK | Test channel: | Middle |
|---|---|---|---|



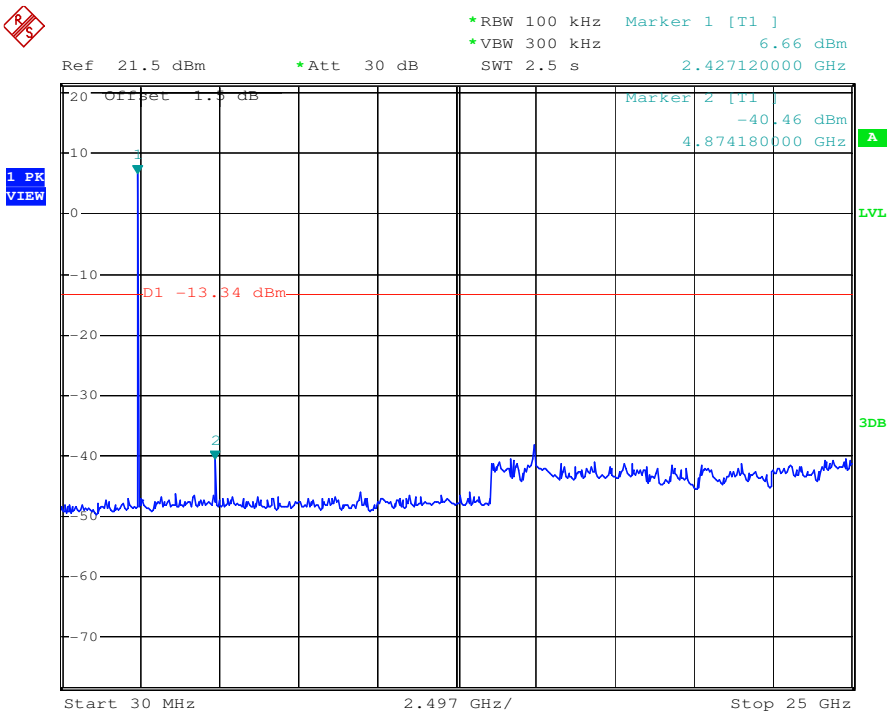

| Test mode: | π/4DQPSK | Test channel: | Highest |
|---|---|---|---|



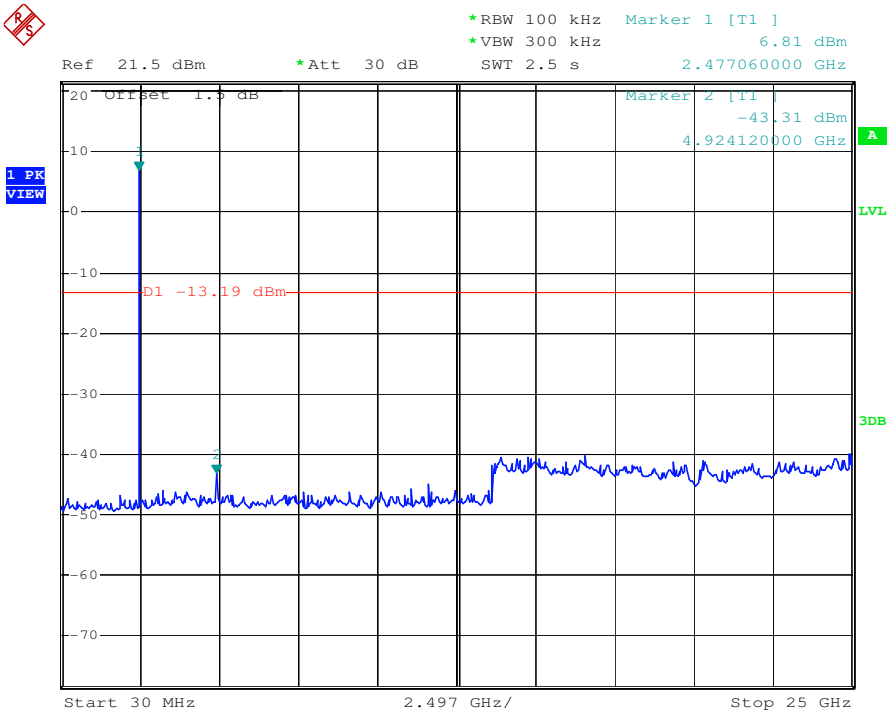
| Test mode: | 8DPSK | Test channel: | Lowest |
|---|---|---|---|




| Test mode: | 8DPSK | Test channel: | Middle |
|---|---|---|---|



| Test mode: | 8DPSK | Test channel: | Highest |
|---|---|---|---|



## 5.10 Pseudorandom Frequency Hopping Sequence

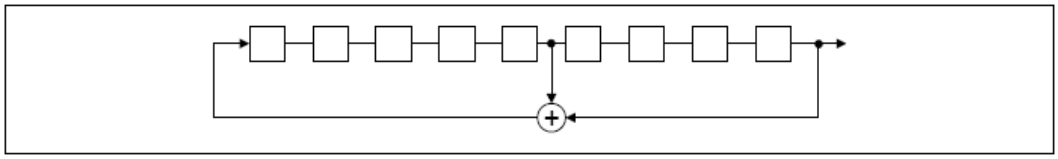
| Test Requirement: | 47 CFR Part 15**C Section 15.247 (a)(1) requirement:** |
|---|---|

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 2400-2483.5 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

**EUT Pseudorandom Frequency Hopping Sequence**

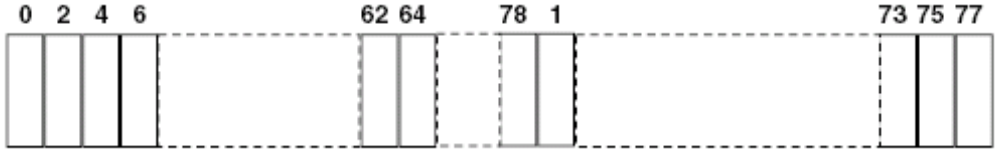
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

• Number of shift register stages: 9
• Length of pseudo-random sequence: 29 -1 = 511 bits
• Longest sequence of zeros: 8 (non-inverted signal)



*Linear Feedback Shift Register for Generation of the PRBS sequence*

An example of Pseudorandom Frequency Hopping Sequence as follow:




Each frequency used equally on the average by each transmitter.
The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

## 5.11 Radiated Spurious Emission

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.209 and 15.205 |
| Test Method: | ANSI C63.10: 2009 |
| Test Site: | Measurement Distance: 3m (Semi-Anechoic Chamber) |

Receiver Setup:

| Frequency | Detector | RBW | VBW | Remark |
|---|---|---|---|---|
| 0.009MHz-0.090MHz | Peak | 10kHz | 30kHz | Peak |
| 0.009MHz-0.090MHz | Average | 10kHz | 30kHz | Average |
| 0.090MHz-0.110MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 0.110MHz-0.490MHz | Peak | 10kHz | 30kHz | Peak |
| 0.110MHz-0.490MHz | Average | 10kHz | 30kHz | Average |
| 0.490MHz -30MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 30MHz-1GHz | Quasi-peak | 100 kHz | 300kHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz | Average |

Limit:

| Frequency | Field strength (microvolt/meter) | Limit (dBuV/m) | Remark | Measurement distance (m) |
|---|---|---|---|---|
| 0.009MHz-0.490MHz | 2400/F(kHz) | - | - | 300 |
| 0.490MHz-1.705MHz | 24000/F(kHz) | - | - | 30 |
| 1.705MHz-30MHz | 30 | - | - | 30 |
| 30MHz-88MHz | 100 | 40.0 | Quasi-peak | 3 |
| 88MHz-216MHz | 150 | 43.5 | Quasi-peak | 3 |
| 216MHz-960MHz | 200 | 46.0 | Quasi-peak | 3 |
| 960MHz-1GHz | 500 | 54.0 | Quasi-peak | 3 |
| Above 1GHz | 500 | 54.0 | Average | 3 |

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

| Test Setup: | |
|---|---|

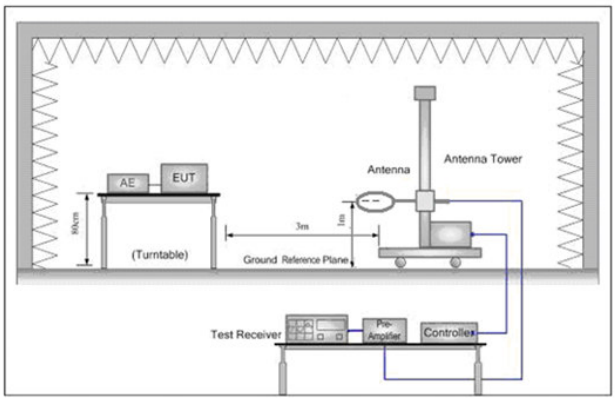



Figure 1. Below 30MHz

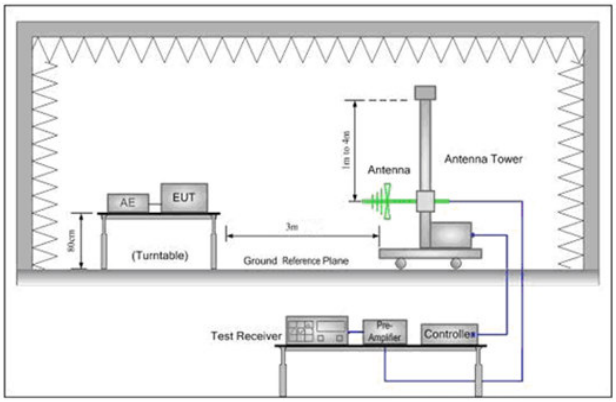



Figure 2. 30MHz to 1GHz

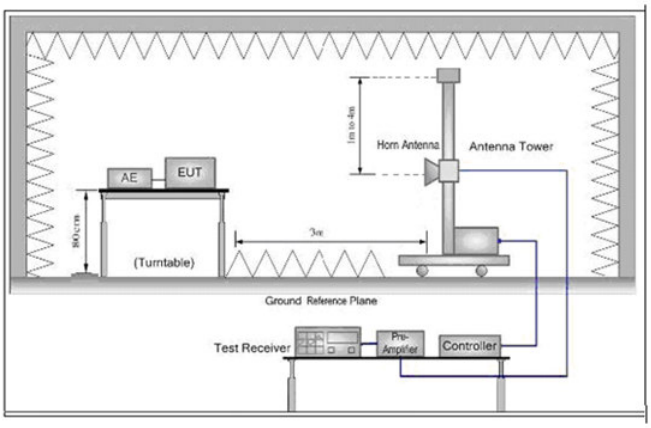


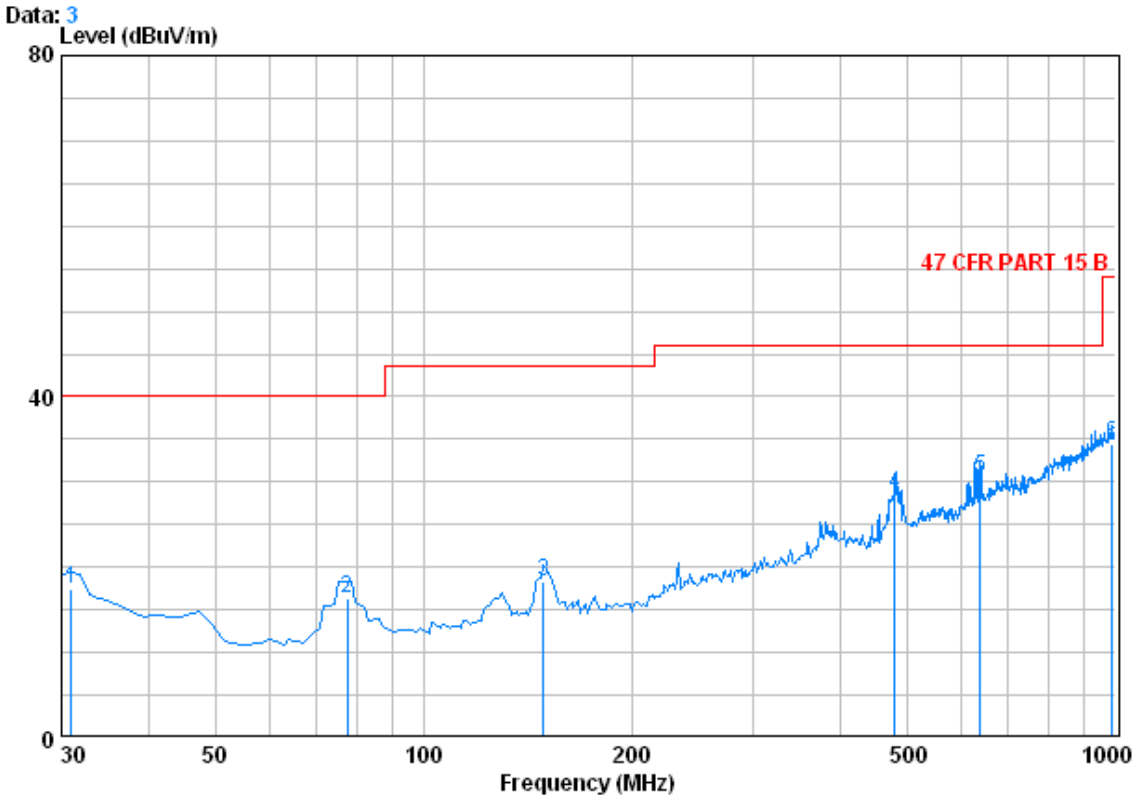

Figure 3. Above 1 GHz

| Test Procedure: | a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.<br>b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.<br>c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.<br>d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.<br>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.<br>f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB |
|---|---|

| | |
|---|---|
| | margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.<br>g. Test the EUT in the lowest channel (2402MHz),the middle channel (2441MHz),the Highest channel (2480MHz)<br>h. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.<br>i. Repeat above procedures until all frequencies measured was complete. |
| Exploratory Test Mode: | Non-hopping mode with all kind of modulation and all kind of data type. |
| Final Test Mode: | Through Pre-scan, find the DH5 of date type is the worst case of GFSK modulation type. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

## 5.11.1 Radiated Emission below 1GHz

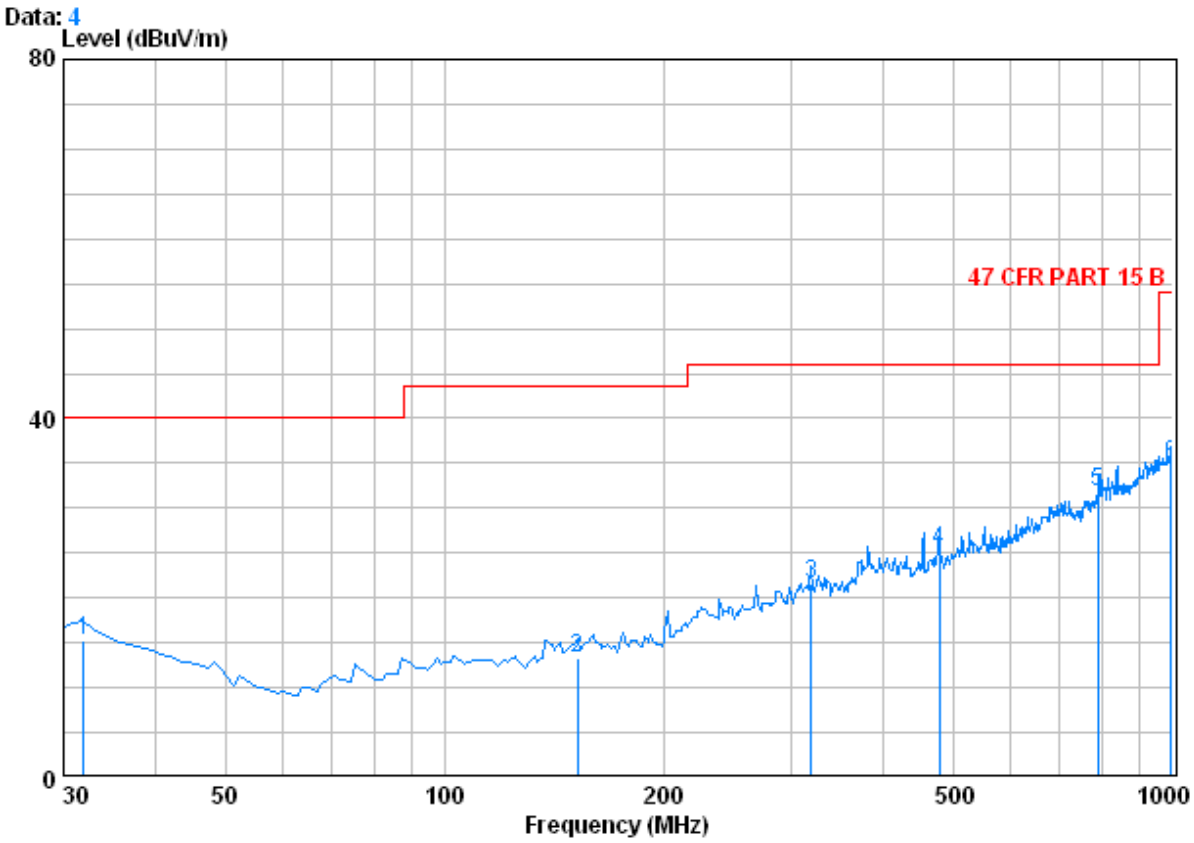
| 30MHz~1GHz (QP) | | |
|---|---|---|
| Test mode: | Charge + Transmitting | Vertical |




Condition : 47 CFR PART 15 B 3m 3142C VERTICAL
Job No. : 3936RF
Mode : Charge + Transmitting

| | Freq | Cable Loss | Antenna Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 30.970 | 0.60 | 14.89 | 27.35 | 29.21 | 17.34 | 40.00 | -22.66 |
| 2 | 77.530 | 1.03 | 7.52 | 27.23 | 34.94 | 16.26 | 40.00 | -23.74 |
| 3 | 149.310 | 1.32 | 8.91 | 26.91 | 34.92 | 18.24 | 43.50 | -25.26 |
| 4 | 479.110 | 2.52 | 17.80 | 27.60 | 35.78 | 28.50 | 46.00 | -17.50 |
| 5 @ | 638.190 | 2.78 | 20.55 | 27.49 | 34.72 | 30.57 | 46.00 | -15.43 |
| 6 | 990.300 | 3.69 | 24.17 | 26.37 | 33.06 | 34.55 | 54.00 | -19.45 |

| Test mode: | Charge + Transmitting | Horizontal |
|---|---|---|




Condition : 47 CFR PART 15 B 3m 3142C HORIZONTAL
Job No. : 3936RF
Mode : Charge + Transmitting

| | Freq | Cable Loss | Antenna Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 31.940 | 0.60 | 14.31 | 27.35 | 27.80 | 15.36 | 40.00 | -24.64 |
| 2 | 152.220 | 1.32 | 9.14 | 26.90 | 29.84 | 13.40 | 43.50 | -30.10 |
| 3 | 319.060 | 1.96 | 14.59 | 26.54 | 31.55 | 21.55 | 46.00 | -24.45 |
| 4 | 478.140 | 2.52 | 17.80 | 27.60 | 32.62 | 25.35 | 46.00 | -20.65 |
| 5 @ | 789.510 | 3.18 | 22.06 | 27.31 | 33.97 | 31.89 | 46.00 | -14.11 |
| 6 | 995.150 | 3.70 | 24.26 | 26.33 | 33.24 | 34.86 | 54.00 | -19.14 |

## 5.11.2 Transmitter Emission above 1GHz

| Worst case mode: | GFSK(DH5) | Test channel: | Lowest | Remark: | Peak |
|---|---|---|---|---|---|

| Frequency (MHz) | Cable Loss (dB) | Antenna Factor (dB/m) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
|---|---|---|---|---|---|---|---|---|
| 1593.340 | 3.99 | 28.84 | 39.39 | 49.32 | 42.76 | 74 | -31.24 | Vertical |
| 1870.490 | 4.23 | 30.81 | 39.51 | 47.51 | 43.04 | 74 | -30.96 | Vertical |
| 2810.846 | 4.91 | 33.14 | 40.16 | 48.37 | 46.26 | 74 | -27.74 | Vertical |
| 3893.520 | 6.31 | 33.68 | 40.95 | 48.78 | 47.82 | 74 | -26.18 | Vertical |
| 4785.075 | 7.42 | 34.73 | 41.61 | 57.56 | 58.10 | 74 | -15.90 | Vertical |
| 6094.137 | 8.01 | 35.82 | 40.84 | 48.62 | 51.61 | 74 | -22.39 | Vertical |
| 1392.247 | 3.80 | 27.91 | 39.31 | 49.26 | 41.66 | 74 | -32.34 | Horizontal |
| 1851.542 | 4.21 | 30.69 | 39.51 | 48.67 | 44.06 | 74 | -29.94 | Horizontal |
| 3249.76 | 5.42 | 33.30 | 40.48 | 49.25 | 47.49 | 74 | -26.51 | Horizontal |
| 4149.351 | 6.66 | 34.22 | 41.15 | 49.40 | 49.13 | 74 | -24.87 | Horizontal |
| 4785.075 | 7.42 | 34.73 | 41.61 | 55.23 | 55.77 | 74 | -18.23 | Horizontal |
| 7301.355 | 8.85 | 35.92 | 39.79 | 48.73 | 53.71 | 74 | -20.29 | Horizontal |

| Frequency (MHz) | Peak Level (dBuV/m) | PDCF (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|
| 4785.075 | 58.10 | -30.81 | 27.29 | 54.00 | -26.71 | Vertical |
| 4785.075 | 55.77 | -30.81 | 24.96 | 54.00 | -29.04 | Horizontal |

| Worst case mode: | GFSK(DH5) | Test channel: | Middle | Remark: | Peak |
|---|---|---|---|---|---|

| Frequency (MHz) | Cable Loss (dB) | Antenna Factor (dB/m) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
|---|---|---|---|---|---|---|---|---|
| 1768.619 | 4.13 | 30.07 | 39.46 | 47.23 | 41.97 | 74 | -32.03 | Vertical |
| 2965.192 | 5.04 | 33.35 | 40.27 | 46.23 | 44.35 | 74 | -29.65 | Vertical |
| 3953.443 | 6.41 | 33.76 | 41.00 | 48.30 | 47.47 | 74 | -26.53 | Vertical |
| 4883.519 | 7.48 | 34.59 | 41.68 | 52.70 | 53.09 | 74 | -20.91 | Vertical |
| 5776.922 | 7.88 | 35.34 | 41.12 | 47.88 | 49.98 | 74 | -24.02 | Vertical |
| 7264.278 | 8.81 | 35.90 | 39.82 | 46.79 | 51.68 | 74 | -22.32 | Vertical |
| 1918.716 | 4.27 | 31.18 | 39.53 | 46.59 | 42.51 | 74 | -31.49 | Horizontal |
| 3049.394 | 5.12 | 33.38 | 40.34 | 47.78 | 45.94 | 74 | -28.06 | Horizontal |
| 4076.070 | 6.55 | 34.03 | 41.09 | 48.19 | 47.68 | 74 | -26.32 | Horizontal |
| 4895.965 | 7.49 | 34.57 | 41.70 | 50.16 | 50.52 | 74 | -23.48 | Horizontal |
| 6851.185 | 8.31 | 35.96 | 40.18 | 48.00 | 52.09 | 74 | -21.91 | Horizontal |
| 8042.903 | 9.34 | 36.01 | 39.15 | 47.68 | 53.88 | 74 | -20.12 | Horizontal |

| Worst case mode: | GFSK(DH5) | Test channel: | Highest | Remark: | Peak |
|---|---|---|---|---|---|

| Frequency (MHz) | Cable Loss (dB) | Antenna Factor (dB/m) | Preamp Factor (dB) | Read Level (dBuV) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | Polarization |
|---|---|---|---|---|---|---|---|---|
| 1593.340 | 2.58 | 28.84 | 39.39 | 52.46 | 44.49 | 74 | -29.51 | Vertical |
| 2118.973 | 2.88 | 32.02 | 39.65 | 50.94 | 46.19 | 74 | -27.81 | Vertical |
| 3088.453 | 3.39 | 33.37 | 40.37 | 48.77 | 45.16 | 74 | -28.84 | Vertical |
| 4883.519 | 4.72 | 34.59 | 41.68 | 52.31 | 49.94 | 74 | -24.06 | Vertical |
| 7413.726 | 6.02 | 35.97 | 39.69 | 49.49 | 51.79 | 74 | -22.21 | Vertical |
| 10139.450 | 6.01 | 37.88 | 37.51 | 46.28 | 52.66 | 74 | -21.34 | Vertical |
| 1642.761 | 4.02 | 29.21 | 39.42 | 51.51 | 45.32 | 74 | -28.68 | Horizontal |
| 1933.424 | 4.27 | 31.31 | 39.54 | 47.16 | 43.20 | 74 | -30.80 | Horizontal |
| 3241.498 | 5.40 | 33.30 | 40.48 | 47.63 | 45.85 | 74 | -28.15 | Horizontal |
| 4004.083 | 6.46 | 33.85 | 41.04 | 47.45 | 46.72 | 74 | -27.28 | Horizontal |
| 5257.662 | 7.65 | 34.65 | 41.57 | 48.84 | 49.57 | 74 | -24.43 | Horizontal |
| 6678.987 | 8.21 | 36.13 | 40.33 | 47.91 | 51.92 | 74 | -22.08 | Horizontal |

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

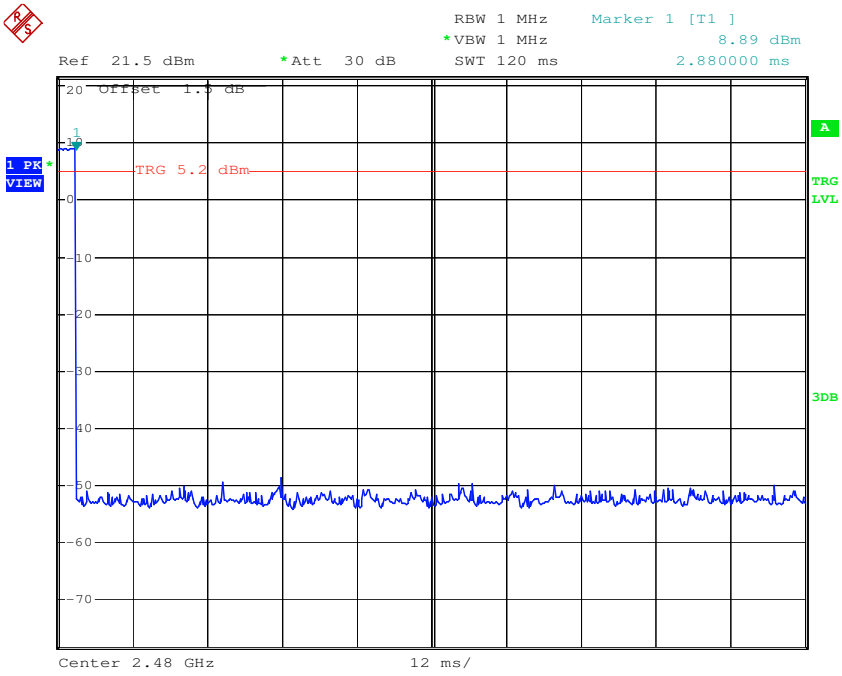
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

   As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

2) The disturbance above 11GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

| PDCF Calculate Formula: |
|---|
| Average value=Peak value + PDCF (pulse desensitization correction factor) |
| PDCF=20 log(Duty cycle)= -30.81dB |
| Duty cycle= T on time / T period = 0.0288 |
| Ton time = 2.88ms |
| T period = 100ms |

**Test plot as follows:**



## 5.12 Band edge (Radiated Emission)

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.209 and 15.205 |
| Test Method: | ANSI C63.10: 2009 |
| Test Site: | Measurement Distance: 3m (Semi-Anechoic Chamber) |
| Limit: | |

| Frequency | Limit (dBuV/m @3m) | Remark |
|---|---|---|
| 30MHz-88MHz | 40.0 | Quasi-peak Value |
| 88MHz-216MHz | 43.5 | Quasi-peak Value |
| 216MHz-960MHz | 46.0 | Quasi-peak Value |
| 960MHz-1GHz | 54.0 | Quasi-peak Value |
| Above 1GHz | 54.0 | Average Value |
| | 74.0 | Peak Value |

Test Setup:

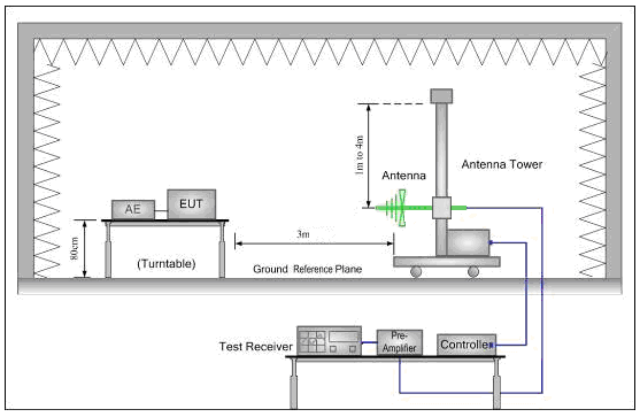



Figure 1. 30MHz to 1GHz

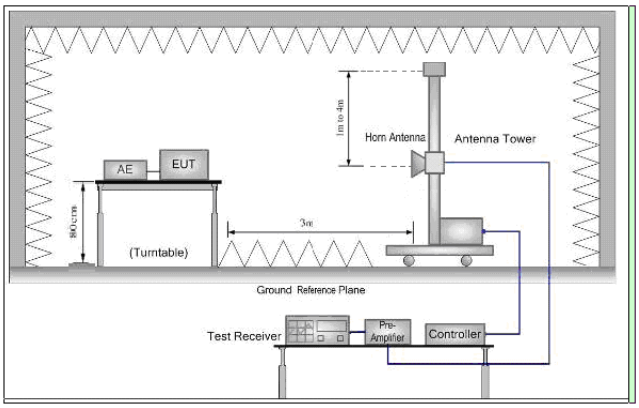
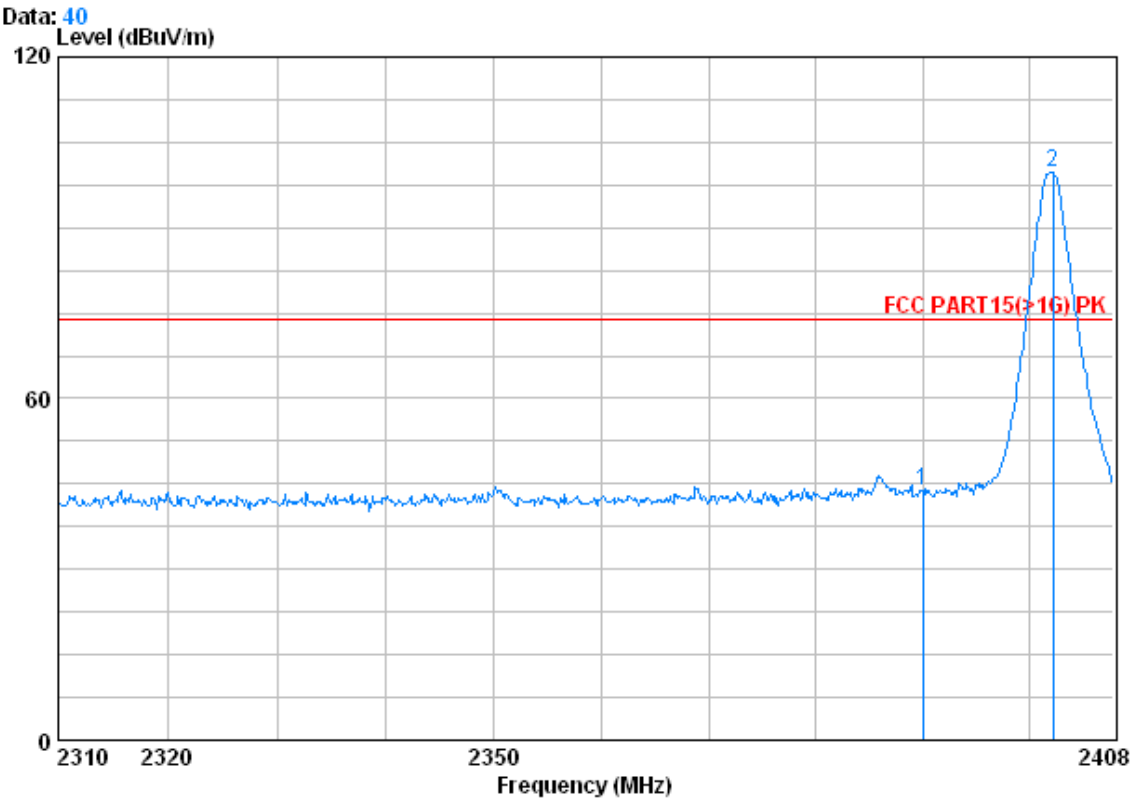



Figure 2. Above 1 GHz

| | |
|---|---|
| Test Procedure: | a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.<br>b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.<br>c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.<br>d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.<br>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.<br>f. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel<br>g. Test the EUT in the lowest channel , the Highest channel<br>h. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.<br>i. Repeat above procedures until all frequencies measured was complete. |
| Exploratory Test Mode: | Non-hopping transmitting mode with all kind of modulation and all kind of data type |
| Final Test Mode: | Through Pre-scan, find the DH5 of date type is the worse case of GFSK modulation type |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

**Test plot as follows:**

| Worse case mode: | GFSK (DH5) | Test channel: | Lowest | Remark: | Peak | Vertical |
|---|---|---|---|---|---|---|



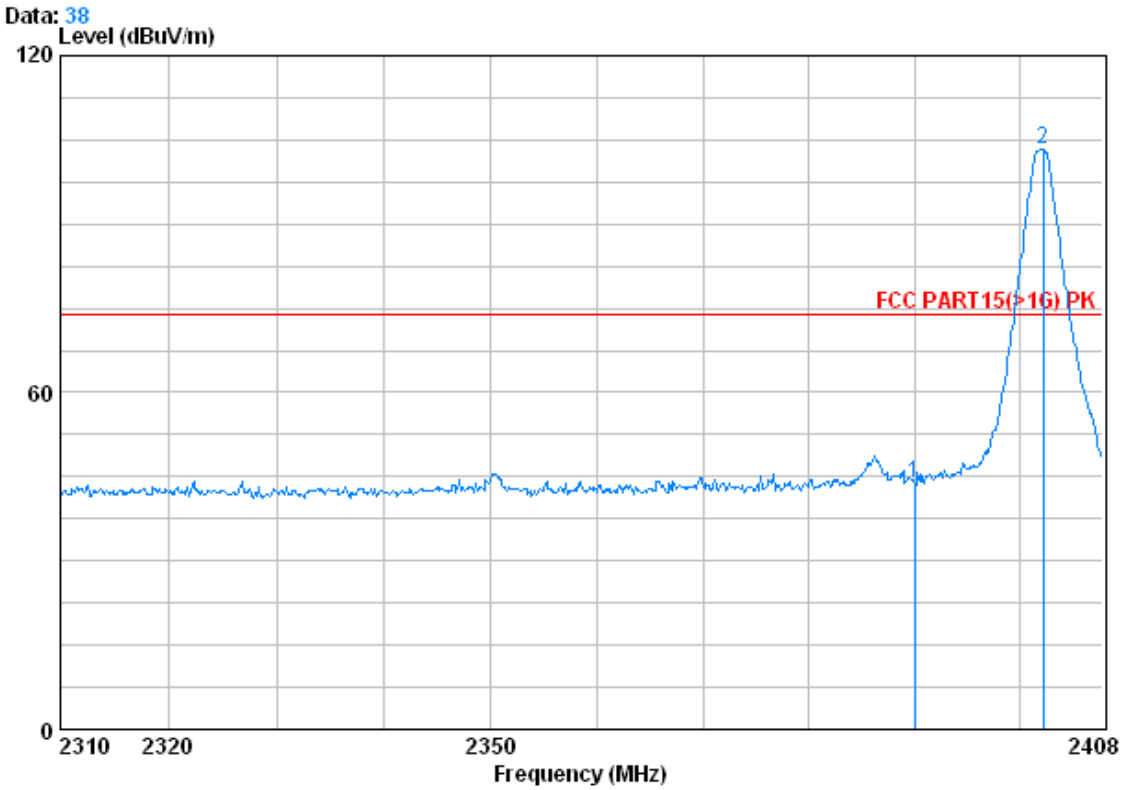

Condition : FCC PART15(>1G) PK 3m VERTICAL
Job No. : 3936RF
Mode : 2402 Bandedge

| | Freq | Cable Loss | Antenna Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 2390.000 | 4.58 | 32.51 | 39.85 | 46.71 | 43.96 | 74.00 | -30.04 |
| 2 @ | 2402.316 | 4.58 | 32.51 | 39.86 | 102.44 | 99.67 | 74.00 | 25.67 |

Band edge (Average)

| Frequency (MHz) | Peak Level (dBuV/m) | PDCF (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|
| 2390.00 | 43.96 | -30.81 | 13.15 | 54.00 | -40.85 | Vertical |

| Worse case mode: | GFSK (DH5) | Test channel: | Lowest | Remark: | Peak | Horizontal |
|---|---|---|---|---|---|---|



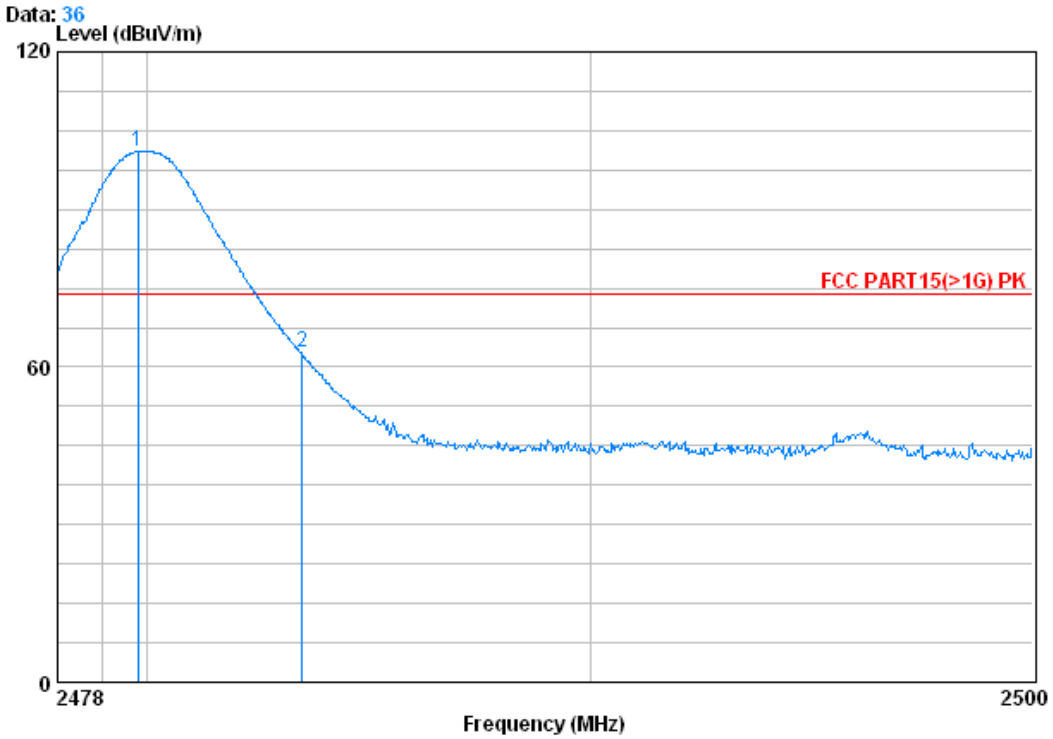

Condition : FCC PART15(>1G) PK 3m HORIZONTAL
Job No. : 3936RF
Mode : 2402 Bandedge

| | Freq | Cable Loss | Antenna Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 2390.000 | 4.58 | 32.51 | 39.85 | 46.66 | 43.91 | 74.00 | -30.09 |
| 2 @ | 2402.316 | 4.58 | 32.51 | 39.86 | 106.13 | 103.36 | 74.00 | 29.36 |

Band edge (Average)

| Frequency (MHz) | Peak Level (dBuV/m) | PDCF (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|
| 2390.00 | 43.91 | -30.81 | 13.10 | 54.00 | -40.90 | Horizontal |

| Worse case mode: | GFSK (DH5) | Test channel: | Highest | Remark: | Peak | Vertical |
|---|---|---|---|---|---|---|



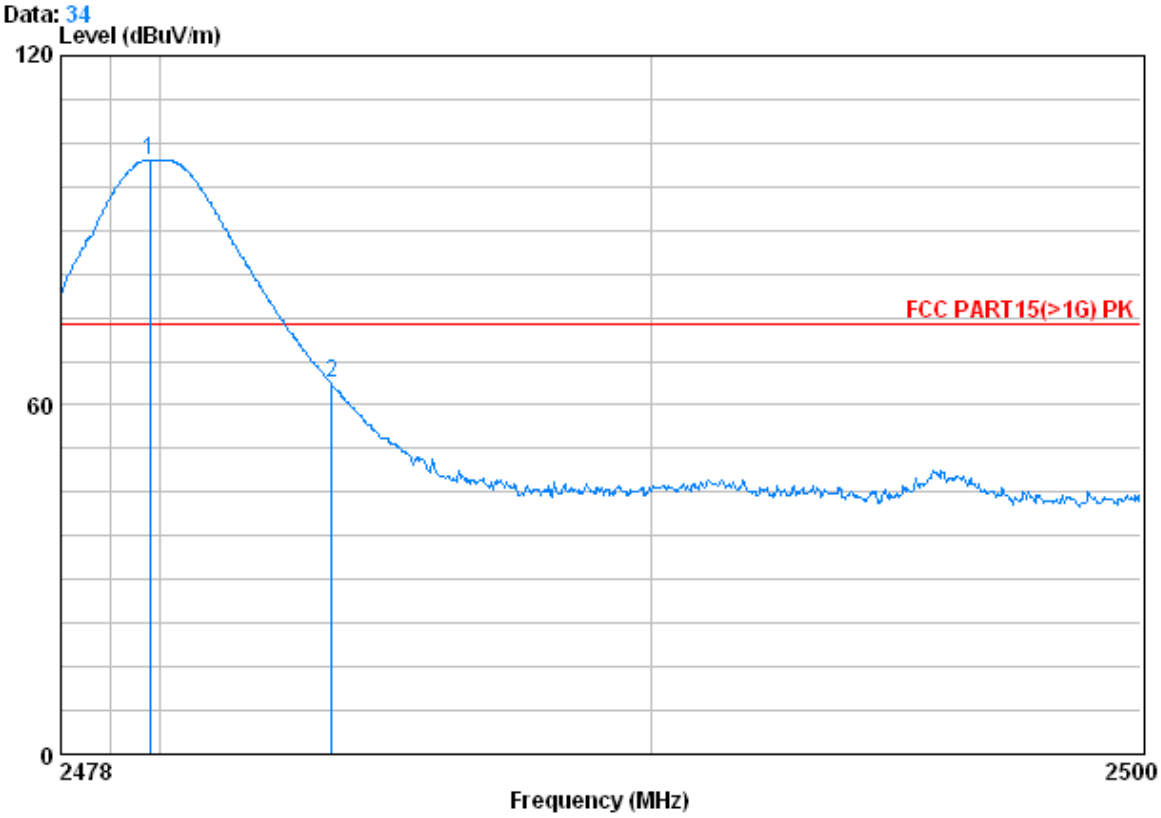

Condition : FCC PART15(>1G) PK 3m VERTICAL
Job No. : 3936RF
Mode : 2480 Bandedge

| | Freq | Cable Loss | Antenna Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 @ | 2479.804 | 4.65 | 32.67 | 39.92 | 103.58 | 100.99 | 74.00 | 26.99 |
| 2 | 2483.500 | 4.65 | 32.67 | 39.92 | 65.24 | 62.64 | 74.00 | -11.36 |

Band edge (Average)

| Frequency (MHz) | Peak Level (dBuV/m) | PDCF (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|
| 2483.50 | 62.64 | -30.81 | 31.83 | 54.00 | -22.17 | Vertical |

| Worse case mode: | GFSK (DH5) | Test channel: | Highest | Remark: | Peak | Horizontal |
|---|---|---|---|---|---|---|




Condition : FCC PART15(>1G) PK 3m HORIZONTAL
Job No. : 3936RF
Mode : 2480 Bandedge

| | Freq | Cable Loss | Antenna Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 @ | 2479.804 | 4.65 | 32.67 | 39.92 | 104.75 | 102.15 | 74.00 | 28.15 |
| 2 | 2483.500 | 4.65 | 32.67 | 39.92 | 66.26 | 63.66 | 74.00 | -10.34 |

Band edge (Average)

| Frequency (MHz) | Peak Level (dBuV/m) | PDCF (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Over Limit (dB) | polarization |
|---|---|---|---|---|---|---|
| 2483.50 | 63.66 | -30.81 | 32.85 | 54.00 | -21.15 | Horizontal |

*Note:*
*The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:*
*Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor*