# Certification Test Report

**FCC ID: AZ489FT7077**
**IC: 109U-89FT7077**

**FCC Rule Part: 15.247**
**IC Radio Standards Specification: RSS-247**

**ACS Report Number: 16-2008.W06.2B**

Manufacturer: Motorola Solutions Sdn Bhd
Model(s): H98QDH9PW7BN

Test Begin Date: **March 7, 2016**
Test End Date: **April 1, 2016**

Report Issue Date: May 10, 2016

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

**Project Manager:**

**Thierry Jean-Charles**
**EMC Engineer**
**Advanced Compliance Solutions, Inc.**



**This report contains 68 pages**

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# 1 GENERAL

## 1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-247.

## 1.2 Product Description

The APX6000 UHF R1 model H98QDH9PW7BN is a two way portable radio capable of analog FM, digital C4FM and TDMA. This radio includes Bluetooth 2.0+EDR, Bluetooth Low Energy (BLE), WLAN 802.11 b/g/n and GPS features. This test report documents compliance of the Bluetooth 2.0+EDR transceiver.

Technical Details

| | |
|---|---|
| Mode of Operation: | Bluetooth 2.1 + Enhanced Data Rate (EDR) |
| Frequency Range: | 2402 MHz - 2480 MHz |
| Number of Channels: | 79 |
| Channel Separation: | 1 MHz |
| Modulations: | GFSK, π/4-DQPSK, 8DPSK |
| TX Data Rates: | GFSK: 1Mbps<br>π/4-DQPSK: 2Mbps<br>8DPSK: 3Mbps |
| Antenna Type/Gain: | PIFA, 2.58 dBi |

## 1.3 Manufacturer Information

Motorola Solutions Sdn Bhd
Plot 2 Bayan Lepas Innoplex,
Industrial Park Mukim 12 SWD
11900 Bayan Lepas, Penang Malaysia

Model Number: H98QDH9PW7BN

Test Sample Serial Number(s): 756TRZ0368 (Radiated & Power Line Conducted Emissions), 756TRX0603 (RF Conducted)

Test Sample Condition: The samples were in good conditions with no observable physical damages.

### 1.4 Test Methodology and Considerations

The EUT was evaluated for radiated, RF conducted and power line conducted emissions for the Bluetooth radio.

Preliminary radiated emission evaluation was performed for the EUT standalone, set in three orthogonal orientations as well as for the EUT set on a single unit charger, the EUT set on a multi-unit charger and the unit connected to a laptop computer via a GCAI cable. The worst case configuration was obtained with the EUT standalone, lying on one side.

The EUT was also evaluated for radiated intermodulation product for the Bluetooth radio transmitting at the same time as the land mobile radio. All intermodulation products were observed to be compliant to the limits of the FCC Section 15.209 and RSS-Gen.

The RF conducted measurements were performed on a sample modified with a temporary connector at the antenna port for direct coupling to the spectrum analyzer.

For power line conducted emissions, preliminary measurements were performed for the unit powered via a multi-unit charger and for the unit set on a single unit charger. The configuration leading to the highest emissions as compared to the limits was then investigated for all the modulations. The results reported in this document correspond to the overall worst case configuration.

**Table 1.4-1: Bluetooth Radio Test configuration**

| Mode of Operations | Frequency (MHz) | Data Rate (kbps) |
|---|---|---|
| GFSK | 2402 | 1000 |
| | 2441 | 1000 |
| | 2480 | 1000 |
| π/4 DQPSK | 2402 | 2000 |
| | 2441 | 2000 |
| | 2480 | 2000 |
| 8 DPSK | 2402 | 3000 |
| | 2441 | 3000 |
| | 2480 | 3000 |

The EUT was also evaluated for unintentional emissions. The results are documented separately in a Declaration of Conformity/Verification test report.

# 2 TEST FACILITIES

## 2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 475089
Industry Canada Lab Code: 4175C

## 2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

## 2.3 Radiated & Conducted Emissions Test Site Description

### 2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl flooring.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flush with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1050 Multi-device controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

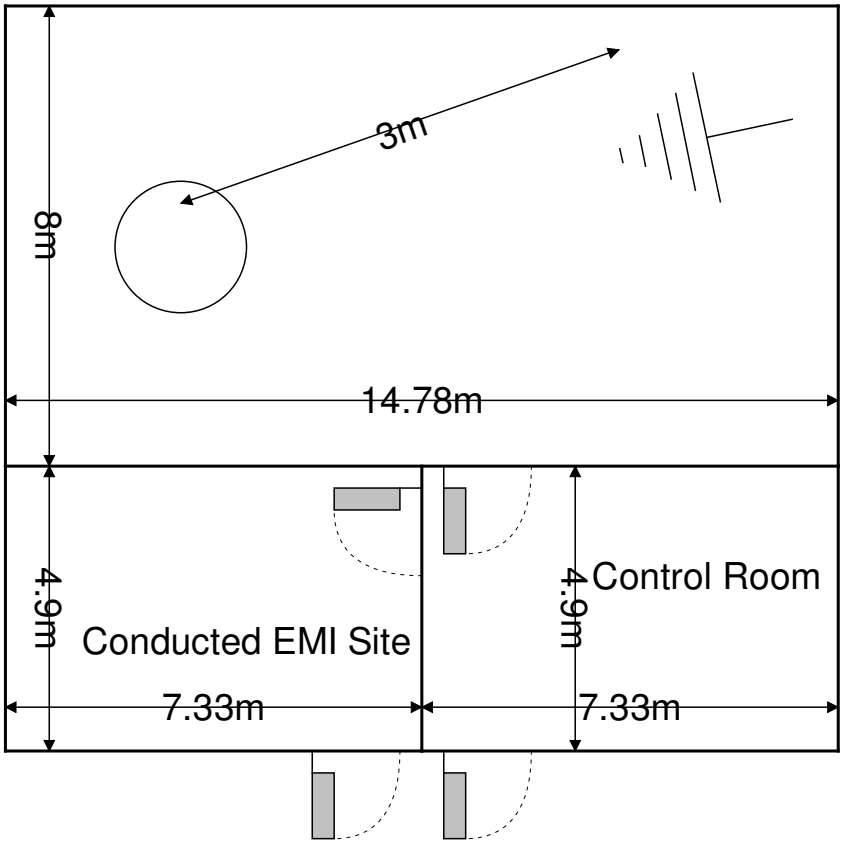


**Figure 2.3.1-1: Semi-Anechoic Chamber Test Site**

### 2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 $m^3$. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825/2R, which are installed as shown in the figure below. For evaluations requiring 230 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a California Instruments signal generator Model 2001RP-OP1.

A diagram of the room is shown below in figure 2.3.2-1:

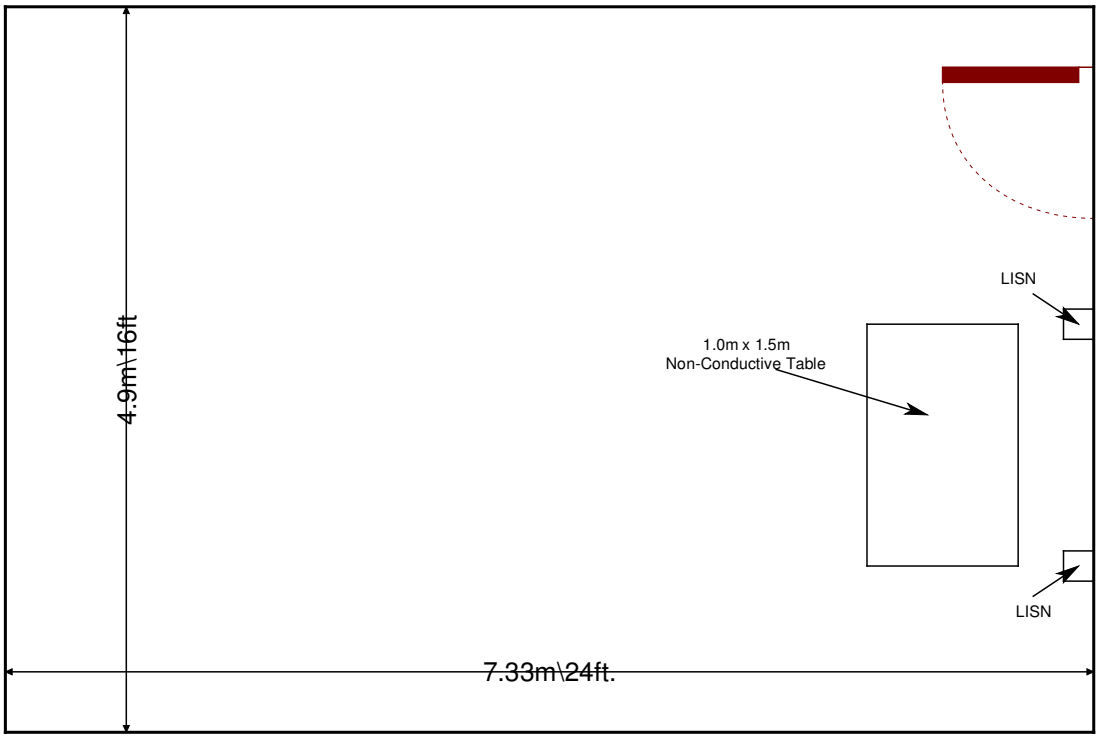


**Figure 2.3.2-1: AC Mains Conducted EMI Site**

## 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016.
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- Industry Canada Radio Standards Specification: RSS-247 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015.
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.

## 4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

**Table 4-1: Test Equipment List**

| AssetID | Manufacturer | Model # | Equipment Type | Serial # | Last Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| 283 | Rohde & Schwarz | FSP40 | Spectrum Analyzers | 1000033 | 7/1/2015 | 7/1/2016 |
| 479 | Electro-Metrics | ALP-70 | Antennas | 158 | 12/3/2015 | 12/3/2017 |
| 523 | Agilent | E7405 | Spectrum Analyzers | MY45103293 | 12/26/2014 | 12/26/2016 |
| 653 | Suhner | SF-102A | Cables | 0944/2A | 4/13/2015 | 4/13/2016 |
| 2002 | EMCO | 3108 | Antennas | 2147 | 11/19/2015 | 11/19/2017 |
| 2004 | EMCO | 3146 | Antennas | 1385 | 11/19/2015 | 11/19/2017 |
| 2006 | EMCO | 3115 | Antennas | 2573 | 4/14/2015 | 4/14/2017 |
| 2008 | COM-Power | AH-826 | Antennas | 81009 | NCR | NCR |
| 2011 | Hewlett-Packard | HP 8447D | Amplifiers | 2443A03952 | 11/18/2015 | 11/18/2016 |
| 2022 | EMCO | LISN3825/2R | LISN | 1095 | 9/14/2015 | 9/14/2017 |
| 2045 | ACS Boca | Conducted Cable Set | Cable Set | 2045 | 11/11/2015 | 11/11/2016 |
| 2070 | Mini Circuits | VHF-8400+ | Filter | 2070 | 11/17/2015 | 11/17/2016 |
| 2072 | Mini Circuits | VHF-3100+ | Filter | 30737 | 11/17/2015 | 11/17/2016 |
| 2086 | Merrimac | FAN-6-10K | Attenuators | 23148-83-1 | 11/16/2015 | 11/16/2016 |
| 2089 | Agilent Technologies, Inc. | 83017A | Amplifiers | 3123A00214 | 12/9/2015 | 12/9/2016 |
| 2111 | Aeroflex Inmet | 40AH2W-20 | Attenuator | 2111 | 7/22/2015 | 7/22/2016 |
| 2112 | Teledyne Storm Products | 921-0101-036 | Cables | 12-06-698 | 11/13/2015 | 11/13/2016 |
| 2121 | ACS Boca | Radiated Cable Set | Cable Set | 2121 | 8/22/2015 | 8/22/2016 |
| 3004 | Teseq | CFL 9206A | Attenuators | 34720 | 10/7/2015 | 10/7/2016 |

**Note: NCR=No Calibration Required**

## 5 SUPPORT EQUIPMENT

**Table 5-1: EUT and Support Equipment (Radiated Emissions)**

| Item # | Type Device | Manufacturer | Model/Part # | Serial # |
|---|---|---|---|---|
| 1 | EUT | Motorola Solutions | H98QDH9PW7BN | 756TRX0603 |

**Note: The EUT was evaluated standalone without any support equipment**

**Table 5-2: EUT and Support Equipment (Power Line Conducted Emissions)**

| Item # | Type Device | Manufacturer | Model/Part # | Serial # |
|---|---|---|---|---|
| 1 | EUT | Motorola Solutions | H98QDH9PW7BN | 756TRX0603 |
| 2 | Multi-Unit Charger | Motorola Solutions | NNTN8844A | N/A |
| 3 | SRX2200 UHF1 ULP Two-Way Radio | Motorola Solutions | H99QDH9PW7BN | 756TSB0792 |
| 4 | APX6000 UHF2 Two-Way Radio | Motorola Solutions | H98SDH9PW7BN | 756TSB0824 |
| 5 | APX6000 7/800 Two-Way Radio | Motorola Solutions | H98UCH9PW7BN | 756TSD0459 |
| 6 | APX6000 UHF1 Two-Way Radio | Motorola Solutions | H98QDH9PW7BN | 756TRX0633 |
| 7 | APX6000 7/800 Two-Way Radio | Motorola Solutions | H98UCH9PW7BN | 756TSD0467 |
| 8 | 6 x Resistive Loads | Motorola Solutions | N/A | N/A |

**Table 5-3: Cable Description (Power Line Conducted Emissions)**

| Cable # | Cable Type | Length | Shield | Termination |
|---|---|---|---|---|
| A | Power | 2.2 m | No | Charger to AC Mains |
| B | 6 x USB | 0.2 m | Yes | Charger to Resistive Load |

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

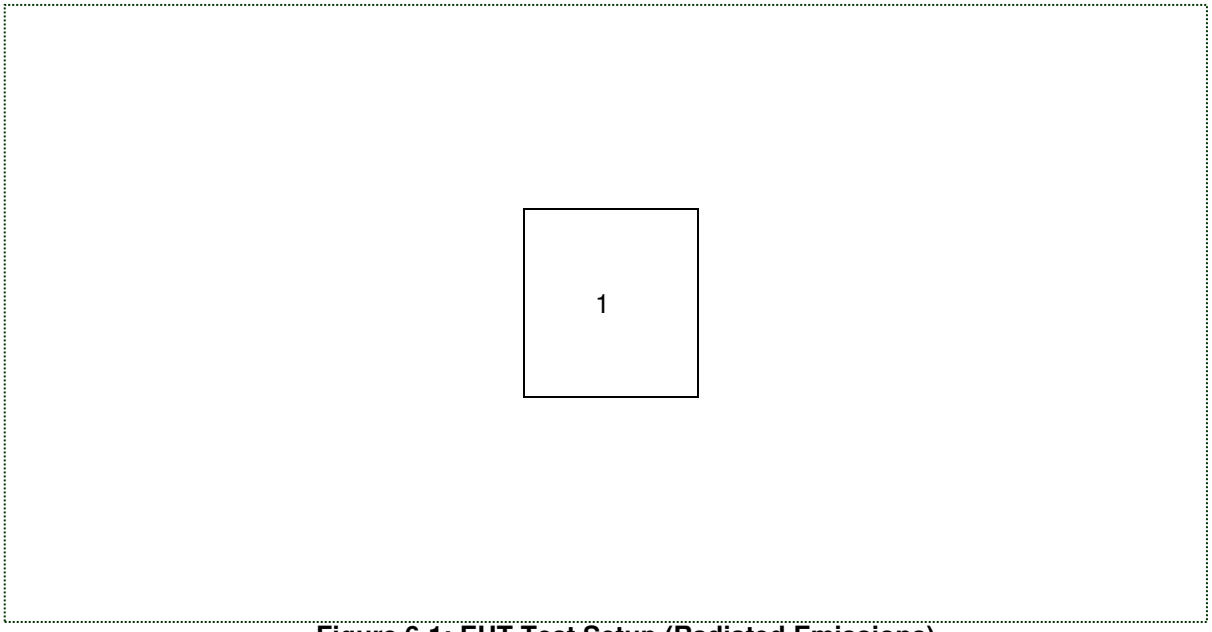


**Figure 6-1: EUT Test Setup (Radiated Emissions)**

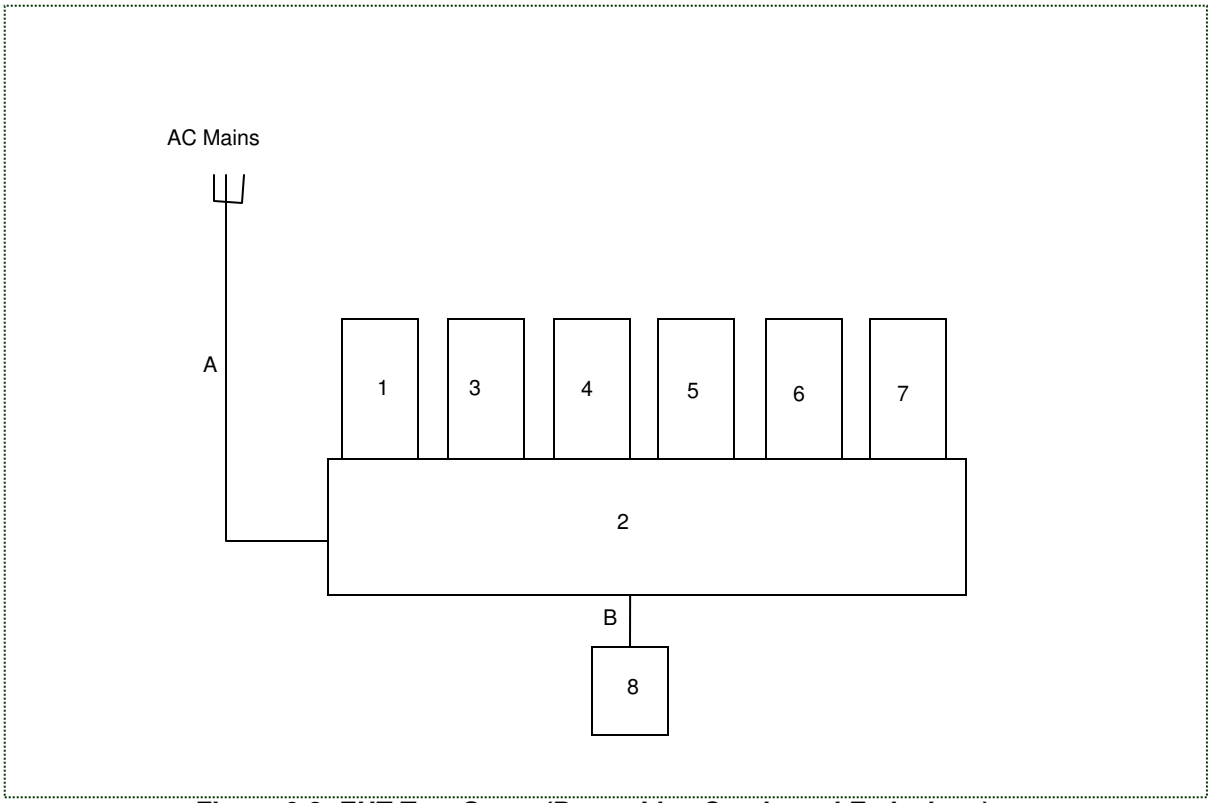


**Figure 6-2: EUT Test Setup (Power Line Conducted Emissions)**

# 7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

## 7.1 Antenna Requirement – FCC: Section 15.203

The EUT uses a 2.58 dBi internal PIFA which connects to the RF port via a spring contact. The EUT meets the requirements of FCC Section 15.203.

## 7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 8.8

### 7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
**Margin = Applicable Limit - Corrected Reading**

### 7.2.2 Measurement Results

Results of the test corresponding to the EUT configuration leading to the worse case emissions are shown below:

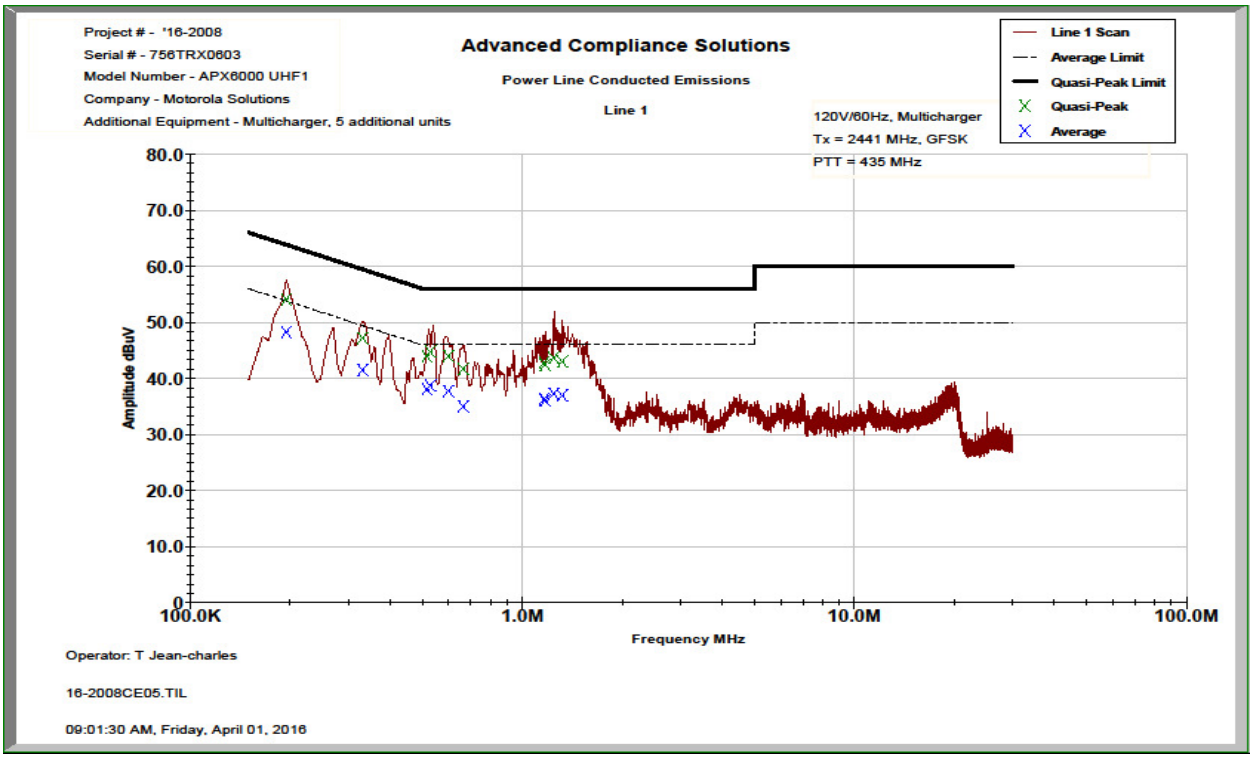


**Figure 7.2.2-1: Conducted Emissions Results – Line 1**

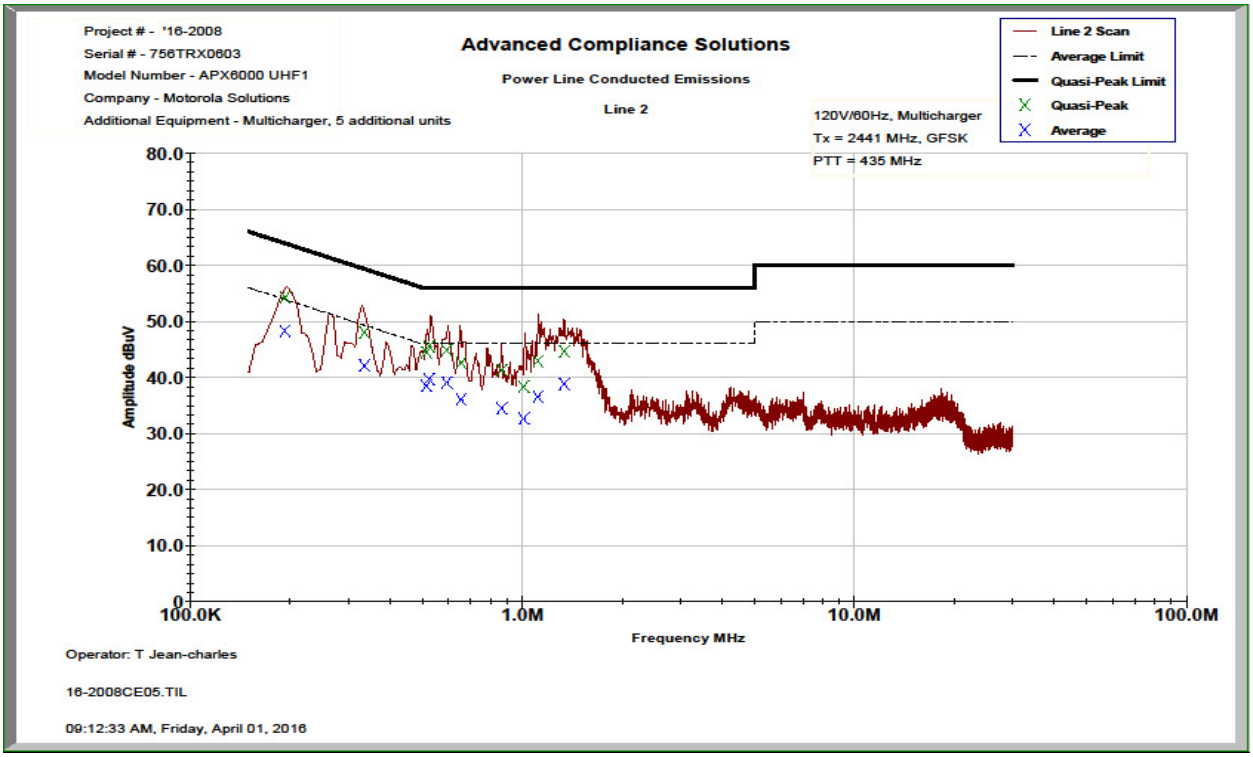


**Figure 7.2.2-2: Conducted Emissions Results – Line 2**

**Table 7.2.2-1: Conducted EMI Results**

☒ Line 1 ☒ Line 2 ☐ Line 3
☐ Line 4
☒ To Ground ☐ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number: 16-2008CE05
Power Supply Description: N/A

| Frequency (MHz) | Uncorrected Reading | | Total Correction Factor (dB) | Corrected Level | | Limit | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|
| | Quasi-Peak | Average | | Quasi-Peak | Average | Quasi-Peak | Average | Quasi-Peak | Average |
| **Line 1** | | | | | | | | | |
| 0.195025 | 43.899 | 38.042 | 10.20 | 54.10 | 48.25 | 63.82 | 53.82 | 9.7 | 5.6 |
| 0.33135 | 37.006 | 31.342 | 10.20 | 47.21 | 41.54 | 59.42 | 49.42 | 12.2 | 7.9 |
| 0.51655 | 33.765 | 27.886 | 10.20 | 43.97 | 38.09 | 56.00 | 46.00 | 12.0 | 7.9 |
| 0.52895 | 34.562 | 28.519 | 10.20 | 44.77 | 38.72 | 56.00 | 46.00 | 11.2 | 7.3 |
| 0.600038 | 33.794 | 27.562 | 10.20 | 43.99 | 37.76 | 56.00 | 46.00 | 12.0 | 8.2 |
| 0.665312 | 31.46 | 24.829 | 10.20 | 41.66 | 35.03 | 56.00 | 46.00 | 14.3 | 11.0 |
| 1.16398 | 32.596 | 26.054 | 10.20 | 42.80 | 36.26 | 56.00 | 46.00 | 13.2 | 9.7 |
| 1.17341 | 32.229 | 25.89 | 10.20 | 42.43 | 36.09 | 56.00 | 46.00 | 13.6 | 9.9 |
| 1.24504 | 33.445 | 27.128 | 10.20 | 43.65 | 37.33 | 56.00 | 46.00 | 12.4 | 8.7 |
| 1.32091 | 32.741 | 26.762 | 10.20 | 42.94 | 36.97 | 56.00 | 46.00 | 13.1 | 9.0 |
| **Line 2** | | | | | | | | | |
| 0.193025 | 44.099 | 38.126 | 10.22 | 54.32 | 48.35 | 63.91 | 53.91 | 9.6 | 5.6 |
| 0.335399 | 37.832 | 31.902 | 10.21 | 48.04 | 42.11 | 59.32 | 49.32 | 11.3 | 7.2 |
| 0.5152 | 34.34 | 28.294 | 10.21 | 44.55 | 38.50 | 56.00 | 46.00 | 11.5 | 7.5 |
| 0.524688 | 35.368 | 29.519 | 10.21 | 45.58 | 39.73 | 56.00 | 46.00 | 10.4 | 6.3 |
| 0.59325 | 34.683 | 28.91 | 10.21 | 44.90 | 39.12 | 56.00 | 46.00 | 11.1 | 6.9 |
| 0.655738 | 32.417 | 25.843 | 10.21 | 42.63 | 36.05 | 56.00 | 46.00 | 13.4 | 9.9 |
| 0.8685 | 31.124 | 24.259 | 10.21 | 41.34 | 34.47 | 56.00 | 46.00 | 14.7 | 11.5 |
| 1.00985 | 28.165 | 22.396 | 10.25 | 38.42 | 32.65 | 56.00 | 46.00 | 17.6 | 13.4 |
| 1.11587 | 32.679 | 26.287 | 10.25 | 42.93 | 36.54 | 56.00 | 46.00 | 13.1 | 9.5 |
| 1.34099 | 34.392 | 28.588 | 10.25 | 44.64 | 38.84 | 56.00 | 46.00 | 11.4 | 7.2 |

## 7.3 Peak Output Power - FCC Section 15.247(b)(1) IC: RSS-247 5.4(2)

### 7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of the spectrum analyzer through suitable attenuation.

### 7.3.2 Measurement Results

Results are shown below:

**Table 7.3.2-1: RF Output Power (π/4 DQPSK)**

| Frequency (MHz) | Power (dBm) |
|---|---|
| 2402 | 5.90 |
| 2441 | 6.42 |
| 2480 | 6.72 |

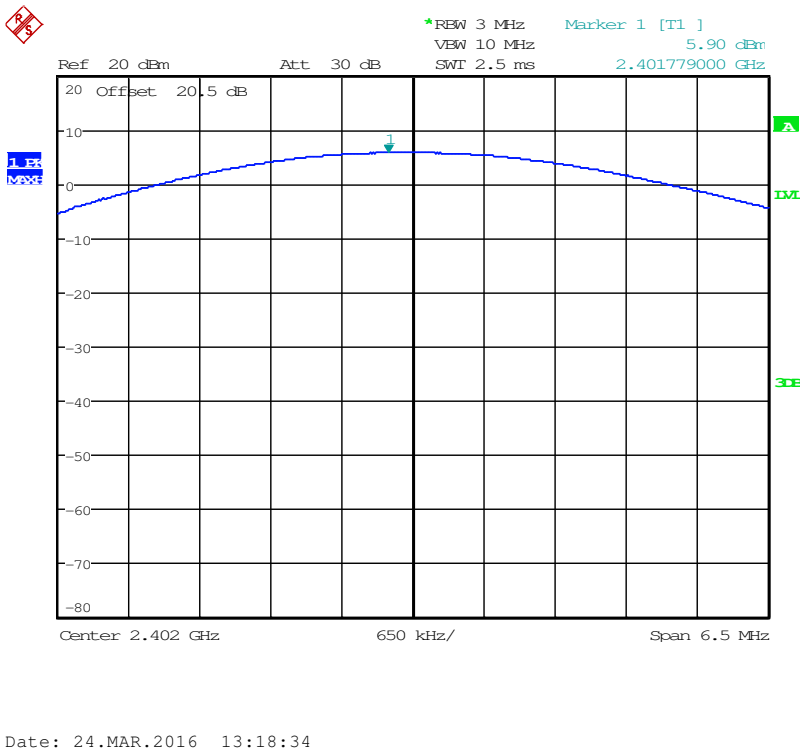


**Figure 7.3.2-1: RF Output Power (π/4 DQPSK) - Low Channel**

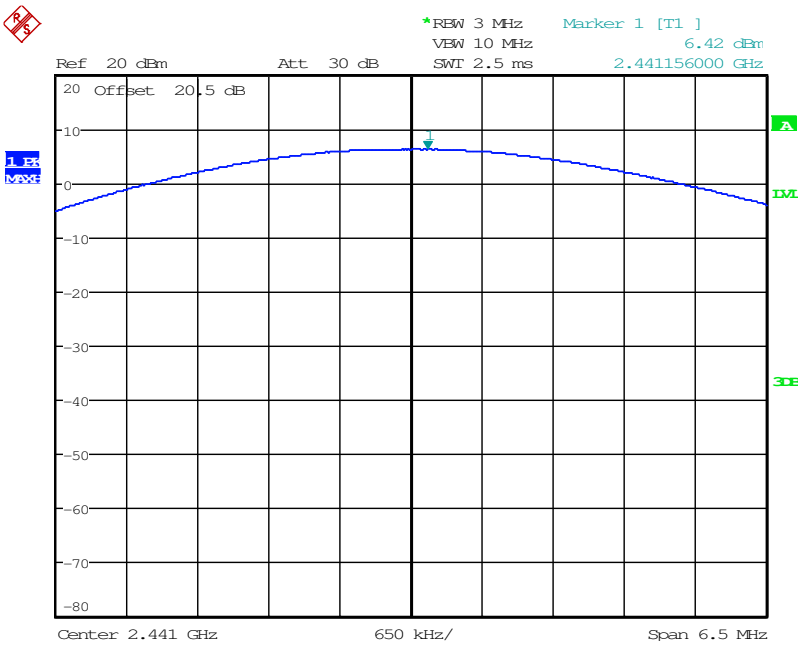


**Figure 7.3.2-2: RF Output Power (π/4 DQPSK) - Middle Channel**

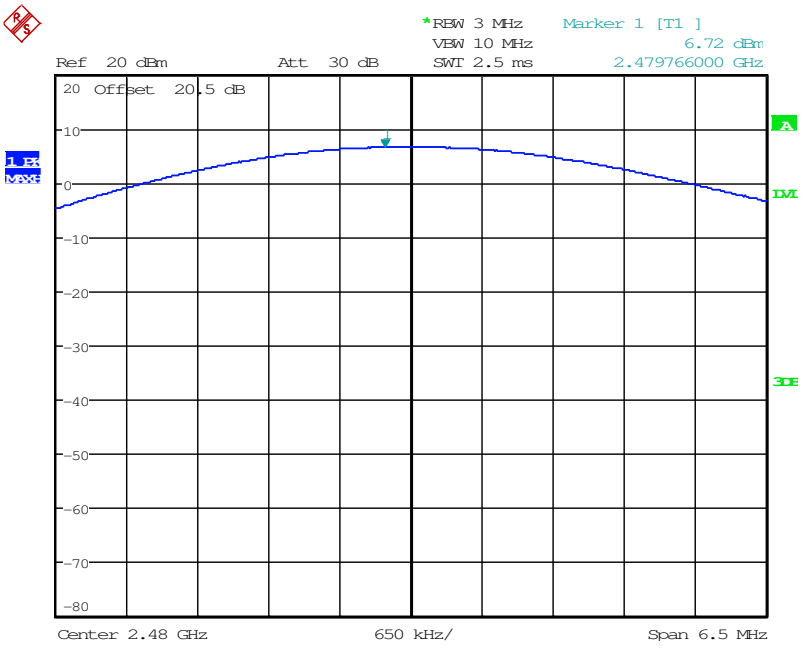


**Figure 7.3.2-3: RF Output Power (π/4 DQPSK) - High Channel**

**Table 7.3.2-2: RF Output Power (8DPSK)**

| Frequency (MHz) | Power (dBm) |
|---|---|
| 2402 | 6.48 |
| 2441 | 6.93 |
| 2480 | 7.27 |

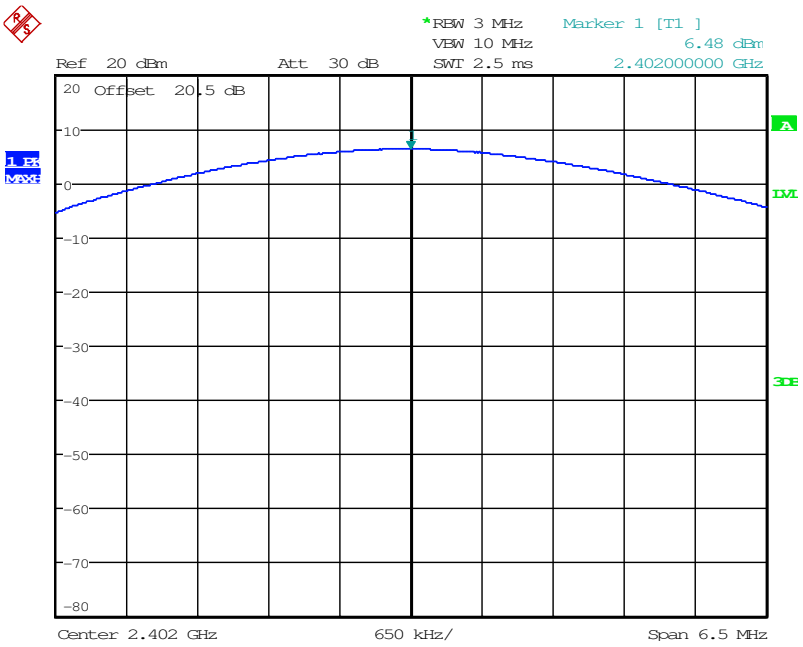


**Figure 7.3.2-4: RF Output Power (8DPSK) - Low Channel**

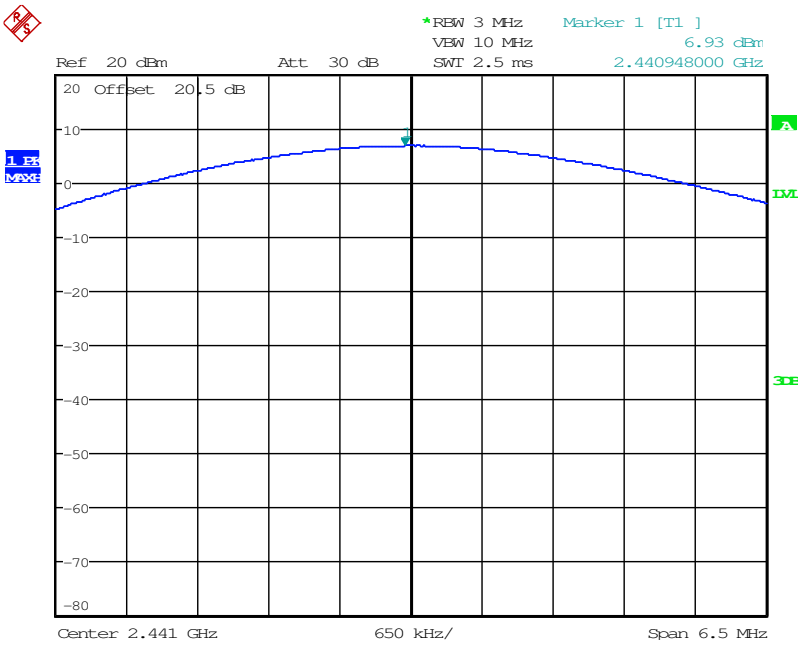


**Figure 7.3.2-5: RF Output Power (8DPSK) - Middle Channel**

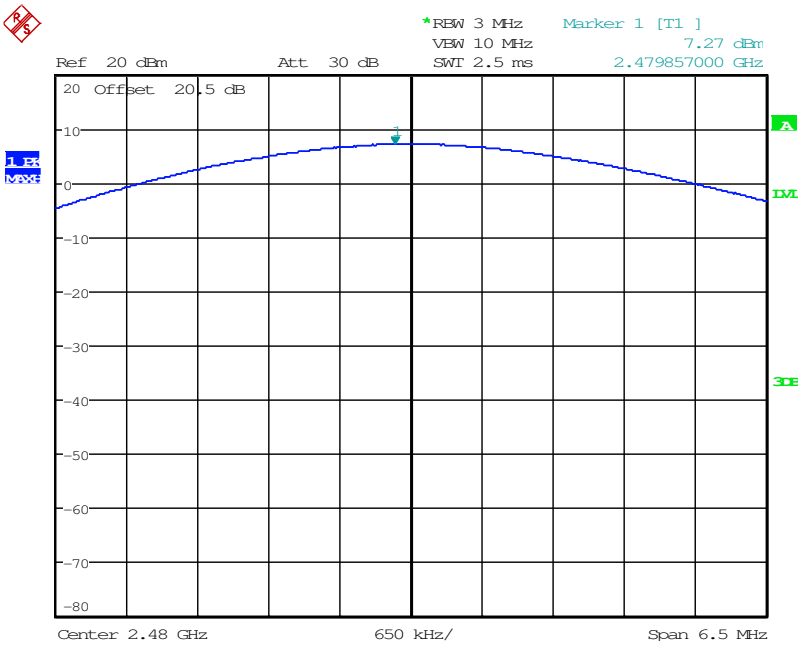


**Figure 7.3.2-6: RF Output Power (8DPSK) - High Channel**

**Table 7.3.2-3 RF Output Power (GFSK)**

| Frequency (MHz) | Power (dBm) |
|---|---|
| 2402 | 8.28 |
| 2441 | 8.77 |
| 2480 | 9.04 |

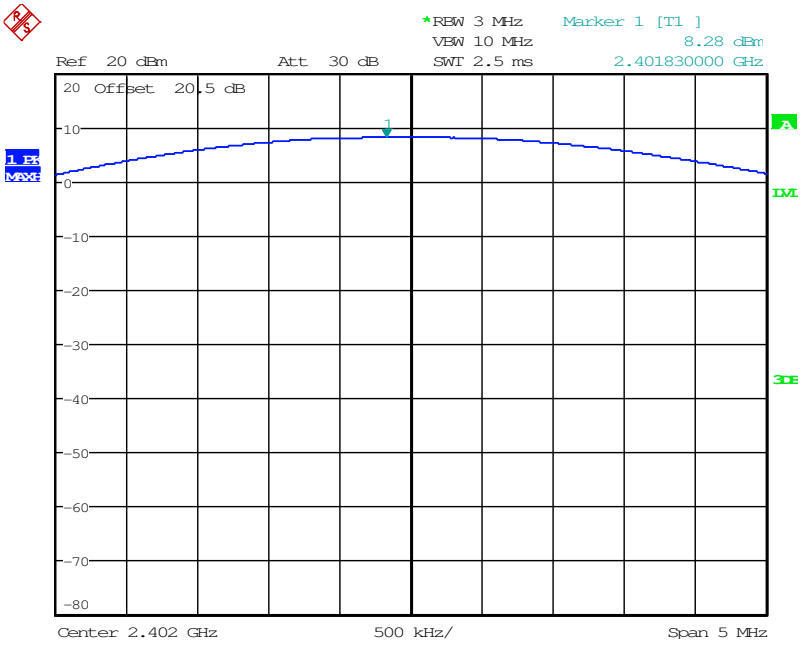


**Figure 7.3.2-7: RF Output Power (GFSK) - Low Channel**

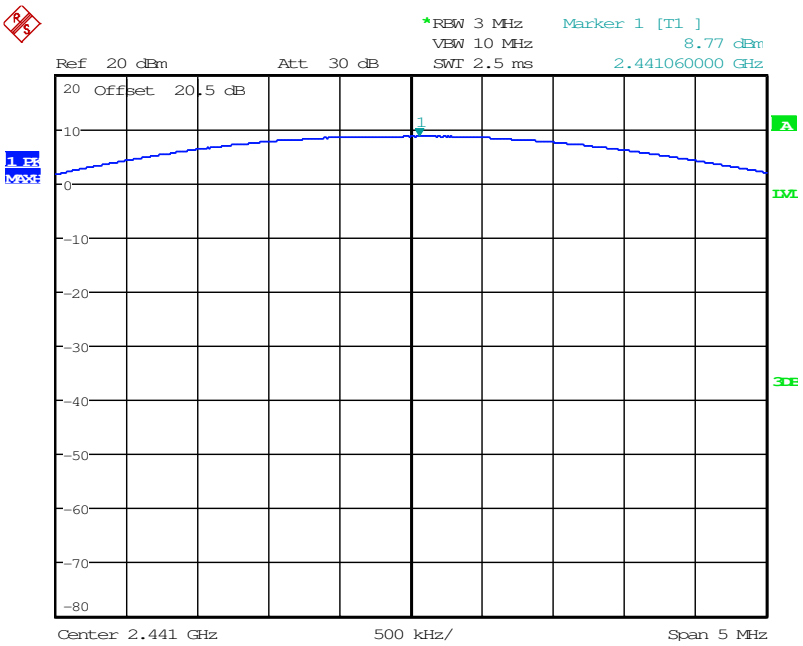


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**Figure 7.3.2-8: RF Output Power (GFSK) - Middle Channel**

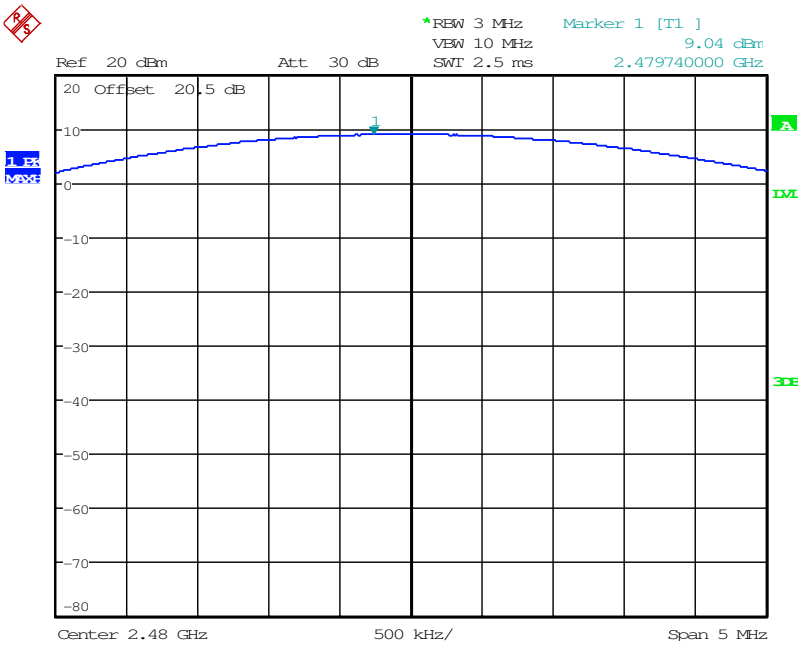


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**Figure 7.3.2-9: RF Output Power (GFSK) - High Channel**

## 7.4 Channel Usage Requirements

### 7.4.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-247 5.1(2)

#### *7.4.1.1* Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to approximately 30% of the channel spacing.

#### *7.4.1.2* Measurement Results

Results are shown below:

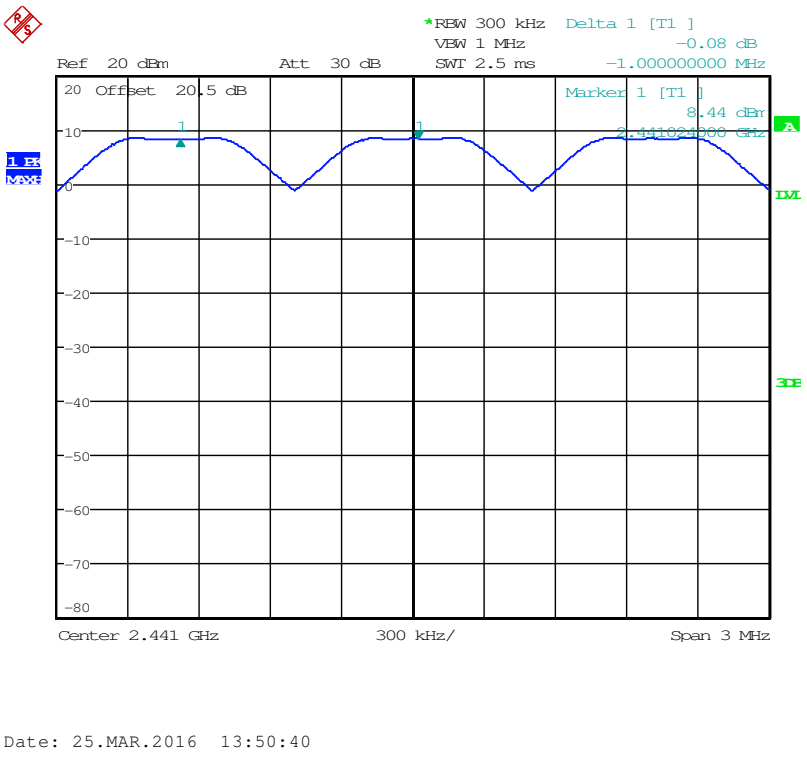


**Figure 7.4.1.2-1: Carrier Frequency Separation**

### 7.4.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(4)

#### *7.4.2.1* Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture the number of hopping channels. The peak detector max hold function was enabled for the measurements.

#### *7.4.2.2* Measurement Results

Results are shown below:

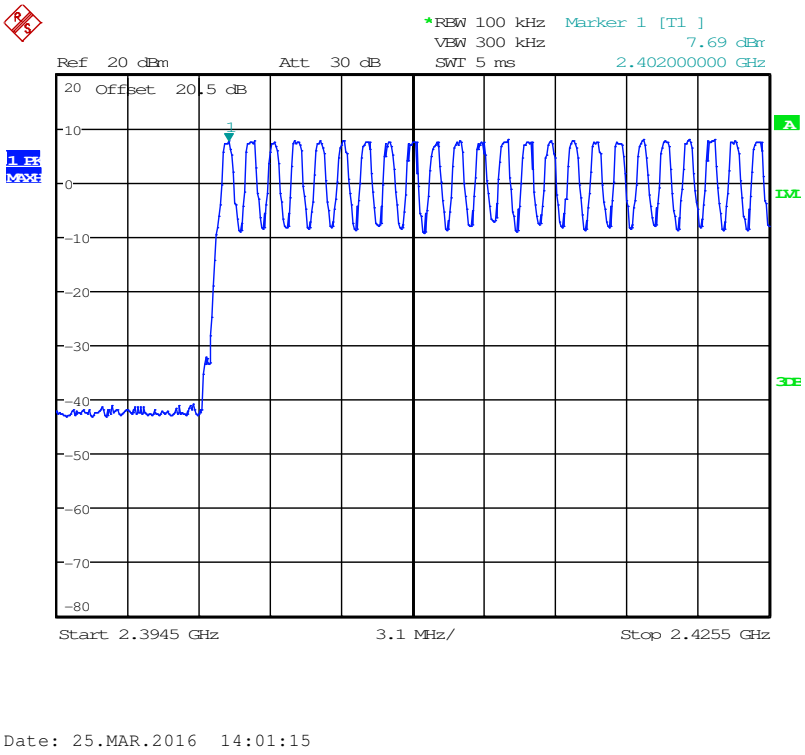


**Figure 7.4.2.2-1: Number of Hopping Channels (1 – 24)**

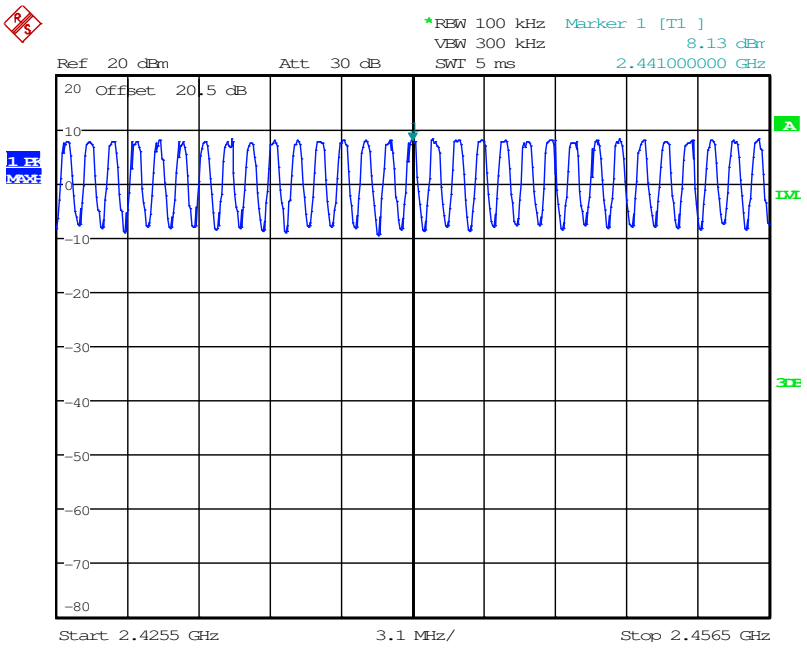


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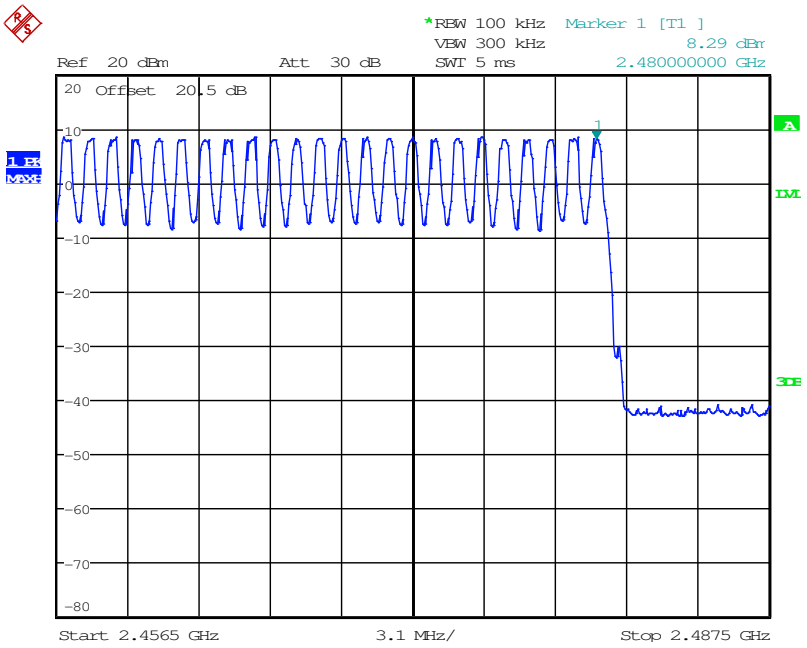
**Figure 7.4.2.2-2: Number of Hopping Channels (25 – 55)**




Date: 25.MAR.2016 14:04:37

**Figure 7.4.2.2-3: Number of Hopping Channels (56 – 79)**

### 7.4.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(4)

#### *7.4.3.1* Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set 0 Hz centered on a hopping channel. The RBW was set to less than 30% of the channel spacing and the sweep time adjusted to capture the entire dwell time per channel with peak detector max hold function.

#### *7.4.3.2* Measurement Results

Results are shown below:

**Table 7.4.3.2-1 Dwell Time on a 31.6 Second Cycle**

| Packet Format | Number of Hops Per Sec. (NHPS) | Number of Hops per Channel Per Sec. (NHPCPS) | Number of hops on a 31.6 s Cycle (NHPC) | Measured Dwell Times (ms) | Dwell Times on a 31.6 s Cycle | Limit (ms) | Status |
|---|---|---|---|---|---|---|---|
| DH1 | 800 | 10.13 | 320 | 0.396 | 126.72 | 400 | PASS |
| DH3 | 400 | 5.06 | 160 | 1.66 | 265.60 | 400 | PASS |
| DH5 | 266.67 | 3.38 | 106.67 | 2.92 | 311.48 | 400 | PASS |

*Notes:

NHPS = (1600 /sec)/ (NT+NR) (where NT and NR are the number of transmit and receive packets, respectively)
NHPCPS = NHPS/79
NHPC = NHPCPS * 31.6s
Dwell Time per Cycle = NHPC* Measured Dwell Time

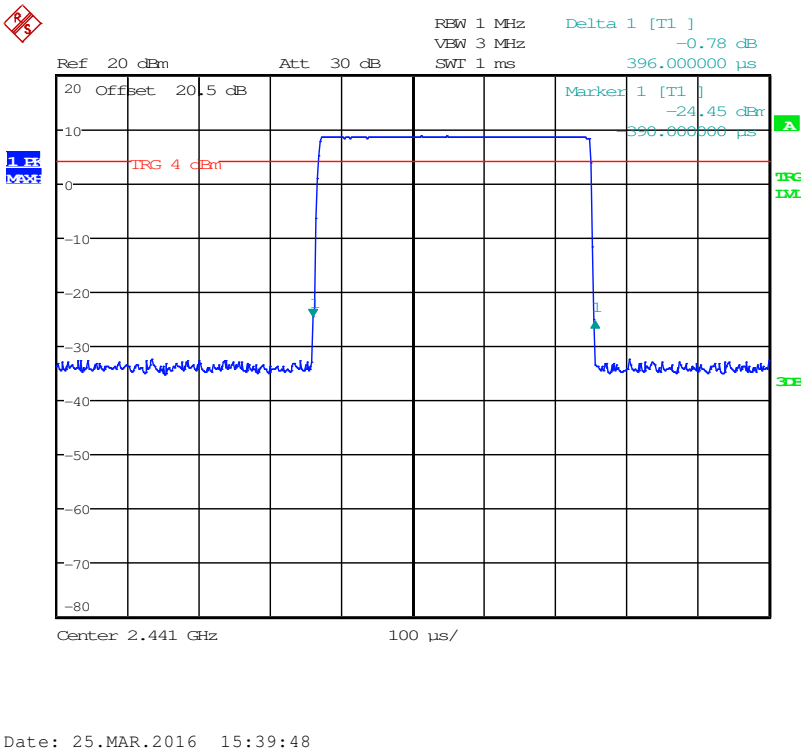



**Figure 7.4.3.2-1: Channel Dwell Time – DH1**

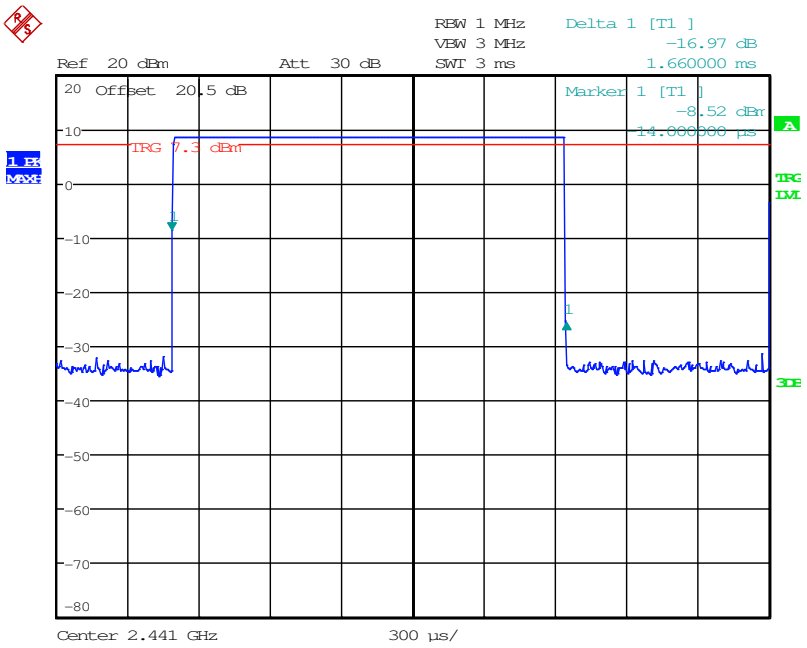



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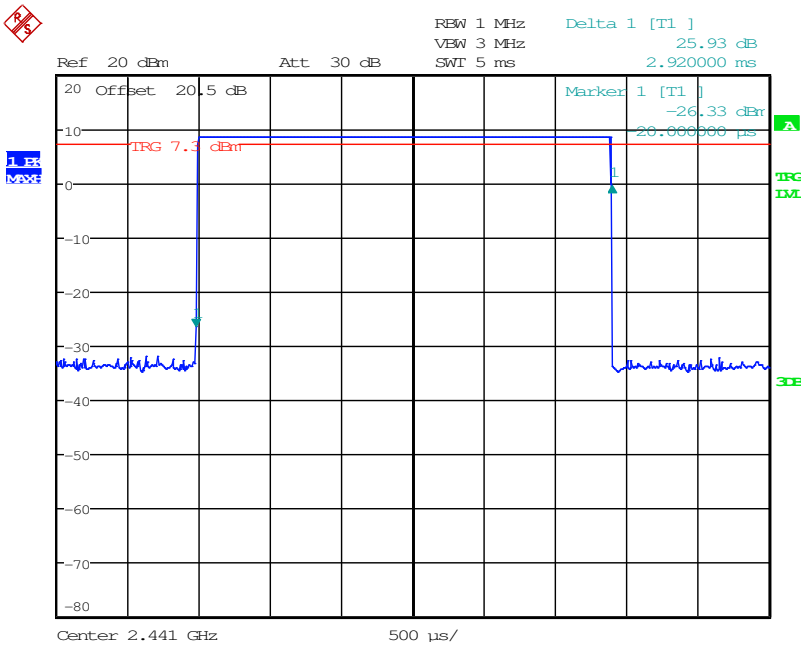
**Figure 7.4.3.2-2: Channel Dwell Time – DH3**




Date: 25.MAR.2016 15:18:01

**Figure 7.4.3.2-3: Channel Dwell Time – DH5**

### 7.4.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-247 5.1(1)

#### *7.4.4.1* Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set to 1% to 5% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. For the GFSK modulation, the Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emissions. For the 8 DPSK and Pi/4DQPSK modulations, the N dB function of the spectrum analyzer was used to measure the 20 dB bandwidth.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. . The occupied 99% bandwidth was measured by using the 99% bandwidth equipment function of the spectrum analyzer.

#### *7.4.4.2* Measurement Results

Results are shown below:

**Table 7.4.4.2-1: 20dB / 99% Bandwidth**

| Frequency [MHz] | 20dB Bandwidth [kHz] | 99% Bandwidth [kHz] |
|---|---|---|
| 2402 | 918.00 | 852.00 |
| 2441 | 924.00 | 852.00 |
| 2480 | 924.00 | 852.00 |

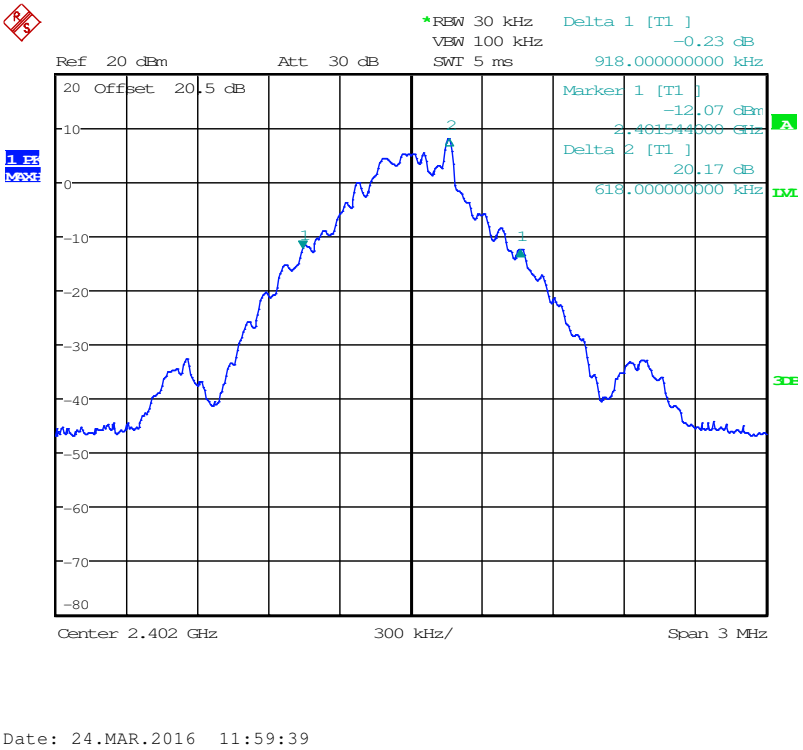
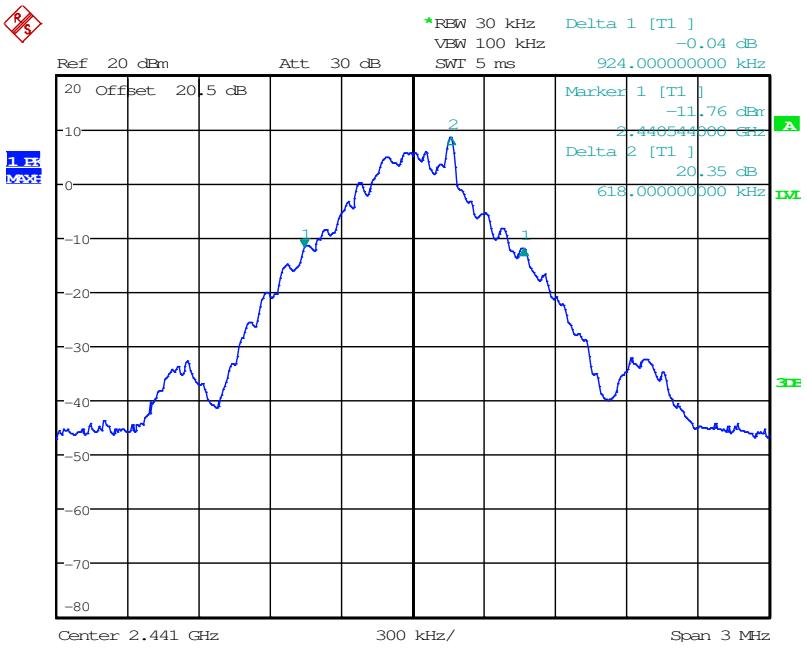
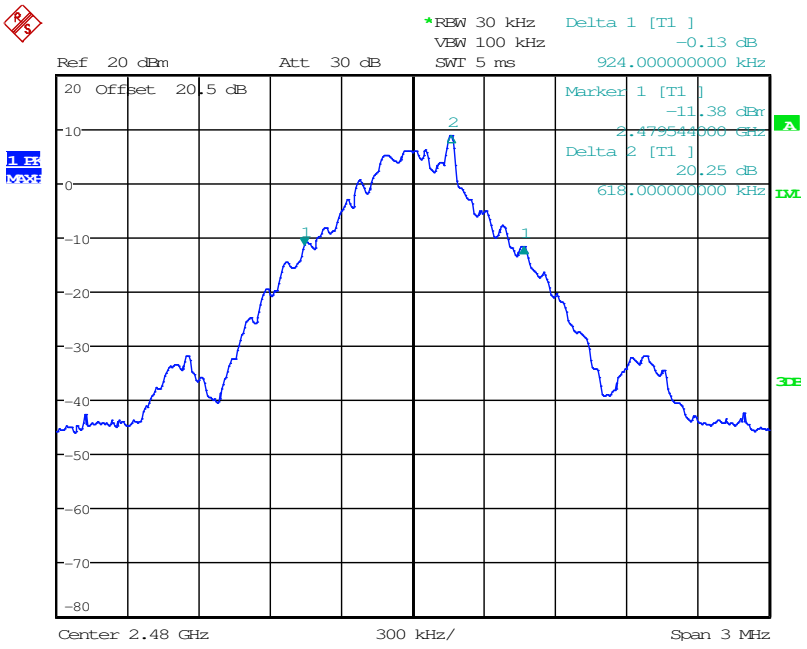



**Figure 7.4.4.2-1: 20dB BW Low Channel (GFSK)**




Date: 24.MAR.2016 12:15:47

**Figure 7.4.4.2-2: 20dB BW Middle Channel (GFSK)**




Date: 24.MAR.2016 12:39:30

**Figure 7.4.4.2-3: 20dB BW High Channel (GFSK)**

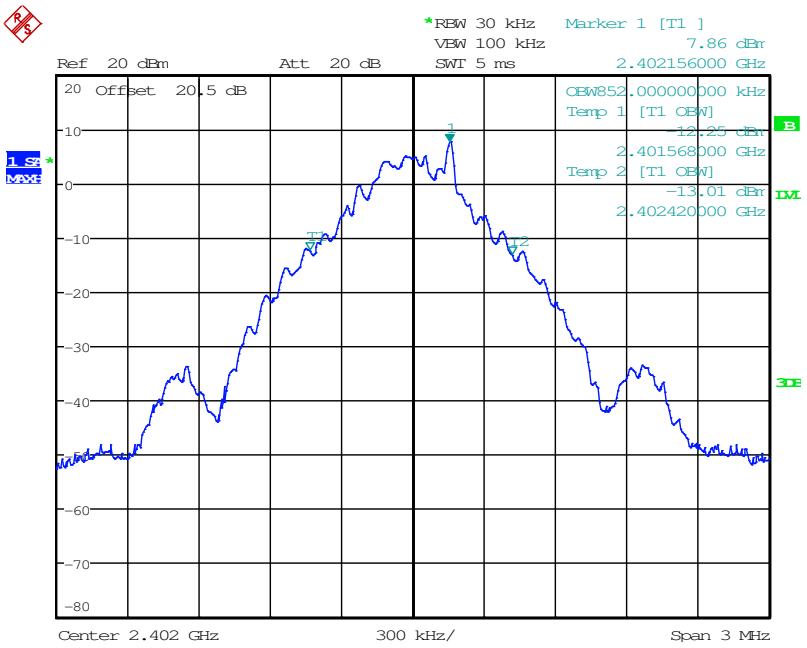



**Figure 7.4.4.2-4: 99% OBW Low Channel (GFSK)**

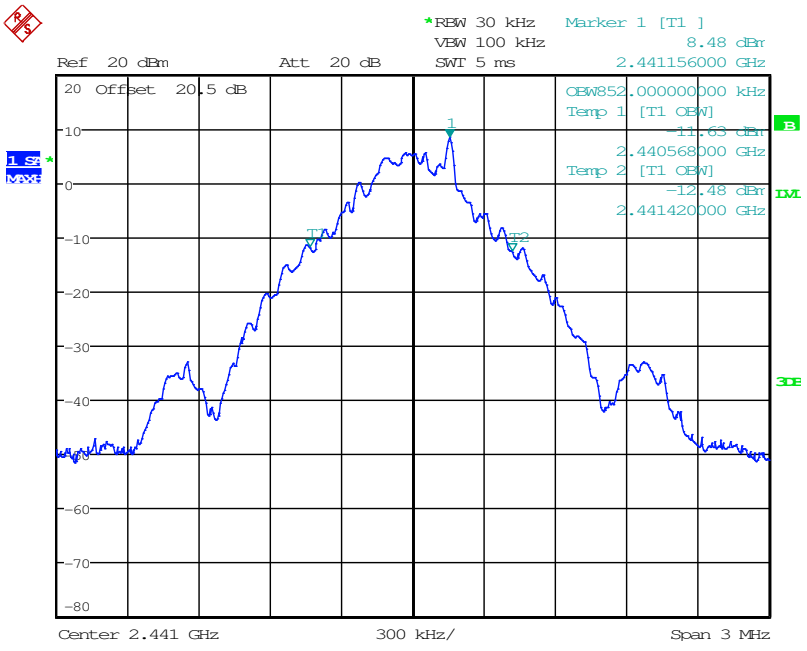



**Figure 7.4.4.2-5: 99% OBW Middle Channel (GFSK)**

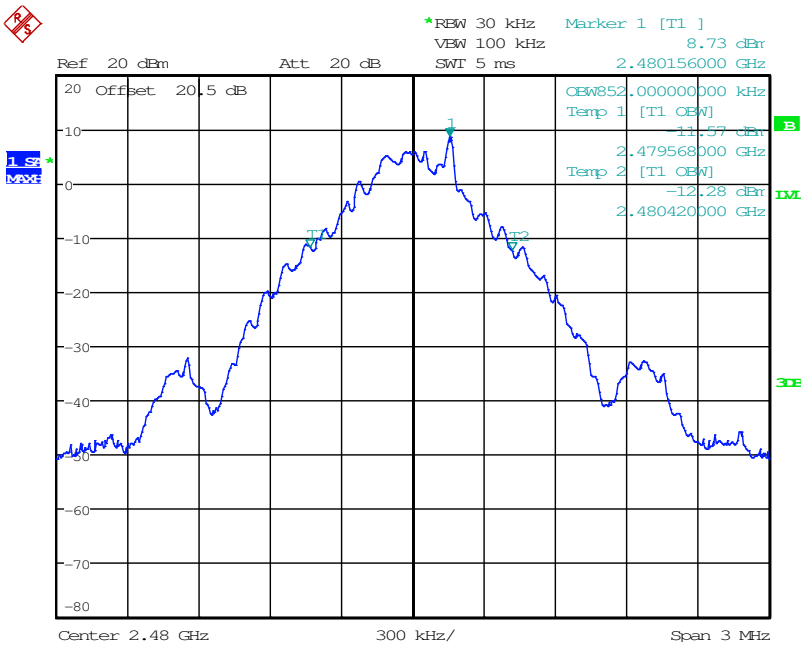



**Figure 7.4.4.2-6: 99% OBW High Channel (GFSK)**

**Table: 7.4.4.2-2: 20dB / 99% Bandwidth (π/4 DQPSK)**

| Frequency [MHz] | 20dB Bandwidth [kHz] | 99% Bandwidth [kHz] |
|---|---|---|
| 2402 | 1266.00 | 1170.00 |
| 2441 | 1242.00 | 1160.00 |
| 2480 | 1260.00 | 1170.00 |

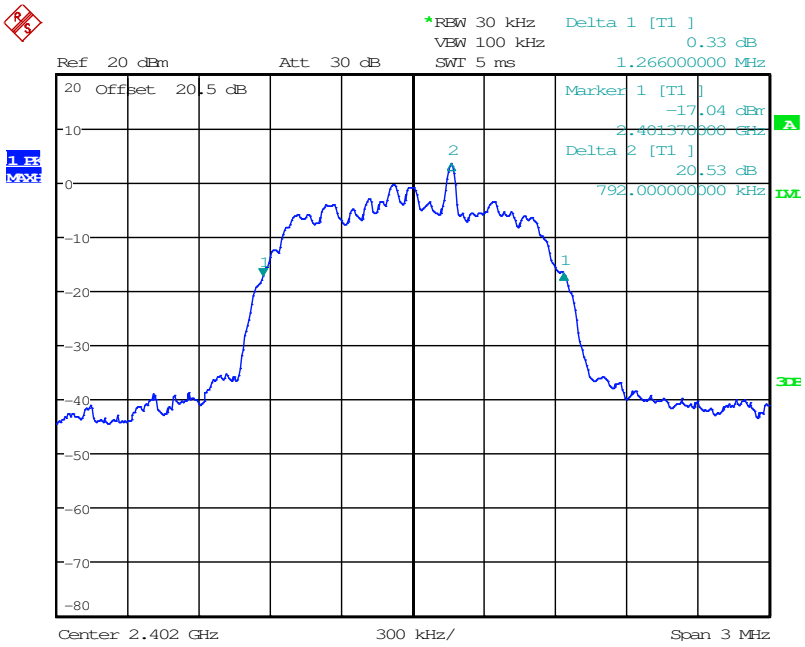
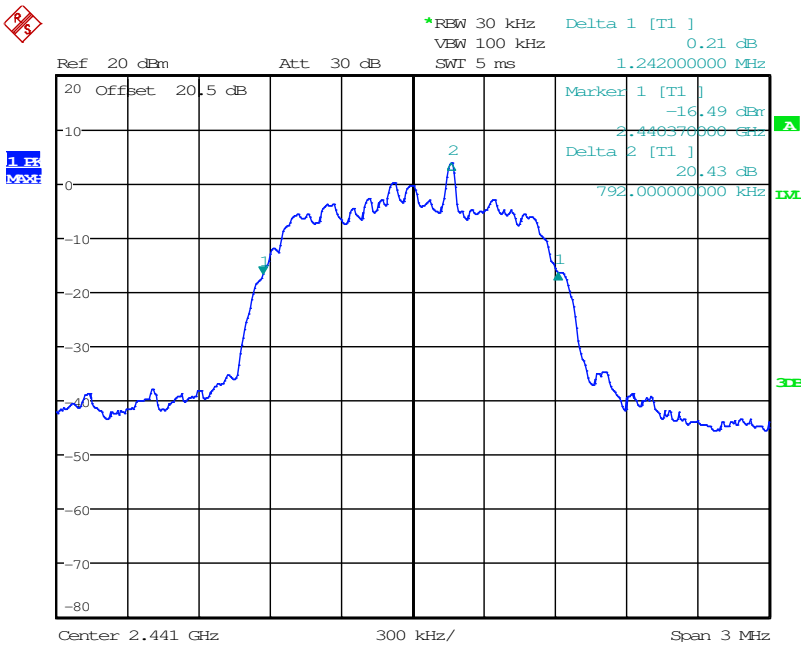
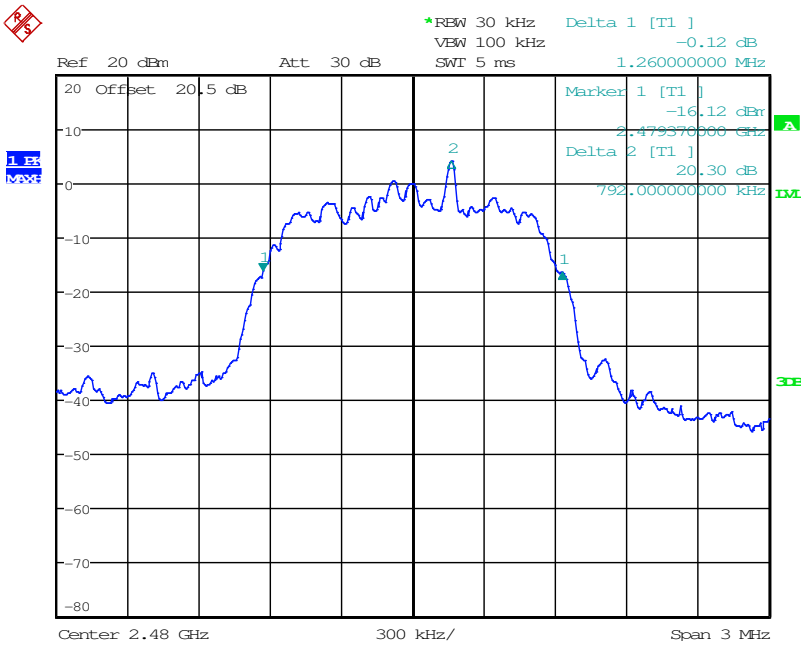



**Figure 7.4.4.2-7: 20dB BW Low Channel (π/4 DQPSK)**




Date: 24.MAR.2016 13:26:41

**Figure 7.4.4.2-8: 20dB BW Middle Channel (π/4 DQPSK)**




Date: 24.MAR.2016 13:59:51

**Figure 7.4.4.2-9: 20dB BW High Channel (π/4 DQPSK)**

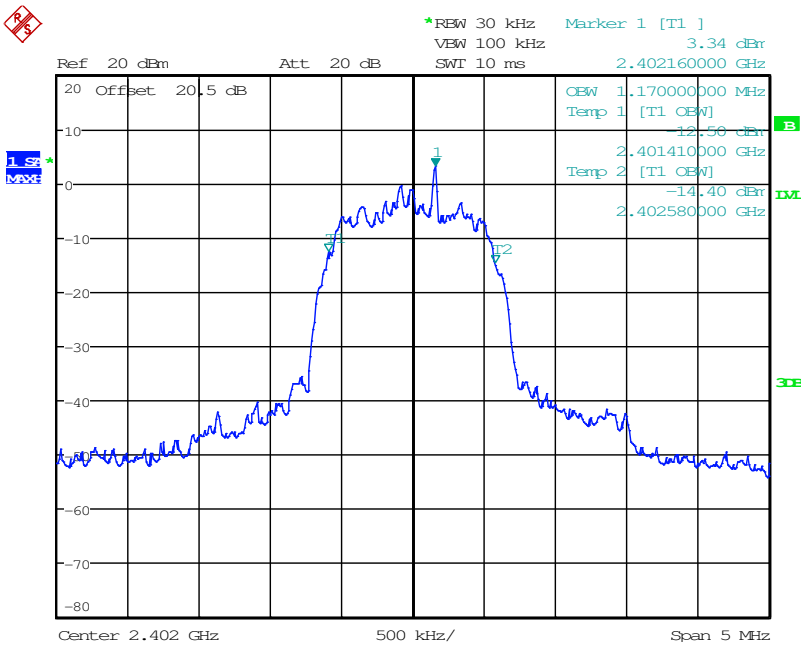



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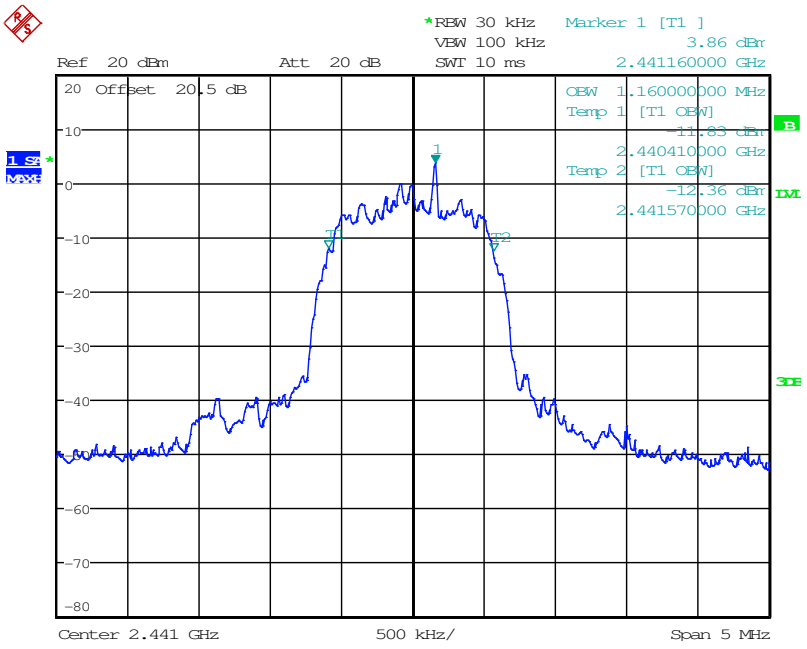
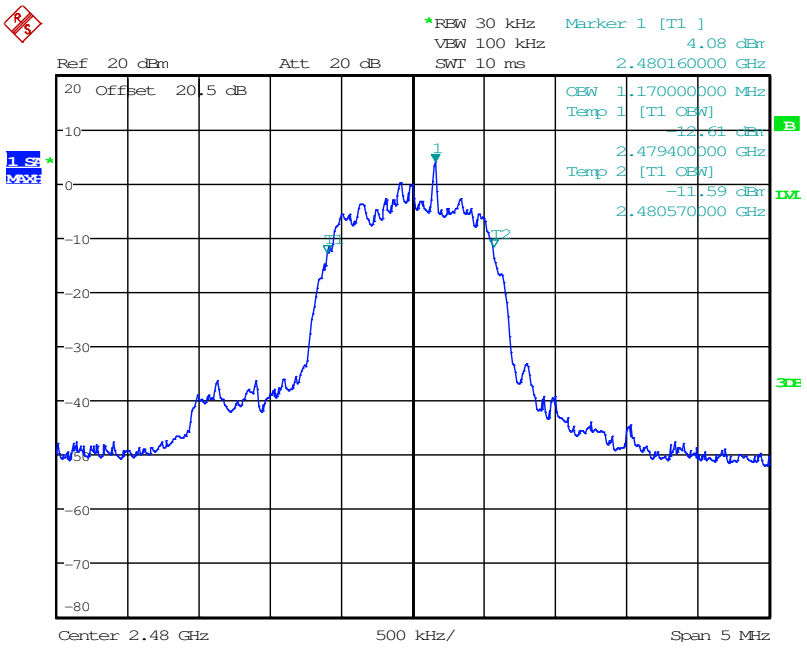
**Figure 7.4.4.2-10: 99% OBW Low Channel (π/4 DQPSK)**




Date: 24.MAR.2016 13:30:35

**Figure 7.4.4.2-11: 99% OBW Middle Channel (π/4 DQPSK)**




Date: 24.MAR.2016 14:03:05

**Figure 7.4.4.2-12: 99% OBW High Channel (π/4 DQPSK)**

**Table 7.4.4.2-3: 20dB / 99% Bandwidth (8DPSK)**

| Frequency [MHz] | 20dB Bandwidth [kHz] | 99% Bandwidth [kHz] |
|---|---|---|
| 2402 | 1278.00 | 1180.00 |
| 2441 | 1272.00 | 1180.00 |
| 2480 | 1272.00 | 1190.00 |

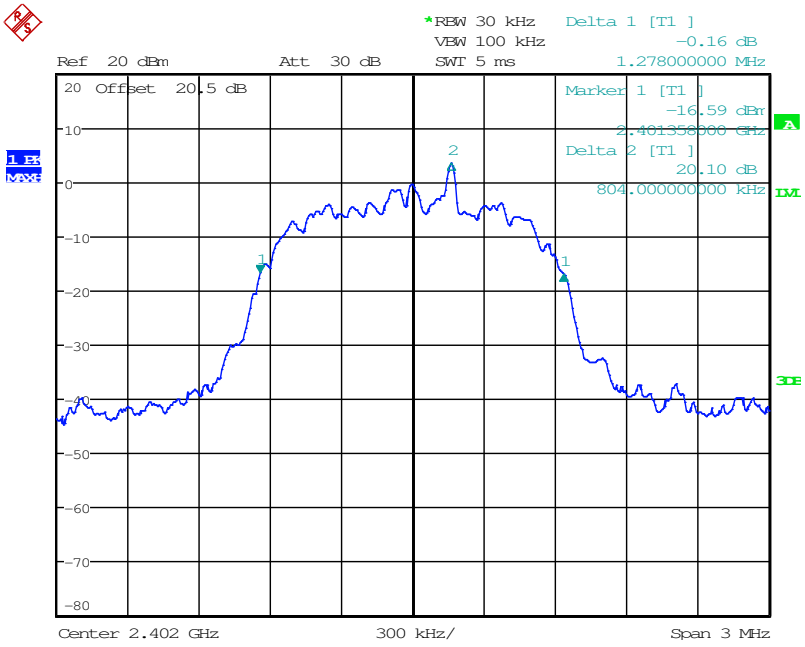
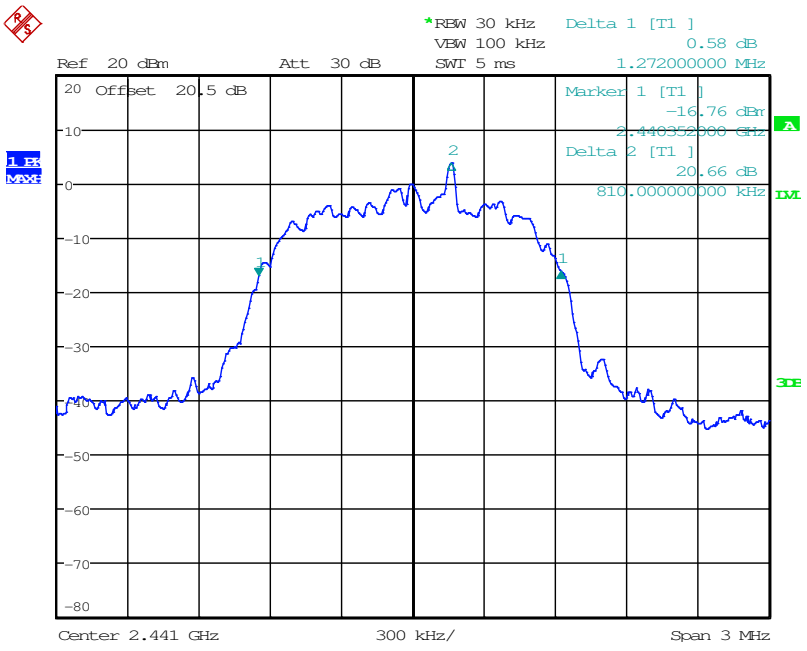
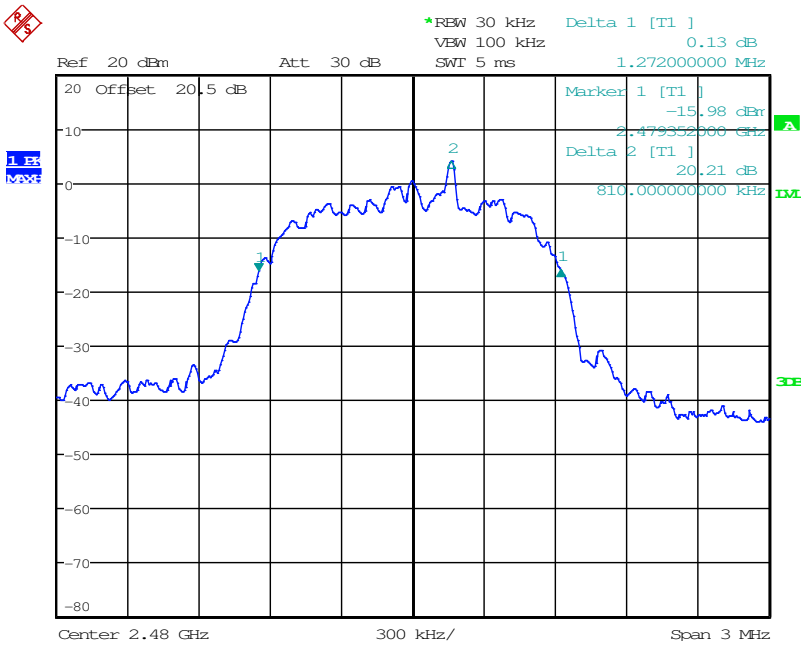



**Figure 7.4.4.2-13: 20dB BW Low Channel (8DPSK)**



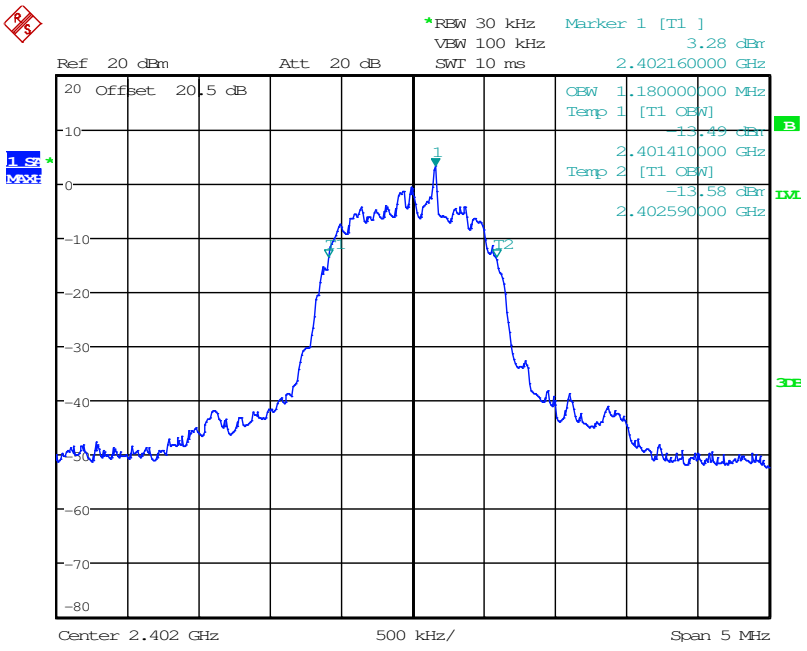

Date: 24.MAR.2016 13:36:11

**Figure 7.4.4.2-14: 20dB BW Middle Channel (8DPSK)**



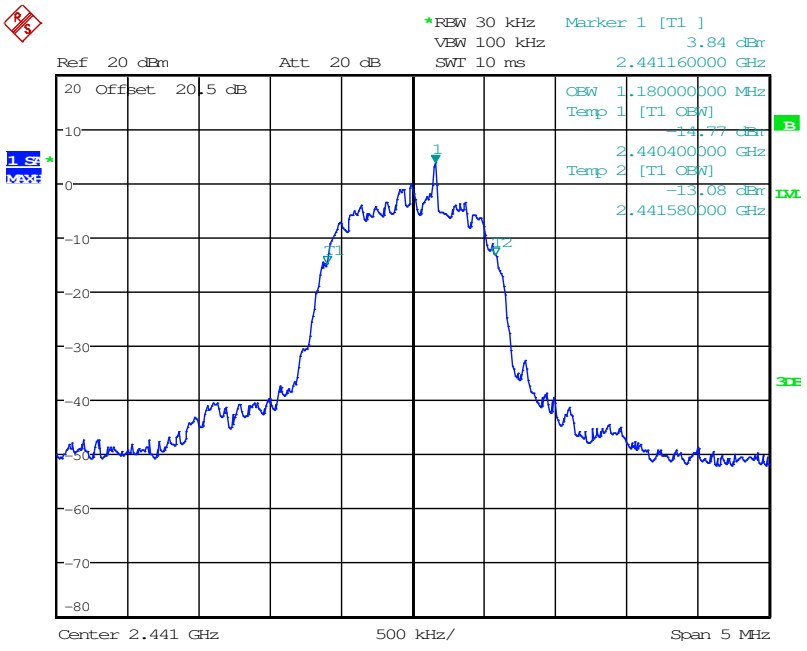

Date: 24.MAR.2016 14:27:49

**Figure 7.4.4.2-15: 20dB BW High Channel (8DPSK)**




Date: 24.MAR.2016 13:08:14

**Figure 7.4.4.2-16: 99% OBW Low Channel (8DPSK)**




Date: 24.MAR.2016 13:33:33

**Figure 7.4.4.2-17: 99% OBW Middle Channel (8DPSK)**

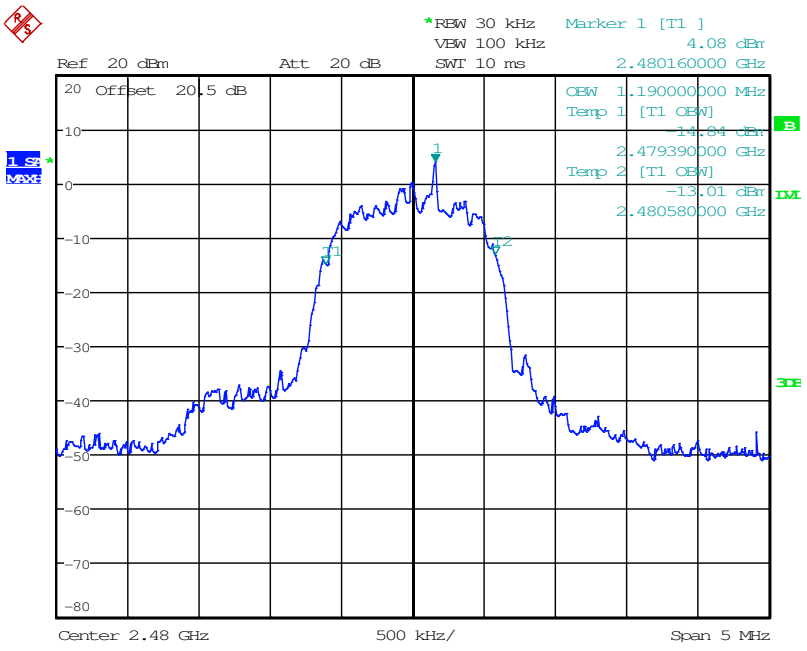



**Figure 7.4.4.2-18: 99% OBW High Channel (8DPSK)**

## 7.5 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-247 5.5

### 7.5.1 Band-Edge Compliance of RF Conducted Emissions

#### *7.5.1.1* Measurement Procedure

The RF output port of the EUT was connected to the input of the spectrum analyzer through suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, which is ≥ 1% of the span, and the VBW was set to >= 300 kHz.

#### *7.5.1.2* Measurement Results

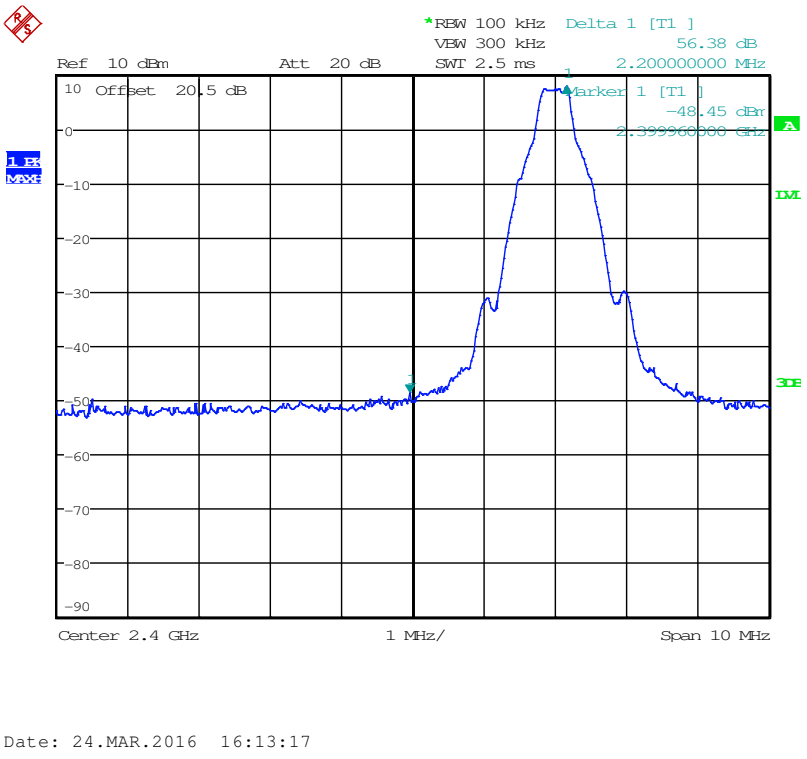



**Figure 7.5.1.2-1: Lower Band-edge (GFSK)**

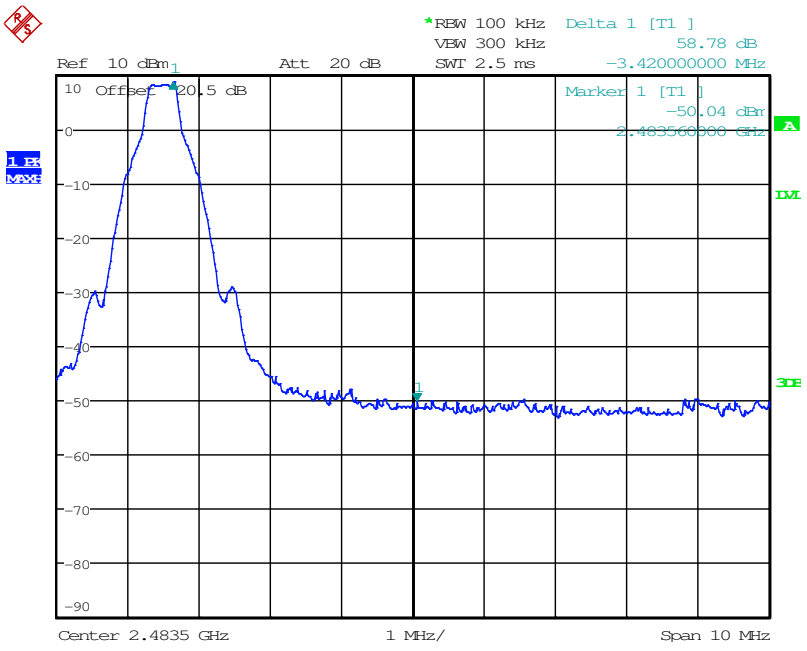



**Figure 7.5.1.2-2: Upper Band-edge (GFSK)**

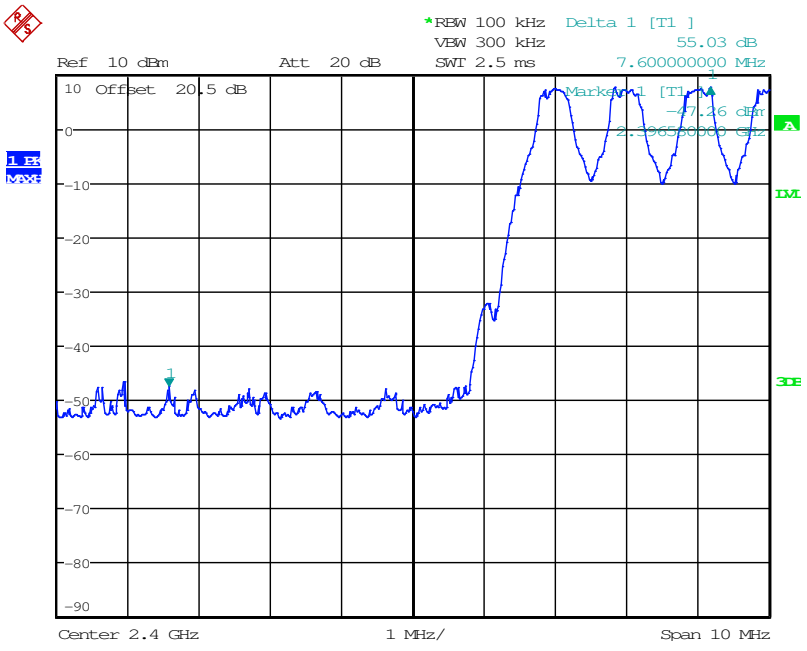
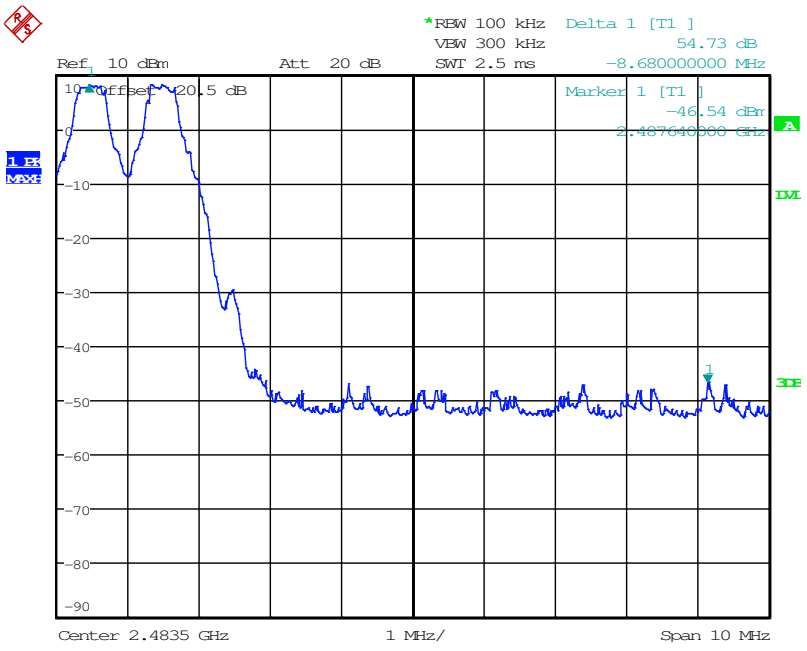



**Figure 7.5.1.2-3: Lower Band-edge – Hopping Mode (GFSK)**




Date: 24.MAR.2016 16:03:55

**Figure 7.5.1.2-4: Upper Band-edge – Hopping Mode (GFSK)**

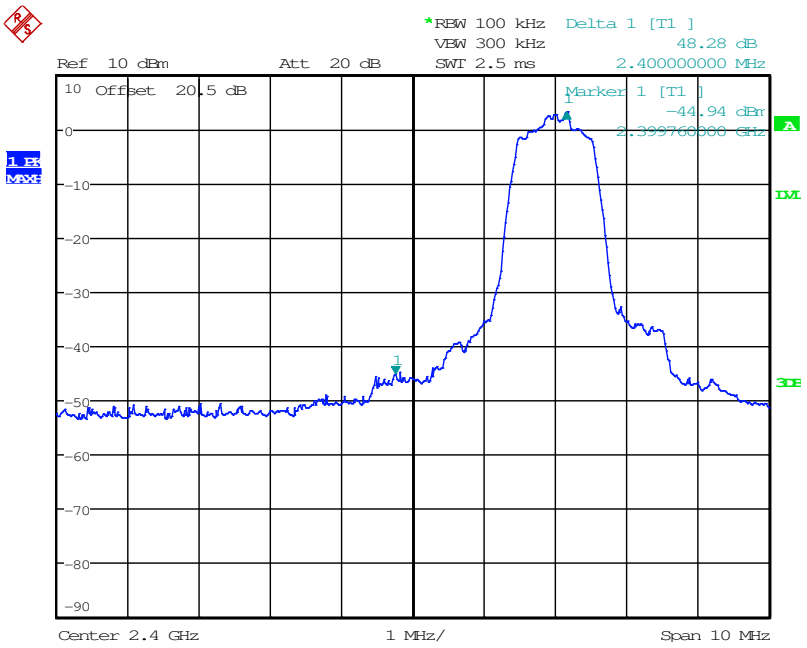



**Figure 7.5.1.2-5: Lower Band-edge (π/4 DQPSK)**

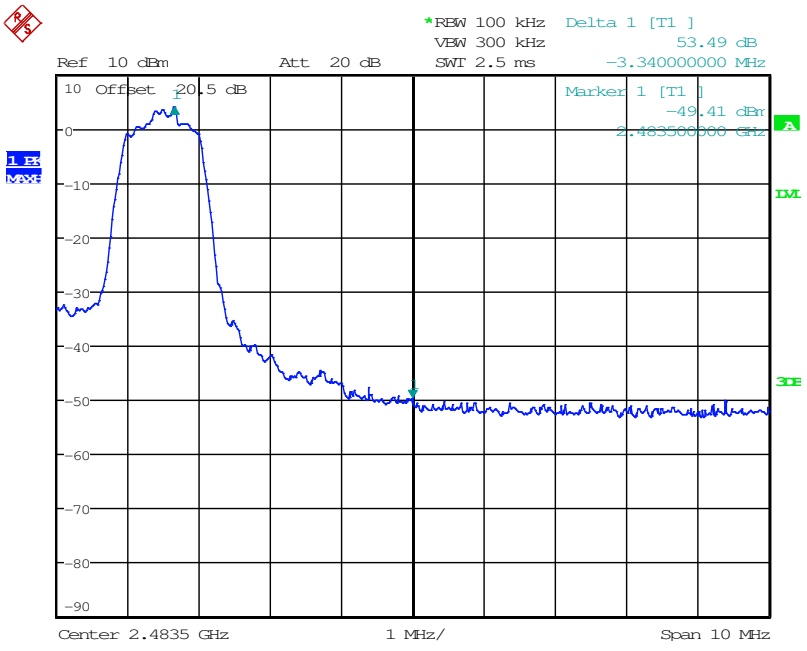
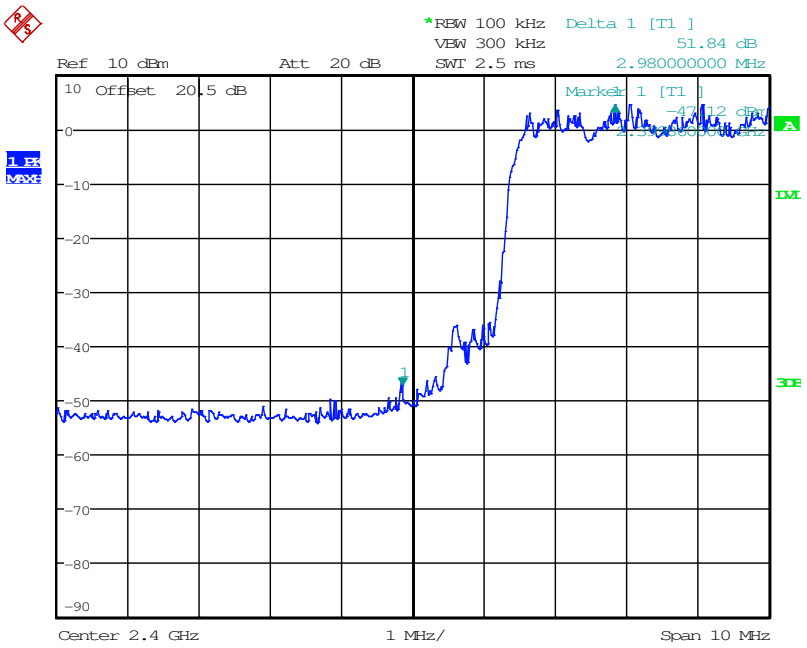
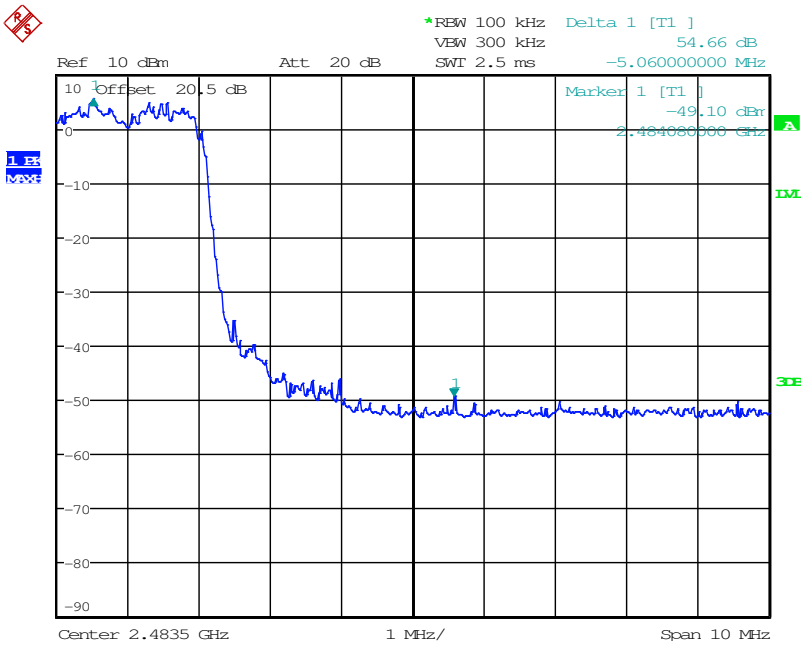



**Figure 7.5.1.2-6: Upper Band-edge (π/4 DQPSK)**



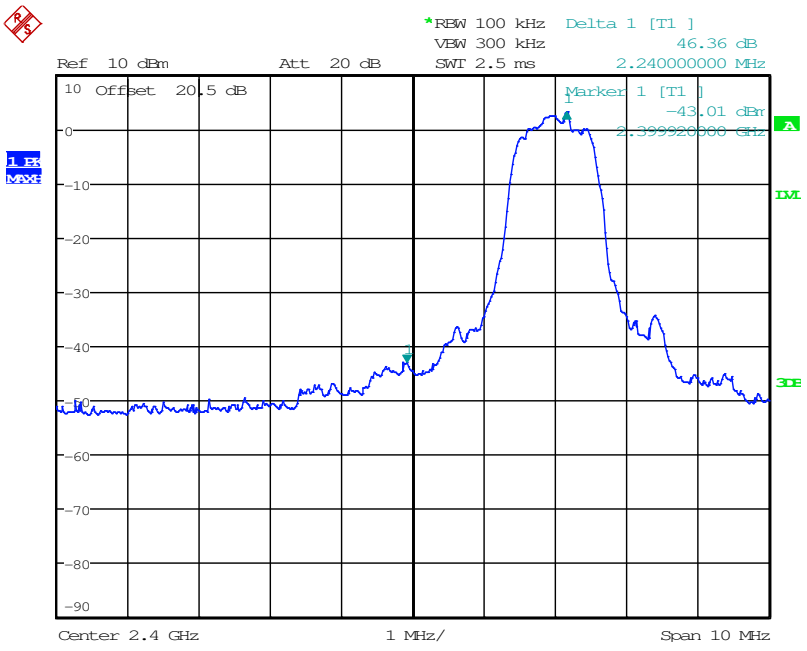

Date: 24.MAR.2016 15:48:07

**Figure 7.5.1.2-7: Lower Band-edge – Hopping Mode (π/4 DQPSK)**



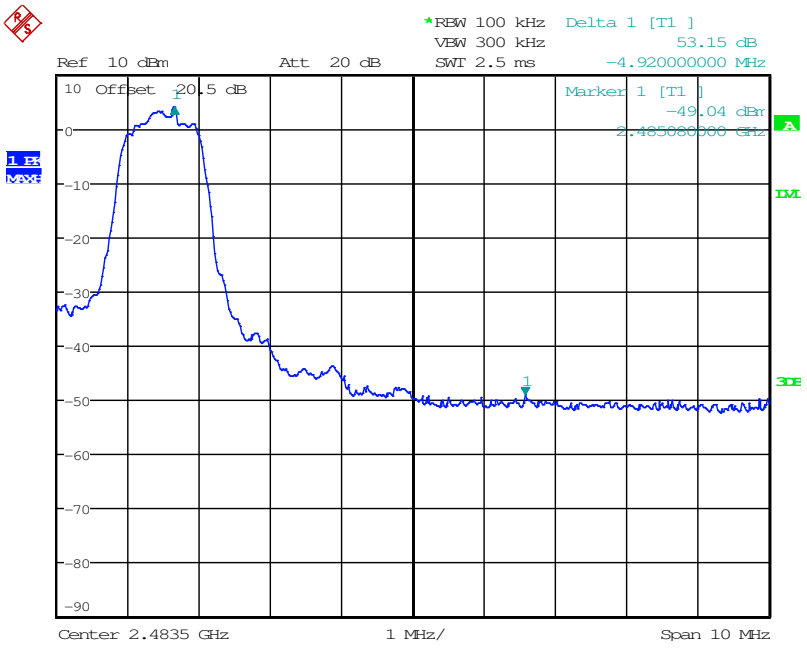

Date: 24.MAR.2016 15:51:23

**Figure 7.5.1.2-8: Upper Band-edge – Hopping Mode (π/4 DQPSK)**



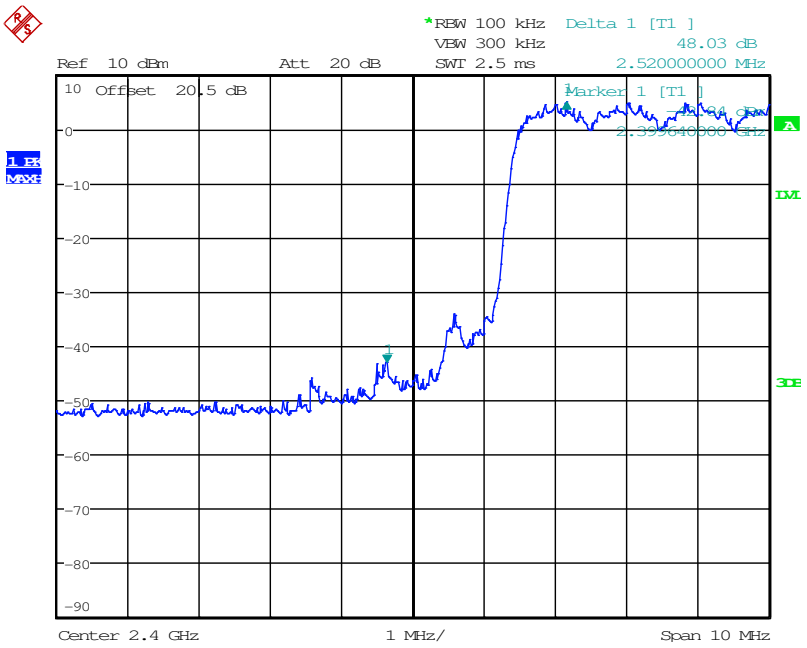

Date: 24.MAR.2016 15:40:20

**Figure 7.5.1.2-9: Lower Band-edge (8DPSK)**



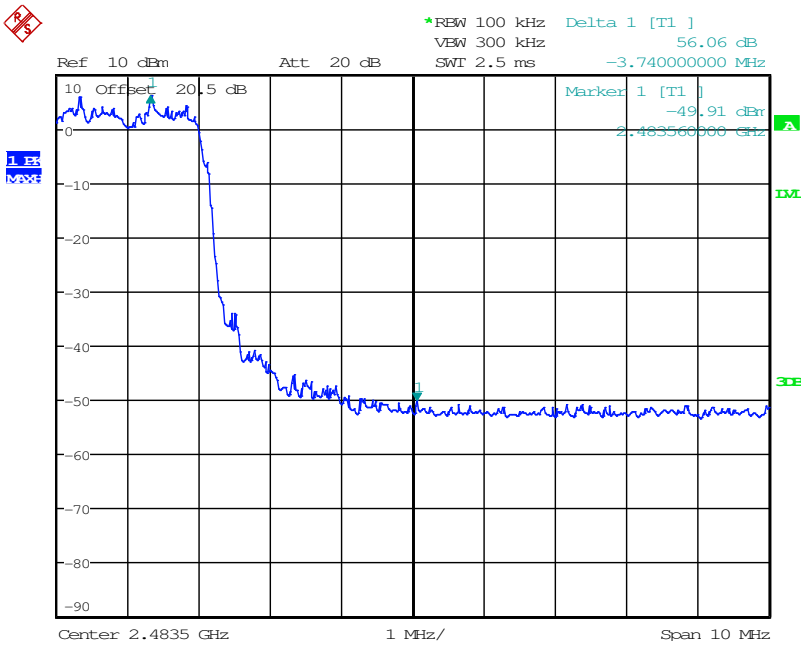

Date: 24.MAR.2016 14:58:35

**Figure 7.5.1.2-10: Upper Band-edge (8DPSK)**




Date: 24.MAR.2016 15:24:00

**Figure 7.5.1.2-11: Lower Band-edge – Hopping Mode (8DPSK)**




Date: 24.MAR.2016 15:07:42

**Figure 7.5.1.2-12: Upper Band-edge – Hopping Mode (8DPSK)**

### 7.5.2 RF Conducted Spurious Emissions

#### *7.5.2.1* Measurement Procedure

The RF output port of the EUT was connected to the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 26 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz. A peak detector function was used with the trace set to max hold. The levels were corrected for cable and attenuator losses.

#### *7.5.2.2* Measurement Results

Results are shown below:

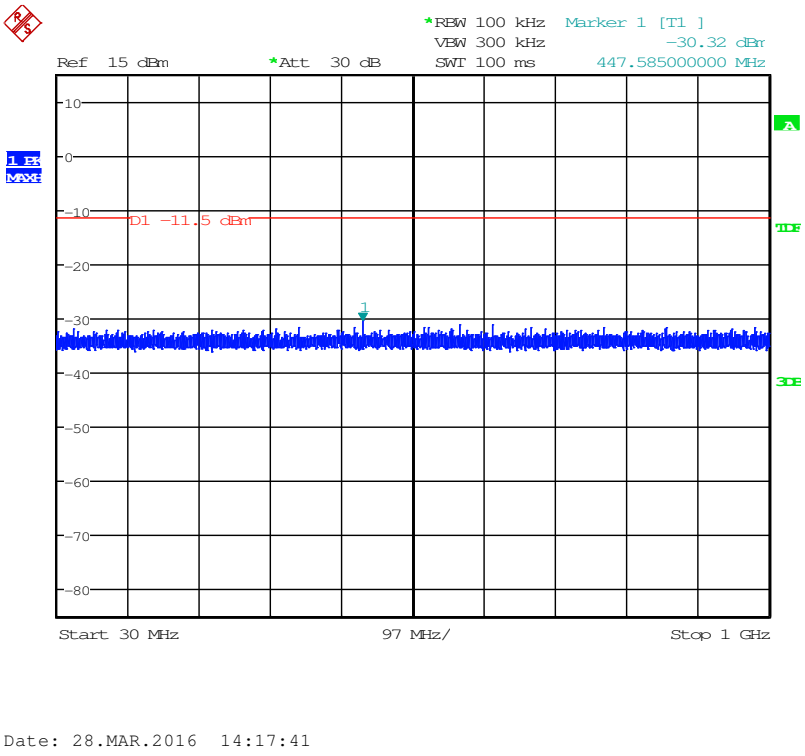
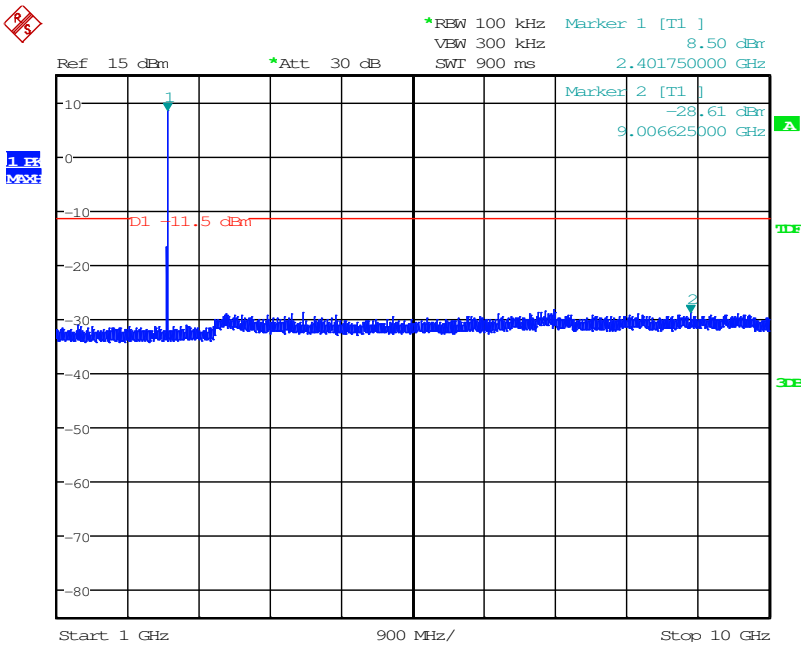
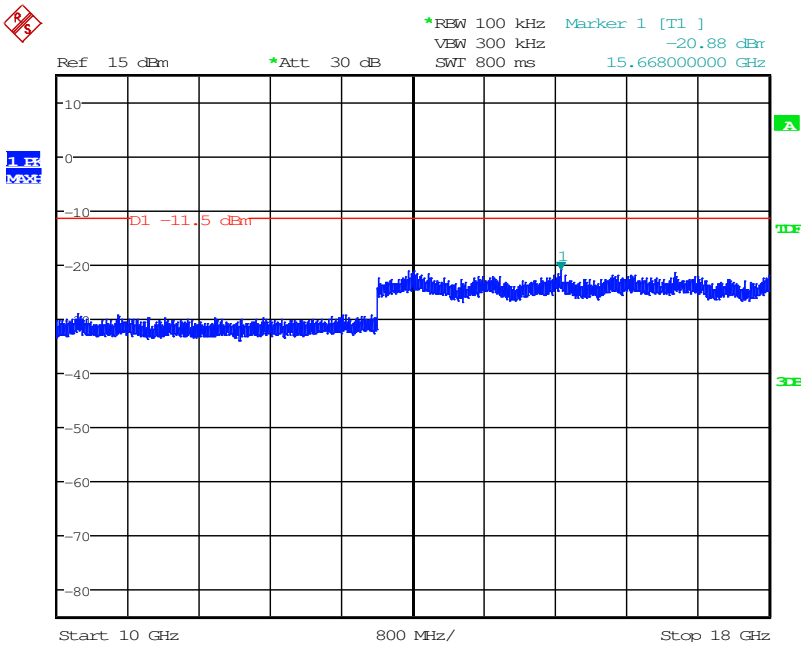



**Figure 7.5.2.2-1: 30 MHz – 1 GHz – Low Channel (GFSK)**



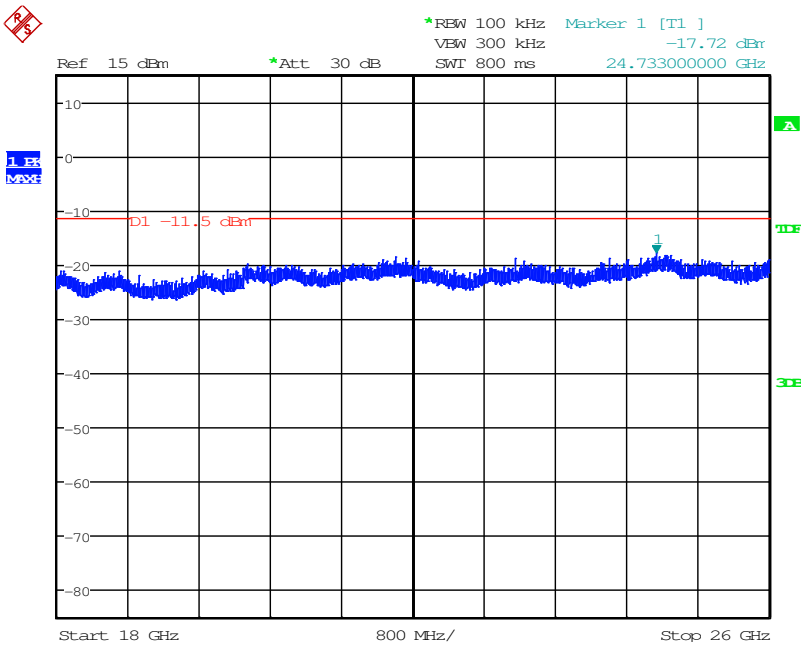

Date: 28.MAR.2016 14:11:43

**Figure 7.5.2.2-2: 1 GHz –10 GHz – Low Channel (GFSK)**



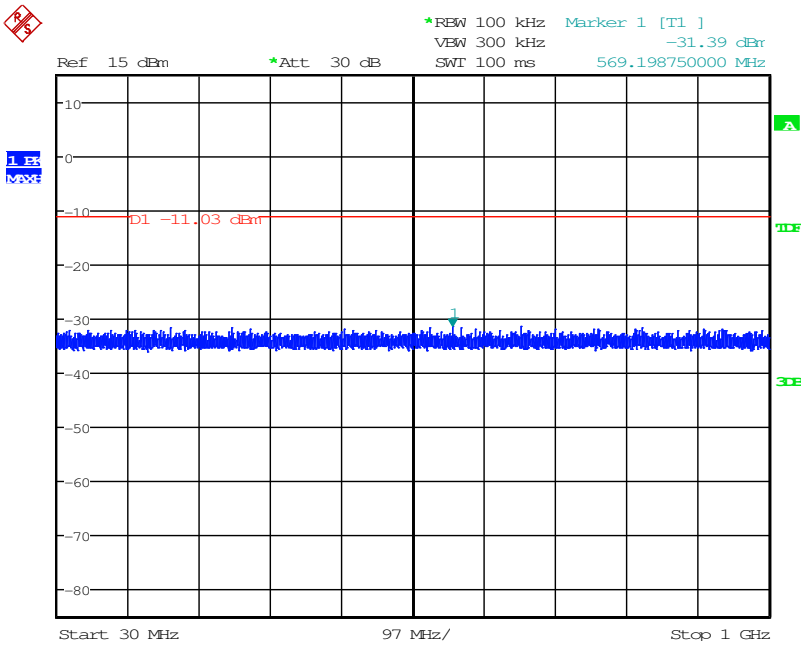

Date: 28.MAR.2016 14:20:23

**Figure 7.5.2.2-3: 10 GHz –18 GHz – Low Channel (GFSK)**



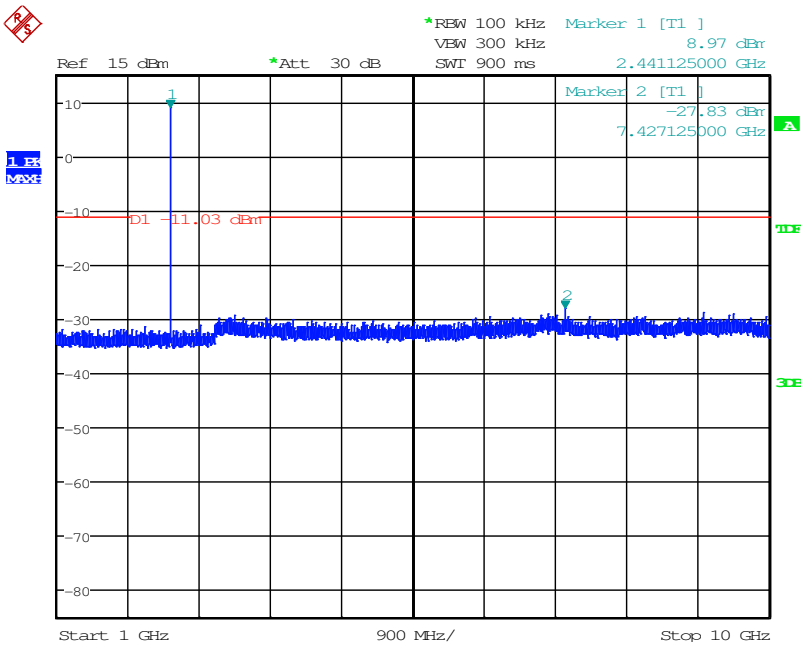

Date: 28.MAR.2016 14:23:40

**Figure 7.5.2.2-4: 18 GHz –26 GHz – Low Channel (GFSK)**



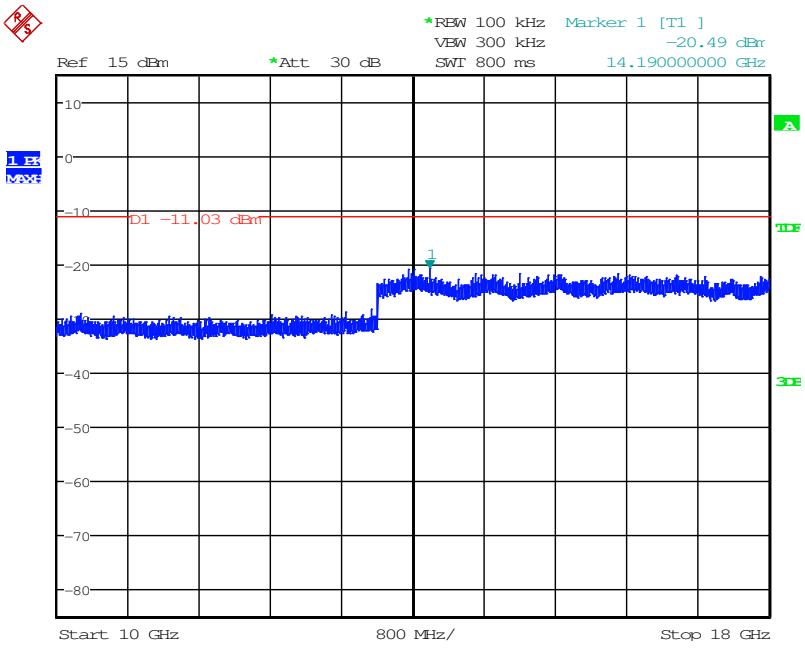

Date: 28.MAR.2016 14:33:25

**Figure 7.5.2.2-5: 30 MHz – 1 GHz –Middle Channel (GFSK)**




Date: 28.MAR.2016 14:30:25

**Figure 7.5.2.2-6: 1 GHz –10 GHz – Middle Channel (GFSK)**




Date: 28.MAR.2016 14:36:26

**Figure 7.5.2.2-7: 10 GHz –18 GHz – Middle Channel (GFSK)**

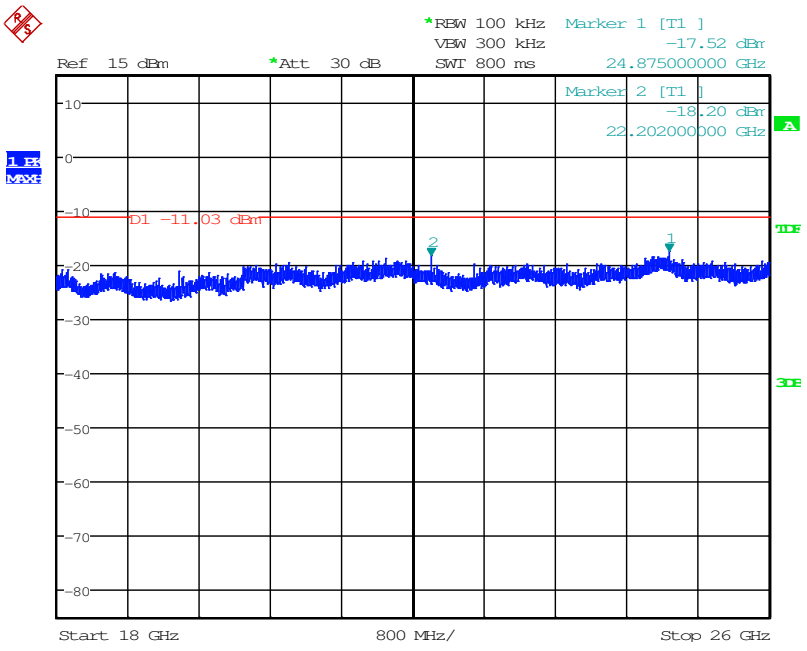



**Figure 7.5.2.2-8: 18 GHz –26 GHz – Middle Channel (GFSK)**

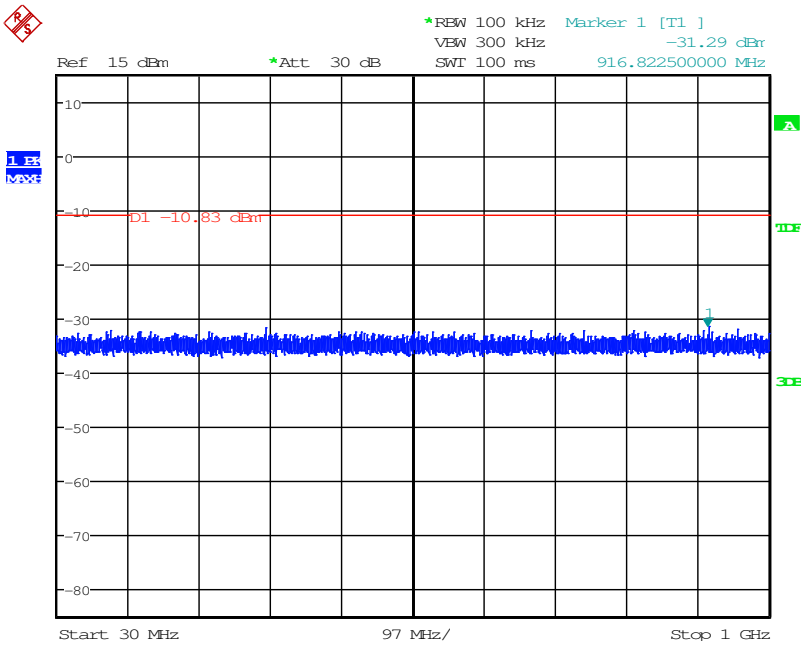
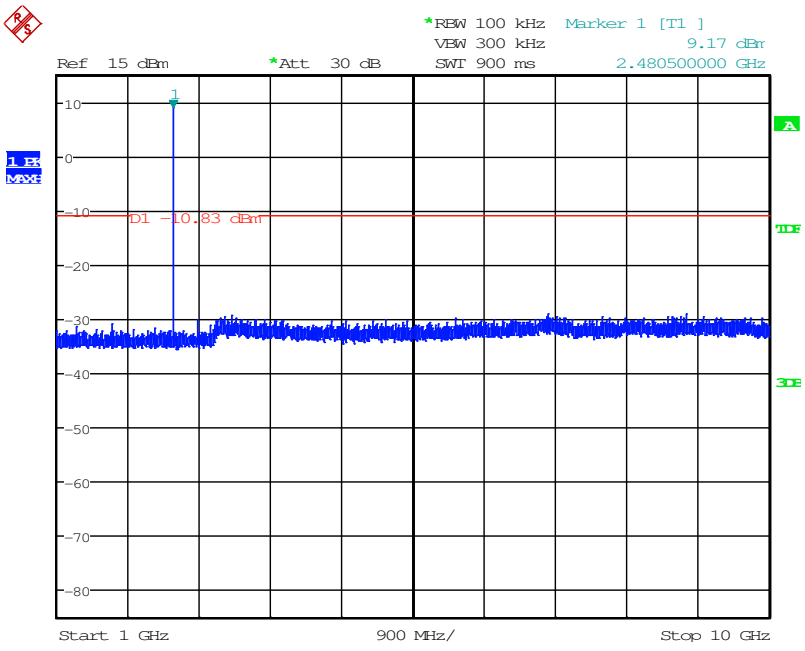
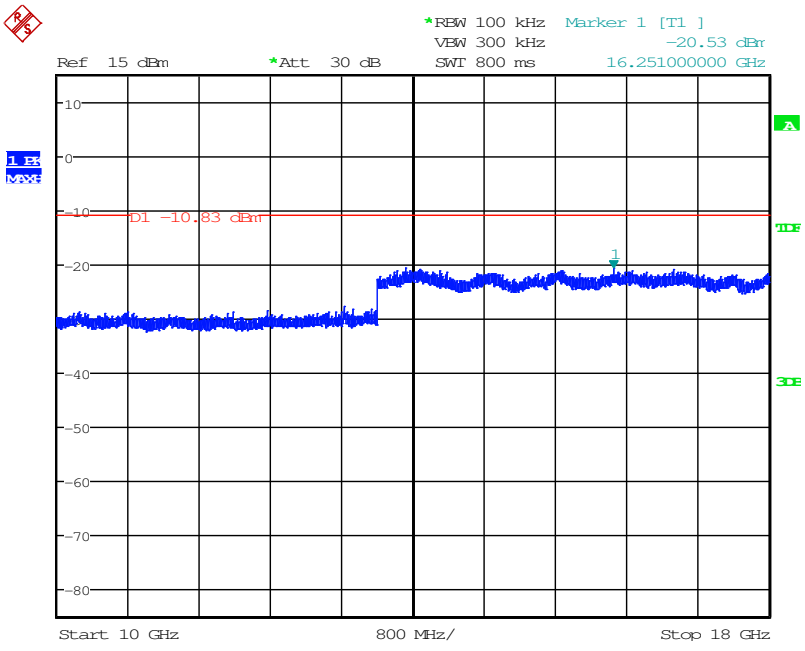



**Figure 7.5.2.2-9: 30 MHz – 1 GHz – High Channel (GFSK)**



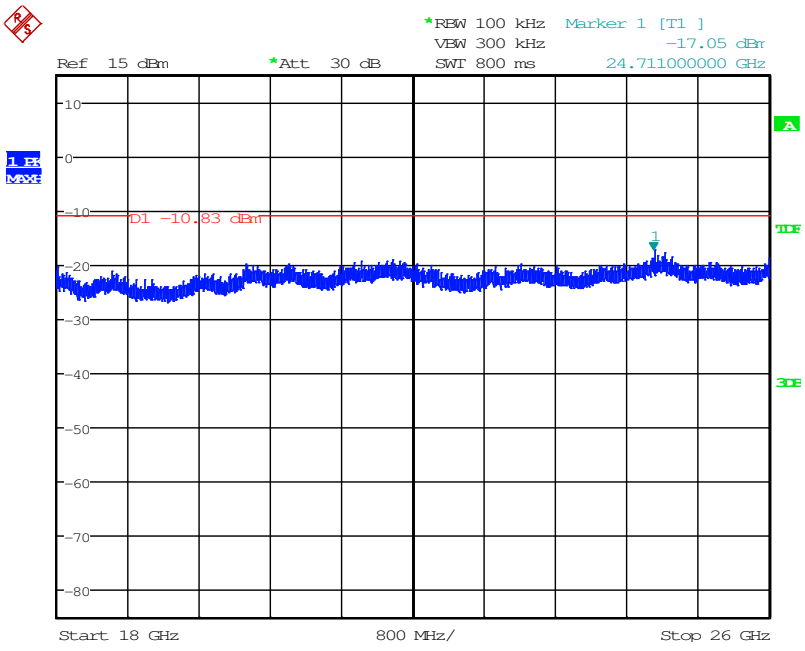

Date: 28.MAR.2016 14:52:43

**Figure 7.5.2.2-10: 1 GHz –10 GHz –High Channel (GFSK)**



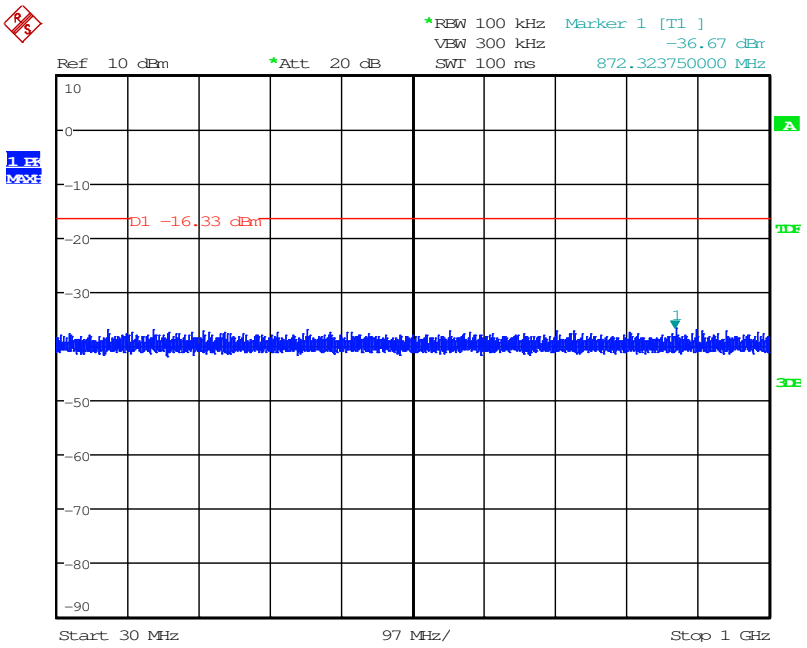

Date: 28.MAR.2016 15:21:55

**Figure 7.5.2.2-11: 10 GHz –18 GHz – High Channel (GFSK)**



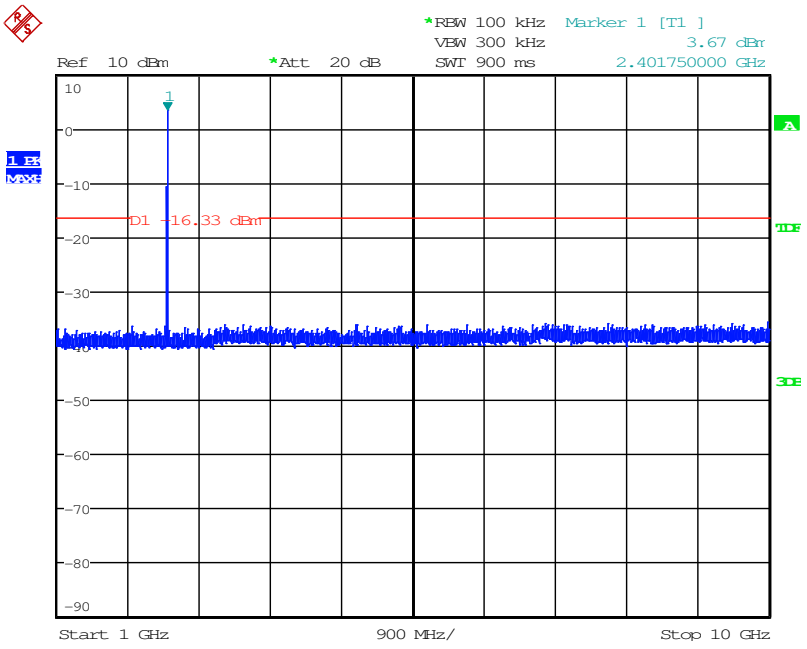

Date: 28.MAR.2016 15:24:08

**Figure 7.5.2.2-12: 18 GHz –26 GHz – High Channel (GFSK)**



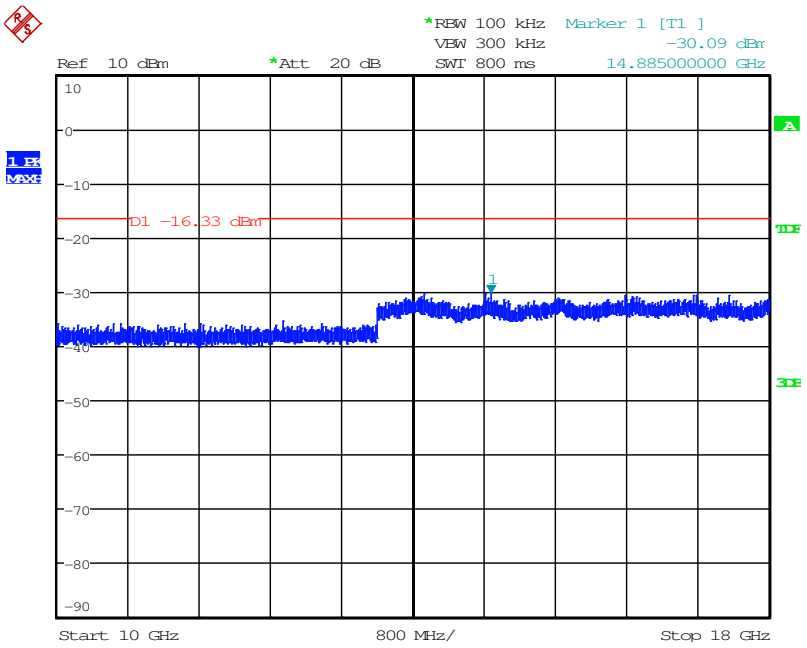

Date: 28.MAR.2016 15:33:04

**Figure 7.5.2.2-13: 30 MHz – 1 GHz – Low Channel (π/4 DQPSK)**



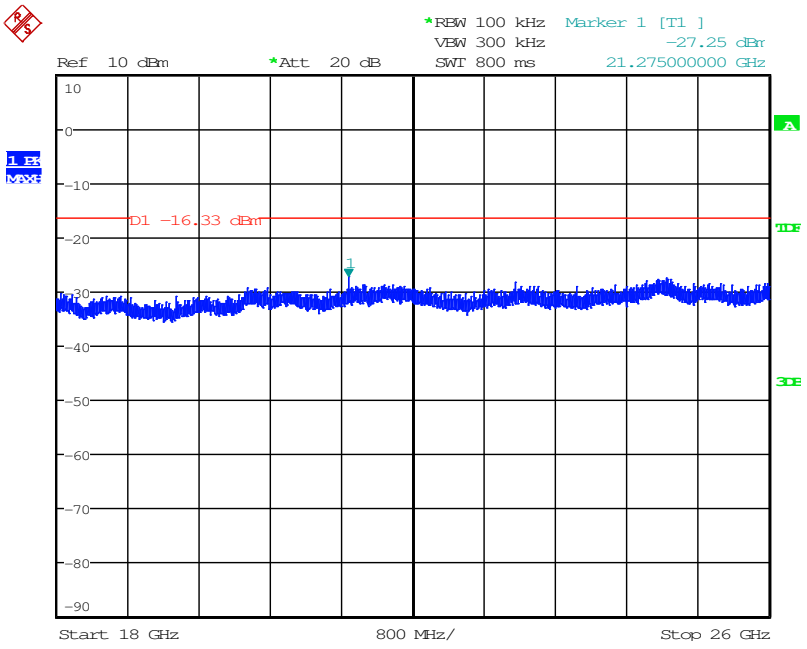

Date: 28.MAR.2016 15:31:11

**Figure 7.5.2.2-14: 1 GHz –10 GHz – Low Channel (π/4 DQPSK)**



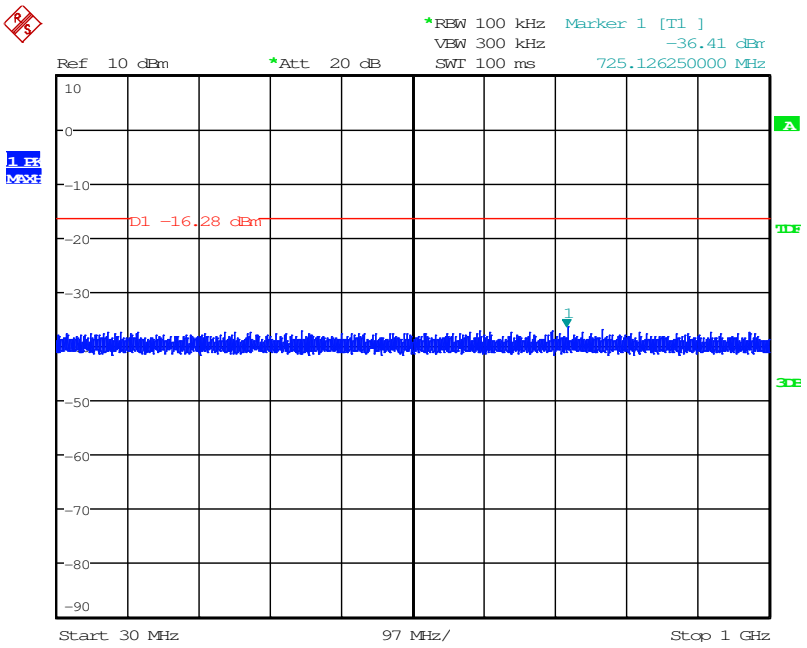

Date: 28.MAR.2016 15:35:30

**Figure 7.5.2.2-15: 10 GHz –18 GHz – Low Channel (π/4 DQPSK)**



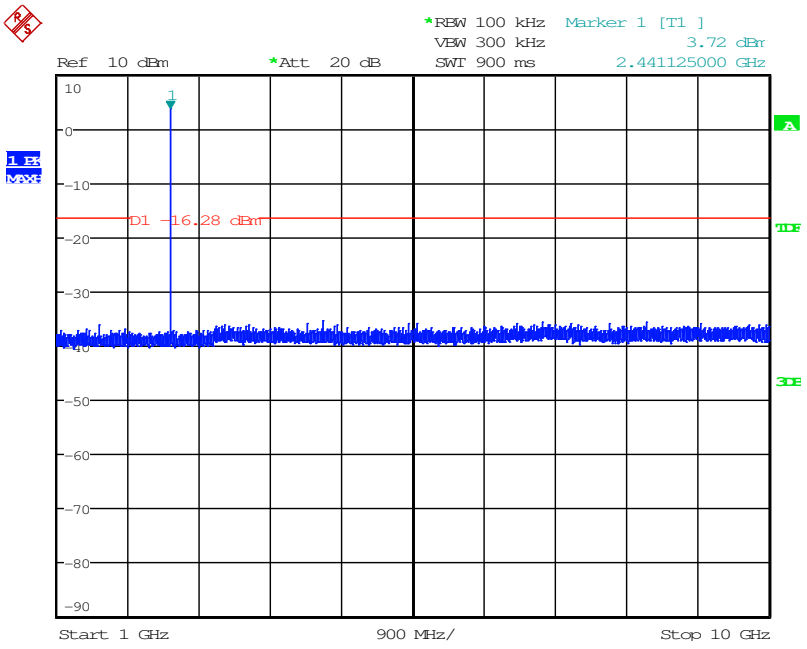

Date: 28.MAR.2016 15:37:26

**Figure 7.5.2.2-16: 18 GHz –26 GHz – Low Channel (π/4 DQPSK)**



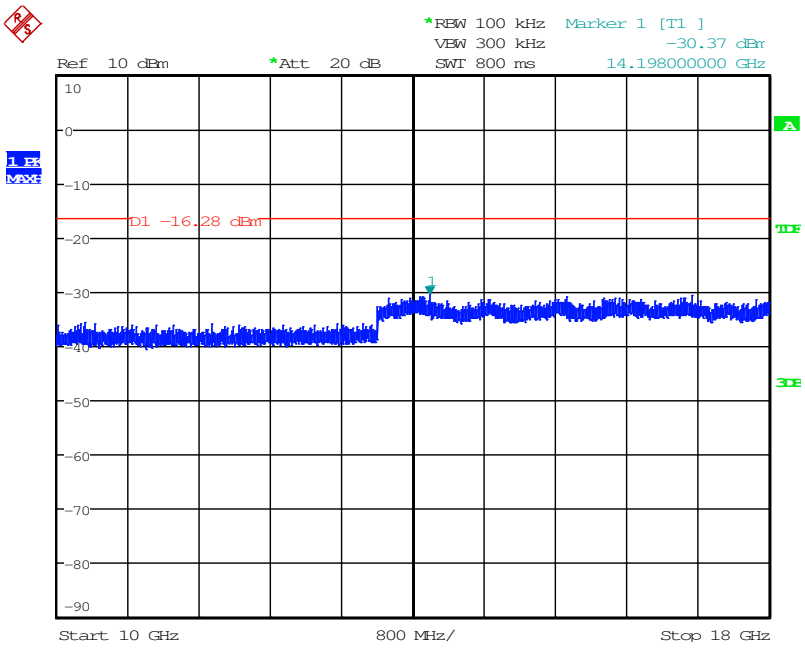

Date: 28.MAR.2016 15:46:26

**Figure 7.5.2.2-17: 30 MHz – 1 GHz –Middle Channel (π/4 DQPSK)**



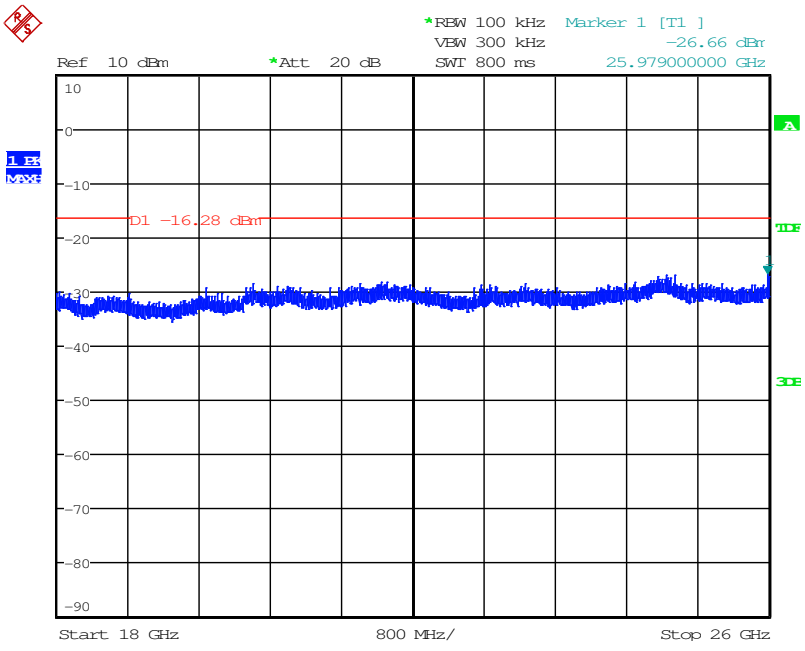

Date: 28.MAR.2016 15:44:35

**Figure 7.5.2.2-18: 1 GHz –10 GHz – Middle Channel (π/4 DQPSK)**



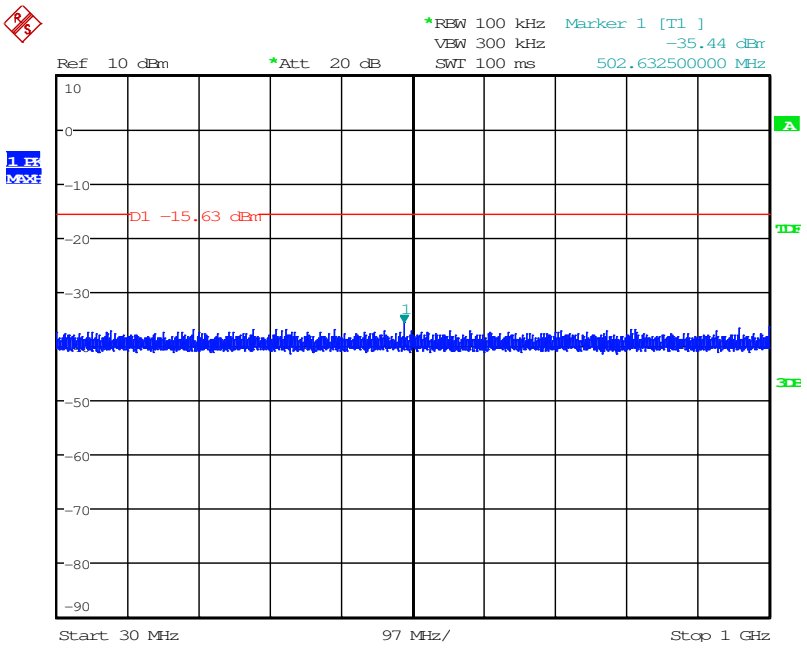

Date: 28.MAR.2016 15:48:09

**Figure 7.5.2.2-19: 10 GHz –18 GHz – Middle Channel (π/4 DQPSK)**



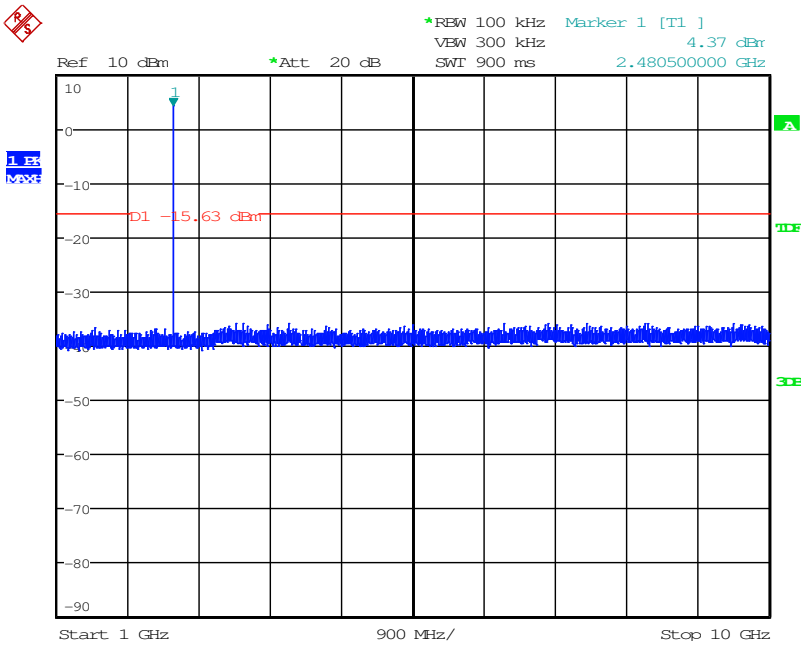

Date: 28.MAR.2016 15:50:51

**Figure 7.5.2.2-20: 18 GHz –26 GHz – Middle Channel (π/4 DQPSK)**



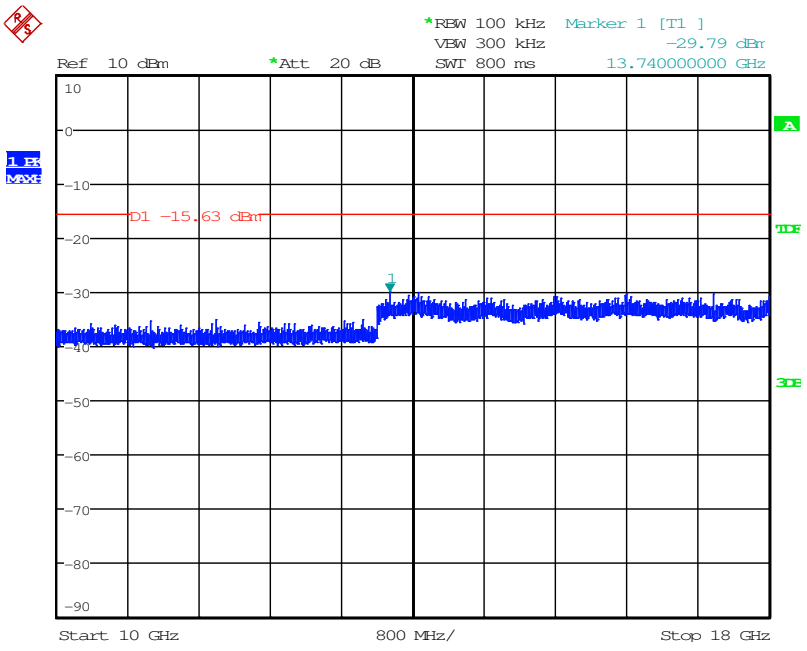

Date: 28.MAR.2016 16:03:20

**Figure 7.5.2.2-21: 30 MHz – 1 GHz – High Channel (π/4 DQPSK)**



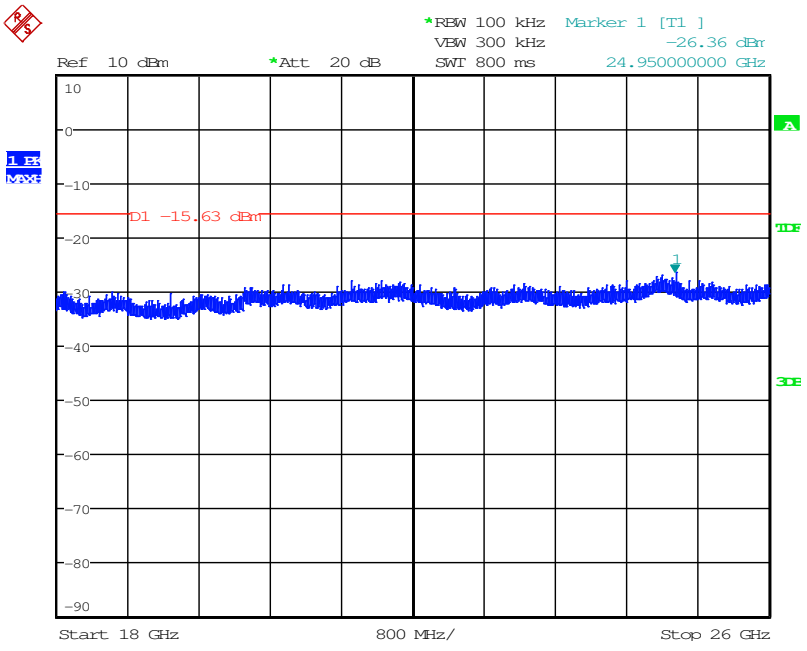

Date: 28.MAR.2016 16:00:20

**Figure 7.5.2.2-22: 1 GHz –10 GHz –High Channel (π/4 DQPSK)**




Date: 28.MAR.2016 16:09:07

**Figure 7.5.2.2-23: 10 GHz –18 GHz – High Channel (π/4 DQPSK)**




Date: 28.MAR.2016 16:12:12

**Figure 7.5.2.2-24: 18 GHz –26 GHz – High Channel (π/4 DQPSK)**

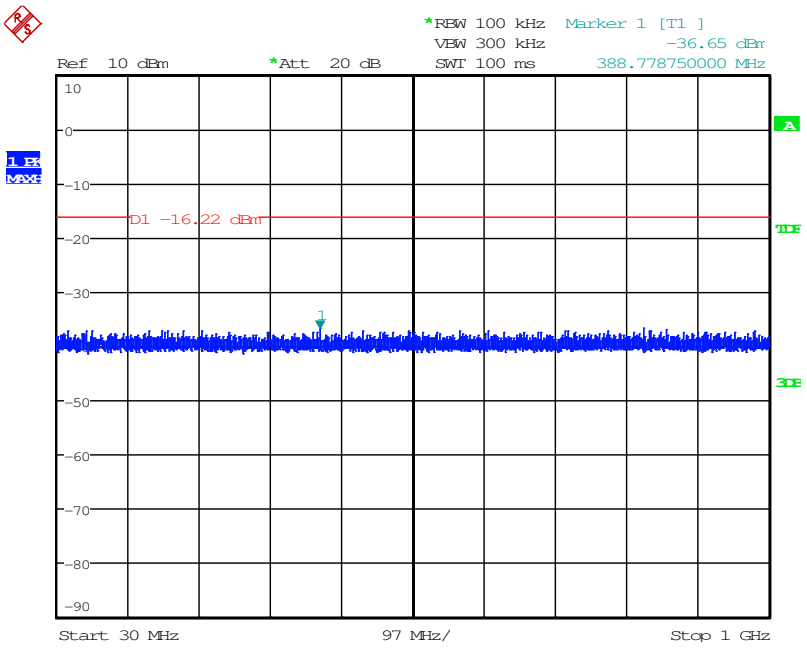



**Figure 7.5.2.2-25: 30 MHz – 1 GHz – Low Channel (8DPSK)**

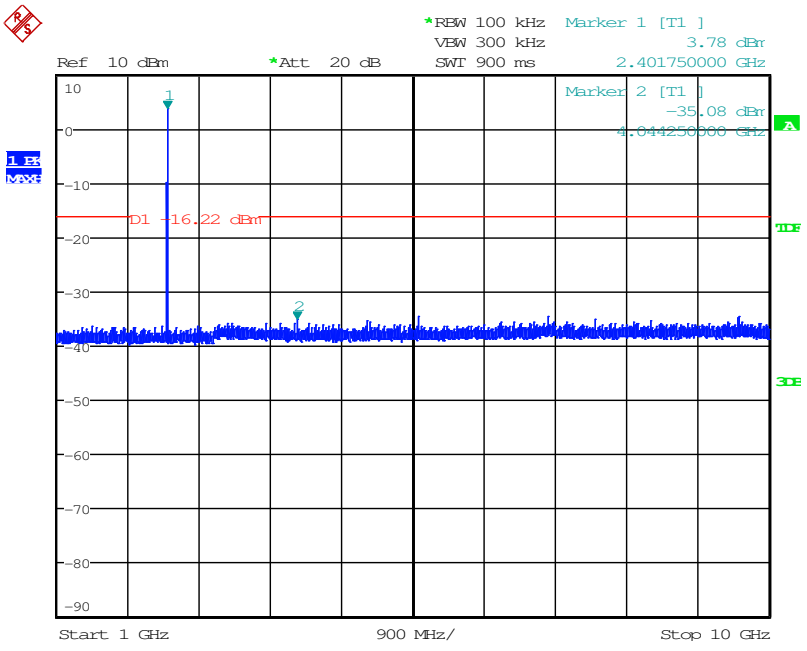
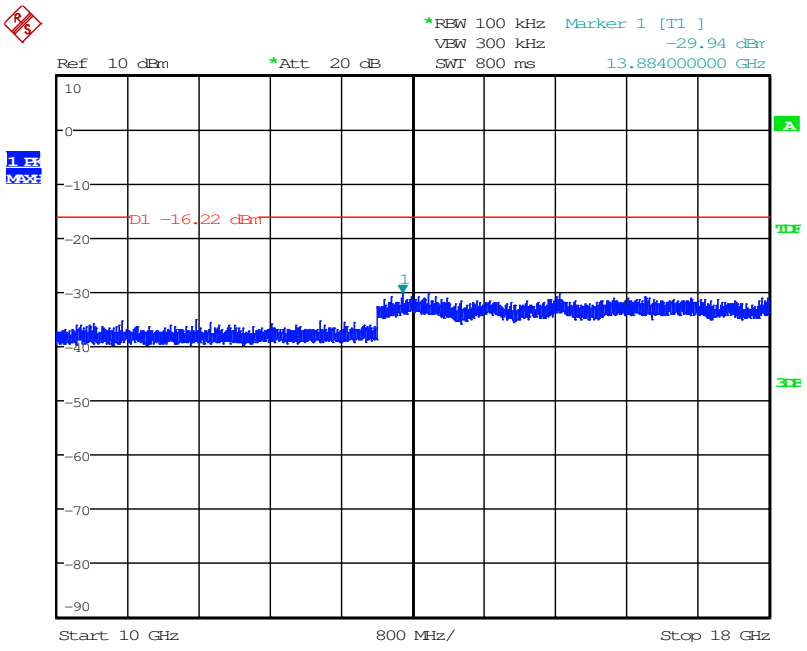
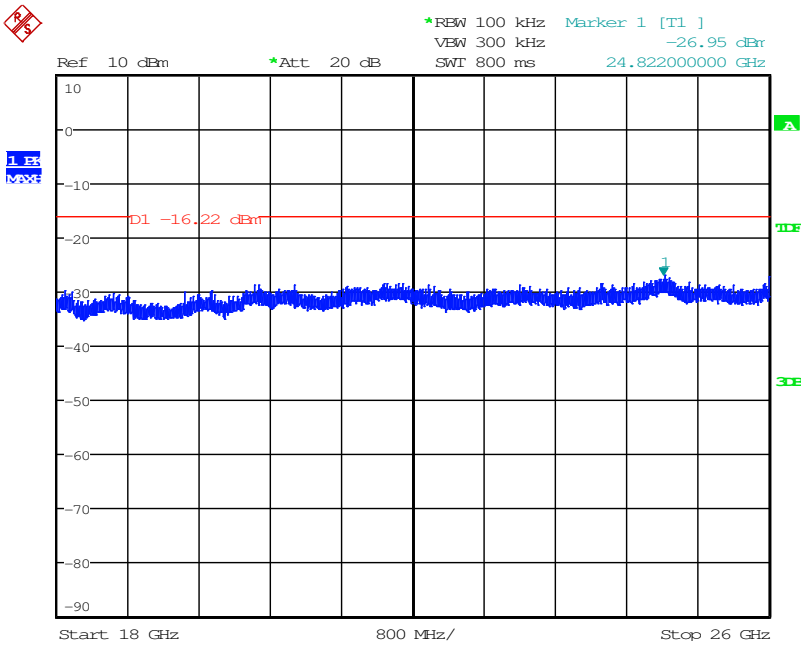



**Figure 7.5.2.2-26: 1 GHz –10 GHz – Low Channel (8DPSK)**




Date: 28.MAR.2016 16:38:31

**Figure 7.5.2.2-27: 10 GHz –18 GHz – Low Channel (8DPSK)**




Date: 28.MAR.2016 16:40:45

**Figure 7.5.2.2-28: 18 GHz –26 GHz – Low Channel (8DPSK)**

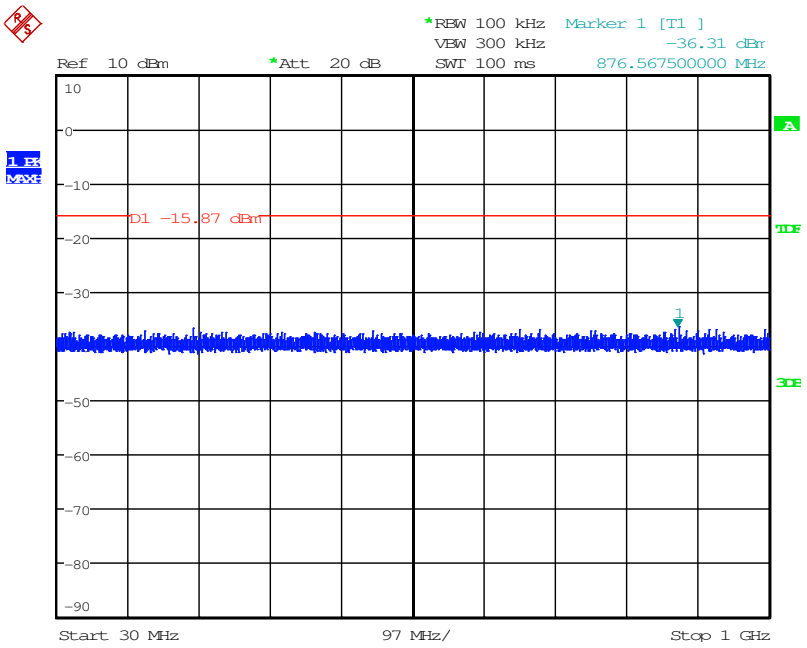



**Figure 7.5.2.2-29: 30 MHz – 1 GHz –Middle Channel (8DPSK)**

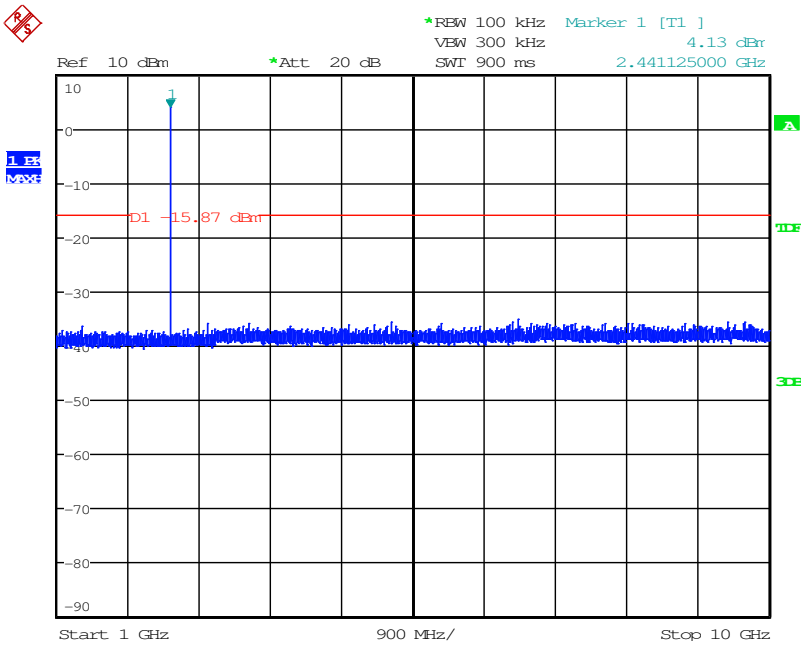
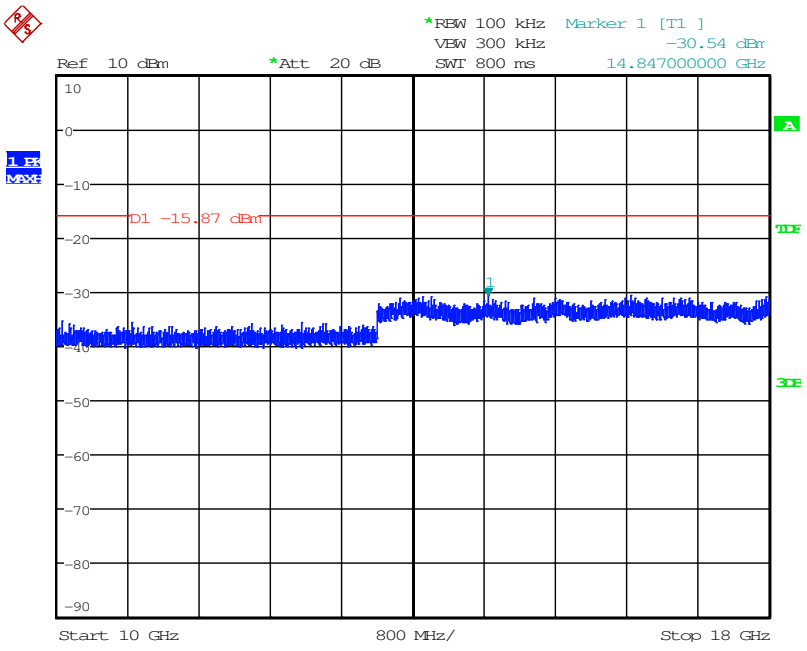
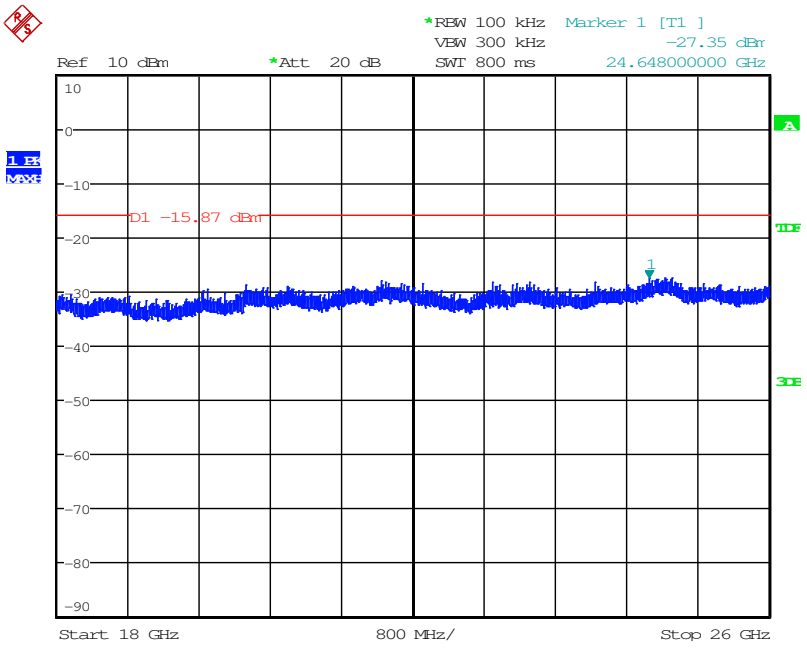



**Figure 7.5.2.2-30: 1 GHz –10 GHz – Middle Channel (8DPSK)**



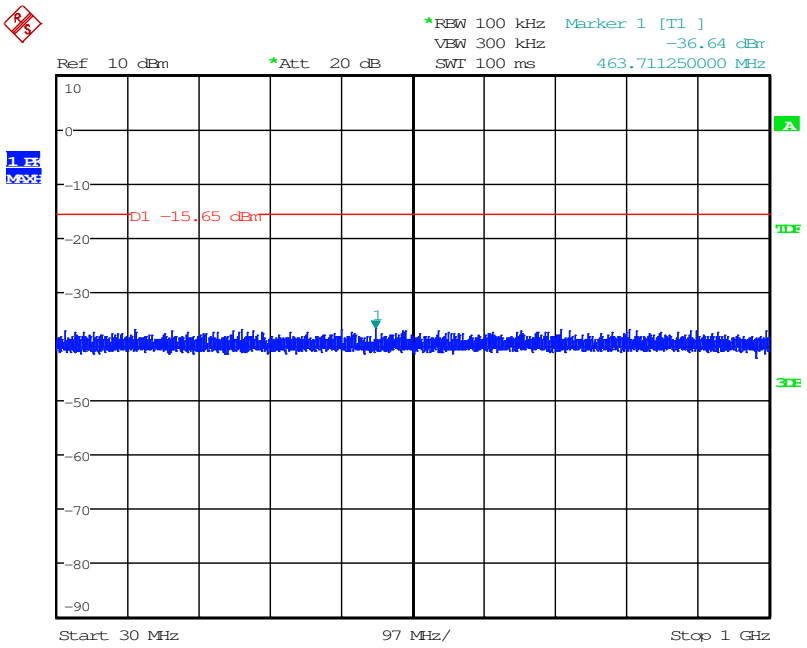

Date: 28.MAR.2016 21:14:41

**Figure 7.5.2.2-31: 10 GHz –18 GHz – Middle Channel (8DPSK)**



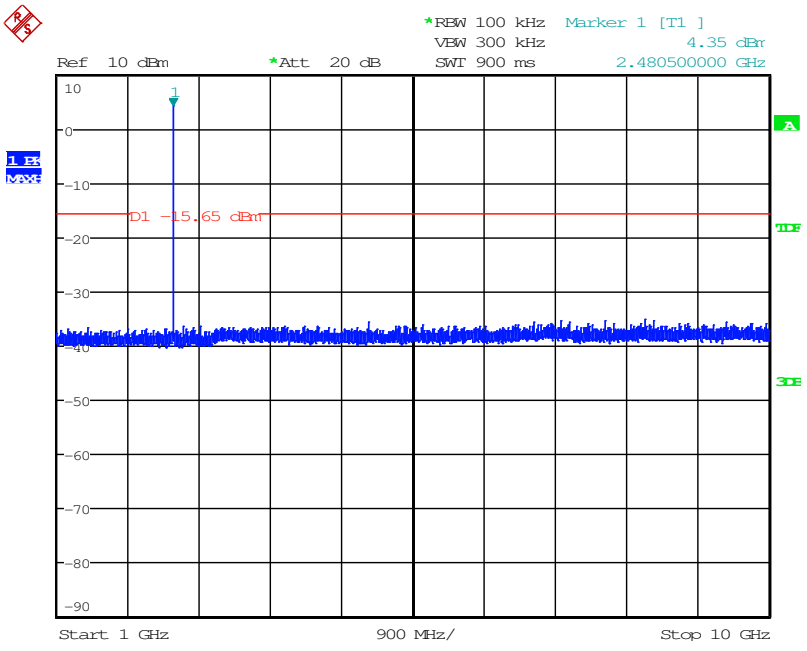

Date: 28.MAR.2016 21:16:42

**Figure 7.5.2.2-32: 18 GHz –26 GHz – Middle Channel (8DPSK)**



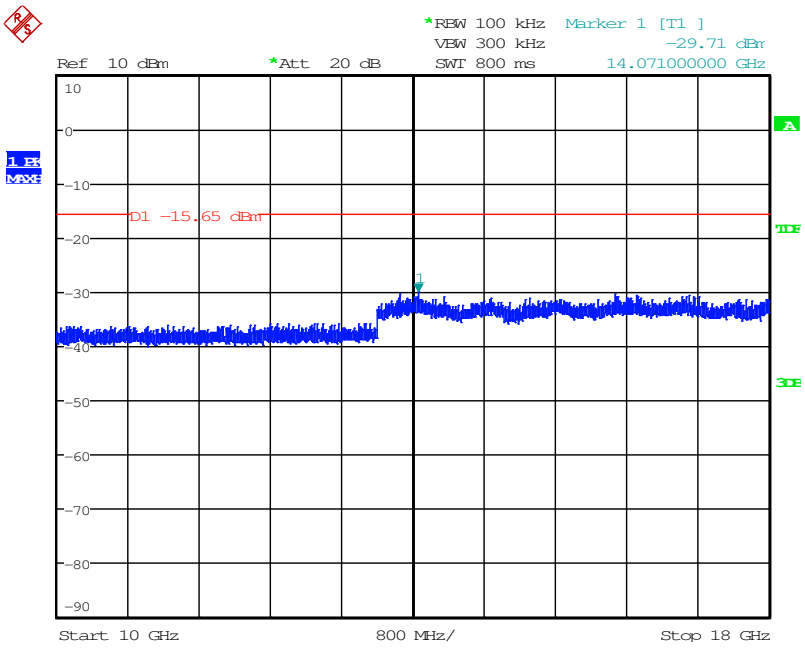

Date: 28.MAR.2016 21:28:51

**Figure 7.5.2.2-33: 30 MHz – 1 GHz – High Channel (8DPSK)**



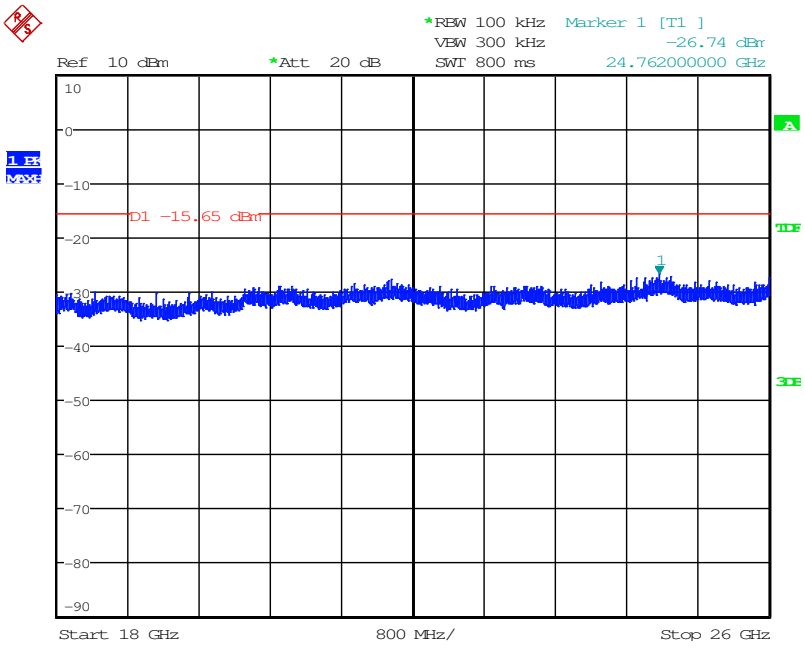

Date: 28.MAR.2016 21:26:25

**Figure 7.5.2.2-34: 1 GHz –10 GHz –High Channel (8DPSK)**




Date: 28.MAR.2016 21:31:22

**Figure 7.5.2.2-35: 10 GHz –18 GHz – High Channel (8DPSK)**




Date: 28.MAR.2016 21:34:44

**Figure 7.5.2.2-36: 18 GHz –26 GHz – High Channel (8DPSK)**

### 7.5.3 Radiated Spurious Emissions within the Restricted Bands - FCC Sections 15.205, 15.209; IC: RSS-Gen 8.9, 8.10

#### *7.5.3.1* Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

For measurements above 30 MHz, the EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements made with RBW and VBW of 1 MHz and 3 MHz respectively. Average measurements were collected in the linear amplitude scale with VBW of 30 Hz.

The EUT was caused to generate a continuous carrier signal on the hopping channel. The average levels were further corrected using a duty cycle correction factor calculated using the transmit channel dwell time over 100 ms. The calculation for the factor is provided in Section 7.5.3.3.

### *7.5.3.2* Measurement Results

Band-edge and radiated spurious emissions found in the restricted bands of 9 kHz to 26 GHz are reported in the tables below.

**Table 7.5.3.2-1: Radiated Spurious Emissions Tabulated Data - GFSK**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel = 2402 MHz** | | | | | | | | | | |
| **2390** | 57.11 | 45.63 | H | -5.60 | 51.51 | 9.34 | 74.0 | 54.0 | 22.5 | 44.7 |
| **12010** | 42.07 | 31.85 | H | 16.59 | 58.66 | 17.75 | 83.5 | 63.5 | 24.8 | 45.8 |
| **12010** | 42.50 | 32.00 | V | 16.59 | 59.09 | 17.90 | 83.5 | 63.5 | 24.4 | 45.6 |
| **Middle Channel = 2441 MHz** | | | | | | | | | | |
| **7323** | 50.84 | 45.22 | H | 8.85 | 59.69 | 23.38 | 74.0 | 54.0 | 14.3 | 30.6 |
| **7323** | 48.15 | 40.56 | V | 8.85 | 57.00 | 18.72 | 74.0 | 54.0 | 17.0 | 35.3 |
| **12205** | 41.10 | 30.12 | H | 16.53 | 57.63 | 15.96 | 83.5 | 63.5 | 25.9 | 47.5 |
| **12205** | 41.29 | 29.97 | V | 16.53 | 57.82 | 15.81 | 83.5 | 63.5 | 25.7 | 47.7 |
| **High Channel = 2480 MHz** | | | | | | | | | | |
| **2483.5** | 63.37 | 59.67 | H | -5.15 | 58.22 | 23.82 | 74.0 | 54.0 | 15.8 | 30.2 |
| **2483.5** | 57.18 | 47.86 | V | -5.15 | 52.03 | 12.01 | 74.0 | 54.0 | 22.0 | 42.0 |
| **7440** | 49.62 | 43.30 | H | 9.37 | 58.99 | 21.98 | 74.0 | 54.0 | 15.0 | 32.0 |
| **7440** | 46.80 | 38.88 | V | 9.37 | 56.17 | 17.56 | 74.0 | 54.0 | 17.8 | 36.4 |
| **12400** | 40.34 | 29.16 | H | 16.47 | 56.81 | 14.93 | 83.5 | 63.5 | 26.7 | 48.6 |
| **12400** | 40.12 | 29.11 | V | 16.47 | 56.59 | 14.88 | 83.5 | 63.5 | 26.9 | 48.6 |

**Notes:**

- **The average levels were further corrected using a duty cycle correction factor consisting of the logarithm of the dwell time over 100 ms.**
- **The emissions above 10 GHz were measured at a test distance of 1m. The limits are corrected accordingly using a distance factor of 20*log(10/3) dB = 9.5 dB.**
- **All emissions above 12.4 GHz were attenuated below the limits and the noise floor of the measurement equipment.**

**Table 7.5.3.2-2: Radiated Spurious Emissions Tabulated Data – (π/4) DQPSK**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel = 2402 MHz** | | | | | | | | | | |
| **2390** | 56.63 | 45.58 | H | -5.60 | 51.03 | 9.29 | 74.0 | 54.0 | 23.0 | 44.7 |
| **12010** | 41.96 | 31.81 | H | 16.59 | 58.55 | 17.71 | 83.5 | 63.5 | 25.0 | 45.8 |
| **12010** | 42.55 | 32.26 | V | 16.59 | 59.14 | 18.16 | 83.5 | 63.5 | 24.4 | 45.3 |
| **Middle Channel = 2441 MHz** | | | | | | | | | | |
| **7323** | 48.79 | 41.36 | H | 8.85 | 57.64 | 19.52 | 74.0 | 54.0 | 16.4 | 34.5 |
| **7323** | 46.54 | 38.15 | V | 8.85 | 55.39 | 16.31 | 74.0 | 54.0 | 18.6 | 37.7 |
| **12205** | 40.85 | 30.14 | H | 16.53 | 57.38 | 15.98 | 83.5 | 63.5 | 26.1 | 47.5 |
| **12205** | 40.91 | 30.15 | V | 16.53 | 57.44 | 15.99 | 83.5 | 63.5 | 26.1 | 47.5 |
| **High Channel = 2480 MHz** | | | | | | | | | | |
| **2483.5** | 59.51 | 51.25 | H | -5.15 | 54.36 | 15.40 | 74.0 | 54.0 | 19.6 | 38.6 |
| **2483.5** | 56.80 | 46.03 | V | -5.15 | 51.65 | 10.18 | 74.0 | 54.0 | 22.4 | 43.8 |
| **7440** | 48.01 | 40.25 | H | 9.37 | 57.38 | 18.93 | 74.0 | 54.0 | 16.6 | 35.1 |
| **7440** | 45.95 | 36.29 | V | 9.37 | 55.32 | 14.97 | 74.0 | 54.0 | 18.7 | 39.0 |
| **12400** | 40.10 | 29.19 | H | 16.47 | 56.57 | 14.96 | 83.5 | 63.5 | 26.9 | 48.5 |
| **12400** | 40.89 | 29.21 | V | 16.47 | 57.36 | 14.98 | 83.5 | 63.5 | 26.1 | 48.5 |

**Notes:**

- **The average levels were further corrected using a duty cycle correction factor consisting of the logarithm of the dwell time over 100 ms.**
- **The emissions above 10 GHz were measured at a test distance of 1m. The limits are corrected accordingly using a distance factor of 20*log(10/3) dB = 9.5 dB.**
- **All emissions above 12.4 GHz were attenuated below the limits and the noise floor of the measurement equipment.**

**Table 7.5.3.2-3: Radiated Spurious Emissions Tabulated Data – 8DPSK**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Low Channel = 2402 MHz** | | | | | | | | | | |
| **2390** | 59.18 | 45.77 | H | -5.60 | 53.58 | 9.48 | 74.0 | 54.0 | 20.4 | 44.5 |
| **12010** | 42.03 | 31.96 | H | 16.59 | 58.62 | 17.86 | 83.5 | 63.5 | 24.9 | 45.6 |
| **12010** | 42.82 | 32.39 | V | 16.59 | 59.41 | 18.29 | 83.5 | 63.5 | 24.1 | 45.2 |
| **Middle Channel = 2441 MHz** | | | | | | | | | | |
| **7323** | 49.05 | 41.45 | H | 8.85 | 57.90 | 19.61 | 74.0 | 54.0 | 16.1 | 34.4 |
| **7323** | 46.57 | 37.85 | V | 8.85 | 55.42 | 16.01 | 74.0 | 54.0 | 18.6 | 38.0 |
| **12205** | 40.90 | 30.45 | H | 16.53 | 57.43 | 16.29 | 83.5 | 63.5 | 26.1 | 47.2 |
| **12205** | 41.00 | 30.13 | V | 16.53 | 57.53 | 15.97 | 83.5 | 63.5 | 26.0 | 47.5 |
| **High Channel = 2480 MHz** | | | | | | | | | | |
| **2483.5** | 63.64 | 51.87 | H | -5.15 | 58.49 | 16.02 | 74.0 | 54.0 | 15.5 | 38.0 |
| **2483.5** | 57.48 | 46.14 | V | -5.15 | 52.33 | 10.29 | 74.0 | 54.0 | 21.7 | 43.7 |
| **7440** | 47.78 | 39.97 | H | 9.37 | 57.15 | 18.65 | 74.0 | 54.0 | 16.8 | 35.4 |
| **7440** | 45.06 | 36.13 | V | 9.37 | 54.43 | 14.81 | 74.0 | 54.0 | 19.6 | 39.2 |
| **12400** | 40.00 | 29.15 | H | 16.47 | 56.47 | 14.92 | 83.5 | 63.5 | 27.0 | 48.6 |
| **12400** | 40.48 | 29.33 | V | 16.47 | 56.95 | 15.10 | 83.5 | 63.5 | 26.6 | 48.4 |

**Notes:**

- **The average levels were further corrected using a duty cycle correction factor consisting of the logarithm of the dwell time over 100 ms.**
- **The emissions above 10 GHz were measured at a test distance of 1m. The limits are corrected accordingly using a distance factor of 20*log(10/3) dB = 9.5 dB.**
- **All emissions above 12.4 GHz were attenuated below the limits and the noise floor of the measurement equipment.**

#### *7.5.3.3* Sample Calculation:

$R_C = R_U + CF_T$

Where:

| | | |
|---|---|---|
| $CF_T$ | = | Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only) |
| $R_U$ | = | Uncorrected Reading |
| $R_C$ | = | Corrected Level |
| AF | = | Antenna Factor |
| CA | = | Cable Attenuation |
| AG | = | Amplifier Gain |
| DC | = | Duty Cycle Correction Factor |

DC = 20*log(2.92/100) = -30.69 dB

**Example Calculation: Peak**
Corrected Level: 57.11 + (-5.6) = 51.51 dBµV/m
Margin: 74 dBµV/m – 51.51 dBµV/m = 22.5 dB

**Example Calculation: Average**
Corrected Level: 45.63 + (-5.6) -30.69 = 9.34 dBµV/m
Margin: 54 dBµV/m – 9.34 dBµV/m = 44.7 dB

## 8 CONCLUSION

In the opinion of ACS, Inc., the model H98QDH9PW7BN manufactured by Motorola Solutions Sdn Bhd meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-247 for the test procedures documented in the test report.

# END REPORT