CETECOM ICT Services GmbH
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RSC-Laboratory

# Accredited testing-laboratory

**DAR registration number: DGA-PL-176/94-D1**

**Recognized by the Federal Communications Commission**
**Anechoic chamber registration no.: 90462 (FCC)**
**Anechoic chamber registration no.: 3462C-1 (IC)**
**Certification ID: DE 0001**
**Accreditation ID: DE 0002**

**Accredited Bluetooth® Test Facility (BQTF)**



| | | |
|---|---|---|
| **Test report no.** | **:** | **1-2107-01-02/10** |
| **Type identification** | **:** | **CT2440ARINC** |
| **Applicant** | **:** | **Broadcast Microwave Services GmbH&Co.KG** |
| **FCC ID** | **:** | **VFB-CT2440ARI-2050** |
| **Test standards** | **:** | **FCC CFR 47 Part 74** |

# Table of contents

# 1 General information

## 1.1 Notes

The test results of this test report relate exclusively to the test item specified in 3.1.1. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

**Test laboratory manager:**

| **2010-09-24** | **Karsten Geraldy** | |
|---|---|---|
| Date | Name | Signature |

**Technical responsibility for area of testing:**

| **2010-09-24** | **Michael Berg** | |
|---|---|---|
| Date | Name | Signature |

Cetecom ICT Services
Accredited Test Laboratory
Untertürkheimer Str. 6-10
D-66117 Saarbrücken

## 1.2 Testing laboratory

**CETECOM ICT Services GmbH**

**Untertuerkheimer Strasse 6 - 10**
**66117 Saarbruecken**
**Germany**
**Phone: + 49 681 5 98 - 0**
**Fax: + 49 681 5 98 - 9075**
**e-mail: info@cetecom.com**
**Internet: http: //www.cetecom.com**

**State of accreditation:** **The test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025**
**DAR registration number: DGA-PL-176/94-D1**

**Testing location, if different from CETECOM ICT Services GmbH:**

**Name :**
**Street :**
**Town :**
**Country :**
**Phone :**
**Fax :**

## 1.3 Details of applicant

| | |
|---|---|
| **Name:** | **Broadcast Microwave Services GmbH&Co.KG** |
| **Street:** | **Schwalbacherstrasse 12** |
| **Town:** | **65321 Heidenrod Kemel** |
| **Country:** | **Germany** |
| **Telephone:** | **+49 6124 7239-27** |
| **Fax:** | **+49 6124 7239-29** |
| **Contact:** | **Mr. Christian Rothe** |
| **E-mail:** | **crothe@bms-inc.com** |
| **Telephone:** | **+49 6124 7239-27** |

## 1.4 Application details

| | |
|---|---|
| **Date of receipt of order:** | **2010-04-09** |
| **Date of receipt of test item:** | **2010-06-21** |
| **Date of start test:** | **2010-06-21** |
| **Date of end test** | **2010-09-07** |
| **Persons(s) who have been present during the test:** | **Mr. Otto** |

# 2 Technical tests

## 2.1 Details of manufacturer

| | |
|---|---|
| Name: | **Broadcast Microwave Services GmbH&Co.KG** |
| Street: | **Schwalbacherstrasse 12** |
| Town: | **65321 Heidenrod Kemel** |
| Country: | **Germany** |

### 2.1.1 Test item

| | |
|---|---|
| Kind of test item: | **TV Broadcast Auxiliary Station** |
| Type identification: | **CT2440ARINC** |
| P/N / S/N: | **P/N 11.2461.100, S/N 091 1013** |
| Frequency: | **1990 - 2110 MHz** |
| Type of Modulation: | **COFDM 2k with sub-modulation: QPSK, 16QAM, 64QAM** |
| Emission Designator: | **6 MHz channel band width: 5M705D7F**<br>**7 MHz channel band width: 6M635D7F**<br>**8 MHz channel bandwidth: 7M564D7F** |
| Antenna: | **N-antenna connector** |
| Power Supply: | **28 Vdc ±10%, 170 W, battery powered** |
| Temperature Range: | **-10 °C to +50 °C** |

Max. peak power conducted: 46.4 dBm
Max. RMS power conducted: 40.6 dBm
Max. peak EIRP: 49.4 dBm

FCC ID: VFB-CT2440ARI-2050

**Remark:**
The signal is COFDM 2k modulated. There are 3 different sub-modulations (QPSK, 16QAM and 64QAM) which have no significant effect on the measurement results as shown on the plots.

### 2.1.2 EUT operating modes

| EUT operating mode no.*) | Description of operating modes | Additional information |
|---|---|---|
| Op. 0 | Normal mode | Normal temperature and power source conditions |
| Op. 1 | | low temperature, nominal power source conditions |
| Op. 2 | | high temperature, nominal power source conditions |

*) EUT operating mode no. is used to simplify the test plan

### 2.1.3 Nominal conditions for testing

| Description | Shortcut | Unit | Value |
|---|---|---|---|
| Nominal Temperature | $T_{nom}$ | °C | **23** |
| Nominal Humidity | $H_{nom}$ | % | **45** |
| Nominal Power Source | $V_{nom}$ | Vdc | **28** |

Type of power source: 28.0 V DC

Extreme conditions are reported in chapter 4.10.

# 3 Summary of measurement results and list of all performed test cases

☒ **No deviations from the technical specifications were ascertained**

☐ There were deviations from the technical specifications ascertained

| TC identifier | Description | Verdict | Date | Remark |
|---|---|---|---|---|
| RF-Testing | FCC CFR 47 Part 74 | PASS | 2010-09-24 | -/- |

| Test Specification / Clause | Test Case | Pass | Fail | N/A | N/P | Results |
|---|---|---|---|---|---|---|
| | | | | | | |
| § 2.1046 / § 74.636 | Measurements required: RF power output / Power limitations (conducted) | X | | | | Channel bandwidth: 6 MHz: 46.4 dBm 7 MHz: 46.4 dBm 8 MHz: 46.3 dBm |
| | | | | | | |
| § 2.1046 / § 74.636 | Measurements required: RF power output / Power limitations (radiated) | X | | | | Channel bandwidth: 6 MHz: 49.4 dBm 7 MHz: 49.4 dBm 8 MHz: 49.3 dBm |
| | | | | | | |
| § 2.1049 | Measurements required: Occupied bandwidth | X | | | | Channel bandwidth: 6 MHz: 5.705 MHz 7 MHz: 6.635 MHz 8 MHz: 7.564 MHz |
| | | | | | | |
| §2.1051 / § 74.637 | Measurements required: Spurious emissions at antenna terminals / Emission mask | X | | | | complies |
| | | | | | | |
| § 2.1051 / § 74.637 | Measurements required: Spurious emissions at antenna terminals / Spurious Emissions - conducted | X | | | | complies |
| | | | | | | |
| § 2.1051 / § 74.637 | Measurements required: Spurious emissions at antenna terminals / Band-Edge compliance | X | | | | complies |
| | | | | | | |
| § 2.1053 / § 74.637 | Measurements required: Field strength of spurious radiation / Spurious Emissions - radiated | X | | | | complies |
| | | | | | | |
| § 2.1055 / § 74.661 | Measurements required: Frequency stability / Frequency tolerance | X | | | | max. 2.5 ppm |

N/A: Not Applicable
N/P: Not Performed

# 4 RF measurement testing

## 4.1 Description of test set-up

### 4.1.1 Radiated measurements

**EIRP Measurements**

Measuring the EIRP using Substitution Method:
(a) The measurements were performed with full rf output power and modulation.
(b) Test was performed at listed 3m test site (listed with FCC, IC).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The TRILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level
Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)
(f) Set the EMI Receiver and #2 as follows:
Center Frequency: test frequency
Resolution BW: 100 kHz
Video BW: same
Detector Mode: positive
Average: off
Span: 3 x the signal bandwidth
(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

**Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method**

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

| | |
|---|---|
| Center Frequency | : equal to the signal source |
| Resolution BW | : 10 kHz |
| Video BW | : same |
| Detector Mode | : positive |
| Average | : off |
| Span | : 3 x the signal bandwidth |

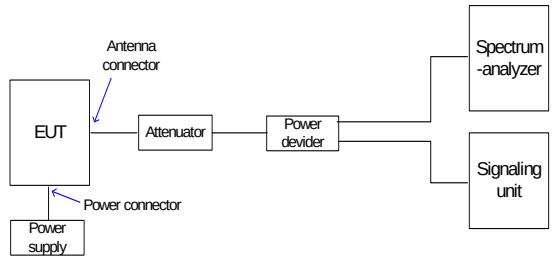
(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level
Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)
(c) Select the frequency and E-field levels for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antennas (substitution antenna): DIPOLE antenna for frequency from 30-1000 MHz or .HORN antenna for frequency above 1 GHz}.
(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna: .DIPOLE antenna for frequency from 30-1000 MHz or .HORN antenna for frequency above 1 GHz }.
(g) If the DIPOLE antenna is used, tune its elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.

(k) The transmitter was rotated through 360 o about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:
P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1
Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction
(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

### 4.1.2 Conducted measurements

The EUT´s RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is connected to the spectrum analyzer. The specific losses for signal path are first checked within a calibration. The measurement readings on the spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.

Exemplary test setup:



## 4.2 Referenced documents

none

## 4.3 Additional comments

The system transmit frequency is programmable in 1 MHz steps in the range from 1990 to 2110 MHz via user interface (multifunctional display).
Per remote control via serial interface 125 kHz steps are possible.

We used three frequencies for testing: carrier at the lower edge of the band, in the middle of the band and at the upper edge of the band. As the occupied bandwidth is completely contained within the band, all emissions of the modulated wanted signal are within the band.

## 4.4 RF output power (conducted) §2.1046 / § 74.636(a)

**Bandwidth 6 MHz**

| TEST CONDITIONS | | | MAXIMUM PEAK OUTPUT POWER (dBm) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1993 | 2050 | 2107 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Peak | 46.4 | 46.2 | 45.7 |
| | | RMS | 40.6 | 40.5 | 40.6 |
| | | | | | |
| Measurement uncertainty | | | ±3dB | | |

**RBW / VBW: 20 MHz**

**Bandwidth 7 MHz**

| TEST CONDITIONS | | | MAXIMUM PEAK OUTPUT POWER (dBm) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1993.5 | 2050 | 2106.5 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Peak | 46.4 | 46.2 | 45.8 |
| | | RMS | 40.6 | 40.5 | 39.9 |
| | | | | | |
| Measurement uncertainty | | | ±3dB | | |

**RBW / VBW: 20 MHz**

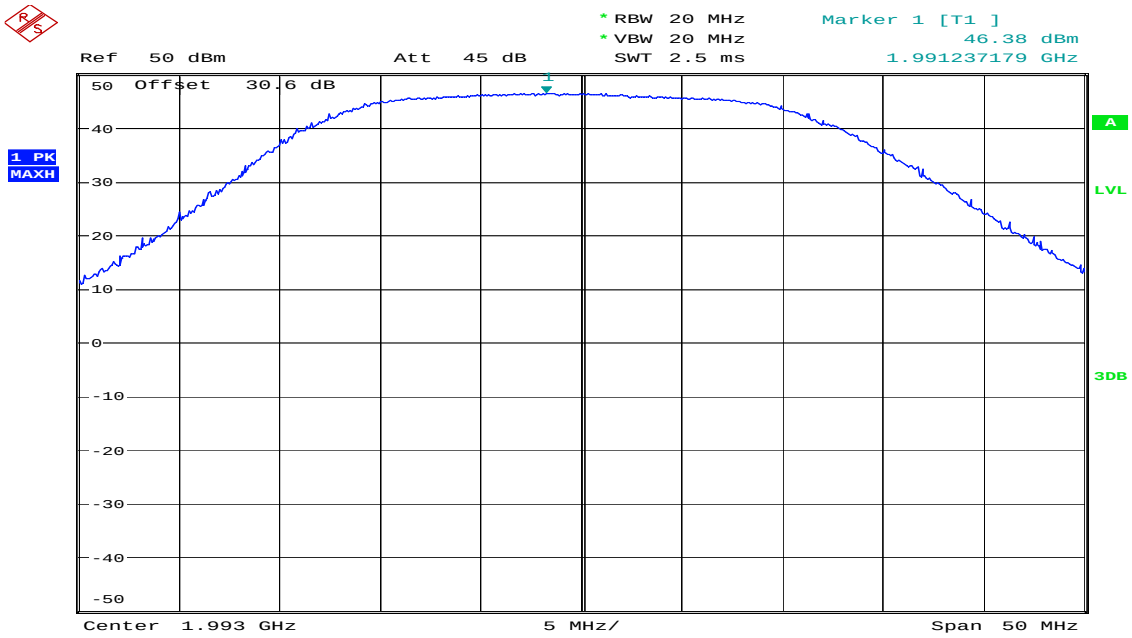
**Bandwidth 8 MHz**

| TEST CONDITIONS | | | MAXIMUM PEAK OUTPUT POWER (dBm) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1994 | 2050 | 2106 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Peak | 46.3 | 46.1 | 45.7 |
| | | RMS | 40.2 | 40.3 | 39.7 |
| | | | | | |
| Measurement uncertainty | | | ±3dB | | |

**RBW / VBW: 20 MHz**

**Remark:**
**The conducted RF output power was measured with all three sub-modulations QPSK, 16QAM and 64QAM. Also different FEC-rates were tested. As no significant differences in the output power were measured only the 64QAM results were recorded as representative values for all sub-modulations.**

Plot 1: Peak RF output power 1993 MHz / 6 MHz (conducted)

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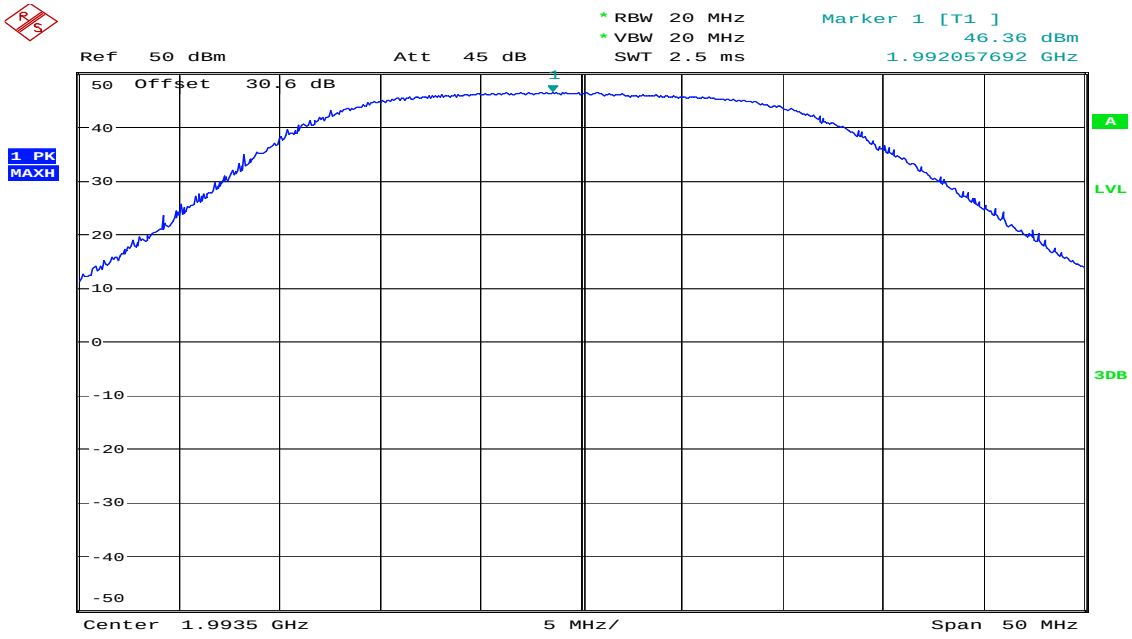
Date: 22.JUN.2010 14:14:37

Plot 2: Peak RF output power 1993.5 MHz / 7 MHz (conducted)

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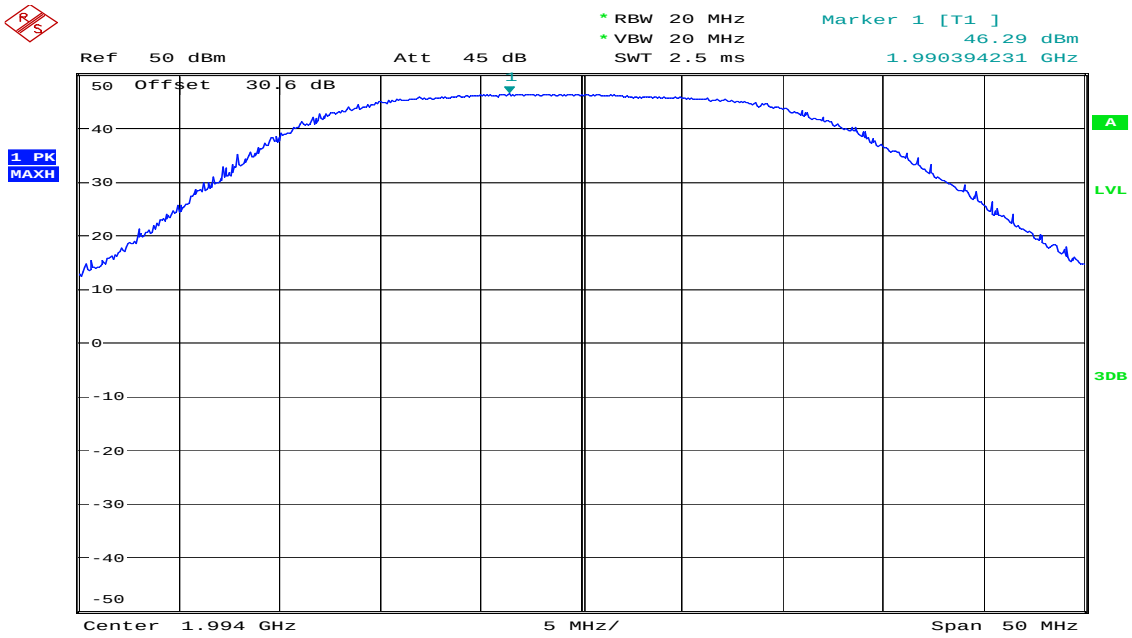
Date: 22.JUN.2010 14:27:17

Plot 3: Peak RF output power 1994 MHz / 8 MHz (conducted)

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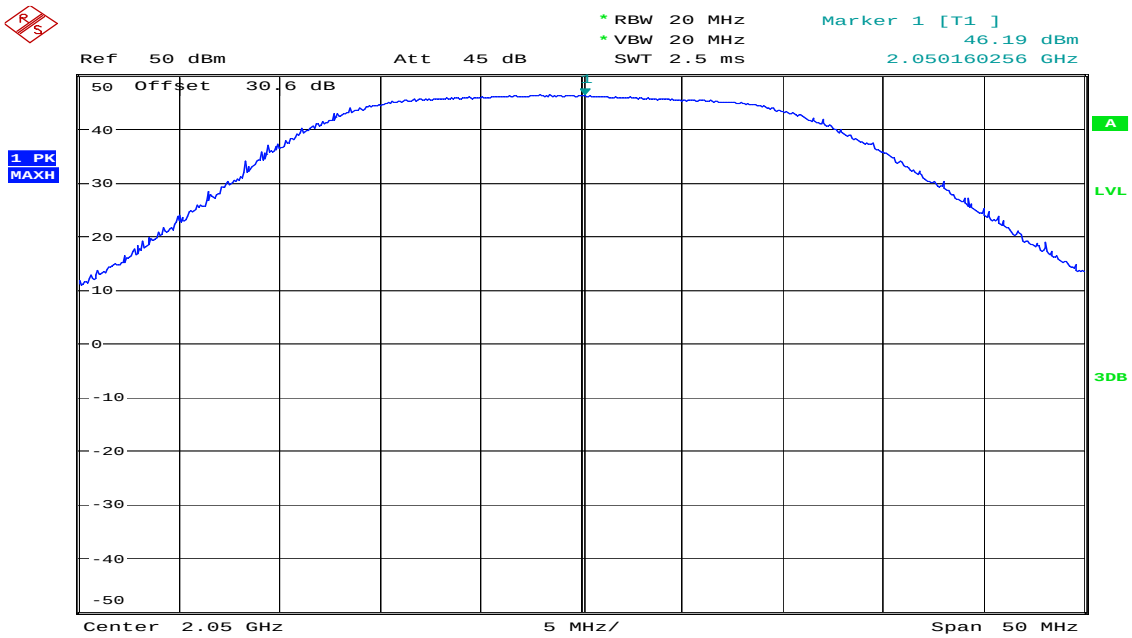
Date: 21.JUN.2010 12:11:17

Plot 4: Peak RF output power 2050 MHz / 6 MHz (conducted)

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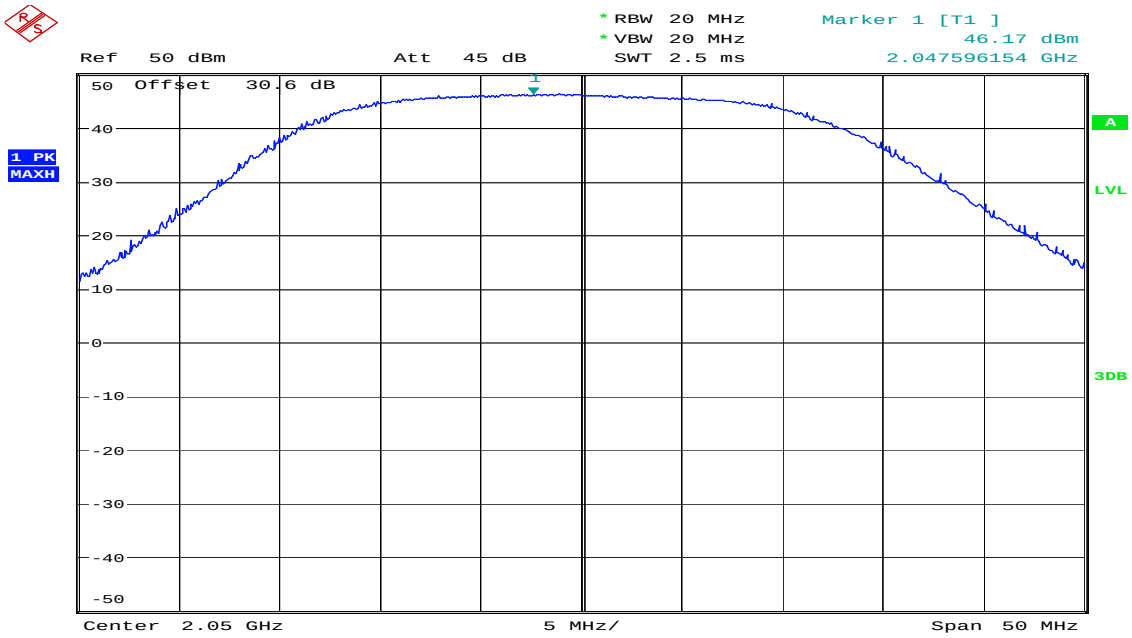
Plot 5: Peak RF output power 2050 MHz / 7 MHz (conducted)

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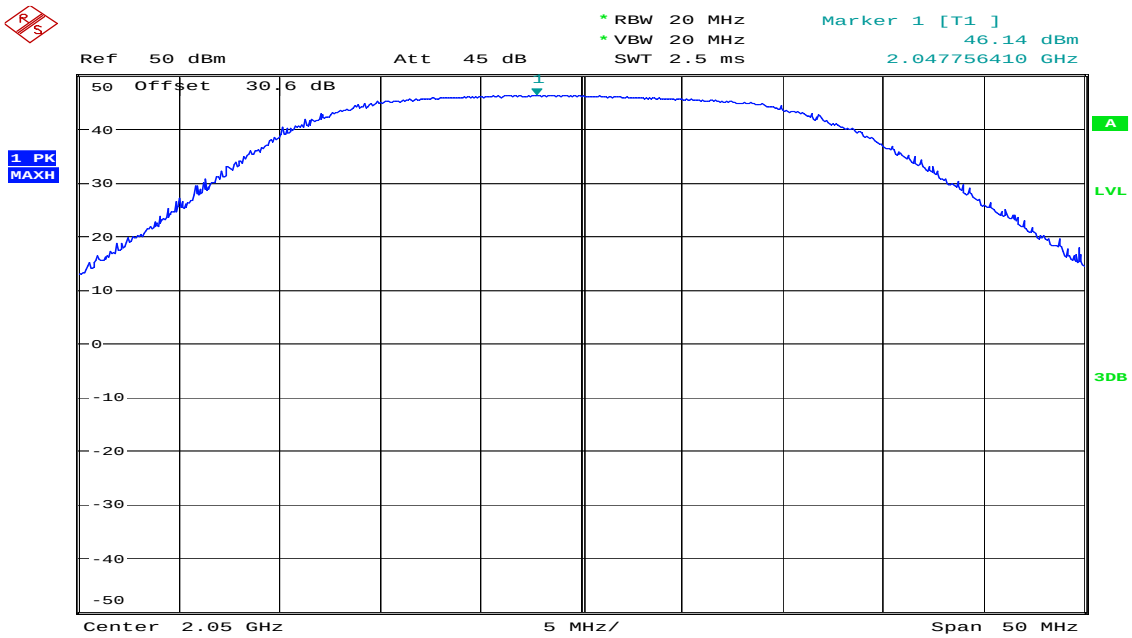
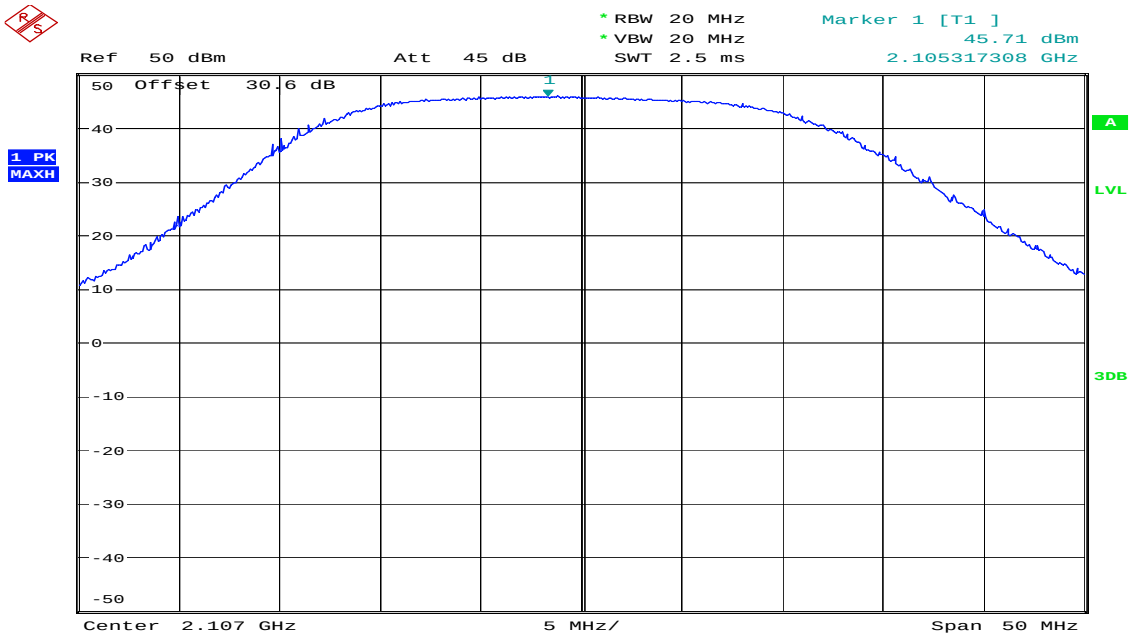
Date: 22.JUN.2010 14:29:35

Plot 6: Peak RF output power 2050 MHz / 8 MHz (conducted)



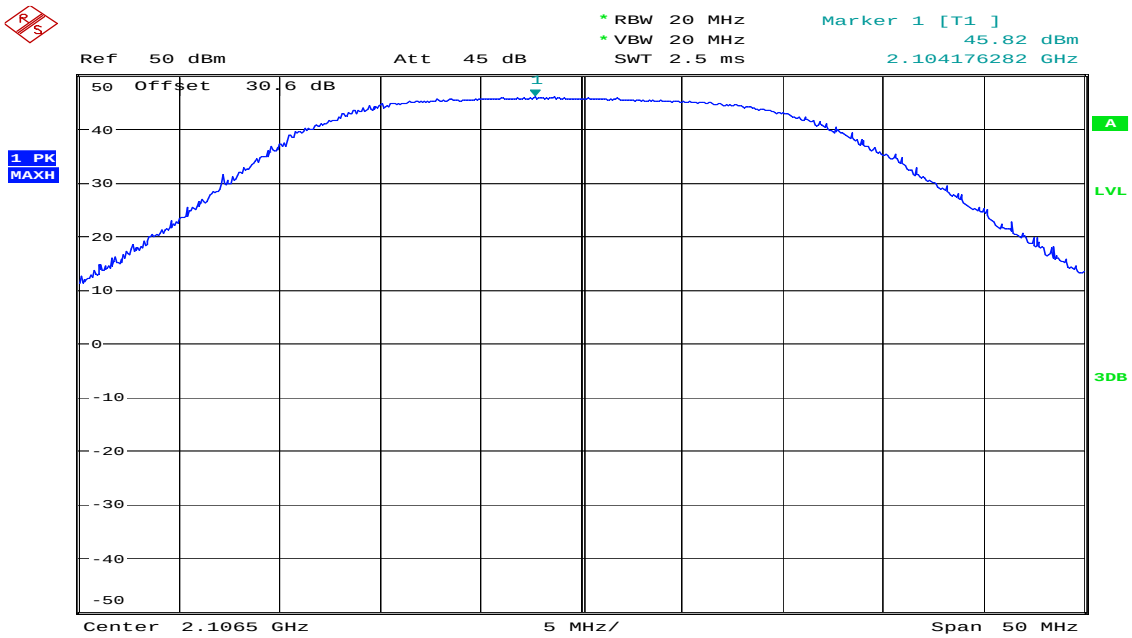

8UFCFH_1826C
Date: 21.JUN.2010 12:59:56

Plot 7: Peak RF output power 2107 MHz / 6 MHz (conducted)



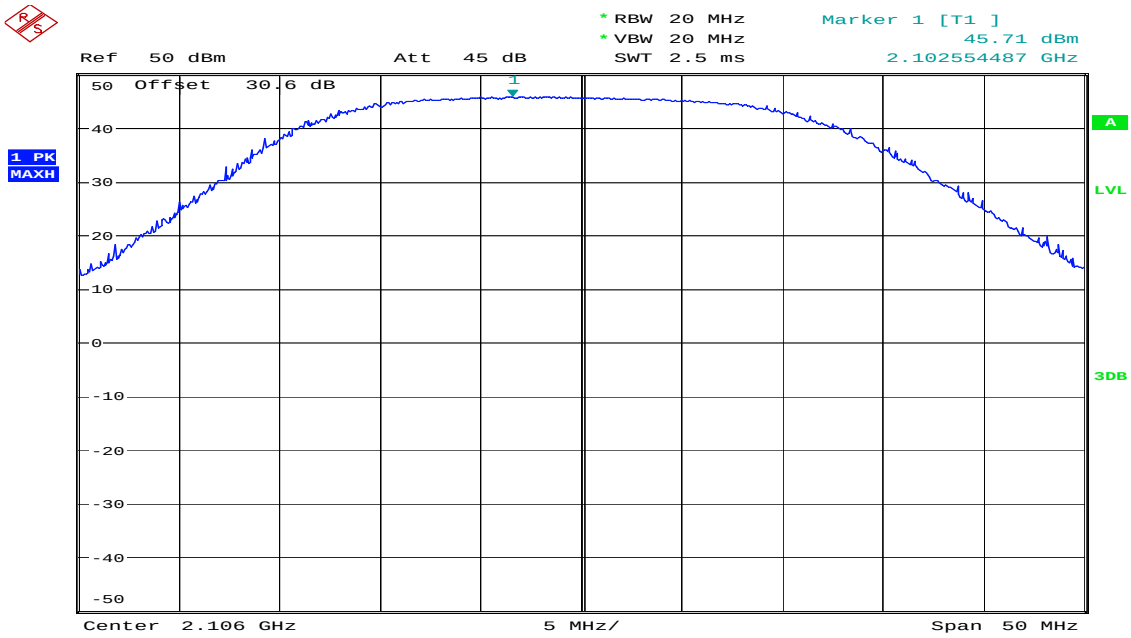

8UFCFH_1826C
Date: 22.JUN.2010 14:20:09

Plot 8: Peak RF output power 2106.5 MHz / 7 MHz (conducted)




8UFCFH_1826C
Date: 22.JUN.2010 14:34:58

Plot 9: Peak RF output power 2106 MHz / 8 MHz (conducted)




Limit according to §74.636(a):

| | |
|---|---|
| Under normal test conditions only | For the frequency band 2025 to 2110 MHz:<br>Maximum allowable transmitter power: 12.0 W / 40.8 dBm |

**Test Result: passed**

## 4.5 RF output power (radiated) §2.1046 / § 74.636(a)

**Bandwidth 6 MHz**

| TEST CONDITIONS | | | MAXIMUM PEAK EIRP (dBm) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1993 | 2050 | 2107 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Peak | 49.4 | 49.2 | 48.7 |
| Measurement uncertainty | | | ±3dB | | |

**RBW / VBW: 20 MHz**

**Bandwidth 7 MHz**

| TEST CONDITIONS | | | MAXIMUM PEAK EIRP (dBm) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1993.5 | 2050 | 2106.5 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Peak | 49.4 | 49.2 | 48.8 |
| Measurement uncertainty | | | ±3dB | | |

**RBW / VBW: 20 MHz**

**Bandwidth 8 MHz**

| TEST CONDITIONS | | | MAXIMUM PEAK EIRP (dBm) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1994 | 2050 | 2106 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Peak | 49.3 | 49.1 | 48.7 |
| Measurement uncertainty | | | ±3dB | | |

**RBW / VBW: 20 MHz**

**Remark:**
**The radiated RF output power (EIRP) was calculated based on the values of the conducted peak output power plus an antenna gain of 3 dBi as specified by the manufacturer / applicant. (see antenna data sheet of *VLA1903LP omnidirectional antenna*).**

Limit according to §74.636(a):

| | |
|---|---|
| Under normal test conditions only | For the frequency band 2025 to 2110 MHz:<br>Maximum allowable EIRP: 35.0 dBW / 65.0 dBm |

**Test Result: passed**

## 4.6 Occupied bandwidth §2.1049 / §74.637 (g)

**Bandwidth 6 MHz**

| TEST CONDITIONS | | | OCCUPIED BANDWIDTH (MHz) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1993 | 2050 | 2107 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Max | QPSK: 5.705 MHz<br>16QAM: 5.667 MHz<br>64QAM: 5.667 MHz | QPSK: 5.679 MHz<br>16QAM: 5.667 MHz<br>64QAM: 5.667 MHz | QPSK: 5.667 MHz<br>16QAM: 5.667MHz<br>64QAM: 5.667 MHz |
| Measurement uncertainty | | | ± 10 kHz | | |

**RBW / VBW: 30 kHz**

**Bandwidth 7 MHz**

| TEST CONDITIONS | | | OCCUPIED BANDWIDTH (MHz) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1993.5 | 2050 | 2106.5 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Max | QPSK: 6.619 MHz<br>16QAM: 6.619 MHz<br>64QAM: 6.619 MHz | QPSK: 6.635 MHz<br>16QAM: 6.603 MHz<br>64QAM: 6.603 MHz | QPSK: 6.619 MHz<br>16QAM: 6.603 MHz<br>64QAM: 6.603 MHz |
| Measurement uncertainty | | | ± 10 kHz | | |

**RBW / VBW: 30 kHz**

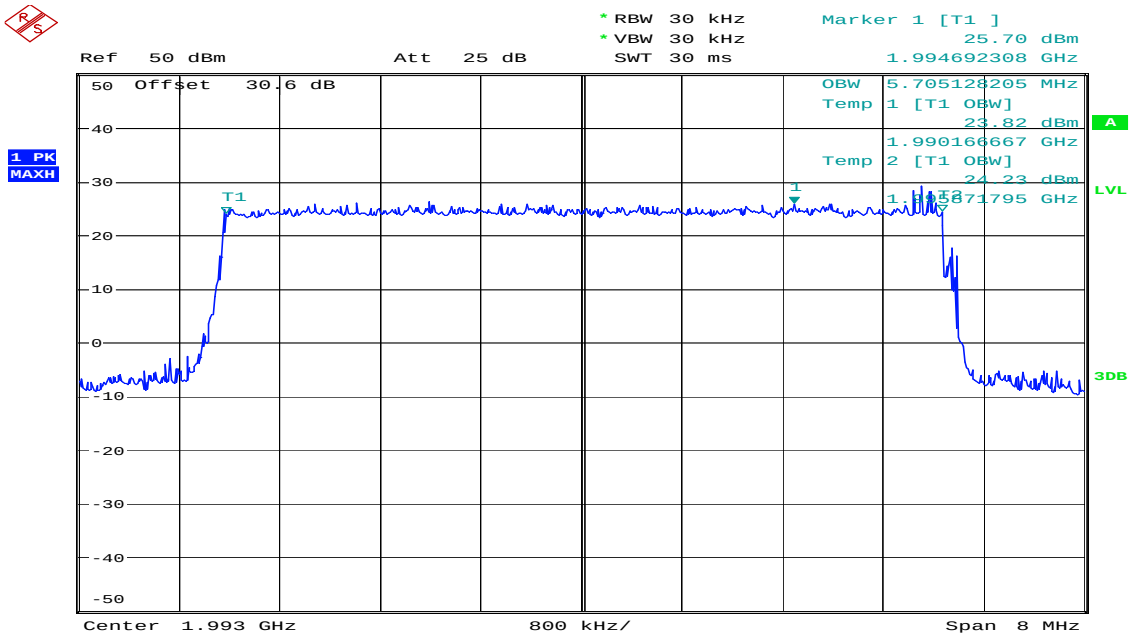
**Bandwidth 8 MHz**

| TEST CONDITIONS | | | OCCUPIED BANDWIDTH (MHz) | | |
|---|---|---|---|---|---|
| Frequency (MHz) | | | 1994 | 2050 | 2106 |
| $T_{nom}$ 23 °C | $V_{nom}$ 28.0 Vdc | Max | QPSK: 7.564 MHz<br>16QAM: 7.564 MHz<br>64QAM: 7.564 MHz | QPSK: 7.564 MHz<br>16QAM: 7.564 MHz<br>64QAM: 7.564 MHz | QPSK: 7.564 MHz<br>16QAM: 7.564 MHz<br>64QAM: 7.564 MHz |
| Measurement uncertainty | | | ± 10 kHz | | |

**RBW / VBW: 30 kHz**

**Remark:**
**The internal function of the spectrum analyzer was used to determine the occupied bandwidth (99%).**

Plot 10: Occupied bandwidth 1993 MHz / 6 MHz QPSK

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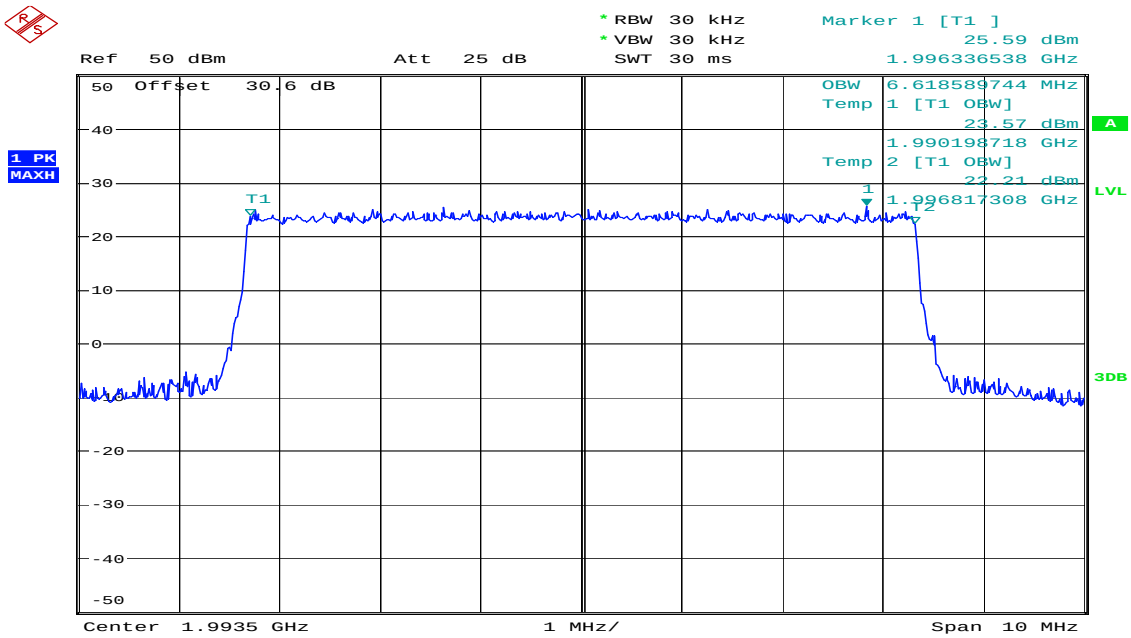
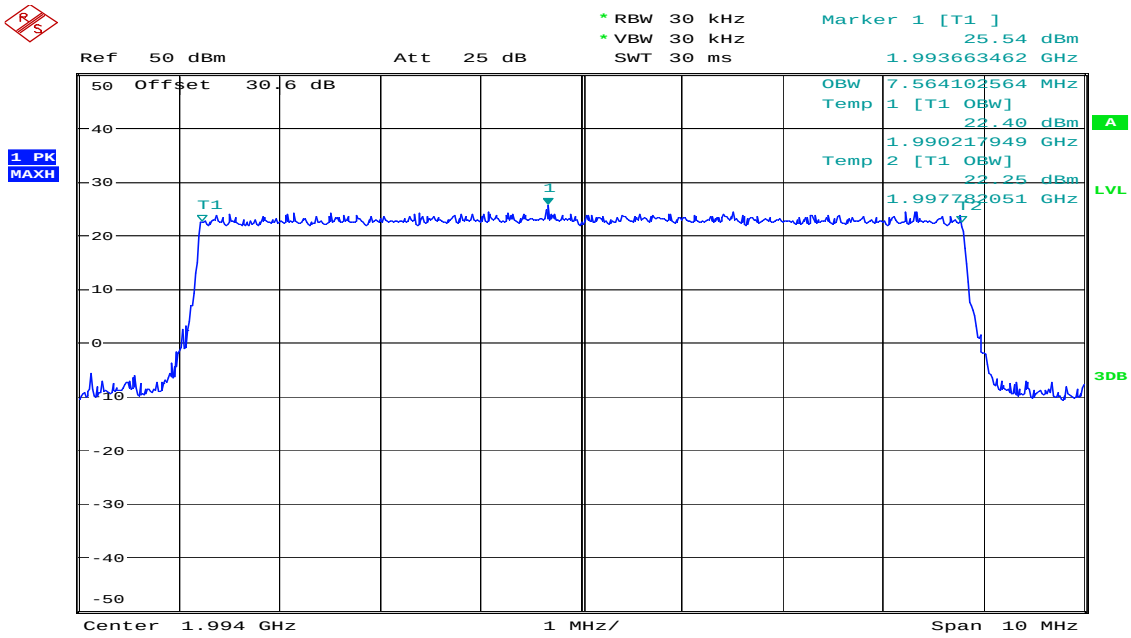
Plot 11: Occupied bandwidth 1993.5 MHz / 7 MHz QPSK




8UFCFH_1826C
Date: 22.JUN.2010 15:10:47

Plot 12: Occupied bandwidth 1994 MHz / 8 MHz QPSK

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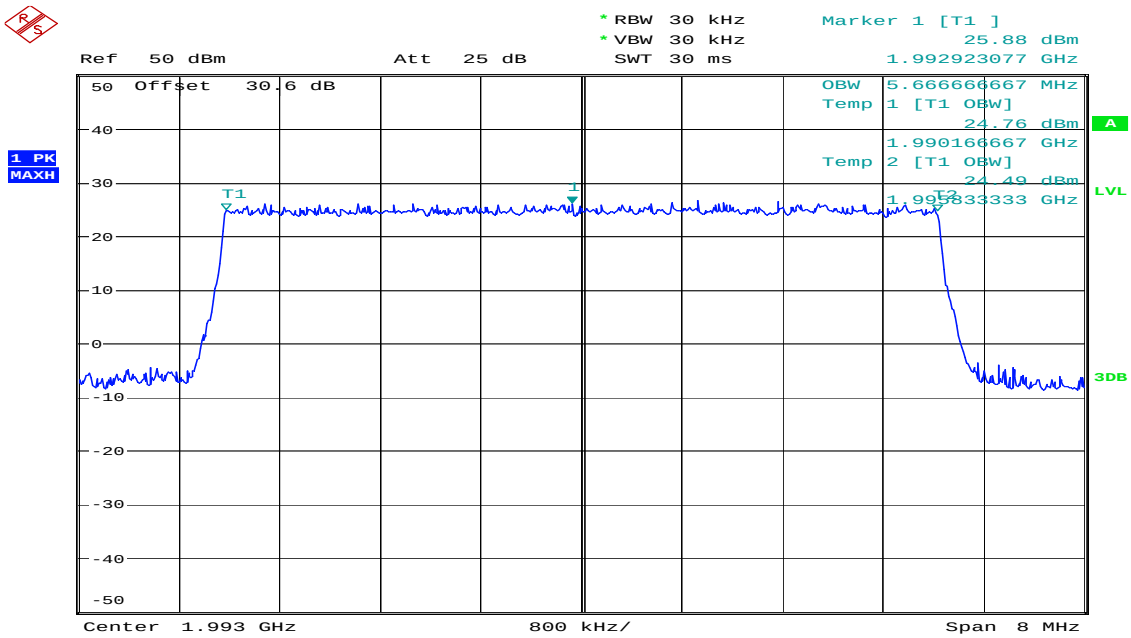
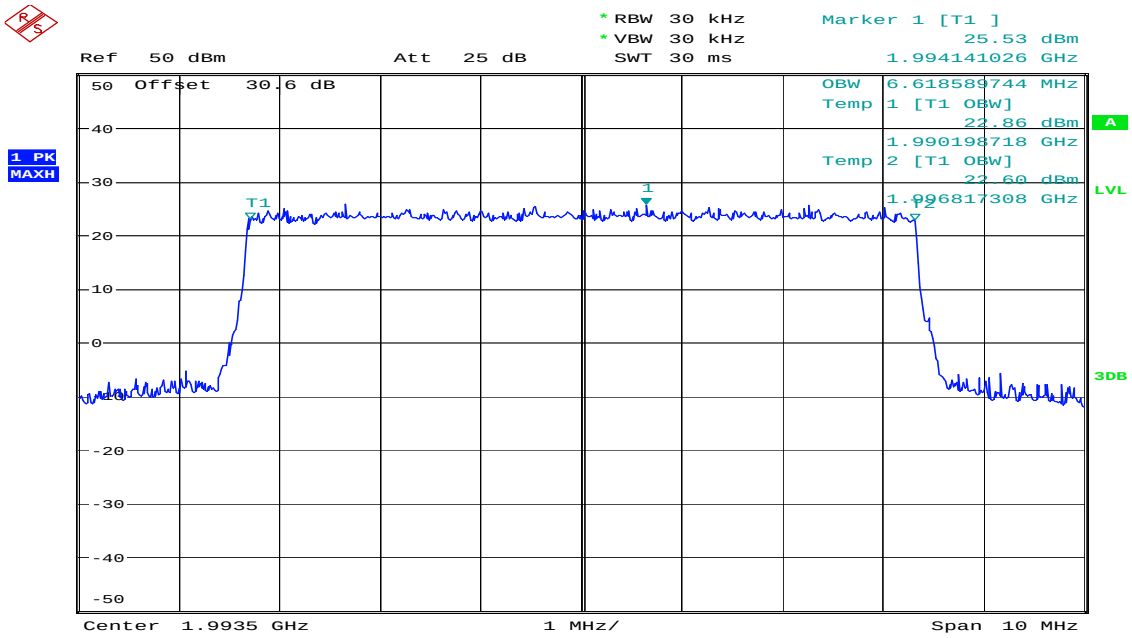
Date: 22.JUN.2010 15:15:31

Plot 13: Occupied bandwidth 1993 MHz / 6 MHz 16QAM



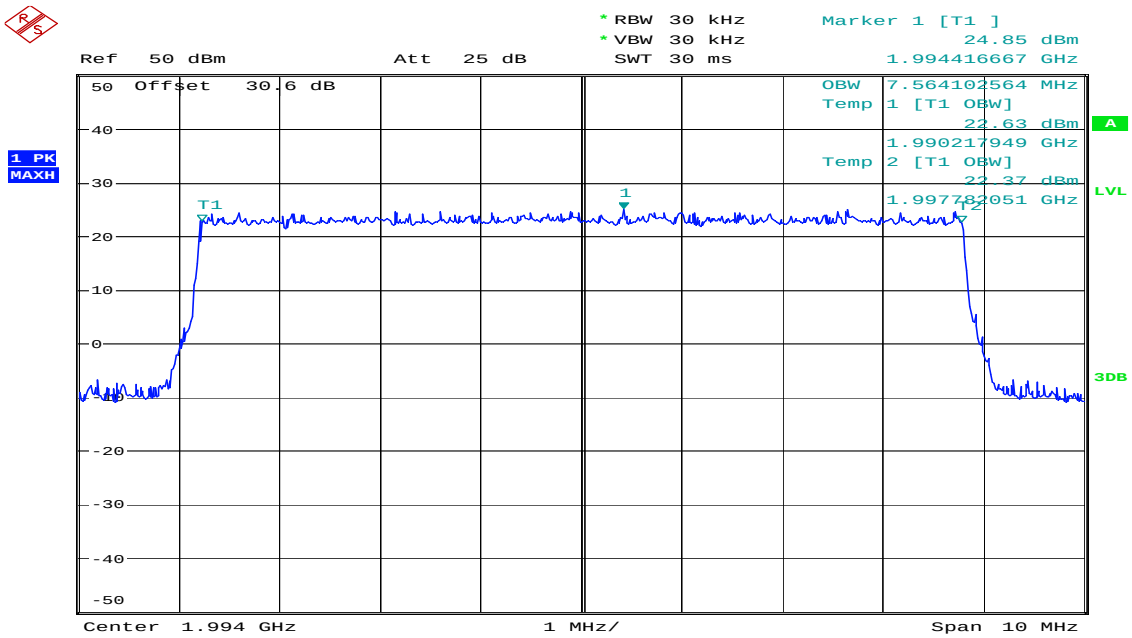

8UFCFH_1826C
Date: 22.JUN.2010 15:05:37

Plot 14: Occupied bandwidth 1993.5 MHz / 7 MHz 16QAM




8UFCFH_1826C
Date: 22.JUN.2010 15:11:13

Plot 15: Occupied bandwidth 1994 MHz / 8 MHz 16QAM




8UFCFH_1826C
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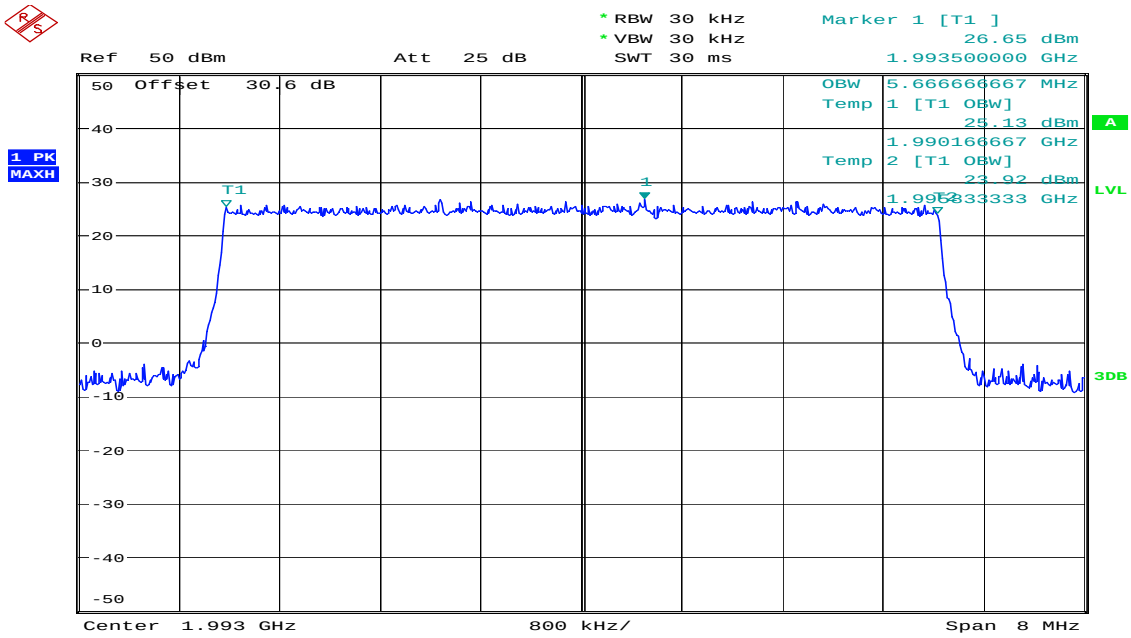
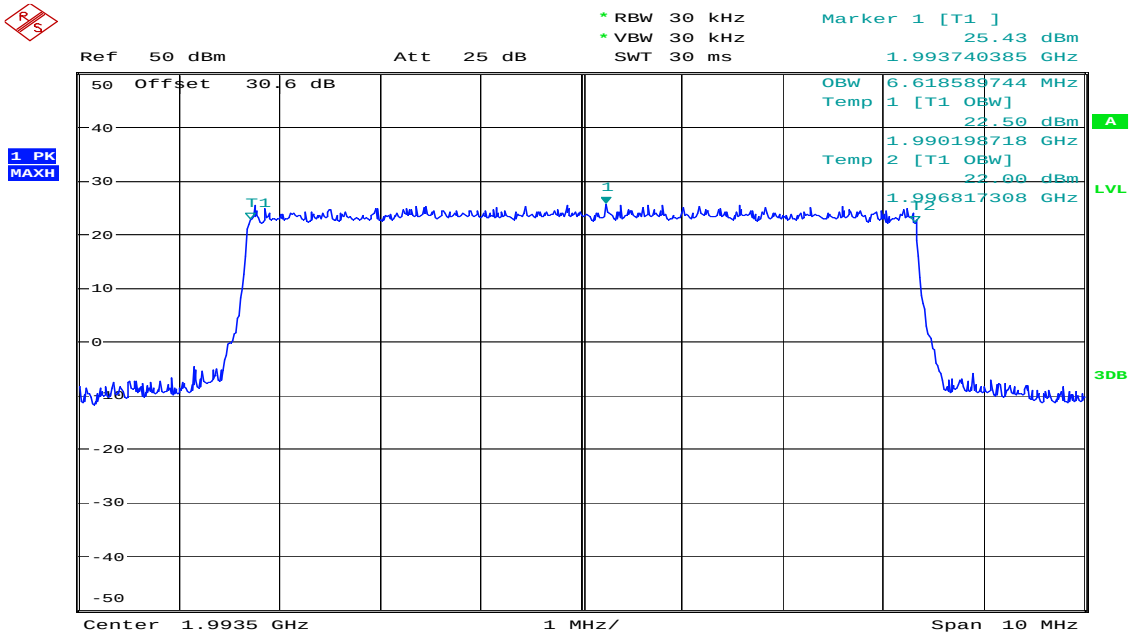
Plot 16: Occupied bandwidth 1993 MHz / 6 MHz 64QAM



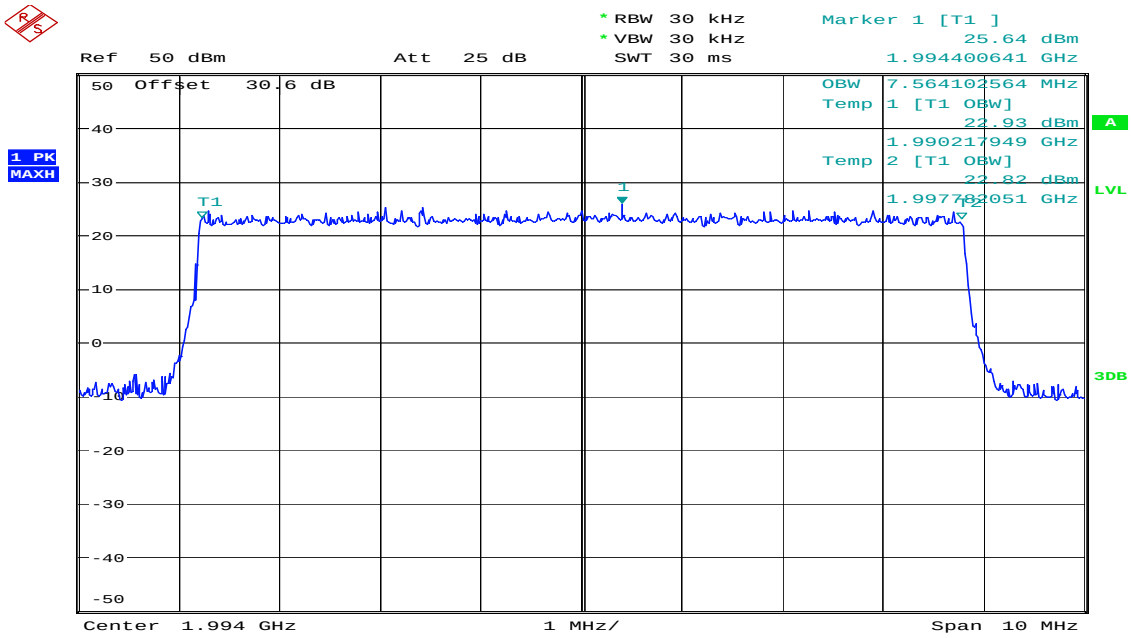

8UFCFH_1826C
Date: 22.JUN.2010 15:06:21

Plot 17: Occupied bandwidth 1993.5 MHz / 7 MHz 64QAM



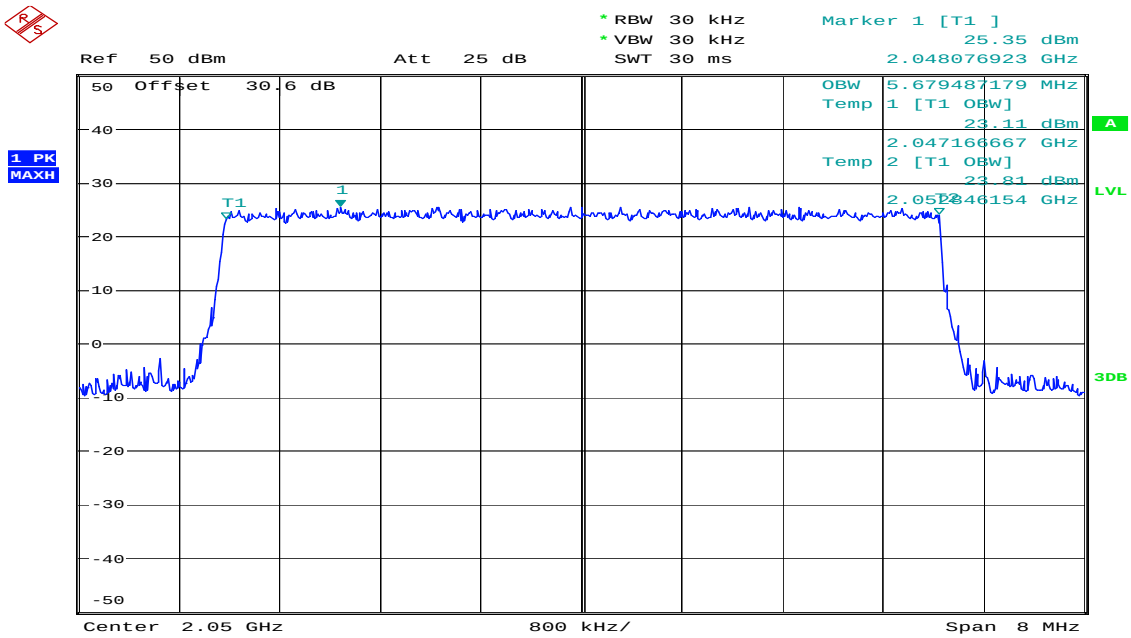

8UFCFH_1826C
Date: 22.JUN.2010 15:11:36

Plot 18: Occupied bandwidth 1994 MHz / 8 MHz 64QAM



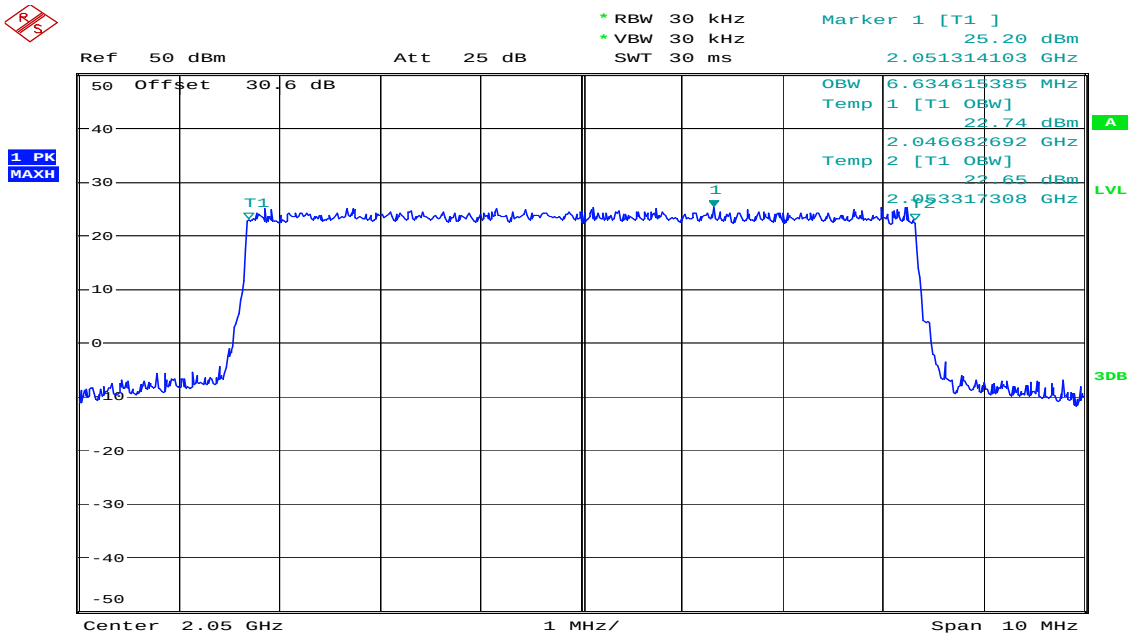

8UFCFH_1826C
Date: 22.JUN.2010 15:16:30

Plot 19: Occupied bandwidth 2050 MHz / 6 MHz QPSK



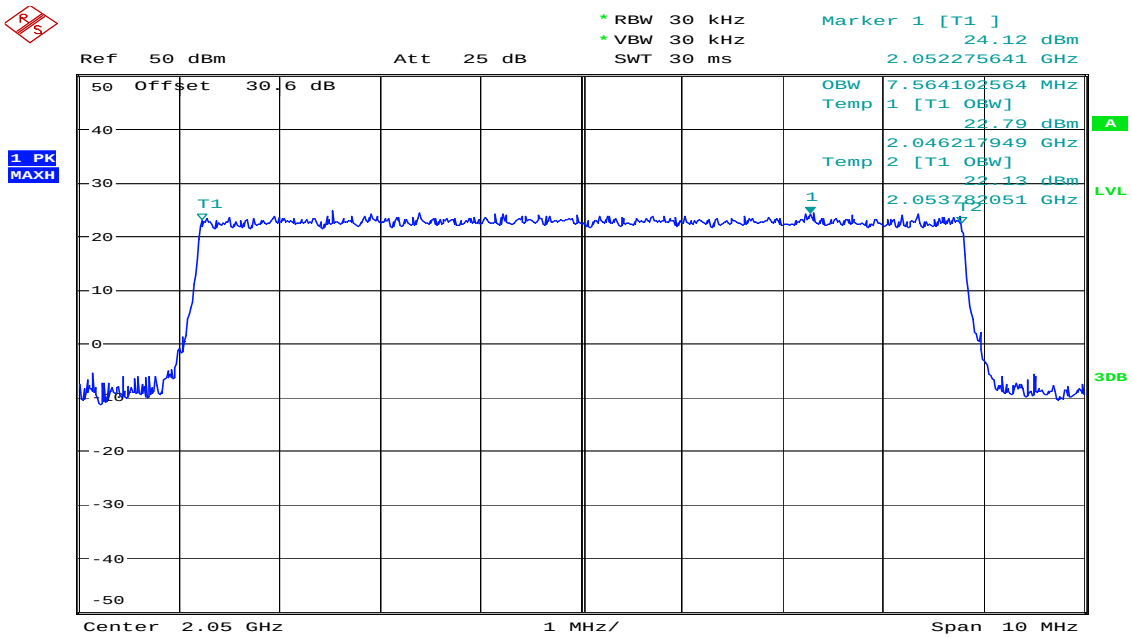

8UFCFH_1826C
Date: 22.JUN.2010 15:07:28

Plot 20: Occupied bandwidth 2050 MHz / 7 MHz QPSK



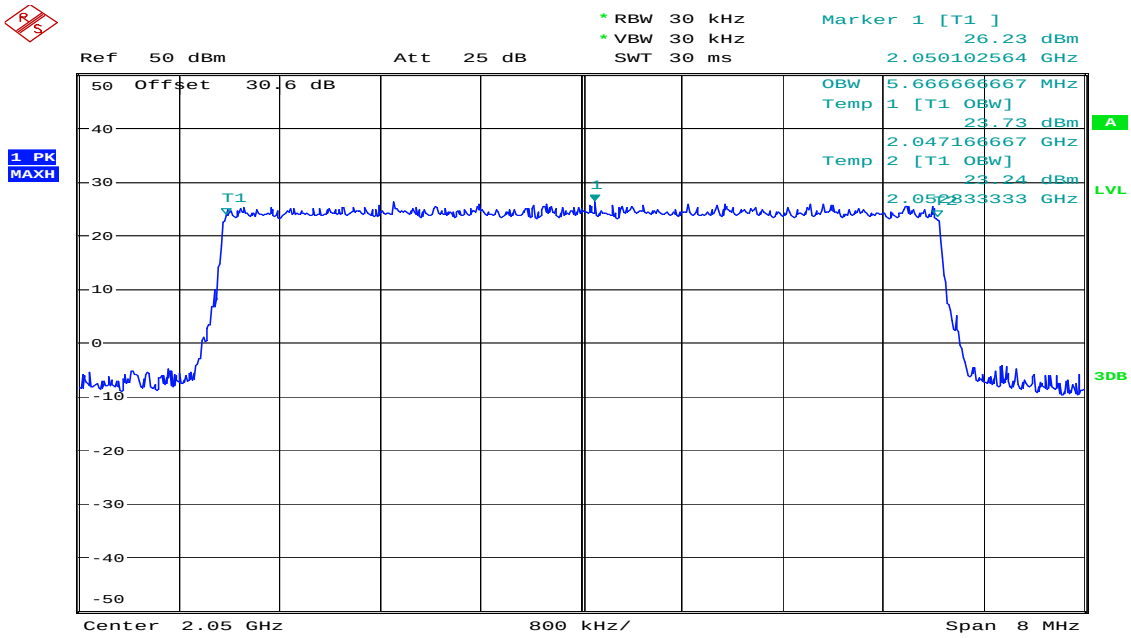

8UFCFH_1826C
Date: 22.JUN.2010 15:12:14

Plot 21: Occupied bandwidth 2050 MHz / 8 MHz QPSK



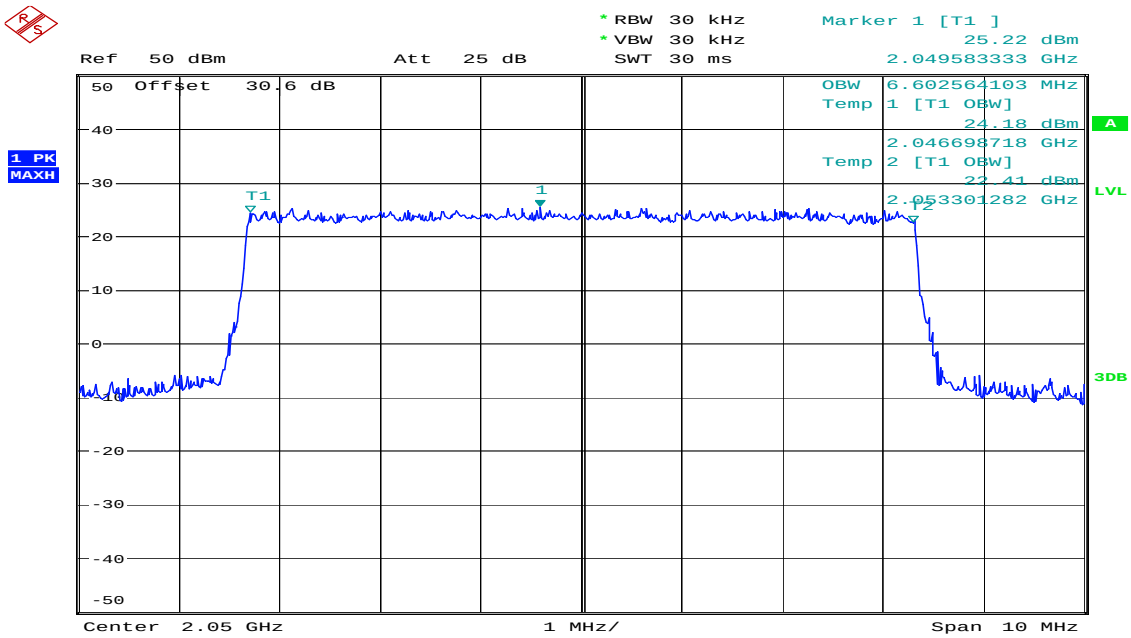

8UFCFH_1826C
Date: 22.JUN.2010 15:17:11

Plot 22: Occupied bandwidth 2050 MHz / 6 MHz 16QAM



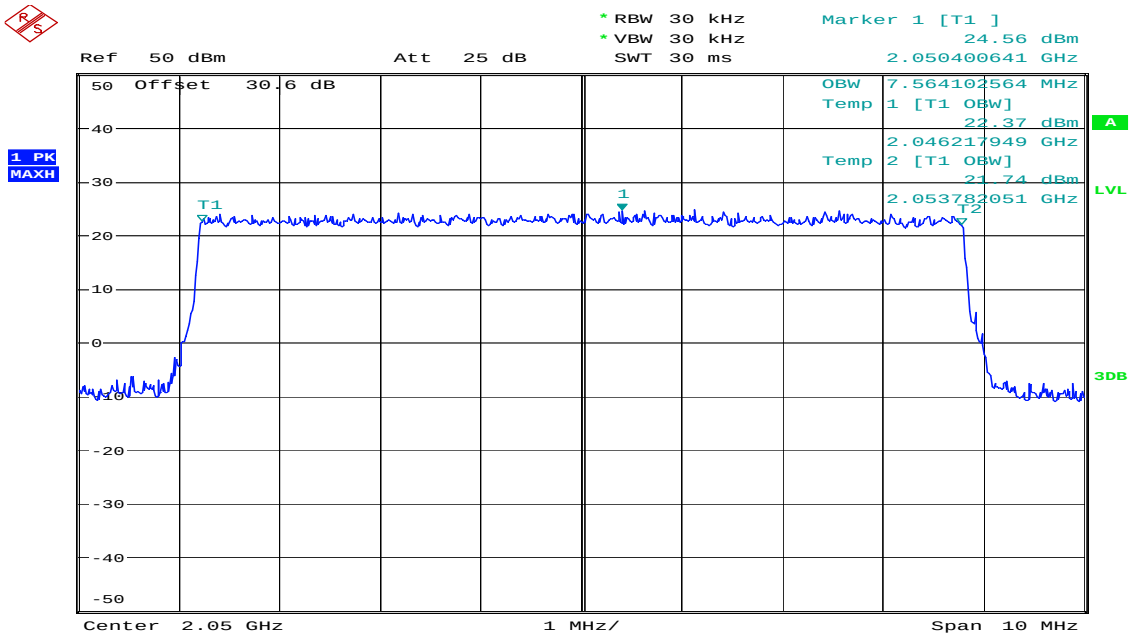

8UFCFH_1826C
Date: 22.JUN.2010 15:07:58

Plot 23: Occupied bandwidth 2050 MHz / 7 MHz 16QAM



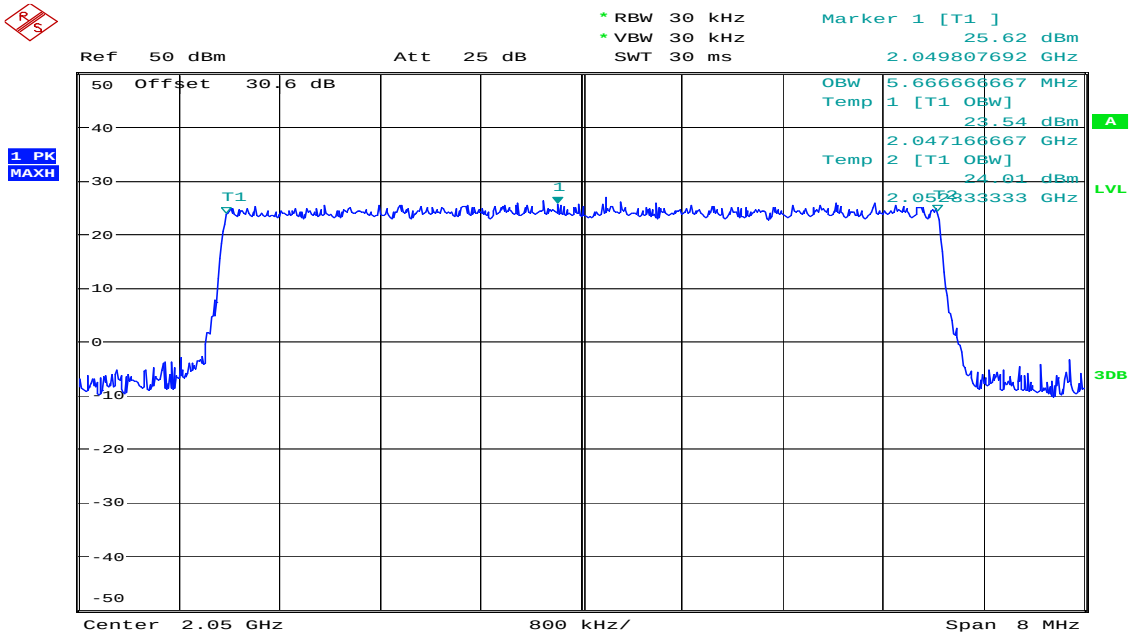

8UFCFH_1826C
Date: 22.JUN.2010 15:12:45

Plot 24: Occupied bandwidth 2050 MHz / 8 MHz 16QAM



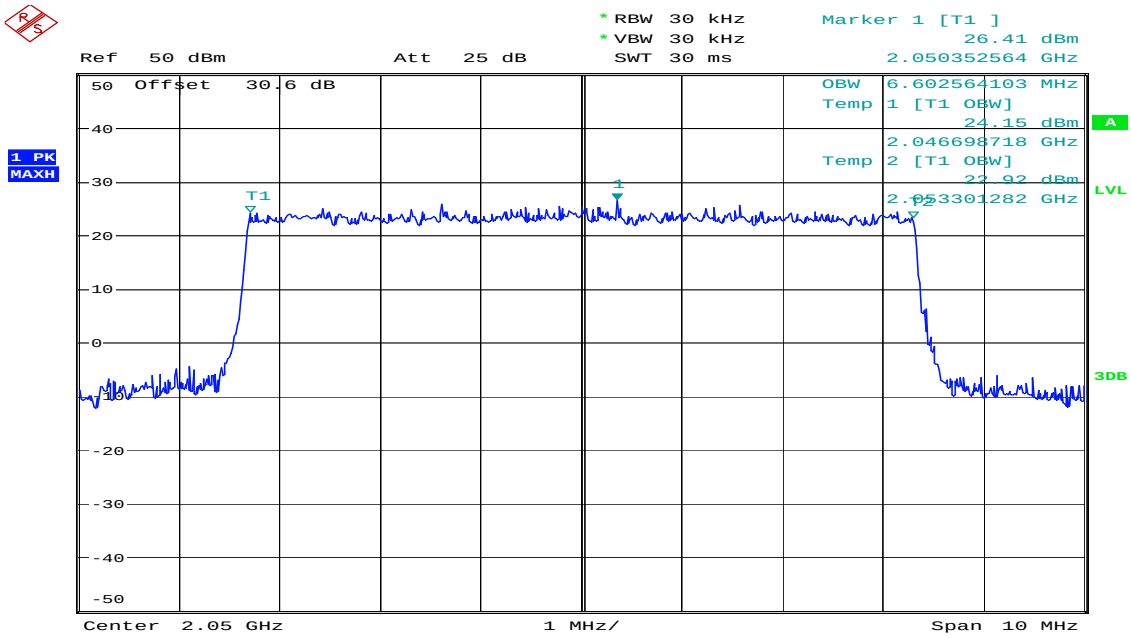

8UFCFH_1826C
Date: 22.JUN.2010 15:17:36

Plot 25: Occupied bandwidth 2050 MHz / 6 MHz 64QAM



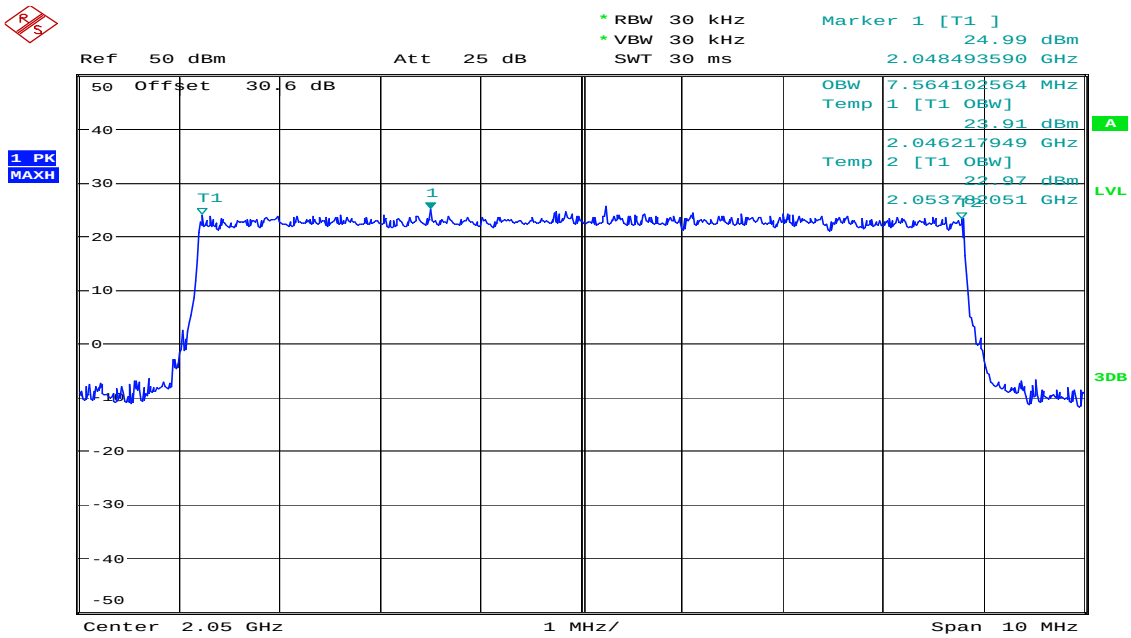

8UFCFH_1826C
Date: 22.JUN.2010 15:08:20

Plot 26: Occupied bandwidth 2050 MHz / 7 MHz 64QAM



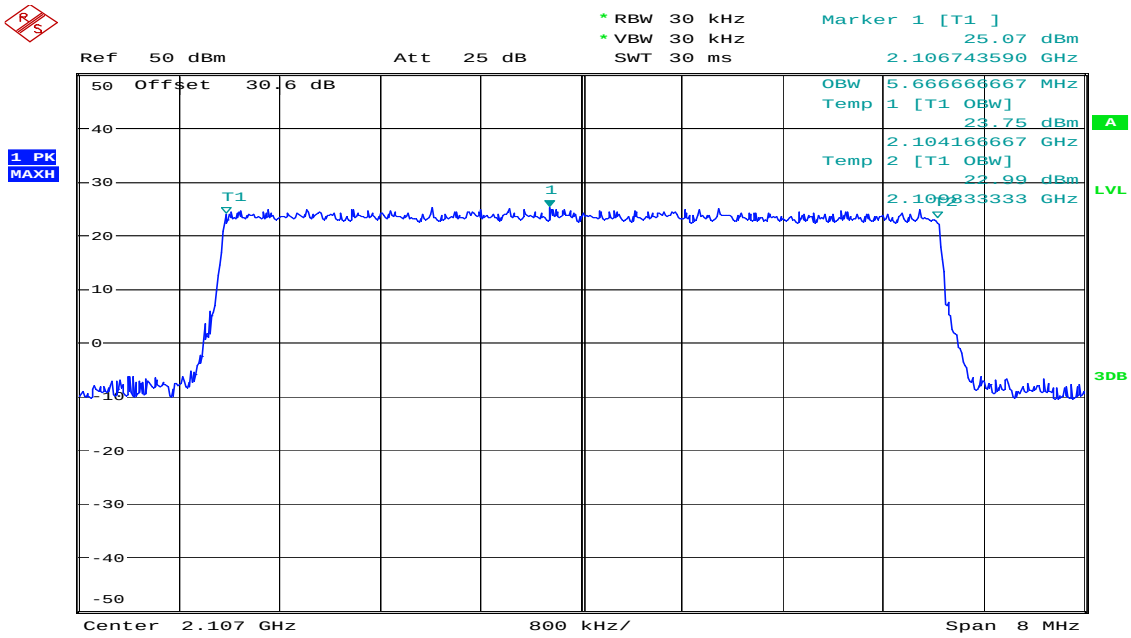

8UFCFH_1826C
Date: 22.JUN.2010 15:13:04

Plot 27: Occupied bandwidth 2050 MHz / 8 MHz 64QAM



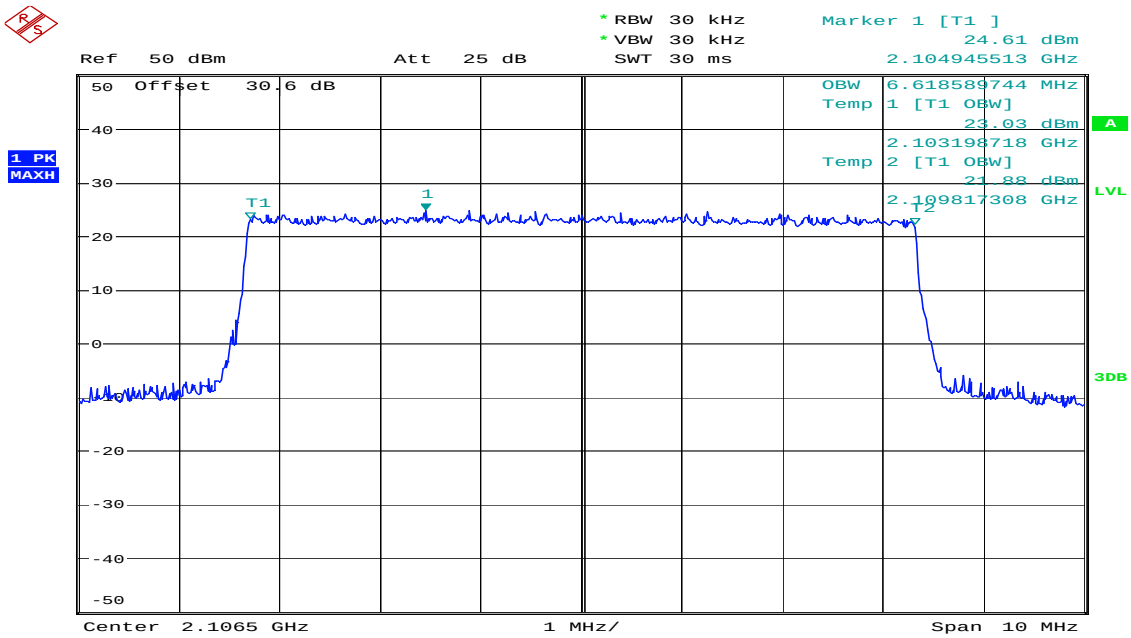

8UFCFH_1826C
Date: 22.JUN.2010 15:17:56

Plot 28: Occupied bandwidth 2107 MHz / 6 MHz QPSK



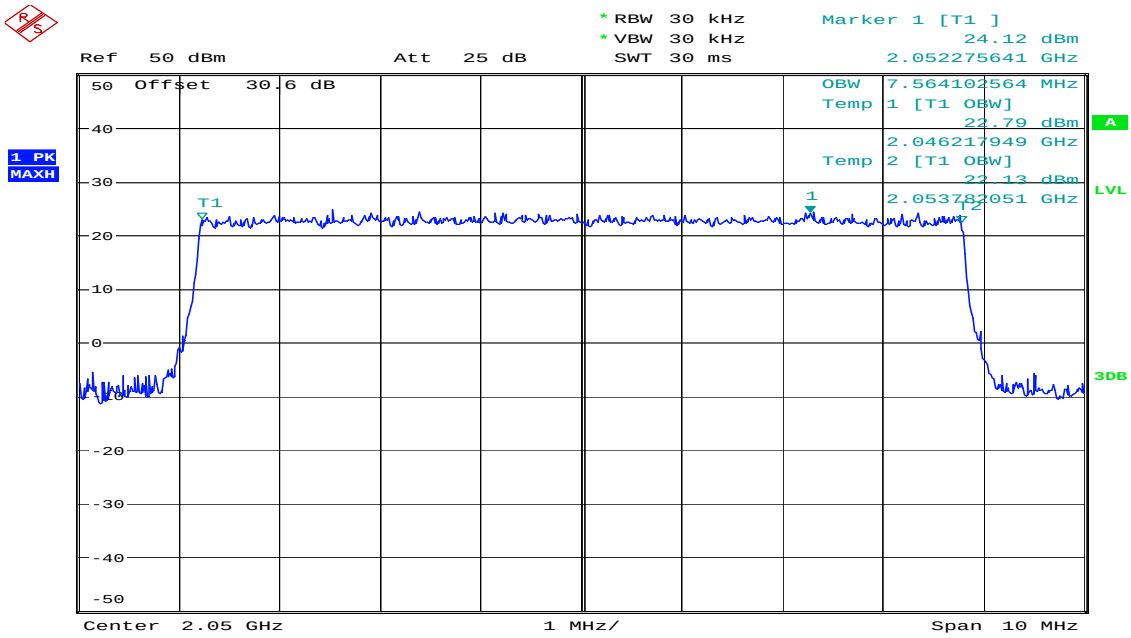

8UFCFH_1826C
Date: 22.JUN.2010 15:08:57

Plot 29: Occupied bandwidth 2106.5 MHz / 7 MHz QPSK



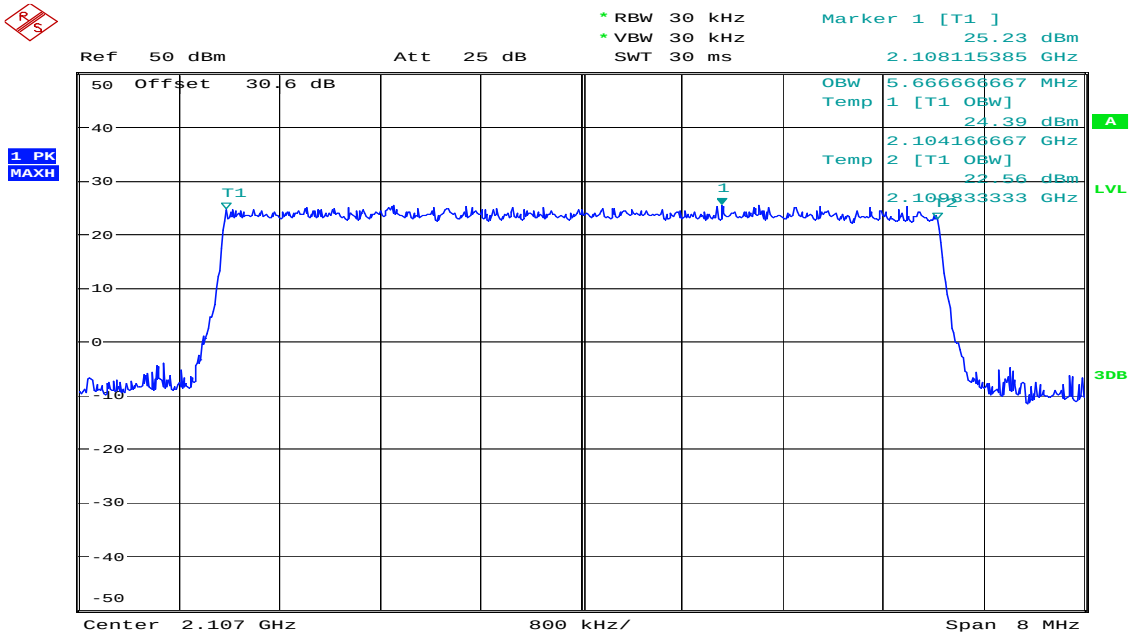

8UFCFH_1826C
Date: 22.JUN.2010 15:13:47

Plot 30: Occupied bandwidth 2106 MHz / 8 MHz QPSK



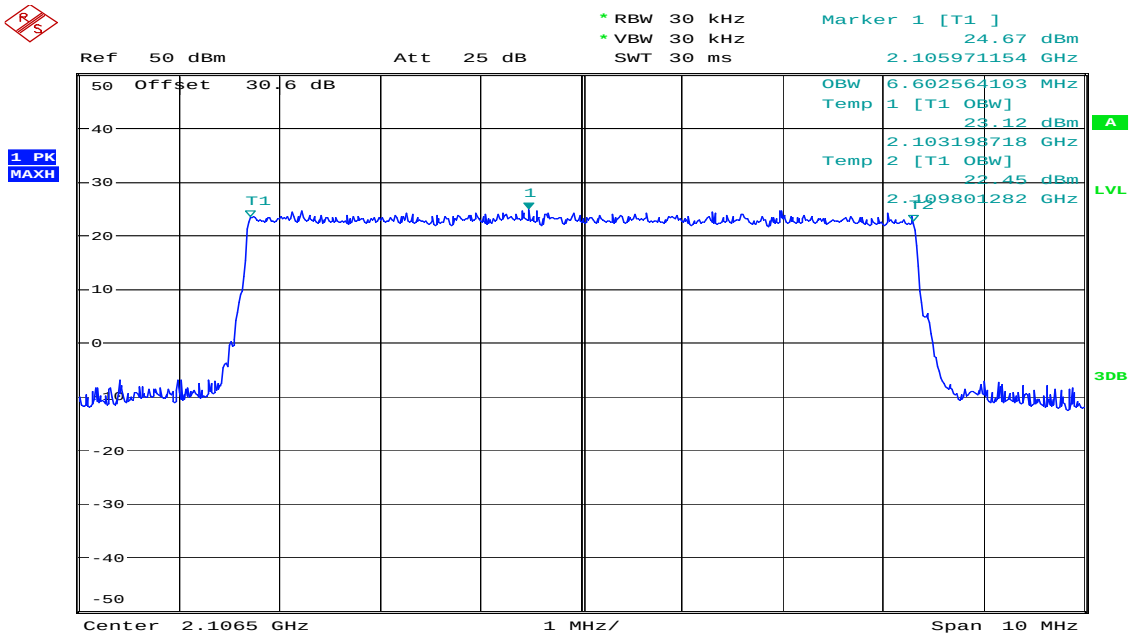

8UFCFH_1826C
Date: 22.JUN.2010 15:17:11

Plot 31: Occupied bandwidth 2107 MHz / 6 MHz 16QAM



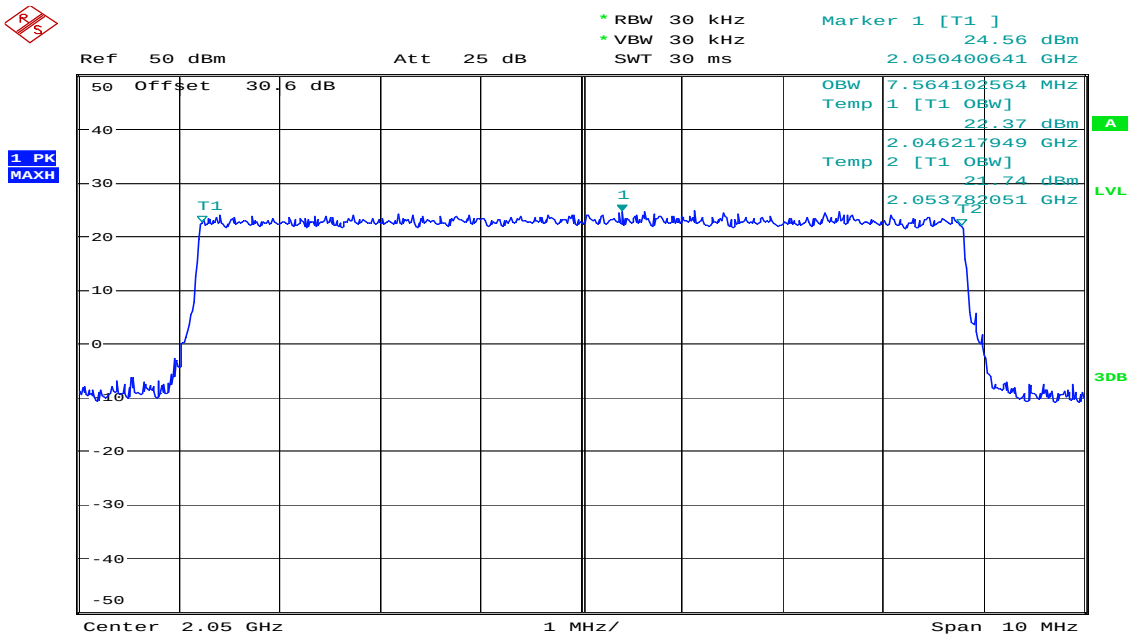

8UFCFH_1826C
Date: 22.JUN.2010 15:09:20

Plot 32: Occupied bandwidth 2106.5 MHz / 7 MHz 16QAM



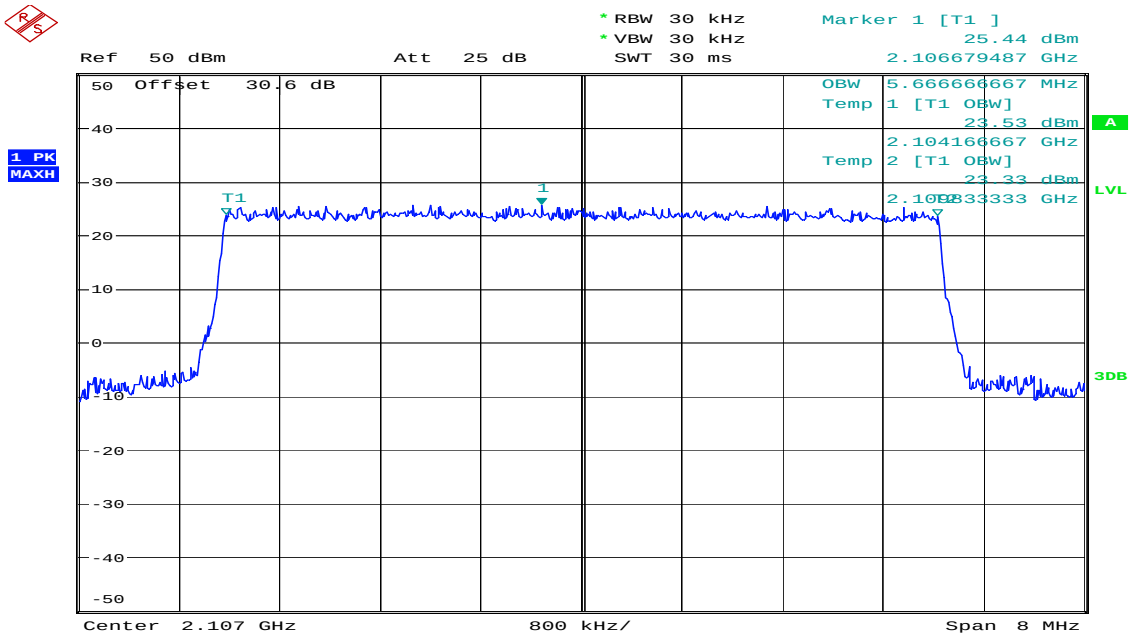

8UFCFH_1826C
Date: 22.JUN.2010 15:14:11

Plot 33: Occupied bandwidth 2106 MHz / 8 MHz 16QAM



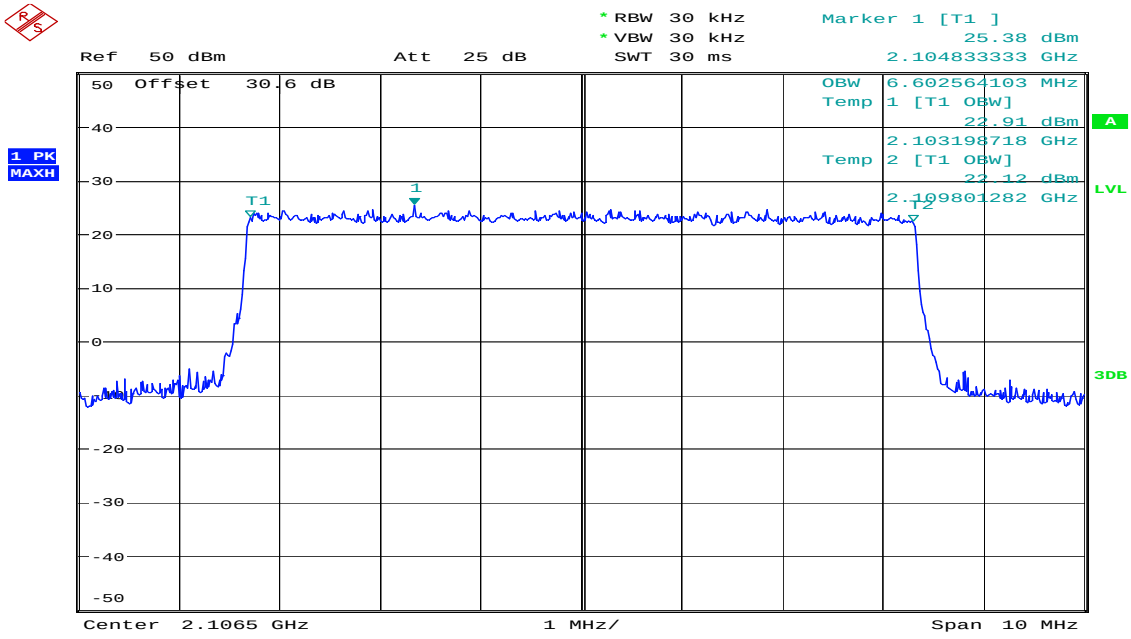

8UFCFH_1826C
Date: 22.JUN.2010 15:17:36

Plot 34: Occupied bandwidth 2107 MHz / 6 MHz 64QAM



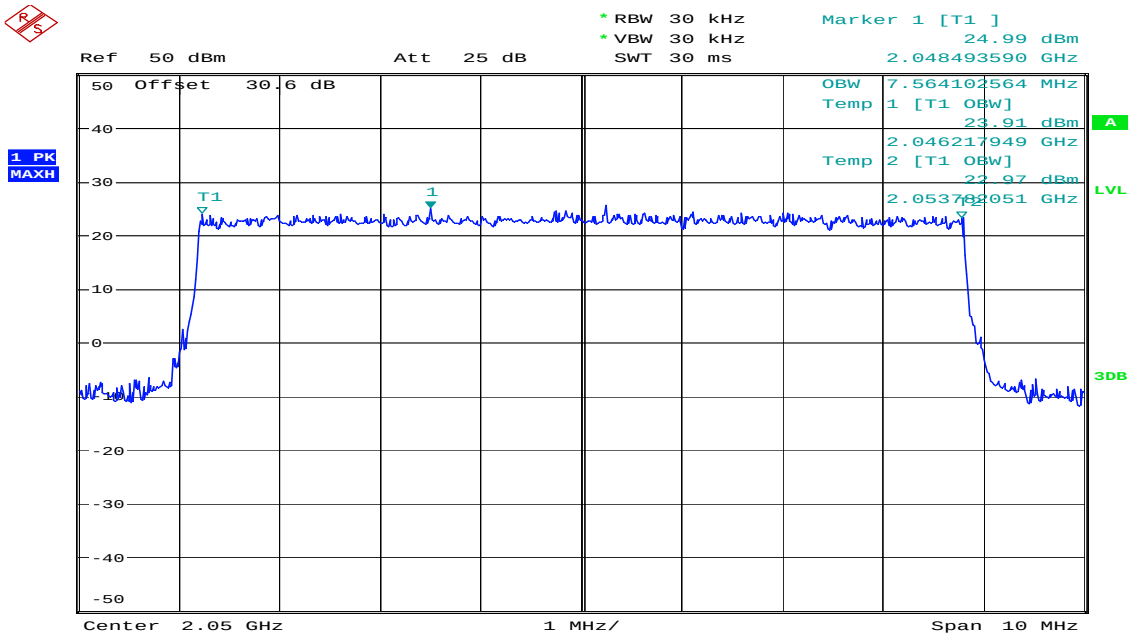

8UFCFH_1826C
Date: 22.JUN.2010 15:09:51

Plot 35: Occupied bandwidth 2106.5 MHz / 7 MHz 64QAM




8UFCFH_1826C
Date: 22.JUN.2010 15:14:39

Plot 36: Occupied bandwidth 2106 MHz / 8 MHz 64QAM




8UFCFH_1826C
Date: 22.JUN.2010 15:17:56

Limit according to §74.637(g):

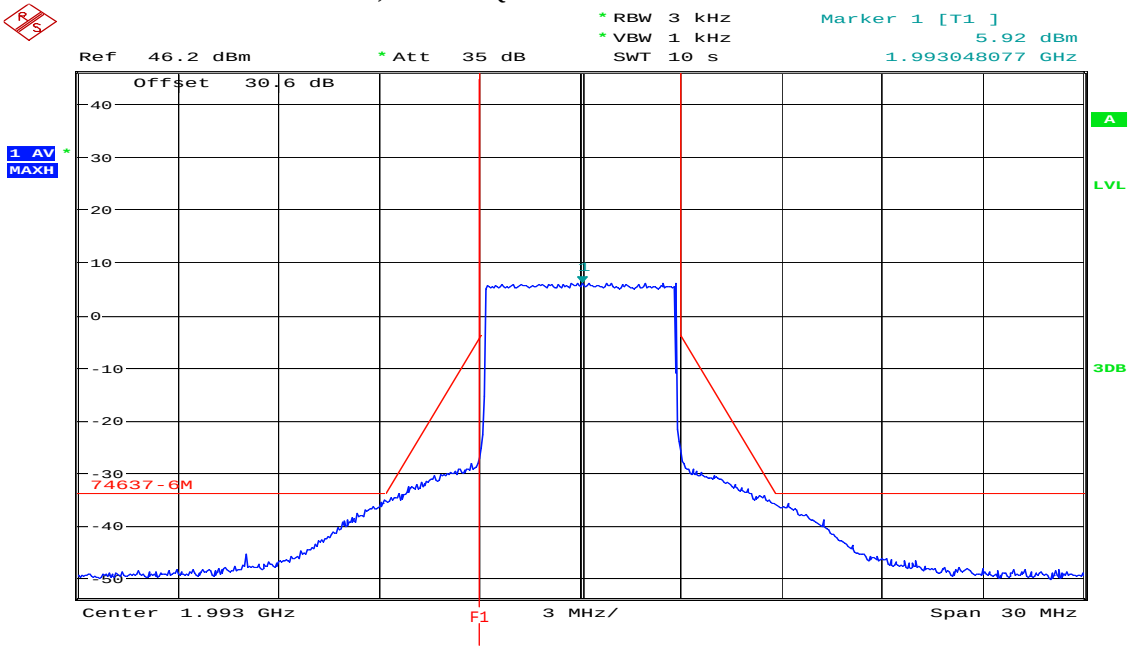
| | |
|---|---|
| Under normal test conditions only | For the frequency band 1900 to 2110 MHz:<br>Maximum authorized bandwidth: 18 MHz |

**Test Result: passed**

## 4.7 Emission mask §2.1051 / §74.637(a)(2)

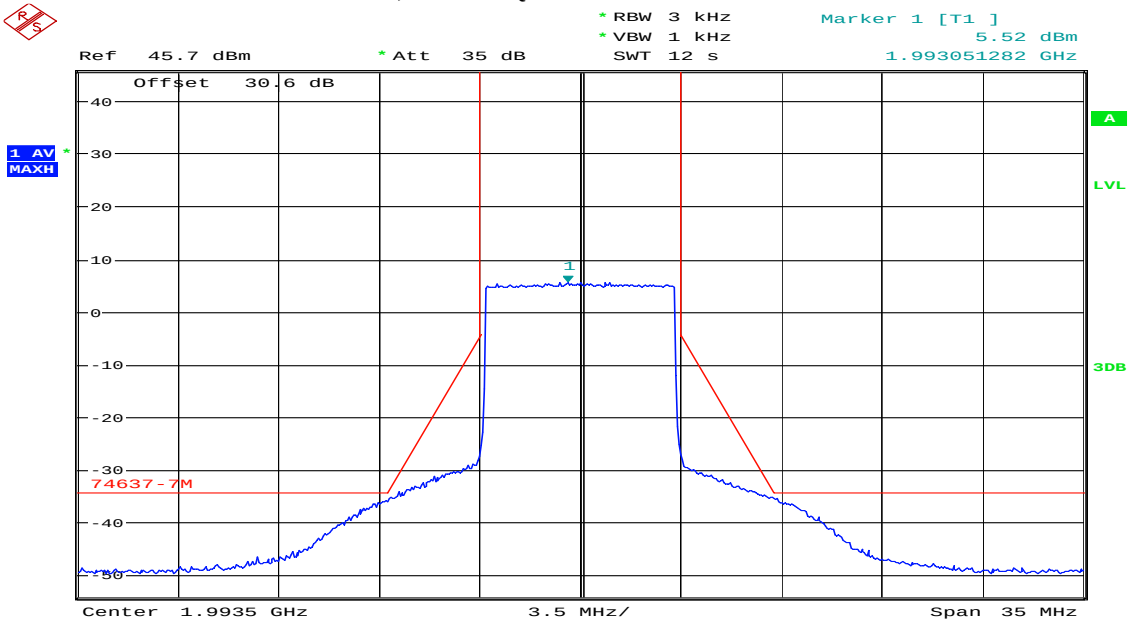
Measurement was done using the emission mask for using transmissions employing digital modulation techniques:

Plot 37: Emission mask 1993 MHz, 6 MHz / QPSK



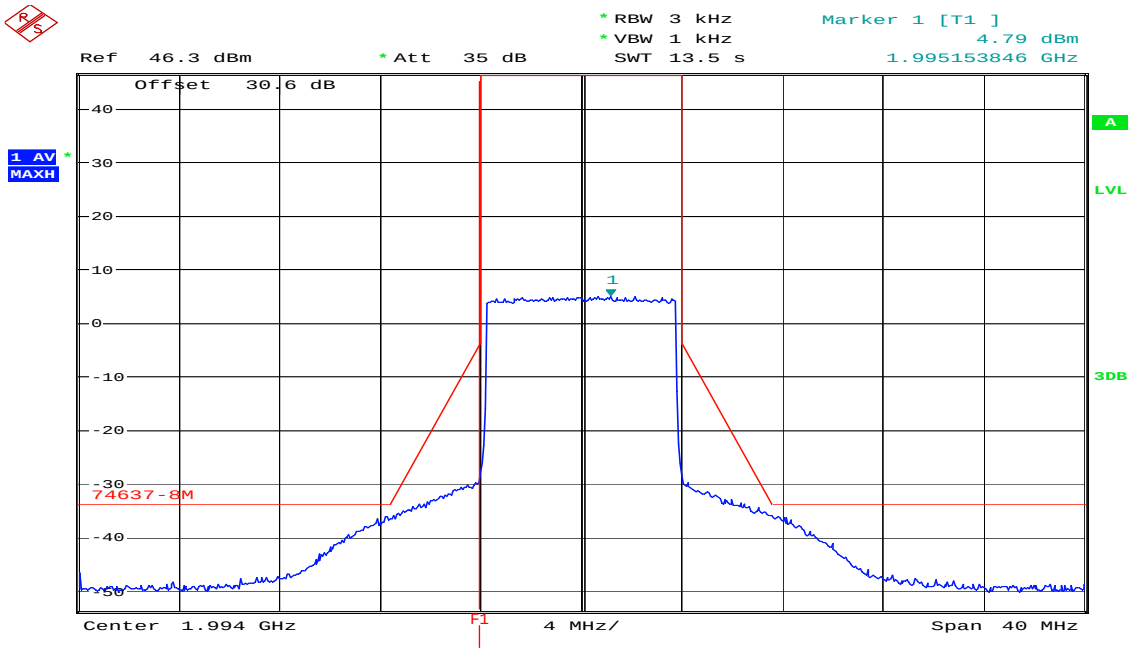

8UFCFH_1826C
Date: 21.JUN.2010 13:29:30

Plot 38: Emission mask 1993.5 MHz, 7 MHz / QPSK



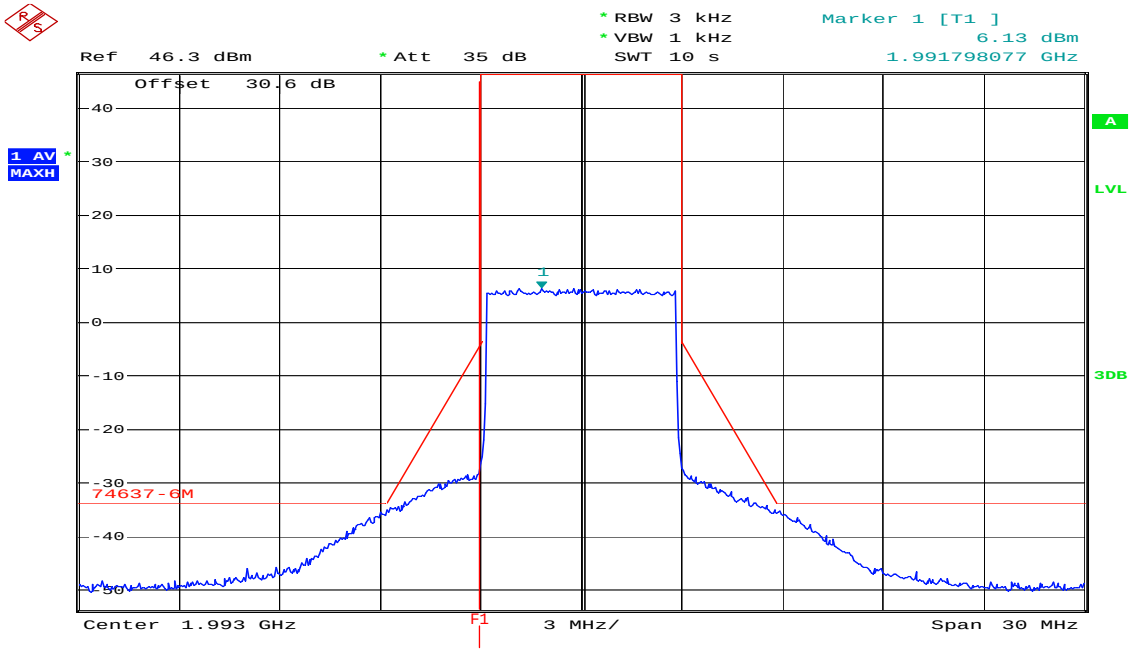

8UFCFH_1826C
Date: 22.JUN.2010 14:48:12

Plot 39: Emission mask 1994 MHz, 8 MHz / QPSK



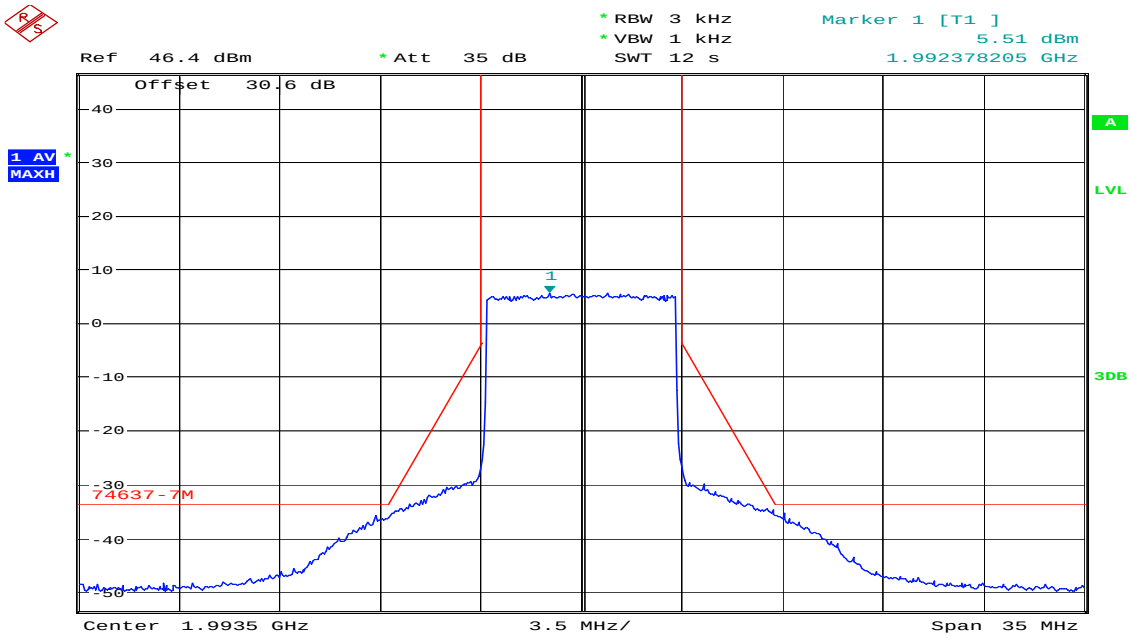

8UFCFH_1826C
Date: 21.JUN.2010 13:08:29

Plot 40: Emission mask 1993 MHz, 6 MHz / 16QAM



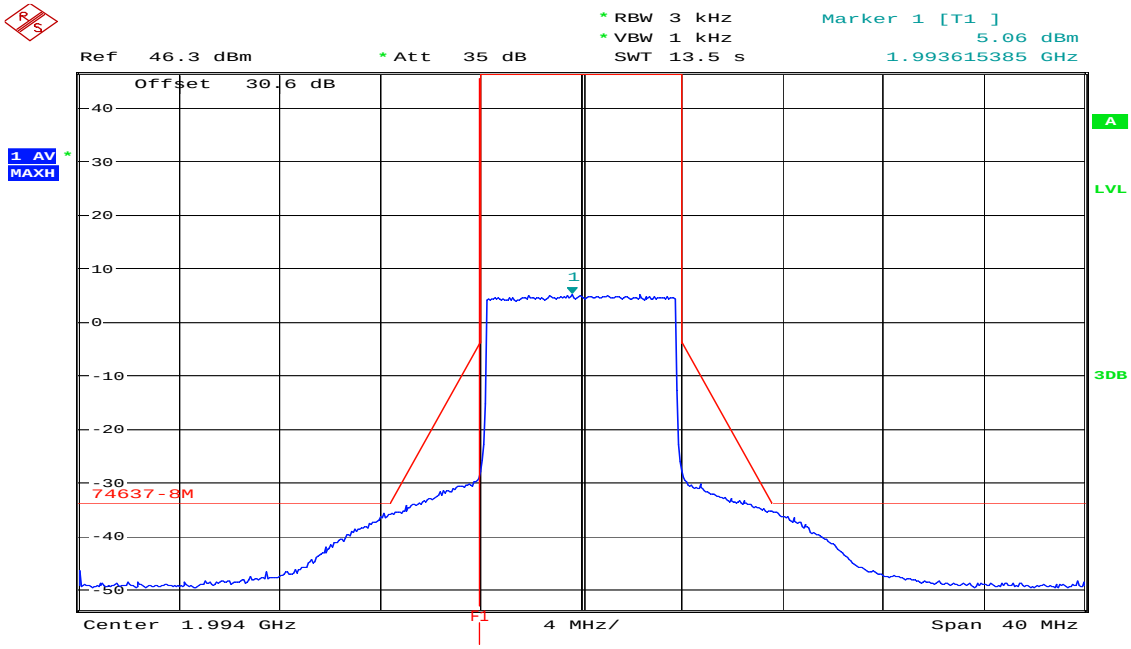

8UFCFH_1826C
Date: 22.JUN.2010 14:39:29

Plot 41: Emission mask 1993.5 MHz, 7 MHz / 16QAM



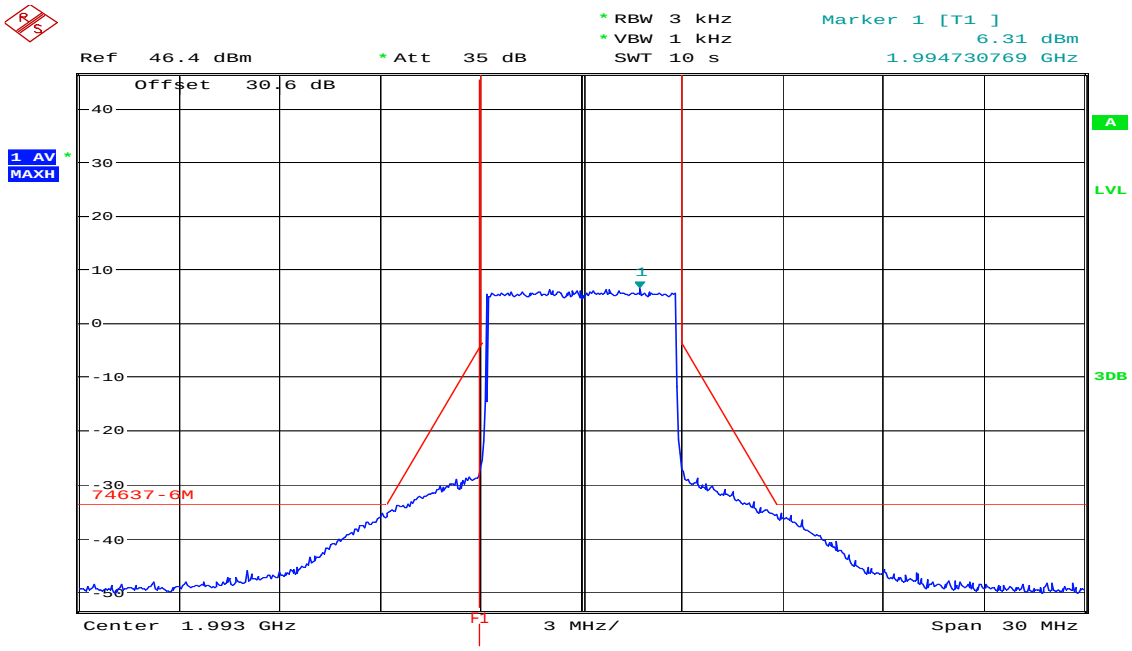

8UFCFH_1826C
Date: 22.JUN.2010 14:50:19

Plot 42: Emission mask 1994 MHz, 8 MHz / 16QAM



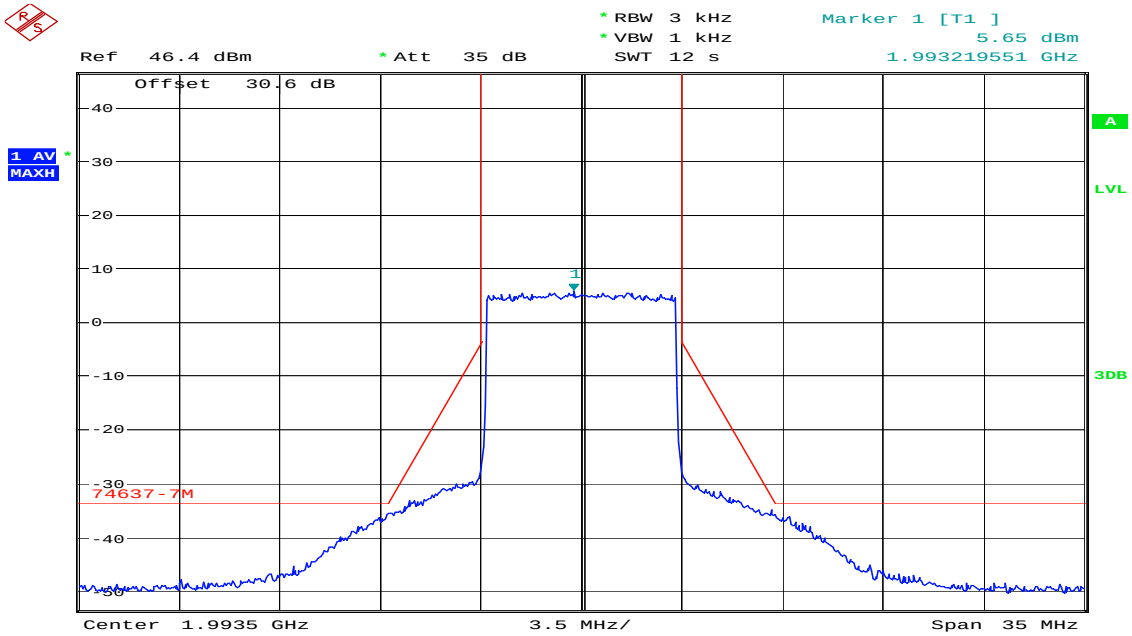

8UFCFH_1826C
Date: 21.JUN.2010 13:12:34

Plot 43: Emission mask 1993 MHz, 6 MHz / 64QAM



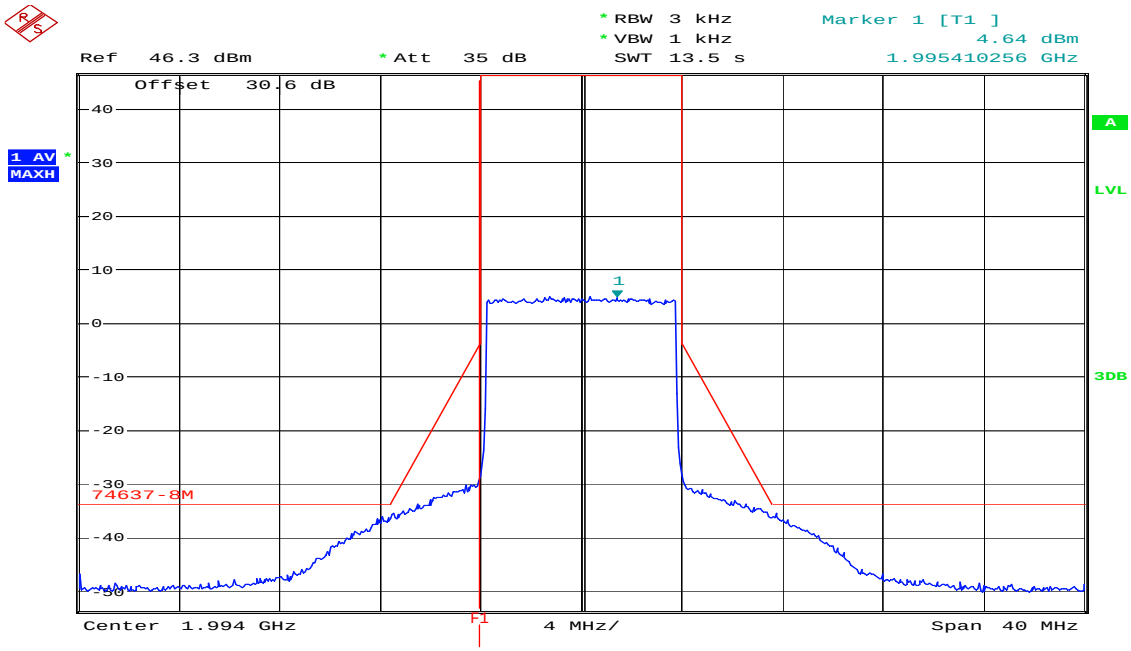

8UFCFH_1826C
Date: 22.JUN.2010 14:40:17

Plot 44: Emission mask 1993.5 MHz, 7 MHz / 64QAM



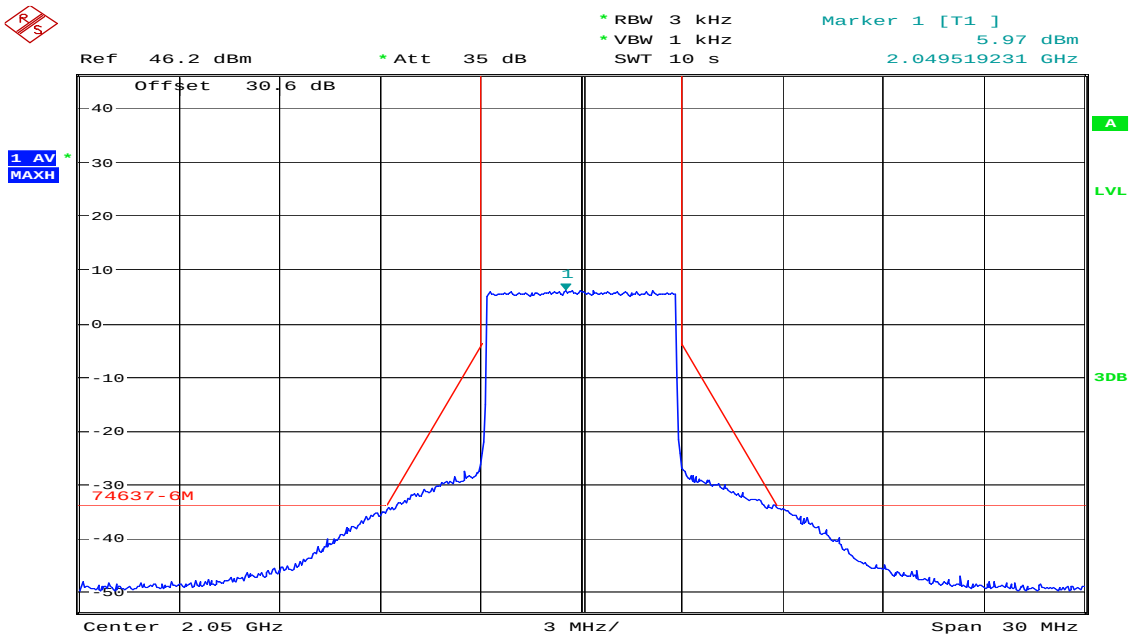

8UFCFH_1826C
Date: 22.JUN.2010 14:50:58

Plot 45: Emission mask 1994 MHz, 8 MHz / 64QAM



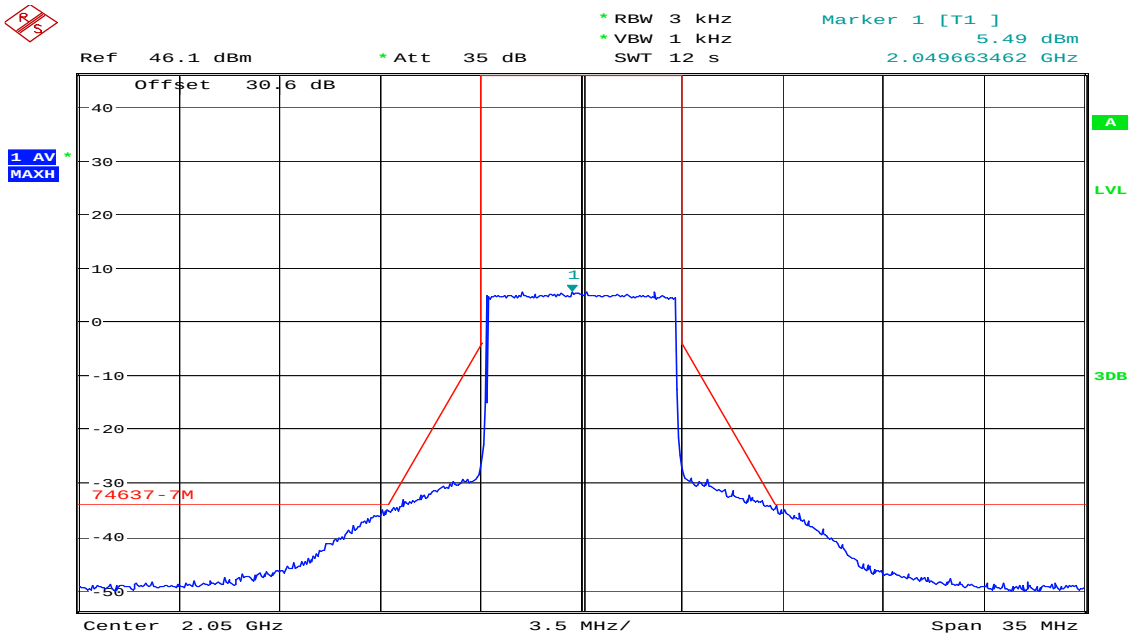

8UFCFH_1826C
Date: 21.JUN.2010 13:13:43

Plot 46: Emission mask 2050 MHz, 6 MHz / QPSK



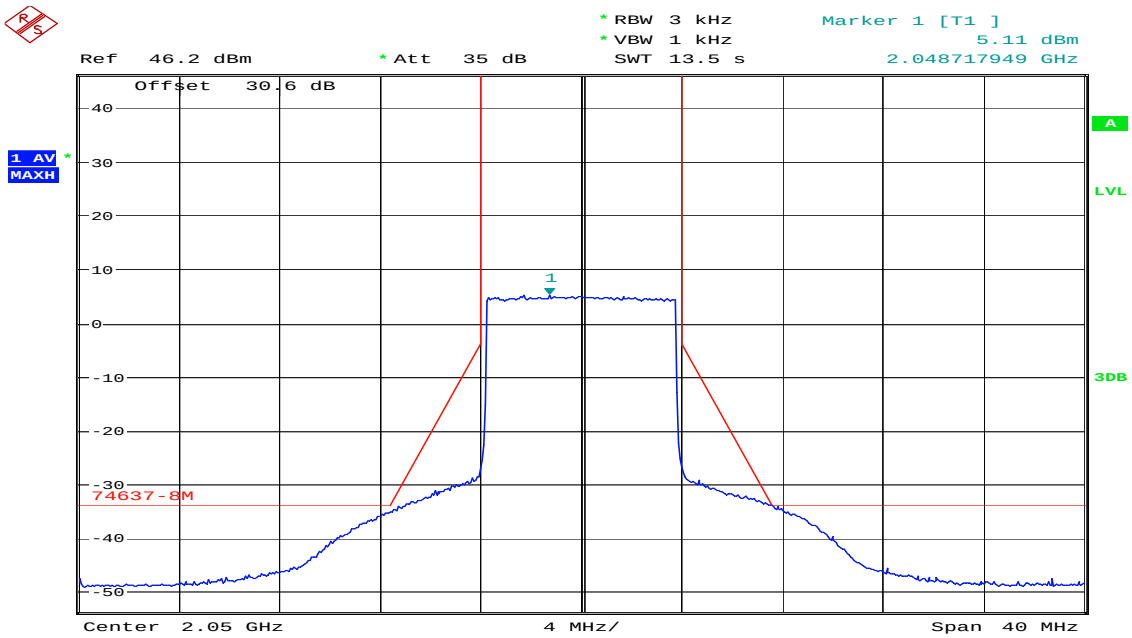

8UFCFH_1826C
Date: 21.JUN.2010 13:31:15

Plot 47: Emission mask 2050 MHz, 7 MHz / QPSK



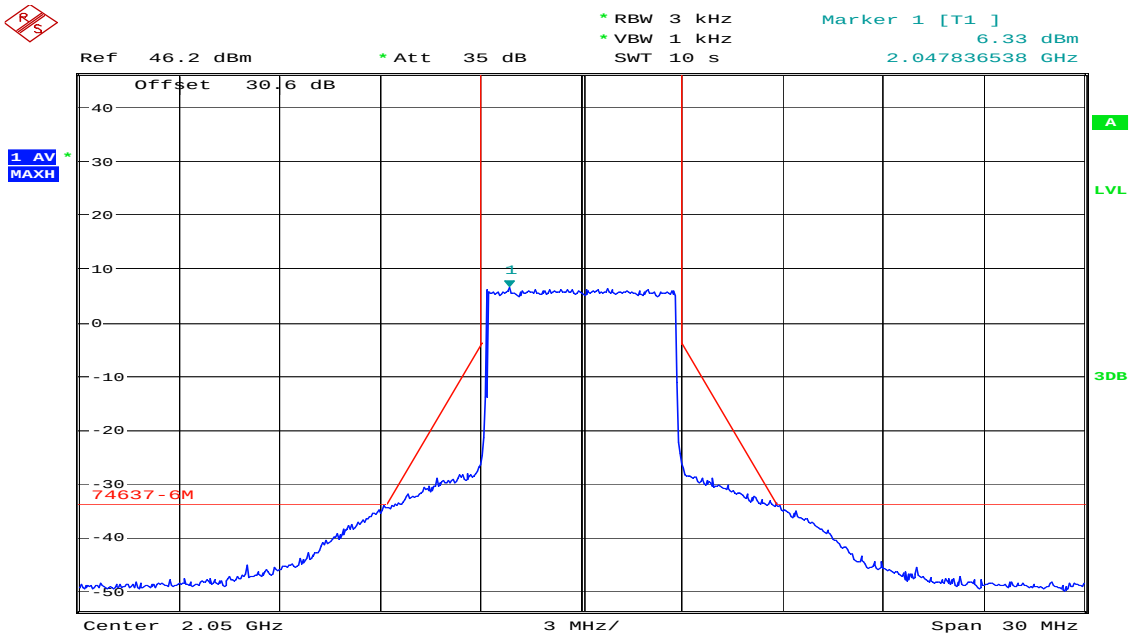

8UFCFH_1826C
Date: 22.JUN.2010 14:52:28

Plot 48: Emission mask 2050 MHz, 8 MHz / QPSK



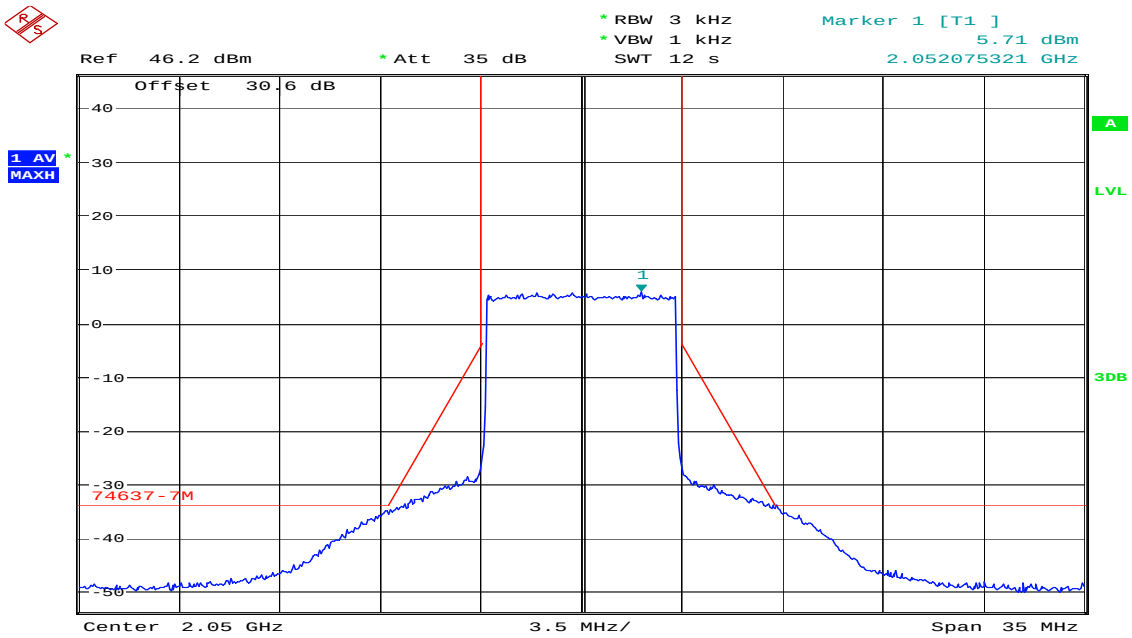

8UFCFH_1826C
Date: 21.JUN.2010 11:39:45

Plot 49: Emission mask 2050 MHz, 6 MHz / 16QAM



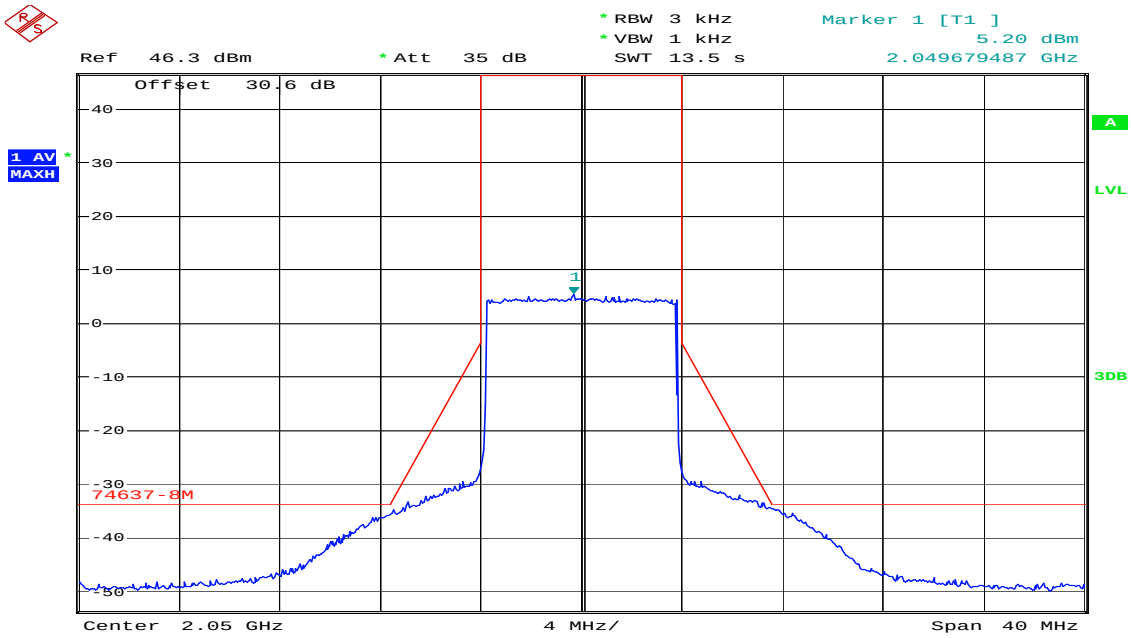

8UFCFH_1826C
Date: 22.JUN.2010 14:42:36

Plot 50: Emission mask 2050 MHz, 7 MHz / 16QAM



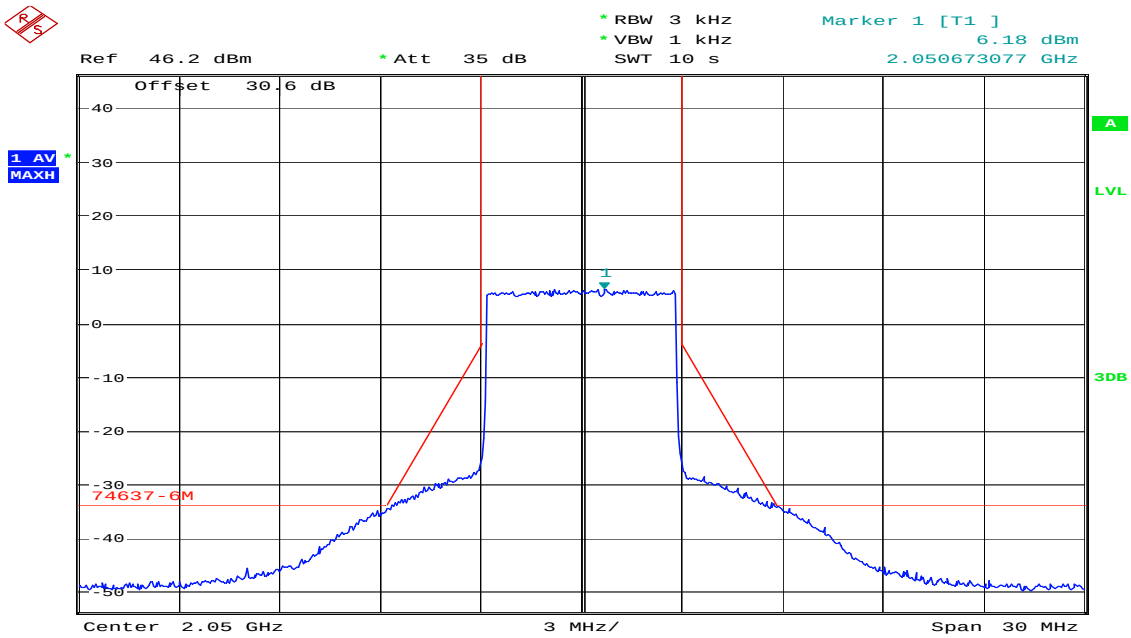

8UFCFH_1826C
Date: 22.JUN.2010 14:53:28

Plot 51: Emission mask 2050 MHz, 8 MHz / 16QAM



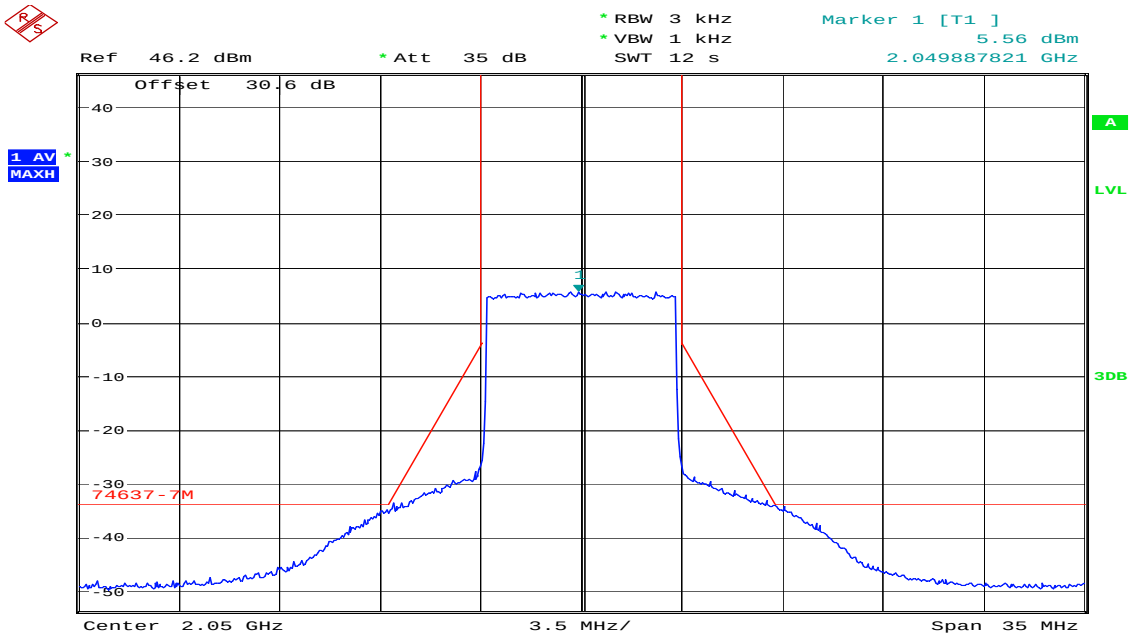

8UFCFH_1826C
Date: 21.JUN.2010 13:15:51

Plot 52: Emission mask 2050 MHz, 6 MHz / 64QAM



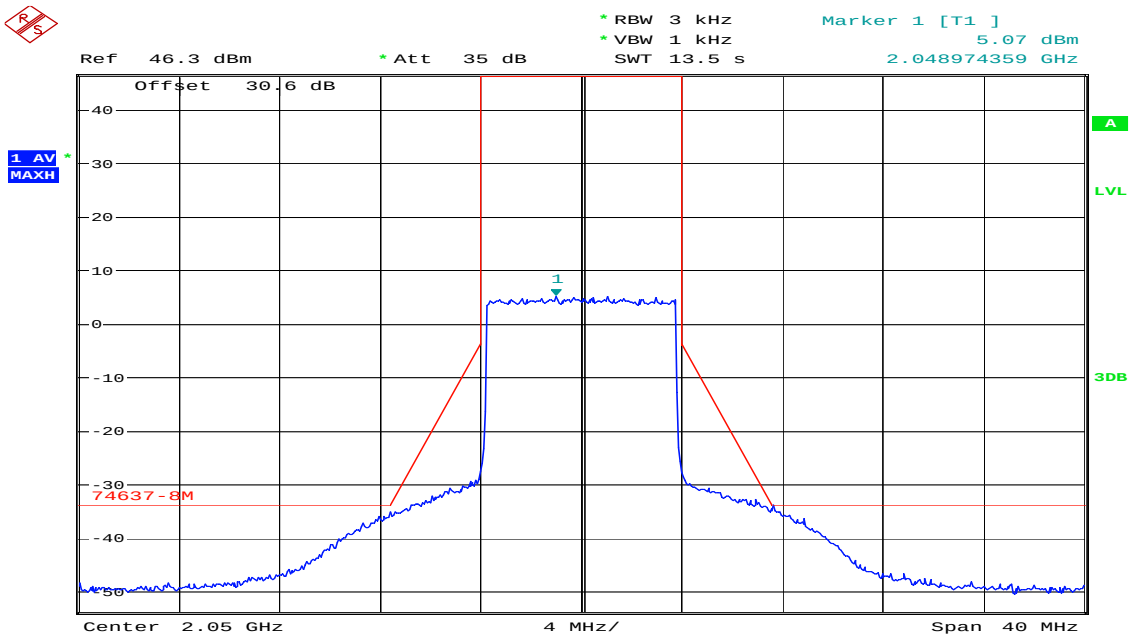

8UFCFH_1826C
Date: 22.JUN.2010 14:41:36

Plot 53: Emission mask 2050 MHz, 7 MHz / 64QAM



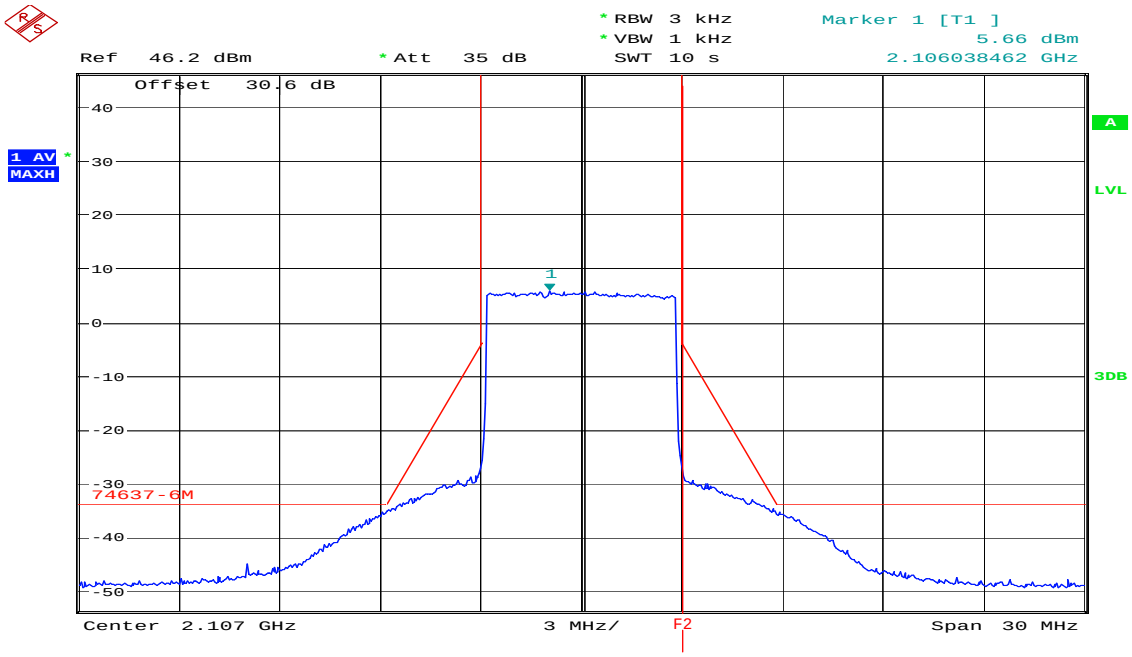

8UFCFH_1826C
Date: 22.JUN.2010 14:54:56

Plot 54: Emission mask 2050 MHz, 8 MHz / 64QAM



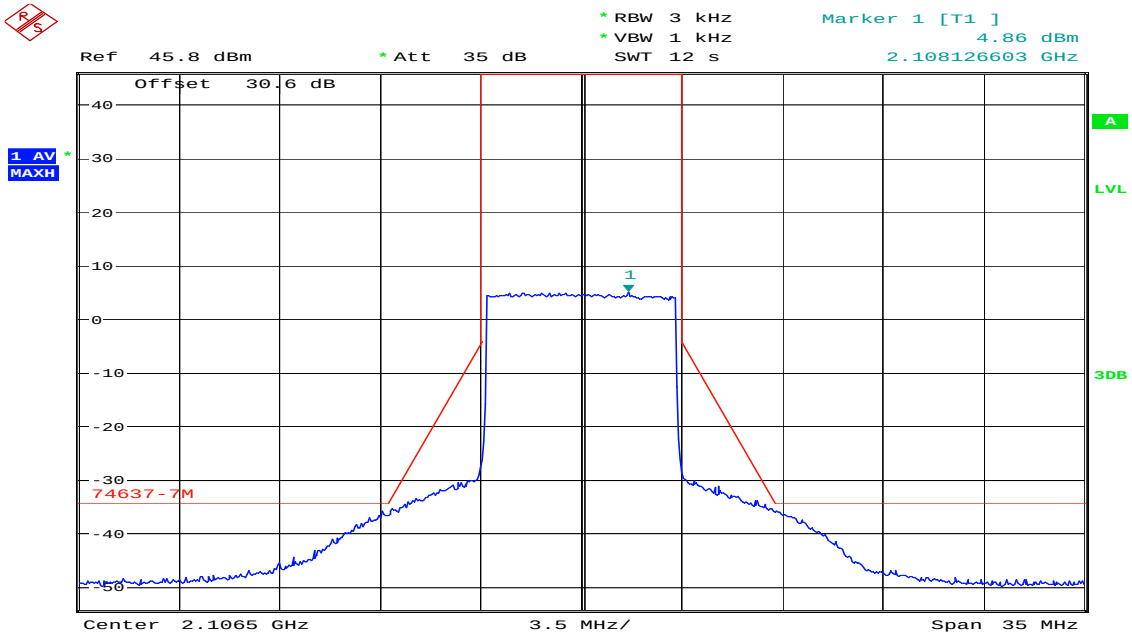

8UFCFH_1826C
Date: 21.JUN.2010 13:14:46

Plot 55: Emission mask 2107 MHz, 6 MHz / QPSK



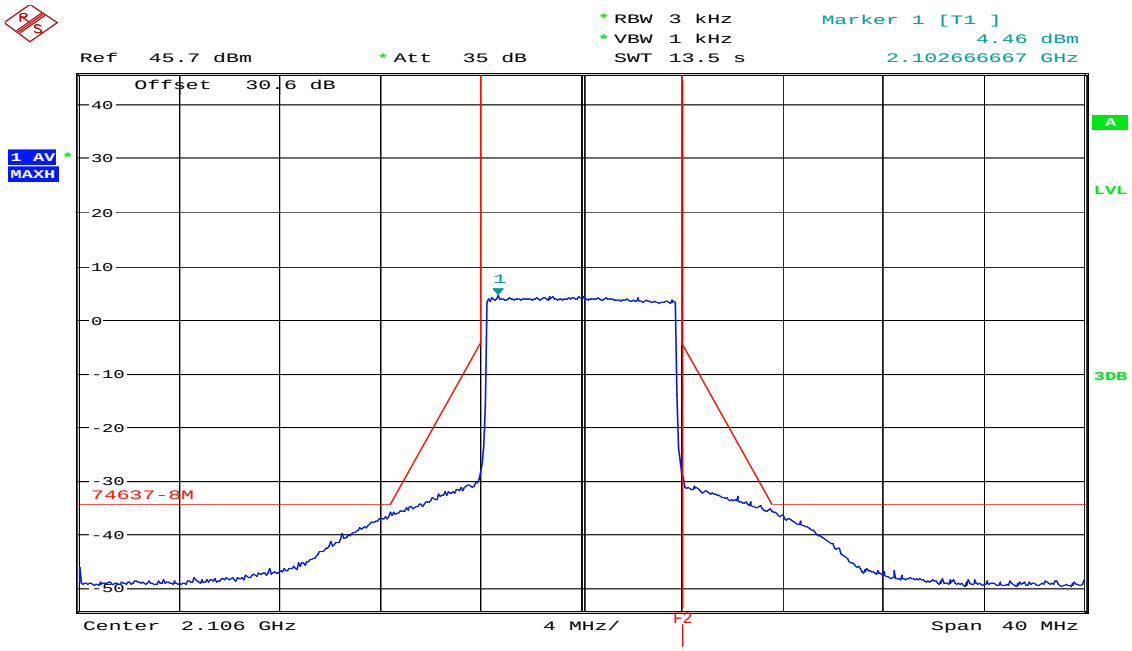

8UFCFH_1826C
Date: 21.JUN.2010 13:33:55

Plot 56: Emission mask 2106.5 MHz, 7 MHz / QPSK



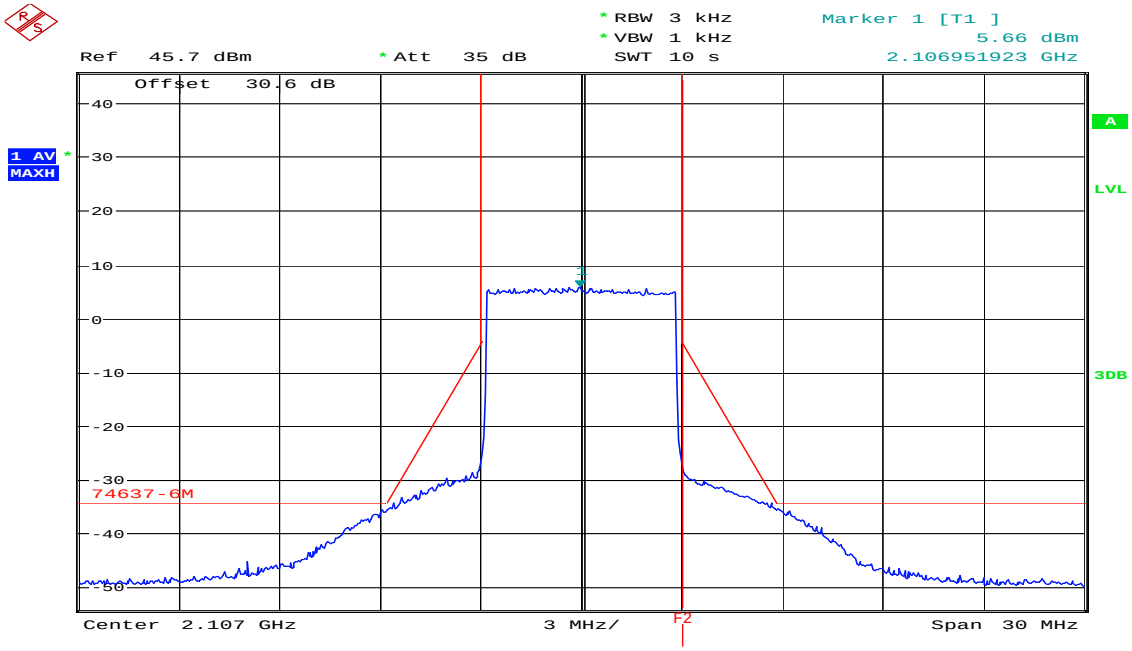

8UFCFH_1826C
Date: 22.JUN.2010 15:00:50

Plot 57: Emission mask 2106 MHz, 8 MHz / QPSK



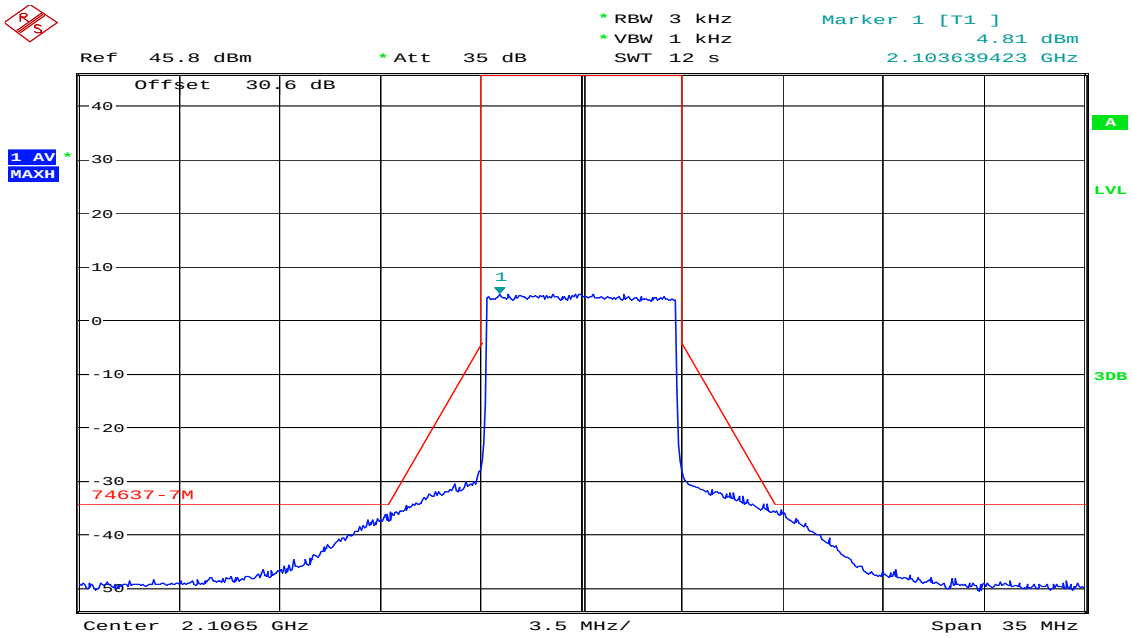

8UFCFH_1826C
Date: 21.JUN.2010 13:07:16

Plot 58: Emission mask 2107 MHz, 6 MHz / 16QAM



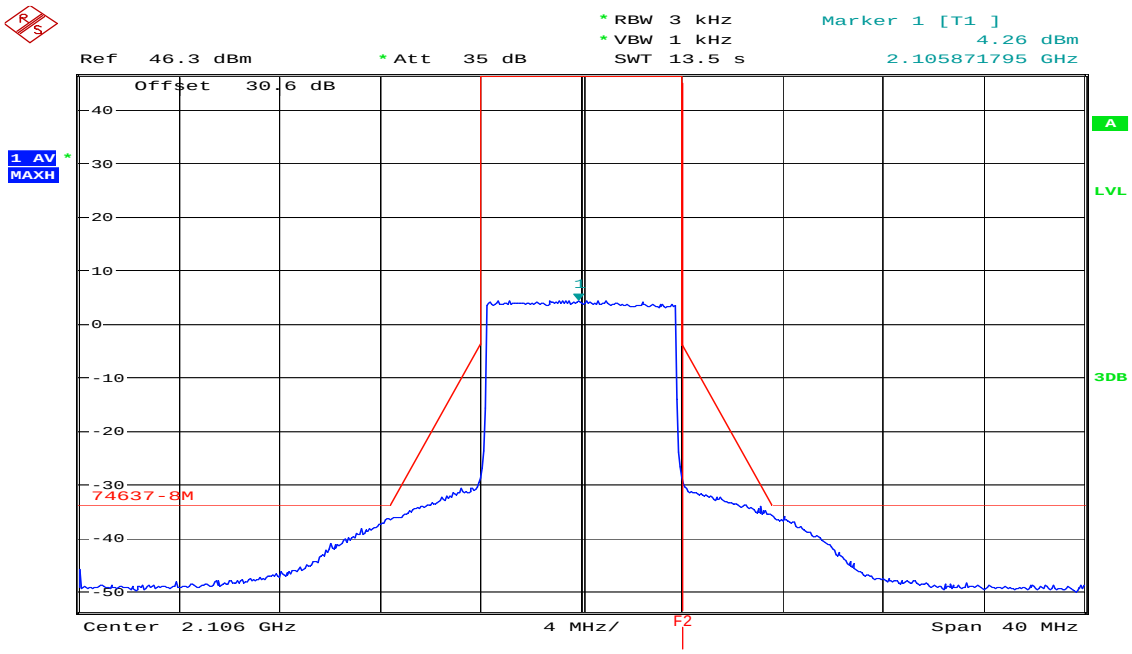

8UFCFH_1826C
Date: 22.JUN.2010 14:43:54

Plot 59: Emission mask 2106.5 MHz, 7 MHz / 16QAM



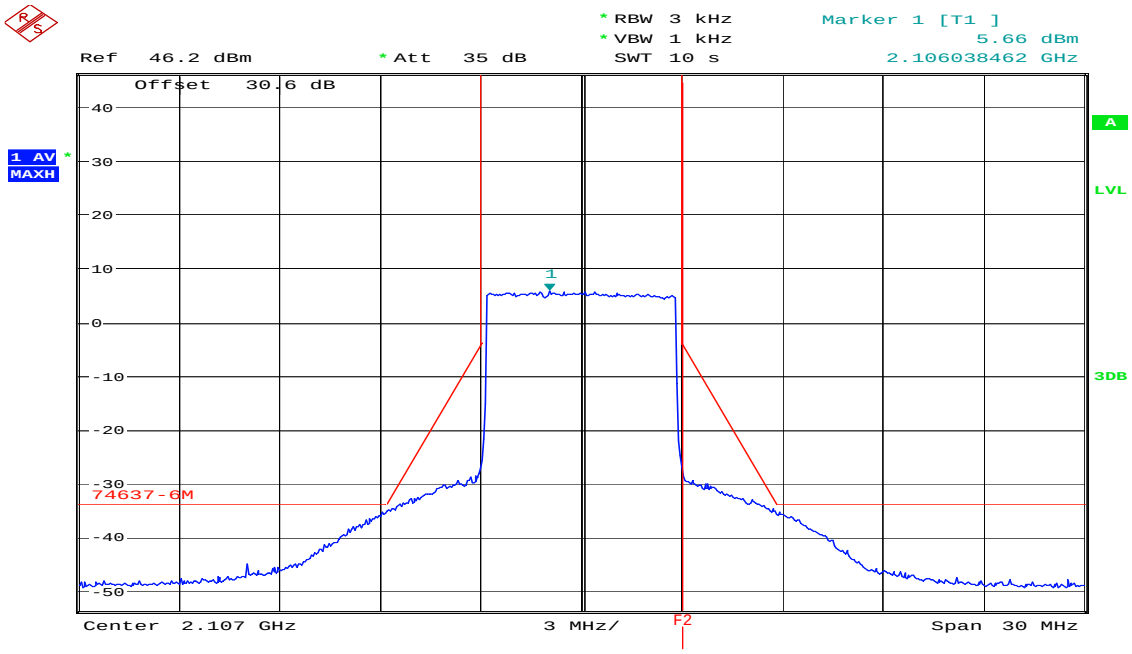

8UFCFH_1826C
Date: 22.JUN.2010 15:01:32

Plot 60: Emission mask 2106 MHz, 8 MHz / 16QAM



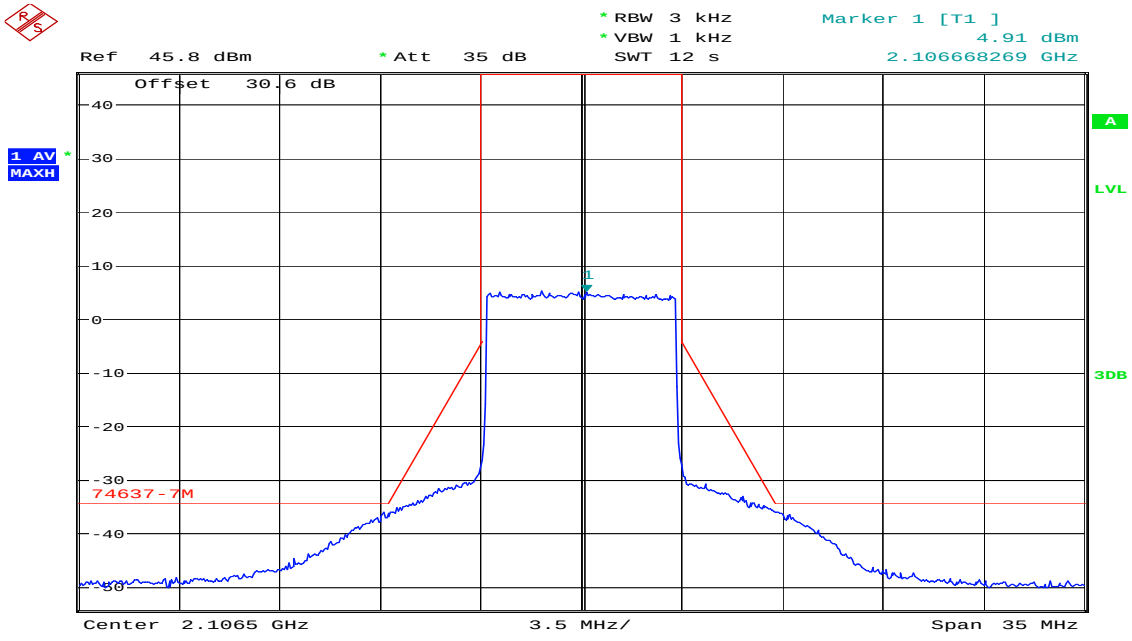

8UFCFH_1826C
Date: 21.JUN.2010 13:17:34

Plot 61: Emission mask 2107 MHz, 6 MHz / 64QAM



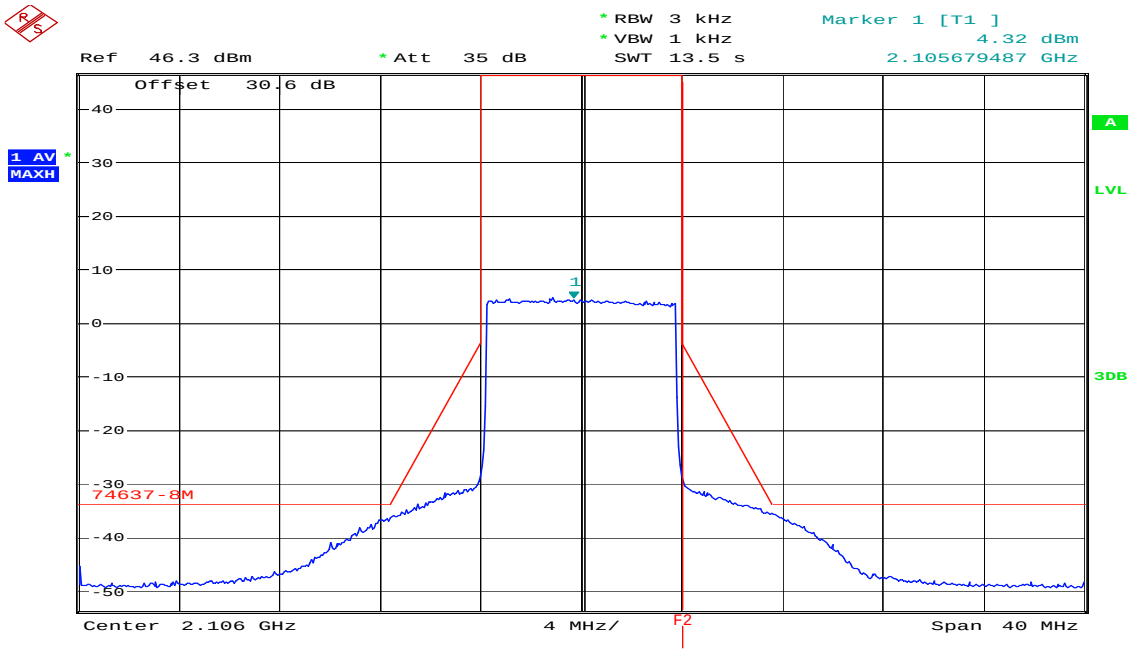

8UFCFH_1826C
Date: 21.JUN.2010 13:33:55

Plot 62: Emission mask 2106.5 MHz, 7 MHz / 64QAM




8UFCFH_1826C
Date: 22.JUN.2010 15:02:24

Plot 63: Emission mask 2106 MHz, 8 MHz / 64QAM




Remark:
Frequency lines F1 and F2 show the lower resp. upper band edge of the used frequency band.

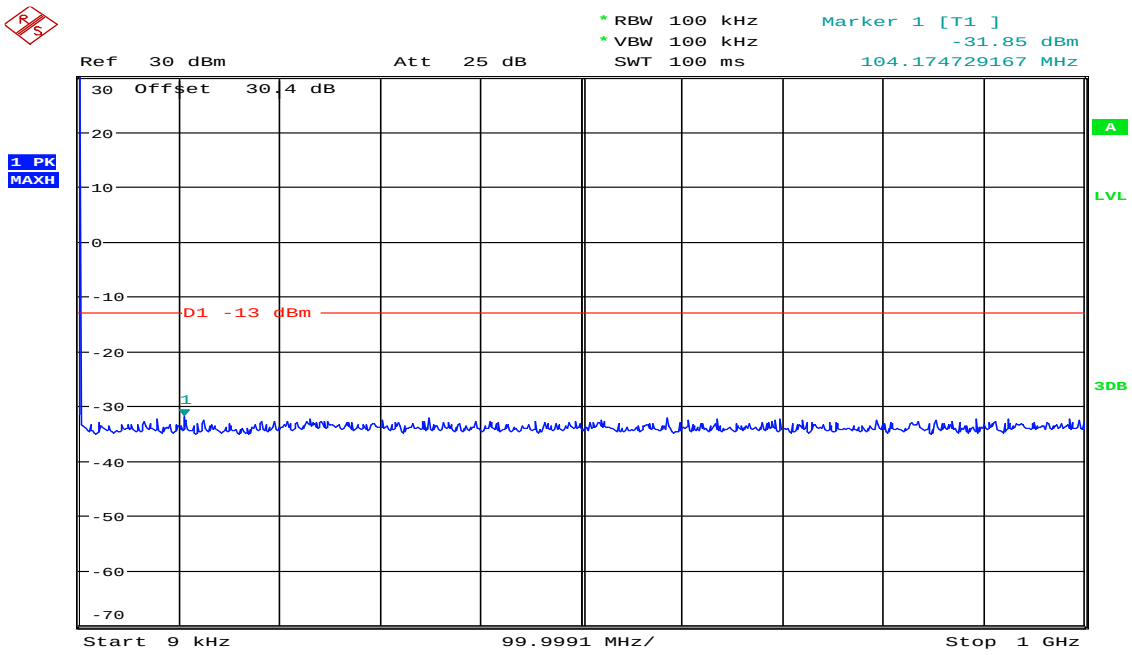
Limit according to §74.637(a)(2)(ii):

| | |
|---|---|
| Under normal test conditions only | The mean power of emissions shall be attenuated below the mean transmitter power ($P_{MEAN}$) in accordance with the following schedule:<br>When using transmissions employing digital modulation techniques: For operating frequencies below 15 GHz, in any 4 kHz reference bandwidth ($B_{REF}$), the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 50 decibels:<br><br>$A = 35 + 0.8\ (G - 50) + 10\ Log_{10}\ B$<br>Attenuation greater than 80 decibels is not required. |

**Test Result: passed**

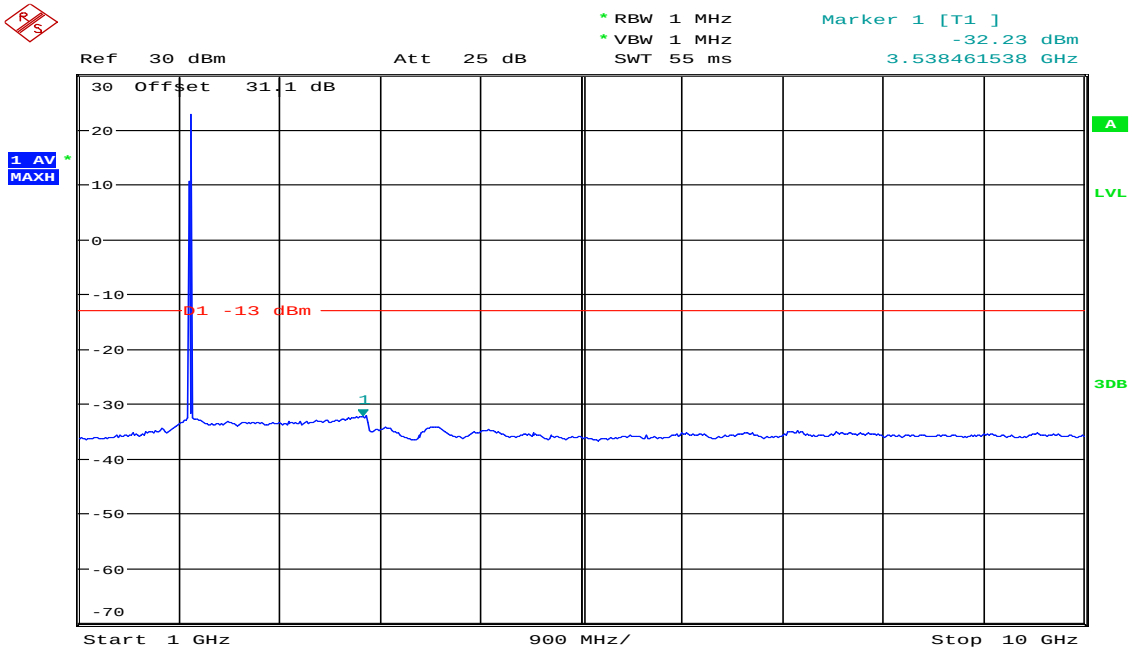
## 4.8 Spurious emissions (conducted) §2.1051 / §74.637(a)(2)

Plot 64: 9 kHz - 1 GHz (1994 MHz)



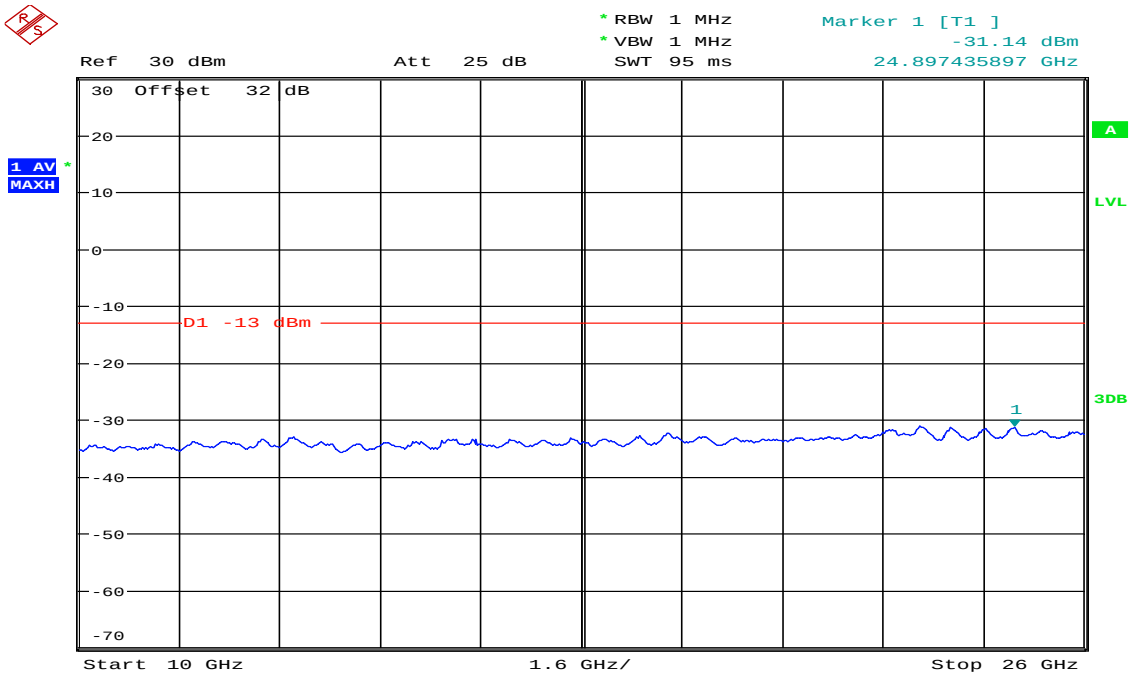

Date: 26.AUG.2010 16:02:40

Plot 65: 1 GHz - 10 GHz (1994 MHz)



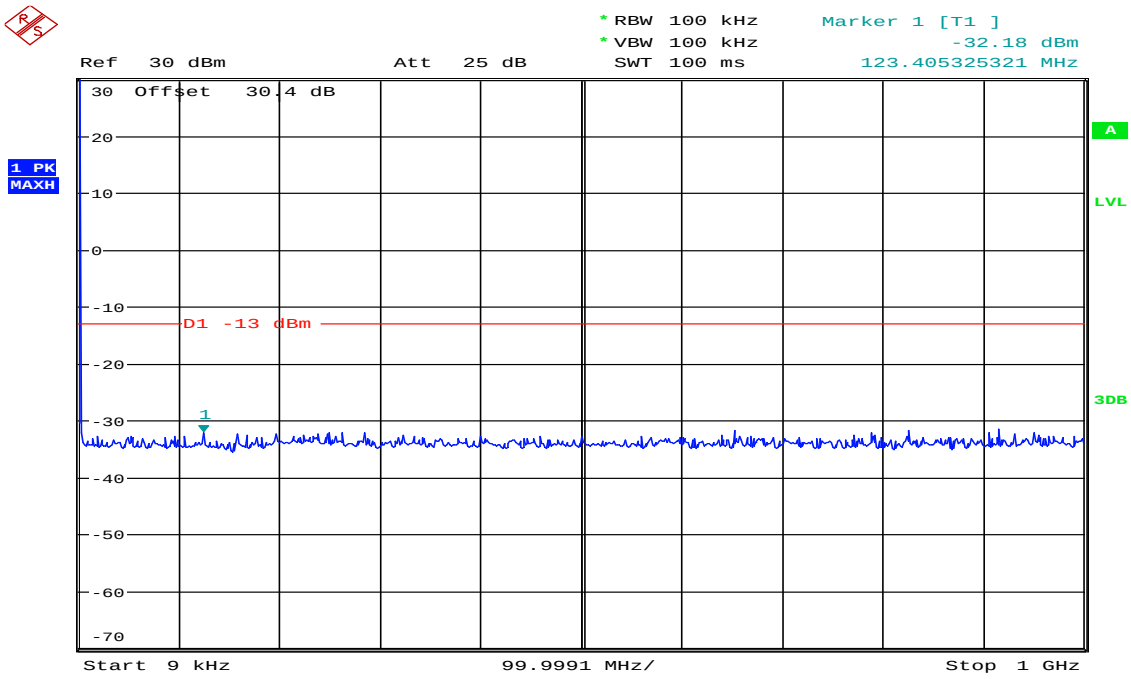

Date: 26.AUG.2010 16:01:19

Plot 66: 10 GHz - 26 GHz (1994 MHz)



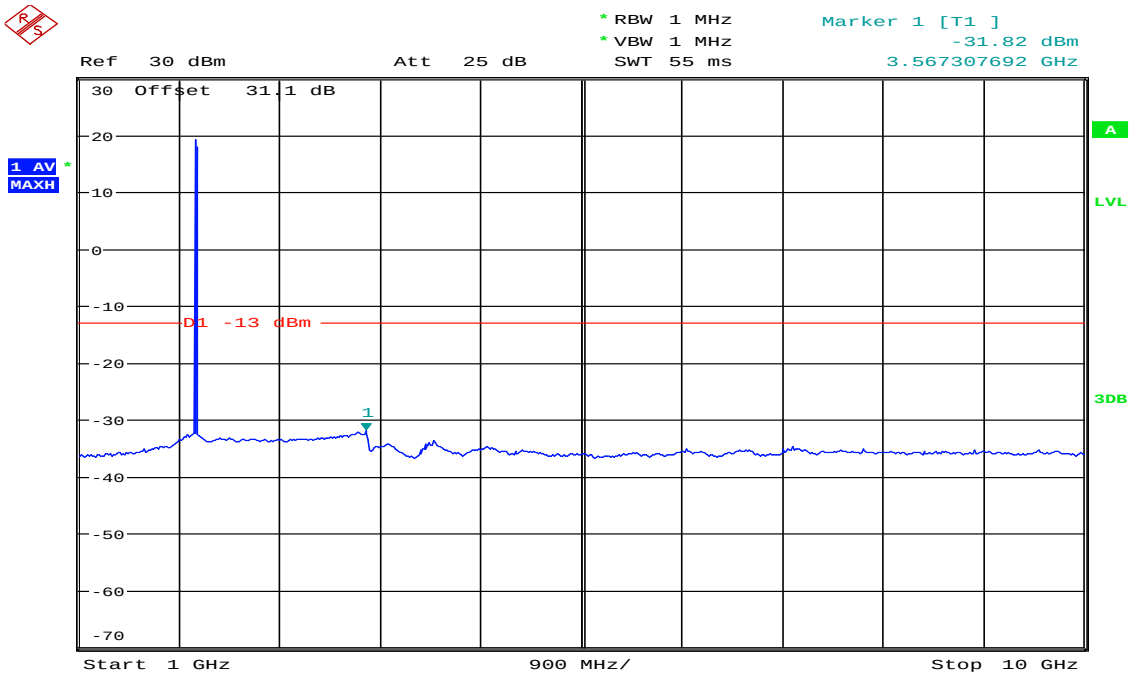

Date: 26.AUG.2010 15:57:56

Plot 67: 9 kHz - 1 GHz (2050 MHz)



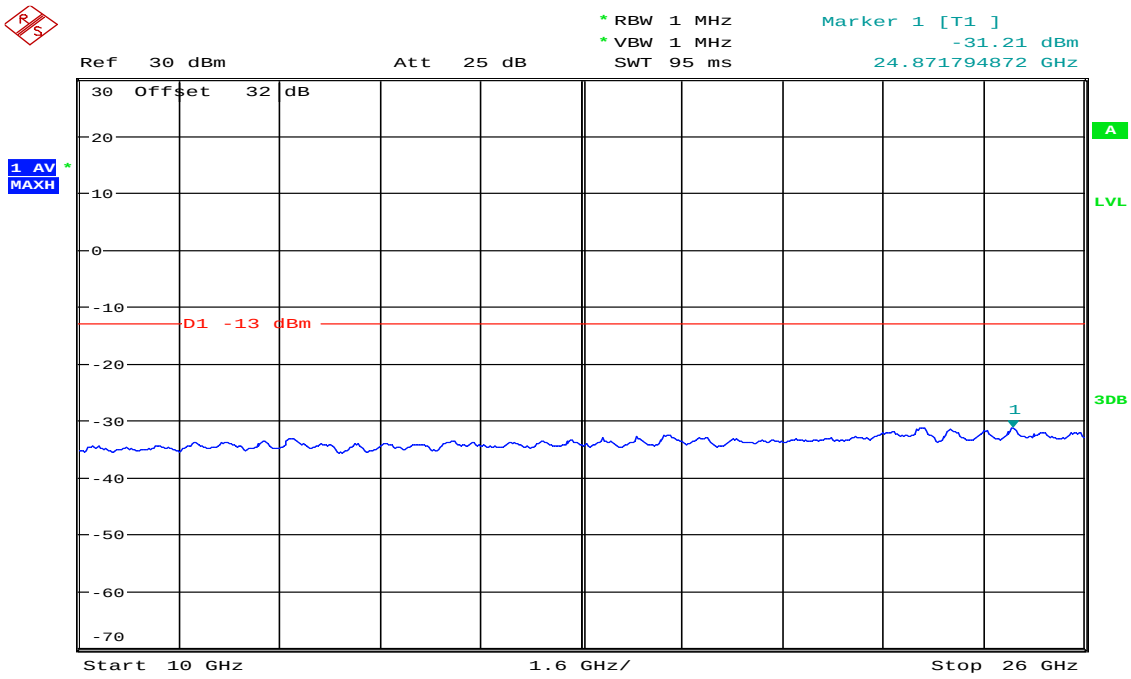

Date: 26.AUG.2010 16:03:14

Plot 68: 1 GHz - 10 GHz (2050 MHz)



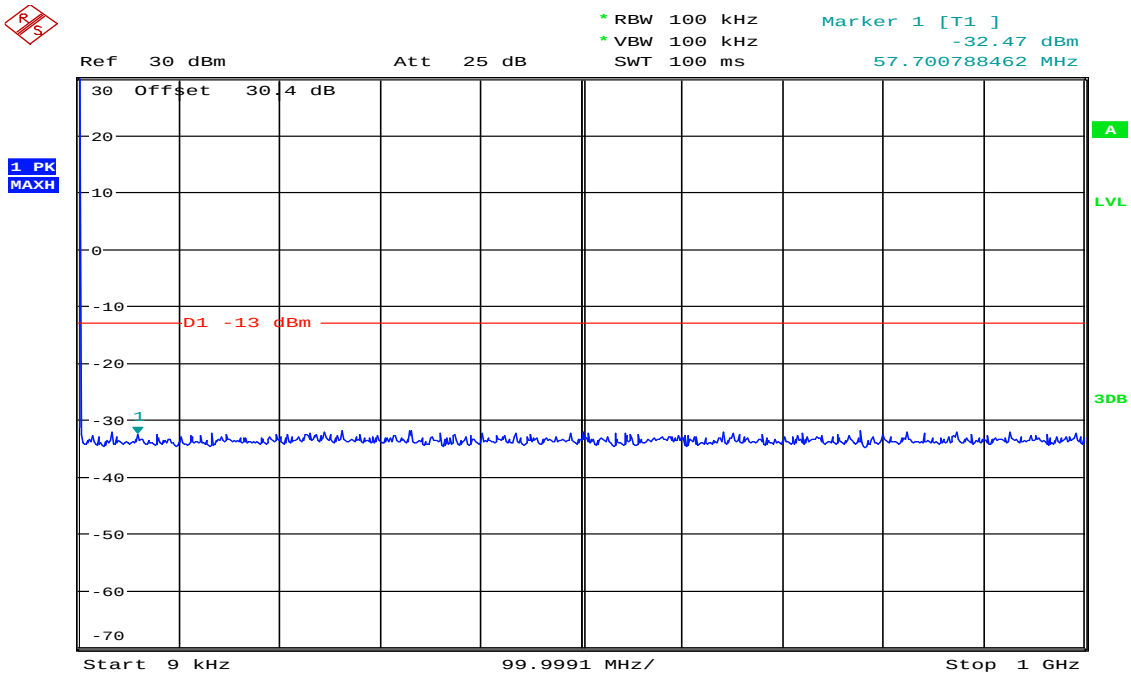

Date: 26.AUG.2010 16:00:40

Plot 69: 10 GHz - 26 GHz (2050 MHz)



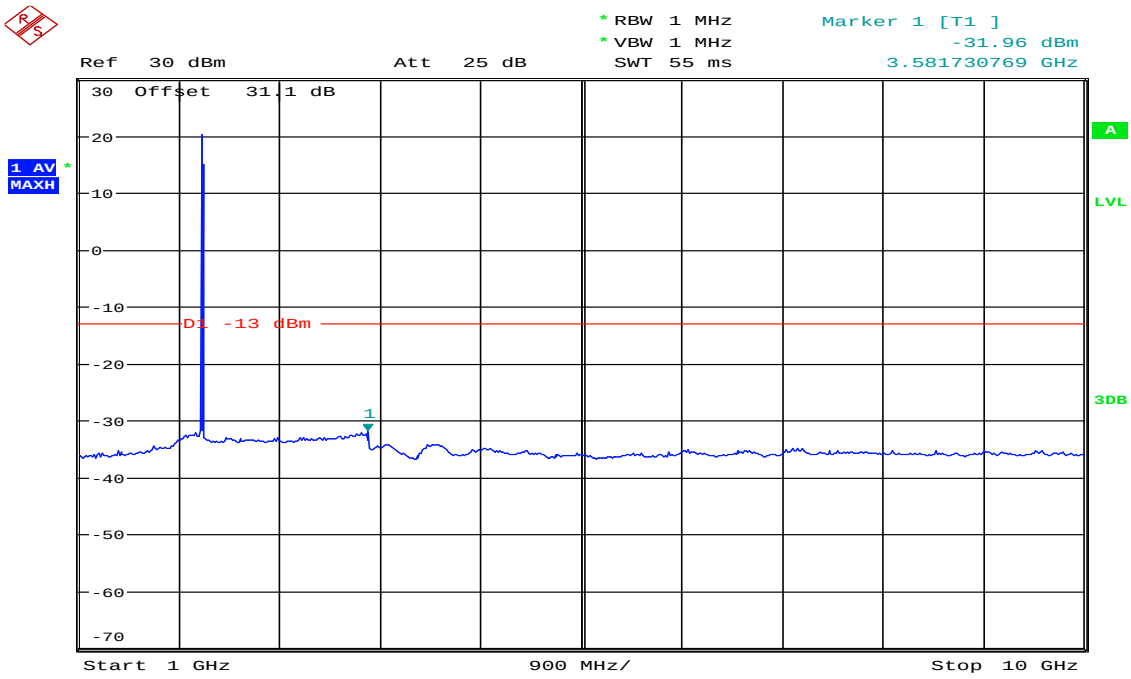

Date: 26.AUG.2010 15:58:23

Plot 70: 9 kHz - 1 GHz (2106 MHz)



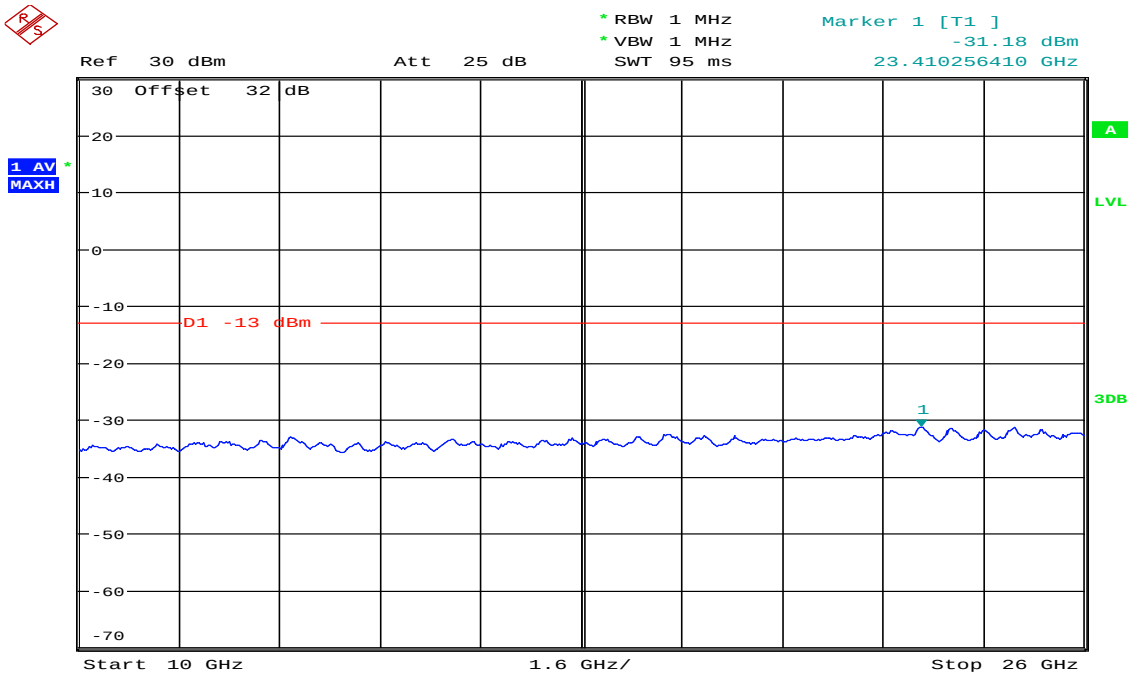

Date: 26.AUG.2010 16:04:18

Plot 71: 1 GHz - 10 GHz (2106 MHz)




Date: 26.AUG.2010 16:00:05

Plot 72: 10 GHz - 26 GHz (2106 MHz)




| SPURIOUS EMISSIONS LEVEL (dBm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1994 MHz | | | 2050 MHz | | | 2106 MHz | | |
| F [MHz] | Detector | Level [dBm] | F [MHz] | Detector | Level [dBm] | F [MHz] | Detector | Level [dBm] |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Measurement uncertainty | | | ±3 dB | | | | | |

**RBW: 100 kHz/1MHz VBW: 100 kHz/1MHz**

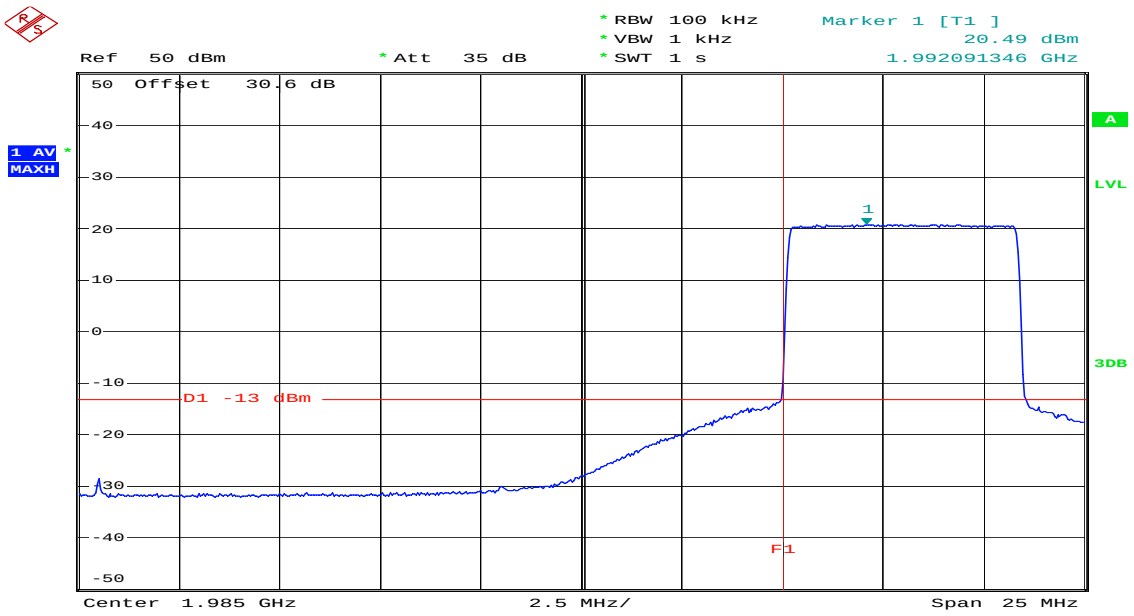
Limit according to §74.637(a)(2)(iii):

| | |
|---|---|
| Under normal test conditions only | The mean power of emissions shall be attenuated below the mean transmitter power ($P_{MEAN}$) in accordance with the following schedule:<br>When using transmissions employing digital modulation techniques: In any 4 kHz reference bandwidth ($B_{REF}$), the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 Log10 ($P_{MEAN}$ in watts) decibels, or 80 decibels, whichever is the lesser attenuation |

**Test Result: passed**

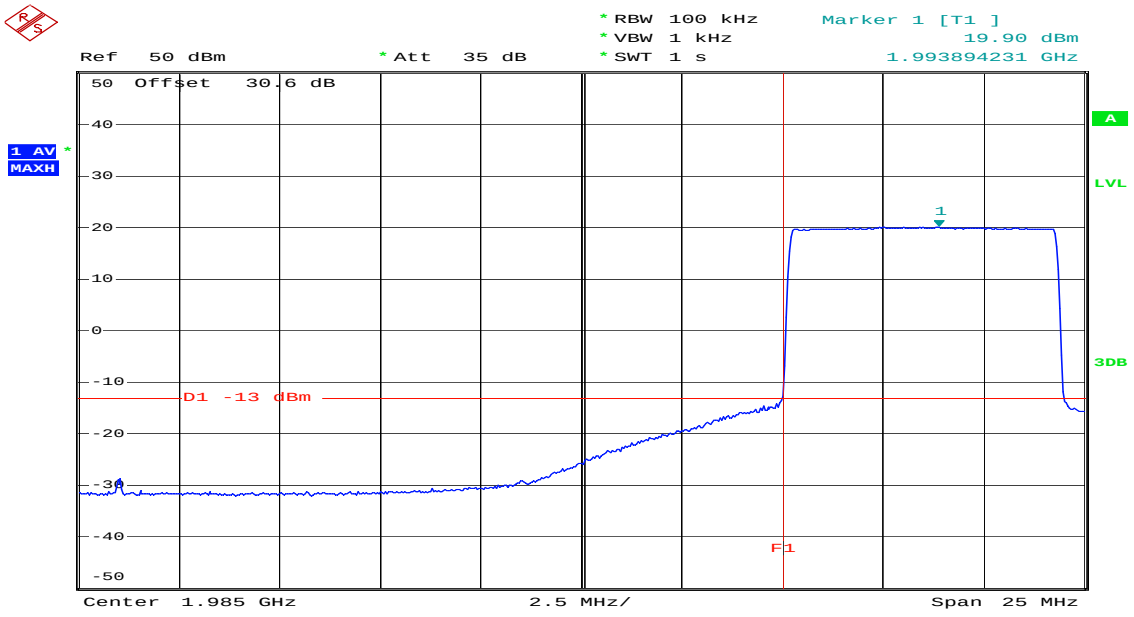
## 4.9 Band-edge compliance §2.1051 / §74.637(a)(2)

Plot 73: Band-edge compliance 6 MHz / QPSK



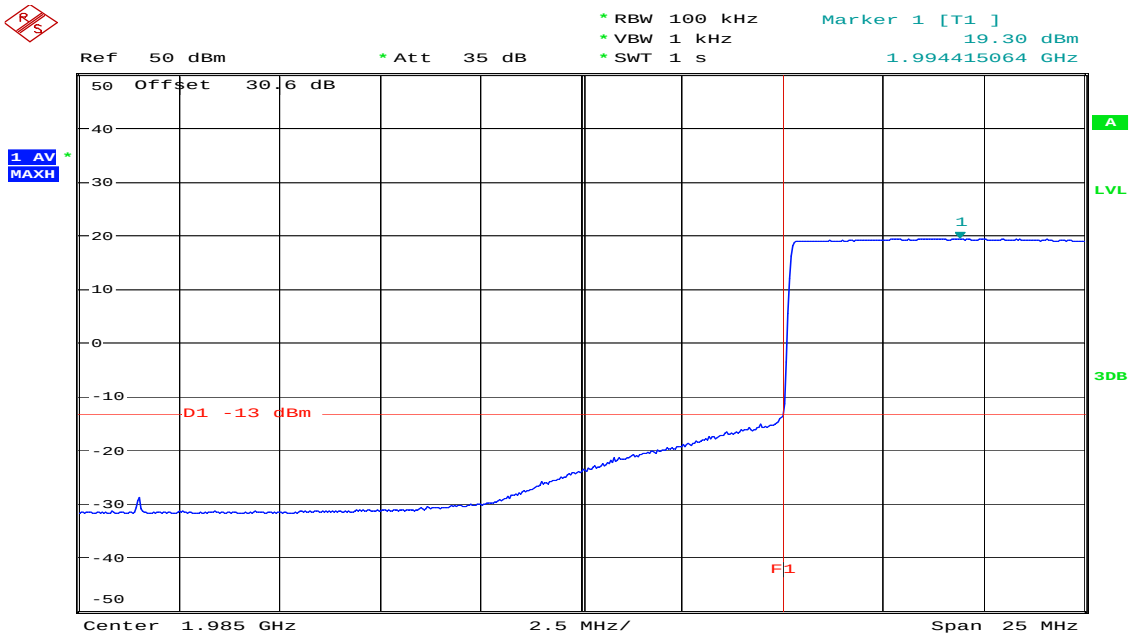

8UFCFH_1826C
Date: 22.JUN.2010 15:25:57

Plot 74: Band-edge compliance 7 MHz / QPSK



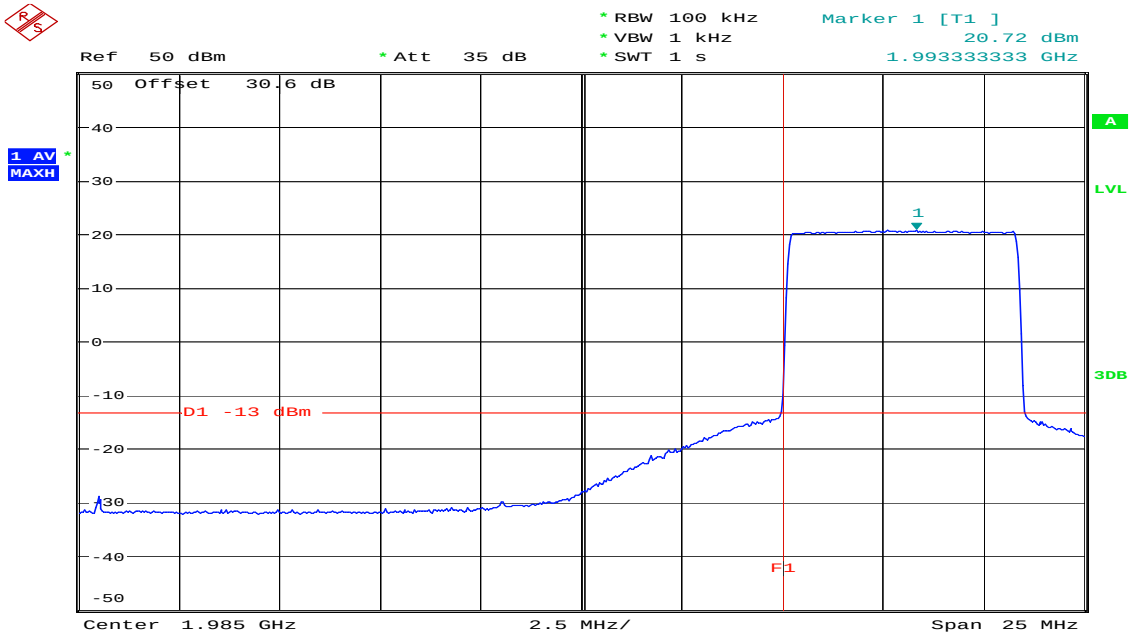

8UFCFH_1826C
Date: 22.JUN.2010 15:27:35

Plot 75: Band-edge compliance 8 MHz / QPSK



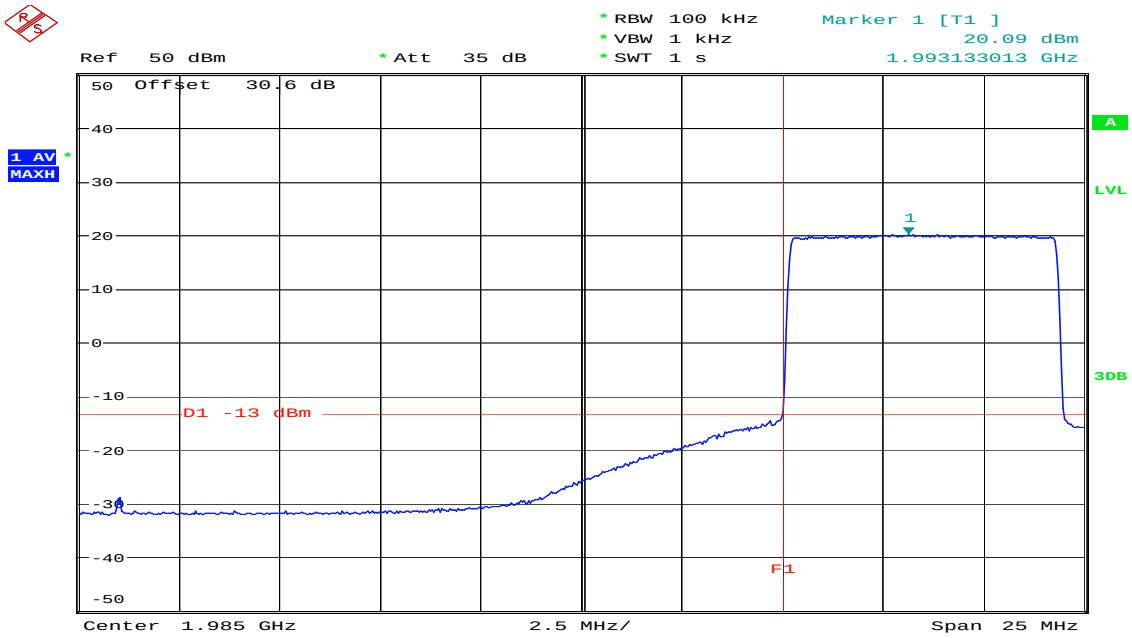

8UFCFH_1826C
Date: 22.JUN.2010 15:36:12

Plot 76: Band-edge compliance 6 MHz / 16QAM



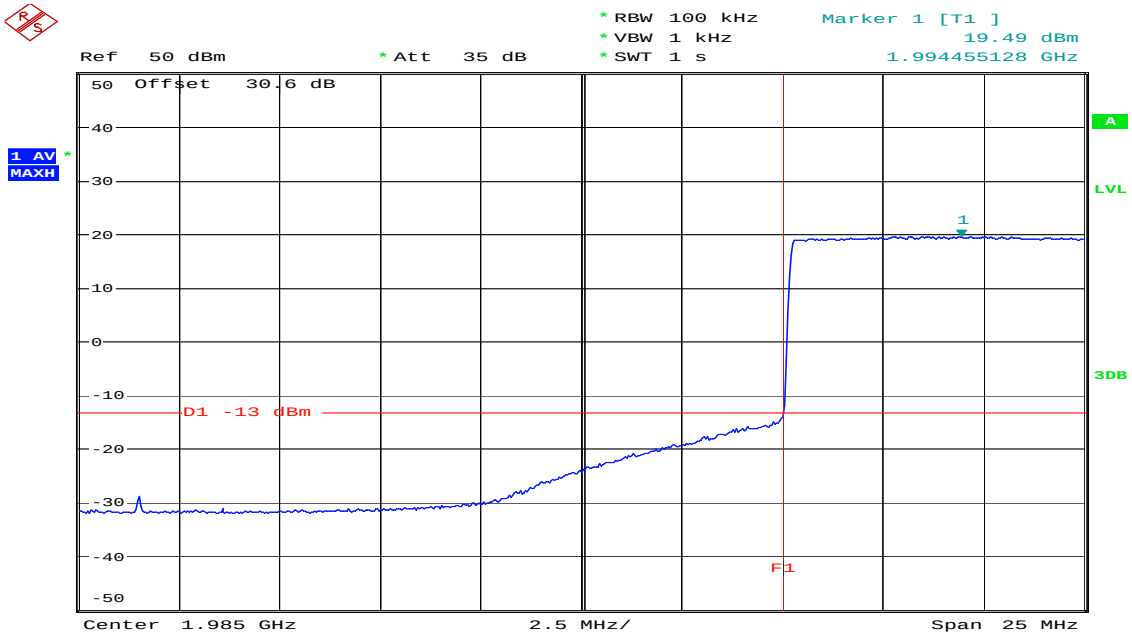

8UFCFH_1826C
Date: 22.JUN.2010 15:26:16

Plot 77: Band-edge compliance 7 MHz / 16QAM



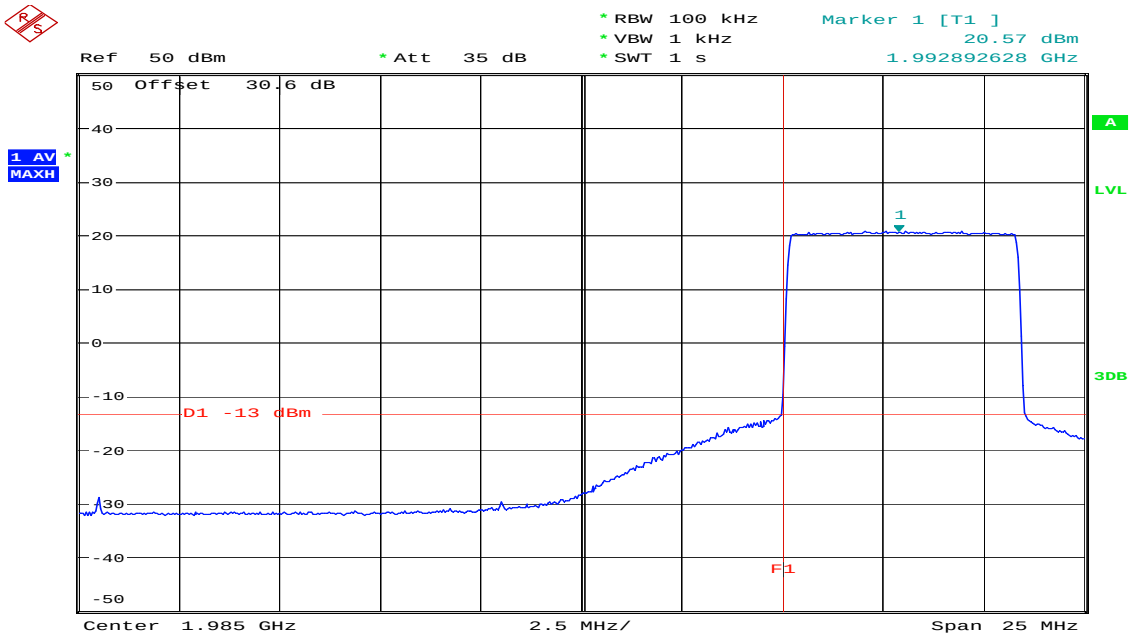

8UFCFH_1826C
Date: 22.JUN.2010 15:27:54

Plot 78: Band-edge compliance 8 MHz / 16QAM



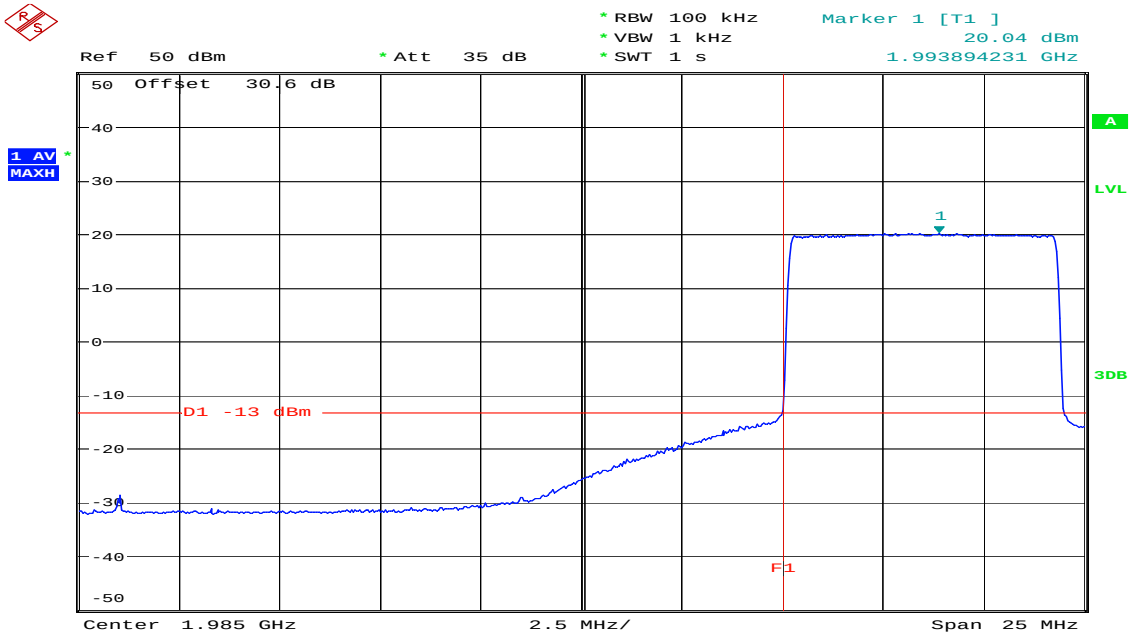

8UFCFH_1826C
Date: 22.JUN.2010 15:36:38

Plot 79: Band-edge compliance 6 MHz / 64QAM



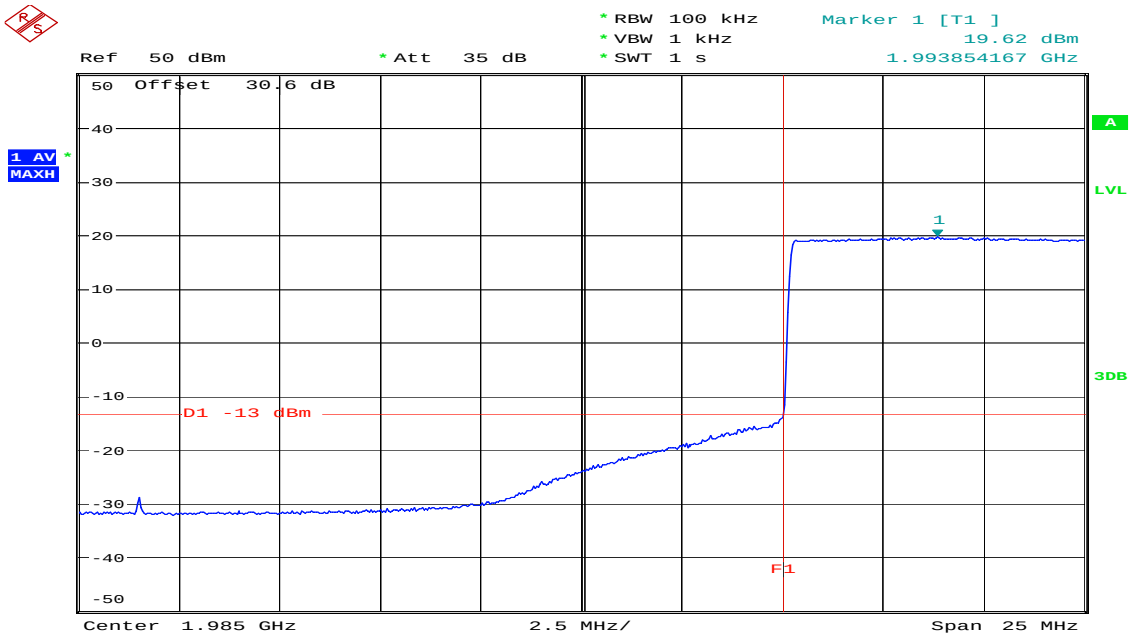

8UFCFH_1826C
Date: 22.JUN.2010 15:26:32

Plot 80: Band-edge compliance 7 MHz / 64QAM



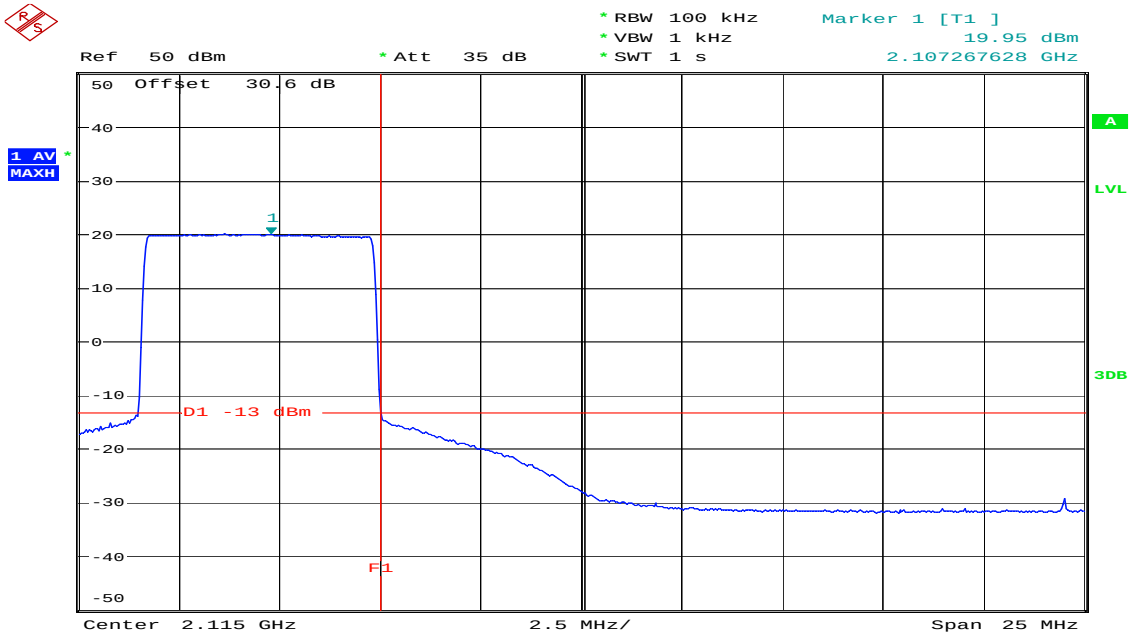

8UFCFH_1826C
Date: 22.JUN.2010 15:35:03

Plot 81: Band-edge compliance 8 MHz / 64QAM



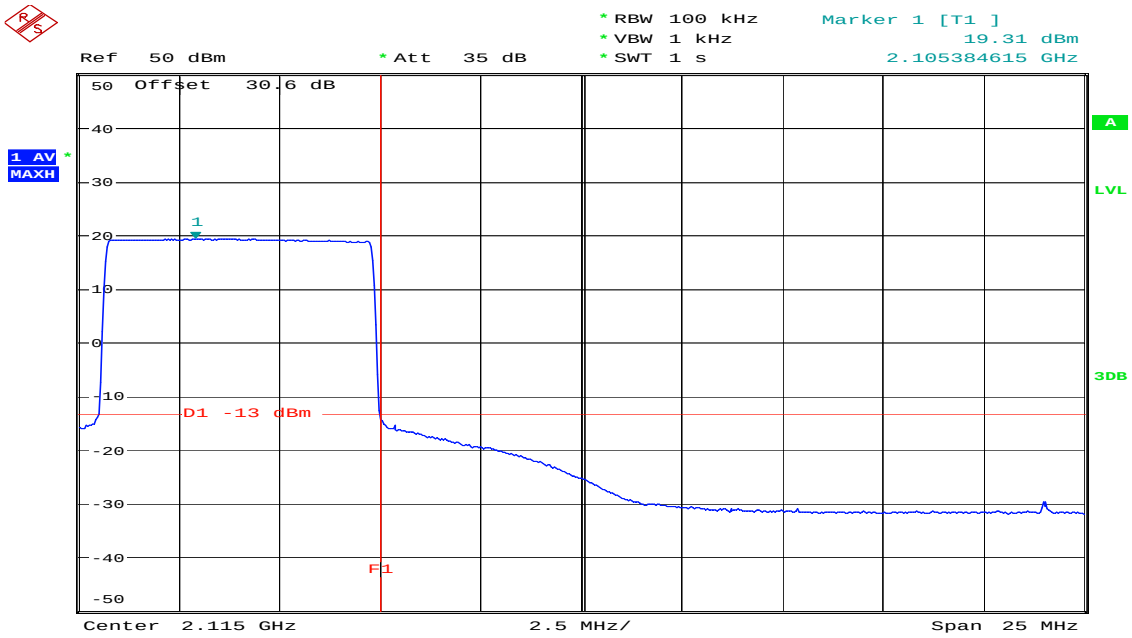

8UFCFH_1826C
Date: 22.JUN.2010 15:37:11

Plot 82: Band-edge compliance 6 MHz / QPSK



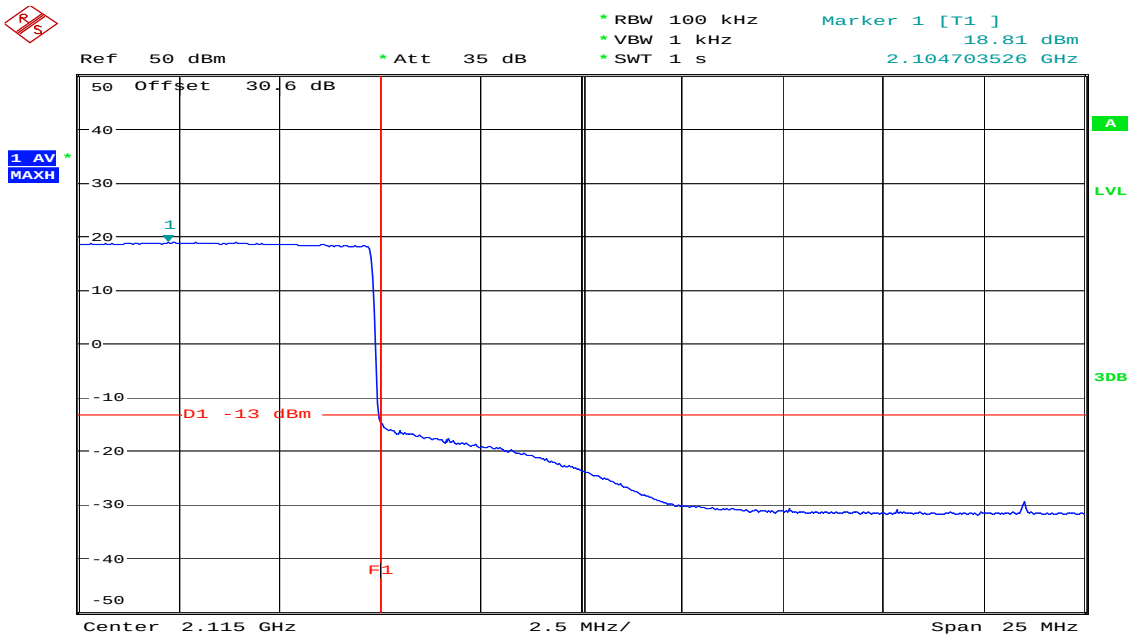

8UFCFH_1826C
Date: 22.JUN.2010 15:38:10

Plot 83: Band-edge compliance 7 MHz / QPSK



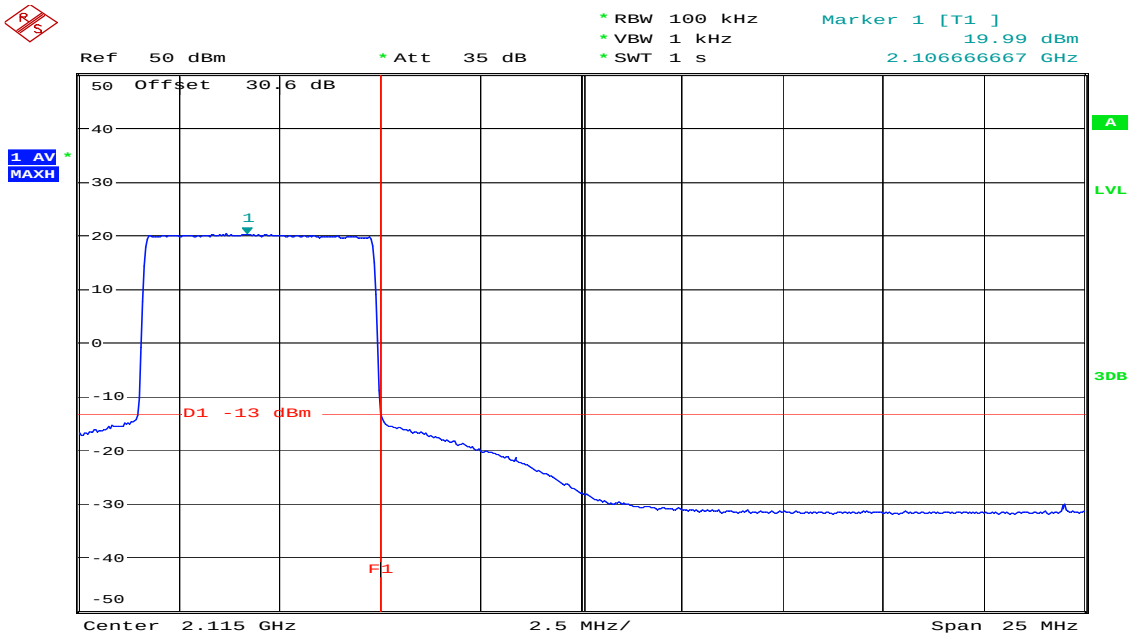

8UFCFH_1826C
Date: 22.JUN.2010 15:39:50

Plot 84: Band-edge compliance 8 MHz / QPSK



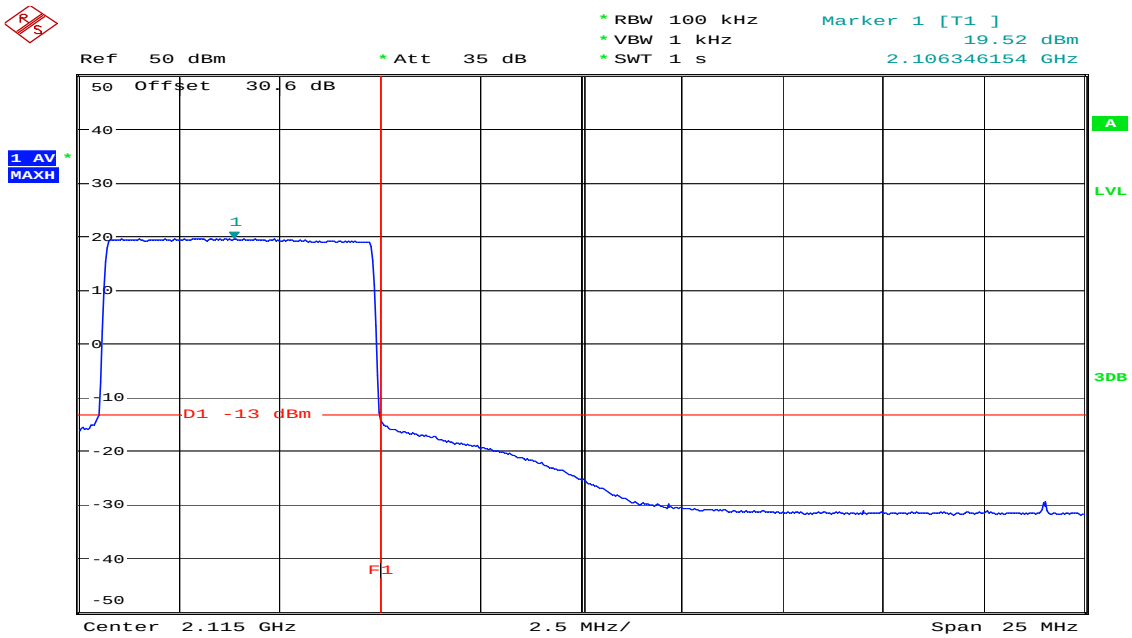

8UFCFH_1826C
Date: 22.JUN.2010 15:41:26

Plot 85: Band-edge compliance 6 MHz / 16QAM



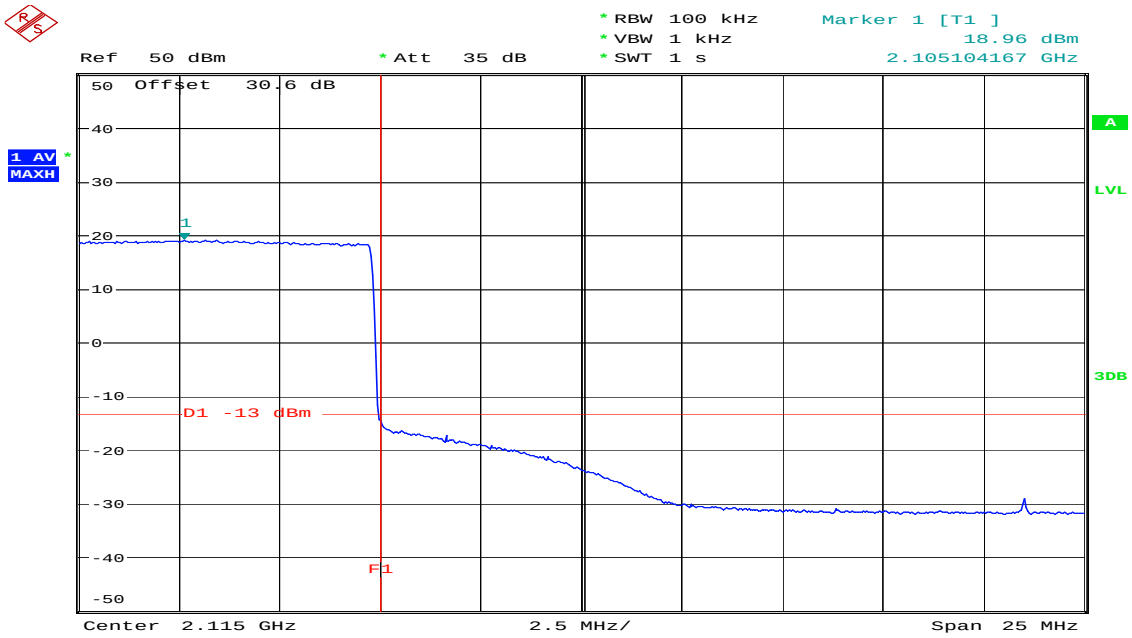

8UFCFH_1826C
Date: 22.JUN.2010 15:38:34

Plot 86: Band-edge compliance 7 MHz / 16QAM



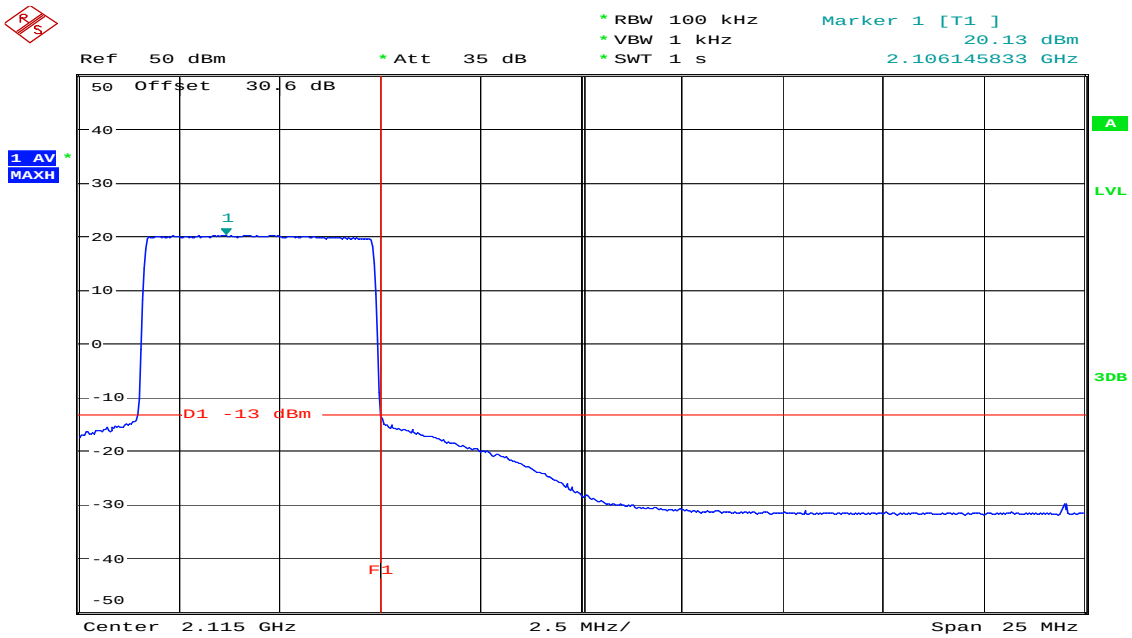

8UFCFH_1826C
Date: 22.JUN.2010 15:40:17

Plot 87: Band-edge compliance 8 MHz / 16QAM



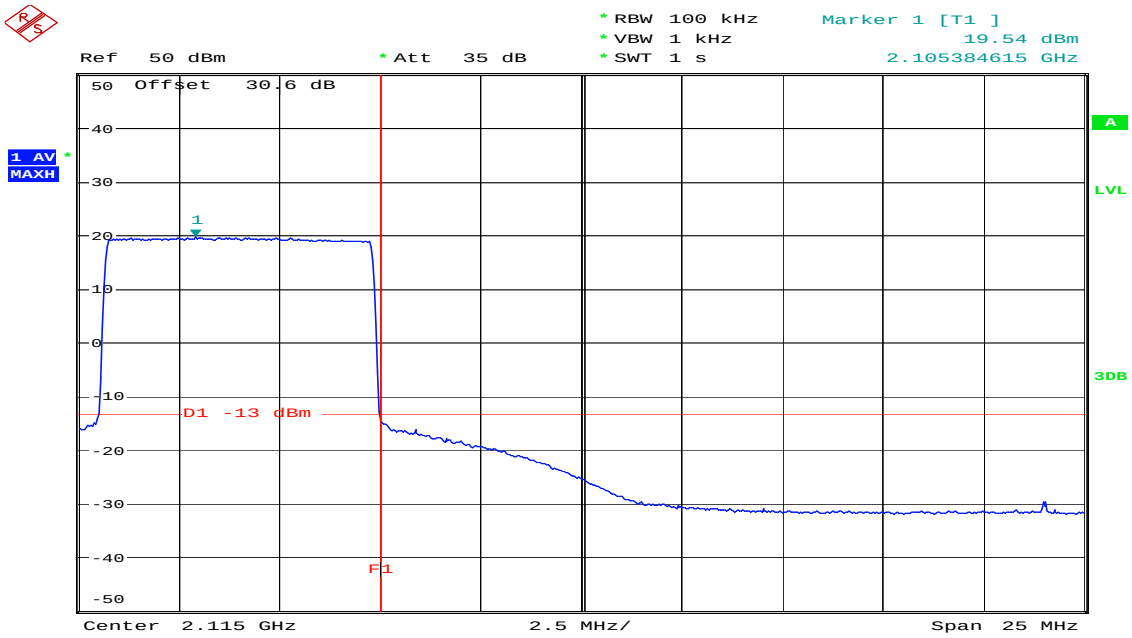

8UFCFH_1826C
Date: 22.JUN.2010 15:41:47

Plot 88: Band-edge compliance 6 MHz / 64QAM



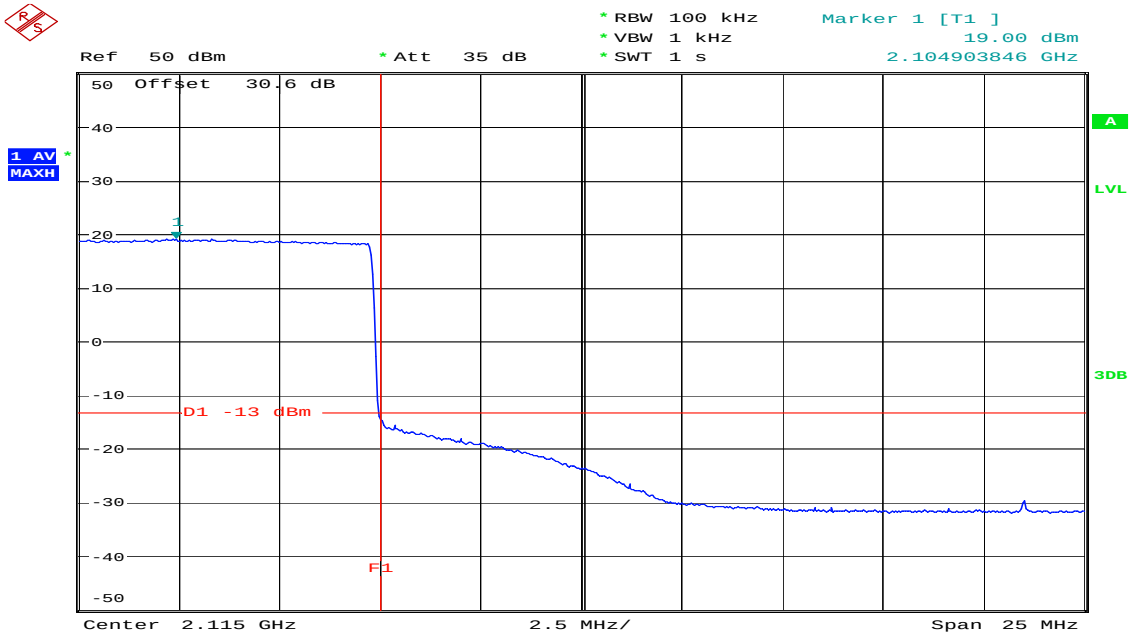

8UFCFH_1826C
Date: 22.JUN.2010 15:38:59

Plot 89: Band-edge compliance 7 MHz / 64QAM




8UFCFH_1826C
Date: 22.JUN.2010 15:40:44

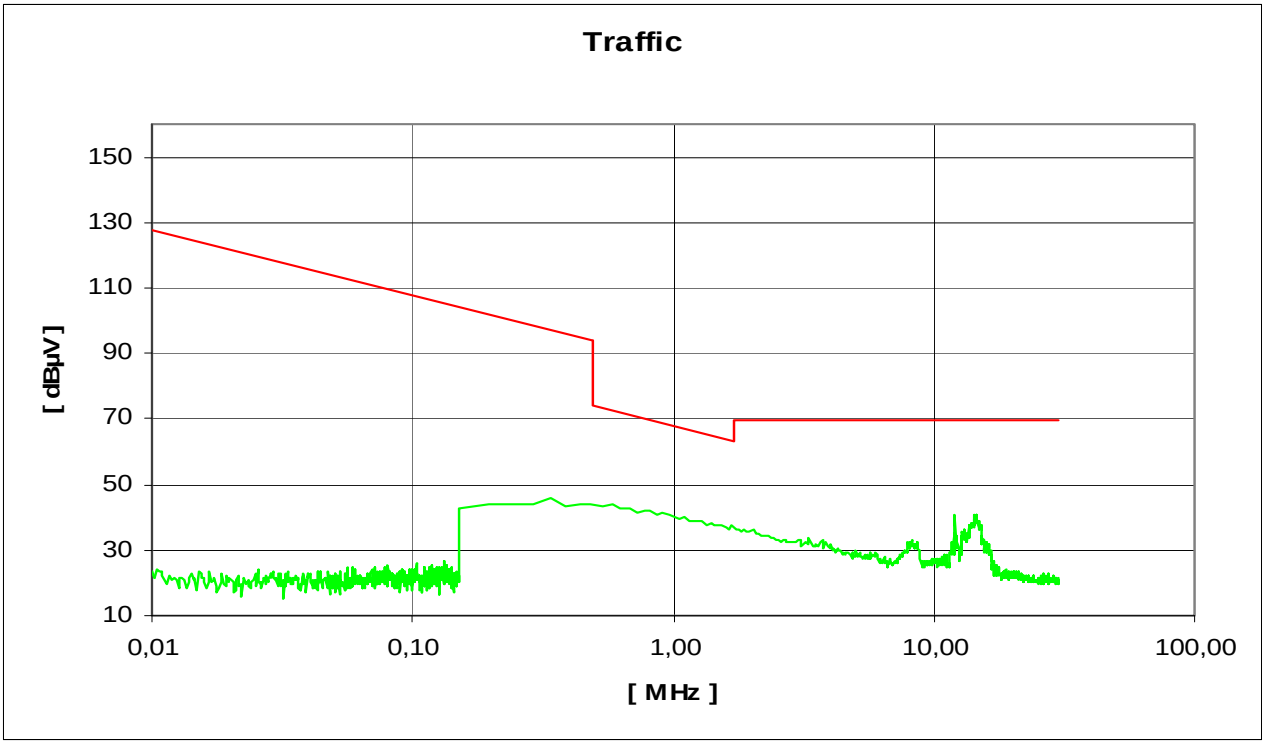
Plot 90: Band-edge compliance 8 MHz / 64QAM



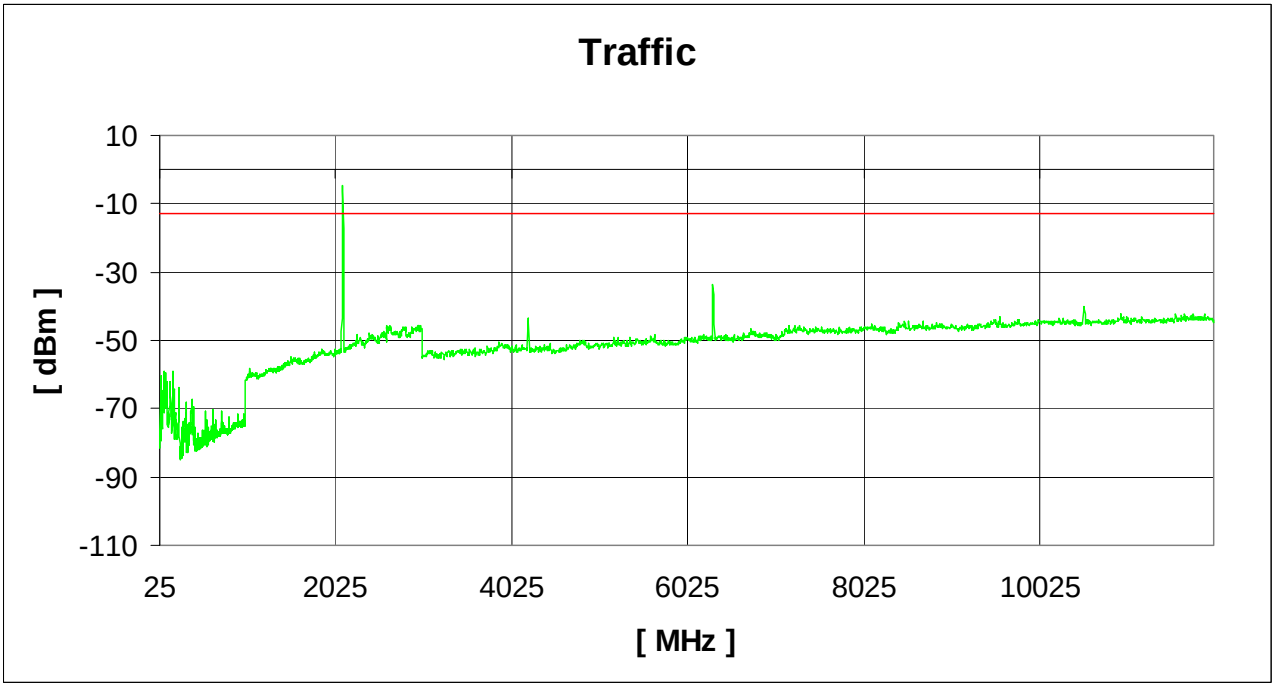

8UFCFH_1826C
Date: 22.JUN.2010 15:42:09

## 4.10 Spurious emissions (radiated) §2.1051 / §74.637(a)(2)

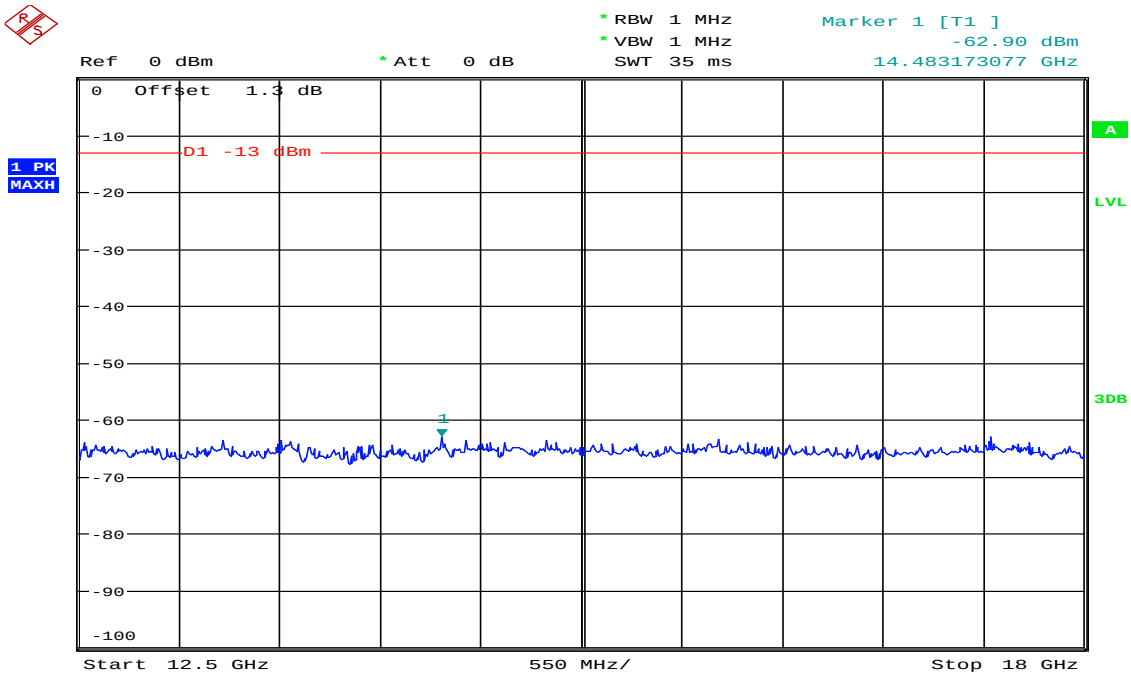
Plot 91: 9 kHz - 30 MHz (valid for all modes)




Plot 92: 25 MHz - 12 GHz (valid for all modes)

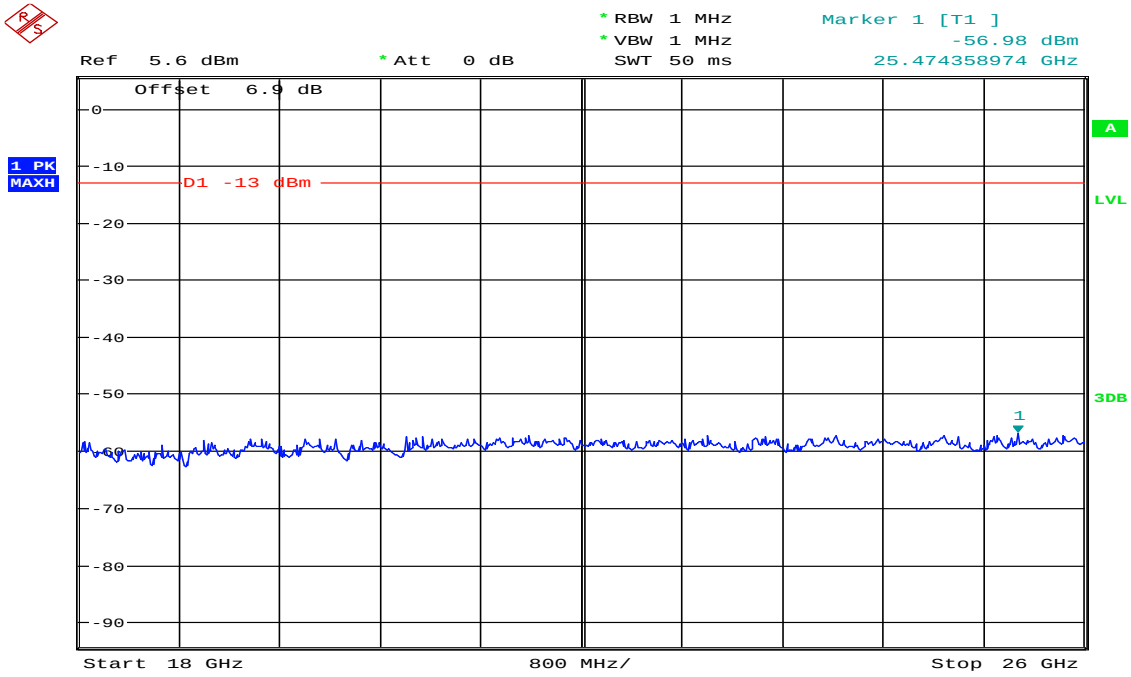


Plot 93: 12 GHz - 18 GHz (valid for all modes)




Date: 27.AUG.2010 11:22:56

Plot 94: 18 GHz - 26 GHz (valid for all modes)




Date: 27.AUG.2010 12:01:08

| SPURIOUS EMISSIONS LEVEL (dBm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2050 MHz | | | | | |
| **F [MHz]** | **Detector** | **Level [dBm]** | **F [MHz]** | **Detector** | **Level [dBm]** | **F [MHz]** | **Detector** | **Level [dBm]** |
| | | | 4100 | PEAK | -43.4 | | | |
| | | | 6150 | PEAK | -33.7 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **Measurement uncertainty** | | | **±3 dB** | | | | | |

**RBW: 100 kHz/1MHz VBW: 100 kHz/1MHz**

Limit according to §74.637(a)(2)(iii):

| | |
|---|---|
| Under normal test conditions only | The mean power of emissions shall be attenuated below the mean transmitter power ($P_{MEAN}$) in accordance with the following schedule:<br>When using transmissions employing digital modulation techniques: In any 4 kHz reference bandwidth ($B_{REF}$), the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 Log10 ($P_{MEAN}$ in watts) decibels, or 80 decibels, whichever is the lesser attenuation |

**Test Result: passed**

## 4.11 Frequency tolerance §2.1055 / §74.661

| Temperature [°C] | $U_{DC}$ [V] | Carrier frequency [MHz] | Measured frequency [MHz] | Difference [kHz] | Difference [ppm] |
|---|---|---|---|---|---|
| -30.0 | 28.0 | 2050 | 2050.005105 | 5.105 | 2.5 |
| -20.0 | 28.0 | 2050 | 2050.003560 | 3.560 | 1.7 |
| -10.0 | 28.0 | 2050 | 2050.002880 | 2.880 | 1.4 |
| 0.0 | 28.0 | 2050 | 2050.002390 | 2.390 | 1.2 |
| +10.0 | 28.0 | 2050 | 2050.001920 | 1.920 | 0.9 |
| +20.0 | 25.0 | 2050 | 2050.001450 | 1.450 | 0.7 |
| +20.0 | 28.0 | 2050 | 2050.001450 | 1.450 | 0.7 |
| +20.0 | 31.0 | 2050 | 2050.001450 | 1.450 | 0.7 |
| +30.0 | 28.0 | 2050 | 2050.000965 | 0.965 | 0.5 |
| +40.0 | 28.0 | 2050 | 2050.000440 | 0.440 | 0.2 |
| +48.0 | 28.0 | 2050 | 2050.000140 | 0.140 | 0.1 |

**Remark:**
**For measuring the frequency stability it was not possible to switch off the modulation.**
**Resolution bandwidth was reduced until the carrier was clearly visible on the spectrum analyzer display.**

**The internal over temperature protection system switched off the RF-signal when reaching the 48 °C.**
**Thus, it was not possible to test the frequency stability at 50°C.**

Limit according to §74.661:

| |
|---|
| Stations in this service shall maintain the carrier frequency of each authorized transmitter to within the following percentage of the assigned frequency: 2025 to 2110 MHz: 0.005% / 50 ppm |

**Test Result: passed**

## 4.12 MPE calculation

These equations are generally accurate in the far field of an antenna but will over predict power density in the near field, where they could be used for making a "worst case" prediction.

$$S = PG/4\pi R^2$$

where S = power density ( in appropriate units, e.g. $mW/cm^2$)
P = power input to the antenna (in appropriate units e.g. mW)
G = power gain of the antenna in the direction of interest relative to the isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units e.g. cm)

Or

$$S = EIRP/4\pi R^2$$

where EIRP = equivalent isotropically radiated power

Calculation:

Calculated for EIRP(RMS)

EIRP (RMS): 43.6 dBm = 22.9 W

calculated minimum safety distance:

R = sqrt(22900 mW / 4π) = 42.7 cm

Limit:

| |
|---|
| 1mW/ $cm^2$ is the reference level for general public exposure according to the OET Bulletin 65, Edition 97-01 Table 1. |

# 5 Test equipment and ancillaries used for tests

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

All reported calibration intervals are calibrations according to the EN/ISO/IEC 17025 standard. These calibrations were performed from an accredited external calibration laboratory.
Additional to these calibrations the laboratory performed comparison measurements with other calibrated systems and performed a weekly chamber inspection.
All used devices are connected with a 10 MHz external reference.
According to the manufacturer's instruction it is possible to establish a calibration interval for the FSP/FSU unit of 24 month, if the device has an external 10 MHz reference.

***Test chamber A:***

| No. | Instrument/Ancillary | Manufacturer | Type | Serial-No. | Internal identification |
|---|---|---|---|---|---|
| | **Radiated emission in chamber A** | | | | |
| A-1 | Spectrum Analyzer | Rohde & Schwarz | ESU26 | 100037 | 300003555 |
| A-2 | Signal Generator | Rohde & Schwarz | SMR20B11 | 1104.0002.20 | 300003593 |
| A-3 | RF System Panel | Rohde & Schwarz | TS RSP | --- | 300003556 |
| A-4 | Relais Matrix | Rohde & Schwarz | PSN | 860673/009 | 300001385 |
| A-5 | Horn Antenna | EMCO | 3115 | 9709-5290 | 300000212 |
| A-6 | Bilog.-Log. Antenna | Schwarzbeck | VULB 9163 | 02/00 | 300003696 |
| A-7 | Notch Filter GSM 900 | Wainwright | WRCD 901.9/903.1EE | 9 | --- |
| A-8 | Notch Filter GSM 1800 | Wainwright | WRCD 1747/1748-5EE | 1 | --- |
| A-9 | Notch Filter GSM 1900 | Wainwright | WRCB 1879.5/1880.5EE | 9 | --- |
| A-10 | Notch Filter GSM 850 | Wainwright | WRCT 837-0.2/50-8EE | 1 | --- |
| A-11 | Notch Filter UMTS | Wainwright | WRCD 1800/2000-0.2/40-5EEK | 2 | --- |
| A-12 | Notch Filter ISM 2400 | Wainwright | WRCG 2400/ 2483-2375/ 2505-50/10SS | 26 | --- |
| A-13 | High Pass Filter 1.1 GHz | Wainwright | WHK 1.1/15G-10SS | --- | --- |
| A-14 | High Pass Filter 2.6 GHz | Wainwright | WHKX 2.6/18G-12SS | --- | --- |
| A-15 | High Pass Filter 7 GHz | Wainwright | WHKX 7.0/18G-8SS | --- | --- |
| A-14 | Amplifier | Miteq | AFS4-00201800-15-10P-6 | US42-0050 2650-28-5A | 300003204 |
| A-16 | Controller | Inn co | CO 2000 | 2020507 | --- |
| A-17 | DC Power Supply | Hewlet Packard | HP6632A | --- | 300000924 |
| A-18 | Computer | F+W | --- | --- | 300003303 |

***Test laboratory 011:***

| No | Equipment/Type | Manuf. | Serial Nr. | Inv. No. Cetecom | Last Calibration | Frequency (months) | Next Calibration |
|---|---|---|---|---|---|---|---|
| 1 | Climatic box VUK 04/500 | Heraeus Vötsch | 32678 | 300000297 | 28.05.2009 | 24 | 28.05.2011 |
| 2 | Spectrum Analyser FSU 50 | R&S | 200012 | 300003443 | 01.07.2010 | 24 | 01.07.2012 |
| 3 | SGH 12 ... 18 GHz | narda | 01005 | 300000787 | cyclic verification | | |
| 4 | SGH 18 ... 27 GHz | narda | 01005 | 300000487 | cyclic verification | | |
| 5 | Adapter WG/SMA | narda | 4609 | -/- | cyclic verification | | |
| 6 | Adapter WG/SMA | flann | 100484 | -/- | cyclic verification | | |
| 7 | 1.5 m 50 Ω / K | Insulated Wire Inc. | 101995 | 300002290 | cyclic verification | | |
| 8 | Attenuator 20dB, k-con. | Inmet | 40A-20dB | -/- | cyclic verification | | |